Geothermal Heat Pump Deployment Efforts at DOE

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Program Technical Priorities

- **Enhanced Geothermal Systems**
  - Strategic Goal: Develop the technology base that creates and sustains commercial-scale EGS reservoirs
- **Technology development of CO2 as an EGS working fluid**
  - The use of CO2 as a working fluid offers the potential for baseload electricity generation and carbon sequestration while conserving water.
  - Carbon credits gained from sequestering the CO2 would offset some of the costs of drilling deep EGS wells.
  - Research has shown that CO2 might be 50% more efficient than H2O for EGS.
  - EGS with CO2 offers the potential to sequester 1 ton per second of CO2 for each GW of electricity generated.
- **Direct Use/ Ground source systems**
  - Represents deployment opportunity and a collaboration opportunity with the Buildings Technologies Program and the Commercialization office within EERE.
- **Research and development of low-temperature resources throughout the United States**
  - Ongoing projects are demonstrating the technical viability of electricity from both low temperature hydrothermal resources and coproduced fluids from oil and gas. These projects will help meet the demand in the gulf coast region.
  - The first commercial-scale low-temperature project consisting of 50 modular units to produce 10 MW was built in less than one year. The project demonstrates the potential for a new geothermal market that is geographically diverse, adaptable, and responsive.

These 4 key areas reflect the spectrum of diverse geothermal opportunities

A brief history of DOE's Involvement with GHPs

1993 - The Edison Electric Institute (EEI), supported by NRECA and EPRI, selected GHPs as one of its five initiatives under the President's Climate Change Action Plan.

1994-DOE, EEI, NRECA, EPRI, IGSHPA, EPA, and several utilities initiated a collaborative effort for GHP market mobilization and technology demonstration called the National Earth Comfort Program

1994 – 1999 - $23.7 million flowed directly through the GHPC, 80 percent from DOE. Utilities may have contributed an additional $37 million on GHP market mobilization programs in their service territories, bringing total program spending to about $60 million.

2001 – DOE Office of EE/RE reorganization eliminated Office of Power Technologies. The new Geothermal Technologies Program focused only on geothermal power generation.

2006-2007 - The President's FY 07-08 budget requests zeroed out the Geothermal Program entirely (cut from $22.8 million in FY 06)

2008 – 2009 – The GTP along with the Office of Buildings Technologies are bringing GHPs back into the fold with major new investments made possible through increased program funding and the ARRA.

GTP's Recent Efforts on Geothermal Heat Pumps (GHP)

- DOE funded two studies from Oak Ridge National Lab (Pat Hughes) and Navigant Consulting to identify existing market barriers that constrain greater GHP market adoption
- Key barriers identified (ORNL)
  - **Tier 1 -**
    1. High first-cost of GHP systems to consumers – Most important!
  - **Tier 2**
    1. Lack of consumer knowledge and/or trust in benefits
    2. Lack of policymaker/regulator knowledge and/or trust in benefits
    3. GHP design and business planning infrastructure limitations
    4. GHP installation infrastructure limitations
  - **Tier 3**
    1. Lack of new technologies and techniques to improve GHP system cost/performance

Major Elements in the American Recovery and Reinvestment Act of 2009 (ARRA)

- $400 million for geothermal activities!
- ITC can be taken in lieu of the PTC
- Tax incentives for a variety of energy efficient and renewable energy technologies, including GHPs
- $3.2 billion will go toward Energy Efficiency and Conservation Block Grants
- The act also stipulates that $3.1 billion of EERE funds will go toward the State Energy Program
- $6 billion to support loan guarantees for renewable energy and electric transmission technologies. The funds are expected to guarantee more than $60 billion in loans. that involve renewable energy, electric transmission, or leading-edge biofuel technologies.

ARRA 2009 – Provides ~$400M for Geothermal Activities & Projects

- $2.5 billion in direct spending for renewable energy and energy efficiency R&D, demonstration and deployment activities.
  - ~$400M funding for geothermal activities & projects –
  - Will enable DOE to fully implement RD&D goals set forth by the 2007 Energy Independence and Security Act of 2007 (EISA)
    - Section 613 – Hydrothermal R&D
    - Section 614 - General Geothermal Systems R&D
    - Section 615 - Enhanced Geothermal Systems R&D
    - Section 616 - Geothermal Energy Production from Oil and Gas Fields and Recovery and Production of Geopressured Gas Resources
    - Section 620 – Educational Pilot Program
    - Section 625 - High Cost Region Geothermal Energy Grant Program

ARRA 2009 Tax Incentives – A Big Boost for GHPs!

- ARRA also extended and improved tax incentives for GHP systems. Effective January 1, 2009:
  - Residential systems
    - Up to 30% of total GHP system cost – without the cap of $2K from 2008 law (EESA)
      - Credit capped at $2000 for equipment placed in service in 2008
    - Credit is unlimited for 2009 thru 2016, can be used to offset AMT tax, combined with solar/wind tax credits, and utilized in more than one year
  - Commercial Systems
    - Up to 10% of total GHP system cost without limit.
    - Credit can be used to offset AMT tax, in conjunction with subsidized financing, and utilized in more than one tax year.
    - Accelerated Depreciation – (5 year MACR depreciation for entire GHP system. Eligible for bonus depreciation in 2009 (50% write-off in first year)
    - ARRA allows for 10% grant in lieu of the energy credit for GHPs placed in service (or begun construction) during 2009-2010
  - For more information, visit www.geoexchange.org or IRS.gov.

American Recovery and Reinvestment Act of 2009

Activity	Description
EGS/Low Temperature, Oil and Gas Demonstrations	Cooperative agreements to investigate advanced reservoir stimulation techniques for EGS in various geological and geographic settings.
EGS Technology R&D	EGS R&D topics include a variety of modeling tools, component R&D and working fluids
Industry Coupled Drilling	DOE's objective is to reduce the high level of risk during the early stages of geothermal project development by funding exploration activities to locate new well sites
National Geothermal Data, Resource Assessment and Classification	Public access to a range of geothermal related data, including the USGS resource assessment data and classification system, will help reduce costs and risks associated with implementing EGS technology for large-scale power generation.
Education and Workforce Development	Creating a competent workforce will accelerate technology deployment and advance the overall technical level of the industry
Ground Source Heat Pumps	Increase the deployment of geothermal heat pumps (GHPs)

DOE's Next Steps

- DOE anticipates the release of several Funding Opportunity Announcements (FOAs) targeted to each of these six major program areas.
- The FOA for GHPs may hit the street as early as May-June 2009.
- The exact content, funding levels, and release schedule will depend on OMB approval

Back Up Slides

Cost-shared step-out approach to Field Projects

EGS Award	Partnered With	Award Amount
AltaRock Energy Inc.	NCPA, University of Utah, TAMU, SAIC, Temple University	$6,014,351
Geysers Power Co.	Lawrence Berkeley National Laboratory	$5,697,700
ORMAT Nevada, Inc.	Geothermex, Lawrence Berkeley National Laboratory, University of Utah, Pinnacle Technologies, GeoMechanics International, UNR, TerraTek/Schlumberger	$3,374,430
University of Utah	U.S. Geothermal, APEX Petroleum Engineering Services, HiPoint Reservoir Imaging, Chevron	$8,928,999
Low Temp Award	**Partnered With**	**Award Amount**
Jay Field	Chena Power, Quantum Resources Management, and UTC Power	$1,448,000

Awarded in FY 2008

The International Partnership for Geothermal Technology

Signed August 28, 2008

Founding Partners: Australia, Iceland, U.S.

Partnership Goals:

1) Exchange of information on best practices and lessons learned
2) Accelerate RD&D
3) Identify and avoid blind alleys
4) Maximize our efforts, limit duplication

International Partnership for Geothermal Technology

Collaboration to accelerate the development of advanced geothermal technologies

FY 2009 – Key Activities

- Announce FOAs for EGS demonstration sites and Component R&D
- Announce Lab call for identified EGS research and development needs
- Release Technology Evaluation Reports *(Drilling and Energy Conversion)*
- Chair IPGT 1st year
- Release Results of Jay Field Coproduction effort with Oil and Gas
- Develop MOU with DOI (BLM)
- Pursue Joint R&D efforts with California Energy Commission
- Develop Analytical Capabilities (i.e., market, value chain, climate, etc)
- Evaluate market barriers to ground source heat pumps deployment
- Undertake detailed systems analysis (climate, market, risk, value chain)
- Develop Baseline EGS Cost data

FY2009 will be a critical year!