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EGS-E

Conceptual model of Enhanced Geothermal System based on excavation technology

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Stability and post-critical growth of a system of cooling or shrinkage cracks

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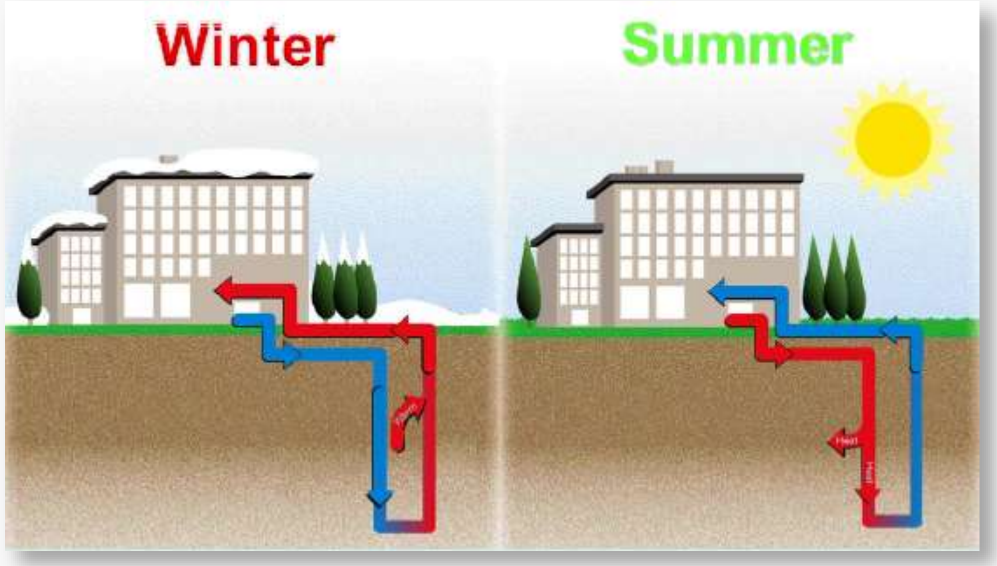
If one cubic mile of granite of 300°C temperature should be cooled to 200°C, the heat released could drive a power plant of 1000 MW (thermal) for 33 years. In the United States there exist numerous geothermal basins where hot rock is close enough to the surface, but most of them are dry, i.e., have no natural water circulation. A study of the methods of tapping the hot dry rock energy is, therefore of considerable importance.

Geothermal Energy




Song, 2009

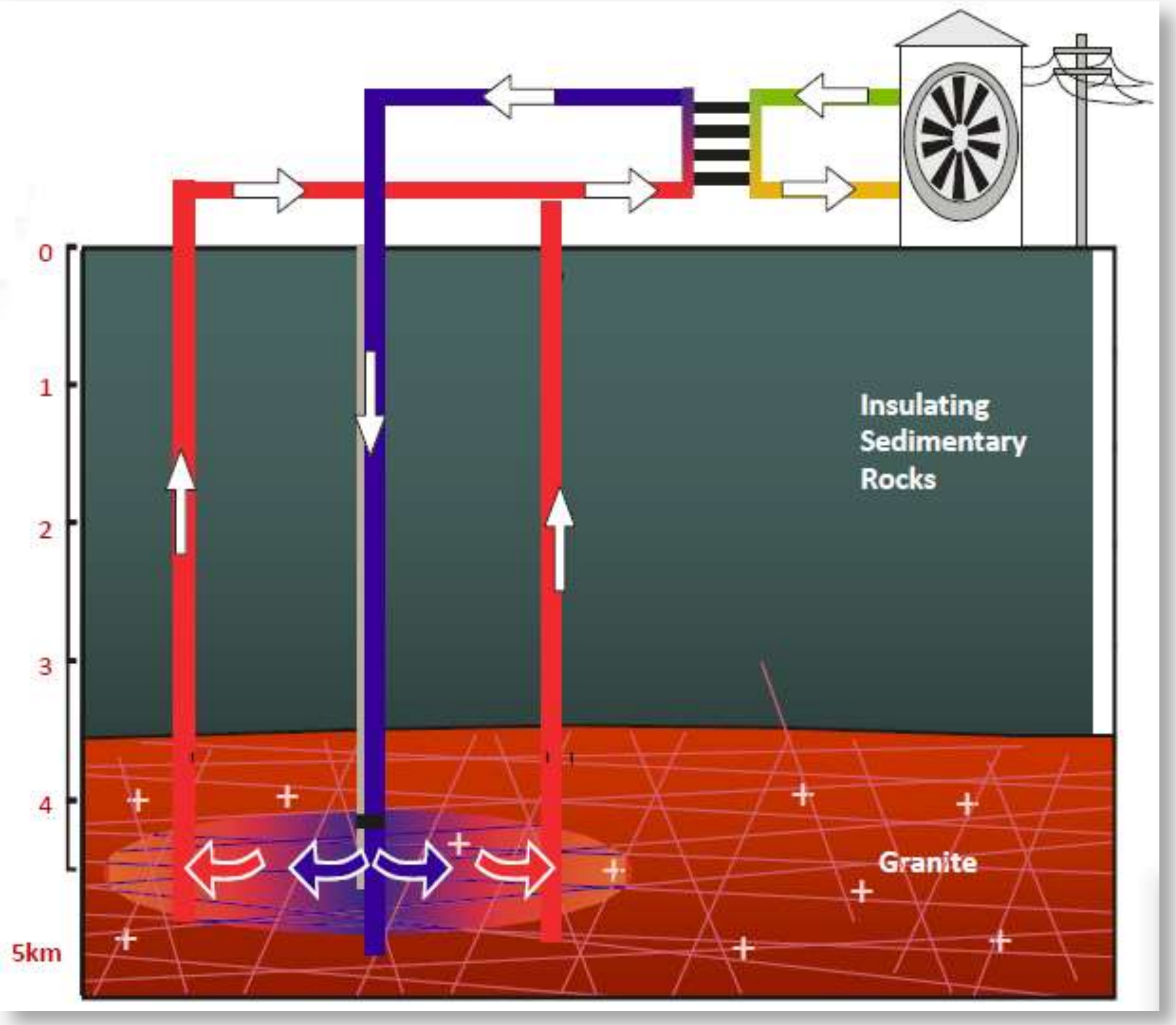
Hydrothermal resources at relatively shallow depth used today for geothermal power production are just pinpoints on a map of global scale. For the unavoidable worldwide energy shortage in the near future, it became clear that both alternative sources of energy and economies in the usage of energy are necessary.

Geothermal Energy

By far the biggest resource of geothermal energy is the crystalline basement in regions with normal to slightly above normal temperature gradients. The basic concept of EGS (Enhanced-Geothermal-Systems) thus consists of creating or enhancing large fracture surfaces in the crystalline basement in order to hydraulically connect two or several boreholes.

EGS

- Drilling wells to 1,000-5,000 m
- Production at 100-250℃
- Hydraulic fracturing
- Crystalline basement
- Heat exchange



EGS history

Fenton Hill, Los Alamos, New Mexico 1972 –1996

Rosemanowes, Cornwall, UK 1978 –1991

Fjallbacka, Sweden 1984 -1989

Hiijori, Japan 1985 -2002

Soultz, France 1987 –present

Ogachi, Japan 1989 –2001

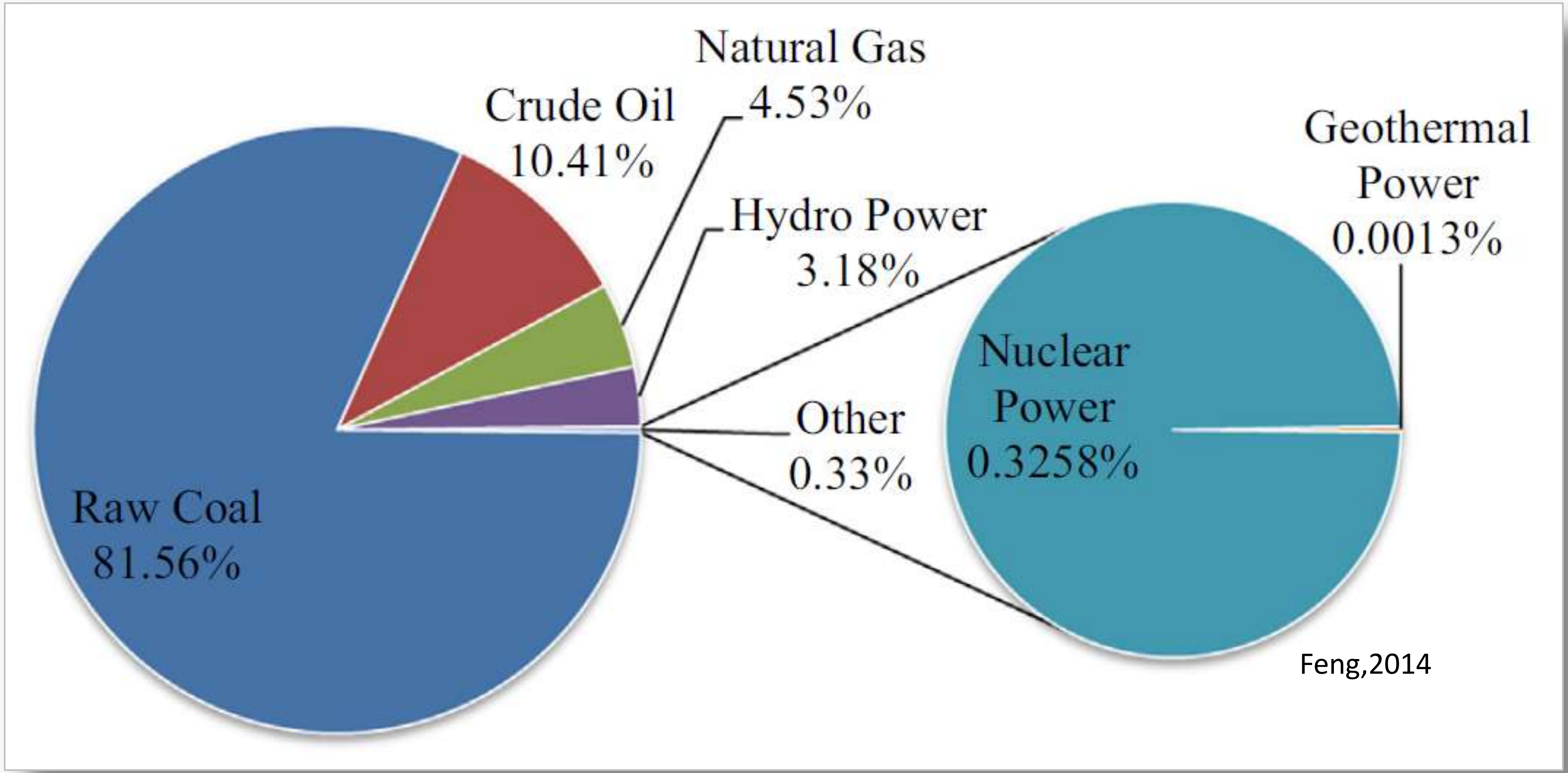
Habanero, Australia 2003 -present

Bad Urach, Germany 2006 -2008

Basel, Switzerland 2005 -2006

Landau, Germany 2004 -2008 (production)

However, EGS shares very small proportion in China.



Advantages of EGS

Clean Energy

EGS: a solution to put the debate of climate change aside

Almost Permanent

24h Base-load Power

Disadvantages of EGS

Low Efficiency

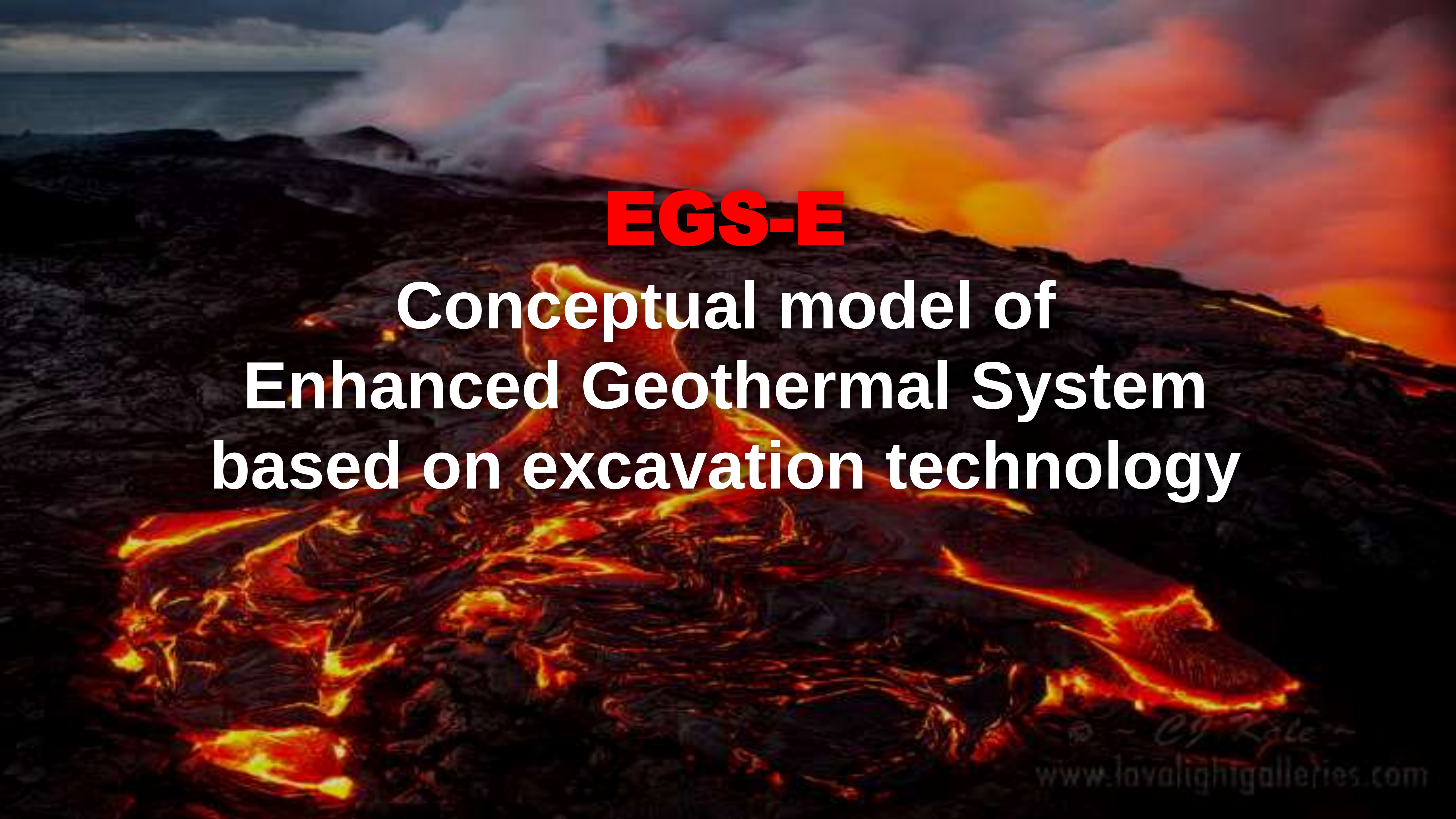
(Impermeable)

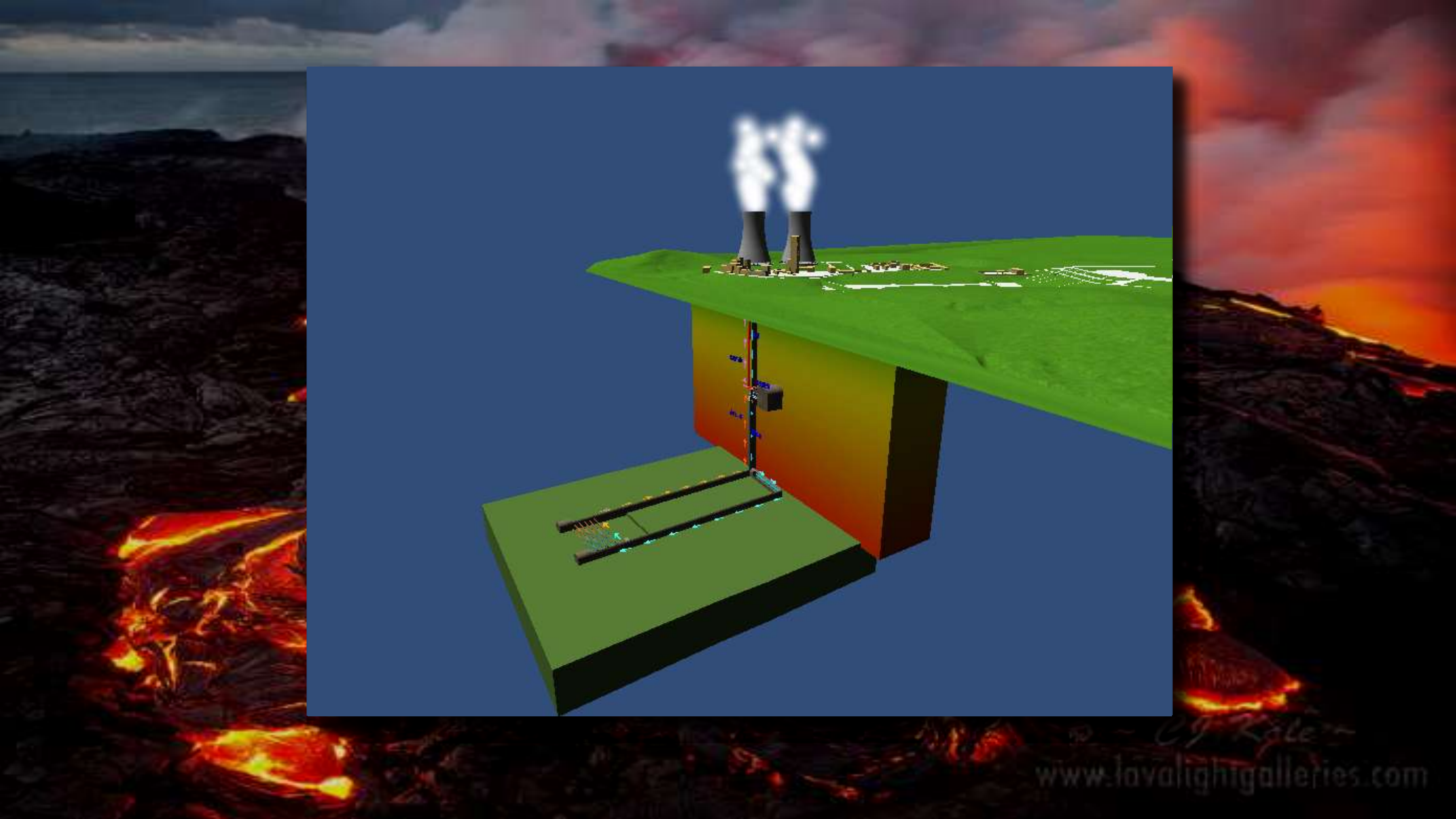
Region Limitation

The key challenge is that a sufficiently large heat exchange surface between rock and circulating fluid to enable transfer of lager amounts of thermal energy is impossible to established.

EGS-E

Conceptual model of Enhanced Geothermal System based on excavation technology

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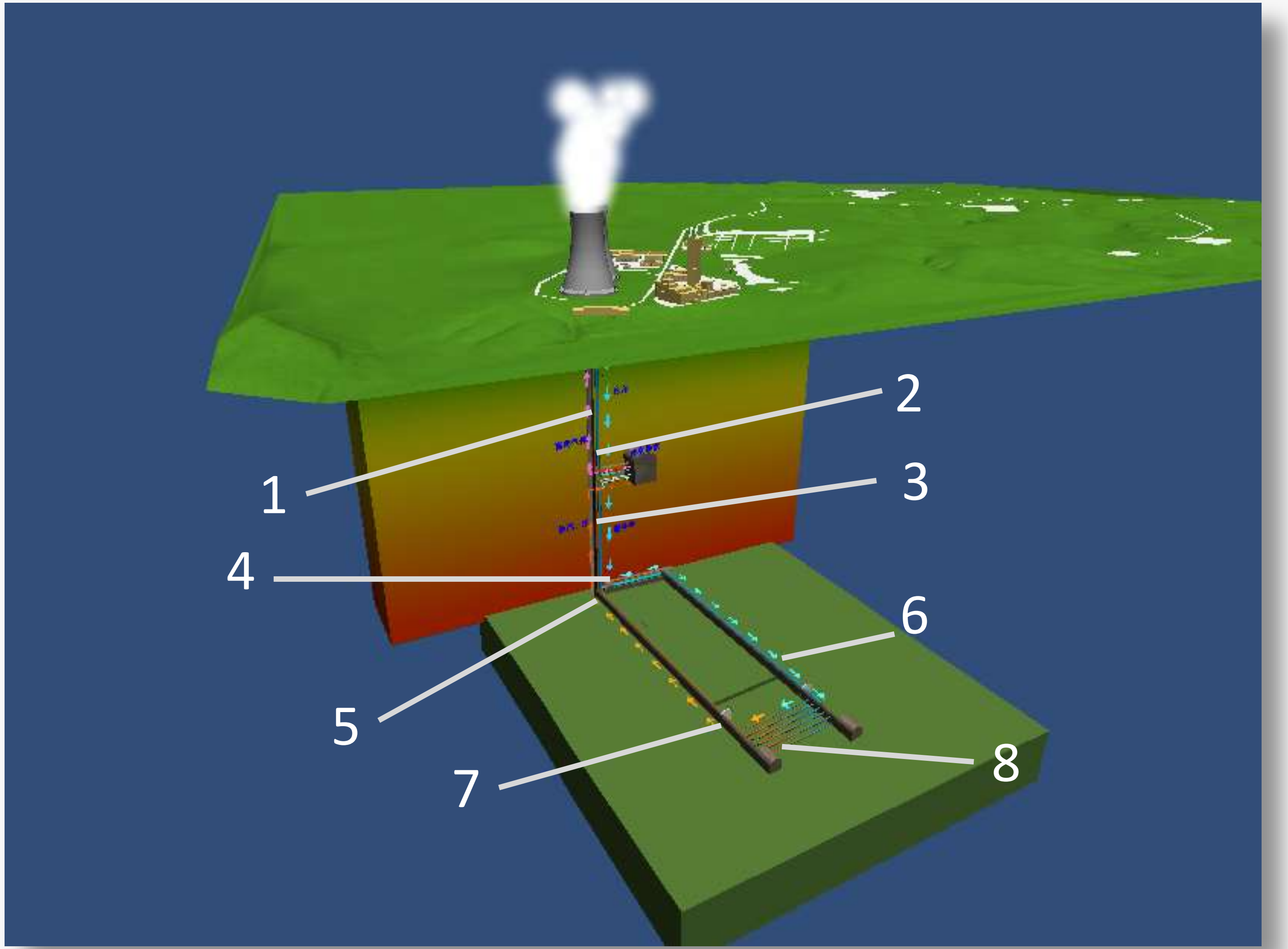
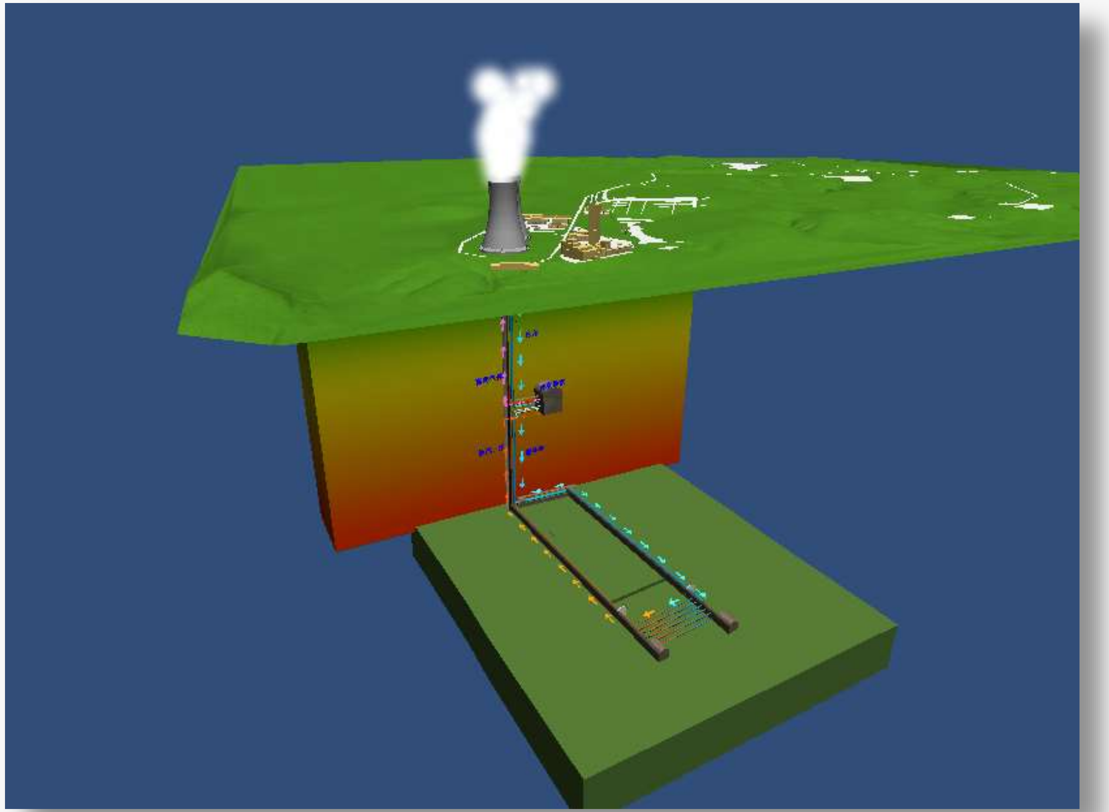


1——Shaft;
2——Injecting Pipeline;
3——Collecting Pipeline;
4——Medium Liquid Sprue;
5——Medium Liquid Collecting Port;
6——Medium Liquid Injecting Roadway;
7——Medium Liquid Collecting Roadway;
8——Boreholes in HDR;

In terminology, we use EGS-D for EGS based on drilling technology, i.e., the conventional EGS.

We use EGS-E for EGS based on excavation technology.

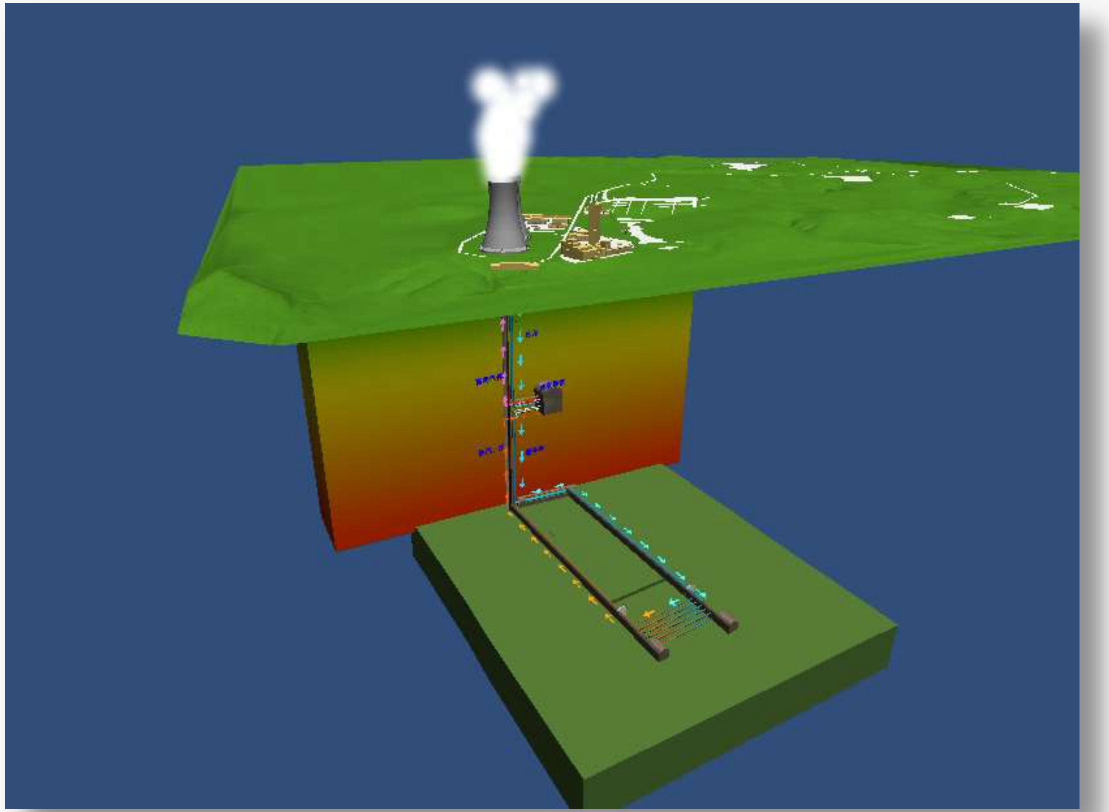
Advantages of EGS-E



1. EGS-E makes a more substantial mass of hot rock be easily accessible at a reasonable depth.

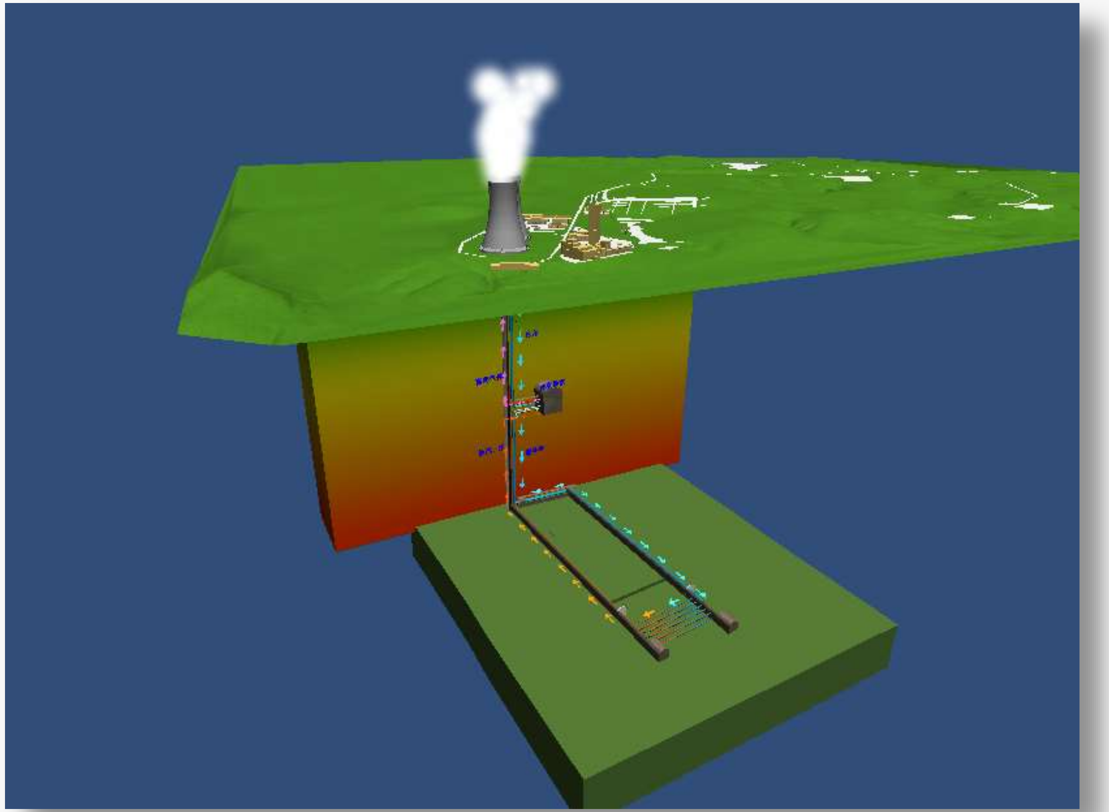
Advantages of EGS-E

2. More fluid flowpaths and heat exchangers or much bigger permeable zone can be easily created with EGS-E, particularly in the deep rock mass

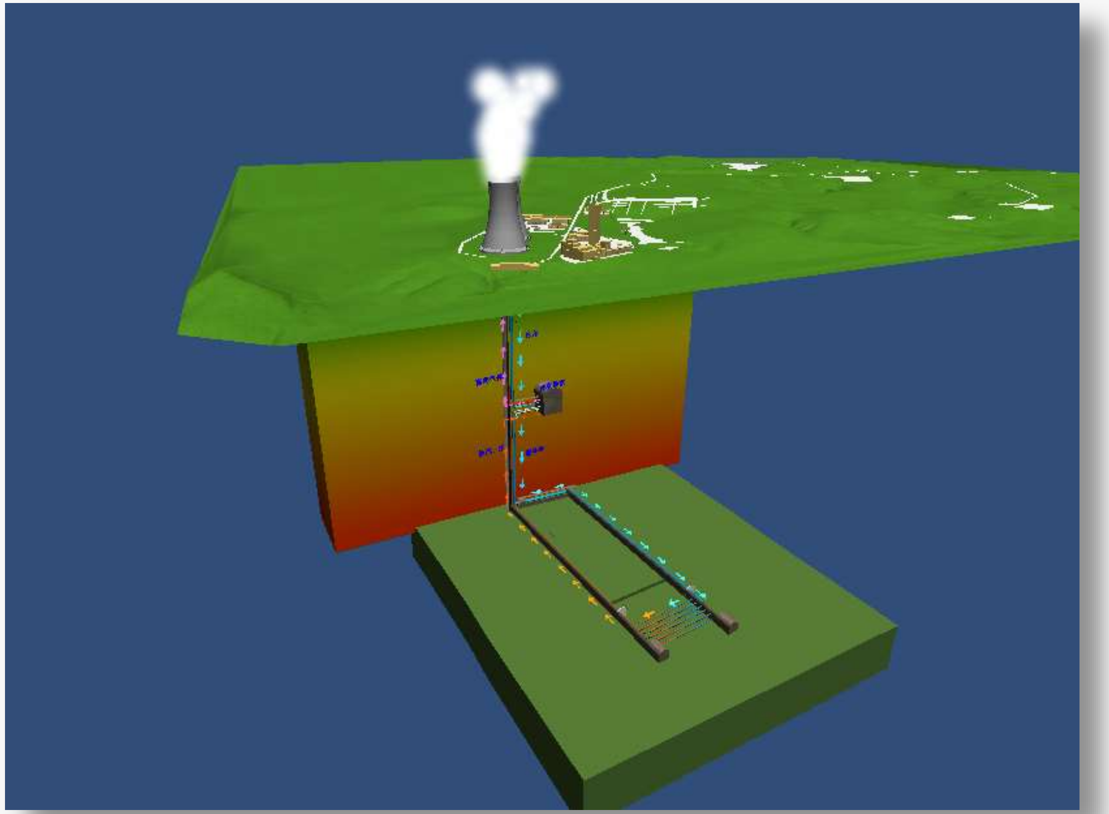


Advantages of EGS-E

3. With EGS-E, a lower flow resistance, enabling high fluid throughputs to carry the required larger amounts of thermal energy to the surface or even underground power-conversion system.

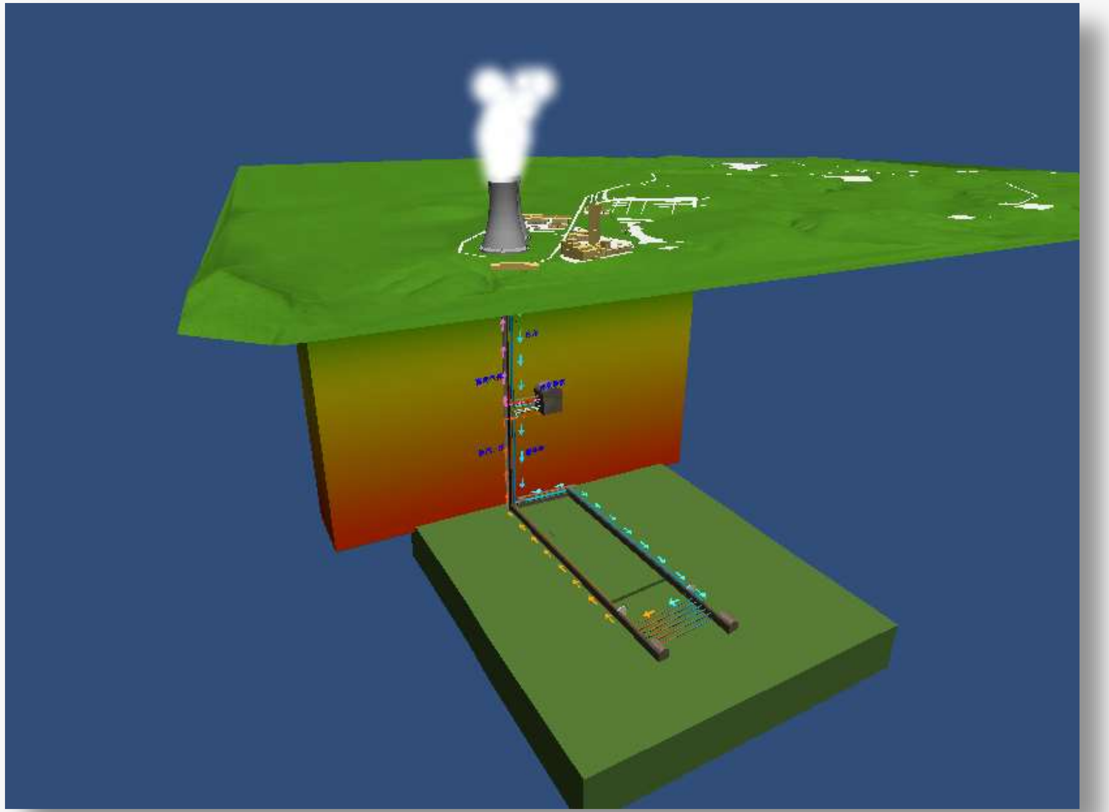


Advantages of EGS-E



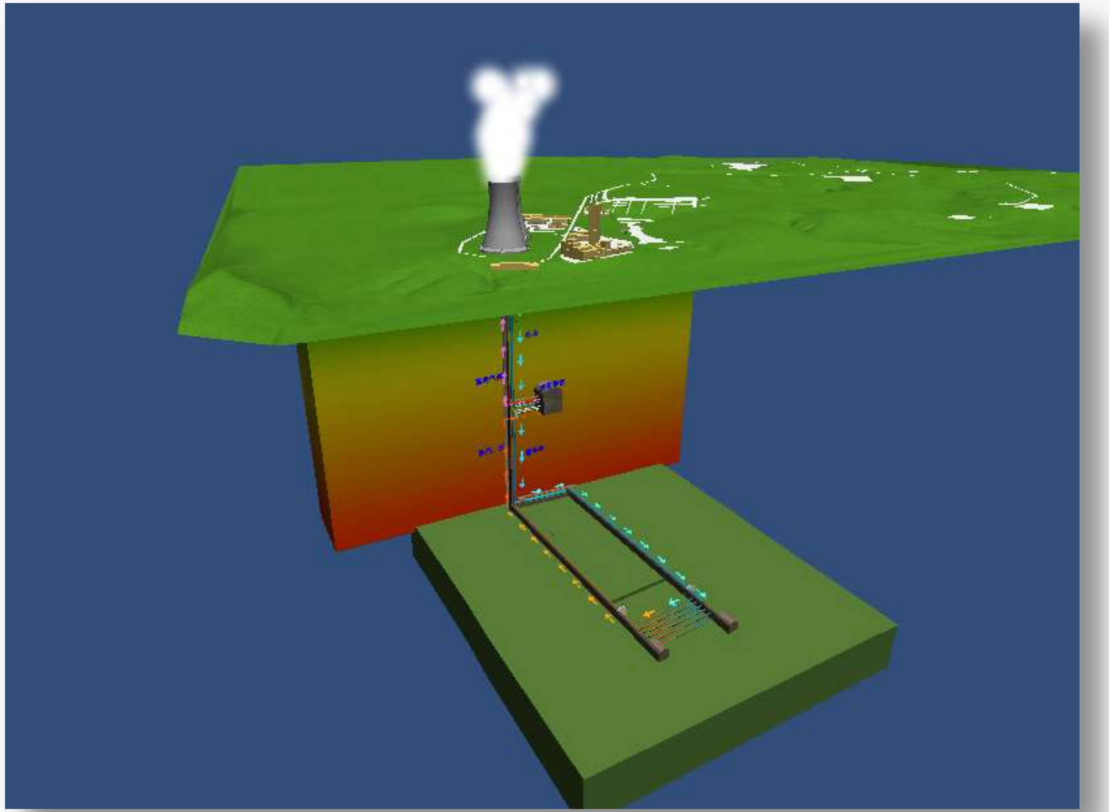
4. With EGS-E, a sufficiently large heat exchange surface between rock and circulating fluid to enable transfer of lager amounts of thermal energy.

Advantages of EGS-E



5. EGS-E makes construction of underground structure more easily to carry out.

Advantages of EGS-E



6. By combining with deeper mining, both EGS-E and mining may reach a higher economical production output.

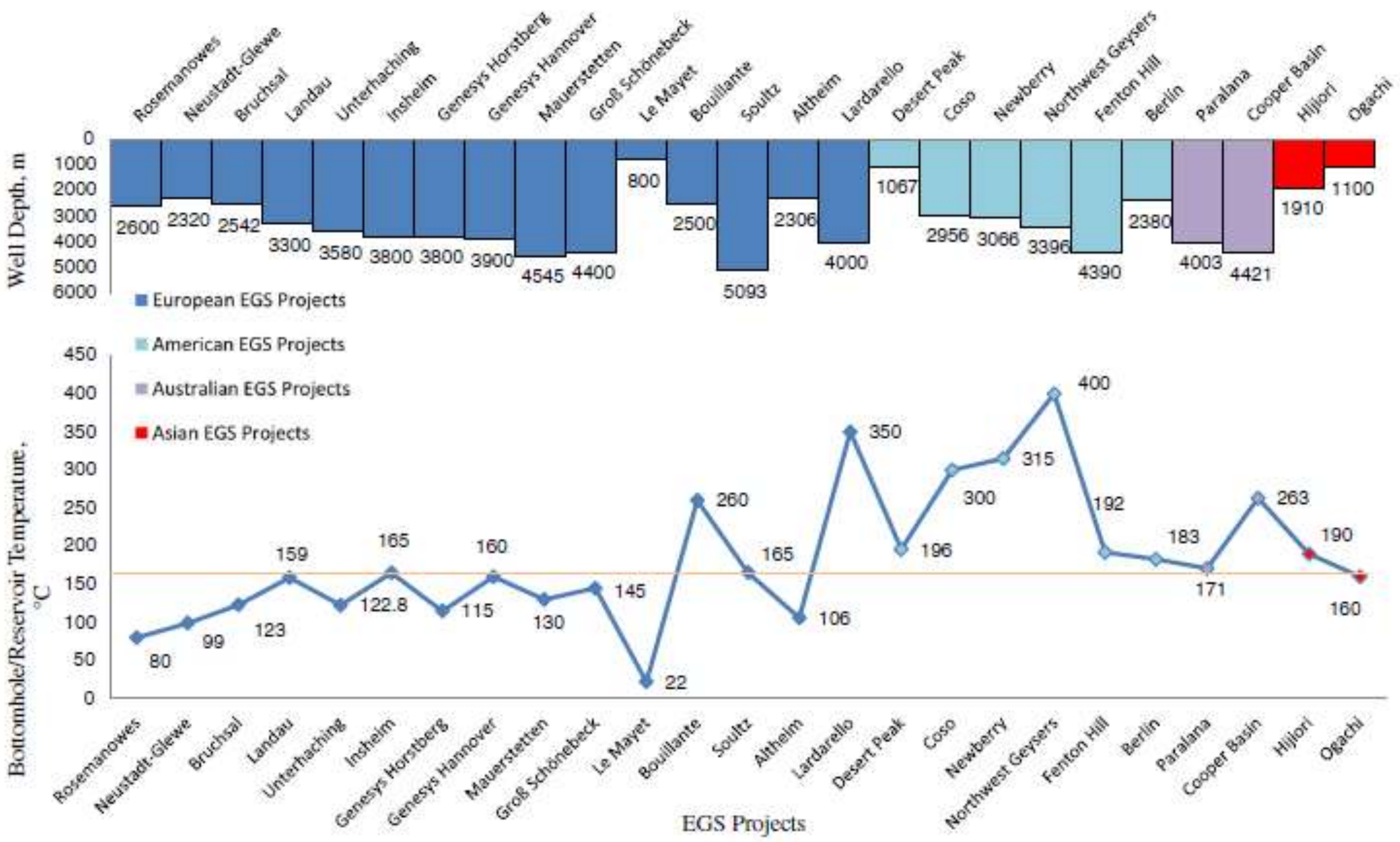


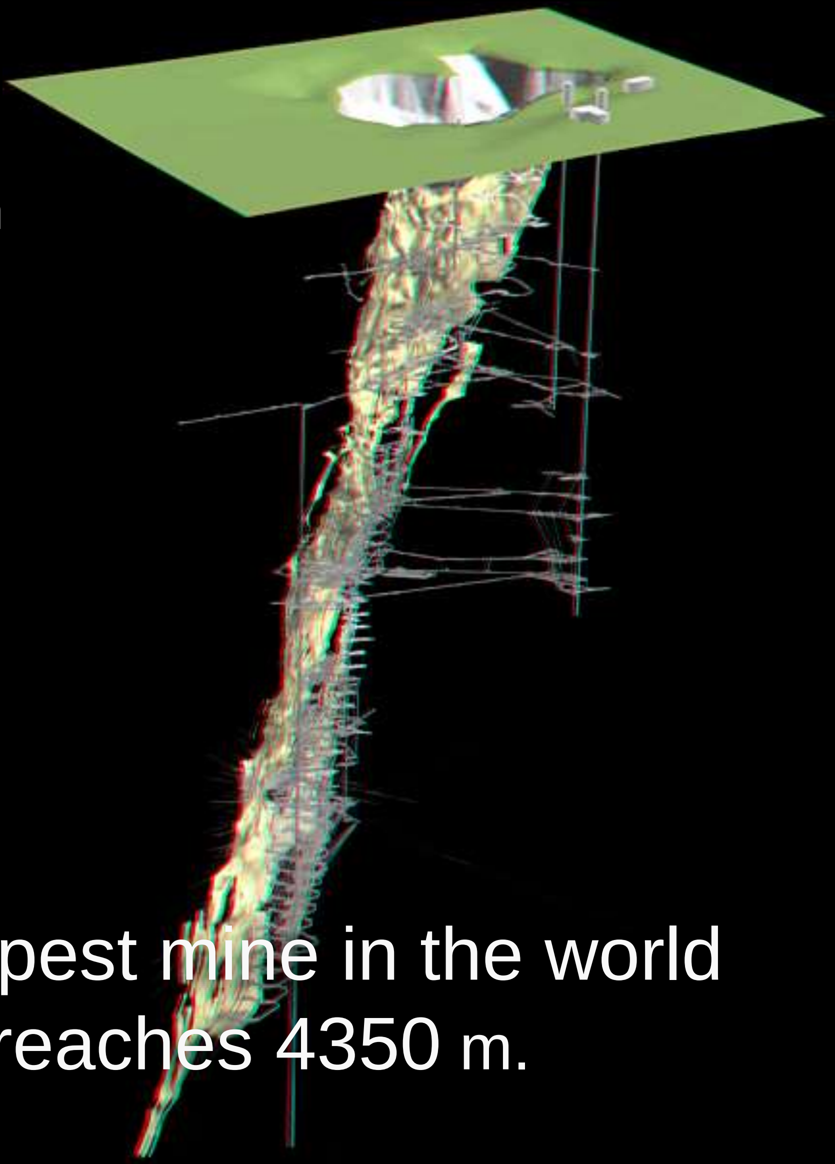
Figure 1 Worldwide EGS projects' reservoir/bottomhole temperature vs. depth.

Breede,2013

The world mining technology already reached the depth the drilling borehole reached

With current mining technology, underground mining at depth more than 3000 m may be uneconomical.

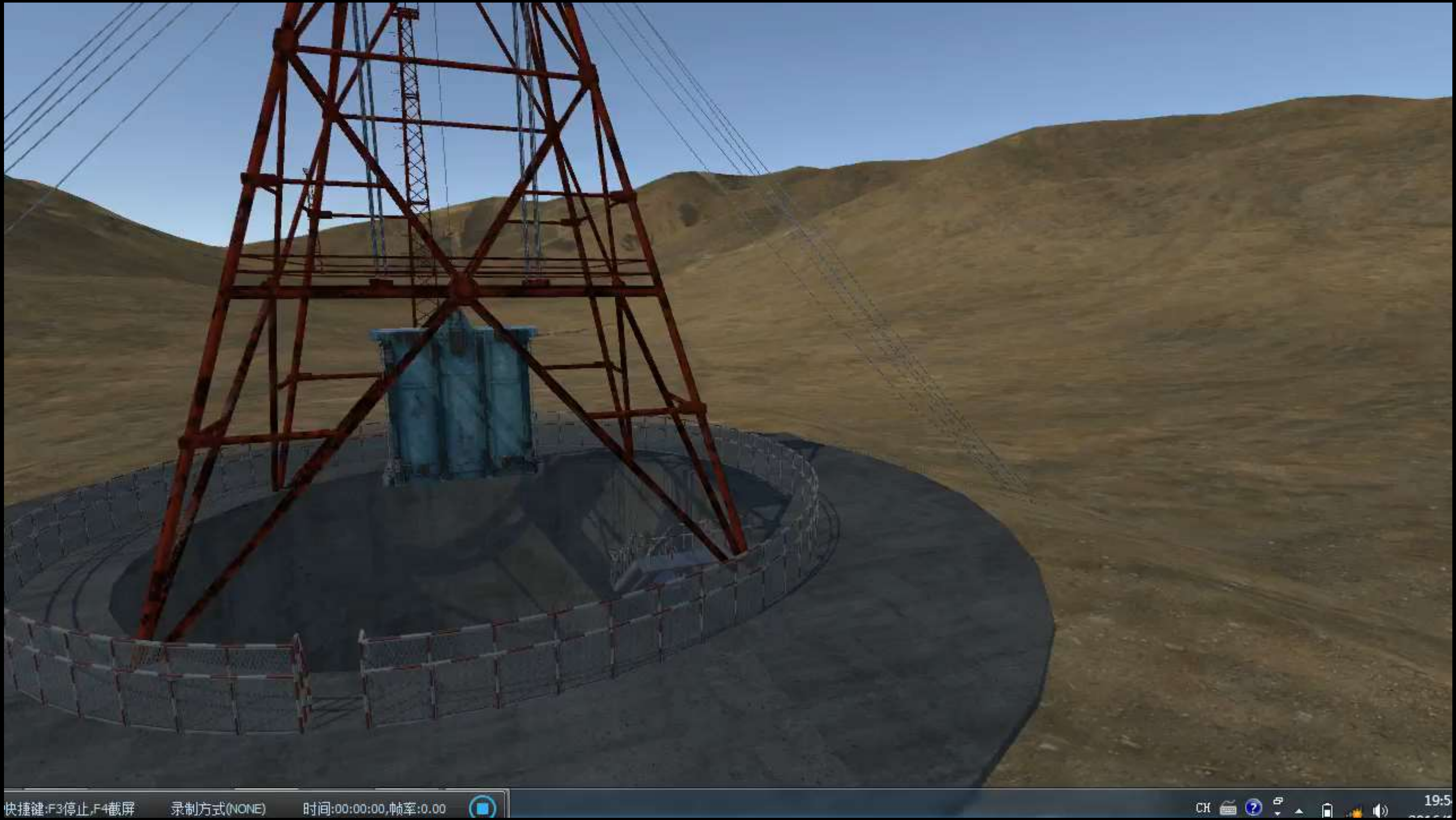
However, a EGS-E project with deep mining as a combination may be economical and provide a win-win solution for our future energy as well as resource shortage problems.



The deepest mine in the world already reaches 4350 m.

Eight of the ten deepest mines in the world reside in a particular region of South Africa, while the remaining two are both located in Ontario, Canada

A VR underground laboratory of EGS-E will be setup soon in DUT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Iceland

Maybe no need for Iceland to save energy and reduce emission

Key difference between Iceland and all other countries?

We can go higher, why not deeper ?

One kilometer tunneling means a small step in human transportation

One kilometer shafting means a big step in human energy supply

Thank you

for your attention