Crystalline Silicon Photovoltaic Cells, Whether or Not Partially or Fully Assembled Into Other Products: Monitoring Developments in the Domestic Industry

Investigation No. TA-201-075 (Monitoring)

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Address all communications to
Secretary to the Commission
United States International Trade Commission
Washington, DC 20436

U.S. International Trade Commission

Washington, DC 20436
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Executive summary

Following the imposition of the safeguard measure effective February 7, 2018, there have been a number of significant developments with respect to the domestic industry for CSPV products, including U.S. producer entries and exits from the industry, changes in import volumes, and generally decreased prices. The price declines for CSPV cells and modules were directionally consistent with the historical downward trend in prices for CSPV products, though parties agreed that the prices were higher than they would have been without the safeguard measure.

With respect to CSPV cells, following the imposition of the safeguard measure, imports increased from 2017 to 2018 and were higher in the first half of 2019 compared with the first half of 2018. Some of the major U.S. CSPV cell producers ceased production, leading to declines in domestic cell production capacity and production from 2017 to 2018 and from the first half of 2018 to the first half of 2019, and only one cell producer remained in operation in the first half of 2019. Employment at U.S. CSPV cell production facilities initially declined from 2017 to 2018 but was higher in the first half of 2019 compared with the first half of 2018. The financial performance of the cell producers generally declined. Additionally, there were changes to the character of certain U.S. CSPV cell operations (i.e., Suniva bankruptcy and SunPower acquisition of SolarWorld) that affected the implementation of adjustment plans.

With respect to CSPV modules, imports initially declined from 2017 to 2018 but were higher in the first half of 2019 compared with the first half of 2018. Multiple large CSPV module producers opened production facilities in the United States particularly in the first half of 2019, leading to increases in domestic module production capacity, production, and market share from 2017 to 2018 and from the first half of 2018 to the first half of 2019. Employment at U.S. CSPV module production facilities initially declined from 2017 to 2018 but was higher in the first half of 2019 compared with the first half of 2018. The U.S. module producers' financial performance showed mixed results.

BACKGROUND

On November 13, 2017, the Commission completed an investigation and issued its report pursuant to section 202 of the Trade Act of 1974 (the "Act"). The Commission determined that CSPV products were being imported into the United States in such increased quantities as to be a substantial cause of serious injury to the domestic industry producing a like or directly competitive article. Among other conclusions, the Commission found that the increase in imports led to lower prices and declining financial performance for the domestic industry. The report also contained recommended remedies to facilitate efforts by the domestic industry and its workers to make a positive adjustment to import competition.

On January 23, 2018, the President imposed a safeguard measure on CSPV products for a period of four years beginning on February 7, 2018, in the form of (1) a tariff-rate quota ("TRQ") on imports of CSPV cells not partially or fully assembled into other products and (2) an increase in duties on imports of CSPV modules. The safeguard measure is applicable to imports from all countries, except for imports from certain developing countries that are members of the WTO, as long as the imports from these countries individually or collectively do not exceed specified volume thresholds. The TRQ portion of the safeguard measure imposes additional tariffs of 30 percent in the first year, 25 percent in the second year, 20 percent in the third year, and 15 percent in the fourth year on imports of CSPV cells in excess of 2.5 gigawatts ("GW") annually. The TRQ contains no individual country allocations, and the in-quota quantity resets annually. The safeguard measure also imposes additional tariffs of 30 percent in the first year, 25 percent in the second year, 20 percent in the third year, and 15 percent in the fourth year on imports of CSPV modules. The first phased reduction of the safeguard measure took effect on February 7, 2019.

The Commission instituted this monitoring proceeding under section 204(a)(2) of the Act for the purpose of preparing a mid-term report to the President and the Congress on the results of its monitoring of developments with respect to the domestic industry since the imposition of the safeguard measure. Pursuant to section 204(a)(1) of the Act, the Commission's report includes information concerning the progress and specific efforts made by workers and firms in the domestic industry to make a positive adjustment to import competition.

In preparing this report, the Commission collected data for calendar years 2016, 2017, and 2018, and interim periods January-June 2018 and January-June 2019. The Commission received useable questionnaire responses from 17 U.S. firms that are estimated to have accounted for more than 90 percent of known U.S. capacity to produce CSPV cells in 2018 and nearly three-fourths of such capacity in the first half of 2019, and approximately 50 percent of known U.S. capacity to produce CSPV modules during 2018 and almost three-fourths of known U.S. module capacity during the first half of 2019. The Commission received useable questionnaire responses from 55 firms that are estimated to have accounted for 83.6 percent of U.S. imports of CSPV cells and CSPV modules during 2018. The Commission also received useable questionnaire responses from 43 U.S. purchasers and 46 foreign producers.

During this proceeding, the Commission received a number of briefs from interested parties, including U.S. producers and importers, Canadian producers, and a Korean producer.[1] The Commission also received submissions from multiple foreign governments, a trade association, a state-level economic development department, state legislative representatives, Congressional representatives, and firms involved in the production of solar products at various points in the supply chain.[2] The Commission held a hearing in Washington, DC, in which it received testimony from industry representatives, state government representatives, and Embassy witnesses.[3] The Commission also conducted on-site fieldwork at Hanwha Q Cells USA Corp. in Dalton, Georgia, and LG Electronics U.S.A., Inc., in Huntsville, Alabama.

MARKET DEVELOPMENTS

As was the case during the safeguard investigation, demand for CSPV products continues to be derived from demand for solar electricity, which is influenced by factors such as cost competitiveness with traditional energy sources, environmental concerns, a desire for national energy independence, total energy consumption, and the availability of Federal, state,

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[1] The Commission received briefs from the following U.S. producers: Auxin Solar ("Auxin"); Hanwha Q CELLS USA, Inc. ("Hanwha"); Heliene USA Inc. ("Heliene USA"); LG Electronics USA, Inc. ("LG USA"); Mission Solar Energy ("Mission"); Silfab Solar WA Inc. ("Silfab WA"); SolarTech Universal, Suniva, Inc. ("Suniva"); and SunPower Manufacturing Oregon LLC ("SunPower"). In addition, briefs or written submissions were submitted by Canadian producers Heliene Inc. ("Heliene Canada"), Silfab Solar Inc. ("Silfab Canada"), and Canadian Solar Solutions Inc. (together with U.S. producers Heliene USA and Silfab WA); Korean producer LG Electronics, Inc. ("LG Korea") (together with U.S. producer LG USA).

[2] The Commission received written submissions from Government of Canada; Government of Singapore; Government of Taiwan; U.S. importer REC Americas LLC ("REC"); the Solar Energy Industries Association ("SEIA"); First Solar, Inc. (a U.S. producer of out-of-scope PV modules and thin film); Utility Scale Solar Coalition; 1366 Technologies (the sole U.S. silicon wafer manufacturer); Hemlock Semiconductor Operations LLC, Wacker Polysilicon North America, LLC, and REC Silicon (U.S. polysilicon producers); and Georgia Department of Economic Development.

[3] The following firms provided testimony at the Commission's hearing: Suniva; Hanwha; Auxin; SunPower; LG USA; LG Korea; Mission; SEIA; REC; Clearway Energy Group; Swinerton Renewable Energy; EDF Renewables; Invenergy LLC; Canadian Solar Inc.; Silfab WA; Silfab Canada; Heliene USA; Heliene Canada; Recurrent Energy, LLC; Government of Canada; NextEra Energy, Inc.; NextEra Energy Resources, LLC; Florida Power & Light Company; Utility Scale Solar Coalition; and Southern Current LLC. Testimony was also delivered by state government representatives Dennis Mock (Mayor of Dalton, Georgia), R. Lynette Laughter (Chairwoman, Whitfield County Board of Commissioners), and Carl Campbell (Executive Director, Dalton-Whitfield County Joint Development Authority), as well as by Embassy representatives Mr. Wijayanto (Commercial Attaché, Embassy of the Republic of Indonesia), Jungsoo Hur (Commercial Counsellor, Embassy of the Republic of Korea), Carrie Goodge O'Brien (Acting Minister-Counsellor, Embassy of Canada), and Oscar Yang (Senior Trade Specialist, Bureau of Foreign Trade, Ministry of Economic Affairs, Taipei Economic and Cultural Representative Office).

and local incentives. Apparent U.S. consumption of CSPV products declined from 2017 to 2018 and was higher in the first half of 2019 than in the first half of 2018. Majorities or pluralities of firms reported that U.S. demand for CSPV products has increased since February 7, 2018, the effective date of the measure, and that future demand for CSPV products will continue to increase.

With respect to import supply in the U.S. market, imports of CSPV cells increased from 2017 to 2018 and were higher in the first half of 2019 compared with the first half of 2018, while imports of CSPV modules initially decreased from 2017 to 2018 but were higher in the first half of 2019 compared with the first half of 2018. These increases occurred as several new CSPV module producers imported CSPV cells to ramp up U.S. production and many firms imported CSPV modules prior to the anticipated stepdown of tax credit incentives occurring after December 31, 2019.

The increase in imports resulted in an increase in importers' June 2019 inventories. Import market share of CSPV products based on quantity increased from 2017 to 2018 and was higher in the first half of 2019 compared with the first half of 2018, and U.S. producers' market share (measured on the basis of cell production to avoid double-counting) declined and was lower in the first half of 2019 compared with the first half of 2018 as U.S. cell production facilities closed. By contrast, reflecting increased U.S. production and shipments of modules that incorporate imported cells, U.S. module producers' market share by value increased from 2017 to 2018, and was higher in the first half 2019 than in the first half 2018. CSPV products from Malaysia, Korea, Thailand, and Vietnam comprised the majority of imports in 2017 and 2018 and the first half of 2019. (Imports from these countries replaced imports from China and Taiwan after antidumping and countervailing duty orders were imposed on CSPV products from China in December 2012 and February 2015 and an antidumping duty order was imposed on CSPV products from Taiwan in February 2015.)

DEVELOPMENTS IN THE DOMESTIC INDUSTRY

Following the imposition of the safeguard measure, the domestic industry experienced decreased capacity and production for CSPV cells but increased capacity and production for CSPV modules. In both CSPV cells and module production there was decreased employment from 2017 to 2018, but higher employment in the first half of 2019 compared with the first half of 2018. U.S. shipments of CSPV cells decreased from 2017 to 2018 and were lower in the first half of 2019 compared to the first half of 2018, but U.S. shipments of CSPV modules increased from 2017 to 2018 and were higher in the first half of 2019 compared to the first half of 2018. U.S. market share for CSPV cells decreased but it increased for CSPV modules. In addition, there were generally lower prices for both CSPV cells and modules. Financial performance varied among producers based on firm-specific circumstances, but overall there were reported declines in the financial performance of U.S. CSPV cell producers and mixed results in the financial performance of U.S. CSPV module producers. As a whole, both U.S. cell and module producers were unprofitable throughout the period, however, unlike for U.S. cell producers, U.S. module producers' operating losses declined from 2017 to 2018 and from the first half of 2018 to the first half of 2019.

At least two CSPV cell production facilities (i.e., Suniva and SunPower) closed during 2018-19, and at least three CSPV module production plants closed during 2018-19, including three module facilities with a combined production capacity of 230 MW during 2018-19. However, five CSPV module manufacturing plants with a combined production capacity of at least 3 GW opened during 2018-19. Consequently, the domestic industry's capacity to produce CSPV cells decreased from 2017 to 2018, and was lower in the first half of 2019, whereas the domestic industry's capacity to produce CSPV modules increased from 2017 to 2018, and was higher in the first half of 2019 than in the first half of 2018. Capacity utilization was higher for CSPV cell and CSPV module producers during the first half of 2019 compared with the first half of 2018. By quantity, the domestic industry's U.S. shipments of CSPV cells declined from 2017 to 2018 and were lower in the first half of 2019 than in the first half of 2018. However, the domestic industry's U.S. shipments of CSPV modules increased from 2017 to 2018 and were higher in the first half of 2019.

The share of apparent U.S. consumption held by U.S. CSPV cell producers increased from 2017 to 2018 and was lower in the first half of 2019 relative to the first half of 2018. However, the share of apparent U.S. consumption held by U.S. CSPV module producers measured by value increased from 2017 to 2018 and between the first half of 2018 and the first half of 2019, as relatively large U.S. module facilities were opened in 2019 by producers such as Hanwha, JinkoSolar, and LG Electronics. Most employment indicators, such as hours worked, wages paid, hourly wages, and productivity, generally show declining trends from 2017 to 2018 for CSPV cell producers but increasing trends for CSPV module producers. Both CSPV cell producers and CSPV module producers generally reported higher employment indicators in the first half of 2019 compared with the first half of 2018.

Based on quarterly sales price data collected on six narrowly defined CSPV modules, with separate pricing data for modules manufactured from U.S.-produced cells and those made from imported cells, prices for imported CSPV products and domestically produced CSPV products generally decreased after the safeguard measure was imposed. The average unit values of U.S. shipments of domestic and imported CSPV cells and CSPV modules generally declined from 2017 to 2018 and were lower in the first half of 2019 relative to the first half of 2018. Other pricing information and statements from participants in these proceedings were mixed, but generally indicated that a combination of factors, including declining polysilicon prices; technology advancements (such as wafer slicing technology, wafer thickness, and efficiency); global supply of CSPV modules; and the cost competitiveness of solar power relative to other energy sources, have consistently driven prices downward, and that the safeguard measure caused U.S. prices for CSPV products to be higher than they would otherwise have been.

ADJUSTMENT EFFORTS

As part of its monitoring under section 204(a)(1) of the Act, the Commission collected information concerning the progress and specific efforts made by workers and firms to make a positive adjustment to import competition. During the remedy phase of the Commission's safeguard investigation, co-petitioner SolarWorld included in its prehearing remedy brief a proposed adjustment plan for implementation in the event of appropriate import relief. However, after SolarWorld's submission of its adjustment plan, the company's Hillsboro, Oregon production assets were acquired by SunPower. By the beginning of 2019, SunPower had retired the Hillsboro facility's CSPV cell line and had upgraded half of the module assembly facility to produce SunPower's proprietary "P Series" modules from monocrystalline silicon cells. Co-petitioner Suniva did not submit a formal adjustment plan at the time of the original safeguard investigation because it was in an active bankruptcy process.[4] As part of the bankruptcy process, Suniva ceased module assembly operations in Saginaw, Michigan, and focused its bankruptcy exit activities on its cell manufacturing operations. Suniva exited bankruptcy in April 2019 under new ownership and is currently working to restart its CSPV cell manufacturing operations in Norcross, Georgia.

The safeguard measure resulted in positive industry adjustments, particularly for U.S. CSPV module producers in the first half of 2019. There was significant expansion and investment in domestic CSPV module manufacturing. At least three firms (including Hanwha, Jinko, and LG) launched new U.S.-based CSPV module operations, and at least two additional firms (Auxin and Heliene) expanded or increased capacity at existing U.S. CSPV module

[4] Other than SolarWorld's inclusion of its plans in its prehearing remedy brief, the only other information regarding adjustment plans came from individual U.S. producer responses to questions in the Commission's safeguard investigation questionnaire concerning efforts to compete and anticipated adjustments in the event relief were provided. No separate proposed adjustment plans were submitted by U.S. producers.

operations. This expansion took place as apparent consumption of U.S. CSPV modules experienced an expansion from the first half of 2018 to the first half of 2019 after declines from 2016 to 2018. U.S. module producers' production, shipments and market share also improved, and operating losses decreased. There have also been acquisitions and restructuring in the industry (e.g., Silfab and SunPower) and several firms have introduced new, innovative products, some with higher efficiency and output (e.g., PowerFilm, SunPower, and Tesla).

Notwithstanding the positive industry adjustments for U.S. CSPV module producers, certain U.S. producers report factors they claim have hindered their adjustment efforts and limited the positive impact of the safeguard measure. The cited factors include stockpiling of imports prior to the implementation of the safeguard measure and again before the stepdown of tax credit incentives at year-end 2019, exporter tariff cost absorption, the increase in input and transportation costs for domestic manufacturers, and the exclusion in June 2019 of bifacial CSPV modules from the safeguard measure. Certain U.S. producers also claim that declines in module prices and tariffs on imported components have created challenges for U.S. manufacturers. In addition, several U.S. CSPV module producers argue that the current 2.5 GW quota on CSPV cell imports will be insufficient to supply the U.S. CSPV module industry and will be exceeded in 2020 and 2021. They argue that an increase of the quota is necessary to protect the growth of the U.S. CSPV module producers, which has been facilitated by the safeguard measure.

Positive industry adjustments for U.S. CSPV cell producers were more limited. For example, U.S. CSPV cell producer Suniva reported that the safeguard measure allowed it a viable exit path from bankruptcy and had a measurable impact on its efforts to restart CSPV cell operations. Suniva asserts, however, that the large size of the current 2.5 GW CSPV cell quota – which did not fill in 2018 and was not expected to fill in 2019 – and the exclusion of bifacial CSPV modules from the safeguard measure have delayed and diluted the remedial effects of the intended relief and hampered its efforts to restart CSPV cell production. Suniva further argues that the current safeguard remedy incentivizes domestic CSPV module assembly more than domestic CSPV cell production, which it claims is vital to advancing U.S. national security interests, ensuring grid reliability, and fostering product research and development. SunPower, after acquiring SolarWorld, restructured by ceasing cell production and focusing on module production.

Several participants in this investigation have suggested modifications to the safeguard measure. The Commission will provide advice on the probable economic effects of certain modifications to the measure pursuant to a request from USTR in an upcoming report as described in Part I.

Part I: Introduction and overview

Background

On May 17, 2017, a petition, as amended, was properly filed under section 202(a) of the Trade Act of 1974 ("The Trade Act") (19 U.S.C. § 2552(a)) by counsel for Suniva Inc. ("Suniva"). The petition alleged that certain crystalline silicon photovoltaic cells, whether or not partially or fully assembled into other products ("CSPV products"), were being imported into the United States in such increased quantities as to be a substantial cause of serious injury, or threat thereof, to the domestic industry producing an article like or directly competitive with the imported article.[1] The Commission conducted an investigation under section 202(b)(1)(A) of the Act. Following receipt of the report from the U.S. International Trade Commission ("USITC" or "Commission") in November 2017 under section 202 of the Act (19 U.S.C. § 2252) containing an affirmative serious injury determination and remedy recommendations,[2] the President, on January 23, 2018, pursuant to section 203 of the Act (19 U.S.C. § 2253), issued Proclamation 9693, imposing a safeguard measure in the form of (a) a tariff-rate quota on imports of CSPV (or "solar") cells not partially or fully assembled into other products and (b) an increase in duties on imports of CSPV modules for a period of four years, effective February 7, 2018.[3] [4] The Commission instituted this proceeding on July 25, 2019,[5] for the purpose of preparing the report to the President and the Congress required by section 204(a)(2) of the Trade Act of 1974 ("the Act")[6] on the results of its monitoring of developments with respect to the domestic industry producing CSPV products since the imposition of the tariff-rate quota on imports of

[1] On May 25, 2017, SolarWorld Americas, Inc. ("SolarWorld") and Suniva notified the Commission that SolarWorld was joining Suniva as co-petitioner in the investigation.

[2] Crystalline Silicon Photovoltaic Cells (Whether or not Partially or Fully Assembled Into Other Products), Inv. No. TA-201-75, USITC Publication 4739, November 2017.

[3] 83 FR 3541, January 25, 2018. A court challenge to the Proclamation was rejected, *Silfab Solar, Inc. v. United States*, 892 F.3d 1340 (Fed. Cir. 2018) (affirming denial of injunctive relief), and ultimately withdrawn.

[4] See the sections entitled "Scope of the Safeguard Remedy" and "Tariff treatment" in Part I of this report for a complete description of the merchandise subject to the safeguard measure.

[5] 84 FR 37674, August 1, 2019.

[6] 19 U.S.C. § 2254(a)(2).

CSPV cells and the increase in duties on imports of CSPV modules. The following tabulation provides information relating to the background and schedule of this proceeding.[7] [8]

Effective date	Action
July 25, 2019	Institution of Commission's monitoring (84 FR 37674, August 1, 2019)
December 5, 2019	Commission's hearing
February 7, 2020	Scheduled date for the Commission's transmittal of report to the President and Congress

Section 204(a)(1) of the Act[9] requires the Commission, so long as any action under section 203 of the Act remains in effect, to monitor developments with respect to the domestic industry, including the progress and specific efforts made by workers and firms in the domestic industry to make a positive adjustment to import competition.[10] Section 204(a)(2) of the Act requires that whenever the initial period of an action under section 203 exceeds 3 years, the Commission shall submit a report on the results of the monitoring under section 204(a)(1) to the President and the Congress not later than the mid-point of the initial period of relief during which the action is in effect, or in this case by February 7, 2020.[11]

WTO proceedings

On May 14, 2018, Korea requested consultations with the United States concerning imposition of the safeguard measure on imports of CSPV products pursuant to the World Trade Organization ("WTO") dispute settlement understanding. On May 24, 2018, China requested to

[7] Pertinent *Federal Register* notices are referenced in appendix A, and may be found at the Commission's website (www.usitc.gov).

[8] A list of witnesses appearing at the hearing is presented in appendix B of this report.

[9] 19 U.S.C. § 2254(a)(1).

[10] Section 201(b)(l) of the Act states that a positive adjustment to import competition occurs when (A) the domestic industry (i) is able to compete successfully with imports after actions taken under section 204 terminate, or (ii) the domestic industry experiences an orderly transfer of resources to other productive pursuits; and (B) dislocated workers in the industry experience an orderly transition to productive pursuits.

Section 201(b)(2) states that the domestic industry may be considered to have made a positive adjustment to import competition even though the industry is not of the same size and composition as the industry at the time the investigation was instituted under section 202(b) of the Act.

[11] A summary of data collected on CSPV products in this proceeding is presented in appendix C. Select data from the original safeguard investigation is presented in appendix D.

join the consultations and on May 25, 2018, the European Union ("EU"), Malaysia, and Thailand requested the same. Subsequently, the United States informed the Dispute Settlement Body ("DSB") that it accepted the requests of China, the EU, Malaysia, and Thailand to join the consultations. On August 14, 2018, Korea requested the establishment of a panel, and at its meeting on September 26, 2018, the DSB established a panel. The panel has not yet been composed.[12]

On August 14, 2018, China also requested consultations with the United States concerning imposition of the safeguard measure on imports of CSPV products pursuant to the WTO dispute settlement understanding. The EU and Thailand requested to join the consultations on August 23, 2018 and August 27, 2018, respectively. Subsequently, the United States informed the DSB that it accepted both requests to join the consultations. On July 11, 2019, China requested the establishment of a panel and at its meeting on August 15, 2019, the DSB established a panel.[13] After the United States and China were unable to agree on panelists, the Director-General determined the composition of the panel on October 24, 2019, at China's request.

Previous and related investigations

Advice on the probable economic effect of certain modifications to the safeguard measure

The Commission is also conducting an investigation at the request of the U.S. Trade Representative ("USTR") to analyze the effect of increasing the level of the tariff-rate quota applicable to imports of CSPV cells from the current 2.5 gigawatts ("GW") to 4, 5, or 6 GW, without other changes to the remedy. On December 6, 2019, following receipt of a letter from the USTR, the Commission instituted this investigation, No. TA-201-75 (Modification), Crystalline Silicon Photovoltaic Cells, Whether or Not Partially or Fully Assembled Into Other Products: Advice on the Probable Economic Effect of Certain Modifications to the Safeguard Measure. The USTR asked the Commission, under section 204(a)(4) of the Trade Act, to advise the President of the probable economic effect on the domestic CSPV cell and module manufacturing industry of modifying the safeguard measure on imports of CSPV products, as

[12] WTO, "DS545: United States – Safeguard Measure on Imports of Crystalline Silicon Photovoltaic Products."

[13] WTO, "DS562: United States – Safeguard Measure on Imports of Crystalline Silicon Photovoltaic Products."

described in Proclamation 9693 of January 23, 2018.[14] The USTR asked that the Commission transmit this report no later than 30 days after it transmits its report in the current monitoring proceeding.[15]

Antidumping and countervailing duty investigations on CSPV cells and modules from China (Inv. Nos. 701-TA-481 and 731-TA-1190) ("CSPV 1")

The antidumping and countervailing duty investigations on CSPV cells and modules from China (Inv. Nos. 701-TA-481 and 731-TA-1190) (hereinafter referred to as "CSPV1") resulted from petitions filed by SolarWorld Industries America, Inc. on October 19, 2011.[16] On October 12, 2012, the U.S. Department of Commerce ("Commerce") announced its final affirmative determinations in its antidumping and countervailing duty investigations on CSPV cells and modules from China. The countervailable subsidy margins ranged from 14.78 percent to 15.97 percent[17] and the estimated weighted-average dumping margins ranged from 18.32 percent to 249.96 percent.[18] In November 2012, the Commission determined that an industry in the United States was materially injured by reason of imports of CSPV cells and modules from China that Commerce found were sold at less than fair value ("LTFV") in the U.S. market and

[14] 84 FR 70565, December 23, 2019. Section 204(a)(4) of the Trade Act (19 U.S.C. 2254(a)(4)) requires the Commission, upon request of the President, to advise the President of its judgment as to the probable economic effect on the industry concerned of any reduction, modification, or termination of the action taken under section 203 of the Trade Act which is under consideration.

[15] Letter from Robert E. Lighthizer, The United States Trade Representative, Executive Office of the President, to David S. Johanson, Chairman, United States International Trade Commission, December 6, 2019.

[16] Crystalline Silicon Photovoltaic Cells and Modules from China, Inv. Nos. 701-TA-481 and 731-TA-1190 (Final), USITC Publication 4360, November 2012 ("CSPV 1 original publication"), p. I-1. Effective October 1, 2014, SolarWorld Industries America, Inc. changed its name to SolarWorld Americas, Inc. Certain Crystalline Silicon Photovoltaic Products from China and Taiwan, Inv. Nos. 701-TA-511 and 731-TA-1246-1247 (Final), USITC Publication 4519, February 2015 ("CSPV 2 original publication"), p. I-1.

[17] 77 FR 63788, October 17, 2012.

[18] 77 FR 63791, October 17, 2012. On August 4, 2015, the U.S. Trade Representative ("USTR") instructed Commerce to implement its determinations under Section 129 of the Uruguay Round Agreements Act ("URAA") regarding the antidumping duty investigation of CSPV cells and modules from China which rendered them not inconsistent with the World Trade Organization ("WTO") dispute settlement findings in the Appellate Body report on United States — Countervailing and Anti-dumping Measures on Certain Products from China, WT/DS449/AB/R (July 7, 2014), and the panel report, as modified by the Appellate Body report, WT/DS449/R (March 27, 2014), adopted by the WTO Dispute Settlement Body on July 22, 2014 (DS 449). Accordingly, Commerce revised the antidumping cash deposit rates to account for double remedies, reflecting rates ranging from 6.68 percent to 238.88 percent. 80 FR 48812, August 14, 2015.

subsidized by the Government of China.[19] Effective December 7, 2012, Commerce issued antidumping and countervailing duty orders on those imports.[20] In CSPV 1, Commerce determined that the country of origin of subject CSPV modules was the country of manufacture of the CSPV cells, including modules assembled outside of China using Chinese CSPV cells. Therefore, the scope of the CSPV 1 orders did not include U.S. imports of CSPV modules assembled in China from CSPV cells made in a country other than China.[21]

On November 1, 2017, the Commission gave notice, pursuant to Section 751(c) of the Tariff Act of 1930, as amended,[22] that it had instituted first five-year reviews of the CSPV 1 orders[23] and on February 5, 2018, the Commission determined that it would conduct full reviews.[24] On the basis of the record developed in the first five-year reviews of the CSPV 1 orders, the Commission determined on March 1, 2019, pursuant to the Tariff Act of 1930, that revocation of the antidumping and countervailing duty orders on CSPV cells and modules from China would be likely to lead to continuation or recurrence of material injury to an industry in the United States within a reasonably foreseeable time.[25] Commerce issued a continuation of the antidumping and countervailing duty orders on imports of CSPV cells and modules from China, effective March 20, 2019.[26]

Antidumping and countervailing duty investigations on CSPV cells and modules from China and Taiwan (Inv. Nos. 701-TA-511 and 731-TA-1246-1247) ("CSPV 2")

The antidumping and countervailing duty investigations on CSPV cells and modules from China and Taiwan (Inv. Nos. 701-TA-511 and 731-TA-1246-1247) (hereinafter referred to as "CSPV 2") resulted from petitions filed by SolarWorld on December 31, 2013.[27] On December 16, 2014, Commerce announced its final affirmative determinations in its antidumping duty investigations on CSPV cells and modules from China and Taiwan and its countervailing duty investigation on CSPV cells and modules from China. The countervailable subsidy margins

[19] CSPV 1 original publication, p. 1 (all six Commissioners reached affirmative determinations). The Commission's determination in CSPV 1 was affirmed on appeal. *See Changzhou Trina Solar Energy Co., Ltd. v. U.S. Int'l Trade Comm'n*, 879 F.3d 1377 (Fed. Cir. 2018).

[20] 77 FR 73017, December 7, 2012; 77 FR 73018, December 7, 2012.

[21] CSPV 2 original publication, pp. 3-4.

[22] 19 U.S.C. 1675(c).

[23] 82 FR 50681 and 50612, November 1, 2017.

[24] 83 FR 8296, February 26, 2018.

[25] 84 FR 8342, March 7, 2019.

[26] 84 FR 10299 and 10300, March 20, 2019.

[27] CSPV 2 original publication, p. I-1.

ranged from 27.64 percent to 49.79 percent for China.[28] The estimated weighted-average dumping margins (in percent ad valorem), as reported by Commerce ranged from 26.71 percent to 165.04 percent for China and 11.45 percent to 27.55 percent for Taiwan.[29] In February 2015, the Commission determined that an industry in the United States was materially injured by reason of imports of certain CSPV cells and modules from Taiwan that Commerce found were sold in the U.S. market at LTFV and imports from China that Commerce found were sold at LTFV and subsidized by the Government of China.[30] Effective February 18, 2015, Commerce issued antidumping and countervailing duty orders on those imports from China and an antidumping duty order on those imports Taiwan.[31] The first five-year reviews of the CSPV 2 orders were initiated by Commerce and instituted by the Commission on January 2, 2020.[32]

In its final CSPV 2 determinations, Commerce defined the subject merchandise from China to include U.S. imports of the following: (1) CSPV modules assembled in China from CSPV cells made in Taiwan and (2) CSPV modules assembled in China from CSPV cells made in third countries. Commerce defined the subject merchandise from Taiwan to include U.S. imports of: (1) CSPV cells made in Taiwan; (2) CSPV modules assembled in Taiwan from CSPV cells made in Taiwan; and (3) CSPV modules assembled in third countries other than China from CSPV cells made in Taiwan. Therefore, the module assembly location determined the country of origin for U.S. imports of modules from China, except for modules covered by the prior CSPV 1 orders (which were considered nonsubject merchandise from China in the CSPV 2 investigations); the cell manufacture location determined the country of origin for U.S. imports of cells and modules from Taiwan.[33]

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[28] 79 FR 76962, December 23, 2014.

[29] 79 FR 76970, December 23, 2014; 79 FR 76966, December 23, 2014.

[30] Chairman Schmidtlein, Vice Chairman Johanson, and Commissioners Williamson and Pinkert voted in the affirmative. Commissioner Broadbent voted in the affirmative with respect to CSPV modules from China and Taiwan and in the negative with respect to CSPV cells from Taiwan (CSPV cells from China were not included in the scope as they were already covered by the CSPV 1 orders). Commissioner Kieff did not participate in the CSPV 2 investigations. 80 FR 7495, February 10, 2015. The Commission's determination in CSPV 2 was affirmed on appeal. *See Kyocera Solar, Inc. v. U.S. Int'l Trade Comm'n*, 844 F.3d 1334 (Fed. Cir. 2016).

[31] 80 FR 8592 and 8596, February 18, 2015.

[32] 85 FR 67, January 2, 2020; 85 FR 120, January 2, 2020.

[33] 79 FR 76962 and 76970, December 23, 2014; *see also* CSPV 2 original publication, pp. 3-4 and 6. The U.S. Court of International Trade ("CIT") affirmed Commerce's scope determinations, as further explained by the agency on remand. *See Sunpower Corp. v. United States*, 253 F.Supp. 3d 1275 (Ct. Int'l Trade 2017); *Kyocera Solar, Inc. v. United States*, 253 F.Supp. 3d 1294 (Ct. Int'l Trade 2017).

Antidumping and countervailing duty investigations on primary raw materials

There are no antidumping or countervailing duty orders currently in effect on U.S. imports of polysilicon, the primary raw material in the production of CSPV cells.

Section 232 investigations (Commerce)[34]

Steel

The relevant HTS subheadings within the scope of this safeguard remedy, 8541.40.60, 8501.31.80, 8501.32.60, 8501.61.00, and 8507.20.80, were not included in the enumeration of certain steel products subject to the additional 25-percent *ad valorem* duties under Section 232 of the Trade Expansion Act of 1962, as amended.[35] However, steel is used in balance of systems components (such as tracking systems on which modules are mounted) for solar installations.[36] [37] Table I-1 presents a summary of current Section 232 tariffs on U.S. imports of steel, by country.

Table I-1
Steel mill articles: Section 232 tariffs summary

Country	Effective date	Ad valorem duty rate	Absolute quotas
Argentina	May 31, 2018	Exempt	180,000 metric tons
Australia	May 31, 2018	Exempt	Exempt
Brazil	May 31, 2018	Exempt	4,193,157 metric tons
Canada	May 20, 2019	Exempt	Exempt
European Union	May 31, 2018	25%	N/A
Korea	April 30, 2018	Exempt	2,631,012 metric tons
Mexico	May 20, 2019	Exempt	Exempt
Turkey	May 21, 2019	25%	N/A
All other countries	March 8, 2018	25%	N/A

Source: U.S. Customs and Border Patrol website: https://www.cbp.gov/trade/programs-administration/entry-summary/232-tariffs-aluminum-and-steel, updated on May 29, 2019.

[34] See appendix E for additional details.
[35] 83 FR 11625, March 15, 2018.
[36] NEXTracker Webpage, https://www.nextracker.com/product-services/solar-storage/nx-horizon/, retrieved October 22, 2019.
[37] See U.S. notes 16(a) and 16(b), subchapter III of chapter 99.

Aluminum

The relevant HTS subheadings within the scope of this safeguard remedy, 8541.40.60, 8501.31.80, 8501.32.60, 8501.61.00, and 8507.20.80, were not included in the enumeration of aluminum products that are subject to the additional 10-percent ad valorem national-security duties under Section 232 of the Trade Expansion Act of 1962, as amended.[38] However, aluminum is used as an input in CSPV module production, as discussed below, and in balance of system components such as racking and mounting systems.[39] [40] Table I-2 presents a summary of current Section 232 tariffs on U.S. imports of aluminum, by country.

Table I-2
Aluminum products: Section 232 tariffs summary

Country	Effective date	Ad valorem duty rate	Absolute quotas
Argentina	May 31, 2018	Exempt	180,939 metric tons
Australia	May 31, 2018	Exempt	Exempt
Canada	May 20, 2019	Exempt	Exempt
Mexico	May 20, 2019	Exempt	Exempt
All other countries	March 8, 2018	10%	N/A

Source: U.S. Customs and Border Patrol website: https://www.cbp.gov/trade/programs-administration/entry-summary/232-tariffs-aluminum-and-steel, updated on May 29, 2019.

Section 301 proceeding[41]

Certain products from China are subject to additional ad valorem duties under Section 301 of the Trade Act of 1974. CSPV modules and cells, which are primarily classified in HTS subheading 8541.40.60, were included in the list of articles subject to the additional 25-percent duties effective August 23, 2018, under Section 301 of the Trade Act of 1974. This list of articles also included HTS subheadings 8501.31.80 and 8501.32.60 (under which CSPV products also enter).[42] [43] HTS subheadings 8501.61.00 and 8507.20.80 (under which CSPV products also enter) were included in the list of goods subject to additional 10-percent ad valorem duties if

[38] 83 FR 11619, March 15, 2018.

[39] Energysage, "What is Solar Racking?" August 22, 2019, https://news.energysage.com/solar-racking-overview/, retrieved October 22, 2019.

[40] See U.S. notes 19(a), 19(b), 19(c), 19(d), and 19(e), subchapter III of chapter 99.

[41] See appendix E for additional details.

[42] 83 FR 40823, August 16, 2018.

[43] See U.S. notes 20(e) and 20(f), subchapter III of chapter 99 which discuses articles and products from China.

they are the product of China and entered the United States on or after September 24, 2018 and prior to May 10, 2019.[44] Goods in HTS subheadings 8501.61.00 and 8507.20.80 exported before May 10, 2019 that entered into the United States by the close of June 14, 2019 continued to be charged the 10-percent additional duty rate. Goods entered on and after June 15, 2019 are subject to the additional 25-percent ad valorem duties, regardless of date of export.[45] Various components used in CSPV module production, such as frames, junction boxes, and backsheets, are also subject to the additional 25-percent ad valorem duties, as are certain balance of system components such as inverters.[46]

Scope of the safeguard remedy

Presidential Proclamation 9693 of January 23, 2018

According to Presidential Proclamation 9693,[47] the President's remedy covers the following CSPV products effective with respect to goods entered, or withdrawn from warehouse for consumption, on or after February 7, 2018, and through February 6, 2022:

> *(a) solar cells, whether or not assembled into modules or made up into panels. . .;*
> *(b) parts or subassemblies of solar cells. . .;*
> *(c) inverters or batteries with CSPV cells attached. . .; and*
> *(d) DC generators with CSPV cells attached. . .*
>
> *. . . the term "crystalline silicon photovoltaic cells" ("CSPV cells") means crystalline silicon photovoltaic cells of a thickness equal to or greater than 20 micrometers, having a p/n junction (or variant thereof) formed by any means, whether or not the cell (or subassemblies thereof. . .) has undergone other processing, including, but not limited to, cleaning, etching, coating, and/or addition of materials (including, but not limited to, metallization and conductor patterns) to collect and forward the electricity that is generated by the cell. Such cells include photovoltaic cells that contain crystalline silicon in addition to other photovoltaic materials. This includes, but is not limited to, passivated emitter rear contact cells, heterojunction with intrinsic thin-layer cells, and other so-*

[44] 83 FR 47974, September 21, 2018.

[45] 84 FR 26930, June 10, 2019.

[46] The goods listed here, which are examples and not an inclusive list of goods subject to additional duties, are included in 9903.88.01, 9903.88.02, and 9903.88.03 in the HTS. Roselund, Christian, "Trump Ratchets up Tariffs on Chinese Products Including Batteries," *PV Magazine*, August 26, 2019, https://pv-magazine-usa.com/2019/08/26/trump-ratchets-up-tariffs-chinese-products-including-batteries/, retrieved November 3, 2019; Sun, Xiaojing, "Look to the Solar Industry for Answers About the Trade War's Impact," *Greentech Media*, August 8, 2019, https://www.greentechmedia.com/articles/read/look-to-the-solar-industry-for-answers-about-trade-wars-impact, retrieved November 3, 2019.

[47] 83 FR 3541, January 23, 2018.

called hybrid cells. . . .{Included are} goods presented in cell form and which at the time of importation are not presented assembled into circuits, laminates or modules or made up into panels.

. . . the term "modules" . . . is a joined group of CSPV cells . . . regardless of the number of cells or the shape of the joined group, that are capable of generating electricity. Also included as a "module" are goods each known as a "panel" comprising a CSPV cell that has undergone any processing, assembly, or interconnection (including, but not limited to, assembly into a laminate). Such CSPV cells assembled into modules or made up into panels include . . . (i) CSPV cells which are presented attached to inverters or batteries . . .; and (ii) CSPV cells classifiable as DC generators . . .

{The remedy} . . . shall not cover--

(1) thin film photovoltaic products produced from amorphous silicon ("a-Si"), cadmium telluride ("CdTe"), or copper indium gallium selenide ("CIGS");

(2) CSPV cells, not exceeding 10,000 mm^2 in surface area, that are permanently integrated into a consumer good whose primary function is other than power generation and that consumes the electricity generated by the integrated CSPV cell. Where more than one CSPV cell is permanently integrated into a consumer good, the surface area for purposes of this exclusion shall be the total combined surface area of all CSPV cells that are integrated into the consumer good; and

(3) CSPV cells, whether or not partially or fully assembled into other products, if such CSPV cells were manufactured in the United States.

{The remedy} . . . shall likewise not cover the following goods, . . .:

(1) 10 to 60 watt, inclusive, rectangular solar panels, where the panels have the following characteristics: (A) length of 250 mm or more but not over 482 mm or width of 400 mm or more but not over 635 mm, and (B) surface area of 1000 cm^2 or more but not over 3,061 cm^2, provided that no such panel with those characteristics shall contain an internal battery or external computer peripheral ports at the time of entry;

(2) 1 watt solar panels incorporated into nightlights that use rechargeable batteries and have the following dimensions: 58 mm or more but not over 64 mm by 126 mm or more but not over 140 mm;

(3) 2 watt solar panels incorporated into daylight dimmers, that may use rechargeable batteries, such panels with the following dimensions: 75 mm or more but not over 82 mm by 139 mm or more but not over 143 mm;

(4) *off-grid and portable CSPV panels, whether in a foldable case or in rigid form containing a glass cover, where the panels have the following characteristics:*

   (A) *a total power output of 100 watts or less per panel;*
   (B) *a maximum surface area of 8,000 cm^2 per panel;*
   (C) *do not include a built-in inverter;*
   (D) *where the panels have glass covers, such panels must be in individual retail packaging (for purposes of this provision, retail packaging typically includes graphics, the product name, its description and/or features, and foam for transport);*

(5) *3.19 watt or less solar panels, each with length of 75 mm or more but not over 266 mm and width of 46 mm or more but not over 127 mm, with surface area of 338 cm^2 or less, with one black wire and one red wire (each of type 22 AWG or 24 AWG) not more than 206 mm in length when measured from panel edge, provided that no such panel shall contain an internal battery or external computer peripheral ports;*

(6) *27.1 watt or less solar panels, each with surface area less than 3,000 cm^2 and coated across the entire surface with a polyurethane doming resin, the foregoing joined to a battery charging and maintaining unit, such unit which is an acrylonitrile butadiene styrene ("ABS") box that incorporates a light emitting diode ("LED") by coated wires that include a connector to permit the incorporation of an extension cable.*

Additional exclusions of September 19, 2018

Pursuant to authority provided by the President, the U.S. Trade Representative (”USTR”) determined that the following additional products should be excluded from the safeguard measure applied to certain solar products, effective with respect to goods entered, or withdrawn from warehouse for consumption, on or after September 19, 2018:[48]

(7) *off-grid, 45 watt or less solar panels, each with length not exceeding 950 mm and width of 100 mm or more but not over 255 mm, with a surface area of 2,500 cm^2 or less, with a pressure-laminated tempered glass cover at the time of entry but not a frame, electrical cables or connectors, or an internal battery;*

(8) *4 watt or less solar panels, each with a length or diameter of 70 mm or more but not over 235 mm, with a surface area not exceeding 539 cm^2, and not exceeding 16 volts, provided that no such panel with these characteristics shall contain an internal battery or external computer peripheral ports at the time of entry;*

[48] 83 FR 47393, September 19, 2018.

(9) solar panels with a maximum rated power of equal to or less than 60 watts, having the following characteristics, provided that no such panel with those characteristics shall contain an internal battery or external computer peripheral ports at the time of entry: (A) Length of not more than 482 mm and width of not more than 635 mm or (B) a total surface area not exceeding 3,061 cm^2;

(10) flexible and semi-flexible off-grid solar panels designed for use with motor vehicles and boats, where the panels range in rated wattage from 10 to 120 watts, inclusive;

(11) frameless solar panels in a color other than black or blue with a total power output of 90 watts or less where the panels have a uniform surface without visible solar cells or busbars;

(12) solar cells with a maximum rated power between 3.4 and 6.7 watts, inclusive, having the following characteristics: (A) A cell surface area between 154 cm^2 and 260 cm^2, inclusive, (B) no visible busbars or gridlines on the front of the cell, and (C) more than 100 interdigitated fingers of tin-coated solid copper adhered to the back of the cell, with the copper portion of the metal fingers having a thickness of greater than 0.01 mm;

(13) solar panels with a maximum rated power between 320 and 500 watts, inclusive, having the following characteristics: (A) Length between 1,556 mm and 2,070 mm inclusive, and width between 1,014 mm and 1,075 mm, inclusive, (B) where the solar cells comprising the panel have no visible busbars or gridlines on the front of the cells, and (C) the solar cells comprising the panel have more than 100 interdigitated fingers of tin-coated solid copper adhered to the back of the cells, with the copper portion of the metal fingers having thickness greater than 0.01 mm;

(14) modules . . . incorporating only CSPV cells that are products of the United States and not incorporating any CSPV cells that are the product of any other country.

Additional exclusions of June 13, 2019

On June 13, 2019, the USTR announced its determination to grant the following additional exclusion requests, effective with respect to goods entered, or withdrawn from warehouse for consumption, on or after June 13, 2019:[49]

[49] 84 FR 27684, June 13, 2019.

(15) bifacial solar panels that absorb light and generate electricity on each side of the panel and that consist of only bifacial solar cells that absorb light and generate electricity on each side of the cells;[50]

(16) flexible fiberglass solar panels without glass components other than fiberglass, such panels having power outputs ranging from 250 to 900 watts;

(17) solar panels consisting of solar cells arranged in rows that are laminated in the panel and that are separated by more than 10 mm, with an optical film spanning the gaps between all rows that is designed to direct sunlight onto the solar cells, and not including panels that lack said optical film or only have a white or other backing layer that absorbs or scatters sunlight.

The safeguard measure

In Presidential Proclamation 9693 of January 23, 2018,[51] the President imposed a safeguard measure on CSPV products for a period of four years beginning on February 7, 2018, in the form of (1) a tariff-rate quota ("TRQ") on imports of solar cells not partially or fully

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[50] The USTR subsequently withdrew the exclusion for bifacial solar panels, effective with respect to articles entered for consumption, or withdrawn from a warehouse for consumption, on or after October 28, 2019. After evaluating newly available information demonstrating that global production of bifacial solar panels is increasing, that the exclusion will likely result in significant increases in imports of bifacial solar panels, and that such panels likely will compete with domestically produced monofacial and bifacial CSPV products in the U.S. market, the USTR determined, after consultation with the Secretaries of Commerce and Energy, that maintaining the exclusion will undermine the objectives of the safeguard measure. 84 FR 54244, October 9, 2019. On October 25, 2019, after a complaint was filed challenging the withdrawal of this exclusion, the CIT issued an order extending the effective date of the withdrawal of the exclusion to November 8, 2019. Court Order, *Invenergy Renewables LLC v. United States*, Ct. No. 19-00192 (Oct. 25, 2019) (ECF No. 29). On November 7, 2019, the CIT granted a temporary restraining order barring the USTR and U.S. Customs and Border Protection ("Customs") from withdrawing the bifacial exclusion until November 21, 2019, or until the CIT rules on the motion for a preliminary injunction. Court Order, *Invenergy Renewables LLC v. United States*, Ct. No. 19-00192 (Nov. 7, 2019) (ECF No. 68). On December 5, 2019, the CIT issued an order preliminarily enjoining USTR and Customs from withdrawing the exclusion until entry of final judgment in the case. Court Order, *Invenergy Renewables LLC v. United States*, Ct. No. 19-00192 (Dec. 5, 2019) (ECF No. 114). On January 27, 2020, the USTR published notice that it was seeking public comment on whether it should maintain the exclusion of bifacial solar panels from the safeguard measure, withdraw the exclusion, or take some other action within his authority with respect to the exclusion. The USTR indicated further that if it determines after receipt of comments it would be appropriate to withdraw the bifacial exclusion or take some other action with respect to this exclusion, it will request that the CIT lift the injunction. 85 FR 4756, January 27, 2020.

[51] 83 FR 3541, January 25, 2018.

assembled into other products and (2) an increase in duties on imports of solar modules. The safeguard measure is applicable to imports from all countries, except for imports from certain developing countries that are members of the WTO, as long as such a country's share of total imports of the product, based on imports during a recent representative period, does not exceed 3 percent, provided that imports that are the product of all such countries with less than 3 percent import share collectively account for not more than 9 percent of total imports of the product.[52]

Tariff-rate quota under the safeguard measure

The safeguard measure imposed a TRQ on imports of solar cells not partially or fully assembled into other products ("CSPV cells") for a period of four years, with unchanging within-quota quantities and annual reductions in the rates of duty applicable to goods entered in excess of those quantities in the second, third, and fourth years. The annual aggregate in-quota quantity of solar cell imports not exceeding 2.5 GW in each year under the TRQ is allocated among all countries, except those that are specifically excluded. Table I-3 presents the safeguard TRQ measure on CSPV cells.

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[52] The countries listed in Presidential Proclamation 9693 as developing countries that are WTO members are: Afghanistan, Albania, Algeria, Angola, Armenia, Azerbaijan, Belize, Benin, Bhutan, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Burkina Faso, Burma, Burundi, Cambodia, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo (Brazzaville), Congo (Kinshasa), Cote d'Ivoire, Djibouti, Dominica, Ecuador, Egypt, Eritrea, Ethiopia, Fiji, Gabon, The Gambia, Georgia, Ghana, Grenada, Guinea, Guinea-Bissau, Guyana, Haiti, India, Indonesia, Iraq, Jamaica, Jordan, Kazakhstan, Kenya, Kiribati, Kosovo, Kyrgyzstan, Lebanon, Lesotho, Liberia, Macedonia, Madagascar, Malawi, Maldives, Mali, Mauritania, Mauritius, Moldova, Mongolia, Montenegro, Mozambique, Namibia, Nepal, Niger, Nigeria, Pakistan, Papua New Guinea, Paraguay, Rwanda, Saint Lucia, Saint Vincent and the Grenadines, Samoa, Sao Tome and Principe, Senegal, Serbia, Sierra Leone, Solomon Island, Somalia, South Africa, South Sudan, Sri Lanka, Suriname, Swaziland, Tanzania, Timor-Leste, Togo, Tonga, Tunisia, Turkey, Tuvalu, Uganda, Ukraine, Uzbekistan, Vanuatu, Yemen (Republic of), Zambia and Zimbabwe. If the President determines that a surge in imports of CSPV products from a developing country that is a WTO member results in imports of that product from that developing country exceeding either of the thresholds described, the safeguard measure shall be modified to apply to such product from such country. Turkey was removed from the list of developing countries as of May 17, 2019. India was removed from the list of developing countries as of June 5, 2019. Proclamation to Modify the List of Beneficiary Developing Countries Under the Trade Act of 1974, May 16, 2019, https://www.whitehouse.gov/presidential-actions/proclamation-modify-list-beneficiary-developing-countries-trade-act-1974/, retrieved January 12, 2020; Proclamation to Modify the List of Beneficiary Developing Countries Under the Trade Act of 1974, May 31, 2019, https://www.whitehouse.gov/presidential-actions/proclamation-modify-list-beneficiary-developing-countries-trade-act-1974-2/, retrieved January 12, 2020.

Table I-3
CSPV cells: Safeguard TRQ measure on cells

Item	Safeguard duty on first 2.5 GW of imported cells	Safeguard duty on imported cells exceeding 2.5 GW (percent)
February 7, 2018 - February 6, 2019	--	30
February 7, 2019 - February 6, 2020	--	25
February 7, 2020 - February 6, 2021	--	20
February 7, 2021 - February 6, 2022	--	15

Source: 83 FR 3541, January 25, 2018.

Import duties under the safeguard measure

The safeguard measure imposed an increase in duties on imports of CSPV modules for a period of four years, with annual reductions in the rates of duty in the second, third, and fourth years. The additional duty is imposed on the declared value of CSPV modules, including the cost or value of the non-cell portions of the modules (such as aluminum frames). Table I-4 presents the import duties under the safeguard measure on CSPV modules.

Table I-4
CSPV modules: Safeguard measure on modules

Item	Safeguard duty on imported modules (percent)
February 7, 2018 - February 6, 2019	30
February 7, 2019 - February 6, 2020	25
February 7, 2020 - February 6, 2021	20
February 7, 2021 - February 6, 2022	15

Source: 83 FR 3541, January 25, 2018.

Tariff treatment

The subject merchandise is provided for in subheading 8541.40.60 of the Harmonized Tariff Schedule of the United States ("HTS"), and has been free of duty under the general duty column since at least 1987. Within subheading 8541.40.60, the subject merchandise was included in statistical reporting numbers 8541.40.6020 ("solar cells, assembled into modules or made up into panels") and 8541.40.6030 ("solar cells, other") through June 30, 2018. As of July 1, 2018, a superior text for crystalline silicon photovoltaic cells (described in statistical note 11 to chapter 85) applies to two subordinate reporting categories, 8541.40.6015 (“assembled into modules or made up into panels”) and 8541.40.6025 (“other”).[53]

Under subheading 9903.45.22, imports of cells in excess of the prescribed TRQ quantity subject to the safeguard measure are currently subject to a general duty rate of 25 percent ad valorem (unless the product of an exempt country); under subheading 9903.45.25 all covered modules from nonexempt countries are currently subject to the safeguard duty rate of 25 percent ad valorem.

These articles may also be imported as parts or subassemblies of goods provided for in subheadings 8501.31.80, 8501.61.00, and 8507.20.80.[54] Inverters or batteries with CSPV cells attached are provided for under HTSUS subheadings 8501.61.00 and 8507.20.80, respectively. In addition, CSPV cells covered by the reviews may also be classifiable as DC generators of subheading 8501.31.80, when such generators are imported with CSPV cells attached. Goods classified in subheadings 8501.31.80 and 8501.61.00 have general duty rates of 2.5 percent ad valorem, and goods classified in subheading 8507.20.80 have a general duty rate of 3.5 percent ad valorem. The following statistical reporting numbers were added on March 1, 2018: 8501.31.8010 (covering DC generators of an output not exceeding 750 W: photovoltaic generators of a kind described in statistical note 9 to subchapter 85),[55] 8501.32.6010 (DC generators of an output exceeding 750 W but not exceeding 75 kW: photovoltaic generators of a kind described in statistical note 9), 8501.61.0010 (AC generators (alternators): photovoltaic

[53] Statistical Note 11: For the purposes of statistical reporting numbers 8541.40.6015 and 8541.40.6025, the term "crystalline silicon photovoltaic cells" means crystalline silicon photovoltaic cells of a thickness equal to or greater than 20 micrometers, having a p/n junction (or variant thereof) formed by any means, whether or not the cell imported under statistical reporting number 8541.40.6025 (or subassemblies thereof imported under statistical reporting number 8541.40.6015) has undergone other processing, including, but not limited to, cleaning, etching, coating, and/or addition of materials (including, but not limited to, metallization and conductor patterns) to collect and forward the electricity that is generated by the cell. Such cells include photovoltaic cells that contain crystalline silicon in addition to other photovoltaic materials. This includes, but is not limited to, passivated emitter rear contact cells, heterojunction with intrinsic thin-layer cells, and other so-called hybrid cells.

[54] The subject cells may be presented as integral elements of subassemblies of components or of goods of these three subheadings, even if not treated as “parts” for tariff purposes.

[55] Statistical Note 9 to chapter 85 provides as follows: For the purposes of heading 8501, photovoltaic generators consist of panels of photocells combined with other apparatus, e.g., storage batteries and electronic controls (voltage regulator, inverter, etc.) and panels or modules equipped with elements, however simple (for example, diodes to control the direction of the current), which supply the power directly to, for example, a motor, an electrolyser. In these devices, electricity is produced by means of solar cells which convert solar energy directly into electricity (photovoltaic conversion).

generators of a kind described in statistical note 9), and 8507.20.8010 (other lead-acid storage batteries: of a kind described in subheading 9903.45.25).[56]

The HTS subheadings and reporting numbers are provided for convenience and the written description of the imported article is dispositive. Decisions on the tariff classification and treatment of imported articles are within the authority of U.S. Customs and Border Protection ("Customs").

Global developments[57]

Global installations

Global photovoltaic ("PV") system installations (including out-of-scope thin film), according to the International Energy Agency ("IEA"), increased from 77.2 gigawatts ("GW")[58] in 2016 to 103.6 GW in 2017, and remained relatively flat at 103.2 GW in 2018 (table I-5).[59] The

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[56] HTS 9903.45.25: Modules as defined in note 18(g) to this subchapter (subchapter III of chapter 99), when the product or originating good of a country other than a country described in note 18(b) to this subchapter.

U.S. Note 18(g) to subchapter III, chapter 99: Subject to the provisions of subdivision (c)(iii) of this note, for purposes of subheading 9903.45.25 to this subchapter, the term "modules" shall include the following goods provided for in subheading 8541.40.60 of the tariff schedule: a module is a joined group of CSPV cells, as such cells are defined in subdivision (c) of this note, regardless of the number of cells or the shape of the joined group, that are capable of generating electricity. Also included as a "module" are goods each known as a "panel" comprising a CSPV cell that has undergone any processing, assembly, or interconnection (including, but not limited to, assembly into a laminate). Such CSPV cells assembled into modules or made up into panels include goods of a type reported for statistical purposes under statistical reporting number 8541.40.6020. Such goods also include (i) CSPV cells which are presented attached to inverters or batteries of subheading 8501.61.00 or 8507.20.80, respectively; and (ii) CSPV cells classifiable as DC generators of subheading 8501.31.80.

[57] See appendix F for additional details and select foreign producer data collected in this proceeding. Additional information on the Chinese industry (including production, production capacity, supply chain, capital expenditures, profitability, research and development spending, and the domestic market), as well as Chinese policies are also included in appendix F.

[58] This report discusses data in terms of watts ("W"), kilowatts ("kW" (equal to 1,000 watts)), megawatts ("MW" (1,000 kW)), and gigawatts ("GW" (1,000 MW)).

[59] The latest version of data from IEA includes revisions to 2016-18 installation totals. Estimates of the size of the global market vary. For example, Wood Mackenzie reported 2018 global installations of 97.4 GW, Solar Power Europe reported 102.4 GW in 2018 installations, PV InfoLink reported 2018 demand of 98.4 GW, and EnergyTrend reported demand of 108.2 GW in 2018. International Energy Agency (IEA) Photovoltaic Power Systems Programme (PVPS), *Trends 2019 in Photovoltaic Applications*, IEA PVPS T1-36:2019, pp. 15 and 97, http://www.iea-pvps.org/index.php?id=trends, retrieved December 12, 2019; Shrestha, Rishab, Benjamin Attia, Manan Parikh, Tom Heggarty, *Global Solar PV Market Outlook Update*, Q2 2019 Executive Summary, Wood Mackenzie, July 2019, p. 5,
(continued...)

largest markets in 2018 were China (44.3 GW, 43 percent of installations), India (10.8 GW, 10 percent), the United States (10.7 GW, 10 percent), and Japan (6.7 GW, 6 percent).[60]

Table I-5
CSPV products: Global PV (including out-of-scope thin film) installations, 2016–18

Country	2016	2017	2018
China	34.6	53.1	44.3
India	4.0	12.9	10.8
United States	15.2	10.8	10.7
Japan	7.9	7.5	6.7
Australia	0.9	1.3	3.8
Germany	1.5	1.8	3.0
Mexico	0.1	0.2	3.6
Turkey	0.8	3.0	2.9
Korea	0.9	1.3	2.3
Netherlands	0.6	0.8	1.5
Rest of World	10.7	10.9	13.6
Total	77.2	103.6	103.2

Note: Top ten countries in installed capacity in 2018.

Source: IEA PVPS, *Trends 2019 in Photovoltaic Applications*, IEA PVPS T1-36:2019, pp. 15 and 97, http://www.iea-pvps.org/index.php?id=trends, retrieved December 12, 2019.

https://www.woodmac.com/our-expertise/focus/Power--Renewables/global-solar-outlook-q2-2019/?utm_source=gtm&utm_medium=article&utm_campaign=wmpr_Q2solaroutlook19, retrieved October 3, 2019; Solar Power Europe, *Global Market Outlook for Solar Power, 2019–2023*, 2019, p. 10, http://www.solarpowereurope.org/wp-content/uploads/2019/05/SolarPower-Europe-Global-Market-Outlook-2019-2023.pdf, retrieved October 3, 2019; REC Silicon, *Second Quarter 2019*, Presentation, July 25, 2019, p. 12, https://webtv.hegnar.no/presentation.php?webcastId=98041401, retrieved October 3, 2019; EnergyTrend, "Global Demand for PV Modules Temporarily Decreases in 3Q19, But Annual Demand May Still Go Above 120GW, Says EnergyTrend," July 17, 2019, https://m.energytrend.com/research/20190717-14551.html, retrieved October 3, 2019.

[60] IEA PVPS, *2019 in Photovoltaic Applications*, IEA PVPS T1-36:2019, pp. 15 and 97, http://www.iea-pvps.org/index.php?id=trends, retrieved December 12, 2019.

Global installations are forecasted to total *** in 2019, *** in 2020, and *** in 2021 (figure I-1).[61] EnergyTrend, which projects 125.5 GW of PV module demand in 2019, forecasts that China will account for 33 percent of demand, followed by the United States (11 percent), India (9 percent), Japan (6 percent), and Vietnam (6 percent).[62] China is likely to remain the largest market in the near term, with the Chinese Photovoltaic Industry Association (CPIA) predicting installations of more than 40 GW in 2019,[63] 40 to 50 GW in 2020, and 45 to 60 GW in 2021.[64] Over the period from 2019-24, Wood Mackenzie forecasts that the largest markets, in descending order, will be China, the United States, India, Japan, Korea, Germany, Spain, Saudi Arabia, France, and Mexico.[65]

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[61] REC Silicon, *Second Quarter 2019*, Presentation, July 25, 2019, p. 12, https://webtv.hegnar.no/presentation.php?webcastId=98041401, retrieved October 3, 2019; ***; Shrestha, Rishab, Benjamin Attia, Manan Parikh, Tom Heggarty, *Global Solar PV Market Outlook Update*, Q2 2019 Executive Summary, Wood Mackenzie, July 2019, p. 5, https://www.woodmac.com/our-expertise/focus/Power--Renewables/global-solar-outlook-q2-2019/?utm_source=gtm&utm_medium=article&utm_campaign=wmpr_Q2solaroutlook19, retrieved October 3, 2019; EnergyTrend, "Global Demand for PV Modules Temporarily Decreases in 3Q19, But Annual Demand May Still Go Above 120GW, Says EnergyTrend," July 17, 2019, https://m.energytrend.com/research/20190717-14551.html, retrieved October 3, 2019.

[62] EnergyTrend, "Global Demand for PV Modules Temporarily Decreases in 3Q19, But Annual Demand May Still Go Above 120GW, Says EnergyTrend," July 17, 2019, https://m.energytrend.com/research/20190717-14551.html, retrieved October 3, 2019.

[63] Taiyang News, "China Installed 11.4 GW New Solar in H1/2019," July 26, 2019, http://taiyangnews.info/markets/china-installed-11-4-gw-new-solar-in-h12019/, retrieved November 6, 2019.

[64] Solar Power Europe, *Global Market Outlook for Solar Power, 2019–2023*, 2019, p. 56, http://www.solarpowereurope.org/wp-content/uploads/2019/05/SolarPower-Europe-Global-Market-Outlook-2019-2023.pdf, retrieved October 3, 2019.

[65] Shrestha, Rishab, Benjamin Attia, Manan Parikh, Tom Heggarty, *Global Solar PV Market Outlook Update*, Q2 2019 Executive Summary, Wood Mackenzie, July 2019, p. 6, https://www.woodmac.com/our-expertise/focus/Power--Renewables/global-solar-outlook-q2-2019/?utm_source=gtm&utm_medium=article&utm_campaign=wmpr_Q2solaroutlook19, retrieved October 3, 2019.

Figure I-1
CSPV products: Global PV installations (including out-of-scope thin film), 2016–18 and projected installations 2019–21

*   *   *   *   *   *   *

Note: Only includes market forecasts published in the second half of 2019.

Source: IEA PVPS, *Trends 2018 in Photovoltaic Applications*, IEA PVPS T1-34:2018, p. 83, http://www.iea-pvps.org/index.php?id=trends, retrieved October 3, 2019; IEA PVPS, *2019 Snapshot of Global PV Markets*, Report IEA PVPS T1-35:2019, p. 5, http://www.iea-pvps.org/?id=266, retrieved October 3, 2019. REC Silicon, *Second Quarter 2019*, Presentation, July 25, 2019, p. 12, https://webtv.hegnar.no/presentation.php?webcastId=98041401, retrieved October 3, 2019; ***; Shrestha, Rishab, Benjamin Attia, Manan Parikh, Tom Heggarty, *Global Solar PV Market Outlook Update*, Q2 2019 Executive Summary, Wood Mackenzie, July 2019, p. 5, https://www.woodmac.com/our-expertise/focus/Power--Renewables/global-solar-outlook-q2-2019/?utm_source=gtm&utm_medium=article&utm_campaign=wmpr_Q2solaroutlook19, retrieved October 3, 2019; EnergyTrend, “Global Demand for PV Modules Temporarily Decreases in 3Q19, But Annual Demand May Still Go Above 120GW, Says EnergyTrend,” July 17, 2019, https://m.energytrend.com/research/20190717-14551.html, retrieved October 3, 2019.

Global industry

Global production and capacity

Global PV cell production (including out-of-scope thin film) increased from 77 GW in 2016 to 104 GW in 2017, then rose to 116 GW in 2018 (figure I-2). PV module production increased from 78 GW in 2016 to 105 GW in 2017, then reached 116 GW in 2018. China was the leading producer in 2018, accounting for 74 percent of PV cell production and 73 percent of PV module production, up from 66 percent and 69 percent, respectively, in 2016.[66] Global PV cell production capacity totaled 172 GW in 2018.[67] Global PV module production capacity (including thin film) increased from 106 GW in 2016 to 133 GW in 2017, then rose to 184 GW in 2018, though effective capacity (which excludes uncompetitive idled older facilities) in 2018 was about 160 MW.[68]

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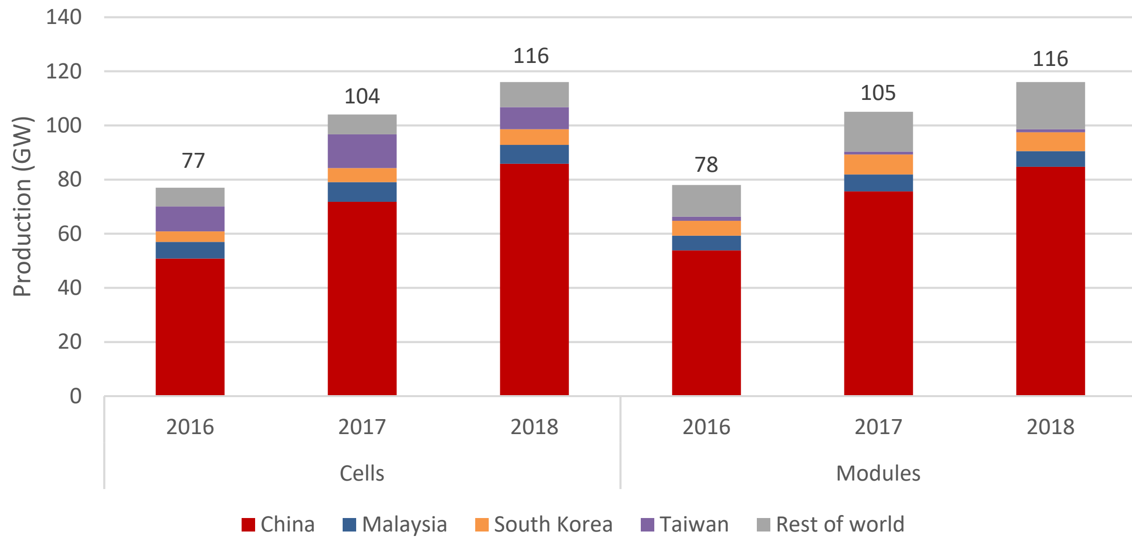
[66] China was also the leading producer of polysilicon (including for semiconductors) and wafers, accounting for 58 percent of polysilicon production in 2018 and 93 percent of wafer production. IEA PVPS data from IEA PVPS, *Trends 2019 in Photovoltaic Applications*, IEA PVPS T1-36:2019, pp. 29-63, http://www.iea-pvps.org/index.php?id=trends, December 12, 2019; IEA PVPS, *Trends 2018 in Photovoltaic Applications*, IEA PVPS T1-34:2018, pp. 56-57, http://www.iea-pvps.org/index.php?id=trends, retrieved October 3, 2019; IEA PVPS, *Trends 2017 in Photovoltaic Applications*, IEA PVPS T1-32:2017, pp. 50 and 53, http://www.iea-pvps.org/index.php?id=trends, retrieved October 3, 2019.

[67] IEA PVPS, *Trends 2019 in Photovoltaic Applications*, IEA PVPS T1-36:2019, p. 62, http://www.iea-pvps.org/index.php?id=trends, December 12, 2019.

[68] IEA PVPS, *Trends 2019 in Photovoltaic Applications*, IEA PVPS T1-36:2019, p. 62, http://www.iea-pvps.org/index.php?id=trends, December 12, 2019. Kaizuka, Izumi, "PV Industry Trends from IEA PVPS Trends Report," June 14, 2018, p. 6, http://www.iea-pvps.org/fileadmin/dam/public/workshop/7th_WCPEC/Status_of_the_PV_market_and_PV_industry_mid-2018.pdf, retrieved November 6, 2019; Izumi Kaizuka, "PV Industry Trends from IEA PVPS Trends Report," September 10, 2019, p. 5, https://www.pvp4grid.eu/wp-content/uploads/2019/09/EUPVSEC_session-2_Izumi-KAIZUKA.pdf, retrieved November 5, 2019; IEA PVPS, *Trends 2018 in Photovoltaic Applications*, Report IEA PVPS T1-34:2018, p. 58, http://www.iea-pvps.org/index.php?id=trends, December 19, 2019.

Figure I-2
Global PV cell and module production, 2016–18



Note: The IEA PVPS report does not separately break out some large producers, such as Vietnam. Includes out-of-scope thin film products.

Source: IEA PVPS, *Trends 2019 in Photovoltaic Applications*, IEA PVPS T1-36:2019, p. 62, http://www.iea-pvps.org/index.php?id=trends, December 12, 2019; IEA PVPS, *Trends 2018 in Photovoltaic Applications*, IEA PVPS T1-34:2018, pp. 56-57, http://www.iea-pvps.org/index.php?id=trends, retrieved October 3, 2019; IEA PVPS, *Trends 2017 in Photovoltaic Applications*, IEA PVPS T1-32:2017, pp. 50 and 53, http://www.iea-pvps.org/index.php?id=trends, retrieved October 3, 2019;

According to PV Tech, the leading CSPV cell producers in 2018, in descending order, were JA Solar (headquartered in China), Tongwei (China), Trina Solar (China), Hanwha Q Cells (Korea), Jinko Solar (China), Longi Solar (China), Shunfeng (China), Canadian Solar (Canada/China), and Aiko Solar (China).[69] The leading CSPV module suppliers in 2018, in descending order, were Jinko Solar (headquartered in China), JA Solar (China), Trina Solar (China), Longi Solar (China), Canadian Solar (Canada/China), Hanwha Q Cells (Korea), Risen Energy (China), GCL-SI (China), and Talesun (China).[70]

[69] Colville, "Top-10 Solar Cell Producers of 2018," *PV Tech*, January 9, 2019, https://www.pv-tech.org/editors-blog/top-10-solar-cell-producers-of-2018, retrieved November 2, 2019.
[70] Colville, "Top 10 Solar Module Suppliers in 2018," *PV Tech*, January 23, 2019, https://www.pv-tech.org/editors-blog/top-10-solar-module-suppliers-in-2018, retrieved October 25, 2019.

Global exports

China is the largest global exporter of PV cells and modules, with exports increasing from $11.36 billion in 2016 to $11.45 billion in 2017 to $13.58 billion in 2018 (table I-6). Exports from China in the first nine months of 2019 totaled $14.9 billion.[71] Korea was the second largest exporter, with $1.6 billion in exports in 2018.[72]

Table I-6
PV cell and module exports, 2016–18

Country	2016	2017	2018
	Value ($1,000)		
China	11,357,287	11,445,467	13,578,389
Korea	1,885,451	1,840,262	1,604,816
Vietnam	1,012,781	2,589,277	1,460,859
Malaysia	See notes	See notes	1,332,540
Taiwan	2,828,722	2,173,907	1,155,796

Notes: Includes out-of-scope thin film products. For Vietnam, data were not available below the HS 6-digit level. Malaysia data prior to 2018 are not included, as some data were not available at the 10-digit level.

Sources: Official exports statistics under HS subheading 8541.40.20 for China from China's customs; Korea under HS subheadings 8541.40.9020, 8541.40.9021 and 8541.40.9022 from Korea's customs and Trade Development Institution; Malaysia under HS subheadings 8541.40.2100 and 8541.40.2200 from Department of Statistics Malaysia; Taiwan under HS subheadings 8541.40.3000 and 8541.40.4000 from Taiwan's Directorate General of Customs; and mirror import data in HS subheading 8541.40 for Vietnam reported by the Global Trade Atlas database, accessed November 1, 2019.

[71] Exports on a global basis are not available since there is not a specific HS number for PV cells and modules. Official exports statistics under HS subheading 8541.40.20 for China from China's customs reported by the Global Trade Atlas database, accessed November 1, 2019.

[72] Official exports statistics for Korea under HS subheading 8541.40.9020, 8541.40.9021 and 8541.40.9022 from Korea's Customs and Trade Development Institution reported by the Global Trade Atlas database, accessed November 1, 2019.

Global capital expenditures[73]

Global capital expenditure costs to build new CSPV cell and module plants declined during 2015–18. The global median capital expenditure to build a CSPV cell plant declined from $0.28 per watt of annual production capacity to $0.12 (figure I-3). The global median capital expenditure to build a CSPV module plant declined from $0.09 per watt of annual production capacity to $0.06 per watt of annual production capacity.[74] China accounted for more than 80 percent of the approximately $9 billion in global CSPV (including ingots, wafers, cells, and modules) capital expenditures in 2018.[75]

U.S. manufacturers provided the following estimates of required capital expenditure costs for CSPV plants in the United States in their posthearing briefs. ***.[76]

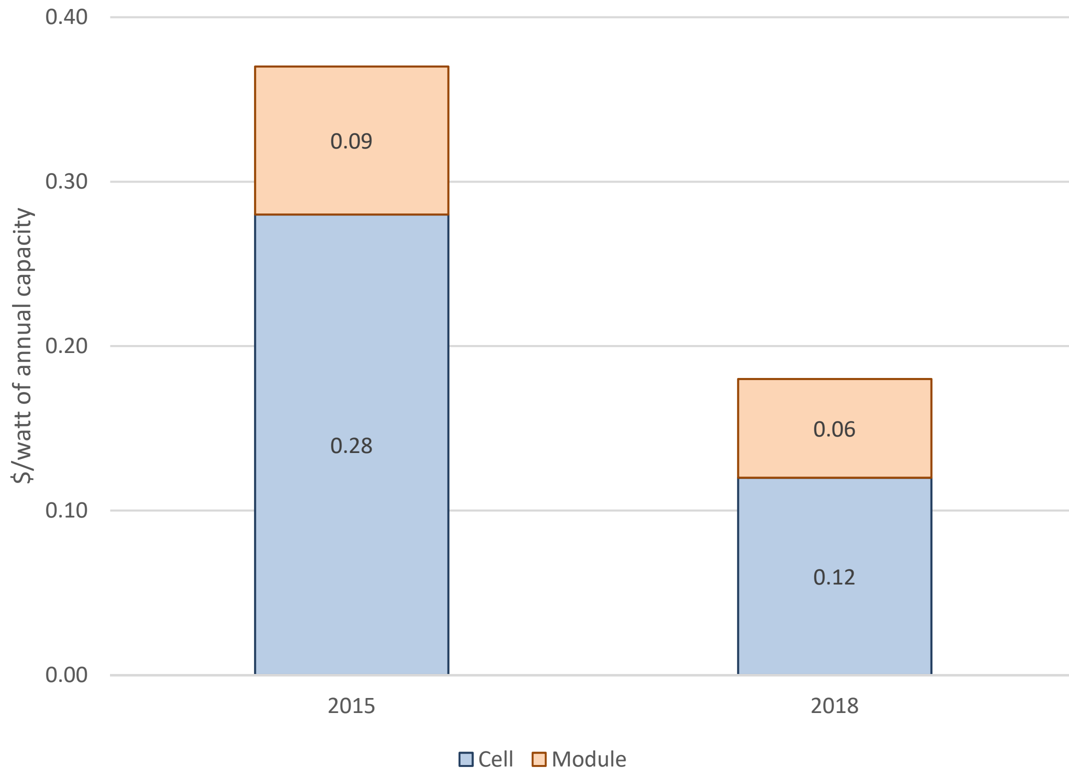
[73] See appendix F for additional details on capital expenditures and financing received by Chinese CSPV manufacturers.

[74] National Renewable Energy Lab data cited in Liu, Zhe, Sarah E. Sofia, Hannu S. Laine, Michael Woodhouse, Sarah Wieghold, Ian Marius Peters, and Tonio Buonassisi, "Revisiting Thin Silicon for Photovoltaics: A Technoeconomic Perspective," *Energy and Environmental Science*, October 25, 2019, p. 2, https://pubs.rsc.org/en/content/articlehtml/2020/ee/c9ee02452b, retrieved December 19, 2019.

[75] China similarly accounted for more than 80 percent of cell only capital expenditures in 2018. Colville, Finlay, "Solar PV Capex Trending at US$9 billion Annually as New GW Fabs in China Slash Investments Required," PV Tech, December 10, 2019, https://www.pv-tech.org/editors-blog/solar-pv-capex-trending-at-us9-billion-annually-as-new-gw-fabs-in-china-sla, retrieved December 18, 2019.

[76] Compiled from data submitted in posthearing briefs.

Figure I-3
Global median capital expenditures for new CSPV cell and module plants, 2015 and 2018



Note: Global median cost.

Source: National Renewable Energy Lab data cited in Liu, Zhe, Sarah E. Sofia, Hannu S. Laine, Michael Woodhouse, Sarah Wieghold, Ian Marius Peters, and Tonio Buonassisi, "Revisiting Thin Silicon for Photovoltaics: A Technoeconomic Perspective," *Energy and Environmental Science*, October 25, 2019, p. 2, https://pubs.rsc.org/en/content/articlehtml/2020/ee/c9ee02452b, retrieved December 19, 2019.

Country profiles

China[77]

Chinese PV cell production,[78] according to the China Photovoltaic Industry Association, increased from 72 GW in 2017 to 85 GW in 2018,[79] with production in the first half of 2019 totaling 51 GW (up 31 percent from the first half of 2018) (figure I-4). Chinese PV module production rose from 75 GW in 2017 to 83 GW in 2018, with production of PV modules totaling 47 GW in first half of 2019 (up 12 percent from the first half of 2018).[80] China's PV cell production capacity increased from 83 GW in 2017 to 128 GW in 2018, while PV module production capacity increased from 105 GW in 2017 to 130 GW in 2018.[81]

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[77] See appendix F for additional details on China's industry and policies.

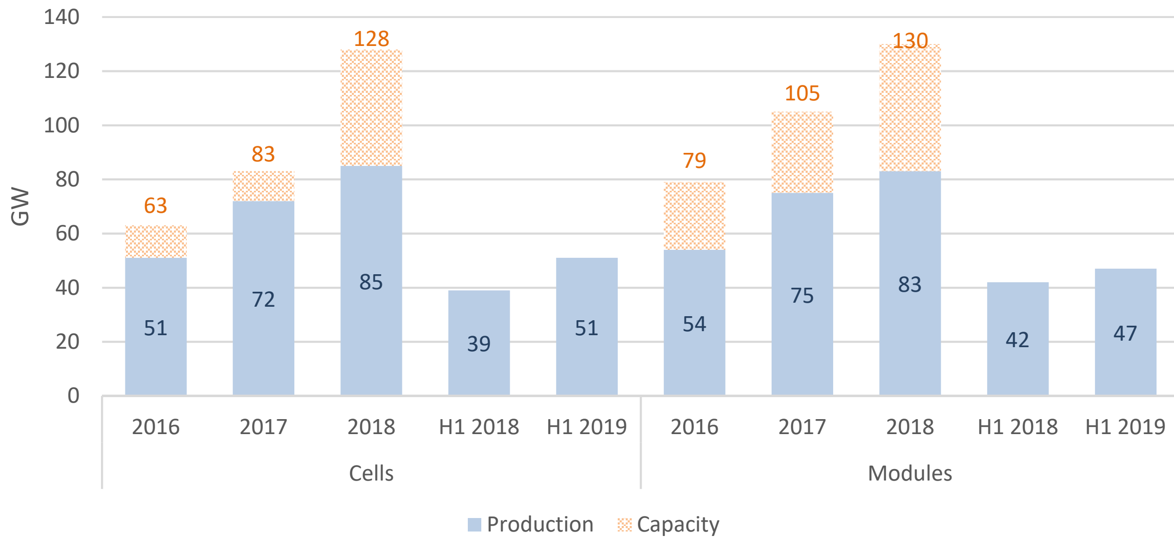
[78] Chinese production of wafers increased from 92 GW in 2017 to 107 GW in 2018, and increased 26 percent in the first half of 2019 to 63 GW. China Photovoltaic Industry Association (CPIA), "China Photovoltaic Industry Development Roadmap," 2019, p. 2, http://www.chinapv.org.cn/road_map.html, retrieved November 4, 2019; Shaw, Vincent, "Chinese Solar Production Figures Continue to Ramp Up," *PV Magazine*, July 26, 2019, https://www.pv-magazine.com/2019/07/26/chinese-solar-production-figures-continue-to-ramp-up/, retrieved November 6, 2019; Fang, Lv, Xu Honghua, Wang Sicheng, Li Hailing, Ma Liyun, and Li Ping "National Survey Report of PV Power Applications in China 2018," IEA PVPS, 2019, p. 19, http://www.iea-pvps.org/?id=93, retrieved December 19, 2019.

[79] Data from the National Bureau of Statistics of China indicate that PV cell production increased from 77 GW in 2016 to 95 GW in 2017 and 96 GW in 2018. Through the first nine months of 2019, production totaled 93 GW, up from 69 GW in the same period in 2018. National Bureau of Statistics of China, http://data.stats.gov.cn/english/easyquery.htm?cn=A01, retrieved November 7, 2019.

[80] CPIA, "China Photovoltaic Industry Development Roadmap," 2019, p. 3, http://www.chinapv.org.cn/road_map.html, retrieved November 4, 2019; Shaw, Vincent, Chinese Solar Production Figures Continue to Ramp Up," *PV Magazine*, July 26, 2019, https://www.pv-magazine.com/2019/07/26/chinese-solar-production-figures-continue-to-ramp-up/, retrieved November 6, 2019; Fang, Lv, Xu Honghua, Wang Sicheng, Li Hailing, Ma Liyun, and Li Ping "National Survey Report of PV Power Applications in China 2018," IEA PVPS, 2019, p. 19–20, http://www.iea-pvps.org/?id=93, retrieved December 19, 2019.

[81] Fang, Lv, Xu Honghua, Wang Sicheng, "National Survey Report of PV Power Applications in China 2016," IEA PVPS, 2017, p. 18, , retrieved December 19, 2019, retrieved November 6, 2019; Fang, Lv, Xu Honghua, Wang Sicheng, Li Hailing, Ma Liyun, and Li Ping "National Survey Report of PV Power Applications in China 2018," IEA PVPS, 2019, p. 19–20, http://www.iea-pvps.org/?id=93, retrieved December 19, 2019.

Figure I-4
CSPV products: Chinese PV cell and module production and capacity, 2016–2018, January–June 2018, and January–June 2019



Note: Production capacity for 2019 is not available. Capacity is not available for partial year periods from these sources.

Source: CPIA, "China Photovoltaic Industry Development Roadmap," 2019, p. 2, http://www.chinapv.org.cn/road_map.html, retrieved November 4, 2019; Shaw, Vincent, "Chinese Solar Production Figures Continue to Ramp Up," *PV Magazine*, July 26, 2019, https://www.pv-magazine.com/2019/07/26/chinese-solar-production-figures-continue-to-ramp-up/, retrieved November 6, 2019; Fang, Lv, Xu Honghua, Wang Sicheng, "National Survey Report of PV Power Applications in China 2016," IEA PVPS, 2017, p. 18, http://www.iea-pvps.org/?id=93, retrieved November 6, 2019; Fang, Lv, Xu Honghua, Wang Sicheng, "National Survey Report of PV Power Applications in China 2017," IEA PVPS, 2018, p. 18, http://www.iea-pvps.org/?id=93, retrieved November 6, 2019; Fang, Lv, Xu Honghua, Wang Sicheng, Li Hailing, Ma Liyun, and Li Ping "National Survey Report of PV Power Applications in China 2018," IEA PVPS, 2019, p. 19–20, http://www.iea-pvps.org/?id=93, retrieved December 19, 2019.

Chinese exports of PV cells and modules increased from $11.4 billion in 2017 to $13.6 billion in 2018 (table I-7). From January to September 2019, exports totaled $14.9 billion.[82] On a unit basis, China's exports increased from approximately *** in 2017 to *** in 2018, and totaled about *** through the first nine months of 2019.[83] The top five export destinations in 2018, by value, were India (16 percent of exports), Japan (13 percent), Australia (9 percent), Mexico (9 percent), and Brazil (4 percent). Through the first nine months of 2019, the Netherlands was the largest export destination.[84] The removal of the minimum import price in the EU in September 2018 (see the discussion below) led to a significant increase in exports to Europe.[85] China's exports to the EU declined from $1.3 billion in 2016 to $607 million in 2017, then increased to $1.2 billion in 2018 and $3.9 billion in the first nine months of 2019.[86]

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[82] Official exports statistics under HS subheading 8541.40.20 for China from China's customs reported by the Global Trade Atlas database, accessed November 2, 2019.

[83] For Q2 2017 through 2019, monthly exports divided by the monthly average multicrystalline CSPV module spot market price for CSPV modules made in China from ***. For Q1 2017, *** data were not available, so the global average multicrystalline CSPV module spot market price was used. Exports also include lower priced cells and higher priced CSPV monocrystalline modules, so actual volume may differ slightly from this estimate. China's report to the IEA indicated 24.2 GW in combined PV cell and module exports in 2016, and TrendForce reported 41 GW of PV module exports in 2019. Official exports statistics under HS subheading 8541.40.20 for China from China's customs reported by the Global Trade Atlas database, accessed November 2, 2019; Fang, Lv, Xu Honghua, Wang Sicheng, "National Survey Report of PV Power Applications in China 2016," IEA PVPS, 2017, p. 18, http://www.iea-pvps.org/index.php?id=93&eID=dam_frontend_push&docID=4107, retrieved November 6, 2019; TrendForce, "Global Demand for PV Modules Temporarily Decreases in 3Q19, but Annual Demand May Still Go Above 120GW, Says TrendForce," July 17, 2019, https://press.trendforce.com/node/view/3274.html, retrieved November 7, 2019; Austin, Ryan, "Solar Energy Costs Trends Over Time," Earth Techling, July 2, 2019, https://earthtechling.com/solar-energy-costs-trends/, retrieved November 7, 2019.

[84] Official exports statistics under HS subheading 8541.40.20 for China from China's customs reported by the Global Trade Atlas database, accessed November 2, 2019.

[85] TrendForce, "Global Demand for PV Modules Temporarily Decreases in 3Q19, but Annual Demand May Still Go Above 120GW, Says TrendForce," July 17, 2019, https://press.trendforce.com/node/view/3274.html, retrieved November 3, 2019; Lin, Corrine. "China's PV Policy Still Under Discussion," *PV Magazine*, April 4, 2019, https://www.pv-magazine.com/2019/04/04/chinas-pv-policy-still-under-discussion/, retrieved November 3, 2019.

[86] Official exports statistics under HS subheading 8541.40.20 for China from China's customs reported by the Global Trade Atlas database, accessed November 2, 2019.

Table I-7
CSPV products: Exports from China, 2016–18, January-September 2018 and January-September 2019

Country	2016	2017	2018	Jan-Sep 2018	Jan-Sep 2019
	Value ($1,000)				
India	2,448,232	3,395,460	2,195,413	1,818,446	1,237,213
Japan	2,558,071	2,069,987	1,825,262	1,339,271	1,371,642
Australia	354,469	678,532	1,288,059	1,051,156	975,671
Mexico	92,008	556,739	1,233,313	1,007,729	705,978
Brazil	341,085	431,907	577,840	445,056	725,226
Ukraine	74,715	97,403	517,895	407,336	801,354
Vietnam	37,223	67,645	466,042	106,674	1,507,154
Netherlands	577,261	252,041	426,546	239,128	1,779,738
Korea	357,999	413,515	362,674	295,450	586,524
United States	1,343,322	622,686	40,831	32,185	36,075
All other	3,172,901	2,859,552	4,644,513	3,331,554	5,165,988
Total	11,357,287	11,445,467	13,578,389	10,073,985	14,892,562
	Share of value (percent)				
India	21.6	29.7	16.2	18.1	8.3
Japan	22.5	18.1	13.4	13.3	9.2
Australia	3.1	5.9	9.5	10.4	6.6
Mexico	0.8	4.9	9.1	10.0	4.7
Brazil	3.0	3.8	4.3	4.4	4.9
Ukraine	0.7	0.9	3.8	4.0	5.4
Vietnam	0.3	0.6	3.4	1.1	10.1
Netherlands	5.1	2.2	3.1	2.4	12.0
Korea	3.2	3.6	2.7	2.9	3.9
United States	11.8	5.4	0.3	0.3	0.2
All other	27.9	25.0	34.2	33.1	34.7
Total	100.0	100.0	100.0	100.0	100.0

Note: Table includes the top ten cumulative export destinations during 2016–September 2019. Based on monthly export data.

Source: Official exports statistics under HS subheading 8541.40.20 for China from China's customs reported by the Global Trade Atlas database, accessed November 2, 2019.

The leading Chinese PV cell and module exporters in the first eight months of 2019 were *** (table I-8). There were some new firms that emerged as *** during 2016–19. For example, ***. On the other hand, some firms are on pace to *** in 2019 than in 2016.[87] Several firms have established production facilities in other Southeast Asian countries.

Table I-8
CSPV products: Exports from China by company, 2016, 2017, and January to August 2019

Firm	2016	2017	2018	Jan-Aug 2019	2016	2017	2018	Jan-Aug 2019
	Value ($1,000)				Share of value (percent)			
***	***	***	***	***	***	***	***	***
***	***	***	***	***	***	***	***	***
***	***	***	***	***	***	***	***	***
***	***	***	***	***	***	***	***	***
***	***	***	***	***	***	***	***	***
***	***	***	***	***	***	***	***	***
***	***	***	***	***	***	***	***	***
***	***	***	***	***	***	***	***	***
***	***	***	***	***	***	***	***	***
***	***	***	***	***	***	***	***	***
***	***	***	***	***	***	***	***	***
***	***	***	***	***	***	***	***	***
***	***	***	***	***	***	***	***	***
***	***	***	***	***	***	***	***	***
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Note: 2018 data are not available. Totals may differ slightly from those from Global Trade Atlas.

Source: ***.

[87] ***.

Korea

Korea's CSPV cell production capacity totaled approximately *** in 2018, while CSPV module production capacity totaled approximately ***.[88] The leading firms, in terms of CSPV cell production capacity, are Hanwha, LG, Hyundai, and Shinsung E&G. Other large CSPV module producers in 2017 included Solarpark Korea, JSPV, Hansol Technics, and S-Energy.[89] Korean producers export a significant share of production, with 2017 PV cell and module exports totaling $1.8 billion. The largest export destinations in 2017 were the United States (58 percent of exports), Japan (14 percent), and the Netherlands (10 percent).[90]

Taiwan

Taiwan's CSPV cell production capacity totaled *** in 2018 and its CSPV module production capacity totaled ***.[91] There has been some recent consolidation in the CSPV

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[88] Compiled from data submitted in response to Commission questionnaires; Park, Chinho, Inchul Hwang, Jaehong Seo, and Deugyoung Jeong, "National Survey Report of Photovoltaic Applications in Korea 2017," 2019, IEA PVPS, p. 23, http://www.iea-pvps.org/index.php?id=93&eID=dam_frontend_push&docID=4683, retrieved October 23, 2019.

[89] Park, Chinho, Inchul Hwang, Jaehong Seo, and Deugyoung Jeong, "National Survey Report of Photovoltaic Applications in Korea 2017," 2019, IEA PVPS, p. 23, http://www.iea-pvps.org/index.php?id=93&eID=dam_frontend_push&docID=4683, retrieved October 23, 2019.

[90] Official exports statistics for Korea under HS subheading 8541.40.9020, 8541.40.9021 and 8541.40.9022 from Korea's Customs and Trade Development Institution as reported by the Global Trade Atlas database, accessed November 1, 2019.

[91] Compiled from data submitted in response to Commission questionnaires; Bellini, Emiliano, "Hard Times for Taiwan's PV Manufacturers," *PV Magazine*, September 18, 2018, https://www.pv-magazine.com/2018/09/18/hard-times-for-taiwans-pv-manufacturers/, retrieved November 10, 2019; Sunengine Webpage, http://www.sunengine.com.tw/index.aspx?action=3&lang=2&cat=5, retrieved November 10, 2019; Tsao, Rhea, "Will Taiwan Meet its 20 GW Solar Goal by 2025?" *PV Magazine*, September 7, 2018, https://www.pv-magazine.com/2018/09/07/will-taiwan-meet-its-20-gw-solar-goal-by-2025/, retrieved November 10, 2019; *Sun & Wind Energy*, "Photovoltaics Industry Worldwide 2015," n.d., http://www.sunwindenergy.com/sites/default/files/poster_pv-weltkarte_2015_englisch.pdf, retrieved November 10, 2019; Energy Taiwan Webpage, https://www.energytaiwan.com.tw/en_US/exh/info.html?id=CD75951A1E366465D0636733C6861689, retrieved November 10, 2019; Anji Technology Webpage, http://www.anjitek.com/index.php?option=module&lang=cht&task=pageinfo&id=420&index=5, retrieved November 10, 2019; *EnergyTrend*, "Tainergy's Expansion Boosts its Cell Capacity to 600 MW in Vietnam," May 4, 2016, https://www.energytrend.com/news/20160504-10493.html, retrieved November 10, 2019; "Tainergy Tech: To Move Solar Cell Production to Vietnam," MarketScreener, January 16, 2019, https://www.marketscreener.com/TAINERGY-TECH-CO-LTD-20706070/news/Tainergy-Tech-to-move-solar-cell-production-to-Vietnam-27872639/, retrieved November 10, 2019; ***; Ming Hwei Energy Webpage, https://www.mhe.com.tw/english/about.html, (continued...)

industry in Taiwan. In October 2017, three solar companies (Gintech, Neo Solar Power, and Solartech) in Taiwan announced plans to merge into United Renewable Energy. Also in October 2017, Motech and Gigasolar announced that they signed a joint venture agreement to form Taiwan Solar Module Manufacturing Co. ("TSMMC") to manufacture modules.[92]

A number of CSPV cell plants in Taiwan closed in 2019. For example, Motech announced in November 2018 that it would close a 1.1 GW CSPV cell plant in Taiwan by the end of January 2019, reducing its CSPV cell capacity in Taiwan from 1.9 GW to 800 MW.[93] Tainergy Tech, which had 300 MW of CSPV cell production capacity in Taiwan, announced that it would close its plant and move production to Vietnam.[94] In April 2019, E-Ton Solar announced plans to close its 800 MW CSPV cell plant in Taiwan and auction the plant along with two idle facilities.[95]

Taiwan's CSPV cell and module exports decreased from $2.8 billion in 2016 to $1.2 billion in 2018. The leading export destinations in 2018 were China (23 percent), Vietnam (15 percent), India (9 percent), Turkey (9 percent), and Germany (7 percent).[96]

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retrieved November 10, 2019; TSEC Webpage, http://www.tsecpv.com/en-global/about/index/about_01, retrieved November 10, 2019; Inventec Solar Energy Webpage, http://www.inventecsolar.com/tw/modules/news/article.php?storyid=1, retrieved November 10, 2019; *EnergyTrend*, "E-Ton Suspends PV-Cell Production," May 1, 2019, https://www.energytrend.com/news/20190501-13802.html, retrieved November 10, 2019.

[92] Crystalline Silicon Photovoltaic Cells and Modules from China, Inv. Nos. 701-TA-481 and 731-TA-1190 (Review), USITC Publication 4874, March 2019 ("CSPV 1 first review publication"), pp. IV-31–IV-32.

[93] CSPV 1 first review publication, p. IV-32; Bellini, Emiliano, "Hard Times for Taiwan's PV Manufacturers," PV Magazine, September 18, 2018, https://www.pv-magazine.com/2018/09/18/hard-times-for-taiwans-pv-manufacturers/, retrieved November 10, 2019.

[94] EnergyTrend, "Tainergy's Expansion Boosts its Cell Capacity to 600 MW in Vietnam," May 4, 2016, https://www.energytrend.com/news/20160504-10493.html, retrieved November 10, 2019; "Tainergy Tech: To Move Solar Cell Production to Vietnam," MarketScreener, January 16, 2019, https://www.marketscreener.com/TAINERGY-TECH-CO-LTD-20706070/news/Tainergy-Tech-to-move-solar-cell-production-to-Vietnam-27872639/, retrieved November 10, 2019.

[95] EnergyTrend, "E-Ton Suspends PV-Cell Production," May 1, 2019, https://www.energytrend.com/news/20190501-13802.html, retrieved November 10, 2019.

[96] Official exports statistics under HS subheadings 8541.40.3000 and 8541.40.4000 from Taiwan's Directorate General of Customs reported by the Global Trade Atlas database, accessed November 1, 2019.

Malaysia

Malaysia's CSPV cell production capacity totaled *** in 2017, while its CSPV module capacity was ***.[97] Leading producers of CSPV cells and/or modules in Malaysia include Flextronics, Hanwha Q Cells, JA Solar, Jinko, Longi, Panasonic, and SunPower. The industry reportedly exports more than 90 percent of production.[98] In 2018, exports totaled $1.3 billion, though this may include thin film products since First Solar also manufactures in the country.[99]

Thailand

Thailand had *** of CSPV cell production capacity and *** of CSPV module production capacity in 2018.[100] There are seven CSPV cell producers in Thailand (Canadian Solar, Astronergy/Chint Solar, Jetion Solar, Solatron, Talesun, Trina Solar, and United Renewable Energy), and at least nine CSPV module producers (Canadian Solar, Ekarat, Full

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[97] Compiled from data submitted in response to Commission questionnaires; The Star, "Tek Seng Shares Fell 5% after Announcing the End of its Solar Business," July 19, 2018, https://www.thestar.com.my/business/business-news/2018/07/19/tek-seng-shares-fell-5pc-after-announcing-the-suspension-of-solar-business/, retrieved November 2, 2019; Mak, Gladys, "Solar PV: Policy, Market & Industry in Malaysia," April 7, 2018, pp. 13-14, https://unef.es/wp-content/uploads/dlm_uploads/2018/04/presentation-task-1_malaysia-april-2018.pdf, retrieved November 2, 2019; Malaysian Solar Resources Webpage, http://www.malaysiansolar.com/content.php?id=6&lang=1, retrieved November 2, 2019; PV HiTech Webpage, https://www.pvhitechsolar.com.my/Solar-Module-Manufacturing-Plant/, retrieved November 2, 2019; IEA PVPS, *Annual Report 2018*, 2019, p. 88, http://www.iea-pvps.org/index.php?id=6, retrieved November 2, 2019; Toenengery Technology Website, http://www.toensolar.com/aboutus.html, retrieved November 8, 2019.

[98] IEA PVPS, *Annual Report 2018*, 2019, p. 88, http://www.iea-pvps.org/index.php?id=6, retrieved November 2, 2019.

[99] Official exports statistics for Malaysia under HS subheadings 8541.40.2100 and 8541.40.2200 from Department of Statistics Malaysia, as reported by the Global Trade Atlas database, accessed November 1, 2019.

[100] Total does not include Tiger Solar, for which production capacity was not available. Compiled from data submitted in response to Commission questionnaires; CSPV 1 first review publication, p. IV-34; ***; Ekarat Webpage, https://www.ekarat.co.th/en/about-us/, retrieved October 23, 2019; Full Solar Webpage, http://www.fullsolar.co.th/; Bureau of Solar Energy Development, Government of Thailand, *National Survey Report of PV Power Applications in Thailand 2015*, IEA PVPS, p. 19, http://www.iea-pvps.org/index.php?id=93&eID=dam_frontend_push&docID=3116, retrieved October 24, 2019.

Solar, Jetion Solar, Schutten Solar, Solartron, Talesun, Tiger Solar, and Trina Solar).[101] Thailand's PV cell and module exports increased from $713 million in 2016 to $1.1 billion in 2017, then declined to $745 million in 2018. The leading export destinations during 2016–18 were the United States (38 percent of exports), the Netherlands (16 percent), Vietnam (13 percent), Germany (6 percent), and China (6 percent). The United States fell to Thailand's fourth largest export destination in 2018, as there was a large decline in exports to the United States in that year.[102]

Vietnam

Vietnam's CSPV cell production capacity was about *** in 2018 and its CSPV module production capacity was about ***.[103] The largest producer, Vina Solar, primarily manufactures CSPV cells and modules under arrangements with other solar manufacturers, such as Neo Solar Power, GCL, and Trina Solar. There were at least eight firms (excluding those where production is operated by Vina Solar) with CSPV cell production in Vietnam in 2018 (Allesun, Boviet Solar, Hanoi Solar, IREX, Tainergy, Tangshan Haitai Vietnam, Trina Solar, and Vina Solar). In addition, there were 16 firms (Allesun, Boviet Solar, Canadian Solar, Dehui Solar,

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[101] CSPV 1 first review publication, p. IV-34; Ekarat Webpage, https://www.ekarat.co.th/en/about-us/, retrieved October 23, 2019; Full Solar Webpage, http://www.fullsolar.co.th/; Solartron Webpage, http://www.solartron.co.th/english/about, retrieved November 3, 2019; Trade Data Information Services, Import Genius Website, https://www.importgenius.com/suppliers/tiger-solar-co-ltd, retrieved November 8, 2019.

[102] Official export statistics in customs numbers 8541.40.90001, 8541.40.21000, and 8541.40.22000 as reported by Thailand Customs in the GTA database, retrieved October 24, 2019.

[103] Vietnam's production capacity is difficult to precisely ascertain given the lack of clarity in some instances as to whether production is done internally or through contract manufacturers. In addition, production capacity data were not available for all firms. Compiled from data submitted in response to Commission questionnaires; CSPV 1 first review publication, pp. IV-32–IV-33; ***; Vina Solar Webpage, http://www.vinasolar.com/, retrieved October 23, 2019; "Tainergy Tech: To Move Solar Cell Production to Vietnam," MarketScreener, January 16, 2019, https://www.marketscreener.com/TAINERGY-TECH-CO-LTD-20706070/news/Tainergy-Tech-to-move-solar-cell-production-to-Vietnam-27872639/, retrieved November 10, 2019; Green Wing Solar Group Webpage, https://greenwingsolar.com/about-us/, retrieved November 8, 2019; Dehui Solar Power, Dehui Profile, http://www.dehui-solar.com/file-11688.html, retrieved November 8, 2019; Viet Nam Green Energy Technology Co.,LTD Webpage, https://vngreenenergy.com/about-vge/, retrieved November 8, 2019; Solar Power Vietnam Technology Website, http://www.solarvietnam.vn/gioi-thieu.html, retrieved November 8, 2019; Industrial Technology Research Institute, Green Energy Industry Development Strategy and Promotion Plan, June 2015, https://km.twenergy.org.tw/ReadFile/?p=KLBase&n=2015915102942.pdf, retrieved November 8, 2019.

Green Wing Solar, Hanoi Solar, IREX, Red Sun Energy, Solar Power Vietnam Technology, Tangshan Haitai Vietnam, Trunsun, Venergy, Viet Nam Green Energy, Vietnergy, Vina Solar, and VSUN) with CSPV module production in 2018.[104] Vietnamese exports in HS subheading 8541.40, which includes out-of-scope products, increased from $1.0 billion in 2016 to $2.6 billion in 2017, then declined to $1.5 billion in 2018. The United States was the largest export destination during 2016–18 (accounting for 33 percent of exports), followed by Turkey (21 percent), the Netherlands (15 percent), China (5 percent), and Korea (5 percent).[105]

Third-country market import restraints

As of January 2016, Canada maintained antidumping and countervailing duties on CSPV modules from China, the EU had antidumping duties on CSPV cells and modules from China, and China had antidumping and countervailing duties on polysilicon from the EU, Korea, and the United States. Currently, Canada's antidumping and countervailing duties on CSPV modules from China and China's antidumping and countervailing duties on polysilicon from Korea remain in effect. The EU measures on CSPV cells and modules from China ended in September 2018, while China terminated duties on polysilicon imports from the EU in November 2018. Additionally, India imposed safeguard duties on CSPV cells and modules in July 2018, while Turkey imposed antidumping duties on CSPV modules from China in April 2017, and these measures also currently remain in effect. A full list of key start and end dates related to third country import restraints is presented in figure I-5.

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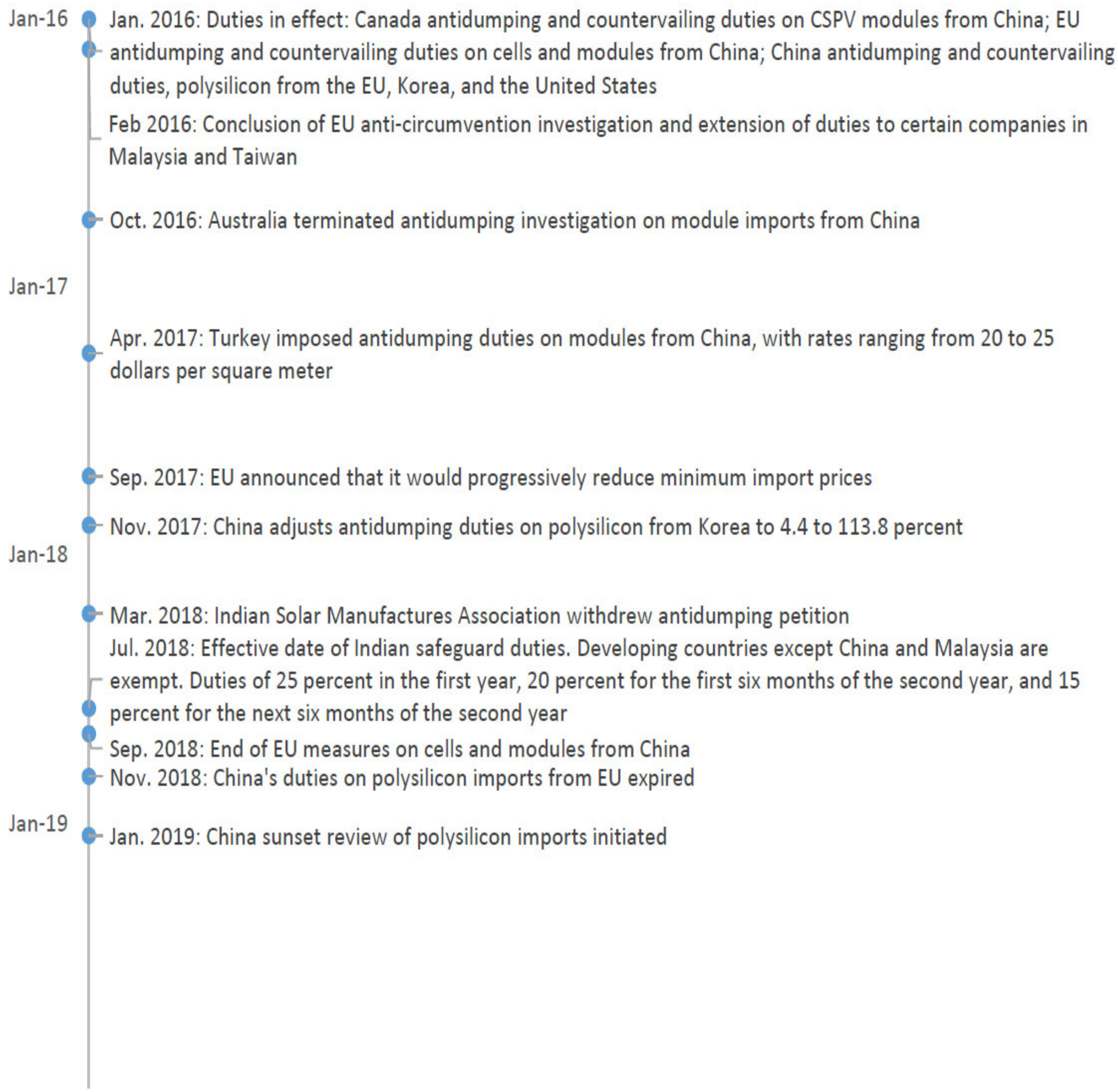
[104] EAST Group, "Vina Solar Was Acquired by EAST for 2.9 billion RMB," News release, 2018, http://www1.eastups.com/en/news_show_15_149.html, retrieved October 24, 2019; CSPV 1 first review publication, pp. IV-32—IV-33; Allesun Webpage, http://www.allesun.com/index.php?s=/About/about.html, retrieved October 24, 2018; Trunsun Webpage, https://www.trunsunsolar.com/about-us/global-network/, retrieved October 24, 2019; Green Wing Solar Group Webpage, https://greenwingsolar.com/about-us/, retrieved November 8, 2019; Dehui Solar Power, Dehui Profile, http://www.dehui-solar.com/file-11688.html, retrieved November 8, 2019; Viet Nam Green Energy Technology Co., Webpage, https://vngreenenergy.com/about-vge/, retrieved November 8, 2019; Solar Power Vietnam Technology Webpage, http://www.solarvietnam.vn/gioi-thieu.html, retrieved November 8, 2019; Industrial Technology Research Institute, Green Energy Industry Development Strategy and Promotion Plan, June 2015, https://km.twenergy.org.tw/ReadFile/?p=KLBase&n=2015915102942.pdf, retrieved November 8, 2019; Hanoi Solar Website, http://hanoisolar.vn/gioi-thieu/lich-su-cong-ty.html, http://hanoisolar.vn/san-pham/pin-silicon-don-tinh-the.html, and http://hanoisolar.vn/san-pham/tam-nang-luong-mat-troi-don-tinh-the.html; Venergy Website, http://venergysolar.com/index.php?c=content&a=list&catid=41.

[105] Based on official imports statistics from Vietnam in HS 8541.40 as reported by the Global Trade Atlas database, retrieved October 24, 2019.

Figure I-5
CSPV: Third-country market import restraints, 2016-19



Source: CSPV 1 first review publication, pp. IV-18–IV-25 and other public data sources.

U.S. developments

U.S. producers

A list of U.S. firms that entered and exited the market during 2016-19 are presented in tables I-9 and I-10.[106] U.S. CSPV cell producer entries and exits (from publicly available data sources) are reported in table I-9.[107] These only include firms that are currently open or have closed manufacturing plants during 2016-19, and do not include changes in production capacity

[106] For additional details regarding industry events in the United States, see part III of this report.

[107] There were also changes in U.S. thin film production capacity during January 2016–September 30, 2019. Thin film is an out-of-scope product (see footnote in the physical properties section for a description of thin film), and this footnote only covers developments at the largest global thin film manufacturer, First Solar (which produces cadmium telluride modules). First Solar invested $175 million to retool its production plant in Ohio to produce its newest, series 6 modules, with the first module production in late 2017 and commercial production starting in 2018. The plant has an annual production capacity of 600 MW. In April 2018, the firm announced plans to invest $400 million to open a second manufacturing plant in Ohio. The plant, with 1.3 GW in annual production capacity, started production in October 2019. The two plants combined have an annual production capacity of 1.9 GW. First Solar also expanded overseas production. First Solar's global production capacity in 2016 (at plants in Malaysia and the United States) totaled 3.2 GW. Global production capacity (at plants in Malaysia, the United States, and Vietnam) of series 6 modules is anticipated to total 5.5 GW in 2020 and 6.6 GW in 2021. First Solar has booked orders that account for all of its production capacity through the second quarter of 2021. First Solar, "First Solar Becomes Largest PV Module Manufacturer in the Western Hemisphere," News release, October 24, 2019, https://investor.firstsolar.com/news/press-release-details/2019/First-Solar-Becomes-Largest-PV-Module-Manufacturer-in-the-Western-Hemisphere/default.aspx, retrieved November 2, 2019; First Solar, "First Solar Announces New U.S. Manufacturing Plant," News release, April 26, 2018, https://investor.firstsolar.com/news/press-release-details/2018/First-Solar-Announces-New-US-Manufacturing-Plant/default.aspx, retrieved November 2, 2019; Roselund, Christian, "First Solar Produces First S6 Module, Seals 800 MW of Deals," *PV Magazine*, December 5, 2017, https://pv-magazine-usa.com/2017/12/05/first-solar-produces-first-s6-module-seals-800-mw-of-deals/, retrieved November 2, 2019; Chavez, John, "Three Years After Layoffs, First Solar Producing Like Never Before," *Toledo Blade*, October 24, 2019, https://www.toledoblade.com/business/energy/2019/10/24/first-solar-energy-producing-like-never-before-perrysburg-lake-township-business/stories/20191024186, retrieved November 2, 2019; First Solar, *2016 Annual Report*, 2017, p. 58, https://investor.firstsolar.com/financials/annual-reports/default.aspx, retrieved November 2, 2019; First Solar, *2018 Annual Report*, 2017, p. 5, https://investor.firstsolar.com/financials/annual-reports/default.aspx, retrieved November 2, 2019; Roselund, Christian, "First Solar is Sold Out Through mid-2021," *PV Magazine*, October 25, 2019, https://www.pv-magazine.com/2019/10/25/first-solar-is-sold-out-through-mid-2021/, retrieved November 2, 2019; First Solar, "First Solar Q1'18 Earnings Call," April 6, 2018, p. 5, https://investor.firstsolar.com/financial-events/default.aspx, retrieved November 2, 2019.

Table I-9
CSPV cells: U.S. firms with CSPV production facilities opening and/or closing, 2016–19

Company	State	Opening year	Closing year	Notes
Plants open as of December 31, 2019				
Panasonic	NY	2018	Not applicable	
Solaria	CA	Not available	Not applicable	
Closed plants				
Mission Solar	TX	Prior to 2016	2016	
Suniva	GA	Prior to 2016	2017	Suniva ceased production in 2017 due to bankruptcy but is emerging from bankruptcy and is working on a plan to restart cell production.
SunPower (former SolarWorld plant)	OR	Prior to 2016	2019	Closing year is the year that CSPV cell manufacturing equipment was put up for auction.
Tesla	CA	Prior to 2016	See note	Tesla listed solar production in Fremont, CA in its annual financial report for the year ending December 31, 2017, but not for the year ending December 31, 2018.
Yingli	TX	Not available	2019	Closing year is based on auction date for cell manufacturing equipment.

Note: This table is based on publicly available information. Information on producers of off-grid products, such as consumer electronic products or solar generators, is not included. In addition, it does not include changes in production capacity at existing plants. SunPower also opened a pilot production line for CSPV cells at a research facility in California in 2017. It is not listed as a CSPV cell production location in their most recent 10-K, so it is not included in this table.

Source: Compiled from publicly available information and CSPV 1 first review publication, pp. III-1–III-2.

or announced plants that have not yet opened.[108] As of December 31, 2019, there were two firms with domestic CSPV cell production: Panasonic and Solaria. Solaria does not appear to do all steps in the CSPV cell production process internally.[109] Five CSPV cell manufacturing facilities

[108] There has been only one announced new U.S. CSPV cell plant. Sunpreme indicated in September 2018 that it planned to open a CSPV cell and module plant in Texas. The first phase of the plant, with 136 MW of capacity, was expected to come online in early 2019. No subsequent updates on the status of the plant or whether the firm is proceeding with the plant are available. Meyer Burger also announced a possible order for heterojunction cell equipment for an unnamed North American start-up, though the order was pending additional fundraising by the customer and no information is available on whether this plant is planned for the United States. CSPV 1 first review publication, p. III-6; Hutchins, Mark, "Meyer Burger Seals $100 Million HJT Order, Expects to Hit Break-even in First Half," *PV Magazine*, July 22, 2019, https://www.pv-magazine.com/2019/07/22/meyer-burger-seals-100-million-hjt-order-expects-to-hit-break-even-in-first-half/, retrieved October 21, 2019.

[109] Solaria, "Solaria PowerXT Residential," Product Specifications, May 23, 2018, https://www.solarcrowdsource.com/wp-content/uploads/2019/05/PowerXT-360R-PD-Specs.pdf, retrieved October 18, 2019; Solaria Webpage, https://www.solaria.com/technology-1, retrieved (continued...)

closed during 2016–19. Two cell production plants closed during 2018–19. This includes the discontinuation of CSPV cell production by SunPower in Oregon following its acquisition of the SolarWorld plant. SunPower produces its P-series CSPV modules at this plant, which use CSPV cells sourced from other companies.[110]

U.S. CSPV module producer entries and exits during 2016–19 (from publicly available data sources) are reported in table I-10. These only include firms that are currently open or have closed manufacturing plants, and do not include changes in production capacity or announced plants that have not yet opened.[111] As of December 31, 2019, there were about 20 U.S. CSPV module manufacturing plants. Of these plants, five plants with a combined production capacity of at least 3 GW opened during 2018–19.[112] At least nine module production plants closed during 2016–19, including three plants with a combined production capacity of 230 MW during 2018–19.[113]

October 18, 2019; Weaver, John Fitzgerald, "Back in Black – California Solar Manufacturer Delivers a Handsome 19.4% Efficient Panel," *electrek*, January 11, 2018, https://electrek.co/2018/01/11/california-solar-panel-manufacturer-handsome-19-4-efficient-panel/, retrieved October 18, 2019.

[110] Danko, Pete and John Bell, "SunPower Selling Former SolarWorld Facility in Hillsboro, Settling into Smaller Operation on Site," *Portland Business Journal*, May 15, 2019, https://www.bizjournals.com/portland/news/2019/05/15/sunpower-selling-former-solarworld-facility-in.html?ana=yahoo&yptr=yahoo, retrieved October 15, 2019; SunPower, Form 10-K, Annual Filing to the Securities and Exchange Commission for the Fiscal Year Ended December 30, 2018, February 14, 2019, pp. 12-13, https://investors.sunpower.com/static-files/7f834a28-3c4e-4846-8b68-7b5fb7392d88, retrieved October 21, 2019.

[111] In addition to the Sunpreme plant noted above, Greenbrilliance announced plans in July 2018 for a 125 MW module plant in Maryland. No additional information on this plant was available. CSPV 1 first review publication, p. III-6.

[112] CSPV 1 first review publication, p. III-6; Pickerel, Kelly, "Hanwha Q CELLS Completes 1.7-GW Panel Assembly Facility in Georgia," *Solar Power World*, February 28, 2019, https://www.solarpowerworldonline.com/2019/02/hanwha-q-cells-completes-1-7-gw-panel-assembly-facility-in-georgia/, retrieved February 28, 2019.

[113] CSPV 1 first review publication, p. III-14.

Table I-10
CSPV modules: U.S. firms with CSPV production facilities opening and/or closing, 2016–19

Company	State	Start year	Year closed	Notes
Plants open as of December 31, 2019				
Auxin Solar	CA	Prior to 2016	Not applicable	
CBS Solar	MI	Prior to 2016	Not applicable	
Hanwha Q-Cells	GA	2019	Not applicable	
Heliene	MN	Prior to 2016	Not applicable	From mid-2016, Silicon Energy produced modules for Heliene at its Minnesota plant. Following the closure of Silicon Energy's plant in 2017, Heliene took over the lease and began manufacturing.
Jinko Solar	FL	2018	Not applicable	
Merlin Solar	CA	2016	Not applicable	Majority stake acquired by Ayala Corporation in 2018.
Mission Solar	TX	Prior to 2016	Not applicable	
LG	AL	2019	Not applicable	
Panasonic/ Tesla	NY	2017	Not applicable	Opening date is for module production by Panasonic. Tesla, which was not producing roof tiles in commercial quantities at the time, indicated in July 2019 that it intended to scale production in the second half of 2019 and in 2020.
PowerFilm	IA	2018	Not applicable	
Prism Solar	NY	Prior to 2016	Not applicable	Majority stake acquired by Genie Energy Ltd. in October 2018.
SBM Solar	NC	Prior to 2016	Not applicable	
Silfab Solar	WA	See note	Not applicable	This plant was built in 2017 by Itek Energy, and replaced a smaller facility. In August 2018, Silfab purchased the plant from Itek.
Solaria	CA	Prior to 2016	Not applicable	
Solartec Energia	TX	Prior to 2016	Not applicable	
SolarTech Universal	FL	Prior to 2016	Not applicable	
SunPower	OR	Prior to 2016	Not applicable	Former SolarWorld plant acquired by SunPower on October 1, 2018.
Sunergy California	CA	2018	Not applicable	
SunSpark Technology	CA	Prior to 2016	Not applicable	
Wanxiang New Energy	IL	Prior to 2016	Not applicable	

Table continued on next page.

Table I-10--Continued
CSPV modules: U.S. firms with CSPV production facilities opening and/or closing, 2016–2019

Company	State	Start year	Year closed	Notes
Closed plants				
Flextronics/SunPower	CA	Prior to 2016	See note	SunPower partnered with contract manufacturer Flextronics to produce modules. The exact date when this manufacturing ended is not publicly available, but it was no longer listed among SunPower's manufacturing locations in its financial report for the year ending January 1, 2017.
Itek Energy	MN	Prior to 2016	2018	
Navajo Universal	AZ	Prior to 2016	2017	
PureSolar	WA	2017	2018	
Seraphim Solar	MS	2016	2018	
Silicon Energy	MN	Prior to 2016	2017	
	WA	Prior to 2016	2016	
Suniva	MI	Prior to 2016	2017	
tenKsolar	MN	Prior to 2016	2017	
Tesla	CA	Prior to 2016	See note	Tesla listed solar production in Fremont, CA in its annual financial report for the year ending December 31, 2017, but not for the year ending December 31, 2018.
Status not available				
Solar Electric America	VA	Around 2018	See note	The company website is active, but the business license is listed as canceled.

Note: This table is based on publicly available information. Information on producers of off-grid products is not included. In addition, it does not include changes in production capacity at existing plants.
Two companies, German Solar USA and Upsolar, indicate that their products are made in the United States, but they are not included in the table since a U.S. production location for these products could not be identified. In addition, Perlight previously indicated that some of its CSPV modules were made in Texas, but this is not currently listed on its webpage as a manufacturing location. Amerisolar, CertainTeed, Colored Solar, and Lumos Solar offer U.S. manufactured products, but media reports or company webpages indicate that manufacturing of these products is done by another firm. Beamreach had a pilot PV production line in California.

Source: Compiled from publicly available information and CSPV 1 first review publication, pp. III-3–III-6.

U.S. policies[114]

The major federal incentive for solar installations is the investment tax credit, which was renewed in 2015 and is scheduled to continue to decline according to the schedule put in place at that time.[115] Since this tax credit's renewal, there have been no changes to major federal solar incentives. There have been a number of state-level changes, however, some of which are highlighted below.

- Renewable portfolio standards: At the state level, 29 states plus the District of Columbia had renewable portfolio standards[116] ("RPS") in both 2016 and 2019.[117] However, a number of these 29 states increased the share of electricity that must come from renewable sources. As a result, the amount of renewable generated electricity required in 2030 increased from 431 terawatt-hours ("TWh") under requirements in place as of 2016 (450 TWh under requirements in 2017) to 600 TWh under requirements in place as of 2019.[118]

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[114] See Part II for additional discussion of U.S. policies.

[115] See Part II.

[116] An RPS is a regulatory mandate that requires entities that supply electricity, such as utility companies, to generate or buy a portion of their retail electricity sales from renewable energy sources, including solar.

[117] The number of states with solar or distributed generation carve-outs (share of the RPS that must be supplied by these sources) decreased from 18 plus the District of Columbia in 2016 to 15 plus the District of Columbia in 2019. Barbose, Galen, "U.S. Renewables Portfolio Standards: 2019 Annual Status Update," July 2019, pp. 8-9, http://eta-publications.lbl.gov/sites/default/files/rps_annual_status_update-2019_edition.pdf, retrieved November 11, 2019; Barbose, Galen, "U.S. Renewables Portfolio Standards: 2019 Annual Status Update," pp. 5-6, April 2016, http://eta-publications.lbl.gov/sites/default/files/lbnl-1005057.pdf, retrieved November 11, 2019.

[118] Barbose, Galen, "U.S. Renewables Portfolio Standards: 2019 Annual Status Update," July 2019, pp. 8 and 24, http://eta-publications.lbl.gov/sites/default/files/rps_annual_status_update-2019_edition.pdf, retrieved November 11, 2019; Barbose, Galen, "U.S. Renewables Portfolio Standards: 2016 Annual Status Update," pp. 5 and 18, April 2016, http://eta-publications.lbl.gov/sites/default/files/lbnl-1005057.pdf, retrieved November 11, 2019; Barbose, Galen, "U.S. Renewables Portfolio Standards: 2017 Annual Status Update," p. 21, July 2017, https://eta-publications.lbl.gov/sites/default/files/2017-annual-rps-summary-report.pdf, retrieved January 21, 2019.

- Public Utility Regulatory Policies Act of 1978 ("PURPA"):[119] PURPA has emerged as a significant driver of utility-scale solar installations in certain states. However, a number of states have recently made changes to avoided cost rates, qualifying project sizes, and contract terms, which have made solar projects under PURPA less attractive.[120]
- Net Metering:[121] The number of states with mandatory net metering rules declined from 44 plus the District of Columbia in 2015 to 39 plus the District of Columbia as of October 2019, with 5 of these states in the process of transitioning to other policies.[122]
- California Solar Roof Mandate: Starting in 2020, PV modules are required for all new residential buildings, with certain exceptions.[123]

Summary data

A summary of data collected on CSPV products in this proceeding is presented in appendix C. Except as noted, U.S. industry data are based on the questionnaire responses of 17 firms that are estimated to have accounted for more than 90 percent of known U.S. capacity to produce CSPV cells and approximately 50 percent of known U.S. capacity to produce CSPV

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[119] This regulation requires utilities to purchase electricity from qualifying facilities (in the case of solar, a solar project that meets size requirements) at the utility's avoided cost. Avoided cost "is the cost a utility would incur if it chose to either provide the energy itself by building new capacity or the cost incurred by purchasing electricity from non-qualifying facilities." EIA, "PURPA-qualifying Capacity Increases, but it's Still a Small Portion of Added Renewables," August 16, 2018, https://www.eia.gov/todayinenergy/detail.php?id=36912, retrieved November 11, 2019; FERC Webpage, https://www.ferc.gov/industries/electric/gen-info/qual-fac/what-is.asp, retrieved November 11, 2019.

[120] St. John, Jeff, "FERC Proposal Brings New Threat to Already-Suffering PURPA Solar Markets," Greentech Media, September 23, 2019, https://www.greentechmedia.com/articles/read/ferc-proposal-could-gut-already-suffering-purpa-solar-markets, retrieved November 11, 2019.

[121] Net metering allows residential and commercial customers that generate their own electricity from solar to receive credit for excess electricity fed into the grid. Residential and commercial customers can use this credit to offset the cost of grid electricity used when their CSPV system does not generate enough electricity to cover their needs.

[122] DSIRE, "Net Metering," October 2019, https://s3.amazonaws.com/ncsolarcen-prod/wp-content/uploads/2019/10/DSIRE_Net_Metering_Oct2019.pdf, retrieved November 11, 2019; DSIRE, "Net Metering," March 2015, https://s3.amazonaws.com/ncsolarcen-prod/wp-content/uploads/2015/04/Net-Metering-Policies.pptx, retrieved November 11, 2019.

[123] Gheorghiu, Lulia, "New California Building Standards Integrate 2020 Rooftop Solar Mandate," *Utility Dive*, December 7, 2018, https://www.utilitydive.com/news/new-california-building-standards-integrate-2020-rooftop-solar-mandate/543803/, retrieved November 11, 2019.

modules during 2018 and almost three-fourths of known U.S. capacity to produce CSPV cells and CSPV modules during the first half of 2019.[124] U.S. import data and related information are based on the questionnaire responses of 55 firms that are estimated to have accounted for 83.6 percent of U.S. imports of CSPV cells and CSPV modules during 2018.[125]

U.S. market participants

U.S. producers[126]

The Commission sent U.S. producers' questionnaires to 239 firms identified by the Commission as possible U.S. producers or U.S. importers of CSPV cells and/or modules. The Commission received usable responses from 17 firms reporting domestic production of CSPV products since January 1, 2016.[127] Presented in table I-11 is a list of responding domestic producers and each company's position on the safeguard measures, production locations, and share of reported production of CSPV products during 2018.

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[124] Estimates are calculated by Commission staff based on a comparison of capacity to produce CSPV cells and modules during 2018 (*** (cells) and *** (modules)) and the first six months of 2019 (*** (cells) and *** (modules)) as reported to the Commission by responding U.S. producers with the total U.S. capacity to produce cells and modules during 2018 (*** (cells) and *** (modules)) and the first six months of 2019 (*** (cells) and *** (modules)) as estimated by Commission staff using U.S. questionnaire responses and publicly available information for non-responding producers.

[125] The estimate is based on a comparison of the total value of 2018 U.S. imports of CSPV cells and modules from all countries reported in the responses to the Commission's U.S. importer questionnaires ($2.479 billion) with total landed-duty paid value ($2.965 billion) of 2018 U.S. imports of CSPV cells and modules as reported by official Commerce import statistics (HTS 8541.40.6015, 8541.40.6020, 8541.40.6025, and 8541.40.6030). Our estimate of the questionnaire data coverage may be slightly understated because the official Commerce statistics may include other products not within the scope of this proceeding, such as thin film solar products.

[126] In the safeguard proceeding, the Commission defined the domestic industry as all U.S. producers of CSPV cells (whether or not partially or fully assembled into other products), including integrated producers of CSPV cells and modules and independent module producers. Crystalline Silicon Photovoltaic Cells (Whether or not Partially or Fully Assembled into Other Products), Inv. No. TA-201-75, USITC Publication 4739, November 2017, vol. I ("Safeguard publication"), p. 18.

[127] In addition to the 17 firms providing usable data, one firm (***) provided a response to the U.S. producer questionnaire that did not contain usable data. The following companies reported that they have not produced CSPV products in the United States since January 1, 2016: ***.

Table I-11
CSPV products: U.S. producers, positions on safeguard measures, location of production, and share of reported production, 2018

Firm	Position on safeguard measures	Production location(s)	Share of cell production (percent)	Share of module production (percent)
Auxin	***	San Jose, CA	***	***
Hanwha Q Cells	***	Dalton, GA Irvine, CA	***	***
Heliene	***	Mountain Iron, MN	***	***
Jinko Solar	***	Jacksonville, FL	***	***
LG	***	Huntsville, AL	***	***
Merlin Solar	***	San Jose, CA	***	***
Mission Solar	***	San Antonio, TX	***	***
Panasonic	***	Buffalo, NY	***	***
PowerFilm	***	Ames, IA	***	***
SBM	***	Concord, NC	***	***
Silfab Solar	***	Bellingham, WA	***	***
SolarTech Universal	***	Riviera Beach, FL	***	***
Suniva	***	Norcross, GA Saginaw Township, MI	***	***
SunPower (pre-acquisition) SolarWorld	***	Hillsboro, OR	***	***
SunPower (post-acquisition)	***	Hillsboro, OR	***	***
Tesla	***	Buffalo, NY Fremont, CA	***	***
Yingli	***	San Antonio, TX	***	***
Total			100.0	100.0

Note: Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent. Explanations of U.S. producers' positions on the safeguard measures are presented in part VII (table VII-2). Hanwha Q Cells began production in *** 2019. Heliene began production at the former Silicon Energy factory in May 2017, dismantled that factory in April 2018, and began production at a new factory in September 2018. Jinko Solar began production in *** 2018. LG began commercial production in *** 2019. Merlin Solar began production in 2016. Mission Solar shut down its cell production operations in *** 2016. Panasonic began production in 2017. PowerFilm's protoype production began in mid-2018 and commercial production began at the beginning of 2019. Silfab Solar began U.S. module assembly operations in *** 2018. Suniva's cell production operations were suspended in May 2017 and its module assembly capacity was liquidated in April 2017. SunPower completed its acquisition of certain assets of SolarWorld Americas in October 2018, including its facility in Hillsboro, Oregon. Tesla acquired SolarCity in Fremont, CA, in 2016 and cell manufacturing ceased at that location in *** 2017. Tesla completed its Buffalo, NY factory in 2016-17 and began "volume" production of SolarRoof at that facility in 2019. Yingli opened a cell production facility in early 2018 and closed that facility in late 2018.

Source: Compiled from data submitted in response to Commission questionnaires.

In addition to the firms that provided questionnaire responses, there are 8 additional plants that had commercial module production in 2018, one of which closed in October 2018 (table I-12). Combined annual production capacity at these plants was 1,030,000 kW in 2018 and 960,000 kW in 2019. The largest of these plants are Sunergy California (600,000 kW annual capacity in 2019) and SunSpark Technology (200,000 kW annual capacity in 2019).[128]

Table I-12
CSPV modules: Production capacity for active producers in 2018 and/or 2019 that did not provide questionnaire responses

Company	Production location	2018 Cell capacity (kW)	2018 Module capacity (kW)	2019 Cell capacity (kW)	2019 Module capacity (kW)	Notes
CBS Solar	Copemish, MI	0	10,000	0	10,000	
Prism Solar	Highland, NY	0	60,000	0	60,000	Subsidiary of Genie Energy Ltd.
Seraphim Solar	Jackson, MS	0	120,000	0	0	Module capacity was 160,000 kW on an annual basis. Closed October 2018.
Solaria	Fremont, CA	40,000	40,000	40,000	40,000	
Solartecmx LLC	Houston, TX	0	30,000	0	30,000	Subsidiary of Mexico-based Solartec Energia.
Sunergy California	McClellan Park, CA	0	600,000	0	600,000	Subsidiary of China-based CSUN. Production capacity sometimes reported as 400,000 kW.
SunSpark Technology	Riverside, CA	0	150,000	0	200,000	Subsidiary of China-based Yiheng Science & Technology Co. Ltd.
Wanxiang	Rockford, IL	0	20,000	0	20,000	Subsidiary of China-based Wanxiang Group.
Total		40,000	1,030,000	40,000	960,000	

Note: This table does not include PureSolar, which auctioned its equipment in March 2018 and for which a specific closing date was not available. Also does not include Itek's Minnesota plant, which had 8 to 10 employees in May 2017 and was planning to wind down operations after fulfilling its contracts. For Seraphim Solar, production capacity is adjusted for the nine full months the plant was open.

Source: Compiled from publicly available information and CSPV 1 first review publication, p. III-14.

[128] Staff contacted these firms on several occasions to elicit a response to the Commission's questionnaire in this proceeding.

U.S. producers' ownership and related or affiliated firms

The Commission asked firms responding to the U.S. producer questionnaire to identify their owners and any related or affiliated firms involved in the production or import of CSPV products. Responses to the Commission's request for information are presented in table I-13. *** U.S. producers (***) reported related foreign producers of CSPV products at some point since January 1, 2016 and all *** responding U.S. producers reported either related U.S. importers of CSPV products or were themselves direct importers of CSPV products. U.S. producers' direct imports of CSPV products are discussed in greater detail in Part III.

Table I-13
CSPV products: U.S. producers' ownership and related and/or affiliated firms

Item / Firm	Firm Name	Affiliated/ Ownership
Ownership:		
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***

Table continued on next page.

Table I-13—Continued
CSPV products: U.S. producers' ownership and related and/or affiliated firms

Item / Firm	Firm Name	Affiliated/ Ownership
Related importers/exporters:		
	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***

Table continued on next page.

Table I-13—Continued
CSPV products: U.S. producers' ownership and related and/or affiliated firms

Item / Firm	Firm Name	Affiliated/ Ownership
Related producers:		
***	***	***
	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***

Note: SunPower announced on November 11, 2019, that it is spinning off its high-efficiency cell and module production into a new company, Maxeon Solar, in partnership with Chinese wafer maker Tianjin Zhonghouan Semiconductor ("TZS"). Maxeon Solar will be headquartered in Singapore, and plans to launch as a publicly traded company on the NASDAQ after the closing of the split. SunPower will retain the P-Series module factory in Hillsboro, Oregon. Roselun, Christian, "SunPower splits in two," PV magazine, November 11, 2019, https://pv-magazine-usa.com/2019/11/11/sunpower-splits-in-two/, retrieved November 12, 2019.

Source: Compiled from data submitted in response to Commission questionnaires.

U.S. importers

The Commission sent U.S. importers' questionnaires to 239 firms identified by the Commission as possible U.S. importers of CSPV cells and/or modules.[129] Questionnaire responses containing usable data were received from 55 firms and are estimated to have accounted for 83.6 percent of U.S. imports of CSPV cells and CSPV modules during 2018.[130] U.S. import data were reported by U.S. importers in their questionnaire responses for January 2016-June 2019 from the following countries: Cambodia, Canada, China, Germany, Hong Kong, India, Indonesia, Italy, Japan, Korea, Malaysia, Mexico, Netherlands, Philippines, Singapore, Taiwan, Thailand, Turkey, and Vietnam. Table I-14 lists all responding U.S. importers of CSPV products, their U.S. headquarters, and their share of the total quantity of reported U.S. imports in 2018.

Table I-14
CSPV products: U.S. importers, their headquarters, and share of total imports for all sources, 2018

Firm	Headquarters	Share of total imports of cells and modules (percent)	Share of total imports of cells (percent)	Share of total imports of modules (percent)
Academy	Katy, TX	***	***	***
Alps	Walnut, CA	***	***	***
Ameresco	Framingham, MA	***	***	***
Attic Breeze	Gatesville, TX	***	***	***
AUO Green Energy	Milpitas, CA	***	***	***
Boviet	San Jose, CA	***	***	***
BYD	Los Angeles, CA	***	***	***
Canadian Solar	Walnut Creek, CA	***	***	***
Cantex	Houston, TX	***	***	***
Carmanah	Victoria, BC (Canada)	***	***	***
Celestica	Merrimack, NH	***	***	***
Chamberlain	Oak Brook, IL	***	***	***
EDF Renewables	San Diego, CA	***	***	***

Table continued on next page.

[129] The following firms reported that they have not imported CSPV products since January 1, 2016: ***.

[130] The estimate is based on a comparison of the total value of 2018 U.S. imports of CSPV cells and modules from all countries reported in the responses to the Commission's U.S. importer questionnaires ($2.479 billion) with total landed-duty paid value ($2.965 billion) of 2018 U.S. imports of cells and modules as reported by official Commerce import statistics (HTS 8541.40.6015, 8541.40.6020, 8541.40.6025, and 8541.40.6030). Questionnaire data coverage presented may be slightly understated because the official Commerce statistics may include other products not within the scope of this proceeding, such as thin film solar products.

Table I-14--Continued
CSPV products: U.S. importers, their headquarters, and share of total imports for all sources, 2018

Firm	Headquarters	Share of total imports of cells and modules (percent)	Share of total imports of cells (percent)	Share of total imports of modules (percent)
ET Solar	Pleasanton, CA	***	***	***
First Solar	Tempe, AZ	***	***	***
Goal Zero	Bluffdale, UT	***	***	***
Grand View	New York, NY	***	***	***
Grape Solar	Eugene, OR	***	***	***
Hanwha America	Irvine, CA	***	***	***
Hanwha Corp.	Irvine, CA	***	***	***
Hanwha Q USA	Dalton, GA	***	***	***
Heliene	Sault Ste. Marie, ON (Canada)	***	***	***
Hyundai Corp. USA	Torrance, CA	***	***	***
Industrial	St Louis, MO	***	***	***
JA Solar	San Jose, CA	***	***	***
Jinko CA	San Francisco, CA	***	***	***
Jinko FL	Jacksonville, FL	***	***	***
LG	Englewood Cliffs, NJ	***	***	***
Longi	San Ramon, CA	***	***	***
Merlin Solar	San Jose, CA	***	***	***
Mission	San Antonio, TX	***	***	***
Panasonic	Newark, NJ	***	***	***
Panasonic (North America)	Buffalo, NY	***	***	***
PowerFilm	Ames, IA	***	***	***
RDK	Buford, GA	***	***	***
REC	San Mateo, CA	***	***	***
Rotech	Markham, ON (Canada)	***	***	***
SBM	Concord, NC	***	***	***
S-Energy	Irvine, CA	***	***	***
Silfab ON	Mississauga, ON (Canada)	***	***	***
Silfab WA	Bellingham, WA	***	***	***
Solar Tech Power	Ontario, CA	***	***	***
SolarTech Universal	Riviera Beach, FL	***	***	***
Solatube	Vista, CA	***	***	***
Sonali	Closter, NJ	***	***	***
Suniva,Inc.	Norcross, GA	***	***	***
SunPower	San Jose, CA	***	***	***
SunPower Corp.	Richmond, CA	***	***	***
SunPower OR (post-acquisition)	Hillsboro, OR	***	***	***
SunPower OR (pre-acquisition) SolarWorld	Hillsboro, OR	***	***	***
Targray	Kirkland, QC (Canada)	***	***	***
Tesla	Fremont, CA	***	***	***
Trina	San Jose, CA	***	***	***
Winaico	Des Plaines, IL	***	***	***
Yingli	Philadelphia, PA	***	***	***
Total		100.0	100.0	100.0

Note: Shares and ratios shown as "0.0" represent values greater than zero but less than "0.05" percent.

Source: Compiled from data submitted in response to Commission questionnaires.

U.S. purchasers

The Commission received 43 usable questionnaire responses from firms that purchased CSPV products since January 1, 2016.[131] [132] [133] [134] Twenty-three of the responding purchasers identified themselves as utility companies/developers (including utility scale developers, solar project developers, a commercial and distributed generation developer, a developer of small utility scale commercial and industrial projects, and a utility company/developer/financier). Ten firms are commercial installers, six are residential installers, six are module assemblers, six are distributors of CSPV modules, and one is a distributor of off grid portable consumer goods.[135] Twelve firms are also "other" firm types, including other types of developers, an end user and retailer (***), a cell manufacturer (***), a technology company ***, an energy service company, and the U.S. entity of a foreign CSPV manufacturer. The largest purchasers of CSPV modules and all CSPV products combined (cells and modules) during January 2016-June 2019 were ***. *** accounted for approximately *** percent of reported purchases during January 2016-June 2019, and *** accounted for approximately *** percent. The largest purchaser of CSPV cells during January 2016-June 2019 was ***. ***.

[131] Of the 43 responding purchasers, 14 purchased domestic CSPV products and 42 purchased imports of CSPV products.

[132] Purchase information was collected separately for cells and modules. Forty-one of the 43 responding firms purchased only modules, two purchased only cells (***), and two purchased both modules and cells (***) during January 2016-June 2019. Among the firms that purchased cells, only one firm (***) reported purchasing domestically produced cells, and all four purchased imported cells. These firms listed the sources of their imported cells as Taiwan (3 firms), and China, Korea, Malaysia, and Vietnam (1 firm each).

[133] This does not include firms which were the importer of record. For a discussion of such firms, including import volumes, see part V.

[134] For firms that purchased imported modules, the reported import sources were Vietnam (24 firms), Korea (22 firms), China (21 firms), Malaysia (20 firms), Thailand (13 firms), Singapore (10 firms), Japan and Taiwan (5 firms each), Canada and India (4 firms each), Mexico and the Philippines (3 firms each), Germany, Italy, and Turkey (2 firms each), and Poland (1 firm).

[135] None of the responding purchasers identified themselves as distributors of CSPV cells.

Almost all responding purchasers (42 of 43 firms) reported that they purchased imported CSPV products before February 7, 2018. Of these 42 purchasers, most (29 firms) reported that their purchasing patterns have been essentially unchanged since then. However, nine firms reduced purchases of imports because of the safeguard measure, and four changed their pattern of purchases of imports for other reasons. These other reasons included a bankruptcy (***), a desire to seek different supply chain options (***), being “forced” to purchase modules from an untested supplier in India (***), and lack of availability of domestic cells (***).

The like or directly competitive product

To determine whether an article is being imported into the United States in such increased quantities as to be a substantial cause of serious injury or the threat thereof, the Commission first defines “the domestic industry producing an article like or directly competitive with the imported article.”[136] In its safeguard determination, the Commission found that domestically produced CSPV products are “like” the imported CSPV products. Specifically, domestically produced CSPV cells are “like” the imported CSPV cells and domestically produced CSPV modules are “like” imported CSPV modules within the scope of the investigation. Additionally, the Commission defined a single domestic product corresponding to the imported products within the scope of the investigation that includes CSPV cells and CSPV modules. It found that although CSPV modules are not “like” CSPV cells, the facts indicated that they are “directly competitive” within the meaning of the safeguard statute and there were no clear lines differentiating them. Consistent with its definition of the like or directly competitive domestic product, the Commission defined the domestic industry as all U.S. producers of CSPV cells (whether or not partially or fully assembled into other products), including integrated producers of CSPV cells and modules and independent module producers.[137] The following information is provided as background on CSVP products and their manufacturing process and uses.

[136] 19 U.S.C. § 2252(b)(1)(A).
[137] Safeguard publication, pp. 13-14 and 16-18.

Physical properties[138]

CSPV cells (figure I-6) use crystalline silicon to convert sunlight to electricity and are the basic elements of a CSPV module. They have a positive layer, a negative layer and a positive-negative junction (p/n junction). Electricity is generated when sunlight strikes the CSPV cell, knocking electrons loose that flow onto thin metal "fingers" that run across the CSPV cell and conduct electricity to the busbars.[139] As of 2018, the most common cell size was 156.75 mm by 156.75 mm (6.17 inches by 6.17 inches), replacing 156.0 mm by 156.0 mm (6.14 inches by 6.14 inches) cells, though firms are commercializing even larger cell sizes.[140] As of 2019, typical CSPV cells typically have wattages ranging from 4 to 5.4 watts per cell.[141] Cells are the essential element in CSPV modules (also commonly referred to as panels), which in turn are the main components of CSPV systems. Solar CSPV systems[142] convert sunlight into electricity for on-site use or for distribution through the electric grid.

[138] This section will cover CSPV cells and modules generally, with a focus on the most common product characteristics. The "discussion of specific products" section will cover various other CSPV technologies and products. Unless otherwise noted, this section is derived from the CSPV 1 first review publication, pp. I-30–I-39. Citations to direct quotes, pictures, and data were retained.

[139] Electricity is carried from the thin metal strips on solar cells to wider metal strips known as busbars. These busbars are interconnected during the manufacturing process so that electricity is carried from the cell to the junction box.

[140] ITRPV, Results 2018, March 2019, p. 42, https://itrpv.vdma.org/#, retrieved July 29, 2019.

[141] ENF Solar Webpage, https://www.enfsolar.com/pv/cell, retrieved October 11, 2019.

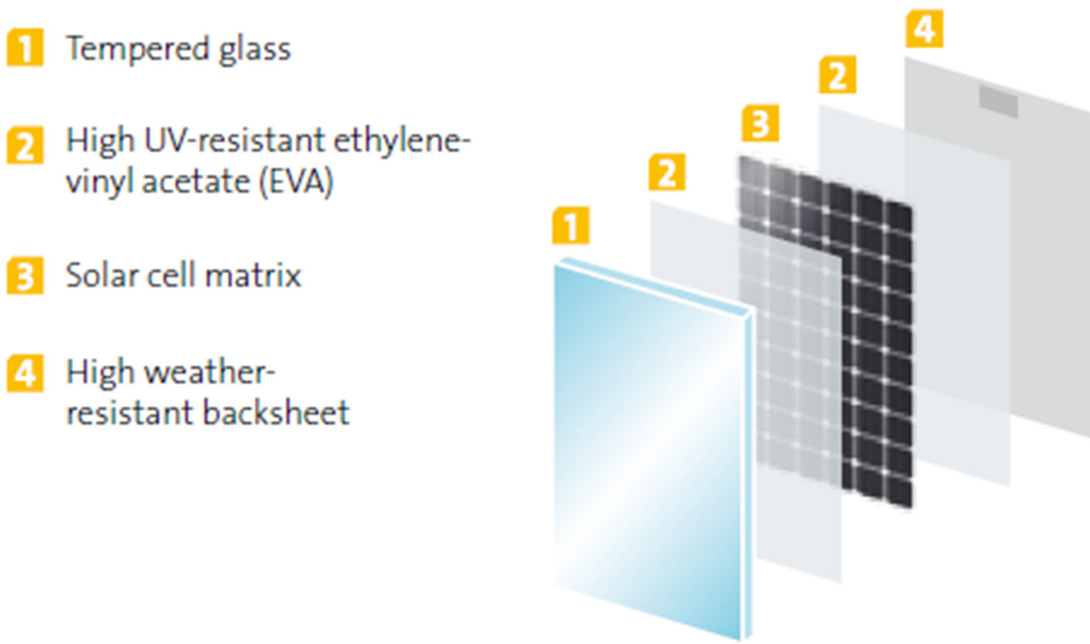
[142] In addition to CSPV products, there is commercial production of thin film photovoltaic products (which are not included in the scope of the investigation). Thin film modules use a several micron thick layer of a photosensitive semiconductor material such as amorphous silicon ("a-Si"), cadmium telluride ("CdTe"), or copper indium (gallium) (di)selenide ("CIS" or "CIGS") to convert sunlight to electricity.

Figure I-6
CSPV products: CSPV cells

Source: SolarWorld Webpage, http://www.solarworld.de/en/group/from-sand-to-module/solar-cells/, retrieved July 6, 2017.

CSPV laminates consist of the CSPV cells that are connected, encapsulated in an ethyl vinyl acetate ("EVA") film,[143] and covered with a glass front layer and a back sheet (figure I-7). The back sheet is most commonly a plastic film composite, though glass is also used in some applications such as bifacial CSPV modules.

Figure I-7
CSPV products: Layers of a typical CSPV laminate



Source: SolarWorld, "SolarWorld Quality," brochure, May 2014, p. 10, https://www.solarworld-usa.com/~/media/www/files/brochures/sw-01-7182us-flyer-solarworldquality.pdf.

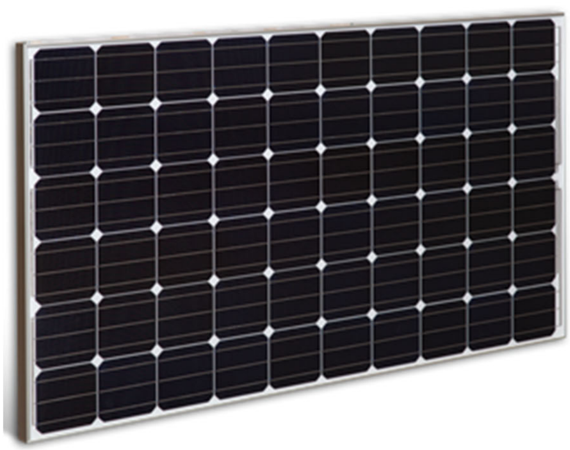
CSPV modules typically consist of the laminate that is framed in aluminum, and then attached to a junction box. CSPV modules can be used in both ground-mounted and rooftop-mounted systems and in both the off-grid market segment and the three on-grid market segments—residential, nonresidential, and utility.[144] The junction box can be connected to other modules, an inverter (which converts the direct current generated by the system to

[143] There are other encapsulation materials that are used, but EVA accounted for more than 90 percent of the market in 2018. ITRPV, Results 2018, March 2019, p. 17, https://itrpv.vdma.org/#, retrieved July 29, 2019.

[144] Photovoltaics ("PV") do not include solar water heat and concentrated solar power ("CSP"). While PV uses a photosensitive semiconductor material to convert sunlight directly to electricity, solar water heat uses sunlight to heat water and CSP uses reflected sunlight to generate steam or a vapor that turns a turbine to generate electricity.

alternating current), or, in the case of off-grid modules, a battery and a charge controller (which controls battery charging). Typical on-grid CSPV modules have 60 or 72 CSPV cells, though there are other configurations and, in some instances, CSPV cells are cut in half resulting in 120 or 144 half-cut CSPV cells (figure I-8).[145] CSPV 60-cell modules are, on average 65 inches long and 39 inches wide, and are typically 1.5 to 2 inches in depth. CSPV 60-cell modules commonly weigh between 33 and 51 pounds. CSPV 72-cell modules are generally around 78 inches long, 39 inches wide, and 1.5 to 2 inches thick.[146] CSPV 72-cell modules generally weigh from 45 to 61 pounds.[147]

Figure I-8
CSPV products: CSPV 60-cell module (left) and 72-cell module (right)




Source: Suniva, Suniva Optimus Series Monocrystalline Solar Modules, OPT Series: OPT 72 cell modules (silver frame), brochure, January 18, 2017, http://suniva.com/documents/[SAMD_0060]%20Suniva%20Optimus%2060%20Silver%20OCOF%20Rev%205%202017%2001%2018.pdf, retrieved December 18, 2018; Suniva, Suniva Optimus Series Monocrystalline Solar Modules, OPT Series: OPT 60 cell modules (silver frame), brochure, January 18, 2017, http://suniva.com/documents/[SAMD_0051]%20Suniva%20Optimus%2072%20cell%2038mmOCOF%20-%20Rev%209%20-%202017%2001%2018.pdf, retrieved December 18, 2018.

[145] In 2018, 60 cell/120 half-cut cells accounted for more than 60 percent of the global market, and 72 cell/144 half-cut cells accounted for more than 30 percent. ITRPV, Results 2018, March 2019, p. 49, https://itrpv.vdma.org/#, retrieved July 29, 2019.

[146] EnergySage, "What is the Average Solar Panel Size and Weight?" n.d., http://news.energysage.com/average-solar-panel-size-weight/, retrieved July 7, 2017.

[147] Schwartz, Joe, "High-Power c-Si PV Module Specifications," *SolarPro*, Issue 10.3, May/June 2017, pp. 48-59, https://solarprofessional.com/articles/products-equipment/modules/high-power-c-si-pv-module-specifications-2017#.WV-8AP6Wx-A, retrieved December 18, 2018.

The two main types of CSPV cells and modules are monocrystalline silicon and multicrystalline (or polycrystalline) silicon, though there are various products within these two categories. Monocrystalline cells are made from a single grown crystal and tend to convert sunlight into electricity more efficiently. Multicrystalline cells have a random crystal structure and tend to have a lower conversion efficiency, though there are a range of conversion efficiencies for monocrystalline and multicrystalline CSPV modules.[148] For example, efficiencies for 72-cell or more multicrystalline CSPV modules listed in SolarPro's 2017 module specifications ranged from 15.2 to 17.8 percent, while efficiencies for monocrystalline CSPV modules ranged from 15.5 to 21.5 percent.[149]

The average output of 60-cell multicrystalline CSPV modules added to the California Energy Commission's PV Module List during 2017–October 15, 2019 was 280 watts and the average output of monocrystalline CSPV modules was 308 watts.[150] The average output of 72-cell multicrystalline CSPV modules was 338 watts, while the average power output of 72-cell monocrystalline CSPV modules was 370 watts.[151] The conversion efficiency of CSPV modules has increased over time.

CSPV modules are also used in off-grid applications. In many instances, CSPV modules typically used in on-grid applications may also be used in off-grid applications. For example, a house that is not connected to the electrical grid could use the same CSPV modules as a house that is grid-connected. However, there are a broad range of off-grid applications, such as power generation in remote locations, mobile power solutions, telecommunications power and lighting systems, and portable consumer goods (such as systems for recharging consumer electronics like tablets and phones) (figure I-9). The CSPV modules used in some of these applications may be different from those typically used in on-grid applications. For example, these products are often designed for specific power and portability requirements, and some CSPV modules have different wattages than CSPV modules used in grid-connected applications.

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[148] Conversion efficiency is the percent of sunlight that is converted to electricity.

[149] Schwartz, Joe, "High-Power c-Si PV Module Specifications," *SolarPro*, Issue 10.3, May/June 2017, pp. 48-59, https://solarprofessional.com/articles/products-equipment/modules/high-power-c-si-pv-module-specifications-2017#.WV-8AP6Wx-A, retrieved December 18, 2018.

[150] Schwartz, Joe, "60-Cell PV Modules Specifications (2017)," *SolarPro*, Issue 10.6, November/December 2017, pp. 42-53, http://solarprofessional.com/articles/products-equipment/modules/60-cell-pv-modules-specifications-2017#.W4_wns5JGUk, retrieved December 18, 2018.

[151] Excludes modules listed as multiple entries of the same model. California Energy Commission PV Module List, October 15, 2019, https://www.gosolarcalifornia.ca.gov/equipment/pv_modules.php, retrieved October 16, 2019.

Figure I-9
CSPV products: Off-grid solar lighting

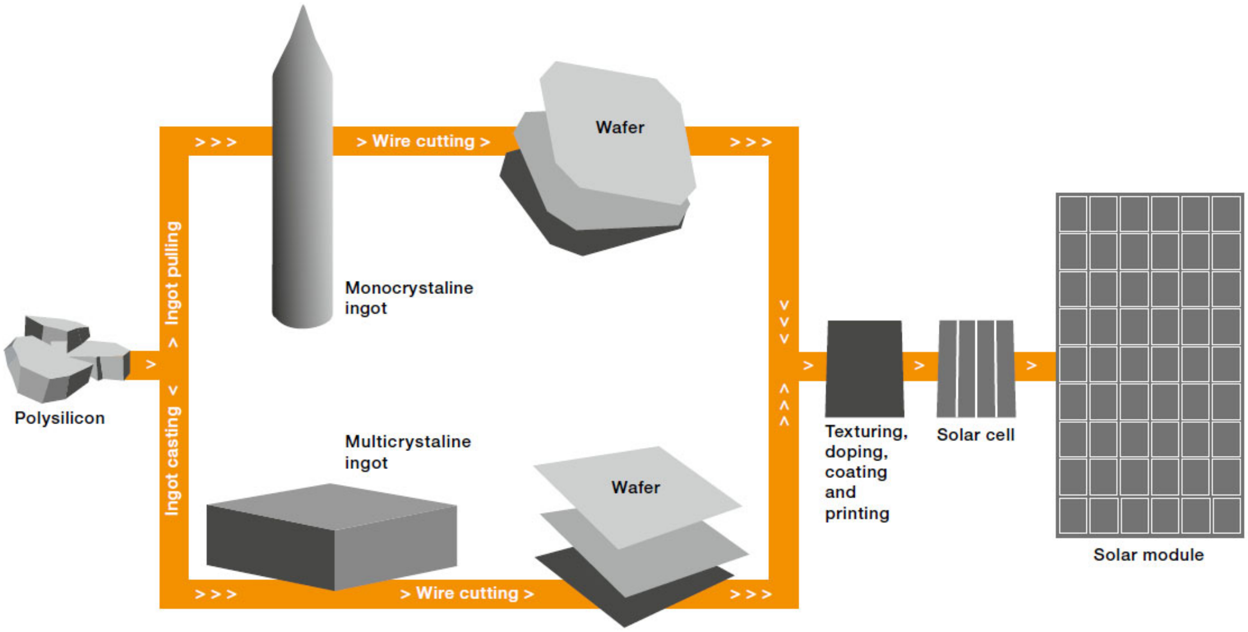
Source: Photo courtesy of DOE/NREL, https://www.nrel.gov/.

Manufacturing facilities and processes[152]

There are five principal stages involved in the manufacture of CSPV products (figure I-10). These are discrete production steps that may be done in different plants or locations, and may be produced in-house or sourced from other companies. First, polysilicon is refined, then it is formed into ingots, using different processes to produce monocrystalline ingots (sometimes referred to as crystals) and multicrystalline ingots. The ingots are then sliced into wafers and converted to CSPV cells, which are then assembled into the finished product, CSPV modules. The following discussion covers some of the most common production processes for each of the five steps.

[152] Unless otherwise noted, this section is derived from CSPV 1 first review publication, pp. I-43–I-49.

Figure I-10
CSPV products: CSPV module production process



Source: Wacker Chemie AG, "Polysilicon," n.d., p. 10, https://www.wacker.com/cms/media/publications/downloads/7416_EN.pdf, retrieved October 8, 2019.

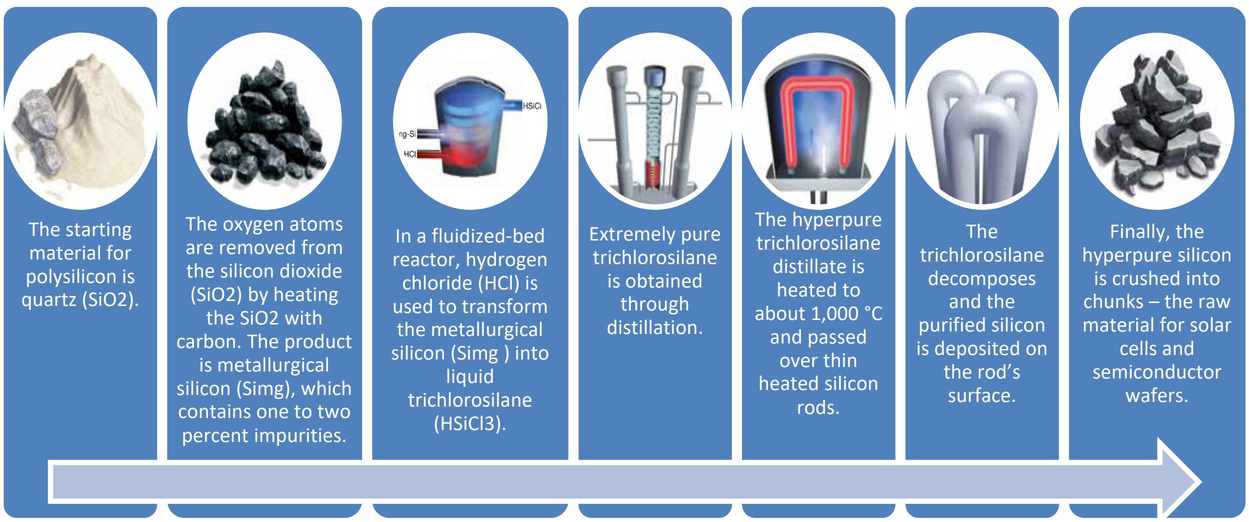
Polysilicon

The first step in the CSPV value chain is refining polysilicon.[153] In the Siemens process (figure I-11), used in the majority of global polysilicon production, first quartz (silicon dioxide) and carbon are heated to around 1,800 degrees Celsius. The carbon reacts with the oxygen, resulting in carbon dioxide and silicon with a purity of around 98 to 99 percent. The silicon is then combined with hydrogen chloride gas at 300 to 350 degrees Celsius, with the reaction

[153] This discussion will focus on the Siemens method, which accounted for more than 85 percent of global production in 2017. Fluidized bed reactor ("FBR") technology accounted for most of the remaining market. Instead of inserting rods, "FBR uses seed granules of purified silicon. The seed granules are fed into a chamber that has heated silane gas entering from below and exiting above. The flow of gas 'fluidizes' the silicon granules, causing them to flow like a liquid, as the silane gas breaks down and deposits silicon layers on them. The granules grow larger and heavier and exit when they are sufficiently large. As they do so, new seed granules and gas are introduced into the chamber and the process continues." The FBR process, which is newer than the Siemens process, uses 80 to 90 percent less energy, requires a smaller footprint, is a continuous process, takes up less space in shipping, and can increase downstream production efficiency. However, the process is difficult to scale and achieve high purity production at low cost. ITRPV, Results 2017 Including Maturity Report, Ninth Edition, September 2018, p. 8; REC Silicon webpage, http://www.recsilicon.com/technology/rec-silicons-fluidized-bed-reactor-process, retrieved June 12, 2017.

resulting in the liquid trichlorosilane. The trichlorosilane is then distilled to increase its purity.[154] Next, heated silicon rods are inserted into a chemical vapor deposition reactor, and hydrogen and trichlorosilane gas are fed into the reactor where they are heated to 1,000 degrees Celsius or more. The silicon from the trichlorosilane is deposited onto the rods, which steadily increase in size until they are removed from the reactor. The resulting high purity polysilicon is crushed into chunks or rocks, then washed, inspected, and packaged.[155]

Figure I-11
CSPV products: Polysilicon refining process (Siemens method)



Source: Wacker Chemie AG, "Polysilicon," n.d., p. 8, https://www.wacker.com/cms/media/publications/downloads/7416_EN.pdf, retrieved October 8, 2019.

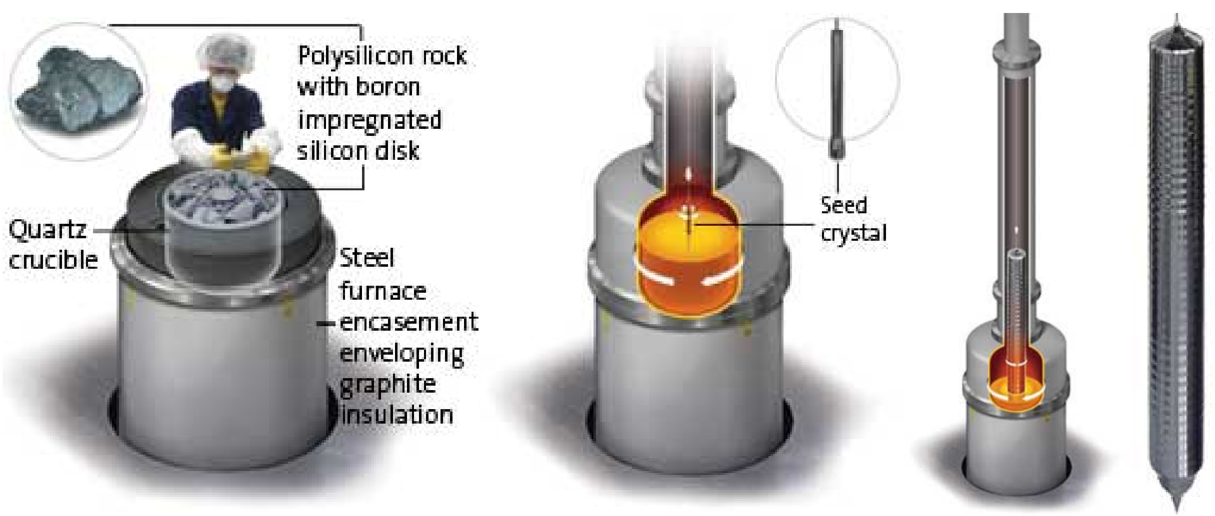
[154] Wacker Chemie AG, "Polysilicon," n.d., p. 8, https://www.wacker.com/cms/media/publications/downloads/7416_EN.pdf, retrieved October 8, 2019.

[155] Wacker Chemie AG, "Polysilicon," n.d., https://www.wacker.com/cms/media/publications/downloads/7416_EN.pdf, retrieved October 8, 2019; Mitsubishi Polysilicon Webpage, http://www.mpsac.com/our_process/, retrieved October 9, 2019.

Ingots

In the Czochralski ("Cz") process[156] for producing crystals used in monocrystalline ingots, polysilicon chunks are first placed into a quartz crucible along with a small amount of boron, which is used to provide a positive electric orientation (figure I-12). The polysilicon often includes both virgin polysilicon and waste polysilicon generated at later stages of the production process.[157] The crucible is then loaded into a Cz furnace and heated to about 2,500 degrees Fahrenheit. Once the polysilicon is melted, a seed crystal is lowered into the material and rotated, with the crucible rotated in the opposite direction. The melt starts to solidify on the seed and the seed is slowly raised out of the melt—creating a single long crystal. The crystal is then cooled before it is moved onto the next step.

Figure I-12
CSPV products: Czochralski process, crucible loading/charging (left), seed crystal (second from left), crystal growing (second from right), and finished crystal (right)



Source: SolarWorld Webpage, https://www.solarworld-usa.com/solar-101/making-solar-panels, retrieved July 15, 2017.

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[156] This discussion will focus on the Czochralski process, which accounted for more than 95 percent of production in 2016. ITRPV, 2016 Results, March 2017, p. 19, http://www.itrpv.net/.cm4all/iproc.php/ITRPV%20Eighth%20Edition%202017.pdf?cdp=a, retrieved December 18, 2018.

[157] JinkoSolar Holding Co., Ltd., Annual Filing to the Securities and Exchange Commission for the Fiscal Year Ended December 31, 2018, Form 20-F, p. 56, http://ir.jinkosolar.com/financials/annual-reports, retrieved October 8, 2019.

The speed of ingot pulling has increased over time, as has the size of ingots.[158] The mass of a typical monocrystalline ingot was more than 200 kg in 2018.[159] Firms are moving toward rechargeable Czochralski ("RCz") and continuous Czochralski ("CCz") production processes. These processes enable firms "to cast more monocrystalline silicon in a single crucible" and RCz use has been accompanied by a shift toward using larger crucibles. These processes thus produce larger ingots, reduce energy use and downtime, and increase crucible life.[160]

For multicrystalline ingots, the first step is loading polysilicon (including virgin and recovered waste) into a quartz crucible in a Directional Silicon Solidification ("DSS") furnace for melting (figure I-13).[161] Argon is fed into the furnace to "remove impurities and inhibit oxidation."[162] The "molten silicon is cast into a block and crystallized, forming a multicrystalline structure as the molten silicon and crucible cool."[163] The mass of mainstream multicrystalline ingots is about 1,100 kg in 2019.[164] A number of companies are upgrading to cast mono (also referred to as quasi-mono or mono-like ingots), which has higher conversion efficiencies. In this process, seed ingots are used in the furnace to produce an ingot with a more mono type crystal structure.[165]

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[158] Roselund, Christian, "The Weekend Read: Secrets of Monocrystalline Silicon," *PV Magazine*, November 24, 2018, https://www.pv-magazine.com/2018/11/24/the-weekend-read-secrets-of-monocrystalline-silicon/, retrieved October 9, 2019.

[159] ITRPV, Results 2018, March 2019, p. 21, https://itrpv.vdma.org/#, retrieved July 29, 2019.

[160] JinkoSolar Holding Co., Ltd., Annual Filing to the Securities and Exchange Commission for the Fiscal Year Ended December 31, 2018, Form 20-F, p. 56, http://ir.jinkosolar.com/financials/annual-reports, retrieved October 8, 2019; Roselund, Christian, "The Weekend Read: Secrets of Monocrystalline Silicon," *PV Magazine*, November 24, 2018, https://www.pv-magazine.com/2018/11/24/the-weekend-read-secrets-of-monocrystalline-silicon/, retrieved October 9, 2019.

[161] JinkoSolar Holding Co., Ltd., Annual Filing to the Securities and Exchange Commission for the Fiscal Year Ended December 31, 2018, Form 20-F, p. 56, http://ir.jinkosolar.com/financials/annual-reports, retrieved October 8, 2019; Yingli, Annual Filing to the Securities and Exchange Commission for the Fiscal Year Ended December 31, 2018, Form 20-F, p. 75, http://ir.yinglisolar.com/financial-information/sec-filings, retrieved October 8, 2019.

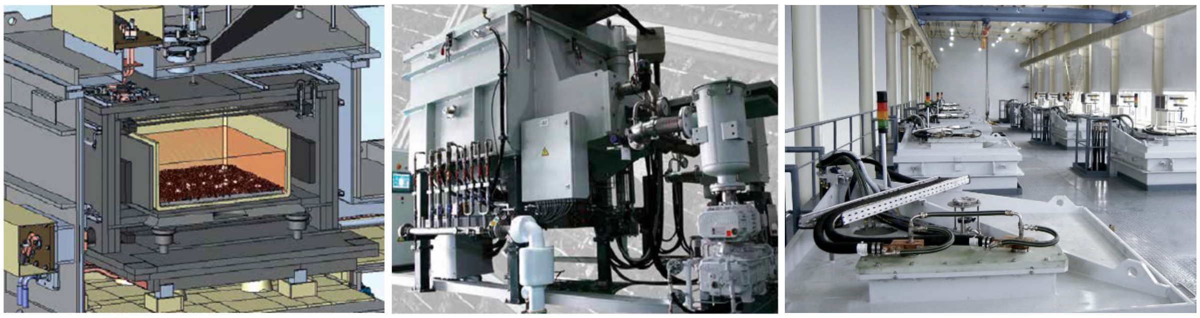
[162] JinkoSolar Holding Co., Ltd., Annual Filing to the Securities and Exchange Commission for the Fiscal Year Ended December 31, 2018, Form 20-F, p. 56, http://ir.jinkosolar.com/financials/annual-reports, retrieved October 8, 2019.

[163] JinkoSolar Holding Co., Ltd., Annual Filing to the Securities and Exchange Commission for the Fiscal Year Ended December 31, 2018, Form 20-F, p. 56, http://ir.jinkosolar.com/financials/annual-reports, retrieved October 8, 2019.

[164] ITRPV, Results 2018, March 2019, p. 20, https://itrpv.vdma.org/#, retrieved July 29, 2019.

[165] Hutchins, Mark, "The Long Read: Change to the Cast," *PV Magazine*, https://www.pv-magazine-india.com/2019/08/03/the-long-read-change-to-the-cast/, retrieved November 3, 2019.

Figure I-13
Furnace for multicrystalline ingots: Cross-section (left), single unit (middle), and installed units (right)



Source: ALD Vacuum Technologies, "SCU450 / SCU800 / SCU1200 / SCU1500 Silicon Crystallization Units," October 2016, p. 2, https://www.ald-vt.com/wp-content/uploads/2018/01/SCU2016.pdf, retrieved October 9, 2019; ALD Vacuum Technologies Webpage, https://www.ald-vt.com/portfolio/engineering/vacuum-metallurgy/silicon-crystallization-unit/, retrieved October 9, 2019.

Wafers

Once the ingot has cooled, it is processed into wafers. For monocrystalline ingots: (1) the top and tail (each end of the cylindrical crystal) are cut off, (2) the remaining portion of the crystal (or ingot) is cut into equal length pieces, (3) the ingot is squared,[166] (4) edges are ground,[167] and (5) a wire saw then slices the ingots into wafers. For multicrystalline ingots (1) the ingot is squared, (2) the squared ingot is cut into blocks, (3) the blocks are tested and any parts of the block that do not pass these tests are cropped off, and (4) the blocks are sliced into wafers using a wire saw.[168] Finally, the wafers are cleaned, dried, and inspected. Manufacturers have generally switched to diamond wire saws, which have several benefits including increasing the speed of the production process.[169]

One emerging technology for wafer production is Direct-to-Wafer or Direct Wafer technology. This technology involves converting molten silicon (or another feedstock) directly into wafers, bypassing the ingot stage.[170] One such process is shown in figure I-14.

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[166] In monocrystalline ingot squaring, the rounded sides of the ingot are cut into four flat sides, leaving only rounded corners.

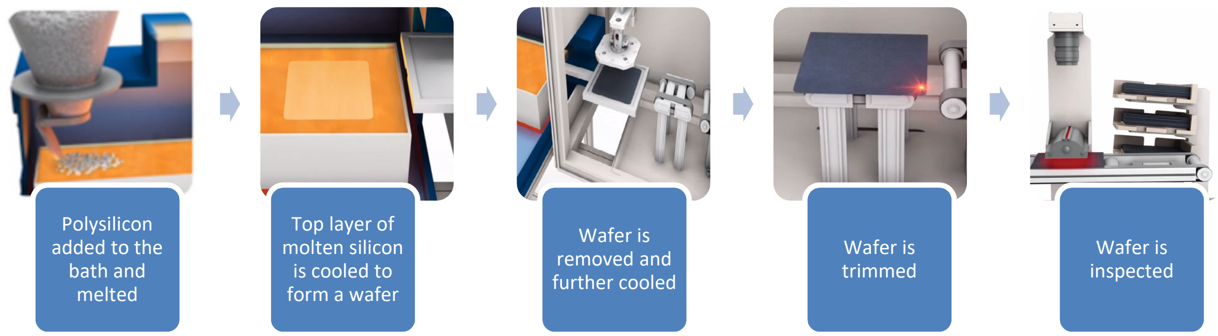
[167] BBS Kinmei webpage, http://www.bbskinmei.co.jp/english/products/solar/, retrieved October 9, 2019.

[168] JinkoSolar Holding Co., Ltd., Annual Filing to the Securities and Exchange Commission for the Fiscal Year Ended December 31, 2018, Form 20-F, p. 56, http://ir.jinkosolar.com/financials/annual-reports, retrieved October 8, 2019.

[169] ITRPV, Results 2018, March 2019, p. 7, https://itrpv.vdma.org/#, retrieved July 29, 2019.

[170] 1366 Technologies webpage, https://1366tech.com/technology-2/, retrieved October 9, 2019; Crystal Technologies Webpage, http://www.xtalsolar.com/reinventing.html, retrieved December 19, 2019.

Figure I-14
CSPV products: Direct wafer manufacturing process



Source: 1366 technologies webpage, https://1366tech.com/technology-2/#ourwafers, retrieved December 19, 2019.

CSPV cells[171]

The monocrystalline and multicrystalline wafers, which are 180 to 200 micrometers thick, are next processed into CSPV cells (figure I-15). The main steps in producing a standard, p-type, aluminum back surface field CSPV cell are as follows:

- **Cleaning and texturing:** First, the wafers are cleaned, then the surface of the wafer undergoes a chemical treatment that reduces the reflection of sunlight and increases light absorption.
- **Diffusion:** In the next step, "phosphorus is diffused into a thin layer of the wafer surface. The molecular-level impregnation occurs as the wafer surface is exposed to phosphorus gas at a high heat, a step that gives the surface a negative potential electrical orientation. The combination of that layer and the boron-doped layer below creates a positive-negative, or p/n, junction–a critical partition in the functioning of a PV cell."[172]
- **Edge isolation:** A thin layer of silicon is then removed from the edge of the CSPV cell to separate the positive and negative layers.
- **Coating:** Next, a silicon nitride antireflective coating is added to the CSPV cells to increase the absorption of sunlight.
- **Printing:** Metals are then printed on the solar CSPV cell to collect the electricity. On the front of the CSPV cell, these metals are printed in thin metal strips called fingers, which

[171] The cell manufacturing process varies by company and technology. This section will only describe the process for producing a standard aluminum back surface field cell and a monocrystalline PERC cell. For more on specific technologies and some of the variation in the production process, see the "discussion of specific products" section.

[172] SolarWorld, "Energy for You and Me" brochure, p. 12.

are connected to the rest of the CSPV module via busbars. A metal layer, typically aluminum, is also printed on the back of the CSPV cell.

- **Co-firing:** The CSPV cells then enter a furnace, where the "high temperature causes the silver paste to become imbedded in the surface of the silicon layer, forming a reliable electrical contact."[173]
- **Testing and sorting:** The final step in the process is the testing and sorting of the CSPV cells based on their characteristics and efficiency.

Producing passive emitter rear contact ("PERC") CSPV cells requires several modifications to the production process for Al-BSF CSPV cells. The first modification is that, in the edge-isolation step, texturing on the rear side of the cell is removed (rear polishing). Further, in addition to coating the front of the cell with silicon nitride, the rear side is passivated with aluminum oxide (AlOx) and an antireflective silicon nitride (SiN) layer is added to the rear side. The final process addition involves using lasers to open holes in the rear passivation layer to allow the aluminum to contact the silicon.[174] See the "Discussion of specific products" section for more information on PERC cells.

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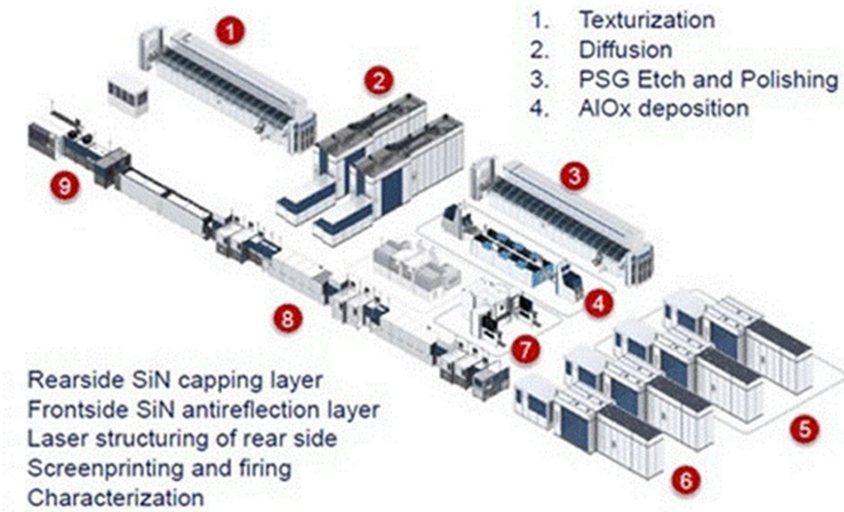
[173] JA Solar, "Form 20-F," April 16, 2013, p. 41.

[174] Chunduri, Shravan K. and Michael Schmela, *PERC Solar Cell Technology, 2018 Edition*, Taiyang News, 2018, pp. 10 and 22, http://taiyangnews.info/reports/, retrieved October 10, 2019; Meyer Burger, "High-Efficiency Technologies: PERC and TOPCon," n.d., p. 5, https://www.meyerburger.com/fileadmin/user_upload/product_downloads/Meyer-Burger-PERC-Factsheet-EN-201905.pdf, retrieved October 10, 2019.

Figure I-15
CSPV products: CSPV cell production process



Source: CETC Solar Energy Webpage, http://cetcsolarenergy.com/products/solar_pv_production_equipments.html, retrieved October 10, 2019.

CSPV modules

The CSPV cells are next assembled into CSPV modules (figure I-16). If half-cut cells are used, the CSPV cells are first cut in half using a laser.[175] Next, a piece of glass is placed on the production line, on top of which is added a piece of ethyl vinyl acetate ("EVA") or another encapsulant. Then a group of CSPV cells is placed in a line and soldered together, creating a string. The strings are then placed on top of the encapsulant, and the string interconnections are soldered together. After this, another layer of EVA and a backsheet are added, then the product is laminated and cured (creating what is referred to as a "laminate"). Excess material is then trimmed, usually a frame is added, and a junction box is attached to the back. CSPV modules are then tested, sorted, and packaged.[176]

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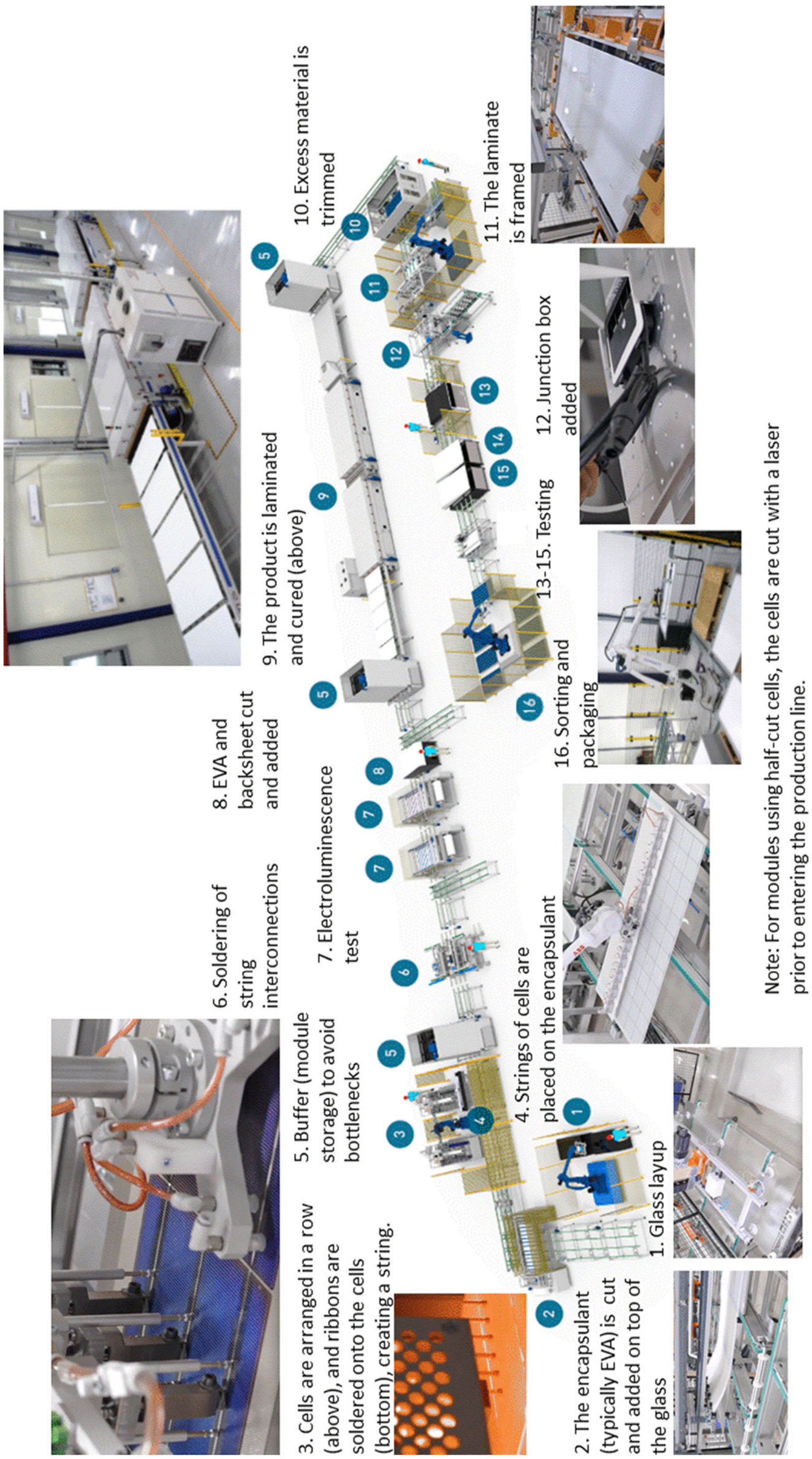
[175] Chunduri, Shravan K. and Michael Schmela, *Advanced Module Technologies*, 2019 Edition, Taiyang News, September 2019, p. 37, http://taiyangnews.info/reports/advanced-module-technologies-2019/.

[176] Ecoprogetti webpage, https://ecoprogetti.com/100mw-fully-automatic/, retrieved October 7, 2019; Mondragon Assembly, "Turnkey Solar Module Manufacturing Line–PV Module Factory–Mondragon Assembly," https://www.youtube.com/watch?v=_KTrq63Q2u4, retrieved October 7, 2019.

Figure I-16
CSPV module production process, fully automated assembly line



Source: Ecoprogetti Webpage, https://ecoprogetti.com/100mw-fully-automatic/, retrieved October 7, 2019; Mondragon Assembly, “Turnkey Solar Module Manufacturing Line–PV Module Factory–Mondragon Assembly,” https://www.youtube.com/watch?v=_KTrq63Q2u4, retrieved October 7, 2019.

Uses and market segments[177]

There are four primary market segments for CSPV products. There are three grid-connected market segments–residential, nonresidential, and utility–and an off-grid market. In the grid-connected market, installations are usually either ground-mounted or roof-mounted. In addition to the CSPV module, there are a number of other components of the installation called the balance of system ("BOS"). The BOS includes components such as the inverter and the racking on which the modules are installed.[178]

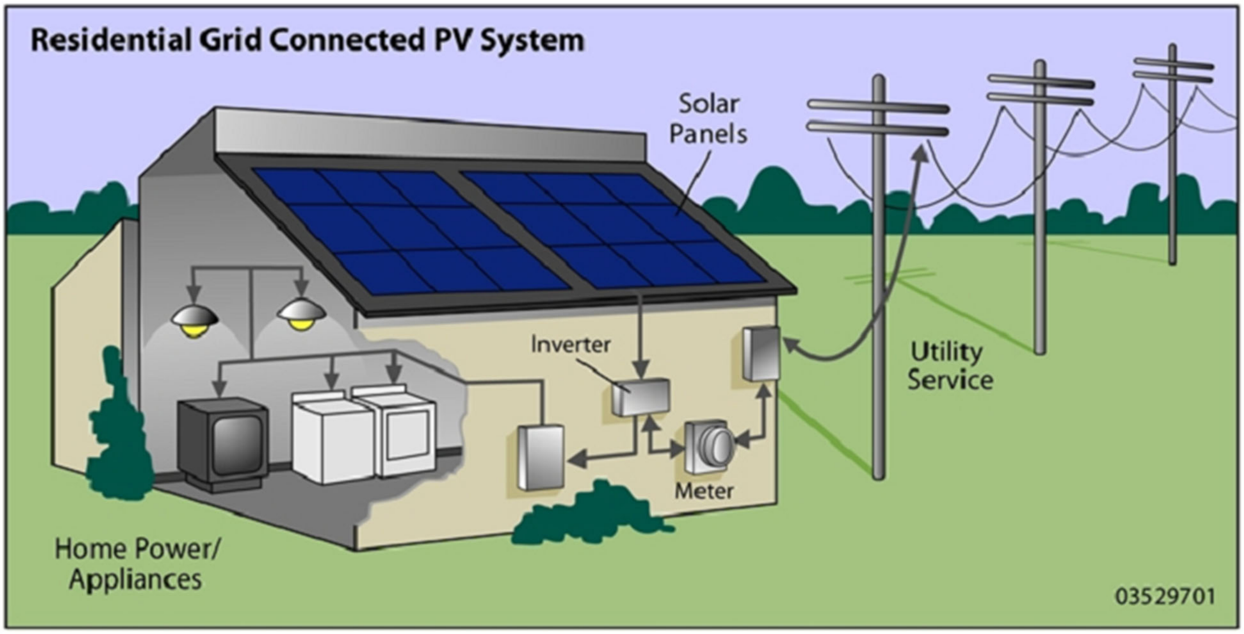
Residential grid-connected systems are installed at individual homes. CSPV modules are typically installed on the roof, though they can also be ground-mounted, and connected to an inverter. The system can use a central inverter, which converts the power from multiple CSPV modules, or each module can have its own microinverter attached. In residential installations, the electricity generated by the system is used for power in the individual home (figure I-17). Homeowners use grid energy when solar electricity generation is not sufficient to meet demand, and often feed energy back into the grid when solar electricity generation exceeds home use. In the United States, the median size of a residential PV installation was 6.4 kW in 2018.[179]

[177] Unless otherwise noted, this section is derived from CSPV 1 first review publication, pp. I-40–I-43. Citations to direct quotes, pictures, and data were retained.

[178] In addition to equipment, there are a number of services associated with installing a PV system such as site assessment and design, permitting, financing, and the system installations, as well as operations and maintenance services after the installation is completed.

[179] Barbose, Galen and Naïm Darghouth, *Tracking the Sun*, 2019 Edition, Lawrence Berkeley National Laboratory, October 2019, p. 10, https://emp.lbl.gov/tracking-the-sun, retrieved November 3, 2019.

Figure I-17
Residential grid-connected CSPV system



Source: DOE, Office of Energy Efficiency and Renewable Energy (EERE) Webpage, http://www.energysavers.gov/your_home/electricity/index.cfm/mytopic=10720, retrieved November 9, 2011.

Nonresidential systems are installed at commercial, industrial, government, and similar buildings and sites. Nonresidential installations are typically larger than residential installations—for nonresidential systems, the median size in 2018 was 47 kW, though systems can be substantially larger.[180] However, they function similarly to residential installations, providing electricity to meet onsite needs, pulling additional electricity from the grid when needed, and feeding excess electricity back into the grid when it is not needed.

[180] Barbose, Galen and Naïm Darghouth, *Tracking the Sun*, 2019 Edition, Lawrence Berkeley National Laboratory, October 2019, p. 10, https://emp.lbl.gov/tracking-the-sun, retrieved November 3, 2019.

Utility systems are generally the largest systems and provide electricity directly to the electric grid for sale to customers rather than for on-site use (figure I-18). These systems are generally ground-mounted and currently tend to use central inverters rather than microinverters. CSPV utility systems may involve fixed-tilt, single-axis tracking (panels rotate to follow the east-west movement of the sun), or dual-axis tracking (panels also move to follow the north-south movement of the sun during the year). Most large systems use single-axis tracking.

Figure I-18
La Ola PV plant, a utility CSPV system on Lanai, Hawaii

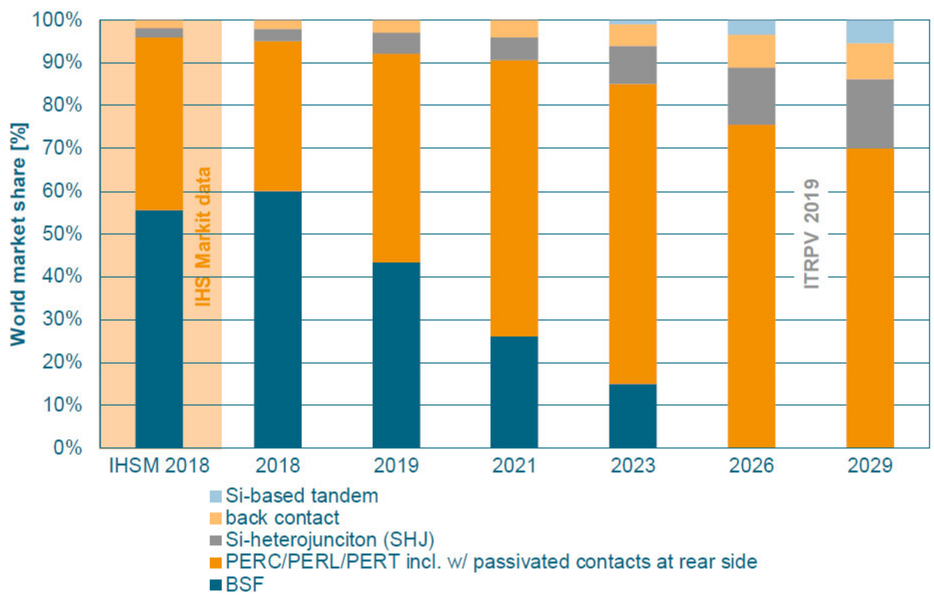
Source: Photo courtesy of DOE/NREL, credit Jamie Keller, https://www.nrel.gov/.

As noted above, there are a broad range of off-grid applications, such as power generation in remote locations, mobile power solutions, telecommunications power and lighting systems, and portable consumer goods (such as systems for recharging consumer electronics like tablets and phones). These systems often have additional BOS components, such as a battery and charge controller, though inverters are not needed for all off-grid applications.

Discussion of specific products[181]

Within the broad areas of monocrystalline[182] and multicrystalline[183] products, there are a number of CSPV cell and module technologies. The production of passive emitter rear contact ("PERC") and related technologies is rapidly increasing, and these technologies accounted for 35 percent of CSPV cell production in 2018 (figure I-19).[184] Manufacturers have also increased the number of busbars used in CSPV cells, with cells containing five or more busbars accounting for more than 40 percent of global production in 2018.[185] Select CSPV cell and module technologies are described below.

Figure I-19
CSPV products: CSPV cell technology shares



Notes: BSF=Back Surface Field, the standard technology prior to the introduction of PERC; Si=Silicon.

Source: ITRPV, Results 2018, March 2019, p. 43, https://itrpv.vdma.org/#, retrieved July 29, 2019.

[181] Unless otherwise noted, this section is derived from CSPV 1 first review publication, pp. I-36–I-38.

[182] Monocrystalline cells are made from a single grown crystal and tend to convert sunlight into electricity more efficiently than multicrystalline cells.

[183] Multicrystalline cells have a random crystal structure and tend to have a lower conversion efficiency.

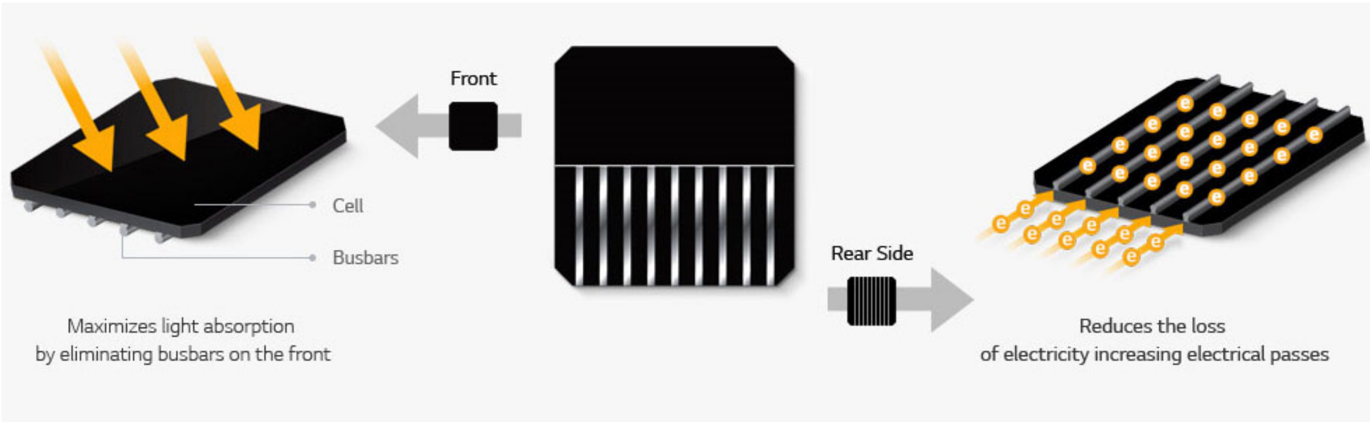
[184] ITRPV, Results 2018, March 2019, p. 44, https://itrpv.vdma.org/#, retrieved July 29, 2019.

[185] ITRPV, Results 2018, March 2019, p. 37, https://itrpv.vdma.org/#, retrieved July 29, 2019.

Back contact CSPV cells

Some manufacturers place metal contacts onto the rear side of the CSPV cell, creating back (or rear contact) cells (figure I-20). This provides several advantages such as reduced shading, improved cell interconnection, and better aesthetics.

Figure I-20
CSPV products: Back contact CSPV cell with no front gridlines (left) compared to a standard cell (right)

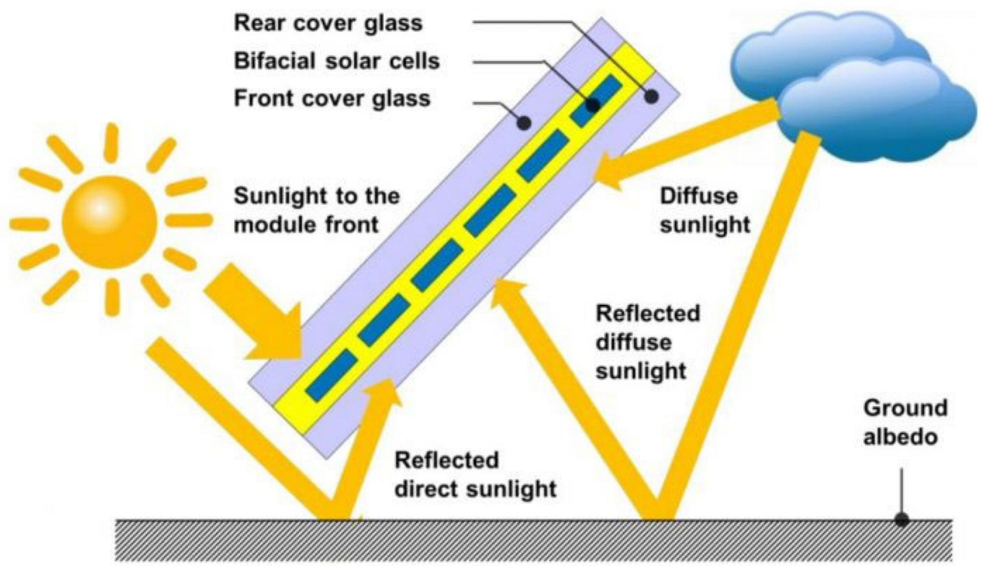


Source: LG Website, https://www.lg.com/uk/business/solar/why-lg-solar/leading-technology, retrieved November 3, 2019.

Bifacial

Bifacial CSPV cells convert light that hits both the front and back of the CSPV cell into electricity (figure I-21). Whereas most CSPV cells have a metalized back layer, bifacial cells allow light through to the back side of the CSPV cell. They often incorporate either the PERC or heterojunction technologies discussed below. When assembled into CSPV modules, they use a transparent back sheet or rear glass layer to allow reflected sunlight on the rear of the CSPV cell.

Figure I-21
CSPV products: Bifacial PV modules absorb sunlight on both sides of the module



Source: Glazer, Becca and Kevin Mayer, "Bifacial or Bust? Engineering Solar Financings of the Future," April 4, 2019, Sol Source, https://www.solsystems.com/blog/2019/04/04/bifacial-or-bust-engineering-solar-financings-of-the-future/, retrieved November 3, 2019.

Global production of bifacial solar cells and modules accounted for a relatively small share of production in 2018, but is projected to rapidly increase. Estimates of global bifacial module production in 2018 ranged from *** to 5 GW.[186] EnergyTrend reports that global bifacial module production capacity totaled 17.4 GW in 2018, but will increase to 37.6 GW in 2019,

[186] ***; Lin, Corrine, "Bifacial Module Demand Continues to Grow," PV Magazine, May 27, 2019, https://www.pv-magazine.com/2019/05/27/bifacial-module-demand-continues-to-grow/.

51.8 GW in 2020 and 73.1 GW in 2021.[187] According to PV InfoLink, major manufacturers in 2018 included Solargiga, Longi, JA Solar, Trina Solar, Jinko Solar, and Canadian Solar.[188]

Global PERC module production capacity, including monofacial and bifacial, totaled 66.3 GW in 2018, and PERC cell production capacity is projected to total 100 GW in 2019.[189] The conversion from production of monofacial PERC cells and modules to bifacial cells and modules is relatively straightforward, as it requires only minor changes in cell and module materials and production processes.[190] According to ***, a plant needs to be shut down for *** to switch from producing monofacial cells and modules to bifacial cells and modules.[191] *** indicates that it takes *** to upgrade a plant from producing monofacial cells and modules to bifacial cells and modules. They further indicated another *** is needed to ramp up production at the plant.[192]

Most research firms anticipate that bifacial module shipments will rapidly increase over the next three years, though the extent to which they are projected to grow varies. The 2019 International Technology Roadmap for Photovoltaic Report (ITRPV) projects that bifacial cells will account for about 30 percent of the crystalline silicon cell market in 2021, though only about one-third of those will go into true bifacial modules. This implies a market share of true bifacial modules of about 10 percent.[193] *** projects that bifacial modules will account for *** of the global market in 2020, and *** in 2025.[194] PV InfoLink forecasts that bifacial modules will increase from 5 percent of the global market in 2018 to 22

[187] EnergyTrend, "Research and Case Studies Have Proven the Benefits of Bifacial Solutions in Lowering the Levelized Cost of PV Electricity," April 9, 2019, https://m.energytrend.com/news/view/13673.html, retrieved December 20, 2019.

[188] Lin, Corrine, "Bifacial Module Demand Continues to Grow," *PV Magazine*, May 27, 2019, https://www.pv-magazine.com/2019/05/27/bifacial-module-demand-continues-to-grow/.

[189] Lin, Corrine, "Bifacial Module Demand Continues to Grow," *PV Magazine*, May 27, 2019, https://www.pv-magazine.com/2019/05/27/bifacial-module-demand-continues-to-grow/.

[190] Chunduri, Shravan K. and Michael Schmela, *Bifacial Solar Module Technology*, 2018 Edition, Taiyang News, 2018, 4, 13, 15, 18, 28–30, http://taiyangnews.info/reports/.

[191] ***.

[192] ***.

[193] ITRPV, Results 2018, March 2019, p. 47, https://itrpv.vdma.org/#, retrieved July 29, 2019.

[194] ***.

percent in 2022.[195] IHS Markit similarly projects that bifacial modules will account for one-third of module production in 2022.[196]

Bifacial module production costs are reportedly less than *** per watt higher than standard module costs. In an April 2019 presentation, the National Renewable Energy Lab (NREL) calculated the production cost of comparable monofacial and bifacial PERC modules manufactured in Asia at $0.287 and $0.289 per watt, respectively.[197]

Building integrated

In addition to standard size CSPV modules, CSPV cells can be used in building-integrated PV ("BIPV modules" or "BIPV products"). BIPV products are materials integrated into the building envelope, such as the façade or roof, containing CSPV cells. These building integrated materials replace conventional construction materials, such as glass or roof shingles, taking over the function that conventional materials would otherwise perform while also producing electricity.

Busbars

Manufacturers are increasing the number of busbars in CSPV cells, which results in higher efficiency and greater power output (figure I-22). Some manufacturers have eliminated busbars, which can provide benefits such as reducing electrical losses and increasing the surface area of the CSPV cell that can absorb sunlight.

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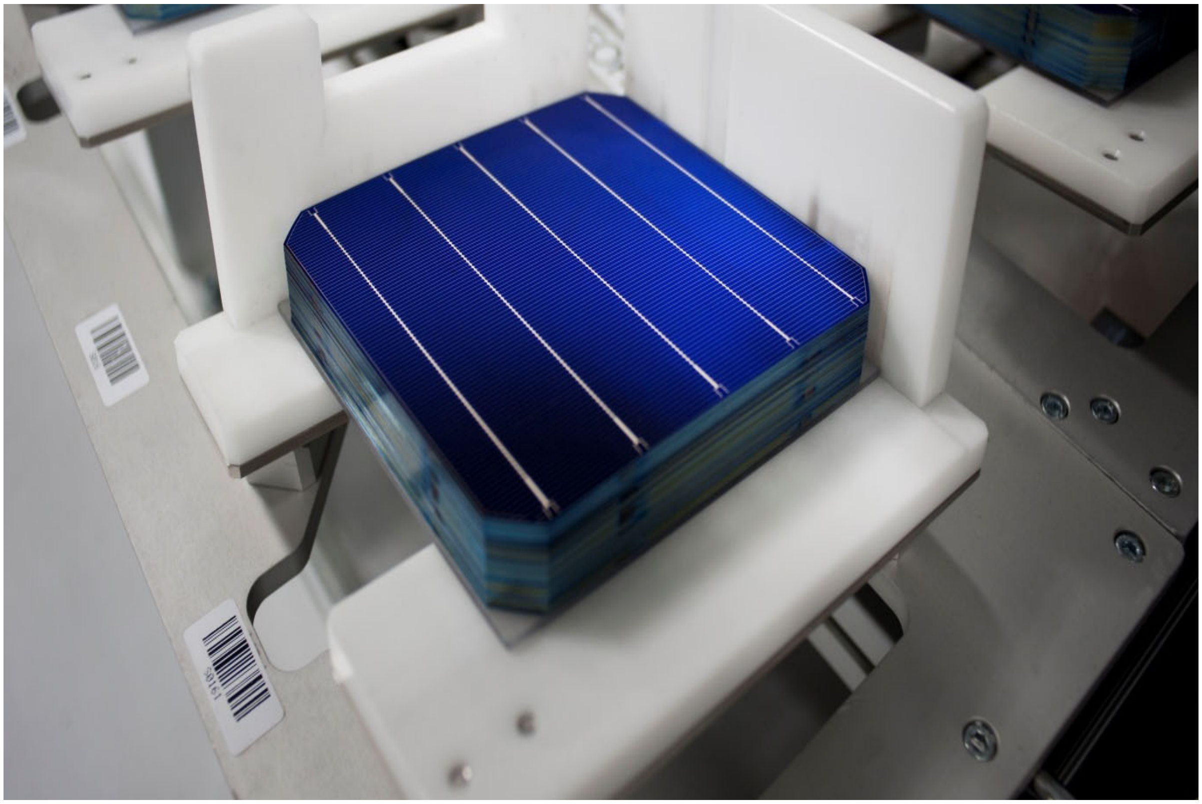
[195] Lin, Corrine, "Bifacial Module Demand Continues to Grow," *PV Magazine*, May 27, 2019, https://www.pv-magazine.com/2019/05/27/bifacial-module-demand-continues-to-grow/.

[196] Zoco, Edurne, "The Sun Rises on the Bifacial Module Market," *PV Magazine*, June 10, 2019, https://www.pv-magazine.com/2019/06/10/the-sun-rises-on-the-bifacial-module-market/.

[197] ***; Woodhouse, Michael, David Feldman, Ran Fu, Brittany Smith, Kelsey Horowitz, Ashwin Ramdas, and Robert Margolis, "The International Supply Chain and Manufacturing Costs for Photovoltaic Modules, and Project Economics of Systems Including Storage," National Renewable Energy Laboratory, Presentation at the Shanghai New Energy Conference, June 5, 2019, p. 15, https://www.osti.gov/servlets/purl/1526203, retrieved December 20, 2019; Chunduri, Shravan K. and Michael Schmela, *Bifacial Solar Module Technology*, 2018 Edition, Taiyang News, 2018, http://taiyangnews.info/reports/, retrieved December 20, 2019.

Figure I-22
CSPV cell containing five busbars



Source: SolarWorld Webpage, https://www.solarworld-usa.com/newsroom/media-downloads, retrieved September 4, 2017.

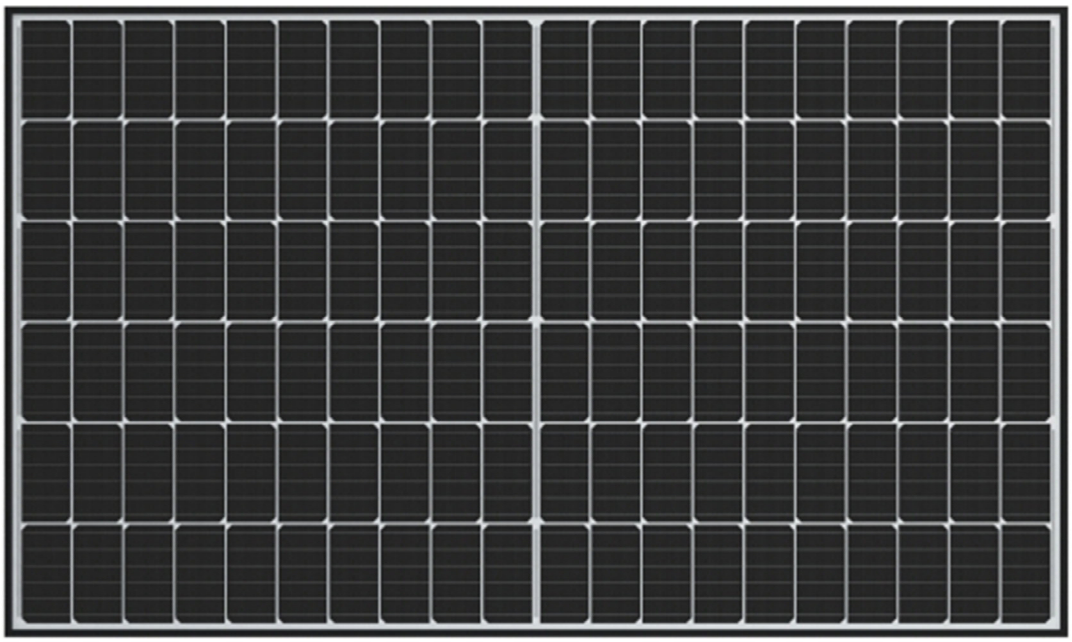
Frameless CSPV modules

Some CSPV modules do not use a frame, which reduces costs. These modules typically use glass as the rear layer to ensure mechanical stability.

Half-cut CSPV cells

Some manufacturers have switched to CSPV modules with half-cut CSPV cells (figure I-23). These are standard CSPV cells that are cut in half, such that a standard 60-cell CSPV module would instead have 120 half cells. Half-cut cells result in lower cell currents and, therefore, reduce power losses and increase cell efficiency and overall module output.

Figure I-23
CSPV products: CSPV module with half-cut cells



Source: Hanwha Webpage, https://www.q-cells.com/en/main/products/solar_panels/residential/residential01.html, retrieved November 3, 2019.

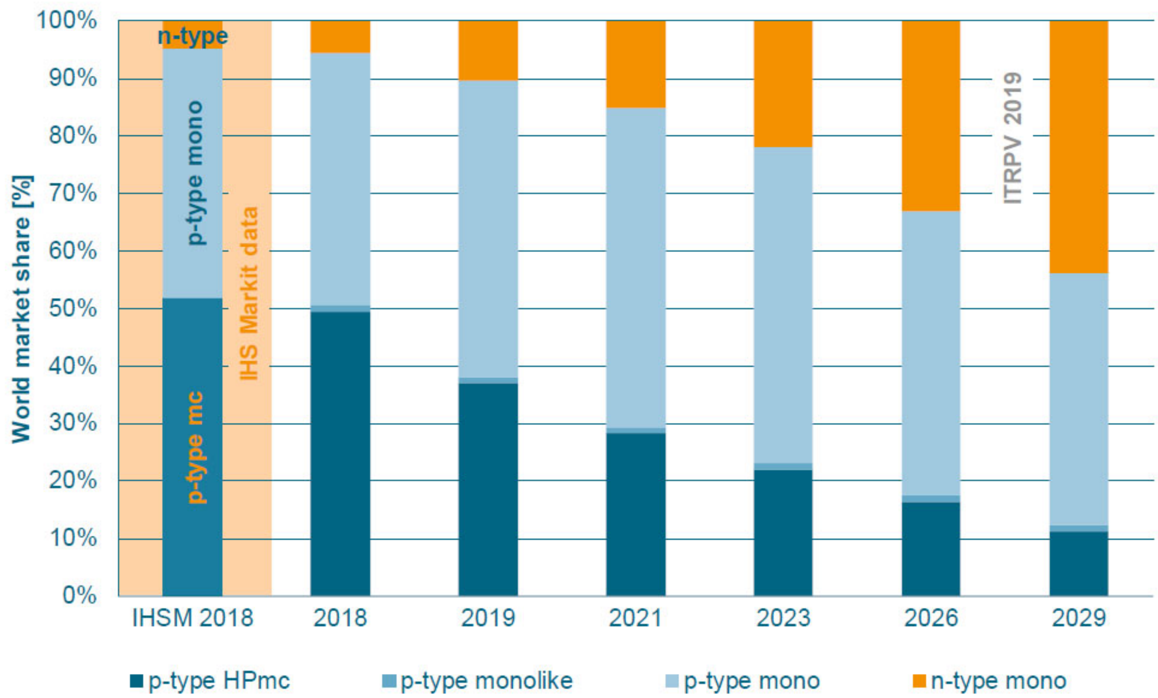
Heterojunction (including HIT)

Heterojunction CSPV cells, which include heterojunction with intrinsic thin layer ("HIT"), add thin layers of photosensitive semiconductor materials (typically amorphous silicon) on top of a monocrystalline wafer. These additional layers increase the absorption of sunlight, and the overall efficiencies of the CSPV cells. They also perform better in hot climates than typical monocrystalline cells. As indicated in figure I-24, the share of production accounted for by heterojunction is expected to substantially increase over the next decade.

n-type mono

In the production of most types of monocrystalline CSPV wafers, the silicon is doped with boron to create a positive electrical orientation. In the production of n-type mono wafers, the silicon is doped with phosphorous to create a negative electrical orientation. In the CSPV cell production process, a positive layer is added to create the p/n junction. N-type CSPV cells can be more expensive to produce, but have a number of benefits, such as higher conversion efficiencies, no light-induced degradation, and the potential use of less pure wafers. N-type mono was a relatively small share of global production in 2018, but is expected to reach 10 percent of production in 2019 and rapidly increase over the next decade (figure I-24).[198]

Figure I-24
CSPV products: Share of wafer production by type



Note: mc=multicrystalline; HP=high performance.

Source: ITRPV, Results 2018, March 2019, p. 41, https://itrpv.vdma.org/#, retrieved July 29, 2019.

[198] ITRPV, Results 2018, March 2019, pp. 40-41, https://itrpv.vdma.org/#, retrieved July 29, 2019.

Passive Emitter Rear Contact ("PERC")

PERC CSPV cells incorporate an additional rear dielectric layer that reflects light that did not generate electricity as it initially passed through the CSPV cell back into the CSPV cell. There is, therefore, another opportunity for the CSPV cell to absorb this light. PERC cells have a higher efficiency, and improved performance in certain conditions, such as low light and high heat conditions. Existing CSPV cell production lines can be reconfigured to produce PERC CSPV cells with the addition of two steps. Therefore, the changeover to PERC technology is relatively straightforward, though there are some challenges with PERC technology such as the potential for more rapid cell degradation. Related technologies include Passivated Emitter Rear Totally Diffused ("PERT") and Passivated Emitter Rear Locally Diffused ("PERL").

Shingling and paving

In shingled CSPV modules, CSPV cells are cut into thin strips, the edges of which are overlapped in the CSPV module (like roof shingles). This reduces resistive losses and, therefore, increases power output. The approach can also improve CSPV module aesthetics.[199] Paving uses half-cells, and is an approach that reduces the gap between cells.[200]

[199] SunPower Webpage, https://businessfeed.sunpower.com/articles/solar-cell-shingling, retrieved October 25, 2019; Chunduri, Shravan K. and Michael Schmela, *Advanced Module Technologies*, 2019 Edition, Taiyang News, September 2019, p. 4, http://taiyangnews.info/reports/advanced-module-technologies-2019/, retrieved October 10, 2019.

[200] Chunduri, Shravan K. and Michael Schmela, *Advanced Module Technologies*, 2019 Edition, Taiyang News, September 2019, p. 4, http://taiyangnews.info/reports/advanced-module-technologies-2019/, retrieved October 10, 2019.

Part II: Conditions of competition in the U.S. market

U.S. market characteristics

There are four primary market segments for CSPV products.[1] The three on-grid market segments are residential, nonresidential (commercial), and utility, and account for the vast majority of CSPV modules sold in the United States. The fourth is the off-grid market, in which CSPV modules and/or cells are part of a mechanism designed to consume all the power generated from the module or cell. Modules vary in size, nominal power output, and efficiency. Typical on-grid modules have 60 or 72 cells (or 120/144 half-cut cells) and currently have an average power output of between 280 watts (for a 60-cell multicrystalline module) and 370 watts (for 72-cell monocrystalline modules).[2] Residential and small commercial solar installations typically use 60-cell modules with a high conversion efficiency due to their smaller size.[3] Larger commercial projects and utility-scale projects typically use 72-cell modules because they are usually less expensive to install due to lower labor and balance of system costs.[4]

Overall, apparent U.S. consumption of CSPV products, by quantity, decreased by *** percent between 2016 and 2018 and decreased by *** percent between 2017 and 2018, but was *** percent higher in January-June 2019 compared to January-June 2018.[5]

All three on-grid market segments have experienced growth since 2016 (as well as since 2017), in both the number of installations and the total wattage of installation projects. Total net generation of solar electricity increased considerably as well, growing by almost double

[1] The vast majority of CSPV cells are used in the production of CSPV modules.

[2] Output efficiency has improved since the original safeguard investigation. At the time of the original investigation, the average power output was between 240 and 340 watts. See SEIA's safeguard investigation prehearing brief, p. 3 and appendix A, pp. 35-36; and safeguard investigation hearing transcript, p. 174 (Messer).

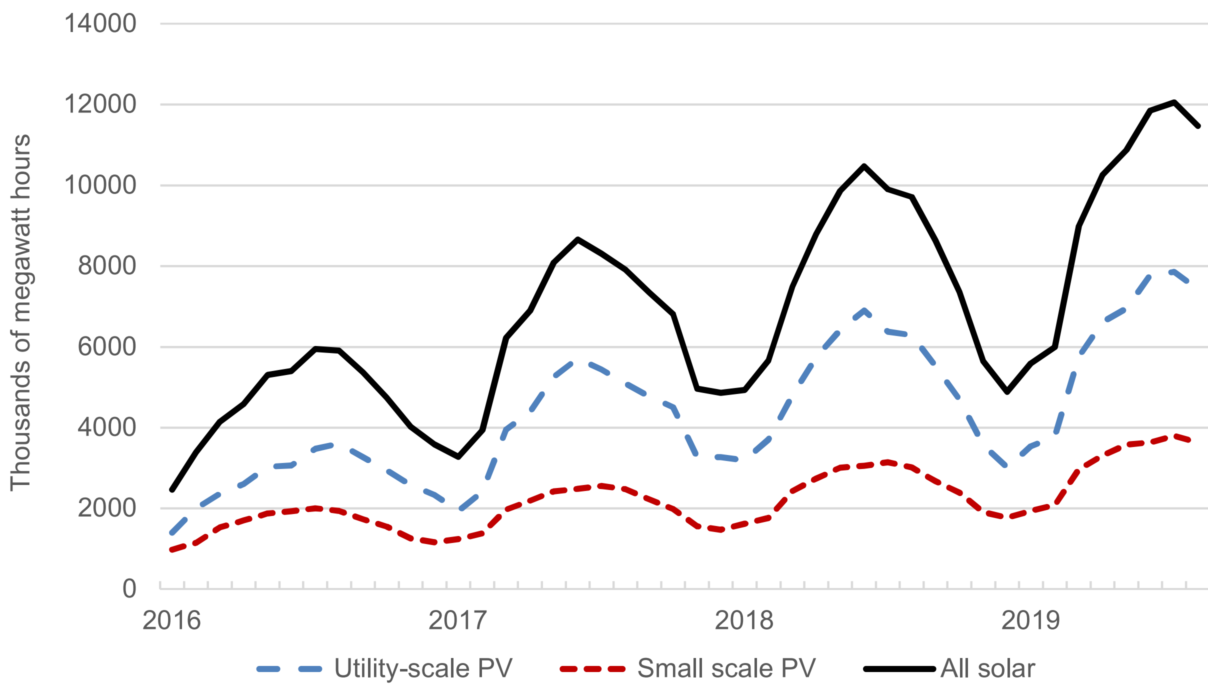
[3] CSPV 60-cell modules are on average 65 inches long and 39 inches wide and typically weigh between 33 and 51 pounds. CSPV 72-modules are generally around 78 inches long and 39 inches wide and typically weigh 45 to 61 pounds. See part I, "Physical properties."

[4] Previously, utilities also purchased 60-cell modules, including 60-cell monocrystalline modules. *See, e.g.*, CSPV 1 original publication.

[5] Between 2012 and 2016, apparent U.S. consumption of 60-cell CSPV modules increased by *** percent and apparent U.S. consumption of 72-cell CSPV modules increased by *** percent. See *Investigation No. TA-20-1-75: Crystalline Silicon Photovoltaic Cells (Whether or not Partially or Fully Assembled into Other Products)*–Staff Report, INV-PP-119, September 11, 2017 ("Safeguard confidential report"), Table C-5.

between January 2016 and December 2018, by almost *** between January 2017 and December 2018, and by 135 percent between December 2018 and August 2019 (figure II-1).

Figure II-1
Solar generation: Net U.S. electricity generation for utility-scale PV, small-scale PV, and all solar, all sectors, monthly, January 2016-August 2019



Source: U.S. EIA, http://www.eia.gov/electricity/data/browser/, retrieved December 11, 2019.

Product changes

Roughly half of the responding firms (8 of 15 U.S. producers and 23 of 43 importers) indicated that there have been significant changes in the product range, product mix, technology, or marketing of CSPV products since February 7, 2018. Nearly all firms highlighted improvements in cell and module efficiency and greater output power as a significant change, with several noting the widespread use of monocrystalline PERC cells[6] and the inclusion of

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[6] As discussed in part I, Passivated Emitter and Rear Contact (or "PERC") cells incorporate an additional rear dielectric layer that reflects light that did not generate electricity as it initially passed through the CSPV cell back into the CSPV cell. PERC cells have a higher efficiency, and improved performance in certain conditions, such as low light and high heat conditions.

bi-facial technology in CSPV products.[7] A few firms stated that there are consistent increases in efficiency in solar modules, with one estimating the improvement cycle to be every six months. U.S. producers and importers *** stated that there has been a shift toward production of half-cut cells,[8] and importer *** highlighted an increase in the use of AC modules as a significant change in the market.[9] Among product- or firm-specific changes, U.S. producer and importer *** reported introducing ***, and *** Tesla reported that it recently introduced a new version of its Solar Roof tiles.[10] Hanwha stated that it uses "high efficiency cells that incorporate the Q.ANTUM mono-PERC technology;" PowerFilm launched ***; SunPower began production of its ***; and other U.S. producers are using CSPV cells in building-integrated PV products (such as roof tiles).[11] In additional comments, importer and purchaser *** stated that the U.S. market is not offered the newest and best module solutions at the pace or scale as other countries due to the impact of the import tariffs, but did not describe what these module solutions were.

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[7] As noted in part I, in June 2019 USTR granted an exclusion to the safeguard measure for bifacial solar panels along with flexible fiberglass solar panels and laminated solar panels. See 84 FR 27684, June 13, 2019, available at https://www.federalregister.gov/documents/2019/06/13/2019-12476/exclusion-of-particular-products-from-the-solar-products-safeguard-measure. On October 9, 2019, USTR withdrew that exclusion, indicating that it would likely result in significant increases in imports of bifacial solar panels and undermine the objectives of the safeguard measure. See 84 FR 54244, October 9, 2019, available at https://www.federalregister.gov/documents/2019/10/09/2019-22074/withdrawal-of-bifacial-solar-panels-exclusion-to-the-solar-products-safeguard-measure. On November 7, 2019, the CIT granted a temporary restraining order barring the USTR and U.S. Customs from withdrawing the bifacial exclusion until November 21, 2019, or until the ruling on the motion for a preliminary injunction. See Court Order, *Invenergy Renewables LLC v. United States*, Ct. No. 19-00192 (Nov. 7, 2019) (ECF No. 68). On December 5, 2019, the CIT issued an order preliminarily enjoining USTR and Customs from withdrawing the exclusion until entry of final judgment in the case. Court Order, *Invenergy Renewables LLC v. United States*, Ct. No. 19-00192 (Dec. 5, 2019) (ECF No. 114).

[8] ***. See ***.

[9] AC modules have an AC inverter mounted onto their backs, which produce AC power with no DC connector. See Solar Power World, *AC modules make a comeback*, available at https://www.solarpowerworldonline.com/2017/10/ac-modules-make-comeback/, retrieved November 10, 2019.

[10] On October 25, 2019, Tesla started selling version 3 of its glass Solar Roof tiles. See CNBC, *Tesla releases a new version of Solar Roof tiles*, available at https://www.cnbc.com/2019/10/25/tesla-releases-solar-roof-tiles-v-3.html, retrieved November 3, 2019.

[11] The Coalition's prehearing brief, pp. 17-18.

Channels of distribution

As shown in table II-1, U.S. producers and importers sold CSPV cells *** to module assemblers. U.S. producers reported selling a plurality to a majority of their CSPV modules to distributors, while importers sold a plurality to a majority of their CSPV modules to utilities/developers.

Table II-1
CSPV products: U.S. producers' and importers' U.S. shipments, by source, product type, and channel of distribution, 2016-18, January-June 2018 and January-June 2019

Item	Period				
	Calendar year			January-June	
	2016	2017	2018	2018	2019
	Share of reported shipments (percent)				
U.S. producers' U.S. shipments of CSPV cells:					
To module assemblers	***	***	***	***	***
To distributors	***	***	***	***	***
To residential installers	***	***	***	***	***
To commercial installers	***	***	***	***	***
To utilities or developers	***	***	***	***	***
U.S. producers' U.S. shipments of CSPV modules:					
To module assemblers	***	***	***	***	***
To distributors	***	***	***	***	***
To residential installers	***	***	***	***	***
To commercial installers	***	***	***	***	***
To utilities or developers	***	***	***	***	***
U.S. importers' U.S. shipments of CSPV cells:					
To module assemblers	***	***	***	***	***
To distributors	***	***	***	***	***
To residential installers	***	***	***	***	***
To commercial installers	***	***	***	***	***
To utilities or developers	***	***	***	***	***
U.S. importers' U.S. shipments of CSPV modules:					
To module assemblers	***	***	***	***	***
To distributors	***	***	***	***	***
To residential installers	***	***	***	***	***
To commercial installers	***	***	***	***	***
To utilities or developers	***	***	***	***	***

Note.--Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent.

Source: Compiled from data submitted in response to Commission questionnaires.

Geographic distribution

Most U.S. producers (11 of 14) and importers (39 of 45) reported that there have not been any changes in the U.S. geographical market areas in which CSPV products were sold since February 7, 2018.[12] Firms that reported changes described production expansions and changes in project locations. U.S. producer and importer *** reported that it expanded residential and commercial sales into additional states, U.S. producer and importer *** reported that it expanded through its distributors to California. *** reported that the safeguard measure prompted it to invest in a new manufacturing facility ***, which opened up new geographic markets and generated new sales ***.

Supply and demand considerations

Impact of section 301 tariffs on Chinese-origin products

U.S. producers, importers, and purchasers were asked if the announcement of the section 301 investigation in June 2018 or the subsequent imposition of tariffs on Chinese-origin products had an impact on the U.S. market for CSPV products. Most firms reported that the 301 tariffs did impact the market.[13] As shown in table II-2, however, when asked to elaborate on how the 301 duties impacted demand and supply for CSPV products in the U.S. market, pluralities of responding producers and purchasers reported no change with regards to demand or supply, while a plurality of importers reported no change in demand but a decrease in supply.[14] Among the other firms reporting a change, more reported a decrease in demand and supply as a result of the 301 tariffs than reported an increase.

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[12] U.S. producers and importers reported selling CSPV products to all regions in the contiguous United States in 2017. CSPV 1 first review publication, p. II-5.

[13] Ten of 15 U.S. producers, 21 of 47 importers, and 24 of 41 purchasers reported that the 301 tariff impacted the market, while 1 U.S. producer, 8 importers, and 5 purchasers reported that it did not. The remaining 4 U.S. producers, 18 importers and 12 purchasers reported that they did not know.

[14] Firms were also asked how the 301 duties impacted prices and raw material costs for CSPV products in the U.S. market. As discussed in part VI, majorities of U.S. producers, importers, and purchasers reported that the 301 increased raw material costs, while a majority of purchasers, a plurality of importers, and 4 of 14 U.S. producers reported that it increased overall prices for CSPV products (see table VI-1).

Table II-2
Impact of 301 duties: Firms' responses regarding the impact of the section 301 announcement and duties on Chinese-origin products in the U.S. market, by type of firm

Item	Increase	No change	Decrease	Fluctuate
Impact on overall demand/anticipated demand for CSPV products				
U.S. producers	3	6	5	---
Importers	3	14	10	6
Purchasers	5	16	9	1
Impact on supply/anticipated supply of CSPV products				
U.S. producers	3	7	4	---
Importers	3	12	13	5
Purchasers	6	14	9	1

Source: Compiled from data submitted in response to Commission questionnaires.

Changes in U.S. supply

Table II-3 provides a summary of the supply factors regarding CSPV cells and CSPV modules from U.S. producers, and table II-4 summarizes the supply factors regarding CSPV products from various import sources.

Domestic production

Table II-3
CSPV products: Supply factors that affect U.S. producers' ability to increase shipments to the U.S. market

Item	2016	2017	2018	2016-18	2016-17	2017-18
	Capacity (kilowatts)			Change in capacity (percent)		
Cells	***	***	***	▼***	▼***	▼***
Modules	***	***	***	▼***	▼***	▲***
	Capacity utilization (percent)			Change in capacity utilization (percentage points)		
Cells	***	***	***	▼***	▼***	▼***
Modules	***	***	***	▼***	▼***	▲***
	Inventories as a ratio to total shipments			Change in inventory ratio (percent)		
Cells	***	***	***	▼***	▼***	▼***
Modules	***	***	***	▼***	▼***	▼***

Note: Responding U.S. producers accounted for more than 90 percent of known U.S. capacity to produce CSPV cells and approximately 50 percent of known U.S. capacity to produce CSPV modules during 2018.

Source: Compiled from data submitted in response to Commission questionnaires.

Based on available information, U.S. producers of CSPV cells appear to have the ability to respond to changes in demand with small changes in the quantity of shipments of U.S.-produced CSPV products to the U.S. market. For these producers, the main contributing factors to this degree of responsiveness of supply include decreases in total capacity and production, limited inventories, a limited ability to shift production from alternate products, and a high level of internal consumption for the cells produced. Factors suggesting a greater responsiveness of supply include the availability of unused capacity and the ability to shift shipments from alternate markets. Six U.S. producers[15] reported capacity and production of cells during 2016-18, though no producer reported production of bi-facial cells or production of cells using rear contact fingers. As noted in part I, as of September 30, 2019, there were two firms with domestic production of CSPV cells: Panasonic and Solaria.[16] Overall production of domestic cells decreased by almost 75 percent between 2016 and 2018 and by almost 45 percent when comparing 2017 to 2018. Almost *** percent of U.S.-produced cells were shipped domestically in 2018 (*** percent were exported), and more than three-quarters were internally consumed during January 2016-June 2019.[17] As discussed in part I, five cell manufacturing facilities closed from January 2016 to September 2019.[18] Domestic module producers also reported decreasing quantities of domestically produced cells and increasing quantities of imported cells used in the production of modules during 2016-18.[19]

U.S. producers of CSPV modules have the ability to respond to changes in demand with moderate-to-large changes in the quantity of shipments of U.S.-produced CSPV products to the U.S. market. The main contributing factors to this degree of responsiveness of supply are decreased capacity and capacity utilization since 2016, although both were higher in 2018 than in 2017 and in the first half of 2019 compared to the first half of 2018. Factors mitigating this responsiveness of supply include limited inventories, a limited ability to shift shipments from alternate markets, and a limited ability to shift production from alternate products. Production and capacity both decreased from 2016 to 2018 (by 16.5 and 9.0 percent, respectively), while production increased by 53.8 percent and capacity increased slightly (by 1.9 percent) between

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[15] The U.S. producers reporting cell production data included ***. Solaria did not provide a response to the Commission's questionnaire in this proceeding.

[16] Suniva testified that while it currently does not produce CSPV cells, it would be able to begin production within 100 days after securing funding. Hearing transcript, pp. 87-88, 119-121 (Card); Suniva's posthearing brief, pp. 14-15. As noted in part I, Solaria does not appear to do all the steps in the CSPV cell production process internally.

[17] During 2018, *** percent of U.S. producers' total shipments were commercially shipped in the United States, and *** percent were exported to unrelated firms. During January-June 2019, almost all (*** percent) were consumed by related firms outside the United States (i.e., ***). See table III-6.

[18] See part I, "U.S. developments."

[19] See part III, "Cell content of U.S.-produced modules."

2017 and 2018. Both production and capacity increased in January-June 2019 compared to January-June 2018; U.S. module producers' capacity was 89.3 percent higher in January-June 2019 compared to January-June 2018, and their overall production was 157.5 percent higher. Overall capacity utilization averaged 53.5 percent for the first half of 2019, as production increases outpaced capacity increases.[20] Export shipments of modules decreased from *** percent of U.S. module producers' total shipments in 2016, to *** percent in 2017, to *** percent in 2018. No export shipments were reported by U.S. module producers in January-June 2019.

Imports

Table II-4
CSPV products: Supply factors that affect foreign producers' ability to increase shipments to the U.S. market

	2016	2017	2018	2016-18	2016-17	2017-18
Country	Capacity (kilowatts)			Change in capacity (percent)		
Canada	***	***	***	***	***	***
China	***	***	***	***	***	***
Germany	***	***	***	***	***	***
India	***	***	***	***	***	***
Indonesia	***	***	***	***	***	***
Japan	***	***	***	***	***	***
Korea	***	***	***	***	***	***
Malaysia	***	***	***	***	***	***
Mexico	***	***	***	***	***	***
Philippines	***	***	***	***	***	***
Singapore	***	***	***	***	***	***
Taiwan	***	***	***	***	***	***
Thailand	***	***	***	***	***	***
Turkey	***	***	***	***	***	***
Vietnam	***	***	***	***	***	***
Other	***	***	***	***	***	***
All reporting foreign producers	***	***	***	▲***	▲***	▲***

Table continued on next page.

[20] As noted in part I, as of September 30, 2019, there were about 20 U.S. CSPV module manufacturing plants. See Part I, "U.S. developments" and Tables I-9 and I-10.

Table II-4–Continued
CSPV products: Supply factors that affect foreign producers’ ability to increase shipments to the U.S. market

Country	2016	2017	2018	2016-18	2016-17	2017-18
	Capacity utilization (percent)			Change in capacity utilization (percentage points)		
Canada	***	***	***	***	***	***
China	***	***	***	***	***	***
Germany	***	***	***	***	***	***
India	***	***	***	***	***	***
Indonesia	***	***	***	***	***	***
Japan	***	***	***	***	***	***
Korea	***	***	***	***	***	***
Malaysia	***	***	***	***	***	***
Mexico	***	***	***	***	***	***
Philippines	***	***	***	***	***	***
Singapore	***	***	***	***	***	***
Taiwan	***	***	***	***	***	***
Thailand	***	***	***	***	***	***
Turkey	***	***	***	***	***	***
Vietnam	***	***	***	***	***	***
Other	***	***	***	***	***	***
All reporting foreign producers	***	***	***	▲ ***	▲ ***	▼ ***
	Inventories as a ratio to total shipments			Change in inventory ratio (percent)		
Canada	***	***	***	***	***	***
China	***	***	***	***	***	***
Germany	***	***	***	***	***	***
India	***	***	***	***	***	***
Indonesia	***	***	***	***	***	***
Japan	***	***	***	***	***	***
Korea	***	***	***	***	***	***
Malaysia	***	***	***	***	***	***
Mexico	***	***	***	***	***	***
Philippines	***	***	***	***	***	***
Singapore	***	***	***	***	***	***
Taiwan	***	***	***	***	***	***
Thailand	***	***	***	***	***	***
Turkey	***	***	***	***	***	***
Vietnam	***	***	***	***	***	***
Other	***	***	***	***	***	***
All reporting foreign producers	***	***	***	▲ ***	▼ ***	▲ ***

Note.--Responding foreign producer/exporter firms accounted for the following estimated shares of module capacity in their respective countries in 2018: Canada-89 percent; China-17 percent; Germany-*** percent; India-*** percent; Indonesia-*** percent; Japan-*** percent; Korea-*** percent; Malaysia-85 percent; Mexico-*** percent; Philippines-*** percent; Singapore-100 percent; Taiwan-*** percent; Thailand-*** percent; and Vietnam-*** percent. Two additional firms provided data on their operations – one from *** and the other from ***. No foreign producer from Turkey provided data on their operations. For additional data on the number of responding firms and their share of capacity from each country, please refer to appendix F.

Source: Compiled from data submitted in response to Commission questionnaires.

Based on available information, producers of CSPV products from the countries listed in table II-4 have the ability to respond to changes in demand with large changes in the quantity of shipments of CSPV products to the U.S. market. The main contributing factors to this degree of responsiveness of supply are large and growing global capacity, some availability of inventories, and the ability to shift shipments from alternate markets to the United States. Factors mitigating this degree of responsiveness of supply include limited ability to shift production from alternate products, growing global demand for CSPV products, and the existence of import measures such as the antidumping and countervailing (AD/CVD) duties on CSPV products from China.

As discussed in part I, global PV cell production (including out-of-scope thin film) increased from 77 GW in 2016 to 104 GW in 2017 to 116 GW in 2018.[21] PV module production (including out-of-scope thin film) increased from 78 GW in 2016 to 105 GW in 2017 to 116 GW in 2018. China is by far the largest producer and exporter of CSPV cells and modules, accounting for 74 percent of cell production and 73 percent of module production in 2018, up from 66 percent and 69 percent, respectively, in 2016. As noted in part I, imports of CSPV products from China are subject to antidumping and countervailing duty rates of 14.78 percent to 249.96 percent.[22] Reported capacity among other major producers of CSPV products, including Korea, Malaysia, Taiwan, and Thailand, all grew over the period, and all reported larger capacities than the United States. Foreign producers in China, India, Indonesia, Korea, Malaysia, Mexico, Taiwan, Thailand, and Vietnam all reported increasing their capacity between 2016 and 2018, and almost all of these countries plus Canada, the Philippines, and Singapore reported increasing their capacity between 2017 and 2018.[23] Among all responding foreign producers, capacity increased by 56.4 percent when comparing 2016 to 2018 and by 25.0 percent when comparing 2017 to 2018. Capacity utilization rates among these countries ranged from 29.3 percent (***) to 96.4 percent (***) and capacity utilization among all responding foreign producers averaged 86.6 percent in 2018, an increase of 0.2 percentage points compared to 2016 but a decrease of 4.3 percentage points compared to 2017. The ratio of inventories to total shipments among the responding foreign producers decreased from 5.5 percent in 2016 to 4.4 percent in 2017 before increasing to 7.2 percent in 2018. The total ending inventories among responding foreign producers was nearly three times the total

[21] See part I, "Global production."
[22] See part I, "Previous and related investigations."
[23] Indonesia reported the same capacity in 2017 and 2018.

reported capacity among responding domestic producers in 2018. None of the responding foreign producers reported being able to switch production to or from alternative products.

Availability of product types

Most responding firms (9 of 15 U.S. producers, 23 of 32 importers, and 14 of 19 purchasers) reported no change in the availability of U.S. produced cells in the U.S. market since February 7, 2018. All responding firms reported, however, that domestically manufactured cells were either unavailable, in short supply, or that the supply had decreased since February 7, 2018. One firm, ***, reported that "there are rumors of domestic suppliers coming online in 2020."[24]

Most U.S. producers (10 of 12 firms) and purchasers (33 of 40 firms) reported that the availability of U.S. produced CSPV modules in the U.S. market has changed since February 7, 2018, while most importers (27 of 39 firms) reported that it has not. Most of the firms reporting a change in the availability of U.S. modules cited an increase in the number of domestic module assemblers and/or a ramping up of existing production facilities.[25] Some firms noted that much of the additional domestic production has been installed by foreign-owned firms. However, a few purchasers reported that the increase in domestic module production has had a limited effect on availability, and that significant amounts of domestic production has already been promised through 2020. A few purchasers also stated that domestic demand still exceeds domestic capacity. *** reported that while the supply of

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[24] Suniva stated that it "continues to work toward restarting CSPV cell production," and that it and other CSPV producers need the continued economic incentive provided by the safeguard to ramp up their U.S. production and employment, maintain the associated research and development, and ensure grid reliability. Suniva's prehearing brief, pp. 2, 9, 37-39.

Hanwha, SunPower, Mission, Auxin, and SolarTech indicated in their prehearing brief that "there has been some minor expansion since 2018 to improve manufacturers' ability to integrate production… {but that} the volume of cells produced domestically is nowhere near the amount necessary to accommodate the growth in the U.S. module industry." The Coalition's prehearing brief, p. 9. Similarly, LG argues that "of the minute U.S. CSPV cell production that does exist, essentially none of it is available on the merchant market," which will "very soon create real hardships to U.S. module manufacturers." LG's prehearing brief, pp. 17-25.

[25] Suniva reported that "along with increased investment and increased employment, reported assembly of CSPV modules has nearly ***, with domestic assembly of over *** kilowatts projected for 2019." Suniva's prehearing brief, p. 4. In their prehearing brief, Hanwha, SunPower, Mission, Auxin, and SolarTech stated that Hanwha is "actively participating" in all segments of the market, including the utility segment, and quoted a draft report from the National Renewable Energy Laboratory ("NREL") indicating that "{t}he largest fraction of capacity (28%), from Hanwha Q Cells and Jinko Solar, prioritizes utility markets." The Coalition's prehearing brief, pp. 11-12, 47-48, Exhibit 3.

U.S. assembled modules started to increase in 2019, it does not provide a meaningful volume or appropriate product types for the utility market.[26]

Regarding the availability of imported cells in the U.S. market, half of U.S. producers and most importers (20 of 31 firms) reported no change since February 7, 2018, while most purchasers (13 of 18 firms) reported that there has been a change. Most firms reporting a change indicated that there has been in increase in the quantity of imported cells. Some firms pointed to the increase in the use of imported cells in the production of domestic modules as a driving factor, while others pointed to an increase in global capacity, particularly in Asian countries.[27] Several firms (including ***[28]) noted that they expect the quota on imported cells to be exceeded by 2020, while purchaser *** suggested that the current quantities are insufficient to meet growing demand. Only one importer (***) reported that the quantity of imported cells has decreased, stating that cells produced in Thailand, Malaysia, and Vietnam were exported to countries other than the United States after the safeguard was implemented. Two importers (***) reported that there has been a shift in sourcing of cells away from China since the safeguard was put in place, and one U.S. producer stated that imported cells became more expensive.

Regarding the availability of imported modules in the U.S. market since February 7, 2018, most importers (23 of 38 firms) reported no change, while most U.S. producers (6 of 11) and purchasers (30 of 40) reported that there has been a change. Most of the firms reporting a change reported an increase in imported modules despite the (in some cases multiple) tariffs on imported CSPV modules.[29] Several purchasers stated that imported modules are in short

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[26] Respondents SEIA and REC Americas argue that several utility scale developers, including ***, reported difficultly in procuring domestically manufactured modules for their utility-scale development projects, and that domestic production does not meet the needs of the utility sector. SEIA and REC Americas prehearing brief, pp. 19-21, 35-45; SEIA and REC Americas posthearing brief, pp. 8-10, Answers to Questions, pp. 39-44. SEIA and REC Americas note that even the domestic industry admits to being unable to meet domestic demand. SEIA and REC Americas posthearing brief, Answers to Questions, pp. 39-44. See also Hearing transcript, pp. 150-152 (Moskowitz, Gurley), 168 (Lynch).

[27] See also part I, “Global production.”

[28] See ***; Hanwha, Mission, Auxin, and SolarTech’s posthearing brief, pp. 12-14.

[29] SEIA and REC Americas argue that NREL and the International Energy Agency (“IEA”) estimate that global capacity and demand will both increase notably through 2022, and that this will put a strain on global supply throughout the safeguard period. Others, including First Solar, Suniva, and 1366 Technologies (the sole domestic silicon wafer manufacturer), argue that there is “chronic global

(*continued*...)

supply due to high demand and the stepdown of incentives like the investment tax credit on December 31, 2019.[30] Some firms reported that imports of Chinese modules have decreased due to tariffs, with other firms indicating that the tariffs have shifted demand toward producers in Southeast Asia, India, and Turkey. *** elaborated that imports from Chinese-owned factories in Thailand and Vietnam "have likely increased."

Purchasers were also asked if certain wattages, types, technologies, or sizes of CSPV products were available from only certain country sources. Most responding purchasers (23 of 40) reported that they were not. Among the 17 purchasers reporting that they were, most commented that bifacial modules are either not available or in short supply from domestic producers. A few firms also reported that higher efficiency and/or higher wattage modules are generally more available outside the United States, primarily from Asia.

Supply constraints

U.S. producers were asked if they had refused, declined, or been unable to supply CSPV products since February 7, 2018. Most U.S. producers (9 of 14) reported that they had not, while five reported that they had. *** reported that one supplier delivered less than originally promised due to a drop in their imports after the safeguard measure was imposed, and that overseas suppliers have "diverted more products away from the U.S. market" due to the measure. *** reported that demand exceeded supply in 2019 for both U.S. and imported CSPV products, and that it had to refuse some new customers in order to fulfill orders with its existing customer base. *** also reported that demand for its product sometimes outpaces its ability to increase production capacity. *** reported that while its market share and customer base increased along with demand, it has declined some orders in fear of the cell quota being exceeded. *** stated that while it has not

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overcapacity" and "global module oversupply," which First Solar argues is driving the domestic industry to feel "intense pressure from low-priced imports." Suniva, quoting a Forbes article, predicts a decline in Chinese home market solar demand "and expects double-digit declines in the global prices of solar modules as a result." SEIA and REC America's prehearing brief, pp. 46-47; First Solar's prehearing brief, pp. 2, 8-13; Suniva's prehearing brief, pp. 15-16; and 1366 Technologies' posthearing brief generally.

[30] The Internal Revenue Service ("IRS") currently grants income tax credits of 30 percent for residential, commercial, and utility-scale solar project owners. This rate is set to reduce to 26 percent in 2020, 22 percent in 2021, and 10 percent for commercial and utility-scale project owners with no reduced taxes for owners of residential solar projects in 2022. In June 2018, the IRS created a legal method to freeze the 30 percent credit for future projects, provided certain conditions are met, through a process informally known as the solar safe harbor agreement. See https://www.irs.gov/pub/irs-drop/n-18-59.pdf, retrieved November 1, 2019.

experienced any supply constraints so far, it anticipates constraints in 2020 and beyond when it expects the quota on cells to be exceeded due to a shortage of domestic cells. *** reported experiencing purchasing and investment constraints.

Purchasers were also asked if any firm had refused, declined, or been unable to supply them with CSPV products since February 7, 2018. In contrast to U.S. producers' responses, most purchasers (28 of 42 responding firms) reported that they had; the other 14 reported that they had not. Several firms reported high demand that has exceeded supply, with some stating that many manufacturers are "booked" through 2019 and 2020. Others noted that supply shortages have begun fairly recently, as of 2019. One firm commented that while all sectors have experienced shortages, such shortages are felt most heavily in the utility sector. Several firms also opined that current high demand and supply shortages are informed by the timing of the income tax credit reduction on December 31, 2019 and/or the next tariff reduction on cells and modules in February 2020.[31] One firm reported that some suppliers of imported CSPV products have declined to supply the market or supplied reduced quantities due to uncertainty about their costs after implementation of the safeguard measure. ***, for example, stated that manufacturers "would often prefer to divert modules to other countries because they do not want to absorb any of the U.S. tariff." Another firm stated that certain models are not available domestically, but did not elaborate.

Changes in U.S. demand

During the safeguard investigation, the Commission found that demand for CSPV products is derived from the demand for solar electricity, which is influenced by factors such as cost competitiveness with traditional energy sources, environmental concerns, a desire for national energy independence, total energy consumption, and the availability of Federal, state, and local incentives.[32]

Electricity demand in the United States remains supplied primarily by conventional sources, with coal and natural gas accounting for nearly two-thirds of all electricity generated. However, the share of electricity generated from renewable energy sources has been steadily increasing. Renewable energy sectors[33] (excluding hydroelectric) accounted for 8.8 percent of electricity generated in the United States in 2016, 10.2 percent in 2017, 10.6 percent in 2018,

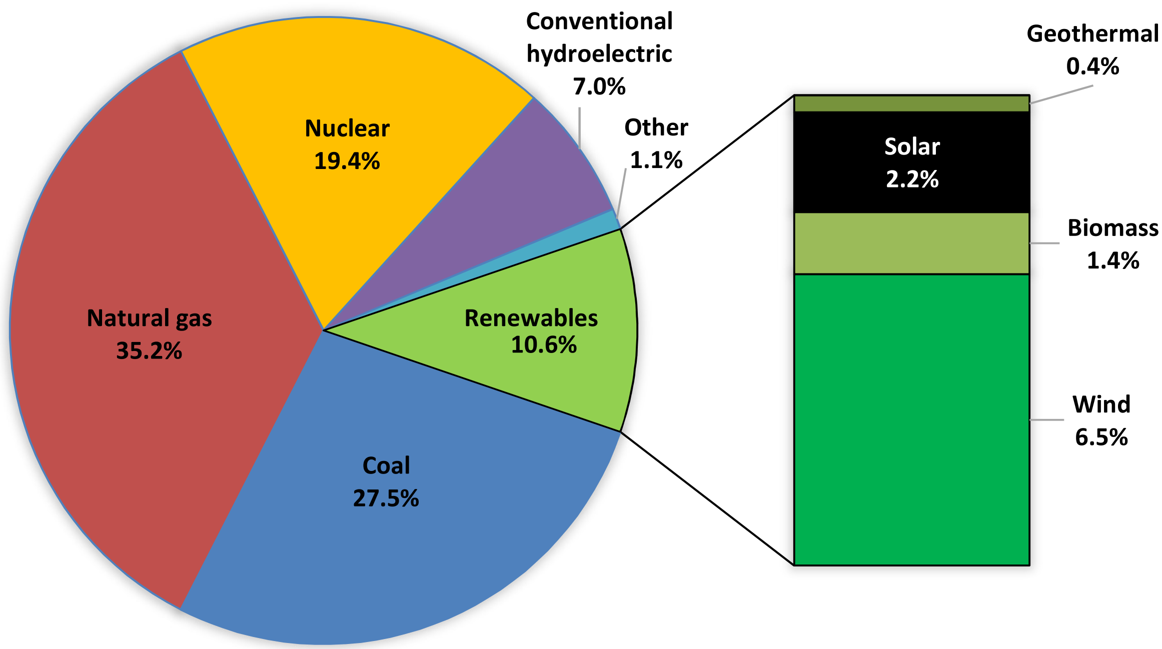
[31] As noted earlier in this section, the duty rate for over quota cells and modules is 25 percent until February 6, 2020. It is set to drop to 20 percent beginning February 7, 2020 through February 6, 2021.

[32] Safeguard publication, vol. I, p. 32.

[33] Renewable energy as described here is comprised of wind, solar, biomass, and geothermal.

and 11.7 percent during January-August 2019 (figures II-2a and II-2b).[34] Among renewables, the share of solar energy (including utility-scale solar and small-scale solar) has increased as well; it accounted for 1.3 percent of total generated electricity in 2016, 1.9 percent in 2017, 2.2 percent in 2018, and 2.8 percent during January-August 2019. While solar generated electricity is one of the smallest sectors, its yearly average output grew by 40.8 percent from 2016 to 2017 and by 20.8 percent between 2017 and 2018.[35] According to industry reports, investments in solar capacity grew steadily during 2012-16, with only investments in natural gas capacity overtaking solar investments since 2017 (figure II-3).

Figure II-2a
Net U.S. electricity generation, by sector, 2018



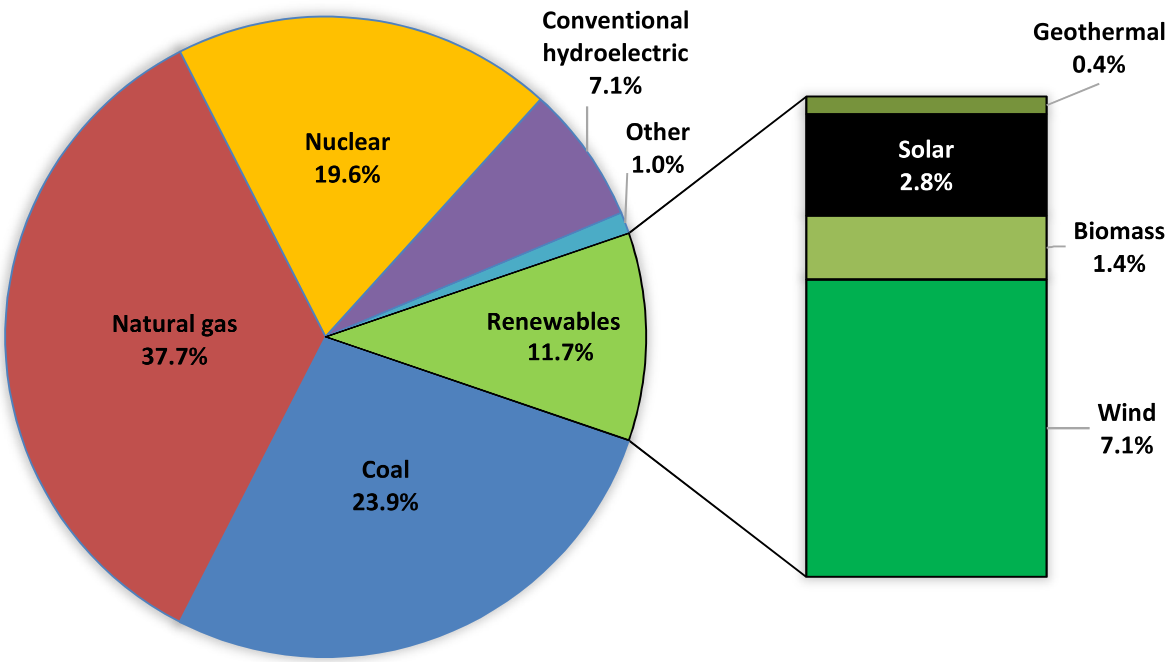
Source: U.S. EIA, http://www.eia.gov/electricity/data/browser/, retrieved December 13, 2019.

[34] U.S. Energy Information Administration website, *Electricity Data Browser*, available at http://www.eia.gov/electricity/data/browser/, retrieved December 13, 2019.

[35] Utility-scale solar generation grew by approximately 77 percent during this time, while small-scale solar generation grew by 57 percent.

The Utility Scale Solar Coalition argues that the utility market is more sensitive (elastic) when panel (module) prices change, and that the utility market has been impacted more negatively than the residential market by the safeguard measure. See Utility Scale Solar Coalition's prehearing brief generally.

Figure II-2b
Net U.S. electricity generation, by sector, January-August 2019



Source: U.S. Energy Information Association, http://www.eia.gov/electricity/data/browser/, retrieved December 13, 2019.

Figure II-3
Energy investments: New U.S. electricity generating capacity additions, 2010-2018, January-August 2019

* * * * * * *

Source: Wood Mackenzie Power Renewables and the Solar Energy Industries Association ("SEIA"), U.S. Solar Market Insight: Q4 2019, Executive Summary, p. 6.

Demand trends

In the original safeguard investigation, the vast majority of firms reported that U.S. demand for CSPV products increased during January 2012-June 2017 due to a reduction in CSPV system prices; Federal, state, and local incentive programs; and a general interest in renewable energy.[36] In the current proceeding, majorities or pluralities of firms also reported that U.S. demand for CSPV products increased since February 7, 2018 and that future demand for CSPV products will continue to increase (table II-5a).[37]

Table II-5a
CSPV products: Firms' responses regarding U.S. demand since February 7, 2018 and anticipated future U.S. demand, by market segment and by type of firm

Item	Increase	No change	Decrease	Fluctuate
Demand since February 7, 2018				
Residential				
U.S. producers	12	1	---	1
Importers	18	4	6	8
Purchasers	15	4	3	2
Commercial				
U.S. producers	6	3	4	1
Importers	12	5	9	10
Purchasers	15	4	7	2
Utility				
U.S. producers	10	2	2	---
Importers	15	3	10	9
Purchasers	23	5	3	2
Anticipated future demand				
Residential				
U.S. producers	11	1	1	1
Importers	22	6	1	7
Purchasers	18	4	---	2
Commercial				
U.S. producers	10	1	1	2
Importers	19	6	2	9
Purchasers	20	3	1	3
Utility				
U.S. producers	8	2	1	2
Importers	20	4	3	10
Purchasers	25	5	1	2

Source: Compiled from data submitted in response to Commission questionnaires.

[36] Safeguard publication, vol. II, p. V-11.

[37] See also Hearing transcript, pp. 200 (O'Sullivan), 217 (Arndt), 286 (Hopper); First Solar posthearing brief, p. 4; LG posthearing brief, pp. 8-9.

Firms generally credited the increase in demand in the residential sector to declining prices, decreasing costs, improved financing for projects, new market openings, the investment tax credit, and the safe harbor law.[38] In explaining increased demand in the commercial and utility sectors, firms pointed to the same general factors, as well as corporate green energy initiatives, improved technology and efficiency, and other pro-solar (and other renewable energy) policies on the state and federal level. For firms that reported a decrease in demand, most referenced the implementation of the safeguard measure and subsequent price increases as the reasons. One firm (***) also cited the expiration of state-level incentives in California, Massachusetts, and Minnesota as a reason, while another (***) cited increased input costs due the 301 tariffs as a reason.

Regarding demand outside the United States, the large majority of firms reported that demand for CSPV products increased since February 7, 2018 and anticipated that it will continue to do so in the future (table II-5b).

Table II-5b
CSPV products: Firms' responses regarding demand outside the United States since February 7, 2018 and anticipated future demand outside the United States, by type of firm

Item	Increase	No change	Decrease	Fluctuate
Demand since February 7, 2018				
U.S. producers	12	1	---	---
Importers	21	4	---	7
Purchasers	21	2	3	2
Anticipated future demand				
U.S. producers	12	1	---	---
Importers	21	3	1	7
Purchasers	23	2	1	2

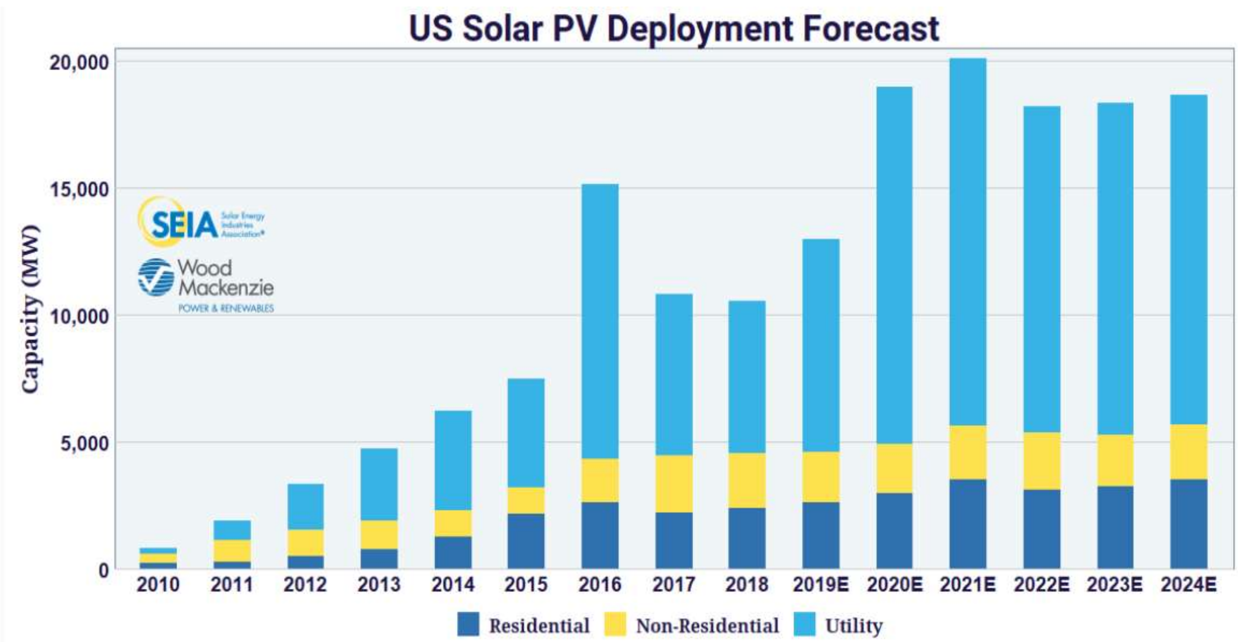
Source: Compiled from data submitted in response to Commission questionnaires.

According to the Solar Energy Industries Association ("SEIA"), the residential, non-residential, and utility markets have all grown in terms of new installations since 2010. Between 2016 and 2018, however, only the non-residential market grew and between 2017 and 2018 only the residential market grew (figure II-4a).[39] The residential market is less than one-third

[38] See also Hearing transcript, pp. 177-178 (Moskowitz).
[39] SEIA and REC Americas argue that apparent consumption in the first half of 2018 is understated relative to demand due in part to a stockpiling of imports in the second half of 2017. SEIA and REC Americas posthearing brief, Answers to Questions, pp. 18-21.

the size of the utility sector (figures II-4a and II-4b).[40] [41] Residential and utility PV installations are forecasted to grow each year between 2018 and 2021, with "{t}he utility-scale market accounting for nearly two-thirds of the total solar market in each of the next few years, led by corporate procurement, increasing renewable portfolio standards, and pure price competitiveness."[42] SEIA anticipates that "over the next five years, total installed solar capacity will more than double, with cumulative deployment topping 100GW by 2021."[43]

Figure II-4a
U.S. PV installation forecast: Total, 2010-2018 actual, and 2019-2024 expected



Source: SEIA/Wood McKenzie, Solar Market Insight, and SEIA, *Solar Industry Research Data*, available at https://www.seia.org/solar-industry-research-data, accessed December 17, 2019.

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[40] There were 2.4 GW of new installations in the residential market in 2018 (up from 2017 by 7 percent), while there were 2.1 GW of new installations in the non-residential market (down by 8 percent from 2017) and 6.2 GW of new installations in the utility sector (down by 3 percent from 2017). Wood Mackenzie Power Renewables and SEIA, U.S. Solar Market Insight: Q3 2019, Executive Summary, p. 16.

[41] SEIA and REC Americas argue that prior to the initiation of the safeguard investigation in 2017, the U.S. solar industry had 16 consecutive years of growth, and that the decline in total installations since 2016 is a direct result of the safeguard investigation. SEIA and REC America's prehearing brief, pp. 7-11, Appendix A, Appendix B.

[42] SEIA website, Solar Industry Research Data, available at https://www.seia.org/solar-industry-research-data, accessed December 17, 2019. See also TECRO's prehearing brief, p. 4.

[43] See also TECRO's prehearing brief, p. 4.

Figure II-4b
U.S. PV installation forecast: Shares by market segment, 2010-2018 actual, 2019-2024 expected

Source: Wood Mackenzie Power Renewables and SEIA, U.S. Solar Market Insight: Q4 2019, Executive Summary, p. 17.

Business cycles

The U.S. market for CSPV products is subject to business cycles, such as seasonally higher demand in warmer months and at calendar year end to finish projects to qualify for various incentive programs for tax accounting purposes.[44] When asked if there had been any change in the business cycles or conditions of competition for CSPV products since February 7, 2018, most U.S. producers (11 of 13 firms) and purchasers (28 of 41 firms) reported that there have been changes, while most importers (26 of 43 firms) reported that there have not.

For the firms reporting changes, several stated that domestic CSPV products are in higher demand, with some reporting a decrease in the competitiveness of foreign modules. One U.S. producer/importer reported an increase in demand in the residential sector but a decrease in demand in utility and commercial sectors. Importer *** noted a shift in demand to high efficiency mono-PERC products, while others reported improved technology and efficiency more generally. Several firms noted an increase in domestic production generally,

[44] Safeguard publication, vol. I, p. 25.

reporting that more suppliers were in the U.S. market and prices were lower. Several firms also reported an increase in competition between domestic producers. One firm (***) reported that domestic prices decreased in the immediate months following the USTR announcement of a bifacial module exclusion to the safeguard measure.[45] One U.S. producer/importer also noted that as the tariff rate for imported CSPV products drops, the price of imports will drop, while another firm (***) stated that Indian modules have been "quite competitive." Importer *** stated that CSPV cell and module production capacity worldwide continues to increase and outstrip demand.

Other firms (although fewer in number) reported that the domestic industry has experienced consolidation or downsizing. One firm also pointed out that material costs have increased due to the combination of the 201, 232, and 301 tariffs, while another (purchaser ***) reported that "projects involving CSPV have become more difficult" as tariffs on CSPV products, aluminum, steel, and other materials have increased installation costs. Purchaser *** stated that some Chinese suppliers ration their supply to the United States in order to avoid paying both AD/CVD and safeguard tariffs. Two importers (***) stated that market prices had increased due to a lack of low-priced Chinese product and general supply shortage. Importer *** stated that there has been a surge of "safe harbor" purchases due to the stepdown of the Solar Investment Tax Credit, which has contributed to this shortage. *** added that it and other firms have established module assembly operations in order to meet demand, but that since most facilities depend on imported cells, the current quota of 2.5 GW may not be sufficiently high for the period starting February 2020.

Changes in purchasing patterns

As discussed in part I, more firms reported purchases of imported CSPV products than domestic CSPV products. Among the 16 responding firms that reported changes in domestic purchases, five firms each reported increased or constant purchases and three firms each reported decreased or fluctuating purchases since February 7, 2018 (table II-6). Among the 36 firms that reported their purchasing patterns for imports, a plurality (17 firms) reported constant purchases since February 7, 2018. Nine firms reported an increase in import purchases, six reported a decrease, and four reported fluctuating purchases of imports.

[45] As discussed in part I and earlier in this section, USTR granted an exclusion to the safeguard measure for bifacial solar panels in June 2019. It announced the withdrawal of this exclusion in October 2019, but is preliminarily enjoined from doing so by court order until entry of final judgment in *Invenergy Renewable LLC v. United States*, Ct. No. 19-00192.

Table II-6
CSPV products: Changes in purchase patterns from U.S. and import sources since February 7, 2018

Purchase source	Did not purchase	Decreased	Increased	Constant	Fluctuated
United States	27	3	5	5	3
Imports	5	6	9	17	4

Source: Compiled from data submitted in response to Commission questionnaires

For the firms that increased their domestic purchases, firms generally cited an increase in the availability of domestic modules, with one firm specifically citing the opening of the Hanwha facility in Dalton, Georgia, currently the largest producer of domestic modules. One of these firms also commented, however, that domestic modules have only recently become available in more than a limited supply, and another reported that domestic manufacturers have largely been unable to meet volume and product requirements. One purchaser also commented that domestic modules rarely contain domestically manufactured cells. For the firms that reported decreasing their domestic purchases, all three responding firms cited a decrease in availability, with one firm stating that it lost a “key USA brand” and that there is “no viable {domestic} equipment,” another firm reporting less domestic supply generally, and another stating that “many suppliers left the business.” One firm also stated that domestic CSPV products commanded a higher price.

For the firms that reported an increase in purchases of imports, firms generally cited growth in demand, growth in supply, and growth in a particular firm’s business as the reasons. One purchaser (***) also reported that it added suppliers due to market-wide shortages, while another stated that there was a lack of domestic suppliers, and another stated that most available capacity remains overseas. Of the firms that reported decreasing their import purchases, all three elaborating firms cited the implementation of the safeguard measure as the reason. One firm stated that suppliers of imported product responded by adding the tariff and additional costs or a risk premium to their module pricing, dramatically increasing the overall price. Another firm stated that since China and other Asian suppliers produce most of the global supply of CSPV products they are better able to offer emerging products such as half-cut PERC and bifacial modules “right away,” but that the safeguard measure suppressed that firm’s demand for these products. The third firm stated that it delayed projects due to dampened demand for utility scale energy caused by the safeguard measure, and that this resulted in a change in its business model. Whereas this firm (***) previously purchased and installed modules, it now develops solar projects and then sells those projects prior to module purchase and construction. It stated that this business model is generally reflective of the solar development industry's current approach.

While most responding purchasers (24 of 41) indicated that they had not changed suppliers since February 7, 2018, 17 purchasers reported that they had. Most of these firms reported adding suppliers, and named Longi (2 firms), as well as Adani, Boviet, Hanwha, JA solar, Mission, Peimar, Phono Solar, URE, XYS Glass (Malaysia), and Yingli (1 firm each) as new suppliers. Among these firms, two of them – Mission and Hanwha – currently produce modules in the United States. One firm (***) elaborated that due to the uncertainty created by the safeguard measure, many suppliers decreased their supply and increased prices, creating the need for supplier diversification. This firm stated that several of its suppliers (including ***) moved their U.S. supply from utility scale to support commercial and residential markets, which paid higher prices than the utility scale market.

Bankability

In the solar industry, bankability refers to "whether projects using the solar products are likely to be offered non-recourse debt financing by banks."[46] BloombergNEF has developed a tiering system for PV module makers based on bankability ***. BloombergNEF bases its ranking criteria on ***. Table II-5 shows the BloombergNEF's tier 1 rankings.

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[46] ***.

Figure II-5
Tier 1 module maker list: BloombergNEF's PV module maker Tier 1 list, as of 3Q 2019

*　　　*　　　*　　　*　　　*　　　*　　　*

Source: BloombergNEF Tier 1 PV Module Maker List, 3Q 2019, August 27, 2019.

BloombergNEF also conducts a survey among "***." Figure II-6 shows the results received ***.

Figure II-6
Bankability survey results: BloombergNEF's PV module bankability results, 2019

* * * * * * *

Source: BloombergNEF Module & Inverter Bankability, July 29, 2019.

Purchasers were asked whether the role of bankability in their or their customers' purchasing decisions have changed since February 7, 2018. The vast majority of responding firms (37 of 41) reported that it has not. Among the four firms reporting that it had, one reported that it had to obtain pricing from manufacturers with less favorable financials/credit worthiness, another reported that adding new suppliers with unknown bankability required considerable time working with them and the U.S. financing lenders, and another added that it is a key factor in deciding new vendors. One purchaser also reported that it was able to convince its banking partners of the quality of a module from a new supplier. ***.[47]

Incentive programs and regulations

Various incentive programs and regulations exist to help solar electricity reach price parity with traditional energy sources, thereby stimulating demand for solar-generated electricity. These incentives include federal and state tax credits, revenues from the sale of solar renewable energy certificates ("SRECs"), cash grants in lieu of tax credits, accelerated depreciation, loan guarantees, and state-based incentives, among others.[48] These fiscal incentives and regulatory measures are designed to benefit system owners, and typically are not directed at any particular domestic or foreign manufacturer of CSPV products.

Tax credits are the most common form of Federal fiscal incentive. Several types of tax credits, which have been modified and extended at various times, have affected the timing of the development of solar projects. As noted earlier in this section, the Solar Investment Tax Credit is a 30 percent tax credit on capital expenditures for new solar PV systems, and has been in place since 2006. To receive a tax credit of 30 percent, these projects must have started construction by the end of 2019, as the value of the credit decreased to 26 percent for projects starting construction in 2020 and will decrease to 22 percent for projects starting construction in 2021. Projects must be completed by December 31, 2023 to receive the tax credits. After 2021 the credit for residential systems will drop to zero while commercial and utility credits will decrease to a permanent 10 percent.[49]

Firms were asked how changes in the level or availability of federal, state, and local government incentives have affected the demand for CSPV products since February 7, 2018. On the federal level, most U.S. producers, importers, and purchasers indicated that changes in

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47 ***.

48 For a discussion of changes to federal and state incentive policies, see part I, "U.S. policies."

49 See "Supply shortages" earlier in this section; see also SEIA, "Solar Investment Tax Credit," http://www.seia.org/policy/finance-tax/solar-investment-tax-credit, retrieved September 16, 2019.

incentives had either no effect on demand or increased demand for CSPV products (table II-7). On the state and local level, responses were more mixed, but most firms reported that demand for CSPV products either didn't change or fluctuated in response to changes in state and local incentives. A plurality of U.S. producers (4 of 13 firms) and the second-largest number of purchasers (11 of 38 firms) reported that demand for CSPV products increased as a result of changes in state or local incentives. Relatively few firms reported that demand for CSPV products decreased in response to changes in state and local incentives.

Table II-7
CSPV products: Firms' responses regarding how changes in the availability of government incentives have affected the demand for CSPV products since February 7, 2018

Item	Increase	No change	Decrease	Fluctuated
Federal government incentives				
U.S. producers	4	5	2	2
Importers	10	12	5	9
Purchasers	18	21	---	2
State and local government incentives				
U.S. producers	4	3	3	3
Importers	5	12	4	14
Purchasers	11	17	4	6

Source: Compiled from data submitted in response to Commission questionnaires

Almost all responding firms highlighted the investment tax credit and impending stepdown on December 31, 2019 as the predominant federal incentive in influencing demand for CSPV products. Most of these firms reported that the tax credit increased demand and fueled equity investments. Others noted that the spike in demand created by the tax credit and safe harbor law created a tight supply, as earlier movers receive a higher credit. One purchaser also mentioned federal bonus depreciation benefits as a factor increasing demand for CSPV products.[50] Some firms suggested that the upcoming stepdown may decrease some demand, although more firms opined that the stepdown would not substantially dampen demand.

[50] The Modified Accelerated Cost Recovery System ("MACRS"), established in 1986, is a "method of depreciation in which a business' investments in certain tangible property are recovered, for tax purposes, over a specified time period through annual deductions. Qualifying solar energy equipment is eligible for a cost recovery period of five years. The market certainty provided by MACRS has been found to be a significant driver of private investment for the solar industry and other energy industries… In response to the economic downturn of 2008, Congress took action to further incentivize capital investment by accelerating the depreciation schedule economy-wide." See SEIA website, *Depreciation of*
(*continued*...)

Firms reported increases or potential increases in the renewable energy portfolio standards of several states, including California, Colorado, Connecticut, Illinois, Massachusetts, Maryland, Maine, North Carolina, Nebraska, New Jersey, New Mexico, Nevada, New York, Texas, Virginia, and Washington. As mentioned in part I, 29 states plus the District of Columbia had renewable portfolio standards in both 2016 and 2019, and several states increased the share of electricity that must come from renewable sources.[51] California's Solar Roof Mandate, in particular, was noted by several firms as a driver of increased demand.[52] Other firms mentioned state tax rebates or exemptions (sales tax, property tax), property assessed clean energy ("PACE") financing, and net metering, while one firm indicated that some major U.S. cities have adopted 100 percent renewable targets.

Other sources of electricity

The demand for CSPV products is derived from the demand for solar electricity. Purchasers can use energy and electricity from a wide variety of sources, ranging from traditional fossil fuels to various forms of renewable energy (including wind, solar, geothermal, and biomass). Electricity providers using renewable energy sources seek to achieve "grid parity" (the point at which the levelized cost of electricity ("LCOE") generated from renewable sources equals the cost from the grid of electricity generated by conventional sources).[53] The LCOE

Solar Energy Property in MACRS, available at https://www.seia.org/initiatives/depreciation-solar-energy-property-macrs, retrieved November 12, 2019.

[51] The amount of renewable generated electricity required in 2030 increased from 431 TWh under requirements in place as of 2016 to 450 TWh under requirements in place as of 2017 to 600 TWh under requirements in place as of 2019. See part I, "U.S. policies."

[52] Starting in 2020, solar power is required for all new residential buildings in California, with certain exceptions. See Part I, "U.S. policies," and New York Times, *California Will Require Solar Power for New Homes*, available at https://www.nytimes.com/2018/05/09/business/energy-environment/california-solar-power.html, retrieved November 12, 2019.

[53] The LCOE represents the per-kW hour cost of building and operating a generating plant over an assumed financial life. Key inputs to calculating LCOE include capital costs, fuel costs, fixed and variable operations and maintenance ("O&M") costs, financing costs, and an assumed utilization rate for each plant type. However, plant owners or investors who finance plants may also value portfolio diversification due to the uncertainty of future fuel prices and future policies. U.S. Energy Information Administration ("EIA"), "Levelized Cost and Levelized Avoided Cost of New Generation Resources in the *Annual Energy Outlook 2019*," February 2019, available at https://www.eia.gov/outlooks/aeo/electricity_generation.php, retrieved November 12, 2019.

varies by region, time of day, and availability of other electricity sources.[54] [55] During periods of non-peak electricity demand in the United States, only lowest-cost generators would be able to sell electricity to the grid, whereas during periods of peak electricity demand, even generators with somewhat higher costs may be able to sell electricity into the transmission or distribution grid. For peak periods, natural-gas generated electricity generally sets the LCOE that CSPV products and other renewable systems must seek to meet, especially for sales to the utility segment.[56] [57]

The EIA estimates the average LCOE for electricity-generating plants entering service in the future. As shown in table II-8, the estimated LCOE for new combined-cycle gas plants ranged from $45.20/MWh to $49.30/MWh in 2019 and from $40.20/MWh to $42.80/MWh in 2023. When tax credits were included, new onshore wind installations had the lowest estimated LCOE for both 2019 and 2023, at $34.50/MWh and $36.60/MWh, respectively. For solar PV installations, the total estimated subsidized LCOE was $53.10 in 2019 and $37.60 in 2023. The difference between the estimated total system LCOE compared to total system LCOE including tax subsidies for new solar PV installations was 24.3 percent in 2019 and 23.0 percent in 2023.

[54] CSPV 2 original publication, p. II-21.

[55] SEIA and REC Americas argue that geographic and market segment variations are critical variables in understanding the LCOE and the solar industry's ability to achieve grid parity in a given area. They argue that the approach traditionally employed by the Commission in estimating elasticities (the Armington approach) "is an inadequate policy tool as it cannot capture critical location-specific and segment-specific demand considerations," and submitted an economic analysis disaggregating these and other variables. See SEIA and REC America's prehearing brief, pp. 12-16, Appendix B; SEIA and REC America's posthearing brief, Explanation of Methodology, Exhibit 1, generally.

[56] CSPV 1 original publication, pp. 21-22.

[57] The Utility Scale Solar Coalition reports that the LCOE of utility-scale solar has declined by 88 percent since 2009, driven primarily by the decrease in the cost of CSPV products. Utility Scale Solar Coalition's prehearing brief, pp. 10-11.

Table II-8
Estimated levelized cost of electricity: U.S. capacity-weighted average LCOE for new generation sources entering service in 2019 and in 2023

	Total System LCOE	Total LCOE including Tax Credits	Total System LCOE	Total LCOE including Tax Credits
	Entering service in 2019 (2016 $/MWh)		Entering service in 2023 (2018 $/MWh)	
Natural gas-fired:				
Conventional combined cycle	49.30	49.30	42.80	42.80
Advanced combined cycle	45.20	45.20	40.20	40.20
Conventional combustion turbine	92.70	92.70	---	---
Advanced combustion turbine	78.30	78.30	77.50	77.50
Wind, onshore	52.40	34.50	42.80	36.60
Solar PV	70.10	53.10	48.80	37.60
Solar thermal	158.90	122.10	---	---

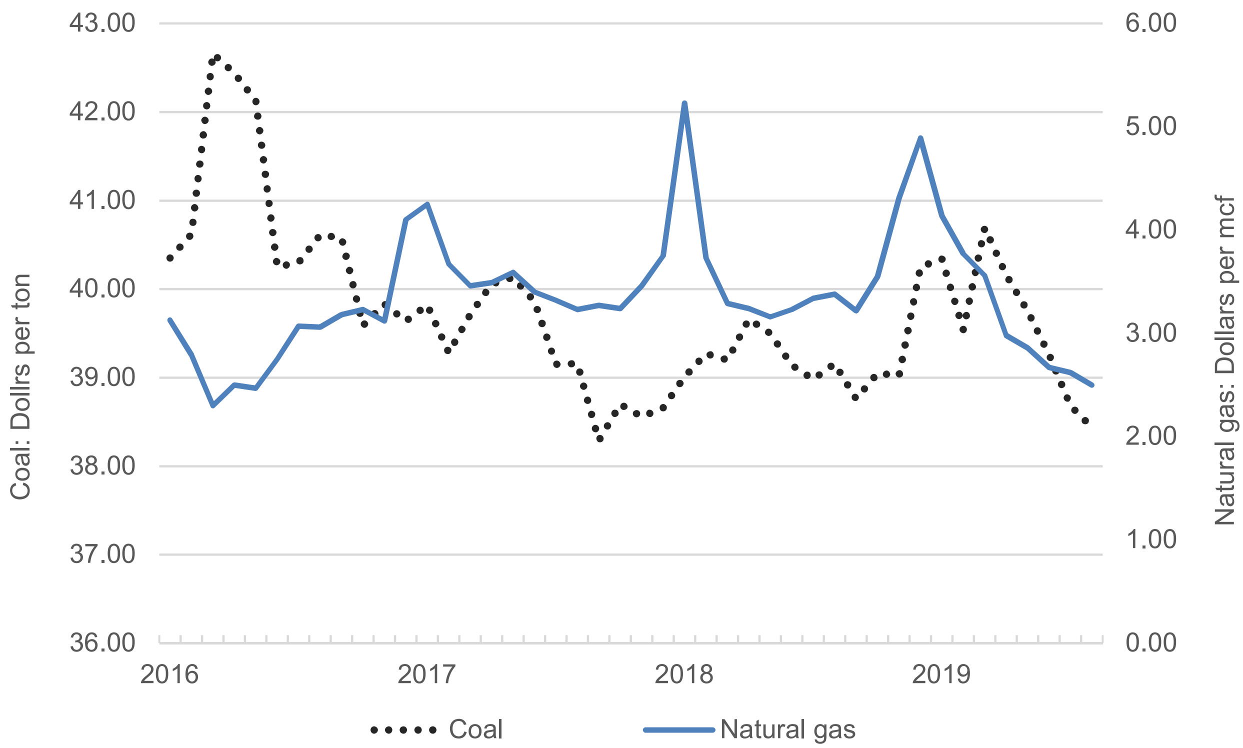
Note: The capacity-weighted average is the average levelized cost per technology, weighted by the new capacity coming online in each region. The capacity additions for each region are based on additions in 2017-2019.

Note: Levelized cost with tax credits reflects tax credits available for plants entering service in 2019 and in 2023. Not all technologies have tax credits available.

Sources: U.S. Energy Information Administration, Annual Energy Outlook 2017 and Annual Energy Outlook 2019.

As shown in figure II-7, the general price trends of coal and natural gas used for electricity generation has fluctuated since 2016, with natural gas showing greater price fluctuations by percent. The average cost of coal fluctuated by a maximum of 10.2 percent during January 2016-August 2019, while the average cost of natural gas fluctuated 56.0 percent during this time. The prices of both fuel sources have fallen consistently since December 2018 (for coal) and March 2019 (for natural gas).

Figure II-7
Coal and natural gas: Average cost of coal and natural gas for electricity generation for all sectors, monthly, January 2016-August 2019



Source: U.S. Energy Information Administration, http://www.eia.gov/electricity/data/browser/, retrieved November 12, 2019.

Part III: U.S. producers' production, shipments, and employment

Overview

In the safeguard investigation on CSPV products, the Commission defined the domestic industry as all U.S. producers of CSPV cells (whether or not partially or fully assembled into other products), including integrated producers of CSPV cells and modules and independent module producers.[1] The information in this section of the report was compiled from responses to the Commission's domestic producers' questionnaire submitted by 17 firms that are estimated to have accounted for more than 90 percent of known U.S. capacity to produce CSPV cells in 2018 and nearly three-fourths of such capacity in the first half of 2019, as well as approximately 50 percent of known U.S. capacity to produce CSPV modules during 2018 and almost three-fourths of such CSPV module capacity during the first half of 2019.[2] The list of responding domestic producers, each company's position on the safeguard measures, production locations, and share of reported production during 2018 is presented in Part I of this report at "U.S. market participants." Seven of the currently largest U.S. CSPV cell and module producers are profiled below.

[1] Safeguard publication, vol. I, p. 18. In the safeguard investigation, the Commission defined a single domestic product corresponding to the imported products within the scope of the investigation that includes CSPV cells and CSPV modules. Safeguard publication, vol. I, p. 16. The term "domestic industry" is defined in section 202(c)(6)(A)(i) of the Trade Act, 19 U.S.C. § 2252(c)(6)(A)(i), as "the domestic producers as a whole of the like or directly competitive article or those producers whose collective production of the like or directly competitive article constitutes a major proportion of the total domestic production of such article."

[2] Estimates are based on a comparison of U.S. producers' reported capacity to produce CSPV cells and modules during 2018 (*** (cells) and *** (modules)) and the first six months of 2019 (*** (cells) and *** (modules)) with the total estimated U.S. capacity to produce cells and modules during 2018 (*** (cells) and *** (modules)) and the first six months of 2019 (*** (cells) and *** (modules)), as calculated by Commission staff using publicly available capacity estimates for known non-responding U.S. producers.

U.S. producer profiles[3]

Hanwha Q CELLS USA, Inc.

Hanwha Q CELLS USA, Inc. ("Hanwha"), located in Dalton, Georgia, is a wholly owned subsidiary of its ultimate parent company based in Korea, Hanwha Chemical Corporation. Reported to be the largest facility of its kind in the Western Hemisphere with an expected annual module production capacity of 1.7 GW and employing around 700 workers, Hanwha began production at its $157 million CSPV module assembly plant in Dalton, Georgia in February 2019.[4] Hanwha assembles modules at its Georgia facility for residential, commercial, and utility markets using cells *** that are manufactured using proprietary Q.ANTUM mono-PERC technology. Hanwha is an importer of cells *** and is related to U.S. importers *** and leading foreign producers of CSPV cells and modules in China, Korea, and Malaysia.

JinkoSolar (U.S.) Industries Inc.

JinkoSolar (U.S.) Industries Inc. ("JinkoSolar"), located in Jacksonville, Florida, is a wholly owned subsidiary of its ultimate parent company based in China, JinkoSolar Holding Co., Ltd. JinkoSolar began commercial production of mono-PERC modules early in 2019 at its new $50.5 million Jacksonville facility. JinkoSolar's new site, with an expected 400 MW of annual production capacity, produces 60-cell (for residential) and 72-cell (for industrial and utilities) mono-PERC modules. The Jacksonville facility, which employs approximately 200 workers, assembles CSPV panels from solar cells produced by its related producer in Malaysia.[5] JinkoSolar is an importer of cells and modules from Malaysia and is related to a U.S. importer *** and leading foreign producers of CSPV cells and modules in China and Malaysia.

[3] Historical information in this section is derived from CSPV 1 first review publication, pp. III-8 – III-11, with updates added from information collected in this proceeding.

[4] In its questionnaire response in this monitoring proceeding, Hanwha reported CSPV module capacity at ***, production at ***, and employment at *** workers during January-June 2019.

[5] In its questionnaire response in this monitoring proceeding, JinkoSolar reported CSPV module capacity at ***, production at ***, and employment at *** workers during January-June 2019.

LG Electronics U.S.A., Inc.

LG Electronics U.S.A., Inc. ("LG"), located in Huntsville, Alabama, is a wholly owned subsidiary of its parent corporation based in Korea, LG Electronics Inc. LG began commercial production of high-performance n-type solar modules for the *** markets in February 2019 at its new $*** Huntsville facility. LG's new site, with an expected 500 MW of annual production capacity, currently employs approximately *** employees.[6] An importer of both cells and modules from Korea, LG is related to a foreign producer of CSPV cells and modules in Korea.

Mission Solar Energy

Mission Solar Energy ("Mission Solar") is headquartered in San Antonio, Texas, and is a fully owned subsidiary of OCI Solar Power.[7] Mission Solar produced n-type monocrystalline (including bifacial) CSPV solar cells and assembled modules with mono and mono-PERC cells in both 60-cell and 72-cell formats for residential, commercial, and utility markets. The company opened its manufacturing plant in San Antonio, Texas, in 2014. In September 2016, however, Mission Solar closed its n-type mono PV cell production lines. Following the closure of cell production, Mission Solar has continued module assembly with CSPV cells imported from Asia (***). Mission Solar's module assembly facility in Texas has an annual capacity to produce *** CSPV modules and employs approximately *** workers.

Suniva, Inc.

Suniva, Inc. ("Suniva"), one of the petitioners in the original Safeguard proceeding, is headquartered in Norcross, Georgia, and produced mono (including PERC) CSPV cells and CSPV modules until April 2017. Suniva was founded in 2007 as a producer of CSPV cells based on the work of the Georgia Institute of Technology's University Center of Excellence in Photovoltaics. In 2015, Shungfeng International Clean Energy (China) acquired approximately 63 percent of Suniva. Suniva started CSPV cell production in Norcross, Georgia, in November 2008 with capacity of 32 MW and, by 2016, Suniva had expanded the capacity to produce CSPV cells at its

[6] In its questionnaire response in this monitoring proceeding, LG reported CSPV module capacity at ***, production at ***, and employment at *** workers during January-June 2019.

[7] OCI Solar Power is a subsidiary of OCI Enterprises, the North American subsidiary of OCI Company, Ltd. (Korea). Mission Solar was formerly known as Nexolon America when it was a joint venture of OCI Solar Power and Texas-based CPS Energy.

Norcross facility to 450 MW. Suniva also opened a CSPV module assembly facility in Saginaw, Michigan in 2015 with the capacity to produce *** of CSPV modules. Since Suniva's capacity to produce CSPV cells (450 MW) was ***.[8]

In April 2017, Suniva filed for bankruptcy protection and production ceased at both its U.S. cell and module manufacturing operations. ***. In April 2019, Suniva successfully completed a reorganization and exited bankruptcy with a court-approved restructuring plan. The company is now under new U.S. ownership (Granite Holdings I, LLC c/o Lion Point Capital) ***. The company stated that it would require an investment of less than $10 million and would take 100 days to restart production once it obtains the necessary capital investment. The restarted company would have 450 MW of monofacial PERC cell capacity or 540 MW of bifacial PERC capacity.[9]

SunPower Manufacturing Oregon LLC (formerly SolarWorld Americas Inc.)

SolarWorld Americas Inc. ("SolarWorld"), headquartered in Hillsboro, Oregon, produced *** CSPV cells and CSPV modules. SolarWorld's Hillsboro, Oregon plant opened in 2008 with operations dedicated to growing crystals and producing wafers and CSPV cells. In 2010, SolarWorld added 350 MW of CSPV module production to become the first fully integrated monocrystalline plant in the Americas.[10] By 2017, SolarWorld reported nameplate production capacity of *** for CSPV modules and *** for CSPV cells.

[8] In its questionnaire response in this monitoring proceeding, Suniva reported annual 2016 CSPV cell and module capacity at ***, production at ***, and employment at *** workers, respectively. During 2017, Suniva's CSPV cell and module capacity was ***, production was ***, and employment was *** workers, respectively.

[9] Hearing transcript, pp. 88-90 (Card).

[10] An additional 150 MW of module capacity was in place at its now-closed Camarillo plant, for a total of 500 MW.

On October 1, 2018, SunPower Corporation announced that it completed its acquisition of certain assets of SolarWorld, including its U.S. manufacturing plant in Hillsboro. SunPower Corporation created SunPower Manufacturing Oregon LLC (“SunPower”) to hold and manage the Hillsboro assets and related operations. It subsequently transitioned the U.S. production facility to produce SunPower’s “P-Series” products, although it continued to produce SolarWorld products during the transition period.[11] Specifically, ***. By the beginning of 2019, SunPower had retired the Hillsboro facility’s CSPV cell line and had upgraded half of the module assembly facility to produce SunPower's proprietary “P Series” modules based on monocrystalline silicon cells.[12] In May 2019, SunPower announced that it would seek to sell the former SolarWorld factory and then lease back a portion of the factory from the new owners to continue assembly of its P-Series modules.[13] Currently, the Hillsboro facility focuses entirely on module assembly – ***.[14] On November 11, 2019, SunPower announced that it plans to spin off its high-efficiency cell and module production into a new company, Maxeon Solar, in partnership with Chinese wafer maker Tainjin Zhonghouan Semiconductor (“TZS”). Maxeon Solar will be headquartered in Singapore and will be launched as a publicly traded company on the NASDAQ after the closing of the split. SunPower will retain the P-Series module factory in Hillsboro, Oregon.[15]

[11] SunPower, “SunPower Begins a New Chapter in American Solar Manufacturing,” News release, October 1, 2018, http://newsroom.sunpower.com/2018-10-01-SunPower-Begins-A-New-Chapter-in-American-Solar-Manufacturing, retrieved December 18, 2018.

[12] SunPower “P Series” modules are shingled modules requiring specialized production equipment ***.

[13] Roselund, Christian, “SunPower is selling the former SolarWorld factory in Oregon,” PV Magazine, May 17, 2019, https://pv-magazine-usa.com/2019/05/17/sunpower-is-selling-the-former-solarworld-factory-in-oregon/, retrieved November 2, 2019.

[14] In addition, SunPower ***.

[15] Roselun, Christian, “SunPower splits in two,” PV magazine, November 11, 2019, https://pv-magazine-usa.com/2019/11/11/sunpower-splits-in-two/, retrieved November 12, 2019.

During January-June 2019, SunPower produced *** of CSPV modules and employed *** workers. SunPower's predecessor (SolarWorld) reported U.S. imports ***. SunPower is a U.S. importer of *** and is also related to U.S. importers *** and leading foreign producers of CSPV products in ***.

Tesla, Inc./Panasonic Solar North America

Tesla, Inc. ("Tesla") is a U.S. producer of electric vehicles and alternative energy solutions, such as solar modules and battery-powered back-up storage units. Tesla has a factory in Buffalo, New York to produce ***. Tesla has a build-to-suit lease arrangement with the Research Foundation for the State University of New York (Foundation).[16] As part of this arrangement, the Foundation constructed the solar cell and panel manufacturing facility and will own the facility and any manufacturing equipment purchased by the Foundation. Tesla will lease the manufacturing facility and equipment for an initial 10-year period, with an option to renew.[17] Tesla initially produced cells and modules at a Fremont, California facility, which opened in 2014.[18]

In December 2016, Tesla entered into an agreement with Panasonic Solar North America ("Panasonic") to manufacture CSPV cells and modules at the Buffalo, New York plant while Tesla managed factory operations and produced solar roof tiles.[19] Panasonic in Buffalo, which was established in ***. During January-June 2019, Panasonic ***

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[16] As part of this arrangement Tesla is required to meet certain operational milestones during the 10-year lease period, including meeting employment level requirements and spending or incurring $5 billion in capital, operational expenses, and other costs in New York State. Failure to meet these requirements would lead to a $41.2 million "program payment" to the Foundation for each year that Tesla failed to meet the specified milestones.

[17] Tesla will pay the Foundation $2.00 annually plus utilities for the lease of the plant.

[18] Tesla acquired SolarCity in 2016, which was working at its location in Fremont, California, to develop higher efficiency cells and modules in-house through its subsidiary, Silevo, which it had acquired in 2014. Tesla began moving production from its initial Fremont, California plant to Buffalo, New York during the fourth quarter of 2017 and currently ***.

[19] In 2017, Tesla announced a new product, SolarRoof, which are tiles that incorporate solar cells.

of CSPV cells and *** of CSPV modules with a reported annual production capacity of *** for cells and *** for modules. With regard to its production of solar roof tiles, Tesla began "volume production" in 2019, with *** produced during January-June 2019. Tesla launched a new version of its solar roof tiles in October 2019, and indicated that it would ramp up to producing 1,000 solar roofs per week over the next few months.[20] Tesla is a U.S. importer of *** and Panasonic is a U.S. importer of *** and is related to a foreign producer of ***.

Developments in the U.S. CSPV products industry

Since January 1, 2016, there have been several developments affecting the U.S. CSPV products industry. Producer entries and exits from the U.S. industry were presented in Part I (see section entitled "U.S. developments"). In January 2018, the President imposed the safeguard measure, effective February 7, 2018, adding product exclusions from the measure in September 2018 and June 2019 and withdrawing a product exclusion in October 2019.[21] In March 2019, Commerce continued the antidumping and countervailing duty orders on CSPV cells and modules from China, and on January 2, 2020, the Commission instituted its first five-year reviews on the antidumping and countervailing duty orders on CSPV cells and modules from China and Taiwan. As discussed in greater detail in Part I, Part II, Part VI, and appendix E, tariffs covering material inputs have been implemented following investigations under Section 232 and Section 301.

In this safeguard monitoring proceeding, domestic producers were asked to indicate whether their firm had experienced any plant openings, relocations, expansions, acquisitions, consolidations, closures, or prolonged shutdowns because of strikes or equipment failure; curtailment of production because of shortages of materials or other reasons, including revision of labor agreements; or any other change in the character of their operations or organization

[20] Lambert, Fred, "Tesla Launches Solarglass (Solar Roof V3) Starting at $33,950 for Average Home," electrek, October 25, 2019, https://electrek.co/2019/10/25/tesla-solarglass-solar-roof-v3-price/, retrieved November 3, 2019; Kolodny, Lora, "Tesla Releases a New Version of Solar Roof Tiles, Aiming to Revitalize its Clean Energy Business," CNBC, October 25, 2019, https://www.cnbc.com/2019/10/25/tesla-releases-solar-roof-tiles-v-3.html, retrieved November 3, 2019.

[21] By court order, however, USTR and Customs are preliminarily enjoined from withdrawing the exclusion until entry of final judgment in *Invenergy Renewables LLC v. United States*, Ct. No. 19-00192.

relating to the production of CSPV products since January 1, 2016. The domestic producers' responses are presented in table III-1.

Table III-1
CSPV products: U.S. producers' reported changes in operations, since January 1, 2016

Item / Firm	Reported changes in operations
Plant openings:	
***	***
***	***
***	***
***	***
***	***
***	***
***	***
***	***
Plant closings:	
***	***
***	***
***	***
***	***
Relocations:	
***	***
Expansions:	
***	***
***	***
Acquisitions:	
***	***
***	***
***	***

Table continued on next page.

Table III-1--Continued
CSPV products: U.S. producers' reported changes in operations, since January 1, 2016

Item / Firm	Reported changes in operations
Prolonged shutdowns or curtailments:	
***	***
***	***
***	***
***	***
Technology:	
***	***
***	***
***	***
Other:	
***	***
***	***

Source: Compiled from data submitted in response to Commission questionnaires.

U.S. production, capacity, and capacity utilization

CSPV cells

U.S. CSPV cell capacity, production, and capacity utilization

Table III-2 and figure III-1 present U.S. cell producers' production, capacity, and capacity utilization. Seven U.S. firms reported usable capacity and production data for CSPV cells in this proceeding for the period January 2016-June 2019.[22] However, with several CSPV cell production facility closures, by 2019, only one firm (Panasonic) reported production of CSPV cells, the majority of which were ***.[23] The largest responding U.S. producers of CSPV cells during 2016-17 were *** and the largest U.S. cell producer during 2018 was ***.

Total U.S. cell capacity fell from *** in 2016 to *** in 2017 and further to *** in 2018. Total U.S. cell capacity was only *** during January-June 2019 compared with *** during January-June 2018 as all reporting U.S. cell producers but Panasonic ceased CSPV cell production in the United States (see table III-1 for details).

Reported data show that total U.S. production of CSPV cells declined by *** percent from *** in 2016 to *** in 2017 and declined further by *** percent to *** in 2018. Total U.S. production of CSPV cells was *** percent lower at *** in January-June 2019 than in the comparable period in 2018. Average capacity utilization of responding domestic CSPV cell producers likewise declined from *** percent in 2016 to

[22] In the Commission's 2017 Section 201 investigation on CSPV products, producer questionnaire responses containing usable data were received from four firms (Mission, SolarWorld, Suniva, and Tesla) that were believed to have accounted for all known U.S. cell production during 2015. Safeguard publication, vol. II, p. I-4 and table III-4. Mission and SolarWorld closed their production facilities in 2016 and 2019 respectively. Tesla and Suniva ceased CSPV cell manufacturing in 2017.

[23] Solaria reportedly has CSPV cell production in the United States but does not appear to do all production steps in the cell manufacturing process in-house. Solaria did not respond to the Commission's questionnaire in this proceeding. Solaria, "Solaria PowerXT Residential," Product Specifications, May 23, 2018, https://www.solarcrowdsource.com/wp-content/uploads/2019/05/PowerXT-360R-PD-Specs.pdf, retrieved October 18, 2019; Solaria Webpage, https://www.solaria.com/technology-1, retrieved October 18, 2019; Weaver, John Fitzgerald, "Back in Black – California Solar Manufacturer Delivers a Handsome 19.4% Efficient Panel," *electrek*, January 11, 2018, https://electrek.co/2018/01/11/california-solar-panel-manufacturer-handsome-19-4-efficient-panel/, retrieved October 18, 2019.

*** percent in 2017 and to *** percent in 2018, but was higher at *** percent during January-June 2019 compared with *** percent during January-June 2018.[24]

Table III-2
CSPV cells: U.S. producers' capacity, production, and capacity utilization, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Capacity (kilowatts)				
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
Suniva	***	***	***	***	***
SunPower (pre-acquisition) SolarWorld	***	***	***	***	***
SunPower (post-acquisition)	***	***	***	***	***
Tesla	***	***	***	***	***
Yingli	***	***	***	***	***
Total capacity	***	***	***	***	***
	Production (kilowatts)				
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
Suniva	***	***	***	***	***
SunPower (pre-acquisition) SolarWorld	***	***	***	***	***
SunPower (post-acquisition)	***	***	***	***	***
Tesla	***	***	***	***	***
Yingli	***	***	***	***	***
Total production	***	***	***	***	***
	Capacity utilization (percent)				
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
Suniva	***	***	***	***	***
SunPower (pre-acquisition) SolarWorld	***	***	***	***	***
SunPower (post-acquisition)	***	***	***	***	***
Tesla	***	***	***	***	***
Yingli	***	***	***	***	***
Average capacity utilization	***	***	***	***	***

Note.--Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent.

Source: Compiled from data submitted in response to Commission questionnaires.

[24] Panasonic reported that it projects its 2020 annual cell production to be ***. Email from ***, December 13, 2019. Suniva reported that it will have the capacity to produce 450 MW of monofacial cells or 540 MW of bifacial cells annually upon the restart of production. Hearing transcript, p. 90 (Card).

Figure III-1
CSPV cells: U.S. producers' capacity, production, and capacity utilization, 2016-18, January to June 2018, and January to June 2019

* * * * * * *

Source: Compiled from data submitted in response to Commission questionnaires.

U.S. producers' CSPV cell technology

Four U.S. cell manufacturers reported using PERC technology, three reported using multicrystalline cell technology, two reported monocrystalline cell technology, and one reported production using HIT technology (table III-3). No U.S. cell producers reported the production of bifacial or hybrid CSPV cells since January 1, 2016.

Table III-3
CSPV products: U.S. producers' reported ability to supply specific technologies since January 1, 2016

Firm	Firms' reported cell technologies					
	Mono	Multi	PERC	HIT	Bifacial	Hybrid
Mission	***	***	***	***	***	***
Panasonic	***	***	***	***	***	***
Suniva	***	***	***	***	***	***
SunPower (post-acquisition)	***	***	***	***	***	***
SunPower (pre-acquisition) SolarWorld	***	***	***	***	***	***
Tesla	***	***	***	***	***	***
Yingli	***	***	***	***	***	***
Total	2	3	4	1	0	0

Source: Compiled from data submitted in response to Commission questionnaires.

CSPV modules

U.S. CSPV module capacity, production, and capacity utilization

Table III-4 and figure III-2 present U.S. module producers' production, capacity, and capacity utilization. Sixteen U.S. firms reported usable capacity and production data for CSPV modules in this proceeding.[25] The largest responding U.S. assemblers of CSPV modules during 2018 were ***, accounting for ***, ***, and *** percent of reported U.S. module assembly, respectively, during 2018 (see part I, table I-11). Reported data show that total U.S. capacity to assemble CSPV modules decreased from *** in 2016 to *** in 2017 before increasing to *** in 2018, as (1) Suniva closed its module assembly operations in Saginaw, Michigan; (2) SolarWorld transitioned to its acquisition by SunPower; and (3) Tesla moved its module production from its Fremont, California facility to the production of SolarRoof at its Buffalo, New York location. However, total U.S. capacity to assemble CSPV modules was *** percent higher at *** in January-June 2019 compared with *** in January-June 2018, as Hanwha, Jinko, and LG opened new CSPV module manufacturing facilities in the United States. Production of CSPV modules declined by *** percent from *** in 2016 to *** in 2017, but increased by *** percent to *** in 2018. Total U.S. module production was *** percent higher during January-June 2019 than in the comparable period in 2018. Average capacity utilization of responding domestic CSPV module producers likewise declined from *** percent in 2016 to *** percent in 2017, increased to *** percent in 2018, and was higher at *** percent during January-June 2019 compared with *** percent during January-June 2018.[26]

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[25] In the Commission's 2017 Section 201 investigation on CSPV products, certain data of 16 U.S. module producers (Itek, Kyocera, Mission, Motech, SBM, Seraphim, Sharp, Silicon, Solaria, SolarTech, SolarWorld, Suniva, Sunstream, TenKSolar, Tesla, and Wanxiang) that were believed to have accounted for 63.9 percent of all known U.S. module production during 2015 were presented in the Commission's report. Safeguard publication, vol. II, p. I-4 and table III-7.

[26] Firms also provided their projections for annual 2020 production and capacity as follows: Auxin (*** of production and *** of capacity); Hanwha (*** of production and *** of capacity); Heliene (*** of production and *** of capacity); Jinko (*** of production and *** of capacity); LG (*** of production and *** of capacity); Mission (*** of production and *** of capacity); Panasonic (*** of production); Silfab (*** of production and *** of capacity); SunPower (*** of production and *** of capacity); and Tesla (*** of production and *** of capacity). Hanwha's, Mission's, and Auxin's posthearing brief, exh. 1, p. 22; Heliene's, Silfab's, and Canadian Solar's posthearing brief, exh. 1, p. 11; LG's posthearing brief, p. 2; Mission's posthearing brief, p. 1; SunPower's posthearing brief, tab 1, question 2; email from ***, December 13, 2019; email from ***, December 17, 2019; and email from ***, December 18, 2019.

In addition to the 16 firms that provided questionnaire responses, there are 7 additional plants with known commercial module production, the largest of which are Sunergy California and SunSpark Technology (see part I, table I-12). Combined annual 2019 capacity at these 7 additional plants is 960 MW.

Table III-4
CSPV modules: U.S. producers' capacity, production, and capacity utilization, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Capacity (kilowatts)				
Auxin	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
SBM	***	***	***	***	***
Silfab	***	***	***	***	***
SolarTech Universal	***	***	***	***	***
Suniva	***	***	***	***	***
SunPower (post-acquisition)	***	***	***	***	***
SunPower (pre-acquisition) SolarWorld	***	***	***	***	***
Tesla	***	***	***	***	***
Total capacity	***	***	***	***	***
	Production (kilowatts)				
Auxin	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
SBM	***	***	***	***	***
Silfab	***	***	***	***	***
SolarTech Universal	***	***	***	***	***
Suniva	***	***	***	***	***
SunPower (post-acquisition)	***	***	***	***	***
SunPower (pre-acquisition) SolarWorld	***	***	***	***	***
Tesla	***	***	***	***	***
Total production	***	***	***	***	***

Table continued on next page.

Table III-4--Continued
CSPV modules: U.S. producers' capacity, production, and capacity utilization, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Capacity utilization (percent)				
Auxin	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
SBM	***	***	***	***	***
Silfab	***	***	***	***	***
SolarTech Universal	***	***	***	***	***
Suniva	***	***	***	***	***
SunPower (post-acquisition)	***	***	***	***	***
SunPower (pre-acquisition) SolarWorld	***	***	***	***	***
Tesla	***	***	***	***	***
Average capacity utilization	***	***	***	***	***

Note.--Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent. From mid-2016, Silicon Energy produced modules at its Minnesota plant for Heliene. Following the closure of Silicon Energy's plant in 2017, Heliene took over the lease and began manufacturing its modules in Minnesota. Heliene did not report the production and capacity of Silicon Energy in its response. Jinko began test production in 2018 and ramped to full commercial production in early 2019.

Source: Compiled from data submitted in response to Commission questionnaires.

Figure III-2
CSPV modules: U.S. producers' capacity, production, and capacity utilization, 2016-18, January to June 2018, and January to June 2019

*   *   *   *   *   *   *

Source: Compiled from data submitted in response to Commission questionnaires.

Cell content of U.S.-produced modules

The Commission requested that domestic CSPV module producers provide data concerning the source of the CSPV cells from which their modules were produced. These data show that during January 2016 to June 2019, the domestic cell content for U.S.-produced modules declined from *** percent in 2016 to *** percent in 2017 and declined further to *** percent in 2018. During January-June 2019, there were only *** of U.S.-produced cells used in the U.S. production of modules, resulting in *** percent of U.S.-produced modules containing cells produced outside the United States (table III-5).

Table III-5
CSPV modules: U.S. producers' module assembly by source of CSPV cell, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Production (kilowatts)				
Module production using.-- Internally produced cells	***	***	***	***	***
Purchased domestic cells	***	***	***	***	***
Purchased imported cells	***	***	***	***	***
Cells from all origins	***	***	***	***	***
	Share of production (percent)				
Module production using.-- Internally produced cells	***	***	***	***	***
Purchased domestic cells	***	***	***	***	***
Purchased imported cells	***	***	***	***	***
Cells from all origins	100.0	100.0	100.0	100.0	100.0

Note.--Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent.

Source: Compiled from data submitted in response to Commission questionnaires.

U.S. producers' shipments

CSPV cells

Following the same general downward trend as U.S. producers' CSPV cell production, the quantity of U.S. producers' total CSPV cell shipments declined by *** percent from 2016 to 2018 (*** percent decline from 2016 to 2017 and *** percent decline from 2017 to 2018), and was *** percent lower in January-June 2019 than in January-June 2018 (table III-6). The unit value of total U.S. shipments likewise consistently declined from a high of $*** per kW reported in 2016 to $*** per kW reported in 2017 to a low of $*** per kW reported in 2018, but was higher at $*** per KW during the first six months of 2019. Most (***

percent in 2018) of the U.S. producers' shipments of CSPV cells were internally consumed in the United States during 2016-18; however, almost all (*** percent) were consumed by related firms outside the United States (i.e., ***) during January-June 2019. Relatively few CSPV cells produced in the United States were sold commercially. During 2018, *** percent of U.S. producers' total shipments were commercially shipped in the United States and *** percent were exported to unrelated firms.

Table III-6
CSPV cells: U.S. producers' U.S. shipments, export shipments, and total shipments, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Quantity (kilowatts)				
Commercial U.S. shipments	***	***	***	***	***
Internal consumption	***	***	***	***	***
U.S. shipments	***	***	***	***	***
Exports to related firms	***	***	***	***	***
Exports to unrelated firms	***	***	***	***	***
Export shipments	***	***	***	***	***
Total shipments	***	***	***	***	***
	Value (1,000 dollars)				
Commercial U.S. shipments	***	***	***	***	***
Internal consumption	***	***	***	***	***
U.S. shipments	***	***	***	***	***
Exports to related firms	***	***	***	***	***
Exports to unrelated firms	***	***	***	***	***
Export shipments	***	***	***	***	***
Total shipments	***	***	***	***	***
	Unit value (dollars per kilowatt)				
Commercial U.S. shipments	***	***	***	***	***
Internal consumption	***	***	***	***	***
U.S. shipments	***	***	***	***	***
Exports to related firms	***	***	***	***	***
Exports to unrelated firms	***	***	***	***	***
Export shipments	***	***	***	***	***
Total shipments	***	***	***	***	***

Table continued on next page.

Table III-6--Continued
CSPV cells: U.S. producers' U.S. shipments, export shipments, and total shipments, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Share of quantity (percent)				
Commercial U.S. shipments	***	***	***	***	***
Internal consumption	***	***	***	***	***
U.S. shipments	***	***	***	***	***
Exports to related firms	***	***	***	***	***
Exports to unrelated firms	***	***	***	***	***
Export shipments	***	***	***	***	***
Total shipments	100.0	100.0	100.0	100.0	100.0
	Share of value (percent)				
Commercial U.S. shipments	***	***	***	***	***
Internal consumption	***	***	***	***	***
U.S. shipments	***	***	***	***	***
Exports to related firms	***	***	***	***	***
Exports to unrelated firms	***	***	***	***	***
Export shipments	***	***	***	***	***
Total shipments	100.0	100.0	100.0	100.0	100.0

Note.--Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent.

Source: Compiled from data submitted in response to Commission questionnaires.

CSPV modules

Table III-7 presents U.S. module producers' U.S. shipments, export shipments, and total shipments. The total shipment quantity of CSPV modules assembled in the United States declined from *** in 2016 to *** in 2017, largely driven by (1) SunPower's transition during its acquisition of SolarWorld; (2) Suniva's closure of its module assembly operations in Saginaw, Michigan; and (3) Mission's ***. The total shipment quantity of CSPV modules assembled in the United States increased from *** in 2017 to *** in 2018 (a level *** percent lower than reported in 2016 (***)), as (1) Panasonic began mass module production at its in Buffalo, New York facility in ***; and (2) Mission ***. The total shipment quantity of CSPV modules assembled in the United States was *** percent higher at *** during January-June 2019 than in the comparable period of 2018, largely driven by the February 2019 opening of the Hanwha CSPV module assembly plant in Dalton, Georgia. Other U.S. CSPV module producers that opened and/or reported increased shipments of modules during the first six months of 2019 include LG, Silfab, Jinko, Panasonic, and Heliene. The value of total module shipments followed the same general trend as quantity, although with a different scale, as the average unit value of total shipments decreased from a high of $*** per kW reported in 2016 to a low of $*** per kW reported in January-June 2019.

Table III-7
CSPV modules: U.S. producers' U.S. shipments, export shipments, and total shipments, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Quantity (kilowatts)				
Commercial U.S. shipments	***	***	***	***	***
Internal consumption	***	***	***	***	***
Transfers to related firms	***	***	***	***	***
U.S. shipments	***	***	***	***	***
Exports to related firms	***	***	***	***	***
Exports to unrelated firms	***	***	***	***	***
Export shipments	***	***	***	***	***
Total shipments	***	***	***	***	***
	Value (1,000 dollars)				
Commercial U.S. shipments	***	***	***	***	***
Internal consumption	***	***	***	***	***
Transfers to related firms	***	***	***	***	***
U.S. shipments	***	***	***	***	***
Exports to related firms	***	***	***	***	***
Exports to unrelated firms	***	***	***	***	***
Export shipments	***	***	***	***	***
Total shipments	***	***	***	***	***
	Unit value (dollars per kilowatt)				
Commercial U.S. shipments	***	***	***	***	***
Internal consumption	***	***	***	***	***
Transfers to related firms	***	***	***	***	***
U.S. shipments	***	***	***	***	***
Exports to related firms	***	***	***	***	***
Exports to unrelated firms	***	***	***	***	***
Export shipments	***	***	***	***	***
Total shipments	***	***	***	***	***

Table continued on next page.

Table III-7--Continued
CSPV modules: U.S. producers' U.S. shipments, export shipments, and total shipments, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Share of quantity (percent)				
Commercial U.S. shipments	***	***	***	***	***
Internal consumption	***	***	***	***	***
Transfers to related firms	***	***	***	***	***
U.S. shipments	***	***	***	***	***
Exports to related firms	***	***	***	***	***
Exports to unrelated firms	***	***	***	***	***
Export shipments	***	***	***	***	***
Total shipments	100.0	100.0	100.0	100.0	100.0
	Share of value (percent)				
Commercial U.S. shipments	***	***	***	***	***
Internal consumption	***	***	***	***	***
Transfers to related firms	***	***	***	***	***
U.S. shipments	***	***	***	***	***
Exports to related firms	***	***	***	***	***
Exports to unrelated firms	***	***	***	***	***
Export shipments	***	***	***	***	***
Total shipments	100.0	100.0	100.0	100.0	100.0

Note: Shipment data presented for U.S.-produced modules contain U.S.-produced and imported CSPV cells. Share shown as "0.0" represent values greater than zero but less than 0.05 percent.

Source: Compiled from data submitted in response to Commission questionnaires.

Most U.S. producers’ shipments (*** percent in 2018) of CSPV modules are commercially shipped in the United States, with a relatively minor amount that are internally consumed in other products or exported outside the United States. Internal consumption of U.S.-produced CSPV modules, which accounted for *** percent of the total U.S. producers’ shipments in every reporting period in terms of quantity, represented ***. *** reported average unit values of these CSPV modules internally consumed into *** ranging from $*** per kW in 2017 to $*** per kW in the first six months of 2018. Transfers to related firms in the United States, which accounted for *** and *** percent of aggregate total shipments in 2016 and 2018, respectively, largely represented ***.

U.S. commercial shipments of modules excluded from the safeguard measure

*** commercial U.S. shipments of CSPV modules, as reported by two U.S. module assemblers (***), include certain CSPV products that are specifically excluded by the safeguard measure (table III-8). Both firms reported that these specifically excluded items were part of the additional exclusions effective on or after June 13, 2019.[27]

*** reported a *** amount of U.S. shipments of CSPV modules incorporating bifacial cells. The firm, which accounted for *** percent of U.S. CSPV module production in 2018, produced *** and *** of these modules during 2018 and the first half of 2019, respectively. *** noted in its questionnaire response that “***.”

*** reported a *** amount of U.S. shipments of CSPV modules incorporating flexible fiberglass. The module producer, which accounted for *** percent of U.S. CSPV module production in 2018, produced *** and *** of these modules during 2018 and the first half of 2019, respectively. *** noted in its questionnaire response that “***.”

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[27] 84 FR 27684, June 13, 2019. One of the exclusions listed in table III-8 is bifacial modules, which, as indicated in part I of this report, was subsequently withdrawn by USTR, effective on or after October 28, 2019. 84 FR 54244, October 9, 2019. However, after a complaint was filed challenging the withdrawal of the exclusion, the CIT issued an order preliminarily enjoining USTR and Customs from withdrawing the exclusion until entry of final judgment in the case. Court Order, Invenergy Renewables LLC v. United States, Ct. No. 19-00192 (Dec. 5, 2019) (ECF No. 114).

Table III-8
CSPV modules: U.S. producers' U.S. shipments of excluded and all other modules, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Quantity (kilowatts)				
U.S. producers' U.S. shipments of.-- Bifacial	***	***	***	***	***
Flexible fiberglass	***	***	***	***	***
Light directing film	***	***	***	***	***
Rear contact fingers	***	***	***	***	***
Low wattage	***	***	***	***	***
All other modules	***	***	***	***	***
All forms	***	***	***	***	***
	Value (1,000 dollars)				
U.S. producers' U.S. shipments of.-- Bifacial	***	***	***	***	***
Flexible fiberglass	***	***	***	***	***
Light directing film	***	***	***	***	***
Rear contact fingers	***	***	***	***	***
Low wattage	***	***	***	***	***
All other modules	***	***	***	***	***
All forms	***	***	***	***	***
	Unit value (dollars per kilowatt)				
U.S. producers' U.S. shipments of.-- Bifacial	***	***	***	***	***
Flexible fiberglass	***	***	***	***	***
Light directing film	***	***	***	***	***
Rear contact fingers	***	***	***	***	***
Low wattage	***	***	***	***	***
All other modules	***	***	***	***	***
All forms	***	***	***	***	***
	Share of quantity (percent)				
U.S. producers' U.S. shipments of.-- Bifacial	***	***	***	***	***
Flexible fiberglass	***	***	***	***	***
Light directing film	***	***	***	***	***
Rear contact fingers	***	***	***	***	***
Low wattage	***	***	***	***	***
All other modules	***	***	***	***	***
All forms	100.0	100.0	100.0	100.0	100.0

Note: Shipment data presented for U.S.-produced modules contain U.S.-produced and imported CSPV cells. Share shown as "0.0" represent values greater than zero but less than 0.05 percent.

Source: Compiled from data submitted in response to Commission questionnaires.

U.S. shipments of or containing U.S.-origin cells for apparent consumption

As discussed in more detail later in Part V, apparent U.S. consumption of U.S. produced CSPV products declined by *** percent from 2016 to 2018 (*** percent decline from 2016 to 2017 and *** percent decline from 2017 to 2018) and was *** percent higher during January-June 2019 compared with January-June 2018 (see table V-7). The apparent U.S. consumption calculation presented in this report consists of the sum of U.S. producers' U.S. shipments of CSPV products and U.S. imports of CSPV products. As shown in table III-9, the U.S. shipments component of apparent U.S. consumption by quantity (in kW) reflects U.S. producers' U.S. shipments of (1) modules that contain U.S.-produced CSPV cells, (2) commercially sold U.S.-produced CSPV cells that are otherwise not reported by module assemblers, and (3) re-imports of modules containing U.S.-origin CSPV cells. This quantity measure excludes any CSPV modules produced in the United States from imported CSPV cells, as those are reported for the purposes of apparent U.S. consumption as imports. However, the U.S. component for value does include the incremental value added in the United States for the module assembly of foreign-origin CSPV cells. The apparent U.S. consumption data that incorporate this U.S. component are presented separately in Part V of this report.

Table III-9
U.S. producers' U.S. shipments of or containing U.S.-origin cells for use in apparent consumption, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Quantity (kilowatts)				
U.S. producers' U.S. shipments.-- Commercially sold cells	***	***	***	***	***
Modules using U.S.-origin cells	***	***	***	***	***
Re-imported modules containing U.S. cells	***	***	***	***	***
Total	***	***	***	***	***
	Value (1,000 dollars)				
U.S. producers' U.S. shipments.-- Commercially sold cells	***	***	***	***	***
Modules using U.S.-origin cells	***	***	***	***	***
Re-imported modules containing U.S. cells	***	***	***	***	***
Valued added to imported cells from U.S. module assembly	***	***	***	***	***
Total	***	***	***	***	***

Note: The quantity for U.S. producers' U.S. shipments reflects the quantity of solar panels sold in the United States. This quantity measure excludes any CSPV modules produced in the United States from imported CSPV cells, as those are reported for the purposes of apparent U.S. consumption as imports. The value for U.S. producers reflects the value of solar panels sold in the United States from producers plus the additional value added to either domestic or imported solar panels from producers. In measuring consumption and market share this methodology avoids reclassifying and/or double counting merchandise already reported once either by a domestic producer or an import.

Source: Compiled from data submitted in response to Commission questionnaires.

U.S. producers' inventories

Table III-10 presents U.S. cell and module producers' end-of-period inventories and the ratio of these inventories to U.S. producers' cell and module production, U.S. shipments, and total shipments**.** Four of the seven firms that reported production of CSPV cells since 2016[28] indicated in their questionnaire responses that they maintained inventories and all but six firms that reported assembly of CSPV modules in the United States indicated in their questionnaire responses that they maintained inventories of modules during at least part of the period from January 2016 to June 2018.

Table III-10
CSPV products: U.S. producers' and U.S. importers' inventories, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Quantity (kilowatts)				
U.S. producers' end-of-period inventories: Cells	***	***	***	***	***
	Ratio (percent)				
Ratio of inventories to.-- U.S. production: Cells	***	***	***	***	***
U.S. shipments: Cells	***	***	***	***	***
Total shipments: Cells	***	***	***	***	***
	Quantity (kilowatts)				
U.S. producers' end-of-period inventories: Modules	***	***	***	***	***
	Ratio (percent)				
Ratio of inventories to.-- U.S. production: Modules	***	***	***	***	***
U.S. shipments: Modules	***	***	***	***	***
Total shipments: Modules	***	***	***	***	***

Note.--Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent.

Source: Compiled from data submitted in response to Commission questionnaires.

Year-end inventories of CSPV cells and the ratio of these inventories to cell shipment and production levels declined from 2016 to 2017 and declined further in 2018, equaling *** percent of total shipments in 2016, *** percent in 2017, and *** percent in 2018. However, during the first six months of 2019, ending inventories of CSPV cells were higher (as ***

[28] Seven U.S. firms reported usable capacity and production data for CSPV cells in this proceeding for the period January 2016-June 2019. However, with several CSPV cell production facility closures, by 2019, only one firm (Panasonic) reported production of CSPV cells.

***), while cell production and shipments declined following the idling/closure of U.S. cell production facilities. In fact, Panasonic was the only U.S. producer of CSPV cells reporting production data during January-June 2019 and most of its shipments were ***. During the first six months of 2019, the ratio of cell producers' ending inventories to U.S. production and total shipments was *** percent and *** percent, respectively, and the ratio to U.S. shipments was *** percent.

Similar trends in inventories reported by U.S. CSPV cell producers were reported by U.S. CSPV module producers. Year-end inventories of CSPV modules and the ratios of module inventories to shipment and production amounts declined from 2016 to 2017 and declined further in 2018, but were higher during January-June 2019 as compared with January-June 2018 (as ***). The ratio of module inventories to total U.S. shipments equaled ***, ***, and *** percent in 2016, 2017, and 2018, respectively, but ranged from *** percent of U.S. production to *** percent of shipments during January-June 2019.

U.S. producers' imports and purchases

All *** U.S. producers of CSPV products (and/or related U.S. importers) reported direct imports of CSPV products since January 1, 2016.[29] Detailed information reported by U.S. CSPV cell and module producers concerning their direct U.S. imports (and/or of those of their related U.S. importers), U.S. production, ratio of U.S. imports to U.S. production, and reasons cited for importing CSPV products are presented in appendix G (table G-1).

[29] ***.

U.S. employment, wages, and productivity

Table III-11 shows U.S. employment-related data reported by U.S. producers of cells and modules. The overall number of production and related workers ("PRWs") employed by firms reporting CSPV cell operations in Commission producer questionnaire responses declined from *** PRWs in 2016 to *** PRWs in 2017 and declined further to *** PRWs in 2018, but was higher at *** PRWs during January-June 2019 than at *** PRWs during January-June 2018. Essentially all other employment indicators related to cell production show similar declines from 2016 to 2017 and again in 2018, with higher hours worked, hours worked per PRW, and unit labor costs during January-June 2019 compared with January-June 2018 and lower wages paid and hourly wages over the same period.[30] Productivity, on the other hand, fluctuated upward from *** kW per hour in 2016 to *** kW per hour before declining to *** kW per hour in 2018, and was lower at *** kW per hour during January-June 2019 compared with *** kW per hour during January-June 2018. The general declines in employment since January 1, 2016 are consistent with the declines in reported CSPV cell production and idling/closures of U.S. cell production facilities.

The overall number of PRWs employed by firms reporting CSPV module assembly operations in Commission producer questionnaire responses declined from *** PRWs in 2016 to *** PRWs in 2017 and to *** PRWs in 2018, but was higher at *** PRWs during January-June 2019 than at *** PRWs during January-June 2018. Total hours worked, hours worked per PRW, and wages paid to module PRWs declined from 2016 to 2017, but increased in 2018 to levels below those reported in 2016. Unit labor costs and hourly wages increased from 2016 to 2017; unit labor costs increased again in 2018 but hourly wages declined. Hours worked, hours worked per PRW, and wages paid were higher during January-June 2019 compared with January-June 2018, but unit labor costs and hourly wages were lower. Productivity fluctuated within a relatively narrow range (0.2-0.3 kW per hour) since January 1, 2016.

[30] Panasonic, the only remaining U.S. cell producer reporting data during January-June 2019, reported declining average hourly wages paid to its PRWs producing CSPV cells from $*** per hour in 2018 to $*** per hour in January-June 2019.

Table III-11
CSPV products: U.S. producers' employment related data, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
Employments data for cells:					
Production and related workers (PRWs) (number)	***	***	***	***	***
Total hours worked (1,000 hours)	***	***	***	***	***
Hours worked per PRW (hours)	***	***	***	***	***
Wages paid ($1,000)	***	***	***	***	***
Hourly wages (dollars per hour)	***	***	***	***	***
Productivity (kilowatts per hour)	***	***	***	***	***
Unit labor costs (dollars per kilowatt)	***	***	***	***	***
Employments data for modules:					
Production and related workers (PRWs) (number)	***	***	***	***	***
Total hours worked (1,000 hours)	***	***	***	***	***
Hours worked per PRW (hours)	***	***	***	***	***
Wages paid ($1,000)	***	***	***	***	***
Hourly wages (dollars per hour)	***	***	***	***	***
Productivity (kilowatts per hour)	***	***	***	***	***
Unit labor costs (dollars per kilowatt)	***	***	***	***	***
Employments data for all CSPV products:					
Production and related workers (PRWs) (number)	***	***	***	***	***
Total hours worked (1,000 hours)	***	***	***	***	***
Hours worked per PRW (hours)	***	***	***	***	***
Wages paid ($1,000)	***	***	***	***	***
Hourly wages (dollars per hour)	***	***	***	***	***

Source: Compiled from data submitted in response to Commission questionnaires.

Part IV: Financial experience of U.S. producers

Background

CSPV producers' financial results are divided into two primary categories: operations of CSPV cell producers and CSPV module producers.[1] [2] The financial results on U.S.-produced CSPV cell operations, which include only commercial sales and transfers, reflect the operations of

[1] All responding U.S. producers had a fiscal year ending on December 31 and most reported their financial results on the basis of U.S. generally accepted accounting principles. The exceptions were ***, which reported their financial results according to International Financial Reporting Standards (IFRS).

[2] In April 2017, Suniva ceased production of CSPV products and filed for Chapter 11 bankruptcy protection. See part III of this report.

four companies: ***.[3] [4] [5] The financial results on U.S.-produced module operations reflect 14 companies: ***.[6]

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[3] Panasonic ***. *** email to USITC staff, December 26, 2019.

[4] SunPower acquired SolarWorld on October 1, 2018 and submitted two separate U.S. producer questionnaire responses, one prior to acquisition and one after the acquisition ***. SunPower's 2018 10-K noted that "the operating results of SolarWorld Americas, which have been included in {SunPower's} consolidated financial statements since the closing date of the acquisition, have not been significant." SolarWorld's 2018 10-K (as filed), p. 145.

***.

***. *** emails to USITC staff, January 23-24, 2020.

[5] U.S. producer *** submitted an incomplete U.S. producer questionnaire and its responses are not included in the aggregated financial data. ***. *** U.S. producer questionnaire.

[6] Two producers *** submitted U.S. producer questionnaires over a month after the deadline. ***. ***. As a result, SG&A expenses, operating profits or (loss), and net income or (loss) of U.S. module producers may be understated and/or overstated.

As described earlier in part III of this report, several U.S. producers effectively began their cell and module operations during the period examined, while several others exited and/or substantially modified their operations. Aggregated financial data for both CSPV cells and modules varied substantially as result of producers entering and exiting the industry from January 1, 2016 to June 30, 2019.

Operations on CSPV cells and modules

Figures IV-1 and IV-2 show the share of net sales quantity in 2018 of responding U.S. producers of cells and modules, respectively. Tables IV-1 and IV-2, respectively, present the income-and-loss data for cell operations (commercial sales and transfers) and the corresponding changes in average cell per kilowatt values. Tables IV-3 and IV-4 present the total market income-and-loss data for module operations and the corresponding changes in module average per kilowatt values.[7] Appendix H presents company-specific financial results of cells and modules.

[7] U.S. cell producers' internal consumption of cells for their downstream module operations is excluded from the financial results presented in this report. *** reported cell operations primarily to support their downstream module production. ***, reported production of cells in 2016 only, with all produced cells consumed internally for module production.

Figure IV-1
CSPV cells: Share of net sales (commercial sales and transfers only) quantity by firm, 2018

*   *   *   *   *   *   *

Source: Compiled from data submitted in response to Commission questionnaires.

Table IV-1
CSPV cells: Results of commercial sales and transfers of U.S. producers, 2016-18, January to June 2018, and January to June 2019

Item	Fiscal year 2016	Fiscal year 2017	Fiscal year 2018	January to June 2018	January to June 2019
	Quantity (kilowatts)				
Commercial sales	***	***	***	***	***
Transfers to related firms	***	***	***	***	***
Total net sales	***	***	***	***	***
	Value (1,000 dollars)				
Commercial sales	***	***	***	***	***
Transfers to related firms	***	***	***	***	***
Total net sales	***	***	***	***	***
Cost of goods sold.-- Wafers	***	***	***	***	***
All other material inputs	***	***	***	***	***
Total raw materials	***	***	***	***	***
Direct labor	***	***	***	***	***
Other factory costs	***	***	***	***	***
Total COGS	***	***	***	***	***
Gross profit or (loss)	***	***	***	***	***
SG&A expense	***	***	***	***	***
Operating income or (loss)	***	***	***	***	***
Interest expense	***	***	***	***	***
All other expenses	***	***	***	***	***
All other income	***	***	***	***	***
Net income or (loss)	***	***	***	***	***
Depreciation/amortization	***	***	***	***	***
Cash flow	***	***	***	***	***
	Ratio to net sales (percent)				
Cost of goods sold.-- Wafers	***	***	***	***	***
All other material inputs	***	***	***	***	***
Total raw materials	***	***	***	***	***
Direct labor	***	***	***	***	***
Other factory costs	***	***	***	***	***
Total COGS	***	***	***	***	***
Gross profit or (loss)	***	***	***	***	***
SG&A expense	***	***	***	***	***
Operating income or (loss)	***	***	***	***	***
Net income or (loss)	***	***	***	***	***

Table continued on next page.

Table IV-1—Continued
CSPV cells: Results of commercial sales and transfers of U.S. producers, 2016-18, January to June 2018, and January to June 2019

Item	Fiscal year			January to June	
	2016	2017	2018	2018	2019
	Ratio to total COGS (percent)				
Cost of goods sold.-- Raw materials	***	***	***	***	***
Direct labor	***	***	***	***	***
Other factory costs	***	***	***	***	***
Total COGS	***	***	***	***	***
	Unit value (dollars per kilowatt)				
Commercial sales	***	***	***	***	***
Transfers to related firms	***	***	***	***	***
Total net sales	***	***	***	***	***
Cost of goods sold.-- Wafers	***	***	***	***	***
All other material inputs	***	***	***	***	***
Total raw materials	***	***	***	***	***
Direct labor	***	***	***	***	***
Other factory costs	***	***	***	***	***
Total COGS	***	***	***	***	***
Gross profit or (loss)	***	***	***	***	***
SG&A expense	***	***	***	***	***
Operating income or (loss)	***	***	***	***	***
Net income or (loss)	***	***	***	***	***
	Number of firms reporting				
Operating losses	***	***	***	***	***
Net losses	***	***	***	***	***
Data	***	***	***	***	***

Note: ***.

Source: Compiled from data submitted in response to Commission questionnaires.

Table IV-2
CSPV cells: Changes in average unit values ("AUVs"), between fiscal years and between partial year periods

Item	Between fiscal years			Between partial year period
	2016-18	2016-17	2017-18	2018-19
	Change in AUVs (dollars per kilowatt)			
Commercial sales	***	***	***	***
Transfers to related firms	***	***	***	***
Total net sales	***	***	***	***
Cost of goods sold.-- Wafers	***	***	***	***
All other material inputs	***	***	***	***
Total raw materials	***	***	***	***
Direct labor	***	***	***	***
Other factory costs	***	***	***	***
Total COGS	***	***	***	***
Gross profit or (loss)	***	***	***	***
SG&A expense	***	***	***	***
Operating income or (loss)	***	***	***	***
Net income or (loss)	***	***	***	***

Source: Compiled from data submitted in response to Commission questionnaires.

Figure IV-2
CSPV modules: Share of net sales quantity by firm, 2018

* * * * * * *

Source: Compiled from data submitted in response to Commission questionnaires.

Table IV-3
CSPV modules: Results of total market operations of U.S. producers, 2016-18, January to June 2018, and January to June 2019

Item	Fiscal year			January to June	
	2016	2017	2018	2018	2019
	Quantity (kilowatts)				
Commercial sales	***	***	***	***	***
Transfers to related firms	***	***	***	***	***
Total net sales	***	***	***	***	***
	Value (1,000 dollars)				
Commercial sales	***	***	***	***	***
Transfers to related firms	***	***	***	***	***
Total net sales	***	***	***	***	***
Cost of goods sold.-- Internally produced cells.-- Wafers	***	***	***	***	***
All other material inputs	***	***	***	***	***
Direct labor	***	***	***	***	***
Other factory costs	***	***	***	***	***
Total, internally produced cells	***	***	***	***	***
Purchased domestically produced cells	***	***	***	***	***
Purchased imported cells	***	***	***	***	***
Cost of cells	***	***	***	***	***
Other raw material costs	***	***	***	***	***
Raw materials	***	***	***	***	***
Direct labor	***	***	***	***	***
Other factory costs	***	***	***	***	***
Total COGS	***	***	***	***	***
Gross profit or (loss)	***	***	***	***	***
SG&A expense	***	***	***	***	***
Operating income or (loss)	***	***	***	***	***
Interest expense	***	***	***	***	***
All other expenses	***	***	***	***	***
All other income	***	***	***	***	***
Net income or (loss)	***	***	***	***	***
Depreciation/amortization	***	***	***	***	***
Cash flow	***	***	***	***	***

Table continued on next page.

Table IV-3—Continued
CSPV modules: Results of total market operations of U.S. producers, 2016-18, January to June 2018, and January to June 2019

Item	Fiscal year			January to June	
	2016	2017	2018	2018	2019
	Ratio to net sales (percent)				
Cost of goods sold.-- Internally produced cells.-- Wafers	***	***	***	***	***
All other material inputs	***	***	***	***	***
Direct labor	***	***	***	***	***
Other factory costs	***	***	***	***	***
Total, internally produced cells	***	***	***	***	***
Purchased domestically produced cells	***	***	***	***	***
Purchased imported cells	***	***	***	***	***
Cost of cells	***	***	***	***	***
Other raw material costs	***	***	***	***	***
Raw materials	***	***	***	***	***
Direct labor	***	***	***	***	***
Other factory costs	***	***	***	***	***
Total COGS	***	***	***	***	***
Gross profit or (loss)	***	***	***	***	***
SG&A expense	***	***	***	***	***
Operating income or (loss)	***	***	***	***	***
Net income or (loss)	***	***	***	***	***
	Ratio to total COGS (percent)				
Cost of goods sold.-- Internally produced cells.-- Wafers	***	***	***	***	***
All other material inputs	***	***	***	***	***
Direct labor	***	***	***	***	***
Other factory costs	***	***	***	***	***
Total, internally produced cells	***	***	***	***	***
Purchased domestically produced cells	***	***	***	***	***
Purchased imported cells	***	***	***	***	***
Cost of cells	***	***	***	***	***
Other raw material costs	***	***	***	***	***
Raw materials	***	***	***	***	***
Direct labor	***	***	***	***	***
Other factory costs	***	***	***	***	***
Total COGS	***	***	***	***	***

Table continued on next page.

Table IV-3—Continued
CSPV modules: Results of total market operations of U.S. producers, 2016-18, January to June 2018, and January to June 2019

Item	Fiscal year			January to June	
	2016	2017	2018	2018	2019
	Average unit value (dollars per kilowatt)				
Commercial sales	***	***	***	***	***
Transfers to related firms	***	***	***	***	***
Total net sales	***	***	***	***	***
Cost of goods sold.-- Internally produced cells.-- Wafers	***	***	***	***	***
All other material inputs	***	***	***	***	***
Direct labor	***	***	***	***	***
Other factory costs	***	***	***	***	***
Total, internally produced cells	***	***	***	***	***
Purchased domestically produced cells	***	***	***	***	***
Purchased imported cells	***	***	***	***	***
Cost of cells	***	***	***	***	***
Other raw material costs	***	***	***	***	***
Raw materials	***	***	***	***	***
Direct labor	***	***	***	***	***
Other factory costs	***	***	***	***	***
Total COGS	***	***	***	***	***
Gross profit	***	***	***	***	***
SG&A expense	***	***	***	***	***
Operating income or (loss)	***	***	***	***	***
Net income or (loss)	***	***	***	***	***
	Number of firms reporting				
Operating losses	***	***	***	***	***
Net losses	***	***	***	***	***
Data	***	***	***	***	***

Note: ***.

Note: The lack of certain cost data for *** (see footnote 6 in this section of the report) impacts the operating profit and net income for the industry as a whole.

Source: Compiled from data submitted in response to Commission questionnaires.

Table IV-4
CSPV modules: Changes in AUVs, between fiscal years and between partial year periods

Item	Between fiscal years			Between partial year period
	2016-18	2016-17	2017-18	2018-19
	Change in AUVs (dollars per kilowatt)			
Commercial sales	***	***	***	***
Transfers to related firms	***	***	***	***
Total net sales	***	***	***	***
Cost of goods sold.-- Internally produced cells.-- Wafers	***	***	***	***
All other material inputs	***	***	***	***
Direct labor	***	***	***	***
Other factory costs	***	***	***	***
Total, internally produced cells	***	***	***	***
Purchased domestically produced cells	***	***	***	***
Purchased imported cells	***	***	***	***
Total cost of cells	***	***	***	***
Other raw material costs	***	***	***	***
Total raw materials	***	***	***	***
Direct labor	***	***	***	***
Other factory costs	***	***	***	***
Total COGS	***	***	***	***
Gross profit	***	***	***	***
SG&A expense	***	***	***	***
Operating income or (loss)	***	***	***	***
Net income or (loss)	***	***	***	***

Source: Compiled from data submitted in response to Commission questionnaires.

Net sales

As shown in table IV-1, the sales volume of cells (commercial sales and transfers) declined dramatically from 2016 to 2018 (declining from 2016-17 and continued to decline from 2017-18), and was higher in January to June 2019 (“interim 2019”) than in January-June 2018 (“interim 2018”).[8] The operations of CSPV cells for each producer shifted each period, with *** accounting for the largest share of net sales value in 2016 and 2017 and ***.

[8] The decline of CSPV cells net sales from 2016-17 is attributable to *** while the increase from 2017-18 is primarily attributable to ***.

***.[9] A new producer, ***, started and stopped CSPV cell operations in 2018, with no CSPV module operations.[10]

The average value of cells (commercial sales and transfer) decreased from 2016 to 2018 (declining from 2016-17 and continued to decline from 2017-18), at $*** per kilowatt in 2016, $*** per kilowatt in 2017, and $*** per kilowatt in 2018; average value of cells (commercial sales and transfer) were lower in interim 2019 than in interim 2018. As shown in table H-1, only two cell producers *** reported net sales in 2016 and 2017 and both contributed to the decline of average value of cells (commercial sales and transfer) in 2016 and 2017. The three cell producers *** reporting net sales of cells (commercial sales and/or transfer) in 2018 had large variations of average net sales values ($*** per kilowatt ***, $*** per kilowatt ***, and $*** per kilowatt ***). The variations in average commercial sales and transfer values for cell producers may be explained by product mix; ***.[11]

As shown in table IV-3, the total market sales volume for CSPV modules presents a somewhat different pattern compared to the commercial sales and transfer of cells. The total market net sales volume of CSPV modules (reflecting commercial sales and transfers, as no internal consumption of modules was reported) declined from 2016 to 2017 before increasing from 2017 to 2018; module net sales volume was much higher in interim 2019 than in interim 2018.[12] Commercial sales of CSPV modules, the largest of the reported sales categories,

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[9] ***.
[10] ***. *** U.S. producer questionnaire, II-4 and II-8.
[11] U.S. producer questionnaire, II-6. ***. *** email to USITC staff, December 26, 2019.
[12] The increase of CSPV module net sales in interim 2019 primarily reflect the sales of ***.

declined from 2016-17 but increased from 2017-18, with the highest sales volume reported in 2018; commercial sales of modules were much higher in interim 2019 than in interim 2018. As shown in table H-1, the increase of module commercial sales in 2018 is primarily attributable to increased sales reported by ***, while the higher level reported in interim 2019 is driven by new module producers ***. Transfers to related firms were a small part of total market sales volume of modules and followed the same trend as the total market volume pattern (decreasing from 2016-17 but increasing from 2017-18).

As shown in table IV-3, average module value declined from 2016 to 2018 (declining from 2016-17 before increasing from 2017-18), at $*** per kilowatt in 2016, $*** per kilowatt in 2017, and $*** per kilowatt in 2018; average module sales value was lower in interim 2019 compared to interim 2018. For U.S. module operations as a whole, the variation of modules average sales values in part reflects *** and new companies entering the CSPV module industry in 2017, 2018, and interim 2019. Two companies *** reported the highest modules average net sales value and were present in the market for all three full-year reporting periods (see table H-1). From 2016 to 2017, ***'s modules average net sales declined while *** reported increases. From 2017 to 2018, the directional pattern of modules average sales value was mixed, with *** reporting the highest modules average values. Average module sales values were lower in interim 2019 than in interim 2018.[13]

Cost of goods sold and gross profit or (loss)

For cells (table IV-1), total raw material cost is the most substantial component of total COGS in 2016 and 2017, reflecting a combination of wafers and all other raw material costs.[14] The share of total cell raw material costs reported for commercial sales and transfer of cells as percent of total COGS decreased from 2016 to 2018 (increasing slightly from 2016-17 before increasing more from 2017-18), at *** percent in 2016 to *** percent in 2017, and *** percent in 2018.[15] Total cell raw material costs as a percent of total COGS were higher in

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[13] Table H-1 shows that U.S. module producers reported a range of average sales values.

[14] The share of total COGS accounted for by all other raw material costs for cell production declined from 2016 to 2018 and was higher in interim 2019 than in interim 2018. ***. Safeguard confidential report, p. III-49, fn. 56.

[15] The pattern of raw materials, direct labor, and other factory costs as percent of total COGS for cells ***. As a result, comparison of shares of raw materials, direct labor, and other factory costs from 2016 to 2018 is of limited use.

interim 2019 than in interim 2018. Average unit raw material costs of cells declined from 2016-17 before increasing slightly from 2017-18, at $*** per kilowatt in 2016, $*** per kilowatt in 2017, and $*** in 2018; average unit raw materials of cells and was lower in interim 2019 than in interim 2018.

For modules (table IV-3), total raw material cost is also the most substantial component of total COGS from 2016 to 2018 (decreasing from 2016-17 but increasing from 2017-18), at *** percent in 2016, *** percent in 2017, and *** percent in 2018 of total COGS. Total raw material costs for CSPV modules reflect internally produced cells, cells purchased from domestically produced and imported sources, and other raw material costs.[16] Company-specific module cost structures varied with the following producers reporting consumption of internally produced cells: ***.[17] *** also purchased cells during the period.[18] The average unit raw material costs of modules declined from declined from 2016-17 and continued to decline from 2017-18, at $*** per kilowatt in 2016, $*** per kilowatt in 2017, and $*** in 2018; average unit raw materials of modules was lower in interim 2019 than in interim 2018.

With respect to cell COGS, *** U.S. producer to include non-recurring items identified as ***. With respect to module COGS,

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[16] ***. Safeguard confidential report, p. III-50, fn. 59.

[17] ***. Safeguard confidential report, p. III-50, fn. 60.

[18] With respect to internally produced cells, the total cost of wafers and all other raw material costs as a share of total module COGS declined from *** percent in 2016 to *** percent in 2017 and declined further to *** percent in 2018 (no raw materials from internal production of cells was reported in interim 2019). Purchased cells from domestic sources as a share of COGS declined from *** percent in 2016 to *** percent in 2017 and declined further to *** percent in 2018; purchased cells from domestic sources as a share of module COGS were lower in interim 2019 than in interim 2018. Purchased cells from imported sources as a share of COGS fluctuated from *** percent in 2016, *** percent in 2017, and *** in 2018; purchased cells from imported sources as a share of COGS was higher in interim 2019 than in interim 2018. The average cost of cells for module production was the lowest per kilowatt in 2018 for the full year periods, regardless of source.

*** reported nonrecurring items identified as write-downs in 2016 and/or 2017.

As shown in table IV-1, U.S. cell producers reported increasing gross losses in absolute values from 2016 to 2018 (gross losses increased from 2016-17 and losses continued to increase from 2017-18); U.S. cell producers reported a higher gross loss in interim 2019 than in interim 2018. Individually (table H-1), U.S. cell producers reported gross losses in *** from 2016 to June 2019, with *** a gross profit reported by *** in 2016. As a share of net sales, gross losses of U.S. cell producers increased from 2016 to 2018 (gross losses as a share of net sales increased from 2016-17 and increased *** from 2017-18), at *** percent in 2016, *** percent in 2017, and *** percent in 2018 (mostly due to ***). Gross loss margins were *** in interim 2019 than in interim 2018, reflecting the gross loss margins of the only U.S. producer (***) that reported net sales of cells in interim 2019.

As shown in table IV-3, U.S. module producers reported increasing gross losses in absolute values from 2016 to 2018 (gross losses increased from 2016-17 but decreased from 2017-18); U.S. module producers reported lower gross losses in interim 2019 than in interim 2018. Individually (table H-1), U.S. module producers reported a wide range of mostly *** gross profit ratios (see table H-1). In absolute terms, *** reported the largest gross loss for modules in 2017. *** accounted for the largest share of module gross profits, turning around from gross losses in 2016 and 2017 to gross profit in 2018 and interim 2019 by both absolute and margin indicators. Other module producers present in the market from January 2016 to June 2019 reported gross losses in both absolute and margin indicators, except for one module producer (***) reporting positive gross results in all five periods. *** module producers *** reported positive gross profits in 2017 and/or 2018 while *** reported negative gross results until interim 2019. Module producers with sales starting in 2019 *** reported *** gross results (***) in interim 2019. Gross profit measures were more mixed for individual U.S. modules producers in interim 2019 than in interim 2018, with the aggregated module producers reporting a lower total gross loss and gross loss as a ratio of sales in interim 2019 than in interim 2018.

Selling, general, and administrative expenses and operating income or (loss)

As shown in table C-1, total SG&A expenses for cell and module operations combined declined from 2016 to 2018 (SG&A expenses declined from 2016-17 and continued to decline from 2017-18); SG&A expenses were higher in interim 2019 than in interim 2018.[19] For U.S cell producers (table IV-1), total SG&A expense ratios (total SG&A expenses divided by total revenue) increased from 2016-17 but declined from 2017-18; SG&A expense ratios for cell producers were *** in interim 2019 than in interim 2018. For U.S. module producers (table IV-3), SG&A expense ratios declined from 2016-17 and continued to decline from 2017-18; SG&A expense ratios for module producers were lower in interim 2019 than in interim 2018. On a company-specific basis (table H-1), cell and module SG&A ratios cover a relatively wide range, with *** reporting the highest ratios and *** reporting the lowest in almost all periods ***.[20] The entry, transition, or exit phase of individual producers during the period examined explains, in part, the large fluctuation of SG&A expense ratios.

As shown in tables IV-1 and IV-3, the U.S. industry reported cell and module operating losses of varying magnitude throughout January 2016 to June 2019.[21] Operating results mostly mirror the gross results. As shown in table H-1, ***. With respect to module operations, *** reported operating losses in 2016 and 2017 but reported operating profits in 2018 and interim 2019. *** reported positive operating results but directional trends varied for these three companies (table H-1).

Other expenses and net income or (loss)

For both U.S. cell and module operations (calculated from tables IV- 1 and IV-3), other expenses, including interest expenses and all other expenses declined from 2016 to 2018 (declining from 2016-17 and continued to decline from 2017-18); other expenses were lower in

[19] ***.

[20] ***. *** email to USITC staff, December 26, 2019.

[21] A variance analysis is not presented in this report due to ***.

interim 2019 than in interim 2018 for both cell and module producers.[22] For cell operations, interest expense declined dramatically from 2016-17 and also from 2017-2018 while interest expense for module operations fluctuated and ended the period somewhat lower. For module operations, other expenses declined from 2016-17 but increased dramatically from 2017-18, mostly attributable to other expenses reported by ***.

The U.S. industry's net losses for both cells and modules were consistently greater than corresponding operating losses throughout the period examined due to the inclusion of interest expense and other expenses. The more pronounced difference between net losses and operating losses in 2016 and 2017 reflects the impairments noted above while net losses from 2017-18 reflects *** operations (see table H-1). Net losses were *** in interim 2019 than in interim 2018 for cell operations *** were lower for module operations.

Capital expenditures and research and development expenses

Table IV-5 presents capital expenditures and research and development ("R&D") expenses by company. The level of overall capital expenditures declined from 2016-17 before increasing dramatically from 2017-18, primarily reflecting the startup expenses reported by *** and ***.[23] Capital expenditures were higher in interim 2019 than in interim 2018 ***.

Six out of 16 producers reported R&D expenses for cells or modules. R&D expenses were focused on cells and reported by *** for their cell operations in 2016 and 2017 but declined from 2017 to 2018 as a result of *** and ***. R&D expenses were lower in interim 2019 than in interim 2018.

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[22] ***.

[23] ***. *** email to USITC staff, December 26, 2019.

Table IV-5
CSPV products: Capital expenditures and R&D expenses for U.S. producers, by firm, 2016-18, January to June 2018, and January to June 2019

Item	Fiscal year ended--			January to June	
	2016	2017	2018	2018	2019
	Capital expenditures (1,000 dollars)				
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
Silfab	***	***	***	***	***
SolarTech	***	***	***	***	***
SolarWorld/SunPower	***	***	***	***	***
Suniva	***	***	***	***	***
Yingli	***	***	***	***	***
Total capital expenditures	***	***	***	***	***
	R&D expenses (1,000 dollars)				
LG	***	***	***	***	***
PowerFilm	***	***	***	***	***
Silfab	***	***	***	***	***
SolarTech	***	***	***	***	***
SolarWorld/SunPower	***	***	***	***	***
Suniva	***	***	***	***	***
Total R&D expenses	***	***	***	***	***

Note: *** SunPower’s 2018 10-K (as filed), p. 145.

Source: Compiled from data submitted in response to Commission questionnaires.

Assets and return on assets

Table IV-6 presents data on the U.S. producers' total assets and their return on assets ("ROA"). Total assets reported for cell and module operations fluctuated from 2016 to 2018. *** accounted for the largest share of cell and module assets in 2016 and 2017 while new producer *** accounted for the largest share of assets in 2018.[24]

Table IV-6
CSPV products: U.S. producers' total assets and return on assets, by firm, 2016-18, January to June 2018, and January to June 2019

Firm	Fiscal year ended-- 2016	2017	2018
	Total net assets (1,000 dollars)		
Hanwha	***	***	***
Heliene	***	***	***
Jinko	***	***	***
LG	***	***	***
Mission	***	***	***
Panasonic	***	***	***
PowerFilm	***	***	***
Silfab	***	***	***
SolarTech	***	***	***
SolarWorld/SunPower	***	***	***
Suniva	***	***	***
Yingli	***	***	***
Total net assets	***	***	***

Tabled continued on next page.

[24] ***. *** U.S. producer questionnaire, III-15.

Table IV-6--Continued
CSPV products: U.S. producers' total assets and return on assets, by firm, 2016-18, January to June 2018, and January to June 2019

Firm	Fiscal year ended--		
	Operating return on assets (percent)		
Hanwha	***	***	***
Heliene	***	***	***
Jinko	***	***	***
LG	***	***	***
Mission	***	***	***
Panasonic	***	***	***
PowerFilm	***	***	***
Silfab	***	***	***
SolarTech	***	***	***
SolarWorld (pre-acquisition)	***	***	***
Suniva	***	***	***
Yingli	***	***	***
Average operating return on assets	***	***	***

Note: At the end of its fiscal year 2018 (December 31, 2018), ***. *** emails to USITC staff, January 23-24, 2020.

Note: No ROA calculation is available ***.

Source: Compiled from data submitted in response to Commission questionnaires.

Part V: U.S. imports, apparent U.S. consumption, and market shares

U.S. imports

The import data presented in this part of the report are compiled from data submitted in response to Commission questionnaires. Import data compiled from official U.S. import statistics using HTS statistical reporting numbers 8541.40.6015, 8541.40.6020, 8541.40.6025, 8541.40.6030, 8541.40.6035, and 8541.40.6045 are presented separately in appendix I.[1]

U.S. imports of CSPV products

Table V-1 and figure V-1 present data for U.S. imports of CSPV products based on the country of origin of the cells.[2] In addition, table V-1 also presents U.S. imports of CSPV modules assembled in Canada, China, and Mexico based on the country of origin of module assembly.

Most (86.4 percent in 2018) of the U.S. imports of CSPV products since 2016 have been in the form of modules, with a relatively smaller share (13.6 percent in 2018) entering the United States in the form of cells. Total U.S. imports of CSPV modules declined by 15.6 percent from 11.6 GW in 2016 to 9.8 GW in 2017 and further declined by 45.9 percent to 5.3 GW in 2018, but were 72.0 percent higher at 4.1 GW during January-June 2019 compared with 2.4 GW during January-June 2018. U.S. imports of CSPV cells increased continuously over this same time period from 265 MW in 2016, to 278 MW in 2017, and 837 MW in 2018, and were 208.4 percent higher at 951 MW during January-June 2019 compared with 308 MW during January-June 2018.

[1] Official U.S. import statistics may be overstated by certain items that are outside the scope of this investigation, such as thin film photovoltaic products. In addition, only import value data are presented in appendix I because quantity data are not collected on the basis of kW for 2016, 2017, and part of 2018.

[2] See the section entitled "Scope of the safeguard remedy" in Part I of this report for a complete description of the merchandise subject to this proceeding.

Table V-1
CSPV products: U.S. imports, by source, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Quantity (kilowatts)				
U.S. imports (based on country of origin of cells) from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Germany	***	***	***	***	***
India	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	***
Thailand	***	***	***	***	***
Turkey	***	***	***	***	***
Vietnam	***	***	***	***	***
All other developing countries	***	***	***	***	***
All other non-developing countries	***	***	***	***	***
All import sources	11,856,373	10,066,330	6,136,626	2,682,400	5,033,392
of which cells	265,382	278,426	836,903	308,336	951,003
of which modules	11,590,991	9,787,904	5,299,723	2,374,064	4,082,389
	Quantity (kilowatts)				
U.S. imports (based on country of origin of module assembly) from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Mexico	***	***	***	***	***

Table continued on next page.

Table V-1--Continued
CSPV products: U.S. imports, by source, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Value (1,000 dollars)				
U.S. imports (based on country of origin of cells) from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Germany	***	***	***	***	***
India	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	***
Thailand	***	***	***	***	***
Turkey	***	***	***	***	***
Vietnam	***	***	***	***	***
All other developing countries	***	***	***	***	***
All other non-developing countries	***	***	***	***	***
All import sources	6,923,693	4,113,432	2,479,151	1,177,300	1,570,461
of which cells	97,028	92,637	260,992	107,724	184,285
of which modules	6,826,665	4,020,795	2,218,159	1,069,576	1,386,176
	Value (1,000 dollars)				
U.S. imports (based on country of origin of module assembly) from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Mexico	***	***	***	***	***

Table continued on next page.

Table V-1--Continued
CSPV products: U.S. imports, by source, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Unit value (dollars per kilowatt)				
U.S. imports (based on country of origin of cells) from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Germany	***	***	***	***	***
India	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	***
Thailand	***	***	***	***	***
Turkey	***	***	***	***	***
Vietnam	***	***	***	***	***
All other developing countries	***	***	***	***	***
All other non-developing countries	***	***	***	***	***
All import sources	584	409	404	439	312
of which cells	366	333	312	349	194
of which modules	589	411	419	451	340
	Unit value (dollars per kilowatt)				
U.S. imports (based on country of origin of module assembly) from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Mexico	***	***	***	***	***

Table continued on next page.

Table V-1--Continued
CSPV products: U.S. imports, by source, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Ratio to U.S. production (percent)				
U.S. imports (based on country of origin of cells) from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Germany	***	***	***	***	***
India	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	***
Thailand	***	***	***	***	***
Turkey	***	***	***	***	***
Vietnam	***	***	***	***	***
All other developing countries	***	***	***	***	***
All other non-developing countries	***	***	***	***	***
All import sources	***	***	***	***	***
of which cells	***	***	***	***	***
of which modules	***	***	***	***	***
	Ratio to U.S. production (percent)				
U.S. imports (based on country of origin of module assembly) from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Mexico	***	***	***	***	***

Table continued on next page.

Table V-1--Continued
CSPV products: U.S. imports, by source, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Share of quantity (percent)				
U.S. imports (based on country of origin of cells) from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Germany	***	***	***	***	***
India	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	***
Thailand	***	***	***	***	***
Turkey	***	***	***	***	***
Vietnam	***	***	***	***	***
All other developing countries	***	***	***	***	***
All other non-developing countries	***	***	***	***	***
All import sources	100.0	100.0	100.0	100.0	100.0
of which cells	2.2	2.8	13.6	11.5	18.9
of which modules	97.8	97.2	86.4	88.5	81.1
	Share of quantity (percent)				
U.S. imports (based on country of origin of module assembly) from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Mexico	***	***	***	***	***
	Rank based on quantity				
U.S. imports (based on country of origin of cells) from.-- Largest source	China	Malaysia	Malaysia	Korea	Malaysia
2nd largest source	Malaysia	Korea	Korea	Malaysia	Korea
3rd largest source	Korea	Thailand	Thailand	Thailand	Vietnam
4th largest source	Taiwan	Vietnam	Vietnam	Vietnam	Thailand
5th largest source	Thailand	China	Singapore	Singapore	Japan
6th largest source	Vietnam	Singapore	Philippines	Philippines	Singapore
7th largest source	Singapore	Philippines	Japan	Japan	Philippines
8th largest source	Germany	Taiwan	Turkey	India	Turkey
9th largest source	Philippines	Japan	Taiwan	Taiwan	Taiwan
10th largest source	India	Germany	India	Turkey	India

Table continued on next page.

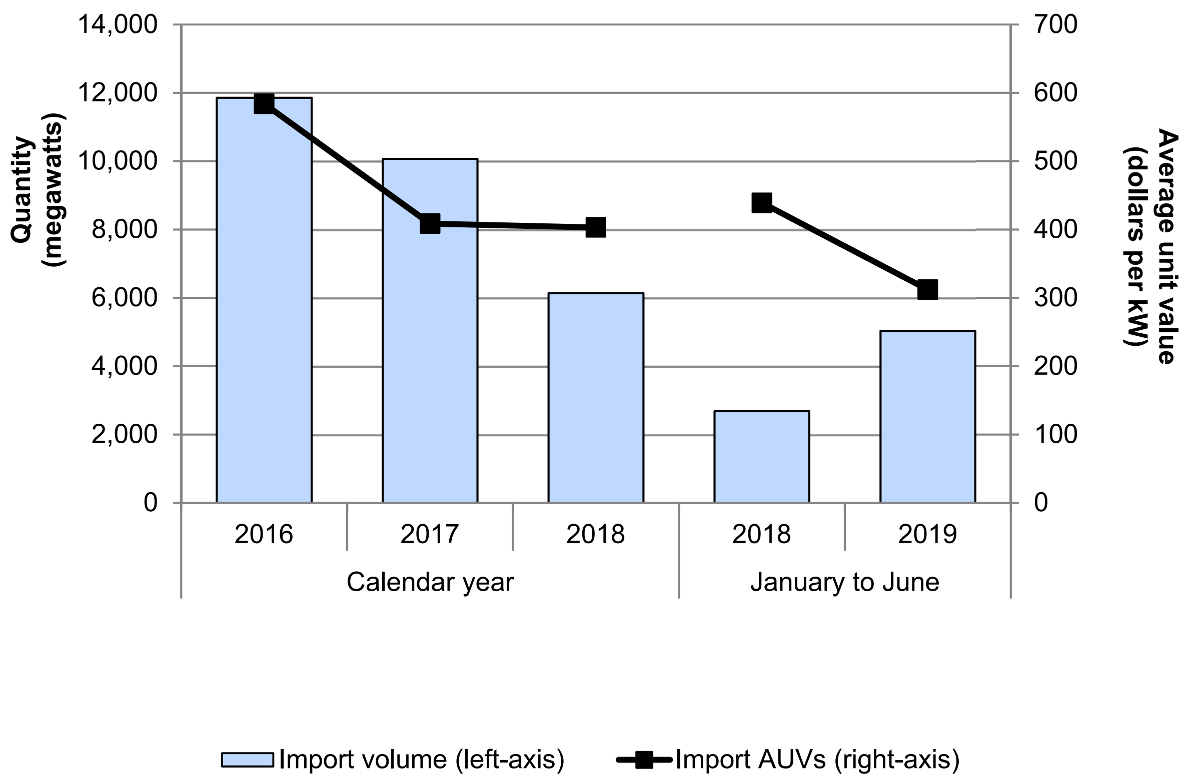
Table V-1--Continued
CSPV products: U.S. imports, by source, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Share of value (percent)				
U.S. imports (based on country of origin of cells) from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Germany	***	***	***	***	***
India	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	***
Thailand	***	***	***	***	***
Turkey	***	***	***	***	***
Vietnam	***	***	***	***	***
All other developing countries	***	***	***	***	***
All other non-developing countries	***	***	***	***	***
All import sources	100.0	100.0	100.0	100.0	100.0
of which cells	1.4	2.3	10.5	9.2	11.7
of which modules	98.6	97.7	89.5	90.8	88.3
	Share of value (percent)				
U.S. imports (based on country of origin of module assembly) from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Mexico	***	***	***	***	***
	Rank based on value				
U.S. imports (based on country of origin of cells) from.-- Largest source	Malaysia	Malaysia	Malaysia	Korea	Malaysia
2nd largest source	China	Korea	Korea	Malaysia	Korea
3rd largest source	Korea	Thailand	Thailand	Thailand	Vietnam
4th largest source	Taiwan	China	Philippines	Philippines	Thailand
5th largest source	Thailand	Vietnam	Singapore	Singapore	Philippines
6th largest source	Singapore	Singapore	Vietnam	Vietnam	Singapore
7th largest source	Vietnam	Philippines	Turkey	Japan	Japan
8th largest source	Philippines	Taiwan	Japan	India	Turkey
9th largest source	Germany	Japan	Taiwan	Turkey	Taiwan
10th largest source	India	Indonesia	China	Taiwan	India

Note.--Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent.

Source: Compiled from data submitted in response to Commission questionnaires.

Figure V-1
CSPV products: U.S. import volumes and average unit values (country-of-origin based on cell manufacture location), 2016-18, January to June 2018, and January to June 2019



Source: Compiled from data submitted in response to Commission questionnaires.

Total U.S. imports of all CSPV products declined by 48.2 percent from 11.9 GW in 2016 to 6.1 GW in 2018 (i.e., a 15.1 percent decline from 11.9 GW in 2016 to 10.1 GW in 2017 and a 39.0 percent decline from 10.1 GW in 2017 to 6.1 GW in 2018), but were 87.6 percent higher at 5.0 GW during January-June 2019 compared with 2.7 GW during January-June 2018. A similar trend is observed for U.S. imports based on value; however, the average unit value of U.S. imports of such CSPV products declined from a high of $584 per kW in 2016 to $409 per kW in 2017 and to $404 per kW in 2018. The average unit value was $439 per kW in January-June 2018 and was at its lowest point at $312 per kW during January-June 2019. Based on the country of origin of cells, the leading supplier of foreign CSPV products to the United States during 2016 was China, representing 27.7 percent of all imports by quantity.[3] By 2017, however, the leading suppliers of foreign CSPV products to the United States were Malaysia and Korea, representing 37.5 percent and 21.8 percent of all imports, respectively, in 2017, 35.0 percent and 28.9 percent, respectively, in 2018, and 43.9 percent and 19.7 percent, respectively, in January-June 2019.

The Commission requested that importing firms also separately report their U.S. imports of CSPV products from Canada, China, and Mexico using the assembly location of the modules to determine the country of origin.[4] According to these data, U.S. imports of CSPV modules

[3] *** reported U.S. imports of CSPV modules from Cambodia in the amount of *** ($***) during January-June 2019. Cambodia is listed in Presidential Proclamation 9693 as a developing country that is a WTO member excluded from the safeguard measure, as long as the country's share of total imports of the product, based on imports during a recent representative period, does not exceed 3 percent, provided that imports that are the product of all such countries with less than 3 percent import share collectively account for not more than 9 percent of total imports of the product. *** U.S. imports from *** accounted for *** percent of total reported U.S. imports of CSPV products during January-June 2019. According to official U.S. import statistics, total U.S. imports of CSPV products from Cambodia during January-June amounted to $1.1 million, which accounted for 0.05 percent of total U.S. imports from all countries. There were no other U.S. importers that reported imports of CSPV products from developing countries listed in Presidential Proclamation 9693 during January 2016-June 2019, except for India and Turkey, which were later removed from the list.

[4] Alternative U.S. import data from Canada and Mexico with country-of-origin based on the assembly location of the modules were requested in accordance with the North American Free Trade Agreement ("NAFTA") rules of origin. As was the case in the original safeguard investigation, alternative U.S. import data from China with country-of-origin based on the assembly location of the modules were also requested in order to consider the separate orders associated with the CSPV 1 and 2 investigations. Antidumping and countervailing duty orders associated with the CSPV 1 investigations concerning China became effective December 7, 2012, and the orders were continued following its first five-year review in March 2019. In the CSPV 1 investigations, Commerce determined that the country of origin of CSPV modules was the country of manufacture of the CSPV cells. Antidumping and countervailing duty orders

(*continued*...)

from Canada declined from *** ($***) in 2016 to *** ($***) in 2017 and declined further to *** ($***) in 2018. U.S. imports of CSPV modules from Canada were lower in January-June 2019 at *** ($***) compared with January-June 2018. The average unit value of U.S. imports of modules from Canada declined from $*** per kW in 2016 to $*** per kW in 2017 and declined further to $*** per kW in 2018. The average unit value of U.S. imports of modules from Canada was $*** per kW in January-June 2019. The share of the total quantity of U.S. imports held by Canadian imports increased from *** percent of total U.S. imports in 2016 to *** percent and *** percent in 2017 and 2018, respectively, but was lower at *** percent in January-June 2019.

U.S. imports of CSPV modules from Mexico declined from *** ($***) in 2016 to *** ($***) in 2017 before increasing to *** ($***) in 2018. U.S. imports of CSPV modules from Mexico were lower in January-June 2019 at *** ($***) compared with January-June 2018. The average unit value of U.S. imports of modules from Mexico declined from a high of $*** per kW in 2016 to $*** per kW in 2017 and declined further to a low of $*** per kW in 2018. The share of the total quantity of U.S. imports held by imports from Mexico fell from *** percent of total U.S. imports in 2016 to *** percent in 2017 before increasing to *** percent in 2018. The share of the total quantity of U.S. imports held by imports from Mexico was *** percent in January-June 2019.

U.S. imports of CSPV modules from China declined from *** ($***) in 2016 to *** ($***) in 2017 and declined further to *** ($***) in 2018. U.S. imports of CSPV modules from China were *** ($***) in January-June 2018 and *** ($***) in January-June 2019. The average unit value of U.S. imports of modules from China declined from $*** per kW in 2016 to $*** per kW in 2017 before increasing to $*** per kW in 2018. The average unit value of U.S. imports of modules from China was $*** per kW in January-June 2019. The share of the total quantity of U.S. imports held by imports from China decreased overall from *** percent of total U.S. imports in 2016 to *** percent and *** percent in 2017 and 2018, respectively. The share of the total quantity of U.S. imports held by imports from China was *** percent in January-June 2019. China was the largest source of U.S. imports of CSPV products during 2016, but was the fifth

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associated with the CSPV 2 investigations concerning China became effective February 18, 2015. In its final CSPV 2 determinations, Commerce defined the subject merchandise from China to include U.S. imports of CSPV modules assembled in China from CSPV cells made in other countries.

largest source of U.S. imports in 2017 before dropping out of the list of top ten largest importers in 2018 and the first half of 2019.

U.S. imports of CSPV cells, by source

Table V-2 and figure V-2 present data for U.S. imports of CSPV cells. Total U.S. imports of CSPV cells increased from 265.4 MW in 2016 to 278.4 MW in 2017 and increased further to 836.9 MW in 2018. Total U.S. imports of CSPV cells were higher at 951.0 MW during January-June 2019 compared with 308.3 MW during January-June 2018. The average unit value of U.S. imports of CSPV cells declined from a high of $366 per kW in 2016 to $333 per kW in 2017 and declined further to $312 per kW in 2018. The average unit value was $349 per kW in January-June 2018 and was at its lowest point at $194 per kW during January-June 2019. The leading suppliers of foreign CSPV cells to the United States during 2016 were Taiwan and Germany, representing *** percent and *** percent of all imports by quantity, respectively. By 2017, however, the leading suppliers of foreign CSPV cells to the United States were Japan, Malaysia, Taiwan, and Vietnam, representing *** percent, *** percent, *** percent, and *** percent of all imports, respectively. During 2018 and the first half of 2019, the leading suppliers of foreign CSPV cells to the United States were Korea and Malaysia, representing *** percent and *** percent of all imports in 2018, respectively, and *** percent and *** percent in January-June 2019, respectively.

Table V-2
CSPV cells: U.S. imports, by source, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year 2016	Calendar year 2017	Calendar year 2018	January to June 2018	January to June 2019
	Quantity (kilowatts)				
U.S. imports from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Germany	***	***	***	***	***
India	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	***
Thailand	***	***	***	***	***
Turkey	***	***	***	***	***
Vietnam	***	***	***	***	***
All other developing countries	***	***	***	***	***
All other non-developing countries	***	***	***	***	***
All import sources	265,382	278,426	836,903	308,336	951,003
	Value (1,000 dollars)				
U.S. imports from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Germany	***	***	***	***	***
India	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	***
Thailand	***	***	***	***	***
Turkey	***	***	***	***	***
Vietnam	***	***	***	***	***
All other developing countries	***	***	***	***	***
All other non-developing countries	***	***	***	***	***
All import sources	97,028	92,637	260,992	107,724	184,285

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Table V-2--Continued
CSPV cells: U.S. imports, by source, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Unit value (dollars per kilowatt)				
U.S. imports from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Germany	***	***	***	***	***
India	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	***
Thailand	***	***	***	***	***
Turkey	***	***	***	***	***
Vietnam	***	***	***	***	***
All other developing countries	***	***	***	***	***
All other non-developing countries	***	***	***	***	***
All import sources	366	333	312	349	194
	Ratio to U.S. cell production (percent)				
U.S. imports from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Germany	***	***	***	***	***
India	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	***
Thailand	***	***	***	***	***
Turkey	***	***	***	***	***
Vietnam	***	***	***	***	***
All other developing countries	***	***	***	***	***
All other non-developing countries	***	***	***	***	***
All import sources	***	***	***	***	***

Table continued on next page.

Table V-2--Continued
CSPV cells: U.S. imports, by source, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year 2016	Calendar year 2017	Calendar year 2018	January to June 2018	January to June 2019
	Share of quantity (percent)				
U.S. imports from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Germany	***	***	***	***	***
India	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	***
Thailand	***	***	***	***	***
Turkey	***	***	***	***	***
Vietnam	***	***	***	***	***
All other developing countries	***	***	***	***	***
All other non-developing countries	***	***	***	***	***
All import sources	100.0	100.0	100.0	100.0	100.0
	Rank based on quantity				
U.S. imports from.-- Largest source	Taiwan	Japan	Korea	Malaysia	Korea
2nd largest source	Germany	Malaysia	Malaysia	Philippines	Malaysia
3rd largest source	Korea	Taiwan	Japan	Japan	Vietnam
4th largest source	Thailand	Vietnam	Vietnam	Vietnam	Japan
5th largest source	Philippines	Philippines	Philippines	Thailand	Taiwan
6th largest source	Malaysia	Germany	Taiwan	Korea	China

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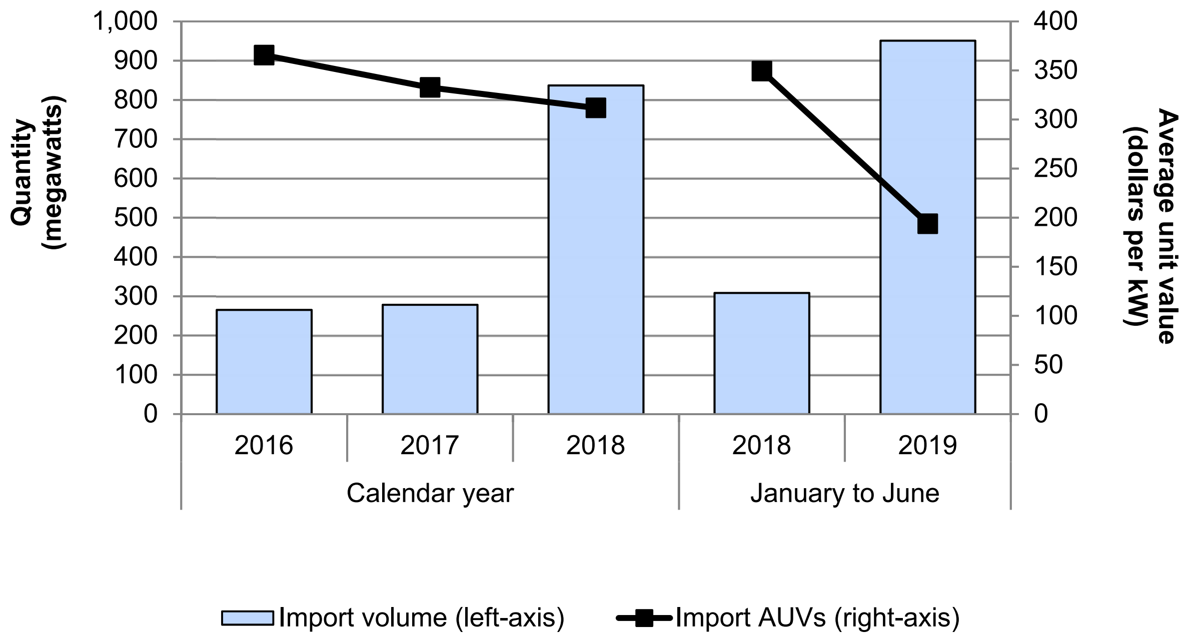
Table V-2--Continued
CSPV cells: U.S. imports, by source, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Share of value (percent)				
U.S. imports from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Germany	***	***	***	***	***
India	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	***
Thailand	***	***	***	***	***
Turkey	***	***	***	***	***
Vietnam	***	***	***	***	***
All other developing countries	***	***	***	***	***
All other non-developing countries	***	***	***	***	***
All import sources	100.0	100.0	100.0	100.0	100.0
	Rank based on value				
U.S. imports from.-- Largest source	Taiwan	Japan	Korea	Malaysia	Korea
2nd largest source	Germany	Philippines	Malaysia	Philippines	Malaysia
3rd largest source	Korea	Vietnam	Japan	Japan	Japan
4th largest source	Thailand	Taiwan	Philippines	Vietnam	Vietnam
5th largest source	Philippines	Malaysia	Vietnam	Taiwan	Taiwan
6th largest source	China	Germany	Taiwan	Korea	Philippines

Note.--Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent.

Source: Compiled from data submitted in response to Commission questionnaires.

Figure V-2
CSPV cells: U.S. import volumes and average unit values, 2016-18, January to June 2018, and January to June 2019



Source: Compiled from data submitted in response to Commission questionnaires.

U.S. imports of CSPV cells, by product types excluded from the safeguard measure

The Commission collected U.S. import data for CSPV cells by types to identify and quantify certain CSPV cells that were specifically excluded from the safeguard measure. The CSPV cell data collected in response to this request are presented in table V-3. During 2016, *** percent of reported U.S. imports of CSPV cells were covered by the safeguard measure. However, by 2017 and 2018, reported data show that only *** percent and *** percent of reported U.S. imports of CSPV cells, respectively, were covered as increases in imports of rear contact cells with tin-coated solid copper fingers ("rear contact/copper fingers")[5] were reported ***. During January-June 2018 and January-June 2019, rear contact cells accounted for *** percent and *** percent of reported U.S. imports of CSPV cells, respectively, as *** reported fewer imports of such cells from *** in the first half of 2019. *** reported imports of bifacial cells. Such reported U.S. imports of bifacial cells, all of which were imported from ***, accounted for *** share (***) of total reported U.S. imports of CSPV cells.

[5] Rear contact cells with tin-coated solid copper fingers are cells with a maximum rated power between 3.4 and 6.7 watts, inclusive, having the following characteristics: (A) A cell surface area between 154 cm^2 and 260 cm^2, inclusive, (B) no visible busbars or gridlines on the front of the cell, and (C) more than 100 interdigitated fingers of tin-coated solid copper adhered to the back of the cell, with the copper portion of the metal fingers having a thickness of greater than 0.01 mm. These items, if entered, or withdrawn from a warehouse for consumption, on or after September 19, 2018 are excluded from the safeguard measure (83 FR 47393, September 19, 2018).

Table V-3
CSPV cells: U.S. importers' U.S. imports, of certain excluded and all other cells, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Quantity (kilowatts)				
U.S. importers' U.S. imports of.-- Bifacial	***	***	***	***	***
Rear contact/copper fingers	***	***	***	***	***
All other cells	***	***	***	***	***
All forms	265,382	278,426	836,903	308,336	951,003
	Value (1,000 dollars)				
U.S. importers' U.S. imports of.-- Bifacial	***	***	***	***	***
Rear contact/copper fingers	***	***	***	***	***
All other cells	***	***	***	***	***
All forms	97,028	92,637	260,992	107,724	184,285
	Unit value (dollars per kilowatt)				
U.S. importers' U.S. imports of.-- Bifacial	***	***	***	***	***
Rear contact/copper fingers	***	***	***	***	***
All other cells	***	***	***	***	***
All forms	366	333	312	349	194
	Share of quantity (percent)				
U.S. importers' U.S. imports of.-- Bifacial	***	***	***	***	***
Rear contact/copper fingers	***	***	***	***	***
All other cells	***	***	***	***	***
All forms	100.0	100.0	100.0	100.0	100.0

Note.--Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent.

Source: Compiled from data submitted in response to Commission questionnaires.

U.S. imports of CSPV modules, by source

Table V-4 and figure V-3 present data for U.S. imports of CSPV modules, by source of imports. The leading supplier of foreign CSPV modules to the United States during 2016 was China, representing *** percent of all imports by quantity in that year. Total U.S. imports of CSPV modules from China (based on country of origin of cells) declined from *** in 2016 to *** in 2017 and declined further to *** in 2018. Total U.S. imports of CSPV modules from China were lower at *** during January-June 2019 compared with *** during January-June 2018. The average unit value of U.S. imports of CSPV modules from China declined from $*** per kW in 2016 to $*** per kW in 2017 but increased to $*** per kW in 2018 and was $*** per kW during January-June 2019.

After 2016, however, the leading supplier of foreign CSPV products to the United States was Malaysia, representing *** percent of all imports in 2017, *** percent in 2018, and *** percent in January-June 2019. Total U.S. imports of CSPV modules from Malaysia (based on country of origin of cells) increased from *** in 2016 to *** in 2017, but declined to *** in 2018. Total U.S. imports of CSPV modules from Malaysia were higher at *** during January-June 2019 compared with *** during January-June 2018. The average unit value of U.S. imports of CSPV modules from Malaysia declined from a high of $*** per kW in 2016 to $*** per kW in 2017 and declined further to $*** per kW in 2018. The average unit value was $*** per kW in January-June 2018 and was at its lowest point at $*** per kW during January-June 2019.

Table V-4
CSPV modules: U.S. imports, by source, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Quantity (kilowatts)				
U.S. imports (based on country of origin of cells) from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Germany	***	***	***	***	***
India	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	***
Thailand	***	***	***	***	***
Turkey	***	***	***	***	***
Vietnam	***	***	***	***	***
All other developing countries	***	***	***	***	***
All other non-developing countries	***	***	***	***	***
All import sources	11,590,991	9,787,904	5,299,723	2,374,064	4,082,389
	Quantity (kilowatts)				
U.S. imports (based on country of origin of module assembly) from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Mexico	***	***	***	***	***

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Table V-4--Continued
CSPV modules: U.S. imports, by source, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Value (1,000 dollars)				
U.S. imports (based on country of origin of cells) from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Germany	***	***	***	***	***
India	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	***
Thailand	***	***	***	***	***
Turkey	***	***	***	***	***
Vietnam	***	***	***	***	***
All other developing countries	***	***	***	***	***
All other non-developing countries	***	***	***	***	***
All import sources	6,826,665	4,020,795	2,218,159	1,069,576	1,386,176
	Value (1,000 dollars)				
U.S. imports (based on country of origin of module assembly) from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Mexico	***	***	***	***	***

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Table V-4--Continued
CSPV modules: U.S. imports, by source, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Unit value (dollars per kilowatt)				
U.S. imports (based on country of origin of cells) from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Germany	***	***	***	***	***
India	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	***
Thailand	***	***	***	***	***
Turkey	***	***	***	***	***
Vietnam	***	***	***	***	***
All other developing countries	***	***	***	***	***
All other non-developing countries	***	***	***	***	***
All import sources	589	411	419	451	340
	Unit value (dollars per kilowatt)				
U.S. imports (based on country of origin of module assembly) from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Mexico	***	***	***	***	***

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Table V-4--Continued
CSPV modules: U.S. imports, by source, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Ratio to U.S. module production (percent)				
U.S. imports (based on country of origin of cells) from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Germany	***	***	***	***	***
India	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	***
Thailand	***	***	***	***	***
Turkey	***	***	***	***	***
Vietnam	***	***	***	***	***
All other developing countries	***	***	***	***	***
All other non-developing countries	***	***	***	***	***
All import sources	***	***	***	***	***
	Ratio to U.S. module production (percent)				
U.S. imports (based on country of origin of module assembly) from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Mexico	***	***	***	***	***

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Table V-4--Continued
CSPV modules: U.S. imports, by source, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Share of quantity (percent)				
U.S. imports (based on country of origin of cells) from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Germany	***	***	***	***	***
India	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	***
Thailand	***	***	***	***	***
Turkey	***	***	***	***	***
Vietnam	***	***	***	***	***
All other developing countries	***	***	***	***	***
All other non-developing countries	***	***	***	***	***
All import sources	100.0	100.0	100.0	100.0	100.0
	Share of quantity (percent)				
U.S. imports (based on country of origin of module assembly) from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Mexico	***	***	***	***	***
	Rank based on quantity				
U.S. imports (based on country of origin of cells) from.-- Largest source	China	Malaysia	Malaysia	Korea	Malaysia
2nd largest source	Malaysia	Korea	Korea	Malaysia	Vietnam
3rd largest source	Korea	Thailand	Thailand	Thailand	Thailand
4th largest source	Taiwan	Vietnam	Singapore	Vietnam	Korea
5th largest source	Thailand	China	Vietnam	Singapore	Singapore
6th largest source	Vietnam	Singapore	Philippines	Philippines	Philippines
7th largest source	Singapore	Philippines	Turkey	India	Turkey
8th largest source	Germany	Taiwan	India	Turkey	Taiwan
9th largest source	Philippines	Japan	Taiwan	Taiwan	India
10th largest source	India	Germany	China	China	China

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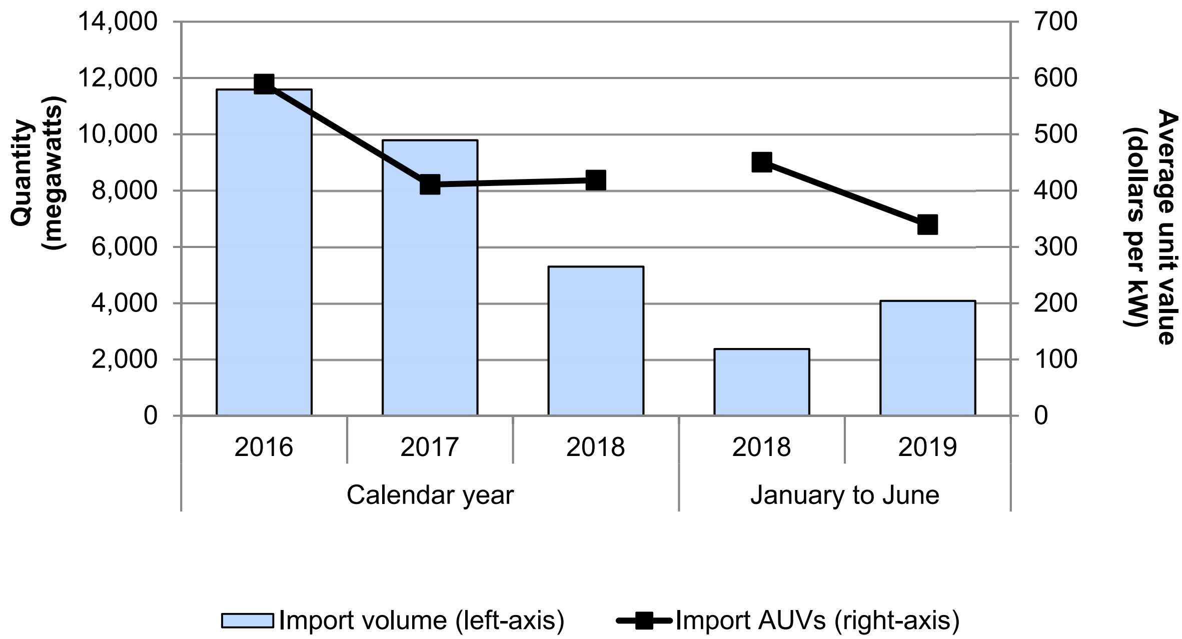
Table V-4--Continued
CSPV modules: U.S. imports, by source, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Share of value (percent)				
U.S. imports (based on country of origin of cells) from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Germany	***	***	***	***	***
India	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	***
Thailand	***	***	***	***	***
Turkey	***	***	***	***	***
Vietnam	***	***	***	***	***
All other developing countries	***	***	***	***	***
All other non-developing countries	***	***	***	***	***
All import sources	100.0	100.0	100.0	100.0	100.0
	Share of value (percent)				
U.S. imports (based on country of origin of module assembly) from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Mexico	***	***	***	***	***
	Rank based on value				
U.S. imports (based on country of origin of cells) from.-- Largest source	Malaysia	Malaysia	Malaysia	Korea	Malaysia
2nd largest source	China	Korea	Korea	Malaysia	Vietnam
3rd largest source	Korea	Thailand	Thailand	Thailand	Korea
4th largest source	Taiwan	China	Singapore	Singapore	Thailand
5th largest source	Thailand	Vietnam	Philippines	Vietnam	Philippines
6th largest source	Singapore	Singapore	Vietnam	Philippines	Singapore
7th largest source	Vietnam	Philippines	Turkey	India	Turkey
8th largest source	Philippines	Taiwan	India	Turkey	Taiwan
9th largest source	Germany	Indonesia	Taiwan	China	India
10th largest source	India	India	China	Taiwan	China

Note.--Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent.

Source: Compiled from data submitted in response to Commission questionnaires.

Figure V-3
CSPV modules: U.S. import volumes and average unit values, 2016-18, January to June 2018, and January to June 2019



Source: Compiled from data submitted in response to Commission questionnaires.

U.S. imports of CSPV modules, by product types excluded from the safeguard measure

The Commission collected U.S. import data for CSPV modules by types to identify and quantify certain CSPV modules that were specifically excluded from the safeguard measure. The data collected in response to this request are presented in table V-5. During 2016-18, greater than 90 percent of reported U.S. imports of CSPV modules presented are modules covered by the safeguard measure, and measurable amounts of excluded items are also imported, such as

Table V-5
CSPV modules: U.S. importers' U.S. imports, of certain excluded and all other modules, by type, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year 2016	Calendar year 2017	Calendar year 2018	January to June 2018	January to June 2019
	Quantity (kilowatts)				
U.S. importers' U.S. imports of.-- Bifacial	***	***	***	***	***
Flexible fiberglass	***	***	***	***	***
Light directing film	***	***	***	***	***
Rear contact/copper fingers	***	***	***	***	***
Low wattage	***	***	***	***	***
All other modules	10,786,747	9,329,016	4,776,099	2,145,722	3,171,661
All forms	11,590,991	9,787,904	5,299,723	2,374,064	4,082,389
	Value (1,000 dollars)				
U.S. importers' U.S. imports of.-- Bifacial	***	***	***	***	***
Flexible fiberglass	***	***	***	***	***
Light directing film	***	***	***	***	***
Rear contact/copper fingers	***	***	***	***	***
Low wattage	***	***	***	***	***
All other modules	6,015,038	3,710,185	1,911,496	929,052	1,062,838
All forms	6,826,665	4,020,795	2,218,159	1,069,576	1,386,176
	Unit value (dollars per kilowatt)				
U.S. importers' U.S. imports of.-- Bifacial	***	***	***	***	***
Flexible fiberglass	***	***	***	***	***
Light directing film	***	***	***	***	***
Rear contact/copper fingers	***	***	***	***	***
Low wattage	***	***	***	***	***
All other modules	558	398	400	433	335
All forms	589	411	419	451	340
	Share of quantity (percent)				
U.S. importers' U.S. imports of.-- Bifacial	***	***	***	***	***
Flexible fiberglass	***	***	***	***	***
Light directing film	***	***	***	***	***
Rear contact/copper fingers	***	***	***	***	***
Low wattage	***	***	***	***	***
All other modules	93.1	95.3	90.1	90.4	77.7
All forms	100.0	100.0	100.0	100.0	100.0

Note: Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent.

Source: Compiled from data submitted in response to Commission questionnaires.

modules incorporating bifacial cells,[6] flexible fiberglass solar panels,[7] modules incorporating rear contact cells with tin-coated solid copper fingers,[8] and low wattage modules.[9] There were no reported U.S. imports of CSPV products incorporating light directing film.[10] The reported data show that U.S. imports of all types of specifically excluded items declined from 2016 to 2018 and were lower in January-June 2019 compared with January-June 2018, with the exception of CSPV products incorporating bifacial cells. Such bifacial U.S. imports were comparatively among the *** average unit values of all U.S. imports, ranging from $***

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[6] Bifacial solar panels that absorb light and generate electricity on each side of the panel and that consist of only bifacial solar cells that absorb light and generate electricity on each side of the cells entered, or withdrawn from a warehouse for consumption, on or after June 13, 2019 were excluded from the safeguard measure (84 FR 27684, June 13, 2019). Although the USTR subsequently withdrew the exclusion for bifacial solar panels, effective with respect to articles entered for consumption, or withdrawn from a warehouse for consumption, on or after October 28, 2019 (84 FR 54244, October 9, 2019), the CIT has preliminarily enjoined USTR and Customs from withdrawing the bifacial exclusion until entry of final judgment in the case. Court Order, *Invenergy Renewables LLC v. United States*, Ct. No. 19-00192 (Dec. 5, 2019) (ECF No. 114).

[7] Flexible fiberglass solar panels without glass components other than fiberglass, such panels having power outputs ranging from 250 to 900 watts entered, or withdrawn from a warehouse for consumption, on or after June 13, 2019 are excluded from the safeguard measure (84 FR 27684, June 13, 2019).

[8] Rear contact cells with tin-coated solid copper fingers are defined above. Modules incorporating such cells are modules with a maximum rated power between 320 and 500 watts, inclusive, having the following characteristics: (A) Length between 1,556 mm and 2,070 mm inclusive, and width between 1,014 mm and 1,075 mm, inclusive, (B) where the cells comprising the module have no visible busbars or gridlines on the front of the cells, and (C) the cells comprising the module have more than 100 interdigitated fingers of tin-coated solid copper adhered to the back of the cells, with the copper portion of the metal fingers having thickness greater than 0.01 mm. These items, if entered, or withdrawn from a warehouse for consumption, on or after September 19, 2018 are excluded from the safeguard measure (83 FR 47393, September 19, 2018).

[9] Presidential Proclamation 9693 excluded six specific “low wattage” products from application of the safeguard measure, which took effect on February 7, 2018 (83 FR 3541, January 25, 2018). An additional five specific “low wattage” products entered, or withdrawn from a warehouse for consumption, on or after September 19, 2018 are also excluded from the safeguard measure (83 FR 47393, September 19, 2018). These items are listed in Part I of this report (“Scope of the safeguard remedy”).

[10] CSPV products incorporating light directing film include modules consisting of cells arranged in rows that are laminated in the module and that are separated by more than 10 mm, with an optical film spanning the gaps between all rows that is designed to direct sunlight onto the cells, and not including modules that lack said optical film or only have a white or other backing layer that absorbs or scatters sunlight. Such CSPV products entered, or withdrawn from a warehouse for consumption, on or after June 13, 2019 are excluded from the safeguard measure (84 FR 27684, June 13 19, 2019).

per kW to $*** per kW during the annual reporting periods and $*** per kW during January-June 2019. U.S. imports of bifacial CSPV modules increased from *** in 2016 to *** in 2017 before declining to *** in 2018. U.S. imports of bifacial CSPV modules were higher at *** during January-June 2019 than at *** during January-June 2018. Bifacial module imports accounted for *** percent of total U.S. imports of CSPV products during 2016-18 (as well as in the first half of 2018), but accounted for *** percent of total U.S. imports of CSPV products during January-June 2019.

Importers' CSPV technology

A majority of the responding U.S. importers reported imports of CSPV products containing monocrystalline cells (37 out of 51 responding to this request) and multicrystalline cells (26 out of 51) since January 1, 2016, whereas almost one-half of responding U.S. importers reported imports of CSPV products containing PERC cells (24 out of 51) (table V-6). A minority of U.S. importers reported imports of CSPV products containing bifacial cells (10 out of 51), hybrid cells (4 out of 51), and HIT cells (4 out of 51).

The largest importing firms during 2018 were ***, which together accounted for *** of reported total U.S. CSPV imports during the period of investigation (see Part I, table I-14).[11] All of the largest importing firms reported imports of monocrystalline and *** reported imports of multicrystalline cells.

Table V-6
CSPV products: U.S. importers' reported ability to supply specific technologies, since January 1, 2016

Firm	Firms' reported cell technologies					
	Mono	Multi	PERC	HIT	Bifacial	Hybrid
Academy	***	***	***	***	***	***
Alps	***	***	***	***	***	***
Ameresco	***	***	***	***	***	***
Attic Breeze	***	***	***	***	***	***
AUO Green	***	***	***	***	***	***
Boviet	***	***	***	***	***	***

Table continued on next page.

[11] *** reported imports from ***; *** reported imports from ***; *** reported imports from ***; and *** reported imports from ***.

Table V-6
CSPV products: U.S. importers' reported ability to supply specific technologies, since January 1, 2016

Firm	Firms' reported cell technologies					
	Mono	Multi	PERC	HIT	Bifacial	Hybrid
BYD	***	***	***	***	***	***
Canadian Solar	***	***	***	***	***	***
Cantex	***	***	***	***	***	***
Carmanah	***	***	***	***	***	***
Celestica	***	***	***	***	***	***
Chamberlain	***	***	***	***	***	***
EDF Renewables	***	***	***	***	***	***
ET Solar	***	***	***	***	***	***
First Solar	***	***	***	***	***	***
Goal Zero	***	***	***	***	***	***
Grand View	***	***	***	***	***	***
Grape	***	***	***	***	***	***
Hanwha America	***	***	***	***	***	***
Hanwha Corp.	***	***	***	***	***	***
Hanwha USA	***	***	***	***	***	***
Heliene	***	***	***	***	***	***
Hyundai	***	***	***	***	***	***
Industrial	***	***	***	***	***	***
JA Solar	***	***	***	***	***	***
Jinko CA	***	***	***	***	***	***
Jinko FL	***	***	***	***	***	***
LG	***	***	***	***	***	***
Longi	***	***	***	***	***	***
Merlin	***	***	***	***	***	***
Mission	***	***	***	***	***	***
Panasonic	***	***	***	***	***	***
Panasonic NA	***	***	***	***	***	***
PowerFilm	***	***	***	***	***	***
RDK	***	***	***	***	***	***
REC	***	***	***	***	***	***
Rotech	***	***	***	***	***	***
SBM	***	***	***	***	***	***
S-Energy	***	***	***	***	***	***
Silfab ON	***	***	***	***	***	***
Silfab WA	***	***	***	***	***	***
SolarTech Power	***	***	***	***	***	***
SolarTech Universal	***	***	***	***	***	***
Solatube	***	***	***	***	***	***
Sonali	***	***	***	***	***	***
Suniva	***	***	***	***	***	***
SunPower OR (post-acquisition)	***	***	***	***	***	***
SunPower OR (pre-acquisition) SolarWorld	***	***	***	***	***	***
SunPower CA	***	***	***	***	***	***
SunPower Corp	***	***	***	***	***	***
Targray	***	***	***	***	***	***
Tesla	***	***	***	***	***	***
Trina	***	***	***	***	***	***
Winaico	***	***	***	***	***	***
Yingli	***	***	***	***	***	***
Total	37	26	24	4	10	4

Source: Compiled from data submitted in response to Commission questionnaires.

U.S. importers' imports subsequent to June 30, 2019

The Commission requested importers to indicate whether they had imported or arranged for the importation of CSPV products for delivery after June 30, 2019. The quarterly data reported by responding importers show that U.S. imports are expected to increase from the third quarter of 2019 into the last quarter of 2019, but decline in the first two quarters of 2020 (table V-7). The leading sources of arranged foreign CSPV products to the United States during July 2019-June 2020 are Malaysia (U.S. importers ***), Vietnam (U.S. importers ***), Korea (U.S. importers ***), and Thailand (U.S. importers ***), representing *** percent, *** percent, *** percent, and *** percent of all imports by quantity, respectively. The total quantity of reported U.S. imports for the first half of 2019 (5.0 MW) (see table V-1) and arranged U.S. imports for the second half of 2019 (8.6 MW) totals 13.7 MW of U.S. imports expected for calendar year 2019, which is 122.6 percent higher than the annual import level of 6.1 MW reported for calendar year 2018 (compare table V-1 and table V-7). Further, the total quantity of arranged U.S. imports for the first half of 2020 (6.8 MW) is 34.5 percent higher than the U.S. import level reported for the first half of 2019 (5.0 MW).

Table V-7
CSPV products: Arranged U.S. imports with country-of-origin based on manufacture location, July 2019 through June 2020

Item	Period				
	Jul-Sept 2019	Oct-Dec 2019	Jan-Mar 2020	Apr-Jun 2020	Total
	Quantity (kilowatts)				
Arranged U.S. imports (based on country of origin cells) from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Germany	***	***	***	***	***
India	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	***
Thailand	***	***	***	***	***
Turkey	***	***	***	***	***
Vietnam	***	***	***	***	***
All other developing countries	***	***	***	***	***
All other non-developing countries	***	***	***	***	***
All import sources	4,012,326	4,615,423	3,775,237	2,996,300	15,399,285
	Share of quantity (percent)				
Arranged U.S. imports (based on country of origin cells) from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Germany	***	***	***	***	***
India	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	***
Thailand	***	***	***	***	***
Turkey	***	***	***	***	***
Vietnam	***	***	***	***	***
All other developing countries	***	***	***	***	***
All other non-developing countries	***	***	***	***	***
All import sources	100.0	100.0	100.0	100.0	100.0

Note.--Shares and ratios shown as "0.0" represent values greater than zero but less than 0.05 percent.

Source: Compiled from data submitted in response to Commission questionnaires.

U.S. importers' inventories

Table V-8 presents data for inventories of U.S. imports of CSPV products held in the United States. A majority (30 of 55) of responding importers indicated in their questionnaire responses that they maintained inventories during at least part of the period since January 2016. Most U.S. inventories held by U.S. importers (*** percent in 2018 and *** percent in January-June 2019) were reported by ***. U.S. importers' end-of-period inventories fluctuated from *** in 2016 to *** in 2017 and to *** in 2018, but were higher at *** during January-June 2019 than reported in the comparable period in 2018. The ratios of inventories to imports and shipments increased from *** percent in 2016 to *** percent in 2017 and to *** percent in 2018, but were lower at *** percent during January-June 2019 compared with *** percent during January-June 2018.

Table V-8
CSPV products: U.S. importers' inventories, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Quantity (kilowatts)				
U.S. importers' end-of-period inventories	***	***	***	***	***
	Ratio (percent)				
Ratio of inventories to.-- U.S. imports	***	***	***	***	***
U.S. shipments of imports	***	***	***	***	***
Total shipments of imports	***	***	***	***	***

Note.--Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent.

Source: Compiled from data submitted in response to Commission questionnaires.

U.S. imports relative to production

As was the case in the original safeguard investigation, U.S. imports remained greater than U.S. production since January 1, 2016 (see table V-1). The ratio of U.S. imports to U.S. production increased from *** percent in 2016 to *** percent in 2017, before declining to *** percent in 2018. The ratio of U.S. imports to U.S. production was lower at *** percent in January-June 2019 than at *** percent in January-June 2018. The largest declines in the ratio of U.S. imports relative to U.S. production were reported for CSPV products from China, Germany, Korea, Malaysia, and Taiwan.

Apparent U.S. consumption and market shares

Tables V-9 and V-10 and figures V-4 and V-5 present data on apparent U.S. consumption and U.S. market shares for CSPV products. Tables V-11 and V-12 and figures V-6 and V-7 present data on apparent U.S. merchant market consumption and U.S. market shares for CSPV cells. Tables V-13 and V-14 and figures V-8 and V-9 present data on apparent U.S. total market consumption and U.S. market shares for CSPV modules.

Apparent U.S. consumption of CSPV products, by quantity, declined by *** percent from *** in 2016 to *** in 2018 (i.e., a *** percent decline from *** in 2016 to *** in 2017 and a *** percent decline from *** in 2017 to *** in 2018), but was *** percent higher at *** in January-June 2019 compared with *** in January-June 2018. By value, apparent U.S. consumption of CSPV products declined by *** percent from $*** in 2016 to $*** in 2018 (i.e., a *** percent decline from $*** in 2016 to $*** in 2017 and a *** percent decline from $*** in 2017 to $*** in 2018), but was *** percent higher at $*** during January-June 2019 compared with $*** in January-June 2018. Apparent U.S. merchant market consumption of CSPV cells, by quantity, increased from *** in 2016 to *** in 2017 to *** in 2018), and was higher at *** in January-June 2019 compared with *** in January-June 2018. By value, apparent U.S. merchant market consumption of CSPV cells declined from $*** in 2016 to $*** in 2017 but increased to $*** in 2018, and was higher at $*** during January-June 2019 compared with $*** in January-June 2018. Apparent U.S. total market consumption of CSPV modules, by quantity, declined from *** in 2016 to *** in 2017 and to *** in 2018, but was higher at *** in January-June 2019 compared with *** in January-June 2018. By value, apparent U.S. total market consumption of CSPV modules declined from $*** in 2016 to $*** in 2017 and to $*** in 2018, but was higher at $*** during January-June 2019 compared with $*** in January-June 2018.

The U.S. producers' component of apparent U.S. consumption of CSPV products declined overall by *** percent from *** in 2016 to *** in 2017 to *** in 2018, and was *** percent lower at *** during January-June 2019 compared with *** in January-June 2018. The U.S. import component of apparent U.S. consumption decreased overall by 48.2 percent from 12 GW in 2016 to 10 GW in 2017 to 6 GW in 2018, but was 87.6 percent higher at 5 GW during January-June 2019 compared with 3 GW in January-June 2018.

The U.S. producers accounted for a relatively small and declining share of the U.S. market for CSPV products during the period of investigation. During 2016, the U.S. producers accounted for *** percent of total apparent U.S. consumption by quantity and *** percent by value. By 2017 and 2018, however, the share of apparent U.S. consumption held by domestic producers fell to *** and *** percent by quantity, respectively, while it fluctuated to *** and *** percent by value, respectively. During January-June 2019, U.S. producers accounted for *** percent of total apparent U.S. consumption by quantity and *** percent by value.[12]

Even as U.S. consumption for CSPV products declined from 2016 to 2017 and further to 2018, certain foreign suppliers, primarily Korea and Malaysia, captured a larger share of the U.S. market. The market share held by Korean imports, on the basis of quantity, increased from *** percent in 2016 to *** percent in 2017 to *** percent in 2018; whereas that held by Malaysian imports increased from *** percent in 2016 to *** percent in 2017 before declining slightly to *** percent in 2018. On the other hand, the market share held by China and Taiwan (for which there are currently antidumping and/or countervailing duty orders in place) declined overall by *** and *** percentage points, respectively, from 2016 to *** percent and *** percent of the U.S. market in 2018, respectively. The market share held by Chinese imports, on the basis of quantity, declined from *** percent in 2016 to *** percent in 2017 to *** percent in 2018; whereas that held by imports from Taiwan declined from *** percent in 2016 to *** percent in 2017 before declining further to *** percent in 2018.

[12] As previously indicated in part III of this report, the U.S. shipments component of apparent U.S. consumption by quantity (in kW) reflects U.S. producers' U.S. shipments of (1) modules that contain U.S.-produced CSPV cells, (2) commercially sold U.S.-produced CSPV cells that are otherwise not reported by module assemblers, and (3) re-imports of modules containing U.S.-origin CSPV cells. This quantity measure excludes any CSPV modules produced in the United States from imported CSPV cells, as those are reported for the purposes of apparent U.S. consumption as imports. The U.S. component for value includes the value of solar panels sold in the United States from producers plus the incremental value added in the United States for the module assembly of foreign-origin CSPV cells. In measuring consumption and market share this methodology avoids reclassifying and/or double counting merchandise already reported once either by a domestic producer or an import.

Table V-9
CSPV products: Apparent U.S. consumption, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Quantity (kilowatts)				
U.S. producers' U.S. shipments	***	***	***	***	***
U.S. imports (based on country of origin of cells) from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Germany	***	***	***	***	***
India	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	***
Thailand	***	***	***	***	***
Turkey	***	***	***	***	***
Vietnam	***	***	***	***	***
All other developing countries	***	***	***	***	***
All other non-developing countries	***	***	***	***	***
All import sources	11,856,373	10,066,330	6,136,626	2,682,400	5,033,392
of which cells	265,382	278,426	836,903	308,336	951,003
of which modules	11,590,991	9,787,904	5,299,723	2,374,064	4,082,389
Apparent U.S. consumption	***	***	***	***	***
	Quantity (kilowatts)				
U.S. imports (based on country of origin of module assembly) from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Mexico	***	***	***	***	***

Table continued on next page.

Table V-9--Continued
CSPV products: Apparent U.S. consumption, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Value (1,000 dollars)				
U.S. producers' U.S. shipments	***	***	***	***	***
U.S. imports (based on country of origin of cells) from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Germany	***	***	***	***	***
India	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	***
Thailand	***	***	***	***	***
Turkey	***	***	***	***	***
Vietnam	***	***	***	***	***
All other developing countries	***	***	***	***	***
All other non-developing countries	***	***	***	***	***
All import sources	6,923,693	4,113,432	2,479,151	1,177,300	1,570,461
of which cells	97,028	92,637	260,992	107,724	184,285
of which modules	6,826,665	4,020,795	2,218,159	1,069,576	1,386,176
Apparent U.S. consumption	***	***	***	***	***
	Value (1,000 dollars)				
U.S. imports (based on country of origin of module assembly) from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Mexico	***	***	***	***	***

Note.--Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent. The quantity for U.S. producers' U.S. shipments reflects the quantity of solar panels sold in the United States. This quantity measure excludes any CSPV modules produced in the United States from imported CSPV cells, as those are reported for the purposes of apparent U.S. consumption as imports. The value for U.S. producers reflects the value of solar panels sold in the United States from producers plus the additional value added to either domestic or imported solar panels from producers. The average unit values presented for U.S. producers' U.S. shipments exclude the value added to imported solar panels. In measuring consumption and market share, this methodology avoids reclassifying and/or double counting merchandise already reported once either by a domestic producer or an importer.

Source: Compiled from data submitted in response to Commission questionnaires.

Table V-10
CSPV products: Market shares, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Quantity (kilowatts)				
Apparent U.S. consumption	***	***	***	***	***
	Share of quantity (percent)				
U.S. producers' U.S. shipments	***	***	***	***	***
U.S. imports (based on country of origin of cells) from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Germany	***	***	***	***	***
India	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	***
Thailand	***	***	***	***	***
Turkey	***	***	***	***	***
Vietnam	***	***	***	***	***
All other developing countries	***	***	***	***	***
All other non-developing countries	***	***	***	***	***
All import sources	***	***	***	***	***
of which cells	***	***	***	***	***
of which modules	***	***	***	***	***
Apparent U.S. consumption	100.0	100.0	100.0	100.0	100.0
	Share of quantity (percent)				
U.S. imports (based on country of origin of module assembly) from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Mexico	***	***	***	***	***

Table continued on next page.

Table V-10--Continued
CSPV products: Market shares, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Value (1,000 dollars)				
Apparent U.S. consumption	***	***	***	***	***
	Share of value (percent)				
U.S. producers' U.S. shipments	***	***	***	***	***
U.S. imports from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Germany	***	***	***	***	***
India	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	***
Thailand	***	***	***	***	***
Turkey	***	***	***	***	***
Vietnam	***	***	***	***	***
All other developing countries	***	***	***	***	***
All other non-developing countries	***	***	***	***	***
All import sources	***	***	***	***	***
of which cells	***	***	***	***	***
of which modules	***	***	***	***	***
Apparent U.S. consumption	100.0	100.0	100.0	100.0	100.0
	Share of value (percent)				
U.S. imports (based on country of origin of module assembly) from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Mexico	***	***	***	***	***

Note.--Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent.

Source: Compiled from data submitted in response to Commission questionnaires.

Figure V-4
CSPV products: Apparent U.S. consumption based on quantity, 2016-18, January to June 2018, and January to June 2019

* * * * * * *

Source: Compiled from data submitted in response to Commission questionnaires.

Figure V-5
CSPV products: Apparent U.S. consumption based on value, 2016-18, January to June 2018, and January to June 2019

* * * * * * *

Source: Compiled from data submitted in response to Commission questionnaires.

Table V-11
CSPV cells: Apparent U.S. merchant market consumption, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Quantity (kilowatts)				
U.S. producers' commercial U.S. shipments	***	***	***	***	***
U.S. imports from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Germany	***	***	***	***	***
India	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	***
Thailand	***	***	***	***	***
Turkey	***	***	***	***	***
Vietnam	***	***	***	***	***
All other developing countries	***	***	***	***	***
All other non-developing countries	***	***	***	***	***
All import sources	265,382	278,426	836,903	308,336	951,003
Apparent U.S. merchant market consumption	***	***	***	***	***

Table continued on next page.

Table V-11--Continued
CSPV cells: Apparent U.S. merchant market consumption, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Value (1,000 dollars)				
U.S. producers' commercial U.S. shipments	***	***	***	***	***
U.S. imports from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Germany	***	***	***	***	***
India	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	***
Thailand	***	***	***	***	***
Turkey	***	***	***	***	***
Vietnam	***	***	***	***	***
All other developing countries	***	***	***	***	***
All other non-developing countries	***	***	***	***	***
All import sources	97,028	92,637	260,992	107,724	184,285
Apparent U.S. merchant market consumption	***	***	***	***	***

Note.--Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent.

Source: Compiled from data submitted in response to Commission questionnaires.

Table V-12
CSPV cells: Market shares for the U.S. merchant market, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Quantity (kilowatts)				
Apparent U.S. merchant market consumption	***	***	***	***	***
	Share of quantity (percent)				
U.S. producers' commercial U.S. shipments	***	***	***	***	***
U.S. imports from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Germany	***	***	***	***	***
India	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	***
Thailand	***	***	***	***	***
Turkey	***	***	***	***	***
Vietnam	***	***	***	***	***
All other developing countries	***	***	***	***	***
All other non-developing countries	***	***	***	***	***
All import sources	***	***	***	***	***
Apparent U.S. merchant market consumption	100.0	100.0	100.0	100.0	100.0

Table continued on next page.

Table V-12--Continued
CSPV cells: Market shares for the U.S. merchant market, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Value (1,000 dollars)				
Apparent U.S. merchant market consumption	***	***	***	***	***
	Share of value (percent)				
U.S. producers' commercial U.S. shipments	***	***	***	***	***
U.S. imports from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Germany	***	***	***	***	***
India	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	***
Thailand	***	***	***	***	***
Turkey	***	***	***	***	***
Vietnam	***	***	***	***	***
All other developing countries	***	***	***	***	***
All other non-developing countries	***	***	***	***	***
All import sources	***	***	***	***	***
Apparent U.S. merchant market consumption	100.0	100.0	100.0	100.0	100.0

Note.--Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent.

Source: Compiled from data submitted in response to Commission questionnaires.

Figure V-6
CSPV cells: Apparent U.S. merchant market consumption based on quantity, 2016-18, January to June 2018, and January to June 2019

* * * * * * *

Source: Compiled from data submitted in response to Commission questionnaires.

Figure V-7
CSPV cells: Apparent U.S. merchant market consumption based on value, 2016-18, January to June 2018, and January to June 2019

*   *   *   *   *   *   *

Source: Compiled from data submitted in response to Commission questionnaires.

Table V-13
CSPV modules: Apparent U.S. total market consumption, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Quantity (kilowatts)				
U.S. producers' U.S. shipments	***	***	***	***	***
U.S. imports (based on country of origin of cells) from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Germany	***	***	***	***	***
India	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	***
Thailand	***	***	***	***	***
Turkey	***	***	***	***	***
Vietnam	***	***	***	***	***
All other developing countries	***	***	***	***	***
All other non-developing countries	***	***	***	***	***
All import sources	11,590,991	9,787,904	5,299,723	2,374,064	4,082,389
Apparent U.S. consumption	***	***	***	***	***
	Quantity (kilowatts)				
U.S. imports (based on country of origin of module assembly) from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Mexico	***	***	***	***	***

Table continued on next page.

Table V-13--Continued
CSPV modules: Apparent U.S. total market consumption, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Value (1,000 dollars)				
U.S. producers' U.S. shipments	***	***	***	***	***
U.S. imports (based on country of origin of cells) from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Germany	***	***	***	***	***
India	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	***
Thailand	***	***	***	***	***
Turkey	***	***	***	***	***
Vietnam	***	***	***	***	***
All other developing countries	***	***	***	***	***
All other non-developing countries	***	***	***	***	***
All import sources	6,826,665	4,020,795	2,218,159	1,069,576	1,386,176
Apparent U.S. consumption	***	***	***	***	***
	Value (1,000 dollars)				
U.S. imports (based on country of origin of module assembly) from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Mexico	***	***	***	***	***

Note.--Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent.

Source: Compiled from data submitted in response to Commission questionnaires.

Table V-14
CSPV modules: Market shares for the total market, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Quantity (kilowatts)				
Apparent U.S. consumption	***	***	***	***	***
	Share of quantity (percent)				
U.S. producers' U.S. shipments	***	***	***	***	***
U.S. imports (based on country of origin of cells) from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Germany	***	***	***	***	***
India	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	***
Thailand	***	***	***	***	***
Turkey	***	***	***	***	***
Vietnam	***	***	***	***	***
All other developing countries	***	***	***	***	***
All other non-developing countries	***	***	***	***	***
All import sources	***	***	***	***	***
Apparent U.S. consumption	100.0	100.0	100.0	100.0	100.0
	Share of quantity (percent)				
U.S. imports (based on country of origin of module assembly) from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Mexico	***	***	***	***	***

Table continued on next page.

Table V-14--Continued
CSPV products: Market shares for the total market, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Value (1,000 dollars)				
Apparent U.S. consumption	***	***	***	***	***
	Share of value (percent)				
U.S. producers' U.S. shipments	***	***	***	***	***
U.S. imports from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Germany	***	***	***	***	***
India	***	***	***	***	***
Indonesia	***	***	***	***	***
Japan	***	***	***	***	***
Korea	***	***	***	***	***
Malaysia	***	***	***	***	***
Mexico	***	***	***	***	***
Philippines	***	***	***	***	***
Singapore	***	***	***	***	***
Taiwan	***	***	***	***	***
Thailand	***	***	***	***	***
Turkey	***	***	***	***	***
Vietnam	***	***	***	***	***
All other developing countries	***	***	***	***	***
All other non-developing countries	***	***	***	***	***
All import sources	***	***	***	***	***
Apparent U.S. consumption	100.0	100.0	100.0	100.0	100.0
	Share of value (percent)				
U.S. imports (based on country of origin of module assembly) from.-- Canada	***	***	***	***	***
China	***	***	***	***	***
Mexico	***	***	***	***	***

Note.--Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent.

Source: Compiled from data submitted in response to Commission questionnaires.

Figure V-8
CSPV products: Apparent U.S. total market consumption based on quantity, 2016-18, January to June 2018, and January to June 2019

* * * * * * *

Source: Compiled from data submitted in response to Commission questionnaires.

Figure V-9
CSPV products: Apparent U.S. total market consumption based on value, 2016-18, January to June 2018, and January to June 2019

* * * * * * *

Source: Compiled from data submitted in response to Commission questionnaires.

Part VI: Pricing data

Factors affecting prices

Raw material costs

The main underlying raw material input for CSPV cells is polysilicon, which is used to make ingots and wafers. One of the primary raw cost components of CSPV modules, in turn, is the cells made from polysilicon ingots and wafers. The price of polysilicon ingots and wafers fluctuated during the period but declined overall (figure VI-1). Between early 2016 and late 2017 the price of polysilicon rose intermittently, while the price of wafers initially dropped but then remained steady. Since the fourth quarter of 2017, the prices of both polysilicon and wafers have dropped, normalizing somewhat since late 2018. The prices of cells and modules followed similar patterns (figure VI-2). According to industry reports, the drop in these prices is due to decreased U.S. demand and high inventories of polysilicon.[1]

Raw material costs are the largest component of the total cost of goods sold ("COGS") for both cells and modules. Based on industry data, the cost of cells made up, on average, between 49.2 and 50.9 percent of the price of modules during 2016-18 and was 53.3 percent during the first half of 2019.[2] As shown in figure VI-2, the average price of domestic multi modules generally decreased throughout 2016, increased through the fourth quarter of 2017, and decreased thereafter. According to these data, the average prices of multi and mono modules generally followed similar trends through 2018 and the first half of 2019, regardless of source. Beginning in the second quarter of 2019, however, the average prices for U.S. and global multi and global mono modules either remained flat or decreased, while the average price of U.S. mono PERC modules increased.

[1] *U.S. Solar Market Insight: 2018 Year in Review, Executive Summaries*, Wood Mackenzie Power Renewables and the Solar Energy Industries Association ("SEIA"), March 2019, p. 18; *Ingot, Wafer Prices Dropping; Market Momentum Needed,* PV Magazine, October 25, 2018, available at http://www.pv-magazine.com/2018/10/25/ingot-wafer-prices-dropping-market-momentum-needed/, retrieved November 5, 2019.

[2] For data and a discussion on raw material costs as a percentage of the total cost of goods sold, see part IV.

Figure VI-1
Polysilicon ingots and wafers: Price trends for polysilicon ingots and wafers, quarterly, first quarter of 2016 through the third quarter of 2019

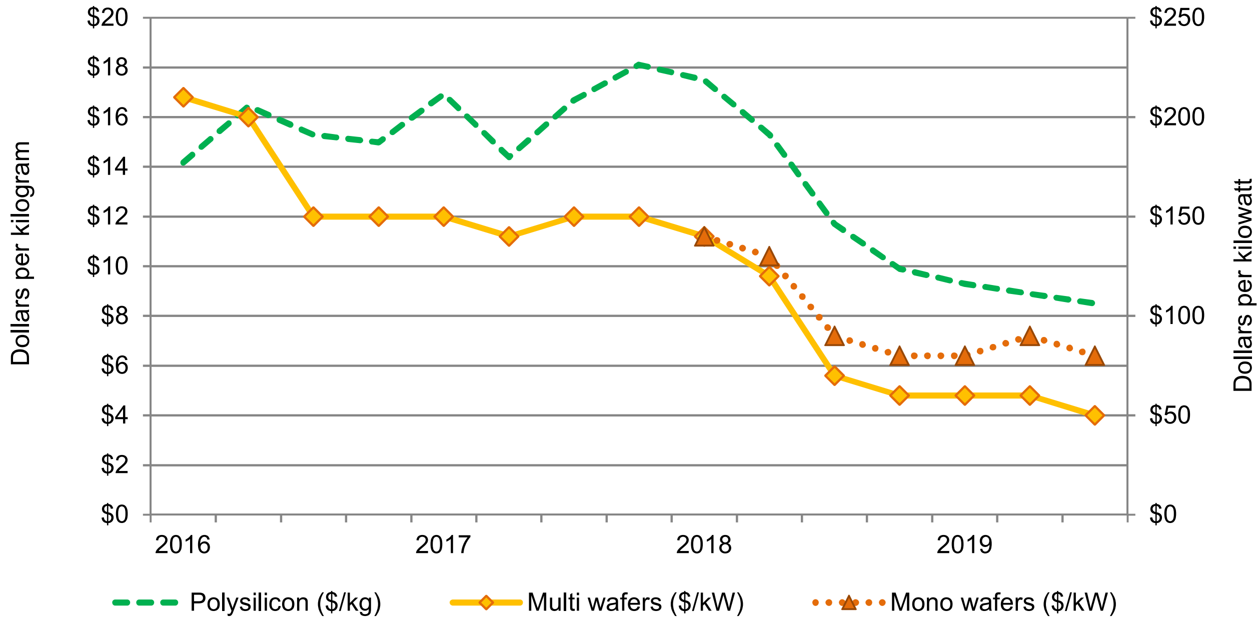
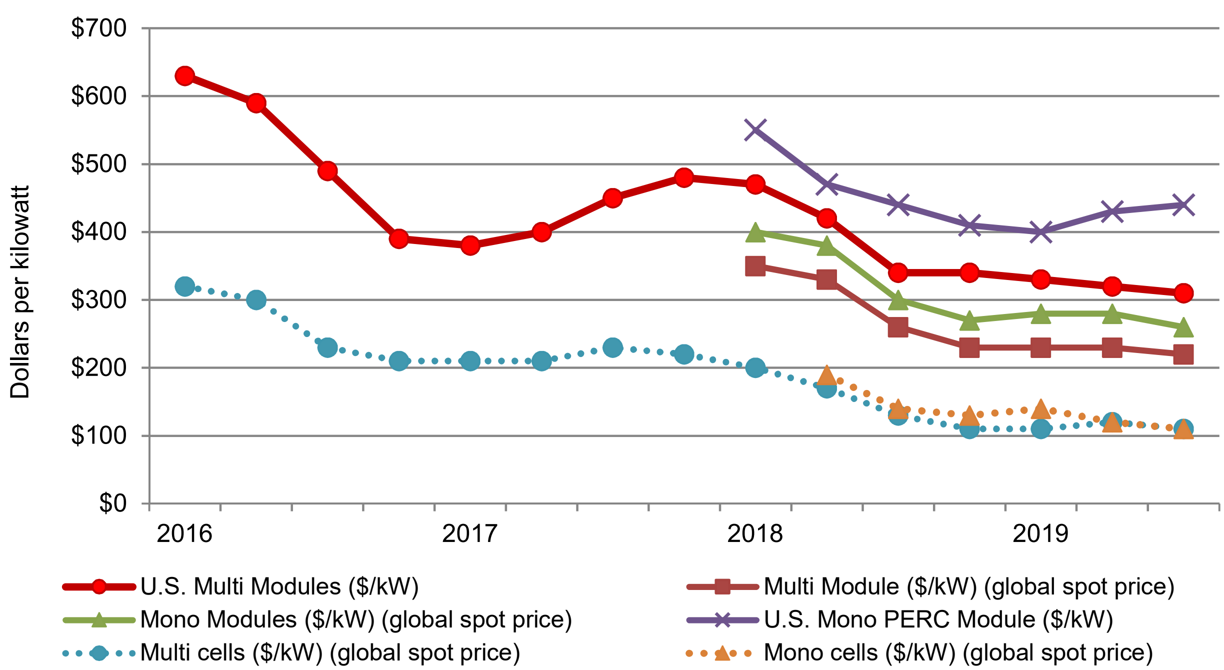


Figure VI-2
CSPV cell and module prices: Average prices for CSPV cells and modules, quarterly, first quarter of 2016 through the third quarter of 2019



Note: Starting in the first quarter of 2019, the Wood McKenzie U.S. Solar Market Insight expanded its coverage to include pricing on mono wafers, mono cells, and mono modules going back to the first quarter of 2018.

Source: Wood Mackenzie Power Renewables and the Solar Energy Industries Association ("SEIA"), U.S. Solar Market Insight: 2016-2018 Year in Review, Q3 2019, Executive Summaries.

Impact of section 232 and 301 tariffs on CSPV prices

U.S. producers, importers, and purchasers were asked if the announcement of the section 232 investigation in April 2017 or subsequent imposition on tariffs of imported steel and aluminum products beginning in March 2018 had any impact on the raw material prices for CSPV products. Among U.S. producers, six reported that it did, six reported that it did not, and three did not know. Among importers and purchasers, most firms did not know;[3] most of the remaining importers and purchasers reported that the 232 announcement and tariffs did impact raw material prices.[4] For those firms reporting an impact, most indicated that the 232 tariff increased raw material costs and overall prices (table VI-1).

As discussed in part II, when asked if the section 301 tariffs on Chinese-origin products impacted the market, most firms reported that it did not change demand or supply. As shown in table VI-1, however, most firms reported that it increased raw material costs, and pluralities of importers and purchasers and 4 of 14 U.S. producers reported that it increased overall prices for CSPV products.[5]

[3] Twenty-seven of 46 importers and 22 of 42 purchasers reported that they did not know if the 232 tariffs impacted raw material prices.

[4] Ten importers and 16 purchasers reported that the 232 tariff did impact raw material prices, while 9 importers and 4 purchasers reported that it did not.

[5] As discussed in part I, CSPV cells and modules were included in the second list of articles subject to additional 25-percent duties, effective August 23, 2018, under Section 301 of the Trade Act of 1974. Various other components used in the production of CSPV modules, such as aluminum frames, junction boxes, backsheets, and solar glass are also subject to the additional 25-percent ad valorem duties, as are certain balance of system components such as inverters. See part I, “Section 301 proceeding.”

Table VI-1
Impact of 232 and 301 duties: Firms' responses regarding the impact of the section 232 and section 301 announcements and duties on CSPV products in the U.S. market, by type of firm

Item	Increase	No change	Decrease	Fluctuate
232: Impact on raw material costs of CSPV products				
U.S. producers	6	2	1	---
Importers	9	3	---	4
Purchasers	13	1	---	1
232: Impact on prices of CSPV products				
U.S. producers	5	5	---	---
Importers	9	6	---	5
Purchasers	14	3	2	1
301: Impact on raw material costs/anticipated raw material costs for CSPV products				
U.S. producers	12	1	1	---
Importers	19	4	1	7
Purchasers	16	2	1	2
301: Impact prices/anticipated prices for CSPV products				
U.S. producers	4	5	3	2
Importers	14	9	3	8
Purchasers	16	7	2	4

Source: Compiled from data submitted in response to Commission questionnaires.

Other factors impacting CSPV prices

In addition to raw material costs, several other factors influence the prices of CSPV products, including AD/CVD duties, the exemption of bifacial modules from the safeguard measure, and other macroeconomic factors. In addition to the section 301 tariffs on imported aluminum frames, ethylene vinyl acetate ("EVA") and some backsheet material, these components can also be subject to AD/CVD duties.[6] Purchaser *** reported that "projects involving CSPV have become more difficult" as tariffs on CSPV products, aluminum, steel, and other materials have increased installation costs. As noted in parts I and II, imports of CSPV products from China are also subject to AD/CVD duty rates ranging from 14.78 percent to 249.96 percent.[7] Several firms also pointed to the exclusion of bifacial panels as a major factor

[6] See the Coalition's prehearing brief, p. 44, Exhibit 3, table 4. The Coalition argues that U.S. supply chains for such products ***.

[7] See part I, "Previous and related investigations" and part II, "Changes in U.S. supply."

influencing CSPV module prices.[8] *** reported that domestic prices decreased in the immediate months following the USTR announcement of a bifacial module exclusion to the safeguard measure. Several firms also reported a global oversupply of CSPV products as having an influence on domestic CSPV prices. Importer *** stated that CSPV cell and module production capacity worldwide continues to increase and outstrip demand. The Coalition argues that "data on the record of this mid-term review also show that the oversupply in the market in 2018 led to a significant decrease in the U.S. market prices – by as much as 25%."[9]

Data from energy research and consultancy firm Wood Mackenzie indicates that global cell shipments, as a percentage of global cell capacity, decreased year over year from 2016-18. Global cell production as a percentage of global cell capacity also decreased between 2016 and 2017 but increased *** between 2017 and 2018, albeit to a level that remained lower than 2016. While global production and shipments of cells are both projected to be higher in 2019 compared to 2018, 2019-21 projections suggest that global cell capacity will continue to outpace cell production and shipments (figure VI-3a).[10] Global module shipments and module production, as percentages of global module capacity, both increased between 2016 and 2017 and decreased between 2017 and 2018, and both (in contrast to cells) were higher in 2018 compared to 2016. Global module capacity is also projected to outpace production and shipments of modules in 2019-2021 (figure VI-3b).[11]

[8] See Hearing transcript, p. 54 (Nicely); Hanwha, Mission, Auxin, and SolarTech's prehearing brief on the Issue of Bifacial Modules, generally; Suniva's prehearing brief, pp. 19-26; Hanwha, Mission, Auxin, and SolarTech's posthearing brief, pp. 6-12; and Suniva's posthearing brief, pp. 8-10.

As discussed in parts I and II, USTR granted an exclusion to the safeguard measure for bifacial solar panels in June 2019. It announced the withdrawal of this exclusion in October 2019, but is preliminarily enjoined from doing so by court order.

[9] The Coalition's prehearing brief, p. 41.

[10] Global CSPV cell shipments as a percentage of global CSPV cell capacity decreased from *** percent in 2016 to *** percent in 2017 to *** percent in 2018, and is projected to decrease from *** percent in 2019 to *** percent in 2021.

[11] Global CSPV module shipments as a percentage of global CSPV module capacity increased from *** percent in 2016 to *** percent in 2017 before decreasing to *** percent in 2018. It is projected to decrease from *** percent in 2019 to *** percent in 2021.

Figure VI-3a
Global cell capacity, shipments, and production: Global capacity, shipments, and production of CSPV cells, 2010-2018 actual, 2019-2021 projected

* * * * * * *

Source: SEIA and REC Americas posthearing brief, exhibit B-3 (Wood Mackenzie, PV Pulse, April 2019); and staff calculations based on questionnaire data.

Figure VI-3b
Global module capacity, shipments, and production: Global capacity, shipments, and production of CSPV modules, 2010-2018 actual, 2019-2021 projected

* * * * * * *

Note: ***.

Source: SEIA and REC Americas posthearing brief, exhibit B-3 (Wood Mackenzie, PV Pulse, April 2019); and staff calculations based on questionnaire data.

In other comments, SEIA and REC Americas argue that a combination of factors, including polysilicon prices; technology advancements (such as wafer slicing technology, wafer thickness, and efficiency); and the cost competitiveness of solar power relative to other energy sources, have consistently driven prices downward "for decades," and that the safeguard measure caused U.S. prices for CSPV products to be higher than they would otherwise have been.[12] SunPower also stated that domestic prices for CSPV products are higher than they would have been without the implementation of the safeguard measure.[13]

Impact of conventional energy price changes on raw material costs and CSPV prices

Firms were also asked how changes in the price of electricity generated from domestic conventional energy sources have affected the price of solar generated electricity since February 7, 2018. As shown in table VI-2, responses were mixed, but firms generally reported that changes in the price of conventional energy caused the price of solar generated electricity to either not change, fluctuate, or decrease. The largest number of firms (30 of 82 responding U.S. producers, importers, and purchasers) reported that changes in the price of conventional energy caused no change the price of solar generated electricity. Twenty-five responding firms reported that changes in the price of conventional energy caused the price of solar electricity to fluctuate, and 24 reported that it caused the price of solar electricity to decrease. Only three firms reported that it caused the price of solar electricity to increase.

Table VI-2
CSPV products: Firms' responses regarding how changes in the price of U.S. conventional energy affected the price of solar generated electricity since February 7, 2018, by type of firm

Item	Increase	No change	Decrease	Fluctuate
U.S. producers	---	2	5	4
Importers	1	11	8	13
Purchasers	2	17	11	8

Source: Compiled from data submitted in response to Commission questionnaires.

Among the firms reporting that the price of traditional electricity sources led to decreases in the price of CSPV products, several suggested that solar energy is in competition mostly with gas. Other firms reported that gas prices are low, partially due to an increase in supply due to domestic fracking, and that solar prices must remain low in order for it to remain

[12] SEIA and REC Americas posthearing brief, Answers to Questions, pp. 28-36.
[13] Hearing transcript, pp. 125, 128 (Werner), 162 (Gurley).

competitive. Among the firms reporting that the price of traditional electricity sources increased the price of CSPV products, importer *** reported that higher gas and electricity prices lead to more demand for solar energy, and purchaser *** reported that gas price volatility and comparatively higher coal prices has led to solar prices becoming more competitive.

Lead times

During the safeguard investigation, a little more than half of U.S. producers' and importers' commercial shipments of CSPV products were produced-to-order, with the remaining share from U.S. producers and 37.9 percent from importers sold from inventories.[14] Lead times for produced-to-order product averaged 43 days for U.S. producers and 62 days for importers. In the current proceeding, 12 of 16 U.S. producers and 37 of 44 importers reported that the average lead time between a customer's order and the date of delivery for their firms' sales of domestically produced CSPV products have not changed since February 7, 2018. Among the U.S. producers reporting changes to their lead times since February 7, 2018, two reported increases due to demand that outpaced production, one reported a "rapidly increasing" sales volume (but did not elaborate on how that affected lead time), and one reported decreased lead times due to increased capacity and production. Among importers, all seven elaborating firms reported that lead times have increased.

Pricing practices

Pricing methods and discounts

During the safeguard investigation, most U.S. producers and importers reported using transaction-by-transaction negotiations to sell their CSPV products, but several also reported using contracts and set price lists. In terms of quantity, *** was sold ***.[15] Pluralities of U.S. producers and importers reported not offering any type of discount, although some discounts based on quantity and total volume were reported, and importers offered some additional discounts ***. In the current proceeding, the large majority of responding firms reported no changes in pricing methods, discount practices, or shares of sales on a contract vs. spot basis since February 7, 2018.

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[14] Safeguard publication, vol. II, p. V-13.
[15] Safeguard publication, vol. II, p. V-20.

Price related factors

U.S. producers, importers, and purchasers were asked how important 16 specific factors were in terms of their contribution to the prices of CSPV products since February 7, 2018. They were also asked how changes in the same 16 factors have influenced the prices of CSPV products in the U.S. market since February 7, 2018 (tables VI-3a, VI-3b, and VI-3c). As shown in the tables, U.S. producers, importers, and purchasers all indicated that U.S. demand, the cost of raw materials, the section 201 safeguard measure, import competition, and technology improvements were among top five "very important" factors. Majorities or pluralities of U.S. producers, importers, and purchasers also agreed that U.S. demand, the cost of raw materials, and the section 201 safeguard measure led to increases in the price of CSPV products, and majorities or pluralities agreed that technology improvements decreased the price of CSPV products since February 7, 2018. Regarding the role of competition from imports, however, firms were more evenly split. A plurality of U.S. producers and a slight plurality of purchasers reported that competition from imports decreased the prices of CSPV products, while a slight plurality of importers reported that it had no effect.

Table VI-3a
CSPV products: U.S. producers' perceptions regarding various factors' relative importance on price and their impact on CSPV prices, by factor

Factor	Importance on factor			Impact on price		
	Very	Somewhat	Not at all	Increase	Decrease	No effect
Cost of raw materials	12	2	1	12	1	2
Demand in the United States	13	2	---	8	2	4
Import competition	11	2	2	3	8	4
Technology improvements	8	6	1	6	7	2
Section 201 Safeguard measures	10	4	1	11	1	3
Productivity of domestic producers	8	6	1	5	5	4
Market patterns	7	4	4	3	1	10
Domestic production capacity	5	5	5	7	4	4
State and local government incentives	7	5	3	1	4	9
Competition between U.S. producers	3	9	3	4	4	7
Transportation/delivery cost	3	6	6	6	1	8
Demand outside the United States	3	7	5	5	2	7
Substitute competition (e.g. thin film)	2	5	8	1	3	11
Allocation of capacity to alternate products	2	1	12	2	---	13
Labor agreements, contracts, etc.	1	3	11	1	---	13
Prices of conventional energy	1	11	3	---	4	10
Other	1	1	1	1	1	1

Source: Compiled from data submitted in response to Commission questionnaires.

Table VI-3b
CSPV products: U.S. importers' perceptions regarding various factors' relative importance on price and their impact on CSPV prices, by factor

Factor	Importance on factor			Impact on price		
	Very	Somewhat	Not at all	Increase	Decrease	No effect
Demand in the United States	29	5	6	14	12	12
Section 201 Safeguard measures	25	10	7	27	2	13
Cost of raw materials	21	11	7	23	3	13
Technology improvements	18	13	8	12	14	13
Import competition	19	11	9	11	14	15
State and local government incentives	16	10	14	8	4	25
Market patterns	10	13	13	6	5	26
Productivity of domestic producers	9	13	16	6	7	24
Demand outside the United States	11	14	14	8	6	23
Domestic production capacity	9	11	18	11	4	24
Transportation/delivery cost	9	14	17	12	---	27
Competition between U.S. producers	7	16	15	10	6	23
Allocation of capacity to alternate products	4	9	26	6	2	31
Labor agreements, contracts, etc.	4	8	25	2	2	33
Substitute competition (e.g. thin film)	3	12	22	7	2	30
Prices of conventional energy	3	23	12	2	6	29
Other	2	1	3	2	2	3

Source: Compiled from data submitted in response to Commission questionnaires.

Table VI-3c
CSPV products: Purchasers' perceptions regarding various factors' relative importance on price and their impact on CSPV prices, by factor

Factor	Importance on factor			Impact on price		
	Very	Somewhat	Not at all	Increase	Decrease	No effect
Demand in the United States	35	3	2	31	2	5
Section 201 Safeguard measures	32	6	3	35	---	6
Import competition	28	8	4	14	15	11
Cost of raw materials	24	13	2	27	4	12
Technology improvements	23	13	4	8	23	9
Market patterns	21	10	6	18	5	13
Demand outside the United States	18	10	10	15	7	14
State and local government incentives	18	12	9	8	8	23
Domestic production capacity	9	12	18	12	10	16
Allocation of capacity to alternate products	7	9	22	12	---	22
Transportation/delivery cost	8	16	16	13	1	26
Prices of conventional energy	8	18	12	2	6	27
Productivity of domestic producers	7	13	18	5	6	25
Competition between U.S. producers	6	13	20	6	3	30
Labor agreements, contracts, etc.	5	10	24	3	1	32
Substitute competition (e.g. thin film)	4	19	16	4	4	30
Other	3	1	2	2	1	3

Source: Compiled from data submitted in response to Commission questionnaires.

Price data

The Commission requested U.S. producers and importers to provide quarterly data for the total quantity and f.o.b. value of the following CSPV products shipped to unrelated U.S. customers during January 2016-June 2019.[16] [17]

Product 1.--Multicrystalline silicon module with front-side area of less than 1.9 square meters and a peak power wattage between 240w to 290w, inclusive, P-max or Wp as measured under Standard Test Conditions ("STC").

***Product 2*.--**Monocrystalline silicon module with front-side of less than 1.9 square meters and a peak power wattage between 270w to 320w, inclusive, P-max or Wp as measured under Standard Test Conditions ("STC").

***Product 3*.--**Multicrystalline silicon module with front-side area of greater than or equal to 1.9 square meters and a peak power wattage between 290w to 340w, inclusive, P-max or Wp as measured under Standard Test Conditions ("STC").

***Product 4*.--**Monocrystalline silicon module with front-side area of less than 1.9 square meters and a peak power wattage between 325w to 375w, inclusive, P-max or Wp as measured under Standard Test Conditions ("STC").

***Product 5*.--**Monocrystalline silicon module with front-side area of greater than or equal to 1.9 square meters and a peak power wattage between 325w to 375w, inclusive, P-max or Wp as measured under Standard Test Conditions ("STC").

***Product 6*.--**Monocrystalline silicon module with front-side area of greater than or equal to 1.9 square meters and a peak power wattage between 380w to 430w, inclusive, P-max or Wp as measured under Standard Test Conditions ("STC").

U.S. producers were asked to provide separate pricing data for modules manufactured from U.S.-produced cells and those made from imported cells. Data distinguishing between modules produced from imported cells and domestically sourced cells can be found in Appendix J, while the data presented below group all U.S.-produced modules together. Importers were

[16] These pricing products differ from those collected in the safeguard investigation. In the current proceeding, staff removed descriptions on the number of cells (60 and 72) and added descriptions on surface area (modules less than 1.9 meters and greater than or equal to 1.9 meters) as well as the universal testing standard "STC" for power wattage. Additionally, pricing product 4 from the safeguard investigation was broken into two categories – monocrystalline and multicrystalline. Collectively, these amendments increased the number of pricing products from four to six.

[17] Price data from the safeguard investigation are contained in appendix D.

asked to provide pricing data for modules produced from cells made in the following countries: Canada, China, Germany, Korea, Malaysia, Mexico, the Philippines, Singapore, Taiwan, Thailand, Vietnam, all other developing countries, and all other non-developing countries. Ten U.S. producers[18] and 21 importers provided usable pricing data for sales of the requested products, although not all firms reported pricing in all quarters for all pricing products, product types, or import sources.[19] Pricing data reported by these firms accounted for approximately *** percent of U.S. producers' U.S. commercial shipments of CSPV modules (including modules made from U.S.-origin cells and modules made from foreign-origin cells), and *** percent of U.S. imports of CSPV modules from all import sources in 2018.

Price data for products 1-6 are presented in tables VI-4 to VI-9 and figures VI-4 to VI-9. These tables and graphs present combined domestic prices (modules made from U.S. cells and modules made from imported cells), and combined import prices. As noted above, disaggregated price data for these six products imported from the import sources listed above and prices for U.S. modules made from both U.S.-origin cells and foreign-origin cells are presented in appendix J.

[18] Two U.S. producers (***) reported price data for modules made from U.S.-origin cells, and eight U.S. producers (***) reported price data for modules made from foreign-origin cells.

[19] Per-unit pricing data are calculated from total quantity (in kilowatts) and total value data provided by U.S. producers and importers. The precision and variation of these figures may be affected by rounding, limited quantities, and producer or importer estimates. In some quarters, *** several importers provided aberrant or erroneous pricing data, or provided data in thousands (instead of actual) kilowatts and/or dollars. Staff requested amendments from these firms and received corrected data from some, but not all, of them. In the cases for which a revision was not received, staff has amended or deleted the non-conforming data.

Table VI-4
CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 1, by quarter, January 2016-June 2019

Period	U.S. modules		Imported modules	
	Price (dollars per kilowatt)	Quantity (kilowatts	Price (dollars per kilowatt)	Quantity (kilowatts
2016: January-March	***	***	***	***
April-June	***	***	***	***
July-September	***	***	***	***
October-December	***	***	***	***
2017: January-March	***	***	***	***
April-June	***	***	***	***
July-September	***	***	***	***
October-December	***	***	***	***
2018: January-March	***	***	***	***
April-June	***	***	***	***
July-September	***	***	***	***
October-December	***	***	***	***
2019: January-March	***	***	***	***
April-June	***	***	***	***

Product 1: Multicrystalline silicon module with front-side area of less than 1.9 square meters and a peak power wattage between 240w to 290w, inclusive, P-max or Wp as measured under Standard Test Conditions (“STC”).

Source: Compiled from data submitted in response to Commission questionnaires.

Table VI-5
CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 2, by quarter, January 2016-June 2019

Period	U.S. modules		Imported modules	
	Price (dollars per kilowatt)	Quantity (kilowatts	Price (dollars per kilowatt)	Quantity (kilowatts
2016:				
January-March	***	***	***	***
April-June	***	***	***	***
July-September	***	***	***	***
October-December	***	***	***	***
2017:				
January-March	***	***	***	***
April-June	***	***	***	***
July-September	***	***	***	***
October-December	***	***	***	***
2018:				
January-March	***	***	***	***
April-June	***	***	***	***
July-September	***	***	***	***
October-December	***	***	***	***
2019:				
January-March	***	***	***	***
April-June	***	***	***	***

Product 2: Monocrystalline silicon module with front-side of less than 1.9 square meters and a peak power wattage between 270w to 320w, inclusive, P-max or Wp as measured under Standard Test Conditions ("STC").

Source: Compiled from data submitted in response to Commission questionnaires.

Table VI-6
CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 3, by quarter, January 2016-June 2019

Period	U.S. modules		Imported modules	
	Price (dollars per kilowatt)	Quantity (kilowatts	Price (dollars per kilowatt)	Quantity (kilowatts
2016:				
January-March	***	***	***	***
April-June	***	***	***	***
July-September	***	***	***	***
October-December	***	***	***	***
2017:				
January-March	***	***	***	***
April-June	***	***	***	***
July-September	***	***	***	***
October-December	***	***	***	***
2018:				
January-March	***	***	***	***
April-June	***	***	***	***
July-September	***	***	***	***
October-December	***	***	***	***
2019:				
January-March	***	***	***	***
April-June	***	***	***	***

Product 3: Multicrystalline silicon module with front-side area of greater than or equal to 1.9 square meters and a peak power wattage between 290w to 340w, inclusive, P-max or Wp as measured under Standard Test Conditions (“STC”).

Source: Compiled from data submitted in response to Commission questionnaires.

Table VI-7
CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 4, by quarter, January 2016-June 2019

Period	U.S. modules: Price (dollars per kilowatt)	U.S. modules: Quantity (kilowatts	Imported modules: Price (dollars per kilowatt)	Imported modules: Quantity (kilowatts
2016:				
January-March	***	***	***	***
April-June	***	***	***	***
July-September	***	***	***	***
October-December	***	***	***	***
2017:				
January-March	***	***	***	***
April-June	***	***	***	***
July-September	***	***	***	***
October-December	***	***	***	***
2018:				
January-March	***	***	***	***
April-June	***	***	***	***
July-September	***	***	***	***
October-December	***	***	***	***
2019:				
January-March	***	***	***	***
April-June	***	***	***	***

Product 4: Monocrystalline silicon module with front-side area of less than 1.9 square meters and a peak power wattage between 325w to 375w, inclusive, P-max or Wp as measured under Standard Test Conditions (“STC”).

Source: Compiled from data submitted in response to Commission questionnaires.

Table VI-8
CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 5, by quarter, January 2016-June 2019

Period	U.S. modules		Imported modules	
	Price (dollars per kilowatt)	Quantity (kilowatts	Price (dollars per kilowatt)	Quantity (kilowatts
2016:				
January-March	***	***	***	***
April-June	***	***	***	***
July-September	***	***	***	***
October-December	***	***	***	***
2017:				
January-March	***	***	***	***
April-June	***	***	***	***
July-September	***	***	***	***
October-December	***	***	***	***
2018:				
January-March	***	***	***	***
April-June	***	***	***	***
July-September	***	***	***	***
October-December	***	***	***	***
2019:				
January-March	***	***	***	***
April-June	***	***	***	***

Product 5: Monocrystalline silicon module with front-side area of greater than or equal to 1.9 square meters and a peak power wattage between 325w to 375w, inclusive, P-max or Wp as measured under Standard Test Conditions (“STC”).

Source: Compiled from data submitted in response to Commission questionnaires.

Table VI-9
CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 6, by quarter, January 2016-June 2019

Period	U.S. modules		Imported modules	
	Price (dollars per kilowatt)	Quantity (kilowatts	Price (dollars per kilowatt)	Quantity (kilowatts
2016:				
January-March	***	***	***	***
April-June	***	***	***	***
July-September	***	***	***	***
October-December	***	***	***	***
2017:				
January-March	***	***	***	***
April-June	***	***	***	***
July-September	***	***	***	***
October-December	***	***	***	***
2018:				
January-March	***	***	***	***
April-June	***	***	***	***
July-September	***	***	***	***
October-December	***	***	***	***
2019:				
January-March	***	***	***	***
April-June	***	***	***	***

Product 6: Monocrystalline silicon module with front-side area of greater than or equal to 1.9 square meters and a peak power wattage between 380w to 430w, inclusive, P-max or Wp as measured under Standard Test Conditions ("STC").

Source: Compiled from data submitted in response to Commission questionnaires.

Figure VI-4
CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 1, by quarter, January 2016-June 2019

* * * * * * *

Product 1: Multicrystalline silicon module with front-side area of less than 1.9 square meters and a peak power wattage between 240w to 290w, inclusive, P-max or Wp as measured under Standard Test Conditions ("STC").

Source: Compiled from data submitted in response to Commission questionnaires.

Figure VI-5
CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 2, by quarter, January 2016-June 2019

*   *   *   *   *   *   *

Product 2: Monocrystalline silicon module with front-side of less than 1.9 square meters and a peak power wattage between 270w to 320w, inclusive, P-max or Wp as measured under Standard Test Conditions (“STC”).

Source: Compiled from data submitted in response to Commission questionnaires.

Figure VI-6
CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 3, by quarter, January 2016-June 2019

* * * * * * *

Product 3: Multicrystalline silicon module with front-side area of greater than or equal to 1.9 square meters and a peak power wattage between 290w to 340w, inclusive, P-max or Wp as measured under Standard Test Conditions (“STC”).

Source: Compiled from data submitted in response to Commission questionnaires.

Figure VI-7
CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 4, by quarter, January 2016-June 2019

* * * * * * *

Product 4: Monocrystalline silicon module with front-side area of less than 1.9 square meters and a peak power wattage between 325w to 375w, inclusive, P-max or Wp as measured under Standard Test Conditions ("STC").

Source: Compiled from data submitted in response to Commission questionnaires.

Figure VI-8
CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 5, by quarter, January 2016-June 2019

* * * * * * *

Product 5: Monocrystalline silicon module with front-side area of greater than or equal to 1.9 square meters and a peak power wattage between 325w to 375w, inclusive, P-max or Wp as measured under Standard Test Conditions ("STC").

Source: Compiled from data submitted in response to Commission questionnaires.

Figure VI-9
CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 6, by quarter, January 2016-June 2019

* * * * * * *

Product 6: Monocrystalline silicon module with front-side area of greater than or equal to 1.9 square meters and a peak power wattage between 380w to 430w, inclusive, P-max or Wp as measured under Standard Test Conditions (“STC”).

Source: Compiled from data submitted in response to Commission questionnaires.

Price trends

In general, prices decreased during January 2016-June 2019. Table VI-10 summarizes the price trends, by product and by source. As shown in the table, domestic prices decreased *** by 39.3 to 54.2 percent when comparing the first quarter of 2016 to the second quarter of 2019 and by 12.8 to 28.9 percent when comparing the first quarter of 2017 and the second quarter of 2019. Domestic price decreases *** ranged from an average quarterly change of 2.7 percent to 5.8 percent when comparing the first quarter of 2016 to the second quarter of 2019 and 1.5 percent to 5.4 percent when comparing the first quarter of 2017 to the second quarter of 2019. The only domestic product that showed an increase in price was ***, which showed an average quarterly change of 0.4 percent.

For imports, the price decreases *** between the first quarter of 2016 and the second quarter of 2019 ranged from 8.4 percent to 53.3 percent, for an average quarterly change for all pricing products of between 0.7 percent and 5.7 percent. When comparing the first quarter of 2017 to the second quarter of 2019, import prices decreased for *** by between 5.8 percent and 19.4 percent, for an average quarterly change for *** of between 0.7 percent and 4.1 percent. Imported *** showed an increase in price between the first quarter of 2017 and the second quarter of 2019 of 32.0 percent, for an average quarterly change of 3.1 percent.

Table VI-10
CSPV products: Summary of weighted-average f.o.b. prices for products 1-6 from the United States and other countries

Item	Number of quarters	Low price (dollars per kilowatt)	High price (dollars per kilowatt)	Change in price, Q1 2016 to Q2 2019 (percent)	Average quarterly price change, Q1 2016 to Q2 2019 (percent)	Change in price, Q1 2017 to Q2 2019 (percent)	Average quarterly price change, Q1 2017 to Q2 2019 (percent)
Product 1							
United States	***	***	***	***	***	***	***
All import sources	***	***	***	***	***	***	***
Product 2							
United States	***	***	***	***	***	***	***
All import sources	***	***	***	***	***	***	***
Product 3							
United States	***	***	***	***	***	***	---
All import sources	***	***	***	***	***	***	***
Product 4							
United States	***	***	***	***	***	***	***
All import sources	***	***	***	***	***	***	***
Product 5							
United States	***	***	***	***	***	***	***
All import sources	***	***	***	***	***	***	***
Product 6							
United States	***	***	***	***	***	***	***
All import sources	***	***	***	***	***	***	***

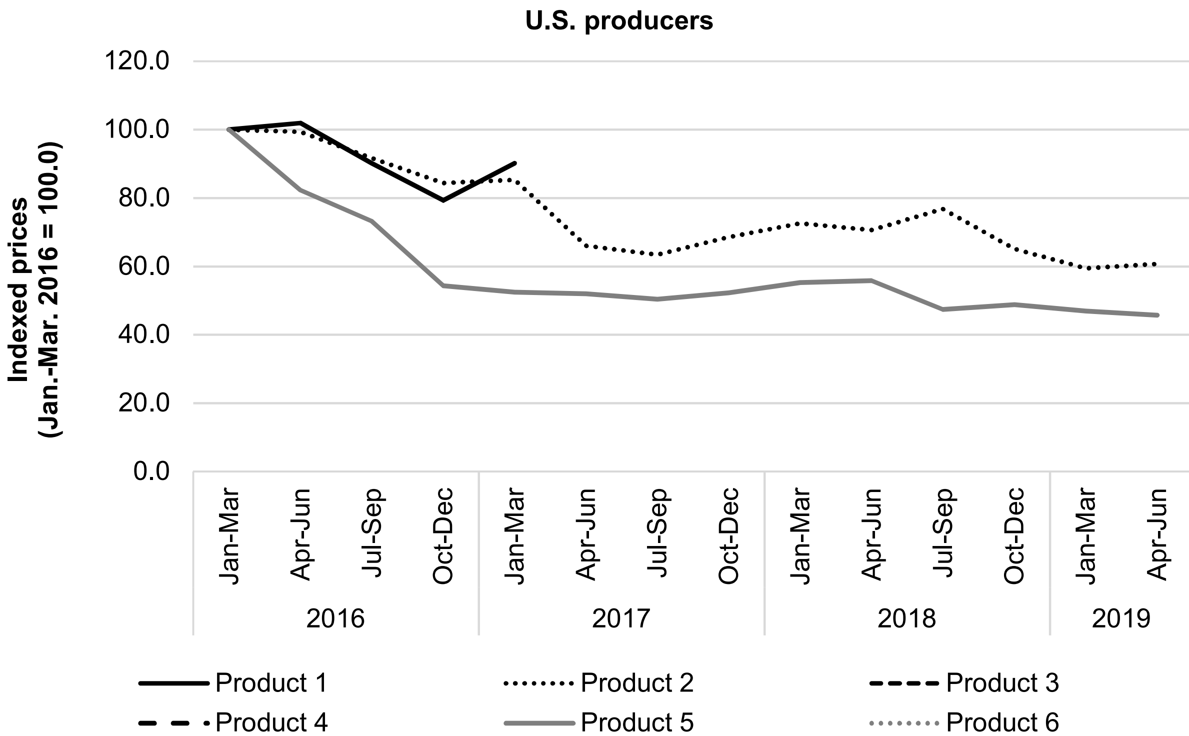
Note: Changes in price over the period are calculated for products in which data are reported in the first quarter of 2016 and the second quarter of 2019. Average quarterly price changes are presented for each product in which there are data present during any quarter of the period.

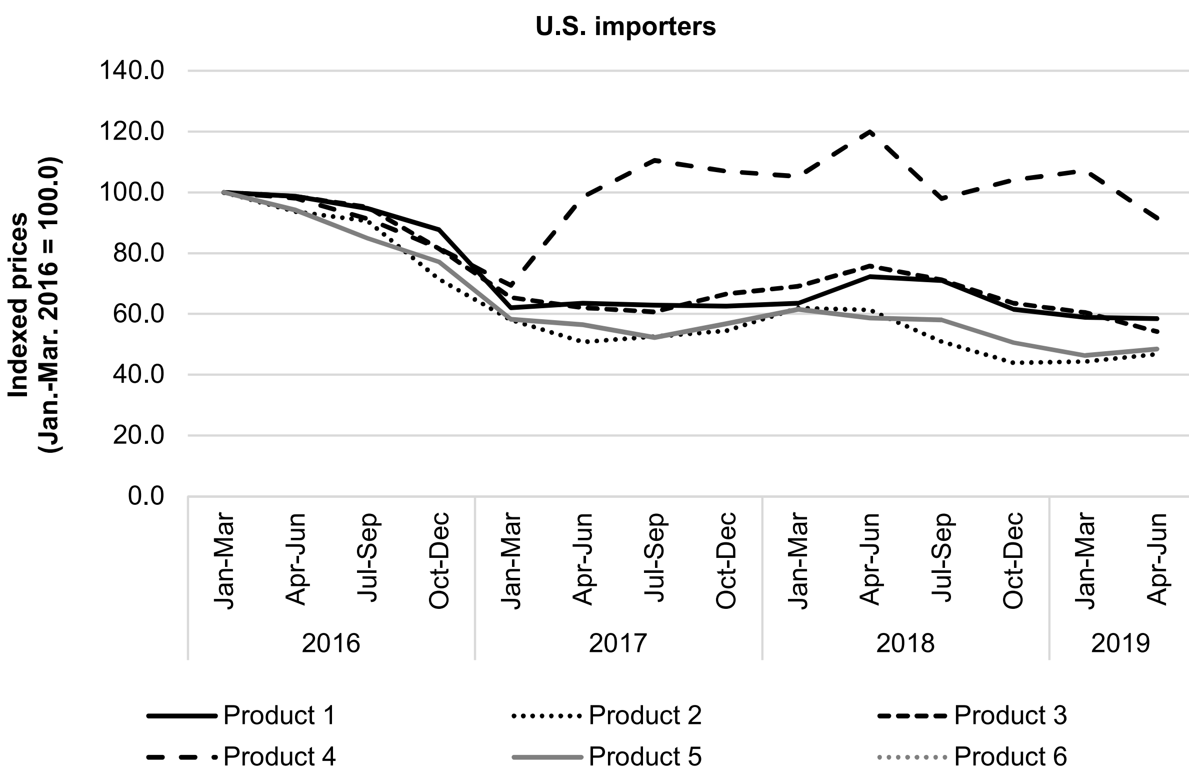
Note: In the safeguard investigation, prices for all five of the pricing products decreased during 2012-16 between 48.5 and 73.2 percent for domestic origin CSPV products and between 45.7 and 51.0 percent for imported CSPV products.

Source: Compiled from data submitted in response to Commission questionnaires.

As shown in figure VI-10, price decreases for most pricing products followed similar patterns for both U.S. producers and importers.

Figure VI-10
CSPV products: Indexed U.S. producer and importer prices, January 2016-June 2019





Source: Compiled from data submitted in response to Commission questionnaires.

Price comparisons

As shown in table VI-11, prices for imported CSPV modules were below those for U.S.-produced modules in 32 of 43 instances, for a total of 9.0 GW. In the remaining 11 instances, prices for imported CSPV modules were above U.S.-produced modules, for a total of 1.2 GW.

Table VI-11
CSPV products: Instances of foreign-origin modules below and above U.S.-origin modules, by product, January 2016-June 2019

Comparison	Total number of comparisons	Imports lower than domestic		Imports higher than domestic	
		Number of quarters	Quantity (kilowatts)	Number of quarters	Quantity (kilowatts)
Product 1	***	***	***	***	***
Product 2	***	***	***	***	***
Product 3	***	***	***	***	***
Product 4	***	***	***	***	***
Product 5	***	***	***	***	***
Product 6	***	***	***	***	***
All products	43	32	9,038,216	11	1,200,384

Note: In the safeguard investigation, prices for foreign-origin CSPV products were lower than U.S.-origin CSPV products in 33 of 52 instances (***) and higher in the other 19 instances (***).

Source: Compiled from data submitted in response to Commission questionnaires.

Part VII: Adjustment efforts and comments on the safeguard measure

Adjustment plans

Following the vote on injury in the Commission's safeguard investigation, one U.S. producer (SolarWorld, i.e., prior to acquisition by SunPower) included in its prehearing remedy brief a proposed adjustment plan for implementation in the event of appropriate import relief.[1] The applicable excerpt from that brief is reproduced below {footnotes omitted}.

> ***VII. THE DOMESTIC SOLAR INDUSTRY'S ADJUSTMENT TO IMPORTS***
>
> *The relief recommended by the Commission should be aimed {sic} giving the U.S. solar products industry the "breathing space" to adjust positively to competition with imports. Elsewhere in this brief, SolarWorld has recommended a variety of options aimed at providing such relief, as well as forestalling and combatting circumvention. Here, SolarWorld lays out its vision for what the solar industry in the United States should look like after safeguard relief is phased out. SolarWorld also recounts the specific actions that the current members of the industry have committed to undertake during the relief period. These efforts, which involve expenditures of approximately $***, will increase U.S. product range, capacity, and employment, while enabling cost savings that will permit the U.S. industry to compete more effectively against imports. Coupled with effective relief, SolarWorld believes that these efforts are realistically targeted at achieving healthy competitive conditions for the U.S. industry, and enabling the industry to compete effectively against imports on a going-forward basis.*

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[1] Other than SolarWorld's inclusion of its plans in its prehearing remedy brief and individual U.S. producer responses to questions in the Commission's Safeguard questionnaire concerning efforts to compete and anticipated adjustments in the event relief were provided, no separate proposed adjustment plans were submitted by U.S. producers. U.S. producers' responses on adjustment plans submitted in the Safeguard questionnaire were presented at tables D-1 and D-2 in the Commission's report in the Safeguard proceeding and are reproduced in appendix D of this report.

*In assessing the domestic solar industry's plan for adjusting to imports, and its commitments to undertake significant investment to achieve such adjustment, the Commission should pay no heed to entities such as the Solar Energy Industry Association, which have complained that U.S. solar manufacturers did not file an adjustment plan within 120 days of the petition. As even SEIA admits, the Trade Act of 1974 does not require the filing of an adjustment plan at all. Moreover, a robust, realistic plan {sic} adjustment plan depends on the scope of the injury determination, as well as on a determination of what relief efforts may be most effective given that scope. A{s} such, it would have made little sense for the domestic industry to prematurely present a plan that would be overtaken by events, and which would have to be substantially revised. In this regard, SolarWorld would also like to point out that, ***, incorporating the proposed adjustment plan into the remedy proposal permits greater accuracy as to the proposed adjustments.*

With the benefit of the agency's injury finding, and in light of the domestic industry's evaluation of potential remedies and its own current position as of the date of this filing, SolarWorld is able to present an adjustment plan that it believes is both realistic and achievable. SolarWorld stresses, however, that achievement of this adjustment plan requires effective import relief that enables U.S. producers to achieve profitability during the relief period. Further, in light of the technologically complex and competitive nature of this industry, it is not possible to forecast every investment that will be made by every U.S. producer during the relief period.

Below, SolarWorld first describes the conditions that it believes will characterize a healthy U.S. solar industry, and which form goals for the domestic industry's position as it emerges from the relief period. SolarWorld then recounts the commitments that both SolarWorld and other companies made in their questionnaire responses. Finally, SolarWorld briefly addresses the fact that both its overall vision for the industry, and the ability of individual firms to enact the commitments described in their questionnaire responses, necessarily depend on effective relief.

A. The Conditions That Will Characterize a Healthy Industry

As the Commission has found, the U.S. solar industry has suffered serious injury by reason of global imports of solar products. Many producers have exited the market entirely; factories have closed, jobs have been lost, and profits have sunk, even as demand continues to rise. In order to adapt successfully to imports, the solar industry will need to become profitable once again, increase production, increase the diversity of its product offerings, and revive upstream production that has relocated overseas. Below, SolarWorld describes some of the conditions that will characterize a healthy, post-relief industry that can compete effectively with imports. SolarWorld believes that these conditions form a reasonable goal for the industry, and can be achieved given the commitments described in subsection VII.B below, and given relief that provides an effective breathing space for the industry to recover from the serious injury that it has suffered.

More producers. *SolarWorld envisions that a healthy industry would be comprised of at least 5-6 competing U.S.-based cell/module producers. Each of these producers will have 1 GW or more of capacity, in order to achieve scale and raw material purchasing power. SolarWorld believes that, with a minimum of 5-6 such producers, the U.S. solar products industry will be well placed to provide competitively priced product to consumers across the country, and across distribution channels.*

Lowered production costs. *U.S. production costs have risen as producers exited the market in the face of import competition, and the remaining producers were unable to finance improvements to their facilities that would permit cost savings. A healthy industry, however, will have lowered production costs that not only enable U.S. producers to compete with imports in the U.S. market, but abroad. Given growing global solar demand, SolarWorld expects that a fully adjusted U.S. solar industry will be fully competitive in the U.S. market and able to export a substantial portion of its yearly production by the end of a safeguards remedy period.*

Competitive for government contracts. *A healthy U.S. industry should be fully competitive to supply all U.S. military and federally funded projects. This means an industry that has multiple producers with sufficient production capacity and product diversity to supply such projects, and whose cost structure enables it to compete effectively for such business.*

A revived upstream production chain. *It is not only U.S. production of solar cells and modules that has suffered during the past five years. U.S. production operations for upstream inputs into solar production, such as polysilicon, wafers, ribbon, solar glass, and aluminum frames have also suffered, and are currently very limited. SolarWorld envisions a U.S. solar products industry that can access U.S.-based supply for a growing portion of its needs, and becomes progressively less dependent on import supply.*

New R&D partnerships. *SolarWorld envisions that each U.S. producer in a revived and healthy solar industry will be engaged in research & development partnerships with one or more major U.S. research universities. Such public/private research, including partnerships supported by the U.S. Department of Energy, will lead to new solar patents, new and more efficient solar products, and increased cost savings in production operations. SolarWorld notes that independent commentators have pointed to vigorous R&D as a potent means for restoring U.S. solar competitiveness.*

Increased cell and module efficiency. *SolarWorld believes that, given effective relief, the U.S. industry can continue to improve cell and module efficiency every year. The continuing development of more efficient products will contribute to the overall competitiveness of U.S. solar products, both in the U.S. market and abroad, and will increase solar product demand.*

Long term supply contracts. *The enhanced production capacity, product diversity, and cost savings achieved during the relief period will permit U.S. solar companies to form long term, stable commercial supply relationships with major U.S. companies, commercial installers, and corporate leaders. U.S. producers have already developed top-notch customer service and relations programs in an attempt to compete with imports, but have lost ground to the low prices offered by such products, affecting sales, production, and product offerings. During the relief period, the U.S. industry will aim to regain this ground and to transform their superior service into relationships that will enable to industry to effectively compete with imports after the relief period ends.*

B. U.S. Solar Producers Have Committed to Significant Adjustment Measures During the Relief Period

*In their responses to the Commission's questionnaires, the remaining members of the domestic solar products industry described in detail specific investments that they would be able to undertake during a relief period. These efforts, which involve expenditures of approximately $***, will increase U.S. product range, capacity, and employment, while enabling cost savings that will permit the U.S. industry to compete more effectively against imports. Coupled with effective relief, SolarWorld believes that these efforts are realistically targeted at achieving healthy competitive conditions for the U.S. industry, and enabling the industry to compete effectively against imports on a going-forward basis.*

1. SolarWorld is Committed to Engaging in Significant Measures During a Period of Temporary Relief to Allow it to Adjust to Imports

*In its questionnaire response, SolarWorld described approximately $*** in investments it plans to undertake during the relief period in order to affirmatively adjust to import competition. The proposed investments will increase SolarWorld's ***. Indeed, in the few days since the Commission's injury vote, SolarWorld has already begun hiring back workers and ramping up its production efforts in anticipation of meaningful relief.*

*SolarWorld proposes to use the relief period to implement investments aimed at ***. In particular, SolarWorld proposes to spend more than $*** to ***. In conjunction with this increase in ***, the company also proposes to increase its ***.*

*In addition to increasing its overall ***, SolarWorld has also committed to *** through an approximately $*** investment to produce ***. A further $*** would go toward increasing ***.*

2. Other Producer Commitments

*SolarWorld is not the only U.S. manufacturer that has committed to taking concrete steps to adjust to import competition, and compete more effectively against imports, during the relief period. Producers other than SolarWorld have stated that they will invest a collective $*** in an effort to adjust to import competition.*

Such adjustments include:

- *$*** by *** to ***.*
- *$*** by *** to ***;*
- *$*** by *** to ***;*
- *$*** by *** to ***;*
- *$*** by *** to ***.*
- *$*** by *** to ***, and a further $*** aimed at ***; and*
- *$*** by *** to ***.*

C. The Measures Described Above are Based on Estimated Profitability During a Temporary Relief Period

The goals and commitments described above are specific and achievable, but only to the extent that the remedy ultimately recommended and adopted in this case is sufficient to allow the U.S. industry to generate profits during the relief period. The remedy being proposed by the industry is aimed at achieving this goal, thus allowing the relief period to be of maximal effectiveness. Further, in light of the technologically complex and competitive nature of this industry, it is not possible to forecast every investment that will be made by every new or existing producer during the relief period. Nonetheless, the commitments laid out above provide a realistic framework for the U.S. solar industry's actions during the relief period, based on the current status of their facilities and equipment. If the ultimate remedy is sufficient to allow sustained operating profitability during the relief period, these adjustments can be implemented and will equip the producers to compete effectively against imports once relief is phased out.[2]

[2] SolarWorld's prehearing remedy brief, September 27, 2017, pp. 49-57.

Commentary on adjustment plans

U.S. producers were asked in the Commission's questionnaire whether they had submitted adjustment plans to the Commission in connection with the original safeguard investigation on CSPV products, or indicated to USTR since the initiation of the original safeguard investigation that they would make adjustments in their operations that would permit them to compete more effectively with imports after relief expires if they were to receive import relief as a result of that investigation. Of the 17 responding firms, 14 reported that they had not done so. The remaining three firms (Suniva, SunPower (pre-acquisition SolarWorld), and SunPower (post-acquisition)) provided commentary in their responses to the Commission's questionnaire on the implementation of their adjustment plans (table VII-1).

Table VII-1
CSPV products: U.S. producers' response to adjustment plans

Firm	Adjustment plans
Suniva	***
SunPower/ Solar World (pre- and post-acquisition)	***

Source: Compiled from data submitted in response to Commission questionnaires.

Trade adjustment assistance for workers

On November 28, 2017, the U.S. Department of Labor ("DOL") submitted a report to the President, pursuant to section 224(b) of the Trade Act of 1974, on the extent to which U.S. workers in the CSPV products industry are likely to be certified as eligible for trade adjustment assistance ("TAA") and if such workers might be covered by existing U.S. government adjustment programs.[3] The DOL's study on CSPV products as required under Section 224 found the following:

1. The DOL received TAA petitions for 20 worker groups involved in the production of CSPV products since January 2012. Seventeen of those worker groups were certified as eligible to apply for TAA, resulting in an estimated 2,124 workers eligible to apply for individual benefits under the TAA Program.
2. The DOL estimated that 562 additional workers were likely to be covered by certified TAA petitions before the end of the year 2019, which included 230 CSPV cell producers and 332 module producers.
3. The DOL determined that sufficient funding was available to provide TAA benefits and services to these workers. In FY 2017, the DOL provided $391 million to states to provide training and other activities for TAA participants, as well as $294 million in funding for Trade Readjustment Allowances, and $31 million in Reemployment Trade Adjustment Assistance funds.
4. The DOL found that training and benefits under the Trade Act, other DOL programs, and programs at other federal agencies are sufficient to assist workers in the CSPV industry to adjust to the trade impact.

In order to receive TAA benefits and services, the affected group of workers must be certified by the DOL as eligible to apply for such benefits. To begin this process, a petition must be filed with the DOL, after which the DOL collects information to determine if the group of workers meets the eligibility criteria. Since the November 28, 2017 transmittal of the DOL's report to the President, one additional firm (SolarTech Universal, LLC) filed a petition in December 2017 with the DOL for TAA benefits and was certified as eligible, resulting in an

[3] 82 FR 57617, December 6, 2017.

estimated additional 19 workers eligible to apply for individual benefits under the TAA Program.[4]

Significance of relief

U.S. producers were asked to indicate their position on the safeguard measures (see "U.S. market participants" in part I) and to provide an explanation of their position. Their explanations are shown in table VII-2.

Table VII-2
CSPV products: U.S. producers' narratives on their position on safeguard measures

Firm	Position on safeguard measures
Auxin	***
Hanwha	***
Jinko	***
LG	***
Merlin	***

Table continued on next page.

[4] Data on TAA Petitions and Determinations, U.S. Department of Labor, https://www.doleta.gov/tradeact/taa-data/petitions-determinations-data/, retrieved on November 3, 2019.

Table VII-2--Continued
CSPV products: U.S. producers' narratives on their position on safeguard measures

Firm	Position on safeguard measures
Mission	***
PowerFilm	***
SBM	***
Silfab	***
Suniva	***

Table continued on next page.

Table VII-2--Continued
CSPV products: U.S. producers' narratives on their position on safeguard measures

Firm	Position on safeguard measures
SunPower (pre-acquisition) SolarWorld and Sunpower (post-acquisition)	***
Tesla	***
Yingli	***

Source: Compiled from data submitted in response to Commission questionnaires.

U.S. producers were also asked to describe the significance of the safeguard measure in terms of the measure's effect on several aspects of their firm's operations. As shown in table VII-3, all U.S. producers provided a response.

Table VII-3
CSPV products: U.S. producers' reported significance of the safeguard measures

Category	Firm	Significance of the safeguard measure
Production capacity, production, shipments, inventories, and employment	***	***
	***	***
	***	***
	***	***
	***	***
	***	***
	***	***
	***	***
	***	***
	***	***
	***	***
	***	***

Table continued on next page.

Table VII-3--Continued
CSPV products: U.S. producers' reported significance of the safeguard measures

Category	Firm	Significance of the safeguard measure.
Production capacity, production, shipments, inventories, and employment	***	***
	***	***
	***	***
	***	***
	***	***

Table continued on next page.

Table VII-3--Continued
CSPV products: U.S. producers’ reported significance of the safeguard measures

Category	Firm	Significance of the safeguard measure.
Return on investment, ability to generate capital to finance the modernization of domestic plant(s) and equipment, or ability to maintain existing levels of expenditures for research and development	***	***
	***	***
	***	***
	***	***
	***	***
	***	***
	***	***
	***	***
	***	***
	***	***
	***	***
	***	***
	***	***
	***	***
	***	***
	***	***
	***	***

Table continued on next page.

Table VII-3--Continued
CSPV products: U.S. producers' reported significance of the safeguard measures

Category	Firm	Significance of the safeguard measure.
Changes in your firm's collective bargaining agreements	***	***
	***	***
	***	***
	***	***
	***	***
	***	***
	***	***
	***	***
	***	***
	***	***
	***	***
	***	***
	***	***
	***	***
	***	***
	***	***
	***	***

Source: Compiled from data submitted in response to Commission questionnaires.

U.S. importers were also asked to describe the significance of the safeguard measure in terms of its effect on their imports, U.S. shipments, exports, and inventories. Responses provided are shown in table VII-4.

Table VII-4
CSPV products: U.S. importers' reported significance of the safeguard measures

Firm	Significance of the safeguard measure.
***	***
***	***
***	***
***	***
***	***
***	***
***	***

Table continued on next page.

Table VII-4--Continued
CSPV products: U.S. importers' reported significance of the safeguard measures

Firm	Significance of the safeguard measure.
***	***
***	***
***	***
***	***
***	***
***	***
***	***
***	***
***	***
***	***
***	***
***	***
***	***
***	***
***	***
***	***
***	***
***	***

Table continued on next page.

Table VII-4--Continued
CSPV products: U.S. importers’ reported significance of the safeguard measures

Firm	Significance of the safeguard measure.
***	***
***	***
***	***
***	***

Table continued on next page.

Table VII-4--Continued
CSPV products: U.S. importers' reported significance of the safeguard measures

Firm	Significance of the safeguard measure.
***	***
***	***
***	***
***	***
***	***
***	***
***	***
***	***
***	***
***	***
***	***

Table continued on next page.

Table VII-4--Continued
CSPV products: U.S. importers' reported significance of the safeguard measures

Firm	Significance of the safeguard measure.
***	***
***	***
***	***
***	***
***	***
***	***
***	***
***	***
***	***

Table continued on next page.

Table VII-4--Continued
CSPV products: U.S. importers' reported significance of the safeguard measures

Firm	Significance of the safeguard measure.
***	***
***	***

Source: Compiled from data submitted in response to Commission questionnaires.

Post-relief efforts

The Commission's questionnaires asked U.S. producers whether they had undertaken any efforts to compete more effectively in the U.S. market for CSPV products since February 7, 2018. U.S. producers' responses are presented in table VII-5.

Table VII-5
CSPV products: U.S. producers' narratives on their efforts to compete

Firm	Efforts
***	***
***	***
***	***
***	***

Table continued on next page.

Table VII-5--Continued
CSPV products: U.S. producers' narratives on their efforts to compete

Firm	Efforts
***	***
***	***
***	***
***	***
***	***
***	***
***	***

Table continued on next page.

Table VII-5--Continued
CSPV products: U.S. producers' narratives on their efforts to compete

Firm	Efforts
***	***
***	***
***	***

Source: Compiled from data submitted in response to Commission questionnaires.

U.S. producers and importers were asked whether they have made any efforts to increase product availability to their customers, either in terms of the quantity of products available or by increasing their product offerings since the implementation of safeguard measures on February 7, 2018. Most responding firms (including 12 of 14 U.S. producers and 25 of 45 importers) reported that they have.

Among responding U.S. producers, four firms (Hanwha, Jinko, LG, and Silfab) reported launching new U.S.-based module operations, and two additional firms (Auxin and Heliene) reported expanding their existing U.S. module operations or increasing capacity. Two module firms reported launching new products (PowerFilm (***) and Sunpower (***), two firms (***) reported improving power output,[5] and one (***) reported research and development for ***. Tesla did not highlight specific efforts since February 7, 2018, but stated that it continuously works to provide innovative products, such as the Solar Roof, unveiled in 2016, and to improve existing products.[6] Suniva reported that the safeguard measure has allowed it a viable exit path from bankruptcy and has had a measurable impact on its efforts to restart operations, but that the exclusion of bifacial products from the safeguard measure by the USTR in May 2019 ***.[7]

Among importers, in addition to the efforts noted above, several firms reported improved efficiency in their existing offerings (including ***) or launching new products focused on higher efficiency (***). Others reported offering new products (including Ameresco (***), Panasonic (***), and Trina (***), or increasing product offerings to meet growing demand (***). *** reported that it now offers more U.S.-made modules and *** reported that it has attempted to find more suppliers outside of China and Taiwan as a result of the safeguard measure. *** also reported increasing production at its factory in Malaysia.

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[5] ***.

[6] On October 25, 2019, Tesla started selling version 3 of its glass Solar Roof tiles. See CNBC, *Tesla releases a new version of Solar Roof tiles*, available at https://www.cnbc.com/2019/10/25/tesla-releases-solar-roof-tiles-v-3.html, retrieved November 3, 2019.

[7] Suniva also indicated in its prehearing brief that the 2.5 GW quota (which has not filled since the measure was imposed) has delayed the impact of the safeguard measure on U.S. cell production. Suniva's prehearing brief, pp. 1-2.

In addition, purchasers were asked whether, based on their experience, domestic producers have taken certain specified steps toward making positive adjustments to import competition since February 7, 2018, including introducing new or innovative products, improving product quality, expanding marketing efforts (including e-commerce), and/or improving customer service. As shown in tables VII-6 and VII-7, a majority of responding purchasers reported that U.S. producers have taken all of the specified steps to adjust to import competition.

Table VII-6
CSPV products: Producer actions taken to adjust to import competition since February 7, 2018, as reported by U.S. purchasers, by number of responding firms

Action	Yes	No
Introduction of new or innovative products	29	11
Improved product quality	27	10
Expansion of marketing efforts	25	12
Improvements in customer service	30	6
Other efforts	28	8

Source: Compiled from data submitted in response to Commission questionnaires.

Table VII-7

CSPV products: Purchasers' reported experience with domestic producers' actions taken since February 7, 2018

Firm	Producers' perceived action(s)				
	Introduce innovative product	Improve product quality	Expansion	Improvement in service	Other efforts
***	***	***	***	***	***
***	***	***	***	***	***
***	***	***	***	***	***
***	***	***	***	***	***
***	***	***	***	***	***
***	***	***	***	***	***
***	***	***	***	***	***
***	***	***	***	***	***
***	***	***	***	***	***
***	***	***	***	***	***
***	***	***	***	***	***
***	***	***	***	***	***
***	***	***	***	***	***
***	***	***	***	***	***
***	***	***	***	***	***
***	***	***	***	***	***
***	***	***	***	***	***
***	***	***	***	***	***
***	***	***	***	***	***
***	***	***	***	***	***
***	***	***	***	***	***
***	***	***	***	***	***
***	***	***	***	***	***
***	***	***	***	***	***
***	***	***	***	***	***
***	***	***	***	***	***
***	***	***	***	***	***
***	***	***	***	***	***
***	***	***	***	***	***
***	***	***	***	***	***
***	***	***	***	***	***
***	***	***	***	***	***
***	***	***	***	***	***
***	***	***	***	***	***
***	***	***	***	***	***

Table continued on next page.

Table VII-7--Continued
CSPV products: Purchasers' reported experience with domestic producers' actions taken since February 7, 2018

Firm	Producers' perceived action(s)				
	Introduce innovative product	Improve product quality	Expansion	Improvement in service	Other efforts
***	***	***	***	***	***
***	***	***	***	***	***
***	***	***	***	***	***
***	***	***	***	***	***
***	***	***	***	***	***
***	***	***	***	***	***
***	***	***	***	***	***
All responding purchasers	29	27	25	30	28

Note: "1" indicates that the purchaser reported that domestic producers have taken the particular action since February 7, 2018. "---" indicates that the purchaser either reported that the domestic producers have not taken the particular action or did not respond to the question.

Source: Compiled from data submitted in response to Commission questionnaires.

Regarding the introduction of new or innovative products, firms generally cited more efficient and/or higher output modules.[8] Among the firms reporting that domestic products have not introduced new or innovative products, some reported comparable levels of innovation and efficiency between the United States and foreign sources. One purchaser suggested that domestic manufacturers generally offer a less efficient product, and another reported that the U.S. industry is primarily focused on standard monofacial 60- and 72-watt modules for the residential and commercial markets. One firm also noted that domestic cells are still not widely available, despite the quota on imported cells.

Regarding quality improvements, *** reported that domestic producers have acquired more stringent certifications and are offering more extended warranties, while a few firms stated that U.S. product has consistently been of high quality and continues to improve. Among the firms reporting no improvement in quality, one firm reported that domestic and foreign product quality is comparable, while another indicated that domestic offerings are "standard," and another suggested that domestic products have experienced quality control issues and delays as new facilities ramp up production.

[8] One firm noted that out-of-scope thin-film PV producer *** has continued to innovate, but that "most of their production is done in foreign countries."

Regarding the expansion of marketing efforts, firms generally noted an expansion of online advertising. One firm highlighted the launching of Hanwha and LG's module production operations in the United States, and one firm reported that China Sunergy has heavily marketed its modules being manufactured in California.[9]

In additional comments, several firms noted the expansion of production operations into the United States by foreign-based companies, with several references to Hanwha and LG's facilities in Dalton, Georgia, and Huntsville, Alabama. Other firms reported that domestic producers still cannot meet U.S. demand for CSPV products, with one firm (***) stating that "they would have to increase capacity 50-fold to help." Others reported that there is almost no cell production in the United States, with no visible efforts to revive or launch new cell production. One firm (***) reported that international competition is also improving, and another (***) reported that political support for conventional energy sources over renewable energy disincentivizes such investment in the United States. One purchaser (***) stated that domestic producers are less incentivized to innovate, improve quality, expand their marketing, or improve customer service as a result of the safeguard measure.

Comments on the effectiveness of the safeguard measure

Suniva

Suniva alleges that the safeguard measure has saved or created more than *** American CSPV module assembly jobs, increased worker hours and wages, incentivized numerous companies to invest in U.S. module assembly (including over *** in new investment), *** the reported assembly of CSPV modules since 2016, and is achieving these results without causing harm to the market for solar energy in the United States.[10] It states, however, that the 2.5 GW CSPV cell exclusion and the exclusion of bifacial modules from the safeguard measure has delayed/diluted the benefits of the intended relief. While Suniva successfully exited bankruptcy in April 2019, it argues that its efforts to restart cell production have been hampered by these exclusions, and that the current safeguard remedy

[9] In February 2017, China Sunergy announced intentions to construct a 400 megawatt facility in Sacramento, CA. See California Governor's Office of Business and Economic Development, *Chinese solar company selects McClellan Park in Sacramento for first U.S. facility*, available at http://www.business.ca.gov/Newsroom/ArticleId/15/chinese-solar-company-selects-mcclellan-park-in-sacramento-for-first-us-facility, retrieved November 3, 2019.

[10] Suniva prehearing brief, pp. 1, 4, and 10-15.

incentivizes domestic module assembly more than domestic cell production.[11] Additionally, it argues that domestic cell production is vital to U.S. national security interests, is necessary to ensuring grid reliability, and that losing a domestic CSPV cell industry would result in losing associated research and development.[12] Suniva also states that bifacial CSPV modules are not a niche product, as USTR interpreted it at the time of its exclusion, and that the bifacial exclusion created a stockpiling effect and "had a disproportionately negative impact on Suniva, as {the exclusion} occurred just weeks after it exited Chapter 11."[13]

Suniva argues that the rate of the remedy stepdown should be slowed, the exclusion of bifacial CSPV products from the safeguard should be eliminated, and the 2.5 GW tariff rate quota on CSPV cell imports should not be increased, as doing so "would be contrary to the goals of the 201… and undercut the ability of commercial CSPV cell production to grow."[14] It states that adopting its recommendation would assist in the restart of Suniva's cell production, which it could accomplish within 100 days of receiving the necessary capital investment, and thereby "facilitate an instantaneous near-quadrupling of the U.S. CSPV cell manufacturing capacity."[15]

Hanwha, SunPower, Mission, Auxin, and SolarTech Universal

Hanwha, SunPower, Mission, Auxin, and SolarTech Universal (prehearing brief)

Hanwha, SunPower, Mission, Auxin, and SolarTech Universal note in their jointly filed prehearing brief that the safeguard measure resulted in a significant expansion in domestic solar manufacturing, as firms such as Hanwha, LG, and Jinko have made major investments to start production in the United States and other firms have invested in expanding their existing U.S. production operations. They estimate that these investments will result in manufacturing capacity of around 5 GW. The current U.S. CSPV industry, which is centered around module assembly, has introduced new, innovative products with higher efficiency and output. At the same time, the domestic market has expanded.[16]

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[11] Suniva prehearing brief, p. 6.
[12] Suniva prehearing brief, pp. 34-39.
[13] Suniva prehearing brief, pp. 6-7 and 19-28; Suniva posthearing brief, pp. 8-10.
[14] Suniva prehearing brief, pp. 31-39; Suniva posthearing brief, pp. 5-8.
[15] Suniva prehearing brief, p. 31; Suniva posthearing brief, pp. 14-15; and hearing transcript, pp. 88 and 114 (Card).
[16] Hanwha, SunPower, Mission, Auxin, and SolarTech Universal prehearing brief, pp. 5-6, 10, 14, and 16-18.

The firms contend that "the safeguard measure has been largely effective in reducing the quantity of imported modules and increasing the revenues and incomes of U.S. producers of CSPV modules in Year 1,"[17] but note that "U.S. producers still experienced *** in 2018 and interim 2019."[18] Further, declines in module prices and tariffs on imported components have created challenges for U.S. manufacturers.[19] Therefore, they assert that it is important for the safeguard measure to remain in place for the entire four-year duration.[20] With respect to cells, the firms argue that the cell quota will be exceeded in 2020 and 2021 and an "increase of the TRQ is necessary to protect the growth of module producers, which has been facilitated by the safeguard measures in effect."[21]

Hanwha, Mission, Auxin, and SolarTech Universal (prehearing brief, bifacial)

Hanwha, Mission, Auxin, and SolarTech Universal also jointly filed a separate brief on bifacial modules. The firms contend that the "the bifacial exclusion is effectively a loophole for Chinese-owned companies in China and South East Asia to ship bifacial solar modules to the United States free of duties."[22] They note that imports of bifacial modules had already started to increase before the exclusion was granted, and that they have significantly undermined the effectiveness of the relief. They assert that firms will export substantially more bifacial modules to the United States as a result of the exclusion.[23] They argue that the relief needs to continue for the full four years at the highest possible duty rates.[24]

[17] Hanwha, SunPower, Mission, Auxin, and SolarTech Universal prehearing brief, p. 21.
[18] Hanwha, SunPower, Mission, Auxin, and SolarTech Universal prehearing brief, p. 21.
[19] Hanwha, SunPower, Mission, Auxin, and SolarTech Universal prehearing brief, p. 40.
[20] Hanwha, SunPower, Mission, Auxin, and SolarTech Universal prehearing brief, p. 21.
[21] Hanwha, SunPower, Mission, Auxin, and SolarTech Universal prehearing brief, pp. 54-55.
[22] Hanwha, Mission, Auxin, and SolarTech Universal prehearing brief, p. 6.
[23] Hanwha, Mission, Auxin, and SolarTech Universal prehearing brief, p. 8.
[24] Hanwha, Mission, Auxin, and SolarTech Universal prehearing brief, pp. 11-12.

Hanwha, Mission, and Auxin (posthearing brief)

In their jointly filed posthearing brief, Hanwha, Mission, and Auxin argue that the safeguard measure on solar modules should continue for the intended four years at the highest possible duty rates and that the bifacial loophole should be eliminated because it threatens the effectiveness of the entire Section 201 relief.[25] They assert that the bifacial exclusion is having a negative impact on manufacturers' profitability and ramp-up of production. They further assert it is leading to an increase in imports, reducing prices, and "hollowing the remedy put in place by the President."[26]

They also reiterate their position that the current cell quota will be insufficient to meet domestic demand starting in 2020, and contend that the module industry would be harmed if the quota is not increased.[27] They assert that the current quota could negatively impact module production because "(1) it would add a 20% tariff on cells to the already high costs of domestic module manufacturing, thus lowering revenues and making it more difficult for producers to reach profitability and (2) it would act as a constraint on the supply of modules, whereby some module producers may forego orders if the TRQ is filled."[28]

SunPower (posthearing brief)

SunPower notes in its posthearing brief that the safeguard measure has resulted in positive industry adjustments. Domestic module producers in operation at the time of the safeguard are becoming more economically viable and expanding capacity. At the same time, there has been so much new capacity brought online that that domestic industry's market share is likely to significantly improve. SunPower contends, however, that several developments have limited the positive impact, however, including stockpiling prior to the implementation of tariffs, exporters' tariff cost absorption, and higher input and transportation costs for domestic manufacturers.[29]

SunPower avers that in years 3 and 4 of the safeguard, the existing quota on cells will be insufficient to supply the domestic industry. Therefore, it argues there is a need for a larger cell quota that allows for the import of a sufficient quantity of duty-free cells.[30]

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[25] Hanwha, Mission, and Auxin posthearing brief, p. 12.
[26] Hanwha, Mission, and Auxin posthearing brief, pp. 6, 9, and 11.
[27] Hanwha, Mission, and Auxin posthearing brief, pp. 12 and 14.
[28] Hanwha, Mission, and Auxin posthearing brief, p. 13.
[29] SunPower posthearing brief, p. 4.
[30] SunPower posthearing brief, pp. 5 and 7.

LG Electronics

LG Electronics USA and LG Electronics (collectively "LGE") contends that since the implementation of the safeguard measure, capital expenditures have been undertaken, four new U.S. module producers have come online (including LGE's new "state of the art high efficiency n-type" module production facility in Hunstville, Alabama), domestic employment in these new plants has increased ***, and domestic module production capacity has doubled.[31] It argues that domestically produced cells are "essentially unavailable" today, however, as the two largest domestic producers of cells during the original safeguard investigation (SolarWorld and Suniva) currently ***, and that domestic module producers must rely on imported cells in order to maintain production, increase capacity utilization, and continue making positive adjustments.[32]

LGE argues that there should not be any changes with respect to the safeguard measures as applied to CSPV modules, such as early termination of the measure or a reduction in the level of import duties, and argues that doing so would result in a dramatic increase in module imports and a crash of module selling prices in the United States.[33] It also argues that the safeguard measures on CSPV cells should be "significantly relaxed" in order to allow for continued growth of the module industry.[34]

[31] LGE prehearing brief, pp. 1-2 and 5-13.
[32] LGE prehearing brief, pp. 1-2 and 17-20.
[33] LGE prehearing brief, pp. 2-3 and 25-33.
[34] LGE prehearing brief, pp. 17-25. LGE estimates a production capacity for U.S. module producers in 2019-20 of over 4GB. See LGE prehearing brief, pp. 22, table 3.

SEIA and REC Americas

In their jointly filed briefs, the Solar Energy Industries Association ("SEIA") and REC Americas LLC ("REC") argue that the costs of the safeguard measures exceed their benefits.[35] Specifically, according to SEIA and REC, the Section 201 tariffs have raised domestic prices of modules relative to global prices and the projected baseline, limiting demand for solar energy by lowering the profitability of the ongoing solar projects and by causing projects not to be built.[36] They contend that the resulting opportunity costs amounted to over $19 billion in foregone investments, over 8 GW in fewer solar installations, and as many as 62,000 in fewer jobs.[37] Additionally, SEIA and REC argue that despite the impact on domestic prices, the Section 201 tariffs did not spur any new investment in domestic cell production. They further argue that while the domestic industry has added 4 GW of U.S. module capacity, the new module operations are not labor intensive and that overall U.S. module capacity does not meet the needs of the U.S. market, particularly the utility segment.[38]

SEIA and REC also jointly argue that in light of the reduced demand caused by the safeguard measures, the domestic industry's inability to serve large-scale utility projects, and the failure of the tariffs to contribute to the success of the overall solar industry, the Section 201 tariffs should be terminated.[39] Barring termination of the tariffs, they argue that subject imports from Canada and Singapore should be excluded from the safeguard measures and the utility segment should be allowed access to imported bifacial modules.[40] SEIA and REC also argue against slowing the pace of liberalization of the safeguard measures.[41]

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[35] SEIA and REC prehearing brief, pp. 1-55; SEIA and REC posthearing brief, pp. 1-8. According to SEIA and REC, the statute requires the Commission to examine the domestic industry's adjustment within the context of the broader market and evaluate whether the effect of the Section 201 tariffs had greater economic and social benefits than costs. *See id.* at Appendix A, pp. 2-4.

[36] SEIA and REC posthearing brief, pp. 3-8, Appendix A, pp. 18-38.

[37] SEIA and REC posthearing brief, pp. 3-4, Appendix A, pp. 16-18.

[38] SEIA and REC posthearing brief, pp. 5-10, Appendix A, pp. 39-53.

[39] SEIA and REC prehearing brief, pp. 59-61; SEIA and REC posthearing brief, pp. 10-12. SEIA and REC argue that the agency has the authority and discretion to inform the President on the impact of the safeguard measures and make recommendations to terminate or moderate them. SEIA and REC prehearing brief, pp. 55-58; SEIA and REC posthearing brief, Appendix A, p. 4.

[40] SEIA and REC prehearing brief, pp. 61-68; SEIA and REC posthearing brief, pp. 12-13.

[41] SEIA and REC posthearing brief, pp. 13-14.

In briefs filed separately from SEIA, REC argues that the Commission should again recommend to the President to exclude Singapore from the safeguard remedy.[42] REC points to the overall decline in imports of CSPV products from Singapore from January 2016 to June 2019 as underscoring that imports from Singapore are not a substantial cause of serious injury or threat thereof to the domestic industry. It further argues that pursuant to the free trade agreement between the United States and Singapore and resulting beneficial economic relationship, and the unique circumstances that exist in Singapore, a country exclusion for Singapore is warranted.[43] Specifically, it contends that REC Solar Pte. Ltd. ("REC Solar"), its affiliated producer in Singapore, is and has been the sole producer of CSPV products in Singapore since its establishment in 2009. Given the level of investment required, the limited available land on Singapore, high land, utility, and labor costs, and long construction time, REC argues that it would be difficult for any new producers of CSPV products in Singapore to establish themselves in the future.[44]

Canadian Solar, Heliene, and Silfab

Heliene Inc. ("Heliene"), Silfab Solar Inc. ("Silfab"), and Canadian Solar Solutions Inc. ("Canadian Solar"), Canadian producers and exporters of subject CSPV modules (collectively the "Canadian Industry"), together with U.S. CSPV module manufactures Silfab Solar WA Inc. ("Silfab USA") and Heliene USA Inc. ("Heliene USA"), jointly filed briefs in the safeguard monitoring proceeding. In their briefs, these firms argue that the Commission correctly analyzed the Canadian imports separately in the Section 201 investigation, as directed by the NAFTA Implementation Act, and made a negative finding.[45]

They note that the three Canadian CSPV module producers, which were the same three producers at the time of the original safeguard investigation, reported declines in the aggregate production capacity in Canada over the monitoring period and that the Canadian industry remained "very small."[46] They assert that the Canadian industry has become "even more intertwined, complementary, and codependent" with the U.S. CSPV industry since the original safeguard investigation and has increasingly played an important and positive role in the U.S.

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[42] REC prehearing brief, pp. 3-14; REC posthearing brief, pp. 4-8.
[43] REC prehearing brief, pp. 7-13; REC posthearing brief, pp. 4-5.
[44] REC prehearing brief, p. 14; REC posthearing brief, pp. 5-8.
[45] Canadian Industry prehearing brief, pp. 3-4.
[46] Canadian Industry prehearing brief, pp. 7 and 13-16; Canadian Industry posthearing brief, p. 5.

CSPV industry.[47] They highlight the substantial Canadian investments in two U.S. CSPV module producers, Silfab USA and Heliene USA.[48]

These firms also argue that, as was the case in the original safeguard investigation, U.S. imports from Canada represented a miniscule and decreasing volume of CSPV imports from Canada throughout the monitoring period and have never been among the top 5 suppliers of subject imports.[49] They assert that the record evidence in this monitoring investigation validates the Commission's negative finding in the safeguard investigation and recommendation to exclude Canada,[50] and urge the Commission to conclude again that imports from Canada should be excluded from the safeguard measure.[51] Additionally, they argue for an increase in the TRQ on cells above 2.5 GW to a level sufficient to facilitate additional investment in U.S. module manufacturing in light of the request by the USTR for an analysis of a possible increase in the TRQ on cells above 2.5 GW to 4, 5, or 6 GW.[52]

First Solar[53]

First Solar, Inc. ("First Solar") argues that the safeguard measure has enabled the domestic module industry to grow, limited further declines in U.S. market prices with the curb of imports, and enabled the growth of the larger solar industry in the United States.[54]

First Solar asserts that the safeguard remedy is serving its intended purpose and must not be prematurely terminated, using the example of increased imports in the U.S. market when USTR excluded bifacial cells from the safeguard remedy.[55] First Solar also disputes the facts presented by SEIA's prehearing brief that First Solar is focused on foreign production, providing information on First Solar's new $400 million thin film plant in Perrysburg, Ohio, which started PV module production in 2019, and the re-opening of its existing plant.[56]

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[47] Canadian Industry prehearing brief, pp. 7 and 13-16; Canadian Industry posthearing brief, p. 5.
[48] Canadian Industry prehearing brief, p. 2; Canadian Industry posthearing brief, p. 5.
[49] Canadian Industry prehearing brief, pp. 10-11.
[50] Canadian Industry posthearing brief, p. 3.
[51] Canadian Industry prehearing brief, p. 2; Canadian Industry posthearing brief, p. 6.
[52] Canadian Industry posthearing brief, p. 6.
[53] First Solar is not part of the CSPV domestic industry, but it is a producer of out-of-scope CSPV products (e.g., PV modules and thin film) in the United States.
[54] First Solar posthearing brief, pp. 2-5.
[55] First Solar posthearing brief, pp. 6-7.
[56] First Solar posthearing brief, pp. 7-8. As previously noted in this report, First Solar invested $175 million to retool its existing production plant in Ohio to produce its newest, series 6 modules, with the first module production in late 2017 and commercial production starting in 2018. In April 2018, the firm announced plans to invest $400 million to open a second manufacturing plant in Ohio. The plant, with

(*continued*...)

Hemlock, Wacker, and REC Silicon

Hemlock Semiconductor Operations LLC ("Hemlock"), Wacker Polysilicon North America, LLC ("Wacker"), and REC Silicon (collectively the "U.S. polysilicon producers") jointly argue that China has long focused on a number of industrial policies, subsidies, unfair trade practices, and other actions to favor domestic Chinese manufacturers in the solar energy sector and has targeted polysilicon as a priority industry for innovation and global domination. They argue further that aggressive Chinese practices have created significant gaps in the U.S. solar manufacturing value chain, most notably for ingots and wafers, and that China now has a near monopoly on global ingot and wafer production as capacity in the United States for those components has been systematically eliminated. Therefore, since the U.S. polysilicon producers have no direct customers for their production in the United States, they argue that U.S. polysilicon capacity is under imminent threat.[57] They argue that without key upstream segments of the solar manufacturing value chain in the United States, it will be impossible to develop a viable U.S. CSPV cell industry. In turn, the lack of domestically produced CSPV cells will force U.S. CSPV module producers to continue to rely on foreign suppliers, which puts the domestic module producers in a precarious position and jeopardizes their sustainability.[58]

1.3 GW in annual production capacity, started production in October 2019. First Solar, "First Solar Becomes Largest PV Module Manufacturer in the Western Hemisphere," News release, October 24, 2019, https://investor.firstsolar.com/news/press-release-details/2019/First-Solar-Becomes-Largest-PV-Module-Manufacturer-in-the-Western-Hemisphere/default.aspx, retrieved November 2, 2019; First Solar, "First Solar Announces New U.S. Manufacturing Plant," News release, April 26, 2018, https://investor.firstsolar.com/news/press-release-details/2018/First-Solar-Announces-New-US-Manufacturing-Plant/default.aspx, retrieved November 2, 2019; Roselund, Christian, "First Solar Produces First S6 Module, Seals 800 MW of Deals," PV Magazine, December 5, 2017, https://pv-magazine-usa.com/2017/12/05/first-solar-produces-first-s6-module-seals-800-mw-of-deals/, retrieved November 2, 2019; Chavez, John, "Three Years After Layoffs, First Solar Producing Like Never Before," Toledo Blade, October 24, 2019, https://www.toledoblade.com/business/energy/2019/10/24/first-solar-energy-producing-like-never-before-perrysburg-lake-township-business/stories/20191024186, retrieved November 2, 2019; First Solar, 2016 Annual Report, 2017, p. 58, https://investor.firstsolar.com/financials/annual-reports/default.aspx, retrieved November 2, 2019; First Solar, 2018 Annual Report, 2017, p. 5, https://investor.firstsolar.com/financials/annual-reports/default.aspx, retrieved November 2, 2019; Roselund, Christian, "First Solar is Sold Out Through mid-2021," PV Magazine, October 25, 2019, https://www.pv-magazine.com/2019/10/25/first-solar-is-sold-out-through-mid-2021/, retrieved November 2, 2019; First Solar, "First Solar Q1'18 Earnings Call," April 6, 2018, p. 5, https://investor.firstsolar.com/financial-events/default.aspx, retrieved November 2, 2019.

[57] U.S. polysilicon producers posthearing brief, p. 3.

[58] U.S. polysilicon producers posthearing brief, p. 4.

The U.S. polysilicon producers urge the Commission to consider the impact of the current safeguard measure on the entirety of the solar manufacturing value chain in the United States. They argue that the current safeguard relief does not provide a sufficient basis for the long-term viability of U.S. CSPV cell production. They contend that "positive measures to incentivize and develop" the foundational segments of a strong and complete U.S. solar manufacturing value chain are essential for the rejuvenation and long-term viability of a U.S. CSPV cell industry and a healthy U.S. solar manufacturing industry.[59]

1366 Technologies

1366 Technologies, the only U.S. silicon wafer manufacturer,[60] asserts that the record and the hearing testimony of U.S. manufacturers clearly demonstrate the benefits of the safeguard in providing the U.S. CSPV module industry the breathing room necessary to compete. It argues, however, that modifications to the safeguard measures have the potential to positively effect change throughout the solar value chain. It contends that the Commission should consider the entire solar value chain, including the wafer and polysilicon segments of the solar industry, and argues that the silicon wafer is the most vital and valuable component of the CSPV cell.[61]

1366 Technologies argues that a safeguard measure expanded to address U.S. Direct-to-Wafer manufacturing equipment would avoid any additional and irreparable damage to U.S. manufacturing across the entire sector. It also argues that an amended safeguard measure that provides a product exclusion for CSPV cells and modules based on Direct-to-Wafer technology and using U.S. polysilicon would create immediate demand from foreign producers for U.S. manufacturing equipment and U.S. silicon. It predicts that the impact of such a modification to the safeguard measure would dramatically extend the reach without compromising the CSPV module industry's positive but unfinished adjustment.[62]

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[59] U.S. polysilicon producers posthearing brief, p. 5.

[60] Production of the silicon wafer is the second step of the solar manufacturing value chain, following polysilicon production and preceding CSPV cell and module production. 1366 Technologies invented a wafer manufacturing process (direct-to-wafer manufacturing) that produces solar wafers directly from molten polysilicon (see part I, figure I-14 illustrating the direct wafer production process). This process is in contrast to traditional wafer manufacturing (such as that used in China), which uses polysilicon to produce solid ingots which are then sawed into wafers.

[61] 1366 Technologies posthearing brief, p. 3.

[62] 1366 Technologies posthearing brief, pp. 5 and 7.

Utility Scale Solar Coalition

The Utility Scale Solar Coalition argues that there has been a decline in U.S. solar installations and resulting job losses following the implementation of the safeguard measures on CSPV products, with the United States falling behind the rest of the world in total solar installations, thereby threatening the development of a robust domestic manufacturing supply chain. It also argues that utility-scale solar installations are more sensitive to CSPV module prices than residential installations and that the safeguard measures resulted in an increase in CSPV module prices and a consequent decline in utility-scale solar installations. It asserts that the only remedy for restoring growth to the U.S. industry producing CSPV products is to restore growth to U.S. solar installations.[63]

Foreign Governments

Government of Canada

The Government of Canada argues that imports from Canada should not have been included in the safeguard measure, as a majority of the Commission found in the original safeguard proceeding that imports from Canada were not a "substantial share" of total imports, and did not "contribute importantly" to the injury caused by imports. It asserts that, contrary to both U.S. law and U.S. obligations under NAFTA, U.S. imports from Canada were nevertheless included within the final safeguard measures imposed in this case.[64]

It also argues that the safeguard measures have led to significant reductions in U.S. imports of CSPV products from Canada and that the factual basis to exclude from the safeguard measure the U.S. imports from Canada is now even stronger than during the original safeguard investigation. Specifically, it notes that Canada has remained absent from the list of the top five U.S. import suppliers and accounted for only a small and declining share of the U.S. market.[65] The Government of Canada asserts that the Canadian industry has less capacity to export CSPV modules to the United States compared with the capacity level reported in the original safeguard investigation. It indicates that firms in Canada have been restructuring, expanding operations in the United States and scaling back operations in Canada.[66]

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[63] Utility Scale Solar Coalition posthearing brief, pp. 1-2.
[64] Government of Canada prehearing brief, p. 1.
[65] Government of Canada prehearing brief, pp. 1-2; Government of Canada posthearing brief, p. 1.
[66] Government of Canada prehearing brief, p. 16.

The Government of Canada, therefore, argues that imports from Canada should be excluded from the safeguard measure.[67] Further, it argues that the exclusion of imports from Canada "is necessary for the positive adjustment of the domestic industry" as two CSPV production facilities in the United States, which were established by two major Canadian producers of CSPV modules, Heliene Inc. and Silfab Solar Inc., rely on the financial support of their Canadian parents to sustain and expand their U.S. growth through the start-up phase.[68]

Government of Singapore

The Government of Singapore argues that the safeguard measure has been counterproductive to U.S. job creation and industry growth and has not strengthened the U.S. solar industry as intended. Therefore, it argues that the measure should be removed. It asserts that U.S. imports are necessary to support the continued healthy growth of the U.S. solar industry as the U.S. domestic production of CSPV products remains insufficient to satisfy the growing U.S. demand. Further, it argues that CSPV products manufactured in Singapore are niche, premium products that are not substitutable for CSPV products manufactured in the United States. It contends that the volume of the U.S. imports of CSPV cells and modules from Singapore is modest and does not pose a threat to the U.S. CSPV industry.[69]

Government of Taiwan

The Government of Taiwan asserts that there is insufficient CSPV cell production in the United States to meet the demand of U.S. CSPV module producers and that imported CSPV cells are necessary. It argues that the 2.5 GW TRQ will be exhausted during the next two years and the safeguard tariffs on the over-quota amounts will constrain U.S. module manufacturing growth. Therefore, it argues that the TRQ on CSPV cells should be gradually increased in the third and fourth year of the safeguard measure in order to meet the future demands of U.S. CSPV module producers and U.S. module installation growth.[70]

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[67] Government of Canada prehearing brief, pp. 1-2 and 16.
[68] Government of Canada posthearing brief, pp. 3-4.
[69] Government of Singapore posthearing brief, pp. 2-3.
[70] Government of Taiwan prehearing brief, pp. 1-6.

Georgia Department of Economic Development

The Commissioner for the Georgia Department of Economic Development submitted a statement in support of continuation of the safeguard measures. The Commissioner notes that, due in large part to the safeguard measures, Hanwha opened the largest U.S. CSPV module production facility in Georgia. The Commissioner contends that the safeguard measures resulted in U.S. job growth and increased investment in solar technologies, with over $200 million of investment in Georgia and the addition of more than 650 jobs. The Commissioner argues that, although substantial progress has been made in Georgia and around the country, the safeguard measure remains necessary to protect solar manufacturers. Therefore, the Commissioner avers that the safeguard measures be continued for the remaining two years, as designed.[71]

[71] Georgia Department of Economic Development written statement, pp. 1-2.

ADDITIONAL COMMENTS OF COMMISSIONER JASON E. KEARNS

As I explained in the Commission's recent monitoring proceeding involving Large Residential Washers,[1] I believe it is useful to compare actual experience under the safeguard measure to what the recommended remedies were expected to achieve. In addition, in seeking to understand the extent to which the domestic CSPV industry is making a positive adjustment to import competition that is durable, in my view it is important to be mindful of the global landscape of competition in CSPV products. I will address these two points in turn.

In the original section 201 investigation on CSPV products, after assessing various remedies, Commissioners recommended particular remedies that were estimated to result in certain changes in prices and volumes of imports and domestic product. These estimates supported the Commissioners' assessment of what remedy was appropriate to address the serious injury it found and to facilitate efforts by the domestic industry to make a positive adjustment to import competition; in other words, what improvements in market conditions would give the industry the breathing space it needed to implement adjustment plans. The estimates were based on, at least in part, a partial-equilibrium model.

While the President did not select the remedy recommended by any Commissioner, the measures imposed were closest to the remedy recommendation that garnered the most support among Commissioners (2 of 4).[2] The actual and recommended remedies both provide for 4 years of relief with tariffs imposed on modules, and on cells that exceed an annual quota, of 30% *ad valorem*, declining by 5 percentage points each year. The key divergence is that the actual duty-free tariff rate quota (TRQ) for imported cells is 2.5 GW, as compared to a 1 GW TRQ (with annual growth over the period) recommended by these Commissioners. Nevertheless, given the similarity in basic structure between the actual and recommended remedies, I believe it is appropriate to compare the estimated economic effects of the partial-equilibrium model with actual experience under the safeguard measure.

As the report shows, an important market development was the establishment of additional U.S. module-producing capacity, much of which came on line in 2019. Therefore, the table below includes a comparison of the first year of the safeguard measure (2018) to the Year

[1] Large Residential Washers: Monitoring Developments in the Domestic Industry, Inv. No. TA-204-013, USITC Publication 4941, August 2019, Additional Comments of Commissioner Jason E. Kearns.

[2] *See Crystalline Silicon Photovoltaic Cells, Whether or Not Partially Assembled into Other Products, Investigation No. TA-201-075,* USITC Publication 4739, November 2017, p. 149.

1 estimates, as well as a comparison of the second year, using annualized 2019 data, to estimates for Year 2.[3]

CSPV Products: Estimated First- and Second-Year Effects of Tariff-Rate Quota and Actual Experience

	Year 1 estimate (model)	2018 (actual)	Year 2 estimate (model)	2019 (annualized 2019 actual)	2019 (annualized 2019 proxy)
% change in quantity of imported cells	***	***	***	***	***
% change in quantity of imported modules	***	***	***	***	***
% change in quantity of U.S. modules using U.S. cells	***	***	***	***	***
% change in price of U.S. modules using U.S. cells	***	***	***		
% change in overall price of modules in the U.S. market	***	***	***	***	
% change in deployment of modules in the U.S. market	***	***	***	***	***
Change in revenue from U.S. modules using U.S. cells ($ millions)	***	***	***	***	
Change in operating income from U.S. modules using U.S. cells ($ millions)	***	***	***		
Change in revenue from U.S. modules using foreign cells ($ millions)	***	***	***	***	
Change in operating income from U.S. modules using foreign cells ($ millions)	***	***	***	***	
Combined change in revenue from U.S. production ($ millions)	***	***	***	***	
Combined change in operating income from U.S. production ($ millions)	***	***	***	***	

Notes:

--In both the model results and the actual data, imports from Canada and Singapore have been excluded, but no specific product types have been excluded

--Annualized 2019 actual data (fourth column) are interim 2019 data x 2

--Annualized 2019 proxy data (fifth column) are staff estimates for certain indicators that incorporate record information regarding actual 2H 2019 developments, when the quantity of imports of cells and modules was greater than in 1H 2019

--Price of U.S. modules using U.S. cells is AUV of total commercial shipments (total value divided by total quantity) of those modules

--Price of modules in US market is weighted average of all six pricing products combined

--Actual "Change in deployment of modules in the U.S. market" is based on apparent consumption (domestic shipments + import shipments)

--Actual change in operating income represents a reduction in operating losses

--Price and income for modules using U.S. cells are not reported for 2019 given the very small quantity of those modules

Source: Compiled from data collected in monitoring investigation and *Crystalline Silicon Photovoltaic Cells, Whether or Not Partially Assembled into Other Products, Investigation No. TA-201-075,* USITC Publication 4739, November 2017, p. 149.

[3] In comparing these numbers, it is important to note the limitations of the model used by the Commission; perhaps most significantly, it assumes that other conditions in the market remain constant. I also note that the baseline data for the model were from 2016, whereas the baseline data for assessing the effects of the safeguard measure (effective February 7, 2018) were from 2017.

In comparing the actual relief to the estimated relief, I wish to highlight three elements. First, the large increase in the quantity of imported cells, and the large decline in revenues from U.S. modules using U.S. cells, differ from the estimated trends. Second, revenues from modules using imported cells grew significantly more than what was estimated. Both of these divergences likely reflect the fact that the actual duty-free TRQ on imported cells was significantly larger than the recommended TRQ. These trends suggest relatively more limited breathing space for the cell segment of the CSPV industry than estimated for the recommended relief and relatively more breathing space for the module segment.[4] Third, module prices in the U.S. market did not increase as estimated, and in fact declined in 2019. This indicates a less favorable price environment for all U.S. CSPV producers than what was considered by these Commissioners to be needed for a positive adjustment (although lower prices may have benefitted consumers).

Turning to my second topic, if the U.S. industry has the temporary breathing space it needs, the next question is, what does a 'positive adjustment to import competition' mean in the context of the global CSPV market? As described in detail in Appendix F of this Report, in recent years the Chinese industry producing CSPV products, and upstream polysilicon and wafer products, has been provided with massive ongoing support at both the central and local government levels.[5] A result has been China's dominant and rising share of the global market of each product along the CSPV supply chain.[6] This basic situation existed at the time of the original safeguard investigation and in all likelihood will persist beyond the 4-year period of safeguard relief.

One might ask how a U.S. industry can be expected to adjust to import competition when that competition flows steadily from massive subsidies and other industrial policies. Given the seemingly permanent trade-distorting foreign industrial policies on a massive scale, I

[4] A point of discussion at the Commission's hearing was the importance of cell production and whether the United States can have a viable CSPV module industry if it does not have a viable cell industry. *See, e.g.,* tr. at 96, 101-102, 136-143, 145-147. I note that up to half or more of the value of a completed module comes from cell production. Report at Table IV-3.

[5] To be sure, the United States also provides tax credits and other subsidies, both at the federal and state level. But these programs pale in comparison to those provided by other governments, particularly China. And frequently U.S. programs incentivize CSPV consumption whereas foreign programs often incentivize CSPV production. Perhaps most strikingly, the Chinese government even subsidizes its CSPV producers when they relocate to other countries to avoid antidumping and countervailing duties imposed on imports from China. *See* Report, App. F at F-41-42 and Table F-2.

[6] Report at Figures F-3 (polysilicon), F-5 (wafers), F-7 (cells), and F-9 (modules).

see in the global market for CSPV products aspects of a competition between market-based capitalism and state capitalism.[7]

This of course is not the only U.S. industry that has suffered or will suffer serious injury as a result of the trade distortions that arguably result from state capitalism. Recent reports indicate that China is now targeting electric vehicles, for example.[8]

Multiple leading companies in the CSPV industry have taken substantial actions to establish operations and introduce innovative products with business plans focused on longer-term viability in the United States. I think is it fair to say that there has been a fairly robust industry response to the safeguard measures with respect to new and expanded domestic module capacity and production. At the same time I believe one should be clear-eyed about the global environment for CSPV products in which the domestic industry finds itself during and likely following these safeguard measures. Safeguard measures may well have been necessary to provide relief to U.S. CSPV producers from injurious surges in imports,[9] but they are not sufficient to resolve the conflict between market-based capitalism and state capitalism that this market appears to exemplify.

I offer a final thought. China has built dozens of CSPV production factories and employs millions of workers in the CSPV value chain, including in manufacturing, distribution, installation, and R&D.[10] It essentially fully supplies its large domestic market and, at the same time, exports massive quantities of CSPV products abroad. For China, addressing climate change means jobs. One has to wonder whether there would be greater support for efforts to address climate change in the United States if the U.S. had as many CSPV factories and jobs as China does.

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[7] *See* National Intelligence Council, *Global Trends 2025: A Transformed World*, NIC 2008-003 (November 2008), at 8-9 (rise in states in Asia whose economic policies "blur distinctions between public and private"); see also Branko Milanovic, "The Clash of Capitalisms: The Real Fight for the Global Economy's Future," in *Foreign Affairs*, January/February 2020, p. 10.

[8] The Washington Post, *The Next China Trade Battle Could Be Over Electric Cars*, https://www.washingtonpost.com/business/2020/01/16/next-china-trade-battle-could-be-over-electric-cars/, accessed Jan. 27, 2020.

[9] *See* Jackson, John H., *The World Trading System*, 2d. Ed. (1997) at 178-179 (safeguard measures in context of trade between countries with different economic systems).

[10] Fang, Lv, Xu Honghua, Wang Sicheng, "National Survey Report of PV Power Applications in China 2017," IEA PVPS, 2018, p. 21, http://www.iea-pvps.org/?id=93, retrieved November 6, 2019.

APPENDIX A

FEDERAL REGISTER NOTICES

The Commission makes available notices relevant to its investigations and reviews on its website, www.usitc.gov. In addition, the following tabulation presents, in chronological order, *Federal Register* notices issued by the Commission during the current proceeding.

Citation	Title	Link
84 FR 37674, August 1, 2019	*Crystalline Silicon Photovoltaic Cells, Whether or Not Partially or Fully Assembled Into Other Products: Monitoring Developments in the Domestic Industry Institution and Scheduling Notice for the Subject Investigation*	https://www.govinfo.gov/content/pkg/FR-2019-08-01/pdf/2019-16363.pdf
84 FR 67960, December 12, 2019	*Crystalline Silicon Photovoltaic Cells, Whether or Not Partially or Fully Assembled Into Other Products; Monitoring Developments in the Domestic Industry; Amendment*	https://www.govinfo.gov/content/pkg/FR-2019-12-12/pdf/2019-26774.pdf

APPENDIX B

LIST OF HEARING WITNESSES

CALENDAR OF PUBLIC HEARING

Those listed below appeared as witnesses at the United States International Trade Commission's hearing:

Subject: Crystalline Silicon Photovoltaic Cells, Whether or Not Partially or Fully Assembled into Other Products: Monitoring Developments in the Domestic Industry

Inv. No.: TA-201-75 (Monitoring)

Date and Time: December 5, 2019 - 9:30 a.m.

Sessions were held in connection with this investigation in the Main Hearing Room (Room 101), 500 E Street, SW., Washington, DC.

STATE GOVERNMENT APPEARANCES:

The Honorable Dennis Mock, Mayor of Dalton, Georgia

The Honorable R. Lynette Laughter, Chairwoman, Whitfield County Board of Commissioners

Carl Campbell, Executive Director, Dalton-Whitfield County Joint Development Authority

EMBASSY APPEARANCES:

Embassy of the Republic of Indonesia
Washington, DC

Mr. Wijayanto, Commercial Attaché

Embassy of the Republic of Korea
Washington, DC

Jungsoo Hur, Commercial Counsellor

Embassy of Canada
Washington, DC

Carrie Goodge O'Brien, Acting Minister-Counsellor

Taipei Economic and Cultural Representative Office
Washington, DC

Oscar Yang, Senior Trade Specialist, Bureau of Foreign Trade,
Ministry of Economic Affairs

OPENING REMARKS:

Panel 1 (**Matthew J. McConkey,** Mayer Brown LLP; and
John M. Gurley, Arent Fox LLP)
Panel 2 (**Matthew R. Nicely**, Hughes Hubbard & Reed LLP)

Panel 1:

Mayer Brown LLP
Washington, DC
on behalf of

Suniva, Inc. ("Suniva")

Matt Card, President and Chief Operating Officer, Suniva, Inc.

Jeffrey Klenk, Director, Berkeley Research Group, LLC

Robert Rogowsky, Special Advisor and Professor,
Berkeley Research Group, LLC

Warren Payne, Senior International Trade Advisor,
Mayer Brown LLP

Matthew J. McConkey) – OF COUNSEL

Arent Fox LLP
Washington, DC
on behalf of

Hanwha Q CELLS USA, Inc.

Jinhong (Martin) Park, Head of Strategy, Marketing & HR,
Hanwha Q CELLS USA, Inc.

Scott Moskowitz, Director of Strategy and Market Intelligence,
Hanwha Q CELLS USA, Inc.

Lisa Nash, Human Resources Manager,
Hanwha Q CELLS USA, Inc.

Panel 1 (continued):

Andrew Munro, General Counsel, Hanwha Q CELLS USA, Inc.

Mamun Rashid, Chief Executive Officer, Auxin Solar Inc.

W. Bradley Hudgens, Senior Economist, Georgetown Economic Services, LLC

Michael T. Kerwin, Director, Georgetown Economic Services, LLC

John M. Gurley)
) – OF COUNSEL
Diana Dimitriuc-Quaia)

TradeWins LLC
Washington, DC
on behalf of

SunPower Manufacturing Oregon (SPMOR)

Thomas Werner, Chief Executive Officer, SunPower Corp.

John R. Magnus) – OF COUNSEL

Curtis, Mallet-Prevost, Colt & Mosle LLP
Washington, DC
on behalf of

LG Electronics USA, Inc.
LG Electronics, Inc.

Brian Lynch, Director of Solar and ESS Sales, LGEUS

Daniel L. Porter)
Gina M. Colarusso) – OF COUNSEL
Kimberly A. Reynolds)

Sidley Austin LLP
Washington, DC
on behalf of

Mission Solar Energy ("Mission")

Paul Mutchler, Director of Commercial Operations, Mission Solar Energy LLC

Neil R. Ellis) – OF COUNSEL

Panel 2:

Hughes Hubbard & Reed LLP
Washington, DC
on behalf of

Solar Energy Industries Association ("SEIA")
REC Americas LLC

Ryan Creamer, Chief Executive Officer, sPower; Acting Chair, SEIA

Abigail Ross Hopper, President and Chief Executive Officer, SEIA

Justin Baca, Vice President of Markets and Research, SEIA

Craig Cornelius, Chief Executive Officer, Clearway Energy Group

George Hershman, President, Swinerton Renewable Energy

Cary Hayes, Chief Executive Officer, REC Americas LLC

James Resor, Chief Executive Officer,
EDF Renewables Distributed Solutions Inc.

Arthur Fletcher, Senior Vice President, Invenergy LLC

Thomas J. Prusa, PhD, Professor, Department of Economics,
Rutgers University

James P. Dougan, Vice President, Economic Consulting Services, LLC

Matthew R. Nicely)
Dean A. Pinkert) – OF COUNSEL
Julia K. Eppard)

Hogan Lovells US LLP
Washington, DC
on behalf of

Canadian Solar Inc.
Silfab Solar WA, Inc.
Silfab Solar, Inc
Heliene USA Inc.
Heliene Inc.
Recurrent Energy, LLC

Martin Pochtaruk, President, Heliene Inc. and Heliene USA Inc.

Panel 2 (continued):

Paolo Maccario, President and Chief Executive Officer,
Silfab Solar, Inc. and Silfab Solar WA, Inc.

Vincent Ambrose, General Manager for North America, Canadian Solar Inc.

Michael Arndt, Managing Director of Development, Recurrent Energy, LLC

Jonathan T. Stoel)
Michael G. Jacobson) – OF COUNSEL
Nicholas W. Laneville)

Curtis, Mallet-Prevost, Colt & Mosle LLP
Washington, DC
on behalf of

Government of Canada

Christopher Dunn)
) – OF COUNSEL
Tung Nguyen)

Holland & Knight LLP
Washington, DC
on behalf of

REC Americas LLC

Cary Hayes, President, REC Americas LLC

Ronald A. Oleynik) – OF COUNSEL

NextEra Energy, Inc.
NextEra Energy Resources, LLC
Florida Power & Light Company
Juno Beach, FL

Michael O' Sullivan, Senior Vice President-Development,
NextEra Energy Resources, LLC

H. Deen Kaplan, of Counsel, Hogan Lovells US LLP

Warren Maruyama, of Counsel, Hogan Lovells US LLP

Panel 2 (continued):

Utility Scale Solar Coalition
Charleston, SC

Hamilton Davis, Director of Regulatory Affairs, Southern Current LLC

REBUTTAL/CLOSING REMARKS:

Panel 1 (**Matthew J. McConkey,** Mayer Brown LLP; and **John R. Magnus**, TradeWins LLC)
Panel 2 (**Dean A. Pinkert**, Hughes Hubbard & Reed LLP)

APPENDIX C

SUMMARY DATA

Cell and Modules; All Producers; Total Market

Table C-1
CSPV products: Summary data concerning the U.S. total market, 2016-18, January to June 2018, and January to June 2019
(Quantity=kilowatts; Value=1,000 dollars; Unit values, unit labor costs, and unit expenses=dollars per kilowatt; Period changes=percent--exceptions noted)

	Reported data					Period changes			
	Calendar year			January to June		Calendar year			Jan-Jun
	2016	2017	2018	2018	2019	2016-18	2016-17	2017-18	2018-19
U.S. consumption quantity:									
Amount	***	***	***	***	***	▼***	▼***	▼***	▲***
Producers' share (fn1)	***	***	***	***	***	▼***	▼***	▼***	▼***
Importers' share (based on origin of cell) (fn1):									
Canada	***	***	***	***	***	▲***	▲***	▼***	▼***
China	***	***	***	***	***	▼***	▼***	▼***	▼***
Germany	***	***	***	***	***	▼***	▼***	▼***	▼***
India	***	***	***	***	***	▲***	▼***	▲***	▼***
Indonesia	***	***	***	***	***	▼***	▲***	▼***	▲***
Japan	***	***	***	***	***	▲***	▲***	▲***	▲***
Korea	***	***	***	***	***	▲***	▲***	▲***	▼***
Malaysia	***	***	***	***	***	▲***	▲***	▼***	▲***
Mexico	***	***	***	***	***	***	***	***	▲***
Philippines	***	***	***	***	***	▲***	▲***	▲***	▼***
Singapore	***	***	***	***	***	▲***	▲***	▲***	▼***
Taiwan	***	***	***	***	***	▼***	▼***	▼***	▲***
Thailand	***	***	***	***	***	▲***	▲***	▼***	▼***
Turkey	***	***	***	***	***	▲***	***	▲***	▲***
Vietnam	***	***	***	***	***	▲***	▲***	▼***	▲***
Other developing countries	***	***	***	***	***	***	***	***	▲***
Other non-developing countries	***	***	***	***	***	▼***	▼***	▼***	▼***
All import sources	***	***	***	***	***	▲***	▲***	▲***	▲***
Importers' share (based on location of module assembly) (fn1):									
Canada	***	***	***	***	***	▲***	▲***	▲***	▼***
China	***	***	***	***	***	▼***	▼***	▼***	▼***
Mexico	***	***	***	***	***	▲***	▼***	▲***	▼***
U.S. consumption value:									
Amount	***	***	***	***	***	▼***	▼***	▼***	▲***
Producers' share (fn1):									
Fully domestic value	***	***	***	***	***	▼***	▼***	▼***	▼***
Value added to imports	***	***	***	***	***	▲***	▼***	▲***	▲***
Total	***	***	***	***	***	▲***	▼***	▲***	▲***
Importers' share (based on origin of cell) (fn1):									
Canada	***	***	***	***	***	▲***	▲***	▼***	▼***
China	***	***	***	***	***	▼***	▼***	▼***	▼***
Germany	***	***	***	***	***	▼***	▼***	▼***	▼***
India	***	***	***	***	***	▲***	▲***	▲***	▼***
Indonesia	***	***	***	***	***	▼***	▲***	▼***	▼***
Japan	***	***	***	***	***	▲***	▲***	▲***	▲***
Korea	***	***	***	***	***	▲***	▲***	▲***	▼***
Malaysia	***	***	***	***	***	▲***	▲***	▼***	▲***
Mexico	***	***	***	***	***	***	***	***	▲***
Philippines	***	***	***	***	***	▲***	▼***	▲***	▼***
Singapore	***	***	***	***	***	▲***	▼***	▲***	▼***
Taiwan	***	***	***	***	***	▼***	▼***	▼***	▲***
Thailand	***	***	***	***	***	▲***	▲***	▼***	▼***
Turkey	***	***	***	***	***	▲***	***	▲***	▲***
Vietnam	***	***	***	***	***	▲***	▲***	▼***	▲***
Other developing countries	***	***	***	***	***	***	***	***	▲***
Other non-developing countries	***	***	***	***	***	▼***	▼***	▼***	▼***
All import sources	***	***	***	***	***	▼***	▲***	▼***	▼***
Importers' share (based on location of module assembly) (fn1):									
Canada	***	***	***	***	***	▲***	▲***	▲***	▼***
China	***	***	***	***	***	▼***	▼***	▼***	▼***
Mexico	***	***	***	***	***	▲***	▼***	▲***	▼***

Table continued on next page.

Table C-1--Continued
CSPV products: Summary data concerning the U.S. total market, 2016-18, January to June 2018, and January to June 2019
(Quantity=kilowatts; Value=1,000 dollars; Unit values, unit labor costs, and unit expenses=dollars per kilowatt; Period changes=percent--exceptions noted)

	Reported data					Period changes			
	Calendar year			January to June		Calendar year			Jan-Jun
	2016	2017	2018	2018	2019	2016-18	2016-17	2017-18	2018-19
U.S. imports (based on origin of cell) from:									
Canada:									
Quantity	***	***	***	***	***	▲ ***	▲ ***	▼ ***	▼ ***
Value	***	***	***	***	***	▲ ***	▲ ***	▼ ***	▼ ***
Unit value	***	***	***	***	***	▲ ***	▲ ***	▼ ***	▼ ***
China:									
Quantity	***	***	***	***	***	▼ ***	▼ ***	▼ ***	▼ ***
Value	***	***	***	***	***	▼ ***	▼ ***	▼ ***	▼ ***
Unit value	***	***	***	***	***	▼ ***	▼ ***	▲ ***	▼ ***
Germany:									
Quantity	***	***	***	***	***	▼ ***	▼ ***	▼ ***	▼ ***
Value	***	***	***	***	***	▼ ***	▼ ***	▼ ***	▼ ***
Unit value	***	***	***	***	***	▲ ***	▼ ***	▲ ***	▼ ***
India:									
Quantity	***	***	***	***	***	▲ ***	▼ ***	▲ ***	▼ ***
Value	***	***	***	***	***	▲ ***	▲ ***	▲ ***	▼ ***
Unit value	***	***	***	***	***	▼ ***	▲ ***	▼ ***	▼ ***
Indonesia:									
Quantity	***	***	***	***	***	▼ ***	▲ ***	▼ ***	▲ ***
Value	***	***	***	***	***	▼ ***	▲ ***	▼ ***	▲ ***
Unit value	***	***	***	***	***	▼ ***	▲ ***	▼ ***	▼ ***
Japan:									
Quantity	***	***	***	***	***	▲ ***	▲ ***	▲ ***	▲ ***
Value	***	***	***	***	***	▲ ***	▲ ***	▲ ***	▲ ***
Unit value	***	***	***	***	***	▼ ***	▼ ***	▼ ***	▼ ***
Korea:									
Quantity	***	***	***	***	***	▼ ***	▲ ***	▼ ***	▲ ***
Value	***	***	***	***	***	▼ ***	▼ ***	▼ ***	▼ ***
Unit value	***	***	***	***	***	▼ ***	▼ ***	▼ ***	▼ ***
Malaysia:									
Quantity	***	***	***	***	***	▼ ***	▲ ***	▼ ***	▲ ***
Value	***	***	***	***	***	▼ ***	▼ ***	▼ ***	▲ ***
Unit value	***	***	***	***	***	▼ ***	▼ ***	▼ ***	▼ ***
Mexico:									
Quantity	***	***	***	***	***	***	***	***	▲ ***
Value	***	***	***	***	***	***	***	***	▲ ***
Unit value	***	***	***	***	***	***	***	***	▲ ***
Philippines:									
Quantity	***	***	***	***	***	▲ ***	▲ ***	▲ ***	▼ ***
Value	***	***	***	***	***	▼ ***	▼ ***	▲ ***	▼ ***
Unit value	***	***	***	***	***	▼ ***	▼ ***	▲ ***	▲ ***
Singapore:									
Quantity	***	***	***	***	***	▼ ***	▼ ***	▲ ***	▼ ***
Value	***	***	***	***	***	▼ ***	▼ ***	▲ ***	▼ ***
Unit value	***	***	***	***	***	▼ ***	▼ ***	▲ ***	▼ ***
Taiwan:									
Quantity	***	***	***	***	***	▼ ***	▼ ***	▼ ***	▲ ***
Value	***	***	***	***	***	▼ ***	▼ ***	▼ ***	▲ ***
Unit value	***	***	***	***	***	▼ ***	▼ ***	▼ ***	▼ ***
Thailand:									
Quantity	***	***	***	***	***	▼ ***	▲ ***	▼ ***	▲ ***
Value	***	***	***	***	***	▼ ***	▲ ***	▼ ***	▲ ***
Unit value	***	***	***	***	***	▼ ***	▼ ***	▲ ***	▼ ***
Turkey:									
Quantity	***	***	***	***	***	▲ ***	***	▲ ***	▲ ***
Value	***	***	***	***	***	▲ ***	***	▲ ***	▲ ***
Unit value	***	***	***	***	***	▲ ***	***	▲ ***	▼ ***
Vietnam:									
Quantity	***	***	***	***	***	▲ ***	▲ ***	▼ ***	▲ ***
Value	***	***	***	***	***	▼ ***	▲ ***	▼ ***	▲ ***
Unit value	***	***	***	***	***	▼ ***	▼ ***	▼ ***	▼ ***

Table continued on next page.

Table C-1--Continued
CSPV products: Summary data concerning the U.S. total market, 2016-18, January to June 2018, and January to June 2019
(Quantity=kilowatts; Value=1,000 dollars; Unit values, unit labor costs, and unit expenses=dollars per kilowatt; Period changes=percent--exceptions noted)

	Reported data					Period changes			
	Calendar year			January to June		Calendar year			Jan-Jun
	2016	2017	2018	2018	2019	2016-18	2016-17	2017-18	2018-19
U.S. imports (based on origin of cell) from:--Continued									
All other developing countries:									
Quantity	***	***	***	***	***	***	***	***	▲***
Value	***	***	***	***	***	***	***	***	▲***
Unit value	***	***	***	***	***	***	***	***	▲***
All other non-developing countries:									
Quantity	***	***	***	***	***	▼***	▼***	▼***	▼***
Value	***	***	***	***	***	▼***	▼***	▼***	▼***
Unit value	***	***	***	***	***	▼***	▼***	▼***	▲***
All import sources:									
Quantity	11,856,373	10,066,330	6,136,626	2,682,400	5,033,392	▼(48.2)	▼(15.1)	▼(39.0)	▲87.6
Value	6,923,693	4,113,432	2,479,151	1,177,300	1,570,461	▼(64.2)	▼(40.6)	▼(39.7)	▲33.4
Unit value	$584	$409	$404	$439	$312	▼(30.8)	▼(30.0)	▼(1.1)	▼(28.9)
U.S. imports (based on location of module assembly) from:									
Canada:									
Quantity	***	***	***	***	***	▼***	▼***	▼***	▼***
Value	***	***	***	***	***	▼***	▼***	▼***	▼***
Unit value	***	***	***	***	***	▼***	▼***	▼***	▼***
China:									
Quantity	***	***	***	***	***	▼***	▼***	▼***	▲***
Value	***	***	***	***	***	▼***	▼***	▼***	▼***
Unit value	***	***	***	***	***	▼***	▼***	▲***	▼***
Mexico:									
Quantity	***	***	***	***	***	▼***	▼***	▲***	▼***
Value	***	***	***	***	***	▼***	▼***	▲***	▼***
Unit value	***	***	***	***	***	▼***	▼***	▼***	▼***
U.S. producers':									
Cells: Average capacity quantity	***	***	***	***	***	▼***	▼***	▼***	▼***
Cells: Production quantity	***	***	***	***	***	▼***	▼***	▼***	▼***
Cells: Capacity utilization (fn1)	***	***	***	***	***	▼***	▼***	▼***	▲***
Modules: Average capacity quantity	***	***	***	***	***	▼***	▼***	▲***	▲***
Modules: Production quantity	***	***	***	***	***	▼***	▼***	▲***	▲***
Modules: Capacity utilization (fn1)	***	***	***	***	***	▼***	▼***	▲***	▲***
U.S. shipments (fn2):									
Quantity	***	***	***	***	***	▼***	▼***	▼***	▼***
Value:									
Fully domestic value	***	***	***	***	***	▼***	▼***	▼***	▼***
Valued added to imports	***	***	***	***	***	▲***	▼***	▲***	▲***
Total value	***	***	***	***	***	▼***	▼***	▲***	▲***
Unit value	***	***	***	***	***	▼***	▼***	▼***	▼***
Export shipments:									
Quantity	***	***	***	***	***	▼***	▼***	▼***	▲***
Value	***	***	***	***	***	▼***	▼***	▼***	▲***
Unit value	***	***	***	***	***	▼***	▼***	▼***	▼***
Ending inventory quantity	***	***	***	***	***	▼***	▼***	▼***	▲***
Inventories/total shipments (fn1)	***	***	***	***	***	▼***	▼***	▲***	▲***
Production workers	***	***	***	***	***	▼***	▼***	▼***	▲***
Hours worked (1,000s)	***	***	***	***	***	▼***	▼***	▲***	▲***
Wages paid ($1,000)	***	***	***	***	***	▼***	▼***	▲***	▲***
Hourly wages (dollars per hour)	***	***	***	***	***	▲***	▲***	▲***	▼***
Cells: Productivity (kilowatts per hour)	***	***	***	***	***	▲***	▲***	▼***	▼***
Cells: Unit labor costs	***	***	***	***	***	▼***	▼***	▼***	▲***
Modules: Productivity (kilowatts per hour)	***	***	***	***	***	▲***	▼***	▲***	▲***
Modules: Unit labor costs	***	***	***	***	***	▲***	▲***	▼***	▼***

Table continued on next page.

Table C-1--Continued
CSPV products: Summary data concerning the U.S. total market, 2016-18, January to June 2018, and January to June 2019
(Quantity=kilowatts; Value=1,000 dollars; Unit values, unit labor costs, and unit expenses=dollars per kilowatt; Period changes=percent--exceptions noted)

	Reported data					Period changes			
	Calendar year			January to June		Calendar year			Jan-Jun
	2016	2017	2018	2018	2019	2016-18	2016-17	2017-18	2018-19
U.S. cell and U.S. module producers' results: Regardless of origin of cells:									
Net sales:									
Quantity	***	***	***	***	***	▼***	▼***	▲***	▲***
Value	***	***	***	***	***	▼***	▼***	▲***	▲***
Unit value	***	***	***	***	***	▼***	▼***	▲***	▼***
Cost of goods sold (COGS)	***	***	***	***	***	▼***	▼***	▲***	▲***
Gross profit or (loss) (fn3)	***	***	***	***	***	▼***	▼***	▲***	▲***
SG&A expenses	***	***	***	***	***	▼***	▼***	▼***	▲***
Operating income or (loss) (fn3)	***	***	***	***	***	▲***	▲***	▲***	▼***
Net income or (loss) (fn3)	***	***	***	***	***	▲***	▲***	▼***	▲***
Capital expenditures	***	***	***	***	***	▲***	▼***	▲***	▲***
Unit COGS	***	***	***	***	***	▼***	▼***	▼***	▼***
Unit SG&A expenses	***	***	***	***	***	▼***	▼***	▼***	▼***
Unit operating income or (loss) (fn3)	***	***	***	***	***	▲***	▼***	▲***	▲***
Unit net income or (loss) (fn3)	***	***	***	***	***	▲***	▼***	▲***	▲***
COGS/sales (fn1)	***	***	***	***	***	▲***	▲***	▼***	▼***
Operating income or (loss)/sales (fn1)	***	***	***	***	***	▲***	▼***	▲***	▲***
Net income or (loss)/sales (fn1)	***	***	***	***	***	▼***	▼***	▲***	▲***
U.S. cell and U.S. module producers' results: Using U.S.-origin cells:									
Net sales:									
Quantity	***	***	***	***	***	▼***	▼***	▼***	▼***
Value	***	***	***	***	***	▼***	▼***	▼***	▼***
Unit value	***	***	***	***	***	▼***	▼***	▲***	▼***
Cost of goods sold (COGS)	***	***	***	***	***	▼***	▼***	▼***	▼***
Gross profit or (loss) (fn3)	***	***	***	***	***	▼***	▼***	▲***	▼***
SG&A expenses	***	***	***	***	***	▼***	▼***	▼***	▼***
Operating income or (loss) (fn3)	***	***	***	***	***	▲***	▼***	▲***	▲***
Net income or (loss) (fn3)	***	***	***	***	***	▼***	▼***	▼***	▲***
Unit COGS	***	***	***	***	***	▲***	▲***	▲***	▲***
Unit SG&A expenses	***	***	***	***	***	▲***	▲***	▲***	▼***
Unit operating income or (loss) (fn3)	***	***	***	***	***	▼***	▼***	▼***	▼***
Unit net income or (loss) (fn3)	***	***	***	***	***	▼***	▼***	▼***	▲***
COGS/sales (fn1)	***	***	***	***	***	▲***	▲***	▲***	▲***
Operating income or (loss)/sales (fn1)	***	***	***	***	***	▼***	▼***	▼***	▼***
Net income or (loss)/sales (fn1)	***	***	***	***	***	▼***	▼***	▼***	▼***
U.S. module producers' results: Using Foreign-origin cells:									
Net sales:									
Quantity	***	***	***	***	***	▲***	▼***	▲***	▲***
Value	***	***	***	***	***	▲***	▼***	▲***	▲***
Unit value	***	***	***	***	***	▼***	▼***	▲***	▼***
Cost of goods sold (COGS)	***	***	***	***	***	▲***	▼***	▲***	▲***
Gross profit or (loss) (fn3)	***	***	***	***	***	▲***	▼***	▲***	▲***
SG&A expenses	***	***	***	***	***	▼***	▼***	▼***	▲***
Operating income or (loss) (fn3)	***	***	***	***	***	▲***	▲***	▲***	▼***
Net income or (loss) (fn3)	***	***	***	***	***	▲***	▲***	▲***	▼***
Unit COGS	***	***	***	***	***	▼***	▼***	▼***	▼***
Unit SG&A expenses	***	***	***	***	***	▼***	▼***	▼***	▼***
Unit operating income or (loss) (fn3)	***	***	***	***	***	▲***	▲***	▲***	▲***
Unit net income or (loss) (fn3)	***	***	***	***	***	▲***	▲***	▲***	▲***
COGS/sales (fn1)	***	***	***	***	***	▼***	▲***	▼***	▼***
Operating income or (loss)/sales (fn1)	***	***	***	***	***	▲***	▲***	▲***	▲***
Net income or (loss)/sales (fn1)	***	***	***	***	***	▲***	▲***	▲***	▲***

Notes:

Note.--Shares and ratios shown as “0.0” percent represent non-zero values less than “0.05” percent (if positive) and greater than “(0.05)” percent (if negative). Zeroes, null values, and undefined calculations are suppressed and shown as “---“. Period changes preceded by a “▲” represent an increase, while period changes preceded by a “▼” represent a decrease.

fn1.--Reported data are in percent and period changes are in percentage points.
fn2.-- The quantity for U.S. producers' U.S. shipments reflects the quantity of Solar panels sold in the United States. The value for U.S. producers' reflects the value of Solar panels sold in the United States from producers~ plus the additional value added to either domestic or imported Solar panels from producers. The average unit values presente for U.S. producers' U.S. shipments excluded the value added to imported Solar panels. In measuring consumption and market share this methodology avoids reclassifying and/or double counting merchandise already reported once either by a domestic producer or an impor
fn3.--Percent changes only calculated when both comparison values represent profits; The directional change in profitability provided when one or both comparison values represent a loss.

Source: Compiled from data submitted in response to Commission questionnaires.

Modules Only, Total Market

Table C-2
CSPV modules: Summary data concerning the U.S. total market, 2016-18, January to June 2018, and January to June 2019
(Quantity=kilowatts; Value=1,000 dollars; Unit values, unit labor costs, and unit expenses=dollars per kilowatt; Period changes=percent--exceptions noted)

	Reported data					Period changes			
	Calendar year			January to June		Calendar year			Jan-Jun
	2016	2017	2018	2018	2019	2016-18	2016-17	2017-18	2018-19
U.S. consumption quantity:									
Amount	***	***	***	***	***	▼***	▼***	▼***	▲***
Producers' share (fn1)	***	***	***	***	***	▲***	▼***	▲***	▲***
Importers' share (fn1):									
Canada	***	***	***	***	***	▲***	▲***	▼***	▼***
China	***	***	***	***	***	▼***	▼***	▼***	▼***
Germany	***	***	***	***	***	▼***	▼***	▼***	▼***
India	***	***	***	***	***	▲***	▼***	▲***	▼***
Indonesia	***	***	***	***	***	▼***	▲***	▼***	▲***
Japan	***	***	***	***	***	▲***	▲***	▼***	▼***
Korea	***	***	***	***	***	▲***	▲***	▲***	▼***
Malaysia	***	***	***	***	***	▲***	▲***	▼***	▲***
Mexico	***	***	***	***	***	***	***	***	▲***
Philippines	***	***	***	***	***	▲***	▲***	▲***	▼***
Singapore	***	***	***	***	***	▲***	▲***	▲***	▼***
Taiwan	***	***	***	***	***	▼***	▼***	▼***	▲***
Thailand	***	***	***	***	***	▲***	▲***	▼***	▼***
Turkey	***	***	***	***	***	▲***	***	▲***	▲***
Vietnam	***	***	***	***	***	▲***	▲***	▼***	▲***
Other developing countries	***	***	***	***	***	***	***	***	▲***
Other non-developing countries	***	***	***	***	***	▼***	▼***	▼***	▼***
All import sources	***	***	***	***	***	▼***	▲***	▼***	▼***
Importers' share (based on location of module assembly) (fn1):									
Canada	***	***	***	***	***	▲***	▲***	▲***	▼***
China	***	***	***	***	***	▼***	▼***	▼***	▼***
Mexico	***	***	***	***	***	▲***	▼***	▲***	▼***
U.S. consumption value:									
Amount	***	***	***	***	***	▼***	▼***	▼***	▲***
Producers' share (fn1)	***	***	***	***	***	▲***	▼***	▲***	▲***
Importers' share (fn1):									
Canada	***	***	***	***	***	▲***	▲***	▼***	▼***
China	***	***	***	***	***	▼***	▼***	▼***	▼***
Germany	***	***	***	***	***	▼***	▼***	▼***	▼***
India	***	***	***	***	***	▲***	▲***	▲***	▼***
Indonesia	***	***	***	***	***	▼***	▲***	▼***	▼***
Japan	***	***	***	***	***	▲***	▲***	▼***	▼***
Korea	***	***	***	***	***	▲***	▲***	▲***	▼***
Malaysia	***	***	***	***	***	▲***	▲***	▼***	▲***
Mexico	***	***	***	***	***	***	***	***	▲***
Philippines	***	***	***	***	***	▲***	▼***	▲***	▼***
Singapore	***	***	***	***	***	▲***	▲***	▲***	▼***
Taiwan	***	***	***	***	***	▼***	▼***	▼***	▲***
Thailand	***	***	***	***	***	▲***	▲***	▼***	▼***
Turkey	***	***	***	***	***	▲***	***	▲***	▲***
Vietnam	***	***	***	***	***	▲***	▲***	▼***	▲***
Other developing countries	***	***	***	***	***	***	***	***	▲***
Other non-developing countries	***	***	***	***	***	▼***	▼***	▼***	▼***
All import sources	***	***	***	***	***	▼***	▲***	▼***	▼***
Importers' share (based on location of module assembly) (fn1):									
Canada	***	***	***	***	***	▲***	▲***	▲***	▼***
China	***	***	***	***	***	▼***	▼***	▼***	▼***
Mexico	***	***	***	***	***	▲***	▼***	▲***	▼***

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Table C-2--Continued
CSPV modules: Summary data concerning the U.S. total market, 2016-18, January to June 2018, and January to June 2019
(Quantity=kilowatts; Value=1,000 dollars; Unit values, unit labor costs, and unit expenses=dollars per kilowatt; Period changes=percent--exceptions noted)

	Reported data					Period changes			
	Calendar year			January to June		Calendar year			Jan-Jun
	2016	2017	2018	2018	2019	2016-18	2016-17	2017-18	2018-19
U.S. imports from:									
Canada:									
Quantity	***	***	***	***	***	▲***	▲***	▼***	▼***
Value	***	***	***	***	***	▲***	▲***	▼***	▼***
Unit value	***	***	***	***	***	▲***	▲***	▼***	▼***
China:									
Quantity	***	***	***	***	***	▼***	▼***	▼***	▼***
Value	***	***	***	***	***	▼***	▼***	▼***	▼***
Unit value	***	***	***	***	***	▲***	▼***	▲***	▲***
Germany:									
Quantity	***	***	***	***	***	▼***	▼***	▼***	▼***
Value	***	***	***	***	***	▼***	▼***	▼***	▼***
Unit value	***	***	***	***	***	▲***	▲***	▲***	▼***
India:									
Quantity	***	***	***	***	***	▲***	▼***	▲***	▼***
Value	***	***	***	***	***	▲***	▲***	▲***	▼***
Unit value	***	***	***	***	***	▼***	▲***	▼***	▼***
Indonesia:									
Quantity	***	***	***	***	***	▼***	▲***	▼***	▲***
Value	***	***	***	***	***	▼***	▲***	▼***	▲***
Unit value	***	***	***	***	***	▼***	▲***	▼***	▼***
Japan:									
Quantity	***	***	***	***	***	▲***	▲***	▼***	▼***
Value	***	***	***	***	***	▲***	▲***	▼***	▼***
Unit value	***	***	***	***	***	▲***	▼***	▲***	▼***
Korea:									
Quantity	***	***	***	***	***	▼***	▲***	▼***	▼***
Value	***	***	***	***	***	▼***	▼***	▼***	▼***
Unit value	***	***	***	***	***	▼***	▼***	▼***	▼***
Malaysia:									
Quantity	***	***	***	***	***	▼***	▲***	▼***	▲***
Value	***	***	***	***	***	▼***	▼***	▼***	▲***
Unit value	***	***	***	***	***	▼***	▼***	▼***	▼***
Mexico:									
Quantity	***	***	***	***	***	***	***	***	▲***
Value	***	***	***	***	***	***	***	***	▲***
Unit value	***	***	***	***	***	***	***	***	▲***
Philippines:									
Quantity	***	***	***	***	***	▲***	▼***	▲***	▼***
Value	***	***	***	***	***	▼***	▼***	▲***	▼***
Unit value	***	***	***	***	***	▼***	▼***	▲***	▲***
Singapore:									
Quantity	***	***	***	***	***	▼***	▼***	▲***	▼***
Value	***	***	***	***	***	▼***	▼***	▲***	▼***
Unit value	***	***	***	***	***	▼***	▼***	▲***	▼***
Taiwan:									
Quantity	***	***	***	***	***	▼***	▼***	▼***	▲***
Value	***	***	***	***	***	▼***	▼***	▼***	▲***
Unit value	***	***	***	***	***	▲***	▼***	▲***	▼***
Thailand:									
Quantity	***	***	***	***	***	▼***	▲***	▼***	▲***
Value	***	***	***	***	***	▼***	▲***	▼***	▲***
Unit value	***	***	***	***	***	▼***	▼***	▲***	▼***
Turkey:									
Quantity	***	***	***	***	***	▲***	***	▲***	▲***
Value	***	***	***	***	***	▲***	***	▲***	▲***
Unit value	***	***	***	***	***	▲***	***	▲***	▼***
Vietnam:									
Quantity	***	***	***	***	***	▼***	▲***	▼***	▲***
Value	***	***	***	***	***	▼***	▲***	▼***	▲***
Unit value	***	***	***	***	***	▼***	▼***	▲***	▼***

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Table C-2--Continued

CSPV modules: Summary data concerning the U.S. total market, 2016-18, January to June 2018, and January to June 2019

(Quantity=kilowatts; Value=1,000 dollars; Unit values, unit labor costs, and unit expenses=dollars per kilowatt; Period changes=percent--exceptions noted)

	Reported data					Period changes			
	Calendar year			January to June		Calendar year			Jan-Jun
	2016	2017	2018	2018	2019	2016-18	2016-17	2017-18	2018-19
U.S. imports from:--Continued									
All other developing countries:									
Quantity	***	***	***	***	***	***	***	***	▲***
Value	***	***	***	***	***	***	***	***	▲***
Unit value	***	***	***	***	***	***	***	***	▲***
All other non-developing countries:									
Quantity	***	***	***	***	***	▼***	▼***	▼***	▼***
Value	***	***	***	***	***	▼***	▼***	▼***	▼***
Unit value	***	***	***	***	***	▼***	▼***	▼***	▲***
All import sources:									
Quantity	11,590,991	9,787,904	5,299,723	2,374,064	4,082,389	▼(54.3)	▼(15.6)	▼(45.9)	▲72.0
Value	6,826,665	4,020,795	2,218,159	1,069,576	1,386,176	▼(67.5)	▼(41.1)	▼(44.8)	▲29.6
Unit value	$589	$411	$419	$451	$340	▼(28.9)	▼(30.3)	▲1.9	▼(24.6)
U.S. imports (based on location of module assembly) from:									
Canada:									
Quantity	***	***	***	***	***	▼***	▼***	▼***	▼***
Value	***	***	***	***	***	▼***	▼***	▼***	▼***
Unit value	***	***	***	***	***	▼***	▼***	▼***	▼***
China:									
Quantity	***	***	***	***	***	▼***	▼***	▼***	▼***
Value	***	***	***	***	***	▼***	▼***	▼***	▼***
Unit value	***	***	***	***	***	▲***	▼***	▲***	▼***
Mexico:									
Quantity	***	***	***	***	***	▼***	▼***	▲***	▼***
Value	***	***	***	***	***	▼***	▼***	▲***	▼***
Unit value	***	***	***	***	***	▼***	▼***	▼***	▼***
U.S. producers':									
Average capacity quantity	***	***	***	***	***	▼***	▼***	▲***	▲***
Production quantity	***	***	***	***	***	▼***	▼***	▲***	▲***
Capacity utilization (fn1)	***	***	***	***	***	▼***	▼***	▲***	▲***
U.S. shipments:									
Quantity	***	***	***	***	***	▼***	▼***	▲***	▲***
Value:	***	***	***	***	***	▼***	▼***	▲***	▲***
Unit value	***	***	***	***	***	▼***	▼***	▲***	▼***
Export shipments:									
Quantity	***	***	***	***	***	▼***	▼***	▼***	▼***
Value	***	***	***	***	***	▼***	▼***	▼***	▼***
Unit value	***	***	***	***	***	▼***	▼***	▼***	▼***
Ending inventory quantity	***	***	***	***	***	▼***	▼***	▼***	▲***
Inventories/total shipments (fn1)	***	***	***	***	***	▼***	▼***	▼***	▲***
Production workers	***	***	***	***	***	▼***	▼***	▼***	▲***
Hours worked (1,000s)	***	***	***	***	***	▼***	▼***	▲***	▲***
Wages paid ($1,000)	***	***	***	***	***	▼***	▼***	▲***	▲***
Hourly wages (dollars per hour)	***	***	***	***	***	▲***	▲***	▲***	▼***
Productivity (kilowatts per hour)	***	***	***	***	***	▲***	▼***	▲***	▲***
Unit labor costs	***	***	***	***	***	▲***	▲***	▼***	▼***

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Table C-2--Continued
CSPV modules: Summary data concerning the U.S. total market, 2016-18, January to June 2018, and January to June 2019
(Quantity=kilowatts; Value=1,000 dollars; Unit values, unit labor costs, and unit expenses=dollars per kilowatt; Period changes=percent--exceptions noted)

	Reported data					Period changes			
	Calendar year			January to June		Calendar year			Jan-Jun
	2016	2017	2018	2018	2019	2016-18	2016-17	2017-18	2018-19
U.S. module producers' results: Regardless of origin of cells:									
Net sales:									
Quantity	***	***	***	***	***	▼***	▼***	▲***	▲***
Value	***	***	***	***	***	▼***	▼***	▲***	▲***
Unit value	***	***	***	***	***	▼***	▼***	▲***	▼***
Cost of goods sold (COGS)	***	***	***	***	***	▼***	▼***	▲***	▲***
Gross profit or (loss) (fn2)	***	***	***	***	***	▲***	▼***	▲***	▲***
SG&A expenses	***	***	***	***	***	▼***	▼***	▼***	▲***
Operating income or (loss) (fn2)	***	***	***	***	***	▲***	▲***	▲***	▲***
Net income or (loss) (fn2)	***	***	***	***	***	▲***	▲***	▲***	▲***
Capital expenditures	***	***	***	***	***	▲***	▼***	▲***	▲***
Unit COGS	***	***	***	***	***	▼***	▼***	▼***	▼***
Unit SG&A expenses	***	***	***	***	***	▼***	▼***	▼***	▼***
Unit operating income or (loss) (fn2)	***	***	***	***	***	▲***	▼***	▲***	▲***
Unit net income or (loss) (fn2)	***	***	***	***	***	▲***	▼***	▲***	▲***
COGS/sales (fn1)	***	***	***	***	***	▲***	▲***	▼***	▼***
Operating income or (loss)/sales (fn1)	***	***	***	***	***	▲***	▼***	▲***	▲***
Net income or (loss)/sales (fn1)	***	***	***	***	***	▲***	▼***	▲***	▲***
U.S. module producers' results: Using U.S.-origin cells:									
Net sales:									
Quantity	***	***	***	***	***	▼***	▼***	▼***	▼***
Value	***	***	***	***	***	▼***	▼***	▼***	▼***
Unit value	***	***	***	***	***	▼***	▼***	▲***	▲***
Cost of goods sold (COGS)	***	***	***	***	***	▼***	▼***	▼***	▼***
Gross profit or (loss) (fn2)	***	***	***	***	***	▼***	▼***	▲***	▲***
SG&A expenses	***	***	***	***	***	▼***	▼***	▼***	▼***
Operating income or (loss) (fn2)	***	***	***	***	***	▲***	▼***	▲***	▲***
Net income or (loss) (fn2)	***	***	***	***	***	▼***	▼***	▼***	▲***
Unit COGS	***	***	***	***	***	▼***	▼***	▼***	▲***
Unit SG&A expenses	***	***	***	***	***	▲***	▲***	▲***	▲***
Unit operating income or (loss) (fn2)	***	***	***	***	***	▼***	▼***	▼***	▲***
Unit net income or (loss) (fn2)	***	***	***	***	***	▼***	▼***	▼***	▲***
COGS/sales (fn1)	***	***	***	***	***	▲***	▲***	▼***	▼***
Operating income or (loss)/sales (fn1)	***	***	***	***	***	▼***	▼***	▲***	▲***
Net income or (loss)/sales (fn1)	***	***	***	***	***	▼***	▼***	▼***	▲***
U.S. module producers' results: Using Foreign-origin cells:									
Net sales:									
Quantity	***	***	***	***	***	▲***	▼***	▲***	▲***
Value	***	***	***	***	***	▲***	▼***	▲***	▲***
Unit value	***	***	***	***	***	▼***	▼***	▲***	▼***
Cost of goods sold (COGS)	***	***	***	***	***	▲***	▼***	▲***	▲***
Gross profit or (loss) (fn2)	***	***	***	***	***	▲***	▼***	▲***	▲***
SG&A expenses	***	***	***	***	***	▼***	▼***	▼***	▲***
Operating income or (loss) (fn2)	***	***	***	***	***	▲***	▲***	▲***	▼***
Net income or (loss) (fn2)	***	***	***	***	***	▲***	▲***	▲***	▼***
Unit COGS	***	***	***	***	***	▼***	▼***	▼***	▼***
Unit SG&A expenses	***	***	***	***	***	▼***	▼***	▼***	▼***
Unit operating income or (loss) (fn2)	***	***	***	***	***	▲***	▲***	▲***	▲***
Unit net income or (loss) (fn2)	***	***	***	***	***	▲***	▲***	▲***	▲***
COGS/sales (fn1)	***	***	***	***	***	▼***	▲***	▼***	▼***
Operating income or (loss)/sales (fn1)	***	***	***	***	***	▲***	▲***	▲***	▲***
Net income or (loss)/sales (fn1)	***	***	***	***	***	▲***	▲***	▲***	▲***

Notes:

Note.--Shares and ratios shown as "0.0" percent represent non-zero values less than "0.05" percent (if positive) and greater than "(0.05)" percent (if negative). Zeroes, null values, and undefined calculations are suppressed and shown as "---". Period changes preceded by a "▲" represent an increase, while period changes preceded by a "▼" represent a decrease.

fn1.--Reported data are in percent and period changes are in percentage points.
fn2.--Percent changes only calculated when both comparison values represent profits; The directional change in profitability provided when one or both comparison values represent a loss.

Source: Compiled from data submitted in response to Commission questionnaires.

Cells Only, Merchant Market

Table C-3
CSPV cells: Summary data concerning the U.S. merchant market, 2016-18, January to June 2018, and January to June 2019
(Quantity=kilowatts; Value=1,000 dollars; Unit values, unit labor costs, and unit expenses=dollars per kilowatt; Period changes=percent--exceptions noted)

	Reported data					Period changes			
	Calendar year			January to June		Calendar year			Jan-Jun
	2016	2017	2018	2018	2019	2016-18	2016-17	2017-18	2018-19
U.S. consumption quantity:									
Amount	***	***	***	***	***	▲***	▲***	▲***	▲***
Producers' share (fn1)	***	***	***	***	***	▲***	▲***	▲***	▼***
Importers' share (fn1):									
Canada	***	***	***	***	***	***	***	***	***
China	***	***	***	***	***	▲***	▲***	▲***	▼***
Germany	***	***	***	***	***	▼***	▼***	▼***	▼***
India	***	***	***	***	***	***	***	***	***
Indonesia	***	***	***	***	***	***	***	***	***
Japan	***	***	***	***	***	▲***	▲***	▼***	▼***
Korea	***	***	***	***	***	▲***	▼***	▲***	▲***
Malaysia	***	***	***	***	***	▲***	▲***	▲***	▼***
Mexico	***	***	***	***	***	***	***	***	***
Philippines	***	***	***	***	***	▲***	▲***	▼***	▼***
Singapore	***	***	***	***	***	***	***	***	***
Taiwan	***	***	***	***	***	▼***	▼***	▼***	▲***
Thailand	***	***	***	***	***	▲***	▼***	▲***	▼***
Turkey	***	***	***	***	***	***	***	***	***
Vietnam	***	***	***	***	***	▲***	▲***	▼***	▼***
Other developing countries	***	***	***	***	***	***	***	***	***
Other non-developing countries	***	***	***	***	***	▼***	▼***	***	***
All import sources	***	***	***	***	***	▼***	▼***	▼***	▲***
U.S. consumption value:									
Amount	***	***	***	***	***	▲***	▼***	▲***	▲***
Producers' share (fn1)	***	***	***	***	***	▲***	▼***	▲***	▼***
Importers' share (fn1):									
Canada	***	***	***	***	***	***	***	***	***
China	***	***	***	***	***	▲***	▲***	▲***	▼***
Germany	***	***	***	***	***	▼***	▼***	▼***	▼***
India	***	***	***	***	***	***	***	***	***
Indonesia	***	***	***	***	***	***	***	***	***
Japan	***	***	***	***	***	▲***	▲***	▼***	▲***
Korea	***	***	***	***	***	▲***	▼***	▲***	▲***
Malaysia	***	***	***	***	***	▲***	▲***	▲***	▼***
Mexico	***	***	***	***	***	***	***	***	***
Philippines	***	***	***	***	***	▲***	▲***	▼***	▼***
Singapore	***	***	***	***	***	***	***	***	***
Taiwan	***	***	***	***	***	▼***	▼***	▼***	▲***
Thailand	***	***	***	***	***	▲***	▼***	▲***	▼***
Turkey	***	***	***	***	***	***	***	***	***
Vietnam	***	***	***	***	***	▲***	▲***	▼***	▲***
Other developing countries	***	***	***	***	***	***	***	***	***
Other non-developing countries	***	***	***	***	***	▼***	▼***	***	***
All import sources	***	***	***	***	***	▼***	▲***	▼***	▲***

Table continued on next page.

Table C-3--Continued
CSPV cells: Summary data concerning the U.S. merchant market, 2016-18, January to June 2018, and January to June 2019
(Quantity=kilowatts; Value=1,000 dollars; Unit values, unit labor costs, and unit expenses=dollars per kilowatt; Period changes=percent--exceptions noted)

	Reported data					Period changes			
	Calendar year			January to June		Calendar year			Jan-Jun
	2016	2017	2018	2018	2019	2016-18	2016-17	2017-18	2018-19
U.S. imports from:									
Canada:									
Quantity	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***
China:									
Quantity	***	***	***	***	***	▲***	▲***	▲***	▲***
Value	***	***	***	***	***	▲***	▲***	▲***	▲***
Unit value	***	***	***	***	***	▼***	▼***	▼***	▼***
Germany:									
Quantity	***	***	***	***	***	▼***	▼***	▼***	▼***
Value	***	***	***	***	***	▼***	▼***	▼***	▼***
Unit value	***	***	***	***	***	▲***	▼***	▲***	▼***
India:									
Quantity	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***
Indonesia:									
Quantity	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***
Japan:									
Quantity	***	***	***	***	***	▲***	▲***	▲***	▲***
Value	***	***	***	***	***	▲***	▲***	▲***	▲***
Unit value	***	***	***	***	***	▼***	▼***	▼***	▼***
Korea:									
Quantity	***	***	***	***	***	▲***	▼***	▲***	▲***
Value	***	***	***	***	***	▲***	▼***	▲***	▲***
Unit value	***	***	***	***	***	▲***	▲***	▲***	▼***
Malaysia:									
Quantity	***	***	***	***	***	▲***	▲***	▲***	▲***
Value	***	***	***	***	***	▲***	▲***	▲***	▼***
Unit value	***	***	***	***	***	▲***	▲***	▲***	▼***
Mexico:									
Quantity	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***
Philippines:									
Quantity	***	***	***	***	***	▲***	▲***	▲***	▼***
Value	***	***	***	***	***	▲***	▲***	▲***	▼***
Unit value	***	***	***	***	***	▲***	▲***	▼***	▼***
Singapore:									
Quantity	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***
Taiwan:									
Quantity	***	***	***	***	***	▼***	▼***	▼***	▲***
Value	***	***	***	***	***	▼***	▼***	▼***	▲***
Unit value	***	***	***	***	***	▼***	▼***	▼***	▼***
Thailand:									
Quantity	***	***	***	***	***	▲***	▼***	▲***	▼***
Value	***	***	***	***	***	▲***	▼***	▲***	▼***
Unit value	***	***	***	***	***	▼***	▲***	▼***	▼***
Turkey:									
Quantity	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***
Vietnam:									
Quantity	***	***	***	***	***	▲***	▲***	▲***	▲***
Value	***	***	***	***	***	▲***	▲***	▲***	▲***
Unit value	***	***	***	***	***	▲***	▲***	▼***	▼***

Table continued on next page.

Table C-3--Continued

CSPV cells: Summary data concerning the U.S. merchant market, 2016-18, January to June 2018, and January to June 2019

(Quantity=kilowatts; Value=1,000 dollars; Unit values, unit labor costs, and unit expenses=dollars per kilowatt; Period changes=percent--exceptions noted)

	Reported data					Period changes			
	Calendar year			January to June		Calendar year			Jan-Jun
	2016	2017	2018	2018	2019	2016-18	2016-17	2017-18	2018-19
U.S. imports from:--Continued									
All other developing countries:									
Quantity	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***
All other non-developing countries:									
Quantity	***	***	***	***	***	▼***	▼***	***	***
Value	***	***	***	***	***	▼***	▼***	***	***
Unit value	***	***	***	***	***	▼***	▼***	***	***
All import sources:									
Quantity	265,382	278,426	836,903	308,336	951,003	▲215.4	▲4.9	▲200.6	▲208.4
Value	97,028	92,637	260,992	107,724	184,285	▲169.0	▼(4.5)	▲181.7	▲71.1
Unit value	$366	$333	$312	$349	$194	▼(14.7)	▼(9.0)	▼(6.3)	▼(44.5)
U.S. cell producers':									
Average capacity quantity	***	***	***	***	***	▼***	▼***	▼***	▼***
Production quantity	***	***	***	***	***	▼***	▼***	▼***	▼***
Capacity utilization (fn1)	***	***	***	***	***	▼***	▼***	▼***	▲***
Commercial U.S. shipments:									
Quantity	***	***	***	***	***	▲***	▲***	▲***	▼***
Value:	***	***	***	***	***	▲***	▼***	▲***	▼***
Unit value	***	***	***	***	***	▼***	▼***	▲***	▼***
Export shipments:									
Quantity	***	***	***	***	***	▼***	▼***	▼***	▲***
Value	***	***	***	***	***	▼***	▼***	▼***	▲***
Unit value	***	***	***	***	***	▼***	▼***	▼***	▼***
Ending inventory quantity	***	***	***	***	***	▼***	▼***	▼***	▲***
Inventories/total shipments (fn1)	***	***	***	***	***	▼***	▼***	▼***	▲***
Production workers	***	***	***	***	***	▼***	▼***	▼***	▲***
Hours worked (1,000s)	***	***	***	***	***	▼***	▼***	▼***	▲***
Wages paid ($1,000)	***	***	***	***	***	▼***	▼***	▼***	▼***
Hourly wages (dollars per hour)	***	***	***	***	***	▼***	▲***	▼***	▼***
Productivity (kilowatts per hour)	***	***	***	***	***	▲***	▲***	▼***	▼***
Unit labor costs	***	***	***	***	***	▼***	▼***	▼***	▲***
U.S. cell producers' merchant market results:									
Net sales:									
Quantity	***	***	***	***	***	▼***	▼***	▼***	▲***
Value	***	***	***	***	***	▼***	▼***	▼***	▲***
Unit value	***	***	***	***	***	▼***	▼***	▼***	▼***
Cost of goods sold (COGS)	***	***	***	***	***	▼***	▼***	▲***	▲***
Gross profit or (loss) (fn2)	***	***	***	***	***	▼***	▼***	▼***	▼***
SG&A expenses	***	***	***	***	***	▼***	▼***	▼***	▲***
Operating income or (loss) (fn2)	***	***	***	***	***	▼***	▲***	▼***	▼***
Net income or (loss) (fn2)	***	***	***	***	***	▼***	▲***	▼***	▼***
Capital expenditures	***	***	***	***	***	▲***	▼***	▲***	▼***
Unit COGS	***	***	***	***	***	▲***	▼***	▲***	▼***
Unit SG&A expenses	***	***	***	***	***	▲***	▼***	▲***	▼***
Unit operating income or (loss) (fn2)	***	***	***	***	***	▼***	▼***	▼***	▲***
Unit net income or (loss) (fn2)	***	***	***	***	***	▼***	▼***	▼***	▲***
COGS/sales (fn1)	***	***	***	***	***	▲***	▲***	▲***	▼***
Operating income or (loss)/sales (fn1)	***	***	***	***	***	▼***	▼***	▼***	▲***
Net income or (loss)/sales (fn1)	***	***	***	***	***	▼***	▼***	▼***	▲***

Notes:

Note.--Shares and ratios shown as "0.0" percent represent non-zero values less than "0.05" percent (if positive) and greater than "(0.05)" percent (if negative). Zeroes, null values, and undefined calculations are suppressed and shown as "---". Period changes preceded by a "▲" represent an increase, while period changes preceded by a "▼" represent a decrease.

fn1.--Reported data are in percent and period changes are in percentage points.
fn2.--Percent changes only calculated when both comparison values represent profits; The directional change in profitability provided when one or both comparison values represent a loss.

Source: Compiled from data submitted in response to Commission questionnaires.

Table C-4

CSPV products: Channels of distribution by type for U.S. producers and importers, 2016-18, January to June 2018, and January to June 2019

(Quantity=kilowatts; Value=1,000 dollars; Unit values, unit labor costs, and unit expenses=dollars per kilowatt; Period changes=percent--exceptions noted)

	Reported data					Period changes			
	Calendar year			January to June		Calendar year			Jan-Jun
	2016	2017	2018	2018	2019	2016-18	2016-17	2017-18	2018-19
Commercial and Residential:									
Quantity:									
United States	***	***	***	***	***	▼***	▼***	▼***	▲***
Import sources	***	***	***	***	***	▼***	▼***	▼***	▲***
All sources	***	***	***	***	***	▼***	▼***	▼***	▲***
Share of quantity (fn1)									
United States	***	***	***	***	***	▼***	▼***	▲***	▲***
Import sources	***	***	***	***	***	▲***	▲***	▼***	▼***
All sources	***	***	***	***	***	***	***	***	***
Ratio to overall apparent consumption (fn1)									
United States	***	***	***	***	***	▼***	▼***	▲***	▲***
Import sources	***	***	***	***	***	▲***	▲***	▲***	▼***
All sources	***	***	***	***	***	▲***	▲***	▲***	▼***
Utilities:									
Quantity:									
United States	***	***	***	***	***	▼***	▼***	▲***	▲***
Import sources	***	***	***	***	***	▼***	▼***	▼***	▲***
All sources	***	***	***	***	***	▼***	▼***	▼***	▲***
Share of quantity (fn1)									
United States	***	***	***	***	***	▲***	▼***	▲***	▲***
Import sources	***	***	***	***	***	▼***	▲***	▼***	▼***
All sources	***	***	***	***	***	***	***	***	***
Ratio to overall apparent consumption (fn1)									
United States	***	***	***	***	***	▲***	▼***	▲***	▲***
Import sources	***	***	***	***	***	▼***	▼***	▼***	▲***
All sources	***	***	***	***	***	▼***	▼***	▼***	▲***

Notes:

Note.--Shares and ratios shown as "0.0" percent represent non-zero values less than "0.05" percent (if positive) and greater than "(0.05)" percent (if negative). Zeroes, null values, and undefined calculations are suppressed and shown as "---". Period changes preceded by a "▲" represent an increase, while period changes preceded by a "▼" represent a decrease.

fn1.--Reported data are in percent and period changes are in percentage points.

Source: Compiled from data submitted in response to Commission questionnaires.

APPENDIX D

SELECT DATA FROM SAFEGUARD INVESTIGATION

Table C-1a: CSPV products: Total market: Summary data concerning the U.S. market with country-of-origin of imports based on cell manufacture location, 2012-16

Table C-1b: CSPV products: Summary data concerning the U.S. market with country-of-origin of imports based on cell manufacture location except modules assembled in NAFTA countries, 2012-16

Table C-2: CSPV products: Summary data concerning the merchant U.S. market for cells, 2012-16

Table C-3a: CSPV products: Summary data concerning the total U.S. market for modules with country-of-origin of imports based on cell manufacture location, 2012-16

Table C-3b: CSPV products: Summary data concerning the total U.S. market for modules with country-of-origin of imports based on cell manufacture location except modules assembled in NAFTA countries, 2012-16

Table C-4: CSPV products: Apparent consumption and market shares for by channel for modules (utilities vs. residential and commercial installation), 2012-16

Table C-5: CSPV products: Apparent consumption and market shares by 60-cell vs 72-cell modules, 2012-16

Table C-6: CSPV products: Apparent consumption and market shares by mono- vs multi-crystaline cell modules 2012-16

Table V-11: CSPV products: Sales of U.S. produced and imported cells and modules, by wattage ranges, 2012-16

Table V-12: CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 1, by quarters, 2012-16

Table V-13: CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 2, by quarters, 2012-16

Table V-14: CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 3, by quarters, 2012-16

Table V-15: CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 4, by quarters, 2012-16

Table V-16: CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 5, by quarters, 2012-16

Table G-1: CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 1, by quarters, 2012-16

Table G-2: CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 2, by quarters, 2012-16

Table G-3: CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 3, by quarters, 2012-16

Table G-4: CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 4, by quarters, 2012-16

Table G-5: CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 5, by quarters, 2012-16

Remedy Recommendations

Table D-1: CSPV products: U.S. producers' efforts to compete more effectively in the U.S. market, by reporting firm, January 2012 – June 2017

Table D-2: CSPV products: U.S. producers' anticipated adjustments under safeguard import relief

CSPV products: Total market: COO petition

Table C-1a
CSPV products: Summary data concerning the U.S. market with country-of-origin of imports based on cell manufacture location, 2012-16
(Quantity=kW; Value=1,000 dollars; Unit values, unit labor costs, and unit expenses=dollars per kilowatt; Period changes=percent--exceptions noted)

	Reported data					Period changes				
	Calendar year					Between calendar years				
	2012	2013	2014	2015	2016	2012-16	2012-13	2013-14	2014-15	2015-16
U.S. consumption quantity:										
Amount	***	***	***	***	***	***	***	***	***	***
Producers' share (fn1)	***	***	***	***	***	***	***	***	***	***
Importers' share (fn1):										
Canada	***	***	***	***	***	***	***	***	***	***
China	***	***	***	***	***	***	***	***	***	***
Germany	***	***	***	***	***	***	***	***	***	***
Indonesia	***	***	***	***	***	***	***	***	***	***
Japan	***	***	***	***	***	***	***	***	***	***
Korea	***	***	***	***	***	***	***	***	***	***
Malaysia	***	***	***	***	***	***	***	***	***	***
Mexico	***	***	***	***	***	***	***	***	***	***
Philippines	***	***	***	***	***	***	***	***	***	***
Singapore	***	***	***	***	***	***	***	***	***	***
Taiwan	***	***	***	***	***	***	***	***	***	***
Thailand	***	***	***	***	***	***	***	***	***	***
Vietnam	***	***	***	***	***	***	***	***	***	***
All other sources	***	***	***	***	***	***	***	***	***	***
All import sources	***	***	***	***	***	***	***	***	***	***
U.S. consumption value:										
Amount	***	***	***	***	***	***	***	***	***	***
Producers' share (fn1)	***	***	***	***	***	***	***	***	***	***
Importers' share (fn1):										
Canada	***	***	***	***	***	***	***	***	***	***
China	***	***	***	***	***	***	***	***	***	***
Germany	***	***	***	***	***	***	***	***	***	***
Indonesia	***	***	***	***	***	***	***	***	***	***
Japan	***	***	***	***	***	***	***	***	***	***
Korea	***	***	***	***	***	***	***	***	***	***
Malaysia	***	***	***	***	***	***	***	***	***	***
Mexico	***	***	***	***	***	***	***	***	***	***
Philippines	***	***	***	***	***	***	***	***	***	***
Singapore	***	***	***	***	***	***	***	***	***	***
Taiwan	***	***	***	***	***	***	***	***	***	***
Thailand	***	***	***	***	***	***	***	***	***	***
Vietnam	***	***	***	***	***	***	***	***	***	***
All other sources	***	***	***	***	***	***	***	***	***	***
All import sources	***	***	***	***	***	***	***	***	***	***
U.S. imports from:										
Canada:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
China:										
Quantity	326,846	82,264	1,263,270	3,311,513	2,720,193	732.3	(74.8)	1,435.6	162.1	(17.9)
Value	291,878	69,976	747,148	1,680,733	1,258,864	331.3	(76.0)	967.7	125.0	(25.1)
Unit value	$893	$851	$591	$508	$463	(48.2)	(4.7)	(30.5)	(14.2)	(8.8)
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Germany:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Indonesia:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Japan:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Korea:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Malaysia:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Mexico:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Philippines:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Signapore:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Taiwan:										
Quantity	1,065,160	2,113,220	2,090,974	852,758	1,118,967	5.1	98.4	(1.1)	(59.2)	31.2
Value	743,337	1,349,271	1,274,305	467,820	606,449	(18.4)	81.5	(5.6)	(63.3)	29.6
Unit value	$698	$638	$609	$549	$542	(22.3)	(8.5)	(4.6)	(10.0)	(1.2)
Ending inventory quantity	128,249	116,508	200,189	170,345	91,083	(29.0)	(9.2)	71.8	(14.9)	(46.5)
Thailand:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Vietnam:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
All other sources:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
All import sources:										
Quantity	2,162,388	3,101,412	4,582,898	8,430,393	12,813,568	492.6	43.4	47.8	84.0	52.0
Value	1,904,664	2,214,457	3,014,861	4,967,865	7,060,489	270.7	16.3	36.1	64.8	42.1
Unit value	$881	$714	$658	$589	$551	(37.4)	(18.9)	(7.9)	(10.4)	(6.5)
Ending inventory quantity	303,409	327,638	560,211	1,107,536	1,238,641	308.2	8.0	71.0	97.7	11.8

Table continued on next page.

Table C-1a--Continued
CSPV products: Summary data concerning the U.S. market with country-of-origin of imports based on cell manufacture location, 2012-16
(Quantity=kW; Value=1,000 dollars; Unit values, unit labor costs, and unit expenses=dollars per kilowatt; Period changes=percent--exceptions noted)

	Reported data					Period changes				
	Calendar year					Between calendar years				
	2012	2013	2014	2015	2016	2012-16	2012-13	2013-14	2014-15	2015-16
U.S. producers': (fn3)										
Average capacity quantity	***	***	***	***	***	***	***	***	***	***
Production quantity	***	***	***	***	***	***	***	***	***	***
Capacity utilization (fn1)	***	***	***	***	***	***	***	***	***	***
U.S. shipments (fn4):										
Quantity	***	***	***	***	***	***	***	***	***	***
Value (fn5)	***	***	***	***	***	***	***	***	***	***
Unit value (fn6)	***	***	***	***	***	***	***	***	***	***
Export shipments:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Inventories/total shipments (fn1)	***	***	***	***	***	***	***	***	***	***
Production workers	***	***	***	***	***	***	***	***	***	***
Hours worked (1,000s)	***	***	***	***	***	***	***	***	***	***
Wages paid ($1,000)	***	***	***	***	***	***	***	***	***	***
Hourly wages (dollars)	***	***	***	***	***	***	***	***	***	***
Productivity (watts per hour)	***	***	***	***	***	***	***	***	***	***
Unit labor costs	***	***	***	***	***	***	***	***	***	***
Net sales: (fn7)										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Cost of goods sold (COGS)	***	***	***	***	***	***	***	***	***	***
Gross profit or (loss)	***	***	***	***	***	***	***	***	***	***
SG&A expenses	***	***	***	***	***	***	***	***	***	***
Operating income or (loss)	***	***	***	***	***	***	***	***	***	***
Net income or (loss)	***	***	***	***	***	***	***	***	***	***
Unit COGS	***	***	***	***	***	***	***	***	***	***
Unit SG&A expenses	***	***	***	***	***	***	***	***	***	***
Unit operating income or (loss)	***	***	***	***	***	***	***	***	***	***
Unit net income or (loss)	***	***	***	***	***	***	***	***	***	***
COGS/sales (fn1)	***	***	***	***	***	***	***	***	***	***
Operating income or (loss)/sales (fn1)	***	***	***	***	***	***	***	***	***	***
Net income or (loss)/sales (fn1)	***	***	***	***	***	***	***	***	***	***

Notes:

fn1.--Reported data are in percent and period changes are in percentage points.
fn2.--Undefined.
fn3.--Generally the data for U.S. producers in this table are limited to U.S.-origin cells and modules containing U.S.-origin cells.
fn4.--U.S. producers' U.S. shipments include U.S. producers' exports of cells that have been re-imported after being formed into modules and/or laminates in other countries.
fn5.--The value of U.S. producers' U.S. shipments includes value added to foreign-origin cells. See part IV for details.
fn6.--The average unit values of U.S. producers' U.S. shipments are calculated exclusive of the value added to foreign-origin cells. See part IV for details.
fn7.--Financial results in this table include derived module revenue and costs based on relative production using U.S.-origin cells plus the data from merchant market cell operations.

Source: Compiled from data submitted in response to Commission questionnaires.

Table C-1b
CSPV products: Summary data concerning the U.S. market with country-of-origin of imports based on cell manufacture location except modules assembled in NAFTA countries, 2012-16

* * * * * * *

Table C-2
CSPV products: Summary data concerning the merchant U.S. market for cells, 2012-16

* * * * * * *

CSPV modules: Total market: COO Petition

Table C-3a
CSPV products: Summary data concerning the total U.S. market for modules with country-of-origin of imports based on cell manufacture location, 2012-16
(Quantity=kW; Value=1,000 dollars; Unit values, unit labor costs, and unit expenses=dollars per kilowatt; Period changes=percent--exceptions noted)

	Reported data					Period changes				
	Calendar year					Between calendar years				
	2012	2013	2014	2015	2016	2012-16	2012-13	2013-14	2014-15	2015-16
U.S. consumption quantity:										
Amount	***	***	***	***	***	***	***	***	***	***
Producers' share (fn1)	***	***	***	***	***	***	***	***	***	***
Importers' share (fn1):										
Canada	***	***	***	***	***	***	***	***	***	***
China	***	***	***	***	***	***	***	***	***	***
Germany	***	***	***	***	***	***	***	***	***	***
Indonesia	***	***	***	***	***	***	***	***	***	***
Japan	***	***	***	***	***	***	***	***	***	***
Korea	***	***	***	***	***	***	***	***	***	***
Malaysia	***	***	***	***	***	***	***	***	***	***
Mexico	***	***	***	***	***	***	***	***	***	***
Philippines	***	***	***	***	***	***	***	***	***	***
Singapore	***	***	***	***	***	***	***	***	***	***
Taiwan	***	***	***	***	***	***	***	***	***	***
Thailand	***	***	***	***	***	***	***	***	***	***
Vietnam	***	***	***	***	***	***	***	***	***	***
All other sources	***	***	***	***	***	***	***	***	***	***
All import sources	***	***	***	***	***	***	***	***	***	***
U.S. consumption value:										
Amount	***	***	***	***	***	***	***	***	***	***
Producers' share (fn1)	***	***	***	***	***	***	***	***	***	***
Importers' share (fn1):										
Canada	***	***	***	***	***	***	***	***	***	***
China	***	***	***	***	***	***	***	***	***	***
Germany	***	***	***	***	***	***	***	***	***	***
Indonesia	***	***	***	***	***	***	***	***	***	***
Japan	***	***	***	***	***	***	***	***	***	***
Korea	***	***	***	***	***	***	***	***	***	***
Malaysia	***	***	***	***	***	***	***	***	***	***
Mexico	***	***	***	***	***	***	***	***	***	***
Philippines	***	***	***	***	***	***	***	***	***	***
Singapore	***	***	***	***	***	***	***	***	***	***
Taiwan	***	***	***	***	***	***	***	***	***	***
Thailand	***	***	***	***	***	***	***	***	***	***
Vietnam	***	***	***	***	***	***	***	***	***	***
All other sources	***	***	***	***	***	***	***	***	***	***
All import sources	***	***	***	***	***	***	***	***	***	***
U.S. imports from:										
Canada:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
China:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Germany:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Indonesia:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Japan:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Korea:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Malaysia:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Mexico:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Philippines:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Signapore:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Taiwan:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Thailand:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Vietnam:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
All other sources:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
All import sources:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***

Table C-3a--Continued
CSPV products: Summary data concerning the total U.S. market for modules with country-of-origin of imports based on cell manufacture location, 2012-16
(Quantity=kW; Value=1,000 dollars; Unit values, unit labor costs, and unit expenses=dollars per kilowatt; Period changes=percent--exceptions noted)

	Reported data					Period changes				
	Calendar year					Between calendar years				
	2012	2013	2014	2015	2016	2012-16	2012-13	2013-14	2014-15	2015-16
U.S. producers': (fn3)										
Average capacity quantity	929,827	913,452	716,900	871,603	1,245,807	34.0	(1.8)	(21.5)	21.6	42.9
Production quantity	538,633	447,129	440,259	552,968	669,089	24.2	(17.0)	(1.5)	25.6	21.0
Capacity utilization (fn1)	57.9	48.9	61.4	63.4	53.7	(4.2)	(9.0)	12.5	2.0	(9.7)
U.S. shipments:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Export shipments:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Inventories/total shipments (fn1) (fn3)	***	***	***	***	***	***	***	***	***	***
Production workers	1,293	1,080	956	1,038	1,253	(3.1)	(16.5)	(11.5)	8.6	20.7
Hours worked (1,000s)	3,041	2,335	1,781	2,095	2,364	(22.3)	(23.2)	(23.7)	17.6	12.8
Wages paid ($1,000)	***	***	***	***	***	***	***	***	***	***
Hourly wages (dollars)	***	***	***	***	***	***	***	***	***	***
Productivity (watts per hour)	***	***	***	***	***	***	***	***	***	***
Unit labor costs	***	***	***	***	***	***	***	***	***	***
Net sales:										
Quantity	581,762	464,771	472,355	527,683	623,846	7.2	(20.1)	1.6	11.7	18.2
Value	607,615	410,608	420,661	476,920	484,359	(20.3)	(32.4)	2.4	13.4	1.6
Unit value	$1,044	$883	$891	$904	$776	(25.7)	(15.4)	0.8	1.5	(14.1)
Cost of goods sold (COGS)	858,747	545,848	422,575	432,924	488,577	(43.1)	(36.4)	(22.6)	2.4	12.9
Gross profit or (loss)	(251,132)	(135,240)	(1,914)	43,996	(4,218)	(98.3)	(46.1)	(98.6)	[fn2]	[fn2]
SG&A expenses	125,946	68,803	56,642	54,526	210,773	67.4	(45.4)	(17.7)	(3.7)	286.6
Operating income or (loss)	(377,078)	(204,043)	(58,556)	(10,530)	(214,991)	(43.0)	(45.9)	(71.3)	(82.0)	1,941.7
Net income or (loss)	(551,170)	(217,135)	(54,504)	(21,071)	(224,873)	(59.2)	(60.6)	(74.9)	(61.3)	967.2
Unit COGS	$1,476	$1,174	$895	$820	$783	(46.9)	(20.4)	(23.8)	(8.3)	(4.5)
Unit SG&A expenses	$216	$148	$120	$103	$338	56.1	(31.6)	(19.0)	(13.8)	227.0
Unit operating income or (loss)	$(648)	$(439)	$(124)	$(20)	$(345)	(46.8)	(32.3)	(71.8)	(83.9)	1,627.0
Unit net income or (loss)	$(947)	$(467)	$(115)	$(40)	$(360)	(62.0)	(50.7)	(75.3)	(65.4)	802.7
COGS/sales (fn1)	141.3	132.9	100.5	90.8	100.9	(40.5)	(8.4)	(32.5)	(9.7)	10.1
Operating income or (loss)/sales (fn1)	(62.1)	(49.7)	(13.9)	(2.2)	(44.4)	17.7	12.4	35.8	11.7	(42.2)
Net income or (loss)/sales (fn1)	(90.7)	(52.9)	(13.0)	(4.4)	(46.4)	44.3	37.8	39.9	8.5	(42.0)

Notes:

Note.--Share and ratios shown as "0.0" represent values greater than zero but less than "0.05" percent.

fn1.--Reported data are in percent and period changes are in percentage points.
fn2.--Undefined.
fn3.--U.S. producers' data in this table includes modules assembled from U.S.-origin cells and from foreign-origin cells.

Source: Compiled from data submitted in response to Commission questionnaires.

Table C-3b
CSPV products: Summary data concerning the total U.S. market for modules with country-of-origin of imports based on cell manufacture location except modules assembled in NAFTA countries, 2012-16
(Quantity=kW; Value=1,000 dollars; Unit values, unit labor costs, and unit expenses=dollars per kilowatt; Period changes=percent--exceptions noted)

	Reported data					Period changes				
	Calendar year					Between calendar years				
	2012	2013	2014	2015	2016	2012-16	2012-13	2013-14	2014-15	2015-16
U.S. consumption quantity:										
Amount	***	***	***	***	***	***	***	***	***	***
Producers' share (fn1)	***	***	***	***	***	***	***	***	***	***
Importers' share (fn1):										
Canada	***	***	***	***	***	***	***	***	***	***
China	***	***	***	***	***	***	***	***	***	***
Germany	***	***	***	***	***	***	***	***	***	***
Indonesia	***	***	***	***	***	***	***	***	***	***
Japan	***	***	***	***	***	***	***	***	***	***
Korea	***	***	***	***	***	***	***	***	***	***
Malaysia	***	***	***	***	***	***	***	***	***	***
Mexico	***	***	***	***	***	***	***	***	***	***
Philippines	***	***	***	***	***	***	***	***	***	***
Singapore	***	***	***	***	***	***	***	***	***	***
Taiwan	***	***	***	***	***	***	***	***	***	***
Thailand	***	***	***	***	***	***	***	***	***	***
Vietnam	***	***	***	***	***	***	***	***	***	***
All other sources	***	***	***	***	***	***	***	***	***	***
All import sources	***	***	***	***	***	***	***	***	***	***
U.S. consumption value:										
Amount	***	***	***	***	***	***	***	***	***	***
Producers' share (fn1)	***	***	***	***	***	***	***	***	***	***
Importers' share (fn1):										
Canada	***	***	***	***	***	***	***	***	***	***
China	***	***	***	***	***	***	***	***	***	***
Germany	***	***	***	***	***	***	***	***	***	***
Indonesia	***	***	***	***	***	***	***	***	***	***
Japan	***	***	***	***	***	***	***	***	***	***
Korea	***	***	***	***	***	***	***	***	***	***
Malaysia	***	***	***	***	***	***	***	***	***	***
Mexico	***	***	***	***	***	***	***	***	***	***
Philippines	***	***	***	***	***	***	***	***	***	***
Singapore	***	***	***	***	***	***	***	***	***	***
Taiwan	***	***	***	***	***	***	***	***	***	***
Thailand	***	***	***	***	***	***	***	***	***	***
Vietnam	***	***	***	***	***	***	***	***	***	***
All other sources	***	***	***	***	***	***	***	***	***	***
All import sources	***	***	***	***	***	***	***	***	***	***
U.S. imports from:										
Canada:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
China:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Germany:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Indonesia:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Japan:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Korea:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Malaysia:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Mexico:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Philippines:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Signapore:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Taiwan:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Thailand:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Vietnam:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
All other sources:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
All import sources:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***

Table C-3b--Continued
CSPV products: Summary data concerning the total U.S. market for modules with country-of-origin of imports based on cell manufacture location except modules assembled in NAFTA countries, 2012-16
(Quantity=kW; Value=1,000 dollars; Unit values, unit labor costs, and unit expenses=dollars per kilowatt; Period changes=percent--exceptions noted)

	Reported data					Period changes				
	Calendar year					Between calendar years				
	2012	2013	2014	2015	2016	2012-16	2012-13	2013-14	2014-15	2015-16
U.S. producers': (fn3)										
Average capacity quantity	929,827	913,452	716,900	871,603	1,245,807	34.0	(1.8)	(21.5)	21.6	42.9
Production quantity	538,633	447,129	440,259	552,968	669,089	24.2	(17.0)	(1.5)	25.6	21.0
Capacity utilization (fn1)	57.9	48.9	61.4	63.4	53.7	(4.2)	(9.0)	12.5	2.0	(9.7)
U.S. shipments:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Export shipments:										
Quantity	***	***	***	***	***	***	***	***	***	***
Value	***	***	***	***	***	***	***	***	***	***
Unit value	***	***	***	***	***	***	***	***	***	***
Ending inventory quantity	***	***	***	***	***	***	***	***	***	***
Inventories/total shipments (fn1) (fn3)	***	***	***	***	***	***	***	***	***	***
Production workers	1,293	1,080	956	1,038	1,253	(3.1)	(16.5)	(11.5)	8.6	20.7
Hours worked (1,000s)	3,041	2,335	1,781	2,095	2,364	(22.3)	(23.2)	(23.7)	17.6	12.8
Wages paid ($1,000)	***	***	***	***	***	***	***	***	***	***
Hourly wages (dollars)	***	***	***	***	***	***	***	***	***	***
Productivity (watts per hour)	***	***	***	***	***	***	***	***	***	***
Unit labor costs	***	***	***	***	***	***	***	***	***	***
Net sales:										
Quantity	581,762	464,771	472,355	527,683	623,846	7.2	(20.1)	1.6	11.7	18.2
Value	607,615	410,608	420,661	476,920	484,359	(20.3)	(32.4)	2.4	13.4	1.6
Unit value	$1,044	$883	$891	$904	$776	(25.7)	(15.4)	0.8	1.5	(14.1)
Cost of goods sold (COGS)	858,747	545,848	422,575	432,924	488,577	(43.1)	(36.4)	(22.6)	2.4	12.9
Gross profit or (loss)	(251,132)	(135,240)	(1,914)	43,996	(4,218)	(98.3)	(46.1)	(98.6)	[fn2]	[fn2]
SG&A expenses	125,946	68,803	56,642	54,526	210,773	67.4	(45.4)	(17.7)	(3.7)	286.6
Operating income or (loss)	(377,078)	(204,043)	(58,556)	(10,530)	(214,991)	(43.0)	(45.9)	(71.3)	(82.0)	1,941.7
Net income or (loss)	(551,170)	(217,135)	(54,504)	(21,071)	(224,873)	(59.2)	(60.6)	(74.9)	(61.3)	967.2
Unit COGS	$1,476	$1,174	$895	$820	$783	(46.9)	(20.4)	(23.8)	(8.3)	(4.5)
Unit SG&A expenses	$216	$148	$120	$103	$338	56.1	(31.6)	(19.0)	(13.8)	227.0
Unit operating income or (loss)	$(648)	$(439)	$(124)	$(20)	$(345)	(46.8)	(32.3)	(71.8)	(83.9)	1,627.0
Unit net income or (loss)	$(947)	$(467)	$(115)	$(40)	$(360)	(62.0)	(50.7)	(75.3)	(65.4)	802.7
COGS/sales (fn1)	141.3	132.9	100.5	90.8	100.9	(40.5)	(8.4)	(32.5)	(9.7)	10.1
Operating income or (loss)/sales (fn1)	(62.1)	(49.7)	(13.9)	(2.2)	(44.4)	17.7	12.4	35.8	11.7	(42.2)
Net income or (loss)/sales (fn1)	(90.7)	(52.9)	(13.0)	(4.4)	(46.4)	44.3	37.8	39.9	8.5	(42.0)

Notes:

Note.--Share and ratios shown as "0.0" represent values greater than zero but less than "0.05" percent.

fn1.--Reported data are in percent and period changes are in percentage points.
fn2.--Undefined.
fn3.--U.S. producers' data in this table includes modules assembled from U.S.-origin cells and from foreign-origin cells.

Source: Compiled from data submitted in response to Commission questionnaires.

Table C-4
CSPV products: Apparent consumption and market shares for by channel for modules, 2012-16

*   *   *   *   *   *   *

Table C-5
CSPV products: Apparent consumption and market shares by 60-cell vs 72-cell modules, 2012-16

*   *   *   *   *   *   *

Table C-6
CSPV products: Apparent consumption and market shares by mono- vs multi-crystaline cell modules 2012-16

*   *   *   *   *   *   *

Two U.S. producers and 31 importers provided usable pricing data for sales of the requested products, although not all firms reported pricing for all products for all quarters.[43] [44] Pricing data reported by these firms accounted for approximately 83.3 percent of U.S. producers' U.S. shipments of CSPV products and 74.1 percent of U.S. importers' U.S. shipments of CSPV products in 2016.[45] [46]

The pricing product definitions consisted of a monocrystalline cell with an efficiency range of 5 percent, and four modules, each with peak power range of 50 watts. U.S. producers and importers reported their commercial shipment volumes for these pricing products, broken into narrower efficiency and wattage ranges. As shown in table V-11, U.S. producers and importers generally reported sales of CSPV cells and modules within similar efficiency and wattage ranges.[47]

Table V-11
CSPV products: Sales of U.S. produced and imported cells and modules, by wattage ranges, 2012-16

* * * * * * *

U.S. producers' price data volumes for sales of monocrystalline modules *** accounted for the *** of reported price data. Importers reported price data primarily for sales of multicrystalline modules, with products 2 and 4 accounting for the majority of price data volumes of foreign-origin product. Both U.S. producers and importers reported *** quantities of sales of monocrystalline cells (product 1), accounting for *** of domestic price data and in 2016 and *** of importers' price data in 2015.

Price data for products 1-5 are presented in tables V-12 to V-16 and figures V-8 to V-12. Prices are reported by import source in Appendix G.

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[43] Per-unit pricing data are calculated from total quantity and total value data provided by U.S. producers and importers. The precision and variation of these figures may be affected by rounding, limited quantities, and producer or importer estimates.

[44] Price data were requested by the origin of the cell. U.S. module assemblers that used imported cells were requested to report their price data in the importer questionnaire.

[45] U.S. importer *** revised its pricing data on August 31, 2016. These revisions changed the prices and quantities for product 1. See email from *** and *** revised importer questionnaire response, section III-2.

[46] Products 2-5 overlap with the pricing products 1-8 from the previous AD/CVD investigations. The wider wattage ranges in products 2-5 encompass the shifts to higher wattage modules during the five-year period of investigation. Table V-11 provides a breakout of the reported price data by narrower wattage ranges. *Certain Crystalline Silicon Photovoltaic Products from China and Taiwan*, Invs. Nos. 701-TA-511 and 731-TA-1246-1247 (Final) USITC Publication 4519 February 2015 at p. V-5.

[47] For product 5, U.S. producers' reported price data were split between the two wattage categories, while importers' reported price data fell in the lower wattage category in 2015.

Table V-12
CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 1, by quarters, 2012-16

*   *   *   *   *   *   *

Table V-13
CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 2,[1] by quarters, 2012-16

Period	U.S.-origin		Foreign-origin	
	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)
2012: Jan.-Mar.	***	***	1,059	84,005
Apr.-June	***	***	910	151,062
July-Sept.	***	***	837	193,745
Oct.-Dec.	***	***	805	188,753
2013: Jan.-Mar.	***	***	723	178,906
Apr.-June	***	***	713	240,438
July-Sept.	***	***	726	338,025
Oct.-Dec.	***	***	738	259,915
2014: Jan.-Mar.	***	***	735	216,823
Apr.-June	***	***	728	287,980
July-Sept.	***	***	751	289,276
Oct.-Dec.	---	***	735	367,474
2015: Jan.-Mar.	---	***	713	333,306
Apr.-June	---	***	692	494,227
July-Sept.	---	***	674	482,561
Oct.-Dec.	***	***	667	517,662
2016: Jan.-Mar.	---	***	641	360,330
Apr.-June	---	***	632	330,869
July-Sept.	---	***	592	335,198
Oct.-Dec.	---	***	535	265,793

[1] Product 2: 60 cell Multicrystalline silicon module, with a peak power wattage between 240w to 290w, inclusive, P-max or Wp.

Source: Compiled from data submitted in response to Commission questionnaires.

Table V-14
CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 3, by quarters, 2012-16

* * * * * * *

Table V-15
CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 4,[1] by quarters, 2012-16

Period	U.S.-origin		Foreign-origin	
	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)
2012: Jan.-Mar.	--	0	869	67,598
Apr.-June	--	0	***	***
July-Sept.	--	0	749	92,542
Oct.-Dec.	--	0	716	85,968
2013: Jan.-Mar.	--	0	***	***
Apr.-June	--	0	706	244,778
July-Sept.	--	0	697	329,372
Oct.-Dec.	--	0	690	323,929
2014: Jan.-Mar.	--	0	683	413,580
Apr.-June	--	0	687	666,572
July-Sept.	--	0	721	469,675
Oct.-Dec.	--	0	713	408,065
2015: Jan.-Mar.	--	0	716	310,628
Apr.-June	--	0	682	675,210
July-Sept.	--	0	652	1,221,632
Oct.-Dec.	--	0	641	1,763,922
2016: Jan.-Mar.	--	0	626	1,820,336
Apr.-June	--	0	623	2,130,333
July-Sept.	--	0	605	1,880,659
Oct.-Dec.	--	0	472	1,253,620

[1] Product 4: 72 cell Multicrystalline silicon module, with a peak power wattage between 290w to 340w, inclusive, P-max or Wp.

Source: Compiled from data submitted in response to Commission questionnaires.

Table V-16
CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 5, by quarters, 2012-16

* * * * * * *

Figure V-8
CSPV products: Weighted-average prices and quantities of domestic and imported product 1, by quarters, 2012-16

* * * * * * *

Figure V-9
CSPV products: Weighted-average prices and quantities of domestic and imported product 2, by quarters, 2012-16

* * * * * * *

Figure V-10
CSPV products: Weighted-average prices and quantities of domestic and imported product 3, by quarters, 2012-16

* * * * * * *

Figure V-11
CSPV products: Weighted-average prices and quantities of domestic and imported product 4, by quarters, 2012-16

* * * * * * *

Figure V-12
CSPV products: Weighted-average prices and quantities of domestic and imported product 5, by quarters, 2012-16

* * * * * * *

Thirty-one importers reported price data. Twenty importers provided price data for Taiwan, 13 for China, 11 for Korea, 11 for Malaysia, 9 for German, 9 for Vietnam, 6 for Thailand, 1 for Singapore, and 7 for all other sources (Netherlands, India, Japan, Portugal, and Turkey).[1] These price items and accompanying data are comparable to those presented in tables V-12 to V-16. Price and quantity data for individual country sources are shown in tables G-1 to G-5.

Table G-1
CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 1,[1] by quarters, 2012-16

* * * * * * *

Table G-2
CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 2,[1] by quarters, 2012-16

* * * * * * *

Table G-3
CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 3,[1] by quarters, 2012-16

* * * * * * *

Table G-4
CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 4,[1] by quarters, 2012-16

* * * * * * *

Table G-5
CSPV products: Weighted-average f.o.b. prices and quantities of domestic and imported product 5,[1] by quarters, 2012-16

* * * * * * *

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[1] There are antidumping and countervailing duty orders in place on imports from China and Taiwan. Antidumping and countervailing duty orders associated with the *CSPV 1* investigations became effective December 7, 2012. Antidumping and countervailing duty orders associated with the *CSPV 2* investigations became effective February 18, 2015.

REMEDY RECOMMENDATIONS

In order to address the serious injury to the domestic industry producing CSPV products and be most effective in facilitating the efforts of the domestic industry to make a positive adjustment to import competition, the Commission recommended a series of actions.

With regard to CSPV cells, Chairman Schmidtlein recommends a tariff-rate quota with an in-quota tariff rate of 10 percent ad valorem and an in-quota volume level of 0.5 gigawatts. For U.S. imports of cells that exceed the 0.5 gigawatts volume level, she recommends a tariff rate of 30 percent ad valorem. Chairman Schmidtlein recommends that this tariff-rate quota be implemented for four years and that the in-quota level be incrementally raised and the tariff rate be incrementally reduced during the remedy period. With regard to CSPV modules, she recommends an ad valorem tariff rate of 35 percent to be incrementally reduced during the 4-year remedy period. Chairman Schmidtlein also recommends that the President initiate international negotiations to address the underlying cause of the increase in imports of CSPV products and alleviate the serious injury thereof. Having made findings that U.S. imports from Australia, the CAFTA-DR countries, Colombia, Israel, Jordan, Panama, Peru, Singapore, and the beneficiary countries under CBERA were not a substantial cause of the serious injury experienced by the domestic industry, Chairman Schmidtlein recommends to the President that U.S. imports from these countries be excluded from the remedy.

Chairman Schmidtlein's Recommended Remedy				
	Year 1	Year 2	Year 3	Year 4
Cells: Tariff rate Quota				
In-Quota Tariff Rate	10%	9.5%	9.0%	8.5%
In-Quota Volume Level	0.5 gigawatts	0.6 gigawatts	0.7 gigawatts	0.8 gigawatts
Out-of-Quota Tariff Rate	30%	29%	28%	27%
Modules: Tariff (Ad Valorem)	35%	34%	33%	32%

Vice Chairman David S. Johanson and Commissioner Irving A. Williamson recommend that for a 4-year period the President impose (1) a tariff-rate quota on imports of CSPV products in cell form, and (2) increased rates of duty on imports of CSPV products in module form. For imports of CSPV products in cell form, they recommend an additional 30 percent ad valorem tariff on imports in excess of 1 gigawatt. In each subsequent year, they recommend that this tariff rate decrease by five percentage points and that the in-quota amount increase by 0.2 gigawatts. The rate of duty on in-quota CSPV products in cell form will remain unchanged. For imports of CSPV products in module form, Vice Chairman Johanson and Commissioner Williamson recommend an additional 30 percent ad valorem tariff, to be phased down by five percentage points per year in each of the subsequent years. Having made a negative finding with respect to imports from Canada under section 311(a) of the North American Free Trade Agreement Implementation Act, they recommend that such imports be excluded from the above tariff-rate quota and increased rates of duty. Further, Vice Chairman Johanson and Commissioner Williamson recommend that the above tariff-rate quota and increased rates of duty not apply to imports from the following countries with which the United States has FTAs: Australia, Colombia, Costa Rica, the Dominican Republic, El Salvador, Guatemala, Honduras, Israel, Jordan, Nicaragua, Panama, Peru, and Singapore. They also recommend that the tariff-rate quota and increased rates of duty not apply to imports from the CBERA beneficiary countries. Vice Chairman Johanson and Commissioner Williamson recommend that the President direct the United States Department of Labor and the United States Department of Commerce to provide expedited consideration of any application for trade adjustment assistance for workers and/or firms that are affected by subject imports. They recommend the President's consideration of the product exclusions requested by Respondents to which Petitioners have not objected and have indicated they would work to draft appropriate product-specific exclusions. Finally, they recommend that the President also consider any appropriate funding mechanisms that may facilitate a positive adjustment to import competition.

Commissioner Meredith M. Broadbent recommends that the President impose a quantitative restriction on imports of CSPV products into the United States, including cells and modules, for a four-year period, administered on a global basis. She recommends that the quantitative restriction be set at 8.9 gigawatts in the first year and increase by 1.4 gigawatts each subsequent year. In accordance with section 1102 of the Trade Agreements Act of 1979 (19 U.S.C. § 2581) and the President's authority in section 203(a)(3)(F) of the Trade Act of 1974 (19 U.S.C. § 2253(a)(3)(F)), she also recommends that the President administer these quantitative restrictions by selling import licenses at public auction at a minimum price of one cent per watt. She recommends that the President, to the extent permitted by law, authorize the use of funds equal to the amount generated by import license auctions to provide development assistance to domestic CSPV product manufacturers for the duration of the remedy period, such as through authorized programs at the United States Department of Energy (DOE). Commissioner Broadbent also recommends that the President implement other appropriate adjustment measures, including the provision of trade adjustment assistance by the United States Department of Labor and the United States Department of Commerce to workers and firms affected by import competition. Having made an affirmative finding with respect to imports from Mexico under section 311(a) of the NAFTA Implementation Act, she recommends that the President allocate no less than 720 megawatts to Mexico during the first year within the global quantitative restriction, which would expand by 115 megawatts each year. Having made a negative finding with respect to imports from Canada under section 311(a) of the NAFTA Implementation Act, Commissioner Broadbent recommends that such imports be excluded from the quantitative restriction. Furthermore, she recommends that this quantitative restriction not apply to imports from Australia, the CAFTA-DR countries, Colombia, Israel, Jordan, Panama, Peru, Singapore, and the CBERA beneficiary countries.

Attachment 1

Remedy Recommendations of Vice Chairman David S. Johanson and Commissioner Irving A. Williamson

Table 1 summarizes the remedy recommendation for each of the four years in the remedy period.

Table 1: Summary of Remedy Recommendations

	Year 1	Year 2	Year 3	Year 4
Ad Valorem Tariff on Imported Modules	30%	25%	20%	15%
Quota Amount in TRQ on Imported Cells	1 GW	1.2 GW	1.4 GW	1.6 GW
In-Quota Rate in the TRQ on Imported Cells	0%	0%	0%	0%
Out-of-Quota Rate in the TRQ on Imported Cells	30%	25%	20%	15%

Based on these assumptions, we estimated the recommended remedy will have the effects reported in table 2:

Table 2: Estimated Economic Effects over the 4 Years of the Recommended Remedy

	Year 1	Year 2	Year 3	Year 4
% Change in the Quantity of Imported Cells*	***	***	***	***
Change in the GW of Imported Cells	***	***	***	***
% Change in the Quantity of Imported Modules	***	***	***	***
Change in the GW of Imported Modules	***	***	***	***
% Change in the Quantity of U.S. Modules Using U.S. Cells	***	***	***	***
Change in the GW of U.S. Modules Using U.S. Cells	***	***	***	***
% Change in the Price of U.S. Modules Using U.S. Cells	***	***	***	***
% Change in the Overall Price of Modules in the U.S. Market	***	***	***	***
% Change in the Deployment of Modules in the U.S. Market	***	***	***	***
Change in Revenue from U.S. Modules Using U.S. Cells (million dollars)	***	***	***	***
Change in Operating Income from U.S. Modules Using U.S. Cells (million dollars)	***	***	***	***
Change in Revenue from U.S. Cells Used in Foreign Modules Exported to the United States (million dollars)	***	***	***	***
Change in Operating Income from U.S. Cells Used in Foreign Modules Exported to the United States (million dollars)	***	***	***	***
Change in Revenue from U.S. Modules Using Foreign Cells (million dollars)	***	***	***	***
Change in Operating Income from U.S. Modules Using Foreign Cells (million dollars)	***	***	***	***
Combined Change in Revenue from U.S. Production (million dollars)	***	***	***	***
Combined Change in Operating Income from U.S. Producers (million dollars)	***	***	***	***
Change in U.S. Tariff Revenues (million dollars)	***	***	***	***

Note: These effects are rounded to 0.1.

*This is the percentage change in the quantity of imported cells used in U.S. modules.

Assumptions used in the model:

- The baseline data for each year is based on GTM Research projected growth in total CSPV deployment in the U.S. market, assuming that the first year of the remedy is 2018 and the fourth year of the remedy is 2021.
- The price elasticity of total demand in the market is -1.
- The domestic supply elasticity is 4.
- The other elasticity values in the model are at the mid-points of the ranges in the final staff report.
- The remedy does not apply to imports from Canada or Singapore.

Appendix: Modeling Results and Estimated Effects of Various Remedies

The modeling results presented here are from three remedy scenarios, which are:

- **Broadbent remedy**: My remedy includes a one cent per watt minimum import license auction price and a quota on all CSPV products that will not likely be binding under current demand projections. Therefore, I use a $0.01/watt specific tariff on both CSPV modules and cells as a proxy for estimating the economic effects of my remedy.
- **25/0 % AVT**: I considered a 25 percent ad valorem tariff on CSPV modules and a 0 tariff on CSPV cells to assess the effects of a more moderate remedy than that proposed by petitioners.
- **Petitioner remedy**: SolarWorld's proposed remedies, which Suniva agreed with, include a $0.32/watt specific tariff and 5.70 GW quota on CSPV modules as well as a $0.25/watt specific tariff and 0.22 GW quota on CSPV cells.

Additional notes and assumptions:

- All remedies modeled here assume exclusion of imports from Singapore and Canada. All other imports excluded from the remedy recommendations are *de minimis* or zero, and therefore are not excluded from the model.
- Estimates of downstream employment are derived from my own calculations based on modeling results for CSPV deployment. I assumed that downstream employment in the BOS manufacturing and project development/installation sectors would decline proportionally with CSPV deployment.
- All results are for the first year of the remedy, which would correspond most directly with 2018 based on the timing of this investigation.
- Baseline quantity and employment estimates are ***.
- I use a domestic supply elasticity of ***, an import supply elasticity of ***, and a demand elasticity of *** for all scenarios.
- Imports of modules, as presented in the results below, include CSPV modules imported from covered sources subject to the remedies, in addition to imports from countries not covered by the remedies and imports of CSPV modules made from U.S. cells.

Quantities (***)

Factor	***	***	***	***
U.S. modules made from U.S. cells	***	***	***	***
U.S. modules made from foreign cells	***	***	***	***
Imports of modules	***	***	***	***
Total CSPV module deployments	***	***	***	***

Change in Quantities (***)

Factor	***	***	***	***
U.S. modules made from U.S. cells	***	***	***	***
U.S. modules made from foreign cells	***	***	***	***
Imports of modules	***	***	***	***
Total CSPV module deployments	***	***	***	***

Change in Quantities (%)

Factor	***	***	***	***
U.S. modules made from U.S. cells	***	***	***	***
U.S. modules made from foreign cells	***	***	***	***
Imports of modules	***	***	***	***
Total CSPV module deployments	***	***	***	***

Change in Prices (%)

Factor	***	***	***	***
U.S. modules made from U.S. cells	***	***	***	***
Imports of cells	***	***	***	***
Imports of modules	***	***	***	***
All CSPV modules	***	***	***	***

Change in Operating Income ($ *)**

Factor	***	***	***	***
U.S. modules made from U.S. cells	***	***	***	***
U.S. modules made from foreign cells	***	***	***	***
U.S. cells used in foreign-produced imported modules	***	***	***	***
Total U.S. operating income	***	***	***	***
***				

Estimates of Downstream Employment (Number of Workers)

Factor	***	***	***	***
Project Development/Installation	***	***	***	***
Balance of System Manufacturing	***	***	***	***
Total Downstream Employment	***	***	***	***

U.S. producers were asked whether their firm has undertaken or planned any efforts to compete more effectively in the U.S. market for CSPV cells (whether or not partially or fully assembled into other products) ("CSPV products") since 2012. The following five U.S. producers that together represented *** percent of reported U.S. CSPV module production during January 2012-December 2016 responded that they had not made any efforts to compete more effectively since 2012: ***. None of these firms manufactured CSPV cells in the United States during the period of investigation. The following eight U.S. producers that together represented *** percent of reported U.S. CSPV cell production and *** percent of reported U.S. CSPV module production during January 2012-December 2016 responded that they had made efforts to compete more effectively since 2012: ***. The aggregate reported expenditures involved in these U.S. producers' efforts to compete was $***. U.S. producers were further instructed to provide a description of (1) the efforts made since 2012 to compete more effectively, (2) the year in which the effort was made, (3) the expenditure involved, and (4) the specific competitive advantage sought or acquired. The responses of the U.S. producers to this request are presented in table D-1.

Table D-1
CSPV products: U.S. producers' efforts to compete more effectively in the U.S. market, by reporting firm, January 2012 – June 2017

* * * * * * *

U.S. producers were asked if they were to receive import relief as a result of this safeguard investigation, would the firm and/or its workers make adjustments in its operations producing CSPV products that would permit it to compete more effectively with imports of CSPV products. The following six U.S. producers that together represented *** percent of reported U.S. CSPV cell production and *** percent of reported U.S. CSPV module production during January 2012-December 2016 responded that they would not make any adjustments in their operations if they were to receive import relief: ***. The following seven U.S. producers that together represented *** percent of reported U.S. CSPV cell production and *** percent of reported U.S. CSPV module production during January 2012-December 2016 responded that if they were to receive import relief, they would make adjustments in their operations: ***. The aggregate reported anticipated expenditures involved were $***. U.S. producers were also instructed to describe (1) the specific adjustment actions that they would make during any period of relief that would permit them to compete more effectively with imports, (2) the anticipated expenditure involved, and (3) the specific competitive advantage expected to be gained by the adjustment. The firms were asked to include adjustment actions that were in addition to those that they would incur notwithstanding any relief under section 202 and which was described in the previous table above. The responses of the U.S. producers to this request are presented in table D-2.

Table D-2
CSPV products: U.S. producers' anticipated adjustments under safeguard import relief

* * * * * * *

APPENDIX E

SECTION 232 AND SECTION 301 PROCEEDINGS

Section 232 investigations (Commerce)[1]

Steel

On April 19, 2017, Commerce initiated an investigation under section 232 of the Trade Expansion Act of 1962 as amended (19 U.S.C. 1862), to assess the impact of steel imports on the national security of the United States.[2] [3] Commerce submitted the results of the investigations to the President on January 11, 2018.[4] On March 8, 2018, the President announced his decision to impose 25 percent ad valorem duties on specified steel mill products from all U.S. trading partners, except Canada and Mexico.[5] [6]

On March 22, 2018, the President authorized the suspension of tariffs on steel and aluminum products of the following countries: Argentina, Australia, Brazil, Canada, Mexico, member countries of the European Union, and Korea.[7] On April 30, 2018, the President announced that the expiration of exemptions on tariffs on steel and aluminum imports from Canada, the European Union member states, and Mexico would occur on May 31, 2018.[8] The President also announced the exemptions were extended permanently for Korea in return for agreeing to product-specific quotas beginning on January 1, 2019.[9] Exemptions for Argentina, Australia, and Brazil were also extended until alternative restraints could be finalized.[10]

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[1] The information in this appendix is primarily from *Large Residential Washers: Monitoring Developments in the Domestic Industry, Inv. Nos. TA-204-013,* USITC Publication 4941, August 2019, pp. F-3–F-9.

[2] U.S. Department of Commerce website: https://www.commerce.gov/news/press-releases/2018/01/statement-department-commerce-submission-steel-section-232-report, retrieved December 11, 2018.

[3] Section 232 of the Trade Expansion Act of 1962 (19 U.S.C. §1862) authorizes the Secretary of Commerce to conduct these investigations.

[4] U.S. Department of Commerce website: https://www.commerce.gov/news/pressreleases/2018/01/statement-department-commerce-submission-steel-section-232-report, retrieved December 11, 2018.

[5] 83 FR 11625, March 15, 2018.

[6] For the purposes of this proclamation, "articles of iron or steel" are defined at the Harmonized Tariff Schedule (HTS) six-digit level as: 7206.10 through 7216.50, 7216.99 through 7301.10, 7302.10, 7302.40 through 7302.90, and 7304.10 through 7306.90, including any subsequent revisions to these HTS classifications.

[7] 83 FR 13361, March 28, 2018.

[8] 83 FR 20683, May 7, 2018.

[9] 83 FR 20683, May 7, 2018.

[10] 83 FR 20683, May 7, 2018.

On May 31, 2018, under a Presidential Proclamation issued under Section 232 of the Trade Expansion Act of 1962, the President announced tariffs would no longer be suspended for steel and aluminum imports from Mexico, Canada, and the European Union, effective July 1, 2018. Steel products from these countries became subject to a 25 percent ad valorem duty.[11]

A subsequent Presidential proclamation established absolute quotas for Argentina, Brazil, and Korea as an alternate to the 25 percent ad valorem duty for imports of steel mill articles, effective June 1, 2018 (leaving Australia as the only country exempt from both tariffs and quotas).[12] [13] On August 10, 2018, the President authorized adjusting the ad valorem tariff on steel imports from Turkey from 25 percent to 50 percent.[14]

In the President's proclamation establishing the tariff under Section 232, the Secretary of Commerce was authorized to provide relief from the 25 percent ad valorem duties for any steel articles determined "not to be produced in the United States in a sufficient and reasonably available amount or of a satisfactory quality and is also authorized to provide such relief based upon specific national security considerations. Such relief shall be provided for any article only after a request for exclusion is made by a directly affected party located in the United States."[15] Approved exclusions are made on a product specific basis and are limited to the individual or organization that submitted the specific exclusion request, unless Commerce approves a broader application of the product based exclusion request for additional importers.[16]

On June 20, 2018, Commerce announced its first set of product exclusions granted from Section 232 tariffs on steel imports. Forty-two exclusion requests were granted, covering seven companies importing steel products from Japan, Sweden, Belgium, Germany, and China.[17]

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[11] 83 FR 25857, June 5, 2018.

[12] U.S. Customs and Border Protection, "QB 18-126 Absolute Quotas for Steel Mill Articles: Argentina, Brazil and Korea," https://www.cbp.gov/trade/quota/bulletins/qb-18-126-absolute-quota-aluminum-products-argentina-brazil-south-korea, retrieved December 11, 2018.

[13] U.S. Customs and Border Protection, "Section 232 Tariffs on Aluminum and Steel," https://www.cbp.gov/trade/programs-administration/entry-summary/232-tariffs-aluminum-and-steel, retrieved December 11, 2018.

[14] 83 FR 40429, August 15, 2018.

[15] *U.S. Department of Commerce, Bureau of Industry and Security, "Section 232 National Security Investigation of Steel Imports Information on the Exclusion and Objection Process,"* https://www.bis.doc.gov/index.php/232-steel, retrieved December 11, 2018.

[16] 83 FR 12106, March 19, 2018.

[17] The seven companies receiving the exclusions are: Schick Manufacturing, Inc. of Shelton, Connecticut; Nachi America Inc. of Greenwood, Indiana; Hankev International of Buena Park, California; Zapp Precision Wire of Summerville, South Carolina; U.S. Leakless, Inc. of Athens, Alabama; Woodings Industrial Corporation of Mars, Pennsylvania; and PolyVision Corporation of Atlanta, Georgia. The exempted products were not specified. U.S. Department of Commerce, "Department of Commerce Grants First Product Exclusion Requests from Section 232 Tariffs on Steel Imports,"

(*continued*...)

On May 16, 2019, the President modified proclamation 9705 to remove the higher tariff on steel imports from Turkey imposed by Proclamation 9772, and to instead impose a 25 percent ad valorem tariff on steel imports from Turkey, commensurate with the tariff imposed on such articles by the Section 232 remedy imported from most other countries.[18]

On May 19, 2019, the President issued two Proclamations adjusting Proclamations 9704 and 9705 after the United States announced an agreement with Canada and Mexico to remove the Section 232 tariffs for steel imports from those countries.[19]

Aluminum

On April 26, 2017, Commerce initiated an investigation under section 232 of the Trade Expansion Act of 1962 as amended (19 U.S.C. 1862), to assess the impact of aluminum imports on the national security of the United States.[20] [21] Commerce submitted the results of the investigations to the President on January 19, 2018.[22] On March 8, 2018, the President announced his decision to impose 10 percent ad valorem duties on specified aluminum products from all U.S. trading partners, except Canada and Mexico.[23] [24]

On March 22, 2018, the President authorized the suspension of tariffs on steel and aluminum products of the following countries: Argentina, Australia, Brazil, Canada, Mexico, member countries of the European Union, and Korea.[25] On April 30, 2018, the President announced that the expiration of exemptions on tariffs on steel and aluminum imports from Canada, the European Union member states, and Mexico would occur on May 31, 2018.[26]

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https://www.commerce.gov/news/press-releases/2018/06/department-commerce-grants-first-product-exclusion-requests-section-232, retrieved December 11, 2018.

[18] White House website: https://www.whitehouse.gov/presidential-actions/proclamation-adjusting-imports-steel-united-states/, retrieved June 6, 2019.

[19] White House website: https://www.whitehouse.gov/presidential-actions/proclamation-adjusting-imports-steel-united-states-2/, retrieved June 6, 2019.

[20] U.S. Department of Commerce website: https://www.commerce.gov/issues/trade-enforcement/section-232-aluminum#memo, retrieved December 19, 2018.

[21] Section 232 of the Trade Expansion Act of 1962 (19 U.S.C. §1862) authorizes the Secretary of Commerce to conduct these investigations.

[22] White House website: https://www.whitehouse.gov/presidential-actions/presidential-proclamation-adjusting-imports-aluminum-united-states/, retrieved December 19, 2018.

[23] 83 FR 11619, December 19, 2018.

[24] For the purposes of this proclamation, "articles of aluminum" are defined at the Harmonized Tariff Schedule (HTS) as: 7601, 7604, 7605, 7606, 7607, 7608, 7609, 7616.99.51.60, and 7616.99.51.70, including any subsequent revisions to these HTS classifications.

[25] 83 FR 13355, December 19, 2018.

[26] 83 FR 20677, December 19, 2018.

Exemptions for Argentina, Australia, and Brazil were also extended until alternative restraints could be finalized.[27]

On May 31, 2018, under a Presidential Proclamation issued under Section 232 of the Trade Expansion Act of 1962, the President announced tariffs will no longer be suspended for steel and aluminum imports from Brazil, Mexico, Canada, and the European Union, effective July 1, 2018. Aluminum products from these countries will be subject to a 10 percent ad valorem duty.[28]

A subsequent Presidential proclamation established absolute quotas for Argentina, as an alternate to the 10 percent ad valorem duty for imports of aluminum articles, effective June 1, 2018 (leaving Australia as the only country exempt from both tariffs and quotas).[29]

In the President's proclamation establishing the tariff under Section 232, the Secretary of Commerce was authorized to provide relief from the 10 percent ad valorem duties for any steel articles determined "not to be produced in the United States in a sufficient and reasonably available amount or of a satisfactory quality and is also authorized to provide such relief based upon specific national security considerations. Such relief shall be provided for any article only after a request for exclusion is made by a directly affected party located in the United States."[30] Approved exclusions are made on a product specific basis and are limited to the individual or organization that submitted the specific exclusion request, unless Commerce approves a broader application of the product based exclusion request for additional importers.[31]

On June 20, 2018, Commerce announced its first set of product exclusions granted from Section 232 tariffs on aluminum imports. Sixty-two exclusion requests were granted, with the following companies receiving the exclusions: Ball Metal Beverage Container Corp. of Broomfield, Colorado; Bemis Company, Inc. of Neenah, Wisconsin; Channel Alloys of Norwalk, Connecticut; Constellium-UACJ ABS LLC of Bowling Green, Kentucky; Cornell Dubilier Marketing of Liberty, South Carolina; Garmco, Inc. of Winter Garden, Florida; Generac Power Systems of Waukesha, Wisconsin; International Converter, LLC of Caldwell, Ohio; Mandel Metals, Inc. of Franklin Park, Illinois; ProAmpac Intermediate Inc. of Cincinnati, Ohio; Schluter Systems of Plattsburgh, New York; Trinidad/Benham Corp. of Denver, Colorado.[32] The exempted products

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[27] Ibid.

[28] 83 FR 25849, December 19, 2018.

[29] U.S. Customs and Border Protection, "Section 232 Tariffs on Aluminum and Steel," https://www.cbp.gov/trade/programs-administration/entry-summary/232-tariffs-aluminum-and-steel, retrieved December 11, 2018.

[30] *U.S. Department of Commerce Announces Steel and Aluminum Tariff Exclusion Process* https://www.commerce.gov/news/press-releases/2018/03/us-department-commerce-announces-steel-and-aluminum-tariff-exclusion, retrieved December 19, 2018.

[31] 83 FR 12106, March 19, 2018.

[32] U.S. Department of Commerce, *Requirements for Submissions Requesting Exclusions from the Remedies Instituted in Presidential Proclamations Adjusting Imports of Steel into the United States and Adjusting Imports of Aluminum into the United States; and the Filing Objections to Submitted Exclusion*

(*continued*...)

include 6020 T8 Cold finished aluminum bars, high purity etched and “formed foil, and cansheet body stock of 3104/H19 alloy.[33]

On May 19, 2019, the President issued two Proclamations adjusting Proclamations 9704 and 9705 after the United States announced an agreement with Canada and Mexico to remove the Section 232 tariffs for aluminum imports from those countries.[34]

Section 301 proceeding

Section 301 of the Trade Act of 1974, as amended (“Trade Act”),[35] authorizes the USTR, at the direction of the President, to take appropriate action to respond to a foreign country’s unfair trade practices. On August 18, 2017, the USTR initiated an investigation into certain policies and practices of the Government of China related to technology transfer, intellectual property, and innovation.[36] On April 6, 2018, the USTR published its determination that the acts, policies, and practices of China under investigation are unreasonable or discriminatory and burden or restrict U.S. commerce, and are thus actionable under section 301(b) of the Trade Act.[37] The USTR determined that it was appropriate and feasible to take action and proposed the imposition of an additional 25 percent duty on products from China with an annual trade value of approximately $50 billion. The additional duties were initially proposed in two tranches. Tranche 1 covered 818 tariff subheadings, with an approximate annual trade value of $34 billion.[38] Tranche 2 covered 279 tariff subheadings, with an approximate annual trade value of $16 billion.

On September 21, 2018, the USTR published a notice in the *Federal Register* modifying its prior action in accordance with the specific direction of the President under his authority pursuant to section 307(a)(1) of the Trade Act, determining to include 5,745 full and partial tariff subheadings with an approximate annual trade value of $200 billion, while maintaining the prior action. The USTR determined that the rate of additional duty is initially 10 percent ad valorem, effective September 24, 2018.[39]

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request for Steel and Aluminum, Docket ID BIS-2018-0002, https://www.regulations.gov/docket?D=BIS-2018-0002, retrieved December 20, 2018.

[33] S&P Global, “US Commerce grants first Section 232 aluminum product exclusion,” https://www.spglobal.com/platts/en/market-insights/latest-news/metals/071318-us-commerce-grants-first-section-232-aluminum-product-exclusions, retrieved December 20, 2018.

[34] White House website: https://www.whitehouse.gov/presidential-actions/proclamation-adjusting-imports-aluminum-united-states/, retrieved June 6, 2019.

[35] 19 U.S.C. § 2411.

[36] 82 FR 40213, August 24, 2017.

[37] 83 FR 14906, April 6, 2018.

[38] 83 FR 28710, June 20, 2018.

[39] 83 FR 47974, September 21, 2018.

Goods that are the product of China and that entered the United States on or after September 24, 2018 and prior to May 10, 2019 were subject to additional 10 percent *ad valorem* duties (annexes A and C of 83 FR 47974), after an earlier action to raise that rate in March 2019 was postponed. Goods exported before May 10 but entered into the United States by the close of June 14, 2019 continued to be charged the 10 percent additional duty rate. Goods entered on and after June 15, 2019 are subject to the additional 25 percent ad valorem duties, regardless of date of export.[40] [41]

[40] 83 FR 47974, September 21, 2018; 84 FR 26930, June 10, 2019.

[41] CSPV modules and cells, which are primarily classified in HTS subheading 8541.40.60, were included in the list of articles subject to the additional 25-percent duties effective August 23, 2018, under Section 301 of the Trade Act of 1974. This list of articles also included HTS subheadings 8501.31.80 and 8501.32.60. HTS subheadings 8501.61.00 and 8507.20.80 were included in the list of articles goods subject to additional 10 percent ad valorem duties starting September 24, 2018, and 25 percent duties starting in May/June 2019.

APPENDIX F

SELECT FOREIGN PRODUCER DATA

The foreign industries

Foreign industry data presented in this appendix are based on the questionnaire responses of 46 producers/exporters of CSPV products as follows:

Canada: 5 firms accounting for approximately 89 percent of 2018 CSPV module capacity in Canada.[1]
China: 4 firms accounting for approximately 15 percent of CSPV cell production and 24 percent of CSPV module production in 2018 in China.[2]
France: 1 firm accounting for approximately *** percent of CSPV cell production and *** percent of CSPV module production in 2018 in France.[3]
Germany: 1 firm accounting for *** percent of CSPV cells production capacity and *** percent of CSPV module production capacity in Germany in 2018.[4]
Hong Kong: 2 exporting firms that export CSPV modules to the US not produced by their firm.

[1] There is no known cell production in Canada. Baldus-Jeursen, C., Y. Poissant, and Wes Johnston, National Survey Report of PV Power Applications in Canada 2018, IEA PVPS, 2019, p. 24, http://www.iea-pvps.org/?id=93, retrieved November 3, 2019; Baldus-Jeursen, C., Y. Poissant, and P. Bateman, National Survey Report of PV Power Applications in Canada 2018, IEA PVPS, 2019, p. 27, http://www.iea-pvps.org/?id=93, retrieved November 3, 2019.

[2] These firms accounted for *** percent of cell production capacity and *** percent of module production capacity in 2018. Fang, Lv, Xu Honghua, Wang Sicheng, "National Survey Report of PV Power Applications in CHINA 2017," IEA PVPS, 2018, p. 18, http://www.iea-pvps.org/?id=93, retrieved November 6, 2019; Fang, Lv, Xu Honghua, Wang Sicheng, "National Survey Report of PV Power Applications in CHINA 2017," IEA PVPS, 2018, p. 18, http://www.iea-pvps.org/?id=93, retrieved November 6, 2019.

[3] Melodie de l'Epine, "National Survey Report of PV Power Applications in France 2018," IEAPVPS, 2019, http://www.iea-pvps.org/?id=93, November 4, 2019.

[4] PV Magazine, "Hörmann Group Takes Innotech's Insolvent Cell Production Over," August 20, 2015, https://www.pv-magazine.com/2015/08/20/hormann-group-takes-innotechs-insolvent-cell-production-over_100020683/, retrieved November 3, 2019; bSolar Webpage, http://www.b-solar.com/AboutUs.aspx, retrieved November 3, 2019; German Federal Ministry for Economic Affairs and Energy, "Country Presentation Germany," IEA PVPS, April 2018, p. 8, https://unef.es/wp-content/uploads/dlm_uploads/2018/04/country_presentation_germany_50thpvps-task1_kuching.pdf, retrieved November 3, 2019.

India: 2 firms accounting for approximately *** percent of CSPV cell production capacity and *** percent of CSPV module production capacity in India.[5]
Indonesia: 3 firms accounting for approximately *** percent of CSPV cell production capacity and *** percent of CSPV module production capacity in Indonesia.[6]
Japan: 1 firm accounting for approximately *** percent of CSPV cell production capacity and *** percent of CSPV module production capacity in Japan in 2018.[7]
Korea: 3 firms accounting for approximately *** percent of CSPV cell production capacity and *** percent of CSPV module production capacity in Korea in 2018.[8]
Malaysia: 7 firms accounting for 82 percent of CSPV cell capacity and 85 percent of CSPV module capacity in 2018 in Malaysia.[9]
Mexico: 3 firms accounting for approximately *** percent of CSPV cell capacity in Mexico and approximately *** percent of CSPV module capacity in Mexico in 2018.[10]

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[5] ***.

[6] ***. For several firms, production capacity was not available. These firms are not included for the purposes of this calculation. Hamdi, Elrika, "Indonesia's Solar Policies," Institute for Energy Economics and Financial Analysis, February 2019, p. 25, http://ieefa.org/wp-content/uploads/2019/02/Indonesias-Solar-Policies_February-2019.pdf, retrieved November 3, 2019.

[7] Mitsuhiro Tamazaki, and Osamu Ikki, "National Survey Report of PV Power Applications in Japan 2018," IEA PVPS, 2019, http://www.iea-pvps.org/index.php?id=93&eID=dam_frontend_push&docID=4855, retrieved November 5, 2019, p. 45.

[8] Park, Chinho, Inchul Hwang, Jaehong Seo, and Deugyoung Jeong, "National Survey Report of Photovoltaic Applications in Korea - 2017," 2019, IEA PVPS, p. 23, http://www.iea-pvps.org/index.php?id=93&eID=dam_frontend_push&docID=4683, retrieved October 23, 2019.

[9] The Star, "Tek Seng Shares Fell 5% after Announcing the End of its Solar Business," July 19, 2018, https://www.thestar.com.my/business/business-news/2018/07/19/tek-seng-shares-fell-5pc-after-announcing-the-suspension-of-solar-business/, retrieved November 2, 2019; Mak, Gladys, "Solar PV: Policy, Market & Industry in Malaysia," April 7, 2018, pp. 13–14, https://unef.es/wp-content/uploads/dlm_uploads/2018/04/presentation-task-1_malaysia-april-2018.pdf, retrieved November 2, 2019; Malaysian Solar Resources Webpage, http://www.malaysiansolar.com/content.php?id=6&lang=1, retrieved November 2, 2019; PV HiTech Webpage, https://www.pvhitechsolar.com.my/Solar-Module-Manufacturing-Plant/, retrieved November 2, 2019; IEA PVPS, Annual Report 2018, 2019, p. 88, http://www.iea-pvps.org/index.php?id=6, retrieved November 2, 2019; Toenergy Technology Website, http://www.toensolar.com/aboutus.html, retrieved November 8, 2019.

[10] IEA PVPS, Annual Report 2017, 2018, p. 91, http://www.iea-pvps.org/index.php?id=6&eID=dam_frontend_push&docID=4412 , retrieved November 4, 2019; and Safeguard report, p. IV-17.

Philippines: 1 firm accounting for all known cell production and approximately *** percent of CSPV module capacity in the Philippines in 2018.[11]
Singapore: 2 firms accounting for all known cell and CSPV module production in Singapore.[12]
Taiwan: 7 firms accounting for approximately *** percent of CSPV cell capacity and *** percent of CSPV module capacity in Taiwan in 2018.[13]

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[11] ***; and Solar Philippines Webpage, https://www.solarphilippines.ph/about/, retrieved November 3, 2019.

[12] ***.

[13] Bellini, Emiliano, "Hard Times for Taiwan's PV Manufacturers," *PV Magazine*, September 18, 2018, https://www.pv-magazine.com/2018/09/18/hard-times-for-taiwans-pv-manufacturers/, retrieved November 10, 2019; Sunengine Webpage, http://www.sunengine.com.tw/index.aspx?action=3&lang=2&cat=5, retrieved November 10, 2019; Tsao, Rhea, "Will Taiwan Meet its 20 GW Solar Goal by 2025?" *PV Magazine*, September 7, 2018, https://www.pv-magazine.com/2018/09/07/will-taiwan-meet-its-20-gw-solar-goal-by-2025/, retrieved November 10, 2019; Sun & Wind Energy, "Photovoltaics Industry Worldwide 2015," n.d., http://www.sunwindenergy.com/sites/default/files/poster_pv-weltkarte_2015_englisch.pdf, retrieved November 10, 2019; Energy Taiwan Webpage, https://www.energytaiwan.com.tw/en_US/exh/info.html?id=CD75951A1E366465D0636733C6861689, retrieved November 10, 2019; Anji Technology Webpage, http://www.anjitek.com/index.php?option=module&lang=cht&task=pageinfo&id=420&index=5, Retrieved November 10, 2019; *EnergyTrend*, "Tainergy's Expansion Boosts its Cell Capacity to 600 MW in Vietnam," May 4, 2016, https://www.energytrend.com/news/20160504-10493.html, retrieved November 10, 2019; "Tainergy Tech: To Move Solar Cell Production to Vietnam," MarketScreener, January 16, 2019, https://www.marketscreener.com/TAINERGY-TECH-CO-LTD-20706070/news/Tainergy-Tech-to-move-solar-cell-production-to-Vietnam-27872639/, retrieved November 10, 2019; ***; Ming Hwei Energy Webpage, https://www.mhe.com.tw/english/about.html, retrieved November 10, 2019; TSEC Webpage, http://www.tsecpv.com/en-global/about/index/about_01, retrieved November 10, 2019; Inventec Solar Energy Webpage, http://www.inventecsolar.com/tw/modules/news/article.php?storyid=1, retrieved November 10, 2019; *EnergyTrend*, "E-Ton Suspends PV-Cell Production," May 1, 2019, https://www.energytrend.com/news/20190501-13802.html, retrieved November 10, 2019.

Thailand: 2 firms accounting for approximately *** percent of CSPV cell capacity and *** percent of CSPV module capacity in Thailand in 2018.[14]
Vietnam: 2 firms accounting for approximately *** percent of CSPV cell capacity and *** percent of CSPV module capacity in Vietnam in 2018.[15]

Table F-1 presents data concerning capacity, production, capacity utilization, and exports reported by foreign producers/exporters of CSPV products in response to the Commission's questionnaire.

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[14] Tiger Solar Co., Ltd. is not included in this calculation as production capacity was not available. Final report publication, p. IV-34; ***; Ekarat Webpage, https://www.ekarat.co.th/en/about-us/, retrieved October 23, 2019; Full Solar Webpage, http://www.fullsolar.co.th/; Bureau of Solar Energy Development, Government of Thailand, National Survey Report of PV Power Applications in Thailand 2015, IEA PVPS, p. 19, http://www.iea-pvps.org/index.php?id=93&eID=dam_frontend_push&docID=3116, retrieved October 24, 2019.

[15] ***. Data for Solar Power Vietnam used in this calculation is the most recent available production data. Production capacity at Hanoi Solar Technology and Venergy was not available and is not included in this calculation. Final report publication, p. IV-32-33; Vina Solar Webpage, http://www.vinasolar.com/, retrieved October 23, 2019; ***; Vina Solar Webpage, http://www.vinasolar.com/, retrieved October 23, 2019; Green Wing Solar Group Webpage, https://greenwingsolar.com/about-us/, retrieved November 8, 2019; Dehui Solar Power, Dehui Profile, http://www.dehui-solar.com/file-11688.html, retrieved November 8, 2019; Viet Nam Green Energy Technology Co., LTD Webpage, https://vngreenenergy.com/about-vge/, retrieved November 8, 2019; Solar Power Vietnam Technology Website, http://www.solarvietnam.vn/gioi-thieu.html, retrieved November 8, 2019; Industrial Technology Research Institute, Green Energy Industry Development Strategy and Promotion Plan, June 2015, https://km.twenergy.org.tw/ReadFile/?p=KLBase&n=2015915102942.pdf, retrieved November 8, 2019.

Table F-1
CSPV products: Summary data on foreign industries, 2016-18, January to June 2018, January to June 2019, and projections calendar years 2019 and 2020

Item	Actual experience					Projections	
	Calendar year			January to June		Calendar year	
	2016	2017	2018	2018	2019	2019	2020
Canada, Cells: Capacity (kW)	***	***	***	***	***	***	***
Production (kW)	***	***	***	***	***	***	***
Capacity utilization (%)	***	***	***	***	***	***	***
Exports to the US (kW)	***	***	***	***	***	***	***
Exports to all other destinations (kW)	***	***	***	***	***	***	***
Ratio exports to US production (%)	***	***	***	***	***	***	***
Ratio exports to all other production (%)	***	***	***	***	***	***	***
Canada, Modules: Capacity (kW)	***	***	***	***	***	***	***
Production (kW)	***	***	***	***	***	***	***
Capacity utilization (%)	***	***	***	***	***	***	***
Exports to the US (kW)	***	***	***	***	***	***	***
Exports to all other destinations (kW)	***	***	***	***	***	***	***
Ratio exports to US production (%)	***	***	***	***	***	***	***
Ratio exports to all other production (%)	***	***	***	***	***	***	***
China, Cells: Capacity (kW)	***	***	***	***	***	***	***
Production (kW)	***	***	***	***	***	***	***
Capacity utilization (%)	***	***	***	***	***	***	***
Exports to the US (kW)	***	***	***	***	***	***	***
Exports to all other destinations (kW)	***	***	***	***	***	***	***
Ratio exports to US production (%)	***	***	***	***	***	***	***
Ratio exports to all other production (%)	***	***	***	***	***	***	***
China, Modules: Capacity (kW)	***	***	***	***	***	***	***
Production (kW)	***	***	***	***	***	***	***
Capacity utilization (%)	***	***	***	***	***	***	***
Exports to the US (kW)	***	***	***	***	***	***	***
Exports to all other destinations (kW)	***	***	***	***	***	***	***
Ratio exports to US production (%)	***	***	***	***	***	***	***
Ratio exports to all other production (%)	***	***	***	***	***	***	***

Table continued on next page.

Table F-1
CSPV products: Summary data on foreign industries, 2016-18, January to June 2018, January to June 2019, and projections calendar years 2019 and 2020

Item	Actual experience					Projections	
	Calendar year			January to June		Calendar year	
	2016	2017	2018	2018	2019	2019	2020
Germany, Cells: Capacity (kW)	***	***	***	***	***	***	***
Production (kW)	***	***	***	***	***	***	***
Capacity utilization (%)	***	***	***	***	***	***	***
Exports to the US (kW)	***	***	***	***	***	***	***
Exports to all other destinations (kW)	***	***	***	***	***	***	***
Ratio exports to US production (%)	***	***	***	***	***	***	***
Ratio exports to all other production (%)	***	***	***	***	***	***	***
Germany, Modules: Capacity (kW)	***	***	***	***	***	***	***
Production (kW)	***	***	***	***	***	***	***
Capacity utilization (%)	***	***	***	***	***	***	***
Exports to the US (kW)	***	***	***	***	***	***	***
Exports to all other destinations (kW)	***	***	***	***	***	***	***
Ratio exports to US production (%)	***	***	***	***	***	***	***
Ratio exports to all other production (%)	***	***	***	***	***	***	***
India, Cells: Capacity (kW)	***	***	***	***	***	***	***
Production (kW)	***	***	***	***	***	***	***
Capacity utilization (%)	***	***	***	***	***	***	***
Exports to the US (kW)	***	***	***	***	***	***	***
Exports to all other destinations (kW)	***	***	***	***	***	***	***
Ratio exports to US production (%)	***	***	***	***	***	***	***
Ratio exports to all other production (%)	***	***	***	***	***	***	***
India, Modules: Capacity (kW)	***	***	***	***	***	***	***
Production (kW)	***	***	***	***	***	***	***
Capacity utilization (%)	***	***	***	***	***	***	***
Exports to the US (kW)	***	***	***	***	***	***	***
Exports to all other destinations (kW)	***	***	***	***	***	***	***
Ratio exports to US production (%)	***	***	***	***	***	***	***
Ratio exports to all other production (%)	***	***	***	***	***	***	***

Table continued on next page.

Table F-1--Continued
CSPV products: Summary data on foreign industries, 2016-18, January to June 2018, January to June 2019, and projections calendar years 2019 and 2020

Item	Actual experience					Projections	
	Calendar year			January to June		Calendar year	
	2016	2017	2018	2018	2019	2019	2020
Indonesia, Cells: Capacity (kW)	***	***	***	***	***	***	***
Production (kW)	***	***	***	***	***	***	***
Capacity utilization (%)	***	***	***	***	***	***	***
Exports to the US (kW)	***	***	***	***	***	***	***
Exports to all other destinations (kW)	***	***	***	***	***	***	***
Ratio exports to US production (%)	***	***	***	***	***	***	***
Ratio exports to all other production (%)	***	***	***	***	***	***	***
Indonesia, Modules: Capacity (kW)	***	***	***	***	***	***	***
Production (kW)	***	***	***	***	***	***	***
Capacity utilization (%)	***	***	***	***	***	***	***
Exports to the US (kW)	***	***	***	***	***	***	***
Exports to all other destinations (kW)	***	***	***	***	***	***	***
Ratio exports to US production (%)	***	***	***	***	***	***	***
Ratio exports to all other production (%)	***	***	***	***	***	***	***
Japan, Cells: Capacity (kW)	***	***	***	***	***	***	***
Production (kW)	***	***	***	***	***	***	***
Capacity utilization (%)	***	***	***	***	***	***	***
Exports to the US (kW)	***	***	***	***	***	***	***
Exports to all other destinations (kW)	***	***	***	***	***	***	***
Ratio exports to US production (%)	***	***	***	***	***	***	***
Ratio exports to all other production (%)	***	***	***	***	***	***	***
Japan, Modules: Capacity (kW)	***	***	***	***	***	***	***
Production (kW)	***	***	***	***	***	***	***
Capacity utilization (%)	***	***	***	***	***	***	***
Exports to the US (kW)	***	***	***	***	***	***	***
Exports to all other destinations (kW)	***	***	***	***	***	***	***
Ratio exports to US production (%)	***	***	***	***	***	***	***
Ratio exports to all other production (%)	***	***	***	***	***	***	***

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Table F-1--Continued
CSPV products: Summary data on foreign industries, 2016-18, January to June 2018, January to June 2019, and projections calendar years 2019 and 2020

Item	Actual experience					Projections	
	Calendar year			January to June		Calendar year	
	2016	2017	2018	2018	2019	2019	2020
Korea, Cells: Capacity (kW)	***	***	***	***	***	***	***
Production (kW)	***	***	***	***	***	***	***
Capacity utilization (%)	***	***	***	***	***	***	***
Exports to the US (kW)	***	***	***	***	***	***	***
Exports to all other destinations (kW)	***	***	***	***	***	***	***
Ratio exports to US production (%)	***	***	***	***	***	***	***
Ratio exports to all other production (%)	***	***	***	***	***	***	***
Korea, Modules: Capacity (kW)	***	***	***	***	***	***	***
Production (kW)	***	***	***	***	***	***	***
Capacity utilization (%)	***	***	***	***	***	***	***
Exports to the US (kW)	***	***	***	***	***	***	***
Exports to all other destinations (kW)	***	***	***	***	***	***	***
Ratio exports to US production (%)	***	***	***	***	***	***	***
Ratio exports to all other production (%)	***	***	***	***	***	***	***
Malaysia, Cells: Capacity (kW)	***	***	***	***	***	***	***
Production (kW)	***	***	***	***	***	***	***
Capacity utilization (%)	***	***	***	***	***	***	***
Exports to the US (kW)	***	***	***	***	***	***	***
Exports to all other destinations (kW)	***	***	***	***	***	***	***
Ratio exports to US production (%)	***	***	***	***	***	***	***
Ratio exports to all other production (%)	***	***	***	***	***	***	***
Malaysia, Modules: Capacity (kW)	***	***	***	***	***	***	***
Production (kW)	***	***	***	***	***	***	***
Capacity utilization (%)	***	***	***	***	***	***	***
Exports to the US (kW)	***	***	***	***	***	***	***
Exports to all other destinations (kW)	***	***	***	***	***	***	***
Ratio exports to US production (%)	***	***	***	***	***	***	***
Ratio exports to all other production (%)	***	***	***	***	***	***	***

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Table F-1--Continued
CSPV products: Summary data on foreign industries, 2016-18, January to June 2018, January to June 2019, and projections calendar years 2019 and 2020

Item	Actual experience					Projections	
	Calendar year			January to June		Calendar year	
	2016	2017	2018	2018	2019	2019	2020
Mexico, Cells: Capacity (kW)	***	***	***	***	***	***	***
Production (kW)	***	***	***	***	***	***	***
Capacity utilization (%)	***	***	***	***	***	***	***
Exports to the US (kW)	***	***	***	***	***	***	***
Exports to all other destinations (kW)	***	***	***	***	***	***	***
Ratio exports to US production (%)	***	***	***	***	***	***	***
Ratio exports to all other production (%)	***	***	***	***	***	***	***
Mexico, Modules: Capacity (kW)	***	***	***	***	***	***	***
Production (kW)	***	***	***	***	***	***	***
Capacity utilization (%)	***	***	***	***	***	***	***
Exports to the US (kW)	***	***	***	***	***	***	***
Exports to all other destinations (kW)	***	***	***	***	***	***	***
Ratio exports to US production (%)	***	***	***	***	***	***	***
Ratio exports to all other production (%)	***	***	***	***	***	***	***
Philippines, Cells: Capacity (kW)	***	***	***	***	***	***	***
Production (kW)	***	***	***	***	***	***	***
Capacity utilization (%)	***	***	***	***	***	***	***
Exports to the US (kW)	***	***	***	***	***	***	***
Exports to all other destinations (kW)	***	***	***	***	***	***	***
Ratio exports to US production (%)	***	***	***	***	***	***	***
Ratio exports to all other production (%)	***	***	***	***	***	***	***
Philippines, Modules: Capacity (kW)	***	***	***	***	***	***	***
Production (kW)	***	***	***	***	***	***	***
Capacity utilization (%)	***	***	***	***	***	***	***
Exports to the US (kW)	***	***	***	***	***	***	***
Exports to all other destinations (kW)	***	***	***	***	***	***	***
Ratio exports to US production (%)	***	***	***	***	***	***	***
Ratio exports to all other production (%)	***	***	***	***	***	***	***

Table continued on next page.

Table F-1--Continued
CSPV products: Summary data on foreign industries, 2016-18, January to June 2018, January to June 2019, and projections calendar years 2019 and 2020

Item	Actual experience					Projections	
	Calendar year			January to June		Calendar year	
	2016	2017	2018	2018	2019	2019	2020
Singapore, Cells: Capacity (kW)	***	***	***	***	***	***	***
Production (kW)	***	***	***	***	***	***	***
Capacity utilization (%)	***	***	***	***	***	***	***
Exports to the US (kW)	***	***	***	***	***	***	***
Exports to all other destinations (kW)	***	***	***	***	***	***	***
Ratio exports to US production (%)	***	***	***	***	***	***	***
Ratio exports to all other production (%)	***	***	***	***	***	***	***
Singapore, Modules: Capacity (kW)	***	***	***	***	***	***	***
Production (kW)	***	***	***	***	***	***	***
Capacity utilization (%)	***	***	***	***	***	***	***
Exports to the US (kW)	***	***	***	***	***	***	***
Exports to all other destinations (kW)	***	***	***	***	***	***	***
Ratio exports to US production (%)	***	***	***	***	***	***	***
Ratio exports to all other production (%)	***	***	***	***	***	***	***
Taiwan, Cells: Capacity (kW)	***	***	***	***	***	***	***
Production (kW)	***	***	***	***	***	***	***
Capacity utilization (%)	***	***	***	***	***	***	***
Exports to the US (kW)	***	***	***	***	***	***	***
Exports to all other destinations (kW)	***	***	***	***	***	***	***
Ratio exports to US production (%)	***	***	***	***	***	***	***
Ratio exports to all other production (%)	***	***	***	***	***	***	***
Taiwan, Modules: Capacity (kW)	***	***	***	***	***	***	***
Production (kW)	***	***	***	***	***	***	***
Capacity utilization (%)	***	***	***	***	***	***	***
Exports to the US (kW)	***	***	***	***	***	***	***
Exports to all other destinations (kW)	***	***	***	***	***	***	***
Ratio exports to US production (%)	***	***	***	***	***	***	***
Ratio exports to all other production (%)	***	***	***	***	***	***	***

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Table F-1--Continued
CSPV products: Summary data on foreign industries, 2016-18, January to June 2018, January to June 2019, and projections calendar years 2019 and 2020

Item	Actual experience					Projections	
	Calendar year			January to June		Calendar year	
	2016	2017	2018	2018	2019	2019	2020
Thailand, Cells: Capacity (kW)	***	***	***	***	***	***	***
Production (kW)	***	***	***	***	***	***	***
Capacity utilization (%)	***	***	***	***	***	***	***
Exports to the US (kW)	***	***	***	***	***	***	***
Exports to all other destinations (kW)	***	***	***	***	***	***	***
Ratio exports to US production (%)	***	***	***	***	***	***	***
Ratio exports to all other production (%)	***	***	***	***	***	***	***
Thailand, Modules: Capacity (kW)	***	***	***	***	***	***	***
Production (kW)	***	***	***	***	***	***	***
Capacity utilization (%)	***	***	***	***	***	***	***
Exports to the US (kW)	***	***	***	***	***	***	***
Exports to all other destinations (kW)	***	***	***	***	***	***	***
Ratio exports to US production (%)	***	***	***	***	***	***	***
Ratio exports to all other production (%)	***	***	***	***	***	***	***
Turkey, Cells: Capacity (kW)	***	***	***	***	***	***	***
Production (kW)	***	***	***	***	***	***	***
Capacity utilization (%)	***	***	***	***	***	***	***
Exports to the US (kW)	***	***	***	***	***	***	***
Exports to all other destinations (kW)	***	***	***	***	***	***	***
Ratio exports to US production (%)	***	***	***	***	***	***	***
Ratio exports to all other production (%)	***	***	***	***	***	***	***
Turkey, Modules: Capacity (kW)	***	***	***	***	***	***	***
Production (kW)	***	***	***	***	***	***	***
Capacity utilization (%)	***	***	***	***	***	***	***
Exports to the US (kW)	***	***	***	***	***	***	***
Exports to all other destinations (kW)	***	***	***	***	***	***	***
Ratio exports to US production (%)	***	***	***	***	***	***	***
Ratio exports to all other production (%)	***	***	***	***	***	***	***

Table continued on next page.

Table F-1--Continued
CSPV products: Summary data on foreign industries, 2016-18, January to June 2018, January to June 2019, and projections calendar years 2019 and 2020

Item	Actual experience					Projections	
	Calendar year			January to June		Calendar year	
	2016	2017	2018	2018	2019	2019	2020
Vietnam, Cells: Capacity (kW)	***	***	***	***	***	***	***
Production (kW)	***	***	***	***	***	***	***
Capacity utilization (%)	***	***	***	***	***	***	***
Exports to the US (kW)	***	***	***	***	***	***	***
Exports to all other destinations (kW)	***	***	***	***	***	***	***
Ratio exports to US production (%)	***	***	***	***	***	***	***
Ratio exports to all other production (%)	***	***	***	***	***	***	***
Vietnam, Modules: Capacity (kW)	***	***	***	***	***	***	***
Production (kW)	***	***	***	***	***	***	***
Capacity utilization (%)	***	***	***	***	***	***	***
Exports to the US (kW)	***	***	***	***	***	***	***
Exports to all other destinations (kW)	***	***	***	***	***	***	***
Ratio exports to US production (%)	***	***	***	***	***	***	***
Ratio exports to all other production (%)	***	***	***	***	***	***	***

Table continued on next page.

Table F-1--Continued
CSPV products: Summary data on foreign industries, 2016-18, January to June 2018, January to June 2019, and projections calendar years 2019 and 2020

Item	Actual experience					Projections	
	Calendar year			January to June		Calendar year	
	2016	2017	2018	2018	2019	2019	2020
Other, Cells: Capacity (kW)	***	***	***	***	***	***	***
Production (kW)	***	***	***	***	***	***	***
Capacity utilization (%)	***	***	***	***	***	***	***
Exports to the US (kW)	***	***	***	***	***	***	***
Exports to all other destinations (kW)	***	***	***	***	***	***	***
Ratio exports to US production (%)	***	***	***	***	***	***	***
Ratio exports to all other production (%)	***	***	***	***	***	***	***
Other, Modules: Capacity (kW)	***	***	***	***	***	***	***
Production (kW)	***	***	***	***	***	***	***
Capacity utilization (%)	***	***	***	***	***	***	***
Exports to the US (kW)	***	***	***	***	***	***	***
Exports to all other destinations (kW)	***	***	***	***	***	***	***
Ratio exports to US production (%)	***	***	***	***	***	***	***
Ratio exports to all other production (%)	***	***	***	***	***	***	***

Note: Summary data presented for “Other” countries were submitted by ***.

Source: Compiled from data submitted in response to Commission questionnaires.

The industry in China

This section compiles data and information on the historical development of the Chinese industry. The data used here are primarily compiled from databases and data sets that offer long-term historical data on the industry in China. As most sources report data from 2010, the text will focus on 2010 to 2018 or 2019. Longer term data, as available, are in tables and charts. *** data for 2019 are as of ***.

Supply chain

Polysilicon

China's production of polysilicon increased more than 450 percent during 2010–18, rising from 45,000 metric tons in 2010 to 259,000 metric tons in 2018 (figure F-1).[16] China accounted for 58 percent of global production in 2019.[17]

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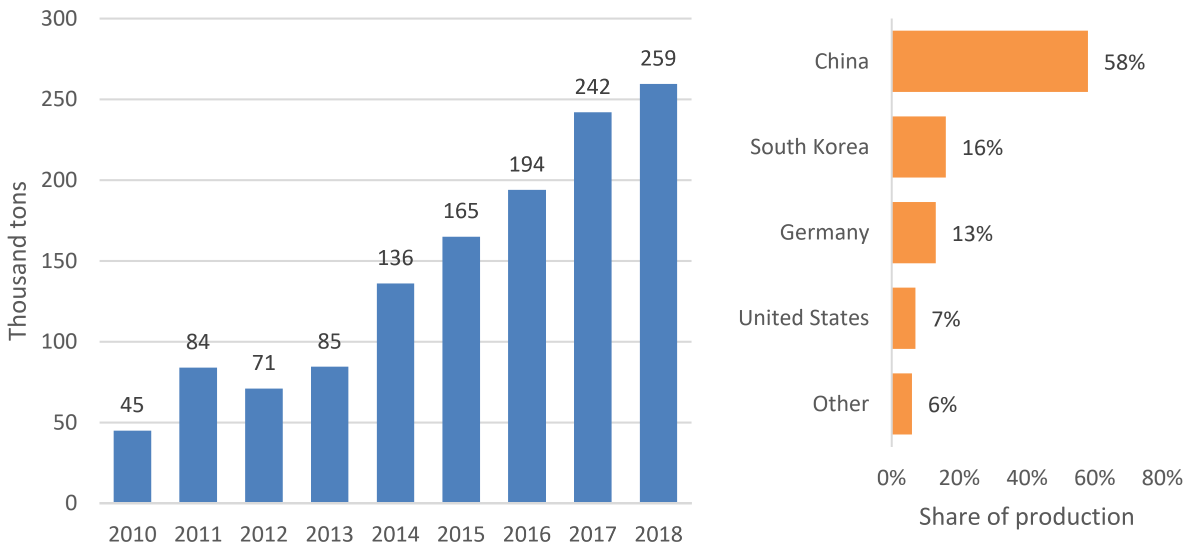
[16] CPIA, "China Photovoltaic Industry Development Roadmap," 2019, p. 2, http://www.chinapv.org.cn/road_map.html, retrieved November 4, 2019; Fang, Lv, Xu Honghua, Wang Sicheng, Li Hailing, Ma Liyun, and Li Ping "National Survey Report of PV Power Applications in China 2018," IEA PVPS, 2019, p. 18, http://www.iea-pvps.org/?id=93, retrieved December 19, 2019.

[17] IEA PVPS, *Trends in Photovoltaic Applications 2019*, Report IEA PVPS T1-36:2019, p. 59, http://www.iea-pvps.org/?id=256, retrieved December 19, 2019.

Figure F-1
Polysilicon: Production of polysilicon in China, 2010–18 (left) and shares of global production held by largest producing countries, 2018 (right)



Source: CPIA, "China Photovoltaic Industry Development Roadmap," 2019, p. 2, http://www.chinapv.org.cn/road_map.html, retrieved November 4, 2019; IEA PVPS, *Trends in Photovoltaic Applications 2019*, Report IEA PVPS T1-36:2019, p. 59, http://www.iea-pvps.org/?id=256, retrieved December 19, 2019; Fang, Lv, Xu Honghua, Wang Sicheng, Li Hailing, Ma Liyun, and Li Ping "National Survey Report of PV Power Applications in China 2018," IEA PVPS, 2019, p. 18, http://www.iea-pvps.org/?id=93, retrieved December 19, 2019.

Chinese imports of silicon with a purity of at least 99.99 percent reached 160,000 tons in 2017, then declined to 140,000 tons in 2018 (figure F-2). Chinese imports from the United States peaked at 33,000 tons in 2012.[18] China imposed antidumping and countervailing duty orders on imports of polysilicon from Korea and the United States in January 2014, and on imports from the European Union in May 2014. China imposed antidumping duties on U.S. imports that ranged from 53.3 to 57.0 percent, with some firms also subject to a countervailing duty rate of 2.1 percent. Korean producers were subject to antidumping rates of 2.4 to 48.7 percent, which were raised to 4.4 to 113.8 percent in November 2017. Korea's largest polysilicon producer, OCI, was subject to duties of 2.4 percent as of 2014 and 4.4 percent from 2017. European producers were subject to antidumping duties of 42 percent and countervailing duties of 1.2 percent. However, China exempted the largest European producer, Wacker Chemie, from duties due to an agreement not to sell below a minimum price. China ended the duties on European imports in October 2018. As of September 1, 2014, China also suspended applications to import polysilicon under processing trade regimes (goods imported and used in exported products), through which polysilicon had entered duty free (though imports under existing contracts were allowed to continue).[19]

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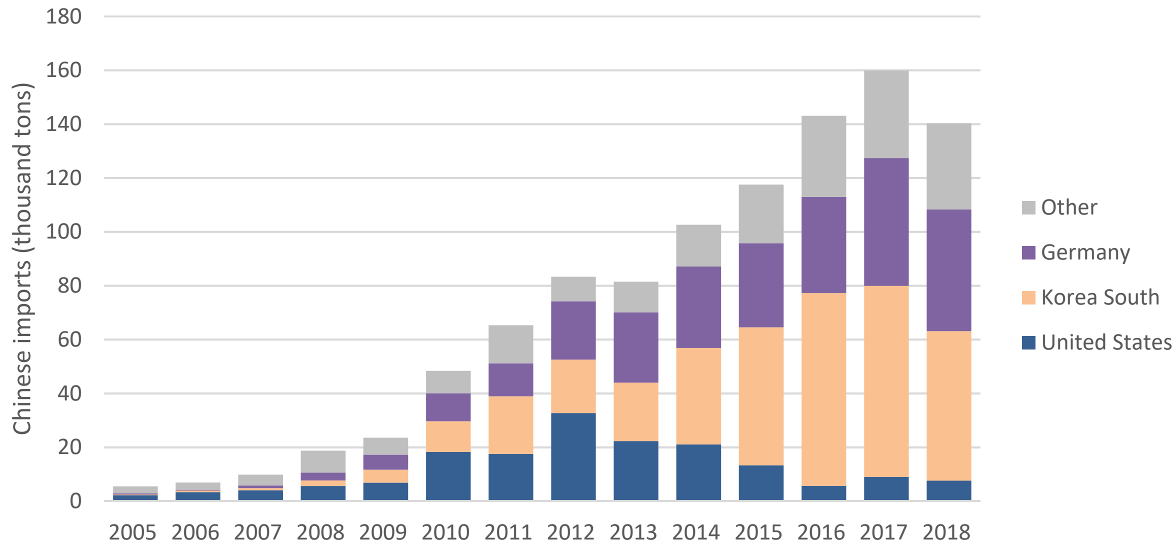
[18] Official import statistics under HS subheading 2804.61 for China from China's customs reported by the Global Trade Atlas database, accessed December 19, 2019.

[19] CSPV 1 first review publication, pp. IV-20–IV-21; Parnell, John, "China to Close Polysilicon Import Loophole from End of Month," *PV Tech*, August 15, 2015, https://www.pv-tech.org/news/china_to_ban_polysilicon_imports_from_end_of_month, retrieved January 4, 2014; Clover, Ian, "China to Close Polysilicon Import Loophole from September," PV Magazine, August 15, 2014, https://www.pv-magazine.com/2014/08/15/china-to-close-polysilicon-import-loophole-from-september_100016112/, retrieved January 4, 2020; *PV Magazine*, "China Imposes Punitive Duties on EU Polysilicon," May 6, 2014, https://www.pv-magazine.com/2014/05/06/china-imposes-punitive-duties-on-eu-polysilicon_100014989/, retrieved January 4, 2020; International Centre for Trade and Sustainable Development, "China Moves Forward with Duties on EU Polysilicon," May 8, 2015, http://www.ictsd.org/bridges-news/biores/news/china-moves-forward-with-duties-on-eu-polysilicon, retrieved January 4, 2020; China Ministry of Commerce, "MOFCOM Announcement No. 78 of 2017 on Ruling of the Midterm Review of Dumping and Dumping Margin of Imports of Solar-grade Polycrystalline Silicon Originated in the Republic of Korea," November 22, 2017, http://english.mofcom.gov.cn/article/policyrelease/buwei/201711/20171102676127.shtml, retrieved January 4, 2020; Hutchins, Mark, "The Weekend Read: Polysilicon and Wafer Manufacturer Ranking," PV Magazine, February 24, 2018, https://www.pv-magazine.com/2018/02/24/the-weekend-read-from-the-top/, retrieved January 4, 2020.

Figure F-2
Silicon: Chinese imports of silicon with a purity of 99.99 percent or higher, 2005–18



Source: Official import statistics under HS subheading 2804.61 for China from China's customs reported by the Global Trade Atlas database, accessed December 19, 2019.

Chinese polysilicon production capacity increased from *** in 2010 to *** in 2019 (figure F-3). There was a particularly *** in capacity from 2018 to 2019, reflecting ***. There were *** plants in China in 2019, but the *** largest plants accounted for *** percent of production capacity. China's share of global production capacity was *** during 2011–16, but increased to *** in 2019.[20]

[20] ***.

Figure F-3
Polysilicon: Chinese polysilicon production capacity and share of global capacity, 2010–19

* * * * * * *

Source: ***.

Wafers

The production of wafers in China increased more than 850 percent during 2010–18, rising from 11 GW in 2010 to 107 GW in 2018 (figure F-4).[21] Capacity utilization in China in 2018 was 73 percent.[22] China accounted for 93 percent of global wafer production in 2018.[23]

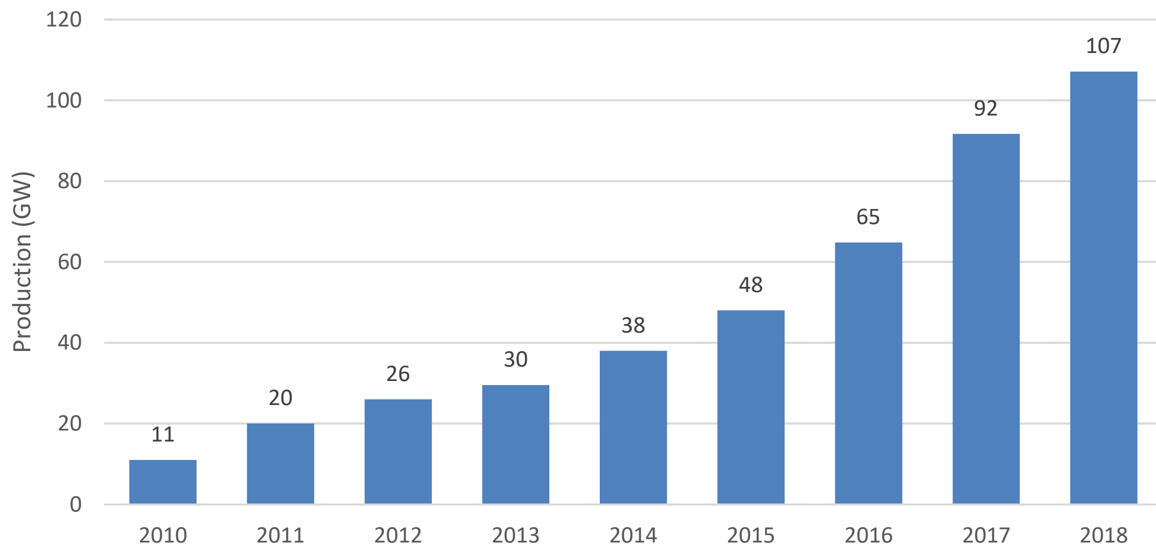
[21] CPIA, "China Photovoltaic Industry Development Roadmap," 2019, p. 2, http://www.chinapv.org.cn/road_map.html, retrieved November 4, 2019; Fang, Lv, Xu Honghua, Wang Sicheng, Li Hailing, Ma Liyun, and Li Ping "National Survey Report of PV Power Applications in China 2018," IEA PVPS, 2019, p. 19, http://www.iea-pvps.org/?id=93, retrieved December 19, 2019.

[22] Capacity utilization for 2018 is calculated based on capacity reported to the IEA to ensure comparability with production data, while *** capacity data are presented below for time series and comparison to global capacity purposes. Fang, Lv, Xu Honghua, Wang Sicheng, Li Hailing, Ma Liyun, and Li Ping "National Survey Report of PV Power Applications in China 2018," IEA PVPS, 2019, p. 19, http://www.iea-pvps.org/?id=93, retrieved December 19, 2019.

[23] IEA PVPS, *Trends in Photovoltaic Applications 2019*, Report IEA PVPS T1-36:2019, p. 59, http://www.iea-pvps.org/?id=256, retrieved December 19, 2019.

Figure F-4

Wafers: Production of wafers in China, 2010-18



Source: CPIA, "China Photovoltaic Industry Development Roadmap," 2019, p. 2, http://www.chinapv.org.cn/road_map.html, retrieved November 4, 2019; Fang, Lv, Xu Honghua, Wang Sicheng, Li Hailing, Ma Liyun, and Li Ping "National Survey Report of PV Power Applications in China 2018," IEA PVPS, 2019, p. 19, http://www.iea-pvps.org/?id=93, retrieved December 19, 2019.

Chinese wafer production capacity increased from *** in 2010 to *** in 2019 (figure F-5). China's share of global wafer production capacity increased from *** percent in 2010 to *** percent in 2019. There were *** wafer manufacturing plants in China, with a median capacity of *** in 2019. Plants with a capacity of at least *** accounted for *** of Chinese production capacity in 2019.[24]

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[24] ***.

Figure F-5
Wafers: Wafer production capacity in China and share of global capacity held by China, 2010–19

*   *   *   *   *   *   *

Source: ***.

CSPV cells and modules

Cells

Production of cells in China increased almost 700 percent during 2010–18, rising from 11 GW in 2010 to 85 GW in 2018 (figure F-6). The share of global production held by China increased from 9 percent in 2005 to 43 percent in 2010, then reached 73 percent in 2018.[25] The capacity utilization rate in 2018 was 66 percent.[26]

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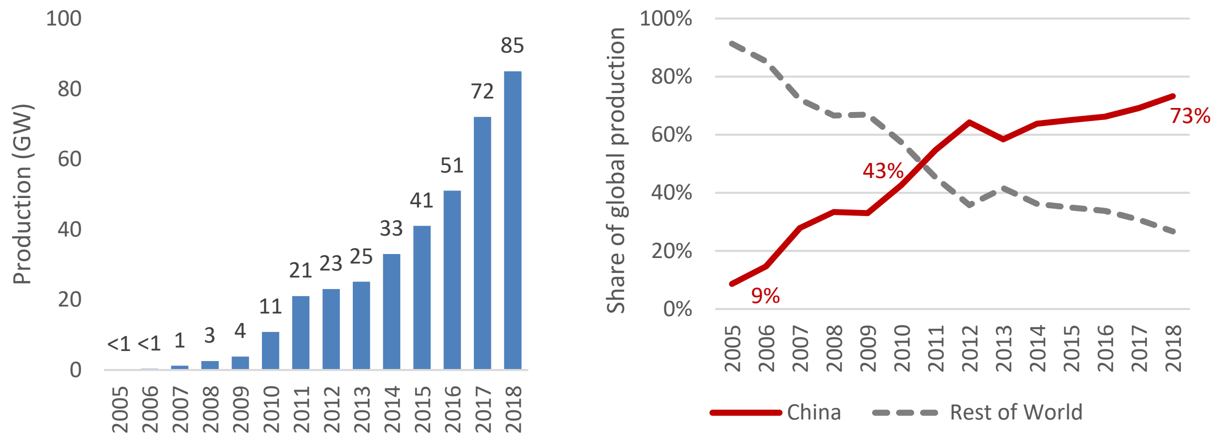
[25] Data for China and the world include thin film products. CPIA, "China Photovoltaic Industry Development Roadmap," 2019, p. 3, http://www.chinapv.org.cn/road_map.html, retrieved November 4, 2019; China data prior to 2010 and data for the rest of the world for all years is from IEA PVPS, *Trends in Photovoltaic Applications*, 2006–2019 editions, http://www.iea-pvps.org/?id=256, retrieved December 19, 2019; Fang, Lv, Xu Honghua, Wang Sicheng, Li Hailing, Ma Liyun, and Li Ping "National Survey Report of PV Power Applications in China 2018," IEA PVPS, 2019, p. 19, http://www.iea-pvps.org/?id=93, retrieved December 19, 2019.

[26] Capacity utilization for 2018 is calculated based on capacity reported to the IEA to ensure comparability with production data, while *** capacity data are presented below for time series and comparison to global capacity purposes. Fang, Lv, Xu Honghua, Wang Sicheng, Li Hailing, Ma Liyun, and Li Ping "National Survey Report of PV Power Applications in China 2018," IEA PVPS, 2019, p. 19, http://www.iea-pvps.org/?id=93, retrieved December 19, 2019.

Figure F-6
CSPV cells: PV production in China, 2005–18 (left) and share of global PV production held by China, 2005–18 (right)



Note: Data include thin film products.

Source: CPIA, "China Photovoltaic Industry Development Roadmap," 2019, p. 3, http://www.chinapv.org.cn/road_map.html, retrieved November 4, 2019; China data prior to 2010 and data for the rest of the world for all years is from IEA PVPS, *Trends in Photovoltaic Applications*, 2006–19 editions, http://www.iea-pvps.org/?id=256, retrieved December 19, 2019; Fang, Lv, Xu Honghua, Wang Sicheng, Li Hailing, Ma Liyun, and Li Ping "National Survey Report of PV Power Applications in China 2018," IEA PVPS, 2019, p. 19, http://www.iea-pvps.org/?id=93, retrieved December 19, 2019.

CSPV cell production capacity in China increased from *** in 2010 to *** in 2018 (figure F-7). The share of global production capacity held by China increased from *** percent in 2010 to *** percent in 2019. In 2019, there were *** cell manufacturing plants in China, with a median annual production capacity of ***. Of these plants, *** had an annual production capacity of at least 1 GW. Of these *** plants, *** had at least 2.5 GW in annual production capacity and *** of these *** plants had at least 5 GW in annual production capacity.[27]

[27] ***.

Figure F-7
CSPV cells: CSPV cell production capacity in China and share of global capacity held by China, 2010–19

* * * * * * *

Source: ***.

Modules

PV module production in China increased almost 700 percent during 2010–18, rising from 11 GW in 2010 to 83 GW in 2018 (figure F-8). The share of global module production held by China increased from 14 percent in 2005 to 50 percent in 2010, then rose to 72 percent in 2018.[28] The capacity utilization rate for module production in China was 64 percent.[29]

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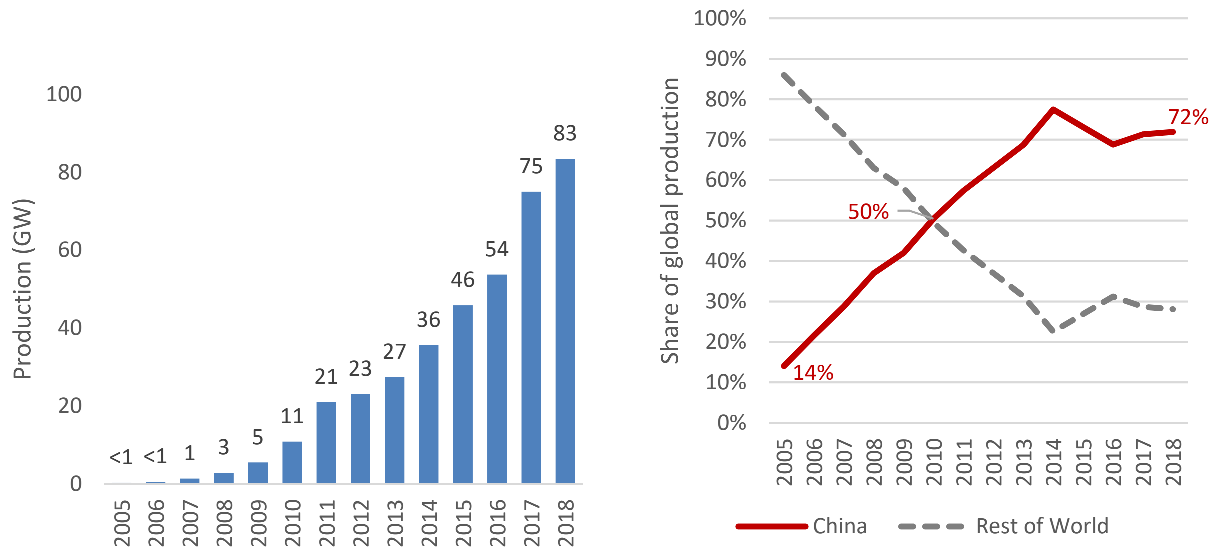
[28] Data include thin film products. CPIA, "China Photovoltaic Industry Development Roadmap," 2019, p. 3, http://www.chinapv.org.cn/road_map.html, retrieved November 4, 2019; China data prior to 2010 and data for the rest of the world for all years is from IEA PVPS, *Trends in Photovoltaic Applications*, 2006–19 editions, http://www.iea-pvps.org/?id=256, retrieved December 19, 2019; Fang, Lv, Xu Honghua, Wang Sicheng, Li Hailing, Ma Liyun, and Li Ping "National Survey Report of PV Power Applications in China 2018," IEA PVPS, 2019, p. 20, http://www.iea-pvps.org/?id=93, retrieved December 19, 2019.

[29] Capacity utilization for 2018 is calculated based on capacity reported to the IEA to ensure comparability with production data, while *** capacity data are presented below for time series and comparison to global capacity purposes. Fang, Lv, Xu Honghua, Wang Sicheng, Li Hailing, Ma Liyun, and Li Ping "National Survey Report of PV Power Applications in China 2018," IEA PVPS, 2019, p. 20, http://www.iea-pvps.org/?id=93, retrieved December 19, 2019.

Figure F-8
CSPV modules: PV production of modules in China, 2005–18 (left) and share of global PV production held by China and rest of world, 2005–18 (right)



Note: Data include thin film products.

Source: CPIA, "China Photovoltaic Industry Development Roadmap," 2019, p. 3, http://www.chinapv.org.cn/road_map.html, retrieved November 4, 2019; China data prior to 2010 and data for the rest of the world for all years is from IEA PVPS, *Trends in Photovoltaic Applications*, 2006–2019 editions, http://www.iea-pvps.org/?id=256, retrieved December 19, 2019; Fang, Lv, Xu Honghua, Wang Sicheng, Li Hailing, Ma Liyun, and Li Ping "National Survey Report of PV Power Applications in China 2018," IEA PVPS, 2019, p. 20, http://www.iea-pvps.org/?id=93, retrieved December 19, 2019.

CSPV module production capacity in China increased from *** in 2010 to *** in 2019 (figure F-9). The share of global module production capacity in China was *** during this time period, ranging from *** percent to *** percent of global module capacity. There were *** module production plants in China in 2019, with a median annual production capacity of ***. Of these plants, *** had an annual production capacity of at least 1 GW. Further, *** of these *** plants had an annual production capacity of at least 2.5 GW, and *** of these *** plants had an annual production capacity of at least 5 GW.[30]

[30] ***.

Figure F-9
CSPV modules: CSPV module production capacity in China and share of global capacity held by China, 2010–19

* * * * * * *

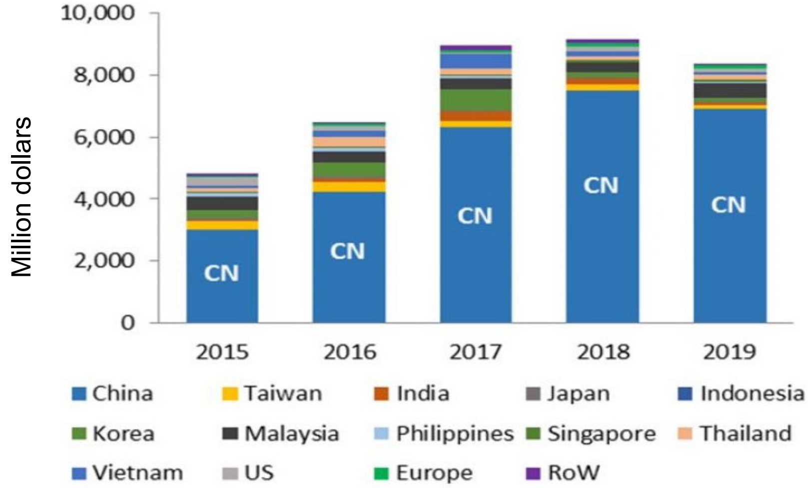
Source: ***.

Capital expenditures

Reflecting the large increase in capacity shown above, China accounted for most of the approximately $9 billion in global CSPV capital expenditures (including ingots, wafers, cells, and modules) in 2018, and China's share increased during 2015–18 (figure F-10). Examining cells specifically, China's share of global capital expenditures increased from less than 60 percent in 2015 to more than 80 percent in 2018 (figure F-11).[31]

[31] Colville, Finlay, "Solar PV Capex Trending at US$9 billion Annually as New GW Fabs in China Slash Investments Required," *PV Tech*, December 10, 2019, https://www.pv-tech.org/editors-blog/solar-pv-capex-trending-at-us9-billion-annually-as-new-gw-fabs-in-china-sla, retrieved December 18, 2019.

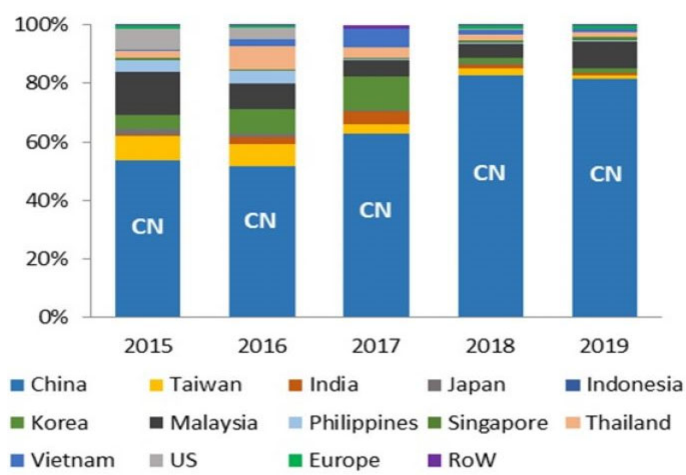
Figure F-10
CSPV products: Global capital expenditures for ingots, wafers, CSPV cells, and CSPV modules, 2015-19



Notes: 2019 data are projections. Given declining costs for building plants, decreases in spending do not necessarily translate to lower capacity additions in GW terms.

Source: Colville, Finlay, "Solar PV Capex Trending at US$9 billion Annually as New GW Fabs in China Slash Investments Required," *PV Tech*, December 10, 2019, https://www.pv-tech.org/editors-blog/solar-pv-capex-trending-at-us9-billion-annually-as-new-gw-fabs-in-china-sla, retrieved December 18, 2019.

Figure F-11
CSPV cells: Share of global capital expenditures for CSPV cells



Notes: 2019 data are projections.

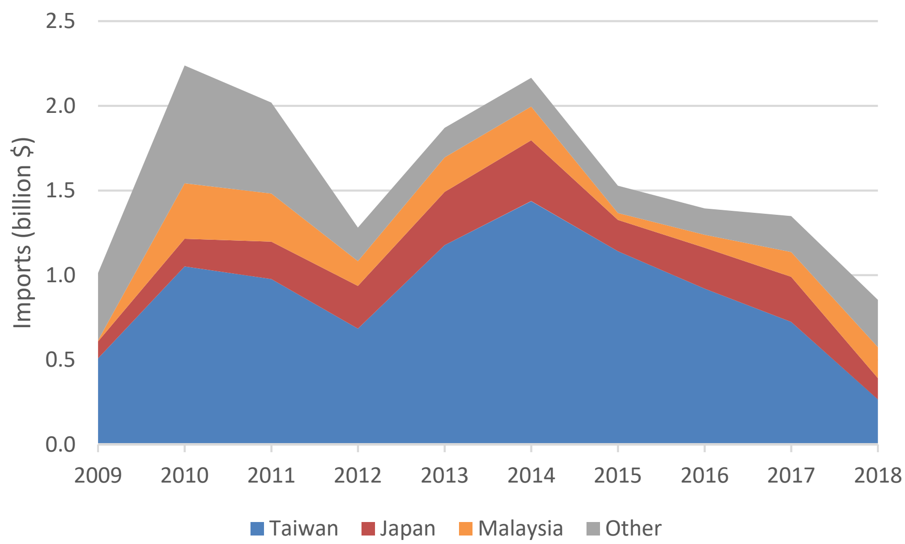
Source: Colville, Finlay, "Solar PV Capex Trending at US$9 billion Annually as New GW Fabs in China Slash Investments Required," *PV Tech*, December 10, 2019, https://www.pv-tech.org/editors-blog/solar-pv-capex-trending-at-us9-billion-annually-as-new-gw-fabs-in-china-sla, retrieved December 18, 2019.

Trade in China

Chinese imports

Chinese PV (including thin film) imports peaked at $2.2 billion in 2010, and returned close to that level in 2014 (figure F-12). Chinese imports then declined to $855 million in 2018. Taiwan was the leading source of Chinese imports throughout 2009–18, but Chinese imports from Taiwan peaked at $1.4 billion in 2014 before falling to $267 million in 2018.[32]

Figure F-12
CSPV products: Chinese imports of CSPV cells and modules, 2009–18



Notes: Changes in the value of imports may not reflect changes in volumes, due to the declining price of solar cells and modules.

Source: Official import statistics under HS subheading 8541.40.20 for China from China's customs reported by the Global Trade Atlas database, accessed December 18, 2019.

[32] Official import statistics under HS subheading 8541.40.20 for China from China's customs reported by the Global Trade Atlas database, accessed December 18, 2019.

Chinese exports

The quantity of Chinese PV exports, including thin film, increased from *** in 2012 to *** in 2018, and reached *** during January to September 2019 (figure F-13).[33] The share of Chinese exports that went to the United States was between 9 and 11 percent during 2011–16, then declined in 2017 and 2018 (figure F-14). Other large markets showed more variability, with European markets initially accounting for a large share of exports, and major Asian market subsequently capturing a large share of export value.[34]

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[33] For all quarters except Q1 2016 to Q1 2017, quarterly exports divided by the quarterly average multicrystalline CSPV module spot market price for CSPV modules made in China from ***. For Q1 2016 to Q1 2017, *** data were not available, so the global average multicrystalline CSPV module spot market price was used. Exports also include lower priced cells and higher priced CSPV monocrystalline modules, so actual volume may differ slightly from this estimate. Official exports statistics under HS subheading 8541.40.20 for China from China's customs reported by the Global Trade Atlas database, accessed December 19, 2019; Austin, Ryan, "Solar Energy Costs Trends Over Time," Earth Techling, July 2, 2019, https://earthtechling.com/solar-energycosts-trends/, retrieved November 7, 2019; ***.

[34] Official export statistics under HS subheading 8541.40.20 for China from China's customs reported by the Global Trade Atlas database, accessed December 19, 2019.

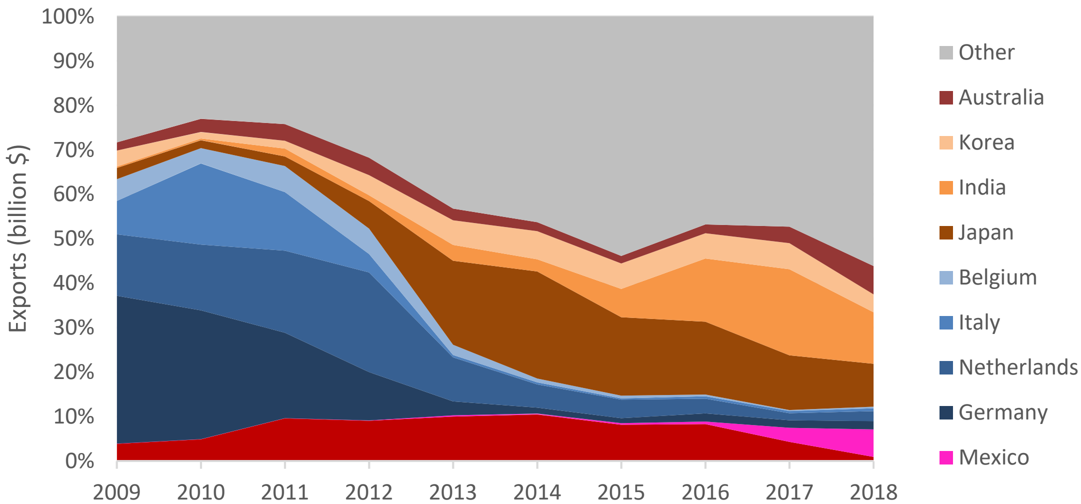
Figure F-13
CSPV products: Chinese exports of CSPV cells and module, by quantity, 2012–18

*   *   *   *   *   *   *

Notes: For all quarters except Q1 2016 to Q1 2017, quarterly exports divided by the quarterly average multicrystalline CSPV module spot market price for CSPV modules made in China from ***. For Q1 2016 to Q1 2017, *** data were not available, so the global average multicrystalline CSPV module spot market price was used. Exports also include lower priced cells and higher priced CSPV monocrystalline modules, so actual volume may differ slightly from this estimate.

Source: Official exports statistics under HS subheading 8541.40.20 for China from China's customs reported by the Global Trade Atlas database, accessed December 19, 2019; Austin, Ryan, “Solar Energy Costs Trends Over Time,” Earth Techling, July 2, 2019, https://earthtechling.com/solar-energy-costs-trends/, retrieved November 7, 2019; ***.

Figure F-14
CSPV products: Chinese exports of CSPV cells and module, by destination, 2009–18



Notes: Markets to which China exported at least $1 billion in at least one year are shown separately.

Source: Official export statistics under HS subheading 8541.40.20 for China from China's customs reported by the Global Trade Atlas database, accessed December 19, 2019.

Chinese companies' production capacity in Southeast Asia

Chinese firms have also substantially increased their production of cells and modules outside of China, including in Southeast Asia. In 2013, Chinese firms had *** cell production capacity in Malaysia, Thailand, and Vietnam and *** of module production capacity.[35] In 2018, Chinese firms plus Canadian Solar had *** of cell capacity and *** of module capacity in Malaysia, *** of cell capacity and *** of module capacity in Thailand, and *** of cell capacity and *** of module capacity in Vietnam.[36]

[35] ***.

[36] See sources for coverage percentages above.

Net income

Net income data was compiled for 59 Chinese companies[37] with CSPV cell and/or CSPV module production (figure F-15). The actual number of companies shown for a given year varies, reflecting firm entries, exits, and changes in data availability. The share of companies with a negative net income increased from *** percent in 2010 to *** percent in 2012, and then declined to *** percent in 2015. In the three most recent available years, *** percent of companies had a negative net income in 2016, *** percent had a negative net income in 2017, and *** percent had a negative net income in 2018.[38]

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[37] The data include publicly traded companies as well as private firms with at least 500 MW of annual CSPV cell or CSPV module production capacity in 2019 that were included in the *** database and for which net income data was available for at least one year. All companies manufacture CSPV cells and/or CSPV modules, but many are also vertically integrated upstream or downstream. The data exclude companies with a substantial focus on non-CSPV activities, as well as companies that solely produce other components in the supply chain (such as polysilicon) and do not produce CSPV cell or CSPV modules. Changes in the number of companies are not necessarily indicative of firm entries and exits as data availability for certain firms varies by year. Subsequent financial data in this appendix will be for a subset of these companies for which data were available. In several instances, data for two subsidiaries were listed separately. These subsidiaries remain listed as separate companies in the data presented here.

[38] ***.

Figure F-15
CSPV products: Number of Chinese companies with positive and negative net income, 2010–18

* * * * * * *

Note: The data include publicly traded companies as well as private firms with at least 500 MW of annual CSPV cell or CSPV module production capacity in 2019 that were included in the *** database and for which net income data was available for at least one year. All companies manufacture CSPV cells and/or CSPV modules, but many are also vertically integrated upstream or downstream. The data exclude companies with a substantial focus on non-CSPV activities, as well as companies that solely produce other components in the supply chain (such as polysilicon) and do not produce CSPV cell or CSPV modules. Changes in the number of companies are not necessarily indicative of firm entries and exits as data availability for certain firms varies by year. Subsequent financial data in this appendix will be for a subset of these companies for which data were available. In several instances, data for two subsidiaries were listed separately. These subsidiaries remain listed as separate companies in the data presented here.

Source: ***.

Research and development

Spending on research and development among 26 Chinese CSPV companies was compiled for 2010–18 and is shown in figure F-16 as a share of total revenue. Though data are impacted by changes in the list of publicly traded companies, average firm spending in 2018 was *** and the median was ***. There is significant variation in spending as a share of revenue by company.[39]

[39] ***.

Figure F-16
CSPV products: Chinese companies spending on R&D as a share of total revenue, 2010–18

*   *   *   *   *   *   *

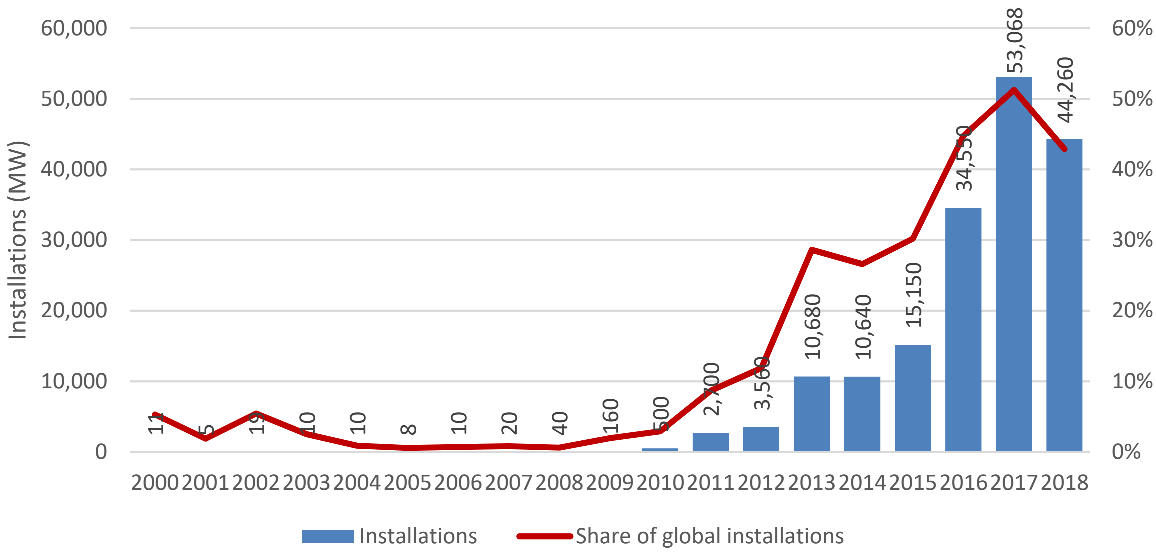
Source: ***.

Installations

PV installations in China increased from 0.5 GW in 2010 to 53.1 GW in 2017, then declined to 44.3 GW in 2018 (figure F-17). China's share of global installations also peaked at 51 percent in 2017, before declining to 43 percent in 2018.[40]

[40] IEA PVPS, *Trends in Photovoltaic Applications 2019*, Report IEA PVPS T1-36:2019, p. 97, http://www.iea-pvps.org/?id=256, retrieved December 19, 2019.

Figure F-17
CSPV products: Chinese PV installations and share of global installations, 2000–18



Source: IEA PVPS, *Trends in Photovoltaic Applications 2019*, Report IEA PVPS T1-36:2019, p. 97, http://www.iea-pvps.org/?id=256, retrieved December 19, 2019.

Policies

This section will discuss Chinese CSPV policies. It will be broadly broken up into two areas, supply and demand policies. Chinese demand policies that encourage the installation of CSPV products, however, are not entirely separate from industrial policies. For example, a number of the policies are designed, in part, to provide a market for domestic manufacturers and encourage upgrading of Chinese CSPV manufacturing to more advanced technology. This section will not cover all CSPV policies in China, but rather will focus broadly on the major policy areas.

CSPV supply policies

Electricity

Local governments in China provide incentives to CSPV manufacturers in the form of reduced electricity bills. ***

***.[41] ***.[42]

Land and equipment

Local governments in China provide low-cost land and infrastructure, as well as funding for equipment purchases. ***.[43] ***.[44] Local governments also provide grants to firms to purchase new manufacturing equipment.[45] Trina Solar received government grants for purchases of property, plant, and equipment of $38 million during 2008–15, including $25 million during 2008-10.[46]

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[41] ***.

[42] ***.

[43] ***; Bradsher, Keith, "On Clean Energy, China Skirts Rules," *The New York Times*, September 8, 2010, https://archive.nytimes.com/www.nytimes.com/2010/09/09/business/global/09trade.html, retrieved December 24, 2019; Ball, Jeffrey, Dan Reicher, Xiaojing Sun, and Caitlin Pollock, *The New Solar System*, Steyer-Taylor Center for Energy Policy and Finance, March 2017, pp. 120–121, https://www-cdn.law.stanford.edu/wp-content/uploads/2017/03/2017-03-20-Stanford-China-Report.pdf, retrieved December 29, 2019.

[44] ***.

[45] Ball, Jeffrey, Dan Reicher, Xiaojing Sun, and Caitlin Pollock, *The New Solar System*, Steyer-Taylor Center for Energy Policy and Finance, March 2017, p. 127, https://www-cdn.law.stanford.edu/wp-content/uploads/2017/03/2017-03-20-Stanford-China-Report.pdf, retrieved December 29, 2019.

[46] Information after 2015 is not available due to the privatization of the company. Trina, "Form 20-F," Annual filing to the Securities and Exchange Commission for the fiscal year ended December 31, 2009, March 17, 2010, p. F-8, https://www.sec.gov/Archives/edgar/data/1382158/000095012310025600/0000950123-10-025600-index.htm, retrieved December 28, 2019; Trina, "Form 20-F," Annual filing to the Securities and Exchange Commission for the fiscal year ended December 31, 2012, April 2, 2013, p. F-10, https://www.sec.gov/Archives/edgar/data/1382158/000110465913026502/a12-29784_120f.htm, retrieved December 28, 2019; Trina, "Form 20-F," Annual filing to the Securities and Exchange Commission for the fiscal year ended December 31, 2015, April 19, 2016, p. F-8, https://www.sec.gov/Archives/edgar/data/1382158/000110465916112305/a16-1508_120f.htm, retrieved December 28, 2019.

Loans

Chinese PV manufacturers received extensive loans from banks such as the China Development Bank, the Agricultural Bank of China, Bank of China, China Construction Bank, and the Industrial and Commercial Development Bank of China, with some of these loans unsecured, far in excess of company assets, and with favorable interest rates. Suntech, for example, received multiple loans that did not require collateral or guarantees.[47] ***.[48] According to a report during LDK's bankruptcy proceedings,[49] the company had $7.8 billion in debt, 80 percent of which was unsecured, with the largest debt owed to the China Development Bank (CDB) ($1.1 billion), China Construction Bank ($0.8 billion), and Agricultural Bank of China ($0.5 billion). The main three subsidiaries accounted for $6.3 billion of the debt, but had assets of only $1.9 billion.[50] According to one report, "government-affiliated banks in China have continued to provide debt to China based solar companies whose balance sheets

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[47] Suntech, "Form 20-F," Annual filing to the Securities and Exchange Commission for the fiscal year ended December 31, 2009, May 11, 2010, p. F-36, https://www.sec.gov/Archives/edgar/data/1342803/000095012310047699/0000950123-10-047699-index.htm, retrieved December 28, 2019; Suntech, "Form 20-F," Annual filing to the Securities and Exchange Commission for the fiscal year ended December 31, 2005, April 27, 2006, p. F-18, https://www.sec.gov/Archives/edgar/data/1342803/000114554906000550/0001145549-06-000550-index.htm, retrieved December 28, 2019.

[48] ***.

[49] This discussion covers the Chinese units that entered bankruptcy in November 2015, and not the U.S.-listed unit that separately entered bankruptcy.

[50] Dong Jing, Wu Hongyuran and Dong Tongjian, "LDK Solar Stares Into the Abyss," *Caixin*, October 12, 2017, https://www.caixinglobal.com/2017-10-12/ldk-solar-stares-into-the-abyss-101155521.html, retrieved December 24, 2019; Federal Reserve Webpage, https://www.federalreserve.gov/releases/H10/hist/dat00_ch.htm, retrieved December 30, 2019.

would make it exceedingly difficult for them to secure new loans from non-Chinese lenders" (see discussion of distressed companies, below).[51]

Firms often received low interest rates, either directly from the lending institution or with the help of local governments. Suntech, for example, received an interest free three-year loan from Jiangsu International Trust & Investment Corporation.[52] Similarly, Jinko received interest free loans from Jiangxi Guochuang Investment Co., Ltd., "a government background entity who provided the interest-free loan to the Company to support its daily operations," in 2016 and 2017.[53] ***.[54] ***.[55]

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[51] Ball, Jeffrey, Dan Reicher, Xiaojing Sun, and Caitlin Pollock, *The New Solar System*, Steyer-Taylor Center for Energy Policy and Finance, March 2017, p. 132, https://www-cdn.law.stanford.edu/wp-content/uploads/2017/03/2017-03-20-Stanford-China-Report.pdf, retrieved December 29, 2019.

[52] Suntech, "Form 20-F," Annual filing to the Securities and Exchange Commission for the fiscal year ended December 31, 2009, May 11, 2010, p. F-36, https://www.sec.gov/Archives/edgar/data/1342803/000095012310047699/0000950123-10-047699-index.htm, retrieved December 28, 2019; Suntech, "Form 20-F," Annual filing to the Securities and Exchange Commission for the fiscal year ended December 31, 2005, April 27, 2006, p. F-18, https://www.sec.gov/Archives/edgar/data/1342803/000114554906000550/0001145549-06-000550-index.htm, retrieved December 28, 2019.

[53] JinkoSolar, "Form 20-F," Annual Filing to the Securities and Exchange Commission for the fiscal year ended December 31, 2018, April 10, 2019, p. F-42, https://www.sec.gov/Archives/edgar/data/1481513/000114420419019055/tv516936_20f.htm, retrieved January 3, 2020.

[54] ***; Bradsher, Keith, "On Clean Energy, China Skirts Rules," The New York Times, September 8, 2010, https://archive.nytimes.com/www.nytimes.com/2010/09/09/business/global/09trade.html, retrieved December 24, 2019.

[55] ***.

The amount of funding provided by Chinese banks is extensive, and broad based. ***.[56] Over the period from 2010 to September 2011, Mercom Capital Group reported $40.7 billion in loan transactions between Chinese banks and Chinese CSPV manufacturers, though not all of those loans were drawn down.[57] Figure F-18 presents the total liabilities and debt of select Chinese companies and figure F-19 presents the current ratio and debt to asset ratio.

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[56] ***; Hanwha, "Hanwha Chemical Acquires 49.99% Stake in Solarfun Power," News release, August 3, 2010, https://www.hanwha.com/en/news_and_media/press_release/hanwha_chemical_acquires_49_99_stake_in_solarfun_power.html, retrieved December 24, 2019.

[57] Wesoff, Eric, "The Reality of China's Billions in Solar Loans," *Greentech Media*, September 28, 2011, https://www.greentechmedia.com/articles/read/the-reality-of-chinas-billions-in-solar-loans, retrieved December 30, 2019.

Figure F-18

CSPV products: Total liabilities and debt of select Chinese companies, 2010–18

* * * * * * *

Source: ***.

Figure F-19

CSPV products: Current ratio (current assets/current liabilities) (left) and debt to asset ratio (total liabilities/total assets) (right) for select Chinese companies, 2010–18

* * * * * * *

Source: ***.

Chinese Banks have also funded overseas manufacturing investments by Chinese firms, including downstream investments, sales, and manufacturing. In 2012, for example, Jinko signed a five year strategic cooperation agreement with CDB that would allow it to borrow up to $1 billion "to develop its overseas expansion, merger, acquisition, and downstream business, including project development and EPC for Photovoltaic ("PV") solar power plants."[58] Chinese companies received loans from Chinese banks, local banks, and the International Finance Corporation for their investments in Southeast Asian manufacturing, as indicated in table F-2.

[58] Jinko, "JinkoSolar Signs US$1 Billion Strategic Cooperation Agreement with China Development Bank," News release, December 7, 2012, http://ir.jinkosolar.com/index.php/news-releases/news-release-details/jinkosolar-signs-us1-billion-strategic-cooperation-agreement, retrieved December 24, 2019.

Table F-2
CSPV products: Examples of loans for manufacturing plant investments in Southeast Asia by Chinese firms

Manufacturer	Country	Amount	Lenders
JinkoSolar	Malaysia	$25 million for trade finance and working capital	Malayan Banking Berhad
JinkoSolar	Malaysia	$60 million for upgrade of CSPV cell lines to PERC	International Finance Corporation (IFC)
Canadian Solar	Thailand	$210 million for new CSPV manufacturing plant	Siam Commercial Bank; China Minsheng Banking Corporation
Trina Solar	Thailand	$100 million loan for capital expenditures and $43 million for working capital	Siam Commercial Bank; China Minsheng Banking Corporation; others not identified
Trina Solar	Vietnam	$30 million for production at CSPV cell plant	VietinBank

Note: Based on investments for which the lender could be identified based on publicly available information.

Source: Trina Solar, "Trina Solar Launches Operations at Thailand Manufacturing Facility and Signs a US$143 million Syndicated Financing Facilities Agreement," News release, March 28, 2016, https://www.trinasolar.com/us/news/trina-solar-launches-operations-thailand-manufacturing-facility-and-signs-us143-million, retrieved January 3, 2020; Hutchins, Mark, "Canadian Solar Secures US$210 million Loan for Thailand Facility," *PV Magazine*, January 16, 2017, https://www.pv-magazine.com/2017/01/16/canadian-solar-secures-us210-million-loan-for-thailand-facility/, retrieved January 3, 2020; JinkoSolar, "JinkoSolar Signs USD25 Million Tradeline with Maybank," News release, http://ir.jinkosolar.com/news-releases/news-release-details/jinkosolar-signs-usd25-million-tradeline-maybank, retrieved January 3, 2020; Ryan, Conor, "IFC to Invest US$60 million in Jinko Malaysia as Company Upgrades to PERC Cell Technology," *PV Tech*, April 29, 2017, https://www.pv-tech.org/news/ifc-to-invest-us60-million-in-jinko-malaysia, retrieved January 3, 2020; Trina Solar, "Trina Solar in Vietnam: Secures US$30M Agreement with VietinBank, Provides Modules to Country's Largest Private PV Project," News release, September 10, 2018, https://www.trinasolar.com/en-apac/resources/blog/sun-09092018-1943, retrieved January 3, 2020.

Research and Development

The central government ***.[59] Firms are also able to deduct research and development expenses, with the provisions that "if eligible research expenditures do not 'form part of the intangible assets value,' an additional 50 percent deduction from taxable income may be taken on top of the actual accrual amount. Where these expenditures form the value of certain intangible assets, the expenditures may be amortized based on 150 percent of the intangible assets costs."[60] The central government ***.[61]

Local governments implemented a variety of incentives to support research and development, as well. In many instances, governments provide grants directly to manufactures.[62] For example, in Yangzhou, where a number of companies have research and engineering activities,[63] ***.[64] ***

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[59] ***.

[60] 77 FR 17455.

[61] ***.

[62] Ball, Jeffrey, Dan Reicher, Xiaojing Sun, and Caitlin Pollock, *The New Solar System*, Steyer-Taylor Center for Energy Policy and Finance, March 2017, p. 128, https://www-cdn.law.stanford.edu/wp-content/uploads/2017/03/2017-03-20-Stanford-China-Report.pdf, retrieved December 29, 2019.

[63] Yangzhou Xinjing Solar Technology Co., Ltd. Webpage, https://en.yzxjgf.com/intro/1.html, retrieved December 29, 2019; Zipp, Kathie, "Solar Efficiency Innovation Center," May 3, 2012, *Solar Power World*, https://www.solarpowerworldonline.com/2012/05/solar-efficiency-innovation-center/, retrieved December 29, 2019; K.D New Energy Technology CO., LTD Webpage, http://www.kdenergy.cn/company.asp, retrieved December 29, 2019.

[64] ***; RMB converted to U.S. dollars based on the year of the publication from exchange rates on Federal Reserve Webpage, https://www.federalreserve.gov/releases/H10/hist/dat00_ch.htm, retrieved December 30, 2019.

***.[65]

Taxes

Chinese CSPV manufacturers received a variety of tax exemptions and reductions. Prior to 2008, Chinese CSPV manufacturers that qualified as productive foreign invested enterprises expected to remain in business during their first ten years were exempt from income taxes for their first two profitable years, and could pay income taxes at half the standard rate in the subsequent three years of profitability. This law was discontinued in 2008, but firms that qualified for it prior to that time period could continue to receive the benefit.[66] CSPV firms, as of 2008, may also qualify as high or new technology enterprises and therefore qualify to have the tax rate reduced from 25 percent to 15 percent.[67] Further, CSPV companies have qualified for duty exemptions on imported manufacturing equipment, and VAT exemptions on domestic and imported manufacturing equipment.[68] ***.[69]

[65] ***; Ball, Jeffrey, Dan Reicher, Xiaojing Sun, and Caitlin Pollock, *The New Solar System*, Steyer-Taylor Center for Energy Policy and Finance, March 2017, p. 133, https://www-cdn.law.stanford.edu/wp-content/uploads/2017/03/2017-03-20-Stanford-China-Report.pdf, retrieved December 29, 2019.

[66] 77 FR 17451–17452.

[67] 77 FR 17452.

[68] 77 FR 17452–17453.

[69] ***; Ball, Jeffrey, Dan Reicher, Xiaojing Sun, and Caitlin Pollock, *The New Solar System*, Steyer-Taylor Center for Energy Policy and Finance, March 2017, pp. 127, 130–131, https://www-cdn.law.stanford.edu/wp-content/uploads/2017/03/2017-03-20-Stanford-China-Report.pdf, retrieved December 29, 2019.

Chinese firms that invested overseas received a range of tax benefits from the governments in those countries. In Southeast Asia, for example, firms received tax exemptions and reductions for an initial period of years in Thailand, Malaysia, and Vietnam. In addition, firms receive other tax benefits such as duty exemptions for machinery imports and additional deductions.[70]

Distressed companies

Local governments and Chinese banks have also directly intervened to assist financially distressed companies, often delaying bankruptcy and influencing the structure of the firms that reemerge. In 2012 and 2013, for example, LDK Solar received assistance from local governments and several different banks. This included a $159 million syndicated loan organized by the Bank of Jiangxi in 2012, a $325 million loan from CDB and other banks in 2013, a $317 million fund established by the government to help the firm repay debt, the acquisition of a 20 percent stake in the company by a company in which a local government held a 40 percent stake, and pressure on the banks from the local government related to the handling of interest payments. Most of the administrators appointed during the bankruptcy process were local government officials or individuals with ties to the local government.[71] The company completed its reorganization in January 2018, and continues to be a CSPV producer.[72]

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[70] This section does not comprehensively review policies in the countries in which firms have invested. Jinko Solar, 2018 Annual Report, May 8, 2019, p. F-30, http://ir.jinkosolar.com/static-files/cff7be11-1bfc-43fc-910a-1ea6d35c1310, retrieved December 29, 2019; Canadian Solar, "Form 20-F," Annual filing to the Securities and Exchange Commission for the fiscal year ended December 31, 2018, p. F-51, https://www.sec.gov/Archives/edgar/data/1375877/000104746919002579/a2238593z20-f.htm, retrieved December 30, 2019; MacDonald, Scott, *Solar Photovoltaic Energy in Thailand: An Assessment of Government Support Mechanisms*, LSE Asia Research Centre, September 27, 2012, p. 10, http://www.lse.ac.uk/asiaResearchCentre/_files/ThaiGovScholarScottMacDonald.pdf, retrieved December 31, 2019.

[71] Dong Jing, Wu Hongyuran and Dong Tongjian, "LDK Solar Stares Into the Abyss," *Caixin*, October 12, 2017, https://www.caixinglobal.com/2017-10-12/ldk-solar-stares-into-the-abyss-101155521.html, retrieved December 24, 2019; RMB converted to U.S. dollars based on the average exchange rate in the year in which the loan was issued from the Federal Reserve Webpage, https://www.federalreserve.gov/releases/H10/hist/dat00_ch.htm, retrieved December 30, 2019.

[72] Saiwei Solar Technology Group Webpage, http://www.saiweisolar.com/en/about/ldk/, retrieved December 24, 2019.

Shanghai Chaori defaulted on $14.7 million in interest payments on bonds in March 2014.[73] In October 2014, as part of its restructuring, it was announced that Golden Concord (an upstream producer) and other investors would acquire a 66 percent stake in the company. Shanghai Chaori ***. At the same time, China Great Wall Asset Management Co. and another investor guaranteed money owned to bondholders.[74]

In the case of Yingli, another entity with difficulty in meeting its financial obligations, Chinese banks and the local government have actively sought to assist the company. According to one report, for example, the ***.[75] According to the report, ***.[76]

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[73] Wei, Lingling, "Shanghai Chaori in Default on Bond Interest Payments," *The Wall Street Journal*, March 6, 2014, https://www.wsj.com/articles/shanghai-chaori-in-default-on-bond-interest-payments-1394166463, retrieved December 29, 2019.

[74] There are differences in publicly available reports about the amount guaranteed by these entities. Wang, Wynne, "Shanghai Chaori Unveils Closely Watched Restructuring Plan," *The Wall Street Journal*, October 8, 2014, https://www.wsj.com/articles/shanghai-chaori-unveils-closely-watched-restructuring-plan-1412750771?mod=article_inline, retrieved December 29, 2019; *Photon*, "GCL-Poly to Acquire 30% of Chaori Solar, Considers Sale of Wafer Manufacturing Business," October 11, 2014, https://www.photon.info/en/news/gcl-poly-acquire-30-chaori-solar-considers-sale-wafer-manufacturing-business, retrieved December 29, 2019; ***.

[75] ***.

[76] ***. Converted to U.S. dollars based on Federal Reserve Webpage, https://www.federalreserve.gov/releases/H10/hist/dat00_ch.htm, retrieved December 30, 2019.

Other grants

CSPV manufacturers in China receive a range of other grants and funding from government sources. For example, Trina reported receiving "unrestricted cash government subsidies" during 2009-15 of $25 million.[77] Longi listed more than 130 projects under the category of "government subsidy" for which the company had a balance at the start of the year or received money in 2018.[78]

Supply chain

CSPV cell and module producers benefited not only from the policies through which they directly received support, but also through policies directed at the supply chain. For example, the European Commission identified subsidy rates of 3.2 percent to 16.7 percent for participating producers of solar glass in its countervailing duty investigation.[79] Chinese producers of aluminum extrusions (which include module frames) benefit from a range of government policies to support the aluminum industry.[80] The Chinese government has

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[77] Trina, "Form 20-F," Annual filing to the Securities and Exchange Commission for the fiscal year ended December 31, 2011, p. F-19. https://www.sec.gov/Archives/edgar/data/1382158/000110465912022420/a12-6567_120f.htm, retrieved December 28, 2019; Trina, "Form 20-F," Annual filing to the Securities and Exchange Commission for the fiscal year ended December 31, 2012, April 2, 2013, p. F-21, https://www.sec.gov/Archives/edgar/data/1382158/000110465913026502/a12-29784_120f.htm, retrieved December 28, 2019; Trina, "Form 20-F," Annual filing to the Securities and Exchange Commission for the fiscal year ended December 31, 2015, April 19, 2016, p. F-18, https://www.sec.gov/Archives/edgar/data/1382158/000110465916112305/a16-1508_120f.htm, retrieved December 28, 2019.

[78] LONGi Green Energy Technology Co., Ltd., *Annual Report 2018*, April 30, 2019, pp. 249–262, https://en.longigroup.com/uploadfile/network/2019/07/20190702100700106.pdf, retrieved December 24, 2019.

[79] European Commission, Commission Implementing Regulation (EU) No 471/2014 of 13 May 2014 imposing definitive countervailing duties on imports of solar glass originating in the People's Republic of China, *Official Journal of the European Union*, May 14, 2014, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32014R0471, retrieved December 30, 2019.

[80] USITC, *Aluminum: Competitive Conditions Affecting the U.S. Industry*, Publication No. 4703, Investigation No. 332-557, June 2017, pp. 253–267, https://www.usitc.gov/publications/332/pub4703.pdf, retrieved December 30, 2019.

supported energy intensive polysilicon production[81] through reduced electricity rates, and other policies. For example, LDK "received regularly significant electricity fee subsidies from the Financial Bureau of Xin Yu Economic Zone" for its polysilicon production operations.[82] Daqo received reduced electricity rates from the government in Xinjiang as part of the approval for the expansion of its polysilicon manufacturing plant.[83] In 2018, Daqo also received "unrestricted cash government subsidies" totaling $13.1 million.[84]

CSPV demand policies

Early off-grid policies

Initial solar policies in China focused on increasing deployment in rural, off-grid areas. ***.[85] In addition, ***

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[81] For a discussion of antidumping and countervailing duties on imports of polysilicon from the EU, Korea, and the United States, see the supply chain section above.

[82] European Union, Council Implementing Regulation No 1239/2013 of 2 December 2013, *Official Journal of the European Union*, December 5, 2013, L 325/120, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013R1239&from=EN, received December 24, 2019.

[83] Bellini, Emiliano, "Daqo Gets Government Approval and Cheaper Power for Poly Production Expansion," *PV Magazine*, May 25, 2018, https://www.pv-magazine.com/2018/05/25/daqo-gets-government-approval-and-cheaper-power-for-poly-production-expansion/, retrieved December 30, 2019.

[84] Daqo, "Form 20-F," Annual report to the Securities and Exchange Commission for the fiscal year ended December 31, 2018, April 17, 2019, p. F-14, https://www.sec.gov/Archives/edgar/data/1477641/000114420419020070/tv517398_20f.htm, retrieved December 30, 2019.

[85] ***.

***.[86]

Renewable Energy Law

The Renewable Energy Law, ***.[87] ***.[88]

PV Building Project and Golden Sun

China subsequently moved toward wider-scale deployment, with three programs started in 2009 that resulted in awards for more than 6 GW of cumulative capacity during 2009–12 (figure F-20):[89]

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[86] ***.

[87] ***.

[88] ***.

[89] IEA PVPS, *Annual Report 2013*, May 6, 2015, p. 49, http://www.iea-pvps.org/index.php?id=6&eID=dam_frontend_push&docID=2040, retrieved December 29, 2019.

- The PV Building Project (also called the Rooftop Subsidy Program) ***.[90] The program was intended to increase and gain experience with solar deployment, and to support domestic manufacturing by decreasing reliance on foreign markets and creating a stable domestic market.[91]
- The Golden Sun Demonstration Program, ***.[92] The Ministry of Finance indicated that the program was designed to gain experience with large-scale PV power generation as well reduce the reliance of Chinese manufacturers on international markets and encourage industrial upgrading/technological progress.[93]
- The central government ***.[94]

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[90] China Ministry of Finance Webpage, http://www.mof.gov.cn/zhengwuxinxi/caizhengxinwen/200904/t20090421_134899.htm, retrieved December 29, 2019; ***; Wang, Ucilia, "Confusion, Political Spat Emerge for China Solar Subsidies," *Greentech Media*, April 2, 2009, https://www.greentechmedia.com/articles/read/confusion-political-spat-emerge-for-china-solar-subsidies-5992, retrieved December 29, 2019.

[91] China Ministry of Finance Webpage, http://www.mof.gov.cn/gkml/caizhengwengao/2009niancaizhengbuwengao/caizhengwengao200904/200906/t20090630_173343.htm, retrieved December 29, 2019.

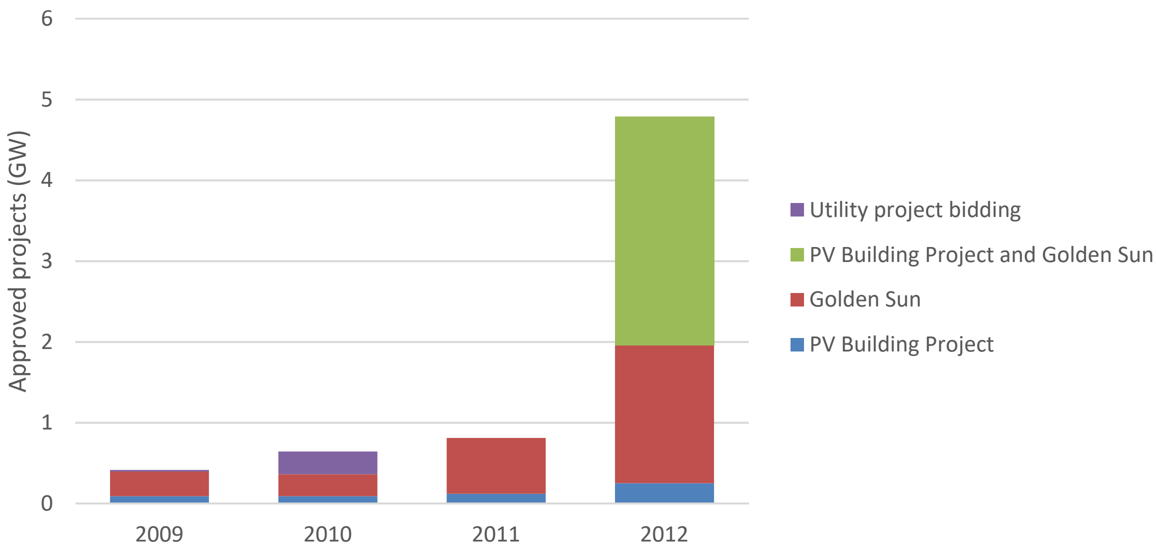
[92] Wang, Ucilia, "Chinese Gov't Will Pay to Install 500MW Solar," *Greentech Media*, July 21, 2009, https://www.greentechmedia.com/articles/read/china-govt-will-pay-to-install-500mw-solar, retrieved December 29, 2019; ***.

[93] China Ministry of Finance Webpage, http://www.mof.gov.cn/zhengwuxinxi/caizhengxinwen/200911/t20091113_232469.htm, retrieved December 29, 2019.

[94] ***; IEA PVPS, *Annual Report 2013*, May 6, 2015, p. 49, http://www.iea-pvps.org/index.php?id=6&eID=dam_frontend_push&docID=2040, retrieved December 29, 2019.

Figure F-20

CSPV products: PV projects in China approved by the central government, 2009–12, excluding the FIT implemented in 2011



Note: Contemporaneous reports indicate a higher total for approved capacity in the first phase of the Golden Sun Program.
Source: IEA PVPS, *Annual Report 2013*, May 6, 2015, p. 49, http://www.iea-pvps.org/index.php?id=6&eID=dam_frontend_push&docID=2040, retrieved December 29, 2019; Wang, Ucilia, "Here Comes China's $3B, 'Golden Sun' Projects," *Greentech Media*, November 16, 2019, https://www.greentechmedia.com/articles/read/here-comes-chinas-3b-golden-sun-projects, retrieved December 29, 2019.

Feed-in-tariff

China's feed-in tariff ("FIT") is one of the main policies that the government used to encourage domestic solar PV installations.[95] China released a nationwide FIT in July 2011.[96] China's FIT established a rate for PV-generated electricity, with this rate varying by region and type of installation (distributed and ground mounted).[97] The initial policy set a FIT rate for projects completed in 2011, and a lower rate for projects completed after 2011.[98] Rates were revised downward in 2013, 2016, 2017, and 2018. In May 2018, the Chinese government ordered a stop to further approval of utility-scale projects under the FIT, and capped 2018 distributed installations under the FIT at 10 GW (though any distributed project completed by the end of May would be eligible).[99]

China released new policies in 2019 that were designed to start transitioning from subsidized PV installations to non-subsidized installations. The first policy is for grid parity projects. Projects that can provide electricity at a cost that is at or below the coal benchmark price will not receive direct compensation for electricity generation (though they may receive other support related to land prices or financing). They will receive 20 year power purchase agreements and there is no limit on the number of such projects that can be completed. Projects that are not competitive with the coal benchmark price can be forwarded by the local governments to be included in a national reverse auction (and will be eligible for a feed-in tariff). The results of the first such auction were released in July 2019, with 22.8 GW of projects receiving approval. These projects must be completed by the end of 2019, or face a small penalty. Projects not completed by the end of June 2020 will be cancelled.[100]

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[95] CSPV 1 first review publication, p. IV-10.

[96] Xu Honghua, Charlie Dou, Wang Sicheng, and Lv Fang, "National Survey Report of PV Power Applications in China, 2011," August 15, 2012, p. 28, http://www.iea-pvps.org/?id=93, retrieved December 24, 2019.

[97] The initial FIT only had one rate nationwide. Xu Honghua, Charlie Dou, Wang Sicheng, and Lv Fang, "National Survey Report of PV Power Applications in China, 2011," August 15, 2012, p. 28, http://www.iea-pvps.org/?id=93, retrieved December 24, 2019.

[98] Xu Honghua, Charlie Dou, Wang Sicheng, and Lv Fang, "National Survey Report of PV Power Applications in China, 2011," IEA PVPS, August 15, 2012, p. 28, http://www.iea-pvps.org/?id=93, retrieved December 24, 2019.

[99] CSPV 1 first review publication, p. IV-10.

[100] Parnell, John, "China to Support Nearly 23GW of Solar with New Feed-in Tariff," *PV Tech*, July 12, 2019, https://www.pv-tech.org/news/china-to-support-nearly-23gw-of-solar-with-new-feed-in-tariff,

(*continued*...)

Changes in China's FIT rate have a significant impact on the timing of installations in China. Projects approved under a prior year's FIT rate could typically still receive that rate if completed by the end of June. Combined with the halt in new utility projects in 2018, this led to higher installations in the first half of the year in 2016 and 2018 (figure F-21). In 2017, a large number of projects were not completed by the end of June and spilled over into July. While August-December installations were down from the pace of installations in the first half of the year, there were a number of other policy drivers that led to record installations in those months, such as a push to complete projects ahead of an expected end to some provincial policies and anticipated reduction in the distributed FIT, as well as the completion of poverty alleviation and top runner projects (see discussion below).[101]

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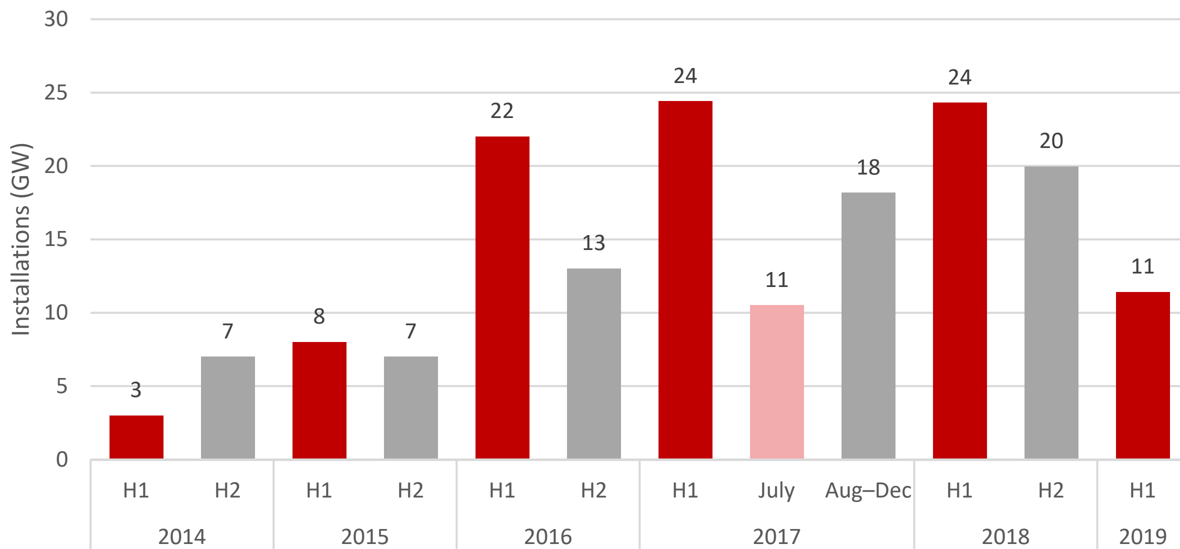
retrieved December 30, 2019; Apricum, "Towards a Subsidy-free Era for China's Solar PV Market," November 19, 2019, https://www.apricum-group.com/towards-a-subsidy-free-era-for-chinas-solar-pv-market/, retrieved December 30, 2019; *T&D World*, "China Plans Subsidy-Free Solar, Wind Power Pilot Projects," January 23, 2019, https://www.tdworld.com/renewables/article/20972155/china-plans-subsidyfree-solar-wind-power-pilot-projects, retrieved December 30, 2019; *Reuters*, "China Launches Subsidy-free Solar, Wind Power after Project Costs Fall" January 9, 2019, https://de.reuters.com/article/us-china-energy-renewables/china-launches-subsidy-free-solar-wind-power-after-project-costs-fall-idUSKCN1P30ZQ, retrieved December 30, 2019; Bellini, Emiliano and Max Hall, "China Auction Allocates Subsidies for 22.7 GW of Solar with Lowest bid of $0.0407/kWh," *PV Magazine*, July 12, 2019, https://www.pv-magazine.com/2019/07/12/china-auction-allocates-subsidies-for-22-7-gw-of-solar-with-lowest-bid-of-0-0407-kwh/, retrieved December 30, 2019.

[101] Safeguard publication, pp. IV-21–IV-22; CSPV 1 first review publication, pp, IV-9–IV-11; Apricum, "The Hungry Dragon: Explaining China's 50 GW+ PV Market in 2017," December 18, 2017, https://www.apricum-group.com/the-hungry-dragon-explaining-chinas-50-gw-pv-market-in-2017/, retrieved December 27, 2019.

Figure F-21
CSPV products: PV installations in China, 2014–H1 2019



Notes: H1: 1st half of the year; H2: 2nd half of the year.

Source: Safeguard publication, p. IV-22; Clover, Ian, "China Installed 24.4 GW of Solar in First Half of 2017, Shows Official NEA Data," *PV Magazine*, August 7, 2017, https://www.pv-magazine.com/2017/08/07/china-installed-24-4-gw-of-solar-in-first-half-of-2017-shows-official-nea-data/, retrieved December 27, 2019; Bellini, Emiliano, "China Added 11.4 GW of Solar Capacity in First Half of this Year," *PV Magazine*, August 23, 2019, https://www.pv-magazine.com/2019/08/23/china-added-11-4-gw-of-solar-capacity-in-first-half-of-this-year/, retrieved December 27, 2019; Hill, Joshua S., "China Continues Massive Solar Installations With 10.52 GW In July, Already Exceeds 2020 Target," *CleanTechnica*, "August 22, 2017, https://cleantechnica.com/2017/08/22/china-continues-massive-solar-installations-10-52-gw-july-already-exceeds-2020-target/, retrieved December 27, 2019; Osborne, Mark, "China Installed 24.3GW of Solar Power in the First Half of 2018," PV Tech, August 2, 2018, https://www.pv-tech.org/news/china-installed-24.3gw-of-solar-power-in-the-first-half-of-2018, retrieved January 12, 2020; Fang, Lv, Xu Honghua, Wang Sicheng, Li Hailing, Ma Liyun, and Li Ping "National Survey Report of PV Power Applications in China 2018," IEA PVPS, 2019, p. 45, http://www.iea-pvps.org/?id=93, retrieved December 19, 2019.

Top Runner Program

The Top Runner Program, which was introduced in 2015, is a reverse auction designed to support the installation, and therefore the development and production, of more advanced solar technologies. Modules installed as part of the program must meet certain minimum energy efficiency levels.[102] The first phase in 2015 totaled 1 GW, the second phase in 2016 was for 5.5 GW, and the third phase in 2017 was for 6.5 GW, with 1.5 GW of that going to the Super Top Runner program (which required even higher efficiency modules).[103] The top runner program has helped drive the adoption of more advanced technologies among Chinese manufacturers, including PERC and bifacial, and contributed to the shift toward monocrystalline production.[104] In the third phase (applications in 2017), 52 percent of the winning bids planned to use bifacial modules, 33 percent mono PERC (including some with Metal Wrap Through (MWT)) and 14 percent multi PERC (including some with MWT) (figure F-22).[105]

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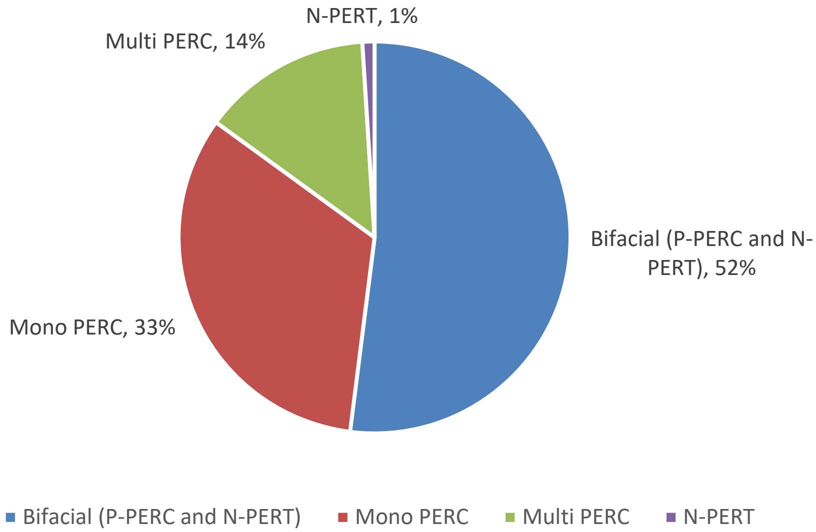
[102] CSPV 1 first review publication, p. IV-10.

[103] Lv Fang, Xu Honghua, and Wang Sicheng, "National Survey Report of PV Power Applications in China, 2017," IEA PVPS, 2018, p. 25, http://www.iea-pvps.org/?id=93, retrieved December 24, 2019; Lv Fang, Xu Honghua, and Wang Sicheng, "National Survey Report of PV Power Applications in China, 2016," IEA PVPS, 2018, p. 25, http://www.iea-pvps.org/?id=93, retrieved December 24, 2019; Haugwitz, Frank, "China Expected to Install a Whopping 50 GW of Solar in 2017 – AECEA," Mercom India, October 18, 2017, https://mercomindia.com/china-expected-install-whopping-50-gw-solar-2017-aecea/, retrieved December 30, 2019.

[104] Fang, Lv, Xu Honghua, Wang Sicheng, Li Hailing, Ma Liyun, and Li Ping "National Survey Report of PV Power Applications in China 2018," IEA PVPS, 2019, p. 26, http://www.iea-pvps.org/?id=93, retrieved December 19, 2019; Lin, Corrine, "Outlook for n-type," *PV Magazine*, January 30, 2019, https://www.pv-magazine.com/2019/01/30/outlook-for-n-type/, retrieved December 30, 2019; Gifford, Jonathan, "Long Read: Double Glass Can Spell Double Trouble," *PV Magazine*, January 19, 2019, https://www.pv-magazine-australia.com/2019/01/19/long-read-double-glass-can-spell-double-trouble/, retrieved December 30, 2019.

[105] MWT is an approach in "which holes are drilled in cells and metal contacts are wrapped through, allowing electricity to be evacuated off the back of the cell." Lions Shih, "Bid Winners of China's Top Runner Program (3rd phase) Have Been Announced, Mono-Si Products Account for More than 60%, Says TrendForce," TrendForce, May 24, 2018, https://press.trendforce.com/press/20180524-3107.html, retrieved December 26, 2019; Roselund, Christian, "Silfab Says It Will Bring Metal Wrap Through Solar to the United States," *PV Magazine*, March 8, 2019, https://pv-magazine-usa.com/2019/03/08/silfab-say-it-will-bring-metal-wrap-through-solar-to-the-united-states/, retrieved December 30, 2019.

Figure F-22
CSPV products: Winning bids in China's third phase of the Top Runner Program, by technology



Source: Lions Shih, "Bid Winners of China's Top Runner Program (3rd phase) Have Been Announced, Mono-Si Products Account for More than 60%, Says TrendForce," TrendForce, May 24, 2018, https://press.trendforce.com/press/20180524-3107.html, retrieved December 26, 2019.

Other policies

China has implemented a number of other policies to encourage PV installations.[106] For example, the Solar Poverty Alleviation program provides financial support for low-income households to purchase solar modules and guarantees a set rate for excess electricity sent to the electric grid.[107] In 2013, the government provided a 50 percent reduction in the VAT for PV electricity sales.[108]

[106] This section will provide examples of other policies, but will not provide a comprehensive discussion of all PV policies in China.

[107] CSPV 1 first review publication, p. IV-10.

[108] Lv Fang, Xu Honghua, and Wang Sicheng, "National Survey Report of PV Power Applications in China, 2013," September 30, 2014, p. 21, http://www.iea-pvps.org/?id=93, retrieved December 24, 2019.

Local governments also often have their own policies to incentivize the installation of PV systems. ***.[109]

[109] ***; Lv Fang, Xu Honghua, and Wang Sicheng, "National Survey Report of PV Power Applications in China, 2013," IEA PVPS, September 30, 2014, p. 23, http://www.iea-pvps.org/?id=93, retrieved December 24, 2019; ***.

APPENDIX G

DETAILED FIRM BUSINESS MODELS

Table G-1
CSPV products: Auxin's business model, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year 2016	Calendar year 2017	Calendar year 2018	January to June 2018	January to June 2019
	Quantity (kilowatts)				
Production of cells	***	***	***	***	***
	Quantity (kilowatts)				
Production of modules.-- Using internally produced cells	***	***	***	***	***
Using purchases of domestic cells	***	***	***	***	***
Using purchases of imported cells	***	***	***	***	***
Total module assembly in the US	***	***	***	***	***
	Share of quantity (percent)				
Production of modules.-- Using internally produced cells	***	***	***	***	***
Using purchases of domestic cells	***	***	***	***	***
Using purchases of imported cells	***	***	***	***	***
Total module assembly in the US	***	***	***	***	***
	Quantity (kilowatts); Value (1,000 dollars); Unit value (dollars per kilowatt)				
U.S. imports of cells-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
U.S. imports of modules.-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
U.S. imports of cells and modules.-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
	Narratives				
Import sources: Cells	***				
Import sources: Modules	***				
Import sources: Cells and modules	***				
Reason for importing	***				
	Ratio to production (percent)				
Ratio of imports to U.S. cell production	***	***	***	***	***
Ratio of imports to U.S. module production	***	***	***	***	***

Table continued on next page.

Table G-1--Continued
CSPV products: Hanwha's business model, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Quantity (kilowatts)				
Production of cells	***	***	***	***	***
	Quantity (kilowatts)				
Production of modules.-- Using internally produced cells	***	***	***	***	***
Using purchases of domestic cells	***	***	***	***	***
Using purchases of imported cells	***	***	***	***	***
Total module assembly in the US	***	***	***	***	***
	Share of quantity (percent)				
Production of modules.-- Using internally produced cells	***	***	***	***	***
Using purchases of domestic cells	***	***	***	***	***
Using purchases of imported cells	***	***	***	***	***
Total module assembly in the US	***	***	***	***	***
	Quantity (kilowatts); Value (1,000 dollars); Unit value (dollars per kilowatt)				
U.S. imports of cells-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
U.S. imports of modules.-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
U.S. imports of cells and modules.-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
	Narratives				
Import sources: Cells	***				
Import sources: Modules	***				
Import sources: Cells and modules	***				
	***				
	***				
Reason for importing	***				
	Ratio to production (percent)				
Ratio of imports to U.S. cell production	***	***	***	***	***
Ratio of imports to U.S. module production	***	***	***	***	***

Table continued on next page.

Table G-1--Continued
CSPV products: Heliene's business model, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year 2016	Calendar year 2017	Calendar year 2018	January to June 2018	January to June 2019
	Quantity (kilowatts)				
Production of cells	***	***	***	***	***
	Quantity (kilowatts)				
Production of modules.-- Using internally produced cells	***	***	***	***	***
Using purchases of domestic cells	***	***	***	***	***
Using purchases of imported cells	***	***	***	***	***
Total module assembly in the US	***	***	***	***	***
	Share of quantity (percent)				
Production of modules.-- Using internally produced cells	***	***	***	***	***
Using purchases of domestic cells	***	***	***	***	***
Using purchases of imported cells	***	***	***	***	***
Total module assembly in the US	***	***	***	***	***
	Quantity (kilowatts); Value (1,000 dollars); Unit value (dollars per kilowatt)				
U.S. imports of cells-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
U.S. imports of modules.-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
U.S. imports of cells and modules.-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
	Narratives				
Import sources: Cells	***				
Import sources: Modules	***				
Import sources: Cells and modules	***				
Reason for importing	***				
	Ratio to production (percent)				
Ratio of imports to U.S. cell production	***	***	***	***	***
Ratio of imports to U.S. module production	***	***	***	***	***

Table continued on next page.

Table G-1--Continued
CSPV products: Jinko's business model, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year 2016	Calendar year 2017	Calendar year 2018	January to June 2018	January to June 2019
	Quantity (kilowatts)				
Production of cells	***	***	***	***	***
	Quantity (kilowatts)				
Production of modules.-- Using internally produced cells	***	***	***	***	***
Using purchases of domestic cells	***	***	***	***	***
Using purchases of imported cells	***	***	***	***	***
Total module assembly in the US	***	***	***	***	***
	Share of quantity (percent)				
Production of modules.-- Using internally produced cells	***	***	***	***	***
Using purchases of domestic cells	***	***	***	***	***
Using purchases of imported cells	***	***	***	***	***
Total module assembly in the US	***	***	***	***	***
	Quantity (kilowatts); Value (1,000 dollars); Unit value (dollars per kilowatt)				
U.S. imports of cells-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
U.S. imports of modules.-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
U.S. imports of cells and modules.-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***

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Table G-1--Continued
CSPV products: Jinko's business model, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Narratives				
Import sources: Cells	***				
Import sources: Modules	***				
Import sources: Cells and modules	***				
Reason for importing	***				
	***				
	Ratio to production (percent)				
Ratio of imports to U.S. cell production	***	***	***	***	***
Ratio of imports to U.S. module production	***	***	***	***	***

Table continued on next page.

Table G-1--Continued
CSPV products: LG's business model, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Quantity (kilowatts)				
Production of cells	***	***	***	***	***
	Quantity (kilowatts)				
Production of modules.-- Using internally produced cells	***	***	***	***	***
Using purchases of domestic cells	***	***	***	***	***
Using purchases of imported cells	***	***	***	***	***
Total module assembly in the US	***	***	***	***	***
	Share of quantity (percent)				
Production of modules.-- Using internally produced cells	***	***	***	***	***
Using purchases of domestic cells	***	***	***	***	***
Using purchases of imported cells	***	***	***	***	***
Total module assembly in the US	***	***	***	***	***
	Quantity (kilowatts); Value (1,000 dollars); Unit value (dollars per kilowatt)				
U.S. imports of cells-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
U.S. imports of modules.-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
U.S. imports of cells and modules.-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
	Narratives				
Import sources: Cells	***				
Import sources: Modules	***				
Import sources: Cells and modules	***				
Reason for importing	***				
	Ratio to production (percent)				
Ratio of imports to U.S. cell production	***	***	***	***	***
Ratio of imports to U.S. module production	***	***	***	***	***

Table continued on next page.

Table G-1--Continued
CSPV products: Merlin's business model, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Quantity (kilowatts)				
Production of cells	***	***	***	***	***
	Quantity (kilowatts)				
Production of modules.-- Using internally produced cells	***	***	***	***	***
Using purchases of domestic cells	***	***	***	***	***
Using purchases of imported cells	***	***	***	***	***
Total module assembly in the US	***	***	***	***	***
	Share of quantity (percent)				
Production of modules.-- Using internally produced cells	***	***	***	***	***
Using purchases of domestic cells	***	***	***	***	***
Using purchases of imported cells	***	***	***	***	***
Total module assembly in the US	***	***	***	***	***
	Quantity (kilowatts); Value (1,000 dollars); Unit value (dollars per kilowatt)				
U.S. imports of cells-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
U.S. imports of modules.-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
U.S. imports of cells and modules.-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
	Narratives				
Import sources: Cells	***				
Import sources: Modules	***				
Import sources: Cells and modules	***				
Reason for importing	***				
	Ratio to production (percent)				
Ratio of imports to U.S. cell production	***	***	***	***	***
Ratio of imports to U.S. module production	***	***	***	***	***

Table continued on next page.

Table G-1--Continued
CSPV products: Mission's business model, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year 2016	Calendar year 2017	Calendar year 2018	January to June 2018	January to June 2019
	Quantity (kilowatts)				
Production of cells	***	***	***	***	***
	Quantity (kilowatts)				
Production of modules.-- Using internally produced cells	***	***	***	***	***
Using purchases of domestic cells	***	***	***	***	***
Using purchases of imported cells	***	***	***	***	***
Total module assembly in the US	***	***	***	***	***
	Share of quantity (percent)				
Production of modules.-- Using internally produced cells	***	***	***	***	***
Using purchases of domestic cells	***	***	***	***	***
Using purchases of imported cells	***	***	***	***	***
Total module assembly in the US	***	***	***	***	***
	Quantity (kilowatts); Value (1,000 dollars); Unit value (dollars per kilowatt)				
U.S. imports of cells-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
U.S. imports of modules.-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
U.S. imports of cells and modules.-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
	Narratives				
Import sources: Cells	***				
Import sources: Modules	***				
Import sources: Cells and modules	***				
Reason for importing	***				
	Ratio to production (percent)				
Ratio of imports to U.S. cell production	***	***	***	***	***
Ratio of imports to U.S. module production	***	***	***	***	***

Table continued on next page.

Table G-1--Continued
CSPV products: Panasonic's business model, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year 2016	Calendar year 2017	Calendar year 2018	January to June 2018	January to June 2019
	Quantity (kilowatts)				
Production of cells	***	***	***	***	***
	Quantity (kilowatts)				
Production of modules.-- Using internally produced cells	***	***	***	***	***
Using purchases of domestic cells	***	***	***	***	***
Using purchases of imported cells	***	***	***	***	***
Total module assembly in the US	***	***	***	***	***
	Share of quantity (percent)				
Production of modules.-- Using internally produced cells	***	***	***	***	***
Using purchases of domestic cells	***	***	***	***	***
Using purchases of imported cells	***	***	***	***	***
Total module assembly in the US	***	***	***	***	***
	Quantity (kilowatts); Value (1,000 dollars); Unit value (dollars per kilowatt)				
U.S. imports of cells-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
U.S. imports of modules.-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
U.S. imports of cells and modules.-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
	Narratives				
Import sources: Cells	***				
Import sources: Modules	***				
Import sources: Cells and modules	***				
Reason for importing	*** ***				
	Ratio to production (percent)				
Ratio of imports to U.S. cell production	***	***	***	***	***
Ratio of imports to U.S. module production	***	***	***	***	***

Table continued on next page.

Table G-1--Continued
CSPV products: PowerFilm's business model, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Quantity (kilowatts)				
Production of cells	***	***	***	***	***
	Quantity (kilowatts)				
Production of modules.-- Using internally produced cells	***	***	***	***	***
Using purchases of domestic cells	***	***	***	***	***
Using purchases of imported cells	***	***	***	***	***
Total module assembly in the US	***	***	***	***	***
	Share of quantity (percent)				
Production of modules.-- Using internally produced cells	***	***	***	***	***
Using purchases of domestic cells	***	***	***	***	***
Using purchases of imported cells	***	***	***	***	***
Total module assembly in the US	***	***	***	***	***
	Quantity (kilowatts); Value (1,000 dollars); Unit value (dollars per kilowatt)				
U.S. imports of cells-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
U.S. imports of modules.-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
U.S. imports of cells and modules.-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
	Narratives				
Import sources: Cells	***				
Import sources: Modules	***				
Import sources: Cells and modules	***				
Reason for importing	***				
	Ratio to production (percent)				
Ratio of imports to U.S. cell production	***	***	***	***	***
Ratio of imports to U.S. module production	***	***	***	***	***

Table continued on next page.

Table G-1--Continued
CSPV products: SBM's business model, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Quantity (kilowatts)				
Production of cells	***	***	***	***	***
	Quantity (kilowatts)				
Production of modules.-- Using internally produced cells	***	***	***	***	***
Using purchases of domestic cells	***	***	***	***	***
Using purchases of imported cells	***	***	***	***	***
Total module assembly in the US	***	***	***	***	***
	Share of quantity (percent)				
Production of modules.-- Using internally produced cells	***	***	***	***	***
Using purchases of domestic cells	***	***	***	***	***
Using purchases of imported cells	***	***	***	***	***
Total module assembly in the US	***	***	***	***	***
	Quantity (kilowatts); Value (1,000 dollars); Unit value (dollars per kilowatt)				
U.S. imports of cells-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
U.S. imports of modules.-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
U.S. imports of cells and modules.-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
	Narratives				
Import sources: Cells	***				
Import sources: Modules	***				
Import sources: Cells and modules	***				
Reason for importing	***				
	Ratio to production (percent)				
Ratio of imports to U.S. cell production	***	***	***	***	***
Ratio of imports to U.S. module production	***	***	***	***	***

Table continued on next page.

Table G-1--Continued
CSPV products: Silfab's business model, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year 2016	Calendar year 2017	Calendar year 2018	January to June 2018	January to June 2019
	Quantity (kilowatts)				
Production of cells	***	***	***	***	***
	Quantity (kilowatts)				
Production of modules.-- Using internally produced cells	***	***	***	***	***
Using purchases of domestic cells	***	***	***	***	***
Using purchases of imported cells	***	***	***	***	***
Total module assembly in the US	***	***	***	***	***
	Share of quantity (percent)				
Production of modules.-- Using internally produced cells	***	***	***	***	***
Using purchases of domestic cells	***	***	***	***	***
Using purchases of imported cells	***	***	***	***	***
Total module assembly in the US	***	***	***	***	***
	Quantity (kilowatts); Value (1,000 dollars); Unit value (dollars per kilowatt)				
U.S. imports of cells-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
U.S. imports of modules.-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
U.S. imports of cells and modules.-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
	Narratives				
Import sources: Cells	***				
Import sources: Modules	***				
Import sources: Cells and modules	***				
Reason for importing	***				
	Ratio to production (percent)				
Ratio of imports to U.S. cell production	***	***	***	***	***
Ratio of imports to U.S. module production	***	***	***	***	***

Table continued on next page.

Table G-1--Continued
CSPV products: Solar Tech Universal's business model, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Quantity (kilowatts)				
Production of cells	***	***	***	***	***
	Quantity (kilowatts)				
Production of modules.-- Using internally produced cells	***	***	***	***	***
Using purchases of domestic cells	***	***	***	***	***
Using purchases of imported cells	***	***	***	***	***
Total module assembly in the US	***	***	***	***	***
	Share of quantity (percent)				
Production of modules.-- Using internally produced cells	***	***	***	***	***
Using purchases of domestic cells	***	***	***	***	***
Using purchases of imported cells	***	***	***	***	***
Total module assembly in the US	***	***	***	***	***
	Quantity (kilowatts); Value (1,000 dollars); Unit value (dollars per kilowatt)				
U.S. imports of cells-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
U.S. imports of modules.-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
U.S. imports of cells and modules.-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
	Narratives				
Import sources: Cells	***				
Import sources: Modules	***				
Import sources: Cells and modules	***				
Reason for importing	***				
	Ratio to production (percent)				
Ratio of imports to U.S. cell production	***	***	***	***	***
Ratio of imports to U.S. module production	***	***	***	***	***

Table continued on next page.

Table G-1--Continued
CSPV products: Suniva's business model, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Quantity (kilowatts)				
Production of cells	***	***	***	***	***
	Quantity (kilowatts)				
Production of modules.-- Using internally produced cells	***	***	***	***	***
Using purchases of domestic cells	***	***	***	***	***
Using purchases of imported cells	***	***	***	***	***
Total module assembly in the US	***	***	***	***	***
	Share of quantity (percent)				
Production of modules.-- Using internally produced cells	***	***	***	***	***
Using purchases of domestic cells	***	***	***	***	***
Using purchases of imported cells	***	***	***	***	***
Total module assembly in the US	***	***	***	***	***
	Quantity (kilowatts); Value (1,000 dollars); Unit value (dollars per kilowatt)				
U.S. imports of cells-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
U.S. imports of modules.-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
U.S. imports of cells and modules.-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
	Narratives				
Import sources: Cells	***				
Import sources: Modules	***				
Import sources: Cells and modules	***				
Reason for importing	***				
	Ratio to production (percent)				
Ratio of imports to U.S. cell production	***	***	***	***	***
Ratio of imports to U.S. module production	***	***	***	***	***

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Table G-1--Continued
CSPV products: Sunpower's (pre-acquisition) business model, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Quantity (kilowatts)				
Production of cells	***	***	***	***	***
	Quantity (kilowatts)				
Production of modules.-- Using internally produced cells	***	***	***	***	***
Using purchases of domestic cells	***	***	***	***	***
Using purchases of imported cells	***	***	***	***	***
Total module assembly in US	***	***	***	***	***
	Share of quantity (percent)				
Production of modules.-- Using internally produced cells	***	***	***	***	***
Using purchases of domestic cells	***	***	***	***	***
Using purchases of imported cells	***	***	***	***	***
Total module assembly in US	***	***	***	***	***
	Quantity (kW); Value (1,000 dollars); Unit value ($/kW)				
U.S. imports of cells-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
U.S. imports of modules.-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
U.S. imports of cells and modules.-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
	Narratives				
Import sources: Cells	***				
Import sources: Modules	***				
Import sources: Cells and modules	***				
Reason for importing	***				
	Ratio to production (percent)				
Ratio of imports to U.S. cell production	***	***	***	***	***
Ratio of imports to U.S. module production	***	***	***	***	***

Table continued on next page.

Table G-1--Continued
CSPV products: Sunpower's (post-acquisition) business model, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year 2016	Calendar year 2017	Calendar year 2018	January to June 2018	January to June 2019
	Quantity (kilowatts)				
Production of cells	***	***	***	***	***
	Quantity (kilowatts)				
Production of modules.-- Using internally produced cells	***	***	***	***	***
Using purchases of domestic cells	***	***	***	***	***
Using purchases of imported cells	***	***	***	***	***
Total module assembly in the US	***	***	***	***	***
	Share of quantity (percent)				
Production of modules.-- Using internally produced cells	***	***	***	***	***
Using purchases of domestic cells	***	***	***	***	***
Using purchases of imported cells	***	***	***	***	***
Total module assembly in the US	***	***	***	***	***
	Quantity (kilowatts); Value (1,000 dollars); Unit value (dollars per kilowatt)				
U.S. imports of cells-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
U.S. imports of modules.-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
U.S. imports of cells and modules.-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
	Narratives				
Import sources: Cells	***				
Import sources: Modules	***				
Import sources: Cells and modules	***				
Reason for importing	***				
	Ratio to production (percent)				
Ratio of imports to U.S. cell production	***	***	***	***	***
Ratio of imports to U.S. module production	***	***	***	***	***

Table continued on next page.

Table G-1--Continued
CSPV products: Tesla's business model, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year			January to June	
	2016	2017	2018	2018	2019
	Quantity (kilowatts)				
Production of cells	***	***	***	***	***
	Quantity (kilowatts)				
Production of modules.-- Using internally produced cells	***	***	***	***	***
Using purchases of domestic cells	***	***	***	***	***
Using purchases of imported cells	***	***	***	***	***
Total module assembly in the US	***	***	***	***	***
	Share of quantity (percent)				
Production of modules.-- Using internally produced cells	***	***	***	***	***
Using purchases of domestic cells	***	***	***	***	***
Using purchases of imported cells	***	***	***	***	***
Total module assembly in the US	***	***	***	***	***
	Quantity (kilowatts); Value (1,000 dollars); Unit value (dollars per kilowatt)				
U.S. imports of cells-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
U.S. imports of modules.-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
U.S. imports of cells and modules.-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
	Narratives				
Import sources: Cells	***				
Import sources: Modules	***				
Import sources: Cells and modules	***				
Reason for importing	***				
	Ratio to production (percent)				
Ratio of imports to U.S. cell production	***	***	***	***	***
Ratio of imports to U.S. module production	***	***	***	***	***

Table continued on next page.

Table G-1--Continued
CSPV products: Yingli's business model, 2016-18, January to June 2018, and January to June 2019

Item	Calendar year 2016	Calendar year 2017	Calendar year 2018	January to June 2018	January to June 2019
	Quantity (kilowatts)				
Production of cells	***	***	***	***	***
	Quantity (kilowatts)				
Production of modules.-- Using internally produced cells	***	***	***	***	***
Using purchases of domestic cells	***	***	***	***	***
Using purchases of imported cells	***	***	***	***	***
Total module assembly in the US	***	***	***	***	***
	Share of quantity (percent)				
Production of modules.-- Using internally produced cells	***	***	***	***	***
Using purchases of domestic cells	***	***	***	***	***
Using purchases of imported cells	***	***	***	***	***
Total module assembly in the US	***	***	***	***	***
	Quantity (kilowatts); Value (1,000 dollars); Unit value (dollars per kilowatt)				
U.S. imports of cells-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
U.S. imports of modules.-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
U.S. imports of cells and modules.-- Quantity	***	***	***	***	***
Value	***	***	***	***	***
Unit value	***	***	***	***	***
	Narratives				
Import sources: Cells	***				
Import sources: Modules	***				
Import sources: Cells and modules	***				
Reason for importing	***				
	Ratio to production (percent)				
Ratio of imports to U.S. cell production	***	***	***	***	***
Ratio of imports to U.S. module production	***	***	***	***	***

Note.--Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent.

Source: Compiled from data submitted in response to Commission questionnaires.

APPENDIX H

FINANCIAL EXPERIENCE OF U.S. PRODUCERS

Table H-1
CSPV products: Select results of operations of U.S. producers, by company, 2016-18, January to June 2018, and January to June 2019

Item	Fiscal year			January to June	
	2016	2017	2018	2018	2019
	Total net sales (kilowatts)				
Panasonic	***	***	***	***	***
Suniva	***	***	***	***	***
Sunpower (post-acquisition)	***	***	***	***	***
Sunpower (pre-acquisition) Solar World	***	***	***	***	***
Yingli	***	***	***	***	***
Open market cell producers	***	***	***	***	***
Auxin	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
SBM	***	***	***	***	***
Silfab	***	***	***	***	***
SolarTech Universal	***	***	***	***	***
Suniva	***	***	***	***	***
Sunpower (post-acquisition)	***	***	***	***	***
Sunpower (pre-acquisition) Solar World	***	***	***	***	***
Total market module producers	***	***	***	***	***
All producers, all levels of production	***	***	***	***	***
	Total net sales (1,000 dollars)				
Panasonic	***	***	***	***	***
Suniva	***	***	***	***	***
Sunpower (post-acquisition)	***	***	***	***	***
Sunpower (pre-acquisition) Solar World	***	***	***	***	***
Yingli	***	***	***	***	***
Open market cell producers	***	***	***	***	***
Auxin	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
SBM	***	***	***	***	***
Silfab	***	***	***	***	***
SolarTech Universal	***	***	***	***	***
Suniva	***	***	***	***	***
Sunpower (post-acquisition)	***	***	***	***	***
Sunpower (pre-acquisition) Solar World	***	***	***	***	***
Total market module producers	***	***	***	***	***
All producers, all levels of production	***	***	***	***	***

Table continued next page.

Table H-1--Continued
CSPV products: Select results of operations of U.S. producers, by company, 2016-18, January to June 2018, and January to June 2019

Item	Fiscal year			January to June	
	2016	2017	2018	2018	2019
	Cost of goods sold (1,000 dollars)				
Panasonic	***	***	***	***	***
Suniva	***	***	***	***	***
Sunpower (post-acquisition)	***	***	***	***	***
Sunpower (pre-acquisition) Solar World	***	***	***	***	***
Yingli	***	***	***	***	***
Open market cell producers	***	***	***	***	***
Auxin	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
SBM	***	***	***	***	***
Silfab	***	***	***	***	***
SolarTech Universal	***	***	***	***	***
Suniva	***	***	***	***	***
Sunpower (post-acquisition)	***	***	***	***	***
Sunpower (pre-acquisition) Solar World	***	***	***	***	***
Total market module producers	***	***	***	***	***
All producers, all levels of production	***	***	***	***	***
	Gross profit or (loss) (1,000 dollars)				
Panasonic	***	***	***	***	***
Suniva	***	***	***	***	***
Sunpower (post-acquisition)	***	***	***	***	***
Sunpower (pre-acquisition) Solar World	***	***	***	***	***
Yingli	***	***	***	***	***
Open market cell producers	***	***	***	***	***
Auxin	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
SBM	***	***	***	***	***
Silfab	***	***	***	***	***
SolarTech Universal	***	***	***	***	***
Suniva	***	***	***	***	***
Sunpower (post-acquisition)	***	***	***	***	***
Sunpower (pre-acquisition) Solar World	***	***	***	***	***
Total market module producers	***	***	***	***	***
All producers, all levels of production	***	***	***	***	***

Table continued next page.

Table H-1--Continued
CSPV products: Select results of operations of U.S. producers, by company, 2016-18, January to June 2018, and January to June 2019

Item	Fiscal year			January to June	
	2016	2017	2018	2018	2019
	SG&A expenses (1,000 dollars)				
Panasonic	***	***	***	***	***
Suniva	***	***	***	***	***
Sunpower (post-acquisition)	***	***	***	***	***
Sunpower (pre-acquisition) Solar World	***	***	***	***	***
Yingli	***	***	***	***	***
Open market cell producers	***	***	***	***	***
Auxin	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
SBM	***	***	***	***	***
Silfab	***	***	***	***	***
SolarTech Universal	***	***	***	***	***
Suniva	***	***	***	***	***
Sunpower (post-acquisition)	***	***	***	***	***
Sunpower (pre-acquisition) Solar World	***	***	***	***	***
Total market module producers	***	***	***	***	***
All producers, all levels of production	***	***	***	***	***
	Operating income or (loss) (1,000 dollars)				
Panasonic	***	***	***	***	***
Suniva	***	***	***	***	***
Sunpower (post-acquisition)	***	***	***	***	***
Sunpower (pre-acquisition) Solar World	***	***	***	***	***
Yingli	***	***	***	***	***
Open market cell producers	***	***	***	***	***
Auxin	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
SBM	***	***	***	***	***
Silfab	***	***	***	***	***
SolarTech Universal	***	***	***	***	***
Suniva	***	***	***	***	***
Sunpower (post-acquisition)	***	***	***	***	***
Sunpower (pre-acquisition) Solar World	***	***	***	***	***
Total market module producers	***	***	***	***	***
All producers, all levels of production	***	***	***	***	***

Table continued next page.

Table H-1--Continued
CSPV products: Select results of operations of U.S. producers, by company, 2016-18, January to June 2018, and January to June 2019

Item	Fiscal year			January to June	
	2016	2017	2018	2018	2019
	Net income or (loss) (1,000 dollars)				
Panasonic	***	***	***	***	***
Suniva	***	***	***	***	***
Sunpower (post-acquisition)	***	***	***	***	***
Sunpower (pre-acquisition) Solar World	***	***	***	***	***
Yingli	***	***	***	***	***
Open market cell producers	***	***	***	***	***
Auxin	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
SBM	***	***	***	***	***
Silfab	***	***	***	***	***
SolarTech Universal	***	***	***	***	***
Suniva	***	***	***	***	***
Sunpower (post-acquisition)	***	***	***	***	***
Sunpower (pre-acquisition) Solar World	***	***	***	***	***
Total market module producers	***	***	***	***	***
All producers, all levels of production	***	***	***	***	***
	COGS to net sales ratio (percent)				
Panasonic	***	***	***	***	***
Suniva	***	***	***	***	***
Sunpower (post-acquisition)	***	***	***	***	***
Sunpower (pre-acquisition) Solar World	***	***	***	***	***
Yingli	***	***	***	***	***
Open market cell producers	***	***	***	***	***
Auxin	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
SBM	***	***	***	***	***
Silfab	***	***	***	***	***
SolarTech Universal	***	***	***	***	***
Suniva	***	***	***	***	***
Sunpower (post-acquisition)	***	***	***	***	***
Sunpower (pre-acquisition) Solar World	***	***	***	***	***
Total market module producers	***	***	***	***	***
All producers, all levels of production	***	***	***	***	***

Table continued next page.

Table H-1--Continued
CSPV products: Select results of operations of U.S. producers, by company, 2016-18, January to June 2018, and January to June 2019

Item	Fiscal year			January to June	
	2016	2017	2018	2018	2019
	Gross profit or (loss) to net sales ratio (percent)				
Panasonic	***	***	***	***	***
Suniva	***	***	***	***	***
Sunpower (post-acquisition)	***	***	***	***	***
Sunpower (pre-acquisition) Solar World	***	***	***	***	***
Yingli	***	***	***	***	***
Open market cell producers	***	***	***	***	***
Auxin	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
SBM	***	***	***	***	***
Silfab	***	***	***	***	***
SolarTech Universal	***	***	***	***	***
Suniva	***	***	***	***	***
Sunpower (post-acquisition)	***	***	***	***	***
Sunpower (pre-acquisition) Solar World	***	***	***	***	***
Total market module producers	***	***	***	***	***
All producers, all levels of production	***	***	***	***	***
	SG&A expense to net sales ratio (percent)				
Panasonic	***	***	***	***	***
Suniva	***	***	***	***	***
Sunpower (post-acquisition)	***	***	***	***	***
Sunpower (pre-acquisition) Solar World	***	***	***	***	***
Yingli	***	***	***	***	***
Open market cell producers	***	***	***	***	***
Auxin	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
SBM	***	***	***	***	***
Silfab	***	***	***	***	***
SolarTech Universal	***	***	***	***	***
Suniva	***	***	***	***	***
Sunpower (post-acquisition)	***	***	***	***	***
Sunpower (pre-acquisition) Solar World	***	***	***	***	***
Total market module producers	***	***	***	***	***
All producers, all levels of production	***	***	***	***	***

Table continued next page.

Table H-1--Continued
CSPV products: Select results of operations of U.S. producers, by company, 2016-18, January to June 2018, and January to June 2019

Item	Fiscal year			January to June	
	2016	2017	2018	2018	2019
	Operating income or (loss) to net sales ratio (percent)				
Panasonic	***	***	***	***	***
Suniva	***	***	***	***	***
Sunpower (post-acquisition)	***	***	***	***	***
Sunpower (pre-acquisition) Solar World	***	***	***	***	***
Yingli	***	***	***	***	***
Open market cell producers	***	***	***	***	***
Auxin	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
SBM	***	***	***	***	***
Silfab	***	***	***	***	***
SolarTech Universal	***	***	***	***	***
Suniva	***	***	***	***	***
Sunpower (post-acquisition)	***	***	***	***	***
Sunpower (pre-acquisition) Solar World	***	***	***	***	***
Total market module producers	***	***	***	***	***
All producers, all levels of production	***	***	***	***	***
	Net income or (loss) to net sales ratio (percent)				
Panasonic	***	***	***	***	***
Suniva	***	***	***	***	***
Sunpower (post-acquisition)	***	***	***	***	***
Sunpower (pre-acquisition) Solar World	***	***	***	***	***
Yingli	***	***	***	***	***
Open market cell producers	***	***	***	***	***
Auxin	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
SBM	***	***	***	***	***
Silfab	***	***	***	***	***
SolarTech Universal	***	***	***	***	***
Suniva	***	***	***	***	***
Sunpower (post-acquisition)	***	***	***	***	***
Sunpower (pre-acquisition) Solar World	***	***	***	***	***
Total market module producers	***	***	***	***	***
All producers, all levels of production	***	***	***	***	***

Table continued next page.

Table H-1--Continued
CSPV products: Select results of operations of U.S. producers, by company, 2016-18, January to June 2018, and January to June 2019

Item	Fiscal year			January to June	
	2016	2017	2018	2018	2019
	Unit net sales value (dollars per kilowatt)				
Panasonic	***	***	***	***	***
Suniva	***	***	***	***	***
Sunpower (post-acquisition)	***	***	***	***	***
Sunpower (pre-acquisition) Solar World	***	***	***	***	***
Yingli	***	***	***	***	***
Open market cell producers	***	***	***	***	***
Auxin	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
SBM	***	***	***	***	***
Silfab	***	***	***	***	***
SolarTech Universal	***	***	***	***	***
Suniva	***	***	***	***	***
Sunpower (post-acquisition)	***	***	***	***	***
Sunpower (pre-acquisition) Solar World	***	***	***	***	***
Total market module producers	***	***	***	***	***
All producers, all levels of production	***	***	***	***	***
	Unit raw materials (dollars per kilowatt)				
Panasonic	***	***	***	***	***
Suniva	***	***	***	***	***
Sunpower (post-acquisition)	***	***	***	***	***
Sunpower (pre-acquisition) Solar World	***	***	***	***	***
Yingli	***	***	***	***	***
Open market cell producers	***	***	***	***	***
Auxin	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
SBM	***	***	***	***	***
Silfab	***	***	***	***	***
SolarTech Universal	***	***	***	***	***
Suniva	***	***	***	***	***
Sunpower (post-acquisition)	***	***	***	***	***
Sunpower (pre-acquisition) Solar World	***	***	***	***	***
Total market module producers	***	***	***	***	***
All producers, all levels of production	***	***	***	***	***

Table continued next page.

Table H-1--Continued
CSPV products: Select results of operations of U.S. producers, by company, 2016-18, January to June 2018, and January to June 2019

Item	Fiscal year			January to June	
	2016	2017	2018	2018	2019
	Unit direct labor (dollars per kilowatt)				
Panasonic	***	***	***	***	***
Suniva	***	***	***	***	***
Sunpower (post-acquisition)	***	***	***	***	***
Sunpower (pre-acquisition) Solar World	***	***	***	***	***
Yingli	***	***	***	***	***
Open market cell producers	***	***	***	***	***
Auxin	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
SBM	***	***	***	***	***
Silfab	***	***	***	***	***
SolarTech Universal	***	***	***	***	***
Suniva	***	***	***	***	***
Sunpower (post-acquisition)	***	***	***	***	***
Sunpower (pre-acquisition) Solar World	***	***	***	***	***
Total market module producers	***	***	***	***	***
All producers, all levels of production	***	***	***	***	***
	Unit other factory costs (dollars per kilowatt)				
Panasonic	***	***	***	***	***
Suniva	***	***	***	***	***
Sunpower (post-acquisition)	***	***	***	***	***
Sunpower (pre-acquisition) Solar World	***	***	***	***	***
Yingli	***	***	***	***	***
Open market cell producers	***	***	***	***	***
Auxin	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
SBM	***	***	***	***	***
Silfab	***	***	***	***	***
SolarTech Universal	***	***	***	***	***
Suniva	***	***	***	***	***
Sunpower (post-acquisition)	***	***	***	***	***
Sunpower (pre-acquisition) Solar World	***	***	***	***	***
Total market module producers	***	***	***	***	***
All producers, all levels of production	***	***	***	***	***

Table continued next page.

Table H-1--Continued
CSPV products: Select results of operations of U.S. producers, by company, 2016-18, January to June 2018, and January to June 2019

Item	Fiscal year			January to June	
	2016	2017	2018	2018	2019
	Unit COGS (dollars per kilowatt)				
Panasonic	***	***	***	***	***
Suniva	***	***	***	***	***
Sunpower (post-acquisition)	***	***	***	***	***
Sunpower (pre-acquisition) Solar World	***	***	***	***	***
Yingli	***	***	***	***	***
Open market cell producers	***	***	***	***	***
Auxin	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
SBM	***	***	***	***	***
Silfab	***	***	***	***	***
SolarTech Universal	***	***	***	***	***
Suniva	***	***	***	***	***
Sunpower (post-acquisition)	***	***	***	***	***
Sunpower (pre-acquisition) Solar World	***	***	***	***	***
Total market module producers	***	***	***	***	***
All producers, all levels of production	***	***	***	***	***
	Unit other gross profit or (loss) (dollars per kilowatt)				
Panasonic	***	***	***	***	***
Suniva	***	***	***	***	***
Sunpower (post-acquisition)	***	***	***	***	***
Sunpower (pre-acquisition) Solar World	***	***	***	***	***
Yingli	***	***	***	***	***
Open market cell producers	***	***	***	***	***
Auxin	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
SBM	***	***	***	***	***
Silfab	***	***	***	***	***
SolarTech Universal	***	***	***	***	***
Suniva	***	***	***	***	***
Sunpower (post-acquisition)	***	***	***	***	***
Sunpower (pre-acquisition) Solar World	***	***	***	***	***
Total market module producers	***	***	***	***	***
All producers, all levels of production	***	***	***	***	***

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Table H-1--Continued
CSPV products: Select results of operations of U.S. producers, by company, 2016-18, January to June 2018, and January to June 2019

Item	Fiscal year			January to June	
	2016	2017	2018	2018	2019
	Unit SG&A expenses (dollars per kilowatt)				
Panasonic	***	***	***	***	***
Suniva	***	***	***	***	***
Sunpower (post-acquisition)	***	***	***	***	***
Sunpower (pre-acquisition) Solar World	***	***	***	***	***
Yingli	***	***	***	***	***
Open market cell producers	***	***	***	***	***
Auxin	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
SBM	***	***	***	***	***
Silfab	***	***	***	***	***
SolarTech Universal	***	***	***	***	***
Suniva	***	***	***	***	***
Sunpower (post-acquisition)	***	***	***	***	***
Sunpower (pre-acquisition) Solar World	***	***	***	***	***
Total market module producers	***	***	***	***	***
All producers, all levels of production	***	***	***	***	***
	Unit operating income or (loss) (dollars per kilowatt)				
Panasonic	***	***	***	***	***
Suniva	***	***	***	***	***
Sunpower (post-acquisition)	***	***	***	***	***
Sunpower (pre-acquisition) Solar World	***	***	***	***	***
Yingli	***	***	***	***	***
Open market cell producers	***	***	***	***	***
Auxin	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
SBM	***	***	***	***	***
Silfab	***	***	***	***	***
SolarTech Universal	***	***	***	***	***
Suniva	***	***	***	***	***
Sunpower (post-acquisition)	***	***	***	***	***
Sunpower (pre-acquisition) Solar World	***	***	***	***	***
Total market module producers	***	***	***	***	***
All producers, all levels of production	***	***	***	***	***

Table continued next page.

Table H-1--Continued
CSPV products: Select results of operations of U.S. producers, by company, 2016-18, January to June 2018, and January to June 2019

Item	Fiscal year			January to June	
	2016	2017	2018	2018	2019
	Unit Net income or (loss) (dollars per kilowatt)				
Panasonic	***	***	***	***	***
Suniva	***	***	***	***	***
SunPower (post-acquisition)	***	***	***	***	***
SunPower (pre-acquisition) SolarWorld	***	***	***	***	***
Yingli	***	***	***	***	***
Open market cell producers	***	***	***	***	***
Auxin	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
SBM	***	***	***	***	***
Silfab	***	***	***	***	***
SolarTech Universal	***	***	***	***	***
Suniva	***	***	***	***	***
SunPower (post-acquisition)	***	***	***	***	***
SunPower (pre-acquisition) SolarWorld	***	***	***	***	***
Total market module producers	***	***	***	***	***
All producers, all levels of production	***	***	***	***	***

Note: The lack of certain cost data for *** (see Part IV, footnote 6 of the report) impacts the operating profit and net income for the industry as a whole.

Note.--Shares and ratios shown as “0.0” percent represent non-zero values less than “0.05” percent (if positive) and greater than “(0.05)” percent (if negative). Zeroes, null values, and undefined calculations are suppressed and shown as “---“.

Source: Compiled from data submitted in response to Commission questionnaires.

APPENDIX I

OFFICIAL U.S. IMPORT STATISTICS AND TRQ FILL RATE

Table I-1
CSPV products: U.S. imports using official statistics, by source, 2016-18, January to September 2018, and January to September 2019

Item	Calendar year			January to September	
	2016	2017	2018	2018	2019
	Value (1,000 of dollars)				
U.S. imports from.-- Canada	88,736	133,226	41,202	36,420	16,206
China	1,531,623	555,423	25,558	21,986	10,375
Germany	163,827	24,412	4,484	4,354	1,300
India	6,741	30,825	72,531	54,126	62,242
Indonesia	1,810	5,167	5,356	3,725	5,433
Japan	113,732	84,747	136,695	109,660	70,506
Korea	1,331,309	1,110,079	629,116	450,423	454,324
Malaysia	2,530,531	1,616,750	1,268,603	812,644	1,919,672
Mexico	854,638	269,939	328,605	270,731	114,222
Philippines	125,307	20,877	33,736	33,019	3,901
Singapore	360,180	158,546	175,308	130,112	132,097
Taiwan	245,781	26,840	25,299	21,231	75,857
Thailand	531,950	444,355	193,852	159,970	322,761
Turkey	4,622	3,582	71,255	49,781	99,885
Vietnam	529,803	799,072	449,413	318,400	1,196,133
All other sources	66,423	51,565	7,928	5,841	11,784
All import sources	8,487,013	5,335,405	3,468,941	2,482,423	4,496,698
of which cells	137,273	112,916	302,542	229,204	297,658
of which modules	8,349,739	5,222,489	3,163,398	2,253,219	4,199,040
	Share of value (percent)				
U.S. imports from.-- Canada	1.0	2.5	1.2	1.5	0.4
China	18.0	10.4	0.7	0.9	0.2
Germany	1.9	0.5	0.1	0.2	0.0
India	0.1	0.6	2.1	2.2	1.4
Indonesia	0.0	0.1	0.2	0.2	0.1
Japan	1.3	1.6	3.9	4.4	1.6
Korea	15.7	20.8	18.1	18.1	10.1
Malaysia	29.8	30.3	36.6	32.7	42.7
Mexico	10.1	5.1	9.5	10.9	2.5
Philippines	1.5	0.4	1.0	1.3	0.1
Singapore	4.2	3.0	5.1	5.2	2.9
Taiwan	2.9	0.5	0.7	0.9	1.7
Thailand	6.3	8.3	5.6	6.4	7.2
Turkey	0.1	0.1	2.1	2.0	2.2
Vietnam	6.2	15.0	13.0	12.8	26.6
All other sources	0.8	1.0	0.2	0.2	0.3
All import sources	100.0	100.0	100.0	100.0	100.0
of which cells	1.6	2.1	8.7	9.2	6.6
of which modules	98.4	97.9	91.2	90.8	93.4

Table continued on next page.

Table I-1--Continued
CSPV products: U.S. imports using official statistics, by source, 2016-18, January to September 2018, and January to September 2019

Item	Calendar year			January to September	
	2016	2017	2018	2018	2019
	Rank based on value				
U.S. imports from.-- 1st largest source	Malaysia	Malaysia	Malaysia	Malaysia	Malaysia
2nd largest source	China	Korea	Korea	Korea	Vietnam
3rd largest source	Korea	Vietnam	Vietnam	Vietnam	Korea
4th largest source	Mexico	China	Mexico	Mexico	Thailand
5th largest source	Thailand	Thailand	Thailand	Thailand	Singapore
6th largest source	Vietnam	Mexico	Singapore	Singapore	Mexico
7th largest source	Singapore	Singapore	Japan	Japan	Turkey
8th largest source	Taiwan	Canada	India	India	Taiwan
9th largest source	Germany	Japan	Turkey	Turkey	Japan
10th largest source	Philippines	India	Canada	Canada	India

Note: Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent. The data presented may include other products not within the scope of this proceeding, such as thin film solar products. HTS statistical reporting numbers 8541.40.6035 and 8541.40.6045 (added July 1, 2018), which largely cover out-of-scope items, are included in the data presented for the purpose of comparability across all time periods. Imports entering the United States under these two numbers amounted to $519.6 million during July to December 2018 and $768.7 million during January-June 2019.

Source: Official U.S. import statistics using HTS statistical reporting numbers 8541.40.6015, 8541.40.6020, 8541.40.6025, 8541.40.6030, 8541.40.6035, and 8541.40.6045, accessed November 12, 2019.

Table I-2
CSPV products: U.S. monthly imports using official statistics, January 2010 to October 2019

Year	Month	CIF value	Safeguard duties	AD-CVD deposits	Total duties and deposits	LDPV including AD-CVD deposits
		Value (1,000 dollars)				
2010	January	146,071	---	***	***	***
	February	146,351	---	***	***	***
	March	176,769	---	***	***	***
	April	141,737	---	***	***	***
	May	155,129	---	***	***	***
	June	197,424	---	***	***	***
	July	189,861	---	***	***	***
	August	261,683	---	***	***	***
	September	332,975	---	***	***	***
	October	261,153	---	***	***	***
	November	337,080	---	***	***	***
	December	345,610	---	***	***	***
2011	January	304,250	---	***	***	***
	February	342,069	---	***	***	***
	March	352,772	---	***	***	***
	April	347,692	---	***	***	***
	May	398,142	---	***	***	***
	June	443,039	---	***	***	***
	July	394,199	---	***	***	***
	August	438,866	---	***	***	***
	September	412,692	---	***	***	***
	October	491,560	---	***	***	***
	November	510,382	---	***	***	***
	December	615,423	---	***	***	***
2012	January	708,368	---	***	***	***
	February	762,273	---	***	***	***
	March	565,708	---	***	***	***
	April	307,443	---	***	***	***
	May	429,215	---	***	***	***
	June	377,921	---	***	***	***
	July	394,965	---	***	***	***
	August	399,212	---	***	***	***
	September	426,412	---	***	***	***
	October	368,666	---	***	***	***
	November	304,156	---	***	***	***
	December	169,360	---	***	***	***

Table continued on next page.

Table I-2--Continued
CSPV products: U.S. monthly imports using official statistics, January 2010 to October 2019

Year	Month	CIF value	Safeguard duties	AD-CVD deposits	Total duties and deposits	LDPV including AD-CVD deposits
		Value (1,000 dollars)				
2013	January	217,521	---	***	***	***
	February	196,950	---	***	***	***
	March	313,129	---	***	***	***
	April	301,937	---	***	***	***
	May	287,223	---	***	***	***
	June	326,882	---	***	***	***
	July	361,110	---	***	***	***
	August	365,997	---	***	***	***
	September	363,869	---	***	***	***
	October	357,245	---	***	***	***
	November	298,882	---	***	***	***
	December	330,361	---	***	***	***
2014	January	284,217	---	***	***	***
	February	313,771	---	***	***	***
	March	447,328	---	***	***	***
	April	374,063	---	***	***	***
	May	536,831	---	***	***	***
	June	370,239	---	***	***	***
	July	456,942	---	***	***	***
	August	264,408	---	***	***	***
	September	351,230	---	***	***	***
	October	265,480	---	***	***	***
	November	313,545	---	***	***	***
	December	308,726	---	***	***	***
2015	January	177,509	---	***	***	***
	February	242,209	---	***	***	***
	March	391,434	---	***	***	***
	April	501,254	---	***	***	***
	May	407,466	---	***	***	***
	June	552,877	---	***	***	***
	July	500,513	---	***	***	***
	August	600,246	---	***	***	***
	September	621,163	---	***	***	***
	October	670,263	---	***	***	***
	November	690,837	---	***	***	***
	December	727,273	---	***	***	***

Table continued on next page.

Table I-2--Continued
CSPV products: U.S. monthly imports using official statistics, January 2010 to October 2019

Year	Month	CIF value	Safeguard duties	AD-CVD deposits	Total duties and deposits	LDPV including AD-CVD deposits
		Value (1,000 dollars)				
2016	January	715,725	---	***	***	***
	February	662,103	---	***	***	***
	March	803,652	---	***	***	***
	April	803,988	---	***	***	***
	May	876,360	---	***	***	***
	June	920,708	---	***	***	***
	July	772,497	---	***	***	***
	August	806,553	---	***	***	***
	September	708,882	---	***	***	***
	October	595,177	---	***	***	***
	November	472,928	---	***	***	***
	December	348,440	---	***	***	***
2017	January	174,008	---	***	***	***
	February	174,618	---	***	***	***
	March	335,190	---	***	***	***
	April	238,619	---	***	***	***
	May	331,758	---	***	***	***
	June	311,654	---	***	***	***
	July	367,595	---	***	***	***
	August	464,355	---	***	***	***
	September	558,233	---	***	***	***
	October	821,736	---	***	***	***
	November	868,999	---	***	***	***
	December	688,640	---	***	***	***
2018	January	497,029	---	***	***	***
	February	187,374	439	***	***	***
	March	157,396	52	***	***	***
	April	187,543	1,533	***	***	***
	May	193,233	18,973	***	***	***
	June	226,246	28,553	***	***	***
	July	295,376	37,241	***	***	***
	August	273,622	33,958	***	***	***
	September	307,213	36,642	***	***	***
	October	327,051	33,429	***	***	***
	November	337,043	34,358	***	***	***
	December	227,292	27,345	***	***	***

Table continued on next page.

Table I-2--Continued
CSPV products: U.S. monthly imports using official statistics, January 2010 to October 2019

Year	Month	CIF value	Safeguard duties	AD-CVD deposits	Total duties and deposits	LDPV including AD-CVD deposits
		Value (1,000 dollars)				
2019	January	209,208	16,589	***	***	***
	February	278,881	22,219	***	***	***
	March	355,677	28,217	***	***	***
	April	325,309	34,615	***	***	***
	May	475,318	55,960	***	***	***
	June	523,506	60,988	***	***	***
	July	549,981	56,955	***	***	***
	August	707,646	67,861	***	***	***
	September	654,241	73,527	***	***	***
	October	783,386	83,201	Not available	***	***

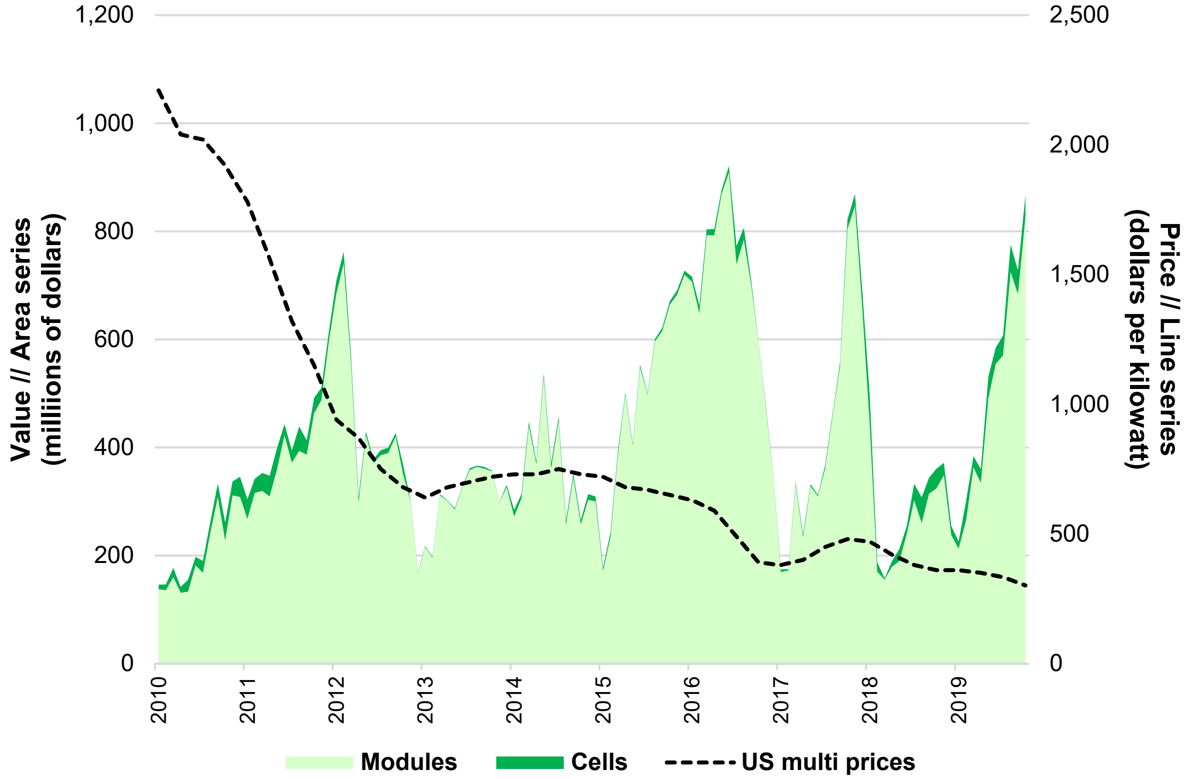
Source: Official U.S. import statistics and proprietary Customs records for HTS statistical reporting numbers 8541.40.6015, 8541.40.6020, 8541.40.6025, 8541.40.6030, 8541.40.6035, and 8541.40.6045, accessed December 10, 2019.

Figure I-1
CSPV products: Value of U.S. imports, various related duties, and domestic U.S. module prices, by month, January 2010 to October 2019

* * * * * * *

Source: Official U.S. import statistics and proprietary Customs records using HTS statistical reporting numbers 8541.40.6015, 8541.40.6020, 8541.40.6025, 8541.40.6030, 8541.40.6035, and 8541.40.6045, and SEIA U.S. module prices, accessed December 10, 2019.

Figure I-2
CSPV products: Value of U.S. imports and domestic U.S. module prices, by month, January 2010 to October 2019



Source: Official U.S. import statistics using HTS statistical reporting numbers 8541.40.6015, 8541.40.6020, 8541.40.6025, 8541.40.6030, 8541.40.6035, and 8541.40.6045, and SEIA U.S. module prices, accessed December 10, 2019.

Figure I-3
CSPV products: Share value of U.S. imports and various related duties, and domestic U.S. module prices, by month, January 2010 to October 2019

* * * * * * *

Source: Official U.S. import statistics and proprietary Customs records using HTS statistical reporting numbers 8541.40.6015, 8541.40.6020, 8541.40.6025, 8541.40.6030, 8541.40.6035, and 8541.40.6045, and SEIA U.S. module prices, accessed December 10, 2019.

Table I-3
CSPV cells: Quota fill rates for year 1 (end date February 6, 2018) and year 2 (as of February 3, 2020)

Country/region	Quota beginning period	Quota region/ country effective begin date	Quota region/ country effective end date	Quota region/ country maximum quantity (kW)	Quota/license allocated quantity (kW)	Quota region/ country percent filled
India	January 2019	06/05/2019	02/06/2020	0		0.00%
Turkey	January 2019	05/23/2019	02/06/2020	0		0.00%
WTO	February 2018	02/07/2018	02/06/2019	2,500,000,000	706,980,264.8	28.28%
	January 2019	02/07/2019	02/06/2020	2,500,000,000	2,332,355,149	93.29%

Source: U.S. Customs and Border Protection, Quota Status Report Year-End 2018 and Quota Status Report February 3, 2020, https://www.cbp.gov/trade/quota/tariff-rate-quotas, accessed February 3, 2020.

APPENDIX J

PRICE DATA BY COUNTRY SOURCE AND U.S. PRODUCERS

As noted in part VI, ten U.S. producers and 21 importers provided usable pricing data for modules, with importers providing data for CSPV modules from China, Germany, Korea, Malaysia, Singapore, Taiwan, Thailand, Vietnam, and other non-developing countries Hong Kong, Italy, and the Netherlands.[1] [2] Two U.S. producers[3] provided price data for CSPV modules made from U.S.-origin cells, and eight U.S. producers[4] provided price data for CSPV modules made from foreign-origin cells. These data are presented separately and combined in tables J-1 to J-6. In part VI, the importers' pricing data were presented for all import sources together. In this appendix, the importers' pricing data are presented by country of origin. Disaggregated import price and quantity data for all import sources are shown in tables J-7 through J-12.

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[1] Per-unit pricing data are calculated from total quantity (in kilowatts) and total value data provided by U.S. producers and importers. The precision and variation of these figures may be affected by rounding, limited quantities, and producer or importer estimates.

In some quarters, *** several importers provided aberrant or erroneous pricing data, or provided data in thousands (instead of actual) kilowatts and/or dollars. Staff requested amendments from such firms and received corrected data from some, but not all, of these firms. In the instances for which a revision has was not received, staff has amended or deleted the non-conforming data.

[2] No importer reported price data from Canada, Mexico, or the Philippines.

[3] The U.S. producers providing price data for modules made from U.S.-origin cells were ***.

[4] The U.S. producers providing price data for modules made from foreign-origin cells were ***.

Table J-1
CSPV products: Weighted-average f.o.b. prices and quantities of domestic product 1, by quarter, January 2016-June 2019

Period	U.S. modules (U.S.-origin cells)		U.S. modules (Foreign-origin cells)		U.S. modules (Combined U.S.- and foreign-origin cells)	
	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)
2016: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2017: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2018: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2019: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***

Product 1: Multicrystalline silicon module with front-side area of less than 1.9 square meters and a peak power wattage between 240w to 290w, inclusive, P-max or Wp as measured under Standard Test Conditions (“STC”).

Source: Compiled from data submitted in response to Commission questionnaires.

Table J-2
CSPV products: Weighted-average f.o.b. prices and quantities of domestic product 2, by quarter, January 2016-June 2019

	U.S. modules (U.S.-origin cells)		U.S. modules (Foreign-origin cells)		U.S. modules (Combined U.S.- and foreign-origin cells)	
Period	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)
2016: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2017: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2018: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2019: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***

Product 2: Monocrystalline silicon module with front-side of less than 1.9 square meters and a peak power wattage between 270w to 320w, inclusive, P-max or Wp as measured under Standard Test Conditions (“STC”).

Source: Compiled from data submitted in response to Commission questionnaires.

Table J-3
CSPV products: Weighted-average f.o.b. prices and quantities of domestic product 3, by quarter, January 2016-June 2019

Period	U.S. modules (U.S.-origin cells)		U.S. modules (Foreign-origin cells)		U.S. modules (Combined U.S.- and foreign-origin cells)	
	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)
2016: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2017: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2018: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2019: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***

Product 3: Multicrystalline silicon module with front-side area of greater than or equal to 1.9 square meters and a peak power wattage between 290w to 340w, inclusive, P-max or Wp as measured under Standard Test Conditions ("STC").

Source: Compiled from data submitted in response to Commission questionnaires.

Table J-4
CSPV products: Weighted-average f.o.b. prices and quantities of domestic product 4, by quarter, January 2016-June 2019

Period	U.S. modules (U.S.-origin cells)		U.S. modules (Foreign-origin cells)		U.S. modules (Combined U.S.- and foreign-origin cells)	
	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)
2016: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2017: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2018: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2019: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***

Product 4: Monocrystalline silicon module with front-side area of less than 1.9 square meters and a peak power wattage between 325w to 375w, inclusive, P-max or Wp as measured under Standard Test Conditions (“STC”).

Source: Compiled from data submitted in response to Commission questionnaires.

Table J-5
CSPV products: Weighted-average f.o.b. prices and quantities of domestic product 5, by quarter, January 2016-June 2019

Period	U.S. modules (U.S.-origin cells)		U.S. modules (Foreign-origin cells)		U.S. modules (Combined U.S.- and foreign-origin cells)	
	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)
2016: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2017: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2018: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2019: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***

Product 5: Monocrystalline silicon module with front-side area of greater than or equal to 1.9 square meters and a peak power wattage between 325w to 375w, inclusive, P-max or Wp as measured under Standard Test Conditions ("STC").

Source: Compiled from data submitted in response to Commission questionnaires.

Table J-6
CSPV products: Weighted-average f.o.b. prices and quantities of domestic product 6, by quarter, January 2016-June 2019

	U.S. modules (U.S.-origin cells)		U.S. modules (Foreign-origin cells)		U.S. modules (Combined U.S.- and foreign-origin cells)	
Period	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)
2016: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2017: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2018: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2019: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***

Product 6: Monocrystalline silicon module with front-side area of greater than or equal to 1.9 square meters and a peak power wattage between 380w to 430w, inclusive, P-max or Wp as measured under Standard Test Conditions (“STC”).

Source: Compiled from data submitted in response to Commission questionnaires.

Table J-7a
CSPV products: Weighted-average f.o.b. prices and quantities of imported product 1, by quarter, January 2016-June 2019

Period	China		Germany		Korea	
	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)
2016:						
Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2017:						
Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2018:						
Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2019:						
Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***

Period	Malaysia		Singapore		Taiwan	
	Price (dollars per kilowatt)	Quantity (kilowatts	Price (dollars per kilowatt)	Quantity (kilowatts	Price (dollars per kilowatt)	Quantity (kilowatts
2016:						
Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2017:						
Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2018:						
Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2019:						
Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***

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Table J-7b
CSPV products: Weighted-average f.o.b. prices and quantities of imported product 1, by quarter, January 2016-June 2019

Period	Thailand		Vietnam		All other non-developing countries	
	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)
2016:						
Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2017:						
Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2018:						
Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2019:						
Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***

Product 1: Multicrystalline silicon module with front-side area of less than 1.9 square meters and a peak power wattage between 240w to 290w, inclusive, P-max or Wp as measured under Standard Test Conditions (“STC”).

Source: Compiled from data submitted in response to Commission questionnaires.

Table J-8a
CSPV products: Weighted-average f.o.b. prices and quantities of imported product 2, by quarter, January 2016-June 2019

Period	China		Germany		Korea	
	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)
2016: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2017: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2018: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2019: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***

Period	Malaysia		Singapore		Taiwan	
	Price (dollars per kilowatt)	Quantity (kilowatts	Price (dollars per kilowatt)	Quantity (kilowatts	Price (dollars per kilowatt)	Quantity (kilowatts
2016: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2017: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2018: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2019: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***

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Table J-8b
CSPV products: Weighted-average f.o.b. prices and quantities of imported product 2, by quarter, January 2016-June 2019

Period	Thailand		Vietnam		All other non-developing countries	
	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)
2016: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2017: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2018: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2019: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***

Product 2: Monocrystalline silicon module with front-side of less than 1.9 square meters and a peak power wattage between 270w to 320w, inclusive, P-max or Wp as measured under Standard Test Conditions (“STC”).

Source: Compiled from data submitted in response to Commission questionnaires.

Table J-9a
CSPV products: Weighted-average f.o.b. prices and quantities of imported product 3, by quarter, January 2016-June 2019

Period	China		Germany		Korea	
	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)
2016:						
Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2017:						
Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2018:						
Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2019:						
Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***

Period	Malaysia		Singapore		Taiwan	
	Price (dollars per kilowatt)	Quantity (kilowatts	Price (dollars per kilowatt)	Quantity (kilowatts	Price (dollars per kilowatt)	Quantity (kilowatts
2016:						
Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2017:						
Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2018:						
Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2019:						
Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***

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Table J-9b
CSPV products: Weighted-average f.o.b. prices and quantities of imported product 3, by quarter, January 2016-June 2019

Period	Thailand		Vietnam		All other non-developing countries	
	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)
2016: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2017: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2018: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2019: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***

Product 3: Multicrystalline silicon module with front-side area of greater than or equal to 1.9 square meters and a peak power wattage between 290w to 340w, inclusive, P-max or Wp as measured under Standard Test Conditions ("STC").

Source: Compiled from data submitted in response to Commission questionnaires.

Table J-10a
CSPV products: Weighted-average f.o.b. prices and quantities of imported product 4, by quarter, January 2016-June 2019

Period	China		Germany		Korea	
	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)
2016: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2017: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2018: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2019: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***

Period	Malaysia		Singapore		Taiwan	
	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)
2016: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2017: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2018: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2019: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***

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Table J-10b
CSPV products: Weighted-average f.o.b. prices and quantities of imported product 4, by quarter, January 2016-June 2019

Period	Thailand		Vietnam		All other non-developing countries	
	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)
2016: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2017: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2018: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2019: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***

Product 4: Monocrystalline silicon module with front-side area of less than 1.9 square meters and a peak power wattage between 325w to 375w, inclusive, P-max or Wp as measured under Standard Test Conditions (“STC”).

Source: Compiled from data submitted in response to Commission questionnaires.

Table J-11a
CSPV products: Weighted-average f.o.b. prices and quantities of imported product 5, by quarter, January 2016-June 2019

Period	China		Germany		Korea	
	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)
2016:						
Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2017:						
Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2018:						
Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2019:						
Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***

Period	Malaysia		Singapore		Taiwan	
	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)
2016:						
Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2017:						
Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2018:						
Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2019:						
Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***

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Table J-11b
CSPV products: Weighted-average f.o.b. prices and quantities of imported product 5, by quarter, January 2016-June 2019

Period	Thailand		Vietnam		All other non-developing countries	
	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)
2016: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2017: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2018: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2019: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***

Product 5: Monocrystalline silicon module with front-side area of greater than or equal to 1.9 square meters and a peak power wattage between 325w to 375w, inclusive, P-max or Wp as measured under Standard Test Conditions (“STC”).

Source: Compiled from data submitted in response to Commission questionnaires.

Table J-12a
CSPV products: Weighted-average f.o.b. prices and quantities of imported product 6, by quarter, January 2016-June 2019

Period	China		Germany		Korea	
	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)
2016: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2017: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2018: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2019: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***

Period	Malaysia		Singapore		Taiwan	
	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)
2016: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2017: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2018: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2019: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***

Table continued on next page.

Table J-12b
CSPV products: Weighted-average f.o.b. prices and quantities of imported product 6, by quarter, January 2016-June 2019

Period	Thailand		Vietnam		All other non-developing countries	
	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)	Price (dollars per kilowatt)	Quantity (kilowatts)
2016: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2017: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2018: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***
July-Sept.	***	***	***	***	***	***
Oct.-Dec.	***	***	***	***	***	***
2019: Jan.-Mar.	***	***	***	***	***	***
Apr.-June	***	***	***	***	***	***

Product 6: Monocrystalline silicon module with front-side area of greater than or equal to 1.9 square meters and a peak power wattage between 380w to 430w, inclusive, P-max or Wp as measured under Standard Test Conditions (“STC”).

Source: Compiled from data submitted in response to Commission questionnaires.