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

# iiESI/IEA Workshop on Renewables and Energy Systems Integration

**September 8, 2014**


Steve Chalk

Deputy Assistant Secretary for Renewable Power

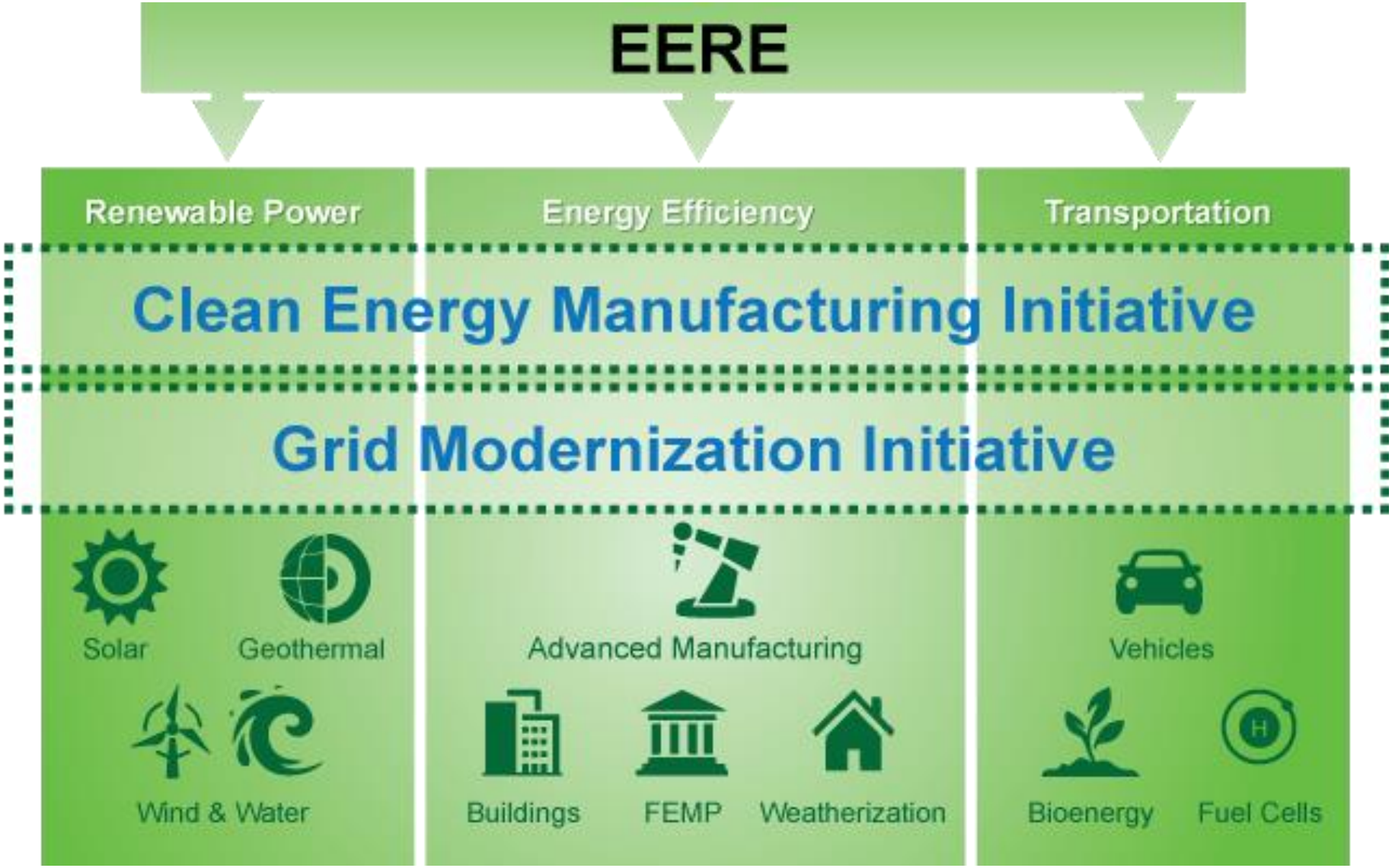
# Administration Goals

*"We will respond to the threat of climate change knowing that the failure to do so would betray our children and future generations."*

*- President Obama, Second Inaugural Address, January 2013*

- **Reduce GHG emissions** in the range of 17% by 2020
- **80% electricity from diverse clean energy** by 2035
- **Reduce net oil imports by 50%** by 2020
- **Double energy productivity** by 2030

# EERE Technology Programs



# DOE Renewable Power Strategies

**Goal:** Increase the generation of electric power from renewable resources.

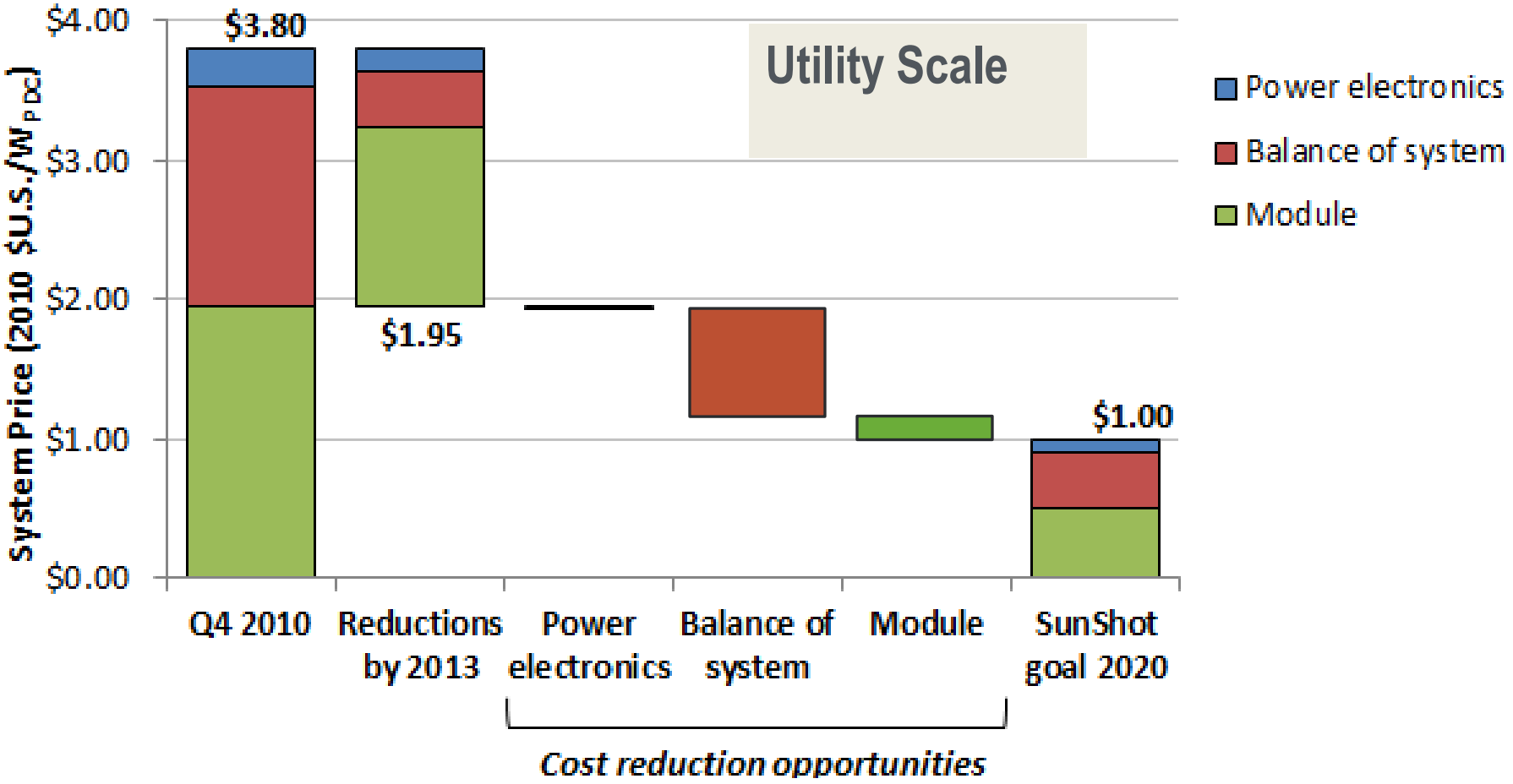
**Objective:** Develop cost-effective renewable power technologies and break down market barriers to their deployment to enable the accomplishment of national goals for clean electricity generation and wide-spread deployment of renewable generation in every region of the country by 2020.

## Major Strategies:

- **Cost Reduction and Performance Improvement**
- **Technology Validation and Risk Reduction**
- **Addressing Market Barriers**

# SunShot

## *All renewable power options driving towards unsubsidized cost parity*



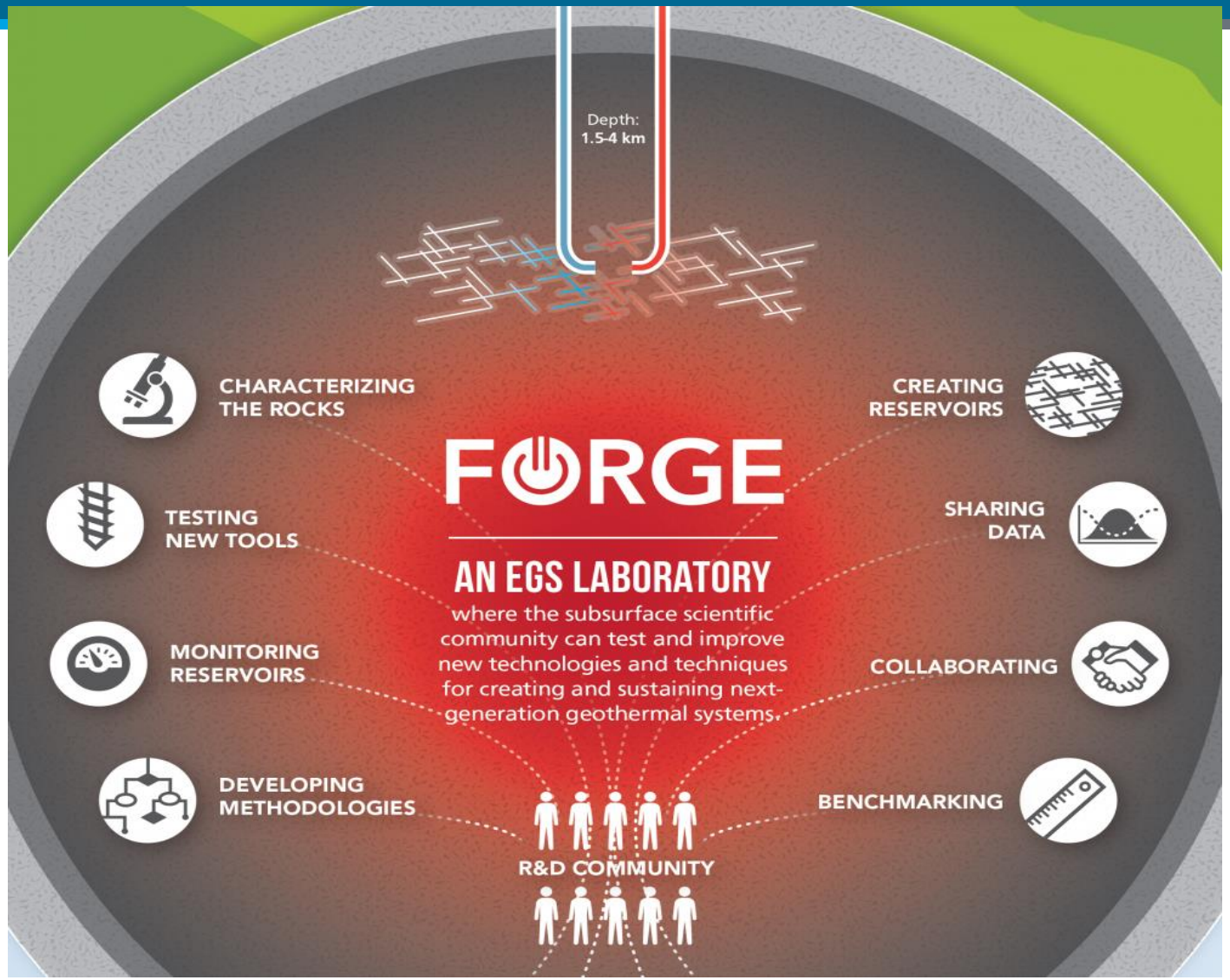

Sources: Margolis , R., et al. (2012). "*SunShot Vision Study*." DOE/GO-102012-3037. Golden, CO: National Renewable Energy Laboratory, pp. 265. Accessed 2013: http://www1.eere.energy.gov/solar/pdfs/47927_appendices.pdf; Goodrich, A; James, T; and Woodhouse, M. "*Residential, Commercial, and Utility-Scale 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).

# Offshore Wind Demonstrations

- **Innovative designs for various climates**
- **All permitting and environmental analysis**
- **Grid-tied and off-take agreements**

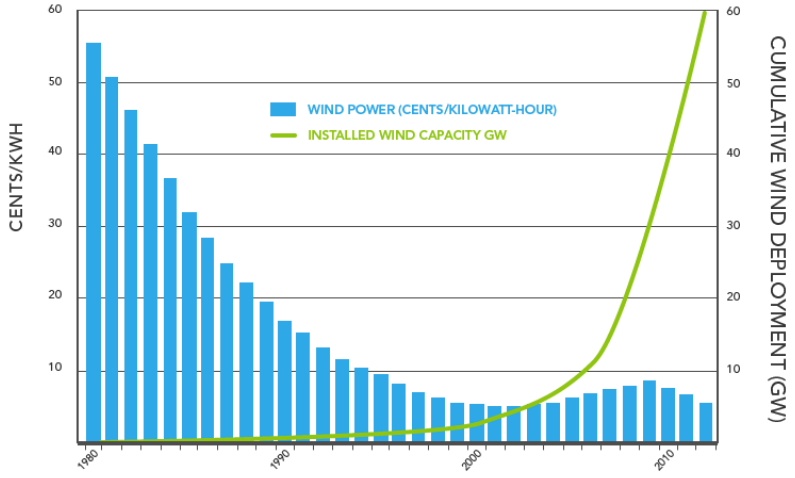
- 4,000 GW off-shore resource
- 50:50 cost-shared; construction and operation by the end of 2017
- First *at-scale* deployments of **advanced technologies** in U.S.
- 3 of 7 down-selected for deployment:
  - *Virginia*
  - *Oregon*
  - *New Jersey*
- Continue designs for innovative teams for coastal Maine and Lake Erie deployments

# Frontier Observatory for Research in Geothermal Energy

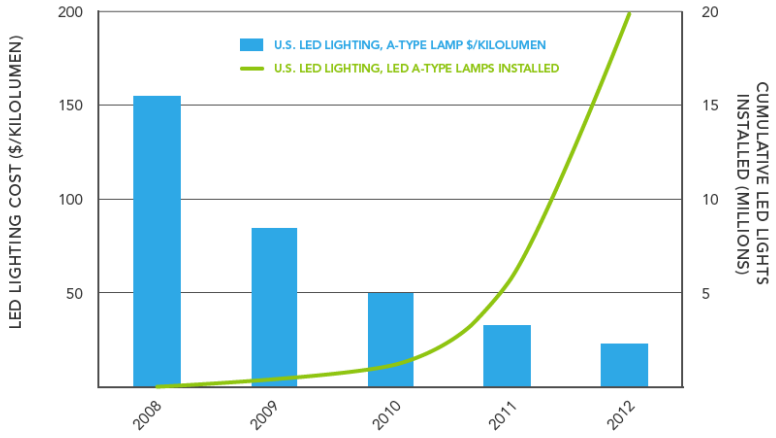


# DOE Report: Revolution Now

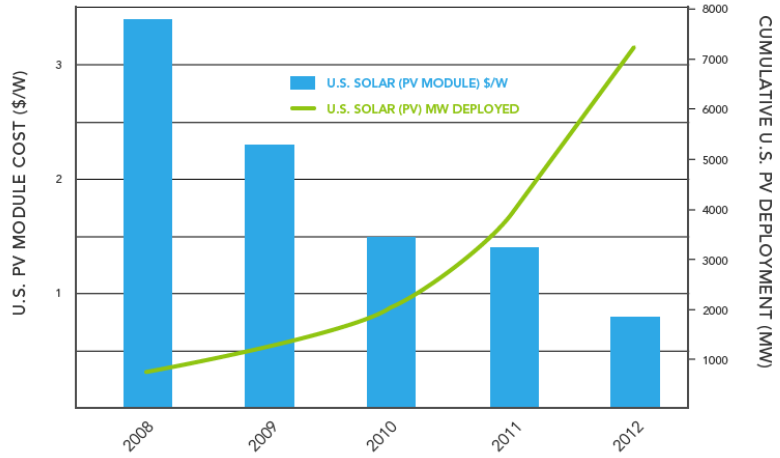
Deployment and Cost for U.S. Land-Based Wind
1980-2012



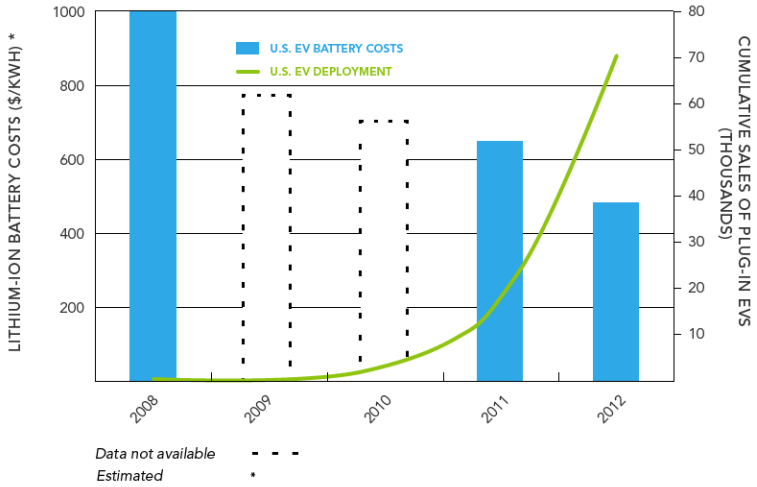

Deployment and Cost for A-Type LED Lights
2008-2012




U.S. Deployment and Cost for Solar PV Modules
2008-2012



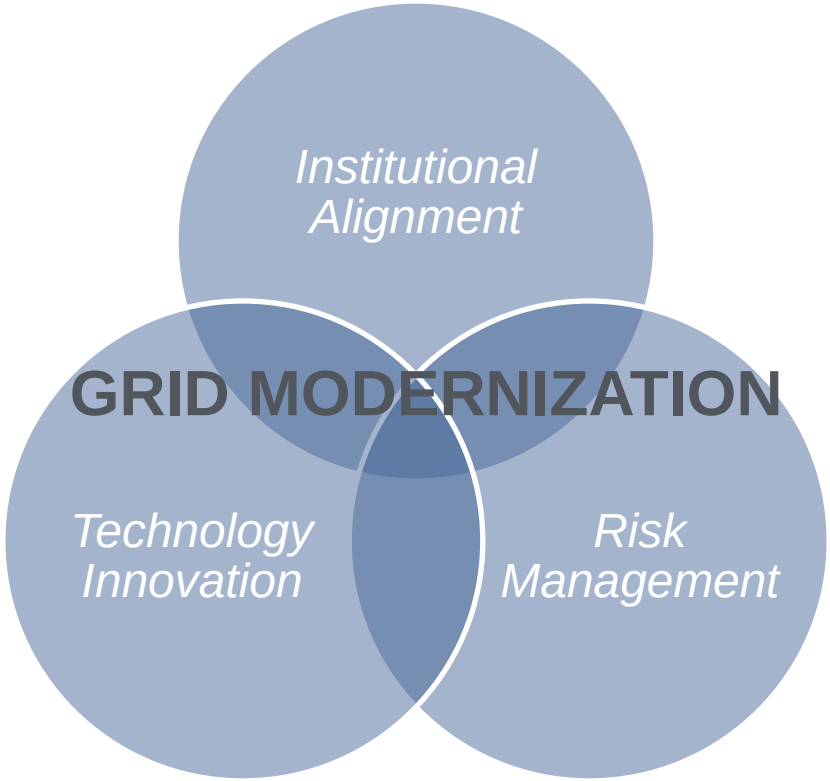

Deployment and Cost for Electric Vehicles and Batteries*
2008-2012



# Key Drivers Transforming the Grid

| | |
|---|---|
| Variable Generation | • Rapid increase in variable generation makes balancing generation and load more challenging which increasing system operational uncertainty |
| Increase in # of Active Devices | •Rise in distributed energy resources and active loads requiring visibility and control |
| Emergence of Two-Way Power Flow | • The increase of distributed generation and smart devices are resulting in a massive increase in two-way power flow. |
| Addressing Grid Stability | • Wind and solar technologies are threatening the stability of the grid due to the reduction in systems inertia and interconnection standards that don't support system reliability. |
| Institutional | • Renewable and Energy Efficiency Portfolio Standards, distributed generation, and energy storage are threatening the existing business model for the grid. |

# DOE Grid Modernization Framework




- ***Institutional Alignment:*** Focus on key policy questions related to regulatory practices, market designs, and business models
- ***Technology Innovation:*** Increase the emphasis on coordination and create tools and technologies that measure, analyze, predict, and control the grid of the future. R&D areas of activity
  - ***Design and Planning Tools***
  - ***System Control and Power Flow***
  - ***Sensing and Measurements***
  - ***Devices and Integrated Testing***
  - ***Security and Emergency Response***
- ***Risk Management through Multi-scale Demonstrations:*** Collaborate with regulators, utilities and other stakeholder groups to test and demonstrate combinations of promising new technologies and new institutional approaches.

# Preliminary Program Objectives to Support Modernized Grid Framework

Technology Innovation

| | |
|---|---|
| Institutional Alignment | •Evaluate regulatory and policy options and implications of various grid ownership and operations models – new utility business models evaluated |
| Design and Planning Tools | •Develop planning tools that integrate transmission and distribution and system dynamics and can use high performance computing platforms - deliver 50x speed-up |
| System Control and Power Flow | •Increase ability to coordinate and control up to millions of devices and integrate with energy management systems – coordinate millions of devices; enable one-minute contingency analysis at the interconnect scale |
| Sensing and Measurements | •Develop sensors, analytics, and visualizations that enable 100% observability of generation, loads and system dynamics across the electric system – develop low cost sensors at all scales, handle 1000x data volumes, visualization tools, dynamic accuracy |
| Devices and Integrated Testing | •Develop advanced grid control and integration devices and validate integrated systems that can optimize operations at high variable RE penetrations and provide high reliable service – validate 50-100% DG penetration scenarios on feeders |
| Security and Emergency Response | •Develop advanced security (cyber and physical) solutions and real-time incident response capabilities – capable of identifying cyber events in real-time and analyzing within 12 hours. |
| Risk Mitigation through Multi-scale Demonstrations | •Develop megawatt-scale demonstrations that show transfer of the technologies developed through R&D activities into the field |

# New Capability: NREL's Energy Systems Integration Facility

**Rooftop PV & Wind**

**Energy Storage Lab**
Residential, Community & Grid Battery Storage, Flywheels & Thermal

**Smart Power Lab**
Buildings & Loads

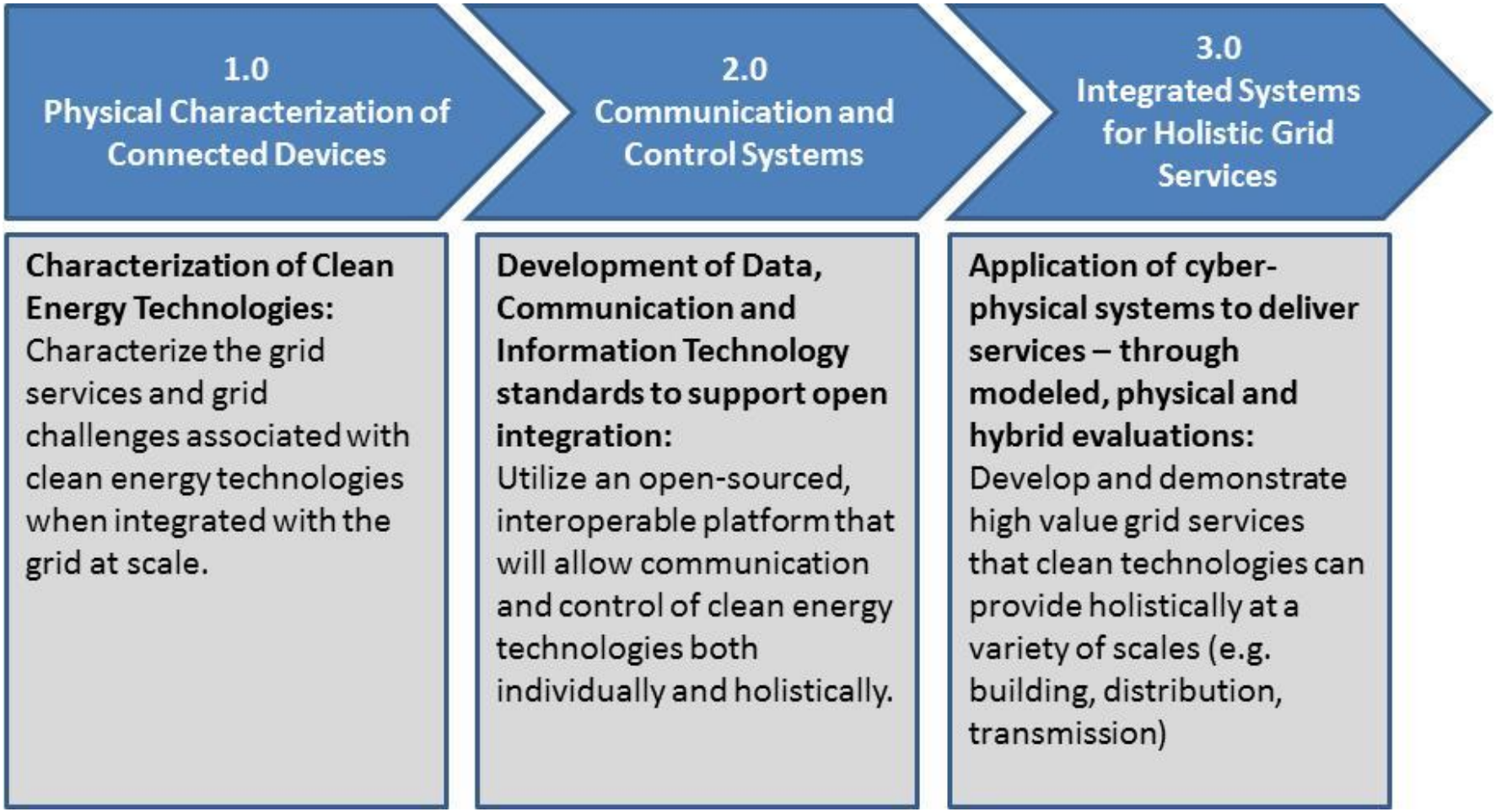

**Energy Systems Integration Lab**
Fuel Cells, Electrolyzers

**Outdoor Test Area**
EVs, Power Transformers

**Power Systems Integration Lab**
PV Simulator

# Current Activities in Grid Modernization: INTEGRATE Solicitation

## Builds on Collaboration Across Buildings, Solar, Vehicles, Hydrogen Fuel Cells, and Wind/Water Technology Offices



# More Information

EERE Grid Integration Director:

Kevin.Lynn@ee.doe.gov

Renewable Power Deputy Assistant Secretary:

Steven.Chalk@ee.doe.gov