High-Potential Working Fluids for Next-Generation Binary ORC for EGS

Supercritical ORC

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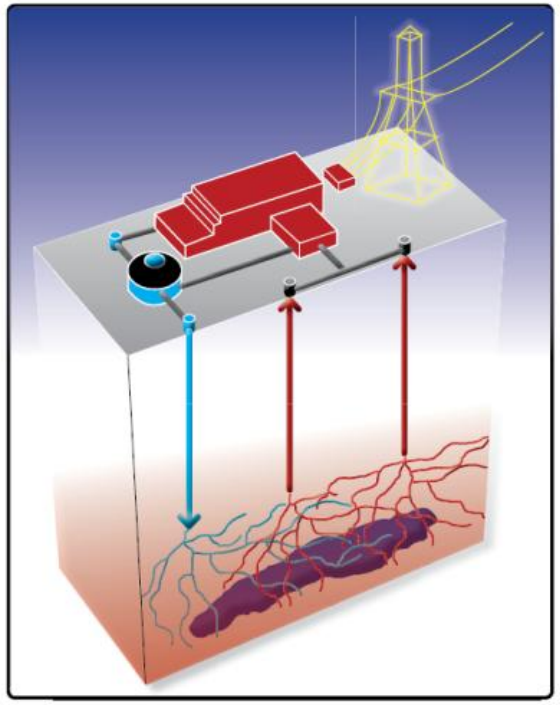
Overview

Find optimized working fluid/advanced cycle combination for EGS applications

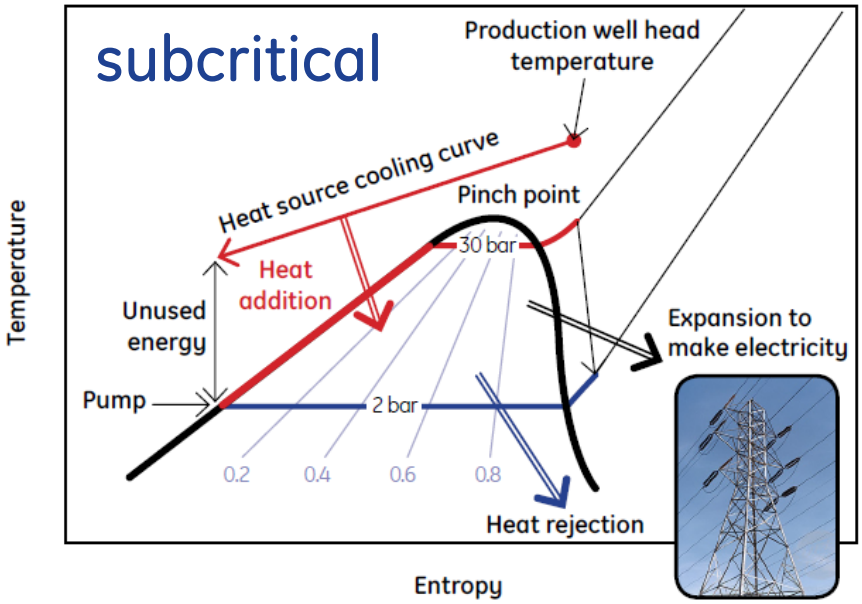
Tradeoff between well cost & power conversion unit cost

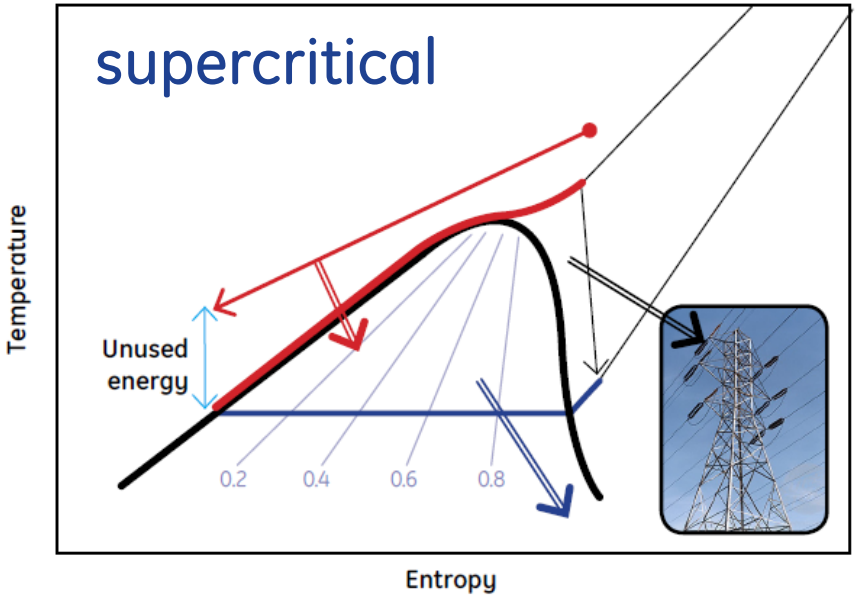
3 Phases:

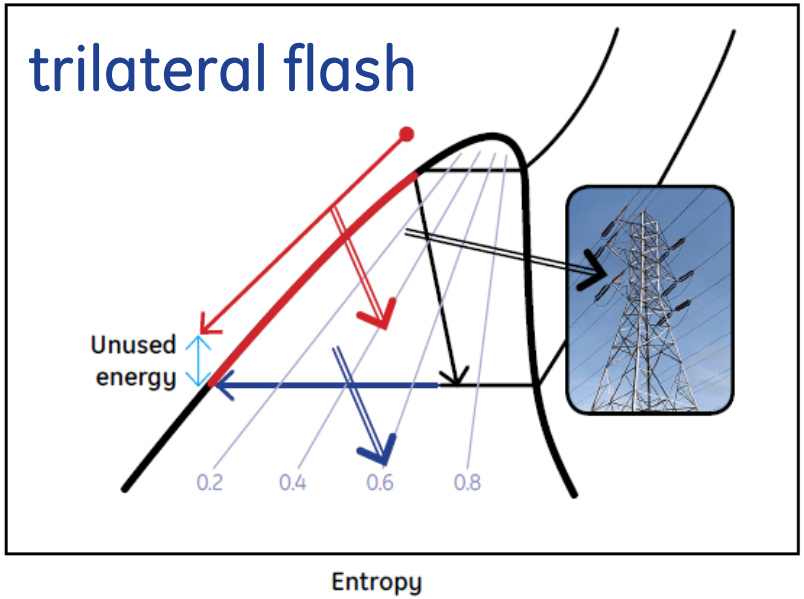
1. Technical analysis
2. Techno-economic analysis
3. Build Pilot ORC



Organic Rankine Cycles







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Fluid Screening

Screening criteria:

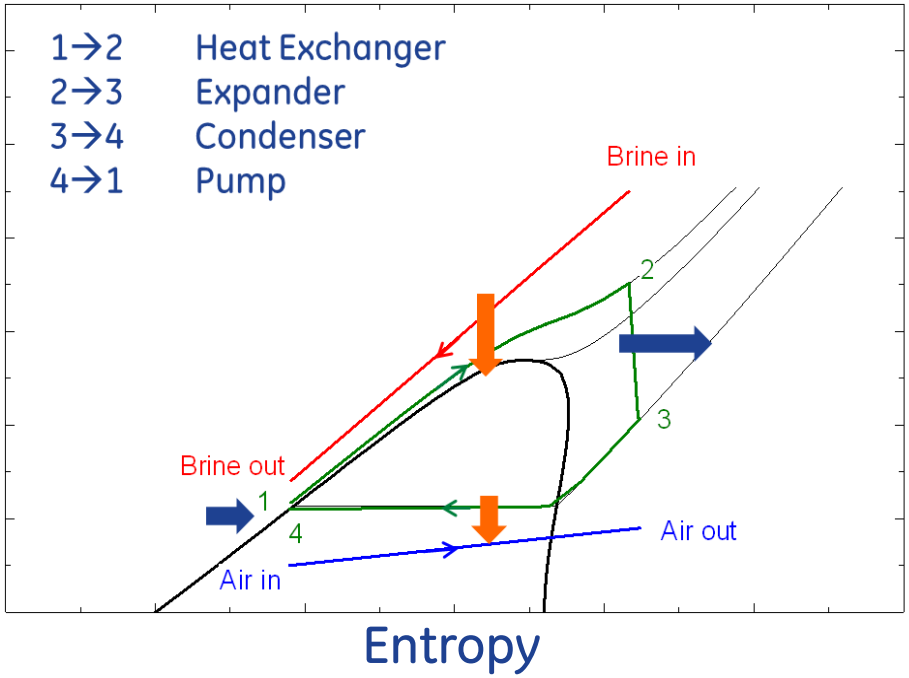
- T_{melt} < ambient temperature
- $T_{critical}$ > ambient temperature
- T_{boil} < 350 °C
- Global Warming Potential < 150
- Low to no Ozone Depletion Potential
- Low toxicity

Ranking criteria:

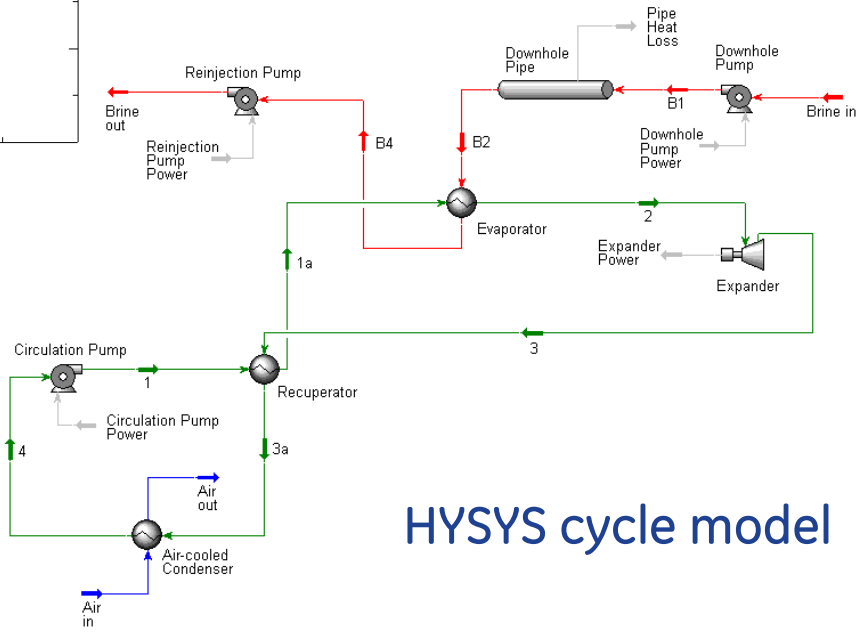
- High density
- High thermal conductivity
- High molecular weight
- Number of atoms per molecule

17,000+ available → 35 high-potential

Supercritical ORC



Temperature & Pressure above critical point

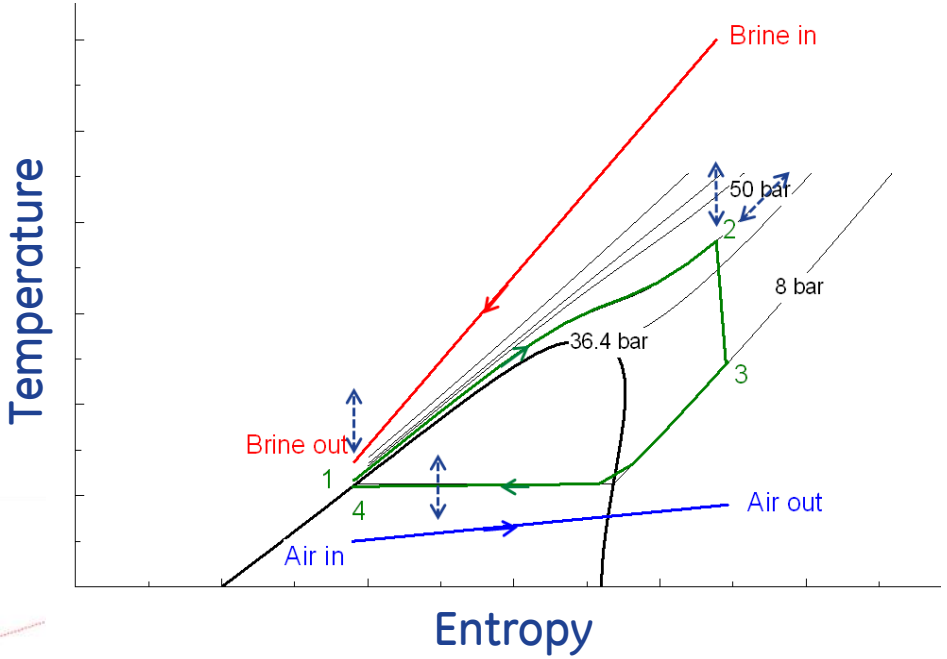


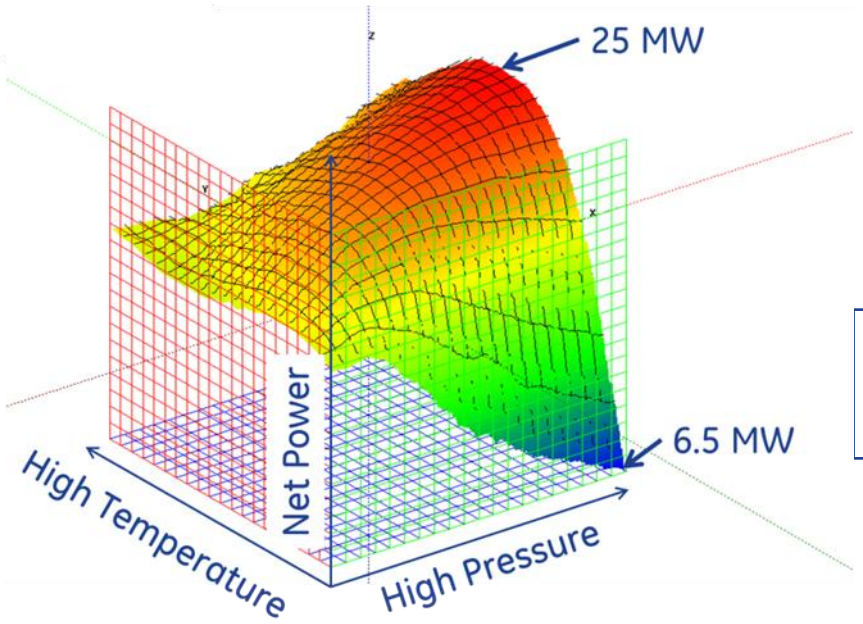
HYSYS cycle model

Cycle Optimization

Optimization variables:

- Brine out temperature
- Working fluid
  - Pressure into expander
  - Temperature into expander
  - Condensation pressure





Higher pressure **and** optimal temperature yields higher net power

Supercritical Cycle: Benefits and Challenges

Benefits:

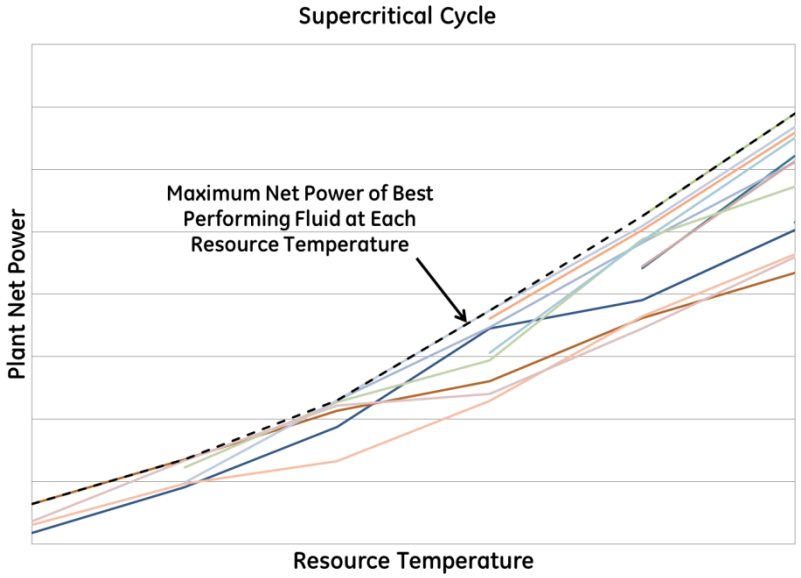
- Better match between resource cooling curve & working fluid heating curve
- Use existing expander technology
- Single primary heat exchanger

Challenges:

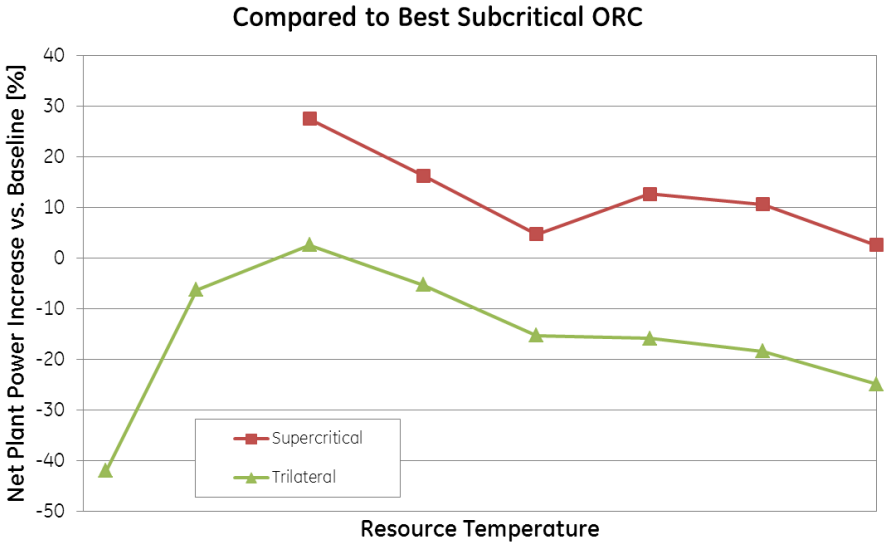
- High pressures required
- High pressure ratio in expander
- Supercritical heat transfer
- Uncertainty of properties in supercritical region

Net Power vs. Resource Temperature

No single best fluid for all resource temperatures



Best supercritical cycle beat best trilateral and subcritical cycle at given resource temperature



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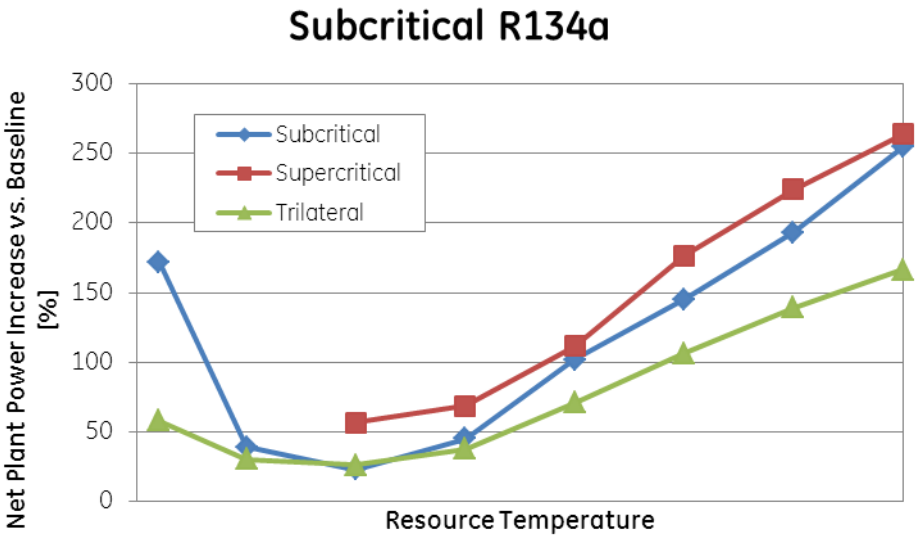
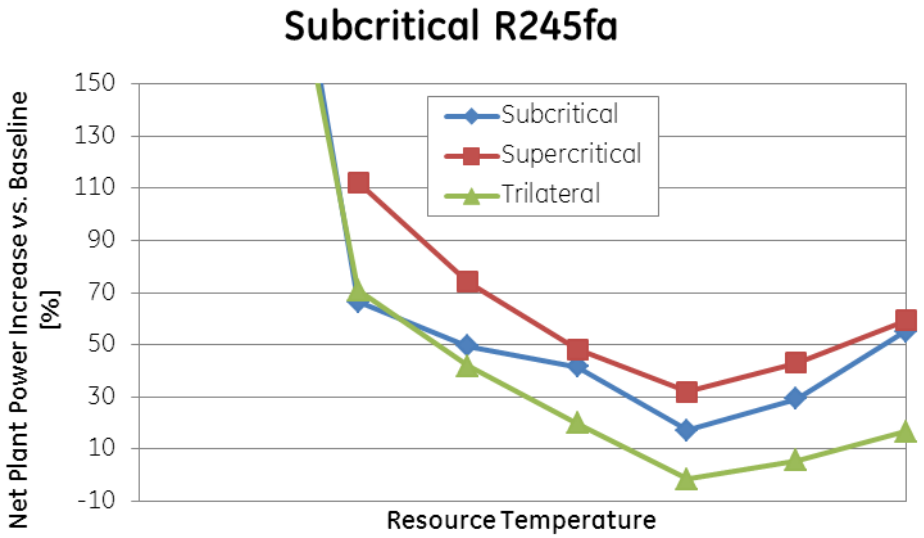
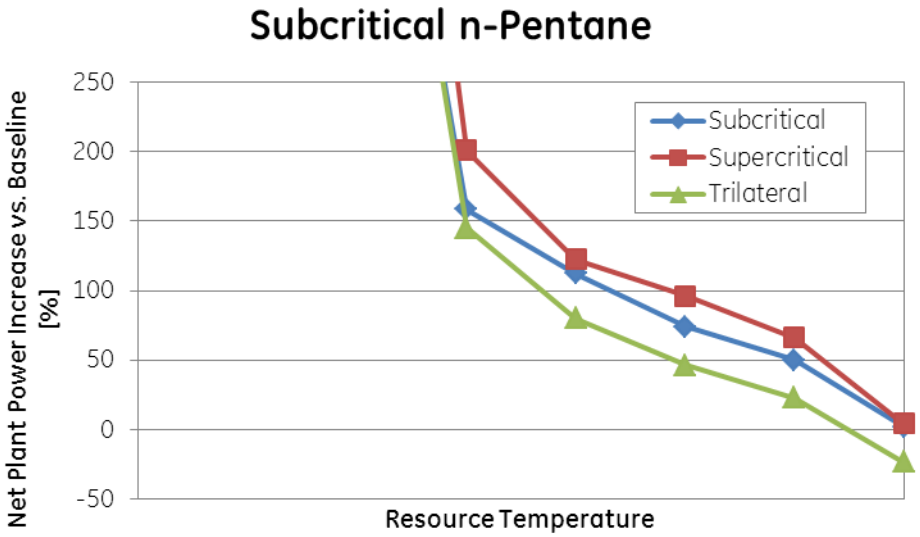
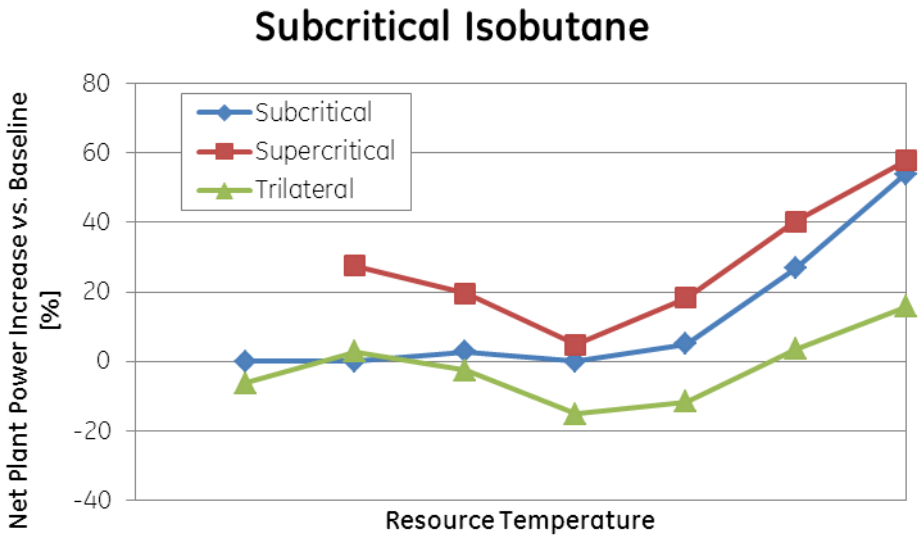
Comparison with Baseline Cycles









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Outperform current standard cycles & fluids

Summary

- Down-selected 35 high-potential fluids (from 17,000+)
- Compared performance of high potential working fluid / advanced cycle combinations
  - No single best fluid for all resource temperatures
  - Outperform standard cycles on market
- Next phases:
  - Economic analysis & comparison
  - Pilot ORC

Thank you.

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