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Challenge Brief [TD2]

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Procurers

Supporting organisations

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Challenge Summary

Background, current situation, expected demand

It is expected that 90% of the currently existing building stock will still be in service in 2050, the year in which many cities want to reach carbon neutrality. European policies and legislation are in place to accelerate the decarbonisation in the building sector, starting out, however, from a situation where renovation is making only a moderate contribution (0.4 to 1.2% of buildings per year) and the complete replacement of the existing stock is very slow (1-1.5% per year) and not desirable. To achieve our climate goals, renovation in Europe must be accelerated, lifting many more existing buildings to an optimal efficiency level as well as maximising the self-use of renewable energy.

An increasing number of cities, regions and other owners of major building portfolios wish to achieve 100% renewable energy supply (RES) in their buildings. These actors are faced with barriers, such as individual constraints for adaptation for each building, provision of supply and storage, optimisation of operation and integration of solutions across technologies. Integration of the optimal selection of cutting-edge Renewable Energy technologies requires a level of expertise most owners and their planners cannot be expected to acquire. The construction sector is extremely fragmented, where more than 95% of manufacturers and professionals operate as Small and Medium-Sized Enterprises (SMEs), and most in separate national or local markets. Furthermore, investors have a natural preference for low-risk solutions and a scepticism to complexity.

Currently, there are no adequate products on the market which can deliver a 100% renewable building without undertaking invasive measures to the envelope. The Buyers Group alone operates 21,000 buildings; almost a dozen other procurers are already following the project with more expected. Their portfolios constitute ten-thousands of buildings with sufficient envelope quality to deploy the envisioned solutions. Procurers wish these buildings to be supplied by 100% local RES within a short timeframe. To make this possible, it is expected that suppliers will follow an "active approach", optimising heavy loads in heating, ventilation, and air conditioning (HVAC) etc, adding intelligent (remote) control, energy production and storage while responding to specific usage requirements to optimise the entire building.

The common challenge

Suppliers are to design, develop, and test an innovative **Renovation Approach** capable of generating **Renovation Packages** delivering 100% renewable energy supply to any existing non-residential building with adequate envelope quality. The Renovation Approach is to be tested through generating and implementing Renovation Packages for specific non-residential buildings in Buyers Group portfolios, the **Demonstration Sites.**

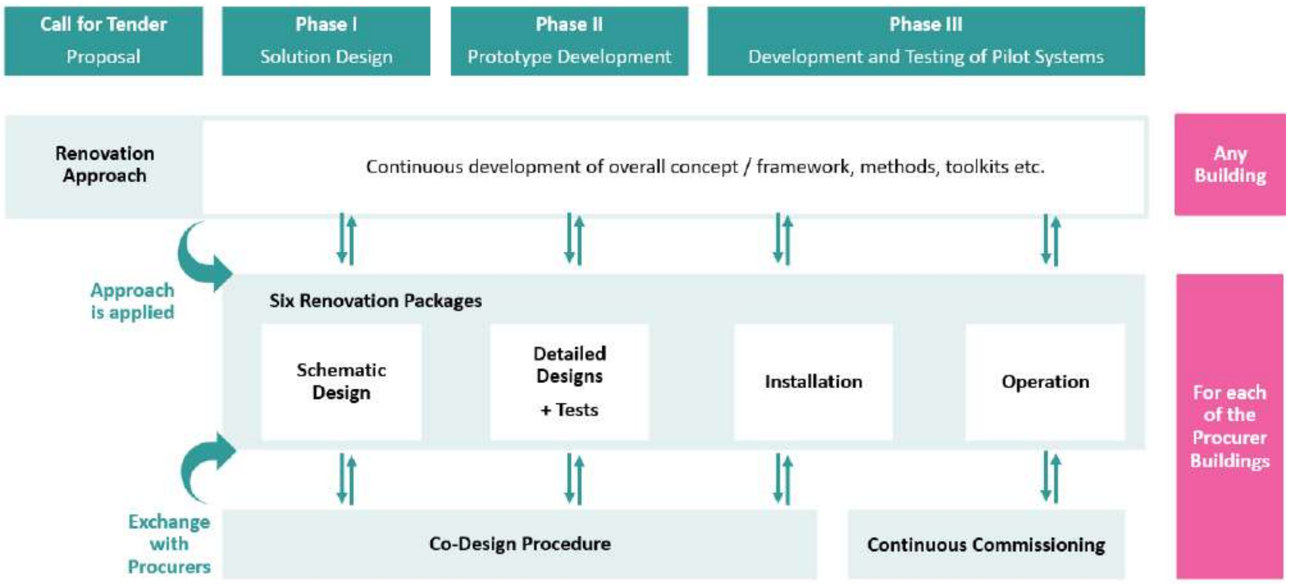
Figure 1. From a generic Renovation Approach to specific Renovation Packages

A supplier's Renovation Approach is expected to constitute a complete set of methods, technologies, services and devices integrated in a well-documented toolkit which includes at least: building assessment framework, system design and control approach, RES production, interoperable integration of legacy devices, data management and data sharing, building control, storage solutions, finance and contracting models, life-cycle cost approach, continuous commissioning, behaviour-targeting education and training of occupants and professionals.

During Phase I and Phase II**,** suppliers adapt, extend, and apply their Renovation Approach to generate Renovation Packages for six specific buildings in Buyers Group portfolios with increasing level of detail. During these two phases, suppliers will apply their Co-Design procedure[1] to facilitate information exchange, involvement, decision-making etc. Successful tenderers for Phase III will then implement the Renovation Packages in three allocated buildings, ensure performance and apply the Continuous Commissioning procedure. The initial delivery of the Renovation Package is to be turnkey-ready.

Starting with the proposal, all phases constitute R&D work on the supplier's Renovation Approach, resulting in continuous improvements based on lessons learnt during application and research.

Figure 2. Summary of core activities per phase



[1] The Co-Design procedure constitutes part of the Renovation Approach as described in the Challenge Brief.

Demonstration Sites

The Demonstration Sites are six non-residential buildings: three schools and three offices. Information on the buildings is provided in the Annex C of the Challenge Brief.

Structure of the document

The Challenge Brief is divided into sections each linked to a corresponding award sub-criterion (e.g. 1.1. to sub-criterion T1, 2.1 to sub-criterion CF1). The Tender Application Template (TD6) follows the same structure and provides detail on expected content in each section of the proposal.

Information completing the description of the Challenge (sections 1 to 3) is collected in the Annex. The following content is included:

- Annex A: procuRE building blocks: Referencing building blocks presented in pitch deck and during OMCs to sections in this document
- Annex B: procuRE Personas: Describing the user groups to be expected on-site
- Annex C: Informative Summary of Demonstration Sites
- Annex D: Open Market Consultation Report
- Annex E: Reference Buildings and Climate Data

The most recent version of the Pitch Deck summarising content from OMCs and including large-scale version of graphics used in Tender documents can be downloaded via the procuRE website.

1 Technical Criterion

1.1 T1 – System Integration

1.1.1 Renovation Approach to achieve 100% RES in existing buildings.

Challenge: According to the Energy Performance of Buildings Directive 2018/844/EU (EPBD), the energy performance of a building shall be determined on the calculated or the **actual annual energy demand** for meeting the different needs associated with its typical use, including the energy demand for heating and cooling to maintain the desired indoor comfort, and for providing domestic hot water. In procuRE, the electricity consumption of all appliances and systems within the building are to be included in the actual final annual energy demand.

The actual annual energy demand of a building is, to the greatest economically feasible extent, to be covered by **on-site renewable energy sources**. "On-site" refers to the building and its nearest vicinity – air, surface, ground and underground –, which, in any case, cannot exceed the building premises or attached structures. Although, for some Demonstration Sites large land surface is available, the procurers want to make sure that the solutions adopted are highly replicable at all their building stock. During the project, solution proposals for functional structures within described perimeters (e.g. courtyard) will be assessed during Co-Design on a case-by-case basis. The extent to which this goal is met is measured with indicators (section 1.2). Energy drawn from networks or otherwise delivered to the site is not an on-site energy resource.

Self-consumption is to be maximised hereby reducing interaction with energy networks. Local and temporal disparities between the production and use of renewable energy in buildings should be considered with sufficient frequency. Energy networks can be relied on to cover exceptional weather, failures etc.

The impact of operators and occupants increases in highly efficient and integrated buildings. The dimensions of **control, comfort and costs** are to be balanced in the overall approach.

1.1.2 System package design

Context: Most current energy retrofit projects do not set out from application of an adequate set of tools, but are disjointed, involving only one or a few buildings, and design starts more or less from scratch in each project. Also, many current retrofit projects result in buildings which do not operate as designed. Specific efficiency measures in the design are either not designed with the users in mind or are often not respected in construction and operation, resulting in performance not matching the original design intent. In some instances, individual systems are optimised impeding the efficiency of other systems or the building as a whole. In addition, the specification of building performance is often limited to targets for final energy or primary energy use after retrofit. In consequence, Continuous Commissioning is often not possible. Current contractors often externalise the effort of coordinating specialists to procurers who do not have the necessary resources and in-house expertise to perform these tasks efficiently and effectively.

Challenge: Suppliers are expected to offer a fully documented Renovation Approach which represents the full mastery of system specifications, independent of the size, type, and location of the building. Design procedures in the Approach are to minimise the planning efforts, concentrating and organising the necessary expertise from specialists, in particular of complex HVAC systems. The Renovation Approach must include a modular and adaptable set of technologies for energy production, storage, and management with effective and reliable components. Challenges for each of these technologies are described in the following sections.

As part of the Renovation Approach, suppliers must include comprehensive design procedures which can be as easily applied to projects covering single-buildings renovations and scalable to larger portfolio renovations anywhere in Europe. The following elements are considered the minimum necessary:

A clearly specified **design workflow** extending across the entire renovation process (design to operation) and the entire value chain. This must enable all disciplines (architects, engineers, technology providers, system integrator, energy manager…), procurers, building occupants and other stakeholders to exchange information and participate in design with clear trigger points and checks to ensure all required specialists (e.g., HVAC) and stakeholders are involved. Current reliance on procurers to fill these gaps must not be continued. The workflow is also to explain and ensure that all regulation and code requirements are met. For interaction with procurers and in support of their decision-making, the workflow has a specific "Interface to Procurers" (see Section PM1).

A **modelling and selection methodology** enabling the supplier to quickly select the best suited components for any given set of buildings, e.g. from the technologies and services mentioned in the Sections 1.1.3 to 1.1.6. This includes any components to complete the HVAC design.

The **output** of these efforts results in a Renovation Package which is specific to one building, containing clear definition of components and systems performance specifications that can easily be understood by non-technical personnel. The Renovation Packages generated must consider current building characteristics, future building use, context, regulatory framework, and climate at the location of the building. (The minimum criteria for a Renovation Package for each phase are described in TD1 section 2.1.2).

Further elements may be included by suppliers. **Procurers will welcome innovative platforms, such as BIM or others,** capable of linking stakeholders, integrating data streams, highlighting decision requirements, and providing necessary tools for modelling and verification, including to measure the energy, comfort, and health performance, as well as acting or offering building logbooks. It is considered a merit if a platform centralises and harmonises core processes from initial design to operation. This does not preclude attaching value-adding modules or micro-services from one or more third-party vendors.

1.1.3 System package monitoring and management

Context: Most current systems for monitoring and managing buildings in operation still treat each component of a system as a separate unit, with a specific function which is independent of the others. This impedes attempts at optimal operation of the whole system. This fragmented approach is often reflected in the structure of databases. To optimise behaviour and settings, operators and occupants must analyse multiple components in parallel, themselves. Monitoring and management hardware and software can offer more.

Challenge: Suppliers are challenged to include in their Renovation Approach a streamlined approach to components and processes for the operation phase of the building. Management and monitoring are to provide a "second view" on the building to ensure that design performance is achieved during operation without impeding other performance characteristics (e. g., comfort). The automated and continuous assessment of the monitoring data available needs to be the basis for energy efficiency optimisation and Continuous Commissioning (see PM1). As occupants are central to the functioning of each building – there is no smart building without informed and smart users – the monitoring systems **must have user interfaces that deliver easy-to-understand information to support behaviour change** (see T3).

Suppliers are expected to define clear and meaningful **Key Performance Indicators** (KPIs) that allow the building energy performance to be evaluated from an energy and environmental point of view at appliance, system and building levels as well as comfort and other critical or desirable functions. A mandatory set is described in T2. **Minimum and targeted performance** values are to be defined for applicable KPIs, complemented by, and linked to contractual regulations regarding costs and conditions, among other aspects, in case of divergence. These indicators should be defined in a way to demonstrate, through a Continuous Commissioning, the assessed performance also during the building operation, considering the metering and billing of energy use. These indicators give a comprehensive overview of the building, including flexibility, energy efficiency, occupant comfort, awareness and satisfaction, Smart Readiness Indicator.

For an efficient collection of measurements and a reliable calculation of the indicators, a **Monitoring System Guideline** needs to be developed where the minimum set of requirements (sensors and meters) for the monitoring and control system to be installed are defined taking precisions and tolerance fully into account. If additional sensors are deemed to provide added-value or be requested by procurers during Co-Design, these are to be documented in a subsection, including an explanation of their purpose. This Guideline will also contain the definition of all procedures linked to assess the minimum and targeted performance parameters, also feeding into Continuous Commissioning. The system must be able to recognise **manual temporary overrides** by building operators diverging from the automated management and calculate and verifiably record any additional costs resulting from such activity. Cases of divergence are to be collected, summarised, and presented as part of Continuous Commissioning procedure (PM1).

In addition to this, the monitoring system should be equipped with a remote facility and an energy management system with control and maintenance features for the building's technical systems. The **BEMS** (Building Energy Management System) should base the control not only on fixed schedules, but also on occupation, occupant behaviours and needs, system efficiency, RES availability, storage state of charge and network energy utilisation peaks and fares, among other parameters Forecasts are to cover beyond the near-term future (i.e. next hours). The system should include easy access for building operators to override system settings temporarily, record the reasons for such activity and indicate the consequence of such activity (for more detail see 1.1.6). It should be transparent to the operator when or whether the system restores automated control. The use of **smart controls** based on predictive or advanced rule-based controls would be a plus.

The system shall also create minimal and targeted information for informing and influencing occupant behaviour when deemed necessary (see T3). Upon request, it should be possible to integrate easily understandable graphics and core figures in public displays or websites linked to the building.

Similarly, as fault detection and diagnostics reduce energy consumption and discomfort due to interruption of the service, **predictive maintenance strategies** should be offered to guarantee the early detection of malfunctioning components, extend equipment lifespan, the reduction of safety, health, environmental and quality risks, as well as overall reduced costs.

1.1.4 Energy production and distribution components

Context: Public administrations and other building owners are flooded with information on RES and HVAC technologies. However, it is currently very difficult for retrofit procurers to build the necessary analytical vision of what HVAC and RES solutions they should adopt and procure for their building stock.

Challenge: suppliers are expected to improve the framework conditions for procurers to select and adopt renewable production and distribution technologies which have a **low final energy use**, **high renewable energy harvest** and **minimal life cycle impact** on the environment and the costs (LCA and LCC). Suppliers are encouraged to pre-select technologies as part of their Renovation Approach. **As a set, pre-selected technologies must** cover the procuRE climatic zones, regulatory regimes, and contexts, and be able to be safely applied to offices and schools. Most technologies should be already on the market or soon ready to be commercialised, with adaptation to the social, economic, regulatory, and environmental context of the Buyers Group Demonstration Sites, completed or at least planned.

Suppliers are expected to mostly select **proven technologies** that are cost-effective and easy-to-install, with **performance demonstrated** by standards or specifications or for selected core components, demonstrated during prototype testing in Phase II. A **minimal and coherent set** of scalable and modular pre-selected technologies capable of delivering all above will be considered a plus.

Information provided as part of the Renovation Approach for inclusion in Renovation Packages must **include core descriptions and indicators** enabling procurers to acquire and improve the knowledge base to continuously speed up and improve decisions during Co-Design and with view on multiple future renovations of the building stock using the Renovation Approach.

1.1.5 Energy storage components

Context: Energy storage will play a key role in enabling the EU to develop a low-carbon society and to ensure lasting energy flexibility and security. For a 100% RES driven building, the challenge is to have a balance between supply and demand. For this, the use of thermal and electric storage becomes key for increasing the building flexibility, shifting loads, and shaving peaks.

Challenge: suppliers are expected to improve the framework conditions for procurers to select and adopt thermal and electric storages technologies which **maximise the self-use** of the renewable energy produced on-site, they balance (**high) specific energy storage capacity**, **low specific investment cost** and **minimal life cycle impact** on the environment and the costs (LCA and LCC) depending on building constraints. Suppliers are encouraged to pre-select technologies as part of their Renovation Approach. **As a set, pre-selected technologies must** cover procuRE climatic zones, regulatory regimes and contexts and be able to be safely applied to offices and schools. Most technologies should be already on the market or soon ready to be commercialised, with adaptation to the social, economic, regulatory, and environmental context of the Buyers Group Demonstration Sites completed or at least planned.

Suppliers need to describe how they will construct safe and **reliable advanced energy storage solutions** based on **market or ready to be commercialised** individual components, their performance, constraints, and requirements (e.g., system, space). **Proven technologies** should be cost-effective and easy-to-install, with **performance** ensured by specifications or compliance with standards or shown for selected core components or integrated during prototype testing in Phase II. A **minimal and coherent set** of scalable and modular pre-selected technologies capable of delivering all above will be considered a plus.

Information provided as part of the Renovation Approach for inclusion in Renovation Packages must **include core descriptions and indicators,** in particular on **optimal storage choice and scale**, enabling procurers to acquire and improve the knowledge base to continuously speed up and improve decisions during Co-Design and with view on multiple future renovations of the building stock using the Renovation Approach.

1.1.6 Energy management components

Context: Integration of RES, energy storages and efficient components in a comfortable and healthy environment requires active control of the building technical systems, and functional information easily accessible to operators and occupants. Current Facility Management and Building Energy Management Systems (BEMS) do not cover all segments and provide insufficient information to ensure 100% RES operation.

Challenge: Suppliers are encouraged to pre-select technologies as part of their Renovation Approach. **As a set, pre-selected technologies must** cover all relevant use cases, regulatory regimes and contexts and be safely applied to offices and schools and **integrate legacy equipment** and installations. Most technologies should be already on the market or soon ready to be commercialised, with adaptation to the social, economic, regulatory, and environmental context of the Buyers Group Demonstration Sites completed or at least planned. **Proven technologies** should be cost-effective and easy-to-install, with **performance demonstrated** by standards or specifications or for selected core components or integrated during prototype testing in Phase II. A **minimal and coherent set** of scalable and modular pre-selected technologies capable of delivering all below will be considered a plus. (It will be possible to update the list of building level components during the project).

Suppliers are requested to select **cost-effective, low-impact monitoring and control systems**, devoted to gather data from sensors installed at zone and central levels, and to activate and optimise HVAC and electricity management. Solutions will need to be **highly flexible** to adapt to any HVAC system, centralised or local. **New generation**, wireless and self-powered sensors will gather information from storage, from the indoor and external environment and from the HVAC system, critical systems etc. **Actuators** or information and communications technology (ICT) solutions activate relevant legacy devices ensuring they can be monitored and controlled where necessary. All newly installed equipment (production, distribution, storage) shall either support all required functions by default or be equipped with necessary devices. On building level, information and commands are sent and collected by **a central control unit** capable to communicate with all technical systems using **stable and non-intrusive communication protocols and standards**. **State of the art IT-security strategies** are to be provided for the implemented system. It is <u>not</u> the aim to digitise every single aspect of the building, but digitalisation is a key aspect for achieving 100% RES operation, comfort, and a healthy environment.

A challenge lies in **integrating all data sources and making systems interoperable**. Independent of how (e.g., database formats, AI) and where (e.g., fog, edge, cloud) this is achieved, the following **functionalities** are to be provided to relevant actors in one or several systems **using harmonised**

and suitable interfaces and visualisations which are comprehensible for stakeholders with different backgrounds and skills:

- Features of usual Facility Management solutions for procures and operators
- Features of usual Building Energy Management solutions (BEMS) for procurers and operators
- Use and evaluation of indicators building, system and component performance
- Reports and insights for the Continuous Commissioning and maintenance process
- Documentation and automated entries into a building logbook (ideally linked to or a continuation of the Renovation Packages)
- Export or linking functionality to city-wide energy management solutions and/or BIM platforms
- Meaningful and timely information provided by data analysis algorithms on energy consumption, comfort, and health for occupants (to be utilised as part of T3)

Procurers welcome solutions in which all or some operator user and procurer user facing functionality is centralised in one innovative (BIM) platform. It is considered a plus if the operational processes and interfaces are a continuation of the system package design workflows using the same solutions. An additional plus would be if the building logbook and specific Renovation Packages are strongly linked.

1.2 T2 – Degree of achievement of objectives in reference / demonstration buildings

In addition to demonstrating the innovativeness and solidity of their proposals all along the design and commissioning phases by means of qualitative information provided, the suppliers are requested to assess and provide quantitative indicators showing the energy efficiency, environmental impact, and Indoor Environmental Quality (IEQ) levels achieved through the set of measures proposed during design phases and to be verified after systems commissioning.

The indicators are to be calculated for the buildings provided by the Buyers Group, namely:

- Initial proposal: Two reference buildings (school, office) in two climate zones (see Annex E: Reference Buildings and Climate Data)
- Phase I+II: All six Demonstration Sites. The results are part of the Renovation Package which constitute part of Call-off Offer for Phase II and III respectively (see TD1 section 2.1 for detail)
- Phase III: Documentation and Continuous Commissioning for allocated Demonstration Sites

The results of all calculations are to be entered in the Tender Application Template (TD6) accompanied by the description of the methodology and the complete time series into the Excel Annex (TD6a). Yearly values will be used to quantitatively assess overall performance accompanied by a qualitative assessment of linked hourly distributions. Multiple tenders can achieve the highest score – the focus is on a balanced and affordable approach as close as possible to 100% RES.

1.2.1 Energy Key Performance Indicators

The energy performance KPIs asses how effectively on-site RES will be harvested and exploited. In the calculation of KPIs, one year is defined as 8760 hours.

Final energy consumption (E_F)

This indicator refers to the utilisation of different energy vectors to cover the energy demand of the building independently of their origin, either local or remote (i.e., energy networks). The procurers want to make sure first that the best technologies with the least overall costs are exploited, minimising the energy needed on site.

The suppliers are requested to assess and provide final energy consumption values for each of the energy vectors (e. g. thermal, electric) utilised on site, at least on an hourly basis for the entire year. For each building accounted for in the specific design phase, the suppliers are requested to provide both whole-building energy consumption expressed in kWh/h and specific energy consumption per gross building volume (including façades volume) expressed in kWh/(m^3h). In addition to these values, suppliers are also requested to assess and provide yearly final energy consumption both in MWh/y and kWh/(m^3y). The yearly final energy consumption values are obtained integrating the hourly final energy consumption over the entire year.

Assessment: The procurers will use both yearly final energy consumption values (MWh/y and kWh/(m^3y)) for the quantitative assessment of the system performance, and the hourly distribution to verify the calculations presented.

Both dynamic simulations and semi-dynamic methods accepted by European and National norms are acceptable calculation methods. The suppliers are requested to provide indication on the calculation method and the boundary conditions adopted, together with the results obtained as part of the offer and future deliverables at the end of each design phase.

On-site renewable energy production (RE_P)

This indicator refers to the on-site production of renewable energy for the different energy vectors utilised on-site. Procurers want to make sure that the best available technologies are exploited, maximising the coverage of the energy needed on site by means of locally available RES.

“On-site” refers to the building and its nearest vicinity – air, surface, ground and underground –, which, in any case, cannot exceed the building premises or attached structures. Although, for some Demonstration Sites large land surface is available, the procurers want to make sure that the solutions adopted are highly replicable at all their building stock. During the project, solution proposals for functional structures within described perimeters (e.g., courtyard) will be assessed during Co-Design on a case-by-case basis.

The suppliers are requested to assess and provide on-site renewable energy production values for each of the energy vectors utilised on site, at least on an hourly basis for the entire year. For each building accounted for in the specific design phase, the suppliers are requested to provide both overall on-site renewable energy production expressed in kWh/h and specific renewable energy production per gross building volume (including façades volume) expressed in kWh/(m^3h). In addition to these values, suppliers are also requested to assess and provide yearly on-site renewable energy production both in MWh/y and kWh/(m^3y). The yearly on-site renewable energy production values are obtained by integrating the hourly on-site renewable energy production over the entire year.

Assessment: The procurers will use both yearly on-site renewable energy production values (MWh/y and kWh/(m^3y) for the quantitative assessment of the system performance, and the hourly distribution to verify the calculations presented.

Both dynamic simulations and semi-dynamic methods accepted by European norms are acceptable as calculation methods. The suppliers must provide descriptions of the calculation method and the adopted boundary conditions, together with the results obtained as part of the deliverables at the end of each design phase.

Renewable energy share (RE_Sh)

This indicator states the fraction of final energy consumed that is either covered by renewable energy produced on-site during the same timeframe or previously produced and stored on-site. The suppliers are requested to assess and provide renewable energy share values for each of the energy vectors utilised on site, at least on an hourly basis for the entire year.

This indicator is calculated for each energy vector “j” using the following formula:

$$RE\_Sh_{i,j} = \left. \frac{\left(E_{REU,i} + E_{EFS,i}\right)}{E_{F,i}} \right|_j$$

Where:

- $RE\_Sh_{i,j}$ is the renewable energy share calculated at hour “i", for each of the energy vectors “j” covered through renewable energy.
- $E_{REU,i}$ is the renewable energy produced on-site at hour “i” and used to cover a final energy use during the same hour.
- $E_{EFS,i}$ is the renewable energy previously generated and stored on-site used to cover the final energy use during hour “i”.
- $E_{F,i}$ is the final energy consumption at hour “i”, for each of the energy vectors “j”.

In addition to hourly values, suppliers are also requested to assess and provide yearly renewable energy share values. For each energy vector “j”, the yearly on-site renewable energy share value is obtained as the integral of the hourly values:

$$RE\_Sh_{Y,j} = \left. \frac{\sum_1^{8760}\left(E_{REU,i} + E_{EFS,i}\right)}{\sum_1^{8760} E_{F,i}} \right|_j$$

Assessment: The procurers will use both yearly renewable energy share for the quantitative assessment of the system performance and the hourly values distribution to check the temporal coverage of building energy use by means of the renewable energy produced contemporarily and/or previously produced and stored on-site.

Renewable energy production to consumption ratio (RE_PCR)

For each energy vector, this indicator refers to the fraction of renewable energy produced on-site that is contemporaneously consumed in the building, hence reflecting the **temporal concurrency of renewable energy production and final energy consumption**. For each of the energy vectors used on site and on an hourly basis, the values should be calculated as the ratio of renewable energy produced on site and the final energy consumption in the same timeframe. The fraction can be higher than 1 during some periods due to overproduction.

The renewable energy production to consumption ratio shall be calculated as:

$$RE\_PCR_{i,j} = \left. \frac{E_{REP,i}}{E_{F,i}} \right|_j$$

Where:

- $RE\_PCR_{i,j}$ is the renewable energy production to consumption ratio calculated at hour "i", for each of the energy vectors "j" covered through renewable energy.
- $E_{REP,i}$ is the total renewable energy produced on site at hour "i", for each of the energy vectors "j" covered through renewable energy.
- $E_{F,i}$ is the final energy consumption at hour "i" for each of the energy vectors "j".

In addition to hourly values, the suppliers are requested to assess and provide also yearly renewable energy production to consumption ratio. For each energy vector "j", yearly renewable energy production to consumption ratio shall be calculated as:

$$RE\_PCR_{Y,j} = \left.\frac{\sum_{1}^{8760} E_{REP,i}}{\sum_{1}^{8760} E_{F,i}}\right|_{j}$$

Assessment: The procurers will use both the yearly renewable energy production to consumption ratio for the quantitative assessment of the system performance, and the hourly values distribution to check whether an attempt has been placed on continuously balancing local renewable energy production and the building's final energy use. As some buildings like schools are not in use during relevant periods of the day and of the year, a better matching reduces the need for storage capacity installed optimising the utilisation of renewable energy produced on-site.

On-site renewable energy utilisation (RE_UT)

This indicator refers to the renewable energy that is produced and used or stored on site, hence without being exported and then re-imported to the building premises. Export/Import of on-site produced renewable energy has a cost for the community, both environmental and economic, due to losses, infrastructures to be set up, etc. The procurers want to make sure that the burden onto the community is minimised technically and economically as much as possible. The suppliers are requested to assess and provide on-site renewable energy utilisation values for each of the energy vectors utilised on site, at least on an hourly basis. The values should be calculated as the ratio of renewable energy produced and used or stored on-site along the considered timeframe, and the renewable energy produced in the same timeframe. The on-site renewable energy utilisation shall be calculated as:

$$RE\_UT_{i,j} = \left.\frac{\left(E_{REU,i} + E_{ETS,i}\right)}{E_{REP,i}}\right|_{j}$$

Where:

- $RE\_UT_{i,j}$ is the renewable energy utilisation calculated at hour "i", for each of the energy vectors "j" covered through renewable energy.
- $E_{REU,i}$ is the renewable energy produced at hour "i" and used to cover a final energy use during the same hour.
- $E_{ETS,i}$ is the renewable energy produced and stored on-site at hour "i".
- $E_{REP,i}$ is the total renewable energy produced on-site at hour "i", for each of the energy vectors "j".

In addition to the hourly values, suppliers are required to assess and provide yearly on-site renewable energy utilisation values. For each energy vector "j", the yearly on-site renewable energy utilisation value shall be calculated as:

$$RE\_UT_{Y,j} = \left. \frac{\sum_{1}^{8760}\left(E_{REU,i} + E_{ETS,i}\right)}{\sum_{1}^{8760} E_{REP,i}} \right|_{j}$$

Assessment: The procurers will use both yearly on-site renewable energy utilisation values for the quantitative assessment of the system performance, and the hourly values distribution to check whether continuous balancing of local renewable energy production and utilisation has been achieved.

1.2.2 IEQ Key Performance Indicators

Retrofitting of buildings should not have only an energy dimension, but also consider users, whose health and welfare are of utmost relevance for the Procurers. Accordingly, IEQ should be considered as a key element of the Suppliers' proposals.

Starting in Phase I, more or less stringent IEQ requirements for each Demonstration Sites might be negotiated with the procurers through the Co-Design procedure. Better comfort conditions offered, e.g., accounting for improved humidity control compared to the minimum normative requirements, will be a merit.

Indoor air temperature (IEQ_T)

Suppliers are requested to respect minimum requirements in terms of thermo-hygrometric air conditions as per European and national normative. During occupancy hours, the temperature should never fall below 21°C nor exceed 25°C.

Assessment: The procurers will use the total number of hours during which the indoor air temperature level is being exceeded for the quantitative assessment of the system performance, and the hourly distribution to check how continuous achieved conditions are.

Indoor air quality (IEQ_AQ)

Suppliers are requested to assure that suitable air quality conditions are delivered to the building users during occupancy hours, according to the best practices and technologies available today and in line with the European and national regulatory requirements.

The suppliers are requested to assess and provide air quality conditions values at least in terms of ppm of CO_2 and provide the number of hours above the threshold of 1000 ppm CO_2. The suppliers are requested to provide descriptions of the calculation method and the adopted boundary conditions, together with the results obtained as part of the deliverables at the end of each design phase.

Assessment: The procurers will use the average CO_2 value and the total number of hours during which CO_2-threshold is being exceeded for the quantitative assessment of the system performance, and the hourly distribution to check how continuous achieved conditions are.

----RELEVANT ONLY FROM PHASE I

Lighting conditions (IEQ_LC)

Suppliers are requested to assure that comfortable lighting conditions are delivered to the building users during occupancy hours, according to the best practices and technologies available today and the European and national regulatory requirements.

The suppliers are requested to assess and provide illuminance values in lux (cd/m²), UGR (Unified Glare Index) and CRI (Colour Rendering Index) at representative working/training places. Both dynamic simulations and semi-dynamic methods, accounting for coupled artificial and natural lighting effects and for automated controls and accepted by European norms are acceptable calculation methods. The suppliers are requested to provide indication on the calculation method and the boundary conditions adopted, together with the results obtained as part of the deliverables at the end of each design phase.

1.2.3 Environmental Key Performance Indicators

CO_2 emissions during operation (E_CO2)

The performance indicator relates on the carbon dioxide (CO_2) emissions of the proposed retrofit solution during building operation; the emissions values are to be computed based on the net final energy drawn from energy networks. For each energy vector imported on site, the suppliers are requested to use CO_2 emission factors derived from the most recent Covenant of Mayors (CoM) Emission Factors[2]. During the proposal, the most recent default values are to be used. During the project, national emission values reported in the CoM resource for each Demonstration Site are to be used.

Assessment: The procurers will use the total from all vectors for the quantitative assessment of the system performance.

----RELEVANT ONLY FROM PHASE II

Global warming potential over the system Life Cycle (E_GWP)

Starting from Phase II of the design process, the Suppliers will be requested to also assess global warming potential (GWP, measured in kg CO2-Equivalent) of the system over its Life duration, from “cradle to grave”. GWP assessment will need to account for components’ manufacturing, transportation on site and disposal at life end, as well as for the installation process. These data are to be determined based on product-specific environmental product declarations (EPDs). If specific environmental declaration datasets are unavailable, recognised generic datasets[3] are to be used. Datasets need to comply with DIN EN 15804.

Waste management (E_W)

Starting from Phase II of the design process, the Suppliers will be requested to define and implement a plan for the management and possibly recycling of the waste materials produced during installation phases. Suppliers will need to provide information on the mass and type of waste generated together with the amount of such mass that will be recycled.

1.2.4 Suggestions of further performance indicators

Suppliers may suggest further performance indicators to be documented and recorded in Renovation Packages, during lab-tests and/or operation across all sites.

[2] Joint Research Centre Data Catalogue - CoM Default Emission Factors - European Commission (europa.eu)

[3] For instance https://www.oekobaudat.de/en

1.3 T3 – Training & Education of professionals and users

Context: **Operators** – including energy professionally employed by the municipality as well as third-party contractors needed for repairs etc. – are faced with increasing complexity of building operation with many contractors having little to no experience with digital solutions. Whilst some issues are structural such as the lack of vocational education and training (VET), the suppliers of solutions also often consider training to be the responsibility of the customers.

Occupants' behaviour and habits influence the performance of a building, and more so in highly efficient and automated buildings. There is a significant gap between what is known to work to engage individuals in behaviour change and what is currently being applied in practice in the energy efficiency domain. Projects for public buildings tend to address the collective rather than the individual which leads to the typical problems surrounding the use of public resources and personal involvement.

Challenge: Suppliers are expected to deploy innovative training and education methods and materials. Learning should be **blended in daily use**, in particular for ICT and software. The flow between usage and learning should be seamless, not creating a burden or a substantial effort to increase knowledge.

Training of operators

ICT-systems should be intuitive and instructive with learning incorporated using recent best practice, especially when new features are deployed. Suppliers will describe how assistance is provided transparently across systems and technologies. A single touch point would be considered a plus. Shared viewing solutions and / or secure remote desktops are expected.

Suppliers provide a **learning platform** including a curated (self-)training programme for municipality staff including operators and if helpful procurers. The programme should be adapted to the requirements of the specific building based on the Renovation Package and be responsive to pre-existing user knowledge. Procurers have no preference as to the formats used as part of the programme.

Documentation of systems and hardware should clearly describe responsibilities in operation, regarding automation and any manual tasks needed on-site. Suppliers are expected to provide easily understandable materials and / or demonstrate innovative and interactive materials, (e.g. embedding existing smartphones and tablets for augmented realities) accessible for all professional levels including installers. In Phase III, instructions are to be provided in the official languages, and other native languages spoken by installers, where applicable.

Regarding **third-party contractors**, suppliers are to outline what knowledge will be required for reliable and timely operation and maintenance activities and how this is ensured. Solutions could include training and accrediting installers.

If full-service providers are to minimise dependency on inexperienced third-party installers in the long-term reducing the need for above, this should be referenced here, and quality and feasibility of the approach clearly described as part of PM2/3.

Education of occupants

The supplier's approach to education will ensure the technical solution described above is feasible with users and will help to avoid the traditional operator-occupant conflict regarding comfort and requested, actual and perceived control.

Suppliers are expected to develop a **solution that makes occupants aware of their behaviour's impact** and, in combination with carefully tailored training measures, makes them feel responsible to reflect on their behaviour if it is energetically relevant or if health could be improved without increasing consumption. Suppliers will offer information and feedback to occupants which suggests specific action including information on how the building's consumption levels would change as well as the impact (e.g. climate impact, monetary terms) of not acting documented to be most successful in the given context. The entire system will be designed to ensure that all the building occupants (workers, teacher, pupils…) can easily understand and interact with the building without any need for extensive training.

Children and other curios occupants are to be considered with creative features. Both, on-the-spot learning elements for energy usage/savings, data or technology used in the building (e.g., via QR-Codes, printable information) as well as serious games or gamification features (e.g. treasure hunts, orienteering, simulations) are to be provided. Games are accessible to teachers and can be used during on an average school hour and, where possible without additional effort, incorporate live data. Long-term competitions such as leading boards or topical challenges are only to be introduced if they are clearly incorporated into the overall education approach.

Suppliers are invited to, where possible, utilise and reference personas described in Annex B: procuRE Personas in their descriptions of services.

1.4 T4 – Innovativeness compared to market state-of-art

Context: It is the procuRE Buyers Group's position that for many applications a sufficient range of technologies and components exists to renovate the Demonstration Sites to a 100% RES-level. The challenge does not lie in achieving a certain amount of energy savings or renewable energy production and storage, but to develop a complete and innovative Renovation Approach that addresses the requirements of the building owners to retrofit their building stock.

Challenge: Suppliers are to prove how their proposed Renovation Approach goes beyond the current state-of-the-art in renovation, hereby showing that it is innovative; and which elements of it are to be further developed or improved in the R&D services to be delivered.

2 Commercial Feasibility Criterion

2.1 CF1 – Investment and energy service contracting and financing models / Costs

Context: Multiple barriers for public administrations exist to progress as expected in the Renovation Wave and to achieve 2050 targets. The most obvious are design and investments costs which limit the number of renovations which can be financed per year. Although the market is offering novel contracts to large private projects, these concepts remain often inaccessible for public procurers aiming to retrofit individual buildings (unattractive investment) and / or aiming for holistic and complex solutions as envisaged (perception of risk) and /or inadequate information performance on the energy efficiency measures is provided (both). As presented in the technical section, many procurers may not have the capacity or organisational capability to act on this gap.

Since the issues arise from a lack of structured information, the Renovation Approach is to provide more clarity on the overall framework conditions to be deployed and in a second step calculate total cost of ownership for individual Renovation Packages, digressing from the current practice and preference of most procurers.

Challenge: Suppliers are expected to develop and deliver an **innovative approach to the financing of energy renovation** and following O&M including (i) technical and financial due diligence (ii) financial risk quantification; (iii) identification of eligible public funding; (iv) access to platforms enabling matching of investment demand and offers.

Leveraging available funding opportunities (public and/or private), suppliers must describe a **financing scheme** for **single building retrofits and** are expected to also offer a separate or complementary **portfolio level scheme.** These schemes leverage investment capital for public procurers able to cluster building retrofit actions to increase the scale of investment to make it more attractive to investors and reduce risk.

Independent of the volume of the retrofit, the approach should clearly describe and quantify the investment (capex), energy services (opex) and contracting models as well as their costs and conditions to be used at least in the countries represented by the Buyers Group. **Procurers do not state a requirement or specific preference for any contracting model**.

The approach should achieve the following to the largest extent possible:

- **Enable a larger number of renovations per year** by flattening or reducing the cost curve
- Increase **confidence on benefits and reduce connected risks** for procurers and investors by creating transparency about all aspects of models/funding and existing experience with it
- Integrate **innovative financing methods** with funding opportunities to leverage a wider range of funds, including existing and upcoming (inter)national funding schemes for specific Renovation Packages
- Produce swiftly preliminary and detailed **economic plans** including
    - structure of contracts for energy and facility management services,
    - clarity on ownerships and a clear and concise calculation of all costs for procurers at least on yearly basis (e.g. annual fees, design, investment, operation, and maintenance costs), including:
        - the use of incentives,

        - contracting schemes and
        - financing models
    - as well as uncomplicated rule set for discretions from performance benchmark / KPIs induced by either party
- Where relevant consider the EU taxonomy for sustainable activities.

It would be considered a plus if future contracts would actively promote the social dimension of any action, creating new business opportunities and generating highly skilled jobs at local level as part of the planning, installing, and managing of the renovation solutions they will deliver.

2.2 CF2 – Commercialisation Plan

Context: The construction market is highly fragmented and often siloed across countries. The large number of players increases the efforts and the perceived risks by procurers. The involvement of many actors also often leads to delays. At the same time, Europe is expected to start the Renovation Wave with many actors requiring a larger number of renovations to a higher energetic level.

Challenge: suppliers are expected to describe the envisaged methodology and business plan to bring their Renovation Approach to the market, including:

- Organisational structure facing procurers (e.g., one-stop-shops)
- Applicability of Renovation Approach to other building types
- Access to market in countries represented by the Buyers Group
- Access to market across the EU and other countries
- Measures on certification and standardisation

3 Project Management Criterion

3.1 PM1 – Interface to procurers

Context: Currently, operators of building cannot procure a full Renovation Package or the necessary service from one provider and are therefore forced to buy-in and sometimes coordinate services and works increasing the number of possible points of failure. This situation is overburdening the customer in terms of resources and the expertise required to be kept in-house.

Challenge: suppliers are expected to remove procurers from the inner workflow of system package design to the largest extent possible whilst enabling procures whenever required to make rapid and informed decisions on the elements of the Renovation Package as presented. The challenge lies in finding the best balance between information and involvement. Ideally, the same interface is also during operation.

3.1.1 Toolkit

A solution is required to manage information collection and exchange, file access and documentation with procurers (and possibly all specialists or other external stakeholders). It provides access to a recent version of the Renovation Package as well as the history. The solution must require as little training as possible. The solution could be integrated into a BIM solution or utilise existing cloud-based solutions. The solution must observe necessary certifications and data safety and protection regulation.

Suppliers are free in suggesting how, where and when information is exchanged, or decisions are triggered. These procedures are to be described for design, planning and implementation (Co-Design Procedure) as well as operation & maintenance (Continuous Commissioning) clearly linking the description to the related supplier workflows.

3.1.2 Co-Design Procedure

The initial commissioning of a renovation is complex and might require input or decisions from procurers at various points in time. Depending on the scope of the renovation, a wide range of requirements need to be collected from varying roles at the procuring organisation (individuals with decision making power or controlling the budget), operators of the building (energy or facility mangers) and occupants to the extent possible. Additionally, these inputs need to be aligned with a wide range of regulations and building codes (see Annex C: Informative Summary of Demonstration Sites).

An efficient, effective, and reliable Co-Design Procedure includes at least the following:

- One-face to the customer approach
- Clarity on responsibilities and timing
- A process for information requests from supplier to procurer ensuring minimal friction and effort
- Regular exchange meetings in which suppliers inform the procurers about the most recent version of the Renovation Package and state of work
- Decision making tools based on relevant information and the documentation in Renovation Packages
- Transparency on the most recent version and recent changes in the Renovation Package aiding quick orientation by procures

Suppliers should take the following key principles into consideration:

- It is inclusive as it **includes representatives from all stakeholder groups involved** in the future service delivery and utilises feedback, advice and decisions service from procurers, operators, possibly occupants and other professionals in the field,
- It is **actor-centred** as each step consists of the actions of individual or collective entities (persons or organisations) and is described, enacted, and analysed in that perspective,
- It is **iterative** in its overall approach and in each step, as changes and adaptations are a natural part of the process,
- It is **evaluative** since each step, its alignment with the previous ones (summative perspective) and its anticipated impacts on following steps (formative perspective) are evaluated empirically,
- It is **outcome-focused** as it is designed to achieve outcomes, where the potential solutions can be rapidly tested, effectiveness measured, and the scaling of these solutions can be developed with stakeholders and in context.

3.1.3 Continuous Commissioning

Continuous Commissioning should be a highly standardised process requiring little effort on the procurer side. Among others, clear timelines, trigger points for actions, report formats, meeting agendas ensure that targeted performance and costs are achieved and any mitigation measures necessary do not lead to sudden cost hikes. Any preparation of a Continuous Commissioning process considers at least:

- Performance against KPIs
- Divergence from performance targets including reasons and costs incurred from operator activity
- Operating and maintenance costs
- Impact of occupant behaviour, unused potentials, and the utilisation of education
- Predictive maintenance
- Recommendations for mitigation and / or optimisation measures

Furthermore, the process should include transparent and open **lessons to be learnt for future renovation measures** in all or specific building types / scenarios to continuously improve the Renovation Approach and as a result future Renovation Packages, anticipating the close relationship supplier and procurer would have when more renovations are triggered.

Wherever possible, Continuous Commissioning should be an extension of the Co-Design Procedure with clear documentation in monitoring and management systems and/ or the logbook.

3.2 PM2 – Quality and completeness of the work-plan as well as detail of task and result descriptions

Challenge: suppliers are expected to remove inefficiencies typically encountered during design, retrofit and operation / continuous commissioning and make transparent how a Renovation Package is drafted, (co-)designed and finalised as well as how the renovation procedure would take place and what provisions exist during operation. This requires a comprehensive workplan, to include work packages, tasks, and responsibilities. The workplan needs to be drawn out for all PCP phases.

3.3 PM3 – Feasibility of plan and resources to meet the objectives

Challenge: procuRE requires suppliers to integrate many systems (legacy and new). Suppliers are to take over the responsibility for interoperability and system-wide optimisation. The process of applying (and further developing) the Renovation Approach to any given building will have to be complete and smooth. The supplier is asked to describe the choice of any subcontractors for the tender and / or during the project lifetime, at the very beginning of Phase III at the latest.

Overall, the details on the resources needed to achieve the work-plan have to be provided for each organisation involved in the tender. Other required resources, such as those for travel and licenses, need to also be quantified and provided.

The operational capacity of the suppliers aligned with the plan and resources need to be convincing and address all phases (for detail in each Phase see TD1 section 2.1). The tender plan should have a convincing operational capacity, e.g., reflected already in the consortium composition, or by having a plan and reserved budget for involving local (sub)contractors while complying with the limit on use of subcontracting.

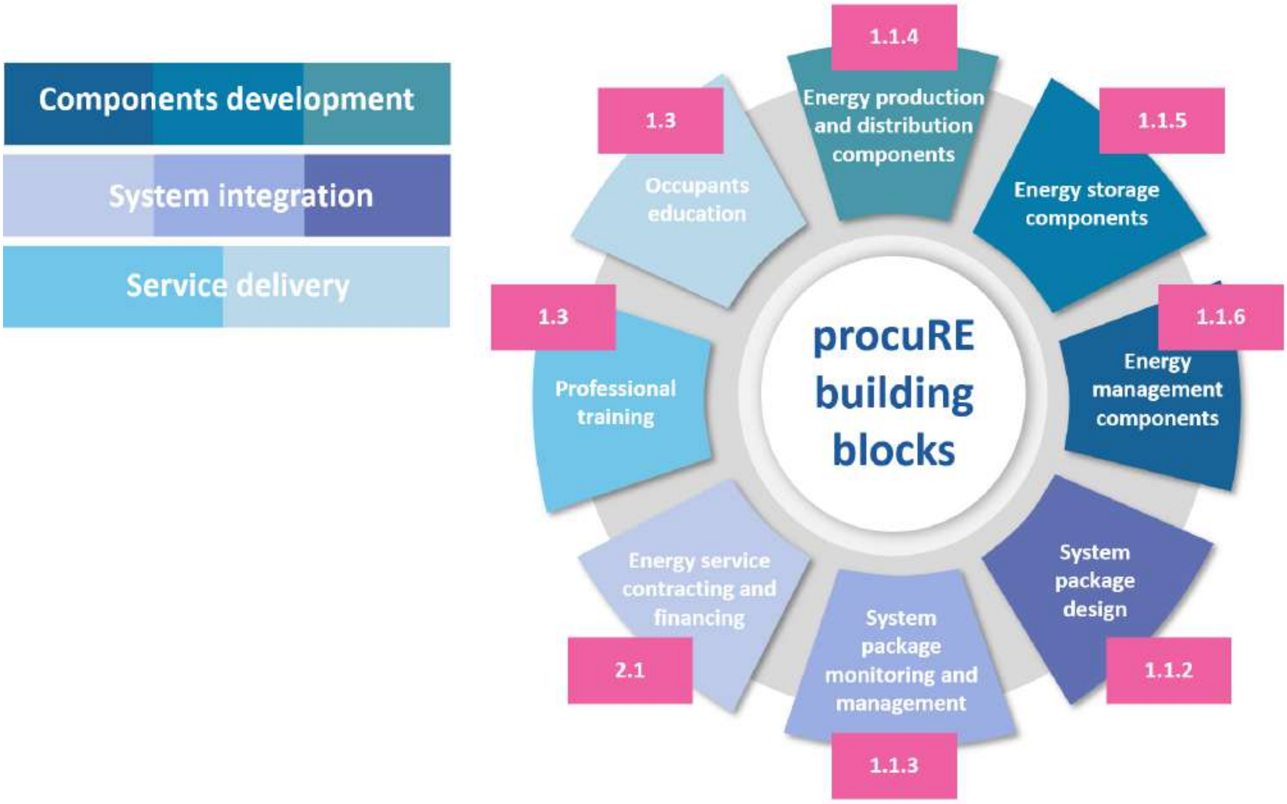
The supplier shall describe how it will provide timely operational and maintenance services after the end of the project. If the approach relies on local partners or (sub)contractors not part of the initial consortium, the supplier shall describe how it will attract and enable these during Phase I and II for the following phases and / or the duration after the project.

ANNEX

The following content is complementary.

4 Annex A: procuRE building blocks

The common challenge was presented as a set of building blocks during open market consultation and in the pitch deck. The content of these slides has been incorporated in the Challenge Brief. The following graphic refers to relevant sections in this document.



5 Annex B: procuRE Personas

A persona identifies user profiles with different personal and socio-economic background and varying needs. It also considers the potential benefits that can be derived from digital resources for the person and associated stakeholders. These personas, once finished, will be made freely available with the hope that they will make a positive impact on the development and implementation of information and technology products.

Personas will be developed throughout the project and used in future guidance. A preliminary list of clearly identifiable personas was developed.

Table 1: Preliminary list of personas for procuRE.

Persona ID	Description
Adult Occupant - Champion	Adult occupant that is in continuous interaction with the procuRE system, e.g., someone working in the building, and is driven about sustainability issues. They are interested in taking an active role to ensure the efficient operation of the building and contribute to environmental protection.
Adult Occupant - Regular	Adult occupant that is in continuous interaction with the procuRE system, e.g., someone working in the building, and is not particularly interested in sustainability and energy issues or interacting with the procuRE system. They may require more motivation and information to be involved in the operation of the building.
Child Occupant	Child occupant that is in continuous interaction with the procuRE system, e.g., a student in a school. They have limited possibilities to interact with the system, but their behaviours are important to ensure good indoor comfort and energy performance.
Operator	The person who has the main responsibility for the operation of the building. Energy manager, janitor, facility managers.
Procurer	The person who works at the procuring organisation and has decision making power about the procuRE project.

Based on this, and information available in the literature, five personas have been developed, the Procurer “Mateo”, the Operator “Zeynep”, the Champion Adult Occupant “Filipe”, the Regular Adult Occupant “Maya” and the Child Occupant “Sofia”. Each have a representative age, occupation, education/previous knowledge, and frustrations related to procuRE.

*The description of personas, in particular motivation and frustrations, are **generalised examples** and descriptions therein should be considered as such. The Challenge Brief in sections 1-3 prevails.*

	Procurer	Operator	Occupant 'Champion'	Occupant 'Regular'	Occupant 'Child'
Personal Information	 Mateo, 58	 Zeynep, 47	 Filipe, 35	 Maya, 40	 Sofia, 10
Occupation	Head of Public Procurement	Energy Manager	Teacher	Office Worker	Pupil
Education/ Previous Knowledge	Mateo holds an advanced degree in Finance and has decades of experience in procurement. He is very familiar with the local legal frame work.	Zeynep holds a degree in engineering and is highly technologically savvy. She is very familiar with the current state of the building and the HVAC and energy systems in place. She is very passionate about sustainability and energy savings and listens to podcasts to stay up to date.	Filipe is well educated; he holds a graduate degree and likes to keep up to date by reading relevant articles online; he doesn't read specialist journals. He has a good basic understanding of renewable energy and the science behind it but doesn't know about the engineering or real world challenges. However, Filipe is interested in learning more	Maya holds a degree in Business and Administration. While sometimes she hears about renewable energy topics from friends or in the news, she does not actively search them out. Maya does not have a particular interest in renewable energy.	Sofia has learned a little about energy at school but has only a very basic knowledge. She does not know much about renewable energy types or retrofits.
Motivations	Mateo is interested in renewable energy but has no overview of technologies and contractual models inducing insecurity to make decisions. He sees any retrofit as an extension of life of the building and is concerned with the security and durability of work	As Zeynep is interested in sustainability, she is excited about making the building as efficient as possible. Zeynep sees the maintenance cost as a bigger consideration than the initial investment cost. She would like a system which uses sensors to pre-emptively flag	For Filipe this project presents a valuable learning experience. He would like to use this opportunity to connect sustainability to students' everyday lives and impact their behaviour. By updating students during the course of the building works he hopes to build a personal connection to the project and its	Maya's primary concern is the comfort of her work environment. While she supports the use of renewable energies, she does not want it to interfere with her productivity. This year she is particularly concerned about ventilation and its impact on her health	Sofia is excited about the project coming to her school and is keen to learn more about renewable energy. She wants to have positive impact on the planet. Moreover, she would like to see the new equipment which has been installed in the school herself and

	done. All systems must be robust against user error and able to operate in case of failure. Losing use of buildings for prolonged periods is not acceptable. Any new systems must be future proof. Work should be completed on time and to an agreed standard.	problems and explain when and where they occurred, thus simplifying her work.	outcomes. He would like to see an intelligent system which can display current data on energy used/ stored as well as individual breakdowns by classroom. He hopes he can use this to educate students on the effects of their own actions and how best to reduce energy consumption.	because of viruses. She would like an improved air quality and hopes that plants can be incorporated to improve the work environment. Maya is excited whenever offi ce amenities are upgraded. She is hoping the office will look modern and sleek.	learn about its functions. She likes sharing what she learned at school with her family members.
Frustrations	Due to previous experiences, Mateo lacks trust in suppliers and is stressed when he must re-convene with financing partners du e to poor initial detail. He is worried about being saddled with experimental technology with no long-term contact or after-care services provided by suppliers. As some public buildings are heritage listed, he is also worried about the limitations or increased costs this causes. He is worried about wasting time and money developing an oversized system just to cover rare peaks. Mateo does not want the building function to be impeded by the new design.	Currently, the heating system has only one control which is accessible to all occupants. This means anyone can directly turn off the system for the whole building if their office is too hot. When thinking of the retrofit her main concerns are her ability to maintain the site, for example how much time needs to be spent on maintenance and the availability of replacement parts and experience d or specialised staff.	Filipe is frustrated by the difficulties caused by the school's outdated HVAC system. In the summer cooling is inefficient causing an environment where students are uncomfortable and disrupting their learning. Because the system cannot run independently in different sectors, some classrooms are either too hot or too cold.	Maya is frustrated that the current HVAC system is too complicated and only the operator knows how to control the thermostat. She is worried about being disturbed by lengthy restorations to the building. Maya does not want to sacrifice office floor space for a renovation.	During summer, the large windows make it difficult to read the whiteboard when the sun is bright. Due to the inefficient HVAC system classrooms take a long time to heat up or cool down disrupting Sofia's productivity and ruining some sensitive activities (e.g. baking or science experiments).

6 Annex C: Informative Summary of Demonstration Sites

The following sections represent an **informative summary** of main information and characteristics of the Demonstration Sites.

During Phase I (see section 2.1 in TD1), **suppliers will organise and conduct a building diagnosis** (HVAC system, building physics, opportunities etc.) of all Demonstration Sites, to verify building information and collect any missing information which is deemed to be necessary for the design process. They will furthermore **implement the Co-Design procedure**.

6.1 Informative Summary: Barcelona

6.1.1 Building description

Building geometry and physics

Tester building (with a single party wall) with a rectangular PB+3 plant and basement plant, built in 1850 for use by offices and data centre. It is a building with the predominance of the solid over the openings. Although it was rehabilitated in 2010, its opaque closures have no thermal insulation. Rehabilitation of 2010 did include a replacement of existing windows for other air-chambered aluminium ones on the plants P1, P2, and P3, but on the ground floor the frame was changed, but not the glass. The openings have wood slats as solar protections.

General information

Building owner
Name: Sant Boi de Llobregat City Council
Address: Plaça Ajuntament, 1, 08830 Sant Boi de Llobregat, Barcelona
Telephone: 93 635 12 00
E-Mail: -
Responsibilities: -
Building management/operator
Name: Zeljko Kulic
Address: Ajuntament de Sant Boi de Llobregat. Plaça Ajuntament, 1, 08830 Sant Boi de Llobregat,
Telephone: 93 635 12 00
E-Mail: zkulic@santboi.cat
Responsibilities: Building maintenance manager
Building address and construction year
Plaça Ajuntament, 1, 08830 Sant Boi de Llobregat, Barcelona
City council central offices plus the city council data centre were built in 1850 but has experienced several refurbishments, the last one on 2010.

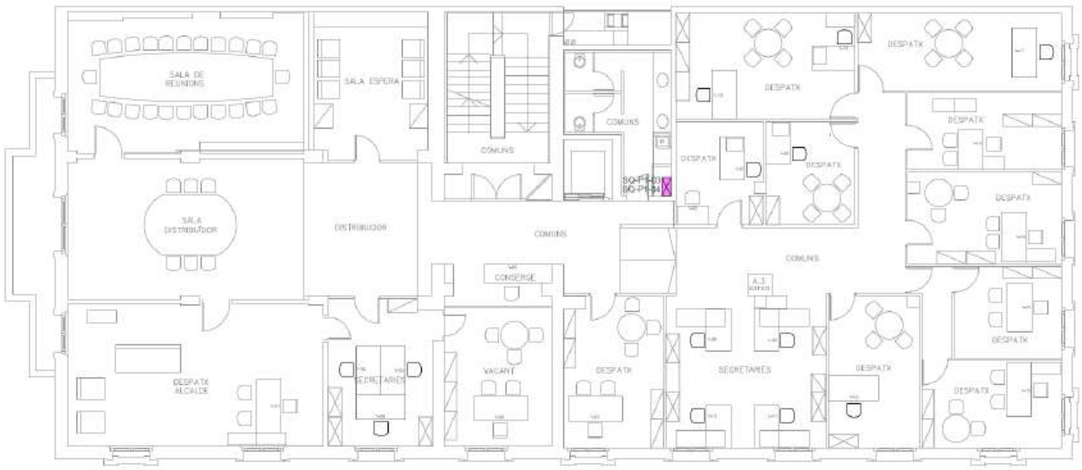
Building geometry information

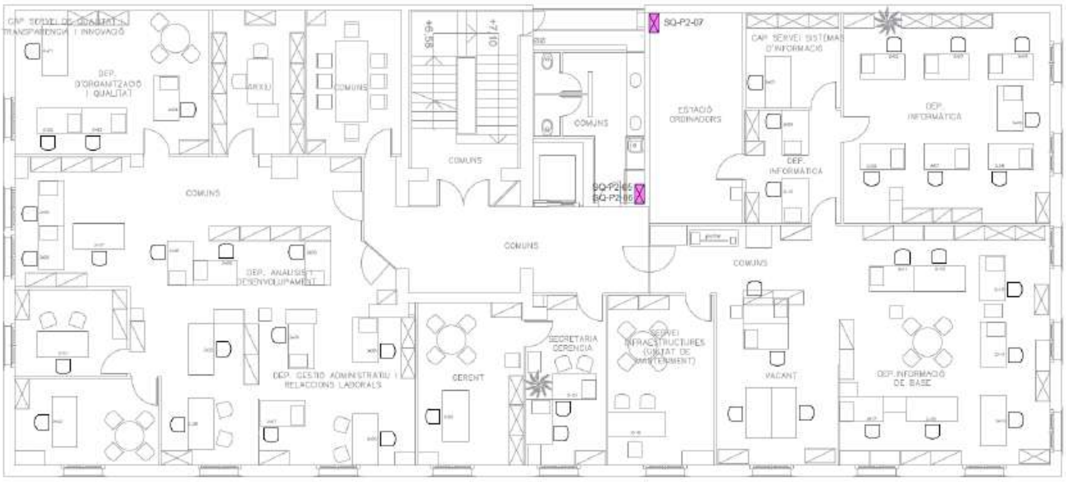
Gross total area (m^2)	2.431,62 m^2
Total built volume (m^3)	6.028,5 m^3

Number of floors	subterranean floor +base floor + 3 floors
Floor height	Base floor: 3,5m / Rest of floors: 2,8

Building exterior

Plans of the first floor and second floor





Wall construction

The building walls are monolithic walls, 30 cm wide with no insulation.

Type of surface	Orientation / typology	U-value [W/m²K]
External wall		2.02
Ground wall		0.99
Roof	Flat roof	0.5
Windows	Double glazed	3 / 5.6

Occupancy

Type of activity	N. of users	N of rooms	Regular use	Schedule (h)
Plenary room	121	1	Occasional	
Offices	155	4	Yes	Mo-Fr 7:00 – 19:00

Heating and cooling system

The building has a bi-tube system with heat pump that uses water as a conductor and is divided with an option to replace air and wall fan-coils.

This system serves all the offices in the building. At the same time this system is completed with autonomous systems consisting of 8 heat pumps with coolant that serves by splits or wall consoles to other uses other than office, such as: the SF4 area (plenary room) and F2.3 (computer room, UPS, and switchboard).

The system is partially controlled remotely. The change of programming from summer to winter is done manually by the building's energy manager. The change of air conditioning mode is done in two phases from the observation of the outside and inside temperature. In the first phase, the air conditioning installation is stopped in heating mode and the space is left without air conditioning for a few weeks in spring, after the outside temperatures cause discomfort inside, the cooling mode is activated with other programming times.

The building requires a complete renovation of the heating and cooling and ventilation systems with the exception of the plenary room. The Data Centre would need and upgrade to a free night cooling system.

*Renewables: Currently there is a small photovoltaic plant on the roof of 5kWp that we would like to expand

The cutting systems of all these air conditioning systems are distributed in different locations and all they enjoy a central digital programmer located in the central electrical distribution box.

The program is from Monday to Friday from 7:30 a.m. to 7:00 p.m.

Heating, cooling and domestic hot water system

Indicator	**Zone**	**Typology**	**Capacity**
Heating system	Offices	Reversible heat pump	255 kW
	Underground ad Plenary room	2x Reversible heat pumps	2x 13.5 kW
	Second floor	Heat pump Split air conditioning system	8.2 kW
		Heat pump Multi-Split air conditioning system (two indoor units)	4.4 kW
		Autonomous system of heat pumps with split type refrigerant that serves the computer room (CPD)	11.2 kW
		Autonomous system of heat pumps with split type refrigerant that serves the computer room (CPD)	8 kW
DHW system	n/a		
Cooling system	Offices	Reversible heat pump	211 kW
	Underground ad Plenary room	2x Reversible heat pumps	2x 12 kW
	Second floor	Heat pump Split air conditioning system	7.1 kW
		Heat pump Multi-Split air conditioning system (two indoor units)	4.0 kW
		Autonomous system of heat pumps with split type refrigerant that serves the computer room (CPD)	9.6 kW

	Autonomous system of heat pumps with split type refrigerant that serves the computer room (CPD)	2x 6.75 kW

Mechanical ventilation

Ventilation system	Heat recovery	Zone	Flow rate	Schedule
Mechanical ventilation	Yes	Ground and first floor	1’750 m³/h	Mo-Fr 7:30 - 16:00
Mechanical ventilation	Yes	Second and third floor		Mo-Fr 7:30 - 19:00

Since 2020 a renewal system has been installed that allows free-cooling. The installation works by default by means of a CO2 probe but it is also activated in summer when the outside temperature is lower than the inside temperature. As it is a plenary room with high thermal loads, this extra ventilation does not only occur at night.

Illumination

The building's lighting consists, mainly, of tl8 fluorescent screens with electromagnetic ballast and downlight with low-power fluorescent lamps. Very punctually, some halogen lamp can be found.

The system has low degree of division in sectors and no area has regulatory and control devices. At the same time the number of hours of lightening is between 2,450-3,120 hours depending on the space. There is no use of natural light primarily for two factors: the lack of installation sector and the small dimension of the openings.

Zone	N. luminaires	Total power (W)	Luminaire type
First floor	7	145	Low consumption
	7	350	Dicroica
	64	6520.5	Fluorescent
	3	216	Halogen
Second floor	7	460	Low consumption
	79	9867	Fluorescent
Third floor	4	82.8	Low consumption
	81	7286.4	Fluorescent
	3	400	Halogen

	13	296.7	Low consumption
Other floors	115	7946.5	Fluorescent
	43	7400	Halogen

List of appliances

Appliance	**N. appliances**	**Total power (kW)**	**Schedule**
Elevator	1	5	7:00 – 16:00
computers and monitor	114	48.4	8:00 – 15:00
Split units	65	10.255	7:00-19:00

Energy consumption

The 3.0A access tariff is for a low voltage light supplies. It only allows the contractor a power greater than 15 kW.

The main characteristic of the 3.0 tariffs is that it presents hourly discrimination in three periods. This means that at the time of billing, the price of electricity will be different in each time slot.

Peak Period: is between 11 a.m. and 3 p.m. (summer) and between 6 p.m. and 10 p.m. (winter). It corresponds to the hours where the price of electricity is highest.

Valley Period: refers to the time slot that runs from 08:00 a.m. to 11:00 a.m., and from 3:00 p.m. to 12:00 p.m. (summer) and from 8:00 a.m. to 6:00 p.m., and from 10:00 p.m. to 12:00 p.m. . It corresponds to the period in which the price of electricity is cheaper compared to peak hours, but it is not the cheapest.

Supervalle period: includes the hours that go from 00:00 to 08:00 throughout the year. It is the cheapest time slot of the three mentioned periods.

Another characteristic of this type of bill is that there is a variable part of the bill that depends on the energy consumed and a fixed part that depends on the contracted power. At the same time there are other concepts such as: reactive energy penalty, meter rental, taxes, which also includes the rate.

TOTAL energy consumption	**Unit**	**Value**
Electricity consumption	[kWh/year]	≈270832
Gas consumption	[kWh/year]	
Electricity price	[€/kWh]	≈0.15
Gas price	[€/m³]	

Energy consumption per end use	Unit	Value
Space Heating	[kWh/year]	38249,64
Space cooling	[kWh/year]	67334,80
Domestic Hot Water	[kWh/year]	0
Electrical devices	[kWh/year]	≈ 150’000
Computer server electricity	[kWh/year]	≈ 48’186.5

6.1.2 Building requirements

Requirements on envelope

Improve thermal insulation of building envelope. The building has a certain heritage interest.

Level of protection (IPA): B-1a

Intervention criteria

- Façade:
    - Adaptation to the colour scheme.
    - Treatment of the dividing wall with the same colour and quality as the façade.
    - Sign adaptation
    - No heating or cooling machines on the windows
    - Wiring regularization

Requirements on HVAC system

Possible intervention to the HVAC and lighting system:

- The data centre would need to be upgraded with an HVAC system that allows free night-time cooling.
- Replace 80% of the fixtures that are currently fluorescent and halogen. Energy monitoring could be increased with 5 lines.
- Improved air conditioning management when natural ventilation is being practiced.

Requirements on monitoring and control system

Remote control: LOXONE. Several mini-servers + sensors + actuators. The entire air and climate renewal system is controlled: 1 CO2 probe and 1 temperature and humidity probe.

Telemetry There is no telemetry of consumption per plant. The available telemetry is of the global consumption, global air conditioning of the building and CPD of the building.

Device	Model	Number of Units	Room (N. and type)	Parameters measured	Available communication protocol

Temperature and humidity probe		1 unit ?? 13 units 11 units	Floor -1 Floor 1 Floor 2 Floor 3	Temperature and humidity	Modbus RTU/TCP
CO2 probes		1 unit 1 unit 1 unit 1 unit	Floor -1 Floor 1 Floor 2 Floor 3	CO2	Modbus RTU/TCP

Requirements on maintenance

Requirements on renewable energy installation

Renewables: Currently there is a small photovoltaic plant on the roof of 5kWp that we would like to expand.

The main aspects to be respected for photovoltaic installations are the following:

• Three types of self-consumption: (i) without surpluses, (ii) with surpluses under compensation and (iii) with surpluses not under compensation.

• Regulation of collective self-consumption.

• For photovoltaic installations the installed power will be the maximum power of the inverter.

• The consumer and the owner of the facility are allowed to be different.

• Simplification of processing

- Installations without surpluses or those with surpluses of up to fifteen kilowatts (15 kW) do not need access and connection permits.
- For installations of up to 100 kW connected to low voltage, the access contract with the distributor will be made ex officio by the distribution company.

• Establishes the measurement equipment to install

- In general, only a bidirectional measurement equipment is needed at the border point.
- Collective self-consumption, with surpluses not covered by compensation with various supply contracts or non-renewable technology, must have 2 teams. One for consumption and another that measures net generation.
- In certain cases, the measurement counter is allowed to be located outside the boundary point.

• Establishes the economic regime. Several possibilities are established depending on the type of self-consumption:

- Self-consumption with surpluses under compensation: They can (i) sell the energy in the pool, or (ii) compensate monthly surpluses, through the valuation of the excess hourly energy -simplified compensation. The amount to be compensated may never exceed the monthly assessment of the hourly energy consumed.
- Self-consumption with surpluses not eligible for compensation. They must sell the surpluses in the market.

• Automatic registration in the Self-consumption Register for certain cases.

Self-consumption modalities

• Self-consumption without surpluses: an anti-spill mechanism is necessary to prevent injection into the network. Annex 1 of this document includes the types of systems allowed, as well as their connection diagrams. In accordance with Law 24/2013, this type of self-consumer will be considered "consumer subject"

• Self-consumption with surpluses: those that inject energy into the transmission and distribution network. Under this modality there will be two figures: (i) "consumer subject" and (ii) "producer subject". Likewise, the modality of self-consumption with surplus is subdivided into two categories.

- Surplus under compensation: when all the following conditions are met: (i) renewable technology, (ii) P≤100kW, (iii) If necessary, only a single supply contract for consumption and auxiliary services would have been signed, (iv) the self-consumer has signed a surplus compensation contract and (iv) facilities not subject to the Specific Remuneration Regime.
- Surpluses not eligible for compensation: anyone who does not meet all the requirements of the previous one ”or who or want to take advantage of this modality.

The mode of self-consumption may be modified annually.

Likewise, in all cases, storage systems may be installed.

Sale of energy to the grid

a) This modality can be used for all forms of self-consumption, being mandatory in the case of self-consumers not benefiting from surplus compensation.

b) Under this regime, the excess hourly energy operates as a grid installation. In other words, the hourly price of the pool or, where appropriate, Specific Remuneration Scheme (if the facility has granted it) is valued.

c) Self-consumers who operate under this modality will be considered producers and must comply with the provisions of the regulations (representative, etc.)

d) Likewise, the energy sold must satisfy the generation toll (€ 0.5 / MWh) and its economic valuation will be subject to the 7% tax.

Requirements and suggestions for occupants

- Monitor in the entrance hall where you can see the energy consumption of the building and by floors
- Contest of energy consumption by plants
- Prize for the best energy saving idea.

6.2 Informative Summary: Eilat

6.2.1 Building description

The building is the old airport terminal building which is being converted to an off-grid innovation centre. The building is part of a bigger plan that changes the entire airport area including the landing strips and surroundings. The innovation centre is focused on the relative advantages that Eilat has, such as renewable energy, energy efficiency, Marine bio-technology and smart transportation.

Alongside procuRE, Eilat City is investing about one million Euros in order to create better insulation for the external walls and windows and to prepare the infrastructure needed for the HVAC systems such as piping and natural ventilation. The specifications of the tender will be available before Phase I begins.

General information

Building owner
Name: Eilat City
Address: P.O. 14
Telephone: 972-8-6367392
E-Mail: assaf@eilat.muni.il
Responsibilities: Env. Unit Manager
Building management/operator
Name: Roni Pasha
Address: Eilat City
Telephone: +972-8-6367392
E-Mail: ronypasha@gmail.com
Responsibilities: Project Engineer (Terminal)
Building address and construction year
Almogim 12, Eilat (old) Terminal
1980's – retrofitted in 2000

Building geometry information

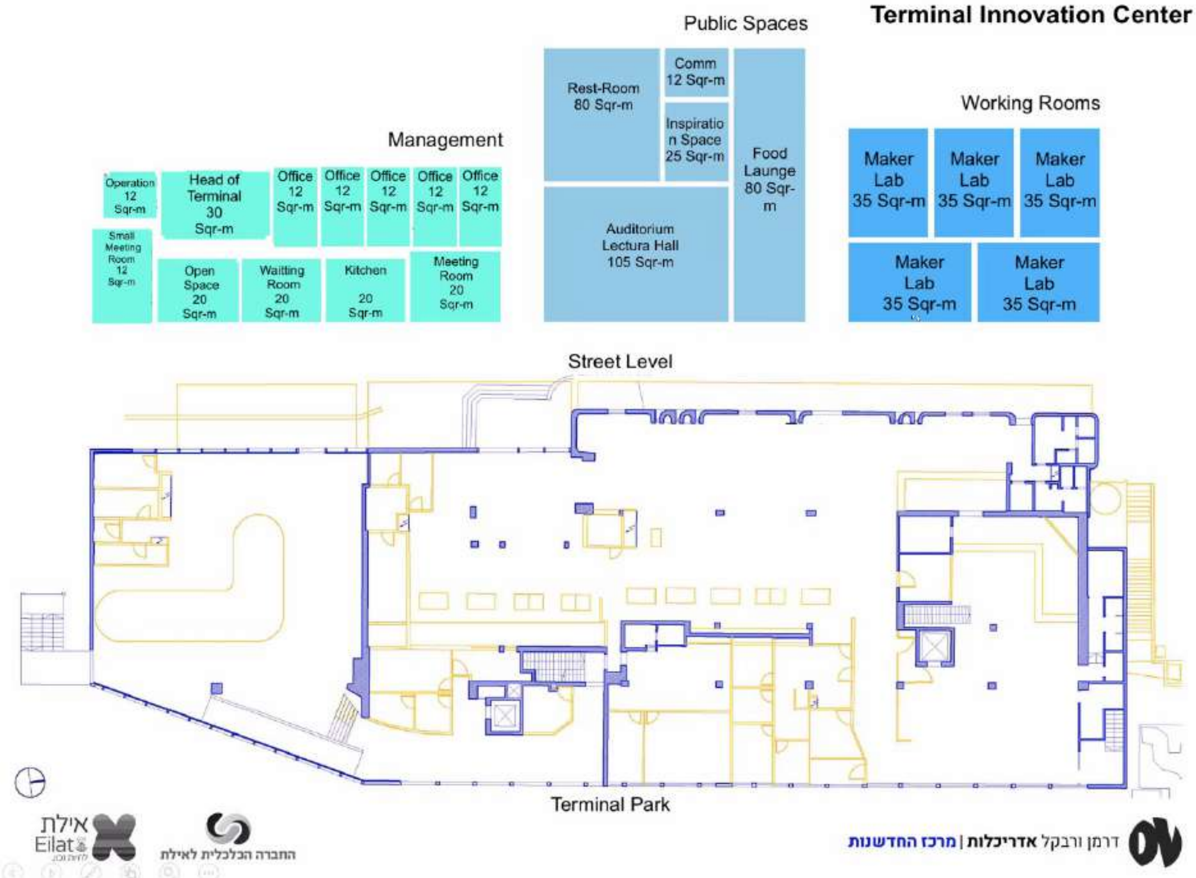
Gross total area (m^2)	1'171 m^2

Total built volume (m^3)	Makers Labs – 437.5 m^3 Public Spaces – 755 m^3 Offices – 485 m^3 Museum – 1250 m^3 Total – 2'927.5 m^3
Number of floors	2
Floor height	2.5 m
Number of offices	18

Building exterior

View of the east façade of the terminal

Plant of the basement and zoning



Wall construction

Type of surface	Orientation / typology	U-value [W/m²K]
External wall		0.403
Ground wall		0.5

Roof	Flat roof	0.403
Windows	Double glazed	2.2

Occupancy

Type of activity	N. of users	N of rooms	Regular use	Schedule (h)
Halls and Open Spaces	50	3	yes	Mo-Fr 07:00-17:00
Offices and Labs	60	17	yes	Mo-Fr 07:00-17:00
Auditorium	100	1	Occasional	Mo-Fr 09:00-20:00

Heating and cooling system

The HVAC systems are expected to be air to air or water to air systems. The systems can be either local per space or centralized. The water heating is done by solar water heaters.

Heating, cooling and domestic hot water system

Indicator	Zone	Typology	Capacity
Heating system	Centralized	Air-to-air heat pump	50*9 units kW
DHW system	n/a		
Cooling system	Decentralized	Air to air split units (legacy equipment)	52.65*9 units

Mechanical ventilation

Illumination

Lighting system is LED band Halogen based at present. In the new plan all luminaries will be LED based as well as natural light.

Zone	N. luminaires	Total power (W)	Luminaire type
Halls and Open Spaces	60	14	LED
Offices and Labs	17*4	14	LED
Auditorium	NA		

List of appliances

Zone	N. appliances	Total power (kW)	Schedule
Building	35	37.67	Occasionally

Energy consumption

TOTAL energy consumption	Unit	Value
Electricity consumption	[kWh/year]	≈174,411
Gas consumption	[m³/year]	
Electricity price	[nis/kWh - €/kWh]	0.46 - 0.618
Gas price	[€/m³]	NO USE FOR GAS

Energy consumption per end use	Unit	Value
Space Heating	[kWh/year]	Not available at present
Space cooling	[kWh/year]	Not available at present
Domestic Hot Water	[kWh/year]	Not available at present
Electrical devices	[kWh/year]	Not available at present

6.2.2 Building requirements

Requirements on envelope

No specific requirements

Requirements on HVAC system

The operation of all HVAC and lighting system needs to be significantly improved through procuRE:

- Real-Time monitoring and control with UI for the municipal and building managers.
- Improved air conditioning management when natural ventilation is being practiced.

Alongside procuRE, the HVAC and lighting system infrastructure such as piping and vents will be replaced with additional budget. This includes replacement of 100% of the fixtures that are currently fluorescent and halogen. The data centre will be upgraded with an HVAC system that allows free night-time cooling.

Requirements on monitoring and control system

Full C&C is needed in the building and systems. The monitoring should be in real time and send alerts when subsystems not working properly.

Requirements on maintenance

Preventative maintenance as well as connection to the monitoring and control systems.

Requirements on renewable energy installation

The renewable energy should be PV solar systems and possibly micro wind turbines.

Under any scenario, the RE systems should be connected to a local energy storage and supply the energy for the building.

There are three modes in which the system can work:

1. Islanding Mode – The energy storage system as well as the PV systems are disconnected from the grid. Under islanding mode, The system's inverters should prevent any injection of electricity to the grid.
2. Surplus Mode – The energy storage system is connected to the grid and injecting only surplus energy to the grid.
3. Grid Mode – The energy storage is connected to the grid without connection to the PV system.

The PV should be installed on the rooftop of the building and use additional spaces, if necessary, such as parking spaces alongside the building

The storage system should work without the renewable energy for at least four hours per day.

All PV material and related material need to be approved by the Israel Electric Company and adjusted to prevent harmonies or reduced electricity values.

The PV should be maximize to produce as much energy as possible and should be bi-facial and at least 535 W per panel.

The Building Energy Storage System (BESS) control system interface shall be integrated with the HVAC and lighting systems. The engineering tasks shall include, but not be limited to, the following:

- Communication protocol to be utilized for all communications between the BESS control system interface and data concentrator
- The BESS control system interface will have the ability to accept Automatic Governor Control set point signals from master station or a local controller
- The ramp rate of charging and discharging of the BESS shall be programmable or set to a defined value by manually entering a value into the BESS HMI or by the building management system communicating a ramp rate set point.
- Provide monitoring access and control access to all proposed BESS modes of operation, state of charge, kW/kVAR setpoints, local/remote control, and BESS alarms/status, etc.

6.3 Informative Summary: Istanbul

6.3.1 Building description

General information

Building owner
Name: Yildiz Technical University
Address: Yildiz Technical University, Davutpasa Campus, 34220, Esenler, Istanbul
Telephone:
E-Mail:
Responsibilities: Building owner.
Building management/operator

Name: Umut Yüksek
Address: Çifte Havuzlar, Davutpaşa Cd., 34220 Esenler/İstanbul
Telephone: 0546 790 05 25
E-Mail: umut.yuksek@ismek.ist
Responsibilities: Building Responsible
Building address and construction year
Çifte Havuzlar, Davutpaşa Cd., 34220 Esenler/İstanbul
2015

Building geometry information

Gross total area (m^2)	6.755,73 m^2
Total built volume (m^3)	8.620 m^3
Number of floors	1. School Building • Basement • Ground floor: 983 m^2 • 1st floor: 1446 m^2 • 2nd floor: 1045 m^2 • 3rd floor: 510 m^2 2. Administrative Building • Basement: 262 m^2 • Ground floor: 250 m^2 • 1st floor: 367 m^2
Floor height	3,58 m
Number of offices (specify how many are occupied)	2 offices for administration staffs

Building exterior

Wall construction

Type of surface	Orientation / typology	Uvalue [W/m²K]
External wall		0.4
Ground wall		0.3
Roof	Flat roof (glass)	3.6
Windows	Double glazed	3.6

Occupancy

Type of activity	N. of users	N of rooms	Regular use	Schedule (h)
Offices	28	6	Y	08:30-21:30
Rooms	458	33	Y	08:30-21:30
Laboratory	90	4	N	08:30-21:30
Service rooms	173	76	N	08:30-21:30

Heating and cooling system

There are 13 external VRV units in total. There are 16 indoor VRF units connected to Samsung brand outdoor units. These are used for heating the glass corridor (F1.20-Bridge). The remaining VRF units heat the rest of the building. Also, there are 2 Samsung external VRV units, 11 Arçelik external VRV units

In addition to the boiler pumps, it was considered appropriate to use a separate circulation pump for each zone, since the pressure losses of the piping system are excessive in the school building. In the administration building, additional zone pumps were not used because the loss was small. Boiler and radiator circuit are fed by boiler pump.

Heating, cooling and domestic hot water system

Indicator	Zone	Typology	Capacity
Heating system	School	VRV Heat pump	45 kW + 50.4 kW
	Administrative office	VRV	142 kW
DHW system	School	Condenser gas boiler	120 kW
	Administrative office	Gas boiler	Not specified
Cooling system	School	VRV	40 kW + 44.8 kW
	Administrative office	VRV	126.4 kW

Mechanical ventilation

Ventilation system	Heat recovery	Zone	Flow rate	Schedule
Mechanical ventilation	No	School – ground floor	2741 m³/h	08:00 / 17:00
Mechanical ventilation	No	School – first floor	7668 m³/h	08:00 / 17:00
Mechanical ventilation	No	School – second floor	3281 m³/h	08:00 / 17:00
Mechanical ventilation	No	School – third floor	2932 m³/h	08:00 / 17:00
Night ventilation	No	School (just laboratory)	700 m³/h	00:00 / 05:00
Mechanical ventilation	No	Administrative building – basement	2367 m³/h	08:00 / 17:00
Mechanical ventilation	No	Administrative building – ground floor	756 m³/h	08:00 / 17:00
Mechanical ventilation	No	Administrative building – first floor	743 m³/h	08:00 / 17:00
Night ventilation	No	School	?? m³/h	00:00 / 05:00

Illumination

Zone	N. luminaires	Total power (W)	Luminaire type
School building	2’192	47’776	Fluorescent + spot
Administrative building	555	12’310	Fluorescent + spot
		…	…
		…	…

Appliances

Zone	N. appliances	Total power (kW)	Schedule
School building	3’407	2056.5	
Administrative building			
		…	…
		…	…

Energy consumption

TOTAL energy consumption	**Unit**	**Value**
Electricity consumption	[kWh/year]	583.175
Gas consumption	[m³/year]	3.161
Electricity price	[€/kWh]	0,1127
Gas price	[€/m³]	0,1968

Energy consumption per end use	Unit	Value
Space Heating	[kWh/year]	157.473,00
Space cooling	[kWh/year]	184.735,00
Domestic Hot Water	[kWh/year]	33.636,00
Electrical devices	[kWh/year]	207.068,34

6.3.2 Building requirements

According to the Energy Efficiency Law No.5627 and the Regulation on Energy Performance in Buildings issued in accordance with this, Energy Identity Document (EID) in order to ensure the effective and efficient use of energy and energy resources in buildings, prevention of energy waste and protection of the environment, as a minimum, the building's energy need and energy consumption classification, greenhouse gas emission level, insulation properties and efficiency of heating and / or cooling systems.

Requirements on envelope

Requirements on HVAC system

The heating and cooling system is centralized meaning that when one zone of the building requires H/C it is provided to the whole causing overheating or overcooling.

Requirements on monitoring and control system

- To integrate the data control system of building to the IMM's SCADA System
- There is not a management system

Requirements on maintenance

- To integrate intelligent maintenance and repair information system about energy production infrastructure,
- To find maintenance and repair piece in Turkey's market and adequate service network.
- Education and interest of maintenance person

Requirements on renewable energy installation

For PV, the system can be used after technical agreement with the electricity distributor company.

Law No. 7103:

"9. With the purpose of generating electricity based on renewable energy sources within the scope of activities that can be carried out without license in accordance with the Electricity Market Law No. 6446 dated 14/3/2013, the installed power on the roofs and / or facades of the houses they own or rented up to a maximum of 10 kW (including 10 kW) Those who sell the surplus of electrical energy produced only from a generation facility to the last source supplier (including those established by the flat owners for the purpose of meeting the common electrical energy need of the main real estate) (The third paragraph provision is not taken into account in the application of this paragraph.)"

All renewable energy sources have exemptions (up to 10 kW tax exemption) (May be insufficient for ISMEL Building.)

Requirements and suggestions for occupants

- Survey users quarterly,
- Distribution of energy information package (guide, saving bulb, etc.)
- Installation of energy saving screen in the main corridor of building.

6.4 Informative Summary: Nuremberg

6.4.1 Building description

The building has been constructed in 2016 as an ultra-low-energy building according to the passive house standard. It has two stories at its highest and is partially with basement. It houses a school and a daycare centre. The flat roofs are covered with gravel (no green roofs).

General information

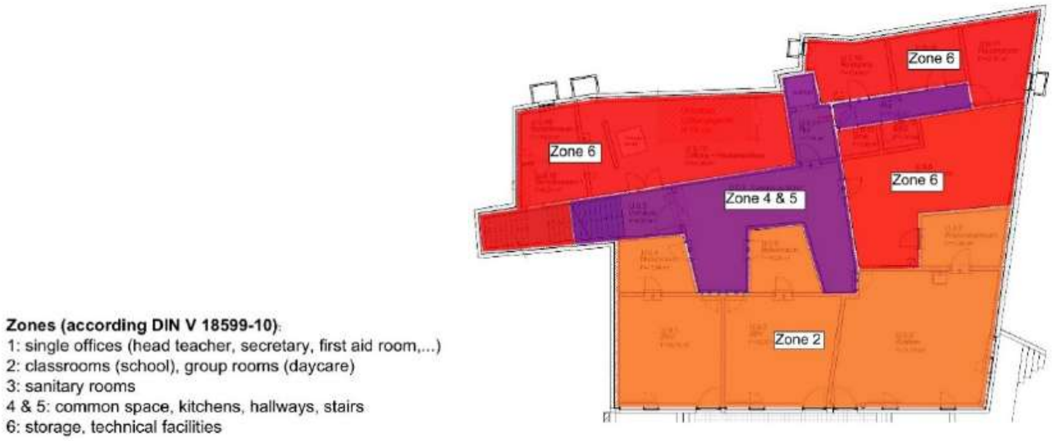
Building owner
Name: City of Nuremberg
Address: Rathausplatz 2
Telephone:
E-Mail:
Responsibilities: responsible body / financing of building issues
Building management/operator
Name: HVE Schule und Sport
Address: An der Fleischbrücke 1-3, 90403 Nürnberg
Telephone:
E-Mail:
Responsibilities: Facility operation and management of school buildings
Building address and construction year
Viatisstraße 270, 90480 Nuremberg
2016

Building geometry information

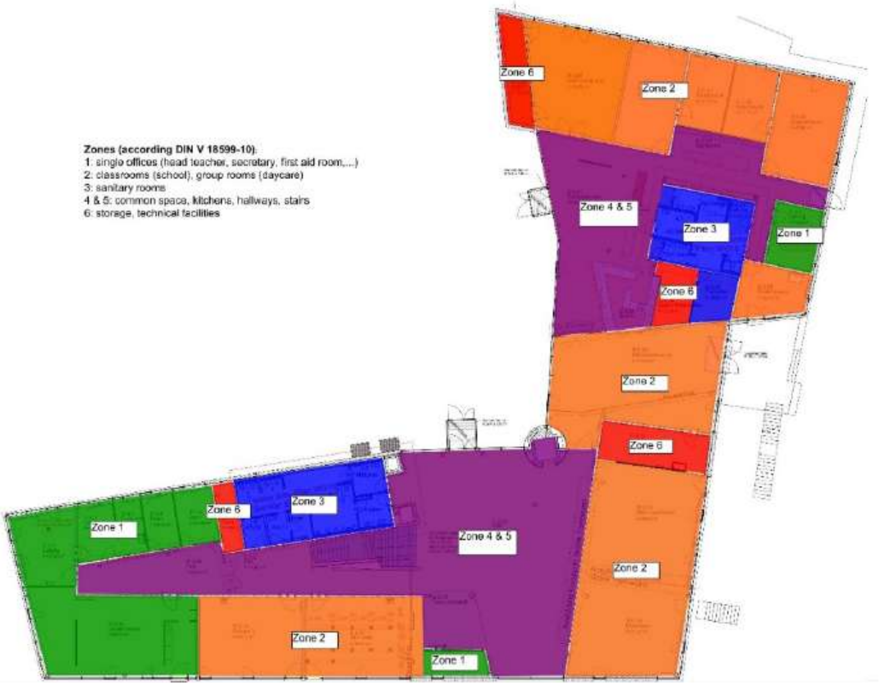
Gross total area (m^2)	3,405 m^2
Total built volume (m^3)	13,563 m^3
Number of floors	2 (+ basement)
Floor height	3.88 m (clear headroom: 3.05 m)
Number of offices (specify how many are occupied)	6

Building exterior

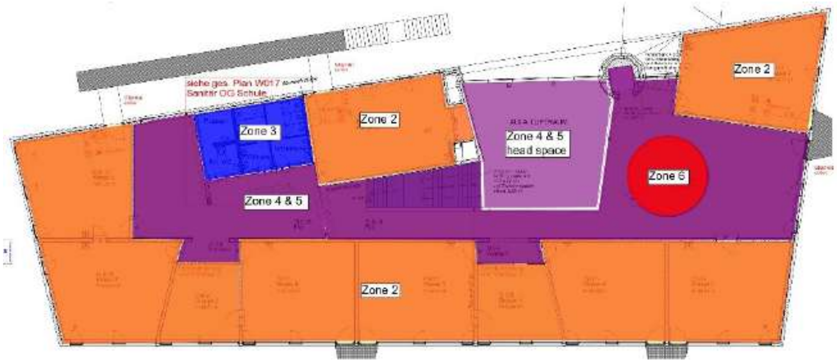
Plan of the basement and zoning



Plans of the ground floor and zoning



Plan of the first floor and zoning



Zones (according DIN V 18599-10):
1: single offices (head teacher, secretary, first aid room,...)
2: classrooms (school), group rooms (daycare)
3: sanitary rooms
4 & 5: common space, kitchens, hallways, stairs
6: storage, technical facilities

Wall construction

Type of surface	Orientation / typology	Uvalue [W/m²K]
External wall		0.104 / 0.119
Ground wall		0.171
Roof	Flat roof	0.123 / 0.095
	Sloping roof	0.088
Windows	Triple glazed	0.53

Occupancy

Type of activity	N. of users	N of rooms	Regular use	Schedule (h)
Education, self-learning, schooling (zone 2)	220	25	Y	Mo-Fr 07:00-16:00
Office-work, meetings (zone 1)	25	7	Y	Mo-Fr 07:00-16:00
Moving between zones; stopover; preparing meals (zone 4/5)	250	24	Y	Mo-Fr 07:00-16:00
Technical checks, cleaning, maintenance (zone 6)	15	15	N	
Short-term stay/ sanitary rooms (zone 3)	260	15	Y	Mo-Fr 07:00-15:00

Heating and cooling system

The building does not have active cooling. Instead, motorized ventilation flaps aid passive night cooling. Heat is provided via radiators and generated with a gas condensing boiler. Hot water is provided via electric boilers and flow-type heaters. The entire building is equipped with a centralized mechanical ventilation system with heat recovery.

In the building, 4 heating circuits are installed:

1. Radiators in school
2. Radiators in day care
3. heating register with heat recovery (plate heat exchanger) for ventilation-System school
4. heating register with heat recovery (plate heat exchanger) for ventilation-System day care

Heating, cooling and domestic hot water system

Indicator	Zone	Typology	Capacity
Heating system	Centralized	Condensing Heater (gas)	90 kW
DHW system	Decentralized	19x electric boilers	2 kW (each)
		2x decentralised flow-type heaters	5.7 kW (each)
Cooling system	n/a		

Mechanical ventilation

Ventilation system	Heat recovery	Zone	Flow rate	Schedule
Mechanical ventilation	Yes	School and Daycare	11,720 m³/h	Mo-Fr 7:00-16:00 (winter time)
Night ventilation	No	School and Daycare	Extract air	18:00-06:00
Night ventilation	No	School and daycare	Ventilation flaps open	22:00 / 05:00

Illumination

The lighting is provided by modern fluorescent tubes. The light is partially controlled by presence detectors. **Zone**	**N. luminaires**	**Total power (W)**	**Luminaire type**
1 – single offices	Average power of lighting in zone: 13.7 W/m²	2,600 W	fluorescent
2 – classrooms & group rooms	Average power of lighting in zone: 9.9 W/m²	12,000 W	fluorescent
3 – sanitary rooms	Average power of lighting in zone: 10.1 W/m²	2,000 W	fluorescent
4 / 5 – common space, kitchens, hallways, stairs	Average power of lighting in zone: 11.2 W/m²	12,000 W	fluorescent
6 – storage, technical facilities	Average power of lighting in zone: 7.3 W/m²	1,800 W	fluorescent

List of appliances

Electricity consuming appliances include the dishwashers, food warmers, the ventilation system, decentralized water heaters, and the projectors (the latter are in each classroom).

Zone	N. appliances	Total power (kW)	Schedule
2	15x ultra-short throw projectors	5.4	during classroom use
2	burning kiln	7	very rarely
3	17x electric water boilers 2x flow-type water heaters	45.4	occasionally
3	washing machine	1.5	3x per week afternoon
3	washing machine	1.5	once each weekday afternoon
3	dryer	1	3x per week afternoon
4/5	2x electric water boilers	4	occasionally
4/5	3x oven	10.5	Mo-Fr occasionally, ca. 1 hour per day
4/5	3x dishwasher	10.7	Mo-Fr 0.5 hours per afternoon
4/5	3x ceramic glass cooktop	33	Mo-Fr 1 hour per day (around noon)
4/5	4x food warmer	3.02	Mo-Fr 2 h/ day (around noon)
4/5	Elevator	?	rarely
6	3x heating water pumps	0.735	during winter 05:00-16:00, never @ full power
6	washing machine	1.5	once each weekday afternoon
6	washing machine	1.5	once a month

Energy consumption

Two separate electricity circuits with separate meters and separate tariffs for electricity consumption:

- fixed energy price for day care: 0.217 EUR/kWh excl. VAT
- tariff with high / low price @ daily schedule for school
  - weekdays (Monday to Friday) from 10.00 p.m. to 6.00 a.m. the following day, Saturdays from 1.00 p.m. to midnight, Sundays, and public holidays from 0.00 to 6.00 a.m. of the following day: **0.171 EUR /kWh excl. VAT**
  - other times than above mentioned: **0.188 EUR /kWh excl. VAT**
- Base price per year
  - 75.00 EUR/year excl. VAT in fixed price tariff
  - 1,080.00 EUR/year excl. VAT in high/low tariff

Price per monthly peak power demand (in kW) in high/low price tariff (7.22 EUR/kW excl. VAT per month)

A quarter-hourly electricity consumption profile for the day care area and for the overall building (14 days of average usage) as well as for the school area (whole year) is available and will be provided upon request. The electrical power peak for the school area is between 20 kW and 25 kW in a time frame between 8.00 h and 12.30h, mostly during winter.

For gas consumption:

- Fixed price for kWh: 0.0355 €/kWh excl. VAT

Additional base price per year: 159.80 €/year excl. VAT

TOTAL energy consumption	Unit	Value
Electricity consumption	[kWh/year]	≈49,260
Gas consumption	[m³/year]	≈7,550
Electricity price	[€/kWh]	circa 0.25 €/kWh
Gas price	[€/kWh]	circa 0.06 €/kWh

Energy consumption for each use (space heating and cooling, domestic hot water, and electric devices) is not available.

6.4.2 Building requirements

According to the Energy Efficiency Law No.5627 and the Regulation on Energy Performance in Buildings issued in accordance with this, Energy Identity Document (EID) in order to ensure the effective and efficient use of energy and energy resources in buildings, prevention of energy waste and protection of the environment, as a minimum, the building's energy need and energy consumption classification, greenhouse gas emission level, insulation properties and efficiency of heating and / or cooling systems.

The building envelope complies with the passive house standard and is not to be changed.

Requirements on envelope

The outer shell of the building must not be altered significantly, which also does not make sense. Windows, sunshades, doors and walls are built according the technical standards of 2015.

Requirements on HVAC system

The existing gas condensing boiler unit can stay as a backup system for unusually cold winters. It should stay connected to the heating system, even if another heating system will be installed as main system. Replacement is not necessary, the existing boiler is already up-to-date.

Due to the cold winters, seasonal energy storages would be a solution to consider.

Mandatory comfort conditions set for the individual building must be met at all times:

Minimum indoor temperatures during the heating period:

Office rooms	during use	20 °C	at the beginning of use	19 °C
Corridors and staircases	generally	12 °C	occasional presence	15 °C
Toilet		15 °C		
Secondary rooms / utility rooms		15 °C		
Classrooms	during use	20 °C	at the beginning of use	17 - 19 °C
Washing and shower rooms		22 °C		
gymnastics room		17°C		
Workrooms (e.g. crafts)		18 °C		
Workshop		17 °C		
assembly hall	during use	20 °C	at the beginning of use	17 – 19 °C
Kitchens	at the beginning of use	18 °C		
Common room / recreation room	during use	20 °C	at the beginning of use	19 °C

In the case of Nuremberg's pilot building **neither corridors nor staircases are separated rooms.** They are being used as classrooms and recreation rooms / common space and need to be heated accordingly.

Indoor temperatures during summer:

The aim is for the room temperature **not to exceed the limit of 26°C**. During a prolonged period of summer heat, the room temperature should be about 3 K below the outside air temperature during the usual hours of use.

Night cooling of the building is supported in summer by the ventilation system and motorized ventilation flaps. This mode of operation is to be continued.

- Brightness: 500 lux (glare-free), according to national workplace guidelines for school buildings
- Brightness for corridors and stairways: at least 100 lux, 200 lux strongly recommended
- air exchange rate: 20 $m^3/(h*person)$ plus the air volume required for the secondary rooms
- The tolerance range for room humidity is between 25 and 60 %rh. A humidity value of 25% in winter is considered the lower tolerable limit.
- CO_2-Concentration: target <1000 ppm; Hygienically critical 1000-2000 ppm; Hygienically unacceptable >2000 ppm

Requirements on monitoring and control system

An energy management software is in place for supervision of energy consumption of all City's buildings by the municipal energy managers. Automatic data transfer of all energy consumption meters to the energy management software has to be provided. This is at best implemented by offering an open interface via BACnet IP with documented data points for each meter.

Requirements on maintenance

every pipe system has to be tested once a year;

Elevator: maintenance/check: yearly

All fixed electrical equipment, incl. fire shutters: safety check / maintenance: all 4 years

Ventilation system: filter replacement: yearly

Windows, doors, ventilation flaps: maintenance: yearly

Heating system: maintenance: Half-yearly

Requirements on renewable energy installation

Guaranteed feed-in tariff for PV systems up to 100 kWp. Depending on the amount of installed overall PV-power in the country, the tariff is lowered infrequently. Depending on the date of operation start, a PV-system gets the tariff fixed for the next full 20 years following the year of installation.

The building's plot may be suitable for the installation of ground probes for heat pumps.

PV-system larger than 100 kWp have to market their electricity by themselves @ market price.

Requirements and suggestions for occupants

- Information of all teachers
- Poster / information board could be helpful
- Live visualization of energy production and consumption.

6.5 Informative Summary: Vila Nova de Gaia

6.5.1 Building description

The building is a school - Centro Escolar Manuel António Pina - that was built between 2012 and 2014 and consists of 16 rooms for basic education and 6 rooms for kindergarten with more than 500 daily users. It is equipped with a multi-sports room, library, media library, multipurpose room, study rooms, canteen, and auditorium. It also has a children's playground and a vast recreational area to Lavandeira Natural Park.

General information

Building owner
Name: Vila Nova de Gaia Municipality
Address: Rua de Álvares Cabral
Telephone: +351 223747250
E-Mail: geral@cm-gaia.pt
Responsibilities:

Building management/operator
Name: Armando
Address: Rua de Raimundo de Carvalho
Telephone: +351 22 374 80 10
E-Mail:
Responsibilities: Building maintenance operator
Building address and construction year
Rua de Raimundo de Carvalho
2014

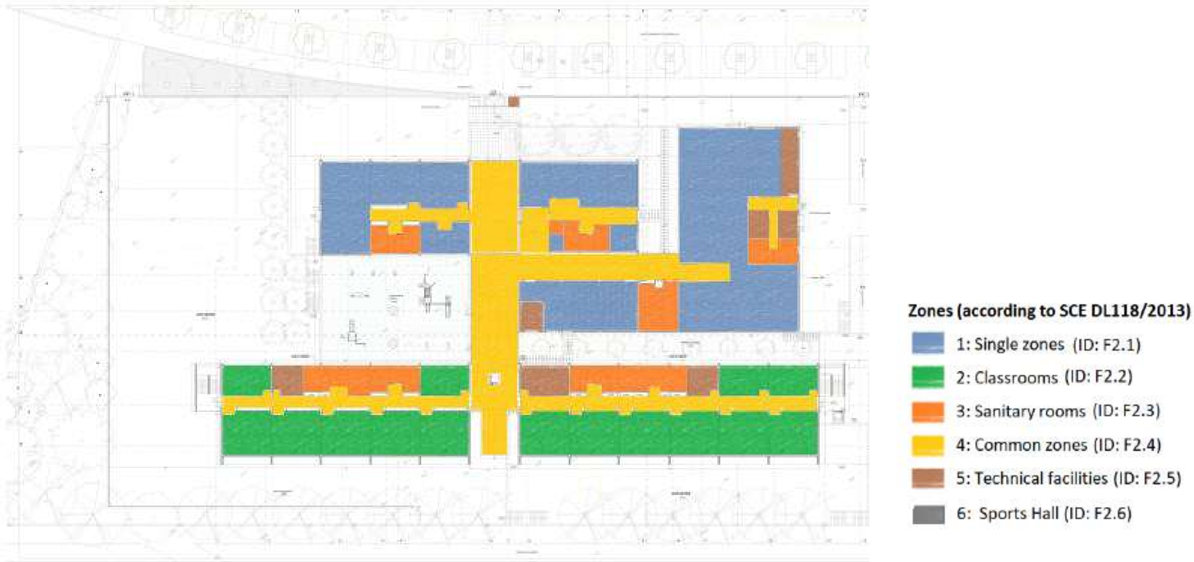
Building geometry information

Gross total area (m^2)	First floor: 198,7 Second floor: 4.181,6 Third floor 1.196,7 Total: 5.576,2
Total built volume (m^3)	18.000
Number of floors	3
Floor height	3,5 m
Number of offices	53

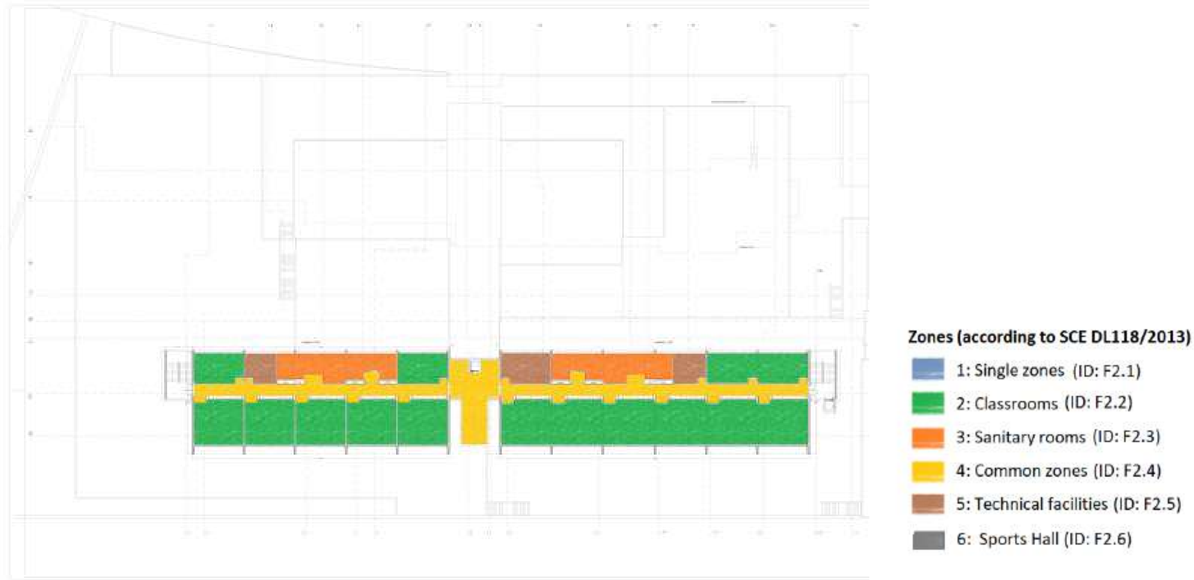
Pictures and plans

View of the main entrance of the building

Plant of the second floor



Plant of the third floor



Wall construction

The exterior façades are double walls with an air gap. The exterior walls are covered with white cement boards for extra acoustic insolation while the interior walls are made out of plasterboards. The flat roof structure consists of reinforced concrete slabs with thermal isolation. The windows are of stainless steel profiles and thermo-lacquered panels, with thermal cutting and double glazing.

Type of surface	Orientation / typology	Uvalue [W/m²K]
External wall		0,497
Ground wall		0,748
Roof	Flat roof	0,35
Windows	Double glazed	2,8

Occupancy

The occupancy follows the school period, shown in the next table. In December and from July till September, the school breaks, the school remains open. During this period, the number of users is decreased by 2/3 of the normal usage.

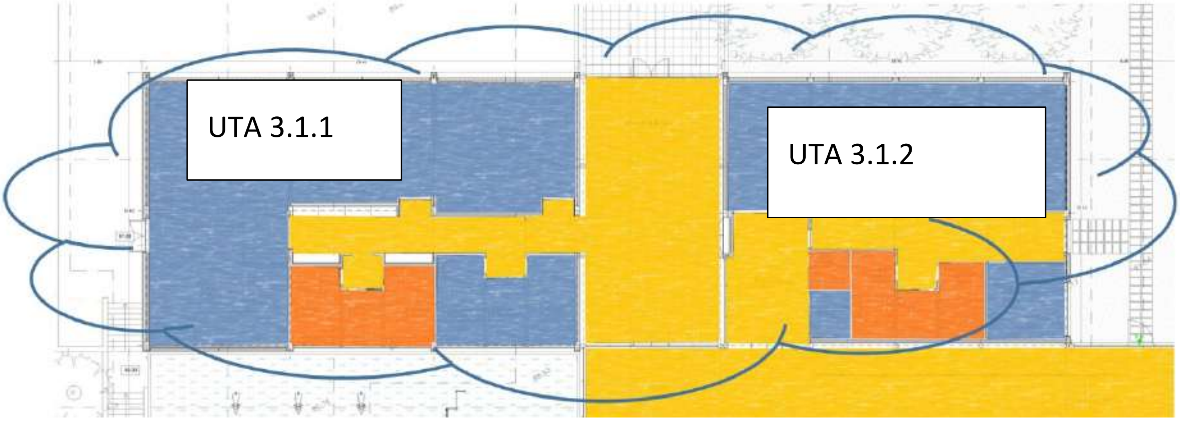
Type of activity	N. of users	N of rooms	Regular use	Schedule (h)
Classrooms	529	22	Yes	Mo-Fr 09:00-15:30
Leisure Activities	66	3	Yes	Mo-Fr 07:30-09:00
Curriculum Enrichment Activities	222	9	Yes	Mo-Fr 15:30-19:30
Sports Hall	15	1	Yes	Mo-Fr 18:30-00:00

Heating and cooling system

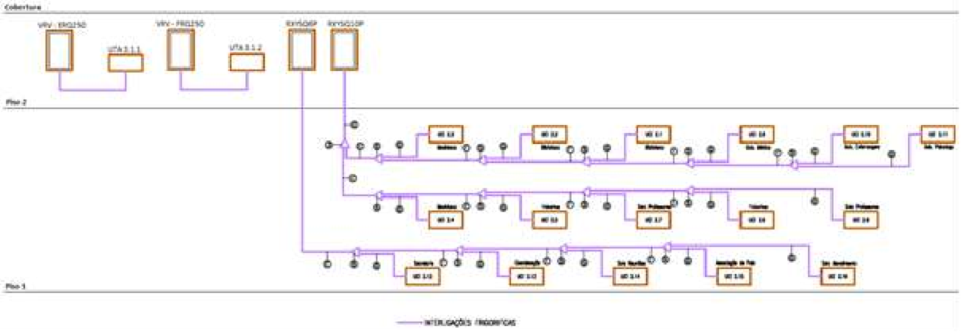
The two existing boilers serve hot water for heating the building, through a two water pipes system. The boilers are connected to the ten air handling units (AHU); therefore, they are heating the entire building.

For cooling, there are two main VRF systems, two VRF for the two AHU and two VRF for indoor units. The AHUs (UTA) have a direct expansion battery, UTA 3.1.1 (ERQ250) provides cooled and heated air to the following rooms: library, professor lounge, mediateca, and medical rooms (ID: F2.1). UTA 3.1.2 (ERQ250) provides cooled and heated air to the administration rooms (ID: F2.1). Parallel to these two machines, there are two additional VRF (RXYSQ…) systems that are connected to indoor expansion units, one per room (library, professor lounge, mediateca, medical rooms, and administration rooms).

VRF Cooled and Heated areas (ID: F2.1; F2.3; F2.4), blue areas

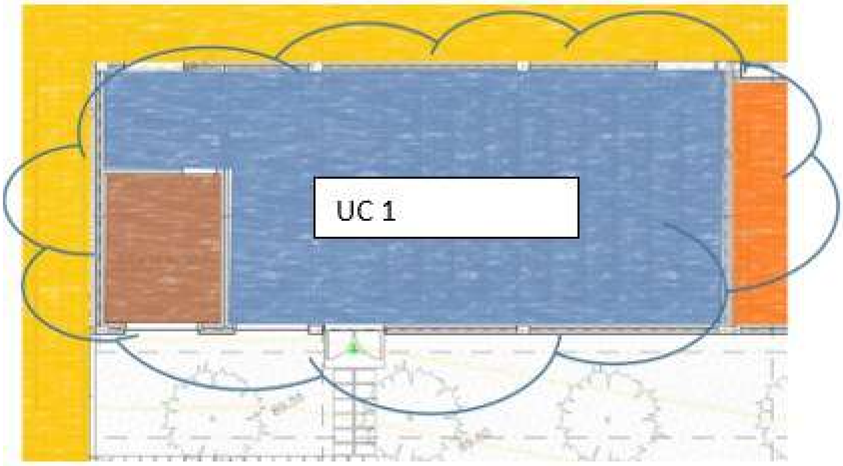


VRF Schematic



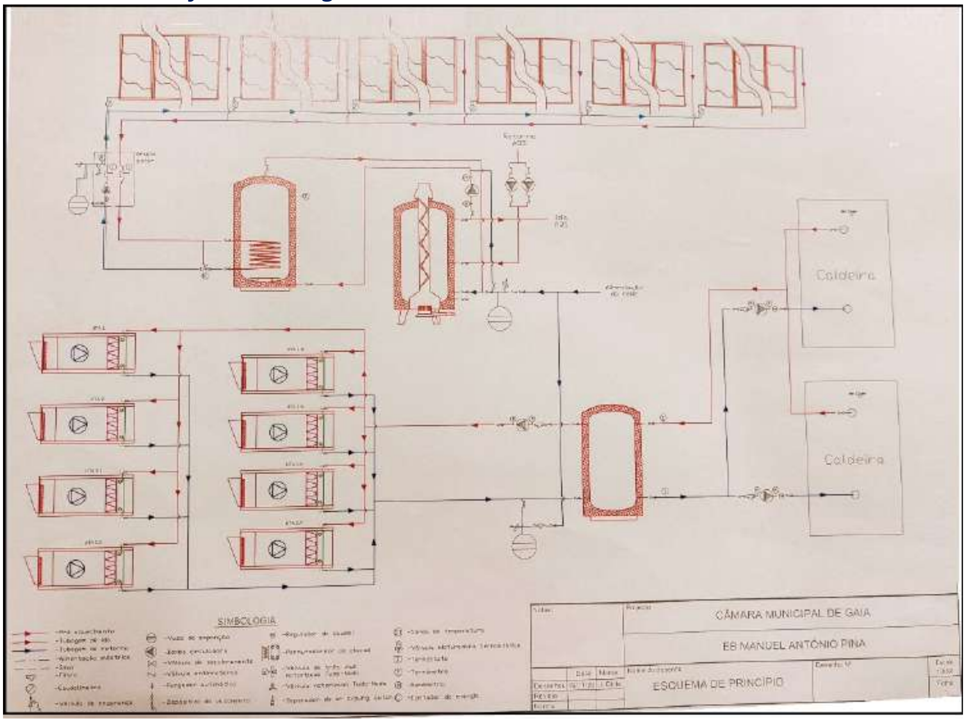
LENNOX machine is a heat pump compact rooftop machine that provides heating or cooling to the auditorium.

Rooftop, auditorium area



The building has a solar thermal (ST) system with 20 solar panels. The hot water from ST is used for DHW, which has also a natural gas boiler as a backup/support system.

HVAC Scheme for Heating and domestic Hot Water



Heating, cooling and domestic hot water system

Indicator	Zone	Typology	Capacity
Heating system	Centralized	Gas boiler	150 kW
	AHU 3.1.1	VRV system	31,5 kW
	AHU 3.1.2	VRV system	31,5 kW
	AHU 3.1.1	VRV system	31,5 kW
	AHU 3.1.2	VRV system	18 kW
	Auditorium	Reversible Heat pump	32,1 kW
DHW system	Centralized	Gas boiler	30,6 kW
Cooling system	AHU 3.1.1	VRV system	28 kW
	AHU 3.1.2	VRV system	28 kW
	AHU 3.1.1	VRV system	15,5 kW
	AHU 3.1.2	VRV system	15,5 kW
	Auditorium	Reversible Heat pump	32,2 kW

Mechanical ventilation

Ventilation system	Heat recovery	Zone	Flow rate	Schedule
Mechanical ventilation	Yes	library, professor lounge, mediateca and medical rooms, administration rooms	5.040 m³/h	8h00 - 19h30

Illumination

Most of the lights are T5 with 49 W but with different luminaires. Sports hall have SON with 250 W. Overall, the building has a high level of natural light. The electrical appliances are mainly computers, projectors, and kitchen equipment (freezers, cold storage cabinets, microwaves, etc).

List of luminaires

Zone	N. luminaires	Total power (W)	Luminaire type
Floor 1	69	4.429	Diverse (FLC, GU10, SON, T5)
Floor 2	427	24.072	Diverse (FLC, G24q, SON, MHN-TD, T5)
Floor 3	192	8.597	Diverse (FLC, G24q, T5)

List of appliances

Zone	N. appliances	Total power (kW)	Schedule
Building	157	67,54	Occasionally

Energy consumption

Energy Tariff

The electricity tariff is divided into a four-hour period in a weekly cycle. This means that on weekends active energy is cheaper and on labour days is divided into different periods (image below in Portuguese). Also, there is a component called “Network” that includes contracted power, peak power (highest value of power during that period of time in that month), reactive power, and the charges related to the use of the grid during the four-hour period. Besides this, the taxes are (not including VAT): CAV that is a fixed fee and IECE related to energy consumption.

Hourly tariff

Ciclo semanal para todos os fornecimentos em Portugal Continental			
Período de hora legal de Inverno		**Período de hora legal de Verão**	
De segunda-feira a sexta-feira		De segunda-feira a sexta-feira	
Ponta:	09.30/12.00 h 18.30/21.00 h	Ponta:	09.15/12.15 h
Cheias:	07.00/09.30 h 12.00/18.30 h 21.00/24.00 h	Cheias:	07.00/09.15 h 12.15/24.00 h
Vazio normal:	00.00/02.00 h 06.00/07.00 h	Vazio normal:	00.00/02.00 h 06.00/07.00 h
Super vazio:	02.00/06.00 h	Super vazio:	02.00/06.00 h
Sábado		Sábado	
Cheias:	09.30/13.00 h 18.30/22.00 h	Cheias:	09.00/14.00 h 20.00/22.00 h
Vazio normal:	00.00/02.00 h 06.00/09.30 h 13.00/18.30 h 22.00/24.00 h	Vazio normal:	00.00/02.00 h 06.00/09.00 h 14.00/20.00 h 22.00/24.00 h
Super vazio:	02.00/06.00 h	Super vazio:	02.00/06.00 h
Domingo		Domingo	
Vazio normal:	00.00/02.00 h 06.00/24.00 h	Vazio normal:	00.00/02.00 h 06.00/24.00 h
Super vazio:	02.00/06.00 h	Super vazio:	02.00/06.00 h

Electricity tariff

For every component of the tariff, the costs are (2020 costs assumed):

Network				
Active Energy	Inverno / Winter	Horas de ponta	0,0567 €	€/kWh
		Horas cheias	0,0407 €	
		Horas de vazio normal	0,0146 €	
		Horas de super vazio	0,0140 €	
	Verão / Summer	Horas de ponta	0,0564 €	
		Horas cheias	0,0404 €	
		Horas de vazio normal	0,0145 €	
		Horas de super vazio	0,0141 €	
Reactive Energy		Fornecida - Escalão 1	0,0083 €	€/kvarh
		Fornecida - Escalão 2	0,0252 €	
		Fornecida - Escalão 3	0,0756 €	
		Recebida	0,0189 €	
Power		Horas de ponta	5,2360 €	€/kW.mês
		Contratada	0,9370 €	
Taxes		IECE	0,0010 €	€/kWh
		CAV	2,6500 €	€/mês

Active Energy			
Active Energy	Horas de ponta	0,0706 €	€/kWh
	Horas cheias	0,0679 €	
	Horas de vazio normal	0,0568 €	
	Horas de super vazio	0,0563 €	

The price of active energy is the same during the contract. What can change is the network active energy (use of the grid during the four-hour period) and all of the other costs associated with the "Network" component.

Gas tariff

Bills are in the Teams folder.

Natural gas billing is complex. First, the building has a low-pressure tariff (BP). Because the contract is in a free market regime, there is a network and a utility component. For the utility, there's only one cost directly related to gas consumption.

For the network, there are seven components: global use of the network; transport network; distribution network off-peak; MP-BP distribution network off-peak; Fixed Term; transport network capacity; IECGN. For every component of the tariff, the costs are (2021 costs assumed):

Natural Gas tariff

Network			
Network Use	Global do Sistema	0,00037740 €	€/kWh
	Rede Transporte	0,00036902 €	
	Rede Dist. Fora Vazio	0,01053035 €	
	Rede Dist. MP-BP Fora Vazio	0,00171407 €	
	Rede Dist. Termo Fixo	2,12050000 €	€/dia
	Rede Transp. Cap. Util. Entrada	0,00009108 €	€/kWh_médio.dia
Taxes	IECGN	0,00592900 €	€/kWh

Consumption Energy			
Energy	Fixed Value	0,0258 €	€/kWh

TOTAL energy consumption	Unit	Value
Electricity consumption	[kWh/year]	≈130.868,3
Gas consumption	[m³/year]	≈10.289,5
Electricity price	[€/kWh]	0,17425
Gas price	[€/m³]	0,07635

6.5.2 Building requirements

1. The interventions should not impact the normal functioning of the building;
2. Users security above all;
3. The school was funded by European/National funds, so any foreseen intervention should be verified by the municipality to validate its compliance;
4. Requirements on Energy Performance of Buildings (Decree-Law n.º 101-D/2020):
    a. Interior room temperature
    b. Air exchange rates
    c. Relative Humidity
    d. CO_2 and other pollutants max concentration
5. Lighting Requirements (EN 12464);
6. Other building requirements can arise from national legislation or municipal regulations.

Requirements on envelope

- Requirements on Energy Performance of Buildings (Decree-Law n.º 101-D/2020)

Requirements on HVAC system

- HVAC needs improvement, especially regarding overheating in classrooms;
- At minimum, sports hall lighting needs to be changed from sodium to LED.

Requirements on monitoring and control system

There is an EMS in the building but several systems need reprogramming

In the next table, one can find a shortlist of EMS equipment. There are several more on the building, including electricity and natural gas counters. For these counters, there is not data log.

Device	Model	Number of Units	Location	Parameters measured	Available communication protocol
	TRANE UC400	2	Main Technical Room	programmable BACnet unit controller	BACnet
	TRANE XM30	2	Main Technical Room	Expansion Modules	BACnet
	TRANE XM70	1	Main Technical Room	Expansion Modules	BACnet
	HAGER SM103E	1	Q.E.	Electricity	unknown
	HAGER EC370	5	Q.E.	Electricity	unknown
	unknown	3	Main Technical Room	Natural Gas	unknown

Requirements on maintenance

For newly installed equipment, a Maintenance Plan should be provided to the building owner.

Requirements on renewable energy installation

There are no subsidies for PV. Only self-consumption is interesting in terms of finance

Requirements and suggestions for occupants

- Flyers for students take home;
- Gamification between classrooms;
- Gamification between other schools

6.6 Informative Summary: Velenje

6.6.1 Building description

The focus of the Velenje pilot are 2 buildings located in a rural setting in the village of Vinska Gora about 6 kilometres to the south-east (next to the regional road G1-4 Velenje-Črnova) from the city centre of Velenje, Slovenia**.**

The main building (**building A**) was constructed in 1973 and partially renovated in 2002 (Parcel number: 176; Cadastral municipality: 975 Vinska gora; Building ID: 260). It features conventional brick masonry construction**,** has a heated usable surface of A_{nh} = 587,0 m^2 and nett heated volume of V_{nh} = 1875,0 m^3. The total area of the thermal envelope is 1460,0 m^2, with a building shape factor of f_O = 0,638 m^{-1}. The main building is a branch of the elementary school Gorica (itself located in the city of Velenje) and is used for primary (elementary) level education. The building consists of classrooms, playrooms, washrooms and restrooms, a kitchen with pantry, offices, hallways, and a boiler room.

The site also features an adjacent (physically separated) multipurpose hall (**building B**) that has a main function as the sports gymnasium used by the school (Parcel number: 482; Cadastral municipality: 975 Vinska gora; Building ID: 261). The multipurpose hall also has one apartment (occupied living quarters), offices, several conference rooms and restrooms used by the local community, interest associations (mountaineering club) and other visitors. It`s also constructed with conventional brick masonry construction and has a heated usable surface of A_{nh} = 1360,60 m^2 and nett heated volume of V_{nh} = 6698,0 m^3. The total area of the thermal envelope is 3160,99 m^2, with a building shape factor of f_O = 0,407 m^{-1}. Building B had undergone energy renovation of the thermal envelope in 2020 (EPS energy insulation, XPS under construction, rockwool fire barrier).

Building A and building B share a common central heating system located in the basement of building A. The boiler room is located in the basement of building A, whereby building B is connected via pipes placed in an underground shaft. Both buildings are owned directly or indirectly by the City municipality of Velenje.

The primary focus of the PCP demonstration pilot is building A whereas building B is of interest to be included most notably because of 1.) the existing connection of the central heating system, 2.) the availability of a large roof that is suitable for solar power generation and 3.) potential application of building B for thermal storage or other applications that would require larger volumes/surfaces.

General information

Building owner
Name: Municipality of Velenje
Address: Titov trg 1, 3320 Velenje
Telephone: 00386 3 89 61 600
E-mail: info@velenje.si
Responsibilities: Financing building operation and maintenance
Building management/operator
Name: mag. Peter Kovač
Address: Titov trg 1, 3320 Velenje
Telephone: 00386 3 89 61 600
E-mail: peter.kovac@velenje.si
Responsibilities: Investment in building operation, maintenance, and renovation measures
Building address and construction year
Vinska Gora 31c, 3320 Velenje
1973 – retrofit works in 2002

Building A geometry information

Gross total area (m²)	587,0 (nett)
Total built volume (m³)	1875,0 (nett)
Number of floors	2 (+1)[4]
Floor height	2,5 – 3,3 m

Building B geometry information

Gross total area (m²)	1360,00 (nett)
Total built volume (m³)	6698,00 (nett)
Number of floors	2 (+1)[5]
Floor height	2,5 (room) – 8,4 m (sports hall)

[4] Two heated floors occupied by building users and one non-heated basement floor where the boiler room is located

[5] Heated basement under a smaller section of the southern part of the building

Site overview of the Velenje Pilot (Vinska Gora, Slovenia)

A – Main pilot building (Branch elementary school Vinska Gora)

B – Multipurpose hall (sports gymnasium)

C – School football field/basketball court and playground

D – Kindergarten (new building, **not a subject of the pilot project**)

Site overview of parcels of the Velenje pilot location (Vinska Gora, Slovenija)

Building A is located on parcel number 176 that is place within the larger parcel 479/1. Building B is located on parcel number 482/2. The sports field is located on parcel 478, while the children's playground along with the area around building A are part of the larger parcel 479/1. All parcels are owned by the City municipality of Velenje.

View of the southern side of the school – 1 (building A)

View of the eastern side of the school (main entrance) - 2 (building A)

View of the eastern side of the school 2 (main entrance) - 3 (building A)

View of the northern side of the school - 4 (building A)

View of the northern side of the school - 5 (building A)

View of the northern side of the school - 6 (building A)

View of the western side of the school - 7 (building A)

View of the western side of the school - 8 (building A)

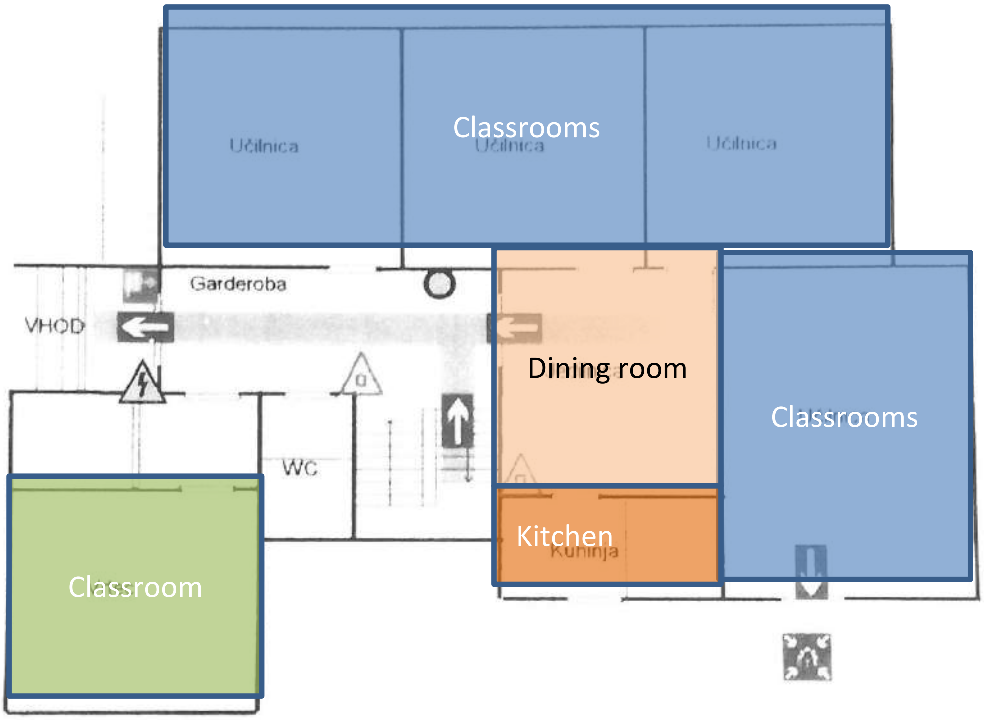
View of the western side of the multipurpose hall - 1 (building B)

View of the southern side of the multipurpose hall - 2 (building B)

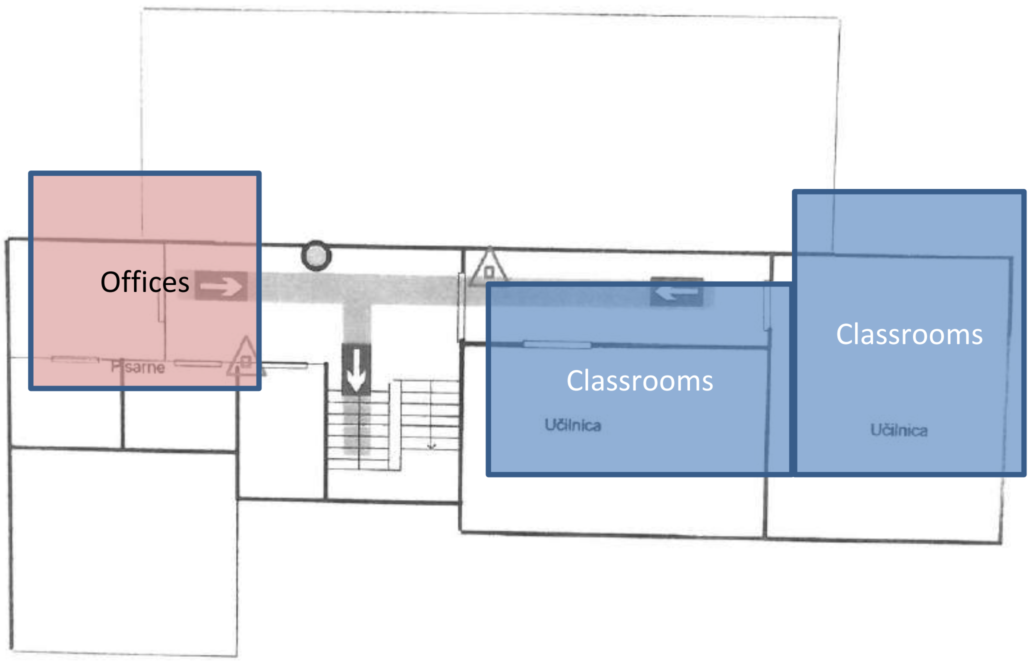
View of the eastern side of the multipurpose hall - 3 (building B)

View of the northern side of the multipurpose hall - 4 (building B)

Plant and zone distribution of the ground floor (building A)



Plant and zone distribution of the first floor (building A)



Wall construction

Transmittance value of external surfaces (building A)

Type of surface	Orientation / typology	Uvalue [W/m²K]

External wall	**Type A** - full plasterboards 1400 (0,0125 m) - EPS 100 (0,05 m) - wooden covering (0,012 m) - mineral wool (0,08 m) - polyethylene foil 1000 (0,0002 m) - plasterboard plate (0,015 m) Orientation/Surface: South +10° (34,48 m²)	0.27
	Type B - extended lime mortar 1900 - brick 1500 - pigment façade mortar Orientation/Surface: South +10° (15,51 m²) Orientation/Surface: East +10° (82,16 m²) Orientation/Surface: North +10° (67,44 m²) Orientation/Surface: West +10° (69,96,44 m²)	1.355
	Type C - baumit edelputz special (0,003 m) - baumit haftmoertel (0,005 m) - facade insulation panels eps f 039 (0,05 m) - net and hollow brick 1400 (0,29 m) - extended lime mortar 1900 (0,025 m) Orientation/Surface: South +10° (28,38,71 m²) Orientation/Surface: West +10° (37,80 m²) Orientation/Surface: North +10° (32,71 m²)	0.509
	Type P1 - filling plates (0,03 m) Orientation/Surface: North +10° (8,10 m²)	1.109
	Type P2 - full plasterboards 1400 (0,0125 m) - mineral wool (0,08 m) - polyethylene foil 1000 (0,0002 m) - plasterboard plate (0,015 m) Orientation/Surface: North +10° (7,50 m²)	0.442
Ground wall	**Type T1**	0.358

	- sand and grass (0,3 m) - concrete 2400 (0,16 m) - multilayer bitumen hydro insulation 1200 (0,012 m) - EPS - Expanded Polystyrene 100 (Fragmat) (0,04 m) - concrete 2200 (0,06 m) - PVC (0,006 m) Orientation/Surface: 0° (31,72 m²)	
	Type T7 - concrete 2400 (0,16 m) - multilayer bitumen hydro insulation 1200 (0,012 m) - EPS - Expanded Polystyrene 100 (Fragmat) (0,04 m) - concrete 2200 (0,06 m) - PVC (0,006 m) Orientation/Surface: 0° (55,76 m²)	0,286
Roof[6]	**Type J** - glass wool URSA DF 40 (0,1 m) - polyethylene foil 1000 (0,0002 m) - wooden covering (0,015 m) - hor. air-flow up- E = 0.20 D = 0.02 (0,01 m) - plasterboard plate (0,0125 m) Orientation/Surface: 0° (197,64 m²)	0.226
	Type E - glass wool URSA DF 40 (0,08 m) - polyethylene foil 1000 (0,0002 m) - plasterboard plate (0,0125 m) Orientation/Surface: 0° (274,19 m²)	0,213
Windows	**Double glazed, PVC frame** Orientation/Surface: South +10° (53,36 m²) Orientation/Surface: East +10° (4,58 m²) Orientation/Surface: North +10° (47,63 m²) Orientation/Surface: West +10° (17,64 m²)	1,100
Doors	**Type 1** Orientation/Surface: North +10° (2,25 m²)	1,109
	Type 2 Orientation/Surface: East +10° (5,50 m²)	1,600

[6] Flat ceiling towards and unheated attic below a sloped roof

	Type 3 <u>Orientation/Surface</u>: North +10° (1,54 m^2)	1,100

Transmittance value of external surfaces (building B)

Type of surface	Orientation / typology	Uvalue [W/m²K]
External wall	**Type A** - extended lime mortar (0,025 m) - brick 1400 (0,29 m) - pigment façade mortar (0,025 m) - insulation adhesive - EPS - Expanded Polystyrene (0,16 m) - final covering layer Baumit (0,008 m) <u>Orientation/Surface</u>: South +25° (158,52 m^2) <u>Orientation/Surface</u>: East +25° (167,35 m^2) <u>Orientation/Surface</u>: North +25° (214,32 m^2) <u>Orientation/Surface</u>: West +25° (186,42 m^2)	0,208
Ground wall	**Type T (floor on terrain)** - parquet (0,02 m) - wooden floor-boards (0,015 m) - glass wool URSA DF 40 (0,05 m) - multilayer bitumen hydro insulation (0,010 m) - concrete 2400 (0,15 m) - sand and fine gravel (0,30 m) <u>Orientation/Surface</u>: 0° (833,2 m^2)	0,513
	Type K (floor on terrain) - PVC flooring (0,005 m) - concrete 2200 (0,060 m) - polyethylene foil 1000 (0,0002 m) - EPS - Expanded Polystyrene (0,05 m) - multilayer bitumen hydro insulation (0,010 m) - concrete 2400 (0,15 m) - sand and fine gravel (0,30 m) <u>Orientation/Surface</u>: 0° (149,6 m^2)	0,524
	Type Z (floor above external air) - pinewood - polyethylene foil 1000 (0,0002 m) - mineral wool (0,10 m) - concrete 2400 (0,12 m) <u>Orientation/Surface</u>: 0° (124,1 m^2)	0,339
Roof[7]	**Type cD** - wooden covering (0,012 m) - vapour barrier (0,00053 m)	0,311

[7] Flat ceiling towards and unheated attic below a sloped roof

	- glass wool URSA SF 35 (0,05 m) - wooden boards (0,02 m) - breather membrane foil (0,00047 m) - roof panel (0,05 m) Orientation/Surface: 0° (1029,78 m^2)	
	Type cK - extended lime mortar 1900 (0,020 m) - concrete 2400 (0,20 m) - multilayer bitumen hydro insulation (0,010 m) - XPS (URSA N-III-PZ-I) Extruded polystyrene (0,050 m) - concrete 2400 (0,06 m) - Asphalt (0,05 m) Orientation/Surface: 0° (37,80 m^2)	0,528
Windows	**Double glazed, PVC frame** Orientation/Surface: South +25° (12,48 m^2) Orientation/Surface: East +25° (98,05 m^2) Orientation/Surface: North +25° (3,84 m^2) Orientation/Surface: West +25° (33,30 m^2)	1,100
Doors	**Type 1 (non-transparent)** Orientation/Surface: West +25° (2,00 m^2) Orientation/Surface: South +25° (2,10 m^2)	1,600
	Type 2 (non-transparent) Orientation/Surface: North +25° (4,00 m^2) Orientation/Surface: South +25° (8,05 m^2) Orientation/Surface: East +25° (4,60 m^2)	2,000
	Type 3 (transparent) Orientation/Surface: West +25° (4,05+5,50+5,13 m^2)	1,600

Occupancy

In 2020 there had been 73 students enrolled in the education process, with 8 teachers, one cook and a part time cleaning person (fully employed, partially working on the main primary school Gorica in Velenje).

Occupancy of zones (building A)

Type of activity	N. of users	N of rooms	Regular use	Schedule (h)
Classrooms	73 + 8	8	Yes	Regular use (8h) from beginning of September until end of June
Dining room	73 + 8	1	Yes	Regular use (8h) from beginning of September until end of June

Offices	8	2	Yes	Regulars use (8h) from mid-August to beginning of July

The multi-purpose hall (gymnasium part) is used for sports/sport education of the students of the primary school. In addition, the sports hall is used for recreational purposes by various groups of local residents. The school is closed in summer and the sports hall is also not used for recreation therefore practically no activity is conducted in July and August. There are several offices located in the building that are used by members of different associations (retirees, mountaineers, local community, etc.). There is also one occupied apartment (living quarters) spanning over 3 rooms on the 2nd floor. The south part of the sports hall also features a stage for performing various performances and cultural displays (separated from the sports hall by curtains). In the basement on the south side of the building (below the stage) there is a conference hall sporadically used for various types of events (seating capacity for app. 60 people).

As a sport education hall for the primary school as well as for recreational use by the local residents

Occupancy of zones (building B)

Type of activity	N. of users	N of rooms	Regular use	Schedule (h)
Sports hall (plus wardrobes, restrooms, sporting goods storage)	73 + 2 (primary school) 48	6	Yes	Regular use (8h) from beginning of September until end of June
Apartment	1	3	Yes	Living space
Offices (Retirees' association	20	2	No	Irregular use (2h/week)
Office (Mountaineer association)	5	1	No	Irregular use (1h/week)
Office (Building operator/maintenance)	1	2	Yes	Regular use (3h/day)
Kitchen	5	1	No	Irregular use (1h/week)
Conference room	10	1	No	Irregular use (1h/week)
Conference hall (basement)	40	1	No	Irregular use (8h/month)

Heating and cooling system

Both buildings are supplied with heat through a central heating system. The boiler room is placed in the basement of the primary school (building A). The heat is generated by a low temperature, three pass condensing high efficiency combustion **oil boiler (Viessmann VITOPLEX 200 – 200 kW)**. The heating system is divided into three separate heating branches, where one is used for space heating of the school (building A), one for the space heating of multipurpose hall (building B) and the third for the preparation of DHW in the multipurpose hall (building B). The distribution of heat demand between the buildings is not properly monitored. The distribution system consist of column and panel type radiators, with thermostatic heads but without thermostatic valves. Domestic hot water (DHW) within the heating season is supplied by the oil boiler. Outside the heating season, DHW is prepared in the heating substation (building B) with an electric boiler and also locally with **electric heaters (Gorenje TIKI)** for the requirements of washrooms. A **cooling system is not installed** (school is closed throughout the summertime).

Boiler room, Viessmann Vitoplex 200 (building A)

Boiler room, distribution/heating branches (building A)

Electric heater for DHW (building A)

Electric heater for DHW 2 (building A)

Electric heater for DHW 2 (building A)

Column radiators in the classroom (building A)

Heating substation for DHW (building B)

Panel radiators in the sports hall (building B)

Heating, cooling and domestic hot water system

Table 2 – Heating, cooling and DHW systems main characteristics

Indicator	Zone	Typology	Capacity
Heating system	Both buildings	Condensing high efficiency combustion oil boiler	200kW
DHW system	Both buildings (during the heating season)		
	Decentralized (outside the heating season)	Electric boilers (placed locally)	2 kW (several units)
Cooling system	/	/	/

Mechanical ventilation

There are no systems for ventilation or heat recovery installed. The building is ventilated sporadically by opening or tilting windows when indoor air quality is perceived to be inadequate.

Illumination

Building A is equipped with fluorescent lighting fixtures T5/T8 with mechanical or electronic ballasts. In building B, the surfaces the sports hall is covered by 40 MH lighting systems (metal halide) with nominal power output of 400 W each. Other lighting elements in the majority are covered by different types of fluorescent lighting with integrated ballast, reflection raster fittings and so on. A minor part of the lighting is represented by CFL (compact fluorescents) and incandescent light bulbs.

Fluorescent lighting fixture, hallway

Fluorescent lighting fixture, classroom 1

Fluorescent lighting fixture, classroom 2

MH reflectors in the sports hall (building B)

Fluorescent lighting fixtures in wardrobe (building B)

List of luminaires

Zone	N. luminaires	Total power (W)	Luminaire type
Building A	358	10220	Florescent Tubes T5/T8 (different lengths and setups)
Building B	40	16000	MH reflectors 400 W
Building B	450	9991,45	Florescent Tubes T5/T8 (different lengths and setups)
Building B	20	1200	Incandescent light bulbs

Appliances

Zone - Building A	N. appliances	Total power (kW)	Schedule
Dishwasher	1		Mon.-Fri. 10:00 – 14:00
Fridge	1		24/7
Stove	1		Mon.-Fri. 10:00 – 14:00
Zone - Building B			
Actuators (window tilt)	5	1	/
Refrigerator	2	0,18	24/7
Washing machine	2	4	/
Dishwasher	1	2	/
Zone - Building B (apartment)			
Refrigerator	1	0,1	24/7
Washing machine	1	2	/
Dishwasher			/
Router	1	50	24/7
Television	1	0,2	/

Energy consumption

Energy Tariff

Building A has 2 electricity metering points (two counters). Both feature a two-tariff billing systems (high and low tariff). High tariff is each day between 6:00 and 22:00. Low tariff is every day between 22:00 and 6:00 and on Saturday and Sunday all day: 0:00 – 24:00. National holidays are also counted as low tariff. Bills for each counter are combination of distributor system operator and for supplier of electricity. The price for electricity is established with a contract (usually with fixed duration) with the supplier and represents about one third of the actual costs. Additional taxes and levies according to national legislation are attributed to the bill either based on the unit of electricity consumed or in relation to the buildings network connection capacity (building A = 11 kW). A 22% VAT is imposed on the total cost. Building B is connected to the nearby transformer station with 4 metering points (four counters). It applies the same double tariff charging regime as building B.

Oil tariff

The wholesale price of oil is determined on the market at the time when the order and supply of oil to the location is carried out, whereby currently the price is above 1,0 EUR per litre. Additional levies and VAT is also imposed on the total price. Both buildings are supplied with energy for space heating through a central heating system from the condensing oil boiler (located in the basement of building A). The distribution of energy consumption neither between the two building nor in terms of any given time period (for e.g. year/heating season) are not monitored or known. The energy consumption is derived solely from the actual supply of heating oil to the building. Within the 3 year reference period (2018 – 2020) light heating oil was supplied 7 times with a total of **27734 litres**. A uniform average heating value of 10,06 kWh/l is attributed to the fuel implying a total energy use of 279.004,04 kWh during the 3 year period (93001,35 kWh per annum).

TOTAL energy consumption	**Unit**	**Value**
Electricity consumption	[kWh/year]	*Building A* 13700 (2018) 13825 (2019) 8670 (2020) *Building B* 20251 (2017) 21132 (2018) 32780 (2019)
Electricity cost	[€/year]	*Building A* 2.389,02 € (2018) 2.684,44 € (2019) 1.732,88 € (2020)

		Building B
		2.842,44 (2017)
		3.101,41 (2018)
		4.161,70 (2019)
Electricity price	[€/kWh]	0,07858 (High tariff)
	[€/kWh]	0,05498 (Low tariff)
Excise duty	[€/kWh]	0,00305
Network surcharge	[€/kWh]	0,03901(High tariff)
		0,02999 (Low tariff)
Capacity charge	[€/kW]	0,741412 *[8]
PSO Levy	[€/kW]	0,99297
EE (energy efficiency) levy	[€/kWh]	0,00080
Market levy	[€/kWh]	0,00013
VAT	[%]	22
Nett unit price	**[€/kWh]**	**0,187402** [9]
Oil consumption	[kWh/year]	≈ 93001,35 kWh (both buildings)
		≈ 9244,67 l (AHV = 10,06 kWh/l)
		134.814,06 kWh (2018)
		78.789,92 kWh (2019)
		65.400,06 kWh (2020)
Oil cost	[€/year]	≈ 2.859,87 € (average)
		4.139,73 € (2018)
		2.506,59 € (2019)
		1.933,29 € (2020)
Oil price	[€/L]	0,71885
Excise duty	[€/L]	0,1575
Environmental tax	[€/L]	0,04671
EE (energy efficiency) levy	[€/L]	0,0080
PSO Levy	[€/L]	0,0099

[8] Network connection has a capacity of 11 kW.

[9] Average price per unit of electricity depends on the electricity used within a particular billing period (cca. 18,7 c€/kWh is the calculated average for November 2020).

VAT	[%]	22
Nett unit price	[€/L]	0,84367 [10] > 1,0 EUR/l (current price estimate)

NOTE: Energy demand has declined in 2019 due to the reallocation of the kindergarten (day care) from the premises of the elementary school (building A) to the neighbouring building. In addition, energy demand for 2020 was greatly reduced due to COVID-19 related lockdowns when the educational process was not implemented.

Energy consumption per end use	**Unit**	**Value**
Space Heating	[kWh/year]	≈ 93000 kWh Building A: 32550 kWh * Building B: 60450 kWh *
Space cooling	[kWh/year]	/**
Domestic Hot Water	[kWh/year]	≈ 8500 kWh ***
Electrical devices	[kWh/year]	Building A: 13825 kWh (2019) Building B: 32780 kWh (2019) ≈ 46000 kWh/year ****

* The energy consumption is calculated based on the supply of heating oil and is not monitored for individual building. Based on the calculated temperature deficit, its estimated that 35% of the energy demand for space heating is allocated to the school (building A) and 65% to the multipurpose hall (building B). The figures take into account the energy demand for DHW during the heating season.

** No cooling system in place

*** DHW is prepared either with the oil boiler (heating oil) or through electric heaters. The energy demand can only be estimated based on the projected use of DHW in the building.

**** The consumption of individual electrical devices (lighting, electric appliances) is not monitored and can only be estimated.

[10] Average price depends on the current market price (cca. 0,84367 €/l is the calculated average for the last supply of oil to the building in February 2020. Current wholesale market price is around 1,02 – 1,05 €/l).

6.6.2 Building requirements

- The building(s) must be fully ready for operation by the beginning of the school years (September)
- The energy supply for the buildings must be designed with sufficient redundancy to ensure operation also through unpredictable weather events (for e.g. above normal cold weather).

Requirements on envelope

- The thermal envelope of the building A must be equipped with additional layers of insulation, either part of an energy supply (for e.g. integrated solar panels) or storage (for e.g. thermal storage panels) system (reduce draft, improve thermal comfort)

Requirements on HVAC system

- Change the existing heating source from heating oil to a renewable energy source.
- Install a ventilation system to ensure high level of indoor air quality and thermal comfort (improve thermal management – some classrooms are either too hot or too cold,
- Install digital solutions that display the operation of the building.

Requirements on monitoring and control system

- Install a central management system with sensors and actuators that will allow both algorithm and manual (override) control of the building
- Comprehensive energy management information system (for energy and facility management) must be a part of the central management system
- Implementation of smart indoor lighting system
- Energy consumption of school and sports hall to be monitored and managed separately

The monitoring and operational features of the building should include (data collection: energy consumption electrical energy, space heating, DHW – building level, energy consumption of lighting systems and appliances, energy consumption on different heating branches, radiators – calorimeters, temperature, CO_2 concentration, air velocity, illuminance, user satisfaction/ operational capacity: automatic operation of building according to optimal value of a set of above mentioned parameters, remote overview and control of building systems, mobile app)

Device	Model	Number of Units	Parameters measured	Available communication protocol
Electrical consumption meter	DSO	2	Consumption kWh	Not (only information for measured values)
Water consumption meter	operator	1	Consumption m3	Not
thermostatic heads on radiators	different	All radiators	Regulation of space temperature	Not

Requirements on maintenance

- Minimum maintenance requirements
- The system should be easy to operate, robust and reliable while providing the highest level of comfort, health, and safety to the building occupants as possible, however if system stability of operation is clearly demonstrated, the actual complexity is not important.

- The system(s) should not require frequent onsite maintenance especially during the school year.
- Maintenance works should never disrupt the educational process and ordinary use schedules of the buildings.

Requirements on renewable energy installation

Photovoltaic systems:

In situation, if grid not under voltage, inverter must block distribution the electricity into the grid.

By national found “ECO found” is subsidy for PV installation (tender:71SUB-SO19) on level up to 180,00 € for 1 kVA.

Solar thermal systems:

By national found “ECO found” is subsidy (tender: 82FS-PO20) on level up to 20 % recognized costs.

Requirements and suggestions for occupants

- Visualize savings of fossil fuels in dynamic infographics
- Visual representation of energy uses with loss diagram – Sankey)
- Schematic of buidling system operations
- Digital displays in the building
- Desktop and web application (access with computer or smart device)
- Demonstration of project activities/results on events on national level
- Open days for interested groups
- The outdoor area around the buildings should reflect in some way the renewable energy context of the building (like mentioned energy playground)
- Install charging stations for electric vehicles (cars and bicycles)
- Include occupancy and positions sensors (indicating if classrooms are in use, if windows are opened, if lights are on) and automatic regulation for a set of boundary conditions (switch of light when classroom not occupied)
- Provide comprehensive trainings for building operators with international accreditation to manage such systems from suppliers (added value to operators)

7 Annex D: Open Market Consultation Report

The OMC have the objectives to not only create awareness about possibilities for innovative/ dialogue-based procurement strategies, but also to communicate the challenge to the market and get input for tender development. This is part of an ongoing process of creating a common vision 100% renewable energy supply in existing building stock.

In preparation of the PCP call for tender, OMCs with potential suppliers and other relevant market actors have been held to capture the views of the market about procuRE and the challenge to retrofit buildings to become energy self-sufficient on 100% renewable energy.

The purpose of the OMCs is to canvass wide stakeholder opinion on the suitability of procuRE. With the market consultation, the consortium has:

- informed the market about the procuRE opportunities.
- explained in detail the PCP process to potential suppliers (often referred to as companies but including also other stakeholders from research and academia).
- opened a dialogue with potential suppliers about the scope of procurement envisaged in the project (incl. technical specifications).
- facilitated matchmaking among potential suppliers in need of support in the building of consortia capable of addressing the needs of the procuRE procurers in full.

The actions included in the OMC process to meet the above objective consisted of 13 main activities: nine online OMCs, one online OMC questionnaire, one online questionnaire in Portugal, one matchmaking tool and the management of Frequently Asked Questions (FAQs):

OMC activities.

By implementing all the activities, procuRE will be able to prepare an accurate procurement with a feasible scope by finding out whether technologies are commercially available, learn more about the advantages and disadvantages of coverage of the desired functionalities, and assess whether to include other aspects not initially considered.

7.1 Organising the OMCs During the COVID-19 Pandemic

Before explaining each of the activities carried out during the OMC and its outcomes, it is important to highlight that procuRE OMCs were affected by the COVID-19 pandemic. procuRE partners preferred to host Open Market Consultations in the form of webinars rather than postponing the OMC for several reasons, such as high level of interest from the market.

When partners were executing the initial plan, the pandemic forced us to make the following changes:

- Each of the procuRE procurers had planned to organise an OMC in English or the local language at their own premises. Due to the COVID-19 outbreak, the OMCs were organised online.

- In addition, two international webinars were planned in English to cover a wider number of stakeholders. This was maintained as in the original plan, reinforcing the dissemination efforts put in place to attract a good number of participants.

7.2 Open Market Consultations and Related Events

Table 1 presents all the events, including OMCs and other events where there was an opportunity to present the project and receive feedback from the market actors. Given the COVID-19 pandemic, all events have taken place digitally so far, although the Eilat Eilot Renewable Energy Conference is expected to take place physically in Israel should the COVID-19 restrictions be eased.

Details of planned and executed procuRE events.

Date	Event	Language	Location
22.04.2021	OMC Slovenia	Slovenian	Online
28.04.2021	OMC Spain	Spanish	Online
29.04.2021	OMC Germany 1	German	Online
05.05.2021	OMC Portugal	Portuguese	Online
27.05.2021	OMC Turkey	Turkish	Online
10.06.2021	The EU Smart Cities Marketplace Forum	English	Online
16.06.2021	OMC Israel	Hebrew	Online
23.06.2021	OMC Germany 2	German	Online
24.06.2021	EU #RiDaysEU	English	Online
25.06.2021	International OMC	English	Online
09.07.2021	Global OMC	English	Online
20.07.2021	Preferred Partner Forum	English	Online

Considering all the participants in the organised procuRE OMCs, 436 registered in the procuRE OMCs and 219 of them attended the events, resulting in a participation rate of 50%. Table 2 presents the number of people that registered and attended or later watched the OMCs.

Number of registered and attended people in the OMCs.

	Turkey	Portugal	Germany	Spain	Israel	Slovenia	Intern.	Global	Total
Registered	135	46	29	72	60	54	40	27	436
Attended	37	24	21	45	26	23	28	15	219
Views on YouTube	81	47	33	36	7	15	15	11	245

The profile of the participants has covered a wide spectrum of stakeholders, from the demand-side to manufacturers of solutions and researchers. This allowed for the collection of input from various market actors, contributing to the formation of the common challenge and the award criteria. All webinars followed the same agenda and the content delivered was based on the slides that were collectively prepared for this activity, with translated text into the local language and minor changes.

The duration of the webinars was approximately two hours; they combined presentations and Q&A sessions. All OMCs were recorded and uploaded to the procuRE website. The agenda used for the presentations was as follows:

1. Welcome & Introduction
2. procuRE Aim & Scope
3. Procurement of Innovation and Tender Process
4. Q&A on project and process
5. Information on Local Building
6. Q&A on local site
7. Next Steps

Table 3 presents information on the speakers that participated in the OMCs.

List of speakers involved in procuRE OMCs.

OMC Slovenia	
Date	22 April 2021
Speakers:	**Niko NATEK** – KSSENA **Nejc JURKO** – KSSENA **Sašo MOZGAN** – KSSENA **Boštjan KRAJNC** – KSSENA
OMC Spain	
Date	28 April 2021
Speakers:	**Gil LLADÓ** – AMB **Rita APIRICI** – AMB **Sergi PEREZ** – AMB **Chiara DIPASQUALE** – EURAC
OMC Germany 1 & 2	
Date	29 April 2021 & 23 June 2021
Speakers:	**Peter PFEIFER** – City of Nuremberg **Alexander NORDHUS** – City of Nuremberg
OMC Portugal	
Date	06 May 2021
Speakers:	**Luís CASTANHEIRA** – Energaia

	João ENCARNAÇÃO– Energaia
OMC Turkey	
Date	27 May 2021
Speakers:	**Touraj ASHRAFIAN** – Ozyegin University **Neşe GANİÇ SAĞLAM** – Ozyegin University **Ece KALAYCIOĞLU ÖZDEMİR** - Ozyegin University **Hasan MANCAK** – Istanbul Metropolitan Municipality **Yıldız Münevver RÜZGAROĞLU** – Istanbul Metropolitan Municipality
OMC Israel	
Date	16 June 2021
Speakers:	**Elad TOPEL** – City of Eilat
OMC International	
Date	25 June 2021
Speakers:	**Georg VOGT** – Empirica **Mehmet Börühan BULUT** – Empirica **Niko NATEK** – KSSENA **Chiara DIPASQUALE** – EURAC
OMC Global	
Date	9 July 2021
Speakers:	**Georg VOGT** – Empirica **Mehmet Börühan BULUT** – Empirica **Niko NATEK** – KSSENA **Roberto Fedrizzi**– EURAC

7.3 Open Market Questionnaire

An Open Market Questionnaire to be filled online was used to collect input from the market actors, mainly suppliers and procurers, but also other relevant actors, that could be used for preparing the procuRE Technical Specifications for the PCP. It included questions on the background of the responding organisation, the perceived challenges against and opportunities for achieving retrofits with 100% RES, the structure of the PCP process, and the interest to submit a tender.

7.3.1 Respondents' profile

According to the results, 10 out of 12 respondents identified themselves as suppliers, whereas one answered that they were a procurer and another respondent selected "Other". Most respondents represented micro-sized (<10 employees and ≤ € 2 m turnover) organisations, with one from a small (< 50 employees and ≤ € 10 m turnover) and another one from a medium-sized (< 250 employees and ≤ € 50 m turnover) organisation, as presented below. None of the respondents represented a large (> 250 employees and > € 50 m turnover) organisation.

Size of the organisations that answered the OMC questionnaire.

Answering the open-ended question "Describe the areas of expertise your organisation focuses on", most respondents wrote that they work with energy and building technologies, with others active in consultancy related to sustainability and energy. Respondents' background covered all the eight building blocks of procuRE, providing valuable insights into the market for these solutions.

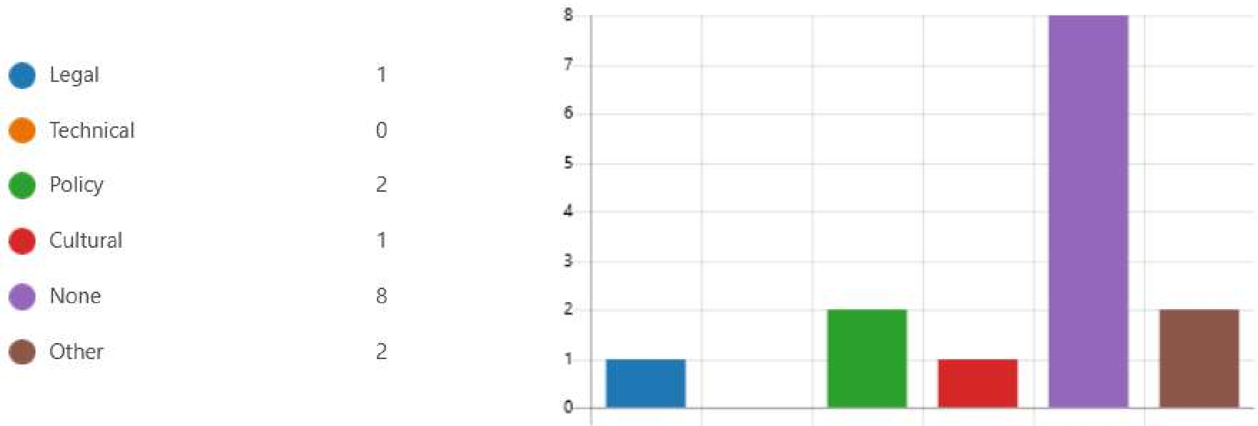
Eleven out of 12 respondents answered that they have downloaded the procuRE Slide Deck, which provides information on the PCP and the common challenge it addresses.

7.3.2 Views on procuRE and the PCP

According to all respondents, there is not a similar solution to procuRE on the market that covers all the building blocks. Eleven out of 12 respondents answered that the scope of procuRE was clear and feasible, although one pointed out that they did not think it was clear how to participate in procuRE, pointing out that each building is different.

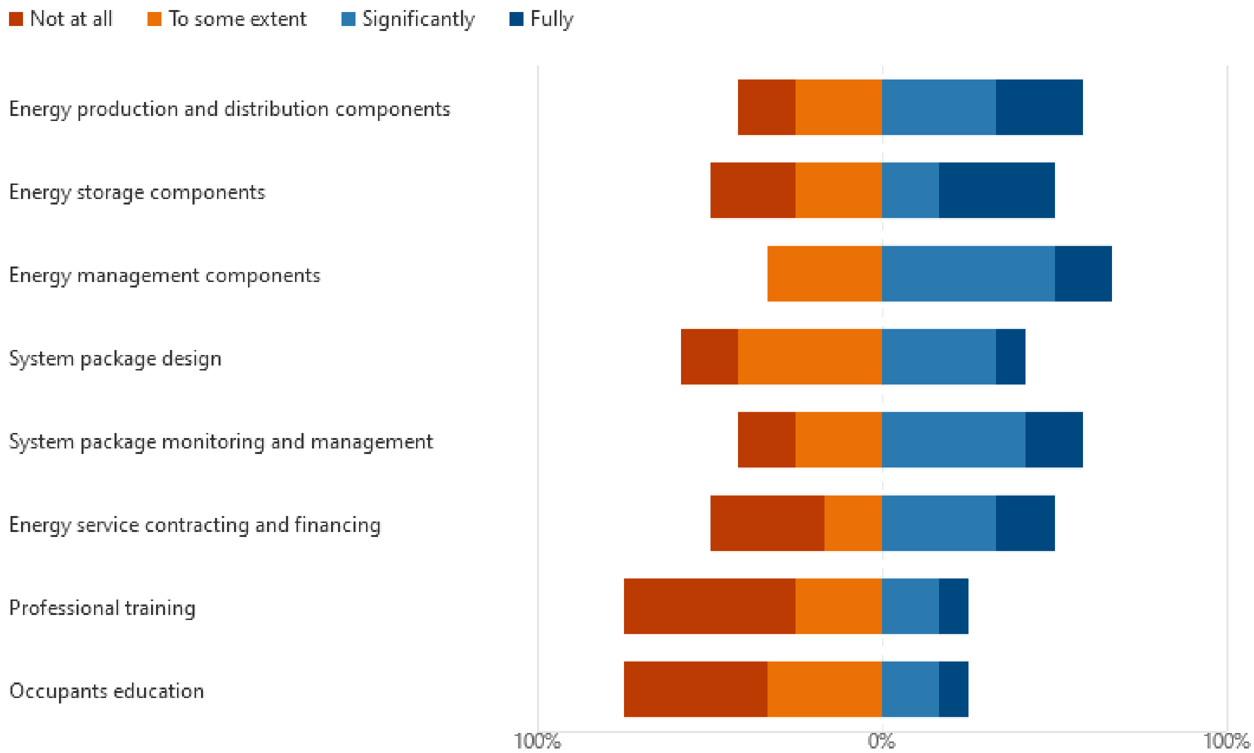
Reflecting upon the structure of the PCP, eleven out of 12 respondents said that they agreed with the time and budget distribution between the Phases 1, 2 and 3 of the PCP. On the issue of how many sites (i.e. buildings) should a supplier consortium equip in phase 3, six respondents answered that each supplier should equip three sites, while four of them answered that each supplier should equip two sites. Two respondents selected "Other", although it was not specified how many sites that they believe a supplier should equip. When asked about which performance indicators and/or award criteria should be used to assess the proposals, they mentioned "degree of self-sufficiency", "level of innovation", "CO_2 savings" and "economic efficiency".

Figure below shows answers to the question "In your opinion, are there any barriers or constraints to address the procuRE challenge by your organisation?". Eight respondents answered that there were no barriers, two answered that there are policy-related barriers, one answered that there were legal barriers and another respondent selected cultural barriers. Two respondents answered "Other", but did not indicate what barriers or constraints they see.



Barriers or challenges to address the procuRE challenge.

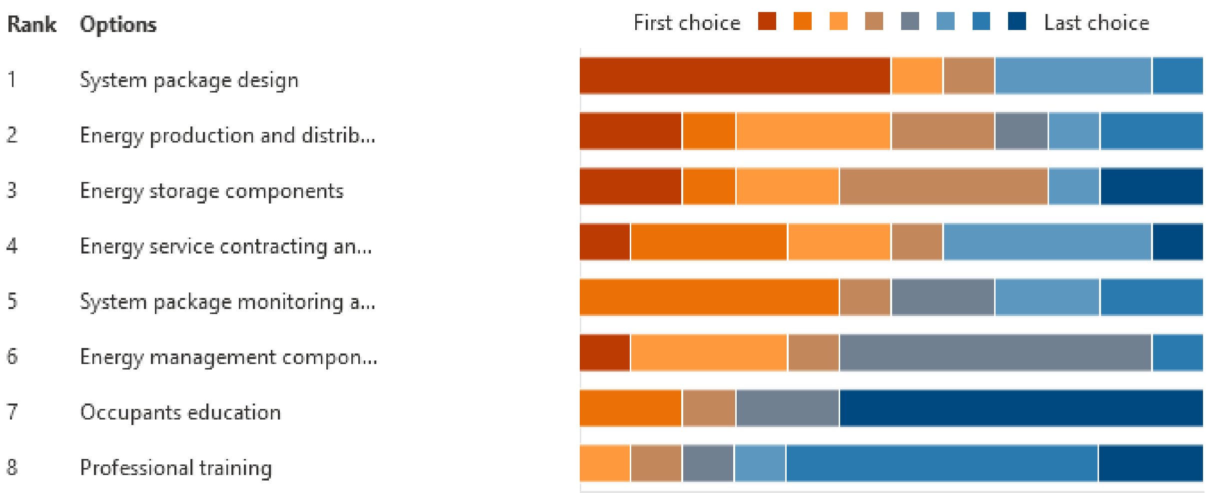
The respondents were then asked about how well they see their own solution covering each building block. As presented in Figure below, their solutions appeared to match the most with “Energy storage components” and “Energy management components”, and the least with “Occupants’ training” and “Professional training”. The results suggest that these two blocks can be particularly challenging to address by the suppliers themselves.



Answers on how well the respondents’ own solution covering each building block.

Figure below presents the respondents’ answers to the question “In your opinion, where lies the difficulty in developing a solution? Please order the building blocks from most difficult (top) to least difficult (bottom). The results suggest that “System package design” is the most difficult, reflecting the core challenge of procuRE, achieving harmonious operation between the needed solutions to undertake 100% renewable retrofits. Although not viewed as challenging, “Energy production and distribution components” and “Energy storage components” were also the blocks that were ranked high by the respondents.

Providing explanations to open-ended questions, some respondents pointed out that sizing energy supply systems right, accurate projections of the demand and flexibility to maximise the economic and environmental benefits are important to minimise the challenges for “Energy production and distribution”. For “Energy storage components”, some respondents highlighted the necessity to use both thermal and electric storage, while others space availability, the price of electricity and types of use for electricity as important factors. For “Energy management components”, the respondents pointed out the need to be able to feed external data to the system, such as weather data, and the necessity to have standardised communication protocols. Regarding “System package design”, they highlighted that there need to be collaborative partners for its development to ensure meeting the set targets. On “System package monitoring and management”, they pointed out that open data interfaces should be mandatory and the dashboards presenting parameters should not be global, presenting only relevant information for the target group. Challenges that were mentioned related to “Energy service contracting and financing” were the need to have more financial institutions that can provide financial solutions, such as leasing, and partnerships with other relevant organisations. Regarding “Professional training”, a challenge was identified as the training of the existing personnel including installers and operators. Finally, on “Occupants’ education”, gamification, incentives, and the necessity to have solutions in the local language and not just English were the named challenges.



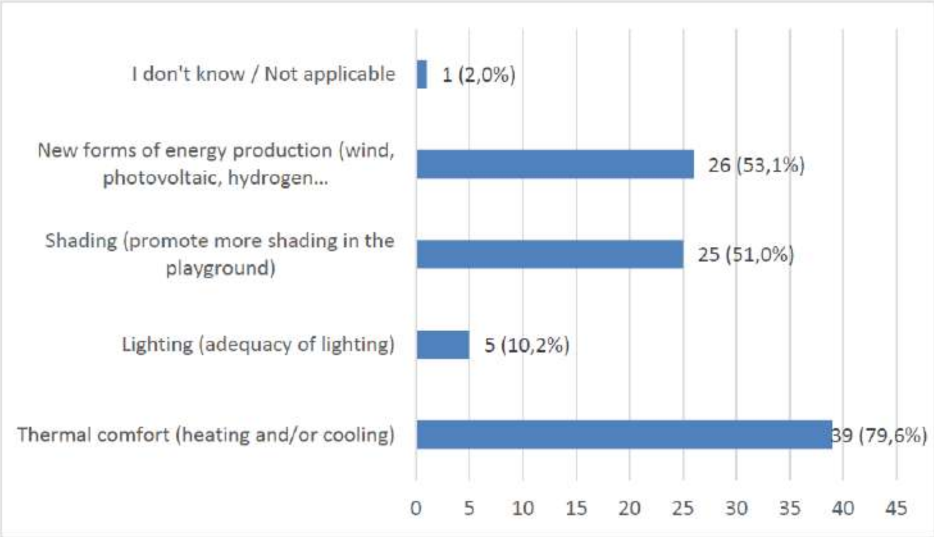
Building blocks ordered by respondents according to the difficulty to address.

7.4 Online Questionnaire in Portugal

For the Portuguese site, an online questionnaire directed at the parents of the students that study at the school was used to collect additional data. A total of 49 respondents answered the questions. This section presents the important findings of the questionnaire.

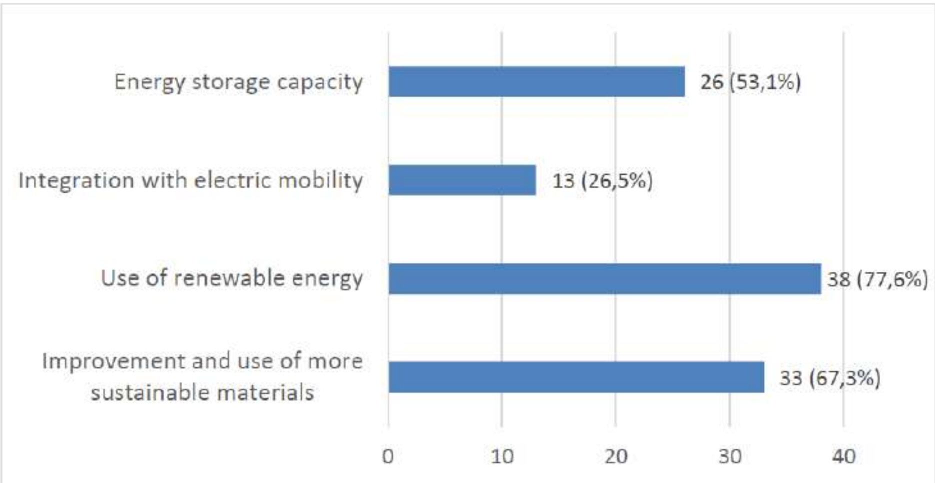
When asked about what they would improve about the current building, with the option to make multiple choices, nearly 80% of the respondents selected “Thermal comfort”, which suggest a low level of satisfaction with the thermal comfort of the current building. Around half of them selected

"New forms of energy production" and "Shading", but only 10% selected lighting, suggesting that it is not considered a particular issue with the current building, according to the parents.



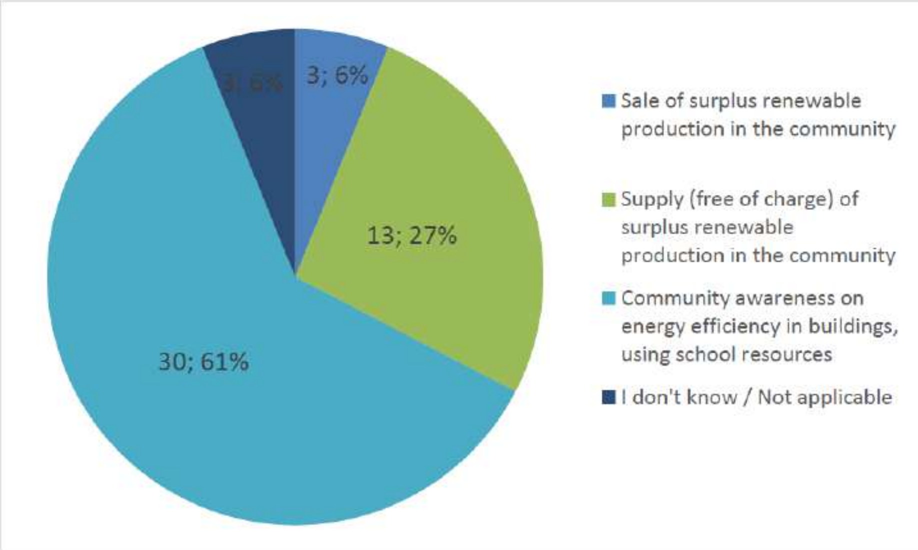
Answers on what to improve in the current building.

The results presented in Figure below shows that the parents firstly define a 100% renewable building as a building that uses renewable energy, with nearly 78% percent of the respondents who selected this answer. This was followed by "Improvement and use of more sustainable materials", which was selected by 67% of the respondents. It appears that the parents do not necessarily associate a 100% renewable building as only around 26% selected this answer.



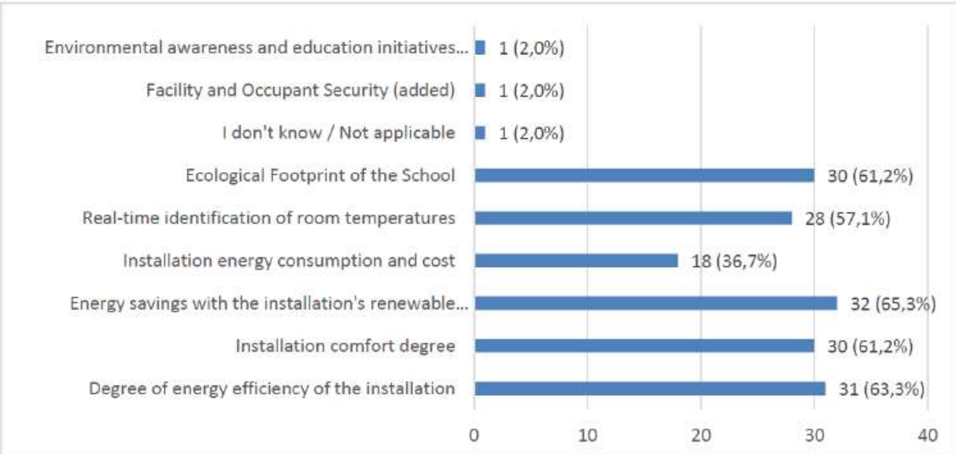
Definition of a 100% renewable building

When asked about what services or functionalities that the building should offer, 61% of the respondents answered “Community awareness on energy efficiency in buildings, using school resources. This answer was followed by “Supply (free of charge) of surplus renewable production in the community, selected by 27% of the respondents. Only a few respondents (6%) considered “Sale of surplus renewable production in the community” to be a primary functionality.



Expected services or functionalities of the building.

According to the parents they would prefer most to receive information, through an online system, on the energy savings of the building through renewable energy supply (65%), the energy efficiency of the installations (63%), as well as on the ecological footprint of the school and the indoor comfort degree (both 61%).



Type of information to be presented to the parents.

7.5 Matchmaking Platform

ProcuRE has encouraged suppliers that cannot cover all the building blocks required for the procuRE solutions to team up with other suppliers. Organisations that are interested in finding partners to create consortia are published on the website. As of 27 September 2021, there are 36 companies that are registered on the platform.

The matchmaking tool is still open. New entries can be submitted via the website and will be added throughout the tendering process. The form that is to be filled out in order to be registered can be found on the procuRE website.

7.6 OMC Conclusions

Despite the COVID-19 outbreak, the procuRE OMCs have attracted wide stakeholders' participation from various countries. This has provided valuable feedback and input for the consortium in terms of the challenge we are tackling: retrofitting buildings to become self-sufficient on 100% renewable energy.

The main conclusions that can be extracted based on the OMCs, the OMC questionnaire, the focus group interviews are:

- There is no solution available on the market that can solve the challenge posed by procuRE.
- Collaboration between suppliers is needed to address the procuRE challenge, particularly for smaller players like SMEs. Suppliers required external support to broker relationships to enable them to work together and highly appreciated the matchmaking tool that was made available.
- Relevant requirements for the tender have been collected, in terms of functional and non-functional requirements, legal and regulatory requirements; and operational, staff and business requirements.
- The consortium has understood the potential barriers to participation that exist and has put in place measures that can soften their impact. Such barriers were mainly of technical and cultural nature.
- Capacity-building in terms of Pre-Commercial Procurement as an instrument has been one of the objectives during the OMCs, informing the participants about its advantages, functioning and other practical aspects.
- After the OMC activities, the procuRE consortium is focused on maintaining the high level of interest and engagement from the participants, ensuring a high number of quality bids during the tender.

8 Annex E: Reference Buildings and Climate Data

Annex E describes the reference building and contains climate data to be used during calculation.

The content is attached as a self-standing archive file TD2a.