Accelerating Energy renovation solution for Zero Energy buildings and Neighbourhoods

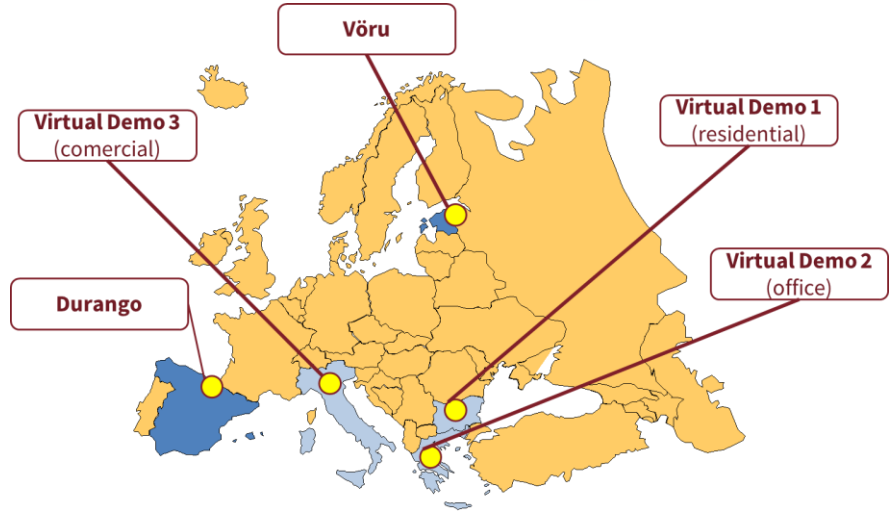
This project has received funding from the European Union's H2020 Research and Innovation under grant agreement No 768718.
The sole responsibility for the content lies with the authors. It does not necessarily reflect the opinion of the European Union.

The EU project RenoZEB in numbers

- Call: H2020-EEB-2017
- 42 months: October 2017 – February 2021
- 19 European partners
- 3 demonstration buildings + 3 virtual demonstration buildings

→ To achieve:

- 16% cost reduction of renovation
- 60% energy consumption reduction
- 65% renovation process time reduction



Background

- Currently only **1.2 % of the building stock** is replaced annually
- To accomplish the 2050 targets increase the rate to **2.9% necessary**
- Currently retrofitting processes are **expensive, complex and disturbing**, with many uncertainties and several inefficacies
- Information is not properly shared, multiple errors and duplicated efforts

RenoZEB strategy:

- technological attractive solutions (**multifunctional modular "plug and play" system**)
- a **well-designed renovation methodology**
- **cloud collaborative environment**
- **involvement** of all key stakeholders
- **property value** as main trigger for nZEB renovation Market

Main Objective

Unlock the nZEB renovation market leveraging the gain on property value through a new systemic approach to retrofitting that will include:

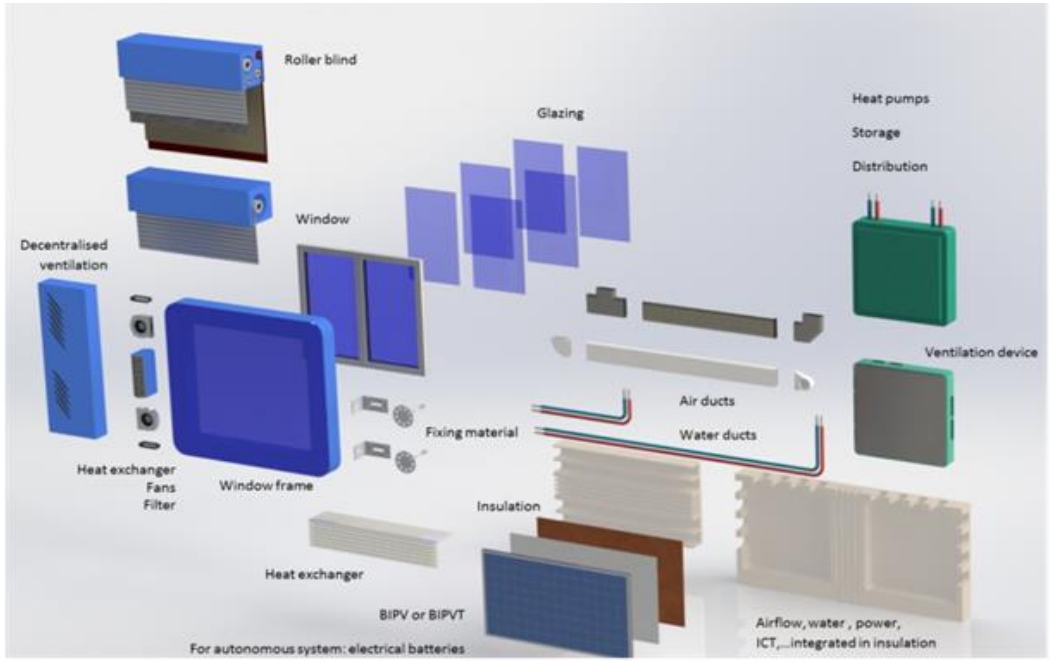
- innovative components
- processes
- decision making methodologies
- to guide all value-chain actors in the nZEB building renovation process

4 main pillars:

- **Reduce energy consumption**, increasing the share of RES in buildings
- **Cost & risk reduction** with low disruption during building renovation, to attract customers interest
- **Replicability and adaptability** through modularity in order to capture a large-scale renovation market
- **Property-value** as trigger

RenoZEB facade - The concept

- **Prefabricated window module** and roller shutter
- **Multifunctional insulation** boards
- Ventilation units with heat recovery
- Building Integrated Photovoltaics (**BIPV**) and batteries
- Building Integrated Solar Thermal Systems (**BIST**)
- **Intelligent façade** controller (integrated sensors and façade controller)
- "**Click-in**" fixing mechanisms



RenoZEB facade - Products selection

Requirements	Proposed Technology/solution			
	1	2	3	4
	Compact SA	Roka Compact	HELLA TRAV FRAME	TUBBACK Varwindmontage system
				
Ventilated façade	N/A	•••	N/A	N/A
Plug and play	•••	•••	•••	•
Low-cost multifunctional insulation boards	•	•	•	••
Commercially available PV modules	N/A	N/A	N/A	N/A
Commercially available solar thermal collectors	N/A	N/A	N/A	N/A
"Click in system" for air ducts, heat exchangers for	N/A	N/A	N/A	N/A
Integration of hydraulic, electric and HVAC	N/A	N/A	N/A	N/A
Modular, Pre-cast and Easy Assembly-Disassembly	•••	•••	••	•
minimize on-site work	•••	•••	••	•
improve product quality	•••	•••	•••	••
reduce costs	••	••	••	•
Industrialization	•••	•••	•••	•
minimize on-site work	•••	•••	•••	•
cost reduction	••	••	••	•
improve quality	•••	•••	•••	•
increased safety	•••	•••	•••	•
Less intrusive system	•••	•••	••	••
prioritize outdoor interventions	•••	•••	••	•••
avoid interruption in the dwellings	•••	••	••	•••
reduce the duration of the interventions	•••	•••	••	•
off-site manufacturing	••	•••	•••	•
plug-and-play solutions	••	•••	••	•
optimized building processes	••	•••	••	•
Aesthetic and functional integration	•••	••	••	•••
harmonizing architectonic rehabilitation with social acceptance	•••	•	•	••
expectations of the architects	•••	••	••	•••
Integration and adaptation of multifunctional insulation	•••	•••	••	••
use of recycled material	••	••	••	••
recyclability of the final solution	••	••	••	••
reduction of heat and pressure losses	•••	•••	••	•
fire protection	••	••	••	••
prefabricated window insulation frames	•••	•••	•••	•
minimum of heat losses	•••	•••	••	•
Integration of thermal and PV modules	•••	•	•	•
Integration into the RenoZEB envelop and building concept solution	•••	•	•	•
Connection elements				
Integrate subsystems in a holistic approach	•••	•••	••	•
Development of the Smart-IoT façade module	N/A	N/A	N/A	N/A
Low-cost sensors	N/A	N/A	N/A	N/A
Low-intrusive installation	N/A	N/A	N/A	N/A
Embedding in the module	N/A	N/A	N/A	N/A
Integration with PV and battery system	N/A	N/A	N/A	N/A
Data collections system with common protocols	N/A	N/A	N/A	N/A
Plug & play solution	N/A	N/A	N/A	N/A
Points achieved	22	22	15	15

Prefabricated window module and roller shutter

Building Integrated Photovoltaics (BIPV) and batteries

Requirements	Proposed component		
	1	2	3
	BIPV semitransparent	BIPV Crystaline partially in glass	BIPV crystaline
			
Ventilated façade	•••	•••	•••
Plug and play	•••	•••	•••
Low-cost multifunctional insulation boards	•	•	•
Commercially available PV modules	•••	•••	•••
Commercially available solar thermal collectors	N/A	N/A	N/A
"Click in system" for air ducts, heat exchangers for ventilation, pipes and/or electrical or ICT cables	•••	•••	•••
Integration of hydraulic, electric and HVAC	••	••	••
Modular, Pre-cast and Easy Assembly-Disassembly	••	••	••
minimize on-site work	•••	•••	•••
improve product quality	••	••	••
reduce costs	••	••	••
Industrialization	•••	•••	•••
minimize on-site work	•••	•••	•••
cost reduction	•••	•••	•••
improve quality	•••	•••	•••
increased safety	•••	•••	•••
Less intrusive system	•••	•••	•••
prioritize outdoor interventions	•••	•••	•••
avoid interruption in the dwellings	•••	•••	•••
reduce the duration of the interventions	•••	•••	•••
off-site manufacturing	•••	•••	•••
plug-and-play solutions	•••	•••	•••
optimized building processes	••	••	••
Aesthetic and functional integration	••	••	••
harmonizing architectonic rehabilitation with social acceptance	••	••	••
expectations of the architects	••	••	••
Integration and adaptation of multifunctional insulation	•	•	•
use of recycled material	•	•	•
recyclability of the final solution	•	•	•
reduction of heat and pressure losses	N/A	N/A	N/A
fire protection	N/A	N/A	N/A
prefabricated window insulation frames	N/A	N/A	N/A
minimum of heat losses	N/A	N/A	N/A
Integration of thermal and PV modules	•••	•••	•••
Integration into the RenoZEB envelop and building concept solution	•••	•••	•••
Connection elements	•••	•••	•••
Integrate subsystems in a holistic approach	•••	•••	•••
Development of the Smart-IoT façade module	•••	•••	•••
Low-cost sensors	N/A	N/A	N/A
Low-intrusive installation	•	•	•••
Embedding in the module	•••	•••	•••
Integration with PV and battery system	•••	•••	•••
Data collections system with common protocols	N/A	N/A	N/A
Plug & play solution	•••	•••	•••
Points achieved	35	35	35

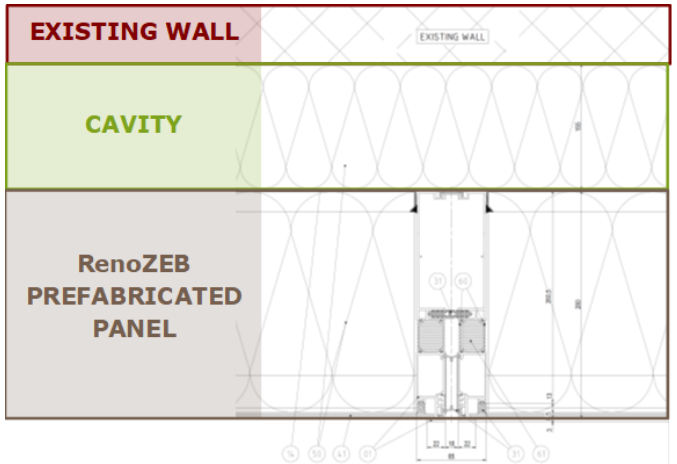
RenoZEB facade - Building and thermal analysis

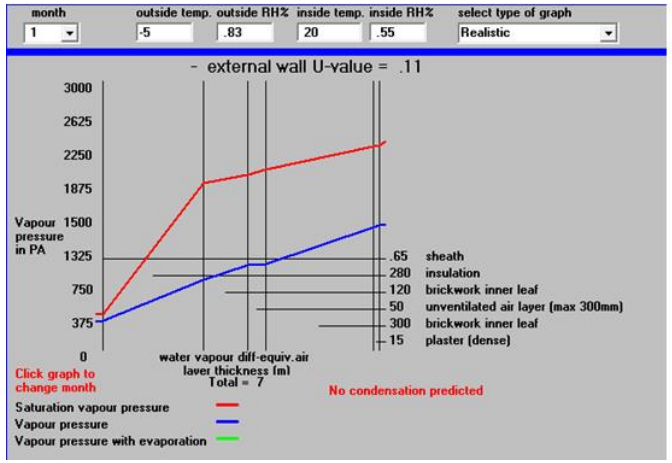
Building's boundary conditions

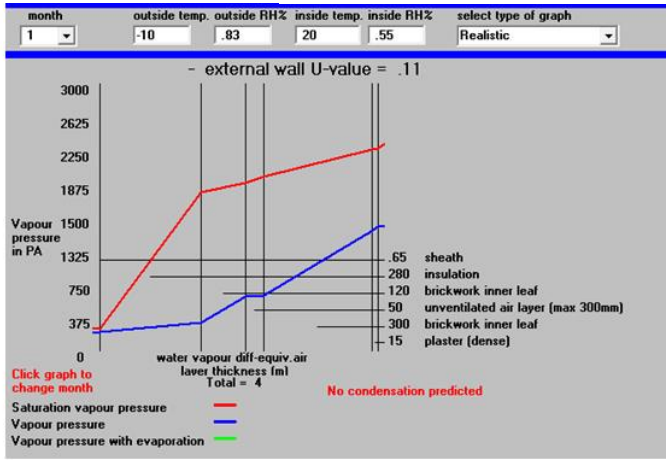
- Existing load bearing structure
- Existing openings

Identification of facade panels:

- Primary panels (window unit)
- Secondary panels (opaque, technical units)
- Eventual aggregation of units







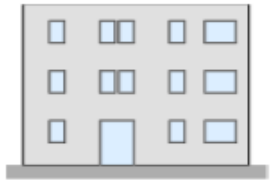


Figure 1: Phase 1 – existing building

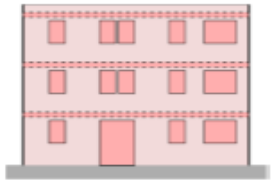


Figure 2: Phase 2 – boundary conditions

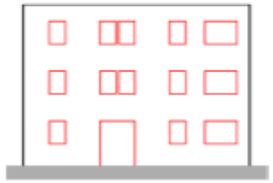


Figure 3: Phase 3 – identification of baseline

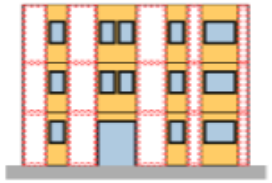


Figure 4: Phase 4a – primary modules designed

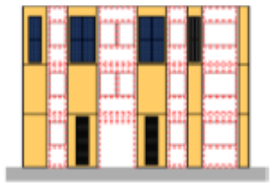


Figure 5: Phase 4b – secondary modules designed

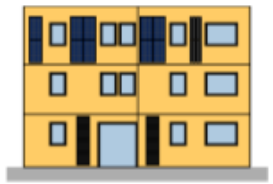


Figure 6: Phase 4c – module aggregation design

RenoZEB facade - Units

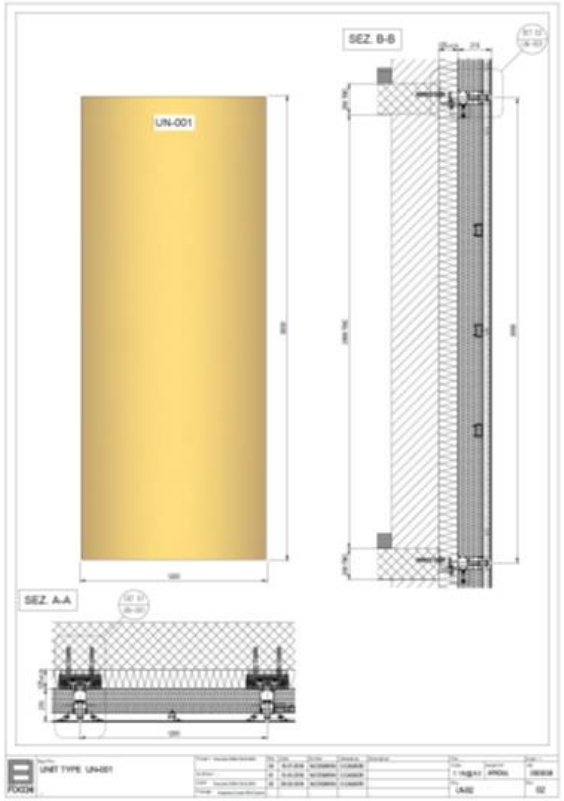
RenoZEB in demo

DURANGO (Spain)
U_{CW} = 0,14 W/m²K < 0,28 W/m²K

VORU (Estonia)
U_{CW} = 0,127 W/m²K < 0,13 W/m²K

OPAQUE UNIT (max 1200 x 3000 mm)
BASE COMPONENTS:

- Unitized system prefabricated off-site
- Installation on-site on brackets fixed to the slab edge
- Aluminium structure
- Various external finishing
- Mechanical restraint to guarantee the possibility to replace finishings with other materials or technical elements



RenoZEB facade - Units

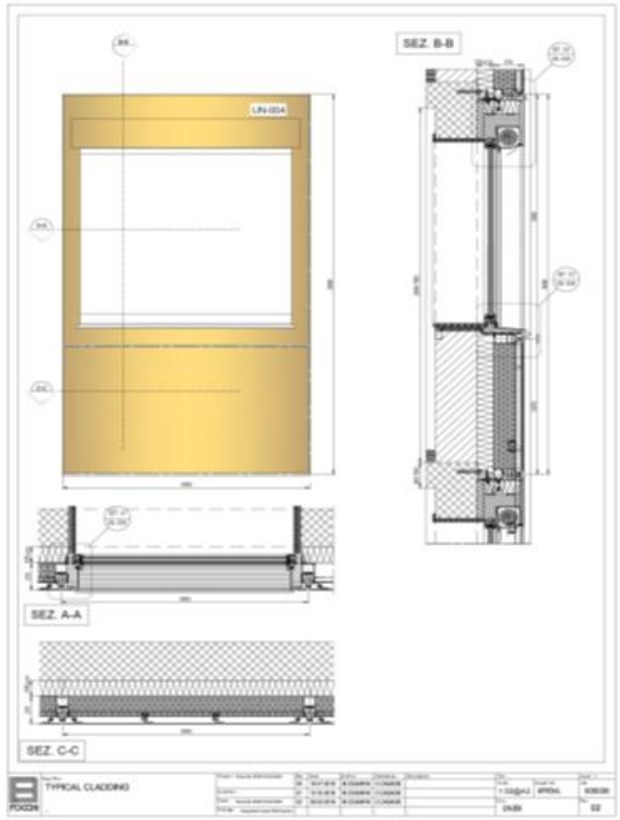
RenoZEB in demo

DURANGO (Spain)
U_{CW} = 0,66 W/m^{2}K < 1 W/m^{2}K

VORU (Estonia)
U_{CW} = 0,47 W/m^{2}K < 0,63 W/m^{2}K

WINDOW UNIT (max 2200 x 3000 mm)

- Each type of window (materials, openings typology), with/without roller shutter integrated
- Eventual ventilation integrated in window monoblock



RenoZEB facade - Units

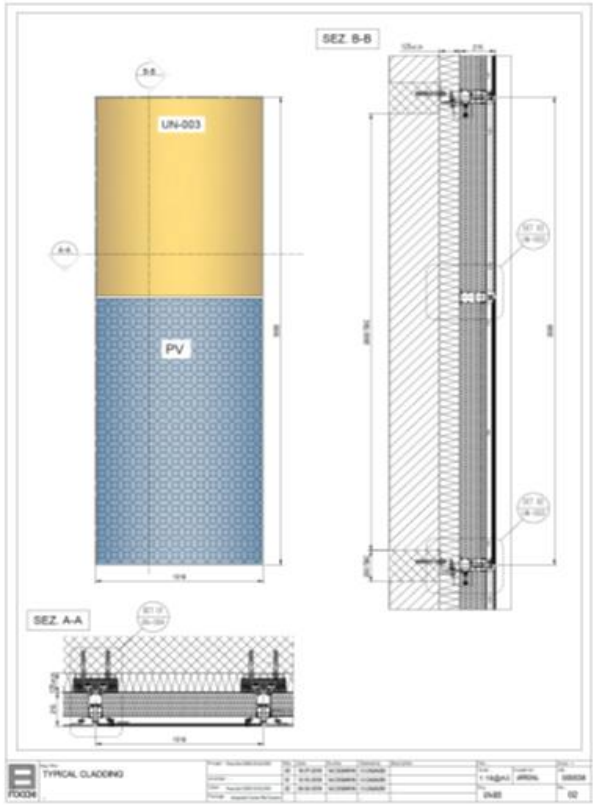
RenoZEB in demo

DURANGO (Spain)
U_{CW} = 0,149 W/m^{2}K < 0,28 W/m^{2}K

VORU (Estonia)
U_{CW} = 0,13 W/m^{2}K < 0,13 W/m^{2}K

PV UNIT (max 1000 x 3000 mm)

- PV integratred in facade with cavity for ventilation to preserve panel effieciency and eventually to use heated air for ventilation



RenoZEB facade - Units

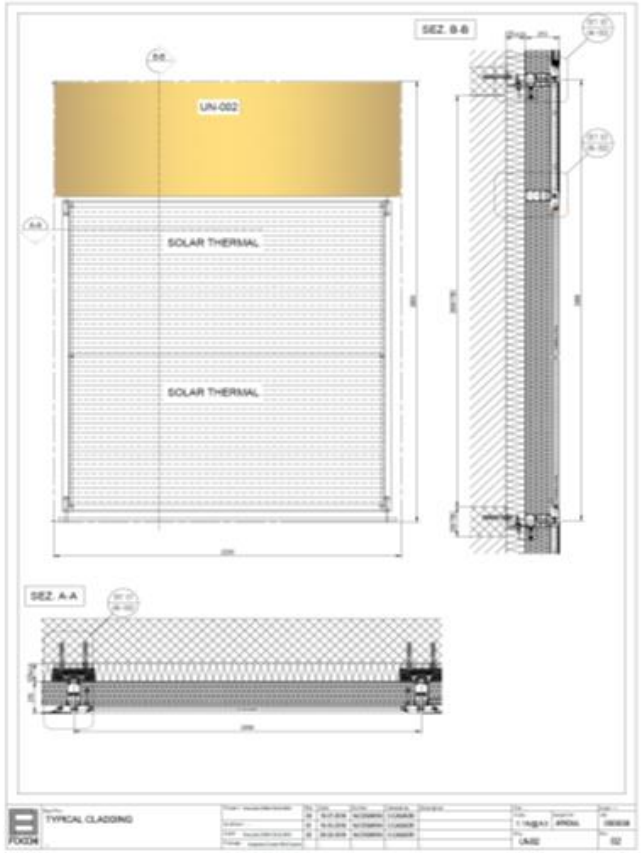
RenoZEB in demo

DURANGO (Spain)
U_{CW} = 0,139 W/m^{2}K < 0,28 W/m^{2}K

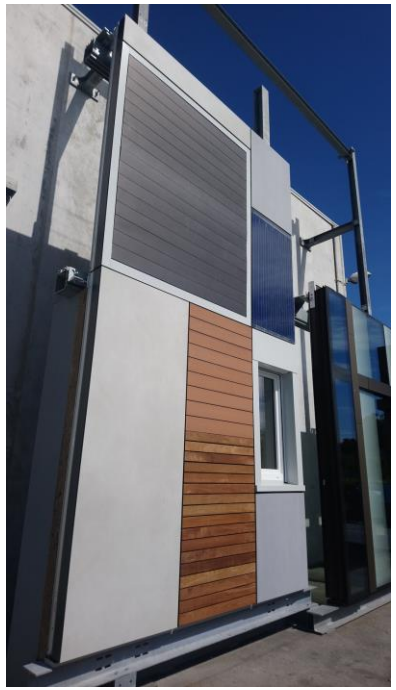
VORU (Estonia)
U_{CW} = 0,12 W/m^{2}K < 0,13 W/m^{2}K

SOLAR THERMAL COLLECTOR UNIT
(max 2000 x 3000 mm)

- Water thermal solar collector with water to be used also for DHW to have higher water temperature



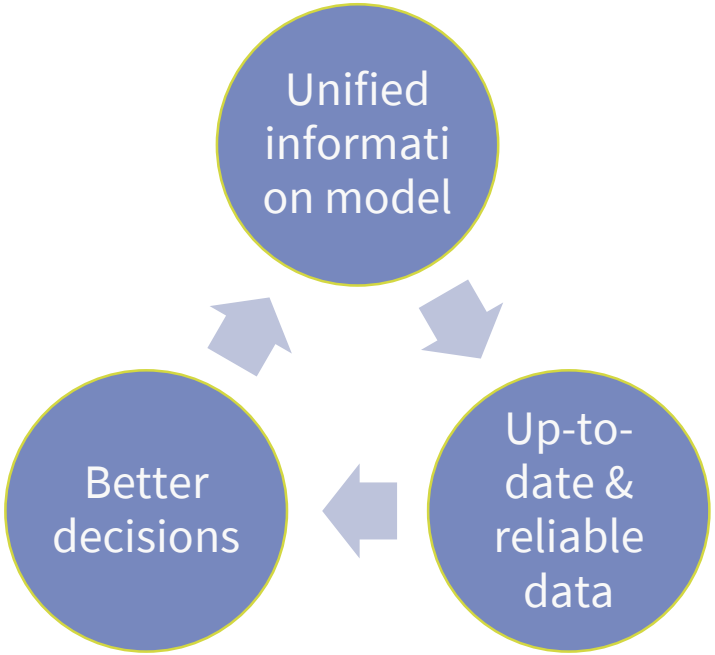
RenoZEB facade - Prototype

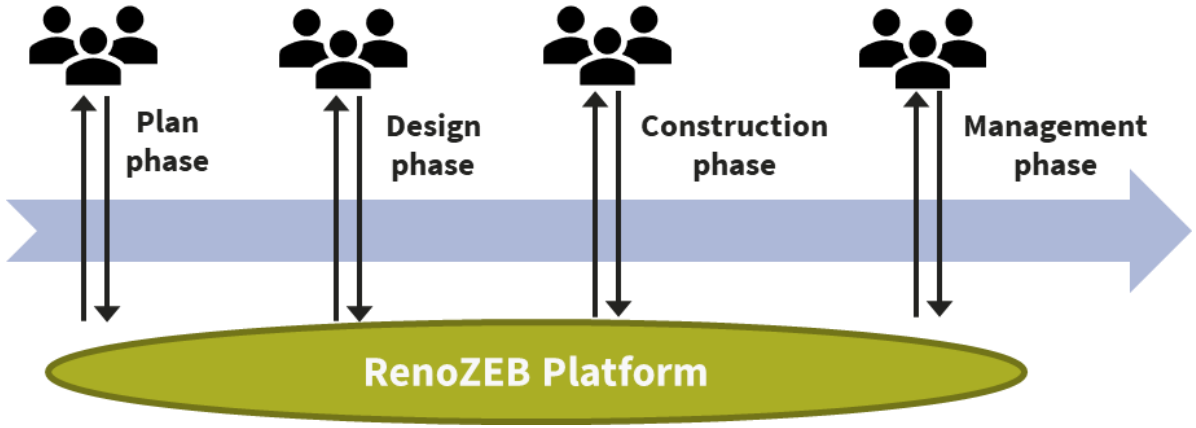


nD Collaborative Environment

Concept

- Objective: to develop a **collaborative environment to integrate deep renovation value chain** around Open BIM standards such as IFC
- Support the digitalization of the whole process and the integration of all actors

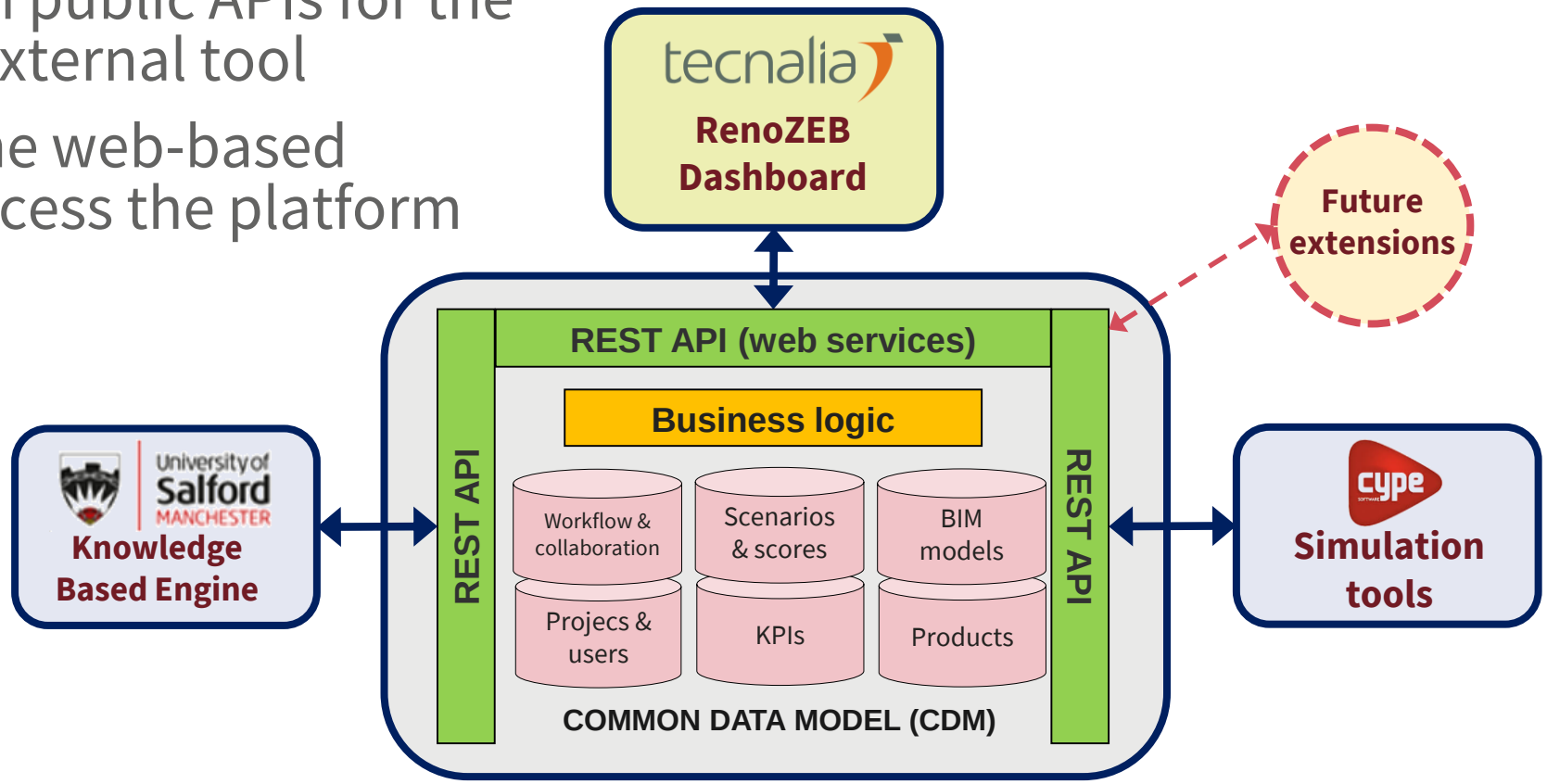




nD Collaborative Environment

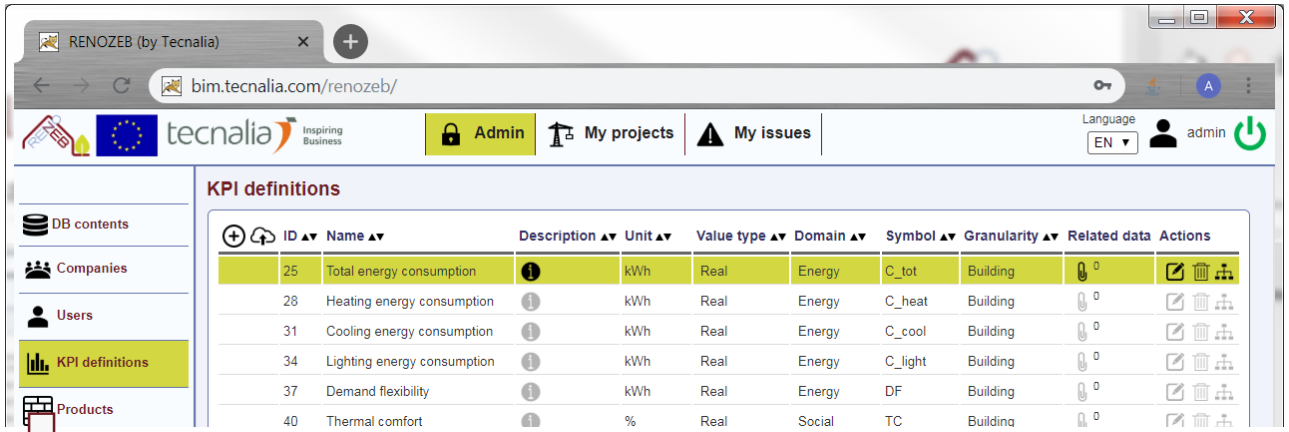
Architecture

- Cloud platform with public APIs for the integration of any external tool
- The dashboard is the web-based unified portal to access the platform



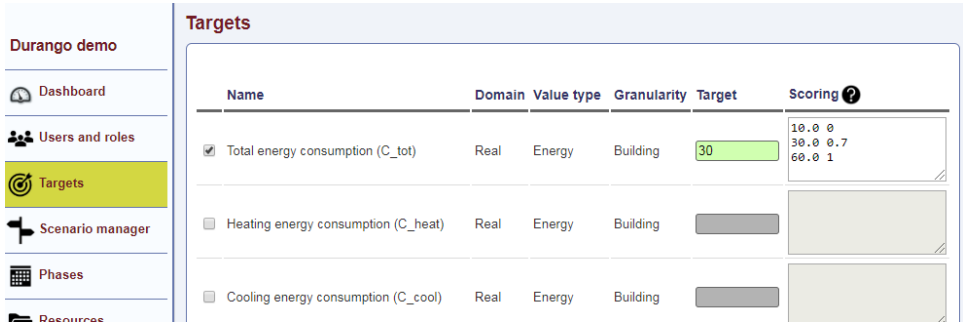
nD Collaborative Environment

Ongoing work: KPI management



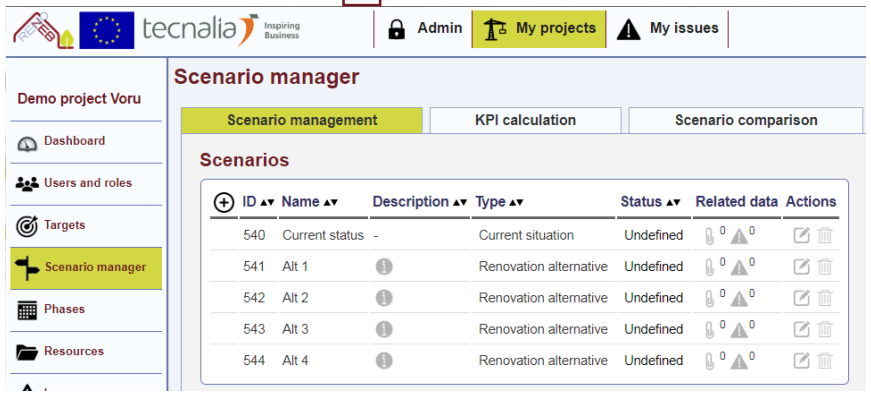
Define KPIs

Evaluate scenarios



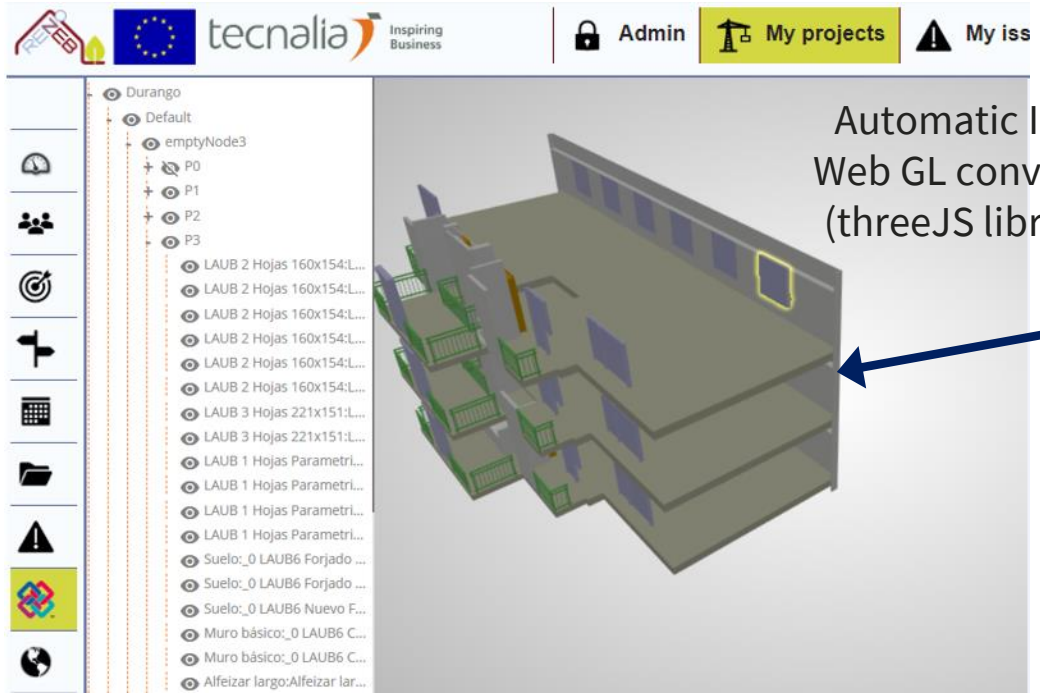
Select KPIs & define targets

Define scenarios

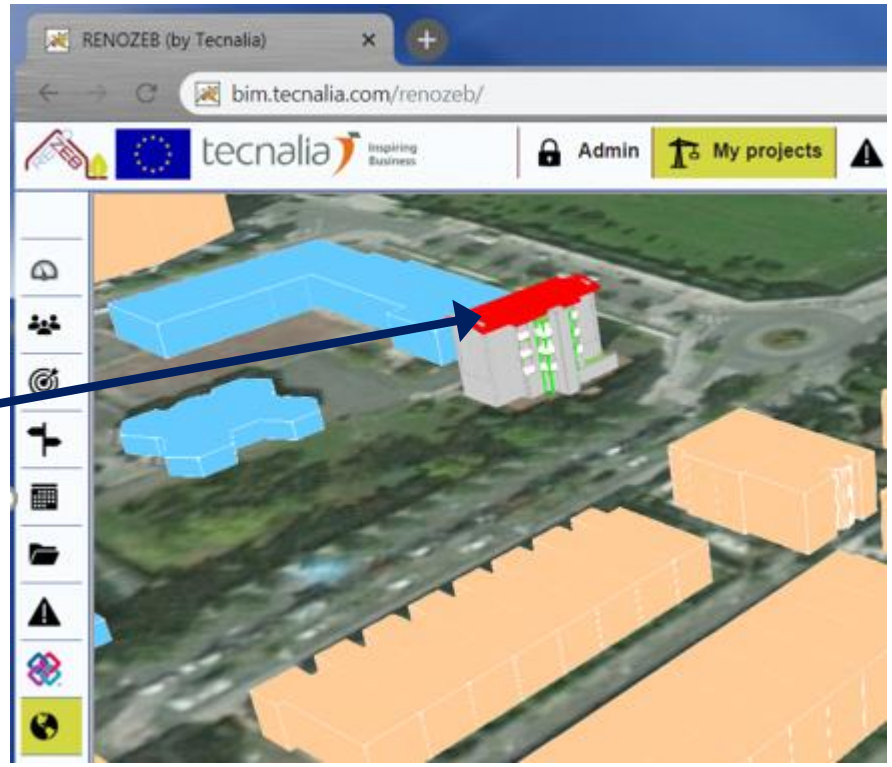


nD Collaborative Environment

Ongoing work: IFC viewers



Automatic IFC to Web GL conversion (threeJS libraries)



Automatic IFC to KML conversion & web viewing (cesium libraries)

Detailed mode

Building view (with internal navigation)

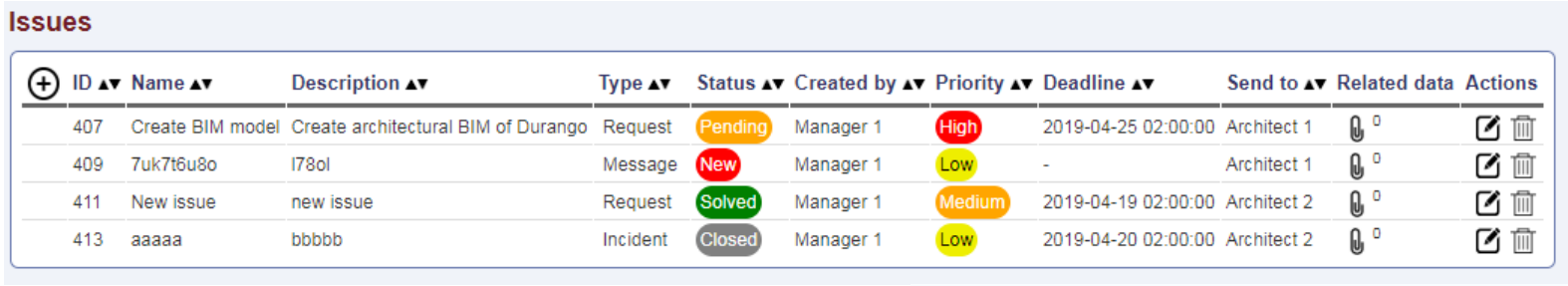
Georreferenced view

(GIS context)

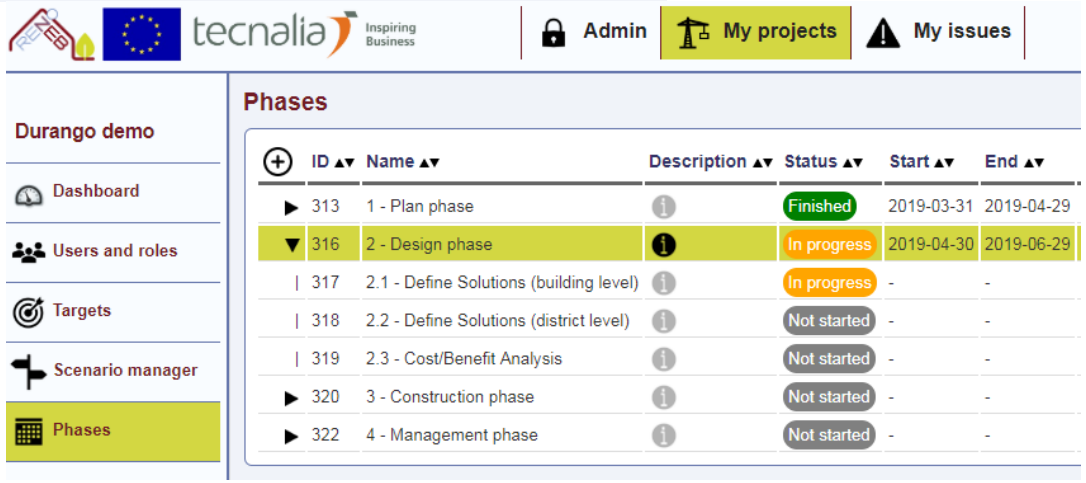
nD Collaborative Environment

Other functionalities

- Issue management & collaboration



- Phases/tasks managements

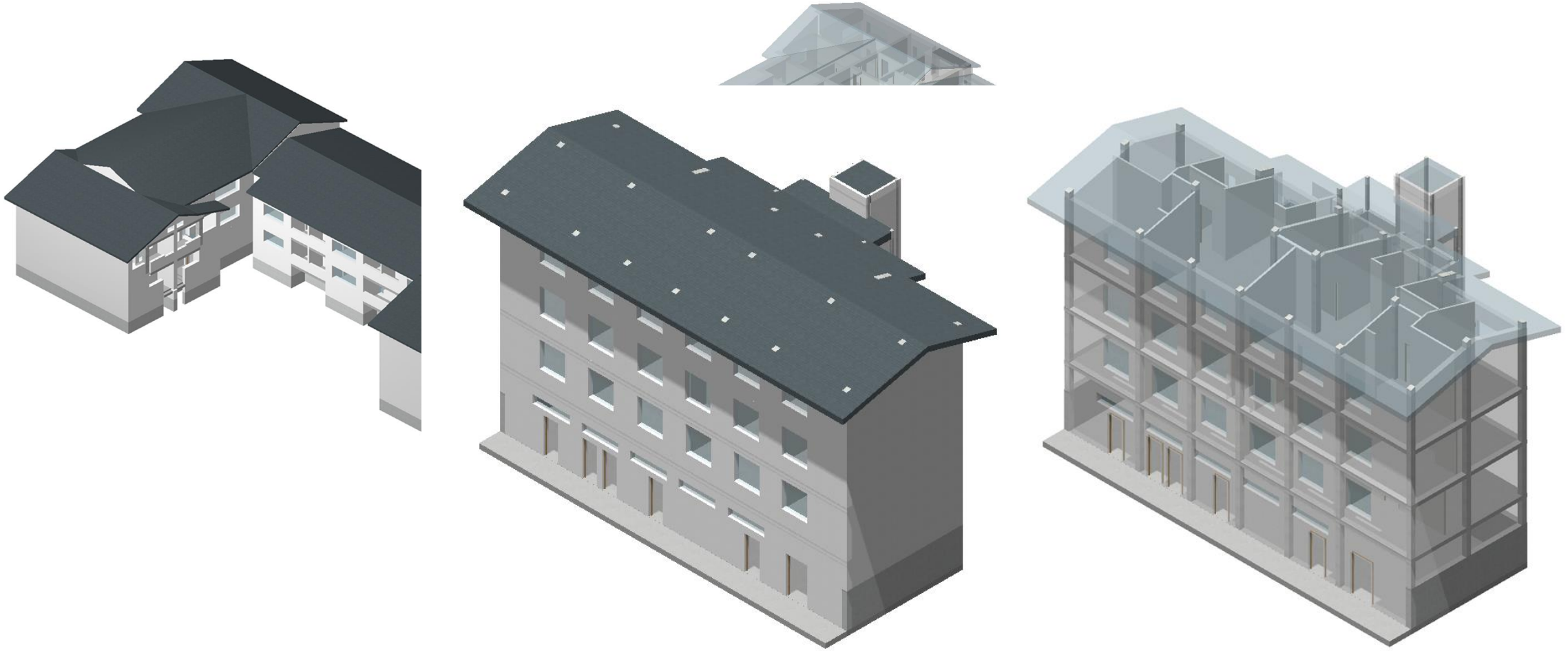


Integrated Services

Development of **integrated services** to facilitate **RenoZEB renovation process**:

- **Design Tool** to create the building model.
- **E-catalogue** of renovation solutions
- **Configurator** to help during the design process.
- **Management Tool** for construction and logistics.

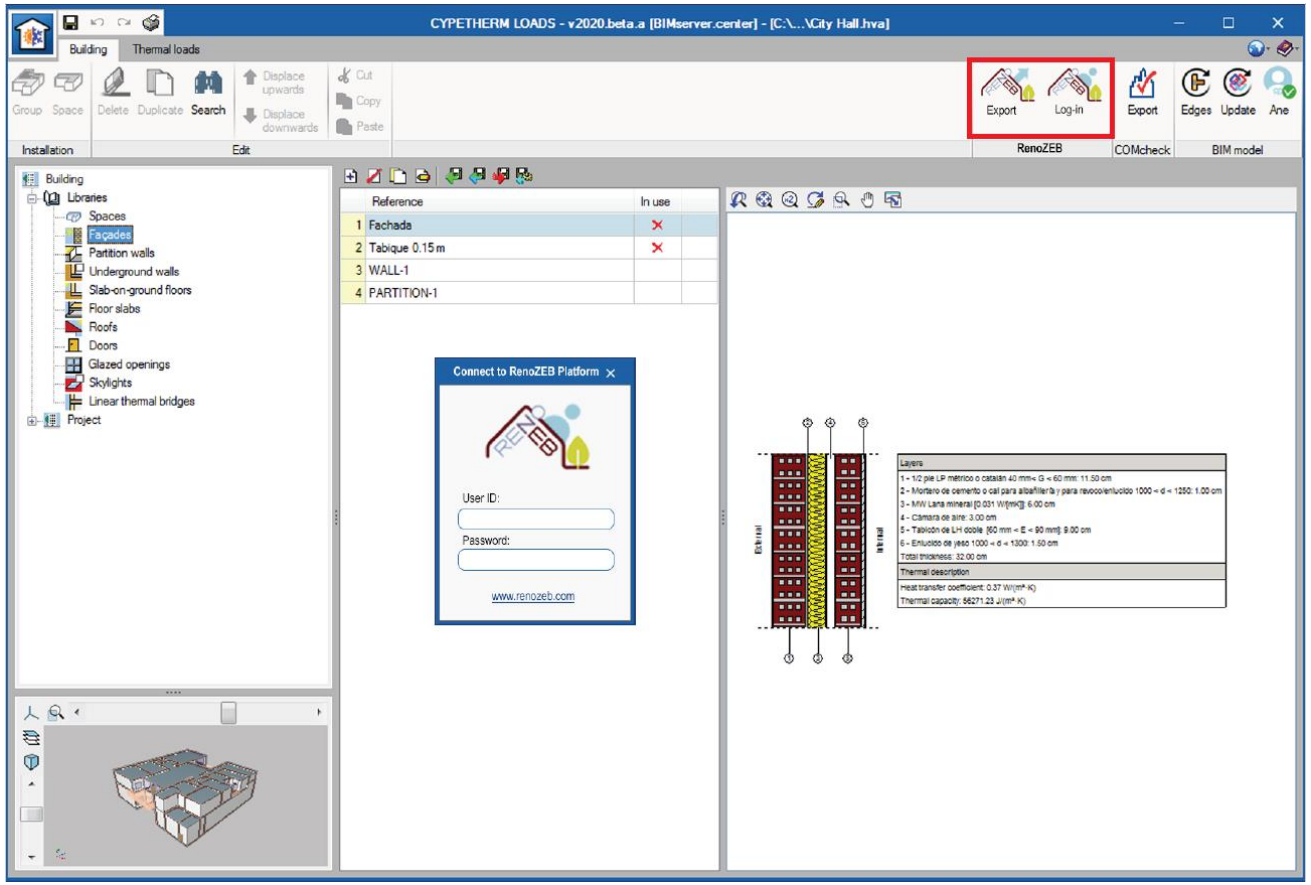
BIM Model Generation Tool



Development of an Innovative Data Repository

E-Catalogue: 76 solutions

- **Facade insulation**
- **Floor insulation**
- **Roof insulation**
- **Window systems**
- **Heating and Cooling systems**
- **Ventilation**
- **Photovoltaic panels**



Configurator to design and analyse RenoZEB solutions

IFC BUILDER

https://www.youtube.com/watch?v=mPHVh95G3YI

CYPETHERM Eplus

https://www.youtube.com/watch?v=1a4kQk3I7aM

CYPETHERM LOADS

https://www.youtube.com/watch?v=5tShFaCLQ5U

CYPETHERM IMPROVEMENTS

POINT CLOUD OPTIMZATION

E-CATALOGUE IMPLEMENTATION

Smart logistic and construction management tool

- READ IFC ENTITIES
- CREATE A QR CODE FOR THAT ENTITY
- ADD INFORMATION TO THE QR CODE
  - DATES
  - PDF, YOUTUBE
- GANNT CHART WITH ALL THE ELEMENTS

Thank you for your attention

Coordinator: Michele Vavallo

michele.vavallo@solintel.eu

Solintel

This project has received funding from the European Union's H2020 Research and Innovation under grant agreement No 768718.
The sole responsibility for the content lies with the authors. It does not necessarily reflect the opinion of the European Union.