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Policy paper on building renovation by public actors
- Insights from procuRE implementation

The procuRE consortium recommends public action on:

- Research on 'system focused renovation' (efficiency, electrification renewables, smartness) as means towards a zero-emission building stock.
- Conduct a procurement of innovative solutions (PPI) to increase competitiveness of 'system focused renovations' (efficiency, electrification, renewables, smartness)
- Develop a commissioning/project solution for municipalities to procure, coordinate, deploy and operate large number of renovations (with upgrade potential for one-stop-shops).
- Encourage the establishment of turn-key providers able to integrate and deploy efficiency, renewable energy and smartness

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Research on 'system focused renovation' (efficiency, electrification renewables, smartness) as means towards a zero-emission building stock

Background

The legislative overhaul of Fit for 55 profoundly increases the ambition and urgency of achieving climate targets. Buildings account for >40% of all energy consumed. The recast of the EPBD focuses on stricter targets for decarbonising and reducing fossil dependency in both the existing and newly constructed building stock. Renovation of the existing buildings remains the biggest challenge due to the complexity, diversity and implementation barriers. By 2050 all existing buildings should be transformed into zero-emission buildings. The EED requires all cities above 45,000 inhabitants to develop heating and cooling plans. 75% of the existing building stock is inefficient and requires action to reach zero-emission targets by 2050.

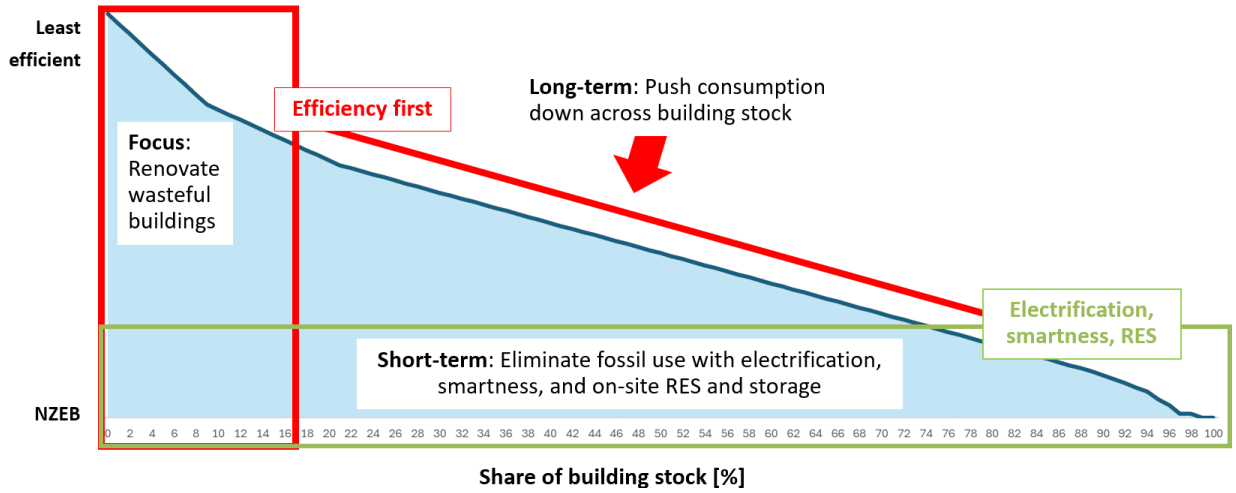
About authors and procuRE project outline

The cities in the innovation procurement procuRE have ambitious net-zero targets. To succeed energy consumption in all public buildings must tackled within the next 10-15 years. This is impossible, given the workload of regular renovation projects as well as various constraints described in further detail below. Instead, the project aims to identify approaches which merge efficiency first for high-energy systems (e.g. HVAC, light), on-site renewable energy sources and storage whilst integrating old systems to ensure efficient operation. The original Challenge Brief describes the varying challenges for large-scale pick-up in detail.[1]

Achieving zero-emission target in existing building stock

The performance of the buildings stock can be displayed by sorting each building from high consumption to low consumption. The resulting graphic shows the distribution of buildings' average yearly energy consumption as a function of the building stock share. The concept is similar to a load duration curve[2] used for energy systems and in energy production.

Figure 1. Building stock sorted by level of consumption– exemplary depiction[3]



1 https://procure-pcp.eu/wp-content/uploads/2022/05/procuRE-RfT-TD2-Challenge-Brief-SHORT.pdf

2 See references on Springer: https://www.sciencedirect.com/topics/engineering/load-duration-curve

3 Since data access to EPCs is limited and not harmonised the exact shape of the profile is unknown and content of the recommendation.

Following the efficiency first principle, the current EU policy targeting the building stock consists of two major vectors:

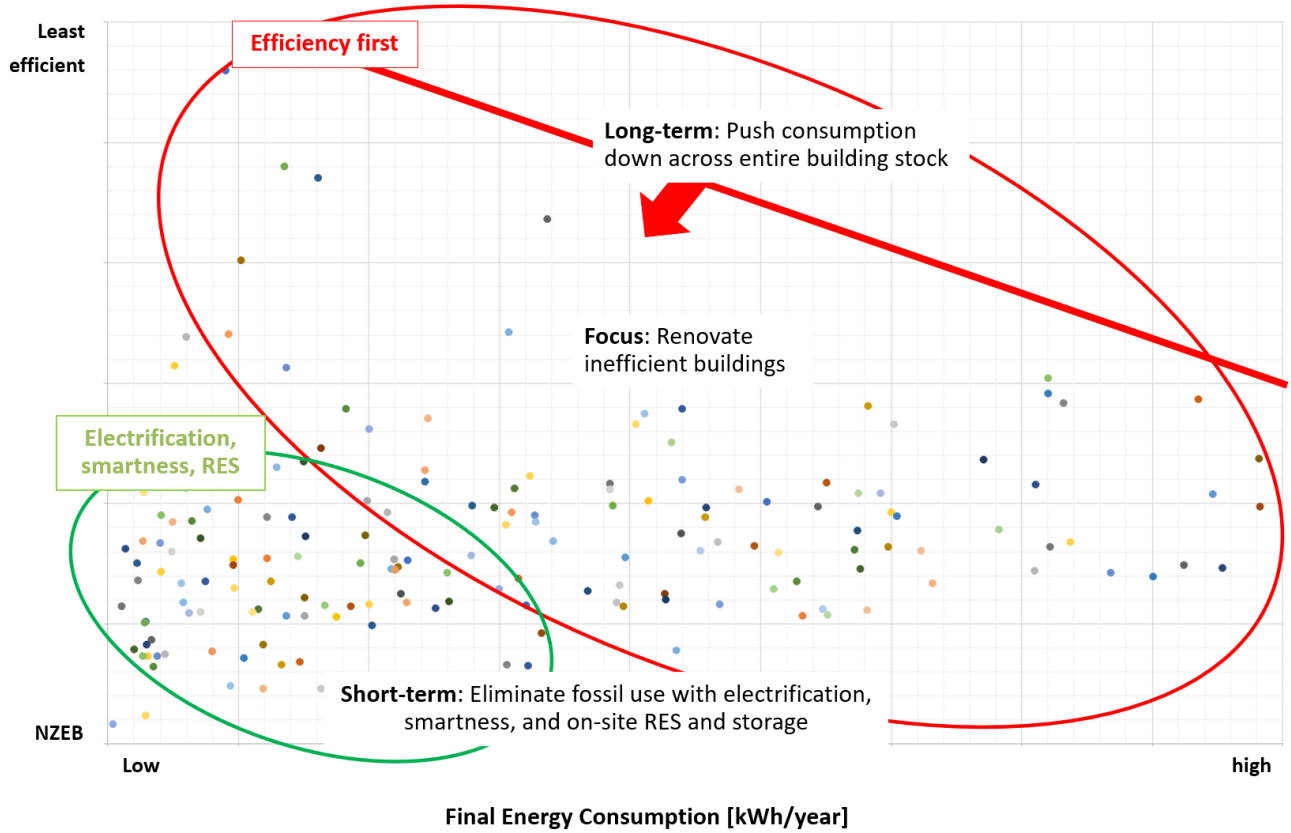
- The **focus is on high-consumption buildings** to reap the lowest-hanging fruit with the highest energetic return on investment (e.g. minimum requirements, incentives, renovation passports).
- **Long-term**, the consumption of the entire building stock is to be pushed downwards by a large number of measures such building standards on national level and implementation of renovation passports on individual level.

This paper suggests to complement the strategy with and additional short-term pillar targeting buildings with adequate envelope quality to electrify and de-fossilise consumption to the largest possible degree provided it is possible to achieve this with minimal planning and construction effort and at low costs.

Local example of a building stock

The structure of the local buildings stocks is a key driver in the search for an alternative approach to reduce energy consumption and emissions. The below graphic depicts the building stock of a mid-sized city as data points mapped by their total consumption and specific energy consumption per square meter (actual data as of 2024).

Figure 2. Sample Building Stock of a medium-sized City – Heating Energy Consumption



The distribution of buildings thins out in both dimensions. The largest number of buildings has small or medium sized consumption with varying levels of efficiency. This corresponds well with the fact that most buildings are small and mid-sized.

Current city activity often focuses on the small number of large consumers and buildings with very low efficiency. For the rest of the building stock – smaller and medium-sized buildings – renovations are driven by need to do something bringing along some energy savings. These renovations are extremely labour intensive in planning, commissioning and implementation.

For most cities and local economies the current "renovation load" is already overburdening – this includes both the municipal staff as well as most trades required. Availability of easily accessible funds clearly play a role as recent years have shown that increasing local demand combined with the material dependency of Europe will result in high prices eventually reducing the total number of renovations. To progress, horizontal measures such as deployment of heat pumps are sometimes undertaken. However, naïve installations typically omit efficiency potentials and are poorly integrated with legacy systems. Whilst combination with RES is obvious, it is often omitted or poorly designed inducing medium-term risk of congestion in the local grid.

This paper suggests investigating solutions which are able to tackle the large number smaller and medium sized buildings. The measures should utilise economies of scale, minimise material use, can be undertaken within a couple of months. This will enable cities to utilise precocious capacity on low efficiency building stock.

Municipal/regional needs and insights (procuRE project)

The procuRE project underpins the EC policy for zero-emission buildings by aiming to lift many buildings to the optimal efficiency level and remove fossil dependency through maximising on-site RES production and optimising self-sufficiency through system integration and smartness without intervention in building fabric. The project deploys a replicable Renovation Approach capable of delivering the highest possible renewable energy supply to an existing non-residential building with adequate envelope quality at affordable costs.

An increasing number of cities, regions and other owners of major building portfolios wish to achieve fossil-free buildings by 2035/2040 (e.g. Nuremberg need to switch 120 buildings from gas to heat pumps). There are an estimated 780,000 educational buildings and 3.4 million offices in the EU[4]. Only 9% of non-residential buildings are already nZEB.

Building departments and energy agencies in municipalities are unable to deliver the necessary scope of renovations due to a lack of capacity (staff including specialists) and the complexity of renovation processes (including the increasing number of technologies). The suggested approaches bring the following advantages to cities and the wider European industry:

- De-fossilisation completed within a couple of months and at low costs of €50-220 Euro per square meter for buildings greater than 2,000 m² and 500 Euro/m² for a 700 m²office. (i.e. no lengthy measures to the envelope).
- Economies of scale are utilised as most effort is occurring off-site at industrial scale (e.g. production of PV and storage, ready-to-install preparation of BACs and devices)
- Capacity of trades and city resources are freed up to focus on inefficient buildings requiring time-consuming envelope measures (i.e. planning, permits. Construction) with low impact are avoided;
- Integrating complex systems (e.g. HVAC, RES, storage, BACS), increasing efficiency, users' comfort and other Smart-Ready Indicator (SRI[5]) linked benefits.

4 https://ec.europa.eu/energy/eu-buildings-database_en

5 https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings/smart-readiness-indicator_en

- Reduction of environmental impact and material waste.
- Facilitation of rapid turnkey offers with great potential for ESCOs linking incentives to fossil-free building operation.

Evidence on the implementation of the active renovation approach is currently being collected in six non-residential buildings (three schools and three offices).

Recommendation/Request

Establish "specific consumption curves" of building stock for Member States and conduct research into the potential of eliminating fossil fuel consumption through high-impact efficiency gains, smartness, RES and storage with focus on small and medium sized buildings.

The current version of DEEP[6] does not map measures covering smartness, storage and RES hereby excluding a wide range of technologically available options. Since financial institutions are notoriously averse to complexity – it being perceived as risk – system focused renovations considering the building as a whole are unlikely to gather funding. Partner EURAC has conducted research for an PPP which could be included.

One-stop-shops will be able to understand the local market conditions including prices, delays due to labour or material shortages. To minimise emissions in the local building stock and integrate with the heating and cooling plants, one-stop-shops need a larger set of tools. They require guidance on how to identify buildings with adequate efficiency which could be suitable for a system renovation approach utilising high-impact efficiency, electrification, renewables and storage. Further, they will require guidance and training as well as communication means to explain such novel approach.

Suggested Instruments (any): Technical or feasibility study or fitness check, JRC paper. Alternatively, a large CSA aiming for a large base.

Conduct a procurement of innovative solutions (PPI) to increase competitiveness of 'system focused renovations' (efficiency, electrification, renewables, smartness)

Background

The procuRE project has conducted an innovation procurement for system focused renovations. Currently, six buildings are being deployed and tested. The cites in the consortium are willing to equip further buildings following this approach.

This paper suggests building on the progress and establish a PPI following the procuRE PCP and further advance the competitiveness of providers able to renovate buildings systematically hereby eliminating emissions to the largest possible degree.

Insights from procuRE

The pre-commercial procurement procuRE has foreseen three major innovation components:

- Integrate various off-the-shelf systems to electrify and de-fossilise consumption of in buildings with adequate envelope quality to the largest possible degree

6 https://deep.ec.europa.eu/

- Define a renovation approach and tools which can be applied to other buildings quickly and cheaply.
- Coordination process between cities and suppliers

The future PPI should cover the first two aspects. The third aspect should be excluded for reasons described in the following section.

Suggested scope of a PPI

The PPI should challenge the entire market for competition. To ensure this is possible all lessons of the procuRE project are to be incorporated (a first lessons learnt deliverable was submitted and full guidance is foreseen). To achieve scale, the following should be achieved (a full motivation in deliverables) – the list is non-exhaustive:

- Procure system renovations for multiple buildings per site.
- Enable fully localised tenders (i.e. do not mix multiple cross-border services within the same lot) to establish nationally present and active suppliers.
- Ensure the main supplier provides turn-key services and being fully responsible for organisation of any local subcontractors required.
- Optimise the maximisation problem of:
    - increasing energy efficiency,
    - increasing RES and storage,
    - increasing comfort and health of users,
    - minimising the impact on the grid and increasing grid flexibility where possible,
    - reducing cost and implementation effort.
- Integrate legacy and new active systems for optimal operation and continuous commissioning.
- Demand tools and documentation capable of being replicated form the first renovation to other similar sites.
- Enshrine relevant KPIs to be followed through all stages of planning and deployment.
- Fixate milestones suitable for the instrument and innovation desired.
- Increase competitiveness of successful suppliers.
- Show capacity to recruit follower cities willing to procure the solution having reached competitive price levels.

With regard to the renovation cost of each building, it should be noted that procuRE budget and number of buildings was defined before an unprecedented period of inflation which impacted procuRE and resulted in a reduction in the size of storage capacity compared to what was tendered. Hence, to achieve the maximum impact, on average, half a million per building for material and works costs are considered viable. In addition, suppliers will require budget for development of their tools and the highly scalable planning process. The organisation in lots would further incentivise economies of scale and establishing of national offices.

Recommendation/Request

Establish a PPI of sufficient size to equip at least three buildings per site, ideally in six or more cities. The overall suggested budget is 15-18 million (50% funding).

Suggested Instruments: PPI.

Develop a commissioning/project solution for municipalities to procure, coordinate, deploy and operate large number of renovations (with upgrade potential for one-stop-shops)

Background

Currently, operators of public building encounter huge difficulties when procuring a renovation or the necessary services and are therefore forced to buy-in and sometimes coordinate services and works increasing the number of possible points of failure. For decades, renovation projects have been suffering from coordination and communication breakdowns leading to additional effort required.

The current situation is overburdening to cities and regions in terms of resources and the expertise required to be kept in-house. As a result, fewer renovations are planned and conducted delaying the ambitions of cities to become carbon-neutral and to lead by example.

During renovations, the devil is in the detail (e.g. is each element load-bearing, can cables go across a surface, is there sufficient space, access during school holidays). Any such questions should only be answered once reliably and not hold up work. This requires clear structures, processes and communication on both sides.

Insights from procuRE

The pre-commercial procurement attempted to trigger innovation in this critical area as a secondary objective. Unfortunately, the suppliers have not delivered sufficient innovation in this regard. The reason are connected to the fact that the incentives and needs of suppliers (i.e. the party developing the renovation) and procurers (i.e. cities) are not aligned. There is no benefit for suppliers to disclose intermediate steps and planning or make all calculations and iterations traceable even if proactive procurers would be the enabled to improve the process, avoid or flag possible errors and added costs down the line. The current experience has and will remain to induce immense efficiency losses in time and costs which cannot be utilised for another renovation. In this context, the procuRE project has repeatedly assessed BIM solutions which, at this stage, are to complex, incomplete and expensive for renovation projects in average size buildings.

This paper argues that cities need better tools for project management of renovation projects. Current tools are biased towards the needs of contractors which results in outsourcing of effort and inefficient use of time in the responsible departments.

A dedicated and specialised tool for basic multi-stakeholder project management of renovations (or simplified and extended BIM) is required which is able to cover organisational and procedural aspects of planning, exchanging on and implementing a renovation. An efficient, effective, and reliable commissioning solution includes at least the following:

- One-face to the customer approach
- Clarity on responsibilities and timing from design to implementation
- 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

- Regarding data
  - A near live working repository for all related files including intermediate iterations
  - Transparency on the most recent version and all recent changes to the Renovation Package aiding quick orientation by procurers
  - Where possible and utilised integration and links to BIM models or other tools
- In addition, the following features are desirable after commissioning was completed:
  - Interactive training and upskilling materials for building operators
  - Tracking of performance against KPIs
  - Reasoning for divergence from performance targets including cost estimates
  - Transparency on operating and maintenance costs
  - Analysis of impact of occupant behaviour, unused potentials, and the utilisation of education
  - Predictive maintenance
  - Recommendations for mitigation and / or optimisation measures

Recommendation/Request

Support development of a commissioning, two-sided project management tool (building on existing frameworks) for public organisations and/or support co-development of simplified BIM solutions with cities (i.e. not those targeting high-yield new built projects), which the cities can customise and enforce onto renovation contractors. The tool should be globally installable or provided via a platform at low costs. It needs to be applied and tested during regular renovation processes. It should be scalable permitting testing by parties not at the core of requirement collection and use case design. Any emerging solution is likely to benefit the entire renovation market.

Potential to deploy in one-stop-shop: Once developed and tested, the solution could also be deployed as part of one-stop-shops for renovations for persons and SMEs with the local public body (i.e. energy agency or building operator) serving as a gateway and advising organisations during renovations. Full transparency provided by the solution would enable third-parties to quickly and easily contribute at any stage of a renovation project.

Suggested Instruments: Launch a topic for RIA or IA of €6-10 million Euros (or a dedicated PCP of €8-10 million) for development and testing. If it is also to be tested as part of a one-stop-shop, the sum should be increased as it may require significant personal effort.

Remarks: Given the market research conducted by the procuRE PCP and the request conducted through the PCP, the market is not expected to deliver the product by itself as the 'cost' of intransparency and inefficiency can be fully externalised to the procuring public organisations (e.g. cities and regions). Public action is advised.

Encourage the establishment of turn-key providers able to integrate and deploy efficiency, renewable energy and smartness

Background

Active system integration increases the interdependencies and complexity of renovations both regarding physical connections (i.e. wires, piping) and IT-systems during design and implementation. During design, interoperability must be ensured which, however, is often complicated as the leading or most restrictive system might only emerge during planning. Also during implementation, it is helpful if the system is considered as a whole to ensure that all use cases are implemented.

As described above it is often necessary to contract multiple trades during renovations. This complexity results in greater need of communication, mistakes and as a result of both costs.

Finally, renovations with multiple interconnected systems imply friction during operation, clear responsibility for guarantee and maintenance.

As of today, only a small number of turnkey providers able to conduct an active-system renovation exist. Turnkey providers are – at the minimum – contractors able to involve and provide all necessary trades. By extension, they also typically offer design and planning services also offering start to end services.

This paper argues that establishment of turnkey providers, especially in connection with active and smart systems, should be supported.

procuRE insights (complementing background)

During procuRE, suppliers specialised on holistic and systemic renovation had to develop six Renovation Packages for six buildings in direct exchange with the cities. Ultimately, two suppliers were selected and are installing three buildings each.

Despite procurer's direct access to local subcontractors, the selection and coordination of subcontractors required extensive effort. In some cases, local project managers needed to be hired. In any case a local face to the customer and to the sub-contractors is crucial for success.

Recommendation/Request

Support, incentivise and facilitate the creation of turnkey-providers, particularly in the field of smart and renewable energy renovations.

Suggested Instruments: CSAs documenting the need and supporting the creation and merger of businesses to become turnkey providers on local level.

Procurers

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