

Ground Source (Geothermal) Heat Pumps: Their Role in Renewable Energy & Energy Efficiency Policy

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Colorado Geothermal Working Group
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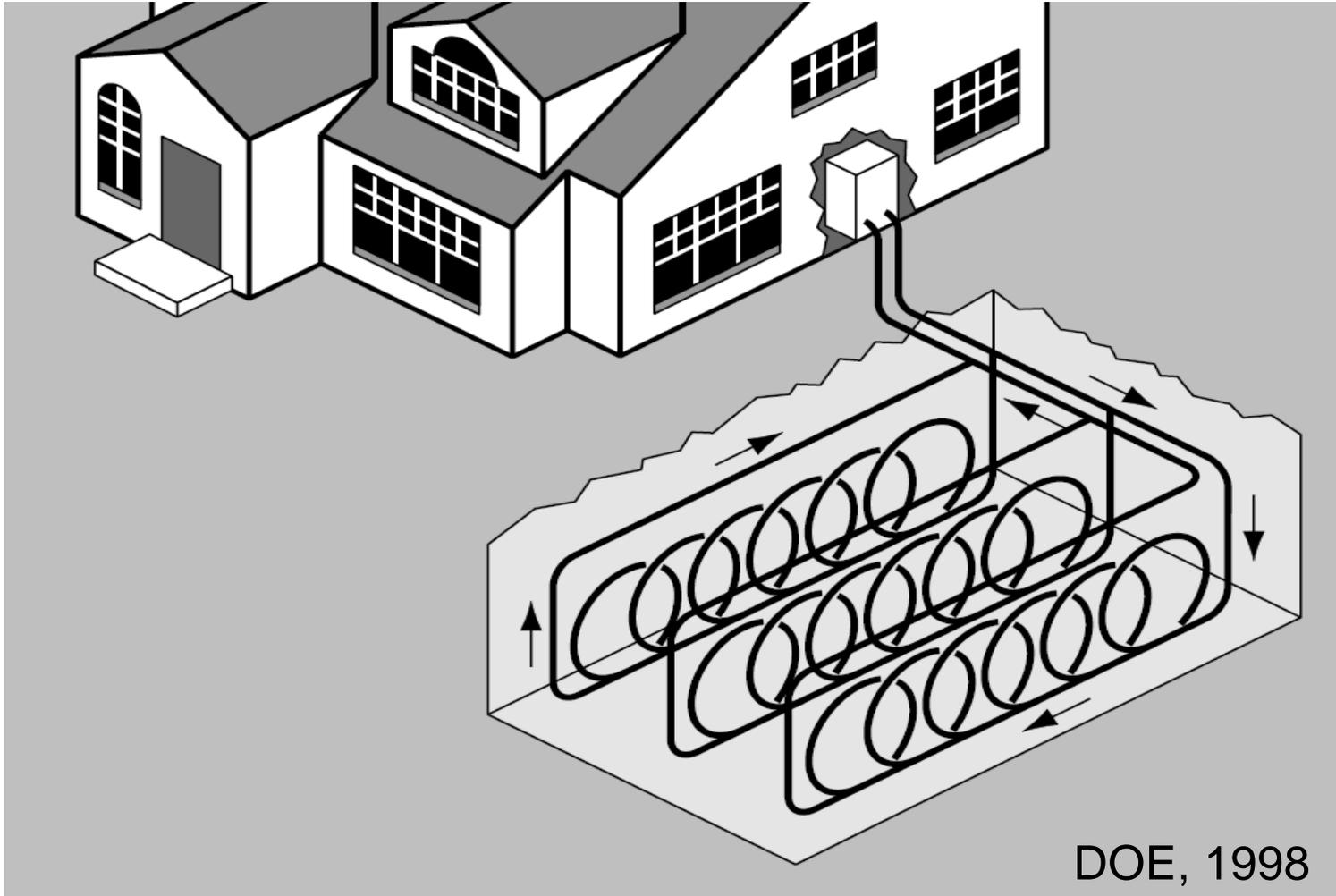
What are Ground Source Heat Pumps?

- GSHP are energy transport mechanisms used for space heating and cooling
- Do not burn fossil fuels to provide heat
- Concentrate heat from an energy source (ground) and release it indoors
- In cooling mode, work similar to an air conditioner except that the ground serves as the heat sink
- GSHP do not produce heat. They transfer thermal energy from one location to another.
- Can be paired with a desuperheater to provide hot water

Typical GSHP Configurations

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- Horizontal closed loop (slinky)



Typical GSHP Configurations

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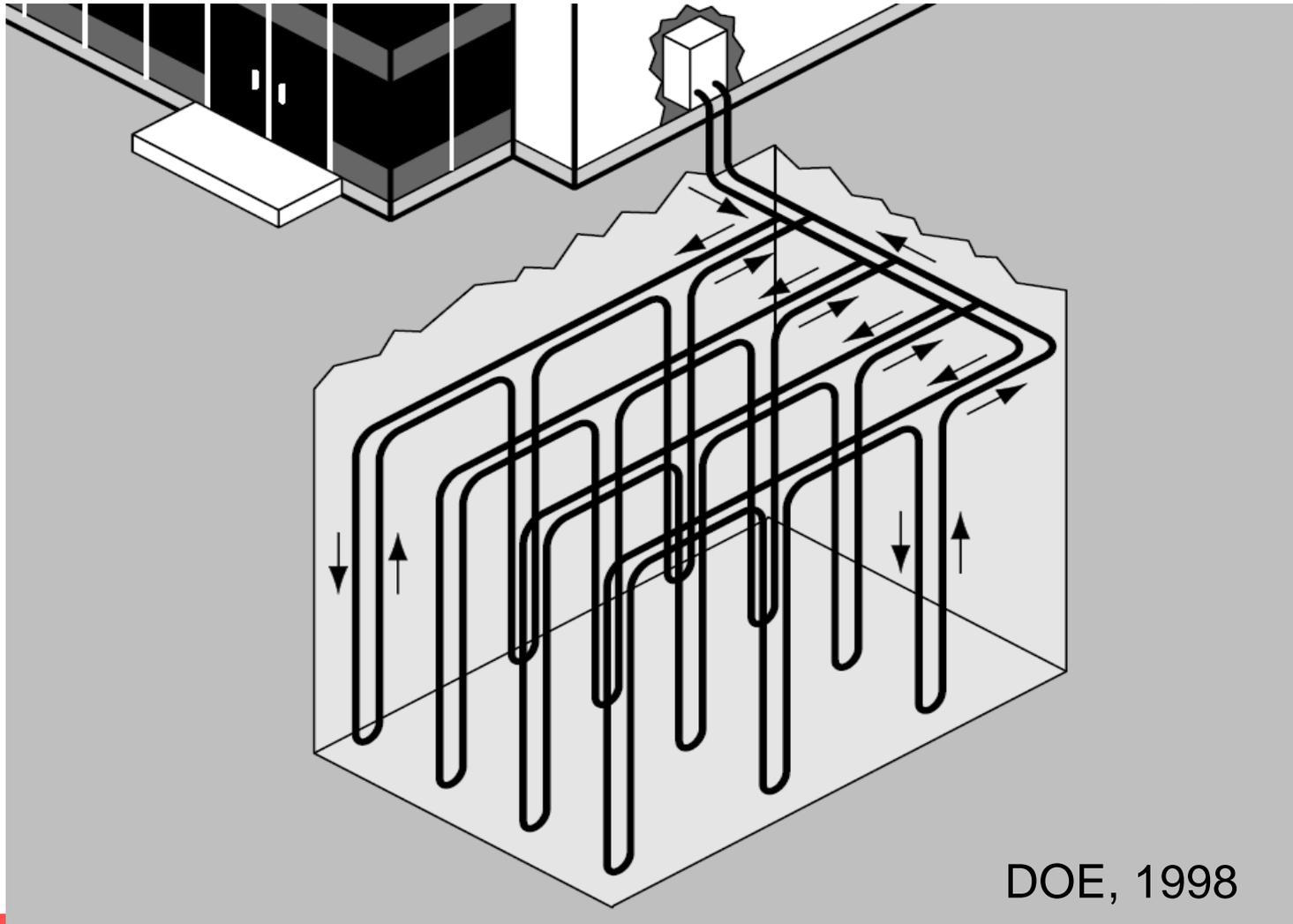
- Horizontal closed loop (slinky)



Typical GSHP Configurations

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➤ Vertical closed loop

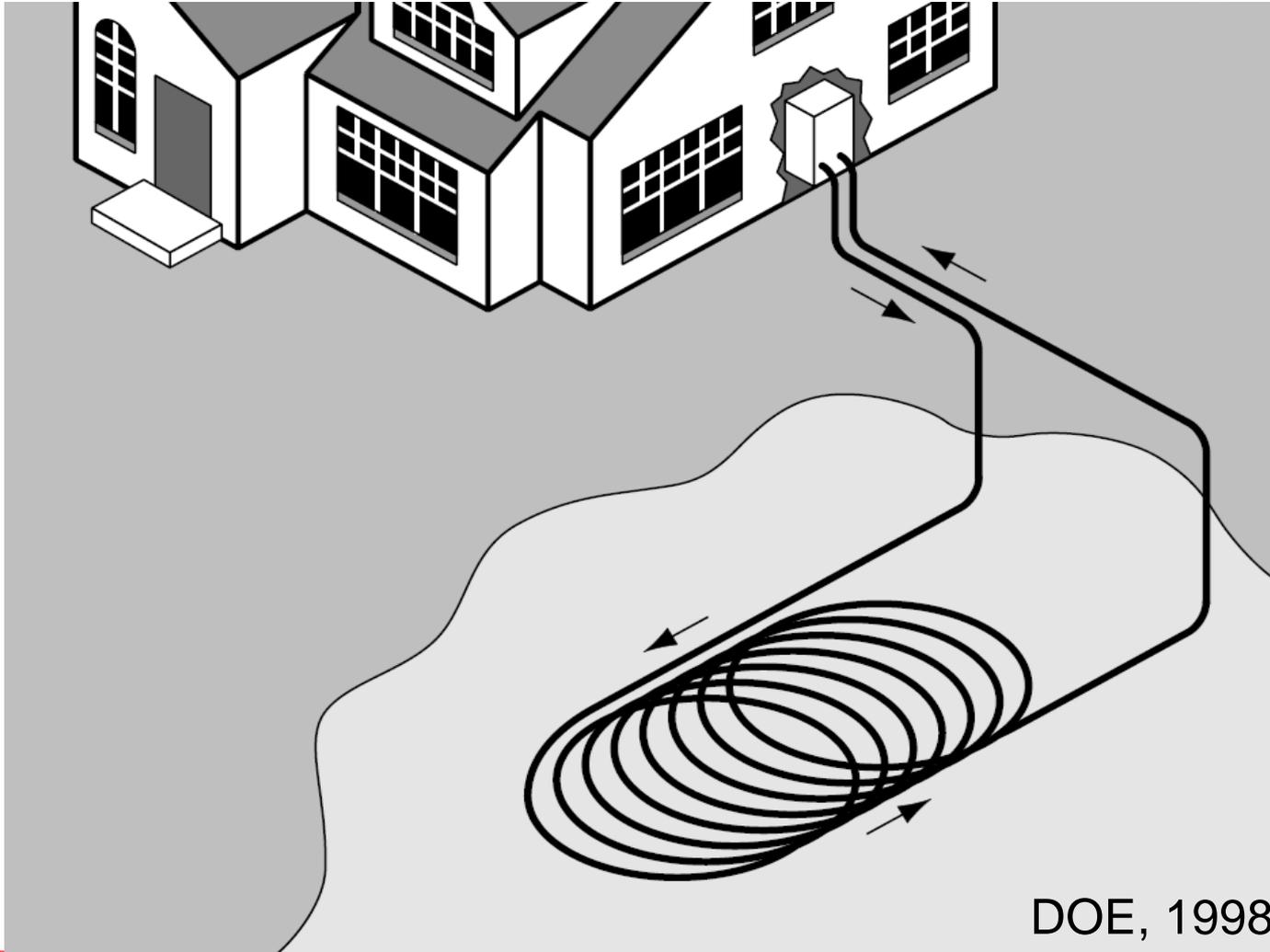


DOE, 1998

Typical GSHP Configurations

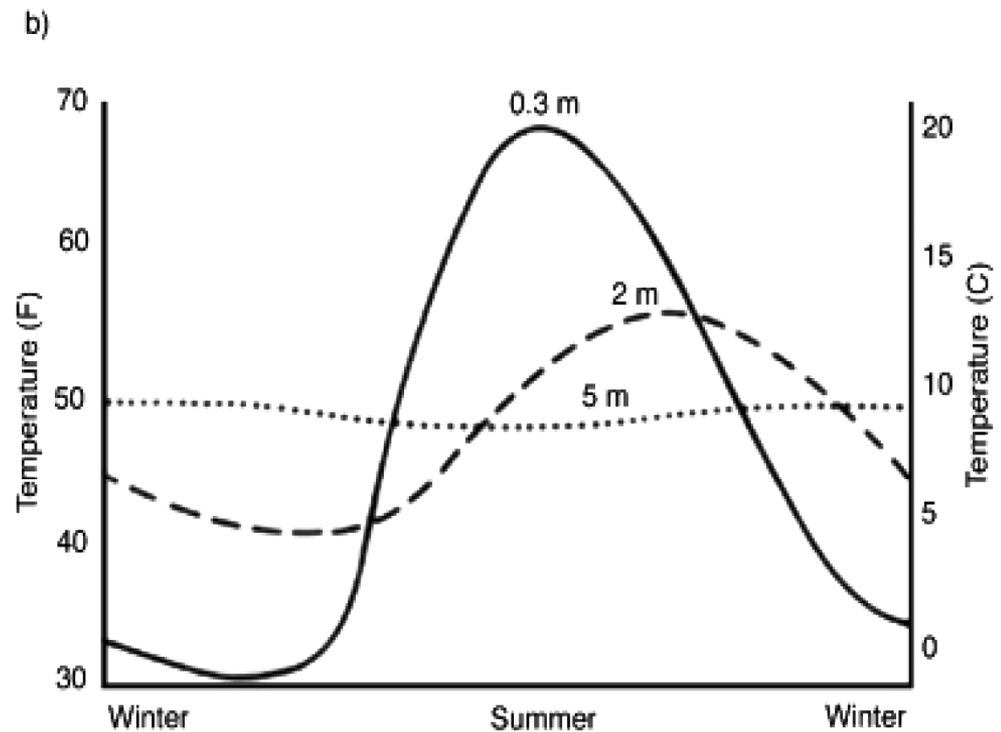
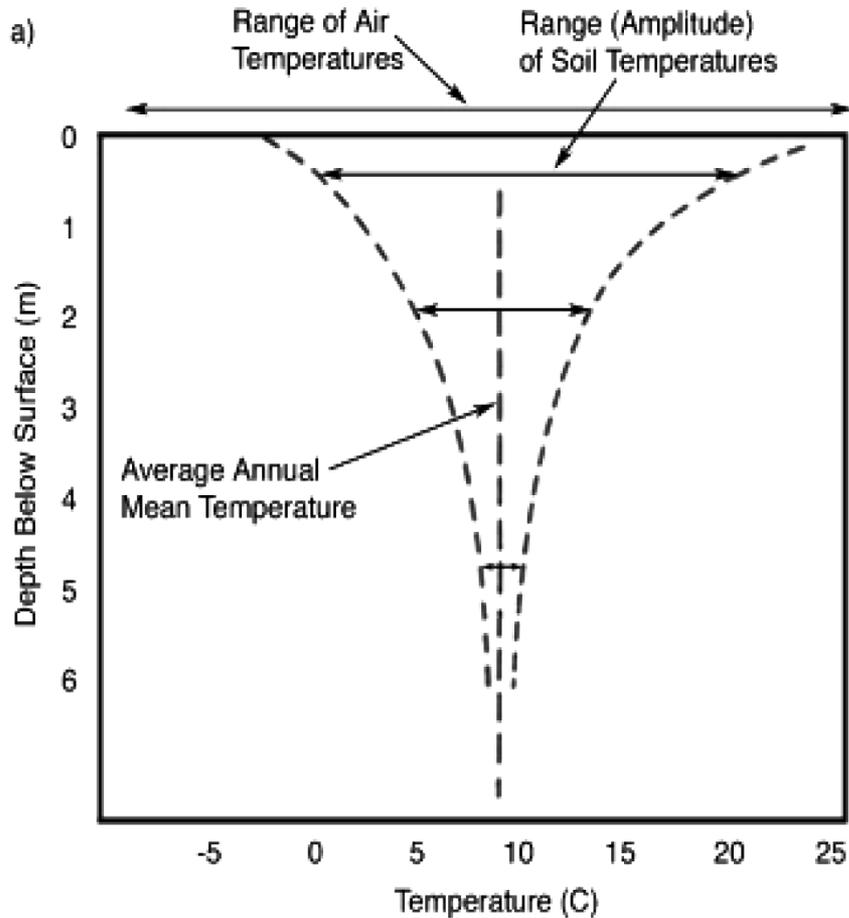
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- Surface water closed loop (slinky)

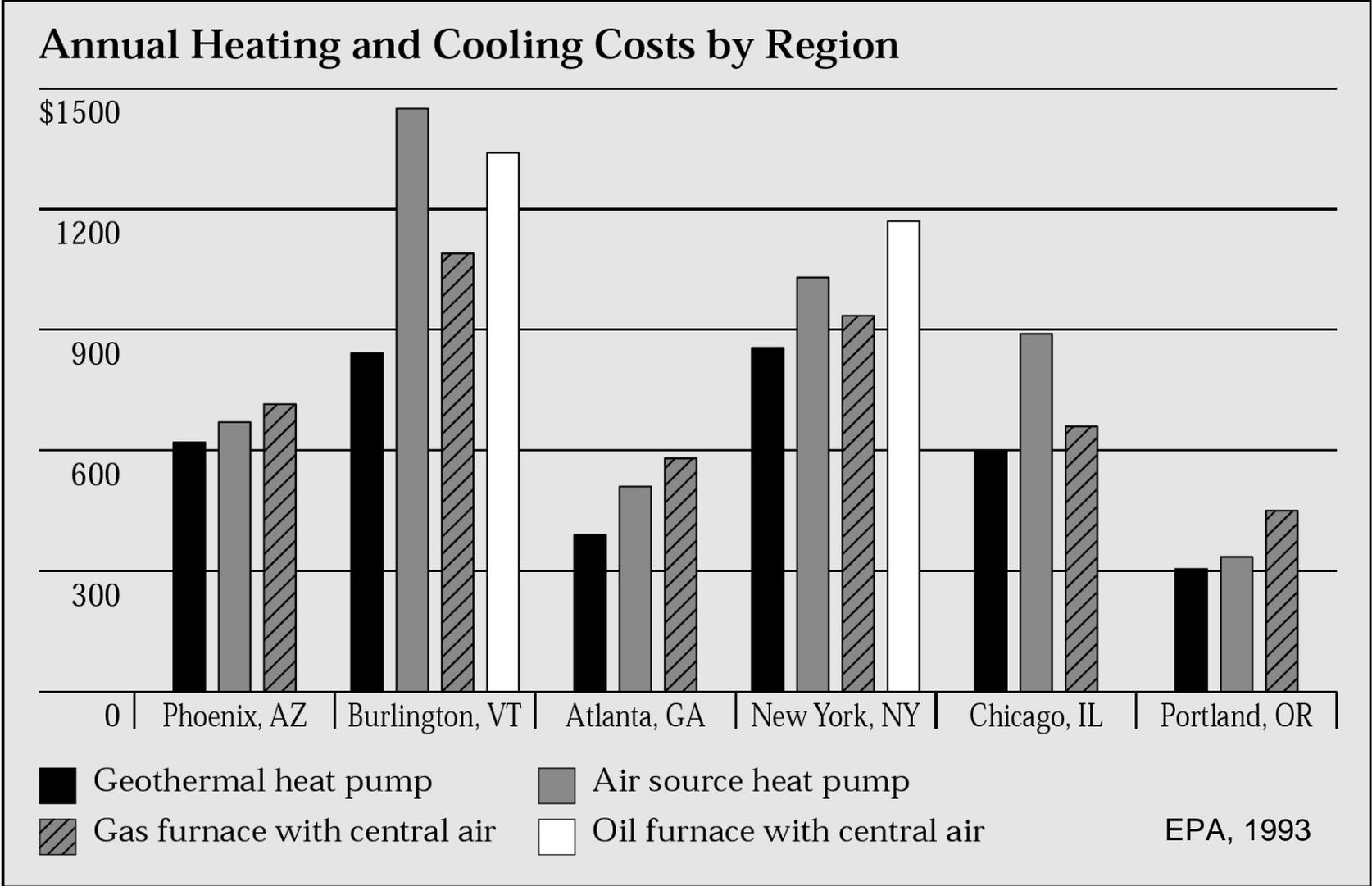


DOE, 1998

Solar or Geothermal?



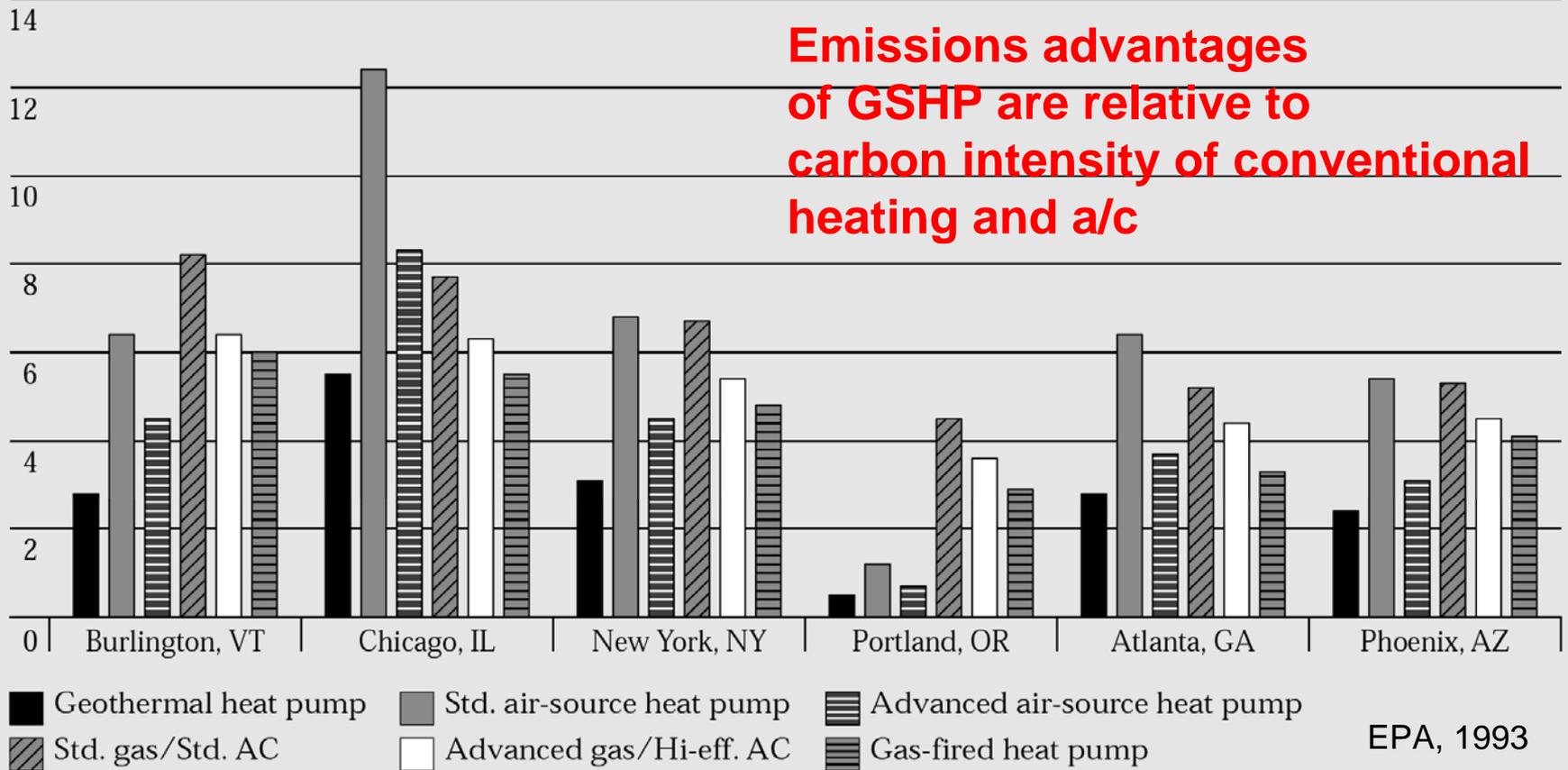
GSHP Cost Advantages



GSHP CO₂ Emissions Advantages



Annual Carbon Dioxide Emissions from Space Conditioning Equipment by Region
(in thousands of kilograms per year)



GSHP Market Penetration

➤ Reportedly > 1,000,000 installed

Model	1999	2000	2001	2002	2003	2004	2005
ARI-320	7,910	7,808	NA	6,445	10,306	9,130	9,411
ARI-325/330	31,631	26,219	NA	26,802	25,211	31,855	34,861
Other Non-ARI Rated	2,138	1,554	NA	3,892	922	2,821	3,558
Totals	41,679	35,581	NA	37,139	36,439	43,806	47,830

NA=Not Available. No survey was conducted for 2001.

Source: Energy Information Administration, Form EIA-902, "Annual Geothermal Heat Pump Manufacturers Survey."

EIA, 2007

GSHP Distribution

Destination	ARI-320	ARI-325/330	Other Non-ARI Rated GHPs	Total
Exported	262	3,206	1,093	4,561
Midwest	1,463	13,942	1,231	16,636
Northeast	1,785	4,711	355	6,851
South	4,081	11,187	589	15,857
West	1,815	1,795	290	3,900
US Territories	5	20		25
Total	9,411	34,861	3,558	47,830

Note: The Midwest Census Region consists of Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. The Northeast Census Region consists of Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont. The South Census Region consists of Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, South Dakota, Texas, Virginia, West Virginia, and Wyoming.

"Export" in Table 60 and "Exporter" in Table 61 are different. "Export" refers to shipments outside of the country, while "Exporter" is the type of customer.

Source: Energy Information Administration, Form EIA-902, "Annual Geothermal Heat Pump Manufacturers Survey."

GSHP Forecast

Freedonia Group

- 2006: 52,000 units
- 2011: 76,000
- 2016: 111,000

Geoexchange

	Annual Units	Total Units	New Annual MWt	Total MWt
2006	70,000	1,000,000	517	7,385
2011	146,454	1,626,998	1,082	12,016
2015	264,354	2,485,939	1,952	18,360
2025	1,157,165	8,990,382	8,546	66,397
2029	2,088,714	15,777,045	7,713	108,807
2050	6,805,282	138,607,585	12,565	1,011,106

Public Policy Goals for Supporting RE&EE

Rationale for incentives

Costs will diminish due to::

- Economies of scale
- Learning curve progress
- Increased competition on the part of
 - ⇒ System providers as new entrants are drawn into the industry
 - ⇒ Customers for incentive payments
- Technological advance



Public Policy Goals for Supporting RE&EE

What do you hope to achieve?

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- Energy security
- Conservation of scarce resources
 - ⇒ Fuel
 - ⇒ Water
- Reduced environmental impacts
- Economic development
- Technological advancement
 - ⇒ Cost reduction
 - ⇒ Promote specific resources (e.g., solar, GSHP)



Incentive Program Design Considerations

- Goals for the program?
- Who will receive the incentive payments?
- Source of funds?
- Capacity or performance based?
- Form of incentives?
 - ⇒ Rebates
 - ⇒ Tax credits/exemptions
 - ⇒ Loan guarantees
- Level of incentive payments?
- Phase out?
- Impact of federal policies?
- Program administration?
 - ⇒ Utility
 - ⇒ Municipality
 - ⇒ State agency



Program Funding & Cost Recovery Mechanics

- Public Benefits Fund/System Benefits Charge
- Taxes/General Revenues
- Rates & Rate Riders
- Clean Energy Fund (GEO)
- Mineral Severance Tax
- Carbon Tax



Incentive Structures

- Rebates
 - ⇒ Buy down first cost
- Tax credits/exemptions
 - ⇒ Income tax credit/exemption from income
 - ⇒ Property tax exemption
 - ⇒ Sales tax exemption
 - ⇒ Use existing bureaucracy
- Low interest loan programs
 - ⇒ Decrease monthly payment, improve cash flow
- County/municipal tax credits/tax rebates
 - ⇒ Per SB07-145

GSHP and the RES

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- RES is an *Electric* Standard, not an all-energy standard
- Thermal production is not eligible
- Eligible technologies displace electricity
- GSHP are really an energy efficiency device
 - ⇒ In Colorado, displaces primarily natural gas for heating
 - ⇒ More appropriate for a DSM program



Non-Incentive Approach to Fostering GSHP

- Principal barrier is high first cost
- Learn from experience with another technology that has high first cost and long payback
 - ⇒ PV solar services model
- Geothermal Heat Suppliers Act, 1984
 - ⇒ Only exclusion from utility monopoly
- Third party would own and install system
 - ⇒ Sell metered thermal energy to customer
- Near term application: GEOS, Arvada, CO



Where to get yours?

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renewables





Thank you



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