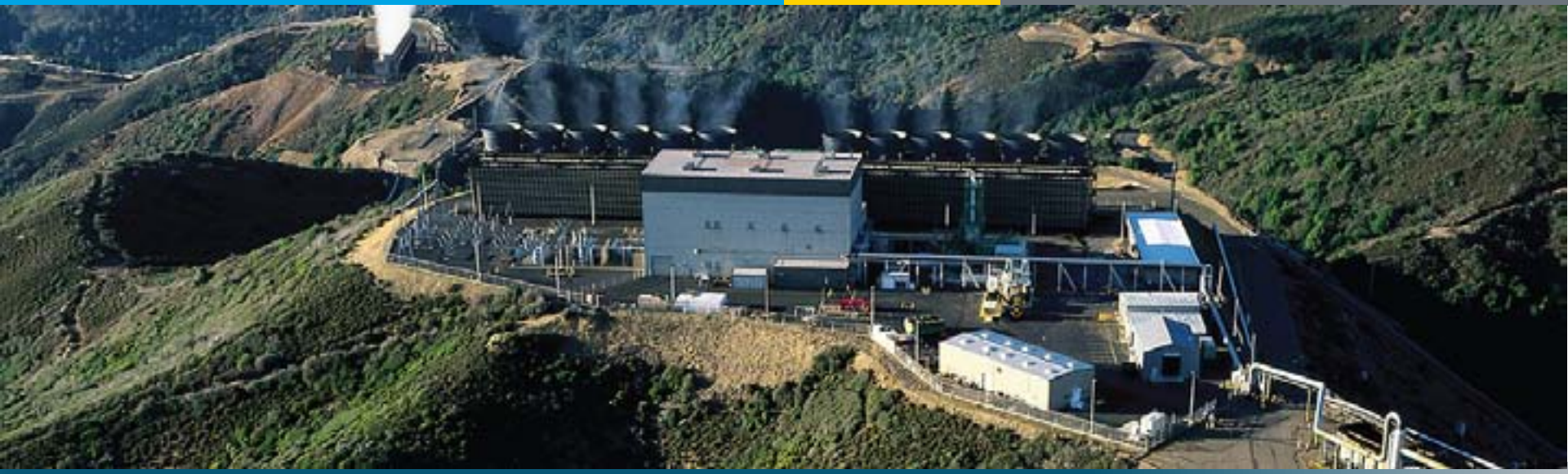
U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy



Ground Source Heat Pump Subprogram Overview

May 18, 2010

Geothermal Technologies Program Peer Review

Crystal City, VA

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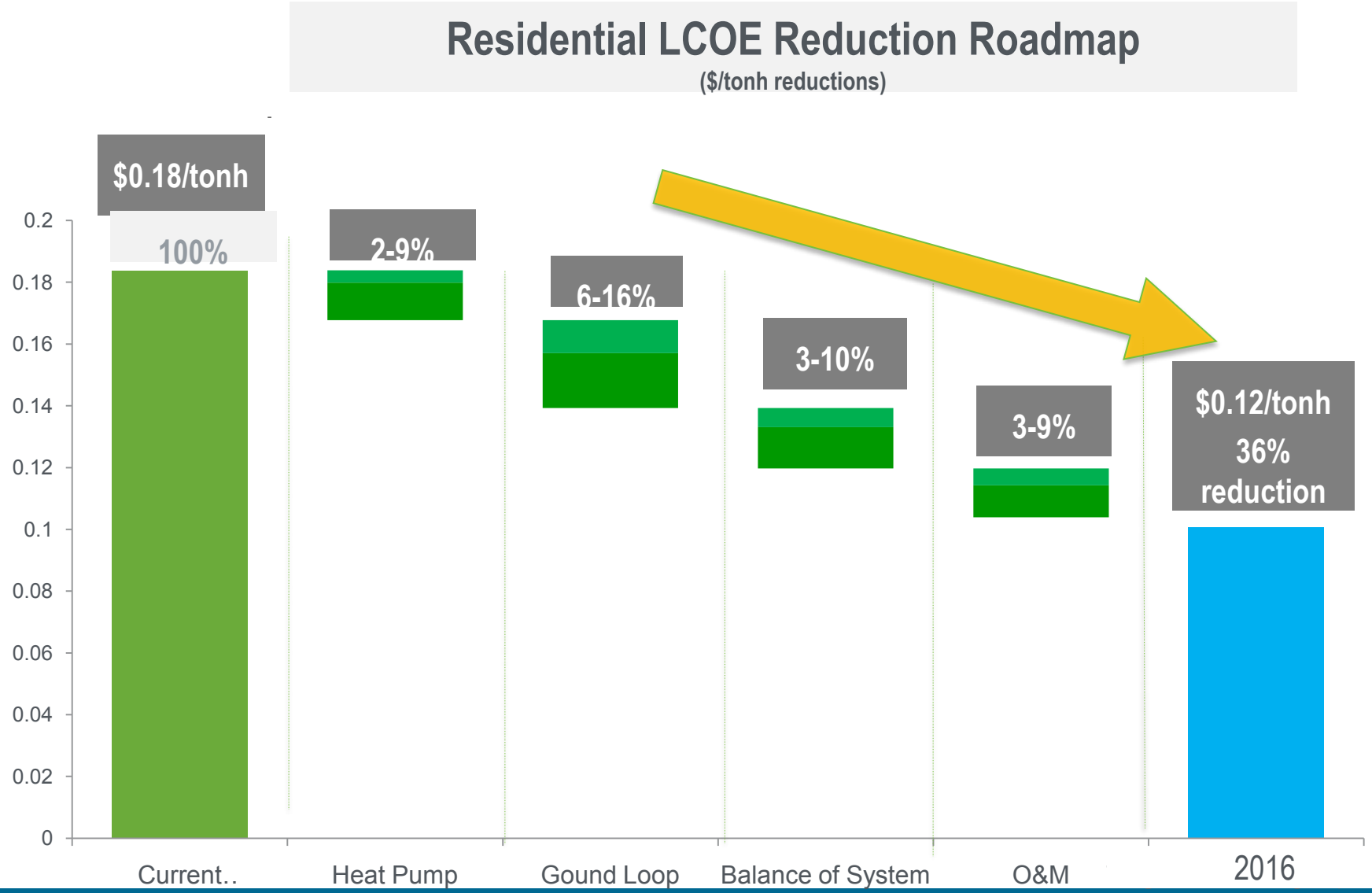
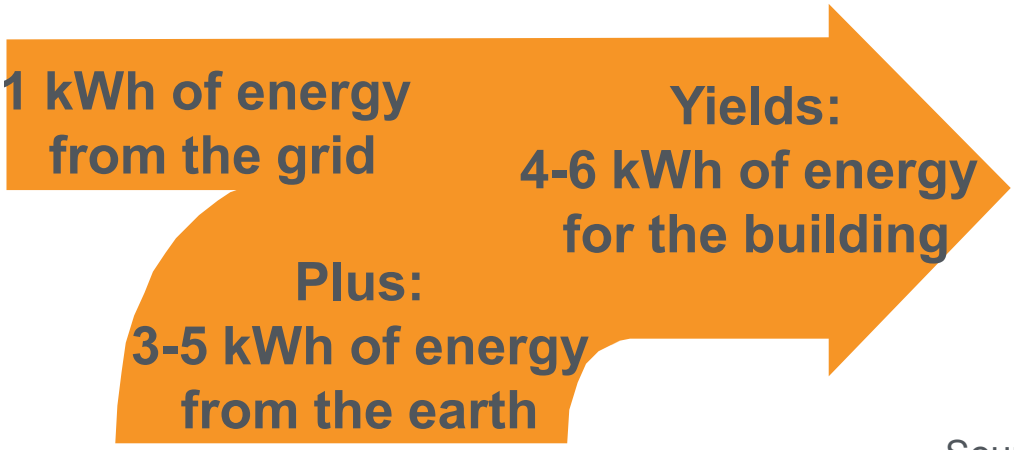
Geothermal Technologies Program
Office of Energy Efficiency and Renewable Energy
U.S. Department of Energy

Technology Pathway



Opportunity



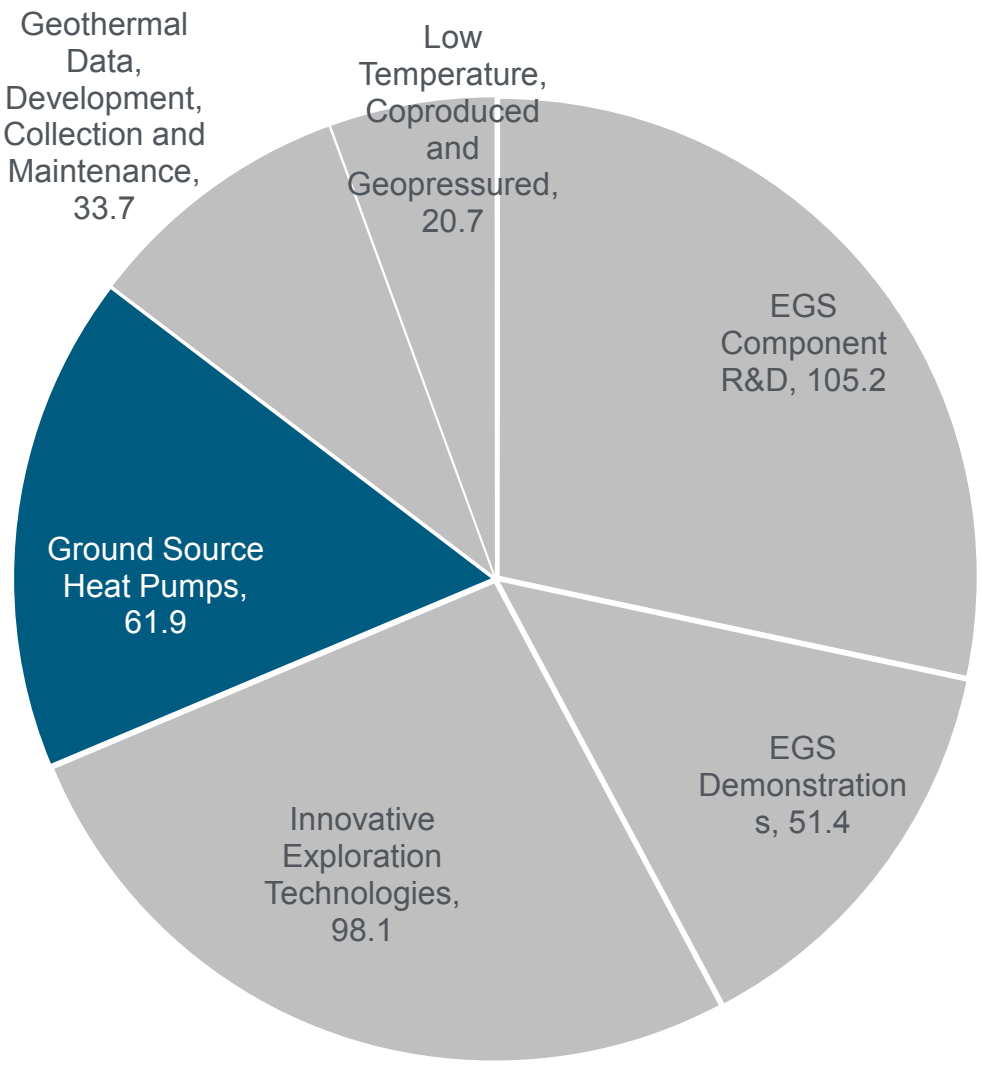
Source: Climate Master

400-600% Efficient

- GHPs use 30 to 60% less energy than typical furnaces with air conditioners
- Increased efficiency comes from using the Earth as a heat source or sink

DOE Investments

- Recovery Act provided $62 million for GSHPs 50 Ton minimum per project
- (http://apps1.eere.energy.gov/geothermal/projects/by_technology.cfm)
- 25 demonstrations awardees include commercial and multi-residential demonstration projects



Projects

- Recovery Act set 50 Ton minimum per project—Largest is 15,000 tons
- http://apps1.eere.energy.gov/geothermal/projects/by_technology.cfm
- 25 awardees include commercial and multi-residential demonstrations

Projects are located at universities (Ball State see photo right) reqjuired they train water well drillers for high volome

- **Farms**
- **Solid waste processing facility**
- **Courthouse, Prison**
- **Ice rink**
- **Military installation**
- **Theater, Museum**
- **Private businesses**

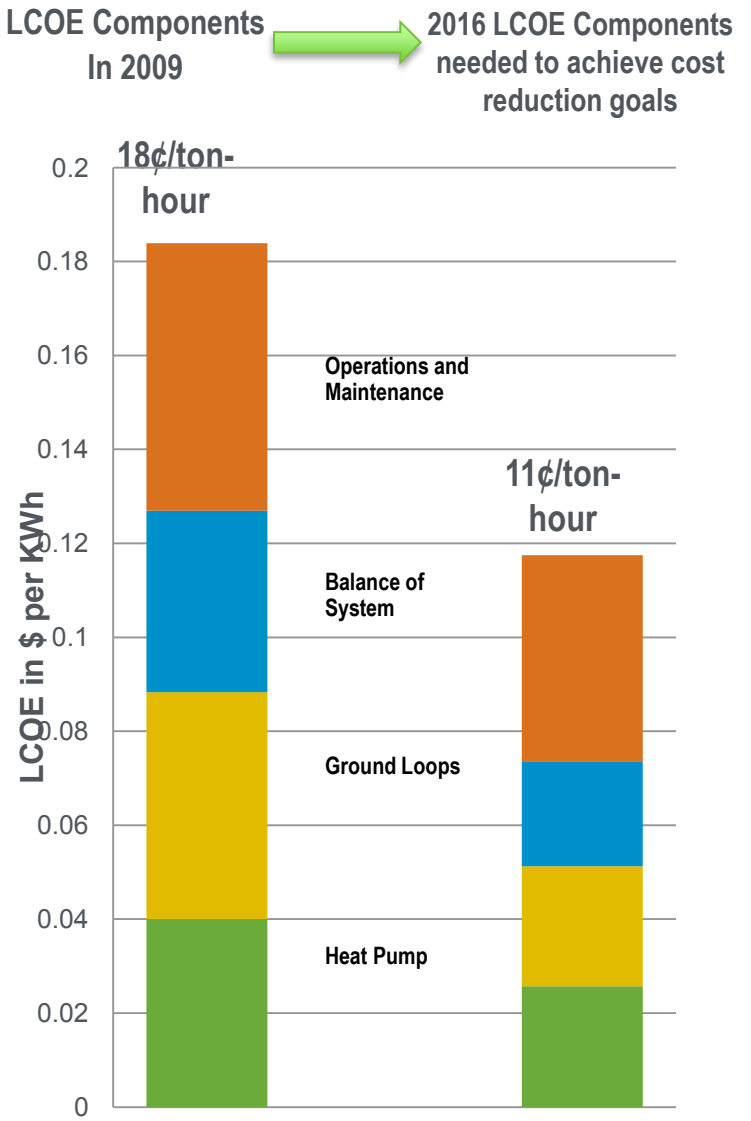
New heat 'sources' include water-filled abandoned mines, waste water, and and a 'river source' loop

Short-term Goals: Residential LCOE

SHORT TERM: *By 2016 reduce upfront cost by 30% (compensate for tax credit expiration) right>

Goal of external expert group: a 10-fold increase in GSHP market penetration by 2016!

- Given uncertainty over future program existence, long term goals have not been finalized
- Your comments on these goals and suggestions for other goals are highly encouraged.



DOE's will attack key market barriers that have prevented GSHPs from reaching their full commercial potential:

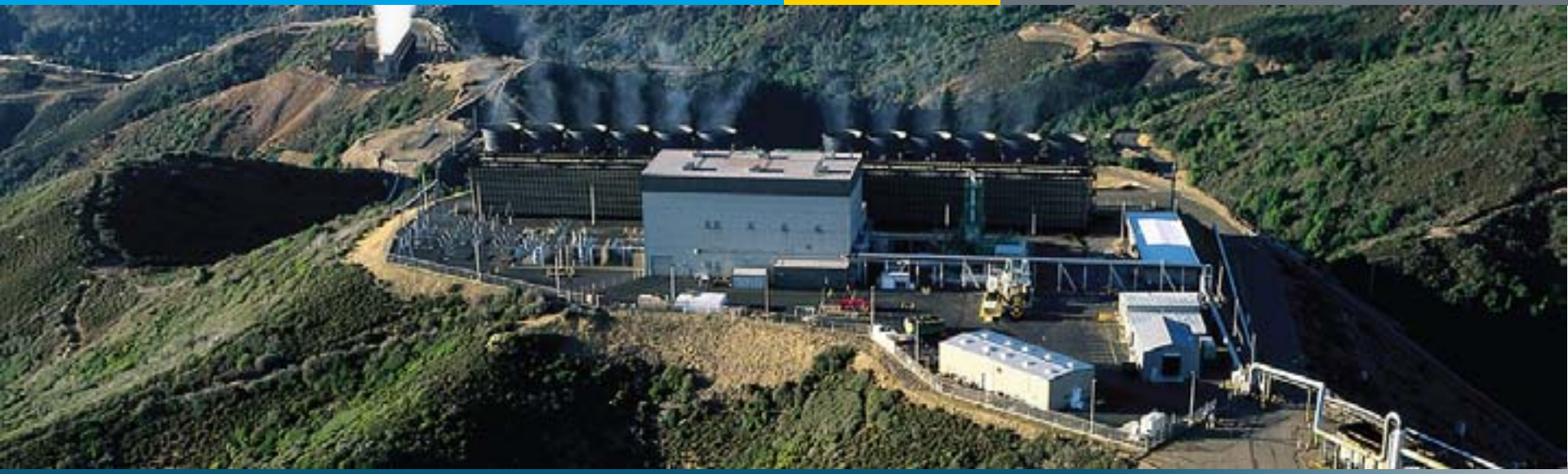
- Limited consumer knowledge and trust in GHP systems
- High installation cost
- Lack of business and financing approaches to address first cost
- Insufficient infrastructure of trained designers, installers and drillers

DOE actions to remove these barriers include:

- Provide high quality performance and cost data from all demos to consumers and engineers
- Better data plus certification project will increase consumer trust
- Learning by doing in demos, incentives will reduce installation cost
- Demonstration of many new business and financing approaches (e.g. Innovative Financing Model, "Micro-Utility", State Tax-Increment Financing, "Micro Green Utility, State Lottery Funds, Low-Interest Loans, Energy Performance Contracts) will lower initial costs.
- Each demo will serve as a catalyst for infrastructure in its own region.

What's Next?

- At **DOE**, a brand new subprogram??—GSHP staff in the process of moving to the Buildings Technology Program
- The **GSHP industry**—has been growing at 40% per year—but still only 1% of market
- **Utilities** call GSHP 'the bomb' because of its enormous efficiency increase (30-60%) and load leveling.
- **Water well drillers** could be switching from a declining to a rapidly expanding industry.
- **Climate Change Policymakers** are starting to see GSHP as a major solution (e.g. NAS report).
- **Building owners**, from Homeowners to Municipalities to the Federal Government need to join the ground source heat pump club.
- But we have to convince them and for that **we need YOU** and



Thank you!

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Municipal GSHPs

- GHSPs can be competitive with typical HVAC systems in city-wide applications on first- and life-cycle cost basis
- Based on a DOE/ORNL study of 18 schools (200 tons) in Lincoln, NE

The Test:

•GHPs compared with standard HVAC options (air-cooled chiller, VAV air handling system, and gas-fired hot water boiler

•54 GHP units, 200 tons, 120 vertical loops

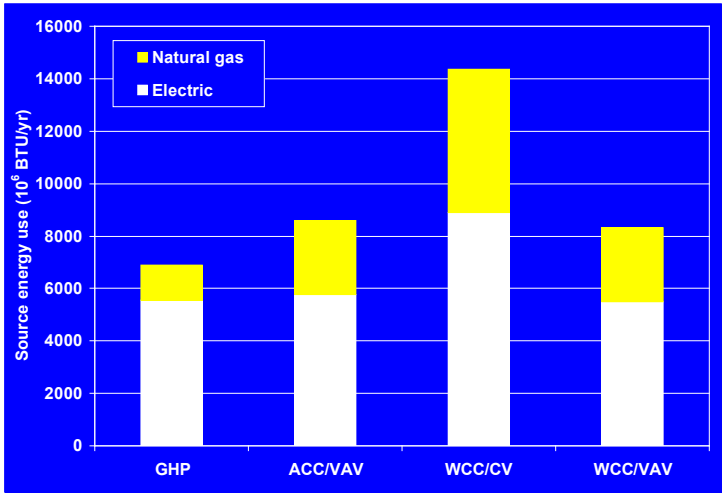
Results: Geothermal Wins!

•Lowest first &lifecycle cost

•Lower maintenance cost

•Reduced energy use (17%)

•Reduced energy costs (24%)



Source: ORNL

	Baseline Geothermal	Option 1 ACC/VAV	Option 2 WCC/CV	Option 3 WCC/VAV
Initial Cost	**$1,021,257**	**$1,129,286**	**$835,916**	**$1,164,268**
First year maintenance cost	$7,383	$7,824	$13,651	$7,928
First year electric cost	$22,138	$23,037	$34,152	$19,448
First year gas cost	$3,533	$10,963	$23,944	$11,034
Water cost			$385	$385
Total annual O&M costs	**$33,054**	**$41,824**	**$73,826**	**$38,795**
Life Cycle Cost	**$1,498,835**	**$1,734,327**	**$1,912,297**	**$1,728,736**