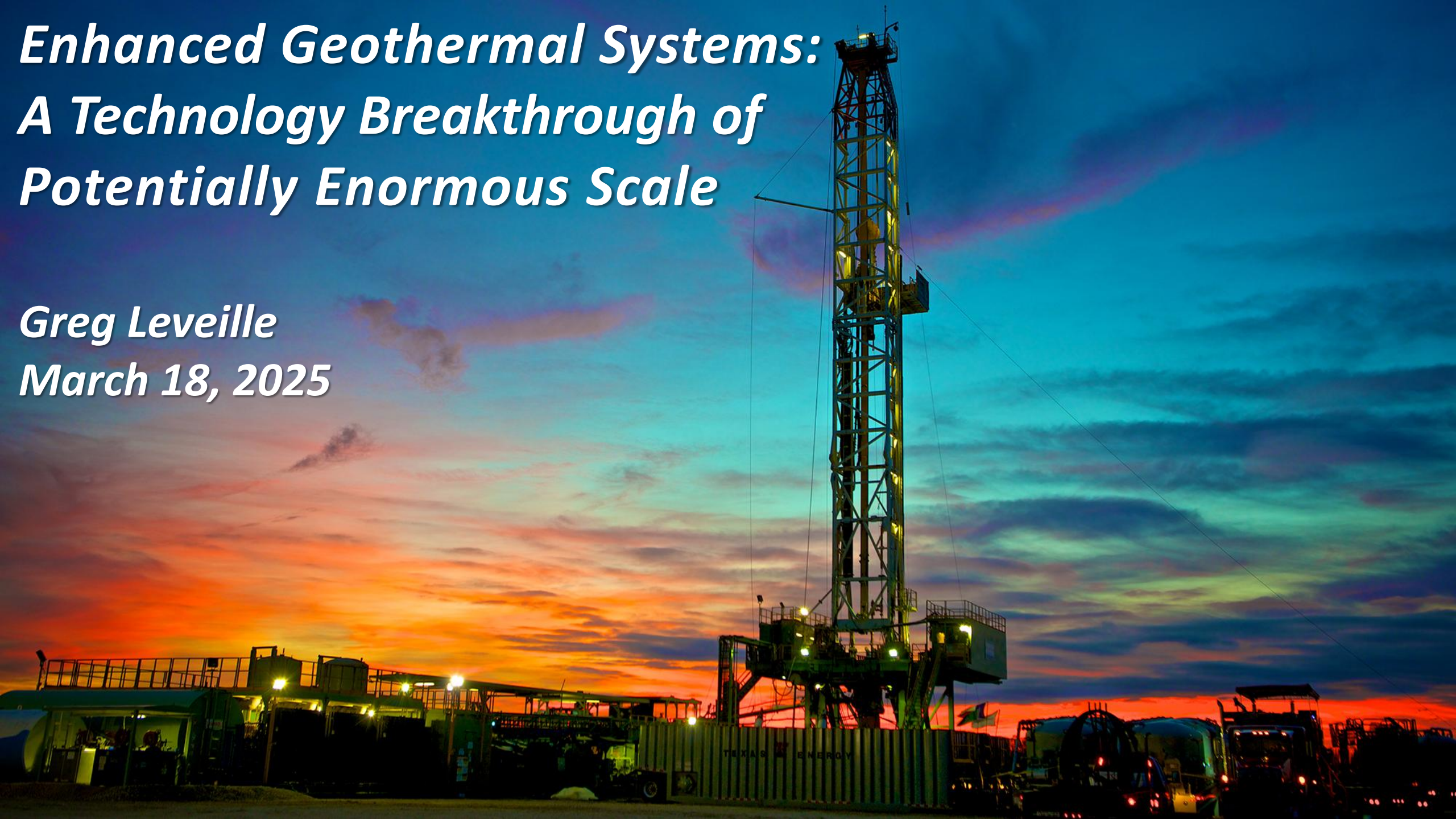
Enhanced Geothermal Systems: A Technology Breakthrough of Potentially Enormous Scale

Greg Leveille

March 18, 2025



Geothermal power: Immense potential, disappointing results until recently

The heat within the Earth is sufficient to provide a nearly inexhaustible supply of electricity

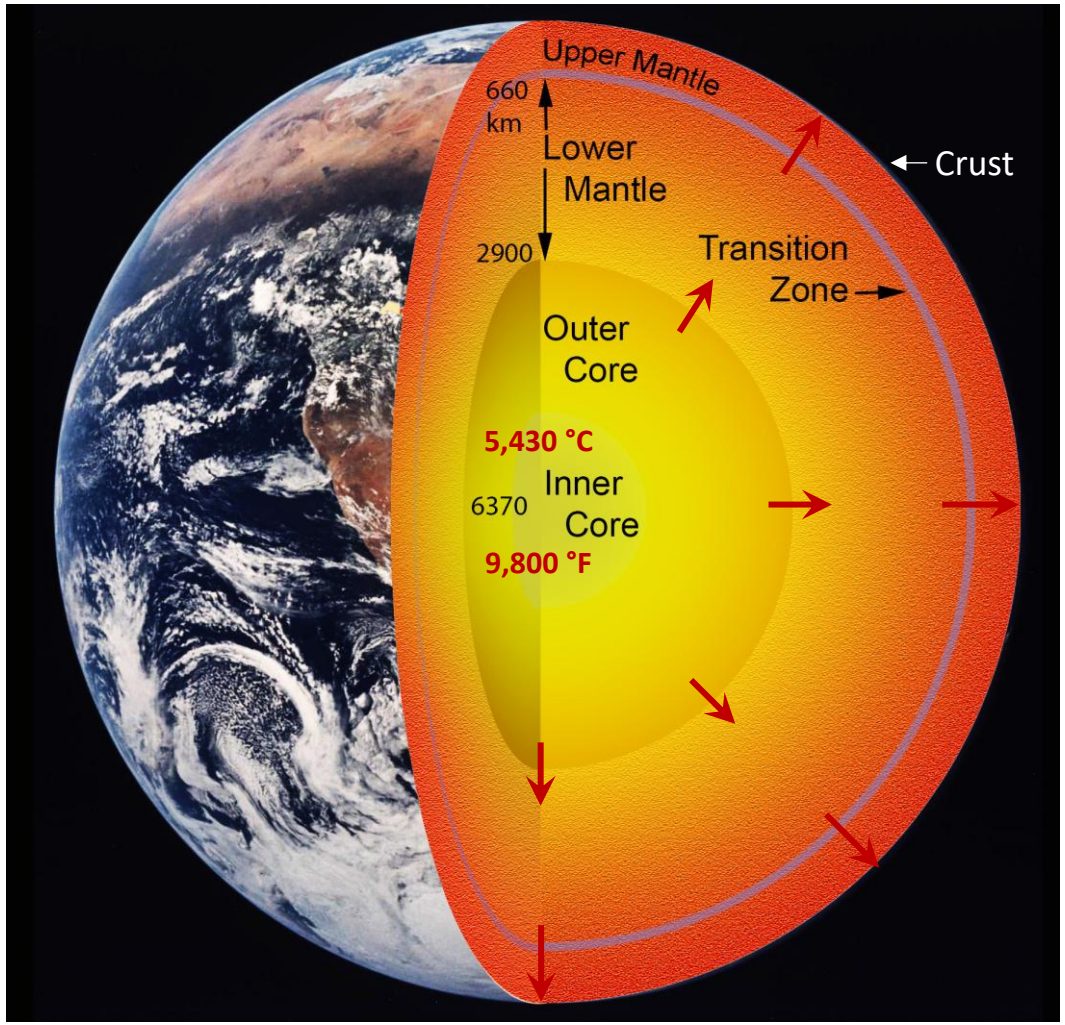
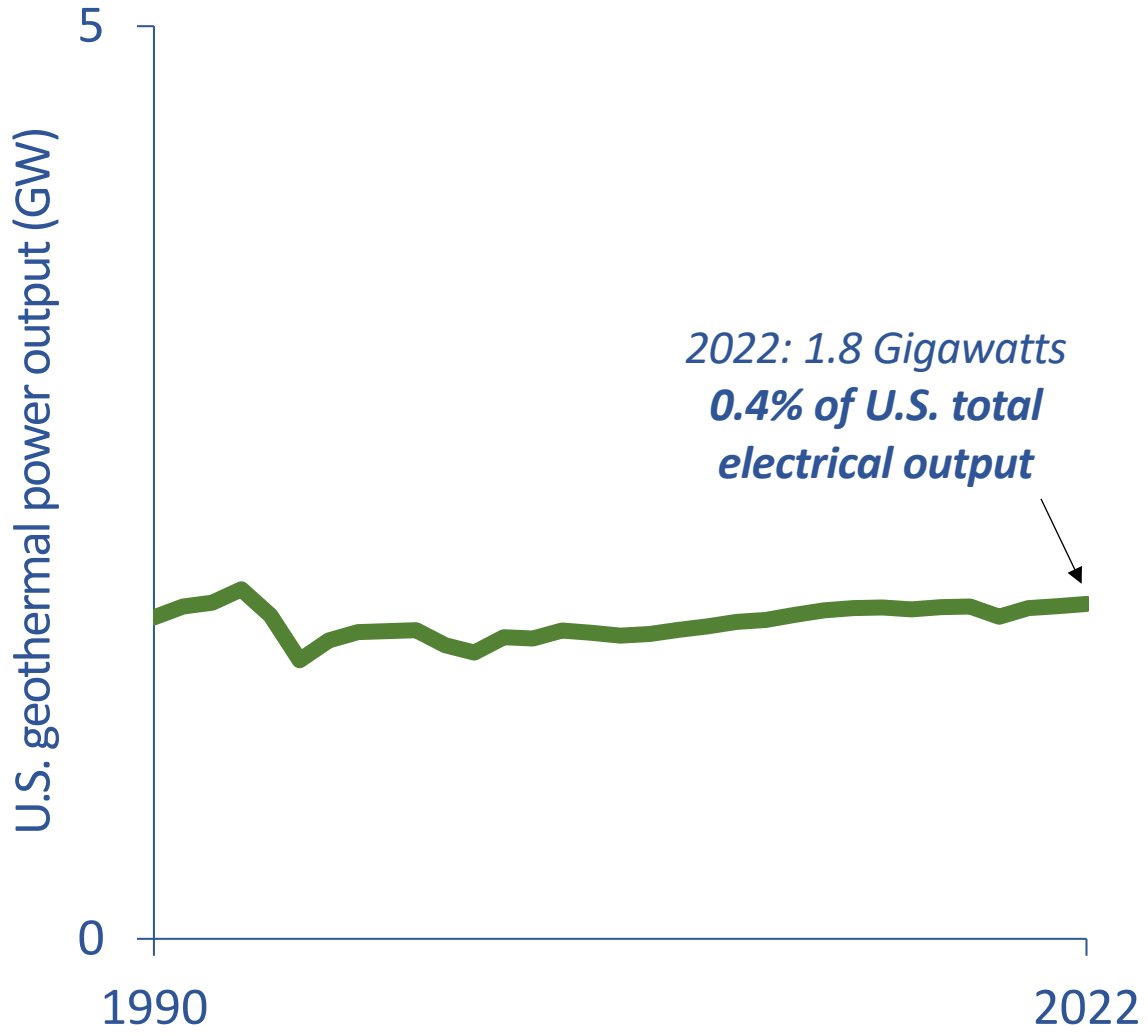


Diagram modified after Steve Jacobsen, Department of Earth, Environmental, and Planetary Sciences, Northwestern University

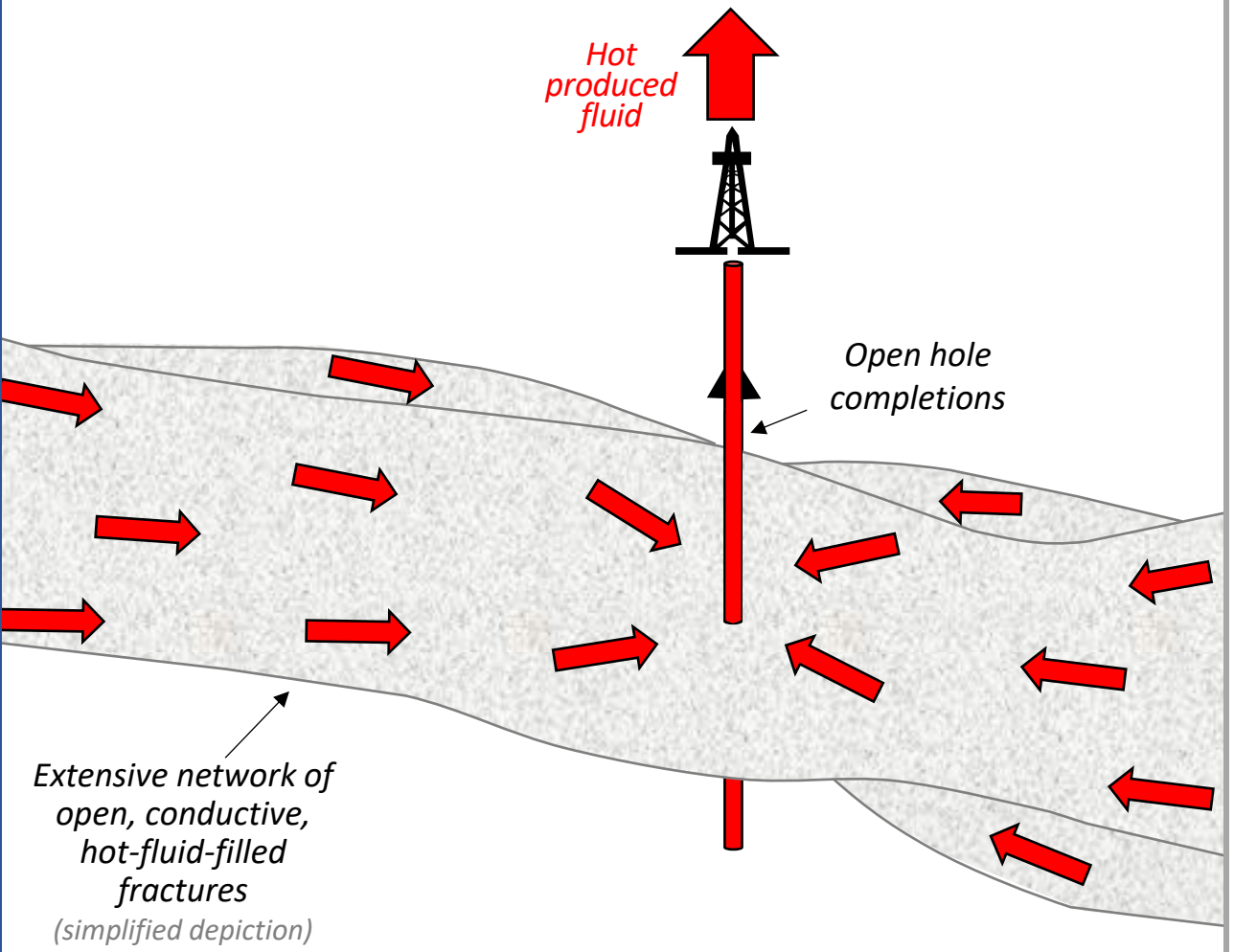
But getting from technically recoverable heat to commercially viable power has been challenging



Source: U.S. EIA; curve shown is the average instantaneous output from geothermal power plants

Past approaches to extracting heat for power production have met with limited success

Hydrothermal (naturally occurring) systems

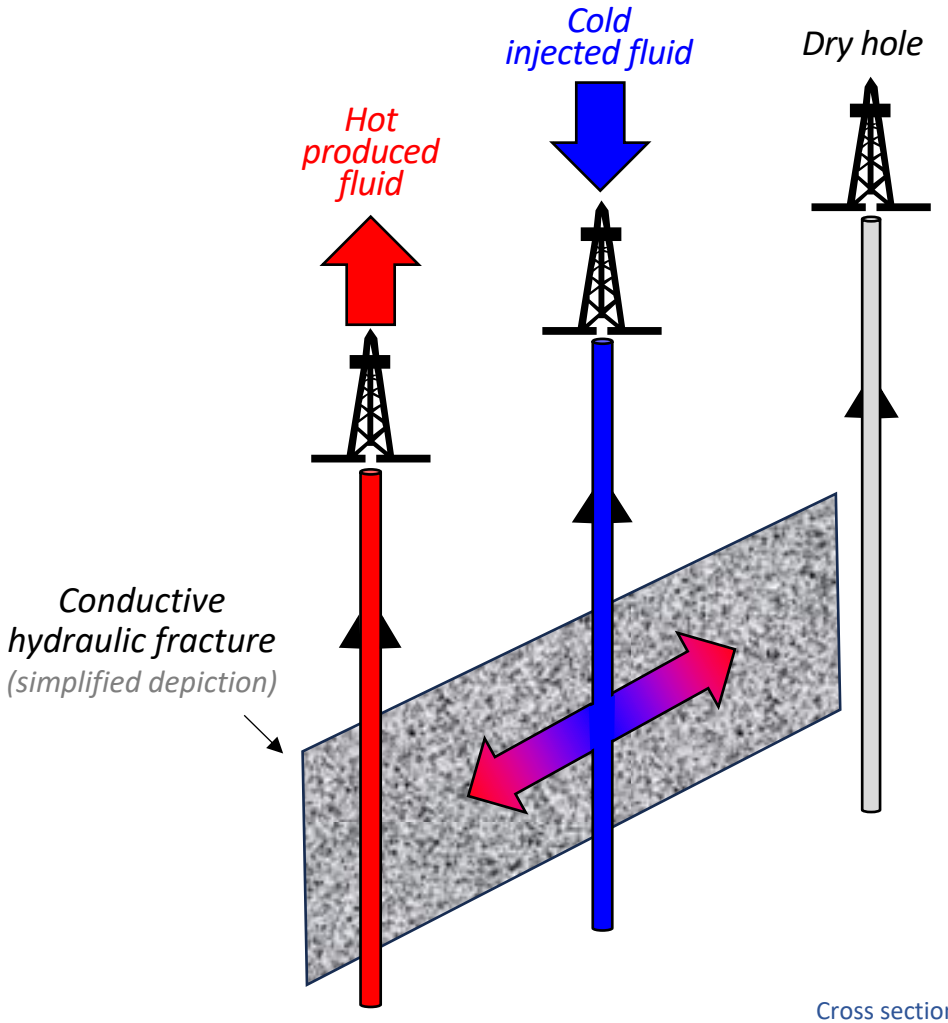


Cross section view; not to scale

RELATIVELY RARE AND HARD TO FIND

Example: The Geysers, California

Enhanced geothermal systems with vertical wells



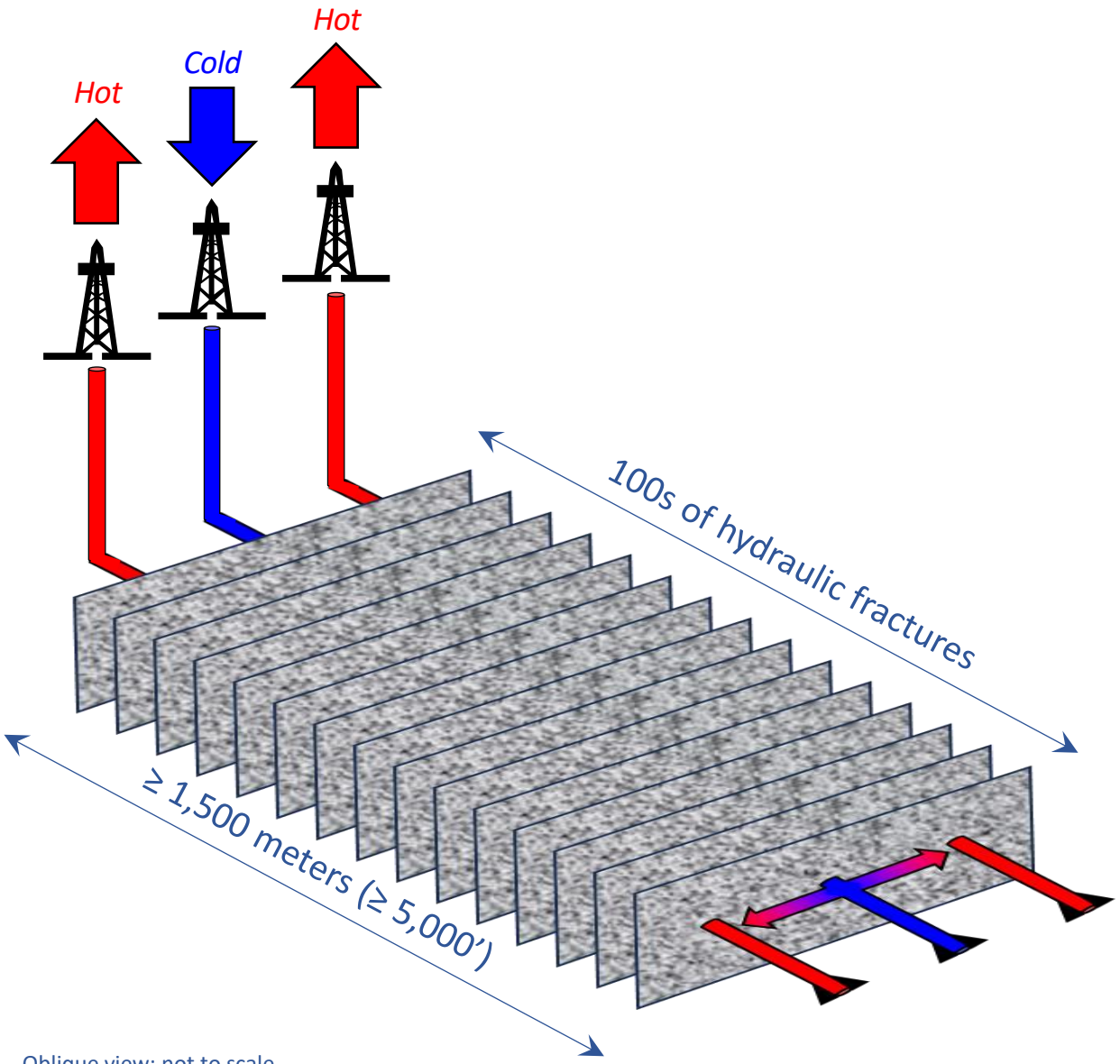
Cross section view; not to scale

EXCEEDINGLY DISAPPOINTING

Example: Most EGS projects between 1970-2023

Technology transfer from the oil and gas industry has transformed EGS economics

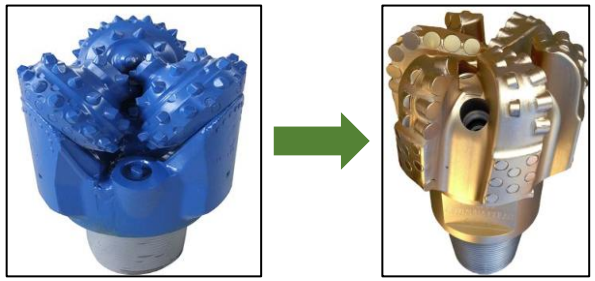
Hydraulically fractured horizontal wells



Oblique view; not to scale

Latest oil and gas drilling technologies

Drill bit design



Roller Cone PDC

Physics-based drilling

Fred Dupriest
& Sam Noynaert

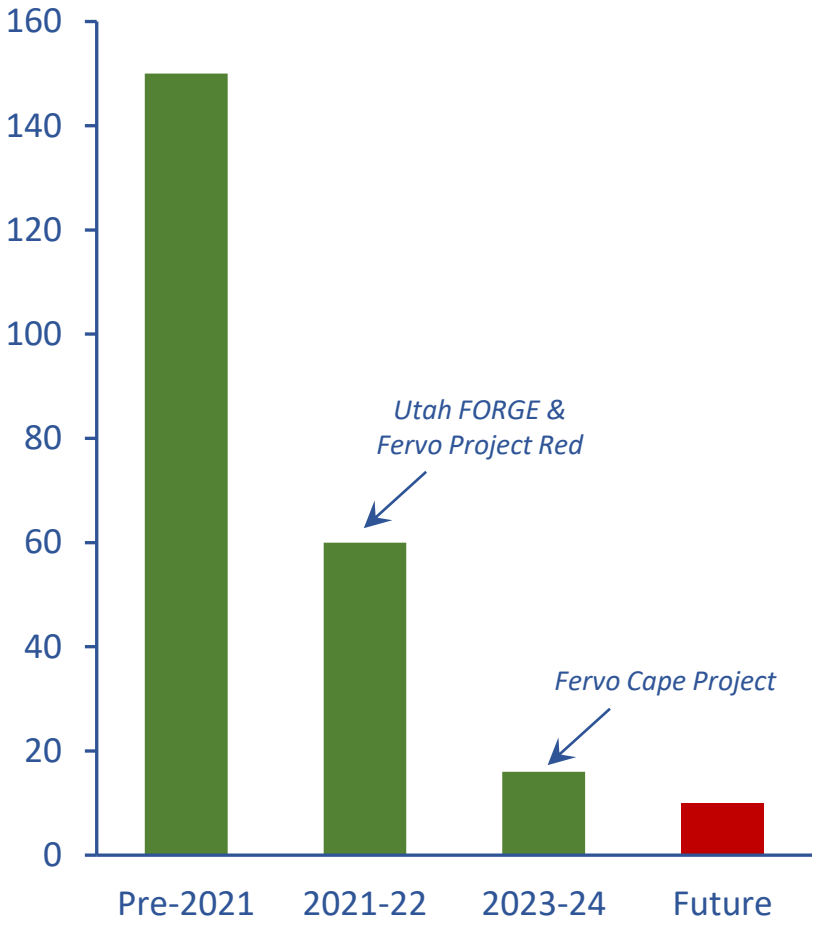
Texas A&M University

EGS = Enhanced geothermal systems; PDC = Polycrystalline diamond compact (bits)

These technological innovations have delivered game changing results

Spectacular drilling performance improvements

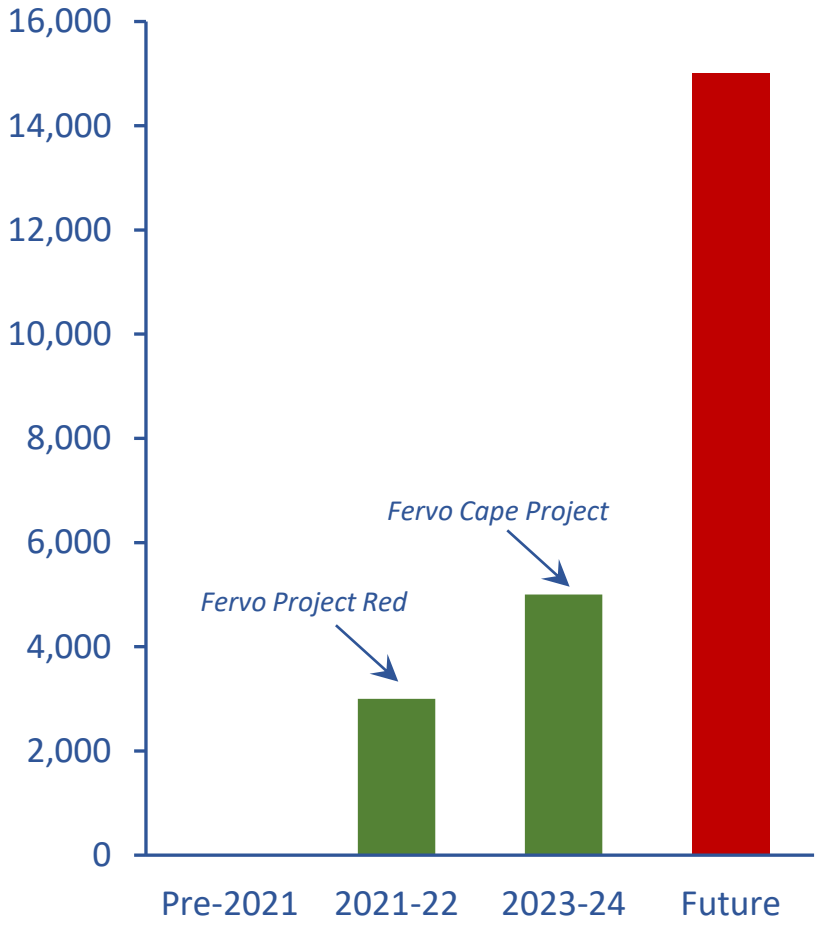
Drilling days to 12,000’ MD (≈ 3,600 m)



Sources: El-Sadi et al, 2024, Review Of Drilling Performance In A Horizontal EGS Development; Winkler & Swearingen, 2021, Summary of Drilling Activities, Utah FORGE; MD = Measured depth

Ability to D&C horizontal EGS wells in basement rocks

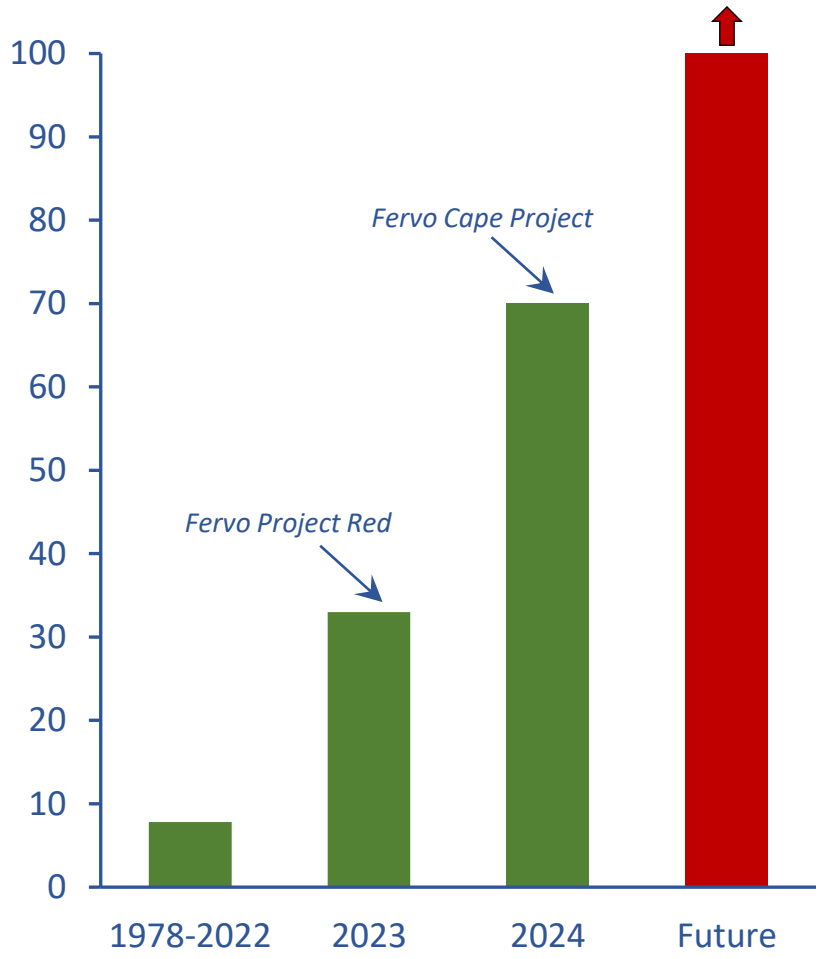
Lateral length (feet)



Note: The first fully horizontal EGS wells drilled were those drilled by Fervo at their Blue Mountain project in 2022. D&C = drill and complete

Near order-of-magnitude increase in per well production

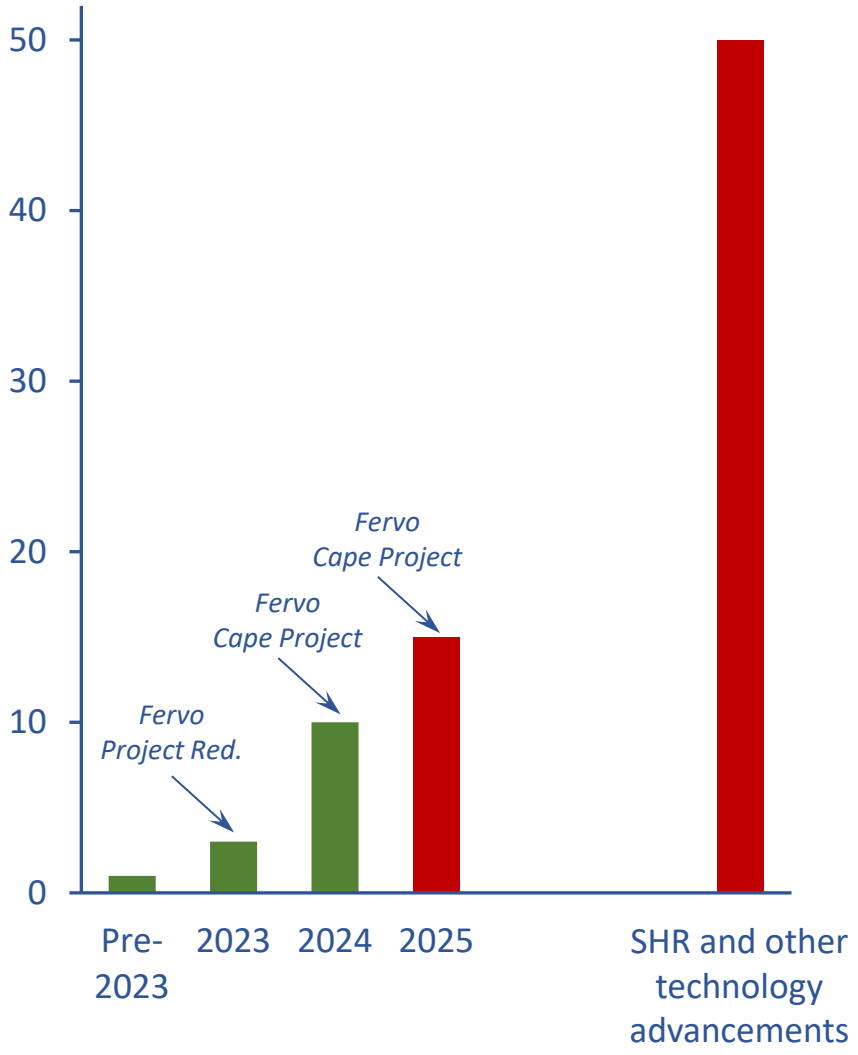
Peak production flow rate (MBFPD)



Note: 1978 – 2020 data from 11 projects; average peak flow rate shown (7,800 bfpd); range was from 2,700 to 16,300; MBFPD = thousands of barrels of fluid per day

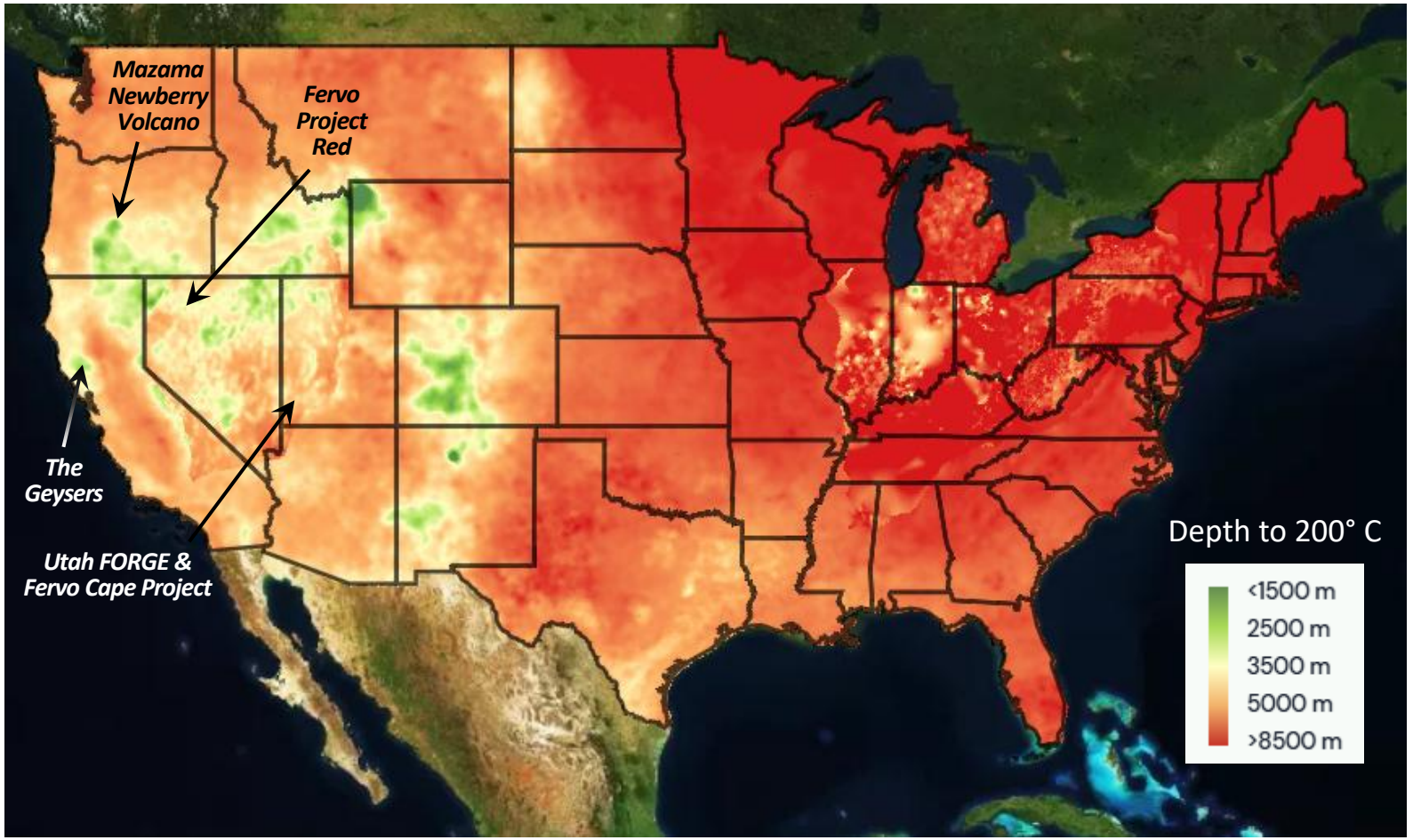
Remaining EGS upsides are significant; the U.S. is well positioned to lead the way

Per well power output (MW)



MW = Megawatts (one million watts); SHR = Super hot rocks

The U.S. possesses considerable geothermal resources



Map copied from Project Innerspace's website, February 2025