PED-ID

Holistic assessment and innovative stakeholder involvement process
for identification of Positive-Energy-Districts

D5.1 Living Labs: PED-ID experiences in Sweden, Austria & Czech Republic

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Authors	Camilla Rampinelli (e7) Gerhard Hofer (e7) Václav Šebek (SEVEn) Jakub Kvasnica (SEVEn) Jiří Karásek (SEVEn) Andreas Eggertsen Teder (white) Keith Boxer (white)

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Version	Date of issue	Content and changes	Edited by
V1	27/06/2022	Final Version	Camilla Rampinelli (e7)

Peer reviewed by:

Partner	Reviewer
white	Andreas Eggertsen Teder (white)
SEVEn	Václav Šebek (SEVEn) Jakub Kvasnica (SEVEn)

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Acronyms table

AT	Austria
CO_2	Carbon Dioxide
CZ	Czech Republic
EE	Energy Efficiency
EU	European Union
GHG	Green House Gases
PED	Positive Energy Districts
RES	Renewable Energy Sources
SE	Sweden
UBP	Uppsala Business Park

1 Introduction

1.1 PED-ID Project

PED-ID is an innovation project that aims to accelerate the decarbonisation of the urban environment, by promoting the implementation of Positive-Energy-Districts (PED). PEDs essentially are districts in urban areas that manage their resources to achieve net-zero energy balance (more energy is produced than consumed) and to reduce the emissions of greenhouse gases. This project **provides decision-makers with improved information about PED options and impacts at an early stage and creates a corresponding knowledge-based** participation process. The data will be collected and calculated with the help of a methodology and prepared for the appropriate target group. The target groups can actively use these in the data-driven participation process, consolidate their opinions and make decisions based on data. This process will be tested using real Living Labs of potential PED projects. This concerns the participation process and the development of the necessary data. With the help of this method, the decision on PED sites will be accelerated to reach the goal of 100 PED sites in Europe.

1.2 The Living Lab experience

An essential part of the PED-ID work scope was to apply in real environment contexts the methods and tools developed specifically for PEDs in the previous work packages. This testing procedure happened through our Living Labs, located in Sweden, Austria and Czech Republic.

The objective of this task was not only to test but also to optimize the further development methods, processes and presentation tools using actual areas and initiatives involving building and urban developers, municipalities and many more stakeholders. Therefore, the whole PED-ID project was elaborated in an iterative feedback loop, in which we re-assessed our proposed methodology based on the living lab experience.

1.3 Scope of this document

The topics in the report are divided as follows:

- **Sweden | Uppsala Business Park**: Reporting on the actions and process developed in this living lab: PED vision, Stakeholder engagement, results achieved.
- **Austria | Kempelenpark**: Reporting on the actions and process developed in this living lab: PED vision, Stakeholder engagement, results achieved
- **Czech Republic | Rožnov pod Radhoštěm**: Reporting on the actions and process developed in this living lab: PED vision, Stakeholder engagement, results achieved.
- **Tailored Criteria Catalogue for PED-ID Living Labs**: Application of the criteria catalog proposed - how to describe a PED with specific technical indicators.
- **Cross Country Evaluation**: Comparing experiences, lessons learned and achievements.

2 Sweden | Uppsala Business Park

2.1 Site description

Uppsala Business Park (UBP) is a Lifescience district in Uppsala, a city located north of Stockholm. The city is known for Uppsala University, founded in the 15th century. The innovation-based industry has sprung out of a collaboration between the Universities in Uppsala, business development and society. The district was developed by Pharmacia in the 60s that laid the foundation for the life science and biotech industry that characterize the district. The sector gained an international reputation and made advances in the life science industry. For decades, leading research and production of pharmaceuticals and diagnostic instruments were made here. In 1971 the main Pharmacia laboratory building won the Kasper Salin Prize for the best building in Sweden and still represents one of the great architectonic achievements of the modern era. The jury stated that "the facility is an example of buildings where the requirements for technical rationality and a good working environment have been combined in a strong artistic design.

Figure 1: Illustration of Uppsala Business Park and surroundings (Source: Mandaworks)

Key data:

- **Approximate area of the site:** 700 000 m² total area
- **New building** area to be developed by 2031 within the area: 300 000 m²
- **Type of buildings**: Commercial and industrial buildings mainly Life science industry
- **Organisation**: one urban district developer that leads the process, 1 main building owner that will develop new buildings within the district.

In 2006 the real estate company Klövern (now Corem) acquired a large section of the UBP area and formed the Uppsala Business Park brand. Today UBP is home to almost 100 life sciences companies. Mandaworks won the invited competition to masterplan the district in 2020. The masterplan will form an important part of Uppsala's southern expansion adding new laboratories, offices, industrial facilities, schools and long-stay research housing.

2.2 Stakeholder engagement

The **Södertörns model** [1] was applied to the stakeholder engagement process in UBP Living Lab. The model is an **integrated concept that in dialogue, enables solutions to critical societal challenges through collaboration between municipalities, academia and business**. The four property owners and developers within UBP: Johnson & Johnson, Fresenius Kabi, Thermo Fischer, and Corem (the main property owner and initiator of the PED process), were engaged in the dialogue on how to achieve the PED ambition from the very start of the process.

The utility company and representatives from the municipalities joined the process at a later stage. A process leader was appointed who planned the work, led workshops, and managed the engagement process and communication strategy (White architects). The **facilitator initiated individual qualitative interviews with key persons from the engaged property developers**. The individual interviews proved important to understand the stakeholders' motivations to engage in the process and identify conflicts that inhibited collaboration. The facilitator's main role was to gain trust in the PED process.

The developer and project initiator (Corem) played an essential part in the process as project leader. The **developer gave direction to the work and provided the project with high resolution energy consumption and production data** (hourly values). The master planner (Mandaworks) was involved and engaged in the process. The architect's engagement was crucial for connecting the ambition to the physical planning. The master planner provided the 3D model of the structural plan and phasing strategy. An energy specialist (Projektenergi AB) was appointed by Corem. The energy specialist brought the solution for the low-energy heating and cooling grid concept to the table. An important stepping stone for the process was a study trip for the core team to a reference project that was designed by the energy specialist (Umeå hospital). By experiencing the realized low-energy thermal grid on site, the team was convinced that the energy concept would also be suitable for UBP. The **local utility company (Vattenfall) was engaged in the process with the responsibility to calculate and develop energy scenarios for the whole area** in 2031. The utility company developed four low-energy strategy scenarios with varying levels of complexity. The most ambitious scenario for the energy system achieved minimum energy flows with the surrounding district heating and cooling system. The low energy demand was achieved in the scenario with a local heating and cooling grid, utilization of waste heat from the industrial processes within the district coupled with geothermal wells. The utility company was also responsible for developing the business model for the PED energy system.

The municipalities were engaged from the start of the project as core stakeholders. Initially, the cities were represented in the process by an energy strategist from the planning department. At a later

[1] http://sodertornsmodellen.com/home

stage, more representatives from Uppsala municipalities were engaged in the process of integrating the PED ambitions into the spatial planning process. The dialogue with the planning officer (a responsible person for the planning process from the municipalities) and a representative from the building permit division in the municipalities was essential to anchor the PED ambition in the planning process and to start the dialogue on suitable areas for PV production within UBP where there are cultural heritage values that the municipalities would like to preserve.

The following stakeholders were involved in this process:

- **Urban district developer:**
  - Corem
- **Trusted intermediary and energy expert:**
  - White architects (trusted intermediary and process leader)
  - Projektenergi AB (energy concept)
  - Sustainable innovation (communication strategy)
- **Building owners:**
  - Johnson & Johnson
  - Thermo Fischer
  - Fresenius Kabi
  - Corem
- **Utility company:**
  - Vattenfall
- **Architects and planners:**
  - Mandaworks
- **City of Uppsala:**
  - Department for Energy Planning
  - Department for Urban planning and building permit
  - Department for City Planning Department

2.3 PED Process

The project was initiated with a series of meetings between the core stakeholders to set the stage for stakeholder engagement. When the key stakeholders were identified and engaged in the process, a kick-off workshop was held to clarify the common goal of achieving plus energy standard.

The system boundaries and definition of PED were also selected for the project in the kick-off workshop. Initially, the utility company (Vattenfall) had a moderate engagement, but as the project developed, their engagement grew, and their contribution became a cornerstone in the development of the PED ambition with the development of the four energy scenarios and the development of the bsuiness model. The municipalities had a significant role as an authority. The proactive engagement of the energy strategist from the municipalities gave valuable support and confidence to the process. The dialogue with the planning department was necessary to integrate the ambition into the planning process of UBP and raise several challenges with building code and legislation. The developer and initiator (Corem) contributed significantly to the process with their clear ambition and strong motivation to achieve a PED. The leadership and highly qualified energy strategy provided the project with high-quality energy data and innovative energy concepts.

The following data was used in the assessment:

- Specific data on building energy consumption - reference year 2020 (hourly values)
- Masterplan for the area
- Four energy scenarios developed by the utility company
- Time schedule for phasing of the construction of new buildings
- Prediction of energy consumption in new buildings and calculated potential solar energy production within UBP in 2031

The **main challenges** for realization of a Positive Energy District that have been identified in the process

- The **business model** for the local energy market needs to be developed to establish robust long term contracts with predictable costs for the stakeholders. The utility company will have to develop the suggested business model further to ensure buy in from the stakeholders.
- **Integration of PED objectives and scenarios** for energy consumption and solar production in the physical planning process and control documents is key for if the ambition to be followed through in all the phases of the urban development. Today there is no one who has the role or responsibility to lead the work and set criteria for the PED target in the planning process. The PED enabler role and responsibility is of importance as the building code in Sweden does not yet give clear directives on how to handle the question of PEDs in the planning process.
- Further studies need to be investigated for stormwater management in combination with 65% solar panels on roofs within the district, as **there is a goal conflict within the project** with a demand for 100 % green roofs to manage storm water run off on the roofs.
- Integration of solar panels on the facade of existing buildings with regard to cultural-historical values needs to be discussed with the authorities in order to identify possible solutions for **building integrated PV on the existing buildings**.
- A **dialogue** with an experienced fire consultant about solar panels in combination with green roofs needs to be initiated as the fire code needs to be interpreted by a fire engineer in order to get a sign off on a bio-solar roof solutions.
- The **question of ownership and responsibility for operation** and renovation as well as back up capacity of the local energy system needs to be clarified between the municipalities, utility company and property owner.

The initiated process will continue after the PED-ID project has finished with the commitment made by Corem. The next step in the implementation phase benefit from further development through:

- Appointment of a PED process leader for the implementation phase of the roadmap.
- Develop the business model for the local energy model with financial and legal expertise.
- Continue the communication and stakeholder engagement strategy with the inclusion of a development of a behavioural change program.

2.4 Results achieved

A roadmap for how Uppsala Business Park can become a Positive Energy District was developed in collaboration between the property owners, the utility company and the municipality. An energy balance scenario for UBP shows that it is possible to reach the Positive Energy District goal in 2031.

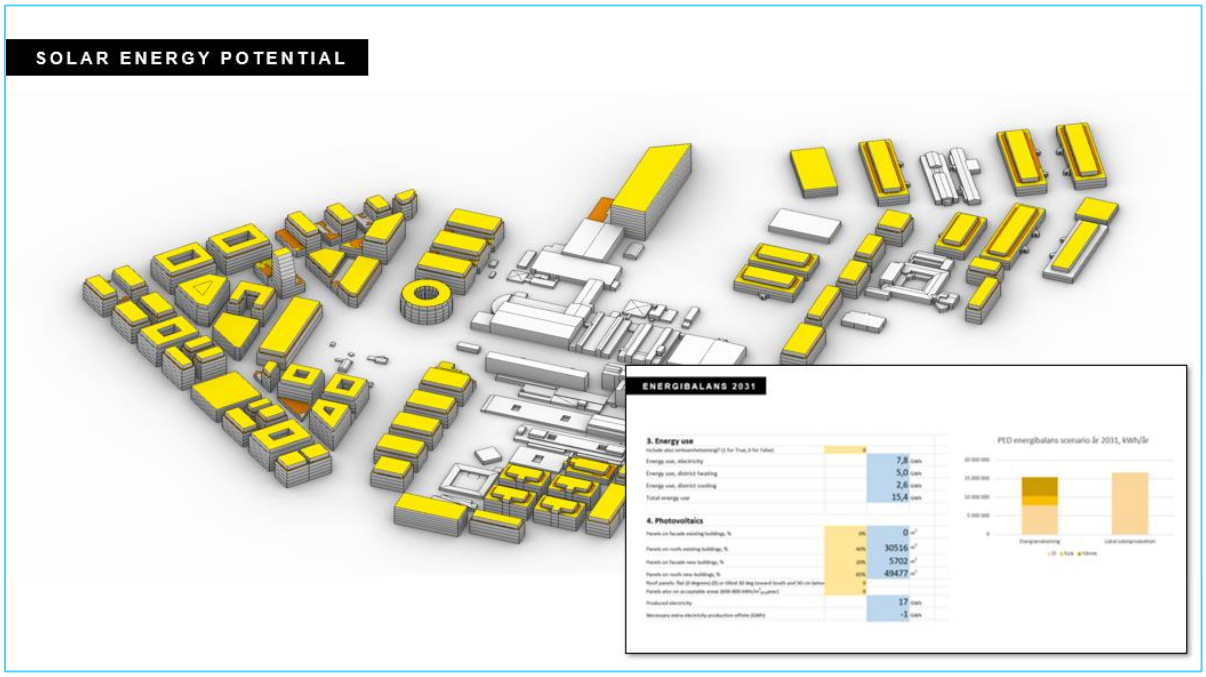


Figure 2: Screen shot of the PED energy balance tool develop in the project. (Source: White architects)

The **concept for achieving a net plus energy balance** within UBP is based on a strategy to minimize the energy consumption within the existing buildings within the district with 40%. The first steps in the renovation program of the existing buildings show energy reductions of 44% which give confidence to the strategy. By utilizing waste heat from one of the laboratories within the district in a planned balanced local heating and cooling grid coupled with ground sourced heat pumps and geo energy the heating and cooling demand can be brought down to a minimum. Approximately 300 000 m2 new energy efficient life science laboratory buildings are planned to be built by 2031. Solar panels on 65% of the roof area of the existing buildings and new buildings in combination with utilization of 20% of the façade area of new buildings within the district is calculated to produce more energy than consumed by the buildings energy demand in 2031 in this scenario.

The **roadmap to achieve positive energy balance in 2031 was developed** in collaboration with the stakeholders. The road map was accompanied with an energy balance tool and a solar potential 3D model analysis that can be used in the further development of- and to strengthen communication within the project and function as a tool to guide the process towards the realization of UBP Positive Energy District.

3 Austria | Kempelenpark

3.1 Site description

A new, diverse urban district is being created at "Kempelenpark" in Vienna. Around 1,100 rental flats will be created in what has been a purely commercial location up to now. Two thirds of these will be built on a non-profit basis and one third will be privately financed. This will enable high-quality and at the same time affordable living. In combination with a wide range of commercial areas, local supply and the construction of an all-day primary school and a kindergarten, a balanced mix of living space will be created.

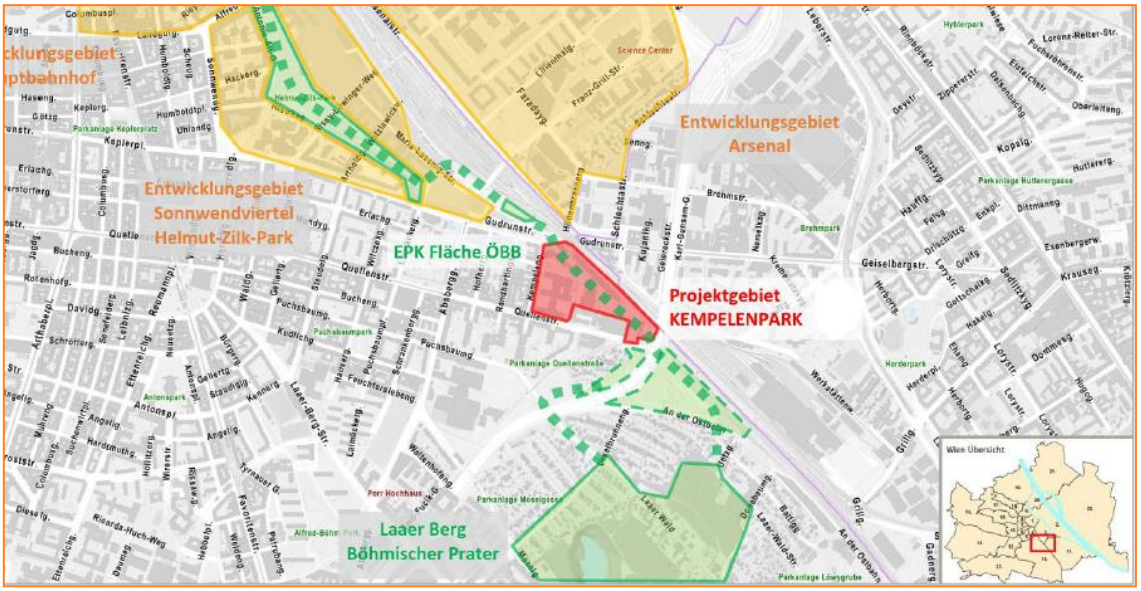


Figure 3: Overview plan of the selected area and surroundings (Source: city map, city of Vienna; edited by STC)

Key data:

- **Size of area**: 50,000 m² total area
- **Number of apartments**: 1,100
- **Building area for business use**: 25,000 m²
- **Type of buildings**: 80% for residential use, 20% for business use
- **Organisation**: one urban district developer that leads the process, 5 individual building owners that will develop buildings, 8 different building projects

A large public park forms the heart of the urban development planning. Together with the adjoining green spaces, the area will contribute to a climatically pleasant living environment in the future. Sustainable mobility and the networking of inner-city routes (Sonnwendviertel and Böhmischer Prater) make the new urban quarter a promising project for the entire district.

Figure 4: Overview of selected area (Source: google maps, edited by e7)

The urban developer of this area, co-applicant STC, set ambitious goals for sustainability and quality of living planned in this district. In the field of energy and CO2, this district should be both, a Positive-Energy-District and Zero-Carbon Neighbourhood. By implementation of the Digital Twin approach, these goals should be realised also in the operation phase of this district.

3.2 Stakeholder engagement

The stakeholder engagement process aims to develop integrated solutions with future building owners. The goals of the stakeholder engagement are to implement a cross-property and cross-system greening ty and cross-system greening and energy concept for the "Am Kempelenpark" neighbourhood development. This will be realized with innovative, identity-creating participation processes and a comprehensive quality assurance process. The focus lies on an interconnected consideration of integral greening concepts with higher-level water management and plus-energy concepts.

In this process, concrete and measurable quality goals are defined with the developers for the quality framework provided by the neighbourhood developer on the topics of greening, water management and energy supply, and broken down to building site level, or the necessary infrastructure is divided among the properties.

The close interrelationships between infrastructural green space, rainwater and greywater management and the local energy concept are worked out and cast into requirements for the planning of each building site. A quality assurance process for planning, construction and operation is to ensure that the jointly set goals are also realised.

The necessary monitoring is defined for this process. With this kind of participatory coordination between the developers even before the actual planning begins, with the networking of the greening, water and energy systems, as well as the interlocking of the infrastructure of the general neighbourhood with that of the properties, lieBeKlima is breaking new ground in integral planning.

The following stakeholders are involved in this process:

- **Urban district developer:**

  - STC
- **Experts:**
  - e7 energy innovation & engineering: energy expertise
  - grünplan: expertise in urban greenings
  - University of Natural Resources and Life Sciences, Institute of Sanitary Engineering and Water Pollution Control (SIG): expertise in water ressources
  - Realitlab: coordination of stakeholder engagement process
- **Building owners**
  - Heimat Österreich: non-profit building developer
  - BG Frieden: non-profit building developer
  - WBV-GPA: non-profit building developer
  - STC: building developer
- **Architects and planners:**
  - Delugan Meissl: architects
  - Architekturbüro Knötzl: architects
  - rajek&barosch: landscape architecture
- **City of Vienna:**
  - Department for Urban Development and Planning
  - Department for Architecture and Urban Design
  - Department for Energy Planning
  - Department for District Planning and Land Use
  - Department for Road Administration and Road Construction
  - Department for Vienna City Gardens
  - Department for Viennese Waters
  - Department for City Planning Department

This process will be continued after project end of PED-ID.

3.3 PED Process

The goal for this urban district development is to become a Positive Energy District. Besides stakeholder engagement process, e7 together with the urban district developer STC developed an energy concept for this district, taking into account renewable potential on site.

The following methods and activities were carried out during this assessment:

- Spatial Energy Analysis in selected area and adjacent zone (regional energy potential)
  - Special focus on waste water use as there is a big sewage system bordering the urban district
- Demand Side Scenarios based on scenarios for building types and users (incl. requirement for Energy-Plus buildings with focus on energy efficiency first)
- Local and regional renewable energy potential based on Spatial Energy Analysis and Demand Side Scenarios
- Potential of energy flexibility, Demand Side Management and cross-sectoral integration
- Existing local energy supply concepts and energy supply companies

- Perspective for Positive Energy Balance of selected area

The following data was used in this assessment:

- Masterplan for this urban district
- Specific data on building use
- Time schedule for construction phase of buildings
- Existing energy supply
- Spatial energy data from the City of Vienna
- Specific data from sewage system

3.4 Results achieved

The work is still ongoing and will be continued after the end of PED-ID. As 18 months of project duration is a very little time frame for urban development, work in PED-ID could just initiate a process and give first orientation targeting Positive Energy District.

Figure 5: Kempelenpark vision by STC. Source: kamkempelenparkt.at

The first **integrated energy concept** taking into account renewable energy source at site was developed and discussed with the urban district developer STC. This first concept will serve as input to the stakeholder process.

In the stakeholder process, **workshops and discussions** between future building owners, urban district developers and experts took place. Other workshops will follow to develop cross-property quality assurance process for water, greening and energy.

Results of the **quality assurance process for planning**, construction and operation can serve the new specifications for the City of Vienna. This concept should also be applied for other urban district development processes in the future.

This should result in the greatest possible cost-benefit optimisation for the developers and users, as economic potential is also made possible by leveraging synergies. It is important not to lose sight of the big picture. The property boundaries between the properties should not be "noticeable".

The energy concept will be further assessed and developed in order to fulfil the requirements for Positive Energy Districts. Stakeholders are convinced about that but there is still work to do to become a Positive Energy District.

4 Czech Republic | Rožnov pod Radhoštěm

4.1 Site description

The Living lab area is located in a town of Rožnov pod Radhoštěm (Rosenaw), which lies in the eastern part of the Czech Republic at the edge of a moutain range of Moravian-Silesian Beskyds. Rožnov has more than 16,000 inhabitants and it is significant both tourist and industrial place.

The town of Rožnov pod Radhoštěm has set ambitious sustainable development goals. Municipal energy plan has been declared stating as its **objectives upgrading municipal buildings into a passive standard, create an energy community and implementing additional energy efficiency measures. Climate action is also priority**. Rožnov has initiated numerous energy saving and climate action education activities in local schools. Following up, feasibility study of a prospective PED area emerged quite naturaly. Thus, a **Living lab has been established in cooperation with the municipal office and its energy manager**.

Living lab in Rožnov **is implemented in a developed area**, therefore it focuses on renovation of existing buildings mixed with new constructions of the Cultural Centre and Library extension. As the Centre and Library extension are designed in passive standard with heat pumps and photovoltaic power plant, its consumption parametres are included in Positive energy district project.

Figure 6: Overview plan of the selected area and surroundings (Source: mapy.cz, edited by SEVEn)

4.2 Stakeholders engagement

Rožnov pod Radhoštěm is a municipality within the top tier climate-action and energy-efficiency aware cities in the Czech Republic. When choosing a municipality to establish a PED Living Lab, Rožnov came as a an obvious choice. Indeed, based upon earlier collaboration with the town hall, a relation was established quickly. Municipal council, a lead political body, was considering a RES installation on

municipal property and the PED Living Lab offer came at the right moment. From the very inception of the Living Lab, the **PED was intended as a public undertaking**. Therefore, the municipality was the key stakeholder and only municipal real estate was considered. That made the stakeholder engagement somewhat more simple than would be the case with more building owners.

In the beginning of the project, Rožnov representatives have had only a vague notion of what the PED could represent. The new concept is not known by general public. PED introduction also coincides with increasing interest in Energy Communities (EC) in the country. Clear differentiation between the two is highly recommended in any future PED promoting and development actions. PED concept was nonetheless in line with the city's climate and energy goals. A more thorough acquaintance with the concept of PEDs took place during the project hand in hand with the PED concept development. In the end, a **full understanding of the idea of PED** has been achieved.

The most of the communication occurred with the municipal energy manager as the representative of the municipality. Energy manager then facilitated communication with other stakeholders — city administration and a municipally owned buildings facility management company Komerční domy Rožnov — as needed. These stakeholders were contacted directly only in urgent and necessary cases. This simpler communication arrangement was possible mainly due to the fact that the city or its budgetary organisations owned all objects included in the Living Lab. Nonetheless, an important takeaway is that larger organisations, such as the municipal office, are diverse organisms with intricate structure and numerous internal actors. So, even though a municipality is just one stakeholder, a collaboration requires diversity in approaches to succeed.

4.3 PED Process

At first, two possible areas were considered as potential Positive energy districts. In both areas, a basic survey and data collection at the basic level took place. Energy performance certificates were obtained.

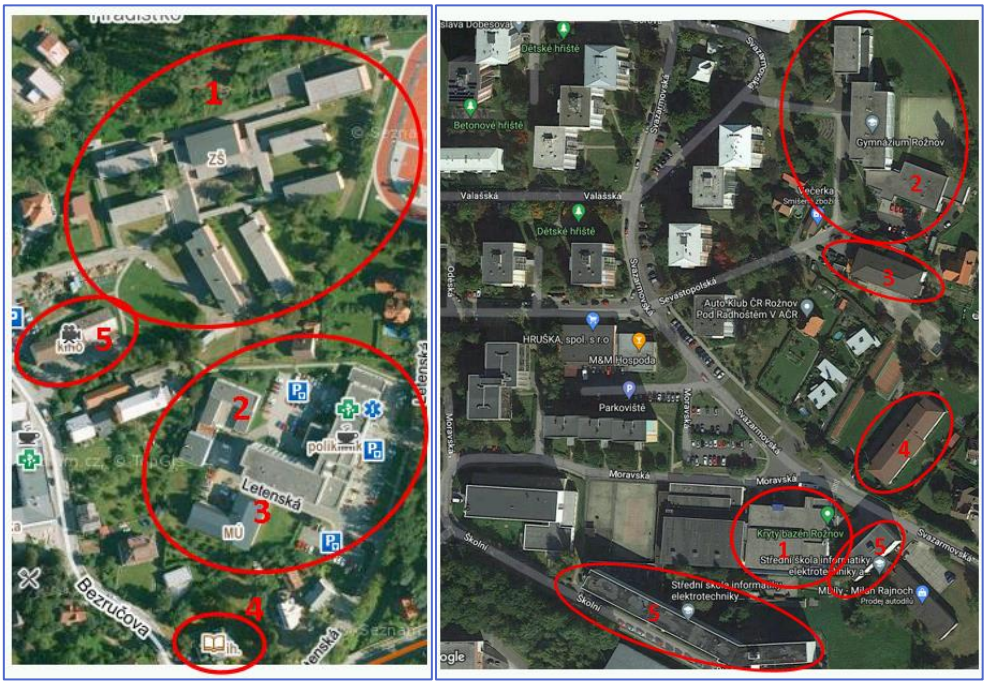


Figure 7: Overview of 2 potential areas" (right) (Source: mapy.cz, edited by SEVEn)

Area „Pod Skalou“ (left figure)	
Building No.	**Building**
1	Elementary school Pod Skalkou
2	Hospital
3	City Hall
4	Library (without extension)
5	Cinema (future cultural center)

Area „Swimming pool Rožnov“ (right figure)	
Building No.	**Building**
1	Covered swimming pool
2	Elementary school Koryčanské Paseky
3	Kindergarten Koryčanské Paseky
4	Gymnasium Rožnov
5	High school of Computer Science, Electrical Engineering and Crafts

Table 1: Overview of objects considered for the PED in each area

Subsequently, brief analysis of both areas was conducted with aim at identifying cons and pros of both areas and preliminary assessment of the feasibility of the PED concept. Energy performance certificates provided an indicative picture of the parameters of objects - e.g. potential for renovation.

Area „Pod Skalou“ (left figure)	
PROs	**CONs**
Better area compactness	High energy consumption
The objects are supplied with energy from the same distributor	The building of the cultural center is not built and it is not clear what its final consumption will be
The buildings are owned and managed by the city	Limited possibility of using RES
The buildings have outdated heat sources and their renovation is not part of the EPC project	
Roof surfaces are suitable for PV plants	

Area „Swimming pool Rožnov“ (right figure)	
PROs	**CONs**
Variety of objects (better for energy flexibility)	Insufficient roof area for PV
The objects are supplied with energy from the same distributor	A distributor is a smaller entrepreneur who could make it significantly more difficult to disconnect from distribution
	Some of the buildings are under the administration and ownership of the region, not municipality
	Seasonal operation of all considered objects
	Planned project with energy guarantee in the case of a swimming pool

Table 2: Overview of pros and cons of considered PED areas

Based on the quality analysis of barriers and challenges as well as preliminary assessment (see next point) and consultation with city representatives, the area "Pod Skalou" was selected as the most appropriate. However, only municipal buildings are considered for further assessment. Private buildings (mostly small family houses) are not included at this stage.

Data collection

- **Process of data gathering:**
  - Documents provided by city´s energy manager – building documentations, energy assessments of buildings, energy performance certificates of buildings
  - Documents provided in cooperation with Energy service company (ESCO) conducting project in one of the building – details and energy consumptions for selected objects
  - Local investigations and photographs – by SEVEn and ESCO
  - Video calls to clarify the information
- **Process of data analysis:**
  - Preliminary assessment – first, a preliminary assessment was carried out, during which the current technical-technology state and energy consumption of the buildings along with area rough potential were analysed (spatial energy analysis). The analysis focused on determining the default energy consumption of buildings, the estimation of energy consumption of buildings after the implementation of energy saving measures and the needed performance of renewable energy sources to cover the energy consumption with the target was to achieve energy surplus on an annual basis. The RES potential of the area was also part of the analysis.
  - Thorough assessment – secondary, based on a preliminary assessment, an agreement with the city's representatives and further achieved information, Energy audits are created for the objects in the area. The pre-selected technical solutions are assessed in detail technically, economically and environmentally. Based on the Energy audits and further stakeholder dialogue, the possible scenarios are developed.
- **Holistic assessment / solutions considered:**
  - Based on the preliminary assessment, possible technical solutions were considered, for which their indicative potential was quantified. The aim was to cover the energy consumption of buildings with renewable sources as much as possible. Possible solutions were consulted with the city's energy manager and subsequently with other city representatives (e.g. Construction department). Subsequently, possible solutions are specified in the energy audits.
  - Holistic assessment first takes into account the "energy first principle", i.e. on the reduction of basic energy consumption of the buildings, which means in particular the improvement of the thermal-technical parameters of the building envelope prior to measures in technologies (e.g. new heat sources) and others. The renovation of building envelope should also be comprehensive, not only partial, if possible.
  - Subsequently, technologies are asessed – HVAC systems, energy sources for space heating and water heating along with the heating system optimization, LED lighting (this is mandatory for all buildings) and IRC/measuring and controlling systems.

Models and scenarios

Based on the preliminary assessment, a first possible scenario was developed. The energy balance of the area as well as individual objects was processed using Sankey diagrams. Scenario with its possible minor variants was discussed with the stakeholders.

Object	State	Natural gas	Grid electricity	PVE	Heat pump	Estimated reduction in energy demand
		MWh				
Cultural Center	Current	-	85	24	85	n/a
	Proposed	-	-	**109**	**85**	
Library	Current	-	80	12	20	n/a
	Proposed	-	-	**92**	**20**	
City Hall	Current	102	32	-	-	heat 20%, electricity 20%
	Proposed	-	-	**28**	**80**	
Elementary school	Current	850	142	-	-	heat 20%, electricity 20%
	Proposed	-	-	**115**	**680**	
Health Center	Current	650	185	-	-	heat 20%, electricity 20%
	Proposed	-	-	**150**	**520**	

Table 3: Preliminary scenario for energy balance

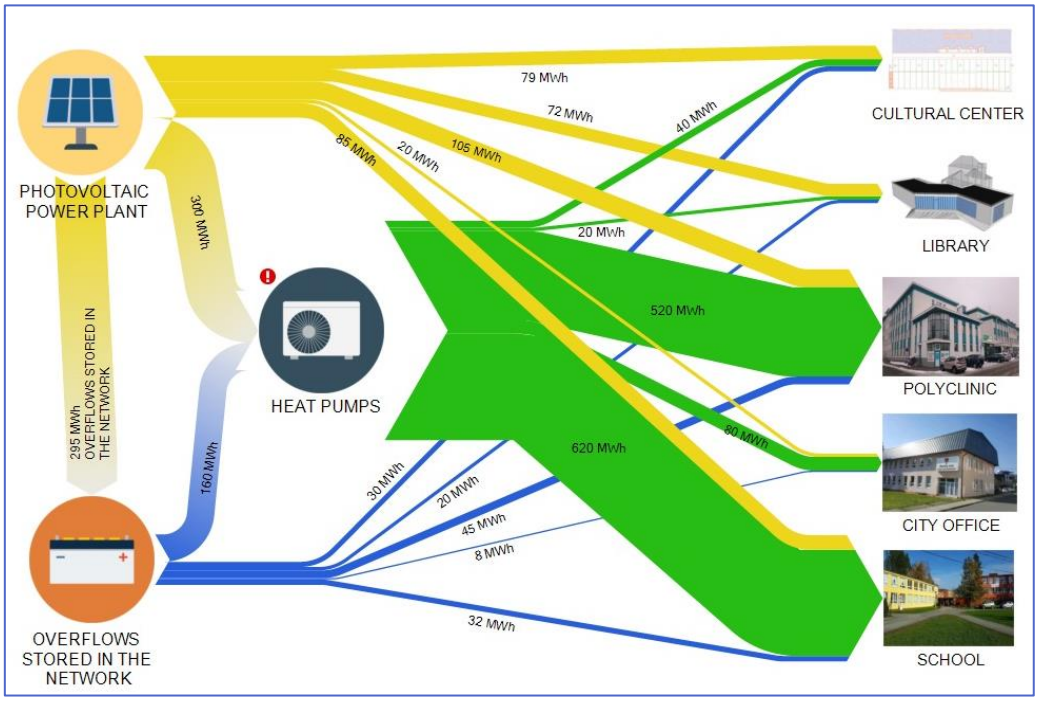


Figure 8: Preliminary scenario for energy balance in the form of Sankey diagram

Subsequently, in the second half of the 2022, the resulting feasible scenarios will be developed, based on which it will be possible to select the final solution. The possible construction of a biogas plant will be addressed in the scenarios. Scenarios will also contain implementation schedule and financial analysis along with a proposal for appropriate funding (probably a combination with the use of a grant financing) for the implementation of the Positive energy district.

In the current state of the project, this part has not yet been achieved. It is assumed that the selection of the solution will take place at the turn of 2022/2023, after discussion with the new city management (elections are taking place in the city).

4.4 Results achieved

Within the project, high degree of interconnection of individual phases of the holistic methodology emerged. The individual steps often slightly overlap depending on the specifics of the area and the activity and requirements of the stakeholders.

In case of Rožnov, working with stakeholders was relatively easy thanks to the fact that the municipality had adpoted energy saving and climate protection policies and was in favor seeking ambitious objectives. Moreover, stakeholders understand well the essence of the PED concept and its goals and they are interested in its form and possibilities of implementation. This is recognised as very important for the project development and viability.

Although the implementation of a PED brings a number of benefits – from a positive energy balance during the year and a reduction in energy costs, improving the quality of life to reducing the climate impact of the operation – the financial aspect of the project remains crucial pre-condition to implementation of the project. In this case, Rožnov has limited access to bank loans and limited own funds due to existing exposure in other investment projects. It is therefore necessary to look for suitable financial instruments, grants or other options (e.g. a loan through a city organization instead of the city itself).

Learnings:

During the work on the Living Lab in Rožnov, a number of barriers and opportunities emerged. As the analysis progressed, it was often found that what was initially considered a barrier eventually turned into an advantage and vice versa.

- In the beggining of the project, the construction measures were considered as a great opportunity for energy savings (except the objects, where they had already been implemented). However, the analysis showed that they do not bring as much savings as expected and have a long payback period.
- Similary, new construction (new cultural centre) seemed like an obstacle because not much information was known about the building and it was no longer possible to influence the construction project. However, it was found that the building is built in accordance with the philosophy of the city in a passive standard along with using heat pumps and photovoltaics, which is very favourable for the living lab.
- An energy performance contracting project (EPC - energy service with a guaranteed result) is currently underway in some of the buildings. This reduces the scope for implementing some of the more significant energy saving measures. On the other hand, the energy saving

measures implemented within the EPC project will reduce future energy consumption, but the investment cost are matter of EPC project and not PED project.

What was delivered:

- Feasibility study for the selected Positive energy district area in the town of Rožnov pod Radhoštěm.
- Other background documents for the needs of the energy manager and the town.
- Workshop introducing the PED concept and its implementation process in the early stages of the project. The workshop included a presentation of other living labs from the PED-ID project and a presentation of other (potential) PED areas in the Czech Republic. Networking included.

Collaboration with Rožnov municipality continues beyond the PED-ID project. The aim is to create a holistic study with the possibilities of achieving PED in the addressed area, that will be used by the city administration for urban development.

5 Tailored Criteria Catalogue for PED-ID Living Labs

In the very early stages of a PED process, it is critical to define with all stakeholders involved the specific vision and objectives of the project, **establishing general requirements and indicators**. These will include requirements for energy efficiency and renewable energy sources, and possibly also for the environment, economy, management and other aspects. These agreements can be structured in a "Criteria Catalog", further explored and addressed in report ***D4.1 -Criteria catalogue for Positive-Energy- Districts***[2]. In this section, we revisit the requirements listed in report D4.1 and apply them to the three Living Labs, analysing individual aspects of what a "plus-energy definition" looks like for each of them.

5.1 SE | Uppsala

Core objective

Objective	Selected Option
Plus-energy balance	●
Plus-emissions balance	●

General indicators

Indicators
Total primary energy
GHG emissions

Accounting Period

Period accounting	Period under consideration/ temporal balance limit
Annual	1 Year

Spatial Boundaries

Spatial delimitation	Choice
Building envelope (e.g., PV on the roof)	●
Structural plan – Building properties	●

[2] https://sustainableinnovation.se/app/uploads/2022/05/PED-ID_D4.1_PEDcriteria_V5_220415.pdf

Energy Uses Boundaries

Category	Sector	Energy use	Selected
Operational energy	Building operation	Heating	●
		Cooling	●
		Ventilation	●
		Auxiliary energy (pumps, fans, elevators etc)	●
		Lighting	●

Example of a Summary of the Energy Requirements for Uppsala Business Park, SE

Dimensions of observation	Determination
Indicator energy service	Building energy demand (fastighetsenergi)
Target	Plus energy balance
Accounting period	Annual
Spatial boundaries	Heat: Energy production within and outside the district Electricity: Production within the building properties
Energy use boundaries	Energy demand and production for operation of the buildings and the heating and cooling system within the district (fastighetsenergi)

5.2 AT | Kempelenpark

Core objective

Objective	Selected Option
Plus-energy balance	●
Plus-emissions balance	●

General indicators

Indicators
Total primary energy
GHG emissions

Accounting Period

Period accounting	Period under consideration/ temporal balance limit
Annual	1 Year

Spatial Boundaries

Spatial delimitation	Choice
Development area of the building (e.g., PV on the roof)	●
Property of the building (e.g., PV on the property)	●
Property with energy resources from outside the property (e.g., biomass boiler)	●

Energy Uses Boundaries

Category	Sector	Energy use	Selected
Operating energy	Building operation	Heating	●
		Cooling	●
		De-/Humidification	●
		Auxiliary energy	●
		Lighting	●
	User electricity	Household electricity	●
		Operating electricity	●
	Process energy	Process heating	●
		Process cooling	●
		Process current	●
	District	Lighting	●
		Supply	●
		Disposal	●
Embedded energy	BG0	Thermal building envelope	●
	BG1	Complete thermal building envelope	●
	BG2	BG1 incl. internal walls	●
	BG3	BG2 incl. internal walls, basement components, unheated buffer rooms	●
	BG4	BG3 incl. open development areas	
	BG5	BG4 incl. building services	
	BG6	BG5 incl. entire outdoor facilities	

Mobility	Passenger mobility	Public Transport	●
		Sharing Mobility	●
		Motorised private transport	●
	Transport of goods	Transport of goods	

Example of a Summary of the Energy Requirements for Kempelenpark, AT

Dimensions of observation	Determination
Indicator energy service	Total primary energy, CO2 Emission
Target	Plus energy balance, Plus emission balance
Accounting period	Annual
Spatial boundaries	Heat: Energy production outside the property, with direct supply Electricity: Production on the property
Energy use boundaries	All operating energy Embedded Energy → BG0 – BG3 Everyday mobility: → Passenger Mobility

5.3 CZ | Rožnov pod Radhoštěm

Dimensions of observation	Determination
Indicator energy service	Total primary energy
Target	Plus energy balance
Accounting period	Annual
Spatial boundaries	Heat: Property with energy resources from outside the property (heat pumps and natural gas boilers) Electricity: Production on the property in combination with Energy supply outside the property
Energy use boundaries	All operating energy Embedded Energy → BG0 – BG1 Everyday mobility: Motorised private transport

5.4 Rating system for PEDs

A rating system can be a tool not only to compare the status and requirements of a project but also to understand where we are and the level we could be ideally. When talking about PEDs, there are different aspects that can be evaluated and compared, but ultimately it isprimarly about positive energy balance and lower GHG emissions.

PED-ID proposed a scale with 5 levels to categorize ped projects, according to their energy and environmental aspects. It can vary from, for example, from accounting only operating energy up to embodied energy and mobility. On the environmental side, we can take into account only RES locally genarted up to total primary energy sifficinecy and neutral CO2 emissions.

Table 4: Possible rating system for PEDs

Energy services	Indicator	Accounting Period	Rating
Operating Energy	Renewable primary energy	yearly	Level 1 Basic level
Operating Energy + either embedded energy or mobility	Total primary energy	yearly	Level 2
Operating Energy + embedded energy + mobility	Total primary energy + CO2 emission	monthly	Level 3
Operating Energy + embedded energy + mobility	Total primary energy + CO2 emission	hourly	Level 4
Operating Energy + embedded energy + mobility	Total primary energy + CO2 emission	Shorte minute interval	Level 5 Top Level

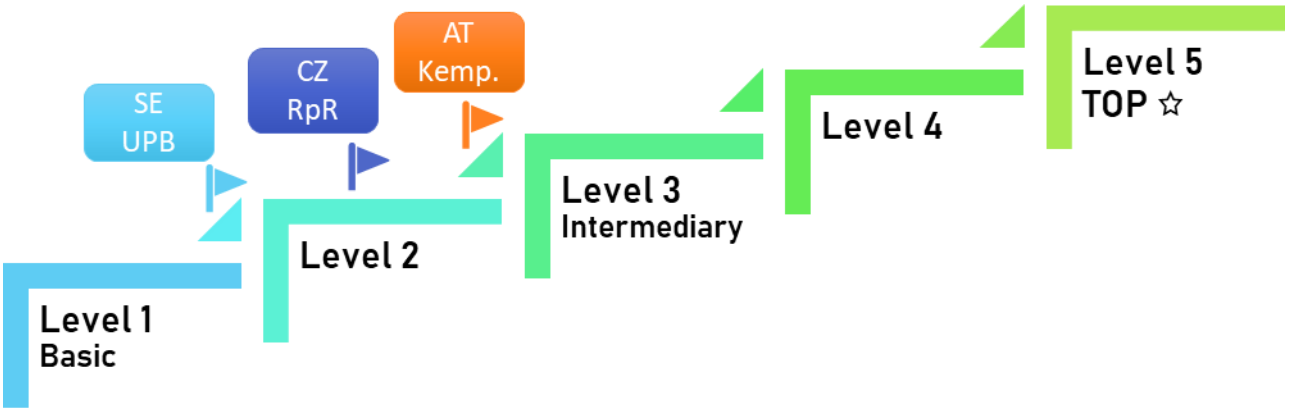


Figure 9: Rating scale of PED-ID Living Labs

The **UPB Living Lab in Sweden** had as core objective plus energy balance and GHG emissions and Austria for the PED process. It accounts in the positive energy balance only operating energy. Still, in Uppsala there is a high demand for heating in many months of the year, which imposes a big challenge even when only accounting the buildings energy demand in the equation. According to the rating

system, it will be **between levels 1 and 2**, since it also considers the total primary energy needs in the calculation but not the embodied factor.

The **Austrian Living lab** presents also a core goal of positive energy & GHG emission balance. It considers in the definition not only operative energy but also embedded energy and mobility aspects, as shown in the criteria catalog. Still, the accounting period is yearly. Therefore the living lab is rated between **level 2 and 3.**

According to the rating system, the Positive energy district in **Rožnov pod Radhoštěm can be classified in level 2**. The district address all the operating energy on an annual basis with use of total primary energy indicator. Embedded energy will be taken in accout for construction materials for thermal building envelope. As the project is likely to be co-financed by the grant, the use of an environmental-friendly materials or accounting their carbon/energy footprint is a frequent requirement. The mobility is addressed minimally within the area. The area is small with only a few side roads and there are no significant roads passing through the area. However, as part of the renovation of buildings in the area, it is also planned to carry out preparations for electromobility - e.g. establishment of charging stations that will primarily use electricity from RES.

6 Cross Country evaluation

The experiences and insights gained in the Living Labs are collected, evaluated and discussed on a transnational basis within an evaluation framework and create the basis for revised methods and processes. We should highlight:

6.1 Similarities

The three living labs started from the same aspiration expressed by the owners of the area in question: the motivation to be an exponent of a climate-neutral district and to invest in the deployment of locally generated renewable energy. This was one of the main drivers that pushed the stakeholders to join the PED initiative and provide a Letter of Intent. It could be a strategy for future PED initiatives to get key stakeholders on board by exploring the motivation for installing RES and becoming a climate-neutral champion.

Also, in the three Living Labs, after different processes of stakeholder engagement and communication with involved parties still, a common result was achieved:

- a specific PED objective for the area, as described in the criteria catalog in section 6;
- a primary energy concept for plus-energy balance, considering modeling scenarios and the areas' energy consumption;
- and a guideline for the following steps to further develop and implement a PED.

6.2 Factors for success

Success in a PED process means not only quantitative results in a specific time frame but also qualitative ones, such as gained know-how, engagement of stakeholders and acceptability of actions.

- **Getting key stakeholders on board**: PEDs can be quite an extensive process, demanding engagement from many different sectors and actors. One way to facilitate the engagement of so many different parties is to find the person or organization to get on board that others would follow.
- **Development of a PED vision**: The PED concept should be adapted according to the local resources and context. Therefore, the best approach is to develop the PED vision with stakeholders: What are the project goals and objectives? What is the system boundaries configuration? What do we want to achieve in a specific timeframe? All of these questions should be discussed and clearly articulated with the stakeholder involved.
- **Project champion**: Who might have the "spiritual ownership" of the process? Who has a direct interest in the project's outcomes? This will be your project champion, the stakeholder with the motivation and connections to push forward the PED process. It could be the building developer or the local authority, in AT and SE were the building developers and in CZ it is still missing.
- **Workshop**: In many cases, a certain amount of capacity building is necessary to transmit properly ideas and concepts about energy and efficiency, and workshops are good tools to

gather stakeholders and discuss these topics openly. It clarifies the process and brings them together.

- **The technical assessment** was fundamental to show municipality and building developer the ladder to reach positive energy balance - step by step with specific actions that will transform the plan from business as usual to net-zero energy to positive energy. It is a didactic way to illustrate the transformation and activities needed to take place.

6.3 Barriers & difficulties faced

The barriers faced were different among the living labs, mainly because they are directly connected to local circumstances and context, such as financing instruments, regulations, energy service companies and business structure. Here are the overall barriers and challenges that were encountered in the living lab experience:

- The **economic viability** is still challenging to reach the "plus" standard: going from a net-zero to a puls energy standard requires significant investments, which in turn is a challenge for many municipalities and building developers. There needs to be a more articulated incentive (financing, taxes, regulations) to drive these projects to be plus in their energy balance.
- The question is always "**who pays**" for the PED process, specifically at the early stages. And as demonstrated in this report, PEDs require extra effort in the initial steps to define goals and objectives and, more importantly, involve stakeholders and simulate scenarios. There needs to be some form of financing to assist in this early stage of the development of the process.
- The **business model** for the local energy market needs to be developed to establish robust long-term contracts with predictable costs for the stakeholders. PEDs are challenging traditional energy services and supply business models and utilities need to revise their practices. They must develop business models that include local energy market sufficiency and management in their portfolio to ensure buy-in from the stakeholders.
- **Lack of experience & knowledge:** PEDs are still a concept under development and therefore are unknown. There is low experience and few projects in advanced stages. This culminates that it needs extra efforts from the team to convey the concept and general objectives to all stakeholders involved. Also, in some countries, it is a challenge to integrate the energy aspect into urban planning, especially in the early stages of projects.
- **Influence of local authorities**: This is especially recurrent in smaller cities, where the neighborhood transformation process relies mainly on the local authorities – and, therefore, is susceptible to political changes. Ter should be better strategies and structures to prevent PED initiatives from stopping due to elections or changes in the municipality command.

Strategies to overcome challenges

- **Net-zero vs. Positive**: One way to overcome this debate is conveying the message: to be climate neutral, there must be a surplus in the energy balance to account for other factors such as embodied energy-carbon and more to achieve future goals, we need to aim higher. Also, there is the possibility of monetizing PED energy generation surplus to surrounding areas or utilities, it depends on the context.
- **PEDs are also about changing the mindset regarding urban transformation –** to speak about climate neutrality, we must also talk about energy consumption and generation. In a PED process, we are not only trying to produce local renewable energy but also lowering the

consumption to a minimum level possible and managing the production to optimize the system – we want to achieve sufficiency!

- **PEDs are not only pathways to climate neutrality but also to secure energy supply and resilience:** The local energy sufficiency that PEDs promote also promotes security in the energy supply, mitigation of energy poverty, and the energy system's resilience in the face of new challenges and cost reduction.

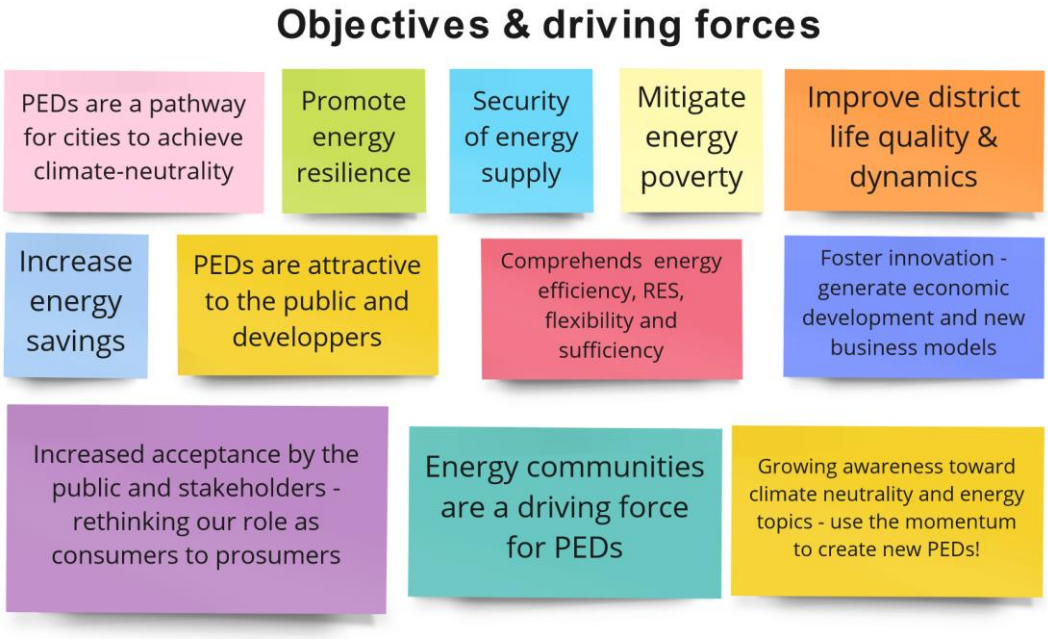
Key learnings & recommendations

Besides what has been reported in the previous sections, the PED-ID project has organized an internal workshop to discuss the main learnings and results achieved with the Living Lab experience throughout the 18 months. Here are the outcomes of this discussion:

- PEDs make sense now because they require a change in the way of thinking and designing neighborhood-level actions and transformation - this stimulates innovation and new ways to deal with old problems.
- PED projects should collaborate and share challenges, learnings and success stories. Only within a strong network of collaboration between initiatives can we prosper and achieve 100 PEDs in Europe by 2030.
- Guidelines are essential for project developers and stakeholders: structuralizing the issues and steps of the PED process and clarifying what needs to be assessed, integrated and executed as the project progresses.
- There is still a lack of discussion regarding energy planning in the urban planning sector - this needs to be intensified by all actors involved. Integrating energy planning into the urban sector needs to be a business-as-usual approach. Urban planners are showing more interest in combining energy planning into their projects.
- The dependency on local authorities is still a reality in PEDs, which can become a problem when elections and changes happen. Municipalities should always have a better mechanism to guarantee the continuity of these initiatives.
- A holistic method is recommended for assessing and developing scenarios of a PED: To achieve positive energy balance, we must explore all alternatives available locally and optimize solutions – synergies.
- Collaboration is fundamental in PEDs – getting stakeholders on board, communicating and keeping them engaged is a challenge that a trusted intermediary should address.
- Navigate the process – a set of different skills is required to communicate and assist others in navigating through the PED process: energy, urban design, building efficiency, RES production, energy management, mobility and more.

In the following pages are more key learnings and conclusions discussed in the workshop that should be useful to future projects and interested parties to develop PEDs:


Structure of a PED process
Integration of renovation and new buildings: different strategies
Guidelines on how to proceed are crucial to get actions off the ground
Still no experience from cradle to grave : PEDs are still a learn-by-doing process
The boundaries of the system need to be established together with stakeholders at the earliest stages
Finding the best solutions is the looping process to optimize strategies and synergies
Urban planning needs to integrate energy planning
Communication
PED is the energy pillar of climate-neutrality, and encompasses other concepts such as net-zero energy buildings, RES generation, energy flexibility and more
PED is still a abstract concept for many - communication should focus on clarifying ideas, goals and actions of the process - a pathway to climate neutrality
communication is a sustainable way to engage actors in a PED process, and needs to be strategize according to target groups
Coach & PED facilitator
Management: someone that support stakeholder to navigate through each step of the PED process
Letter of Intention serves as a commitment instrument
From the start we need to find the "right" partners with the power to make it happen
per-relationship between stakeholders need to be understood: conflict and history
A trusted intermediary that supervises actions & disseminates information across all stakeholders


Objectives & driving forces
PEDs are a pathway for cities to achieve climate-neutrality
Promote energy resilience
Security of energy supply
Mitigate energy poverty
Improve district life quality & dynamics
Increase energy savings
PEDs are attractive to the public and developpers
Comprehends energy efficiency, RES, flexibility and sufficiency
Foster innovation - generate economic development and new business models
Increased acceptance by the public and stakeholders - rethinking our role as consumers to prosumers
Energy communities are a driving force for PEDs
Growing awareness toward climate neutrality and energy topics - use the momentum to create new PEDs!


Stakeholders
It is critical to map stakeholders & understand their driving forces for a PED
We need time to properly engage stakeholders & get them on board
Communication strategy is key to success
The PED vision, targets and objectives should be built together
Address ownership and financial aspects
Face-to-face meetings & workshops are important for the exchange, solve and progress
Business Models can be ways to engage stakeholders and guarantee longevity to actions planned

PED-ID TEAM

Coordinator:

ENERGY INNOVATION ENGINEERING	e7 Energy Markt Analyse GmbH (e7)

Partners:

FACULTY OF CIVIL ENGINEERING CTU IN PRAGUE	Czech Technical University in Prague, Faculty of Civil Engineering (CVUT)
SEVEn	SEVEn, Energy Efficiency Center, z.ú. (SEVEn)
Sustainable Innovation	Sustainable Innovation AB (SUST)
white	White Arkitekter AB (WHITE)

CONTACT

Project Coordinator:

e7 Energy Markt Analyse GmbH

Camilla Borges Rampinelli | camilla.rampinelli@e-sieben.at

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