GEOTHERMAL ENERGY
in
OREGON
2015

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Use of Geothermal Energy in the U.S.

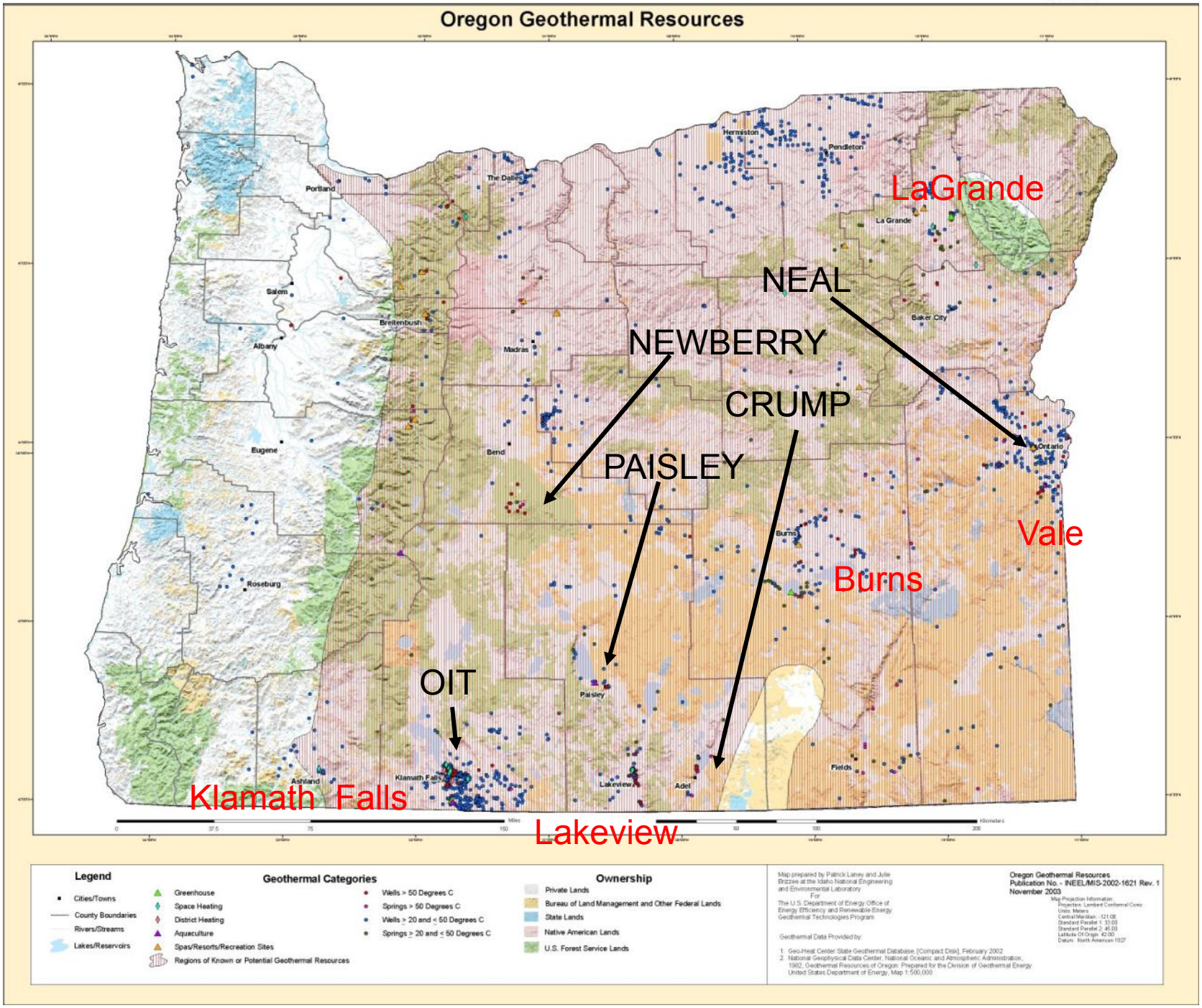
- 2,800 megawatts of **electricity** supplying 4 million people in western U.S. and Hawaii
- 500 thermal megawatts of **direct uses**
- 400,000 **heat pumps** nationwide, providing 1,500 thermal megawatts of heating and cooling

GEOTHERMAL RESOURCES

- Geothermal water has been used directly in Oregon for >100 years & making power in Oregon since 2010.

- Geothermal steam is generating power in Italy for >100 years & California for >50 years.

Oregon Geothermal Resources
Publication No. - INEEL/MIS-2002-1621 Rev. 1
November 2003

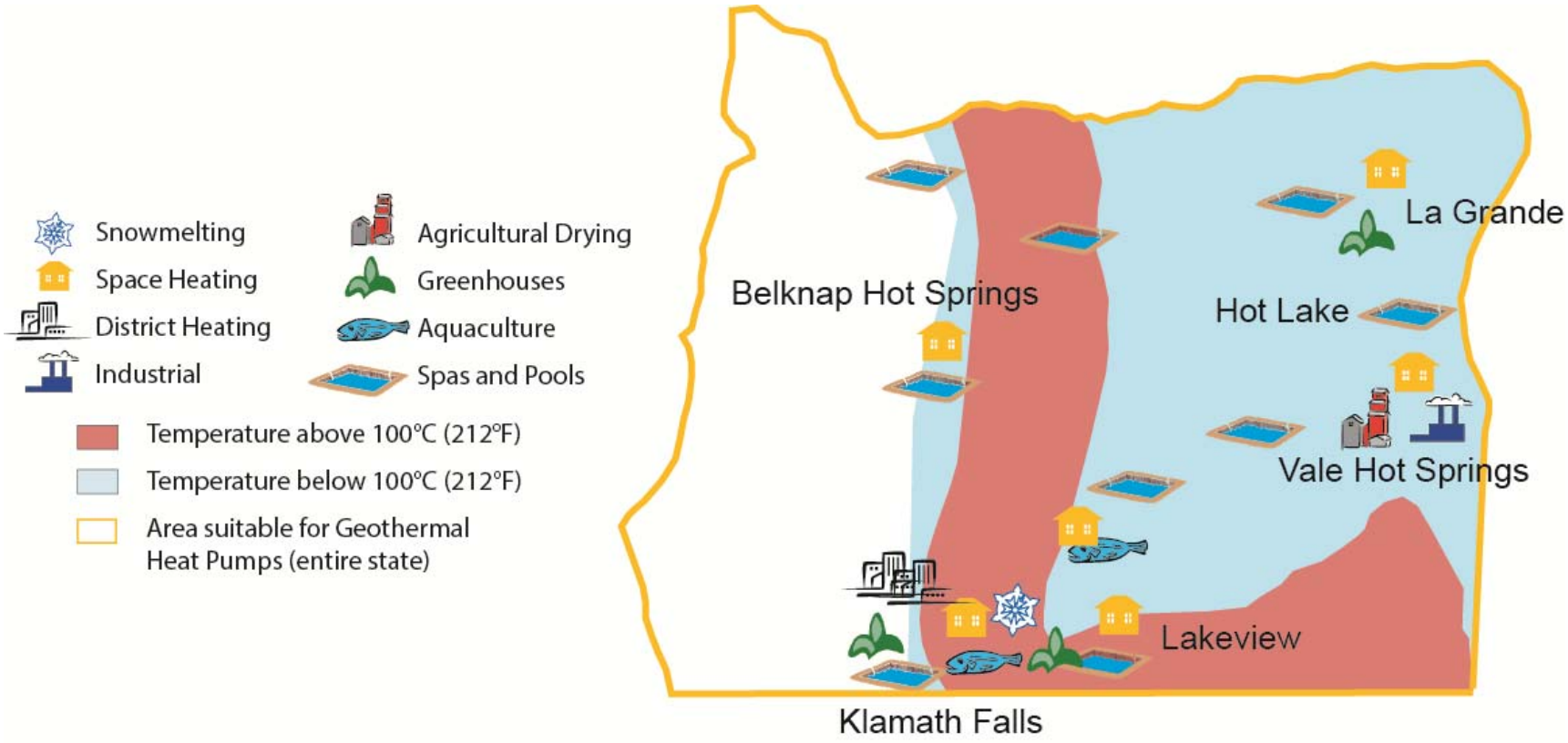


DIRECT USE

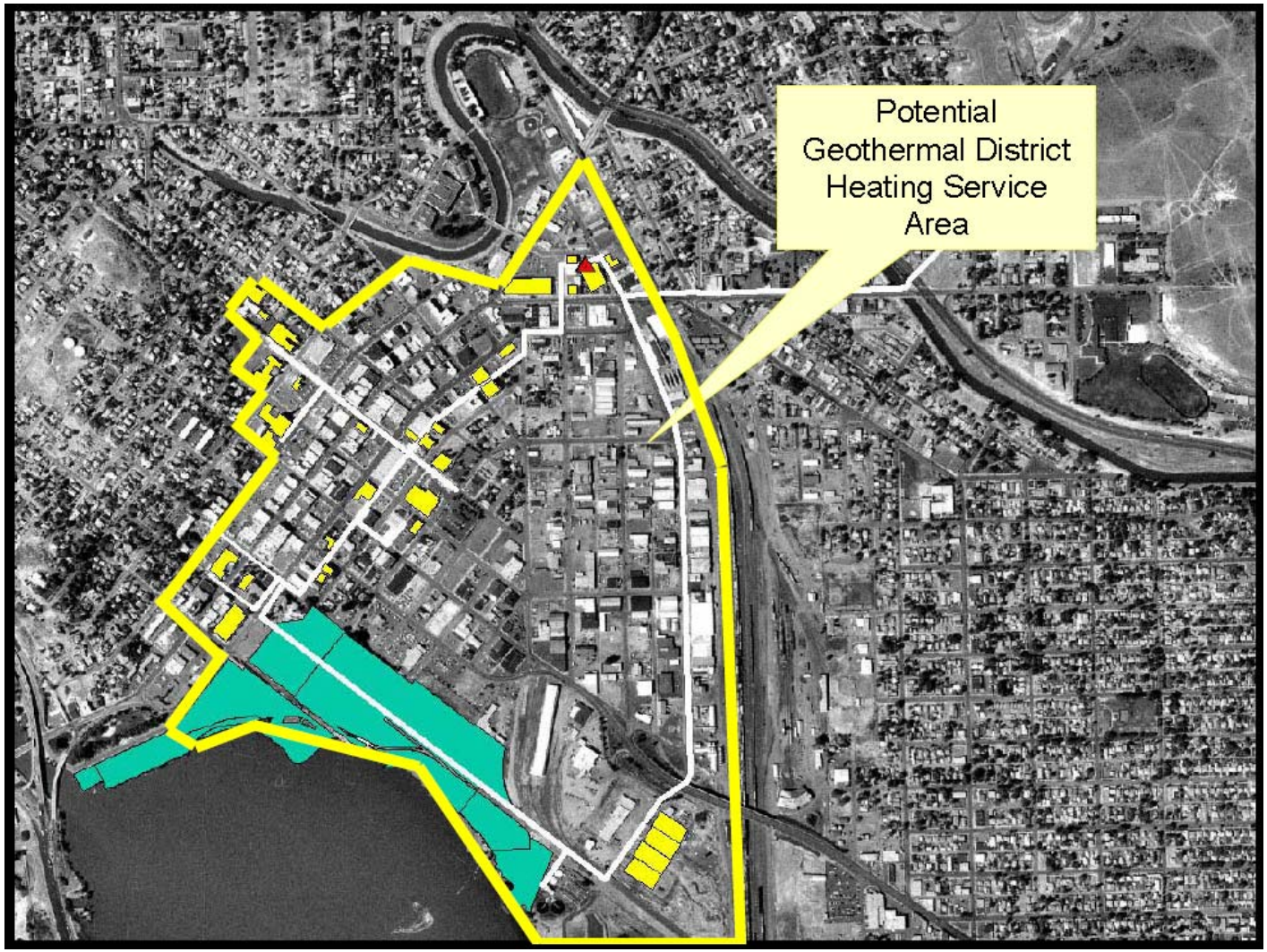
- Hot spring water piped to
  - pools, buildings, greenhouses.

- Wells in Klamath Falls Oregon supply hospital, schools, college, downtown business core, brewpub, and funeral parlor.

DIRECT USE


Snowmelting
Space Heating
District Heating
Industrial
Agricultural Drying
Greenhouses
Aquaculture
Spas and Pools
Temperature above 100°C (212°F)
Temperature below 100°C (212°F)
Area suitable for Geothermal Heat Pumps (entire state)
La Grande
Belknap Hot Springs
Hot Lake
Vale Hot Springs
Lakeview
Klamath Falls

KLAMATH FALLS



Klamath Falls – Oregon Institute of Technology

KLAMATH FALLS

- OIT uses (3) 90ºC wells to heat the campus and now generate power
- In-line 280 kW power plant started operating Feb. 5, 2010
- 1.2 MW power plant added 2014
- With solar, all campus energy needs met

NEAL HOT SPRINGS

U.S. GEOTHERMAL

- $140M project ~22 MW Net
- Production well examples:
  - NHS-1 is 700 meters deep with 135ºC
  - NHS-5 is 850 m & 141ºC
- Idaho Power purchases power & built transmission line
- 2012 Commercial Operation

Source: www.usgeothermal.com

OREGON GEOTHERMAL POWER PLANTS

Date of Operation	Location	Developer	Gross MW
12-Nov-12	Neal HS	US Geo.	30.1
October 14	Paisley	SVEC	3.4
30-Apr-14	OIT	OIT	1.75
1-Apr-10	OIT	OIT	0.28
		TOTAL	35.53

Sources: OIT Geo-Heat Center, Surprise Valley Electrification Corp., US Geothermal Inc.

ENVIRONMENT

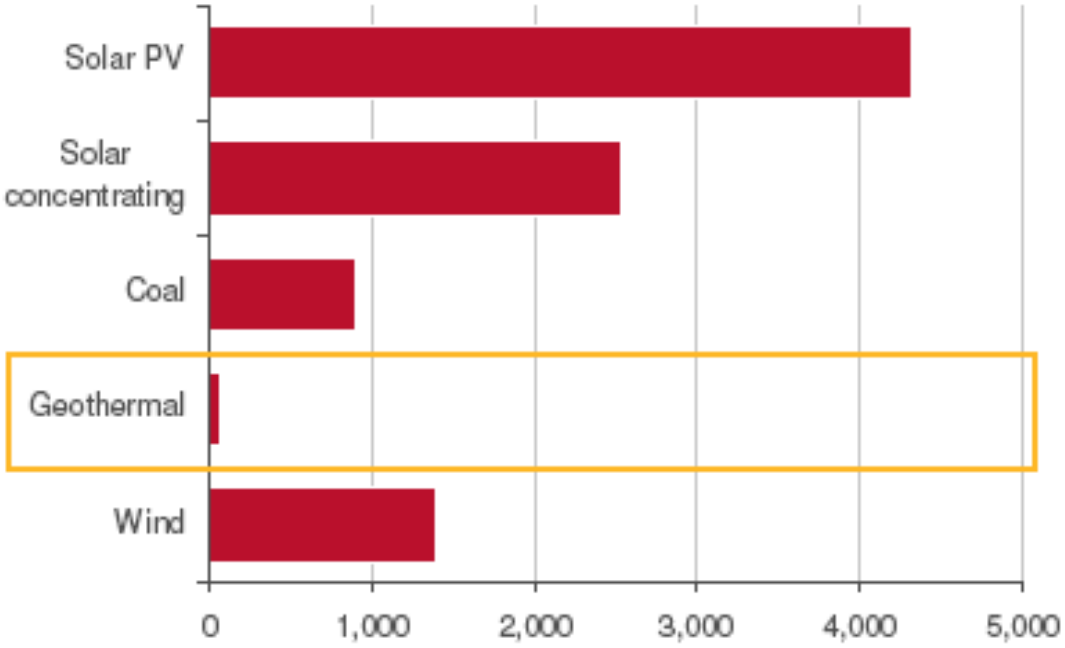
lbs/ per megawatt hour	Nitrogen oxide (Nox)	Sulphur Dioxide (SO2)	Carbon Dioxide (CO2)	Particulates (PM)
Coal	4.31	10.39	2191	2.23
Coal, life cycle emissions	7.38	14.8	na	20.3
Oil	4	12	1672	na
Natural Gas	2.96	0.22	1212	0.14
Geothermal (flash)	0	0.35	60	0
Geothermal (binary)	0	0	0	neglible
Geothermal (Geysers steam)	0.00104	0.000215	89	neglible

source: GEA, 2007

ENVIRONMENT

Land Use

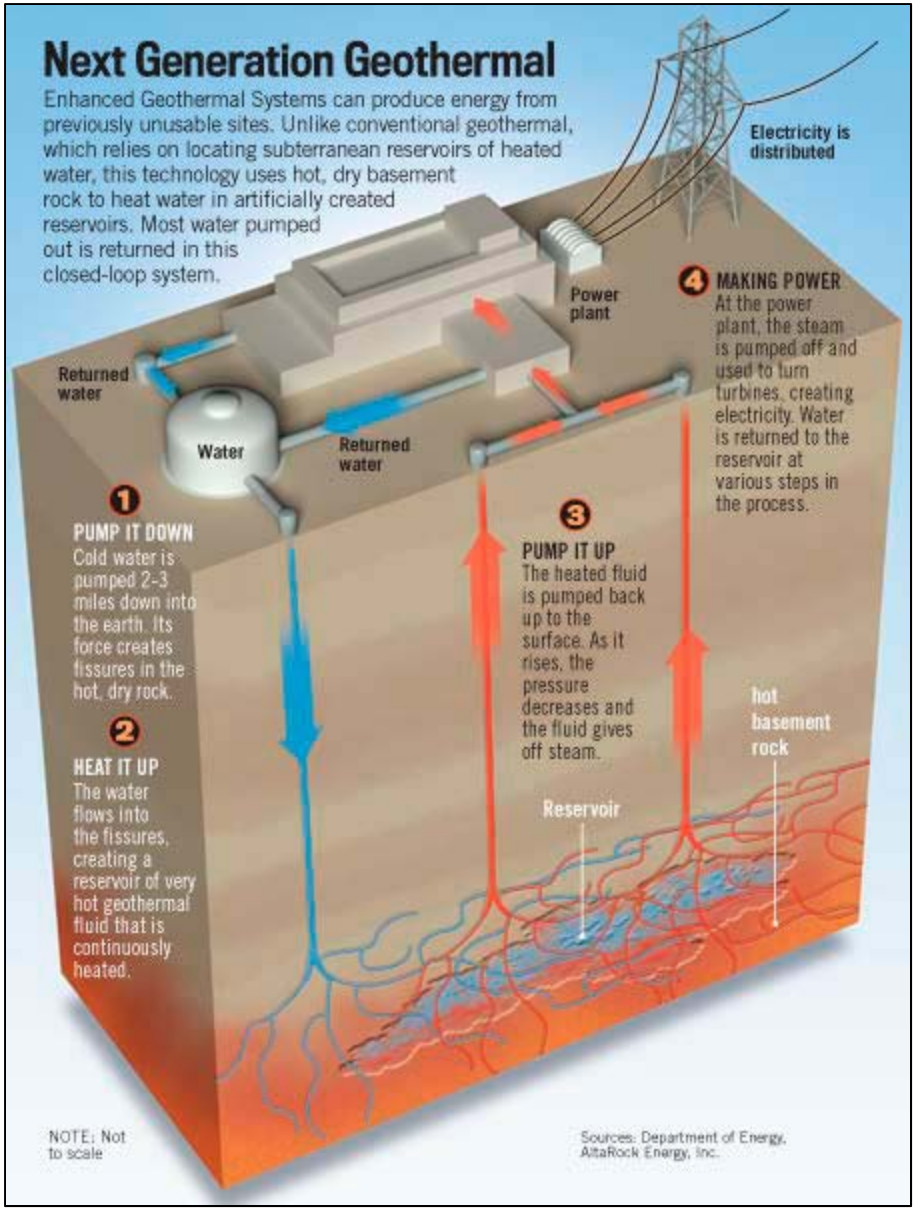
in acres/ 1 billion kWh (1 GWh, Source: NREL, AWEA and others)



Energy Trust
Renewable Energy Program

- Projects 20 MW and under
- Power sale to Pacific Power or Portland General Electric

- **Project Development Assistance**
- **Project incentives**



Newberry

- Past well drilling
- High Temps 250°C (+500°F)
- Bleeding edge technology
- Public & private backing
- http://blog.newberrygeothermal.com

GEOTHERMAL SUMMARY

- Substantial direct use on-line
- 35.53 MW Power on-line
- 40 MW Power in development
- 120+ MW near term potential

SOURCES

- Geo-Heat Center geoheat.oit.edu/
- ODOE oregon.gov/ENERGY
- US DOE www1.eere.energy.gov/geothermal
- Geothermal Resources Council www.geothermal.org
- Geothermal Education Office geothermal.marin.org/
- Companies active in Oregon
- http://blog.newberrygeothermal.com/