

Renewable Energy Programs

U.S. DEPARTMENT OF
ENERGY

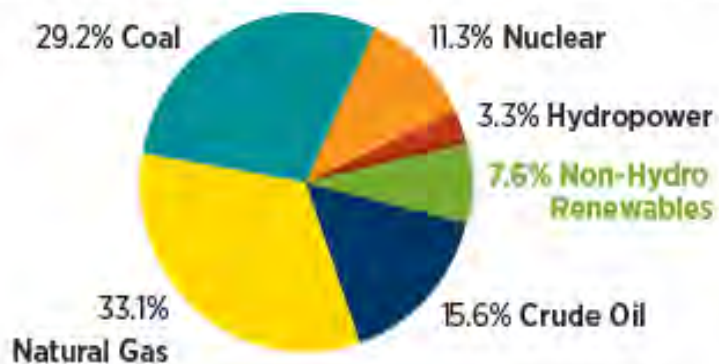
Energy Efficiency &
Renewable Energy



2012 NASEO/ASERTTI
*State Energy Policy and
Technology Outlook Conference*
February 9, 2012

U.S. Energy Production and Electric Generation (2010)

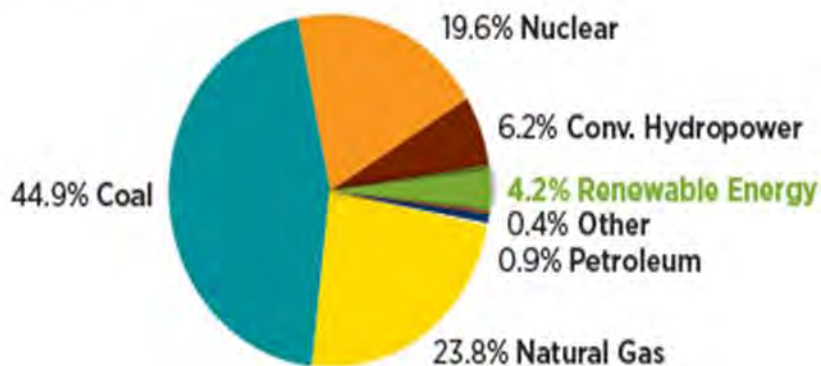
U.S. Energy Production (2010): 74.9 Quadrillion Btu



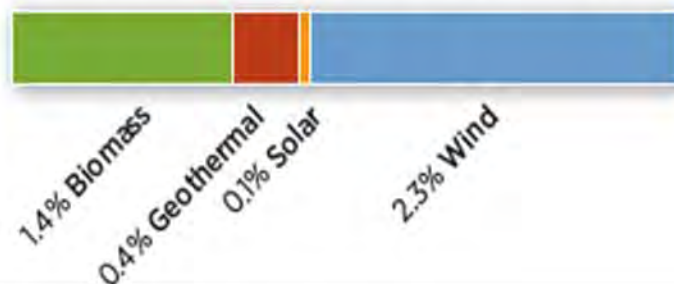
U.S. Non-Hydro Renewable Energy Production:
5.2 Quadrillion Btu



U.S. Electric Net Generation (2010): 4,123 billion kWh



U.S. Renewable Generation: 171 billion kWh



Reduce energy consumption. Reduce GHG emissions by 17% by 2020 and 83% by 2050, from a 2005 baseline. Innovate clean energy technologies to keep America competitive in the 21st century.

Achieve rapid gains in the efficient use of energy:

- Enable the cost-effective energy retrofits of 1.1 million housing units.
- Achieve a 20% improvement in commercial building energy efficiency by 2020.

Reducing oil imports by one-third by 2025. Transform the U.S. into the world leader in new transportation technologies:

- Supporting deployment of 1 million electric vehicles on the road by 2015.

Deriving 80% of America's electricity from clean energy sources by 2035. Accelerate growth in domestic renewable energy supplies:

- Double renewable energy generation (excluding conventional hydropower and biomass) from 2008-2012.



	FY 2010 Approp.	FY 2011 Approp.	FY 2012 Conference
Hydrogen and Fuel Cell Technologies	170,297	95,847	104,000
Biomass and Biorefinery Systems RD&D	216,225	179,979	200,000
Solar Energy	243,396	259,556	290,000
Wind Energy	79,011	78,834	93,593
Geothermal Technology	43,120	36,992	38,000
Water Power	48,669	29,201	59,000
Subtotal, Renewable Energy	800,718	680,409	784,593
Energy Efficiency, Strategic Programs, Program Direction and Adjustments	1,415,674	1,091,062	1,030,498
Total, Energy Efficiency and Renewable Energy	2,216,392	1,771,471	1,815,091

Does not include loan guarantees, ARPA-e, and OE funding, tax credits and other incentives

Sunshot: $\$1/W_{DC}$ ($\$0.06/\text{kW-h}$) by 2020 (unsubsidized, utility scale)

Module Innovation:

- F-PACE – close gap between production cell efficiency and lab efficiency and theoretical maximum efficiency (\$36M)
- Incubator – innovative PV and CSP storage prototypes (\$6M). **New \$12M solicitation released yesterday.**
- Next Gen II - 36% Si cell, hot carrier collection, thin film Si, high efficiency a-Si, new microstructures, layers, etc. (\$22M)

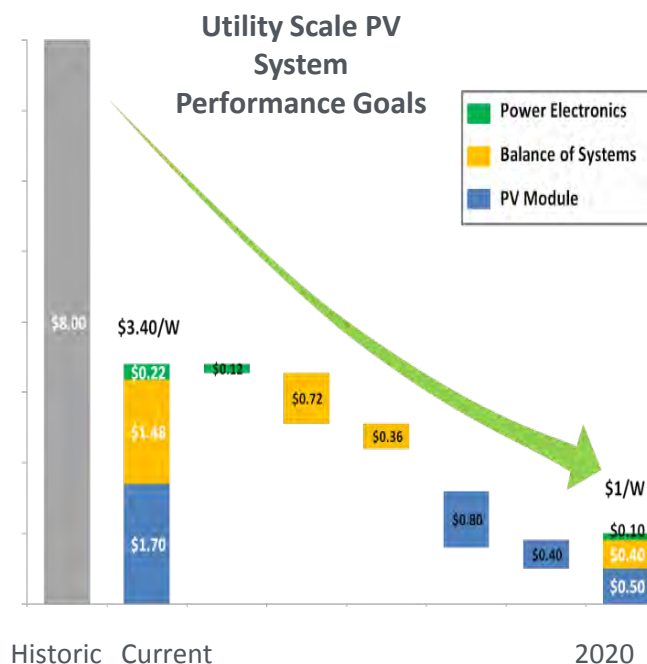
Balance of System

- “Soft” Cost: open-source siting tools and permitting information, address barriers to interconnection, net metering, higher penetration, model codes (\$14M), plus \$7M for “incubator” approach – closes 1/16/12.
- “Rooftop Solar Challenge” - \$12M to 22 regions
- Regional partnerships to streamline and reduce permitting processes and costs (\$12.5M planned)
- “Extreme” BOS: BIPV; tracking, racking, wiring, etc (\$42M)

Power Electronics

- ARPA –E collaboration.
- SEGIS – high penetration, innovative inverters, smart grid linkage, eliminate voltage variability (\$26M)

CSP – New \$60M solicitation for 20 projects; closed 2/7/12. Pre-application required.



Promoting Manufacturing Innovation and U.S. Competitiveness:

- PVMI I – \$112M for 3 consortia: university consortium to conduct industry relevant research; manufacturing development facilities for advanced silicon-based and CIGS-based manufacturing.
- PVMI II (SUNPATH) – Support initial ramp up to high volume manufacturing; \$50M available with maximum DOE project contribution \$25M (75% non Federal cost share). Under evaluation.

Transitioning technology development from land to off-shore systems

- **Land-based Utility Wind (1-5MW+):** Improve key component and overall system reliability, improve energy capture and efficiency, advance controls and system optimization
- **Offshore Wind (3-10+MW):** focus on deep-water floating designs to access higher wind resources & large scale deployment, develop next generation components, system and architectures, and drive technology development and demonstration for long-term survivability in harsh and complex offshore environments.
- **Small & Midsize Wind (<1 MW):** Optimize system design for low wind speed classes for medium size turbines, and broaden certification of emerging systems.



Large Blade Facility, Boston, MA

Upgrading National Infrastructure

- Large Wind Blade Test Facility (Boston, MA) - \$24.7 M
- Large Dynamometer Test Facility (Charleston, SC) - \$44.5 M
- NWTC Dynamometer Upgrade (Golden, CO) - \$9.5 M

Offshore Technology Development & Market Barriers

- Technology Advancement – Offshore platform designs, simulation for maximizing energy capture, wave simulations, rotors and control systems (\$25M)
- Market Barrier Removal – Ecological studies, supply chain assessments, transmission planning, infrastructure and O&M analyses, resource assessments (\$18M)
- Advanced Turbines – superconducting direct drive and other direct drive systems (\$7.5M)

Offshore Technology Demonstration

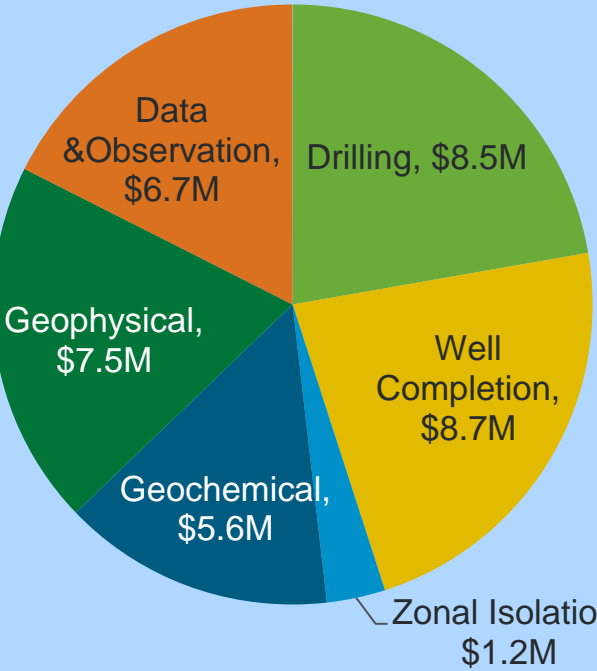
- University of Maine – DeepCwind
- **New draft solicitation released – Public meeting held February 7th. Final solicitation to be released by end of February.**

Geothermal Technologies Program

The Program targets undiscovered hydrothermal (30 GWe potential) and enhanced geothermal systems, and invests in technologies that lower the costs and risks of geothermal resource access, characterization and creation.

September, 2011 R&D Funding Opportunity
Up to \$38 million (total) over three years

32 projects will develop and test new ways to locate geothermal resources and improve resource characterization, drilling, and reservoir engineering techniques



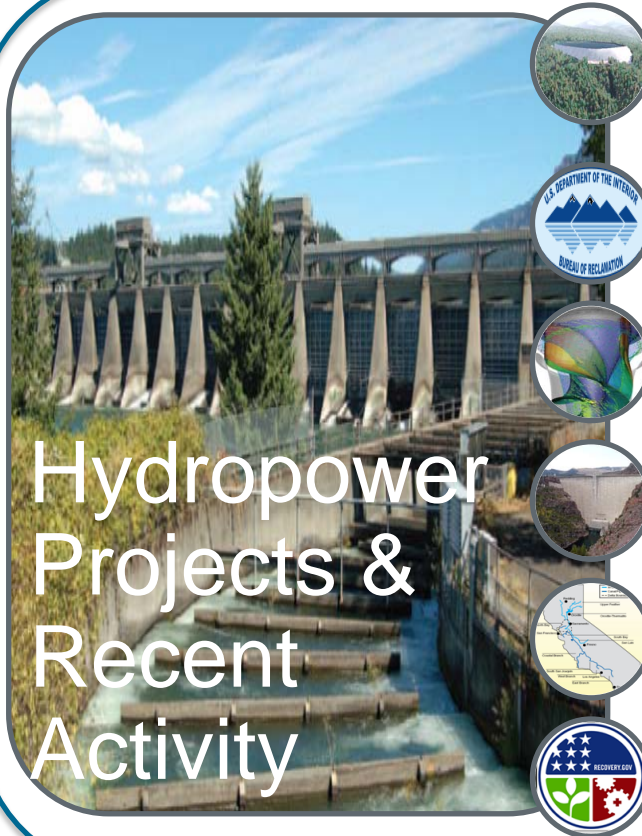
The Program has seven enhanced geothermal systems (EGS) demonstration projects in a variety of geological environments.



Recipient	Site	Update
Ormat Technologies Inc.	Desert Peak, NV	Completed a four stage stimulation. Team is currently working on a path forward for 2012
Geysers Power Company, LLC	The Geysers, CA	Developer intends to begin stimulating in the near future
University of Utah	Raft River, ID	NEPA approval granted July 7 for well rework, simulation and monitoring. Well will be re-opened in October
Ormat Technologies Inc.	Bradys Hot Springs, NV	Currently developing a stimulation plan and geologic model
AltaRock Energy Inc.	Newberry Volcano, OR	Submitted Environmental Assessment package to BLM
TGP Development Co.	New York Canyon, NV	Drilling continues in Coyote Canyon
NakNek Electric Association	NakNek, AK	Evaluating the condition of well in order to determine a path forward

DOE Technology Priorities – Hydropower

- Small Hydropower: 60+ GW potential at new sites, non-powered dams, conduits
- Advanced Pumped Storage: Utility-scale storage solution capable of integrating RE technologies
- Increasing generation from existing hydropower systems: Capacity gains and operational optimization



Advanced Hydropower Development Awards 2011: \$17 million investment in 16 R&D projects in 11 states:

- **Small Hydropower:** Innovative technologies to cost-effectively capture readily available low head hydro development opportunities.
- **Pumped Storage Hydropower:**
 - Quantify the economic value of PSH to the grid, accounting for ancillary benefits not currently monetized.
 - Support the advancement of an existing PSH development project.
- **Environmental Mitigation Technologies:** innovative technologies to enhance environmental performance while increasing generation
 - Alden Turbine Project - Full Scale 10MW prototype project led by EPRI with Brookfield Power with 98% fish passage survival.
- **System Testing at a DOI Bureau of Reclamation Facility:** supports system tests of innovative, low-head, small hydropower technologies at a non-powered Bureau of Reclamation site.

DOE-DOI-USACE MOU 2010 - DOE, Reclamation, and Corps engaged in a number of collaborative activities to promote hydropower at federal facilities.

Recovery Act Investment 2009 - 7 projects for \$31Million to modernize existing hydropower infrastructure to increase both quantity and value of generation, and address environmental performance with LCOE under \$0.04/kWh...resulting in an additional 181,000 kW-hrs of hydro generation.

Free Flow Power

- 40 kW river in-stream turbine deployed in the MS River on 6/20/2011.
- 2nd deployment achieved in MA (August 2011)

Columbia Power Technologies

- Wave energy converter deployed in March 2011 in Puget Sound, WA. Presently in operation, controlled remotely from Corvallis, OR.

Ocean Renewable Power Company

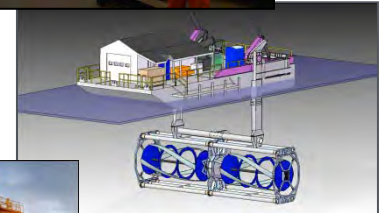
- The first of five 150 kW tidal turbines in a grid connected array will be deployed in Maine's Western Passage in Summer 2012.

Ocean Power Technologies

- The first 150kW WEC of a 10 device array will be deployed in Summer 2012 in Reedsport, OR.

Snohomish Public Utility District

- Two grid-connected 6-meter turbines will be deployed in Admiralty Inlet in 2013.
- Field measurements continued making this the best characterized tidal site in the US.



Accelerating a Sustainable Bio Industry (Fuels, Power and Co-Products)

- Cellulosic ethanol technology development status at \$4.13 per gge vs 2012 target of \$3.25 per gge.
- Assisted EPA in testing for E-15 waiver decision; continuing refueling pump support.
- Two DOE grants/loan guarantee for commercial scale cellulosic ethanol (POET and Abengoa). USDA loan guarantees of \$400M (Ineos, Enerkem, Coskata).
- Transitioning to “Drop –In” infrastructure compatible bio-based hydrocarbons (diesel, gasoline and jet fuel). Dozen pilots underway. New \$12M investment for catalysts/new conversion thermochemical and biochemical routes.
- DPA drop-in hydrocarbon biofuels initiative with Navy and USDA – integrated biorefinery encompassing whole supply chain; nominally 10M gal/yr. to be blended 50/50 with fossil-based fuel, also allows innovative pilots; RFI issued.
- R&D consortia and pilots (Algenol, Solazyme and Sapphire Energy) to achieve sustainable, affordable, and scalable algae-based biofuels.



Artist Rendition of Project Liberty,
Emmetsburg, Iowa

Updated “*Billion Ton*” study:

- By 2022, 1 billion dry tons cellulosic feedstock resources. By 2030, ranges from about 1.0 to 1.6 billion depending on the scenario. Sufficient resource potential exists to meet the 2022 RFS2 advanced biofuel goals as well as significant additional biomass for electricity, chemicals, transportation fuels, and other uses.

Fuel Cell Technology Development for Multiple Applications and Fuels

Projected high-volume cost of fuel cells has been reduced to \$49/kW (2011)*

- More than 30% reduction since 2008
- More than 80% reduction since 2002

Real world validation marks progress

Vehicles & Infrastructure

- 155 fuel cell vehicles and 24 hydrogen fueling stations with a fill time of 4 to 6 minutes for 4 kg
- Demonstrated fuel cell efficiency of up to 59%
- 2,500 hours (nearly 75K miles) durability
- Validated over 250 mile vehicle range on one fill (430 miles on one vehicle)
- New hydrogen storage tank and materials (\$7M)

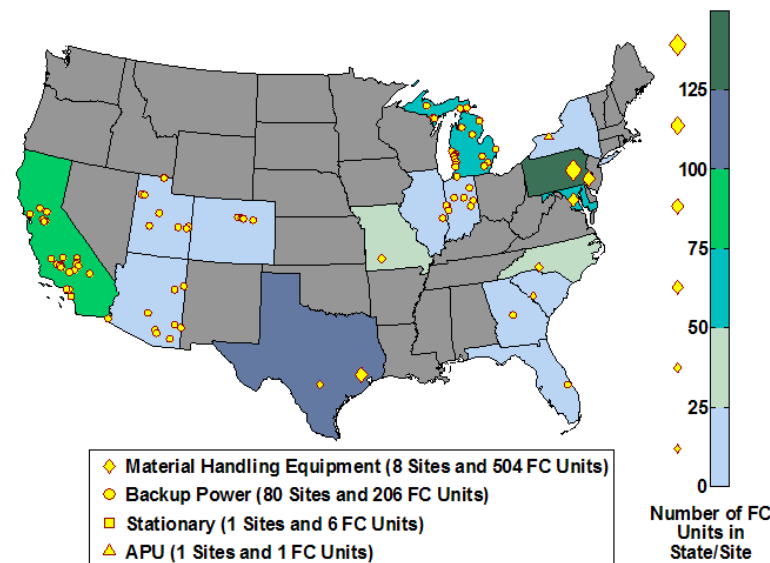
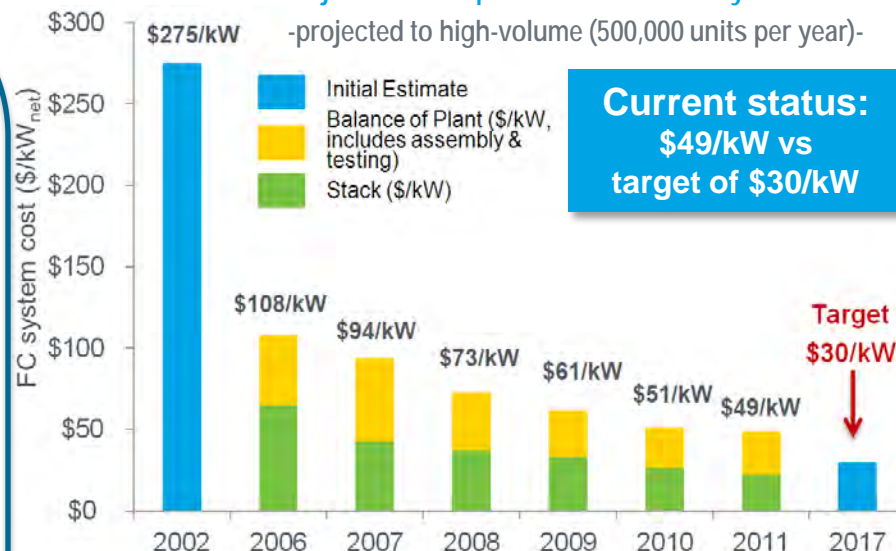
Demonstrated world's first Tri-generation station (CHHP with 54% efficiency)

ARRA & Market Transformation deployments

- ARRA projects have deployed more than 800 fuel cells to date for use in forklifts and backup power at several companies including Sprint, AT&T, FedEx, Kimberly Clark, and Whole Foods.

Projected Transportation Fuel Cell System Cost

-projected to high-volume (500,000 units per year)-



*Based on projection to high-volume manufacturing (500,000 units/year).

**Projected cost, based on analysis of state-of-the-art technology