FUELING THE FUTURE: THE LATEST IN GEOTHERMAL INNOVATION

GREENFIRE ENERGY
power to the planet.
November 2024

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DEVELOPING A GLOBAL PORTFOLIO OF PROJECTS

NORTH AMERICA

ThinkGeoEnergy

GreenFire Energy awarded funding for demonstration project at The Geysers

The California Energy Commission has awarded $2.7 million to GreenFire Energy Inc. for demonstration of its geothermal GreenLoop technology...

JPT Society of Petroleum Engineers (SPE)

Hot Prospects: Good News Keeps Flowing for These Four Geothermal Firms

The latest signs that momentum is building in the geothermal space include military bases.

Apr 18, 2024

APAC

ThinkGeoEnergy

USTDA awards grant to pilot GreenFire technology in the Philippines

The USTDA has signed an award agreement with EDC for the testing of GreenFire Energy's advanced geothermal tech at one of EDC's wells in Leyte, Philippines.

Nov 13, 2023

SSA

ThinkGeoEnergy

KenGen approves GreenFire closed-loop application in Olkaria geothermal field, Kenya

GreenFire Energy has received approval from KenGen to deploy the GreenLoop technology generate power from a currently idle geothermal well in Olkaria, Kenya.

Apr 5, 2024

ThinkGeoEnergy

International team assembled to develop geothermal in Tatun Mountains, Taiwan

An international team including Taipower, TCC, Baseload Power Taiwan, and GreenFire Energy will be developing geothermal in the Tatun...

1 week ago

Energy Global

GreenFire Energy Inc. and PT Medco Power Indonesia enter MOU

GreenFire Energy has developed a versatile, closed-loop Advanced Geothermal System (AGS) called GreenLoop. GreenLoop can economically access the...

Jul 21, 2023

Revitalizing Mature Geothermal Assets with Improved Geothermal Recovery Techniques

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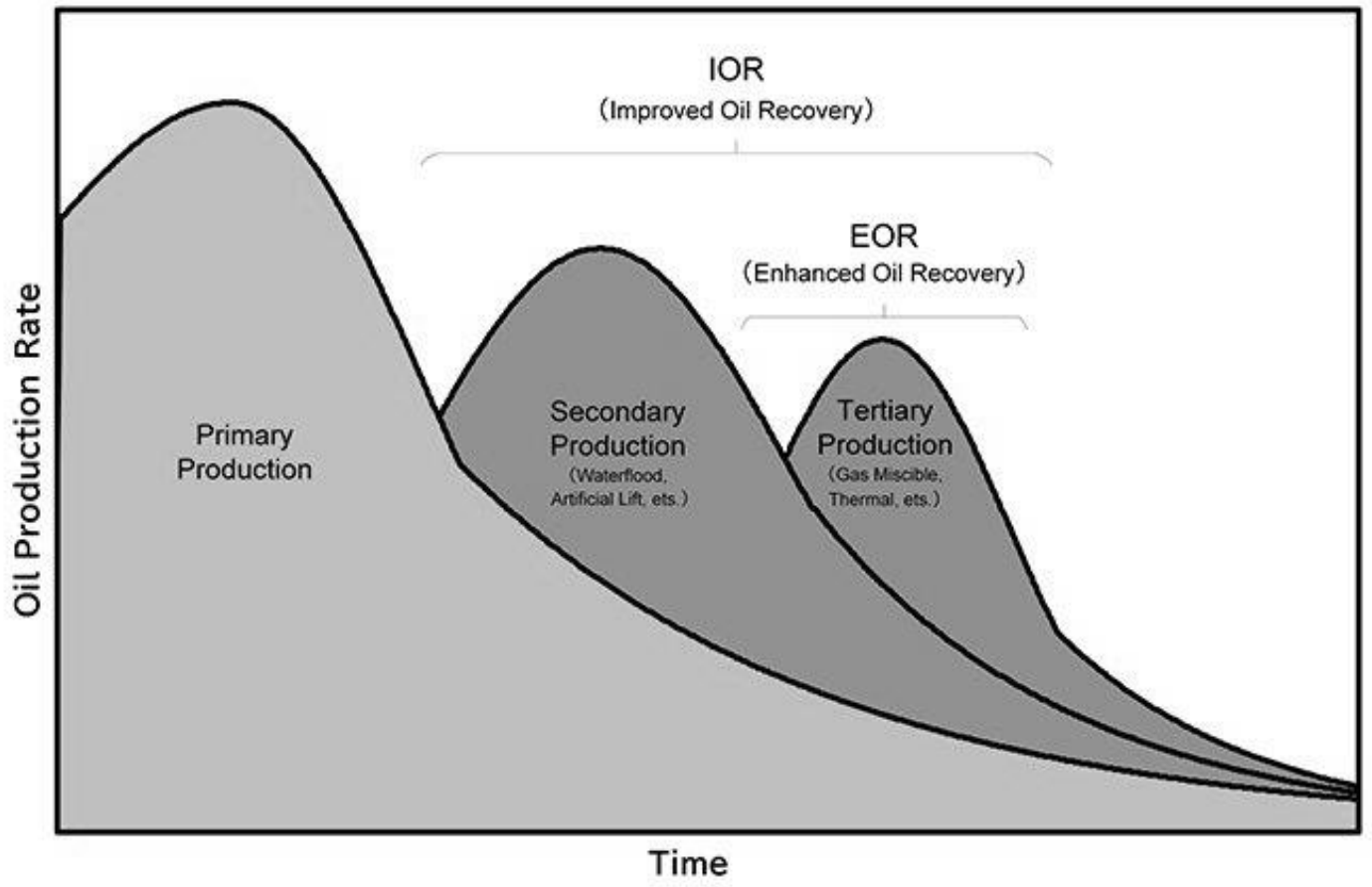
- **Improving Heat Recovery in existing geothermal assets**
  - **Downhole Heat Exchanger**
  - Water Injection/Pressure Maintenance
  - Acidizing & Stimulation
  - Artificial Lift
  - Infill Drilling

Analogous to the Oil & Gas Industry



EGS and AGS projected to grow significantly in the 2030's

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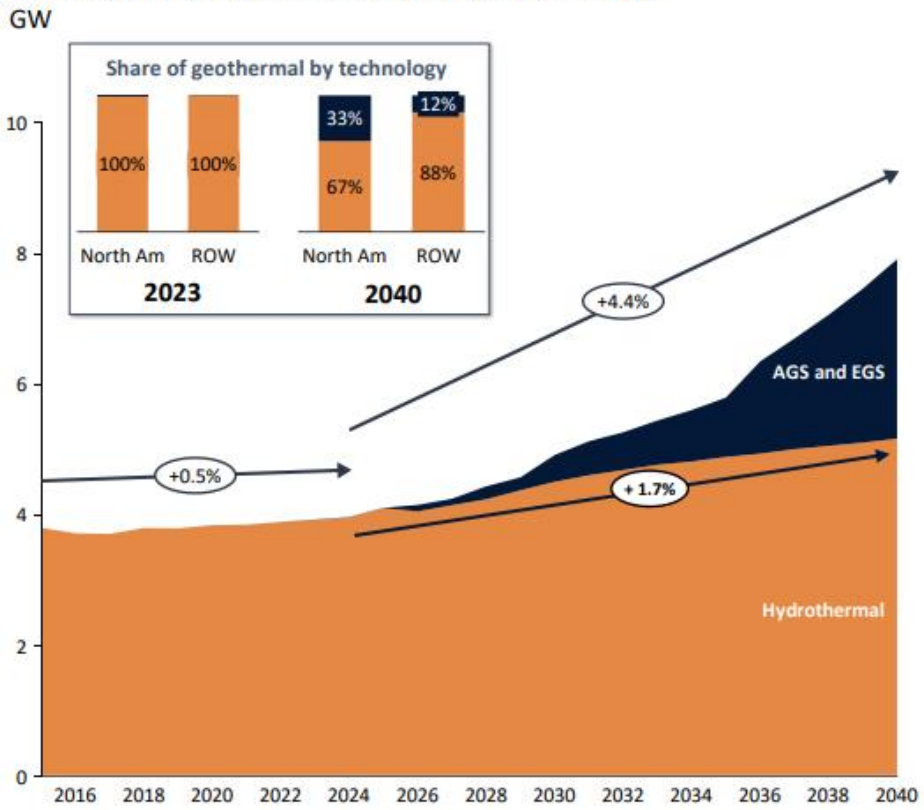
US Installed geothermal capacity by technology



Advantages of AGS and EGS over conventional geothermal

	Enhanced (EGS)	Advanced (AGS)
Siting constraint	✓ • Can access areas with hot dry rock and no naturally occuring geothermal fluids • EGS can utilize lower temperature resources, can operate below 150 C required by conventional	✓ • Highly flexible siting since adaptable to different reservoir composition, temperature and depths • Closed-loop system enables flexibility in working fluid such as supercritical CO2 • Ability to be installed installed in existing wells is large opportunity
Exploration and drilling cost	⊖ • Costly drilling requirements to 1-5 km to reach sufficient temperatures	✓ • Brownfield well use avoids surveying and drilling • Significantly higher longevity, offsetting high initial cost
Lengthy permitting	⊖ • Permitting times are longer and more complex than hydrothermal due to hydraulic fracturing • Additional regulation for federal lands in western US • Additional subsurface rights needed	✓ • **No EPA permits required** as a closed-loop systems results in no materials injection or extraction • Single well design enables small area use, avoiding need for additional subsurface rights as with U-loop system
Resource depletion	⊖ • Faster drawdown rates as artificial reservoirs cool rock more rapidly, there are typically lower reservoir volumes and no natural recharge	✓ • No extraction of materials leads to stable temperatures and long operational lifetimes
Environmental impact	⊖ • Fracking carries risk of induced seismisity • Substantial water use requirement	✓ • No induced seismicity • Low water usage, making it applicable for arid regions

Source: Rystad Energy research and analysis, Geothermal Analysis dashboard

Flexible Well Design: Steam & 2-Phase

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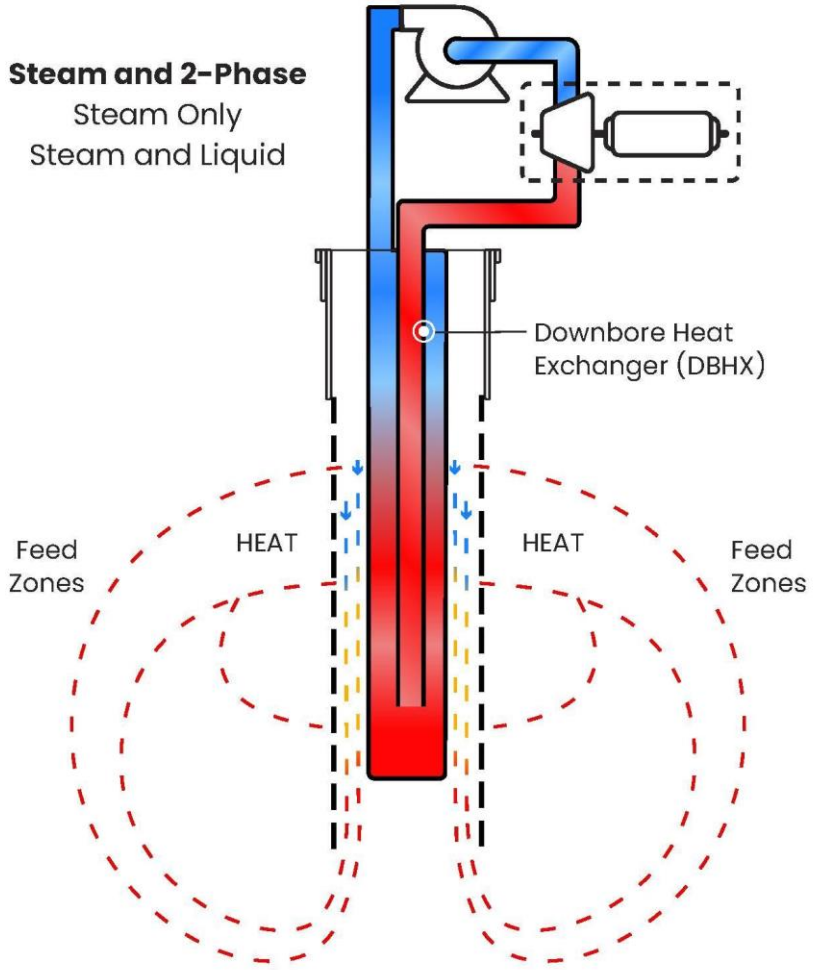
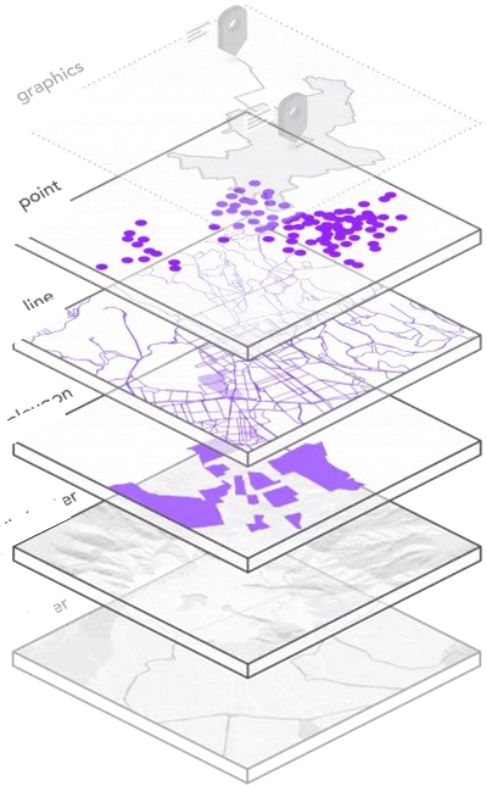
- Typically has a tube-in-tube Downbore Heat Exchanger (DBHX)
- Can use various working fluids (including ORC binary power plant fluids)
- Produces hot fluids at the surface at targeted conditions for both conventional steam flash and ORC power plants
- Condensation occurs on the DBHX releasing the latent heat of vaporization, descends, and is recycled back in the reservoir
- Working fluid temperature control sets saturation temperature and pressure that can avoid mineral deposition or scaling
- Manufactured flow systems and forced flow designs



Well and Asset Screening

The GreenFire Energy quick evaluation tool has been used to couple simple geothermal potential asset information with basic Geographical information system (GIS) wellbore and reservoir data for analytical power potential estimation.



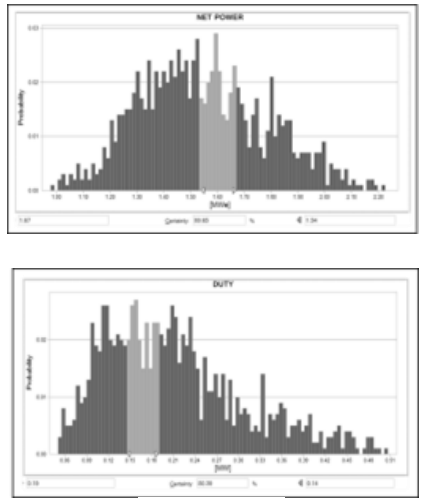
GIS data extraction process

Data & Statistic correlations

Parameter	Min	Average	Max
Reservoir Pressure			
Reservoir Transmissivity			
Reservoir Enthalpy			
Reservoir Temperature			
Feedzone Depth			

Wellbore, Pad, Geographical area of interest summary data

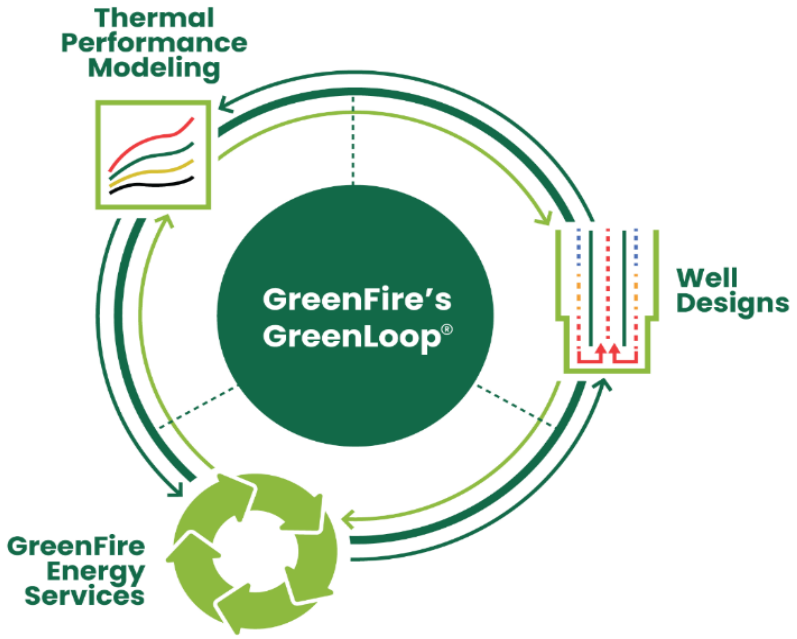
Quick evaluation Tool

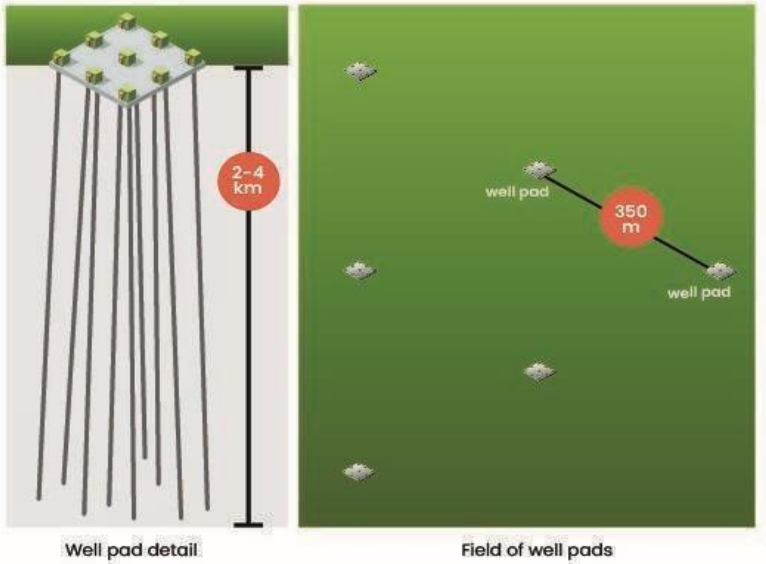


Potential

0.5 MWe to 2.0 MWe for 185C to 265C reservoir temperatures

GreenFire Detailed Engineering Approach





Thermal Performance Modeling

- Estimates the net power from a given asset
- Evaluates the potential of a given geothermal resource to determine the optimal configuration
- Sensitivity reviews of performance and operating parameters

Well Designs

- The physical attribute of the designed system including the architecture of the GreenFire AGS system, size and specification of materials, working fluid, and other site-specific requirements
- Configured to provide optimum output

GreenFire Energy Services

- Engineering services
- Construction and installation
- Operation and maintenance

Improve Production for Existing Assets:

The Geysers Demonstration Project funded by the California Energy Commission in Partnership with Calpine

Challenge

- Maximizing the resource mass in the Geyser's reservoir.

Proposed Solution

- Extract heat from the reservoir and convert to electricity at the surface to prevent further reservoir pressure decline and minimize decline
- Optimize the GreenFire AGS working fluid to ensure minimum parasitic pumping load and maximize net electric power
- Operate GreenFire AGS so that the produced hot fluids match existing surface systems

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Profile of DV-13 for DBHX Installation

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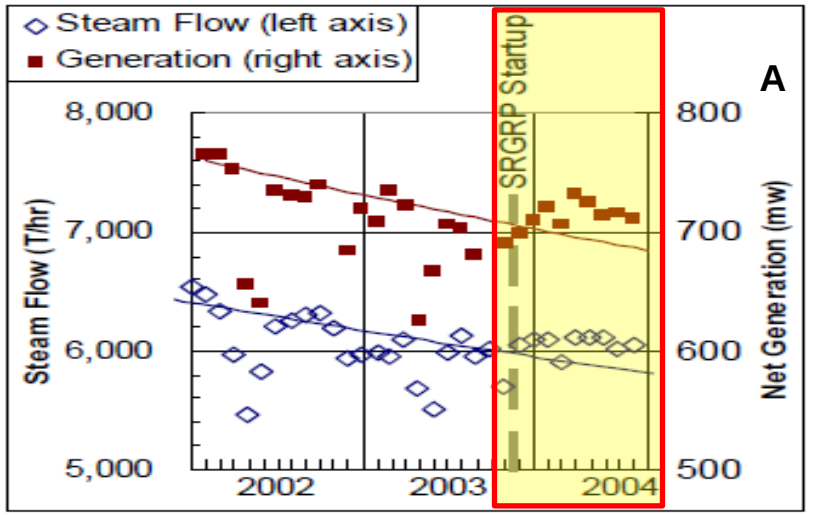
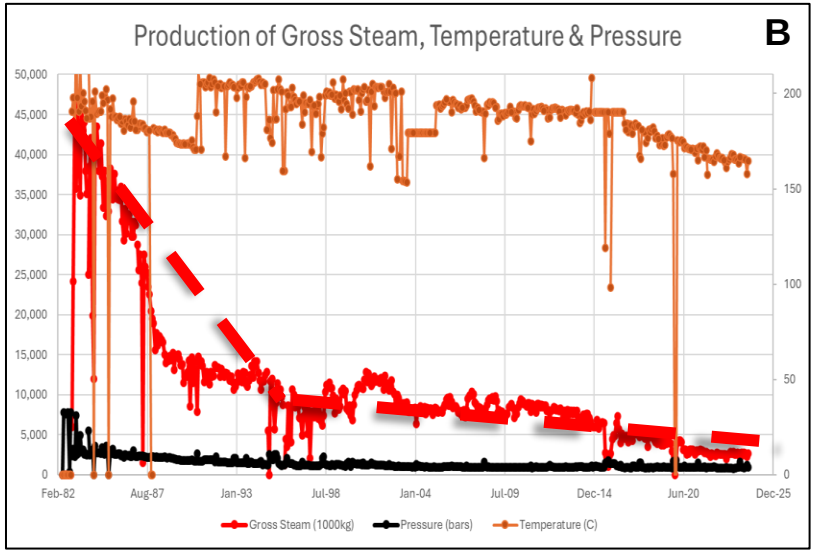
The Geysers Generation

- Over 60 years of operation with conventional technology.
- Historic decline in production and reservoir pressure.
- Historical reinjection effectiveness of about 46% (Sanyal et al., 2011).
- Stark M. et al (2005) in Fig "A" shows positive effects on the Southeast Geysers Effluent Pipeline Project (SEGEP)
- Plenty of opportunities with idle and existing wells at the Geysers



DV13 Marginal well

- See Fig "B", the production of DV-13 from1982 to 2024:
  - 56kg/hr to 3 kg/hr
  - 198C to 164C
  - 13.7 to 4.1 bars

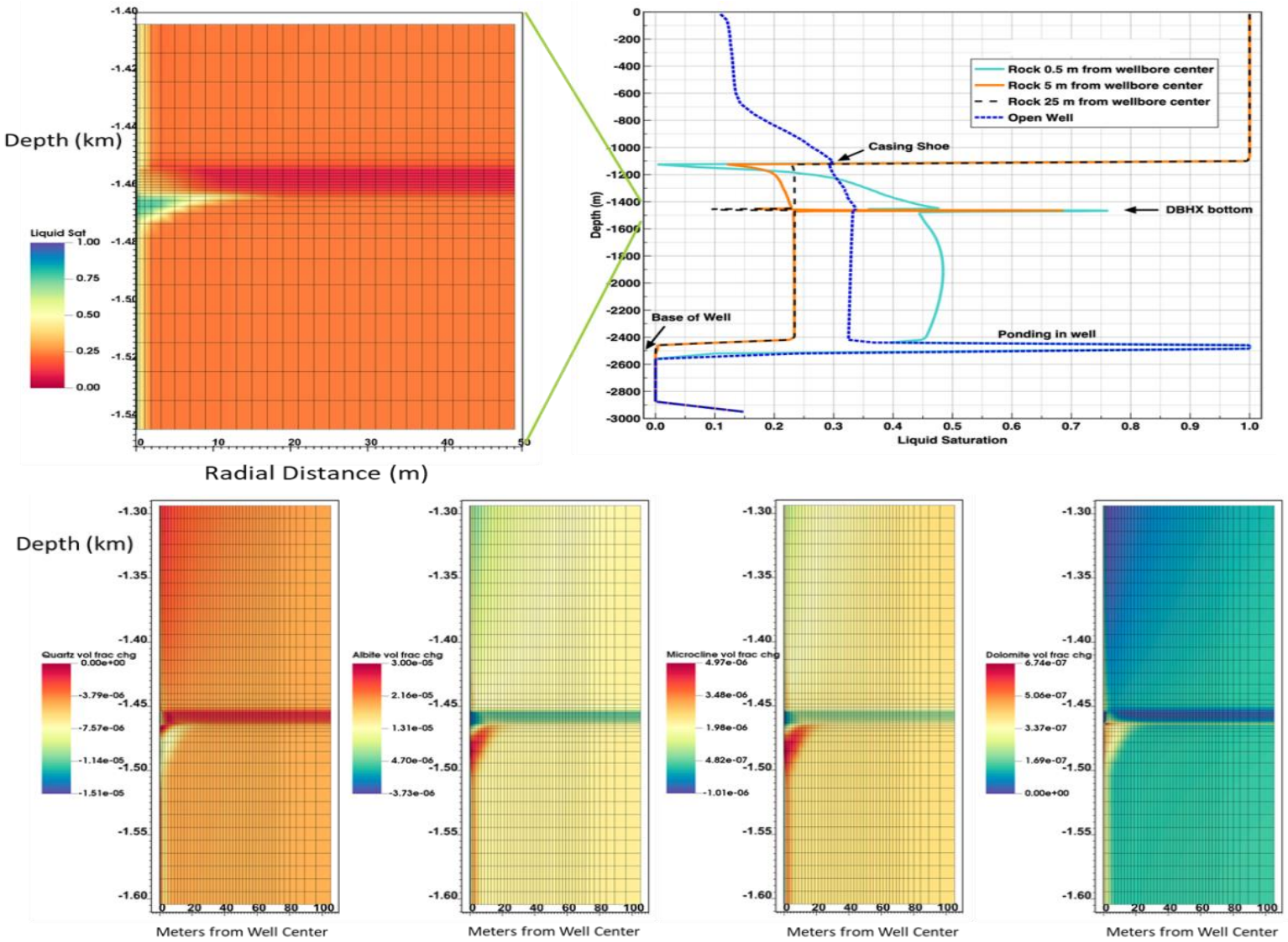


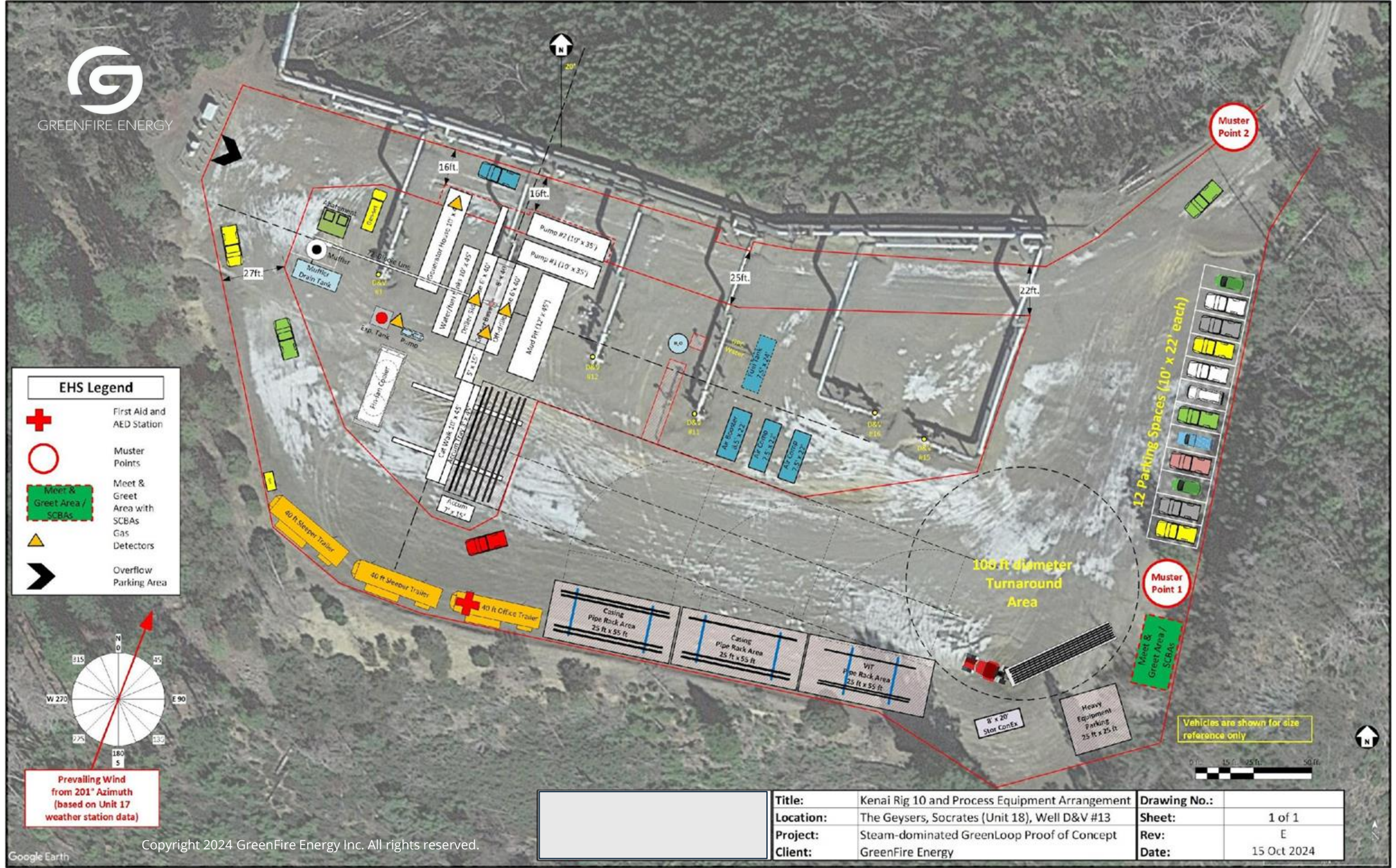
GreenFire Technology

- Downhole heat exchanger (DBHX) to increased inflow/heat extraction
- Optimal control of surface closed-loop flow rate:
- Lower saturation temperature → Reduced wellbore pressure → increase inflow
- Enhanced pressure drawdown
- Mass conservation

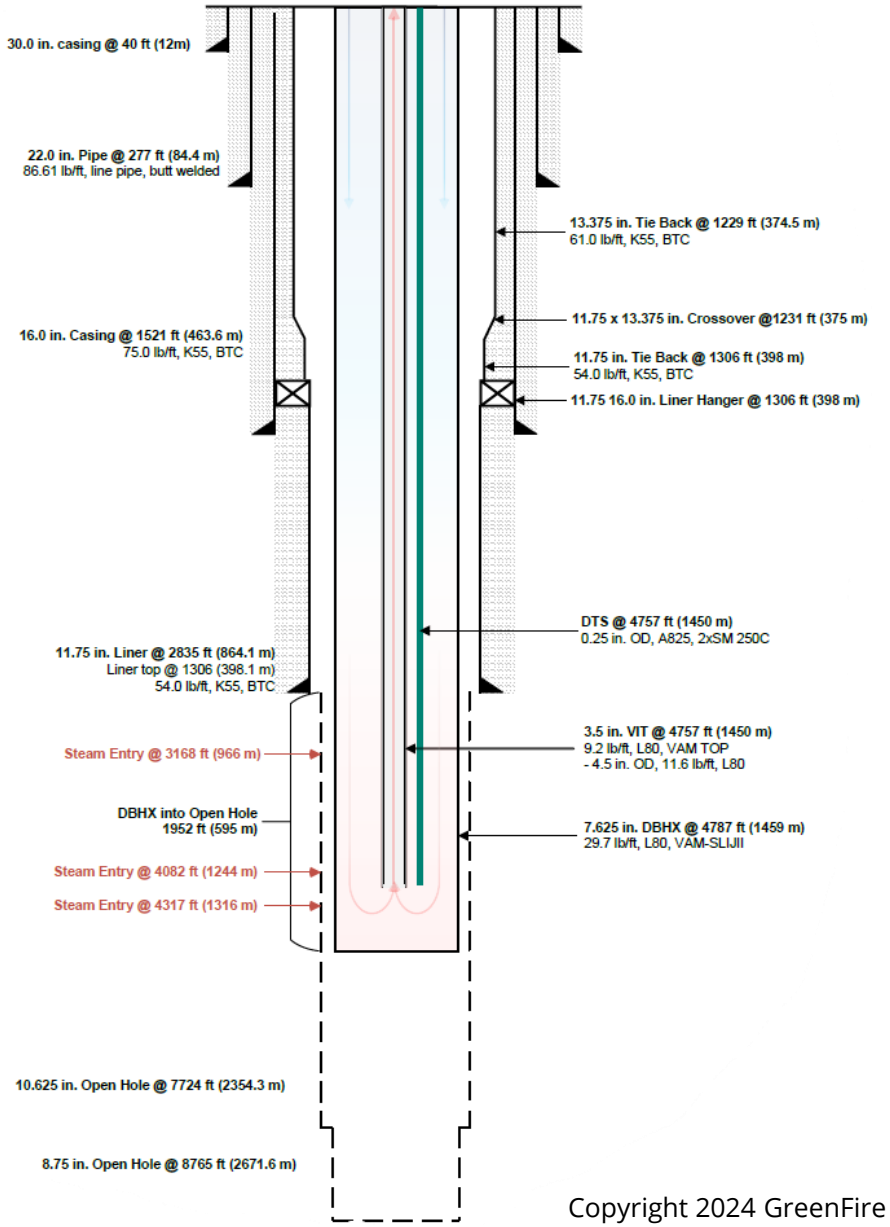
Reservoir Numerical Model

- Liquid saturation as a function of radial distance is shown in the first two figures on the right.
- Highly efficient condensation of steam from the feed zone on the DBHX is observed resulting in ponding and reinjection of condensed liquid at the bottom of the well.
- The bottom 4 plots show that the risk of scaling/solids deposition is very low around the DBHX because saturation temperature, pressure and DBHX flow can be controlled/optimized for performance and sustainable production.
- In addition, the risk of seismic events occurring is also very low.





Well Workover Conditions:



1. **Currently a Producing Steam Well**
   - 40 years +

2. **Well Workover Design Specifications:**
   a) ~4,800’ DBHX
   b) VIT with DTS Fiber run to ~4760’

3. **Risks and Contingencies Planned For**
   a) Casing Integrity will be evaluated during planned operations and as such potential casing options planned include:
      i. 7” OD DBHX casing tapered option
      ii. 9 5/8” Cladding of well to 2825’
   b) Well Control operations and variable media to used dependent on conditions encountered

GreenFire AGS Surface Test System

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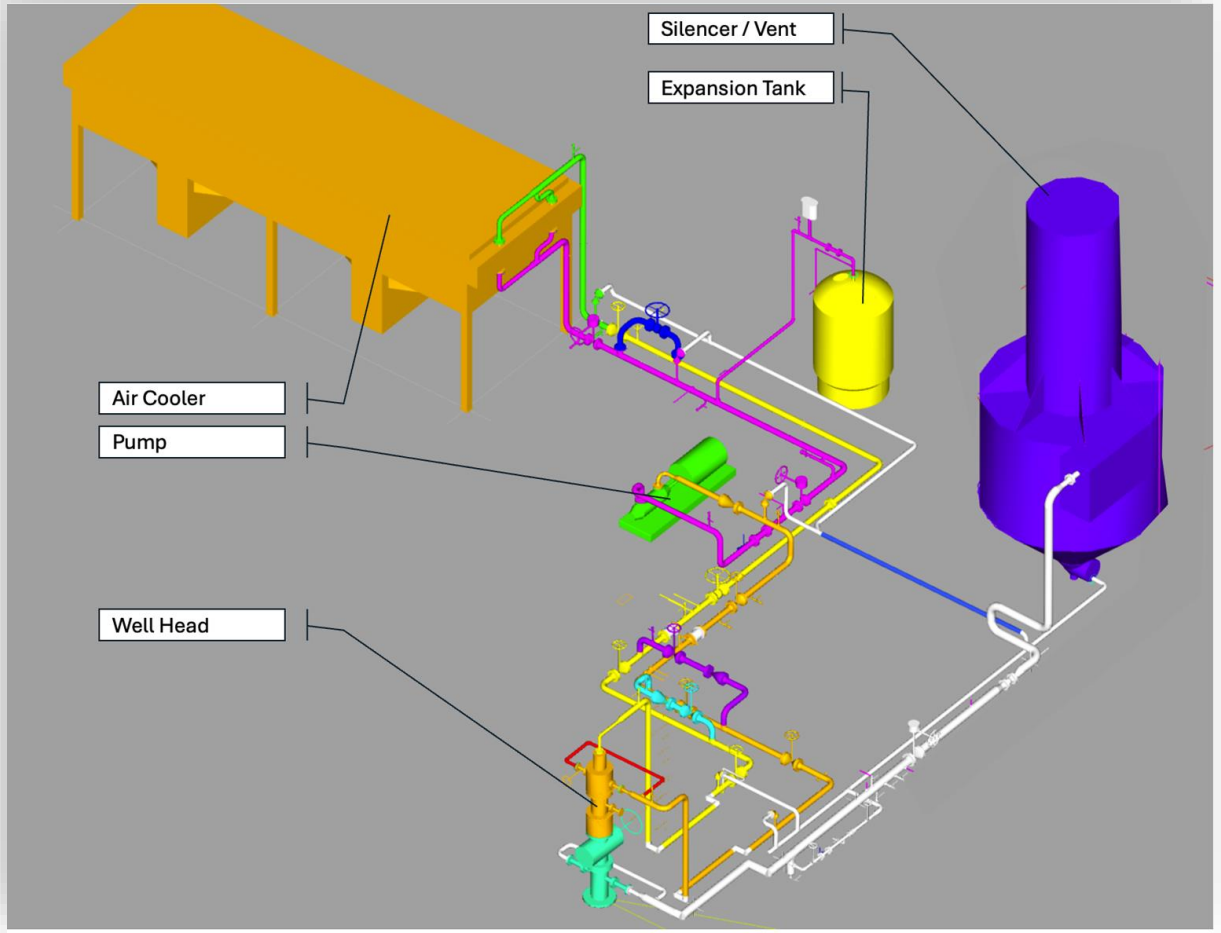
Navisworks 3D Model

- Air Cooler
- Pump
- Expansion Tank
- Instrumentation
- Piping
- Vent System



Next Steps

- Calpine offers a pre-commercial demonstration of DBHX technology
  - Planning for Installation Q4-2024
  - Commissioning Q1-2025
  - Testing to begin Q1-2025
  - Testing Complete Q2-2025
- Commercial Scale-Up with other Key Partners and Developers globally

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PREMIUM, RESILIENT POWER FOR INDUSTRY

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Scalable, **site-specific solutions for maximized energy output** by teams with subsurface oil and gas knowledge and know-how.

STRATEGIC PARTNERS & INVESTORS:

Baker Hughes
Subsurface Characterization
Accessing Reservoir Data
Construction Management
Power Plant Maintenance & Operations

HP
Automated Drilling
Large Drilling Campaigns
Capital Efficiencies

vallourec
Specialized Components
Operationalize Sustainability
International Expansion