## What is RenoZEB?

RenoZEB is a modular 'plug-and-play' cladding system, designed to be retrofitted onto existing buildings to improve insulation, ventilation, airtightness and generate energy through integrated photovoltaics and solar thermal panels.

The objectives of RenoZEB can be summarised in four main pillars:

- Reduce energy consumption, while increasing the share of renewable energy in buildings
- Cost & risk reduction with low disruption during building renovation
- Replicability and adaptability through modularity and off-site construction
- Property value as a trigger for renovation

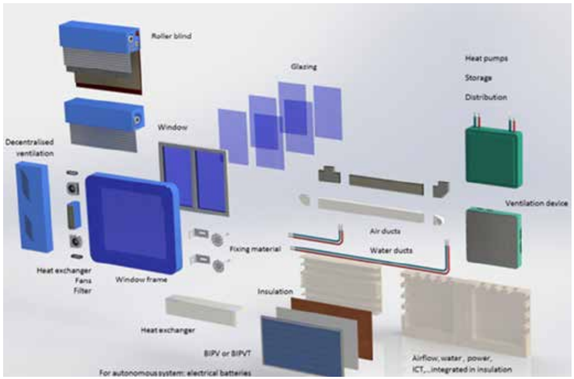
The system comprises an aluminium sub-frame, fixed into the existing building's superstructure, onto which the cladding panels are mounted. A layer of mineral wool insulation is fixed to the facade behind the cladding. The panel types are as follows:

- Window module with integrated roller shutter
- Opaque insulated cladding boards, with a range of finishes
- Ventilation with heat recovery
- Building Integrated Photovoltaics (BIPV) with battery storage
- Building Integrated Solar Thermal (BIST)

Smart controls that regulate the active systems are integrated into the facade panels. A RenoZEB renovation will also include a refurbishment of the existing systems, for example upgrading the ventilation or changing the light fittings to LED, to ensure that energy consumption is minimised.

The panel types can be manufactured to a variety of sizes, each with a maximum module size: max. 1,000 x 3,000mm for the BIPV up to max. 2,200 x 3,000mm for the wnidow unit. Primary and secondary modules can therefore be designed bespoke to each building to suit its layout and fenestration.

The panels are currently manufcatured by Italian firm FOCCHI, who has markets in Italy and the UK but its intention is to license the production to local manufacturers throughout Europe, proving initial training for the system installation.






| January 2022

## RenoZEB's USPs

RenoZEB is not the only proprietary cladding system in the market: indeed, most existing rainscreen cladding systems could be used as over-cladding for an existing structure. What makes RenoZEB unique is its holistic stance to refurbishment, with an evidence-led approach to energy modelling and performance monitoring.

**Energy Modelling**

For each project, RenoZEB constructs a BIM model of the existing building, which enables design options to be explored and projected energy performance to be calculated.

**BIM Sharing**

The BIM model is shared with clients via an open-source interface, which enables them to obtain live data and understand the refurbishment options, using the manufacturer's own cladding software.

**Integration of Services**

Unlike many cladding systems that focus solely on improvement of insulation and aesthetics, a RenoZEB refurbishment also comprises an upgrade of the building services: this consists of a renovation of the main systems and by integrating services into the facade system itself in the form of ventilation, heating and heat-recovery and energy generation.

**Design Flexibility**

Most cladding systems have some level of aesthetic flexibility within their range of finishes but are limited by a single material. RenoZEB is unique in the sense that it offers a variety of cladding materials, including render and timber cladding, which enables it to respond better to local vernacular, client choice and available supply chains.

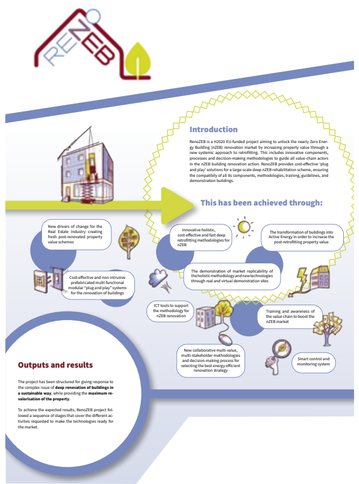
**Supply Chain**

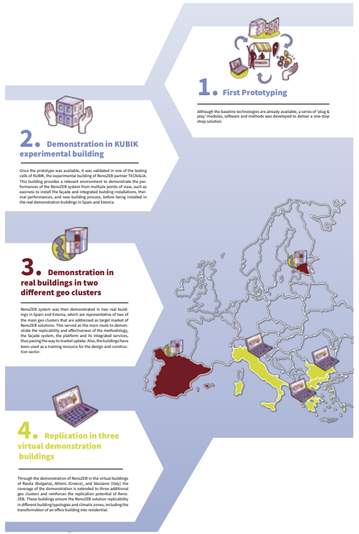
The manufacture of RenoZEB already boasts an established supply chain, manufactured by Focchi, which has a base in both Italy and UK. However, with the successful expansion of the system, it is anticipated that FOCCHI will train and outsource to local manufacturers, creating a more robust and localised supply chain.

**Performance Monitoring**

Following a RenoZEB refurbishment, a period of monitoring is conducted to assess the performance in use, generating a feedback loop to contribute towards an improvement in future projects.







| January 2022

## Context

Emissions from the built environment account for around 40% of the UK's total carbon footprint and despite the improvements in construction of new buildings, 80% of the buildings in 2050 have already been built [1].

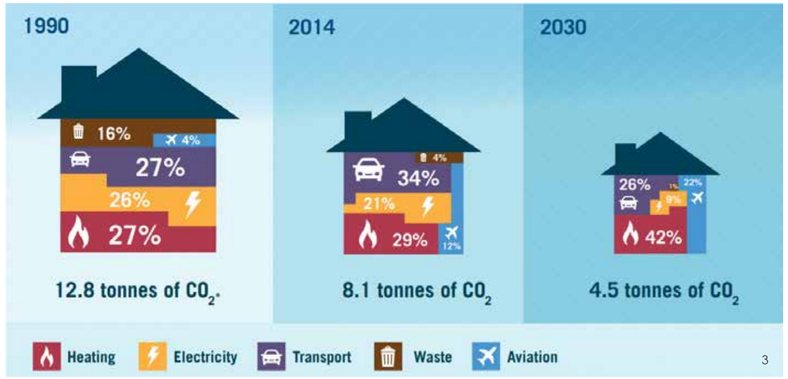
A RenoZEB renovation can achieve 60% energy consumption reduction and offsets much of the additional demand with BIPV, BIST and integrated heat pumps, resulting in a near zero energy building (nZEB).

As part of their response to the commitments enshrined in the Climate Change Act 2008 and the Net Zero Carbon target in 2019, the incumbent Government set out its strategy to achieve Net Zero in 2021, part of which included investment in renovation of existing buildings.

*"Upgrading fuel poor homes to EPC Band C by 2030 where reasonably practicable and providing additional funding to the Home Upgrade Grant and the Social Housing Decarbonisation Fund – investing £1.75 billion."* [2]

The Phase 1 report of the inquiry into the tragedy at Grenfell Tower irreversibly changed the industry's attitude towards building cladding, particularly over-cladding of existing buildings.

RenoZEB panels have been tested to EN 13501-1, which resulted in an A reaction to fire, when used in conjunction with an A1 / A2 cladding material on the opaque panels.




1. UK Green Building Council, '*Climate Change*'. sourced https://www.ukgbc.org/climate-change-2/ (25th January 2022)

2. HM Government (2021), '*Net Zero Strategy: Build Back Greener*'. UK: HH Associates Ltd.

3. Comittee on Climate Change (2016), '*The Fifth Climate Budget*'



| January 2022

# Case Study 1: Rannaliiva, Võru, Estonia

- 16 dwellings in two/three-storey building
- 8no. 1B2P / 4no. 2B3P / 4no. 3B5P flats
- Built in late 1980's
- Net habitable area: 1,307m$^2$

The intervention on the envelope of the building to be refurbished included the complete façade. The façade solution installed was externally insulated with the developed multifunctional solution with the thickness of insulation material necessary to provide a U value of 0.18 [W/m2K]. At the same time, this solution contributed to increase the air tightness of the façade and to reduce the energy loss associated to infiltration.

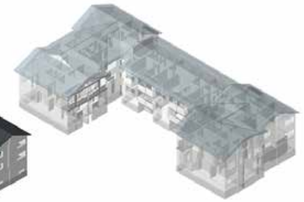
Additionally, all the windows of the building were substituted by RenoZEB windows with high performance low emissivity glazing.

The RenoZEB low invasive ventilation system was deployed to provide heat recovery (minimum energy efficiency of 80%). Thanks to the multifunctional facade solution the ventilation ducts were fully integrated in the facade providing optimal insulation of the ducts. This enabled minimizing the energy loss of the ducts up to negligible values.

The heating system of the buildings was replaced with a new one. The main effect of this is that temperature in apartments is balanced out and temperature differences between apartments is avoided. The other effect is developing a system for the hot water. This helped reduce the additional costs for hot water that was produced by local electric boilers. Old heat exchangers in boiler rooms were removed and new ones installed. Similarly, old piping was replaced and a system for smart metering and regulation was implemented.

In order to allow the efficient operation of energy consumption a metering system was installed. The system included the necessary energy meters required to measure the thermal energy consumption of each dwelling in order to enable accurate system cost allocation to inhabitants.

| | Before Renovation | After Renovation |
|---|---|---|
| **Facade U-Value** | 0.8 W.m$^{-2}$.K$^{-1}$ | 0.18 W.m$^{-2}$.K$^{-1}$ |
| **Roof U-Value** | 0.8 W.m$^{-2}$.K$^{-1}$ | 0.18 W.m$^{-2}$.K$^{-1}$ |
| **Window U-Value** | 2.5 W.m$^{-2}$.K$^{-1}$ | 1.0 W.m$^{-2}$.K$^{-1}$ |
| **Energy Use** | 270 kWh.m$^{-2}$ | |





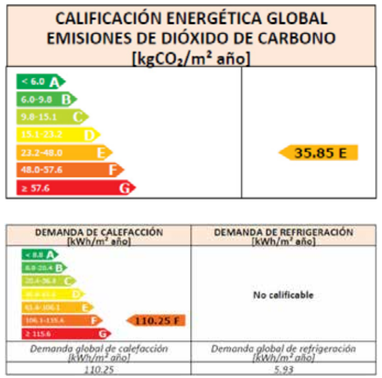
| January 2022

## Case Study 2: Laubideta 6, Durango, Spain

- Seven dwellings in four-storey building
- Built in 1965
- Net habitable area: 306m²

The façade closure consists of a double leaf, an outer sheet of double hollow brick at half-mast, 4 cm insulation, air chamber and interior partition of hollow brick, 3 cm thick, plastered and painted inside. It is a roof is 4 waters, formed from poplar partitions and exterior closure in curved ceramic tile.

The building's energy performance certificate EPC, made in 2015, classifies the building as follows:




| | Before Renovation | After Renovation |
|---|---|---|
| **Facade U-Value** | ??? $W.m^{-2}.K^{-1}$ | ??? $W.m^{-2}.K^{-1}$ |
| **Roof U-Value** | ??? $W.m^{-2}.K^{-1}$ | ??? $W.m^{-2}.K^{-1}$ |
| **Window U-Value** | ??? $W.m^{-2}.K^{-1}$ | ??? $W.m^{-2}.K^{-1}$ |
| **Energy Use** | ??? $kWh.m^{-2}$ | |



| January 2022