# Technology Development Needs for sCO2 Heat Exchangers

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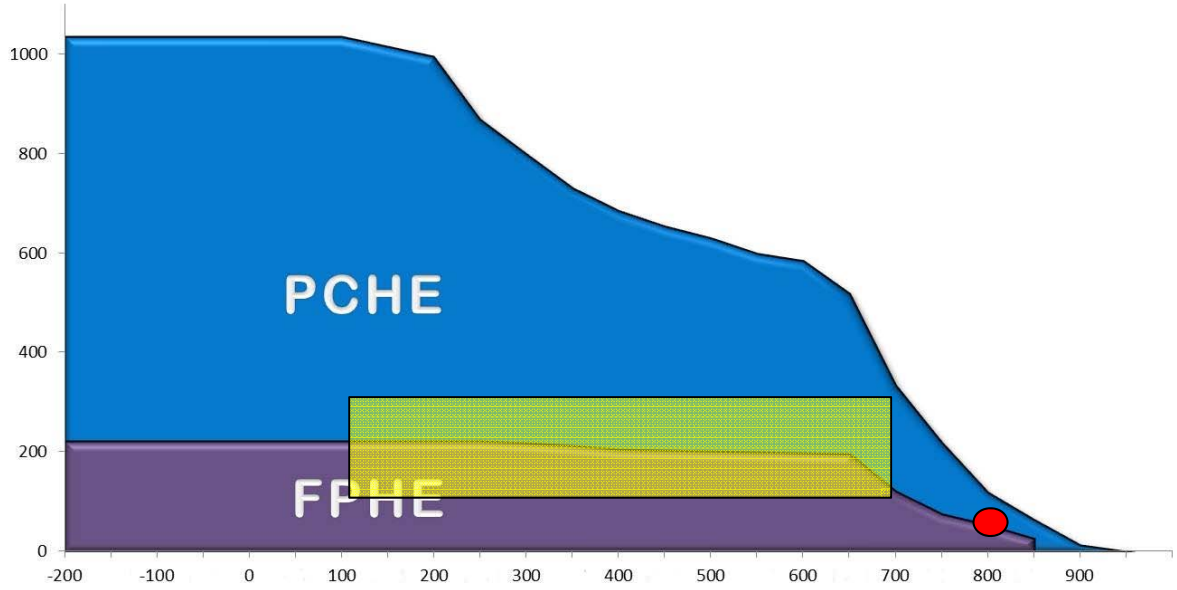
Thursday 15 October 2015 – San-Diego

# Technical Challenges

- Heat Exchangers
  - Design Pressure



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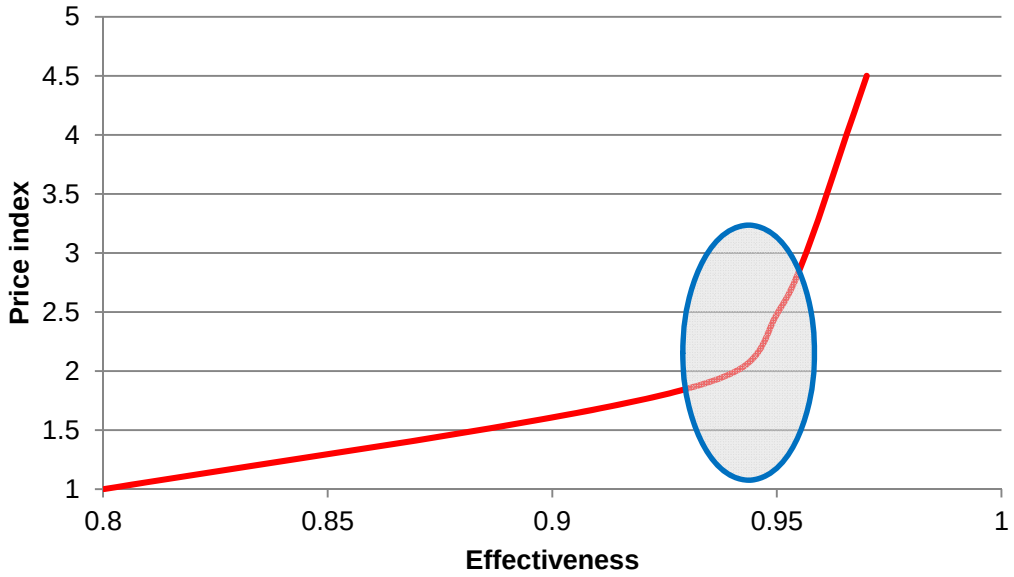
  - Temperature Approach



# Technical Challenges

- Heat Exchangers
  - Design Pressure
  - Temperature Approach
  - Material of construction
- Existing materials
  - 316L – 649°C
  - >649°C – higher grade alloys (HR 120 – 617?)
  - Corrosion behaviour?
- New Materials
  - Must be strong, corrosion resistant, cheap and available in many product form:
  - Which one?

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- Heat Exchangers
  - Design Pressure
  - Temperature Approach
  - Material of construction
  - Recuperators?
- Existing Technology
  - ASME ‘U’ qualified
  - Proven performance in sCO2 test loops since 2003 (TIT, SNL, Echogen, GE, KAERI)
  - Proven performances in many other Brayton cycles (Nitrogen, Air, Helium).

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  - Recuperators?
  - Coolers?




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  - Material of construction
  - Recuperators?
  - Coolers?
- Existing Technology
  - 30 years of PCHE gas coolers
  - Many units used in extremely harsh offshore environments
  - Mature products
    - 2200 PCHE (<85 tons)
    - 15 FPHE (<50 tons)
  - 304 / 304L / 316 / 316L / Duplex / Ti Grade 2 / 6 Moly

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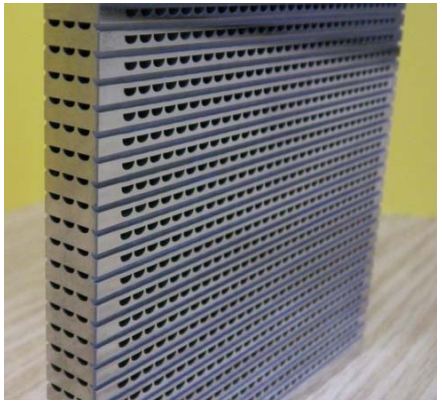
  - IHX?



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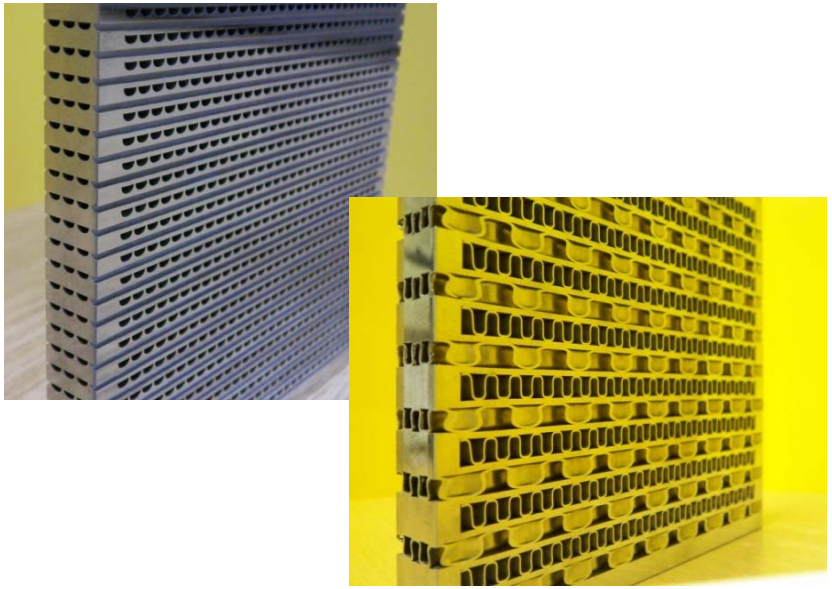

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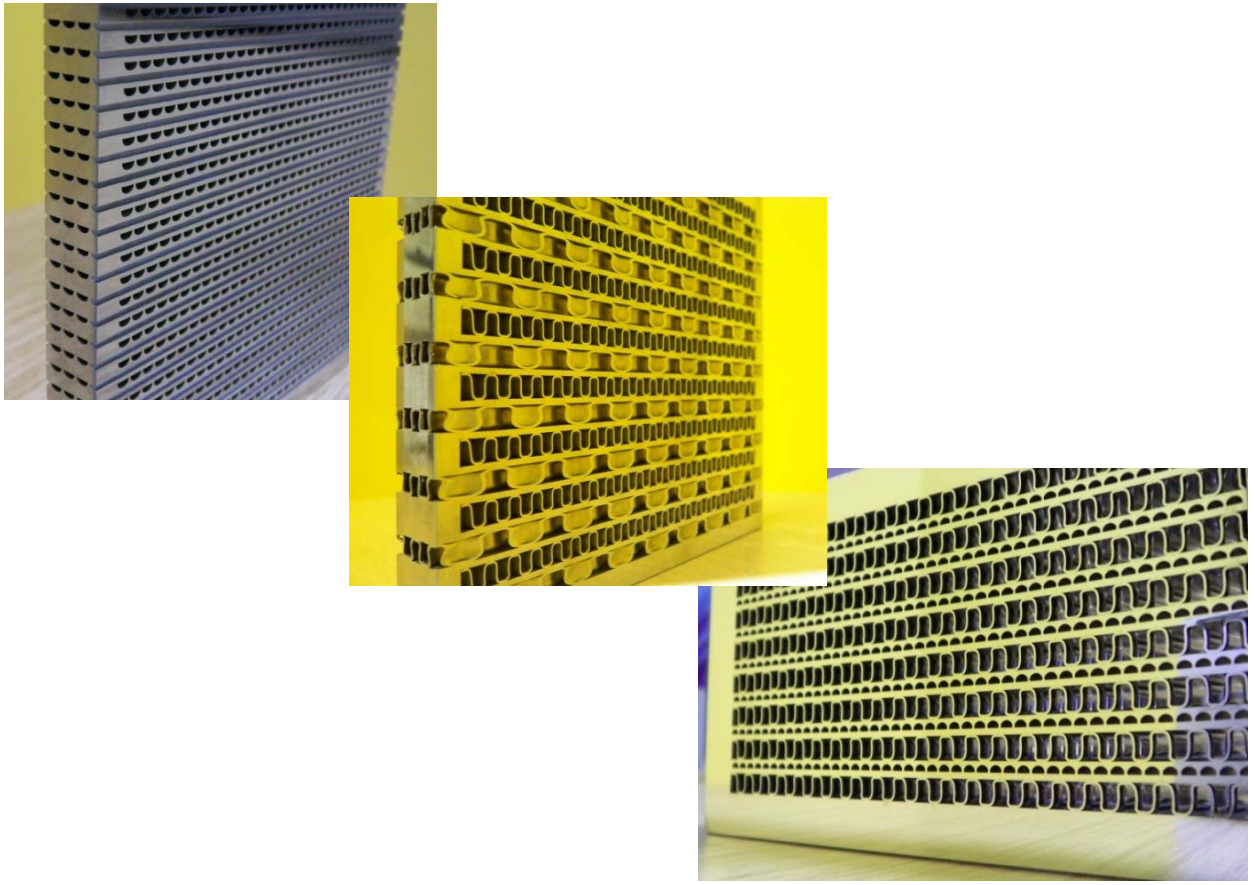

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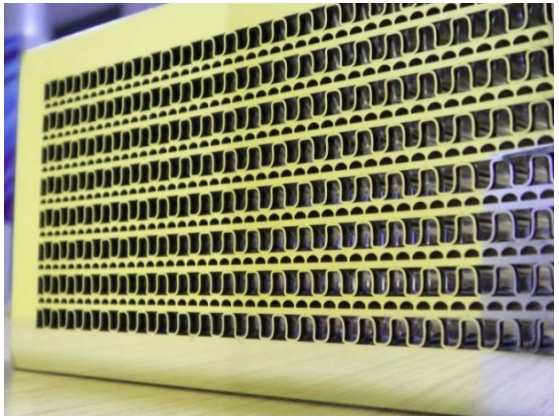
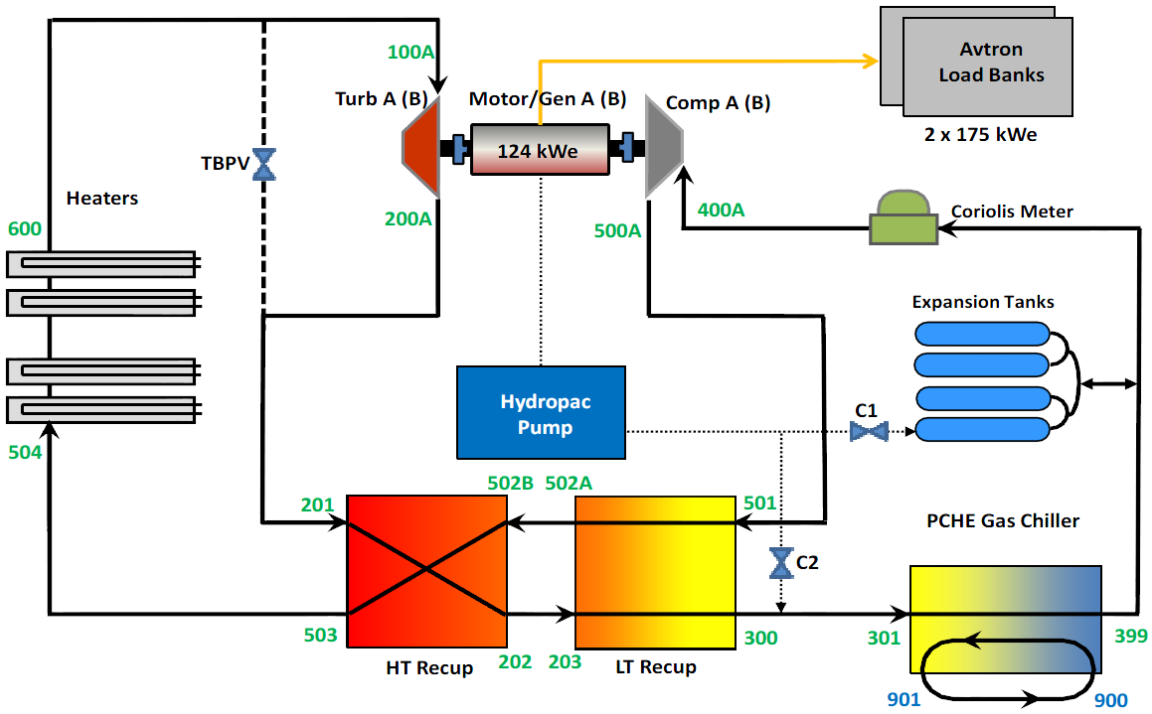
- Heat Exchangers
  - Design Pressure
  - Temperature Approach
  - Material of construction
  - Recuperators?
  - Coolers?
  - IHX?
- IHX needs development
  - High temperature section (material)
  - Most likely hybrid to address
    - Low pressure and pressure drop on the hot side
    - High pressure on the sCO2 side



# Technical Challenges

- Test Loop overall
  - Design and components optimisation



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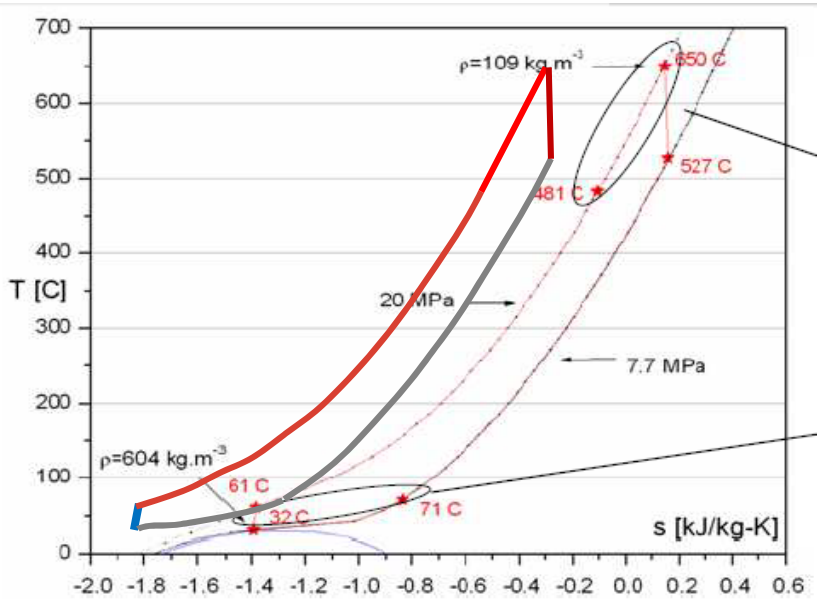
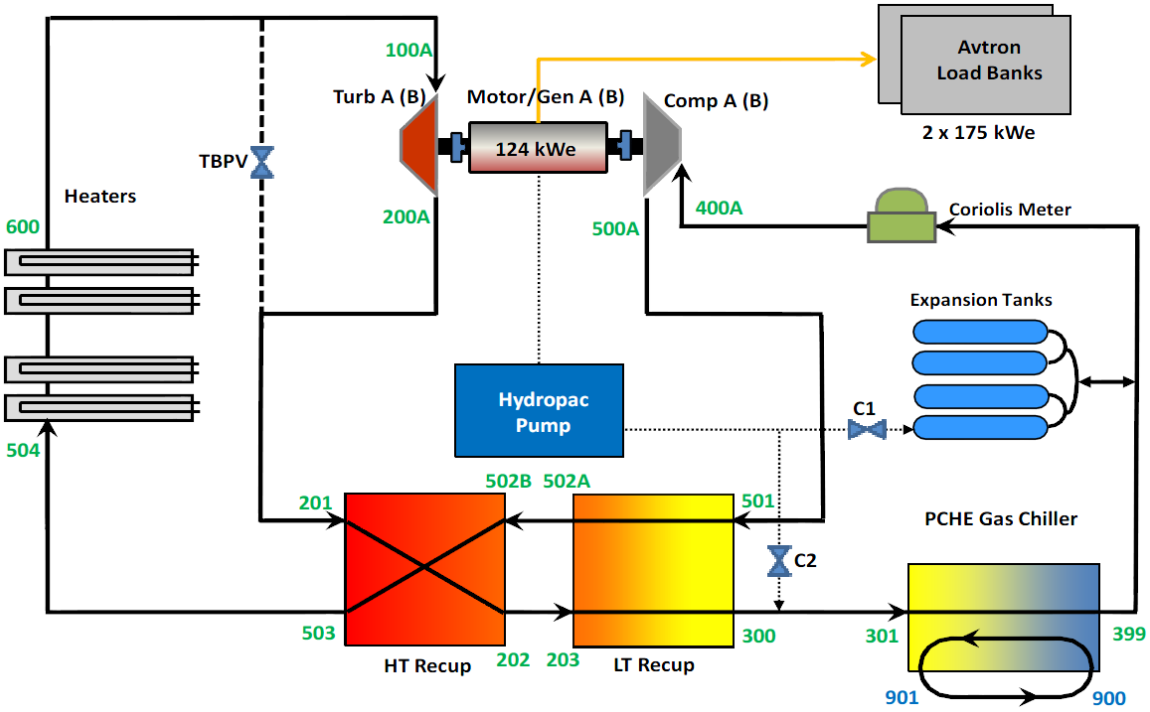
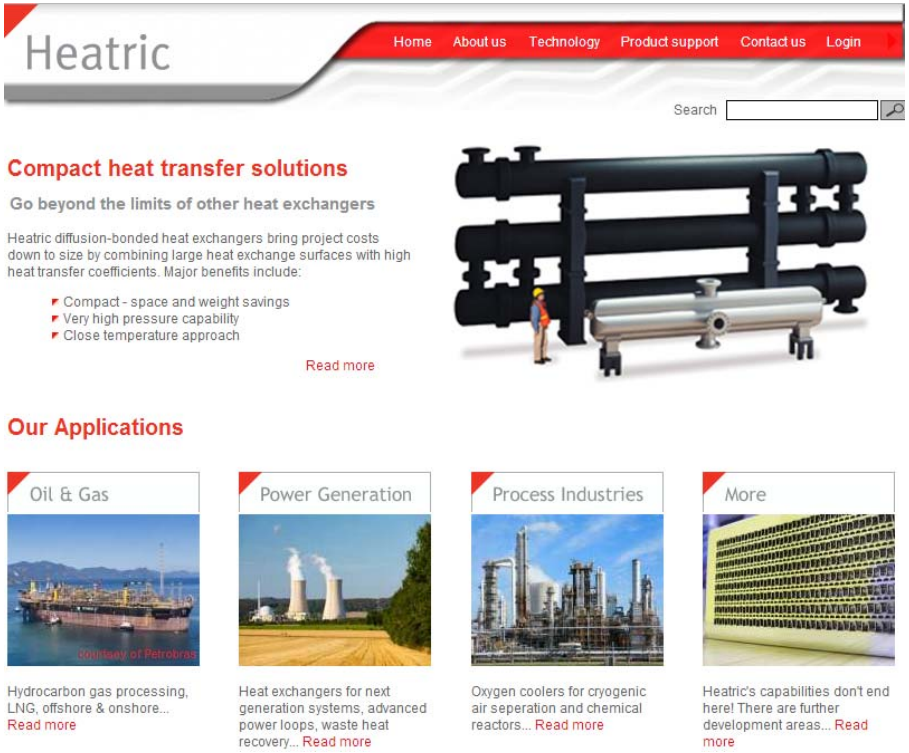


# Technical Challenges

- Test Loop overall
  - Design and components optimisation
  - Control (start-up, shutdown, off-design cases …)
  - Influence off various material of construction on various components



# Thank you

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