Measuring the Costs and Economic, Social, and Environmental Benefits of Nationwide Geothermal Heat Pump Deployment and The Potential Employment, Energy, and Environmental Impacts of Direct Use Applications

May 18, 2010

Principal Investigator:
Liz Battocletti
Bob Lawrence & Associates, Inc.

Ground Source Heat Pump Demonstration Projects

Mandatory Overview Slide

- Timeline
  - 29 January 2010 - 31 January 2013
- Budget
  - Total project funding: $1,878,333
  - DOE share: $1,499,601
  - Awardee share: $378,732
  - Funding for FY10: $627,151
- Barriers
  - Ground Source Heat Pumps - Reduce levelized cost of electricity ($/ton) by 30% by 2016
- Partners
  - Bob Lawrence & Associates, Inc. (BL&A)
  - California Geothermal Energy Collaborative (CGEC)
  - Geo-Heat Center, Oregon Institute of Technology (GHC-OIT)

Relevance/Impact of Research

Project objectives:

- To measure the costs and economic, social, and environmental benefits of nationwide geothermal heat pump (GHP) deployment => Geothermal Heat Pump Cost-Benefit Analysis

- To survey selected states as to their potential employment, energy use and savings, and environmental impact for direct use applications => Geothermal Direct Use Analysis and Technical Assistance

(1) Geothermal Heat Pump Cost-Benefit Analysis (CBA)

- Addresses findings of Oak Ridge National Laboratory 2008 study
  - Need to assemble independent, hard data on costs and benefits of GHPs.
  - Need to independently assess the national benefits of GHP deployment.
- Led by BL&A and CGEC
  - BL&A – lead on overall CBA
  - CGEC – lead on geographic analysis
    - Focus on 30 largest U.S. metropolitan areas

Scientific/Technical Approach

30 largest U.S. metropolitan areas *

Group 1 – Year 1	Group 2 – Year 2	Group 3 – Year 3
1. New York-Northern New Jersey-Long Island, NY-NJ-PA	11. Detroit-Warren-Livonia, MI	21. Denver-Aurora, CO
2. Los Angeles-Long Beach-Santa Ana, CA	12. Phoenix-Mesa-Scottsdale, AZ	22. Pittsburgh, PA
3. Chicago-Naperville-Joliet, IL-IN-WI	13. San Francisco-Oakland-Fremont, CA	23. Portland-Vancouver-Beaverton, OR-WA
4. Dallas-Fort Worth-Arlington, TX	14. Riverside-San Bernardino-Ontario, CA	24. Cincinnati-Middletown, OH-KY-IN
5. Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	15. Seattle-Tacoma-Bellevue, WA	25. Sacramento--Arden-Arcade--Roseville, CA
6. Houston-Sugar Land-Baytown, TX	16. Minneapolis-St. Paul-Bloomington, MN-WI	26. Cleveland-Elyria-Mentor, OH
7. Miami-Fort Lauderdale-Pompano Beach, FL	17. San Diego-Carlsbad-San Marcos, CA	27. Orlando-Kissimmee, FL
8. Atlanta-Sandy Springs-Marietta, GA	18. St. Louis, MO-IL	28. San Antonio, TX
9. Washington-Arlington-Alexandria, DC-VA-MD-WV	19. Tampa-St. Petersburg-Clearwater, FL	29. Kansas City, MO-KS
10. Boston-Cambridge-Quincy, MA-NH	20. Baltimore-Towson, MD	30. Las Vegas-Paradise, NV

* U.S. Census Bureau, Population Division, Release Date: March 19, 2009

Scientific/Technical Approach

(1) Geothermal Heat Pump Cost-Benefit Analysis

- Literature survey
- Data collection and database creation
- Cost-benefit analysis of nationwide geothermal heat pump deployment, using hard data to calculate the real costs and lifetime benefits of GHPs
- Web-accessible portal
- Technical papers and presentations

(2) Geothermal Direct Use Analysis and Technical Assistance

- Survey six (6) states as to their potential employment, energy use and savings, and environmental impact for direct use applications
- Continue to provide technical support to increase the direct use of geothermal resources in the U.S.
- Led by GHC-OIT

(2) Geothermal Direct Use Analysis and Technical Assistance

- Direct use surveys of six (6) states
- Technical assistance on geothermal direct use applications
  - *Quarterly Bulletin* (12 issues)
  - Website (http://geoheat.oit.edu/)
  - Technical papers and presentations

Fiscal Year 2010 Milestones

- ARRA and DOE-GTP quarterly progress reports
- Presentation at CGEC Forum
- *Quarterly Bulletin* (2)
- Data collection – site visits and surveys
- Initial geographic database with preliminary data
- Draft subset of published maps and datasets
- Sub-report (1) of GHP CBA
- State report (1)

Award finalized on 24 February 2010

Progress to date:

- Project start-up, subcontracts finalized, action plan developed
- Training
  - International Ground Source Heat Pump Association (IGSHPA)-accredited training through HeatSpring Learning Institute (February 2010)
  - PI certified as an accredited Ground Source Heat Pump Loop Installer, and received a certificate from ISCO Industries in Butt Fusion and Socket Fusion

Accomplishments, Expected Outcomes and Progress

- Research and literature survey underway
- Data collection underway
- Technology transfer
  - Abstract accepted for presentation at the 2010 Geothermal Resources Council (GRC) Annual Meeting
  - PI joined IGSHPA, the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), and the National Groundwater Association (NGWA)
  - PI will present project at the California Geothermal Energy Collaborative Forum on 10 May 2010
- Geothermal Contact Database (GCD) updated – currently contains 3,507 people

(1) Geothermal Heat Pump Cost-Benefit Analysis
Planned accomplishments/outcomes:

- Database containing the specific costs and benefits of GHP use in 30 major metropolitan areas
- Web-accessible portal for public access
- Biannual sub-reports (5)
- Final CBA report
- Technical papers and presentations

(2) Geothermal Direct Use Analysis and Technical Assistance

Planned accomplishments/outcomes:

- State surveys (6)
- *Quarterly Bulletins* (12)
- Technical papers and presentations

Project Management/Coordination

- Effort is led by seasoned, successful, and highly experienced Geothermal R&D support project managers with decades of experience:
  - Bob Lawrence is the lead individual for the overall Project Team. Dr. Lawrence has over 35 years of R&D management experience.
  - Liz Battocletti (PI)
  - John Lund and Toni Boyd (GHC-OIT)
  - Bill Glassley (CGEC)
- BL&A, CGEC, and the GHC-OIT will work closely with the National Geothermal Data System to ensure data are provided to the system as requested.

Future Directions

Fiscal Year 2011 Milestones

- ARRA and DOE-GTP quarterly progress reports
- DOE-GTP annual progress report
- *Quarterly Bulletin* (4)
- Data collection site visits and surveys
- Technical paper for GRC Annual Meeting
- Sub-reports (2) of GHP CBA
- State reports (2)
- Geographic regional compilation

Mandatory Summary Slide

Estimated economic benefits of increased GHP deployment

	2007	At 10% of Total HVAC Market	At 33% of Total HVAC Market
Employment (person-years)	1,219	7,901	26,074
Domestic Manufacturers	17	110	364
Shipments	86,396	560,000	1,848,000
Revenue ($,000s)	$218,972	$1,419,329	$4,683,785
Annual North American HVAC Market (2008)	5,600,000	5,600,000	5,600,000
Percentage of Total HVAC Market	1.54%	10%	33%

If GHPs accounted for 33% of the U.S. market, annual revenues would total $4.68 billion with 26,074 person-hours of employment. This estimate does not factor in increased taxes or decreased GHG emissions reductions, both which would be substantial.

Mandatory Summary Slide

- Using low- and moderate-temperature geothermal resources for heating, cooling, and direct use applications can significantly help DOE achieve its key Strategic Goals of:
  - diversifying the country's energy portfolio,
  - reducing the country's dependence on oil, and
  - ameliorating the environmental impacts of energy production and use.