

NAVIGANT

ENERGY

R&D Roadmap for Ground-Source Heat Pumps

*Discussion Forum –
IGSHPA Conference 2011*



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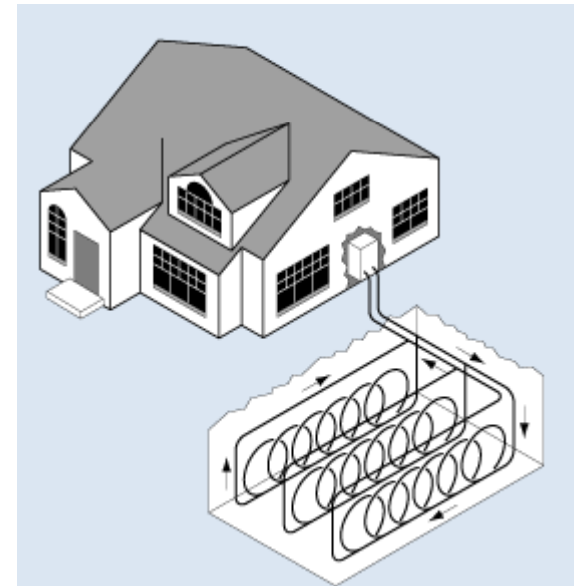
Brainstorming Tasks

5

Additional Questions

Navigant Consulting Inc.,
on behalf of the United States Department of Energy,
welcomes you to this forum on
Ground-Source Heat Pumps

- » Introductions
- » Logistical information
- » Brief project overview / purpose



The Department of Energy aims to:

Facilitate research and development on advanced GSHP technologies that reduce the barriers to greater market penetration.



How?

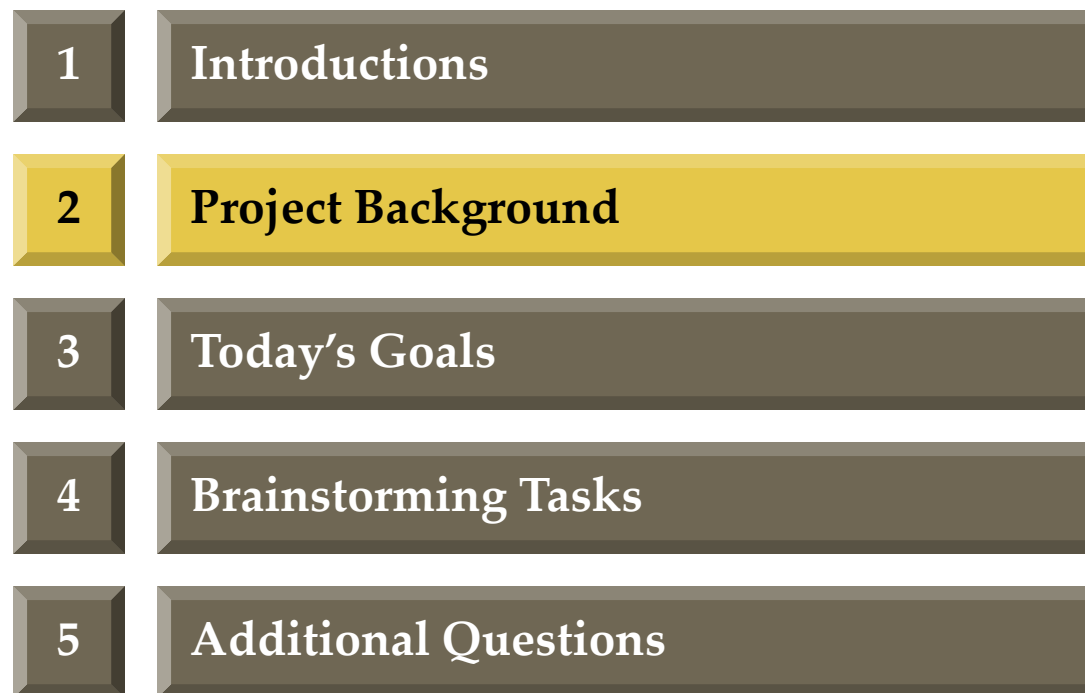
By supporting research and development activities, including developing analysis tools, participating in pilot testing and evaluations, and testing & evaluating equipment.

How does this forum help?

By aggregating stakeholder feedback that the Department will use directly in creating an R&D roadmap, including tasks and potential roles for various stakeholders.

Image:
http://msdadmin.scican.net/mhs/mhs_area_imc/webquests/The%20Giver/Pictures/globe3.jpg

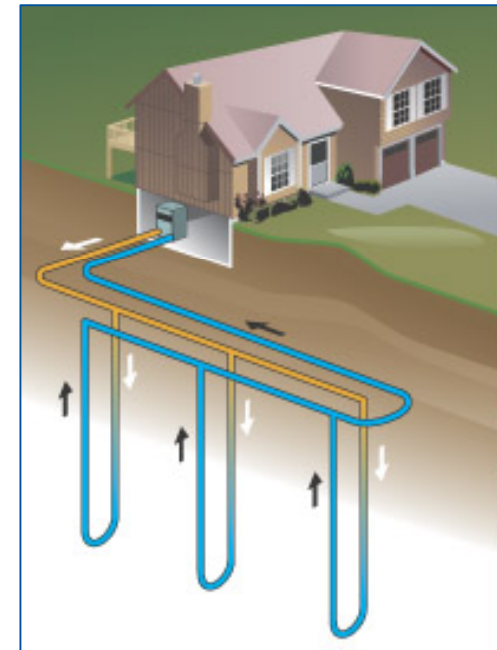
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High Efficiency GSHPs have proven primary energy savings of upwards of 50%.

Average Primary Energy Savings vs. Baseline Technologies

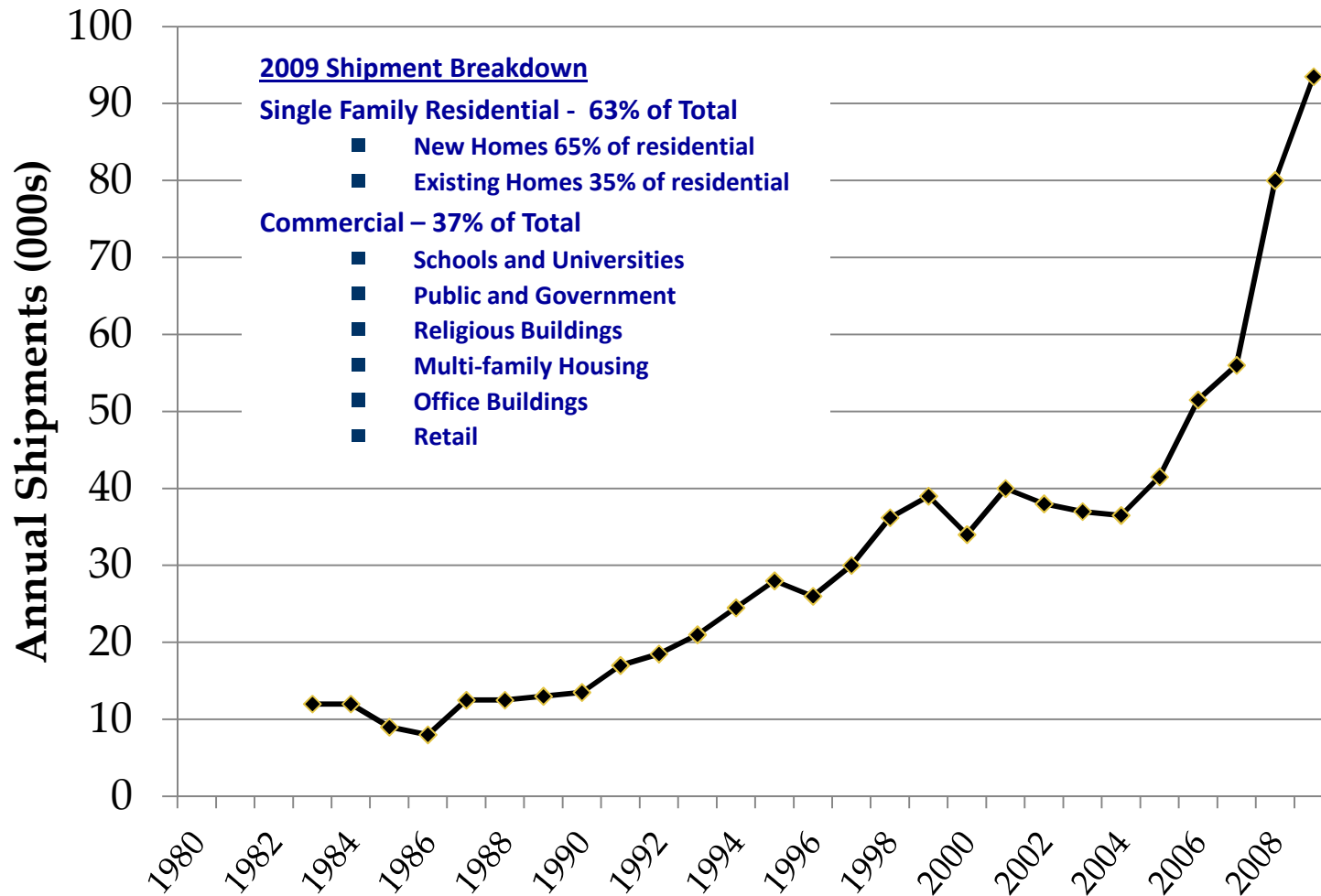
		Advanced ASHP	Typical-Efficiency GSHP	High-Efficiency GSHP
Residential	Vs. Typical ASHP	20-30%	25-50%	50-70%
	Vs. Typical Furnaces and A/C	20-30%	25-30%	50-60%
Commercial	Vs. Typical ASHP	5-10%	20-45%	45-60%



Data Source: NCI 2009.
 Photo Source: http://www1.eere.energy.gov/geothermal/pdfs/gshp_overview.pdf

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Since 2005, GSHP annual shipments more than doubled to almost 100k units/yr; however, this is only 2% of the air conditioner and air-source heat pump market (5.1MM/yr).



Source: <http://www.waterfurnace.com/downloads/Shareholders2010.pps>
<http://buildingsdatabook.eren.doe.gov/TableView.aspx?table=5.3.1>
http://www.eia.gov/cneaf/solar_renewables/page/ghpsurvey/ghpssurvey.html

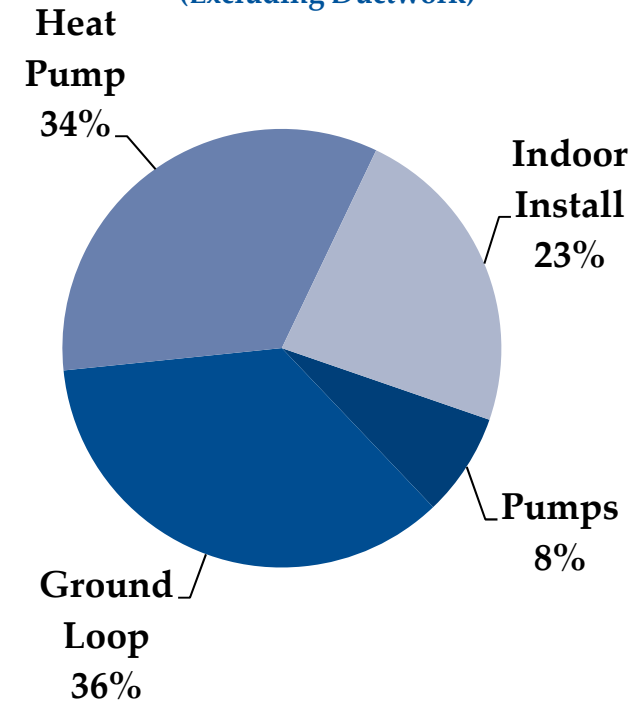
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A high efficiency residential air-source heat pump is generally less expensive than a GSHP.

	Cooling Efficiency (SEER)	Heating Efficiency (COP)	Typical Installed Cost (\$/Ton)
Air-Source	13 – 17	2.3 – 3.1*	\$1,450 – \$2,300
Ground-Source	16 – 30	3.4 – 5.0	\$3,000 – \$5,250

Typical GSHP Installed Costs by Component

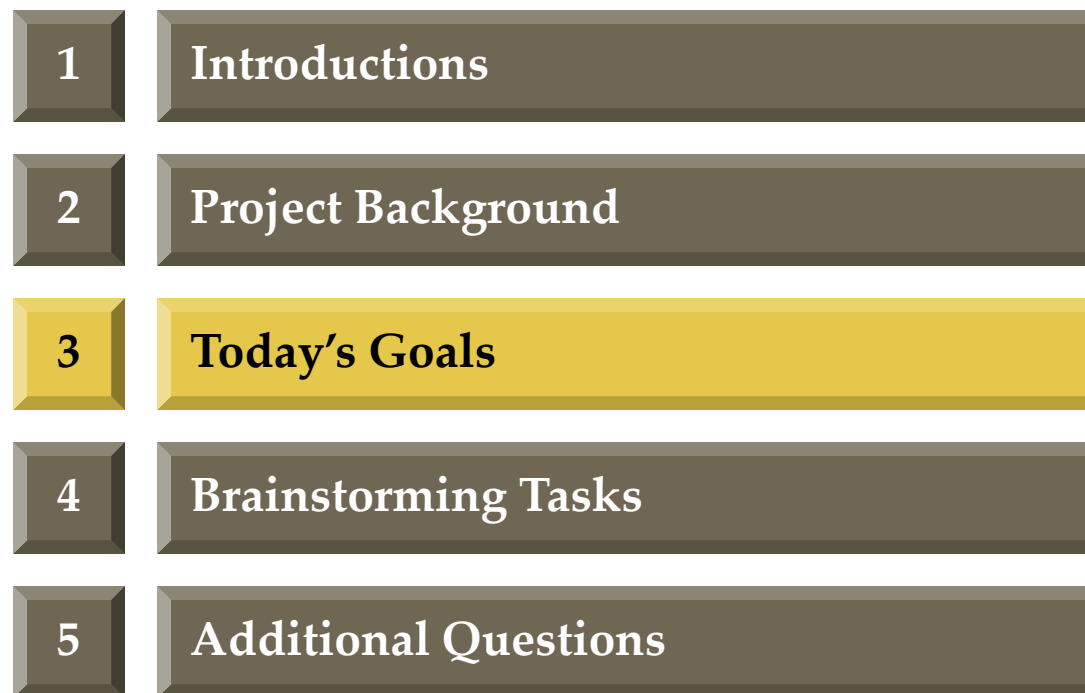
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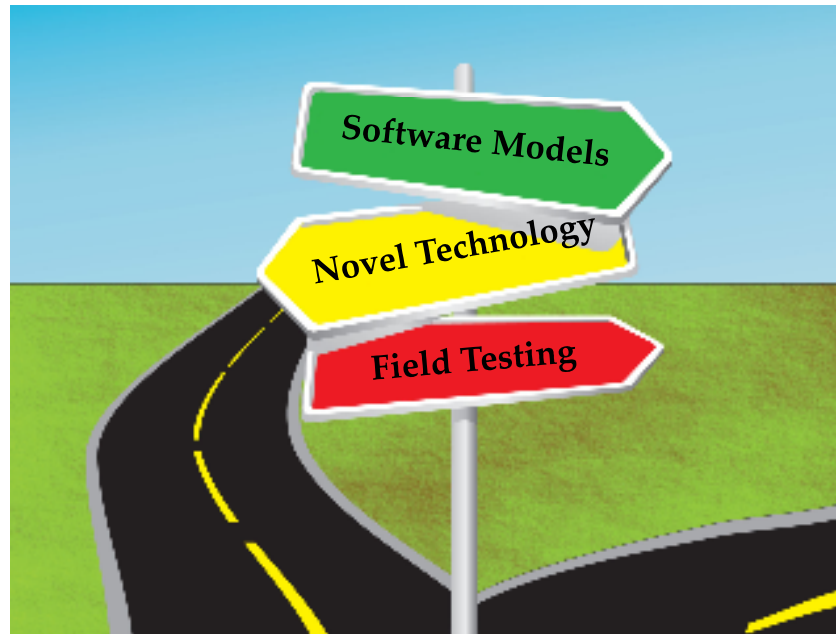
Data Source: http://www1.eere.energy.gov/geothermal/pdfs/gshp_overview.pdf

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*Calculated from HSPF

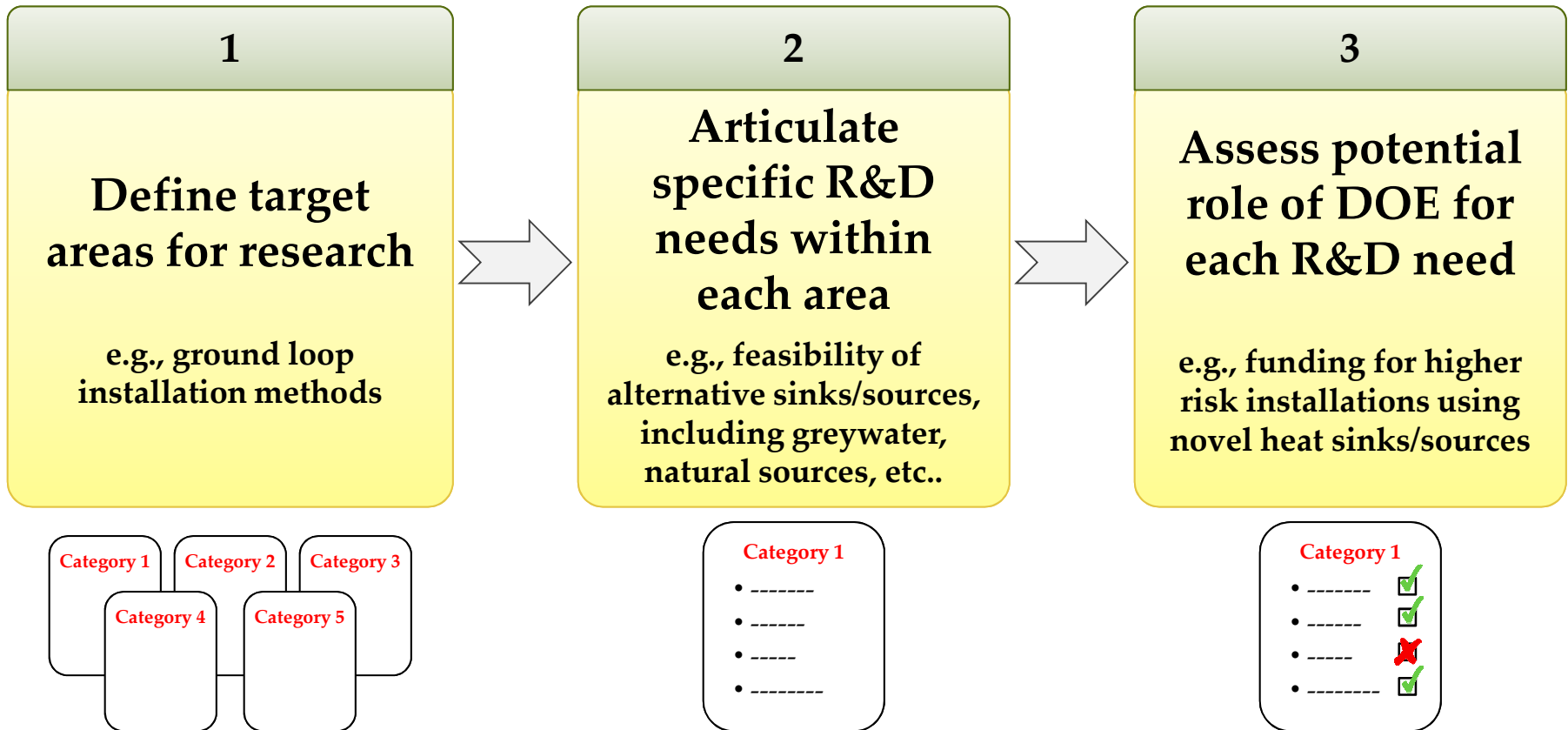
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The objective of this project is to create an R&D roadmap to enable the DOE to address barriers to adoption of ground-source heat pumps.



Today's discussion should focus on innovative and emerging ground-source heat pump related solutions for use in all sizes of residential and commercial buildings.

We plan to achieve these goals during today's forum:



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Task 1: Define different categories of research needs

Ground Loop

Ground Loop – heat exchanger designs, configurations, installation and monitoring

Other
Component
Technologies &
Processes

Other component technologies – drills, refrigerants, pumps etc.

System Design
and Analysis
Tools

System Design – Hybrid GSHP control strategies, optimization techniques, analytical tools, etc

Hybrid and
Combination
GSHP

Hybrid & Combination GSHP – e.g., GSHP + mine water and leveraging of existing heat sink/source options

Task 2: Articulate specific R&D needs for each category

Ground Loop	<ul style="list-style-type: none">• Materials• Designs• Reduced borehole resistance HX• Shape/structure, e.g., Concentric -tube HX
Other Component Technologies & Processes	<ul style="list-style-type: none">• Drilling processes and drill bits• Working fluids (CO₂, etc)
System Design and Analysis Tools	<ul style="list-style-type: none">• Optimize system efficiency and capital cost• Hybrid GSHP control algorithms• Optimized borefield analysis tools
Hybrid and Combination GSHP	<ul style="list-style-type: none">• GSHP + Mine water, sewage water, solar thermal, open loop, ponds/rivers, etc.

Task 3: Assess potential role for DOE for each R&D need. DOE Can assist by:

Ground Loop

- E.g., Materials – Supporting laboratory testing of materials...

Other Component Technologies & Processes

- E.g., Working Fluids (CO₂, etc) – Coordinating field demonstration and data analysis...

System Design and Analysis Tools

- E.g., Optimized borefield analysis tools – Guiding validation of software with field data...

Hybrid and Combination GSHP

- E.g, GSHP + wastewater – Expand educational outreach on combination systems across the U.S....

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Additional questions for discussion:

Are there any other relevant issues that we did not discuss today?

How should we solicit further feedback for this project?

Who else should we talk to?

Are there any other logical forums for stakeholder discussion?

We will provide a summary the information gathered today to anyone that has provided us with an email address.

Key CONTACTS



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**Please make sure that your name, company,
and email are on the sign-in sheet!**