The Department of Energy's Clean Energy Manufacturing Initiative

Dr. David Danielson
Assistant Secretary of Energy, Energy Efficiency and Renewable Energy
Libby Wayman, Director Clean Energy Manufacturing Initiative

Secretary of Energy Advisory Board Meeting

December 3, 2014

Outline for Today's Discussion

- Motivation: Why is DOE focusing on advanced manufacturing and manufacturing competitiveness as a priority thrust?
- Proper Role: What is DOE's proper role in supporting U.S. manufacturing competiveness?
- DOE Clean Energy Manufacturing Initiative: What is DOE doing in this thrust area?

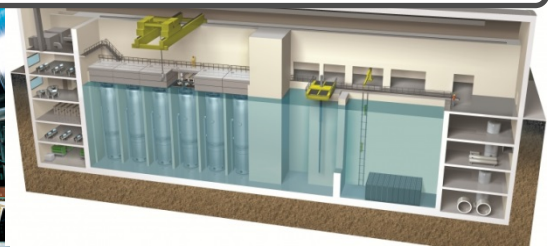
Clean Energy Manufacturing: Basics

Clean Energy Manufacturing:
Making things such that lifecycle energy-related environmental impact is improved in the production, use, and disposal/re-use of the product made.

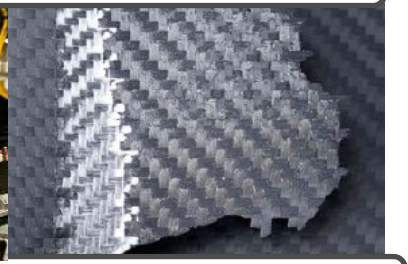
Advanced Manufacturing:
Making things in a manner such that advanced technology provides a competitive advantage over practices widely in use today

Manufacturing Products that Generate Clean Energy

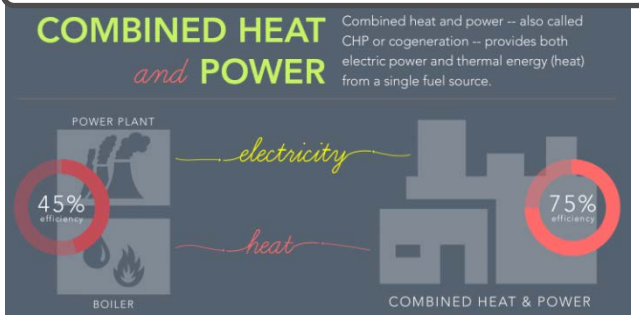




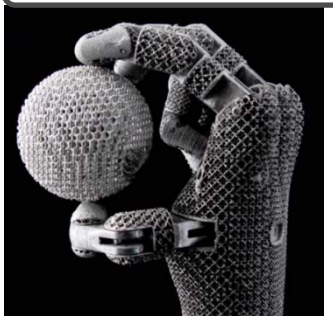
…& Products that Save Energy

Decreasing Energy Costs and GHG in Manufacturing



Advanced Manufacturing Technology




Clean Energy Manufacturing: Motivation

DOE Mission: Enhance U.S. security and economic growth through transformative science, technology innovation, and market solutions to **meet our energy, nuclear security, and environmental challenges.**

Advanced Manufacturing innovation can accelerate progress toward clean energy and climate goals

- Technology-Specific Manufacturing Innovation
  - Manufacturing processes for specific energy technologies require innovation. Example: Turbine blade manufacturing, battery electrode manufacturing
- Platform Manufacturing Innovations for Clean Energy Technologies
  - Platform technologies can accelerate development and enable new performance in energy technologies. Examples: composites fabrication, wide bandgap semiconductor device fabrication, data visualization and modeling
- Energy Efficiency for Energy Intensive Industries
  - The U.S. industrial sector accounts for approx. 34% of delivered energy
  - The U.S. industrial sector accounts for approx. 20% of greenhouse gas emissions, in addition to electricity generation (32%)
  - Technologies and technical assistance can enhance efficiency and reduce emissions. Examples: combined heat and power, advanced controls

Clean Energy Manufacturing: Motivation

DOE Mission: Enhance U.S. security and economic growth through transformative science, technology innovation, and market solutions to meet our energy, nuclear security, and environmental challenges.

Clean Energy Manufacturing offers a substantial opportunity to enhance U.S. security and economic growth

- Opportunity of Manufacturing
  - Balance of Trade, Multiplier Effect, Wages, 12% U.S. GDP, U.S. Exports (60%), Mfg Firms Dominate Private Sector R&D (70%), feedback to innovation
- Energy in the Manufacturing Sector
  - Lower energy costs can enhance manufacturing competitiveness
  - Energy efficiency can reduce costs and emissions
- Manufacturing in the Energy Sector
  - Growing global market opportunity
  - Opportunity to enhance energy security, economic growth

Clear and consistent congressional direction to focus on "Advanced Manufacturing activities, as well as research and development across the Department, to ultimately create manufacturing jobs in the United States."

DOE Clean Energy Manufacturing Initiative

Vision

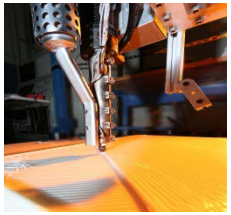
For the U.S. to be the world leader in translating cutting-edge science and technology innovation in clean energy and industrial energy productivity into high-value U.S. manufacturing activities, enabling substantial economic growth, energy security, and accelerated innovation.

Objectives

- Enhance U.S. competitiveness in manufacturing clean energy technologies
- Enhance U.S. competitiveness in manufacturing across the board by implementing energy productivity measures and leveraging low-cost domestic fuels and feedstocks

Manufacturing Competitiveness

The extent to which a country is selected for the location for manufacturing, while supporting rising wages and standards of living.



Additive Manufacturing

Carbon Fiber Production

Wind Turbine Blade Manufacturing

Gas Turbine Manufacturing

Aircraft Brackets by Additive Manufacturing

Criteria & Considerations for DOE Activities in Clean Energy Manufacturing

- Mission Impact:
  - If this effort is successful, will it have a large positive impact on U.S. energy metrics?
- Additionality:
  - Will the effort, at the available funding levels, make a large difference relative to what the private sector (or other funding entities) is already doing or going to do?
- Proper Role of Government and of DOE:
  - Is the effort a proper role for DOE versus something best left to the private sector or other organizations, including other federal agencies?

Some Examples of Out of Scope Activities for DOE

- Trade Policy
- Tax Policy
- Financial support to a non first-of-a-kind new manufacturing plant

DOE Modalities for Supporting Clean Energy Manufacturing Competitiveness

- Technology R&D: Individual Projects, Consortia, Shared Facilities
- Manufacturing Scale-Up Demonstration/Risk Reduction: Shared Facilities
- Pilot and Demonstration-Scale Manufacturing
- Pioneering Commercial Scale Manufacturing
- Loan Guarantees for Clean Energy Manufacturing (ATVM)
- Technical Assistance for Manufacturers
- Honest Broker Data Collection/Dissemination & Analysis
- Stakeholder Convening
- Public-Private Partnerships to Overcome Market Barriers

(Note: Not all modalities apply to all situations; specific tools apply in specific situations)

Examples of Key Elements of DOE's Clean Energy Manufacturing Initiative

Application Specific, Project Focused Advanced Manufacturing R&D Efforts

- Wind Power - Taller Turbine Towers: Development of lifecycle cost-competitive tower solutions that address the challenges of fabricating, transporting, assembling, maintaining, and decommissioning towers for turbine hub heights of at least 120 m (e.g. Keystone Systems – on-site distributed tower manufacturing using spiral welding)

Application Specific, Project Focused Advanced Manufacturing Scale-Up Demonstration Efforts

- SunShot SUNPATH effort (Scaling Up Nascent PV Technologies at Home): cost-shared support for pilot manufacturing demonstrations of advanced new PV technologies – SOITEC CPV mfg facility in San Diego, CA
- Bioenergy Technologies Office's Integrated Biorefinery (IBR) program: cost-shared support for pilot and demonstration scale first-of-a-kind biofuels plants (Sapphire Energy pilot algae growth, biofuels production)

Application Specific, Project Focused Pioneering Commercial-Scale Manufacturing Plants

- Bioenergy Technologies Office's IBR program (cellulosic ethanol – i.e. POET)
- DOE Loan Programs Manufacturing Investments (i.e. Tesla)

Consortium-Based Platform Manufacturing Technology RD&D Centers

- Carbon Fiber Composites for Clean Energy NNMI ($70/5 years) – focusing on developing the integrated advanced materials and manufacturing technology processes to bring carbon fiber composites into mainstream use in clean energy (automotive, gas storage, wind blades, etc) and more broadly
- ORNL Manufacturing Demonstration Facility – Additive Manufacturing

Clean Energy Manufacturing Competitiveness Analysis

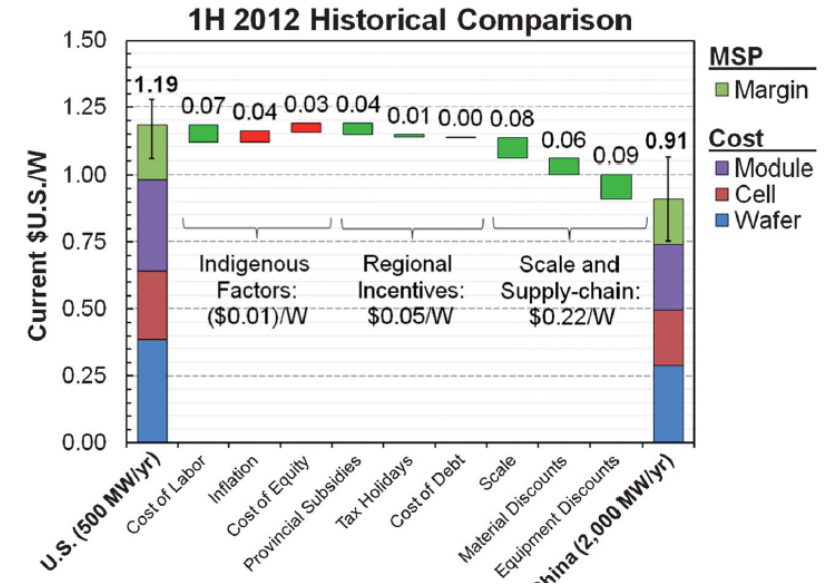
- International "minimum sustainable price" modeling by EERE's SunShot Initiative was used by U.S. Department of Commerce in its handling of solar trade cases.

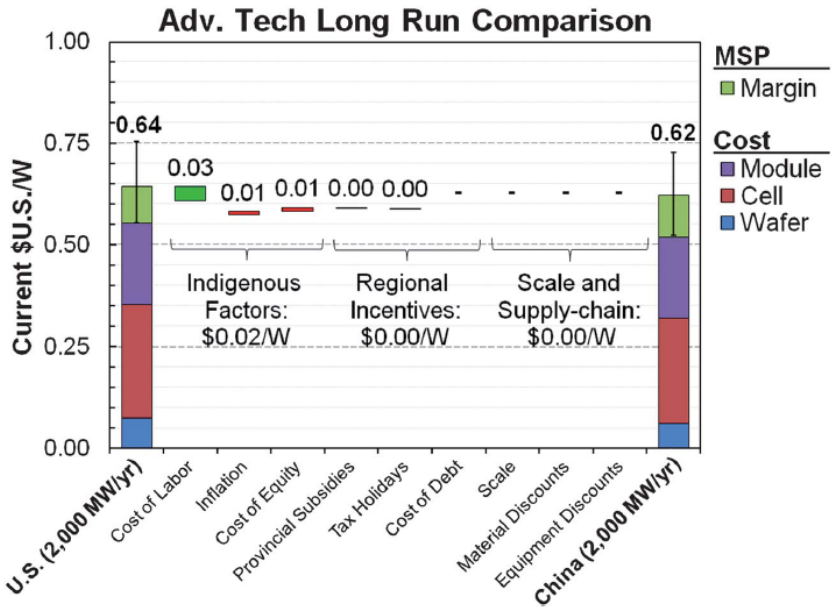
Public-Private Partnerships to Address Market Barriers

- Technical Assistance, Better Plants Challenge

Clean Energy Manufacturing Competitiveness Analysis

Silicon Solar Modules





Topics underway:

- Solar Modules
- Wind Turbine Blades
- Power Electronics
- Carbon Fiber
- Building Technologies
- Fuel Cells
- EV Batteries

- R&D: Contribution to the technology development roadmap
- U.S. Competitiveness: Identification and quantification of underlying drivers for U.S. manufacturing competitiveness

Clean Energy Manufacturing Initiative: Future Directions

- Continued Program Level Investments Leveraging Advanced Manufacturing
- Continued Investment in Shared National RD&D Infrastructure for Manufacturing Innovation and Scale-Up
  - National Network for Manufacturing Innovation Institutes
  - "Materials Manufacturing Acceleration" Centers/Shared Facilities
  - Manufacturing Demonstration Facilities (National Labs)
- Enhancing Relevance and Impact of National Labs on Manufacturing Competitiveness
- Clean Energy Manufacturing Competitiveness Analysis Center
- Cross-Cutting Advanced Manufacturing Efforts in Budget Proposals

Additional Information

Congressional Priority and Direction

2014 House Appropriations Bill

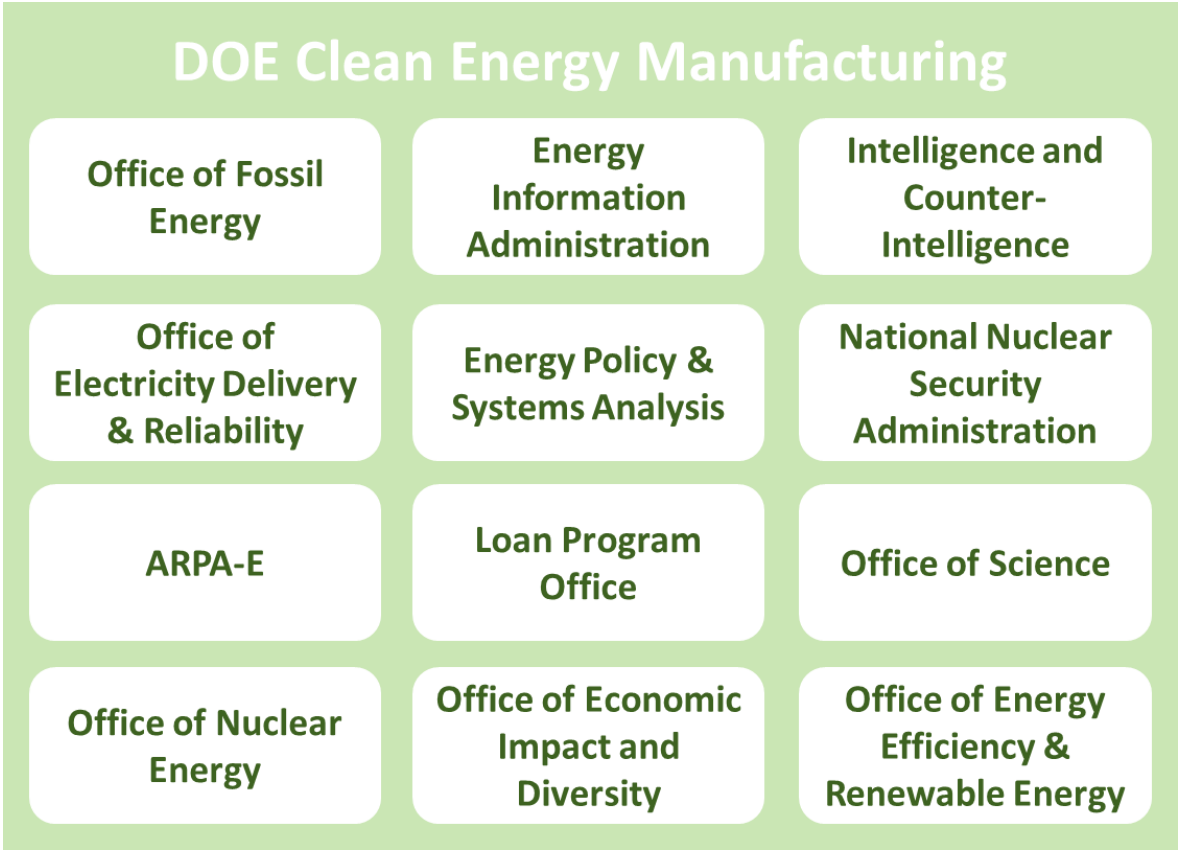
Priorities.—Within limited resources in fiscal year 2014, the Committee focuses funding on programs that address future high gas prices and support American manufacturing, two of the Committee's highest priorities. Funding for these two priorities comprises two-thirds of all research funding in the new account, compared to less than half under current levels. In addition, the recommendation fully supports efforts to strengthen the resilience and cyber security of our electricity infrastructure. **The Advanced Manufacturing Program**, formerly Industrial Technologies, **will fund activities to help American manufacturers compete in the global marketplace.** Energy costs are a major contributor to manufacturing costs, and technology innovations that steeply reduce energy consumption in industrial and manufacturing processes can give American manufacturers competitive advantages. **Further, the Committee funds activities throughout all research and development programs targeted at lowering the manufacturing cost of emerging energy technologies. The Committee is concerned that, historically, technology innovations developed through energy efficiency and renewable energy research and development ultimately lead to manufacturing of new or cheaper products overseas. The Committee cautions the Department against this pitfall and charges the new program with targeting the Advanced Manufacturing activities, as well as research and development across the Department, to ultimately create manufacturing jobs in the United States.**

Congressional Priority: IP Protection

2014 House Appropriations Bill

"As noted in previous years, the Department has not been successful at ensuring that intellectual property developed with U.S. taxpayer funds benefits those same taxpayers. The Department still has no coherent strategy to track and improve domestic exploitation of Department-developed intellectual property. Without such a strategy, U.S. manufacturing will too frequently be forced to play ''catch-up'' with foreign competitors benefitting from ideas formed here in the U.S. The Committee strongly urges the Secretary to take more of a leadership role in improving U.S. manufacturing and domestic intellectual property retention and includes direction to this effect in the ''Department of Energy'' section.

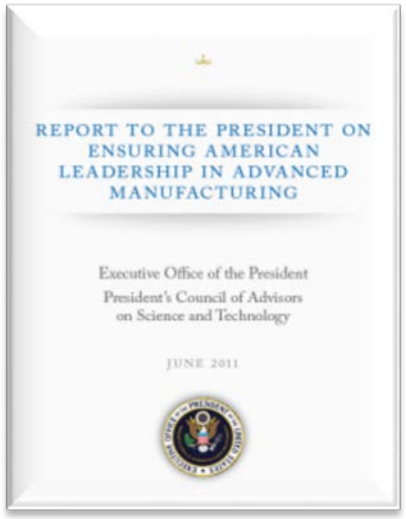
A coordinated approach across DOE

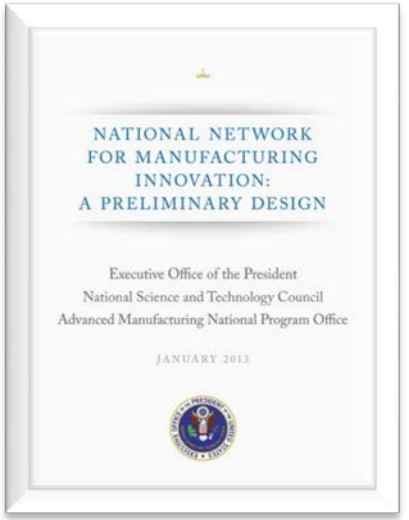


An integrated Clean Energy Manufacturing strategy that supports President Obama's comprehensive national manufacturing strategy

- Coordinated approach: Coordination of manufacturing efforts for energy across individual offices
- Joint efforts across multiple offices

National Manufacturing Policy & DOE's Role





- DOE is active across the pillars of the Administration's Policy & in several resulting efforts
- DOE is a leader in **advanced manufacturing innovation** and implementing the **National Network for Manufacturing Innovation (NNMI)**

NNMI:

National Manufacturing Policy Landscape

Advanced Manufacturing Partnership (AMP)

National Science & Technology Council (NSTC)

Advanced Manufacturing National Program Office (AMNPO)

President Obama's Export Initiative & Trade Promotion

Investing in Manufacturing Communities Partnership (IMCP)

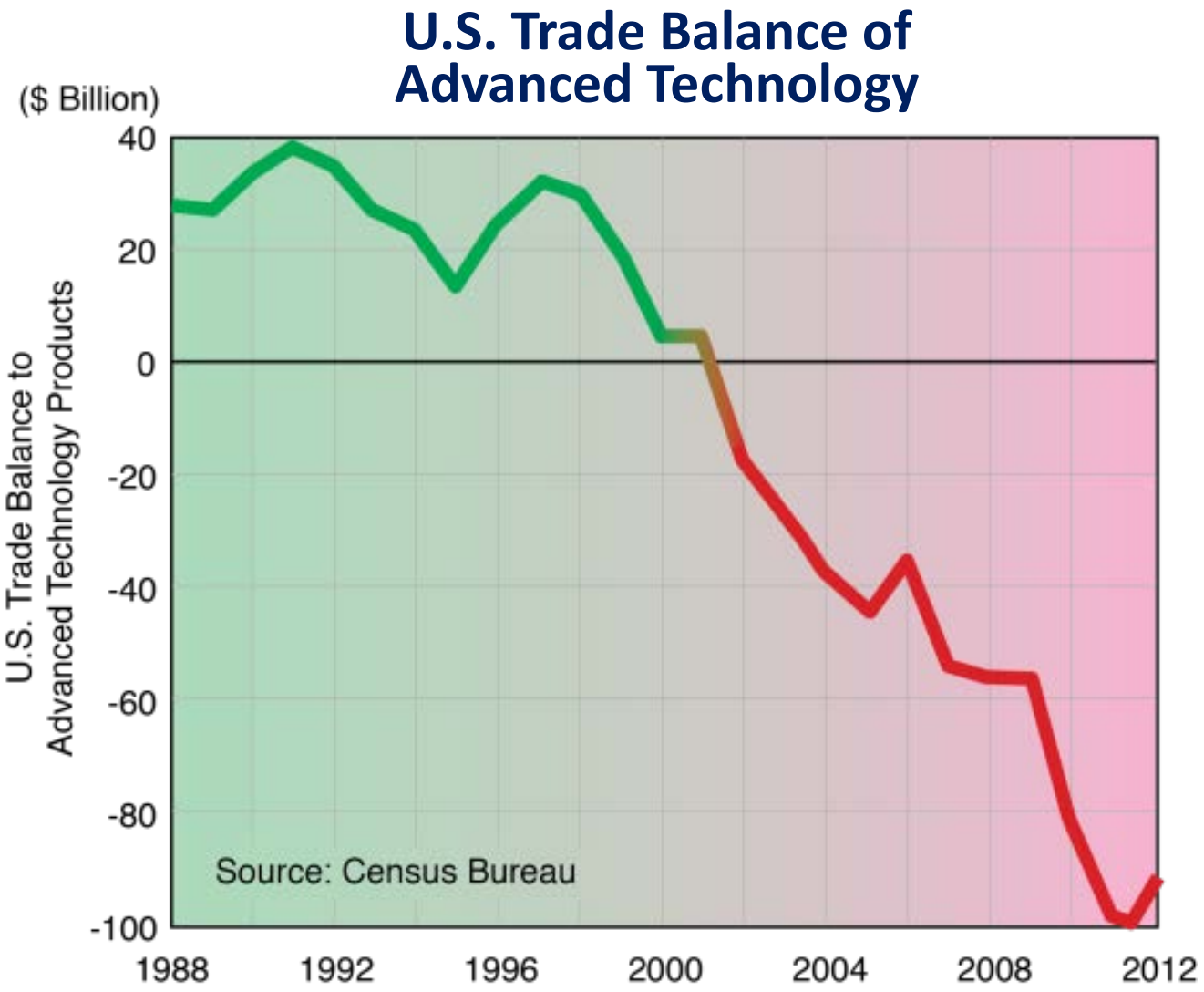
Significance of Manufacturing

12% of U.S. GDP

12 million U.S. jobs

60% of U.S. Exports

70% of Private Sector R&D



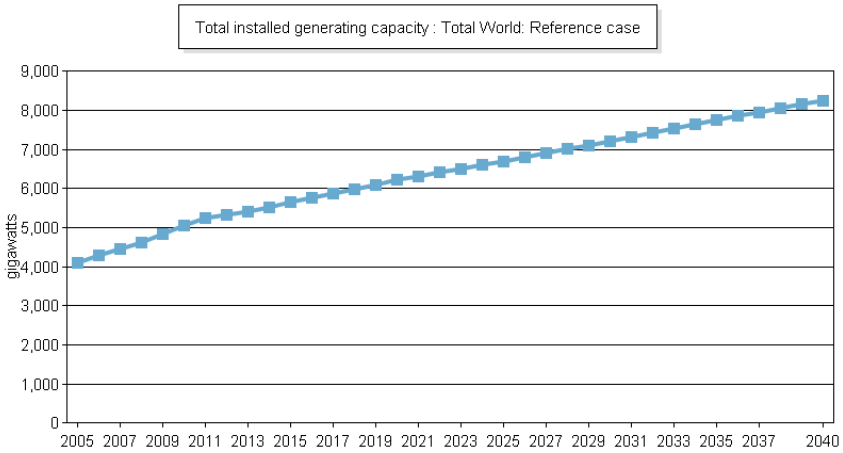
The Significance of Clean Energy Manufacturing

Advanced Manufacturing Enhancement of Energy Technologies

Advanced Manufacturing Technologies like additive manufacturing are enabling new components for higher performance in technologies like jet engines

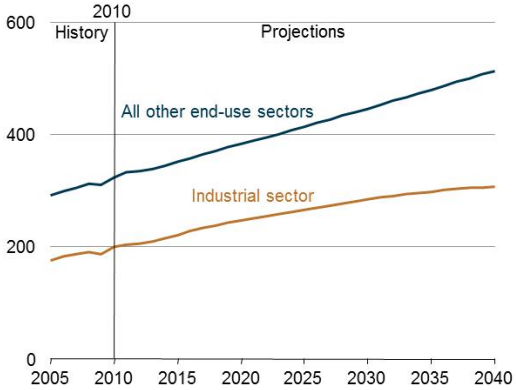
Source: GE Capital

Global Energy Market Opportunity



Source: eia Independent Statistics & Analysis U.S. Energy Information Administration

The Manufacturing Sector & Energy

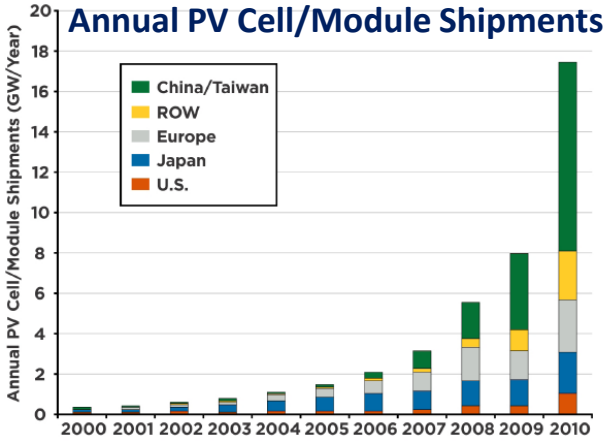


38% of global delivered energy consumption

$11B annual savings in manufacturing due to low-cost natural gas

Sources: EIA International Energy Outlook 2013, Bureau of Economic Analysis, Census Bureau, PWC http://www.pwc.com/us/en/industrial-products/publications/shale-gas.jhtml

Race to Capture the Market



Source: Mints (2011a)

Clean Energy Manufacturing Strategy

Innovation

- Clean Energy Manufacturing R&D across technologies
- Clean Energy Manufacturing Innovation Institutes
  Wide Bandgap Semiconductors | Advanced Composites
- Clean Energy Manufacturing Demonstration Facilities
  Additive Manufacturing | Roll-to-Roll | Carbon Fiber
- Innovation Built to Scale
  Entrepreneurial Portfolio | Technologists in Residence
- Technical Assistance for Energy Efficiency in Manufacturing

Workforce Development
- Workforce Training Pilot

Business Environment
- Advanced Energy Manufacturing Tax Credits
- State-led Strategies

Level Playing Field
- Global Clean Energy Manufacturing Analysis

Global Clean Energy Manufacturing Analysis