Solar Energy Policy: Lessons and Opportunities

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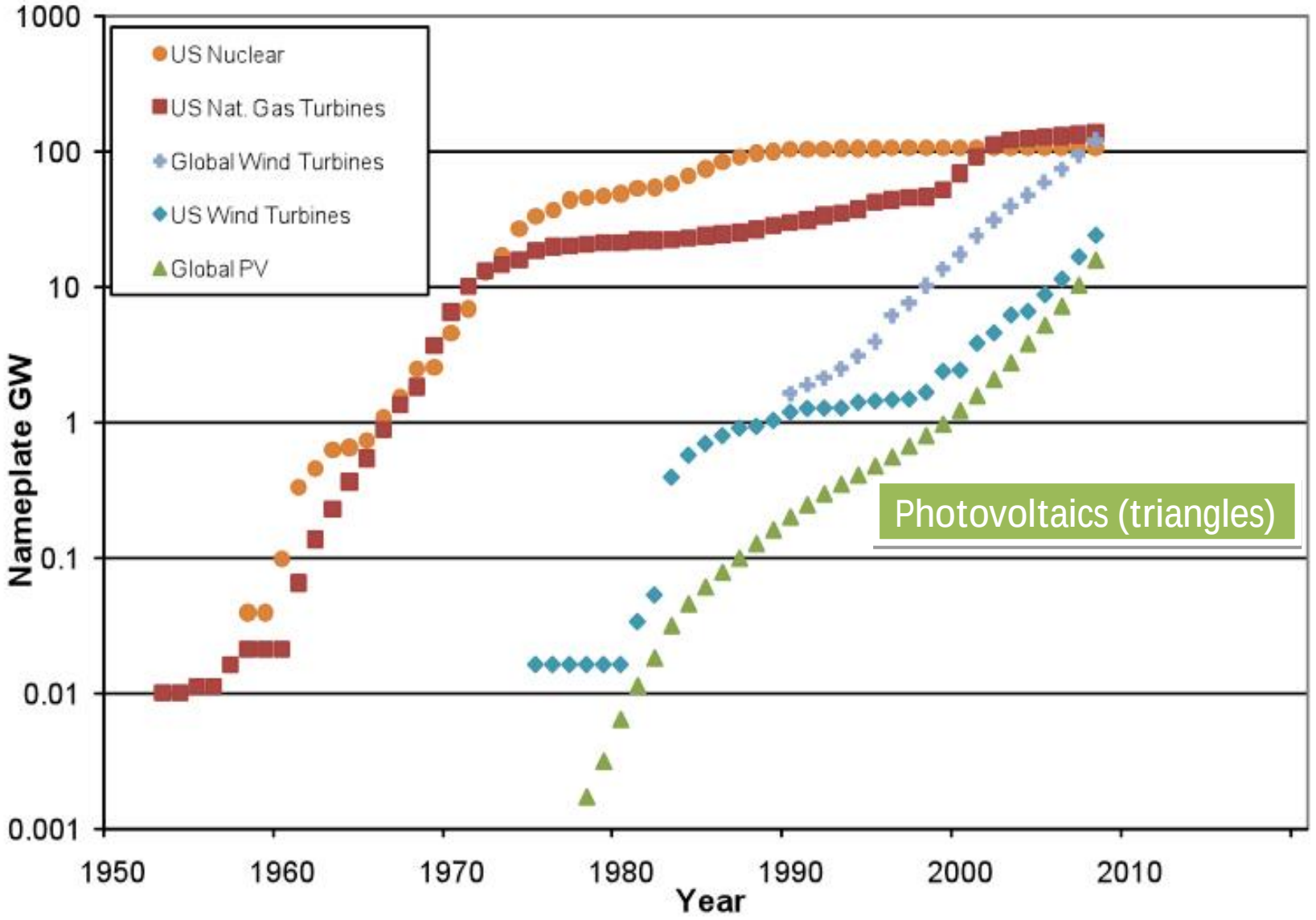
- Solar meets important societal goals
  - Price stability and climate change
- Solar cannot become cost-effective without both R&D and market-pull funding
- Solar has a record of success when funded
- Progress is
  - Science and technology development
  - Learning by doing
  - Economies of scale (including market efficiency)

Rapid deployment has occurred in prior technology innovations and is now occurring in wind and PV (source: T. Peterson, 2010)



Solar Policy Payoffs

Germany

- Policy of market incentives is the biggest driver of PV success *worldwide*
  - Investment growth
  - Cost reductions
  - Market growth throughout the world
- Collateral plusses
  - Local job creation
  - Local energy
  - Experience in managing PV output variability

US

- Incredibly effective in creating new, significant PV technologies (CdTe, CIGS, III-V concentrators)

Thanks

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http://solar.gwu.edu/

http://thesolarreview.org/

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Alhama de Granada, Spain (1.88MW); Phoenix Solar AG

New Initiatives in U.S. Solar Energy Policy

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The Parker Ranch installation in Hawaii

Meeting Global Challenges:
US-German Innovation Policy
The National Press Club
Washington, DC
November 1, 2010

John Lushetsky

Program Manager
Solar Energies Technology Program
U.S. Department of Energy

Solar Energy Resource

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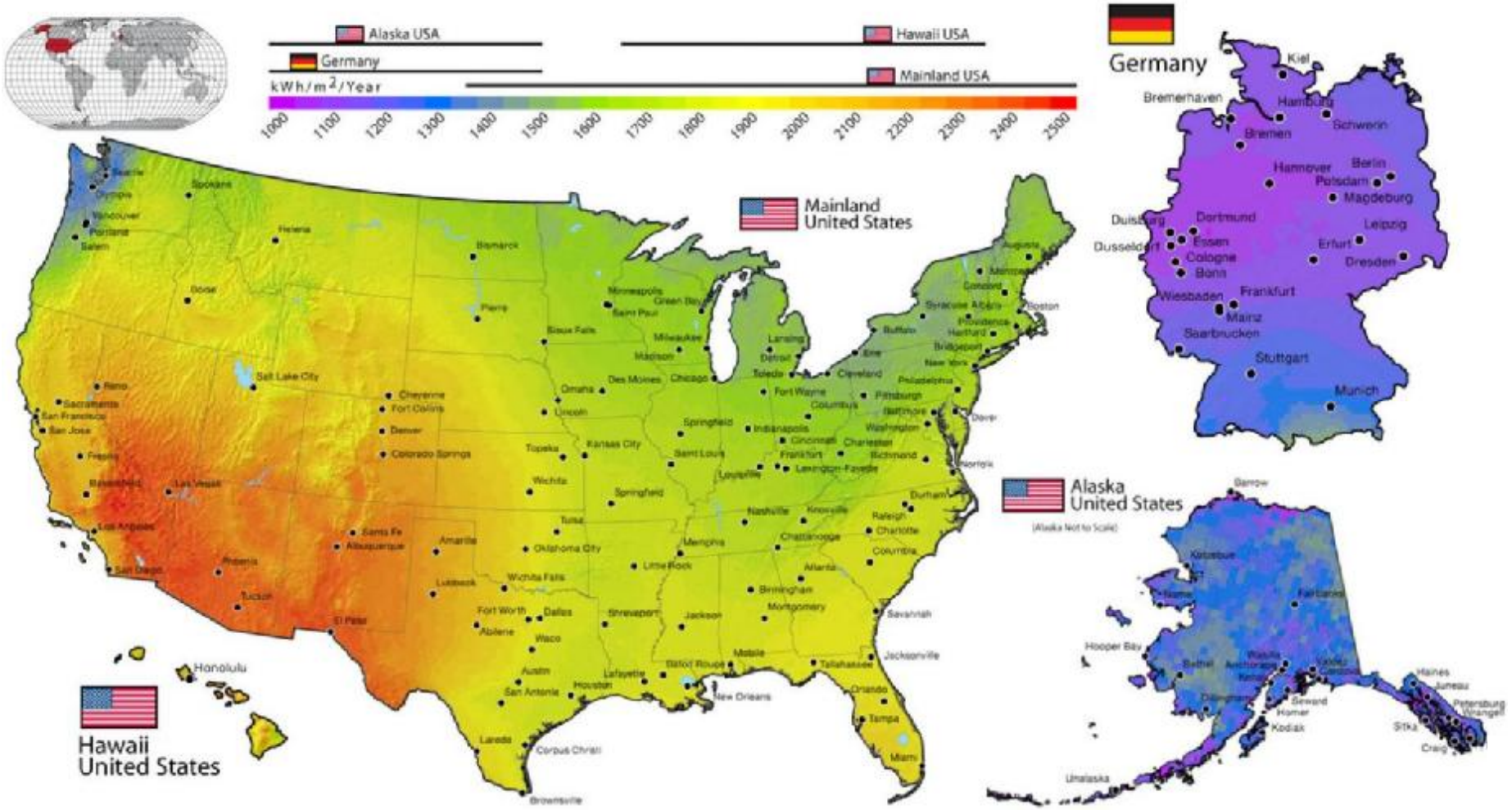
- The amount of solar energy reaching a location on earth depends upon the latitude, atmospheric conditions, time of year, etc.
  - Ø Germany's "sunniest" spot receives only 60% of the energy that reaches the "sunniest" spot in the U.S.



German & U.S. Solar PV Markets

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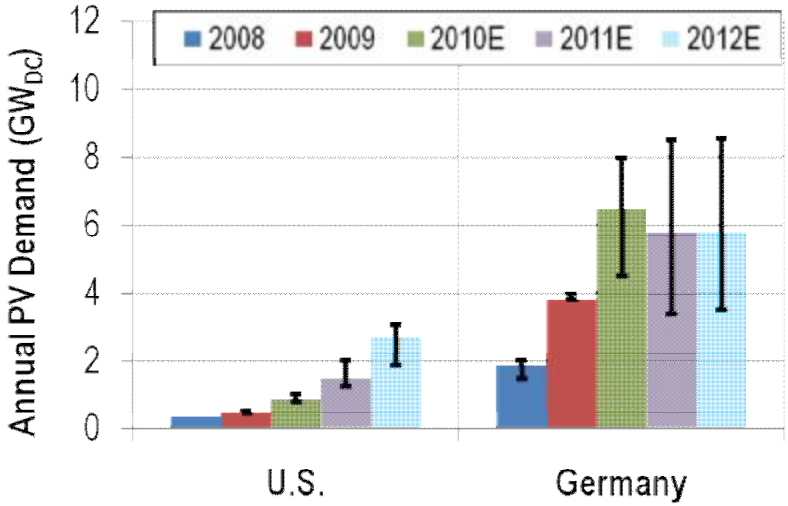
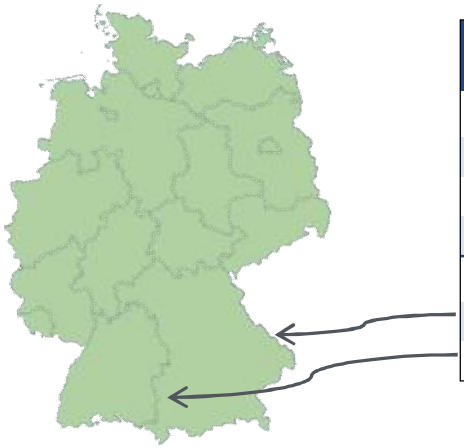
- Germany overcame a solar energy resource potential equivalent to the state of Alaska's to become the world's leading PV installation market
  - Even more impressive are the market penetration rates for the leading German States





	2009 Annual Installed (MW_{PV})	2009 Installed Watts Per Sq. Mile (PV)	2009 Installed Watts Per Capita (PV)
U.S. (national)	438	124	1.4
California	214	1,370	5.8
Hawaii	13	1,962	9.7
New Jersey	57	7,712	6.6
Germany (national)	3,806	27,607	46.4
Baden-Württemberg	551	39,898	51.2
Bayern	1,485	54,513	118.6

U.S. PV Installation Data: Interstate Renewable Energy Council (10/23/10), **German PV Installation Data**: Bundesnetzagentur (10/26/10), **U.S. Area & Population Data**, U.S. Census Bureau (12/09 & 4/04), **German Area & Population Data**: German Federal Statistics Portal (10/26/10).
Note: Q4'09 data for German is preliminary data. Area data for U.S. is land area while data for Germany is total area. Land area data was not readily available. This issue is not expected to meaningfully change the results as Baden-Württemberg and Bayern are both landlocked.
German Map: Courtesy Wikimedia Commons
Projected PV Demand Source: Barclays (6/28/10), Bloomberg NEF (7/30/10), Goldman Sachs (6/27/10), Lazard Capital Markets (7/26/10), Stifel Nicolaus (7/16/10), UBS (7/29/10)

Policy Measures to Promote Solar Technologies

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- There are many policies which fit within two general categories which can be used to accelerate the development & deployment of solar energy
- Technology Focused:
  - R&D and Manufacturing Tax Credit: Encourages private companies to develop and manufacture new & improved technologies & techniques
  - R&D Funding: Grants to support basic and applied research and development
- Deployment Focused:
  - Feed-In Tariff (FIT): Creates an easily entered into "pre-packaged" contract where a system owner is guaranteed to be paid a set price for each kWh of electricity generated over several years or decades. Usually, other changes which decrease the complexity or regulatory burden are also packaged into the policy.
  - Renewable Portfolio Standard (RPS): Requires utilities to obtain a certain amount of their electricity from renewable energy sources by a certain date or face a financial cost.
  - Investment Tax Credit (ITC): Allows a system owner to apply a percentage of the installed cost of a system to decrease their tax bill.
  - Loans, Loan Guarantees, Lower Cost Capital: Helps a company to install a solar system by decreasing the risk inherent in being amongst the first firms to utilize a new & innovative solar technology, or by making less costly capital available.
  - Modified Depreciation: Allows a business to apply a greater portion of a solar system's cost against its tax bill sooner than would otherwise have been allowed.

German & U.S. Solar Incentive Structures

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- Although there are notable differences between the policy approaches taken in Germany & the U.S., there are also notable similarities
  - Both countries are using a combination of existing institutions & systems while also pioneering the creation of modern new approaches to quickly develop & deploy solar energy technologies

	Germany	U.S.
Principal Solar Incentive	National Feed-In Tariff	30% Investment Tax Credit (ITC)*
Other Federal Solar Incentives	• Accelerated Depreciation • R&D Funding • Programs Offering Access To Less Costly Capital	• Grant In Lieu of the Investment Tax Credit (ITC)* • R&D Funding • Manufacturing Tax Credit • Loan Guarantees • Modified Accelerated Cost-Recovery Depreciation & Bonus Depreciation
Other State Incentives	• Tax Credits (if applicable)	• State, Local, & Utility Incentives (if applicable) • Renewable Portfolio Standards (if applicable)

*The Recovery Act created a temporary Cash Grant In Lieu of the 30% ITC for commercial taxpayers. However, a system which begins construction after 2010 is not currently eligible for this program.

Sources: FIT Information: Couture, Cory, Kreycik, William, NREL (7/10), EPIA (8/1/10), German Electricity Rate: BDEW (4/10/10), Euro Exchange Rate: OANDA 2009 Bid Average, U.S. Electric Rate: EIA-826 (Preliminary Data)

German Feed-In Tariff (FIT) Changes

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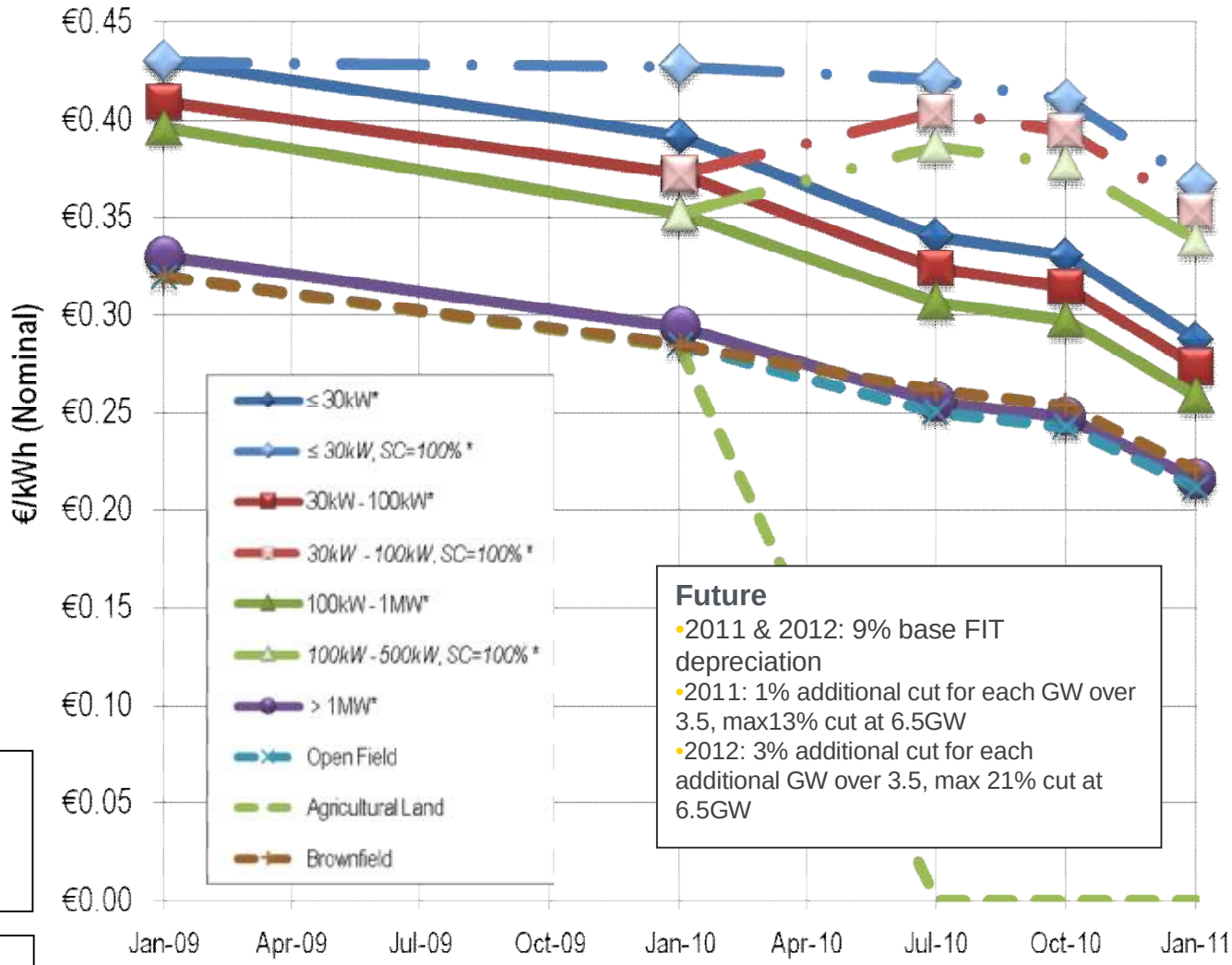
- FIT revised as of 1/1/10 with additional changes effective on 7/1/10 & 10/1/10
  - Encourage on-site consumption with a €0.08/kWh bonus through 2011
    - may be extended, only €0.0362/kWh if less than 30% of solar energy is consumed on-site
- FIT financed by electricity rate-payers
  - In 2009 the German FIT (all techs) cost net €4.6 billion, which is:
    - 0.21% of the German 2009 GDP
    - $29.0 billion if the 2009 German GDP is adjusted to the size of the U.S. GDP



- * indicates a Rooftop system.
- "SC" is self consumption. Figure at right shows the effective subsidy for a rooftop array at 100% self-consumption (includes avoided retail electricity cost).
- Figure assumes a FIT degression triggered by installation of more than 6.5 GWp in 2010.

Sources: Barclays (3/23/09), Bloomberg NEF (9/2/09 & 8/6/10), BMU (3/18/10), Cowen (3/4/10 & 3/15/10), Discussion with the German Embassy (3/18/10), EPIA (8/1/10), EuroStat (8/24/10), IMF World Economic Outlook (4/10), Official Minutes of the German Bundestag (7/8/10), OMB MSR (6/23/10)

U.S. Feed-In Tariff? 50+ Markets

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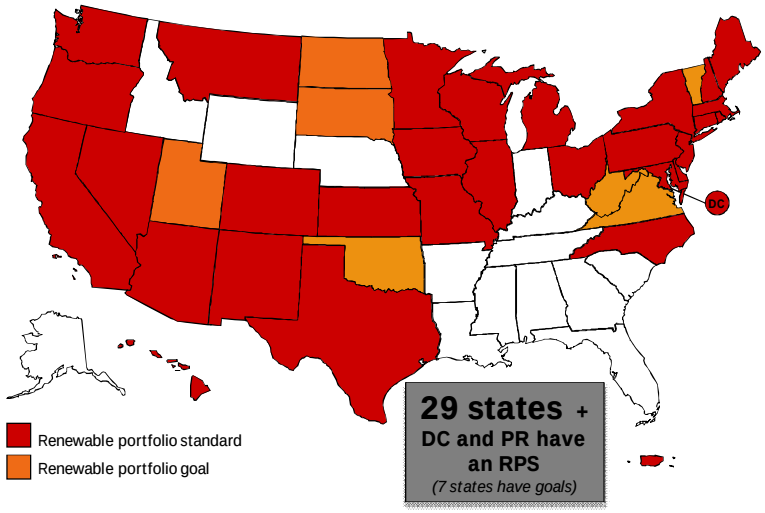
- The size, complexity, and regulatory framework of the U.S. electric industry makes a national Feed-In Tariff (FIT) difficult
  - Some U.S. cities and electric utilities have sought to create a FIT
    - Alaska, Hawaii, & Texas can more easily employ state-wide FITs since their electric grids are mostly independent
    - Other states may have the authority to create a FIT under existing law, but the issue is still being adjudicated
  - State RPS targets, Federal, State, & Local incentives, & Federal research funding, all continue to offer a realistic means to support the deployment of cost-effective renewable energy

Feed-In Tariffs (FIT)

State Renewable Portfolio Standards (RPS)



FIT Information & Map: Couture, Cory, Kreycik, William, NREL (7/10), RPS Map: DSIRE (9/10)

Market Maturity Impact on Installed System Price

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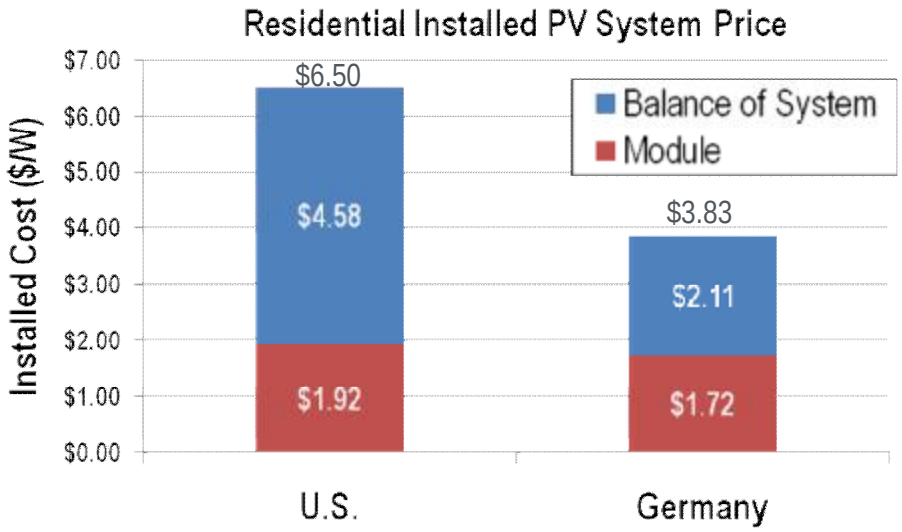
- Residential PV system prices vary widely between the U.S. and Germany

- Module price accounts for only a small part of the installed system price variation
  - The similarity in module prices reflects the global nature of the PV module market



- The difference in installed system prices is largely due to different Balance Of System costs which include the costs of: installation, other materials, permitting, & grid connection
  - The economies of scale, increased competition, development of local markets supporting solar installations, and improved procedures & regulations resulting from the German solar installation market's growth, have probably been the factors that have allowed such substantial installed system cost reductions

Installed System Price: Module price data does not include retail mark-up in either Germany or the U.S. Data for German is from Bloomberg NEF (10/2010) while U.S. data is from the California Solar Initiative. A Euro/USD exchange rate of 0.76 was assumed, the simple average of the daily exchange rates thus far in 2010 (Oanda, 10/8/10

German & U.S. Solar Incentive Structures

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	Germany	U.S.
Advantage	• Simple (& stable structure) tends to encourage investors • Faster & less complicated connection and power purchase process	• Incentive automatically adjusts as installed cost declines, since it is based upon a percentage of total installed cost
Disadvantage	• Does not respond to market & price signals quickly • Can be difficult to control overall policy costs	• If a company does not have a sufficient tax bill, it can be difficult, costly, and/or time-consuming to utilize the ITC

*The Recovery Act created a temporary Cash Grant In Lieu of the 30% ITC for commercial taxpayers. However, a system which begins construction after 2010 is not currently eligible for this program.

Sources: FIT Information: Couture, Cory, Kreycik, William, NREL (7/10), EPIA (8/1/10), German Electricity Rate: BDEW (4/10/10), Euro Exchange Rate: OANDA 2009 Bid Average, U.S. Electric Rate: EIA-826 (Preliminary Data)

- The various approaches taken by both countries each have intended and unintended consequences
  - For instance, although the German Feed-In Tariff may provide a more predictable incentive from the perspective of project investors, there is a high degree of market instability when the rates are periodically updated

U.S. DOE's Solar Energy Technologies Program

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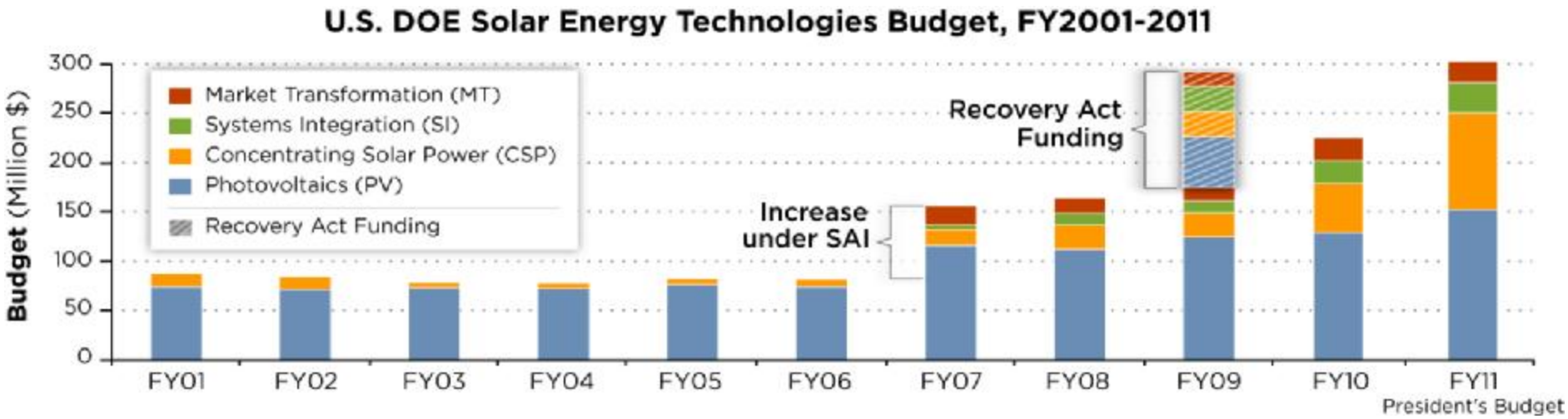

Note: Data for FY10 excludes $22 million in funding for the Fuels from Sunlight Energy Innovation Hub

Government Solar R&D

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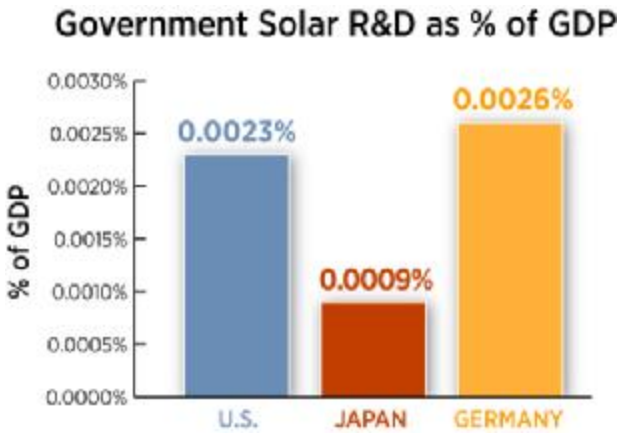
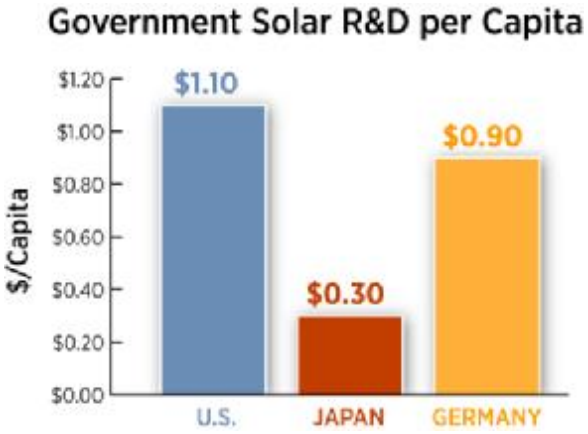
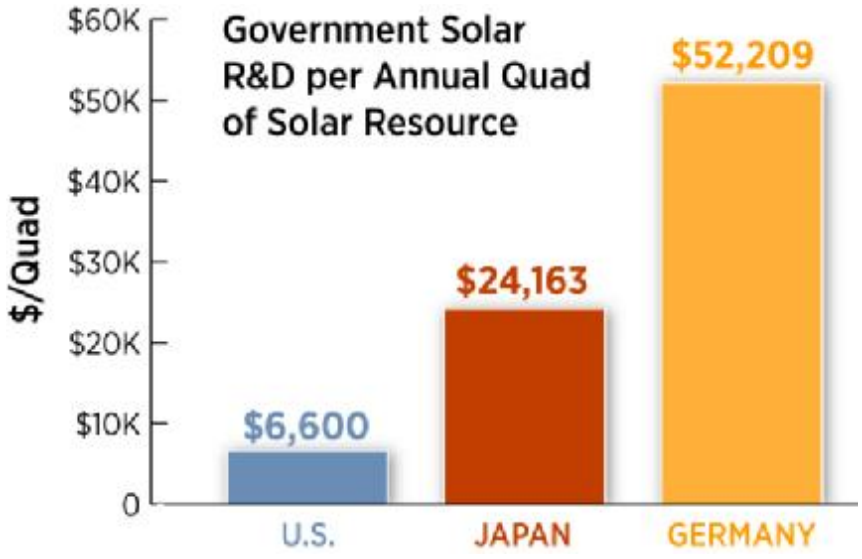


- The U.S. & German Governments invest about the same amount in solar R&D when adjusted for GDP
- The U.S. invests slightly more than Germany when adjusted for population
- However, the U.S. invests only 3/10 of what Japan and only 1/10 of what Germany invests in solar R&D when adjusted for the total solar energy available to each country





•Japan and German Data: Solar R&D spending and GDP (PPP) were for 2009.
•U.S. Data: Solar R&D spending and projected GDP (PPP) for 2010.
•Currency Conversion: 1.394 Euro/USD & 0.0107 JPY/USD (www.oanda.com, annual average for 2009)

Venture Capital & Private Equity Investment in Solar Technologies

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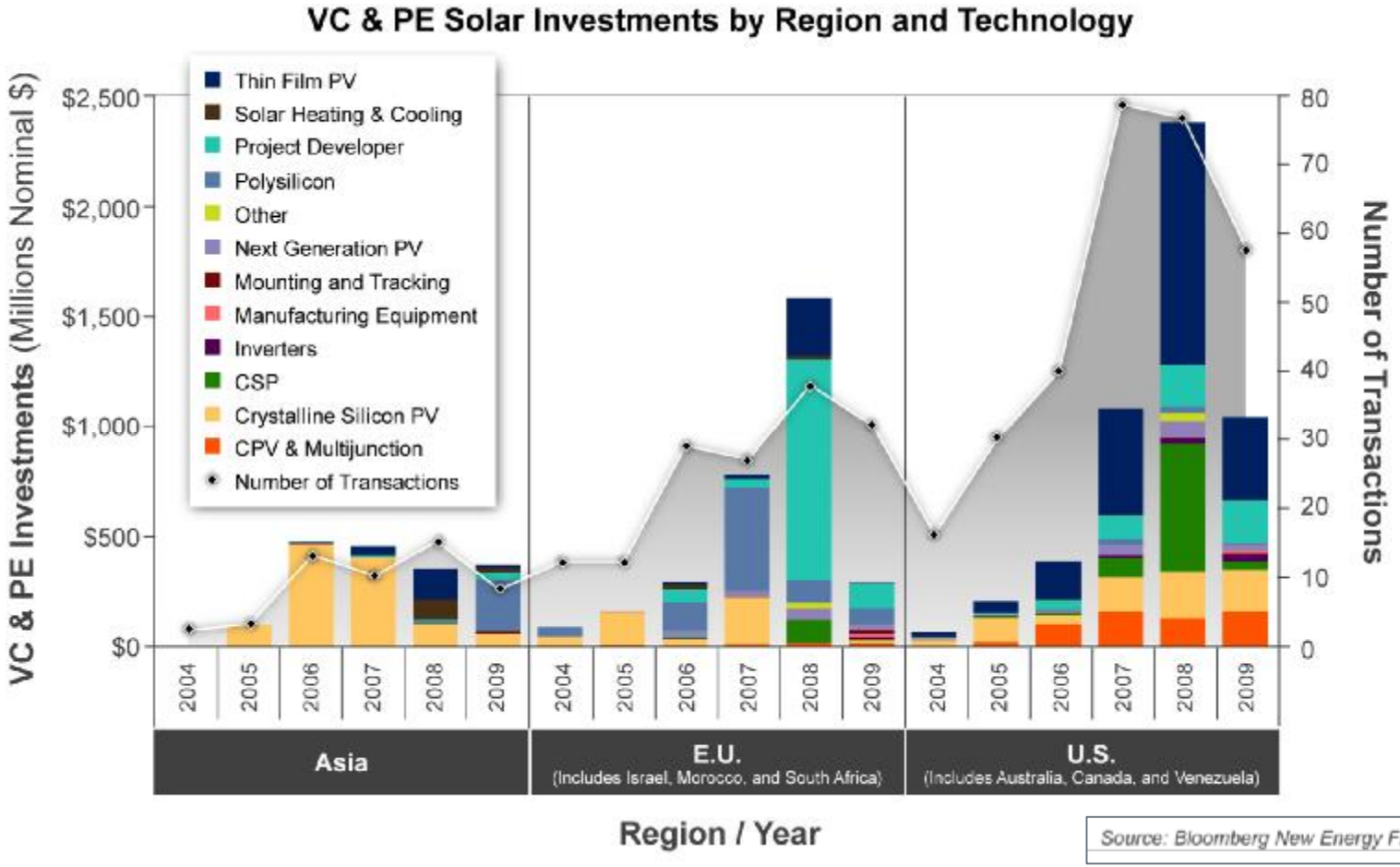
- Prevalence of longer-term, technology centered investments in the U.S., while the E.U. is more centered on Project Development investments
  - This may be reflective of the different market and incentive structures utilized in the E.U. and U.S.



Source: Bloomberg New Energy Finance (4/9/10)

Key Parts of the U.S. Recovery Act Supporting Renewables Deployment

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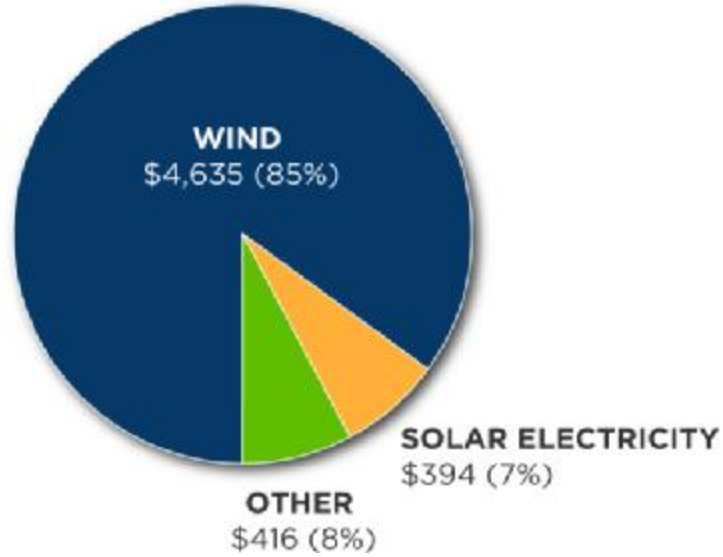
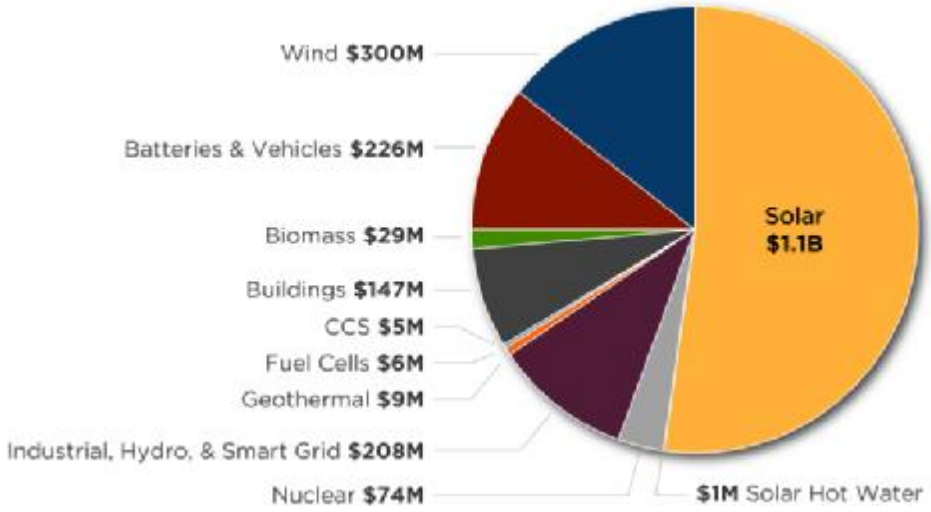
Grant in Lieu of the Investment Tax Credit

- Grant for 30% of renewables' installed cost available within weeks of a project entering service
- As of late-October 2010, $5.4B awarded to all technologies, with $394M to solar energy projects
  - Represents $1.3B of total solar project investment





Advanced Energy Manufacturing Tax Credit

- $2.3B competitively awarded as a 30% tax credit to 183 major clean energy manufacturing projects across 43 states
  - Solar energy projects received roughly 50% the funding, which represents total solar manufacturing project investment of $3.8B

Sec. 1603: Other includes: Biomass (Closed & Open Loop), Combined Heat & Power, Fuel Cell, Geothermal (Electricity & Heat Pump), Hydropower, Landfill Gas, Microturbine, Solar Heating, & Solar Lighting. Source: U.S. Treasury Database (10/27/10)
Sec. 48C: 160 of 183 selections are shown, representing over $2B

Progress in the DOE Loan Guarantee Program

$3.8B in Awards for Solar Projects and Manufacturing

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Solyndra – May 2009
$535 Million for PV Manufacturing

BrightSource Energy – February 2010
$1.37 Billion for Solar Tower Project

Abengoa – July 2010
$1.45 Billion for Solar Trough Project

Abound Solar – July 2010
$400 Million for PV Manufacturing

Effect of Manufacturing Incentive Programs

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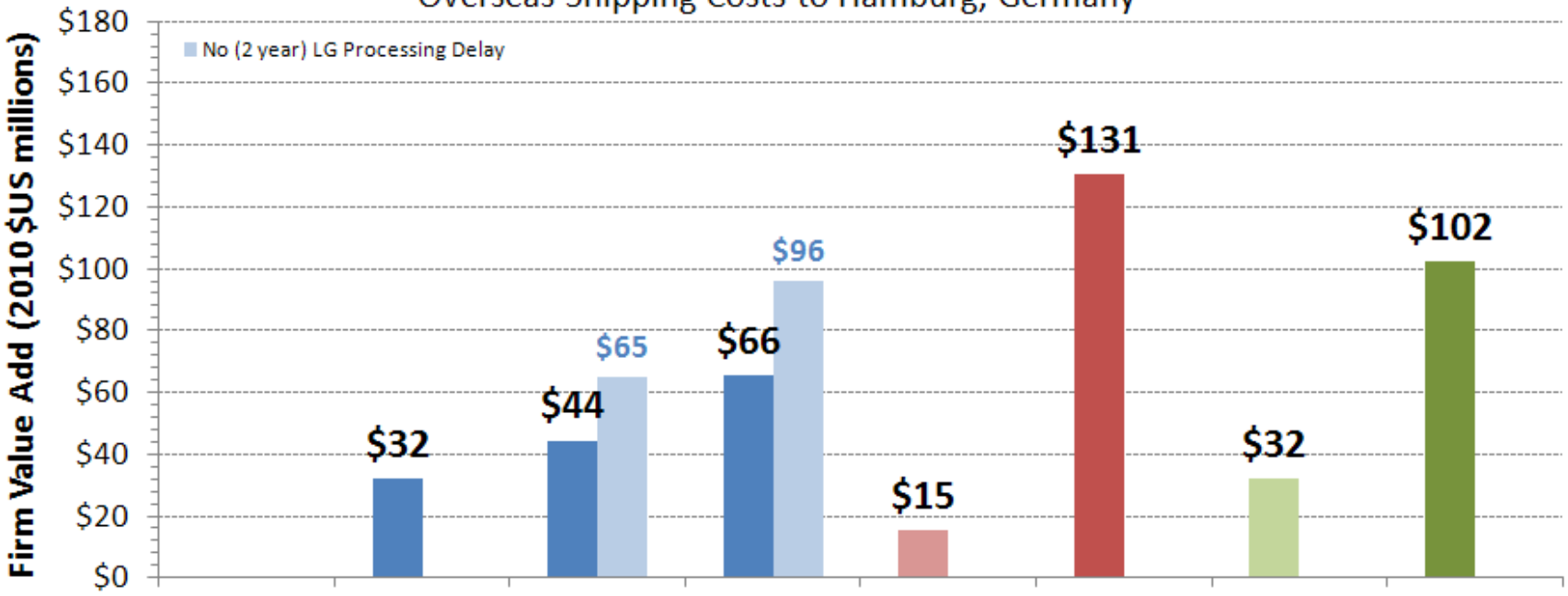
c-Si Cell and Module Manufacturer (250MW Plant)

Overseas Shipping Costs to Hamburg, Germany



	US	US (MTC)	US (Loan Guarantee)	US (MTC, LG, state incentives)	China	China Incentives	Malaysia	Malaysia Incentives
Module cost ($/W)	$0.91	$0.89	$0.91	$0.89	$0.86	$0.86	$0.88	$0.85
Shipping Cost	$0.05	$0.05	$0.05	$0.05	$0.06	$0.06	$0.05	$0.05
Total ($/W)	$0.96	$0.94	$0.96	$0.94	$0.92	$0.92	$0.93	$0.90
Cost of Capital	23%	23%	16%	16%	35%	23%	26%	26%

Source: NREL

Conclusions

- A variety of policy measures are available to accelerate the development and market introduction of new clean energy technologies.
- The U.S. has chosen a hybrid approach of Federal supply- and demand-incentives layers with State demand driven programs.
- Germany has had great success with it's demand side Feed-In Tariff that has been central to launching a new global solar industry.
- Both countries need to continually monitor policy approaches in what is a very dynamic market and technological environment.

Hermann Scheer – In Memoriam
Leader and Solar Energy Visionary

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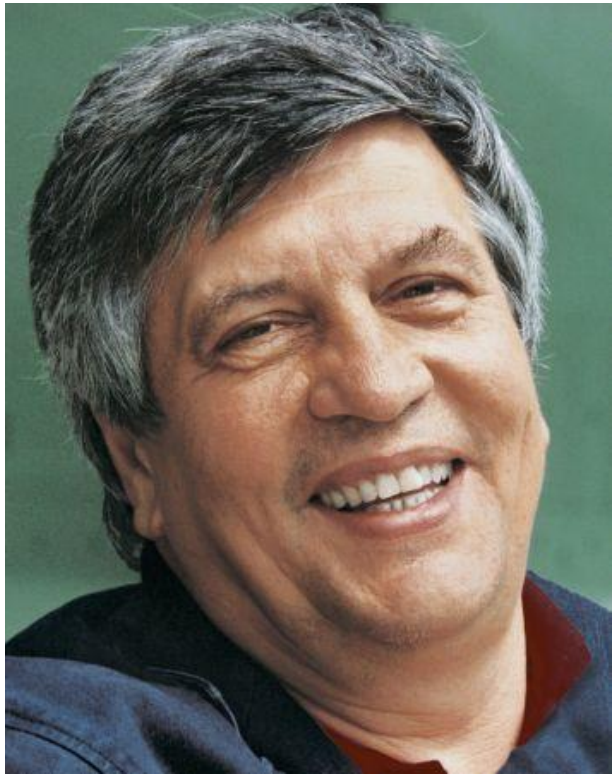

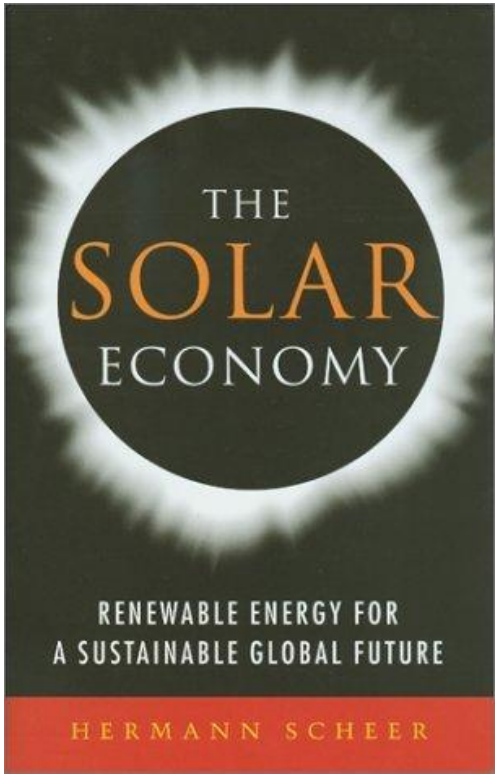

Thank You

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