

Industrial Thermal Energy Recovery Conversion and Management

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WASTE HEAT RECYCLING TECHNOLOGY



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Synesis
sustainable automation

Arluy
Takes care of you

CETRI
Center for Technology Research & Innovation

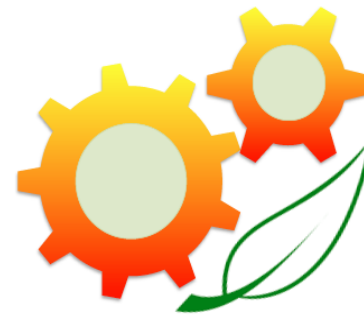
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www.itherm-project.eu



SPIRE
Sustainable Process Industry through
Resource and Energy Efficiency



I-ThERM

**Industrial Thermal Energy
Recovery Conversion
and Management**

I-ThERM

**DEVELOP AND DEMONSTRATE INNOVATIVE PLUG AND PLAY
TECHNOLOGIES FOR WASTE HEAT RECOVERY AND CONVERSION
FROM BOTH HIGH AND LOW TEMPERATURE WASTE HEAT
SOURCES: 70-1000 °C FOR PROCESS HEATING AND HEAT TO
POWER CONVERSION**

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OPPORTUNITIES AND BENEFITS

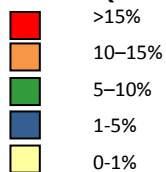
OPPORTUNITIES

- 30% - 50% of Energy input to thermal processes in industry is lost as waste heat
- Significant potential exists for the recovery and efficient utilization of this heat
- To fully exploit this potential, new innovative technologies and practices are needed

BENEFITS

- REDUCTION of fossil fuel use
- REDUCTION of CO₂ emissions
- REDUCTION in operating costs

Waste heat recovery potential in EU28 (370.42 TWh/yr)



I-ThERM CONTRIBUTIONS

- ◆ Enable application of new innovative technologies to waste heat recovery and heat to power conversion
- ◆ Produce 15% higher energy conversion efficiencies compared to current practices
- ◆ Produce CO₂ emission reductions at demonstration plant in excess of 20%



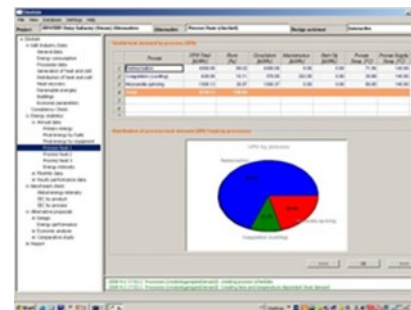
WEB-BASED HEAT RECOVERY MONITORING AND EVALUATION

Innovation

Development of an on-line monitoring, evaluation and control optimisation system to maximise energy conversion efficiency of heat recovery and heat to power conversion technologies

Progress

- EINSTEIN Expert system tool has been upgraded to incorporate the I-ThERM heat recovery and heat to power conversion technologies
- Hardware and software tools are being developed to enable real-time communication between monitoring and control system and EINSTEIN tool



Future activities

- Implement monitoring and control system to demonstration technologies
- Use web based monitoring and evaluate, in real-time, performance of the I-ThERM technologies at the specific demonstration sites



HIGH TEMPERATURE HEAT TO POWER CONVERSION

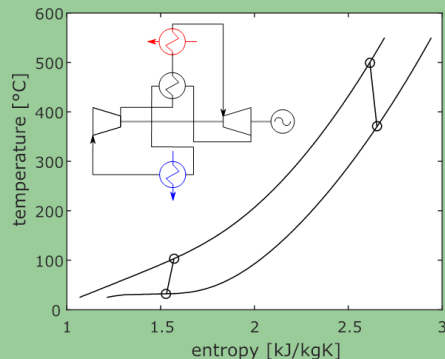
SUPERCRITICAL CO₂ (sCO₂) POWER CYCLE

Innovation

Development and demonstration of a 50 kWe supercritical CO₂ high temperature heat to power system

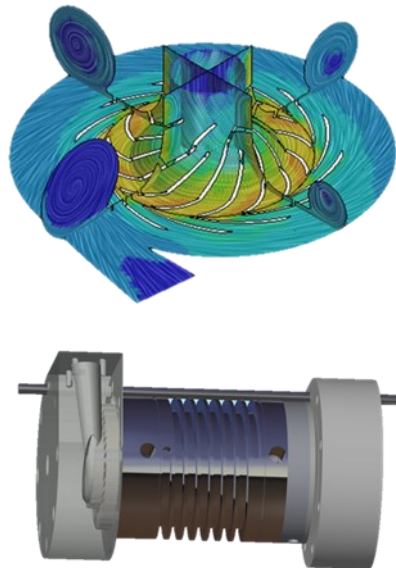
Progress

- Demonstration facility has been designed
- Procurement of major equipment in progress
- sCO₂ has been designed
- Turbomachinery and heat exchangers are being manufactured



Future activities

- Assemble and commission high temperature ~700 °C heat source
- Assemble sCO₂ prototype heat to power system, and integrate with heat source
- Demonstrate sCO₂ system and evaluate its performance



TWO-PHASE HEAT RECOVERY TECHNOLOGES

FLAT HEAT PIPES

Innovation

Development and demonstration of flat heat pipe technology for high temperature heat recovery from steel manufacturing plant

Progress

- Prototype unit designed and tested in laboratory
- Prototype tested in Arcelor Mittal steel wire drawing plant



Future activities

- Use learnings from prototype for development and demonstration of 200 KW_{th} unit

CONDENSING ECONOMISERS

Innovation

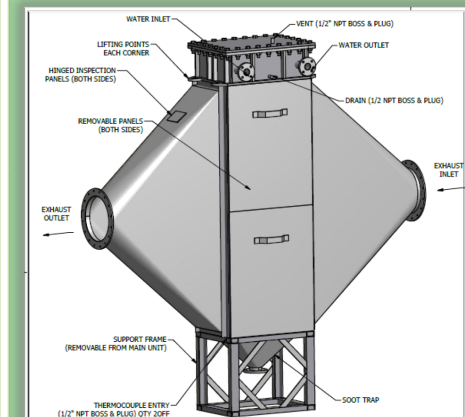
Low cost heat-pipe based high efficiency economiser (HPCE) to recover energy from condensing vapours in baking oven exhausts

Progress

- Baking oven characterised
- HPCE system is being designed

Future activities

- Manufacture, install and demonstrate the system at Arluy baking plant



HEAT EXCHANGER COATINGS

Innovation

Investigate and develop heat exchanger coatings for harsh environments/high temperature and acidic exhaust condensate

Progress

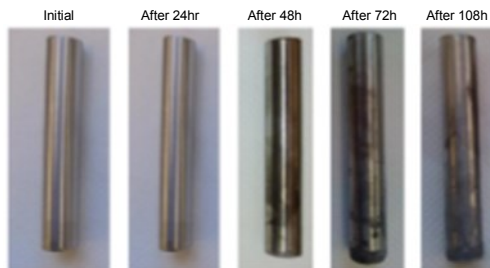
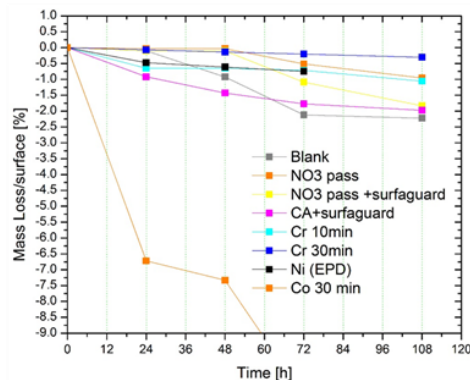
- State of the art review on coatings completed
- Testing and evaluation in the laboratory in progress investigating:
 - Influence of wetting phenomena
 - Coatings for different metallic materials
 - Coating deposition methods



Future activities

- Methods to enhance dropwise condensation
- Investigation of methods to enhance condensate removal
- Identification of most appropriate coatings for I-ThERM applications
- Implementation and evaluation of coatings on heat exchangers

40% H₂SO₄ corrosion tests



LOW TEMPERATURE HEAT TO POWER CONVERSION

THE TRILATERAL FLASH CYCLE (TFC) SYSTEM

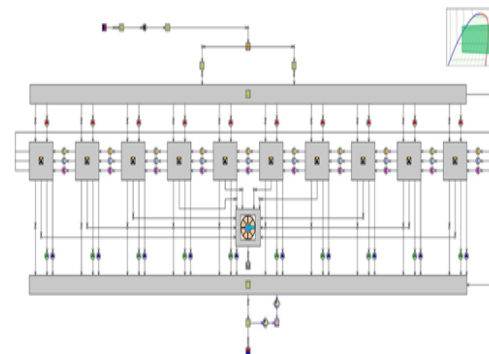
Innovation

Development and demonstration for the first time of a 120 kWe low temperature ~70-100 °C TFC heat to power conversion system

Progress

- Principles of TFC have been tested on small scale rigs

- Prototype system has been designed and manufactured for 2.0 MW_{th} and ~70 °C heat source



Future activities

- Install and test prototype system at Spirax Sarco
- Install and monitor system at a TATA Steel site for demonstration and evaluation of its performance

