U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

Geothermal Technologies Office

Quarterly Update: February 25, 2021

Dr. Susan Hamm, Director

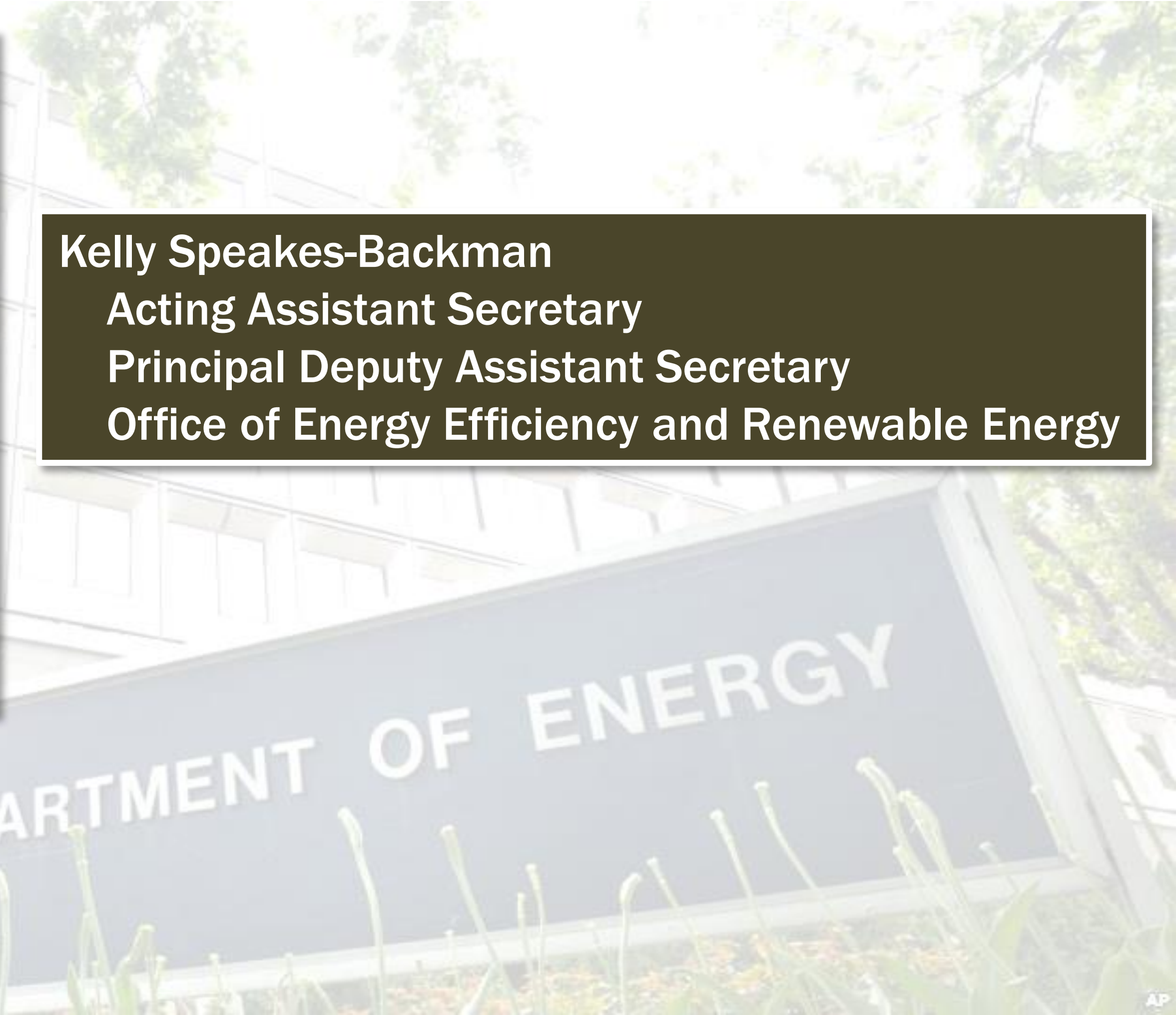
Image: Calpine

Today's Agenda

February 25, 2021 / 1:00-2:30 PM ET
Webinar topics or suggestions? Contact us at: DOE.geothermal@ee.doe.gov

Topic	Speaker
Biden-Harris administration priorities	Kelly Speakes-Backman, Acting Assistant Secretary, EERE
News from the Hill Office updates	Sue Hamm, GTO Director
Utah FORGE drilling highlights	John McLennan, Univ. of Utah, Guest Speaker
FORGE R&D solicitations update	Lauren Boyd, EGS Program Manager
SLOPE overview	Sean Porse, DMA Program Manager Megan Day, Senior Energy Planner, NREL Kevin McCabe, Researcher, NREL
Geothermal Design Challenge Collegiate Competition	Elisabet Metcalfe, Acting Stakeholder Lead
Q&A	Submit your question via WebEx chat

Biden-Harris Administration Priorities



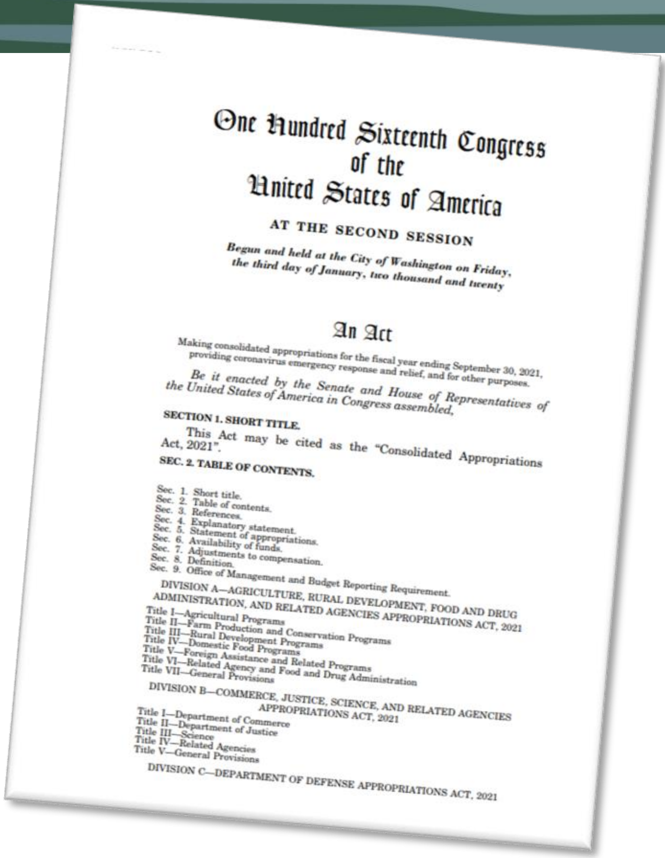
Kelly Speakes-Backman
Acting Assistant Secretary
Principal Deputy Assistant Secretary
Office of Energy Efficiency and Renewable Energy

H.R. 133 – Consolidated Appropriations Act, 2021

Section 3002: Advanced Geothermal Innovation Leadership

Authorizes:

- R&D for exploration technologies
- Demonstration of exploratory drilling technologies
- Reservoir Thermal Energy Storage
- Oil and Gas Technology Transfer Initiative
- Critical materials R&D
- Flexible operations of geothermal power plants
- Integrated Energy Systems
- Drilling Data Repository
- Three (3) FORGE sites
- EGS demonstrations
- GHP R&D
- Direct Use R&D
- Education & outreach
- Technical assistance
- Advanced computing and machine learning
- International partnerships
- Update to geothermal resource assessments
- Etc…



One Hundred Sixteenth Congress
of the
United States of America

AT THE SECOND SESSION

Begun and held at the City of Washington on Friday, the third day of January, two thousand and twenty

An Act

Making consolidated appropriations for the fiscal year ending September 30, 2021, providing coronavirus emergency response and relief, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the "Consolidated Appropriations Act, 2021".

SEC. 2. TABLE OF CONTENTS.

Geothermal Market Report & Multi-Year Performance Plan

Geothermal Market Report – Coming This Spring!

- Produced in partnership with Geothermal Rising and the National Renewable Energy Laboratory.

Multi-Year Performance Plan – Coming This Spring!

- Topic areas will include resource exploration, drilling and reservoir development, maximizing resource opportunities, and geothermal's value to the future electricity grid.

Photo: Eric Larson / UtahFORGE

New Project: Cornell Earth Source Heat

Researchers at **Cornell University** have begun drilling at 2.5 km depth to verify conditions and test the viability of campus heating via low-temperature geothermal resources. This project includes the development of technical, regional, economic, and environmental success metrics.

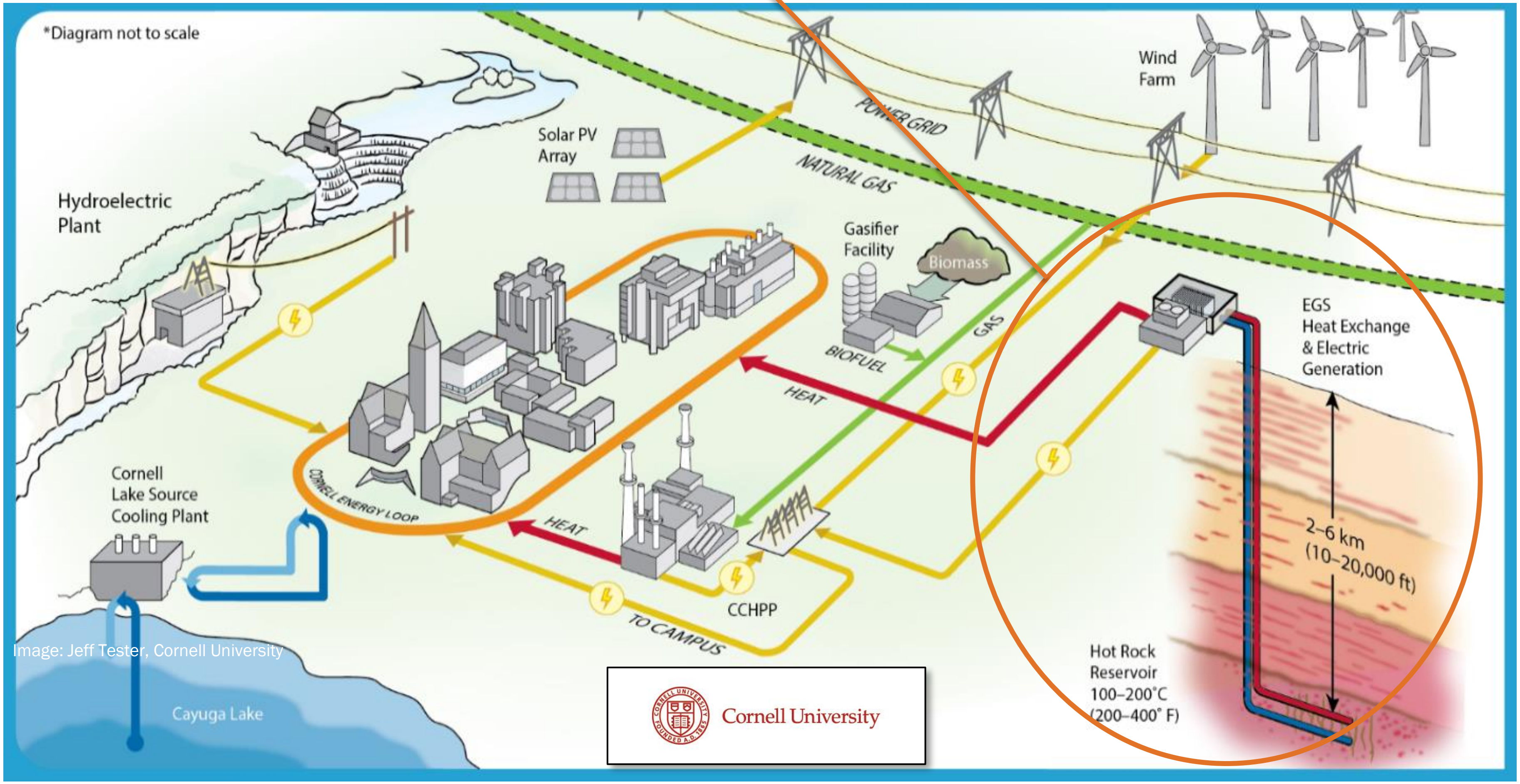
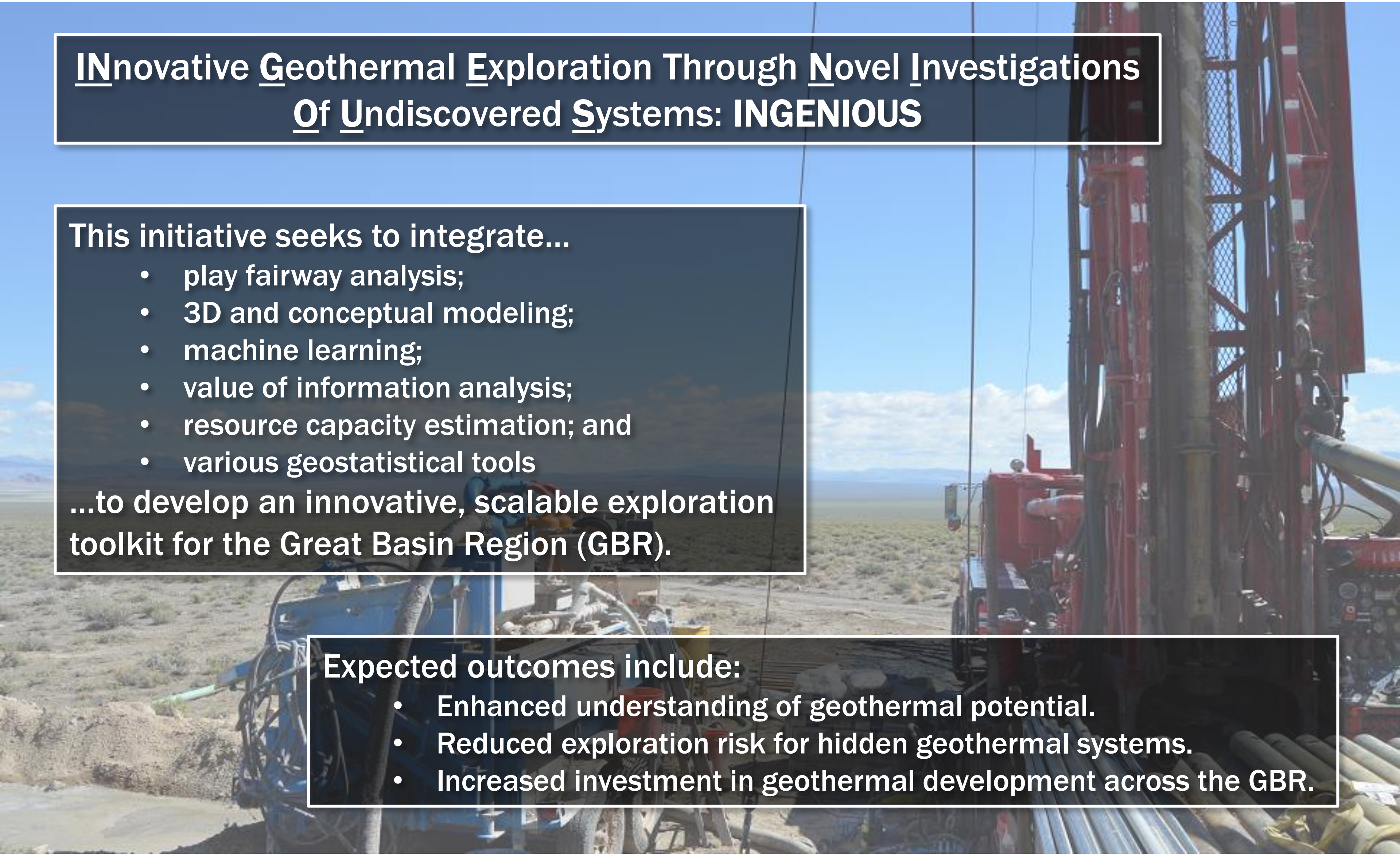


Image: Jeff Tester, Cornell University

New Project: INGENIOUS / University of Nevada-Reno



INnovative Geothermal Exploration Through Novel Investigations Of Undiscovered Systems: INGENIOUS

This initiative seeks to integrate…

- play fairway analysis;
- 3D and conceptual modeling;
- machine learning;
- value of information analysis;
- resource capacity estimation; and
- various geostatistical tools

…to develop an innovative, scalable exploration toolkit for the Great Basin Region (GBR).

Expected outcomes include:

- Enhanced understanding of geothermal potential.
- Reduced exploration risk for hidden geothermal systems.
- Increased investment in geothermal development across the GBR.

GTO – Now Hiring

ENERGY.GOV

Office of

ENERGY EFFICIENCY & RENEWABLE ENERGY

Geothermal Technologies Office

To receive the posting by email, write us at: doe.geothermal@ee.doe.gov

February 23, 2021

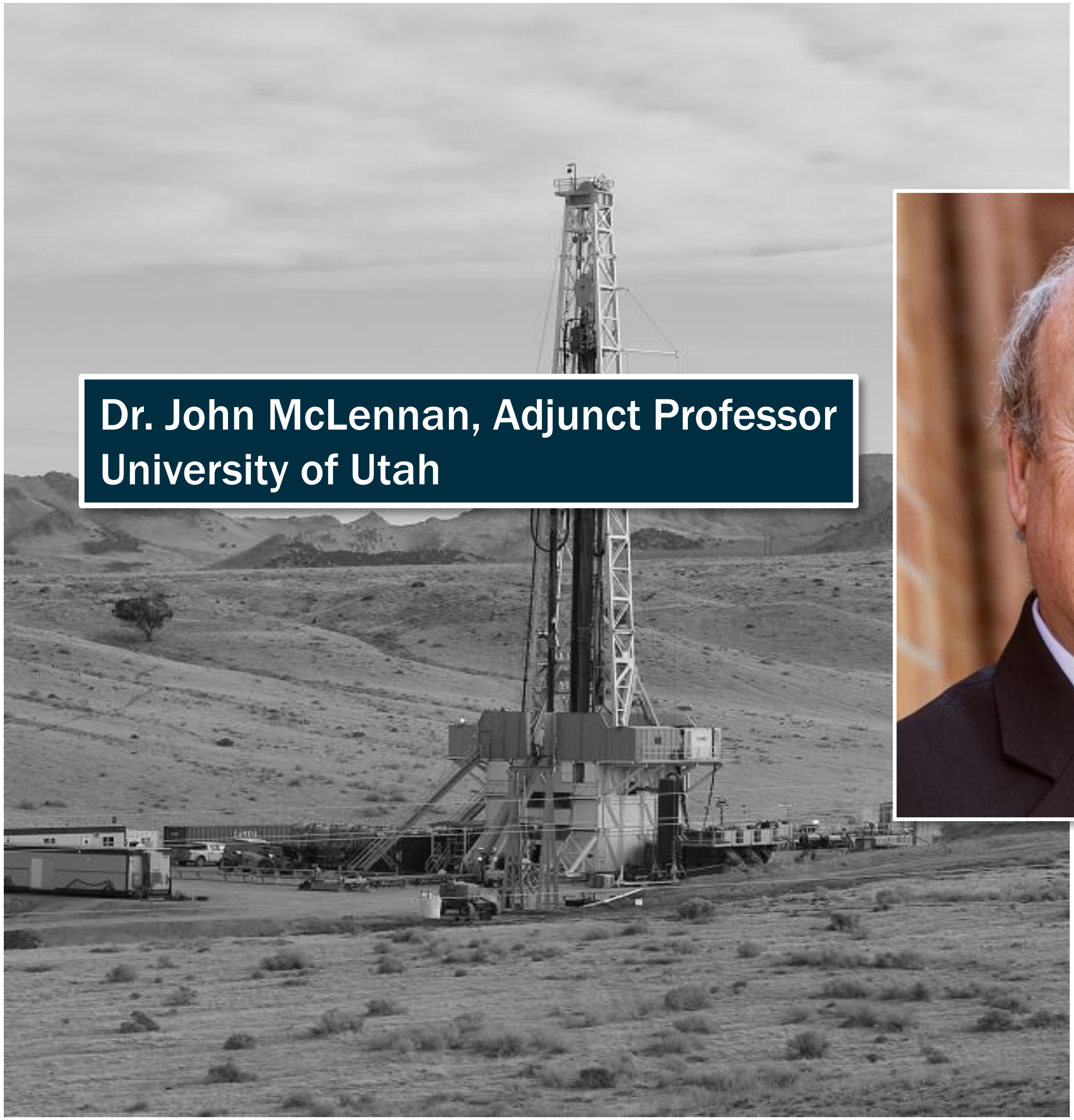
GTO is Hiring - Apply Now!

Are you a general engineer or physical scientist interested in working for the Department of Energy's (DOE) Geothermal Technologies Office (GTO)? GTO is currently seeking applicants for a General Engineer/ Physical Scientist position (GS-0801/1301-14) to serve as the **FORGE Technology Lead** within our Enhanced Geothermal Systems (EGS) subprogram in Golden, Colorado or Washington, D.C.

GTO conducts research and development to reduce costs and risks associated with geothermal development by supporting innovative technologies that address key exploration and deployment barriers.

Interested applicants are required to submit (1) a resume and (2) a writing sample (outlined below) to eerehiring@ee.doe.gov, copying Lauren Boyd (Lauren.Boyd@ee.doe.gov) and Susan Hamm (Susan.Hamm@ee.doe.gov), **by 5:00 p.m. ET on March 16, 2021**. Further information on application requirements can be found on the EERE Employment Opportunities Page.

Utah FORGE Drilling: Advancing the EGS Agenda



Dr. John McLennan, Adjunct Professor
University of Utah

UTAH FORGE
U.S. Department of Energy

Drilling FORGE Well 16A(78)-32: Advancing the EGS Agenda

February 25, 2021
John McLennan

www.UtahFORGE.com

EGI Energy & Geoscience Institute at the University of Utah · Utah Geological Survey · UUSS university of utah seismograph stations · INL Idaho National Laboratory · Beaver County · SWCA · USGS science for a changing world · U.S. Department of the Interior Bureau of Land Management · State of Utah School and Institutional Trust Lands Administration · Smithfield · Golder · Geothermal Resource Group · Seequent

UTAH FORGE

U.S. Department of Energy

Funding for this work was provided by the U.S. DOE under grant DE-EE0007080 "Enhanced Geothermal System Concept Testing and Development at the Milford City, Utah FORGE Site"

We thank the many stakeholders who are supporting this project, including Smithfield, Utah School and Institutional Trust Lands Administration, and Beaver County as well as the Utah Governor's Office of Energy Development.

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EGI Energy & Geoscience Institute at the University of Utah | Utah Geological Survey | UUSS university of utah seismograph stations | INL Idaho National Laboratory | Beaver County | SWCA

USGS science for a changing world | U.S. Department of the Interior Bureau of Land Management | State of Utah School and Institutional Trust Lands Administration | Smithfield | GOLDER | Geothermal Resource Group Tapping the Earth's Energy | SEEQUENT

What is FORGE?

Frontier Observatory for Research in Geothermal Engineering

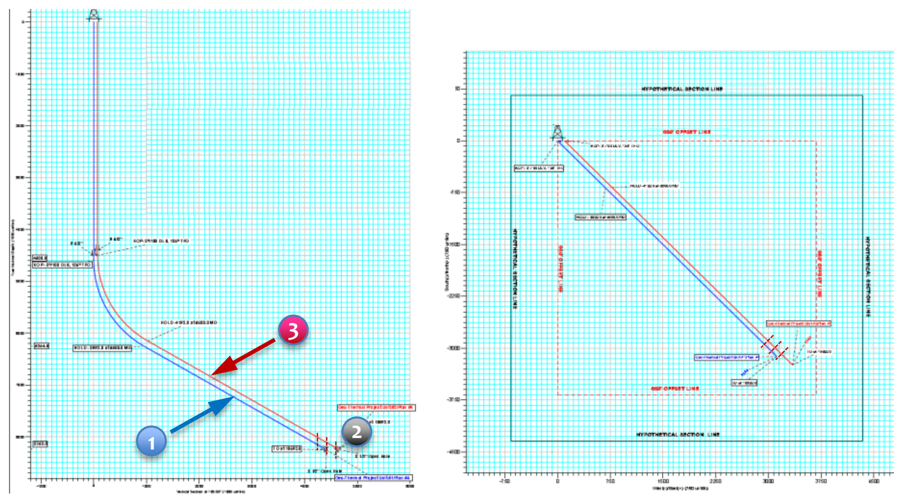
Conceptual Agenda at FORGE

1. Drill Injection Well
2. Hydraulically Fracture (Multiple Stages)
3. Drill Production Well to Intersect Fractures

Conceptual Commercial Agenda

- Injected Cold Water Circulates Through Hydraulic Fractures
- Hot Water Brought to Surface Through Production Well
- Flashed to Steam and/or Run Through Organic Rankine Cycle Binary Plant

FORGE Concept Schematic



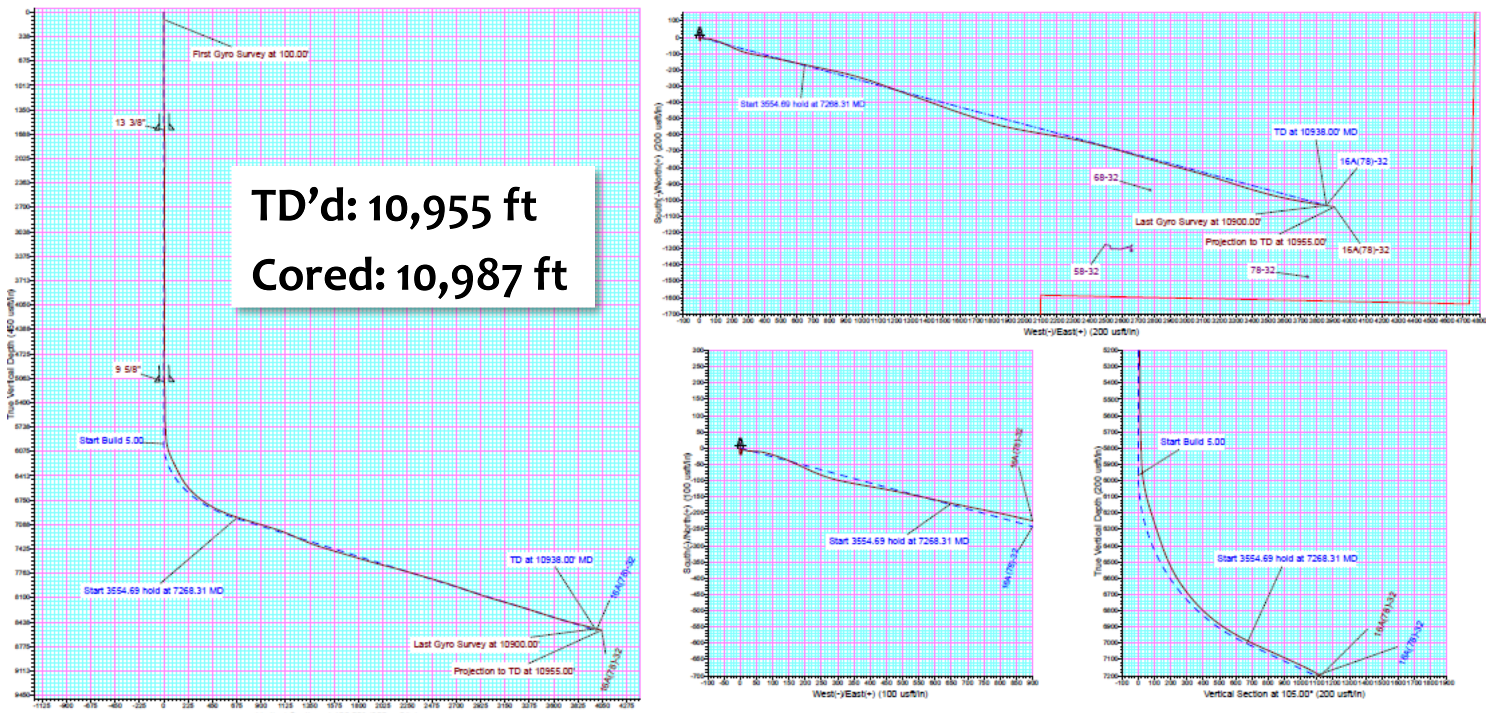
Elevation (Side) View

Plan (Map) View

UTAH FORGE U.S. Department of Energy

Drilling Status: Well 16A(78)-32

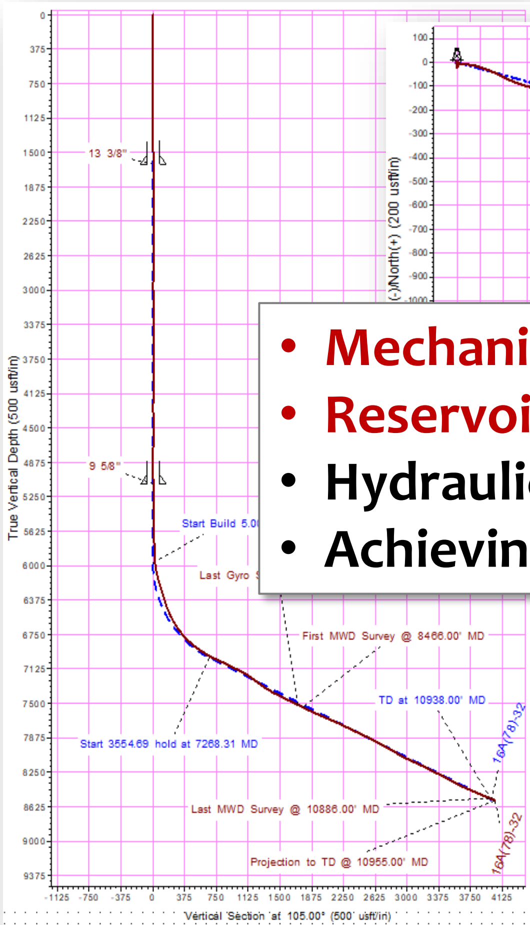
Project: Forge
Site: Beaver County, UT
Well: 16A(78)-32
GL: GE + RKB (5414' + 30') @ 5444.00usft (Frontier 16)
SHL Northing: 13987645.20
SHL Easting: 1097896.92
Rig: Frontier 16
Plan: Design: 16A(78)-32 plan 1

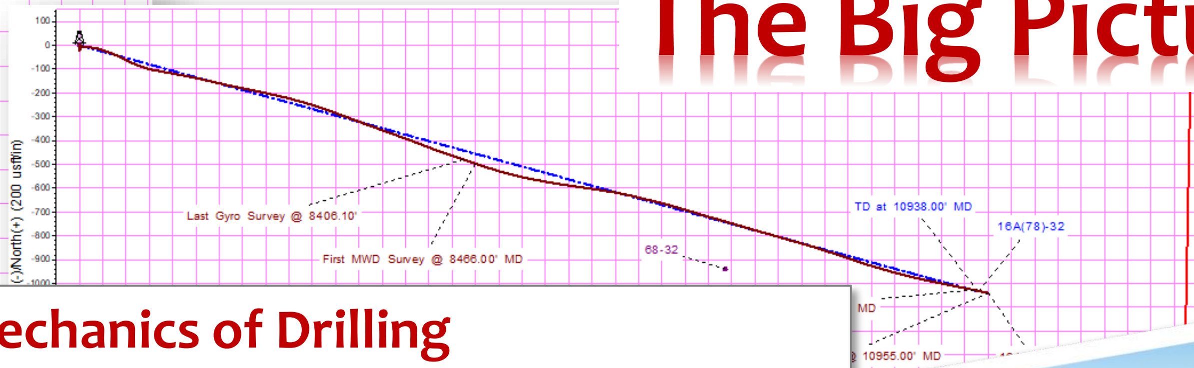


TD'd: 10,955 ft

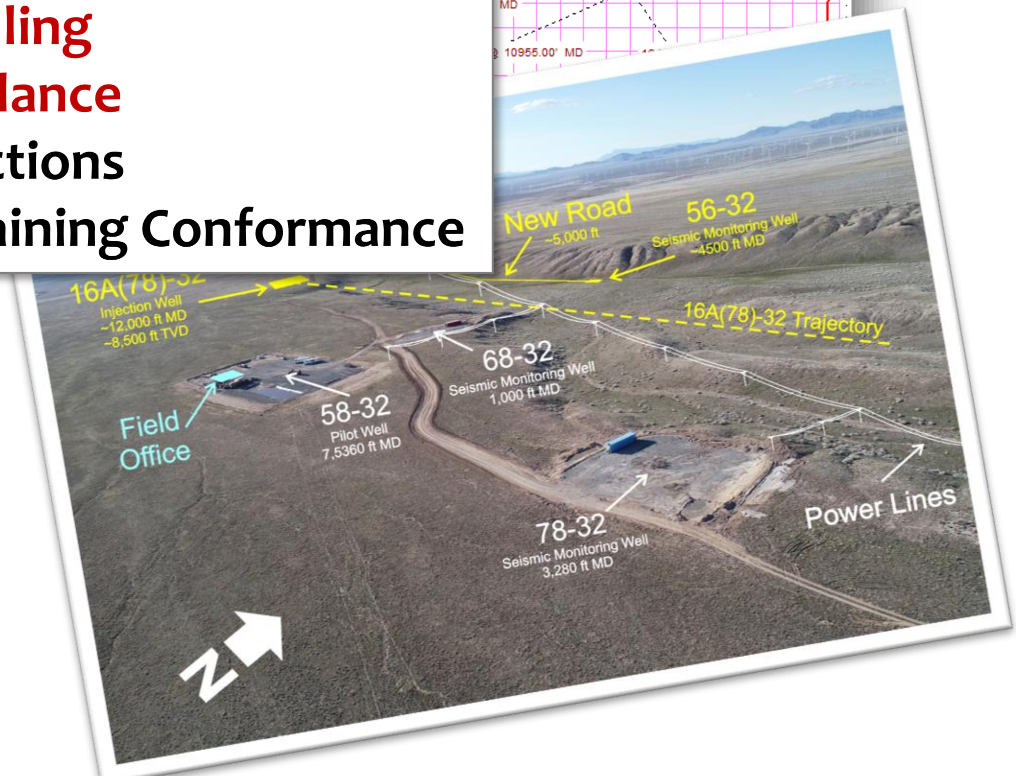
Cored: 10,987 ft

The Big Picture

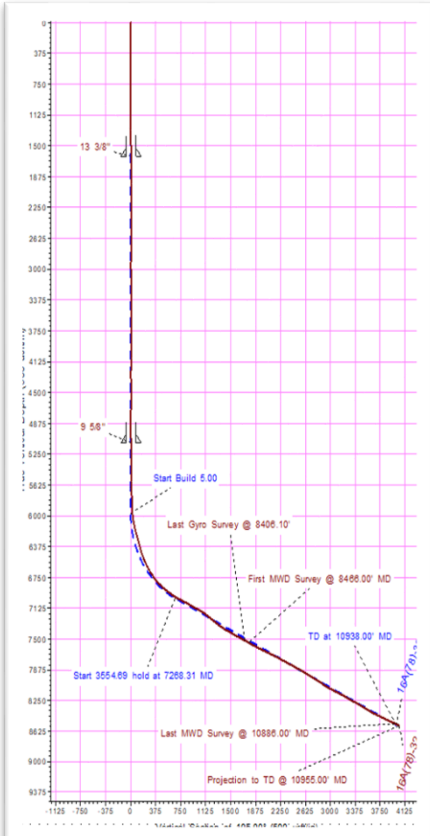


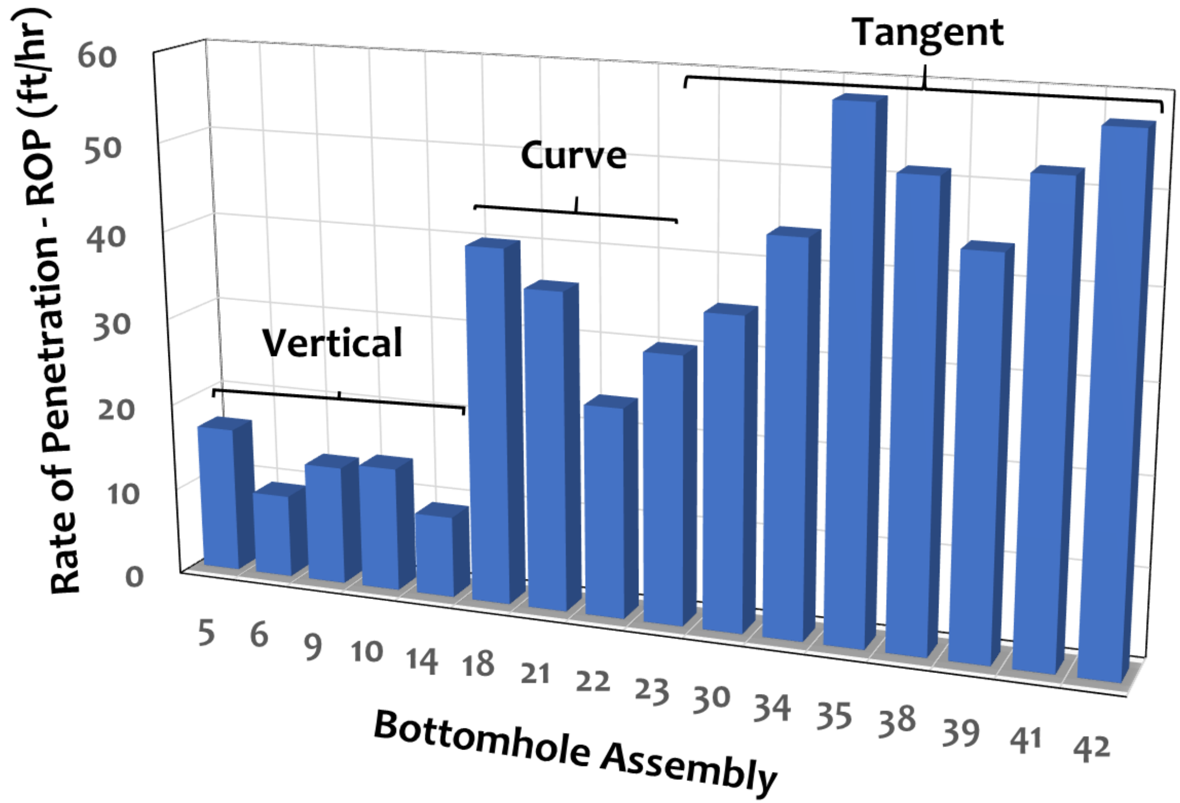


- **Mechanics of Drilling**
- **Reservoir Surveillance**
- **Hydraulic Connections**
- **Achieving/Maintaining Conformance**



Mechanics of Drilling: Evolution of PDC Bit Designs





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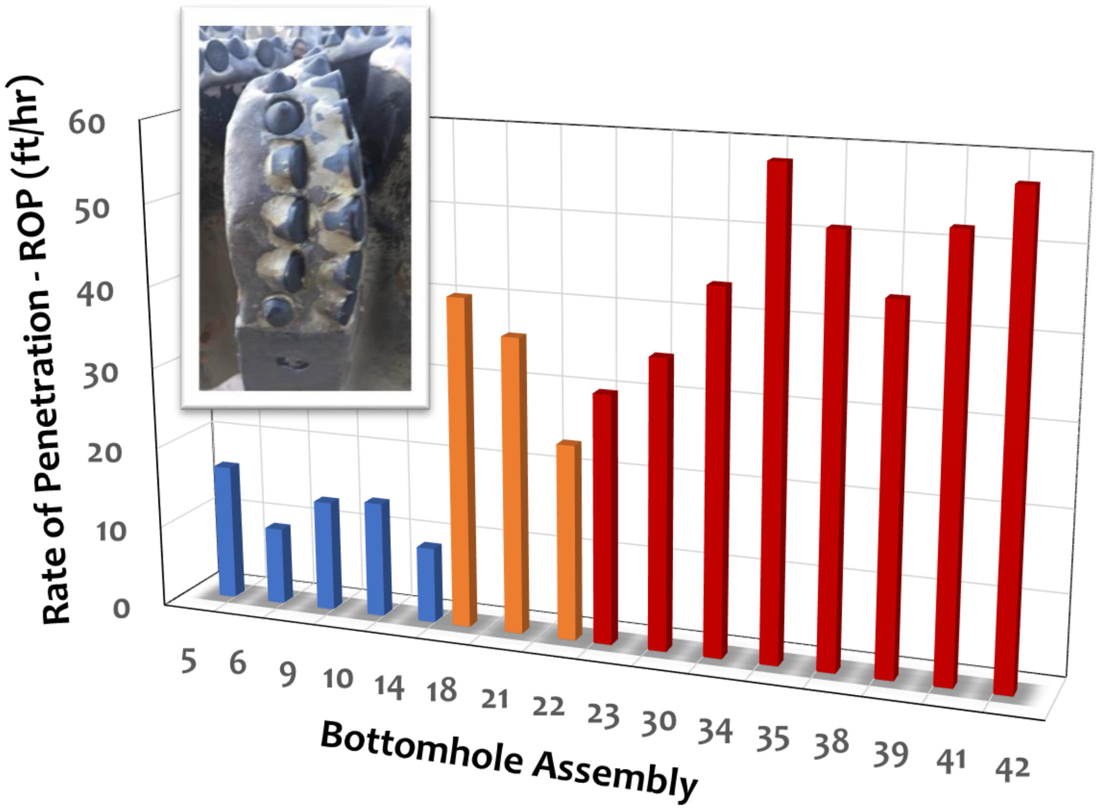
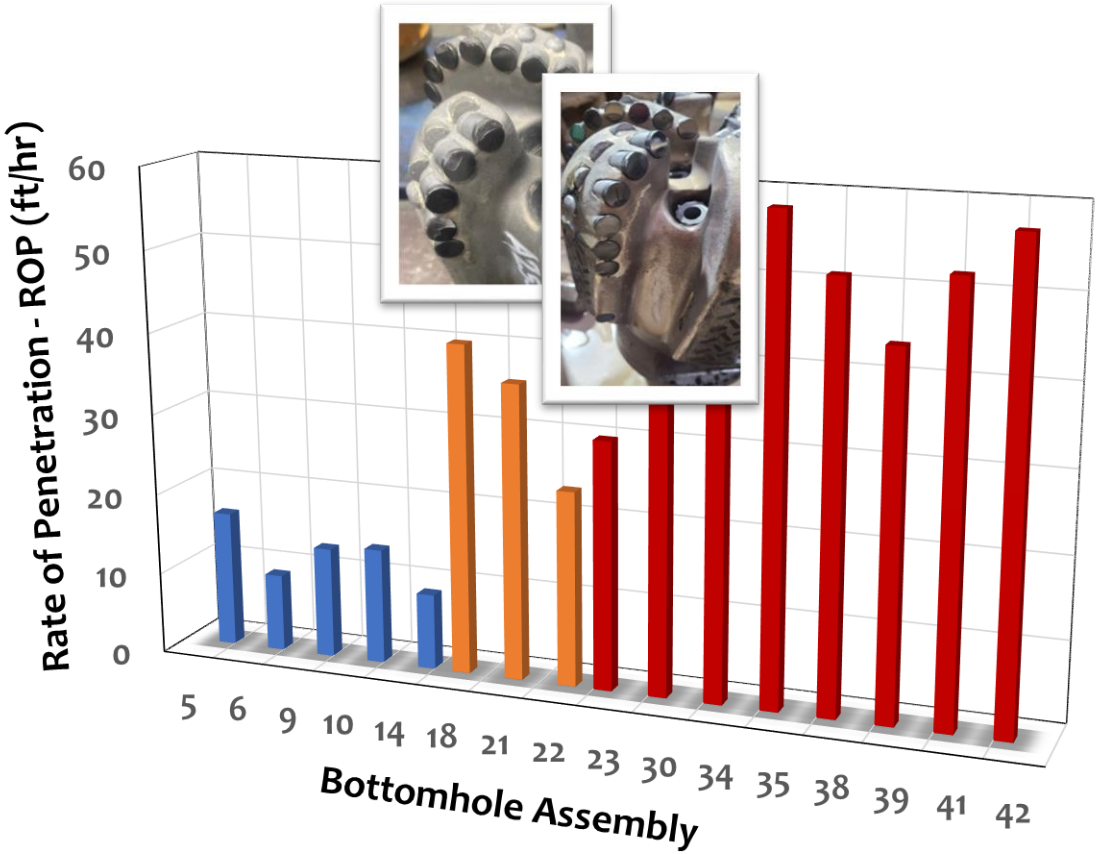
Mechanics of Drilling: Evolution of Bit Designs



Vertical in Granite

- Confirm utility of 13 mm cutters in the granite (as opposed to 16 mm)
- Evaluated the utility of conical cutters as TCCs/depth limiters
- Weight transfer issues

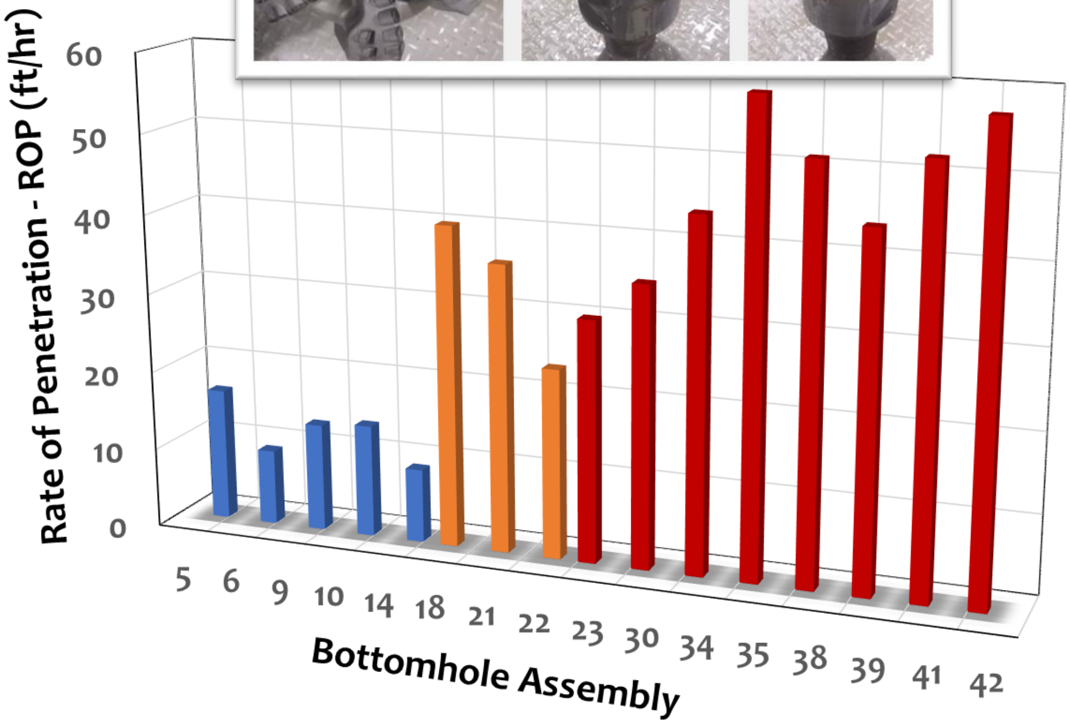
Mechanics of Drilling: Evolution of Bit Designs



Drilling the Curve

- 5°/100 ft
- 13 mm cutters
- Evaluated depth limiters and TCCs
- Evaluated stabilizer or roller reamer above motor
- Reaming

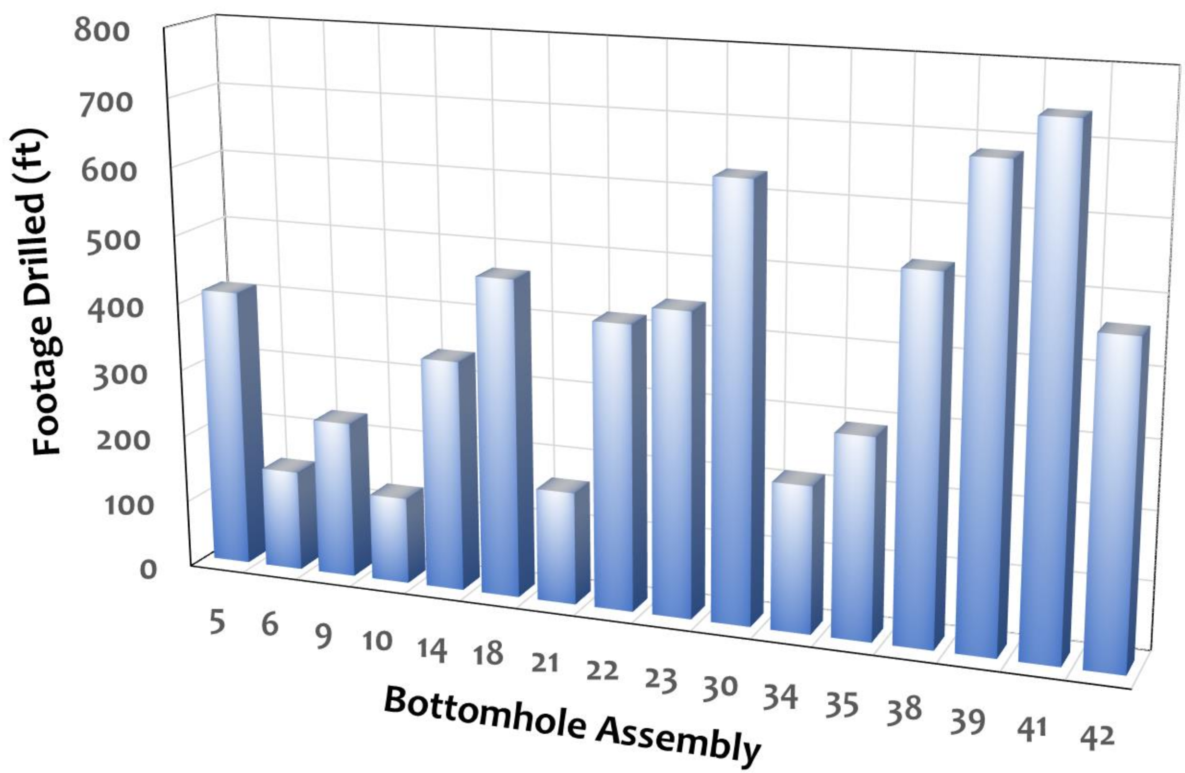
Mechanics of Drilling: Evolution of Bit Designs

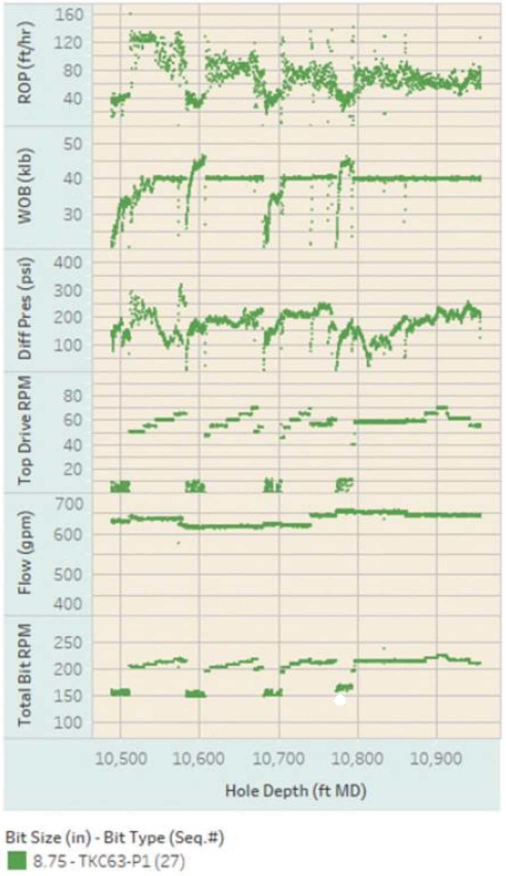


65 ° Tangent

- Tried five blades, six blades preferable
- More aggressiveness
- Alternating shaped 3D cutter layout ("SaberTooth")
- Higher shaped 3D cutter count
- Agitator
- Mid-motor body stabilizer
- Dynamics recording

Mechanics of Drilling: Evolution of Bit Designs





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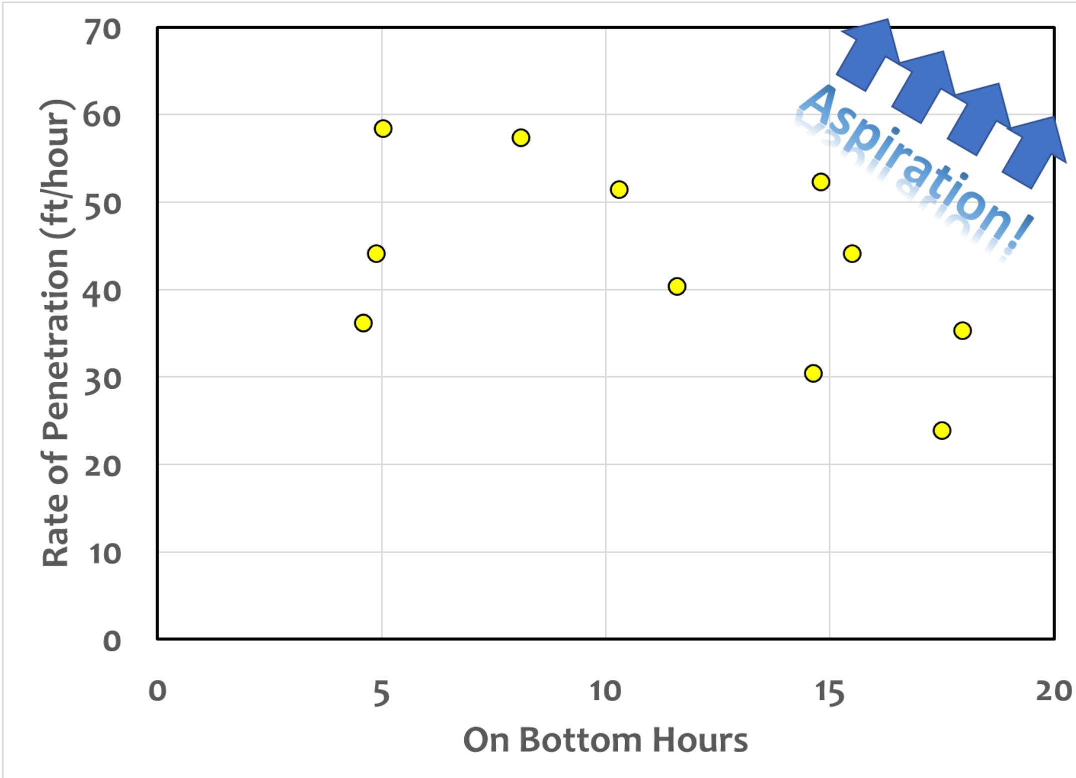
Mechanics of Drilling: Evolution of Bit Designs



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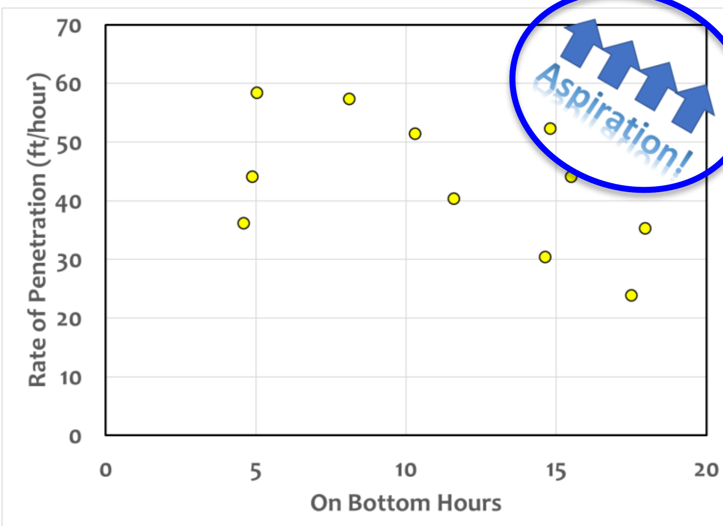
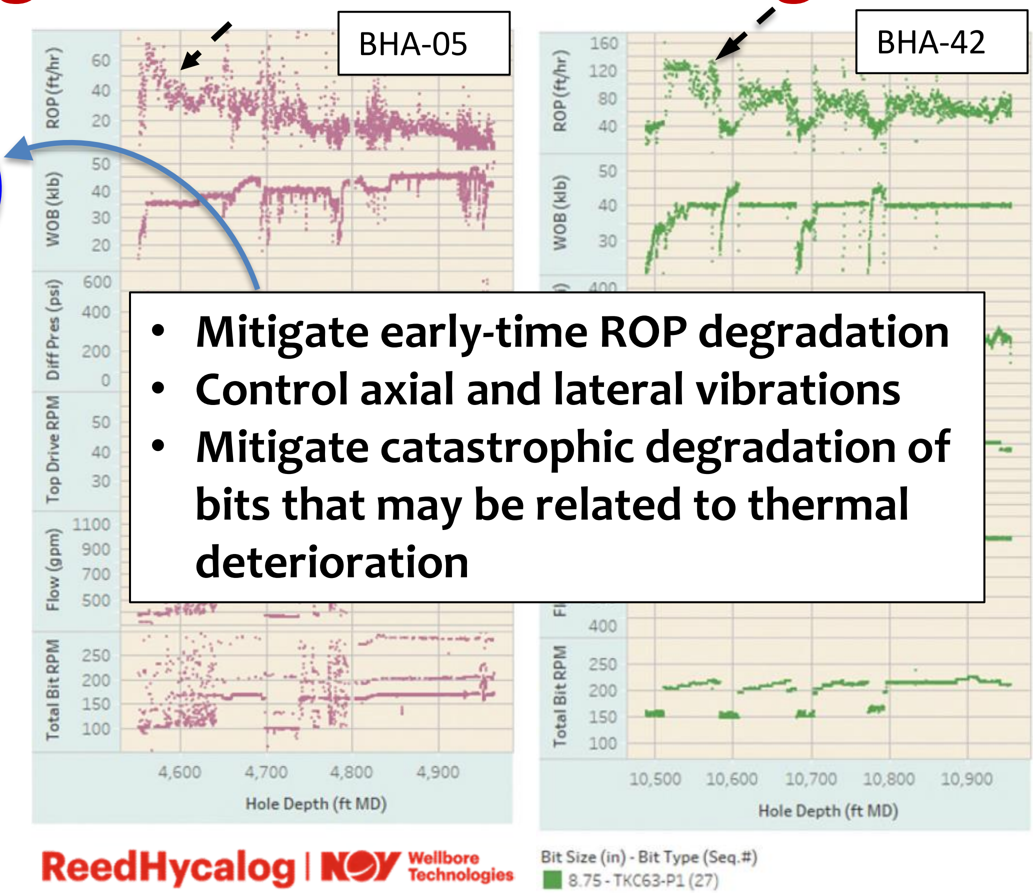




- Mitigate early-time ROP degradation
- Control axial and lateral vibrations
- Mitigate catastrophic degradation of bits that may be related to thermal deterioration

Mechanics of Drilling: Physics-Based Drilling

MSE_{Total} is energy (work) being done by bit and string combined.

$$MSE_{Total} = \frac{4WOB}{\pi D^2} + \frac{480 \times \left(TOR_{surf} - TOR_{motor}\right) \times RPM_{surf}}{D^2 \times ROP} + \frac{480 \times TOR_{motor} \times RPM_{motor}}{D^2 \times ROP}$$

With motor data:

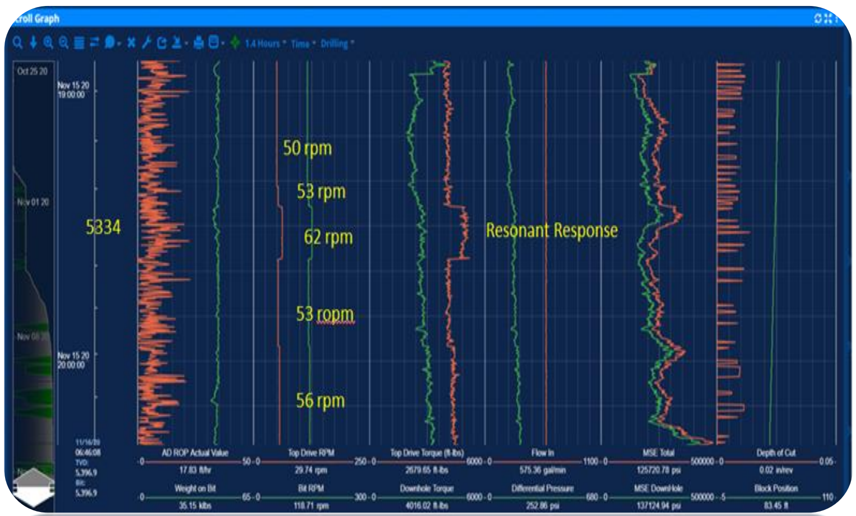
$$MSE_{Total} = \frac{4WOB_{surf}}{\pi D^2} + \frac{480 \times TOR_{surf} \times RPM_{surf}}{D^2 \times ROP} + \frac{480 \times (K_t \Delta P)(K_n Q)}{D^2 \times ROP}$$

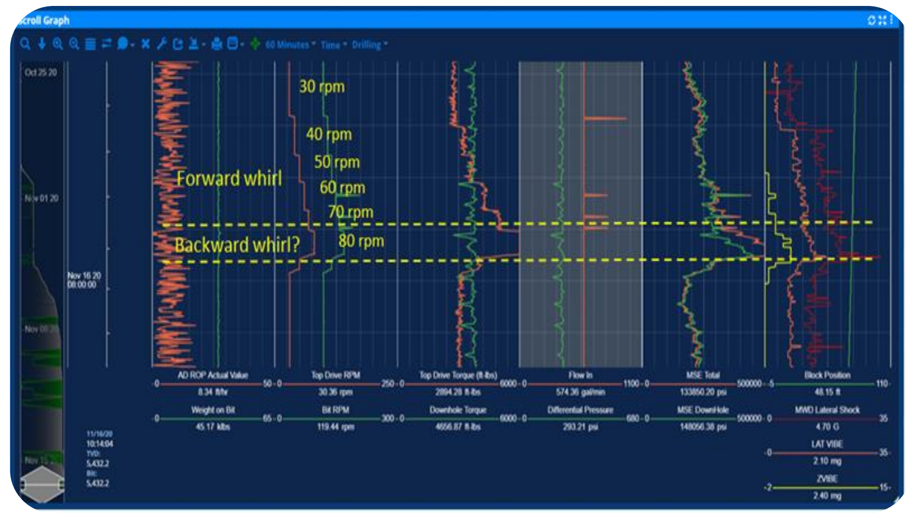
With MWD data:

$$MSE_{Total} = \frac{4WOB_{MWD}}{\pi D^2} + \frac{480 \times TOR_{surf} \times RPM_{surf}}{D^2 \times ROP} + \frac{480 \times TOR_{MWD} \times RPM_{MWD}}{D^2 \times ROP}$$

See for example, Dupriest, 2020, SPE Webinar

Mechanics of Drilling: Physics-Based Drilling



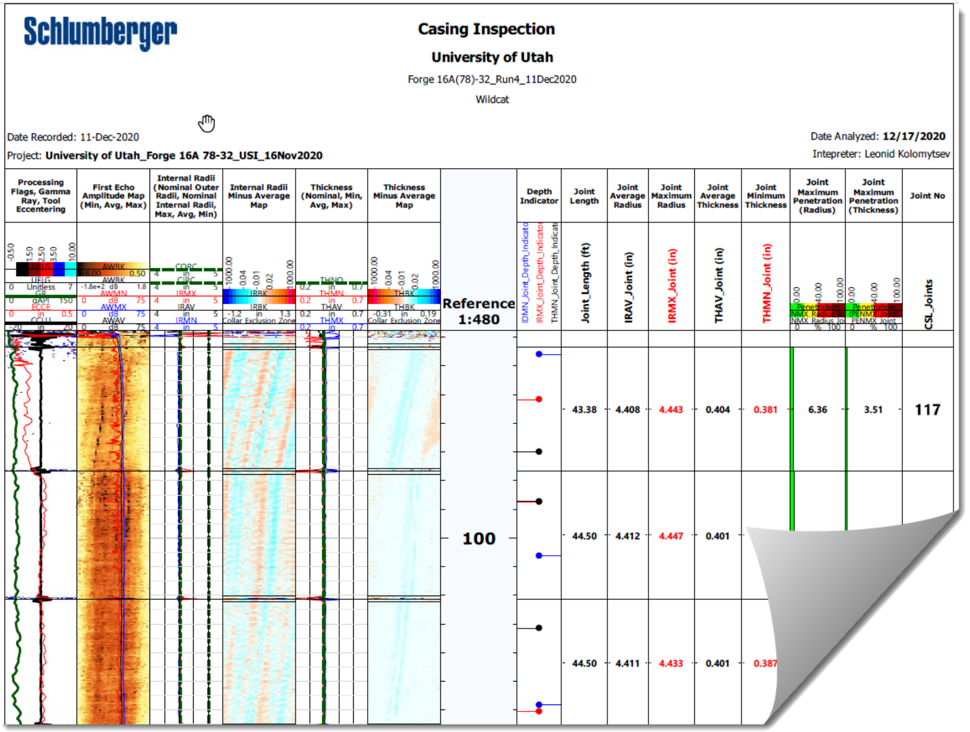


Images Courtesy Fred Dupriest TAMU

Reservoir Surveillance: Logging Programs

Operations:

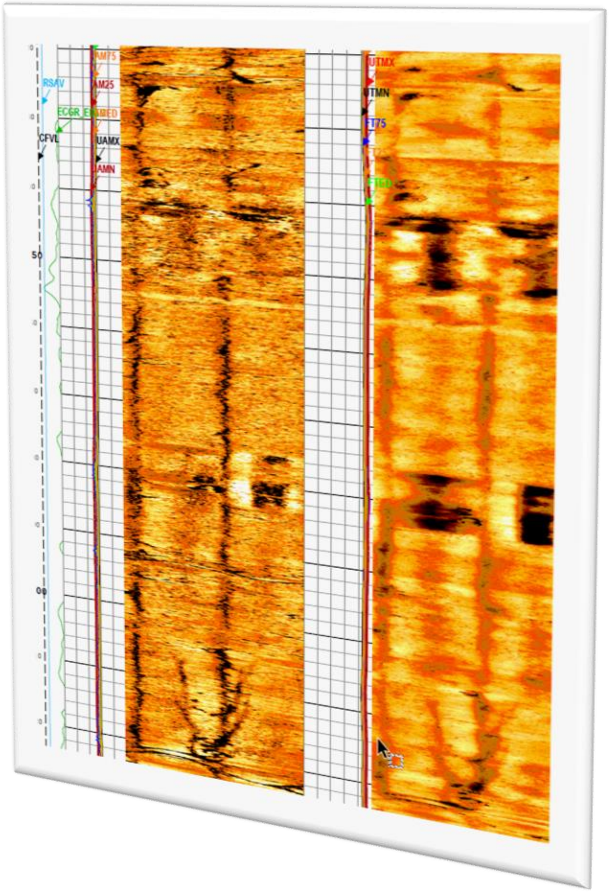
- Nov 16: Isolation Scanner for Intermediate Casing Cement Quality and Baseline Caliper
- Nov 25: UBI, TD at 5,500 feet
- Dec 2: UBI, TD at 7,085 feet
- Dec 11: UBI, TD at 8,535 feet
- Dec 26: UBI data not acquired



Reservoir Surveillance: Logging Programs

Operations:

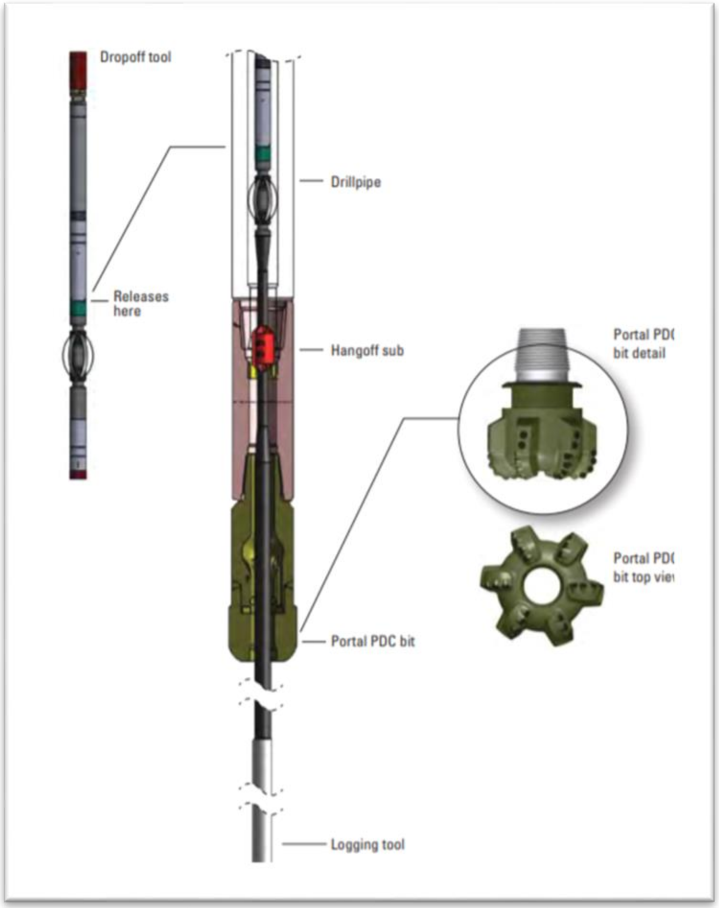
- Nov 16: Isolation Scanner for Intermediate Casing Cement Quality and Baseline Caliper
- Nov 25: UBI, TD at 5,500 feet
- Dec 2: UBI, TD at 7,085 feet
- Dec 11: UBI, TD at 8,535 feet
- Dec 26: UBI data not acquired, TD
- Petromac taxi worked well in 65° tangent



Reservoir Surveillance: Logging Programs

Operations:

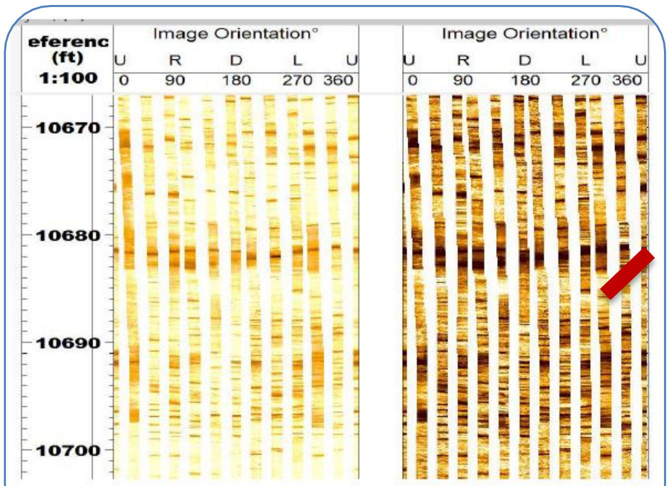
- Dec 27: Thrubit QuadCombo and FMI (Density not acquired, FMI data not interpretable, excellent GR, Resistivity, Neutron Porosity, Dipole Sonic)
- Dec 29: Rerun FMI successfully from 10, 923 to 4,851 ft MD



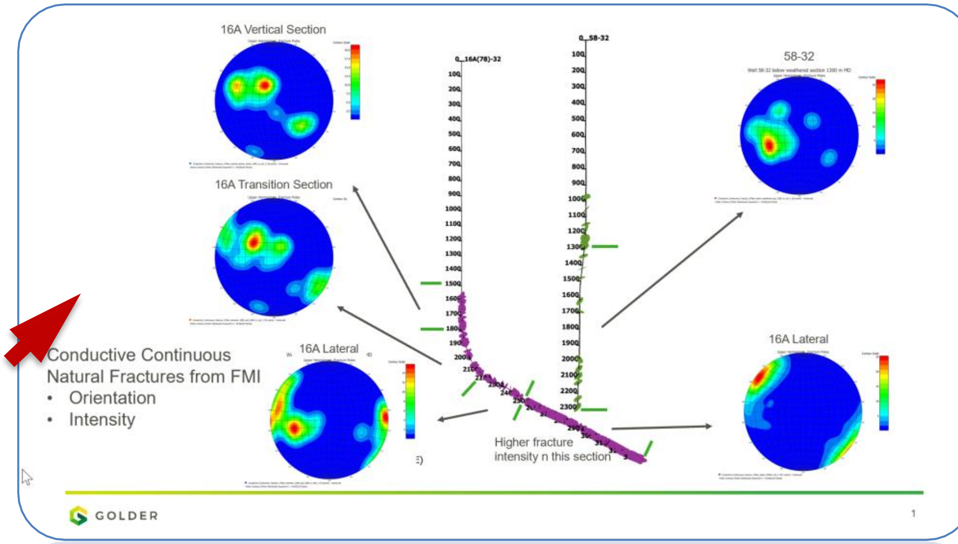
Reservoir Surveillance: Logging Programs

Operations:

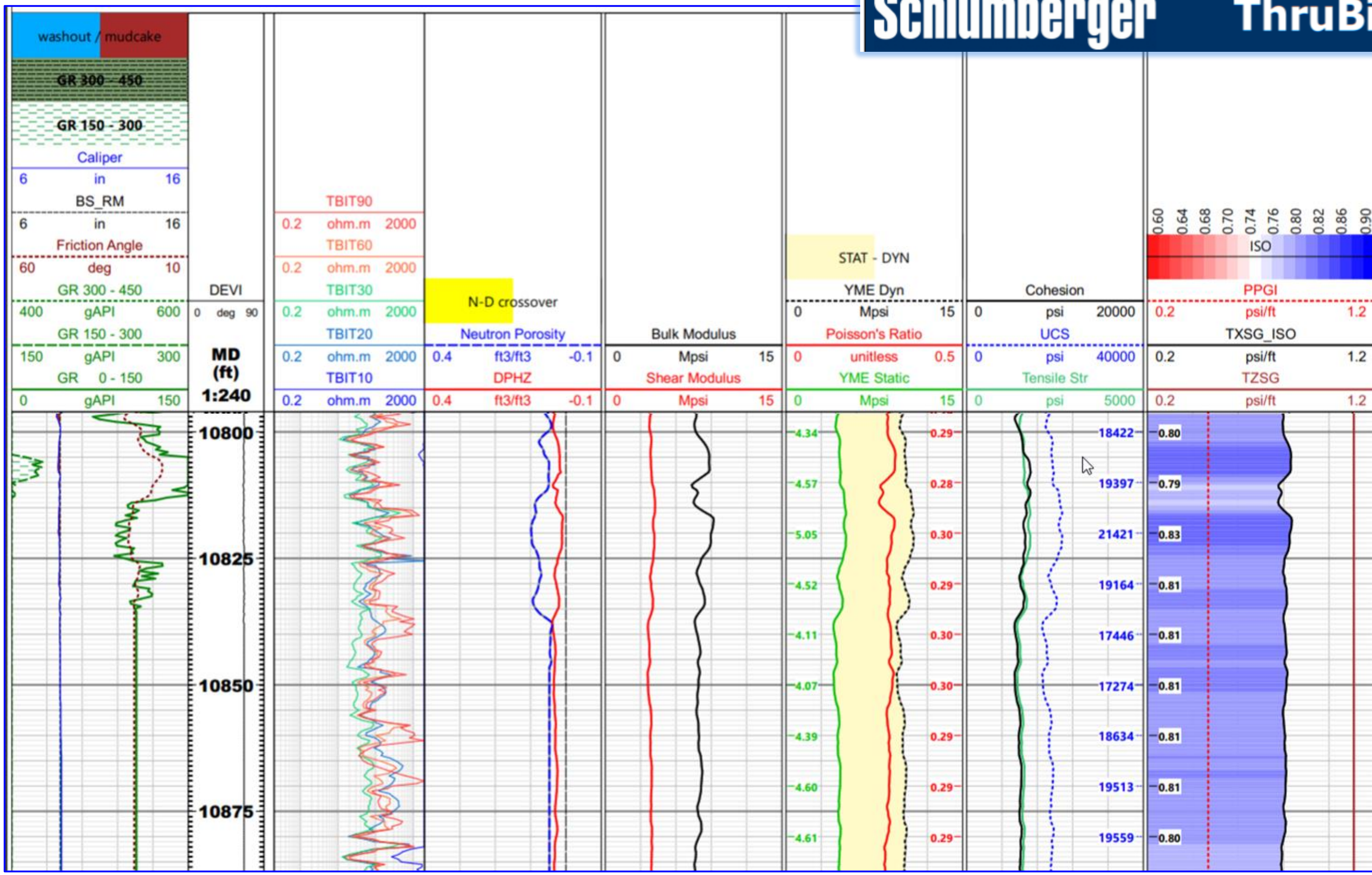
- Dec 29: Rerun **FMI** successfully from 10, 923 to 4,851 ft MD



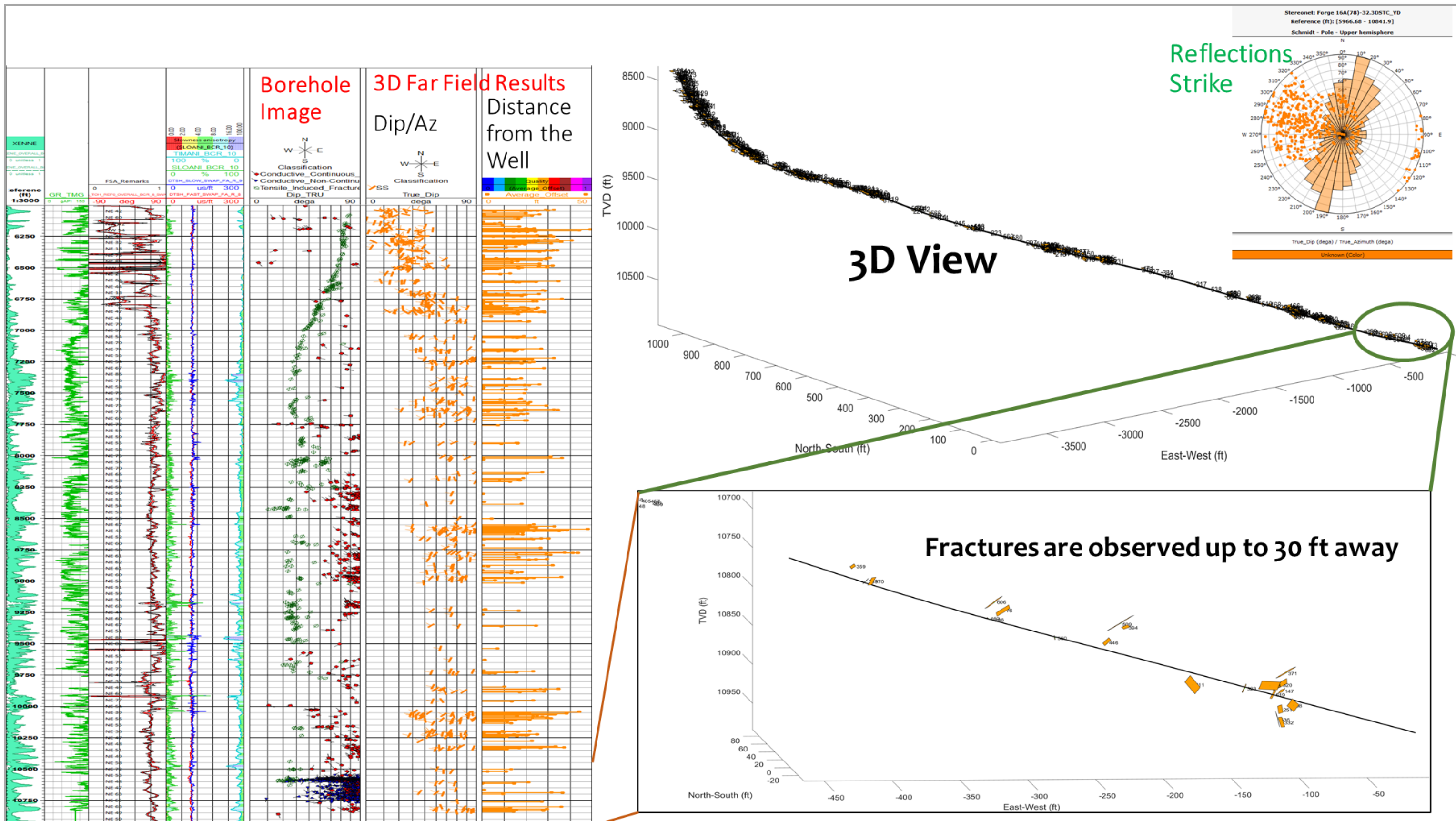
PRELIMINARY PROCESSED IMAGE



Schlumberger ThruBitDipole



Far-Field Sonic Processing: Image and 3D Far-Field Results



Schlumberger

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Reservoir Surveillance: Coring Programs

Operations: Vertical BHA 15

- 90’ core barrel
- Bit Type: CCl – 913
- 10’ cut. 8.8’ recovered (5,846’ to 5,856’ MD)
- ROP 1.94’/hr, 350-400 GPM, 40-60 RPM, 4K-8K WOB
- No break off bottom

Operations: Vertical BHA 17

- 60’ core barrel
- Bit Type: CCl – 713
- 34’ cut. 31.5’ recovered (5,858’ to 5,892’ MD)
- ROP 5.5’/hr, 350-400 GPM, 40-60 RPM, 4K-8K WOB
- No break off bottom

Reservoir Surveillance: Coring Programs

Operations: Vertical and at

Status:

- Multiple Coring Runs
- Improvements Required for Catching Core
- Potential Improvements in Non-Jamming Technologies
- 7-Blade Bits Seemed to Perform Better
- Barrel Length

Reservoir Surveillance: Openhole XLOT

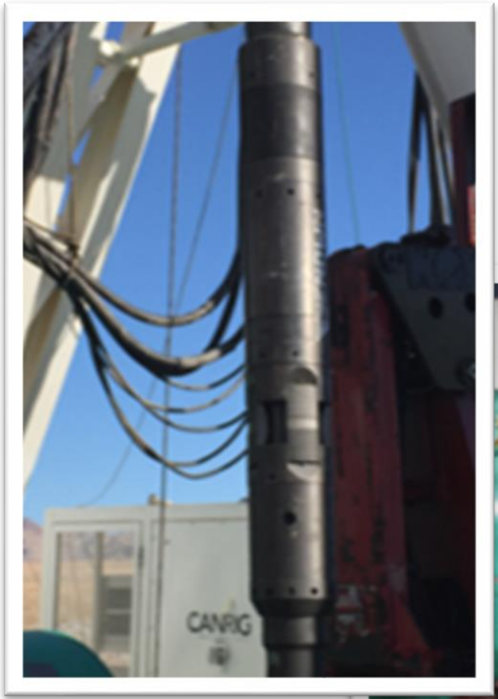
Chronology

- Run 1: Packer run to 7325 ft, tool would not shift
- Run 2: Packer run to 7,974 ft. The tool failed. Ball did not seat, and tool did not shift
- Run 3: Packer set at 8458 ft, but did not seal

Reservoir Surveillance: DFIT

Chronology

- Run to 10,610’ setting depth and drop ball to set
- Packer did not seal
- Continued with a dead string: low rate microfrac, DFIT with shut-in, DFIT with flowback, and DFIT with annulus open
- Packer released with some difficulty and successfully retrieved



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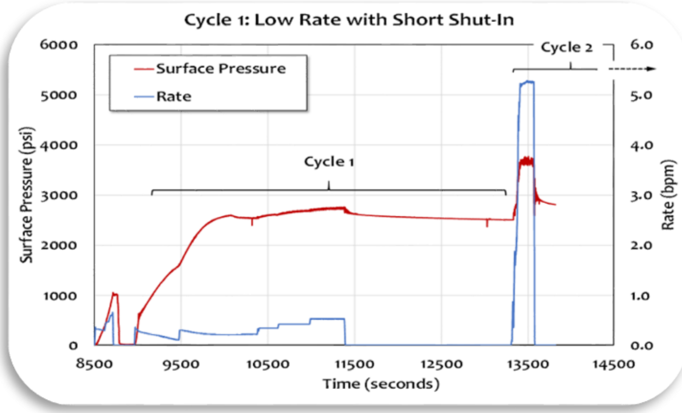
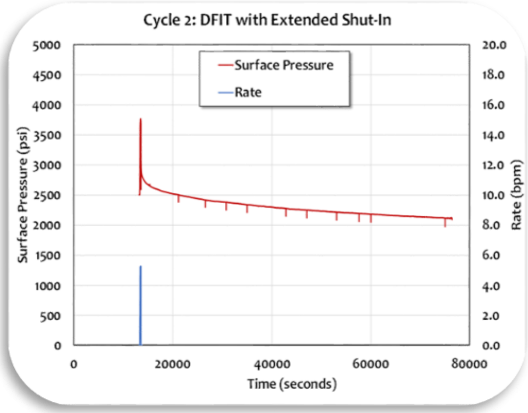
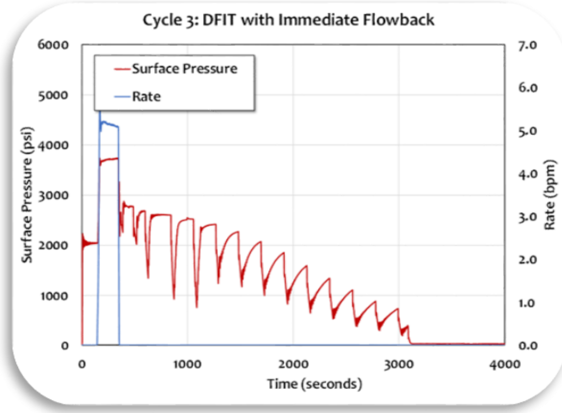
Reservoir Surveillance: DFIT

DFIT (Diagnostic Fracture Injection Test)







- Acquired quality injection data
- Applicable for calibrating logging predictions of in-situ stress
- Easily treatable (at least in openhole) consistent with previous experience
- Permeability lower than in offset well
- Further demonstration of the viability of flowback data

UTAH FORGE U.S. Department of Energy

Well 16A(78)-32 as Part of FORGE Research Agenda

- Platform for optimizing drilling technologies in directional setting (technologies and workflows)
- Platform completed for future stimulation at the toe
- Platform completed for future R&D deployment
- Comprehensive data set for stimulation design and R&D implementation
- Demonstration/confirmation of technology gaps

References Soon Available and Ongoing Work

- Winkler, D. and Swearingen, L. 2021. FORGE Well 16A(78)-32: EOWR and Lessons Learned, February.
- McLennan, J. 2021. 16A(78)-32 End of Well Report, March.
- Xing, P. 2021. DFIT Analysis for Well 16A(78)-32, March.
- Ongoing research by Prof. Sam Noynaert, Prof. Fred Dupriest, Alkassoum Toure, Paul Ofoche, Texas A&M University
- Ongoing research by Dr. David Raymond and team at Sandia National Laboratory
- ….

Utah FORGE Update

Lauren Boyd, EGS Program Manager
Geothermal Technologies Office

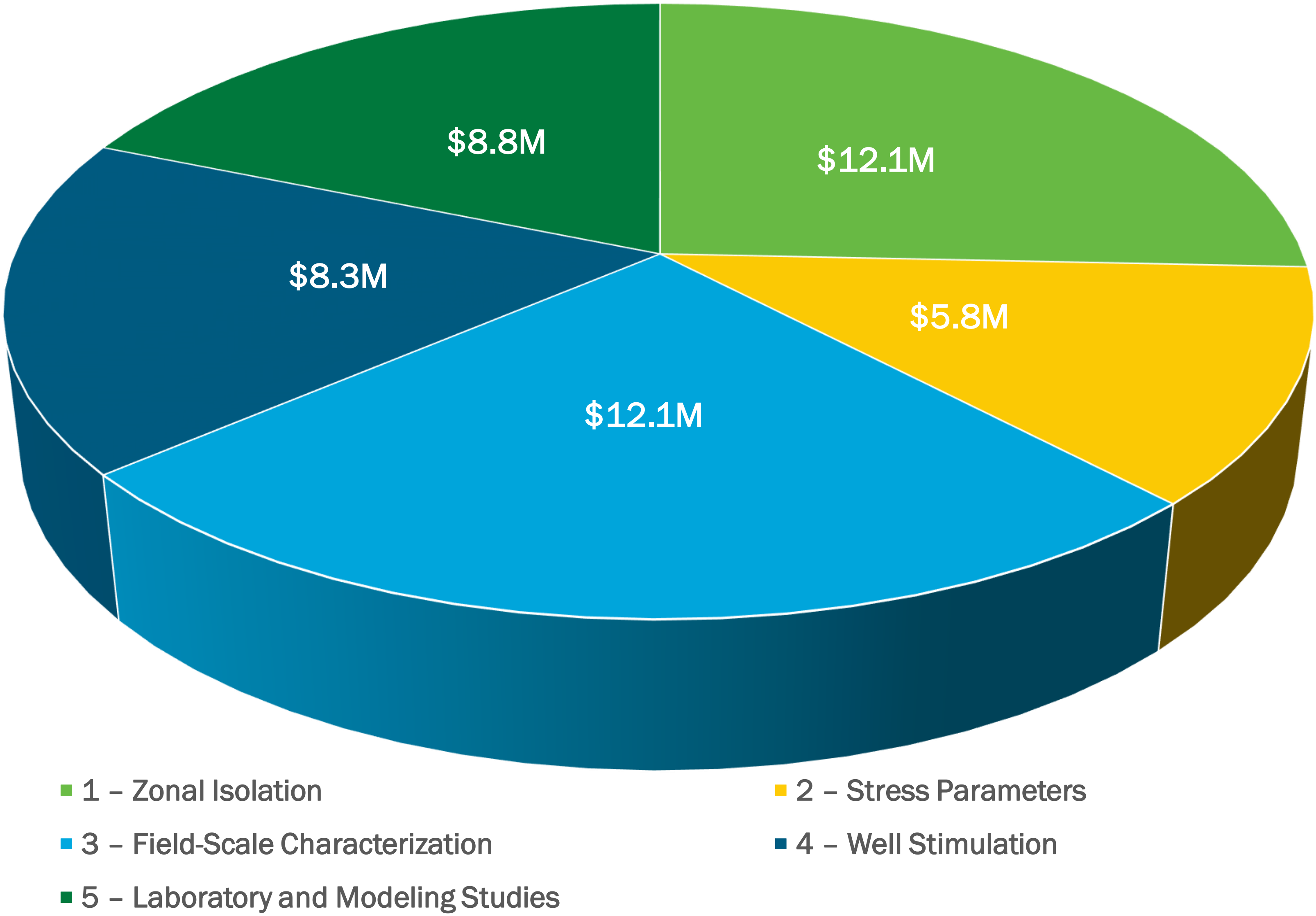
2020 FORGE Activities

Photo Credit: Eric Larson

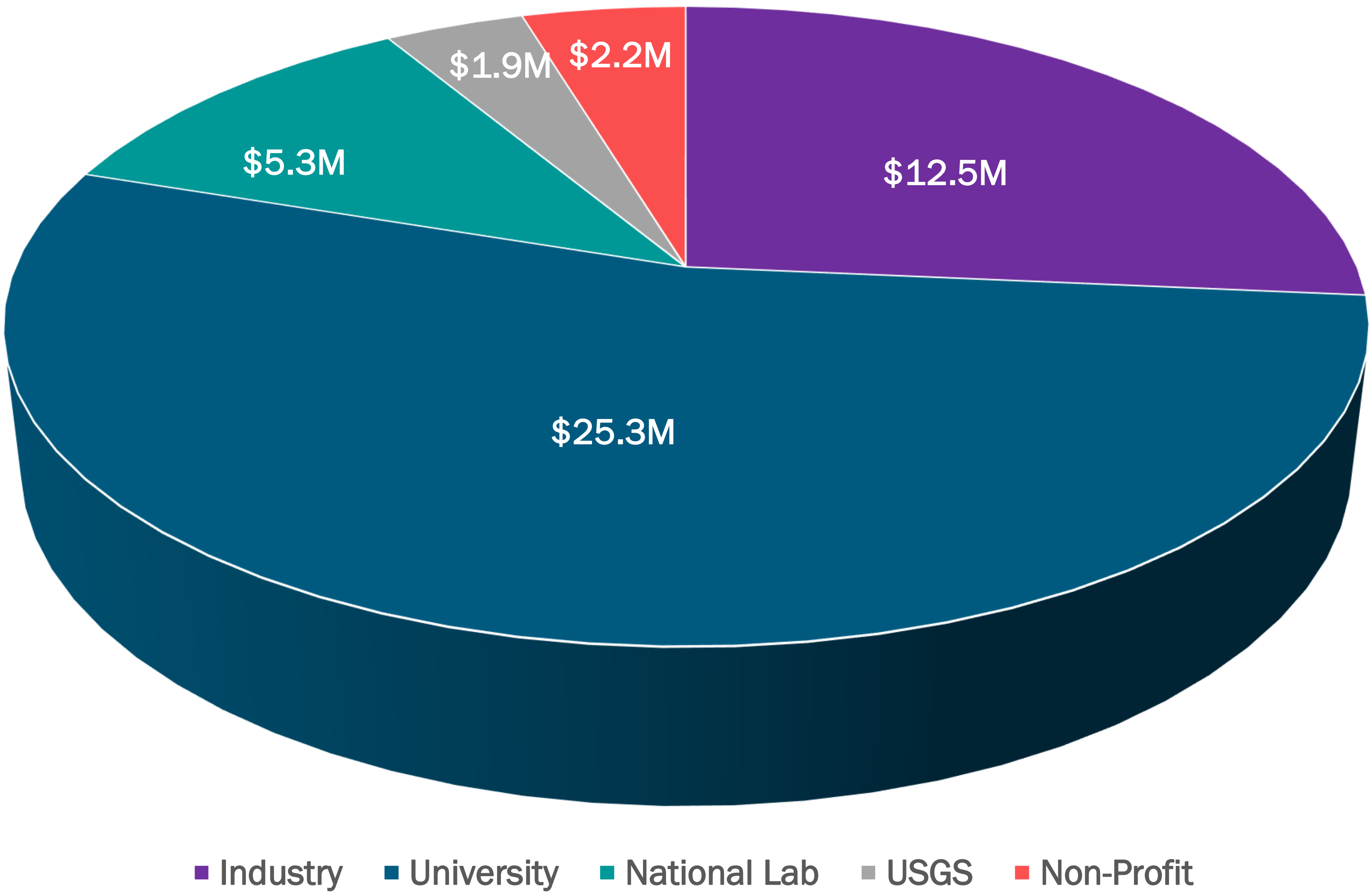
Utah FORGE Solicitation 2020-1 Summary

Topic Area	Anticipated Funding Level	Anticipated Number of Awards	Number of Awards Recommended for Selection
1 – Zonal Isolation	$12M	1 to 3	3
2 – Stress Parameters	$3M	1 to 3	3
3 – Field-Scale Characterization	$8M	1 to 4	4
4 – Well Stimulation	$12M	1 to 3	2
5 – Laboratory and Modeling Studies	$11M	1 to 6	5
TOTAL	**$46M**	**6 to 19**	**17**

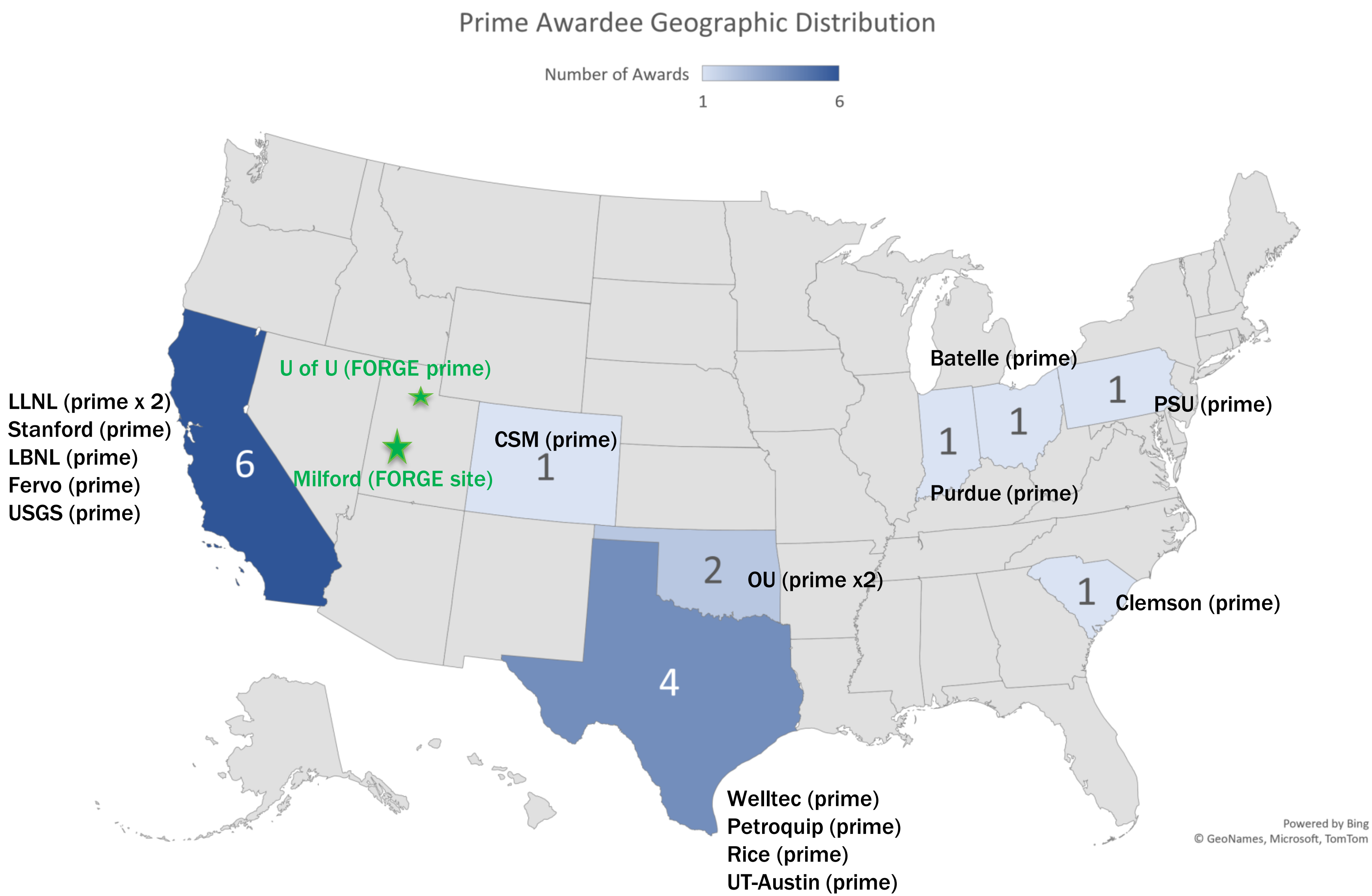
Estimated Negotiated Funding by Topic Area



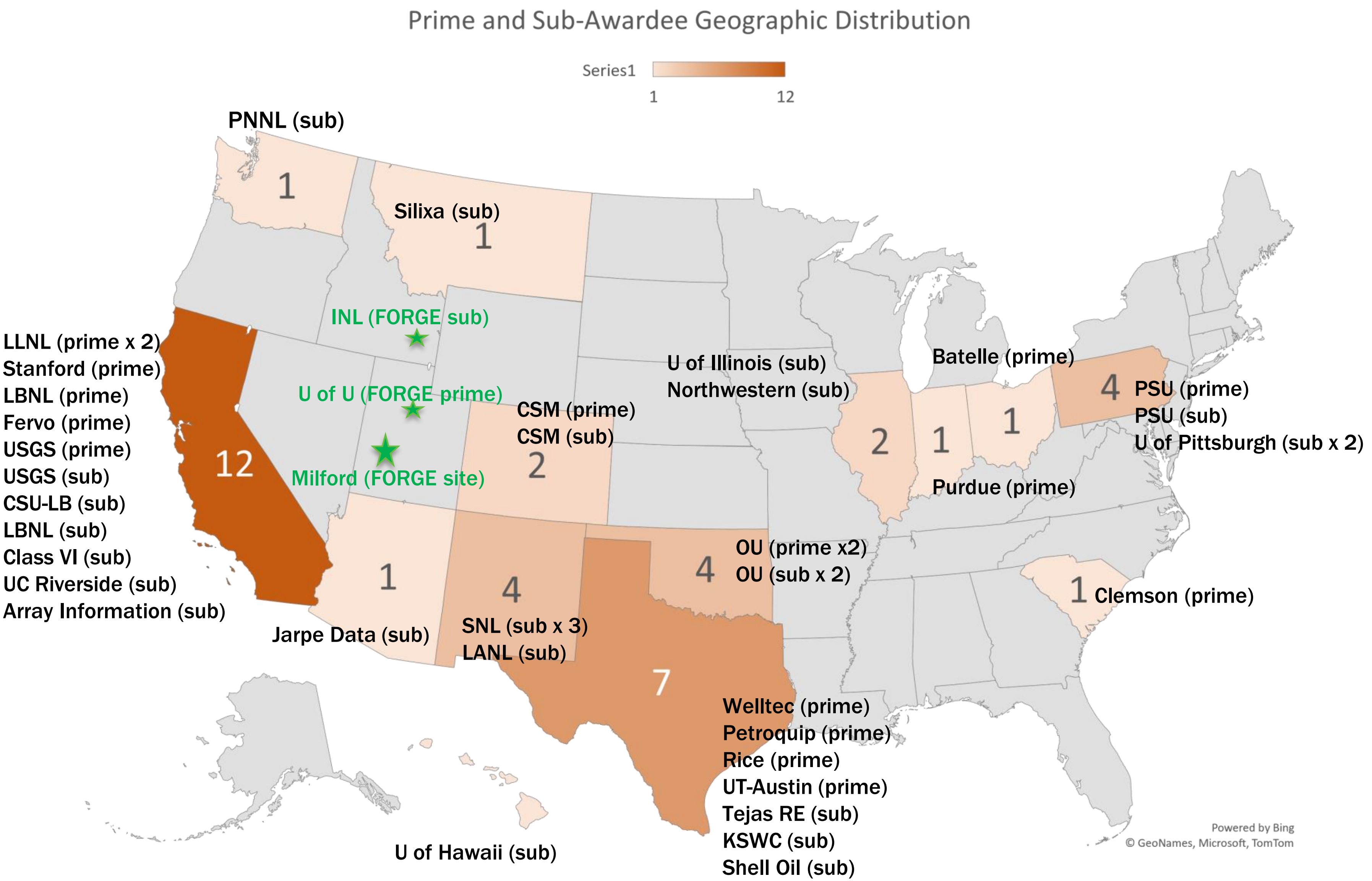
Estimated Negotiated Funding by Prime/Subcontractor Type



Prime Awardee/Subcontractor Geographic Distribution



Prime Awardee/Subcontractor Geographic Distribution



Detail on Projects Recommended for Selection

Topic Area	Prime Awardee	Project Title
1	Welltec	Development of a Smart Completion & Stimulation Solution
1	Petroquip Energy Services, LLC	Zonal Isolation Solution for Geothermal Wells
1	Colorado School of Mines	Development of Multi-Stage Fracturing System and Wellbore Tractor to Enable Zonal Isolation During Stimulation and EGS Operations in Horizontal Wellbores
2	Battelle Memorial Institute	Battelle - FORGE Topic 2
2	Lawrence Livermore National Laboratory	Closing the Loop Between In-Situ Stress Complexity and EGS Fracture Complexity
2	The University of Oklahoma	Application of Advanced Techniques for Determination of Reservoir-Scale Stress State at FORGE
3	Clemson University	A Strain Sensing Array to Characterize Deformation at the FORGE Site
3	Stanford University	Wellbore Fracture Imaging Using Inflow Detection Measurements
3	Lawrence Berkeley National Laboratory	Joint Electromagnetic/Seismic/InSAR Imaging of Spatial-Temporal Fracture Growth and Estimation of Physical Fracture Properties During EGS Resource Development
3	Rice University	Fiber-Optic Geophysical Monitoring of Reservoir Evolution at the FORGE Milford Site

Detail on Projects Recommended for Selection (continued)

Topic Area	Prime Awardee	Project Title
4	Fervo Energy Company	Optimization and validation of a plug-and perf stimulation treatment design at FORGE
4	The University of Texas at Austin	Design and Implementation of Innovative Stimulation Treatments to Maximize Energy Recovery Efficiency at the Utah Forge Site
5	Pennsylvania State University	Seismicity-Permeability Relationships Probed Via Nonlinear Acoustic Imaging
5	Lawrence Livermore National Laboratory	Coupled Investigation of Fracture Permeability Impact on Reservoir Stress and Seismic Slip Behavior
5	U.S. Geological Survey	Evolution of Permeability and Strength Recovery of Shear Fractures under Hydrothermal Conditions
5	The University of Oklahoma	Experimental Determination, and Modeling-Informed Analysis of Thermo-Poromechanical Response of Fractured Rock for Application to FORGE
5	Purdue University	Role of Fluid and Temperature in Fracture Mechanics and Coupled THMC Processes for Enhanced Geothermal Systems

State and Local Planning for Energy (SLOPE)

Sean Porse, DMA Lead Analyst
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Megan Day, Senior Energy Planner
National Renewable Energy Laboratory

U.S. DEPARTMENT OF
ENERGY

Office of
ENERGY EFFICIENCY &
RENEWABLE ENERGY

The State and Local Planning for Energy (SLOPE) Platform

Megan Day -- Senior Energy Planner, National Renewable Energy Laboratory

Kevin McCabe – Researcher, National Renewable Energy Laboratory

What is the State and Local Planning for Energy (SLOPE) Platform?

- A collaboration between **nine** Department of Energy (DOE) **technology offices** and the National Renewable Energy Laboratory
- A platform to enable more **data-driven state and local energy planning** by integrating dozens of distinct sources of energy efficiency, renewable energy, and (coming later in 2021) sustainable transportation data and analyses
- An **easy-to-access, online platform** supporting state and local energy planning and decision making with over 8,400 visits in FY20

gds.nrel.gov/slope

What questions can SLOPE answer?

gds.nrel.gov/slope

Consumption
What are the current and projected electricity consumption and expenditures by sector in my jurisdiction?

Efficiency
What is the energy efficiency savings potential and what are the most cost-effective measures for single-family homes in my state?

Renewables
What is the comparative generation potential of 14 renewable energy technologies in my jurisdiction compared to surrounding jurisdictions?

Sustainable Transportation (coming soon)
What could future electricity and fuel consumption and vehicle miles traveled look like under different scenarios?

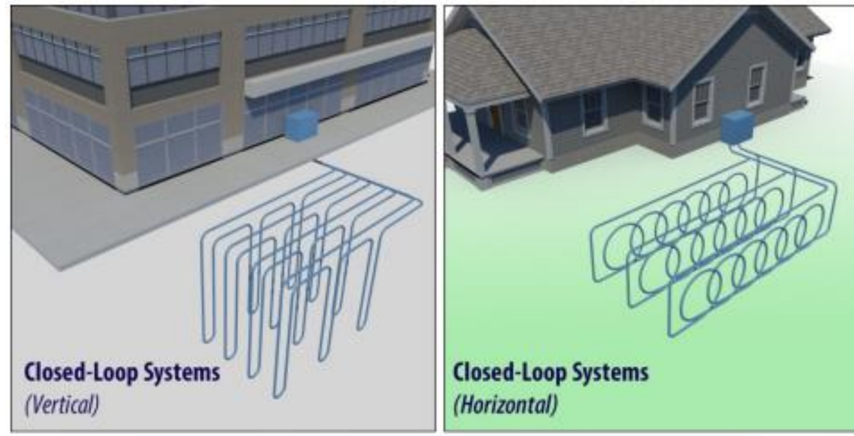
Cost of Energy
How do the costs of utility-scale and distributed renewables, fossil fuel, storage, and efficiency compare in my jurisdiction?

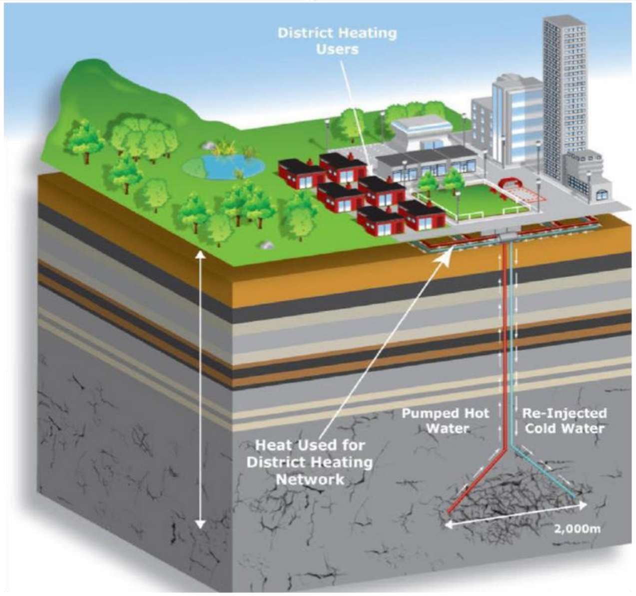
Generation Scenarios
What could the mix of renewables and fossil fuel generation on my grid look like under different scenarios?

Geothermal Datasets in SLOPE

Geothermal heat pump (GHP) and existing geothermal district heating (GDH) economic potential estimates leverage analysis completed for the Geothermal Vision (GeoVision) Study.

The Distributed Geothermal Market Demand (dGeo) model was developed specifically for the study to explore the potential role of geothermal distribution energy resources in meeting thermal energy demands in the United States.





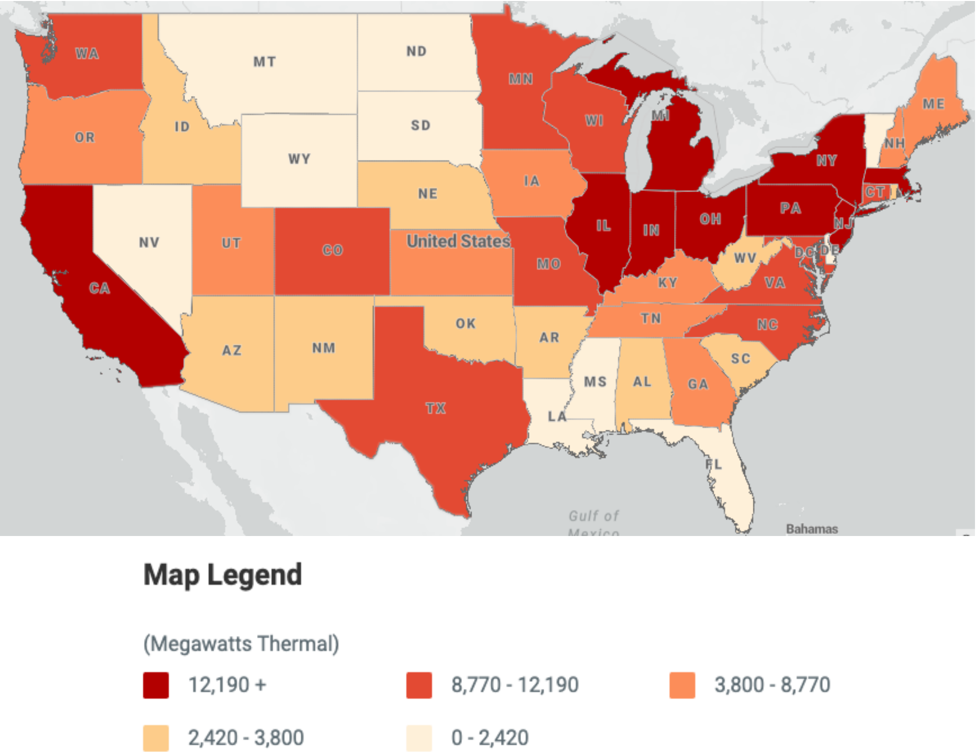
Geothermal Heat Pump Economic Potential

GHP economic potential was modeled using several different parameters and inputs, including:

- Resource assumptions (ground thermal conductivity)
- Cost and performance variables (capex, opex, efficiency improvements)
- Fuel costs (cost to operate traditional HVAC equipment, such as natural gas, fuel oil, etc.)
- Projected building and thermal load growth

Detailed cashflow analysis was conducted to determine economic metrics for GHP systems in the residential and commercial sectors. Systems with a positive net present value (NPV) were considered "economic."

The sum of all economically viable systems represents the economic potential.



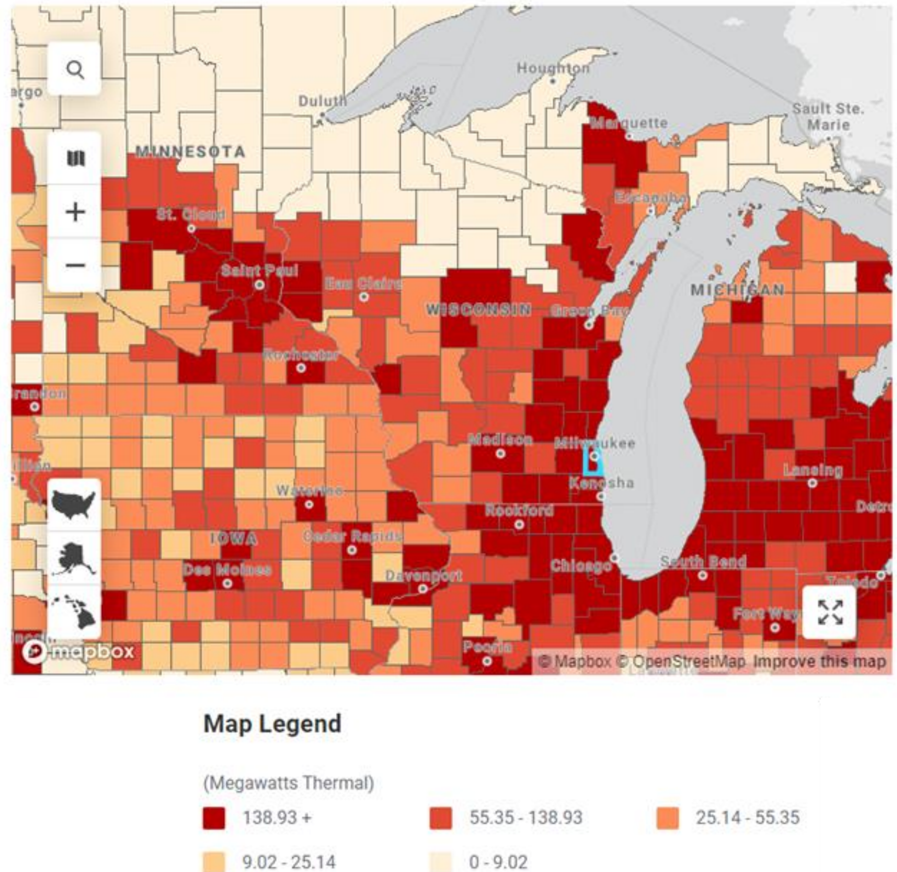
Geothermal Heat Pump Economic Potential
(Milwaukee, WI)

SLOPE indicates that Milwaukee County has comparatively high economic potential for geothermal heat pumps.

Replacing natural gas heating with geothermal heat pumps could support Milwaukee's greenhouse gas reduction goals.

Replacing electric air conditioning with geothermal heat pumps could reduce Milwaukee's high electricity costs.

Geothermal Heat Pump Economic Potential by county



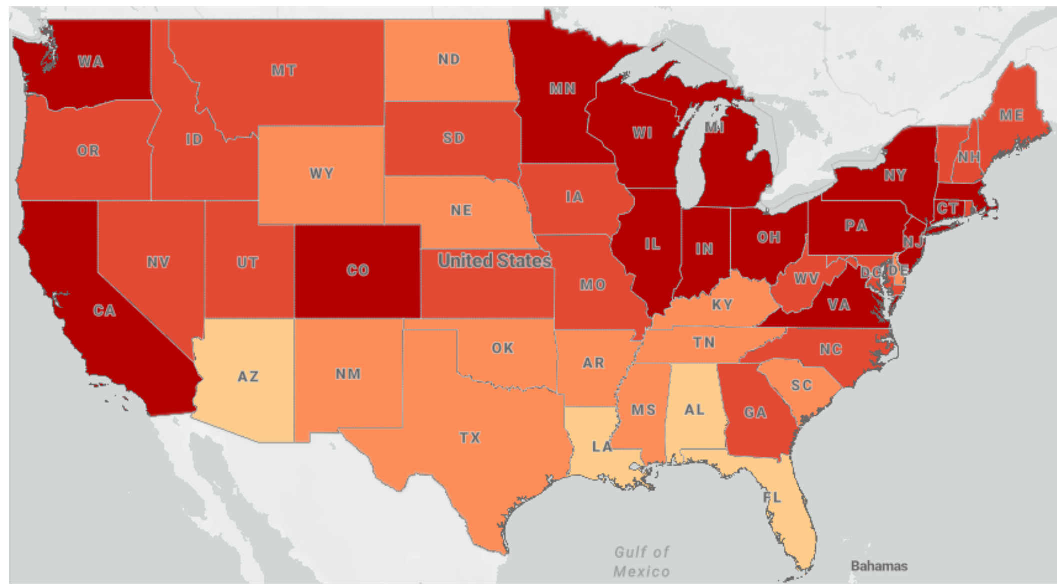
Existing Geothermal District Heating Economic Potential

To support the GeoVision study, the dGeo model also simulated the economic potential for “existing” GDH systems.

Existing communities evaluate the economic feasibility of installing a GDH system by considering both the availability of a shallow, low-temperature geothermal resource and the proximity of a demand center that can utilize this supply.

Detailed levelized cost analysis included significant capital costs for resource exploration, drilling wells, and distribution networks, in comparison with the levelized cost of traditional heating fuels. Supply and demand curves were constructed to determine the amount of economically viable geothermal capacity that could provide district heating for communities.

Geothermal District Heating Economic Potential in Existing Buildings by State (2050)



Map Legend

(MWth)

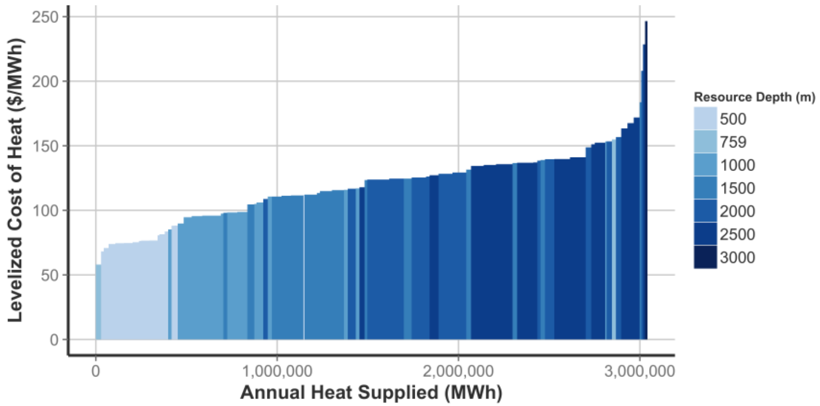
- 2,644 +
- 730 - 2,644
- 80 - 730
- 0 - 80

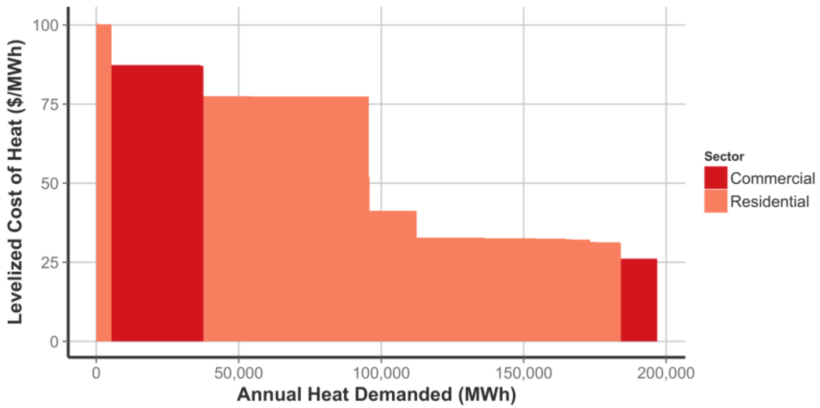
Geothermal District Heating in New Construction

The construction of a GDH system is a massive infrastructural effort. While the economic potential of GDH for existing buildings and communities showed promise, in practice, retrofitting a community to use a GDH system is nearly unheard of. The cost and effort required is simply too high.

This new analysis utilizes a dataset that gives Census tract-level projections of building growth through 2050 as an "analog" for new community development.

Demand curves were created that represent the additional thermal demand and levelized cost of heat for these new communities. When intersected with the supply curve of available geothermal resources, the amount of economically viable geothermal capacity (economic potential) can be estimated.





Gleason, M., K.McCabe, M. Mooney, B. Sigrin, and X. Liu. 2017. The Distributed Geothermal Market Demand Model (dGeo): Documentation (NREL/TP-6A20-67388). Golden, CO: National Renewable Energy Laboratory. https://www.nrel.gov/docs/fy18osti/67388.pdf.

Geothermal District Heating in New Construction

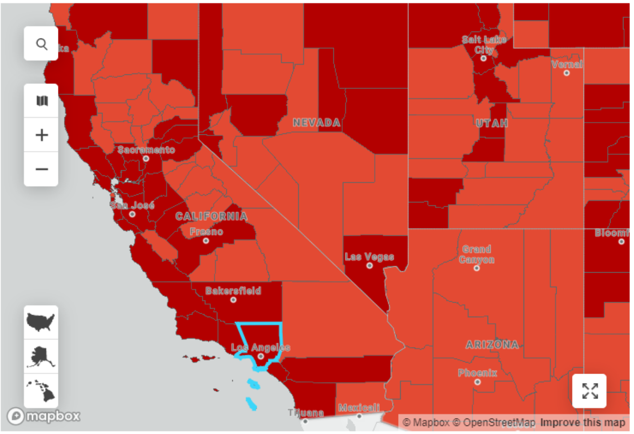
Economic Potential (Los Angeles County, CA)

In Los Angeles County, CA, the expected new community growth, in combination with available low-temperature geothermal resources, results in several MW_{th} of economic potential.

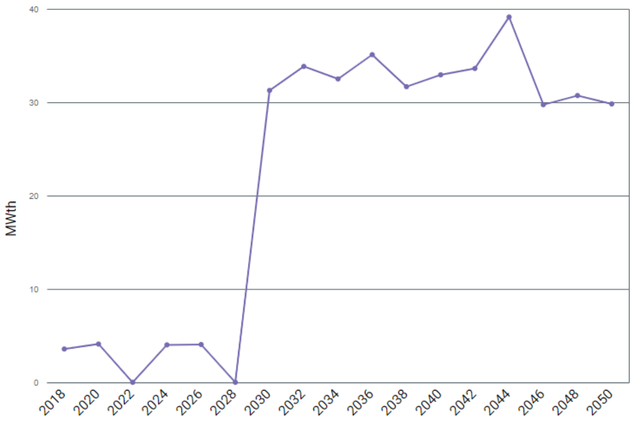
The GeoVision study assumed that Enhanced Geothermal Systems (EGS) could become commercially viable in 2030—this massive resource base adds more potential to the estimate for L.A. County into the future.

The variability of the economic potential estimate in the time series graph is a function of the multidimensional nature of the model inputs. The assumed new building/community growth, cost and performance variables, fuel price volatility, thermal load growth, and many other datasets combine to result in a variable output of economic potential over time.

Geothermal District Heating Economic Potential in New Construction by County



Geothermal District Heating Economic Potential in New Construction by County



Map Legend

(MWth)

0.16 +

0 - 0.16

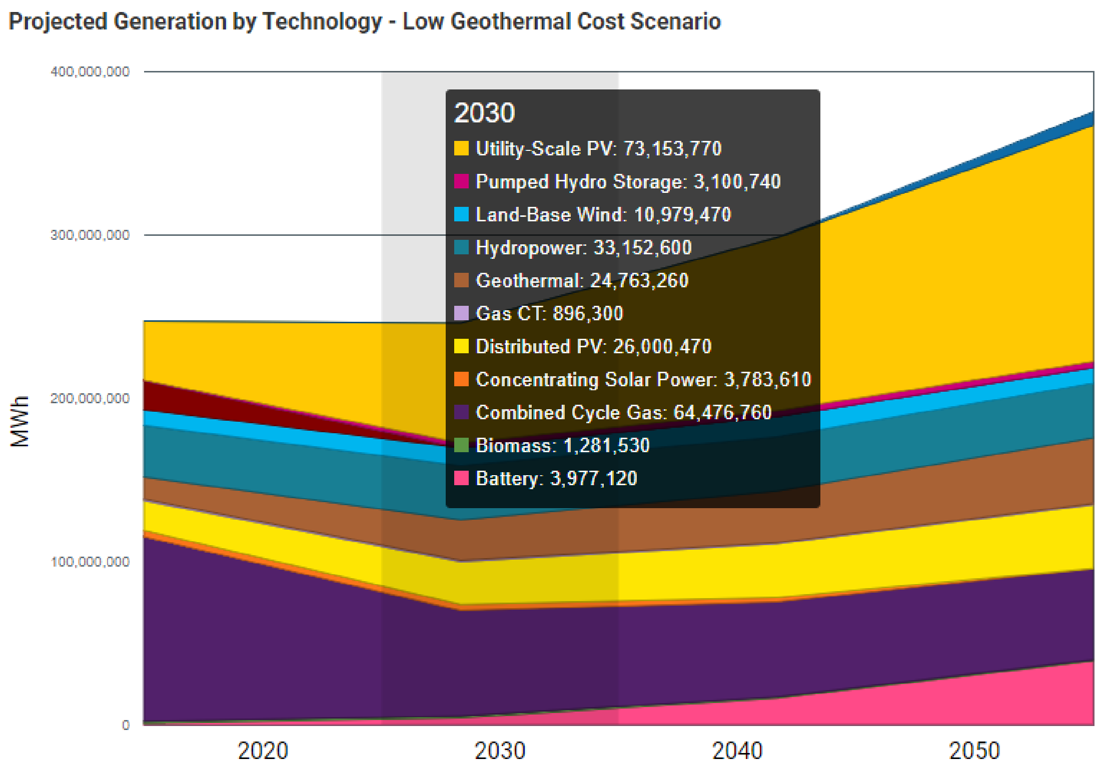
Data Filters ⓘ

Capacity MWth

Electricity Generation Projections
(California)

SLOPE delivers Standard Scenarios to help illustrate the potential grid mix of electricity generation sources.

Under a Low Geothermal Cost Scenario, California is projected to generate 40,376 GWh of electricity from geothermal sources by 2050.



Questions?

Thank you!

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Student Competitions

Elisabet Metcalfe, Acting Stakeholder Lead
Geothermal Technologies Office

Fall 2020 Geothermal Design Challenge

Nine multi-disciplinary teams developed infographics on a geothermal theme of their choice.

First Place: University of North Dakota, Thermal Vision

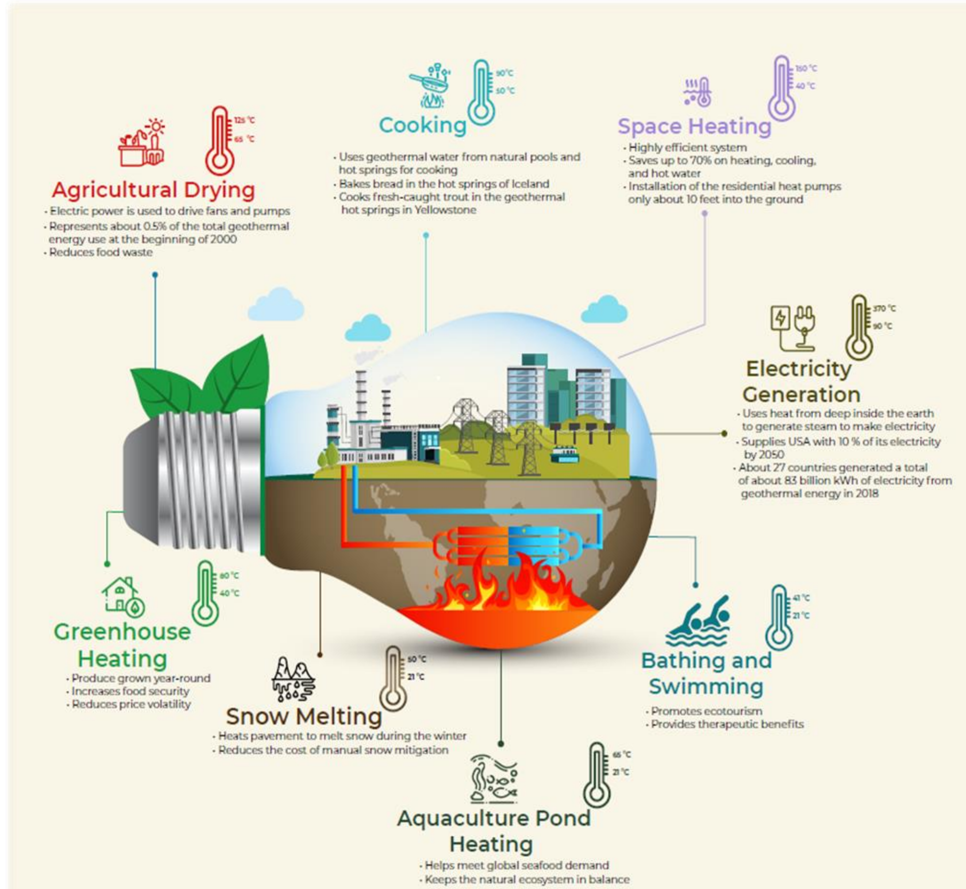
- Submission: "Geothermal Applications for the World”

Second Place: University of California Santa Cruz, Geo Slugs

- Submission: "Green & Unseen: The Future of Geothermal Power”

Third Place: Antelope Valley College (Lancaster, CA)

- Submission: "The Heat Beneath Our Feet”



Fall 2020 Winner: University of North Dakota, Thermal Vision

Spring 2021 Collegiate Competition

- Multidisciplinary student teams will compete for national recognition and cash prizes with creative concepts directly leveraging geothermal energy to heat and cool buildings, campuses, districts, or communities.
- Students gain real-world renewable energy industry experience designing a use case, performing a resource assessment, and evaluating usage and loads.

Questions?

We always welcome your feedback.
DOE.geothermal@ee.doe.gov

The **Geothermal Technologies Office (GTO)** works to reduce the cost and risk associated with geothermal development by supporting innovative technologies that address key exploration and operational challenges.

Visit us at: www.energy.gov/eere/geothermal