RE-SKIN

# D4.1 - Optimized technical specifications of each component I

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# Deliverable Information Sheet

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# History of changes

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| 0.1 | 12/01/2023 | First draft, establishing document structure | N. Aste, F. Leonforte, C. Del Pero |
| 0.2 | 23/02/2023 | First version, incorporating input from all participants | F. Leonforte, C. Del Pero |
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| 1.0 | 03/03/2023 | Final version addressing all further comments | N. Aste, F. Leonforte, C. Del Pero |

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# Disclaimer

# 1. Executive summary

This document represents the first Deliverable of WP4 and contains the initial release of the optimized technical specification of each component of the toolkit.

More in detail, in Chapter 2, a preliminary overview of the main components involved in RESKIN has been provided. After that, in Chapters from 3 to 11, the technical specifications of each new or updated element were defined, in order to allow its synergic integration, considering the project objectives and the constraints related to the integration needs. The activity has been carried out starting from the features of the components/solutions of each consortium partner, which represent the baseline for the development of the toolkit.

Considering the early stage of the project, for some products the detailed information reported in the document is referred to the current version under development, for others are instead related to the selected option that will be further assessed, thus to be modified/updated during the next stages of the research.

Finally, in Chapter 12 a methodology to provide a unique and standardised components' identification, in order to avoid ambiguity in the items' nomenclature, is briefly introduced.

# 2. Overview of the RESKIN’s components

RESKIN is a multifunctional toolkit within which tools and subcomponents cooperate organically to achieve high levels of energy efficiency and allow for an effective interface with the Smart Grid. The system is driven by a cloud-based platform, concentrating managing and operational logics that supports decision-making in the planning phase and optimizes energy performance the whole lifecycle.

The main subcomponents developed within the project, preliminary described in the present document, are the following:

- hybrid prefabricated photovoltaic-thermal roof, with refurbished PV modules, recycled aluminium profiles, boxed sustainable steel and biosourced insulation;
- multifunctional prefabricated façade with self-supporting panels and biosourced insulation;
- Multi-Input/Multi-Output power controller to optimize interconnection among generation, storage and electric loads;
- hydronic air-to-water DC modular heat pump;
- battery pack for PV electricity storage and pick management, made with recycled electric vehicle batteries;
- smart DC fan-coils for heating/cooling to replace existing radiators and be connected to the existing heating pipes;
- cloud-based platform with DSS and BEMS functions;
- smart charger for electric vehicles;

In the following section a brief description of each component abovementioned, as well as the main technical specifications, have been provided.

# 3. Hybrid building-integrated photovoltaic-thermal (BIPVT) system

The BIPVT roofing system is organized according to a modular structure. The system is designed in order to be integrated in common sloped roofs, replacing the external covering, waterproof and insulation layers.

The upper cover is constituted by PV modules that can be characterized by various sizes. Within the module, the cell area can cover the entire glazed surface or can be distributed in a grid where the spacing between adjacent columns and rows can allow a direct gain of solar radiation to the backward absorber plate. Different performances can be achieved by changing the cell area density in order to balance electricity and thermal energy outputs of the system. The airflow into the gap (between the PV panel and the absorber plate) can be generated by using a fan (forced-flow) or through buoyancy effect (natural convection). Fresh air removes the heat absorbed by the collector, cooling at the same time the rear of the PV module with the effect of an increment in the electrical conversion efficiency.

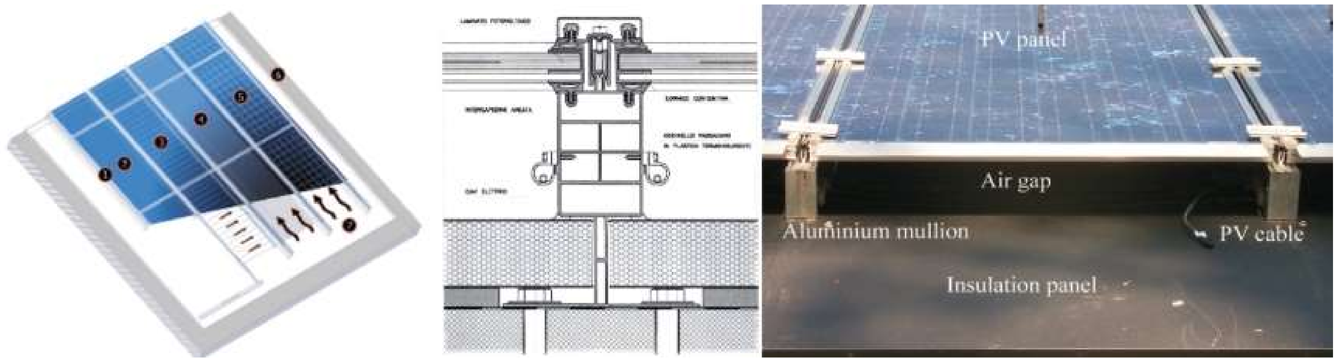


**Figure 1.** Schematic view of the BIPVT roof

The installation of the PV modules is provided through metal profiles, joined to the underlying slab or roof framework. Inside the air gap formed by the channelled hybrid modules, box-shaped sheet metal panels, containing bio-polyurethane foam, act as absorbing plates and as insulation layer.

The recycled aluminium profiles constitute the core interface structure and perform the functions of fixing, mechanical resistance, structural stability. The PV modules are housed in the profiles in the same way as glass curtain façades and the gaskets guarantee water tightness and airtightness.

More in detail, the metallic profile has been designed with a cup-shape cross section, in order to allow, in the lower part, the perfect installation of the insulating box and, in the intermediate part, an air gap which enables the rear-ventilation of the modules, preventing them from overheating and heat recovery.

The profile is wider in the upper part, narrower in correspondence of the insulation housing and spread out at the base in a longitudinal plate with buttonholes for fixing screws to the underlying structure.

## 3.1. Technical data and performances

The main technical data and performances of the system are listed below. It should be noted that the technical data reported hereafter are strictly related to the module size.

**Dimensions**

- Size of the modular system unit (Width/Height/Thickness) [cm]: 90-120/140-180/20-25
- Weight [kg/m$^2$]: 20-30

**Technical features**

- Sound attenuation in operating conditions [dBA]: ≈ 30
- Water penetration: sealed
- Air tightness: Class A
- Reaction to fire (class): BS3D0

**Energy performances**

- Thermal transmittance [W/m$^2$K]: <0.25
- Electric efficiency [%]: 15-20
- Electric power output in STC [W$_p$/ m$^2$]: 150-200
- Maximum system voltage [V]: ≈ 1000
- Solar thermal power [W/m$^2$]: 150-200
- Thermal efficiency (UNI 8937) [%]: 20-45

## 3.2. Notes

The system is designed to host different sizes of PV module, for this reason the dimensions of the modular system unit are variable.

The metal profiles also serve as housing for the electrical wires of the system.

To complete the roof system, a special piece, called blind panel, will be integrated in aluminium profiles instead of the PV module. It consists of a folded metal sheet, manufactured in different sizes to be integrated in the BIPVT roof. Through this configuration it is possible to achieve an aesthetic uniformity of the roof. Such blind panels, in fact, can be used as special connection pieces for irregularly shaped application surfaces.

The portions of the roof not covered by the BIPVT system, will be equipped with standing seam sheeting, back insulated with the biosourced foam used in the BIPV roof.

# 4. Modular multifunctional façade cladding

The multifunctional prefabricated façade system is organized according to a modular structure. The system is designed to be integrated into vertical facades, adding the outer layers of cladding, waterproofing and insulation.

It comprises prefabricated panels in standardized size modules joined by a tongue-and-groove system that ensures watertightness and modularity to be adapted to variable geometries of buildings.

The panels are made of high-strength steel sheets with weatherproofing and biobased coating on their outer face. The insulating section is incorporated with the injection of organic polyurethane compound with bioformulation. This way, it is possible to align with the environmental objectives of a circular economy and benefits of high energy savings in the different use cases.

The installation system is projected with an adaptive sealed chamber, spacing with a separation from the current façade, sufficient to host the new technical elements (e.g., wires, pipes, etc.). The internal chamber works as a thermal resistance when it acts as a sealed airtight gap in cold seasons, varying the transmissivity when the ventilation is opened in warm seasons.

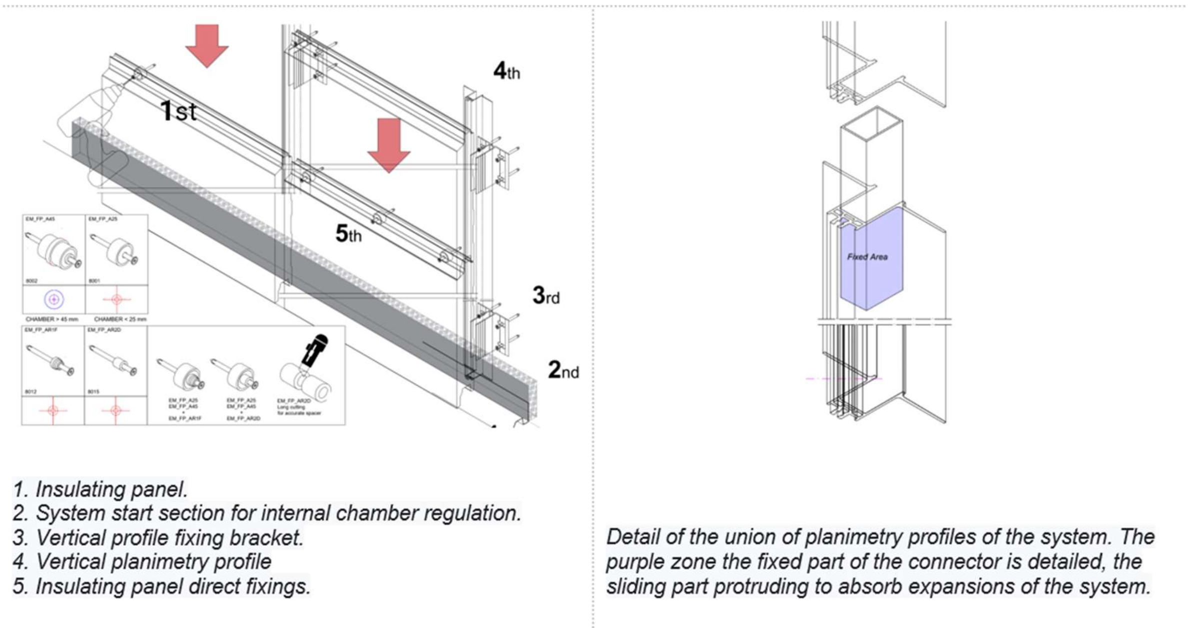


**Figure 2.** Main elements of the multifunctional cladding system

The installation is carried out with rectification profiles by which the system panels are supported, being fixed to the resistant facing by point fixings, allowing great design flexibility while minimizing thermal bridges. The profiles are made of aluminium and steel, with installation by means of extension connectors and brackets to absorb plumb and level imperfections of the existing walls.

## 4.1. Technical data and performances

The main technical data of the system are listed below.

**Dimensions**

- Length [cm]: up to 500
- Width [cm]: 100 - 115
- Thickness [cm]: 6, 8, 10
- Weight [kg/$m^2$]: 13.6, 14.4, 15.2

**Technical features**

- Sound attenuation in operating conditions [dBA]: ≈ 30
- Water penetration: sealed
- Air tightness: Class A
- Reaction to fire (class): BS3D0

**Energy performances**

- Thermal transmittance [W/$m^2$K]: <0.33 (thickness 60 mm)
- Thermal transmittance [W/$m^2$K]: <0.30 (thickness 80 mm)
- Thermal transmittance [W/$m^2$K]: <0.26 (thickness 100 mm)

## 4.2. Notes

At the junction points with individual façade elements (windows, corners, etc...) specific elements will be designed and developed to compensate the dimensional tolerances.

On balconies it is possible to maintain the same solution as the rest of the façade, unless the dimensions are too small or there are installations that cannot be removed. In the latter case, a tailored solution will be proposed.

The coverage of gas piping will be resolved with specific elements that ensure ventilation and thus compliance with fire prevention rules.

# 5. Smart fan-coil

The smart fan-coils are conceived to substitute radiators, using the existing hydronic pipes when they are in good maintenance state, or new pipes added within the RESKIN facade if existing pipes are compromised. The units operate as small water-to-air heat pumps, by extracting or releasing heat to the hydronic network and thus providing heating/cooling/dehumidification in every room according to punctual needs. More in details, the smart fan-coils will use a DC compressor to increase/decrease the temperature of the water coming from the centralized DC heat pump, according to the energy demand of each room. This allows to minimize heat losses on the existing distributions pipes and to avoid condensation in cooling mode.

These devices will also integrate several sensors to allow the precise control of room temperature/RH and the monitoring of detailed energy consumption and air quality.

In order to reduce the embodied energy, the enclosures of the fan-coils will be made of sustainable steel sheets.

**Figure 3.** Preliminary view of the smart fan-coil without (left) and with (right) metal casing

## 5.1. Technical features and performances

The main technical features and performances of the fan-coil are listed below.

**Dimensions**

- Size (Length, Width, Height) [mm]: 750, 200, 700
- Weight [kg]: 30-40

**Technical features**

- Power supply voltage [V]: 48 (72 as an option)
- Power supply current [A]: 5-7 (may change if 72 V will be adopted)
- Maximum air flow rate [$m^3$/h]: 500
- Compressor type: DC compressor, reciprocating

**Energy performances**

- Maximum useful thermal power (heating mode) [kW]: 1.4 - 2.4
- Maximum useful thermal power (cooling mode) [kW]: 1.2
- COP: 4.5 (W15A20)
- EER: 7.2 (W15A26)
- Maximum sound power in operating conditions [dBA]: ≈ 35

## 5.2. Notes

A specific component, called Smart DHW boiler, will be developed for the decentralized domestic hot water production. It couples the same small-size DC compressor of the fan-coil to an insulated water tank and a second water heat exchanger, in order to provide and store DHW.

# 6. DC Heat Pump

The heat pump is designed to easy substitute an existing boiler using fossil energy sources. It is coupled with buffer tanks to store heat energy. The main energy consumption of the heat pump is the compressor, and it runs by DC power supply.

The heat pump is air-to-water, therefore, it uses ambient air as an heat source. The typical structure of an air-source heat pump consists in an outdoor unit and an indoor unit, where the outdoor unit acts as an air heat exchanger. However, outdoor units require space outside of the building and create an acoustic impact. Furthermore, it can cause negative esthetic impacts. For such reasons, the proposed HP is a packaged one, which can route the ambient air into the heat pump by using air ducts.

The heat pump design consists of two parts: the bottom part integrates compressor, water-side heat exchanger, expansion valve, and other auxiliaries; the upper part includes air-side heat exchanger and fans. The casing is specially designed to be well-coupled and tight joint with duct system.

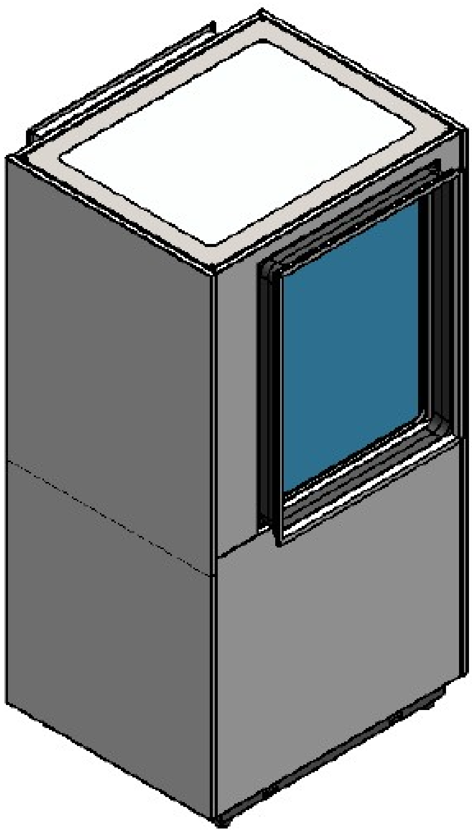

**Figure 4.** Preliminary design of heat pump package

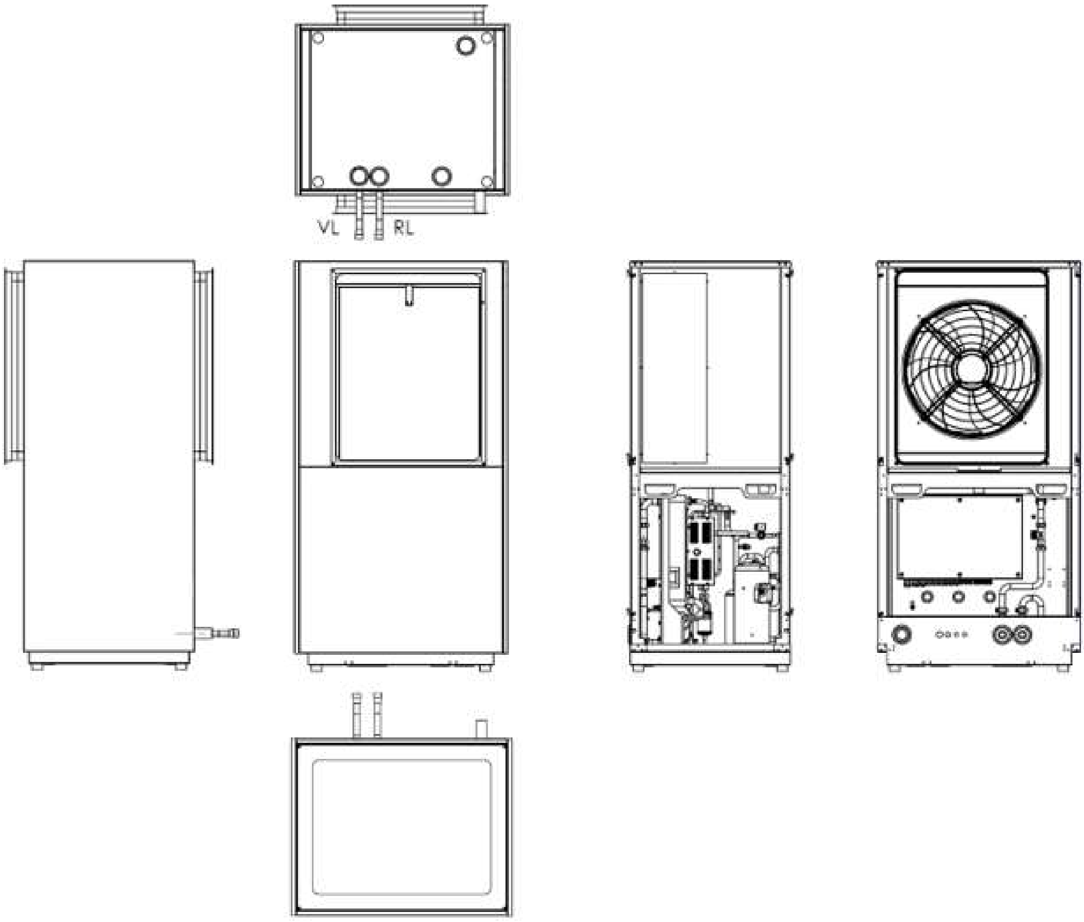


**Figure 5.** Preliminary design - projection views of 6 directions

## 6.1. Technical data and performances

The main technical data and performances of the HP are listed below.

**Dimensions**

- Size of the modular system unit (Width/Height/Depth) [cm]: 100-130/190-230/100-120
- Weight [kg]: 300 - 400

**Technical features**

- Air volume [$m^3$/h]: 2000 – 8000
- Air inlet flow temperature [°C]: -15 – 45
- Volume water flow [$m^3$/h]: 0.5 – 3.5
- Heat pump water outlet temperature [°C]: 20 - 60
- Working fluid: R515B
- Compressor: Scroll
- Compressor speed [rpm]: 1200 – 5000

- Fill amount [Liter]: 4 – 8
- Oil amount [Liter]: 1 – 3
- Power supply type: DC
- Input voltage [V]: 600 – 700
- Compressor input voltage [V]: 400
- Frequency [Hz]: 50
- Current [A]: 15 – 25
- Fuse-fan: thermal relay
- Max. nominal current – fan [A]: 1.1 – 1.7
- Earth leakage circuit breaker [mA]: 30
- Fan power [W]: 50 - 500

**Energy performances**

- Nominal heating capacity [kW]: 12 – 18
- Nominal cooling capacity [kW]: 9 - 12
- Compressor power consumption [kW]: 2 – 10
- COP (heating): 2.5 – 5.5 (air source: -10 – 10°C, water target temperature: 25 – 45°C)
- EER (cooling): 3.5 – 6 (air source: 35°C – 20°C, water target temperature: 7 – 12°C)

## 6.2. Notes

The technical data is corresponded to each unit. To achieve higher target heating capacity, it is necessary to use multiple heat pumps. This enables to achieve flexible system operation.

The heating energy output is variable depending on the air source conditions, and COP changes accordingly.

# 7. Multi-input/multi-output converter (MIMO)

The multi-input/multi-output (MIMO) converter allows to interface different energy sources (e.g. PV panels, batteries, grid) and supplying various loads (DC and AC). The converter configuration is designed in order to ensure high conversion efficiencies, limited size/weight, and standalone operation.

At present, two different options are proposed for the MIMO configuration, as reported below and shown in the following figures. The MIMO converter comprises a grid-connected four-leg AC/DC converter with several accessible DC ports. In particular, on the DC side, the converter integrates photovoltaic (PV) modules and batteries while supplying the heat pump and the smart fan coils. A smart electric-vehicle (EV) charger unit can be connected on the AC side.

In order to reduce the cost and size, the converter DC-bus can directly supply the DC heat pump without an additional DC/DC stage. For this reason, the rated MIMO DC-bus voltage is defined into a predefined range to satisfy the load and grid requirements.

The smart fan coils are supplied by unidirectional DC/DC converters at low voltage (e.g., 48 V) and are installed close to each fan-coils/group of fan-coils. In fact, although the fan-coils could be supplied with low voltage distribution lines starting from the MIMO, this would imply high voltage drop and losses on the distribution wires. For this reason, in order to minimize distribution power losses and to reduce wiring sections, the proposed MIMO configuration provides an accessible DC port at the rated DC-bus voltage. In this way, the energy can be transmitted at high voltage up to the connection points of the DC/DC converters. Two possible solutions have been considered to adapt the voltage to the smart fan coil requirement. The first is to install a DC/DC converter for each fan coil, while the second is to install some DC/DC converters supplying portions of the building. The two solutions will be furtherly compared, even considering the characteristics of the building, to get the final solution.

The PV modules are interfaced through several DC/DC power optimizers. In this way, a distributed maximum power point tracking can be adopted, maximizing power production. The PV array configuration can be defined in accordance with the required power to be installed, considering the MIMO DC-bus voltage range.

Lastly, the batteries are interfaced through a bidirectional DC/DC converter managing the power flowing into the storage system. The design of the DC/DC converter depends on the battery voltage ratings. In particular, by increasing the latter, the converter's size, weight and cost can be reduced. A technical discussion is currently ongoing with SOLAR on this point, in order to identify the best option.

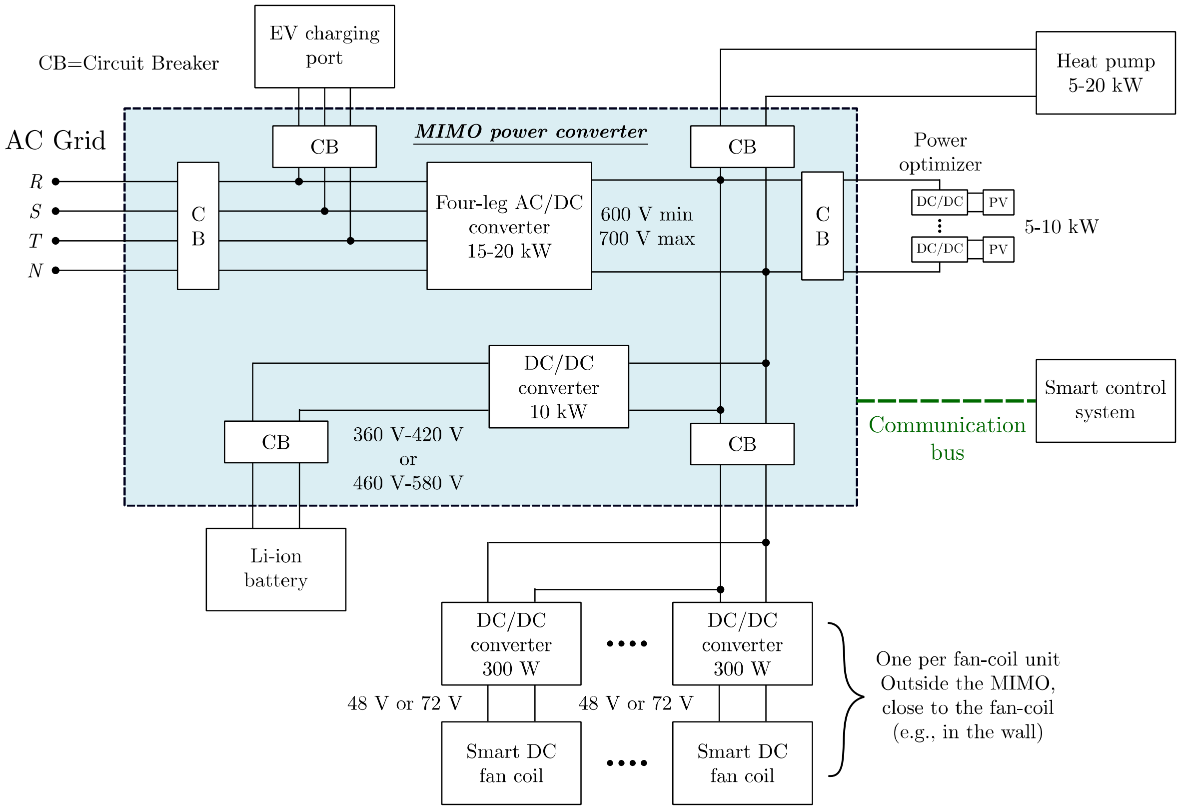


**Figure 6.** First possible solution for the MIMO converter

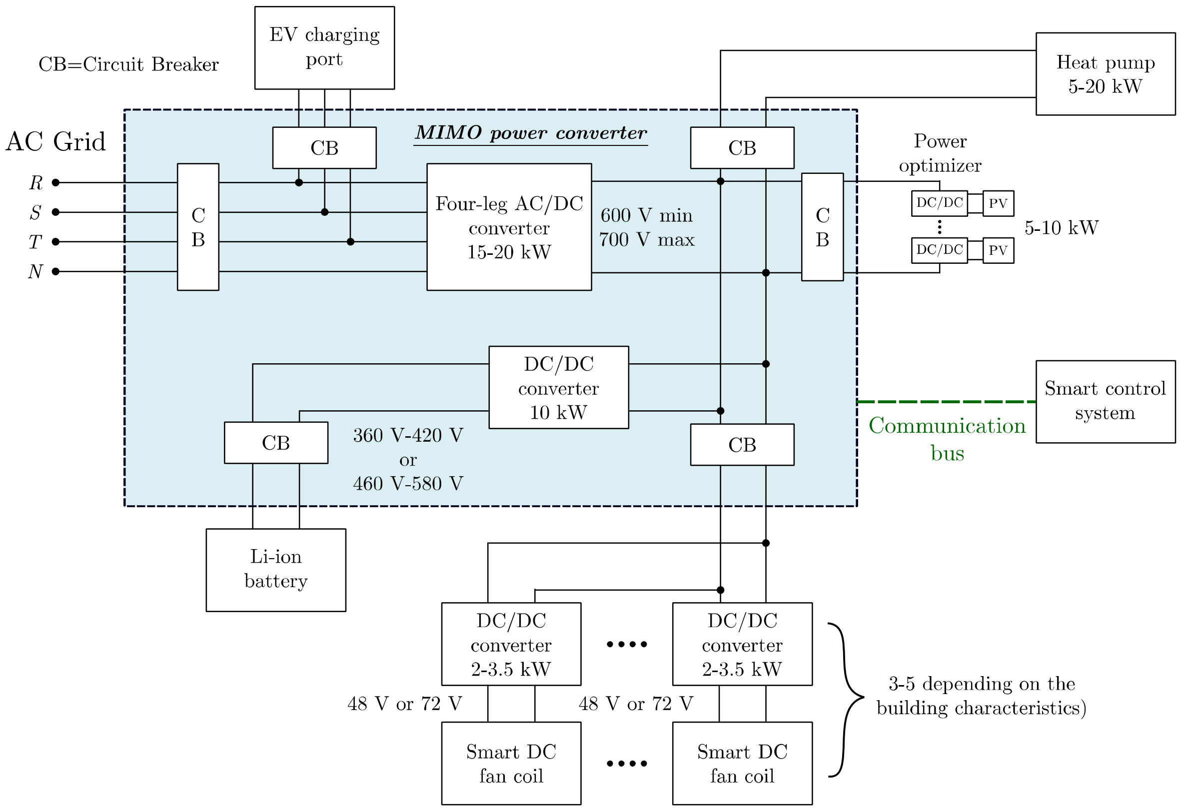


**Figure 7.** Second possible solution for the MIMO converter

## 7.1. Technical data and performances

The main technical data and performances of the converter are listed below.

**Dimensions**

- Main unit (Width/Height/Depth) [cm]: 60 x 60 x 40
- Power optimizer (Width/Height/Depth) [cm]: < 10 x 10 x 8
- Fan coil DC/DC - 300 W (Width/Height/Depth) [cm]: < 10 x 10 x 8
- Fan coil DC/DC - 3 kW (Width/Height/Depth) [cm]: < 25 x 25 x 24

**Technical features**

- AC/DC Four-leg converter port power [kW]: ≈ 15-20
- MIMO DC-bus voltage range [V]: min. 600 – max. 700
- DC-DC battery converter power [kW]: ≈ 10
- DC-DC battery converter voltage [V]: HV (600 –700) – LV (360 – 420 or 460 – 580)
- PV system power [kW]: ≈ 10 (power optimizer 300W – 600W each)
- DC-DC fan coil converter voltage [V]: HV (600 –700) – LV (48 or 72)
    - Solution 1: DC-DC fan coil converter power [W]: ≈ 300 (one per each fan-coil)
    - Solution 2: Three-to-five DC/DC converters with 2-3.5kW power each.

**Energy performances**

- AC/DC Four-leg converter port efficiency [%]: > 94
- DC-DC battery converter efficiency [%] > 93
- PV system efficiency [%] > 90
- DC-DC fan coil converter efficiency:
    - Solution 1: individual DC-DC fan coil converter efficiency [%]: > 90
    - Solution 2: Concentrated DC/DC converters efficiency [%]: > 92

## 7.2. Notes

The reported dimensions and efficiency are roughly estimated and will be verified during the realization of the prototype units.

The final configuration related to the smart fan coils' feeding will depend on further studies regarding wire cost, available points of connection, and safety concerns. It is necessary to verify the feasibility of installing the DC/DC converters directly into the fan coil case according to the safety requirements. Otherwise, considering the available connection points, defining the optimal converters position is necessary to maximize the conversion efficiency.

The battery voltage is not finally defined but some possibilities will be analysed in the following months and discussed in the next version of the deliverable.

# 8. EV charger

Two different types of charging infrastructures will be developed by upgrading ENELX commercial solutions. More in detail, the 2 proposed versions are the following:

A. the first one is an AC charging infrastructure, capable of connecting one vehicle at a time. It has power ranging from 3.7 kW to 22 kW;
B. the second version can connect and charge up to two vehicles simultaneously. It has a power of up to 22 kW.


**Figure 8.** View of the two versions of EV charger (version A on the left and B on the right)

At this stage of the project, both versions will be considered for the application within the RESKIN package. However, a more specific technical assessment will be carried out in the next stages of the project according to the technical specification of the MIMO converter.

## 8.1. Technical data and performances

Hereafter the technical data and performances of the two models are reported.

*VERSION A*

**Dimensions**

- Dimensions (Width/Height/Depth) [mm]: 153x180x42
- Weight [kg]: 5-10

**Technical features**

- Operative temperature [°C]: -40 ÷ +60
- Operative RH [%]: 5% - 95%
- Max. altitude [m]: 2000

**Energy performances**

- Power [kW]: 3.7-22
- Current [A]: 32
- Voltage [V]: 230 (1-phase) or 400 (3-phase)

*VERSION B*

**Dimensions**

- Dimensions (Width/Height/Depth) [mm]: 353x1475x333
- Weight [kg]: 60

**Technical features**

- Operative temperature [°C]: -25 ÷ +50
- Operative RH [%]: 5% 95%
- Max. altitude [m]: 2000

**Energy performances**

- Power [kW]: 22
- Current [A]: 64
- Voltage [V]: 400 (3-phase)

## 8.2. Notes

While version A allows to charge just one vehicle, the second model allows to recharge also two vehicles simultaneously, with the same maximum power of 22 kW.
Both versions are equipped with two locking systems that prevent unauthorized disconnection of the plugs during charging. They are both suitable for outdoor installation (IP55; IK08)

# 9. Battery Pack

The battery pack to be integrated in the toolkit will be made with repurposed battery cells coming from the automotive sector. More in details the cell type is the LEV40, extracted from Mitsubishi Outlander PHEV.
The cells are manufactured by the Japanese company GS-Yuasa.


**Figure 9.** View of a single battery cell adopted in the project

By integrating these cells, the single battery pack will be made by 160 or 192 battery cells (to be defined together with PSC, according to the MIMO specifications).
The BMS (Battery Management System) will be a new component specifically adopted for the scope of the project. At present the choice is to use a REC-BMS product in master-slave configuration.

## 9.1. Technical features and performances

The main technical features and performances of the single battery cell are listed below.

**Dimensions**

- Length [mm]: 171 (±0.5)
- Width [mm]: 32.5 (±0.5)
- Height (over terminals) [mm]: 111 (±1)
- Weight [kg]: 1.4

**Technical features**

- Storage temperature (recommended) [°C]: -20°C to +35
- Charge temperature [°C]: -25°C to +60

- Discharge temperature [°C]: -25°C to +60
- Lifecycle: 5500 cycles (with 80% of initial capacity)

**Energy performances**

- Nominal voltage [V]: 3.75
- Operating voltage range [V]: 2.75 to 4.1
- 1-hr rate typical Capacity at 25°C [Ah]: 40 Ah
- Charge voltage limit at 25°C (continuous) [V]: 4.1
- Charge voltage limit at 25°C (60mSec) [V]: 4.2
- Charge termination threshold current [A]: <0.5
- Maximum Charge Current (-25°C) [A]: 8
- Maximum Charge Current (-10°C) [A]: 20
- Maximum Charge Current (0°C) [A]: 40
- Maximum Charge Current (10-40°C) [A]: 100
- Maximum Charge Current (50°C) [A]: 80
- Maximum Charge Current (55°C) [A]: 40
- Maximum Charge Current (60°C) [A]: 16
- Maximum discharge continuous current [A]: 240

The main energy performance features of the 160-cells battery pack are provided below.

- Nominal voltage [V]: 600
- Operating voltage range [V]: 440 to 656
- Nominal capacity (new cells) [kWh]: 0.11
- Expected capacity at time of installation [kWh]: 16.8 kWh

## 9.2. Notes

According to the storage need of each building, different battery packs can be connected in parallel to reach the desired capacity.

# 10. Refurbished PV module

The proposed PV modules derive from a refurbishing process that allows worn-out components to be reused, avoiding their disposal.
At present, the product to be used within the project is a 3 bus-bar PV module integrating 60 polycrystalline cells (6 inches each), with a nominal power of 235 $W_p$.
The module has an aluminum frame which encloses a glass-backsheet laminate. The front glass is tempered and has a thickness of 3.2 mm.
The main dimensional features are shown in the figure below.

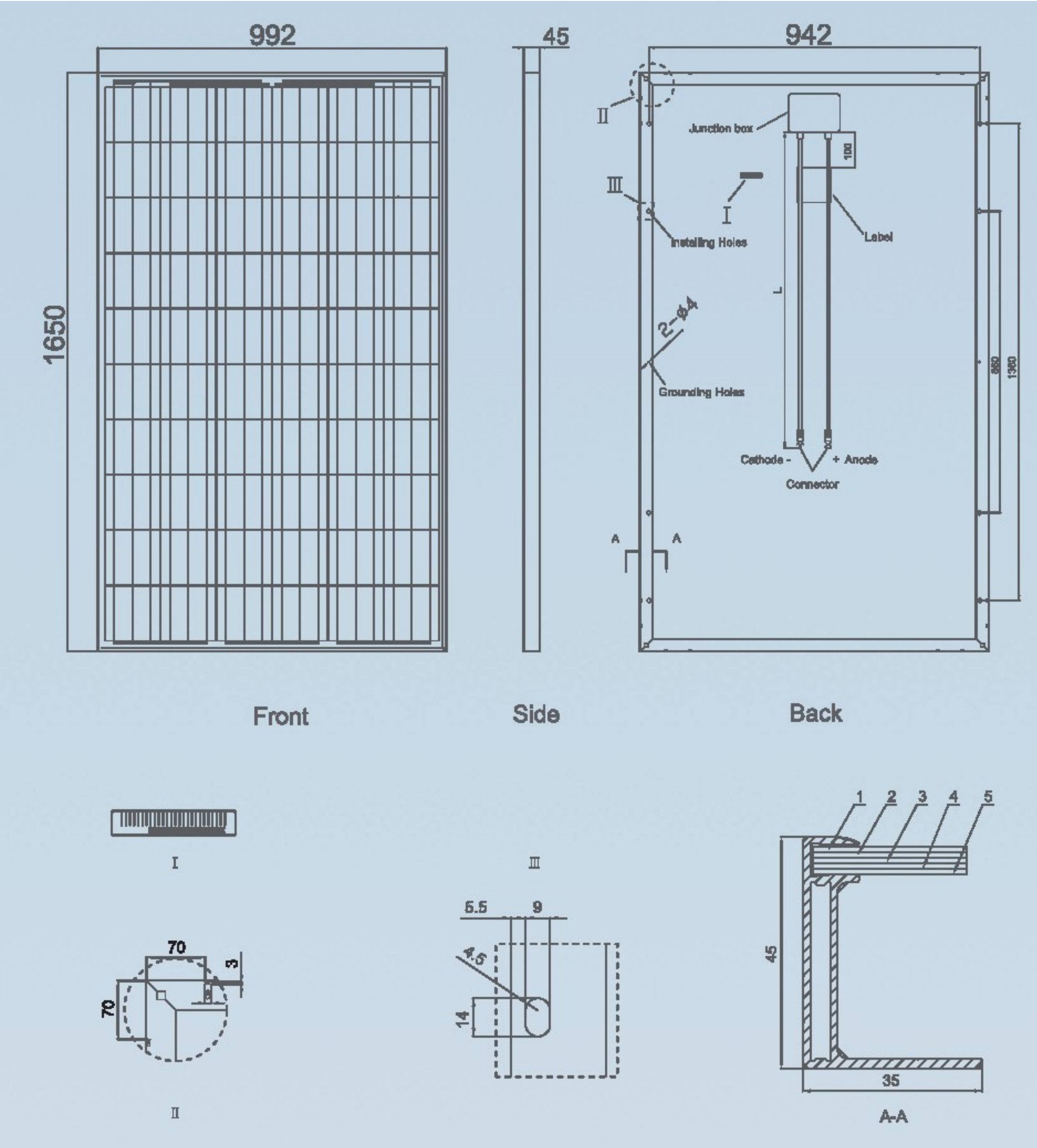


**Figure 10.** Main features of the refurbished PV modules (size in mm)

## 10.1. Technical features and performances

The main technical features and performances of the PV module are listed below.

**Dimensions**

- Size of the module (Width/Height/Depth) [mm]: 992/1650/35-45
- Weight [kg/m$^2$]: 19

**Technical features**

- Water penetration: sealed, IP65 for the junction box
- Air tightness: Class A
- Fire resistance (class): Class C

**Energy performances**

- Maximum power at STC [W]: 235
- Voltage at maximum power point [V]: 29.8
- Open-circuit voltage [V]: 36.9
- Current and maximum power point [A]: 7.89
- Short-circuit current [A]: 8.47
- Module efficiency [%]: 14.35
- Maximum system voltage [V]: 1000
- Temperature coefficient on Pmax [%/°C]: -0.45
- NOCT [°C]: 45

## 10.2. Notes

The power tolerance of the delivered PV modules on the rated value is +/- 5%.

The output cables have a section of 4 mm$^2$ and a length of 90 cm each.

# 11. DSS/BEMS platform

The platform already developed for the HEART project will be improved to support the new requirements for the RESKIN project.

In detail, the DSS (Decision Support System) will be extended in several aspects: a set of new models targeting circularity will be created together with ENELX and POLIMI and implemented to provide additional information to support the building owner. This new set of circularity models will be implemented next to the actual Life Cycle Assessment (LCA) and Life Cycle Cost (LCC) models as an independent micro-service allowing to execute the models as a stand-alone application or as integrated to the result of the DSS. While additional screen will be developed for the standalone version of the circularity model, the actual screen of the DSS will be reviewed to take the new models into account. Finally, the resulting dashboard of the DSS will be reviewed to offer a better user experience to the building owner, and a new application will be provided to allow the technical maintenance of the models.

A new Building Energy Management System (BEMS) will be implemented with CTIC/POLIMI and integrated in the platform. RESKIN project will analyse the different options to take advantages of WEB 3.0 principles (Distributed Application and Blockchain's Ledger) in term of security, accountability, control, ownership, and collaboration over distributed data that are collected in the building. The migration of the BEMS to WEB 3.0 will infer an update of the current Building Management System (BMS) micro-application and the tenant micro-application. Connectors will be implemented to the new data repositories.

In order to collaborate in the RESKIN platform and potentially with other platforms, both DSS and BEMS will rely on a common understanding of the different data that are collected about the buildings. No matter where the data comes from IoT devices installed in the building, from the energy manager filling information in the screens or from architects describing the building, each data must be identified and categorised. Consequently, the actual virtual description of the building must evolve to a multi-layer digital twin of the building. Research will be performed to structure the different layers to take into account the physical static information contained in the BIM, the real time status information from the sensors, the simulation results from the DSS and finally the operational information generated by the regulation component of the BEMS. The semantic of the data and the nomenclature of the systems will be enforced and uniformized across the different layers of the digital twin and reflected in all the modules of the RESKIN platform.

A new notifications engine will be set to inform users when specific events happen on their devices or within their connected environment. When the device is not sending any data since a certain time or if it has an error status or its readings are outside of the defined boundaries, alerts will be sent to the right person, via email or SMS. Notification flows will adapt to the organization processes

by allowing users to create specific escalation path informing the right users. The users will be able to indirectly integrate alarms based on the BEMS component.
Academic management of the models and parameters will be enforced to ensure long term support of the platform. A reporting function that lets the academic users to export raw data (CSV/Excel) will be provided to allow users to cut across a set of raw data and combine them with external sources to get the answer to their questions.
According to what described above, the planned architecture of the RESKIN platform is show in the following scheme.

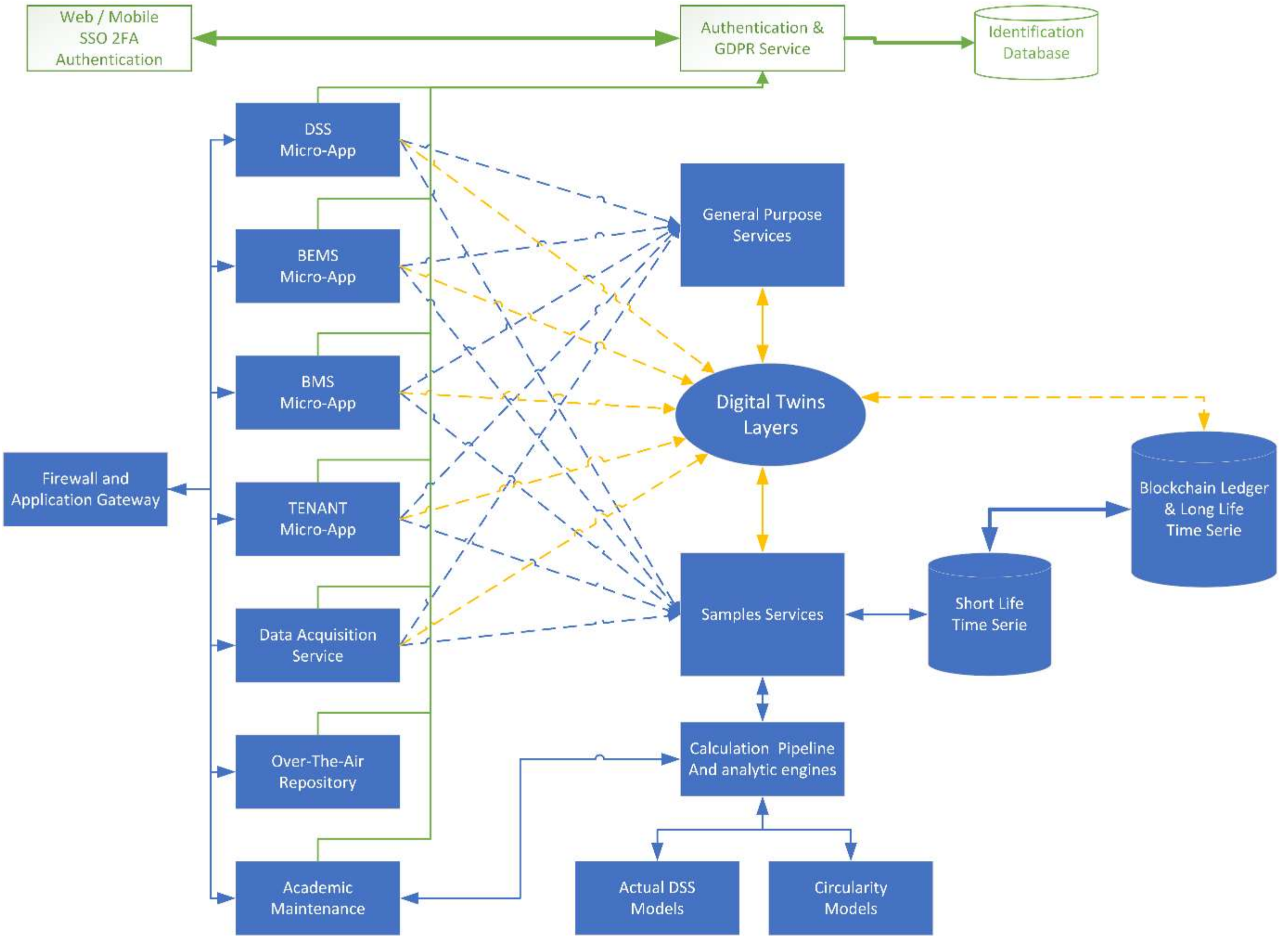


**Figure 11.** Planned architecture of the RESKIN platform

All the communication will be secured by the latest version of the Transport Layer Security (TLS/HTTPS). Communication between the device and platform and between the users and the platform will be only available after Two Factor Authentication process.
The RESKIN platform will enforce the privacy of the different users by maintaining a centralized Identity management component, used by all the other components of the platform. Only the

required data will be accessible by the module after consent of the user. Revocation process and Consent list will be provided to the users.

Different mechanisms will be implemented to secure the communication and to protect the integrity and the confidentiality of the interactions between the devices and the RESKIN platform. The entire communication channel between the Wireless Sensor Node (gateway) and the platform will be encrypted to prevent man-in-the-middle attack and backdoors. This means that even if the message travels through different solutions, it will only be readable when it reaches the platform for processing, decreasing the attack surface whatever using, be it HTTP, AMQP, or MQTT, all over TLS.

# 12. Components' identification and data collection

During the project, the components developed in RESKIN will be identified by a unique and standardised way in order to create a registry where all the information, organised in datasheets, and the documents concerning different characteristics and performances can be collected, updated and shared between all the partners and stakeholder over time.

The proposal is to assume the OmniClass Construction Classification System, also known as OmniClass™ or OCCS, as unique classification system for the entire RE-SKIN system. The choice has fallen on OCCS for its international dissemination and completeness.

The OmniClass Construction Classification System is a classification and coding system used for the organising and retrieving of information for the construction industry. It covers the full facility lifecycle from conception to demolition or reuse, and all types of construction in the built environment. It is useful for Building Information Modelling (BIM), organising reports and object libraries. OmniClass is derived from internationally-accepted standards developed by the International Organisation for Standardisation (ISO) and the International Construction Information Society (ICIS) and has been developed from the early-1990s to the present.

OmniClass comprises 15 tables. Each table can be used independently to classify a particular type of information, or entries on it can be combined with entries on other tables to classify more complex subjects.

The 15 OmniClass tables enable to break down the construction environment into discrete types of information:

Table 11 - Construction Entities by Function
Table 12 - Construction Entities by Form
Table 13 - Spaces by Function
Table 14 - Spaces by Form
Table 21 - Elements
Table 22 - Work Results
Table 23 - Products
Table 31 - Phases
Table 32 - Services
Table 33 - Disciplines
Table 34 - Organizational Roles
Table 35 - Tools
Table 36 - Information
Table 41 - Materials

Table 49 – Properties

In such respect, in the further advancement of the work, a classification and coding of the characteristics and properties of the RE-SKIN components will be proposed by extracting levels from the OCCS Tables.