

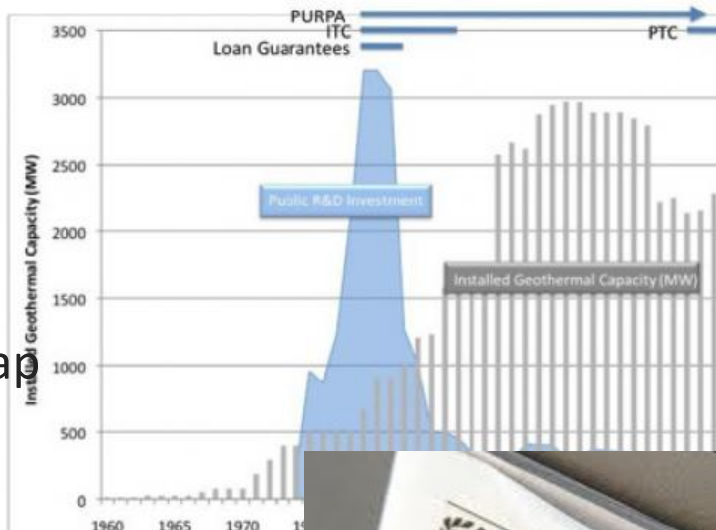


Enel Salt Wells - Courtesy of Enel Green Power – North America

Iceland Geothermal Conference 2013
Geothermal Policies and Impacts in the U.S.
Jay Nathwani, Chief Engineer

March 7, 2013

1. Current Market
2. Budget Profile
3. Regulatory Roadmap
4. Different Policies
5. Impact of Policies
6. Path Forward
7. Conclusion

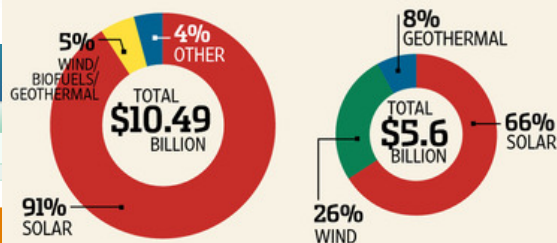


Energy in Play

The Obama administration has backed renewable energy, particularly solar power.

Loan guarantees under stimulus-funded Energy Department program (loans from Treasury)

Partial loan guarantees under the same program (loans from private financing institutions)



Note: Totals for Section 1705 program (started in 2009 and ended Sept. 30, 2011)
Source: Department of Energy

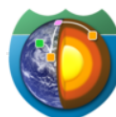
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GEOTHERMAL ENERGY



Geothermal Regulatory Roadmap

Since April 2012, the Geothermal Regulatory Roadmap (GRR) Team has been working with federal, state and local agencies to develop a working guide for agency, industry and policymaker use in an effort to understand processes and timelines and identify potential areas of concern. The project is sponsored by the DOE Geothermal Technologies Office (GTO).



The roadmapping initiative covers the eight western states, including California, Nevada, Hawai'i, Alaska, Idaho, Utah, Oregon and Montana (shown in green on the map). The roadmap is being developed at the federal and



Roadmap Sections

Browse or filter sections of the roadmap to view flowcharts, narratives, and lists of links and supporting documents. Note that the roadmap is currently under development and is being modified regularly.



Getting Started

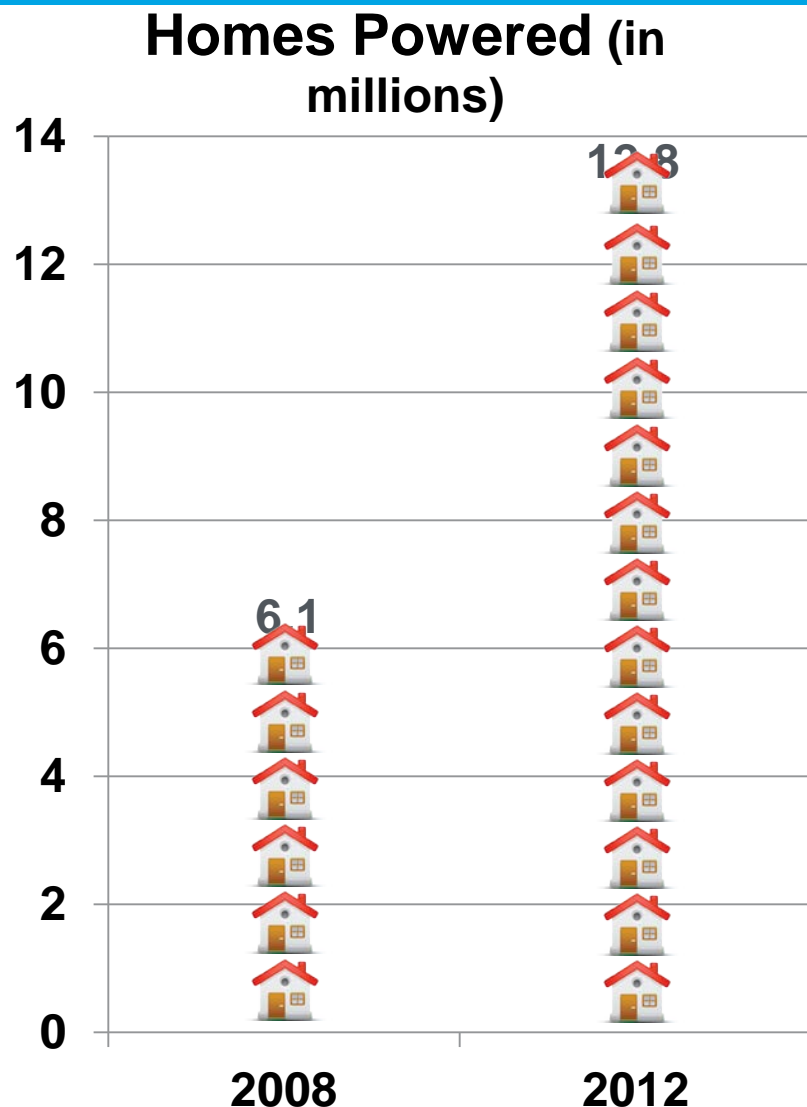
New to the Geothermal Regulatory Roadmap? Check

“We will respond to the threat of climate change, knowing that the failure to do so would betray our children and future generations. Some may still deny the overwhelming judgment of science, but none can avoid the devastating impact of raging fires, and crippling drought, and more powerful storms. **The path towards sustainable energy sources will be long and sometimes difficult. But **America cannot resist this transition; we must lead it.**”**

- President Obama



Official White House Photo by Lawrence Jackson



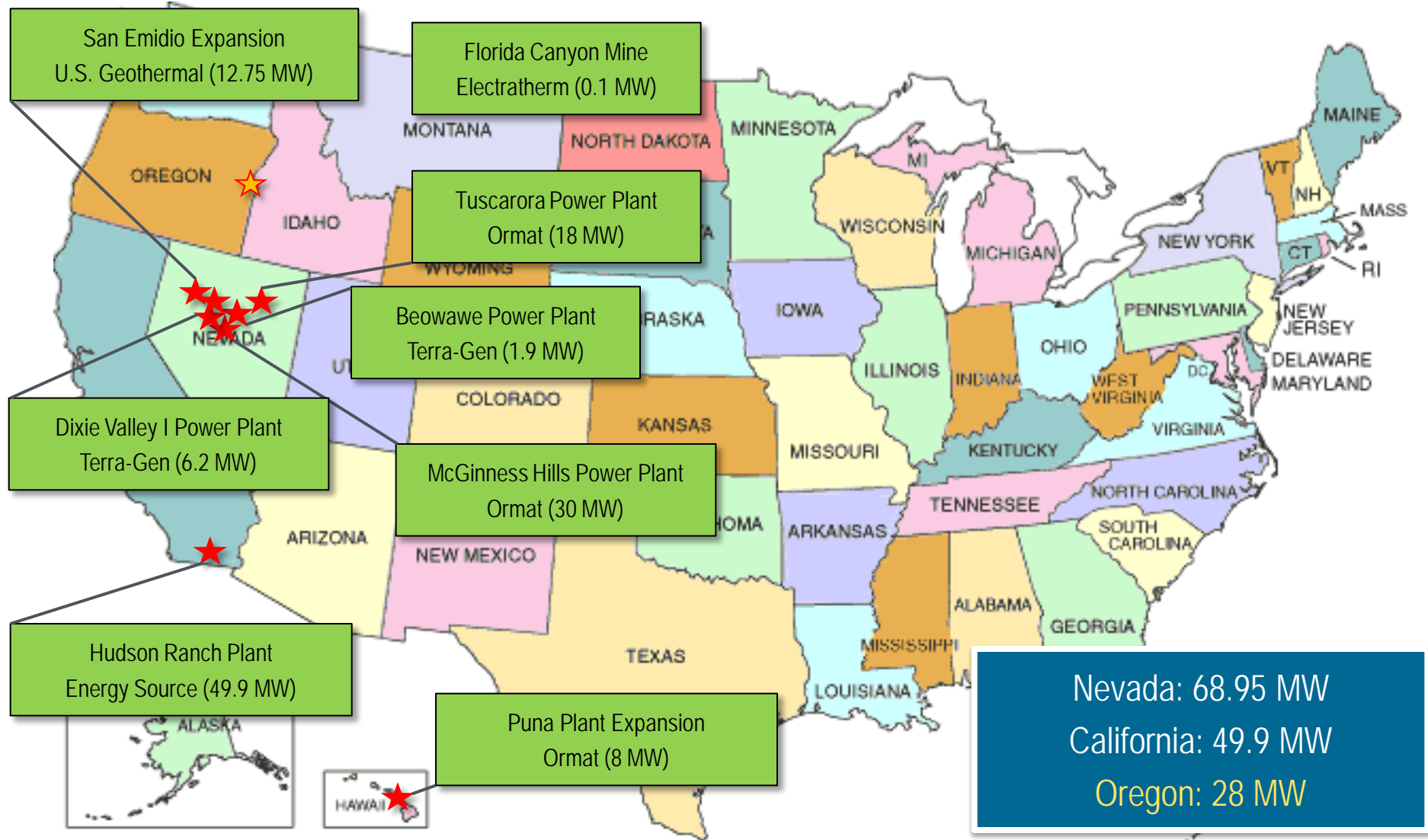
Since 2008, the U.S. has **doubled** renewable energy generation from wind, solar, and **geothermal** – EERE enabled this growth

Source: EIA Electric Power Monthly

Geothermal Power Plants

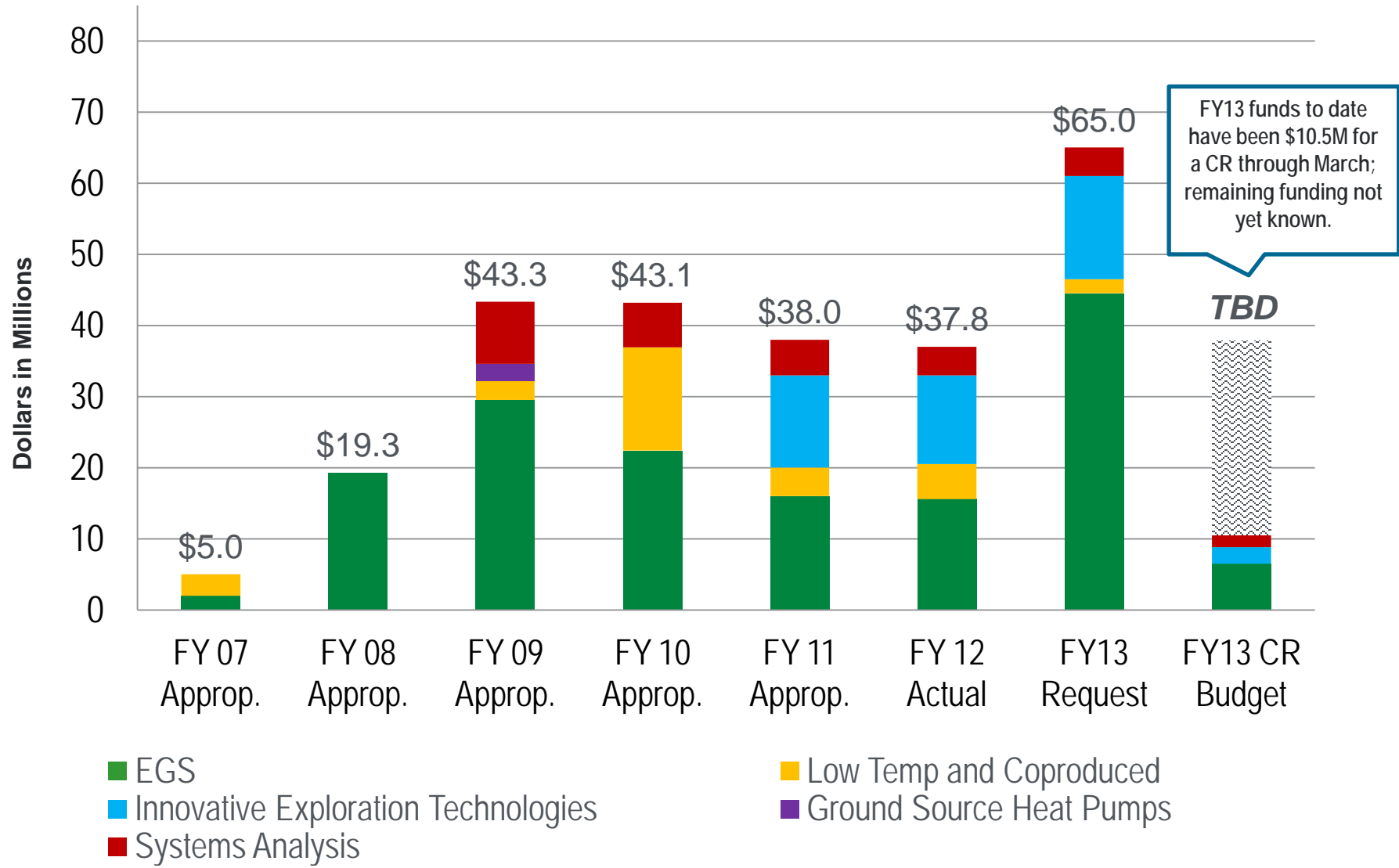
2011-2012

Geothermal power plants brought online/expanded in 2011-13 (154 MW)



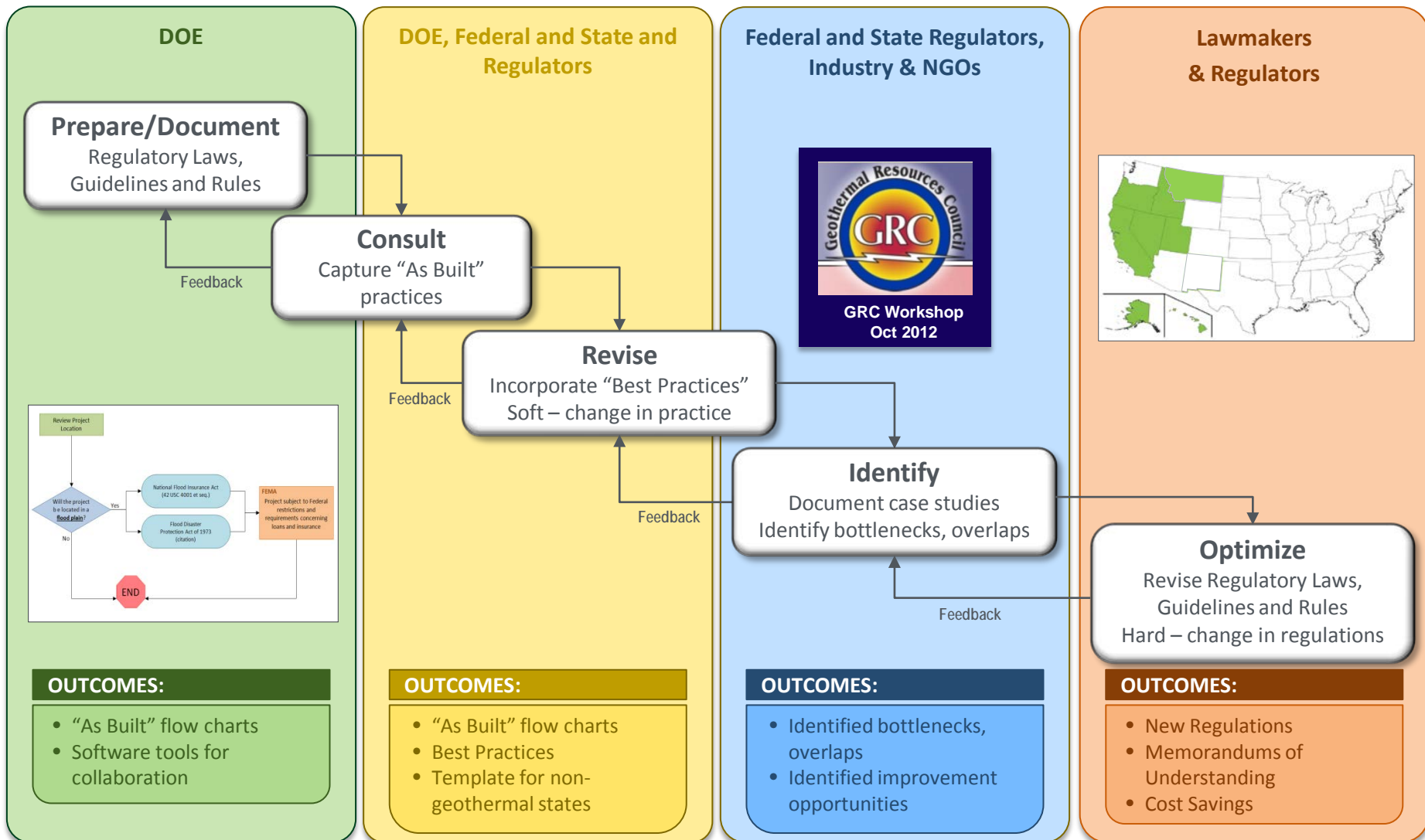
Budget Overview

Challenging but a good path forward



Geothermal Regulatory Roadmaps

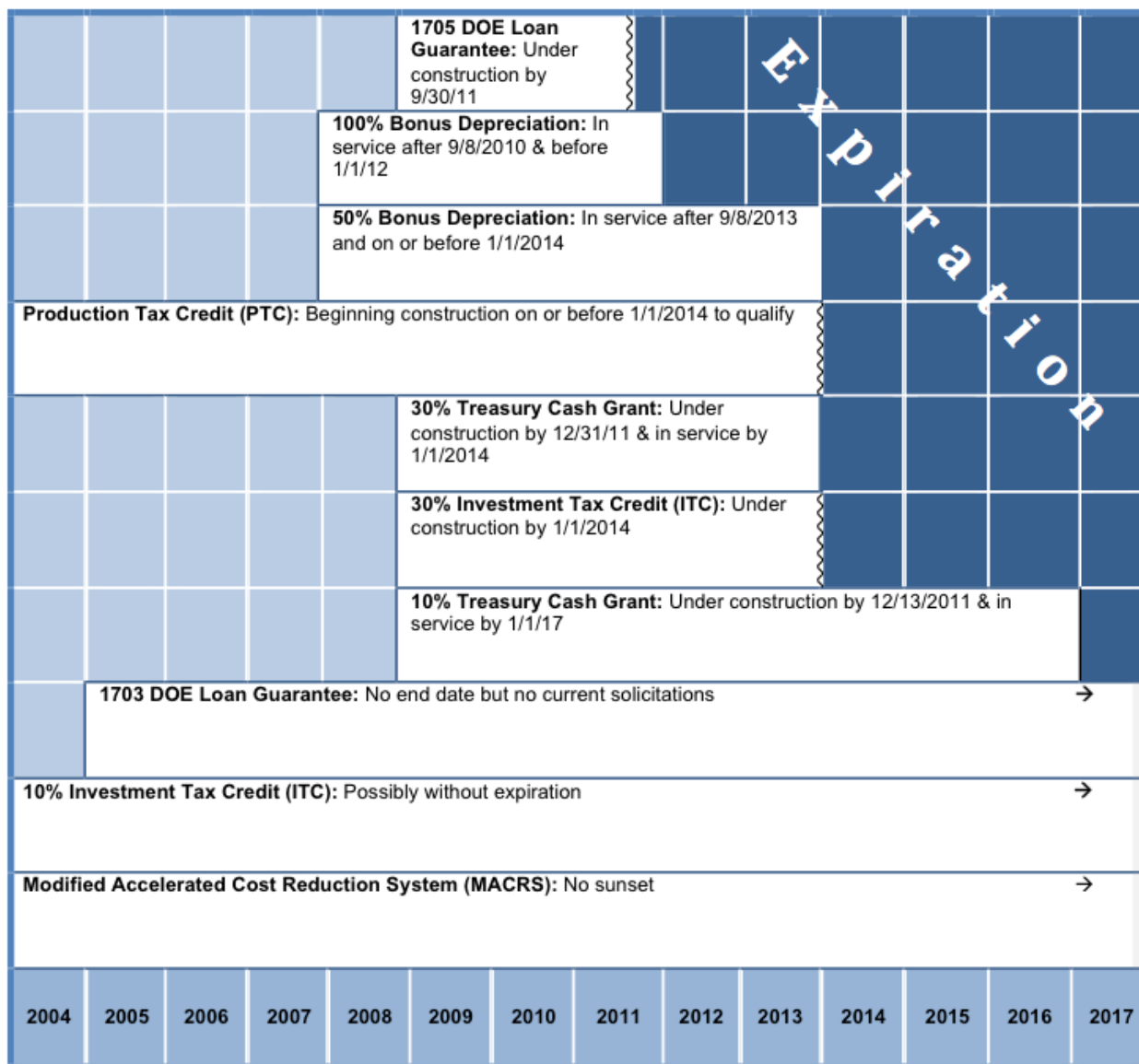
<http://en.openei.org/wiki/GRR>



Catalyzed and facilitated process

Streamlined process

Timeline of U.S. Federal Geothermal Financial Incentives



Source: Adapted from Speer 2012, "Geothermal Brief: Market and Policy Impacts Update."

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.

Funding Announcement

- February 2009
 - Section 48c appropriated \$2.3 B to provide businesses with tax credits for existing and new manufacturing facilities that support energy generation or conservation.
 - Up to 30% of qualified investment cost.
 - Must be certified in advance with IRS.
- February 2013
 - \$150M release of previously allocated 48C tax credits.
 - Application Deadline: July 23, 2013
 - IRS Award: November 15, 2013

Info: <http://www.energy.gov/recovery/48C.htm>

Questions: 48Cquestions@hq.doe.gov



Geothermal Awards

- Lone Star Drill Bits, LLC of Texas was awarded \$112,500 for specialized equipment to manufacture PDC drill bits for EGS applications.
- ClimateMaster, Inc. of Oklahoma awarded \$8,941,626 to expand a component manufacturing facility for geothermal heat pumps.

Issue:

- High cost and difficulty securing financing when deploying new energy projects.

Objective:

- Support early commercial use of innovative technologies which avoid, reduce or sequester greenhouse gases or air pollutants.

1703 - Innovative Projects

- Under **1703**, Congress appropriated **\$51.0B** from FY 2007 - FY 2009 for innovative renewable energy generation and manufacturing, advanced nuclear, advanced fossil, bio fuels and transmission.

1705 - Conventional Projects

- Under **ARRA (1705)**, an additional **\$32.6B** was appropriated for conventional renewable energy systems and electric power transmission. Includes \$4B for credit subsidy. Construction must begin by September 30, 2011.

Geothermal Loan Guarantee Program (GLGP)*

- East Mesa - \$1,000,000
- Brady Hot Spring - \$3,500,000
- Brawley - \$1,800,000
- Westmorland - \$29,100,000
- others

Geothermal Awards to Date:

- Ormat Technologies - \$189,000,000 (McGinness Hills, Tuscarora, Jersey Valley)
- U.S. Geothermal - \$96,800,000 (Neal Hot Springs)
- Nevada Geothermal Power - \$78,800,000 (Blue Mountain/Faulkner)

* Original Loan Guarantee Program

US Treasury – 1603 Cash Grant

(in Lieu of Production or Investment Tax Credit)



Issue:

- High cost and difficulty finding financing when deploying new renewable energy projects

Objective:

- Under ARRA 1603, the Treasury can make grants for renewable energy facilities in lieu of Investment Tax Credits (ITC) or Production Tax Credits (PTC).

Eligibility:

- Geothermal Heat Pumps (10% of eligible costs)
- Geothermal Facilities (10-30% of eligible costs)
- In service date: 2009-2010/or
- Begin construction of the property: 2009-2011
 - “Safe Harbor” Rule: > 5% of total cost incurred

Geothermal Electric Generation Awards under 1603

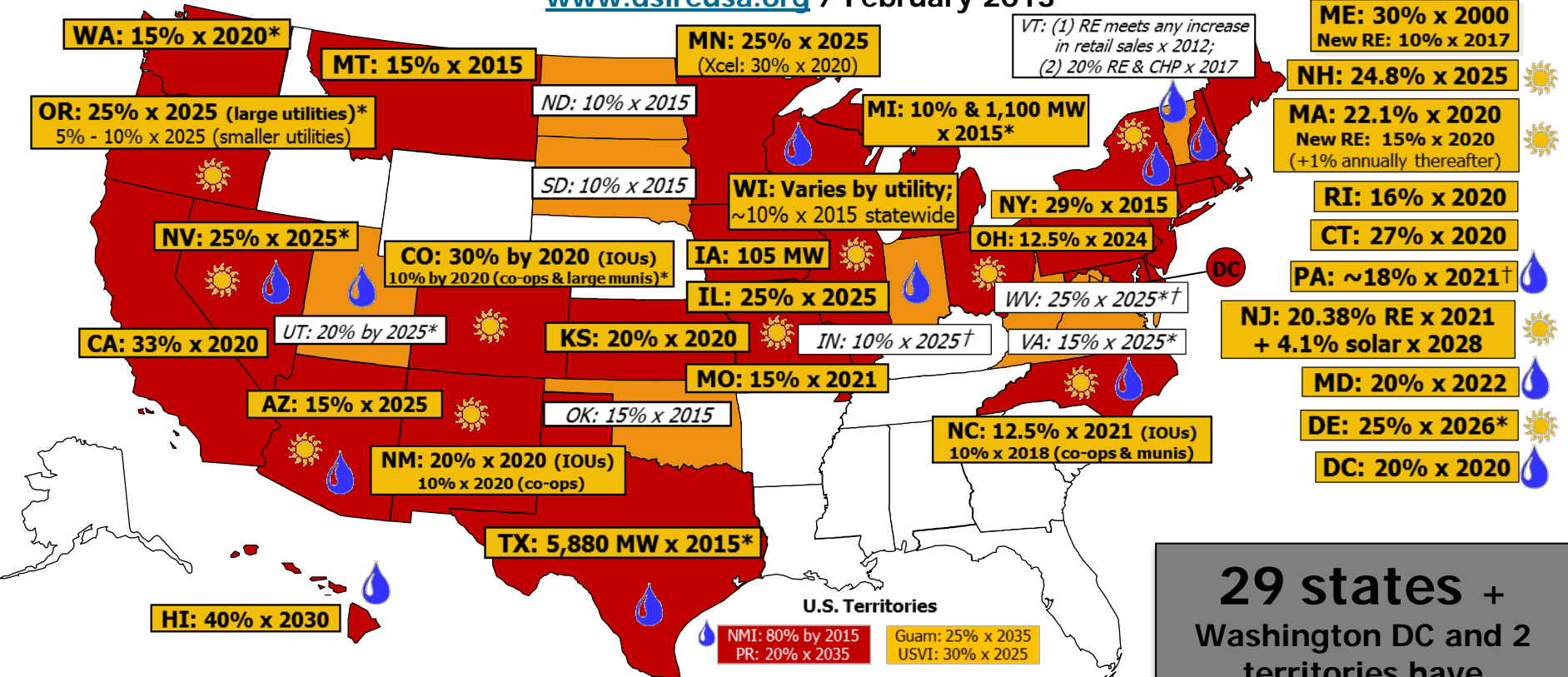
- Recovery Act (Section 1603). The program utilized rolling applications, with a deadline of October 1, 2011.
- Email questions: 1603Questions@do.treas.gov

Geysers Power Co., LLC	CA	\$14,179,955	12/17/2012
CPN Wild Horse Geothermal, LLC	CA	\$4,972,514	11/20/2012
USG Nevada LLC	NV	\$10,653,382	11/6/2012
ORNI 39 LLC	NV	\$46,939,885	9/15/2012
Hudson Ranch Power I LLC	CA	\$102,086,944	6/21/2012
ORNI 42 LLC	NV	\$23,822,345	6/5/2012
ORNI 15 LLC	NV	\$34,608,728	5/11/2012
Puna Geothermal Venture	HI	\$13,821,143	4/14/2012
AMOR IX, LLC	NV	\$2,112,178	2/29/2012
Beowawe Binary, LLC	NV	\$1,679,932	10/5/2011
NGP Blue Mountain I LLC	NV	\$65,741,725	7/6/2011
ORNI 18 LLC	CA	\$108,285,626	8/17/2010
Thermo No. 1 BE-01, LLC	UT	\$32,990,089	2/16/2010
Enel Salt Wells, LLC	NV	\$21,196,478	9/21/2009
Enel Stillwater, LLC	NV	\$40,324,394	9/21/2009
Total Awards		\$523,442,890	

From <http://www.ustreas.gov/recovery/1603.shtml>

Renewable Portfolio Standard Policies

www.dsireusa.org / February 2013



29 states + Washington DC and 2 territories have Renewable Portfolio Standards
(8 states and 2 territories have renewable portfolio goals)

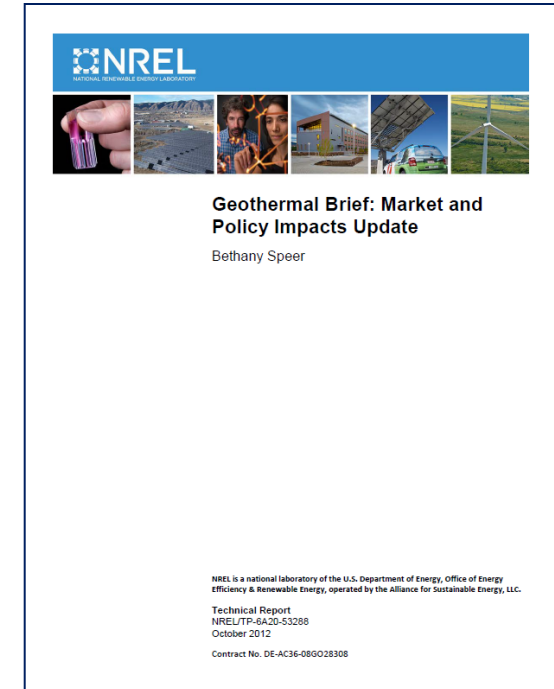
- Renewable portfolio standard
- Renewable portfolio goal
- 💧 Solar water heating eligible
- ☀️ Minimum solar or customer-sited requirement
- ✳️ Extra credit for solar or customer-sited renewables
- † Includes non-renewable alternative resources

Sites from Late-1970s to Early-1980s Programs

DOE Developed Site	Capacity
Boewawe: Beowawe, NV	18 MW
Coso Junction: China Lake, CA	302 MW
Desert Peak: Churchill County, NV	9 MW
Dixie Valley: Dixie Valley, NV	64 MW
Hawaii Geothermal Area: Pahoia, HI	35 MW
Honey Lake: Lassen County, CA & Washoe County, NV	55 MW
Imperial Valley: Imperial County, CA	102 MW
Mammoth-Pacific: Mono County, CA	40 MW
Raft River: Cassia County, ID	16 MW
Roosevelt Hot Springs: Milford/Beaver, UT	42 MW
Salton Sea: Calipatria, CA	339 MW
Soda Lake: Fallon, NV	23 MW
Stillwater: Fallon, NV	48 MW
Total	1,093 MW

Source: Adapted from Speer 2012, "Geothermal Brief: Market and Policy Impacts Update."

1. Historically, U.S. federal government has offered a mix of financial incentives for geothermal development
 - Public Utilities Regulatory Policy Act (PURPA)
 - Loan Guarantee
 - Cost-shared Drilling
 - Program Research and Development Announcement
 - Tax Credits
2. Currently, primary incentive mechanisms based on U.S. tax code (e.g. tax credits & accelerated depreciation),
 - Financial Assistance (Grants, Cooperative Agreements, Technical Assistances)
 - Loan Guarantee Program
 - Renewable Portfolio Standards
 - Tradable Renewable Certificates
 - Tax Credits
3. Geothermal market build-out in U.S. is due to:
 - Cost-share drilling investments
 - Geothermal Loan Guarantee Programs
 - Federal Tax Incentives
 - Public Utilities Regulatory Policy Act (PURPA)



More information:

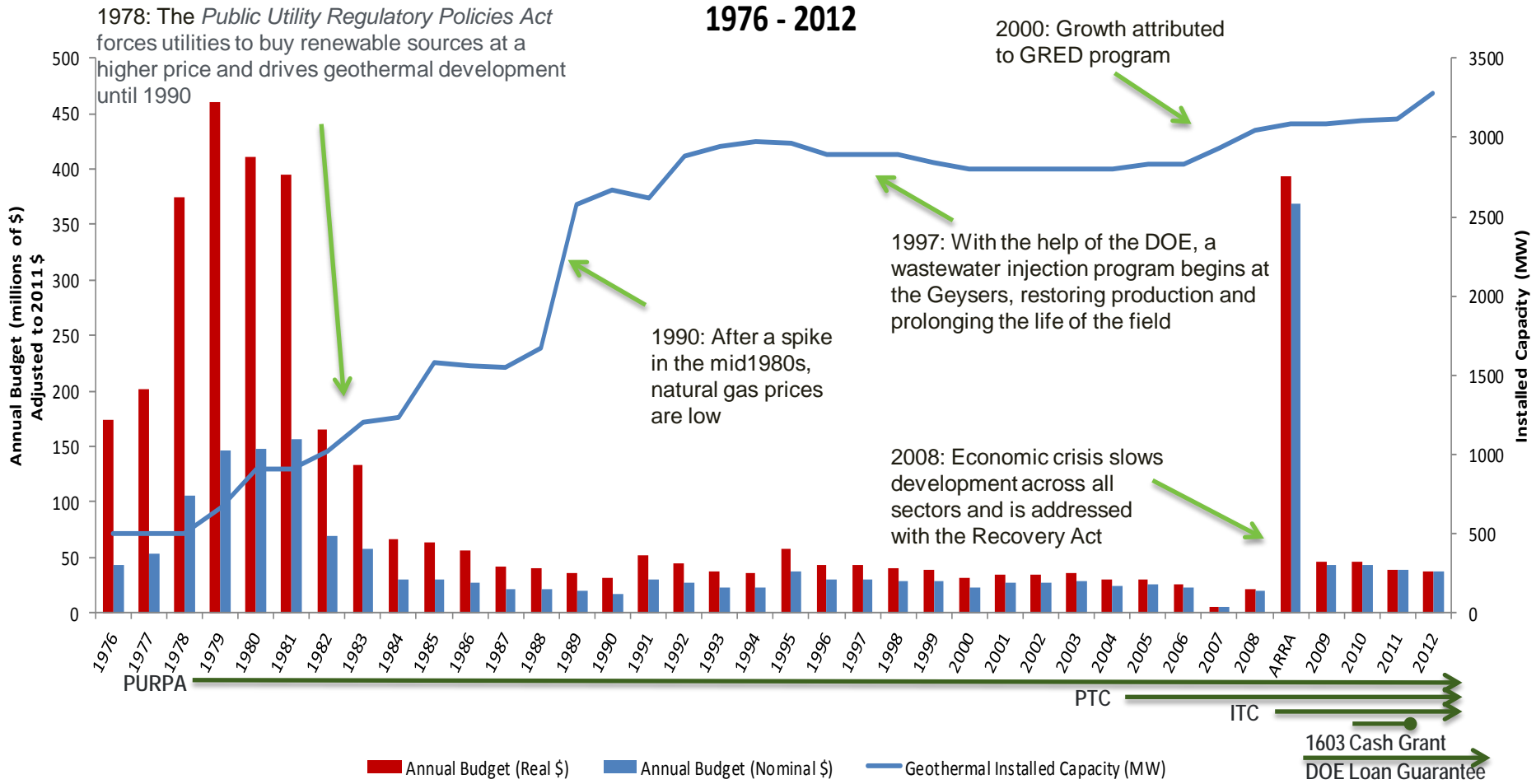
<http://www.nrel.gov/docs/fy13osti/53288.pdf>

Geothermal History

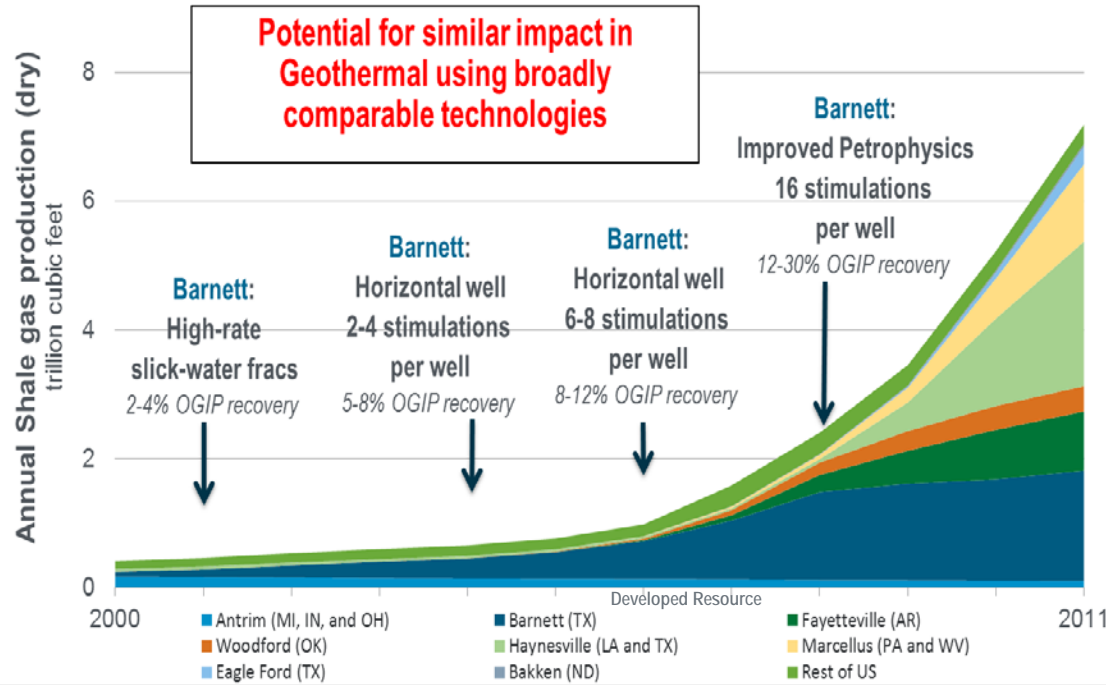
1976-2012

The Geothermal Technologies Office annual budget peaked in the late 1970s, helping to drive an increase in installed capacity that lasted about ten years.

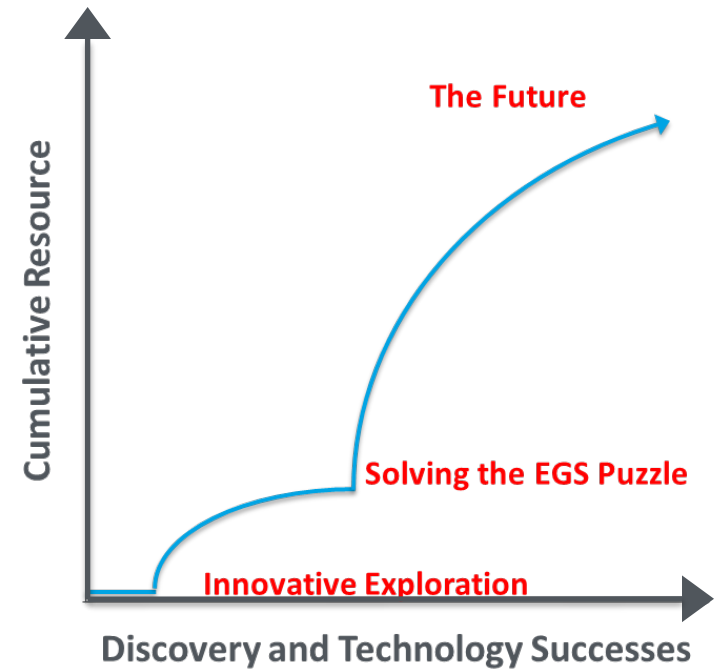
Annual Budget for the Geothermal Technologies Office and Installed Capacity



Shale Gas: Technology Innovations Spawnd Sector Transformation



Geothermal Development Potential



Sources: Lippman Consulting, Inc. 2011. Technology advances from King, 2012 (SPE 152596)

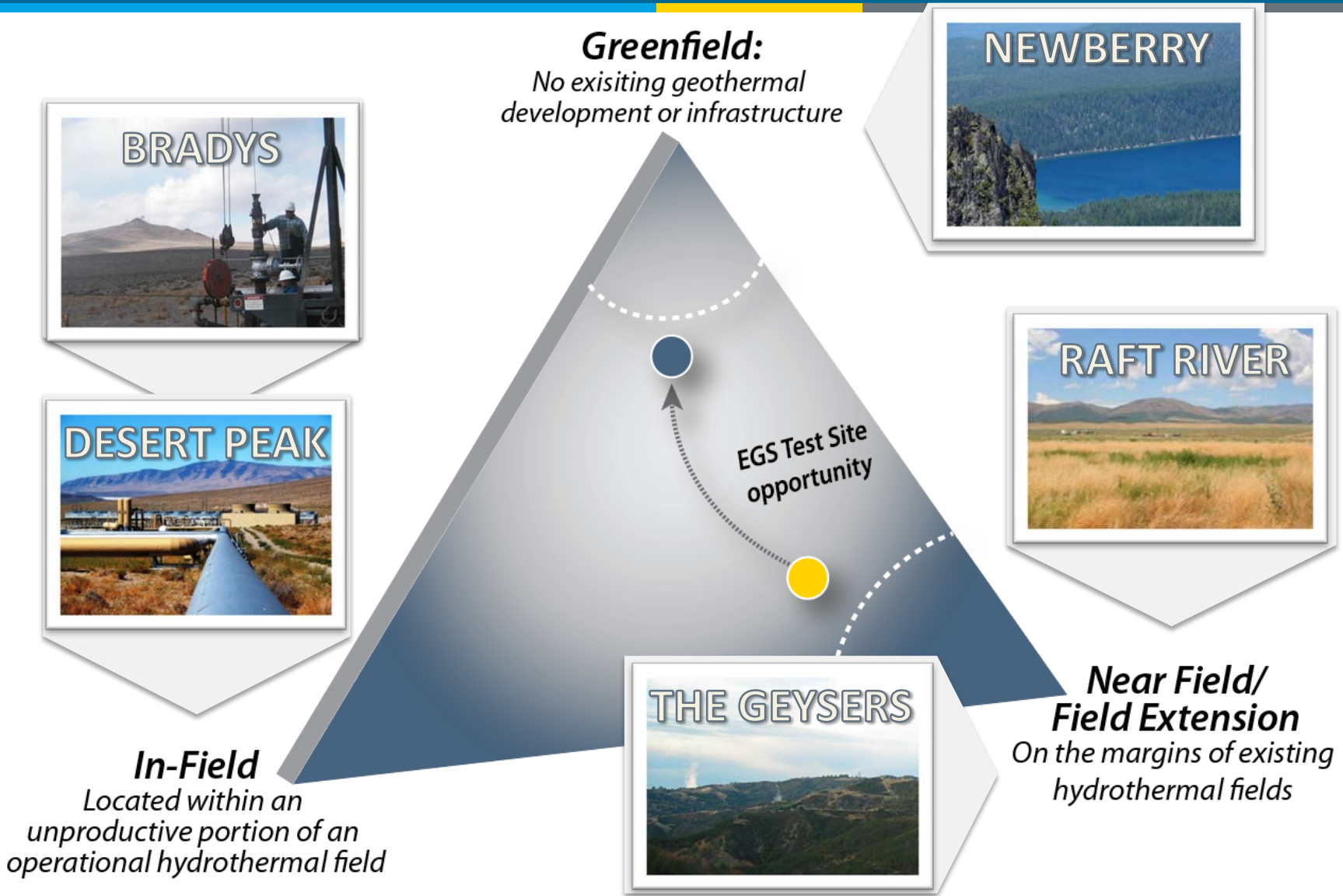
Geothermal Program Balance

Transition from Near to Long Term

	Low Temp	Co-Production	Hydrothermal	EGS
<u>Timeline</u>	Current	Near Term	Near to Intermediate	Long Term
<u>Strategy</u>	Distributed Energy	Leverages O&G investment	Sector Growth	Transformation
<u>Scale</u>	100's KW to several MW scale	10's-100's MW scale, aggregate to several GW potential	10's GW additional potential	10's - 100's GW potential, but high risk
<u>Constituency</u>	Local or Rural, Direct Use	Growing Interest, New Potential Sector	Majority of the Private Sector	Fewer Players

Enhanced Geothermal Systems (EGS)

Facies Concept – A Continuum



EGS Technology

Vast Resource

Field Lab Vision

Tested in an Ideal Setting

How It Works

Man-made reservoir is created in hot rock that has insufficient natural permeability or fluid saturation.

Fluid is injected into the subsurface under carefully controlled conditions, causing pre-existing fractures to re-open, creating permeability.

Fluid is then circulated throughout the now-fractured rock and heat transported to the surface, where electricity is generated.

- High Cost of Drilling
- Reservoir creation
- Subsurface Characterization
- Sustained Reservoir Production
- Risk Management & Mitigation

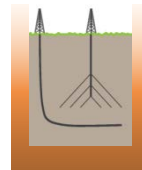
Benefits

A potentially important contributor to the US energy portfolio

- Baseload, non-intermittent energy source
- Minimal, environmental footprint, low emissions, and virtually carbon-free
- An incredible 100+ GW potential

EGS Field Lab

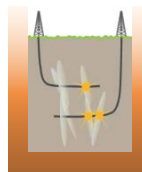
- Enable cutting-edge research, drilling, and testing.
- Directly benefit existing technologies in all areas of research in the geothermal space.
- Ultimately validate and optimize EGS technology into a replicable model for commercial scale-up.



BARRIERS

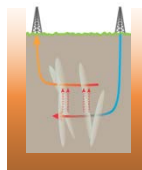
Reservoir Access

New well geometries and concepts, optimized drilling



Reservoir Creation

Characterize local stress, zonal isolation, novel fracturing methods, increase fractured volume per well



Productivity

Increase flow rates without excessive pressure needs or flow localization



Sustainability

Maintain productivity with minimal thermal drawdown and water losses

SOLUTIONS

Hard/Hot-rock drilling, completion technologies

Horizontal wells – a first for geothermal

Rotary steering

Stress-field diagnostics

Smart tracers

Advanced Reservoir Modeling

Zonal Isolation

High-T sensors

Cross-well monitoring

Diverter technologies

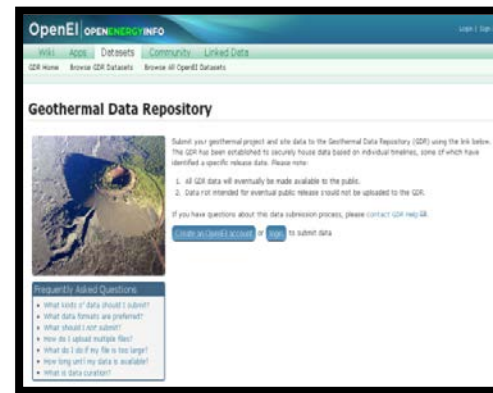
Fully horizontal drilling has never been attempted in geothermal development.

- Ensure open access to both negative & positive experimental data & analysis
- Require DOE-funded geothermal R&D projects to provide appropriate data
 - Prefer structured, linked data that is publicly accessible
- Incentivize industry, government & academia to host or provide data to an NGDS node
- Express GTO policy implementation with guidance document

Capture, Evaluate, Describe & Deliver Data



<http://geothermaldata.org/>



<https://gdr.openei.org/>



<http://www4.eere.energy.gov/geothermal/projects>

National Geothermal Data System & DOE Geothermal Data Repository http://www1.eere.energy.gov/geothermal/data_systems.html

- Email - Jay.nathwani@ee.doe.gov
- Geothermal Technologies Office Website - <http://www.eere.energy.gov/geothermal>
- NGDS Website - http://www.eere.energy.gov/geothermal/data_systems.html
- Regulatory Roadmaps - <http://en.openei.org/wiki/GRR>
- Geothermal Projects - <http://www4.eere.energy.gov/geothermal/projects>

Thank You