

A stylized, colorful illustration of a cityscape. It features various building silhouettes in shades of blue, green, and red. Some buildings have intricate patterns or textures, like a grid or wavy lines. The overall style is modern and graphic.

53rd

AiCARR International Conference

12-13-14 march 2024

Fiera Milano, Rho (MI) | MCE 2024

From NZEB to ZEB: the buildings of the next decades for a healthy and sustainable future

 **AICARR**
Cultura e Tecnica per Energia Uomo e Ambiente

 60 anni di cultura

53rd AiCARR International Conference
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From NZEB to ZEB: the buildings
of the next decades for a healthy
and sustainable future

A stylized, colorful graphic of a city skyline. It features various building shapes in shades of blue, green, orange, and purple. Some buildings have intricate patterns like grids or lines. The style is modern and abstract.

New generation energy performance certificate: development and application in an Italian case study as an EU proof of concept

SALVALAI Graziano^a, SESANA Marta Maria^b,
ISACCO Ilaria^a

^aPolitecnico di Milano, Italy

^bUniversità degli studi di Brescia, Italy

Decarbonization of the EU building stock

Buildings are the single largest energy consumer in Europe:

- **40%** of the energy consumption
- **36%** of the energy-related greenhouse gas emissions
- **75%** of not energy efficient buildings



Revised Energy Performance of Buildings Directive (EPBD):

- Minimum Energy Performance Standards
- **New generation Energy Performance Certificate**
- Renovation Roadmaps and Passports



New generation EPCs

Common template with a defined set of indicators regarding:

- Energy efficiency and renewable energy
- Greenhouse gas emissions
- Plant systems and building's envelope characterization
- Indoor thermal comfort and IAQ

User-centric approach for EPC comprehension and assessment

Reliability and affordability of the calculation approach



EPC RECAST

H2020 project which aims to:

- **Develop a toolbox** to implement a new generation of EPCs
- **Validate** the compliance of the methodology in terms of **user-friendliness and reliability**
- Deliver a **clear, consistent, reliable and effective EPC** for both experts and non-experts

Multidisciplinary project consortium involving:

- Research and academia
- Industry
- International associations

The logo for EPC RECAST features the text 'EPC RECAST' in a bold, dark blue, sans-serif font. To the right of the word 'EPC' is a stylized icon consisting of a square with a checkmark inside, all enclosed within a house-like shape with a pointed top.

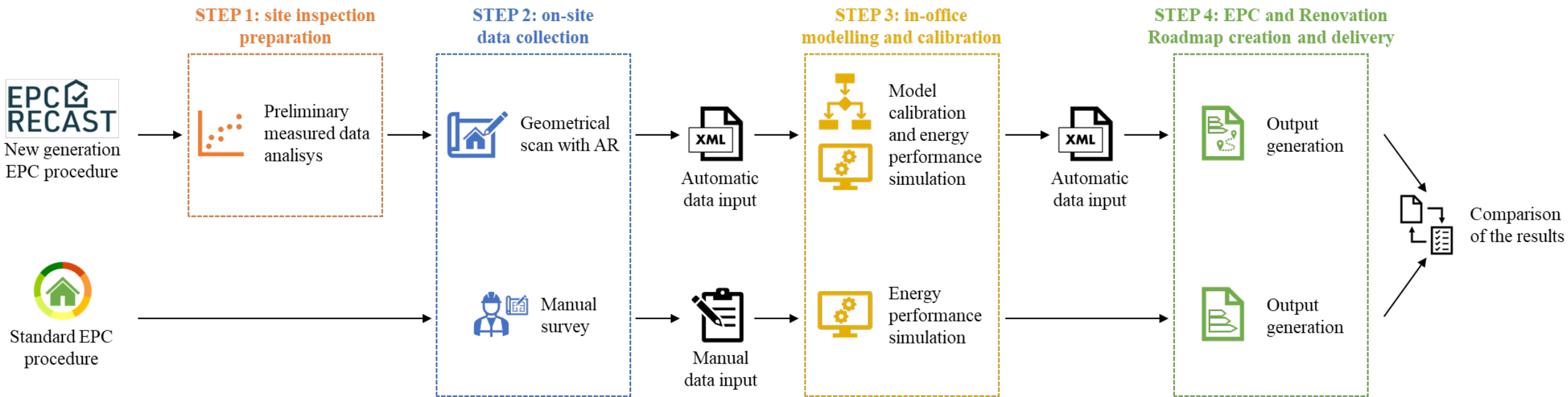
EPC RECAST TEAM



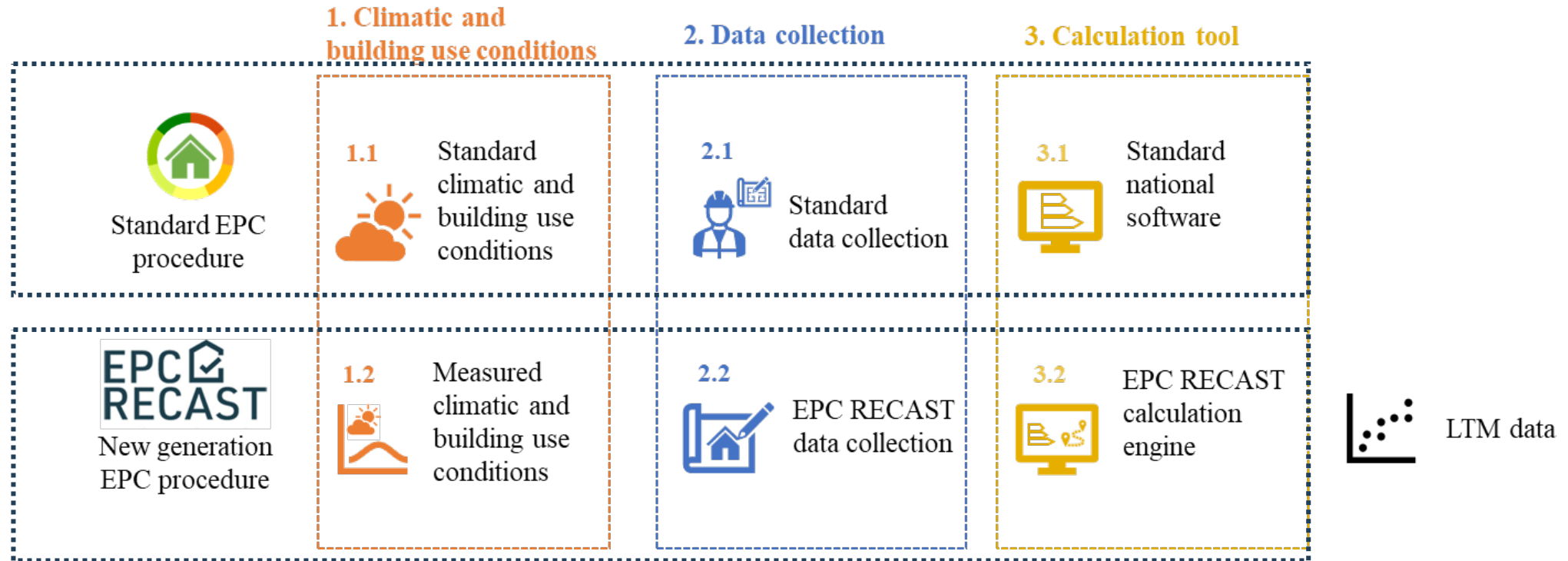
POLITECNICO
MILANO 1863



EPC RECAST testing method



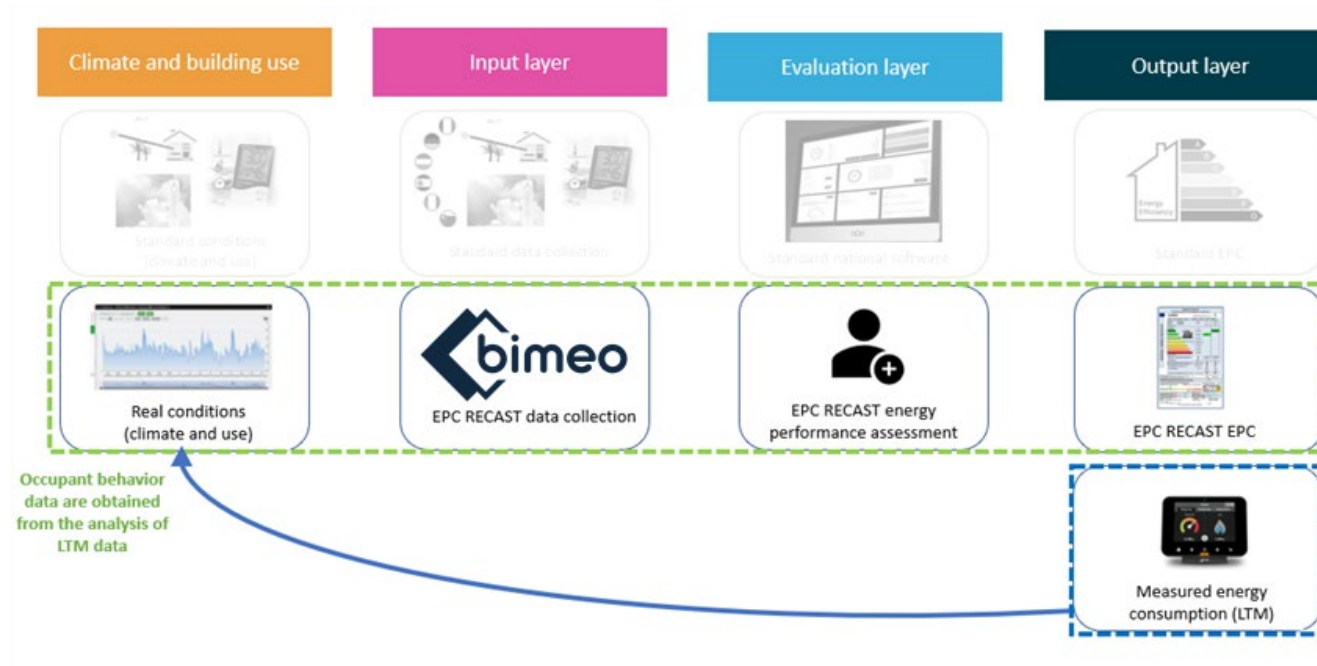
The Quantitative Verification Strategy



Examples of evaluation strategies

Strategy n.1:

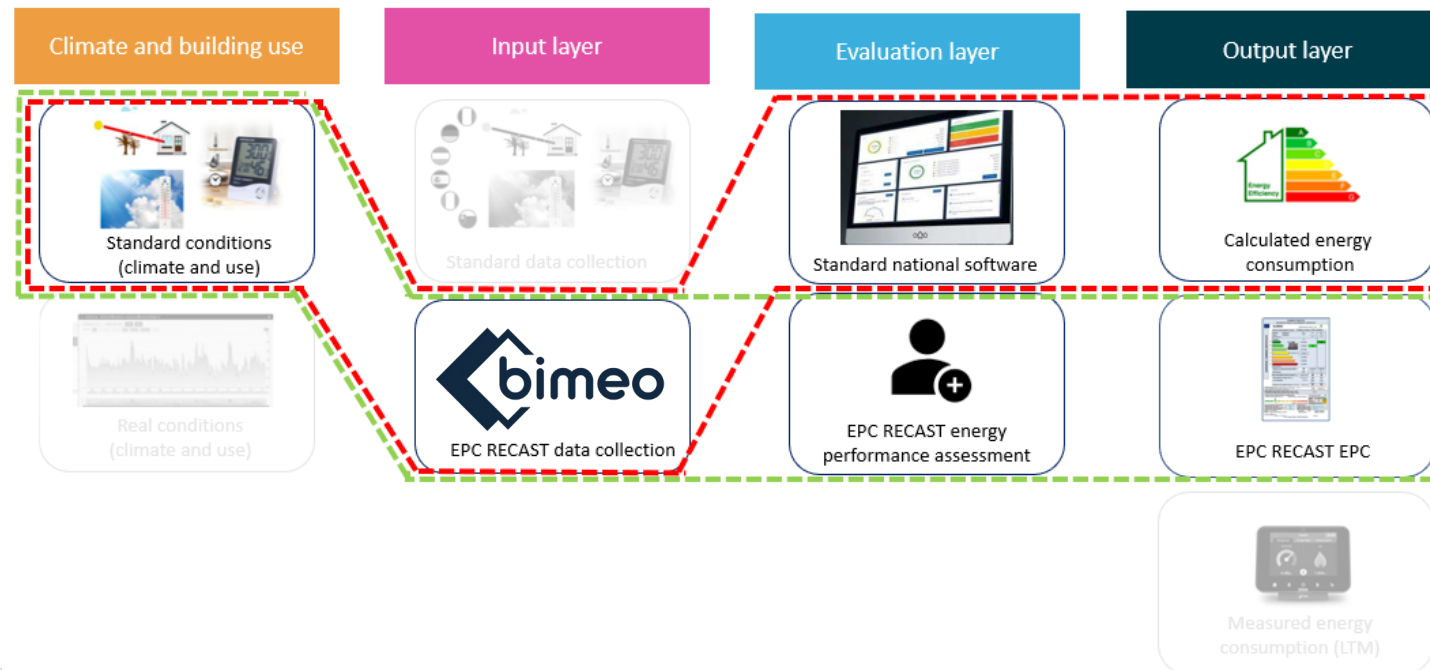
- New generation EPC - calculated energy needs [PE for heating/cooling/DHW]
- Long-Term Monitoring - real energy needs - [PE for heating/cooling/DHW]



Examples of evaluation strategies

Strategy n.8:

- New generation EPC - calculated energy needs [PE for heating/cooling/DHW]
- National procedure + EPC RECAST data collection – calculated energy needs

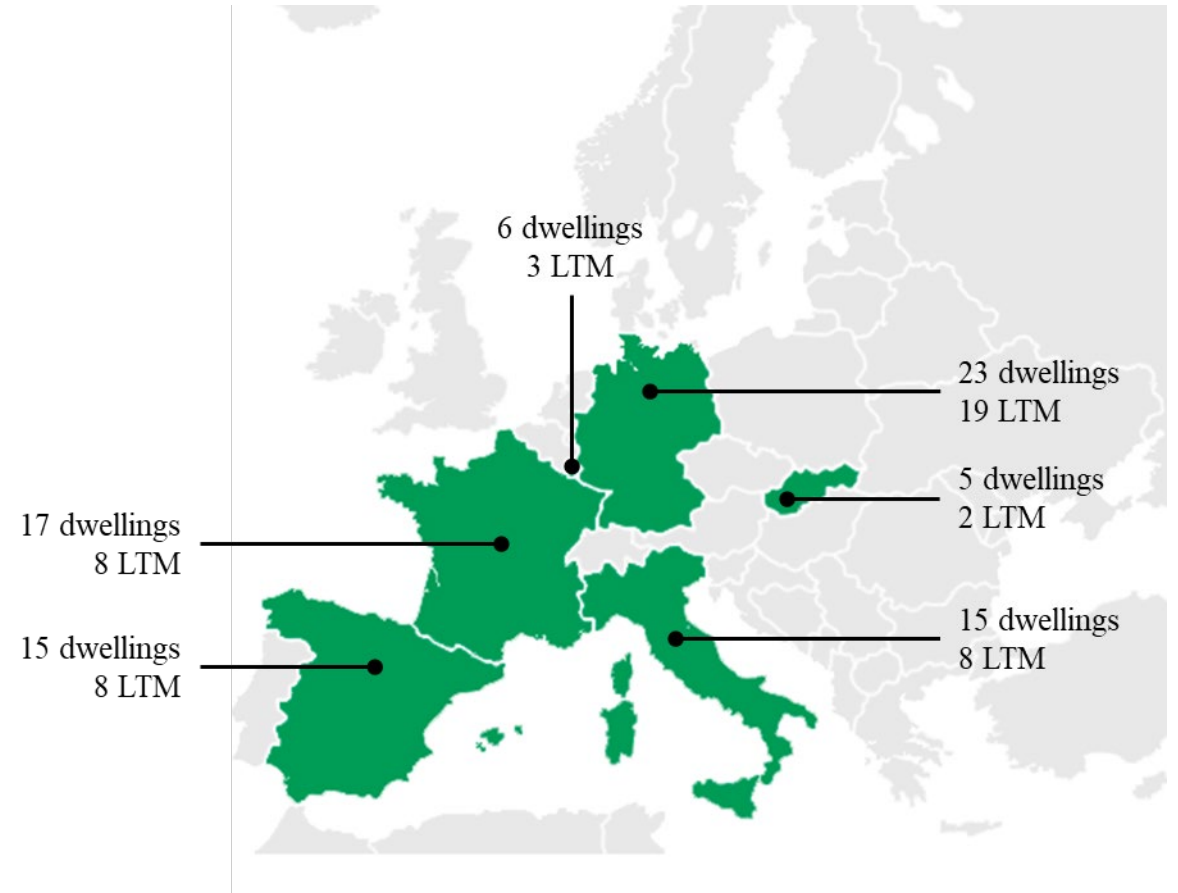


Case studies for testing

81 demo cases across EU, different in:

- Building typologies
- Periods of construction
- Levels of renovation actions
- Plant systems typologies
- Energy performance

48 demonstrators with LTM of actual energy consumption and indoor climate conditions



IT 01 LTM



- Ev. 1
- Ev. 1.1
- Ev.8

IT 02 LTM



- Ev. 1
- Ev. 1.1
- Ev.8

IT 03 LTM



- Ev. 1
- Ev. 1.1
- Ev. 7
- Ev.8

IT 04



- Ev. 4
- Ev.8

IT 05 LTM



- Ev. 1
- Ev. 1.1
- Ev.8

IT 06



- Ev. 1
- Ev. 1.1
- Ev.8

IT 07 LTM



- Ev. 1
- Ev. 1.1
- Ev.8

IT 08 LTM



- Ev. 1
- Ev. 1.1
- Ev.8

IT 09



- Ev. 4
- Ev.8

IT 10



- Ev. 4
- Ev.8

IT 11 LTM



- Ev. 1
- Ev. 1.1
- Ev.8

IT 12



- Ev. 4
- Ev.8

IT 13



- Ev. 4
- Ev.8

IT 14



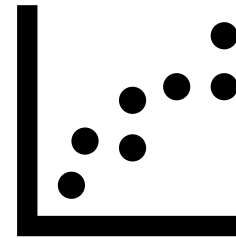
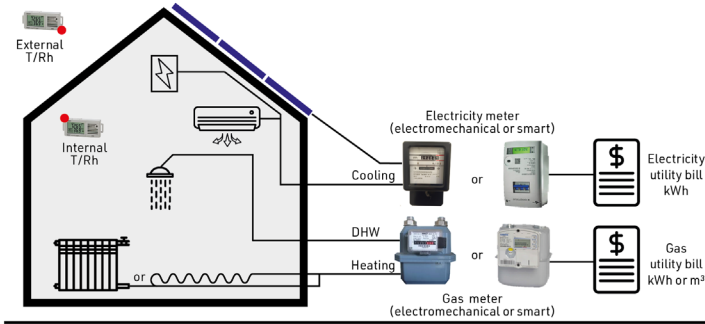
- Ev. 4
- Ev. 7
- Ev.8

IT 15

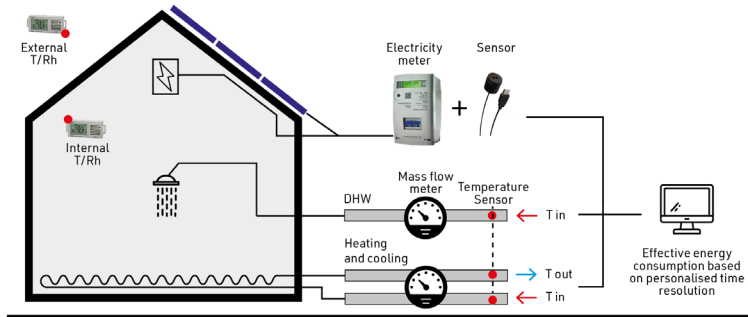


- Ev. 4
- Ev.8

Application of the methodology



Long-Term Monitoring
energy consumption



Application of the methodology

In/out condition



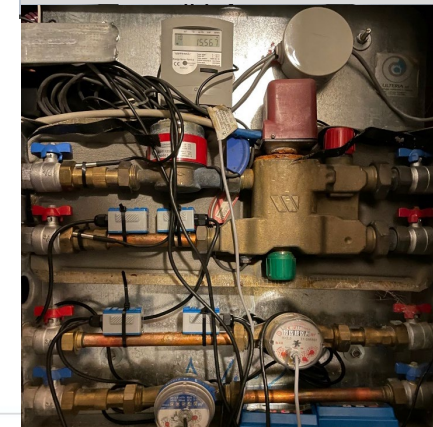
Gateway for online continuous data transmission



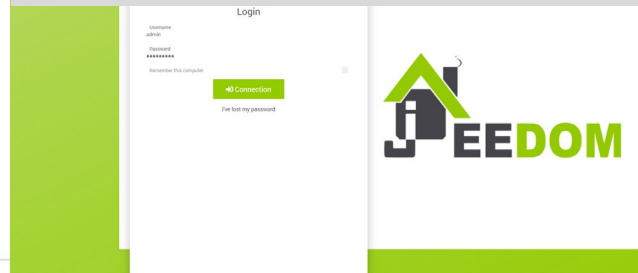
Electrical energy



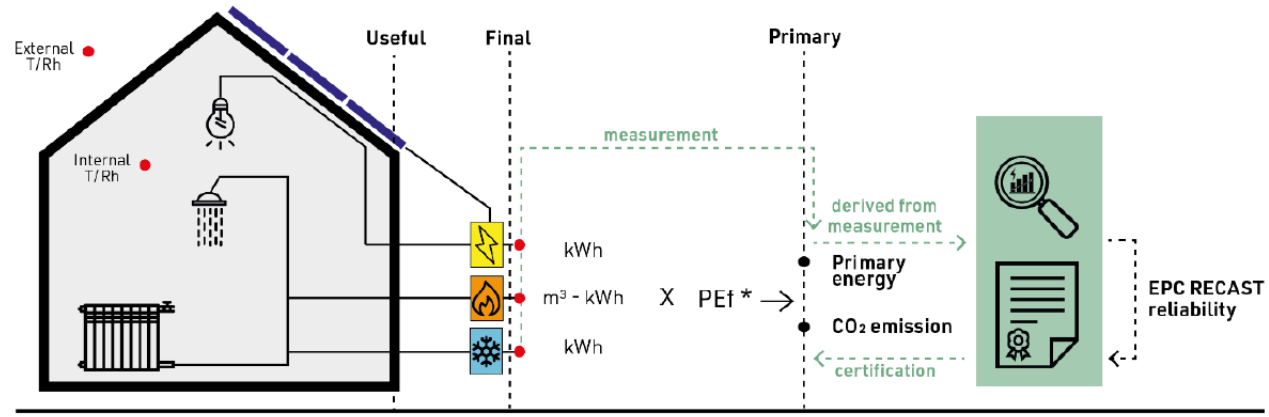
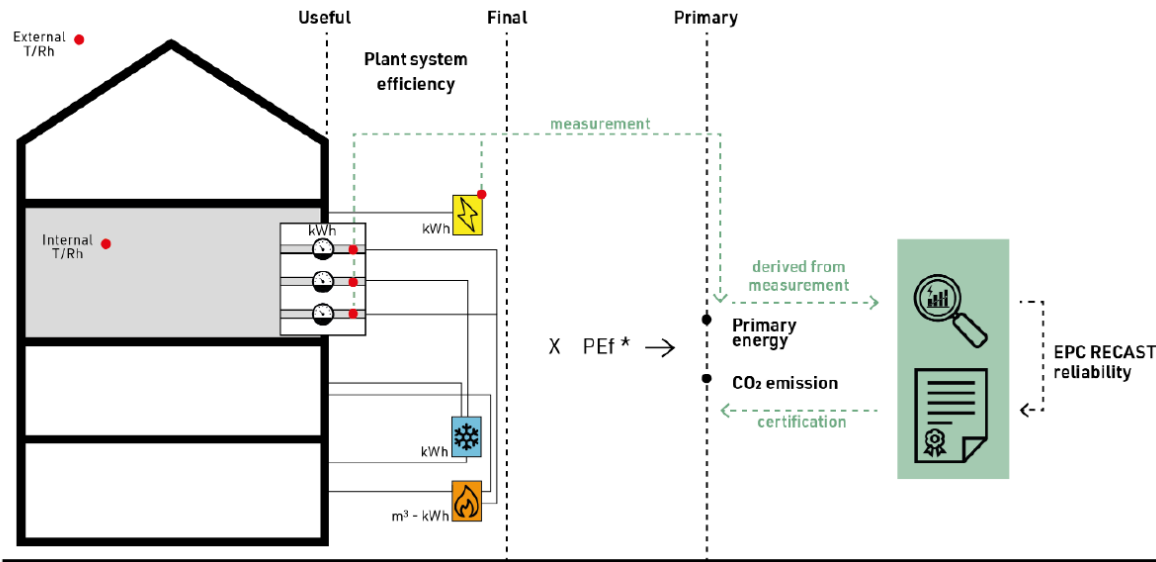
Thermal energy



EPC recast platfor



Application of the methodology



* Primary energy factors for energy carrier (electricity, district heating, district cooling, biofuel oli and gas)

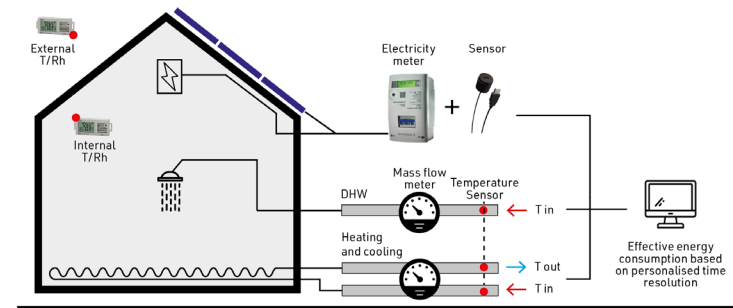
The methodology include the PE calculation procedure using national primary energy factors for the different energy vectors.

Application of the methodology

Case study in Lombardy Region, Italy.

Key information:

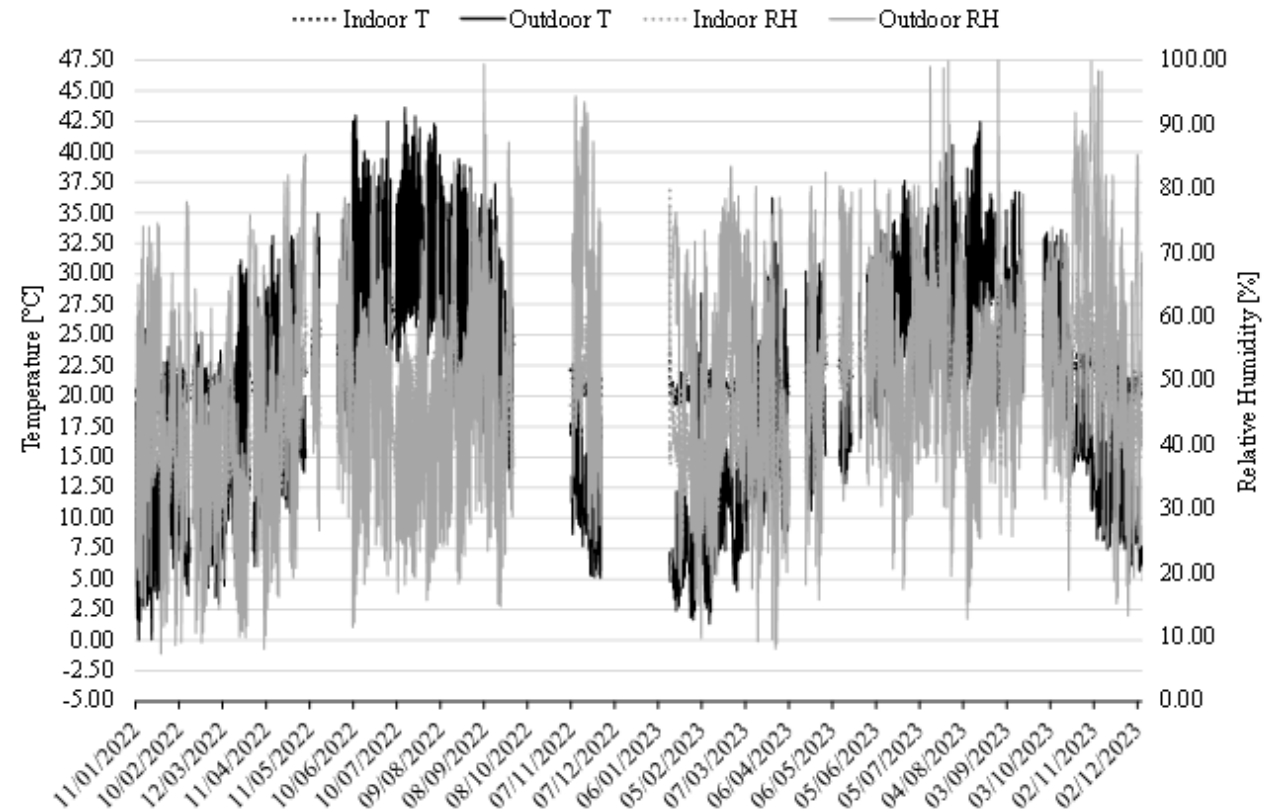
- Apartment in multifamily building.
- Year of construction 2009.
- Traditional reinforced concrete structure.
- Insulated wall with ETICS and roof.
- Radiant floor for heating/cooling.
- Gas boiler for heating and DHW.
- Ciller for cooling.
- Centralized mechanical ventilation, single flow.
- Solar panel collectors for DHW.



Long-Term Monitoring

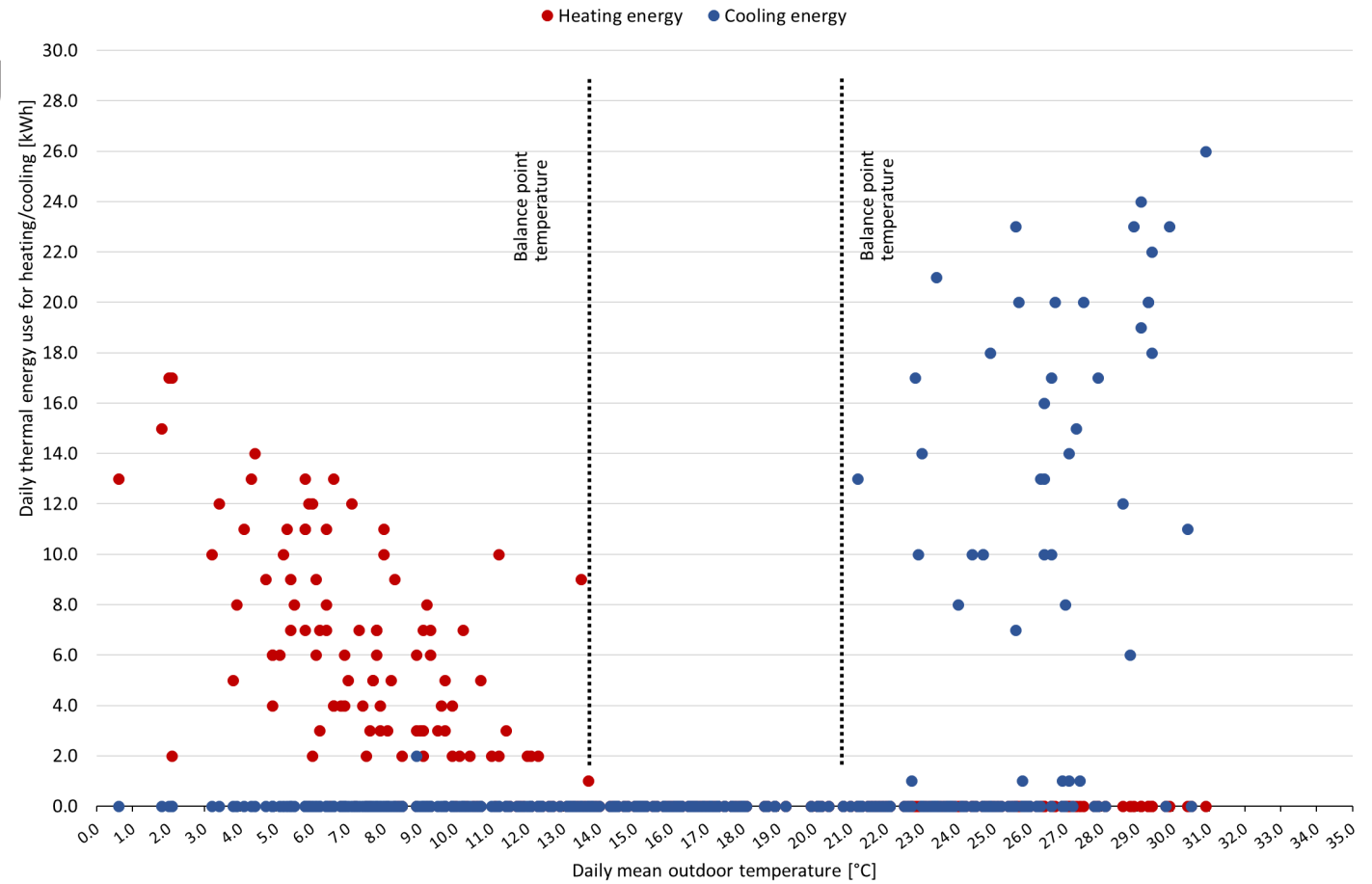
Outdoor climatic conditions: air temperature and relative humidity.

Indoor climatic conditions: air temperature and relative humidity as real conditions of building use



Long-Term Monitoring

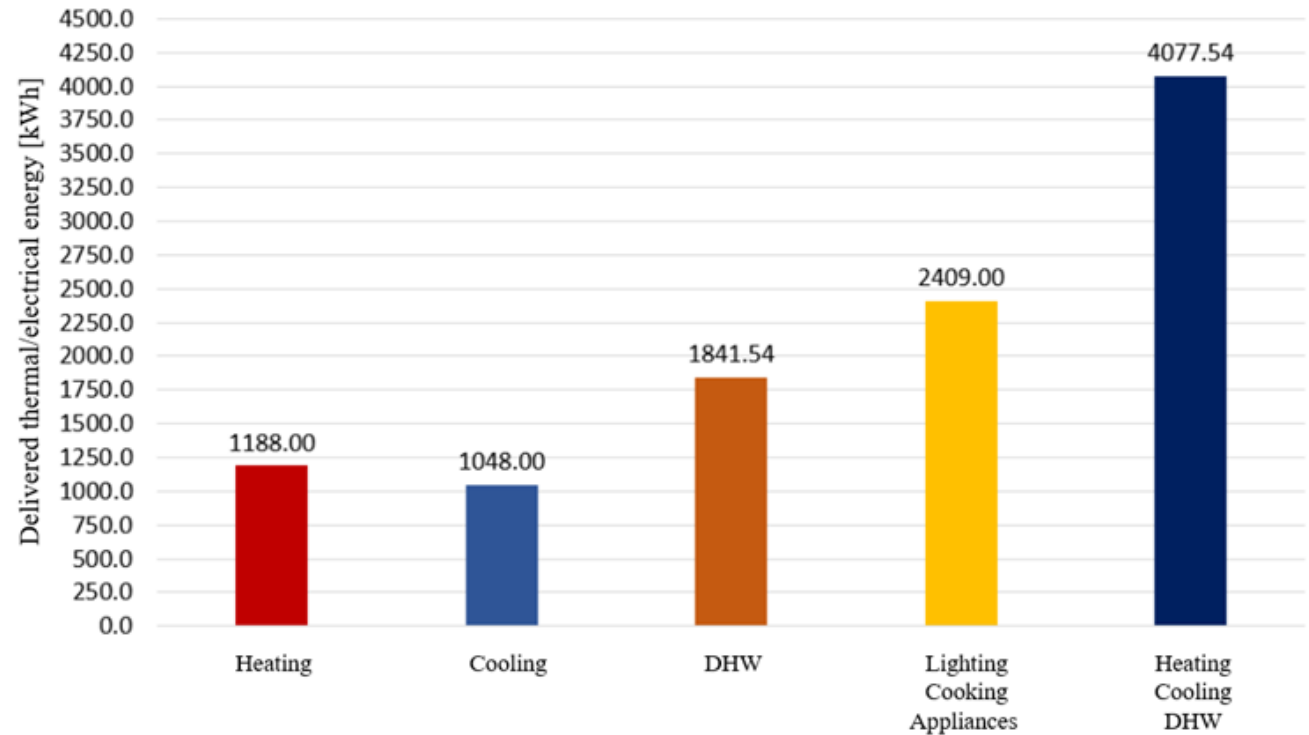
Measured daily heating/cooling energy needs [kWh]



Long-Term Monitoring

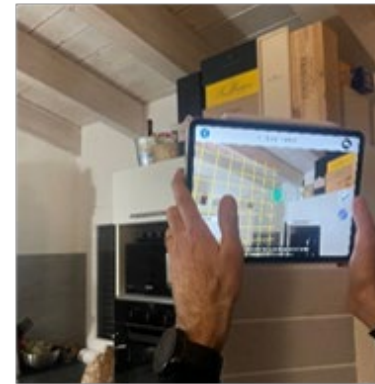
Aggregation of the measured energy:
heating/cooling/DHW/electricity
[kWh]

Comparison between energy simulation and real conditions to verify the reliability of EPC RECAST methodology

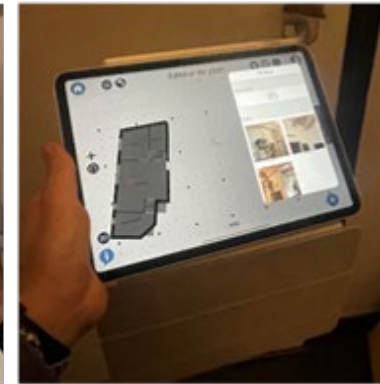


EPC RECAST on-site data collection

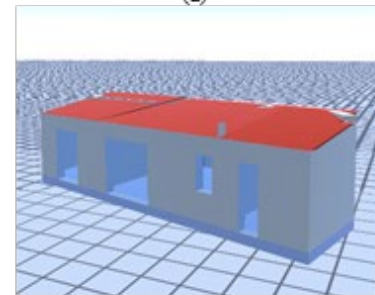
Fast/high accuracy geometrical survey using the Lidar technology.
Data enrichment of the geometry during the survey through specific questionnaires.



(a)



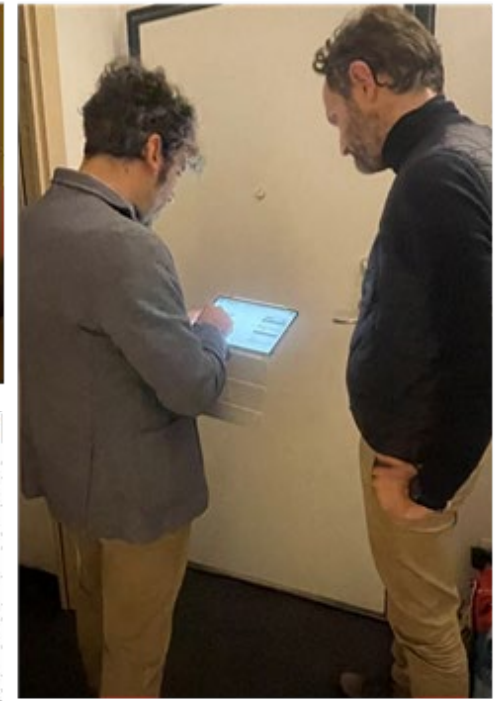
(b)



(c)



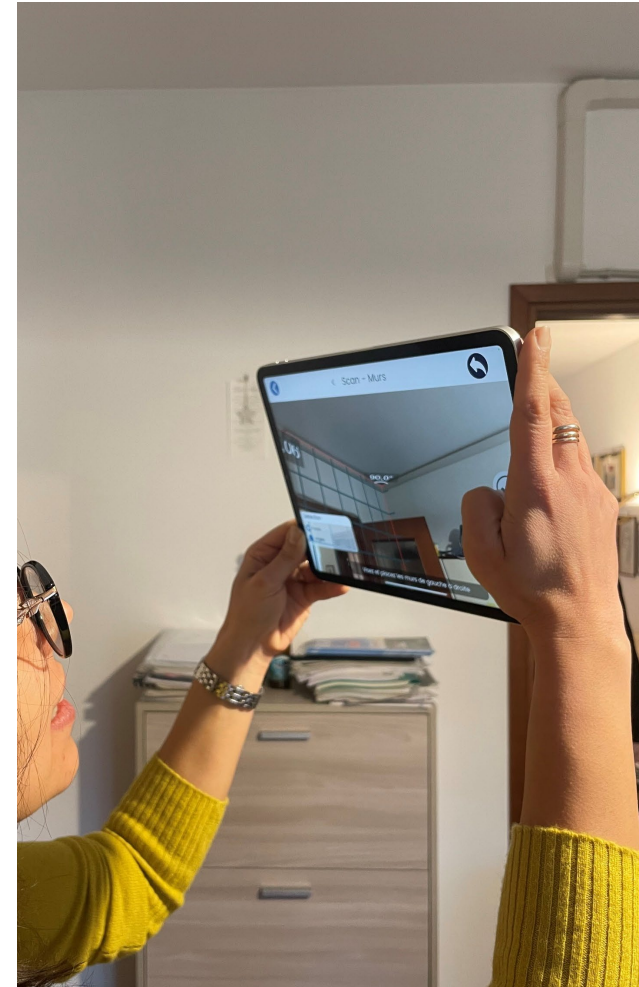
(d)



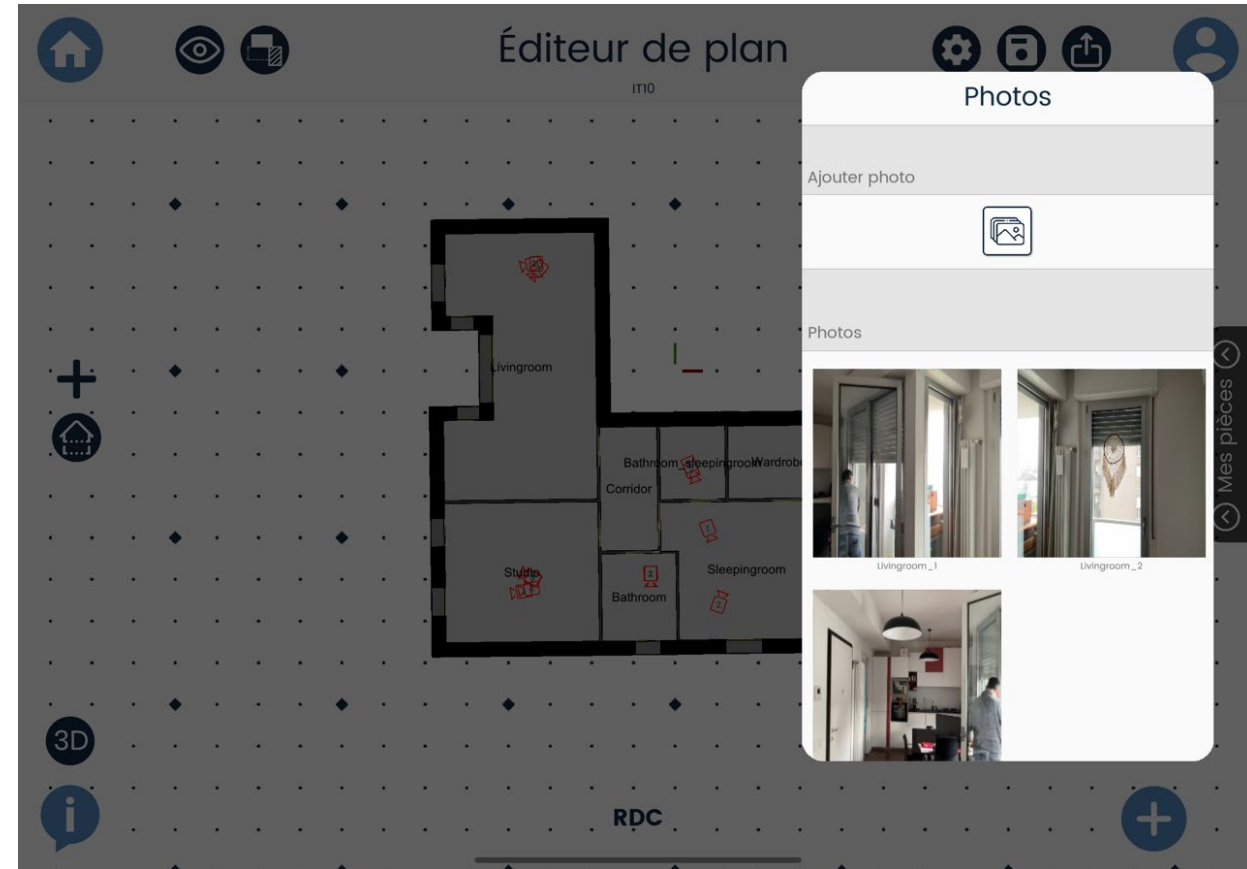
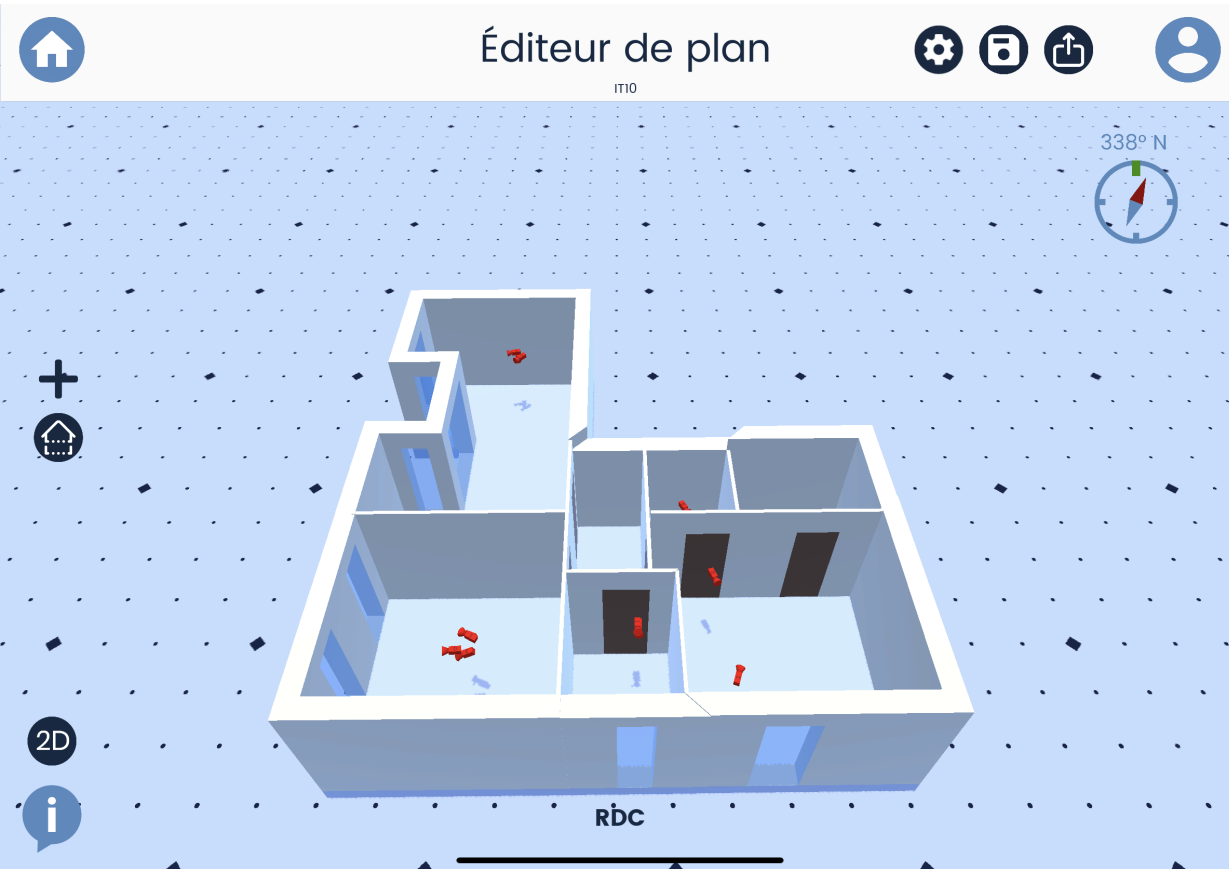
(e)



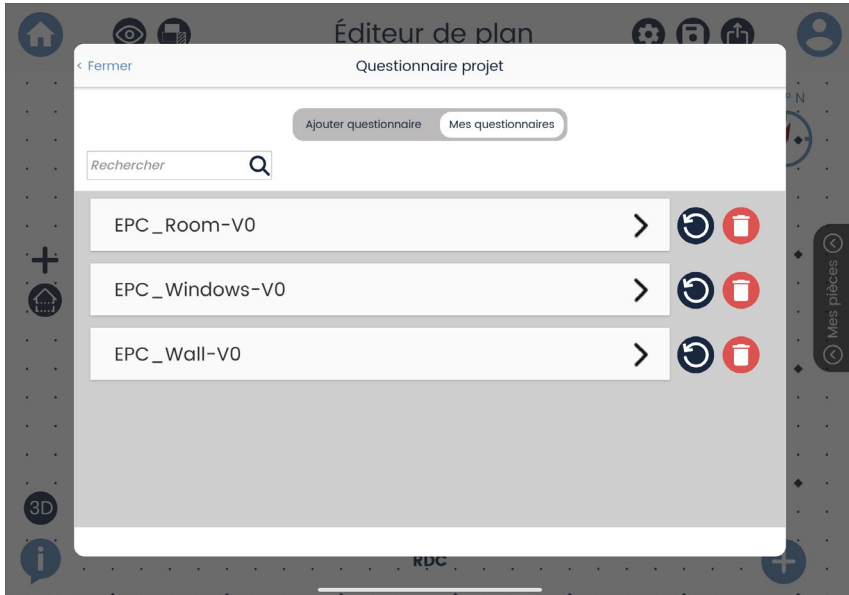
EPC RECAST on-site data collection



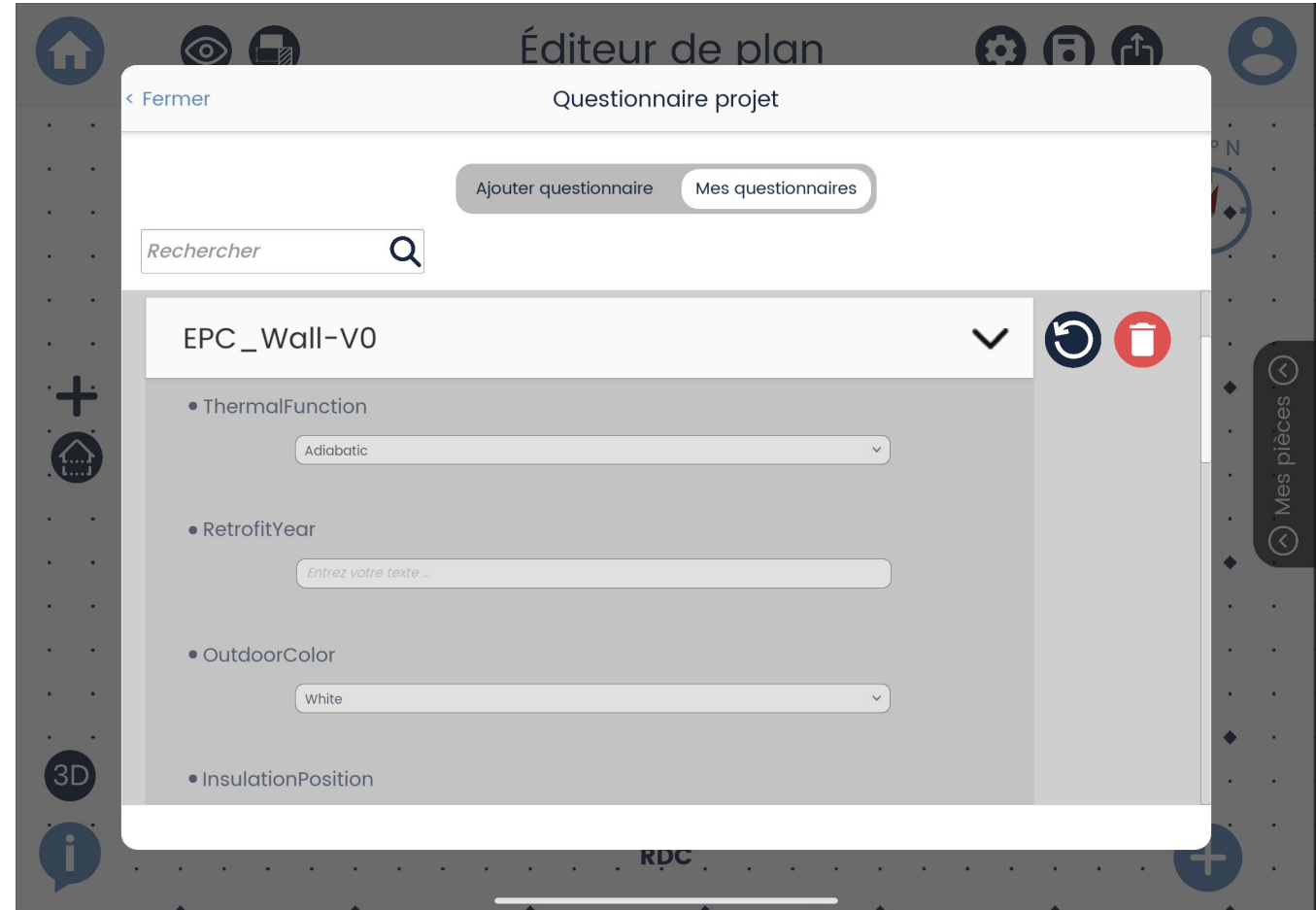
EPC RECAST on-site data collection



EPC RECAST on-site data collection



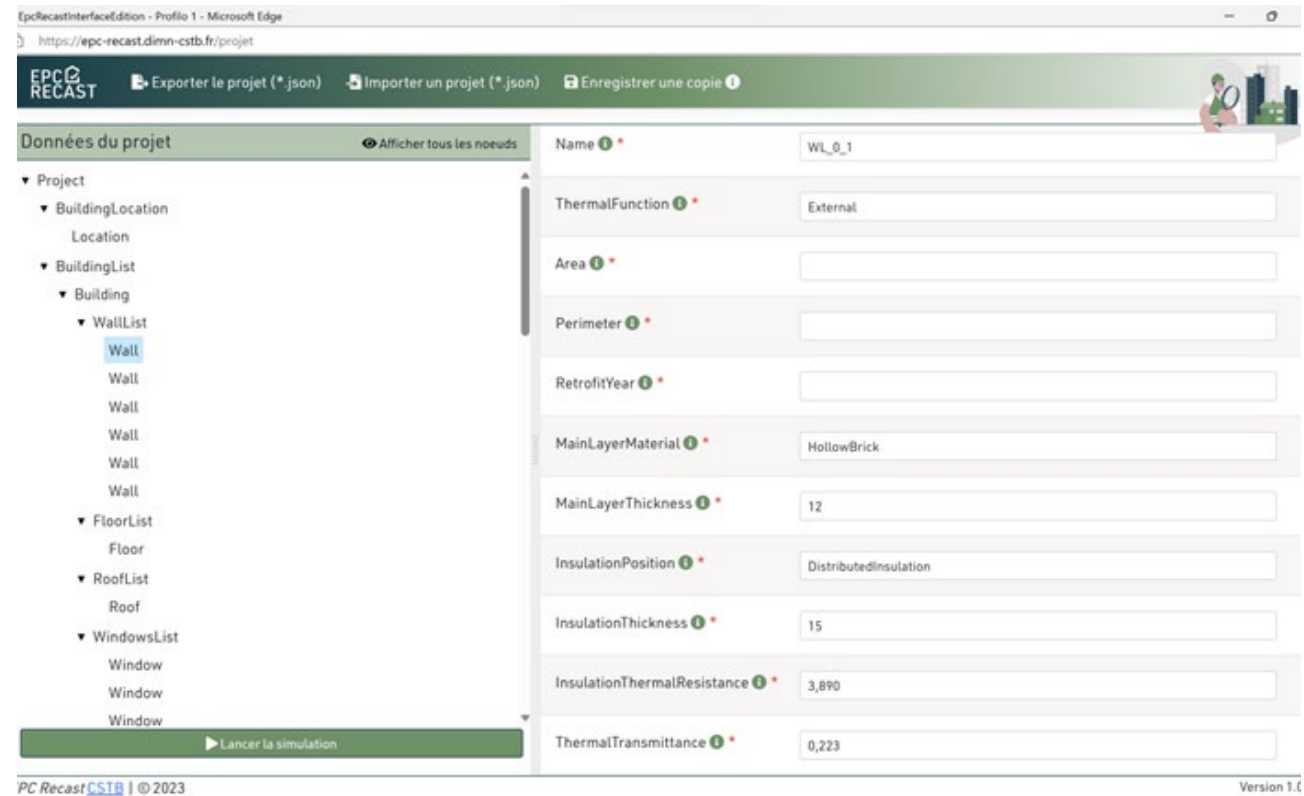
Data enrichment for energy calculation. Detailed description for room/windows/wall.



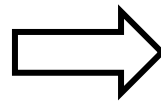
EPC RECAST calculation engine

Online interface with:

- Automatically generated XML file with enriched geometry.
- Data check and modification.
- Data inclusion of unknown values from standard/regulations.



IT01 – Evaluation Strategy



Period of monitoring from smart meter: 02/2022-01/2023
Period of monitoring from bills: 01/2022-12/2022

$PE_{SEPC,tot}$: 131.54 kWh/m²y

$PE_{SEPC,H}$: 33.73 kWh/m²y

$PE_{SEPC,C}$: 19.16 kWh/m²y

$PE_{SEPC,DHW}$: 50.20 kWh/m²y

$PE_{SM,tot}$: 40.76 kWh/m²y

$PE_{SM,H}$: 16.28 kWh/m²y

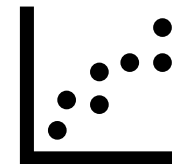
$PE_{SM,C}$: 6.17 kWh/m²y

$PE_{SM,DHW}$: 18.31 kWh/m²y

$PE_{B,el}$: 64.55 kWh/m²y

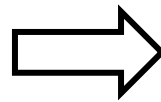


**STANDARD
EPC**



**REAL
PERFORMANCE**

IT01 – Evaluation Strategy



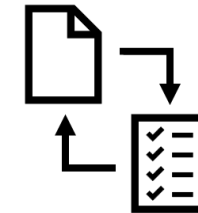
$Var_{SEPC-SM,tot}$: **-69%**

$Var_{SEPC-SM,H}$: **-52%**

$Var_{SEPC-SM,C}$: **-68%**

$Var_{SEPC-SM,DHW}$: **-64%**

EI_{B-SEPC} : **49%**



**Results comparison
(Standard EPC as
benchmark)**

Conclusions

Testing method:

- Affordability of LTM in terms of costs
- Reliability of LTM in terms of data quality and storable information
- Rapidity and precision of geometrical data collection tool
- Fast and solid geometrical data enrichment

Improvement of EPCs:

- More reliability of the energy assessment thanks to the monitoring of real conditions





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EPC-RECAST



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R

RELIABILITY

E

ENERGY AND BEYOND

C

COMPARABILITY

A

AWARENESS, ACCEPTANCE & USER-FRIENDLINESS

S

STANDARDS & SMART-READINESS

T

TRANSPARENCY

**EPC
RECAST**
ENERGY PERFORMANCE
CERTIFICATE RECAST

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Thank you for your
kind attention

Authors contacts: graziano.salvalai@polimi.it,
ilaria.isacco@polimi.it, marta.sesana@unibs.it



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