Use of Hydrocarbon Wells System to Harness the Geothermal Potential of Oklahoma Sedimentary Basins: Opportunities for Energy Transition and Workforce Development

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Mewbourne School of Petroleum and Geological Engineering

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THE UNIVERSITY OF OKLAHOMA

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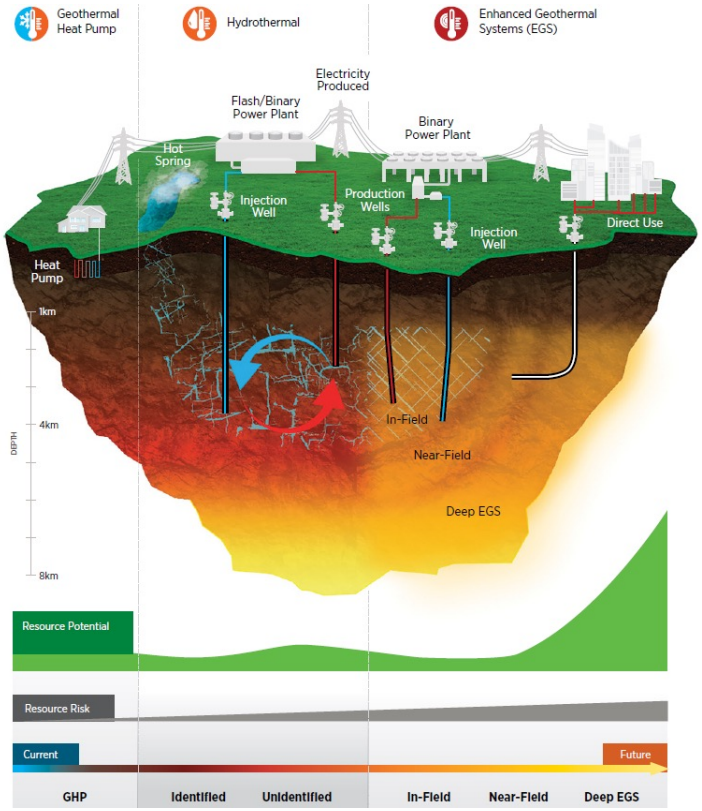
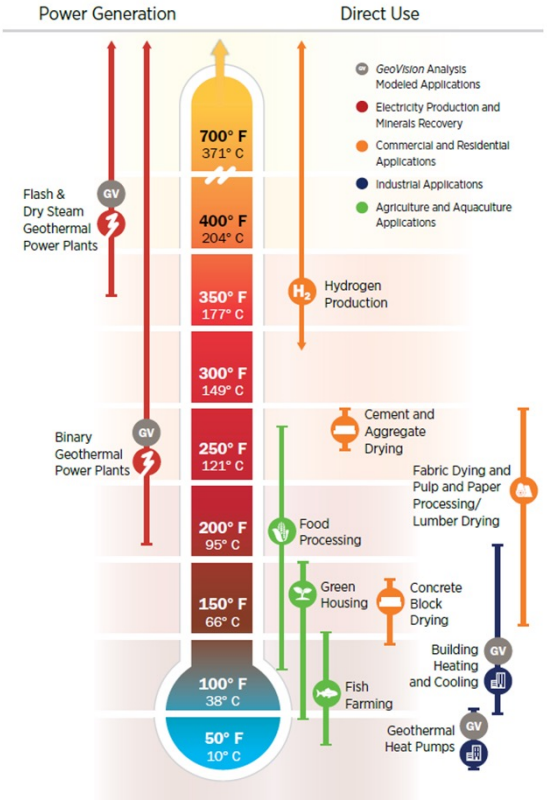
11/16/2022

Geothermal Diversity, Opportunities and Challenges





DOE GTO GeoVision Report

Geothermal Diversity, Opportunities and Challenges

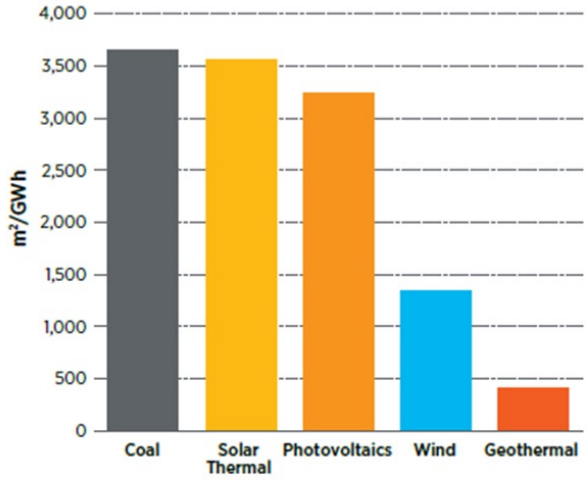
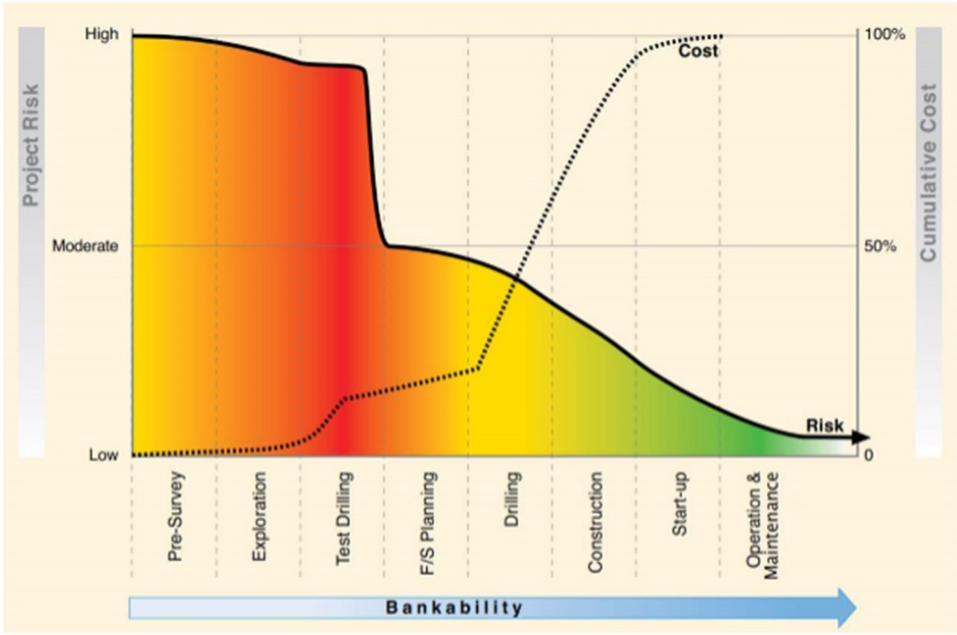


Figure 2-16. Land footprint by GWh_e for various electricity-generation technologies

Source: Kagel et al. 2007

Figure Note: Coal includes mining. Photovoltaics (solar) assumes central-station photovoltaic projects, not rooftop systems. Wind reflects land occupied by turbines and service roads.



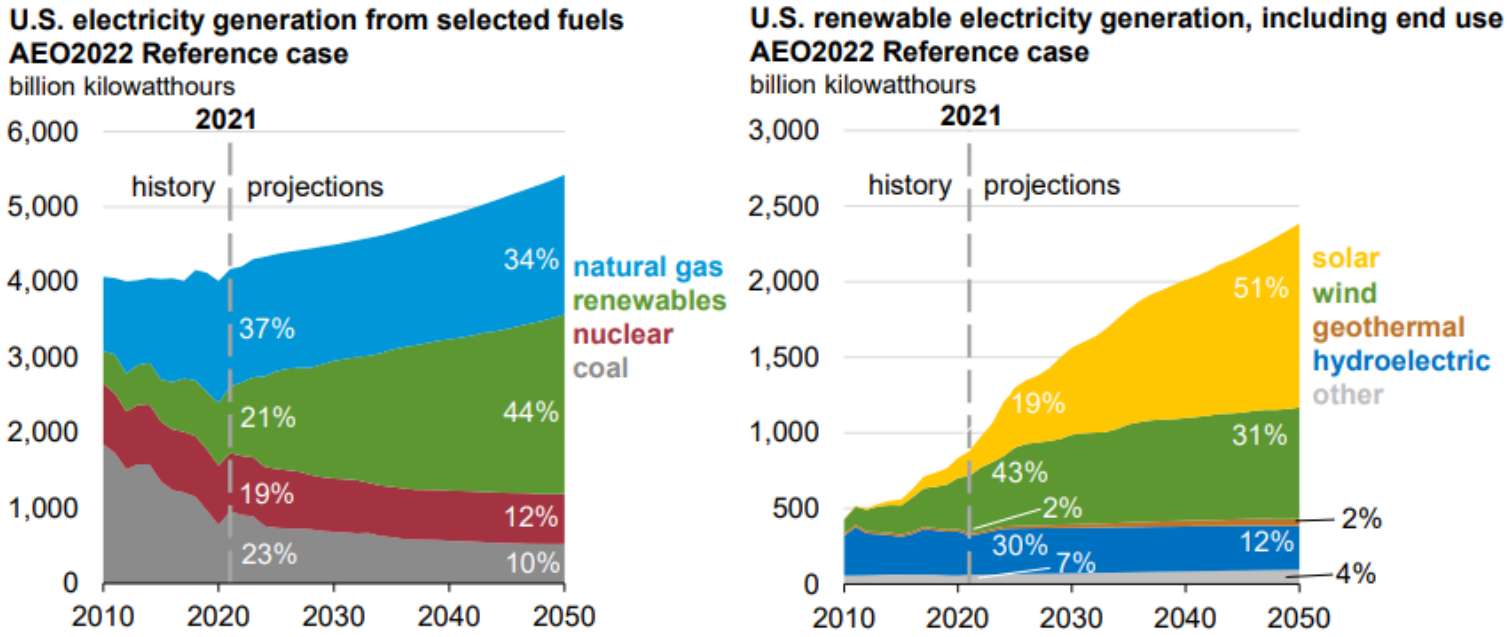
Source: Gehringer and Victor 2012

Figure 7. Diagram of perceived geothermal project risk and cumulative investment costs over time

DOE GTO GeoVision Report

Where are we heading in geothermal development?

U.S. electricity generation and shares from selected fuels and renewable sources



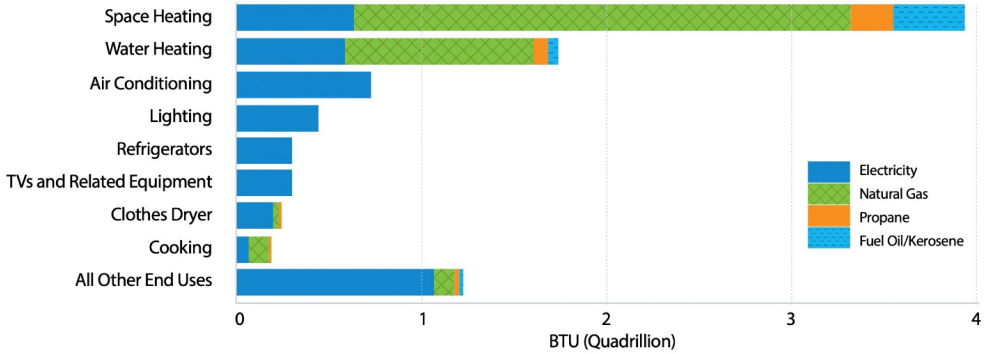
Source: U.S. Energy Information Administration, Annual Energy Outlook 2022 (AEO2022)

Why harvesting geothermal energy in sedimentary basins?

- Let us review some facts…
- Drilling in sedimentary basins tend to be easier and less costly
- A larger geographical diversity to access sedimentary basins
- Access to higher permeability in some sedimentary basins
- Known Geology
- Stimulation and rich know-how in sedimentary basins
- Scalable and experience leverage

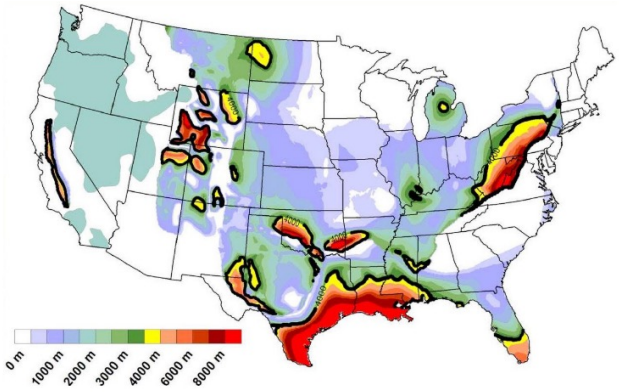
Geothermal Energy for Direct Use

- TARGETING THE NEEDS OF HEAT FOR END USERS
- Space and water heating represent 65% of residential electricity demand.
- Geothermal direct use can supply the demand of water and spaces heating.
- Geothermal direct use offers a reliable solution in harsh winter areas.

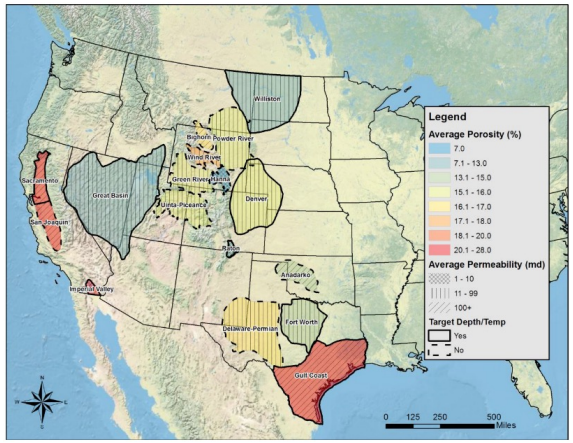


EIA survey of residential electricity distribution in the US (Robins et al., 2021).

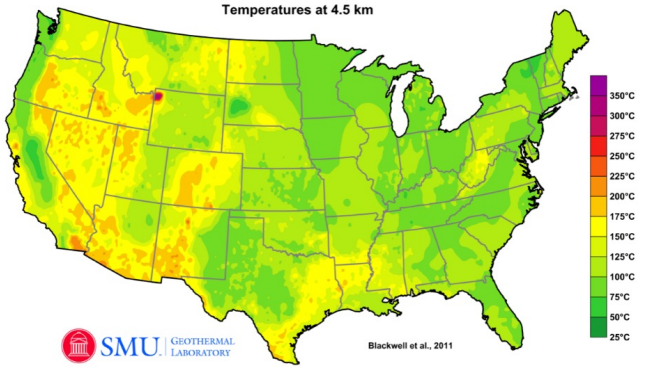
Diversity of Sedimentary Basins Distribution (US)

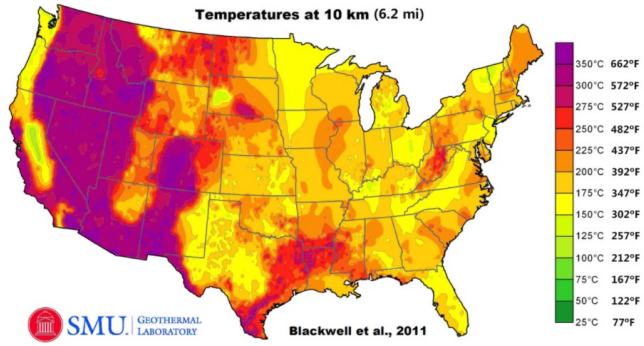


Sediment thickness in the continental United States (INL, 2006).



Porosity, permeability, depth, and temperature relationships for candidate sedimentary basins in the western United States (Anderson, 2013).





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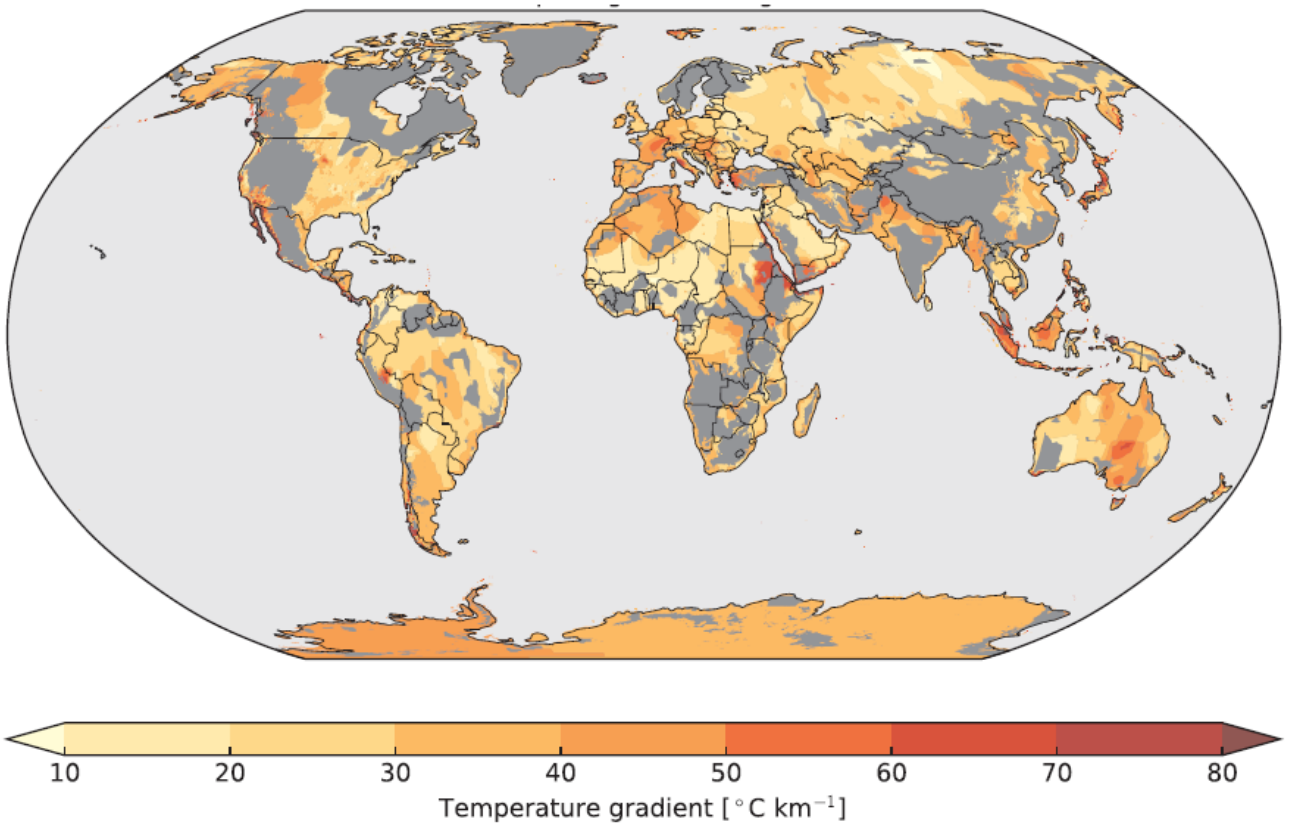
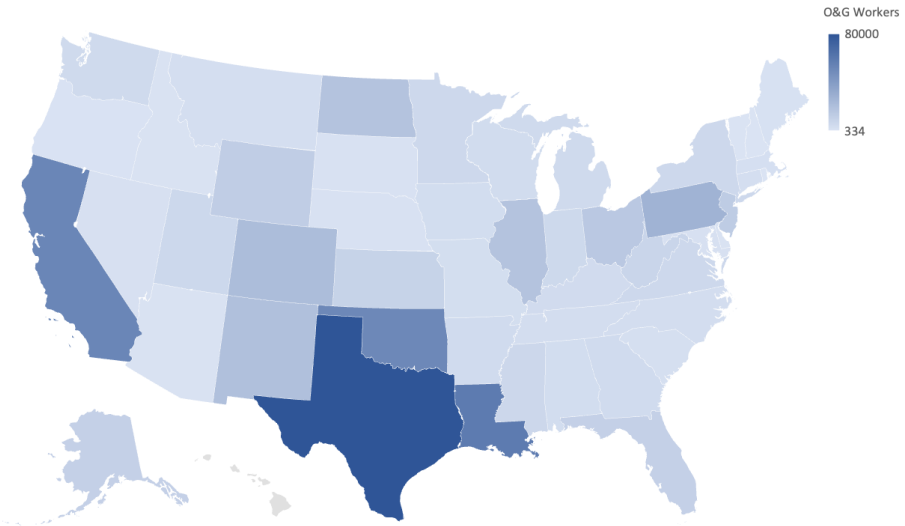
Global Opportunities



Geothermal energy in deep aquifers: A global assessment of the resource base for direct heat utilization, Elsevier, Renewable and Sustainable Energy Reviews, 2017

Synergies with Oil and Gas Industry



Investment Capital and Risk Management

Transferable Skills, Technology and Workforce

Leverage existing Oil and Gas assets, (pipelines, …)

Repurposing Opportunities

Geothermal power for green hydrogen production and storage

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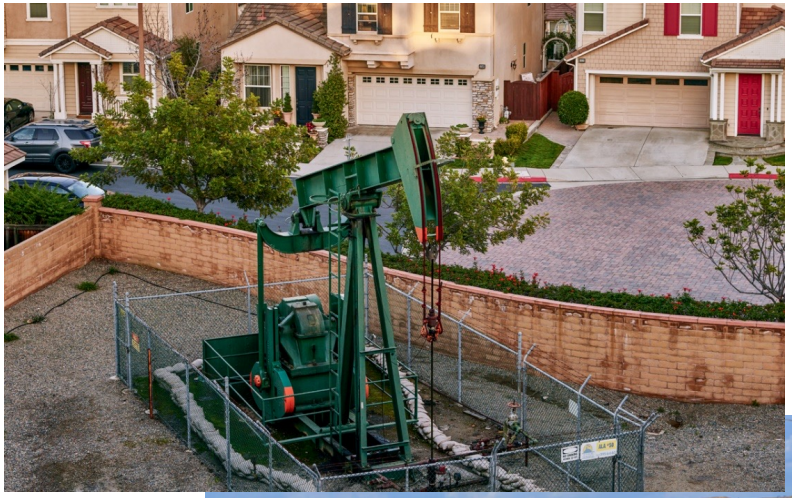
Repurposing Opportunities

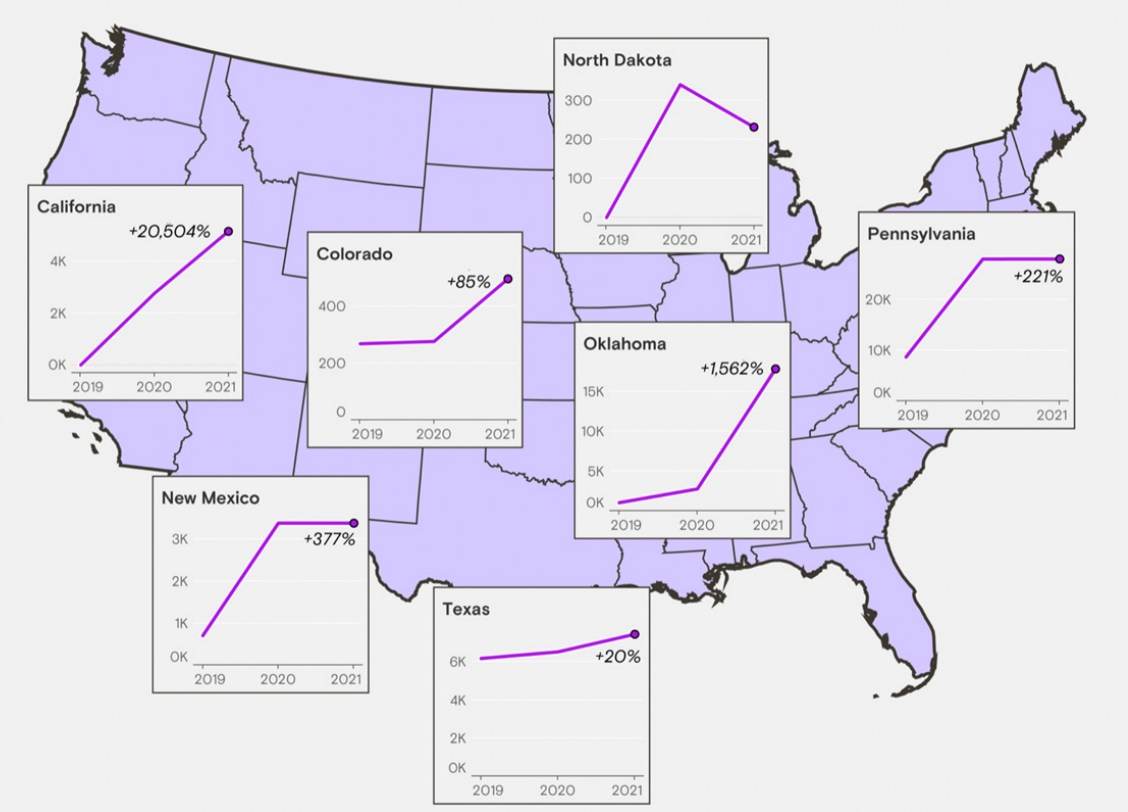


Images courtesy of NY Times, Nacho Corbella, Spencer Lowell, Frederic J. Brown/ via Getty Image

Repurposing Opportunities: Inactive Wells are Increasing Every Day

3 Million Estimated total inactive, non-operational and orphaned wells no longer producing, non-P&A and where no owner could be identified or found.

1 Million New wells currently drilled will be a liability in the future.



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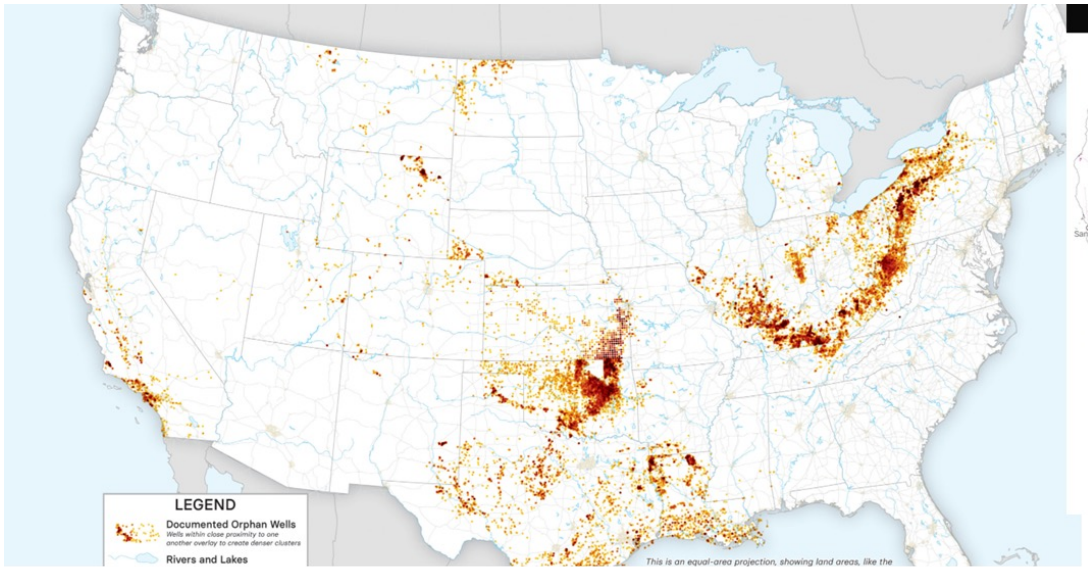
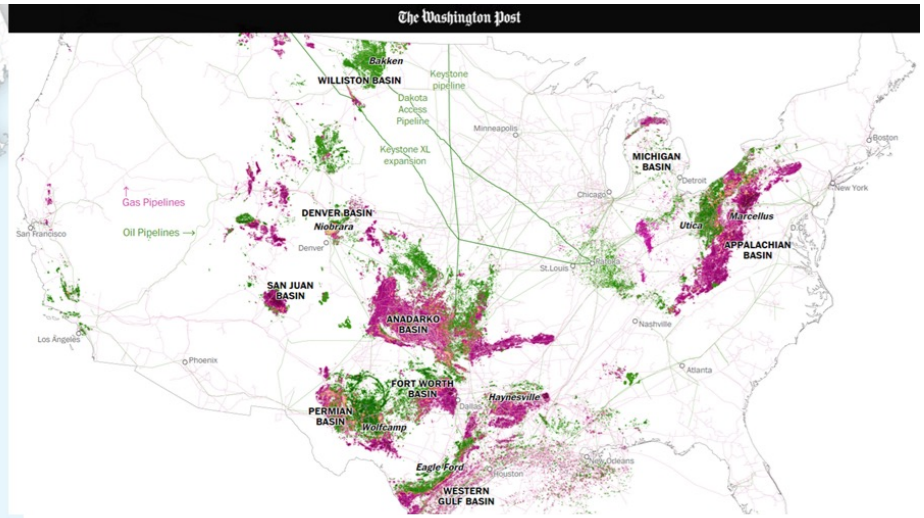
Potentials to Scale Across the US





The U.S. Environmental Protection Agency estimates that there are more than 3 million total abandoned oil and gas wells.

US EPA

There are more than 900,000 active oil and gas wells in the United States, and more than 130,000 have been drilled since 2010, according to Drillinginfo, a company that provides data and analysis to the drilling industry.

The Washington Post

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Repurposing Benefits

- Reallocate P&A cost for repurposing
- Extend the life of assets (revenue for well owners, landowners, community benefits)
- Help with the stability of the grid
- Energy options in remote areas
- ESG (Environmental, social, and corporate governance) for Oil and Gas companies

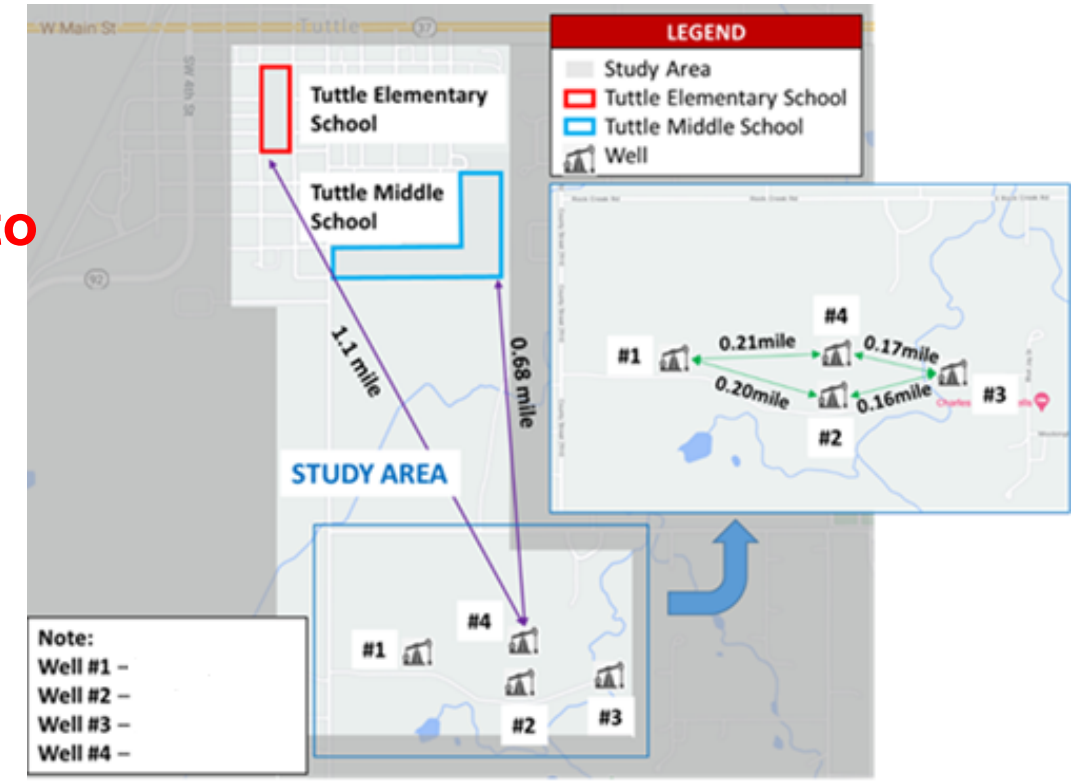
Ideal Repurposing Candidates

- Wells with records of good ***casing and cement integrity***
- Depleted fields
- Close to high population densities, agricultural centers, remote operations and/or facilities (military complexes, chemical plants)
- Access to pipelines for energy transfer
- Electricity/Direct Use Options
- Availability of batch wells/fields

Demonstration of Repurposing Hydrocarbon Wells

University of Oklahoma HUG Program

Hydrocarbon Wells Upcycled to Geothermal (HUG)



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Demonstration of Repurposing Hydrocarbon Wells

https://m.youtube.com/watch?v=dcssYR06070

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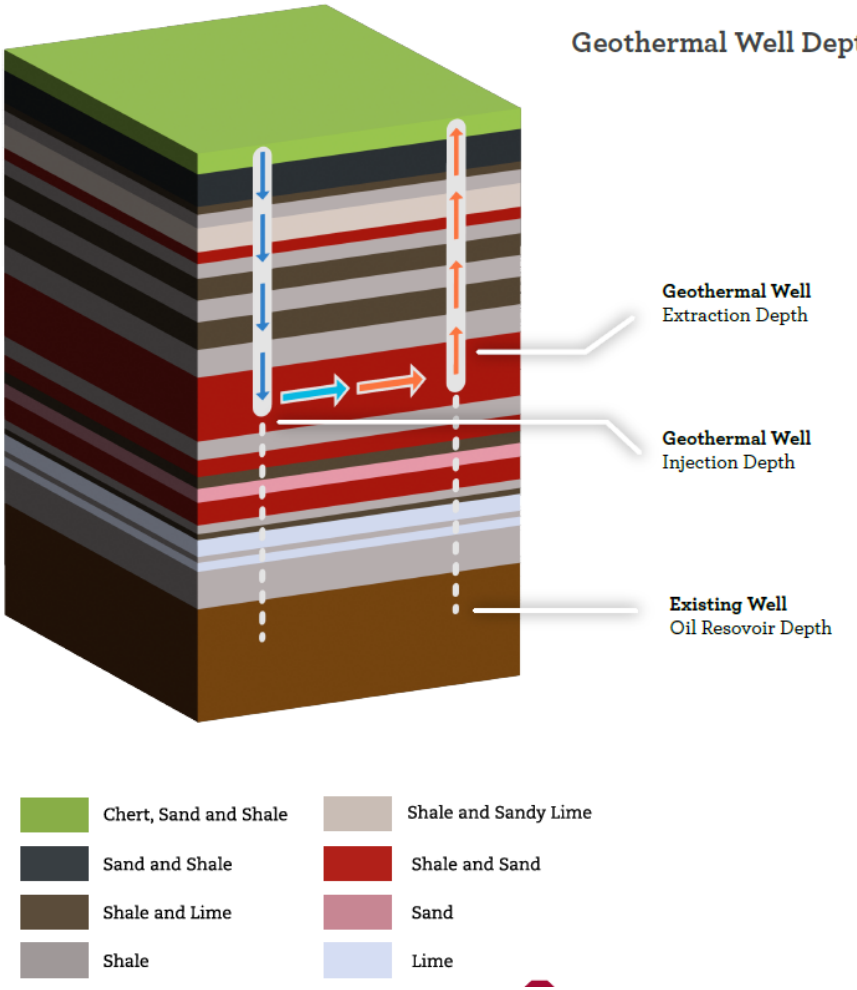
Demonstration of Repurposing Hydrocarbon Wells



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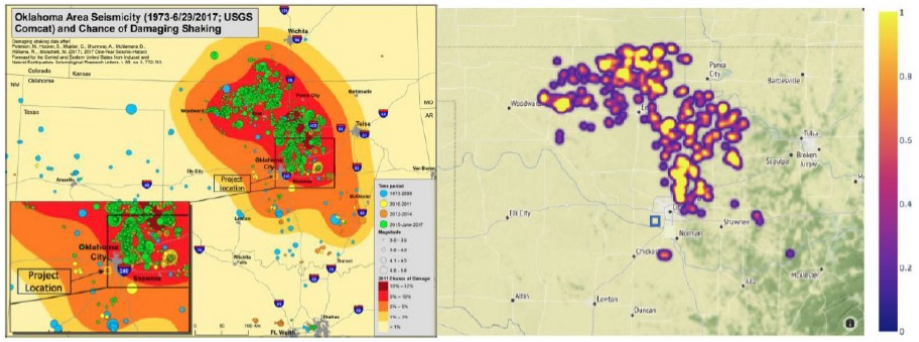
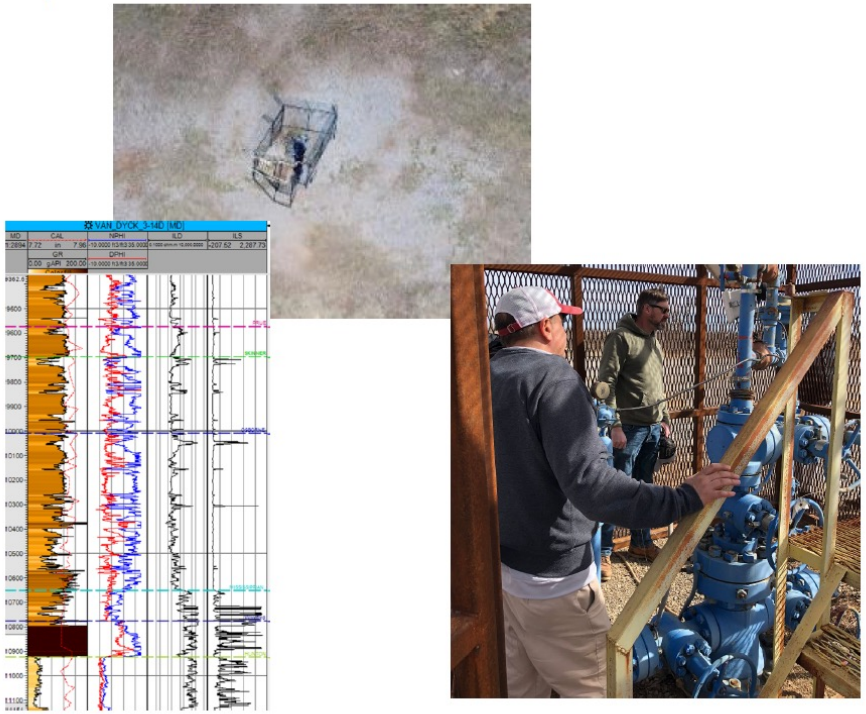
Demonstration of Repurposing Hydrocarbon Wells

- Four inactive wells drilled in 1985, 2002, 2003, 2005
- Final depth of 10,000-12,000 ft
- Good well integrity conditions
- Known geologically
- Very low seismicity risk





Left: Oklahoma historical seismicity events. The location of the project (Tuttle, OK) is represented in the yellow square in the figure (Modified from USGS 2021). Right: machine learning approach for induced seismicity evaluation. The proposed area is marked with a blue square.

End Users Information

Public School Students

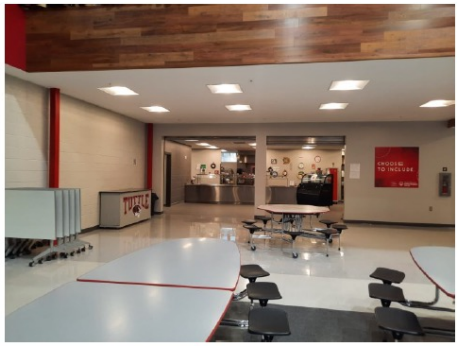
More than 1700 students

- Tuttle High School
  - Grades: 9-12
- Tuttle Middle School
  - Grades: 6-8
- Tuttle Elementary School
  - Grades: 1-5

City of Tuttle

TUTTLE

Public School District



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Project Progress

- Kick off (September 2022)
- Feasibility studies
- Permitting
- Workover plan preparation
- Field tests (2023)

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Concluding Remarks

- Various sedimentary offer a combination of deep sedimentary columns and high-temperature gradients, which allows access to geothermal resources in new regions.
- Going beyond volcanic areas and hot hydrothermal regions allows us to expand the targeting regions to geothermal assets.
- Tech transfer to reduce the cost of drilling
- Oil and gas synergies with geothermal and shared workforce
- Repurposing opportunities for direct use and electricity productions
- Overcoming various challenges (permitting, energy ownership, royalty, etc.)
- Repurposing demonstration

Acknowledge

BLUE CEDAR ENERGY

U.S. DEPARTMENT OF ENERGY

NREL Transforming ENERGY

Baker Hughes

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