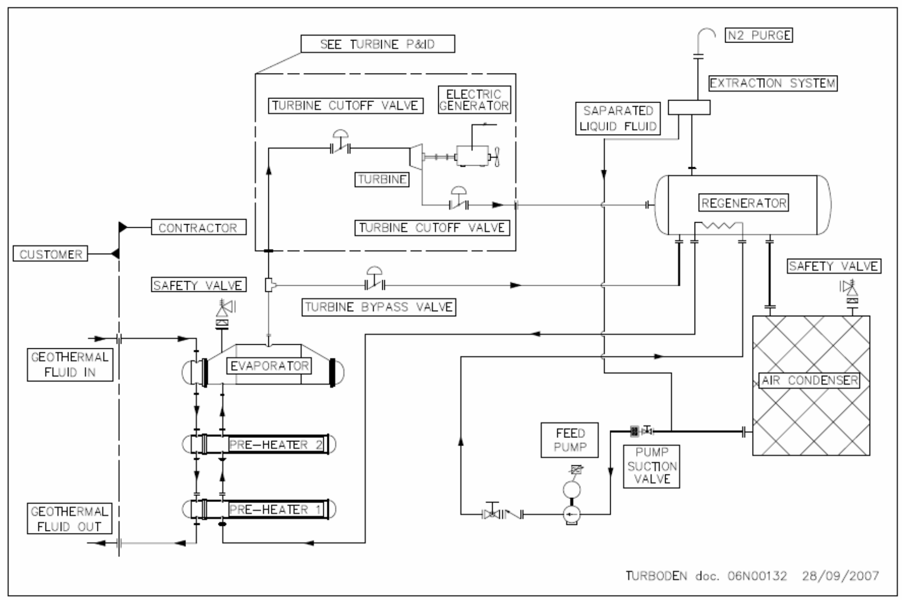
# Economic perspectives for developing EGS




**ENGINE Final Conference - Vilnius**

**D. Fritsch – GEIE EMC**

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# What is the market for EGS ?

• **<u>Power</u> : low efficiency of conversion systems, but product easy to distribute to the customer (demonstrative projects)**

• **<u>Heat</u> : many possible uses (domestic heating, industrial process, agriculture…), higher efficiency, but product not easy to distribute to the customer (opportunities)**

# Industrial position in Europe facing EGS

1. In Europe, energy utilities/ industrial companies are rarely competent both in underground and surface facilities (ENEL case is actually an exception)
2. Industrials prefer to leave development & risk to others (specifically on the drilling side for electrical utilities)
3. Small and complex systems as EGS are difficult to explain and sell to industrials compared to other ENR systems (for instance wind or solar farms)

☞ " WAIT AND SEE …"

# Investment consideration

- Is it possible to develop EGS in Europe today on a Project Finance point of view ?

- How to make an EGS project “bankable” ?

# Economical approach

(1) Basic EGS configuration (3 MWe case)

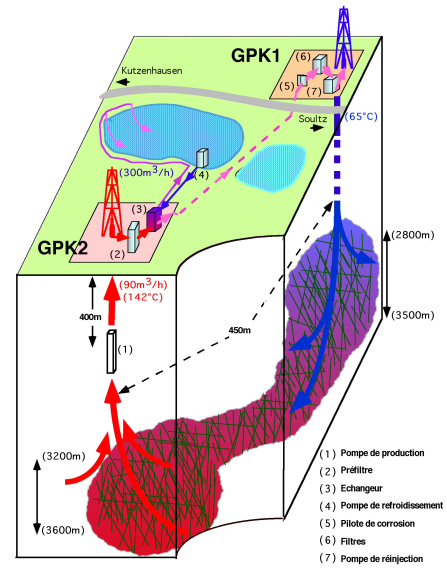
(2) Costs repartition of the basic case

(3) Technical and economical criteria

(4) Business plan results and tariff issue

(5) Sensibility analysis

(6) Is CHP an alternative for studied case ?




# 3 MWe doublet case (1)
# - Basic configuration -

- 2 wells system at # 3000 m depth,
  1 submersible pump at 400 m depth

- Geothermal target : $T_{Prod}$ = 150°C, Q = 80 kg/s,
  $T_{Reinj}$ = 75°C ⇨ $P_{th}$ = 24 MWth *($P_{th}=Q.\rho.c_p.\Delta T$)*

- ORC binary plant, air cooled, efficiency = 12,5%
  ⇨ <u>3 MWe (gross output power)</u>

- Auxiliaries consumption (including pumping) :
  1 MWe (33% of GP) ⇨ 2 MWe (net output power)

# 3 MWe doublet case (2)
# - Costs repartition -

| | | |
|---|---|---|
| 2 wells (6 M€ each) | 12 M€ | 60% of total |
| ORC plant (3 MWe) | 4,5 M€ | 1500 €/kWi |
| Pumping system | 0,8 M€ | LSP, injection pump |
| BOP (CW, Mech., Elec.) | 1,2 M€ | Outdoor plant |
| Reservoir investigation | 0,5 M€ | MT, VSP, stimulation |
| Contingencies | 1 M€ | 5% of total |
| **TOTAL** | **20 M€** | **6700 €/kWi (gross power installed cost)** |

# 3 MWe doublet case (3) - Technical & Economical criteria -

- 2 years of construction, 15 years of operation at 8400 hours/year (96% plant capacity factor)
- Sale of energy = based on the net output power
- Operation costs = 3,5% of CAPEX (700 k€/year)
- Investment during operation = 0,5 M€ / 5 years
- No reservoir depletion ( $T_{Prod}$, permeability … )

**Project IRR target = 10%** (before tax, constant €)

Géothermie Soultz

# 3 MWe doublet case (4) - Results and tariff issue -

- In order to satisfy the Project IRR target of 10%, the net output power must be sold at <u>21 c€/kWh</u> (210 €/MWh)

- <u>In France</u> the EGS tariff is 12 c€/kWh (125 €/MWh, 2006 conditions) applied on net output power, indexed on production and services costs every year, which gives an IRR of 0% (!) with the same basic assumptions

- <u>In Germany</u>, the EGS tariff is 16 c€/kWh (150 €/kWh) applied on gross output power, but not indexed (flat rate) ; with a cost of electricity for auxiliaries consumption of 6 c€/kWh (60 €/Mwh, market price) it gives an IRR of 8%

# 3 MWe doublet case (5)
# - Sensibility analysis-

☞ **Maintain a Project IRR of 10%**

| Parameter | Variation | Impact on tariff |
|---|---|---|
| 2 wells cost (CAPEX) | 10 to 14 M€ (+- 17%) | 19,4 to 22,6 c€/kWh |
| Auxiliaries consumption | 0,8 to 1,2 MWe (27% to 40% of GP) | 19,1 to 23,4 c€/kWh |
| Operating cost (OPEX) | 0,4 to 1 M€/year (2 to 5% of CAPEX) | 19,2 to 22,8 c€/kWh |
| **All together** | **Best & worst cases** | **16 to 27 c€/kWh** |

# 3 MWe doublet case (6)
# - Is cogeneration an alternative ? -

- **Principle** : decrease $T_{Reinj}$ from 75°C to 45°C and use the extra geothermal heat (9 MWth) for district heating in order to generate further incomes

- **Assumptions** : total investment = 25 M€ (+ 5 M€), heat sold during 5 months a year (3650 hours, winter time) at a tariff of 2,5 c€/kWh (25 €/MWh)

- **Result** : Electricity still to be sold at 20 c€/kWh (instead of 21 c€ / kWh) in order to maintain the same Project IRR of 10%

☞ **In this case, Heat & Power co-generation does not solve the tariff issue of pure power generation (!)**

# EGS versus Wind, Biogas or Solar energy (1 – Tariff)

- Onshore wind farm (France) : 8 c€/kWh
- EGS (France) : 12 c€/kWh
- Offshore wind farm (France) : 13 c€/kWh
- Biogas (France) : 14 c€/kWh
- EGS (Germany) : 16 c€/kWh
- Solar photovoltaic (France) : 30-55 c€/kWh

# EGS versus Wind, Biogas or Solar energy (2 – Pros and Cons)

## Pros

- Compare to Wind or Solar, EGS does not depend on climate, seasons or day/night succession ( base load )
- 1 MWe of installed EGS is equivalent to 3 - 4 MWe of installed Wind Energy ( ⇨ cost of installed capacity !)
- Compare to Biogas, EGS *(nearly)* does not produce CO2 in the atmosphere ( ORC = zero emission cycles )

## Cons

- EGS is much more complex than Wind or Solar systems
- Auxiliaries consumption is an issue ( pumping power )
- Induced seismicity can be a major issue and has to be managed and mitigated *("don't go too deep …")*

# Conclusions

A – Drilling issue (cost, but also rig availability)

B – Pumping issue / auxiliaries consumption

C – Power tariff issue of EGS (⇨ 20 c€/kWh)

D – Heat supply alternative (industrial market)

E – Size effect for EGS development ( x sites)