Sustainable Process Industry through Resource and Energy Efficiency

Industrial Thermal Energy Recovery Conversion and Management

I-ThERM

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

EE-18-2015
Project Number: 680599

Pilot Implementation Challenge and Lessons Learned

Savvas A Tassou & Giuseppe Bianchi

Brussels, 07/02/2019

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 680599.

Aim of I-ThERM Project

Investigate, design, build and demonstrate innovative plug and play waste heat recovery solutions to facilitate optimum utilisation of energy in selected industrial applications with high replicability and energy recovery potential in the temperature range 70°C-1000°C.

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Major Objectives:

- Develop heat recovery and heat to power conversion technologies in packaged or easily customisable plug and play forms that can readily be applied in industry.
- Develop an intelligent system for monitoring and on-line integration and control of the operation of these technologies to maximise heat recovery and conversion.
- Implement, monitor and evaluate the performance of the technologies, evaluate their impact on overall energy consumption and CO_2 emissions.
- Disseminate the outputs widely to industry, other key stakeholders and policy makers.

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CONSORTIUM

13 partners: 3 large industry, 7 SMEs, 3 RTDs

Brunel University London

spirax sarco

ΤΕΧΝΟΛΟΓΙΚΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΚΥΠΡΟΥ 2004

TATA TATA STEEL

ENOGIA

An ISO9001 Organisation econotherm WASTE HEAT RECYCLING TECHNOLOGY

ArcelorMittal

avanzare nanomaterials... part of our everyday life

energy perts .net

Synesis

Arluy Takes care of you

CETRI Center for Technology Research & Innovation

ΤΕΧΝΟΛΟΓΙΚΟ ΕΚΠΑΙΔΕΥΤΙΚΟ ΙΔΡΥΜΑ ΣΤΕΡΕΑΣ ΕΛΛΑΔΑΣ

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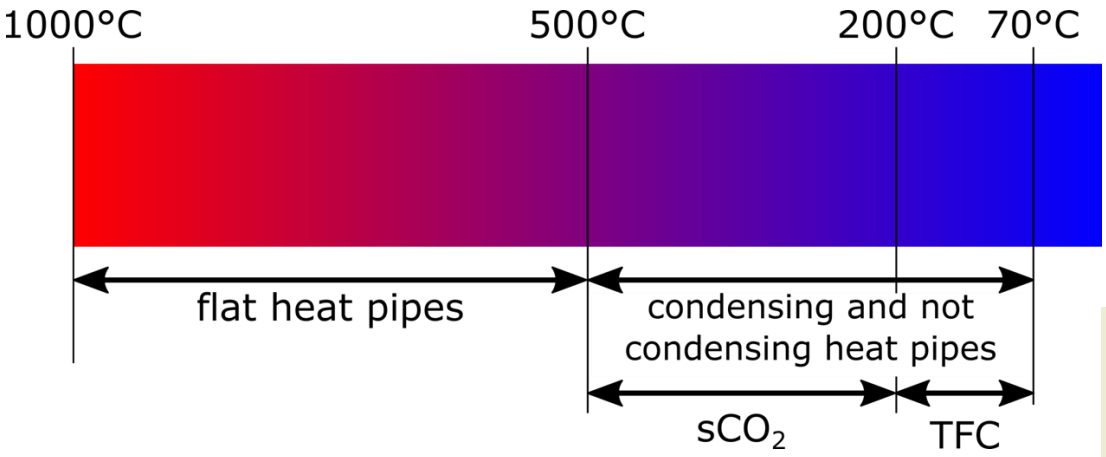
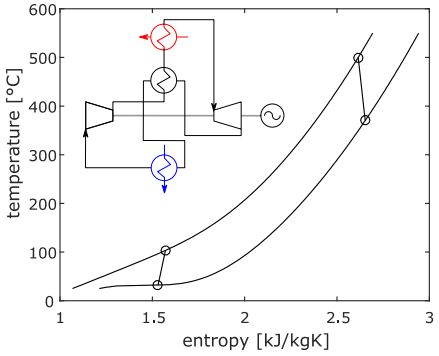
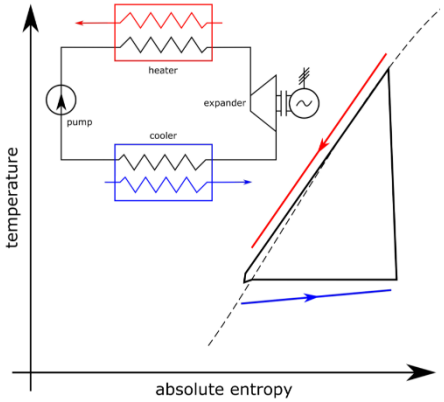
4 PLUG AND PLAY TECHNOLOGIES



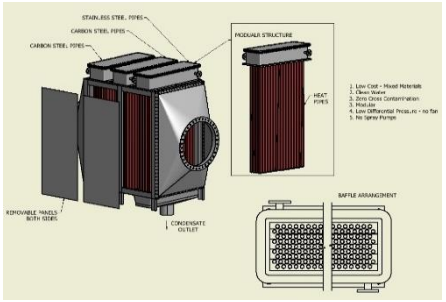
Flat Heat Pipe System



Supercritical CO_2 (sCO_2) cycle



Trilateral Flash Cycle (TFC)



Heat Pipe Condensing Economiser

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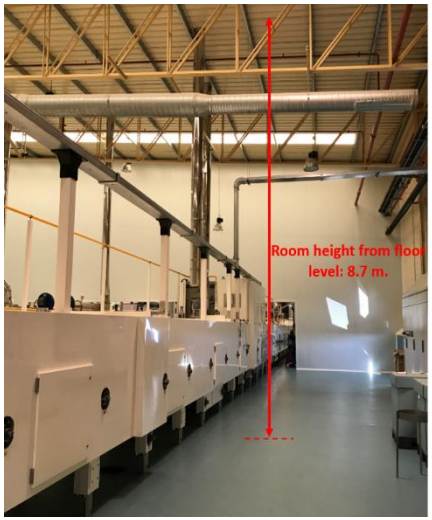
Pilot Implementation Challenges
Lessons Learned

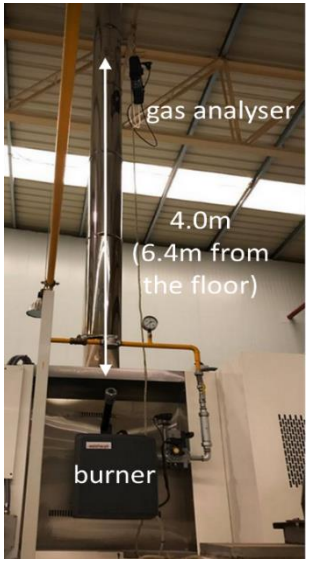
Heat Pipe Condensing Economiser (HPCE)

Objective:
Develop HPCE system to enhance heat recovery from corrosive exhausts – application in many industries.

Demonstration:
Arluy (Spain) – Biscuit Manufacturer.
Exhaust heat recovery from bakery oven.

Research and Development work:
i) development and application of innovative coatings to protect against condensation;
ii) design and manufacture HPCE system; Implement coatings and controls;
iii) test, evaluate and demonstrate system





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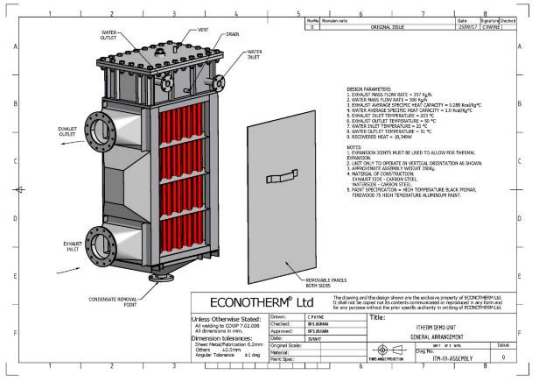
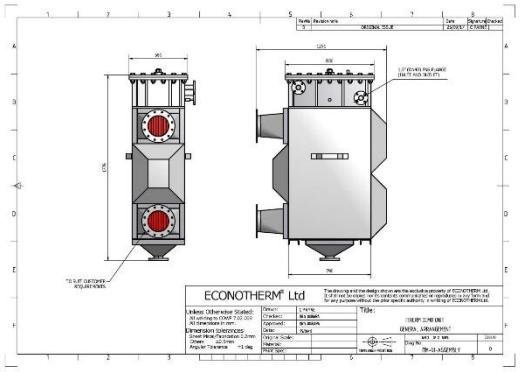
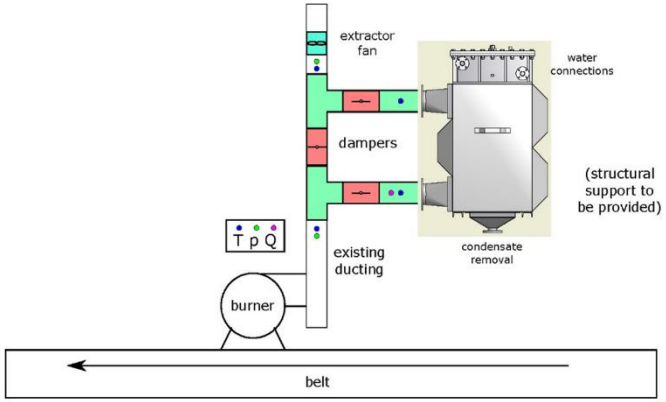
Heat Pipe Condensing Economiser (HPCE)

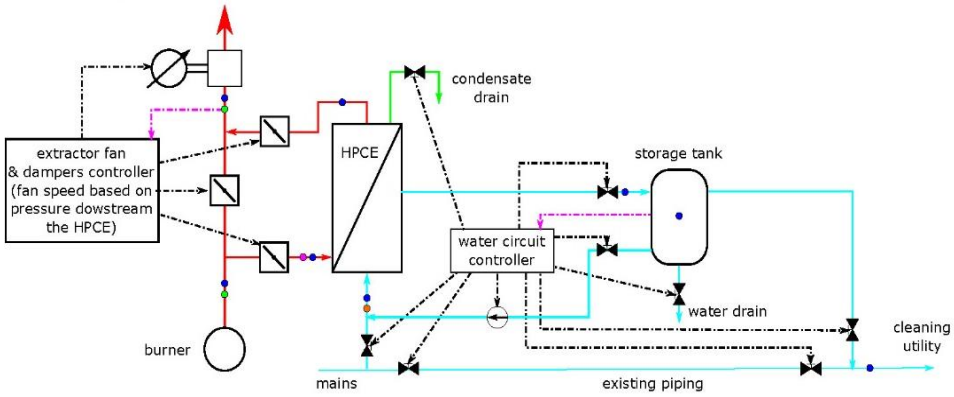






Issues with demonstration:

- Quantity and level of corrosiveness of exhaust gases
- Demand for hot water too far from point of heat recovery adding to cost of piping and pumping
- Continuous operation of ovens – disruption from the installation of the heat recovery system.
- Alternative demonstration sites are being considered



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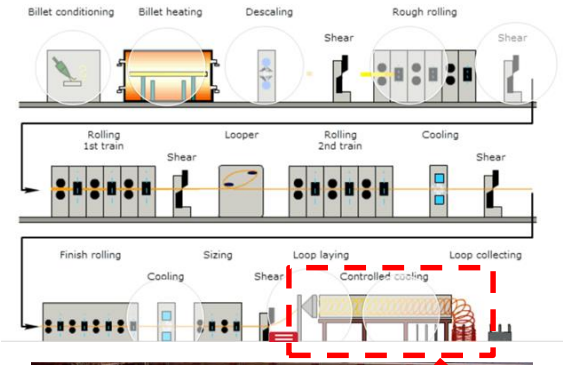
Flat Heat Pipe System (FHPS)

Objective:
Develope a heat pipe system to facilitate waste heat recovery from hot solids/high temperature radiant surfaces (> 500ºC).

Demonstration:
ArcellorMittal (Spain) – Steel manufacture.
Heat recovery from Wire Rod Mill.

Research and Development work:

i) simulate, design and manufacture modular prototype unit;
ii) test the unit in laboratory and site;
iii) implement and demonstrate a 200 kW unit at ArcellorMittal site.



Wire rod mill

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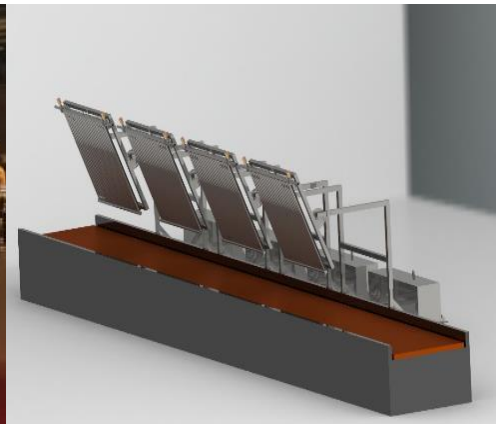
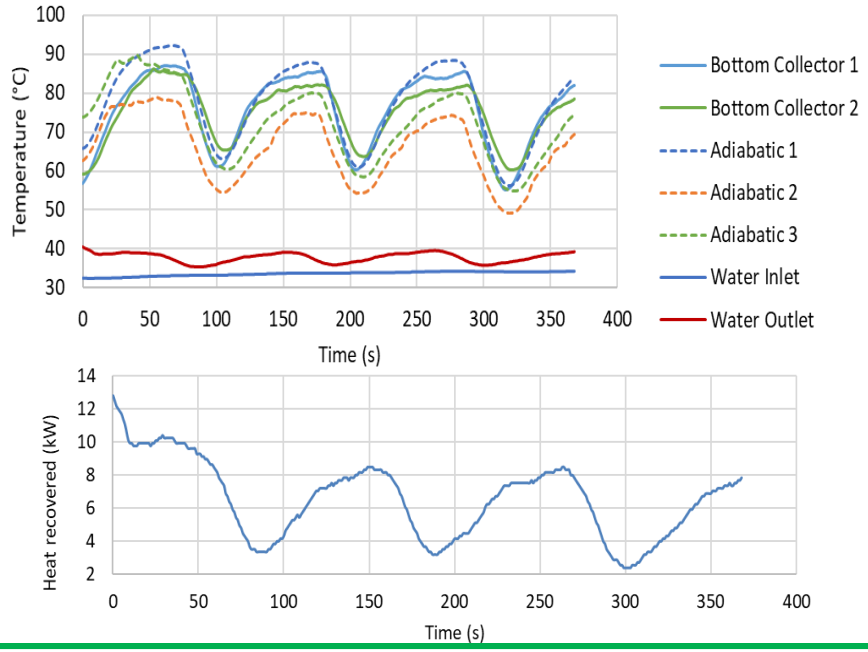
Flat Heat Pipe Systems (FHPS)



Issues with demonstration:

- Significant difficulties in installing a 200 kW system in the factory.
- Easy accessibility to the cooling line required if something goes wrong
- Long distance from point of heat recovery to point of heat utilisation.



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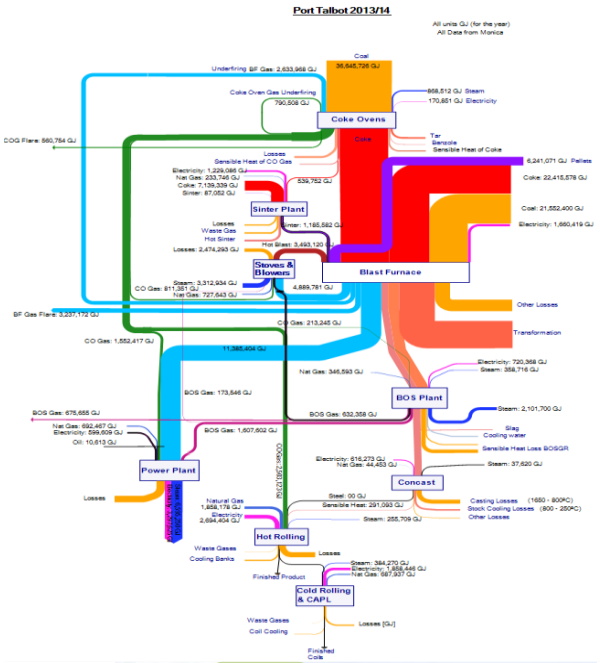
Trilateral Flash Cycle System (TFC)



Objective:

Develop build and demonstrate a TFC system suitable for waste heat to power conversion at less than 100^{o}C.

Demonstration:

Tata Steel (Port Talbot UK).

Heat rejection from ammonia plant.

Research and Development work:

i) simulate, design and build a 100 kWe unit;

ii) test and fine tune the unit at Spirax Sarco;

iii) implement and demonstrate the unit at Tata Steel.

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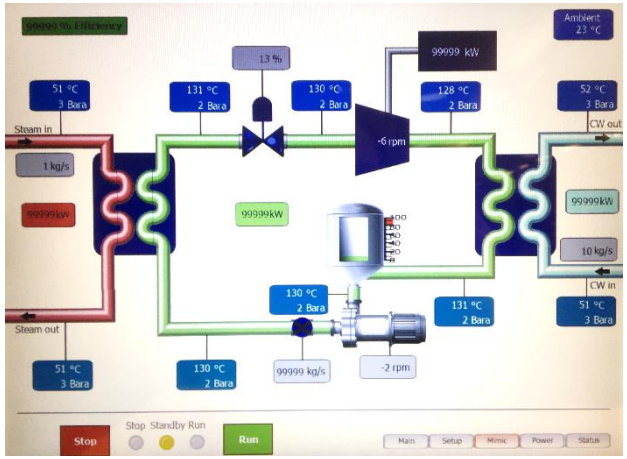
Trilateral Flash Cycle System (TFC)

Issues with demonstration:

- Significant quantities of waste heat – identifying suitable application proved very difficult.
- Tata Steel in the UK went through difficult times so demonstration was not a priority for a period.
- Issues now addressed- demonstration progressing very well



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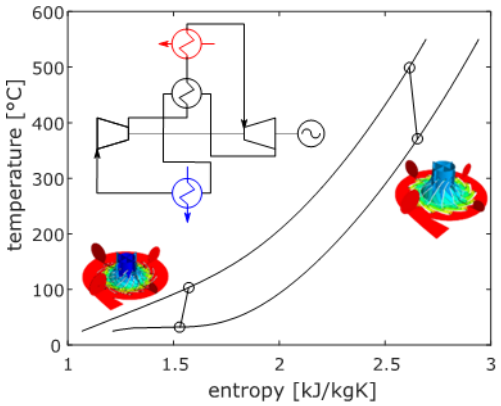
Supercritical CO_2 (sCO_2) heat to power Cycle

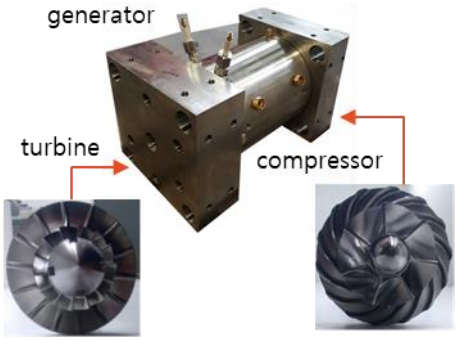
Objective:
Develop build and demonstrate a 50 kWe sCO_2 system suitable for waste heat to power conversion at temperatures up to 800°C.

Demonstration:
Brunel University London.
Heat rejection from gas fired heat source.

Research and Development work:

i) Simulate, design and build a 50 kWe unit;
ii) Design and procure a 1.0 MW heat source;
iii) Design and build test facilities;
iv) Commission, test and demonstrate the unit.





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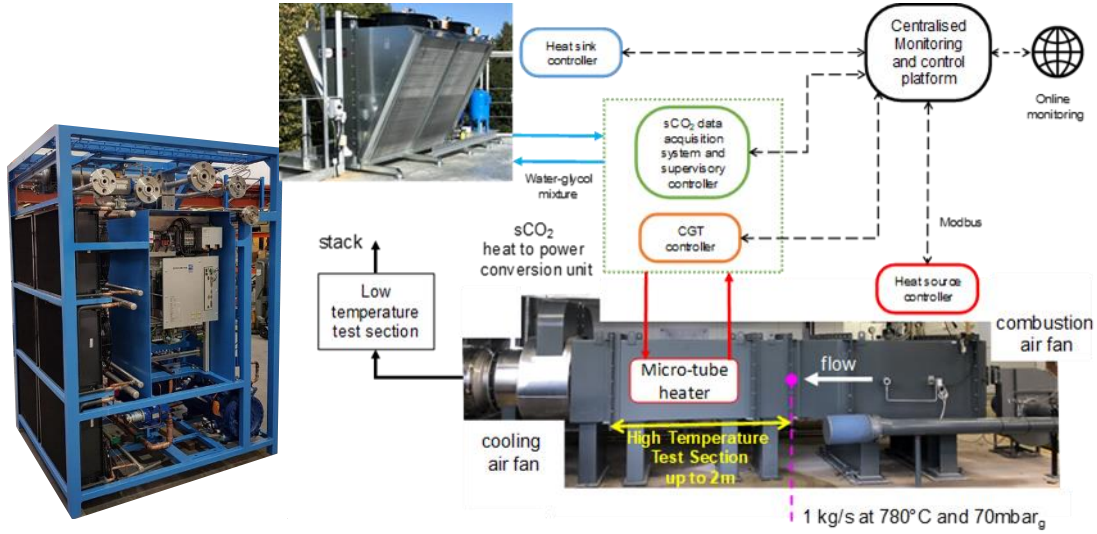
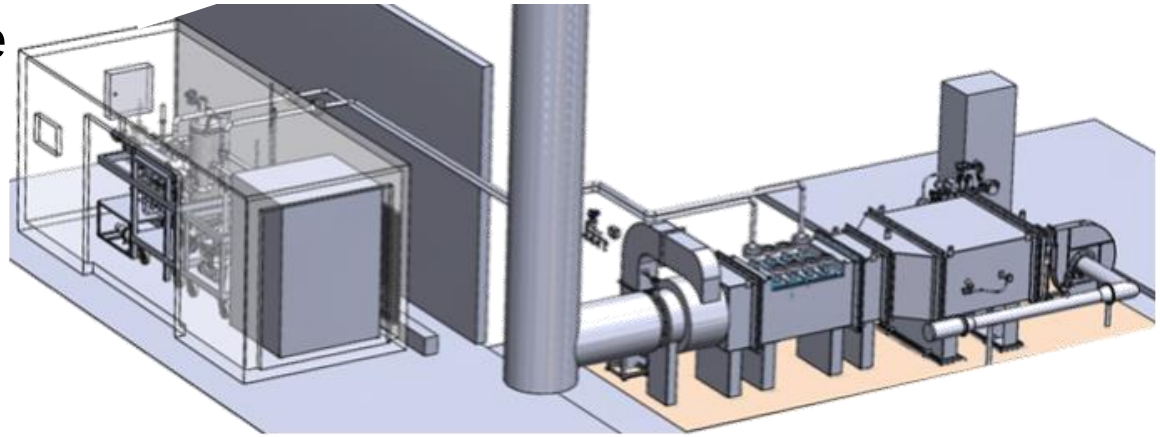
Supercritical CO_2 (sCO_2) heat to power Cycle

Issues with demonstration

- Availability of components and even materials.
- High costs
- Limited design and manufacturing expertise of high pressure/temperature components.
- Long delivery times





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Lessons Learned with I-ThERM

- More time spent on pin-pointing demonstration location in a large site at the application stage can save significant time and uncertainty.
- Demonstration projects can be very complex – more difficult if starting TRL is low.
- Disruption of manufacturing processes to install the demonstration technology very difficult.
- Safety and commercial risks can be prohibitive.
- Costs and complexities can be very easily underestimated
- Demonstration at smaller scale might be necessary before full-scale implementation at manufacturing site.

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