

Geothermal Heat and Power

HIGHLIGHTS

- PROCESS AND TECHNOLOGY STATUS** – The global capacity of geothermal power plants is approximately 9 GW_e, with an annual electricity generation of about 60 TWh_e, which is equivalent to less than 1% of the global electricity demand. Geothermal heating plants have a global capacity of approximately 18,000 MW_{th} and produce about 63 TWh_{th} per year. By and large, technologies for the exploitation of what is called ‘conventional and shallow’ geothermal energy resources are commercially available. These technologies include: ■ **Dry steam plants;** ■ **Flash plants;** ■ **Binary plants;** ■ **Combined-cycle or hybrid plants;** ■ **Combined Heat and Power based on geothermal energy;** ■ **Heating based on geothermal energy.** However, these resources are rather limited. The current challenge is the development of **Enhanced Geothermal Systems (EGS)** – also known as ‘Hot Dry Rocks’ - to exploit *deep geothermal resources*, which could expand the potential of geothermal energy considerably. An overview of temperature levels, applications and the variety of exploitation technologies of geothermal resources, is shown in Figure 1.
- COSTS** – The investment cost of **geothermal power plants** depends considerably on the site, depth and characteristics of the geothermal resources. A value of \$4000/kW_e (US\$ 2008) may represent an average indicative cost, with considerable variations. Assuming an average annual operation and maintenance (O&M) cost of 3.5% of the investment cost (approximately \$140/kW_e per year), the resulting generation cost is approximately \$90/MWh. For **geothermal-based combined heat and power plants**, the investment cost is higher (typically, \$10,000/kW_e), the O&M costs are around \$250/kW_e per year, and the generation cost may reach approximately \$200/MWh. For **geothermal heating systems**, an average investment cost is estimated at \$1800/kW_{th}, with the O&M costs at \$35/kW_{th}. The heat generation cost is approximately \$45/MWh_{th}.
- POTENTIAL AND BARRIERS** – Large-scale geothermal power development is currently limited to tectonically active regions such as areas near plate boundaries, rift zones, and mantle plumes or hot spots. These active, high heat-flow areas include countries around the ‘Ring of Fire’ (Indonesia, The Philippines, Japan, New Zealand, Central America, and the West Coast of the United States) and rift zones such as Iceland and East Africa. These areas are the most promising for geothermal development in the next decade, with a potential increase of geothermal power capacity from 13 GW_e in 2010 to 30 GW_e in 2030. If technological breakthroughs made new geothermal power technologies available (EGS), then geothermal power might expand to other regions and commercial geothermal capacity could increase beyond 30 GW_e.

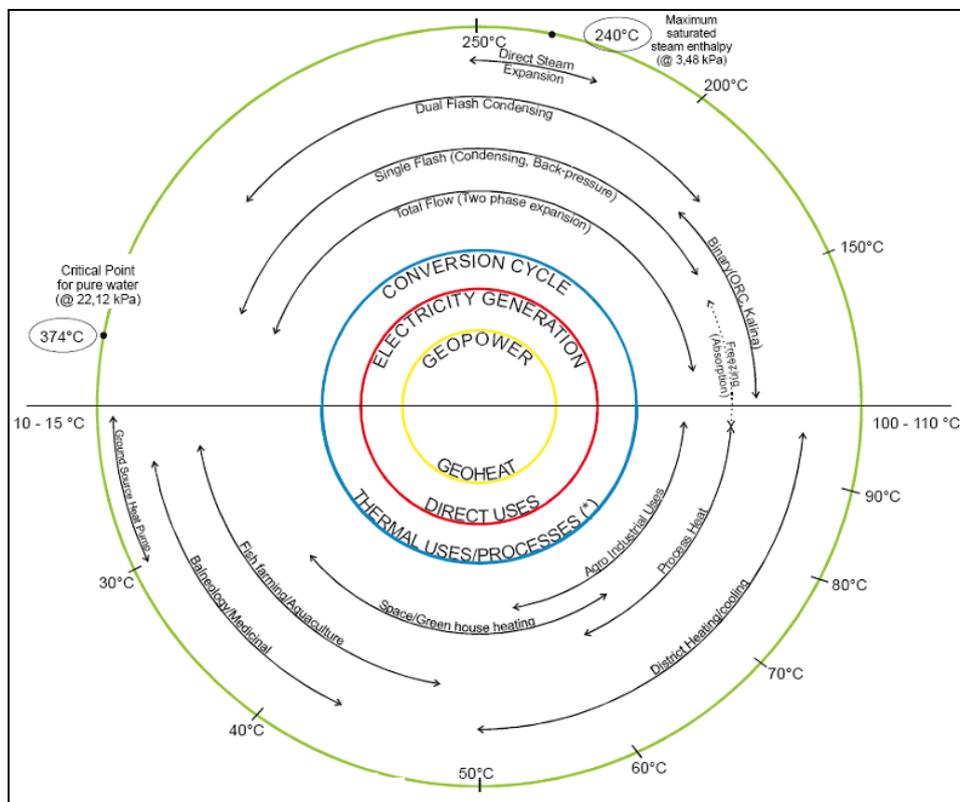


Fig. 1 - Geothermal resource utilisation potential (Antics and Ungemach, 2009)