Industrial Thermal Energy Recovery Conversion and Management

Industrial Thermal Energy Recovery, Conversion and Management 'I-ThERM'

EE-18-2015
Project Number: 680599

Market uptake

Feasibility and cost-effectiveness
Financing energy efficiency in industrial settings

Savvas A Tassou & Giuseppe Bianchi

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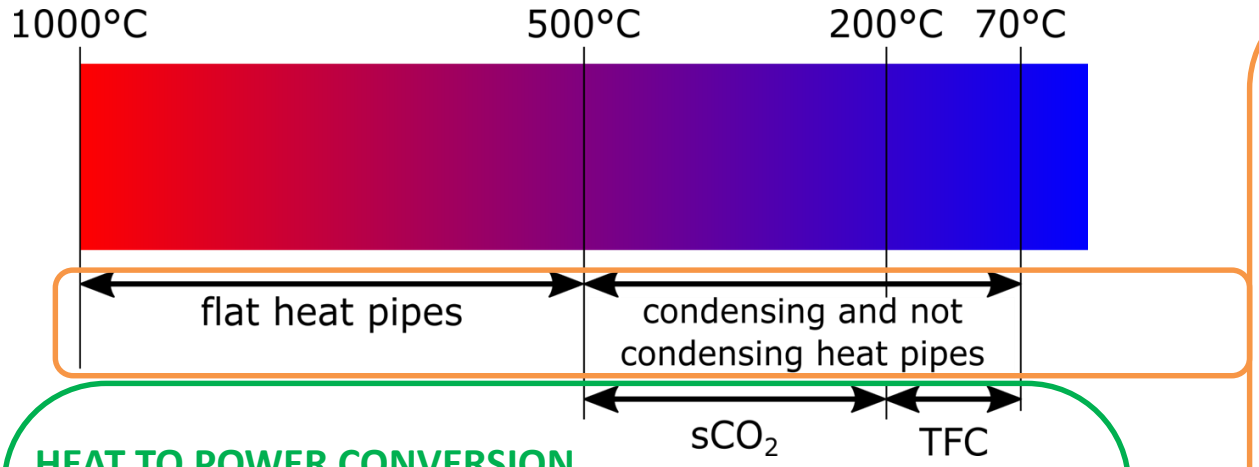
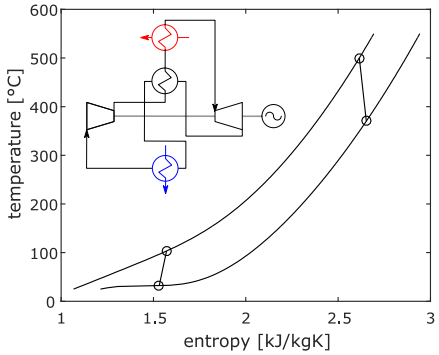
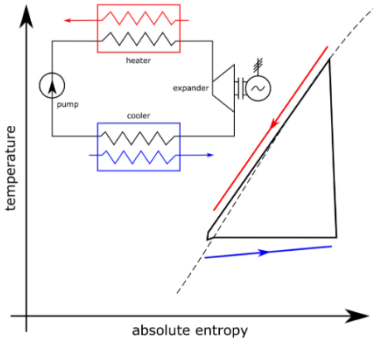
I-THERM'S PLUG AND PLAY TECHNOLOGIES



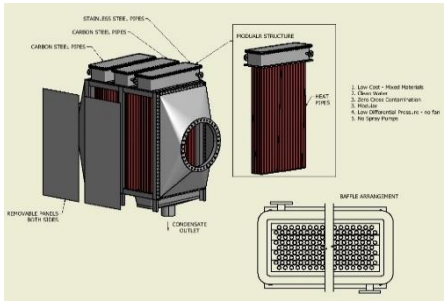
HEAT TO POWER CONVERSION



Supercritical CO_2 (sCO_2) cycle



Trilateral Flash Cycle (TFC)



Heat Pipe Condensing Economiser

Flat Heat Pipe System

HEAT RECOVERY

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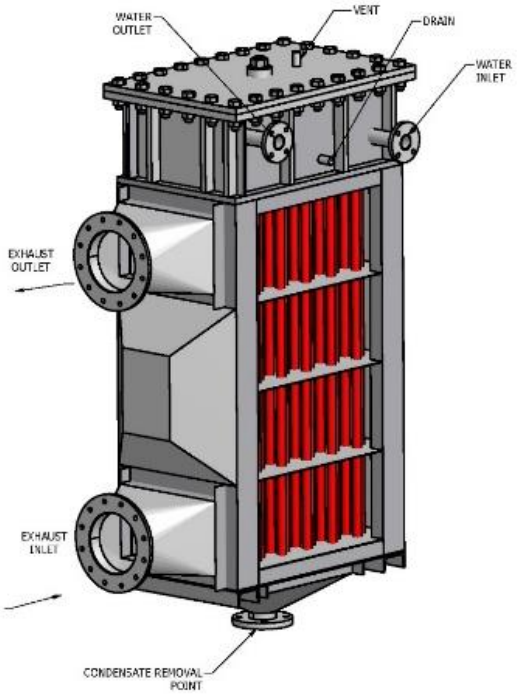
Heat Pipe Condensing Economiser (HPCE)

Technology Advantages:

- Corrosion resistance
- Ease of maintenance and repair-replace individual pipes.
- Higher efficiency than convention CEs



Key Application Areas:

- Biomass and oil fired system exhausts
- Oil & gas
- Iron & steel
- Acidic exhausts

Financial Metrics:

- For power: >150 kW_{th}
- Target investment cost: ~150 €/kW_{th}
- Pay back period (8000 h/yr): <1 year
- Emission savings (150kW_{th} unit): 288 tCO_{2eq}/yr

Challenges for Exploitation:

- Coating development, costs if exotic alloys used.
- Impact of engineering works on the business case

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Flat Heat Pipe System (FHPS)

Technology Advantage:

- Heat recovery from radiant heat sources
- Modularity
- Different shapes can be used
- Wide range of temperatures

Key Application Areas:

- Steel industry
- Glass industry
- Any radiant waste heat source

Financial Metrics:

- For power range: >200 kWth
- Pay back period (8000h/yr): 1.7-2.5 years
- Emission savings (200kWth unit): 336 tCO_{2eq}/yr

Challenges for Exploitation:

- Niche markets
- Impact of engineering works on the business case

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Trilateral Flash Cycle System (TFC)

Technology Advantages:

- Heat to power conversion from low grade heat sources
- Better heat utilization than ORCs
- Easy to apply for liquid effluents

Key Application Areas:

- Any low grade waste heat source (<100°C)
- Geothermal
- Food Industry
- Chemical & Petrochemical Industry

Financial Metrics:

- For power range: 100-300 kWe
- Target investment cost: 1500-2000 €/kWe
- Emission savings (100kWe unit): 350 tCO_{2eq}/yr

Challenges for Exploitation:

- Financing of investment
- Competition with ORCs
- Different markets are being explored

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Supercritical CO_2 (sCO_2) heat to power Cycle

Technology Advantages

- Heat to power conversion from high grade heat sources
- Potential for much higher efficiency than ORCs and conventional Rankine cycle systems
- Very Compact

Key Application Areas

- Any high grade waste heat source (>350°C)
- Decarbonisation of fossil fuelled power plants
- Nuclear power generation
- Concentrated solar power generation

Financial Metrics

- Too early stage to establish with confidence
- The larger the system the more competitive
- Target- 300 kWe for 1,0 MWth
- Pay back period (8000h/yr): 3.5-5.0 years
- Emission savings (300kWe unit): 1070 tCO_{2eq}/yr

Challenges for Exploitation:

- High equipment cost
- Low technology readiness levels

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Lessons Learned with I-ThERM

- Waste heat recovery is an opportunity for business and the environment
- Challenges are partly technological but also very importantly economical
  - Quick return on investment
  - Minimal interference with the core industrial process
  - Risk (technical, economic, safety)
  - Generally lack of incentives and approrpiate financial instruments

Natural gas price statistics: https://ec.europa.eu/eurostat/statistics-explained/index.php/Natural_gas_price_statistics#Natural_gas_prices_for_non-household_consumers

Emissions factors: http://data.europa.eu/89h/jrc-com-ef-comw-ef-2017

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