National Workshop on Heat Pumping Technologies

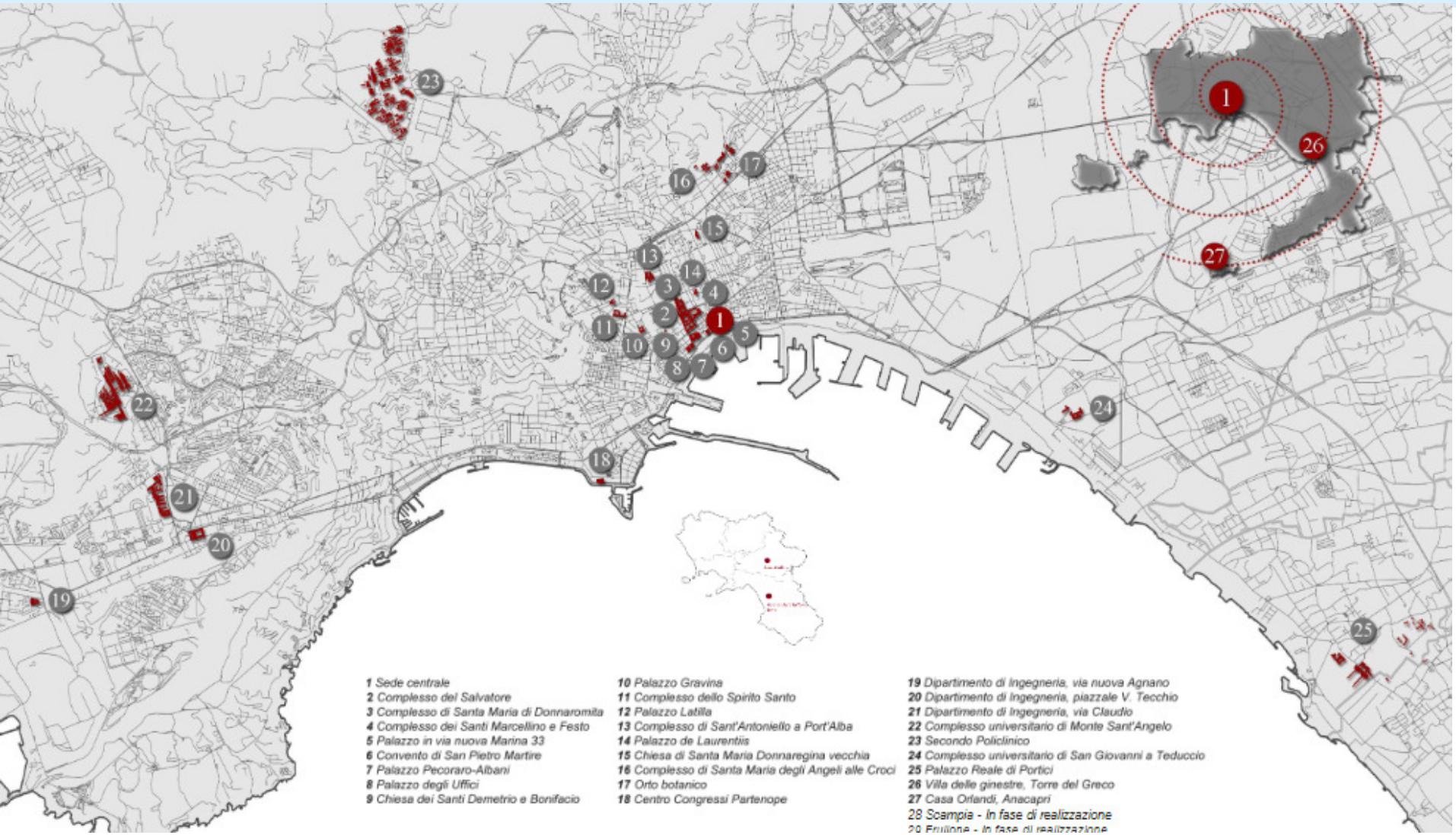
Research activities at University of Naples Federico II

Prof. Alfonso William Mauro

Full Professor

November, 17th 2026 – Pisa, Italy

Federico II University of Naples



LARGEST PUBLIC UNIVERSITY IN THE SOUTHERN ITALY

- 26 Departments
- 5.600 employees
- Around 80.000 students







Sustainable heating & cooling research group

Professors

Rita Mastrullo
Professor - Retired



Alfonso William Mauro
Full Professor



Luca Viscito
Associate Professor



Assistant Professors/Researchers

Francesco Pelella
Assistant Professor



Adelso Flaviano Passarelli
Post-doc Researcher



Francesco Di Salvatore
Post-doc Researcher

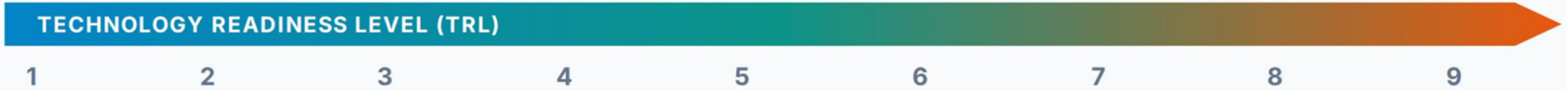


PhD Students

Valeria Piscopo
3rd Year PhD



Management Strategy



LOW TRL (UP TO 3-4)

In-House

- Small-scale experimental activities.
- Digital twin lab.
- Advanced physical modeling.

LOW-MEDIUM (UP TO 4-5)

Partner Collaborations

- Large infrastructure access.
- Controlled experiment execution.
- ENEA and UPV collaboration.

HIGH TRL (6-9)

Industrial & Public

- Full-scale field demonstrators.
- Real-world site validation.
- Industrial scale-up partnerships.

Applications – Method - Aim

Parametric performance analysis for residential and industrial applications

Devices

- Electric Heat Pumps (EHP)
- Advanced refrigeration plants
- Complex energy systems

Method

- Simulations under real conditions
  (seasonal performance, fault-free or faulty conditions, frost)
- Physics-based performance modeling
- Integration with Machine Learning

Domains

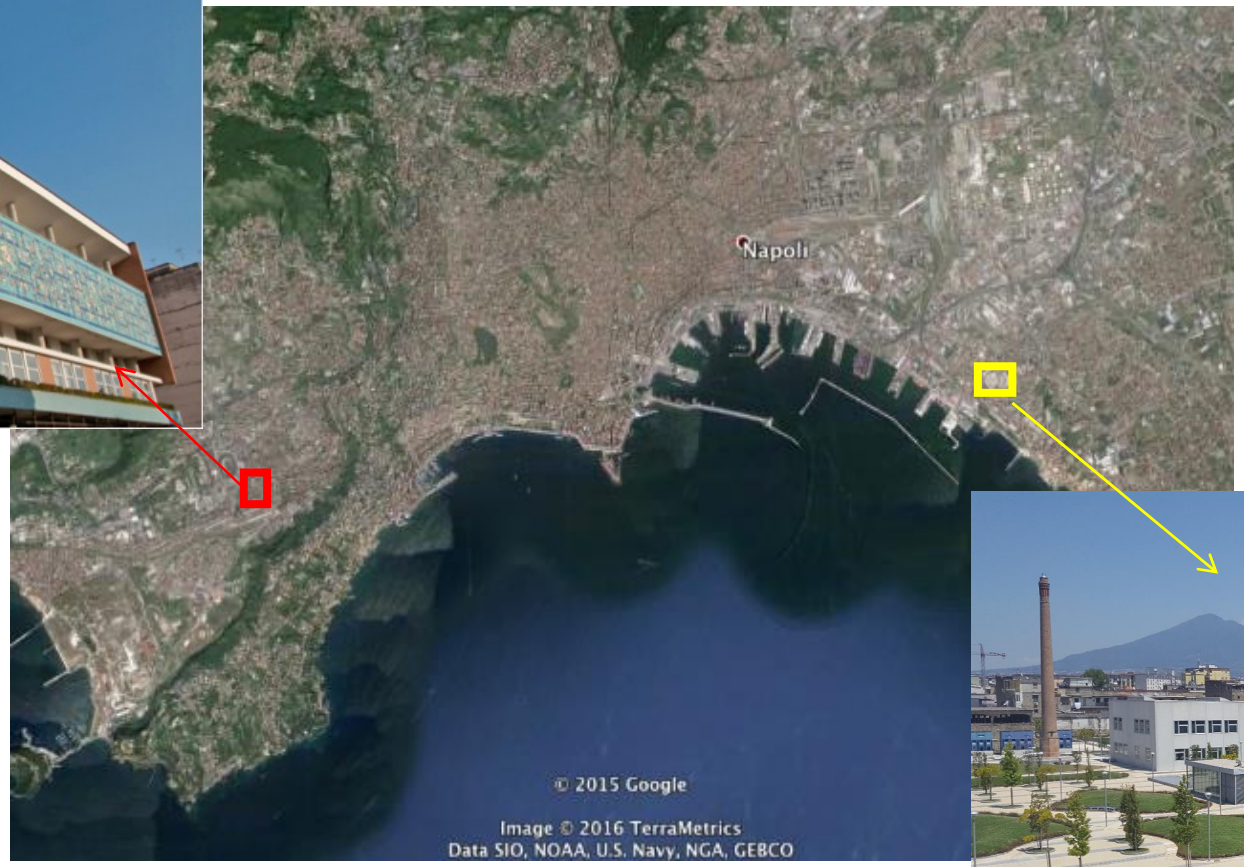
- Residential heating and cooling
- Data center cooling
- Vertical farms
- Industrial processes and refrigeration

Our Aim

- Comparison of design options
  (multi-source, heat storage, component substitution, fluid analysis)
- Control strategies
  (model predictive control, control maps, defrost strategies)

Locations







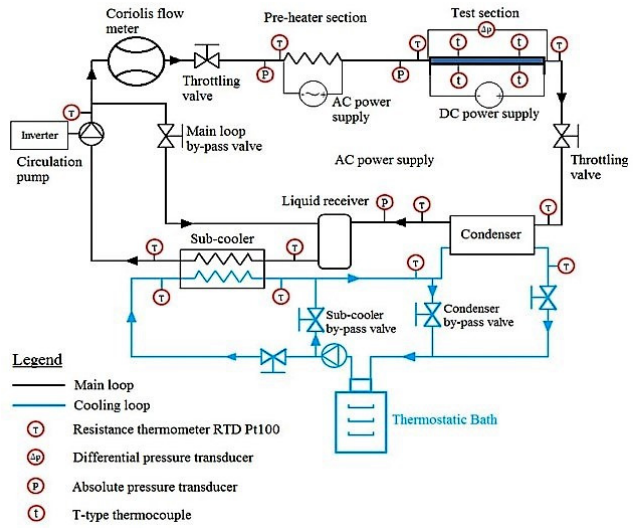
Dept of Industrial Engineering
Refrigeration Lab

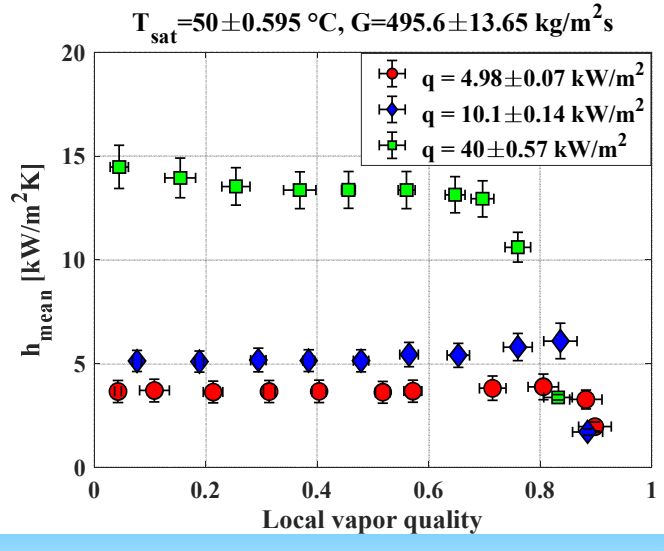
Technology Transfer Center
Digital Twin Lab

Two-phase heat transfer / Experimental activity

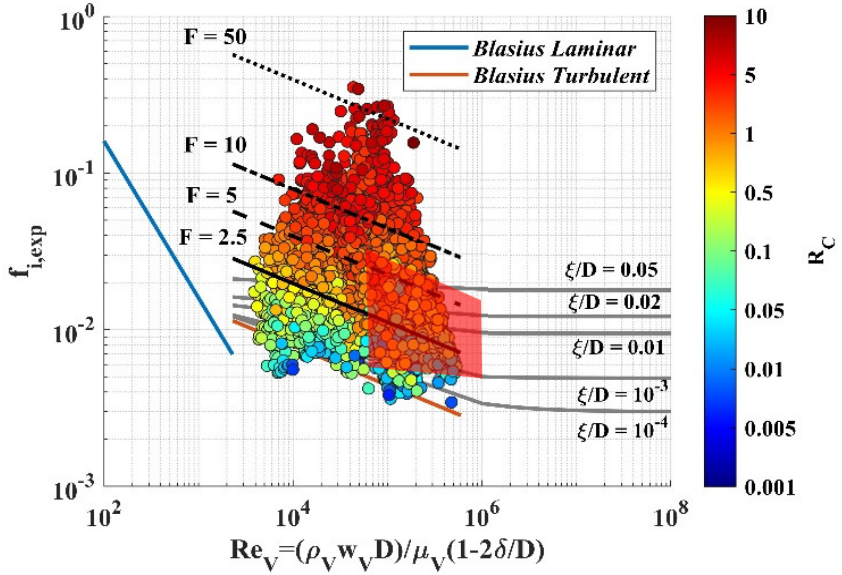


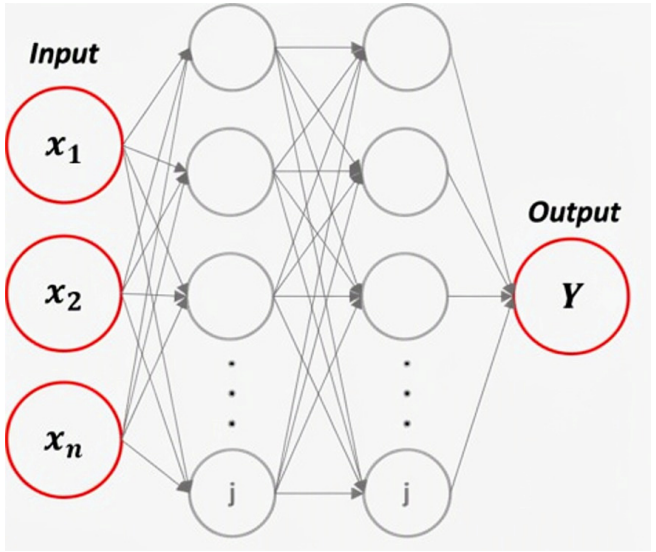
- **Some Refrigerants: R744, R1234ze, R32, R450A, R1233zd, R290, R454C, R513A, ethanol.**
- Experiments
- Assessment and development of specific predictive methods (both correlations and ML based)

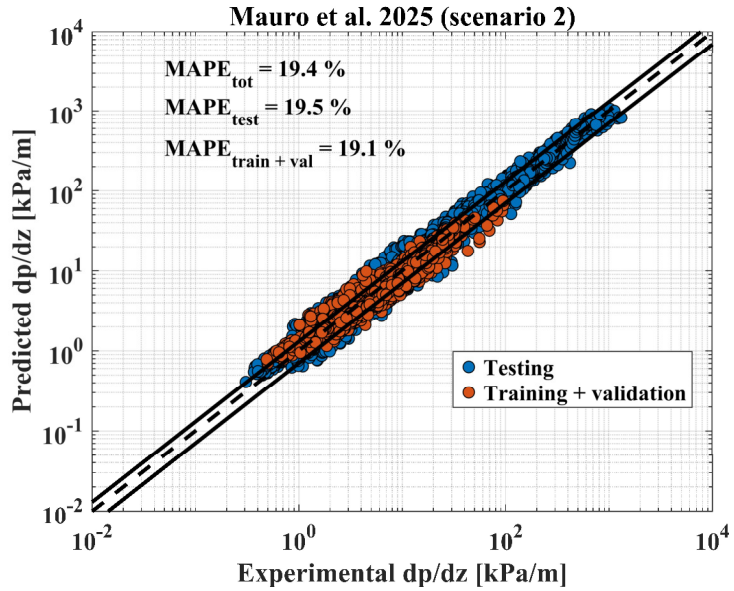




Two-phase heat transfer / Predictions
Physics-based and AI-based



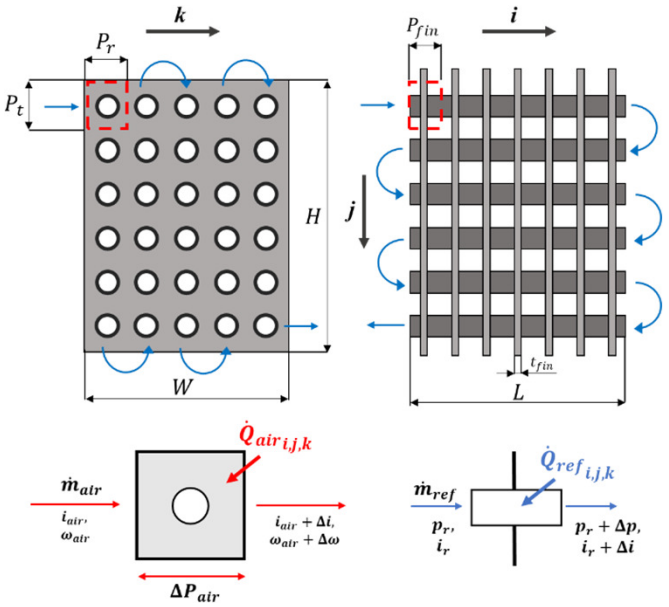


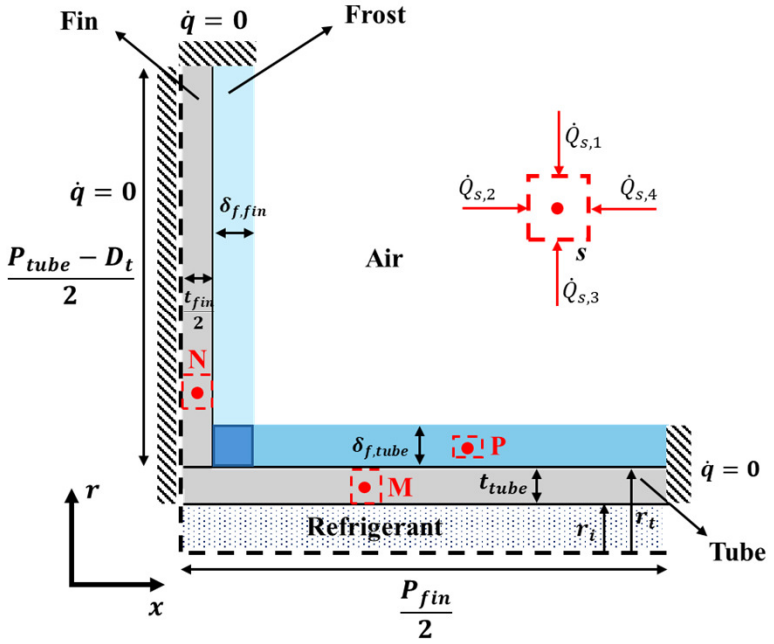


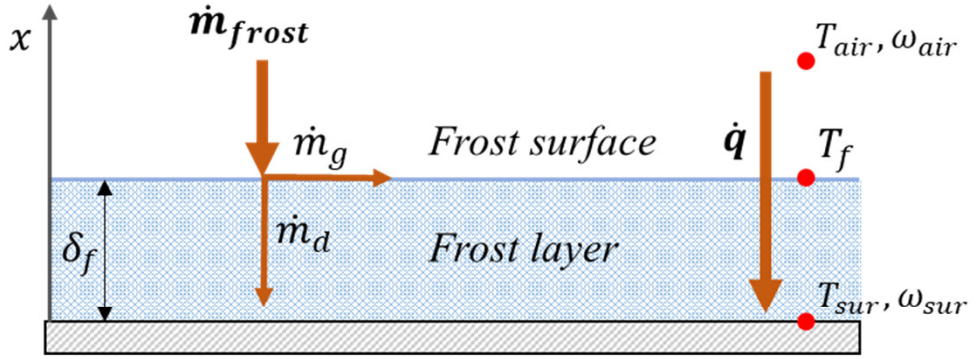
Development of new predictive models, both physic-based and AI-based

Assessment of predictive methods

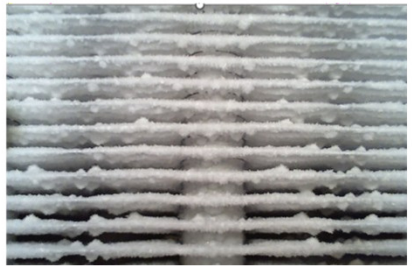
Frost formation / Experimental activity





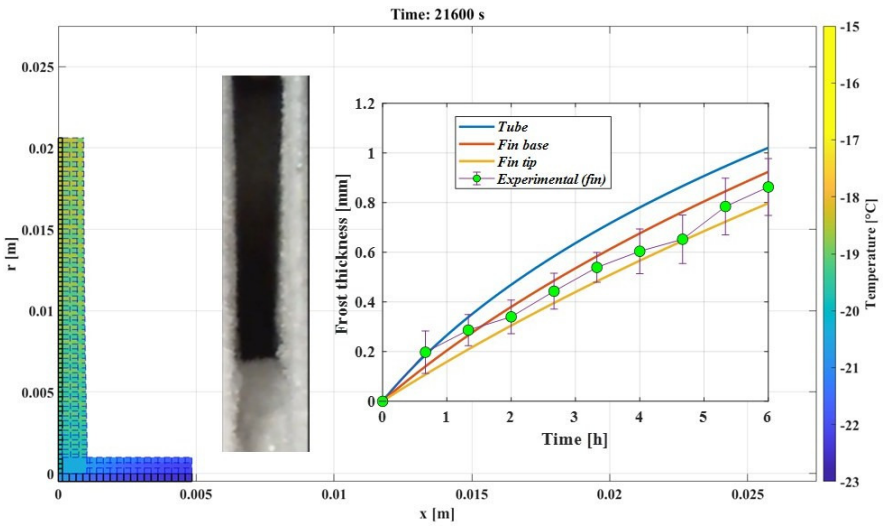


$t = 0 \rightarrow 3h$, *frost growth*



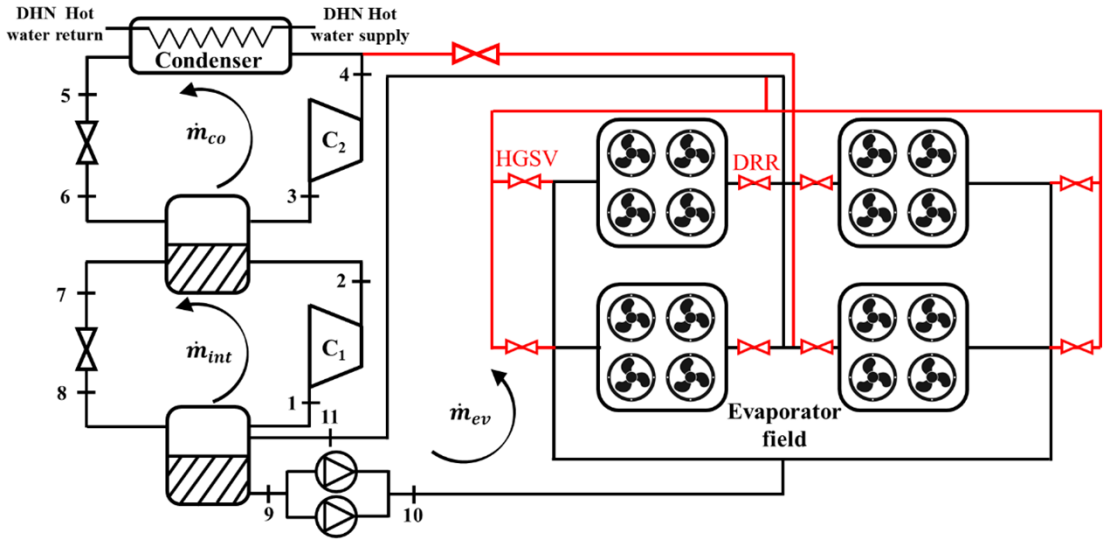
$t = 4h$ *defrost completed*

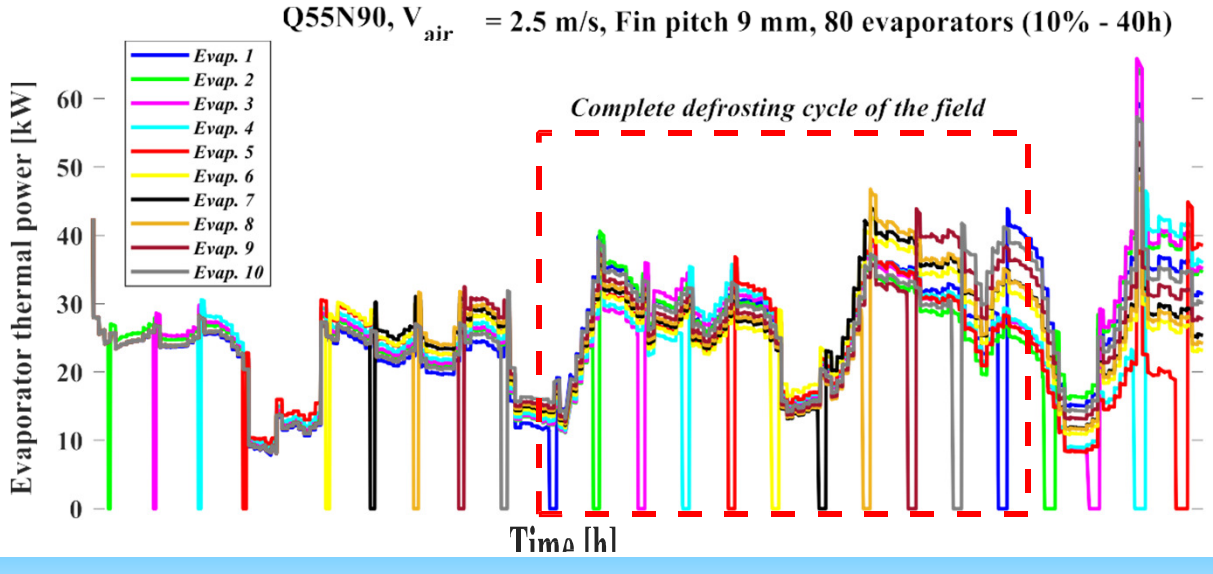




Modelling Activities: district heat pumps under frosting conditions







In collaboration with:

LU-VE GROUP
leadership with passion

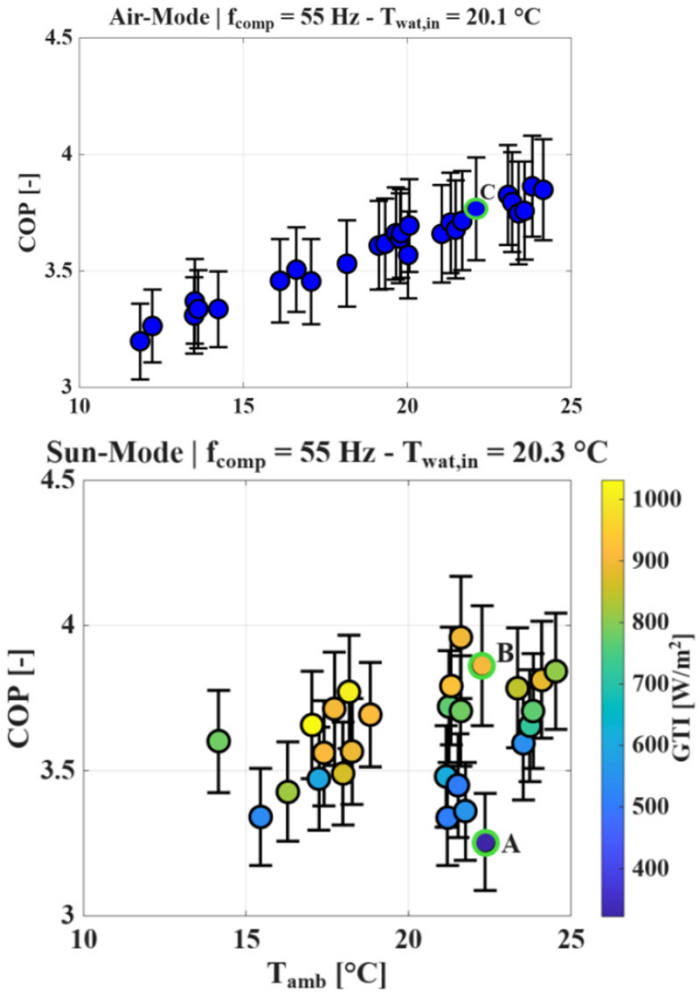
Dual Source Heat Pumps

Experimental Setup with DX-PVT Panels

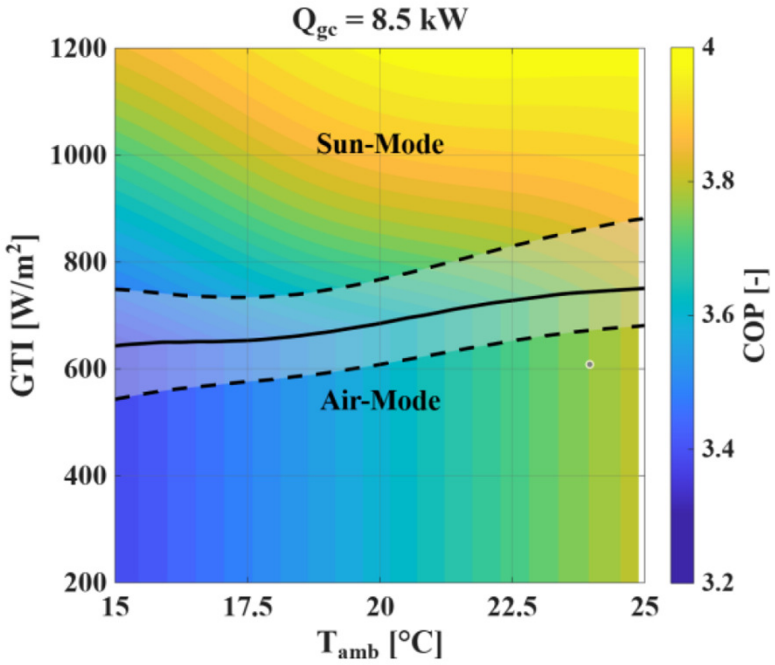




Experimental Results

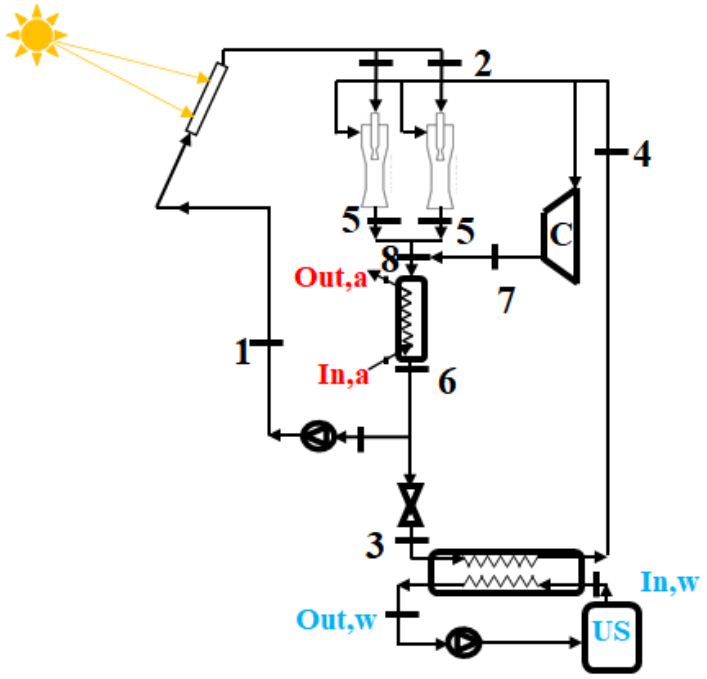


Optimal Control Strategy



In collaboration with:

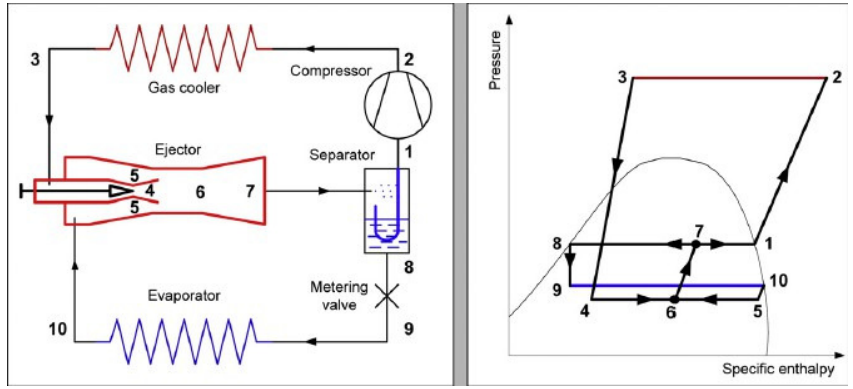
Heat driven and Ejector technologies



Driven by waste heat or thermal solar sources

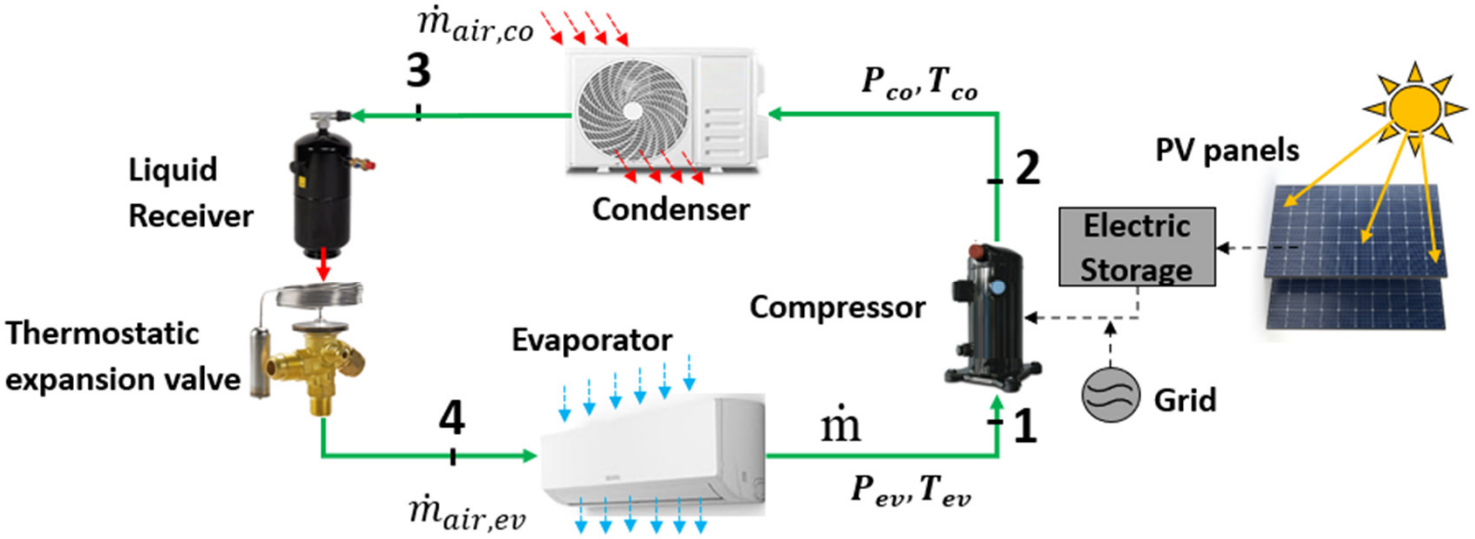


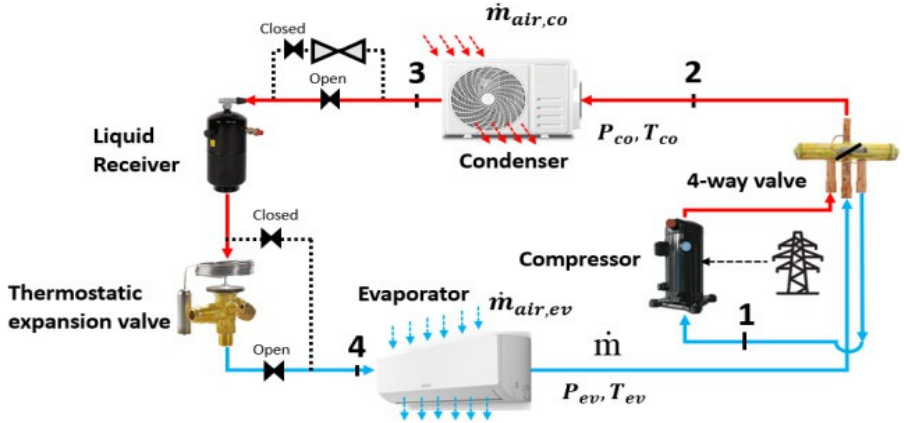
Multi-ejector system

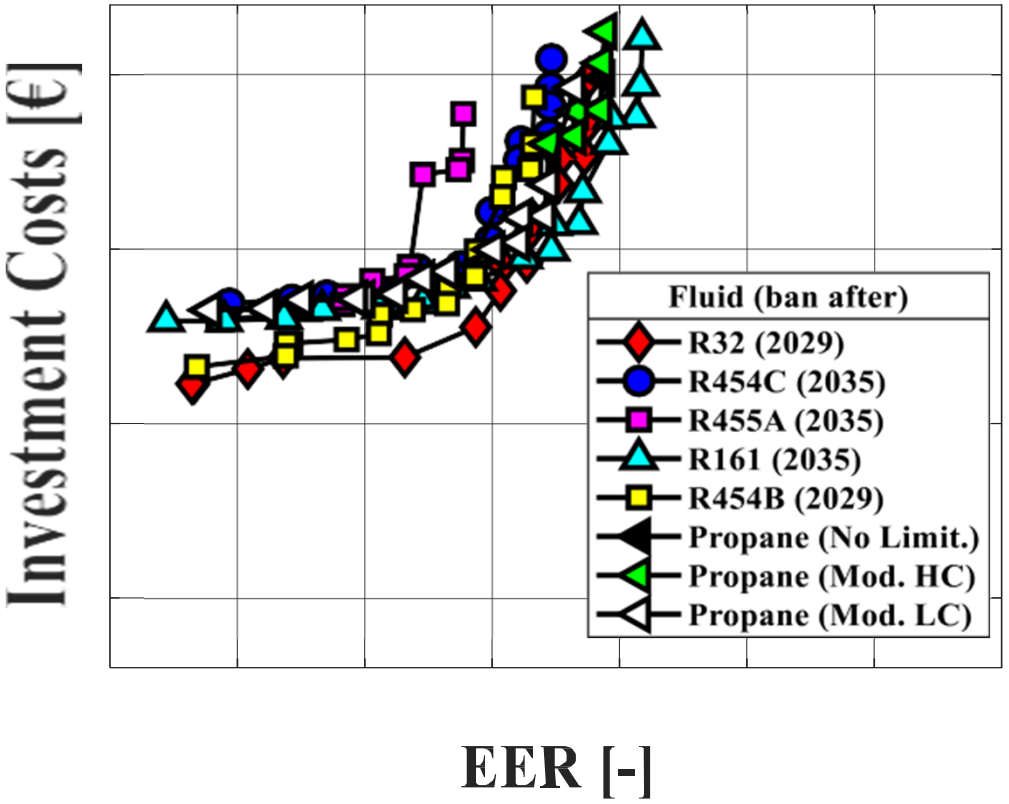


In collaboration with:

Modelling Activities: parametric design of heat pumps



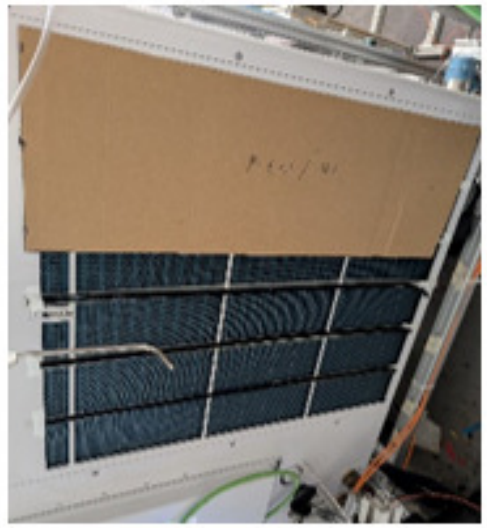




Propane HPs under faulty conditions



Mal distribution



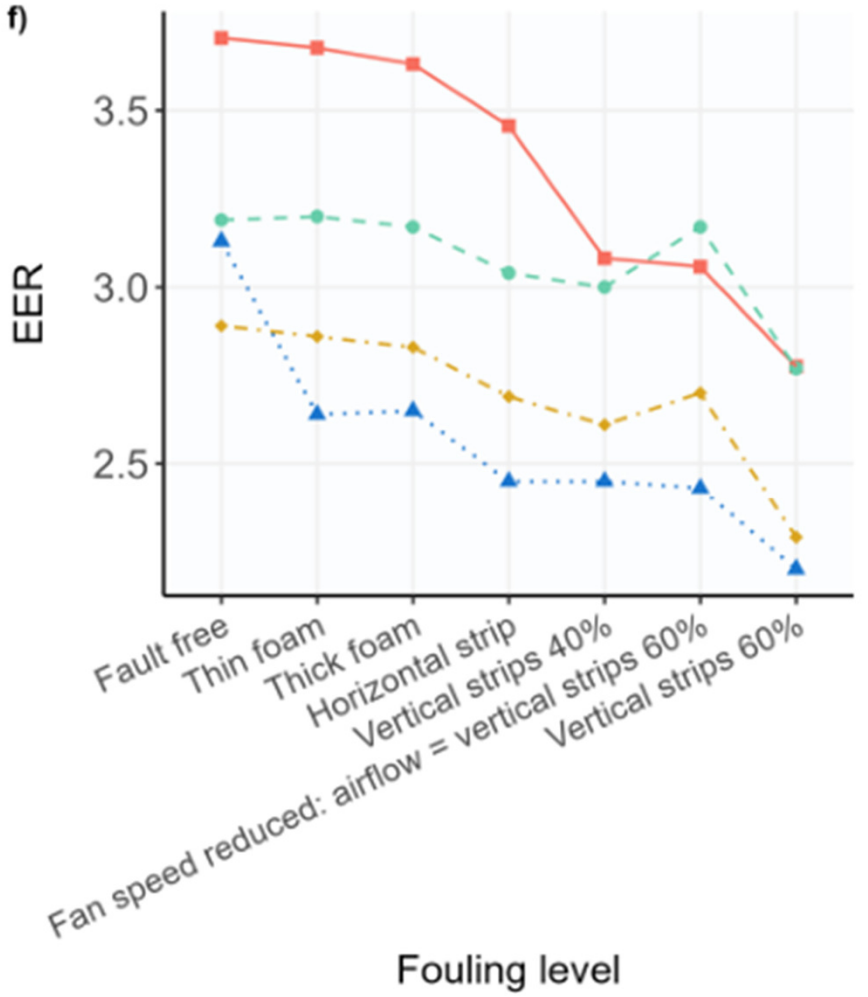
Fouling



THICK



THIN+THICK

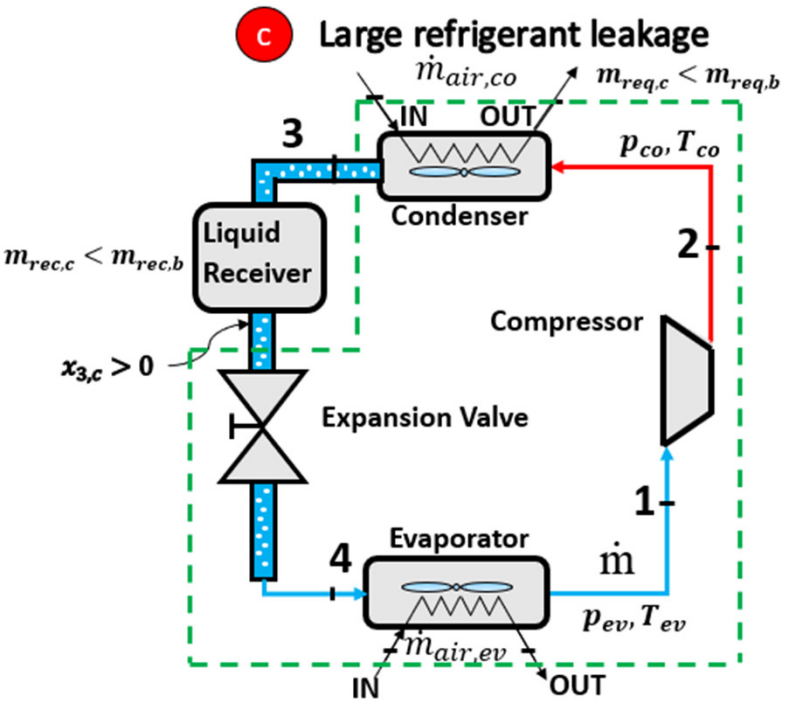


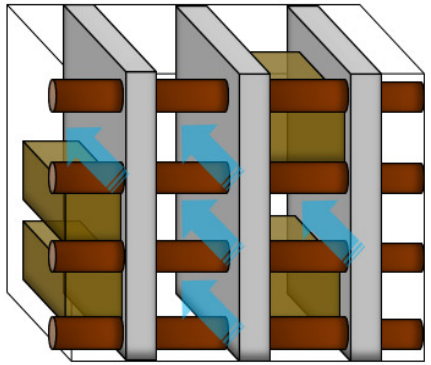
In collaboration with:

UNIVERSITAT POLITÈCNICA DE VALÈNCIA

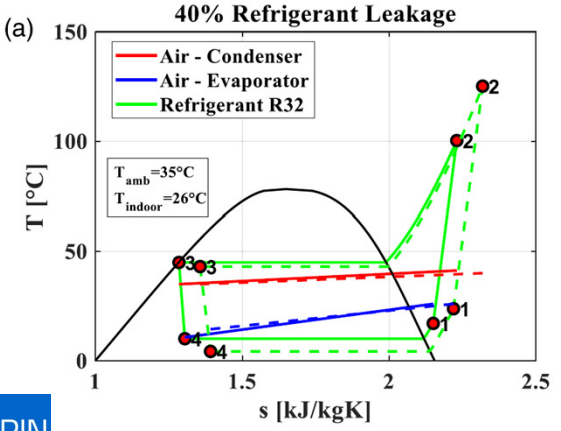
Modelling Activities: Soft Faults

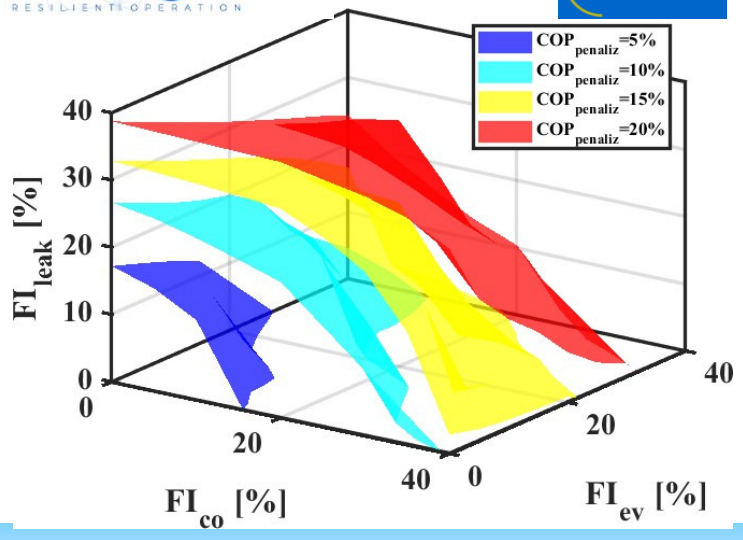
Refrigerant Leakage and HEX fouling





Effect of faults on system performances





Innovation projects

BEYOND
RESILIENT OPERATION

- https://www.beyondproject.eu/

Title

Method For Smart And Affordable Evaluation Of Simultaneous Faults In Heating And Cooling Systems Based On Compressed Vapor Technology

(GA #101162436)

European Innovation Council

Funded by the European Union

Università degli Studi di Napoli Federico II

Universitat Politècnica de València

Thank you

Prof. Alfonso William Mauro –
Full Professor

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