Baker Hughes

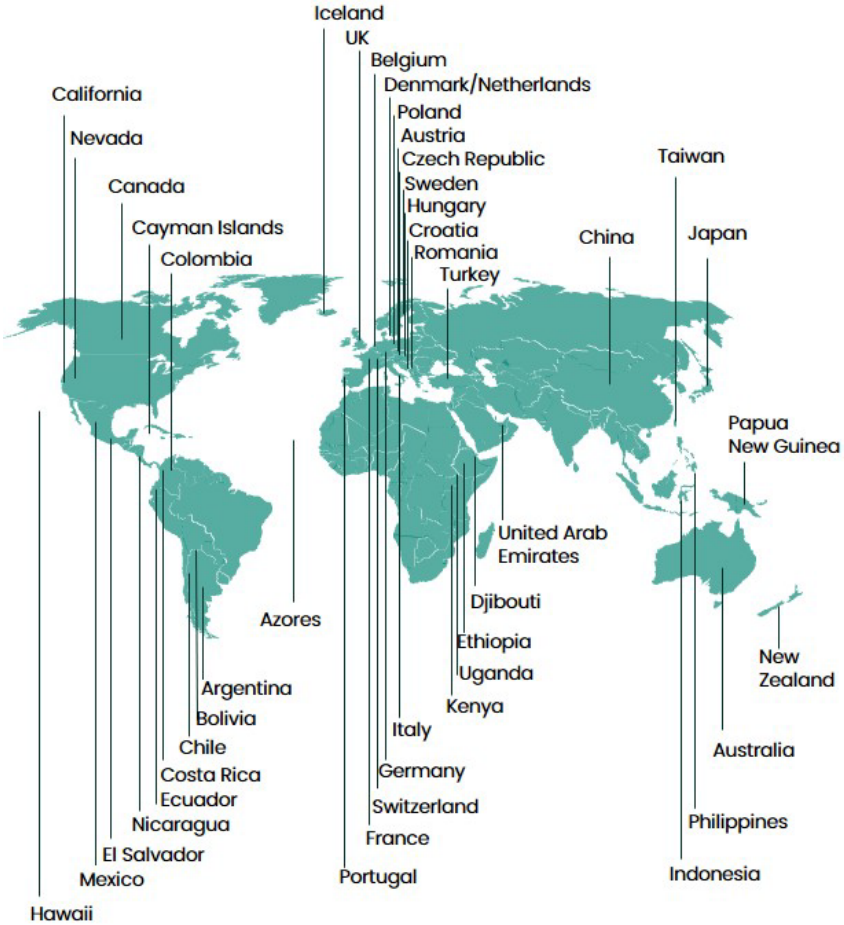
# Geothermal solutions

## Energy production is evolving

The IEA estimates that a 10% annual increase in geothermal well production over the next 10 years is the bare minimum needed to meet future demands on geothermal energy[1]. With 2020 generation rates of 15.4 GW, the world will need geothermal sources to provide at least 40 GW annually by the year 2030 and 103 GW by the year 2040 to meet global carbon neutrality by 2050.

## Baker Hughes is the geothermal energy expert

Baker Hughes is the only company in the world that can provide subsurface and surface products and services from planning to power generation. We are leaders in technology and commercial innovation, and hold strong partnerships in the services community. Baker Hughes provides geothermal power management responsive to the specific needs of geothermal projects.

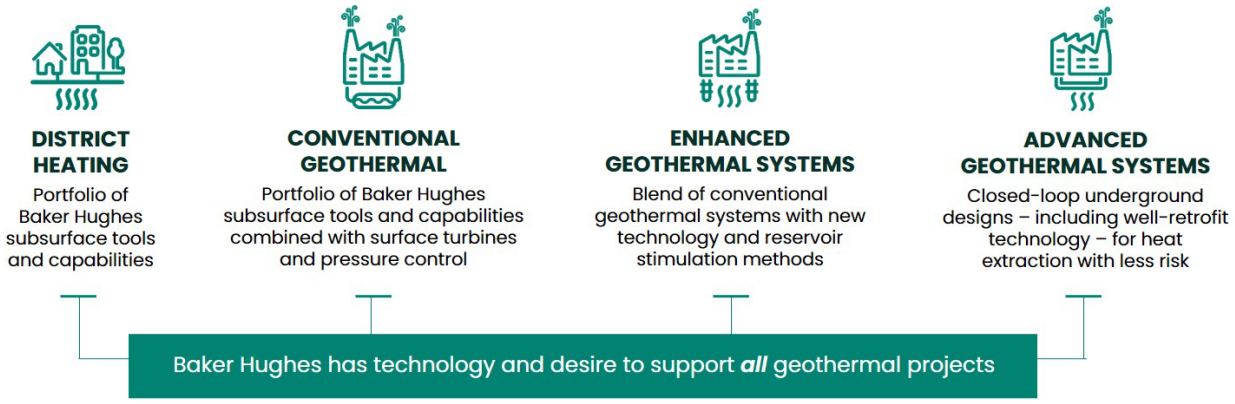



Baker Hughes geothermal experience



[1] IEA (2020), Geothermal, IEA, Paris https://www.iea.org/reports/geothermal

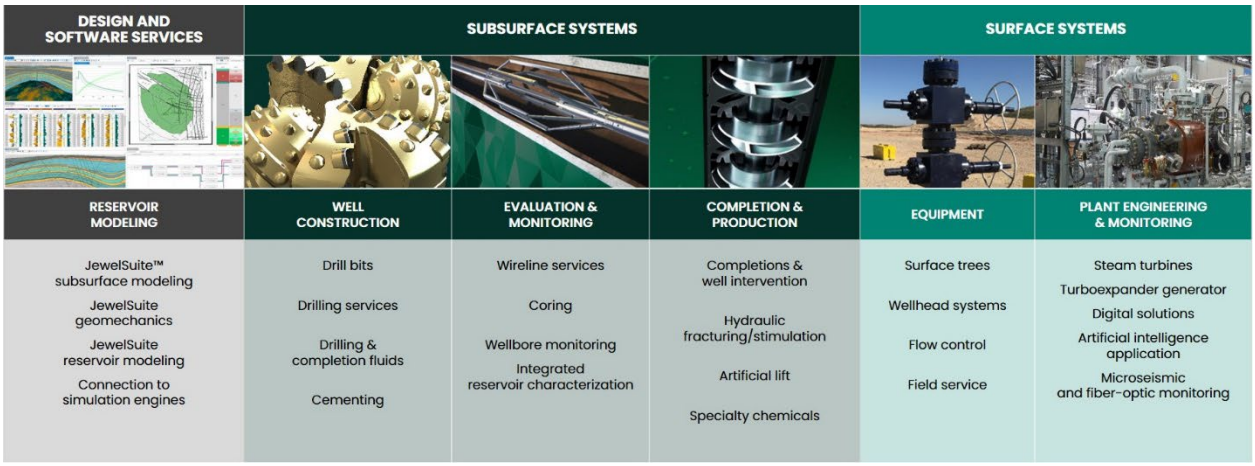
## Baker Hughes' geothermal portfolio spans subsurface to power generation



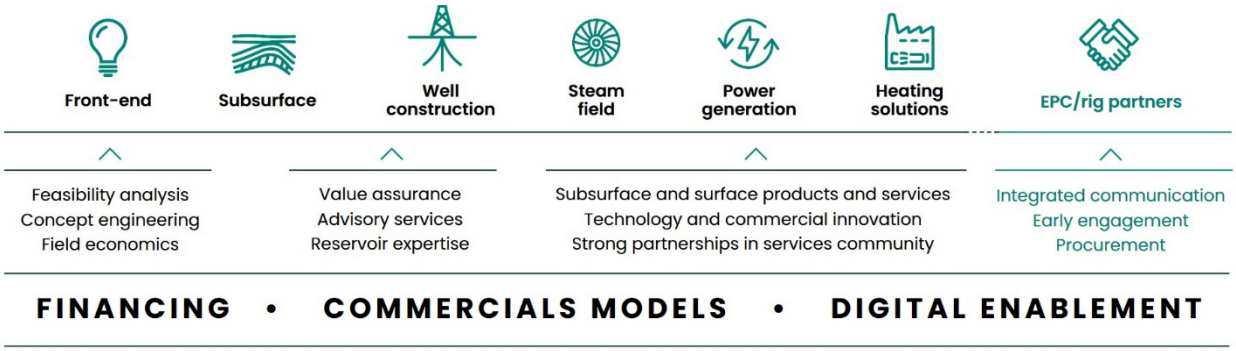

Baker Hughes is a leader in providing high-temperature products and services for geothermal development around the world by offering a complete range of capabilities and when necessary, forging strategic alliances with others in the service industry. From initial feasibility studies and wellbore construction, through stimulation, steam production, and power generation of your geothermal well, Baker Hughes draws on more than 40 years of geothermal experience, reliable equipment, and specialized technologies to safely and efficiently tap into this clean, renewable energy source.

**Our comprehensive technology portfolio delivers reliable and predictable performance.**

Our advanced technology tackles challenging rock formations, high temperatures, and harsh well conditions to tap geothermal energy's potential. Our focus on geothermal technology ranges from emulating the wellbore conditions of geothermal wells, to testing high-temperature materials and components, full bottomhole assemblies, submersible pumps and total integration and project management for geothermal well construction and power generation.



## Baker Hughes has years of geothermal experience




Baker Hughes has provided products and services for decades on geothermal wells and power generation and has the experience of many major international projects.

- We have over 40 years of expertise working in harsh geothermal environments
- We have supplied equipment, products, and services on over 1,800 geothermal wells in 25 countries
- We are committed to the research and development of high temperature drilling equipment and products
- We have qualified experienced personnel and high temperature equipment & products
- We have a substantial R&D program dedicated to geothermal specific technology, including high temperature drilling and efficient power production from geothermal resources
- Our subsurface experts, located in nearly every geothermal region, offer a rich mix of skill in hot reservoirs, geomechanics, and reservoir chemistries
- Our centralized HQ Geothermal Solutions organization manages and ensures knowledge transition for execution excellence, consistently determining the right technology for each application
- Our surface power generation engineers apply their expertise to original equipment manufacturer in power generation, plant management, control systems and condition monitoring

## Our geothermal experience is global

**Iceland**
- 300°C directional drilling system
- Deepest and hottest well ever drilled

**New Zealand: Optimized plan for new well development**
- High-temperature reservoir
- Wellbore instability and losses
- Local restrictions

**USA: Enhanced production by 20 MW**
- Characterization of in situ state of stress
- Geothermal production

**Japan: Reduced AFE by 50%, saving $2MM and enabling customer to drill one additional well**
Igneous rocks, multiple bit trips, low ROP

**Indonesia: Optimized well trajectories to increase well productivity**
- Stress sensitive fractures
- Drilling and stimulation

**Indonesia: Increased output up to 424 MW and saved $25 million**
- Geothermal production
- Wellbore instabilities

**USA: Exact wellbore place with minimal losses**
- Deep directional drilling
- Basalt formation
- High temperature ~343°C

**Germany: Saved 16 days of operation and 8 days of completion operations**
- Deep directional drilling
- Precise wellbore placement

**Finland: Saved 50 days of AFE**
- Basement granite (UCS 85ksi)
- Deep directional drilling

**USA: Characterized and qualified discovery well**
- Stress field, natural fracturing, geomechanical properties
- Cross Multipole Array Acoustilog (XMAC™) service

**Indonesia: Saved 5 days of drilling**
Igneous rocks, UCS 15-35kpsi, high temperature ~200°C

**Turkey: Saved 5 days of drilling**
- High temperature ~250°C, 4509m deep
- Abrasive formation with high vibrations

**Australia: Proved electricity generation feasible and profitable**
- Wellbore instabilities
- Optimize production

**Philippines: Expanded power plant within existing development block**
- Drilling and production
- Reservoir within existing permit area

Baker Hughes' experience in subsurface geothermal well development and production combined with our history in reliably conveying the heat transfer and producing power from it gives us the unparallel capability to create high quality geothermal power generation while reducing project capex and time to getting power generation online.

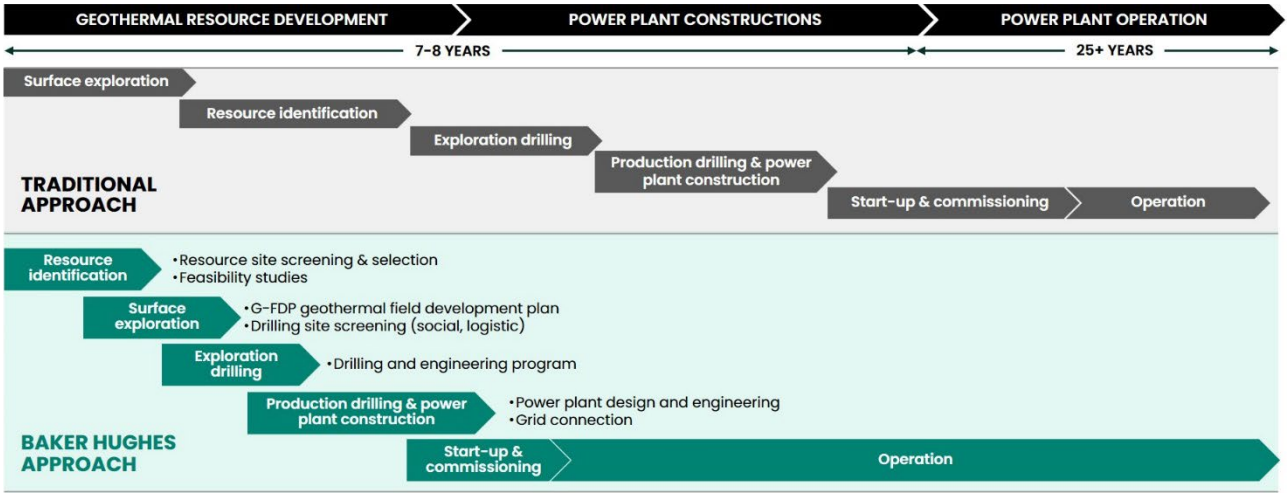
## Integration and project management ensure more efficient operations

Our project teams are experienced in working in the most challenging conditions and trained to execute efficiently in the geothermal field.

| | PROJECT MANAGEMENT | | | | | | |
|---|---|---|---|---|---|---|---|
| | RESERVOIR OPTIMIZATION | LEAN WELL CONSTRUCTION & WELLHEAD | PLANT ENGINEERING & CONSTRUCTION | INNOVATIVE COMMERCIAL MODELS | FINANCING | | |
| GEOTHERMAL VALUE CHAIN | Administration and project management | Establishment | Resource exploration | Production and injection wells | Production and injection system | Power plant | Grid connection |
| | Project management | Concession or lease acquisition | Surface exploration | Mobilization | Separators | Power plant design and engineering | Grid connection |
| | Project and company administration | Permitting | Shallow drilling | Drilling | Production pumps | Turbines | Switch yards |
| | Insurance costs | Environmental studies | Assessment through pre-feasibility and feasibility studies | Logging | Production pumps | Digital controls | Transmission |
| | Financing contingencies | Civil works | EPC partners | Testing | Injection pumps | Complete phase of construction | |
| | | | | | Corrosion inhibition systems | Testing and controlling | |

Baker Hughes
Baker Hughes and partners

## Our integrated approach mitigates risk and gets projects online faster



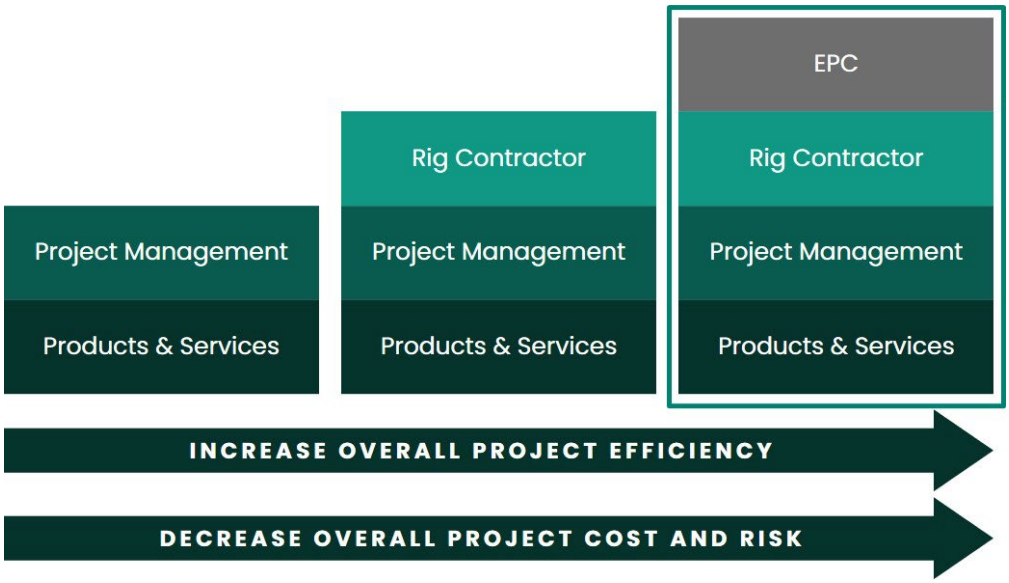

## Service delivery models improve efficiency and reduce risks

Because geothermal projects require high capital investment up-front, you may need a partner with the confidence and willingness to invest in the project's success.

Our understanding of a project's risks, both subsurface and surface, as well as our access to capital resources, enables us to offer unique commercial opportunities through equity mechanisms and financial lending practices.

**Service delivery models**

- We provide products and services through a range of delivery models, ranging from discrete supply to a turnkey approach, where incentives of the rig and EPC contractors are aligned with Baker Hughes
- Models for service delivery are also paired with unique commercial and financial models that can only be offered by Baker Hughes. We want to be your partner, rather than your contractor.




## Baker Hughes and carbon neutrality

**We will accelerate the reduction of our own carbon emissions.** We will achieve 50% carbon footprint reduction of all Baker Hughes production sites by 2030 and net-zero carbon emissions by 2050.

**We will promote your carbon emission reduction.** We will provide products and services with reduced emissions to decrease our customers' respective carbon footprints for their operations, projects, and products.

**We will position for new frontiers.** We will innovate and develop new physical and digital technologies and business models to capitalize on energy transition.

## Baker Hughes is ready to take geothermal forward

### WE ARE COMMITTED

**Baker Hughes is committed to making energy cleaner, safer, and more efficient.** We are developing new geothermal technologies to help the world meet net-zero emissions targets. Geothermal isn't new to us. Our experience includes 40+ years in the industry, working on 1800 wells in 25+ countries.

**We're ready to take geothermal forward.** Advanced geothermal systems (AGS) and enhanced geothermal systems (EGS) promise new opportunities.

### WE ARE DIFFERENT

**We connect subsurface and surface to deliver commercial success.** We have horizontal expertise in subsurface equipment and systems as well as surface acumen and technology. We focus on outcomes. We are committed to reducing CapEx/TotEx, improving NPV, and increasing ROI.

**We reduce time to first power.** From feasibility studies to well construction and production integrity technology and services to turbomachinery, advanced process solutions, digital, and automation capabilities, we provide integrated rapid execution.

### WE ARE READY

**Our value comes from what we know – and how we apply challenges.** We have expertise to assess and optimize reservoir models and well operations, from exploration to heat utilization. We have advanced technology to tackle reservoir evaluation, well construction, and geothermal power generation. We have proven project management to make geothermal projects economic.

**Our partnerships bring a complete solution.** From rig contractors to EPC companies, we provide the solution, start to finish.

**Our commercial models meet any need.** Our commercial payment is performance-linked and outcome-based.