Call Secretariat
JPI Urban Europe – PED Pilot Call

JPI Urban Europe
Final Report for the General Public
Positive Energy Districts and Neighbourhoods (PED Pilot Call)

1. KEY DATA OF THE PROJECT

SHORT TITLE	PED-ID
LONG TITLE	Holistic assessment and innovative stakeholder involvement process for identification of Positive-Energy-Districts
PROJECT NUMBER	Application ID 36759740
PROJECT PERIOD	from 01.01.2021 to 30.06.2022
PROJECT WEBSITE	https://www.e-sieben.at/de/projekte/20049_PED_ID.php
KEYWORDS	PED, Holistic Assessment, Stakeholder Engagement, Guidelines

2. EXECUTIVE SUMMARY

Cities are a big part of the climate problem – specifically when talking about energy and how it is consumed, generated and managed. Significant changes must be made to transform urban environments into climate-friendly and zero emissions areas, and all starts at the district level. Imagine if all buildings are connected in your neighbourhood, managing resources efficiently and generating more local renewable energy than it consumes? This is scenario is possible with PEDs.

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**) in cities throughout Europe. PEDs are districts in urban areas that manage their resources to achieve positive energy balance (**more energy is produced than consumed**) and reduce the local emissions of greenhouse gases. This project provides decision-makers with improved **information about PED solutions and methods** that support project development, focusing on the first stages of development, and forming a knowledge-based participation process. The methods were developed based on data collected and experience gathered from Living Labs and workshops with stakeholders. The goal is for PED designers and developers to use these tools and methods in a data-driven participation process, make decisions based on data, and find the best scenario for each location. With the help of this method, the decision on PED sites will be accelerated to reach the goal of 100 PED sites in Europe.

An essential part of the PED-ID work scope was to apply the methods and tools developed specifically for PED design in real environments. This testing procedure happened through our Living Labs in Sweden, Austria and Czech Republic. The objective was to test and optimize the methods, processes and presentation tools using actual areas and initiatives involving building and urban developers, municipalities and many more stakeholders. The final results were achieved through an iterative feedback loop. We re-assessed our proposed methodology based on the living lab experience. The project's main results and findings are described in detail in the following publications:

- Holistic Stakeholder Model for early PEDs: Description of the proposed Stakeholder engagement methodology and tools adapted to PED projects.
- Process Map from Knowledge-based Approach for PEDs: We summarise the stakeholder engagement methodology and its application in Living labs, highlighting key findings and success factors.
- Annex: Identifying the Potential Role of Digital Twins in Supporting PEDs: Exploring the use of Digital Twins and how they can support PED design.
- Holistic assessment and innovative stakeholder involvement process for identification of Positive-Energy-Districts: A comprehensive handbook explaining methods and concepts on designing and selecting solutions for PED projects.
- Visual concept for presentation of results of PED assessment: A manual showing how to communicate the holistic method and process of developing energy scenarios to general audiences and stakeholders.
- Criteria catalogue for Positive-Energy-Districts: Proposed template to assist stakeholders in describing different PEDs using standard technical criteria.
- PED agreement model for cities and municipalities: Quality agreement proposal for setting requirements between stakeholders regarding a PED project.
- Living Labs: PED-ID experiences in Sweden, Austria & Czech Republic: Report of the experience and lessons learned from Living Labs.
- Guidelines for PED projects at early stages of development: A summary of all relevant information concerning PEDs + Roadmap and Process map focused on the early development stages.

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4. SUMMARY OF THE CONTEXT AND OVERALL OBJECTIVES OF THE PROJECT

Cities require a lot of energy and currently account for more than 70% of global CO2 emissions and this is expected to grow. The energy needs to be produced sustainably and used efficiently. Today, this is not done on a large enough scale. A positive energy district, or a PED, is a neighbourhood that produces a surplus of renewable energy, which can help to achieve net-zero CO2 emissions. New buildings are designed with high energy performance and existing buildings are upgraded. The neighbourhood then stores, manages and smartly uses energy. PEDs are a proven solution to lower CO2 emissions and already exist in European cities today, but we need more.

The PED-ID project is an EU-funded initi-ative that provides decision-makers with guidance about methods, tools and other solutions for PEDs at an early stage of development. Stakeholders can use these tools directly in a PED process to consoli-date their options, making decisions based on data in a holistic assessment. The methods were developed based on data collected and experience gathered from Living Labs. The target groups can actively use these tools in a data-driven participation process to consolidate their opinions and make data-based decisions. With the help of this method, the decision on PED sites will be accelerated to reach the goal of 100 PED sites in Europe.

An essential part of the PED-ID work scope was to apply the methods and tools developed specifically for PED design in real environments. This testing procedure happened through our Living Labs in Sweden, Austria and Czech Republic. The objective was to test and optimize the further development methods, processes and presentation tools using actual areas and initiatives involving building and urban developers, municipalities and many more stakeholders. Some of the solutions proposed and results achieved were:

- **Establish a stakeholder engagement methodology** – to be implemented in PEDs regardless of location and highlight key strategies to bring stakeholders on board. The methodology was used in the project's three Living Labs; from this cooperation, new initiatives have emerged, resulting in new PED projects for the mid and long term. Partners in other urban transformation projects will use the methodology, thus being actively implemented and enhanced as time passes.

- **Dissemination of PED concept to a broader audience** – experience gained throughout the project will be passed on in each country, disseminating knowledge about PEDs and methods, thus boosting this programme. Through videos and presentations, we disseminated to urban developers and local authorities what a PED is and why they are essential tools to be used for achieving climate neutrality in cities.

- **Holistic assessment handbook** – as an urban transformation process, a PED involves many aspects such as energy, building, mobility, public spaces, commercial facilities and many more. Therefore a holistic assessment is the best approach to develop the solutions and scenarios for a PED, taking into account the many factors relevant to the neighbourhood. The handbook presented in D3.1 is powerful guidance for all aspects of the project.

- **Tools to support PED design and decision making** – a series of tools are presented, along with templates that PED developers can use. The goal is to adapt methods to the PED process and to give support from the stakeholder engagement and communication to the solution design and quality standards. Having this information properly, clearly organised and consolidated is critical to avoid misunderstandings and problems in implementation and keep stakeholders on board.

- **PED guidelines** – including roadmap, general information about each aspect of a PED project and available methodologies in a document that would be easy to navigate. The goal is to summarise the critical information about the development of PEDs at early stages to a broader public. This will help flourish PED initiatives and demystify the concepts involved to local authorities, companies, and the public.

- **Roadmap & process map** – The roadmap and process map developed and presented in D4.3 are key tools for stakeholders to understand, plan and manage a PED project. These tools are being used and disseminated to the living lab associates and other projects and initiatives.

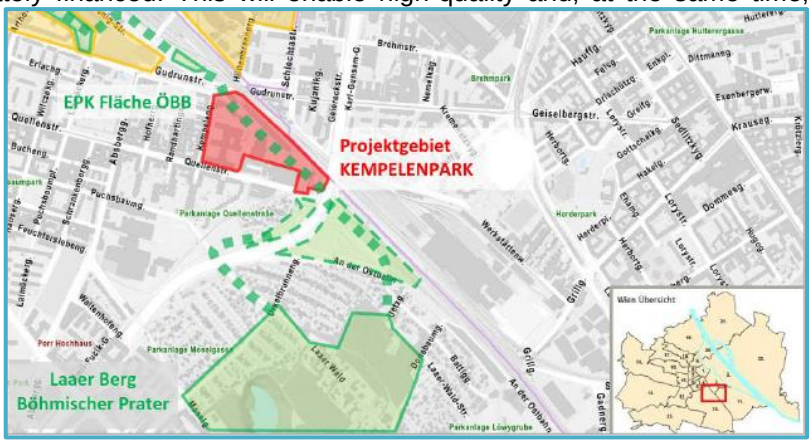
Living Labs:

1) Uppsala Business Park | Sweden: Uppsala Business Park (UBP) is a Life science district in Uppsala, a city located north of Stockholm. The innovation-based industry has sprung out of a collaboration between the Universities in Uppsala, business development and society. Pharmacia developed the district in the 60s, which laid the foundation for the life science and biotech industry that characterize the community. In 2006 the real estate company Klövern (now Corem) acquired a large section of the UBP area and formed the Uppsala Business Park brand. Mandaworks won the invited competition to masterplan the district in 2020. The master plan will form an essential part of Uppsala's southern expansion adding new laboratories, offices, industrial facilities, schools and long-stay research housing.

Main aspects:

- 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.

2) Kempelenpark | Austria: Kempelenpark is an existing commercial-only area located in Vienna that will be completely remodeled. There will be built approximately 1,100 rentals flats two-thirds will be made on a non-profit basis, and one-third will be privately financed. This will enable high-quality and, at the same time, affordable living. They are combined 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 spaces. The goals for the Kempelenpark area are positive energy balance, climate resilience, cross-property greening, energy and water concept, quality assurance method and participative process of urban development.



Main aspects:

- PED area: Complete renovation of an existing 50,000 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.

3) Rožnov pod Radhoštěm | Czech Republic: The Living lab area is located in the Czech town of Rožnov pod Radhoštěm (Rosenaw), which lies in the eastern part of the Czech Republic at the edge of a mountain range of Moravian-Silesian Beskyds. Rožnov has more than 16,000 inhabitants, and it is a significant both tourist and industrial place. Living lab in Rožnov is implemented in a developed area**.** Therefore it focuses on renovating 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 a photovoltaic power plant, their consumption parameters are included in the Positive energy district project.

Main aspects:

- PED area: Renovation of an existing buildings along with new construction
- Type of buildings: 100% public buildings owned by municipality
- Organisation: town of Rožnov as a leader of the PED process, 3 individual building projects (energy services with guaranteed results, construction of new cultural centre and PED project)

5. WORK PERFORMED AND MAIN RESULTS ACHIEVED

Benefits from PEDs: PEDs form urban transformation processes that integrate energy and urban planning process to achieve positive energy and climate-neutral neighbourhood. By combining these two areas into one holistic plan, PEDs are capable of providing many benefits to stakeholders and the city, such as:

- **A road to achieving climate neutrality in urban environments**: by integrating energy aspects, sustainability and climate neutrality into urban projects, PEDs represent pathways for cities to achieve climate neutrality. It promotes behavioural changes at many levels: in city design and urban planning, energy supply/management/consumption, building standards (energy efficiency first) and overall consumer behaviour (changing from a passive role to an active role in energy communities).

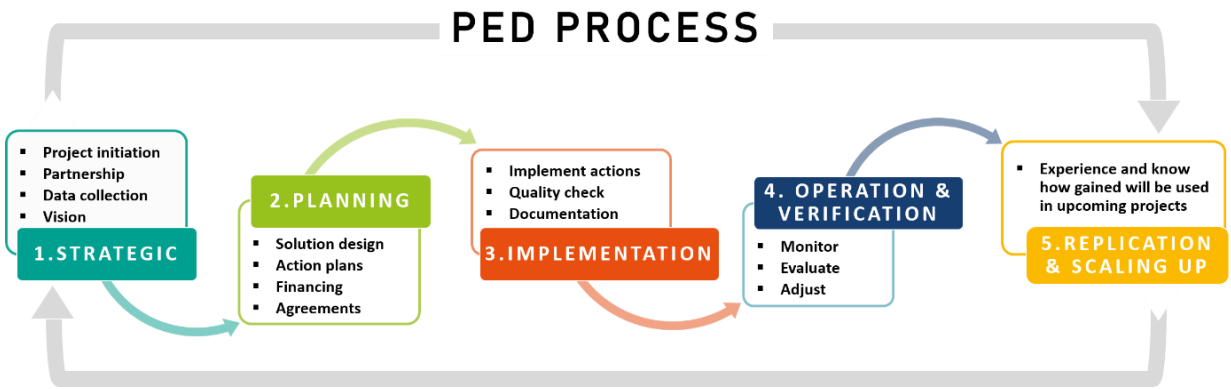
- **Energy resilient neighbourhoods:** areas that not only have a plus energy balance but also ensure business and users a reliable and regular supply of energy and contingency measures in place to guarantee energy access for all. Energy resiliency is also a way to mitigate energy poverty and supply citizens with reliable and climate-neutral energy sources for everyday activities.

- **Reduce energy costs:** In PEDs, energy savings and thus cost reduction come from shifting energy supply to a local level and managing the energy consumption and flexibility available along with energy-efficient buildings.

- **Improve life quality and district dynamics:** Ultimately, the PED actions and process will not only reach a climate-neutral and plus-energy neighbourhood but also a sustainable one, where stakeholders aim to live, work and develop.

- **Fostering innovation:** This makes sense in the PED context because they require a change in the way of thinking and designing neighbourhood-level actions and transformation. In this environment, new solutions and innovative designs and concepts are fertile ground to grow and be tested. It does not necessarily mean high-tech approaches, but new strategies and arrangements that contribute to the PED goals can come up as solutions for the project.

PED-ID Process Map: PEDs are not only projects but also processes – it involves a series of tasks that retro-feed one another and achieve the PED goal in a learn-by-doing practice. PEDs depend highly on local conditions (physical, social, and economic, regulatory factors), thus making it very complex to establish a definite process map to follow top-to-bottom by developers. Nevertheless, some steps should be more-less similar to PEDs throughout Europe. Below is presented an overview of how a PED process looks like from the very early stages until the replication phase:



1. **Strategic**: Establishing support and network for the process. Early stages of development, in which partnerships are formed, data is collected and analysed, and overall PED objectives and goals are agreed upon.
2. **Planning**: This is where concepts for the PED are created, solutions and designs are developed, and agreements between stakeholders are set. Here, we are planning and investigating what could be done in the PED area.
3. **Implementation**: This is where concepts for the PED are created, solutions and designs are developed, and agreements between stakeholders are set. Here, we are planning and investigating what could be done in the PED area.
4. **Operation & Verification**: This is where concepts for the PED are created, solutions and designs are developed, and agreements between stakeholders are set. Here, we are planning and investigating what could be done in the PED area.
5. **Replication**: Disseminate and share the results with other potential districts - learnings, challenges and experiences.

Stakeholders: Are all companies, persons and organisations that may be affected or impacted by the project. In an urban transformation process such as PEDs, it is essential to communicate and engage stakeholders from the very early stage to achieve project goals. The stakeholder engagement methodology used in PED-ID was based on a previous experience with multi-stakeholder and co-creation processes related to sustainable urban development: The Södertörn Model[1]. It highlights three important core city planning and urban development elements and proposes that urban development should be:

1) KNOWLEDGE-BASED:	2) COLLABORATIVE:	3) VALUE-CREATING:
Urban planning based on knowledge, using methods for gathering & analysing data and channels for sharing it.	With a participatory process for creating a shared vision for the project, understanding needs & desires.	Through increasing cooperation in the early planning stages, identifying synergies or "win-wins".

Mapping and analysing stakeholders: Knowing who is affected or involved by the project is the first step. Stakeholder mapping is a crucial exercise to determine who are the stakeholders involved in the process, what are their needs, what is the level of engagement needed, the communication strategy needed.

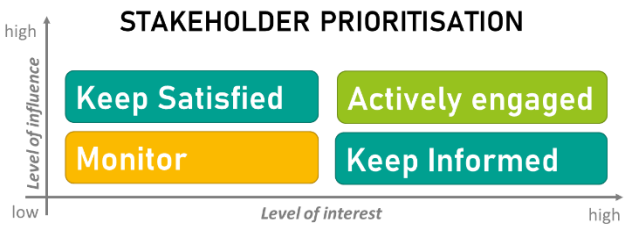
- **Step 1:** List and analyse the different stakeholders: name, their potential impact and influence over the project (low, medium, high), what is important to the stakeholders = their driving forces, their potential contribution or in worst case risk to block the project and finally the strategy to engage them:

STAKEHOLDER ANALYSIS MATRIX

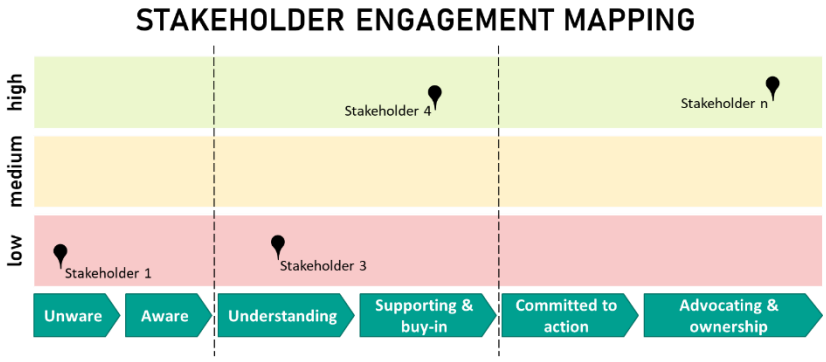
Name	Contact	How much does the PED impact them?	How much influence do they have over the project?	What is important to them?	How could they contribute to the project?	How could they block/stop the project?	Possible strategy to get them on board

- **Step 2:** All the stakeholders can then be mapped into this matrix depending on their influence and interest. This is a key to understand the communication strategy to be used with each one.

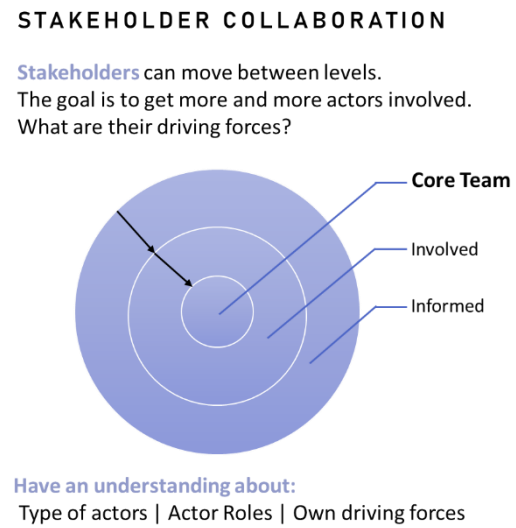
[1] http://sodertornsmodellen.com/home



- **Step 3:** Map the stakeholders using engagement matrix – the different stages of engagement are here divided into the categories: Unaware, Awareness, Understanding, Support and Buy-in, commitment and action and Advocacy and Ownership. This should be updated as the project involves and relationships are being created and change. The matrix is a footprint showing the level of engagement of all parties.



Engagement process: Both internally and externally, communications are essential for successfully realizing a PED. A joint communication strategy should be developed with the involvement of the main stakeholders, who may also have useful resources available to support the communications activities. Key messages can be developed that relate to the interests and aspirations of the main stakeholders (from the analysis matrix). The stakeholder engagement level (shown by the engagement mapping matrix) is also a key aspect to be considered in the communication strategy. According to their collaboration and engagement role, stakeholders can move between levels: core team, involved or informed. In PED projects, a substantial number of stakeholders should be involved from the initial stages up to the operation phase. The core team can, for example, consist of the leading developer, the municipality and a coordinating part or a process leader. The core team will grow gradually and be better defined as the project advances – attracting more stakeholders from the "involvement" and "informed" spheres. The goal is to get more stakeholders involved or at least informed. In this case, as the PED project advances, more stakeholders will gravitate around the project and will board the engagement spheres progressively. It is also essential to understand the different stakeholders driving forces – as well per actor as individually as an employee or as a private. What are their motivations? Value? Brand? Employees driving forces? Customers driving forces? All of these factors should serve as pillars of the communication strategy that may focus more on workshops, social media, events and other strategies to bring these groups on board.



Creating a PED Vision & quality standards: At the start of the process, the stakeholders will need to be

introduced to the PED concept since it is still not a familiar terminology to most people. It is also necessary to dialogue with the stakeholders about establishing the system boundaries and agreeing on the PED definition that will form the basis of the specific PED development. Establishing a PED quality agreement requires commitment from all parties associated with the project to achieve the proposed objectives by monitoring the progress and actions planned at different stages of development. Some essential points to be considered when developing a standard quality statement are:

THE VISION OF THE PROJECT: The requirements established should contribute to the project's vision. These are ways to verify whether the overall project objectives and targets will be achieved and when.

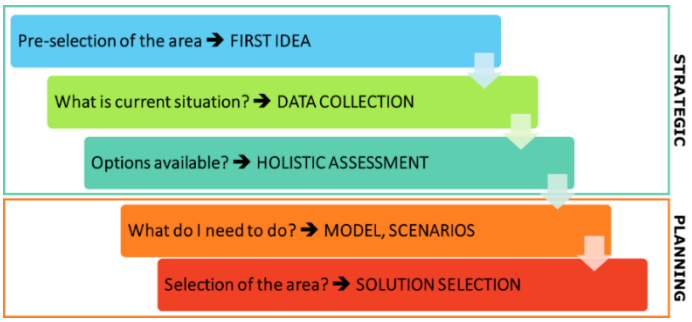
ENGAGEMENT: In this decision process, all parties must communicate actively and be heard. It is essential that each requirement set resulted from a common decision or agreement of all stakeholders involved.

RESPONSIBILITIES: for each requirement established, it is important to define the stakeholders who will be directly involved or in charge of the action. They would report the status and plans to achieve the objective set in different project phases

The purpose of this agreement model is to detail terms & responsibilities concerning the distinct aspects involved in a PED project – thus being an instrument for quality assurance to all stakeholders involved. Generally, it is said that a solid Quality Agreement should clearly describe what will be executed and who is responsible. Below is an example of the areas that a PED quality agreement should cover:

Sector	Issue addressed	Actions committed	Responsible party & contributors	Control	
				Planning	Execution
Energy use & production	Energy Supply	▪			
	Local Renewable Energy Production	▪			
	Thermal Energy	▪			
	Lighting	▪			
	Energy Flexibility	▪			
Building Structure	New buildings	▪			
	Refurbishment	▪			
	Energy needs	▪			
	Architecture	▪			
Circularity	Material flow	▪			
	Water & Waste	▪			
Mobility	Decarbonise	▪			
	Pedestrians	▪			
	Bicycles	▪			
	E-vehicles	▪			
	Public Transport	▪			
Open Spaces	Public Spaces	▪			
	Green areas	▪			
Social aspects	Housing	▪			
	Fulfilment of essential needs	▪			
Management & PR	Management	▪			
	Communication	▪			

PED-ID Holistic method for designing a PED: Holistic assessment of PEDs consists of several key steps. As an Urban transformation process, a PED involves a large number of aspects such as energy, building, mobility, public spaces, commercial facilities and many more. Therefore a holistic assessment is the best approach to develop the solutions and scenarios for a PED, taking into account the many factors that are relevant to the neighbourhood. First, there is a preselection of the area, where the PED in question could possibly be implemented. For this area, the data have to be collected on the basis of which the technical and technological solutions can be selected. The assessment of potential solutions leads to the development of possible implementation scenarios. The scenarios are assessed on the basis of indicators and benchmarks and then the final solution with the final area is selected.



Pre-selection of the area ➔ FIRST IDEA

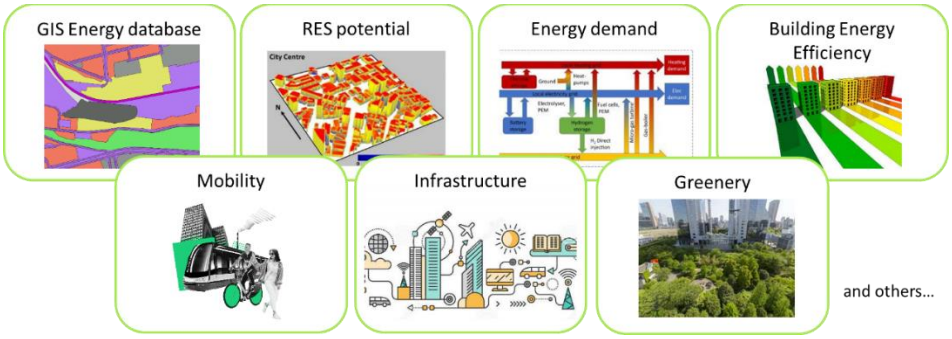
- **Assess the initial status of the area**: Is it a green field area? Extending existing urban area? Deep renovation of existing urban area?
- **Verify are the resources available:** Analyse the resources, delimitations, opportunities and challenges in the area. Based on these scans of the neighbourhood, the system and physical boundaries of the PED can be delimited.
- **Define the PED boundaries**: delimitate the buildings and physical infrastructure to be included, as well as the system boundaries (energy and other resources supply, distribution, consumption…)

Complexity level	Green field	Extending existing urban area	Renovation of existing area
Implementation	Low	Medium	High
Data collection	Low	Medium	High
Citizen engagement	Low	Medium	High
Ownership-/-property	Low	Medium	High
Impact on climate protection	Low	Medium	High
Financing	Low	Medium	High

- **Engage stakeholders:** Map and assess the level of commitment needed from stakeholders involved in the process.

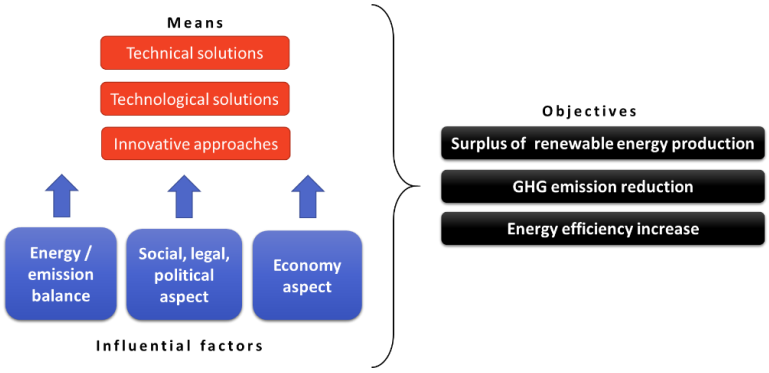
What is current situation? ➔ DATA COLLECTION

- **Identify the current state:** Collect data related to the social, economic, environmental, regulatory and energy aspects related to the selected area: GIS Energy database, renewable energy potential, energy demand, building efficiency standards, heritage marks, transport & mobility, infrastructure and services, green potential, citizen preferences and more.
- **Estimate energy demand:** Based on the PED initial state (green area, renovation) different approaches can be used to determine the energy demand. It could be based on real measured data, or in predictions based on new buildings standards and occupancy. Either, an energy demand for the PED needs to be estimated in order to plan the renewable supply and production.



Options available? ➔ HOLISTIC ASSESSMENT

It is necessary to assess different solutions in terms of their benefits and requirements and to their feasibility in the PED area, based on the data collection.

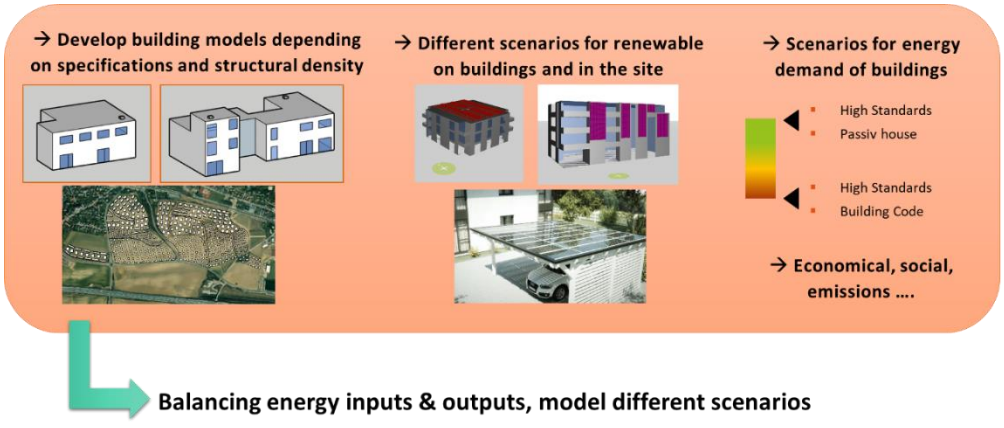


Within the PEDs, an effort is expected for maximum utilization of the area's potential to reduce the energy consumption, greenhouse gas emissions (GHG), and increase renewable energy production. Technical concepts are then used to develop models and scenarios for PED implementation.

The commonly used technologies in such projects generally refer to the three energy pillars: **Generation, Efficiency and Flexibility**. The solutions can be combined in order to achieve the goals established for the project. The various combination possibilities will be the backbone of different use cases and scenarios that will be considered and simulated by the technical experts for the PED.

What do I need to do? ➔ MODEL, SCENARIOS

Models are great instruments for studying and exploring possible solutions and scenarios for a PED. The site's limitations and the potential need to be carefully examined, unveiling the project's possibilities based on the existing conditions, building codes and regulations in the area. A synergic relationship between the



technical solutions planned for each sector needs to be established to achieve the PED goals. That means when the **buildings** and construction sites are being planned, there should be considerations made towards the **mobility** (location and integration of EV charges, pathways…), the **RES generation** (especially shading over PV sites, incorporation of roof and façade panels...) and **flexibility**.

Selection of the area? ➔ SOLUTION SELECTION

Then the decision on the solutions and strategies to be implemented in a PED needs to follow an evaluation of multiple criteria, both **quantitative and qualitative** (e.g., ensuring the quality of the indoor environment). It is not easy to combine the various scenarios and criteria for energy, finance, emissions, and stakeholders preferences, and imply in an iterative process until the final concept is achieved.

Quantitative criteria	Scenario 1	Scenario 2	Scenario 3
Positive energy balance reached (✓/ X)			
Total primary energy consumption (TJ)			
RES energy generation (TJ)			
Total investment costs (EUR)			
Total operational costs (EUR)			
Qualitative criteria	**Scenario 1**	**Scenario 2**	**Scenario 3**
Life comfort and quality improvement			
Social acceptability			
Score achieved per scenario			

Multi-Criteria Decision Analysis (MCDA): It establishes that stakeholders should be brought together in a co-development process for enhancing sustainable urban planning. MCDA follows technical analysis and introduces additional criteria – economic, social, regarding urban planning etc. The aim is to benchmark technical scenarios vis-à-vis more subjective criteria beyond simply achieving PED energy balance or not.

1. Defining criteria together with stakeholders and allocating weights to the different criteria with stakeholders.
2. Definition of the decision-making scheme: weights from each criteria selected.
3. Deciding according to defined criteria and test the energy balance.

QUANTITATIVE	
PED level	

• Total investment cost (CAPEX)
• Investment efficiency (specific cost of saved energy and CO_2)
• Operational costs (OPEX)
• Degree of energy self-sufficiency
  ○ Export
  ○ Import
• Total energy consumption decrease
• Total GHG emissions decrease
• Total RES energy production	

Individual measure level	
• Total investment cost (CAPEX) • Investment efficiency (specific cost of saved energy and CO2) • Operational costs (OPEX) • Energy savings (%) • Energy savings (TJ) • Total GHG emissions decrease	

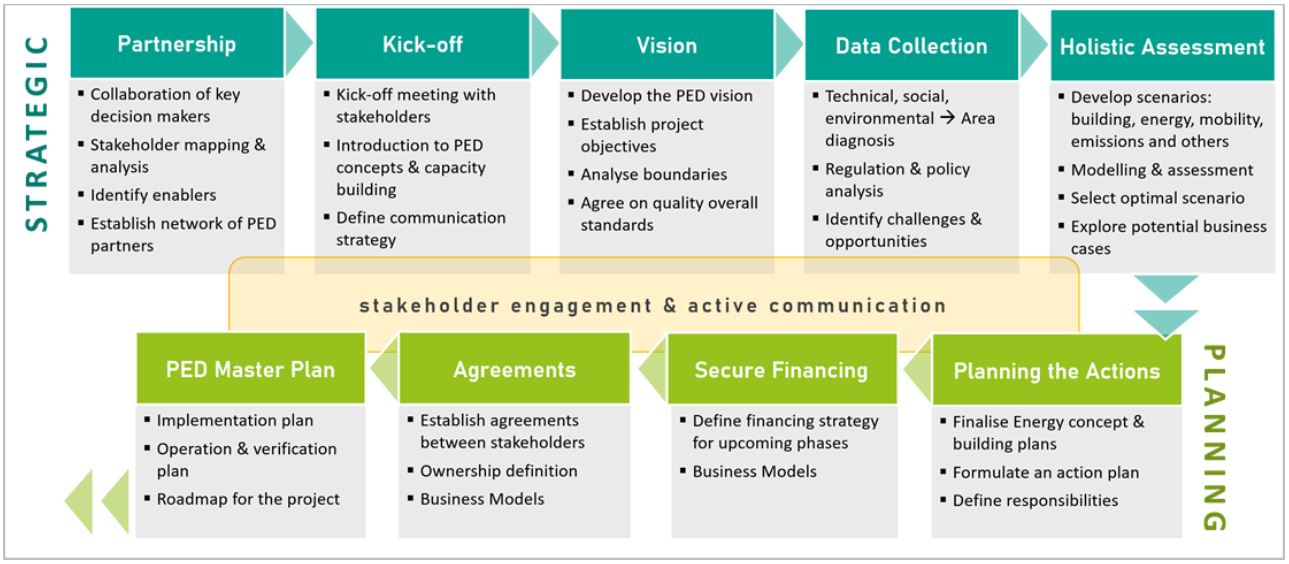
QUALITATIVE
General criteria
• Urban development • Improving life quality • Overall feasibility and demands of PED implementation • Social acceptance • Aesthetics, appearance, inclusion in the area • Legal barriers
Economic assessment
• Payback period • Available subsidies
Non-energy benefits
• Technical – condition of the buildings, quality, life cycle, energy security, energy independence • Social – public health, content, contentment, labour productivity, life standard • Environmental – local and global climate impact • Other – urban development, public acceptance, appearance…

Communicating the holistic process with stakeholders: Transmitting correctly each stage of the holistic method to stakeholders is essential to achieve good results. From the very idea to a mutual understanding and agreement among all the involved stakeholders. The information flow in both directions increases as the PED process progresses. However, to make the process sustainable and reach a feasible decision option in the end, it is necessary to narrow down the amount of information in the end and based the decision making on just a few selected benchmark parameters. The concept is depicted below:

Objective	Level of detail	Complexity Simple → Complex			
Tell the basic idea, get a go/no-go	Simple, plain				
Obtain the necessary	Detailed, not aggregated				
Formulate scenarios	Comprehensive, aggregated				
Benchmarking, making PED investment decision	Simple, few parameters				

In the beginning, only a vague understanding of PED opportunities is expected on the side of most of the stakeholders. Following the path of slowly widening the presentations' scope and data requirements, a consultant may get stakeholders on board, gather sufficient hard data and subjective limits, and define technically, economically, environmentally, and socially acceptable scenarios of PED development. Then, following the converse process of narrowing down the selected options and facilitating relevant stakeholders' final decision making.

Roadmap: To summarise the many steps presented so far in this guideline, we have proposed the following roadmap to be used from the very early stages of development until the end of planning phase:



Living Lab Results:

Uppsala Business Park | Sweden: 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. 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.

Kempelenpark | Austria: 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. Delivered Results:

- **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
- **Conception of Positive Energy Balance** of selected area

Rožnov pod Radhoštěm | Czech Republic: In case of Rožnov, working with stakeholders was relatively easy thanks to the fact that the municipality had adopted energy saving and climate protection policies and was in favour 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). Delivered results:

- **Spatial Energy Analysis** in selected area and adjacent neighbourhood with aim to cover the energy consumption of buildings with renewable sources as much as possible
- **Demand Side Scenarios** based on scenarios for building types and users with focus on energy efficiency first principle and use of renewable sources (preferably heat pumps)
- **Local and regional renewable energy potential** based on Spatial Energy Analysis and Demand Side Scenarios (construction of a biogas plant to cover part of energy consumption)
- **Potential for creating energy community within the area**
- **Feasibility study with focus on reaching Positive Energy Balance** of selected area

6. PROGRESS BEYOND THE STATE OF THE ART AND EXPECTED POTENTIAL IMPACT

Besides the pragmatic work developed in PED-ID project, there were many discussions between project partners and stakeholders to address questions about PED projects and its many perspectives. The main learnings from this process are listed below.

- **PEDs make sense** now because they require a change in the way of thinking and designing neighbourhood-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.

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.

Impacts: PED-ID was a short project in the framework of urban development. The focus was on the preparatory and strategic stages of a PED, focusing on supporting stakeholders and helping them navigate the first stages of development. However, we were able to reach all goals proposed in the beginning and even more. Through the workshops and collaboration there are follow-up projects coming soon and, most importantly, we were able to disseminate what a PED is and stimulate new initiatives.

Short-term impacts (project duration):

- Dissemination and consolidation of what a PED is and concept around it.
- Workshops with stakeholders
- Development of a holistic method to design PED scenarios and assess them.
- Stakeholder engagement tailored for PED development.
- Tools for assisting decision making based on data and common indicators.
- Energy concept for the three living labs – yearly positive energy balance.
- Consolidation of a roadmap and guidelines to assist stakeholder and project developers to start their PED process.

Mid-term impacts (5 years):

- Implementation of energy concept and strategies proposed in the living labs: integration of RES, energy efficient buildings and management.
- Increase of energy resilience and security in the living lab areas
- Reduction of energy costs for stakeholders in the PED.
- Improvement of life quality and district dynamics.
- New collaborations between project partners and living labs – spin-offs from PED-ID.

Long-term impacts (10 years):

- Tools developed by PED-ID will support and increase the number of PED initiatives in the EU.
- Change in the mindset of urban development – include energy as a key aspect of the agenda.
- PEDs as a way to achieve climate neutrality in urban environments:
- Fostering innovation – creating an environment that foster and pursue innovation in order to become climate neutral.

7. OUTLOOK

To achieve a sustainable and decarbonised urban transformation, initiatives such as the Positive energy districts need to establish in a concise way between all the actors involved in the project what the technical standards and requirements are for the different facets of the project. The process should not only aim at aspects of renewable energy generation but also at improving the structure and efficiency of the systems and, consequently the quality of life in the neighbourhood. Each project will need to develop a unique set of requirements to be agreed upon by all parties. The model presented in this report should be seen as a mine map to assist future agreements for developing countries.

Barriers & difficulties faced:

- The **economic viability** is still challenging to reach the "plus" standard: going from a net-zero to a pulls 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 neighbourhood transformation process relies mainly on the local authorities – and, therefore, is susceptible to political changes. There 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.

Follow-up projects: Up to this point, there is not an official follow-up project involving all PED-ID partners and the living lab parties. However, new opportunities and proposals are under work at the moment as new pathways to continue the work:

- **Digital Twins and PEDs**: Partners of the consortium proposed a new project focusing on Digital Twins as quality assurance and supportive tools for PED design.
- **PED initiatives** in Sweden, Austria and Czech Republic: Through workshop and other dissemination activities, the partners have been in contact with developers who want to implement PED process in new initiatives.