Hurricane

Sector coupling hub for circular use of thermal and industrial waste

Hubs 4 Circularity – cluster webinar
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02/04/2025

Co-funded by the European Union

HURRICANE is funded under the call HORIZON-CL4-2023-TWIN-TRANSITION-01-37 within Horizon Europe, the European Union's framework programme for research and innovation (grant agreement no.:10113849)

Sustainable circular economy transition:

From industrial symbiosis to hubs for circularity

HURRICANE transforms traditional steelmaking plants into multi-sectoral circular hubs, pioneering a sector-coupling initiative at the Ghent site of ArcelorMittal Belgium.

Project scale:
24.836.547,25€

EU grant:
19.090.973,75€

11 partners from
4 countries

Project duration:
60 months

Project dates:
Jan 2024
– Dec 2028

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Challenges for the industry

High CO_2 emissions

- Traditional steelmaking contributes significantly to industrial emissions

Resource inefficiency

- Significant waste of thermal energy and raw materials

Energy dependency

- High reliance on fossil fuels and external energy sources

Community impact

- Limited integration with local energy needs

Main objectives

Resource efficiency

- 20% reduction in energy, water, and raw material consumption

Circular economy

- Create multi-sectoral circular hubs for industrial symbiosis

Community integration

- Connect industry with local communities through district heating

Sustainability

- Demonstrate scalable solutions for industrial decarbonization

Project scope

Transforming the steel industry

Creating multi-sectoral circular hubs

- By connecting existing circular projects (Steelanol, Torero, RecHycle)
- By implementing a heat grid

Innovative waste heat recovery

Connecting industry with communities

Consortium

Belgian Partners

ArcelorMittal

CRM GROUP

vito

Lokaal bestuur Zelzate

Sint-Jan-Baptist psychiatrisch centrum

provincie Oost-Vlaanderen

FNARMIT

German Partners

DBFZ

Italian Partners

Università Politecnica delle Marche

Portuguese Partners

PDM

Technologies for a circular hub

Heat recovery solutions

- Innovative heat exchanger technology for both radiative and conductive heat exchangers

Heat upgrading solutions

- 3 MW heat pump to upgrade heat from the low temperature heat grid

Heat grid back up

- Steam expansion turbine as back up for the heat grid to guarantee continuous supply of heat

Digital integration

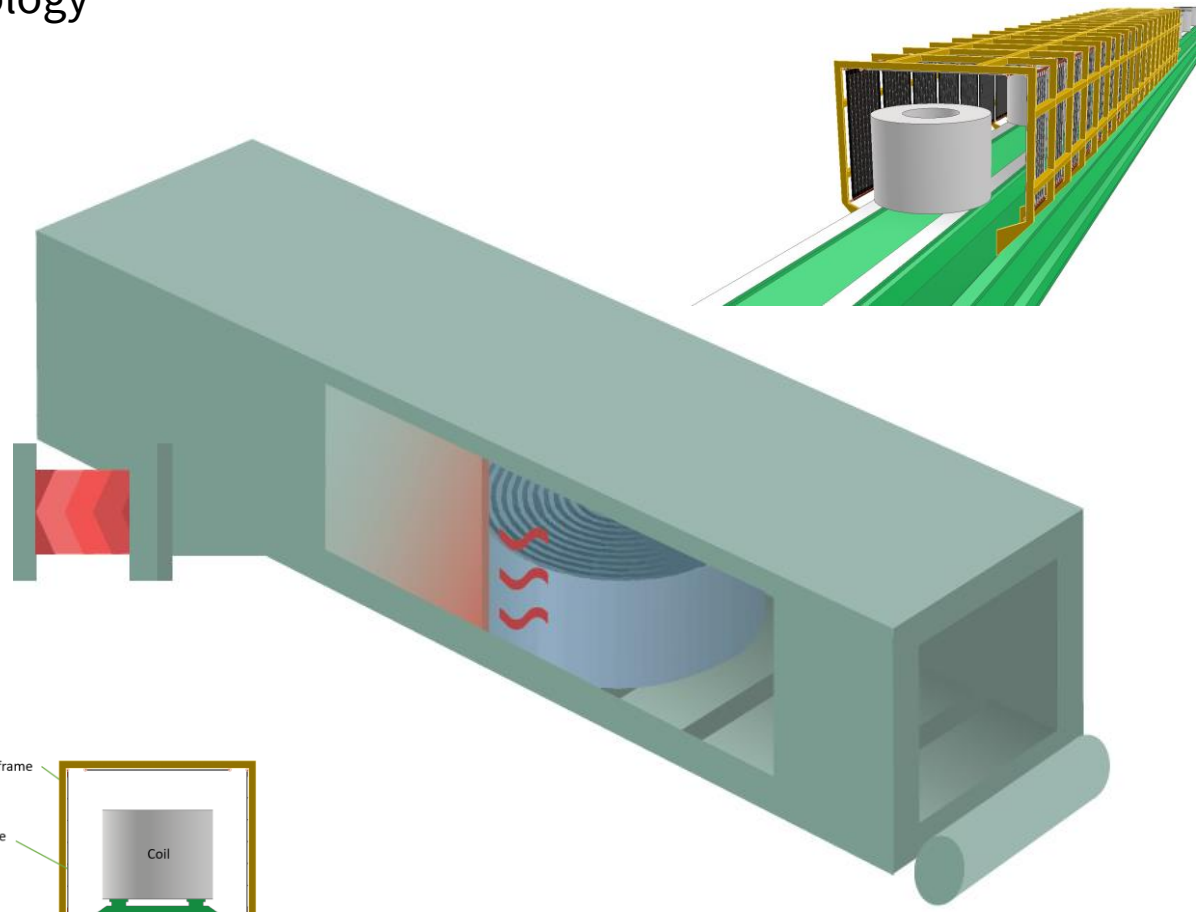
- Smart monitoring and control systems

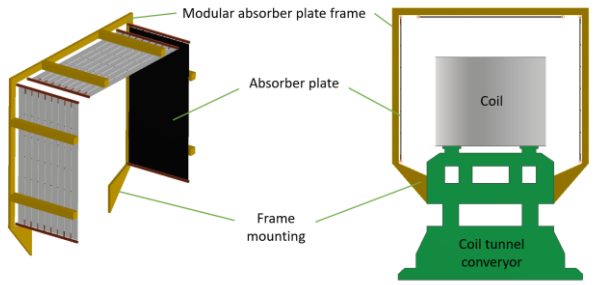
Technologies/demonstrations

Heat recovery solutions: innovative heat exchanger technology

Radiative heat exchanger

- Coils are leaving the hot strip mill at approx. 500 – 600 °C
- First-of-their-kind panels collect heat by radiation
- Enables the recovery of up to 3 MW of power (with a potential of >18 GWh per year)
- TRL: 5 → 7



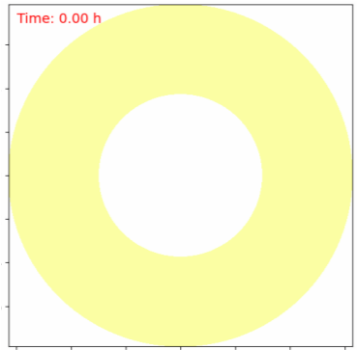


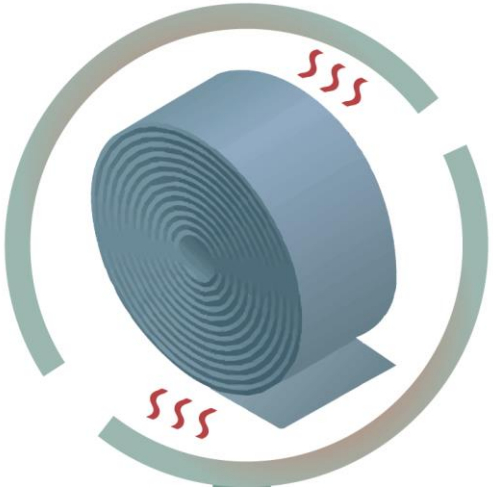
Technologies/demonstrations

Heat recovery solutions: innovative heat exchanger technology

Conductive heat exchanger

- Fast cooling of the coils
- Up to 300 kW per coil can be harvested
- Average number of coils produced yearly: 230.000 coils
- TRL: 5 → 7



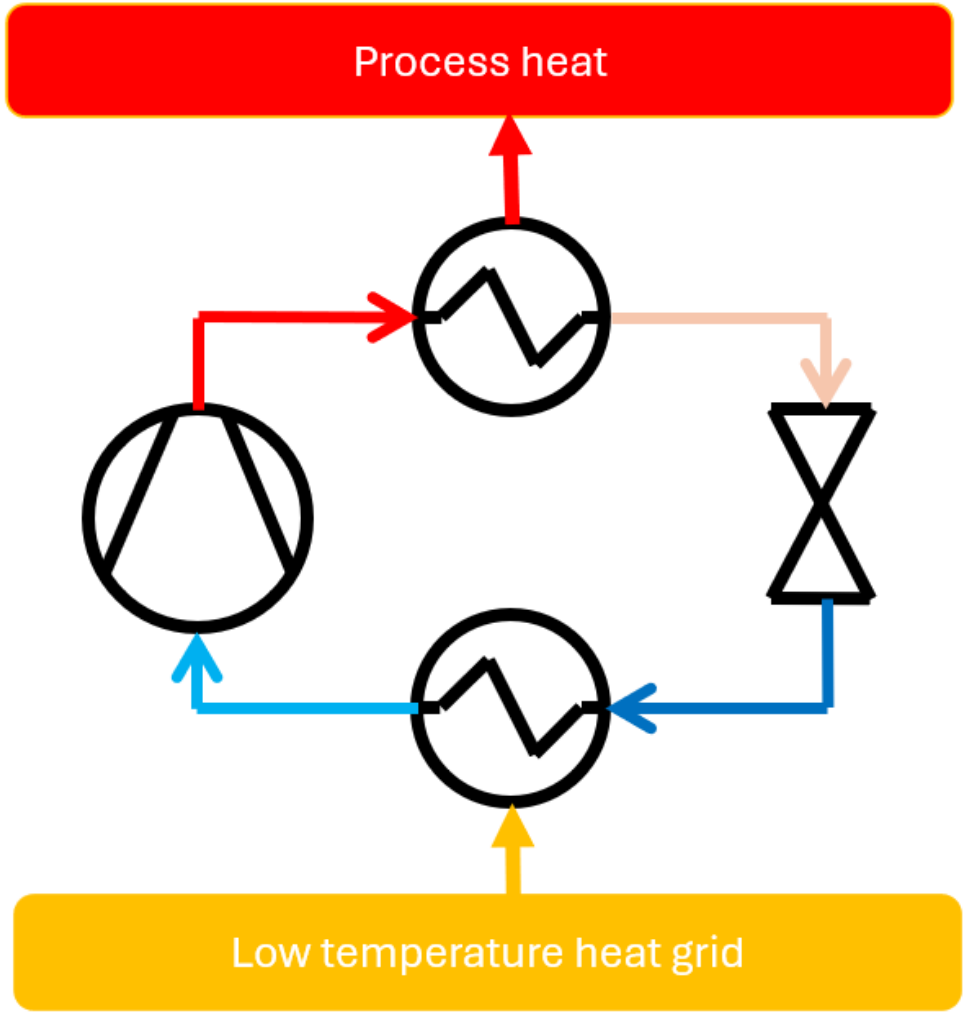


Technologies/demonstrations

Heat upgrading solutions:

Heat pump

- 70°C → 120 °C
- Thermal power > 3MWth
- COP > 3,5
- TRL 5 → 7

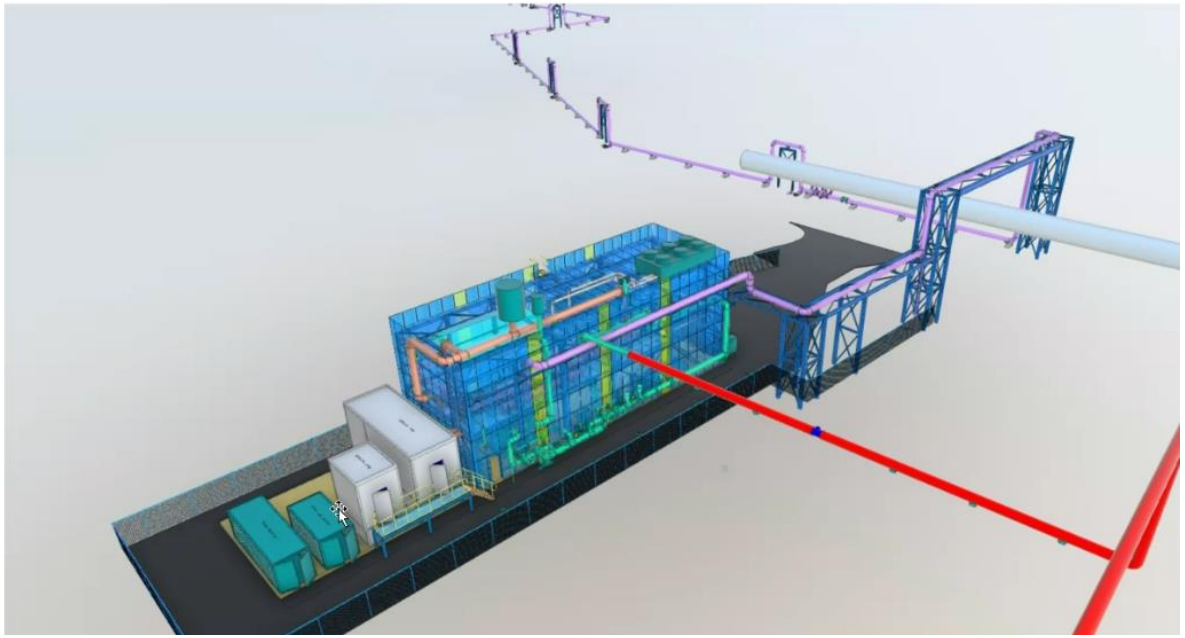


Technologies/demonstrations

Heat grid back up:

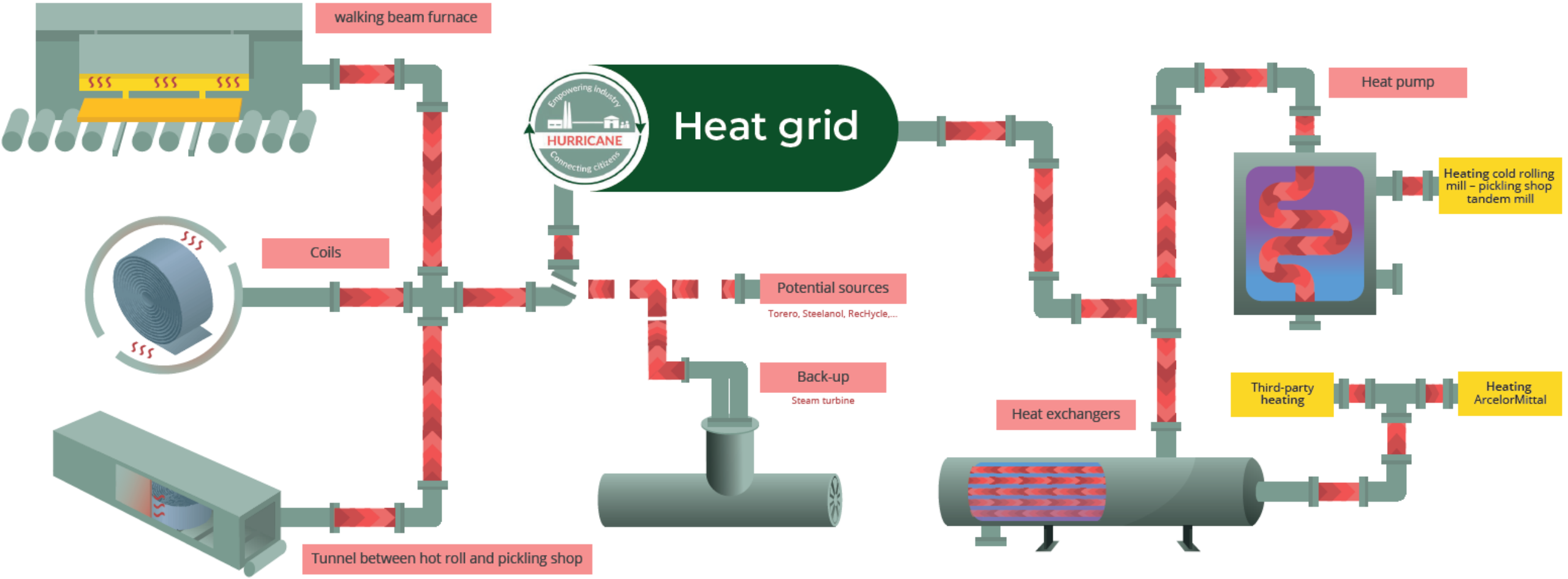
Steam expansion turbine

- Connected to a sludge treatment plant (treating 2/3 of the sludge of the Flemish households)
- HP steam 40 barg → LP steam 11 barg
- TRL: 7 → 9

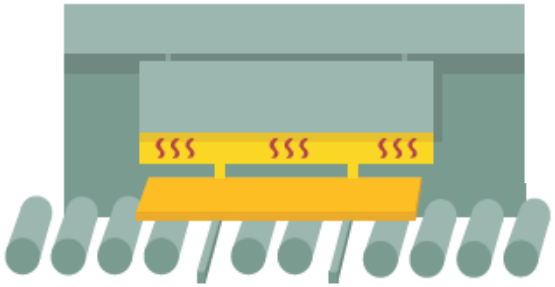


Demonstrations – circular hub

- Heat grid at the site of ArcelorMittal Ghent



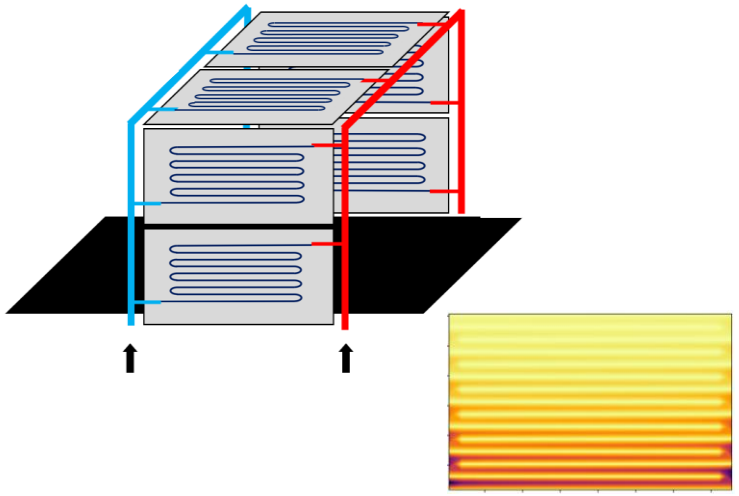
Heat recovery units: an overview



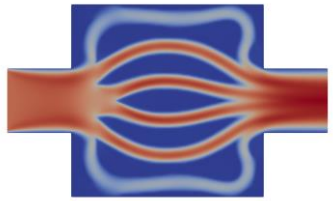
Tunnel	Coil yard	Walking beam furnace
• Radiation • Up to **3 MW** can be harvested	• Conduction • Up to **300 kW per coil** can be harvested	• Cooling system + plate HEX • Up to **8 MW** can be harvested

15 - 20 MW in total → **100 – 140 GWh** per year

Heat recovery in the tunnel



Vermani S. *et al*, VITO



Vermani, Tosto, VITO

Current infrastructure

- Design **parameters**
- Design **limitations**

Baseline design

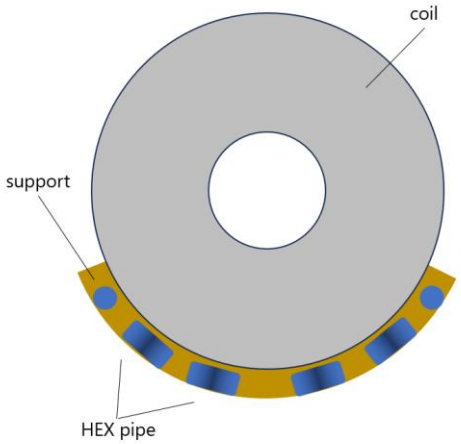
- **0D:** System modelling
- **2D-3D:** Component-level design

Optimization

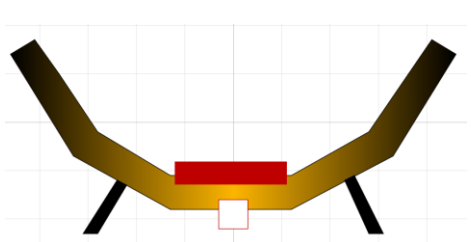
- CFD based **topology optimization**

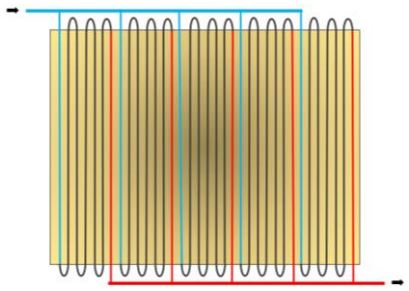
Heat recovery in the coil yard

WHR configuration



Models & simulations

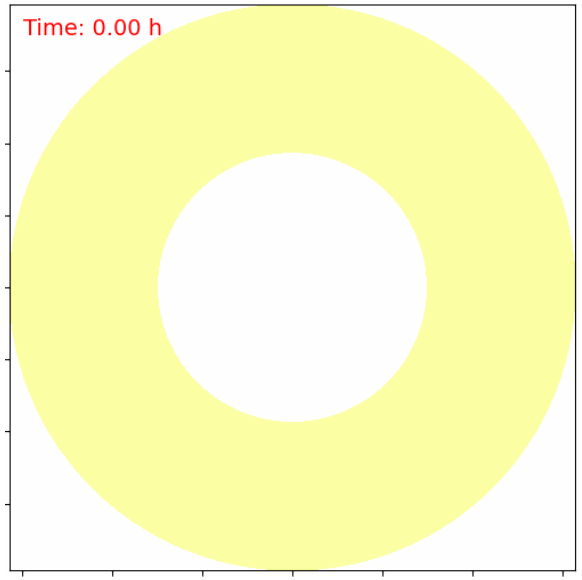




0D system → 2D topology modeling

Results

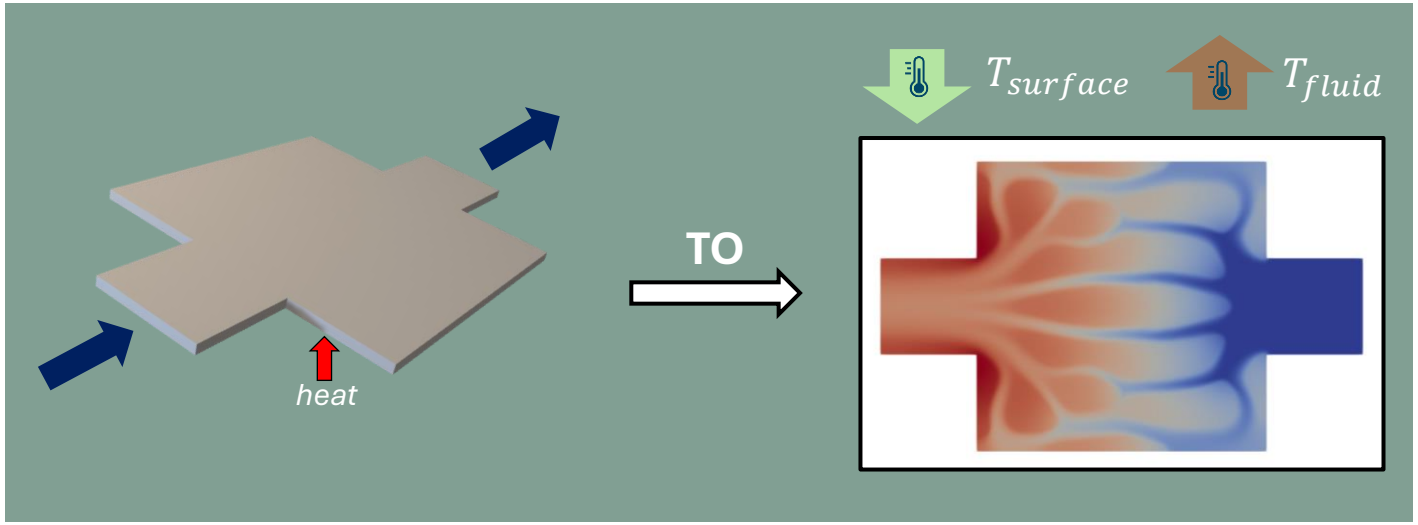
90% coverage

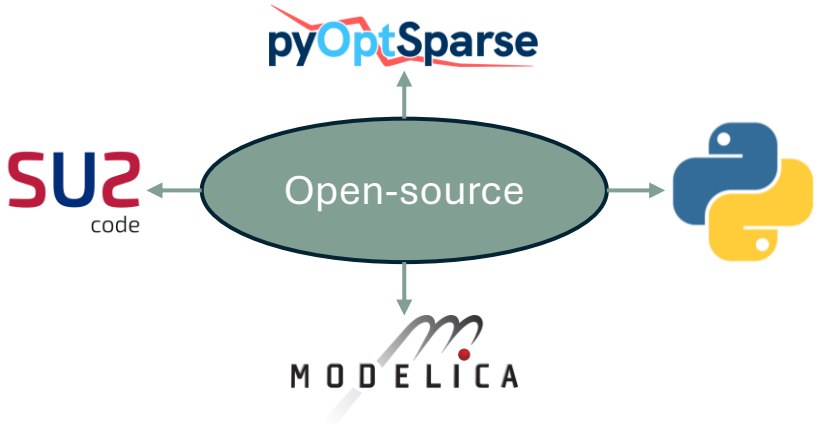


- Cooling time: days → **few hours**
- At peak **300 kW** harvested per coil

Optimization framework & tools

- Computational fluid dynamics (CFD) based optimization
  - Shape optimization
  - **Topology optimization (TO)**
- System modeling and digital twin development





District Heating Network (DHN)

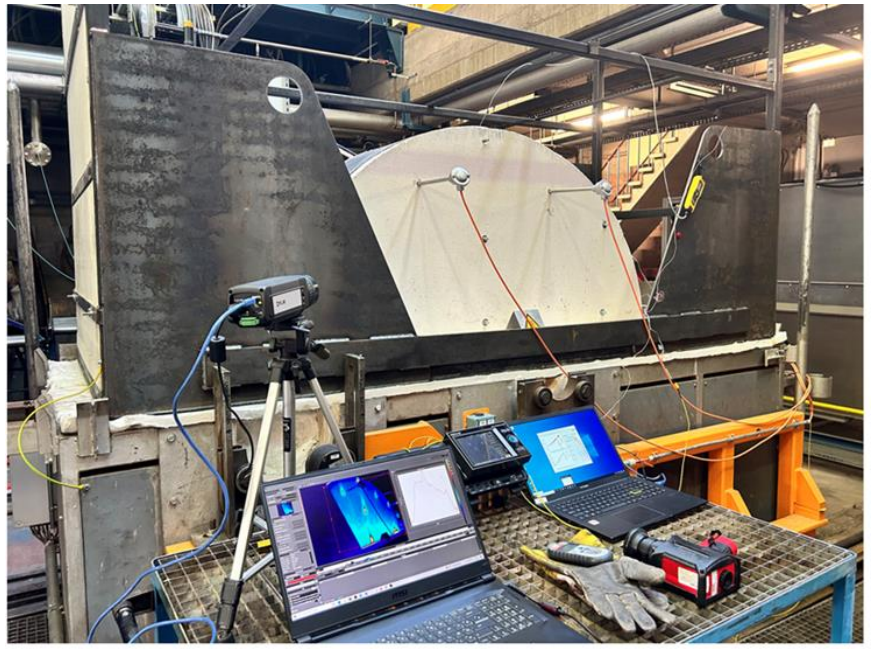
- Control and digitalization of DHN: **STORM**

- Design and optimization of DHN: **PathOpt**

Harvesting coil waste heat (lab trials)

- Coil simulator

Industrial hot coils



Hot coil laboratory simulator

Radiation surface with thermocoupels

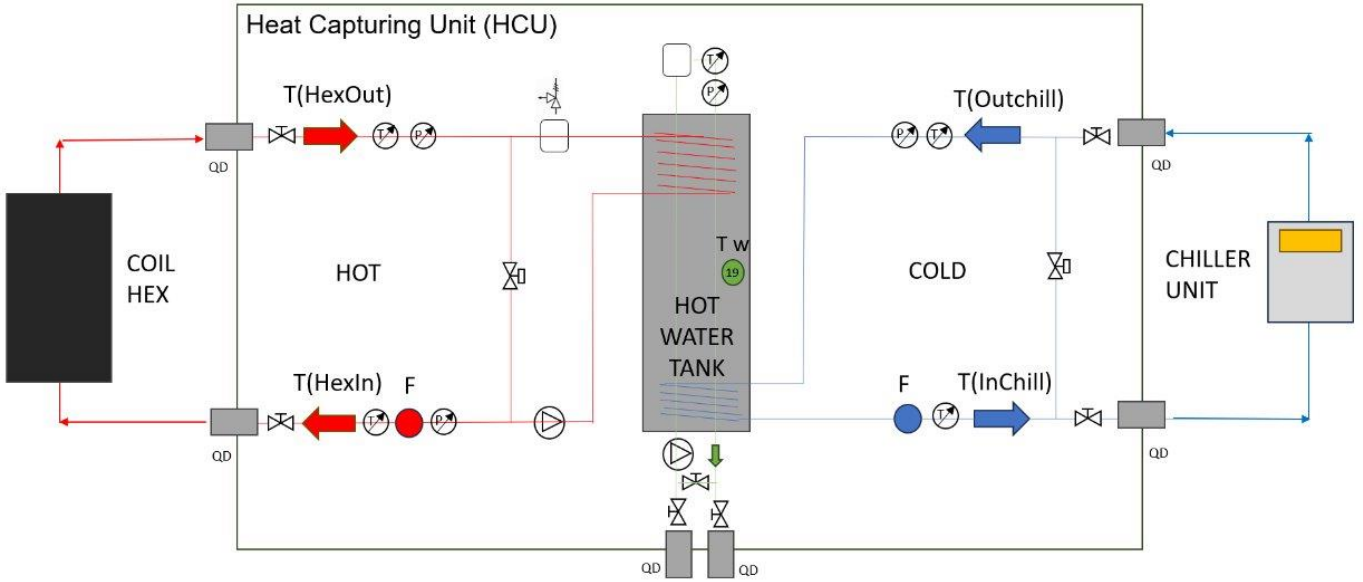
90kW hot coil simulation stand in laboratory (~1m^2, up to 650°C surface temperature)

Thermal camera, thermocouples and flux sensor

Radiation and conduction heat transfer trials (semi full scale)

Harvesting coil waste heat (lab trials)

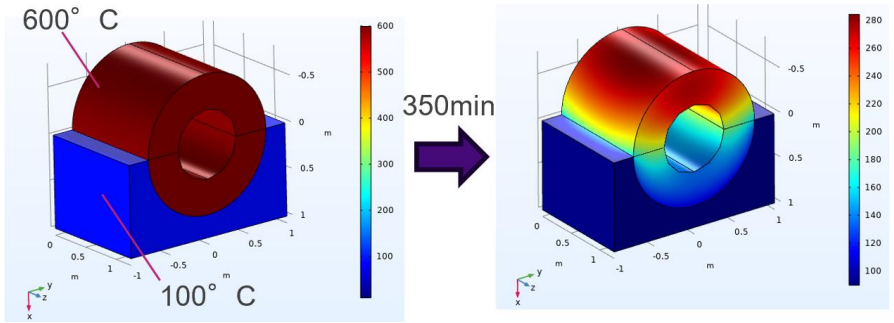
Heat capturing unit to measure the thermal power of the heat exchangers

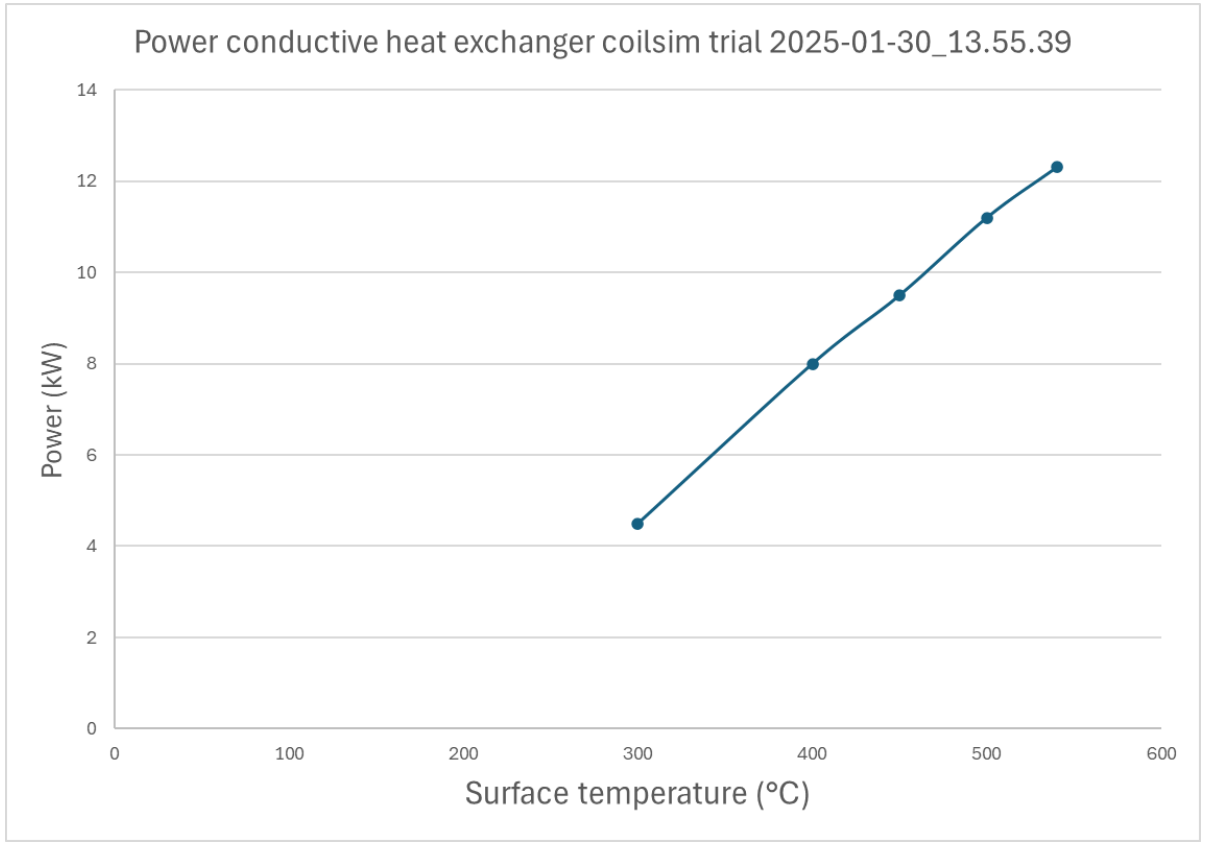


→ Measuring the power (W) of the HEXs
→ Comparison HEXs (radiation and conduction)

Harvesting coil waste heat (lab trials)

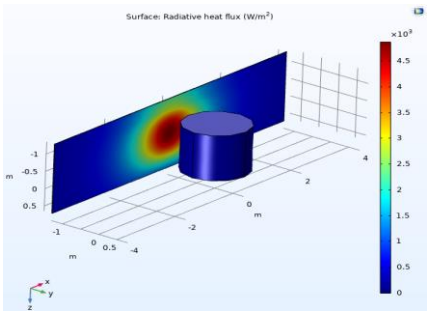
- Conductive coil heat exchanger

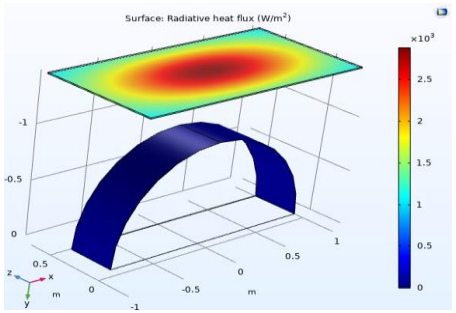


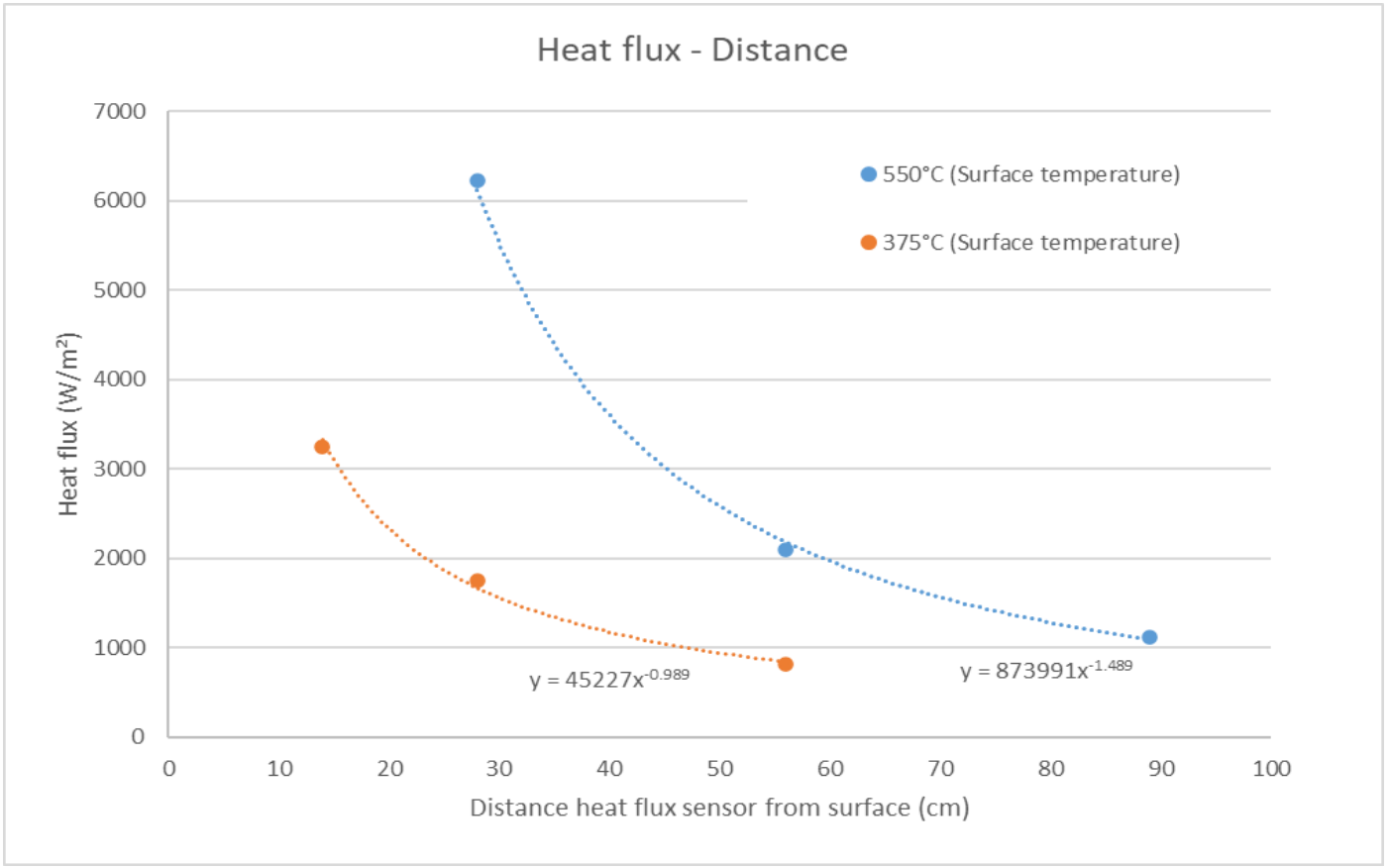


Harvesting coil waste heat (lab trials)

- Radiation panel heat exchanger





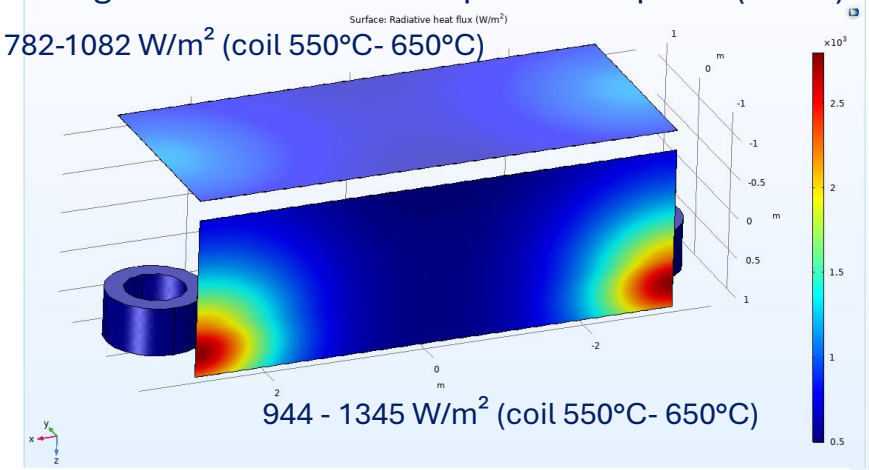


Harvesting coil waste heat (lab trials)

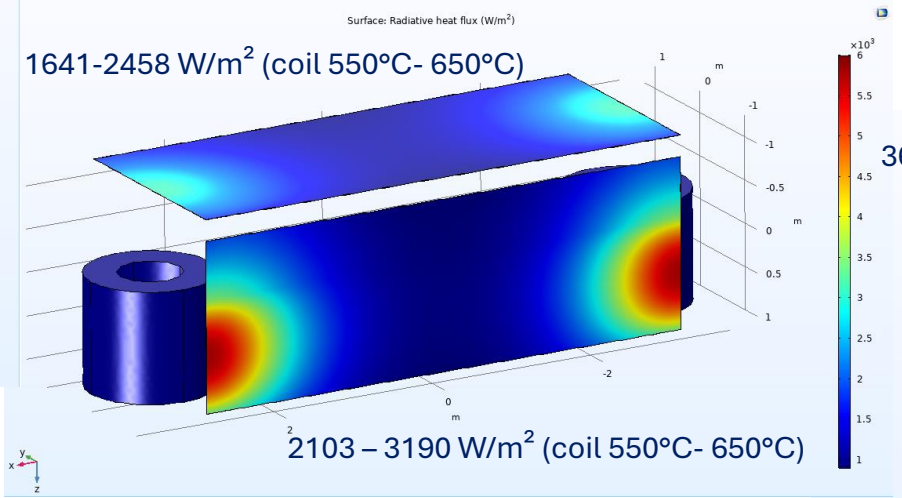
Coil simulator trials: Upscaling to tunnel concept

- Radiation panel 6m x (2m + 2.5m + 2m)
- Coil temperatures: 550°C, 600°C and 650°C

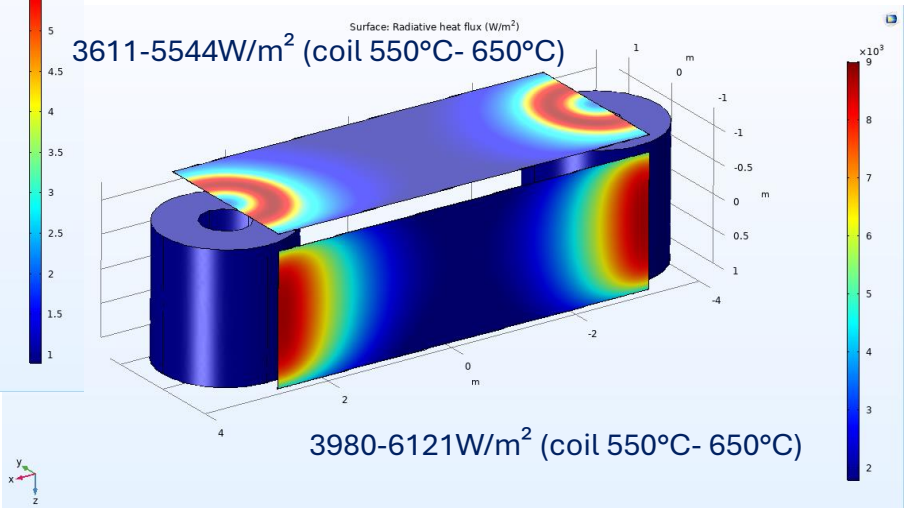
Average radiative heat flux top and side panel (W/m^2)



Coils Ø1.2m – H 0.6m



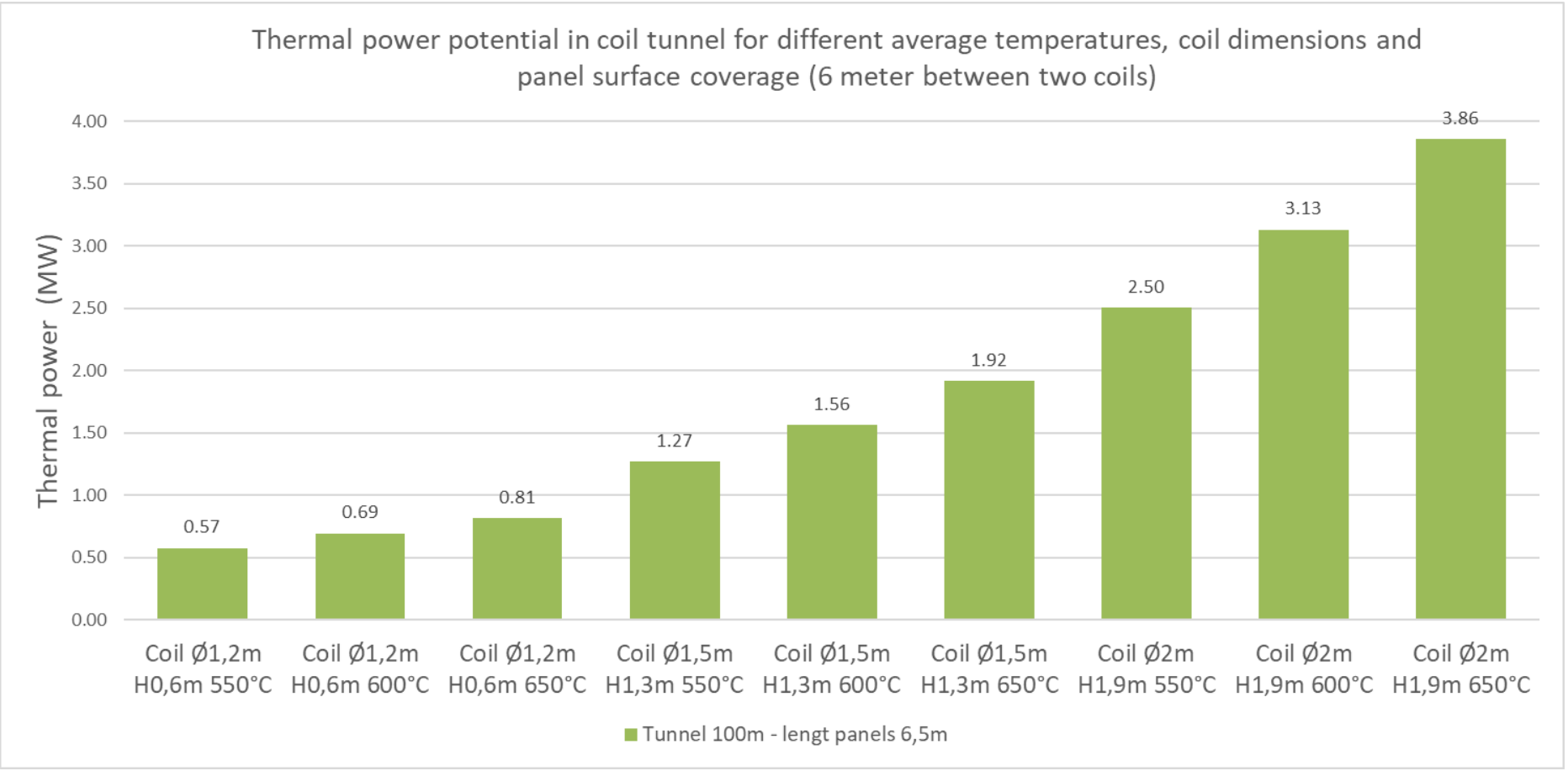
Coils Ø1.5m – H 1.3m

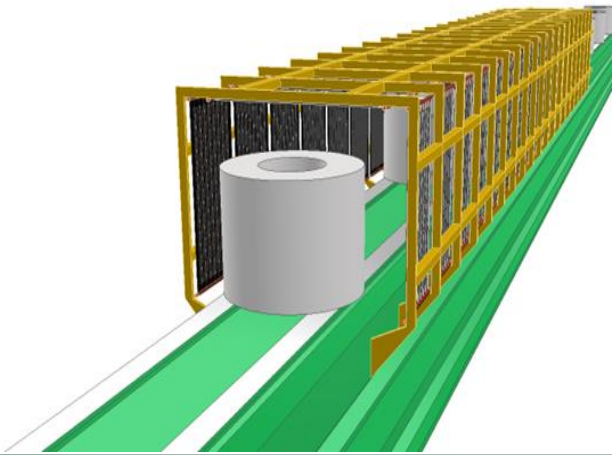


Coils Ø2m – H 1.9m

Harvesting coil waste heat (lab trials)

Coil simulator trials: Upscaling to tunnel concept





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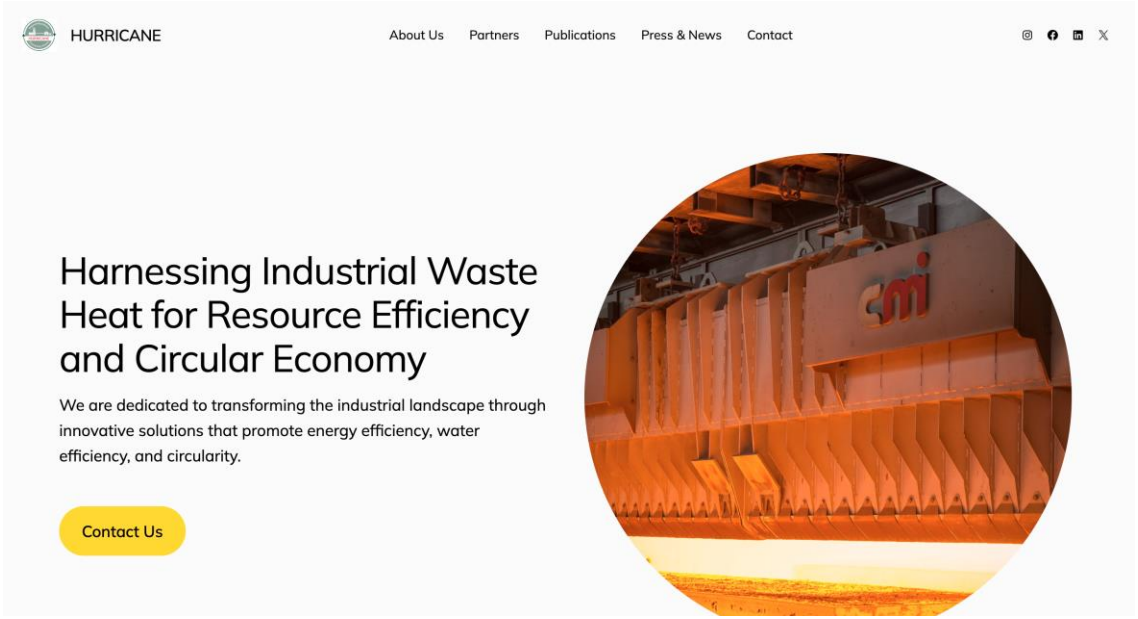

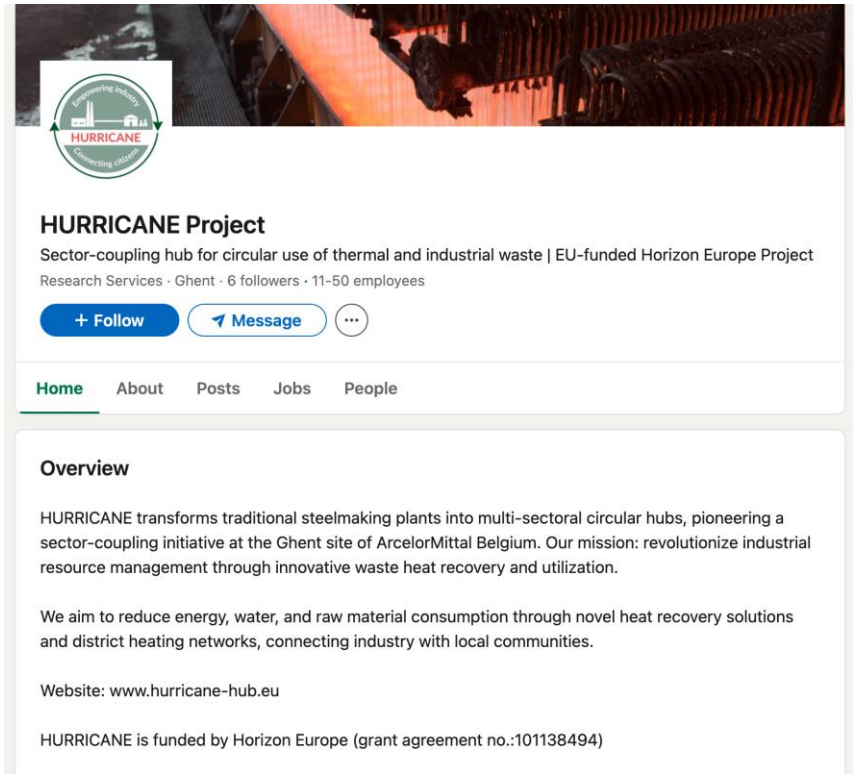

Thank you!

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