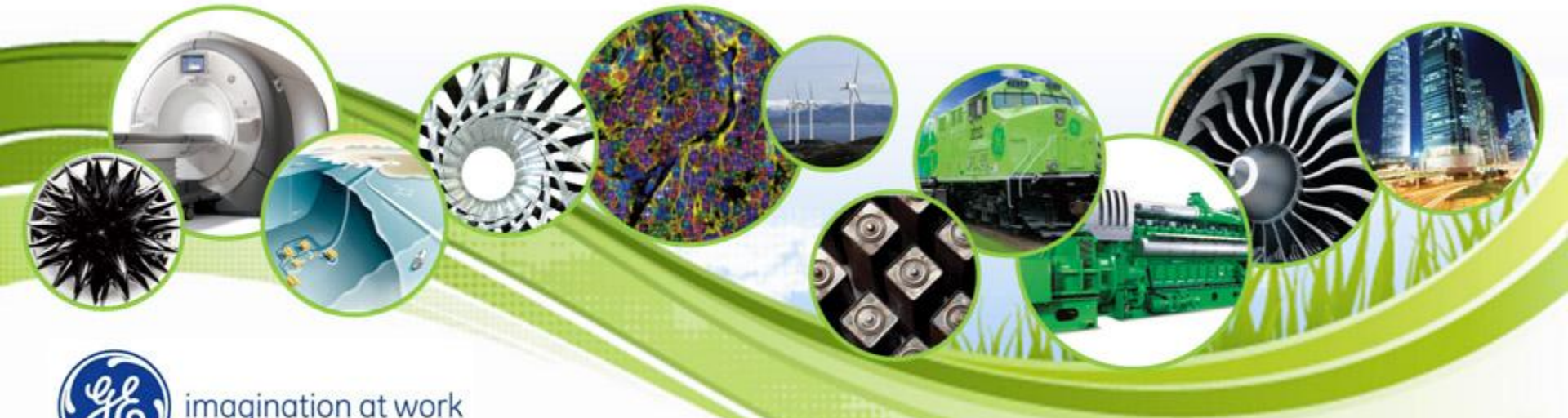


High-Potential Working Fluids for Next-Generation Binary ORC

Anna Lis Laursen
GE Global Research Center
September 23rd, 2011



imagination at work

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GE Global Research Locations



AMSTC
Ann Arbor, MI



Global Research HQ
Niskayuna, NY



Global Research - Europe
Munich, Germany



China Technology Center
Shanghai, China



**Brazil
Technology
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Bangalore, India

Acknowledgement

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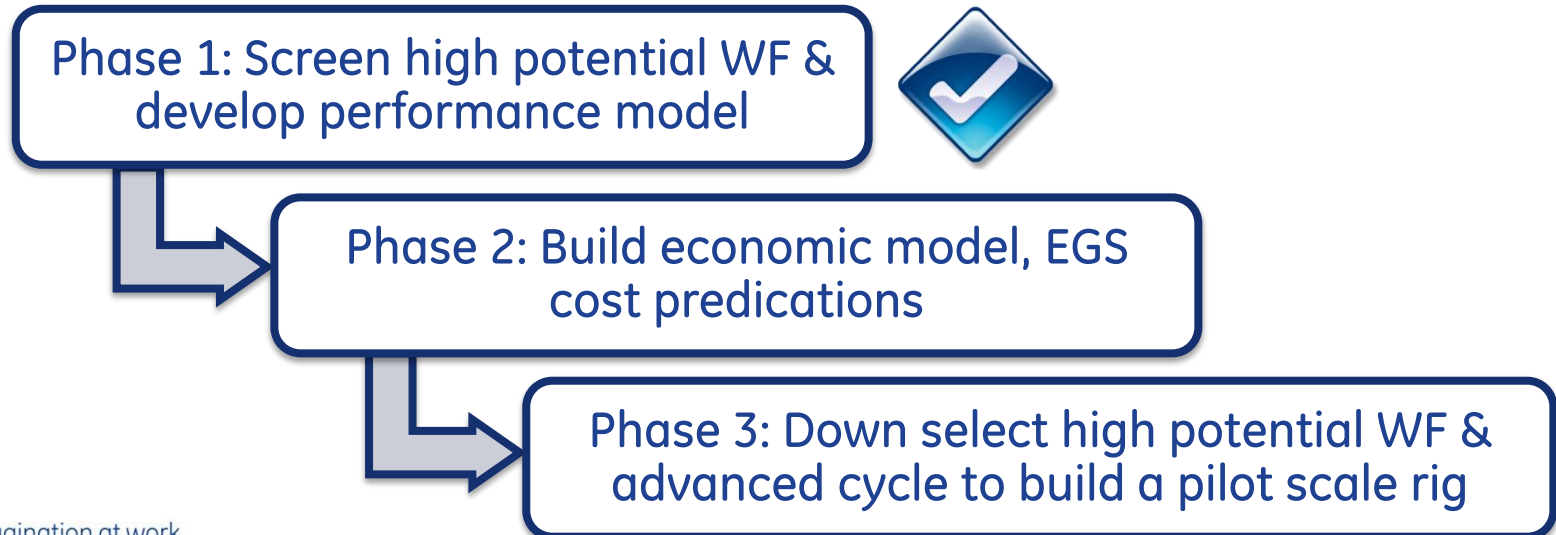
“This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty express or imply, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe on privately owned rights. Reference herein to any specific commercial product, process or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.”

Program Overview

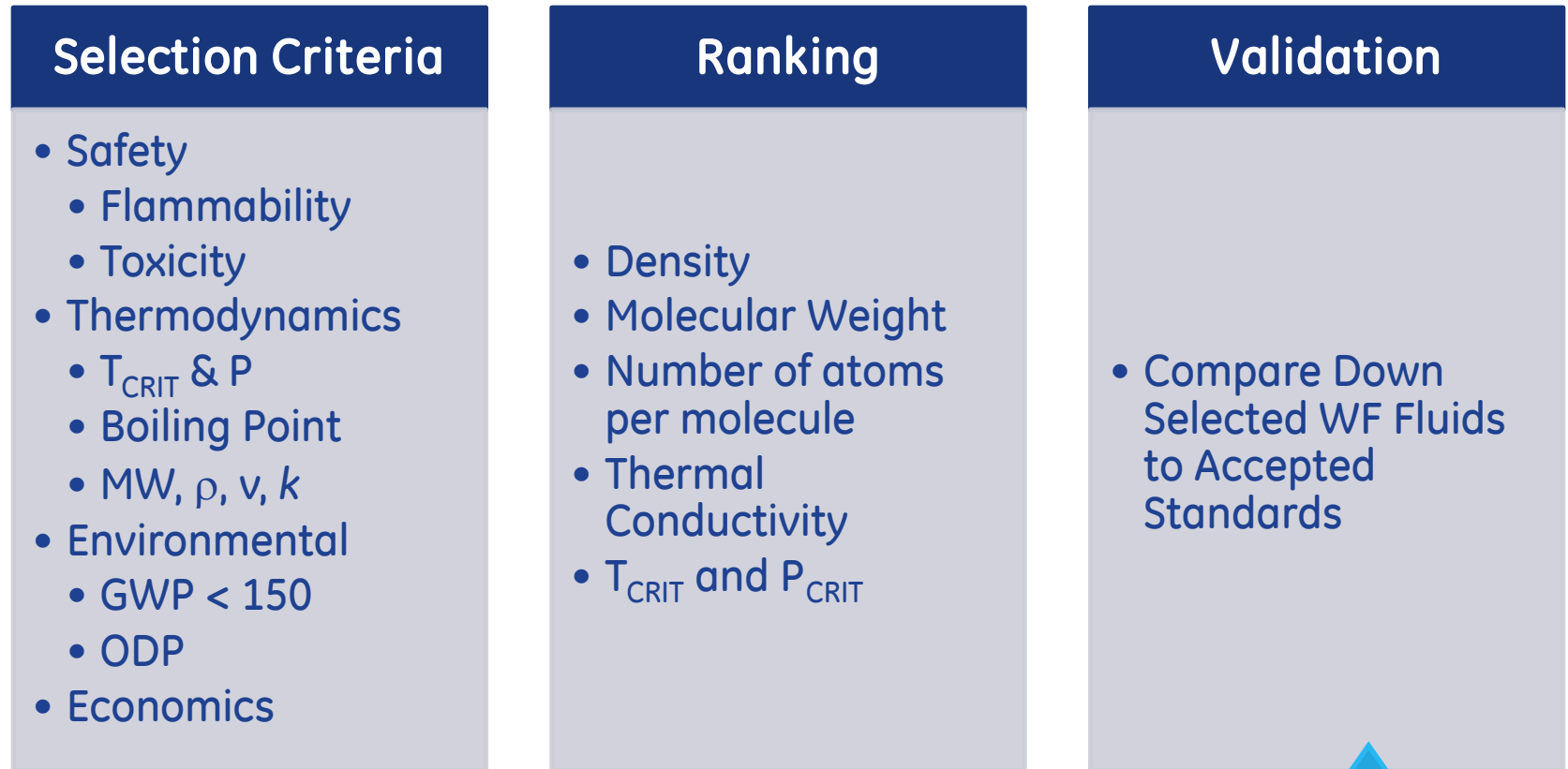
The DOE – Geothermal Technologies Program supports R&D and demonstration activities with industry, universities and national laboratories to improve performance and lower the cost of geothermal technology and expand geothermal resources.

Objective: Identify high-potential working fluids combined with advanced cycle for EGS application.

3-Phase, 3-year and \$3.75M effort



Fluid Selection and Validation



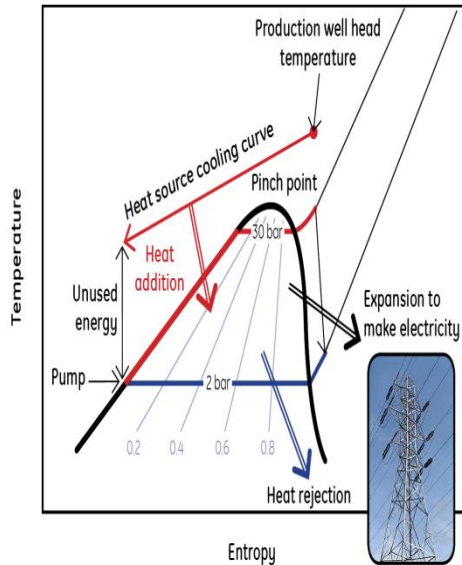
Down Selected WF Fluids from 17,000 to 35



imagination at work

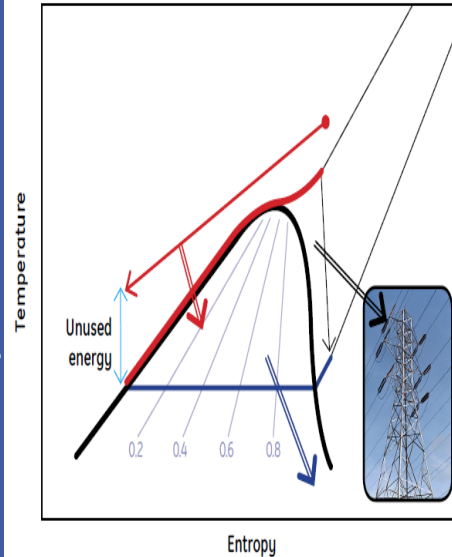
Cycles Evaluated

Subcritical



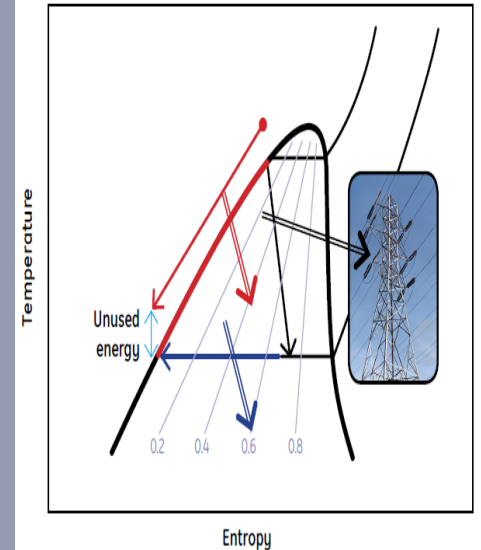
Standard Simple Cycle

Supercritical



Above Critical P Point

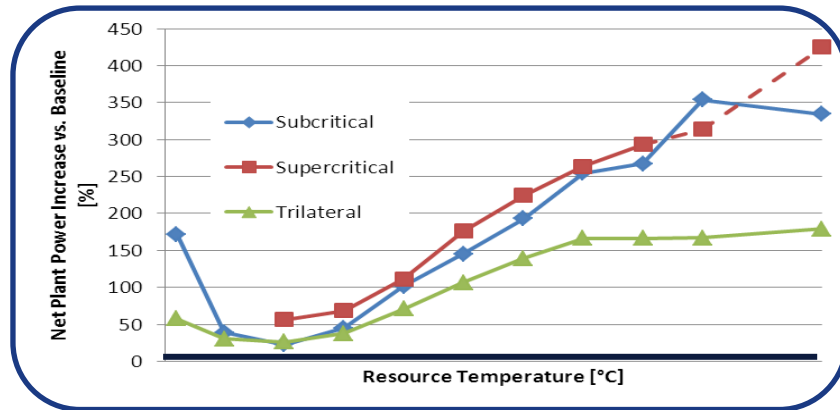
Trilateral Flash



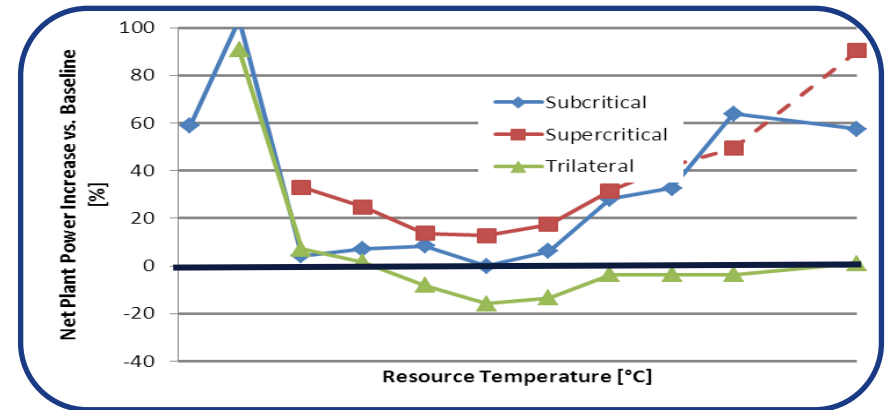
Low T Heat Recovery

Organic Rankine Cycles

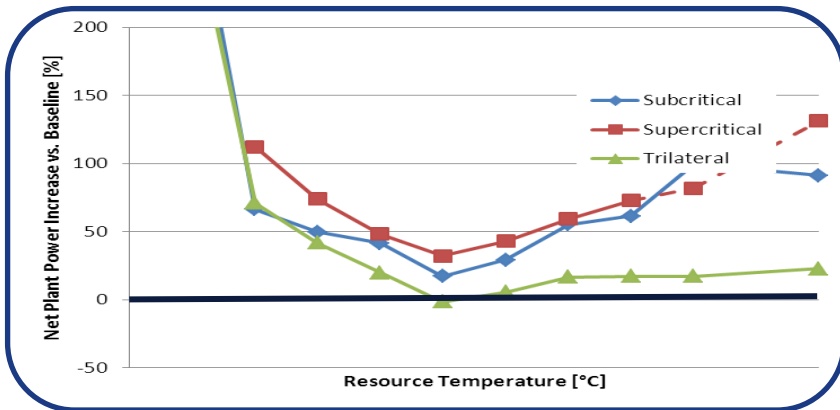
Cycle Comparison to Traditional Working Fluids



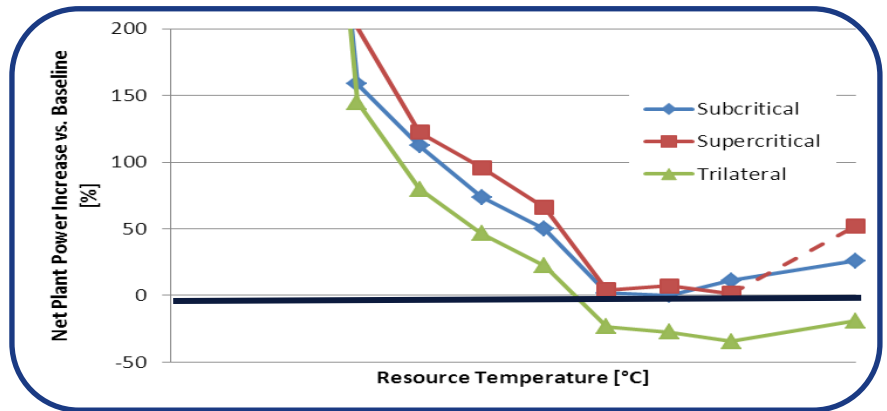
134a



n-Butane



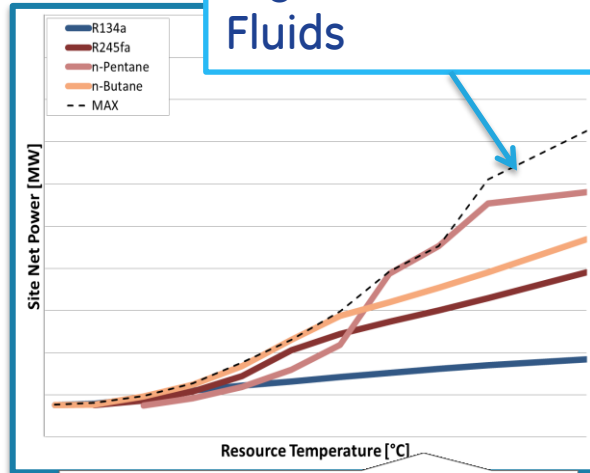
R245fa



n-Pentane

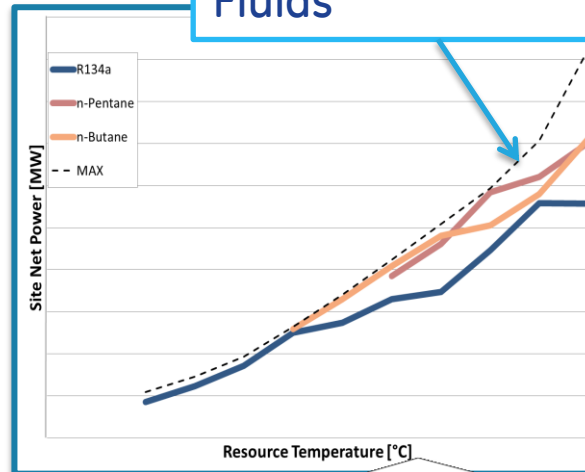
Fluid Performance Results

Max Net Power of Highest Performing Fluids



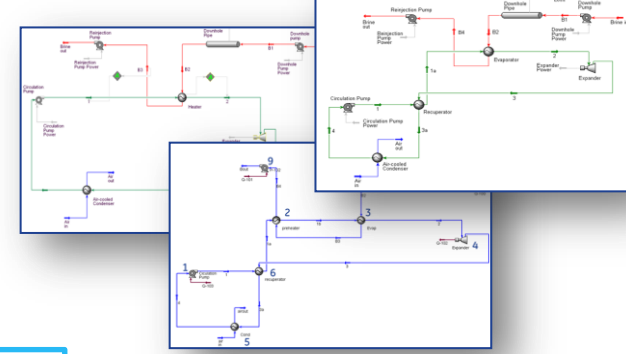
Subcritical Site Net Power

Max Net Power of Highest Performing Fluids

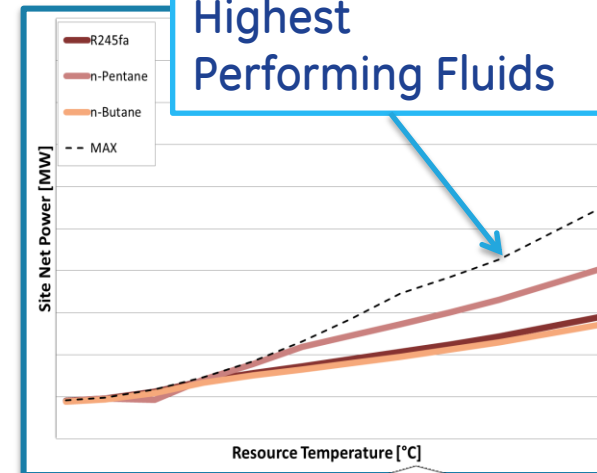


Supercritical Site Net Power

ASPEN cycle models



Max Net Power of Highest Performing Fluids



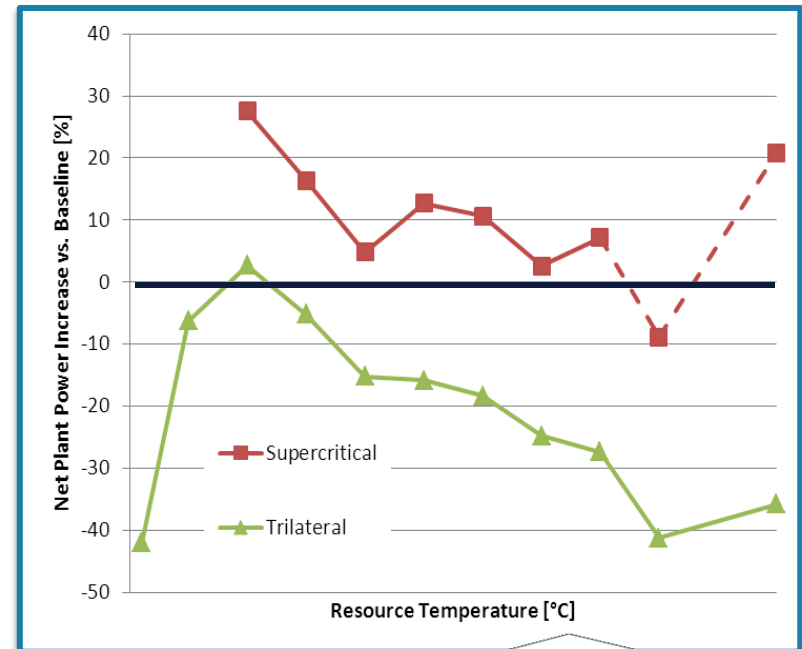
Trilateral Site Net Power

Overall Findings

- With a combination of WF and advanced cycle, performance can be improved 30-50%
- There is no single highest performance fluid for all resource temperatures or cycle

With the 35 high performing WF identified, the next step is to:

- Evaluate the economics
- Develop a Pilot Scale Rig



Cycle Performance Compared to Subcritical

Thank You!

