Solar Energy Technologies Program

Mission, Vision, and Organizational Overview

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Key messages

- SETP is a multi-faceted program charged with the accelerate of solar technologies to achieve high penetration across the US and grid parity by 2015.
- SETP funds technology development for a portfolio of photovoltaic and concentrated solar power technologies through both the national labs and directly to industry.
- System Integration and Market Transformation are key sub-programs that address issues related to commercialization and wide-spread penetration of solar technology.
- The main challenge for the SETP going forward will be to adjust to dynamic industry conditions and changes in technology and market requirements to cost effectively reach program goals.

The PV market has enjoyed strong growth over the last 5 years

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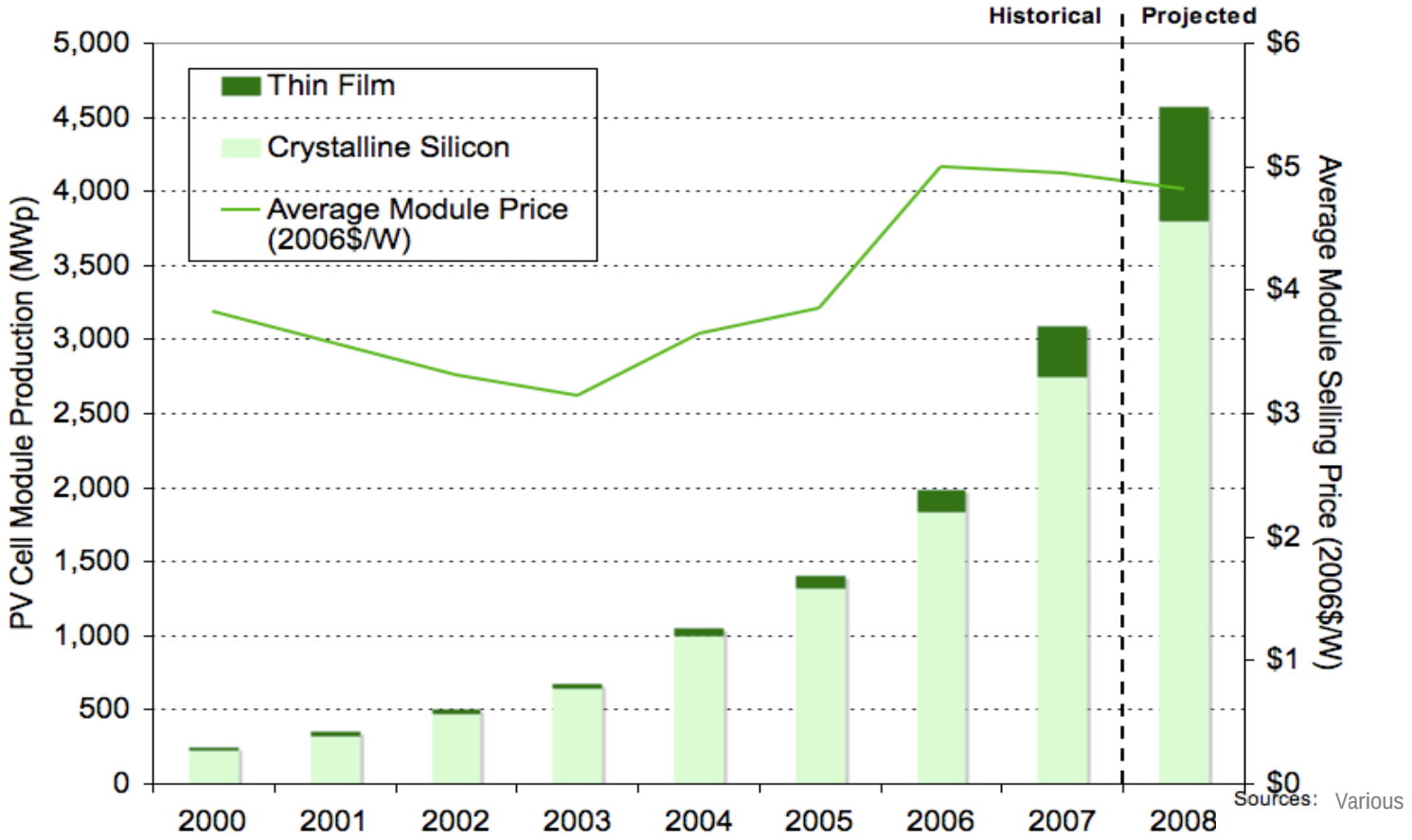
PV module production has grown significantly, but the rise in silicon feedstock prices has temporarily reversed the historical trend of declining average module selling prices



The PV industry is being driven by markets outside the US

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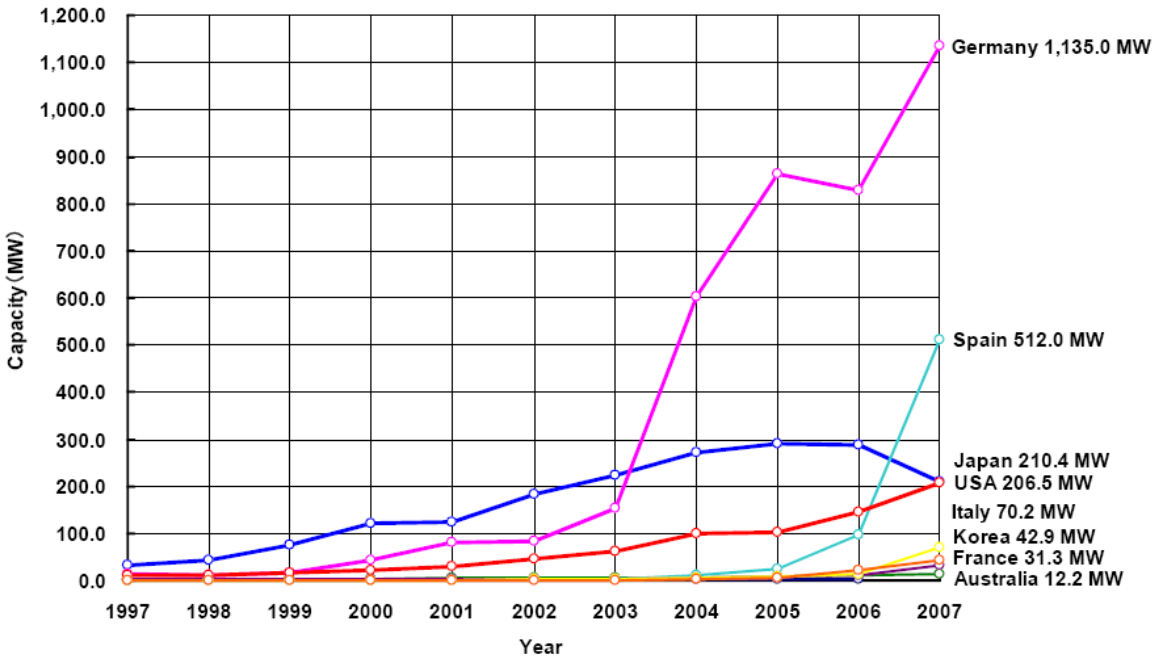
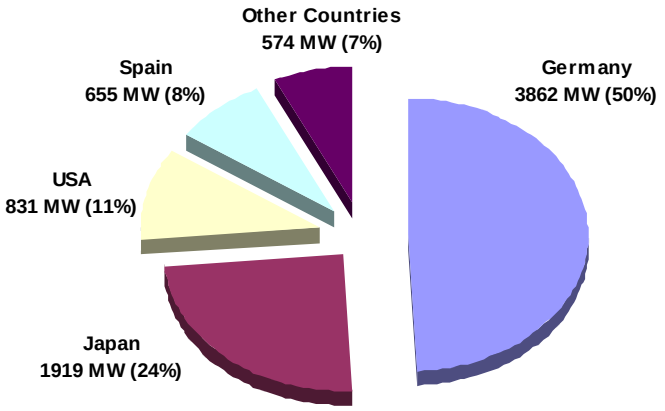
At the end of 2007, cumulative installed PV capacity was estimated to be 7,800 MW world-wide, 93% of which is located in Germany, Japan, the US and Spain

- 7,200 MW is grid-connected
- In addition, there is 430 MW of installed concentrating solar power (CSP),
  including 419 MW in the US and 11 MW in Spain

Trends in Annual Installed PV Capacity in IEA-PVPS Member Countries, through 2007



Cumulative Installed PV Capacity through 2007



Source: IEA

There has been considerable uncertainty on PV market size growth projections

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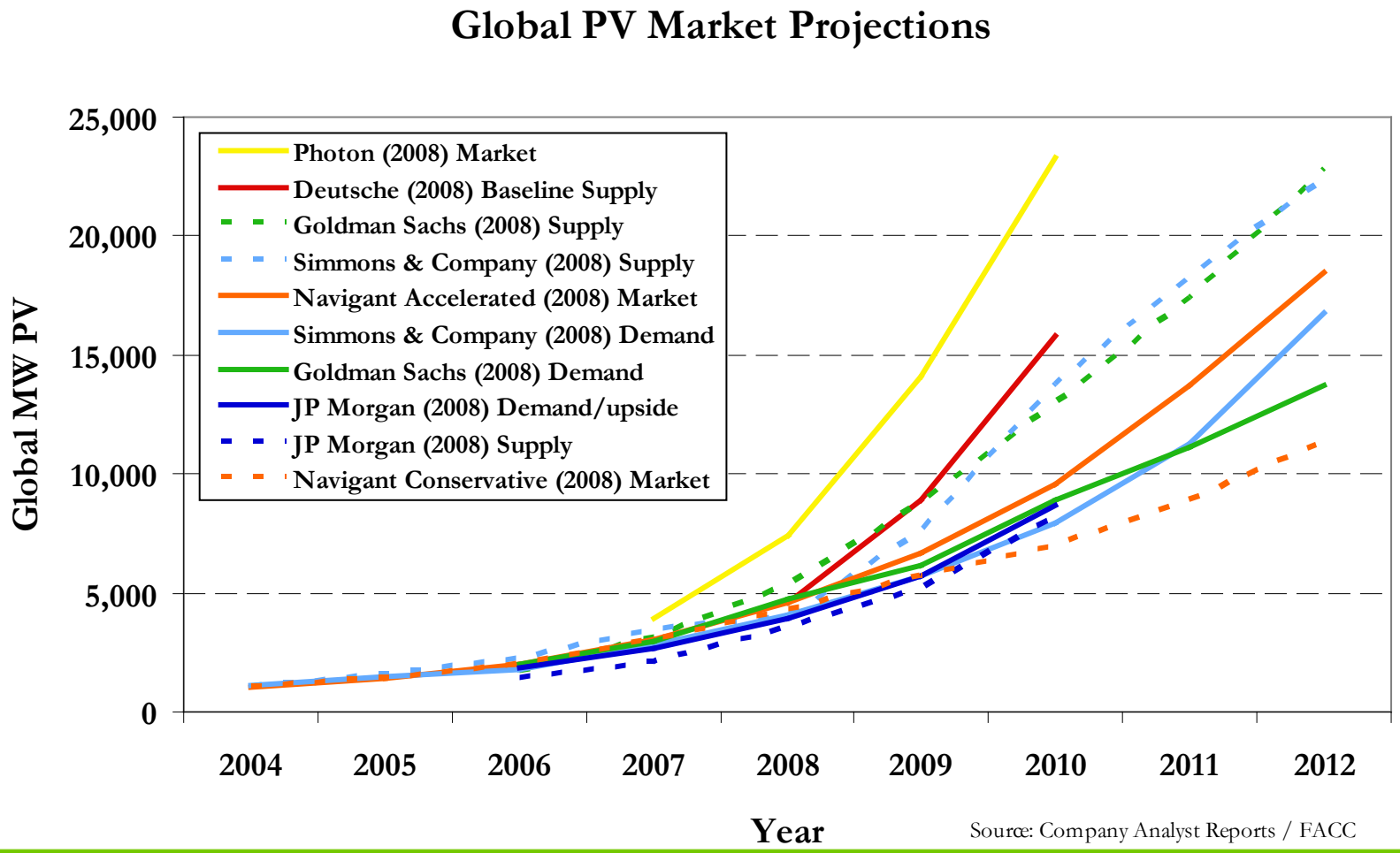
This uncertainly has been compounded by the recent global economic slowdown and financial crisis



Source: Company Analyst Reports / FACC

While significant progress has been made, PV system costs must be reduced by >2-3X to reach wide-spread grid parity

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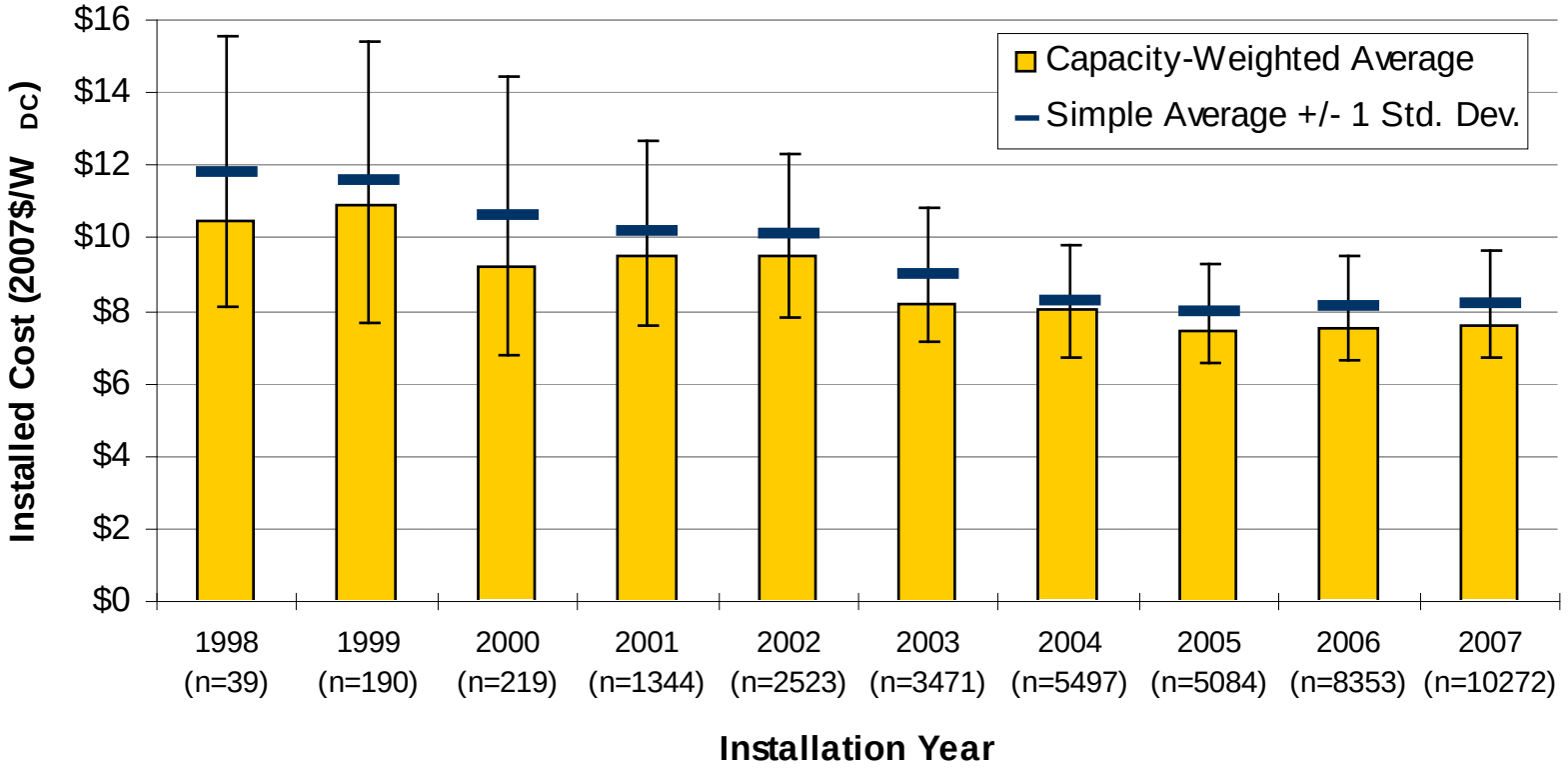
Average annual reduction of $0.32/$W_{DC}$ in real 2007$ (3.1%/yr real, 4.8%/yr nominal) from 1998-2007, but no apparent reduction in costs since 2005



Souce: Wiser, Barbose, Peterman (LBNL)

Global private investments in solar, by region and technology

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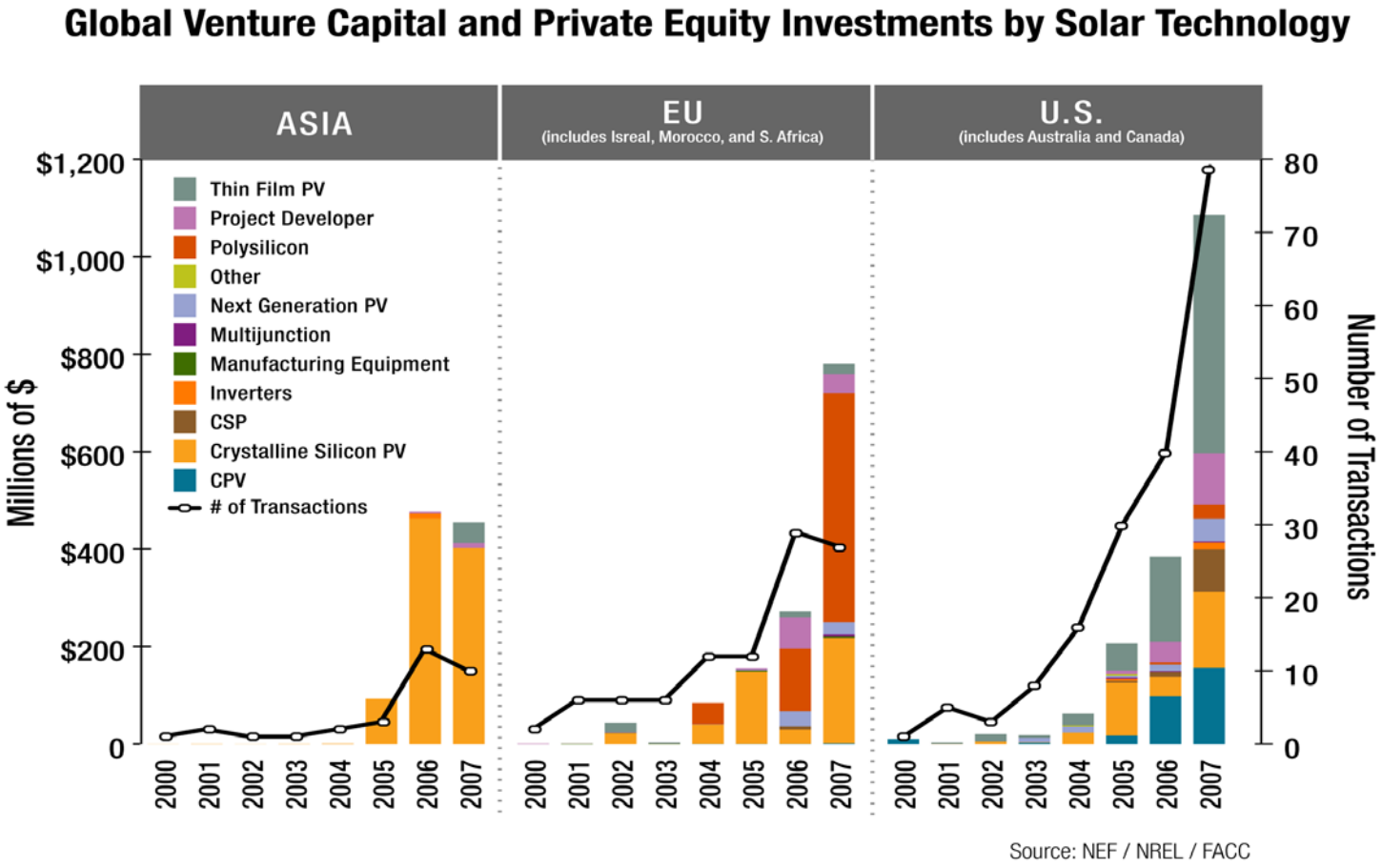
The US is the most diversified in solar technologies receiving VC and PE financing, with substantial investment in thin film PV, as well as CPV and CSP

- In Europe, most of the funding has been to polysilicon and c-Si PV companies
- In Asia, almost all investment has gone to c-Si PV



U.S. Department of Energy Budget Breakdown

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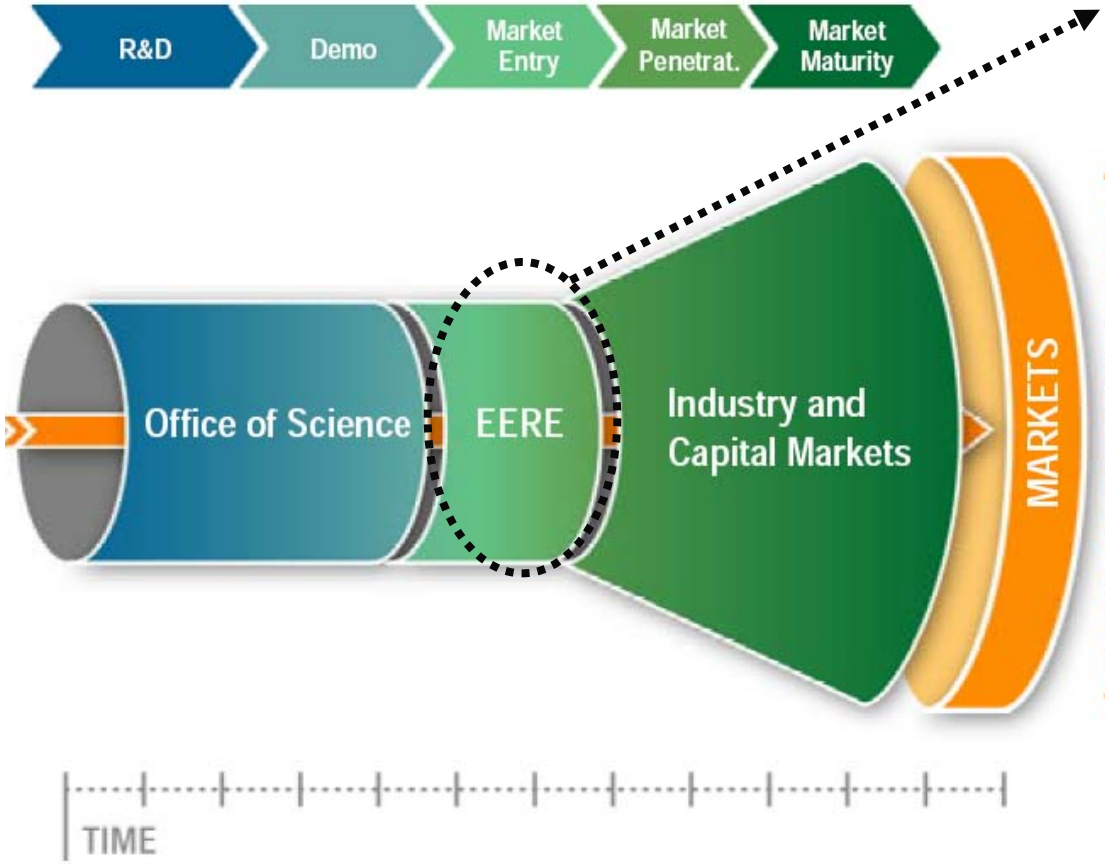
U.S. Department of Energy

Annual Budget: $23.9 Billion (FY08)



Energy Efficiency, Renewable Energy (EERE)

Annual Budget: $1.7 Billion (FY08)

10 Programs

Energy Efficiency

- Building Technologies
- Weatherization & Intergovernmental
- Industrial Technologies
- Federal Energy Management
- Vehicles

Renewable Energy

- Wind & Hydropower
- Biomass
- Geothermal
- Hydrogen, Fuel Cells & Infrastructure
- and ….

Solar Energy Technologies Program (SETP)

Annual Budget: $168 Million (FY08)

~20 Staff (incl. contractors)

The mission of DOE's Solar Program is to

Reach grid parity by 2015 and accelerate the wide-spread adoption of solar electric technologies across the United States

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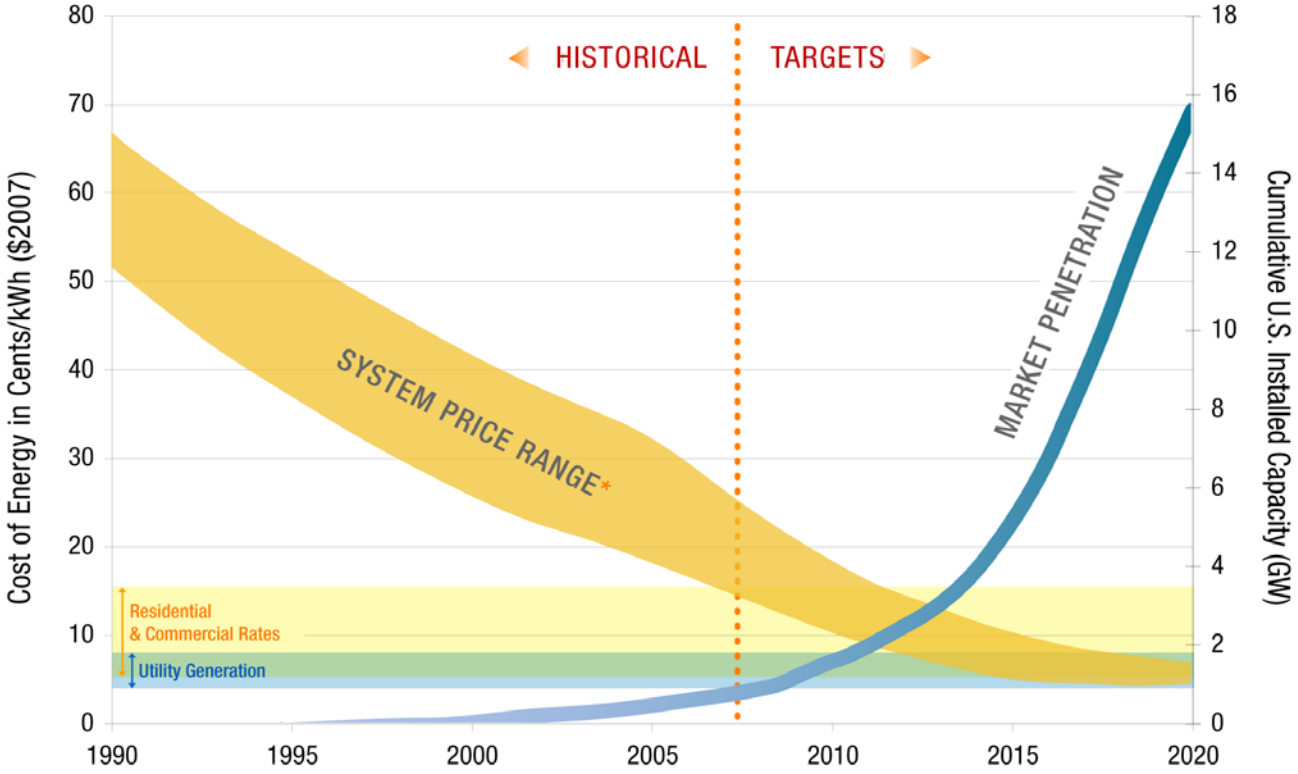
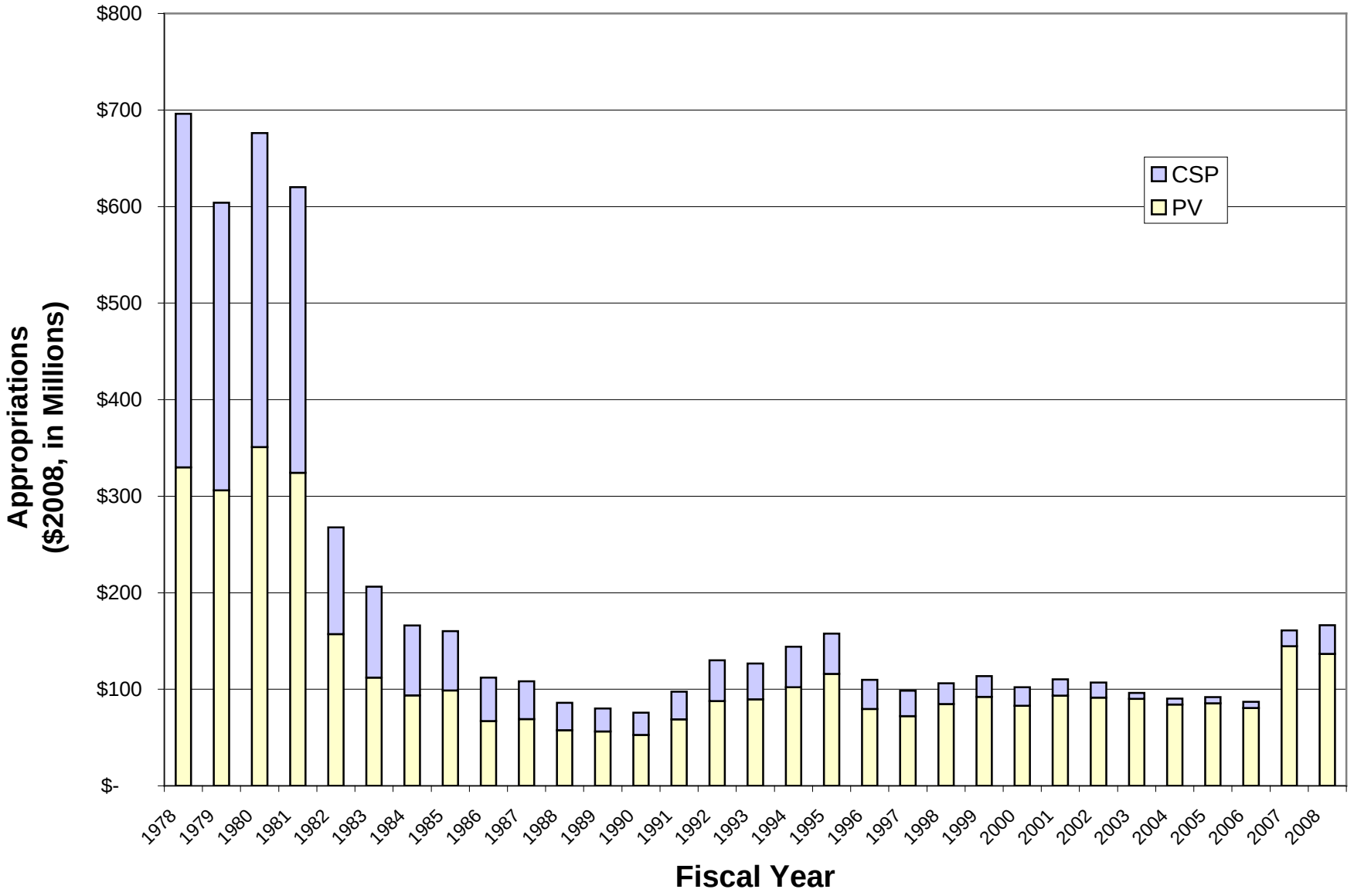
The SETP is focused on enabling high penetration of solar energy technologies and achieving grid parity by 2015



Market Sector	Current U.S. Market Price Range (¢/kWh)	Cost (¢/kWh) Benchmark 2005	Cost (¢/kWh) Target 2010	Cost (¢/kWh) Target 2015
Residential	5.8 - 16.7	23 - 32	13 - 18	8 - 10
Commercial	5.4 - 15.0	16 - 22	9 - 12	6 - 8
Utility	4.0 - 7.6	13 - 22	10 - 15	5 - 7

Solar Program Budget History



FY09 Projected Solar Budget

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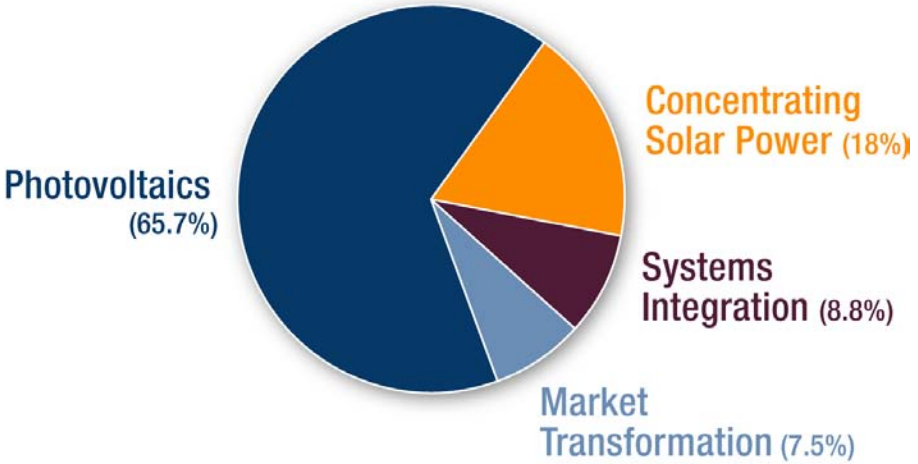
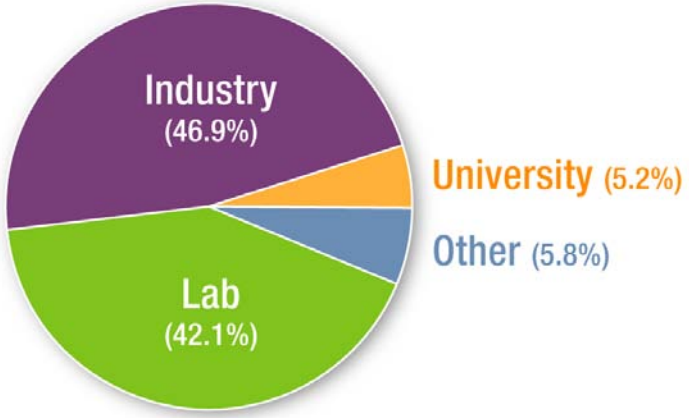
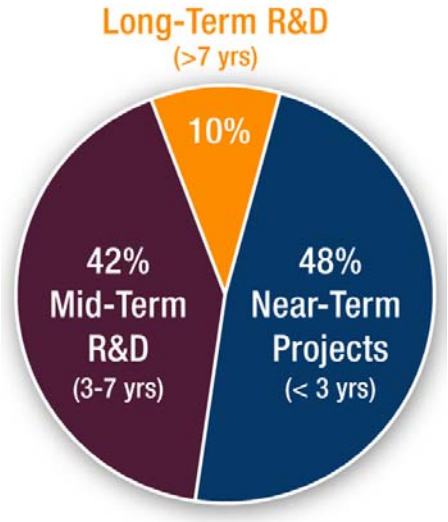
By Technology



By Recipient



By Term



NREL and SNL provide a strong base for solar development partnerships with industry

- **Over 200 scientists and engineers with deep understanding of all solar technologies**
- **Areas of expertise**
  - Crystalline silicon and thin-film PV
  - Flat-plate and concentrator PV
  - Process development and engineering
  - System development and testing
  - Measurement and characterization
  - Reliability engineering
  - Next-generation PV technologies
  - CSP components and testing
  - Grid integration and power electronics

Collaboration Types

- Cooperative R&D Agreements (CRADA)
- Work-for-Others
- Technical Service Agreements
- Technology Licensing

DOE's Solar Energy Technologies Program (SETP) works along the whole RD&D pipeline

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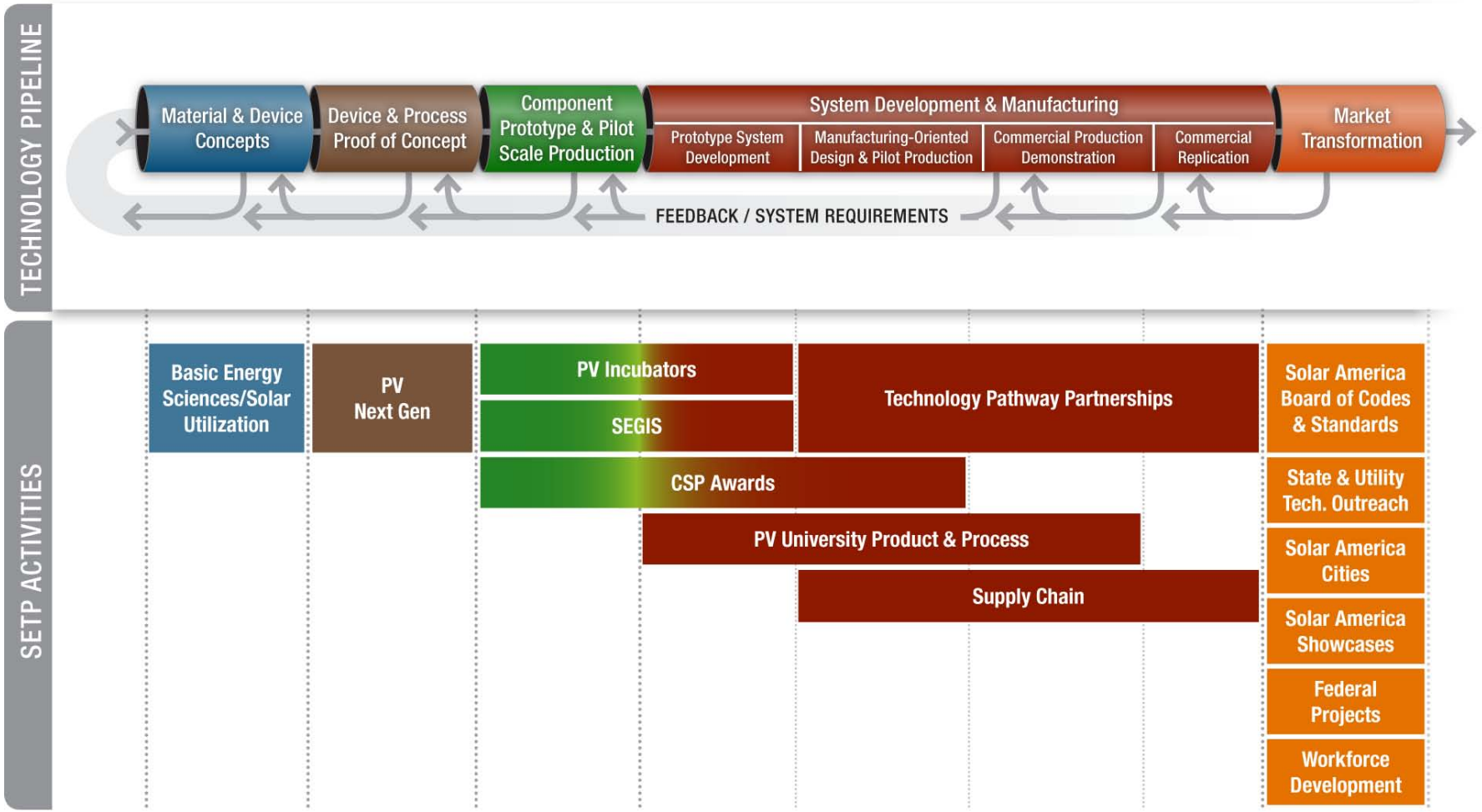

The SETP is a critical part of the total funding available for solar technologies

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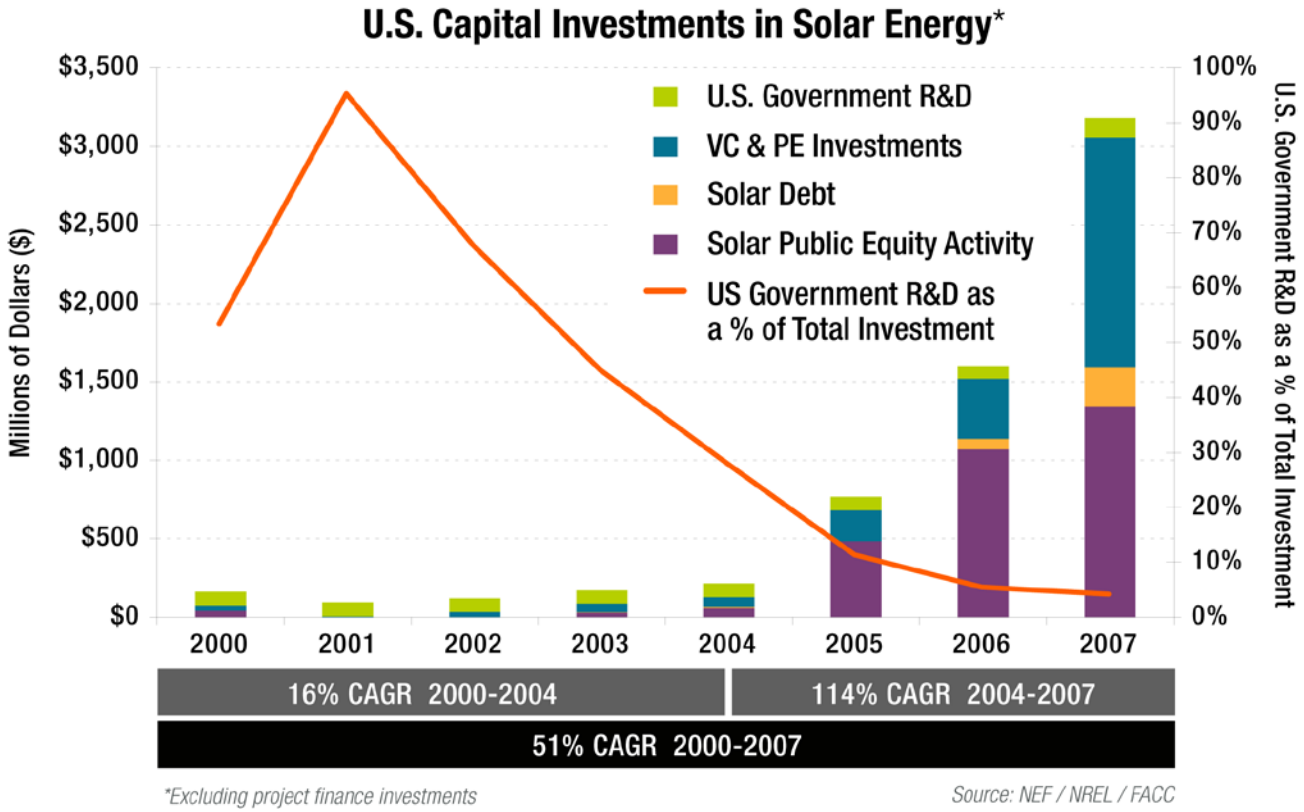

DOE Funding Advantages

1. Structured efforts with focus on full system costs (¢/kWh)
2. Preferential access to national labs
3. Fostering support for solar within large companies
4. Legitimizing young companies and new technology
5. Non-dilutive to company financing; minimal IP requirements

Challenges for Photovoltaics

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- Continue to drive down costs and develop sufficient product diversity to address and maximize all market segments
- Ensure adequate supply chain for a large and rapidly growing industry
- Continue to provide reliable products with 30 yr lifetimes (both actual and perceived)

Challenges for Concentrating Solar Power

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- Cost reductions and efficiency improvements must be achieved
  - Increase mirror reflectivity and durability
  - Increase receiver absorption
  - Identify lower freezing-point chemical solutions for heat storage
  - Increase heat storage beyond 7 hours
  - Grow the supply chain for advanced components
  - Develop innovative CSP systems for lower cost and operation in wider areas
- Identify the appropriate land areas for construction and ensure environmental impacts are minimized
- Develop a streamlined federal land application process

Technical Challenges for High-Penetration PV

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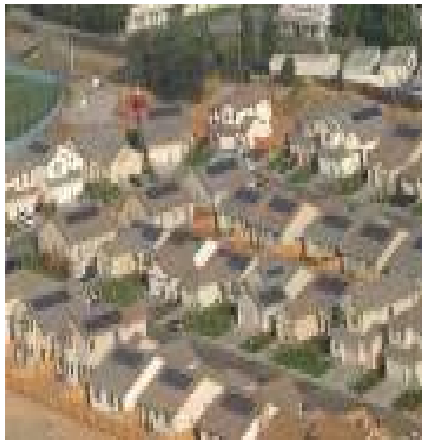
- Ensure safe and reliable two-way electricity flow
- Develop smart grid interoperability
- Develop advanced communication and control functionalities of inverters
- Integrate renewable systems models into power system planning and operation tools
- Integrate with energy storage, load management, and demand response to enhance system flexibility
- Understand high-penetration limiting conditions
- Understand how various climates and cloud transients affect system reliability



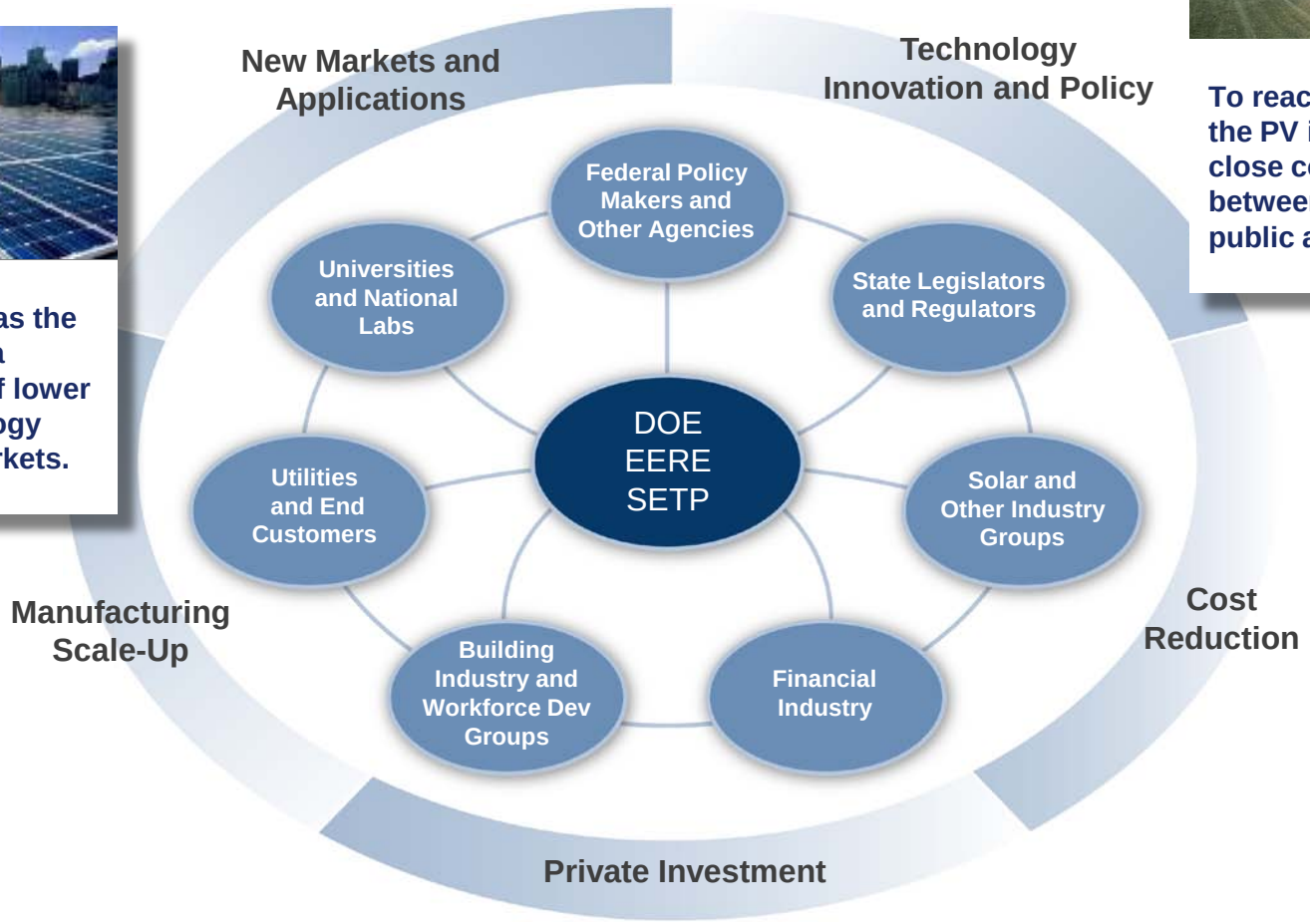
Challenges for Market Transformation

- Shortage of information about solar technologies and little consumer awareness
- Insufficient product standards
- Inconsistent interconnection, net metering, and utility rate structures and practices for solar systems
- Inadequate codes and complex and expensive permitting procedures
- Inconsistent and insufficient state and local financial incentives and other market drivers
- Lack of flexible, sophisticated, and proven financing mechanisms
- Limited education for and insufficient numbers of trained and experienced personnel and services

The SETP works with a number of stakeholders to grow and accelerate the U.S. the Solar Industry

The PV industry has the potential to enter a *"virtuous cycle"* of lower cost, new technology and expanded markets.

To reach it's full potential, the PV industry requires close coordination between a number of public and private entities.



Thank You

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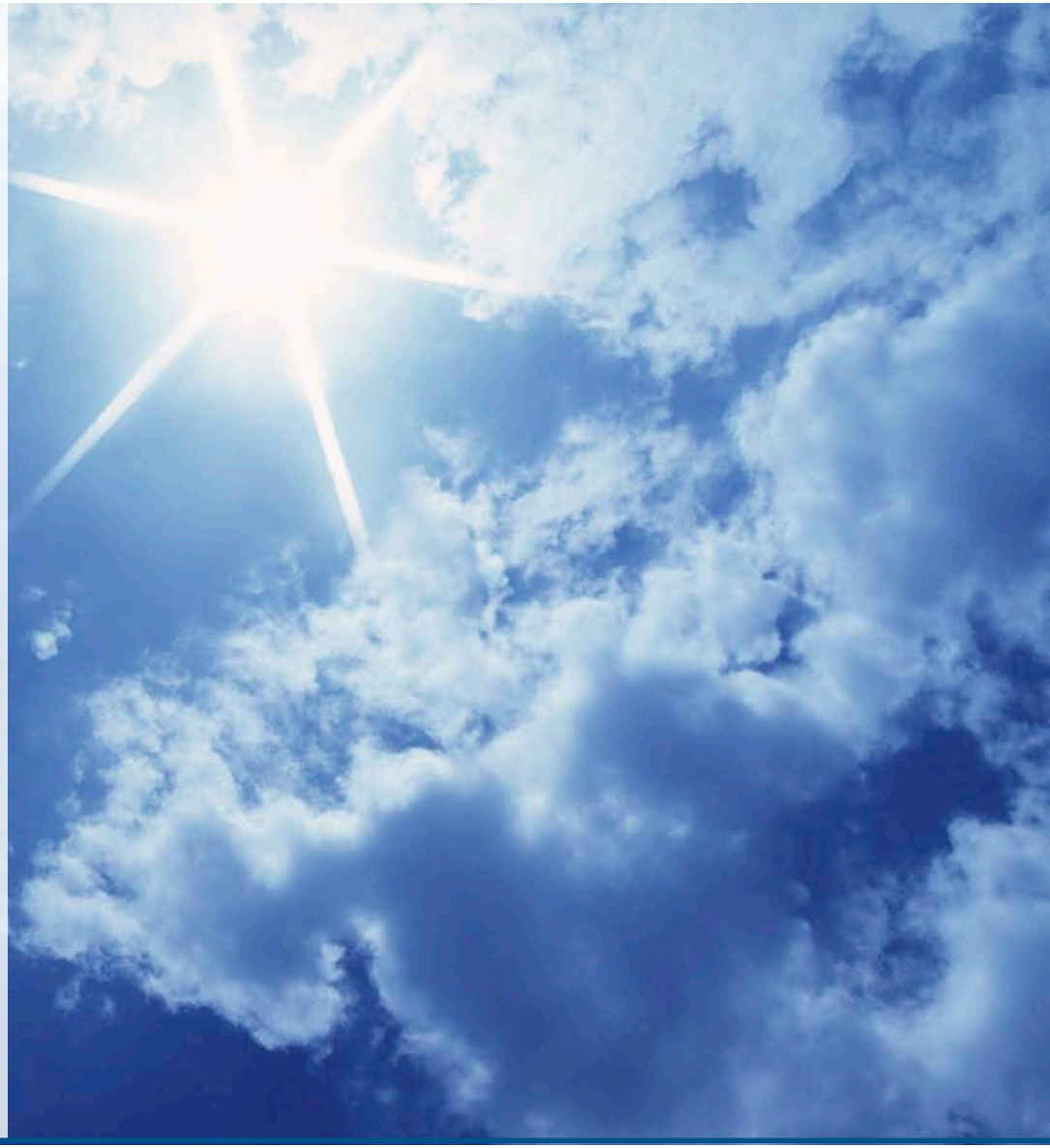

Potential New Initiatives

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- PV
  - BOS Reduction
  - BIPV
  - Next Gen
  - University Research
- CSP
  - Thermal Storage
  - Baseload/Higher Temp
  - Extended Geography
- Market Transformation
  - Colleges and Universities
  - Corporate Campuses
  - Showcases and Special Projects
- Grid Integration
  - Energy Storage
  - Large scale data collection and analysis
  - Industry Test and Evaluation Support
- Other
  - International outreach
  - Manufacturing base development
  - Workforce development
  - Next generation solar fuels
  - Demonstration Projects