BOSTON CONSULTING GROUP

Unlocking the Full Potential of Geothermal Power

2023 Geothermal Energy Machinery and Systems (GEMS) Workshop

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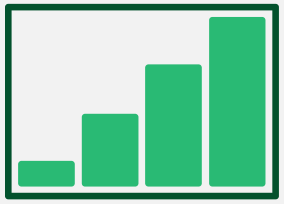
Today's discussion focuses on four questions



How big?

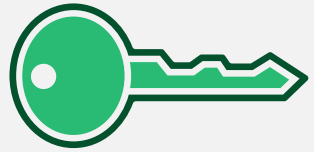
The potential impact of EGS on US geothermal market size

How fast?

The rate of deployment and learning over the next 30 years

How much?

Target date for EGS reaching cost parity with other baseload sources



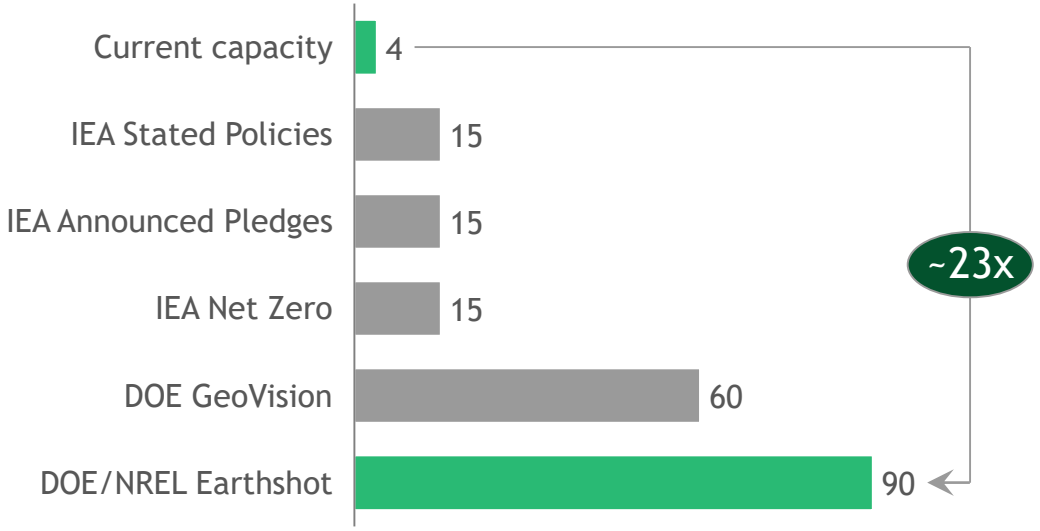
What's needed?

Drivers that will enable geothermal to scale in the US

How big? | EGS has potential to increase US geothermal over 20x by 2050

Forecasts of US geothermal deployment by 2050 with tech improvements

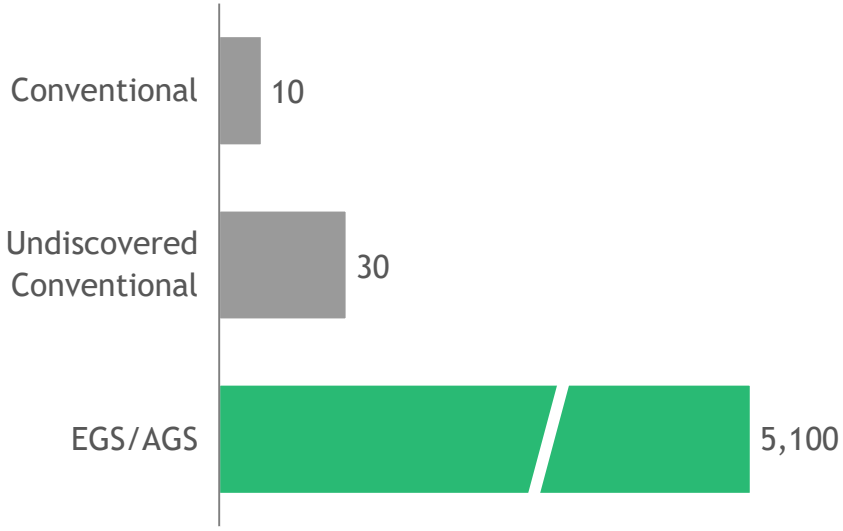
Cumulative 2050 US geothermal deployment (GW)[1]



Optimistic scenarios have geothermal accounting for ~15% of the electricity generation …

Forecast of US geothermal technical potential

Estimated 2050 technical potential of US geothermal (GW)



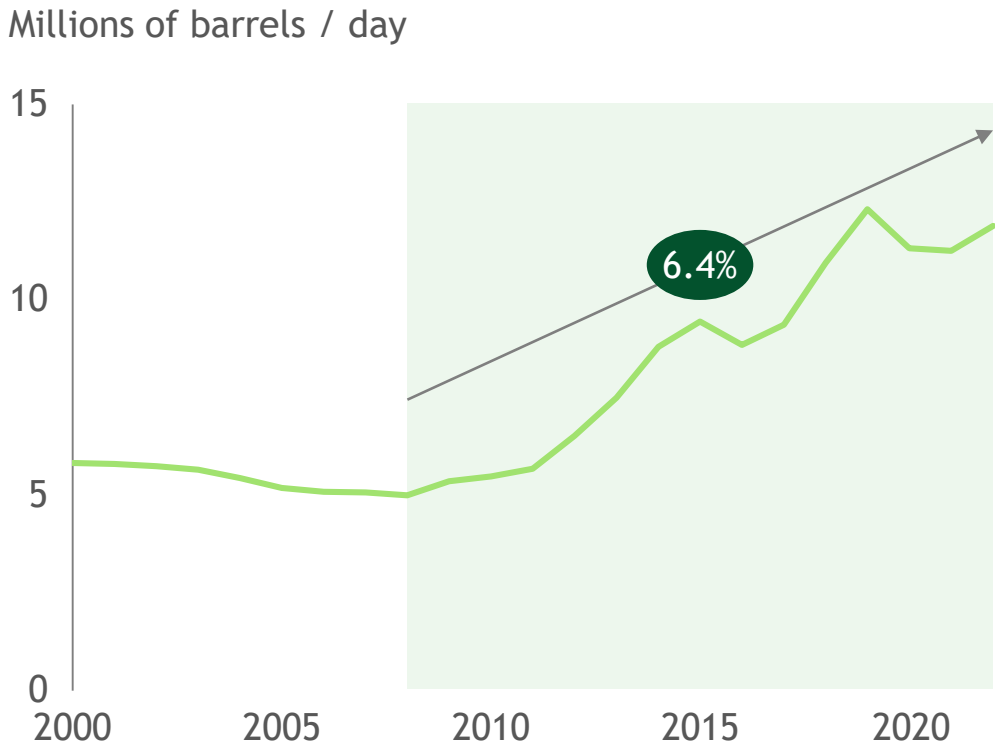
… while only using ~1.5% of the technical resources added due to advances in EGS technology

1. All forecasts are through 2050; STEPS – stated policies, APS – announced pledges, NZE – net zero are the three scenarios used by IEA in their WEO, IRENA represents the optimistic forecast put together by the agency, and DOE refers to DOE GeoVision report
Source: IEA WEO 2022, IRENA, DOE GeoVision Report – 2022; BCG analysis

How fast? | EGS can drive geothermal growth at ~12% CAGR through 2050, similar to transformative change in unconventional oil and other climate tech

Comparison of US oil & gas growth pre & post-fracking innovations

US daily oil production



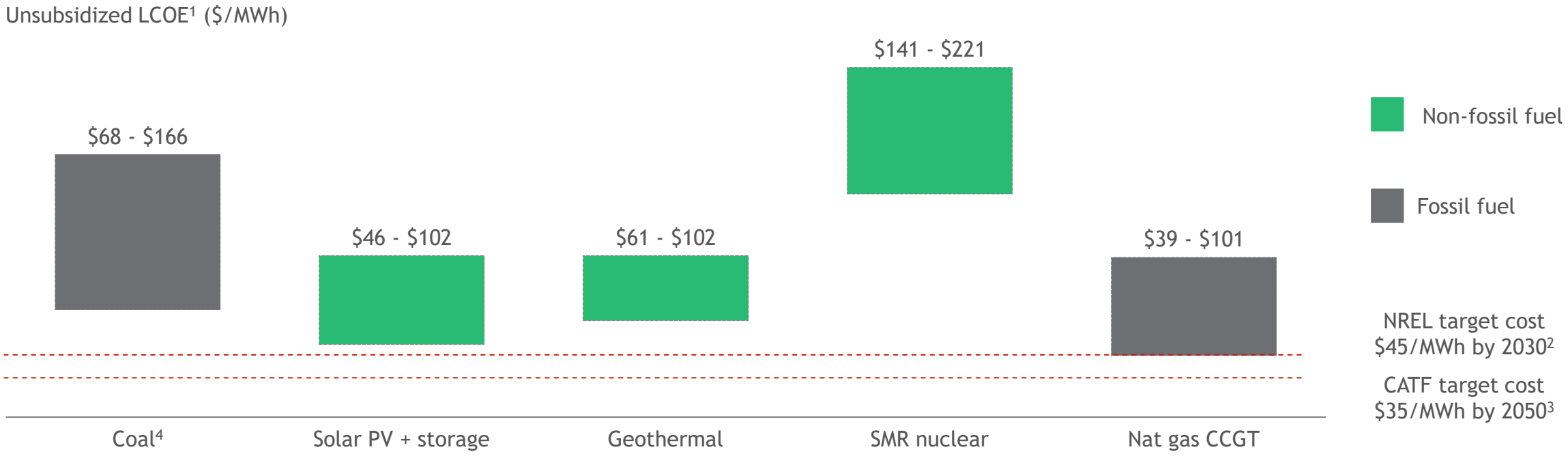
Climate technology learning rates (LR)

Source	LR (%)
Lithium-ion batteries	30%
Solar PV	23%
Natural gas turbines	15%
Offshore wind	12%
Onshore wind	12%
Biomass power plant	11%
Nickel-metal hydride HEV batteries	11%
Flue gas desulfurization systems	11%

Source: EIA, BCG analysis

How much? | With innovation and similar levels of investment as other climate technologies, EGS could reach $45/MWh by 2030

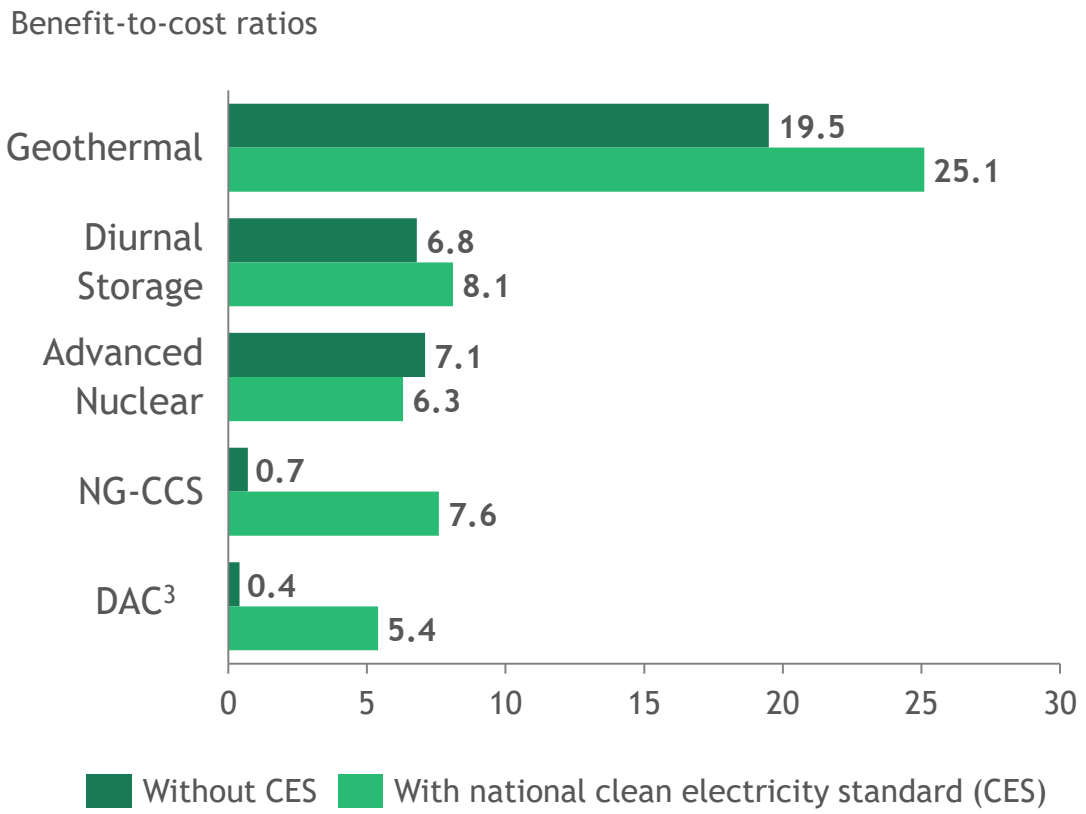
Upon reaching targets, EGS/AGS competitive with cheapest, firm dispatchable resources



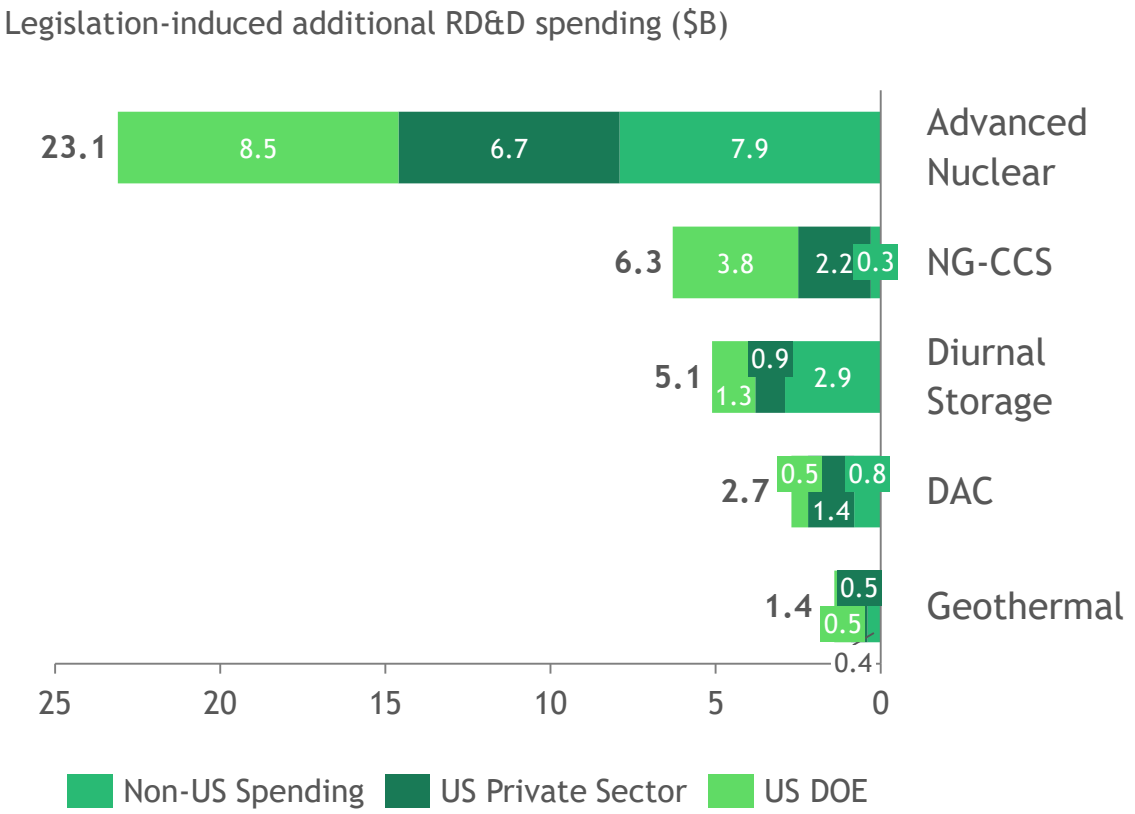
1. Range based on NREL Annual Technology Baseline LCOE for hydro/flash assets (lower end) and NF EGS/flash (upper end) 2. NREL EGS Shot Analysis for GTO,
3. Clean Air Task Force Superhot Rock Report 4. High end includes carbon capture and storage
Source: IEA World Energy Outlook; IEA Projected Cost of Generating Electricity; Lazard LCOE Analysis v16; NREL Annual Technology Baseline; BCG Analysis

What's needed? | Geothermal needs to close the capital gap

Despite having the highest average benefit-cost ratios[1] …



… the projected 10-year, fully funded RD&D spending for geothermal dramatically lags other technologies



1. Estimated benefit-cost ratios from 10 years of RD&D funding using weighted-average (expected value) benefits over 20 years 2. Projected additional RD&D spending resulting from legislation if fully funded for 10 years
Source: Resources for the Future 2021, BCG Analysis


Thank You

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