Positive Energy Building Upgrade Plan for Kuringen

In the case of **Kuringen**, the building under replication does not constitute an independent building; instead, it belongs to a larger district area, which makes the PEB implementation effort a more ambitious job. Instead of renovating, in this redevelopment project, the decision was for the social housing apartments to be demolished, this way being possible to rebuild them in a more compact way, which allows an increase in the number of dwellings and thus employ a central heating system that covers a more significant number of beneficiaries.
The social housing company WIL (Wonen In Limburg) is the building owner and responsible for managing the site. This includes technical operations, user administration, social services and support for their tenants.

While the Flemish Society for Social Housing provides guidelines for new construction and renovation projects, support on technical aspects such as renewable energy technologies and PEB concepts is not included. As a result, the social housing company is responsible for knowledge and capacity building in these areas. Therefore, WIL considers the PEB concept as a good practice example of how to use energy technology optimally.

WIL emphasizes the importance of incorporating PEB replication in renovation projects. The number of prospective tenants has been steadily increasing in recent years, and there simply aren't enough dwellings available to meet the demand. While in many cases, it may be more effective to demolish and rebuild, renovation is often chosen instead due to the shorter lead time.

An important driver for rebuilding older dwellings is the trend to build more compact. Older dwellings are often large in terms of available floor surface compared to modern standards. More dwellings can be created on existing building plots, which in terms of energy efficiency, is also the preferred option.

In addition, redeveloping the full building stock helps retrofit the energy system since the new building elements can already be focused on applying newer and more updated, environmentally friendly materials and practices. Older buildings usually hinder the use of such elements because, at the time of their construction, they were not thought to support systems of this kind.

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1 Baseline assessment of the implementation environment

1.1 Building description

Within this project outdated social housing apartments from the 1970s are demolished and rebuilt. The decision to rebuild most of the apartment buildings was motivated by two main drivers. First, a detailed cost assessment indicated that renovation costs accounted for more than 80% of the costs for new built. In addition, new buildings could be constructed more compact which resulted in a significant increase in number of dwellings on the same surface area.

The replication case in Kuringen is part of a larger redevelopment project. In Figure 1 the masterplan is presented. In 2023, the buildings on the far left are already in use while the buildings on the lower right corner are still under construction. Therefore, the project conducted is to fully redevelop the building stock, carried out by WIL as building promoter, and constructed by DBV Architecten, during the years of 2016-2018. The typology of the building is aimed to be of residential multi-family apartments, with a total of 30 dwellings and a central heating system connected to a small scale heating network.

Figure 1 Overview of the area which is under redevelopment - buildings considered in replication plans are located on the left and marked in green (image courtesy: Cordium - WIL) (Address: Rode Rokstraat, 3511 Kuringen, Belgium)

1.2 Regulatory aspects and public support schemes

Rode Rok Building Regulations
At a local level, in the city of Hasselt, there are a series of guidelines[1] for spatial integration, architectural development, and living quality in residential construction projects, which are as follows:

Solar panels or boiler systems should always be designed as an integrated part of the roof surface. Free-standing constructions are not allowed. In this sense, solar panels must be integrated into the roof surface for sloping roofs. For flat roofs, the latter must be within the orthogonal structure of the main volume.

The architectural development must realize spatial integration in a contemporary, high-quality manner. All structures must be constructed from materials responsible for durability and appearance. They must fit harmoniously into the environment and form a coherent whole within their plot.

[1] HERZIENING "RODE ROK" 102Bis naar 102Ter, STEDENBOUWKUNDIGE VOORSCHRIFTEN

Furthermore, residential units must prioritize living quality, ensuring natural lighting, ventilation, and privacy. First-floor terraces are permitted if they don't compromise neighbouring privacy, with potential shielding incorporated into the design.

Preservation of existing trees and relief is required and must be indicated on building plans, with allowances for justified changes. Entrances to garages should be minimized, with individual underground garages allowed only with environmental justifications. Further information can be found in the information note on ordinary urban planning regulations of Rode Rok.

National and regional level regulations
At a national level, only fire resistance and energy performance are regulated. Fire resistance is arranged in terms of risk classes related to fire-fighting equipment. The general objectives of the legislation determine the minimum conditions to be met by the design, construction, and layout of buildings.

The applicable energy performance requirements have set criteria for primary energy consumption, insulation level, ventilation rate, overheating, and technical installations. These requirements differ for new or renovated buildings and units depending on the function (residential, office, educational, other non-residential). As of 2025, fossil fuel-based heating systems will no longer be allowed for new residential buildings, and low-temperature heat emission systems will become obligatory.

There are regulatory aspects to consider when installing larger PV or PVT installations (> 10kVA). The DSO needs to verify whether the local grid can support the new PV installation. This study is free of charge for installations up to 25 kVA. For larger installations, the fee can amount to 550 € per connection. This procedure can be initiated via a web form on the DSO website (www.fluvius.be).

PV installations larger than 30 kVA require grid disconnection protection according to the Synergrid technical requirements. The investment costs for a grid disconnection setup are approximately 5 to 10 k€ per unit.

The technology packages considered in the replication plan all exceed the threshold of 30 kVA. Therefore, these additional investment costs are taken into account. The impact on the global costs over 20 years is limited.

In 2022, a framework for energy sharing was established in Flanders under the incentive of the European Clean Energy Package. This framework provides a legal basis for trade and energy sharing between stakeholders. The local DSO facilitates this by managing and sharing detailed energy consumption data. Energy transactions are evaluated on a 15-minute time basis. The following transactions are made possible:

- Peer-to-peer trade.
- Multiple peer-to-peer trade.
- Energy sharing within a building.
- Energy sharing between buildings with the same owner.
- Energy sharing within a (renewable) energy community.

The most attractive solution is for social housing companies (SHCs) in the context of PEBs' energy sharing within the SHCs' patrimony. Moreover, PEBs can be considered the cornerstone of this setup.

Buildings with large PV installations can provide excess energy to buildings that still have a net electricity demand at that moment, such as a building without PV and with a central electrical heat pump consuming electricity from a building with excess PV energy.

According to the most recent 2023 numbers for Flanders, 756 projects are registered where energy is shared in one of the formats mentioned above. Approximately 50% of these projects share energy between buildings of the same owner.

Thorough insulation is essential for an energy-efficient building envelope to reach the PEB standard. For renovation projects, nZEB insulation levels should be considered a target; for new-built projects, this is already a requirement, according to EPBD. Therefore, PEB technologies should be considered first for more recent buildings that meet the EPBD requirements during construction.

EU level
At the EU level, new constructions must ensure the building meets high energy performance standards in accordance with the EPBD. The directive also mandates optimizing health, indoor air quality, and comfort levels in building energy calculations and highlights the IEQ impacts on health, productivity, and overall well-being of building occupants.

1.3 Social Dimension

Converting buildings to Positive Energy Buildings involves more than upgrading the technical infrastructure. Social aspects should also be considered to improve the wellbeing of residents and the local community. In the three Belgian replication plans, the targeted buildings house socially vulnerable populations. Rather than focusing solely on one specific demographic, a diverse range of socially vulnerable groups in considered, ensuring inclusivity, and addressing various social challenges. This way, societal groups most prone to energy poverty can benefit from energy-efficient renovations, ultimately decreasing their energy consumption. As the project findings of EXCESS show, this goes along with education and methods to increase energy efficiency on the apartment/unit level and the overall energy management of the building. Recent studies suggest that energy-efficient renovations prove to significantly decrease overall energy costs for tenants in social housing, showing that energy-efficient renovations can tackle energy poverty.[2] In the replication case of Kuringen, which is part of a larger district, energy trading and the embeddedness of the replication building into the area are other important factors to consider for the social sustainability of integrating positive energy technologies into the new built apartment blocks.

[2] Aranda J, Zabalza I, Conserva A, Millán G. Analysis of Energy Efficiency Measures and Retrofitting Solutions for Social Housing Buildings in Spain as a Way to Mitigate Energy Poverty. *Sustainability*. 2017; 9(10):1869. https://doi.org/10.3390/su9101869

2 Technical information / design specifications

Key technologies installed

- Geothermal heat pumps (2 x 39 kWth) with 14 x 100m boreholes. The BTES is not used for cooling purposes. The heating architecture is central, and once all buildings are completed, the individual central heating systems will be connected with each other via a thermal network similar to the heating architecture in the Excess demo site in Kuringen. There is a gas-fired backup heating system (70 + 80kWth).
- Underfloor heating and radiators inside the apartments
- Individual ventilation systems without heat recovery (type C)
- Solar thermal panels for domestic hot water, 6 x 24 vacuum tube solar collectors

Energy balance

The specific energy demand of the buildings is compared to the energy demand of the EXCESS demo project in Figure 2. Since the Rode Rok buildings were constructed more recently, the building envelope is more efficient due to strict EPBD requirements. In addition, the heat generation system is already advanced compared to the heat generation systems typically installed in similar buildings. Also, the building promoter considered essential learnings from the Excess demo site in the design process (e.g., collective heating, decentralised boilers, etc.)

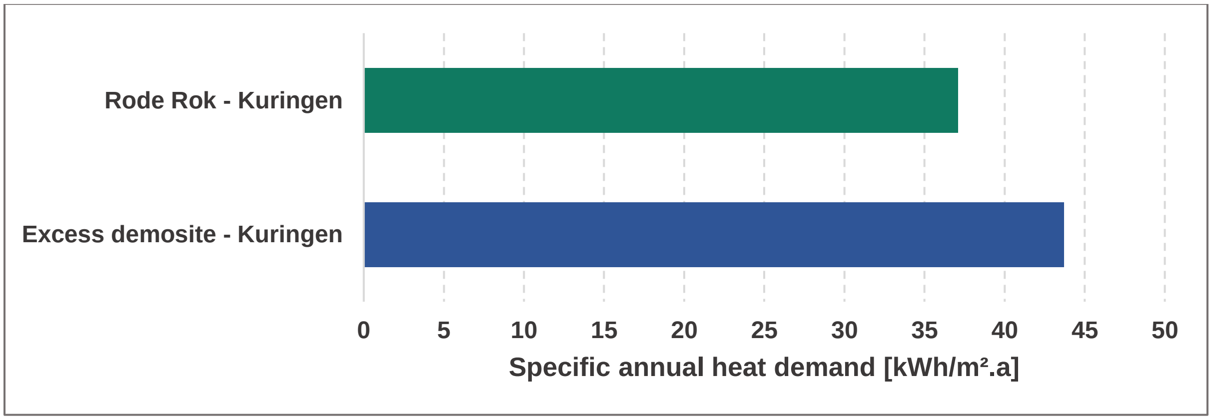


Figure 2: Specific heat demand for space heating according to EPB calculation method

PEB evaluation

The Kuringen replication plan is the largest of all three, with around 130 dwellings. Two PEB technology packages are considered. Both packages include geothermal heating, solar thermal, and PV panels. A PV installation of 76 kW is required to reach the PEB target; therefore, the minimum package consists of a PV installation of 76 kW (PV_min). The large roof surface area of the buildings could facilitate a larger PV installation of up to 200 kW; this is considered the maximal scenario (PV_max).

The following technology packages are evaluated for project Rode Rok:

- Collective geothermal heat pump + District heating network + PV_{min} **(HPgeo_DHN_PV_min)**
- Collective geothermal heat pump + District heating network + PV_{max} **(HPgeo_DHN_PV_max)**

With:

- PV_{min} The minimal surface of PV is installed in order to reach PEB level (Net primary energy demand = 0)
- PV_{max}: All available roof surface area is used to install PV.

Individual heating systems are not considered due to the apartments' heating network and heat interface units. Air source heat pumps are not considered since geothermal heat pumps are already installed on-site.

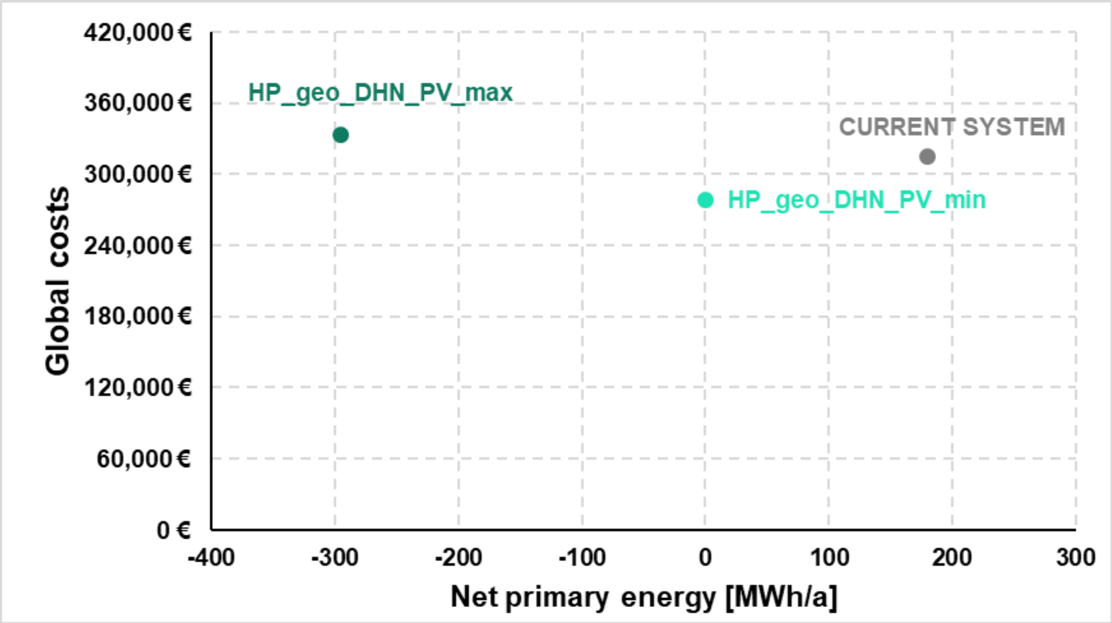


Figure 3 Global costs of PEB technology packages for project Rode Rok in Kuringen

Based on the results of the techno-economic analysis, the building is very suitable for the conversion to PEB:

- Well-insulated and energy-efficient building envelope
- Energy-efficient geothermal heat pumps are already installed.
- Large roof surface available (ideal orientation and no shading) for the installation of PV
- Thermal storage capacity for heating and domestic hot water storage provides flexibility to increase the self-consumption ratio.
- The heating concept (centralized with the heating network) allows retrofitting solutions.

As Figure 3 shows, global costs increase slightly when scaling up the size of the PV installation. Over a period of 20 years, the global costs can be reduced by +/- 38k€ for the minimum PV package.

3 Business model details & possible financing arrangements

The social housing company can rely on the Flemish climate fund or apply for specific subsidy schemes to implement energy efficiency schemes in social housing infrastructure. These schemes can be used for large and smaller renovation projects (e.g., heating system replacement and building envelope thermal performance improvement). In July 2023, a total resource volume of 70 M€ was available within the climate fund.

Photovoltaic panels are also applied more frequently in social houses. The Aster project (supported by the European Commission and the European Investment Bank) is accelerated using an appropriate split-incentive financing model. The social housing company invests in PV panels, and the tenants purchase PV energy from the social housing company at a reduced tariff. Excess electricity is sold to the market. This model can also be applied to other energy-efficient technologies.

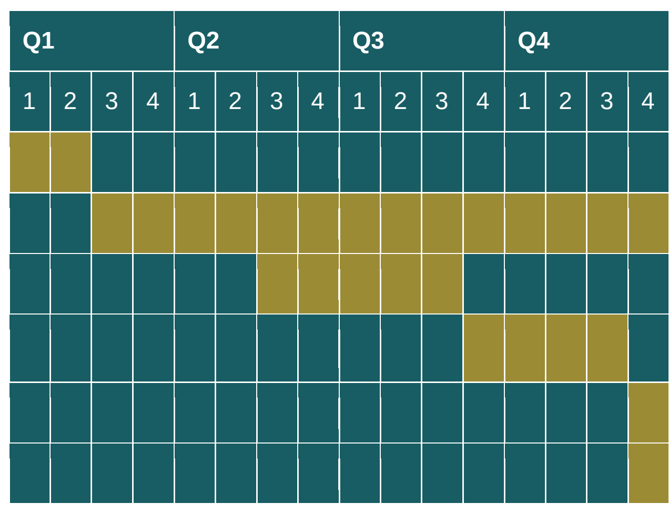
Under the incentive of the Energy Performance of Buildings Directive, heat pumps are also becoming more widespread for new building projects, such as the replication case in Kuringen. The social housing company invests in energy-efficient technology, and the users benefit from the savings on their energy consumption. The social housing company receives a reduction in the real estate tax for energy-efficient dwellings. WIL also recovers part of the additional investment for centralized sustainable heating systems via the heat tariff.

4 Possible PEB upgrade timeline

A high-level upgrade timeline is included in the replication plans. This timeline includes experiences from the demo partners gained during the roll-out of the PEB concepts during the Excess project. No permits are required for the installation of the technology packages considered. The installation of the roof PV installation is very straightforward and will only cause minimal disruptions in the heating system operations during the installation phase. The energy management system can be applied without hardware modifications to the existing building management control system. The total duration of the project is estimated to be approximately one year.

PEB Upgrade Activities in M01 to M06

- Activity A – Concept definition
- Activity B – Project planning
- Activity C – Project procurement
- Activity D – Installation process
- Activity E – Commissioning
- Activity F – System monitoring



5 Local Governments Recommendations

Local governments support the development of affordable housing, with social housing being a key component. Each municipality in Flanders has been assigned a binding objective, which sets the minimum number of social housing units that must be provided within their territory by 2025.

In an effort to accelerate the energy efficiency of these dwellings, local governments could support PEB retrofits in various ways:

First, local governments should establish support mechanisms to facilitate the access of energy efficiency to the market via energy communities.

To encourage the building of PEBs, local planning should enable higher density and more compact buildings while energy efficiency goals can be incorporated in local zoning plans.

In addition, complementing regional and national grant or subsidy schemes, local governments could entertain the establishment of a special fund for PEB support and/or act as a guarantor for banks to offer low-interest loans for PEB projects.

In the context of privately owned houses, LGs could also set up a fund to support low-income households and those at risk of energy poverty to implement energy renovations. When feasible, more flexible requirements should be introduced regarding energy performance systems in buildings.

Lastly, local governments should enhance technical advisory services (One-Stop Shops) so that building owners could approach public officers to support them with decision making on which measures, subsidies or grants to apply for in order to enhance energy performance of buildings.