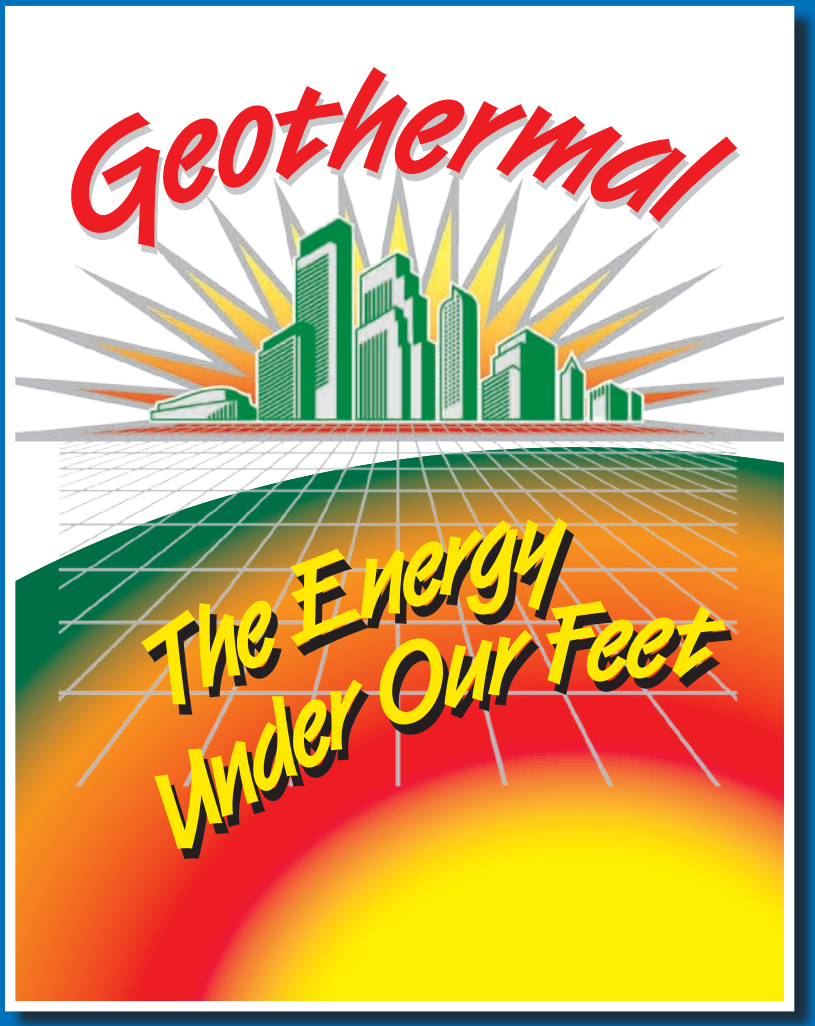
A national laboratory of the U.S. Department of Energy
Office of Energy Efficiency & Renewable Energy

NREL National Renewable Energy Laboratory

Innovation for Our Energy Future



Geothermal Technologies Program

The Earth houses a vast energy supply in the form of geothermal resources. Domestic resources are **equivalent to a 30,000-year energy supply** at our current rate for the United States! In fact, geothermal energy is used in all 50 U.S. states today. While the entire resource base cannot be recovered, the recovery of even a very small percentage of this heat would make a large difference to the nation's energy supplies. New-low temperature electric generation technology may greatly expand the geothermal resources that can be developed economically today.

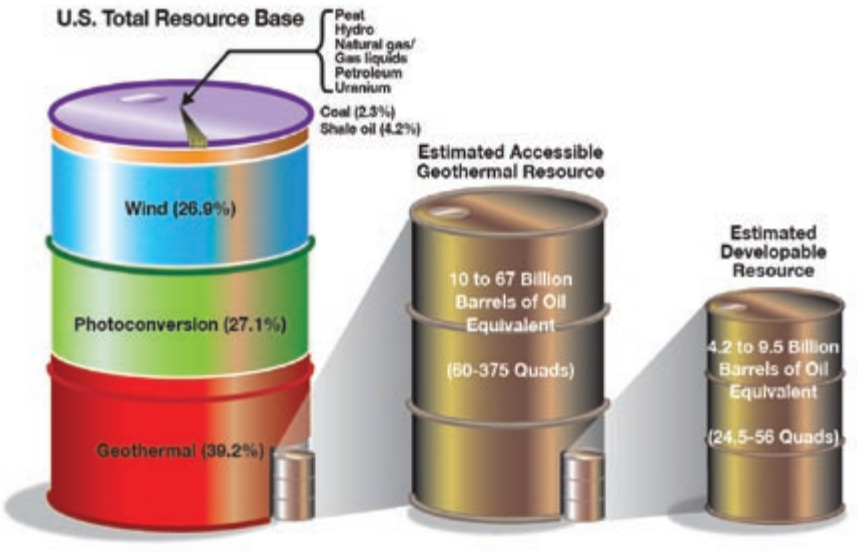


Figure 1. U.S. Energy and Geothermal Resources

Note: U.S. Total Resource Base from Characterization of U.S. Energy Resources and Reserves, December 1989, U.S. Department of Energy, DOE/CE-0279. Data for "Estimated Accessible Geothermal Resource" and "Estimated Developable Resource" are from Table 1.

Energy resources are traditionally classified according to the degree of certainty and the economic feasibility of exploiting the particular resource. The U.S. Geological Survey (USGS) and the U.S. Department of Energy (DOE) have used such identifying terms for resource classification. Following are simple definitions of these classification terms:

U.S. Total Resource Base – Resource base is all of a given material in the Earth's crust, whether its existence is known or unknown and regardless of cost considerations[a].

Estimated Accessible Geothermal Resource – The accessible resource base for geothermal energy is that part of the resource base shallow enough to be reached by production drilling in the foreseeable future[a].

Estimated Developable Resource – This category is the subset of the accessible resource base that the workshop experts believe likely to be developed in future years.

[a]Source: Assessment of Geothermal Resources of the United States – 1978, USGS Circular 790.

This brochure is based on *Geothermal – The Energy Under Our Feet, Geothermal Resources Estimates for the United States*, NREL/TP-840-40665, November 2006.

Table 1. Findings by Resource Category

			Estimated Developable Resource*		
	Estimated Accessible Resource (MWe)	2006 (Actual MWe)	2015 (MWe)	2025 (MWe)	2050 (MWe)
Shallow Hydrothermal (Identified) >90˚C/194˚F	30,000	2,800	10,000	20,000	30,000
Shallow Hydrothermal (Unidentified) >150˚C/302˚F	120,000		TBD	TBD	TBD
Co-Produced & Geopressured	>100,000	2[3]	10,000 to 15,000	70,000	>100,000
Deep Geothermal	1,300,000 to 13,000,000	0	1000	10,000	130,000
Thermal Uses	(MWt)	(MWt)	(MWt)	(MWt)	
Direct Uses	>60,000	620	1600	4,200	45,000
Geothermal Heat Pumps	>1,000,000	7,385	18,400	66,400	>1,000,000
GHP[6] Avoided Power	120,000	880	2,100	8,000	120,000

* *These resource estimates represent a consensus of a group of experts who considered existing resource assessments. There is considerable uncertainty in the estimates as many resources are hidden, and exploration to date has been relatively limited. The figures shown above are not a resource assessment, but, even with uncertainty,* ***clearly show that the U.S. geothermal resource is a very large and important domestic energy source.***

Table 2. Co-Produced and Geopressured Resources (estimated developable resources)

	2015	2025	2050
Co-Produced	5,000 MWe	10,000 to 20,000 MWe	30,000 to 40,000 MWe
Geopressured	5,000 to 10,000 MWe	50,000 to 60,000 MWe	70,000 to 80,000 MWe

Credit: National Energy Technology Laboratory (NETL)

Enhanced Oil Recovery – Using co-produced geothermal fluids for power production from oil and gas wells can extend the economic life of these wells, thus contributing more domestic production.

Table 3. Energy Equivalents by Resource Category (see full report for calculation method)

Resource Category	Estimated Accessible Resource	Estimated Developable Resource – 2050
Shallow Hydrothermal (Identified) >90°C/194°F	0.81 Quads 135 million BOE	0.81 Quads 135 million BOE
Shallow Hydrothermal (Unidentified) >150°C/302°F	3.2 Quads 540 million BOE	–
Co-Produced & Geopressured	2.7 Quads 450 million BOE	2.7 Quads 450 million BOE
Deep Geothermal	35.1 to 351 Quads 5.8 to 58.5 BBOE	3.5 to 35 Quads 0.58 to 5.8 BBOE
Direct Use	0.88 Quads 150 million BOE	15 Quads 112.5 million BOE
Geothermal Heat Pumps (GHP)	15 Quads 2.5 billion BOE	15 Quads 2.5 BBOE
GHP[6] Avoided Power	1.8 Quads 300 million BOE	1.8 Quads 300 million BOE
Total	**60–375 Quads 10–67 billion BOE**	**24.5 to 56 Quads 4.2 to 9.5 billion BOE**

Energy Comparison Information

U.S annual energy consumption equals about 100 quads (EIA, 2004).

U.S annual electricity production equals about 40 quads (EIA, 2004).

U.S. petroleum demand equals about 21 million bbl/day, 7.67 billion bbl/yr (EIA, 2004).

World petroleum demand equals about 84 million bbl/day, 30 billion bbl/yr (EIA, 2004).

Energy Equivalents

1 Quad = 0.170 billion barrels of oil, 170 million barrels of oil

1 Quad = 45 million short tons of coal

1 Quad = 1 trillion cubic ft. of dry natural gas

1000 KWh = 0.59 barrels of crude oil

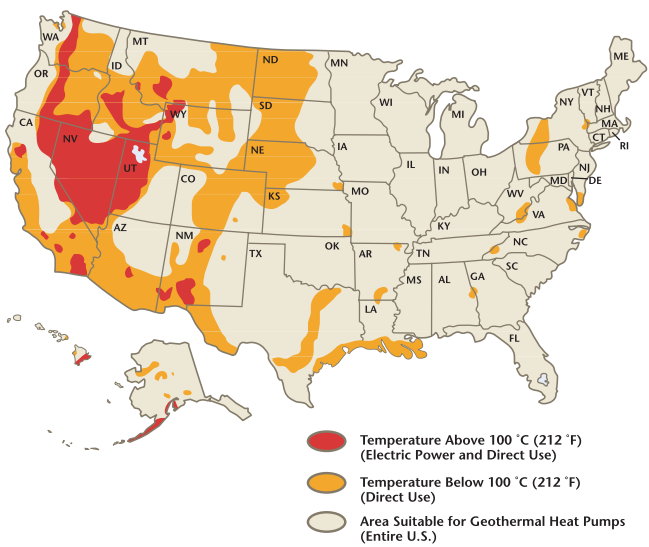
1000 KWh = 0.15 short tons (300 lb.) of coal

1000 KWh = 3,300 cubic ft. of dry natural gas

1 barrel of crude oil = 1,700 kWh

1 barrel of crude oil = 5,600 cubic feet of dry natural gas

1 barrel of crude oil = 0.26 short tons (520 pounds) of coal.

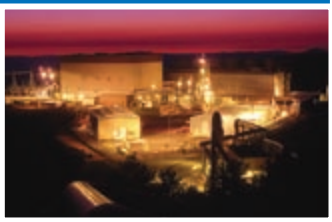


The Nation's geothermal resources represent a huge energy resource, providing the U.S. with various ways to use them and enhance national security, and economic and environmental health.

Strategic Value

Use of domestic geothermal energy resources has strategic value for the nation. Geothermal resources can contribute to:

Clean electricity generation



Baseload power production, having high capacity factors

Coproduction and enhanced oil recovery, thus gaining more elec. and oil

Distributed energy systems with modular and shorter development timeframe advantages

Ethanol and biodiesel production – thermal energy requirements

Direct-use for building energy needs

Hydrogen production – via off-peak electrolysis

Mineral recovery, such as silica and zinc – both strategic minerals in short supply

Rural economic development – aquaculture and horticulture, and lumber drying

Climate change help – by offsetting needs for fossil-fueled power plants

Geothermal Technologies Program

Geothermal

Energy from Our Earth

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For More Information

U.S. Department of Energy,
Geothermal Technologies Program
Web: *www1.eere.energy.gov/geothermal*

Geothermal - The Energy Under Our Feet
Web: *www1.eere.energy.gov/geothermal/pdfs/40665.pdf*

GeoPowering the West
Web: *www.eere.energy.gov/geothermal/gpw*

Geothermal Energy Association
Web: *www.geo-energy.org*

Geothermal Resources Council
Web: *www.geothermal.org*

Geothermal Heat Pump Consortium
Web: *www.geoexchange.org/index.htm*

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