Department of Energy – EERE Renewable Power Initiatives

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

June 5, 2014

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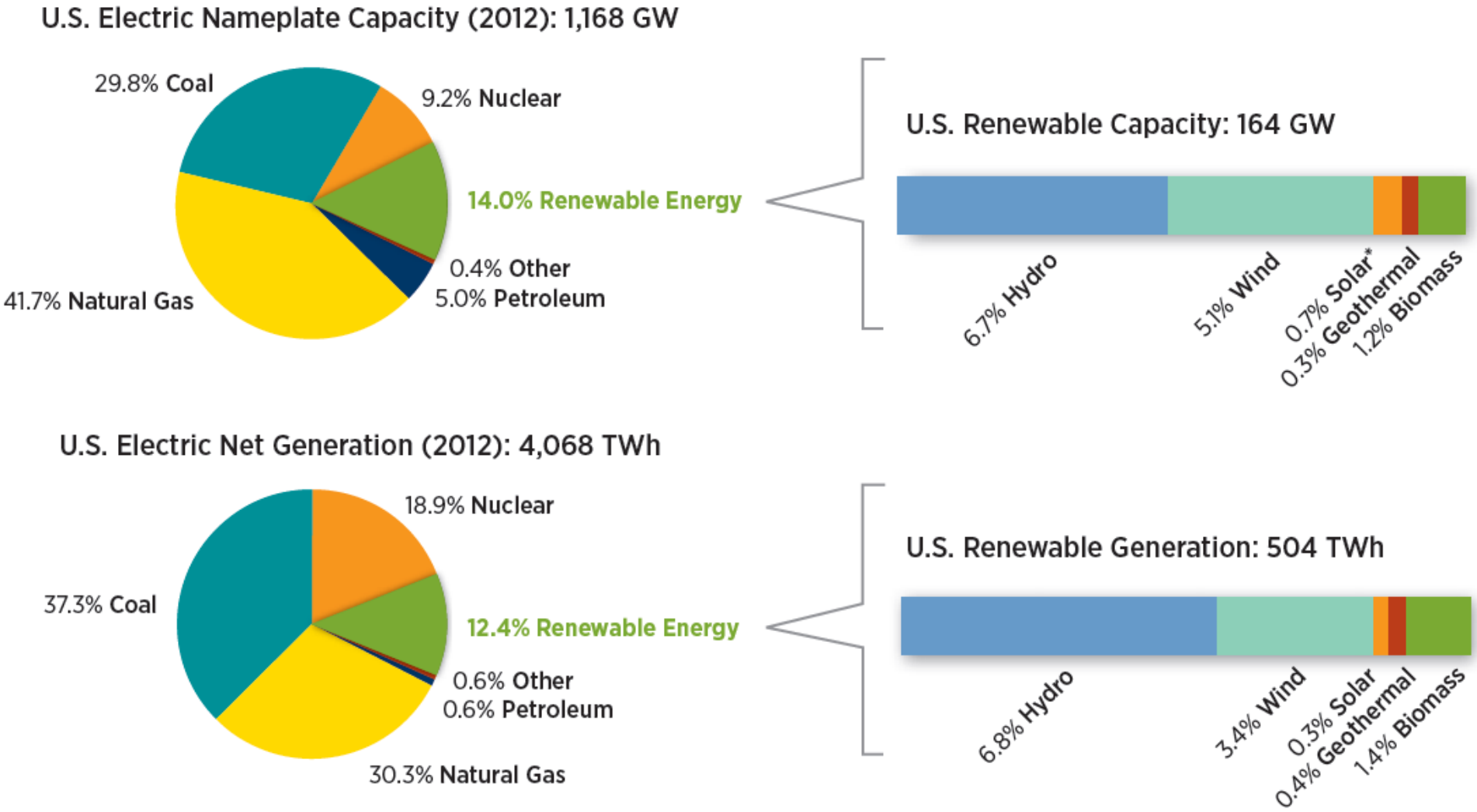
U.S. Department of Energy

Today's Presentation

- Renewable Power Industry in the U.S.
- Administration Goals
- DOE Efforts
- EERE Mission & Organization
- EERE Renewable Power Programs

Renewable Power in the U.S.

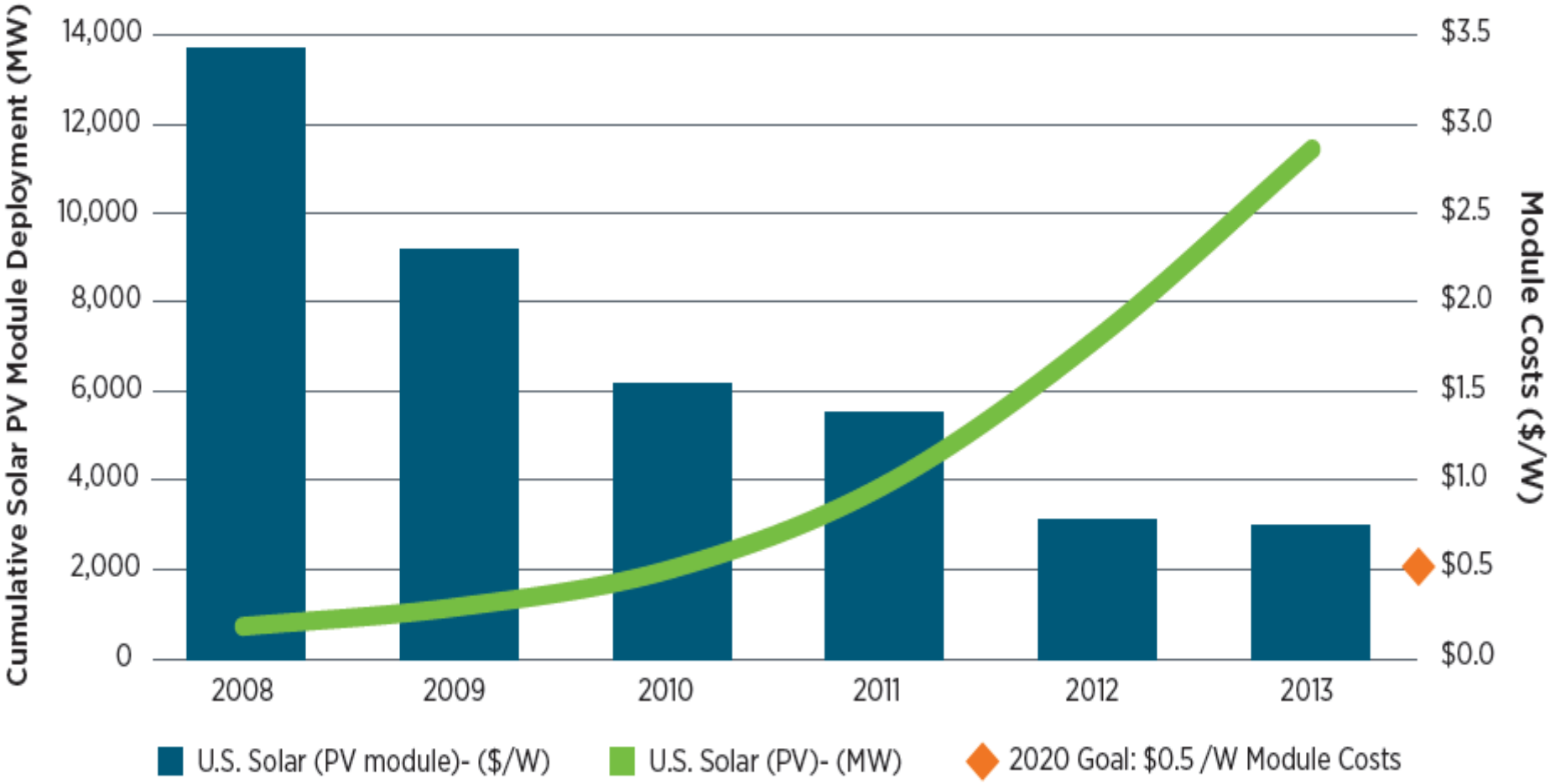
U.S. Electricity Nameplate Capacity and Generation (2012)



Source: Renewable Energy Data Book 2012

Renewable Power in the U.S.

Cumulative Solar PV Deployment



Source: NREL

Administration Goals

Energy Goals:

- Reduce oil imports by 50% by 2025 from 2008 levels.
- Derive 80% of America's electricity from clean energy sources by 2035.
- Reduce greenhouse gas emissions by 17% by 2020 and 83% by 2050, from a 2005 baseline.

Climate Action Plan:

- By 2020, double wind, solar and geothermal electricity generation again. First doubling in 2012 from 2008 baseline.
- Federal government to consume 20% of its electricity from renewable sources by 2020.
- Expand and modernize the electric grid.

U.S. Department of Energy Strategic Plan

Strategic Objective 1
Supports the President's Climate Action Plan with "all of the above" resources.

Strategic Objective 2
Strengthen U.S. energy infrastructure.

Strategic Objective 3
Strengthen the connection between advances science and technology innovation.

- **Quadrennial Energy Review (QER)**
- **Cross-Cutting Tech Teams**

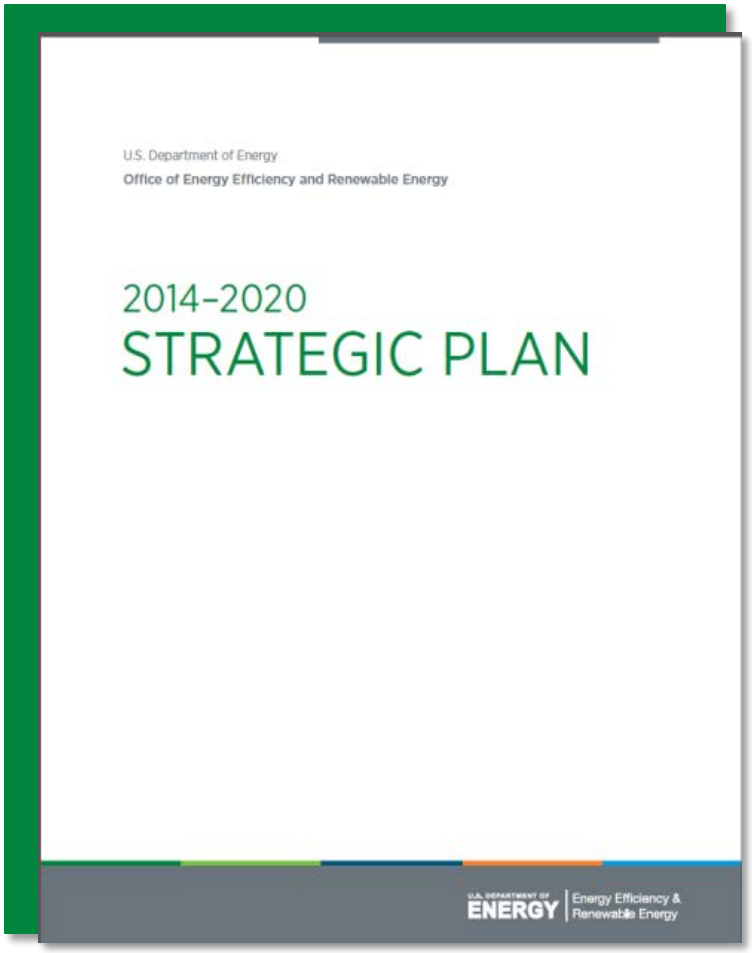
Vision

A strong and prosperous America powered by clean, affordable, and secure energy.

Mission

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

EERE
Strategic Plan



Vision

Mission

Principles

Strategic Goals

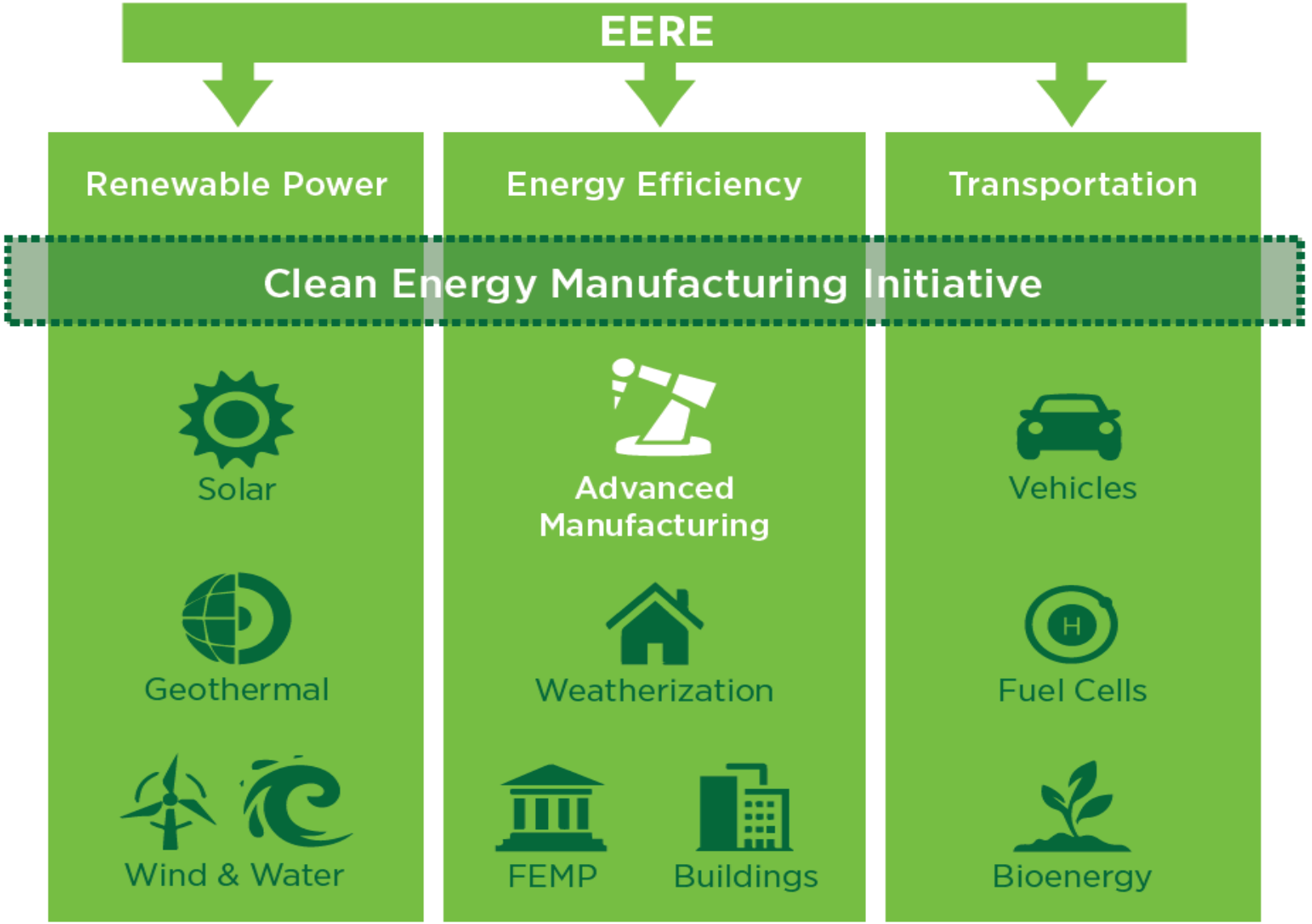
Sector Objectives

Success Indicators

GOALS

- Accelerate the development and adoption of sustainable transportation technologies.
- Increase the generation of electric power from renewable sources.
- Improve the energy efficiency of our homes, buildings, and industries.
- Stimulate the growth of a thriving domestic clean energy manufacturing industry.

EERE
Organizational Structure



EERE
Office of Energy Efficiency and Renewable Energy

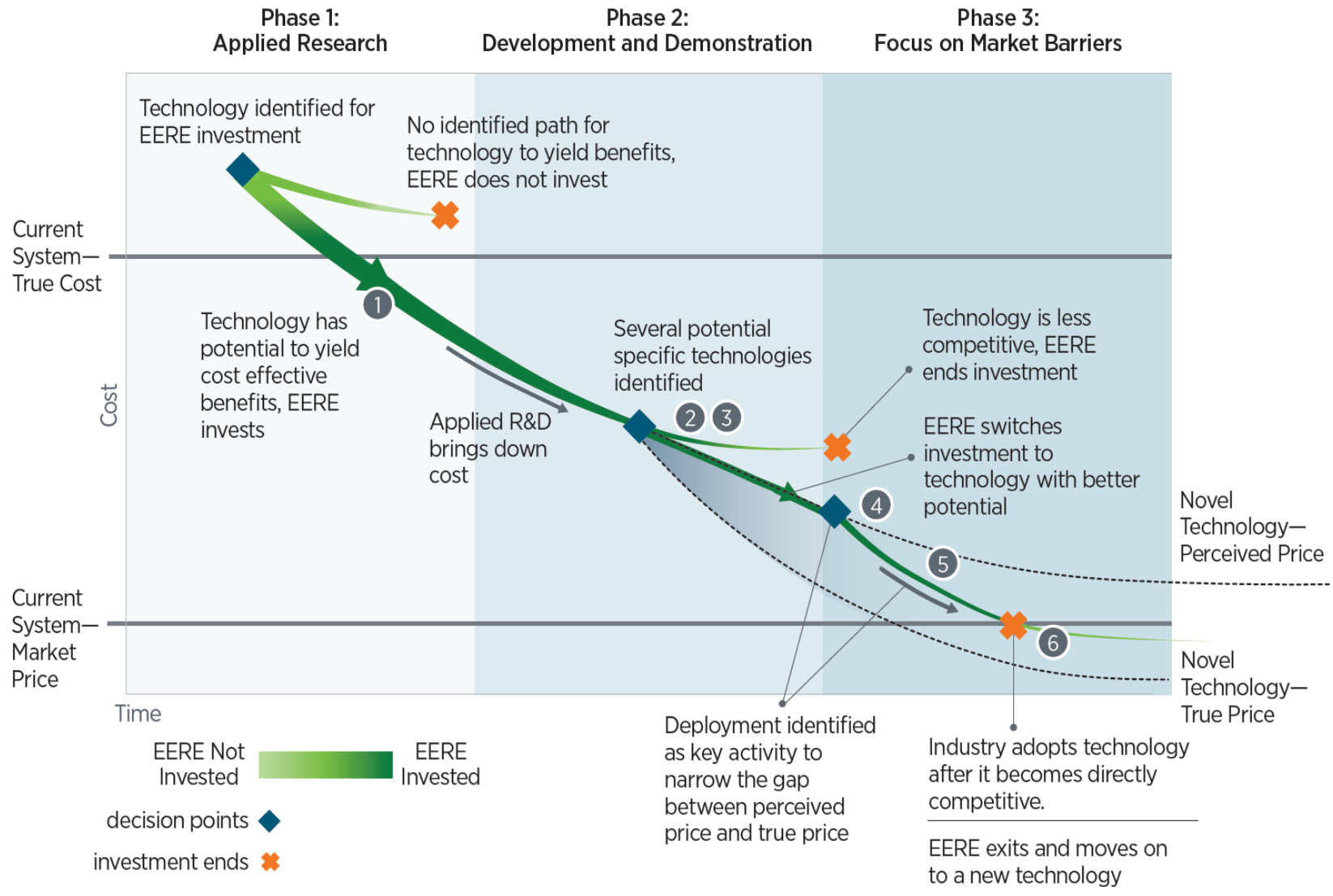
EERE seeks to develop renewable energy technologies so that they are cost-competitive with traditional sources of energy without subsidies

Major Strategies

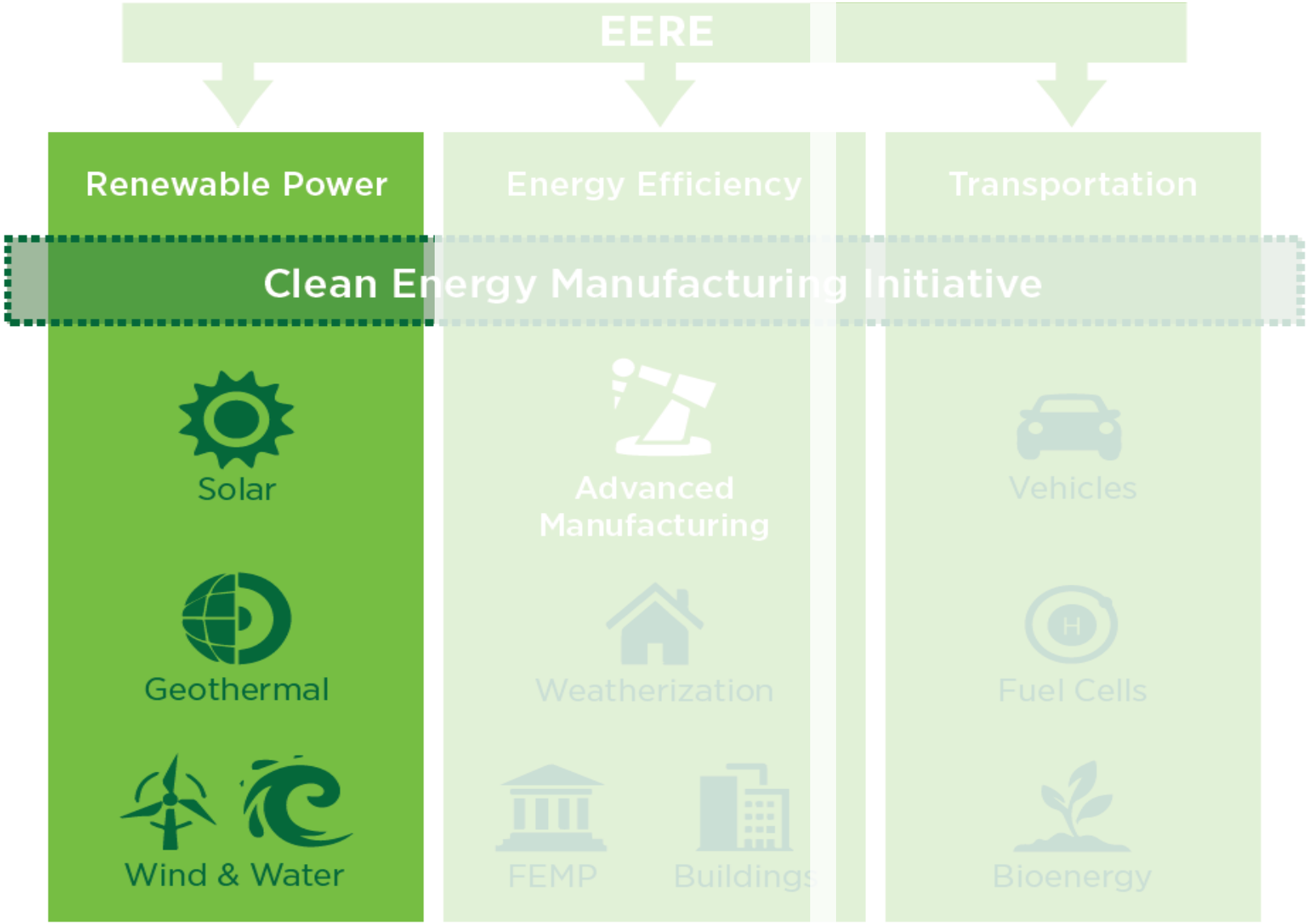
1. Applied Research: Cost reduction & performance improvement
2. Development & Demonstration: technology validation and risk reduction
3. Focus on market barriers

EERE
High Impact in Everything We Do

The EERE Investment Pathway



EERE
Organizational Structure



U.S. Renewable Energy Potential

Source: National Renewable Energy Laboratory, 2010, 2012

Solar Energy Technologies Office: SETO

Solar Energy Technologies Office: SETO

SunShot Initiative's goal is to develop solar energy technologies to reduce the costs of solar photovoltaic (PV) and concentrated solar power (CSP) energy technologies to be cost-competitive without subsidies with conventional energy sources by 2020.

Portfolio

- **Photovoltaic R&D** - Advances R&D that has resulted in US leadership in world records, scientific publications, and patents to provide US industry technology advantages
- **Concentrating Solar Power R&D** - Develops advanced thermal storage to enable CSP to provide dispatchable electricity.
- **Systems/Grid Integration** - Develops technologies to enable integration of solar power with the grid for reliability and resiliency
- **Soft Balance of Systems** - Work with state and local governments to reduce red tape and soft costs which now can be about 50% of residential costs
- **Innovations in Manufacturing** - Increase US market share for manufacturing value add commensurate with domestic market demand through manufacturing process R&D

Challenges

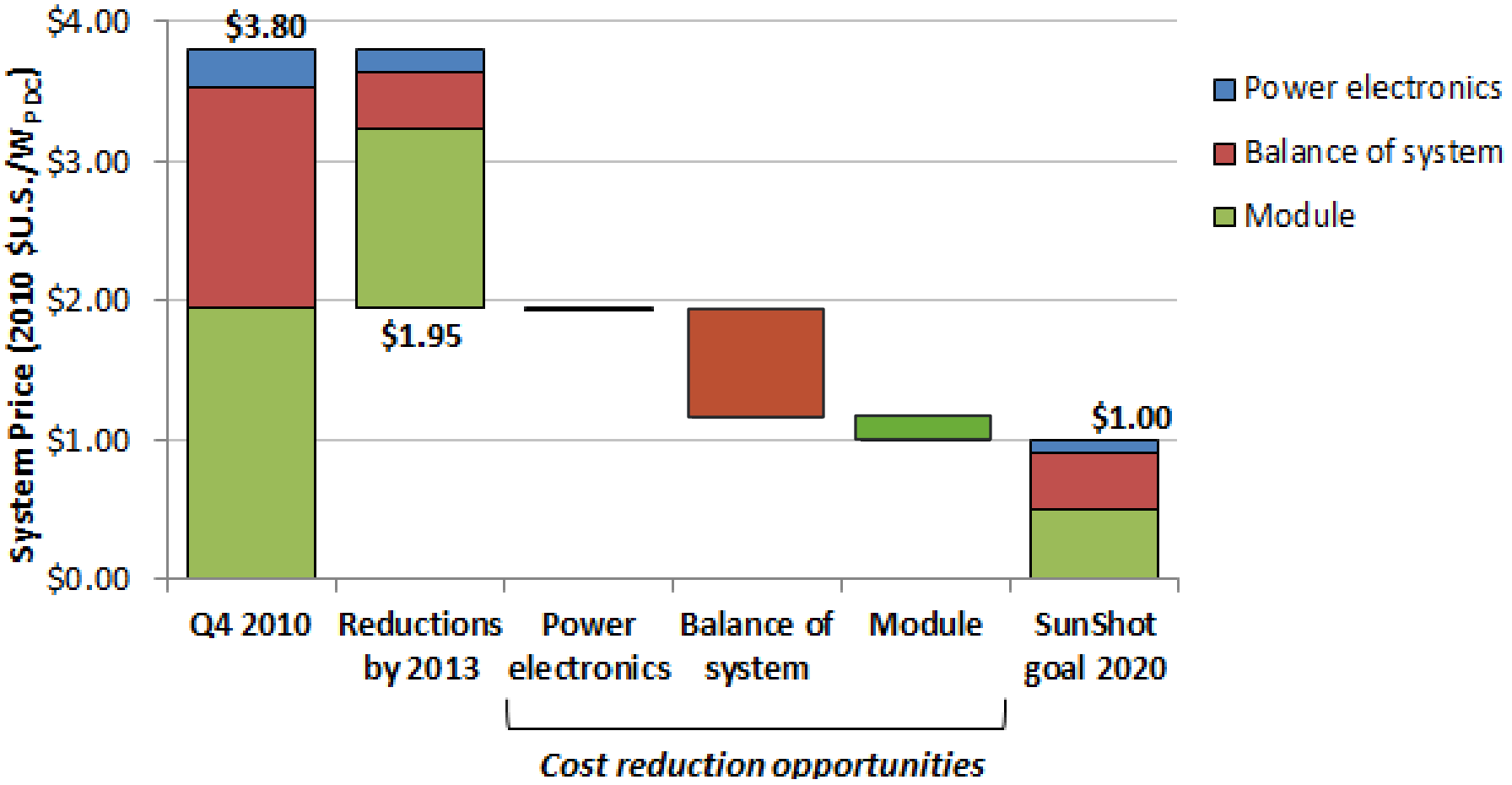
- Hardware cost advances have outpaced soft costs and soft costs have been difficult to reduce.
- With higher penetration of renewables, system-wide grid integration becomes increasingly critical.
- US-based manufacturers are facing stiff competition in a very intense global marketplace.

Opportunities

- Creative ways to engage with stakeholders to realize reductions in soft costs
- Develop technologies to minimize integration costs
- Stronger partnerships with industry to assist US manufacturing competitiveness

SETO: SunShot

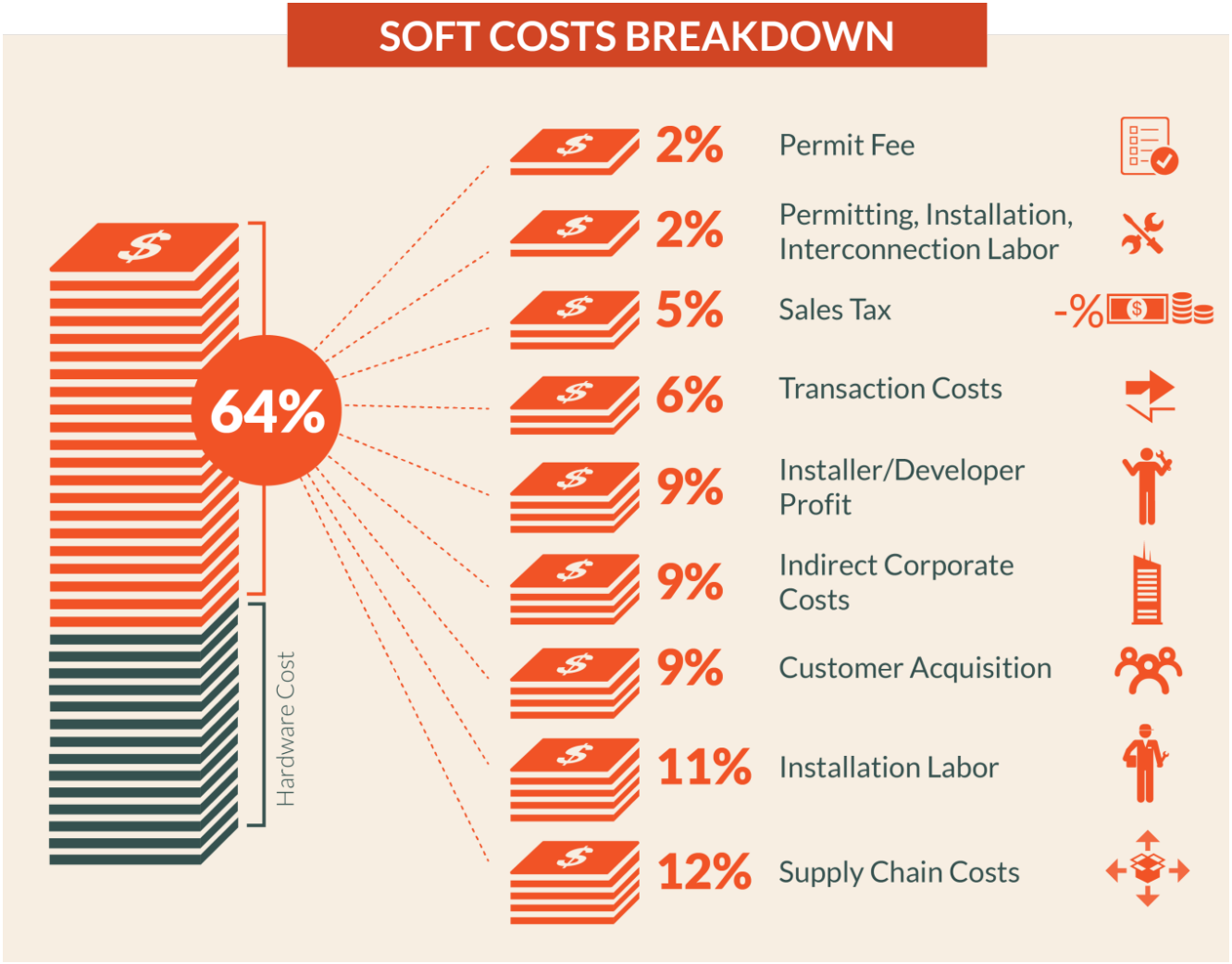
Utility Scale PV Progress Q4 2013



Sources: Margolis , R., et al. (2012). "*SunShot Vision Study*." DOE/GO-102012-3037. Golden, CO: National Renewable Energy Laboratory, pp. 265. Accessed 2013: http://www1.eere.energy.gov/solar/pdfs/47927_appendices.pdf; Goodrich, A; James, T; and Woodhouse, M. "*Residential, Commercial, and Utility-Scale Photovoltaic System Prices in the United States: Current Drivers and Cost Reduction Opportunities.*" NREL Technical Report No. TP-6A20-53347, Available Online at: www.nrel.gov/docs/fy12osti/53347.pdf . ; NREL internal (PV system cost) analysis (September 2013).

SETO: SunShot

Direct Cost Competitive Solar by 2020



Up to ~~50%~~

64% of the cost of a solar installation

Source: Second Annual Benchmarking…", Friedman et al., in preparation.

Wind & Water Power Technologies Office: WWPTO

Wind & Water Power Technologies Office: WWPTO

The mission of the Wind and Water Power Technologies Office (WWPTO) is to accelerate widespread U.S. development and deployment of clean, affordable, reliable, and domestic wind and water power to promote national security, economic growth, and environmental quality. WWPTO supports achieving the President's goal of doubling renewable energy by 2020 by investing in high risk, transformative technology innovations that industry does not address.

Portfolio

- Land-based Utility-scale Wind
  - Reduce unsubsidized LCOE to $0.057/kWh by 2020 and $0.042/kWh by 2030*
- Distributed Wind
  - Develop a national strategy for distributed wind which leverages and promotes continued U.S. manufacturing
- Offshore Wind
  - Reduce unsubsidized LCOE to $0.167/kWh by 2020 and $0.136/kWh by 2030 for fixed-bottom systems*
- Marine and Hydrokinetic
  - Achieve cost-competitiveness at local coastal hurdle rates of roughly $0.15/kWh by 2030*
- Hydropower
  - Deploy up to 70 GW of new hydropower to meet 15% projected U.S. electricity demand from Water in 2030, up from 7% today

**All costs at a 7% discount rate*

Challenges

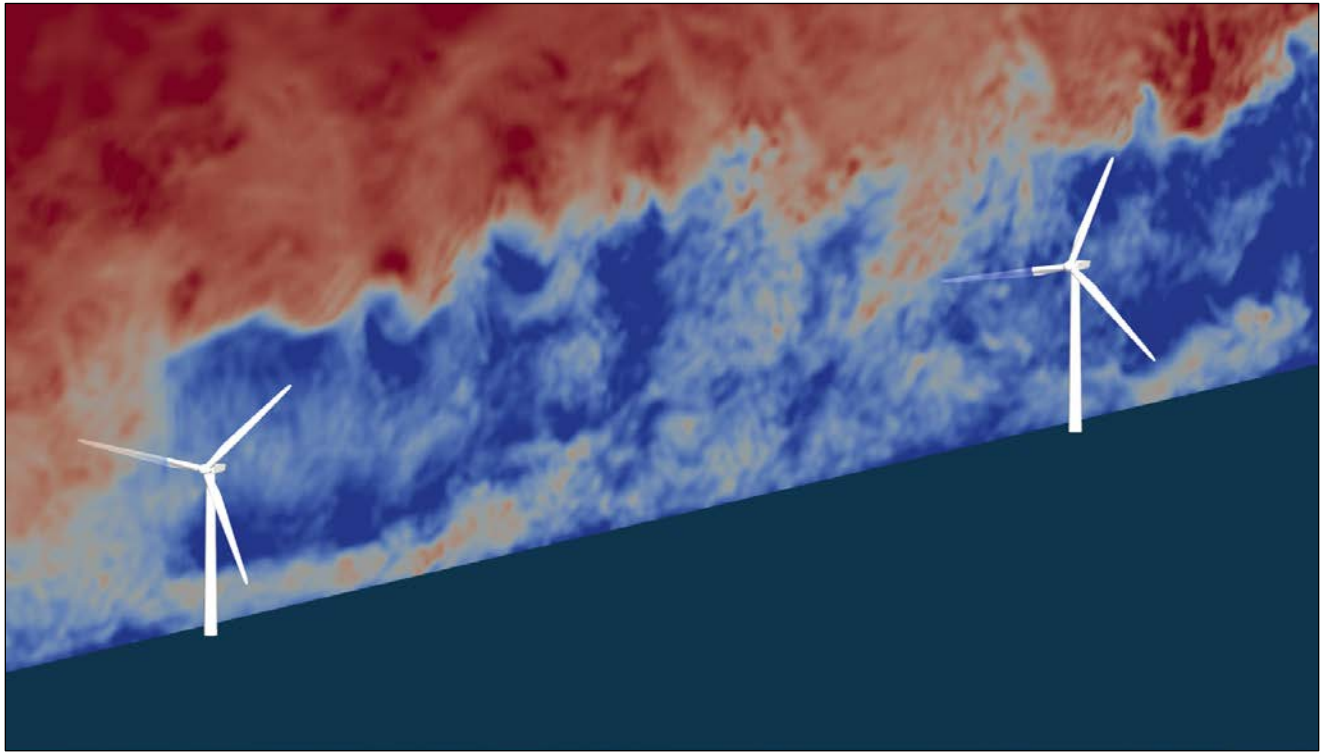
- LCOE reduction for unsubsidized competition
- Technology reliability and readiness improvements
- Market barrier reduction for accelerated GW-scale deployment
  - Siting, regulatory and permitting, environmental (including avian and aquatic), human-use (including radar, public acceptance, and existing uses), transmission and interconnection
- Grid integration to enable high RE penetration
- International supply chain competition

Opportunities

- Optimize plant performance to reduce LCOE
- Provide essential test infrastructure to reduce technology risk and open markets
- Mitigate barriers and streamline permitting processes to speed deployment
- Optimize grid integration and transmission
- Strengthen U.S. competitiveness by maintaining and expanding domestic manufacturing

WWPTO: A2e Atmosphere to Electrons

- Wind Farm level analysis
- Improved understanding of the complex physics governing wind flow into and through wind farms
- Develop high-fidelity simulation models.
- Impact the design process to accelerate the maturation of the innovative wind plant technology.



DOE wind turbine inflow measurement and modeling capabilities help determine the reasons for wind plant underperformance.

Turbine-wake interactions can reduce overall wind power plant efficiency by as much as *20% to 30%*

WWPTO: Offshore Wind

Consistent with DOE/DOI's the *National Offshore Wind Strategy,* Offshore Wind activities will support research that is expected to simultaneously improve offshore wind power plant performance, reduce capital and operational costs and reduce market barriers—directly contributing to the office goal of lowering the cost of energy. This activity supports a multi-year program to facilitate the creation of a U.S. offshore wind industry.

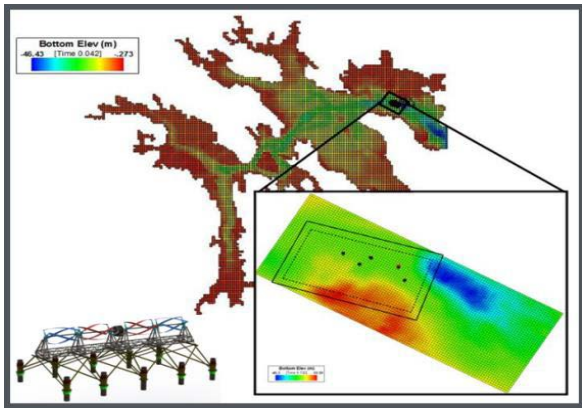
- Tremendous U.S. offshore wind resource, exceeding 50 quads (4,000 GW), which is approximately 4 times the nation's current annual electricity production
- The Offshore Wind Demonstration Funding Opportunity is a 5-year initiative
- 2014: Down-selected 3 of 7 projects to move to final design, construction, and installation activities:
  - *Virginia*
  - *Oregon*
  - *New Jersey*
- Projects are expected to be in operation by the end of 2017, and will represent some of the very first at-scale deployments in the United States.

WWPTO: Marine & Hydrokinetic Technologies

Marine and Hydrokinetic Technologies (MHK) capture the energy of waves and currents (e.g., tides or ocean current).

Ocean Power TechnologieTest s Power Buoy at Navy Wave Energy Site, HI

- **MHK Research and Design**
- **Validate Open-Source Advanced Design Tools**
- **Monitoring Technology Testing and Research**:



Output of Sandia National Laboratories' Environmental Fluid Dynamics Code, a tool to predict optimum array configurations, in Cobscook, Maine

DOE aims to compress technology development timelines to reduce the LCOE for MHK devices to local coastal hurdle rates of $0.12-$0.15 per kilowatt-hour (kWh) by 2030

WWPTO: HydroNEXT

The new ***HydroNEXT*** initiative will focus on accelerating the use of hydropower through development and demonstration of technologies to lower cost, improve performance, and reduce environmental impacts of hydropower.

- **HydroMax:** Capturing near-term growth opportunities through R&D on technologies to cost-effectively improve performance and increase sustainable generation at existing water resources infrastructure.
- **Low Impact New Development (LIND):** A new set of hydro technologies is needed to capture the wide range of low impact development opportunities that are currently available from new stream-reach development.
- **Environmental Performance Analysis + Regulatory Process Improvement:** High-level, predictive analysis is needed to assess LIND designs and inform future design requirements to meet environmental performance needs and ease the permitting processes for future deployments of LIND technologies. DOE will also develop a tool to reduce permitting barriers and increase efficiency and transparency of federal permitting processes.

Through HydroNEXT, the Energy Department aims to **double hydropower generation in the U.S.** by 2030 (an additional 300 TWh) to create a large and enduring economic and environmental benefit to the U.S.

Geothermal Technologies Office

Geothermal Technologies Office

The mission of the Geothermal Technologies Office is to accelerate the development and deployment of clean, domestic geothermal resources that will provide valuable, stable and secure electricity and thermal energy and support a cleaner environment.

Portfolio

- **Enhanced Geothermal Systems (EGS):** Creating and developing long-life, economic and sustainable fractured reservoirs which have overall potential to add 100-500 Gwe at competitive costs.
- **Low Temperature/Co-Produced (LT):** Demonstrating co-production, cascading system and strategic material technologies at working scale.
- **Innovative Exploration Technologies (IET):** Developing tools and technologies which lower the cost and risk of geothermal drilling, development and measurement.
- **Systems Analysis (SA):** Lowering barriers to geothermal development through accurate analysis, and engagement on non-technical barriers such as regulatory and financial.

Challenges

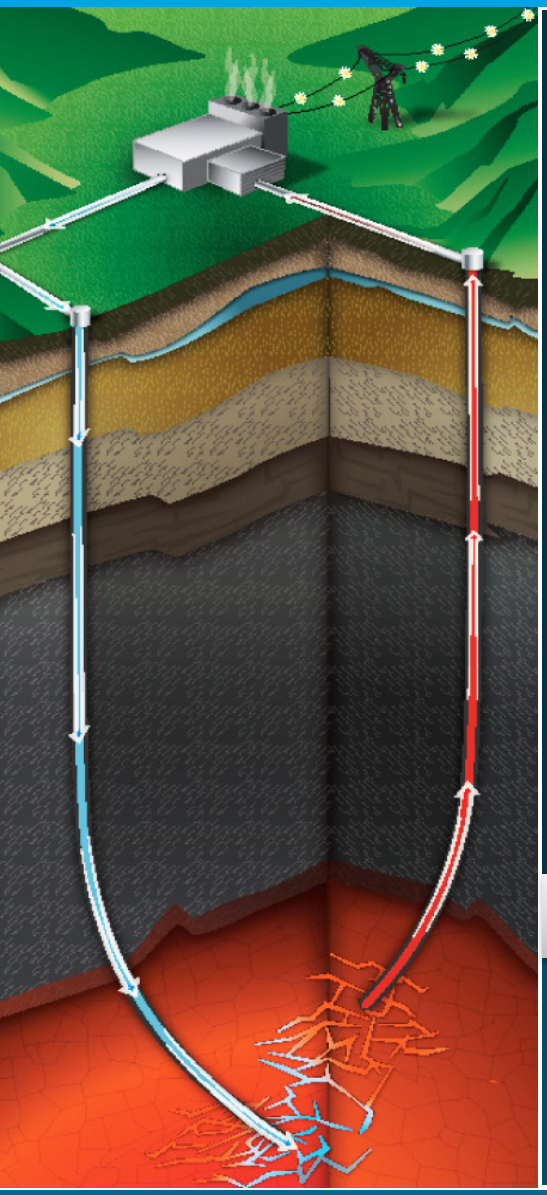
- **EGS:** Risk–averse private sector unable to advance EGS at required scale
- **LT:** To date, no commercial co-pro projects have been advanced
- **IET:** Low risk geothermal fields have been identified, next challenge is finding and economically drilling “blind” systems
- **SA:** Unacceptably lengthy permitting and regulatory timelines, coupled with low investor confidence in geothermal system reliability

Opportunities

- DOE-led demonstration projects and EGS Field Laboratory project (FORGE), building upon 2013 EGS success at Desert Pk
- First Co-pro working project in a working oil and gas field
- First geothermal “play fairway” analysis and mapping, following by proof of concept validation and drilling
- Implementation of best practices resulting from geothermal regulatory roadmap, combined with timeline surety

Geothermal : FORGE

Frontier Observatory for Research in Geothermal Energy



Promote transformative science and engineering to:

- Validate and optimize enhanced geothermal systems (EGS) technology
- Perfect access and creation of productive and sustainable reservoirs
- Capture and disseminate high fidelity data in real-time to all stakeholders
- Ensure reproducibility for commercial scale-up

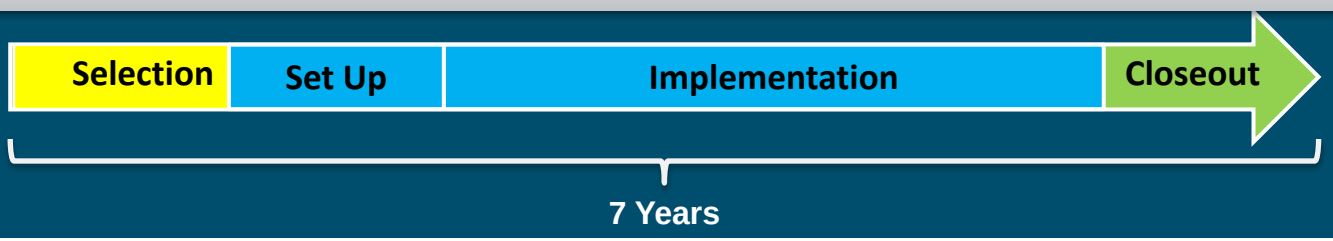
Federal Role:

- Test technologies/take technical risks not possible in private sector
- Work under aggressive timeframe

Partnerships:

- Facilitate broad collaboration among all stakeholders and scientific communities
- Welcome a wide-range of R&D performers provided technology advance EGS development and deployment.

Direct benefits to multiple areas of subsurface research



Grid Integration

Energy Systems Integration Facility (ESIF)

- NREL's largest R&D facility (182,500 ft^2/20,000 m^2)
- Space for 200 NREL staff and research partners
- 15 state-of-the-art hardware laboratories
- Integrated megawatt-scale electrical, thermal and fuel infrastructure
- High performance computation and data analysis capabilities
- 2-D/3-D advanced visualization

http://www.nrel.gov/esi/esif.html

EERE
Engagement with the States

- **"Living Laboratories"**
  - New approaches
  - Regional economies
- **Cities, States and Associated Institutions**
  - PUCs, State Universities, State Energy Offices

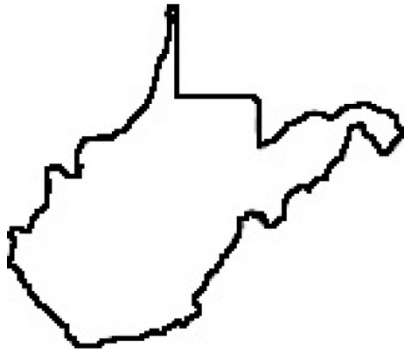
EERE Support:

- Direct Funding through EERE's State Energy Program and Weatherization Assistance Program
- Competitive Funding across Tech Offices
- Development of Best Practices and Targeted Technical assistance
- Provision of information resources and tools
  - Regulatory Roadmaps, Analysis Reports, Online Databases (DESIRE)

EERE
Engagement with the States

DOE Energy Information Administration

http://www.eia.gov/state/?sid=WV



EERE State and Local Solutions Center:

The State and Local Solution Center and Technical Assistance Program (TAP) provide resources, events, and assistance to state, local, tribal, and K-12 school district leaders working to unlock a clean energy economy.

http://www1.eere.energy.gov/wip/solutioncenter/

EERE POC for West Virginia:

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Backup Slides

EERE Public Affairs

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Energy Efficiency and Renewable Energy
Solar, Geothermal, Wind, Water: FY 2012 to FY 2015 Funding

(Dollars in Thousands)

Program/Subprogram	FY 2012 Appropriation From FY12 Col of FY14 Req	FY 2013 Appropriation From FY13 Col of FY15 Req	FY 2014 Appropriation From FY14 Col of FY15 Req
Solar Energy	**284,702**	**269,050**	**257,058**
Concentrating Solar Power	44,922	43,080	48,571
Photovoltaic R&D	75,563	150,580	56,641
Systems Integration	47,916	45,773	52,816
Balance of Systems Soft Cost Reduction	31,897	29,617	42,558
Innovations in Manufacturing Competitiveness	84,404	0	44,472
NREL Site Wide Facility Support	0	0	12,000
Geothermal Technologies	**36,979**	**35,025**	**45,775**
Enhanced Geothermal Systems	15,556	20,103	27,084
Low Temperature and Coproduced Resources	4,940	2,942	4,708
Hydrothermal	12,483	8,092	10,285
Systems Analysis	4,000	3,888	3,698
NREL Site Wide Facility Support	0	0	0
Wind Energy	**91,813**	**86,129**	**88,126**
Technology Development and Testing	73,054	62,399	61,006
Technology Application	18,759	23,730	18,120
Resource Characterization and Technology RD&T	0	0	0
Technology Validation and Market Transformation	0	0	0
Mitigate Market Barriers	0	0	0
Modeling and Analysis	0	0	0
NREL Site Wide Facility Support	0	0	9,000
Water Power	**58,076**	**54,687**	**58,565**
Marine and Hydrokinetic Technologies	33,684	35,456	41,275
Hydropower Technologies	24,392	19,231	17,290
NREL Site Wide Facility Support	0	0	0
TOTALS	**471,570**	**444,891**	**449,524**

FY 2015 Budget Summary Table

Dollars in Thousands	FY 2013 Current	FY 2014 Enacted	FY 2015 Request	FY 2015 vs FY 2014
Renewable Electricity	**444,891**	**449,524**	**521,300**	**+71,776**
- Solar Energy Technologies	269,050	257,058	282,300	+25,242
- Wind Energy Technologies	86,129	88,126	115,000	+26,874
- Water Power Technologies	54,687	58,565	62,500	+3,935
- Geothermal Technologies	35,025	45,775	61,500	+15,725
EERE Total	**1,691,757**	**1,900,641**	**2,316,749**	**+416,108**

FY 2015 Budget Summary Table

Dollars in Thousands	FY 2013 Current	FY 2014 Enacted	FY 2015 Request	FY 2015 vs FY 2014
Transportation	**584,199**	**614,955**	**705,183**	**+90,228**
- Vehicle Technologies	303,165	289,737	359,000	+69,263
- Bioenergy Technologies	185,190	232,290	253,200	+20,910
- Hydrogen and Fuel Cell Technologies	95,844	92,928	92,983	+55
Renewable Electricity	**444,891**	**449,524**	**521,300**	**+71,776**
- Solar Energy Technologies	269,050	257,058	282,300	+25,242
- Wind Energy Technologies	86,129	88,126	115,000	+26,874
- Water Power Technologies	54,687	58,565	62,500	+3,935
- Geothermal Technologies	35,025	45,775	61,500	+15,725
End-Use Efficiency	**535,354**	**617,449**	**857,700**	**+240,251**
- Advanced Manufacturing	114,254	180,471	305,100	+124,629
- Federal Energy Management Program	28,265	28,248	36,200	+7,952
- Building Technologies	204,601	177,868	211,700	+33,832
- Weatherization and Intergovernmental Programs	188,234	230,862	304,700	+73,838
Corporate Support Programs	**208,889**	**231,513**	**237,779**	**+6,266**
Subtotal, Energy Efficiency and Renewable Energy	**1,773,333**	**1,913,441**	**2,321,962**	**+408,521**
- Use of Prior Year Balances	-81,576	-2,382	-5,213	N/A
- Rescission of Prior Year Balances	0	-10,418	0	N/A
Total, Energy Efficiency and Renewable Energy	**1,691,757**	**1,900,641**	**2,316,749**	**+416,108**

Major Drivers of Renewable Energy Deployment

Federal Policy

Production Tax Credit (PTC): 2.2¢/kWh tax credit for wind, geothermal, and closed-loop biomass; 1.1¢/kWh for other eligible technologies.

Investment Tax Credit (ITC): 30% tax credit for solar, fuel cells and small wind; 10% for geothermal, microturbines, and CHP.

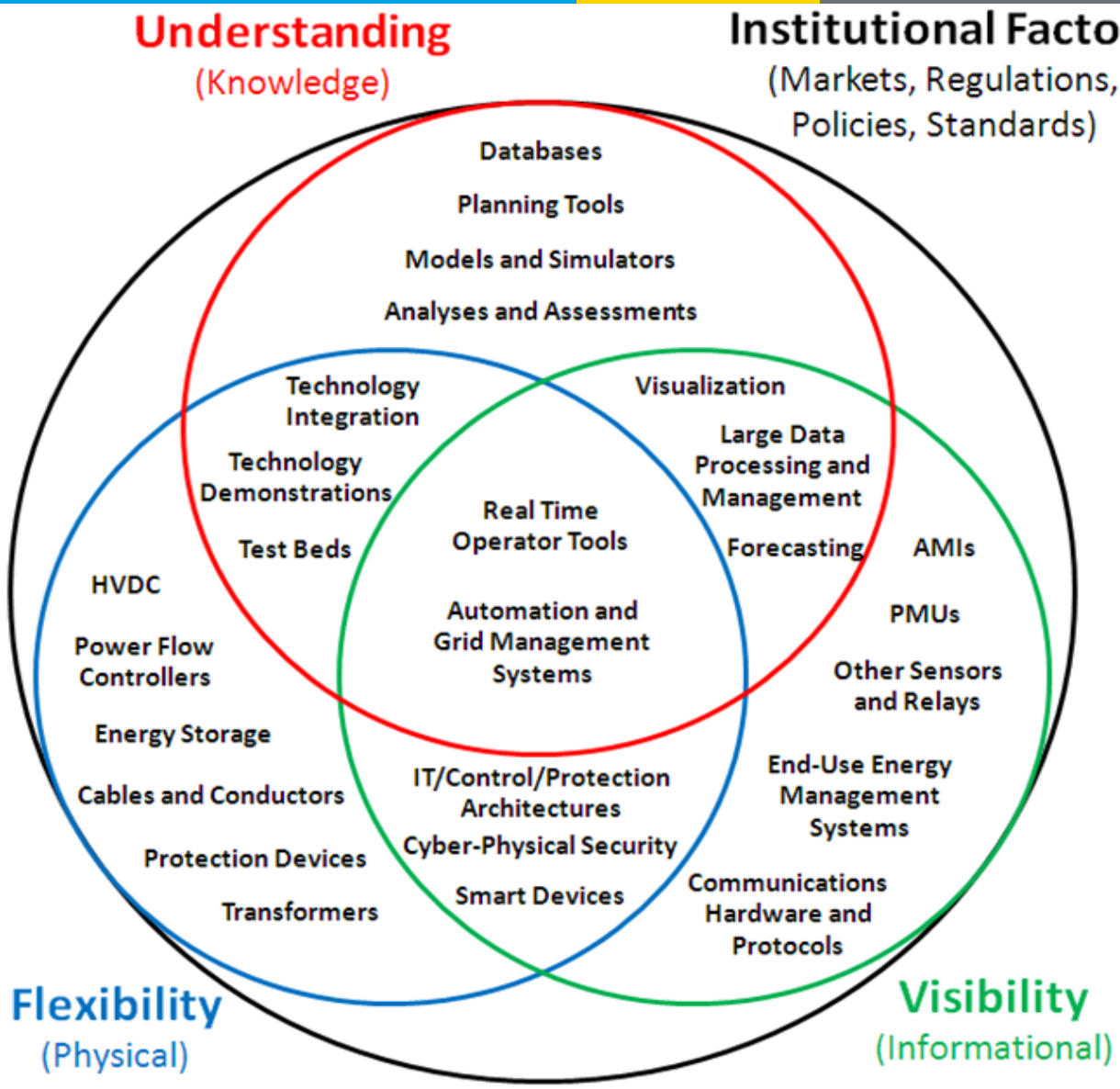
Accelerated Depreciation (MACRS): enables wind project owners to depreciate the vast majority of their investments over a five- to six-year period for tax purposes. An even-more-attractive first-year "bonus depreciation" schedule was enacted in 2008.

Note: Under current law, the PTC, ITC, and bonus depreciation will expire for new wind projects at the end of CY 2012

State Policy

Renewable Portfolio Standard (RPS): Obligates utilities to procure a percentage of electricity from renewable sources. 29 states (plus DC and Puerto Rico) have an RPS on the books.

EERE Cross-Cutting Initiative: Grid Integration

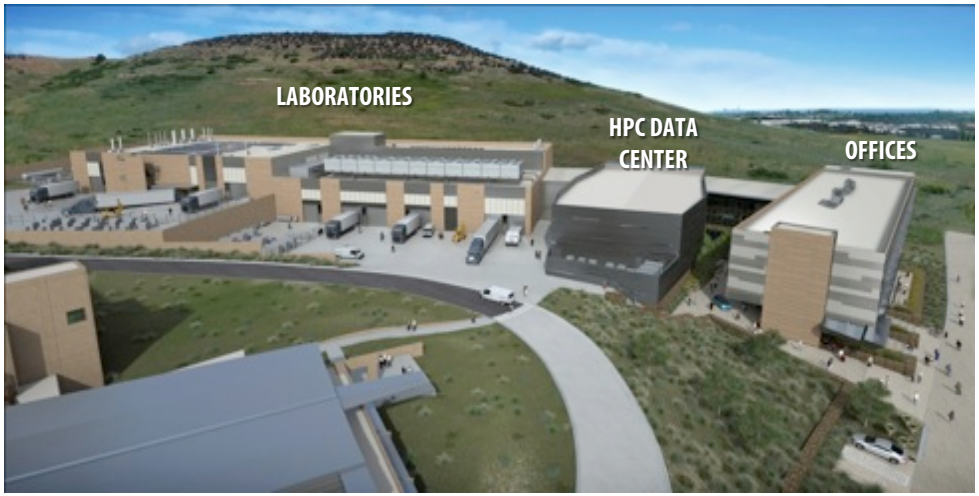


Grid Integration

Energy Systems Integration Facility (ESIF)

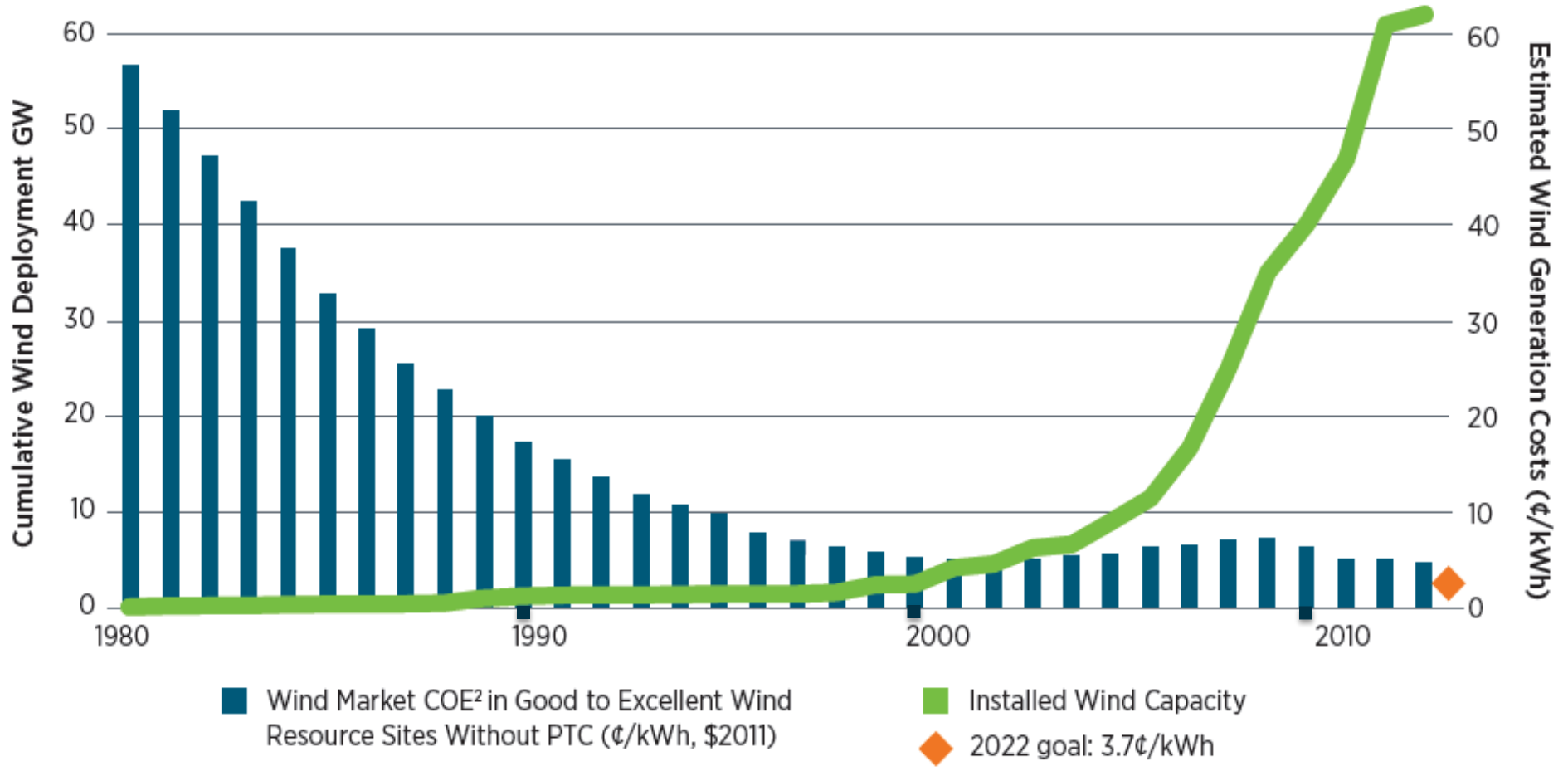
Addressing the challenges of integrating clean energy technologies into the energy systems infrastructure at all scales.

- ESIF will complete the first full year of RD&D in FY14.
- Numerous projects will be conducted with a variety of participants including DOE, Federal and State government, academia, not-for-profit enterprises and commercial businesses.
- A major DOE cross-cutting project titled INTEGRATES was begun with EERE support and continues to deliver results.
- In FY 2015, ESIF will continue normal operations and expand investments to function as a DOE User Facility supporting a group of peer reviewed competitively selected projects addressing a scope of work defined by DOE.



Renewable Power in the U.S.

Cumulative Wind Deployment



Source: NREL

Geothermal Technologies Office