SEIA Solar Energy Industries Association®

Joint Respondents' Presentation

Crystalline Silicon Photovoltaic Cells (Whether or Not Partially or Fully Assembled into Other Products), Inv. No. TA-201-75

Safeguard Investigation Hearing on Injury U.S. International Trade Commission

August 15, 2017 - Washington DC

Matthew R. Nicely

Partner

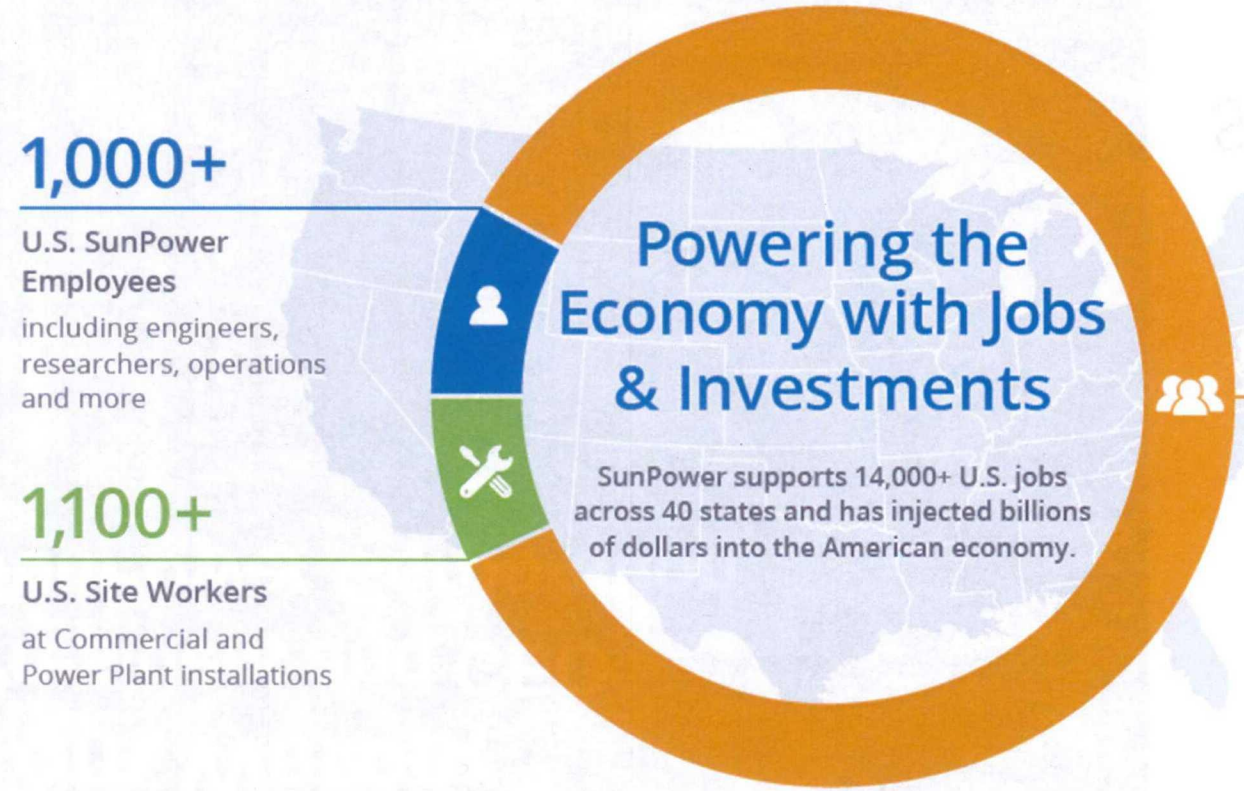
Hughes Hubbard & Reed

Hughes
Hubbard
& Reed

Tom Werner

President and CEO
SunPower Corporation

SUNPOWER®



1,000+

U.S. SunPower Employees

including engineers, researchers, operations and more

1,100+

U.S. Site Workers

at Commercial and Power Plant installations

12,000+

U.S. Dealer Employees

including Residential and Commercial installers and technicians

850+

U.S. suppliers supporting Residential, Commercial and Power Plant businesses

515

SunPower U.S. dealerships, supporting thousands of local jobs

4.4GW

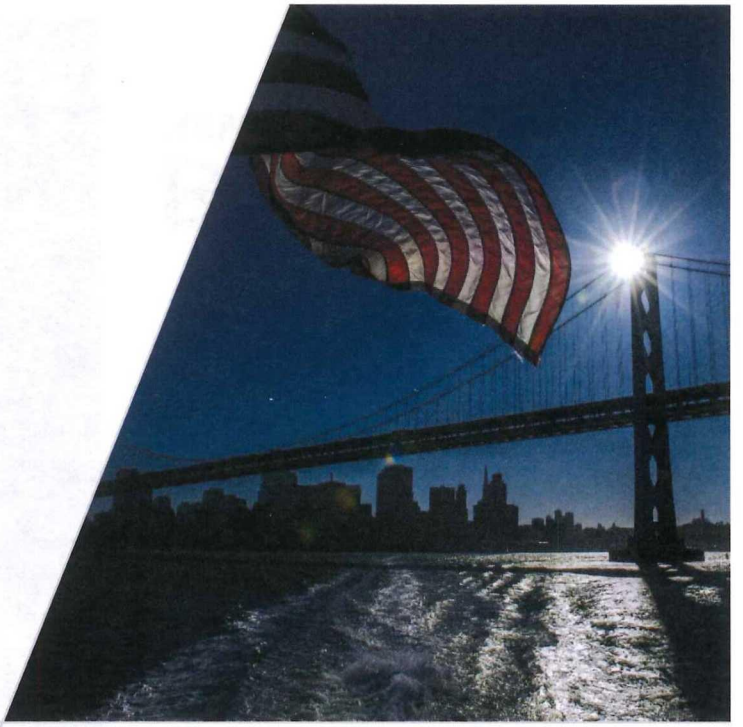
installed U.S. capacity, including 1.2 GW Residential and 960MW Commercial

SUNPOWER®

Amy Grace

Head of North America Research
Bloomberg New Energy Finance

Bloomberg
NEW ENERGY FINANCE



U.S. Solar PV and Power Markets

Report for the U.S. International Trade Commission

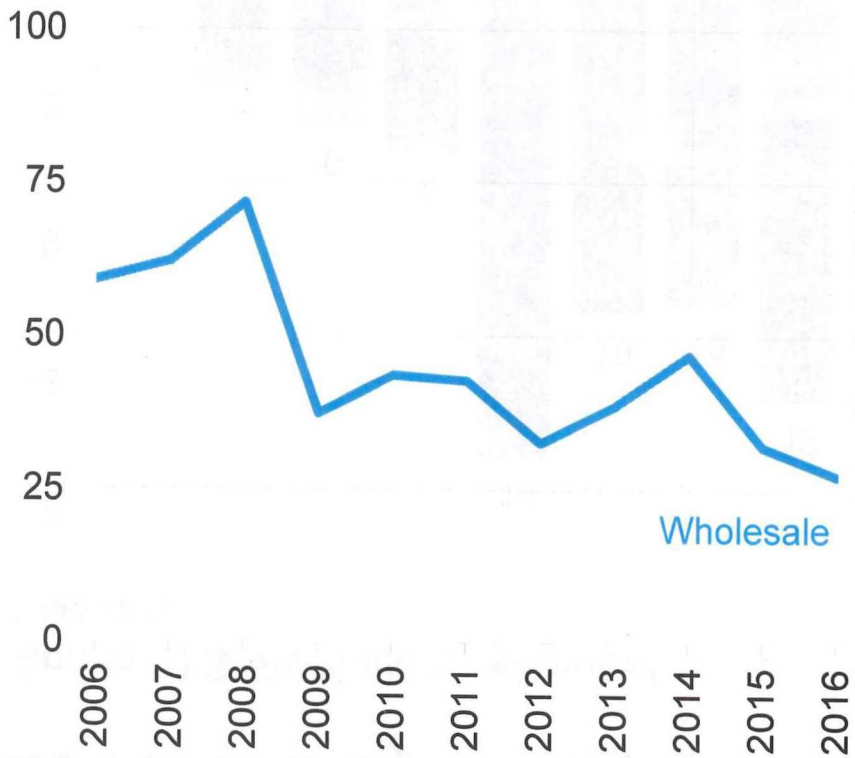
Amy Grace

Bloomberg New Energy Finance

U.S. wholesale power prices have fallen to historic lows.

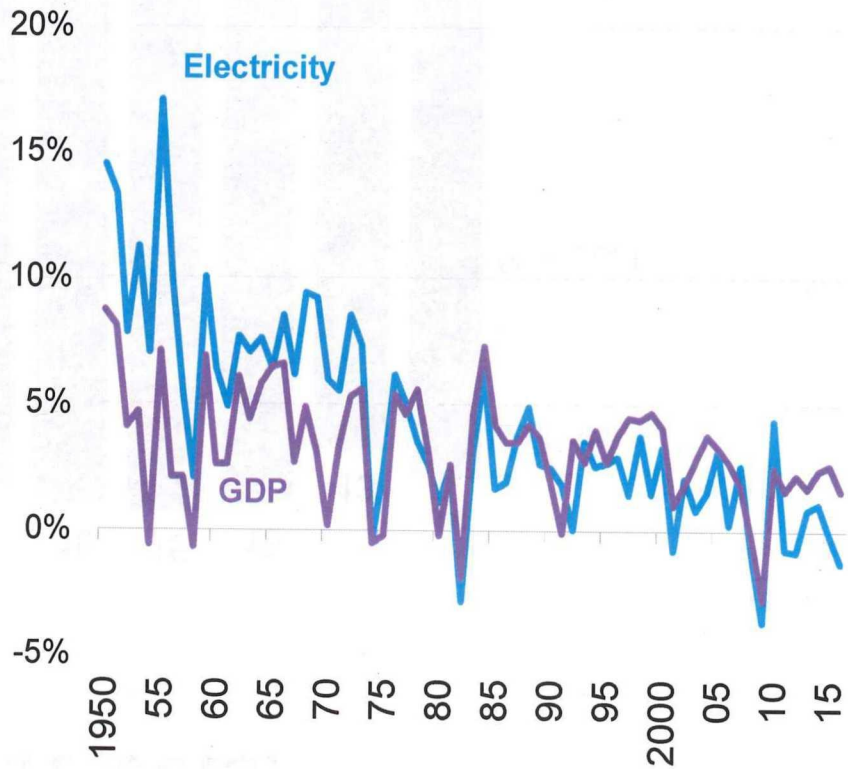
Average U.S. electricity prices

USD per megawatt-hour (real 2016)



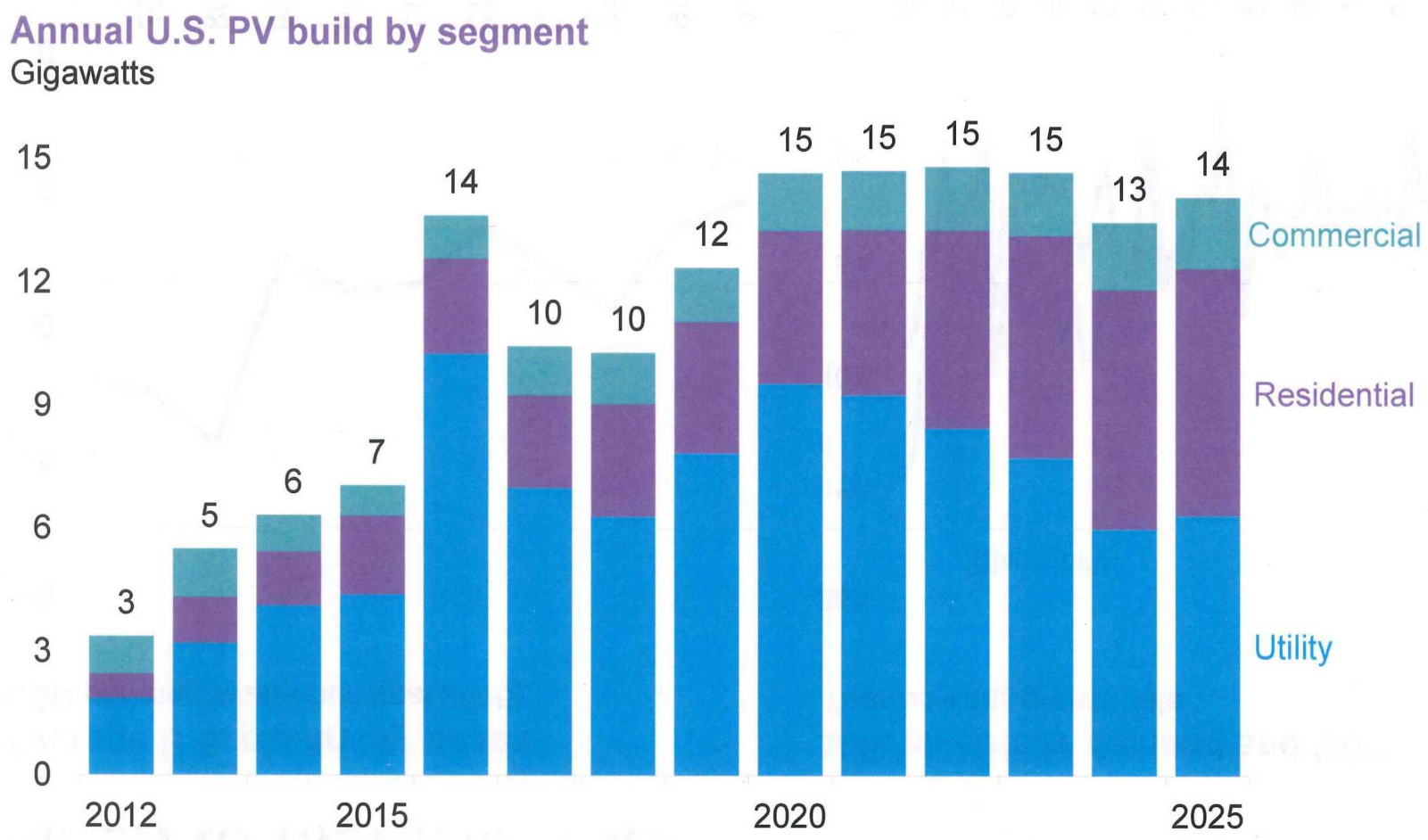
U.S. electricity demand and GDP

Year-on-year growth rate



Source: Bloomberg New Energy Finance, EIA, U.S. Bureau of Economic Analysis Note: GDP is chained 2009 year-on-year.

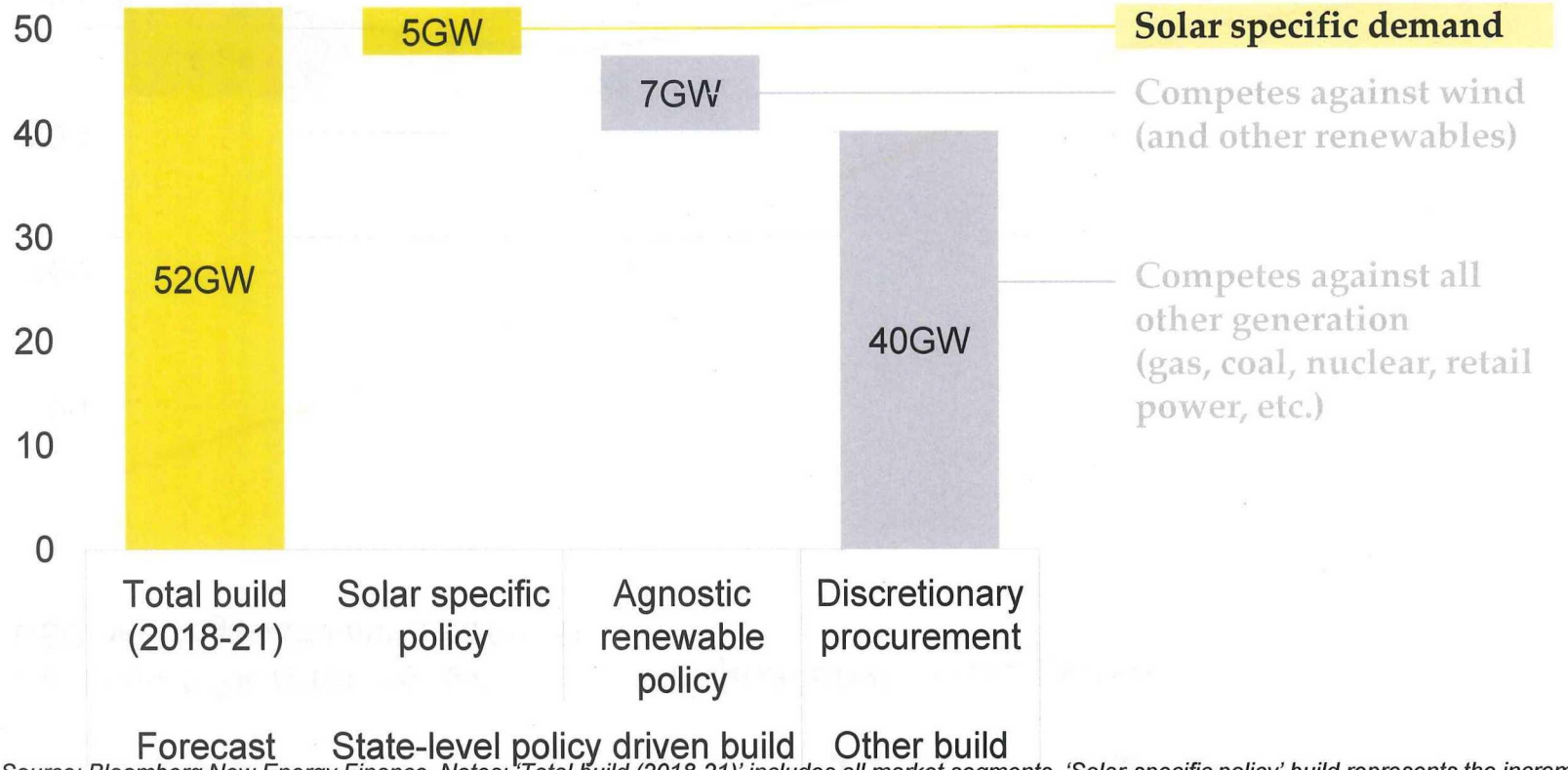
U.S. solar installations boomed in 2016, led by utility-scale projects.



Source: Bloomberg New Energy Finance

Future build must be economic as most state policy mandates have been met.

Four-year (2018-21) U.S. PV build forecast broken down by driver

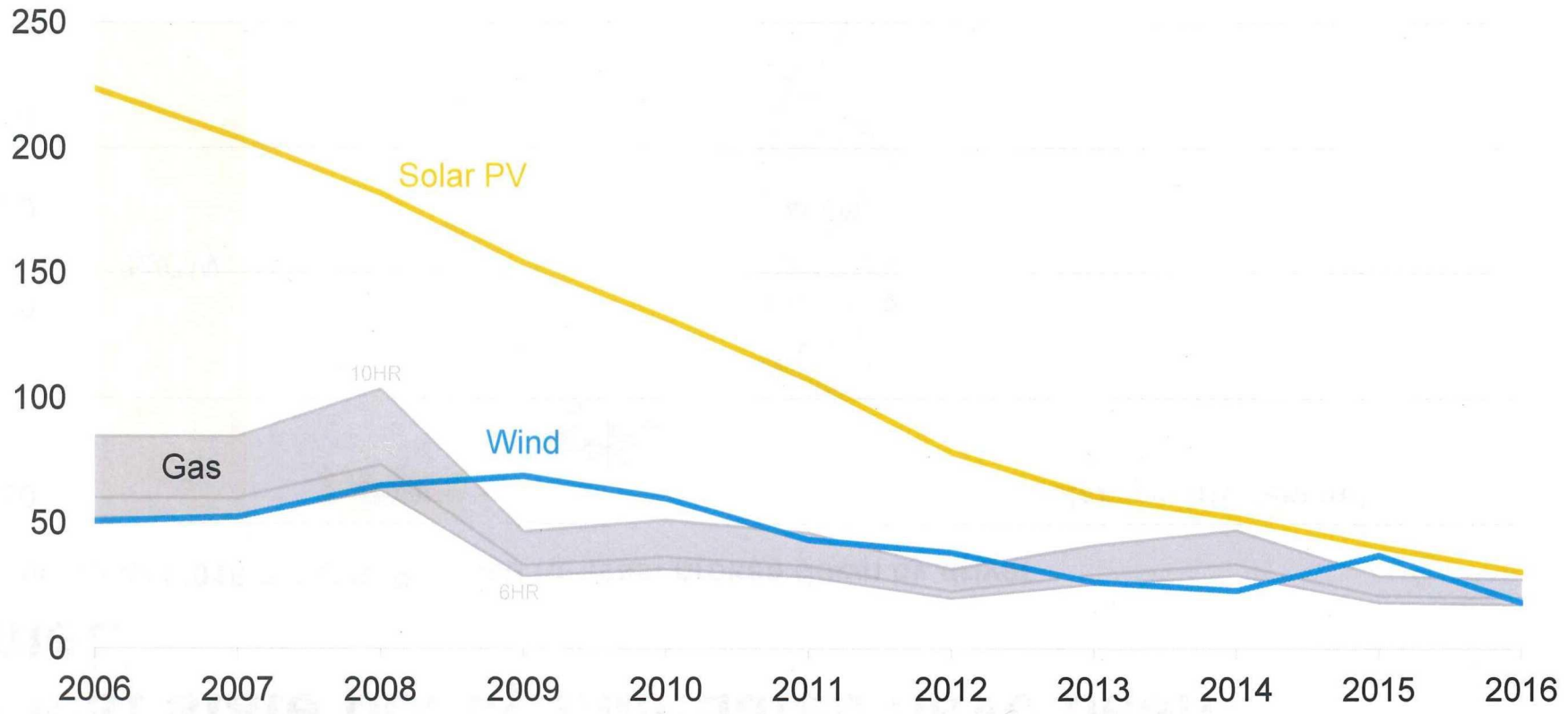


Source: Bloomberg New Energy Finance Notes: 'Total build (2018-21)' includes all market segments. 'Solar-specific policy' build represents the incremental solar build needed to meet mandatory state renewable portfolio standard (RPS) solar and distributed generation (DG) carve outs in 2021. 'Agnostic renewable policy' build includes our estimate of how much solar will be built to meet mandatory state RPS (excluding solar and DG carve outs) and other non-RPS renewable energy mandates by 2021.

Low wholesale prices increase competition among all types of generators.

Average PPA price vs. short run marginal cost of gas generation

USD per megawatt-hour (real 2016)



Source: Bloomberg New Energy Finance, U.S. Department of Energy (LBNL). Note: HR = 'Heat Rate' (MMBtu/MWh); Levelized, time-of-day adjusted contract price shown.

Craig Cornelius

Senior VP, Renewables

NRG Energy, Inc.

Jim Lamon

CEO

DEPCOM Power, Inc.

DEPCOM POWER®

Dan Shugar

Founder & CEO

NEXTracker, Inc.

NEXTracker™

Edward Fenster

Co-founder & Executive Chairman
Sunrun Inc.

Bastel Wardak

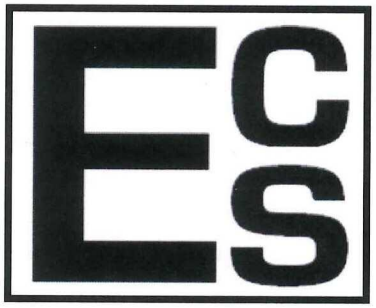
Founder & President

California Solar Systems

CA Solar Systems

James P. Dougan

Vice President
Economic Consulting Services LLC



ECONOMIC CONSULTING SERVICES, LLC

BEFORE THE
UNITED STATES INTERNATIONAL TRADE COMMISSION

IN THE MATTER
OF
CRYSTALLINE SILICON PHOTOVOLTAIC CELLS, WHETHER OR NOT PARTIALLY OR FULLY ASSEMBLED INTO OTHER PRODUCTS

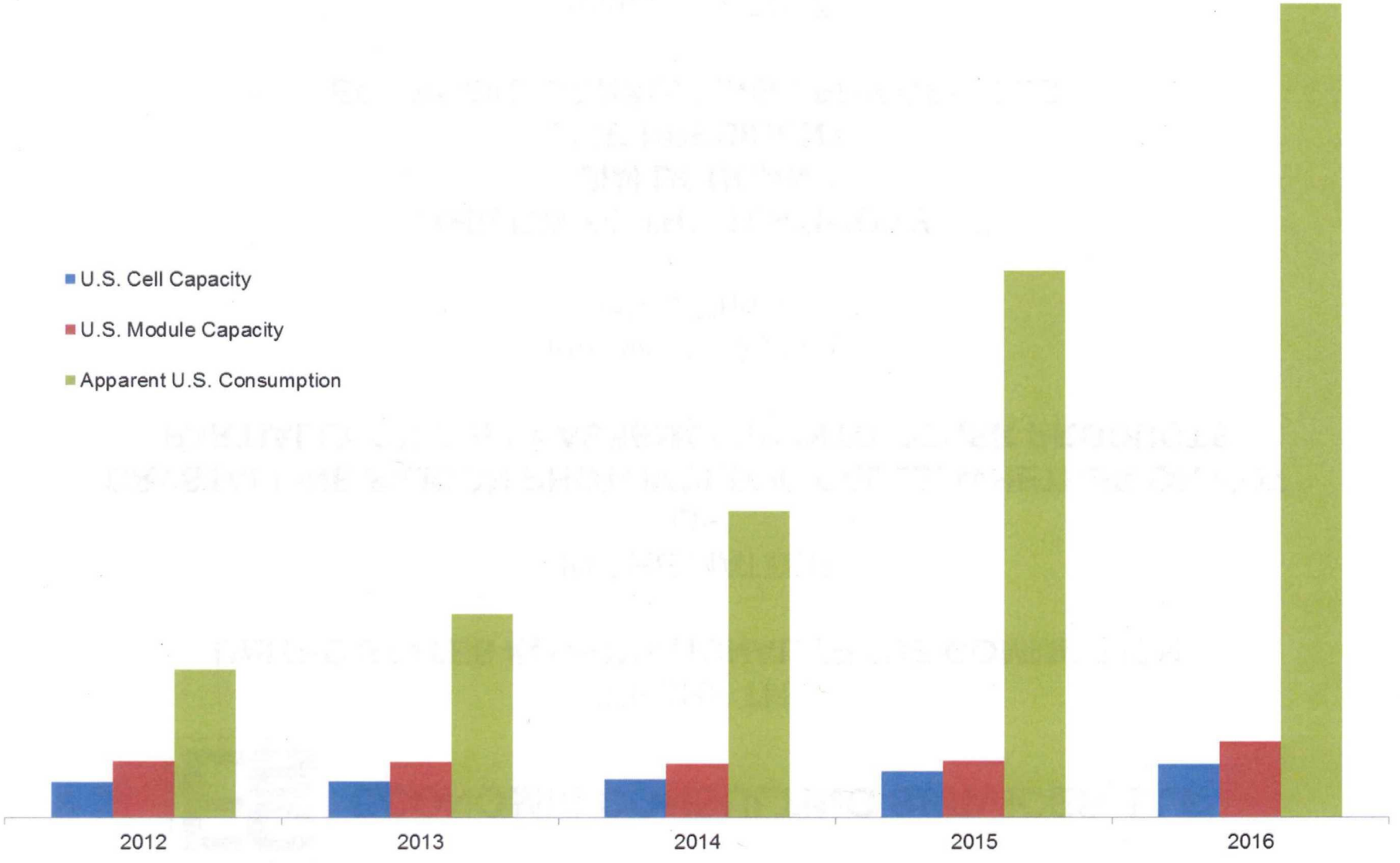
Inv. No. TA-201-75
Injury Phase

EXHIBITS TO THE TESTIMONY OF
JIM DOUGAN
VICE PRESIDENT
ECONOMIC CONSULTING SERVICES, LLC

August 15, 2017

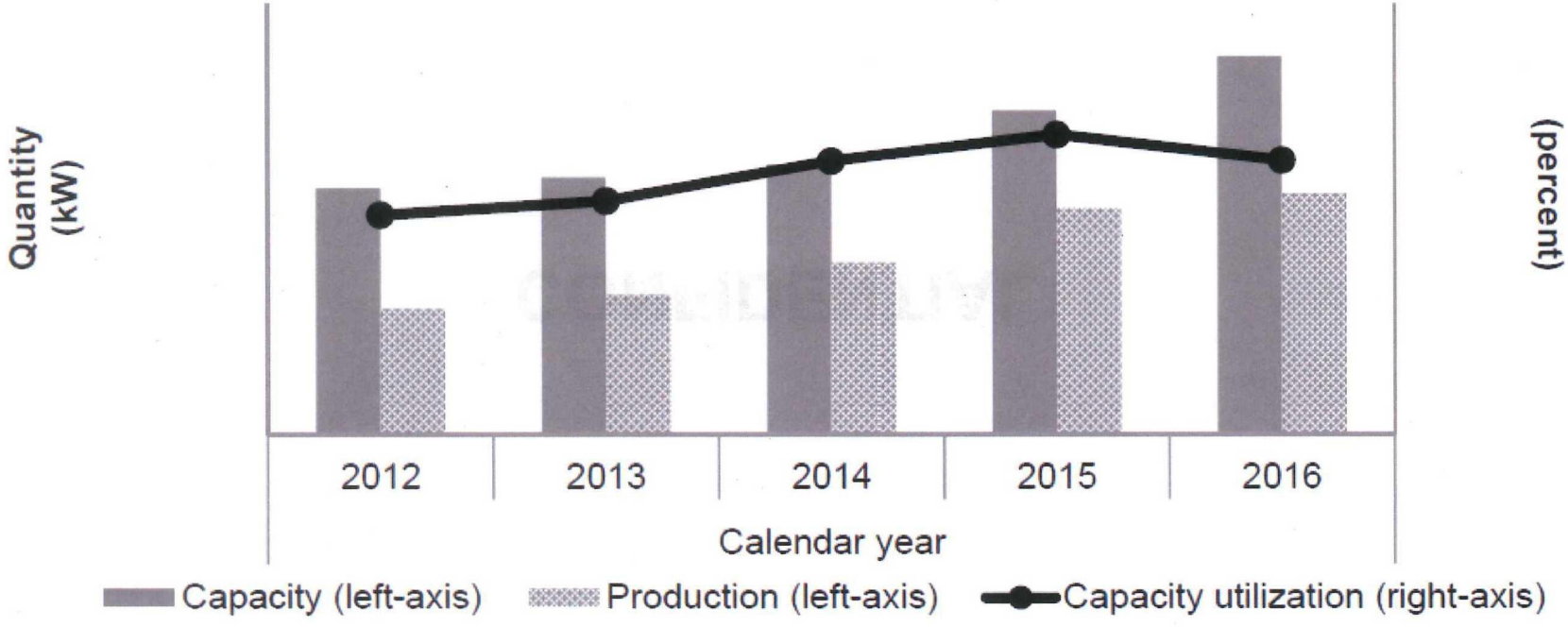
Washington, D.C.

Apparent U.S. Consumption Far Outstripped Domestic Cell and Module Capacity Over the POI



Source: CR at Table III-4, Table III-5, and Table IV-1.

Figure III-1
CSPV cells: U.S. producers' production, capacity, and capacity utilization, 2012-16



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

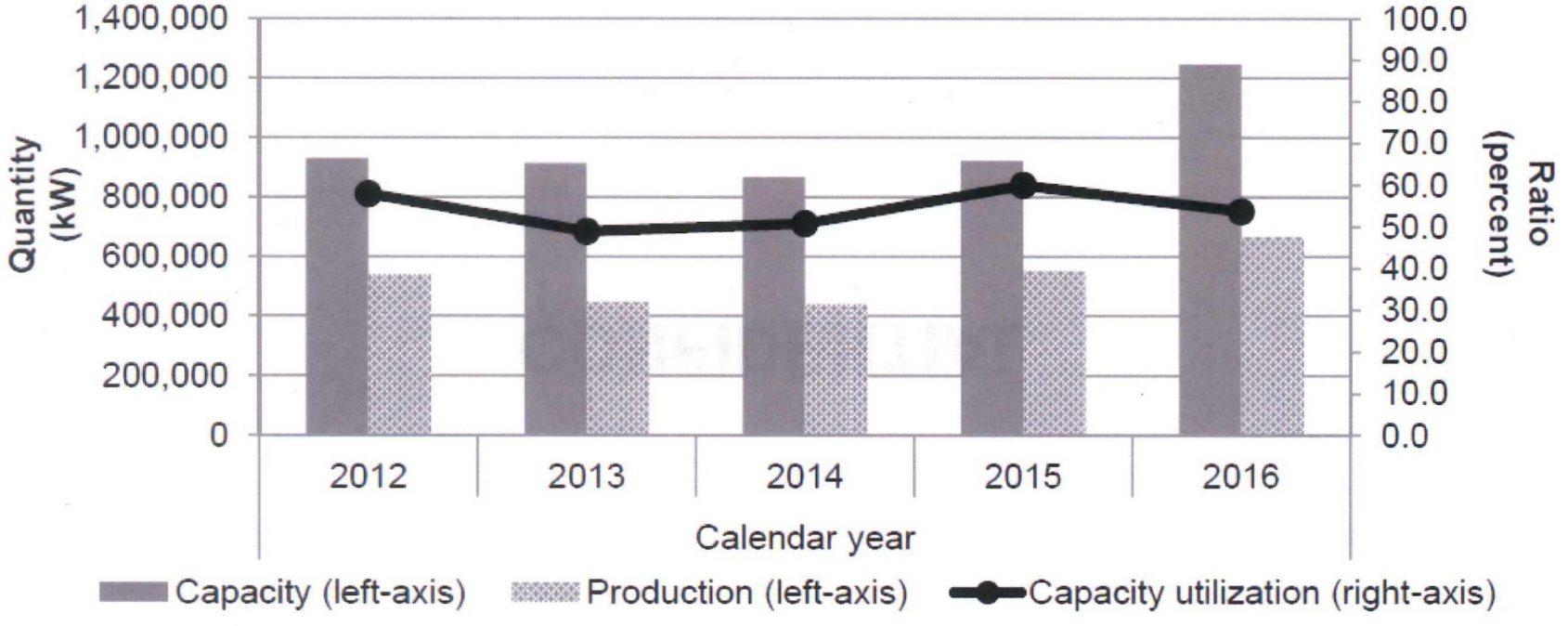
CONFIDENTIAL

Source: CR at Table III-4.

CONFIDENTIAL

Source: CR at Table III-4; U.S. Producers' Questionnaires at II-10.

Figure III-2
CSPV modules: U.S. producers' production, capacity, and capacity utilization, 2012-16



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

CONFIDENTIAL

Source: CR at Table II-4 and Table III-4.

CONFIDENTIAL

Source: CR at Table II-4.

CONFIDENTIAL

Source: U.S. Producers' Questionnaires at II-11, II-14; Importers' Questionnaires at II-6, II-8, II-10, II-12, II-14, II-16, II-18, II-20, II-22, II-24, II-26, II-28, II-30, II-32, II-34, II-36, II-38, II-40, II-42, II-44, II-48, and II-50.

CONFIDENTIAL

Source: U.S. Producers' Questionnaires at IV-3; Importers' Questionnaires at III-3.

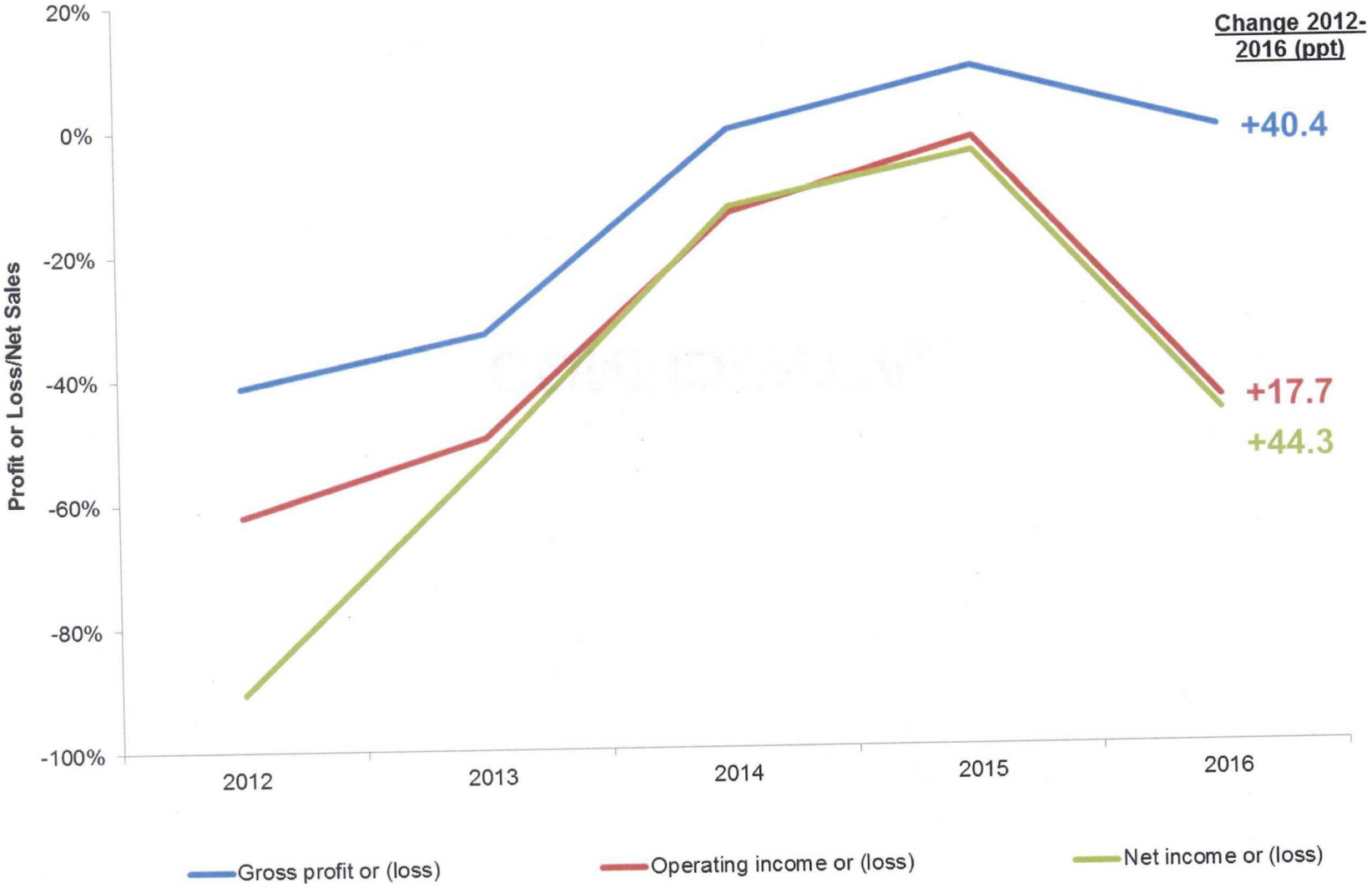
CONFIDENTIAL

Source: [ ] U.S. Producers' Questionnaire at IV-2; [ ] U.S. Importers' Questionnaire at III-2c.

CONFIDENTIAL

Source: CR at Table III-16.

U.S. Module Producers' Profitability Improved Over the POI



Source: CR at Table III-19.

CONFIDENTIAL

Source: CR at Table III-19; U.S. Producers' Questionnaires at III-9c.

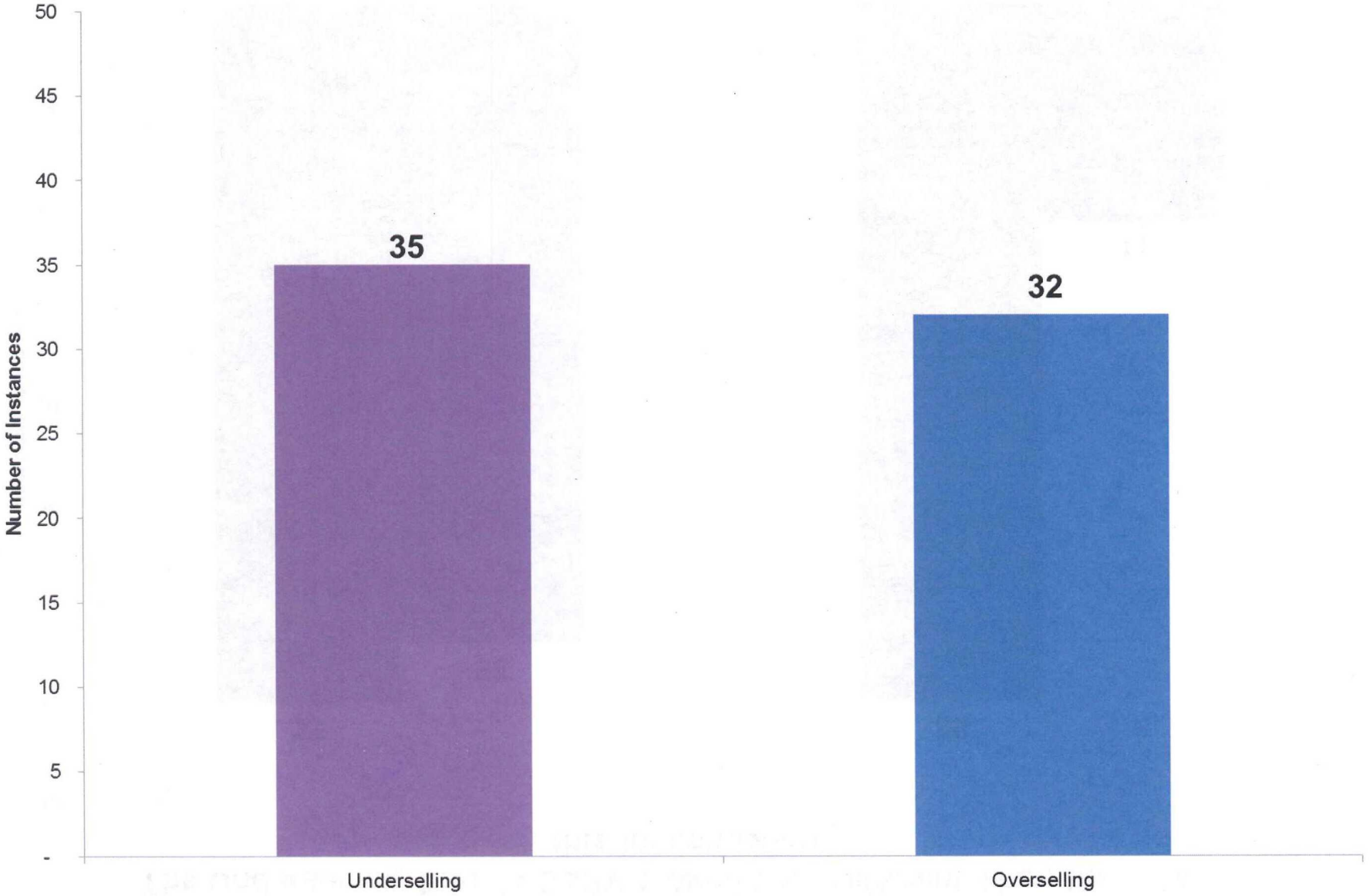
CONFIDENTIAL

Source: CR at Tables III-2 and III-22.

CONFIDENTIAL

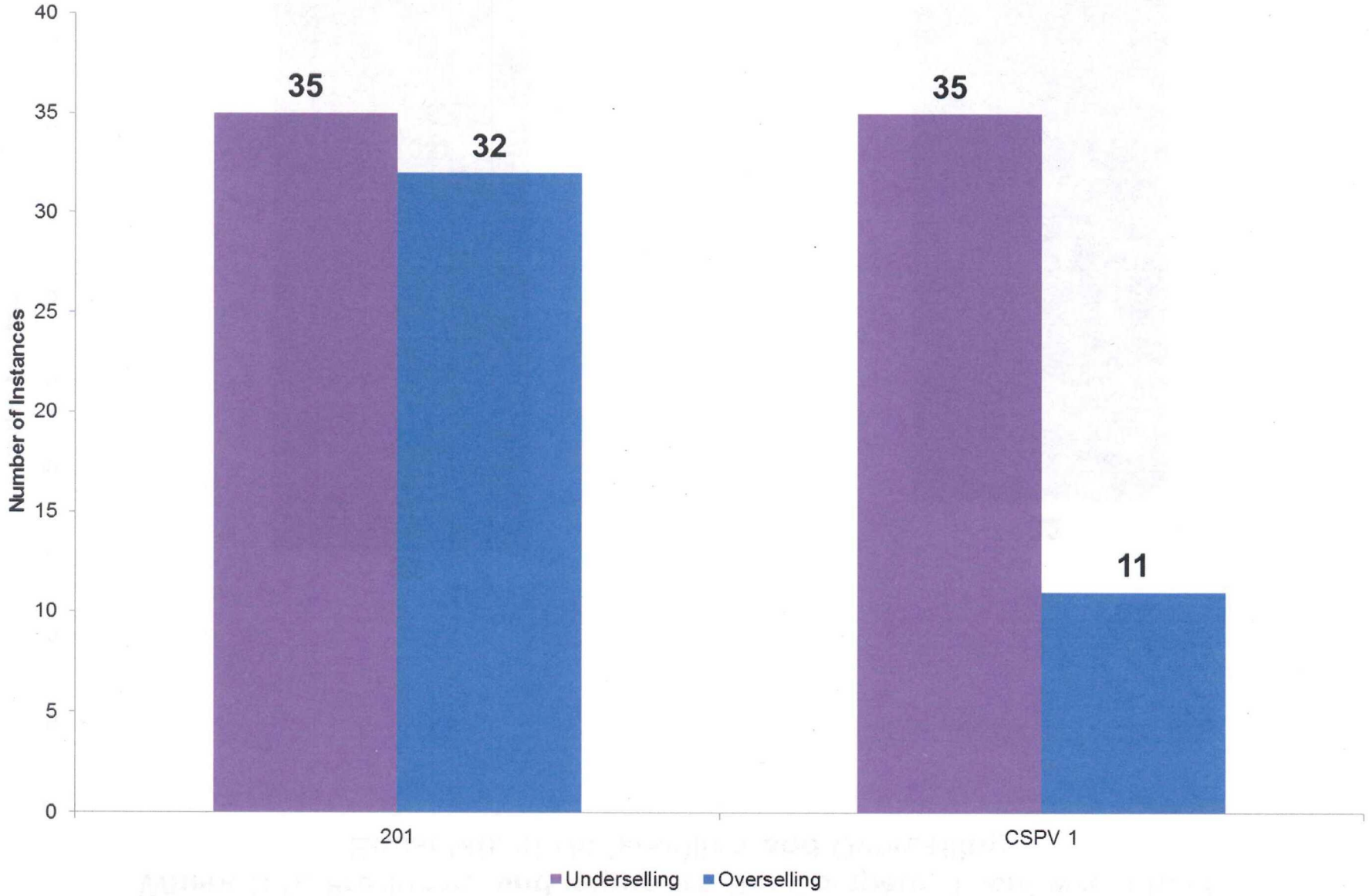
Source: CR at Appendix G.

Where U.S. Producers and Importers Did Compete, There was a Near Equal Mix of Underselling and Overselling



Source: PR at Table V-18.

The Underselling Data in CSPV 1 Were Very Different Than the Data in this Investigation

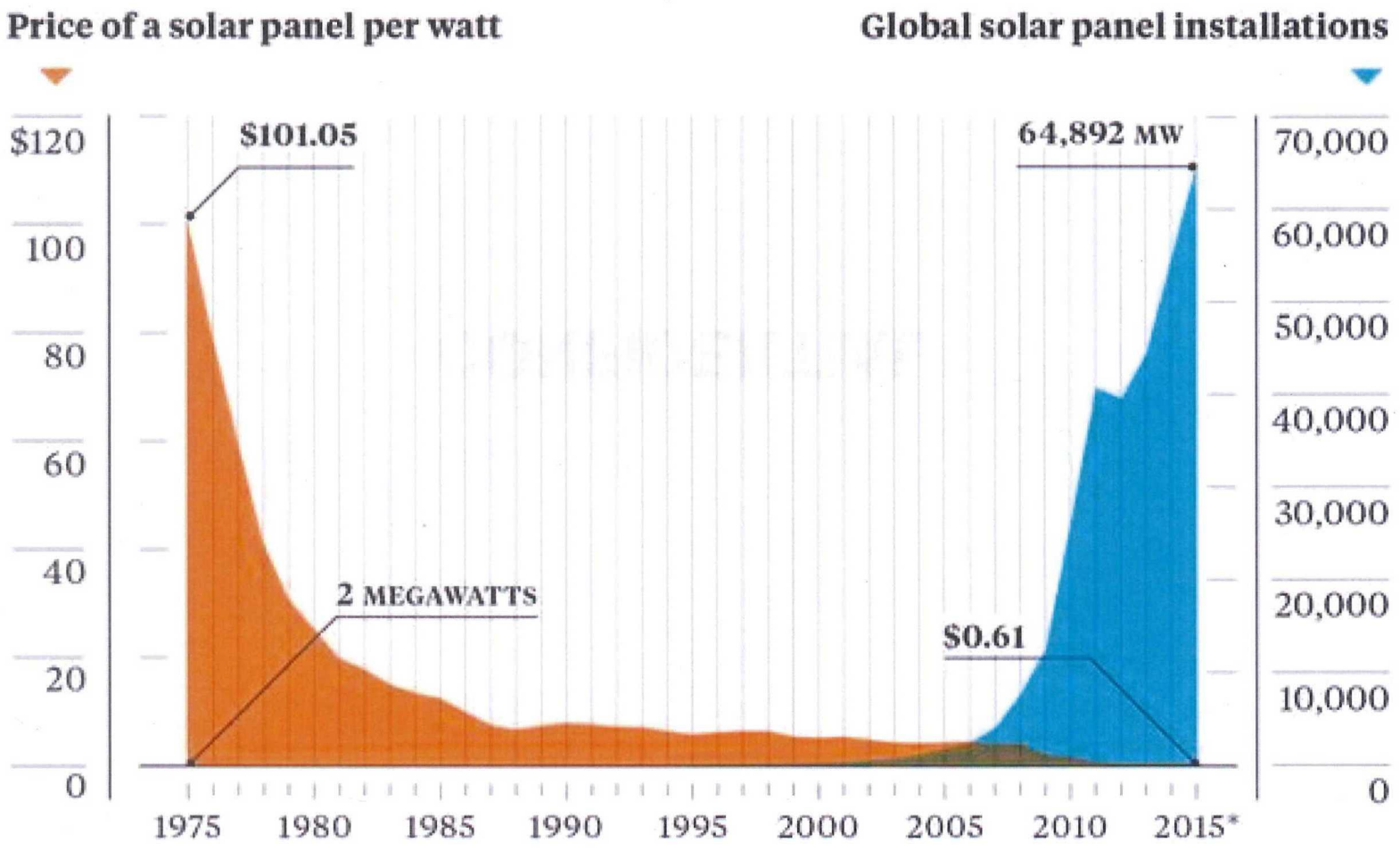


Source: PR at Table V-18; *CSPV 1* PR at Table V-8.

CONFIDENTIAL

Source: CR/PR at Table V-19; U.S. Purchasers' Questionnaires at III-17.

Demand Increased Precisely Because Prices Declined



Source: https://www.treehugger.com/renewable-energy/striking-chart-showing-solar-power-will-take-over-world.html

Thomas J. Prusa

Professor and Chair
Department of Economics
Rutgers University

RUTGERS
THE STATE UNIVERSITY
OF NEW JERSEY

BEFORE THE

UNITED STATES INTERNATIONAL TRADE COMMISSION

IN THE MATTER

OF

CRYSTALLINE SILICON PHOTOVOLTAIC CELLS, WHETHER OR NOT PARTIALLY OR FULLY ASSEMBLED INTO OTHER PRODUCTS

Inv. No. TA-201-75

Injury Phase

EXHIBITS TO THE TESTIMONY OF

THOMAS J. PRUSA
Professor and Chair
Department of Economics
Rutgers University

August 15, 2017

Washington, D.C.

RUTGERS
THE STATE UNIVERSITY
OF NEW JERSEY

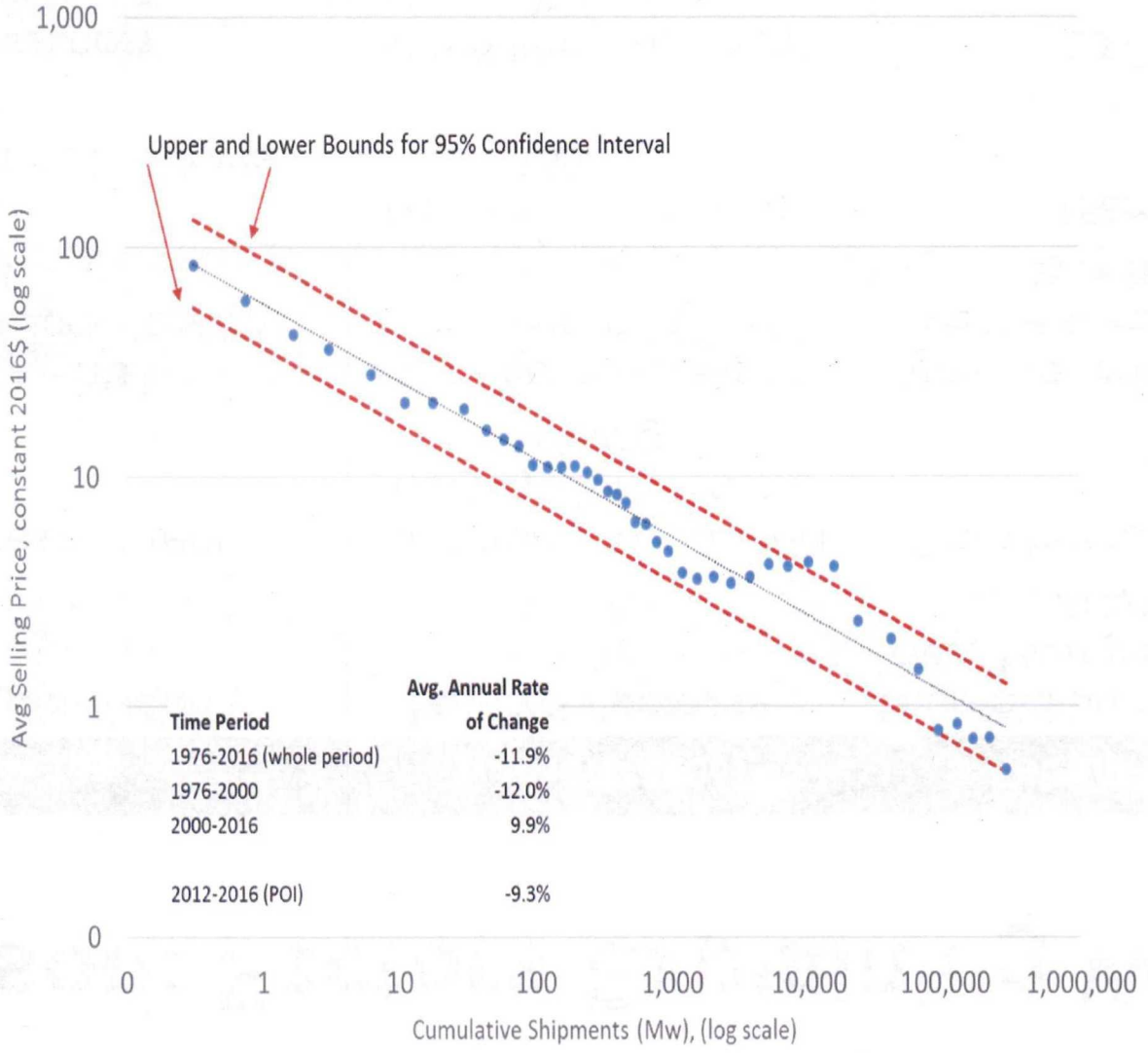
Overview

- Formal statistical study of CSPV pricing over the period
- National and state-level data; 60-cell & 72-cell modules
- Under no circumstances do I find imports to be the most important cause of price changes in either the 60-cell module or 72-cell module market

Technological Advancement in CSPV Industry

- Long-term, persistent cost-reductions
- "No energy technology has changed more dramatically than PV" (Nemet, 2006)
- Seminal study: Swanson (2006)

Swanson's Law



Swanson: Factors Explaining Why (1)

Factors	Swanson (2006)	Recent Period
1) Price of polysilicon	Ten-fold decrease	Four-fold decrease (from over $60/kg to less than $15/kg)
2) Advances in screen printing	Move from evaporated metal grids to screen printing	3 bus bar to 5 bus bar
3) Improvements in technology to slice wafers	Move from ID saws to wire saws	Move to diamond-wire saws means less material loss (less kerf)
4) Cell size (larger cells → lower costs)	Move from 77mm to 150mm	156mm
5) Wafer thickness (thinner → less material cost)	Move from 500μm to 300μm	180μmm

Swanson: Factors Explaining Why (2)

Factors	Swanson (2006)	Recent Period
6) Efficiency (higher efficiency → less silicon)	Move from 10% to 15% efficiency	PERC technology, 17% efficiency standard; 20-22% efficiency in high end commercial (and over 24% efficiency in lab tests)
7) Process development	Texturing, spray-on techniques, etc.	Acid etching, better & thinner glass, anti-reflective coating, frameless modules
8) Factory size (internal economies of scale)	1MW/year to 400MW/year	Up to 1-3GW/year
9) Automation (lower labor cost, higher yields)	Moving toward greater automation	Continued movement to greater automation; has increased reliability, quality, and throughput

Cost Reductions – All U.S. Module Producers

Percentage Change Over Period, Per Unit Costs

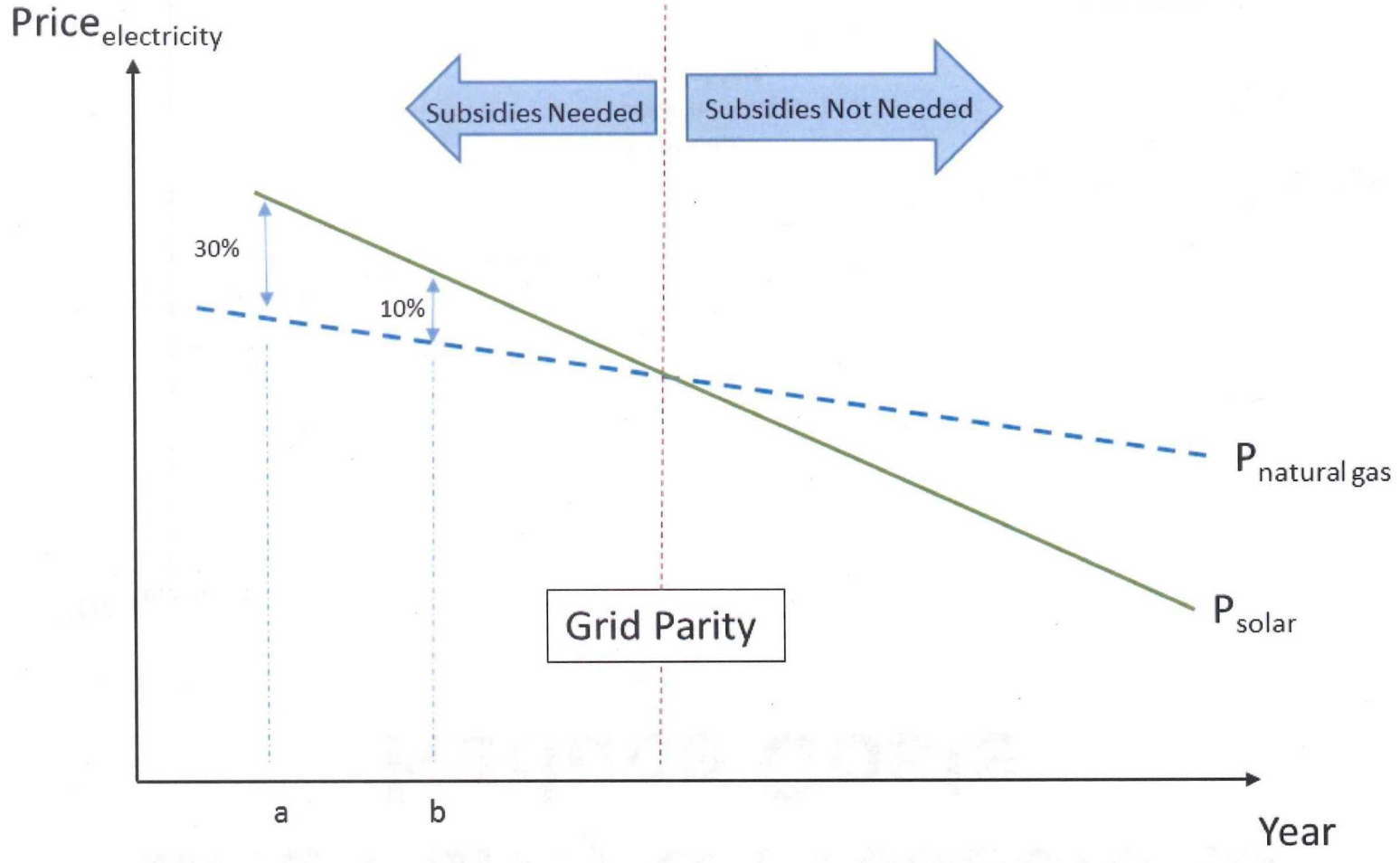
	Total % Change	Avg. Annual % Change
Raw Material	(22.6%)	(6.2%)
Direct Labor	(23.9%)	(6.6%)
Other factory costs	(88.3%)	(41.5%)
Total COGS	(47.0%)	(14.7%)

Not Just Due to Cost of Raw Materials (Avg. Annual % Change)

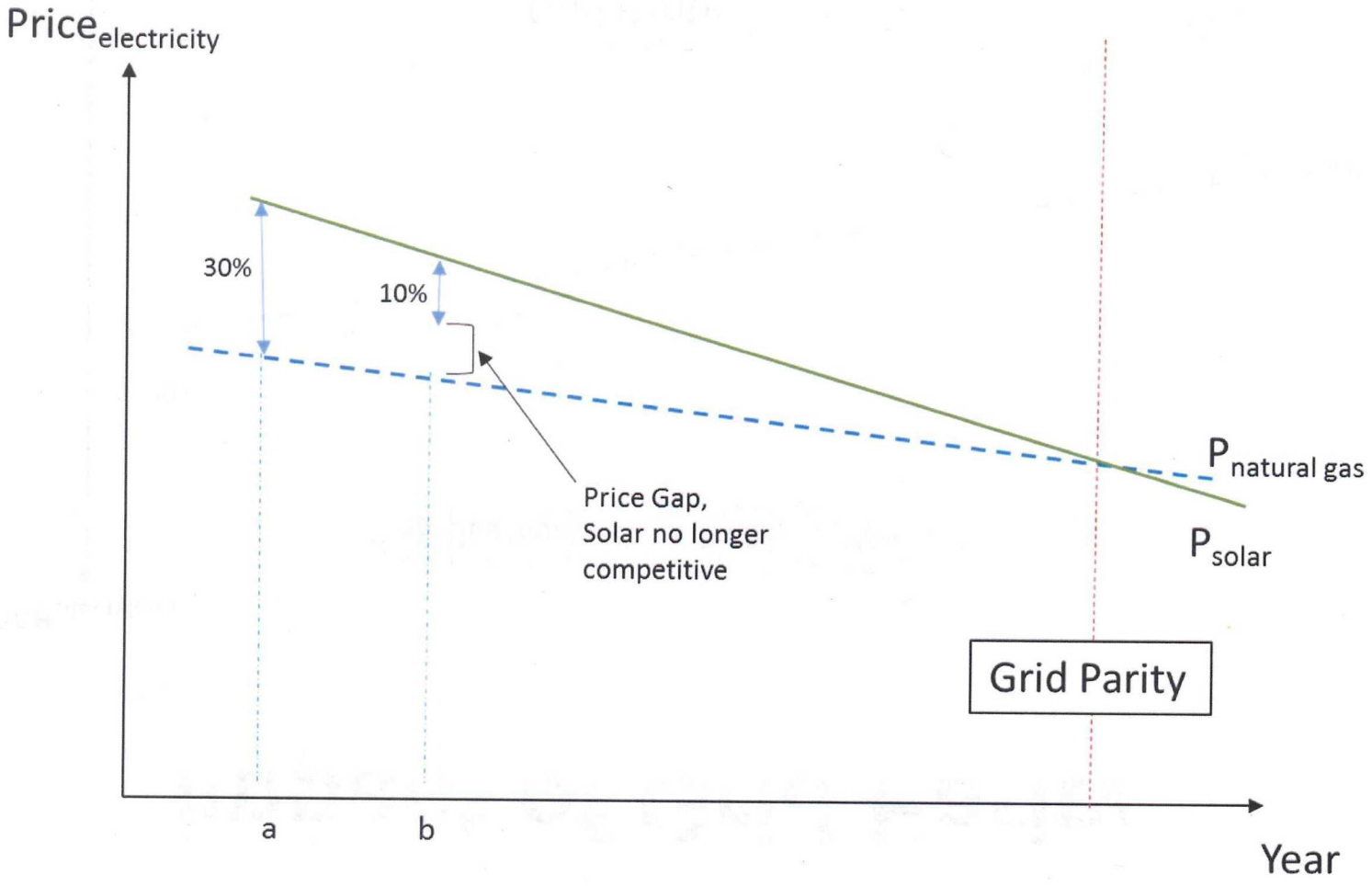
Actual (as reported)	If only Raw Material costs had declined	Difference
(14.7%)	(3.5%)	(11.2%)

Source: PR at Table III-19.

Impact of Grid Parity



Grid Parity & Pressure to Reduce Costs



Empirical Study - Overview

Residential Sector (60-cell modules)

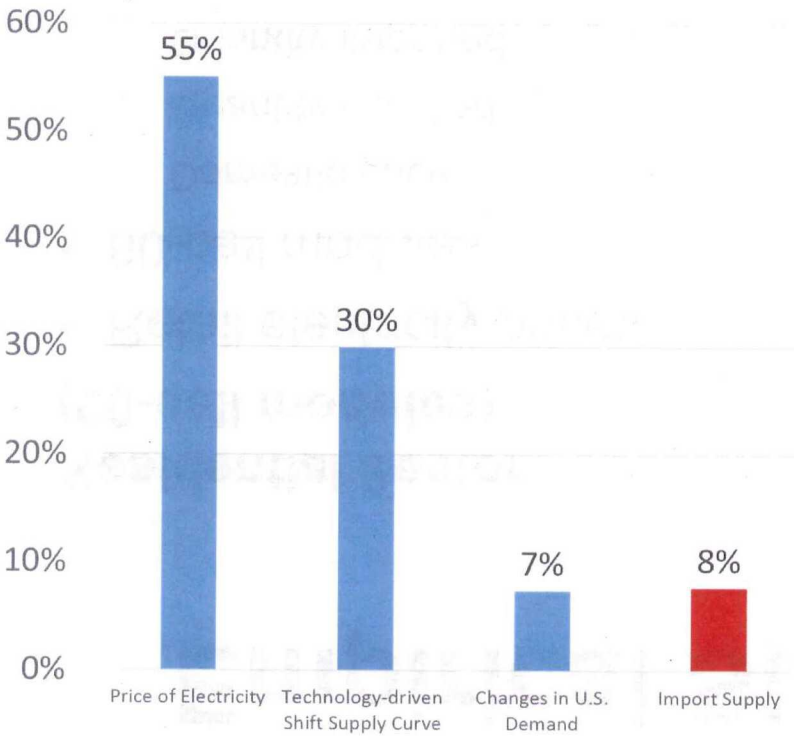
- Retail electricity prices
- 60-cell modules
  - Domestic price
  - Quantity installed
  - Quantity imported
- Price of polysilicon per watt
- Amount of subsidy received by consumers for installing solar panels

Utility Sector (72-cell modules)

- Price of natural gas
- 72-cell modules
  - Domestic price
  - Quantity installed
  - Quantity imported
- Price of polysilicon per watt

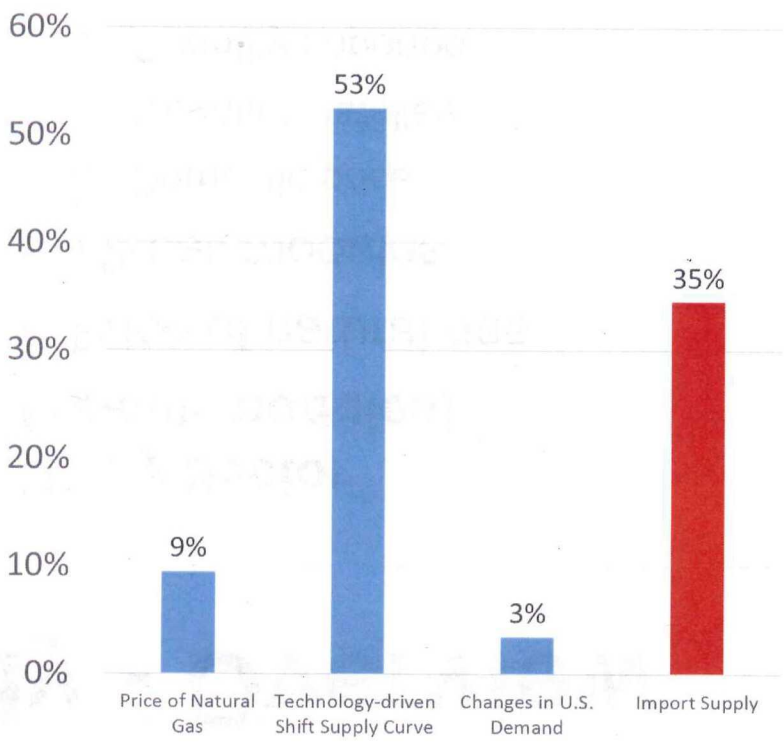
Results – Imports are Never the Largest Factor

Residential Sector (60-cell modules)



National Model, Medium Run

Utility-Scale Sector (72-cell modules)



National Model, Medium Run

Jonathan T. Stoel

Partner

Hogan Lovells

Hogan
Lovells

Paolo Maccario

General Manager and COO

Silfab Solar Inc.

Silfab
SOLAR

Martin Pochtaruk

President
Heliene Inc.

HELIENE

Vincent Ambrose

General Manager for North America

Canadian Solar Inc.

CanadianSolar

Craig Lewis

Partner
Hogan Lovells

Hogan
Lovells

Aaron Hall

President

Borrego Solar Systems, Inc.

BORREGO SOLAR

James Durling

Partner

Curtis, Mallet-Prevost, Colt & Mosle LLP

CURTIS

Steven M. O'Neil

CEO

REC Solar

Spencer S. Griffith

Partner

Akin Gump Strauss Hauer
& Feld LLP

Akin Gump

STRAUSS HAUER & FELD LLP

Deep Patel

Founder & CEO

GigaWatt Inc.

SEIA Solar Energy Industries Association®

Joint Respondents' Presentation

Crystalline Silicon Photovoltaic Cells (Whether or Not Partially or Fully Assembled into Other Products), Inv. No. TA-201-75

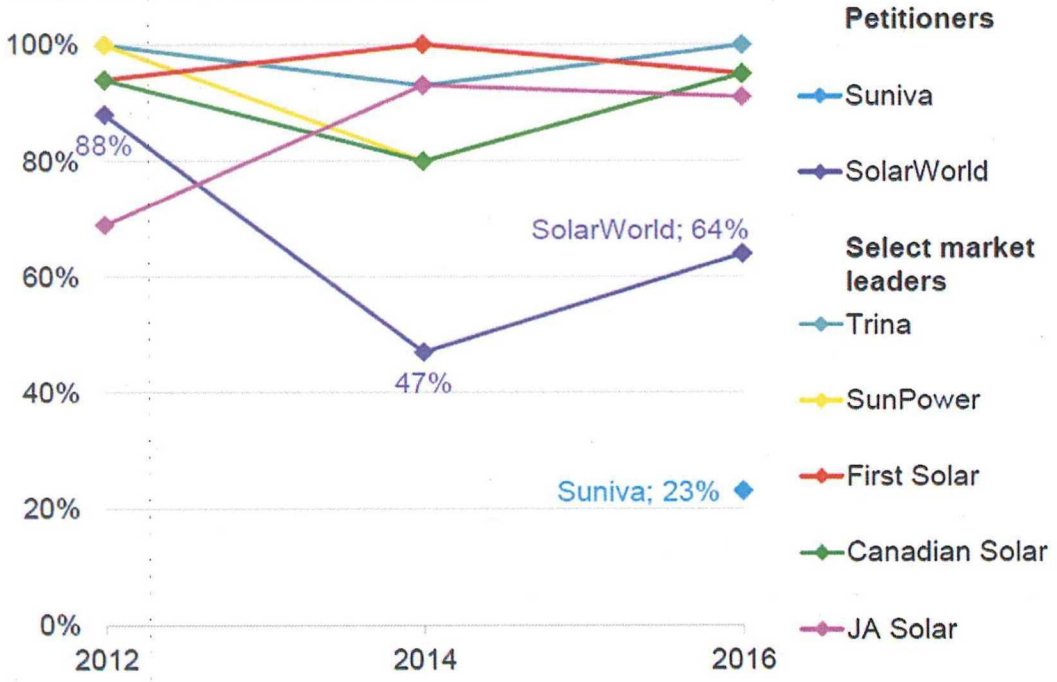
Safeguard Investigation Hearing on Injury U.S. International Trade Commission

August 15, 2017 - Washington DC

Suniva and SolarWorld products are viewed poorly by lenders.

BNEF PV module bankability survey results

Share who consider brand 'bankable'



- SolarWorld was a BNEF Tier 1* module supplier prior to its insolvency; Suniva has never made the Tier 1 list.
- 55% of solar finance professionals had never heard of Suniva branded modules in our 2016 survey. Only 23% responded that Suniva is a bankable product.
- Banks providing non-recourse loans are the most risk-averse type of investor because they receive no upside if the project over-performs or is cheap.
- The BNEF Tier 1 list and bankability survey are indicators of brand reputation, perceived quality and the manufacturers financial strength. They are not technical assessments.

Source: Bloomberg New Energy Finance Note: (*) Tier 1 module manufacturers are those which have provided own-brand, own-manufacture products to six different projects, which have been financed non-recourse by six different (non-development) banks, in the past two years. These 1.5MW+ deals must be tracked by BNEF industry intelligence database – ie, the project location (sufficiently to identify the project uniquely), capacity, developer, bank and module maker must be in the public domain. One exception is manufacturers which have filed for bankruptcy or a form of insolvency protection, or experienced a major default on bond payments.