Deep renovation and prefabricated solutions.

The EU H2020 project 4RinEU

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14th February 2019

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4RinEU
Reliable models for deep renovation

The project 4RinEU has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 723829

4RinEU

Reliable models for deep renovation

Specific challenges to tackle:

- Inefficiency of the building stock
- Few buildings under deep renovation
- Feasible business approach

Needs:

- Comprehensive deep renovation packages
- Reduction of time and cost of renovation

Expected impact:

- **60%** Net primary energy saving
- **15%** Cost reduction (compared with a typical renovation)
- **-50%** time for deep renovation

The Consortium

R&D

IT eurac research

NO SINTEF

Applied Research Centres

DEMO OWNERS

NL WOONZORG NEDERLAND

NO BOLIGBYGG

ES Agència de l'Habitatge de Catalunya

Social housing agencies

CONSULTANCY

IT adermalocatelli WE ANCHOR BUILDING TO THE FUTURE — Energy audit

ES acciona Infraestructuras — Construction company

IT R2M RESEARCH TO MARKET SOLUTION — Research to market

ES AIGUASOL

NL Trecodome

Engineering companies

TECHNOLOGY PARTNERS

DE gumpp & maier solutions made of timber — Manufacturer - prefab timber facades

IT Thermics — Manufacturer - H&C + RES

UK IES — Software developer

Start date: 1 October 2016 - **Duration:** 48 months

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4RINEU Reliable models for deep renovation

Project overview

Fact: we are far from the targeted 3% EU building stock renovation

4RinEU PILLARS

ROBUST TECHNOLOGIES

USABLE METHODOLOGIES

TO ACCURATELY UNDERSTAND THE RENOVATION POTENTIALS

TO ENSURE EFFECTIVE AND PARTICIPATED DESIGN

TO REDUCE CONSTRUCTION TIME AND FAILURES

RELIABLE BUSINESS MODELS

TO ENHANCE THE LEVEL OF CONFIDENCE & TO IDENTIFY THE LEVEL OF RISKS

Impact: to increase efficiency of whole deep renovation process

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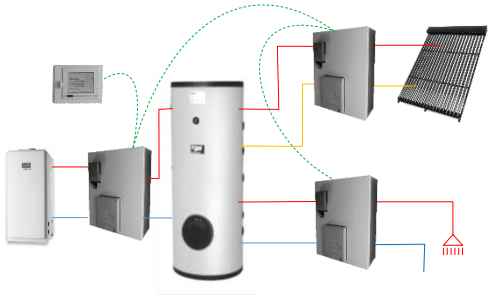
4RinEU technologies

TO REDUCE ENERGY DEMAND

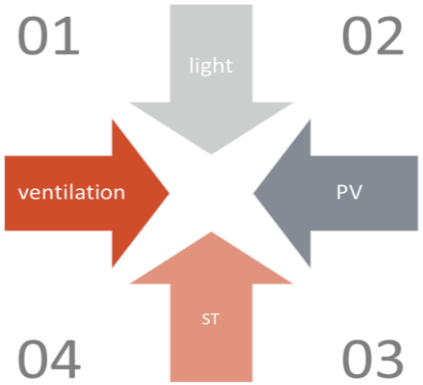
Prefabricated Multifunctional facade

Comfort ceiling fan operation

TO IMPROVE ENERGY EFFICIENCY

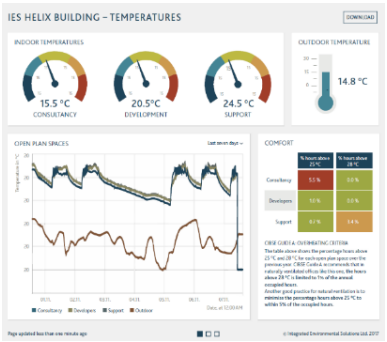


Plug&Play Energy Hub



Early Reno

TO IMPROVE OPERATION



Sensible Data Handler

Component end of life

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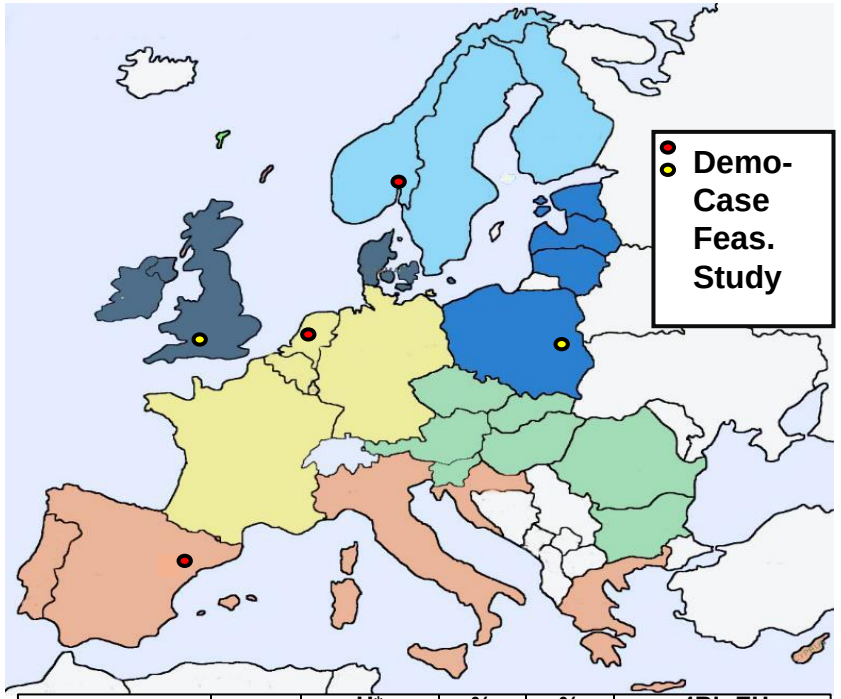
4RinEU implementation



Geo-Cluster	HDD	U* [W/m² K]	% SFH	% MFH	4RinEU Implementation
1. Northern	5445	0.27	62	38	Demo-Case - Norway
2. North-East	3958	0.22	51	49	Early Adopter Poland
3. Cont. West/Central	2758	0.31	67	33	Demo-Case - Nederlands
4. Atlantic	3022	0.27	84	16	Early Adopter - UK
5. Cont. East	2956	0.32	63	37	Hungary
6. Mediterr.	1363	0.85	52	48	Demo-Case - Spain

Europe divided in **6 geoclusters**

Different levels of implementation:

- **3 demo cases** → whole renovation
- **3 Early adopter buildings** → feasibility study

EARLY ADOPTER TEAM

DEMO CASES

HAUGERUDSENTERET
Oslo - Norway

MARIËNheuvel
Soest – The Netherlands

Bellpuig
Spain

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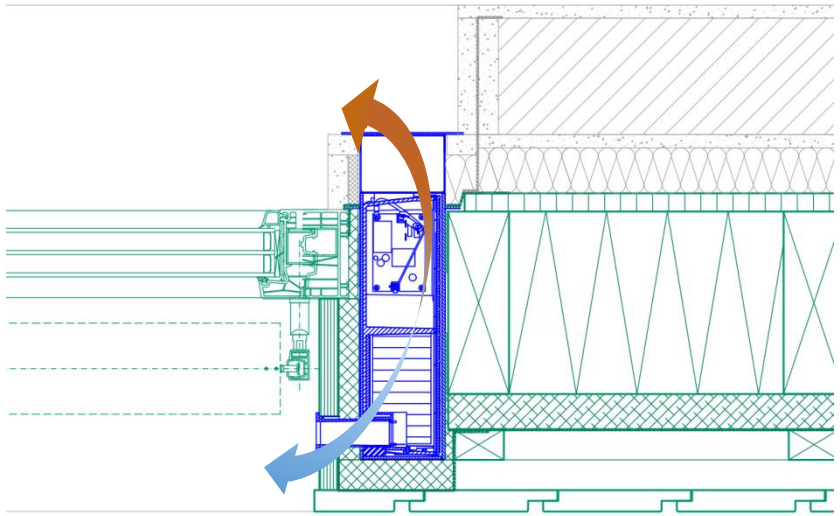

Prefabricated multifunctional timber-frame façade

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gumpp & maier
solutions made of timber

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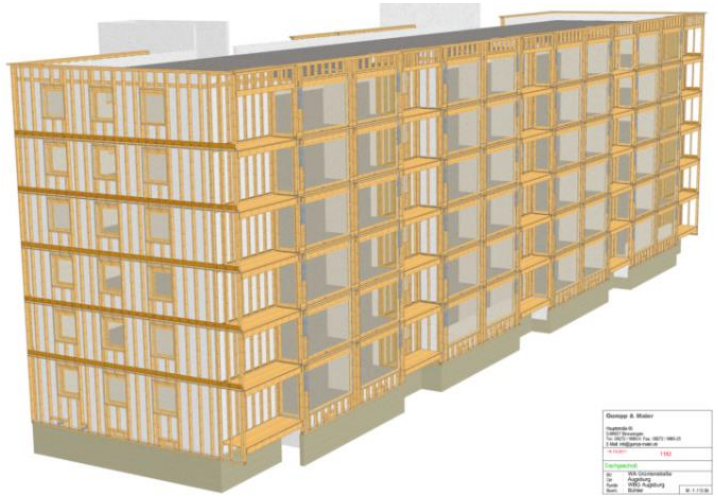
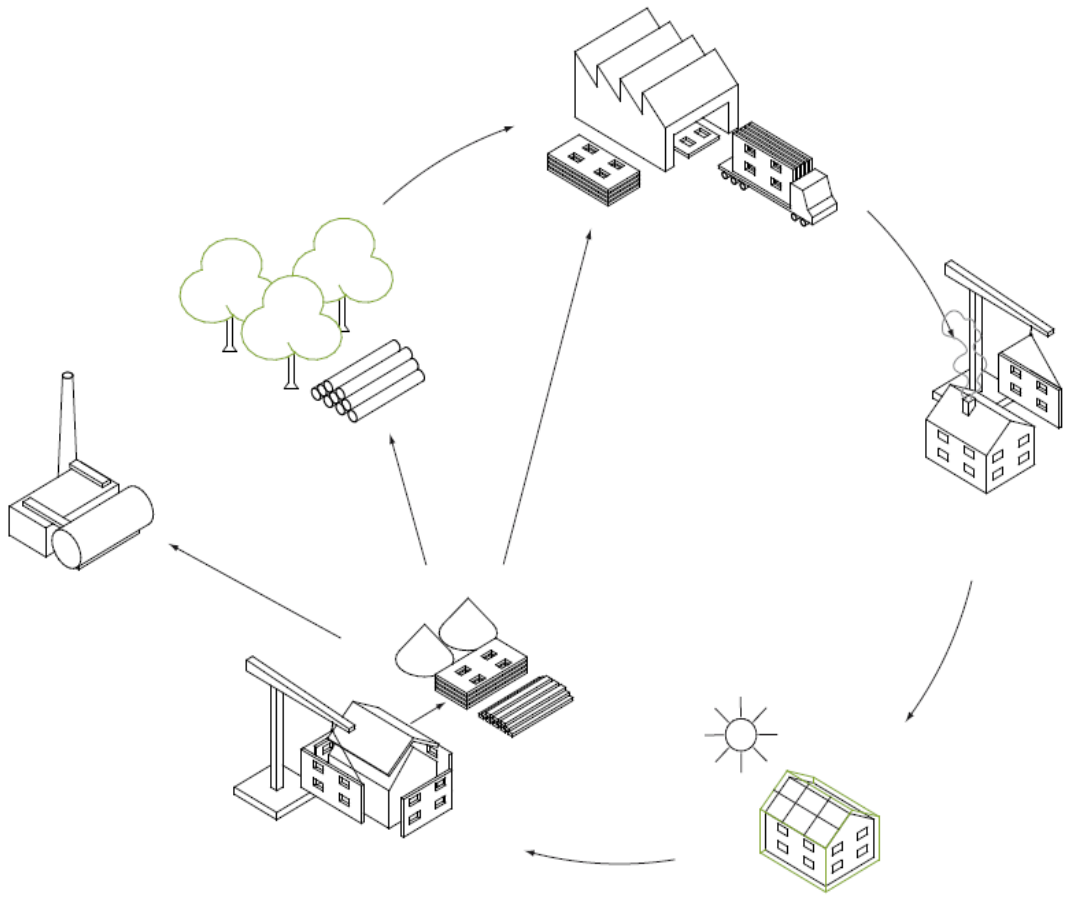
Prefabricated facade elements for renovation

- **New building skin** – fits like a stamp to the existing façade openings
- More than mere thermal insulation
- Deep renovation approach **for buildings at the end of their lifetime**
- Reach state like **new built with new lifetime**
- **Maximize the level of prefabrication**
- **Minimize works on site** and disturbance of tenants



Pictures show renovation project in Grüntenstraße, Augsburg, Germany. Source: Gumpp & Maier GmbH

Why WOOD?



renewable building material

environment friendly and consumes the **least amount of energy** when processed

stores up carbon and has a very **low carbon footprint**

high degree of prefabrication, **rapid installation** on site

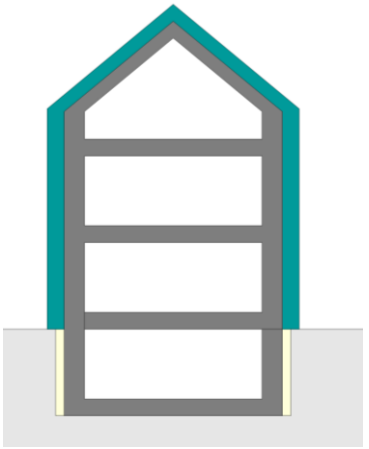
Excellent **earthquakes and fire resistances**

Renovation ↔ Demolition and new building

- Demolition:
  - Additional costs, time effort and disturbance
  - Destruction of embedded grey energy
  - Emissions from demolition and new building

- Minimal renovation:
  - Low investment for the renovation, but
  - Short lifetime of ETICS, high maintenance costs
  - Poor aesthetical appearance outside and low comfort conditions inside
  - Low quality building services:

    High lifetime costs: energy costs and maintenance costs
  - Disturbance of tenants

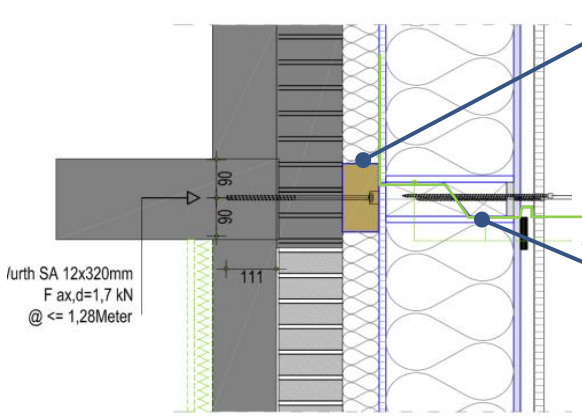


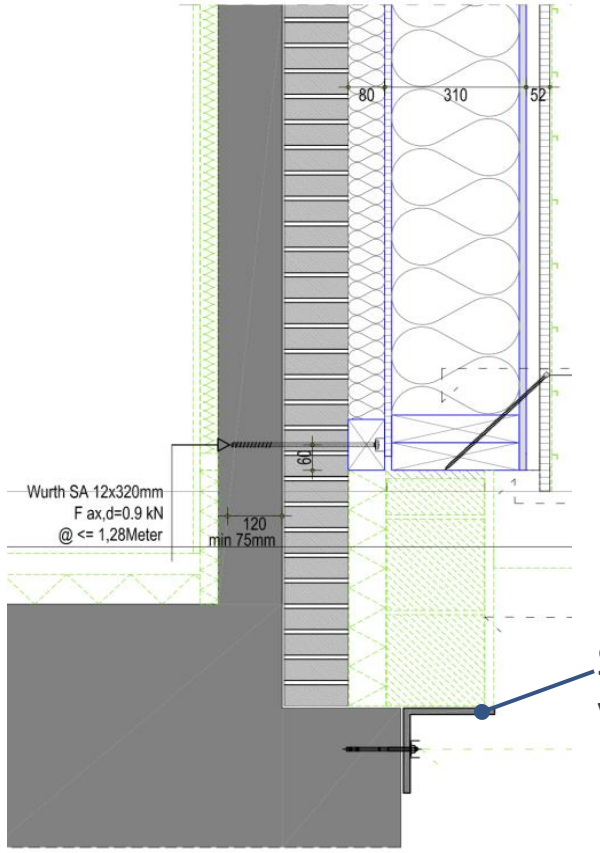
Prefabricated retrofit module

- simple, **easy to apply**, ensure high quality
- **integrated solution** capable of including hot water, ventilation, heating and/or cooling ducts inside the module;
- Apply materials with high potential for **reuse/recycling** and incorporate materials with low embodied energy;
- **Low execution time**;
- Renewal or **improvement of windows**, modification of window openings;
- Reach state like **new built** with **new lifetime**

Building system

- Solving the joints
- Design planning and developing all details prior to construction
- Example: Vertical element connection





Transport and mounting

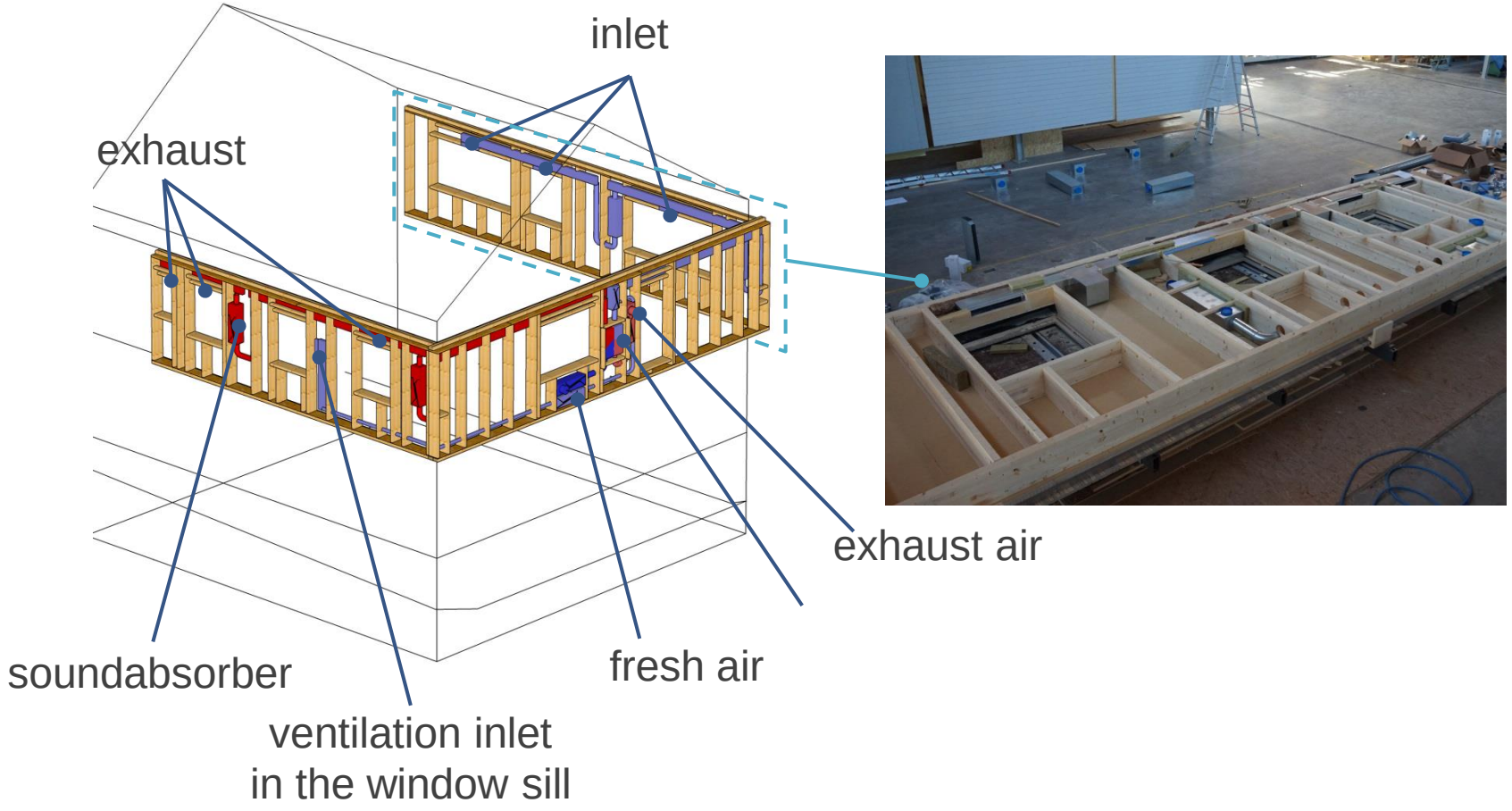
- Typical Element size: 1 storey in height, up to 12 m in length
- Scaffold: Mounted with a gap according to element thickness

Main functions of TPMF

- Minimisation of thermal **transmission losses**
- Improving the **airtightness**
- Using **mechanical ventilation** with an heat recovery system
- Exploiting the integration of **shading devices**
- Integrating **solar active components**
- **New windows**

Ventilation integrated into the facade

- Ventilation integrated into the façade
- Example: decentralized system per floor



SaLüH!

Sanierungsansätze für Lüftung,
Heizung und Warmwasser

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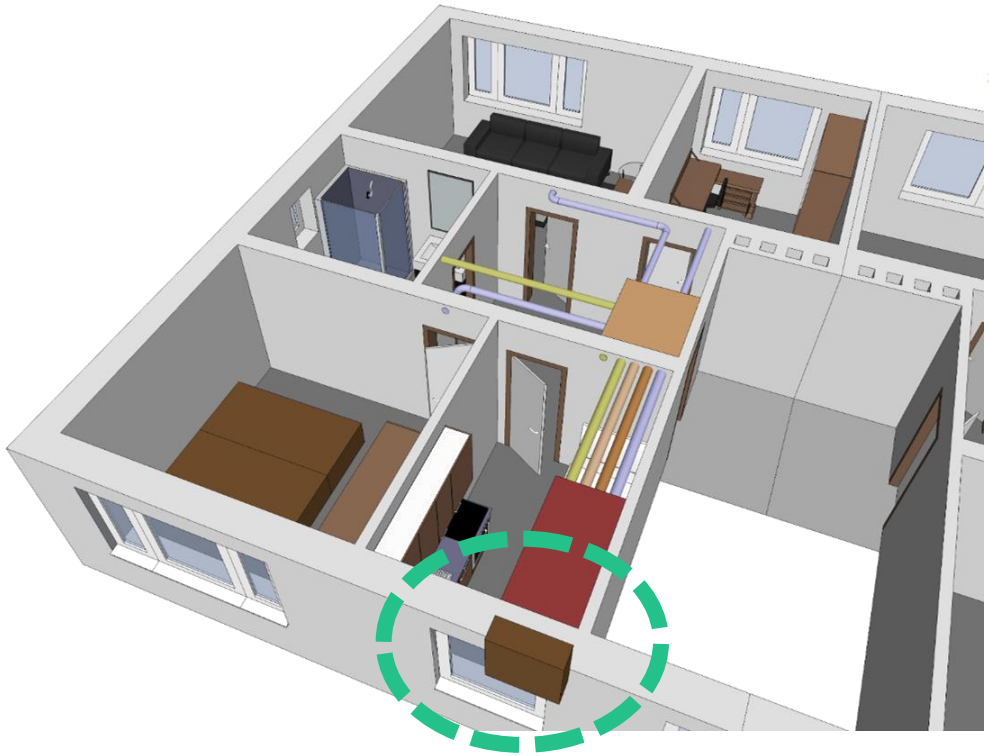

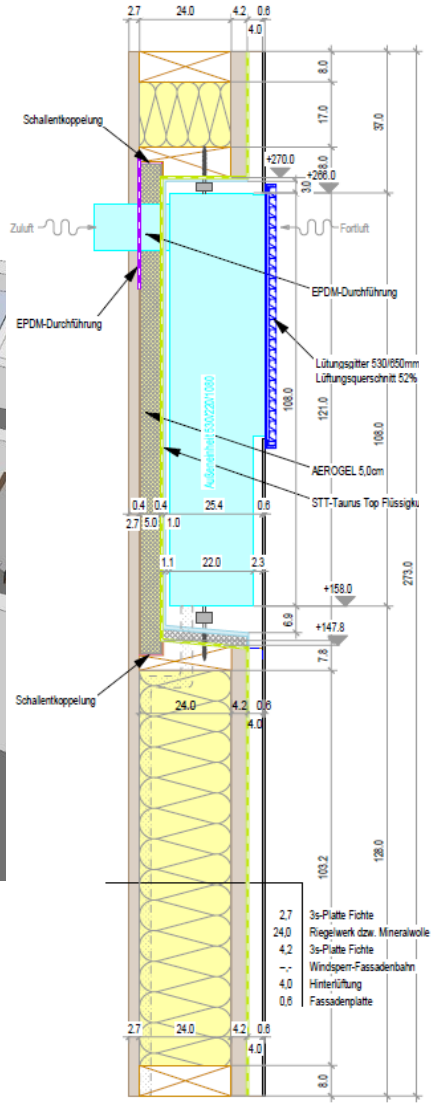

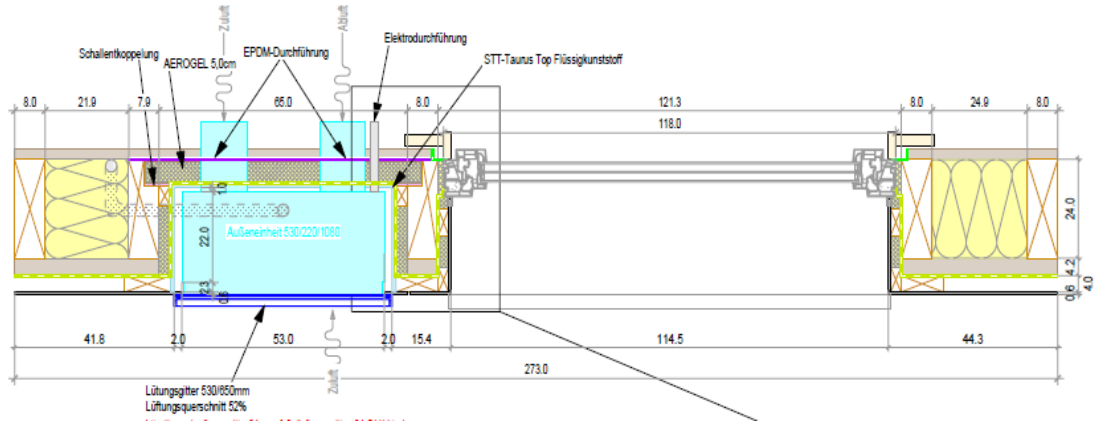

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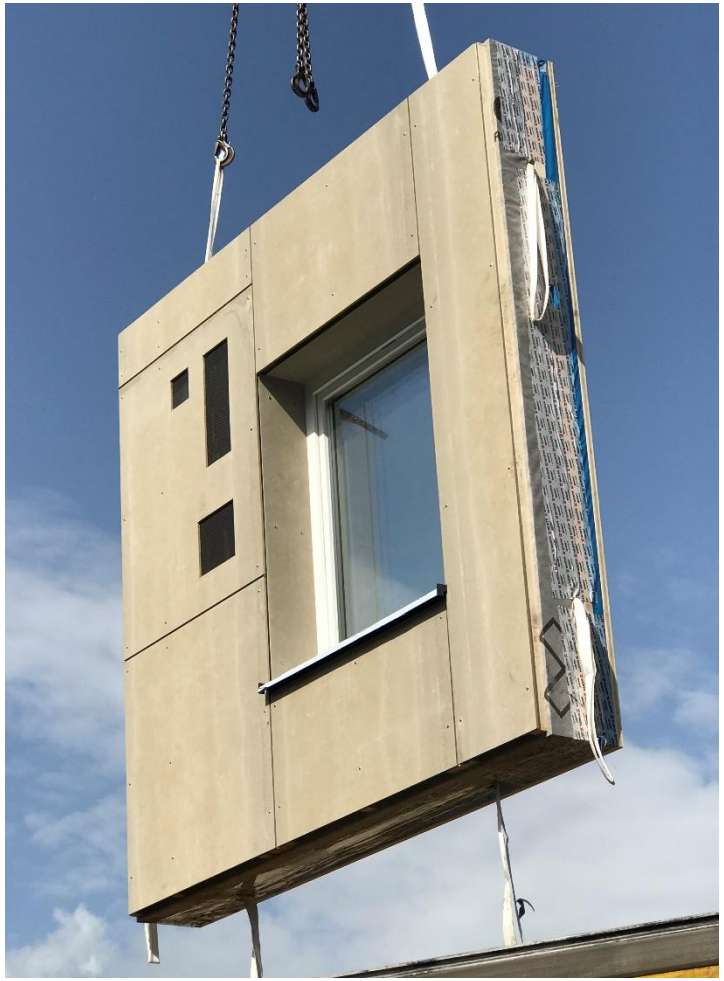

Maximized level of prefabrication

Demonstration wall element developed within 4RinEU project

Prefabricate and transport elements with:

- Cladding
- Windows
- Sun shading
- Decentralized ventilation device with heat recovery
- Solar thermal panel already connected to water pipes

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Libera Università di Bolzano
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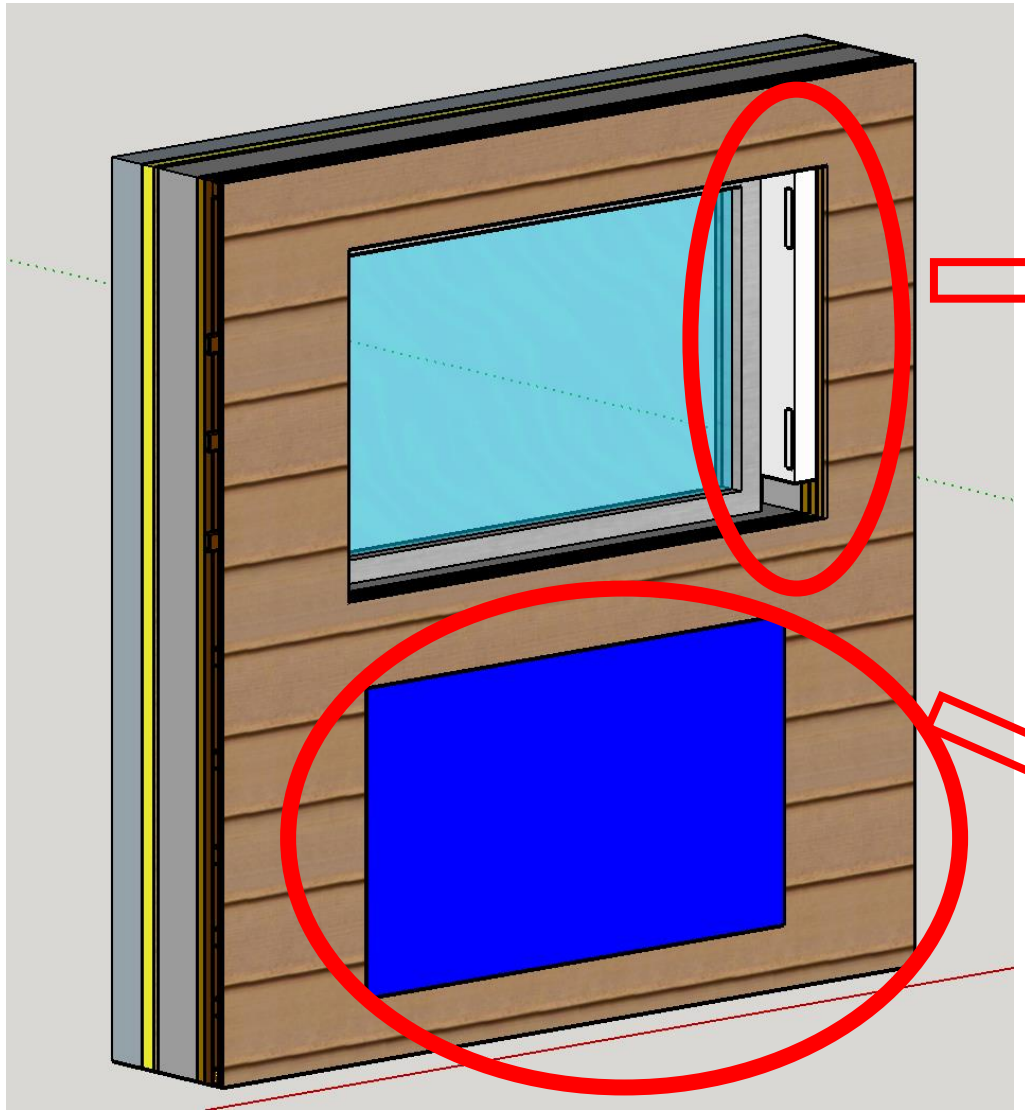
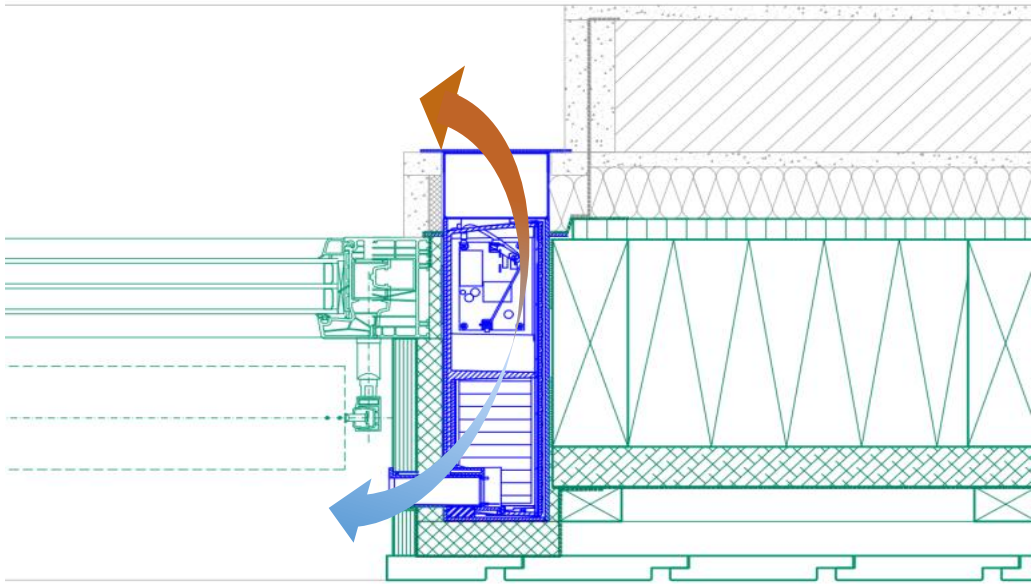
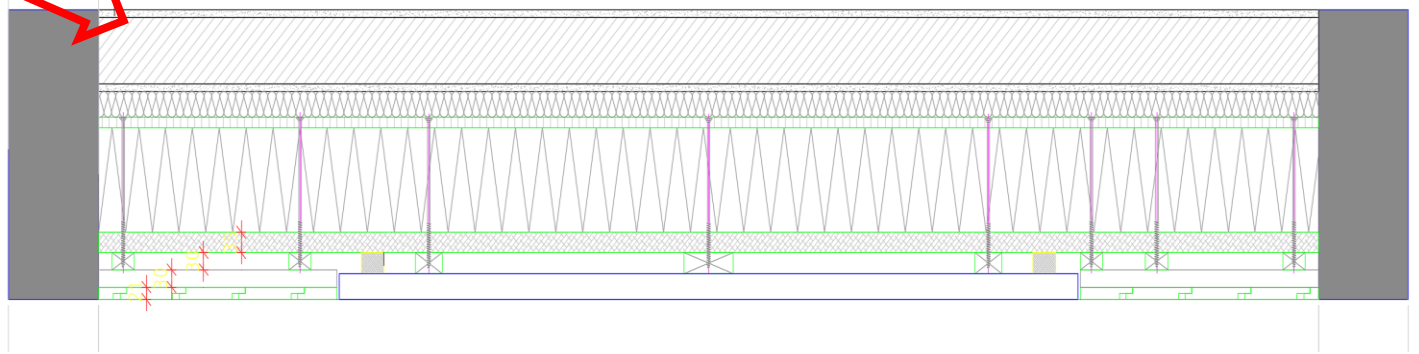
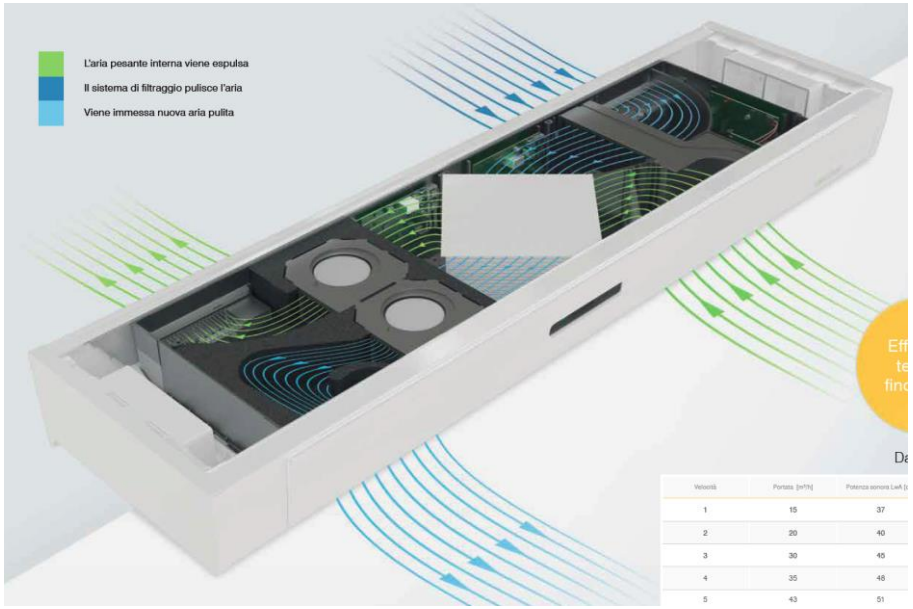






MECHANICAL VENTILATION MACHINE



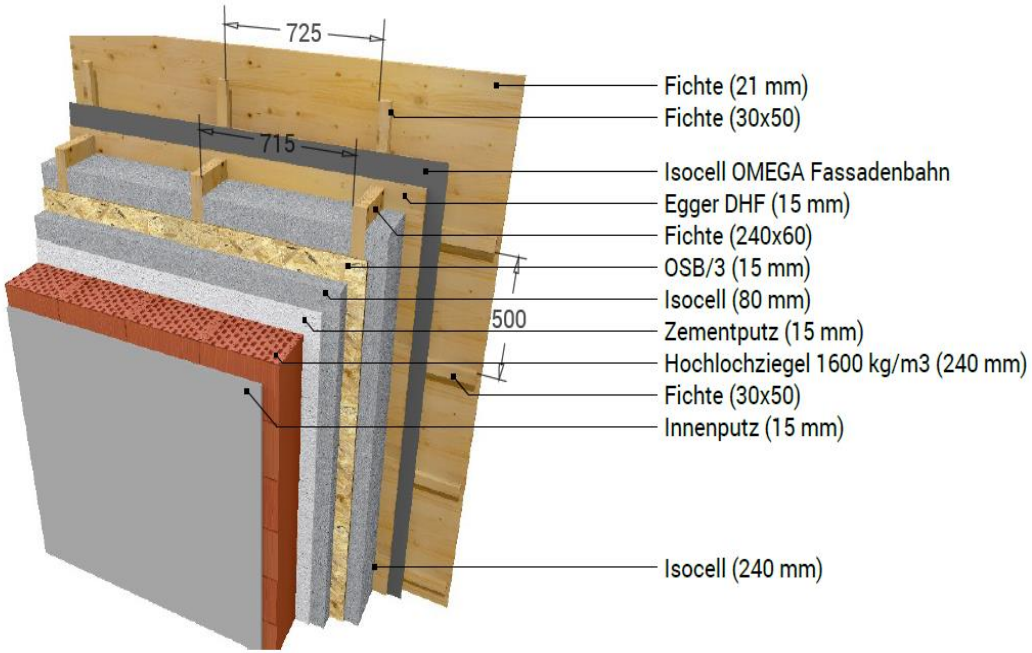
Cross flow mechanical ventilation machine with heat recovery (Thesan Aircare ES)
→ 15 to 43 m^3/h with 82 to 69 % HR

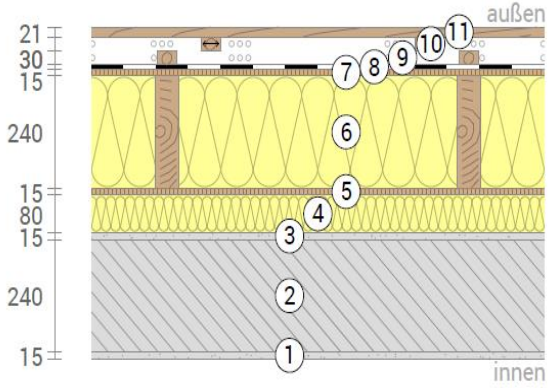
WINDOW

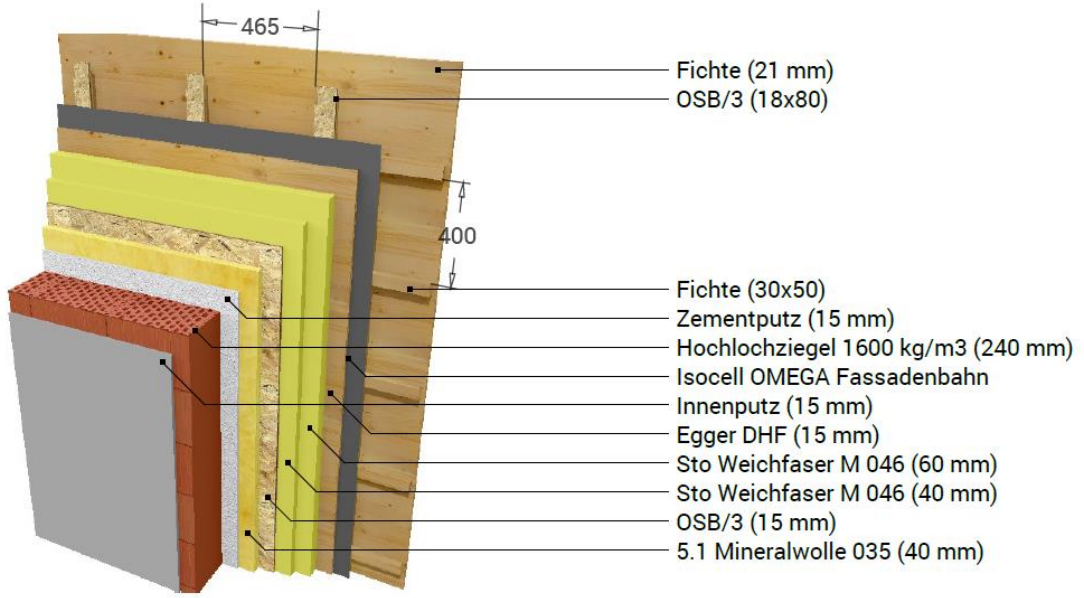
SOLAR THERMAL PANEL

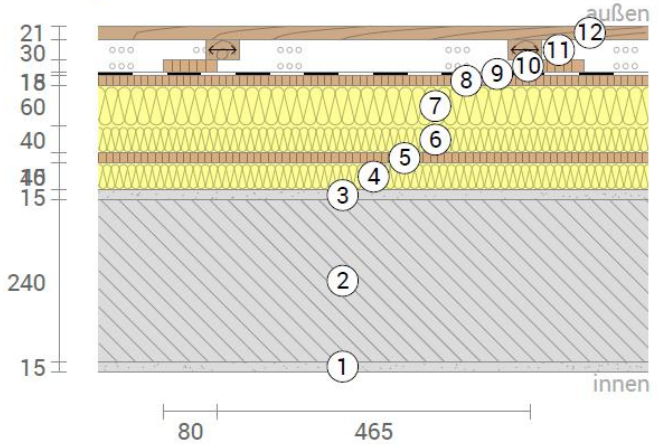
Thin solar thermal panel (Costruzionisolari, PANDA super slim)
→ 1.6m^2,43mm thickness, 90% absorptivity

2 PROTOTYPES TO BE COMPARED: **DIFFERENT LAYOUT & COMPOSITIONS OF PREFABRICATED MODULE**









PROBELEMS CAUSED BY HUMIDITY IN BUILDINGS

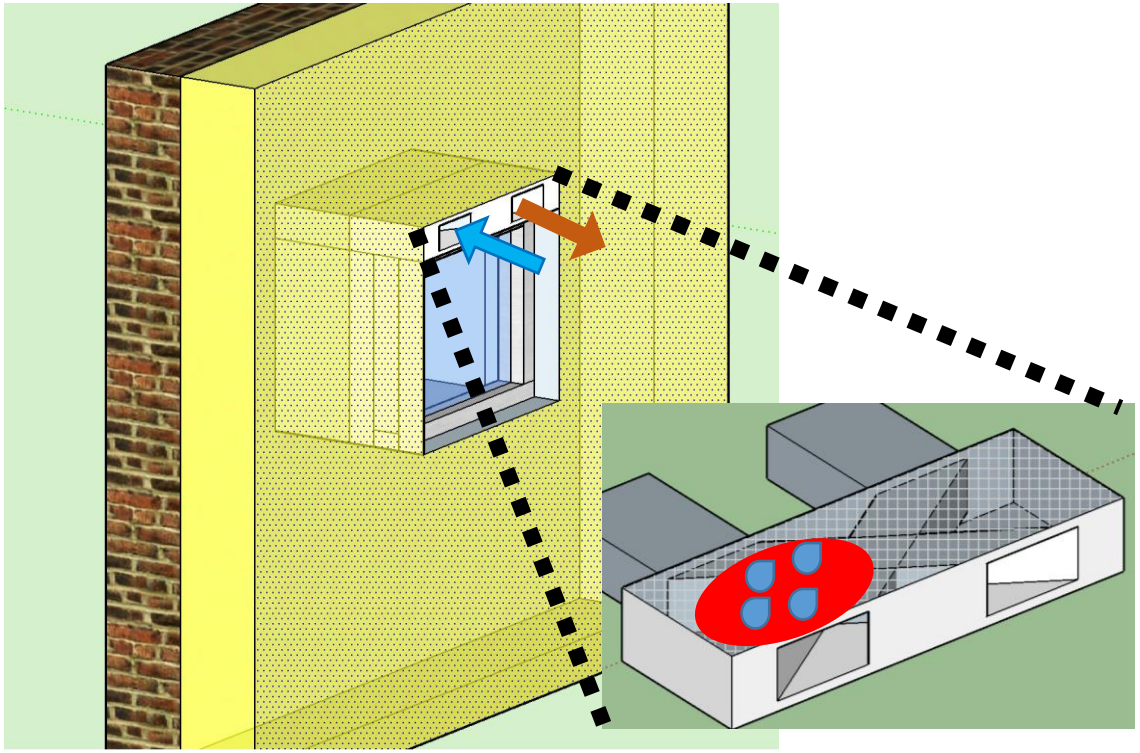
- Comfort and human health
  Respiratory problems and allergic reaction due to mold and spores
  (Conditions for mold growth: surface RH >80%, Surface temperature >5°C)

- Mechanical and performances degradation of materials

- Aesthetic degradation

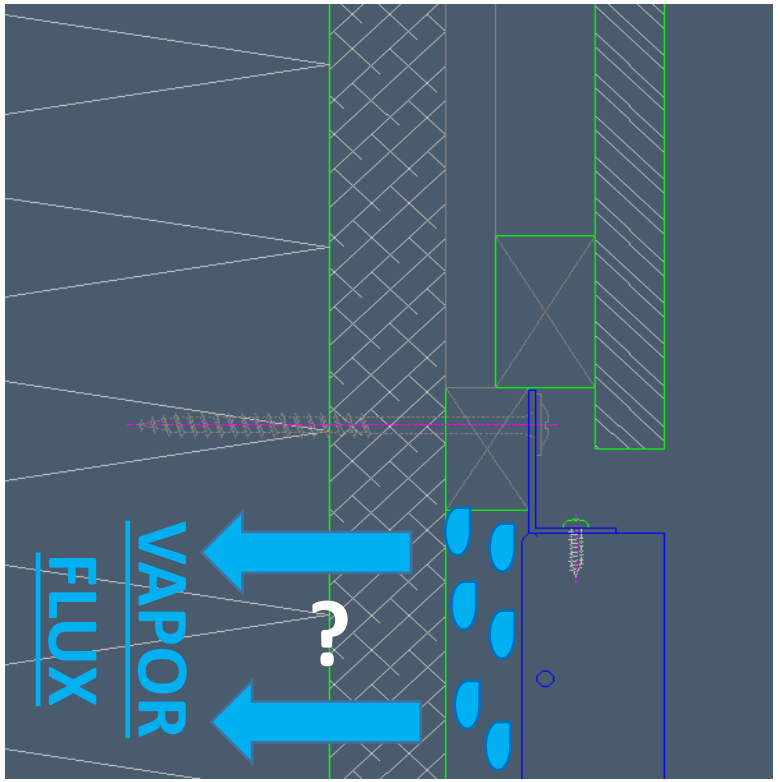
Mechanical ventilation machine integration

- Hygrothermal analyses around the envelope of the machine→ avoiding condensation at interface machine(cold inlet)/module insulation
- Thermal bridge at interface machine/window frame

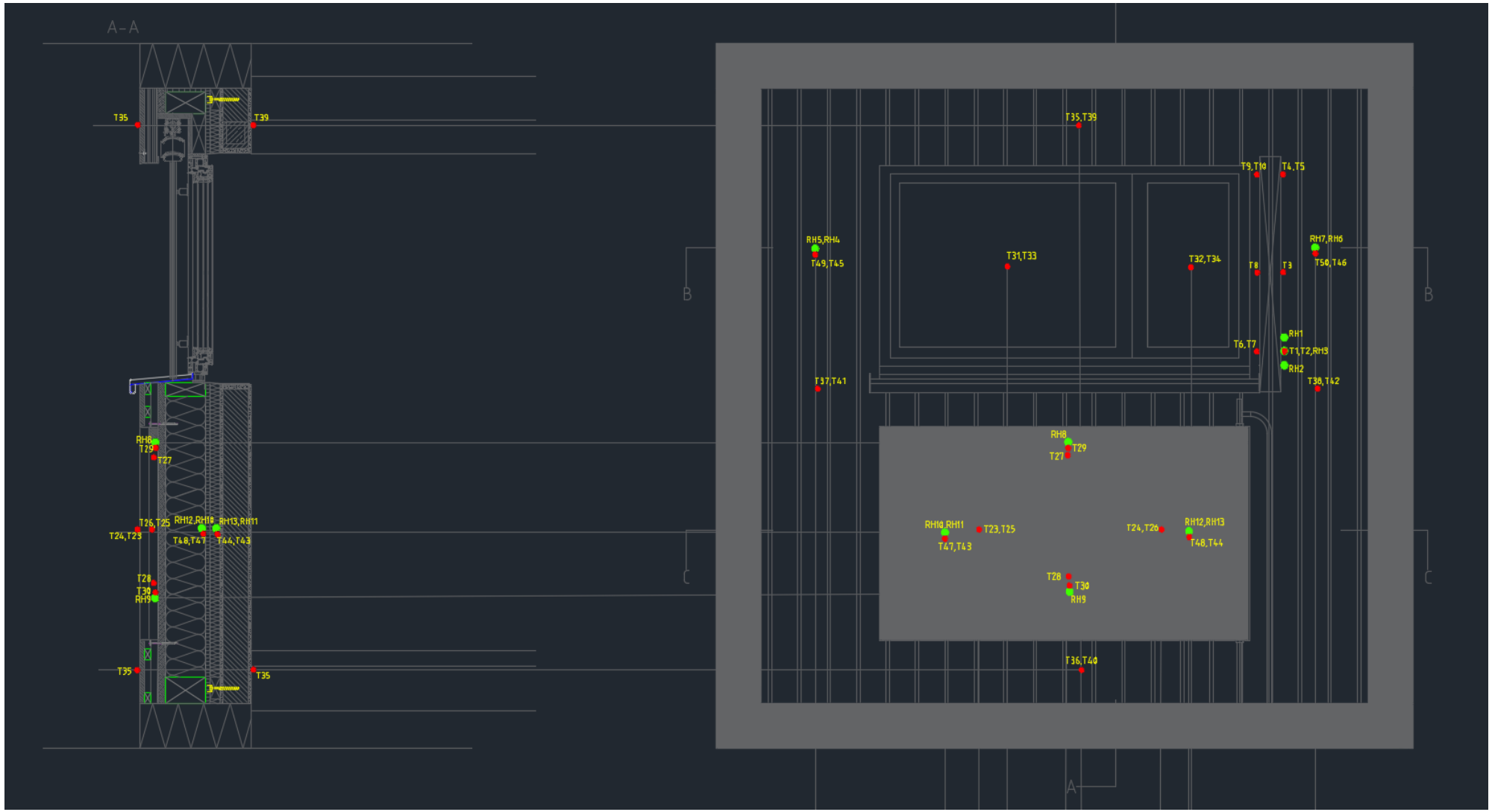


Solar thermal panel integration

- Hygrothermal analyses of the cavity behind the ST panel→vapor transfer may occur from outside to inside



TESTS AT EURAC LABORATORIES



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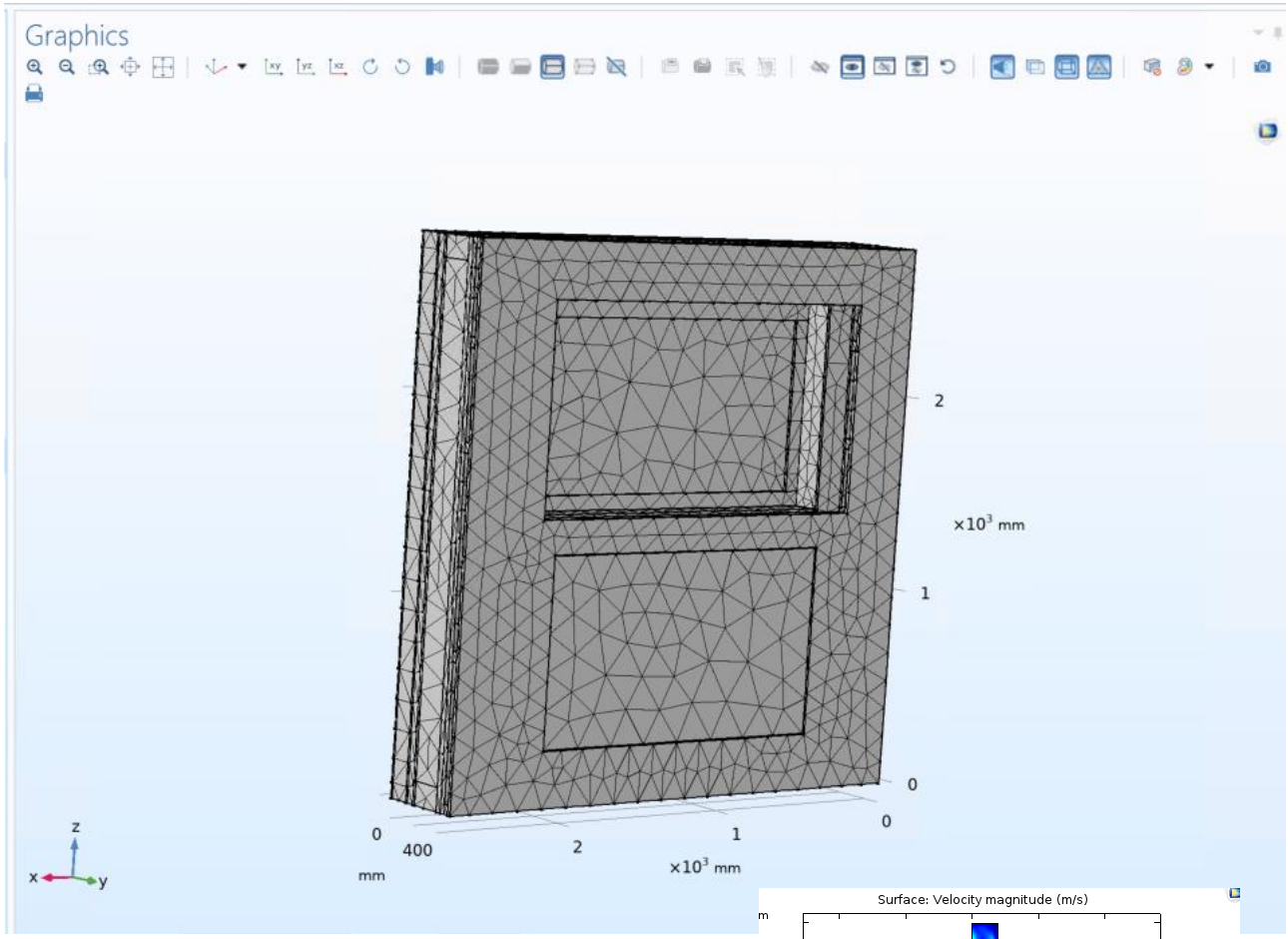
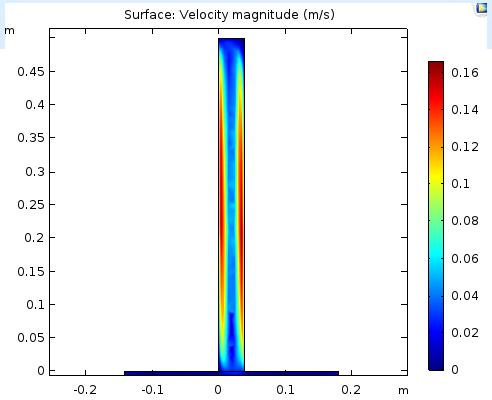
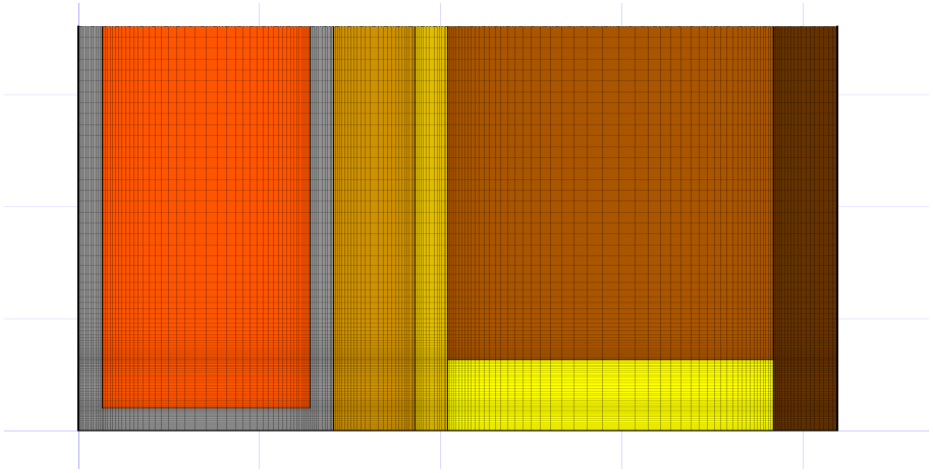
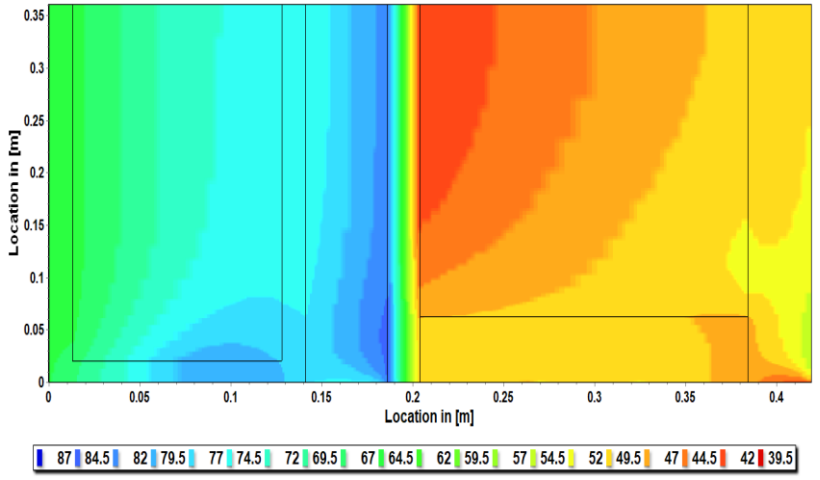
VENTILATION MACHINE/FACADE INTERACTION







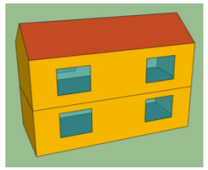
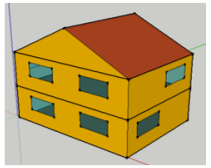
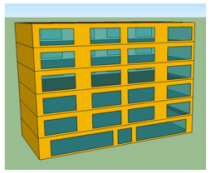
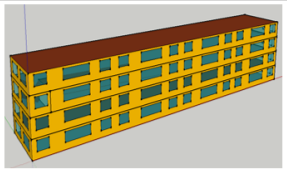


SIMULATION ACTIVITY ON BUILDING LEVEL

APPLYING & EVALUATING PERFORMANCES OF THE RENOVATION PACKAGES

OUTPUT:

- **ENERGY**
- **ENVIRONMENT**
- **COMFORT**

Geo-cluster Geometry	Building characteristics
	Archetype: TERRACED HOUSE (TH) Reference floor area: 88 m^2 Floor Height: 2.8 m
	Archetype: SINGLE FAMILIY HOUSE (SFH) Reference Floor Area: 228 m2 Floor Height: 2.5 m
	Archetype: APARTMENT BLOCK (AB) Reference Floor Area: 1330 m2 Floor Height: 2.6 m
	Archetype: MULTIFAMILY HOUSE (MFH) Reference Floor Area: 3456 m2 Floor Height: 2.8 m

X **6 CLIMATE** X

PARAMETER	Involved controls/technologies	RESULTING COMBINATIONS
RETROFIT CONDITION	Shading control, infiltration control, traditional heating system efficiency, cooling system operability	1
TRADITIONAL HEATING SYSTEM	Heating performed by a traditional system	2
HEAT PUMP HEATING SYSTEM	Heating performed by an heat pump	
NO MECHANICAL VENTILATION	No mechanical ventilation is used	3
DECENTRALIZED VENTILAITON MACHINE	Mechanical ventilation provided by a decentralized system	
CENTRALIZED VENTILAITON MACHINE	Mechanical ventilation provided by a centralized system	
PV INTEGRATED	PV panels presence within the building	2
CEILING FAN & COOLING SYSTEM	Ceiling fan presence within the building (different working combinations)	3
RETROFIT WALL TYPOLOGY	Two different layouts of the prefabricated panel performing the retrofit of the envelope	2
WINDOW TYPOLOGY	Two different new window typologies to be installed in the building	2
INFILTRATION	Takin into account infiltration effect	2
TOT =		288 + 1 (existing case)

DEMO CASE: Oslo - Norway

https://www.youtube.com/watch?v=1_Pf-mg1fkI

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Thank you for your attention.

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