Geothermal Technologies Program

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

Enel Stillwater - Courtesy of Enel Green Power – North America

JoAnn Milliken - Acting Program Manager
Ella Thodal - SRA International

GeoPower Americas
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Program Mission and Vision

The Geothermal Technologies Program supports research, development and demonstration activities with industry, universities, and national laboratories to improve the performance and lower the cost of geothermal technologies and expand geothermal resources.

Mission

Lower the cost of geothermal electricity and reduce the upfront risk of geothermal exploration to establish geothermal energy as a significant contributor to America's future electricity generation

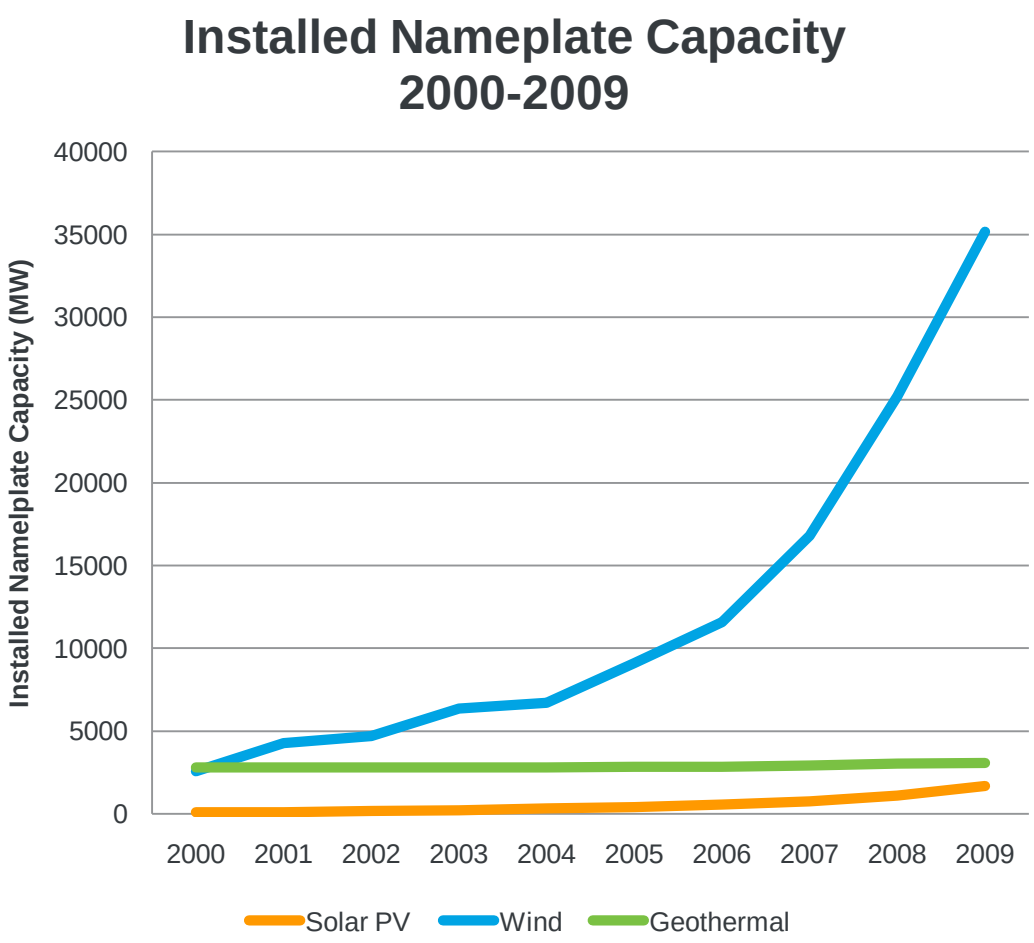
Vision

By 2020, lower the cost of electricity and reduce the upfront cost of electricity to:

- Assist in reaching installed capacity of 12 GWe – a fourfold gain from 2010
- Expand geothermal energy into new regions across the U.S., spurring the economy and creating green jobs nationwide

Renewable Energy Capacity 2000 to 2009

Annual growth of geothermal nameplate capacity lagged behind both solar and wind from 2000-2009.

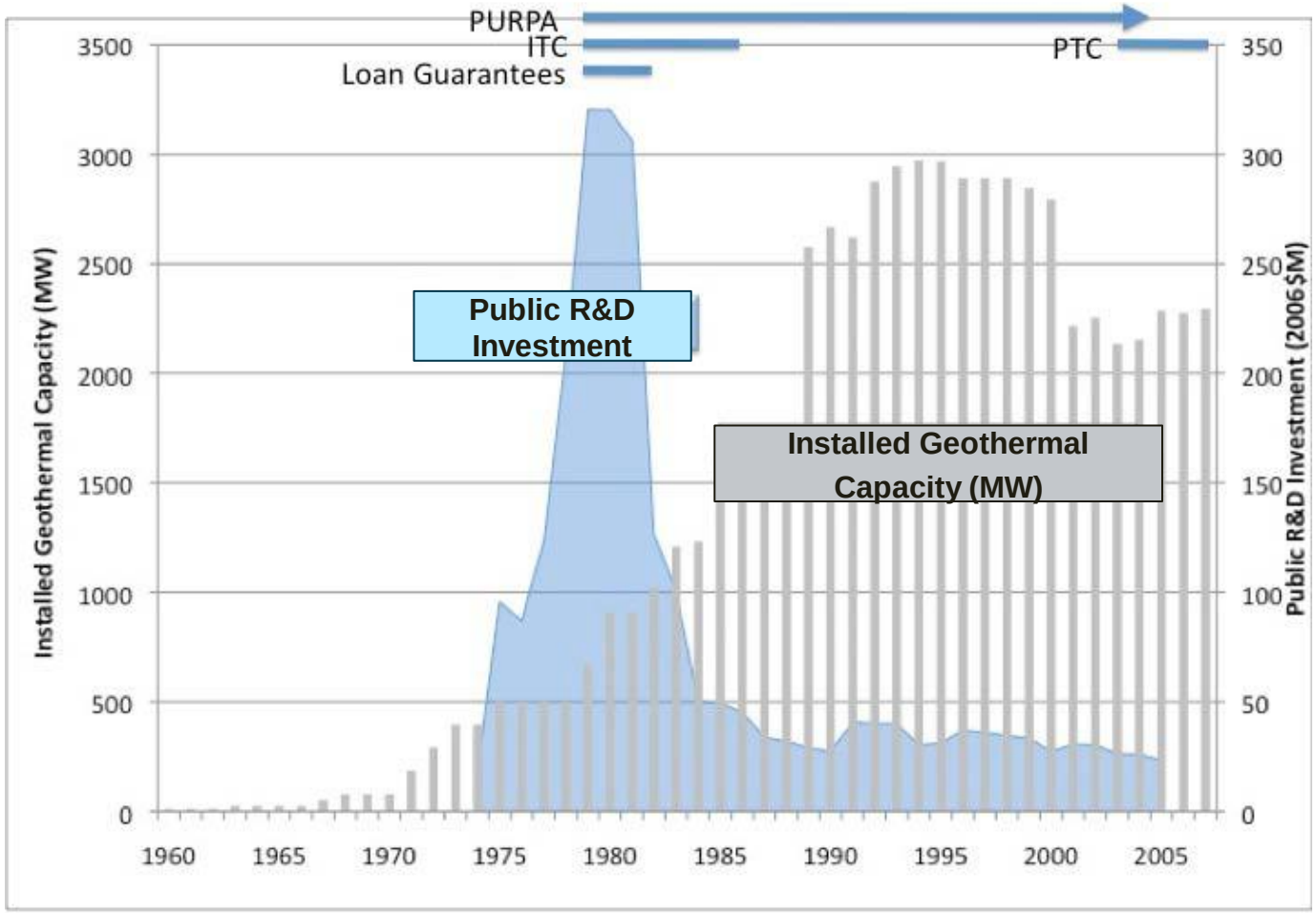


Nameplate Capacity Annual Increase
(Percent Over Previous Year)

Year	Geothermal	Wind	Solar PV
2000	2.20%	2.60%	26.90%
2001	0.00%	65.80%	31.70%
2002	0.00%	9.60%	39.20%
2003	0.00%	35.60%	44.80%
2004	0.00%	5.90%	38.00%
2005	1.10%	35.60%	35.80%
2006	0.10%	26.90%	33.40%
2007	3.70%	45.20%	36.20%
2008	3.50%	50.10%	43.50%
2009	1.50%	39.30%	51.60%

Installed Geothermal Capacity and Public R&D Investment

A 2009 NREL study analyzed the impact of policies and public investment on the growth of installed geothermal capacity.



Analysis showed that the following are critical for success:

- R&D Investment
- Public-private partnerships to streamline permitting
- Consistent and Effective Financial Incentives

From:
Policy Overview and Options for Maximizing the Role of Policy in Geothermal Electricity Development
(NREL) September, 2009

Geothermal Technologies Program
Recent Budget Trend

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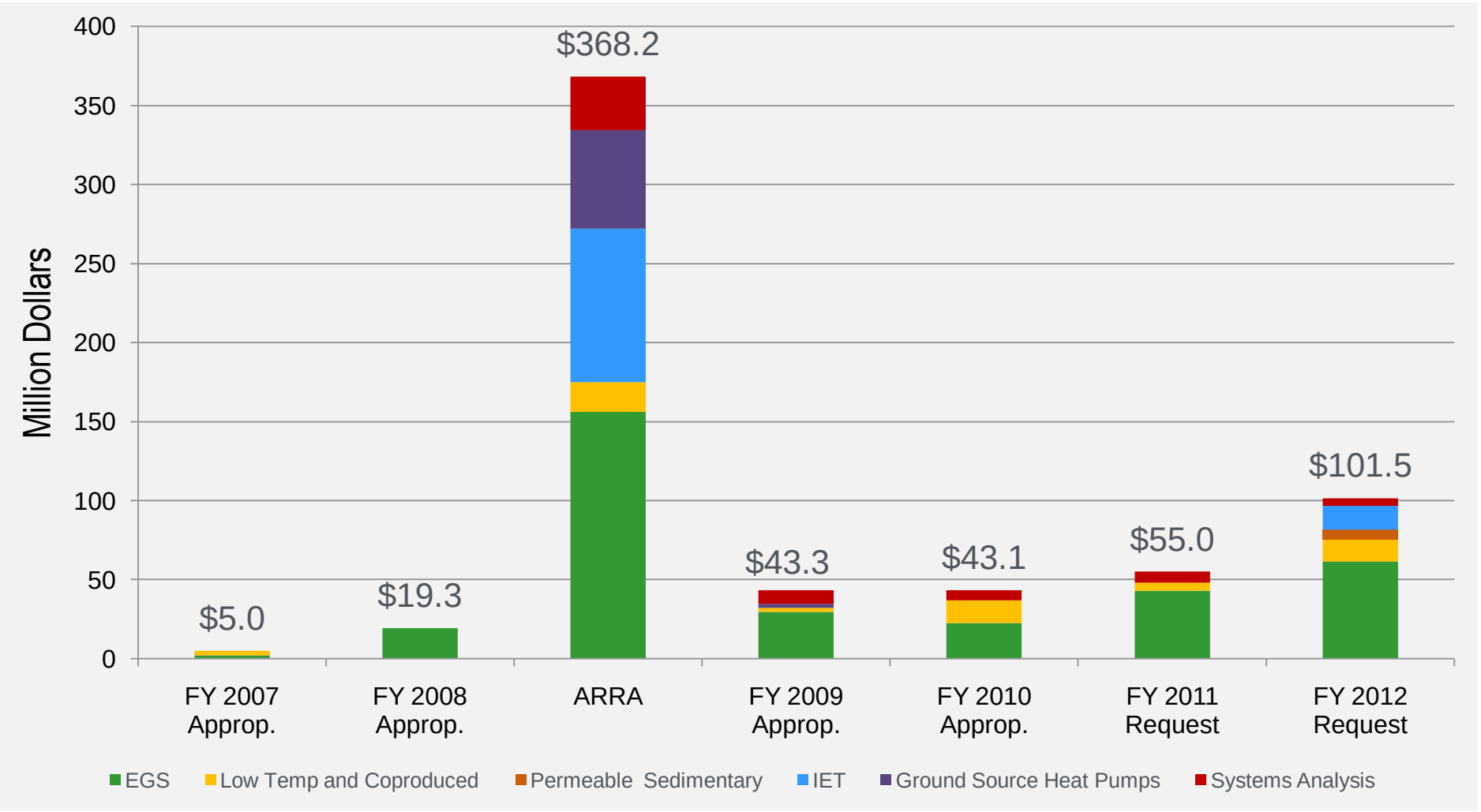
Recovery Act funding and steady increases in FY 2009 – FY 2012 budget requests reflect the Administration's support for geothermal energy.



Geothermal Recovery Projects

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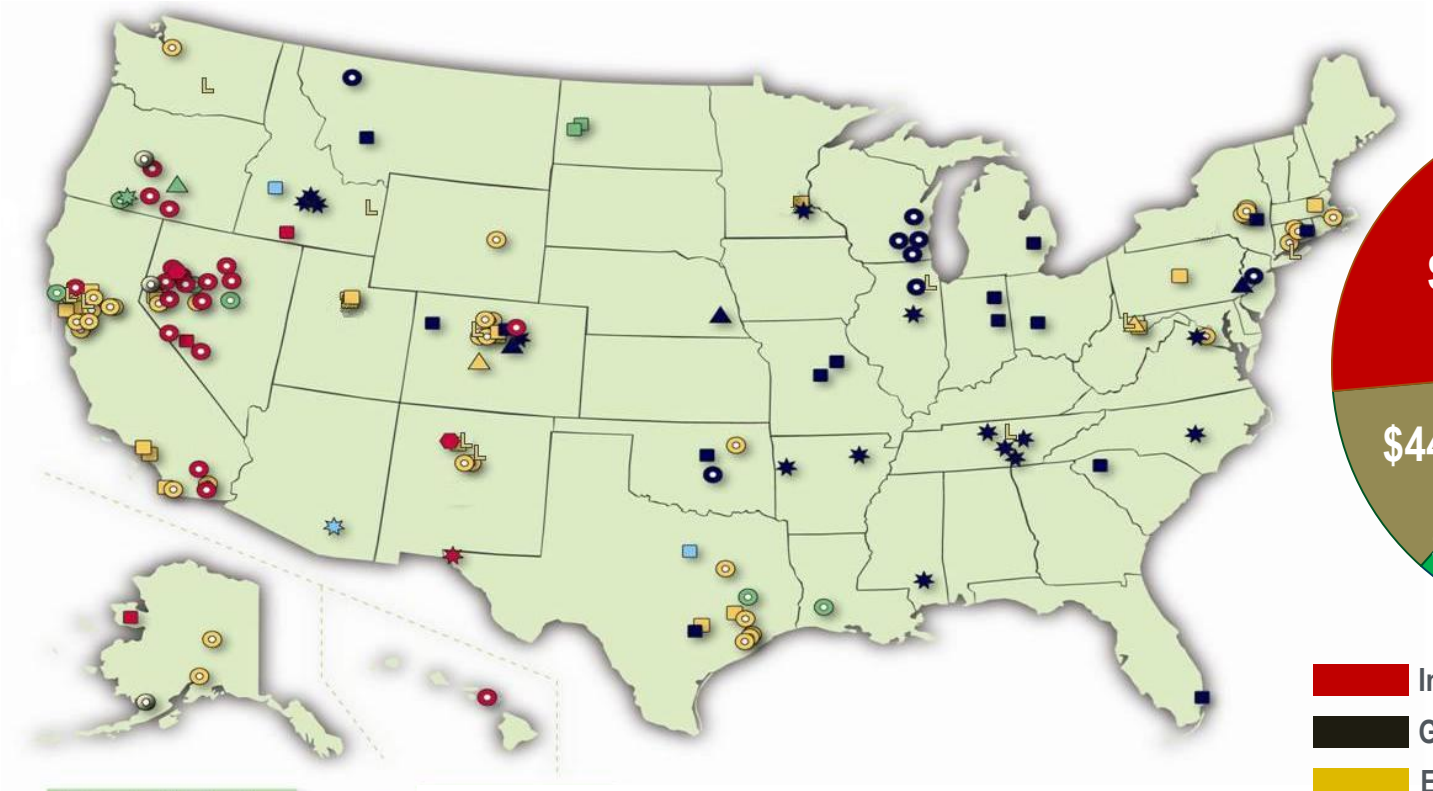
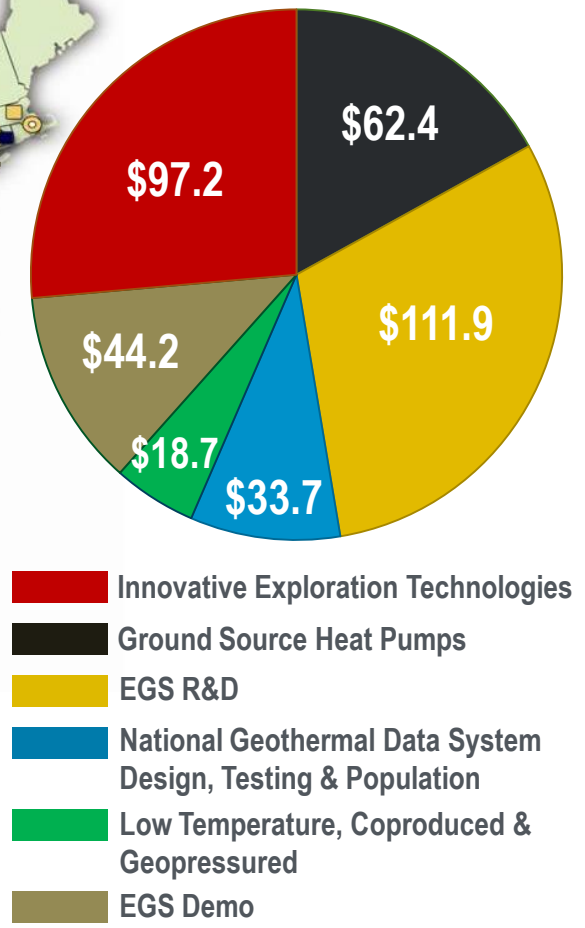
Under the Recovery Act, $368 million in geothermal projects are underway in 39 states – demonstrating a national impact.

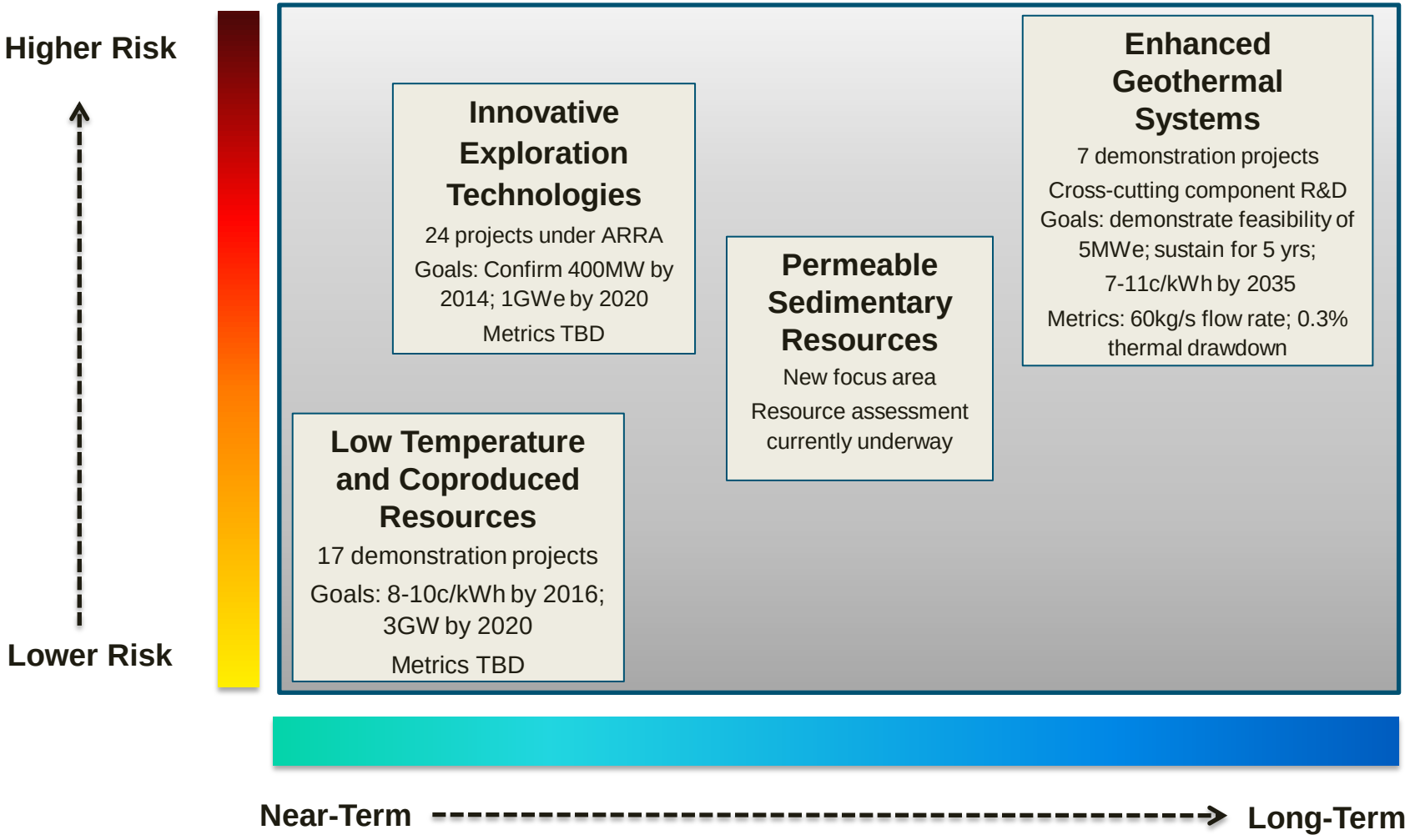


- Total Investment: $368.2
- Total Projects: 148
- States/Districts Represented (Prime Awardee) 39



Program Strategy

The Program supports a diverse portfolio that spans near- to long-term resources and low to high risk technology development, while seeking to enable widespread access to geothermal energy.



FY 2010-2012 Budget Comparison

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

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

Systems Analysis

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

Resource Assessment and Classification

- In partnership with the U.S. Geological Survey, the Program is updating the resource assessment and classification of all geothermal resources

National Geothermal Data System

- Under ARRA, $33.7 M invested in the design, testing and population of the National Geothermal Data System

Techno-Economic Modeling

- Idaho National Lab's Geothermal Electricity Technologies Evaluation Model (GETEM) analyzes cost and performance of geothermal projects
- Modeling is used to assess the impacts of policies and new technologies, to set Program technical targets and monitor progress toward those targets

Loan Guarantee Program

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: $102.2 M
Awarded June, 2010
(conditional)
22 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

Grant in Lieu of Tax Credit

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

Enel Salt Wells - Courtesy of Enel Green Power – North America

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.

So What's Next in the DOE Program?

Funding Opportunities

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

Planned for release in early or late 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

How to Prevent Delays in Receiving Funding

When preparing an application:

1. Have all permits in place (wherever possible)
2. Contact all partners and subs
3. Ensure that partners and subs are in agreement on all aspects of their participation – including budget, cost share and tasks
4. Have indirect rates for your company in place and correct
5. Have cost share well documented
6. Make sure budgets are prepared in the DOE format
7. Check your math

After selection:

1. Avoid changes from original scope – substantial changes will slow the process
2. Perhaps the largest contributor to delays is changes in the role and responsibilities of partners – please make sure this is addressed beforehand

Note that funding opportunities are subject to the appropriations process.

Peer Review - Critical to Program Success

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.
- Volunteer to be a reviewer and help shape the DOE Program
- Meet the program staff and network with other stakeholders.

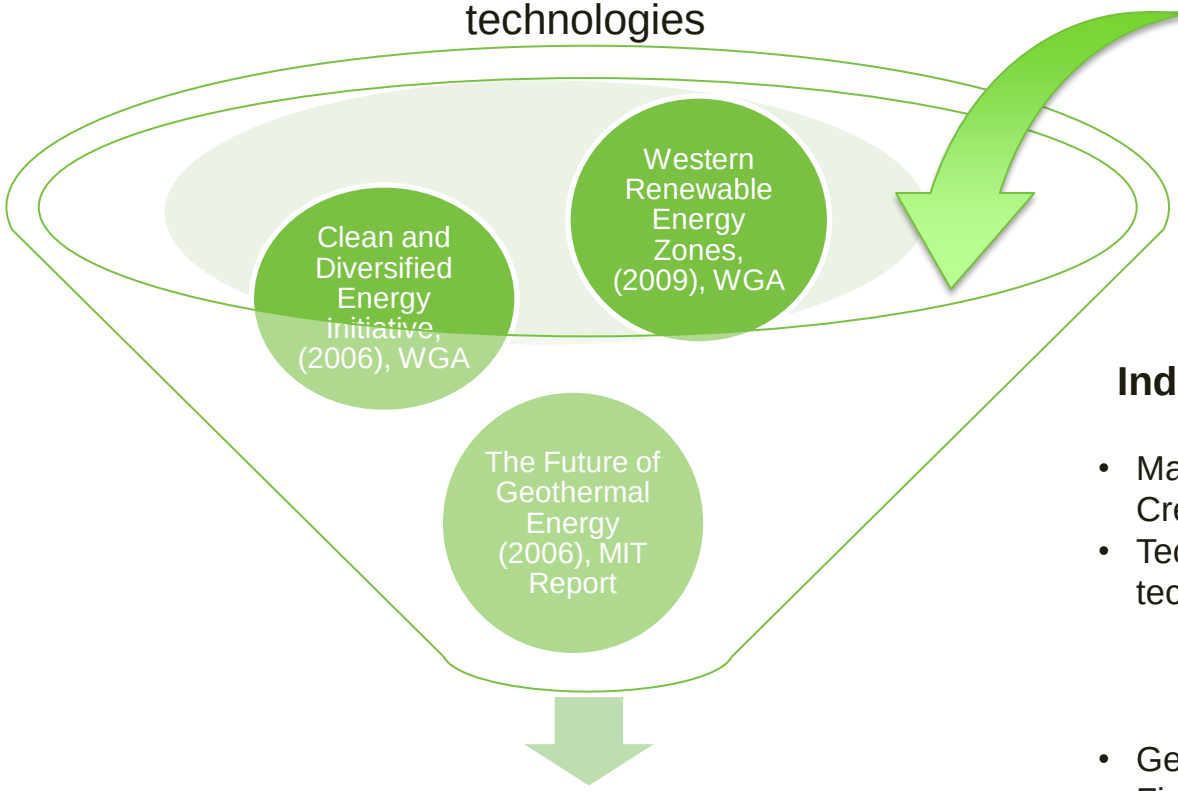
All DOE geothermal projects are described on our website:

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



Industry participation is critical

Input Provided by Industry-Government Focus Groups

- Market Status, Technical Potential & Job Creation
- Technology Cost and Performance of all technology pathways:
  - Hydrothermal, EGS, Geopressured, Coproduced with Oil and Gas, Sedimentary and Direct Use
- Geothermal Project Development (Leasing, Financing, Permitting, Siting)
- Environmental Impacts and Benefits
- Electric Power System Integration
- Policy Drivers

Scenario Analysis of geothermal market penetration by 2035 & 2050

Technical, economic, and environmental considerations to achieving the vision

We Want to Hear From You

Program Management

Area	Staff Lead	Email
Innovative Exploration Technologies	Hildigunnur (Hidda) Thorsteinsson	Hildigunnur.Thorsteinsson@ee.doe.gov
Low Temperature and Coproduced Resources	Timothy Reinhardt	Timothy.Reinhardt@ee.doe.gov
Permeable Sedimentary Resources	Alison LaBonte Greg Stillman	Alison.LaBonte@ee.doe.gov Greg.Stillman@ee.doe.gov
Enhanced Geothermal Systems	Jay Nathwani Lauren Boyd	Jay.Nathwani@ee.doe.gov Lauren.Boyd@ee.doe.gov
Analysis & National Geothermal Data System	Arlene Anderson Angela Crooks	Arlene.Anderson@ee.doe.gov
Education, Workforce Development & Policy	Angela Crooks	Angela.Crooks@ee.doe.gov
Outreach and Communications	Alethia Marble	Alethia.Marble@ee.doe.gov

Geothermal Program Office: 202.287.1818

Additional Information

EERE Request by Program - Increases in Almost All Programs

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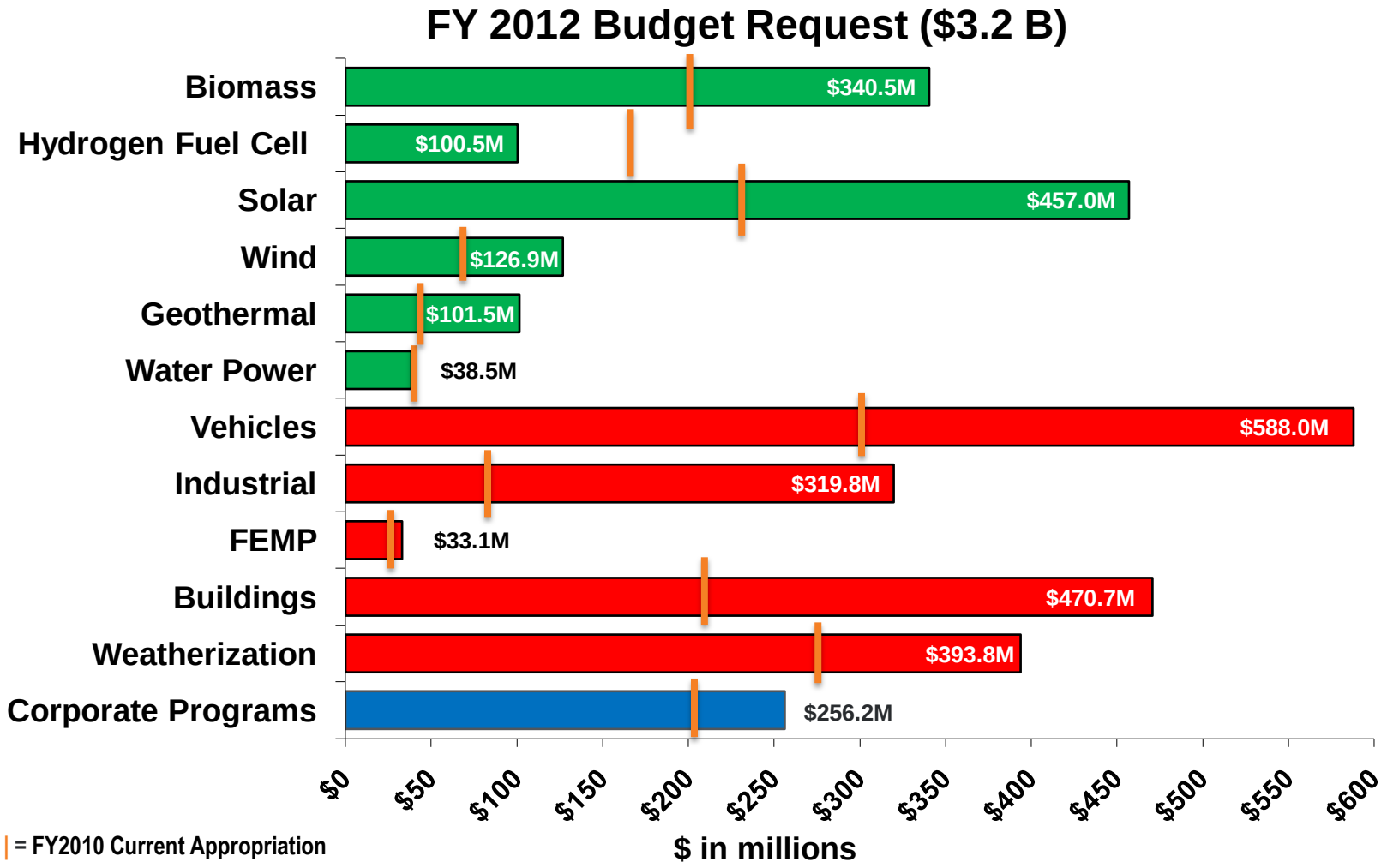

Low Temperature and Coproduced Resources

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The Program develops and demonstrates advanced technologies to lower the cost of electricity for low temperature, coproduced and geopressured resources.

Current Portfolio:

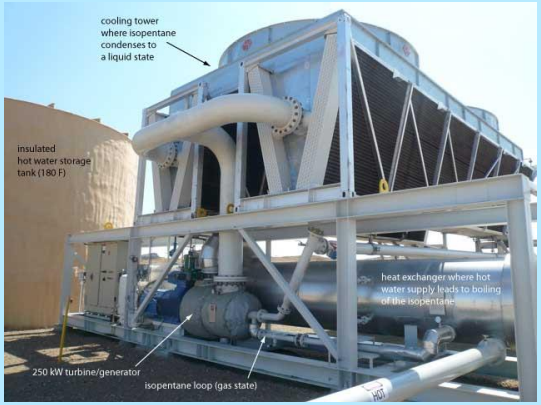
- 17 demonstration projects in progress including bottoming cycles, electric coproduction with hydrocarbons, and cascading approaches with direct use:
  - Low Temperature
  - Coproduced
  - Geopressured
- Testing systems at Rocky Mountain Oilfield Testing Center (RMOTC)

Technologies Included:

- 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.



Goals:

- Reduce LCOE of coproduced resources to $0.08-0.10/kWh by 2016
- Add 3 GW of geothermal capacity from low temperature and coproduced resources by 2020

Technical Targets:

- Will be developed with industry

Innovative Exploration Technologies

The Program is developing innovative exploration technologies to reduce high upfront risks and costs.

Current Status:

- Under the Recovery Act, 24 projects were launched to validate new exploration methods and 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 website:

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

Technologies Included

- 3D-seismic
- Remote sensing
- Geochemistry
- Shallow temperature surveys
- Integrated subsurface models
- Advanced processing of data

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.

Goals:

- Confirm 1 GWe of undiscovered hydrothermal resources by 2020
- Reduce the cost of greenfield exploration

Technical Targets:

- Will be developed with industry

Enhanced Geothermal Systems (EGS)

EGS activities include seven EGS demonstrations and a portfolio of cross-cutting R&D projects.

EGS Demonstration Projects

Recipient	Project Site	Site Information	Status
Ormat Technologies, Inc. ($4.3 M)	Desert Peak, NV	Adjacent to existing hydrothermal sites	Chemical Stimulation (Stimulation Phase 3)
Geysers Power Company, LLC ($6.2 M)	The Geysers, CA	Two existing wells will be reopened and deepened for injection and stimulation	Drilling complete (discovered hottest well in US at ~750° F), infrastructure being put in place
University of Utah ($8.9 M)	Raft River, ID	Improve performance of the existing Raft River geothermal field	Induced Seismicity draft report under review
Ormat Technologies Inc ($3.4 M)	Bradys Hot Springs, NV	Improve performance of the existing geothermal field	Building geologic and structural 3D model
AltaRock Energy Inc ($21.5 M)	Newberry Volcano, OR	High potential in an area without existing geothermal development	Completing EA
TGP Development Co. ($10.4 M)	New York Canyon, NV	Site adjacent to existing hydrothermal sites and shows high temperatures at shallow depths	Waiting for FONSI from DOE
NakNek Electric Association ($12.4 M)	NakNek, AK	Located in remote location in Alaska without existing geothermal development	Financial difficulties; cleaning and logging will be initiated next month

Cross-Cutting Component R&D

- Tools (e.g. smart tracers, induced seismicity) and models that better characterize fractures
- High-temperature and high-pressure tools, sensors and equipment
- Advanced drilling systems to reduce drilling time and cost
- Validation of CO_2 as a working fluid

Goals:

- Establish technical feasibility of 5 MWe by 2015 and sustain for 5 years
- Reduce near-field EGS LCOE to $0.07/kWh and greenfield LCOE to $0.11/kWh by 2035

Technical Targets:

- Improve EGS production well flow rate from 17.5 kg/s to 60 kg/s and thermal drawdown from 3% to 0.3% by 2035