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

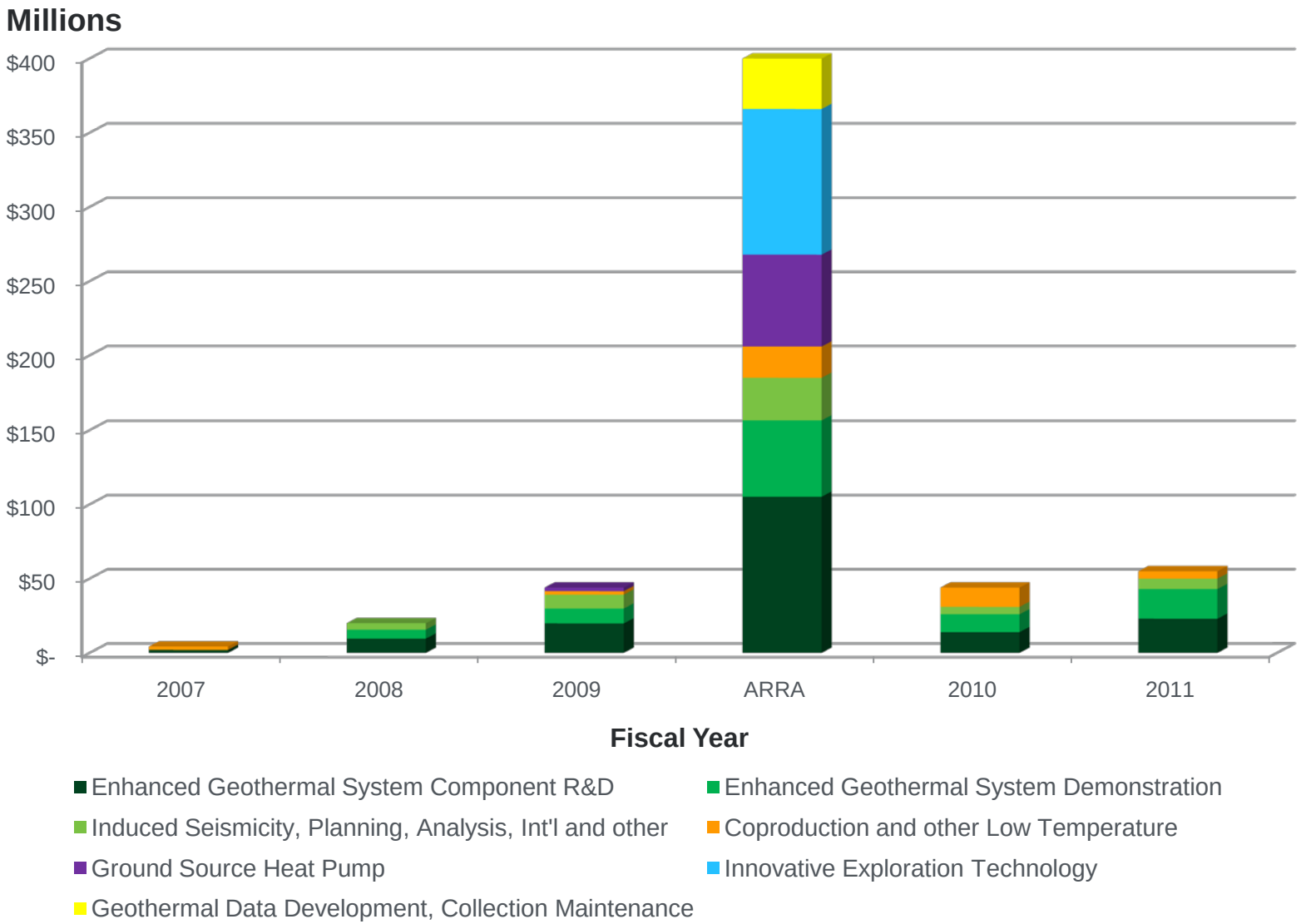
Geothermal Technologies Program 2009-2010 Activities

Geothermal Working Group Meeting

Portland, Oregon

Lauren Boyd
Geothermal Technologies Program
Office of Energy Efficiency and Renewable Energy
U.S. Department of Energy
Lauren.Boyd@ee.doe.gov

GTP Budget Trend



Recovery Act Budget and Initiatives:

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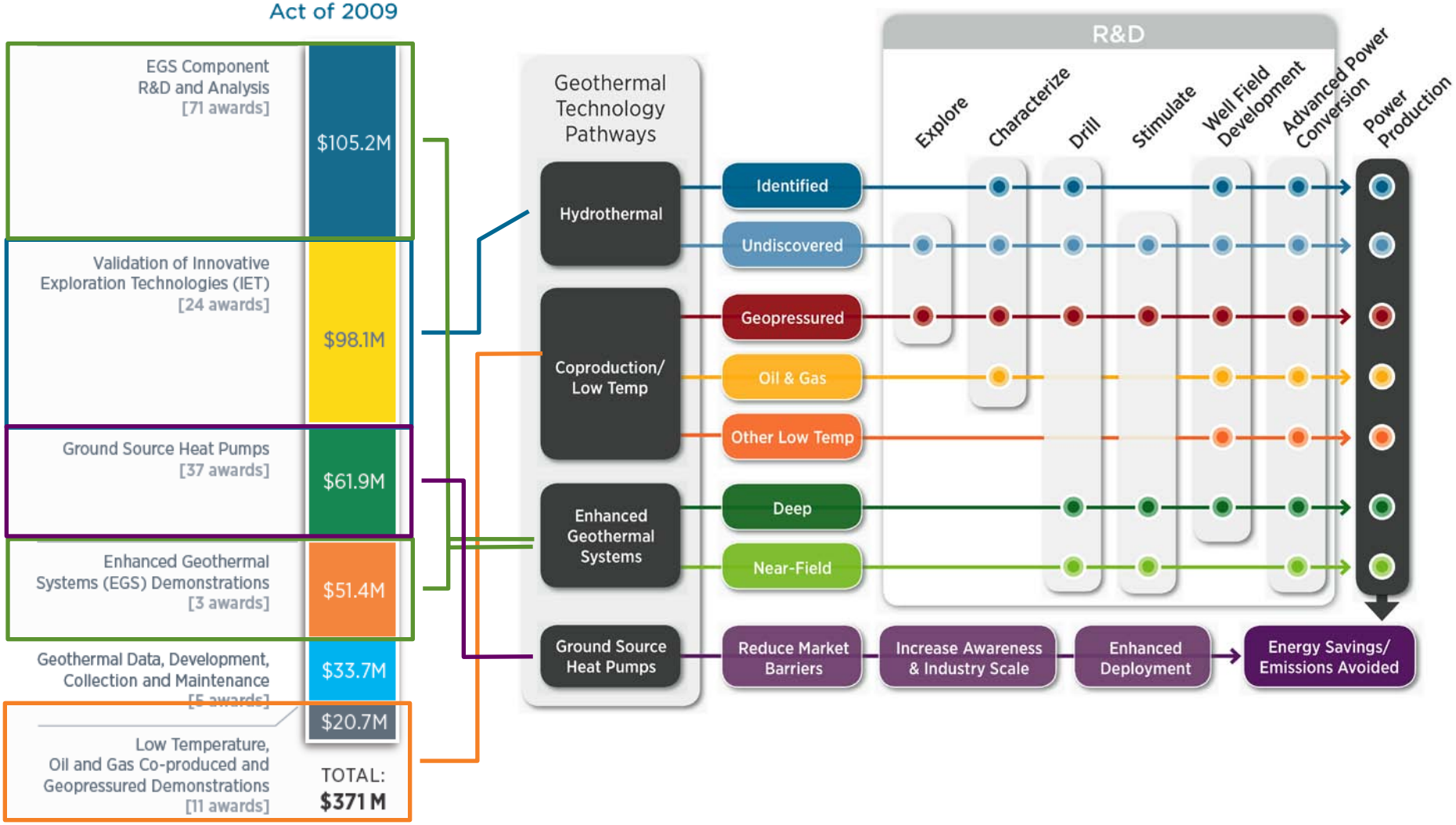
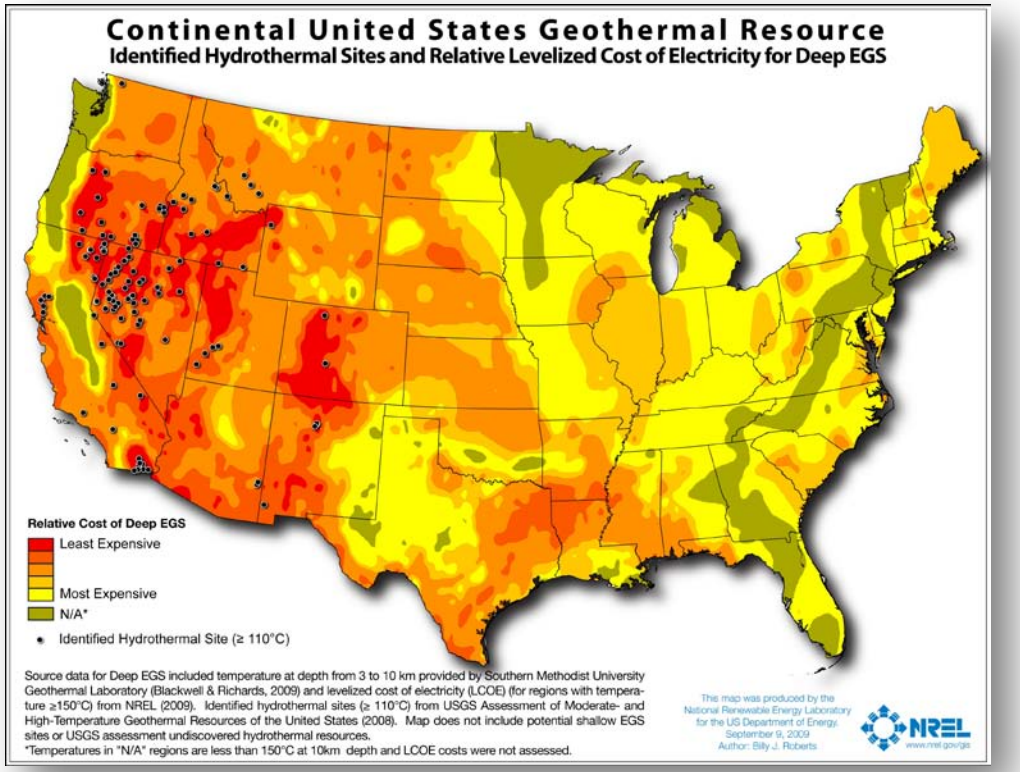
Allocation of Geothermal Funding through the American Recovery and Reinvestment Act of 2009



Validation of Innovative Exploration Technologies

Issue:

- Upfront costs for early development and associated risk are prohibitively high.
- According to the USGS, there is a mean of 30GWe of undiscovered hydrothermal in 13 western states.



Objectives:

- Validate innovative exploration technologies to improve discovery success rate.
- Confirm new geothermal capacity.
- Provide data to the National Geothermal Database (NGDS).

Action:

- Up to $98.1 M in ARRA funds invested in 24 grants to develop new, innovative methods of exploration and to contribute data to NGDS for resource assessment.

Low Temperature, GeoPressured, Coproduction

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Issue:

- Numerous resources too cool for flash steam generation.
- An estimated 10 barrels of water are produced per barrel of oil in North America.
- Facilities have lower cost, shorter lead time, broader geographic distribution than conventional geothermal.

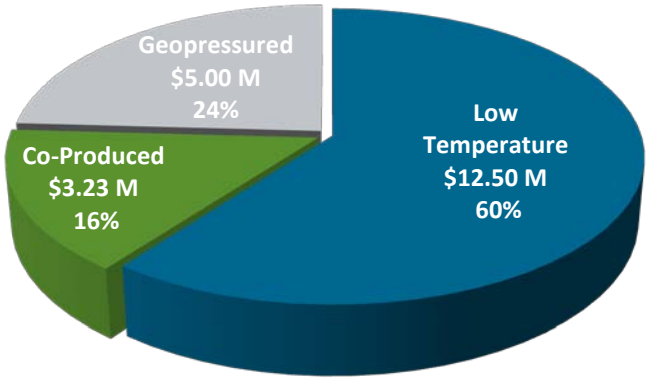
Objective:

- Demonstrate production from oil and gas fields, geopressured fields, and low temperature resources across the U.S.

Action:

- Up to $20.7M in ARRA funds for 11 near-term energy projects including new hybrid plants, and speedy modular plant designs.

Total Funding by Technology

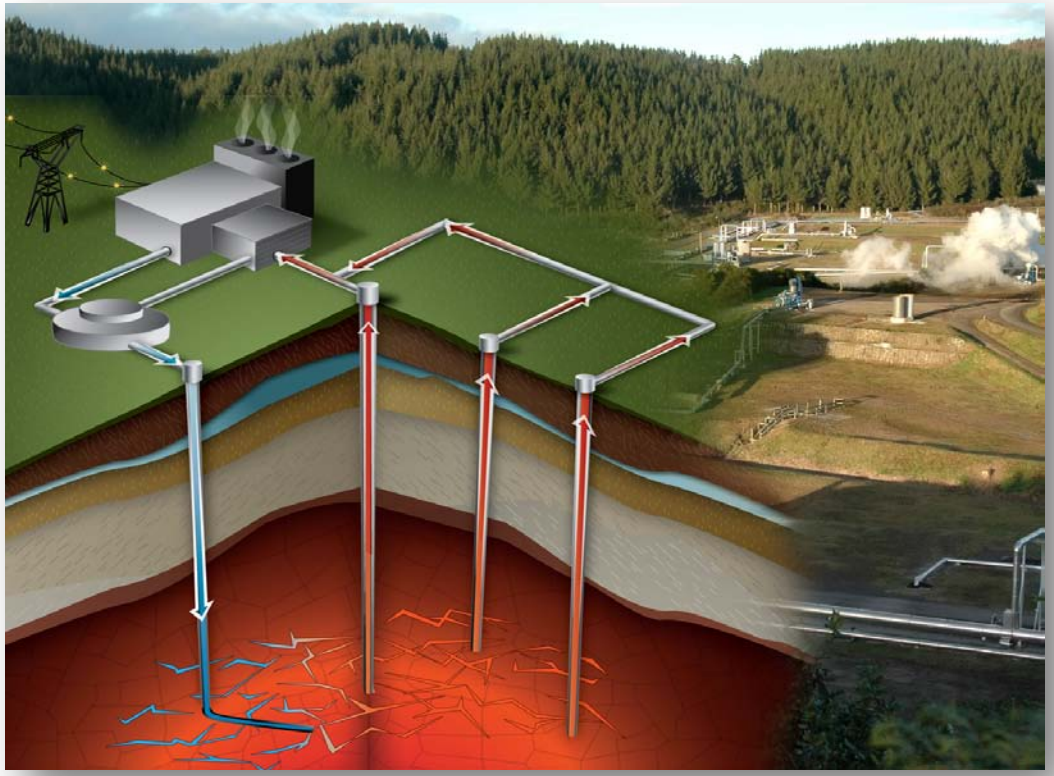


Total Funding: $20.7 M

Enhanced Geothermal Systems

Issue:

- EGS has the highest potential payback, but is the highest risk technology in GTP portfolio.



Objective:

- Demonstrate EGS reservoir creation technology in various geologic formations and geographic regions.
- Quantitatively demonstrate and validate stimulation techniques that sustain fluid flow and heat extraction rates.
- Show that EGS can be scaled up to produce power economically.

Action:

- Four EGS projects underway in California, Nevada and Idaho.
- Up to $51.4 M in ARRA funds for three more demonstration projects in Nevada, Oregon and Alaska to rapidly commercialize technologies, help reduce upfront risk and pave the way for commercialization.

Component Research and Development

Issue:

- High cost of component development limits the progress of geothermal technology.
- Oil field tools need to be adapted for hotter, more rigorous environments

Objective:

- Support cost-shared R&D for both EGS and conventional geothermal to accelerate technology.

Action:

- Up to $105.2M in ARRA funds to projects in EGS R&D at labs, universities and private companies.
- Applications received for 21 of 23 key technology areas.
- R&D Projects in many technologies ne to the Program, including:
  - Spallation drilling to increase drill speeds
  - Tracers
  - Thermo-hydro-chemo-mechanical modeling
  - CO_2 as heat mining fluid
  - Modeling and predicting induced seismicity
  - Measurement While Drilling tools for direction drilling

Ground Source Heat Pumps

Issue:

- Near-term potential to reduce costs for heating and cooling all across the country.
- Market barriers include lack of information and upfront installation/capital costs.

Objective:

- Improve wide-spread deployment by providing access to certified installers and demonstration projects.
- Generate performance data in a variety of climate and soil types.

Action:

- Up to $61.9M in ARRA funds for 37 projects including demonstrations, data gathering and a National Certification Standard for installers.
- Funded Geothermal showcase system at NREL Visitor Center.

National Geothermal Data System, Resource Assessment & Classification

Issue:

- Upfront exploration costs for and associated risk are extremely high.
- There is a need to standardize and centralize geothermal information
- Classification standards need to be updated

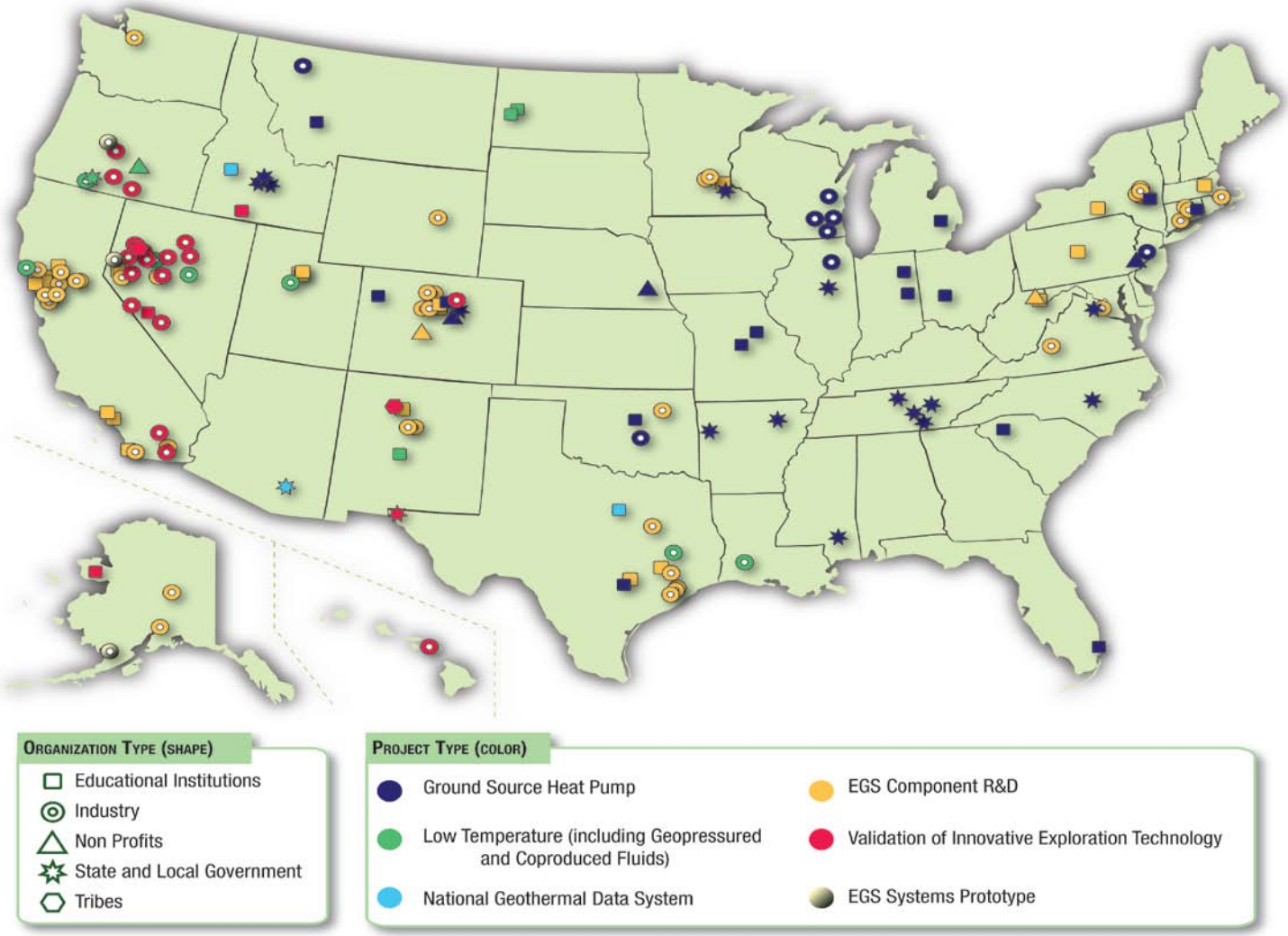
Objectives:

- Reduce exploration costs and risk!
- Expand geothermal resource assessments including:
  - High/moderate/low temp resources
  - EGS, coproduced fluids, geopressured
  - Entire U.S., including AK and HI
- Develop new geothermal resource classification standards

Action:

- Up to $ 30M in ARRA funds
- Implement three step strategy:
  - **Step 1:** *System Design, Development and Testing*: Distributed web-based system design by Boise State University
  - **Step 2:** *Data Development, Collection & Maintenance*: Populate NGDS by linking to data sets in partnership with 46 state geological surveys and other geothermal data providers including Southern Methodist University and GTP technology partners.
  - **Step 3:** *National Resource Assessment and Classification:* Inter-Agency Agreement with U.S. Geological Survey.

Geographic Diversity of Awardees:



Total States Represented: 39

Note: Only prime awardees and demo project sites are depicted on this map.

Projects in Oregon

Topic Area	SubTopic	Awardee	Project Title	Description
EGS Demo	EGS Demonstration	AltaRock Energy, Inc.	Newberry Volcano EGS Demonstration	AltaRock Energy, Inc. will demonstrate EGS technology to demonstrate EGS power generation from the Newberry Known Geothermal Resource Area.
Geothermal Demo	Low Temp	City of Klamath Falls	Klamath Falls Geothermal Low Temperature Power Plant	This funding will faciliate construction of a low temperature power plant combined with a district heating system to help power the city of Klamath Falls, OR.
Geothermal Demo	Low Temp	Johnson Controls, Inc.	Novel Energy Conversion Equipment for Low Temperature Geothermal Resources	Johnson Controls, Inc. will install a low temperature unit on the Oregon Institute of Technology Campus.
Geothermal Demo	Low Temp	Surprise Valley Electrification Corporation	Rural Cooperative Geothermal Development Electric and Agriculture	Surprise Valley Electification Corporation will build a binary power plant utilizing low temperature fluids and enable the construction of a local aquaculture facility.
IET	New Combination of Technologies; Drilling	Nevada Geothermal Power Company	High Precision Geophysics & Detailed Structural Exploration & Slim Well Drilling	Nevada Geothermal Power Co. will test a new low (environmental) impact drilling technique and create a method to model the movement of fluid in the reservoir.
IET	Geochemistry; Seismic	Newberry Geothermal Holdings, LLC	Validation of Innovative Exploration Technologies for Newberry Volcano	Newberry Geothermal Holdings, LLC will use advanced geological techniques to locate geothermal reservoirs in Oregon's Cascade range.
IET	Remote Sensing	ORMAT Nevada, Inc.	Merging high resolution geophysical and geochemical surveys to reduce exploration risk at Glass Buttes, Oregon	ORMAT Nevada will use a combination of advanced geological techniques to identify faults in geothermal reservoirs, with initial tests in Glass Buttes, OR.

Current Status

- **3,152 MWe Installed[1]**
- **4,700-7,160 MWe in planning or development stage**
- **Installed in 8 states now**
- **Expansion into 8 additional states planned**

Data are from the Geothermal Energy Association (GEA) September 2009 and include projects funded by the American Recovery and Reinvestment Act (ARRA). Planned figures represent only developments in stages 1-4.

[1]Geothermal Energy Association 2009

Thank you!

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DOE Requirements for Demo Projects:

- EGS demonstration projects must meet or exceed the International Energy Agency induced seismicity protocol throughout the project performance period.
  - This protocol identifies steps that a geothermal developer can take to extend community outreach and education, cooperate with local authorities, measure induced seismicity, characterize maximum probable events, and enlist independent experts for risk analysis.

- Awardees must collect stress data, background seismicity, and geology data prior to actual field stimulation.
  - Awardee should use predictive stimulation models to estimate and forecast potential induced seismicity magnitude and potential radius of seismicity and develop site specific risk mitigation strategies.

- A DOE team of experts will review results as a part of go/no-go decision point.
  - If judged satisfactory, awardees will be given the go-ahead to conduct field work with adequate permits from local authorities.
  - Otherwise, they will be asked to gather more data and conduct more analysis.

- Awardees should implement special conditions of approval for stimulations (if necessary) including: ***placement of ground motion sensors***, ***monitoring and reporting of operational data and events***, and ***instituting procedures for mitigating emerging seismic events*** up to complete shutdown, if necessary.
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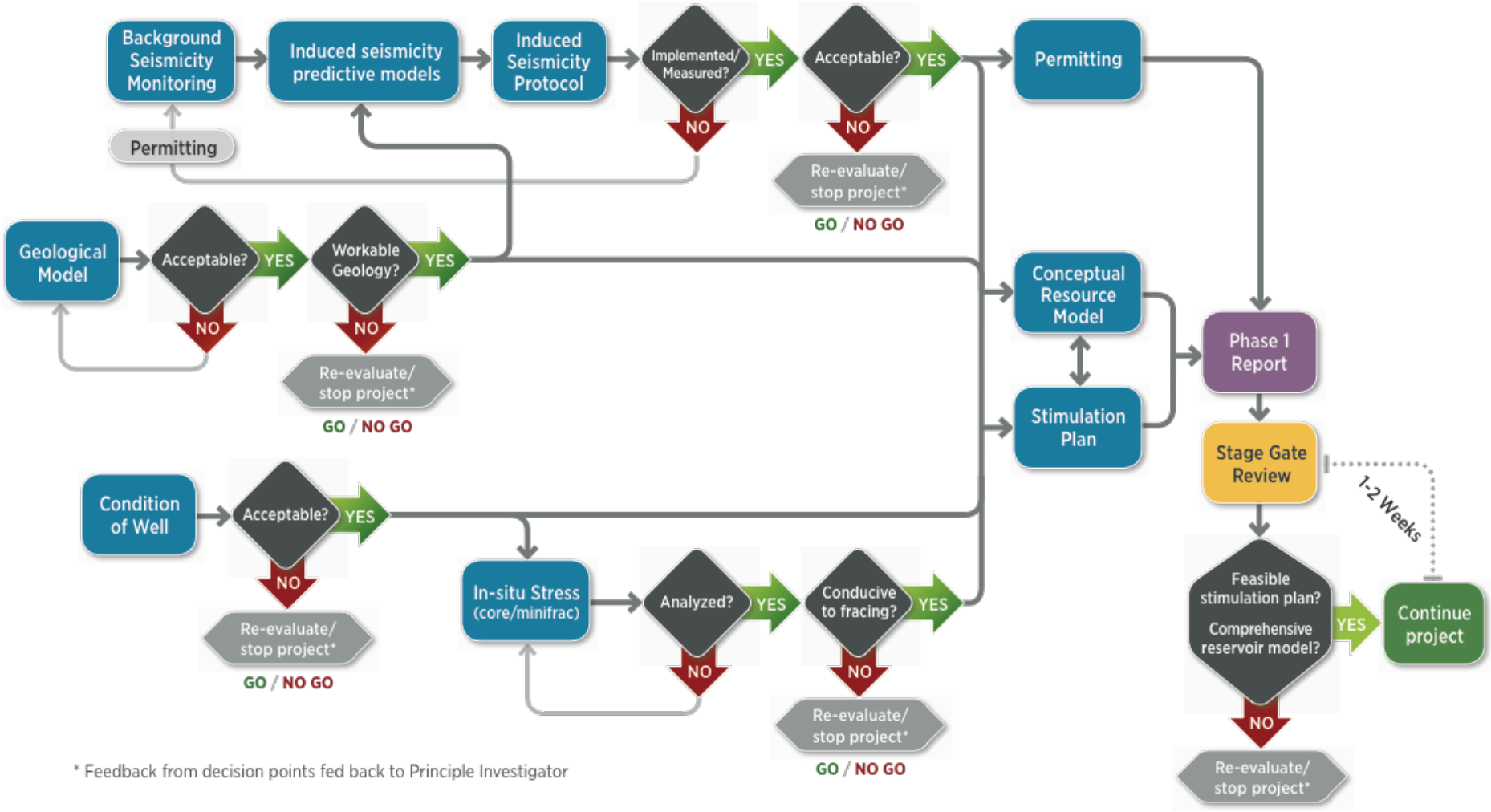
Technical Criteria for EGS Project Decision Points



* Feedback from decision points fed back to Principle Investigator