

Office of Energy Efficiency and Renewable Energy

Fiscal Year 2014 Budget Rollout – Renewable Electricity Generation



U.S. DEPARTMENT OF
ENERGY

Energy Efficiency &
Renewable Energy

Steve Chalk, Deputy Assistant Secretary
April 30, 2013

EERE's National Mission

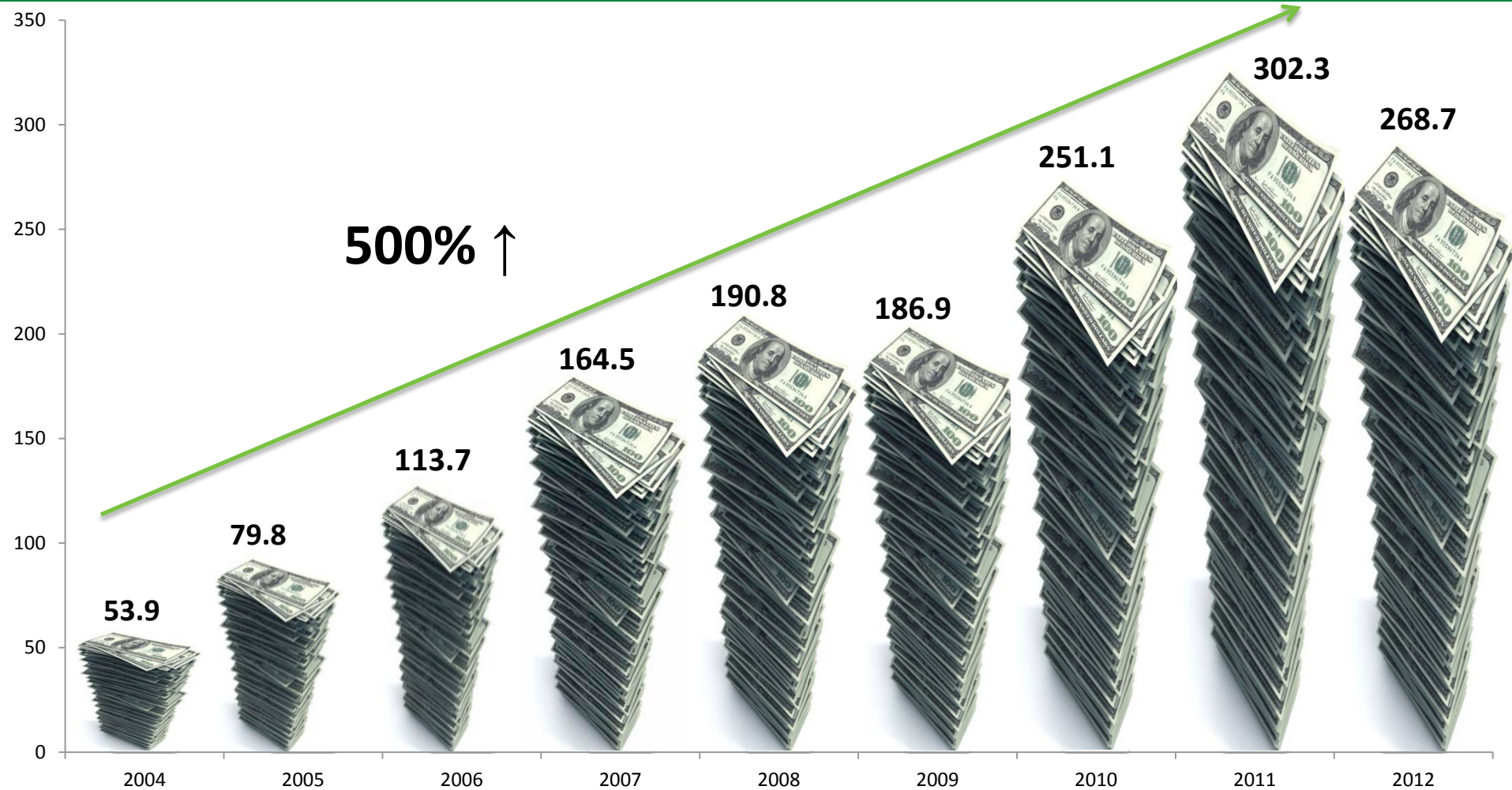
To create American leadership in the global transition to a clean energy economy

- 1) High-Impact Research, Development, and Demonstration to **Make Clean Energy as Affordable and Convenient** as Traditional Forms of Energy**
- 2) **Breaking Down Barriers** to Market Entry**

Why Clean Energy Matters To America

- Winning the most important **global economic development race** of the 21st century
- Creating **jobs** through American innovation
- Enhancing **energy security** by reducing our dependence on foreign oil and gas
- **Saving money** by cutting energy costs for American families and businesses
- **Protecting health and safety** by mitigating the impact of energy production on air quality and climate

Why Clean Energy Matters: Global Race



Global Clean Energy Investment, 2004-2012 (Billions of \$)

Source: Bloomberg New Energy Finance, "Global Trends in Clean Energy Investment" January 2013

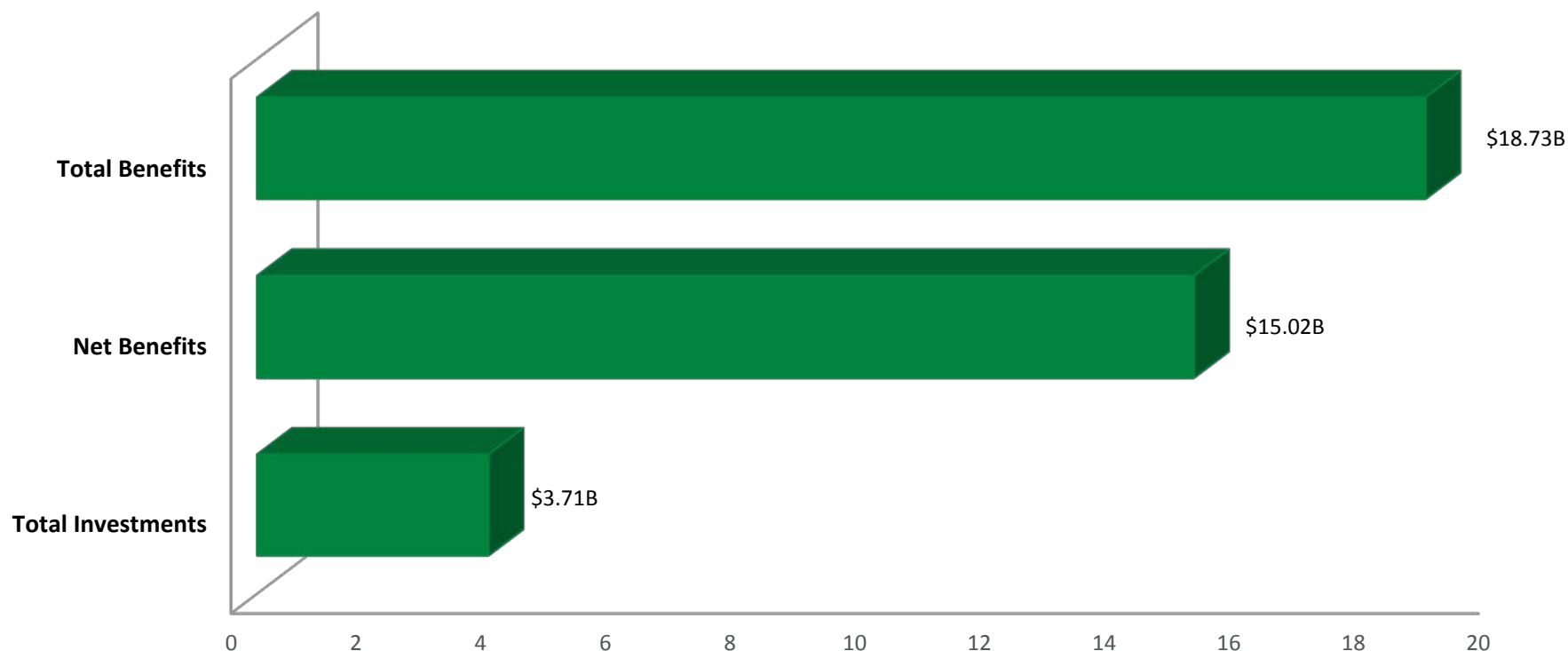
Office of Energy Efficiency and Renewable Energy

A Proven Track Record of Success

- EERE's research and development efforts have accelerated the solar industry's technological progress by an estimated 12 years.
- Since 2007, the SunShot Incubator Program has leveraged about \$90 million in Federal funds to support technology development at about 50 small businesses, with over \$1.7 billion in follow-on private financing.
- In 2012, wind energy added nearly half of all new power capacity in America – even more than new natural gas capacity.
- Through innovation and a robust U.S. wind market, U.S. manufacturing captured more than 70% of the domestic wind energy market in 2012, up from around 35% percent in 2005. The U.S. is home to more than 400 manufacturing companies, across more than 40 states in the wind energy supply chain.
- EERE supported the development and deployment of the first U.S. commercial tidal energy system.
- The first-ever grid-connected tidal power project in the U.S. is now delivering electricity to the utility grid from an underwater power system in Cobscook Bay, Maine.
- The nation's first commercial enhanced geothermal system project to supply electricity to the grid went online in April 2013 and will provide an additional 1.7MW of power to the grid.

Return on Investment: Solar R&D

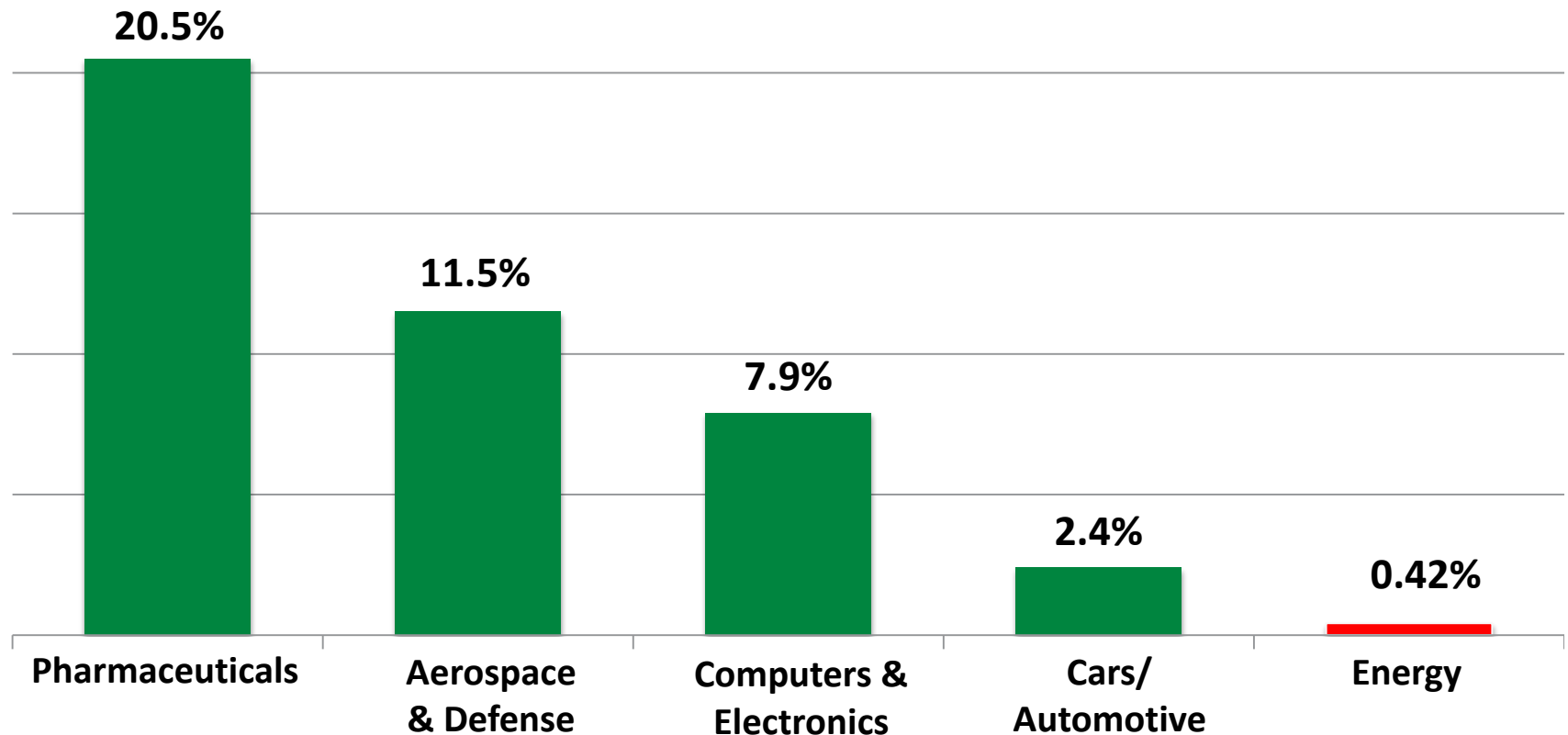
Economic Returns for PV Energy Systems Investments (2008 Dollars)



Investments of **\$3.7 billion** in solar photovoltaic R&D from 1976-2008 resulted in a net economic benefit of **\$15 billion** (2008 dollars) due to module efficiency and reliability improvements.

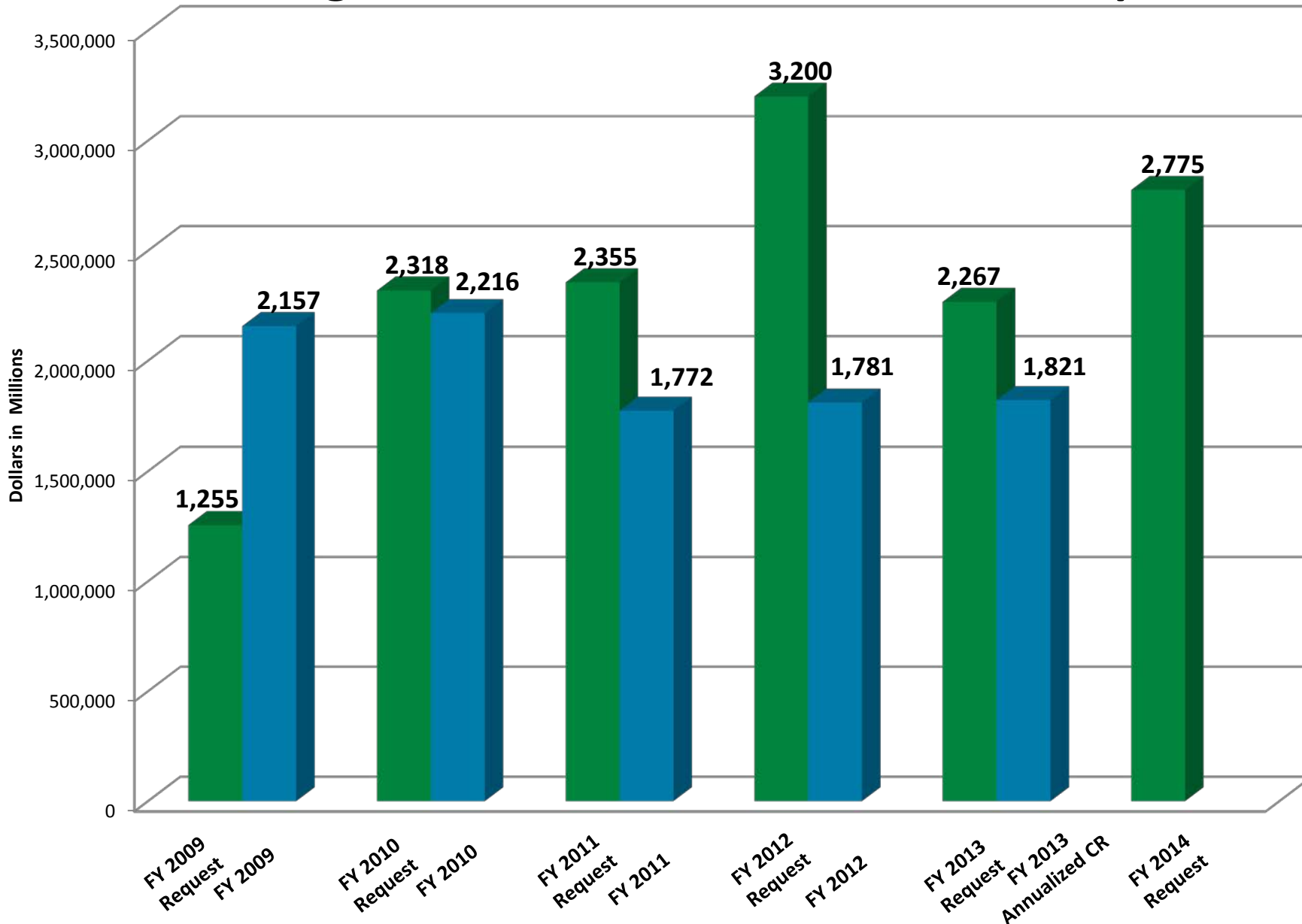
Why Federal Investment?

Low Private Investment in Energy R&D (as % of sales)



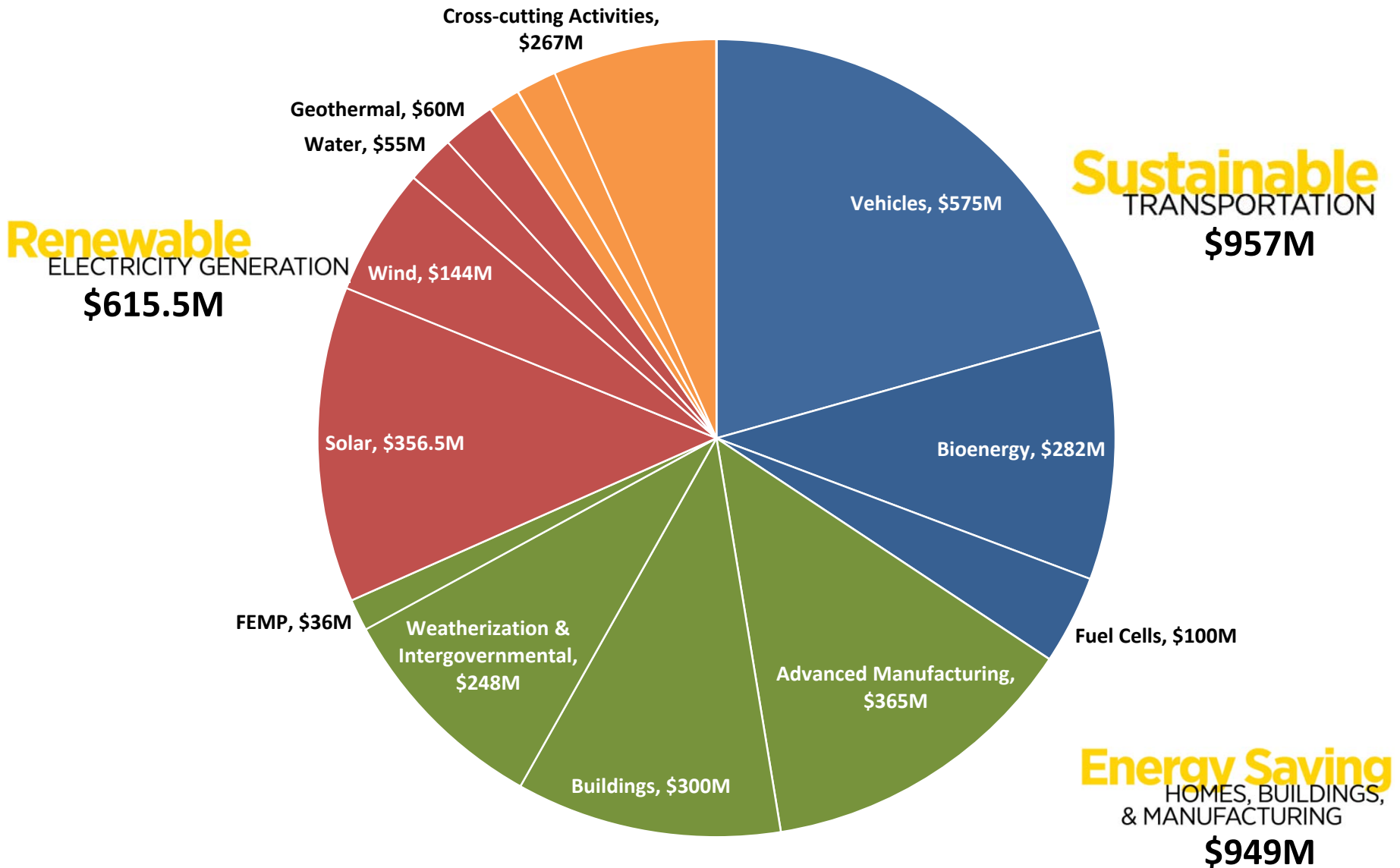
Source: American Energy Innovation Council, *Catalyzing American Ingenuity*, 2012

EERE Budget Trends: FY 2009¹ – FY 2014 Request



¹ Baseline funding does not include ARRA. In Current levels

Fiscal Year 2014 EERE Budget Request - \$2.78B



EERE Budget Summary

	FY 2012 Current	FY 2013 Request	FY 2013 Annualized CR	FY 2014 Request
Sustainable Transportation	617,287	770,000	635,573	957,000
Vehicle Technologies	320,966	420,000	330,819	575,000
Bioenergy Technologies	194,995	270,000	200,496	282,000
Hydrogen and Fuel Cell Technologies	101,326	80,000	104,258	100,000
Energy Efficiency	485,289	872,000	495,690	949,000
Advanced Manufacturing	112,692	290,000	116,287	365,000
Building Technologies	214,706	310,000	220,546	300,000
Federal Energy Management Program	29,891	32,000	30,074	36,000
Weatherization and Intergovernmental Activities	128,000	195,000	128,783	248,000
Renewable Electricity	471,570	490,000	481,785	615,500
Solar Energy	284,702	310,000	290,719	356,500
Wind Energy	91,813	95,000	93,825	144,000
Geothermal Technologies	36,979	65,000	38,094	60,000
Water Power	58,076	20,000	59,147	55,000
Corporate	216,311	250,000	217,635	267,000
Facilities and Infrastructure	26,311	26,400	26,472	46,000
Program Direction	165,000	164,700	166,010	185,000
Strategic Programs	25,000	58,900	25,153	36,000
Subtotal Energy Efficiency and Renewable Energy	1,790,457	2,337,000	1,830,683	2,788,500
Use of Prior Year Balances	-9,909	-69,667	-9,970	-12,800
Total Energy Efficiency and Renewable Energy	1,780,548	2,267,333	1,820,713	2,775,700



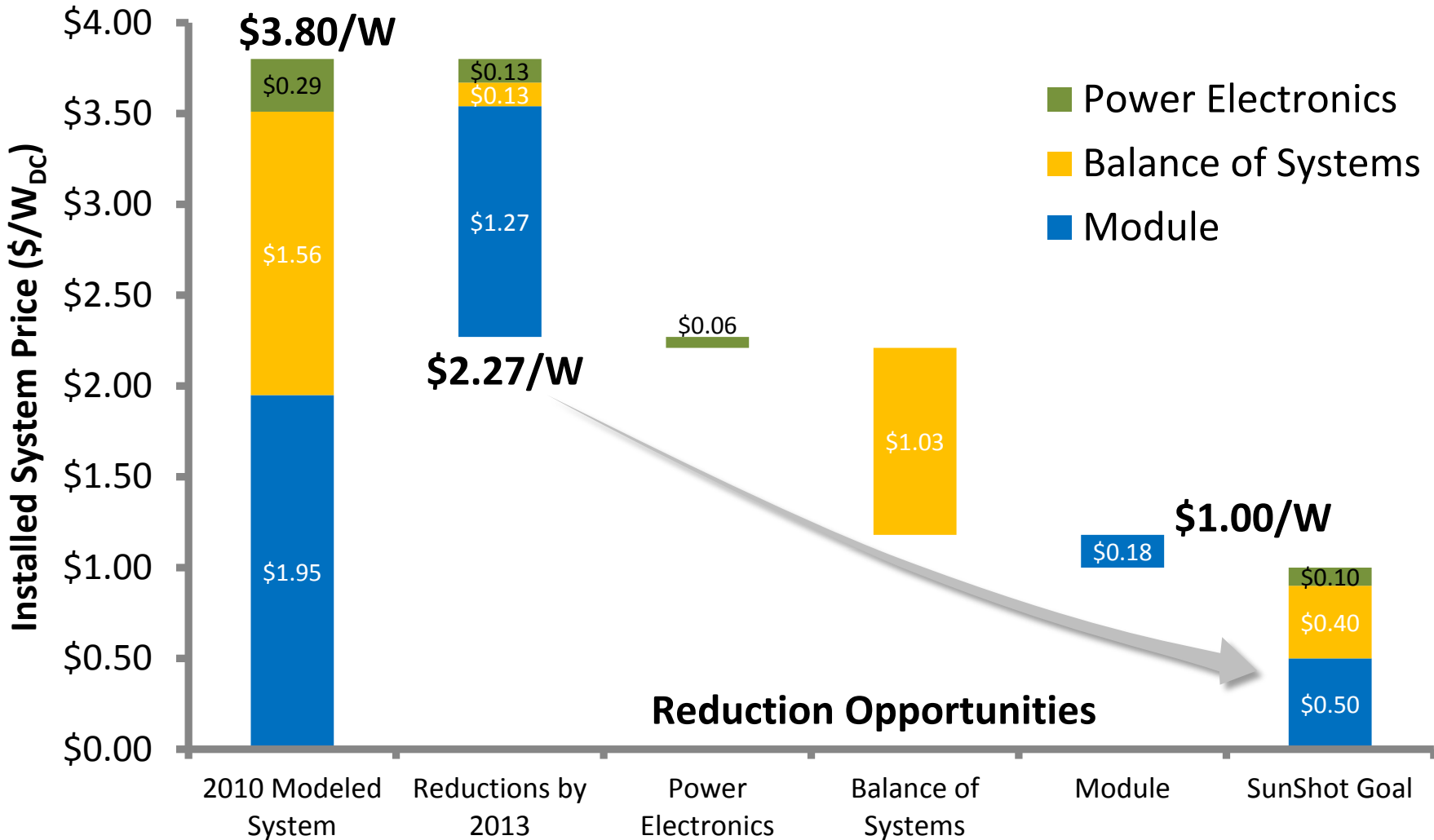
Renewable

ELECTRICITY GENERATION



Cost-competitive solar power without subsidies by 2020 (\$356.5M)

SunShot Utility Scale Progress by Q4 2012



Solar Energy Technologies - Overview

Motivation/Focus

- The Solar Energy Technologies Office supports the SunShot goal to make solar energy technologies cost-competitive with conventional energy sources by 2020. Reducing the total installed cost for utility-scale solar electricity by 75% (2010 baseline) to roughly \$.06/kWh without subsidies will enable rapid, large-scale adoption of solar electricity across the U.S.

Achievements

- Technology Leadership: Over the past 35 years, the Department of Energy has supported R&D that has resulted in more than 50% of the world records for solar cell efficiency. In 2012, new world records came from 3 awardees.
- Leverage of Federal Funds: Since 2007, the SunShot Incubator Program has leveraged about \$90 million in Federal funds to support technology development at about 50 small businesses, with over \$1.7 billion in follow-on private financing.
- Reducing Red Tape: Partnering with state and local governments has led to reduced time and financial costs. For example, Broward County, Florida was able to use online permitting to reduce a months-long process to about 30 minutes. Solarize Massachusetts was able to reduce consumer costs by 25% through group purchasing.
- Enabling a talented and trained workforce: The Solar Instructor Training Network (SITN) of 493 instructors at 261 community colleges developed workforce development programs to train/retrain workers to be skilled professionals in the solar industry and led to 9,780 people preparing to enter the solar job space to support our nation's increased solar demand; according to one industry assessment, the solar industry had a job growth rate of 13.2% from 2011 to 2012.

Goals/Metrics

Solar Energy Technologies Office performance goals are designed to achieve the following targets by 2020:

- Average utility-scale installed system price of $\$1.00/W_{dc}$
- Average commercial-scale installed system price of $\$1.25/W_{dc}$
- Average residential-scale installed system price of $\$1.50/W_{dc}$
- In the 4th quarter of 2012, utility-scale solar priced at $\$2.27/W_{dc}$. Current 2013 bids are about $\$2/W_{dc}$, down 47% from the 2010 baseline and halfway to the 2020 goal
- The current CSP price is about $\$0.185/kWh$. The goal is $\$3.50/W$, including 16 hours of storage (equivalent to $\$0.06/kWh$).

Solar Energy Technologies - FY2014 Budget Request

(Dollars in Thousands)	FY 2012 Current	FY 2013 Annualized CR*	FY 2014 Request
Concentrating Solar Power	44,922	—	90,053
Photovoltaic R&D	75,563	—	79,061
Systems Integration	47,916	—	64,262
Balance of Systems Soft Cost Reduction	31,897	—	61,081
Innovations in Manufacturing Competitiveness	84,404	—	50,043
NREL Site Wide Facility Support	0	—	12,000
Total, Solar Energy Technologies	284,702	290,719	356,500
<small>*FY 2013 amounts shown reflect the P.L. 112 175 continuing resolution level annualized to a full year. These amounts are shown only at the "congressional control" level and above; below that level, a dash (—) is shown.</small>			

Solar Energy Technologies - FY2014 Budget Highlights

Fiscal Year 2014 Priorities:

- **Thermal Storage (\$33M):** Develop advanced energy storage approaches to enable CSP to provide dispatchable electricity, which will improve the ability to integrate renewables to the nation's electricity grid. *(SETO Subprogram: Concentrating Solar Power)*
- **SolarMat II (\$21.6M):** Invest in innovations that can provide U.S. manufacturers a competitive advantage in a challenging global marketplace. *(SETO Subprogram: Innovations in Manufacturing Competitiveness)*
- **Transformational Science and Technology (\$33.6M):** Develop revolutionary next-generation PV technologies, leading to prototype PV cells and/or processes, directly impacting the \$1/Watt (W) paradigm. *(SETO Subprogram: Photovoltaic R&D)*
- **Partnering with States and Local Governments and Utilities (\$48M):** Harmonize and streamline permitting, interconnection, and inspection processes that will result in reduced costs to the consumer and businesses. *(SETO Subprogram: Balance of Systems Soft Cost Reduction)*
- **Grid Integration Initiative (\$30M):** A joint program with the Building and Vehicle Technologies Offices to deliver systems-level, behind-the-meter solutions to grid integration challenges. *(SETO Subprogram: Systems Integration)*

Geothermal Technologies - Overview

Motivation/Focus

- EERE's Geothermal Technologies Office (GTO) targets research, development and demonstration activities that accelerate the development and deployment of clean, domestic geothermal resources.
- Domestic geothermal resources are a reliable and nearly inexhaustible baseload energy source, with greatly reduced greenhouse gas and criteria emissions.
- GTO's priorities are designed to support the administration's goals to have 80% of U.S. electricity generated from clean sources by 2035 and to double generation from wind, solar, and geothermal sources by 2020 (relative to 2012 levels).

Achievements

- Enhanced Geothermal Systems (EGS) demonstration projects: First ever sustained EGS project at commercial-scale in the U.S.; first ever creation of three separate geothermal reservoirs from a single well where none existed before; first ever EGS project to generate commercial electricity in the U.S.
- Low Temperature demonstration projects: First ever commercial production of economically feasible electricity from bottoming-cycle, low-temperature resources (at 205° F).
- Drilling technology: Successfully advanced drilling R&D in geothermal environments, showing increased rates of penetration in hard, crystalline rocks from 10–15 feet per hour (ft/hr) to the target goal of 30 ft/hr.
- Mineral extraction technologies: First ever demonstration facility in the U.S. that co-produces materials like lithium, manganese, and zinc from geothermal brines during the power production process.

Goals/Metrics

- Develop exploration tools to lower the upfront risk of hydrothermal geothermal resource exploration.
- Develop improved methods for developing geological heat reservoirs, which will allow geothermal energy to compete equally with conventional electricity sources in the marketplace.
- Reduce the levelized cost of electricity (LCOE) of hydrothermal geothermal power to \$.06/kilowatt hour (kWh) by 2020.
- Reduce the LCOE of newly developed geothermal systems to \$.06/kWh by 2030.

Geothermal Technologies – FY2014 Budget Request

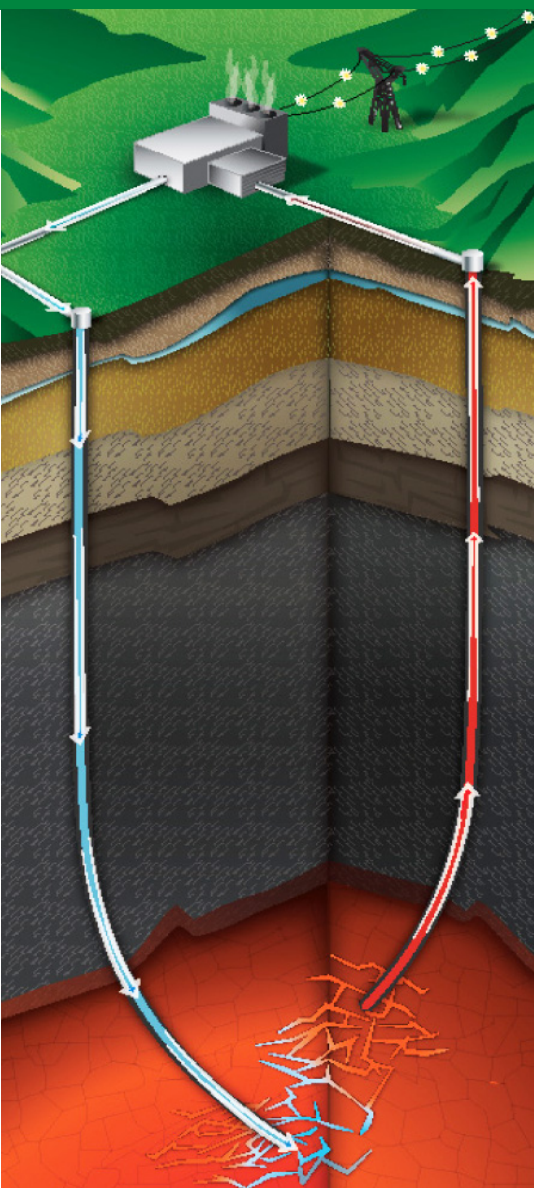
(Dollars in Thousands)	FY 2012 Current	FY 2013 Annualized CR*	FY 2014 Request
Enhanced Geothermal Systems (EGS)	15,556	–	42,000
Low Temperature Co-produced Resources	4,940	–	2,000
Innovative Exploration Technologies	12,483	–	12,000
Systems Analysis	4,000	–	4,000
Total, Geothermal Technologies	36,979	37,772	60,000
<small>*FY 2013 amounts shown reflect the P.L. 112 175 continuing resolution level annualized to a full year. These amounts are shown only at the "congressional control" level and above; below that level, a dash (–) is shown.</small>			

Geothermal Technologies – FY2014 Budget Highlights

Fiscal Year 2014 Priorities:

- **EGS Field Lab (\$30M):** Effort will promote transformative, high-risk science and engineering that will create a commercial pathway to EGS. A key distinction between existing private-sector led demonstration projects and the DOE-managed EGS Field Lab is the ability to develop, test, and comprehensively monitor an engineered reservoir at a scale that has not yet been demonstrated, using new technologies in pre-commercial stages of development. The EGS Field Lab will stimulate collaborative partnerships and data sharing among industry, lab and university users to conduct cutting-edge research, drilling, and testing. This effort will pave the way to rigorous and reproducible approaches to EGS that will reduce industry development risk.
- **EGS R&D (\$12M):** Funding will support new and acutely targeted, competitively selected R&D focused on zonal isolation, novel stimulation methodologies, joint geophysical techniques for fracture and reservoir imaging, unique well designs and configurations, and advanced tracer technologies.
- **Strategic Materials Initiative (\$1M):** This initiative will explore methods to cost-effectively extract valuable and strategically important materials from U.S. geothermal brines, thus creating an additional revenue stream from geothermal power production in the near-term. This initiative will leverage the program's highly successful lithium co-production project in the Salton Sea area in California, which is the first demonstration facility to co-produce lithium, manganese, and zinc from geothermal brines. This project is expected to commence production in late FY 2013 or early FY 2014.

EGS Field Lab (\$30.0M)



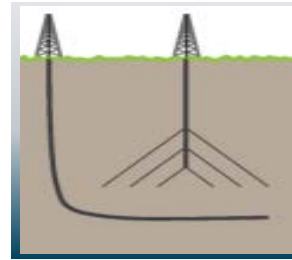
Promote transformative science and engineering to:

- Address key barriers
- Validate and optimize EGS technology
- Ensure deep understanding and reproducibility for commercial scale-up

Value of Federal Role:

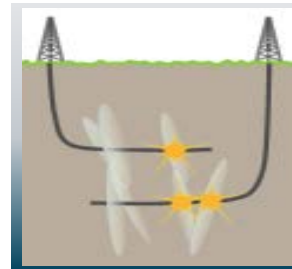
- Leverage technical insights gained from current EGS demonstrations portfolio
- Test technologies/take technical risks not possible in private sector
- Work under aggressive timeframe
- Gather and disseminate comprehensive data sets

Direct benefits to all areas of research in the geothermal space



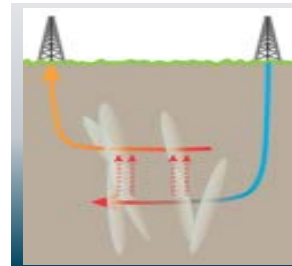
Reservoir Access

New well geometries and concepts, optimized drilling



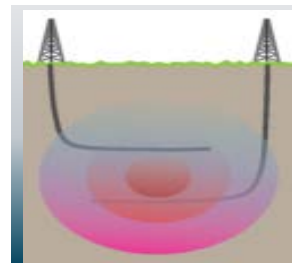
Reservoir Creation

Characterize local stress, zonal isolation, novel fracturing methods, increase fractured volume per well



Productivity

Increase flow rates without excessive pressure needs or flow localization



Sustainability

Maintain productivity with minimal thermal drawdown and water losses

Water Power - Overview

Motivation/Focus

- Through a balanced portfolio approach, investments in marine and hydrokinetic (MHK) and hydropower technologies span transformational technological innovations that seek to enable new water power technologies as viable and substantial renewable energy option for our nation.
- Hydropower currently provides approximately 7 percent of the nation's electricity today—and produces the largest share of renewable generation with 78 GW of installed capacity. Water Power can supply 15% of the nation's electrical energy needs by FY 2030
- For MHK: DOE investments enable the development of innovative technologies and improve the reliability and technology readiness of these systems. DOE is also developing essential test infrastructure needed to accelerate the technology development process and effectively compress the timeline to commercial competitiveness.
- For Hydropower: DOE funds high risk R&D and collaborates with industry and with other Federal agencies in order to accelerate the development and deployment of sustainable hydropower technologies for clean generation and renewables integration.

Achievements

- The Office's resource assessment efforts have demonstrated the potential for water power technologies to provide a material contribution the nation's energy system—providing up to 15% of U.S. electricity needs and integrating variable renewables.
- The Office's efforts targeting the existing fleet (ARRA rehabilitations and tools for optimizing water use) ensure that this ageing infrastructure remains efficient and productive—maintaining and increasing hydropower's 7% of U.S. electricity generation.
- MHK is beginning to emerge as a competitive, viable sector of the energy industry. In 2012, DOE provided critical project development assistance for the first commercial, grid-tied tidal energy project, an essential first step in the development of robust U.S. industry.
- Completed eight hydropower facility assessments; showing 8-15% improvement opportunities for increased generation.

Goals/Metrics

- Marine & Hydrokinetic: From an estimated 2010 COE of 40-60 cents/kWh (wave), cost-competitiveness will be reached with local hurdle rates in major coastal load centers at between 12-15 cents/kWh; these cost reductions could enable up to 23 GW of deployment by 2030.
- Hydropower: By 2020, reduce the cost of energy for high-resource sites to 6 cents/kWh, doing the same for low-resource sites by 2030. These cost reductions can double hydropower's contribution to the nation's energy system—adding up to an additional 70 GW or 300TWh by 2030.
- Renewables Integration: The Office also aims to improve the flexibility of the existing hydropower fleet and facilitate the deployment of up to 30 GW of advanced pumped storage technologies to facilitate the integration of variable renewables such as wind and solar

Water Power – FY2014 Budget Request

(Dollars in Thousands)	FY 2012 Current	FY 2013 Annualized CR*	FY 2014 Request
Marine and Hydrokinetic Technologies	33,684	—	39,500
Hydropower Technologies	24,392	—	15,500
Total, Water Power	58,076	59,147	55,000

*FY 2013 amounts shown reflect the P.L. 112 175 continuing resolution level annualized to a full year. These amounts are shown only at the "congressional control" level and above; below that level, a dash (—) is shown.

Water Power – FY2014 Budget Highlights

Fiscal Year 2014 Priorities:

- **Develop advanced MHK systems and component technologies (\$9.5M)** to increase energy capture, reliability, and survivability for lower costs (*Marine and Hydrokinetic Technologies subprogram*)
- **Construct a controlled conditions deep-water wave tank test facility (\$10M)** allowing U.S. developers to more rapidly optimize design performance and compress the timeline to wave energy converter (WEC) commercial competitiveness (*Marine and Hydrokinetic Technologies subprogram*)
- **Demonstrate and validate MHK performance (\$2M)** through in-water tests of wave point absorber and tidal turbine advanced industry projects (*Marine and Hydrokinetic Technologies subprogram*)
- **Spur the development of breakthrough wave energy technology (\$8)** by initiating the “WEC Prize” design competition to accelerate the advancement of next-generation new wave energy conversion devices (*Marine and Hydrokinetic Technologies subprogram*)
- **Develop advanced hydropower technologies (\$9.5M)** that drive down the cost of new hydropower project development, including standardized generating units with improved energy performance, high efficiency electrical components, and low environmental impact technologies (*Hydropower Technologies subprogram*)
- **Facilitate the integration of variable renewables (\$1M)** by studying and developing new, smaller pumped storage designs that will leverage manufacturing economies of scale and open new markets by avoiding many constraints associated with larger -scale deployments (*Hydropower Technologies subprogram*)
- **Support American clean-energy manufacturing competitiveness (\$10M)** through an initiative aimed at light-weighting MHK devices and developing composite hydropower turbines to reduce COE (*Crosscutting Marine and Hydrokinetic Technologies and Hydropower subprograms*)

Controlled Conditions “Deep Tank” Wave Test Facility (\$10M)

Developing a controlled infrastructure to help allow for rapid design iteration, validation of performance modeling, and the inexpensive testing of wave devices.

- A controlled-conditions, deep-water wave tank test facility decreases the cost and time of mid-TRL (4/5/6) design iteration, enabling:
 - Validation of numerical predictions of annual energy production and survivability;
 - Identification and elimination of component and system technology deficiencies early in the development cycle, decreasing the burden on cash-strapped early-stage companies with innovative technologies; and
 - An ability to reproduce test conditions in order to validate technology improvements. In an effort to leverage industry expertise, innovation, and cost-share, the development of this facility will be competitively awarded.
- The high cost of testing MHK devices in marine environments is prohibitive for early stage companies with innovative designs. DOE intends to develop world-leading test infrastructure and then share non-proprietary test results and lessons learned that would facilitate rapid industry development with a substantial reduction in cost to the developer.
- Without the development of this first-in-the-world test facility, the U.S. risks ceding global leadership in MHK technology development and manufacturing, as well as delaying the attainment of market competitiveness in the largest MHK resource (1,170 TWh/year) until after 2030.

Wind Energy - Overview

Motivation/Focus

- EERE's Wind Energy Office invests in high risk, transformative technology innovations that industry does not address. DOE additionally provides a national testing platform, drives improvements in permitting, and generates methodologies and data needed to address market barriers and grid integration.
- There are 90 quads of U.S. land-based wind potential and 50 quads of U.S. offshore wind potential, which, combined, are more than 10 times the total current U.S. delivered electricity consumption.
- The Office's FY 14 approach is to:
 - Optimize wind plant cost of energy reduction through complex aerodynamics R&D, advanced component development, wind plant reliability improvement and resource characterization
 - Establish a competitive U.S. offshore wind industry through offshore innovation development and offshore system demonstration
 - Optimize grid integration for wind systems through Integration studies and operational forecasting tool development
 - Eliminate and reduce market barriers through accelerated siting and deployment strategies

Achievements

- The unsubsidized cost of U.S. wind energy has decreased by 85%—from more than \$0.55 /kilowatt hour (kWh) in 1980 to \$0.08 /kWh in 2012—and has decreased by 35% over just the last 4 years.
- Wind deployment has grown substantially in the last decade, from 6.6 GW in 2003 to 60 GW in 2012, doubling in the last 4 years and currently providing 3.5% of total U.S. electricity generation.

Goals/Metrics

- Reduce the unsubsidized market LCOE for utility-scale land wind energy systems from a reference wind cost of \$.080/kWh in 2012 to \$.057/kWh by 2020 and \$.042/kWh by 2030*
- Reduce the unsubsidized market LCOE for offshore fixed-bottom wind energy systems from a reference of \$.225/kWh in 2012 to \$.167/kWh by 2020 and \$.136/kWh by 2030*
- Meeting the Offices's LCOE goals will enable meeting the Office's deployment goal of total U.S. wind installed capacity in of 300 GW by 2030, estimated to be able to meet 20 percent of U.S. electricity demand in 2030.

**For Programmatic purposes, all costs are reported at a 7% discount rate.*

Wind Energy – FY2014 Budget Request

(Dollars in Thousands)	FY 2012 Current	FY 2013 Annualized CR*	FY 2014 Request
Technology Development and Testing	73,054	—	99,000
Offshore Wind	34,442	—	46,000
Technology Components R&D	19,525	—	6,500
Plant Optimization	0	—	23,500
Manufacturing	1,389	—	6,000
Testing Infrastructure	15,811	—	5,000
Distributed Wind Technology	1,887	—	7,500
Wind Technology Incubator	0	—	4,500
Technology Application	18,759	—	36,000
Resource Characterization	6,816	—	12,500
Grid Optimization	4,916	—	10,500
Eliminate Market Barriers	7,027	—	13,000
NREL User Facility	0	—	9,000
Total, Wind Energy	91,813	93,825	144,000
*FY 2013 amounts shown reflect the P.L. 112 175 continuing resolution level annualized to a full year. These amounts are shown only at the "congressional control" level and above; below that level, a dash (—) is shown.			

Wind Energy – FY2014 Budget Highlights

Fiscal Year 2014 Priorities:

- **Offshore Wind (\$46.0M):** Key component technology development and validation to increase the viability of offshore wind systems; multi-year program to perform pioneering U.S. offshore wind demonstration projects; and offshore renewable initiative on analysis and development of next-generation offshore wind substructure elements. *(Wind Technology Development and Testing subprogram)*
- **Plant Optimization (\$23.5M):** Plant performance will be optimized through high fidelity modeling activities leveraging key DOE HPC assets. Complex aerodynamics R&D and testing campaigns will focus on understanding complex flow for plant efficiency improvements, atmospheric boundary layer modeling, and wind plant reliability improvement. *(Wind Technology Development and Testing subprogram)*
- **Manufacturing (\$6.0M):** Initiative focused on technical challenges for large scale (> 5MW) components conducive to U.S. manufacturing. *(Wind Technology Development and Testing subprogram)*
- **Wind Technology Incubator (\$4.5M):** Funding program to introduce potentially high-impact promising “off-road-map” new technologies and learning curves into the Wind Energy portfolio. *(Wind Technology Development and Testing subprogram)*
- **Resource Characterization (\$12.5M):** Improved atmospheric understanding of the planetary boundary layer to enable improved forecasting and optimized plant designs. *(Wind Technology Application subprogram)*
- **Grid Optimization (\$10.5M):** Transmission optimization studies for wind systems and operational forecasting tool development to understand and reduce costs associated with integrating variable wind energy into the power system for both utility and distributed applications; and grid integration, coordinated through the DOE Grid Technology Team. *(Wind Technology Application subprogram)*
- **Eliminate Market Barriers (\$13.0M):** Utility-scale wind accelerated siting (including fish and wildlife impact analysis and radar mitigation solutions) and deployment strategies; offshore wind deployment barriers activities including siting, environmental mitigation, radar, and grid integration; and distributed wind-specific market barriers and distributed wind strategic plan. *(Wind Technology Application subprogram)*

Offshore Wind (\$46M)

Consistent with the *National Offshore Wind Strategy*, the Offshore Wind activity will support research that is expected to simultaneously improve offshore wind power plant performance and accuracy of energy projections—directly contributing to the office goal of lowering the cost of energy. This activity supports a multi-year program to perform pioneering U.S. offshore wind demonstration projects.

- The Office’s portfolio includes a significant strategic focus on offshore wind. The U.S. offshore wind industry is in its very early stages, with no offshore wind turbines in the nation’s waters today. There is a tremendous U.S. offshore wind resource, exceeding 50 quads (4,000 GW), which is more than three times larger than the total U.S. delivered electricity use. The proximity of this resource to many major U.S. cities and load centers has the potential to significantly address issues related to transmission cost and siting to access wind energy resources.
- The Offshore Wind Demonstration Funding Opportunity, a 6-year, \$168 million initiative, with multiple recipients competitively awarded in FY 2013, has begun the engineering phase of the demonstration. In 2014 (\$20M), the program anticipates selecting and funding three of seven of projects to move to final design, construction, and installation activities based on project progress in 2012 and 2013 on the engineering and design phase of the Advanced Technology Offshore Wind Demonstration Project initiative. These three offshore wind energy demonstration projects are anticipated to have completed construction and be in operation by the end of 2017, and will represent some of the very first at-scale deployments in the United States.
- This activity will further develop and provide system validation of next-generation offshore wind system designs, including innovative substructure concepts, through the improvement of design codes, validation of model and demonstration-scale testing data, conceptual design optimization, and the development of an offshore meteorology reference facility to drive instrumentation validation and model improvement (\$26M). The activity also includes a new initiative targeted at analysis and development of next-generation offshore wind substructure elements.

Wind Plant Optimization (\$23.5M)

Plant performance optimization activities will seek to understand the complex flow of the resource encountered by a wind turbine and the wake effect that a wind turbine has on surrounding turbines in order to more effectively operate the plant and improve the energy output.

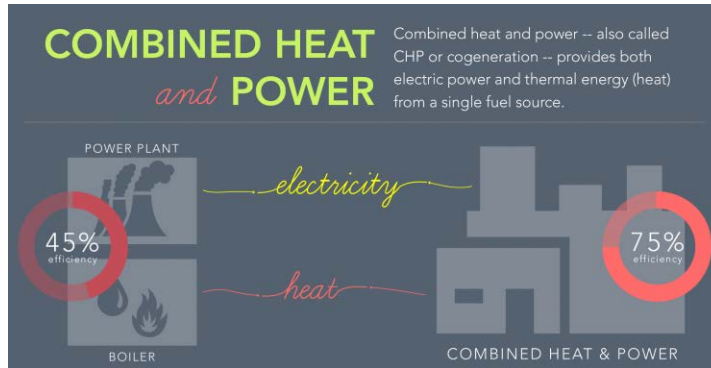
- While the efficiency of an individual turbine (as measured by its capacity factor) may be optimized, turbines in wind farm arrays interact with each other and with the transmission system, through turbine-to-turbine wake effects and system level curtailments—reducing overall wind power plant efficiency by as much as 20% to 30%. The opportunity to reduce LCOE will come from substantial gains in understanding complex wind power plant aerodynamics to improve overall plant capacity factors and interaction at a plant level with the transmission grid system.
- The Office will apply existing key assets, such as large-scale testing facilities, integrated field and sensor capabilities, and the use of High-Performance Computing (HPC) capabilities at the National Laboratories to support the development of detailed product design tools which will be used by industry, government, and universities to model the physics behind aerodynamic inflows and the wind turbine dynamic structural response for specific implementations. Stakeholders will use these tools to integrate new designs into a modeled, operational wind turbine in order to predict the impact of these innovations on performance.
- Under this effort, the office will release a funding opportunity for R&D on cutting-edge technology development for the “Next-Generation Rotor” beyond current architectures and designs that will help enable the development of faster and quieter rotors as integrated in overall plant design. Faster rotors would increase tip speed, which would improve aerodynamic efficiency, and reduce structural weight throughout the entire system. The increase in tip speed will also necessitate advances in noise reduction through new airfoil designs and passive aerodynamic devices applied to rotor blades. The noise mitigation technology could also be used to further reduce noise on turbines in sensitive areas without an increase in the tip speed (i.e., existing turbines).

Cross-Cutting EERE Initiatives

Clean Energy Manufacturing Initiative

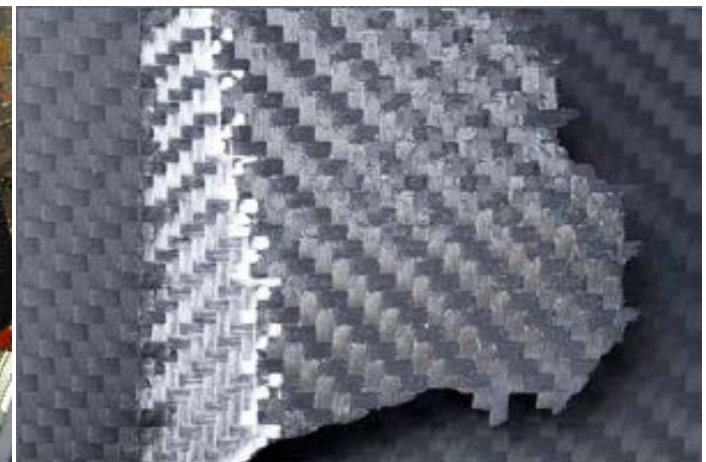
1. Increase U.S. manufacturing competitiveness across the board by increasing energy productivity

– *Enhancing competitiveness of U.S. companies*

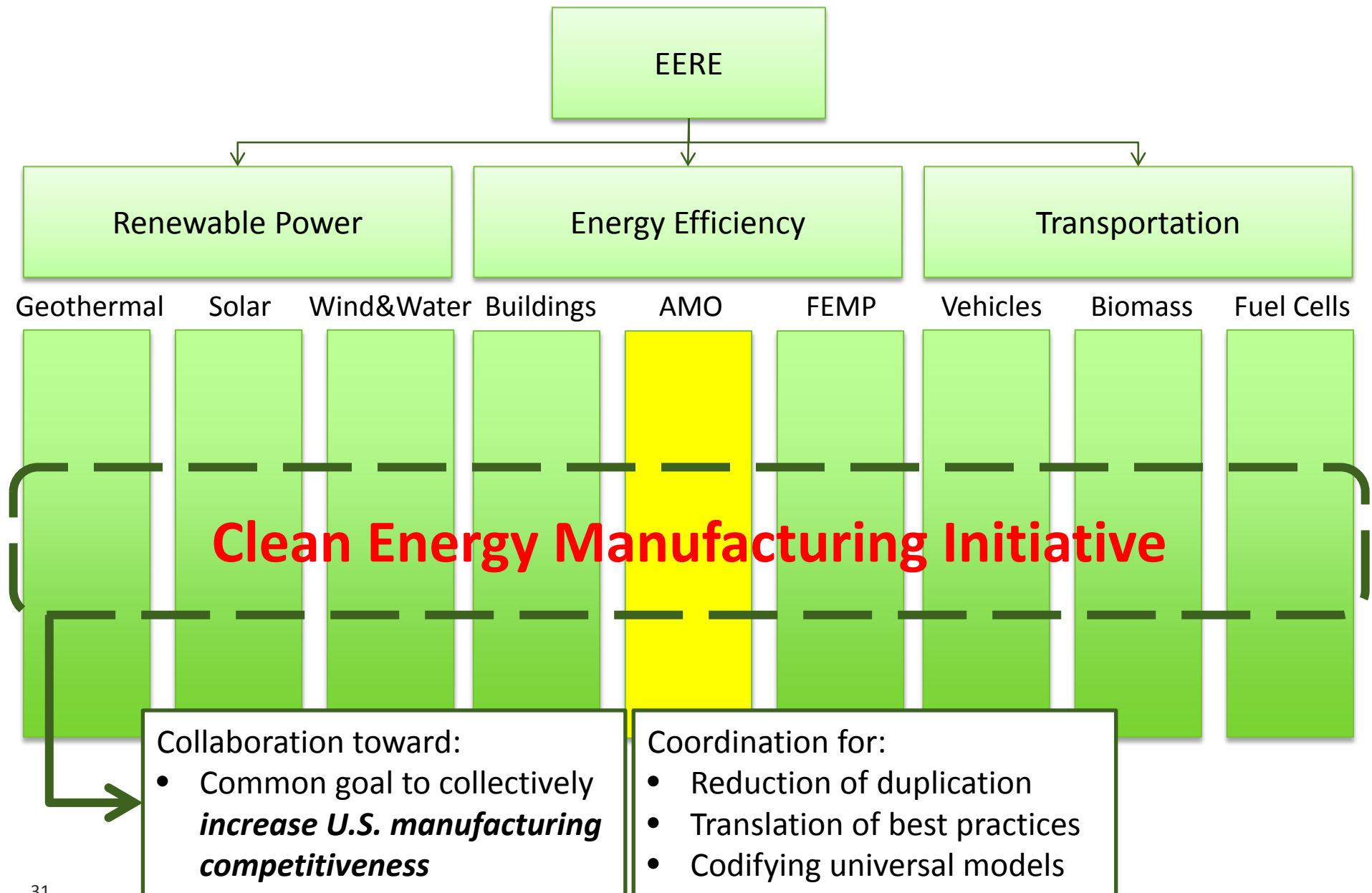


2. Increase U.S. competitiveness in the production of clean energy products

– *Invest in competitive advantages, overcome competitive disadvantages*



Internal Coordination on Clean Energy Manufacturing



EERE Incubators: High-Impact “Off-Roadmap” Technologies (\$110M)

EERE Incubators:

- Pilot expansion of successful “Sunshot Incubator Program” in Solar Energy Technology Office to other EERE technology offices
- Enables ongoing on-ramp for "off-road-map" emerging technology approaches
- Small fraction of annual R&D budget
- SunShot Incubator program has leveraged \$90M in competitively awarded government funds into more than \$1.7B in private-sector follow-on funding

Program Offices	(Dollars in Thousands)
Vehicle Technologies	30,000
Bioenergy Technologies	20,000
Hydrogen and Fuel Cell Technologies	7,500
Wind Energy	4,500
Water Power	1,650
Advanced Manufacturing	20,000
Solar Energy	21,400
Building Technologies	5,000
Total Incubator Investments	\$110,050



EERE Grid Integration Initiative: Goal & Vision (\$80M)

Cross-cutting EERE Program to Address Grid Integration Barriers to High Penetration of EERE Technologies

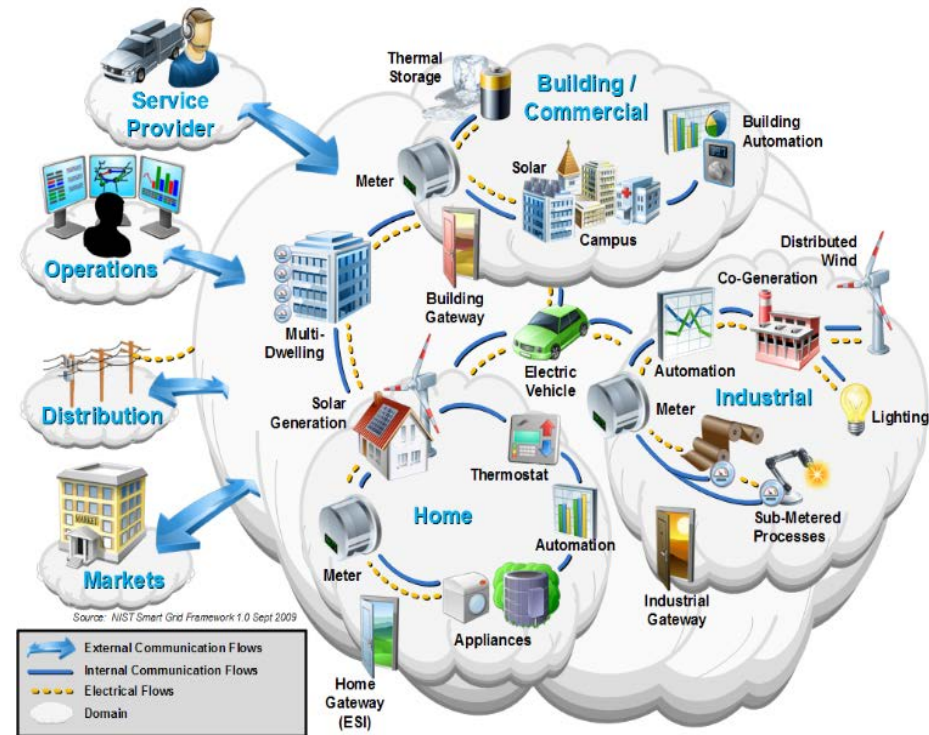
Importance of Integrating Clean Energy Technologies Into the Electricity Grid

Cost reduction alone will not enable large-scale deployment. As clean energy and energy efficient technologies become more prevalent on the customer side of the meter, the distribution system must evolve to accommodate these technologies. Distributed variable resources (e.g., solar, etc.), electric vehicles, and building energy technologies must be holistically integrated to be adopted by utilities or the marketplace at a scale necessary to achieve significant energy, economic, and environmental benefits.

Multi-Program (Solar, Buildings, and Vehicles) Initiative

Address grid integration barriers through joint funding opportunity announcements aimed at load serving utilities and supported by integrated national laboratory effort.

- Protection and restoration
- Systems optimization
- Data management and communications
- Interoperability and standards
- Sensors and data
- Distribution models and tools
- Owner economics



NREL Energy Systems Integration Facility (ESIF) (\$20M)

“Technology User Facility” for public/private partnerships to conduct grid integration experiments.

Need

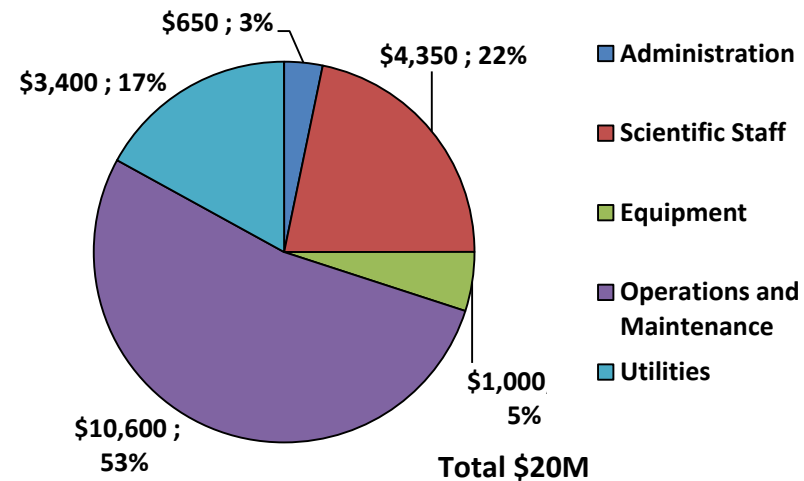
Operate ESIF as a Technology User Facility to maximize utilization of this investment. ESIF provides utilities and other stakeholders a safe “laboratory” to de-risk grid integration barriers without jeopardizing current infrastructure operations or reliability.

R&D Priorities and Operations

- EERE, OE, and other offices as appropriate will provide direction through Steering Committee. All proposals will be peer reviewed. Success metrics will be based on operating hours, number of users, research output, and private sector leveraging.
- Systems experiments: testing and validation of high penetration variable renewable generation, storage systems, electric vehicle charging, building efficiency, and demand response.
- Complex systems research: developing standards for controls, data, and system interfaces.
- Systems simulation: distribution grids, thermal systems, and fuel systems.



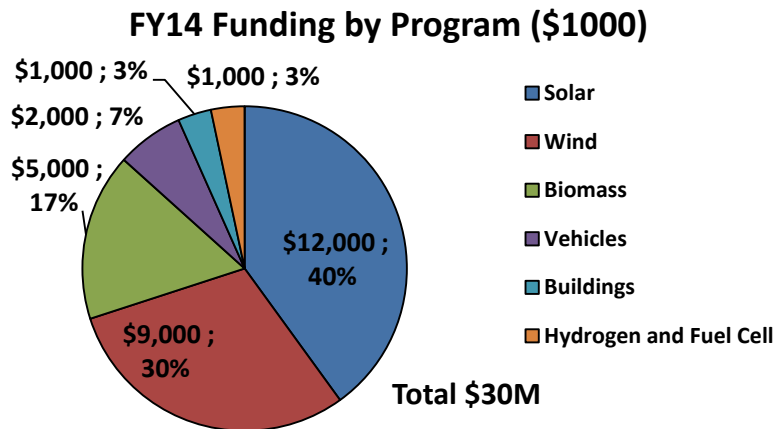
ESIF Operating Costs Breakdown (\$1000)



NREL Site-Wide Facility Costs (\$30M)

- Consistent with other labs, direct charge (instead of overhead) NREL facility maintenance and operations to reduce labor rate multiplier by 15-20%. The amount of work at NREL for the same program funding does not change.
- A more affordable labor rate is necessary for attracting industry and other stakeholders to NREL's unique, high-value RD&D facilities. This will result in increased utilization of the following facilities:

- Solar Process Development & Integration Laboratory
- Solar Outdoor Test Facility
- SERF/S&TF
- Thermal Storage/Optical Char.
- Vehicle Test Facility
- NWTC (field testing, turbine dynamometer, blade testing)
- Integrated Biorefinery Research Facility
- HVAC lab
- Biomass Thermochemical Users Facility
- ReFUEL laboratory
- Thermal Test Facility (Bldgs)
- Automated Home Energy Mgt. Lab



Site Wide Costs

- Maintenance
- Building engineers
- Fire and Emergency Services
- Refuse
- Minor Construction
- Information Services
- Grounds
- Custodial
- Pest Control
- Utilities (electricity, water, heat)
- ES&H
- Shipping & Receiving

Individual program allocations correlate approximately with program funding and major facilities at NREL

For Further Information

Office of Energy Efficiency & Renewable Energy:

<http://www.eere.energy.gov/>

Fiscal Year 2014 EERE Budget Request Information:

http://www1.eere.energy.gov/office_eere/bo_budget_fy14.html

State Summaries: A Snapshot of EERE's Work in States

http://apps1.eere.energy.gov/states/state_summaries.cfm

Cross-cutting EERE Initiatives

SunShot: <http://www1.eere.energy.gov/solar/sunshot/>

EV Everywhere: http://www1.eere.energy.gov/vehiclesandfuels/electric_vehicles/index.html

Clean Energy Manufacturing Initiative: <http://www1.eere.energy.gov/energymanufacturing/index.html>

Renewable Electricity Generation – FY 2014 Technology Office Budget Requests

Geothermal Technologies: http://www1.eere.energy.gov/office_eere/pdfs/budget/geothermal_ataglace_2014.pdf

Solar Energy Technologies:

http://www1.eere.energy.gov/office_eere/pdfs/budget/solar_ataglace_2014.pdf

Wind and Water Power Technologies:

http://www1.eere.energy.gov/office_eere/pdfs/budget/windwater_ataglace_2014.pdf

For more information, please contact EERE Stakeholder Engagement at
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