

Geothermal Technologies Program

U.S. DEPARTMENT OF
ENERGY

Energy Efficiency &
Renewable Energy



Enel Stillwater - Courtesy of Enel Green Power – North America

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**Fiscal Year 2012
Budget Request Briefing
March 8, 2011**

The FY 2012 Budget Request will support a portfolio that balances long-term, high-risk and near-term, low-risk approaches to geothermal energy and enables nationwide geothermal deployment.

The Budget structure includes new subprograms, reflecting increased focus in some areas and increasing the number of subprograms to five:

- Innovative Exploration Technologies
- Low Temperature and Coproduced Resources
- Permeable Sedimentary Resources
- Enhanced Geothermal Systems
- Systems Analysis

Included within the EGS subprogram is an expanded activity in exploring CO₂ as a geofluid to produce power and decrease water use.

The FY 2012 Budget Request proposes increased RD&D in all geothermal resources.

Funding Profile by Subprogram (Comparable Structure to the FY 2012 Request)

(thousands of dollars)	FY 2010 Appropriation*	FY 2011 Request**	FY 2012 Request
Enhanced Geothermal Systems	22,350	43,000	61,535
Innovative Exploration Technologies	0	0	15,000
Low Temperature Coproduced Resources	14,503	5,000	14,000
Permeable Sedimentary Resources	0	0	6,000
Systems Analysis	6,267	7,000	5,000
Total, Geothermal Technologies	43,120	55,000	101,535

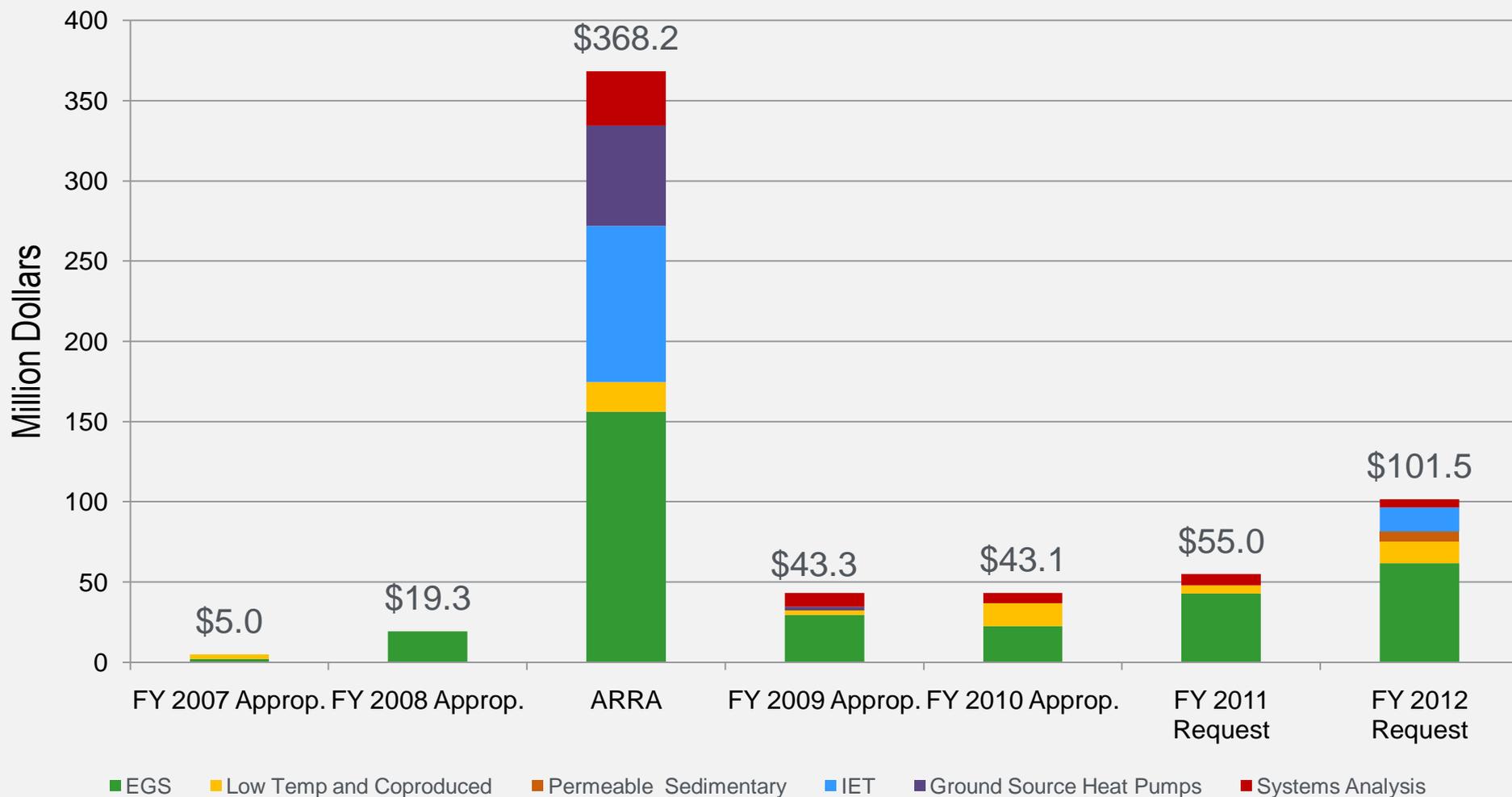
* SBIR/STTR funding transferred in FY 2010 was \$786,000 for SBIR and \$94,000 for STTR

** Currently operating under a FY 2011 Continuing Resolution.

Geothermal Technologies Program

Recent Budget Trend

ARRA funding and steady increases in FY 2009 – FY 2012 budget requests reflect the Administration's support for geothermal RD&D.



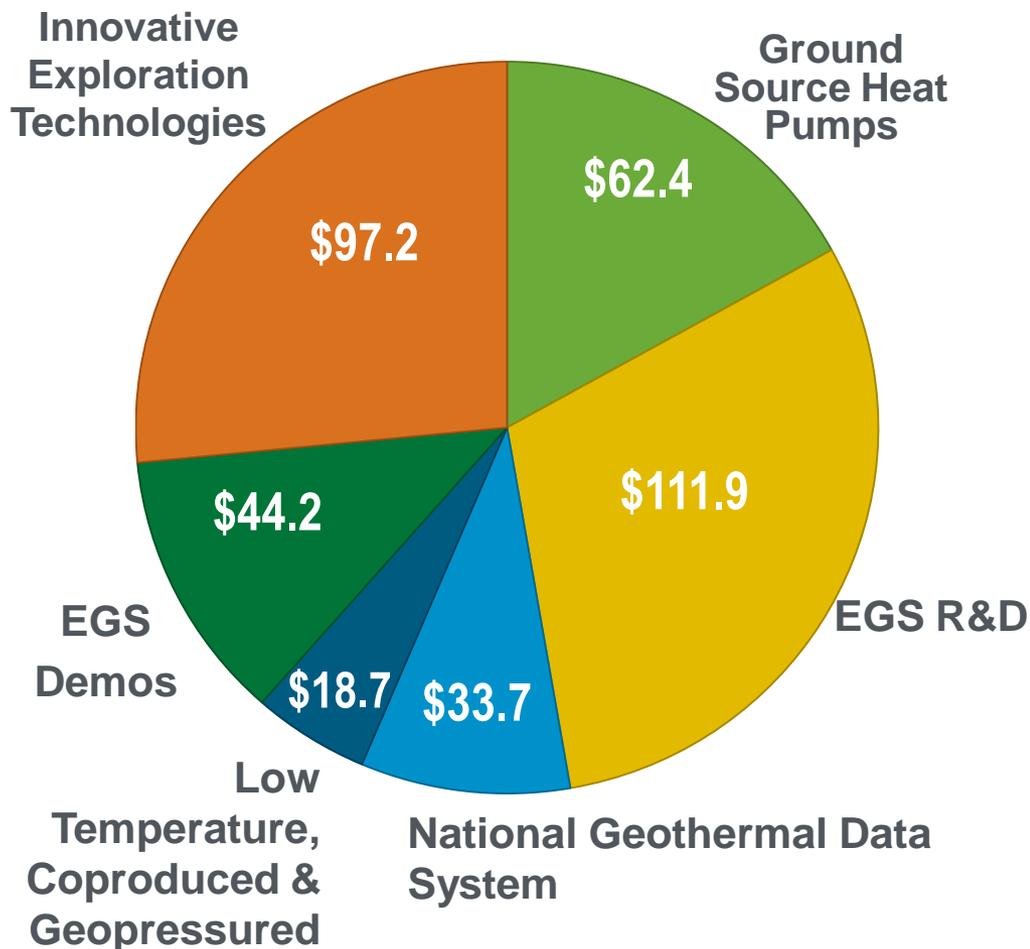
Geothermal Technologies Program ARRA Funding

ARRA funds allowed the program to expand into new technology areas.

Geothermal Technologies Program Recovery Act Funding



Total Investment
\$368.2 M

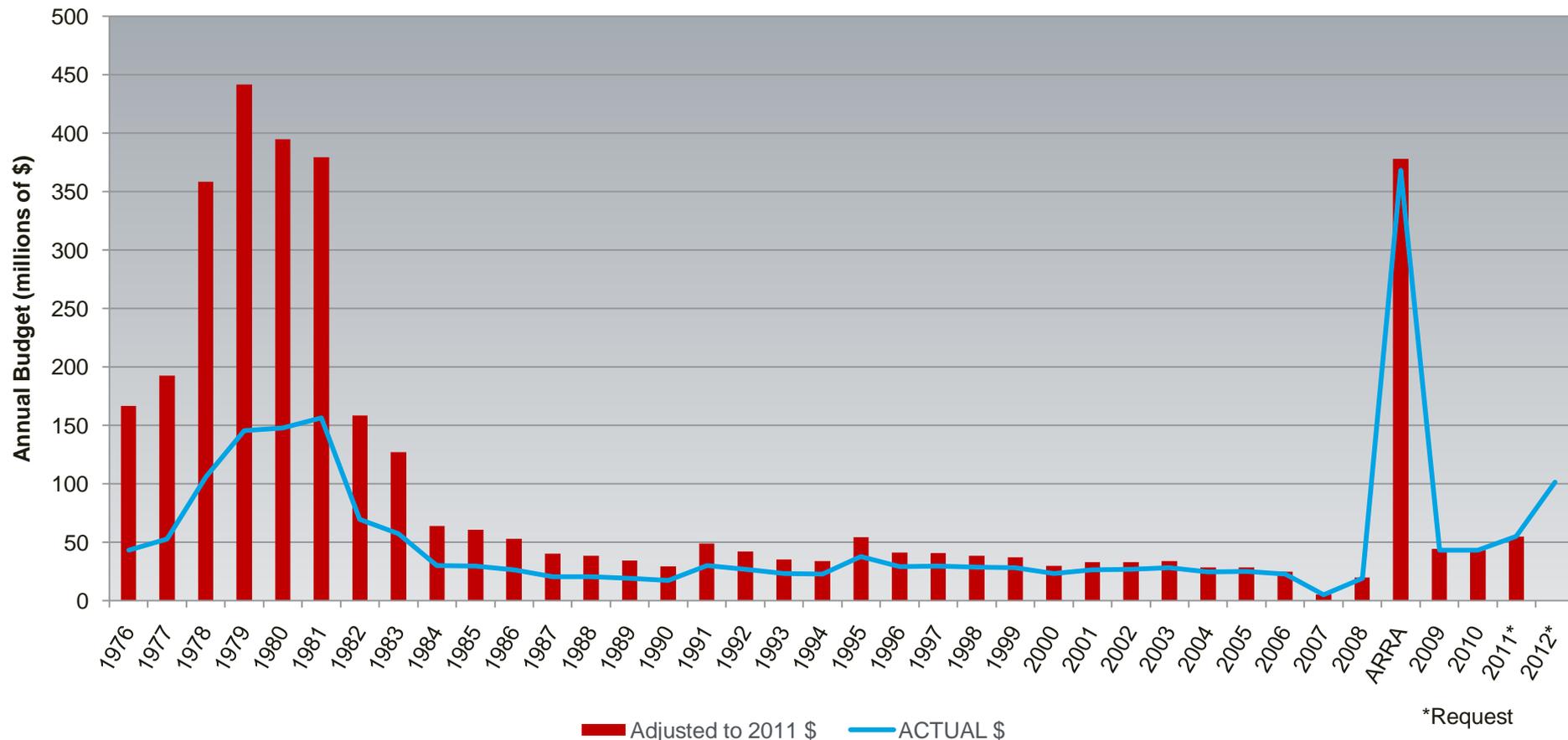


Geothermal Program History

Annual Budget 1976-2012

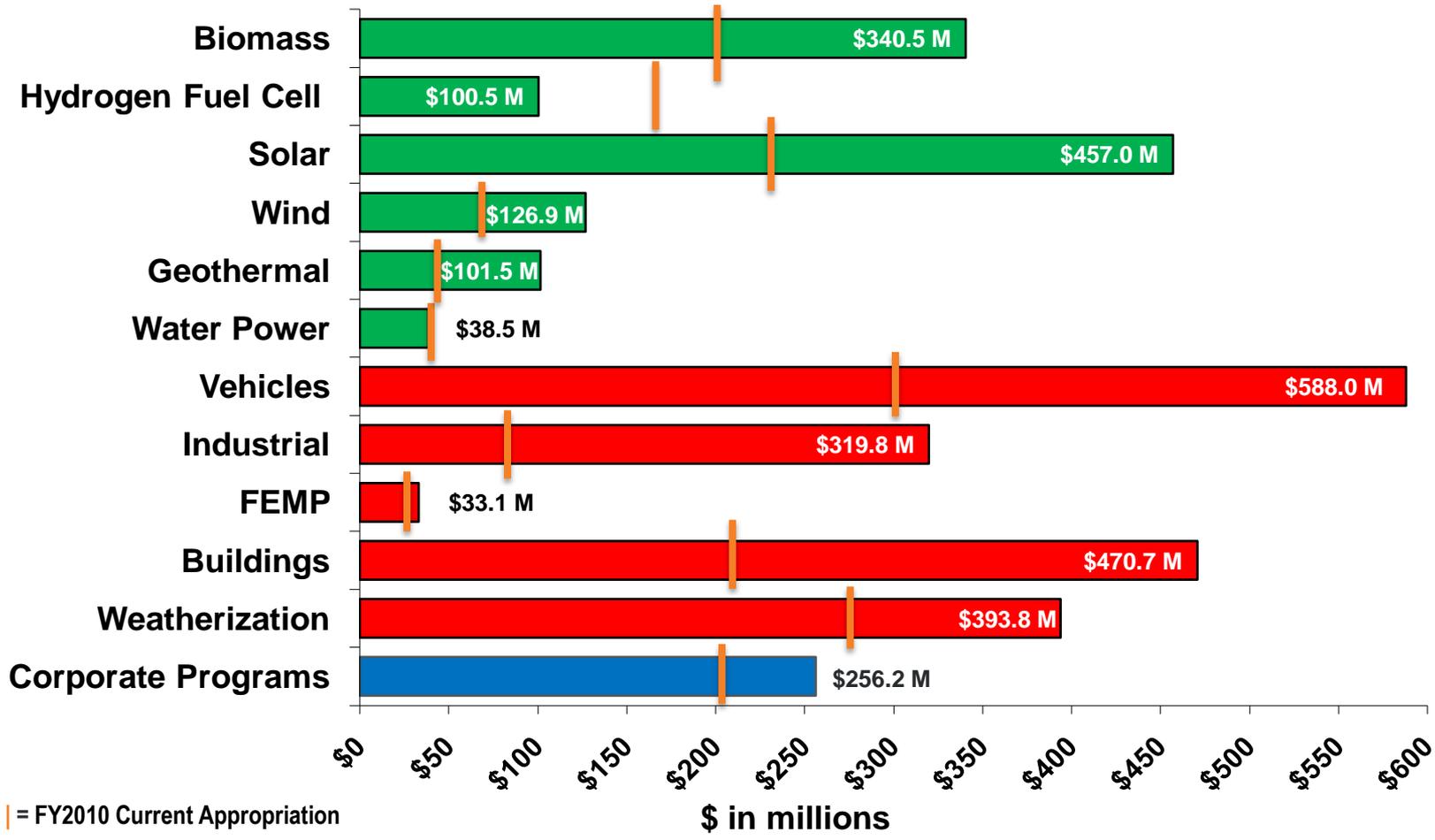
The Geothermal Technologies Program annual budget peaked from the late 70s to early 80s with a recent spike through ARRA.

Annual Budget for the Geothermal Technologies Program 1976 - 2012

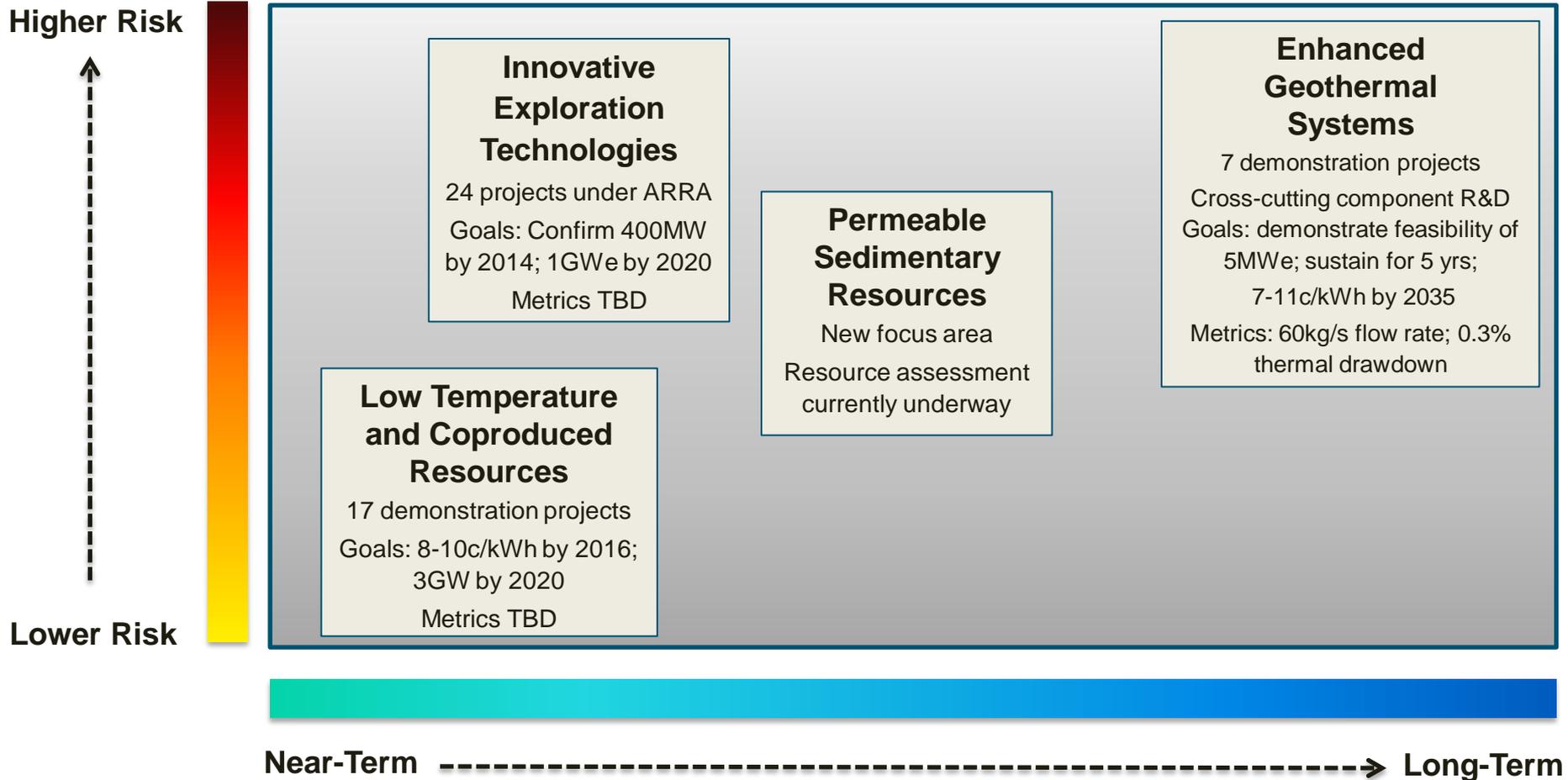


EERE Request by Program - Increases in Almost All Programs

FY 2012 Budget Request (\$3.2 B)



The Program supports a diverse portfolio that spans near- to long-term resources and low to high risk technology development, while seeking to enable 12 GWe of geothermal capacity online by 2020.



EGS efforts focus on establishing viability and exploring the use of CO₂ as a working fluid.

Current Portfolio

- Investment of approximately \$150 M in research and demonstration through ARRA and additional funding through annual appropriations to address major technical barriers and lower the cost of EGS
- Seven EGS demonstrations to validate reservoir creation in different geologic conditions:

Performer	Project Sites
Ormat Technologies, Inc.	Desert Peak, Nevada
Geysers Power Company, LLC	The Geysers, California
University of Utah	Raft River, Idaho
Ormat Technologies, Inc	Bradys Hot Springs, Nevada
AltaRock Energy Inc.	Newberry Volcano, Oregon
TGP Development Co.	New York Canyon, Nevada
NakNek Electric	NakNek, Alaska

FY 2012 Focus

Continue current projects to advance:

- Fracture characterization technologies
- Developing thermo-hydro-mechanical-chemical reservoir models (characterization and prediction)
- Induced seismic monitoring, prediction and mitigation tools
- Logging tools
- Well stimulation technologies
- Zonal isolation tools

Expand work exploring the use of CO₂ as a geofluid including:

- Developing and modifying monitoring tools, methods and models to track CO₂ in geothermal reservoirs

Technical Targets: Improve flow rate from 17.5 kg/s to 60 kg/s and thermal drawdown from 3% to 0.3% by 2035

In FY 2012, the Program will use results from ARRA projects to further develop promising exploration tools and techniques to lower the costs and upfront risks of exploration.

Current Portfolio

- 24 ARRA projects to confirm 400 MW of new hydrothermal resources by 2014
- The Program is working with industry to identify exploration best practices
- Technology needs assessment drafted and is available for peer review on the Program homepage:

http://www1.eere.energy.gov/geothermal/pdfs/iet_needs_assessment_draft.pdf

Project Highlight

Sierra Geothermal confirmed a 147°C resource in Nevada using a cost-effective and innovative combination of hyperspectral imaging and coiled-tube drilling techniques



FY 2012 Focus

- Advance exploration technologies in remote sensing, geochemistry and advanced geophysical techniques which have the potential to dramatically lower costs
- Adapt technologies used in oil and gas and mining exploration, focusing on improving their performance and reducing their cost for geothermal applications

Technical Targets: to be developed with industry

Low Temperature and Coproduced Resources - \$14 M

In FY 2012, the Program will develop and demonstrate technologies that improve power plant efficiency and lower LCOE.

Current Portfolio

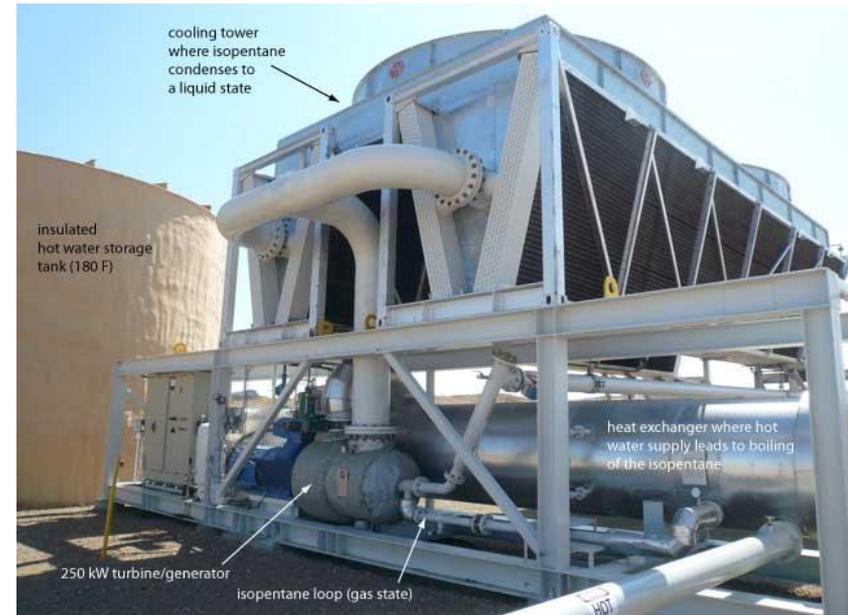
- 17 demonstration projects in progress including bottoming cycles, electric coproduction with hydrocarbons, and cascading approaches with direct use;
 - Low Temperature (11)
 - Coproduced (3)
 - Geopressured (3)
- Testing systems at Rocky Mountain Oilfield Testing Center (RMOTC)

FY 2012 Focus

Technology gaps identified in demonstrations will be addressed through R&D to improve efficiency and reduce LCOE. Potential technologies include:

- Innovative power cycles
- Advanced working fluids
- Hybrid cooling systems
- High-performance heat exchangers

Project Highlight

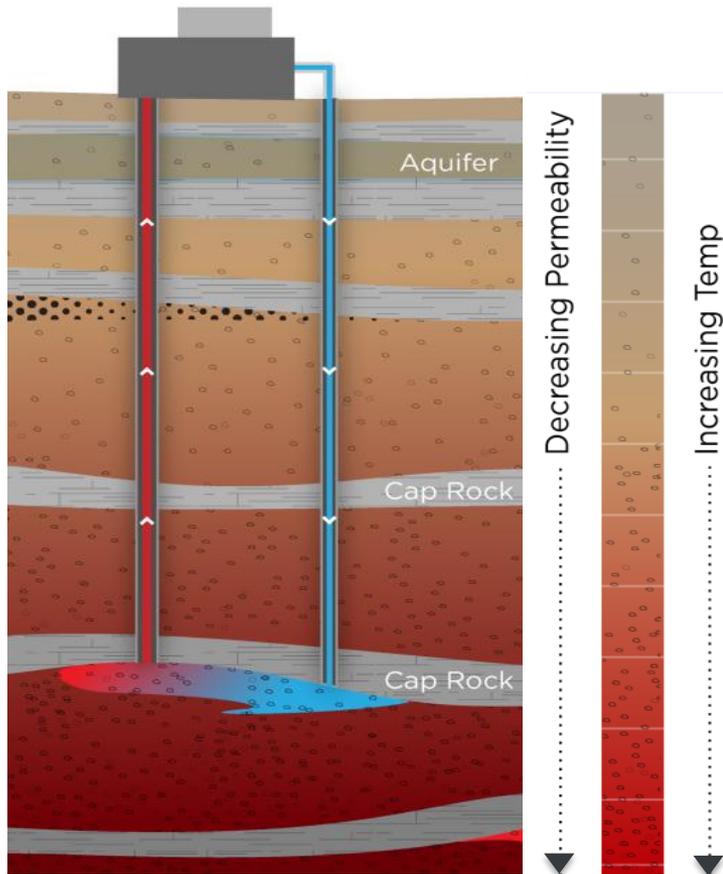


A 250kW Organic Rankine Cycle system produced over 1,104 megawatt hours of power from 6.4 million barrels of coproduced water at 92°C (198°F) at RMOTC

Technical Targets: to be developed with industry

Permeable Sedimentary Resources – \$6 M

Energy production from permeable sedimentary geothermal reservoirs may have lower environmental, technical and financial risks.



Current Efforts

- No current efforts
- Currently reviewing proposals on innovative heat recovery methods that may be applicable to Permeable Sedimentary Resources

FY 2012 Focus

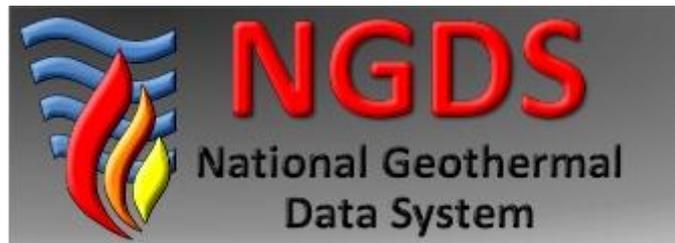
- Demonstrate the ability to generate power from permeable sedimentary reservoirs

Technical Targets: to be developed with industry

Systems Analysis assesses geothermal resources, cost drivers, the impact of policy, and progress toward goals.

Current Portfolio

- Under ARRA, \$33.7 M invested in the design, testing and population of the National Geothermal Data System
- In partnership with the U.S. Geological Survey, the Program is updating the resource assessment and classification of all geothermal resources
- Geothermal Vision Study initiated in FY 2011 to determine impacts and challenges of geothermal deployment scenarios

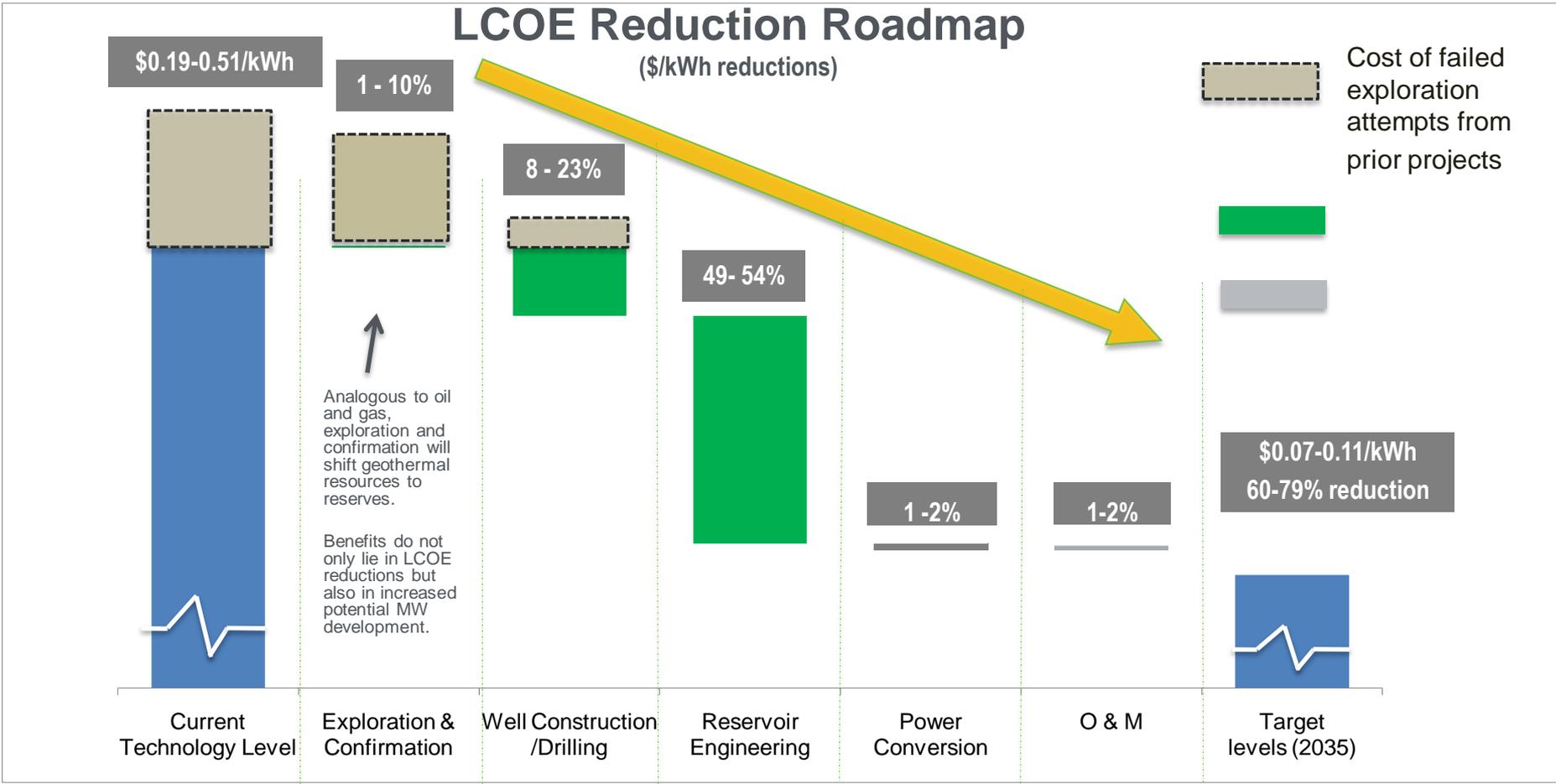


FY 2012 Focus

- Incorporate low temperature, coproduced and geopressed supply curve data into geothermal and renewable energy models
- Continue to assess the impact of policies and regulations
- In partnership with the U.S. Geological Survey, complete the sedimentary basin resource assessment to establish valid resource estimates encouraging industry investment and providing data to the National Geothermal Data System
- Continue to assess geothermal jobs and economic development impacts
- Support education and workforce development activities as needed

EGS LCOE Reduction

The Program uses systems analyses and techno-economic modeling to identify technology cost-drivers.



EGS LCOE range varies from near-field to greenfield

Through SBIR/STTR, the Program supports small businesses to advance geothermal technologies.

Small Business Innovation Research (SBIR) Program and the Small Business Technology Transfer (STTR)

- Administered by the U.S. Small Business Administration (SBA) Office of Technology to ensure that the nation's small, high-tech, innovative businesses are a significant part of the federal government's research and development efforts
- In FY 2010, the Geothermal Technologies Program contributed \$786,000 to the SBIR program and \$94,000 to the STTR program for geothermal projects

Phase I	Advanced Cooling Technologies, Inc.	Vortex Enhanced Direct Contact Heat Exchanger for Geothermal Cooling
	HiFunda, LLC	High-Reliability Cements for Enhanced Geothermal Systems
	NanoSonic, Inc	High Performance Hybrid Polyorganosiloxane Cements for Enhanced Geothermal
	United Silicon Carbide, Inc.	High Temperature Smart Sensor for Downhole Logging and Monitoring
	Weston Geophysical Corp.	Improved Time-Dependent Seismic Monitoring Systems for Enhanced Geothermal Reservoir Characterization
Phase II	MagiQ Technologies	Seismic Sensor
	Physical Optics Corporation	Fiber Optic High Temperature Seismic Sensor
Phase III	Composite Technology Development, Inc.	Improved High-Temperature ESP Motor Lead Extension Cables for Reliable Geothermal Power Production

DOE supports the deployment of advanced and innovative clean energy projects by providing loan guarantees.

1703 - Innovative Projects

- Under 1703, Congress appropriations from FY 2007 to FY 2009 support up to \$51 B in loans for innovative renewable energy generation and manufacturing, biofuels and transmission
 - Applicants are responsible for providing the credit subsidy
- In FY 2012, an additional \$200 M is requested as a credit subsidy to support \$2 B in energy efficiency and renewable energy loans

1705 - Conventional Projects

- Under 1705, an additional \$21B in loan authority for conventional renewable energy systems and \$25 B for advanced electric power transmission
 - Included \$4B for credit subsidy

Geothermal Loan Guarantees Under 1705



US Geothermal, Inc: \$96.8 M
Awarded June, 2010 (Closed
February 2011)
23 MW power plant in Oregon
Note that this project was also
eligible under 1703

Nevada Geothermal Power
Company: \$78.8 M*
Awarded September, 2010
49.5 MW power plant in Nevada
*80% guarantee for a \$98.5 M (total)
loan

Initiated in FY 2009 with \$400 M from ARRA funding. In FY 2012, the ARPA-E budget request is \$550 M for energy projects.

Advanced Research Projects Agency – Energy (ARPA-E)

Administered by the DOE to develop transformational technologies to:

- Reduce dependence on foreign energy imports
- Reduce emissions (including greenhouse gasses)
- Improve energy efficiency
- Improve U.S. leadership in developing and deploying advanced energy technologies

ARPA-E Geothermal Technology

- One geothermal energy project funded in ARPA-E: Foro Energy Hybrid Thermal-Mechanical Drilling Technology (\$9 M)
- Objective: Develop low-contact drilling technology to lower the cost of EGS wells by enabling rapid and sustained penetration of ultra-hard rock formations



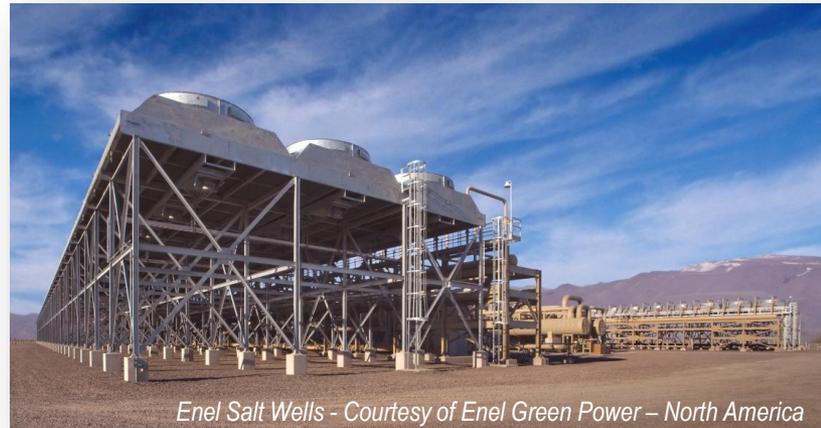
The Treasury can make direct payments in lieu of tax credits to companies that create and place in service renewable energy facilities.

- Under ARRA 1603, the Treasury can make grants for renewable energy facilities in lieu of Investment Tax Credits (ITC) or Production Tax Credits (PTC). Geothermal facilities can apply for awards of 10-30% of eligible costs
- Under Section 707 of the Tax Relief, Unemployment Insurance Reauthorization and Job Creation Act of 2010, this program was extended to projects placed in service after 2011 but only if construction of the property began during 2009, 2010 or 2011
- The FY 2012 Budget Request proposes to extend this program through the 2012 calendar year

Geothermal Electric Generation Awards under 1603

NGP Blue Mountain	NV	\$	57,872,513.00
Enel Salt Wells, LLC	NV	\$	21,196,478.00
Enel Stillwater, LLC	NV	\$	40,324,394.00
Geysers Power Company	CA	\$	2,224,148.00
ORNI 18	CA	\$	108,285,626.00
Thermo No. 1	UT	\$	32,990,089.00
Total			\$262,893,248.00

As of February 18, 2011 from <http://www.ustreas.gov/recovery/1603.shtml>



Advanced Energy Manufacturing Tax Credit (Section 48c)

The Treasury provided tax credits for qualified investments in advanced energy projects to support new, expanded, or re-equipped domestic manufacturing facilities to stimulate economic growth, create jobs, and reduce greenhouse gas emissions.

ARRA Funding

- Section 48c appropriated \$2.3 B to provide businesses with tax credits for existing and new manufacturing facilities that support energy generation or conservation
- Created green manufacturing jobs
- Lone Star Drill Bits, LLC of Texas was awarded \$112,500 for specialized equipment to manufacture PDC drill bits for EGS applications
- According to the Treasury, the \$2.3 B funded less than one-third of the technically acceptable applications submitted



Proposed Extension

- The FY 2012 Budget Request proposes an additional \$5 B in authority
- According to the Treasury, this money will support at least \$15 B in total capital investments, creating tens of thousands of new construction and manufacturing jobs

The Program will soon announce projects selected from the Innovative Heat Recovery Funding Opportunity Announcement (FOA) and is preparing to release a FOA on Geothermal R&D.

Innovative Heat Recovery FOA

- Released in FY 2010, the objective of this FOA is to demonstrate innovative approaches to recovering heat from geothermal reservoirs, including permeable sedimentary geologies, which reduce environmental, technical, and financial risks
 - Selected projects will be announced in March or April 2011

Geothermal R&D FOA

- FY 2011 depending on the FY11 appropriation
- Potential topics include:
 - Innovative exploration technologies
 - Advanced drilling
 - Advanced well completion

You can sign up to receive notifications when FOAs are released :
www.geothermal.energy.gov

Vacancy: Geothermal Technologies Program Manager

The Geothermal Technologies Program is currently seeking a permanent Program Manager in Washington, D.C. The application deadline is March 24, 2011.

About the Position

- Manages and directs the development, implementation, and evaluation of the Geothermal Technologies Program
- Directs the formulation and integration of the Program's scientific, engineering and technical requirements and market analysis
- Identifies and interprets legislative requirements for the Program
- Manages and works closely in partnership with the U.S. industry, academia, and national laboratories

Qualifications

- Expertise and experience in geothermal technology, or energy technology requiring drilling, including performance and cost issues
- See job announcement for additional Executive Core Qualifications

Requirements

- US Citizenship required
- Background and/or Security Investigation is required
- Position may involve some travel
- New appointees must successfully complete a 1 year probationary period

How to Apply

- Application Deadline : March 24, 2011
- See Job Announcement **DOE-11-EE-00117PH** at <http://usajobs.gov/> for more information and to apply

Geothermal Technologies Program Peer Review June 6-10 in Bethesda, MD Bethesda North Marriott

- Principal investigators will present the results of their projects for peer review
- Approximately 140 projects will be presented, representing a total investment of over \$340 million
- Meet the program staff and network with other stakeholders



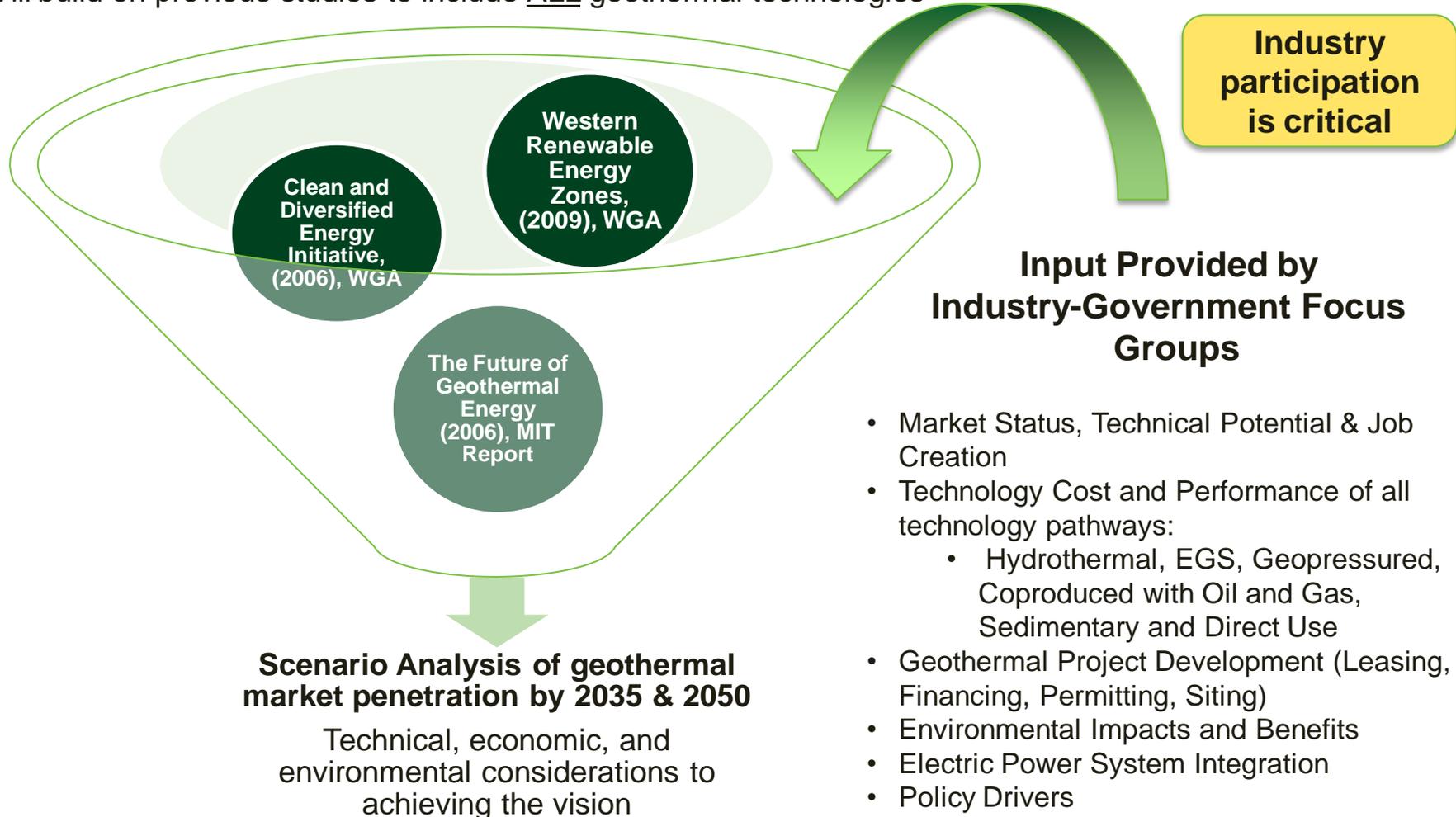
A screenshot of the Geothermal Technologies Program homepage. The page features a navigation menu with options like HOME, ABOUT THE PROGRAM, PROGRAM AREAS, INFORMATION RESOURCES, FINANCIAL OPPORTUNITIES, TECHNOLOGIES, and DEPLOYMENT. The main content area is titled "Projects by State" and includes a map of the United States with state abbreviations. Below the map, there is a list of filter options for projects, such as "By State", "By Project Title", "By Technology", "By Awardee", "By Partner", "By Number", and "By Funding Source".

All DOE geothermal projects are described on our homepage:
www.geothermal.energy.gov

The Geothermal Vision Study – An Important Tool for Policy-Makers

The Geothermal Vision Study will describe how geothermal can play a major role in meeting the Nation's clean energy needs.

Will build on previous studies to include ALL geothermal technologies



Program Management

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