Optimal management of a hybrid heat pump for heating through the assessment of building thermal load and dynamic performance

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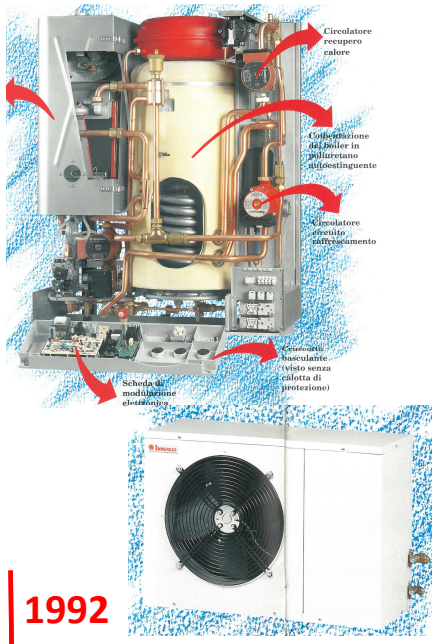
DELL'ENERGIA, DEI SISTEMI, DEL TERRITORIO E DELLE COSTRUZIONI

Hybrid solutions….a long-time story for Immergas

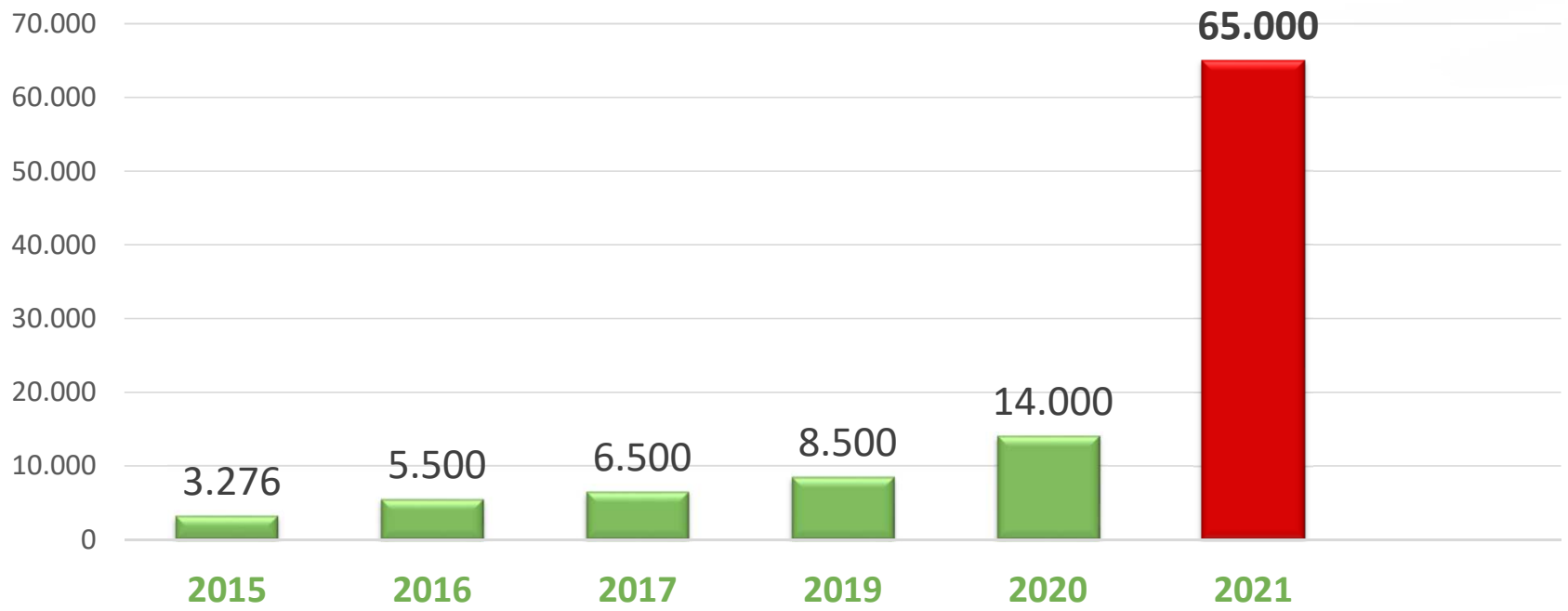


FACTORY MADE

1992	2011	2013	2016	2020	2023
MAGIS ZEUS (21/3,5-7) MAGIS PLUS	GAMMA AUDAX	MAGIS VICTRIX MAGIS HERCULES	MAGIS COMBO	VICTRIX HYBRID	FACTORY MADE HYBRID SOLUTIONS More than 90 solutions

A hybrid heat pump is an attractive solution

Hybrid systems sold in Italian market



(Source: ASSOTERMICA - ASSOCLIMA)

A hybrid heat pump is an attractive solution

Good reasons to invest in hybrid solutions

In **EPBD** (**E**nergy**P**erformanceof**B**uildings**D**irective) Proposal

• Reasons for and objectives of the proposal:

The revision of EPBD is part of the 2021 Commission Work Programme "**Fit for 55**" package and complements the other components of the package proposed in July 2021, setting the vision for achieving a zero-emission building stock by 2050

A **Renovation Wave is coming…** Making Europe more resilient calls for renovation of EU buildings, making them more energy efficient and less dependent on fossil fuels. Renovation is key for reducing the energy consumption of buildings, for bringing down emissions and for reducing energy bills

EUROPEAN
COMMISSION

Brussels, 15.12.2021
COM(2021) 802 final

2021/0426 (COD)

Proposal for a

DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

on the energy performance of buildings (recast)

(Text with EEA relevance)

{SEC(2021) 430 final} - {SWD(2021) 453 final} - {SWD(2021) 454 final}

Source: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2021:802:FIN

A hybrid heat pump is an attractive solution….
to be improved with an optimal management

In today and tomorrow products what can really make the difference is the **management of the hybrid heat pump**

- Which are the aims of a management?
- how to choose and switching strategy between two different heat generators?

Our criteria are based on the answers to these questions:

1. Which generator can meet the load?

2. Which is the most economic generator in order to meet the load?

It’s mandatory to be able to evaluate hybrid heat pump performance in real-life conditions

Evaluation of hybrid heat pump performance

Proposed procedure in 4 main steps:

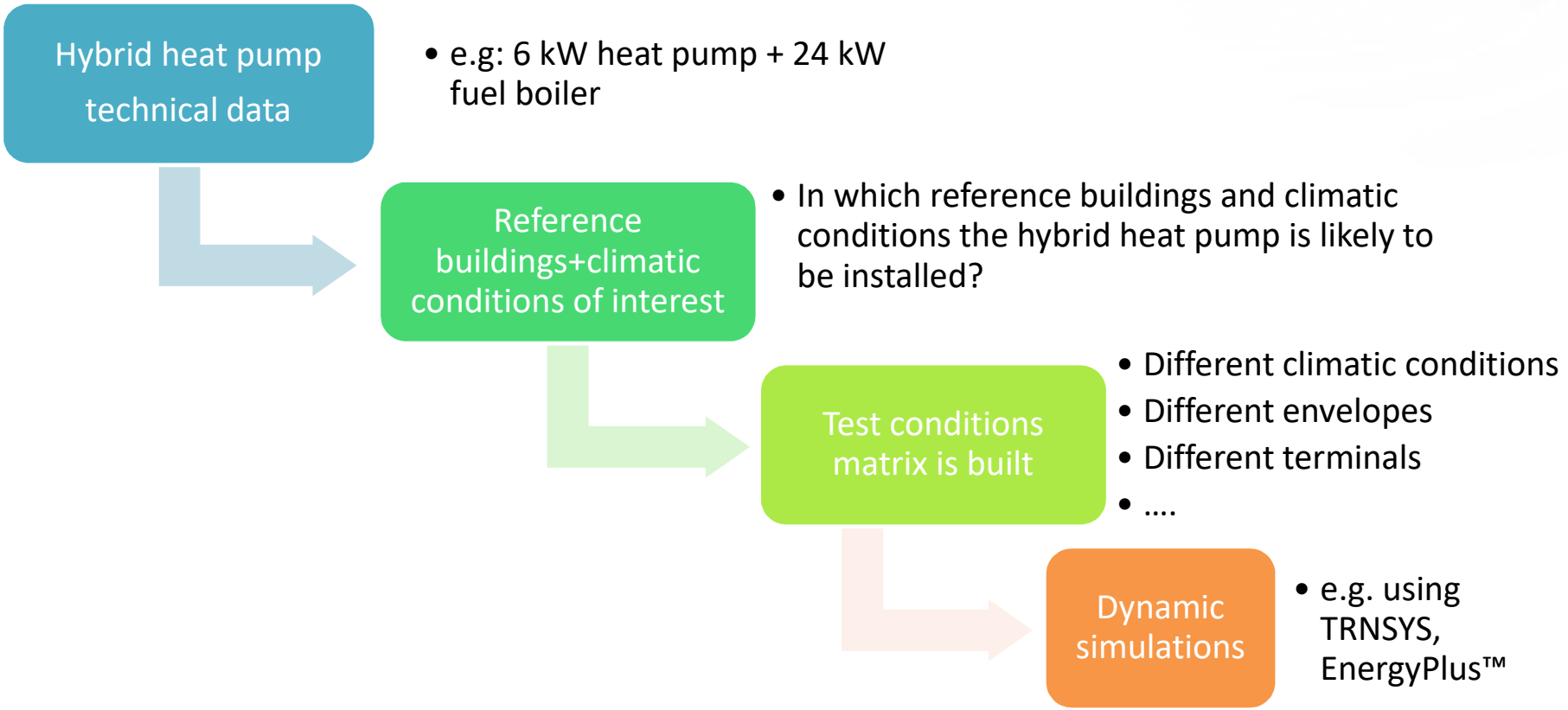
1. Identification of reference buildings: different structural features, different sizes, terminals, different climatic conditions

2. Identification of the most frequent operative conditions (in terms of temperatures and loads)

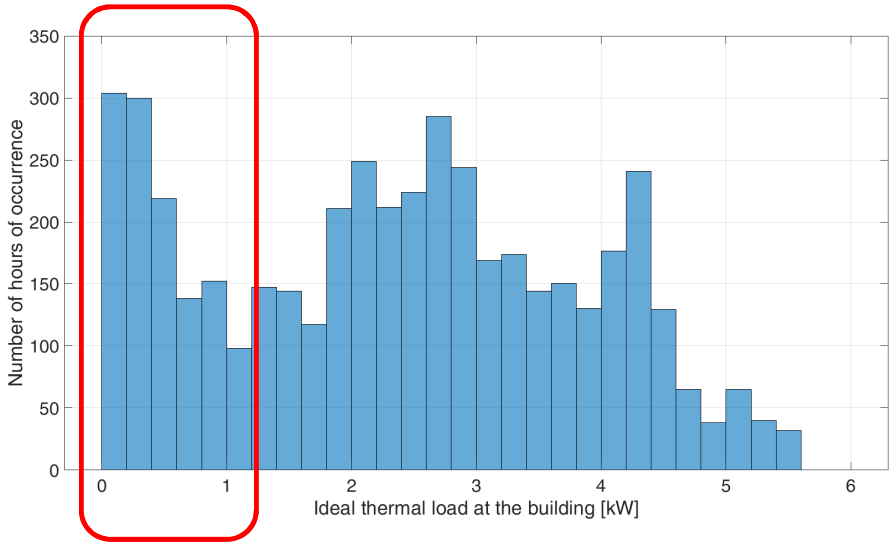
3. Monitoring of heat pumps performance in the most frequent operative conditions

4. Definition of a fitting equation for the evaluation of COP depending on the source temperatures and loads

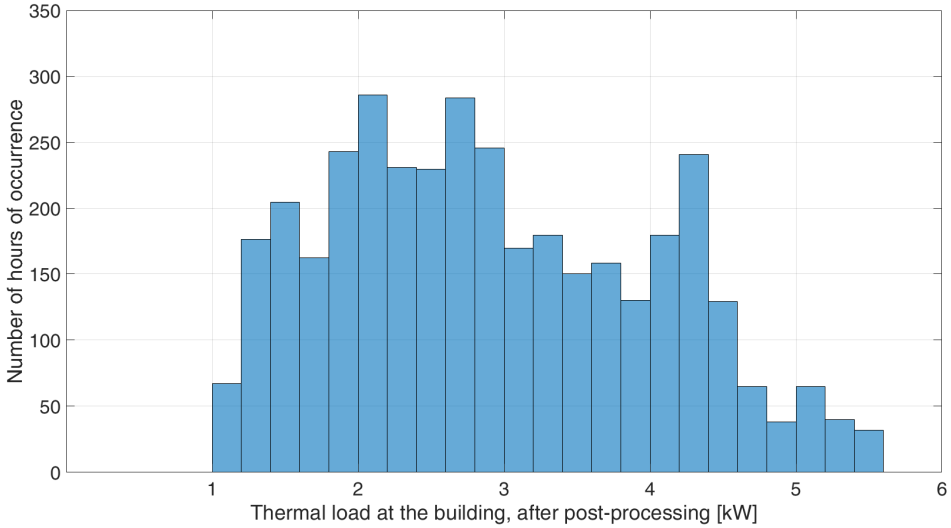
Identification of the most frequent operative conditions



Identification of the most frequent operative conditions (in terms of temperatures and loads)

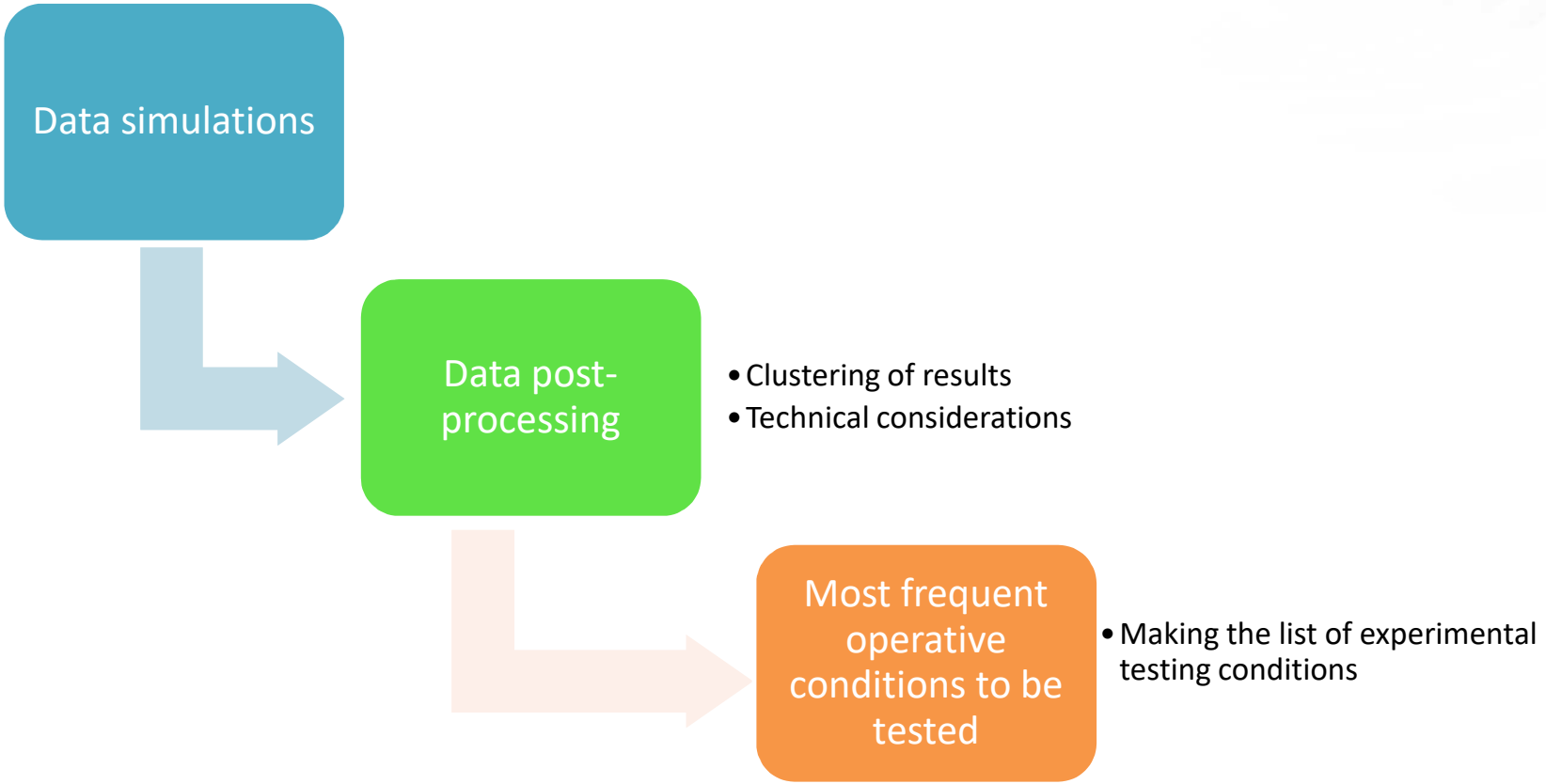


Results of simulations

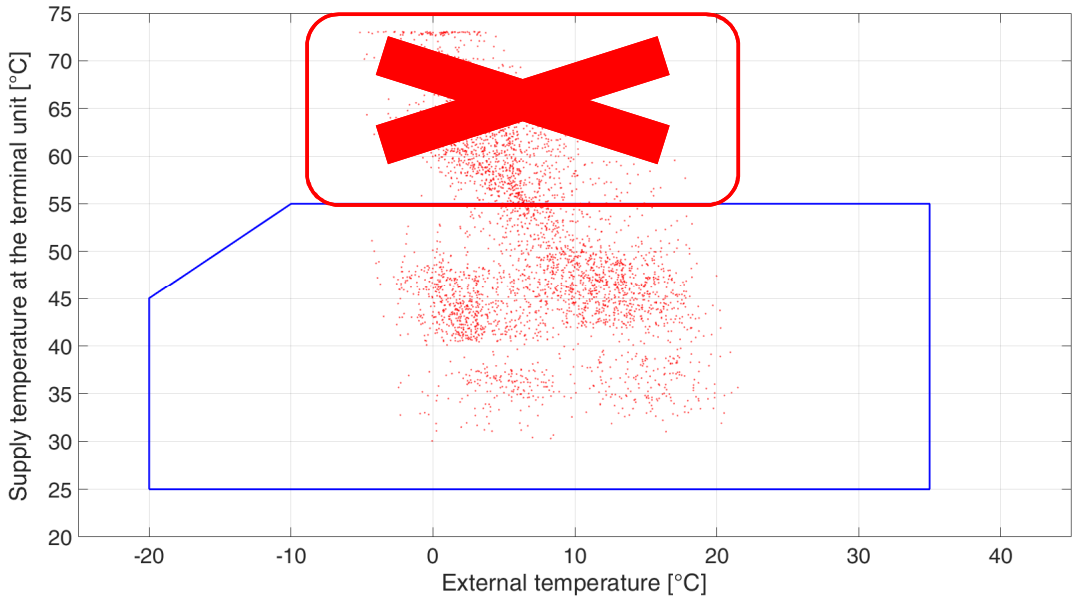


Results of simulations, after data post-processing

Identification of the most frequent operative conditions

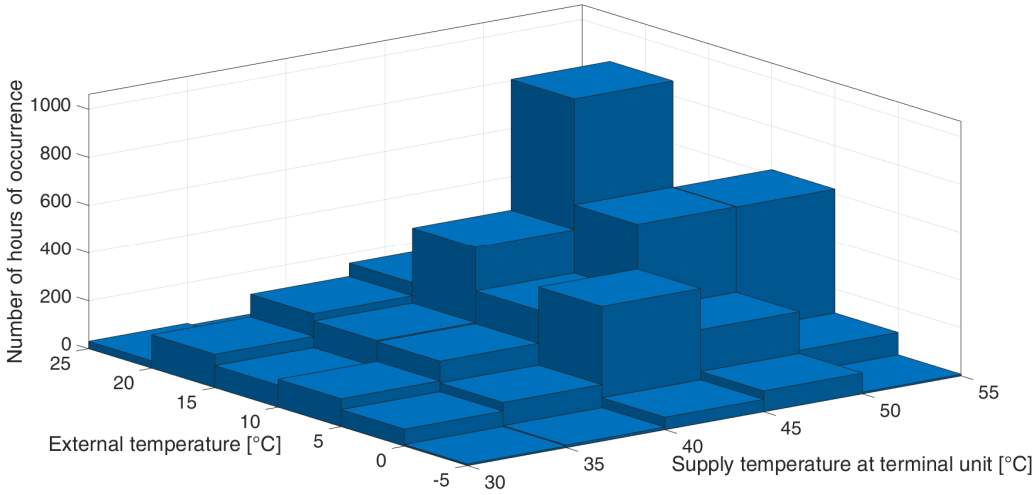


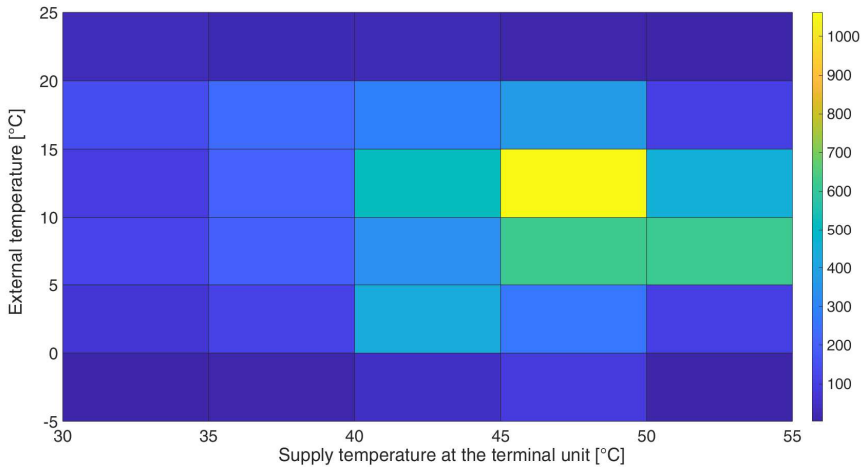
Identification of the most frequent operative conditions



About data post-processing: some operative conditions are not referred to the heat pump

Monitoring of heat pump performances in the most frequent operative conditions



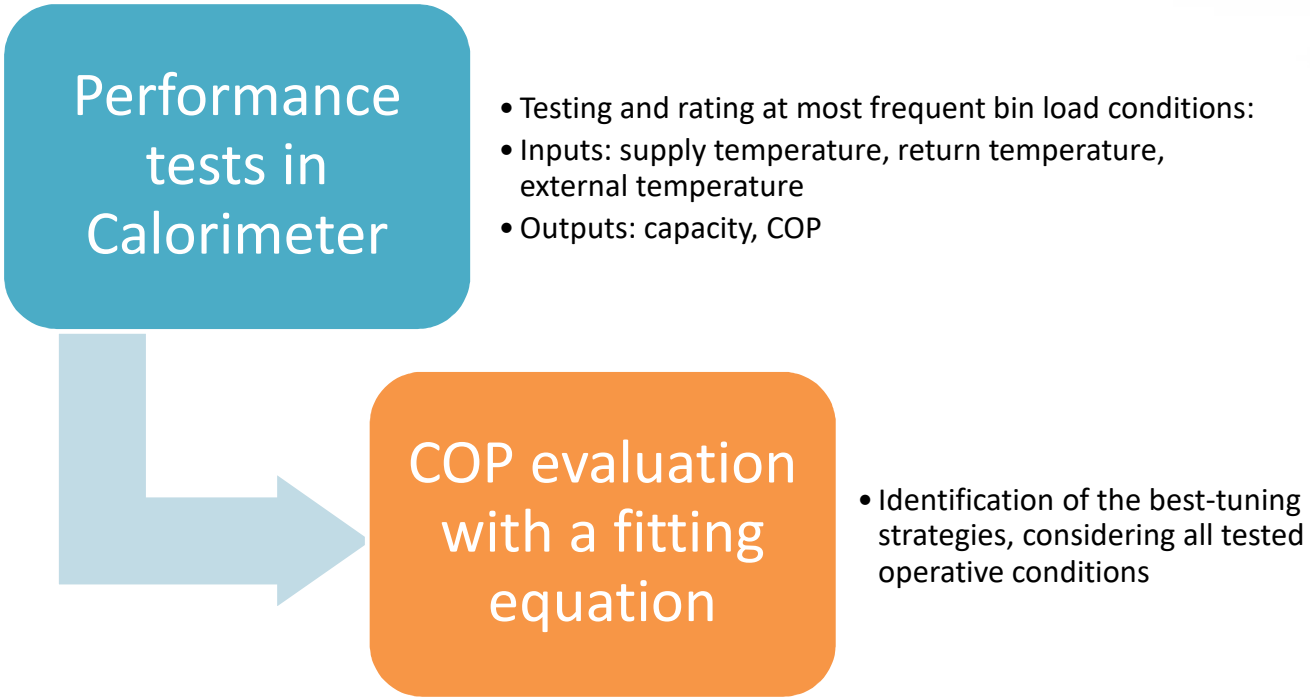


Due to the dynamic simulation results, load estimations, supply temperatures of the emission system in reference buildings for different climatic conditions are known

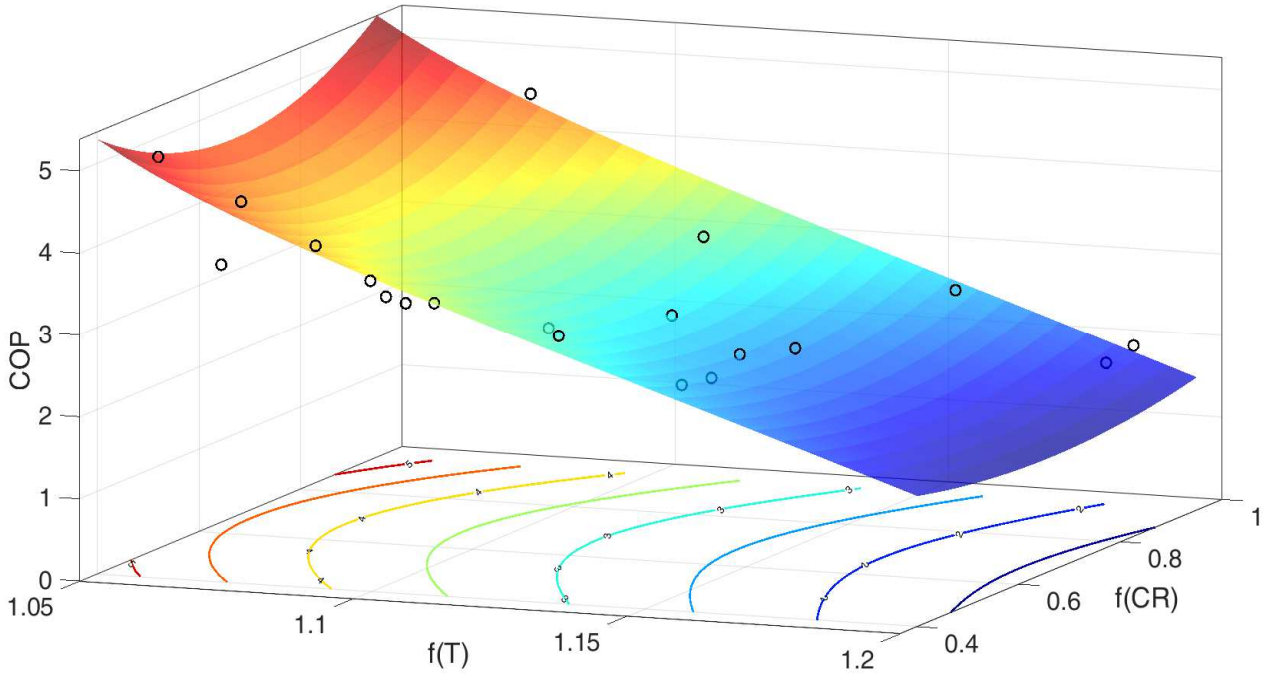
A matrix of bin-occurences of an operative condition is created

A matrix of experimental test conditions is created

Monitoring of heat pump performances in the most frequent operative conditions

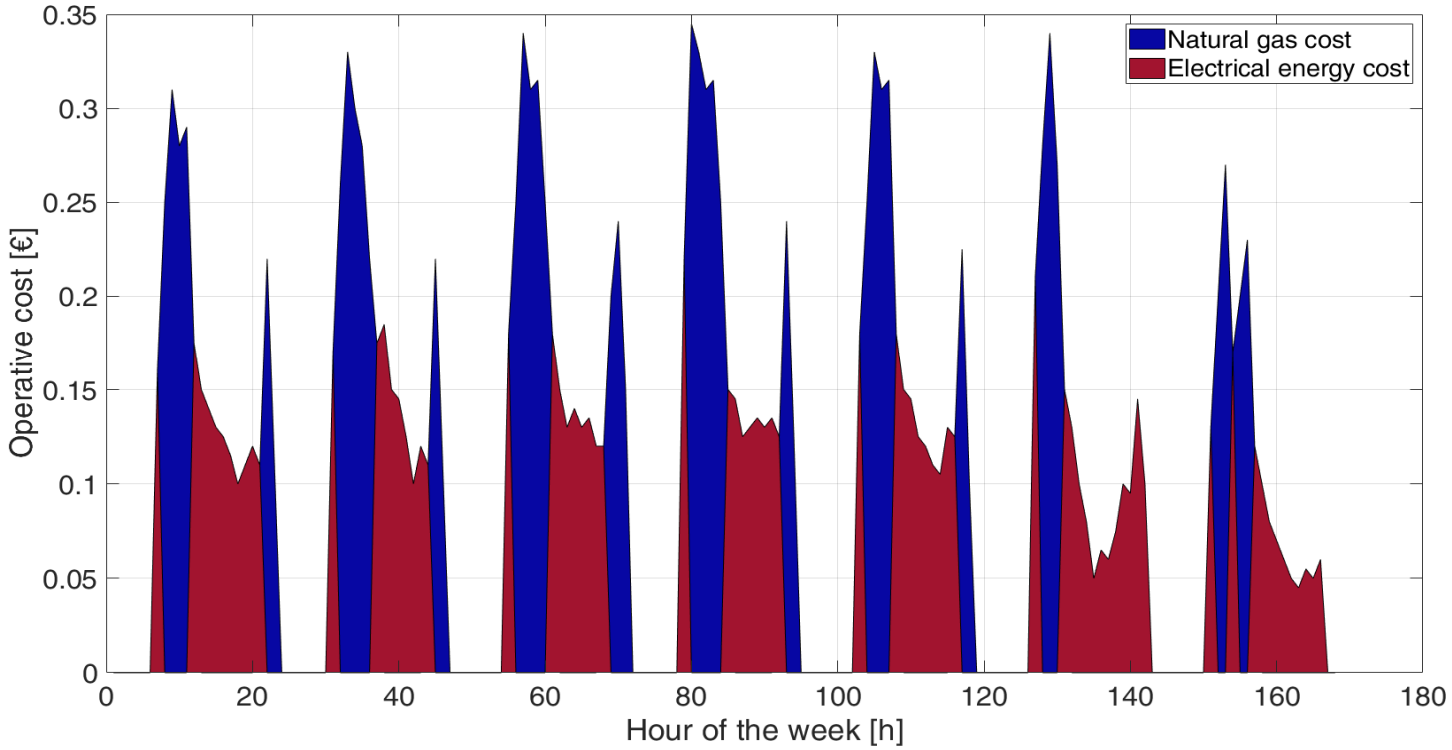


Definition of a fitting equation for the evaluation of COP



An example of a COP mapping result of the fitting procedure

Some cost-analysis



Cost-analysis in a weektime for a ‘80s (low-efficiency) flat

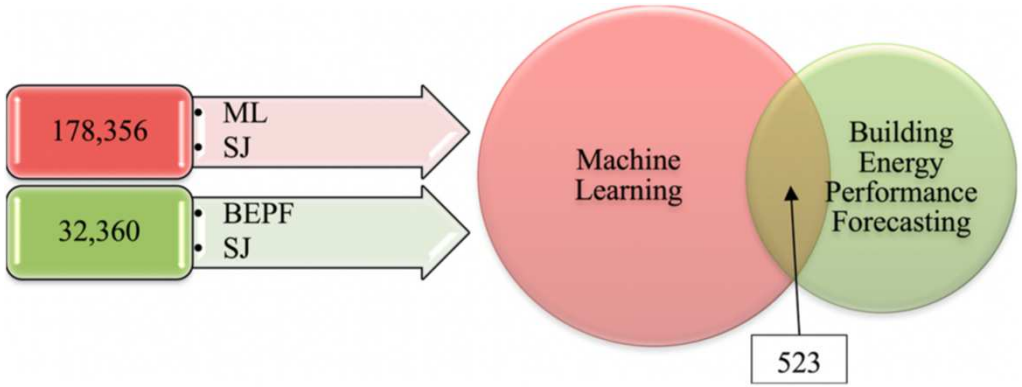
About building energy performance forecasting

This optimized control system is now able to choose the best generator, allowing always comfort conditions and the lowest operative cost

In order to optimize the management an important consideration must be made:

You can meet a load (choosing the correct generator and setting a supply temperature) if a proper and reliable prediction of the load can be made

a Model prediction approach of a building energy performance must be considered



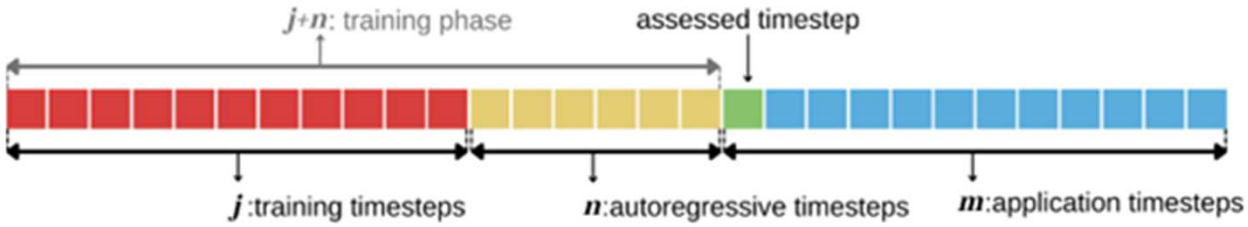
Keywords combinations used for searching Web of Science Database in Scientific Journals (SJ) published in 2015-2018
Source:https://doi.org/10.1016/j.rser.2020.110287

What a popular topic! What a great opportunity!

Estimation of thermal load required by the building through a data driven methodology

This machine-learning approach is based on:

- indoor temperature
- supply temperature
- effective required thermal load monitored during a training period
- other parameters



		Condensing boiler with weather-based control	Hybrid heat pump with weather-based control	Hybrid heat pump with smart control and data-driven estimation of the thermal load
Climatic zone E (Italy) – Flat	Cost savings compared to benchmark [%]	0.0	3.6	19.9
	Share of thermal load from HP [%]	0.0	18.5	49.3
Climatic zone D (Italy) – Flat	Cost savings compared to benchmark [%]	0.0	3.4	21.3
	Share of thermal load from HP [%]	0.0	11.1	56.1
Climatic zone C (Italy) – Flat	Cost savings compared to benchmark [%]	0.0	10.6	27.6
	Share of thermal load from HP [%]	0.0	38.1	71.8
Climatic zone E (Italy) – high efficiency detached house	Cost savings compared to benchmark [%]	0.0	28.3	29.2
	Share of thermal load from HP [%]	0.0	68.3	63.1

Saving up to 20% in low-efficiency buildings (most of buildings in Italy)

Thank you!

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