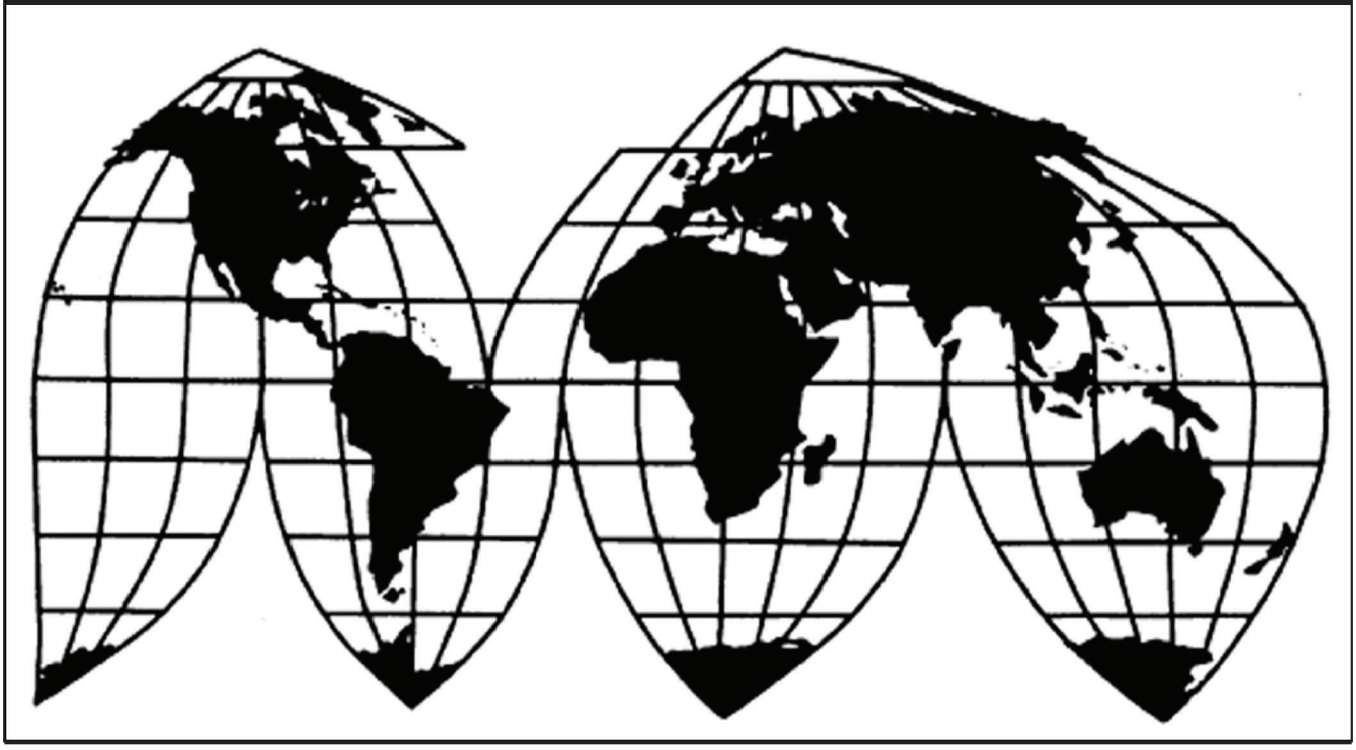
Crystalline Silicon Photovoltaic Cells, Whether or Not Partially or Fully Assembled Into Other Products: Monitoring Developments in the Domestic Industry

Investigation No. TA-201-075 (Second Monitoring)

Publication 5494 **February 2024**

U.S. International Trade Commission



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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
www.usitc.gov

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Executive Summary

The U.S. International Trade Commission ("Commission") is required by section 204(a)(2) of the Trade Act of 1974 to monitor and report on developments with respect to a domestic industry after the imposition of a safeguard remedy no later than the mid-point of the initial period of the relief, and of any period of extension of that safeguard action, while that action is in effect. In this second monitoring proceeding, the Commission gathered and analyzed information regarding developments in the U.S. industry producing certain crystalline silicon photovoltaic cells, whether or not partially or fully assembled into other products ("CSPV products"), since safeguard measures were extended by the President on February 4, 2022 for an additional four years, or through February 6, 2026.

Since the Commission's safeguard extension proceeding, there have been a number of significant developments, including: (1) several announcements of plans to start domestic CSPV cell production in the near term; (2) increased imports of CSPV cells and modules, particularly in the first half of 2023 compared to the first half of 2022; (3) a shift in imports from non-bifacial CSPV cells and modules toward primarily bifacial CSPV cells and modules (bifacial modules are excluded from the safeguard measures) from 2020-22 and when comparing the first half of 2023 with the first half of 2022, with bifacial cells and modules increasingly used in traditionally non-bifacial applications; (4) generally increased prices for CSPV cells and modules; (5) decreased employment in the U.S. CSPV industry from 2020-22, but higher employment during the first half of 2023 compared with the first half of 2022; (6) implementation of the Inflation Reduction Act ("IRA"), which has led to increased investments in domestic CSPV cell and module production; and (7) an anti-circumvention inquiry by the Department of Commerce ("DOC"), which led to a Presidential moratorium on antidumping and countervailing duty ("AD/CVD") tariffs on CSPV products imported from certain Southeast Asian countries.

Background

On November 13, 2017, the Commission completed a global safeguard 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 solar cells not partially or fully assembled into other products and (2) an increase in duties on imports of solar modules. The safeguard measure was applicable to imports from all countries, except for imports from certain developing countries that were 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, did not exceed 3 percent, provided that imports that are the product of all such countries with less than 3 percent import share collectively accounted for not more than 9 percent of total imports of the product.

The TRQ portion of the safeguard measure subjected imports of CSPV cells in excess of 2.5 GW annually to 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. The TRQ contained no individual country allocations, and the in-quota quantity reset annually. The safeguard measure also subjected imports of CSPV modules to 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. The additional duty was 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).

On February 7, 2020, the Commission issued a report on its monitoring of developments with respect to the domestic CSPV products industry. On March 6, 2020, the Commission issued an additional report pursuant to a request from the United States Trade Representative under section 204(a)(4) of the Trade Act (19 U.S.C. 2254(a)(4)), regarding the probable economic effect on the domestic CSPV cell and module manufacturing industry of modifying the safeguard measure. Subsequently, on October 10, 2020, the President determined that the domestic industry had begun to make a positive adjustment to import competition and modified the safeguard measure through Proclamation 10101, which revoked an exclusion previously applied to imports of bifacial modules and increased the duty on imports of cells entered in excess of the TRQ, and the duty on imports of modules, from 15 percent to 18 percent in the fourth year of the safeguard action. On November 16, 2021, the U.S. Court of International Trade issued a decision setting aside Proclamation 10101 as null and void, on the grounds that it was outside the President's delegated statutory authority. The U.S. Court of Appeals for the Federal Circuit reversed this ruling on the eve of the hearing in this proceeding, and the litigation remains ongoing at the time of this report.

On August 6, 2021, the Commission instituted a proceeding following receipt of petitions requesting extension of the safeguard measure in place on imports of CSPV products. On December 8, 2021, the Commission determined that action under section 203 of the Trade

Act with respect to imports of CSPV products continued to be necessary to prevent or remedy serious injury and that there was evidence that the domestic industry was making a positive adjustment to import competition.

On February 4, 2022, the President announced an extension and modification of the existing safeguard measures for CSPV cells and modules for an additional four years. The President increased the TRQ for CSPV cells from 2.5 GW to 5.0 GW for each year; imports of CSPV cells in excess of 5.0 GW annually are subject to additional tariffs of 14.75 percent in the fifth year, 14.5 percent in the sixth year, 14.25 percent in the seventh year, and 14.0 percent in the eighth year. The President also extended the additional duties on imports of CSPV modules, with the same annual reductions in the rates of duty in the fifth, sixth, seventh, and eighth years, and excluded bifacial modules from the safeguard measure. As a result of an agreement between USTR and the Government of Canada, USTR suspended the application of the safeguard measure to imports of CSPV products originating in Canada, applicable as of February 1, 2022.

Second monitoring proceeding

The Commission instituted this proceeding on June 8, 2023, 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. 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 2020, 2021, and 2022, and interim periods January-June 2022 and January-June 2023. The Commission received useable questionnaire responses from 13 U.S. firms that are estimated to have accounted for more than 80 percent of known U.S. capacity to produce CSPV modules in 2022. No U.S. producers reported producing CSPV cells since 2020. The Commission received useable questionnaire responses from 45 firms that are estimated to have accounted for 71.9 percent of U.S. imports of CSPV products during 2022. The Commission also received useable questionnaire responses from 49 U.S. purchasers and 30 foreign producers.

During this proceeding, the Commission received briefs and written submissions from several industry participants, including U.S. producers, importers, and trade associations. The Commission held a hearing in Washington, DC, on November 14, 2023, at which it received testimony from representatives of many of these same industry participants.

Market developments

As was the case during previous proceedings, demand for CSPV products is 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, and local incentives. While electricity demand in the United States remains supplied primarily by conventional sources, the share of electricity generated from renewable energy sources has been steadily increasing.

During the review period, the solar market has been affected by numerous regulatory policies, overlapping incentives, and supply chain disruptions. These include the COVID-19 pandemic; the Withhold Release Order issued by U.S. Customs and Border Protection pursuant to the Uyghur Forced Labor Prevention Act ("WRO/UFLPA"); the section 301, section 232, and AD/CVD tariffs on CSPV products and certain inputs; the IRA; the safeguard tariffs; DOC's anti-circumvention inquiry and subsequent Presidential moratorium on AD/CVD tariffs on CSPV products imported from certain Southeast Asian countries that would otherwise have been applied; and the exemption of bifacial modules from the safeguard measure.

Apparent U.S. consumption of both CSPV cells, which is currently supplied entirely by imports, and CSPV modules fluctuated but increased overall between 2020 and 2022. Apparent U.S. consumption of both CSPV cells and CSPV modules was higher in January-June 2023 than in January-June 2022. The vast majority of responding firms reported that demand for CSPV products inside and outside the United States increased since February 7, 2018 and they expect it to continue to increase across all sectors in the future.

Overall imports of CSPV products increased from 2020 to 2022 and were higher in the first half of 2023 compared with the first half of 2022, as CSPV module producers imported CSPV cells as inputs to ramp up U.S. production and many firms imported CSPV modules prior to the implementation of the IRA. There was a shift in imports from non-bifacial CSPV products to bifacial CSPV products beginning in 2020 and accelerating markedly between 2021 and 2022. Imports of bifacial CSPV products were higher in the first half of 2023 than in the first half of 2022. Import market share for CSPV modules based on quantity decreased overall between 2020 and 2022, decreasing during 2020-21 then increasing during 2021-22, and was higher in the first half of 2023 compared with the first half of 2022. CSPV products from Malaysia, South Korea, Thailand, and Vietnam comprised the majority of imports in 2020-22 and the first half of 2023.

Developments in the domestic industry

Since the extension proceeding, there has been no domestic production of CSPV cells. However, several firms have announced plans to start CSPV cell production in the near future, primarily due to the IRA. During the review period, several firms also invested in domestic CSPV module production or announced planned investments, with the investments geared toward expanding existing operations and opening new facilities. During 2020-22, domestic CSPV module capacity and production fluctuated but increased overall. Capacity was lower while production was higher in the first half of 2023 compared to the first half of 2022; capacity utilization was higher during the first half of 2023 compared with the first half of 2022. By quantity, the domestic industry's U.S. shipments of CSPV modules increased between 2020 and 2022 but were lower in January-June 2023 than in January-June 2022. Although the majority of U.S. producers' production and U.S. shipments consisted of non-bifacial modules, several producers reported using imported bifacial cells in their non-bifacial module production operations.

U.S. CSPV module employment and total hours worked decreased during 2020-22, though improved somewhat from 2021 to 2022, and were higher in January-June 2023 than in January-June 2022. Other employment indicators increased overall between 2020 and 2022, including hours worked per worker, wages paid, hourly wages, productivity, and unit labor costs. CSPV module producers reported higher employment, wages paid, hours worked, and hours worked per worker in the first half of 2023 compared with the first half of 2022, but lower hourly wages, productivity, and unit labor costs.

U.S. CSPV module producers gained market share overall from 2020-22, though their share of the market declined between 2021 and 2022 and was lower in the first half of 2023 than in the first half of 2022. Financial performance varied among module producers based on firm-specific circumstances, and overall results were mixed, with net sales increasing by quantity and value from 2020 to 2022, gross profits improving, and capital expenditures increasing, but the industry operating at a loss throughout the review period. The average unit value of U.S. shipments by the domestic industry producing CSPV modules and of U.S. imports of CSPV cells and CSPV modules alike generally increased between 2020 and 2022 but were lower in January-June 2023 relative to January-June 2022.

Based on quarterly sales price data collected on six narrowly defined CSPV modules, prices for imported CSPV products and domestically produced CSPV products initially decreased through mid-2021, then increased through the end of 2022/beginning of 2023, then decreased thereafter. Prices for imported CSPV modules were lower than prices for U.S.-produced

modules in the majority of quarterly comparisons (45 of 62). Other pricing information and statements from participants in this current proceeding, as in previous proceedings, were mixed regarding price trends, but generally indicated that a combination of factors, including 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, but the safeguard measure caused U.S. prices for CSPV products to be higher than they would otherwise have been.

Industry participants generally reported that the cost of raw materials, demand trends in the United States, the section 201 safeguard measures, and transportation/delivery costs had caused CSPV products' prices to increase since January 1, 2020, while responses were mixed with respect to the impact of local, state, and federal government incentives on the price of CSPV products. Most U.S. producers and a plurality of importers reported that changes in the level of competition from imports also increased prices, while a plurality of purchasers reported that it decreased prices. Technology improvements was the only factor whose change was reported by pluralities of all three firm types (U.S. producers, importers, and purchasers) to lead to price decreases.

Adjustment efforts

Pursuant to 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.

The safeguard measure has resulted in positive industry adjustments in terms of significant expansion and investment in domestic CSPV module manufacturing and announced plans to restart domestic CSPV cell manufacturing. In addition, most trade and employment indicators for the domestic CSPV module industry were higher in 2022 compared to 2017, the year prior to imposition of the safeguard measures, including apparent U.S. consumption, U.S. producers' market share, capacity, production, and employment. While module producers continue to experience operating and net losses, their combined ratios of operating and net income to net sales have improved in 2022 compared to 2017.

Since 2022, at least 11 new U.S. CSPV cell plants have been publicly announced or are under consideration. All 11 CSPV cell plants announced they would begin production sometime during late 2024 through 2026. All but one announced initial capacities ranging from 1 GW to 10 GW. According to Clean Energy Associates ("CEA"), a clean energy advisory company, public announcements of U.S. cell capacity additions total 84 GW, of which CEA expects 33 GW to be

operational by 2027. At least 23 U.S. CSPV module manufacturing plants have been publicly announced and are at various stages of development. Industry experts estimate that over 150 GW in additional module capacity by 2027 has been announced but expect fewer than half of announced investments to be online by 2027. One firm launched new U.S.-based CSPV module operations during 2020-22, and at least eight firms expanded or increased capacity at existing U.S. CSPV module operations.

Notwithstanding these positive industry adjustments, and domestic producers affirming positive effects from the safeguard measure, certain U.S. producers assert that the safeguard measure on imported cells, without sufficient domestic cell manufacturing capacity, has negatively affected CSPV module producers. In addition, certain U.S. producers assert that the exclusion of bifacial CSPV modules from the safeguard remedy has undermined its effectiveness.

In addition, several U.S. CSPV module producers argue that the current 5.0 GW quota on CSPV cell imports will be insufficient to supply the U.S. CSPV module industry and will be exceeded in 2024. They claim that an increase, or elimination, of the quota is necessary to protect the growth of the U.S. CSPV module producers, which has been facilitated by the safeguard measures in effect. On the other hand, U.S. CSPV cell producer Suniva argues that the current CSPV cell quota (which it argues should not be increased) and the exclusion of bifacial CSPV modules from the safeguard measures have limited the benefits of the intended relief. Suniva further argues that given the size of the CSPV cell quota the measure has yet to result in the imposition of meaningful tariffs on CSPV cells, and increasing the TRQ threshold would further prioritize module assembly at the expense of U.S. cell production.

Part I: Introduction and overview

On February 4, 2022, the safeguard action imposed by the President on imports of certain crystalline silicon photovoltaic cells, whether or not partially or fully assembled into other products ("CSPV products"), was extended by an additional four years. Section 204(a)(1) of the Trade Act of 1974 ("The Trade Act") requires the U.S. International Trade Commission ("USITC" or "Commission"), so long as any action under section 203 of the Trade 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. Section 204(a)(2) of the Trade Act requires that whenever the initial period of an action under section 203 exceeds 3 years, or if an extension of such action 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, and of each such extension, during which the action is in effect, or in this case by February 6, 2024. Table I-1 provides information relating to the schedule of this monitoring proceeding.[1]

Table I-1
CSPV products: Information relating to the background and schedule of this proceeding

Effective date	Action
June 8, 2023	Institution of Commission's investigation (88 FR 38892, June 14, 2023)
November 14, 2023	Commission's hearing
February 6, 2024	Scheduled date for the Commission's transmittal of report to the President and Congress

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

Background

On May 17, 2017, a petition, as amended, was properly filed under section 202(a) of the Trade Act (19 U.S.C. § 2552(a)) by counsel for Suniva Inc. ("Suniva"). The petition alleged that 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.[2] The Commission conducted an investigation under section 202(b)(1)(A) of the Trade Act. Following receipt of the report from the Commission in November 2017 under section 202 of the Trade Act (19 U.S.C. § 2252) containing an affirmative serious injury determination and remedy recommendations, the President, on January 23, 2018, pursuant to section 203 of the Trade Act (19 U.S.C. § 2253), issued Proclamation 9693, imposing a safeguard measure in the form of (a) a tariff-rate quota ("TRQ") 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]

On July 25, 2019,[5] the Commission instituted a proceeding for the purpose of preparing a report to the President and the Congress required by section 204(a)(2) of the Trade Act[6] on the results of its monitoring of developments with respect to the domestic industry producing CSPV products since the imposition of the TRQ on imports of CSPV cells and the increase in duties on imports of CSPV modules. On February 7, 2020, the Commission issued its report of its monitoring of developments with respect to the domestic CSPV products industry.[7] Additionally, in response to a request by the U.S. Trade Representative ("USTR") in a letter dated December 6, 2019,[8] the Commission analyzed the effect of increasing the level of the

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

[3] 83 FR 3541, January 25, 2018.

[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).

[7] Crystalline Silicon Photovoltaic Cells, Whether or Not Partially or Fully Assembled Into Other Products: Monitoring Developments in the Domestic Industry, Inv. No. TA-201-075 (Monitoring), USITC Publication 5021, February 2020 ("Monitoring publication").

[8] USTR's request for probable economic effect advice was made pursuant to section 204(a)(4) of the Trade Act (19 U.S.C. § 2254(a)(4)). Section 204(a)(4) of the Trade Act 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
(continued...)

TRQ covering CSPV cells from 2.5 gigawatts ("GW")[9] to 4.0, 5.0, or 6.0 GW, without other changes to the remedy.[10] Following receipt of the monitoring and modification reports, the President issued Proclamation 10101, effective October 10, 2020, revoking the exclusion previously applied to bifacial modules and increasing the duty on cells entered in excess of the TRQ, and the duty on modules, from 15 percent to 18 percent in the fourth year of the safeguard action.[11] On November 16, 2021, the Court of International Trade ("CIT") issued a decision setting aside Proclamation 10101 as null and void, on the grounds that it was outside the President's delegated statutory authority.[12]

On August 6, 2021, the Commission instituted a proceeding following receipt of petitions filed by Auxin Solar Inc. ("Auxin") and Suniva on August 2, 2021 and amended on August 5, 2021, and filed by Hanwha Q CELLS USA, Inc. ("Hanwha"), LG Electronics USA, Inc. ("LG"), and Mission Solar Energy LLC ("Mission") on August 4, 2021, requesting extension of the relief action in place on imports of CSPV products.[13] On December 8, 2021, the Commission determined that action under section 203 of the Trade Act with respect to imports of CSPV products continued to be necessary to prevent or remedy serious injury and that there was evidence that the domestic industry was making a positive adjustment to import competition.[14] After taking into account the information provided in the Commission's report and the

203 of the Trade Act (a safeguard measure) that is under consideration. The President has delegated certain authority to the USTR for this purpose.

[9] 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)).

[10] 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, Inv. No. TA-201-075 (Modification), USITC Publication 5032, March 2020 ("Modification report").

[11] 85 FR 65639, October 16, 2020. The sections "Scope of the safeguard remedy" and "The safeguard measure" in this Part contain additional information on the safeguard measure and excluded products.

[12] *Solar Energy Indus. Ass'n v. United States*, slip op. 21-154 (Ct. Int'l Trade Nov. 16, 2021). On November 13, 2023, the U.S. Court of Appeals for the Federal Circuit issued a decision reversing the judgment of the CIT, upholding the President's interpretation that the statute permitted such modifications of the safeguard measure, finding that the President did not violate the procedural requirements of the statute, and accordingly concluding that Presidential Proclamation 10101 was not invalid. *Solar Energy Indus. Ass'n v. United States*, Case No. 2022-1392 (Fed. Cir. Nov. 13, 2023).

[13] 86 FR 44403, August 12, 2021. The Commission exercised its authority under section 603(a) of the Trade Act (19 U.S.C. 2482(a)) to consolidate the proceedings.

[14] 86 FR 71092, December 14, 2021.

information received from the public,[15] the President issued Proclamation 10339, extending the TRQ covering CSPV cells,[16] and the duty on modules,[17] by an additional four years.

Scope of the safeguard remedy

Presidential Proclamation 9693 of January 23, 2018

According to Presidential Proclamation 9693,[18] 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-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 . . .*

[15] 86 FR 54279, September 30, 2021.

[16] With unchanging within-quota quantities of 5.0 GW for each year and annual reductions in the rates of duty applicable to goods entered in excess of those quantities of cells in the fifth, sixth, seventh, and eighth years. 87 FR 7357, February 9, 2022.

[17] With annual reductions in the fifth, sixth, seventh, and eighth years. Ibid.

[18] 83 FR 3541, January 23, 2018.

{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, 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:[19]

(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;

(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;

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

(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:[20]

(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;
(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,[21] 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 TRQ on imports of solar cells not partially or fully 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.[22]

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[20] 84 FR 27684, June 13, 2019.

[21] 83 FR 3541, January 25, 2018.

[22] The countries listed in Presidential Proclamation 9693 as developing countries that are WTO members and not subject to the safeguard duties or TRQ 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, (continued...)

In Presidential Proclamation 10339 of February 4, 2022,[23] the President announced an extension and modification of the existing safeguard measure for an additional four years beginning on February 7, 2022. The Presidential Proclamation extended the TRQ measure on CSPV cells and increased the within-quota quantity to 5.0 GW for each year. The President also extended the increase in duties on imports of solar modules and included an exemption for bifacial modules. As a result of an agreement between USTR and the Government of Canada reached on July 8, 2022, USTR suspended the application of the safeguard measure on imports of CSPV products originating in Canada, applicable as of February 1, 2022.[24]

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. During the first four years of the measure, the annual aggregate in-quota quantity of solar cell imports not exceeding 2.5 GW in each year under the TRQ was to be allocated among all countries, except those that were specifically excluded. On February 4, 2022, the President extended the measure an additional four years and increased the aggregate in-quota quantity to 5.0 GW in each year. The Presidential Proclamation also extended the annual reductions in the rates of duty applicable to

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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 beneficiary developing countries as of May 17, 2019. India was removed from the list of beneficiary developing countries as of June 5, 2019. Proclamation to Modify the List of Beneficiary Developing Countries Under the Trade Act, 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, May 31, 2019, https://www.whitehouse.gov/presidential-actions/proclamation-modify-list-beneficiary-developing-countries-trade-act-1974-2/, retrieved January 12, 2020.

[23] 87 FR 7357, February 9, 2022.

[24] 87 FR 43369, July 20, 2022.

goods entered in excess of those quantities in the fifth, sixth, seventh, and eighth years. Table I-2 presents the safeguard TRQ measure on CSPV cells.[25]

Table I-2
CSPV cells: Safeguard TRQ measure on cells

Duty in percent ad valorem; quantity in GW

Period	Annual in-quota quantity	Safeguard duty on imported cells exceeding annual in-quota quantity
February 7, 2018 - February 6, 2019	2.5	30.0
February 7, 2019 - February 6, 2020	2.5	25.0
February 7, 2020 - February 6, 2021	2.5	20.0
February 7, 2021 - February 6, 2022	2.5	15.0
February 7, 2022 - February 6, 2023	5.0	14.75
February 7, 2023 - February 6, 2024	5.0	14.50
February 7, 2024 - February 6, 2025	5.0	14.25
February 7, 2025 - February 6, 2026	5.0	14.0

Source: 83 FR 3541, January 25, 2018; 87 FR 7357, February 9, 2022.

Note: The increase in duties in the fourth year of the measure from 15.0 percent to 18.0 percent set forth in Presidential Proclamation 10101 (85 FR 65639, October 16, 2020) was set aside by the CIT on November 16, 2021.

[25] Since the imposition of the safeguard measure, the level of imported cells subject to the TRQ reached 2.5 GW in its fourth year (February 7, 2021 - February 6, 2022). Since the increase in the in-quota quantity to 5.0 GW, the level of imported cells subject to the TRQ has yet to reach 5.0 GW. See U.S. Customs and Border Protection, CSPV Solar Cells Historical Fill Table, May 12, 2023, https://www.cbp.gov/document/report/cpsv-solar-cells-historical-fill-table, retrieved November 2, 2023. As of December 18, 2023, the TRQ for the period beginning February 7, 2023, has been 65.98 percent filled. See U.S. Customs and Border Protection, Weekly Commodity Status Reports, December 18, 2023, at https://www.cbp.gov/trade/quota/tariff-rate-quotas. Historical fill rates and quantities are presented in appendix F.

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. On February 4, 2022, the President extended the measure an additional four years, with annual reductions in the rates of duty in the fifth, sixth, seventh, and eighth years. The additional duty will be 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).[26] Table I-3 presents the import duties under the safeguard measure on CSPV modules.

Table I-3
CSPV modules: Safeguard measure on modules

Duty in percent ad valorem

Period	Safeguard duty on imported modules
February 7, 2018 - February 6, 2019	30.0
February 7, 2019 - February 6, 2020	25.0
February 7, 2020 - February 6, 2021	20.0
February 7, 2021 - February 6, 2022	15.0
February 7, 2022 - February 6, 2023	14.75
February 7, 2023 - February 6, 2024	14.50
February 7, 2024 - February 6, 2025	14.25
February 7, 2025 - February 6, 2026	14.0

Source: 83 FR 3541, January 25, 2018; 87 FR 7357, February 9, 2022.

Note: The increase in duties in the fourth year of the measure from 15.0 percent to 18.0 percent set forth in Presidential Proclamation 10101 (85 FR 65639, October 16, 2020) was set aside by the CIT on November 16, 2021.

[26] 83 FR 3541, January 25, 2018; and 87 FR 7357, February 9, 2022.

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").[27]

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 14.50 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 14.50 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.[28] 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 safeguard measure 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:

[27] 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.

[28] 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.

photovoltaic generators of a kind described in statistical note 9 to subchapter 85),[29] 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 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).[30] 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").

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."[31] When assessing what constitutes the product(s) that is/are like or directly competitive with the imported article(s), the Commission takes into account such factors as (1) the physical properties of the article, (2) its customs treatment, (3) its manufacturing process (i.e., where and how it is made), (4) its uses, and (5) the marketing

[29] 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).

[30] HTS subheading 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.

[31] 19 U.S.C. § 2252(b)(1)(A).

channels through which the product is sold. 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.[32]

Description and applications[33]

CSPV 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[34] convert sunlight into electricity for on-site use or for distribution through the electric grid.

CSPV cells

CSPV cells use crystalline silicon to convert sunlight to electricity and are the basic elements of a CSPV module (figure I-1). CSPV cells may be fully square or may have slightly rounded corners ("pseudo square").

[32] Safeguard publication, pp. 13 and 16-18.

[33] 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. This section is derived from Monitoring publication, pp. I-54–I-59 and I-72–80. Citations to direct quotes, pictures, and data were retained.

[34] 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-1
CSPV products: CSPV cells

Source: International Energy Agency website, https://www.iea.org/reports/solar-pv-global-supply-chains, retrieved December 19, 2023.

Common sizes of CSPV cells, as measured by the side length of the cell, and the type of wafer used in producing cells of that size are shown in table I-4.

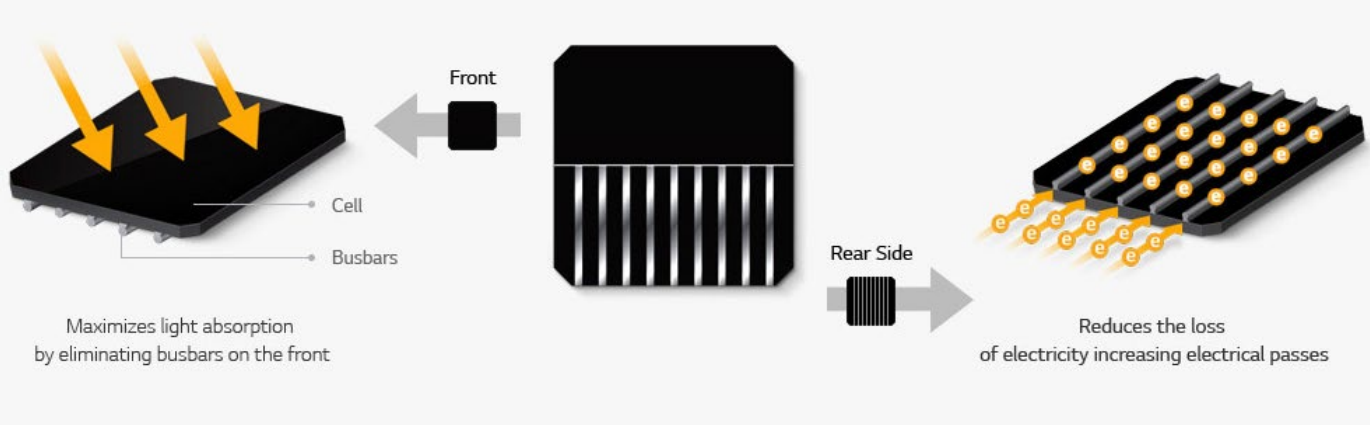
Table I-4
CSPV cells: Examples of wafer sizes used in monocrystalline cell production

Wafer	Side length in mm
M0	156
M2	156.75
G1	158.75
M4	161.7 or 161.75
M6	166
M10	182
M12/G12	210

Sources: ITRPV, *Results 2019 Including Maturity Report 2020*, p. 17, https://itrpv.vdma.org, retrieved September 29, 2021; ITRPV, 2020 Results, p. 14, https://itrpv.vdma.org, retrieved September 28, 2021; and ITRPV, *2022 Results*, p. 11, https://itrpv.vdma.org, retrieved December 11, 2023.

CSPV cells 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.[35] The number of busbars in cells varies, and has increased over time as more busbars improve efficiency and power output.[36] Further, some cells contain no busbars ("busbarless"), which can provide benefits such as reducing electrical losses and increasing the surface area of the CSPV cell that can absorb sunlight. Alternatively, some cells have metal contacts on the rear side of the CSPV cell, creating back (or rear contact) cells (including interdigitated back contact ("IBC") cells) (figure I-2). This provides several advantages such as reduced shading, improved cell interconnection, and better aesthetics.

Figure I-2
CSPV products: Back contact CSPV cells



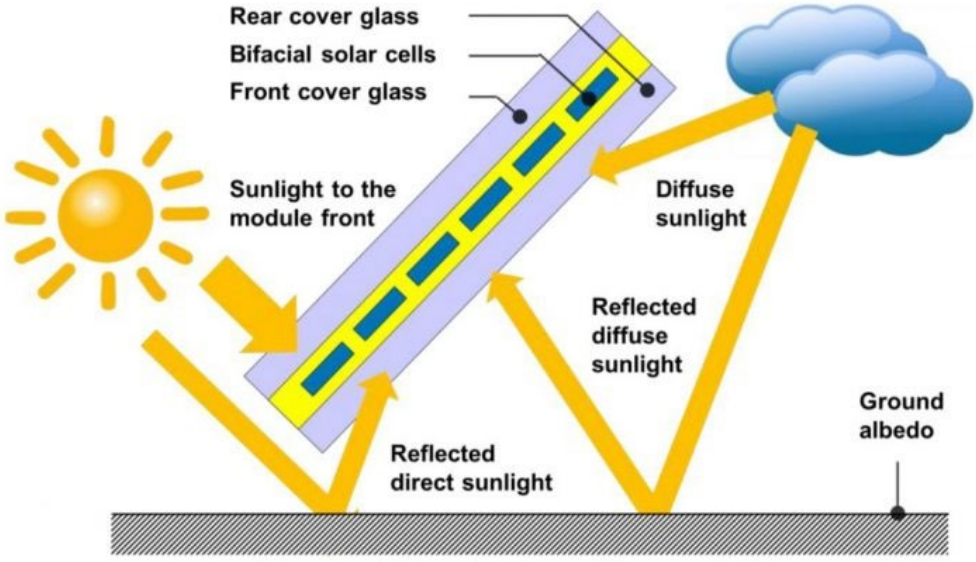
Source: Solar Analytica website, https://solaranalytica.com/lg-neon-r-report/, retrieved December 19, 2023.

[35] 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.

[36] In 2018, 3 and 4 busbar cells accounted for more than 40 percent of the global market, with 5 busbar cells accounting for most of the remaining market. In 2020, there was almost no production of cells with fewer than 5 busbars and cells with more than 6 busbars accounted for more than 40 percent of the global market. In 2022, cells with fewer than 6 busbars accounted for less than 5 percent of the global market, while layouts with 9 to 12 busbar cells accounted for more than 70 percent of the global market. International Technology Roadmap for Photovoltaic (ITRPV), *Results 2018 Including Maturity Report 2019*, p. 37, https://itrpv.vdma.org, retrieved December 20, 2023; ITRPV, *2020 Results,* p. 27, https://itrpv.vdma.org, retrieved December 20, 2023; and ITRPV, *2022 Results*, pp. 27-28, https://itrpv.vdma.org, retrieved December 11, 2023.

CSPV cells can be either monofacial or bifacial. Bifacial CSPV cells convert light that hits both the front and back of the CSPV cell into electricity (figure I-3). Whereas monofacial 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 Passive Emitter Rear Contact ("PERC") or heterojunction technologies, discussed later in this section.

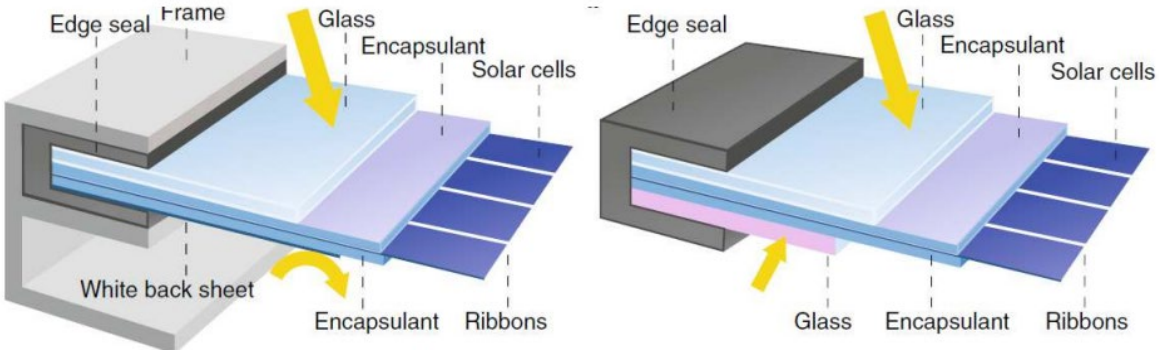
Figure I-3
CSPV products: Bifacial photovoltaic modules absorb sunlight on both sides of the module



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 December 20, 2023.

When assembled into CSPV modules, bifacial modules use a transparent back sheet or rear glass layer to allow reflected sunlight on the rear of the CSPV cell. Figure I-4 shows a monofacial module on the left with a traditional back sheet, and a bifacial module on the right with a glass layer that allows light through the back side of the cell.

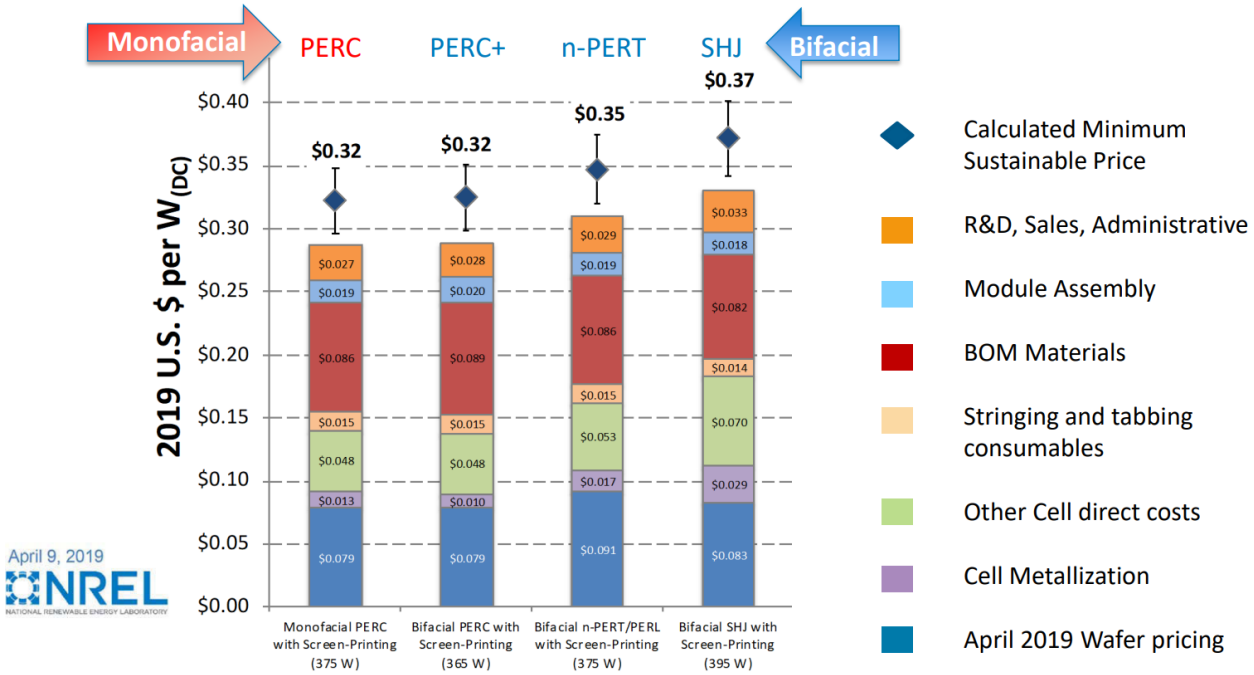
Figure I-4
CSPV products: Assembly of a monofacial module (left) and bifacial module (right)



Source: IEA PVPS, *Bifacial Photovoltaic Modules and Systems: Experience and Results from International Research and Pilot Applications 2021*, IEA-PVPS T13-14:2021, p. 28 https://iea-pvps.org/wp-content/uploads/2021/04/IEA-PVPS-T13-14_2021-Bifacial-Photovoltaic-Modules-and-Systems-report.pdf, retrieved October 23, 2023.

As monofacial and bifacial modules have moved closer to cost parity (figure I-5), manufacturers who have switched from assembling monofacial modules to bifacial modules have had to make a few adjustments to their production lines, such as replacing the traditional back sheet with glass and sourcing bifacial cells.

Figure I-5
CSPV products: Manufacturing cost of monofacial and bifacial modules



Source: National Renewable Energy Laboratory, *Bifacial PV System Performance: Separating Fact from Fiction*, p. 6 https://www.nrel.gov/docs/fy19osti/74090.pdf, retrieved October 23, 2023.

The two main types of CSPV cells are monocrystalline and multicrystalline (or polycrystalline) silicon, though there are various subtypes within these two categories, as discussed below. 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.[37]

Monocrystalline and multicrystalline cells commonly use PERC and related technologies.[38] 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. 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.

Monocrystalline cells can be either p-type or n-type. In the production of p-type of monocrystalline CSPV wafers, the silicon is doped with boron or gallium to create a positive electrical orientation.[39] 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 and no light-induced degradation. Heterojunction n-type CSPV cells (including heterojunction with intrinsic thin layer ("HIT")) add thin layers of photosensitive semiconductor materials (such as amorphous silicon) on top of an n-type monocrystalline wafer. These additional layers increase the absorption of sunlight and the overall efficiencies of the CSPV cells, as well as improve performance in hot climates. Tunnel Oxide Passivated Contacts ("TOPCon") is another technology used for n-type cells. TOPCon cells are created by "depositing a nanometer scale layer of silicon oxide, followed by a thicker polycrystalline silicon layer, between the silicon wafer and metal contacts. The layers reduce charge recombination between the wafer and the contacts, increasing carrier lifetime and resulting in a conversion efficiency boost."[40]

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

[38] Related technologies include Passivated Emitter Rear Totally Diffused ("PERT") and Passivated Emitter Rear Locally Diffused ("PERL").

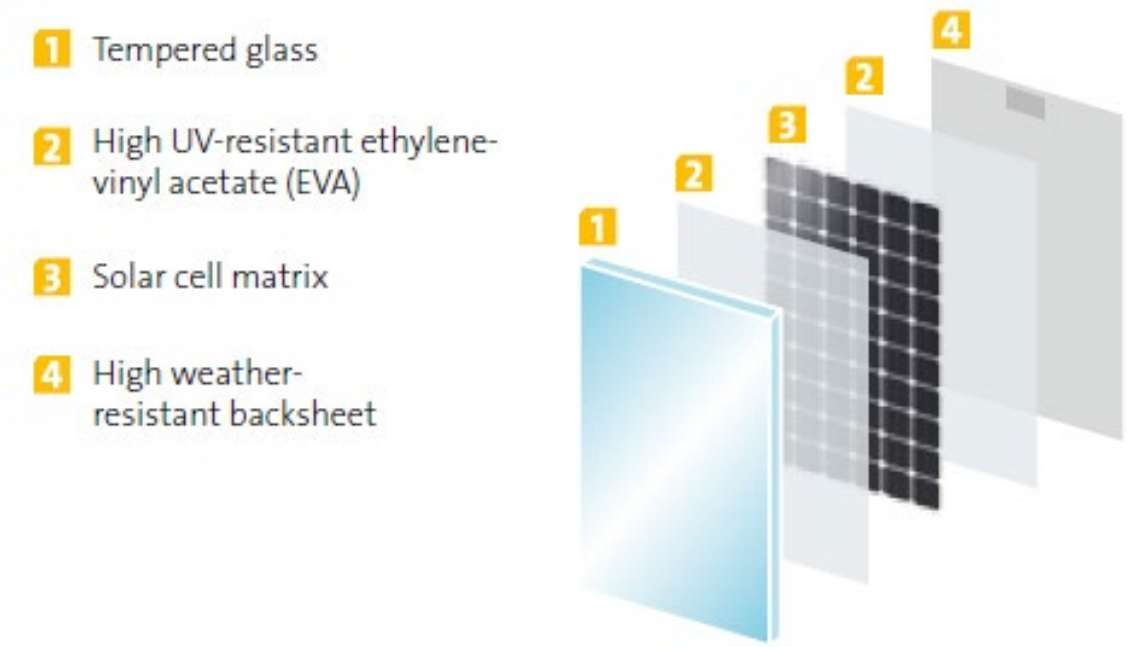
[39] ITRPV, *2020 Results*, pp. 8–9, https://itrpv.vdma.org, retrieved December 20, 2023.

[40] Gifford, Jonathan, "Topcon N-Type Solar Cell Technology Could Be a Rival to Mono PERC," *PV Magazine*, March 7, 2020, https://pv-magazine-usa.com/2020/03/07/topcon-n-type-solar-cell-technology-could-be-a-rival-to-mono-perc/, retrieved December 20, 2023.

CSPV laminates

CSPV laminates consist of CSPV cells that are connected, encapsulated (most commonly in an ethyl vinyl acetate ("EVA") film), and covered with a glass front layer and a back sheet or rear glass (figure I-6). The back sheet is most commonly glass in bifacial CSPV modules and plastic film composite in other modules. CSPV laminates can use full cells or cells cut in smaller pieces, such as half-cut cells. These are standard CSPV cells that are cut, 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. Some products use shingling, paving, and other low or zero gap technologies to reduce the distance between cells.

Figure I-6
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

CSPV modules typically consist of the laminate that is typically framed in aluminum, and then attached to one or more junction boxes (figure I-7).[41] 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.[42] The junction box can be connected to other modules, an inverter (which converts the direct current generated by the system to alternating current), or, in the case of off-grid modules, a battery and a charge controller (which controls battery charging).

Figure I-7
CSPV products: CSPV module with half-cut cells

Source: Solar Power World website, https://www.solarpowerworldonline.com/2019/04/hanwha-q-cells-newest-half-cell-module-will-launch-in-usa-later-this-year/, retrieved December 19, 2023.

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

[42] 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.

The most common on-grid CSPV modules have 60 cells (or 120 half cut cells) or 72 cells (or 144 half cut cells). Common sizes of 72 cell solar modules, depending on the size of the wafer, are shown in table I-5. The average module efficiency, for global module production in 2022, was 21 percent for PERC (and related technologies) p-type monocrystalline, 22 percent for n-type TOPCon monocrystalline, 22.4 percent for n-type heterojunction, and more than 22.5 percent for n-type back contact.[43]

Table I-5
CSPV modules: Typical 72 cell module area by wafer size, 2020

Wafer	Wafer side length in mm	Module area, square meters
M0	156	1.94
M2	156.75	2.00
G1	158.75	2.05
M4	161.7 or 161.75	2.11
M6	166	2.24
M10	182	2.56
M12/G12 (60 cell module)	210	2.40

Sources: Chunduri, Shravan K. and Michael Schmela, *500W+ Solar Modules, 2020 Edition*, Taiyang News, p. 10, http://taiyangnews.info/reports/500w-solar-modules-2020/, retrieved December 19, 2023.

The average output of monocrystalline 60/120 half-cut cell module models newly listed on the California Energy Commission's equipment list increased from 301 watts for models listed in 2018 to 328 watts for models listed in 2020. During January to September 2020, the average output was 370 watts. The average output of monocrystalline 72/144 half-cut cell module models newly listed on the California Energy Commission's equipment list increased from 359 watts in 2018 to 397 watts in 2020 and reached 499 watts during January–October 2021. A declining number of multicrystalline modules were added to the list during 2018-21. For 60/120 half-cut cell module models added to the list the average power increased from 274 watts in 2018 to 285 watts in 2020. During January to October 2021, the average output for 60/120 half-cut cell module models was 340 watts. For 72/144 half-cut cell modules the average power increased from 333 watts in 2018 to 344 watts in 2020.[44]

[43] ITRPV, *2022 Results*, p. 44, https://itrpv.vdma.org, retrieved December 11, 2023.

[44] No multicrystalline 72/144 half-cut module models were added during January to October 2021. No change to the data since October 21, 2021. California Energy Commission, PV Module List - Full Data, October 21, 2021, https://www.energy.ca.gov/sites/default/files/2021-10/PV_Module_List_Full_Data_ADA.xlsx, December 19, 2023.

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.

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 is 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). 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.

Uses and market segments[45]

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.[46]

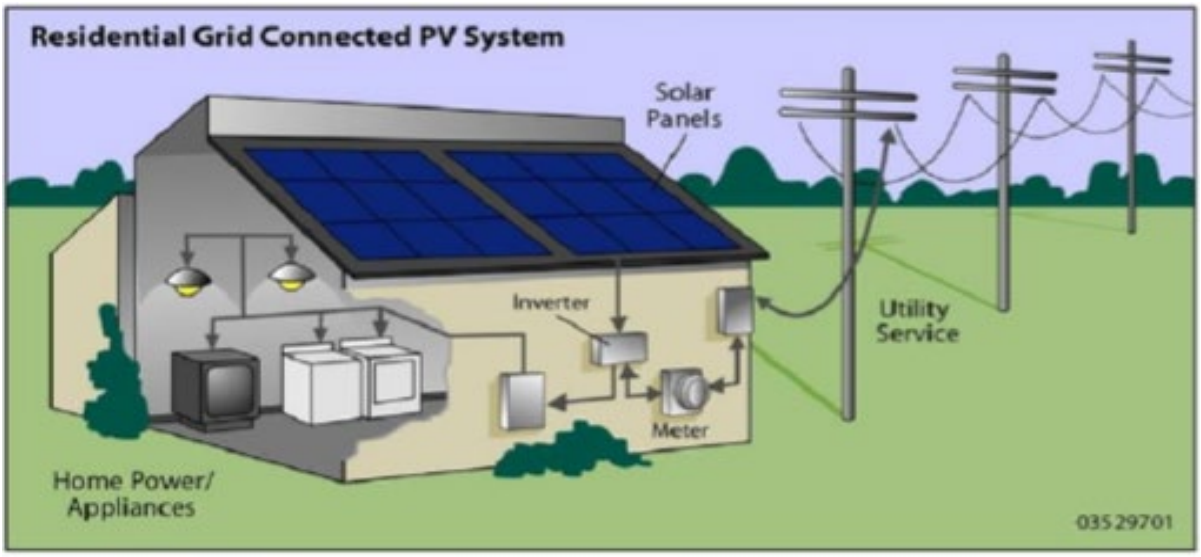
Residential grid-connected systems are installed at individual homes. CSPV modules are typically installed on the roof, though they can also be ground-mounted, and connected to an inverter. The system can use a central inverter, which converts the power from multiple CSPV modules, or each module can have its own microinverter attached. In residential installations, the electricity generated by the system is used for power in the individual home (figure I-8). Homeowners use grid energy when solar electricity generation is not sufficient to meet

[45] This section is derived from Monitoring publication, pp. I-69–I-71. Citations to direct quotes, pictures, and data were retained.

[46] 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.

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 7.2 kW in 2022.[47]

Figure I-8
CSPV products: 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.[48] Nonresidential installations are typically larger than residential installations—for nonresidential systems, the median size in 2022 ranged from 10-100 kW,

[47] Barbose, Galen, Naïm Garghouth, Eric O'Shaughnessy, and Sydney Forrester, *Tracking the Sun, 2023 Edition,* Lawrence Berkeley National Laboratory, September 2023, p. 12, https://emp.lbl.gov/sites/default/files/5_tracking_the_sun_2023_report.pdf, retrieved October 9, 2023.

[48] The nonresidential sector in the WoodMac/SEIA market reports historically included community solar, but community solar is now broken out into a separate sector. Community solar is defined by the U.S. Department of Energy as "any solar project or purchasing program, within a geographic area, in which the benefits of a solar project flow to multiple customers such as individuals, businesses, nonprofits, and other groups. In most cases, customers are benefitting from energy generated by solar panels at an off-site array. Community solar customers can either buy or lease a portion of the solar panels in the array, and they typically receive an electric bill credit for electricity generated by their share of the community solar system—similar to someone who has rooftop panels installed on their home." U.S. Department of Energy Website, "Community Solar Basics," https://www.energy.gov/eere/solar/community-solar-basics, retrieved December 20, 2023. For more information on community solar, see section entitled "U.S. policies."

though systems can be substantially larger.[49] 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.

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-9). 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-9
CSPV products: La Ola PV plant, a utility CSPV system on Lanai, Hawaii

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

[49] Barbose, Galen, Naïm Garghouth, Eric O'Shaughnessy, and Sydney Forrester, *Tracking the Sun, 2023 Edition,* Lawrence Berkeley National Laboratory, September 2023, p. 12, https://emp.lbl.gov/sites/default/files/5_tracking_the_sun_2023_report.pdf, retrieved October 9, 2023.

As shown in table I-6, responding purchasers reported shares of select module technologies for the three grid-connected market segments in the United States. Bifacial modules accounted for *** percent of the residential market, *** percent of the commercial, and *** percent of the utility market. According to responding purchasers, bifacial modules represented *** percent of overall grid-connected market in 2022.

Table I-6
CSPV modules: U.S. purchasers, product type and market segment, 2022
Quantity in kilowatts; Share in percent

Product type	Measure	Residential	Commercial	Utility	Total
Bifacial	Quantity	***	***	***	***
Non-Bifacial	Quantity	***	***	***	***
Bifacial	Share	***	***	***	***
Non-Bifacial	Share	***	***	***	***

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

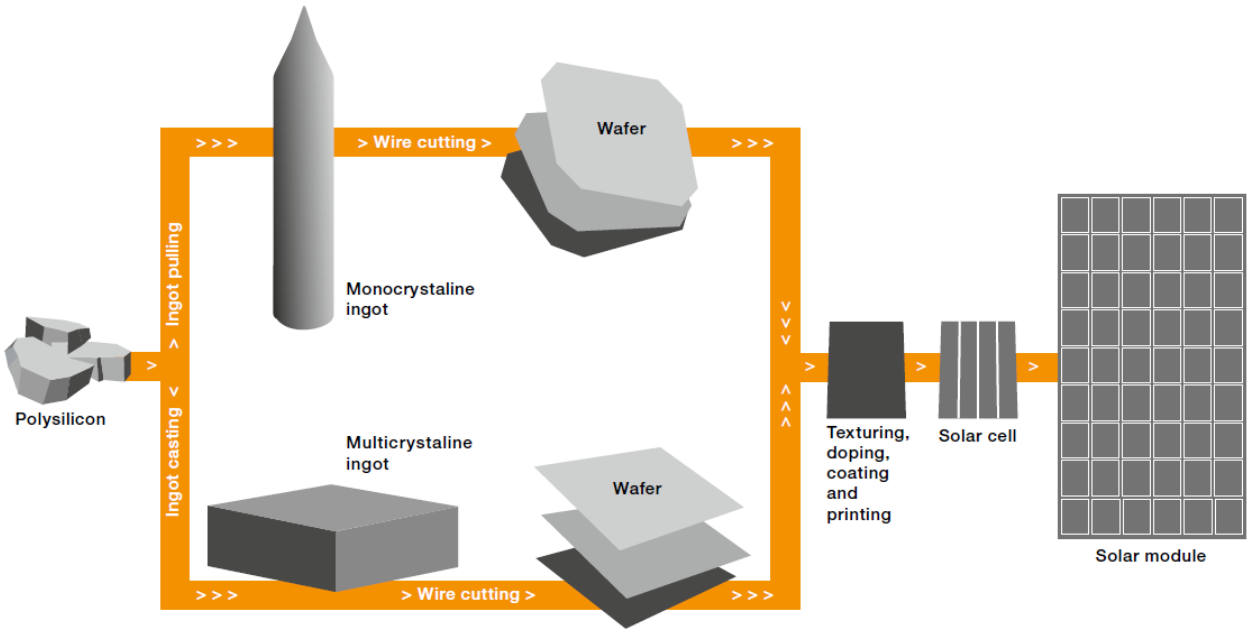
There are a broad range of off-grid applications, such as power generation in remote locations, mobile power solutions, telecommunications power and lighting systems, and portable consumer goods (such as systems for recharging consumer electronics like tablets and phones). These systems often have additional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

Manufacturing facilities and processes[50]

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.

[50] Unless otherwise noted, this section is derived from Monitoring publication, pp. I-59–I-68.

Figure I-10
CSPV products: CSPV module production process



Source: Wacker Chemie AG, "Polysilicon," n.d., p. 10, https://www.wacker.com/h/medias/7416-EN.pdf, retrieved December 20, 2023.

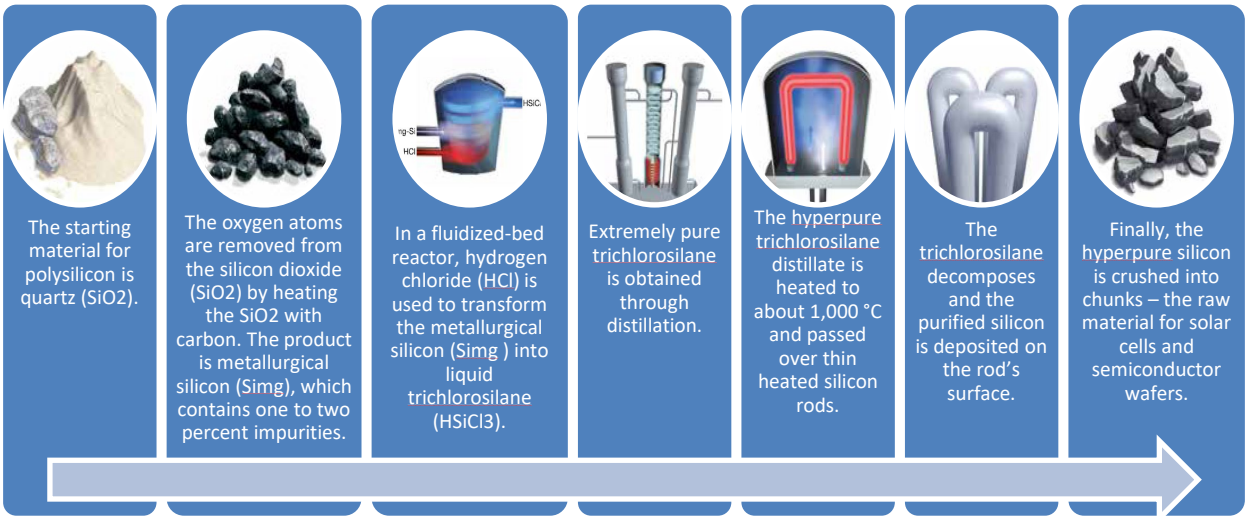
Polysilicon

The first step in the CSPV value chain is refining polysilicon.[51] In the Siemens process (figure I-11), used in the majority of global polysilicon production, 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 resulting in the liquid trichlorosilane. The trichlorosilane is then distilled to increase its purity. Next, heated silicon rods are inserted into a chemical vapor deposition reactor, and hydrogen

[51] This discussion will focus on the Siemens method, which accounted for more than 90 percent of global production in 2022. 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, *2022 Results*, p. 6, https://itrpv.vdma.org, retrieved December 11, 2023; REC Silicon webpage, https://recsilicon.com/technology/, retrieved December 20, 2023.

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.

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



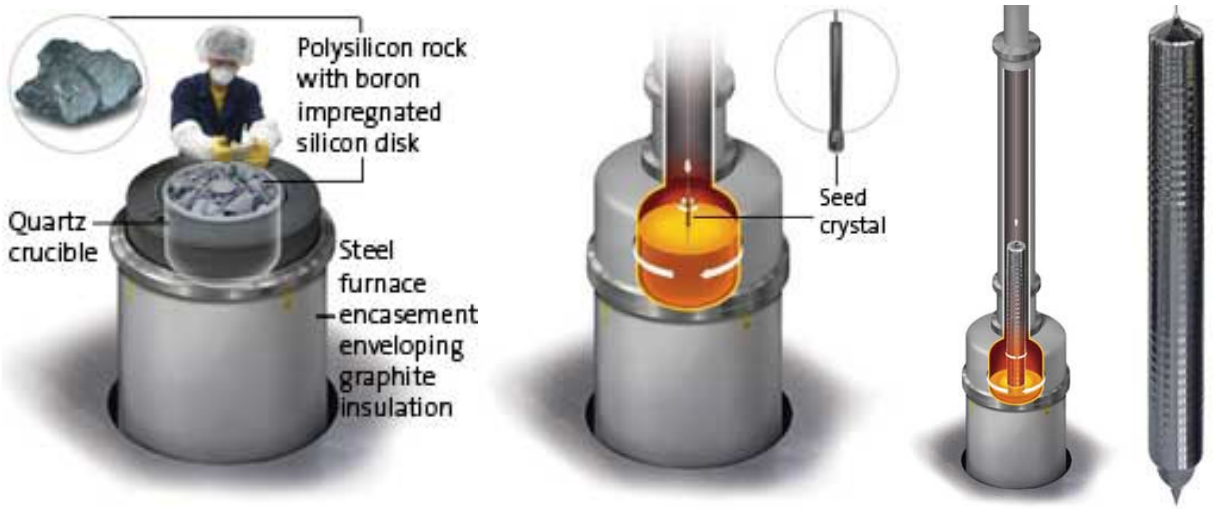
Source: Wacker Chemie AG, "Polysilicon," n.d., p. 8, https://www.wacker.com/h/medias/7416-EN.pdf, retrieved December 20, 2023.

Ingots

In the Czochralski ("Cz") process for producing crystals used in monocrystalline ingots, polysilicon chunks are first placed into a quartz crucible along with a dopant (boron or gallium), which is used to provide a positive electric orientation (figure I-12).[52] The polysilicon often includes both virgin polysilicon and waste polysilicon generated at later stages of the production process. 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.

[52] ITRPV, *2020 Results*, pp. 8–9, https://itrpv.vdma.org, retrieved December 20, 2023.

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)



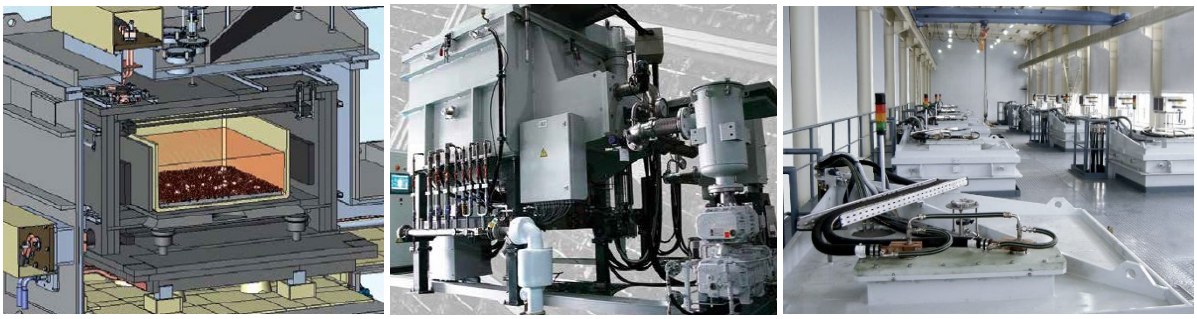
Source: SolarWorld, https://www.slideshare.net/al-solar/solar-101eng-by-solar-world, retrieved December 20, 2023.

The speed of ingot pulling has increased over time, as has the size of ingots.[53] Firms are moving toward rechargeable Czochralski ("RCz") and continuous Czochralski ("CCz") production processes. These processes enable firms to increase the amount that they can cast in a 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.

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). Argon is fed into the furnace to "remove impurities and inhibit oxidation." The "molten silicon is cast into a block and crystallized, forming a multicrystalline structure as the molten silicon and crucible cool." For cast mono ingots (also referred to as quasi-mono or mono-like ingots), which have higher conversion efficiencies, seed ingots are used in the furnace to produce an ingot with a more mono-type crystal structure.

[53] ITRPV, *2022 Results*, p. 8, https://itrpv.vdma.org, retrieved December 11, 2023.

Figure I-13
CSPV products: 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 December 20, 2023; ALD Vacuum Technologies Webpage, https://www.ald-vt.com/portfolio/engineering/vacuum-metallurgy/silicon-crystallization-unit/, retrieved December 20, 2023.

Wafers

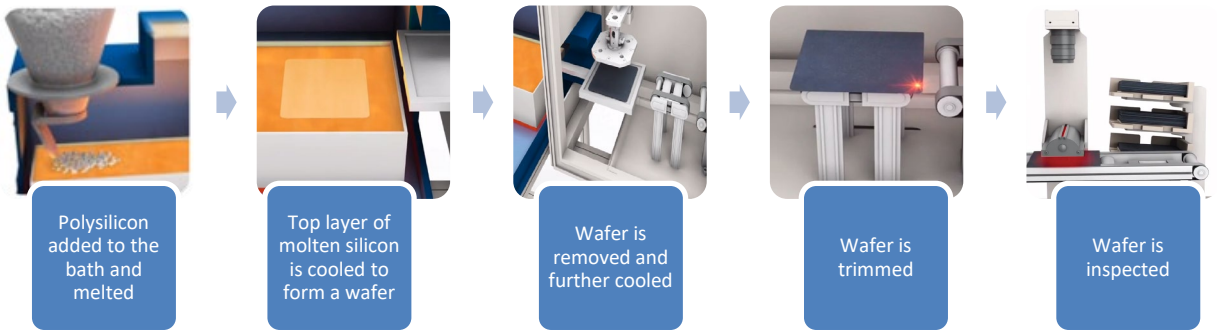
Once the ingot has cooled, it is processed into wafers. For monocrystalline ingots: (1) the top and tail (each end of the cylindrical crystal) are cut off, (2) the remaining portion of the crystal (or ingot) is cut into equal length pieces, (3) the ingot is squared,[54] (4) edges are ground, and (5) 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. 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.[55]

Another 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. One such process is shown in figure I-14.

[54] In monocrystalline ingot squaring, the rounded sides of the ingot are cut into four flat sides, leaving—in some cases—rounded corners.

[55] Bernreuter Research, "Solar wafer makers accelerate switch to diamond wire saws," July 10, 2017, https://www.bernreuter.com/newsroom/polysilicon-news/article/solar-wafer-makers-accelerate-switch-to-diamond-wire-saws/, retrieved December 20, 2023.

Figure I-14
CSPV products: Direct wafer manufacturing process



Source: CubicPV website, https://cubicpv.com/how-the-direct-wafer-process-works/, retrieved December 20, 2023.

CSPV cells[56]

The monocrystalline and multicrystalline wafers 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 doped layer below creates a positive-negative, or p/n, junction–a critical partition in the functioning of a PV cell."[57]
- **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 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.

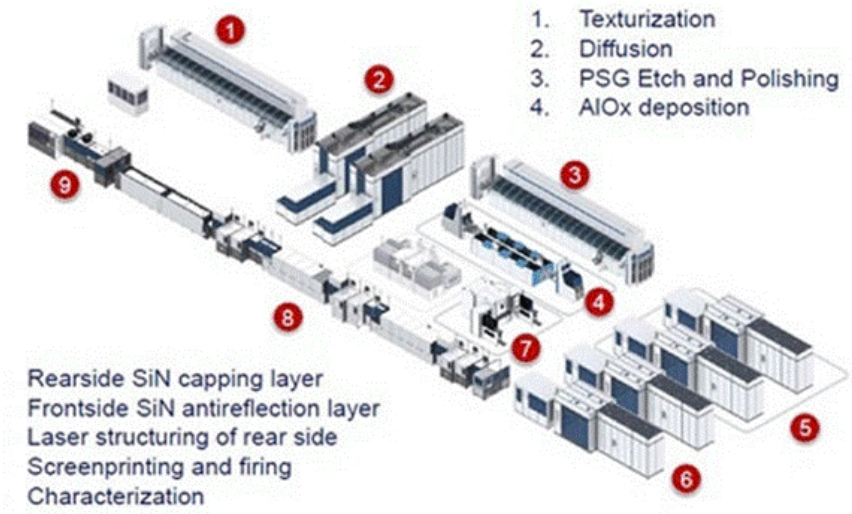
[56] The cell manufacturing process varies by company and technology. This section will only describe the process for producing an aluminum back surface field cell and a monocrystalline PERC cell.

[57] SolarWorld, "Energy for You and Me" brochure, p. 12, https://www.akamaienergyhawaii.com/dimages/17118/solar-101-eng-solar-photovoltaic.pdf, retrieved December 20, 2023.

- **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."[58]
- **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 aluminum back surface field ("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.

Figure I-15
CSPV products: CSPV cell production process



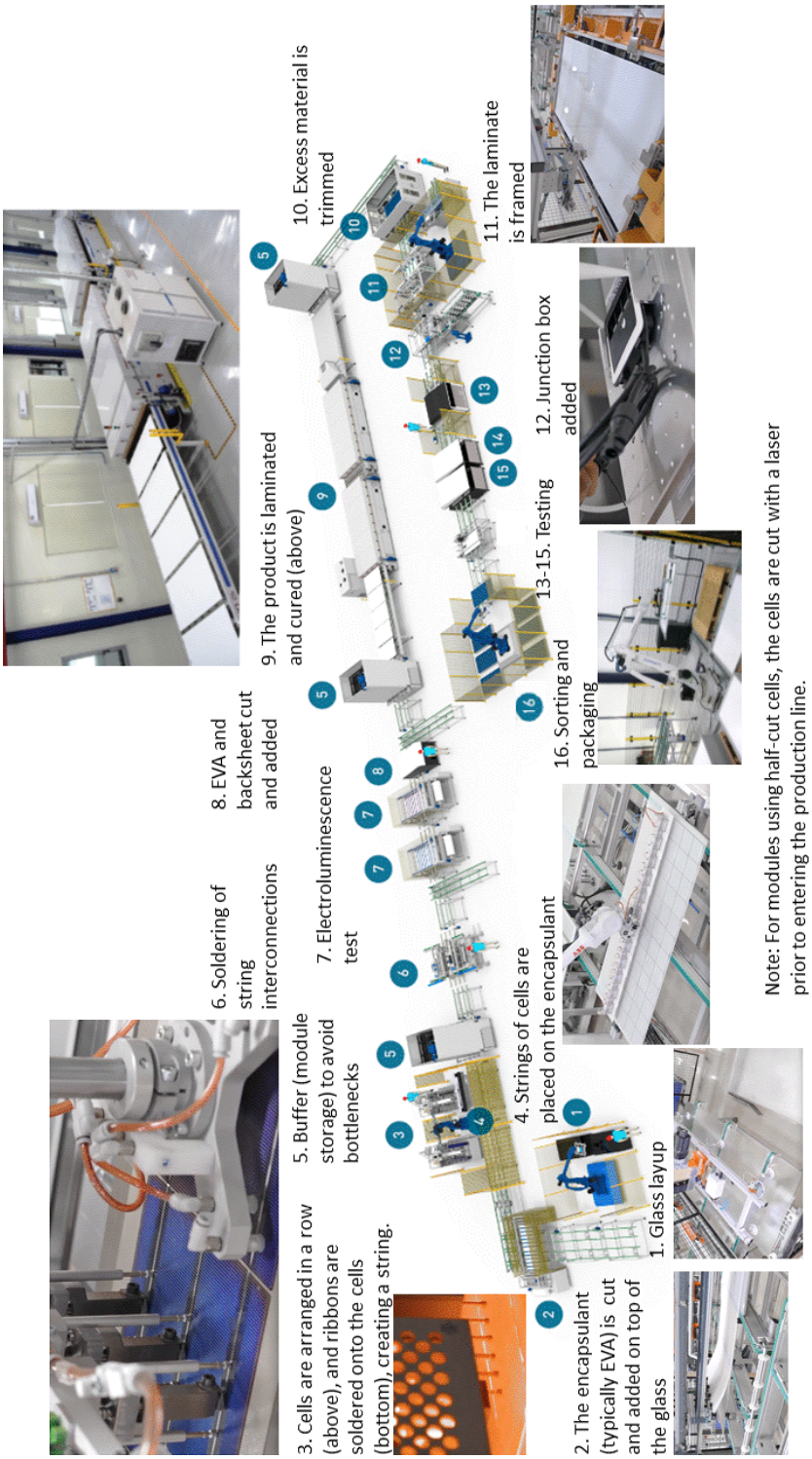
Source: CETC Solar Energy website, http://cetcsolarenergy.com/products/solar_pv_production_equipments.html, retrieved December 20, 2023.

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

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. 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.

Figure I-16
CSPV products: CSPV module production process, highly automated assembly line



Source: Ecoprogetti Webpage, https://ecoprogetti.com/100mw-hc-highly-automatic-production-line/, retrieved December 20, 2023; Mondragon Assembly, "Turnkey Solar Module Manufacturing Line–PV Module Factory–Mondragon Assembly," https://www.youtube.com/watch?v=_KTrq63Q2u4, retrieved December 20, 2023.

Out-of-scope thin-film modules

U.S. installations of thin-film modules in the utility segment, the largest market segment for thin-film products, increased from 3.3 GW in 2020 to 4.8 GW in 2022. Installations of cadmium telluride (CdTe) thin-film modules, increased from 3.3 GW in 2020 to 4.7 GW in 2022 (table I-7). Other technologies accounted for a much smaller share of the utility market.[59] Thin-film modules are installed in residential and nonresidential applications, but account for only a small share of the market.

Table I-7
U.S. thin-film utility installations, by technology and period

Quantity in megawatts

Technology	2020	2021	2022
Cadmium telluride	3,256	4,945	4,692
Copper indium (gallium) selenide	35	0	125
Amorphous silicon	0	0	0
Other	0	345	28
Total	3,291	5,290	4,845

Source: U.S. Department of Energy, Energy Information Administration, 2022 Form EIA-860 – Schedule 3, 'Solar Technology Data' (Operable Units Only), September 19, 2023, https://www.eia.gov/electricity/data/eia860/, retrieved October 9, 2023.

Note: The "other" category is other thin-film products in the data set and is not further defined.

From 2020 to 2021, the share of global production of thin-film silicon technologies decreased from 3.6 percent to 3.4 percent. In 2021, global production of thin-film PV modules was approximately 8.2 GW, of which around 7.9 GW were CdTe PV modules produced by First Solar.[60] First Solar has manufacturing locations in the United States, Vietnam, and Malaysia. As of 2022, First Solar's manufacturing capacity in the United States was approximately 6.3 GW, with plans to add approximately 7.9 GW of capacity by 2026.[61]

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[59] U.S. Department of Energy, Energy Information Administration, 2022 Form EIA-860 – Schedule 3, 'Solar Technology Data' (Operable Units Only), September 19, 2023, https://www.eia.gov/electricity/data/eia860/, retrieved October 9, 2023.

[60] IEA PVPS, *Trends in Photovoltaic Applications 2022*, IEA-PVPS T1-43:2022, p. 49, https://iea-pvps.org/wp-content/uploads/2023/02/PVPS_Trend_Report_2022.pdf, retrieved August 4, 2023.

[61] First Solar, "American Solar: First Solar to Invest up to $1.1 Billion in Fifth US Manufacturing Facility, Adding 3.5 GW of Nameplate Capacity in 2026," July 27, 2023, https://investor.firstsolar.com/news/news-details/2023/American-Solar-First-Solar-to-Invest-up-to-1.1-Billion-in-Fifth-US-Manufacturing-Facility-Adding-3.5-GW-of-Nameplate-Capacity-in-2026/default.aspx, retrieved October 10, 2023.

WTO proceedings

On May 14, 2018, South 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 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, South Korea requested the establishment of a panel and at its meeting on September 26, 2018, the DSB established a panel.[62]

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.[63] 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. On September 2, 2021, the WTO panel circulated its final report in this dispute, rejecting China's claims and upholding the Commission's serious injury determination in its safeguard investigation of imports of CSPV products.[64] China notified the WTO Dispute Settlement Body on September 16, 2021 that it intended to appeal to the WTO Appellate Body certain issues in the panel report, while noting that there is currently no division of the Appellate Body that can be established to hear the appeal.[65]

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

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

[64] WTO, "WT/DS562/R: United States – Safeguard Measure on Imports of Crystalline Silicon Photovoltaic Products, Report of the Panel (2 September 2021)."

[65] WTO, "WT/DS562/12: United States – Safeguard Measure on Imports of Crystalline Silicon Photovoltaic Products (20 September 2021)."

Previous and related Commission investigations

Inv. Nos. 701-TA-481 and 731-TA-1190 ("CSPV 1")

The antidumping ("AD") and countervailing duty ("CVD") investigations on CSPV cells and modules from China (Inv. Nos. 701-TA-481 and 731-TA-1190) (hereinafter referred to as "CSPV 1") resulted from petitions filed by SolarWorld Industries America, Inc. on October 19, 2011.[66] On October 12, 2012, the U.S. Department of Commerce ("Commerce") announced its final affirmative determinations in its AD/CVD investigations on CSPV cells and modules from China. The countervailable subsidy margins ranged from 14.78 percent to 15.97 percent[67] and the estimated weighted-average dumping margins ranged from 18.32 percent to 249.96 percent.[68] 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 subsidized by the Government of China.[69] Effective December 7, 2012, Commerce issued AD/CVD orders on those imports.[70] 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.[71]

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[66] 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.

[67] 77 FR 63788, October 17, 2012.

[68] 77 FR 63791, October 17, 2012. On August 4, 2015, the U.S. Trade Representative 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. 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.

[69] CSPV 1 original publication, p. 1 (all six Commissioners reached affirmative determinations).

[70] 77 FR 73017, December 7, 2012; 77 FR 73018, December 7, 2012.

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

On November 1, 2017, the Commission gave notice, pursuant to Section 751(c) of the Tariff Act of 1930, as amended,[72] that it had instituted its first five-year reviews of the CSPV 1 orders[73] and on February 5, 2018, the Commission determined that it would conduct full reviews.[74] 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 AD/CVD 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.[75] Commerce issued a continuation of the AD/CVD orders on imports of CSPV cells and modules from China, effective March 20, 2019.[76] [77]

Inv. Nos. 701-TA-511 and 731-TA-1246-1247 ("CSPV 2")

The AD/CVD 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.[78] On December 16, 2014, Commerce announced its final affirmative determinations in its AD investigations on CSPV cells and modules from China and Taiwan and its CVD investigation on CSPV cells and modules from China. The countervailable subsidy margins ranged from 27.64 percent to 49.79 percent for China.[79] 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.[80] 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

[72] 19 U.S.C. 1675(c).
[73] 82 FR 50681 and 50612, November 1, 2017.
[74] 83 FR 8296, February 26, 2018.
[75] 84 FR 8342, March 7, 2019.
[76] 84 FR 10299 and 10300, March 20, 2019.
[77] On August 16, 2021, the American Solar Manufacturers Against Chinese Circumvention ("A-SMACC") filed requests with Commerce to investigate imports from certain producers of CSPV cells and modules from China that are completed in Malaysia, Thailand, and Vietnam which they alleged to have circumvented the AD/CVD orders on imports of CSPV products from China. On November 10, 2021, Commerce rejected these requests, citing the refusal of A-SMACC members to publicly identify themselves. Letter from Commerce to Timothy Brightbill, Wiley Rein LLP, Re: Crystalline Silicon Photovoltaic Cells, Whether or Not Assembled into Modules, from the People's Republic of China: Requests for Circumvention Inquiries, November 10, 2021.
[78] CSPV 2 original publication, p. I-1.
[79] 79 FR 76962, December 23, 2014.
[80] 79 FR 76970, December 23, 2014; 79 FR 76966, December 23, 2014.

imports from China that Commerce found were sold at LTFV and subsidized by the Government of China.[81] Effective February 18, 2015, Commerce issued AD/CVD orders on those imports from China and an AD order on those imports from Taiwan.[82]

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.[83]

On January 2, 2020, the Commission gave notice, pursuant to Section 751(c) of the Tariff Act of 1930, as amended,[84] that it had instituted first five-year reviews of the CSPV 2 orders[85] and on April 6, 2020, the Commission determined that it would conduct expedited reviews.[86] On the basis of the record developed in the first five-year reviews of the CSPV 2 orders, the Commission determined on August 31, 2020, pursuant to the Tariff Act of 1930, that revocation of the AD/CVD orders on CSPV cells and modules from China, and revocation of the antidumping duty order on CSPV cells and modules from Taiwan, would be likely to lead to continuation or recurrence of material injury to an industry in the United States within a reasonably foreseeable time.[87] Commerce issued a continuation of the AD/CVD orders on

[81] 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.

[82] 80 FR 8592 and 8596, February 18, 2015.

[83] 79 FR 76962 and 76970, December 23, 2014; *see also* CSPV 2 original publication, pp. 3-4 and 6. The 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).

[84] 19 U.S.C. 1675(c).

[85] 85 FR 120, January 2, 2020.

[86] 85 FR 42430, July 14, 2020.

[87] 85 FR 55319, September 4, 2020.

imports of CSPV cells and modules from China, and of the antidumping duty order on imports of CSPV cells and modules from Taiwan, effective September 11, 2020.[88]

Commerce's Circumvention Inquiries

On April 1, 2022, in response to the request from Auxin, Commerce initiated country-wide circumvention inquiries to determine whether imports of CSPV cells, whether or not assembled into modules, produced in Cambodia, Malaysia, Thailand, or Vietnam using Chinese CSPV cells are circumventing the AD/CVD orders on CSPV cells and modules from China.[89] On June 6, 2022, President Biden declared an emergency under Section 318 of the Tariff Act of 1930, and authorized the Secretary of Commerce to allow the importation, free of AD/CVD duties, of certain solar cells and modules from Cambodia, Malaysia, Thailand, and Vietnam.[90] On September 16, 2022, Commerce published its Final Rule creating procedures in accordance with the President's emergency declaration.[91] On December 8, 2022, Commerce published its preliminary affirmative determinations of circumvention with respect to Cambodia, Malaysia, Thailand, and Vietnam.[92] On May 3, 2023, Congress passed H.J.Res. 39 disapproving of Commerce's September 16 Final Rule.[93] President Biden vetoed H.J.Res. 39 on May 16, 2023,[94] and a vote in the House of Representatives to override the President's veto failed on May 24, 2023.[95] On August 17, 2023, Commerce issued its final determination in the anticircumvention investigation, determining that, with some exceptions, imports of certain solar cells and modules that were completed in Cambodia, Malaysia, Thailand, or Vietnam using parts and components produced in China, and then subsequently exported from Cambodia, Malaysia, Thailand, or Vietnam to the United States, were circumventing the AD/CVD orders on solar cells from China.[96] However, in light of the President's emergency declaration and Commerce's final rule, there will be a moratorium for a period of time (currently through June 2024) on any AD/CVD duties on imports of solar cells and modules from these four countries resulting from Commerce's final determination of circumvention.

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[88] 85 FR 56215, September 11, 2020.
[89] 87 FR 19071, April 1, 2022.
[90] 87 FR 35067, June 9, 2022.
[91] 87 FR 56868, September 16, 2022.
[92] 87 FR 75221, December 8, 2022.
[93] H.J.Res.39, 118th Congress.
[94] The White House, "Message to the House of Representatives – President's Veto of H.J. Res. 39," May 16, 2023.
[95] 118th Congress, Roll Call 233.
[96] 88 FR 57419, August 23, 2023.

Inv. Nos. 701-TA-475 and 731-TA-1177

The AD/CVD investigations on aluminum extrusions, primary raw materials for CSPV products, from China (Inv. Nos. 701-TA-475 and 731-TA-1177) resulted from petitions filed by the Aluminum Extrusions Fair Trade Committee ("AEFTC") and the United Steel, Paper and Forestry, Rubber, Manufacturing, Energy, Allied Industrial and Service Workers International Union ("USW") on March 31, 2010. In May 2011, the Commission determined that an industry in the United States was materially injured by reason of imports of certain aluminum extrusions from China other than certain finished heat sinks ("FHS") that Commerce had found to be sold in the United States at LTFV and subsidized by the government of China.[97] The Commission, however, determined that the domestic FHS industry was not materially injured or threatened with material injury by reason of imports of FHS from China.[98] On May 26, 2011, Commerce issued AD/CVD orders with respect to imports of certain aluminum extrusions from China other than FHS.[99]

On April 1, 2016, the Commission instituted the first five-year reviews.[100] On March 27, 2017, after conducting full reviews,[101] the Commission determined that revocation of the AD/CVD orders on aluminum extrusions 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.[102] Commerce issued a notice of continuation of the orders on April 25, 2017.[103]

The Commission instituted the second five-year reviews on March 1, 2022.[104] On June 6, 2022, the Commission determined to conduct expedited reviews of the orders.[105] On October 21, 2022, the Commission determined that revocation of the AD/CVD orders on aluminum extrusions from China would be likely to lead to continuation or recurrence of material injury to

[97] Certain Aluminum Extrusions from China, Inv. Nos. 701-TA-475 and 731-TA-1177 (Final), USITC Publication 4229, May 2011.

[98] Ibid.

[99] 76 FR 30650, May 26, 2011.; 76 FR 30653, May 26, 2011. The CIT upheld Commerce's revision of the scope language to reflect the exclusion of FHS. Aluminum Extrusions Fair Trade Committee v. United States, 968 F. Supp. 2d 1244 (Ct. Int'l Trade 2014).

[100] Institution of Five-Year Reviews, 81 FR 18884 April 1, 2016.

[101] 81 FR 45304, July 13, 2016.

[102] Certain Aluminum Extrusions from China, Inv. Nos. 701-TA-475 and 731-TA-1177 (Review), USITC Publication 4677, March 2017.

[103] 82 FR 19025, April 25, 2017.

[104] 87 FR 11470 March 1, 2022.

[105] 87 FR 57518 September 20, 2022.

an industry in the United States within a reasonably foreseeable time.[106] Commerce issued a notice of continuation of the orders on November 2, 2022.[107]

Section 232 investigations (Commerce)

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.[108] Steel is generally not a major input into CSPV cells and modules, but may be used in balance of systems components (such as tracking systems on which modules are mounted) for solar installations.[109] [110]

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.[111] 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.[112] [113]

[106] 87 FR 64113, October 21, 2022.
[107] 87 FR 66128, November 2, 2022.
[108] 83 FR 11625, March 15, 2018.
[109] NEXTracker Webpage, https://www.nextracker.com/product-services/solar-storage/nx-horizon/, retrieved October 22, 2019.
[110] See U.S. notes 16(a) and 16(b), subchapter III of chapter 99.
[111] 83 FR 11619, March 15, 2018.
[112] Energysage, "What is Solar Racking?" August 22, 2019, https://news.energysage.com/solar-racking-overview/, retrieved October 22, 2019.
[113] See U.S. notes 19(a), 19(b), 19(c), 19(d), and 19(e), subchapter III of chapter 99.

Section 301 proceeding

CSPV cells and modules imported from China, as well as various components used in CSPV module production such as ethylene vinyl acetate (EVA) encapsulants, tempered glass, and backsheets, are subject to additional 25 percent ad valorem duties under Section 301 of the Trade Act.[114] [115] HTS subheadings 3920.10.00, 3920.62.00, 8501.31.80, 8501.32.60, and 8541.40.60 were included in the August 23, 2019 (List 2) tariff action.[116] HTS subheadings 7007.19.00 and 8507.20.80 were included among the September 24, 2019 (List 3) tariff action.[117] Certain small and low wattage products, however, are exempt from the duties as are certain types of tempered glass used in module production. Table I-8 presents information on section 301 tariffs on select inputs into cell and module production.

[114] 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.

[115] In this current monitoring investigation, U.S. producers of CSPV products reported that certain machinery and equipment used in the manufacture of CSPV products were also included in the Section 301 tariff action. Hanwha reported that the tariff action affected crucibles for producing ingots and diamond wire for making wafers. Suniva reported components used in the print process were also included in the tariff action. See Hearing transcript, pp. 110-111 (Connolly) and p. 111 (Card). Hanwha reported that it is estimated to pay approximately $*** in 2024 in Section 301 duties on imports of key inputs, equipment, and machinery used in the manufacture of CSPV products. Canadian Solar, Heliene, and Silfab reported that collectively they incurred more than $*** in 2023 in Section 301 duties and expect to incur more than $*** in 2024-25. See Hanwha's posthearing brief, pp. 5-6; and Canadian Solar, Heliene, and Silfab's posthearing brief, pp. 6-7.

[116] See U.S. notes 20(c) and 20(d), subchapter III of HTS chapter 99 which discuses articles and products from China. For HTS subheading 9903.88.02, the ad valorem duty is 25.0-percent and included in the August 23, 2019 (List 2) $16 Billion Tariff Action. HTS 8541.40.60 includes out-of-scope thin film products. USTR, *Notice of Modification of Section 301 Action: China's Acts, Policies, and Practices Related to Technology Transfer, Intellectual Property, and Innovation*, 83 FR 40823, August 16, 2018. HTSUS (2021) Revision 8, USITC Publication 5225, October 2021, pp. 99-III-20 - 99-III-23.

[117] See U.S. notes 20(e) and 20(f), subchapter III of chapter 99 which discuses articles and products from China. For HTS subheading 9903.88.03, the ad valorem duty is 25.0-percent and included in the September 24, 2019 (List 3) $200 Billion Tariff Action. 83 FR 47974, September 21, 2018. HTSUS (2021) Revision 8, USITC Publication 5225, October 2021, pp. 99-III-24 - 99-III-46. USTR published a notice on March 26, 2020 that retroactively excluded tempered glass from September 24, 2018, the effective date of the $200 billion action, to August 7, 2020. 85 FR 17158, March 26, 2020.

Table I-8
CSPV products: Section 301 tariffs on CSPV products and select inputs

Item	Associated HTS subheading	List
CSPV cells and modules	8541.42.00; 8541.43.00	List 2
DC photovoltaic generators of an output not exceeding 50 W	8501.71.00	List 2
DC photovoltaic generators of an output not exceeding 750 W	8501.72.10	List 2
DC photovoltaic generators of an output exceeding 750 W but not exceeding 75kW	8501.72.20	List 2
DC photovoltaic generators of an output exceeding 75 kW but not exceeding 375kW	8501.72.30	List 1
Other DC photovoltaic generators	8501.72.90	List 1
AC photovoltaic generators of an output not exceeding 75 kVA	8501.80.10	List 3
AC photovoltaic generators of an output exceeding 75 kVA but not exceeding 375 kVA	8501.80.20	List 1
AC photovoltaic generators of an output exceeding 375 kVA but not exceeding 750 kVA	8501.80.30	List 1
Other AC photovoltaic generators	8501.80.90	List 1
Other lead-acid storage batteries of a kind described in subheading 9903.45.25	8507.20.80	List 3
Wafers	3818.00.00	List 3
EVA encapsulants	3920.10.00	List 2
Backsheets	3920.62.00	List 2
Tempered low iron glass	7007.19.00	List 3
Module frames	8541.90.00	List 1

Source: Compiled from staff research.

Note: List 1 is a $34 billion tariff action, effective July 6, 2018; List 2 is a $16 billion tariff action, effective August 23, 2018; List 3 is a $200 billion tariff action, effective September 24, 2018. Certain small and low wattage products, however, are exempt from the duties as are certain types of tempered glass used in module production. USTR published a notice on March 26, 2020 that retroactively excluded sheets of tempered safety glass, coated with silicone oxide, having a surface area of less than 2.5 m^2, designed to be placed over solar cell panels for protection from external damage (described in statistical reporting number 7007.19.0000) from September 24, 2018, the effective date of the $200 billion action, to August 7, 2020.

Global developments

Global installations

Global PV system installations (including out-of-scope thin-film), according to the International Energy Agency ("IEA"), increased from 145.5 GW in 2020 to 235.8 GW in 2022 (table I-9).[118] The largest markets in 2022 were China (105.5 GW, 44.7 percent of installations), the United States (21.1 GW, 8.9 percent), India (18.1 GW, 7.7 percent), and Brazil (9.9 GW, 4.2 percent).[119]

Table I-9
CSPV products: Global PV (including out-of-scope thin film) installations, by country and period

Installations in GW

Country	2020	2021	2022
China	48.2	55.0	105.5
United States	19.7	24.1	21.1
India	4.4	13.0	18.1
Brazil	2.9	5.7	9.9
Spain	3.5	4.9	8.5
Germany	4.9	5.8	7.2
Japan	8.7	6.6	6.7
Poland	2.6	3.7	4.9
Australia	4.5	4.9	4.2
Netherlands	3.0	3.6	3.9
Rest of World	42.8	47.2	45.8
Total	145.2	174.5	235.8

Source: IEA PVPS, *Trends in Photovoltaic Applications 2021*, IEA-PVPS T1-41:2021, pp. 12-14 https://iea-pvps.org/wp-content/uploads/2022/01/IEA-PVPS-Trends-report-2021-4.pdf, retrieved August 4, 2023; IEA PVPS, *Trends in Photovoltaic Applications 2022*, IEA-PVPS T1-43:2022, pp. 9,11-14 https://iea-pvps.org/wp-content/uploads/2023/02/PVPS_Trend_Report_2022.pdf, retrieved August 4, 2023; IEA PVPS, *Trends in Photovoltaic Applications 2023*, EIA-PVPS T1-43:2023, pp. 11-13 https://iea-pvps.org/wp-content/uploads/2023/10/PVPS_Trends_Report_2023_WEB.pdf, retrieved October 12, 2023.

Note: Top ten countries in installed capacity in 2022.

[118] The latest version of data from IEA includes revisions to 2021-2023 installation totals. IEA PVPS, *Trends in Photovoltaic Applications 2022*, IEA-PVPS T1-43:2022, pp. 11-12 https://iea-pvps.org/wp-content/uploads/2023/02/PVPS_Trend_Report_2022.pdf, retrieved August 4, 2023; IEA PVPS, *Trends in Photovoltaic Applications 2023*, EIA-PVPS T1-43:2023, pp. 11-13 https://iea-pvps.org/wp-content/uploads/2023/10/PVPS_Trends_Report_2023_WEB.pdf, retrieved October 12, 2023.

[119] IEA PVPS, *Trends in Photovoltaic Applications 2023*, EIA-PVPS T1-43:2023, pp. 11-13 https://iea-pvps.org/wp-content/uploads/2023/10/PVPS_Trends_Report_2023_WEB.pdf, retrieved October 12, 2023.

Global installations are forecasted to total approximately 341 GW in 2023, 401 GW in 2024, 462 GW in 2025, 534 GW in 2026, and 617 GW in 2027 (table I-10).[120] China, the United States, and India are expected to remain the top three markets for PV installation through 2027.[121] Germany, Spain, Brazil, Australia, Japan, Poland, and Italy are expected to be in the top ten over the same period. Throughout 2023-27, global demand is expected to grow continuously, with China, the United States, and India forecasted to reach a combined installation capacity of 313 GW in 2027.[122]

[120] Solar Power Europe contends that its estimate for solar power PV installation is conservative compared to those of other leading solar analysts, and pointed out that for 2023, S&P Global (formerly IHS Markit) revised its forecast up to 360 GW from 330 GW, PV Infolink expects 351 GW, and BloombergNEF revised its forecast to 344 GW from 316 GW. Solar Power Europe, *Global Market Outlook for Solar Power, 2023-2027*, June 2023, pp. 6, 26, 32-33 https://api.solarpowereurope.org/uploads/Global_Market_Outlook_2023_2027_report_18b86a4568.pdf, retrieved August 7, 2023.

[121] National Renewable Energy Laboratory (NREL) projects growth in annual global PV installations as well as growth in China, the United States, Europe, and India in 2023-26. China 2023 forecast varied across analysts: 154 GW (BNEF), 120-140 GW (China PV Industry Association), and 148 GW (TrendForce), and 141 GW (Solar Power Europe). The United States 2023 PV installation forecast is 34.9 GW (Solar Power Europe) and 29 GW by the US Solar Energy Industries Association (SEIA) and Wood Mackenzie, published in their June Q2 market update. National Renewable Energy Laboratory, Spring 2023 Solar Industry Update, p. 7 https://www.nrel.gov/docs/fy23osti/86215.pdf, retrieved August 7, 2023; SEIA/Wood Mackenzie, *US Solar Market Insight Report Q2 2023*, June 2023, https://www.seia.org/research-resources/solar-market-insight-report-q2-2023#:~:text=As%20supply%20chain%20constraints%20continue,into%20effect%20in%20mid%2DApril, retrieved August 7, 2023; Solar Power Europe, *Global Market Outlook for Solar Power, 2023-2027*, June 2023, p. 28 https://api.solarpowereurope.org/uploads/Global_Market_Outlook_2023_2027_report_18b86a4568.pdf, retrieved August 7, 2023; Taiyang News, "CPIA Raises Solar Installation Forecast For 2023," July 21, 2023, https://taiyangnews.info/markets/cpia-raises-solar-installation-forecast-for-2023/, retrieved August 7, 2023.

[122] Solar Power Europe, *Global Market Outlook for Solar Power, 2023-2027*, June 2023, pp. 32-34 https://api.solarpowereurope.org/uploads/Global_Market_Outlook_2023_2027_report_18b86a4568.pdf, retrieved August 7, 2023.

Table I-10
CSPV products: Global PV installations (including out-of-scope thin film), projected installations, by period

Installations in GW

Country	2023	2024	2025	2026	2027
Total	341	401	462	534	617

Source: Solar Power Europe, *Global Market Outlook for Solar Power, 2023-2027*, June 2023, p. 26 https://api.solarpowereurope.org/uploads/Global_Market_Outlook_2023_2027_report_18b86a4568.pdf, retrieved August 7, 2023.

Note: Solar Power Europe medium case scenario forecast for the annual solar PV market 2023-2027.

Global industry

Global CSPV supply chain

Polysilicon

Global polysilicon production (including for semiconductors) increased from 520,500 metric tons in 2020 to more than 640,800 metric tons in 2021. In 2022, global production increased to approximately 1,001,350 metric tons.[123] Production is primarily for the solar industry, with production of polysilicon for CSPV cells increasing from 497,300 metric tons in 2020 to 604,812 metric tons in 2021.[124] In 2022, global polysilicon production for CSPV cells increased to approximately 955,575 metric tons.[125] China is the largest global polysilicon producer, accounting for 79 percent of global production in 2021, followed by Germany (6

[123] IEA PVPS, *Trends in Photovoltaic Applications 2021*, IEA-PVPS T1-41:2021, p. 42 https://iea-pvps.org/wp-content/uploads/2022/01/IEA-PVPS-Trends-report-2021-4.pdf, retrieved August 4, 2023; IEA PVPS, *Trends in Photovoltaic Applications 2022*, IEA-PVPS T1-43:2022, p. 43 https://iea-pvps.org/wp-content/uploads/2023/02/PVPS_Trend_Report_2022.pdf, retrieved August 4, 2023; IEA PVPS, *Trends in Photovoltaic Applications 2023*, EIA-PVPS T1-43:2023, p. 46 https://iea-pvps.org/wp-content/uploads/2023/10/PVPS_Trends_Report_2023_WEB.pdf, retrieved October 12, 2023.

[124] Polysilicon production increases at a different rate than CSPV cell production due to annual declines in the volume of polysilicon per watt of output. For example, CSPV cell polysilicon usage declined from 3.1 grams per watt in 2020 to 2.7 grams per watt in 2021. IEA PVPS, *Trends in Photovoltaic Applications 2022*, IEA-PVPS T1-43:2022, pp. 43, 45 https://iea-pvps.org/wp-content/uploads/2023/02/PVPS_Trend_Report_2022.pdf, retrieved August 4, 2023.

[125] IEA PVPS, *Trends in Photovoltaic Applications 2023*, EIA-PVPS T1-43:2023, p. 46 https://iea-pvps.org/wp-content/uploads/2023/10/PVPS_Trends_Report_2023_WEB.pdf, retrieved October 12, 2023.

percent), the United States (4 percent), and Malaysia (3 percent).[126] In 2022, China produced 857,000 metric tons of polysilicon, which accounted for 85.6 percent of global production.[127] During the first half of 2023, China produced more than 600,000 metric tons of polysilicon, a 65 percent increase over the same period in 2022.[128]

Global polysilicon production capacity increased from 627,000 metric tons per year in 2020 to 813,100 metric tons per year in 2021, according to IEA data.[129] In 2022, polysilicon production capacity increased to 1,354,700 metric tons per year as new polysilicon factories came online in China.[130] China's 2022 production was 38 percent higher than its 2021 production.[131] Production capacity is expected to significantly increase to over 2.8 million metric tons by the end of 2023 as capacity enhancement projects come online in China.[132] China's share of global production capacity increased from 75 percent in 2020 (78 percent in 2021) to 87 percent in 2022 and is forecast to reach 91 percent and 92 percent in 2023 and

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[126] Due to tariffs imposed on U.S.-made polysilicon by China, most of the polysilicon production in the United States is used for semiconductors. IEA PVPS, *Trends in Photovoltaic Applications 2023*, EIA-PVPS T1-43:2023, pp. 44, 46-47 https://iea-pvps.org/wp-content/uploads/2023/10/PVPS_Trends_Report_2023_WEB.pdf, retrieved October 12, 2023.

[127] IEA PVPS, *Trends in Photovoltaic Applications 2022*, IEA-PVPS T1-43:2022, p. 44 https://iea-pvps.org/wp-content/uploads/2023/02/PVPS_Trend_Report_2022.pdf, retrieved August 4, 2023.

[128] IEA PVPS, *Trends in Photovoltaic Applications 2023*, EIA-PVPS T1-43:2023, p. 47 https://iea-pvps.org/wp-content/uploads/2023/10/PVPS_Trends_Report_2023_WEB.pdf, retrieved October 12, 2023.

[129] IEA PVPS, *Trends in Photovoltaic Applications 2021*, IEA-PVPS T1-43:2022, p. 43 https://iea-pvps.org/wp-content/uploads/2022/01/IEA-PVPS-Trends-report-2021-4.pdf, retrieved August 4, 2023; IEA PVPS, *Trends in Photovoltaic Applications 2022*, IEA-PVPS T1-43:2022, pp. 44-45 https://iea-pvps.org/wp-content/uploads/2023/02/PVPS_Trend_Report_2022.pdf, retrieved August 4, 2023; IEA PVPS, *Trends in Photovoltaic Applications 2023*, EIA-PVPS T1-43:2023, p. 46 https://iea-pvps.org/wp-content/uploads/2023/10/PVPS_Trends_Report_2023_WEB.pdf, retrieved October 12, 2023.

[130] IEA PVPS, *Trends in Photovoltaic Applications 2023*, EIA-PVPS T1-43:2023, p. 46 https://iea-pvps.org/wp-content/uploads/2023/10/PVPS_Trends_Report_2023_WEB.pdf, retrieved October 12, 2023; PVTIME, "1.5 Million Tonnes of Polysilicon! Massive New Capacities in China Support PV Growth Globally 2023," https://www.pvtime.org/1-5-million-tonnes-of-polysilicon-massive-new-capacities-in-china-support-pv-growth-globally-2023/, retrieved September 21, 2023.

[131] IEA PVPS, *Trends in Photovoltaic Applications 2022*, IEA-PVPS T1-43:2022, p. 44 https://iea-pvps.org/wp-content/uploads/2023/02/PVPS_Trend_Report_2022.pdf, retrieved August 4, 2023; IEA PVPS, *Trends in Photovoltaic Applications 2023*, EIA-PVPS T1-43:2023, pp. 46-47 https://iea-pvps.org/wp-content/uploads/2023/10/PVPS_Trends_Report_2023_WEB.pdf, retrieved October 12, 2023.

[132] IEA PVPS, *Trends in Photovoltaic Applications 2023*, EIA-PVPS T1-43:2023, pp. 46-47 https://iea-pvps.org/wp-content/uploads/2023/10/PVPS_Trends_Report_2023_WEB.pdf, retrieved October 12, 2023; RTS, *PV Activities in Japan and Global PV Highlights*, vol. 28, no. 2, February 2022, p. 31 https://www.rts-pv.com/en/downloads/#7699, retrieved August 9, 2023.

2024, respectively.[133] In 2022, China added approximately 541,600 metric tons of new capacity, with the number of polysilicon manufacturers increasing from 12 at the beginning of the year to 15 by the end of 2022.[134]

Global polysilicon spot prices increased *** percent from January 2020 to January 2021, and again by *** percent from January 2021 to January 2022, while contract prices increased *** percent from January 2020 to January 2021 and again by *** percent from January 2021 to January 2022. Global spot prices decreased *** percent from January 2022 to January 2023, while contract prices decreased *** percent. From January to June 2023, spot prices decreased *** percent and contract prices decreased *** percent. Spot prices in July through September were ***, while contract prices were ***.[135]

Wafers

Global wafer production increased from 167.7 GW in 2020 to 233 GW in 2021, while wafer production capacity increased from 218 GW in 2020 to 415 GW in 2021.[136] In 2022, global wafer production increased to 381 GW, while wafer production capacity increased to 687 GW.[137] Capacity utilization decreased from 77 percent in 2020 to 56 percent in 2021, but

[133] IEA PVPS, *Trends in Photovoltaic Applications 2022*, IEA-PVPS T1-43:2022, p. 44 https://iea-pvps.org/wp-content/uploads/2023/02/PVPS_Trend_Report_2022.pdf, retrieved August 4, 2023; PVTIME, "1.5 Million Tonnes of Polysilicon! Massive New Capacities in China Support PV Growth Globally 2023," https://www.pvtime.org/1-5-million-tonnes-of-polysilicon-massive-new-capacities-in-china-support-pv-growth-globally-2023/, retrieved September 21, 2023; RTS, *PV Activities in Japan and Global PV Highlights*, vol. 28, no. 2, February 2022, p. 31 https://www.rts-pv.com/en/downloads/#7699, retrieved August 9, 2023.

[134] The number of polysilicon manufacturers in China is expected to increase to more than 20 by the end of 2023. IEA PVPS, *Trends in Photovoltaic Applications 2023*, EIA-PVPS T1-43:2023, p. 47 https://iea-pvps.org/wp-content/uploads/2023/10/PVPS_Trends_Report_2023_WEB.pdf, retrieved October 12, 2023.

[135] PVinsights, http://pvinsights.com, retrieved October 14, 2023. See Part VI for additional discussion of polysilicon prices.

[136] IEA PVPS, *Trends in Photovoltaic Applications 2021*, IEA-PVPS T1-43:2022, p. 44 https://iea-pvps.org/wp-content/uploads/2022/01/IEA-PVPS-Trends-report-2021-4.pdf, retrieved August 4, 2023; IEA PVPS, *Trends in Photovoltaic Applications 2022*, IEA-PVPS T1-43:2022, p. 46 https://iea-pvps.org/wp-content/uploads/2023/02/PVPS_Trend_Report_2022.pdf, retrieved August 4, 2023.

[137] IEA PVPS, *Trends in Photovoltaic Applications 2023*, EIA-PVPS T1-43:2023, p. 48 https://iea-pvps.org/wp-content/uploads/2023/10/PVPS_Trends_Report_2023_WEB.pdf, retrieved October 12, 2023; IEA, "Solar PV manufacturing capacity according to announced projects and in the Net Zero Scenario, 2015-2030," July 10, 2023, https://www.iea.org/data-and-statistics/charts/solar-pv-manufacturing-capacity-according-to-announced-projects-and-in-the-net-zero-scenario-2015-2030, retrieved September 27, 2023.

decreased to 55 percent in 2022. China was the largest producer, accounting for 98 percent of wafer production capacity in 2021 and 2022.[138] China's wafer production increased from 161.4 GW in 2020 to 226.6 GW in 2021 to 371.3 GW in 2022, while its production capacity increased from 240 GW in 2020 to 407.2 GW in 2021 to 673 GW in 2022.[139]

There was a significant shift in wafer sizes during 2021-2023. In 2021, G1 (158.75 x 158.75 mm), M4 (161.7 x 161.7 mm), and M6 (166.0 x 166.0 mm) wafers accounted for about 60 percent of the global monocrystalline wafer production, with M10 (182.0 x 182.0 mm) and G12 (210.0 x 210.0 mm) wafers accounting for most of the remaining production.[140] In 2022, M6 wafers and smaller formats (G1 and M4) accounted for less than 40 percent of production, while M10 and G12 wafers accounted for approximately 45 and 15 percent of production, respectively.[141] For 2023, the trend will continue towards larger wafer sizes, with M10 and G12 wafers forecasted to account for approximately 50 and 25 percent of global wafer production, respectively.[142]

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[138] IEA PVPS, *National Survey Report of PV Power Applications in China 2021,* 2022, p. 22 https://iea-pvps.org/wp-content/uploads/2022/11/PVPS-National-Survey-Report-China-2021.pdf, retrieved August 9, 2023; IEA PVPS, *Trends in Photovoltaic Applications 2022*, IEA-PVPS T1-43:2022, p. 46 https://iea-pvps.org/wp-content/uploads/2023/02/PVPS_Trend_Report_2022.pdf, retrieved August 4, 2023; IEA PVPS, *Trends in Photovoltaic Applications 2023*, EIA-PVPS T1-43:2023, p. 48 https://iea-pvps.org/wp-content/uploads/2023/10/PVPS_Trends_Report_2023_WEB.pdf, retrieved October 12, 2023.

[139] IEA PVPS, *National Survey Report of PV Power Applications in China 2020,* 2021, p. 22 https://iea-pvps.org/wp-content/uploads/2021/09/NSR_China_2020.pdf, retrieved August 9, 2023; IEA PVPS, *National Survey Report of PV Power Applications in China 2021,* 2022, p. 22 https://iea-pvps.org/wp-content/uploads/2022/11/PVPS-National-Survey-Report-China-2021.pdf, retrieved August 9, 2023; *IEA* PVPS, *Trends in Photovoltaic Applications 2021*, IEA-PVPS T1-43:2022, p. 45 https://iea-pvps.org/wp-content/uploads/2022/01/IEA-PVPS-Trends-report-2021-4.pdf, retrieved August 4, 2023; IEA PVPS, *Trends in Photovoltaic Applications 2022*, IEA-PVPS T1-43:2022, p. 46 https://iea-pvps.org/wp-content/uploads/2023/02/PVPS_Trend_Report_2022.pdf, retrieved August 4, 2023; IEA PVPS, *Trends in Photovoltaic Applications 2023*, EIA-PVPS T1-43:2023, p. 48 https://iea-pvps.org/wp-content/uploads/2023/10/PVPS_Trends_Report_2023_WEB.pdf, retrieved October 12, 2023.

[140] Longi introduced the M10 wafer in June 2020. PV Magazine, "JA Solar, JinkoSolar, Longi agree on 182mm module standardization," September 29, 2021, https://pv-magazine-usa.com/2021/09/09/ja-solar-jinkosolar-LONGi-agree-on-182mm-module-standardization/, retrieved August 16, 2023; ITRPV, *Results 2021 Including Maturity Report 2022*, p. 12, https://www.vdma.org/international-technology-roadmap-photovoltaic, retrieved August 16, 2023.

[141] ITRPV, *2022 Results*, April 2023, p. 12, https://www.vdma.org/international-technology-roadmap-photovoltaic, retrieved August 16, 2023.

[142] Increasing wafer size is considered by industry experts to be a common way to improve cell and modules wattage. According to ITRPV, it is not clear which of the two wafer formats will become more mainstream in the future, as both M10 and G12 wafers have pros and cons. In June 2021, Chinese solar panel manufacturers JinkoSolar, Longi, and JA Solar jointly published a white paper arguing that M10 (continued...)

Global CSPV cell production and shipments

Global PV cell production (including out-of-scope thin film products) increased from 178 GW in 2020 to 244 GW in 2021.[143] In 2022, global PV cell production increased to 394 GW.[144] Global PV cell production capacity increased from 257 GW in 2020 to 441 GW in 2021.[145] In 2022, global PV cell production capacity increased to 599 GW.[146] *** projects that production capacity will reach *** by the end of 2023.[147] Capacity utilization was 69 percent in 2020, 55 percent in 2021, and 66 percent in 2022.[148] The leading global CSPV

wafers have a lower levelized cost of energy than G12 wafers. In September 2021, these three manufacturers reached an agreement on the standardization of PV modules produced using M10 wafers. IEA PVPS, *Trends in Photovoltaic Applications 2022*, IEA-PVPS T1-43:2022, p. 5 https://iea-pvps.org/wp-content/uploads/2023/02/PVPS_Trend_Report_2022.pdf, retrieved August 4, 2023; PV Magazine, "JA Solar, JinkoSolar, Longi agree on 182mm module standardization," September 29, 2021, https://pv-magazine-usa.com/2021/09/09/ja-solar-jinkosolar-LONGi-agree-on-182mm-module-standardization/, retrieved August 16, 2023; JA, Jinko, Longi, *White Paper on Module Based on 182mm Wafer: Optimal Module Solution for Achieving Lower LCOE of Utility Photovoltaic Power* Station, June 2021, retrieved August 16, 2023; ITRPV, *2022 Results*, April 2023, p. 12, https://www.vdma.org/international-technology-roadmap-photovoltaic, retrieved August 16, 2023.

[143] References to "PV" in this section include out-of-scope thin film products. IEA PVPS, *Trends in Photovoltaic Applications 2021*, IEA-PVPS T1-43:2022, p. 46 https://iea-pvps.org/wp-content/uploads/2022/01/IEA-PVPS-Trends-report-2021-4.pdf, retrieved August 4, 2023; IEA PVPS, *Trends in Photovoltaic Applications 2022*, IEA-PVPS T1-43:2022, p. 47 https://iea-pvps.org/wp-content/uploads/2023/02/PVPS_Trend_Report_2022.pdf, September 22, 2023.

[144] IEA PVPS, *Trends in Photovoltaic Applications 2023*, EIA-PVPS T1-43:2023, p. 50 https://iea-pvps.org/wp-content/uploads/2023/10/PVPS_Trends_Report_2023_WEB.pdf, retrieved October 12, 2023.

[145] IEA PVPS, *Trends in Photovoltaic Applications 2021*, IEA-PVPS T1-43:2022, p. 46 https://iea-pvps.org/wp-content/uploads/2022/01/IEA-PVPS-Trends-report-2021-4.pdf, retrieved September 22, 2023;

[146] IEA PVPS, *Trends in Photovoltaic Applications 2023*, EIA-PVPS T1-43:2023, p. 50 https://iea-pvps.org/wp-content/uploads/2023/10/PVPS_Trends_Report_2023_WEB.pdf, retrieved October 12, 2023.

[147] ***.

[148] IEA PVPS, *Trends in Photovoltaic Applications 2021*, IEA-PVPS T1-43:2022, p. 46 https://iea-pvps.org/wp-content/uploads/2022/01/IEA-PVPS-Trends-report-2021-4.pdf, retrieved September 22, 2023; IEA PVPS, *Trends in Photovoltaic Applications 2022*, IEA-PVPS T1-43:2022, p. 47 https://iea-pvps.org/wp-content/uploads/2023/02/PVPS_Trend_Report_2022.pdf, September 22, 2023; IEA PVPS, *Trends in Photovoltaic Applications 2023*, EIA-PVPS T1-43:2023, p. 50 https://iea-pvps.org/wp-content/uploads/2023/10/PVPS_Trends_Report_2023_WEB.pdf, retrieved October 12, 2023.

cell producers in 2022, as measured by manufacturers' own production, were Tongwei (49.2 GW), Longi (36.2 GW), Aiko (33.7 GW), Trina (33.6 GW), and JA Solar (32.7 GW).[149]

China was the leading global PV cell producer in 2020 totaling 135 GW, accounting for 78 percent of production, followed by Malaysia (6 percent), Vietnam (5 percent), and South Korea (4 percent).[150] In 2021, China's cell production totaled 198 GW, accounting for 81.2 percent of production, followed by Malaysia (5 percent), Vietnam (4 percent), and South Korea (2 percent).[151] In 2022, China's cell production totaled 331 GW, accounting for 84 percent of global production, followed by Malaysia (5 percent), Vietnam (5 percent), and South Korea (1 percent).[152] During the first half of 2023, China's PV cell production totaled more than 220 GW, an increase of more than 60 percent over the same period the previous year.[153]

The size of global cell production plants has increased over time. In 2020, plants with less than 2 GW in annual production capacity accounted for slightly more than 30 percent of the market, 2 to 5 GW plants for almost 50 percent, and plants with more than 5 GW for slightly less than 20 percent.[154] In 2022, plants with less than 2 GW in annual production capacity accounted for slightly less than 20 percent, 2 to 5 GW for 50 percent, and plants with more than 5 GW for slightly more than 30 percent.[155]

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[149] IEA PVPS, *Trends in Photovoltaic Applications 2023*, EIA-PVPS T1-43:2023, p. 50 https://iea-pvps.org/wp-content/uploads/2023/10/PVPS_Trends_Report_2023_WEB.pdf, retrieved October 12, 2023.

[150] IEA PVPS, *Trends in Photovoltaic Applications 2021*, IEA-PVPS T1-43:2022, p. 46 https://iea-pvps.org/wp-content/uploads/2022/01/IEA-PVPS-Trends-report-2021-4.pdf, retrieved September 22, 2023.

[151] IEA PVPS, *Trends in Photovoltaic Applications 2022*, IEA-PVPS T1-43:2022, p. 47 https://iea-pvps.org/wp-content/uploads/2023/02/PVPS_Trend_Report_2022.pdf, September 22, 2023.

[152] IEA PVPS, *Trends in Photovoltaic Applications 2023*, EIA-PVPS T1-43:2023, p. 50 https://iea-pvps.org/wp-content/uploads/2023/10/PVPS_Trends_Report_2023_WEB.pdf, retrieved October 12, 2023.

[153] IEA PVPS, *Trends in Photovoltaic Applications 2023*, EIA-PVPS T1-43:2023, p. 51 https://iea-pvps.org/wp-content/uploads/2023/10/PVPS_Trends_Report_2023_WEB.pdf, retrieved October 12, 2023.

[154] The ITRPV report does not specify if this is by number of plants or weighted by annual production capacity. ITRVP, *2020 Results*, p.32, https://www.vdma.org/international-technology-roadmap-photovoltaic, retrieved August 16, 2023; Trube, Jutta, "Trend: Cell fab size," https://eurec.be/cms/wp-content/uploads/International-Technology-Roadmap-ITRPV-Jutta-Trube.pdf, retrieved September 22, 2023.

[155] ITRPV, *2022 Results*, April 2023, p. 33, https://www.vdma.org/international-technology-roadmap-photovoltaic, retrieved August 16, 2023

The shift in CSPV cell shipments by technology from multicrystalline cells to monocrystalline continued during 2020-2022. Multicrystalline cells declined from *** percent of CSPV cell shipments in 2020 to *** percent in 2022, while monocrystalline cells increased from *** percent in 2020 to over *** percent in 2022 (figure I-17).[156] PERC cells *** monocrystalline and multicrystalline cell technologies shipped in 2020-2022. However, n-type CSPV cells shipments increased, from around *** percent of shipments in 2020 to *** percent in 2022.[157]

Figure I-17
CSPV cells: Global shipments by technology, 2022

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Source: ***.

[156] ***.
[157] ***.

Global CSPV module production

Global CSPV module production increased from 178 GW in 2020 to 242 GW in 2021 and again to 379 GW in 2022.[158] Shipments were lower than production in 2022, with PV module (including out-of-scope thin film) shipments totaling 295 GW.[159] Global production capacity (including out-of-scope thin film products) increased from 328 GW in 2020 to 483 GW in 2021 and again to 717 GW in 2022.[160] Global PV capacity utilization declined from 54 percent in 2020 to 53 percent in 2022.[161] China was the leading global module producer in 2020, 2021, and 2022, accounting for 70, 75, and 78 percent, respectively, of global PV module production.[162] Countries and/or regions with the largest increases in production capacity during 2020-2022 were China (up 260 GW), Asia Pacific region (up 33 GW), and India (up 15 GW).[163] Countries are

[158] IEA PVPS, *Trends in Photovoltaic Applications 2021*, IEA-PVPS T1-43:2022, p. 46 https://iea-pvps.org/wp-content/uploads/2022/01/IEA-PVPS-Trends-report-2021-4.pdf, retrieved September 22, 2023; IEA PVPS, *Trends in Photovoltaic Applications 2022*, IEA-PVPS T1-43:2022, p. 48 https://iea-pvps.org/wp-content/uploads/2023/02/PVPS_Trend_Report_2022.pdf, retrieved September 22, 2023; IEA PVPS, *Trends in Photovoltaic Applications 2023*, EIA-PVPS T1-43:2023, p. 51 https://iea-pvps.org/wp-content/uploads/2023/10/PVPS_Trends_Report_2023_WEB.pdf, retrieved October 12, 2023.

[159] ITRPV, *2022 Results*, April 2023, p. 4, https://www.vdma.org/international-technology-roadmap-photovoltaic, retrieved August 16, 2023.

[160] IEA PVPS, *Trends in Photovoltaic Applications 2023*, EIA-PVPS T1-43:2023, p. 54 https://iea-pvps.org/wp-content/uploads/2023/10/PVPS_Trends_Report_2023_WEB.pdf, retrieved October 12, 2023; IEA, "Solar PV manufacturing capacity according to announced projects and in the Net Zero Scenario, 2015-2030," July 10, 2023, https://www.iea.org/data-and-statistics/charts/solar-pv-manufacturing-capacity-according-to-announced-projects-and-in-the-net-zero-scenario-2015-2030, retrieved September 27, 2023.

[161] IEA PVPS, *Trends in Photovoltaic Applications 2021*, IEA-PVPS T1-43:2022, p. 46 https://iea-pvps.org/wp-content/uploads/2022/01/IEA-PVPS-Trends-report-2021-4.pdf, retrieved September 22, 2023; IEA PVPS, *Trends in Photovoltaic Applications 2023*, EIA-PVPS T1-43:2023, p. 54 https://iea-pvps.org/wp-content/uploads/2023/10/PVPS_Trends_Report_2023_WEB.pdf, retrieved October 12, 2023

[162] IEA PVPS, *Trends in Photovoltaic Applications 2021*, IEA-PVPS T1-43:2022, p. 46 https://iea-pvps.org/wp-content/uploads/2022/01/IEA-PVPS-Trends-report-2021-4.pdf, retrieved September 22, 2023; IEA PVPS, *Trends in Photovoltaic Applications 2022*, IEA-PVPS T1-43:2022, p. 48 https://iea-pvps.org/wp-content/uploads/2023/02/PVPS_Trend_Report_2022.pdf, retrieved September 22, 2023; IEA PVPS, *Trends in Photovoltaic Applications 2023*, EIA-PVPS T1-43:2023, p. 51 https://iea-pvps.org/wp-content/uploads/2023/10/PVPS_Trends_Report_2023_WEB.pdf, retrieved October 12, 2023.

[163] IEA PVPS, *Trends in Photovoltaic Applications 2021*, IEA-PVPS T1-43:2022, pp. 46-47 https://iea-pvps.org/wp-content/uploads/2022/01/IEA-PVPS-Trends-report-2021-4.pdf, retrieved September 22, 2023; IEA, Solar PV manufacturing capacity by component in China, 2021-2024, IEA, Paris https://www.iea.org/data-and-statistics/charts/solar-pv-manufacturing-capacity-by-component-in-china-2021-2024, retrieved September 29, 2023; IEA, Solar PV manufacturing capacity by component in the Asia Pacific Region, 2021-2024, IEA, Paris https://www.iea.org/data-and-statistics/charts/solar-pv-

(continued...)

undertaking significant production capacity additions in 2023, with the leading countries and regions in capacity expansions in 2023 expected to be China (up 249 GW), Asia Pacific region (up 18 GW), and India (up 8 GW).[164]

The largest module producers, in terms of annual production in 2022, were Longi (48.2 GW), Trina (45.4 GW), JA Solar (43.9 GW), Jinko (40 GW), and Canadian Solar (21.1 GW).[165] The firms with the largest annual production capacity at the end of 2022 were Jinko (68 GW), Longi (65 GW), Trina (50 GW), JA Solar (49 GW), and Canadian Solar (32 GW).[166] Together, these firms constitute approximately 37 percent of global capacity.[167] These same companies have announced significant production capacity expansions, totaling an estimated 42 percent of global production capacity additions by 2026.[168] The firms with the largest increases in production capacity during 2020-2022 were Jinko (up 37 GW), Trina (up 28 GW), JA Solar (up 26 GW), Canadian Solar (up 16 GW), and Longi (up 15 GW).[169]

As with cell production plants, the size of global module production plants has increased over time. Module facilities with less than 1 GW or less in annual production capacity

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manufacturing-capacity-by-component-in-the-asia-pacific-region-2021-2024, retrieved September 29, 2023; IEA, Solar PV manufacturing capacity by component in India, 2021-2024, IEA, Paris https://www.iea.org/data-and-statistics/charts/solar-pv-manufacturing-capacity-by-component-in-india-2021-2024, retrieved September 29, 2023.

[164] IEA, Solar PV manufacturing capacity by component in China, 2021-2024, IEA, Paris https://www.iea.org/data-and-statistics/charts/solar-pv-manufacturing-capacity-by-component-in-china-2021-2024, retrieved September 29, 2023; IEA, Solar PV manufacturing capacity by component in the Asia Pacific Region, 2021-2024, IEA, Paris https://www.iea.org/data-and-statistics/charts/solar-pv-manufacturing-capacity-by-component-in-the-asia-pacific-region-2021-2024, retrieved September 29, 2023; and IEA, Solar PV manufacturing capacity by component in India, 2021-2024, IEA, Paris https://www.iea.org/data-and-statistics/charts/solar-pv-manufacturing-capacity-by-component-in-india-2021-2024, retrieved September 29, 2023.

[165] IEA PVPS, *Trends in Photovoltaic Applications 2023*, EIA-PVPS T1-43:2023, p. 51 https://iea-pvps.org/wp-content/uploads/2023/10/PVPS_Trends_Report_2023_WEB.pdf, retrieved October 12, 2023.

[166] RTS, *PV Activities in Japan and Global PV Highlights*, vol. 28, no. 2, February 2022, p. 33 https://www.rts-pv.com/en/downloads/#7699, retrieved August 9, 2023.

[167] IEA PVPS, *Trends in Photovoltaic Applications 2023*, EIA-PVPS T1-43:2023, p. 51 https://iea-pvps.org/wp-content/uploads/2023/10/PVPS_Trends_Report_2023_WEB.pdf, retrieved October 12, 2023; RTS, *PV Activities in Japan and Global PV Highlights*, vol. 28, no. 2, February 2022, p. 33 https://www.rts-pv.com/en/downloads/#7699, retrieved August 9, 2023; IEA, *Energy Technology Perspectives 2023*, p. 219 https://www.iea.org/reports/energy-technology-perspectives-2023, retrieved September 29, 2023.

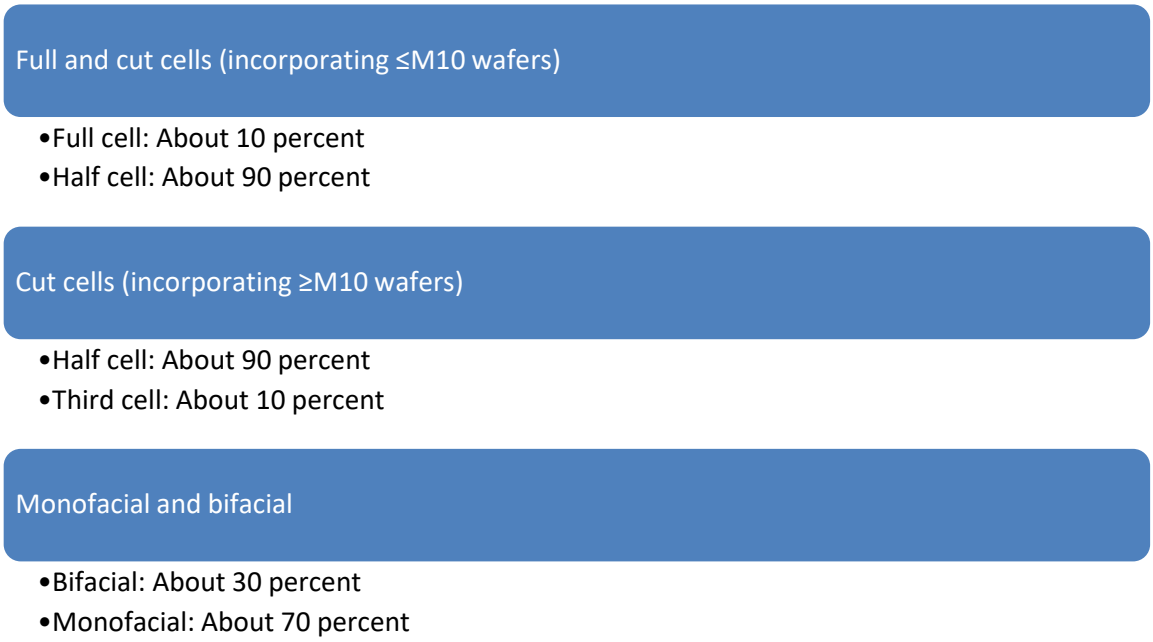
[168] IEA, *Energy Technology Perspectives 2023*, p. 220 https://www.iea.org/reports/energy-technology-perspectives-2023, retrieved September 29, 2023.

[169] RTS, *PV Activities in Japan and Global PV Highlights*, vol. 28, no. 2, February 2022, p. 33 https://www.rts-pv.com/en/downloads/#7699, retrieved August 9, 2023.

accounted for more than 20 percent of plants in 2020, those with 1 GW to 5 GW in annual capacity for more than 60 percent, and those with more than 5 GW in capacity for more than 10 percent.[170] In 2022, facilities with 1 GW or less in annual production capacity accounted for approximately 17 percent, those with 1 GW to 5 GW for about 60 percent, and those with more than 5 GW for about 23 percent.[171]

The global market share of select module technologies is shown in figure I-18. Half-cut cells were about 90 percent of the global market in 2022.[172] Bifacial modules accounted for almost 30 percent of the global market and monofacial for more than 70 percent.[173]

Figure I-18
CSPV modules: Global market share by technology type, 2022



Source: ITRPV, *2022 Results*, April 2023, pp. 43-44, 48 https://www.vdma.org/international-technology-roadmap-photovoltaic, retrieved August 16, 2023.

Note: Technologies with a small share of the market for which data could not be discerned in the report are not included here.

[170] Crystalline Silicon Photovoltaic Cells, Whether or Not Partially or Fully Assembled Into Other Products, Inv. No. TA-201-75 (Extension), USITC Publication 5266, December 2021, p. I-20.
[171] ITRPV, *2022 Results*, April 2023, p. 44, https://www.vdma.org/international-technology-roadmap-photovoltaic, retrieved August 16, 2023.
[172] ITRPV, *2022 Results*, April 2023, pp. 43-44, https://www.vdma.org/international-technology-roadmap-photovoltaic, retrieved August 16, 2023.
[173] ITRPV, *2022 Results*, April 2023, p. 48, https://www.vdma.org/international-technology-roadmap-photovoltaic, retrieved August 16, 2023.

Global exports

China is the largest global exporter of PV cells and modules (including out-of-scope thin film), with exports totaling $46.4 billion in 2022, and $26.3 billion in the first half of 2023 (table I-11). Malaysia was the second largest exporter with $2.4 billion in 2022.

Table I-11
PV products: Global exports, by reporting country and by period

Value in 1,000 dollars; shares in percent

Exporting country	Measure	2022	Jan-Mar 2023	Apr-Jun 2023
United States	Value	48,272	9,014	9,155
China	Value	46,378,414	13,132,932	13,179,097
Netherlands	Value	8,262,228	2,425,445	2,413,694
Malaysia	Value	2,369,525	941,802	1,175,167
Thailand	Value	2,154,048	928,917	1,073,829
South Korea	Value	1,576,203	406,918	298,773
Germany	Value	1,538,782	394,142	348,786
Portugal	Value	745,788	70,363	141,764
Singapore	Value	601,854	199,688	172,321
India	Value	553,917	479,214	464,022
Belgium	Value	435,321	209,193	244,405
Slovenia	Value	405,968	142,807	151,499
All other exporters	Value	2,872,684	826,985	850,722
All reporting exporters	Value	67,943,002	20,167,420	20,523,234
United States	Share of value	0.1	0.0	0.0
China	Share of value	68.3	65.1	64.2
Netherlands	Share of value	12.2	12.0	11.8
Malaysia	Share of value	3.5	4.7	5.7
Thailand	Share of value	3.2	4.6	5.2
South Korea	Share of value	2.3	2.0	1.5
Germany	Share of value	2.3	2.0	1.7
Portugal	Share of value	1.1	0.3	0.7
Singapore	Share of value	0.9	1.0	0.8
India	Share of value	0.8	2.4	2.3
Belgium	Share of value	0.6	1.0	1.2
Slovenia	Share of value	0.6	0.7	0.7
All other exporters	Share of value	4.2	4.1	4.1
All reporting exporters	Share of value	100.0	100.0	100.0

Source: Official exports statistics under HS subheadings 8541.42 and 8541.43 as reported by various national statistical authorities in the Global Trade Atlas Suite database, accessed October 4, 2023. Official global exports statistics from Vietnam under HS subheadings 8541.42 and 8541.43 for 2022 were not available.

Note: Shares and ratios shown as '0.0' represent values greater than zero, but less than '0.05' percent. Zeroes, null values, and undefined calculations are suppressed and shown as "---". United States is shown at the top followed by the countries under investigation, all remaining top exporting countries in descending order of 2022 data.

Country profiles

China

As mentioned previously, China was the leading global PV cell (including out-of-scope thin film) producer in 2020-2022. In 2020, China's production accounted for 78 percent (135 GW) of global production.[174] In 2022, China's PV cell production totaled 331 GW, accounting for 84 percent of global production.[175] Chinese PV module (including out-of-scope thin film) production rose from 124.6 GW in 2020 to 294.7 GW in 2022.[176] China's PV cell (including out-of-scope thin film) production capacity increased from 200 GW in 2020 to 506 GW in 2022, while PV module (including out-of-scope thin film) production capacity increased from 244 GW in 2020 to 552 GW in 2022.[177]

Chinese exports of PV modules (including out-of-scope thin film) increased from 78.8 GW in 2020 to 153.6 GW in 2022.[178] In 2022, Chinese exports of PV cells (including out-of-scope thin film) were valued at approximately $4.0 billion, while exports of PV modules (including out-of-scope thin film) were valued at $42.4 billion.[179] The top five export destinations in 2022, by

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[174] IEA PVPS, *Trends in Photovoltaic Applications 2021*, IEA-PVPS T1-43:2022, p. 46 https://iea-pvps.org/wp-content/uploads/2022/01/IEA-PVPS-Trends-report-2021-4.pdf, retrieved September 22, 2023.

[175] IEA PVPS, *Trends in Photovoltaic Applications 2023*, EIA-PVPS T1-43:2023, p. 50 https://iea-pvps.org/wp-content/uploads/2023/10/PVPS_Trends_Report_2023_WEB.pdf, retrieved October 12, 2023.

[176] IEA PVPS, *Trends in Photovoltaic Applications 2021*, IEA-PVPS T1-43:2022, p. 46 https://iea-pvps.org/wp-content/uploads/2022/01/IEA-PVPS-Trends-report-2021-4.pdf, retrieved September 22, 2023; IEA PVPS, *Trends in Photovoltaic Applications 2023*, EIA-PVPS T1-43:2023, p. 51 https://iea-pvps.org/wp-content/uploads/2023/10/PVPS_Trends_Report_2023_WEB.pdf, retrieved October 12, 2023.

[177] IEA PVPS, *Trends in Photovoltaic Applications 2021*, IEA-PVPS T1-43:2022, p. 46 https://iea-pvps.org/wp-content/uploads/2022/01/IEA-PVPS-Trends-report-2021-4.pdf, retrieved September 22, 2023; *Trends in Photovoltaic Applications 2023*, EIA-PVPS T1-43:2023, pp. 50-51 https://iea-pvps.org/wp-content/uploads/2023/10/PVPS_Trends_Report_2023_WEB.pdf, retrieved October 12, 2023; IEA, Solar PV manufacturing capacity by component in China, 2021-2024, https://www.iea.org/data-and-statistics/charts/solar-pv-manufacturing-capacity-by-component-in-china-2021-2024, retrieved October 2, 2023.

[178] IEA PVPS, *Trends in Photovoltaic Applications 2021*, IEA-PVPS T1-43:2022, p. 46 https://iea-pvps.org/wp-content/uploads/2022/01/IEA-PVPS-Trends-report-2021-4.pdf, retrieved September 22, 2023; IEA PVPS, *Trends in Photovoltaic Applications 2023*, EIA-PVPS T1-43:2023, p. 51 https://iea-pvps.org/wp-content/uploads/2023/10/PVPS_Trends_Report_2023_WEB.pdf, retrieved October 12, 2023.

[179] Official exports statistics under HS subheadings 8541.42 and 8541.43 for China from China's customs as reported in the Global Trade Atlas Suite database, accessed October 3, 2023.

value, for PV cells were Turkey (22 percent), India (16 percent), Cambodia (12 percent), Thailand (11 percent), and South Korea (9 percent).[180] The top five export destinations in 2022, by value, for PV modules were the Netherlands (27 percent), Brazil (11 percent), Spain (7 percent), India (6 percent), and Japan (4 percent).[181]

Malaysia

Malaysia's PV cell (including out-of-scope thin film) production totaled 11.6 GW in 2020, while PV module (including out-of-scope thin film) production was 7.42 GW.[182] In 2021, Malaysia's PV cell production increased to 13.1 GW and production capacity totaled 18.6 GW, while PV module production increased to 9.1 GW.[183] In 2022, Malaysia's PV cell production increased to 19.1 GW and production capacity totaled 24.5 GW, while PV module production increased to 10.8 GW.[184]

Malaysia's exports of PV cells (including out-of-scope thin film) totaled $1.1 billion in 2022, while exports of PV modules (including out-of-scope thin film) totaled $1.2 billion. The top export destinations in 2022, by value, for PV cells were Vietnam (36 percent), China (31 percent), the United States (24 percent), and India (8 percent).[185] The top export destinations in 2022, by value, for PV modules were the United States (75 percent), China (6 percent), and Taiwan (5 percent).[186]

Vietnam

Vietnam's PV cell (including out-of-scope thin film) production totaled 9.4 GW in 2020 and production capacity was over 11 GW, while PV module (including out-of-scope thin film)

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[180] Official exports statistics under HS subheading 8541.42 for China from China's customs as reported in the Global Trade Atlas Suite database, accessed October 3, 2023.

[181] Official exports statistics under HS subheading 8541.43 for China from China's customs as reported in the Global Trade Atlas Suite database, accessed October 3, 2023.

[182] IEA PVPS, *Trends in Photovoltaic Applications 2021*, IEA-PVPS T1-43:2022, pp. 46-47 https://iea-pvps.org/wp-content/uploads/2022/01/IEA-PVPS-Trends-report-2021-4.pdf, retrieved September 22, 2023

[183] IEA PVPS, *Trends in Photovoltaic Applications 2022*, IEA-PVPS T1-43:2022, pp. 47-48 https://iea-pvps.org/wp-content/uploads/2023/02/PVPS_Trend_Report_2022.pdf, retrieved September 22, 2023.

[184] *Trends in Photovoltaic Applications 2023*, EIA-PVPS T1-43:2023, pp. 50-51 https://iea-pvps.org/wp-content/uploads/2023/10/PVPS_Trends_Report_2023_WEB.pdf, retrieved October 12, 2023.

[185] Official exports statistics under HS subheading 8541.42 for Malaysia as reported by national statistical authorities in the Global Trade Atlas Suite database, accessed October 3, 2023.

[186] Official exports statistics under HS subheading 8541.43 for Malaysia as reported by national statistical authorities in the Global Trade Atlas Suite database, accessed October 3, 2023.

production was 14.1 GW and a production capacity totaled 18.3 GW.[187] In 2021, Vietnam's PV cell production decreased to 8.8 GW and production capacity totaled 17 GW, while PV module production increased to 16.4 GW.[188] In 2022, Vietnam's PV cell production increased to 18.8 GW and production capacity totaled 27.5 GW, while PV module production increased to 24.1 GW.[189] Vietnamese exports of PV cells and modules under HS subheading 8541.40, which includes out-of-scope products, increased from $4.5 billion in 2020 to $4.8 billion in 2021.[190] The top export destinations in 2021, by value, for PV cells and modules under HS subheading 8541.40, which includes out-of-scope products, were the United States (74 percent) and China (11 percent).[191]

South Korea

South Korea's PV cell (including out-of-scope thin film) production totaled 6.3 GW in 2020, while PV module (including out-of-scope thin film) production was 9.3 GW.[192] In 2021, South Korea's PV cell production decreased to 5.5 GW, while PV module production decreased to 8 GW.[193] In 2022, South Korea's PV cell production decreased to 4.1 GW, while PV module production decreased to 7.2 GW.[194] South Korea's exports of PV cells (including out-of-scope thin film) totaled $29 million in 2022, while exports of PV modules (including out-of-scope thin

[187] IEA PVPS, *Trends in Photovoltaic Applications 2021*, IEA-PVPS T1-43:2022, pp. 46-47 https://iea-pvps.org/wp-content/uploads/2022/01/IEA-PVPS-Trends-report-2021-4.pdf, retrieved September 22, 2023.

[188] IEA PVPS, *Trends in Photovoltaic Applications 2022*, IEA-PVPS T1-43:2022, pp. 47-48 https://iea-pvps.org/wp-content/uploads/2023/02/PVPS_Trend_Report_2022.pdf, retrieved September 22, 2023.

[189] *Trends in Photovoltaic Applications 2023*, EIA-PVPS T1-43:2023, pp. 50-51 https://iea-pvps.org/wp-content/uploads/2023/10/PVPS_Trends_Report_2023_WEB.pdf, retrieved October 12, 2023.

[190] Official exports statistics under HS subheading 8541.40 for Vietnam as reported by statistical authorities in the Global Trade Atlas Suite database, accessed October 3, 2023. These data may be overstated as HS statistical reporting number 8541.40 may contain products outside the scope of this investigation including photosensitive semiconductor devices and light-emitting diodes.

[191] Official exports statistics under HS subheading 8541.40 for Vietnam as reported by national statistical authorities in the Global Trade Atlas Suite database, accessed December 12, 2023.

[192] IEA PVPS, *Trends in Photovoltaic Applications 2021*, IEA-PVPS T1-43:2022, pp. 46-47 https://iea-pvps.org/wp-content/uploads/2022/01/IEA-PVPS-Trends-report-2021-4.pdf, retrieved September 22, 2023

[193] IEA PVPS, *Trends in Photovoltaic Applications 2022*, IEA-PVPS T1-43:2022, pp. 47-48 https://iea-pvps.org/wp-content/uploads/2023/02/PVPS_Trend_Report_2022.pdf, retrieved September 22, 2023.

[194] *Trends in Photovoltaic Applications 2023*, EIA-PVPS T1-43:2023, pp. 50-51 https://iea-pvps.org/wp-content/uploads/2023/10/PVPS_Trends_Report_2023_WEB.pdf, retrieved October 12, 2023.

film) totaled $1.5 billion.[195] The top export destinations in 2022, by value, for PV cells were the United States (59 percent) and China (20 percent).[196] The top export destination in 2022, by value, for PV modules was the United States (93 percent).[197]

Thailand

Thailand's PV cell (including out-of-scope thin film) production totaled 4.3 GW in 2020 and production capacity totaled 7 GW, while PV module (including out-of-scope thin film) production was 3.2 GW.[198] In 2021, Thailand's PV cell production increased to 5 GW and production capacity totaled 9.7 GW, while PV module production increased to 2.9 GW.[199] In 2022, Thailand's PV cell production increased to 8.7 GW and production capacity increased to 14.3 GW, while PV module production increased to 4.5 GW.[200] Thailand's exports of PV cells (including out-of-scope thin film) totaled $781 million in 2022, while exports of PV modules (including out-of-scope thin film) totaled $1.4 billion.[201] The top export destinations in 2022, by value, for PV cells were Vietnam (58 percent), India (22 percent), the United States (9 percent), and China (5 percent).[202] The top export destinations in 2022, by value, for PV modules were the United States (90 percent) and Taiwan (5 percent).[203]

[195] Official exports statistics under HS subheadings 8541.42 and 8541.43 for South Korea as reported by national statistical authorities in the Global Trade Atlas Suite database, accessed October 3, 2023.

[196] Official exports statistics under HS subheading 8541.42 for South Korea as reported by national statistical authorities in the Global Trade Atlas Suite database, accessed October 3, 2023.

[197] Official exports statistics under HS subheading 8541.43 for South Korea as reported by national statistical authorities in the Global Trade Atlas Suite database, accessed October 3, 2023.

[198] IEA PVPS, *Trends in Photovoltaic Applications 2021*, IEA-PVPS T1-43:2022, p. 46 https://iea-pvps.org/wp-content/uploads/2022/01/IEA-PVPS-Trends-report-2021-4.pdf, retrieved September 22, 2023

[199] IEA PVPS, *Trends in Photovoltaic Applications 2022*, IEA-PVPS T1-43:2022, pp. 47-48 https://iea-pvps.org/wp-content/uploads/2023/02/PVPS_Trend_Report_2022.pdf, retrieved September 22, 2023.

[200] *Trends in Photovoltaic Applications 2023*, EIA-PVPS T1-43:2023, pp. 50-51 https://iea-pvps.org/wp-content/uploads/2023/10/PVPS_Trends_Report_2023_WEB.pdf, retrieved October 12, 2023.

[201] Official exports statistics under HS subheadings 8541.42 and 8541.43 for Thailand as reported by national statistical authorities in the Global Trade Atlas Suite database, accessed October 3, 2023.

[202] Official exports statistics under HS subheading 8541.42 for Thailand as reported by national statistical authorities in the Global Trade Atlas Suite database, accessed October 3, 2023.

[203] Official exports statistics under HS subheading 8541.43 for Thailand as reported by national statistical authorities in the Global Trade Atlas Suite database, accessed October 3, 2023.

Third-country market import restraints

Table I-12 provides information on third-country market import restraints on CSPV modules and their components.

Table I-12
CSPV: Third-country market import restraints, 2016–23

Date	Third-country market import restraint
January 2016	Canada imposed AD/CVD duties on CSPV modules from China
January 2016	EU imposed antidumping (AD) duties on CSPV cells and modules from China.
January 2016	China imposed AD and countervailing (CVD) duties on polysilicon (HTS 2804.61) from the EU, Korea, and the United States.
February 2016	Conclusion of EU anti-circumvention investigation and extension of duties to certain companies in Malaysia and Taiwan.
October 2016	Australia terminated an AD investigation on module imports from China.
April 2017	Turkey imposed AD duties on modules from China, with rates ranging from $20 - $25 per square meter.
April 2017	Korea imposed AD duties on PET film (HTS 3920.90) from Chinese Taipei, Thailand, and the United Emirates.
August 2017	India imposed duties on glass for PV modules from China.
September 2017	EU announced that it would progressively reduce minimum import prices.
November 2017	China adjusts AD duties on polysilicon (HTS 2804.61) from Korea from 4.4 percent to 113.8 percent.
December 2017	Indonesia initiated a sunset review on biaxially oriented polypropylene (BOPP) (HS 3920.20.10, 3920.20.91, 3920.20) from Thailand and Vietnam. Quota limits were placed on Biaxially Oriented Polypropylene from Thailand.
February 2018	Brazil initiated anti-dumping investigations on polyethylene terephthalate films from the Kingdom of Bahrain and Peru. AD duties of $480.15/ton on imports from the Kingdom of Bahrain and $123.20/ton on imports from Peru were effective January 7, 2019.
March 2018	Indian Solar Manufacturers Association withdrew an AD petition.
April 2018	India initiated an AD investigation on ethyl vinyl acetate sheet for solar modules (HTS 3901, 3920, 3921) from China. Anti-dumping duties on China were enforced March 29, 2019.
May 2018	The EU initiated an AD investigation on solar glass (HS 7007.19) from Malaysia.
June 2018	India initiated AD and CVD investigations on textured tempered coated and uncoated glass (7007.19) from Malaysia. On February 26, 2019, India imposed duties of $114.58 per MT.
July 2018	India imposed safeguard duties on solar cells and modules. Developing countries except China and Malaysia, were exempt. The duties include 25 percent in the first year, 20 percent for the first six months of the second year and 15 percent thereafter.
September 2018	EU terminated measures on cells and modules from China.
November 2018	China duties on polysilicon (HS 2804.61) imports from the EU expired.

Table continued on next page.

Table I-12 Continued
CSPV: Third-country market import restraints, 2016–23

Date	Third-country market import restraint
January 2019	China initiated a sunset review of polysilicon (HTS 2804.61) imports from Korea and the United States. AD/CVD measures against Korea and the United States were continued.
August 2019	Indonesia initiated AD investigations on BOPP (HTS 3920.20.10, 3920.20.91, 3920.20) from China and Malaysia.
January 2020	China imposed a 5-year extension on AD duties on imports of solar-grade polysilicon from Korea and the United States.
July 2020	India reviewed the safeguard duty on PV solar cells and modules and granted a one-year extension for products imported from China, Thailand, and Vietnam. Malaysian products were exempted from the safeguard duties.
July 2020	EU extended AD duties on imports of solar glass from China.
March 2021	India announced that it would impose a basic customs duty of 25 percent on PV cells and 40 percent on PV modules, effective April 1, 2022.
September 2022	India announced that no measure would be imposed on solar cells from China, Thailand, Vietnam, as the investigation was terminated.

Source: Extension publication, pp. I-22—I-23; and information collected from each country's semiannual reports from the WTO's committee on Anti-Dumping Practices. Additional information can be found online at: "World Trade Organization's Anti-dumping Gateway," retrieved October 2, 2023.

U.S. developments

U.S. CSPV cell producers

Currently, there are no known firms with domestic CSPV cell production. Table I-13 presents U.S. CSPV cell production facilities that have opened and/or ceased operations during January 2020 through June 2023 (from publicly available data sources).[204] No CSPV cell manufacturing plants were opened during this time, however one CSPV cell manufacturer ceased operations.

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

Table I-13
CSPV cells: U.S. CSPV production facilities ceasing operations, January 2020–June 2023

Company	State	Opening year	Closing year	Notes
Panasonic	NY	2018	2020	Announced it would cease U.S. solar manufacturing operations in May 2020 and exit Tesla's facility in September 2020.

Source: "Panasonic to Wind Down U.S. Manufacturing of Solar Cells and Modules in Buffalo, NY in Alignment with its Global Solar Strategy," https://news.panasonic.com/global/press/data/2020/02/en200226-8/en200226-8-1.pdf, retrieved October 10; and "Tesla and Panasonic end joint solar cell production," https://asia.nikkei.com/Business/Technology/Tesla-and-Panasonic-end-joint-solar-cell-production, retrieved October 10, 2023.

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.

Table I-14 presents planned U.S. CSPV cell production facilities that have been publicly announced. At least 11 new U.S. CSPV cell plants have been publicly announced or are under consideration. [205] All 11 CSPV cell plants announced they would begin production sometime during late 2024 through 2026. All but one, Solar4America, announced initial capacities ranging from 1 GW to 10 GW. According to Clean Energy Associates ("CEA"), a clean energy advisory company, public announcements of U.S. cell capacity additions total 84 GW, of which CEA expects 33 GW to be operational by 2027.[206]

[205] In addition, Suniva announced it would restart its Georgia cell factory in 2024 following support from the IRA. "US solar company Suniva to restart idled factory thanks to Biden climate law," https://www.reuters.com/business/us-solar-company-suniva-restart-idled-factory-thanks-biden-climate-law-2023-10-11/, retrieved October 12, 2023. See also section entitled "U.S. policies."

[206] "PV module procurement – US factory announcements add to complexity," https://www.pv-tech.org/pv-module-procurement-us-factory-announcements-add-to-complexity/, retrieved December 12, 2023.

Table I-14
CSPV cells: New U.S. CSPV cell production facilities announced

n.a.= not available

Company	State	Planned start of production	Notes
Canadian Solar	IN	Late 2025	State-of-the-art solar photovoltaic cell manufacturing plant in Jeffersonville, Indiana with an annual output of 5 GW, equivalent to approximately 20,000 high-power modules per day. Cells produced at this facility will be used at the announced 5 GW module assembly plant in Mesquite, Texas.
Convalt	NY	2025	Factory #2. Producing ingots, wafers, cells and modules in one integrated factory. Will produce Tier 1 panels for residential, commercial & industrial, and utility-scale solar projects. Annual capacity will be 10,000 MW. Expected to begin construction in June 2024 and production in May 2025.
Enel	OK	Late 2024	Facility for both bifacial PV modules and cells. Construction is planned to begin in the fall of 2023 with the first panel produced and available to the market by the end of 2024. Expected to reach 3 GW annual capacity in 2025, with the possibility of a future expansion to 6 GW.
First Solar	LA	2026	Will be First Solar's fifth fully vertically integrated manufacturing facility in the United States. Expected to grow the company's nameplate manufacturing capacity by 3.5 GW.
Heliene	MN	2025	Plans to produce 1 GW of solar modules and 1.5 GW of cells in a new facility in Minnesota. Driven by the IRA, the plan is for the new factory to begin producing modules in 2024 and cells in 2025.
Maxeon Solar	NM	2025	3GW facility for both solar modules and cells. Subject to a successful financial close under the DOE Title 17 Clean Energy Financing Program.

Table continued on next page.

Table I-14 Continued
CSPV cells: New U.S. CSPV cell production facilities announced

n.a.= not available

Company	State	Planned start of production	Notes
Meyer Burger	CO	Q4 2024	With an initial capacity of 2 GW of solar cells per year, the new plant will exclusively supply Meyer Burger's solar module production in Goodyear, Arizona.
Q Cells	GA	Late 2024	In addition to its existing two solar module assembly facilities in Dalton, Georgia, the company will build a new factory in the state that will manufacture 3.3 GW of silicon ingots, wafers, cells, and more finished panels.
Silfab Solar	SC	2024	Anticipated to be fully operational in 2024 with an initial annual capability of 1 GW cell production and an additional 1.2 GW of PV solar module assembly.
Solar4America	n.a.	Late 2024	n.a.
VSK Energy	n.a.	2025	Plans for vertically integrated manufacturing facility in southern U.S. Annual production capacity of 4 GW for cells, ingots, and wafers.

Source: "Canadian Solar Announces U.S. Solar Cell Manufacturing Facility in Jeffersonville, Indiana," https://investors.canadiansolar.com/news-releases/news-release-details/canadian-solar-announces-us-solar-cell-manufacturing-facility, retrieved December 3, 2023; "Convalt Factory #2 10,000 MW Vertically Integrated Solar Manufacturing Plant," https://convalt.com/Watertown4GW.html, retrieved December 3, 2023; "Enel Selects Oklahoma As Site For Planned Solar PV Cell & Panel Manufacturing Facility," https://www.enelnorthamerica.com/newsroom/news/search-press/press/2023/05/3sun-oklahoma, retrieved October 10, 2023; "Heliene plans to manufacture 1 GW solar modules, 1.5 GW solar cells in the U.S.," https://pv-magazine-usa.com/2023/07/31/heliene-plans-to-manufacture-1-gw-solar-modules-1-5-gw-solar-cells-in-the-u-s/, retrieved on December 3, 2023; "Meyer Burger Announces Solar Cell Production Facility in Colorado, USA," https://www.meyerburger.com/en/newsroom/artikel/meyer-burger-announces-solar-cell-production-facility-in-colorado-usa, retrieved October 10, 2023; "Maxeon Solar Technologies Selects Albuquerque, New Mexico as Site for New 3-Gigawatt Solar Cell and Panel Manufacturing Facility," https://mediaroom.maxeon.com/2023-08-10-Maxeon-Solar-Technologies-Selects-Albuquerque,-New-Mexico-as-Site-for-New-3-Gigawatt-Solar-Cell-and-Panel-Manufacturing-Facility,retrieved October 10, 2023; "Qcells will manufacture every part of a silicon solar panel in the United States," https://www.solarpowerworldonline.com/2023/01/qcells-will-manufacture-every-part-of-a-silicon-solar-panel-in-the-united-states/,retrieved October 10, 2023; "Silfab Solar Raises $125M to Execute First Phase for its USA Cell Manufacturing Facility, including a 2nd Investment from ARC Financial," https://silfabsolar.com/silfab-solar-to-execute-usa-cell-manufacturing-facility/, retrieved October 10, 2023; "SPI Energy's Solar4America plans HJT solar cell factory in the U.S," https://pv-magazine-usa.com/2023/07/13/spi-energys-solar4america-plans-hjt-solar-cell-factory-in-the-u-s/, retrieved October 10, 2023; "Vikram Solar forms JV to build vertically integrated solar manufacturing in the US," https://www.pv-tech.org/vikram-solar-forms-jv-to-build-vertically-integrated-solar-manufacturing-in-the-us/, retrieved December 5, 2023.

Note: This table is based on publicly available information. Information on changes in production capacity at existing plants is not included. For further discussion on U.S. production capacity, see part III of this report.

U.S. CSPV module producers

Currently, there are an estimated 18 CSPV module manufacturing plants in the U.S.[207] A list of publicly announced U.S. CSPV module producer entries and exits during January 2020 through June 2023 is reported in table I-15. During this period, five module producing plants opened and three closed.[208]

Table I-15
CSPV modules: U.S. CSPV production facilities opening and/or closing, January 1, 2020–June 30, 2023

n.a.= not available

Company	State	Start year	Year closed	Notes
CHERP Solar Works	CA	2020	n.a.	Awaiting ETL safety certification
Crossroads Solar	IN	2021	n.a.	Located in South Bend, Indiana. Manufacturers both monofacial and bifacial modules.
GAF Energy	CA	2021	n.a.	Facility in San Jose, California
LG	AL	2019	2022	Ceased panel manufacturing due to increased material and logistics costs, as well as severe supply constraints.
Silfab Solar	WA	2021	n.a.	Facility in Burlington, Washington
Solar4America	CA	2023	n.a.	Announced start of production in January. Initial production of 700 MW with capacity to ramp up to 2.4 GW by end of 2023.
Sunergy California	CA	2018	2021	Filed for bankruptcy
SunPower	OR	2018	2021	Former SolarWorld plant acquired by SunPower on October 1, 2018.

Source: "CHERP's big ambitions move closer to fruition," https://claremont-courier.com/latest-news/cherps-big-ambitions-move-closer-to-fruition-69968/, retrieved October 12, 2023; "What it's like starting a new solar panel factory amidst supply chain woes," https://www.solarpowerworldonline.com/2021/09/what-its-like-starting-a-new-solar-panel-factory-amidst-supply-chain-woes/, retrieved October 12, 2023; "Bloomberg: Silicon Valley Getting a Rare New U.S. Solar-Manufacturing Plant," retrieved https://www.gaf.energy/press/bloomberg-silicon-valley-getting-a-rare-new-u-s-solar-manufacturing-plant/, retrieved December 5, 2023;

Table continued on next page.

[207] Solar Manufacturing Map, https://www.energy.gov/eere/solar/solar-manufacturing-map, retrieved December 4, 2023.

[208] Compiled from publicly available information; Monitoring publication, pp. I-40–I-41; CSPV 2 first review publication, pp. I-41–I-42.

Table I-15 Continued
CSPV modules: U.S. CSPV production facilities opening and/or closing, January 1, 2020–June 30, 2023

"LG to exit solar panel manufacturing and close Alabama plant," https://www.solarpowerworldonline.com/2022/02/lg-to-exit-solar-panel-manufacturing-and-close-alabama-plant/, retrieved October 12, 2023; Silfab opens second solar panel assembly facility in Washington State, https://www.solarpowerworldonline.com/2021/08/silfab-opens-second-solar-panel-assembly-facility-in-washington-state/,retrieved October 12, 2023; Solar4America begins module production at 2.4 GW Sacramento factory, https://pv-magazine-usa.com/2023/01/09/solar4america-begins-module-production-at-2-4-gw-sacramento-factory/, retrieved December 5, 2023; Chinese solar panel affiliate in California files bankruptcy, begins liquidating 400-MW plant, https://www.solarpowerworldonline.com/2021/10/chinese-solar-panel-affiliate-in-california-files-bankruptcy-begins-liquidating-400-mw-plant/,retrieved October 12, 2023; SunPower will close former SolarWorld factory in Hillsboro, lay off 170, https://www.oregonlive.com/business/2021/01/sunpower-will-close-former-solarworld-factory-in-hillsboro-lay-off-170.html,retrieved October 12, 2023.

Note: This table is based on publicly available information. Information on changes in production capacity at existing plants is not included.

A number of additional investments in U.S. CSPV module manufacturing have been announced or are under consideration (table I-16). At least 23 plants that have been publicly announced and are at various stages of development. Industry experts estimate that over 150 GW in additional module capacity by 2027 have been announced thus far but expect less than half of announced investments to be online by 2027.[209]

Table I-16
CSPV modules: New CSPV module production facilities announced

n.a.= not available

Company	State	Planned start of production	Notes
Adion Solar	GA	Late 2023	Will initially have a 500-MW annual capacity with room to grow to 1 GW. Plans to manufacture mono- and bifacial solar panels, all focused on the commercial market and potentially the utility-scale market.
Bila Solar	IN	2024	Will produce 1 GW of glassless, frameless solar modules per year.

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[209] PV module procurement – US factory announcements add to complexity, https://www.pv-tech.org/pv-module-procurement-us-factory-announcements-add-to-complexity/, retrieved December 12, 2023.

Table I-16 Continued
CSPV modules: New CSPV module production facilities announced

Company	State	Planned start of production	Notes
Canadian Solar	TX	Late 2023	Module manufacturing plant with an annual output of 5 GW, equivalent to approximately 20,000 high-power modules per day. This will be Canadian Solar's first United States manufacturing facility.
Convalt	ME	2024	Convalt's Factory #0. Establishing one solar module production line with a maximum annual capacity of 638 MW. This location will produce Tier 1 panels for residential, commercial & industrial, and utility-scale solar projects. Construction scheduled to begin October 2023 and commercial operations are scheduled to begin March 2024.
Convalt	NY	Q3 2024	Factory #1. Acquired SunPower Corporation's solar module factory in April 2021. Dismantled entire factory and has moved all the equipment to Watertown, NY. Will produce Tier 1 panels for residential, commercial & industrial and utility scale solar projects, expected to start production in Q3 of 2024.
Convalt	NY	2025	Factory #2. Producing ingots, wafers, cells and modules in one integrated factory. Will produce Tier 1 panels for residential, commercial & industrial, and utility-scale solar projects. Annual capacity will be 10,000 MW. Expected to begin construction in June 2024 and production in May 2025.
Enel	OK	Late 2024	Facility for both bifacial PV modules and cells. Construction is planned to begin in the fall of 2023 with the first panel produced and available to the market by the end of 2024. Expected to reach 3 GW annual capacity in 2025, with the possibility of a future expansion to 6 GW.
First Solar	OH	2023	Its newest Ohio facility, which is scheduled to commence operations in the first half of 2023 and will eventually have an annual capacity of 3.5 GW by 2025.
First Solar	AL	2025	Expected to be commissioned in 2025, with a planned annual capacity of 3.5 GW
First Solar	LA	2026	Will be First Solar's fifth fully vertically integrated manufacturing facility in the United States. Expected to grow the company's nameplate manufacturing capacity by 3.5 GW.

Table continued on next page.

Table I-16 Continued
CSPV modules: New CSPV module production facilities announced

Company	State	Planned start of production	Notes
Heliene	MN	2024	Plans to produce 1 GW of solar modules and 1.5 GW of cells in a new facility in Minnesota. Driven by the Inflation Reduction Act, the plan is for the new factory to begin producing modules in 2024 and cells in 2025.
Hounen	SC	n.a.	U.S. division of Zhejiang Haoneng Optoelectric Co., has announced plans for its first U.S. solar module manufacturing facility in South Carolina, a 1GW factory representing US$33 million in investment.
Illuminate USA	OH	Late 2023	Chinese panel maker Longi Solar and U.S. solar project developer Invenergy have agreed to jointly construct a 5 GW solar panel factory in Pataskala, Ohio, via a newly founded company, Illuminate USA. The factory will make single and bifacial solar modules.
JA Solar	AZ	Q4 2023	Will produce PV modules for commercial and residential rooftop applications, as well as for utility-scale solar power plants deployment with annual production capacity of 2 GW once it is fully functional.
Maxeon Solar	NM	2025	3 GW facility for both solar modules and cells. Subject to a successful financial close under the DOE Title 17 Clean Energy Financing Program.
Meyer Burger	AZ	n.a.	Module facility in Goodyear, Arizona under construction since 2021. Plans to have cells supplied by its own cell production facility in Colorado.
Mitrex	n.a.	Q1 2024	2.5 GW solar panel factory. Will make a mix of building-integrated PV products and traditional solar panels.
Navitas Solar	n.a.	n.a.	Will be built at an undisclosed location in the U.S. Midwest with an initial capacity of 1.2 GW. Will be scaled to 10 GW capacity within a few years.
Hanwha Q Cells	GA	Late 2024	In addition to its existing two solar module assembly facilities in Dalton, Georgia, the company will build a new factory in the state that will manufacture 3.3 GW of silicon ingots, wafers, cells and more finished panels.

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Table I-16 Continued
CSPV modules: New CSPV module production facilities announced

Company	State	Planned start of production	Notes
SEG Solar	TX	2024	Plans to produce 2 GW of solar modules based on n-type TOPCon cell technology. Plans to supply the utility, commercial and residential markets.
Silfab Solar	SC	2024	Anticipated to be fully operational in 2024 with an initial annual capability of 1 GW cell production and an additional 1.2 GW of PV solar module assembly.
Trina Solar	TX	2024	Starting in 2024, when completed the facility will produce 5 GW of modules and source polysilicon from the United States and Europe.
VSK Energy	CO	2024	Plans for vertically integrated manufacturing facility. Module production will be located in Colorado with an initial capacity of 2 GW and expansion of up to 4 GW.

Sources: New solar panel manufacturer to set up in Georgia with 500-MW facility, https://www.solarpowerworldonline.com/2022/12/georgia-adion-solar-500-mw/, retrieved December 3, 2023; Bila Solar announces plans to manufacture lightweight solar modules in U.S.,https://pv-magazine-usa.com/2023/08/29/bila-solar-announces-plans-to-manufacture-lightweight-solar-modules-in-u-s/,retrieved December 3, 2023; Canadian Solar Announces U.S. Module Manufacturing Facility in Mesquite, Texas, https://investors.canadiansolar.com/news-releases/news-release-details/canadian-solar-announces-us-module-manufacturing-facility, retrieved December 3, 2023; Convalt Factory #0 638 MW Solar Manufacturing Plant, https://convalt.com/convalt_factory0.html, retrieved December 3, 2023; Convalt 2,000 MW Factory 1, https://convalt.com/Watertown.html, retrieved December 3, 2023; Convalt Factory #2 10,000 MW Vertically Integrated Solar Manufacturing Plant, https://convalt.com/Watertown4GW.html, retrieved December 3, 2023; Enel Selects Oklahoma As Site For Planned Solar PV Cell & Panel Manufacturing Facility, https://www.enelnorthamerica.com/newsroom/news/search-press/press/2023/05/3sun-oklahoma, retrieved October 10, 2023; First Solar plans $1.1 billion Alabama manufacturing facility with 700 jobs, https://www.madeinalabama.com/2022/11/first-solar-plans-1-1-billion-alabama-manufacturing-facility-with-700-jobs/, retrieved October 22, 2023; First Solar announces plans for fifth U.S. factory, https://www.renewableenergyworld.com/solar/first-solar-announces-plans-for-fifth-u-s-factory/#gref, retrieved October 22, 2023; First Solar webpage, https://www.firstsolar.com/Technology/Manufacturing, retrieved October 22, 2023; Heliene plans to manufacture 1 GW solar modules, 1.5 GW solar cells in the U.S., https://pv-magazine-usa.com/2023/07/31/heliene-plans-to-manufacture-1-gw-solar-modules-1-5-gw-solar-cells-in-the-u-s/, retrieved on December 3, 2023; Hounen Solar America to set up 1GW module assembly plant in South Carolina, https://www.pv-tech.org/us-arm-of-hounen-solar-to-set-up-1gw-us-module-assembly-plant-in-south-carolina/, retrieved December 3, 2023; Longi reveals plans to open 5 GW solar module factory in US market, https://www.pv-magazine.com/2023/03/15/longi-reveals-plans-to-open-5-gw-solar-module-factory-in-us/, retrieved December 3, 2023; JA Solar Announces First U.S. Solar Module Manufacturing Facility in Phoenix, https://www.azcommerce.com/news-events/news/2023/1/ja-solar-announces-first-us-solar-module-manufacturing-facility-in-phoenix/, retrieved December 3, 2023; Mitrex is planning a 2.5-GW solar factory for panels and BIPV products, https://www.solarpowerworldonline.com/2023/04/mitrex-is-planning-a-2-5-gw-solar-factory-for-panels-and-bipv-products/, retrieved on December 3, 2023;

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Table I-16 Continued
CSPV modules: New CSPV module production facilities announced
"Maxeon Solar Technologies Selects Albuquerque, New Mexico as Site for New 3-Gigawatt Solar Cell and Panel Manufacturing Facility", https://mediaroom.maxeon.com/2023-08-10-Maxeon-Solar-Technologies-Selects-Albuquerque,-New-Mexico-as-Site-for-New-3-Gigawatt-Solar-Cell-and-Panel-Manufacturing-Facility,retrieved October 10, 2023; "Meyer Burger to establish solar cell manufacturing in Colorado," https://www.solarpowerworldonline.com/2023/07/meyer-burger-to-establish-solar-cell-manufacturing-in-colorado/,retrieved December 4, 2023; "Navitas Solar sets up US manufacturing unit," https://www.pv-magazine.com/2023/08/24/navitas-solar-sets-up-us-manufacturing-unit/, retrieved December 5, 2023; "Qcells will manufacture every part of a silicon solar panel in the United States," https://www.solarpowerworldonline.com/2023/01/qcells-will-manufacture-every-part-of-a-silicon-solar-panel-in-the-united-states/,retrieved October 10, 2023; "SEG Solar signs agreement for Horad PV manufacturing equipment for Texas plant," https://pv-magazine-usa.com/2023/06/22/seg-solar-signs-agreement-for-horad-pv-manufacturing-equipment-for-texas-plant/, retrieved December 3, 2023; "Silfab Solar Raises $125M to Execute First Phase for its USA Cell Manufacturing Facility, including a 2nd Investment from ARC Financial," https://silfabsolar.com/silfab-solar-to-execute-usa-cell-manufacturing-facility/, retrieved October 10, 2023; "Trina Solar U.S. Bringing PV Manufacturing Facility and Jobs to Wilmer," Texas, https://www.trinasolar.com/us/resources/newsroom/Trina-Solar-US-PV-Manufacturing-Facility-Jobs-Wilmer-Texas, retrieved October 22, 2023; "Vikram Solar forms JV to build vertically integrated solar manufacturing in the US," https://www.pv-tech.org/vikram-solar-forms-jv-to-build-vertically-integrated-solar-manufacturing-in-the-us/, retrieved December 5, 2023.

Note: This table is based on publicly available information. Information on producers of off-grid products and changes in production capacity at existing plants is not included.

U.S. policies[210]

There were changes during 2020-22 to two of the major federal policies that promote solar energy: the Investment Tax Credit ("ITC") and the Production Tax Credit ("PTC"). The ITC was established in 2005 and the PTC in 1992, and they have been extended and modified multiple times thereafter. The ITC reduces the federal income tax liability for a percentage of the cost of a solar system that is installed during the tax year. The PTC is a per kilowatt-hour (kWh) tax credit that reduces the federal income tax liability, adjusted for inflation. The PTC is available to solar systems for the electricity generated for the first 10 years of its operation. The most recent extension of the ITC and PTC was in the Inflation Reduction Act ("IRA") of 2022.[211]

[210] See Part II for additional discussion of U.S. policies.
[211] Public Law 117-169.

The IRA increased the ITC back to 30 percent and extended it through 2034 and extended the PTC of 2.75 cents/kWh through at least 2025 for systems that meet the prevailing wage and apprenticeship requirements or are under 1 megawatt in size.[212] In addition to the baseline credits, the ITC and PTC also offer projects additional credits, such as a domestic content bonus, energy community bonus, and low-income bonus (figure I-19). Projects that meet the domestic content minimums are eligible for a 10 percentage point increase in value of the ITC (i.e., ITC = 40 percent), or a 10 percent increase in value of the PTC (e.g., an additional 0.3 cents/kWh for a 2.75 cents/kWh).[213] [214]

[212] After January 1, 2025, the ITC and PTC will be replaced with the Clean Electricity Investment Tax Credit and the Clean Energy Production Tax Credit, which are generally calculated in the same way as the traditional ITC and PTC and function similarly to the traditional ITC and PTC but are not technology-specific. The Clean Energy Production Tax Credit will be available to electricity generation facilities that come into service after December 31, 2024 and whose greenhouses gas emissions rate is not greater than zero. Solar project owners are generally not eligible to claim both the ITC and PTC, however, they could claim different credits for co-located systems, like solar and storage. Under the IRA, apprenticeship requirements include a labor hours requirement, a ratio requirement, and a participation requirement. U.S. Department of Energy, "Federal Tax Credits for Businesses," last updated August 2023 https://www.energy.gov/eere/solar/federal-solar-tax-credits-businesses, retrieved October 4, 2023; United States Environmental Protection Agency (EPA), "Summary of Inflation Reduction act provisions related to renewable energy," last updated June 1, 2023 https://www.epa.gov/green-power-markets/summary-inflation-reduction-act-provisions-related-renewable-energy, retrieved October 4, 2023; Congressional Research Service (CRS), "Recent Developments in the Federal Multipronged Approach to Solar and Wind Energy," October 3, 2023 https://crsreports.congress.gov/product/pdf/LSB/LSB11054, retrieved October 4, 2023; U.S. Department of Labor, "Inflation Reduction Act Apprenticeship Resources," https://www.apprenticeship.gov/inflation-reduction-act-apprenticeship-resources, retrieved January 16, 2024.

[213] U.S. Department of Energy, "Federal Tax Credits for Businesses," last updated August 2023 https://www.energy.gov/eere/solar/federal-solar-tax-credits-businesses, retrieved October 4, 2023

[214] Domestic producers of CSPV products reported that the U.S. Department of the Treasury and the Internal Revenue Service have not issued final guidance for filing claims for these additional bonus tax credits. See Hearing transcript, pp. 51-52 (Connolly), p. 194 (Pochtaruk), and p. 197 (Hopper). For latest available guidance, see U.S. Department of Treasury website, https://home.treasury.gov/news/press-releases/jy1920, accessed December 4, 2023.

Figure I-19
Summary of Investment Tax Credit (ITC) and Production Tax Credit (PTC) values over time

			Start of Construction						
			2006 to 2019	2020 to 2021	2022	2023 to 2033	The later of 2034 (or two years after applicable year[a])	The later of 2035 (or three years after applicable year[a])	The later of 2036 (or four years after applicable year[a])
ITC	Full rate (if project meets labor requirements[b])	Base Credit	30%	26%	30%	30%	22.5%	15%	0%
		Domestic Content Bonus				10%	7.5%	5%	0%
		Energy Community Bonus				10%	7.5%	5%	0%
	Base rate (if project does not meet labor requirements[b])	Base Credit	30%	26%	6%	6%	4.5%	3%	0%
		Domestic Content Bonus				2%	1.5%	1%	0%
		Energy Community Bonus				2%	1.5%	1%	0%
	Low-income bonus (1.8 GW/yr cap)	<5 MW projects in LMI communities or Indian land				10%	10%	10%	10%
		Qualified low-income residential building project / Qualified low-income economic benefit project				20%	20%	20%	20%
PTC for 10 years ($2022)	Full rate (if project meets labor requirements[b])	Base Credit			2.75 ¢	2.75 ¢	2.0 ¢	1.3 ¢	0.0 ¢
		Domestic Content Bonus				0.3 ¢	0.2 ¢	0.1 ¢	0.0 ¢
		Energy Community Bonus				0.3 ¢	0.2 ¢	0.1 ¢	0.0 ¢
	Base rate (if project does not meet labor requirements[b])	Base Credit			0.55 ¢	0.55 ¢	0.4 ¢	0.3 ¢	0.0 ¢
		Domestic Content Bonus				0.1 ¢	0.0 ¢	0.0 ¢	0.0 ¢
		Energy Community Bonus				0.1 ¢	0.0 ¢	0.1 ¢	0.0 ¢

Source: U.S. Department of Energy, "Federal Solar Tax Credits for Businesses," August 2023 https://www.energy.gov/eere/solar/federal-solar-tax-credits-businesses, retrieved October 4, 2023.

Note: Applicable year is defined as the later of (i) 2032 or (ii) the year the Treasury Secretary determines that there has been a 75 percent or more reduction in annual greenhouse gas emissions from the production of electricity in the United States as compared to the calendar year 2022. Labor requirements signifies certain prevailing wage and apprenticeship conditions are met.

The IRA established the Advanced Manufacturing Production Tax Credit ("45X MPTC") and expanded the Advanced Energy Project Investment Tax Credit ("48C ITC") for manufacturers of eligible components.[215] The 45X MPTC is a per-unit tax credit for each component produced domestically and sold by the manufacturers. The 48C ITC is a U.S. Department of Treasury program that awards tax credits to manufacturers investing in various eligible property.[216] Manufacturers cannot claim the 45X MPTC if components were made at a facility that claimed a 48C ITC.[217] Solar components eligible for the 45X MPTC include PV modules and cells, certain inputs, and tracking system components (table I-17).

[215] The 48C program was first initiated under the American Recovery and Reinvestment Act (ARRA) of 2009 to support investments in projects that establish, expand, or re-equip clean energy manufacturing facilities that produce solar, storage, and electric grid equipment systems and components. The IRA of 2022 allowed for $10 billion in new 48C ITC tax credits and expanded eligible manufacturing facilities under the 48C ITC to include (but not limited to) investments made to produce grid modernization equipment and components, energy storage systems and components, and electrolyzers run on renewable electricity. U.S. Department of Energy, "Federal Tax Credits for Solar Manufacturers," October 2022 https://www.energy.gov/sites/default/files/2022-10/Federal-Tax-Credits-for-Solar-Manufacturers.pdf, retrieved October 4, 2023.

[216] Awardees of these credits can claim the 48C ITC on federal income taxes as a percentage of eligible investment costs placed in service during the tax year. Starting in 2023, awardees are eligible for an ITC of 30 percent of qualifying investment if they satisfy the labor requirements issued by the Treasury Department for any labor associated with re-equipping, expansion, or establishment of eligible properties and facilities. Projects that do not meet the labor requirements are only eligible for a baseline tax credit of 6 percent. Eligible properties include those designed to produce or recycle advanced energy components, such as PV modules, inverters, and batteries, as well as industrial facilities for the processing, refining, or recycling of critical materials. The program is focused on strengthening U.S. supply chains and domestic manufacturing for a net-zero economy, including the solar supply chain, specifically polysilicon, wafer production facilities, ingot and wafer production tools, and solar glass production facilities. U.S. Department of Energy, "Federal Tax Credits for Solar Manufacturers," October 2022 https://www.energy.gov/sites/default/files/2022-10/Federal-Tax-Credits-for-Solar-Manufacturers.pdf, retrieved October 4, 2023; Internal Revenue Service (IRS), "Additional Guidance for the Qualifying Advanced Energy Project Credit Allocation Program under Section 48C(e)," Notice 2023-44, pp. 2,17 https://www.irs.gov/pub/irs-drop/n-23-44.pdf, retrieved October 4, 2023.

[217] If eligible for both tax credits, manufacturing facilities which produce components eligible for the 45X MPTC generally receive more value from this tax credit than the 48C ITC. The 48C ITC is an upfront tax credit calculated based on the investment in a manufacturing facility. The 45X MPTC is earned over time and is dependent on the production and sale of eligible components. U.S. Department of Energy, "Federal Tax Credits for Solar Manufacturers," October 2022 https://www.energy.gov/sites/default/files/2022-10/Federal-Tax-Credits-for-Solar-Manufacturers.pdf, retrieved October 4, 2023.

Table I-17
Summary of PV components eligible for Advanced Manufacturing Production Tax Credit

Eligible components	Definition	Credit amount
Solar-grade polysilicon	Silicon that is suitable for photovoltaic manufacturing and is purified to a minimum purity of 99.999999 percent silicon by mass.	$3 per kilogram (kg)
PV wafer	A thin slice, sheet, or layer of semiconductor material of at least 240 square centimeters that comprises the substrate or absorber layer of one or more photovoltaic cells. Produced by a single manufacturer either i) directly from molten or evaporated solar grade polysilicon or deposition of solar grade thin film semiconductor photon absorber layer, or ii) through formation of an ingot from molten polysilicon and subsequent slicing.	$12 per square meter ($m^2$)
PV cell (crystalline or thin-film)	The smallest semiconductor element of a solar module that performs the immediate conversion of light into electricity.	4¢ per watt-direct current (W_{dc})
Polymeric backsheet	A sheet on the back of a solar module that acts as an electric insulator and protects the inner components of such module from the surrounding environment.	40¢ per m^2
PV module	The connection and lamination of photovoltaic cells into an environmentally protected final assembly that is suitable to generate electricity when exposed to sunlight, and ready for installation without an additional manufacturing process.	7¢ per W_{dc}
Central inverter	Suitable for large utility-scale systems. >1 megawatt-alternating current (MW_{ac}).	0.25¢ per watt-alternating current (W_{ac})
Utility inverter	Suitable for commercial or utility-scale systems. ≥125 kW_{ac}, ≤1 MW_{ac}, with a rated output ≥600 volt three-phase power.	1.5¢ per W_{ac}
Structural fasteners	A component that is used to connect the mechanical and drive system components of a solar tracker to the foundation of such solar tracker, to connect torque tubes to drive assemblies, or to connect segments of torque tubes to one another.	$2.28 per kg

Source: U.S. Department of Energy, "Federal Tax Credits for Solar Manufacturers," October 2022 https://www.energy.gov/sites/default/files/2022-10/Federal-Tax-Credits-for-Solar-Manufacturers.pdf, retrieved October 4, 2023.

Note: Other eligible components include commercial inverters, residential inverters, microinverters, torque tubes for tracking systems, battery components (cells, modules), and certain critical materials in the solar PV supply chain.

According to estimates from the International Energy Agency ("IEA"), if fully monetized, the IRA's available production tax credits could provide U.S. manufacturers cost parity with the lowest-cost manufacturers in China and ASEAN countries (Vietnam, Malaysia, and Thailand) in key segments of the PV supply chain.[218] With IRA manufacturing production tax credits, the average manufacturing cost of polysilicon for U.S. producers could drop from $0.05/watt to $0.04/watt, compared to the average manufacturing cost of $0.04/watt in China and ASEAN countries. The manufacturing cost of wafers would drop from $0.15/watt to $0.09/watt with IRA manufacturing tax credits, compared to $0.13/watt in China and $0.14/watt in ASEAN countries. For cells, the IRA manufacturing tax credits would decrease the manufacturing cost in the U.S. from $0.21/watt to $0.17/watt, compared to $0.17/watt in China and $0.18/watt in ASEAN countries. In terms of module assembly, the manufacturing tax credits would reduce the U.S. manufacturing cost from $0.35/watt to $0.28/watt, compared to $0.30/watt in China and $0.31/watt in ASEAN countries.[219]

In July 2020, the Federal Energy Regulatory Commission ("FERC") revised its rules related to the Public Utilities Regulatory Act ("PURPA").[220] Passed by Congress in 1978, PURPA mandates certain utilities purchase solar-generated electric power from qualifying facilities (for solar, those of a certain size) at the utility's avoided cost.[221] On July 16, 2020, FERC modified the PURPA rules by adjusting qualifying facility ("QF") rates. In addition, the net capacity for most qualifying facilities (including all solar facilities) was lowered from at or below 20 MW down to 5 MW and the new rules made it more challenging for facilities in close proximity to qualify as

[218] IEA, "Will new PV manufacturing policies in the United States, India and the European Union create global PV supply diversification?," December 2022, https://www.iea.org/reports/will-new-pv-manufacturing-policies-in-the-united-states-india-and-the-european-union-create-global-pv-supply-diversification, retrieved October 11, 2023.

[219] IEA, "United States c-Si manufacturing costs with and without the IRA Manufacturing Production Credit incentives, compared to China and ASEAN," November 21, 2022, https://www.iea.org/data-and-statistics/charts/united-states-c-si-manufacturing-costs-with-and-without-the-ira-manufacturing-production-credit-incentives-compared-to-china-and-asean, retrieved October 11, 2023.

[220] 85 FR 86656

[221] Avoided cost is the incremental cost to an electric utility of electric energy or capacity which, but for the purchase from the qualifying facility, such utility would generate itself or purchase from another source. Federal Energy Regulatory Commission, "PURPA Qualifying Facilities," last updated April 10, 2023, https://www.ferc.gov/qf, retrieved January 16, 2024; Solar Energy Industries Association, "PURPA 101," February 2018, https://www.seia.org/sites/default/files/2018-06/SEIA-PURPA-101-Factsheet-2018-April.pdf, retrieved January 16, 2024.

separate facilities.[222] The revised rules have not had major effects on QF development as many states have not adopted the variable energy rate option in their QF contracts.[223]

At the state level, there are many policies established to advance the growth of solar energy, including:

- Renewable Portfolio Standards ("RPS"): 29 states plus the District of Columbia had RPS[224] in 2023, which apply to 58 percent of total U.S. retail electricity sales.[225] Since 2020, several states have passed legislation to increase or expand their renewable or clean-energy targets. For example, Hawaii raised the RPS target by basing its RPS on a percentage of total generation, rather than a percentage of retail sales; Minnesota increased RPS to 55 percent by 2035; and Rhode Island increased RPS to 100 percent by 2033.[226] Approximately 30 percent of all U.S. renewable electricity capacity additions in 2022 was associated with RPS requirements.[227]

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[222] The rule changes grant states three main flexibilities: (1) the ability to require that energy rates (but not capacity rates) in qualifying facility power sales contracts and other legally enforceable obligations vary in accordance with changes in the purchasing utility's avoided costs at the time the energy is delivered; (2) the ability to allow qualifying facilities to retain their rights to fixed energy rates (which could be based on the contract term's projected energy prices); and (3) the ability to set "as available" qualifying facilities energy rates for selling to electric utilities located in organized wholesale power markets at the locational marginal price ("LMP") in those markets (subjected to rebuttable presumption that the LMP represents the as-available avoided costs of utilities located in those markets), at competitive prices from liquid market hubs, or from a formula based on natural-gas prices indices and heat rates.

[223] Utility Dive, "Ninth Circuit largely upholds FERC PURPA reform decision affecting small solar, wind," September 6, 2023 https://www.utilitydive.com/news/ninth-circuit-ferc-purpa-reform-solar-wind-idaho-power-seia/692817/, retrieved October 5, 2023.

[224] 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.

[225] RPS are often "accompanied by a tradable renewable energy certificate (REC) program to facilitate compliance." Barbose, Galen, "U.S. Renewables Portfolio Standards 2021 Status Update: Early Release," February 2021, p. 9, https://eta-publications.lbl.gov/sites/default/files/rps_status_update-2021_early_release.pdf, retrieved October 5, 2023; Barbose, Galen, "U.S. Renewables Portfolio & Clean Electricity Standards: 2023 Status," February 2021, p. 8, https://eta-publications.lbl.gov/sites/default/files/lbnl_rps_ces_status_report_2023_edition.pdf, retrieved October 5, 2023.

[226] Barbose, Galen, "U.S. Renewables Portfolio & Clean Electricity Standards: 2023 Status," February 2021, p. 11, https://eta-publications.lbl.gov/sites/default/files/lbnl_rps_ces_status_report_2023_edition.pdf, retrieved October 5, 2023.

[227] Barbose, Galen, "U.S. Renewables Portfolio & Clean Electricity Standards: 2023 Status," February 2021, p. 4, https://eta-publications.lbl.gov/sites/default/files/lbnl_rps_ces_status_report_2023_edition.pdf, retrieved October 5, 2023.

- Net metering:[228] at the end of 2019, 39 states and the District of Columbia had net metering rules. By 2022, 47 states, the District of Columbia, and all four territories had net metering rules or net metering alternatives.[229]
- Virtual Net Metering was developed for customers who can own a share of an offsite solar energy project and receive compensation for their share of the energy it produces.[230]
- Community solar allows customers to lease or buy part of a bigger, off-site shared PV system.[231] As of December 2022, community solar projects were located in 43 states and the District of Columbia. Community solar projects increased from nearly 3,400 megawatts alternating-current ("MW_{ac}") of total installed capacity at the end of 2020 to approximately 6,000 MW_{ac} at the end of 2022.[232] Approximately 75 percent of the total installed capacity is concentrated in four states: Florida (1,636 MW_{ac}), New York (1,166 MW_{ac}), Minnesota (875 MW_{ac}), and Massachusetts (858 MW_{ac}).[233]
- Third-Party Financing in the form of a power purchase agreement ("PPA") or solar leases: in a PPA, the solar project is financed by a third party and the guarantor agrees to pay a specific rate each month; by contrast, a customer who signs a solar lease agrees to pay a monthly rate for the use of the PV system (the cost covers the system rather than electricity cost and the leases typically range from 10 to 20

[228] 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.

[229] DSIRE, "Net Metering," October 2019, https://s3.amazonaws.com/ncsolarcen-prod/wp-content/uploads/2019/10/DSIRE_Net_Metering_Oct2019.pdf, retrieved October 5, 2023; National Academies of Sciences, Engineering, and Medicine, "The Role of Net Metering in the Evolving Electricity System (2023)," p. 37 https://doi.org/10.17226/26704, retrieved October 5, 2023.

[230] National Renewable Energy Laboratory ("NREL"), "State, Local, & Tribal Governments, Community Solar," https://www.nrel.gov/state-local-tribal/community-solar.html, retrieved October 5, 2023.

[231] Community solar often interacts with other clean energy policies like net metering and virtual net metering, and depending on the design of these policies, some projects may have to comply with U.S. Security and Exchange Commission regulations. Functionally, some form of virtual net metering must exist for community solar to work properly. National Renewable Energy Laboratory ("NREL"), "State, Local, & Tribal Governments, Community Solar," https://www.nrel.gov/state-local-tribal/community-solar.html, retrieved October 5, 2023.

[232] Chan, Gabriel, Kaifeng Xu, Matthew Grimley, Sudha Kannan, Mazen Hassan, and Jenny Sumner, "Sharing the Sun Community Solar Project Data (December 2022)." National Renewable Energy Laboratory, last updated August 16, 2023, https://data.nrel.gov/submissions/220, retrieved October 5, 2023.

[233] U.S. Department of Energy, "Community Solar Market Trends," https://www.energy.gov/communitysolar/community-solar-market-trends, retrieved October 5, 2023.

years).[234] As of August 2021, 29 states, Washington, DC, and Puerto Rico allow for PPAs.[235]

- California Solar Roof Mandate: Starting in 2020, PV modules are required for all new residential buildings, with certain exceptions.[236] In 2021, the California Energy Commission also approved the 2022 Energy Code, which requires builders to include solar power and battery storage in new commercial and high-rise residential projects beginning in 2023.[237]
- Clean Energy Funds ("CEF"): Funded by a small surcharge on electricity consumption, voluntary donations, and utility settlements. CEFs predominately provide funding for renewable energy projects, support rebate programs for renewable energy systems, and provide loan support.[238] For example, the Mass Solar Loan program in Massachusetts offers low-interest loans for solar installations.[239]

Several policy changes in June 2021 limit trade with firms that engage in forced labor. On June 24, 2021, the U.S. Department of Labor added polysilicon and polysilicon-based products as high-priority sectors for enforcement under the Uyghur Forced Labor Prevention

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[234] United States Environmental Protection Agency, "Understanding Third-Party Ownership Financing Structures for Renewable Energy," last updated August 8, 2023, https://www.epa.gov/greenpower/understanding-third-party-ownership-financing-structures-renewable-energy, retrieved October 6, 2023.

[235] DSIRE, "3rd Party Solar PV Power Purchase Agreement," August 2021, https://ncsolarcen-prod.s3.amazonaws.com/wp-content/uploads/2021/12/DSIRE_3rd-Party-PPA_Aug_2021-2.pdf, retrieved October 6, 2023.

[236] Thoubboron, Kerry, "California solar mandate: What you need to know," *EnergySage,* February 27, 2023, https://www.energysage.com/blog/an-overview-of-the-california-solar-mandate/, retrieved October 6, 2023. California Energy Commission, "Solar PV Systems and Solar Ready," https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/online-resource-center/solar, retrieved October 6, 2023.

[237] California Energy Commission, "2022 Building Energy Efficiency Standards for Residential and Nonresidential Buildings," last updated December 23, 2022, https://www.energy.ca.gov/publications/2022/2022-building-energy-efficiency-standards-residential-and-nonresidential, retrieved October 6, 2023; Penn, Ivan, "California Panel Backs Solar Mandate for New Buildings," *The New York* Times, August 11, 2021, https://www.nytimes.com/2021/08/11/business/energy-environment/california-solar-mandates.html, retrieved October 6, 2023.

[238] NREL, "Federal and State Structures to Support Financing Utility-Scale Solar Projects and the Business Models Designed to Utilize Them," April 2012, https://www.nrel.gov/docs/fy12osti/48685.pdf, retrieved October 8, 2023.

[239] MASS Solar Loan, Program Metrics, https://www.masscec.com/program/mass-solar-loan, retrieved October 8, 2023.

Action (UFLPA).[240] On the same day, U.S. Customs and Border Protection ("CBP") issued a Withhold Release Order (WRO) against Hoshine Silicon Industry Co. Ltd. due to its use of forced labor. The WRO applies to "silica-based products made by Hoshine and its subsidiaries as well as to materials and goods (such as polysilicon) derived from or produced using those silica-based products."[241] Also on the same day, the U.S. Department of Commerce, Bureau of Industry and Security, added Xinjian GCL New Energy Material Technology, Co. Ltd; Xinjian Daqo New Energy, Co. Ltd; Xinjian East Hope Nonferrous Metals Co. Ltd.; Hoshine Silicon Industry (Shanshan) Co., Ltd.; Xinjian Production and Construction Corps to the "Entity List" due to their use of forced labor.[242] The "Entity List" restrictions prohibit exports, re-exports and transfers of commodities, software and technology subject to the Export Administration Regulations (EAR) to listed entities without a license.[243]

In fiscal year 2022, CBP reported detaining 1,044 shipments of electronics worth $453 million for examination under the UFLPA, and releasing 348 of those shipments.[244] CBP's UFLPA statistics dashboard groups PV modules and cells within the Electronics industry, however, industry sources have reported that the detained products include PV modules and cells

[240] U.S. Department of Labor, "US Department of Labor Adds Polysilicon from China to 'List of Goods Produced by Child Labor or Forced Labor," June 24, 2021, https://www.dol.gov/newsroom/releases/ILAB/ILAB20210624, retrieved October 9, 2023; U.S. Customs and Border Protection (CBP), "Uyghur Forced Labor Prevention Act (UFLPA) Data Dictionary," p. 1, https://www.cbp.gov/sites/default/files/assets/documents/2023-Jun/forced-labor-data-dictionary.pdf, retrieved October 9, 2023.

[241] This includes cells and modules using materials from Hoshine. U.S. Customs and Border Protection, "The Department of Homeland Security Issues Withhold Release Order on Silica-Based Products Made by Forced Labor in Xinjiang," News release, June 24, 2021, https://www.cbp.gov/newsroom/national-media-release/department-homeland-security-issues-withhold-release-order-silica, retrieved October 9, 2023; U.S. Customs and Border Protection, "Hoshine Silicon Industry Co. Ltd Withhold Release Order Frequently Asked Questions," last modified August 7, 2023, https://www.cbp.gov/trade/programs-administration/forced-labor/hoshine-silicon-industry-co-ltd-withhold-release-order-frequently-asked-questions, retrieved October 9, 2023.

[242] 86 FR 33119; U.S. Department of Commerce, Bureau of Industry and Security, "Supplement No. 4 to Part 744 – ENTITY LIST," May 19, 2023, https://www.bis.doc.gov/index.php/policy-guidance/lists-of-parties-of-concern/entity-list, retrieved October 9, 2023.

[243] DLA Piper, "Impact on the US Solar, Silicon and Related Industries of New US Government Actions Aimed to Address Labor Practices in Xinjiang," July 5, 2021, https://www.dlapiper.com/en-us/insights/publications/2021/07/new-us-government-actions-on-forced-labor-in-xinjiang, retrieved October 9, 2023.

[244] U.S. Customs and Border Protection, "Uyghur Forced Labor Prevention Act Statistics," https://www.cbp.gov/newsroom/stats/trade/uyghur-forced-labor-prevention-act-statistics, retrieved October 9, 2023.

accounting for nearly 1 GW of capacity.[245] Industry sources reported that since implementation of the new law many of the PV modules and cells detained for inspection under the UFLPA were manufactured by Trina Solar, Jinko Solar, and Longi Green Energy.[246]

U.S. installations[247]

U.S. PV installations, including out-of-scope thin film products, increased from 19.9 GW in 2020 to 20.2 GW in 2022, according to WoodMackenzie (WoodMac)/SEIA data (table I-18).[248] The utility segment, according to WoodMac and SEIA, decreased from 14.3 GW in 2020 to 11.8 GW in 2022 and fell from 72 percent to 59 percent of installations.[249] According to the U.S. Energy Information Administration (EIA), U.S. CSPV utility installations, excluding out-of-scope thin film products, increased from 10.8 GW in 2020 to 12.5 GW in 2021, then decreased to 9.3 GW in 2022.[250] The residential market, according to WoodMac/SEIA data, increased from 3.3 GW to 6.0 GW, and its share of the market increased from 16 percent to 29 percent. The nonresidential market increased from 2.3 GW to 2.4 GW, maintaining approximately 12 percent of the market. U.S. PV installation forecasts vary, but most forecasts project U.S. installations of more than 25 GW in 2023 and an average of more than 40 GW in annual installations during 2024-2027.[251]

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[245] Reuters, "Exclusive: U.S. blocks more than 1,000 solar shipments over Chinese slave labor concerns," November 11, 2022, https://www.reuters.com/world/china/exclusive-us-blocks-more-than-1000-solar-shipments-over-chinese-slave-labor-2022-11-11/, retrieved October 9, 2023.

[246] Reuters, "U.S. solar panel imports from China grow, alleviating gridlock, officials say," March 6, 2023, https://www.reuters.com/business/energy/us-solar-panel-imports-china-grow-alleviating-gridlock-officials-say-2023-03-06/, retrieved October 9, 2023.

[247] U.S. installations are not a proxy for apparent consumption of modules due to differences in timing between when a module is shipped and when it is installed. See Modification report, p. D-4.

[248] WoodMac and SEIA data from Bolinger, Mark, and Joachim Seel, *Utility-Scale Solar, 2023 Edition*, Lawrence Berkeley National Laboratory, October 2023, data file, https://emp.lbl.gov/utility-scale-solar, retrieved October 8, 2023.

[249] WoodMac and SEIA data from Bolinger, Mark, and Joachim Seel, *Utility-Scale Solar, 2023 Edition*, Lawrence Berkeley National Laboratory, October 2023, data file, https://emp.lbl.gov/utility-scale-solar, retrieved October 8, 2023.

[250] U.S. Department of Energy, Energy Information Administration, 2022 Form EIA-860 – Schedule 3, 'Solar Technology Data' (Operable Units Only), September 19, 2023, https://www.eia.gov/electricity/data/eia860/, retrieved October 9, 2023.

[251] WoodMac and SEIA data from Bolinger, Mark, and Joachim Seel, *Utility-Scale Solar, 2023 Edition*, Lawrence Berkeley National Laboratory, October 2023, data file, https://emp.lbl.gov/utility-scale-solar, retrieved October 8, 2023; U.S. Department of Energy, Energy Information Administration, Short Term Energy Outlook Data Browser, https://www.eia.gov/outlooks/steo/data/browser/#/?v=23&f=A&s=0&start=2018&end=2024&map=&linechart=~SPEPCGWX_US&maptype=0&ctype=linechart&id=, retrieved October 9, 2023.

Table I-18
CSPV products: U.S. PV installations, by period and sector

Installations in megawatts

Year	Residential	Nonresidential	Utility	Total
2020	3,253	2,347	14,312	19,913
2021	4,250	2,696	17,164	24,111
2022	5,939	2,416	11,839	20,194

Source: WoodMac and SEIA data from Bolinger, Mark, and Joachim Seel, *Utility-Scale Solar, 2023 Edition*, Lawrence Berkeley National Laboratory, October 2023, data file, https://emp.lbl.gov/utility-scale-solar, retrieved October 8, 2023.

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 13 firms that are estimated to have accounted for 80.1 percent of known U.S. capacity to produce CSPV modules during 2022.[252] U.S. import data and related information are based on the questionnaire responses of 45 firms that are estimated to have accounted for 71.9 percent of U.S. imports of CSPV products (cells and modules) during 2022.[253]

[252] Estimates are based on a comparison of U.S. producers' reported capacity to produce CSPV modules during 2022 (4.5 GW) with the total estimated U.S. capacity to produce modules during 2022 (5.6 GW), as calculated by Commission staff using publicly available capacity estimates for known non-responding U.S. producers. See Part III of this report for a detailed discussion of coverage methodology.

[253] The estimate is based on a comparison of the total quantity of 2022 U.S. imports of CSPV cells and modules reported in the responses to the Commission's U.S. importer questionnaires (22.7 GW) with total quantity of 2022 U.S. imports of CSPV cells and modules (31.6 GW) as reported by official Commerce import statistics using HTS statistical reporting numbers 8541.40.6015, 8541.40.6025, 8541.40.6035, 8541.40.6045, 8541.42.0010, 8541.42.0080, 8541.43.0010, and 8541.43.0080. Official Commerce import statistics may be overstated by certain items that are outside the scope of this investigation, such as thin film photovoltaic products. Import data compiled from official U.S. import statistics are presented in appendix F.

U.S. market participants

U.S. producers[254]

The Commission sent U.S. producers' questionnaires to 65 firms identified by the Commission as possible U.S. producers of CSPV cells and/or modules. The Commission received usable responses from 13 firms reporting domestic production of CSPV products since January 1, 2020.[255] Collectively, responding firms are estimated to have accounted for 80.1 percent of known U.S. capacity to produce CSPV modules during 2022.[256]

Presented in table I-19 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 modules during 2022.[257] Additional information regarding U.S. producers' production, shipment, and employment is presented in Part III of this report.

[254] 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.

[255] The following companies reported that they have not produced CSPV products in the United States since January 1, 2020: ***.

[256] Estimates are based on a comparison of U.S. producers' reported capacity to produce CSPV modules during 2022 (4.5 GW) with the total estimated U.S. capacity to produce modules during 2022 (5.6 GW), as calculated by Commission staff using publicly available capacity estimates for known non-responding U.S. producers. See part III of this report for a detailed discussion of coverage methodology.

[257] Panasonic, which ceased operations in 2020, was the only firm to produce CSPV cells during the period for which data were collected. No U.S. producers reported producing CSPV cells since 2020.

Table I-19
CSPV modules: U.S. producers, their position regarding the safeguard measures, location of production, and share of reported production, by firm and product type, 2022

Shares in percent

Firm	Position on safeguard measures	Production location(s)	Share of bifacial module production	Share of non-bifacial module production	Share of all CSPV modules production
Auxin	***	San Jose, CA	***	***	***
GAF Energy	***	San Jose, CA	***	***	***
Hanwha	***	Dalton, GA	***	***	***
Heliene	***	Mountain Iron, MN Riviera Beach, FL	***	***	***
Jinko	***	Jacksonville, FL	***	***	***
LG	***	Huntsville, AL	***	***	***
Merlin	***	San Jose, CA	***	***	***
Mission	***	San Antonio, TX	***	***	***
Panasonic	***	Buffalo, NY	***	***	***
PowerFilm	***	Ames, IA	***	***	***
Silfab	***	Bellingham WA Burlington WA	***	***	***
SunPower	***	Hillsboro, OR	***	***	***
Tesla	***	Buffalo, NY	***	***	***
All firms	Various	Various	100.0	100.0	100.0

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

Note: Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent. Zeroes, null values, and undefined calculations are suppressed and shown as "---". *** did not provide a response regarding its position on the safeguard measure. "N/A" indicates a response was not given for that element.

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

Table I-20 presents information on U.S. producers' ownership, related and/or affiliated firms. Six U.S. producers (***) reported related foreign producers of CSPV products at some point since January 1, 2020 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' imports of CSPV products are discussed in greater detail in Part III.

Table I-20
CSPV products: U.S. producers' ownership and related and/or affiliated firms

Reporting firm	Relationship type and related firm	Details of relationship
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***

Table continued

Table I-20 Continued
CSPV products: U.S. producers' ownership and related and/or affiliated firms

Reporting firm	Relationship type and related firm	Details of relationship
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***
***	***	***

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

Note: “N/A” indicates a response was not given for that element.

U.S. importers

The Commission sent U.S. importers' questionnaires to 110 firms identified by the Commission as possible U.S. importers of CSPV cells and/or modules.[258] Questionnaire responses containing usable data were received from 45 firms and are estimated to have accounted for 71.9 percent of U.S. imports of CSPV cells and CSPV modules during 2022.[259] U.S. import data were reported by U.S. importers in their questionnaire responses during January 2020-June 2023 from the following countries: Cambodia, Canada, China, Croatia, India, Indonesia, Italy, Jordan, Malaysia, Mexico, Philippines, Russia, Singapore, South Africa, South Korea, Taiwan, Thailand, Turkey, and Vietnam. Table I-21 lists all responding U.S. importers of CSPV products, their U.S. headquarters, and their share of the quantity of total U.S. imports during 2022.[260]

[258] The following firms reported that they have not imported CSPV products since January 1, 2020: ***.

[259] The estimate is based on a comparison of the total quantity of 2022 U.S. imports of CSPV cells and modules reported in the responses to the Commission's U.S. importer questionnaires (22.7 GW) with total quantity of 2022 U.S. imports of CSPV cells and modules (31.6 GW) as reported by official Commerce import statistics using HTS statistical reporting numbers 8541.40.6015, 8541.40.6025, 8541.40.6035, 8541.40.6045, 8541.42.0010, 8541.42.0080, 8541.43.0010, and 8541.43.0080). Official Commerce import statistics may be overstated by certain items that are outside the scope of this investigation, such as thin film photovoltaic products. Import data compiled from official U.S. import statistics are presented in appendix F.

[260] During January 2020 through June 2023, 16 firms reported importing cells and 39 firms reported importing modules. Ten firms reported importing both cells and modules.

Table I-21
CSPV products: U.S. importers, their headquarters, and share of total imports from all sources, by firm and product type, 2022

Shares in percent

Firm	Headquarters	Bifacial cells	Non-bifacial cells	All CSPV cells	Bifacial modules	Non-bifacial modules	All CSPV modules	All CSPV products
Acciona	Chicago, IL	***	***	***	***	***	***	***
Alps	Chino Hills, CA	***	***	***	***	***	***	***
Astronergy	Pomona, CA	***	***	***	***	***	***	***
Auxin	San Jose, CA	***	***	***	***	***	***	***
Canadian	Walnut Creek, CA	***	***	***	***	***	***	***
EDF	San Diego, CA	***	***	***	***	***	***	***
Enel	Andover, MA	***	***	***	***	***	***	***
ET	Pleasanton, CA	***	***	***	***	***	***	***
First Solar	Tempe, AZ	***	***	***	***	***	***	***
GAF Energy	San Jose, CA	***	***	***	***	***	***	***
Hanwha	Irvine, CA	***	***	***	***	***	***	***
Hanwha CA	Irvine, CA	***	***	***	***	***	***	***
Hanwha GA	Dalton, GA	***	***	***	***	***	***	***
Heliene	Sault Ste. Marie, Canada	***	***	***	***	***	***	***
Hounen	Chino, CA	***	***	***	***	***	***	***
HT	Istanbul,	***	***	***	***	***	***	***
Invenergy	Chicago, IL	***	***	***	***	***	***	***
Jackery	Fremont, CA	***	***	***	***	***	***	***
JinkoSolar CA	San Francisco, CA	***	***	***	***	***	***	***
JinkoSolar FL	Jacksonville, FL	***	***	***	***	***	***	***
LG	Englewood Cliffs, NJ	***	***	***	***	***	***	***
Longi	San Ramon, CA	***	***	***	***	***	***	***
Maxeon	San Jose, CA	***	***	***	***	***	***	***
Merlin	San Jose, CA	***	***	***	***	***	***	***
Mission	San Antonio, TX	***	***	***	***	***	***	***
NextEra	Juno Beach, FL	***	***	***	***	***	***	***

Table continued.

Table I-21 Continued
CSPV products: U.S. importers, their headquarters, and share of total imports from all sources, by firm and product type, 2022

Shares in percent

Firm	Headquarters	Bifacial cells	Non-bifacial cells	All CSPV cells	Bifacial modules	Non-bifacial modules	All CSPV modules	All CSPV products
Panasonic NJ	Newark, NJ	***	***	***	***	***	***	***
PowerFilm	Ames, IA	***	***	***	***	***	***	***
RDK	Buford, GA	***	***	***	***	***	***	***
REC	Pismo Beach, CA	***	***	***	***	***	***	***
Silfab Canada	Bellingham, WA	***	***	***	***	***	***	***
Silfab WA	Bellingham, WA	***	***	***	***	***	***	***
Sunergy	Bac Giang, Vietnam	***	***	***	***	***	***	***
SunPower CA	Richmond, CA	***	***	***	***	***	***	***
Sunpower OR	Hillsboro, OR	***	***	***	***	***	***	***
Talesun	Rayong, TH	***	***	***	***	***	***	***
Tech-Seal	Houston, TX	***	***	***	***	***	***	***
Tesla	Austin, TX	***	***	***	***	***	***	***
Trina	Fremont, CA	***	***	***	***	***	***	***
Vikram	Westborough, MA	***	***	***	***	***	***	***
VSUN	Newark, CA	***	***	***	***	***	***	***
Winaico	Des Plaines, IL	***	***	***	***	***	***	***
Yingli	Malvern, PA	***	***	***	***	***	***	***
Yingli Renewable Energy	Malvern, PA	***	***	***	***	***	***	***
Zhongli	Hong Kong, China	***	***	***	***	***	***	***
All firms	Various	***	***	***	***	***	***	***

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

Note: Note: Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent. Zeroes, null values, and undefined calculations are suppressed and shown as “---“.

U.S. purchasers

The Commission received 49 usable questionnaire responses from firms that purchased CSPV products since January 1, 2020.[261] [262] Twenty of the responding purchasers identified themselves as utility companies/developers, 12 firms are commercial installers, 8 are residential installers, 6 are distributors of modules, and 5 are module assemblers.[263] Sixteen firms also identified as "other" firm types, including two EPC (Engineering, Procurement, and Construction) firms, two military suppliers, a utility scale installer, a re-seller, an ODM (Original Design Manufacturer) and OEM (Original Equipment Manufacturer) company, a U.S. producer, an importer, an end user and retailer, an O&M (Operations and Maintenance) company, a satellite manufacturer and retailer, and an integrated designer/developer/builder/financier of integrated power systems.

The largest purchaser of CSPV cells during January 2020-June 2023 was ***. *** accounted for *** percent of all reported cell purchases during January 2020-June 2023. The largest purchasers of CSPV modules during January 2020-June 2023 were ***.

[261] Of the 49 responding purchasers, 20 reported purchasing domestic CSPV products and 47 reported purchasing imports of CSPV products. One firm, ***, submitted a purchaser questionnaire response without any purchase quantities because its purchases were too small to be recorded by the USITC's questionnaires, which rounded to the nearest kilowatt. See EDIS doc. no. 805422.

[262] Purchase information was collected separately for bifacial cells and modules and non-bifacial cells and modules. Two firms (***) reported purchasing bifacial cells, and five firms (***) reported purchasing non-bifacial cells. *** reported the source of its bifacial cells as ***, and *** reported the source of its bifacial cells as ***. The purchasers of non-bifacial cells reported their import sources of such products as ***. Two firms, ***, reported purchasing only cells and no modules.

Thirty-four firms reported purchasing bifacial modules and 32 firms reported purchasing non-bifacial modules. Among the firms that reported imports of bifacial modules, the reported import sources were Vietnam (19 firms); Thailand (13 firms); Malaysia (12 firms); South Korea (11 firms); Cambodia (4 firms); India (3 firms); China (2 firms); and Australia, Indonesia, Italy, Jordan, Singapore, and Turkey (1 firm each). Among the firms that reported imports of non-bifacial modules, the reported import sources were Vietnam (16 firms); South Korea (13 firms); Malaysia (11 firms); Thailand (8 firms); Singapore (6 firms); Cambodia (4 firms); Indonesia (3 firms); China (2 firms); and Germany, India, Jordan, Myanmar, the Philippines, and Taiwan (1 firm each).

[263] None of the responding purchasers identified themselves as distributors of CSPV cells or distributors of off-grid CSPV products.

***. *** accounted for *** percent of reported purchases during January 2020-June 2023, and *** accounted for *** percent.

Most purchasers (42 of 49) reported that they purchased imported CSPV products before the safeguard went into effect on February 7, 2018. Of the 42 responding purchasers, a slight plurality (19 firms) reported that their purchasing patterns have remained essentially unchanged since then. Eighteen purchasers reported that their pattern of purchases had changed for reasons other than the safeguard measure. These other reasons included the Department of Commerce's findings on circumvention inquiries,[264] the implementation of the Uyghur Forced Labor Prevention Act, a lack of availability from certain sources, increased demand, quality concerns, supply chain risk management, the IRA incentives,[265] changes in company or supplier ownership, the exclusion of bifacial products from the safeguard measure, stocking up prior to 2020 to take advantage of 'safe harbor' rules, and impacts from the COVID-19 pandemic.

[264] See *U.S. Department of Commerce* website, https://www.commerce.gov/news/press-releases/2023/08/department-commerce-issues-final-determination-circumvention-inquiries.

[265] The IRA offered several incentives for owners of CSPV systems. For more information on the IRA, see section entitled "U.S. policies."

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

U.S. market characteristics

There are three primary on-grid market segments for CSPV products – utility, nonresidential (commercial), and residential.[1] These segments account for the vast majority of CSPV modules sold in the United States. Modules vary in size, nominal power output, and efficiency, and output efficiency continues to improve year after year, including since January 1, 2020. The current solar market is characterized by numerous regulatory policies and overlapping incentives and supply chain disruptions, including the COVID-19 pandemic; the WRO/UFLPA; the section 301, section 232, and AD/CVD tariffs on certain inputs; the IRA; the AD/CVD and safeguard tariffs; the Presidential moratorium on AD/CVD tariffs on CSPV products imported from certain Southeast Asian countries; the DOC's anti-circumvention inquiry; and the exemption of bifacial products from the safeguard measure.[2]

Overall, demand for CSPV cells and modules continues to grow in the United States as well as around the world, and domestic and global production has increased since January 1, 2020 to meet this demand. Apparent U.S. consumption of domestic and imported CSPV modules, by quantity, increased by *** percent between 2020 and 2022 and was *** percent higher during January-June 2023 compared to January-June 2022. Apparent U.S. consumption of imported CSPV cells increased by *** percent from 2020 to 2022 and was *** percent higher during January-June 2023 compared to the same period in 2022.[3] The share of domestic modules consumed in the United States grew from *** percent of the module market in 2020 to *** percent in 2022, and was *** percent of the market in January-June 2023; imports represented *** percent of the module market in 2020, *** percent in 2022, and *** percent in January-June 2023.

Product changes

Most of the responding firms (8 of 13 U.S. producers and 35 of 43 importers) indicated that there have been significant changes in the product range, product mix, technology, or marketing of CSPV products since January 1, 2020. As in each previous phase of these investigations, nearly all firms highlighted improvements in cell and module efficiency and

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

[2] For more on these measures, see part I.

[3] There is currently no U.S. production of CSPV cells, so all domestic module assemblers use imported cells.

greater output power as a significant change.[4] Several firms also indicated a movement in the industry toward larger wafer and module sizes, as well as an increase in the use of bifacial cells and modules, even in the residential sector.[5] Several firms also reported movements away from p-type and multicrystalline technology toward N-type, monocrystalline , PERC, TOPcon, and heterojunction technologies.[6]

Channels of distribution

As shown in table II-1, U.S. producers reported shipping most of their CSPV modules to distributors throughout January 2020-June 2023. Producers' shipments of bifacial modules went primarily to utility companies/developers and residential installers in 2020, utility companies/developers in 2021, and mostly to distributors in 2022 and the first half of 2023.[7] Producers' shipments of non-bifacial modules went mostly to distributors throughout the monitoring period.

[4] In the first monitoring phase investigation, roughly half of the responding firms (8 of 15 U.S. producers and 23 of 43 importers) indicated that there had been significant changes since February 7, 2018, with nearly all firms highlighting improvements in cell and module efficiency and greater output power. Monitoring publication, p. II-2. In the extension investigation, a large majority of firms (including 12 of 13 U.S. producers and 33 of 42 importers) reported that there had been significant changes. As in the first monitoring phase, most of the firms reporting changes identified improvements in cell and module efficiency, larger wafer/cell sizes, more bifacial modules (particularly for the utility segment), and more PERC/mono-PERC modules. A few firms also mentioned a movement from multicrystalline to monocrystalline products. Extension publication, p. II-1.

[5] Several firms indicated that bifacial products are now more price competitive with mono-facial (i.e., non-bifacial) products due to the present exclusion of bifacial products from safeguard duties. *** estimates that bifacial modules are now used in approximately 30 percent of residential installations, despite the inability of most sloped residential rooftop installations to realize the added gains of absorbing light from both sides. See part I, "market segments" for more information on purchasers' estimates of the share of bifacial and non-bifacial modules used by the residential, commercial, and utility sectors.

[6] See https://www.solarpowerworldonline.com/2022/04/what-is-topcon-solar-panel-technology/, accessed October 8, 2023.

[7] Four U.S. producers reported shipments of bifacial modules during the monitoring period – ***. ***. ***, ***, and ***.

Table II-1
CSPV modules: Share of U.S. producers' U.S. shipments by product type, channel of distribution, and period

Shares in percent

Product type	Channel	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Bifacial modules	Module assemblers	***	***	***	***	***
Bifacial modules	Distributors	***	***	***	***	***
Bifacial modules	Residential installers	***	***	***	***	***
Bifacial modules	Commercial installers	***	***	***	***	***
Bifacial modules	Utilities / Developers	***	***	***	***	***
Non-bifacial modules	Module assemblers	***	***	***	***	***
Non-bifacial modules	Distributors	***	***	***	***	***
Non-bifacial modules	Residential installers	***	***	***	***	***
Non-bifacial modules	Commercial installers	***	***	***	***	***
Non-bifacial modules	Utilities / Developers	***	***	***	***	***
All modules	Module assemblers	***	***	***	***	***
All modules	Distributors	***	***	***	***	***
All modules	Residential installers	***	***	***	***	***
All modules	Commercial installers	***	***	***	***	***
All modules	Utilities / Developers	***	***	***	***	***

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

Note: Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent. Zeroes, null values, and undefined calculations are suppressed and shown as "---".

As shown in table II-2, the vast majority of imports of CSPV cells went to module assemblers and most imports of CSPV modules went to utility companies/developers during January 2020-June 2023. Importers shipped bifacial and non-bifacial cells alike primarily to module assemblers. Most of importers' shipments of bifacial modules went primarily to the utility/developer channel through all the time periods covered, while their shipments of non-bifacial modules went mostly to the utility/developer channel in 2020, a plurality to distributors in 2021, a plurality to residential installers in 2022, and a plurality to distributors during January-June 2023.

Table II-2
CSPV products: Share of importers' U.S. shipments by product type, channel of distribution, and period

Shares in percent

Product type	Channel	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Bifacial cells	Module assemblers	***	***	***	***	***
Bifacial cells	Distributors	***	***	***	***	***
Bifacial cells	Residential installers	***	***	***	***	***
Bifacial cells	Commercial installers	***	***	***	***	***
Bifacial cells	Utilities / Developers	***	***	***	***	***
Non-bifacial cells	Module assemblers	***	***	***	***	***
Non-bifacial cells	Distributors	***	***	***	***	***
Non-bifacial cells	Residential installers	***	***	***	***	***
Non-bifacial cells	Commercial installers	***	***	***	***	***
Non-bifacial cells	Utilities / Developers	***	***	***	***	***
All cells	Module assemblers	***	***	***	***	***
All cells	Distributors	***	***	***	***	***
All cells	Residential installers	***	***	***	***	***
All cells	Commercial installers	***	***	***	***	***
All cells	Utilities / Developers	***	***	***	***	***
Bifacial modules	Module assemblers	***	***	***	***	***
Bifacial modules	Distributors	***	***	***	***	***
Bifacial modules	Residential installers	***	***	***	***	***
Bifacial modules	Commercial installers	***	***	***	***	***
Bifacial modules	Utilities / Developers	***	***	***	***	***
Non-bifacial modules	Module assemblers	***	***	***	***	***
Non-bifacial modules	Distributors	***	***	***	***	***
Non-bifacial modules	Residential installers	***	***	***	***	***
Non-bifacial modules	Commercial installers	***	***	***	***	***
Non-bifacial modules	Utilities / Developers	***	***	***	***	***
All modules	Module assemblers	***	***	***	***	***
All modules	Distributors	***	***	***	***	***
All modules	Residential installers	***	***	***	***	***
All modules	Commercial installers	***	***	***	***	***
All modules	Utilities / Developers	***	***	***	***	***

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

Note: Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent. Zeroes, null values, and undefined calculations are suppressed and shown as "---".

Geographic distribution

Most U.S. producers (8 of 11) and importers (33 of 43) reported that there have not been any changes in the U.S. geographical market areas in which CSPV products were sold since January 1, 2020.[8] Two of the three U.S. producers/importers that reported changes (***)

[8] 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.

indicated that fluctuations sometimes occur in the geographic markets they serve based on regional policy/incentive changes, weather patterns, local inventory levels, and the lack of product certification in certain areas. The third firm, ***, reported expanding into new geographic areas due to increased sales. Among other importers, firms generally cited increases in sales to more geographic areas, particularly non-coastal inland areas, as reasons for changes in the areas in which their products are sold. Of the firms that reported changes, most reported serving more geographic areas than before.

Supply and demand considerations

Impact of section 301 tariffs on supply and demand for CSPV products

U.S. producers, importers, and purchasers were asked if the announcement of the section 301 investigation in August 2017 or the subsequent imposition of tariffs on Chinese-origin products had an impact on the demand for CSPV products or supply of CSPV products in the U.S. market. A plurality of firms reported that the section 301 tariffs did impact the market.[9] When asked to elaborate on how the section 301 tariffs impacted demand, majorities of U.S. producers and importers and a plurality of purchasers indicated that the tariffs did not cause a change in demand in the U.S. market. Most of the other responding firms reported that the section 301 tariffs caused an increase in demand. Regarding supply, most responding U.S. producers and pluralities of importers and purchasers indicated that the tariffs did not cause a change in supply in the U.S. market. Most of the remaining U.S. producers and importers reported that the section 301 tariffs increased supply, while most of the remaining purchasers reported that it decreased supply.

[9] Most U.S. producers (9 of 12 firms) and pluralities of responding importers (22 of 44 firms) and purchasers (23 of 48 firms) reported that the section 301 tariffs impacted the market, while 2 U.S. producer, 13 importers, and 5 purchasers reported that they did not. The remaining 3 U.S. producers, 14 importers and 19 purchasers reported that they did not know.

Table II-3
Impact of section 301 tariffs: Firms' responses regarding the impact of the section 301 announcement and tariffs on Chinese-origin products in the U.S. market, by impact and type of firm

Impact on	Firm type	Steadily increase	Fluctuate up	No change	Fluctuate down	Steadily decrease
Demand	U.S. producers	1	1	6	2	0
Demand	Importers	4	7	17	1	0
Demand	Purchasers	3	10	13	4	1
Supply	U.S. producers	0	2	6	2	0
Supply	Importers	1	9	13	5	2
Supply	Purchasers	1	8	11	9	3

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

Among the firms reporting a change, many reported that the section 301 tariffs increased the costs of raw materials, which in addition to other tariffs caused uncertainty in price and/or availability, leading to a decrease in overall demand and supply.[10] However, several firms suggested that overall demand remained strong, and that other factors, including the bifacial exclusion, the IRA, and general economic growth helped maintain healthy demand for and supply of CSPV products. Some firms noted that many companies have responded to the various tariffs and exclusions by adjusting their product mix and/or supply chains, including Chinese companies shifting production to other Southeast Asian countries, in order to capitalize on cost advantages.

Changes in U.S. supply

Table II-4 provides a summary of the supply factors regarding CSPV modules from U.S. producers and responding foreign producers, and table II-5 summarizes the supply factors regarding CSPV cells from various import sources.[11]

[10] Firms were also asked how the section 301 tariffs impacted raw material costs and prices for CSPV products in the U.S. market. As discussed in part VI, firms generally indicated that the section 301 tariffs increased raw material costs. Responses regarding the impact of the section 301 tariffs on overall prices for CSPV products were less pronounced, however, though most firms indicated that the section 301 tariffs either increased or did not impact overall prices of CSPV products (see table VI-1).

[11] As noted elsewhere in this report, the United States had no production of CSPV cells during January 2020-June 2023.

Module production[12]

Table II-4
CSPV modules: Supply factors that affect U.S. producers' and foreign producers' ability to increase shipments of modules to the U.S. market, by country

Quantity in kilowatts; ratios and shares in percent

Factor	Measure	United States	Malaysia	South Korea	Thailand	Vietnam	Other	All foreign industries
Capacity 2020	Quantity	***	***	***	***	***	***	***
Capacity 2022	Quantity	***	***	***	***	***	***	***
Capacity utilization 2020	Ratio	***	***	***	***	***	***	***
Capacity utilization 2022	Ratio	***	***	***	***	***	***	***
Inventories to total shipments 2020	Ratio	***	***	***	***	***	***	***
Inventories to total shipments 2022	Ratio	***	***	***	***	***	***	***
Home market shipments 2022	Share	***	***	***	***	***	***	***
Non-US export market shipments 2022	Share	***	***	***	***	***	***	***

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

Note: Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent. Zeroes, null values, and undefined calculations are suppressed and shown as "---".

Based on available information, U.S. producers of CSPV modules have the ability to respond to changes in demand with moderate changes in the quantity of shipments of U.S.-produced CSPV products to the U.S. market. The main contributing factor to this degree of responsiveness of supply is the availability of unused capacity. Factors mitigating this responsiveness of supply include limited inventories and almost no ability to shift shipments from alternate markets. Domestic producers' overall module production capacity increased by *** percent between 2020 and 2022, although capacity in the first half of 2023 was *** percent lower than the first half of 2022.[13] Domestic module production increased by *** percent between 2020 and 2022 and was *** percent higher in the first half of 2023 compared to the first half of 2022. Inventories decreased from *** percent of total shipments

[12] For more on global module capacity and production, See part I, "Global developments."

[13] Domestic producers' overall capacity has risen since the implementation of the safeguard, almost quadrupling between 2016 and 2022. Domestic CSPV module production capacity was approximately *** kW in 2016, *** kW in 2018, *** kW in 2020, and *** kW in 2022. See Monitoring 1 publication, p. II-6, and Extension publication, p. II-5.

in 2020 to *** percent in 2022. In the first half of 2023, inventories rose to *** percent of total shipments. Domestic producers' module exports remained very low throughout the period at roughly *** percent or below of total shipments.

Based on available information, producers of CSPV modules from countries outside the United States have the ability to respond to changes in demand with large changes in the quantity of shipments of modules to the U.S. market. The main contributing factors to this degree of responsiveness of supply are large and growing global capacity and the ability to shift shipments from their home markets and non-U.S. export markets to the United States. Factors mitigating this degree of responsiveness of supply include a potentially limited overall available capacity and limited inventories. Additionally, some factors that may limit this degree of responsiveness include 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.

Cell production[14]

There is currently no U.S. production of CSPV cells, so table II-5 shows only supply factors from responding foreign producers.

[14] For more on global cell capacity and production, see part I, "Global developments."

Table II-5
CSPV cells: Supply factors that affect foreign producers' ability to increase shipments of cells to the U.S. market, by country

Quantity in kilowatts; ratios and shares in percent

Factor	Measure	Malaysia	South Korea	Thailand	Vietnam	Other	All foreign industries
Capacity 2020	Quantity	***	***	***	***	***	***
Capacity 2022	Quantity	***	***	***	***	***	***
Capacity utilization 2020	Ratio	***	***	***	***	***	***
Capacity utilization 2022	Ratio	***	***	***	***	***	***
Inventories to total shipments 2020	Ratio	***	***	***	***	***	***
Inventories to total shipments 2022	Ratio	***	***	***	***	***	***
Home market shipments 2022	Share	***	***	***	***	***	***
Non-US export market shipments 2022	Share	***	***	***	***	***	***

Source: Compiled from data submitted in response to Commission questionnaires.
Note: Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent. Zeroes, null values, and undefined calculations are suppressed and shown as "---".

Based on available information, producers of CSPV cells from outside the United States have the ability to respond to changes in demand with large changes in the quantity of shipments of CSPV cells to the U.S. market. The main contributing factor to this degree of responsiveness of supply are large and increasing global capacity and the ability to shift shipments from foreign producers' home markets. Factors mitigating this responsiveness of supply include potentially limited overall available capacity, limited inventories, and a somewhat limited ability to shift shipments from non-U.S. export markets. All the individual countries listed in table II-5 aside from *** reported increases in overall cell capacity between 2020 and 2022. Among all responding foreign producers except Malaysia, their home market shipments accounted for nearly 90 percent of their total shipments in 2022.

Availability of supply

U.S. producers, importers, and purchasers were asked if the availability of CSPV cells and/or modules had changed from domestic and imported sources since January 1, 2020.

Most firms reported no change in the availability of domestic cells.[15] For imported cells, the majority of the responding U.S. producers and importers reported no change in availability, while most purchasers (16 of 28 firms) reported that there has been a change in availability. Most of the firms reporting a change in the availability of imported cells indicated that they were more available. Regarding the availability of domestic modules, most U.S. producers and purchasers reported a change in availability, while most importers reported no change in availability. Regarding the availability of imported modules, most U.S. producers, importers, and purchasers reported a change in availability.

Regarding domestic cells, 12 of 13 U.S. producers, 31 of 37 importers, and 20 of 27 purchasers reported that the availability of domestic cells had not changed. As noted elsewhere in this report, there is currently no production of CSPV cells in the United States, and this was commented on by several firms in their questionnaire responses.[16] Some firms, however, including *** reported that the IRA in 2022 spurred some producers to announce intentions to begin producing cells in the United States. Hanwha, for example, stated that it and other solar manufacturers announced investments in domestic cell production as well as other parts of the solar supply chain.[17] Still, a few firms estimated that sufficient ramp-up for domestic availability of U.S.-produced cells would require more time to materialize. For its part, Hanwha indicated that its planned plant in Cartersville, GA will be an integrated plant producing ingots, wafers, cells, and modules by the end of 2024, with the capacity to produce 3.3 gigawatts of cells, which will be used to produce 3.3 gigawatts of modules at the same facility.[18] Regarding imported cells, responses were mixed. Some firms reported more availability due to the implementation of the safeguard measure and increase in foreign cell production, while other firms reported less availability due

[15] As noted elsewhere in this report, the United States had no production of CSPV cells during January 2020-June 2023.

[16] The last two remaining producers of CSPV cells, SolarWorld and Panasonic, ceased cell production in 2019 and 2020, respectively.

[17] Hanwha stated that it "***." See also *Solar Power World* article, https://www.solarpowerworldonline.com/2023/01/qcells-will-manufacture-every-part-of-a-silicon-solar-panel-in-the-united-states/, accessed October 11, 2023.

[18] Hearing transcript pp. 20-21 (Connolly).

to the production and supply constraint challenges brought on by the COVID-19 pandemic, the Commerce anti-circumvention inquiry, and the WRO/UFLPA.[19]

Regarding domestic modules, most of the firms that reported a change in availability reported an increase in their availability and/or an increase in the production of domestic modules. Many firms pointed to the IRA and safeguard measure as contributing factors to this increase. Some firms reported that the supply of domestic modules was limited due in part to the COVID-19 pandemic, although several of these firms also reported expecting more availability in 2024 and beyond. Others reported that while domestic module production has increased it has not been enough to meet the high level of domestic demand. Regarding imported modules, firms citing increased availability pointed to the increase in domestic demand, the exclusion of bifacial modules from the safeguard measure, and the Presidential Proclamation in June 2022 providing a moratorium on AD/CVD tariffs on imports of CSPV cells and modules from Cambodia, Malaysia, Thailand, and Vietnam as contributing factors.[20] Those citing decreased availability of imported modules pointed to the impacts of the COVID-19 pandemic, the WRO and UFLPA, Commerce's anti-circumvention inquiry, and general regulatory uncertainty.

Purchasers were also asked if certain wattages, types, technologies, or sizes of CSPV products were available from only certain country sources. Most responding purchasers (32 of 46) reported that there were not. Among the purchasers reporting that there were, all suggested that there was limited availability in the United States of certain product types. Many firms commented that bifacial modules were either not available or in short supply from domestic producers. Others indicated that modules with larger wafer sizes, as well as modules utilizing TOPCon and N-type technology, are only available in sufficient quantities outside the United States. Some firms suggested that while U.S. producers lag behind Asian producers in supplying these types of products, they expect them to become more available from U.S. producers within the next year or so.

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[19] See *U.S. Customs and Border Protection* website, https://www.cbp.gov/newsroom/national-media-release/department-homeland-security-issues-withhold-release-order-silica, accessed October 11, 2023, and https://www.cbp.gov/trade/forced-labor/UFLPA, accessed October 11, 2023.

[20] *The White House* website, https://www.whitehouse.gov/briefing-room/statements-releases/2022/06/06/declaration-of-emergency-and-authorization-for-temporary-extensions-of-time-and-duty-free-importation-of-solar-cells-and-modules-from-southeast-asia/, accessed October 11, 2023.

Supply constraints

U.S. producers, importers, and purchasers were asked whether they or their suppliers had refused, declined, or been unable to supply CSPV products since January 1, 2020. Most U.S. producers (8 of 13) and importers (27 of 41) reported no such supply constraints, while most purchasers (29 of 46) reported that they did experience constraints. Among the firms reporting supply constraints, most referred to the aforementioned supply challenges, but primarily the plant shutdowns and shipping delays caused by the COVID-19 pandemic. Several also mentioned the WRO/UFLPA and Commerce's anti-circumvention inquiry as factors, and a few mentioned the safeguard measure and/or antidumping duties on Chinese-origin product as constraints. Other constraints noted were related to individual firm or product-specific supply limitations.

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.[21]

While electricity demand in the United States remains supplied primarily by conventional sources, the share of electricity generated from renewable energy sources has been steadily increasing.[22] Since 2018, the share of renewable energy, including wind, solar, biomass, and geothermal (excluding hydroelectric), has increased year over year, growing from 10.6 percent of electricity generated in the United States in 2018 to 16.7 percent in 2022.[23] During January-June 2023, the share of renewable energy was 19.0 percent. Solar-generated power, including utility-scale solar and small-scale solar, has grown from 2.2 percent of all electricity generated in 2018 to 4.8 percent in 2022 (figure II-1). While this is still a relatively small minority of the total generated power, the average output of solar-generated power grew

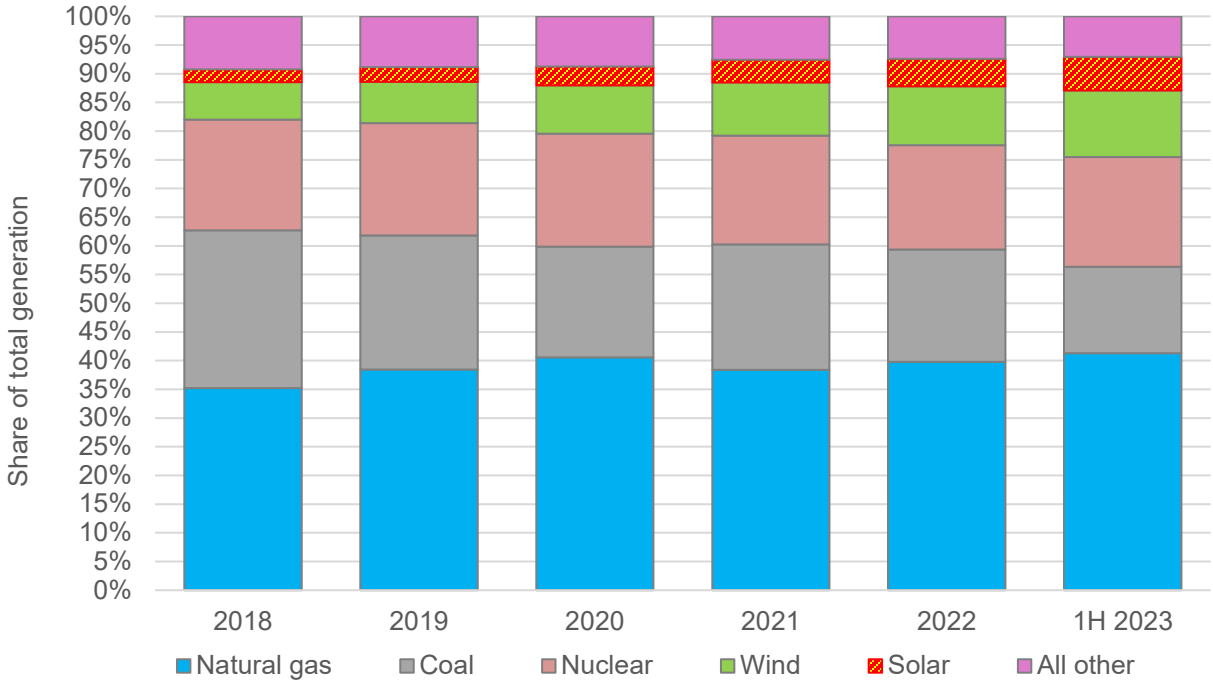
[21] Safeguard publication, vol. I, p. 32.

[22] In 2016, natural gas replaced coal as the largest source of electricity. In general, both coal and natural gas production follow seasonal trends, with peak production times during the warmer months and lower production in the colder months. *U.S. Energy Information Administration* website, http://www.eia.gov/electricity/data/browser/, retrieved October 11, 2023.

[23] Wind and solar make up the vast majority of renewable energy generated in the United States. Wind-generated power currently accounts for a little over 60 percent of renewables and solar-generated power makes up almost 30 percent. Ibid.

by 118.6 percent between 2018 and 2022 (figure II-2).[24] Between 2020 and 2022 alone, the average output of solar-generated power grew by 56.1 percent.

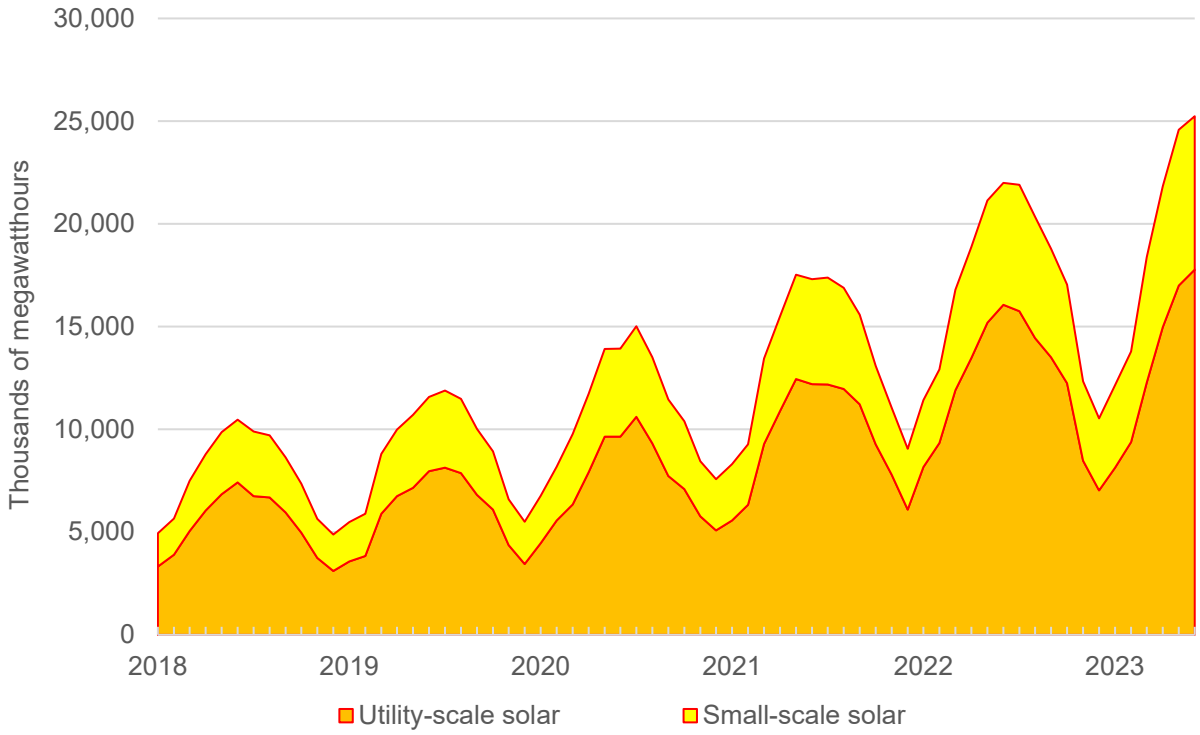
Figure II-1
Types of U.S. electricity generation: Share of total electricity generation in the United States, by type, 2018-22 annual and January-June 2023



Source: U.S. EIA, http://www.eia.gov/electricity/data/browser/, retrieved October 7, 2023.

[24] Utility-scale solar generation grew by 98.1 percent during this time, while small-scale solar generation grew by 128.1 percent.

Figure II-2
Solar electricity generation: Net U.S. electricity generation for utility-scale solar PV and small-scale solar PV, by month, January 2018-June 2023



Source: U.S. EIA, http://www.eia.gov/electricity/data/browser/, retrieved October 7, 2023.

Demand trends

Firms also reported that demand for CSPV products has increased over time. 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.[25] Similarly, in the first monitoring report and extension report, majorities or pluralities of firms reported that U.S. demand for CSPV products increased since February 7, 2018 and that future demand for CSPV products will continue to increase across all sectors.[26]

In the current proceeding, firms were again asked how demand for CSPV products within the United States and outside of the United States had changed since January 1, 2020, as well as how they anticipate demand would change in the future. As shown in tables II-6 and II-7, the vast majority of responding firms reported that demand for CSPV products inside and

[25] Safeguard publication, vol. II, p. V-11.
[26] Monitoring 1 publication, p. II-17 and Extension publication, p. II-14.

outside the United States increased since February 7, 2018 and they expect it to continue to increase across all sectors in the future.

Table II-6
CSPV products: Firms' responses regarding demand inside the United States and outside the United States since January 1, 2020, by market and type of firm

Count in number of firms reporting

Market	Firm type	Steadily increase	Fluctuate up	No change	Fluctuate down	Steadily decrease
Domestic demand for residential	U.S. producers	10	2	0	0	0
Domestic demand for residential	Importers	30	4	2	0	0
Domestic demand for residential	Purchasers	15	6	4	2	0
Domestic demand for commercial	U.S. producers	9	3	0	0	0
Domestic demand for commercial	Importers	26	6	4	1	0
Domestic demand for commercial	Purchasers	16	9	6	2	0
Domestic demand for utility	U.S. producers	11	1	0	0	0
Domestic demand for utility	Importers	30	5	2	1	0
Domestic demand for utility	Purchasers	25	9	3	0	1
Foreign demand across all sectors	U.S. producers	8	0	0	0	0
Foreign demand across all sectors	Importers	27	3	3	0	0
Foreign demand across all sectors	Purchasers	20	5	7	1	0

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

Table II-7
CSPV products: Firms' responses regarding anticipated future demand inside the United States and outside the United States, by market and type of firm

Count in number of firms reporting

Market	Firm type	Steadily increase	Fluctuate up	No change	Fluctuate down	Steadily decrease
Domestic demand for residential	U.S. producers	7	2	0	1	0
Domestic demand for residential	Importers	27	5	1	1	1
Domestic demand for residential	Purchasers	15	4	4	3	2
Domestic demand for commercial	U.S. producers	7	2	0	1	0
Domestic demand for commercial	Importers	24	6	4	2	0
Domestic demand for commercial	Purchasers	16	7	4	5	1
Domestic demand for utility	U.S. producers	8	2	0	0	0
Domestic demand for utility	Importers	30	5	2	0	0
Domestic demand for utility	Purchasers	27	6	2	0	2
Foreign demand across all sectors	U.S. producers	7	1	0	0	0
Foreign demand across all sectors	Importers	26	3	3	0	0
Foreign demand across all sectors	Purchasers	21	3	5	2	2

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

For the firms reporting an increase in demand, several reasons were specified, including incentives like the extension of the Income Tax Credit (ITC),[27] more state-based incentive programs, and Solar Renewable Energy Credits (SREC); lower hardware and software costs for solar arrays; lower financing costs; the rising costs of other fuels and a desire to reduce long-term electricity costs;[28] and greater awareness about the environmental benefits of renewable

[27] The IRA included an extension of the Income Tax Credit for owners of solar arrays to 30% of the costs of new, qualified clean energy property installed anytime from 2022 through 2032. See *Internal Revenue Service* website, https://www.irs.gov/credits-deductions/residential-clean-energy-credit, accessed October 12, 2023.

[28] The cost of natural gas used for electricity generation, which is the biggest cost competitor with solar-generated power, increased almost two-fold on an annual basis between 2018 and 2022. For more information on the cost competitiveness between natural gas and solar, see figure VI-3.

energy. Some firms also reported increases in the amount of corporate Environmental, Social, and Governance (ESG) initiatives and corporate green energy goals in the commercial sector. Only one of the firms that reported a decrease in demand elaborated on a reason, and that firm, purchaser ***, cited increased prices and less attractive financing terms as reasons.

Changes in business cycles or conditions of competition

In the original safeguard investigation, firms indicated that the U.S. market for CSPV products is subject to business cycles, such as seasonally higher demand in warmer months and lower demand in warmer months.[29] In the current monitoring phase, firms were asked whether there have been any changes in the business cycles or conditions of competition for CSPV products since January 1, 2020. Most firms reported that there have been changes, including 8 of 12 U.S. producers, 29 of 44 importers, and 36 of 47 purchasers.

The most commonly referenced changes had to do with the numerous regulatory policies and overlapping supply chain incentives and disruptions, including the COVID-19 pandemic; the WRO/UFLPA; the section 301, section 232, and AD/CVD tariffs on certain inputs; the IRA; the AD/CVD and safeguard tariffs on CSPV products; the Presidential moratorium on AD/CVD tariffs on CSPV products imported from certain Southeast Asian countries; the exemption of bifacial products from the safeguard measure; and the DOC's anti-circumvention inquiry. Many firms also highlighted consistent technological advancements as a condition of competition, as well as increased pricing and source-based competition.

Changes in purchasing patterns

As discussed elsewhere in this report, there is no current production of CSPV cells in the United States; accordingly, all purchases of cells in the United States since January 2020 were of imported cells. The vast majority of module purchases in the United States were also of imported product. As discussed in part I, when asked if they purchased CSPV products before the safeguard was implemented on February 7, 2018, most (42 of 49) purchasers responded in the affirmative, and a plurality of those firms (19) reported that their purchasing patterns have remained essentially unchanged since then. Similarly, when these purchasers were asked how their shares of purchases of CSPV products from different sources had changed since January 1, 2020, most reported that their patterns of purchases of domestic CSPV products were

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

unchanged, and a plurality reported as such with regards to imported CSPV products (table II-8).

Table II-8
CSPV products: Changes in purchasers' purchase patterns from U.S. and import sources since January 1, 2020

Count in number of firms reporting

Purchase source	Steadily increase	Fluctuate up	No change	Fluctuate down	Steadily decrease
United States	3	6	30	4	2
All other countries	11	7	19	12	1

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

Among the firms reporting increases in their purchases of domestic product, the reasons reported for doing so were greater availability of domestic modules, customer requirements, and more competitive pricing. For the firms reporting a decrease in domestic product, the reasons reported were plant closings or a reduced need. One firm also reported decreasing purchases of domestic modules due to more technological advancements from Southeast Asian product.

For the firms that reported increasing their purchases of imported CSPV products, the most commonly cited reason for doing so was increased overall demand. Three purchasers also reported doing so due to greater availability overseas, with one reporting that foreign-manufactured modules were lower in cost. The firms that reported decreasing their purchases of imported product did so for reasons related to business contraction, less competitive pricing, supply issues related to the COVID-19 pandemic, and supply chain uncertainty related to the safeguard tariff, antidumping and countervailing duties, and the WRO/UFLPA.

As shown in table II-9, the majority of responding firms anticipate their purchases of domestic product to either increase or not change. Regarding their purchases of imported CSPV products, a plurality of firms anticipate no change, while a number of reporting firms expect to purchase less imported product in the future.

Table II-9
CSPV products: Anticipated changes in purchasers' purchase patterns from U.S. and import sources through February 6, 2026

Purchase source	Steadily increase	Fluctuate up	No change	Fluctuate down	Steadily decrease
United States	10	16	20	1	0
All other countries	8	7	16	14	3

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

For the firms that expected to increase their purchases of domestic CSPV products, the reasons reported included taking advantage of incentives contained in the IRA and related tax credits and to avoid paying antidumping and countervailing duties on imports from China. For the firms that expect to increase their purchases of imported CSPV products, the reasons reported included expectations of business expansion, demand exceeding domestic supply capability, an expectation of continued domestic supply challenges, and lower prices for imports. For the firms that anticipate decreasing their purchases of imported CSPV products, reasons reported included new signed agreements with domestic producers, a strategic shift toward domestic product, a desire to reduce supply chain risk, and taking advantage of incentives included in the IRA.

Changes in 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. In the original safeguard investigation, the Commission determined that at a minimum, bankability encompasses both the financial viability of a supplier and the product's performance reliability, especially in the CSPV industry where manufacturers provide warranties of 25 years or longer on their products, and allows installing firms to apply for non-recourse loans for their solar development projects.[30] Several companies develop lists of bankable firms in the solar industry, including BloombergNEF, which publishes a "tier 1" list of bankable firms on a quarterly basis, and PV Evolution Labs (PVEL), a lab for PV module testing."[31] Table II-10 shows PVEL's list of top solar module performers in 2023.

[30] Safeguard publication, vol. I, pp. 36 and 55.
[31] *PVEL* website, https://scorecard.pvel.com/about-us/, accessed October 13, 2023.

Table II-10
PVEL 2023 scorecard: PVEL list of top performers in 2023, by firm name and headquarters location(s)

Firm name	Location
Adani Solar	India
AE Solar	China
Aiko Solar	China
Akcome	China
Astronergy	China
Boviet Solar	Vietnam
CanadianSolar	Thailand
DMEGC Solar	China
EGing PV	China
Emmvee	India
ET Solar	China
First Solar	United States, Vietnam
Hanwha Q Cells	South Korea
HG Hyundai	South Korea
Heliene	China
HT-SAAE	Turkey
Huasun	China
JA Solar	China
Jinko	China, Malaysia
Jolywood	China
Maxeon	Mexico
Phono Solar	China
Premier Energies	India
REC group	Singapore
Risen Energy	China
SEG Solar	China
Silfab Solar	Canada
SolarSpace	China
Talesun	China
Trina Solar	China
Vikram Solar	India
VSUN	Vietnam
Waaree	India
Yingli Solar	China
ZNShine Solar	Cambodia

Source: *PVEL*, The 2023 Top Performers, https://scorecard.pvel.com/top-performers/ accessed October 13, 2023.

Purchasers were asked whether the role of bankability in their or their customers' purchasing decisions has changed since January 1, 2020. Most firms (36 of 48) reported that it has not changed. Among the firms reporting that it has, the vast majority reported that

bankability is increasingly important in the selection of suppliers, particularly in larger utility-scale projects, and that scrutiny and standards have risen since January 1, 2020. However, one firm, ***, indicated that it has been willing to take more risks on suppliers in order to fulfill high demand.

Changes in government incentives

Various government incentive programs and regulations exist to incentivize use of CSPV products on a federal, state, and local level. These incentives include federal and state tax credits, Solar Renewable Energy Certificates (SREC); and accelerated depreciation, loan guarantees, and state-based incentives, among others.[32]

Firms were asked if there have been any changes in the level or availability of government incentives for CSPV products since January 1, 2020 and to describe the principal incentive programs whose change has affected the CSPV market. Most responding firms (including 9 of 12 U.S. producers, 28 of 43 importers, and 41 of 47 purchasers) reported that there have been changes in government incentives since January 1, 2020, and almost all of these firms reported an increase or expansion of incentives. By far the most commonly cited change was the passage of the IRA in August 2022 and the extension of tax credits contained therein. As discussed in part I, the IRA included an extension of the Investment Tax Credit, as well as several other incentives, including some designed to benefit domestic producers. Some of the other incentives noted by domestic producers included an Advanced Energy Project Credit, Advanced Manufacturing Production Tax Credit, Production Tax Credit, Clean Electricity Production Credit and Clean Electricity Investment.

Some firms also indicated that many states and cities have announced new or updated incentives designed to spur solar demand, including renewable portfolio standards, net energy metering, renewable energy certificates, the PACE (Property Assessed Clean Energy) program, Solar Rebate Program, state-based tax exemption programs, Community Choice Aggregation (CCA), and state-specific programs such as Sun PV Incentive Program (New York), Renewable Generation Requirement (Texas), California's new home rooftop mandate, a 40 percent renewables target by 2030 in Illinois, and the adoption of 100 percent renewables targets in many major cities.

[32] For more information on changes to federal and state incentive policies, see part I, "U.S. developments."

Part III: Condition of the U.S. industry

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 13 firms that are estimated to have accounted for 80.1 percent of U.S. capacity to produce CSPV modules during 2022.[2] The list of responding domestic producers, each company's position on the safeguard measures, production locations, and share of reported production during 2022 is presented in Part I of this report at "U.S. market participants."[3]

[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 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 modules during 2022 (4.5 GW) with the total estimated U.S. capacity to produce modules during 2022 (5.6 GW), as calculated by Commission staff using publicly available capacity estimates for known non-responding U.S. producers SolarMax (250 MW), Crossroads Solar (12 MW), Hightec Solar (150 MW), and SPI Energy/Solar4America (700 MW). Solar Power World, "Which companies are making solar panels in the United States?", October, 19, 2022, https://www.solarpowerworldonline.com/2022/10/what-companies-are-making-solar-panels-in-the-united-states/; and U.S. Department of Energy, Solar Energy Technologies Office, Solar Manufacturing Map, https://www.energy.gov/eere/solar/solar-manufacturing-map, accessed October 19, 2023. See also SolarMax website, https://www.solarmaxtech.com/solar-products/smx-solar-panels/; Hightec Solar, press release, "Hightec Solar Adds 200MW Automated Panel Line to its Already Popular RV and Off-Grid Solar Panel Line," August 3, 2022, https://www.utilitydive.com/press-release/20220803-hightec-solar-adds-200mw-automated-panel-line-to-its-already-popular-rv-and/; and SPI Energy, https://roic.ai/quote/SPI/transcripts (accessed October 19, 2023).

[3] U.S. producer SBM Solar Inc. ("SBM") submitted an incomplete questionnaire response. Despite staff's multiple attempts, the deficiencies were not resolved and thus SBM is not included in the producer dataset. SBM produces off-grid CSPV products, *** for U.S. military applications. SBM reported a maximum annual production capacity of *** MW. SBM's website, sbmsolar.com, accessed November 29, 2023; and staff correspondence with ***, November 28, 2023 and December 11, 2023. SBM is not included in the capacity methodology discussed above.

(*continued*...)

Table III-1 presents the count of responding U.S. producers that reported actual and planned production of CSPV products by product type.[4] Of the 13 responding producers of CSPV modules, four have ceased operations during 2020-June 2023 (***). *** plans to re-establish its U.S. CSPV assembly operation in late 2024. Panasonic was the only firm to produce CSPV cells during the period for which data were collected. Four firms, ***, Hanwha, Heliene, and Silfab, reported planned production of CSPV cells.[5] In addition, Suniva, ***, announced in October 2023 that it would be restarting its production operations of CSPV cells beginning in early 2024.[6]

(…*continued*)

SolarMax ***. Despite staff's multiple attempts, *** did not provide a response to the U.S. producer questionnaire. SolarMax's website, "Residential Solar Panels Made to a Higher Standard of Quality," https://www.solarmaxtech.com/solar-products/smx-solar-panels/, accessed November 1, 2023; and staff correspondence with ***, November 1, 2023 and with ***, November 6, 2023.

[4] For a detailed discussion of producer entries and exits from the U.S. industry, please see section entitled "U.S. developments" in Part I of this report.

[5] *** reported: ***. In its prehearing brief, Hanwha reported that it is building a new facility that will produce silicon, ingots, wafers, and cells as well as modules by the end of 2024. Hanwha's prehearing brief, p. 17. *** reported: ***. *** reported: ***. U.S. producer questionnaire response of *** and ***, question II-7; and staff correspondence with ***, November 17, 2023. See also Canadian Solar, Heliene, and Silfab's prehearing brief, pp. 16-17.

[6] "Suniva Upgrades Manufacturing and Restarts Operations in Georgia," October 11, 2023, https://suniva.com/suniva-restarts-operations-georgia/, accessed October 23, 2023. See also Suniva's questionnaire response. Yingli Renewable Energy Americas Inc. also ***. Yingli Renewable Americas Inc.'s U.S. producer questionnaire.

Table III-1
CSPV products: Count of U.S. producers' actual and planned production by product type

Product type	Actual production	Planned production
CSPV cells	1	4
CSPV modules	13	10

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

Note: Responses for actual production are since January 1, 2020 and planned production are for 2024 to 2026.

Note: Staff revised Hanwha's questionnaire to report planned production of CSPV cells, consistent with its prehearing brief.

U.S. producer profiles[7]

Nine notable current or historical U.S. CSPV cell and module producers are profiled below.

Auxin Solar

Auxin Solar ("Auxin"), located in San Jose, California, is a U.S.-based module producer founded in 2008. The company currently produces monocrystalline PERC 60 and 72 cell modules and has production of bifacial modules.[8] The company has 150 MW in annual production capacity.[9]

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 South Korea, Hanwha Chemical Corporation. The plant was reported to be the largest facility of its kind in the Western Hemisphere with an announced annual module production capacity of 1.7 GW. Hanwha began production at its $157 million CSPV module assembly plant in Dalton, Georgia in February 2019.

[7] Information in this section is derived from the extension publication, pp. III-2 – III-7, with updates added from information collected in this proceeding.

[8] Auxin Solar website, http://www.auxinsolar.com/products/ and http://www.auxinsolar.com/company/, accessed October 23, 2023.

[9] Solar Power World, "Which companies are making solar panels in the United States?", October, 19, 2022, https://www.solarpowerworldonline.com/2022/10/what-companies-are-making-solar-panels-in-the-united-states/, accessed October 19, 2023.

Hanwha assembles modules at its Georgia facility for residential, commercial, and utility markets using cells *** that are manufactured using proprietary Q.ANTUM technology. During 2020–June 2023, the firm produced ***. The firm is also ***.[10] Hanwha is an importer of cells *** and is related to U.S. importers of modules *** and leading foreign producers of CSPV cells and modules in China, Korea, and Malaysia.

JinkoSolar (U.S.) Industries Inc.

JinkoSolar (U.S.) Industries Inc. ("Jinko"), located in Jacksonville, Florida, is a wholly owned subsidiary of its ultimate parent company based in China, JinkoSolar Holding Co., Ltd. Jinko began commercial production of mono-PERC modules early in 2019 at its $50.5 million Jacksonville facility. During 2020–June 2023, the firm produced ***, adding *** in 2024-2026.[11] Jinko is an importer of cells and modules *** and is related to a U.S. importer *** and foreign producers of CSPV cells and modules in China and Malaysia.

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. The firm produced modules with ***. LG ceased production in 2022.[12] An importer of both cells and modules from Korea, LG is related to a foreign producer of CSPV cells and modules in Korea.

[10] In its questionnaire response in this proceeding, Hanwha reported CSPV module capacity at *** GW, production at *** GW, and employment at *** PRWs during 2022.

[11] In its questionnaire response in this proceeding, Jinko reported CSPV module capacity at *** MW, production at *** MW, and employment at *** PRWs during 2022.

[12] In its questionnaire response in this proceeding, LG reported CSPV module capacity at *** MW, production at *** MW, and employment at *** PRWs during 2022.

Mission Solar Energy

Mission Solar Energy ("Mission") is headquartered in San Antonio, Texas, and is a fully owned subsidiary of OCI Solar Power.[13] Mission Solar produces modules in a variety of cell type and form factors. The company opened its manufacturing plant in San Antonio, Texas, in 2014. In September 2016, however, Mission closed its n-type mono PV cell production lines. Following the closure of cell production, Mission has continued module assembly with CSPV cells imported from ***. In 2021, Mission Solar ***.[14]

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 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 ***.

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

[14] In its questionnaire response in this proceeding, Mission reported CSPV module capacity at *** MW, production at *** MW, and employment at *** PRWs during 2022.

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).

Suniva, ***, announced in October 2023 that it would be restarting its production operations of CSPV cells beginning in early 2024.[15]

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.[16] By 2017, SolarWorld reported nameplate production capacity of *** MW for CSPV modules and *** MW for CSPV cells.

[15] "Suniva Upgrades Manufacturing and Restarts Operations in Georgia," October 11, 2023, https://suniva.com/suniva-restarts-operations-georgia/, accessed October 23, 2023. In addition, in early 2023, Suniva secured a $110 million financing commitment from Orion Infrastructure Capital (OIC) to fund its expansion and signed a multi-year supply agreement of UFLPA-compliant wafers. Ibid. See also Suniva's questionnaire response.

[16] An additional 150 MW of module capacity was in place at its now-closed Camarillo, California 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" or "SPMOR") 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. 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.[17] 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. The Hillsboro facility focused entirely on module assembly – ***. On November 11, 2019, SunPower announced that it planned 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 is a publicly traded company headquartered in Singapore. SunPower originally retained the P-Series module factory in Hillsboro, Oregon. However, SunPower announced, in January 2021, that it would stop production at this facility.[18] In April 2021, Convalt Energy purchased SunPower's production equipment and subsequently shipped the equipment to a 700 MW plant that Convalt planned to open in New York in July 2022. After experiencing delays, construction of Convalt's expanded 2,000 MW facility began in December 2022 and production is expected to begin in the third quarter of 2024.[19]

[17] SunPower "P Series" modules are shingled modules requiring specialized production equipment ***.

[18] In its questionnaire response in this proceeding, SunPower reported CSPV module capacity at *** MW, production at *** MW, and employment at *** PRWs during 2021, the last year of its production operations.

[19] Convalt website, https://convalt.com/Watertown.html, accessed October 24, 2023; and PV Magazine, "Convalt Energy's plans for solar panel manufacturing plant in New York slowed, but not deterred," February 7, 2022, https://pv-magazine-usa.com/2022/02/07/convalt-plans-for-solar-panel-manufacturing-plant-in-new-york-hits-some-snags/, accessed October 24, 2023.

SunPower was a U.S. importer of *** and is also related to U.S. importers *** and formerly to leading foreign producers of CSPV products in Malaysia, Mexico, and Philippines.

Tesla, Inc./Panasonic Solar North America

Tesla, Inc.

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 *** solar roof tiles. Tesla initially produced cells and modules at a Fremont, California facility, which opened in 2014.[20] With regard to its production of solar roof tiles in Buffalo, Tesla began volume production in 2019. Tesla is a U.S. importer of ***. Tesla has *** in its module assembly operations.[21]

Panasonic Solar North America

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.[22] Panasonic in Buffalo, which was established in ***. In February 2020, Panasonic announced that they would end cell and module production in Buffalo by the end of May 2020. Panasonic is related to an importer of ***.

[20] 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 ***.

[21] In its questionnaire response in this proceeding, Tesla reported CSPV module capacity at *** MW, production at *** MW, and employment at *** PRWs during 2022.

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

Changes experienced by the industry

Producers in the United States were asked to report any change in the character of their operations or organization relating to the production of CSPV products since January 1, 2020. All eleven responding producers indicated that they had experienced such changes. Table III-2 presents the changes identified by these producers. Eight firms reported expansions and four firms reported plant closings, including ***, the only remaining U.S. producer of CSPV cells.

Firms were also asked about the impact of the COVID-19 pandemic on their CSPV operations. Twelve of thirteen responding producers reported changes in their supply chain arrangements, production, employment, and/or shipments relating to CSPV products; their responses are presented in table III-3. In general, firms reported production curtailments, production and shipping delays, and increased shipping costs resulting from the COVID-19 pandemic.

Table III-2
CSPV products: U.S. producers' reported changes in operations since January 1, 2020

Item	Firm name and narrative response
Plant openings	***
Plant closings	***
Plant closings	***
Plant closings	***
Plant closings	***
Prolonged shutdowns	***
Prolonged shutdowns	***
Prolonged shutdowns	***
Prolonged shutdowns	***

Item	Firm name and narrative response
Production curtailments	***
Production curtailments	***
Production curtailments	***
Relocations	***
Expansion	***
Expansion	***
Expansions	***
Expansions	***
Expansions	***
Expansions	***

Item	Firm name and narrative response
Expansions	***
Expansions	***
Acquisitions	***
Acquisitions	***
Other	***
Other	***
Other	***

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

Table III-3
CSPV products: U.S. producers' reported impact of COVID-19 pandemic on operations

Firm	Narrative response
***	***
***	***
***	***
***	***
***	***
***	***
***	***

Firm	Narrative response
***	***
***	***
***	***
***	***
***	***

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

Anticipated changes in operations

The Commission asked domestic producers to report anticipated changes in the character of their operations relating to the production of CSPV modules. Nine firms reported such changes; their responses appear in table III-4.

Table III-4
CSPV products: U.S. producers' anticipated changes in operations

Firm	Narrative response
***	***
***	***
***	***
***	***
***	***
***	***
***	***
***	***
***	***

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

U.S. production, capacity, and capacity utilization

CSPV cells

There is no known U.S. production of CSPV cells. As discussed previously, Panasonic reported production of CSPV cells in 2020, which were ***. Panasonic reported cell production of *** MW in 2020 before shutting down its CSPV operations in June 2020.[23]

CSPV modules

Table III-5 and figure III-1 present U.S. module producers' production, capacity, and capacity utilization. Thirteen U.S. firms reported usable capacity and production data for CSPV modules in this proceeding. The largest U.S. assemblers of CSPV modules during 2022 were ***, accounting for *** percent of reported U.S. module assembly, respectively. Between 2020 and 2022, total U.S. capacity to assemble CSPV modules fluctuated and increased overall by 6.8 percent, from 4.2 GW to 4.5 GW, decreasing by 12.1 percent from 2020-21, then increasing by 21.5 percent from 2021-22. Capacity was 4.7 percent lower in January-June 2023 than in January-June 2022. During 2020-22, production of CSPV modules increased by 11.7 percent, from 2.2 GW to 2.5 GW, and was 12.3 percent higher in January-June 2023 than in January-June 2022. Domestic producers' average capacity utilization fluctuated, peaking in 2021 at 68.2 percent, and increasing overall by 2.4 percentage points during 2020-22, from 53.2 percent to 55.6 percent, and was 9.5 percentage points higher in January-June 2023 than in January-June 2022 (62.8 percent compared to 53.3 percent).

[23] Extension Confidential Report, p. III-11 and table III-2; and staff correspondence with ***, September 15, 2023.

Table III-5
CSPV modules: U.S. producers' output, by firm and period

Practical capacity

Capacity in kilowatts

Firm	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Auxin	***	***	***	***	***
GAF Energy	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
Silfab	***	***	***	***	***
SunPower	***	***	***	***	***
Tesla	***	***	***	***	***
All firms	4,185,055	3,680,159	4,470,666	2,348,621	2,237,251

Table continued.

Table III-5 Continued
CSPV modules: U.S. producers' output, by firm and period

Production

Production in kilowatts

Firm	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Auxin	***	***	***	***	***
GAF Energy	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
Silfab	***	***	***	***	***
SunPower	***	***	***	***	***
Tesla	***	***	***	***	***
All firms	2,226,242	2,508,270	2,486,822	1,251,222	1,405,098

Table continued.

Table III-5 Continued
CSPV modules: U.S. producers' output, by firm and period

Capacity utilization

Capacity utilization in percent

Firm	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Auxin	***	***	***	***	***
GAF Energy	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
Silfab	***	***	***	***	***
SunPower	***	***	***	***	***
Tesla	***	***	***	***	***
All firms	53.2	68.2	55.6	53.3	62.8

Note: Capacity utilization ratio represents the ratio of the U.S. producer's production to its production capacity.

Table continued.

Table III-5 Continued
CSPV modules: U.S. producers' output, by firm and period

Share of production

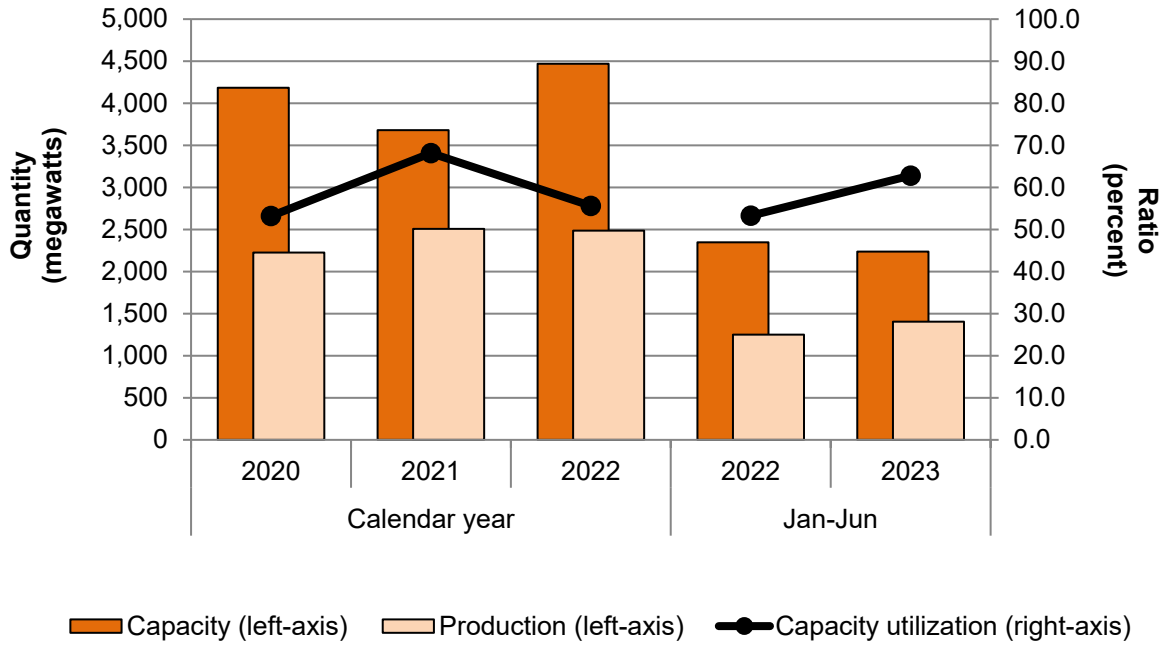
Share in percent

Firm	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Auxin	***	***	***	***	***
GAF Energy	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
Silfab	***	***	***	***	***
SunPower	***	***	***	***	***
Tesla	***	***	***	***	***
All firms	100.0	100.0	100.0	100.0	100.0

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

Note: Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent. Zeroes, null values, and undefined calculations are suppressed and shown as "---".

Figure III-1
CSPV modules: U.S. producers' output, by period



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

Table III-6 and figure III-2 present U.S. module producers' production, capacity, and capacity utilization, by cell type (i.e., bifacial cells or any other type of cell). During 2020-22, non-bifacial modules accounted for the vast majority (over *** percent) of total production of U.S. modules in each year. Non-bifacial module production increased by *** percent between 2020 and 2022, and was *** percent higher in January-June 2023 compared to the same period in 2022. Capacity utilization for non-bifacial modules ranged between *** percent and *** percent during 2020-22, and was higher in January-June 2023 than in January-June 2022. All thirteen responding producers reported production of non-bifacial modules.

Bifacial module production accounted for *** to *** percent of total module production between 2020 and 2022. Bifacial module production more than *** during the same period, but was *** percent lower in January-June 2023 compared with January-June 2022. Capacity utilization for bifacial modules ranged between *** and *** percent during 2020-22, and was lower in January-June 2023 than in January-June 2022. Four of 13 responding producers reported production of bifacial modules.

Table III-6
CSPV modules: U.S. producers' capacity, production, and capacity utilization, by period and product type

Capacity and production in kilowatts; Capacity utilization ratios in percent; Share of production in percent

Product type	Measure	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Bifacial modules	Capacity	238,618	234,199	695,812	416,958	***
Non-bifacial modules	Capacity	3,946,437	3,445,960	3,774,854	1,931,663	***
All CSPV modules	Capacity	4,185,055	3,680,159	4,470,666	2,348,621	2,237,251
Bifacial modules	Production	***	***	***	***	***
Non-bifacial modules	Production	***	***	***	***	***
All CSPV modules	Production	2,226,242	2,508,270	2,486,822	1,251,222	1,405,098
Bifacial modules	Capacity utilization	***	***	***	***	***
Non-bifacial modules	Capacity utilization	***	***	***	***	***
All CSPV modules	Capacity utilization	53.2	68.2	55.6	53.3	62.8
Bifacial modules	Share of production	***	***	***	***	***
Non-bifacial modules	Share of production	***	***	***	***	***
All CSPV modules	Share of production	***	***	***	***	***

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

Note: To avoid double counting, staff allocated capacity for ***, based on share of overall module production (bifacial and non-bifacial). *** reported that it “can produce either bifacial or non-bifacial modules on our U.S. production lines. Whether *** produces bifacial or non-bifacial depends on supply and demand conditions at any given time. Thus, ***’s capacity to produce bifacial or non-bifacial is the same.” Staff correspondence with ***, September 20, 2023. Similarly, *** allocated its capacity between bifacial and non-bifacial modules per staff’s instruction but noted that “in practice, *** does not distinguish between bifacial and monofacial production capacity. *** uses the same facility, equipment and human resources for both productions. Thus, ***'s entire capacity could in theory be allocated toward bifacial production, or non-bifacial production. The percentage of resources allocated for one or the other over any given period is determined by market demand.” Staff correspondence with ***, November 17, 2023.

Figure III-2
CSPV modules: U.S. producers' output, by period and product type

* * * * * * *

Tables III-7 and III-8 present information regarding domestic CSPV module producers' actual and planned production of CSPV products by type of cell and by cell form factor (whether for cell production or to be used in modules.[24] Producers indicate a shift towards larger cell types and form factors.

[24] See Part I for additional information concerning these cell types and form factors.

Table III-7
CSPV modules: Count of U.S. producers' responses regarding production by cell type

Cell type	Actual production	Planned production
Mono	9	2
Multi	3	1
PERC	10	7
Heterojunction	4	1
Bifacial	8	7
P-type	7	3
N-type	4	7
Greater than 162 by 162 millimeters	2	6
All other cell types	1	1

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

Note: Responses for actual production are since January 1, 2020 and planned production are for 2024 to 2026.

Table III-8
CSPV modules: Count of U.S. producers' responses regarding production by cell form factor

Cell form factor	Actual production	Planned production
M0	1	1
G1	6	---
M2	8	---
M4	2	---
M6	9	5
Larger than M6	1	7
All other cell form factors	3	3

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

Note: Responses for actual production are since January 1, 2020 and planned production are for 2024 to 2026.

Constraints on capacity

Tables III-9 and III-10 present a count of producers' reported constraints on their practical capacity and producers' narratives regarding such constraints, respectively. All responding U.S. producers except *** and *** reported constraints in the manufacturing process. Supply of material inputs and logistics/transportation were the most cited constraints on capacity (five firms each). "Other constraints" reported by firms included COVID-19, access to working capital, and Section 301 duties, which limited availability of machinery used in production.

Table III-9
CSPV modules: Count of U.S. producers' reported constraints to practical overall capacity

Item	Count
Production bottlenecks	3
Existing labor force	3
Supply of material inputs	5
Fuel or energy	---
Storage capacity	1
Logistics/transportation	5
Other constraints	3

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

Table III-10
CSPV modules: U.S. producers' reported constraints to practical overall capacity since January 1, 2020

Item	Firm name and narrative response
Production bottlenecks	***
Production bottlenecks	***
Production bottlenecks	***
Existing labor force	***
Existing labor force	***
Existing labor force	***
Supply of material inputs	***

Item	Firm name and narrative response
Supply of material inputs	***
Supply of material inputs	***
Supply of material inputs	***
Storage capacity	***
Logistics/transportation	***
Logistics/transportation	***
Logistics/transportation	***
Logistics/transportation	***
Logistics/transportation	***
Other constraints	***
Other constraints	***
Other constraints	***

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

Note: *** reported supply of material inputs as a constraint on its production but did not provide a narrative response.

U.S. producers' U.S. shipments and exports

Table III-11 presents U.S. module producers' U.S. shipments, export shipments, and total shipments.[25] The quantity of U.S. shipments of CSPV modules increased by 17.8 percent during 2020-22, from 2.2 GW to 2.5 GW, and was 7.7 percent lower in January-June 2023 than in January-June 2022. U.S. shipments accounted for nearly all total shipments. The unit value of U.S. shipments increased by 37.7 percent during 2020-22, from $418 per kilowatt to $575 per kilowatt, and was 5.0 percent lower in January-June 2023 compared to January-June 2022. *** was the only firm to report export shipments, which consisted of "sales of Non-A grade products (i.e., secondary quality products) that were sold to unaffiliated parties who then exported the modules."

Table III-11
CSPV modules: U.S. producers' total shipments, by destination and period

Quantity in kilowatts; value in 1,000 dollars; unit value in dollars per kilowatt; share in percent

Item	Measure	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
U.S. shipments	Quantity	2,154,057	2,467,731	2,537,802	1,298,911	1,198,529
Export shipments	Quantity	***	***	***	***	***
Total shipments	Quantity	***	***	***	***	***
U.S. shipments	Value	900,557	1,082,288	1,460,475	677,625	593,750
Export shipments	Value	***	***	***	***	***
Total shipments	Value	***	***	***	***	***
U.S. shipments	Unit value	418	439	575	522	495
Export shipments	Unit value	***	***	***	***	***
Total shipments	Unit value	***	***	***	***	***
U.S. shipments	Share of quantity	***	***	***	***	***
Export shipments	Share of quantity	***	***	***	***	***
Total shipments	Share of quantity	***	***	***	***	***
U.S. shipments	Share of value	***	***	***	***	***
Export shipments	Share of value	***	***	***	***	***
Total shipments	Share of value	***	***	***	***	***

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

[25] As mentioned previously, ***. Extension Confidential Report, pp. III-11 and III-21 and table III-9; and staff correspondence with ***, September 15, 2023.

Table III-12 presents U.S. module producers' U.S. shipments by type. The majority of U.S. shipments consisted of transfers to related firms, followed by commercial shipments, accounting for *** and *** percent in 2022, respectively. Four of 13 firms reported transfers to related firms, with *** accounting for the great majority (over 85 percent in each period).[26]

Table III-12
CSPV modules: U.S. producers' U.S. shipments, by type and period

Quantity in kilowatts; value in 1,000 dollars; unit value in dollars per kilowatt; share in percent

Item	Measure	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Commercial U.S. shipments	Quantity	***	***	***	***	***
Internal consumption	Quantity	***	***	***	***	***
Transfers to related firms	Quantity	***	***	***	***	***
U.S. shipments	Quantity	2,154,057	2,467,731	2,537,802	1,298,911	1,198,529
Commercial U.S. shipments	Value	***	***	***	***	***
Internal consumption	Value	***	***	***	***	***
Transfers to related firms	Value	***	***	***	***	***
U.S. shipments	Value	900,557	1,082,288	1,460,475	677,625	593,750
Commercial U.S. shipments	Unit value	***	***	***	***	***
Internal consumption	Unit value	***	***	***	***	***
Transfers to related firms	Unit value	***	***	***	***	***
U.S. shipments	Unit value	418	439	575	522	495
Commercial U.S. shipments	Share of quantity	***	***	***	***	***
Internal consumption	Share of quantity	***	***	***	***	***
Transfers to related firms	Share of quantity	***	***	***	***	***
U.S. shipments	Share of quantity	***	***	***	***	***
Commercial U.S. shipments	Share of value	***	***	***	***	***
Internal consumption	Share of value	***	***	***	***	***
Transfers to related firms	Share of value	***	***	***	***	***
U.S. shipments	Share of value	***	***	***	***	***

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

Note: Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent. Zeroes, null values, and undefined calculations are suppressed and shown as "---".

[26] *** reported ***.

Table III-13 presents additional information on U.S. producers' U.S. shipments by type of cell. Most U.S. shipments consisted of non-bifacial modules. The unit value of U.S. shipments of bifacial and non-bifacial modules increased overall during 2020-22. The unit value of U.S. shipments of bifacial modules was higher in January-June 2023 than in January-June 2022, while the unit value for non-bifacial modules was lower during the same period. The unit values of non-bifacial modules shipments were higher in most periods compared to bifacial modules.

Table III-13
CSPV modules: U.S. producers' U.S. shipments, by cell type and period

Quantity in kilowatts; value in 1,000 dollars; unit value in dollars per kilowatt; share in percent

Cell type	Measure	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Bifacial modules	Quantity	***	***	***	***	***
Non-bifacial modules	Quantity	***	***	***	***	***
All modules	Quantity	2,154,057	2,467,731	2,537,802	1,298,911	1,198,529
Bifacial modules	Value	***	***	***	***	***
Non-bifacial modules	Value	***	***	***	***	***
All modules	Value	900,557	1,082,288	1,460,475	677,625	593,750
Bifacial modules	Unit value	***	***	***	***	***
Non-bifacial modules	Unit value	***	***	***	***	***
All modules	Unit value	418	439	575	522	495
Bifacial modules	Share of quantity	***	***	***	***	***
Non-bifacial modules	Share of quantity	***	***	***	***	***
All modules	Share of quantity	100.0	100.0	100.0	100.0	100.0
Bifacial modules	Share of value	***	***	***	***	***
Non-bifacial modules	Share of value	***	***	***	***	***
All modules	Share of value	100.0	100.0	100.0	100.0	100.0

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

Note: *** reported bifacial module unit values ranging from $*** to $*** per kilowatt between 2020 and 2022, and $*** and $*** during January-June 2022 and January-June 2023 respectively, which were *** percent higher than the rest of the industry in each period. By quantity, ***'s share of bifacial U.S. shipments ranged between *** and *** percent during 2020-22, and accounted for *** and *** percent during January-June 2022 and January-June 2023, respectively.

U.S. producers' inventories

Tables III-14 through III-16 present U.S. module producers' end-of-period inventories for all CSPV modules, bifacial modules, and non-bifacial modules, and the ratio of these inventories to U.S. producers' production, U.S. shipments, and total shipments. Eight of 13 responding producers reported ending inventories. Ending inventories of all CSPV modules increased by 12.5 percent during 2020-21, then decreased by 42.1 percent during 2021-22, for an overall decrease of 34.9 percent during 2020-22. U.S. module producers' inventory ratios to U.S. production, U.S. shipments, and total shipments all decreased by more than 3 percentage points between 2020 and 2022. The decrease in inventories and ratios is primarily driven by ***, which substantially drew down its inventories by the end of 2022. Conversely, ending inventories and associated ratios in January-June 2023 were more than two times higher than in January-June 2022. Six of seven producers reported higher inventories in January-June 2023 than in January-June 2022. *** was the only producer that did not report higher inventories in January-June 2023 compared to January-June 2022.

Table III-14
CSPV modules: U.S. producers' inventories and their ratio to select items, by period

Quantity in kilowatts; ratio in percent

Item	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
End-of-period inventory quantity	167,288	188,268	108,965	126,850	308,444
Inventory ratio to U.S. production	7.5	7.5	4.4	5.1	11.0
Inventory ratio to U.S. shipments	7.8	7.6	4.3	4.9	12.9
Inventory ratio to total shipments	***	***	***	***	***

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

Table III-15
Bifacial CSPV modules: U.S. producers' inventories and their ratio to select items, by period

Quantity in kilowatts; ratio in percent

Item	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
End-of-period inventory quantity	***	***	***	***	***
Inventory ratio to U.S. production	***	***	***	***	***
Inventory ratio to U.S. shipments	***	***	***	***	***
Inventory ratio to total shipments	***	***	***	***	***

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

Table III-16
Non-bifacial CSPV modules: U.S. producers' inventories and their ratio to select items, by period

Quantity in kilowatts; ratio in percent

Item	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
End-of-period inventory quantity	***	***	***	***	***
Inventory ratio to U.S. production	***	***	***	***	***
Inventory ratio to U.S. shipments	***	***	***	***	***
Inventory ratio to total shipments	***	***	***	***	***

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

U.S. producers' imports

All U.S. producers of CSPV products (and/or related U.S. importers) reported direct imports of CSPV products since January 1, 2020. Table III-17 presents U.S. producers' module production, imports of cells and/or modules, and ratio of U.S. imports to production.[27] Table III-18 presents each firm's reason for importing.

Table III-17
CSPV products: U.S. producers' U.S. production, imports, and ratio of subject imports to production, by period

Quantity in kilowatts; ratio in percent

Firm	Measure	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
***	Production quantity	***	***	***	***	***
***	Import quantity	***	***	***	***	***
***	Ratio	***	***	***	***	***
***	Production quantity	***	***	***	***	***
***	Import quantity	***	***	***	***	***
***	Ratio	***	***	***	***	***
***	Production quantity	***	***	***	***	***
***	Import quantity	***	***	***	***	***
***	Ratio	***	***	***	***	***

Table continued.

[27] Four U.S. producers (***) confirmed importing bifacial cells for use in the production of non-bifacial modules. See staff correspondence with ***, September 20, 2023; ***, September 24, 2023; and ***, September 15, 2023. A fifth producer, ***, also imported bifacial cells used in the production of non-bifacial modules. See ***'s U.S. producer and importer questionnaire responses, questions II-13 and II-4a respectively.

Table III-17 Continued
CSPV products: U.S. producers' U.S. production, imports, and ratio of subject imports to production, by period

Quantity in kilowatts; ratio in percent

Firm	Measure	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
***	Production quantity	***	***	***	***	***
***	Import quantity	***	***	***	***	***
***	Ratio	***	***	***	***	***
***	Production quantity	***	***	***	***	***
***	Import quantity	***	***	***	***	***
***	Ratio	***	***	***	***	***
***	Production quantity	***	***	***	***	***
***	Import quantity	***	***	***	***	***
***	Ratio	***	***	***	***	***
***	Production quantity	***	***	***	***	***
***	Import quantity	***	***	***	***	***
***	Ratio	***	***	***	***	***
***	Production quantity	***	***	***	***	***
***	Import quantity	***	***	***	***	***
***	Ratio	***	***	***	***	***
***	Production quantity	***	***	***	***	***
***	Import quantity	***	***	***	***	***
***	Ratio	***	***	***	***	***
***	Production quantity	***	***	***	***	***
***	Import quantity	***	***	***	***	***
***	Ratio	***	***	***	***	***
***	Production quantity	***	***	***	***	***
***	Import quantity	***	***	***	***	***
***	Ratio	***	***	***	***	***
***	Production quantity	***	***	***	***	***
***	Import quantity	***	***	***	***	***
***	Ratio	***	***	***	***	***
***	Production quantity	***	***	***	***	***
***	Import quantity	***	***	***	***	***
***	Ratio	***	***	***	***	***
All firms	Production quantity	***	***	***	***	***
All firms	Import quantity	***	***	***	***	***
All firms	Ratio	***	***	***	***	***

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

Note: Imports presented for Hanwha, Jinko, Silfab, and SunPower include imports from their affiliates.

Note: Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent. Zeroes, null values, and undefined calculations are suppressed and shown as "---".

Table III-18
CSPV products: U.S. producers' reasons for importing

Firm	Narrative response
***	***
***	***
***	***
***	***
***	***
***	***
***	***
***	***
***	***
***	***
***	***
***	***
***	***

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

U.S. employment, wages, and productivity

Table III-19 shows U.S. producers' employment-related data for CSPV modules. The overall number of production and related workers ("PRWs") employed by firms and total hours worked decreased during 2020-22, and were higher in January-June 2023 than in January-June 2022. Wages paid increased during 2020-22 and were higher in January-June 2023 than in January-June 2022. Hourly wages similarly increased during 2020-22, but were lower in January-June 2023 than in January-June 2022. Productivity increased by 21.1 percent between 2020 and 2022, from 506.5 kilowatts per 1,000 hours to 613.6 kilowatts per 1,000 hours, and was lower in January-June 2023 than in January-June 2022. Unit labor costs decreased by 8.3 percent during 2020-21, then increased by 12.8 percent during 2021-22, increasing overall by 3.4 percent, and were 6.4 percent lower in January-June 2023 than in January-June 2022.

Table III-19
CSPV modules: U.S. producers' employment related information, by period

Item	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Production and related workers (PRWs) (number)	2,286	2,064	2,080	1,942	2,472
Total hours worked (1,000 hours)	4,395	4,021	4,053	1,920	2,536
Hours worked per PRW (hours)	1,923	1,948	1,949	989	1,026
Wages paid ($1,000)	102,934	106,316	118,865	61,206	64,330
Hourly wages (dollars per hour)	$23.42	$26.44	$29.33	$31.88	$25.37
Productivity (kilowatts per 1,000 hours)	506.5	623.8	613.6	651.7	554.1
Unit labor costs (dollars per kilowatt)	$46.24	$42.39	$47.80	$48.92	$45.78

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

Part IV: Financial experience of U.S. producers

Background[1]

Thirteen U.S. producers provided usable financial results on their CSPV modules operations.[2] [3] [4] [5] All responding U.S. producers reported financial data on a calendar year basis.[6] Nine of the responding U.S. producers provided their financial data on the basis of GAAP.[7] No responding U.S. producer reported production of CSPV cells from January 2020 to June 2023. However, three current U.S. producers of CSPV modules using imported cells (Hanwha, Heliene, and Silfab) announced plans to expand their module capacity and also start CPSV cell production in the United States.[8]

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[1] The following abbreviations are used in the tables and/or text of this section: generally accepted accounting principles ("GAAP"), fiscal year ("FY"), net sales ("NS"), cost of goods sold ("COGS"), selling, general, and administrative expenses ("SG&A expenses"), average unit values ("AUVs"), research and development expenses ("R&D expenses"), and return on assets ("ROA"), period examined ("January 1, 2020 to June 30, 2023"), January to June 2022 ("interim 2022"), and January to June 2023 ("interim 2022").

"CSPV modules" or "modules" in this section of the report refer to both bifacial and non-bifacial CSPV operations. Data specific to bifacial and non-bifacial CSPV modules will explicitly state "bifacial modules" and "non-bifacial modules," respectively.

[2] Three U.S. producers (***) reported financial operations on bifacial modules during the period examined. Their combined bifacial module operations accounted for *** percent of total CSPV module net sales quantity from 2020 to 2022; only (***) reported net sales of bifacial modules in interim 2023.

[3] In 2020, Panasonic ceased operations on CSPV products. See part III of this report.

[4] In May 2021, SunPower ceased operations on CSPV products. See part III of this report.

[5] U.S. producer (*** submitted an incomplete U.S. producer questionnaire with no financial data over a month after the deadline. As a result, *** data are not included in the aggregated financial data.

[6] ***.

[7] Three remaining companies (***) reported their financial results in accordance with International Financial Reporting Standards (IFRS) while one company (***) reported its financial results on a cash basis.

[8] Hanwha is building a $2.3 billion complex to make ingots, wafers and solar cells in Cartersville, Georgia (30 miles south of Hanwha's current Dalton, Georgia CSPV module facility). This greenfield plant is expected to start production in 2024. U.S. producer questionnaires, II-2a; Major solar panel plant opens, https://apnews.com/article/us-solar-panel-plant-hanwha-qcells-georgia-c7717cef3435a2c3197261edf6d0272f, Hanwha to increase U.S. solar, https://www.businesskorea.co.kr/news/articleView.html?idxno=203704, Qcells webpage, https://us.qcells.com/blog/qcells-invests-2-5-billion-in-building-complete-solar-supply-chain-in-u-s/, retrieved October 23, 2023.

(*continued*...)

As described earlier in part III of this report, six U.S. producers (***) substantially ramped up or began their CSPV module operations during the period examined, while (***) ceased their CSPV operations.[9] [10] [11] Aggregated financial data for CSPV modules varied substantially as a result of producers exiting and entering the industry from January 1, 2020 to June 30, 2023. Figure IV-1 presents each responding firm's share of the total reported CSPV module net sales quantity in 2022. Net sales consisted primarily of commercial sales and transfers to related firms, with *** U.S. producer (***) reporting internal consumption for four out of five data periods examined.[12] [13]

In addition, former U.S. CPSV producer Suniva announced plans on October 11, 2023 to re-start CSPV cell production of 1 GW at its idled factory in Norcross, Georgia in spring 2024. Suniva ceased CSPV operations in 2017 and emerged from bankruptcy protection in 2019; earlier in 2023, Suniva received a $110 million financing commitment from New York investment fund Orion Infrastructure Capital to resume its CSPV operations. Suniva webpage, https://suniva.com/suniva-plans-to-restart-solar-cell-manufacturing-operations-in-georgia/ and https://www.reuters.com/business/us-solar-company-suniva-restart-idled-factory-thanks-biden-climate-law-2023-10-11/, retrieved October 16, 2023.

A third company, Enel North America (headquarter in Italy) announced plans to build a solar cell and module factory in Inola, Oklahoma with an investment of more than $1 billion. Construction is planned to begin in fall 2023 for a 3 GW factory, with sales expected toward the end of 2024. Enel selects Oklahoma, https://www.3sun.com/usa/en/search-news/news/2023/09/ENEL-selects-Oklahoma-as-site and Italy's Enel to invest, https://www.reuters.com/sustainability/italys-enel-invest-more-than-1-bln-oklahoma-solar-panel-factory-2023-05-22/, retrieved October 23, 2023.

[9] ***.

[10] ***.

[11] As noted in part III of this report, ***. *** U.S. producer questionnaire, II-2c.

[12] Neither bifacial module producer reported internal consumption during the period examined.

[13] *** ceased CSPV operations in *** and reported *** net sales in interim 2023; its internal consumption of non-bifacial modules accounted for less than *** percent of *** total net sales from 2020 to 2022.

Figure IV-1
CSPV modules: U.S. producers' share of all CSPV modules net sales quantity in 2022, by firm

* * * * * * *

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

Operations on CSPV modules

Table IV-1 presents aggregated data on U.S. producers' operations in relation to CSPV modules, while table IV-2 presents corresponding changes in AUVs. Table IV-3 presents U.S. producers' net sales and operating income by bifacial and non-bifacial modules. Table IV-4 presents selected company-specific financial data.

Table IV-1
CSPV modules: U.S. producers' results of operations, by item and period

Quantity in kilowatts; value in 1,000 dollars; ratios in percent

Item	Measure	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Commercial sales	Quantity	***	***	***	***	***
Internal consumption	Quantity	***	***	***	***	***
Transfers to related firms	Quantity	***	***	***	***	***
Total net sales	Quantity	2,164,218	2,487,011	2,566,125	1,312,640	1,205,619
Commercial sales	Value	***	***	***	***	***
Internal consumption	Value	***	***	***	***	***
Transfers to related firms	Value	***	***	***	***	***
Total net sales	Value	901,263	1,084,705	1,720,179	685,805	676,377
COGS: Raw materials	Value	735,870	925,748	1,342,076	542,590	512,372
COGS: Direct labor	Value	97,759	92,107	100,171	49,665	45,258
COGS: Other factory	Value	90,115	113,146	164,883	64,111	78,284
COGS: Total	Value	923,744	1,131,001	1,607,130	656,366	635,914
Gross profit or (loss)	Value	(22,481)	(46,296)	113,049	29,439	40,463
SG&A expenses	Value	55,305	62,648	184,594	64,066	92,616
Operating income or (loss)	Value	(77,786)	(108,944)	(71,545)	(34,627)	(52,153)
Other expense/(income), net	Value	4,160	2,753	22,014	18,317	12,435
Net income or (loss)	Value	(81,946)	(111,697)	(93,559)	(52,944)	(64,588)
Depreciation/amortization	Value	26,992	27,087	27,643	13,289	19,809
Cash flow	Value	(54,954)	(84,610)	(65,916)	(39,655)	(44,779)
COGS: Raw materials	Ratio to NS	81.6	85.3	78.0	79.1	75.8
COGS: Direct labor	Ratio to NS	10.8	8.5	5.8	7.2	6.7
COGS: Other factory	Ratio to NS	10.0	10.4	9.6	9.3	11.6
COGS: Total	Ratio to NS	102.5	104.3	93.4	95.7	94.0
Gross profit	Ratio to NS	(2.5)	(4.3)	6.6	4.3	6.0
SG&A expense	Ratio to NS	6.1	5.8	10.7	9.3	13.7
Operating income or (loss)	Ratio to NS	(8.6)	(10.0)	(4.2)	(5.0)	(7.7)
Net income or (loss)	Ratio to NS	(9.1)	(10.3)	(5.4)	(7.7)	(9.5)

Table continued.

Table IV-1 Continued
CSPV modules: U.S. producers' results of operations, by item and period

Shares in percent; unit values in dollar per kilowatt; count in number of firms reporting

Item	Measure	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
COGS: Raw materials	Share	79.7	81.9	83.5	82.7	80.6
COGS: Direct labor	Share	10.6	8.1	6.2	7.6	7.1
COGS: Other factory	Share	9.8	10.0	10.3	9.8	12.3
COGS: Total	Share	100.0	100.0	100.0	100.0	100.0
Commercial sales	Unit value	***	***	***	***	***
Internal consumption	Unit value	***	***	***	***	***
Transfers to related firms	Unit value	***	***	***	***	***
Total net sales	Unit value	416	436	670	522	561
COGS: Raw materials	Unit value	340	372	523	413	425
COGS: Direct labor	Unit value	45	37	39	38	38
COGS: Other factory	Unit value	42	45	64	49	65
COGS: Total	Unit value	427	455	626	500	527
Gross profit or (loss)	Unit value	(10)	(19)	44	22	34
SG&A expenses	Unit value	26	25	72	49	77
Operating income or (loss)	Unit value	(36)	(44)	(28)	(26)	(43)
Net income or (loss)	Unit value	(38)	(45)	(36)	(40)	(54)
Operating losses	Count	9	9	7	7	4
Net losses	Count	8	9	7	8	7
Data	Count	12	11	11	11	9

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

Note: Shares represent the share of COGS. Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent. Zeroes, null values, and undefined calculations are suppressed and shown as "---".

Table IV-2
CSPV modules: Changes in AUVs between comparison periods

Changes in percent

Item	2020-22	2020-21	2021-22	Jan-Jun 2022-23
Commercial sales	▲***	▲***	▲***	▲***
Internal consumption	▼***	▼***	▲***	▼***
Transfers to related firms	▲***	▲***	▲***	▼***
Total net sales	▲61.0	▲4.7	▲53.7	▲7.4
COGS: Raw materials	▲53.8	▲9.5	▲40.5	▲2.8
COGS: Direct labor	▼(13.6)	▼(18.1)	▲5.4	▼(0.8)
COGS: Other factory	▲54.5	▲9.4	▲41.3	▲32.9
COGS: Total	▲46.7	▲6.5	▲37.7	▲5.5

Table continued.

Table IV-2 Continued
CSPV modules: Changes in AUVs between comparison periods

Changes in dollar per kilowatt

Item	2020-22	2020-21	2021-22	Jan-Jun 2022-23
Commercial sales	▲***	▲***	▲***	▲***
Internal consumption	▼***	▼***	▲***	▼***
Transfers to related firms	▲***	▲***	▲***	▼***
Total net sales	▲254	▲20	▲234	▲39
COGS: Raw materials	▲183	▲32	▲151	▲12
COGS: Direct labor	▼(6)	▼(8)	▲2	▼(0)
COGS: Other factory	▲23	▲4	▲19	▲16
COGS: Total	▲199	▲28	▲172	▲27
Gross profit or (loss)	▲54	▼(8)	▲63	▲11
SG&A expense	▲46	▼(0)	▲47	▲28
Operating income or (loss)	▲8	▼(8)	▲16	▼(17)
Net income or (loss)	▲1	▼(7)	▲8	▼(13)

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

Note: Period changes preceded by a "▲" represent an increase, while period changes preceded by a "▼" represent a decrease.

Table IV-3
CSPV modules: Select results of U.S. producers' operations, by product type and period

Shares in percent; unit values in dollars per kilowatt; count in number of firms reporting

Item	Measure	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Net sales: Bifacial modules	Quantity	***	***	***	***	***
Net sales: Non-bifacial modules	Quantity	***	***	***	***	***
Net sales: All modules	Quantity	2,164,218	2,487,011	2,566,125	1,312,640	1,205,619
Net sales: Bifacial modules	Share	***	***	***	***	***
Net sales: Non-bifacial modules	Share	***	***	***	***	***
Net sales: All modules	Share	100.0	100.0	100.0	100.0	100.0
Operating income: Bifacial modules	Value	***	***	***	***	***
Operating income: Non-bifacial modules	Value	***	***	***	***	***
Operating income: All modules	Value	(77,786)	(108,944)	(71,545)	(34,627)	(52,153)
Operating income: Bifacial modules	Ratio	***	***	***	***	***
Operating income: Non-bifacial modules	Ratio	***	***	***	***	***
Operating income: All modules	Ratio	(8.6)	(10.0)	(4.2)	(5.0)	(7.7)

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

Table IV-4
CSPV modules: U.S. producers' sales, costs/expenses, and profitability, by firm and period

Net sales quantity

Quantity in kilowatts

Firm	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Auxin	***	***	***	***	***
GAF Energy	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
Silfab	***	***	***	***	***
SunPower	***	***	***	***	***
Tesla	***	***	***	***	***
All firms	2,164,218	2,487,011	2,566,125	1,312,640	1,205,619

Table continued.

Table IV-4 Continued
CSPV modules: U.S. producers' sales, costs/expenses, and profitability, by firm and period

Net sales value

Value in 1,000 dollars

Firm	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Auxin	***	***	***	***	***
GAF Energy	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
Silfab	***	***	***	***	***
SunPower	***	***	***	***	***
Tesla	***	***	***	***	***
All firms	901,263	1,084,705	1,720,179	685,805	676,377

Table continued.

Table IV-4 Continued
CSPV modules: U.S. producers' sales, costs/expenses, and profitability, by firm and period

COGS

Value in 1,000 dollars

Firm	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Auxin	***	***	***	***	***
GAF Energy	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
Silfab	***	***	***	***	***
SunPower	***	***	***	***	***
Tesla	***	***	***	***	***
All firms	923,744	1,131,001	1,607,130	656,366	635,914

Table continued.

Table IV-4 Continued
CSPV modules: U.S. producers' sales, costs/expenses, and profitability, by firm and period

Gross profit or (loss)

Value in 1,000 dollars

Firm	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Auxin	***	***	***	***	***
GAF Energy	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
Silfab	***	***	***	***	***
SunPower	***	***	***	***	***
Tesla	***	***	***	***	***
All firms	(22,481)	(46,296)	113,049	29,439	40,463

Table continued.

Table IV-4 Continued
CSPV modules: U.S. producers' sales, costs/expenses, and profitability, by firm and period

SG&A expenses

Value in 1,000 dollars

Firm	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Auxin	***	***	***	***	***
GAF Energy	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
Silfab	***	***	***	***	***
SunPower	***	***	***	***	***
Tesla	***	***	***	***	***
All firms	55,305	62,648	184,594	64,066	92,616

Table continued.

Table IV-4 Continued
CSPV modules: U.S. producers' sales, costs/expenses, and profitability, by firm and period

Operating income or (loss)

Value in 1,000 dollars

Firm	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Auxin	***	***	***	***	***
GAF Energy	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
Silfab	***	***	***	***	***
SunPower	***	***	***	***	***
Tesla	***	***	***	***	***
All firms	(77,786)	(108,944)	(71,545)	(34,627)	(52,153)

Table continued.

Table IV-4 Continued
CSPV modules: U.S. producers' sales, costs/expenses, and profitability, by firm and period

Net income or (loss)

Value in 1,000 dollars

Firm	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Auxin	***	***	***	***	***
GAF Energy	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
Silfab	***	***	***	***	***
SunPower	***	***	***	***	***
Tesla	***	***	***	***	***
All firms	(81,946)	(111,697)	(93,559)	(52,944)	(64,588)

Table continued.

Table IV-4 Continued
CSPV modules: U.S. producers' sales, costs/expenses, and profitability, by firm and period

COGS to net sales ratio

Ratios in percent

Firm	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Auxin	***	***	***	***	***
GAF Energy	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
Silfab	***	***	***	***	***
SunPower	***	***	***	***	***
Tesla	***	***	***	***	***
All firms	102.5	104.3	93.4	95.7	94.0

Table continued.

Table IV-4 Continued
CSPV modules: U.S. producers' sales, costs/expenses, and profitability, by firm and period

Gross profit or (loss) to net sales ratio

Ratios in percent

Firm	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Auxin	***	***	***	***	***
GAF Energy	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
Silfab	***	***	***	***	***
SunPower	***	***	***	***	***
Tesla	***	***	***	***	***
All firms	(2.5)	(4.3)	6.6	4.3	6.0

Table continued.

Table IV-4 Continued
CSPV modules: U.S. producers' sales, costs/expenses, and profitability, by firm and period

SG&A expenses to net sales ratio

Ratios in percent

Firm	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Auxin	***	***	***	***	***
GAF Energy	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
Silfab	***	***	***	***	***
SunPower	***	***	***	***	***
Tesla	***	***	***	***	***
All firms	6.1	5.8	10.7	9.3	13.7

Table continued.

Table IV-4 Continued
CSPV modules: U.S. producers' sales, costs/expenses, and profitability, by firm and period

Operating income or (loss) to net sales ratio

Ratios in percent

Firm	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Auxin	***	***	***	***	***
GAF Energy	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
Silfab	***	***	***	***	***
SunPower	***	***	***	***	***
Tesla	***	***	***	***	***
All firms	(8.6)	(10.0)	(4.2)	(5.0)	(7.7)

Table continued.

Table IV-4 Continued
CSPV modules: U.S. producers' sales, costs/expenses, and profitability, by firm and period

Net income or (loss) to net sales ratio

Ratios in percent

Firm	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Auxin	***	***	***	***	***
GAF Energy	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
Silfab	***	***	***	***	***
SunPower	***	***	***	***	***
Tesla	***	***	***	***	***
All firms	(9.1)	(10.3)	(5.4)	(7.7)	(9.5)

Table continued.

Table IV-4 Continued
CSPV modules: U.S. producers' sales, costs/expenses, and profitability, by firm and period

Unit net sales value

Unit values in dollar per kilowatt

Firm	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Auxin	***	***	***	***	***
GAF Energy	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
Silfab	***	***	***	***	***
SunPower	***	***	***	***	***
Tesla	***	***	***	***	***
All firms	416	436	670	522	561

Table continued.

Table IV-4 Continued
CSPV modules: U.S. producers' sales, costs/expenses, and profitability, by firm and period

Unit raw material costs

Unit values in dollar per kilowatt

Firm	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Auxin	***	***	***	***	***
GAF Energy	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
Silfab	***	***	***	***	***
SunPower	***	***	***	***	***
Tesla	***	***	***	***	***
All firms	340	372	523	413	425

Table continued.

Table IV-4 Continued
CSPV modules: U.S. producers' sales, costs/expenses, and profitability, by firm and period

Unit direct labor costs

Unit values in dollar per kilowatt

Firm	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Auxin	***	***	***	***	***
GAF Energy	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
Silfab	***	***	***	***	***
SunPower	***	***	***	***	***
Tesla	***	***	***	***	***
All firms	45	37	39	38	38

Table continued.

Table VI-4 Continued
CSPV modules: U.S. producers' sales, costs/expenses, and profitability, by firm and period

Unit other factory costs

Unit values in dollar per kilowatt

Firm	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Auxin	***	***	***	***	***
GAF Energy	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
Silfab	***	***	***	***	***
SunPower	***	***	***	***	***
Tesla	***	***	***	***	***
All firms	42	45	64	49	65

Table continued.

Table IV-4 Continued
CSPV modules: U.S. producers' sales, costs/expenses, and profitability, by firm and period

Unit COGS

Unit values in dollar per kilowatt

Firm	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Auxin	***	***	***	***	***
GAF Energy	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
Silfab	***	***	***	***	***
SunPower	***	***	***	***	***
Tesla	***	***	***	***	***
All firms	427	455	626	500	527

Table continued.

Table IV-4 Continued
CSPV modules: U.S. producers' sales, costs/expenses, and profitability, by firm and period

Unit gross profit or (loss)

Unit values in dollar per kilowatt

Firm	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Auxin	***	***	***	***	***
GAF Energy	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
Silfab	***	***	***	***	***
SunPower	***	***	***	***	***
Tesla	***	***	***	***	***
All firms	(10)	(19)	44	22	34

Table continued.

Table IV-4 Continued
CSPV modules: U.S. producers' sales, costs/expenses, and profitability, by firm and period

Unit SG&A expenses

Unit values in dollar per kilowatt

Firm	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Auxin	***	***	***	***	***
GAF Energy	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
Silfab	***	***	***	***	***
SunPower	***	***	***	***	***
Tesla	***	***	***	***	***
All firms	26	25	72	49	77

Table continued.

Table IV-4 Continued
CSPV modules: U.S. producers' sales, costs/expenses, and profitability, by firm and period

Unit operating income or (loss)

Unit values in dollar per kilowatt

Firm	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Auxin	***	***	***	***	***
GAF Energy	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
Silfab	***	***	***	***	***
SunPower	***	***	***	***	***
Tesla	***	***	***	***	***
All firms	(36)	(44)	(28)	(27)	(43)

Table continued.

Table IV-4 Continued
CSPV modules: U.S. producers' sales, costs/expenses, and profitability, by firm and period

Unit net income or (loss)

Unit values in dollar per kilowatt

Firm	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Auxin	***	***	***	***	***
GAF Energy	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
Panasonic	***	***	***	***	***
PowerFilm	***	***	***	***	***
Silfab	***	***	***	***	***
SunPower	***	***	***	***	***
Tesla	***	***	***	***	***
All firms	(38)	(45)	(36)	(40)	(54)

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

Note: Ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent. Zeroes, null values, and undefined calculations are suppressed and shown as "---".

Net sales

As presented in table IV-1, net sales volume and value of CSPV modules increased from 2020 to 2022, but both were lower in interim 2023 than in interim 2022. One U.S. producer (***) accounted for *** of net sales by quantity and value in all five data periods. Transfers to related firms, the majority of the reported sales categories, increased each year in quantity and value from 2020 to 2022 and were higher in interim 2023 than in interim 2022. Commercial sales of CSPV modules increased irregularly from 2020 to 2022 but were lower in interim 2023 than interim 2022 in both quantity and value. As shown in table IV-1, the increase of CSPV modules net sales is primarily attributable to ***.

Table IV-3 shows that net sales of bifacial modules were very small, accounting for *** percent in 2020, *** percent in 2021, and *** percent in 2022 of total U.S. CPSV modules sales volume. Bifacial modules were essentially a zero share (***) of CSPV modules sales in interim 2023. ***. *** U.S. producer, started selling bifacial modules in 2022 (***) but reported *** net sales of bifacial modules in interim 2023.[14]

Table IV-4 shows that net sales AUVs of CSPV modules ranged widely among U.S. producers, increasing from 2020 to 2022 and were generally higher in interim 2023 than in interim 2022. Table IV-4 shows that the *** largest U.S. producers (***) consistently reported lower net sales AUVs than the industry average, while new and smaller U.S. producers (***) reported dramatically higher net sales AUVs. The variations in average commercial sales and transfer values for CSPV module producers may be explained somewhat by each producer's size in the CSPV market, individual company changes (several increased capacity, three exited the market, and one entered the market), and the type of cells used in their CSPV modules sales.[15]

[14] ***. Hanwha's U.S. producer questionnaire, II-6 and email from ***, September 18, 2023.

[15] As noted earlier in this report, *** CSPV modules. U.S. producer questionnaire, III-9.

Cost of goods sold and gross profit or loss

As presented in table IV-1, raw material costs represented the most substantial share of total COGS from 2020 to June 2023, ranging from 79.7 to 83.5 percent of total COGS. Total raw material costs increased in value from 2020 to 2022 but were lower in interim 2023 than in interim 2022. On a per-unit basis, total raw materials *** increased and were higher in interim 2023 than in interim 2022. As a share of net sales, total raw materials irregularly decreased from 2020 to 2022 and were lower in interim 2023 than interim 2022. Table IV-4 presents company-specific raw material cost AUVs, with variations partially attributable to the type of CSPV module, the volume of sales, and different raw material sourcing among U.S. producers. Total raw material costs for CSPV modules are mostly the cost of imported cells as well as other materials such as solar glass, framing, encapsulants, junction boxes, and backsheets. Table IV-5 presents raw materials, by type.[16]

Table IV-5
CSPV modules: U.S. producers' raw material costs in 2022

Value in 1,000 dollars; share of value in percent

Raw material item	Value	Share of value
Cells (foreign sources)	762,377	56.8
Backsheet costs	30,883	2.3
Encapsulant (e.g., EVA) costs	69,883	5.2
Framing costs	114,320	8.5
Junction boxes costs	33,569	2.5
Solar glass costs	129,763	9.7
All other raw material costs	201,281	15.0
Total raw material costs	1,342,076	100.0

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

[16] Five out of 13 U.S. producers purchased inputs from related firms in 2022. ***.

Other factory costs accounted for the second largest share of total CSPV module COGS, increasing on an absolute basis and per-unit basis, but irregularly decreasing as a share of revenue from 2020 to 2022.[17] Direct labor costs, which accounted for the smallest share of total COGS from 2021 to June 2023, irregularly increased in absolute value but decreased as share of revenue and on a per-unit basis from 2020 to 2022. In absolute terms, as a share of revenue, and on a per-unit basis, other factory costs were higher while direct labor costs were lower in interim 2023 than in interim 2022.[18]

As presented in table IV-1, total COGS and per-unit COGS consistently increased, while as a ratio to net sales COGS inconsistently decreased from 2020 to 2022, primarily resulting from raw material costs fluctuations. Total COGS and the ratio of COGS to net sales were lower, while per-unit total COGS was higher in interim 2023 than in interim 2022.

Table IV-1 shows that the U.S. industry reported gross losses in 2020 and 2021, with gross losses peaking in 2021, before reporting a positive gross profit in 2022; gross profit was higher in interim 2023 than in interim 2022. The positive gross profit in 2022 mostly reflects increased sales at prices higher than raw material cost increases.[19]

SG&A expenses and operating income or loss

As presented in table IV-1, U.S. producers' total SG&A expenses increased from 2020 to 2022 and were higher in interim 2023 than in interim 2022. The AUVs of SG&A expenses irregularly increased from 2020 to 2022; SG&A expense AUVs were higher in interim 2023 than in interim 2022. The SG&A expense ratios (i.e., total SG&A expenses divided by net sales) increased overall from 2020 to 2022 and were higher in interim 2023 than in interim 2022. As shown in table IV-4, *** U.S. producers (***) reported SG&A expenses increasing annually from 2020 to 2022; *** reported higher SG&A

[17] In 2020, direct labor costs as a share of total COGS and as a share of revenue were higher than other factory costs.

[18] ***.

[19] The U.S. industry's gross loss peak in 2021 was partially attributable to five U.S. producers reporting issues with sourcing raw materials resulting from COVID-19. However, ***. U.S. producer questionnaires, II-10 and III-10b.

Hanwha also reported ***. Hanwha's posthearing brief, pp. 5-6 and exh. I, pp. 26-27.

expenses while *** reported lower SG&A expenses in interim 2023 than in interim 2022. *** SG&A expense ratios were lower than the industry average throughout the period, decreasing irregularly from 2020 to 2022 but higher in interim 2023 than in interim 2022. The *** U.S. producers (***) reported higher than industry average SG&A expense ratios due in part to ***, but directional trends varied for these three companies.[20] (***) reported the highest per-unit SG&A expenses *** CSPV modules in 2022.

Table IV-1 shows that the U.S. industry's operating losses, negative operating margins, and negative operating loss AUVs irregularly decreased/improved from 2020 to 2022 but operating losses were higher in interim 2023 than in interim 2022. Operating results mostly mirror the directional trends of gross profit or loss from 2020 to 2022 but differed in the interim periods (largely due to much higher than industry average SG&A expenses reported by ***. As shown in table IV-4, individual U.S. producers of CSPV modules reported large variations in operating results from 2020 to 2022, with 12 out of 13 U.S. producers reporting operating losses in at least one annual year period and seven out of 13 U.S. producers reporting operating losses for all three annual periods.[21] *** U.S. producer ***'s operating losses peaked in 2021, before reporting a positive operating income in 2022; the firm's operating income was lower in interim 2023 than in interim 2022.

All other expenses and net income or loss

Classified below the operating income level are interest expenses, other expenses, and other income. In table IV-1, these items are aggregated and only the net amount is shown. Net all other expenses and income of CSPV modules irregularly increased from 2020 to 2022, driven by interest expenses in 2020 and 2021 and high all other expenses reported by *** in 2022 as it ***; net all other expenses and income were lower in interim 2023 than in interim 2022.[22]

The net losses of CSPV module producers had a similar pattern as operating losses but were consistently greater than corresponding operating losses throughout the period examined

[20] Each of these U.S. producers' sales volume accounted for less than one percent of the total CSPV module industry.

[21] ***.

[22] ***.

due to the inclusion of interest expense and other expenses. Net losses were higher in interim 2023 than in interim 2022 for CSPV module producers in the United States.[23]

Capital expenditures and research and development expenses

Table IV-6 presents capital expenditures, by firm, and table IV-8 presents R&D expenses, by firm. Tables IV-7 and IV-9 present the firms' narrative explanations of the nature, focus, and significance of their capital expenditures and R&D expenses, respectively. The level of overall capital expenditures irregularly increased by 67.0 percent from 2020 to 2022, with the increase reflecting large increases reported by *** installing new production equipment in 2022; capital expenditures were higher in interim 2023 than in interim 2022 (reflecting continued capital expenditures reported by ***). Seven out of 13 producers reported R&D expenses for CSPV modules, four irregularly increased from 2020 to 2022 and two were higher in interim 2023 than in interim 2022 (driven mostly by ***). [24]

Table IV-6
CSPV modules: U.S. producers' capital expenditures, by firm and period

Value in 1,000 dollars

Firm	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Auxin	***	***	***	***	***
GAF Energy	***	***	***	***	***
Hanwha	***	***	***	***	***
Heliene	***	***	***	***	***
Jinko	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
Mission	***	***	***	***	***
PowerFilm	***	***	***	***	***
Silfab	***	***	***	***	***
Tesla	***	***	***	***	***
All firms	29,085	28,242	48,561	14,514	48,391

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

[23] A variance analysis is not shown mostly due to U.S. producers exiting the market, large operational changes of individual U.S. producers, and different cost structures among the reporting firms.

[24] U.S. producers ***.

Table IV-7
CSPV modules: U.S. producers' narrative descriptions of their capital expenditures, by firm

Firm	Narrative on capital expenditures
Auxin	***
GAF Energy	***
Hanwha	***
Heliene	***
Jinko	***
LG	***
Merlin	***.
Mission	***
PowerFilm	***
Silfab	***
Tesla	***

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

Table IV-8
CSPV modules: U.S. producers' R&D expenses, by firm and period

Value in 1,000 dollars

Firm	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Auxin	***	***	***	***	***
GAF Energy	***	***	***	***	***
Heliene	***	***	***	***	***
LG	***	***	***	***	***
Merlin	***	***	***	***	***
PowerFilm	***	***	***	***	***
Silfab	***	***	***	***	***
Tesla	***	***	***	***	***
All firms	***	***	***	***	***

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

Table IV-9
CSPV modules: U.S. producers' narrative descriptions of their R&D expenses, by firm

Firm	Narrative on R&D expenses
Auxin	***
GAF Energy	***
Hanwha	***
Heliene	***
Jinko	***
LG	***
Merlin	***
Mission	***
PowerFilm	***
Silfab	***
Tesla	***

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

Assets and return on assets

Table IV-10 presents data on the U.S. producers' total assets while table IV-11 presents their operating ROA.[25] Table IV-12 presents U.S. producers' narrative responses explaining their major asset categories and any significant changes in asset levels over time. Negative ROA ratios were reported by most U.S. producers, with ***.[26]

Table IV-10
CSPV modules: U.S. producers' total net assets, by firm and period

Value in 1,000 dollars

Firm	2020	2021	2022
Auxin	***	***	***
GAF Energy	***	***	***
Hanwha	***	***	***
Heliene	***	***	***
Jinko	***	***	***
LG	***	***	***
Merlin	***	***	***
Mission	***	***	***
PowerFilm	***	***	***
Silfab	***	***	***
Tesla	***	***	***
All firms (***)	458,765	438,982	450,887

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

[25] The operating ROA is calculated as operating income divided by total assets. With respect to a firm's overall operations, the total asset value reflects an aggregation of a number of assets which are generally not product specific. Thus, high-level allocations are generally required in order to report a total asset value on a product-specific basis.

[26] U.S. producers ***.

Table IV-11
CSPV modules: U.S. producers' ROA, by firm and period

Ratio in percent

Firm	2020	2021	2022
Auxin	***	***	***
GAF Energy	***	***	***
Hanwha	***	***	***
Heliene	***	***	***
Jinko	***	***	***
LG	***	***	***
Merlin	***	***	***
Mission	***	***	***
PowerFilm	***	***	***
Silfab	***	***	***
Tesla	***	***	***
All firms (***)	(13.3)	(26.1)	(15.9)

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

Table IV-12
CSPV modules: U.S. producers' narrative descriptions of their total net assets, by firm

Firm	Narrative on assets
Auxin	***
GAF Energy	***
Hanwha	***
Heliene	***
Jinko	***
LG	***
Merlin	***
Mission	***
PowerFilm	***
Silfab	***
Tesla	***

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

COVID-19 and financial performance

Table IV-13 presents the U.S. producers' narrative responses regarding the effects of COVID-19 on their financial performance.

Table IV-13
CSPV modules: Narrative responses relating to COVID-19 pandemic effects on U.S. producers' financial performance, since January 1, 2020

Firm	Narrative response on COVID-19
Auxin	***
GAF Energy	***
Hanwha	***
Heliene	***
Jinko	***
LG	***
Merlin	***
Mission	***
Panasonic	***
PowerFilm	***
Silfab	***
SunPower	***
Tesla	***

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

Overview

Unless otherwise specified, U.S. import data and related information presented in this part of the report are based on the questionnaire responses of 45 firms.[1] These firms are estimated to have accounted for 71.9 percent of U.S. imports of CSPV products (cells and modules) during 2022.[2] Import data compiled from official U.S. import statistics using HTS statistical reporting numbers 8541.40.6015, 8541.40.6025, 8541.40.6035, 8541.40.6045, 8541.42.0010, 8541.42.0080, 8541.43.0010, and 8541.43.0080 are presented separately in appendix F.[3]

[1] U.S. importers ***and *** submitted incomplete questionnaires and are not included in the importer dataset. In addition, *** initially provided a questionnaire response but later confirmed that it was not the importer of record. Staff correspondence with ***, October 11, 2023.

[2] The estimate is based on a comparison of the total quantity of 2022 U.S. imports of CSPV cells and modules reported in the responses to the Commission's U.S. importer questionnaires (22.7 GW) with total quantity of 2022 U.S. imports of CSPV cells and modules (31.6 GW) as reported by official Commerce import statistics using HTS statistical reporting numbers 8541.40.6015, 8541.40.6025, 8541.40.6035, 8541.40.6045, 8541.42.0010, 8541.42.0080, 8541.43.0010, and 8541.43.0080.

[3] 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.

U.S. imports of CSPV products by type

Table V-1 and figures V-1 and V-2 present data for U.S. imports of CSPV products by type. Total U.S. imports of CSPV products (cells and modules) increased by 16.2 percent between 2020 and 2022, from 19.6 GW to 22.7 GW, and were 79.6 percent higher at 15.3 GW in January-June 2023 compared with 8.5 GW in January-June 2022. The value of U.S. imports followed a similar trend, increasing by 29.9 percent between 2020 and 2022, from $6.0 billion to $7.8 billion, and nearly doubling in January-June 2023 compared to January-June 2022. During 2020-22, the average unit values ranged from a low of $283 per kilowatt in 2021 to a high of $343 per kilowatt in 2022, increasing overall by 11.7 percent. The average unit value was 9.8 percent higher at $343 in January-June 2023 compared to $312 in January-June 2022. During 2020-June 2023, the largest importing firms were ***, which together accounted for approximately *** percent of total reported imports of CSPV products.

During 2020-22, modules accounted for most of the U.S. imports of CSPV products (89.3 percent in 2022), while cells accounted for a relatively smaller share (10.7 percent in 2022). U.S. imports of bifacial cells increased *** between 2020 and 2022, while U.S. imports of bifacial modules doubled during the same period.[4] Conversely, U.S. imports of non-bifacial cells and modules sharply declined between 2020 and 2022, by *** percent and 49.1 percent respectively. U.S. imports of bifacial cells and modules were higher (by *** percent and 145.2 percent respectively) and U.S. imports of non-bifacial cells and modules were lower (by *** percent and 37.0 percent respectively) in January-June 2023 when compared to January-June 2022.

[4] Four U.S. producers (***) confirmed importing bifacial cells for use in the production of non-bifacial modules. See staff correspondence with ***, September 20, 2023; ***, September 24, 2023; and ***, September 15, 2023. A fifth producer, ***, also imported bifacial cells used in the production of non-bifacial modules. See ***'s U.S. producer and importer questionnaire responses, questions II-13 and II-4a respectively.

As a share of total CSPV products by quantity, bifacial modules accounted for 37.8 percent in 2020 and increased to 66.7 percent in 2022 (or 28.9 percentage points). Conversely, non-bifacial modules accounted for 51.7 percent in 2020 and declined to 22.6 percent (or 29.1 percentage points). Cells followed a similar trend with bifacial cells accounting for *** percent of CSPV products in 2020 and increasing to 9.8 percent in 2022 (or *** percentage points) while non-bifacial cells accounted for *** percent in 2020 and declined to 0.9 percent in 2022 (or *** percentage points). The average unit values of bifacial cells, bifacial modules, non-bifacial cells, and non-bifacial modules each increased during 2020-22, and were higher in January-June 2023 than in January-June 2022 except for non-bifacial cells. The average unit values of bifacial cells and modules were lower than the average unit values of non-bifacial cells and modules in each period.

Table V-1
CSPV products: U.S. imports by type and period

Quantity in kilowatts; value in 1,000 dollars; unit value in dollars per kilowatt

Product type	Measure	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Bifacial cells	Quantity	***	815,175	2,226,976	959,422	1,349,860
Non-bifacial cells	Quantity	***	2,012,196	203,287	159,021	11,736
All CSPV cells	Quantity	2,052,100	2,827,371	2,430,263	1,118,443	1,361,596
Bifacial modules	Quantity	7,394,575	11,473,318	15,151,781	5,087,102	12,474,776
Non-bifacial modules	Quantity	10,110,753	5,033,702	5,147,072	2,311,257	1,455,604
All CSPV modules	Quantity	17,505,328	16,507,020	20,298,853	7,398,359	13,930,380
All CSPV products	Quantity	19,557,428	19,334,391	22,729,116	8,516,802	15,291,976
Bifacial cells	Value	***	162,458	593,009	204,165	307,554
Non-bifacial cells	Value	***	434,239	57,124	46,477	3,364
All CSPV cells	Value	442,177	596,697	650,133	250,642	310,918
Bifacial modules	Value	2,232,962	3,235,685	5,153,980	1,605,665	4,263,033
Non-bifacial modules	Value	3,320,780	1,635,056	1,982,086	803,721	672,388
All CSPV modules	Value	5,553,742	4,870,741	7,136,066	2,409,386	4,935,421
All CSPV products	Value	5,995,919	5,467,438	7,786,199	2,660,028	5,246,339
Bifacial cells	Unit value	***	199	266	213	228
Non-bifacial cells	Unit value	***	216	281	292	287
All CSPV cells	Unit value	215	211	268	224	228
Bifacial modules	Unit value	302	282	340	316	342
Non-bifacial modules	Unit value	328	325	385	348	462
All CSPV modules	Unit value	317	295	352	326	354
All CSPV products	Unit value	307	283	343	312	343

Table continued.

Table V-1 Continued
CSPV products: Share of U.S. imports by type and period

Share in percent

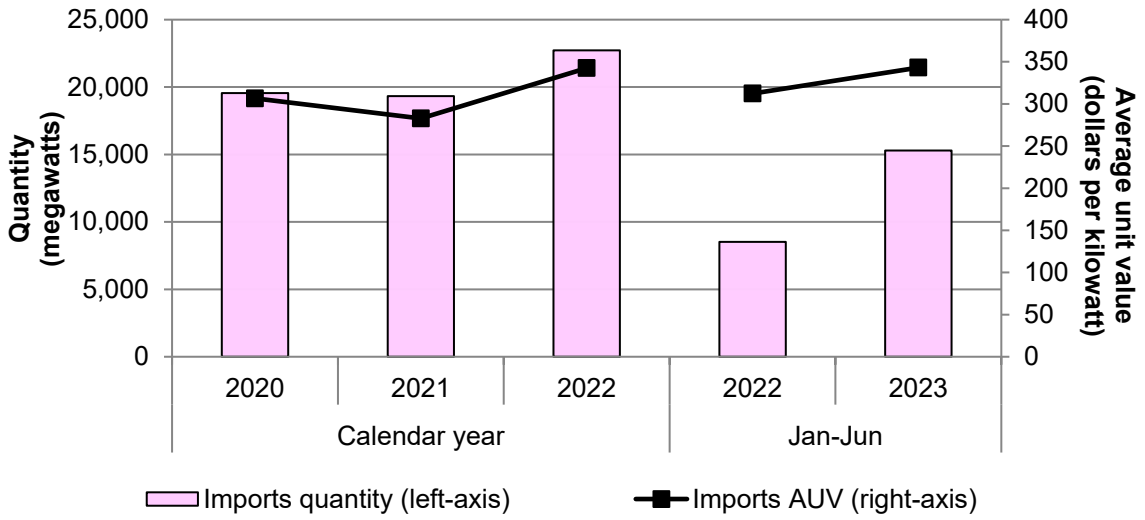
Product type	Measure	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Bifacial cells	Share of quantity	***	4.2	9.8	11.3	8.8
Non-bifacial cells	Share of quantity	***	10.4	0.9	1.9	0.1
All CSPV cells	Share of quantity	10.5	14.6	10.7	13.1	8.9
Bifacial modules	Share of quantity	37.8	59.3	66.7	59.7	81.6
Non-bifacial modules	Share of quantity	51.7	26.0	22.6	27.1	9.5
All CSPV modules	Share of quantity	89.5	85.4	89.3	86.9	91.1
All CSPV products	Share of quantity	100.0	100.0	100.0	100.0	100.0
Bifacial cells	Share of value	***	3.0	7.6	7.7	5.9
Non-bifacial cells	Share of value	***	7.9	0.7	1.7	0.1
All CSPV cells	Share of value	7.4	10.9	8.3	9.4	5.9
Bifacial modules	Share of value	37.2	59.2	66.2	60.4	81.3
Non-bifacial modules	Share of value	55.4	29.9	25.5	30.2	12.8
All CSPV modules	Share of value	92.6	89.1	91.7	90.6	94.1
All CSPV products	Share of value	100.0	100.0	100.0	100.0	100.0

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

Figure V-1
CSPV products: U.S. import quantities and average unit values, by type

* * * * * * *

Figure V-2
CSPV products: U.S. import quantities and average unit values, by period



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

U.S. imports of CSPV products by source

Table V-2 and figure V-3 present CSPV products by source, based on the country of origin of the cells.[5] During 2020-22, Malaysia, Vietnam, and South Korea were the largest sources of CSPV products other than bifacial modules (i.e., all cells and non-bifacial modules), accounting for *** percent of total CSPV products in 2022, respectively. Imports of cells and non-bifacial modules from each source were lower in January-June 2023 than in January-June 2022.

As a share of total CSPV products by quantity, cells and non-bifacial modules accounted for 62.2 percent in 2020 and decreased to 33.3 percent in 2022 (or 28.9 percentage points) as the share of imports of bifacial modules increased by 28.9 percentage points during the same period (from 37.8 percent to 66.7 percent). The share of imports of cells and non-bifacial modules were 21.8 percentage points lower in January-June 2023 than in January-June 2022 (18.4 percent compared to 40.3 percent), while the share of imports of bifacial modules were 21.8 percentage points higher (81.6 percent compared to 59.7 percent).

[5] The Commission did not collect data for imports of bifacial modules by individual source. At questionnaire and report issuance, the product was excluded from the safeguard remedy for most of the period covered by this report. As previously noted, imports of bifacial modules were excluded from the safeguard measure between June 13, 2019 (84 FR 27684) and October 25, 2020 (the effective date of Presidential Proclamation 10101 revoking the exclusion). Imports of bifacial modules were subject to the safeguard measure from October 25, 2020 to November 16, 2021 (the date of the CIT decision), but have been excluded from the measure since November 16, 2021, including the measure as extended in February 2022 by President Biden.

U.S. importers reported imports of bifacial modules from various sources, including China, Malaysia, South Korea, Thailand, and Vietnam. 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. In addition, appendix F presents CSPV products by source, based on official import statistics. 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.

Table V-2
CSPV products: U.S. imports by source and period

Quantity in kilowatts; value in 1,000 dollars

Product type and source	Measure	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
All cells and non-bifacial modules: Cambodia	Quantity	***	***	***	***	***
All cells and non-bifacial modules: Malaysia	Quantity	***	***	***	***	***
All cells and non-bifacial modules: South Korea	Quantity	***	***	***	***	***
All cells and non-bifacial modules: Thailand	Quantity	***	***	***	***	***
All cells and non-bifacial modules: Vietnam	Quantity	***	***	***	***	***
All cells and non-bifacial modules: All other sources	Quantity	***	***	***	***	***
All cells and non-bifacial modules: All import sources	Quantity	12,162,853	7,861,073	7,577,335	3,429,700	2,817,200
Bifacial modules: All import sources	Quantity	7,394,575	11,473,318	15,151,781	5,087,102	12,474,776
All CSPV products	Quantity	19,557,428	19,334,391	22,729,116	8,516,802	15,291,976
All cells and non-bifacial modules: Cambodia	Value	***	***	***	***	***
All cells and non-bifacial modules: Malaysia	Value	***	***	***	***	***
All cells and non-bifacial modules: South Korea	Value	***	***	***	***	***
All cells and non-bifacial modules: Thailand	Value	***	***	***	***	***
All cells and non-bifacial modules: Vietnam	Value	***	***	***	***	***
All cells and non-bifacial modules: All other sources	Value	***	***	***	***	***
All cells and non-bifacial modules: All import sources	Value	3,762,957	2,231,753	2,632,219	1,054,363	983,306
Bifacial modules: All import sources	Value	2,232,962	3,235,685	5,153,980	1,605,665	4,263,033
All CSPV products	Value	5,995,919	5,467,438	7,786,199	2,660,028	5,246,339

Table continued.

Table V-2 Continued
CSPV products: Share of U.S. imports by source and period

Unit value in dollars per kilowatt; share in percent

Product type and source	Measure	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
All cells and non-bifacial modules: Cambodia	Unit value	***	***	***	***	***
All cells and non-bifacial modules: Malaysia	Unit value	***	***	***	***	***
All cells and non-bifacial modules: South Korea	Unit value	***	***	***	***	***
All cells and non-bifacial modules: Thailand	Unit value	***	***	***	***	***
All cells and non-bifacial modules: Vietnam	Unit value	***	***	***	***	***
All cells and non-bifacial modules: All other sources	Unit value	***	***	***	***	***
All cells and non-bifacial modules: All import sources	Unit value	309	284	347	307	349
Bifacial modules: All import sources	Unit value	302	282	340	316	342
All CSPV products	Unit value	307	283	343	312	343
All cells and non-bifacial modules: Cambodia	Share of quantity	***	***	***	***	***
All cells and non-bifacial modules: Malaysia	Share of quantity	***	***	***	***	***
All cells and non-bifacial modules: South Korea	Share of quantity	***	***	***	***	***
All cells and non-bifacial modules: Thailand	Share of quantity	***	***	***	***	***
All cells and non-bifacial modules: Vietnam	Share of quantity	***	***	***	***	***
All cells and non-bifacial modules: All other sources	Share of quantity	***	***	***	***	***
All cells and non-bifacial modules: All import sources	Share of quantity	62.2	40.7	33.3	40.3	18.4
Bifacial modules: All import sources	Share of quantity	37.8	59.3	66.7	59.7	81.6
All CSPV products	Share of quantity	100.0	100.0	100.0	100.0	100.0

Table continued.

Table V-2 Continued
CSPV products: Share of U.S. imports by source and period

Share in percent

Product type and source	Measure	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
All cells and non-bifacial modules: Cambodia	Share of value	***	***	***	***	***
All cells and non-bifacial modules: Malaysia	Share of value	***	***	***	***	***
All cells and non-bifacial modules: South Korea	Share of value	***	***	***	***	***
All cells and non-bifacial modules: Thailand	Share of value	***	***	***	***	***
All cells and non-bifacial modules: Vietnam	Share of value	***	***	***	***	***
All cells and non-bifacial modules: All other sources	Share of value	***	***	***	***	***
All cells and non-bifacial modules: All import sources	Share of value	62.8	40.8	33.8	39.6	18.7
Bifacial modules: All import sources	Share of value	37.2	59.2	66.2	60.4	81.3
All CSPV products	Share of value	100.0	100.0	100.0	100.0	100.0

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

Figure V-3
CSPV products: U.S. import quantities, by source and period

* * * * * * *

U.S. imports of CSPV cells by source[6]

Table V-3 and figures V-4 and V-5 present data for U.S. imports of CSPV cells by source. Total U.S. imports of CSPV cells increased from 2.1 GW in 2020 to its highest level at 2.8 GW in 2021 then declined to 2.4 GW in 2022, for an overall increase of 18.4 percent. U.S. imports of CSPV cells were 21.7 percent higher at 1.4 GW in January-June 2023 compared to 1.1 GW in January-June 2022. Similarly, the value of U.S. imports of CSPV cells increased in each year, for an overall increase of 47.0 percent, and was 24.0 percent higher in January-June 2023 than in January-June 2022. The average unit value increased overall by 24.2 percent from $215 to $268 per kilowatt during 2020-22, and was 1.9 percent higher in January-June 2023 than in January-June 2022 ($228 per kilowatt compared to $224 per kilowatt).

[6] U.S. importers were also asked to report their U.S. imports of CSPV cells by tariff rate quota status in 2022 and January-June 2023. Nearly all U.S. imports of CSPV cells were within quota. Three firms (***) reported small quantities of imports above the quota in 2022, which accounted for approximately 1 percent of total reported U.S. imports in that year.

In addition, two firms reported that their imports were delayed because the applicable in-quota level was reached. *** reported small quantities of imports from Malaysia being delayed due to the quota being reached and paying the duty on one of its shipments that entered before the end of the quota year. *** reported 20 MW of imports from Vietnam that were delayed due to the tariff rate quota being reached.

During 2020 and 2021, the leading supplier of foreign CSPV cells to the United States was South Korea, accounting for *** percent and *** percent of total imports by quantity, respectively. By 2022, however, the leading supplier of foreign CSPV cells to the United States was Malaysia, accounting for *** percent of total imports by quantity, followed by Vietnam, accounting for *** percent. During 2020-22, U.S. imports from Malaysia increased more than ***, while imports from Vietnam increased more than ***. Conversely, U.S. imports from South Korea declined by *** percent during the same period. U.S. imports from Malaysia were *** percent higher in January-June 2023 compared to January-June 2022, while U.S. imports from Vietnam and South Korea were *** and *** percent lower in the same comparison period, respectively.

Table V-3
CSPV cells: U.S. imports by source and period

Quantity in kilowatts; value in 1,000 dollars; unit value in dollars per kilowatt

Source	Measure	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Cambodia	Quantity	***	***	***	***	***
Malaysia	Quantity	***	***	***	***	***
South Korea	Quantity	***	***	***	***	***
Thailand	Quantity	***	***	***	***	***
Vietnam	Quantity	***	***	***	***	***
All other sources	Quantity	***	***	***	***	***
All import sources	Quantity	2,052,100	2,827,371	2,430,263	1,118,443	1,361,596
Cambodia	Value	***	***	***	***	***
Malaysia	Value	***	***	***	***	***
South Korea	Value	***	***	***	***	***
Thailand	Value	***	***	***	***	***
Vietnam	Value	***	***	***	***	***
All other sources	Value	***	***	***	***	***
All import sources	Value	442,177	596,697	650,133	250,642	310,918
Cambodia	Unit value	***	***	***	***	***
Malaysia	Unit value	***	***	***	***	***
South Korea	Unit value	***	***	***	***	***
Thailand	Unit value	***	***	***	***	***
Vietnam	Unit value	***	***	***	***	***
All other sources	Unit value	***	***	***	***	***
All import sources	Unit value	215	211	268	224	228

Table continued.

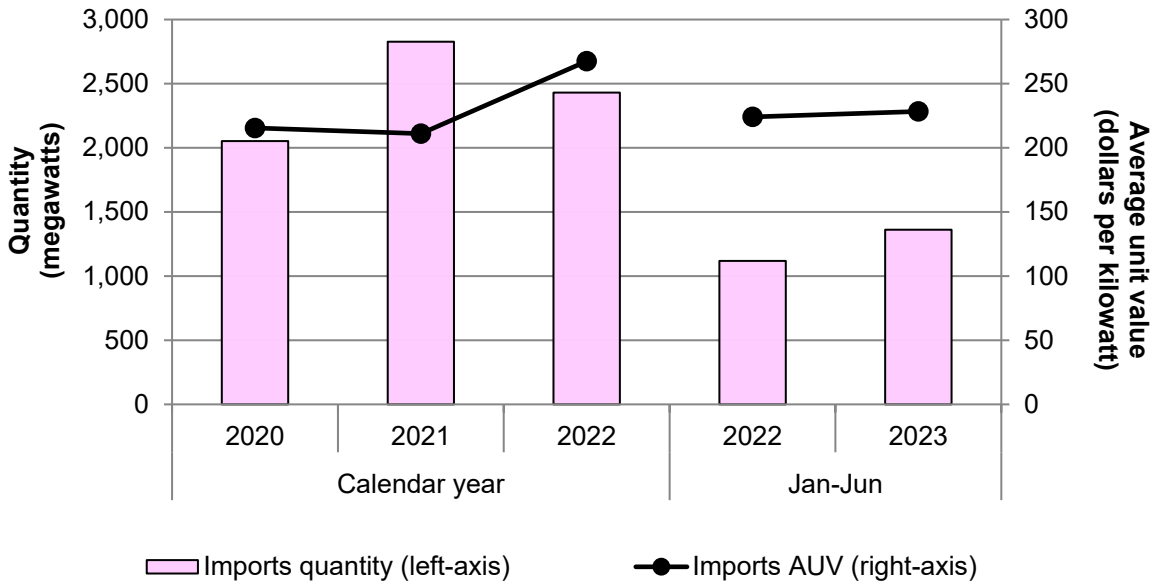
Table V-3 Continued
CSPV cells: Share of U.S. imports by source and period

Share in percent

Source	Measure	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Cambodia	Share of quantity	***	***	***	***	***
Malaysia	Share of quantity	***	***	***	***	***
South Korea	Share of quantity	***	***	***	***	***
Thailand	Share of quantity	***	***	***	***	***
Vietnam	Share of quantity	***	***	***	***	***
All other sources	Share of quantity	***	***	***	***	***
All import sources	Share of quantity	***	***	***	***	***
Cambodia	Share of value	***	***	***	***	***
Malaysia	Share of value	***	***	***	***	***
South Korea	Share of value	***	***	***	***	***
Thailand	Share of value	***	***	***	***	***
Vietnam	Share of value	***	***	***	***	***
All other sources	Share of value	***	***	***	***	***
All import sources	Share of value	***	***	***	***	***

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

Figure V-4
CSPV cells: U.S. import quantities and average unit values, by period



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

Figure V-5
CSPV cells: U.S. import quantities, by type, source, and period

* * * * * * *

U.S. imports of CSPV modules by source

Table V-4 and figures V-6 and V-7 present data for U.S. imports of CSPV modules by source. Total U.S. imports of CSPV modules declined from 17.5 GW in 2020 to 16.5 GW in 2021 then increased to 20.3 GW in 2022, for an overall increase of 16.0 percent. U.S. imports of CSPV modules were almost two times higher at 13.9 GW in January-June 2023 compared to 7.4 GW in January-June 2022. Similarly, the value of U.S. imports of CSPV modules declined from 2020-21 then increased from 2021-22, for an overall increase of 28.5 percent, and was two times higher in January-June 2023 than in January-June 2022. The average unit value increased overall by 10.8 percent from $317 to $352 per kilowatt during 2020-22, and was 8.8 percent higher in January-June 2023 than in January-June 2022 ($354 per kilowatt compared to $326 per kilowatt).

During 2020, the leading supplier of foreign CSPV non-bifacial modules to the United States was Malaysia, accounting for *** percent of non-bifacial module imports, followed by Vietnam and South Korea, accounting for *** and *** percent, respectively. By 2022, South Korea was the leading supplier of foreign CSPV non-bifacial modules to the United States, accounting for *** percent of non-bifacial module imports, followed by Thailand and Vietnam, accounting for *** and *** percent, respectively.[7] This trend is driven by imports from Malaysia, which decreased by *** percent between 2020 and 2022, and accounted for *** percent of non-bifacial module imports in 2022. Eight of nine importers reported decreased imports from Malaysia during 2020-22. In particular, ***, the largest importer of such product in 2020, sharply decreased its imports as it ramped up its U.S. module assembly operations ***. The average unit value of imports of non-bifacial modules increased by 17.2 percent during 2020-22, and was 32.8 percent higher in January-June 2023 than in January-June 2022.

[7] The Commission did not collect data for imports of bifacial modules by individual source. At questionnaire and report issuance, the product was excluded from the safeguard remedy for most of the period covered by this report. U.S. importers reported imports of bifacial modules from various sources, including China, Malaysia, South Korea, Thailand, and Vietnam. 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-4
CSPV modules: U.S. imports by source and period

Quantity in kilowatts; value in 1,000 dollars; unit value in dollars per kilowatt

Product type and source	Measure	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Non-bifacial: Cambodia	Quantity	***	***	***	***	***
Non-bifacial: Malaysia	Quantity	***	***	***	***	***
Non-bifacial: South Korea	Quantity	***	***	***	***	***
Non-bifacial: Thailand	Quantity	***	***	***	***	***
Non-bifacial: Vietnam	Quantity	***	***	***	***	***
Non-bifacial: All other sources	Quantity	***	***	***	***	***
Non-bifacial: All import sources	Quantity	10,110,753	5,033,702	5,147,072	2,311,257	1,455,604
Bifacial: All import sources	Quantity	7,394,575	11,473,318	15,151,781	5,087,102	12,474,776
All CSPV modules	Quantity	17,505,328	16,507,020	20,298,853	7,398,359	13,930,380
Non-bifacial: Cambodia	Value	***	***	***	***	***
Non-bifacial: Malaysia	Value	***	***	***	***	***
Non-bifacial: South Korea	Value	***	***	***	***	***
Non-bifacial: Thailand	Value	***	***	***	***	***
Non-bifacial: Vietnam	Value	***	***	***	***	***
Non-bifacial: All other sources	Value	***	***	***	***	***
Non-bifacial: All import sources	Value	3,320,780	1,635,056	1,982,086	803,721	672,388
Bifacial: All import sources	Value	2,232,962	3,235,685	5,153,980	1,605,665	4,263,033
All CSPV modules	Value	5,553,742	4,870,741	7,136,066	2,409,386	4,935,421
Non-bifacial: Cambodia	Unit value	***	***	***	***	***
Non-bifacial: Malaysia	Unit value	***	***	***	***	***
Non-bifacial: South Korea	Unit value	***	***	***	***	***
Non-bifacial: Thailand	Unit value	***	***	***	***	***
Non-bifacial: Vietnam	Unit value	***	***	***	***	***
Non-bifacial: All other sources	Unit value	***	***	***	***	***
Non-bifacial: All import sources	Unit value	328	325	385	348	462
Bifacial: All import sources	Unit value	302	282	340	316	342
All CSPV modules	Unit value	317	295	352	326	354

Table continued.

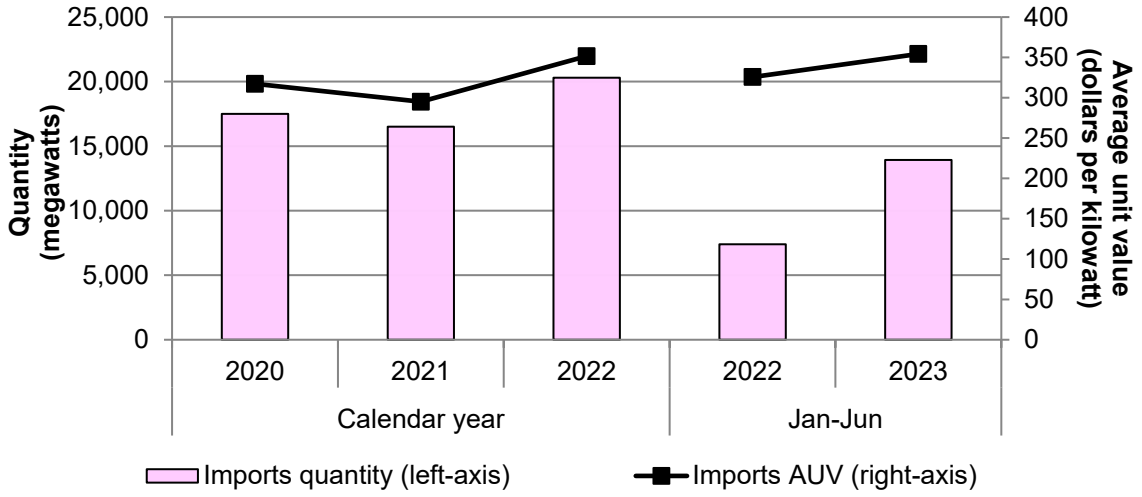
Table V-4 Continued
CSPV modules: Share of U.S. imports by source and period

Share in percent

Product type and source	Measure	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Non-bifacial: Cambodia	Share of quantity	***	***	***	***	***
Non-bifacial: Malaysia	Share of quantity	***	***	***	***	***
Non-bifacial: South Korea	Share of quantity	***	***	***	***	***
Non-bifacial: Thailand	Share of quantity	***	***	***	***	***
Non-bifacial: Vietnam	Share of quantity	***	***	***	***	***
Non-bifacial: All other sources	Share of quantity	***	***	***	***	***
Non-bifacial: All import sources	Share of quantity	57.8	30.5	25.4	31.2	10.4
Bifacial: All import sources	Share of quantity	42.2	69.5	74.6	68.8	89.6
All CSPV modules	Share of quantity	100.0	100.0	100.0	100.0	100.0
Non-bifacial: Cambodia	Share of value	***	***	***	***	***
Non-bifacial: Malaysia	Share of value	***	***	***	***	***
Non-bifacial: South Korea	Share of value	***	***	***	***	***
Non-bifacial: Thailand	Share of value	***	***	***	***	***
Non-bifacial: Vietnam	Share of value	***	***	***	***	***
Non-bifacial: All other sources	Share of value	***	***	***	***	***
Non-bifacial: All import sources	Share of value	59.8	33.6	27.8	33.4	13.6
Bifacial: All import sources	Share of value	40.2	66.4	72.2	66.6	86.4
All CSPV modules	Share of value	100.0	100.0	100.0	100.0	100.0

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

Figure V-6
CSPV modules: U.S. import quantities and average unit values, by type and period



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

Figure V-7
CSPV modules: U.S. import quantities, by type, source, and period

* * * * * * *

Importers' CSPV cell technology

Tables V-5 and V-6 present importers' reported cell technologies. Of 45 responding importers, a majority reported imports of CSPV products containing PERC cells (32), bifacial cells (31), and monocrystalline cells (28). Around one-half of responding U.S. importers reported imports of CSPV products containing P-cells (24) and cells greater than 162 by 162 millimeters (21). A minority of U.S. importers reported imports containing multi cells (14), N-type cells (7), and heterojunction cells (5). Seven firms reported "all other cells," including IBC cells, 182 by 182 millimeter cells, half cells, and MWT PERC cells.

Table V-5
CSPV products: Count of U.S. importers' imports by cell type

Cell type	Count of firms
Mono	28
Multi	14
PERC	32
Heterojunction	5
Bifacial	31
P-type	24
N-type	7
Greater than 162 by 162 millimeter cells	21
All other cell types	7

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

Table V-6
CSPV products: U.S. importers' imports by cell type

Cell type	Mono	Multi	PERC	Hetero-junction	Bifacial	P-type	N-type	Greater than 162 by 162 millimeter cells	All other cell types
Acciona	***	***	***	***	***	***	***	***	***
Alps	***	***	***	***	***	***	***	***	***
Astronergy	***	***	***	***	***	***	***	***	***
Auxin	***	***	***	***	***	***	***	***	***
Canadian	***	***	***	***	***	***	***	***	***
EDF	***	***	***	***	***	***	***	***	***
Enel	***	***	***	***	***	***	***	***	***
ET	***	***	***	***	***	***	***	***	***
First	***	***	***	***	***	***	***	***	***
GAF	***	***	***	***	***	***	***	***	***
Hanwha	***	***	***	***	***	***	***	***	***
Hanwha CA	***	***	***	***	***	***	***	***	***
Hanwha GA	***	***	***	***	***	***	***	***	***
Heliene	***	***	***	***	***	***	***	***	***
Hounen	***	***	***	***	***	***	***	***	***
HT	***	***	***	***	***	***	***	***	***
Invenergy	***	***	***	***	***	***	***	***	***
Jackery	***	***	***	***	***	***	***	***	***
JinkoSolar CA	***	***	***	***	***	***	***	***	***
JinkoSolar FL	***	***	***	***	***	***	***	***	***
LG	***	***	***	***	***	***	***	***	***
LONGi	***	***	***	***	***	***	***	***	***
Maxeon	***	***	***	***	***	***	***	***	***
Merlin	***	***	***	***	***	***	***	***	***
Mission	***	***	***	***	***	***	***	***	***
NextEra	***	***	***	***	***	***	***	***	***
Panasonic NJ	***	***	***	***	***	***	***	***	***
PowerFilm	***	***	***	***	***	***	***	***	***

Table continued.

Table V-6 Continued
CSPV products: U.S. importers' imports by cell type

Cell type	Mono	Multi	PERC	Hetero-junction	Bifacial	P-type	N-type	Greater than 162 by 162 millimeter cells	All other cell types
RDK	***	***	***	***	***	***	***	***	***
REC	***	***	***	***	***	***	***	***	***
Silfab Canada	***	***	***	***	***	***	***	***	***
Silfab WA	***	***	***	***	***	***	***	***	***
Sunergy	***	***	***	***	***	***	***	***	***
SunPower CA	***	***	***	***	***	***	***	***	***
Sunpower OR	***	***	***	***	***	***	***	***	***
Talesun	***	***	***	***	***	***	***	***	***
Tech-Seal	***	***	***	***	***	***	***	***	***
Tesla	***	***	***	***	***	***	***	***	***
Trina	***	***	***	***	***	***	***	***	***
Vikram	***	***	***	***	***	***	***	***	***
VSUN	***	***	***	***	***	***	***	***	***
Winaico	***	***	***	***	***	***	***	***	***
Yingli	***	***	***	***	***	***	***	***	***
Yingli Renewable Energy	***	***	***	***	***	***	***	***	***
Zhongli	***	***	***	***	***	***	***	***	***
Total	28	14	32	5	31	24	7	21	7

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

Tables V-7 and V-8 present importers' reported cell form factors. Importers indicate a shift towards larger form factors.

Table V-7
CSPV products: Count of U.S. importers' imports, by cell form factor

Cell form factor	Count of firms
M0	4
G1	18
M2	16
M4	10
M6	28
Larger than M6	22
All other cell form factors	7

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

Table V-8
CSPV products: U.S. importers' imports by cell form factor

Firm	M0	G1	M2	M4	M6	Larger than M6	All other cell form factors
Acciona	***	***	***	***	***	***	***
Alps	***	***	***	***	***	***	***
Astronergy	***	***	***	***	***	***	***
Auxin	***	***	***	***	***	***	***
Canadian	***	***	***	***	***	***	***
EDF	***	***	***	***	***	***	***
Enel	***	***	***	***	***	***	***
ET	***	***	***	***	***	***	***
First	***	***	***	***	***	***	***
GAF	***	***	***	***	***	***	***
Hanwha	***	***	***	***	***	***	***
Hanwha CA	***	***	***	***	***	***	***
Hanwha GA	***	***	***	***	***	***	***
Heliene	***	***	***	***	***	***	***
Hounen	***	***	***	***	***	***	***
HT	***	***	***	***	***	***	***
Invenergy	***	***	***	***	***	***	***
Jackery	***	***	***	***	***	***	***
JinkoSolar CA	***	***	***	***	***	***	***
JinkoSolar FL	***	***	***	***	***	***	***
LG	***	***	***	***	***	***	***
LONGi	***	***	***	***	***	***	***
Maxeon	***	***	***	***	***	***	***
Merlin	***	***	***	***	***	***	***
Mission	***	***	***	***	***	***	***
NextEra	***	***	***	***	***	***	***
Panasonic NJ	***	***	***	***	***	***	***
PowerFilm	***	***	***	***	***	***	***
RDK	***	***	***	***	***	***	***
REC	***	***	***	***	***	***	***
Silfab Canada	***	***	***	***	***	***	***
Silfab WA	***	***	***	***	***	***	***
Sunergy	***	***	***	***	***	***	***
SunPower CA	***	***	***	***	***	***	***
Sunpower OR	***	***	***	***	***	***	***
Talesun	***	***	***	***	***	***	***
Tech-Seal	***	***	***	***	***	***	***
Tesla	***	***	***	***	***	***	***
Trina	***	***	***	***	***	***	***
Vikram	***	***	***	***	***	***	***

Table continued.

Table V-8 Continued
CSPV products: U.S. importers' imports by cell form factor

Firm	M0	G1	M2	M4	M6	Larger than M6	All other cell form factors
VSUN	***	***	***	***	***	***	***
Winaico	***	***	***	***	***	***	***
Yingli	***	***	***	***	***	***	***
Yingli Renewable Energy	***	***	***	***	***	***	***
Zhongli	***	***	***	***	***	***	***
Total	4	18	16	10	28	22	7

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

U.S. inventories of imported merchandise

Table V-9 presents data for inventories of U.S. imports of CSPV products held in the United States. Twenty-four of 45 responding importers indicated that they maintained inventories during at least part of the period from 2020 to June 2023. U.S. importers' end-of-period inventories nearly doubled between 2020 and 2022, increasing from 2.9 GW in 2020 to 3.4 GW in 2021 to 5.7 GW in 2022, and were 75.2 percent higher in January-June 2023 (5.9 GW) compared to January-June 2022 (3.4 GW). Beginning in 2021, bifacial modules accounted for the majority of total inventories of CSPV products. The ratios of inventories to imports and shipments increased by 10.0 percentage points or more between 2020 and 2022, and were slightly lower in January-June 2023 than in January-June 2022.

Table V-9
CSPV products: U.S. importers' inventories and their ratio to select items, by source and period

Quantity in kilowatts; ratio in percent

Item	Product type	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Inventory quantity	Bifacial cells	***	***	***	***	***
Ratio to imports	Bifacial cells	***	***	***	***	***
Ratio to U.S. shipments of imports	Bifacial cells	***	***	***	***	***
Ratio to total shipments of imports	Bifacial cells	***	***	***	***	***
Inventory quantity	Non-bifacial cells	***	***	***	***	***
Ratio to imports	Non-bifacial cells	***	***	***	***	***
Ratio to U.S. shipments of imports	Non-bifacial cells	***	***	***	***	***
Ratio to total shipments of imports	Non-bifacial cells	***	***	***	***	***
Inventory quantity	All CSPV cells	126,771	278,986	209,929	144,732	225,451
Ratio to imports	All CSPV cells	6.2	9.9	8.6	6.5	8.3
Ratio to U.S. shipments of imports	All CSPV cells	5.9	10.4	8.4	5.8	8.4
Ratio to total shipments of imports	All CSPV cells	***	***	***	***	***
Inventory quantity	Bifacial modules	1,394,440	2,032,965	3,922,904	1,965,655	4,391,168
Ratio to imports	Bifacial modules	18.9	17.7	25.9	19.3	17.6
Ratio to U.S. shipments of imports	Bifacial modules	22.5	18.8	30.8	20.2	18.4
Ratio to total shipments of imports	Bifacial modules	***	***	***	***	***
Inventory quantity	Non-bifacial modules	1,416,469	1,045,355	1,546,511	1,261,230	1,290,702
Ratio to imports	Non-bifacial modules	14.0	20.8	30.0	27.3	44.3
Ratio to U.S. shipments of imports	Non-bifacial modules	14.2	19.4	34.0	31.5	37.7
Ratio to total shipments of imports	Non-bifacial modules	***	***	***	***	***
Inventory quantity	All CSPV modules	2,810,909	3,078,320	5,469,415	3,226,885	5,681,870
Ratio to imports	All CSPV modules	16.1	18.6	26.9	21.8	20.4
Ratio to U.S. shipments of imports	All CSPV modules	17.4	19.0	31.7	23.4	20.8
Ratio to total shipments of imports	All CSPV modules	***	***	***	***	***
Inventory quantity	All CSPV products	2,937,680	3,357,306	5,679,344	3,371,617	5,907,321
Ratio to imports	All CSPV products	15.0	17.4	25.0	19.8	19.3
Ratio to U.S. shipments of imports	All CSPV products	16.0	17.8	28.7	20.7	19.7
Ratio to total shipments of imports	All CSPV products	***	***	***	***	***

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

Apparent U.S. consumption and market shares

Quantity

Table V-10 and figure V-8 present data on apparent U.S. consumption and U.S. market shares by quantity for CSPV cells. Apparent U.S. consumption of CSPV cells, by quantity, increased by 16.9 percent from 2.1 GW in 2020 to 2.5 GW in 2022, and was 7.5 percent higher at 1.35 GW in January-June 2023 compared with 1.25 GW in January-June 2022.

Table V-10
CSPV cells: Apparent U.S. consumption and market shares based on quantity, by source, product type, and period

Quantity in kilowatts; shares in percent

Source and product type	Measure	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
U.S. producers	Quantity	---	---	---	---	---
Imports: Bifacial	Quantity	***	619,951	2,221,967	1,028,218	1,341,774
Imports: Non-bifacial	Quantity	***	2,055,205	277,353	224,479	4,300
Imports: All	Quantity	2,138,882	2,675,156	2,499,320	1,252,697	1,346,074
All sources	Quantity	2,138,882	2,675,156	2,499,320	1,252,697	1,346,074
U.S. producers	Share	---	---	---	---	---
Imports: Bifacial	Share	***	23.2	88.9	82.1	99.7
Imports: Non-bifacial	Share	***	76.8	11.1	17.9	0.3
Imports: All	Share	100.0	100.0	100.0	100.0	100.0
All sources	Share	100.0	100.0	100.0	100.0	100.0

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

Note: Apparent U.S. consumption is derived from U.S. producers' U.S. shipments and U.S. importers' U.S. shipments of imports.

Note: Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent. Zeroes, null values, and undefined calculations are suppressed and shown as "---".

Figure V-8
CSPV cells: Apparent U.S. consumption based on quantity, by source, product type, and period

* * * * * * *

Table V-11 and figure V-9 present data on apparent U.S. consumption and U.S. market shares by quantity for CSPV modules. Apparent U.S. consumption of CSPV modules, by quantity, increased by 8.1 percent from 18.3 GW in 2020 to 19.8 GW in 2022, and was 81.4 percent higher at 14.8 GW in January-June 2023 compared with 8.2 GW in January-June 2022. U.S. producers' share of apparent U.S. consumption of CSPV modules increased overall by 1.1 percentage points from 11.7 percent in 2020 to 12.8 percent in 2022, and was 7.8 percentage points lower in January-June 2023 (8.1 percent) compared to January-June 2022 (15.9 percent). Importers' share of apparent U.S. consumption of bifacial modules increased by 30.5 percentage points between 2020 and 2022, and was 20.8 percentage points higher in January-June 2023 (80.4 percent) compared to January-June 2022 (59.6 percent). Conversely, importers' share of apparent U.S. consumption of non-bifacial modules decreased by 31.5 percentage points between 2020 and 2022, and was 13.0 percentage points lower in January-June 2023 (11.5 percent) compared to January-June 2022 (24.5 percent).

Table V-11
CSPV modules: Apparent U.S. consumption and market shares based on quantity, by source, product type, and period

Quantity in kilowatts; shares in percent

Source and product type	Measure	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
U.S. producers: Bifacial	Quantity	***	***	***	***	***
U.S. producers: Non-bifacial	Quantity	***	***	***	***	***
U.S. producers: All	Quantity	2,154,057	2,467,731	2,537,802	1,298,911	1,198,529
Imports: Bifacial	Quantity	6,185,269	10,789,111	12,726,826	4,876,809	11,923,560
Imports: Non-bifacial	Quantity	9,997,775	5,378,977	4,553,384	2,003,683	1,711,403
Imports: All	Quantity	16,183,044	16,168,088	17,280,210	6,880,492	13,634,963
All sources	Quantity	18,337,101	18,635,819	19,818,012	8,179,403	14,833,492
U.S. producers: Bifacial	Share	***	***	***	***	***
U.S. producers: Non-bifacial	Share	***	***	***	***	***
U.S. producers: All	Share	11.7	13.2	12.8	15.9	8.1
Imports: Bifacial	Share	33.7	57.9	64.2	59.6	80.4
Imports: Non-bifacial	Share	54.5	28.9	23.0	24.5	11.5
Imports: All	Share	88.3	86.8	87.2	84.1	91.9
All sources	Share	100.0	100.0	100.0	100.0	100.0

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

Note: Apparent U.S. consumption is derived from U.S. producers' U.S. shipments and U.S. importers' U.S. shipments of imports.

Note: Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent. Zeroes, null values, and undefined calculations are suppressed and shown as "---".

Figure V-9
CSPV modules: Apparent U.S. consumption based on quantity, by source, product type, and period

* * * * * * *

Value

Table V-12 and figure V-10 present data on apparent U.S. consumption and U.S. market shares by value for CSPV cells. By value, apparent U.S. consumption of CSPV cells increased by 45.2 percent during 2020-22, from $464.9 million to $675.2 million, and was 7.0 percent higher in January-June 2023 compared to January-June 2022.

Table V-12
CSPV cells: Apparent U.S. consumption and market shares based on value, by source, product type, and period

Value in 1,000 dollars; shares in percent

Source and product type	Measure	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
U.S. producers	Value	---	---	---	---	---
Imports: Bifacial	Value	***	120,238	596,988	219,910	304,411
Imports: Non-bifacial	Value	***	442,267	78,168	65,624	1,248
Imports: All	Value	464,924	562,505	675,156	285,534	305,659
All sources	Value	464,924	562,505	675,156	285,534	305,659
U.S. producers	Share	---	---	---	---	---
Imports: Bifacial	Share	***	21.4	88.4	77.0	99.6
Imports: Non-bifacial	Share	***	78.6	11.6	23.0	0.4
Imports: All	Share	100.0	100.0	100.0	100.0	100.0
All sources	Share	100.0	100.0	100.0	100.0	100.0

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

Note: Apparent U.S. consumption is derived from U.S. producers' U.S. shipments and U.S. importers' U.S. shipments of imports.

Note: Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent. Zeroes, null values, and undefined calculations are suppressed and shown as "---".

Figure V-10
CSPV cells: Apparent U.S. consumption based on value, by source, product type, and period

* * * * * * *

Table V-13 and figure V-11 present data on apparent U.S. consumption and U.S. market shares by value for CSPV modules. Apparent U.S. consumption of CSPV modules, by value, increased by *** percent between 2020 and 2022, from $*** to $***, and was *** percent higher in January-June 2023 than in January-June 2022. Based on value, U.S. producers' share of apparent U.S. consumption of CSPV modules increased overall by *** percentage points from *** percent in 2020 to *** percent in 2022, and was *** percentage points lower in January-June 2023 compared to January-June 2022.

Table V-13
CSPV modules: Apparent U.S. consumption and market shares based on value, by source, product type, and period

Value in 1,000 dollars; shares in percent

Source and product type	Measure	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
U.S. producers: Bifacial	Value	***	***	***	***	***
U.S. producers: Non-bifacial	Value	***	***	***	***	***
U.S. producers: All	Value	900,557	1,082,288	1,460,475	677,625	593,750
Imports: Bifacial	Value	2,177,340	3,614,226	5,032,320	1,860,914	4,479,738
Imports: Non-bifacial	Value	3,823,338	2,130,816	2,299,599	1,247,854	770,210
Imports: All	Value	6,000,678	5,745,042	7,331,919	3,108,768	5,249,948
All sources	Value	6,901,235	6,827,330	8,792,394	3,786,393	5,843,698
U.S. producers: Bifacial	Share	***	***	***	***	***
U.S. producers: Non-bifacial	Share	***	***	***	***	***
U.S. producers: All	Share	13.0	15.9	16.6	17.9	10.2
Imports: Bifacial	Share	31.6	52.9	57.2	49.1	76.7
Imports: Non-bifacial	Share	55.4	31.2	26.2	33.0	13.2
Imports: All	Share	87.0	84.1	83.4	82.1	89.8
All sources	Share	100.0	100.0	100.0	100.0	100.0

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

Note: Apparent U.S. consumption is derived from U.S. producers' U.S. shipments and U.S. importers' U.S. shipments of imports.

Note: Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent. Zeroes, null values, and undefined calculations are suppressed and shown as "---".

Figure V-11
CSPV modules: Apparent U.S. consumption based on value, by source, product type, and period

* * * * * * *

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. These cells are then assembled, along with other components, including solar glass, aluminum frames, junction boxes, and backsheet, into CSPV modules. Raw material costs are the largest component of the total cost of goods sold ("COGS") for CSPV modules, and crystalline silicon is the largest individual component.[1] Based on questionnaire data from the current proceeding, the cost of raw materials comprised roughly 80 percent of U.S. producers' COGS between 2020 and 2022.[2]

As shown in figure VI-1, average prices for monocrystalline wafers fluctuated during the period. Wafer prices increased intermittently between January 2020 and mid-2022 before dropping sharply between September 2022 and January 2023. Prices rose again sharply in February 2023 before declining again in May 2023. Overall, prices were lower in June 2023 than in January 2020. The prices for different wafer sizes also converged toward the end of the period, though larger wafer sizes (such as 210mm) were still more expensive than smaller ones (such as 156mm). As shown in figure VI-2, average prices for monocrystalline cells followed a similar pattern, ending lower in June 2023 – and lower still in October 2023 – than in January 2020. Cell prices showed even greater convergence over the period than wafer prices.

[1] According to a 2022 publication from the International Energy Agency (IEA), the cost of crystalline silicon accounted for nearly two-thirds of the cost of raw materials used in CSPV modules. See IEA Special Report on Solar PV Global Supply Chains, available at https://iea.blob.core.windows.net/assets/d2ee601d-6b1a-4cd2-a0e8-db02dc64332c/SpecialReportonSolarPVGlobalSupplyChains.pdf, accessed October 12, 2023.

[2] For data and a discussion on raw material costs as a percentage of the total COGS, see part IV.

Figure VI-1
Wafer prices: Average prices for monocrystalline wafers, by month, January 2020-October 2023

* * * * * * *

Source: *PVInsights*, Spot Price Download, http://pvinsights.com/, accessed October 13, 2023.

Note: Data for 210mm mono wafers, 210mm N-type mono wafers, 182mm mono wafers, and 182mm N-type mono wafers became available beginning in June 2020.

Figure VI-2
Cell prices: Average prices for monocrystalline cells, by month, January 2020-October 2023

* * * * * * *

Source: *PVInsights*, Spot Price Download, http://pvinsights.com/, accessed October 13, 2023.

Impact of section 232 and 301 tariffs on raw material costs and CSPV prices

U.S. producers, importers, and purchasers were asked if the announcement of the section 232 investigation in April 2017 or subsequent imposition of tariffs on imported steel and aluminum products beginning in March 2018 had any impact on the raw material costs and/or prices for CSPV products. Most (9 of 13) U.S. producers reported that the section 232 measures had no impact, while most importers (23 of 44 firms) and purchasers (34 of 49 firms) reported that they did not know.[3] Among the firms that elaborated on how the section 232 measures impacted the U.S. market, most indicated that they increased raw material costs (table VI-1).[4] Firm responses on the impact of the section 232 measures on overall prices of CSPV products were more mixed, though more U.S. producers reported that prices decreased than increased, and more importers and purchasers reported that prices increased than reported that prices decreased.

Table VI-1
Impact of section 232 measures: Firms' responses regarding the impact of the section 232 announcement and measures in the U.S. market, by impact and type of firm

Count in number of firms reporting

Impact on	Firm type	Steadily increase	Fluctuate up	No change	Fluctuate down	Steadily decrease
Raw material costs	U.S. producers	2	1	0	0	0
Raw material costs	Importers	7	3	3	0	0
Raw material costs	Purchasers	7	3	5	0	0
CSPV product prices	U.S. producers	1	0	0	1	1
CSPV product prices	Importers	3	3	2	2	3
CSPV product prices	Purchasers	3	8	7	1	2

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

U.S. producers, importers, and purchasers were also asked if the announcement of the section 301 investigation in August 2017 or the subsequent imposition of tariffs on Chinese-origin products had an impact on the raw material costs or prices for CSPV products in the U.S.

[3] Only one responding U.S. producer reported that the section 232 tariffs had an impact, while four reported that they did not know. Four responding importers and nine purchasers also reported that they had an impact, while 17 importers and six purchasers reported that they did not.

[4] Several of the purchasers that reported not knowing if the section 232 measures had an impact on raw material costs or prices of CSPV products still opined on their impact.

market.[5] As discussed in part II, either pluralities or majorities of responding firms reported that the section 301 tariffs did not change demand or supply. As shown in table VI-1, most firms reported that the section 301 tariffs increased raw material costs and prices for CSPV products.[6]

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

Count in number of firms reporting

Impact on	Firm type	Steadily increase	Fluctuate up	No change	Fluctuate down	Steadily decrease
Raw material costs	U.S. producers	6	4	0	0	0
Raw material costs	Importers	12	11	8	0	0
Raw material costs	Purchasers	6	11	6	1	0
CSPV product prices	U.S. producers	3	3	3	1	0
CSPV product prices	Importers	4	12	10	3	0
CSPV product prices	Purchasers	4	14	7	6	1

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

Among the firms elaborating on the impact of the Section 301 tariffs on raw material costs, all of them indicated that the tariffs raised prices for several inputs, with one firm (***) naming junction boxes specifically. In terms of their impact on prices for CSPV products, some firms indicated that the increase in raw material costs coupled with the decrease in prices for CSPV modules led to a greater economic burden on the part of domestic manufacturers. Others reported that the section 301 tariffs' impact on raw materials led to higher module prices.

Changes in conventional energy prices

As noted in previous staff reports, purchasers can use energy and electricity from a wide variety of sources, ranging from traditional fossil fuels to various forms of renewable energy.

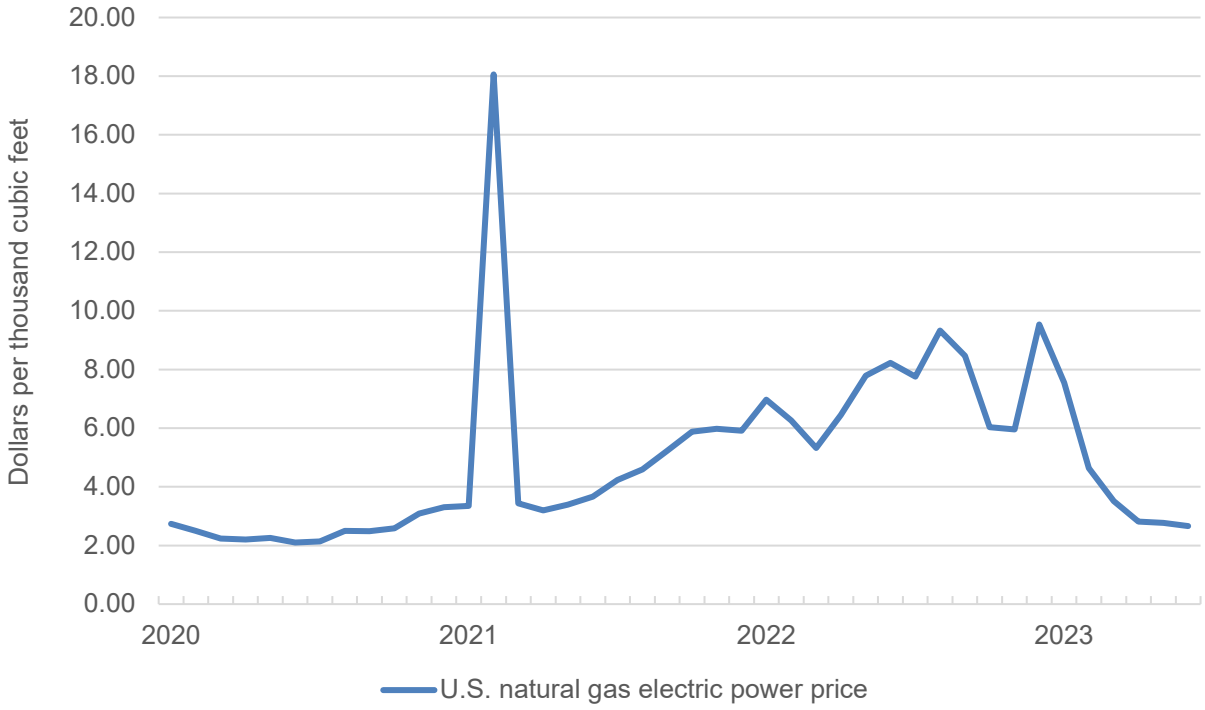
[5] For more on the section 232 investigations, see part I, "Section 232 investigations." For a discussion on how the announcement of the section 301 investigation and subsequent imposition of tariffs impacted the demand for and supply of CSPV products in the U.S. market, see part II.

[6] 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."

Electricity generated from traditional fossil fuel sources still makes up the largest share of the power generated in the United States, and natural gas is the most direct cost-competitive source of power to solar-generated power.

As shown in figure VI-3, the price of natural gas used for electricity generation increased intermittently from $2.74 per thousand cubic feet in January 2020 to $9.53 per thousand cubic feet in December 2022, with a large spike in February 2021 up to $18.06 per thousand cubic feet. In 2023, the price dropped to $2.66 per thousand cubic feet by June of that year.

Figure VI-3
Natural gas prices: U.S. natural gas electric power price, dollars per thousand cubic feet, by month, January 2020-June 2023



Source: U.S. Energy Information Administration, https://www.eia.gov/dnav/ng/ng_pri_sum_dcu_nus_m.htm, October 12, 2023.

When firms were asked if there had been any changes in the price of electricity generated from U.S. conventional energy sources that affected the price of solar-generated electricity since January 1, 2020, most U.S. producers (9 of 12) and importers (22 of 39) reported that there have not, while most purchasers (28 of 38) reported that there have. For the firms reporting in the affirmative, most generally indicated that the combination of lower CSPV module prices along with higher conventional energy prices have increased demand for solar power. Some firms also indicated that inflation and higher interest rates have had an impact on demand for CSPV products.

Changes in lead times

During the original 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.[7] In the current proceeding, when U.S. producers and importers were asked if the average lead time between a customer's order and the date of delivery for their CSPV products had changed since January 1, 2020, most firms reported it had not. However, five of the 11 responding U.S. producers and 19 of 43 responding importers reported that lead times had changed. Most of these firms pointed to supply chain constraints due to the COVID-19 pandemic as a driver of lead time increases, while several others reported that the WRO/UFLPA increased their lead time for imported CSPV products.

Transportation costs to the U.S. market

Transportation costs for CSPV product shipped from all other countries combined to the United States averaged 6.2 percent during 2022. These estimates were derived from official import data and represent the transportation and other charges on imports.[8]

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.[9] In the first monitoring investigation, the large majority of responding firms reported no changes in pricing methods or shares of sales on a contract vs. spot basis since February 7, 2018.[10] In the current proceeding, most U.S. producers (8 of 11) and importers (34 of 43) also reported no changes to how they determine the prices charged for sales of CSPV products since January 1, 2020, and most U.S. producers (10 of 11) and

[7] Safeguard publication, vol. II, p. V-13.

[8] The estimated transportation costs were obtained by subtracting the customs value from the c.i.f. value of the imports for 2022 and then dividing by the customs value based on the HTS statistical reporting numbers 8541.40.6015, 8541.40.6025, 8541.40.6035, 8541.40.6045, 8541.42.0010, 8541.42.0080, 8541.43.0010, and 8541.43.0080, accessed August 11, 2023. Imports are based on the imports for consumption data series.

[9] Safeguard publication, vol. II, p. V-20.

[10] Monitoring 1 publication, p. VI-8.

importers (38 of 42) also reported no changes to the share of their sales of CSPV product sold via a contract vs. spot basis since January 1, 2020.

Regarding discounts, pluralities of U.S. producers and importers in the original safeguard investigation reported not offering any type of discount.[11] In the first monitoring investigation, the large majority of responding firms reported no changes to discount methods since February 7, 2018.[12] In the current proceeding, all responding U.S. producers and most importers (42 of 43) also reported no changes to their discount policies since January 1, 2020.

Price-related factors

U.S. producers, importers, and purchasers were asked whether changes to 17 specific factors have increased, decreased, or had no effect on the price of CSPV products since January 1, 2020, and subsequently to rate the importance of changes in these factors in terms of their contribution to the price of CSPV products.

As shown in tables VI-3, VI-4, and VI-5, in terms of whether changes in these factors have increased, decreased, or had no effect on the price of CSPV products since January 1, 2020, the factors reported by at least half of all three types of firms whose change led to an increase in prices were the following: Cost of raw materials, demand in the United States, Section 201 safeguard measures, and transportation/delivery cost. Responses from U.S. producers, importers and purchasers were mixed with respect to the impact of local, State, and federal government incentives on the price of CSPV products. Most U.S. producers and a plurality of importers reported that changes in the level of competition from imports also increased prices, while a plurality of purchasers reported that it decreased prices. Most purchasers reported that changes in demand outside the United States increased prices. Technology improvements was the only factor whose change was reported by pluralities or co-pluralities of all three firm types to lead to price decreases. The factors reported by at least half of all three types of firms whose change had no effect on prices of CSPV products were the following: allocation of capacity to alternate products; labor agreements, contracts, etc.; and productivity of domestic producers.

[11] Safeguard publication, vol. II, p. V-20.
[12] Monitoring 1 publication, p. VI-8.

Table VI-3
CSPV products: U.S. producers' responses regarding the effect of changes to various purchase factors on prices for CSPV products, by factor

Count in number of firms reporting

Factor	Increased	Decreased	No effect
Competition between U.S. producers	3	4	4
Level of competition from substitute products	1	4	5
Level of competition from imports	7	4	1
Cost of raw materials	10	1	1
Domestic capacity	3	3	5
Allocation of capacity to alternate products	0	0	11
Productivity of domestic producers	3	2	6
Labor agreements, contracts, etc.	3	0	7
Transportation/delivery cost	10	0	1
Market patterns	5	2	4
Demand in the United States	9	2	1
Demand outside the United States	4	2	5
State and local government incentives	4	1	5
Federal government incentives	5	1	4
Prices of conventional energy	4	0	6
Technology improvements	3	4	2
Section 201 Safeguard measures	8	1	3
Other	0	0	1

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

Table VI-4
CSPV products: Importers' responses regarding the effect of changes to various purchase factors on prices for CSPV products, by factor

Count in number of firms reporting

Factor	Increased	Decreased	No effect
Competition between U.S. producers	13	12	17
Level of competition from substitute products	10	13	17
Level of competition from imports	21	18	4
Cost of raw materials	35	5	4
Domestic capacity	12	10	19
Allocation of capacity to alternate products	7	4	30
Productivity of domestic producers	12	8	21
Labor agreements, contracts, etc.	14	1	24
Transportation/delivery cost	37	2	3
Market patterns	18	8	16
Demand in the United States	34	5	5
Demand outside the United States	15	7	18
State and local government incentives	13	10	17
Federal government incentives	16	12	13
Prices of conventional energy	20	2	19
Technology improvements	15	20	7
Section 201 Safeguard measures	32	2	8
Other	1	1	3

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

Table VI-5
CSPV products: Purchasers' responses regarding the effect of changes to various purchase factors on prices for CSPV products, by factor

Count in number of firms reporting

Factor	Increased	Decreased	No effect
Competition between U.S. producers	16	7	25
Level of competition from substitute products	7	5	34
Level of competition from imports	20	20	8
Cost of raw materials	36	8	4
Domestic capacity	19	7	21
Allocation of capacity to alternate products	10	1	35
Productivity of domestic producers	13	6	27
Labor agreements, contracts, etc.	19	1	26
Transportation/delivery cost	42	4	1
Market patterns	28	7	13
Demand in the United States	41	5	2
Demand outside the United States	26	6	16
State and local government incentives	17	7	21
Federal government incentives	24	10	12
Prices of conventional energy	24	5	18
Technology improvements	15	22	9
Section 201 Safeguard measures	33	3	9
Other	2	0	3

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

As shown in tables VI-6, VI-7, and VI-8, responses regarding the importance of these 17 factors were fairly consistent across firm types. At least half of the responding firms of each type (U.S. producers, importers, and purchasers) reported the following factors as "very important:" Cost of raw materials, demand in the United States, federal government incentives, level of competition from imports, Section 201 safeguard measures, technology improvements, and transportation/delivery cost. Majorities of each of the firm types also reported allocation of capacity to alternate products as "not important." The cost of raw materials and demand in the United States were rated as very important factors by the largest number of firms for each firm type.

Table VI-6
CSPV products: U.S. producers' responses regarding the importance of various purchase factors, by factor

Count in number of firms reporting

Factor	Very important	Somewhat important	Not important
Competition between U.S. producers	3	4	3
Level of competition from substitute products	1	5	4
Level of competition from imports	9	3	0
Cost of raw materials	11	1	0
Domestic capacity	3	6	3
Allocation of capacity to alternate products	0	1	10
Productivity of domestic producers	3	6	2
Labor agreements, contracts, etc.	1	5	4
Transportation/delivery cost	6	3	1
Market patterns	5	4	2
Demand in the United States	10	2	0
Demand outside the United States	2	6	3
State and local government incentives	5	4	1
Federal government incentives	7	3	0
Prices of conventional energy	3	3	4
Technology improvements	7	3	0
Section 201 Safeguard measures	6	6	0
Other	0	0	1

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

Table VI-7
CSPV products: Importers' responses regarding the importance of various purchase factors, by factor

Count in number of firms reporting

Factor	Very important	Somewhat important	Not important
Competition between U.S. producers	12	13	15
Level of competition from substitute products	4	23	12
Level of competition from imports	28	12	3
Cost of raw materials	32	8	3
Domestic capacity	13	19	10
Allocation of capacity to alternate products	2	13	26
Productivity of domestic producers	6	22	13
Labor agreements, contracts, etc.	7	14	18
Transportation/delivery cost	27	10	3
Market patterns	20	14	7
Demand in the United States	36	5	2
Demand outside the United States	10	13	16
State and local government incentives	17	15	8
Federal government incentives	21	13	6
Prices of conventional energy	12	15	12
Technology improvements	21	15	4
Section 201 Safeguard measures	24	14	5
Other	2	1	4

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

Table VI-8
CSPV products: Purchasers' responses regarding the importance of various purchase factors, by factor

Count in number of firms reporting

Factor	Very important	Somewhat important	Not important
Competition between U.S. producers	18	10	20
Level of competition from substitute products	7	20	20
Level of competition from imports	37	6	4
Cost of raw materials	40	4	3
Domestic capacity	23	14	12
Allocation of capacity to alternate products	5	14	28
Productivity of domestic producers	17	17	13
Labor agreements, contracts, etc.	9	22	18
Transportation/delivery cost	30	17	0
Market patterns	28	14	5
Demand in the United States	42	5	0
Demand outside the United States	21	15	11
State and local government incentives	18	20	8
Federal government incentives	35	7	4
Prices of conventional energy	16	20	10
Technology improvements	24	20	3
Section 201 Safeguard measures	27	13	6
Other	2	0	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 2020-June 2023.[13]

Product 1.--Monocrystalline silicon module with front-side area of less than 2.0 square meters and a peak power wattage between 350w and 375w, inclusive, P-max or Wp as measured under Standard Test Conditions ("STC"), excluding bifacial modules.

Product 2.--Monocrystalline silicon module with front-side area of less than 2.0 square meters and a peak power wattage between 380w and 415w, inclusive, P-max or Wp as measured under STC, excluding bifacial modules.

Product 3.--Monocrystalline silicon module with front-side area of greater than or equal to 2.0 square meters and a peak power wattage between 350w and 415w, inclusive, P-max or Wp as measured under STC, excluding bifacial modules.

Product 4.--Monocrystalline silicon module with front-side area of greater than or equal to 2.0 square meters and a peak power wattage between 420w and 500w, inclusive, P-max or Wp as measured under STC, excluding bifacial modules.

Product 5.--Monocrystalline silicon module with front-side area of greater than or equal to 2.0 square meters and a peak power wattage greater than or equal to 505w, inclusive, P-max or Wp as measured under STC, excluding bifacial modules.

Product 6.--Monocrystalline silicon bifacial module that generates power on both sides of the panel with front-side area of greater than or equal to 2.0 square meters and a peak power wattage greater than or equal to 350w, inclusive, P-max or Wp as measured under STC).

[13] These pricing products differ from those for which data were collected in the original safeguard investigation, the first monitoring investigation, and the extension investigation. For the current proceeding, staff removed all multicrystalline products and increased the products' surface areas in order to more accurately reflect the current technology more widely used in the industry.

Eight U.S. producers and 23 importers provided usable pricing data for sales of the requested products, although not all firms reported pricing in all quarters for all pricing products or product types.[14] [15] Pricing data reported by these firms accounted for approximately *** percent of U.S. producers' U.S. shipments of CSPV modules and *** percent of U.S. imports of CSPV modules from all import sources combined in 2022.[16] [17]

Price data for products 1-6 are presented in tables VI-9 to VI-14 and figures VI-4 to VI-9.

[14] 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.

[15] Some firms reported pricing data that were inconsistent with the pricing product definitions and/or for product not believed to be competitive with the pricing products as defined. For example, ***. Accordingly, these and other such non-conforming and/or aberrant data have been removed from this analysis. Additionally, since the pricing sections of the U.S. producer and importer questionnaires only allow firms to report quantities in units of one or more kilowatt, some firms' responses were automatically rounded either up or down to "1," which may in some instances skew the average unit values in ways that do not reflect the same firm's average unit values reported in other quarters with larger reported quantities. Several such data points have also been removed from this analysis. Finally, staff requested amendments from several firms that did not respond to requests for revised data. In such cases, staff has amended or deleted the non-conforming data.

[16] Importers were asked for aggregated average prices for all import sources combined. The Commission did not collect individual country pricing data for imports.

[17] ***. See Extension publication, p. VII-6. Similarly, ***. Accordingly, these pricing data have been included in this analysis. See EDIS doc. nos. 805485 and 805487.

Table VI-9
CSPV modules: Weighted-average f.o.b. prices and quantities of domestic and imported product 1, by quarter, January 2020-June 2023

Price in dollars per kilowatt, quantity in kilowatts

Period	U.S. price	U.S. quantity	All import sources price	All import sources quantity
2020 Q1	***	***	***	***
2020 Q2	***	***	***	***
2020 Q3	***	***	***	***
2020 Q4	***	***	***	***
2021 Q1	***	***	***	***
2021 Q2	***	***	***	***
2021 Q3	***	***	***	***
2021 Q4	***	***	***	***
2022 Q1	***	***	***	***
2022 Q2	***	***	***	***
2022 Q3	***	***	***	***
2022 Q4	***	***	***	***
2023 Q1	***	***	***	***
2023 Q2	***	***	***	***

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

Note: Product 1: Monocrystalline silicon module with front-side area of less than 2.0 square meters and a peak power wattage between 350w and 375w, inclusive, P-max or Wp as measured under Standard Test Conditions (“STC”), excluding bifacial modules.

Table VI-10
CSPV modules: Weighted-average f.o.b. prices and quantities of domestic and imported product 2, by quarter, January 2020-June 2023

Price in dollars per kilowatt, quantity in kilowatts

Period	U.S. price	U.S. quantity	All import sources price	All import sources quantity
2020 Q1	***	***	***	***
2020 Q2	***	***	***	***
2020 Q3	***	***	***	***
2020 Q4	***	***	***	***
2021 Q1	***	***	***	***
2021 Q2	***	***	***	***
2021 Q3	***	***	***	***
2021 Q4	***	***	***	***
2022 Q1	***	***	***	***
2022 Q2	***	***	***	***
2022 Q3	***	***	***	***
2022 Q4	***	***	***	***
2023 Q1	***	***	***	***
2023 Q2	***	***	***	***

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

Note: Product 2: Monocrystalline silicon module with front-side area of less than 2.0 square meters and a peak power wattage between 380w and 415w, inclusive, P-max or Wp as measured under STC, excluding bifacial modules.

Table VI-11
CSPV modules: Weighted-average f.o.b. prices and quantities of domestic and imported product 3, by quarter, January 2020-June 2023

Price in dollars per kilowatt, quantity in kilowatts

Period	U.S. price	U.S. quantity	All import sources price	All import sources quantity
2020 Q1	***	***	***	***
2020 Q2	***	***	***	***
2020 Q3	***	***	***	***
2020 Q4	***	***	***	***
2021 Q1	***	***	***	***
2021 Q2	***	***	***	***
2021 Q3	***	***	***	***
2021 Q4	***	***	***	***
2022 Q1	***	***	***	***
2022 Q2	***	***	***	***
2022 Q3	***	***	***	***
2022 Q4	***	***	***	***
2023 Q1	***	***	***	***
2023 Q2	***	***	***	***

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

Note: Product 3: Monocrystalline silicon module with front-side area of greater than or equal to 2.0 square meters and a peak power wattage between 350w and 415w, inclusive, P-max or Wp as measured under STC, excluding bifacial modules.

Table VI-12
CSPV modules: Weighted-average f.o.b. prices and quantities of domestic and imported product 4, by quarter, January 2020-June 2023

Price in dollars per kilowatt, quantity in kilowatts

Period	U.S. price	U.S. quantity	All import sources price	All import sources quantity
2020 Q1	***	***	***	***
2020 Q2	***	***	***	***
2020 Q3	***	***	***	***
2020 Q4	***	***	***	***
2021 Q1	***	***	***	***
2021 Q2	***	***	***	***
2021 Q3	***	***	***	***
2021 Q4	***	***	***	***
2022 Q1	***	***	***	***
2022 Q2	***	***	***	***
2022 Q3	***	***	***	***
2022 Q4	***	***	***	***
2023 Q1	***	***	***	***
2023 Q2	***	***	***	***

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

Note: Product 4: Monocrystalline silicon module with front-side area of greater than or equal to 2.0 square meters and a peak power wattage between 420w and 500w, inclusive, P-max or Wp as measured under STC, excluding bifacial modules.

Table VI-13
CSPV modules: Weighted-average f.o.b. prices and quantities of domestic and imported product 5, by quarter, January 2020-June 2023

Price in dollars per kilowatt, quantity in kilowatts

Period	U.S. price	U.S. quantity	All import sources price	All import sources quantity
2020 Q1	***	***	***	***
2020 Q2	***	***	***	***
2020 Q3	***	***	***	***
2020 Q4	***	***	***	***
2021 Q1	***	***	***	***
2021 Q2	***	***	***	***
2021 Q3	***	***	***	***
2021 Q4	***	***	***	***
2022 Q1	***	***	***	***
2022 Q2	***	***	***	***
2022 Q3	***	***	***	***
2022 Q4	***	***	***	***
2023 Q1	***	***	***	***
2023 Q2	***	***	***	***

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

Note: Product 5: Monocrystalline silicon module with front-side area of greater than or equal to 2.0 square meters and a peak power wattage greater than or equal to 505w, inclusive, P-max or Wp as measured under STC, excluding bifacial modules.

Table VI-14
CSPV modules: Weighted-average f.o.b. prices and quantities of domestic and imported product 6, by quarter, January 2020-June 2023

Price in dollars per kilowatt, quantity in kilowatts

Period	U.S. price	U.S. quantity	All import sources price	All import sources quantity
2020 Q1	***	***	***	***
2020 Q2	***	***	***	***
2020 Q3	***	***	***	***
2020 Q4	***	***	***	***
2021 Q1	***	***	***	***
2021 Q2	***	***	***	***
2021 Q3	***	***	***	***
2021 Q4	***	***	***	***
2022 Q1	***	***	***	***
2022 Q2	***	***	***	***
2022 Q3	***	***	***	***
2022 Q4	***	***	***	***
2023 Q1	***	***	***	***
2023 Q2	***	***	***	***

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

Note: Product 6: Monocrystalline silicon bifacial module that generates power on both sides of the panel with front-side area of greater than or equal to 2.0 square meters and a peak power wattage greater than or equal to 350w, inclusive, P-max or Wp as measured under STC).

Figure VI-4
CSPV modules: Weighted-average f.o.b. prices and quantities of domestic and imported product 1, by quarter, January 2020-June 2023

* * * * * * *

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

Note: Product 1: Monocrystalline silicon module with front-side area of less than 2.0 square meters and a peak power wattage between 350w and 375w, inclusive, P-max or Wp as measured under Standard Test Conditions (“STC”), excluding bifacial modules.

Figure VI-5
CSPV modules: Weighted-average f.o.b. prices and quantities of domestic and imported product 2, by quarter, January 2020-June 2023

* * * * * * *

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

Note: Product 2: Monocrystalline silicon module with front-side area of less than 2.0 square meters and a peak power wattage between 380w and 415w, inclusive, P-max or Wp as measured under STC, excluding bifacial modules.

Figure VI-6
CSPV modules: Weighted-average f.o.b. prices and quantities of domestic and imported product 3, by quarter, January 2020-June 2023

* * * * * * *

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

Note: Product 3: Monocrystalline silicon module with front-side area of greater than or equal to 2.0 square meters and a peak power wattage between 350w and 415w, inclusive, P-max or Wp as measured under STC, excluding bifacial modules.

Figure VI-7
CSPV modules: Weighted-average f.o.b. prices and quantities of domestic and imported product 4, by quarter, January 2020-June 2023

* * * * * * *

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

Note: Product 4: Monocrystalline silicon module with front-side area of greater than or equal to 2.0 square meters and a peak power wattage between 420w and 500w, inclusive, P-max or Wp as measured under STC, excluding bifacial modules.

Figure VI-8
CSPV modules: Weighted-average f.o.b. prices and quantities of domestic and imported product 5, by quarter, January 2020-June 2023

* * * * * * *

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

Note: Product 5: Monocrystalline silicon module with front-side area of greater than or equal to 2.0 square meters and a peak power wattage greater than or equal to 505w, inclusive, P-max or Wp as measured under STC, excluding bifacial modules.

Figure VI-9
CSPV modules: Weighted-average f.o.b. prices and quantities of domestic and imported product 6, by quarter, January 2020-June 2023

* * * * * * *

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

Note: Product 6: Monocrystalline silicon bifacial module that generates power on both sides of the panel with front-side area of greater than or equal to 2.0 square meters and a peak power wattage greater than or equal to 350w, inclusive, P-max or Wp as measured under STC).

Price trends

As shown in figure VI-10, price data from PV Insights indicated that prices between January 2020 and June 2023 decreased for all product types. These price decreases were even more pronounced for modules using newer technology and larger wafers/cells. The data also show prices converging among all module types.

Figure VI-10
Module prices: Average prices for monocrystalline modules, by month, January 2020-October 2023

* * * * * * *

Source: *PVInsights*, Spot Price Download, http://pvinsights.com/, accessed October 13, 2023.

Note: Data for 182mm mono PERC modules became available beginning in July 2020.

According to data received in questionnaire responses, prices showed a mix of increases and decreases. Table VI-15 summarizes the price trends, by product and by source. Data for both the first quarter of 2020 and second quarter of 2023 were only available for three of the six pricing products for domestic producers and five of the six pricing products for imports. As shown in the table, domestic prices decreased for two of the three pricing products by *** and *** percent and increased for the third pricing product by *** percent during January 2020-June 2023. Import prices decreased for two of the five products by *** and *** percent and increased for the other three products by between *** and *** percent during this time.

Table VI-15
CSPV modules: Summary of weighted-average f.o.b. prices, by product and source, first quarter of 2020 to the second quarter of 2023

Prices in dollars per kilowatt; quantity in kilowatts; change in percent

Product	Source	Number of quarters	Quantity	Low price	High price	First quarter price	Last quarter price	Change over period
Product 1	United States	***	***	***	***	***	***	***
Product 1	All import sources	***	***	***	***	***	***	***
Product 2	United States	***	***	***	***	***	***	***
Product 2	All import sources	***	***	***	***	***	***	***
Product 3	United States	***	***	***	***	***	***	***
Product 3	All import sources	***	***	***	***	***	***	***
Product 4	United States	***	***	***	***	***	***	***
Product 4	All import sources	***	***	***	***	***	***	***
Product 5	United States	***	***	***	***	***	***	***
Product 5	All import sources	***	***	***	***	***	***	***
Product 6	United States	***	***	***	***	***	***	***
Product 6	All import sources	***	***	***	***	***	***	***

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

Note: Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent. Percent change is the change from the first quarter to the last quarter of the data collection 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. In the first monitoring investigation, prices for all of the pricing products for which first and last quarter data were available decreased between 39.3 and 54.2 percent for domestic-origin CSPV products and between 8.4 and 53.3 percent for imported CSPV products between January 2016 and June 2019. In the extension investigation, prices for all of the pricing products for which first and last quarter data were available decreased between *** and *** percent for domestic-origin CSPV products and between *** and *** percent for imported CSPV products between January 2018 and June 2021.

As shown in figure VI-11, prices submitted by firms showed similar trends to prices collected from PV Insights, with a mix of increases and decreases throughout the investigation period. In broad terms, prices initially decreased between the beginning of 2020 and mid-2021, then increased through the end of 2022/beginning of 2023, then decreased thereafter.

Figure VI-11
CSPV modules: Indexed U.S. producer and importer prices, by quarter, January 2020-June 2023

* * * * * * *

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

Price comparisons

As shown in table VI-16, prices for imported CSPV modules were lower than prices for U.S.-produced modules in 45 of 62 quarterly instances for a total of 5.0 million kW (5.0 GW). In the remaining 17 instances, prices for imported CSPV modules were higher than prices for U.S.-produced modules for a total of 1.4 million kW (1.4 GW).

Table VI-16
CSPV modules: Instances of foreign-origin module prices below and above U.S.-origin module prices, by product, January 2020-June 2023

Quantity in kilowatts

Product	Type	Number of quarters	Quantity
Product 1	Imports lower than domestic	***	***
Product 2	Imports lower than domestic	***	***
Product 3	Imports lower than domestic	***	***
Product 4	Imports lower than domestic	***	***
Product 5	Imports lower than domestic	***	***
Product 6	Imports lower than domestic	***	***
All products	Imports lower than domestic	45	4,970,351
Product 1	Imports higher than domestic	***	***
Product 2	Imports higher than domestic	***	***
Product 3	Imports higher than domestic	***	***
Product 4	Imports higher than domestic	***	***
Product 5	Imports higher than domestic	***	***
Product 6	Imports higher than domestic	***	***
All products	Imports higher than domestic	17	1,397,169

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

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 (***).

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 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.*

[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 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 *** 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 13 responding firms, 12 reported that they had not done so. The remaining firm, SunPower, provided a commentary in their response to the Commission's questionnaire on the implementation of their adjustment plans (table VII-2).

Table VII-1
CSPV products: Count of U.S. producers' response on submitted adjustment plans

Item	Don't know	No	Yes
Submitted adjustment plans	0	12	1

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

Table VII-2
CSPV products: U.S. producers' adjustment plan narratives

Firm	Narrative on adjustment plans
SunPower	***

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 were 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 cells as required under Section 224 found the following:

1. The DOL received TAA petitions for 20 worker groups involved in the production of CSPV since January 2012.[4] 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.

On July 1, 2022, absent the enactment of legislation that reauthorizes the TAA program, DOL was required to cease making determinations on petitions immediately and has been unable to certify new workers or serve workers separated after this date.[5]

[3] 82 FR 57617, December 6, 2017.

[4] Data on TAA Petitions and Determinations, U.S. Department of Labor, https://www.dol.gov/agencies/eta/tradeact/petitioners/petitions, retrieved on October 29, 2023.

[5] Statement By Secretary Walsh on Termination Of Trade Adjustment Assistance For Workers Program, https://www.dol.gov/newsroom/releases/osec/osec20220701#:~:text=The%20termination%20provisions%20under%20Section,to%20amend%20previously%20certified%20petitions, retrieved on October 29, 2023.

Significance of relief

U.S. producers were asked to describe the significance of the safeguard measure in terms of the measure's effect on several aspects of their firm's operations.[6] ***, ***, and *** did not provide any responses for this question. Responding firms reported the safeguard measures had ***.

Table VII-3
CSPV products: U.S. producers' reported significance of the safeguard measures, by impact type

Impact type	Firm name and narrative on significance of safeguard measures
Trade data impact	***
Trade data impact	***
Trade data impact	***
Trade data impact	***
Trade data impact	***
Trade data impact	***
Trade data impact	***
Trade data impact	***
Trade data impact	***
Trade data impact	***

[6] These aspects include: 1) Production capacity, production, shipments, inventories, and employment ("Trade data impact"); 2) 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 ("Return on investment"); and 3) Changes in firm's collective bargaining agreements ("Labor negotiations").

Impact type	Firm name and narrative on significance of safeguard measures
Return on investment	***
Return on investment	***
Return on investment	***
Return on investment	***
Return on investment	***
Return on investment	***
Return on investment	***
Return on investment	***
Return on investment	***

Impact type	Firm name and narrative on significance of safeguard measures
Collective bargaining agreements	***
Collective bargaining agreements	***
Collective bargaining agreements	***
Collective bargaining agreements	***
Collective bargaining agreements	***
Collective bargaining agreements	***
Collective bargaining agreements	***
Collective bargaining agreements	***

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

U.S. producers were also asked to indicate their position on the safeguard measures (see "U.S. market participants" in part I) regarding CSPV cells and CSPV modules separately, and to provide an explanation of their position. Nine firms provided explanations regarding their position on the safeguard measures for CSPV cells. Their explanations are shown in table VII-4.

Table VII-4
CSPV cells: U.S. producers' narratives on their position on the safeguard measures

Firm	Narrative on their position on the safeguard measures for CSPV cells
***	***
***	***
***	***
***	***
***	***
***	***
***	***
***	***
***	***

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

Eight firms provided explanations regarding their position on the safeguard measures for CSPV modules. Their explanations are shown in table VII-5.

Table VII-5
CSPV modules: U.S. producers' narratives on their position on the safeguard measures

Firm	Narrative on their position on the safeguard measures for CSPV modules
***	***
***	***
***	***
***	***
***	***
***	***
***	***
***	***

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-6.

Table VII-6
CSPV products: U.S. importers' reported significance of the safeguard measures

Firm	Narrative on their position on safeguard measures for CSPV products
***	***
***	***
***	***
***	***
***	***

Firm	Narrative on their position on safeguard measures for CSPV products
***	***
***	***
***	***
***	***

Firm	Narrative on their position on safeguard measures for CSPV products
***	***

Firm	Narrative on their position on safeguard measures for CSPV products
***	***
***	***
***	***
***	***
***	***
***	***
***	***

Firm	Narrative on their position on safeguard measures for CSPV products
***	***
***	***
***	***
***	***
***	***
***	***
***	***
***	***
***	***
***	***

Firm	Narrative on their position on safeguard measures for CSPV products
***	***
***	***
***	***
***	***
***	***
***	***
***	***
***	***
***	***
***	***
***	***

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

U.S. producers were asked to indicate whether their domestic CSPV product operations have been negatively or positively impacted by the exclusion of bifacial CSPV products from the measures since January 1, 2020. Responses provided are shown in tables VII-7 and VII-8.

Table VII-7
CSPV modules: Count of U.S. producers' responses regarding overall effectiveness of measures with bifacial exclusions

Count in number of firms reporting

Item	Not applicable or no impact	Positive impact	Negative impact
Effectiveness of measures with bifacial exclusions	6	1	6

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

Table VII-8
CSPV modules: U.S. producers' narrative responses on the impact of bifacial exclusions on their operations

Firm	Narrative on impact of bifacial exclusions
***	***
***	***
***	***
***	***
***	***

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. Responses provided by U.S. producers are presented in table VII-9.

Table VII-9
CSPV modules: U.S. producers' narratives on their efforts to compete, since February 7, 2018.

Firm	Yes	Narrative on efforts to compete
Auxin	***	***
GAF Energy	***	***
Hanwha	***	***
Heliene	***	***
Jinko	***	***
LG	***	***

Firm	Yes	Narrative on efforts to compete
Merlin	***	***
Mission	***	***
Panasonic	***	***
PowerFilm	***	***
Silfab	***	***
SunPower	***	***
Tesla	***	***

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

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 January 1, 2020, including introducing new or innovative products, improving product quality, expanding marketing efforts (including e-commerce), and/or improving customer service. As shown in table VII-10, for each measure a majority of responding purchasers reported that U.S. producers have not taken the specified steps to adjust to import competition.

Table VII-10
CSPV products: Count of purchasers' responses regarding producer actions taken to adjust to import competition since January 1, 2020

Action taken	No	Yes
Introduction of new or innovative products	***	***
Improved product quality	***	***
Expansion of marketing efforts, including e-commerce	***	***
Improvements in customer service	***	***
Other efforts	***	***

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

Comments on the effectiveness of the safeguard measure

Canadian Solar USA, Heliene, and Silfab

Canadian Solar USA, Heliene, and Silfab (which refer to themselves as the "U.S.-Canadian producers") contend that the TRQ on imports of CSPV cells, in tandem with section 301 duties on other inputs, is harming the U.S. solar industry. They state that U.S. CSPV module capacity could increase by 53 GW before the end of the safeguard measure whereas U.S. CSPV cell capacity will likely only reach 28 GW at a maximum by the same time period.[7] To make up for the estimated differences in module and cell capacity, the U.S.-Canadian producers argue that the TRQ on cells should be removed or increased to at least 20 GW, otherwise U.S. module assemblers will be forced to incur costly tariffs on cell imports.[8] They also advocate for removal of the section 301 duties on machinery and inputs needed for the manufacture of solar products in the United States, many of which, they argue, are available only from China.[9]

[7] U.S.-Canadian producers' posthearing brief, pp. 2-3.
[8] U.S.-Canadian producers' posthearing brief, pp. 4-5.
[9] U.S.-Canadian producers' posthearing brief, pp. 5-7

First Solar

First Solar contends that the safeguard measure has had a positive effect on the U.S. CSPV module industry, but that global overcapacity and the exclusion of bifacial modules have undermined the effectiveness of the safeguard remedy.[10] It states that Chinese and Chinese-owned CSPV producers are largely contributing to excess capacity for CSPV products globally and have exported large volumes of bifacial products to the United States. According to First Solar, these imports of bifacial modules have effectively displaced non-bifacial imports in the U.S. market as ***.[11] First Solar advocates for revocation of the exclusion for bifacial modules.[12]

First Solar also asserts that increasing the TRQ on CSPV cells from 5 GW to 50 GW, or eliminating the TRQ entirely, would undermine the safeguard remedy's effectiveness. It states that an increase in the TRQ would harm the domestic CSPV cell industry's efforts to adjust to import competition while U.S. module producers would be negatively impacted by the increase in low-priced imports of CSPV cells, as declining raw materials prices are already contributing to price declines for modules in the United States. In addition, First Solar states that the projected increases in U.S. CSPV module capacity are premised on announced investments which are subject to delays and ramping up of production beyond the final two years of the safeguard remedy.[13]

Hanwha Q Cells

Hanwha contends that the safeguard measure has helped domestic CSPV module producers make progress towards economic recovery, including investments in new production capacity.[14] It also argues that the safeguard measure has led to investments in other parts of the supply chain for modules.[15] However, it states that the bifacial exclusion and section 301 duties on imports of module inputs, including equipment, are obstacles that have prevented them from fully enjoying the remedy's benefits. It states that the increase in imports of bifacial modules has contributed to declines in module prices and U.S. module assemblers' share of the

[10] First Solar's posthearing brief, p. 1.
[11] First Solar's posthearing brief, pp. 4-6.
[12] First Solar's posthearing brief, pp. 7-8.
[13] First Solar's posthearing brief, p. 2.
[14] Hanwha Q Cells's prehearing brief, pp. 17-19.
[15] Hanwha Q Cells's prehearing brief, pp. 25-27.

U.S. market despite increased apparent U.S. consumption.[16] Hanwha also points to global overcapacity for CSPV modules.[17] It further argues that importers are again stockpiling CSPV products, especially from Southeast Asia, due to the moratorium on AD/CVD duties that would otherwise be imposed due to circumvention of the orders on China.[18]

Hanwha also argues the TRQ on CSPV cells should either be removed or increased due to the expected expansion in U.S. module capacity following passage of the IRA, which it argues will continue to be a gap between domestic module and cell production, and the likelihood that a substantial amount of new domestic cell production will be for module producers' own internal consumption.[19] It states that it alone will require over 5 GW in imports of CSPV cells just to meet its expected production needs next year.[20] Hanwha also argues that the TRQ on cells has no impact on domestic producers' decisions to build new cell facilities and that all such decisions will be driven by the IRA rather than the TRQ. It states the IRA, together with the safeguard on modules, provides a strong incentive for cell manufacturing to take place in the U.S. and that investments in cell production in the U.S. are being undertaken by the same solar companies that are investing in module production.[21]

SEIA

SEIA argues that the domestic industry is making a positive adjustment to import competition,[22] but that the TRQ on CSPV cells is counterproductive and should be eliminated or increased.[23] It states that U.S. module assemblers' capacity is expected to increase by almost 70 GW by 2025 and they will rely primarily on imports of CSPV cells due to projected limited availability of U.S. CSPV cells during the same time period. SEIA notes that CSPV cells are the largest raw material cost for module production and argues the TRQ will have a detrimental effect on the U.S. industry by taxing a key input of U.S. module production.[24] SEIA also argues that the bifacial exclusion has not significantly undermined the effectiveness of the relief.[25]

[16] Hanwha Q Cells's posthearing brief, pp. 2-4.
[17] Hanwha Q Cells's posthearing brief, pp. 4-5.
[18] Hanwha Q Cells's prehearing brief, pp. 54-57.
[19] Hanwha Q Cells's prehearing brief, pp. 61-66, Hanwha Q Cells's posthearing brief, pp. 8-9.
[20] Hanwha Q Cells's posthearing brief, p. 8.
[21] Hanwha Q Cells's posthearing brief, p. 11.
[22] SEIA's posthearing brief, p. 11.
[23] SEIA's prehearing brief, p. 1.
[24] SEIA's prehearing brief, pp. 6-7.
[25] SEIA's posthearing brief, pp. 8-11.

Suniva

Suniva contends that the safeguard measure has had a positive effect on the U.S. CSPV module industry and is reflected in U.S. module assemblers' increased capacity, production, and other economic indicators between 2020 and 2022, as well as several companies' announced plans to begin construction of new facilities in the United States, including for cell production.[26] It states, however, that the TRQ for CSPV cells, which it states did not provide any meaningful tariff relief, and the exclusion of bifacial modules from the safeguard measure have limited the benefits of the intended relief, particularly for cell producers.[27] It also states that the safeguard should no longer apply to Cambodia as a beneficiary developing country.[28]

Suniva argues that any further increases to the TRQ on CSPV cells would not be in the interest of the domestic solar industry. It states that the existing TRQ would be sufficient to provide domestic module assemblers with more duty-free cells than they need, even if module production *** in 2023.[29] Suniva also states that the IRA tax credits provide a greater benefit to module producers than to cell producers, despite the greater costs associated with cell producing facilities compared to module producing facilities, and that increasing the TRQ threshold would further prioritize module assembly at the expense of U.S. cell production.[30]

[26] Suniva's posthearing brief, pp. 1, 3-4.
[27] Suniva's posthearing brief, p. 1.
[28] Suniva's posthearing brief, pp. 1, 14-15.
[29] Suniva's posthearing brief, p. 9.
[30] Suniva's posthearing brief, pp. 10-11.

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 and Commerce during the current proceeding.

Citation	Title	Link
88 FR 38892, June 14, 2023	Crystalline Silicon Photovoltaic Cells, Whether or Not Partially or Fully Assembled Into Other Products: Monitoring Developments in the Domestic Industry	https://www.govinfo.gov/content/pkg/FR-2023-06-14/pdf/2023-12685.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

Inv. No.: TA-201-075 (Second Monitoring)

Date and Time: November 14, 2023 - 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.

OPENING REMARKS:

Panel 1 (**Diana Dimitriuc-Quaia**, ArentFox Schiff LLP *and*
Christopher T. Cloutier, Schagrin Associates

Panel 2 (**Jonathan T. Stoel**, Hogan Lovells US LLP *and*
Matthew R. Nicely, Akin Gump Strauss Hauer & Feld, LLP)

Panel 1:

ArentFox Schiff LLP
Washington, DC
on behalf of

Hanwha Q CELLS USA, Inc. ("Hanwha Q CELLS")

Harold J. Connolly, Vice President/Head of Public Policy and Government Relations, Hanwha Q CELLS USA, Inc.

Scott Moskowitz, Director of Strategy and Market Intelligence, Hanwha Q CELLS USA, Inc.

John Kao, General Counsel, Hanwha Q CELLS USA, Inc.

A Reum Kim, Senior Counsel, Hanwha Q CELLS USA, Inc.

Panel 1 (continued):

Michael Kerwin, Director, Georgetown Economic Services

John M. Gurley)
Diana Dimitriuc-Quaia)
Jessica R. DiPietro) – OF COUNSEL
Yun Gao)
Mario A. Torrico)

Schagrin Associates
Washington, DC
on behalf of

Suniva, Inc. ("Suniva")

Matt Card, President, Suniva

Christopher T. Cloutier) – OF COUNSEL

Panel 2:

Hogan Lovells US LLP
Washington, DC
on behalf of

Canadian Solar US Module Manufacturing Corporation
Canadian Solar (USA) Inc.
Heliene USA Inc. and Heliene Inc.

Martin Pochtaruk, President and CEO, Heliene USA Inc.

Thomas Koerner, President, Americas, Canadian Solar (USA) Inc.

Christophe King, Senior Director, Global Sales Program Management, Canadian Solar (USA) Inc.

Jonathan T. Stoel)
) – OF COUNSEL
Michael G. Jacobson)

Panel 2 (continued):

Akin Gump Strauss Hauer & Feld, LLP
Washington, DC
on behalf of

Solar Energy Industries Association ("SEIA")

Abigail Ross Hopper (remote witness), President and Chief Executive Officer, SEIA

George Hershman (remote witness), President, SOLV Energy

(remote witness) Matthew R. Nicely)
Julia K. Eppard) – OF COUNSEL
Daniel M. Witkowski)

REBUTTAL/CLOSING REMARKS:

Panel 1 (**John M. Gurley**, ArentFox Schiff LLP *and*
Christopher T. Cloutier, Schagrin Associates)

Panel 2 (**Jonathan T. Stoel**, Hogan Lovells US LLP *and*
Matthew R. Nicely, Akin Gump Strauss Hauer & Feld, LLP)

-END-

APPENDIX C

SUMMARY DATA

CSPV cells

Table C-1
CSPV cells: Summary data concerning the U.S. market, by item and by period

Quantity=kilowatts; Value=1,000 dollars; Unit values=dollars per kilowatt; Period changes=percent--exceptions noted

Item	Reported data: Calendar year 2020	Reported data: Calendar year 2021	Reported data: Calendar year 2022	Reported data: Jan-Jun 2022	Reported data: Jan-Jun 2023	Period changes: Comparison years 2020-22	Period changes: Comparison years 2020-21	Period changes: Comparison years 2021-22	Period changes: Jan-Jun 2022-23
U.S. consumption quantity:									
Amount	2,138,882	2,675,156	2,499,320	1,252,697	1,346,074	▲16.9	▲25.1	▼(6.6)	▲7.5
Producers' share (fn1)	---	---	---	---	---	---	---	---	---
Importers' share (fn1):									
Bifacial cells	***	23.2	88.9	82.1	99.7	▲***	▲***	▲65.7	▲17.6
Non-bifacial cells	***	76.8	11.1	17.9	0.3	▼***	▼***	▼(65.7)	▼(17.6)
All CSPV cells	100.0	100.0	100.0	100.0	100.0	---	---	---	---
U.S. consumption value:									
Amount	464,924	562,505	675,156	285,534	305,659	▲45.2	▲21.0	▲20.0	▲7.0
Producers' share (fn1)	---	---	---	---	---	---	---	---	---
Importers' share (fn1):									
Bifacial cells	***	21.4	88.4	77.0	99.6	▲***	▲***	▲67.0	▲22.6
Non-bifacial cells	***	78.6	11.6	23.0	0.4	▼***	▼***	▼(67.0)	▼(22.6)
All CSPV cells	100.0	100.0	100.0	100.0	100.0	---	---	---	---
U.S. importers' U.S. shipments of:									
Bifacial cells:									
Quantity	***	619,951	2,221,967	1,028,218	1,341,774	▲***	▲***	▲258.4	▲30.5
Value	***	120,238	596,988	219,910	304,411	▲***	▲***	▲396.5	▲38.4
Unit value	***	$194	$269	$214	$227	▲***	▲***	▲38.5	▲6.1
Ending inventory quantity	***	***	***	***	***	▲***	▲***	▲***	▲***
Non-bifacial cells:									
Quantity	***	2,055,205	277,353	224,479	4,300	▼***	▲***	▼(86.5)	▼(98.1)
Value	***	442,267	78,168	65,624	1,248	▼***	▲***	▼(82.3)	▼(98.1)
Unit value	***	$215	$282	$292	$290	▲***	▼***	▲31.0	▼(0.7)
Ending inventory quantity	***	***	***	***	***	▼***	▼***	▼***	▼***
All CSPV cells:									
Quantity	2,138,882	2,675,156	2,499,320	1,252,697	1,346,074	▲16.9	▲25.1	▼(6.6)	▲7.5
Value	464,924	562,505	675,156	285,534	305,659	▲45.2	▲21.0	▲20.0	▲7.0
Unit value	$217	$210	$270	$228	$227	▲24.3	▼(3.3)	▲28.5	▼(0.4)
Ending inventory quantity	126,771	278,986	209,929	144,732	225,451	▲65.6	▲120.1	▼(24.8)	▲55.8

Source: Compiled from data submitted in response to Commission questionnaires. 508-compliant tables containing these data are contained in parts III, IV, and V of this report.

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. There was one producer of CSPV cells that exported 100% of its production still operating in 2020 (***) as it was exiting the industry. For information on these operations see Office of Investigation, memorandum INV-TT-131: Investigation No. TA-201-075 (Extension): Crystalline Silicon Photovoltaic Cells, Whether or Not Partially or Fully Assembled Into Other Products--Staff Report, November 19, 2021.

fn1.--Reported data are in percent and period changes are in percentage points.

CSPV modules

Table C-2
CSPV modules: Summary data concerning U.S. market, by item and by period

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			Jan-Jun		Comparison years			Jan-Jun
Item	2020	2021	2022	2022	2023	2020-22	2020-21	2021-22	2022-23
U.S. consumption quantity:									
Amount	18,337,101	18,635,819	19,818,012	8,179,403	14,833,492	▲8.1	▲1.6	▲6.3	▲81.4
Producers' share (fn1)	11.7	13.2	12.8	15.9	8.1	▲1.1	▲1.5	▼(0.4)	▼(7.8)
Importers' share (fn1):									
Bifacial modules	33.7	57.9	64.2	59.6	80.4	▲30.5	▲24.2	▲6.3	▲20.8
Non-bifacial modules	54.5	28.9	23.0	24.5	11.5	▼(31.5)	▼(25.7)	▼(5.9)	▼(13.0)
All CSPV modules	88.3	86.8	87.2	84.1	91.9	▼(1.1)	▼(1.5)	▲0.4	▲7.8
U.S. consumption value:									
Amount	6,901,235	6,827,330	8,792,394	3,786,393	5,843,698	▲27.4	▼(1.1)	▲28.8	▲54.3
Producers' share (fn1)	13.0	15.9	16.6	17.9	10.2	▲3.6	▲2.8	▲0.8	▼(7.7)
Importers' share (fn1):									
Bifacial modules	31.6	52.9	57.2	49.1	76.7	▲25.7	▲21.4	▲4.3	▲27.5
Non-bifacial modules	55.4	31.2	26.2	33.0	13.2	▼(29.2)	▼(24.2)	▼(5.1)	▼(19.8)
All CSPV modules	87.0	84.1	83.4	82.1	89.8	▼(3.6)	▼(2.8)	▼(0.8)	▲7.7
U.S. importers' U.S. shipments of:									
Bifacial modules:									
Quantity	6,185,269	10,789,111	12,726,826	4,876,809	11,923,560	▲105.8	▲74.4	▲18.0	▲144.5
Value	2,177,340	3,614,226	5,032,320	1,860,914	4,479,738	▲131.1	▲66.0	▲39.2	▲140.7
Unit value	$352	$335	$395	$382	$376	▲12.3	▼(4.8)	▲18.0	▼(1.5)
Ending inventory quantity	1,394,440	2,032,965	3,922,904	1,965,655	4,391,168	▲181.3	▲45.8	▲93.0	▲123.4
Non-bifacial modules:									
Quantity	9,997,775	5,378,977	4,553,384	2,003,683	1,711,403	▼(54.5)	▼(46.2)	▼(15.3)	▼(14.6)
Value	3,823,338	2,130,816	2,299,599	1,247,854	770,210	▼(39.9)	▼(44.3)	▲7.9	▼(38.3)
Unit value	$382	$396	$505	$623	$450	▲32.1	▲3.6	▲27.5	▼(27.7)
Ending inventory quantity	1,416,469	1,045,355	1,546,511	1,261,230	1,290,702	▲9.2	▼(26.2)	▲47.9	▲2.3
All CSPV modules:									
Quantity	16,183,044	16,168,088	17,280,210	6,880,492	13,634,963	▲6.8	▼(0.1)	▲6.9	▲98.2
Value	6,000,678	5,745,042	7,331,919	3,108,768	5,249,948	▲22.2	▼(4.3)	▲27.6	▲68.9
Unit value	$371	$355	$424	$452	$385	▲14.4	▼(4.2)	▲19.4	▼(14.8)
Ending inventory quantity	2,810,909	3,078,320	5,469,415	3,226,885	5,681,870	▲94.6	▲9.5	▲77.7	▲76.1

Table continued.

Table C-2 Continued
CSPV modules: Summary data concerning U.S. market, by item and by period

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			Jan-Jun		Comparison years			Jan-Jun
Item	2020	2021	2022	2022	2023	2020-22	2020-21	2021-22	2022-23
U.S. producers' of bifacial modules:									
Practical capacity quantity	238,618	234,199	695,812	416,958	***	▲191.6	▼(1.9)	▲197.1	▼***
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)	***	***	***	***	***	▼***	▲***	▼***	▲***
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. producers' of non-bifacial modules:									
Practical capacity quantity	3,946,437	3,445,960	3,774,854	1,931,663	***	▼(4.3)	▼(12.7)	▲9.5	▲***
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)	***	***	***	***	***	▼***	▼***	▼***	▲***
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)	***	***	***	***	***	▲***	▼***	▲***	▼***

Table continued.

Table C-2 Continued
CSPV modules: Summary data concerning U.S. market, by item and by period

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			Jan-Jun		Comparison years			Jan-Jun
Item	2020	2021	2022	2022	2023	2020-22	2020-21	2021-22	2022-23
U.S. producers' of all CSPV modules:									
Practical capacity quantity	4,185,055	3,680,159	4,470,666	2,348,621	2,237,251	▲6.8	▼(12.1)	▲21.5	▼(4.7)
Production quantity	2,226,242	2,508,270	2,486,822	1,251,222	1,405,098	▲11.7	▲12.7	▼(0.9)	▲12.3
Capacity utilization (fn1)	53.2	68.2	55.6	53.3	62.8	▲2.4	▲15.0	▼(12.5)	▲9.5
U.S. shipments:									
Quantity	2,154,057	2,467,731	2,537,802	1,298,911	1,198,529	▲17.8	▲14.6	▲2.8	▼(7.7)
Value	900,557	1,082,288	1,460,475	677,625	593,750	▲62.2	▲20.2	▲34.9	▼(12.4)
Unit value	$418	$439	$575	$522	$495	▲37.7	▲4.9	▲31.2	▼(5.0)
Export shipments:									
Quantity	***	***	***	***	***	▲***	▼***	▲***	▼***
Value	***	***	***	***	***	▲***	▲***	▲***	▼***
Unit value	***	***	***	***	***	▲***	▲***	▲***	▲***
Ending inventory quantity	167,288	188,268	108,965	126,850	308,444	▼(34.9)	▲12.5	▼(42.1)	▲143.2
Inventories/total shipments (fn1)	***	***	***	***	***	▼***	▼***	▼***	▲***
Production workers	2,286	2,064	2,080	1,942	2,472	▼(9.0)	▼(9.7)	▲0.8	▲27.3
Hours worked (1,000s)	4,395	4,021	4,053	1,920	2,536	▼(7.8)	▼(8.5)	▲0.8	▲32.1
Wages paid ($1,000)	102,934	106,316	118,865	61,206	64,330	▲15.5	▲3.3	▲11.8	▲5.1
Hourly wages (dollars per hour)	$23.42	$26.44	$29.33	$31.88	$25.37	▲25.2	▲12.9	▲10.9	▼(20.4)
Productivity (kilowatts per 1, 000 hours)	506.5	623.8	613.6	651.7	554.1	▲21.1	▲23.1	▼(1.6)	▼(15.0)
Unit labor costs	$46.24	$42.39	$47.80	$48.92	$45.78	▲3.4	▼(8.3)	▲12.8	▼(6.4)
Net sales:									
Quantity	2,164,218	2,487,011	2,566,125	1,312,640	1,205,619	▲18.6	▲14.9	▲3.2	▼(8.2)
Value	901,263	1,084,705	1,720,179	685,805	676,377	▲90.9	▲20.4	▲58.6	▼(1.4)
Unit value	$416	$436	$670	$522	$561	▲61.0	▲4.7	▲53.7	▲7.4
Cost of goods sold (COGS)	923,744	1,131,001	1,607,130	656,366	635,914	▲74.0	▲22.4	▲42.1	▼(3.1)
Gross profit or (loss) (fn2)	(22,481)	(46,296)	113,049	29,439	40,463	▲---	▼---	▲---	▲37.4
SG&A expenses	55,305	62,648	184,594	64,066	92,616	▲233.8	▲13.3	▲194.7	▲44.6
Operating income or (loss) (fn2)	(77,786)	(108,944)	(71,545)	(34,627)	(52,153)	▲---	▼---	▲---	▼---
Net income or (loss) (fn2)	(81,946)	(111,697)	(93,559)	(52,944)	(64,588)	▼---	▼---	▲---	▼---
Unit COGS	$427	$455	$626	$500	$527	▲46.7	▲6.5	▲37.7	▲5.5
Unit SG&A expenses	$26	$25	$72	$49	$77	▲181.5	▼(1.4)	▲185.6	▲57.4
Unit operating income or (loss) (fn2)	$(36)	$(44)	$(28)	$(26)	$(43)	▲---	▼---	▲---	▼---
Unit net income or (loss) (fn2)	$(38)	$(45)	$(36)	$(40)	$(54)	▲---	▼---	▲---	▼---
COGS/sales (fn1)	102.5	104.3	93.4	95.7	94.0	▼(9.1)	▲1.8	▼(10.8)	▼(1.7)
Operating income or (loss)/sales (fn1)	(8.6)	(10.0)	(4.2)	(5.0)	(7.7)	▲4.5	▼(1.4)	▲5.9	▼(2.7)
Net income or (loss)/sales (fn1)	(9.1)	(10.3)	(5.4)	(7.7)	(9.5)	▲3.7	▼(1.2)	▲4.9	▼(1.8)
Capital expenditures	29,085	28,242	48,561	14,514	48,391	▲67.0	▼(2.9)	▲71.9	▲233.4
Research and development expenses	***	***	***	***	***	▲***	▲***	▲***	▲***
Net assets	458,765	438,982	450,887	NA	NA	▼(1.7)	▼(4.3)	▲2.7	NA

Source: Compiled from data submitted in response to Commission questionnaires. 508-compliant tables containing these data are contained in part V of this report.

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. The vast majority of CSPV cells imported in cell form shown here are used by U.S. producers of CSPV modules.

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.

CSPV products (cells and modules)

Table C-3
CSPV products: Summary data concerning the U.S. shipments of imports, by item and period
Quantity=kilowatts; Value=1,000 dollars; Period changes=percent--exceptions noted

Item	Reported data: Calendar year 2020	2021	2022	Jan-Jun 2022	2023	Period changes: Comparison years 2020-22	2020-21	2021-22	Jan-Jun 2022-23
U.S. importers' U.S. shipments of:									
Bifacial cells:									
Quantity	***	619,951	2,221,967	1,028,218	1,341,774	▲***	▲313.5	▲258.4	▲30.5
Value	***	120,238	596,988	219,910	304,411	▲***	▲335.6	▲396.5	▲38.4
Unit value	***	$194	$269	$214	$227	▲***	▲5.3	▲38.5	▲6.1
Ending inventory quantity	***	***	***	***	***	▲***	▲***	▲***	▲***
Non-bifacial cells:									
Quantity	***	2,055,205	277,353	224,479	4,300	▼***	▲3.3	▼(86.5)	▼(98.1)
Value	***	442,267	78,168	65,624	1,248	▼***	▲1.1	▼(82.3)	▼(98.1)
Unit value	***	$215	$282	$292	$290	▲***	▼(2.1)	▲31.0	▼(0.7)
Ending inventory quantity	***	***	***	***	***	▼***	▼***	▼***	▼***
All CSPV cells:									
Quantity	2,138,882	2,675,156	2,499,320	1,252,697	1,346,074	▲16.9	▲25.1	▼(6.6)	▲7.5
Value	464,924	562,505	675,156	285,534	305,659	▲45.2	▲21.0	▲20.0	▲7.0
Unit value	$217	$210	$270	$228	$227	▲24.3	▼(3.3)	▲28.5	▼(0.4)
Ending inventory quantity	126,771	278,986	209,929	144,732	225,451	▲65.6	▲120.1	▼(24.8)	▲55.8
Bifacial modules:									
Quantity	6,185,269	10,789,111	12,726,826	4,876,809	11,923,560	▲105.8	▲74.4	▲18.0	▲144.5
Value	2,177,340	3,614,226	5,032,320	1,860,914	4,479,738	▲131.1	▲66.0	▲39.2	▲140.7
Unit value	$352	$335	$395	$382	$376	▲12.3	▼(4.8)	▲18.0	▼(1.5)
Ending inventory quantity	1,394,440	2,032,965	3,922,904	1,965,655	4,391,168	▲181.3	▲45.8	▲93.0	▲123.4
Non-bifacial modules:									
Quantity	9,997,775	5,378,977	4,553,384	2,003,683	1,711,403	▼(54.5)	▼(46.2)	▼(15.3)	▼(14.6)
Value	3,823,338	2,130,816	2,299,599	1,247,854	770,210	▼(39.9)	▼(44.3)	▲7.9	▼(38.3)
Unit value	$382	$396	$505	$623	$450	▲32.1	▲3.6	▲27.5	▼(27.7)
Ending inventory quantity	1,416,469	1,045,355	1,546,511	1,261,230	1,290,702	▲9.2	▼(26.2)	▲47.9	▲2.3
All CSPV modules:									
Quantity	16,183,044	16,168,088	17,280,210	6,880,492	13,634,963	▲6.8	▼(0.1)	▲6.9	▲98.2
Value	6,000,678	5,745,042	7,331,919	3,108,768	5,249,948	▲22.2	▼(4.3)	▲27.6	▲68.9
Unit value	$371	$355	$424	$452	$385	▲14.4	▼(4.2)	▲19.4	▼(14.8)
Ending inventory quantity	2,810,909	3,078,320	5,469,415	3,226,885	5,681,870	▲94.6	▲9.5	▲77.7	▲76.1
All CSPV products:									
Quantity	18,321,926	18,843,244	19,779,530	8,133,189	14,981,037	▲8.0	▲2.8	▲5.0	▲84.2
Value	6,465,602	6,307,547	8,007,075	3,394,302	5,555,607	▲23.8	▼(2.4)	▲26.9	▲63.7
Unit value	$353	$335	$405	$417	$371	▲14.7	▼(5.1)	▲20.9	▼(11.1)
Ending inventory quantity	2,937,680	3,357,306	5,679,344	3,371,617	5,907,321	▲93.3	▲14.3	▲69.2	▲75.2

Source: Compiled from data submitted in response to Commission questionnaires. 508-compliant tables containing these data are contained in part V of this report.

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.

APPENDIX D

SELECT DATA FROM SAFEGUARD AND MONITORING INVESTIGATIONS

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

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.

CSPV modules: Total market: COO NAFTA

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.

[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

* * * * * * *

[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

* * * * * * *

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	***	***	***	***	***	▼***	▼***	▲***	▼***

Table continued on next page.

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	***	***	***	***	***	▲***	▲***	▼***	▼***

Table continued on next page.

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 E

SELECT FOREIGN PRODUCER DATA

The foreign industries

Foreign industry data presented in this appendix are based on the questionnaire responses of 30 producers/exporters of CSPV products as follows:

Malaysia: 4 firms accounting for *** percent of CSPV cell capacity and *** percent of CSPV module capacity in 2022 in Malaysia.[1]

South Korea: 2 firms accounting for *** percent of CSPV cell capacity, *** percent of CSPV module capacity in 2022 in South Korea.[2]

Thailand: 2 firms accounting for approximately *** percent of CSPV cell capacity and *** percent of CSPV module capacity in Thailand in 2022.[3]

Vietnam: 6 firms accounting for approximately *** percent of CSPV cell capacity and *** percent of CSPV module capacity in Vietnam in 2022.[4]

All other countries: fifteen firms accounting for approximately *** percent of global CSPV cell capacity and *** percent of global CSPV module capacity in 2022.[5] [6]

[1] In 2022, manufacturing capacity for CSPV cells in Malaysia was approximately 20 GW while manufacturing capacity for CSPV modules was approximately 15 GW. See Renewable Energy Manufacturing: Opportunities for Southeast Asia, p. 13.

[2] Coverage for South Korea is based on responding firms' self-reported estimates. *** accounted for *** reported exports of CSPV products from South Korea to the United States in 2022. LG's foreign producer questionnaire response, sections II-6 and II-7. Hanwha (Korea)'s foreign producer questionnaire response, sections II-6 and II-7.

[3] In 2022, manufacturing capacity for CSPV cells in Thailand was approximately 14 GW while manufacturing capacity for CSPV modules was approximately 11 GW. See Renewable Energy Manufacturing: Opportunities for Southeast Asia, p. 13.

[4] In 2022, manufacturing capacity for CSPV cells in Vietnam was approximately 14 GW while manufacturing capacity for CSPV modules was approximately 34 GW. See Renewable Energy Manufacturing: Opportunities for Southeast Asia, p. 13.

[5] In 2022, global manufacturing capacity for solar PV cells was approximately 568 GW while global manufacturing capacity for solar PV modules was approximately 639 GW. IEA: Solar PV, https://www.iea.org/energy-system/renewables/solar-pv, retrieved October 19, 2022.

[6] A questionnaire from a producer in Indonesia was received late and is therefore not included in this coverage calculation and the overall dataset. The firm, PT Sky Energy Indonesia TBK, reported *** KW (*** GW) of capacity and *** KW in total shipments in 2022. PT Sky Energy Indonesia TBK's foreign producer questionnaire response, section II-11b.

Data for Foreign Producers and Exporters of CSPV Cells

Tables E-1 through E-6 present data concerning capacity, production, inventories, and shipments for foreign producers/exporters of CSPV cells in response to the Commission's questionnaire.

Table E-1
CSPV cells: Data for producers in Malaysia, by period

Quantity in kilowatts

Item	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023	Projection 2023	Projection 2024
Capacity	***	***	***	***	***	***	***
Production	***	***	***	***	***	***	***
End-of-period inventories	***	***	***	***	***	***	***
Internal consumption	***	***	***	***	***	***	***
Commercial home market shipments	***	***	***	***	***	***	***
Home market shipments	***	***	***	***	***	***	***
Exports to the United States	***	***	***	***	***	***	***
Exports to all other markets	***	***	***	***	***	***	***
Export shipments	***	***	***	***	***	***	***
Total shipments	***	***	***	***	***	***	***

Table continued

Table E-1 Continued
CSPV cells: Data for producers in Malaysia, by period

Shares and ratios in percent

Item	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023	Projection 2023	Projection 2024
Capacity utilization ratio	***	***	***	***	***	***	***
Inventory ratio to production	***	***	***	***	***	***	***
Inventory ratio to total shipments	***	***	***	***	***	***	***
Internal consumption share	***	***	***	***	***	***	***
Commercial home market shipments share	***	***	***	***	***	***	***
Home market shipments share	***	***	***	***	***	***	***
Exports to the United States share	***	***	***	***	***	***	***
Exports to all other markets share	***	***	***	***	***	***	***
Export shipments share	***	***	***	***	***	***	***
Total shipments share	100.0	100.0	100.0	100.0	100.0	100.0	100.0

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

Note: Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent. Zeroes, null values, and undefined calculations are suppressed and shown as "---".

Table E-2
CSPV cells: Data for producers in South Korea, by period

Quantity in kilowatts

Item	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023	Projection 2023	Projection 2024
Capacity	***	***	***	***	***	***	***
Production	***	***	***	***	***	***	***
End-of-period inventories	***	***	***	***	***	***	***
Internal consumption	***	***	***	***	***	***	***
Commercial home market shipments	***	***	***	***	***	***	***
Home market shipments	***	***	***	***	***	***	***
Exports to the United States	***	***	***	***	***	***	***
Exports to all other markets	***	***	***	***	***	***	***
Export shipments	***	***	***	***	***	***	***
Total shipments	***	***	***	***	***	***	***

Table continued

Table E-2 Continued
CSPV cells: Data for producers in South Korea, by period

Shares and ratios in percent

Item	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023	Projection 2023	Projection 2024
Capacity utilization ratio	***	***	***	***	***	***	***
Inventory ratio to production	***	***	***	***	***	***	***
Inventory ratio to total shipments	***	***	***	***	***	***	***
Internal consumption share	***	***	***	***	***	***	***
Commercial home market shipments share	***	***	***	***	***	***	***
Home market shipments share	***	***	***	***	***	***	***
Exports to the United States share	***	***	***	***	***	***	***
Exports to all other markets share	***	***	***	***	***	***	***
Export shipments share	***	***	***	***	***	***	***
Total shipments share	100.0	100.0	100.0	100.0	100.0	100.0	100.0

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

Note: Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent. Zeroes, null values, and undefined calculations are suppressed and shown as “---“.

Table E-3
CSPV cells: Data for producers in Thailand, by period

Quantity in kilowatts

Item	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023	Projection 2023	Projection 2024
Capacity	***	***	***	***	***	***	***
Production	***	***	***	***	***	***	***
End-of-period inventories	***	***	***	***	***	***	***
Internal consumption	***	***	***	***	***	***	***
Commercial home market shipments	***	***	***	***	***	***	***
Home market shipments	***	***	***	***	***	***	***
Exports to the United States	***	***	***	***	***	***	***
Exports to all other markets	***	***	***	***	***	***	***
Export shipments	***	***	***	***	***	***	***
Total shipments	***	***	***	***	***	***	***

Table continued

Table E-3 Continued
CSPV cells: Data for producers in Thailand, by period

Shares and ratios in percent

Item	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023	Projection 2023	Projection 2024
Capacity utilization ratio	***	***	***	***	***	***	***
Inventory ratio to production	***	***	***	***	***	***	***
Inventory ratio to total shipments	***	***	***	***	***	***	***
Internal consumption share	***	***	***	***	***	***	***
Commercial home market shipments share	***	***	***	***	***	***	***
Home market shipments share	***	***	***	***	***	***	***
Exports to the United States share	***	***	***	***	***	***	***
Exports to all other markets share	***	***	***	***	***	***	***
Export shipments share	***	***	***	***	***	***	***
Total shipments share	100.0	100.0	100.0	100.0	100.0	100.0	100.0

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

Note: Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent. Zeroes, null values, and undefined calculations are suppressed and shown as "---".

Table E-4
CSPV cells: Data for producers in Vietnam, by period

Quantity in kilowatts

Item	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023	Projection 2023	Projection 2024
Capacity	***	***	***	***	***	***	***
Production	***	***	***	***	***	***	***
End-of-period inventories	***	***	***	***	***	***	***
Internal consumption	***	***	***	***	***	***	***
Commercial home market shipments	***	***	***	***	***	***	***
Home market shipments	***	***	***	***	***	***	***
Exports to the United States	***	***	***	***	***	***	***
Exports to all other markets	***	***	***	***	***	***	***
Export shipments	***	***	***	***	***	***	***
Total shipments	***	***	***	***	***	***	***

Table continued

Table E-4 Continued
CSPV cells: Data for producers in Vietnam, by period

Shares and ratios in percent

Item	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023	Projection 2023	Projection 2024
Capacity utilization ratio	***	***	***	***	***	***	***
Inventory ratio to production	***	***	***	***	***	***	***
Inventory ratio to total shipments	***	***	***	***	***	***	***
Internal consumption share	***	***	***	***	***	***	***
Commercial home market shipments share	***	***	***	***	***	***	***
Home market shipments share	***	***	***	***	***	***	***
Exports to the United States share	***	***	***	***	***	***	***
Exports to all other markets share	***	***	***	***	***	***	***
Export shipments share	***	***	***	***	***	***	***
Total shipments share	100.0	100.0	100.0	100.0	100.0	100.0	100.0

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

Note: Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent. Zeroes, null values, and undefined calculations are suppressed and shown as "---".

Table E-5
CSPV cells: Data for producers in other countries, by period

Quantity in kilowatts

Item	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023	Projection 2023	Projection 2024
Capacity	***	***	***	***	***	***	***
Production	***	***	***	***	***	***	***
End-of-period inventories	***	***	***	***	***	***	***
Internal consumption	***	***	***	***	***	***	***
Commercial home market shipments	***	***	***	***	***	***	***
Home market shipments	***	***	***	***	***	***	***
Exports to the United States	***	***	***	***	***	***	***
Exports to all other markets	***	***	***	***	***	***	***
Export shipments	***	***	***	***	***	***	***
Total shipments	***	***	***	***	***	***	***

Table continued

Table E-5 Continued
CSPV cells: Data for producers in other countries, by period

Shares and ratios in percent

Item	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023	Projection 2023	Projection 2024
Capacity utilization ratio	***	***	***	***	***	***	***
Inventory ratio to production	***	***	***	***	***	***	***
Inventory ratio to total shipments	***	***	***	***	***	***	***
Internal consumption share	***	***	***	***	***	***	***
Commercial home market shipments share	***	***	***	***	***	***	***
Home market shipments share	***	***	***	***	***	***	***
Exports to the United States share	***	***	***	***	***	***	***
Exports to all other markets share	***	***	***	***	***	***	***
Export shipments share	***	***	***	***	***	***	***
Total shipments share	100.0	100.0	100.0	100.0	100.0	100.0	100.0

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

Note: Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent. Zeroes, null values, and undefined calculations are suppressed and shown as "---".

Table E-6
CSPV cells: Aggregated data for foreign producers, by period

Quantity in kilowatts

Item	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023	Projection 2023	Projection 2024
Capacity	***	***	***	***	***	***	***
Production	***	***	***	***	***	***	***
End-of-period inventories	***	***	***	***	***	***	***
Internal consumption	***	***	***	***	***	***	***
Commercial home market shipments	***	***	***	***	***	***	***
Home market shipments	***	***	***	***	***	***	***
Exports to the United States	***	***	***	***	***	***	***
Exports to all other markets	***	***	***	***	***	***	***
Export shipments	***	***	***	***	***	***	***
Total shipments	***	***	***	***	***	***	***

Table continued

Table E-6 Continued
CSPV cells: Aggregated data for foreign producers, by period

Shares and ratios in percent

Item	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023	Projection 2023	Projection 2024
Capacity utilization ratio	***	***	***	***	***	***	***
Inventory ratio to production	***	***	***	***	***	***	***
Inventory ratio to total shipments	***	***	***	***	***	***	***
Internal consumption share	***	***	***	***	***	***	***
Commercial home market shipments share	***	***	***	***	***	***	***
Home market shipments share	***	***	***	***	***	***	***
Exports to the United States share	***	***	***	***	***	***	***
Exports to all other markets share	***	***	***	***	***	***	***
Export shipments share	***	***	***	***	***	***	***
Total shipments share	100.0	100.0	100.0	100.0	100.0	100.0	100.0

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

Note: Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent. Zeroes, null values, and undefined calculations are suppressed and shown as “---“.

Data for Foreign Producers and Exporters of CSPV Modules

Tables E-7 through E-12 present data concerning capacity, production, inventories, and shipments reported by foreign producers/exporters of CSPV modules in response to the Commission's questionnaire.

Table E-7
CSPV modules: Data for producers in Malaysia, by period

Quantity in kilowatts

Item	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023	Projection 2023	Projection 2024
Capacity	***	***	***	***	***	***	***
Production	***	***	***	***	***	***	***
End-of-period inventories	***	***	***	***	***	***	***
Internal consumption	***	***	***	***	***	***	***
Commercial home market shipments	***	***	***	***	***	***	***
Home market shipments	***	***	***	***	***	***	***
Exports to the United States	***	***	***	***	***	***	***
Exports to all other markets	***	***	***	***	***	***	***
Export shipments	***	***	***	***	***	***	***
Total shipments	***	***	***	***	***	***	***

Table continued

Table E-7 Continued
CSPV modules: Data for producers in Malaysia, by period

Shares and ratios in percent

Item	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023	Projection 2023	Projection 2024
Capacity utilization ratio	***	***	***	***	***	***	***
Inventory ratio to production	***	***	***	***	***	***	***
Inventory ratio to total shipments	***	***	***	***	***	***	***
Internal consumption share	***	***	***	***	***	***	***
Commercial home market shipments share	***	***	***	***	***	***	***
Home market shipments share	***	***	***	***	***	***	***
Exports to the United States share	***	***	***	***	***	***	***
Exports to all other markets share	***	***	***	***	***	***	***
Export shipments share	***	***	***	***	***	***	***
Total shipments share	100.0	100.0	100.0	100.0	100.0	100.0	100.0

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

Note: Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent. Zeroes, null values, and undefined calculations are suppressed and shown as “---“.

Table E-8
CSPV modules: Data for producers in South Korea, by period

Quantity in kilowatts

Item	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023	Projection 2023	Projection 2024
Capacity	***	***	***	***	***	***	***
Production	***	***	***	***	***	***	***
End-of-period inventories	***	***	***	***	***	***	***
Internal consumption	***	***	***	***	***	***	***
Commercial home market shipments	***	***	***	***	***	***	***
Home market shipments	***	***	***	***	***	***	***
Exports to the United States	***	***	***	***	***	***	***
Exports to all other markets	***	***	***	***	***	***	***
Export shipments	***	***	***	***	***	***	***
Total shipments	***	***	***	***	***	***	***
Resales exported to the United States	***	***	***	***	***	***	***
Total exports to the United States	***	***	***	***	***	***	***

Table continued

Table E-8 Continued
CSPV modules: Data for producers in South Korea, by period

Shares and ratios in percent

Item	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023	Projection 2023	Projection 2024
Capacity utilization ratio	***	***	***	***	***	***	***
Inventory ratio to production	***	***	***	***	***	***	***
Inventory ratio to total shipments	***	***	***	***	***	***	***
Internal consumption share	***	***	***	***	***	***	***
Commercial home market shipments share	***	***	***	***	***	***	***
Home market shipments share	***	***	***	***	***	***	***
Exports to the United States share	***	***	***	***	***	***	***
Exports to all other markets share	***	***	***	***	***	***	***
Export shipments share	***	***	***	***	***	***	***
Total shipments share	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Share of total exports to the United States by producers	***	***	***	***	***	***	***
Share of total exports to the United States by resellers	***	***	***	***	***	***	***
Adjusted share of total shipments exported to the United States	***	***	***	***	***	***	***

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

Note: Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent. Zeroes, null values, and undefined calculations are suppressed and shown as “---“.

Table E-9
CSPV modules: Data for producers in Thailand, by period

Quantity in kilowatts

Item	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023	Projection 2023	Projection 2024
Capacity	***	***	***	***	***	***	***
Production	***	***	***	***	***	***	***
End-of-period inventories	***	***	***	***	***	***	***
Internal consumption	***	***	***	***	***	***	***
Commercial home market shipments	***	***	***	***	***	***	***
Home market shipments	***	***	***	***	***	***	***
Exports to the United States	***	***	***	***	***	***	***
Exports to all other markets	***	***	***	***	***	***	***
Export shipments	***	***	***	***	***	***	***
Total shipments	***	***	***	***	***	***	***

Table continued

Table E-9 Continued
CSPV modules: Data for producers in Thailand, by period

Shares and ratios in percent

Item	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023	Projection 2023	Projection 2024
Capacity utilization ratio	***	***	***	***	***	***	***
Inventory ratio to production	***	***	***	***	***	***	***
Inventory ratio to total shipments	***	***	***	***	***	***	***
Internal consumption share	***	***	***	***	***	***	***
Commercial home market shipments share	***	***	***	***	***	***	***
Home market shipments share	***	***	***	***	***	***	***
Exports to the United States share	***	***	***	***	***	***	***
Exports to all other markets share	***	***	***	***	***	***	***
Export shipments share	***	***	***	***	***	***	***
Total shipments share	100.0	100.0	100.0	100.0	100.0	100.0	100.0

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

Note: Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent. Zeroes, null values, and undefined calculations are suppressed and shown as “---“.

Table E-10
CSPV modules: Data for producers in Vietnam, by period

Quantity in kilowatts

Item	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023	Projection 2023	Projection 2024
Capacity	***	***	***	***	***	***	***
Production	***	***	***	***	***	***	***
End-of-period inventories	***	***	***	***	***	***	***
Internal consumption	***	***	***	***	***	***	***
Commercial home market shipments	***	***	***	***	***	***	***
Home market shipments	***	***	***	***	***	***	***
Exports to the United States	***	***	***	***	***	***	***
Exports to all other markets	***	***	***	***	***	***	***
Export shipments	***	***	***	***	***	***	***
Total shipments	***	***	***	***	***	***	***

Table continued

Table E-10 Continued
CSPV modules: Data for producers in Vietnam, by period

Shares and ratios in percent

Item	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023	Projection 2023	Projection 2024
Capacity utilization ratio	***	***	***	***	***	***	***
Inventory ratio to production	***	***	***	***	***	***	***
Inventory ratio to total shipments	***	***	***	***	***	***	***
Internal consumption share	***	***	***	***	***	***	***
Commercial home market shipments share	***	***	***	***	***	***	***
Home market shipments share	***	***	***	***	***	***	***
Exports to the United States share	***	***	***	***	***	***	***
Exports to all other markets share	***	***	***	***	***	***	***
Export shipments share	***	***	***	***	***	***	***
Total shipments share	100.0	100.0	100.0	100.0	100.0	100.0	100.0

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

Note: Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent. Zeroes, null values, and undefined calculations are suppressed and shown as "---".

Table E-11
CSPV modules: Data for producers in other countries, by period

Quantity in kilowatts

Item	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023	Projection 2023	Projection 2024
Capacity	***	***	***	***	***	***	***
Production	***	***	***	***	***	***	***
End-of-period inventories	***	***	***	***	***	***	***
Internal consumption	***	***	***	***	***	***	***
Commercial home market shipments	***	***	***	***	***	***	***
Home market shipments	***	***	***	***	***	***	***
Exports to the United States	***	***	***	***	***	***	***
Exports to all other markets	***	***	***	***	***	***	***
Export shipments	***	***	***	***	***	***	***
Total shipments	***	***	***	***	***	***	***
Resales exported to the United States	***	***	***	***	***	***	***
Total exports to the United States	***	***	***	***	***	***	***

Table continued

Table E-11 Continued
CSPV modules: Data for producers in other countries, by period

Shares and ratios in percent

Item	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023	Projection 2023	Projection 2024
Capacity utilization ratio	***	***	***	***	***	***	***
Inventory ratio to production	***	***	***	***	***	***	***
Inventory ratio to total shipments	***	***	***	***	***	***	***
Internal consumption share	***	***	***	***	***	***	***
Commercial home market shipments share	***	***	***	***	***	***	***
Home market shipments share	***	***	***	***	***	***	***
Exports to the United States share	***	***	***	***	***	***	***
Exports to all other markets share	***	***	***	***	***	***	***
Export shipments share	***	***	***	***	***	***	***
Total shipments share	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Share of total exports to the United States by producers	***	***	***	***	***	***	***
Share of total exports to the United States by resellers	***	***	***	***	***	***	***
Adjusted share of total shipments exported to the United States	***	***	***	***	***	***	***

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

Note: Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent. Zeroes, null values, and undefined calculations are suppressed and shown as “---“.

Table E-12
CSPV modules: Aggregated data for foreign producers, by period

Quantity in kilowatts

Item	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023	Projection 2023	Projection 2024
Capacity	***	***	***	***	***	***	***
Production	***	***	***	***	***	***	***
End-of-period inventories	***	***	***	***	***	***	***
Internal consumption	***	***	***	***	***	***	***
Commercial home market shipments	***	***	***	***	***	***	***
Home market shipments	***	***	***	***	***	***	***
Exports to the United States	***	***	***	***	***	***	***
Exports to all other markets	***	***	***	***	***	***	***
Export shipments	***	***	***	***	***	***	***
Total shipments	***	***	***	***	***	***	***
Resales exported to the United States	***	***	***	***	***	***	***
Total exports to the United States	***	***	***	***	***	***	***

Table continued

Table E-12 Continued
CSPV modules: Aggregated data for foreign producers, by period

Shares and ratios in percent

Item	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023	Projection 2023	Projection 2024
Capacity utilization ratio	***	***	***	***	***	***	***
Inventory ratio to production	***	***	***	***	***	***	***
Inventory ratio to total shipments	***	***	***	***	***	***	***
Internal consumption share	***	***	***	***	***	***	***
Commercial home market shipments share	***	***	***	***	***	***	***
Home market shipments share	***	***	***	***	***	***	***
Exports to the United States share	***	***	***	***	***	***	***
Exports to all other markets share	***	***	***	***	***	***	***
Export shipments share	***	***	***	***	***	***	***
Total shipments share	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Share of total exports to the United States by producers	***	***	***	***	***	***	***
Share of total exports to the United States by resellers	***	***	***	***	***	***	***
Adjusted share of total shipments exported to the United States	***	***	***	***	***	***	***

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

Note: Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent. Zeroes, null values, and undefined calculations are suppressed and shown as "---".

Presented in table E-13 is a list of responding foreign producers/exporters and a summary of each company's reported data. Table E-14 presents responding foreign producers'/exporters' reported changes in operations since January 1, 2020.

Table E-13
CSPV products: Aggregated summary data for foreign producers, 2022

Firm	Production (kilowatts)	Share of reported production (percent)	Exports to the United States (kilowatts)	Share of reported exports to the United States (percent)	Total shipments (kilowatts)	Share of firm's total shipments exported to the United States (percent)
3 Sun	***	***	***	***	***	***
Canadian (Canada)	***	***	***	***	***	***
Canadian (China)	***	***	***	***	***	***
Canadian (Thailand)	***	***	***	***	***	***
Canadian (Vietnam)	***	***	***	***	***	***
Hanwha (China)	***	***	***	***	***	***
Hanwha (Korea)	***	***	***	***	***	***
Hanwha (Malaysia)	***	***	***	***	***	***
Heliene	***	***	***	***	***	***
Irex	***	***	***	***	***	***
Jinko Solar Technology	***	***	***	***	***	***
Jinko Solar (Malaysia)	***	***	***	***	***	***
Jinko Solar (Vietnam)	***	***	***	***	***	***
LG	***	***	***	***	***	***
Philadelphia	***	***	***	***	***	***
PT. IDN	***	***	***	***	***	***
REC	***	***	***	***	***	***
Red Sun	***	***	***	***	***	***
Silfab	***	***	***	***	***	***
Sino	***	***	***	***	***	***
SunPower (Malaysia)	***	***	***	***	***	***
SunPower (Mexico)	***	***	***	***	***	***
SunPower (Philippines)	***	***	***	***	***	***
Trina (China)	***	***	***	***	***	***
Trina (Thailand)	***	***	***	***	***	***
Trina (Vietnam)	***	***	***	***	***	***
Udhaya	***	***	***	***	***	***
United	***	***	***	***	***	***
Vietnergy	***	***	***	***	***	***
Win Win	***	***	***	***	***	***
All firms	***	100.0	***	100.0	***	***

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

Note: Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent. Zeroes, null values, and undefined calculations are suppressed and shown as "---".

Table E-14
CSPV products: Reported changes in foreign operations since January 1, 2020, by firm

Item	Firm name and accompanying narrative response on changes in foreign operations
Plant openings	***
Plant openings	***
Plant openings	***
Plant openings	***
Plant openings	***
Plant openings	***
Plant openings	***
Plant closings	***
Plant closings	***
Plant closings	***
Plant closings	***
Plant closings	***
Plant closings	***
Plant closings	***
Plant closings	***
Plant closings	***
Prolonged shutdowns	***

Item	Firm name and accompanying narrative response on changes in foreign operations
Prolonged shutdowns	***
Prolonged shutdowns	***
Production curtailments	***
Production curtailments	***
Production curtailments	***
Production curtailments	***
Production curtailments	***
Relocations	***
Expansions	***
Expansions	***
Expansions	***
Expansions	***
Expansions	***
Expansions	***
Expansions	***
Expansions	***
Expansions	***
Expansions	***
Expansions	***

Item	Firm name and accompanying narrative response on changes in foreign operations
Expansions	***
Expansions	***
Expansions	***
Acquisitions	***
Acquisitions	***
Acquisitions	***
Acquisitions	***
Consolidations	***
Consolidations	***
Consolidations	***
Other	***
Other	***
Other	***

Item	Firm name and accompanying narrative response on changes in foreign operations
Other	***
Other	***
Other	***
Other	***

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

APPENDIX F

OFFICIAL U.S. IMPORT STATISTICS

Table F-1
CSPV products: U.S. imports, by source

Quantity in kilowatts; Value in 1,000 dollars

Source	Measure	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Cambodia	Quantity	547,858	800,620	2,371,254	809,707	3,092,127
India	Quantity	204,848	406,202	571,456	63,029	1,526,685
Malaysia	Quantity	9,326,057	8,044,269	6,265,817	3,176,441	4,592,144
Mexico	Quantity	188,984	4,054	539,531	115,332	646,273
Singapore	Quantity	667,688	607,288	706,794	322,803	472,480
South Korea	Quantity	3,568,300	2,946,336	3,143,031	1,122,980	1,621,111
Thailand	Quantity	4,329,612	4,305,412	4,935,342	2,369,568	5,000,752
Vietnam	Quantity	7,737,291	8,048,745	11,266,700	3,928,218	7,645,693
All other sources	Quantity	2,382,181	1,054,082	1,804,063	772,264	1,110,025
All import sources	Quantity	28,952,821	26,217,008	31,603,987	12,680,342	25,707,290
Cambodia	Value	135,861	227,870	799,230	222,464	1,121,046
India	Value	93,833	119,701	262,339	13,759	1,054,845
Malaysia	Value	2,873,479	2,479,322	1,779,920	868,386	1,364,847
Mexico	Value	89,907	3,112	217,636	55,939	218,709
Singapore	Value	201,915	230,924	371,136	127,865	296,410
South Korea	Value	1,042,491	785,152	1,403,857	357,846	788,709
Thailand	Value	1,497,883	1,338,788	1,711,823	769,935	2,039,056
Vietnam	Value	2,622,596	2,346,240	3,694,975	1,264,860	2,281,286
All other sources	Value	681,307	256,330	582,169	234,853	435,947
All import sources	Value	9,239,273	7,787,439	10,823,085	3,915,907	9,600,854

Table continued.

Table F-1 Continued
CSPV products: U.S. imports, by source

Unit value in dollars per kilowatt; Share in percent

Source	Measure	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Cambodia	Unit value	248	285	337	275	363
India	Unit value	458	295	459	218	691
Malaysia	Unit value	308	308	284	273	297
Mexico	Unit value	476	768	403	485	338
Singapore	Unit value	302	380	525	396	627
South Korea	Unit value	292	266	447	319	487
Thailand	Unit value	346	311	347	325	408
Vietnam	Unit value	339	292	328	322	298
All other sources	Unit value	286	243	323	304	393
All import sources	Unit value	319	297	342	309	373
Cambodia	Share of quantity	1.9	3.1	7.5	6.4	12.0
India	Share of quantity	0.7	1.5	1.8	0.5	5.9
Malaysia	Share of quantity	32.2	30.7	19.8	25.1	17.9
Mexico	Share of quantity	0.7	0.0	1.7	0.9	2.5
Singapore	Share of quantity	2.3	2.3	2.2	2.5	1.8
South Korea	Share of quantity	12.3	11.2	9.9	8.9	6.3
Thailand	Share of quantity	15.0	16.4	15.6	18.7	19.5
Vietnam	Share of quantity	26.7	30.7	35.6	31.0	29.7
All other sources	Share of quantity	8.2	4.0	5.7	6.1	4.3
All import sources	Share of quantity	100.0	100.0	100.0	100.0	100.0

Source: Compiled from official U.S. import statistics of the U.S. Department of Commerce using statistical reporting numbers 8541.40.6015, 8541.40.6025, 8541.40.6035, 8541.40.6045, 8541.42.0010, 8541.42.0080, 8541.43.0010, and 8541.43.0080, accessed August 22, 2023. Imports are based on the imports for consumption data series and value data reflect landed duty-paid values.

Note: Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent. Zeroes, null values, and undefined calculations are suppressed and shown as “---“.

Table F-2
CSPV cells: U.S. imports, by source

Quantity in kilowatts; Value in 1,000 dollars

Source	Measure	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Cambodia	Quantity	---	46	6,531	6,358	14,369
India	Quantity	21,517	48	3	0	22,467
Malaysia	Quantity	238,076	712,079	1,622,691	718,457	736,284
Mexico	Quantity	224	243	135	60	56
Singapore	Quantity	1	1,907	1	1	0
South Korea	Quantity	1,316,615	1,196,836	82,973	82,808	25,930
Thailand	Quantity	28,802	105,696	92,397	85,712	4,950
Vietnam	Quantity	196,715	528,105	682,969	311,140	298,227
All other sources	Quantity	420,321	133,181	176,166	81,598	213,526
All import sources	Quantity	2,222,272	2,678,141	2,663,867	1,286,134	1,315,809
Cambodia	Value	---	876	8,976	8,937	2,467
India	Value	7,648	90	39	6	4,352
Malaysia	Value	46,010	131,349	421,374	157,665	201,716
Mexico	Value	132	96	1,839	592	393
Singapore	Value	15	283	4	4	5
South Korea	Value	312,423	260,091	25,848	25,781	4,793
Thailand	Value	3,608	19,617	20,374	18,373	7,437
Vietnam	Value	35,836	96,482	152,279	61,741	60,190
All other sources	Value	89,648	37,460	61,952	31,133	58,135
All import sources	Value	495,321	546,343	692,684	304,234	339,489

Table continued.

Table F-2 Continued
CSPV cells: U.S. imports, by source

Unit value in dollars per kilowatt; Share in percent

Source	Measure	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Cambodia	Unit value	---	18,855	1,374	1,406	172
India	Unit value	355	1,852	11,497	21,293	194
Malaysia	Unit value	193	184	260	219	274
Mexico	Unit value	590	396	13,573	9,862	6,975
Singapore	Unit value	12,465	148	6,185	6,185	43,660
South Korea	Unit value	237	217	312	311	185
Thailand	Unit value	125	186	221	214	1,502
Vietnam	Unit value	182	183	223	198	202
All other sources	Unit value	213	281	352	382	272
All import sources	Unit value	223	204	260	237	258
Cambodia	Share of quantity	---	0.0	0.2	0.5	1.1
India	Share of quantity	1.0	0.0	0.0	0.0	1.7
Malaysia	Share of quantity	10.7	26.6	60.9	55.9	56.0
Mexico	Share of quantity	0.0	0.0	0.0	0.0	0.0
Singapore	Share of quantity	0.0	0.1	0.0	0.0	0.0
South Korea	Share of quantity	59.2	44.7	3.1	6.4	2.0
Thailand	Share of quantity	1.3	3.9	3.5	6.7	0.4
Vietnam	Share of quantity	8.9	19.7	25.6	24.2	22.7
All other sources	Share of quantity	18.9	5.0	6.6	6.3	16.2
All import sources	Share of quantity	100.0	100.0	100.0	100.0	100.0

Source: Compiled from official U.S. import statistics of the U.S. Department of Commerce using statistical reporting numbers 8541.40.6025, 8541.40.6045, 8541.42.0010, and 8541.42.0080, accessed August 22, 2023. Imports are based on the imports for consumption data series and value data reflect landed duty-paid values.

Table F-3
CSPV modules: U.S. imports, by source

Quantity in kilowatts; Value in 1,000 dollars

Source	Measure	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Cambodia	Quantity	547,858	800,573	2,364,723	803,348	3,077,758
India	Quantity	183,331	406,153	571,453	63,029	1,504,219
Malaysia	Quantity	9,087,981	7,332,190	4,643,125	2,457,984	3,855,860
Mexico	Quantity	188,759	3,811	539,395	115,272	646,217
Singapore	Quantity	667,687	605,381	706,794	322,802	472,480
South Korea	Quantity	2,251,685	1,749,500	3,060,058	1,040,173	1,595,182
Thailand	Quantity	4,300,810	4,199,717	4,842,945	2,283,856	4,995,802
Vietnam	Quantity	7,540,576	7,520,640	10,583,731	3,617,077	7,347,466
All other sources	Quantity	1,961,861	920,901	1,627,897	690,666	896,499
All import sources	Quantity	26,730,548	23,538,866	28,940,121	11,394,209	24,391,481
Cambodia	Value	135,861	226,993	790,253	213,526	1,118,579
India	Value	86,185	119,611	262,301	13,753	1,050,492
Malaysia	Value	2,827,469	2,347,973	1,358,547	710,721	1,163,130
Mexico	Value	89,775	3,016	215,797	55,347	218,316
Singapore	Value	201,901	230,642	371,131	127,861	296,406
South Korea	Value	730,067	525,061	1,378,010	332,065	783,916
Thailand	Value	1,494,275	1,319,171	1,691,449	751,562	2,031,619
Vietnam	Value	2,586,760	2,249,758	3,542,696	1,203,119	2,221,096
All other sources	Value	591,659	218,870	520,218	203,719	377,811
All import sources	Value	8,743,953	7,241,096	10,130,402	3,611,673	9,261,365

Table continued.

Table F-3 Continued
CSPV modules: U.S. imports, by source

Unit value in dollars per kilowatt; Share in percent

Source	Measure	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Cambodia	Unit value	248	284	334	266	363
India	Unit value	470	294	459	218	698
Malaysia	Unit value	311	320	293	289	302
Mexico	Unit value	476	791	400	480	338
Singapore	Unit value	302	381	525	396	627
South Korea	Unit value	324	300	450	319	491
Thailand	Unit value	347	314	349	329	407
Vietnam	Unit value	343	299	335	333	302
All other sources	Unit value	302	238	320	295	421
All import sources	Unit value	327	308	350	317	380
Cambodia	Share of quantity	2.0	3.4	8.2	7.1	12.6
India	Share of quantity	0.7	1.7	2.0	0.6	6.2
Malaysia	Share of quantity	34.0	31.1	16.0	21.6	15.8
Mexico	Share of quantity	0.7	0.0	1.9	1.0	2.6
Singapore	Share of quantity	2.5	2.6	2.4	2.8	1.9
South Korea	Share of quantity	8.4	7.4	10.6	9.1	6.5
Thailand	Share of quantity	16.1	17.8	16.7	20.0	20.5
Vietnam	Share of quantity	28.2	31.9	36.6	31.7	30.1
All other sources	Share of quantity	7.3	3.9	5.6	6.1	3.7
All import sources	Share of quantity	100.0	100.0	100.0	100.0	100.0

Source: Compiled from official U.S. import statistics of the U.S. Department of Commerce using statistical reporting numbers 8541.40.6015, 8541.40.6035, 8541.43.0010, and 8541.43.0080, accessed August 22, 2023. Imports are based on the imports for consumption data series and value data reflect landed duty-paid values.

Table F-4
CSPV cells: TRQ fill rates

Year	Quota Limit (kilowatts)	Entered Quantity (kilowatts)	Percent Filled
2018	2,500,000	706,980	28.3
2019	2,500,000	2,370,281	94.8
2020	2,500,000	2,098,333	83.9
2021	2,500,000	2,498,741	100.0
2022	5,000,000	2,681,542	53.6

Source: https://www.cbp.gov/sites/default/files/assets/documents/2023-May/CSPV%20Solar%20Cells%20Historical%20Fill%20Table_0.pdf, accessed on October 23, 2023.

Note: Each year presented is for the TRQ period beginning February 7 and ending February 6. Since the imposition of the safeguard measure, the level of imported cells subject to the TRQ reached 2.5 GW in its fourth year (February 7, 2021 - February 6, 2022).

Note: As of December 18, 2023, the TRQ for the period beginning February 7, 2023, has been 65.98 percent filled. See U.S. Customs and Border Protection, Weekly Commodity Status Reports, December 11, 2023, https://www.cbp.gov/trade/quota/tariff-rate-quotas.

Table F-5
CSPV products: U.S. imports in the twelve-month period through to and including the specified month and year, by source and period

Quantity in kilowatts

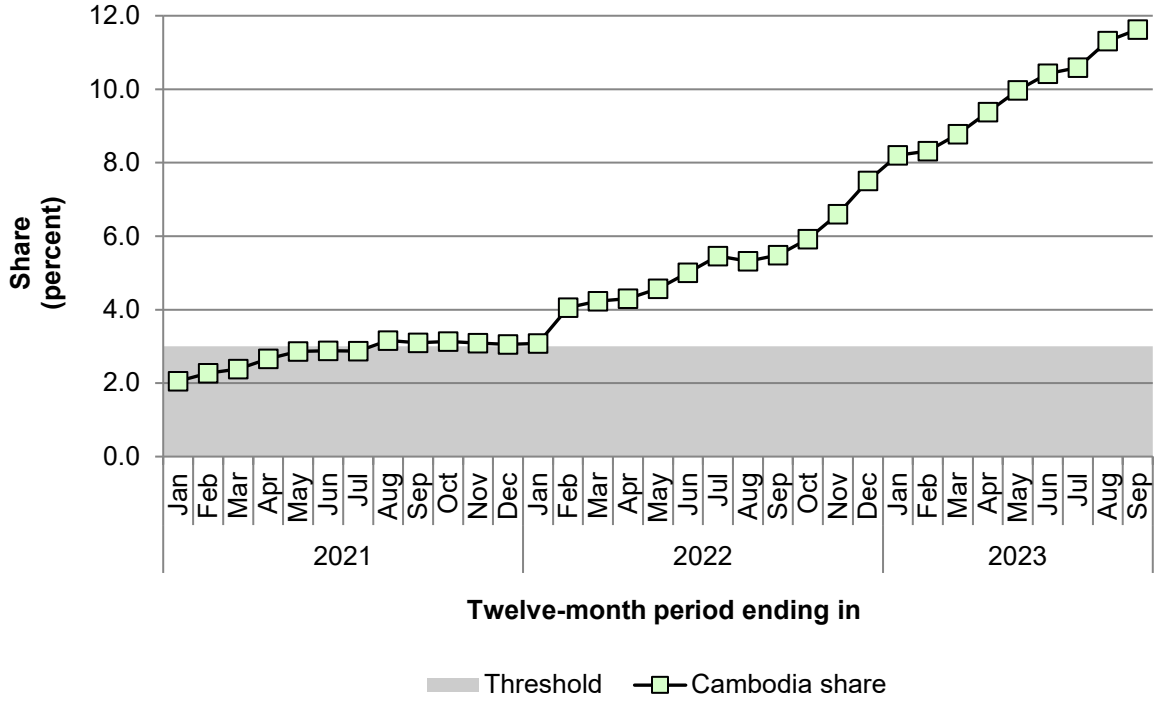
Twelve-month period through to and including	Cambodia quantity	Other than Cambodia quantity	All import sources quantity	Cambodia share	Other than Cambodia share	All import sources share
January 2021	585,934	27,951,292	28,537,226	2.1	97.9	100.0
February 2021	634,901	27,292,145	27,927,046	2.3	97.7	100.0
March 2021	664,548	27,188,480	27,853,028	2.4	97.6	100.0
April 2021	747,951	27,351,902	28,099,853	2.7	97.3	100.0
May 2021	815,545	27,658,858	28,474,403	2.9	97.1	100.0
June 2021	814,595	27,452,711	28,267,307	2.9	97.1	100.0
July 2021	805,895	27,289,067	28,094,962	2.9	97.1	100.0
August 2021	872,606	26,769,428	27,642,033	3.2	96.8	100.0
September 2021	847,778	26,507,589	27,355,368	3.1	96.9	100.0
October 2021	856,236	26,447,897	27,304,133	3.1	96.9	100.0
November 2021	831,937	26,083,045	26,914,982	3.1	96.9	100.0
December 2021	800,620	25,416,388	26,217,008	3.1	96.9	100.0
January 2022	799,609	25,133,514	25,933,123	3.1	96.9	100.0
February 2022	1,043,887	24,662,443	25,706,330	4.1	95.9	100.0
March 2022	1,070,100	24,196,707	25,266,807	4.2	95.8	100.0
April 2022	1,067,243	23,739,639	24,806,882	4.3	95.7	100.0
May 2022	1,117,924	23,350,087	24,468,011	4.6	95.4	100.0
June 2022	1,203,675	22,860,125	24,063,800	5.0	95.0	100.0
July 2022	1,308,993	22,671,051	23,980,044	5.5	94.5	100.0
August 2022	1,323,306	23,535,074	24,858,379	5.3	94.7	100.0
September 2022	1,426,330	24,577,819	26,004,149	5.5	94.5	100.0
October 2022	1,629,998	25,912,120	27,542,118	5.9	94.1	100.0
November 2022	1,919,938	27,151,238	29,071,177	6.6	93.4	100.0
December 2022	2,371,254	29,232,734	31,603,987	7.5	92.5	100.0
January 2023	2,815,156	31,513,695	34,328,851	8.2	91.8	100.0
February 2023	3,022,043	33,310,493	36,332,537	8.3	91.7	100.0
March 2023	3,420,534	35,542,844	38,963,378	8.8	91.2	100.0
April 2023	3,817,022	36,866,944	40,683,965	9.4	90.6	100.0
May 2023	4,248,722	38,374,341	42,623,063	10.0	90.0	100.0
June 2023	4,653,674	39,977,262	44,630,935	10.4	89.6	100.0
July 2023	5,102,707	43,071,376	48,174,084	10.6	89.4	100.0
August 2023	5,713,104	44,796,937	50,510,041	11.3	88.7	100.0
September 2023	6,144,775	46,700,641	52,845,415	11.6	88.4	100.0

Source: Compiled from official U.S. import statistics of the U.S. Department of Commerce Census Bureau using statistical reporting numbers 8541.40.6015, 8541.40.6025, 8541.40.6035, 8541.40.6045, 8541.42.0010, 8541.42.0080, 8541.43.0010, and 8541.43.0080, accessed November 28, 2023. Imports are based on the imports for consumption data series.

Note: These are based on twelve months of data aggregated through the specified year and month, so the observation for January 2021 reflects the February 2020 through January 2021 twelve-month period.

Note: Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent. Zeroes, null values, and undefined calculations are suppressed and shown as “---“.

Figure F-1
CSPV products: U.S. imports in the twelve-month period through to and including the specified month and year, by source and period



Source: Compiled from official U.S. import statistics of the U.S. Department of Commerce Census Bureau using statistical reporting numbers 8541.40.6015, 8541.40.6025, 8541.40.6035, 8541.40.6045, 8541.42.0010, 8541.42.0080, 8541.43.0010, and 8541.43.0080, accessed November 28, 2023. Imports are based on the imports for consumption data series.

Note: These are based on twelve months of data aggregated through the specified year and month, so the observation for January 2021 reflects the February 2020 through January 2021 twelve-month period.

Table F-6
CSPV cells: U.S. imports in the twelve-month period through to and including the specified month and year, by source and period

Quantity in kilowatts

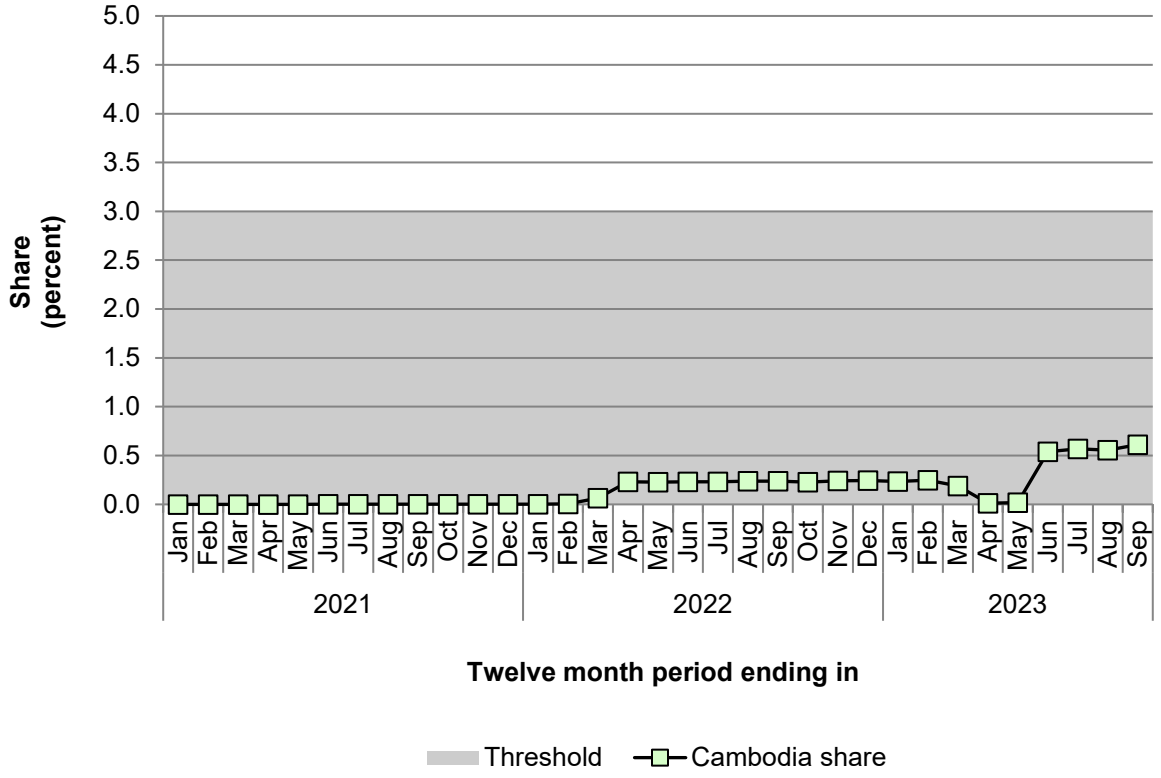
Twelve-month period through to and including	Cambodia quantity	Other than Cambodia quantity	All import sources quantity	Cambodia share	Other than Cambodia share	All import sources share
January 2021	---	2,124,337	2,124,337	---	100.0	100.0
February 2021	---	1,987,241	1,987,241	---	100.0	100.0
March 2021	---	1,994,679	1,994,679	---	100.0	100.0
April 2021	---	2,015,072	2,015,072	---	100.0	100.0
May 2021	---	2,059,457	2,059,457	---	100.0	100.0
June 2021	30	2,175,389	2,175,419	0.0	100.0	100.0
July 2021	33	2,323,894	2,323,927	0.0	100.0	100.0
August 2021	46	2,416,415	2,416,461	0.0	100.0	100.0
September 2021	46	2,479,782	2,479,827	0.0	100.0	100.0
October 2021	46	2,448,638	2,448,684	0.0	100.0	100.0
November 2021	46	2,544,091	2,544,136	0.0	100.0	100.0
December 2021	46	2,678,095	2,678,141	0.0	100.0	100.0
January 2022	46	2,560,494	2,560,541	0.0	100.0	100.0
February 2022	152	2,718,935	2,719,087	0.0	100.0	100.0
March 2022	1,836	2,810,246	2,812,082	0.1	99.9	100.0
April 2022	6,361	2,739,858	2,746,219	0.2	99.8	100.0
May 2022	6,361	2,767,451	2,773,812	0.2	99.8	100.0
June 2022	6,375	2,736,960	2,743,335	0.2	99.8	100.0
July 2022	6,372	2,747,537	2,753,909	0.2	99.8	100.0
August 2022	6,359	2,669,956	2,676,316	0.2	99.8	100.0
September 2022	6,359	2,660,525	2,666,884	0.2	99.8	100.0
October 2022	6,359	2,770,284	2,776,644	0.2	99.8	100.0
November 2022	6,532	2,712,997	2,719,529	0.2	99.8	100.0
December 2022	6,531	2,657,336	2,663,867	0.2	99.8	100.0
January 2023	6,589	2,808,873	2,815,461	0.2	99.8	100.0
February 2023	6,483	2,611,677	2,618,160	0.2	99.8	100.0
March 2023	4,799	2,548,588	2,553,387	0.2	99.8	100.0
April 2023	274	2,592,867	2,593,141	0.0	100.0	100.0
May 2023	476	2,579,153	2,579,629	0.0	100.0	100.0
June 2023	14,541	2,679,000	2,693,542	0.5	99.5	100.0
July 2023	15,400	2,688,987	2,704,387	0.6	99.4	100.0
August 2023	15,992	2,860,659	2,876,651	0.6	99.4	100.0
September 2023	18,206	2,959,786	2,977,992	0.6	99.4	100.0

Source: Compiled from official U.S. import statistics of the U.S. Department of Commerce Census Bureau using statistical reporting numbers 8541.40.6025, 8541.40.6045, 8541.42.0010, and 8541.42.0080, accessed November 28, 2023. Imports are based on the imports for consumption data series.

Note: These are based on twelve months of data aggregated through the specified year and month, so the observation for January 2021 reflects the February 2020 through January 2021 twelve-month period.

Note: Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent. Zeroes, null values, and undefined calculations are suppressed and shown as “---“.

Figure F-2
CSPV cells: U.S. imports in the twelve-month period through to and including the specified month and year, by source and period



Source: Compiled from official U.S. import statistics of the U.S. Department of Commerce Census Bureau using statistical reporting numbers 8541.40.6025, 8541.40.6045, 8541.42.0010, and 8541.42.0080, accessed November 28, 2023. Imports are based on the imports for consumption data series.

Note: These are based on twelve months of data aggregated through the specified year and month, so the observation for January 2021 reflects the February 2020 through January 2021 twelve-month period.

Table F-7
CSPV modules: U.S. imports in the twelve-month period through to and including the specified month and year, by source and period

Quantity in kilowatts

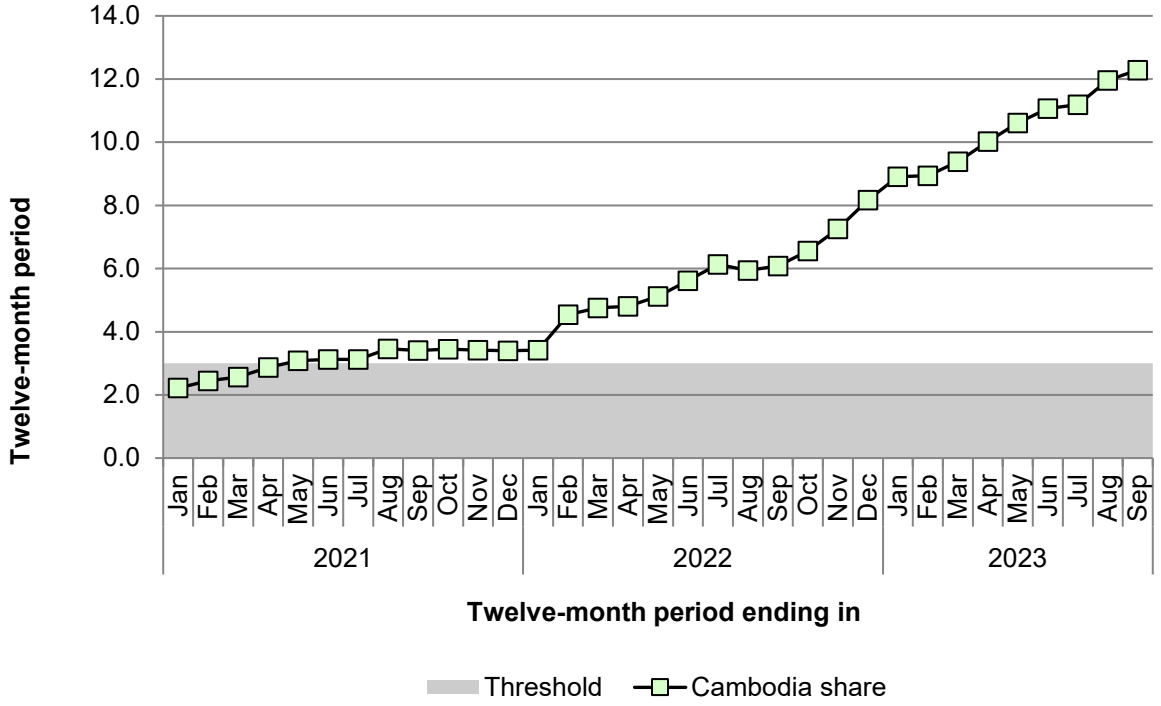
Twelve-month period through to and including	Cambodia quantity	Other than Cambodia quantity	All import sources quantity	Cambodia share	Other than Cambodia share	All import sources share
January 2021	585,934	25,826,956	26,412,889	2.2	97.8	100.0
February 2021	634,901	25,304,904	25,939,805	2.4	97.6	100.0
March 2021	664,548	25,193,801	25,858,349	2.6	97.4	100.0
April 2021	747,951	25,336,829	26,084,780	2.9	97.1	100.0
May 2021	815,545	25,599,401	26,414,946	3.1	96.9	100.0
June 2021	814,565	25,277,323	26,091,888	3.1	96.9	100.0
July 2021	805,862	24,965,174	25,771,035	3.1	96.9	100.0
August 2021	872,560	24,353,013	25,225,573	3.5	96.5	100.0
September 2021	847,733	24,027,808	24,875,541	3.4	96.6	100.0
October 2021	856,191	23,999,259	24,855,450	3.4	96.6	100.0
November 2021	831,892	23,538,954	24,370,846	3.4	96.6	100.0
December 2021	800,573	22,738,293	23,538,866	3.4	96.6	100.0
January 2022	799,563	22,573,019	23,372,582	3.4	96.6	100.0
February 2022	1,043,736	21,943,508	22,987,244	4.5	95.5	100.0
March 2022	1,068,264	21,386,461	22,454,725	4.8	95.2	100.0
April 2022	1,060,882	20,999,781	22,060,663	4.8	95.2	100.0
May 2022	1,111,563	20,582,636	21,694,199	5.1	94.9	100.0
June 2022	1,197,300	20,123,165	21,320,465	5.6	94.4	100.0
July 2022	1,302,622	19,923,513	21,226,135	6.1	93.9	100.0
August 2022	1,316,946	20,865,117	22,182,064	5.9	94.1	100.0
September 2022	1,419,971	21,917,294	23,337,265	6.1	93.9	100.0
October 2022	1,623,638	23,141,835	24,765,474	6.6	93.4	100.0
November 2022	1,913,406	24,438,241	26,351,648	7.3	92.7	100.0
December 2022	2,364,723	26,575,398	28,940,121	8.2	91.8	100.0
January 2023	2,808,567	28,704,823	31,513,390	8.9	91.1	100.0
February 2023	3,015,560	30,698,817	33,714,377	8.9	91.1	100.0
March 2023	3,415,735	32,994,257	36,409,991	9.4	90.6	100.0
April 2023	3,816,748	34,274,077	38,090,824	10.0	90.0	100.0
May 2023	4,248,247	35,795,188	40,043,435	10.6	89.4	100.0
June 2023	4,639,132	37,298,261	41,937,393	11.1	88.9	100.0
July 2023	5,087,307	40,382,390	45,469,697	11.2	88.8	100.0
August 2023	5,697,112	41,936,278	47,633,390	12.0	88.0	100.0
September 2023	6,126,568	43,740,855	49,867,423	12.3	87.7	100.0

Source: Compiled from official U.S. import statistics of the U.S. Department of Commerce Census Bureau using statistical reporting numbers 8541.40.6015, 8541.40.6035, 8541.43.0010, and 8541.43.0080, accessed November 28, 2023. Imports are based on the imports for consumption data series.

Note: These are based on twelve months of data aggregated through the specified year and month, so the observation for January 2021 reflects the February 2020 through January 2021 twelve-month period.

Note: Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent. Zeroes, null values, and undefined calculations are suppressed and shown as “---“.

Figure F-3
CSPV modules: U.S. imports in the twelve-month period through to and including the specified month and year, by source and period



Source: Compiled from official U.S. import statistics of the U.S. Department of Commerce Census Bureau using statistical reporting numbers 8541.40.6015, 8541.40.6035, 8541.43.0010, and 8541.43.0080, accessed November 28, 2023. Imports are based on the imports for consumption data series.

Note: These are based on twelve months of data aggregated through the specified year and month, so the observation for January 2021 reflects the February 2020 through January 2021 twelve-month period.

Table F-8
CSPV cells: U.S. imports, by duty status, source, and period

Quantity in kilowatts; share in percent

Duty status	Source	Measure	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Subject to chapter 99 provisions: Dutied	Malaysia	Quantity	---	5,205	---	---	2,278
Subject to chapter 99 provisions: Not dutied	Malaysia	Quantity	---	---	7	---	1,505
Subject to chapter 99 provisions: Total	Malaysia	Quantity	---	5,205	7	---	3,782
Not subject to chapter 99 provisions	Malaysia	Quantity	238,076	706,874	1,622,684	718,457	732,502
All duty statuses	Malaysia	Quantity	238,076	712,079	1,622,691	718,457	736,284
Subject to chapter 99 provisions: Dutied	Malaysia	Share	---	0.7	---	---	0.3
Subject to chapter 99 provisions: Not dutied	Malaysia	Share	---	---	0.0	---	0.2
Subject to chapter 99 provisions: Total	Malaysia	Share	---	0.7	0.0	---	0.5
Not subject to chapter 99 provisions	Malaysia	Share	100.0	99.3	100.0	100.0	99.5
All duty statuses	Malaysia	Share	100.0	100.0	100.0	100.0	100.0
Subject to chapter 99 provisions: Dutied	South Korea	Quantity	6	---	---	---	---
Subject to chapter 99 provisions: Not dutied	South Korea	Quantity	---	---	---	---	---
Subject to chapter 99 provisions: Total	South Korea	Quantity	6	---	---	---	---
Not subject to chapter 99 provisions	South Korea	Quantity	1,316,610	1,196,836	82,973	82,808	25,930
All duty statuses	South Korea	Quantity	1,316,615	1,196,836	82,973	82,808	25,930
Subject to chapter 99 provisions: Dutied	South Korea	Share	0.0	---	---	---	---
Subject to chapter 99 provisions: Not dutied	South Korea	Share	---	---	---	---	---
Subject to chapter 99 provisions: Total	South Korea	Share	0.0	---	---	---	---
Not subject to chapter 99 provisions	South Korea	Share	100.0	100.0	100.0	100	100
All duty statuses	South Korea	Share	100.0	100.0	100.0	100.0	100.0

Table continued.

Table F-8 Continued
CSPV cells: U.S. imports, by duty status, source, and period

Quantity in kilowatts; share in percent

Duty status	Source	Measure	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Subject to chapter 99 provisions: Dutied	Vietnam	Quantity	10	2,302	34,337	32,665	---
Subject to chapter 99 provisions: Not dutied	Vietnam	Quantity	---	3,458	11	---	---
Subject to chapter 99 provisions: Total	Vietnam	Quantity	10	5,760	34,349	32,665	---
Not subject to chapter 99 provisions	Vietnam	Quantity	196,706	522,345	648,620	278,475	298,227
All duty statuses	Vietnam	Quantity	196,715	528,105	682,969	311,140	298,227
Subject to chapter 99 provisions: Dutied	Vietnam	Share	0.0	0.4	5.0	10.5	---
Subject to chapter 99 provisions: Not dutied	Vietnam	Share	---	0.7	0.0	---	---
Subject to chapter 99 provisions: Total	Vietnam	Share	0.0	1.1	5.0	10.5	---
Not subject to chapter 99 provisions	Vietnam	Share	100.0	98.9	95.0	89.5	100.0
All duty statuses	Vietnam	Share	100.0	100.0	100.0	100.0	100.0
Subject to chapter 99 provisions: Dutied	China	Quantity	225,186	2,052	10	0	13
Subject to chapter 99 provisions: Not dutied	China	Quantity	9,338	2,754	1,906	1,556	940
Subject to chapter 99 provisions: Total	China	Quantity	234,524	4,805	1,915	1,556	952
Not subject to chapter 99 provisions	China	Quantity	3,122	4	3,859	2,737	---
All duty statuses	China	Quantity	237,646	4,809	5,775	4,293	952
Subject to chapter 99 provisions: Dutied	China	Share	94.8	42.7	0.2	0.0	1.3
Subject to chapter 99 provisions: Not dutied	China	Share	3.9	57.3	33.0	36.2	98.7
Subject to chapter 99 provisions: Total	China	Share	98.7	99.9	33.2	36.3	100.0
Not subject to chapter 99 provisions	China	Share	1.3	0.1	66.8	63.7	---
All duty statuses	China	Share	100.0	100.0	100.0	100.0	100.0

Table continued.

Table F-8 Continued
CSPV cells: U.S. imports, by duty status, source, and period

Quantity in kilowatts; share in percent

Duty status	Source	Measure	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Subject to chapter 99 provisions: Dutied	All other sources	Quantity	7,067	7,297	11,214	11,214	---
Subject to chapter 99 provisions: Not dutied	All other sources	Quantity	6	8	95	95	234
Subject to chapter 99 provisions: Total	All other sources	Quantity	7,072	7,305	11,309	11,309	234
Not subject to chapter 99 provisions	All other sources	Quantity	226,147	229,007	258,150	158,127	254,182
All duty statuses	All other sources	Quantity	233,220	236,312	269,459	169,436	254,415
Subject to chapter 99 provisions: Dutied	All other sources	Share	3.0	3.1	4.2	6.6	---
Subject to chapter 99 provisions: Not dutied	All other sources	Share	0.0	0.0	0.0	0.1	0.1
Subject to chapter 99 provisions: Total	All other sources	Share	3.0	3.1	4.2	6.7	0.1
Not subject to chapter 99 provisions	All other sources	Share	97.0	96.9	95.8	93.3	99.9
All duty statuses	All other sources	Share	100.0	100.0	100.0	100.0	100.0
Subject to chapter 99 provisions: Dutied	All import sources	Quantity	232,269	16,855	45,561	43,880	2,290
Subject to chapter 99 provisions: Not dutied	All import sources	Quantity	9,343	6,220	2,019	1,651	2,678
Subject to chapter 99 provisions: Total	All import sources	Quantity	241,612	23,075	47,580	45,531	4,968
Not subject to chapter 99 provisions	All import sources	Quantity	1,980,661	2,655,066	2,616,286	1,240,603	1,310,841
All duty statuses	All import sources	Quantity	2,222,272	2,678,141	2,663,867	1,286,134	1,315,809
Subject to chapter 99 provisions: Dutied	All import sources	Share	10.5	0.6	1.7	3.4	0.2
Subject to chapter 99 provisions: Not dutied	All import sources	Share	0.4	0.2	0.1	0.1	0.2
Subject to chapter 99 provisions: Total	All import sources	Share	10.9	0.9	1.8	3.5	0.4
Not subject to chapter 99 provisions	All import sources	Share	89.1	99.1	98.2	96.5	99.6
All duty statuses	All import sources	Share	100.0	100.0	100.0	100.0	100.0

Source: Compiled from official U.S. import statistics of the U.S. Department of Commerce Census Bureau using statistical reporting numbers 8541.40.6025, 8541.40.6045, 8541.42.0010, and 8541.42.0080, accessed November 28, 2023. Imports are based on the imports for consumption data series. The category "subject to special duties" is based on rate provision codes tied to the Chapter 99 provisions. The rate provision codes do not differentiate between which chapter 99 provisions were applicable, however, for these statistical reporting numbers the chapter 99 provisions for 232 duties are not applicable, so the only overlap might be with imports from China subject to special 301 duties in addition to the special solar safeguard duties under chapter 99 tariff lines 9903.45.21, 9903.45.22, 9903.45.25, and 9903.45.27.

Note: Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent. Zeroes, null values, and undefined calculations are suppressed and shown as "---".

Table F-9
CSPV modules: U.S. imports, by duty status, source, and period

Quantity in kilowatts; share in percent

Duty status	Source	Measure	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Subject to chapter 99 provisions: Dutied	Vietnam	Quantity	3,391,962	3,878,334	957,269	260,060	694,448
Subject to chapter 99 provisions: Not dutied	Vietnam	Quantity	301,338	629,718	185,810	66,286	17,266
Subject to chapter 99 provisions: Total	Vietnam	Quantity	3,693,300	4,508,052	1,143,079	326,346	711,713
Not subject to chapter 99 provisions	Vietnam	Quantity	3,847,276	3,012,588	9,440,653	3,290,732	6,635,752
All duty statuses	Vietnam	Quantity	7,540,576	7,520,640	10,583,731	3,617,077	7,347,466
Subject to chapter 99 provisions: Dutied	Vietnam	Share	45.0	51.6	9.0	7.2	9.5
Subject to chapter 99 provisions: Not dutied	Vietnam	Share	4.0	8.4	1.8	1.8	0.2
Subject to chapter 99 provisions: Total	Vietnam	Share	49.0	59.9	10.8	9.0	9.7
Not subject to chapter 99 provisions	Vietnam	Share	51.0	40.1	89.2	91.0	90.3
All duty statuses	Vietnam	Share	100.0	100.0	100.0	100.0	100.0
Subject to chapter 99 provisions: Dutied	Malaysia	Quantity	5,060,096	4,247,689	416,395	246,386	294,283
Subject to chapter 99 provisions: Not dutied	Malaysia	Quantity	114,921	959,487	157,709	95,856	35,971
Subject to chapter 99 provisions: Total	Malaysia	Quantity	5,175,017	5,207,176	574,104	342,243	330,254
Not subject to chapter 99 provisions	Malaysia	Quantity	3,912,964	2,125,014	4,069,021	2,115,742	3,525,605
All duty statuses	Malaysia	Quantity	9,087,981	7,332,190	4,643,125	2,457,984	3,855,860
Subject to chapter 99 provisions: Dutied	Malaysia	Share	55.7	57.9	9.0	10.0	7.6
Subject to chapter 99 provisions: Not dutied	Malaysia	Share	1.3	13.1	3.4	3.9	0.9
Subject to chapter 99 provisions: Total	Malaysia	Share	56.9	71.0	12.4	13.9	8.6
Not subject to chapter 99 provisions	Malaysia	Share	43.1	29.0	87.6	86.1	91.4
All duty statuses	Malaysia	Share	100.0	100.0	100.0	100.0	100.0

Table continued.

Table F-9 Continued
CSPV modules: U.S. imports, by duty status, source, and period

Quantity in kilowatts; share in percent

Duty status	Source	Measure	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Subject to chapter 99 provisions: Dutied	Thailand	Quantity	1,861,785	3,468,150	948,268	478,572	539,062
Subject to chapter 99 provisions: Not dutied	Thailand	Quantity	49,251	523,007	142,054	73,151	8,196
Subject to chapter 99 provisions: Total	Thailand	Quantity	1,911,036	3,991,156	1,090,322	551,723	547,257
Not subject to chapter 99 provisions	Thailand	Quantity	2,389,774	208,561	3,752,623	1,732,133	4,448,545
All duty statuses	Thailand	Quantity	4,300,810	4,199,717	4,842,945	2,283,856	4,995,802
Subject to chapter 99 provisions: Dutied	Thailand	Share	43.3	82.6	19.6	21.0	10.8
Subject to chapter 99 provisions: Not dutied	Thailand	Share	1.1	12.5	2.9	3.2	0.2
Subject to chapter 99 provisions: Total	Thailand	Share	44.4	95.0	22.5	24.2	11.0
Not subject to chapter 99 provisions	Thailand	Share	55.6	5.0	77.5	75.8	89.0
All duty statuses	Thailand	Share	100.0	100.0	100.0	100.0	100.0
Subject to chapter 99 provisions: Dutied	South Korea	Quantity	312,983	169,891	12,927	5,794	268
Subject to chapter 99 provisions: Not dutied	South Korea	Quantity	37,784	26,096	384	384	---
Subject to chapter 99 provisions: Total	South Korea	Quantity	350,767	195,986	13,311	6,178	268
Not subject to chapter 99 provisions	South Korea	Quantity	1,900,918	1,553,513	3,046,747	1,033,995	1,594,914
All duty statuses	South Korea	Quantity	2,251,685	1,749,500	3,060,058	1,040,173	1,595,182
Subject to chapter 99 provisions: Dutied	South Korea	Share	13.9	9.7	0.4	0.6	0.0
Subject to chapter 99 provisions: Not dutied	South Korea	Share	1.7	1.5	0.0	0.0	---
Subject to chapter 99 provisions: Total	South Korea	Share	15.6	11.2	0.4	0.6	0.0
Not subject to chapter 99 provisions	South Korea	Share	84.4	88.8	99.6	99.4	100.0
All duty statuses	South Korea	Share	100.0	100.0	100.0	100.0	100.0

Table continued.

Table F-9 Continued
CSPV modules: U.S. imports, by duty status, source, and period

Quantity in kilowatts; share in percent

Duty status	Source	Measure	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Subject to chapter 99 provisions: Dutied	Cambodia	Quantity	521	---	---	---	---
Subject to chapter 99 provisions: Not dutied	Cambodia	Quantity	---	---	---	---	---
Subject to chapter 99 provisions: Total	Cambodia	Quantity	521	---	---	---	---
Not subject to chapter 99 provisions	Cambodia	Quantity	547,337	800,573	2,364,723	803,348	3,077,758
All duty statuses	Cambodia	Quantity	547,858	800,573	2,364,723	803,348	3,077,758
Subject to chapter 99 provisions: Dutied	Cambodia	Share	0.1	---	---	---	---
Subject to chapter 99 provisions: Not dutied	Cambodia	Share	---	---	---	---	---
Subject to chapter 99 provisions: Total	Cambodia	Share	0.1	---	---	---	---
Not subject to chapter 99 provisions	Cambodia	Share	99.9	100.0	100.0	100.0	100.0
All duty statuses	Cambodia	Share	100.0	100.0	100.0	100.0	100.0
Subject to chapter 99 provisions: Dutied	India	Quantity	83,166	302,687	33,529	1,589	166,348
Subject to chapter 99 provisions: Not dutied	India	Quantity	18,013	22,607	11,664	2,736	4,149
Subject to chapter 99 provisions: Total	India	Quantity	101,179	325,294	45,193	4,325	170,497
Not subject to chapter 99 provisions	India	Quantity	82,152	80,860	526,260	58,704	1,333,721
All duty statuses	India	Quantity	183,331	406,153	571,453	63,029	1,504,219
Subject to chapter 99 provisions: Dutied	India	Share	45.4	74.5	5.9	2.5	11.1
Subject to chapter 99 provisions: Not dutied	India	Share	9.8	5.6	2.0	4.3	0.3
Subject to chapter 99 provisions: Total	India	Share	55.2	80.1	7.9	6.9	11.3
Not subject to chapter 99 provisions	India	Share	44.8	19.9	92.1	93.1	88.7
All duty statuses	India	Share	100.0	100.0	100.0	100.0	100.0

Table continued.

Table F-9 Continued
CSPV modules: U.S. imports, by duty status, source, and period

Quantity in kilowatts; share in percent

Duty status	Source	Measure	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Subject to chapter 99 provisions: Dutied	Singapore	Quantity	505,587	589,760	87,032	79,274	1,270
Subject to chapter 99 provisions: Not dutied	Singapore	Quantity	6,998	15,621	72,509	22,825	27,922
Subject to chapter 99 provisions: Total	Singapore	Quantity	512,586	605,381	159,541	102,099	29,192
Not subject to chapter 99 provisions	Singapore	Quantity	155,101	---	547,253	220,704	443,288
All duty statuses	Singapore	Quantity	667,687	605,381	706,794	322,802	472,480
Subject to chapter 99 provisions: Dutied	Singapore	Share	75.7	97.4	12.3	24.6	0.3
Subject to chapter 99 provisions: Not dutied	Singapore	Share	1.0	2.6	10.3	7.1	5.9
Subject to chapter 99 provisions: Total	Singapore	Share	76.8	100.0	22.6	31.6	6.2
Not subject to chapter 99 provisions	Singapore	Share	23.2	---	77.4	68.4	93.8
All duty statuses	Singapore	Share	100.0	100.0	100.0	100.0	100.0
Subject to chapter 99 provisions: Dutied	China	Quantity	744,633	21,655	17,338	14,238	1,705
Subject to chapter 99 provisions: Not dutied	China	Quantity	338,179	185,011	171,176	111,919	26,035
Subject to chapter 99 provisions: Total	China	Quantity	1,082,812	206,666	188,514	126,156	27,739
Not subject to chapter 99 provisions	China	Quantity	76,696	7,006	2,249	1,955	210
All duty statuses	China	Quantity	1,159,508	213,672	190,763	128,111	27,949
Subject to chapter 99 provisions: Dutied	China	Share	64.2	10.1	9.1	11.1	6.1
Subject to chapter 99 provisions: Not dutied	China	Share	29.2	86.6	89.7	87.4	93.2
Subject to chapter 99 provisions: Total	China	Share	93.4	96.7	98.8	98.5	99.2
Not subject to chapter 99 provisions	China	Share	6.6	3.3	1.2	1.5	0.8
All duty statuses	China	Share	100.0	100.0	100.0	100.0	100.0

Table continued.

Table F-9 Continued
CSPV modules: U.S. imports, by duty status, source, and period

Quantity in kilowatts; share in percent

Duty status	Source	Measure	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Subject to chapter 99 provisions: Dutied	Mexico	Quantity	---	21	---	---	32
Subject to chapter 99 provisions: Not dutied	Mexico	Quantity	---	---	502	---	---
Subject to chapter 99 provisions: Total	Mexico	Quantity	---	21	502	---	32
Not subject to chapter 99 provisions	Mexico	Quantity	188,759	3,790	538,893	115,272	646,185
All duty statuses	Mexico	Quantity	188,759	3,811	539,395	115,272	646,217
Subject to chapter 99 provisions: Dutied	Mexico	Share	---	0.6	---	---	0.0
Subject to chapter 99 provisions: Not dutied	Mexico	Share	---	---	0.1	---	---
Subject to chapter 99 provisions: Total	Mexico	Share	---	0.6	0.1	---	0.0
Not subject to chapter 99 provisions	Mexico	Share	100.0	99.4	99.9	100.0	100.0
All duty statuses	Mexico	Share	100.0	100.0	100.0	100.0	100.0
Subject to chapter 99 provisions: Dutied	Canada	Quantity	65,787	15,496	2,028	2,028	334
Subject to chapter 99 provisions: Not dutied	Canada	Quantity	1,058	13,618	---	---	---
Subject to chapter 99 provisions: Total	Canada	Quantity	66,845	29,113	2,028	2,028	334
Not subject to chapter 99 provisions	Canada	Quantity	136,186	136,662	431,121	98,674	333,504
All duty statuses	Canada	Quantity	203,030	165,776	433,150	100,702	333,838
Subject to chapter 99 provisions: Dutied	Canada	Share	32.4	9.3	0.5	2.0	0.1
Subject to chapter 99 provisions: Not dutied	Canada	Share	0.5	8.2	---	---	---
Subject to chapter 99 provisions: Total	Canada	Share	32.9	17.6	0.5	2.0	0.1
Not subject to chapter 99 provisions	Canada	Share	67.1	82.4	99.5	98.0	99.9
All duty statuses	Canada	Share	100.0	100.0	100.0	100.0	100.0

Table continued.

Table F-9 Continued
CSPV modules: U.S. imports, by duty status, source, and period

Quantity in kilowatts; share in percent

Duty status	Source	Measure	2020	2021	2022	Jan-Jun 2022	Jan-Jun 2023
Subject to chapter 99 provisions: Dutied	All other sources	Quantity	381,399	160,459	149,819	51,975	40,386
Subject to chapter 99 provisions: Not dutied	All other sources	Quantity	62,862	159,539	42,316	25,832	5,606
Subject to chapter 99 provisions: Total	All other sources	Quantity	444,261	319,998	192,135	77,807	45,993
Not subject to chapter 99 provisions	All other sources	Quantity	155,061	221,455	811,850	384,046	488,720
All duty statuses	All other sources	Quantity	599,322	541,453	1,003,985	461,853	534,713
Subject to chapter 99 provisions: Dutied	All other sources	Share	63.6	29.6	14.9	11.3	7.6
Subject to chapter 99 provisions: Not dutied	All other sources	Share	10.5	29.5	4.2	5.6	1.0
Subject to chapter 99 provisions: Total	All other sources	Share	74.1	59.1	19.1	16.8	8.6
Not subject to chapter 99 provisions	All other sources	Share	25.9	40.9	80.9	83.2	91.4
All duty statuses	All other sources	Share	100.0	100.0	100.0	100.0	100.0
Subject to chapter 99 provisions: Dutied	All import sources	Quantity	12,407,919	12,854,141	2,624,605	1,139,917	1,738,135
Subject to chapter 99 provisions: Not dutied	All import sources	Quantity	930,405	2,534,704	784,124	398,988	125,144
Subject to chapter 99 provisions: Total	All import sources	Quantity	13,338,324	15,388,845	3,408,729	1,538,905	1,863,279
Not subject to chapter 99 provisions	All import sources	Quantity	13,392,225	8,150,022	25,531,392	9,855,304	22,528,202
All duty statuses	All import sources	Quantity	26,730,548	23,538,866	28,940,121	11,394,209	24,391,481
Subject to chapter 99 provisions: Dutied	All import sources	Share	46.4	54.6	9.1	10.0	7.1
Subject to chapter 99 provisions: Not dutied	All import sources	Share	3.5	10.8	2.7	3.5	0.5
Subject to chapter 99 provisions: Total	All import sources	Share	49.9	65.4	11.8	13.5	7.6
Not subject to chapter 99 provisions	All import sources	Share	50.1	34.6	88.2	86.5	92.4
All duty statuses	All import sources	Share	100.0	100.0	100.0	100.0	100.0

Source: Compiled from official U.S. import statistics of the U.S. Department of Commerce Census Bureau using statistical reporting numbers 8541.40.6015, 8541.40.6035, 8541.43.0010, and 8541.43.0080, accessed November 28, 2023. Imports are based on the imports for consumption data series. The category "subject to special duties" is based on rate provision codes tied to the Chapter 99 provisions. The rate provision codes do not differentiate between which chapter 99 provisions were applicable, however, for these statistical reporting numbers the chapter 99 provisions for 232 duties are not applicable, so the only overlap might be with imports from China subject to special 301 duties in addition to the special solar safeguard duties under chapter 99 tariff lines 9903.45.21, 9903.45.22, 9903.45.25, and 9903.45.27.

Note: Shares and ratios shown as "0.0" represent values greater than zero, but less than "0.05" percent. Zeroes, null values, and undefined calculations are suppressed and shown as “---“.

APPENDIX G

DATA TABLES SUPPORTING FIGURES IN PART II

Table G-1
Types of U.S. electricity generation: Total electricity generation in the United States, by type, 2018-22 annual and January-June 2023

Quantity in thousand megawatt hours

Period	Natural gas	Coal	Nuclear	Wind	Solar	All other	Total
2018	1,471,843	1,149,487	807,084	272,667	93,365	386,542	4,180,988
2019	1,588,533	964,957	809,409	295,882	106,894	364,899	4,130,574
2020	1,626,790	773,393	789,879	337,938	130,721	351,046	4,009,767
2021	1,579,190	897,999	779,645	378,197	164,422	310,246	4,109,699
2022	1,689,465	828,993	771,537	434,812	204,110	314,219	4,243,136
1H 2023	814,654	297,603	377,436	227,800	115,986	139,358	1,972,837

Source: U.S. EIA, http://www.eia.gov/electricity/data/browser/, retrieved October 7, 2023.

Table G-2
Types of U.S. electricity generation: Share of total electricity generation in the United States, by type, 2018-22 annual and January-June 2023

Shares in percent

Period	Natural gas	Coal	Nuclear	Wind	Solar	All other	Total
2018	35.2	27.5	19.3	6.5	2.2	9.2	100.0
2019	38.5	23.4	19.6	7.2	2.6	8.8	100.0
2020	40.6	19.3	19.7	8.4	3.3	8.8	100.0
2021	38.4	21.9	19.0	9.2	4.0	7.5	100.0
2022	39.8	19.5	18.2	10.2	4.8	7.4	100.0
1H 2023	41.3	15.1	19.1	11.5	5.9	7.1	100.0

Source: U.S. EIA, http://www.eia.gov/electricity/data/browser/, retrieved October 7, 2023.

Table G-3
Solar electricity generation: Net U.S. electricity generation for utility-scale solar PV, small-scale solar PV, and total solar PV, by month, January 2018-June 2023

Quantity in thousand megawatt hours

Period	Utility-scale solar PV	Small-scale solar PV	Total solar PV
2018 M1	3,319	1,619	4,938
2018 M2	3,896	1,766	5,663
2018 M3	5,056	2,434	7,490
2018 M4	6,057	2,740	8,796
2018 M5	6,849	3,011	9,860
2018 M6	7,415	3,059	10,474
2018 M7	6,755	3,146	9,901
2018 M8	6,695	3,017	9,712
2018 M9	5,961	2,674	8,635
2018 M10	4,970	2,392	7,361
2018 M11	3,743	1,905	5,648
2018 M12	3,110	1,775	4,885
2019 M1	3,580	1,903	5,483
2019 M2	3,836	2,059	5,895
2019 M3	5,899	2,914	8,813
2019 M4	6,752	3,245	9,997
2019 M5	7,162	3,549	10,711
2019 M6	7,971	3,604	11,575
2019 M7	8,133	3,760	11,893
2019 M8	7,877	3,611	11,488
2019 M9	6,817	3,205	10,022
2019 M10	6,093	2,833	8,926
2019 M11	4,364	2,228	6,592
2019 M12	3,453	2,047	5,500
2020 M1	4,459	2,313	6,771
2020 M2	5,561	2,623	8,184
2020 M3	6,350	3,424	9,774
2020 M4	7,921	3,816	11,736
2020 M5	9,653	4,267	13,921
2020 M6	9,654	4,269	13,923
2020 M7	10,610	4,405	15,015
2020 M8	9,315	4,199	13,514
2020 M9	7,732	3,722	11,454
2020 M10	7,085	3,310	10,395
2020 M11	5,767	2,687	8,453
2020 M12	5,091	2,489	7,580

Table continued on next page.

Table G-3—Continued
Solar electricity generation: Net U.S. electricity generation for utility-scale solar PV, small-scale solar PV, and total solar PV, by month, January 2018-June 2023

Quantity in thousand megawatt hours

Period	Utility-scale solar PV	Small-scale solar PV	Total solar PV
2021 M1	5,559	2,750	8,309
2021 M2	6,330	2,939	9,270
2021 M3	9,296	4,158	13,454
2021 M4	10,892	4,610	15,502
2021 M5	12,457	5,063	17,520
2021 M6	12,197	5,107	17,304
2021 M7	12,192	5,192	17,384
2021 M8	11,967	4,924	16,891
2021 M9	11,214	4,370	15,584
2021 M10	9,268	3,821	13,089
2021 M11	7,795	3,259	11,054
2021 M12	6,091	2,970	9,061
2022 M1	8,171	3,247	11,418
2022 M2	9,333	3,577	12,910
2022 M3	11,898	4,900	16,798
2022 M4	13,476	5,409	18,885
2022 M5	15,198	5,946	21,145
2022 M6	16,058	5,941	21,998
2022 M7	15,749	6,157	21,907
2022 M8	14,442	5,910	20,352
2022 M9	13,504	5,282	18,786
2022 M10	12,252	4,790	17,042
2022 M11	8,484	3,852	12,336
2022 M12	7,033	3,501	10,534
2023 M1	8,137	4,020	12,157
2023 M2	9,381	4,412	13,794
2023 M3	12,274	6,104	18,379
2023 M4	14,973	6,855	21,828
2023 M5	17,000	7,588	24,588
2023 M6	17,775	7,465	25,240

Source: U.S. EIA, http://www.eia.gov/electricity/data/browser/, retrieved October 7, 2023.

APPENDIX H

DATA TABLES SUPPORTING FIGURES IN PART VI

Table H-1
Wafer prices: Average prices for monocrystalline wafers, by month, January 2020-October 2023

Price in dollars per kilowatt

Period	210mm N-type mono wafer	210mm mono wafer	182mm N-type mono wafer	182mm mono wafer	161.7mm N-type mono wafer	156mm N-type mono wafer	156mm P-type mono wafer
2020 M1	***	***	***	***	***	***	***
2020 M2	***	***	***	***	***	***	***
2020 M3	***	***	***	***	***	***	***
2020 M4	***	***	***	***	***	***	***
2020 M5	***	***	***	***	***	***	***
2020 M6	***	***	***	***	***	***	***
2020 M7	***	***	***	***	***	***	***
2020 M8	***	***	***	***	***	***	***
2020 M9	***	***	***	***	***	***	***
2020 M10	***	***	***	***	***	***	***
2020 M11	***	***	***	***	***	***	***
2020 M12	***	***	***	***	***	***	***
2021 M1	***	***	***	***	***	***	***
2021 M2	***	***	***	***	***	***	***
2021 M3	***	***	***	***	***	***	***
2021 M4	***	***	***	***	***	***	***
2021 M5	***	***	***	***	***	***	***
2021 M6	***	***	***	***	***	***	***
2021 M7	***	***	***	***	***	***	***
2021 M8	***	***	***	***	***	***	***
2021 M9	***	***	***	***	***	***	***
2021 M10	***	***	***	***	***	***	***
2021 M11	***	***	***	***	***	***	***
2021 M12	***	***	***	***	***	***	***
2022 M1	***	***	***	***	***	***	***
2022 M2	***	***	***	***	***	***	***
2022 M3	***	***	***	***	***	***	***
2022 M4	***	***	***	***	***	***	***
2022 M5	***	***	***	***	***	***	***
2022 M6	***	***	***	***	***	***	***
2022 M7	***	***	***	***	***	***	***
2022 M8	***	***	***	***	***	***	***
2022 M9	***	***	***	***	***	***	***
2022 M10	***	***	***	***	***	***	***
2022 M11	***	***	***	***	***	***	***
2022 M12	***	***	***	***	***	***	***

Table continued on next page.

Table H-1—Continued
Wafer prices: Average prices for monocrystalline wafers, by month, January 2020-October 2023

Price in dollars per kilowatt

Period	210mm N-type mono wafer	210mm mono wafer	182mm N-type mono wafer	182mm mono wafer	161.7mm N-type mono wafer	156mm N-type mono wafer	156mm P-type mono wafer
2023 M1	***	***	***	***	***	***	***
2023 M2	***	***	***	***	***	***	***
2023 M3	***	***	***	***	***	***	***
2023 M4	***	***	***	***	***	***	***
2023 M5	***	***	***	***	***	***	***
2023 M6	***	***	***	***	***	***	***
2023 M7	***	***	***	***	***	***	***
2023 M8	***	***	***	***	***	***	***
2023 M9	***	***	***	***	***	***	***
2023 M10	***	***	***	***	***	***	***

Source: PVInsights, Spot Price Download, http://pvinsights.com/, accessed October 13, 2023.

Note: Data for 210mm mono wafers, 210mm N-type mono wafers, 182mm mono wafers, and 182mm N-type mono wafers became available beginning in June 2020.

Table H-2
Cell prices: Average prices for monocrystalline cells, by month, January 2020-October 2023

Price in dollars per kilowatt

Period	Mono cell	N-type mono cell	PERC mono cell
2020 M1	***	***	***
2020 M2	***	***	***
2020 M3	***	***	***
2020 M4	***	***	***
2020 M5	***	***	***
2020 M6	***	***	***
2020 M7	***	***	***
2020 M8	***	***	***
2020 M9	***	***	***
2020 M10	***	***	***
2020 M11	***	***	***
2020 M12	***	***	***
2021 M1	***	***	***
2021 M2	***	***	***
2021 M3	***	***	***
2021 M4	***	***	***
2021 M5	***	***	***
2021 M6	***	***	***
2021 M7	***	***	***
2021 M8	***	***	***
2021 M9	***	***	***
2021 M10	***	***	***
2021 M11	***	***	***
2021 M12	***	***	***
2022 M1	***	***	***
2022 M2	***	***	***
2022 M3	***	***	***
2022 M4	***	***	***
2022 M5	***	***	***
2022 M6	***	***	***
2022 M7	***	***	***
2022 M8	***	***	***
2022 M9	***	***	***
2022 M10	***	***	***
2022 M11	***	***	***
2022 M12	***	***	***

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Table H-2—Continued
Cell prices: Average prices for monocrystalline cells, by month, January 2020-October 2023

Price in dollars per kilowatt

Period	Mono cell	N-type mono cell	PERC mono cell
2023 M1	***	***	***
2023 M2	***	***	***
2023 M3	***	***	***
2023 M4	***	***	***
2023 M5	***	***	***
2023 M6	***	***	***
2023 M7	***	***	***
2023 M8	***	***	***
2023 M9	***	***	***
2023 M10	***	***	***

Source: PVInsights, Spot Price Download, http://pvinsights.com/, accessed October 13, 2023.

Table H-3
Natural gas prices: U.S. natural gas electric power price, by month, January 2020-June 2023

Price in dollars per thousand cubic feet

Period	Natural gas
2020 M1	2.74
2020 M2	2.50
2020 M3	2.23
2020 M4	2.20
2020 M5	2.26
2020 M6	2.10
2020 M7	2.14
2020 M8	2.50
2020 M9	2.49
2020 M10	2.58
2020 M11	3.09
2020 M12	3.30
2021 M1	3.35
2021 M2	18.06
2021 M3	3.44
2021 M4	3.19
2021 M5	3.39
2021 M6	3.66
2021 M7	4.23
2021 M8	4.59
2021 M9	5.23
2021 M10	5.88
2021 M11	5.98
2021 M12	5.91
2022 M1	6.97
2022 M2	6.26
2022 M3	5.32
2022 M4	6.45
2022 M5	7.79
2022 M6	8.23
2022 M7	7.76
2022 M8	9.33
2022 M9	8.46
2022 M10	6.03
2022 M11	5.96
2022 M12	9.53

Table continued on next page.

Table H-3--Continued
Natural gas prices: U.S. natural gas electric power price, by month, January 2020-June 2023

Price in dollars per thousand cubic feet

Period	Natural gas
2023 M1	7.55
2023 M2	4.64
2023 M3	3.51
2023 M4	2.81
2023 M5	2.77
2023 M6	2.66

Source: U.S. Energy Information Administration, https://www.eia.gov/dnav/ng/ng_pri_sum_dcu_nus_m.htm, October 12, 2023.

Table H-4
Module prices: Average prices for monocrystalline modules, monthly, January 2020-October 2023

Price in dollars per kilowatt

Period	Silicon based mono module	Silicon based N-type mono module	182mm mono PERC module	166mm mono PERC module	158mm mono PERC module	Bifacial mono PERC module
2020 M1	***	***	***	***	***	***
2020 M2	***	***	***	***	***	***
2020 M3	***	***	***	***	***	***
2020 M4	***	***	***	***	***	***
2020 M5	***	***	***	***	***	***
2020 M6	***	***	***	***	***	***
2020 M7	***	***	***	***	***	***
2020 M8	***	***	***	***	***	***
2020 M9	***	***	***	***	***	***
2020 M10	***	***	***	***	***	***
2020 M11	***	***	***	***	***	***
2020 M12	***	***	***	***	***	***
2021 M1	***	***	***	***	***	***
2021 M2	***	***	***	***	***	***
2021 M3	***	***	***	***	***	***
2021 M4	***	***	***	***	***	***
2021 M5	***	***	***	***	***	***
2021 M6	***	***	***	***	***	***
2021 M7	***	***	***	***	***	***
2021 M8	***	***	***	***	***	***
2021 M9	***	***	***	***	***	***
2021 M10	***	***	***	***	***	***
2021 M11	***	***	***	***	***	***
2021 M12	***	***	***	***	***	***
2022 M1	***	***	***	***	***	***
2022 M2	***	***	***	***	***	***
2022 M3	***	***	***	***	***	***
2022 M4	***	***	***	***	***	***
2022 M5	***	***	***	***	***	***
2022 M6	***	***	***	***	***	***
2022 M7	***	***	***	***	***	***
2022 M8	***	***	***	***	***	***
2022 M9	***	***	***	***	***	***
2022 M10	***	***	***	***	***	***
2022 M11	***	***	***	***	***	***
2022 M12	***	***	***	***	***	***

Table continued on next page.

Table H-4—Continued
Module prices: Average prices for monocrystalline modules, monthly, January 2020-October 2023

Price in dollars per kilowatt

Period	Silicon based mono module	Silicon based N-type mono module	182mm mono PERC module	166mm mono PERC module	158mm mono PERC module	Bifacial mono PERC module
2023 M1	***	***	***	***	***	***
2023 M2	***	***	***	***	***	***
2023 M3	***	***	***	***	***	***
2023 M4	***	***	***	***	***	***
2023 M5	***	***	***	***	***	***
2023 M6	***	***	***	***	***	***
2023 M7	***	***	***	***	***	***
2023 M8	***	***	***	***	***	***
2023 M9	***	***	***	***	***	***
2023 M10	***	***	***	***	***	***

Source: PVInsights, Spot Price Download, http://pvinsights.com/, accessed October 13, 2023.

Note: Data for 182mm mono PERC modules became available beginning in July 2020.

Table H-5
CSPV modules: Indexed U.S. producer prices, by quarter, January 2020-June 2023

Price in dollars per kilowatt

Period	Product 1	Product 2	Product 3	Product 4	Product 5	Product 6
2020 Q1	***	***	***	***	***	***
2020 Q2	***	***	***	***	***	***
2020 Q3	***	***	***	***	***	***
2020 Q4	***	***	***	***	***	***
2021 Q1	***	***	***	***	***	***
2021 Q2	***	***	***	***	***	***
2021 Q3	***	***	***	***	***	***
2021 Q4	***	***	***	***	***	***
2022 Q1	***	***	***	***	***	***
2022 Q2	***	***	***	***	***	***
2022 Q3	***	***	***	***	***	***
2022 Q4	***	***	***	***	***	***
2023 Q1	***	***	***	***	***	***
2023 Q2	***	***	***	***	***	***

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

Table H-6
CSPV modules: Indexed importer prices, by quarter, January 2020-June 2023

Price in dollars per kilowatt

Period	Product 1	Product 2	Product 3	Product 4	Product 5	Product 6
2020 Q1	***	***	***	***	***	***
2020 Q2	***	***	***	***	***	***
2020 Q3	***	***	***	***	***	***
2020 Q4	***	***	***	***	***	***
2021 Q1	***	***	***	***	***	***
2021 Q2	***	***	***	***	***	***
2021 Q3	***	***	***	***	***	***
2021 Q4	***	***	***	***	***	***
2022 Q1	***	***	***	***	***	***
2022 Q2	***	***	***	***	***	***
2022 Q3	***	***	***	***	***	***
2022 Q4	***	***	***	***	***	***
2023 Q1	***	***	***	***	***	***
2023 Q2	***	***	***	***	***	***

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