

Geothermal Energy: The Heat Beneath Our Feet



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Utah FORGE PI

Benefits of Geothermal Energy

- Low emission
- Base load power
- Peaking
- Renewable
- Vast resource
- Environmentally benign
- Low costs once established
- Small geographic footprint
- Secure



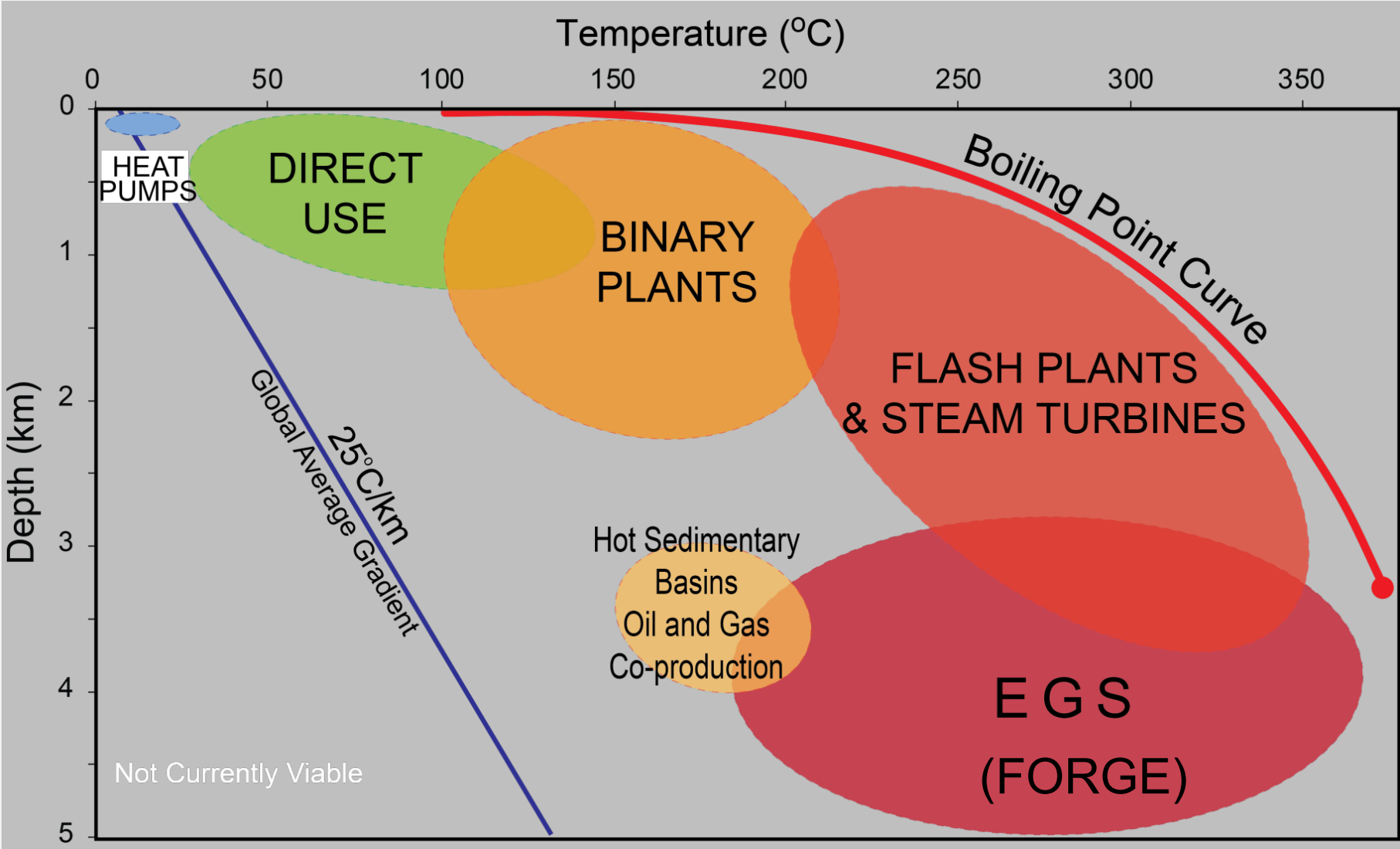
Electric Generation

Space Heating



Spas

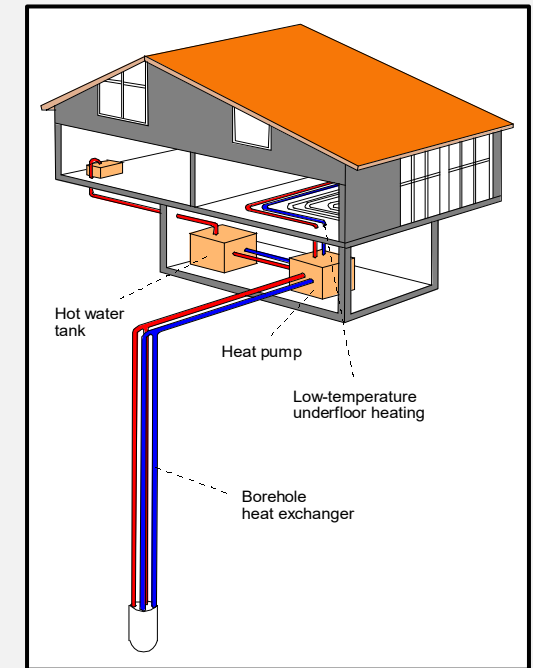
Geothermal Systems



Moore and Simmons, 2013

Geothermal Heat Pumps

- Can be used for heating and cooling
- Extract heat from ground in winter; reject heat in summer
- >1,500,00 units worldwide
- Growing at a rate of 25%/yr
- Savings of 30-70% when heating and 20-50% when cooling

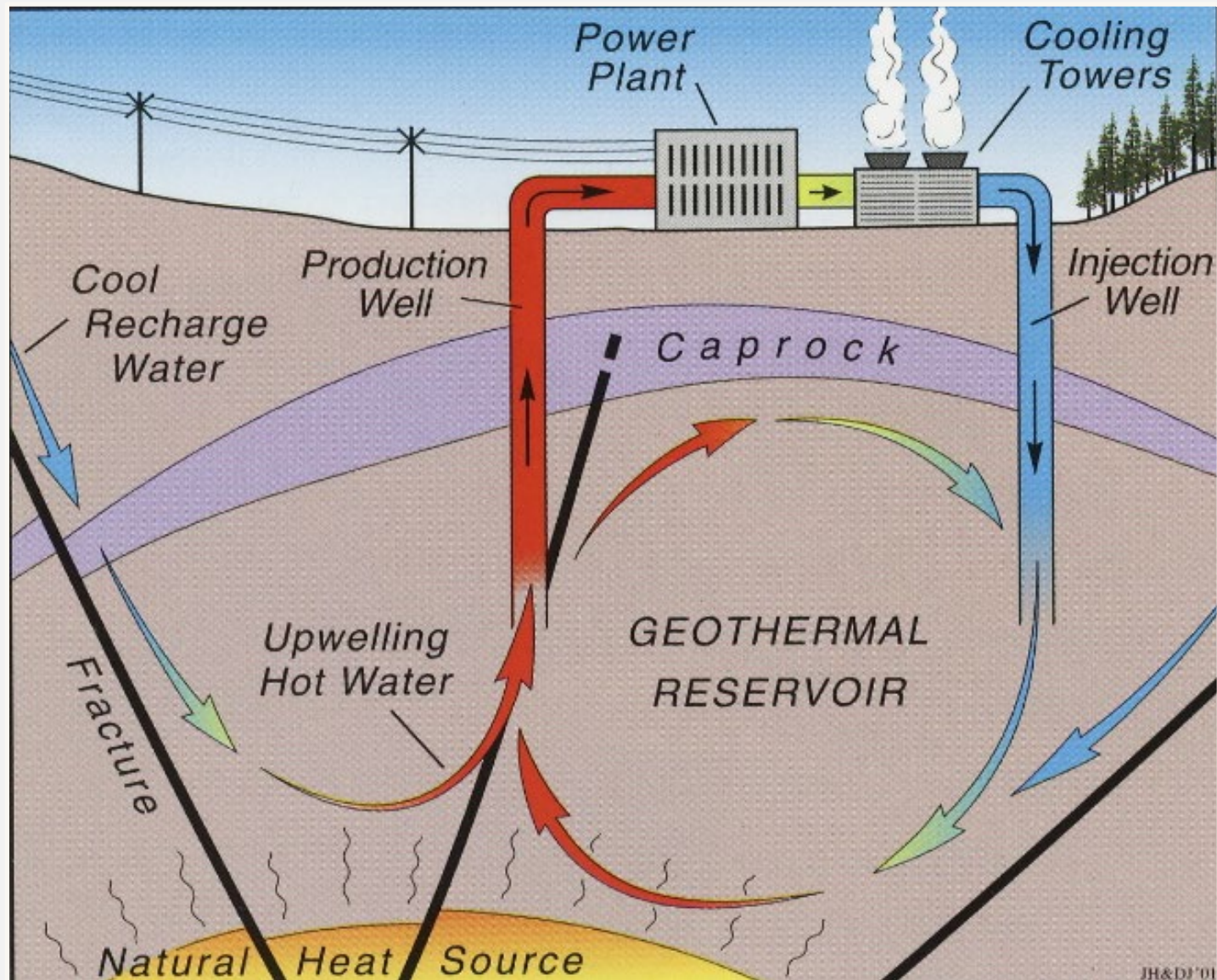


Carolyn and Kem Gardner Building (U of U)

- Save ~\$62,000/year vs traditional mechanical system
- Save 1,440,000 gallons of potable water per year
- Eliminate > 4 tonnes CO₂/year released into the air
- 170 wells to depth of 350 ft

Conventional Geothermal Systems

- A heat source
- Water to transport the heat
- Permeable fractures for the water to move through



Direct Uses of Hot Water

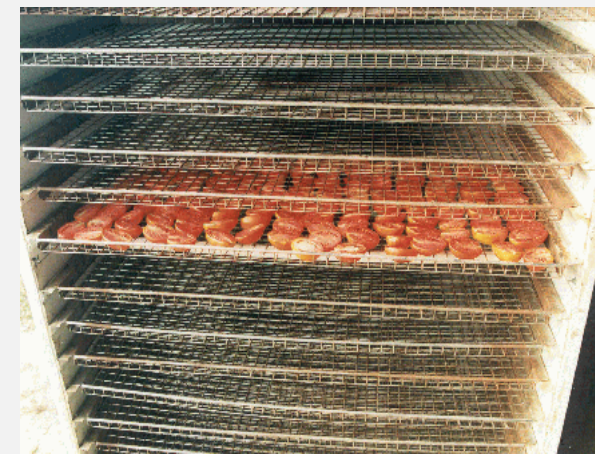
- Spas
- Space Heating and Cooling (70 countries)
- Agriculture (greenhouse heating)
- Aquaculture (tilapia, trout, prawns, alligators)
- Industrial Processes (vegetable drying, paper production)



24 acres of greenhouses (Milgro – Newcastle, Utah)



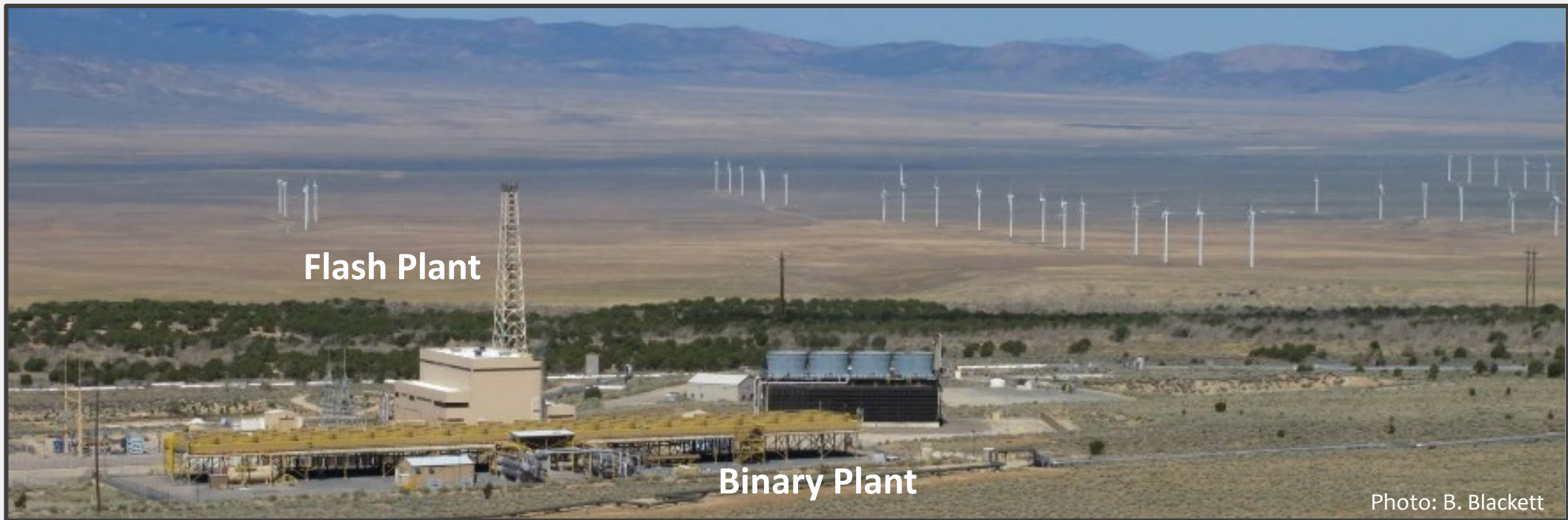
Heating 330,000 sq ft (Utah State Prison)



Vegetable drying (Guatemala)

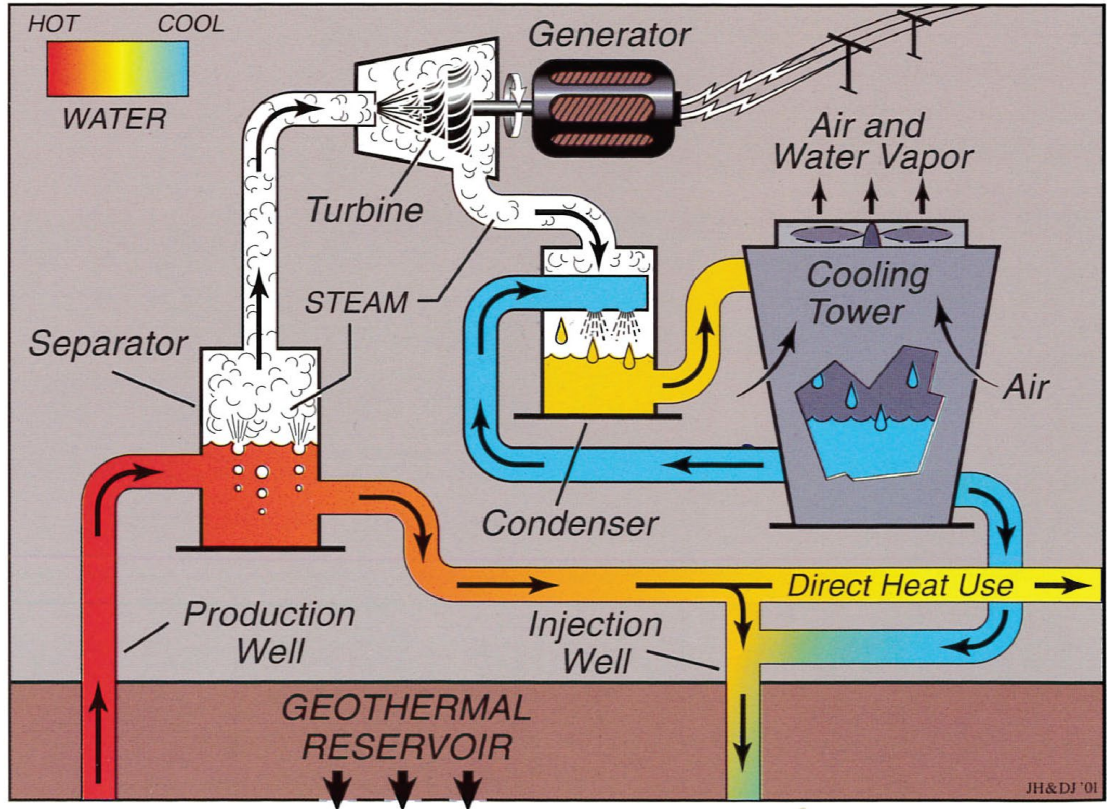
Electric Generation

- Electricity can be generated at temperatures >300 F
- PacifiCorp's 36 MWe Blundell Plant
- Compare footprints of geothermal plant and wind farm

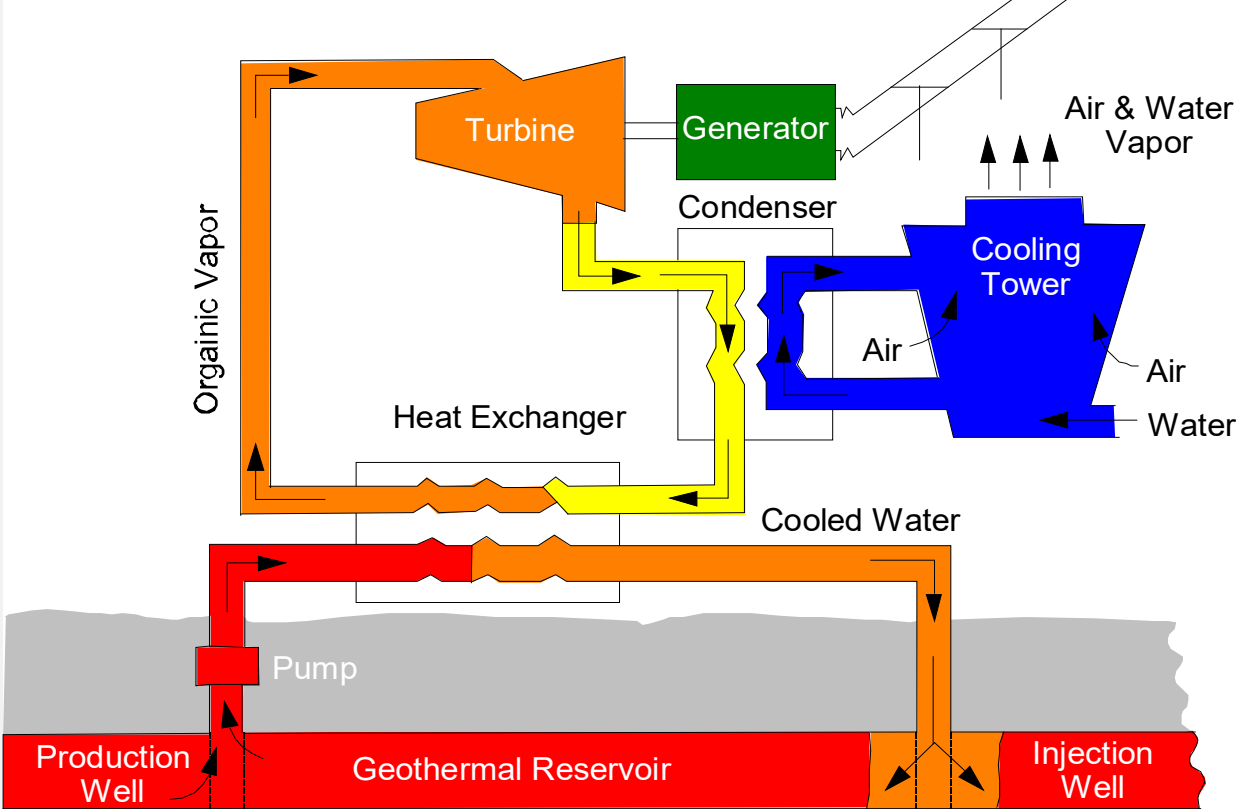


Geothermal Power Plants

Steam Plant



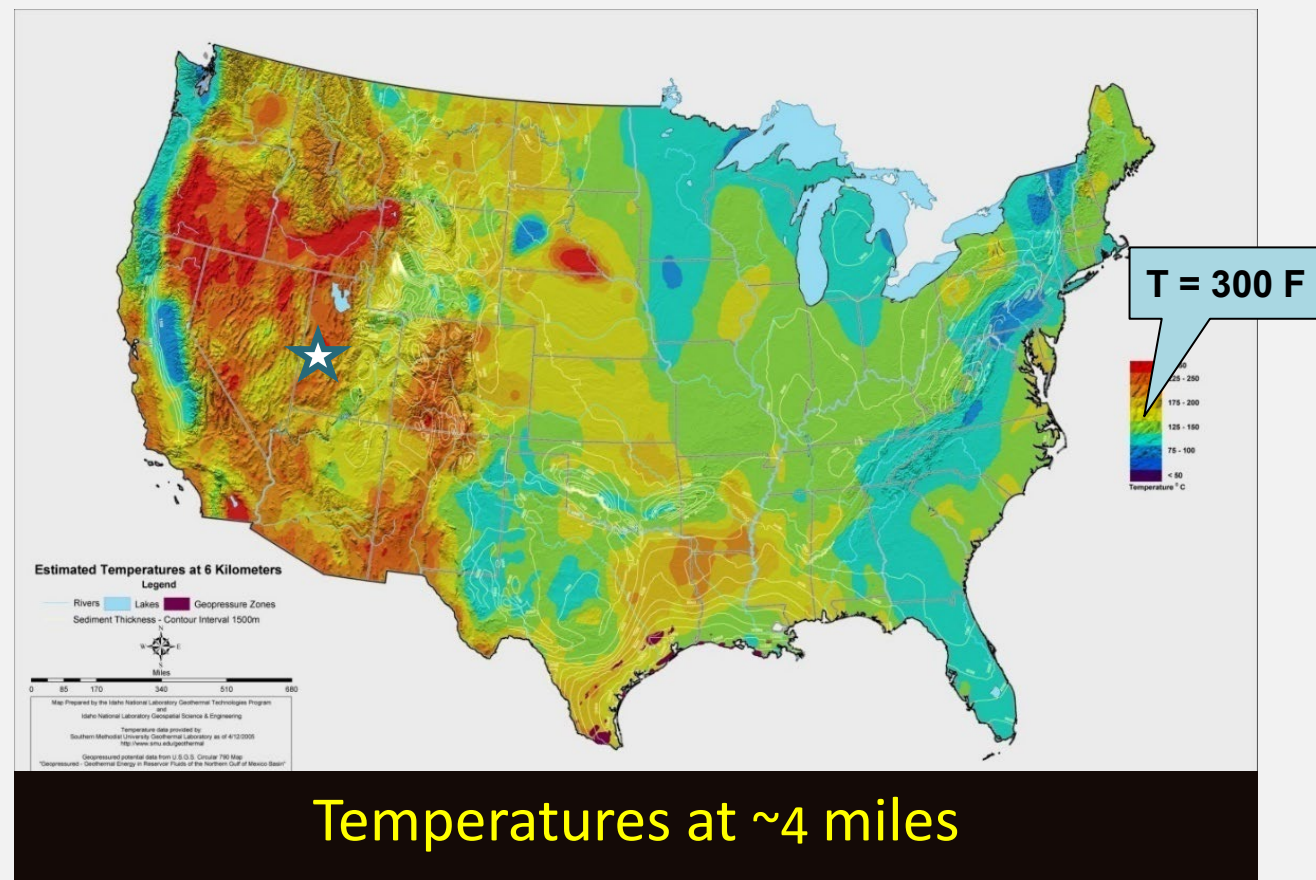
Binary Plant



US Enhanced Geothermal System Resource Base

- The US currently produces ~3700 MWe. Continued development of natural hot spring systems cannot meet DOE's programmatic goals of:
 - 90,000 MWe by 2050
 - Reducing cost of EGS by 90% to \$45 per MW hour
- Requires the creation of geothermal reservoirs where none exist naturally.
- **Tapping even 2% of the energy between 2 to 4 miles, would provide more than 2000 times the yearly US energy needs (Tester and others, 2006).**

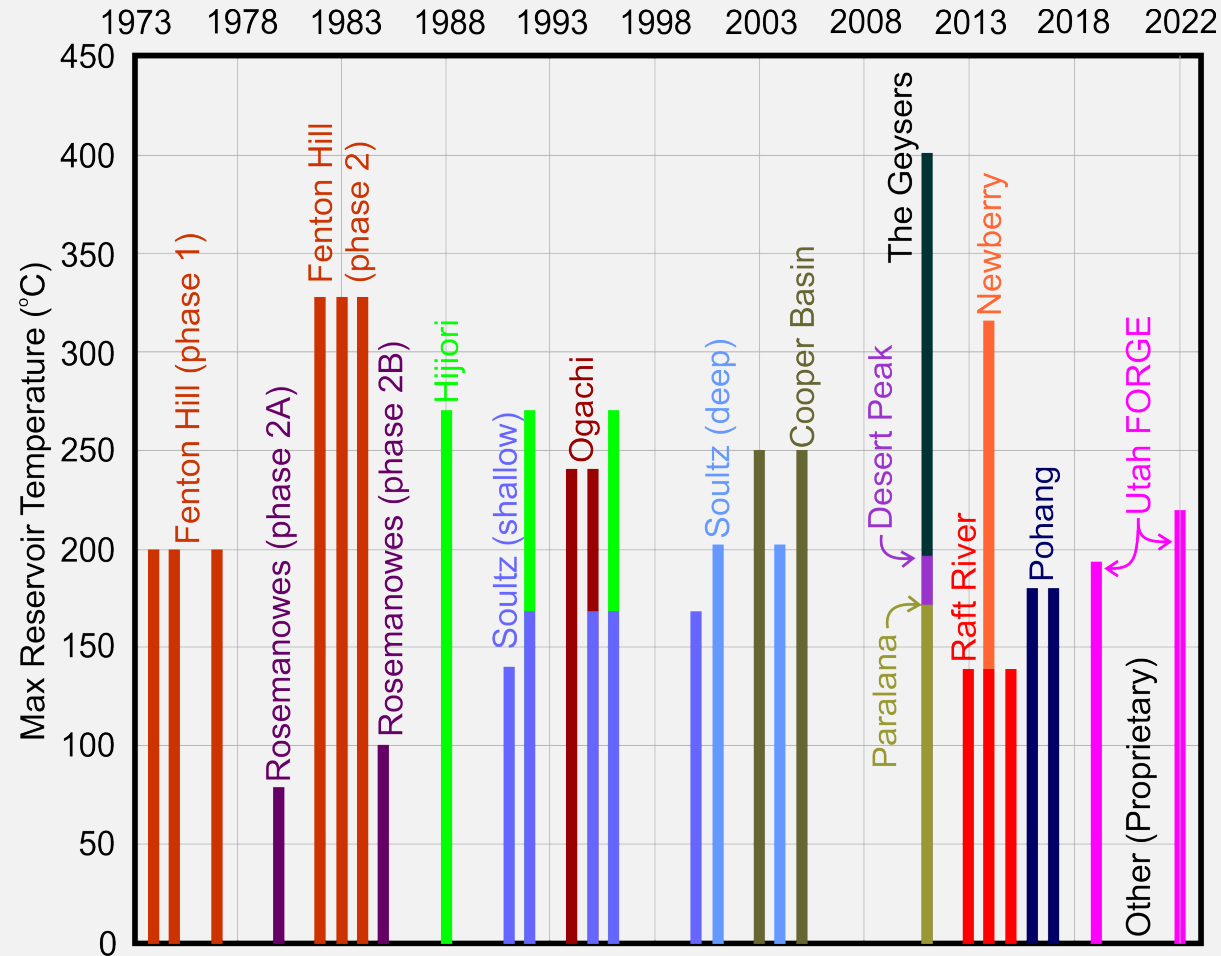
**The heat beneath our feet
is inexhaustible**



Data from SMU; from Tester and others (2006)

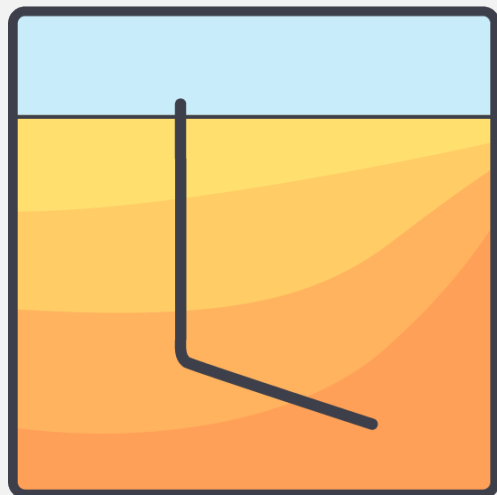
Current State of Enhanced Geothermal System Development

- Over a dozen EGS projects worldwide over past 50 years
- No commercial-scale EGS projects developed from high-T rocks
- Unacceptable levels of induced seismicity have occurred at a few sites
- Flow dominated by a few natural fracture zones in all stimulated systems



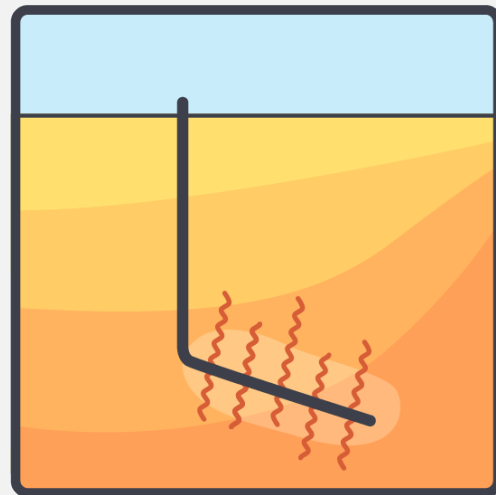
Hydraulically Stimulated Sites

Engineering the Geothermal Reservoir



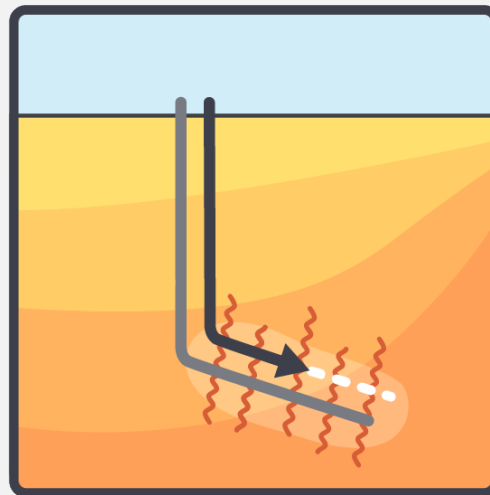
DRILLED 1ST WELL

January 2021



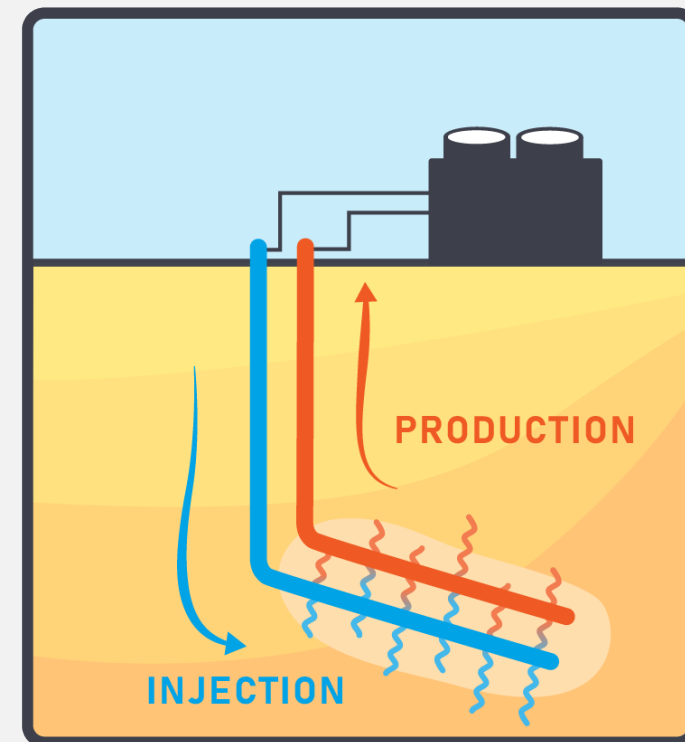
CREATE PERMEABILITY

April 2022



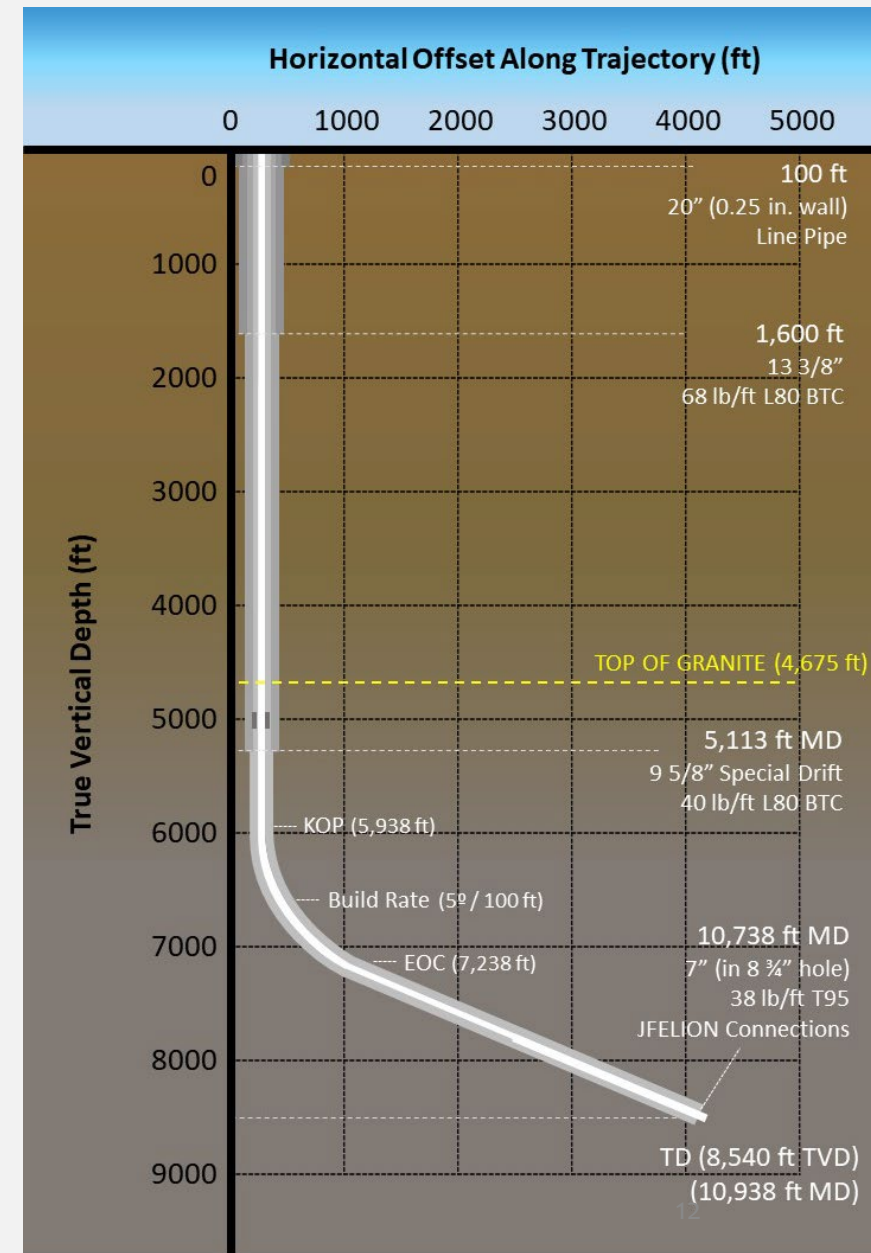
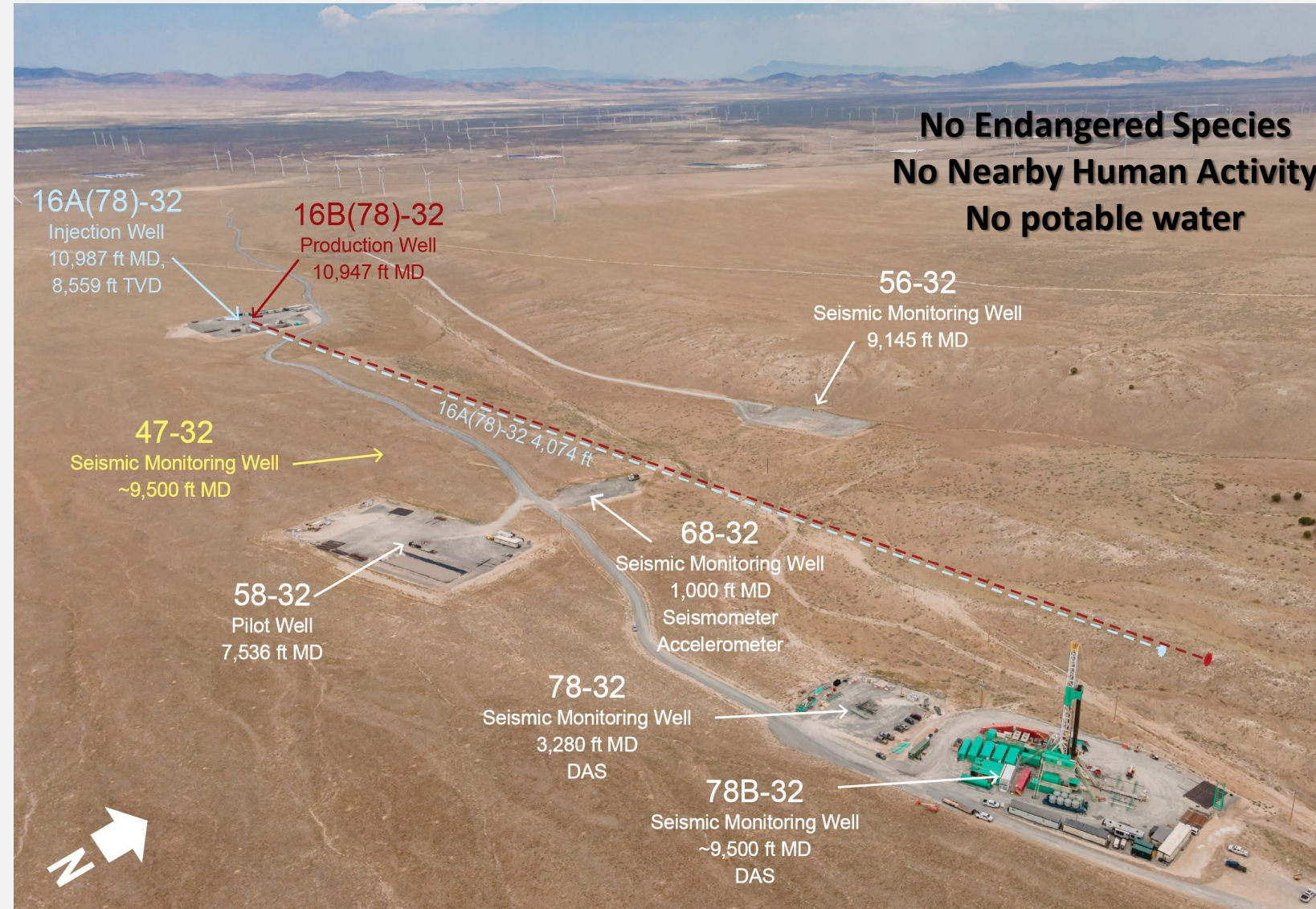
DRILL 2ND WELL

April 2023



2023-2024

Utah FORGE Wells



The Impact of Utah FORGE

- ✓ **World's only field laboratory designed for testing tools/technologies. Essential stepping-stone to commercial large-scale geothermal development throughout the US.**
- ✓ **New technologies developed at Utah FORGE significantly reduced the cost of drilling.**
- ✓ **Providing economic benefits to several rural economically depressed communities by using local services.**
- ✓ **Educating the public, regulators and elected officials via website, social media platforms, YouTube channel, classroom lectures and presentations, K-12 contests, STEM activities and participation at local events.**
- ✓ **All data collected is publicly available without cost.**

openEI Information Data Apps

UtahFORGE

UTAH FORGE

Frontier Observatory for Research in Geothermal Energy [edit]

Welcome to the Utah FORGE information site. The FORGE project began in 2015 to facilitate an environment where scientists and engineers can develop, test, and accelerate breakthroughs in enhanced geothermal systems (EGS) technologies and techniques. More details about the FORGE initiative can be found [here](#).

The Utah FORGE project is managed by the Energy & Geoscience Institute at the University of Utah. Additional information about the Utah FORGE project can be found [here](#).

On this site you will find project details and history as well as the data that the Utah FORGE project has produced. Please use the button links below to access this information. Please note that wells 78-32, 78B-32, 68-32, and 56-32 are seismic monitoring wells, well 58-32 was the first deep well used for stimulation and well 16A(78)-32 is the deep deviated well that has also under stimulation. Thank you for visiting!

Please note that this site is just in its preliminary stage and will be updated over time. Currently the Overview, R&D Projects, Reports, geology, water chemistry, and Well pages are ready with data links.

Additionally, NREL's OpenEI has a great compendium of general geothermal energy information [here](#).

FORGE Test Site

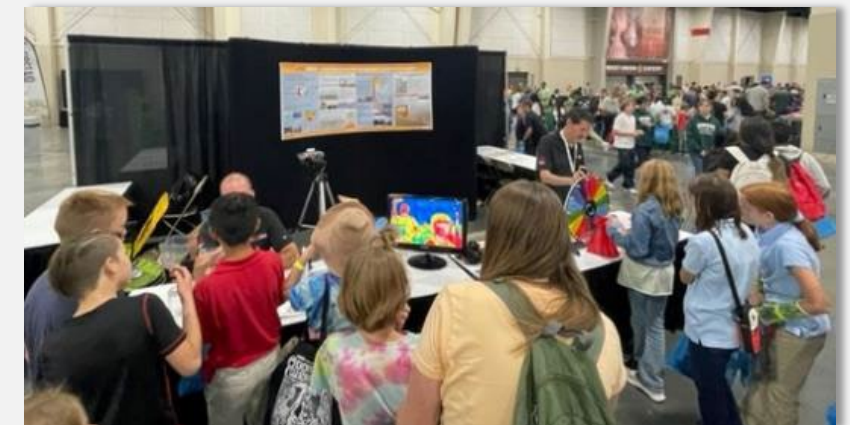
Solar Array Wind Farm Heat Exchanger Roosevelt Hot Springs Geothermal Power Plant

0 5,000 10,000 15,000 Feet

0 1 2 3 4 Kilometers

Overview Geology Water Chemistry Geophysics Earth Model Seismicity R&D Projects Reports

Well 58-32 Well 78-32 Well 78B-32 Well 68-32 Well 56-32 Well 16A(78)-32



THANK YOU

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