

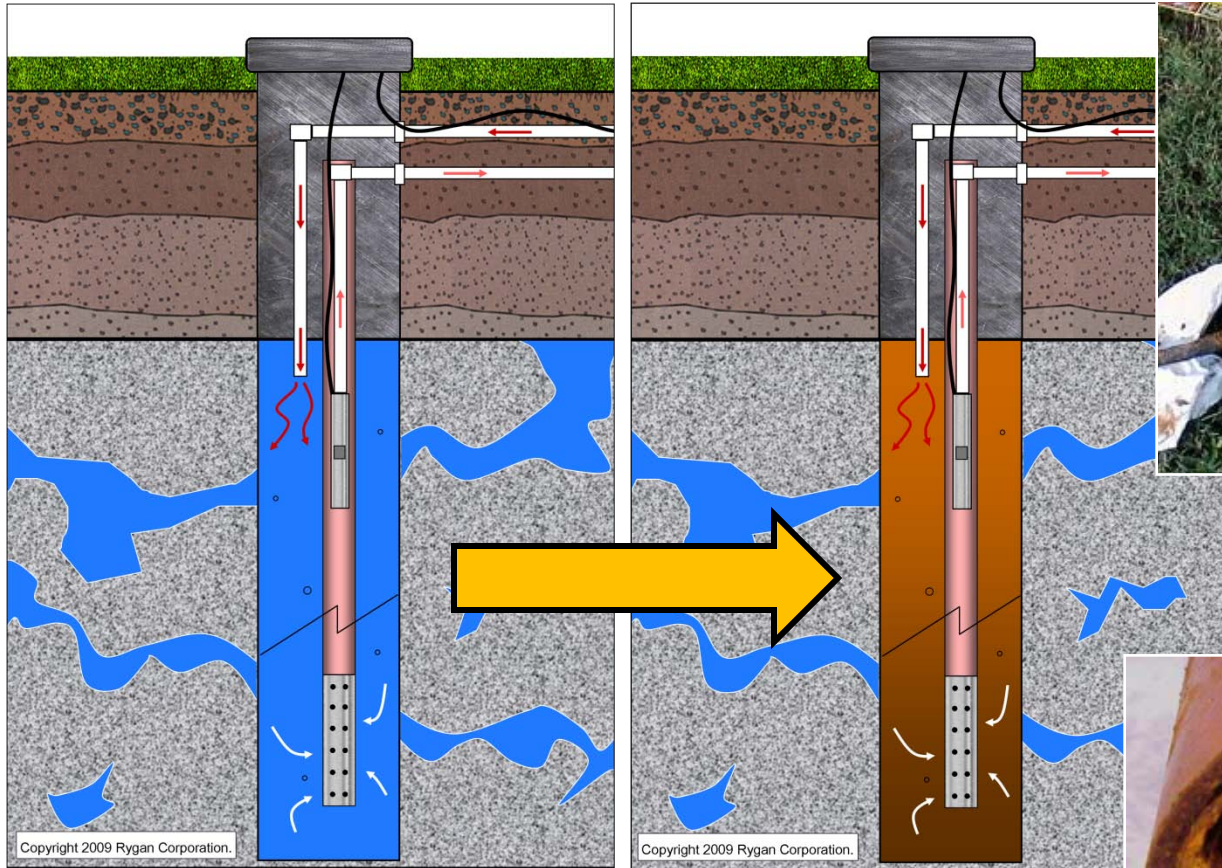


*Raising Geothermal Well Field Performance  
to the "Green Zone" Standard..*

**H**igh  
**P**erformance  
**G**eo  
**X**change

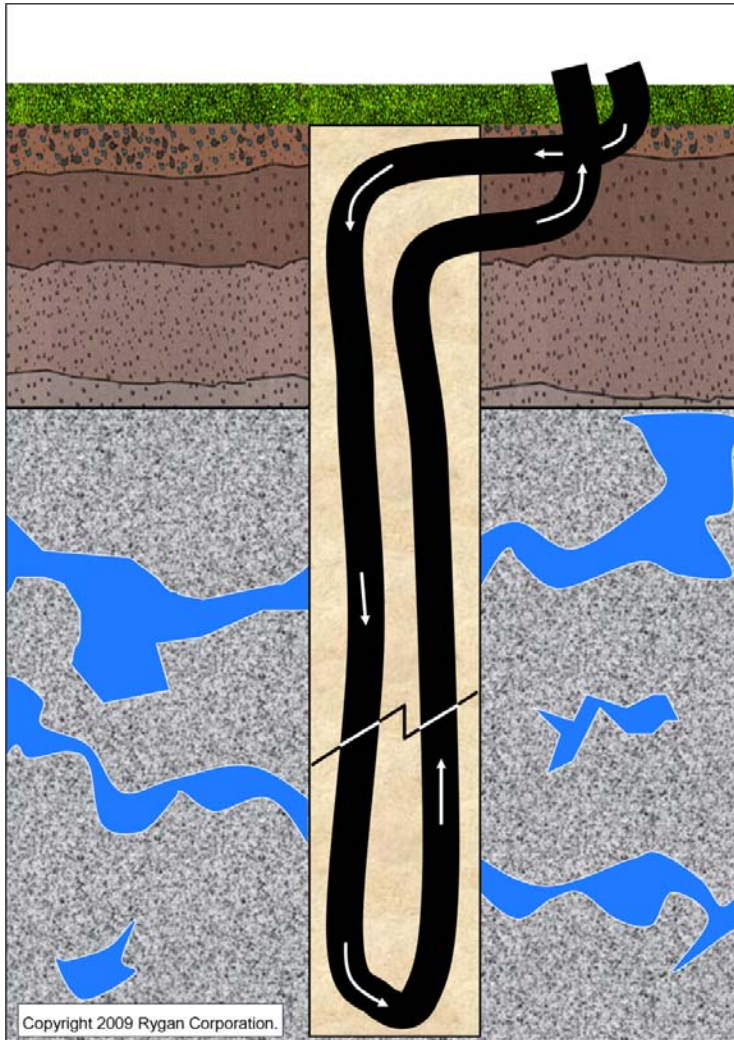


# High Performance Has Often Equated to High Maintenance



**Standing Column Wells** offer improved thermal performance over closed loop systems. Utilized primarily in northeastern states, a single SCW can do the work of multiple closed loop wells. However, brackish water, water with iron or manganese oxides, bacteria or air entrapment can compromise standing column well performance with encrustation or bio-fouling.

# Low Maintenance Has Equated To Low Thermal Performance



**U-Tubes** - Traditional closed systems utilize polyethylene pipe not for thermal performance but for an ability to resist corrosion and connect without mechanical joints. Polyethylene pipe with clay backfill presents high resistance to heat transfer. In order to compensate for the high thermal resistance, large well fields with high bore counts become a necessity.

Closed systems however, allow pumps to remain topside in a mechanical room rather than submerged in a harsh geological environment. If installed properly, a closed well field can remain indefinitely maintenance free.

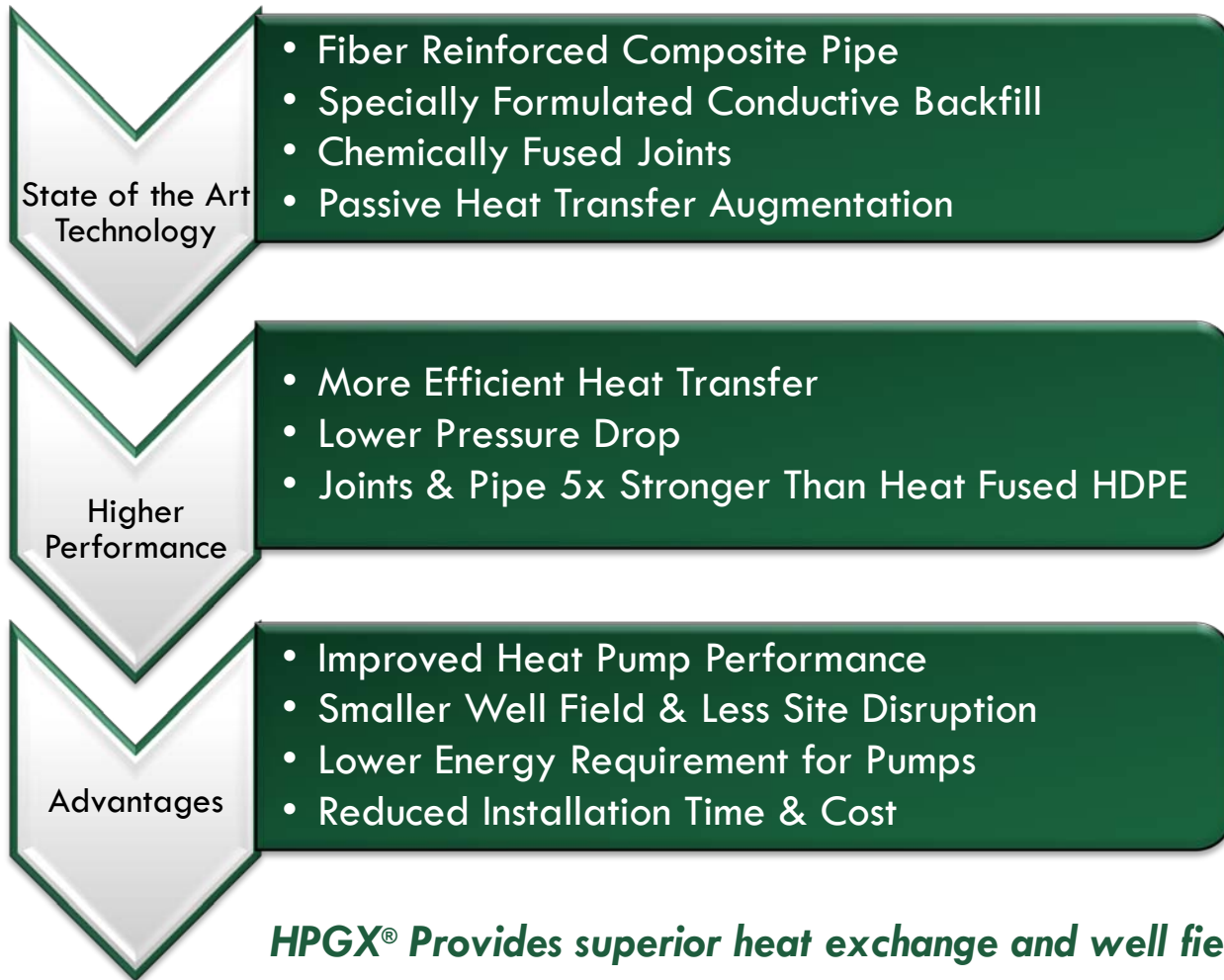




# High Performance Geo Xchange



# HPGX<sup>®</sup> Composite Based Well Fields - The Closed System With Open Performance



***HPGX<sup>®</sup> Provides superior heat exchange and well field performance – traditional fields require more than double the drilling and land space for similar thermal performance***



# The Composite Pipe Around Us...



Composites and Fiber Reinforced Pipe (FRP) are materials of choice for numerous high stress applications. The ability to provide high strength, low weight and withstand corrosive environments have established composites and FRP as the standard for numerous industrial and military applications.



## *Calcium Chloride Processing*



Piping for highly chlorinated and acidic mixtures - operating temperatures between 175°F and 200°F.

## *Comision Federal de Electricidad*



Sulfuric Acid Applications - Tula, Hidalgo Mexico  
194°F Operating temperature

## *Pharmaceutical Sanitary Drain Lines*



Drainage for corrosive pharmaceutical and chemical waste

## *Navajo Generating Station*



Hot brine concentrate and wastewater  
FRP pipe and fittings used to replace carbon steel in the wastewater system  
that had rusted and failed

*Process Waste Stream (Semiconductor)*



Transport of acid waste streams from process center to on-site wastewater treatment center.

## *Fuel Research Center*



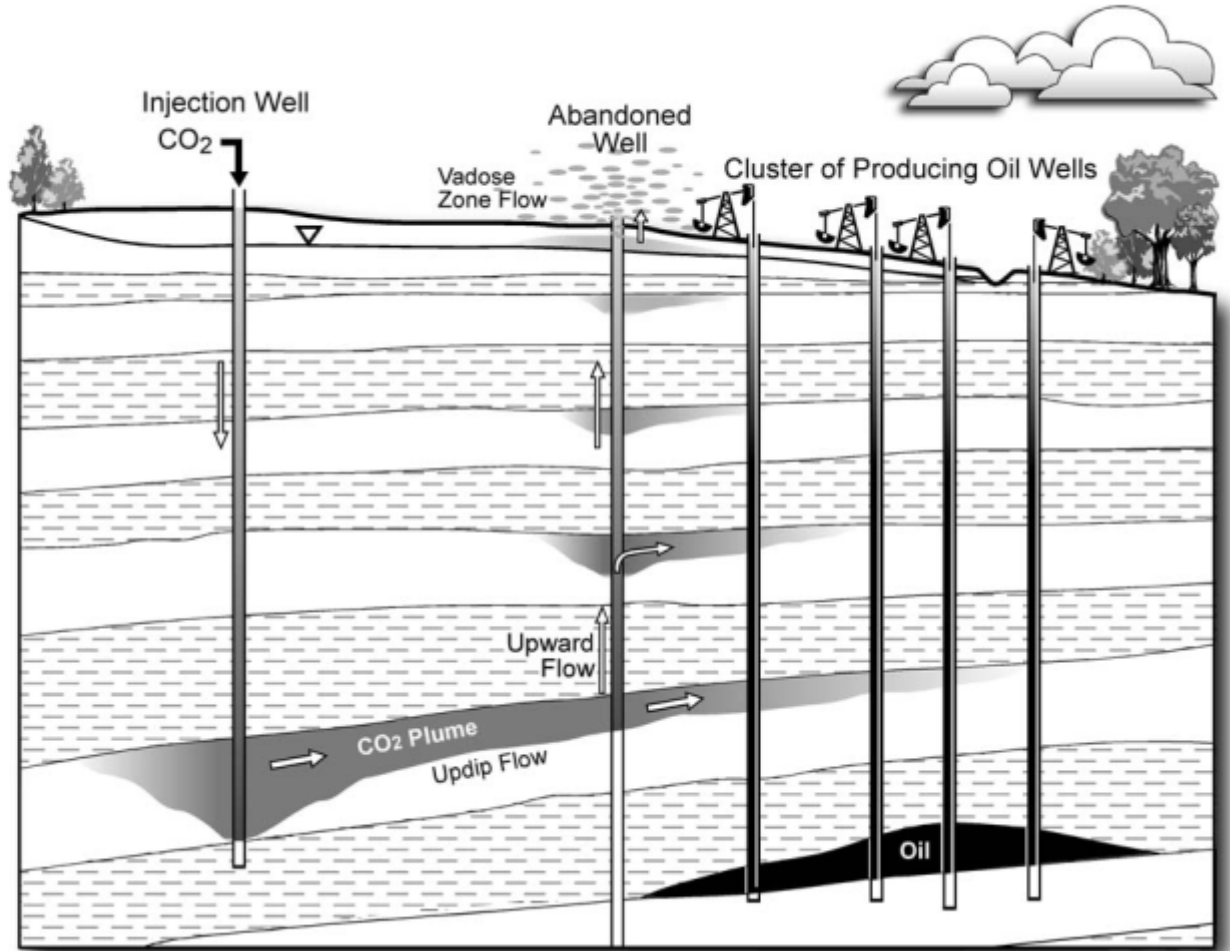
Test site for future fuels - pipe properties won't soften or creep at operating temperatures ranging from  $-40^{\circ}\text{F}$  to  $150^{\circ}\text{F}$ .

# The Composite Pipe Around Us...



Ultra deep (12,000-16,000ft) CO<sub>2</sub> injection wells

Sour gas recovery with heavy hydrogen sulfide





Fiber reinforced composite pipe is the only material approved for the underground transport of gasoline and flammable liquids.

RIGHT: Old vs. New - Pipe in the foreground was installed in 1973 and removed 27 years later when the fueling station was closed.

- ✓ Time Tested - Fiber Reinforced Pipe (FRP) Composite Pipe has been used in high stress environments including burial for over 50 years.
- ✓ Chemically Fused - Pipe & joints are more than 5X stronger than heat fused HDPE.
- ✓ Efficient Heat Exchange - HPGX<sup>®</sup> superior thermal performance allows significant reduction in drilling, land disruption and space requirements when compared to TCL systems

For more information, please visit  
[www.rygancorp.com](http://www.rygancorp.com)





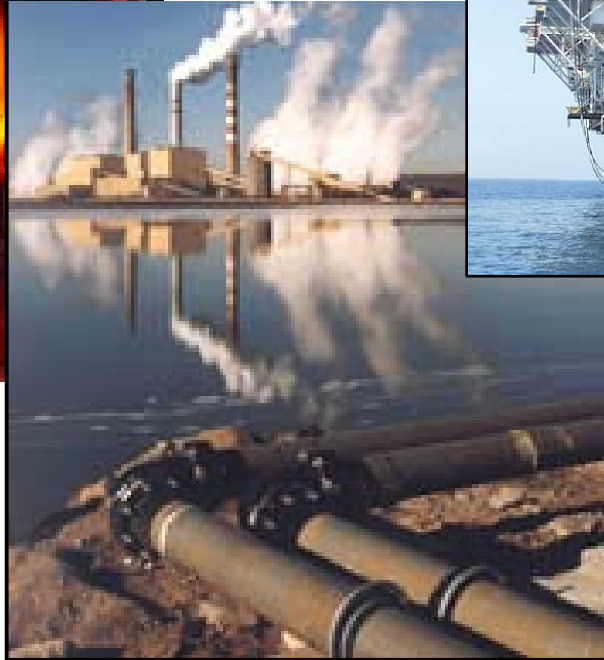
Rygan is a material sciences and development company specializing in the following:

- Composite engineering
- Geology and hydrogeology
- Thermodynamics
- Chemical Engineering

Our manufacturing and R&D partner, Fiber Glass Systems, is a subsidiary of National Oilwell Varco, and has been making time tested composite piping solutions for over 50 years.



More Composite Pipe in More Places. Bar None...



**NOV** Fiber Glass Systems