



HydroVolve®

GEO THERMAL 2024

Percussion-Enhanced Drilling Technology
Supercharges Drilling Performance

Presented by Marc Anderson

Record Breaking Drilling Technology

- Novel Percussion-Enhanced Rotary Drilling System
- Field Trials Q2 2023
- Drilled 2x Faster
- Drilled 3x Further
- Deep, hot, hard rock applications
- Plug and Play into conventional drilling systems
- **Transformational for Geothermal Economics**



Influence of Drilling Cost on Geothermal

- LCOE for geothermal \$56/MWh
Solar PV \$51/MWh, Onshore wind \$52/MWh⁽¹⁾
- Drilling costs **30%-50% of CAPEX**⁽²⁾
- EGS/AGS \$100/MWh, **75% of CAPEX**⁽³⁾



(1)Timilsina, 2020, (2) Dumas, Antics and Ungemach, 2013 (3)Flowers, 2021

How to Reduce Drilling Costs

TIME = COST

Reduce time to drill well

HOW

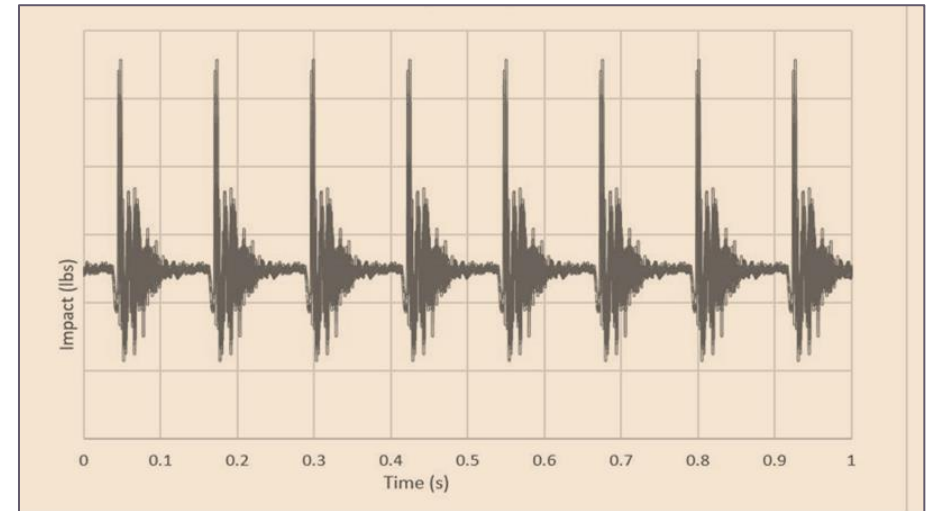
Drill Faster – increase rate of penetration (ROP)

Increase drill bit longevity – reduce flat (tripping) time and bit costs



Percussion and Drilling

- Rapid hammering action - crushing failure of the rock
- Proven to increase drilling ROP by several factors
- Widely practised
- Difficult to achieve downhole
 - Reliability/Longevity
 - Power
 - Well management issues



Percussion-Enhanced Rotary Drilling

- Rotary drilling with PDC bit
- Percussion impulse action additive to weight on bit
- Pre-fractures (softens) the rock
- Increases depth of cut of bit
- Reduces wear on cutting structure
- Low impact to drilling systems

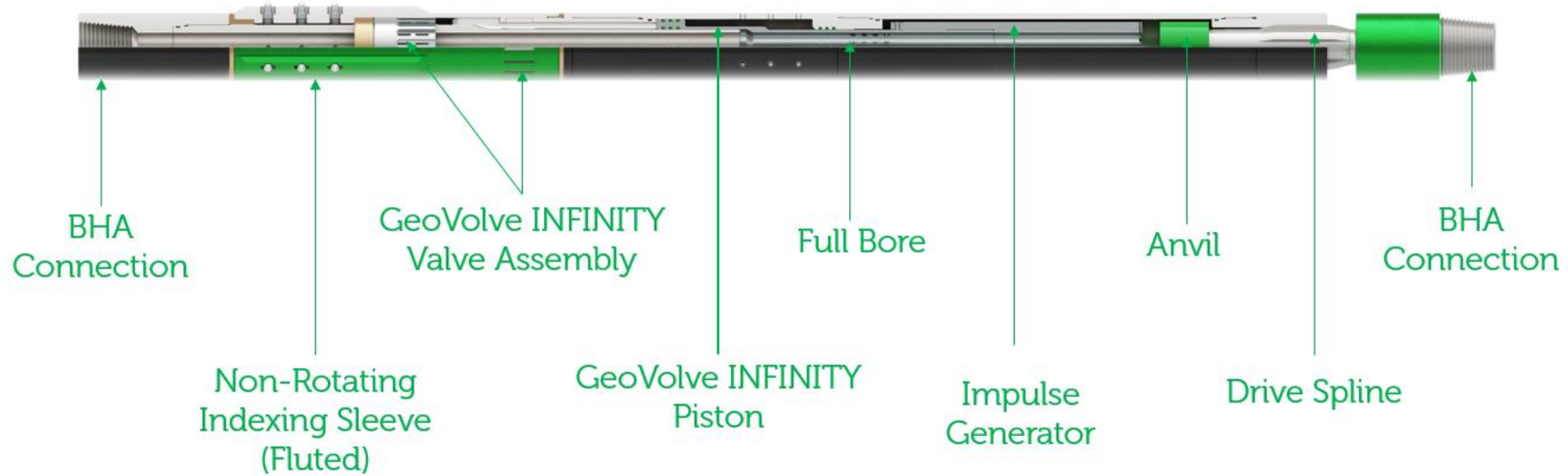


Percussion-Enhanced Rotary Drilling

- Increases ROP
- Increases bit longevity



Percussion-Enhanced Drilling System



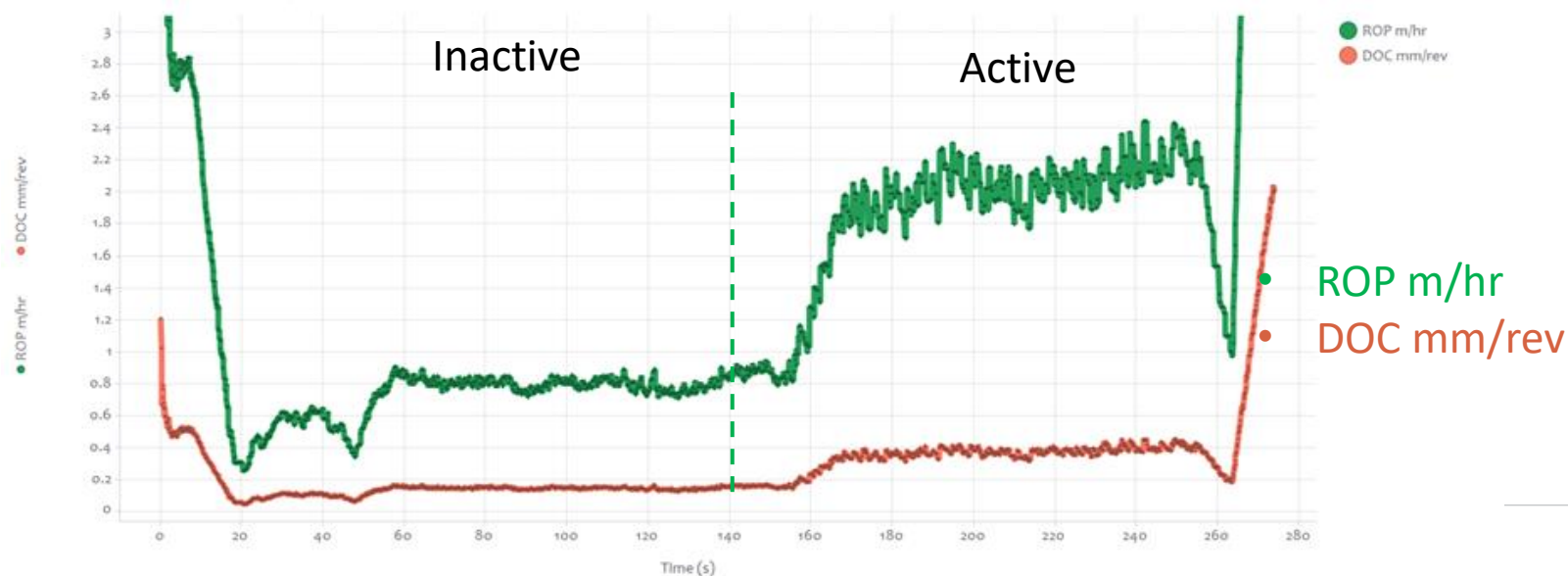
- Plug-and-Play
- Hydraulically powered by drilling fluid
- Automatically operates when drilling
- Introduces no pressure drop
- Full metal valving

Bench Testing and Results



Bench Testing at HydroVolve Drilling Test Centre, Aberdeen

ROP m/hr, DOC mm/rev vs. Time (s)



ROP Increase x2.6

Field Trial Record Breaking Performance

- **Three** sizes deployed: 6" | 8-1/2" | 12-3/4"
- **Fastest** ROP ever recorded in extensively drilled basin
- **Longest** drilled interval ever recorded in extensively drilled basin
- **Doubled** (2x) ROP field average across multiple bit providers
- **Tripled** (3x) distance over field average across multiple bit providers

Field Trial Technical Performance

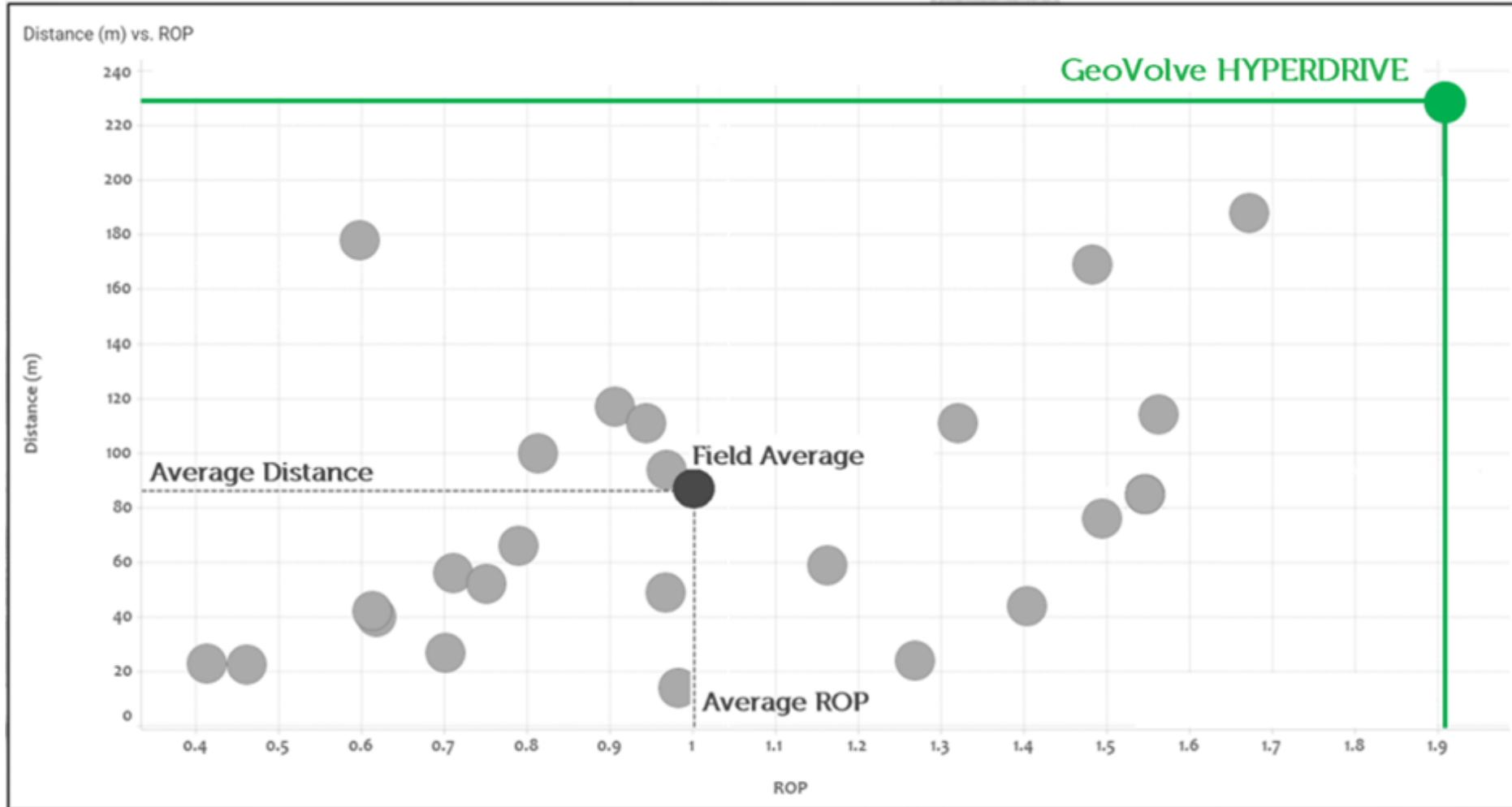
- Flow durability > **350hrs** circulating with **2.1Sg** mud in a single deployment.
- Thermal stability >**28days** on bottom at > **220 degrees C**
- Mechanical reliability >**250hrs** drilling time in one run at >**220 degrees C**
- System and bit durability >**600m** interval, shoe-to-shoe in one run, against best offset well of 220m interval
- Successfully drilled out a **shoe track**
- Proved capability of **TERRABIT** PDC drill bit

Case Study

6" Percussion-Enhanced Drilling System c/w Bespoke PDC Bit

- Deep S-shaped profile well
- Inclination below 20 degrees
- Total depths in excess of 6000m
- High contrast in lithologies varying between
 - 5-8 kpsi shaleand
 - 22-25 kpsi sandstone reservoir and limestone stringers

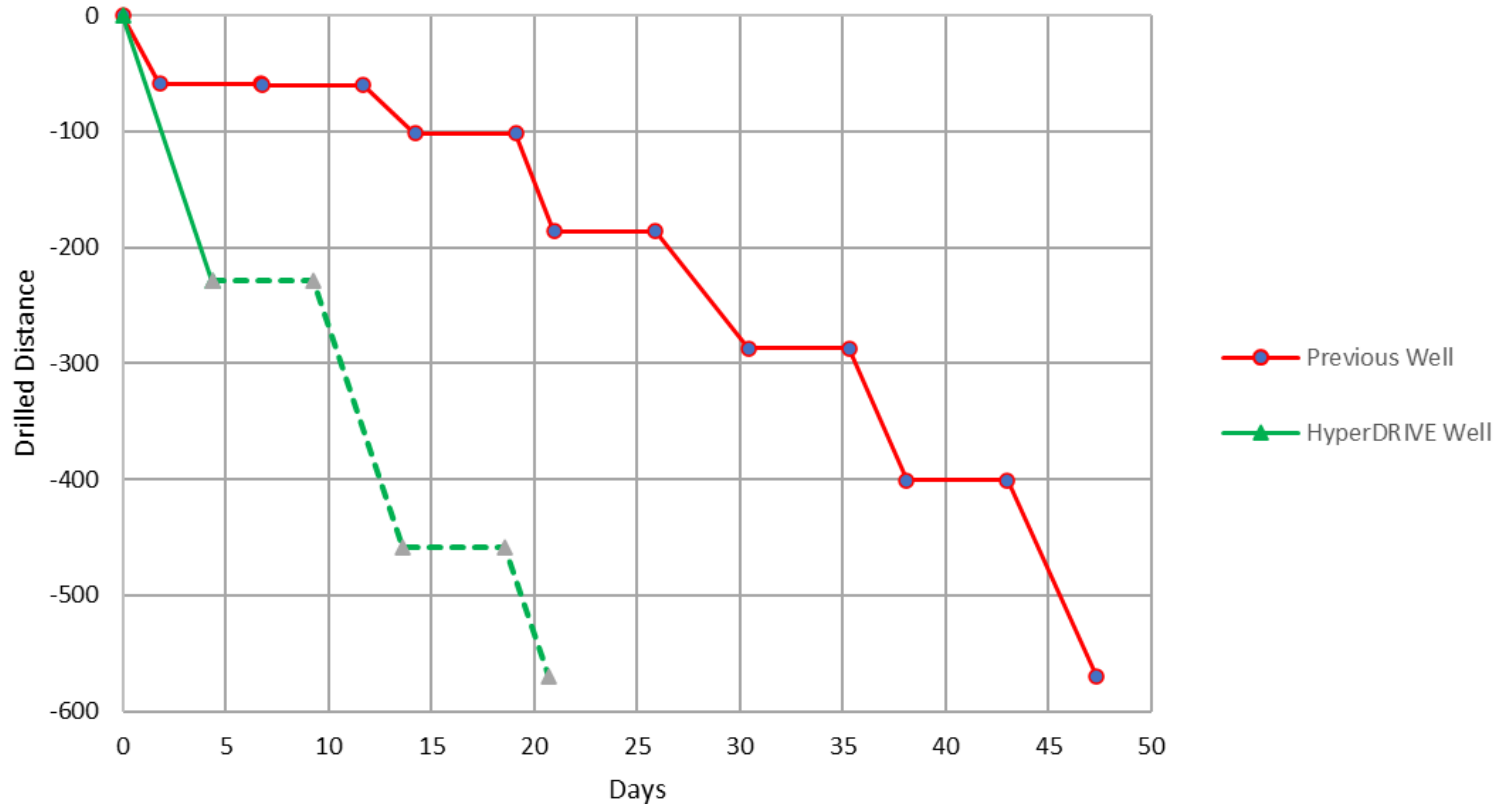
Case Study Results



GeoVolve HYPERDRIVE c/w TERRABIT v's offset

Case Study Results

6" Hole Drilling Performance
Comparison of HyperDRIVE® Well v's Previous Well



Combined actual and projected results against offset:

- Drilling Time Saving: 7.0 Days
- Flat Time Saving: 19.7 Days
- Total Time Saving: 26.7 days
- Drill Bit Saving: 4 Bits

Projected total saving for 600m, 6" interval:

\$1.424m

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What is Next?

- Building inventory throughout Q1 & Q2.
- More pilot wells.
- Multiple, confirmed drilling campaigns with operators to complete throughout 2024.
- Nominated for the Ruggero Bertani European Geothermal Innovation Award!



Many Thanks

Thank you for listening.

