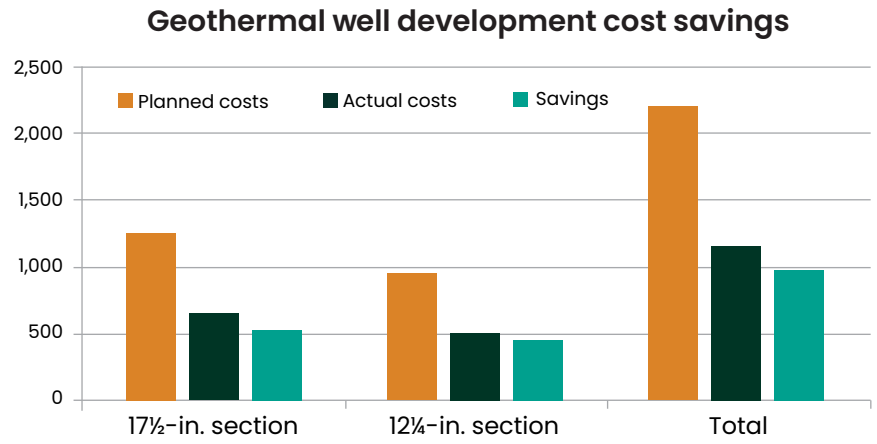
Case study: Geysers Western United States

Comprehensive drilling system delivered quality geothermal well, saved 17 days rig time, $972,500 USD



17.5 days saved = $972,500 USD

A geothermal developer in the western United States had plans to drill five to eight wells and build a power plant and was looking at new technologies to reduce operating costs. Prior to beginning its geothermal drilling campaign, the developer analyzed offset well information to identify challenges that might interfere with its cost reduction goals.

The challenges identified included tool and bit wear due to hard, abrasive rock formations, high-deviation tendencies resulting in difficulty maintaining vertical and directional control, and, in several instances, required correction runs to bring the wellbore back on plan. High drag loads were also observed due to tortuous wellbores and poor hole quality.

The developer's plan for the first well specified drilling a vertical 17 ½-in. section from 405 to 2,487 ft (123 to 758 m). Another 12 ¼-in. section would be drilled from 2,605 to 4,991 ft (794 to 1521 m). This would require an oriented kick-off and a build to an 8° inclination, followed by a tangent section.

To overcome formation challenges, Baker Hughes recommended a comprehensive drilling system that included high-performance drill bits, a fit-for-purpose, automated drilling system, and a fluid system designed for abrasive rock and high-temperature conditions.

Baker Hughes provided its **GX™ roller cone drill bit** and the **MX™ classic tricone drill bit** for this high-speed, high-temperature application. The GX bit provided a proprietary, elastomer seal that resisted thermal degradation, enabling higher rates of penetration (ROP). The MX bit used a patented, SEM II metal seal bearing package for longer bit life and durability, decreasing drilling time.

Finally, the bits' BOSS stabilization design protected the cutting structures

Challenges

- Reduce drilling time without sacrificing wellbore quality and accuracy
- Overcome hard, abrasive, deviated volcanic rock

Results

- Reduced drilling time by 45% while maintaining wellbore integrity
- Increased ROP
- Extended bit life
- Delivered a quality wellbore while eliminating correction runs
- Saved 17.5 days and $972,500 USD in development costs
- Experienced no health, safety and environmental (HSE) issues or nonproductive time (NPT)

from damaging lateral forces, delivering superior stability.

For the vertical section, the Baker Hughes **VertiTrak™ automated vertical drilling system** used real-time inclination updates and closed-loop rib steering to deliver verticality with a maximum inclination of 0.3°.

On the next section, the Baker Hughes **TruTrak™ automated directional drilling system** provided a smooth kick and build, with a maximum dogleg severity of 1.9°/100 ft.

Combining these systems with the high-speed, high-temperature bit technology led to higher ROP and longer bit runs, resulting in time and cost savings.

Designed for the hottest reservoirs, the **PYRO-DRILL™ water-based drilling fluid** delivered superior lubricity and cuttings removal. The PYRO-DRILL fluid is thermally stable at temperatures of more than 600°F (316°C) and results in a low environmental impact.

The Baker Hughes comprehensive drilling system more than doubled ROP compared to offset wells, increased bit life, and reduced the number of drilling days by 17.5, or 45%, when compared to plan. It also maintained excellent wellbore integrity, resulting in smooth casing runs and cementing, further reducing well development costs.

The quality of the wellbore was apparent after a review of the drag reduction data. The data showed that drag was reduced at the target depth to 25,000 lbm (11 340 kg) overpull, compared to 125,000 to 140,000 lbm (56 699 to 63 503 kg) on the offset wells.

The reduction in the number of drilling days by 17.5 helped the developer realize a total savings of $972,500 USD.

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