FACT SHEET ON ENHANCED GEOTHERMAL SYSTEMS: WHY IT IS DIFFERENT TO SHALE GAS

The possibility to produce shale gas in some European countries has triggered a very heated debate about the environmental and social impacts of the technique used to extract gas from shale rocks (today only in the US and Canada); this technique is widely known as hydraulic fracturing or fracking.

Serious concerns over the consequences of the extraction of shale gas has led a number of EU governments (e.g. France and Bulgaria) to ban the use of fracking for fossil fuels and others to put decisions on hold until science clarifies the issues further.

Recently, part of the gas industry has claimed that fracking for shale gas is comparable to the hydraulic stimulation process used for geothermal exploration and that the granting of geothermal exploration permits is creating a double standard.

Building on the experience of the existing EGS plants in operation, the geothermal sector is able to understand the challenges and provide clear answers to the current debate.

This fact sheet will tell you why the stimulation process to engineer geothermal reservoir is safe and environmentally friendly.

Moreover, it will shed light on the key differences between the resources needed, and the different consequences of the processes used for Enhanced Geothermal Systems and for shale gas.

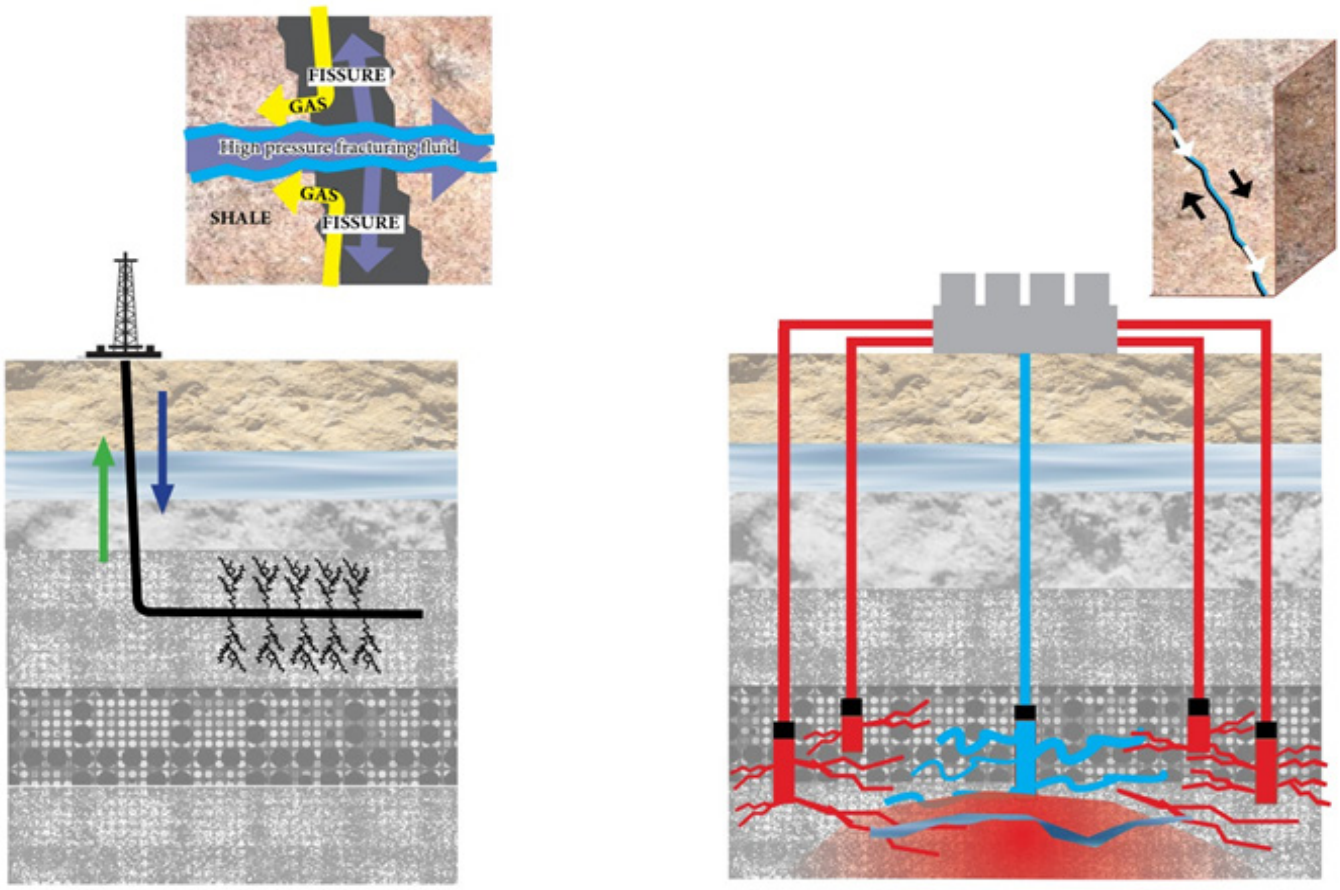
What is EGS?

An Enhanced Geothermal System is an underground reservoir that has been created or improved artificially.

We are used to seeing geothermal electricity in places with highly permeable rocks and high underground water temperatures, for example in Italy (Tuscany) and in Iceland, but most of Europe does not share this geology and enthalpy. **EGS allows us to exploit low temperature areas by increasing the permeability of rocks nearly anywhere.**

How is EGS similar to Shale Gas extraction?

The general objective of extracting an energy source is similar. Indeed, Geothermal and Shale gas methodologies have some similarities: Both use stimulation techniques based on high pressure water injection with the objective to generate a high permeability to extract as much mass flow as possible.



How do EGS and the Shale Gas extraction processes and their consequences differ?

While the physical mechanism can be the same, there are many significant differences

- **The target: renewable geothermal heat in the case of EGS and gas in the case of shale gas;**
- **in the way this process is operated;**
- **the resources and products required;**
- **the impact on the natural underground and surface environment.**

Process

» Targeted rocks and underground environment

Shale gas is locked in rock in a dispersed form (typically in rock with low permeability, in sedimentary basins), without fluid. EGS targets semi-permeable rocks with some discontinuities and where a fluid already exists. Because geothermal power production uses rocks with at least a low permeability it requires stimulation but with lower pressure injection.

» Transport fluids

In the case of EGS, hydraulic stimulation only requires a volume of fluid without specific additives. The fluid used includes natural water with some mineral content (brine) so that the composition of the water being injected matches that of the water occurring naturally in the subsurface. The advantage of EGS is that the permeability is permanently increased; the 'artificial' reservoir is self-sustaining and does not require further stimulation. The stimulation fluid does not need to be pumped back up to the surface as this now forms an integral part of the newly created reservoir.

In the case of shale gas, there is always the need to create new fractures. In order to maintain the fractures open, additives and sand are added to the water. This process needs to be repeated. As these fluids can reduce the production efficiency, they need to be pumped back to the surface.

Hydraulic stimulation implies potential different consequences depending on the underground environment and the fluid.
EGS requires water and minerals, which are not pumped-back as they match with the underground environment.

Resources required and their potential impact

» Impact on water resources and waste treatment

Shale gas: use of water to prepare fracking fluids (water: 90%, proppants: 9.5%, chemicals: 0.5%). A large quantity of water (10.000-20.000 m3 / well) is required and as a result significant level of chemicals. The absence of a natural fluid in the underground requires the supply of water from external sources.

» **Wastewater by-products to be managed**
» **Risk of groundwater contamination**
» **Risk of competition with other water uses (drinking, irrigation, etc.)**

EGS: Moderated quantity of water extracted in situ, plus harmless chemicals, no proppants.

» **No wastewater by-products as the fluid is in harmony with the underground and not pumped-back**
» **No risk of groundwater contamination**
» **No competition with other water uses**

EGS can use water extracted in situ, does not require a large amount of external water as for shale gas. Furthermore, it does not produce wastewater as a by-product.

» Number of wells

Shale gas extraction requires a much larger number of wells than EGS. Shale gas projects usually involve tens of wells as it aims to harness a resource spread accross a large volume and trapped in rocks with very low permeability.

EGS requires fewer wells per project.

» Impact on traffic, noise

The very large quantity of water, sand and additives required for shale gas entails logistical problems: trucks, roads, noise, and pollution.

Shale gas requires a large number of wells and a higher amount of external resources with implications in terms of trucks, traffic, noise, etc.

The possible consequences of hydraulic stimulation used for fossil fuels and geothermal are very different.

The potential environmental risks for which shale gas exploration and exploitation have been banned are indeed inexistent in the case of hydraulic stimulation developed in the framework of deep geothermal in Europe.

What about Earthquakes?

There has been public concern about micro-seismic activity (less than 3,5 on Richter scale) in relation to hydraulic stimulation. Monitoring protocols have been established by the industry, using the long experience of the oil and gas sector in this area.

Geothermal drillers install seismometers and use special purpose software to map the faults and assess the local geology. This enables them to monitor what will happen during the stimulation, to create a risk management plan, and to control micro-seismicity.

Micro-seismicity can be controlled with appropriate monitoring and proven procedures and risk-management plans are well established and continuously improved.

Underground Competition: Priority to long-term sustainable solutions

The European Parliament's resolution (2011/2309(INI) urges public authorities to introduce underground regional planning in order to optimise resource allocation between geothermal energy, shale gas, carbon capture and storage (CCS) and possible other possible underground uses, and thereby maximising the benefits of our underground resources for society.

As our use of the underground changes, we will need to prioritise the way we use it. Shale gas is an extension of classical hydrocarbon technology whereas geothermal energy is a sustainable and renewable energy resource.

Similarities and differences between Shale Gas and Geothermal EGS

	Shale Gas (Impermeable environment)	Geothermal EGS (semi-permeable environment)
Use of hydraulic stimulation	Yes	Yes
Objective of extracting as much mass flow as possible	Yes (gas)	Yes (geothermal heat), but the fluids will be re-circulated in the reservoir
Use of horizontal drilling	Yes, necessary	Not mandatory, and very expensive today
Number of wells used in a production site	Huge number (on overage 3-4 per Km2)	Today: 2-4; in the future more than 3
Degree of hydraulic stimulation	High stimulated volume	Rather limited volume
Wastewater by-products	Yes	No. Natural water from the reservoir can be re-injected
Post-stimulation operations:		
Pumping	Fluids injected with additives	No
Washing	Injection of water to extract excessive agents	No
Storage	Storage tanks on-site	No
Treatment of watewater	Treatment units on-site possible	No need
Evacuation	Tank trucks	No need
Risk of groundwater contamination	Potential	Negligible
Large use of chemicals	Yes	No
Regulatory Framework	Under development	Established