

# Geothermal Reservoir Stimulation

**Sabodh K. Garg**

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# Current Geothermal Installed Capacity (GEA estimates, reported in GRC Bulletin, May-June 2016)

- ▶ United States (end of 2015)
  - 3.7 GW installed nameplate capacity
  - 2.71 GW net capacity
  
- ▶ Global
  - 13.3 GW in 24 countries
  - Predicted to increase to 18.3 GW by 2021

# Enhanced Geothermal Systems (MIT Report : The Future of Geothermal Energy, 2006)

- ▶ US nameplate generating capacity (2006): > 1000 GWe
- ▶ US geothermal resource base to 10 km depth
  - Hydrothermal: 2400 – 9600 Exajoules\*
  - EGS : > 13,400,000 Exajoules\*
- ▶ EGS resource > 1000 Hydrothermal resource
- ▶ EGS resource could provide >100 GWe in 50 years
  
- ▶ \* 1 Exajoule =  $10^{18}$  J

# Development of EGS Resources

- ▶ The key impediment to the successful exploitation of EGS resources remains the creation (or stimulation) of a permeable fracture network.
- ▶ Sustainability of power production depends on the geometry of the fracture network. If the permeability of the fracture network is too small, then it may not be possible to sustain commercial flow rates. Alternatively, high permeability (e.g. a single high permeability fracture connecting production and injection wells) may lead to short-circuiting and premature cold-water breakthrough in the production wells.

# Performance Factors for HDR/EGS Projects

(Abstracted from M.A. Grant, Geothermics, September 2016)

Project	AE Volume (km <sup>3</sup> )	Recovery factor (%)	Productivity Index (kg/s-bar)
Fenton Hill	0.12	2	0.0033-0.0040
Rosemanowes	0.6	0.7	1
Hijori	0.25	0.2	0.5
Cooper Basin	0.4	1.6	0.5
Soultz	2.4		0.4-1

# Comparison of HDR/EGS Projects with Hydrothermal Fields

- ▶ Recovery factor for hydrothermal fields (5 to 15 %) is about an order of magnitude larger than that for past or current EGS projects (0.2 to 2 %)
- ▶ Productivity index for successful hydrothermal wells ( $> 5 \text{ kg/s-bar}$ ) is also much larger than that attained so far in HDR/EGS wells ( $< 1 \text{ kg/s-bar}$ ).
- ▶ Commercial exploitation of HDR/EGS will require about an order of magnitude improvement in the performance factors.

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