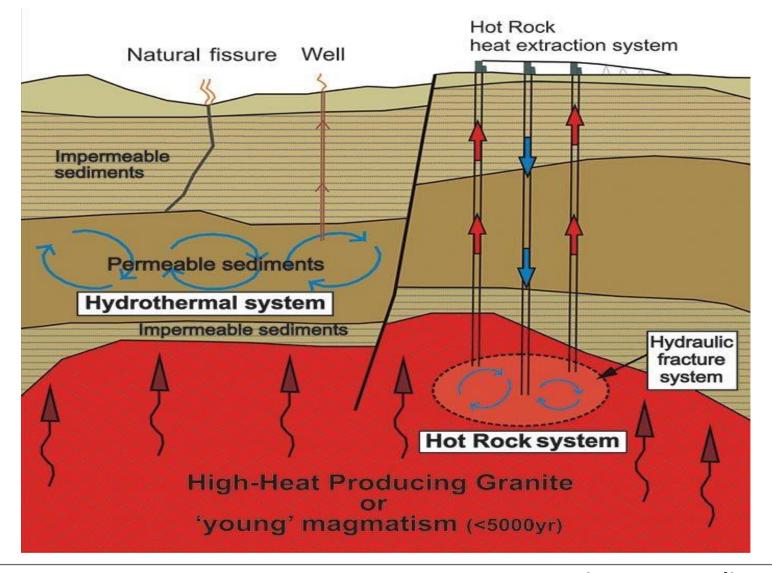




### **Engineered Geothermal System – EGS - Basics**



**Geoscience Australia** 



$$P \sim \eta * c * \Delta T * \dot{m}$$

Power ~ efficiency \* specific heat capacity \* temperature drop \* mass flow

40 
$$MW_T$$
 (> 80% Heat) (~ 100 C) (> 100 l/s)

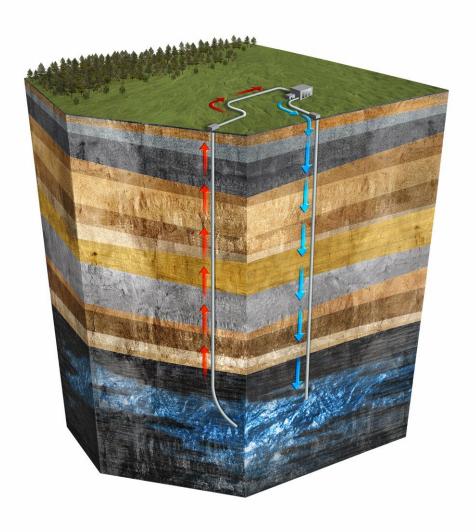
1 liter of 100 °C water 
$$\rightarrow$$
 0.3 MJ

1 liter of crude oil 
$$\rightarrow$$
 30 MJ

Oil/Water = 
$$100 / 1$$
 (E are about the same)

 $\rightarrow$  100 l/s to match!



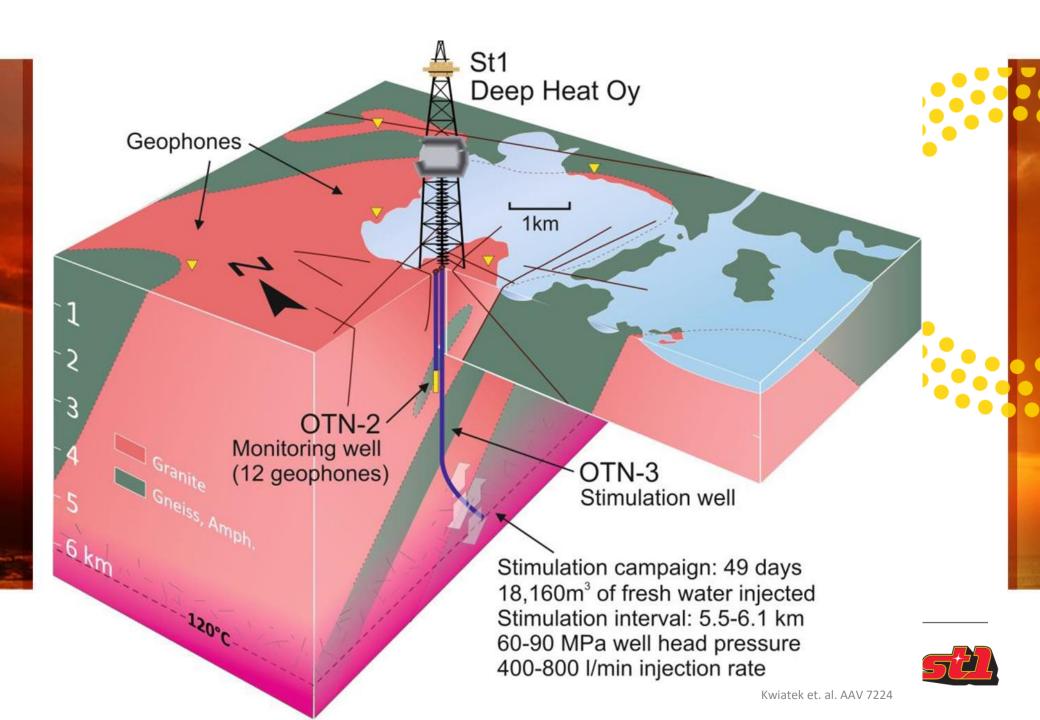


# St1 Deep Heat project: plant concept

- St1 concept is basically an 40 MW EGS (Enhanced Geothermal System) heat plant
  - This gives better efficiency for the plant and allows more electricity to be used in pumping
- Finnish district heating networks are all designed with maximum temperature 120 °C and normal maximal operating temperature is around 115 °C.
  - Summer time minimum temperature is 75 °C
  - This causes the need to drill as far down as 6400 m in Southern Finland

YouTube: "St1 Value Chain"







# **Drilling Efficiency**







#### Seismic Network 17 Surface PGV stations OTN-2 well LASS MP1 × OTN-3 well ▼ Seismic monitoring network Ground motion network Helsinki LEPP MP15 MP5 MP7 UNIV 60.2 RUSK atiitude. MURA TAGC MP9 OTN-2 Array Deep Heat Oy MP12 1 Deep MP13 ▼ OT01 ▼ -2193m MP6 OTRA MALM Array of ←5km west 12 level 3C ▼ OT10 TAPI -2614m 60.15° km 12 Borehole 24.8° 24.9° Seismometer Longitude [°] stations

## Public Acceptance

#### CONDITIONS **GREEN AMBER RED** & ACTIONS PGV ≥ 7.5 mm/s PGV & PGV < 1 mm/s 1 ≤ PGV < 7.5 Magnitude M < 1.0 based: M ≥ 2.1 $1.0 \le M < 2.1$ or or or or Magnitude Only < 1.2 ≥ 1.2 & < 2.1 ≥ 2.1 Based: or or or or Site Specific: See TLS Plan See TLS Plan See TLS Plan **STOP** & Notify Notify & **Actions:** Continue Resume only if Continue permissible Date of last revision: 12 February 2018, thresholds may be revised with approval from ISUH





## **Public Acceptance**

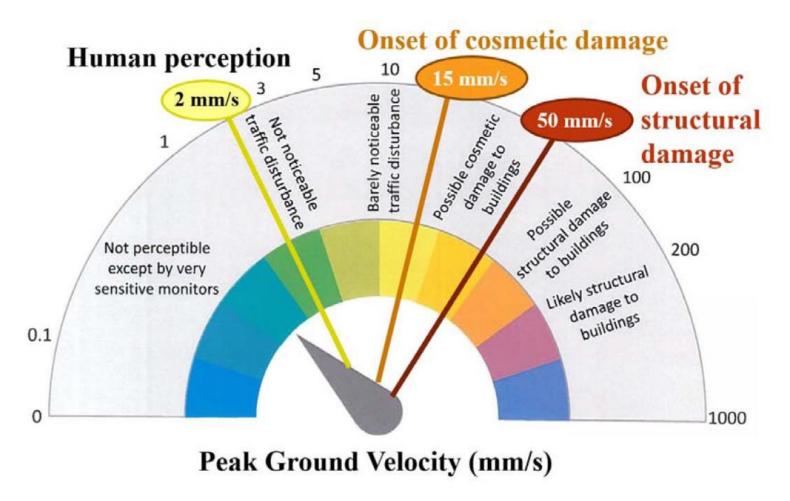


Figure 9. Relationship between PGV and impact (from Bommer, 2017).



#### **Stimulation Control**

