



Solar Power Manufacturing: Opportunities & Challenges

Making It Here Conference

Panel on Manufacturing Opportunities in Solar

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Clean Manufacturing Opportunities

- **Clean energy manufacturing—OEMs and supply chains for renewable energy systems**
 - Solar PV, concentrating solar, and other solar systems
 - Wind power generation
 - Biomass, hydro, geothermal, biofuels, etc.
- **Clean energy transportation systems—OEMs and supply chains for advanced fuel vehicles, public transit and hybrid trucks**
- **Energy efficiency—applications; OEMs & supply chains:**
 - Industrial energy efficiency (IEE)
 - Buildings—residential, commercial, public
 - Equipment manufacturers (CHP, motors, etc.)



Policy Drivers

- **Creating demand for clean energy systems**
 - Energy portfolio standards (RPS, EERS)
 - End-use product energy standards (equipment efficiency; fuel standards)
 - Direct public investments
 - Financial and tax incentives
- **Assuring domestic manufacturing capacity**
 - Financial and tax incentives
 - Technical assistance
 - Domestic content
 - Workforce development



Solar Technologies

■ Solar power

- Photovoltaics (PV) and concentrating solar PVs (CPV)
- Concentrating solar power (CSP)—lenses or mirrors and tracking systems

■ Solar thermal

- Water heating, space heating, space cooling and process heat generation
- Solar concentrating technologies (parabolic dish, trough and Scheffler reflectors) provide process heat for commercial and industrial applications

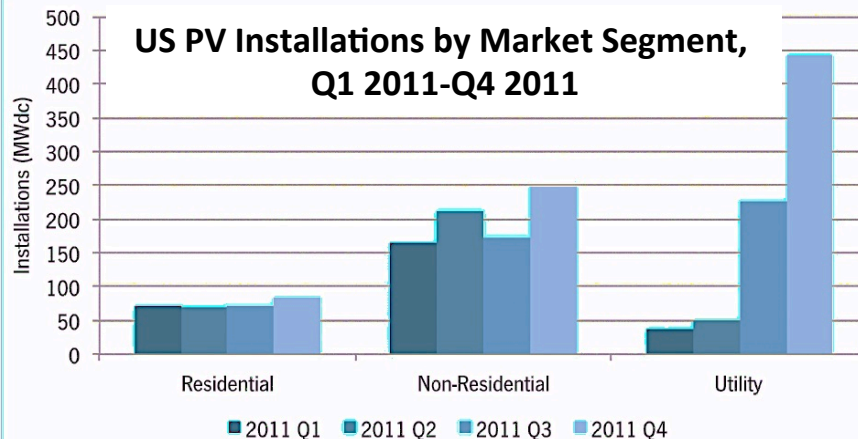
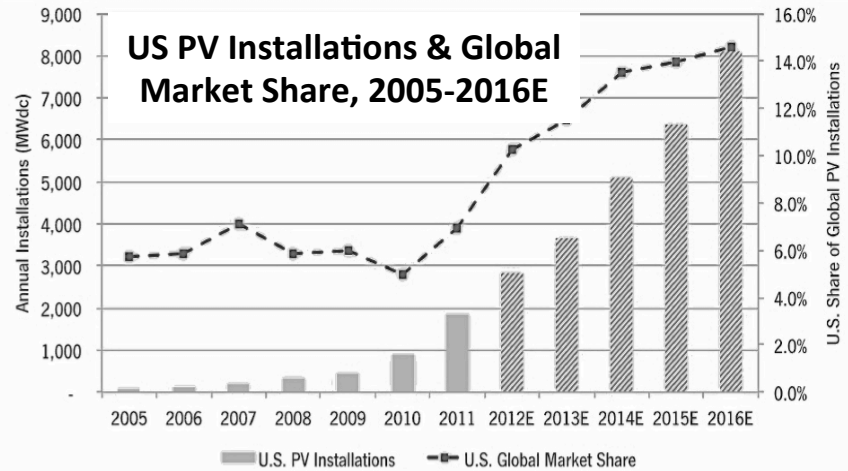
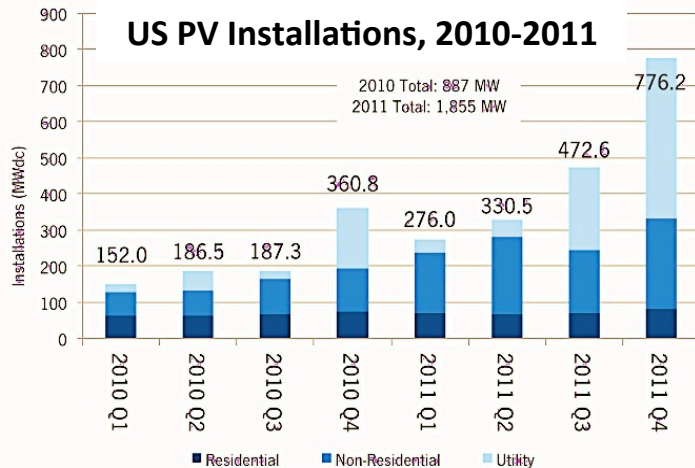
■ Solar lighting, cookers, distillation, chemical processes



U.S. Solar Market 2011

- **U.S. PV installation has been growing**
 - 109% 2011 (1,855 MW), 7% of PV globally, up from 5%, 2010
 - Cumulative U.S. PV capacity=3,954 MW
 - 28 new PV projects >10 MW, up from 2, 2009
 - 8 states installed 50 MW each in 2011, up from 2 in 2009
 - Installation totals 2011 increased in 18 of 23 states
 - Leading states: CA(29%), NJ (17%), next five (AZ, NM, CO, PA, NY; 34%)
 - 61,000 individual PV systems installed 2011; total number >214,000
 - Value of PV systems 2011 climbed \$84 billion, up from \$5 billion, 2010
 - Over 100,000 employed in solar energy sector
- **Concentrating Solar Power (CSP and CPV) growing**
 - >1,000 MW projects under construction as of December 31, 2011
 - As of 12/31/2011, 516 MW of concentrating solar capacity in US

U.S. PV Installations



Source: SEIA, Solar Market
Insight Report Year-in-
Review



Key Events in Solar Energy 2011

Solar Industry

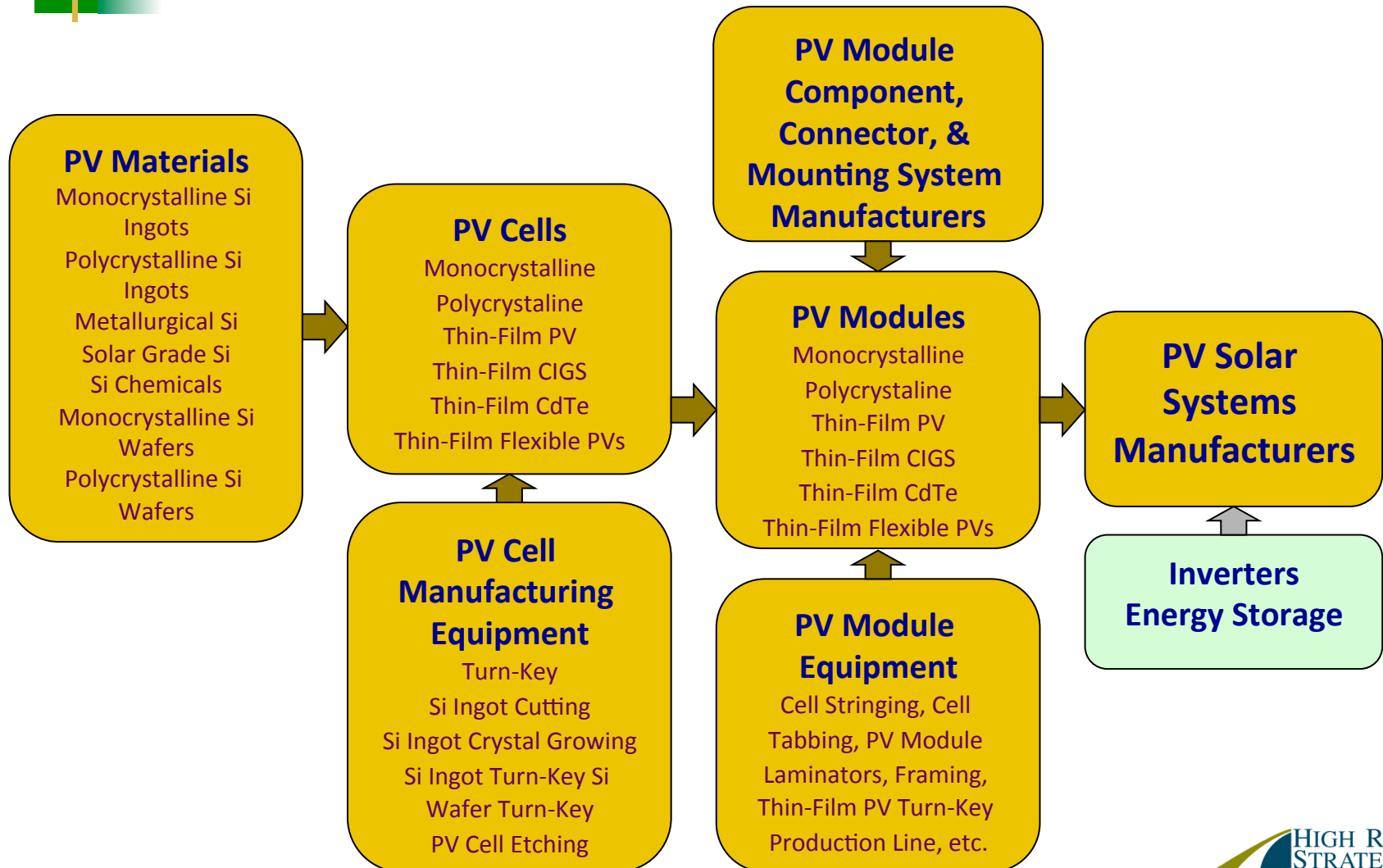
- **Google** invests \$280 million in Solar City tax equity fund (6/14)
- **First Solar** world-record CdTe cell efficiency, 17.3% (7/26)
- **Evergreen Solar** bankruptcy (8/15)
- **Solar Trust of America** announces PV use in Blythe 1 GW solar project (CPV) (8/22)
- **Solyndra** bankruptcy (9/5)
- **GE** announces CdTe facility in CO (10/13)
- **Solar City**, BofA, Merrill Lynch announce closure of financing for SolarStrong (11/29)
- **BP** announces shutting of solar business after more than 40 years (12/20)
- **Sempra Energy** announces 42 MW of 150 MW Mesquite Solar project, AZ (12/27)

Government Related

- **Section 1705 DOE Loan Guarantee** program closes, after offering \$13.3 billion in full or partial guarantees to solar projects and manufacturing facilities (9/30)
- **Solar World** and 6 unnamed partners file anti-dumping countervailing duty petition in front of U.S. government against China and Chinese c-Si cell/module manufacturers (10/19)
- **Section 1603 Treasury Program** expires, forcing industry to revert back to tax equity financing (12/31)

Source: SEIA, *Solar Market Insight Report Year-in-Review*

PV Manufacturing Value Chain





U.S. Solar Manufacturing 2011

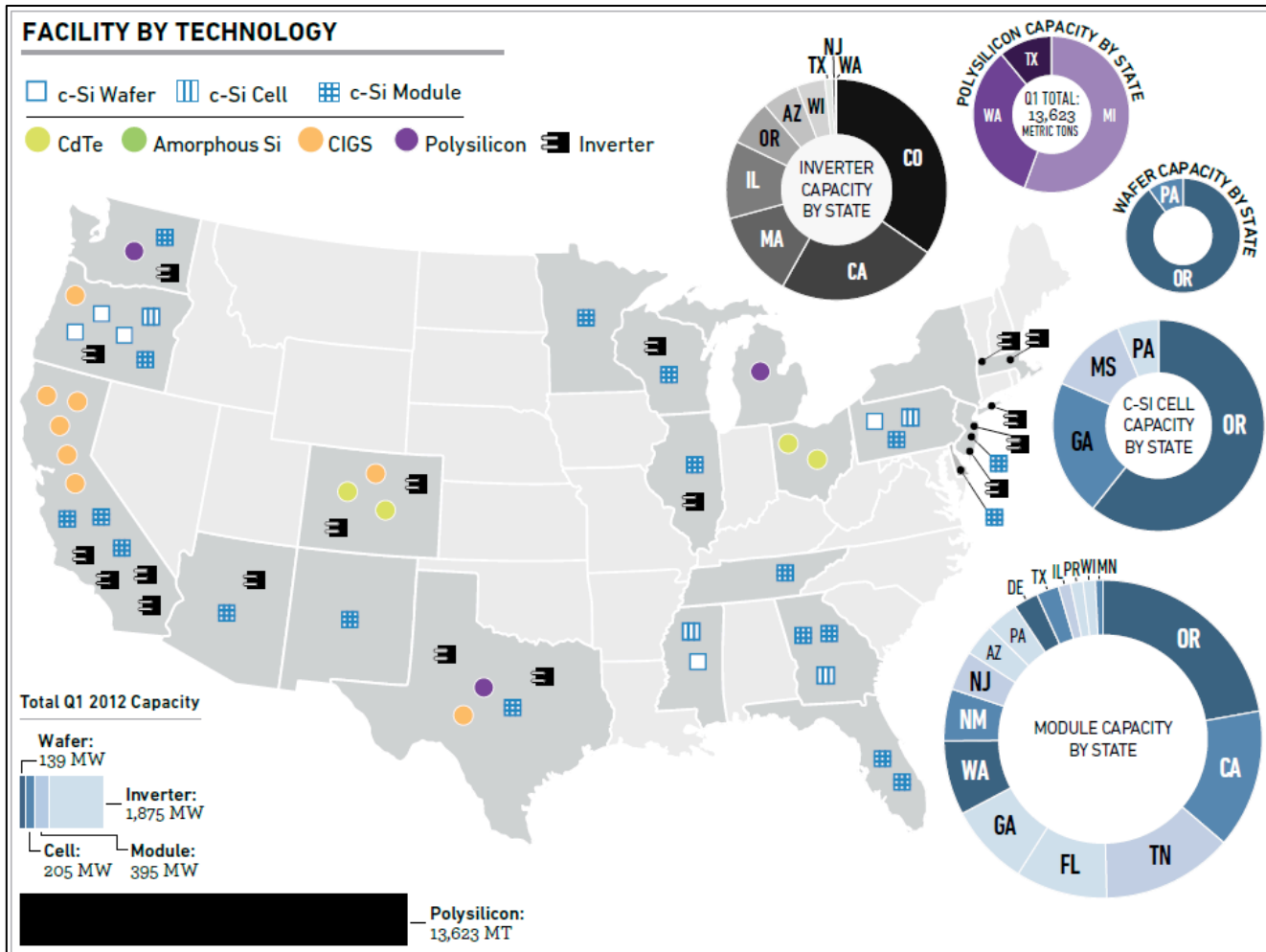
■ Solar manufacturing facilities

- 600 domestic manufacturing facilities in solar value chain
- PV manufacturing facilities in 26 states producing primary PV system components, e.g., solar-grade polysilicon, ingots, wafers, cells, solar modules, inverters
- New facilities opened in AZ, CA, IL, KY, MI, MS, NC, NV, NY, OH, PA, TX, VT, WA, WI
- Further expansion in 2011, 2013: AZ, CO, IN, MA, MS, NC, NV, NY, OH, OR, PA, SC, TN
- Glass and steel supply utility-scale solar power plants, including CSP currently under construction in southwest.

■ Solar manufacturing employment

- 24,000 Americans employed in US solar manufacturing sector
- Solar manufacturing jobs expected to grow by 14%, 2011-2012

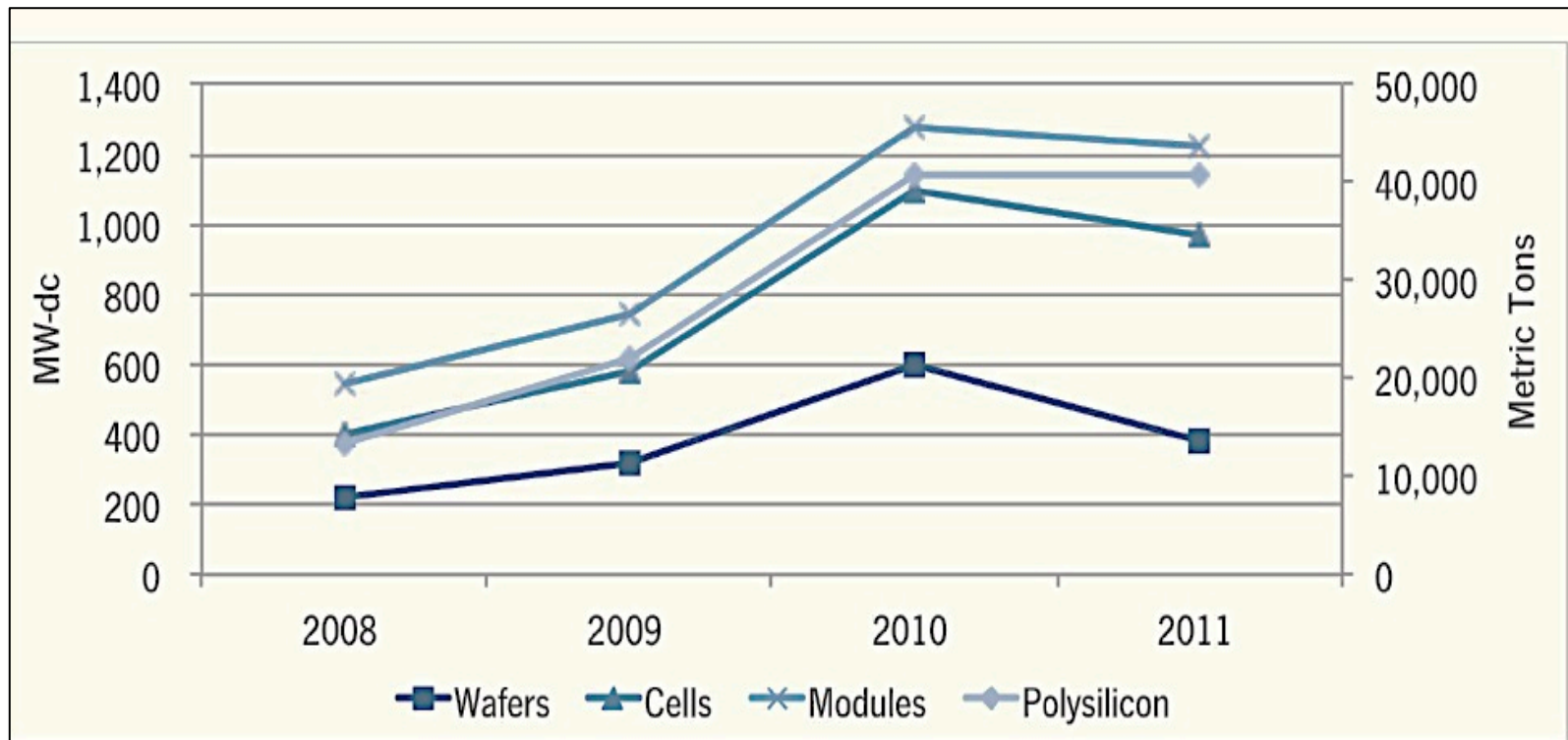
U.S. PV Manufacturing Facilities



Source: SEIA, Solar Market Insight Report Year-in-Review

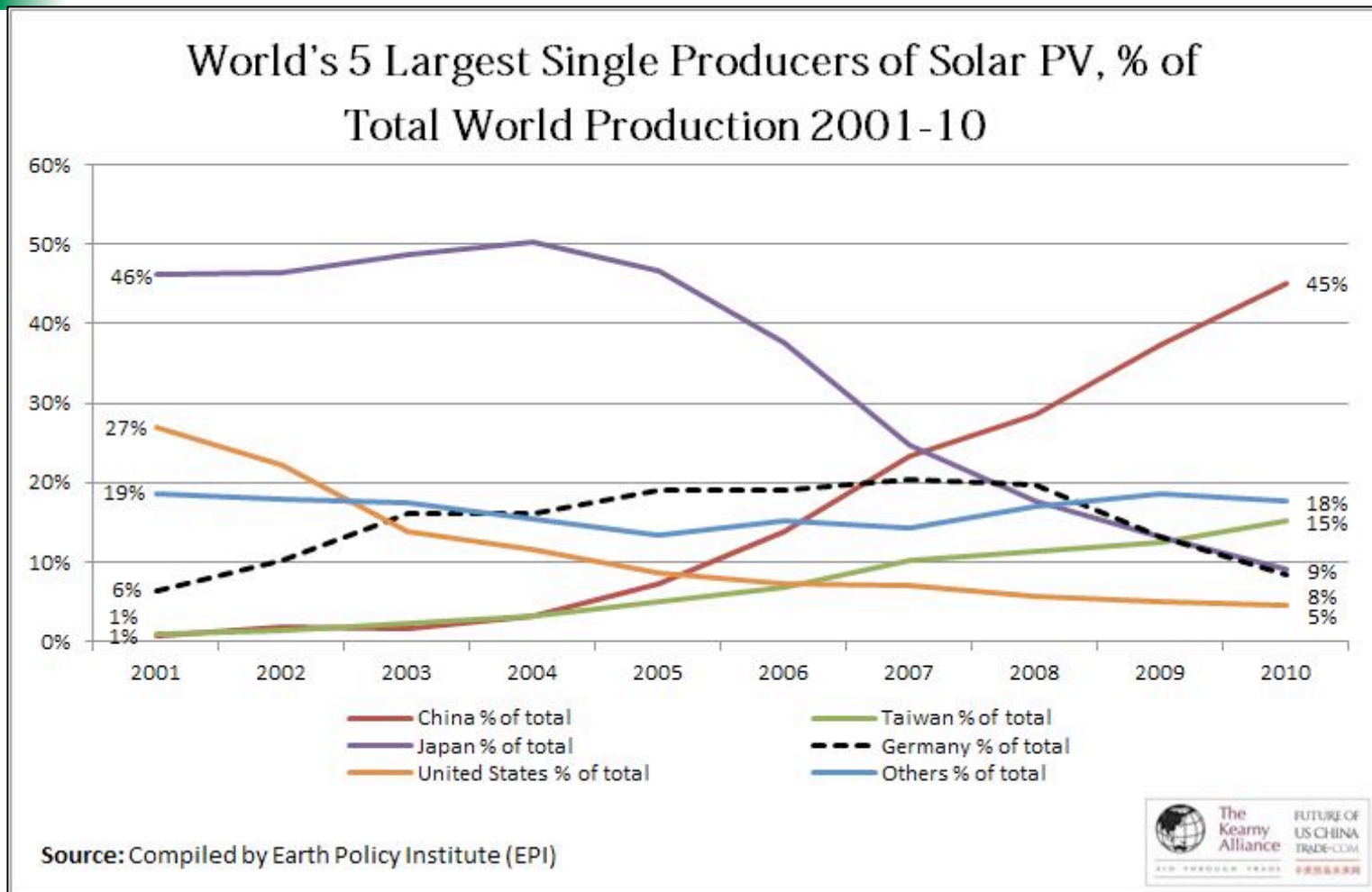
Value Chain Components

■ US PV Production 2008-2011



US modules produced, 2011: Crystalline silicon (68%); cadmium telluride (23%); CIGS (7%); amorphous Si (1%). Thin-film production at 32%, expected to grow.

World Solar PV Production





Solar Energy Policies & Programs

■ Federal Programs

- State Energy Program (SEP)
- American Recovery and Reinvestment Act of 2009 (ARRA)
 - Advanced Energy Manufacturing Tax Credit (Section 48C)
 - 1603 Treasury Program (tax incentives for renewable energy projects)
- 1705 Loan Guarantee Program
- DOE science and innovation R&D: Energy Innovation Hubs; ARPA-E
- DOC/EDA: i6 Green Challenge
- DOL/ETA Green Jobs Initiatives

■ State Policies & Programs

- Capital access: loans, loan guarantees, revolving loans, grants, tax incentives
- Clean energy R&D and innovation programs/tax credits
- Technical assistance to small-medium-size manufacturers (SMMs)
- Green workforce training programs
- Clean energy demand creation: RPS, feed-in tariffs

State CEM Policies

Program	California	Ohio	Michigan
Capital Access [loans, grants, tax credits]	<ul style="list-style-type: none"> Clean Energy Business Financing Program (CEBFP) CalPERS Environmental Investment Initiative (Green Wave) Sales & Use Tax Exclusion (SB 71) Alternative & Renewable Fuel & Vehicle Tech Program (AB 118) 	<ul style="list-style-type: none"> OH Energy Gateway Fund Advanced Energy of OH Bipartisan Job Stimulus Package ss 	<ul style="list-style-type: none"> MI EERE Revolving Loan Fund MI Loan Participation Program MI Collateral Support Program MI Centers of Energy Excellence (COEE) 21st Century Jobs Fund PV Tax Credit
Technology R&D	<ul style="list-style-type: none"> Public Interest Energy Research Program (PIER) CA Innovation Hubs (iHubs) R&D Tax Credit 	<ul style="list-style-type: none"> OH Third Frontier Program OH Hubs of Innovation and Opportunity 	<ul style="list-style-type: none"> MI COEE R&D Tax Exempt Zones ..
SMM Assistance	<ul style="list-style-type: none"> CA MEP Partners: Corp. for Manuf. Excellence; CA Manuf. Technology Consulting 	<ul style="list-style-type: none"> OH MEP Partners: Magnet, Techsolve, 7 Edison Centers 	<ul style="list-style-type: none"> MI MEP Partner: Michigan Manufacturing Technology Center (MMTC)
Workforce Training	<ul style="list-style-type: none"> Clean Energy Workforce Training Program (CEWTP) Alternative Renewable Training Program (AB 118) 	<ul style="list-style-type: none"> Energizing Careers Workforce Training Program (ARRA) 	<ul style="list-style-type: none"> Michigan's Green Jobs Worker Retraining Initiative
Demand-Side Policies	<ul style="list-style-type: none"> AB 32—Global Warming Solutions Act of 2006 Renewable Portfolio Standard (RPS) Feed-In Tariffs Program CA Solar Initiative & New Solar Homes Partnership 	<ul style="list-style-type: none"> Alternative Energy Portfolio Standard (AEPS) 	<ul style="list-style-type: none"> Renewable Portfolio Standard (RPS)



Future Prospects

- **Uncertain Political and Policy Environment**
 - ARRA, section 48C, section 1603, section 1705 programs end
 - Election could affect federal and state clean energy programs and spending
- **Uncertain Market Conditions**
 - Shale gas boom
 - US and global demand for clean energy technologies
 - Increased foreign (China, Germany) competition
 - Anti-dumping-countervailing duty petition: Coalition for American Solar Manufacturing/SolarWorld Industries America Inc.
- **BGA GMAP State Proposals**
 - Clean Energy Bank(s); leverage state pension funds and university endowments
 - Continue/expand existing state CEM and clean energy capital access programs
 - Expand/continue support for R&D, green workforce, MEP assistance to SMMs, demand-side policies