PED-ID

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

D2.1 Process Map from Knowledge-based Approach

Deliverable No.	D2.1
Deliverable Name	Process map from knowledge-based, Digital and Business Model approach
Version	V4
Release date	15/04/2022
Dissemination level	Public
Status	Final
Authors	Keith Boxer (White),

Document history:

Version	Date of issue	Content and changes	Edited by
V1	30/03/2022	First version	Keith Boxer (White)
V2	05/04/2022	Amends in response to inputs from CR and LLK	Keith Boxer (White)
V3	07/04/2022	Amends in response to inputs from AET	Keith Boxer (White)
V4	15/04/2022	Format & text	Camilla Rampinelli (e7)

Peer reviewed by:

Partner	Reviewer
e7	Camilla Rampinelli
White	Lise-Lott Larsson Kolessar
White	Andreas Eggertsen-Teder

This project has received funding from the JPI Urban Europe programme.

Table of contents

List of Figures

Acronyms table

Acronym	Definition
BREEAM	Building Research Establishment Environment Assessment Methodology
DTCC	Digital Twin City Centre
EPC	Energy Performance Contracting
ESCO	Energy Service Company
PED	Positive Energy District
PV	Photovoltaic
RES	Renewable Energy Sources

1Executive Summary

This document summarises the key findings from the tasks carried out within WP2 of the PED-ID project. It includes the conclusions drawn from the application of the Best-practice in the **Stakeholder Engagement methodology** that was assessed in the "living-lab" testbed at Uppsala Business Park in Sweden. It also provides some reflections on the potential role of **Digital Twins in supporting the initial stages of PED development** and the potential for the use of novel business models. PEDs come in all shapes and sizes, and there is no one-size-fits-all approach to PEDs. Many PED projects involve the combination of both existing development and new buildings. Some involve existing urban areas; others may involve new districts or neighbourhoods, university campuses, business parks, housing estates etc. As with most urban transformation processes, the development and realisation of a PED spans over many years, and it can be a challenge to maintain momentum and engagement with stakeholders throughout the entire process.

When a PED involves the design of new blocks of buildings within single ownership, the challenges may be predominantly technical, managerial, and economic. However, where existing urban areas are involved, potentially with multiple owners and stakeholders are concerned, the challenge of creating PEDs is far more complex, as no single entity has the authority or means to realise a PED. In these cases, **effective stakeholder engagement becomes critical**. Our conclusion from applying the stakeholder engagement methodology to the Living Lab in Uppsala, Sweden, is that such complex circumstances here require a need for a skilled process facilitator / trusted intermediary who can inspire and engage the key stakeholders, form partnerships, gain commitments, and facilitate the PED vision development through an open, participatory, co-creation process.

Ideally, the intermediary actor's team should comprise sustainable energy planning and stakeholder engagement expertise, combined with creativity, passion, and pragmatism. It is desirable that they also have experience in delivering similarly challenging and complex planning processes.

The **mapping of key stakeholders**, establishing effective communications between them, and learning about their stories, motivations and aspirations are essential to the process. Ways need to be found, and Resources identified need to be allocated so that the stakeholder engagement may continue throughout the development process, and, where appropriate, also into the PED operation and monitoring phases.

Digital tools are becoming more widely used by those involved in urban development. In recent years, the real estate sector has started to explore the use of Digital Twins. Where they can be made available Digital Twins can be a useful tool when developing and comparing PED scenarios. They can also be used to help communicate data visually and facilitate collective decision making. Digital Twins can also enable the gathering of in-use operational data and thus have the potential to enable the following up and management of the complex interactions that are characteristic of PEDS.

Business models already exist that can capture value for PED stakeholders. It is, therefore, not always necessary to invent new business models. Tried and tested approaches such as Energy Performance Contracting and ESCOs e.g. can be used to create "win-win "solutions. However, awareness of these models is still not very widespread, and it may be necessary to help introduce stakeholders to identify suitable models and partnerships that can be useful for their circumstances. Tried and tested approaches such as Energy Performance Contracting and ESCOs e.g. can be used to create "win-win "solutions.

Co-operative ownership business models, where residents and SMEs can become "Prosumers," i.e. producers of renewable energy (e.g. via rooftop solar) and providers of energy services (e.g. through grid balancing and demand-side management), are also worth exploring as a way of engaging with a broader range of stakeholders.

Digital tools are becoming more widely used by those involved in urban development. In recent years, the real estate sector has started to **explore the use of Digital Twins**. Where they are available, Digital Twins can be a useful tool when developing and comparing PED scenarios. They can also be used to help communicate data visually and facilitate collective decision making. Digital Twins can also enable the gathering of operational data and thus have the potential to support the management of the complex interactions that are characteristic of PEDS.

As **digital tools become more widely used** for the built environment's planning, design, and operation, we envisage that integrated approaches to spatial planning and energy planning will become more frequently adopted. However, it may require that city/regional authorities take steps to facilitate the integration of energy and spatial planning in their own processes and **promote the creation of PEDs** in their strategic land-use plans.

Stakeholder engagement processes have their limitations and can fall short when faced with legislative barriers and regulations that can exacerbate conflicts between public and private infrastructure ownership. In the living lab pilot at Uppsala Business Park, we found that conflicts between "the common good" and private interests mentioned some challenges that may require regulatory flexibility. Creating a "regulatory sandbox" was considered one feasible way to address these. The use of an ESCO, in the form of a public-private partnership, was also proposed as a mechanism that could be worthy of exploring to address specific concerns and create a better alignment of stakeholder interests.

At the time of writing, discussions concerning these proposed innovative approaches for the PED living lab in Uppsala had not reached their conclusion.

2 Introduction

PED-ID Project

2.1 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 are districts in urban areas that manage their resources to achieve net-zero energy balance (more energy is produced than consumed) and reduce greenhouse gas emissions. This project provides decision-makers with improved information about methods, tools and guidance for PEDs at an early stage of development, proposing a knowledge-based participation process. Stakeholders will be able to actively use these methods in the data-driven participation process to consolidate their options and make decisions based on data. This process will be tested using real Living Labs of potential PED projects. With the help of this method, the decision on sites will be accelerated to reach the goal of 100 PED sites in Europe.

Scope of this document

2.2 This document summarises the learning gained from the tasks conducted within WP2 of the PED-ID project. It includes the conclusions drawn from the application of the Best-practice in the Stakeholder Engagement methodology that was evaluated in the "living-lab" testbed at Uppsala Business Park in Sweden. It also provides some reflections on the potential role of Digital Twins in supporting the early stages of PED development and on the potential for the use of novel business models with innovative approaches to stakeholder ownership and operation.

- **Chapter 1**. Contains an executive summary with the main conclusions
- **Chapter 2.** Introduces the PED-ID project and scope of WP2.
- **Chapter 3**. Covers facilitating the process of stakeholder engagement and communication.
- **Chapter 4**. Covers partnership formation and potential business models.
- **Chapter 5.** Addresses creating a Vision, how to keep stakeholders involved and the potential of Digital Twins.
- **Chapter 6**. Includes a summary of experience from applying the methodology at the PED "living lab" at Uppsala Business Park in Sweden.

3 Process-kick off

Stakeholder engagement methodology and its application at UBP

In PED-ID Task 2.1, the aim was to develop "Best-practice" in stakeholder engagement by using a "Knowledge-Based Approach" and to evaluate and further develop the methodology through the application on at least one of the 'Living Labs".

3.1 A "Knowledge-based" approach

In general, a knowledge-based approach involves adapting theories, knowledge, and experience from a range of disciplines and applying them to the new task at hand. The standpoint taken by the PED-ID project was that to be successful, the implementation of Positive Energy Districts and Neighbourhoods must meet the goals of sustainable urban development and maintain desirable urban qualities; whilst also achieving PED energy ambitions.

In developing the stakeholder engagement methodology to be applied in the living lab at Uppsala Business Park in Sweden, White's team drew upon its previous experience in multi-stakeholder engagement and co-creation processes relating to sustainable energy sustainable urban development.

The experience was drawn from "The Södertörn Model"[1] for sustainable urban development, an innovative collaboration process for sustainable urban development, where municipalities, academia, and the private sector work together to create sustainable and attractive urban areas that respond to the needs of citizens. Also considered were the recommendations and lessons learnt on the Intelligent Energy for Europe (IEE) project: "PEPESEC" (Partnership Energy Planning for Sustainable Energy Communities)[2] , which improved energy planning methodologies and developed innovative techniques to facilitate the involvement of politicians, citizens, market actors and other key stakeholders.

Lessons from the Södertörn Model

The Södertörn Model highlights three important core city planning and urban development elements. It proposes that planning and urban development should be:

- **Knowledge-based:** Urban planning that is based on knowledge and data. Methods and tools for gathering and analysing knowledge and data and channels for sharing this knowledge.
- **Collaborative:** With a participatory process for creating a shared vision for how a place should change.
- **Value-creating:** Through increasing cooperation in the early planning stages between public and private actors, identifying synergies, "win-wins", and increasing the possibilities to meet society's challenges.

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

[2] https://www.sharingcities.eu/v2/projects/PEPESEC-Partnership-Energy-Planning-as-a-tool-for-realising-European-Sustainable-Energy-Communities&tpl=home

3.2 Mapping and identifying stakeholders

"Effective stakeholder participation and engagement must include timely access to clear and relevant information, highly skilled facilitation and trusted intermediaries." [2]

The process of mapping, identifying, and analysing key stakeholders relevant to the development of the PED is an essential step. It is also essential to decide how to engage with stakeholders. This depends on the scale and conditions of each project and the number and type of stakeholders identified. PED at Uppsala Business Park was facilitated by a team from White Arkitekter, who organised the stakeholder workshops. The known key stakeholders were invited to these workshops and at the workshops, further mapping of stakeholders was facilitated with inputs from local partners and other key stakeholders. An initial list of stakeholders was subsequently enlarged. Once PED stakeholders have been identified, they can be analysed and categorised under the following categories:

- **How much does the project impact them?**
- **How much influence do they have over the project?**
- **What is important to the stakeholder?**
- **How could the stakeholder contribute to the PED project?**
- **How could the stakeholder hinder the project?**
- **What is the best way to engage the stakeholder?**

The diagram below shows how stakeholders may fall into distinct categories:

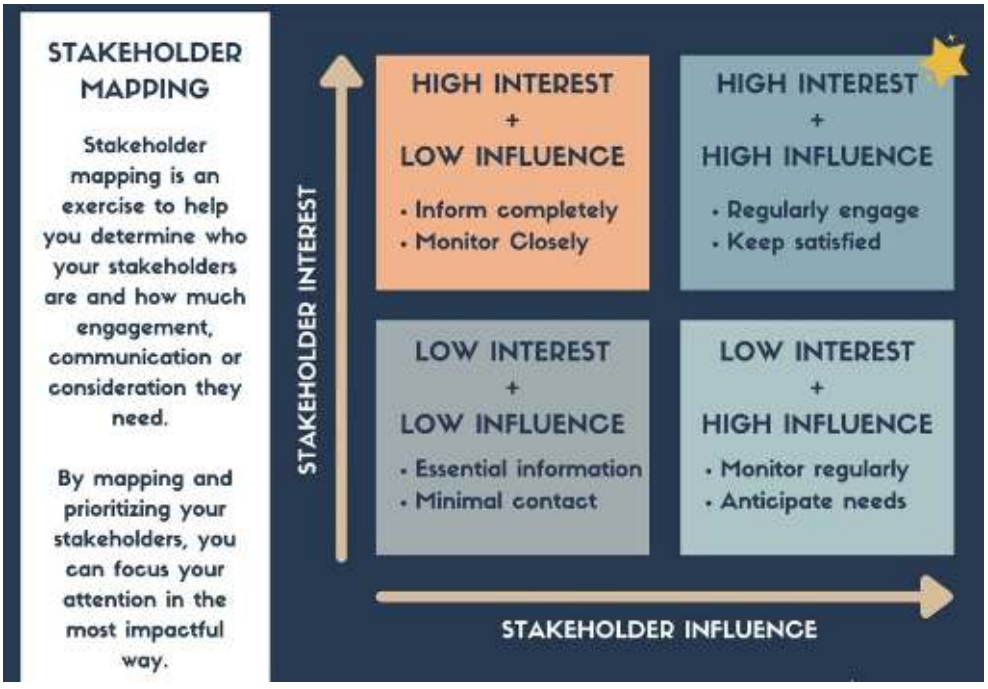

Figure 1 Stakeholder Mapping [5]

The stakeholder engagement process should be used to identify the various stakeholders' interests and motivations for creating a PED. Once the stakeholders have been identified, and the method for engagement has been chosen, the crucial next step is creating a shared vision and commitments necessary for creating a PED.

There are many ways the shared vision may be captured, and the actions needed described. One useful approach is via a co-created Roadmap that identifies the steps needed and timetable for realising the PED.

Clarifying what a PED Project is and developing a vision

At the start of the process, there will be a need to introduce the stakeholders to the PED concept since it is still not a familiar terminology to most people. It is also necessary to dialogue with the stakeholders
3.3 about establishing the system boundaries and agreeing on the PED definition that will form the basis of the specific PED development.

E.g. it may collectively be agreed that all energy production should occur within the defined geographical boundary, or there may be surpluses of renewable or waste energy nearby that can also be used. At this point, the project's definition, scope, and vision should be developed and agreed upon with all the key stakeholders. Communications are another important aspect of sharing and keeping the vision alive.

Communication & engagement during the process

3.4

Both internally and externally, communications are important for the successful realisation of a PED. A joint communications 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. E.g. In some places, the main drivers for developing a PED could be increased energy independence and local job creation. Elsewhere, the achievement of climate goals is the main priority, and in other places reducing costs and addressing fuel poverty could be the driving force.

In one PED-ID case study, we discovered that one of the key drivers for the area developer in realising a PED was to enhance the re-branding of the area by profiling the district as an innovative place with high climate ambitions. Becoming a PED was seen as a potential source of competitive advantage to attract innovative, forward-thinking companies and individuals to locate in the district. This ambition was supported by many of the stakeholders and so the communications strategy was designed to
3.5 support this ambition.

What are the challenges and barriers that were encountered?

Commitment

One of the early challenges can be getting a commitment from the most important actors since there are no legislative frameworks or regulations to enforce the creation of a PED.

At the start of the process, it is important to gain firm commitment to the process from those actors who are identified as essential to success. It is also important to get decision-makers in these organisations to commit the resources needed to fully engage, at least for the duration of the stakeholder process and vision development.

In many cases, important stakeholders will be the architects and other consultants responsible for planning and designing the buildings or other infrastructure in the districts involved. It may be necessary for these consultants to gain permission from their developer clients before fully engaging with stakeholder processes. This should be addressed as early as possible since they may need to charge clients additional fees for time spent on the stakeholder engagement process.

Covid

Working in Covid times has brought challenges for all projects. The restrictions on travel and meetings in person have meant that stakeholder engagement has often had to be held virtually. The illness of key staff, or their families, has caused delays or interruptions to the collaborative working processes. But virtual meetings can sometimes mean that a wider range of stakeholders can be reached more easily.

Continuity

As with most urban transformation processes, the development and realisation of a PED spans over many years, and it is important to find ways to maintain momentum and engagement throughout the entire process.

We would argue that the process leader/trusted intermediary role that White Arkitekter has taken for the PED living lab at Uppsala Business Park has been essential for enabling the success of the stakeholder engagement process and the development of a shared PED vision, and its associated roadmap. However, the implementation of all the activities identified in the PED roadmap was not within the 18-month scope of the PED-ID project. Delivery of the activities described in the PED roadmap requires actions from a broad range of stakeholders. Without continuity of process leadership, some parts of the vision (e.g. those that are not required by planning permissions or other regulatory frameworks) are not implemented, e.g. when challenges are encountered or should stakeholders change.

The journey from vision to realisation is rarely smooth, and the need to adjust course can occur along the way. Where there is no legislative requirement to implement the actions outlined in the roadmap and there is no single entity with responsibility for implementation of the PED vision, the need for ongoing process facilitation becomes quite critical. At Uppsala Business Park we have yet not succeeded in identifying resources for the process facilitator/ trusted intermediary role to continue after the support provided by the PED-ID project ends.

3.6

How to facilitate the process?

Without any statutory instruments (such as planning or building regulations) to regulate the creation of PEDs, combined with the fact that the economic benefits of PEDs are likely to be shared across a wide range of stakeholders (who may not all have the resources for the necessary investments) means that PEDs are something important for tackling climate change, and improving energy efficiency and security of supply, but still not considered essential.

Where the area involved is under the control and/or ownership of a single entity, and involves new buildings and infrastructure, the route towards creating a PED is arguably more straightforward, and the economic value more easily identified and captured.

However, where existing urban areas are involved, potentially with multiple owners and stakeholders, the challenge is far more complex, as no single entity has the authority or means to realise a PED. In these cases, there is a clear need for a process facilitator / trusted intermediary who can help to inspire and engage the key stakeholders and facilitate the vision and co-creation process.

In our experience, awareness of the potential benefits and need for PEDs is still very low. One could hope that cities and municipalities with commitments to reduce CO2 emissions in their geographic areas ought to take the initiative to facilitate the development of PEDs. However, few local authorities have the capacity or financial resources needed without dedicated resources or statutory instruments. Even in places where a profitable business case can be made, getting the key stakeholders to collaborate and make (or allow) the necessary investments is still a complex challenge requiring expert facilitation.

The PED-ID project has outlined a methodology for gaining stakeholder engagement and buy-in and concludes that, in most situations, an experienced process facilitator is essential. But, at present, identifying the resources needed for the process facilitation role is a challenge. Few city authorities have the necessary expertise, nor do they have the financial resources for employing external consultants who would provide that role.

4 Partnership formation

4.1 How to consolidate partnerships?

The requirements on cities and municipalities regarding the energy supply of districts and neighbourhoods have changed completely. From the pure supply of electricity and heat to the generation and management of renewable and waste energy resources by the various parties involved in the area (building investors, owners, tenants, etc.) The public sector goals in terms of reducing energy use and climate protection are not always the same as those of developers, investors, and building owners.

In many cases, the people and companies who invest and construct buildings are the ones who are decisive in implementing them. And these are often non-public authorities. In most cases, additional costs are to be expected at the time of construction due to the higher demands on energy efficiency and the application of renewable energy solutions. Therefore, where there are no mandatory requirements, business cases need to be developed with attractive opportunities and "win-win" solutions that meet stakeholders' needs and expectations.

4.2 Business model types in PEDs

Each PED project will have its own set of circumstances that influence what business models are likely to be successful. They cover the complete process from engineering and design development to the installation's implementation, operation, and maintenance. What can be viable is highly dependent on many local factors, including energy prices, regulations, market actors, subsidy mechanisms (such as feed-in tariffs for renewable energy) and local resources. It is crucial to identify attractive opportunities with value propositions that meet stakeholders' needs and expectations. Suitable business models already exist in other contexts, so the challenge can be to identify those that are most appropriate and have a chance of being successful in the specific contexts of the PED project. Some typical business model areas are shown in the illustration below:

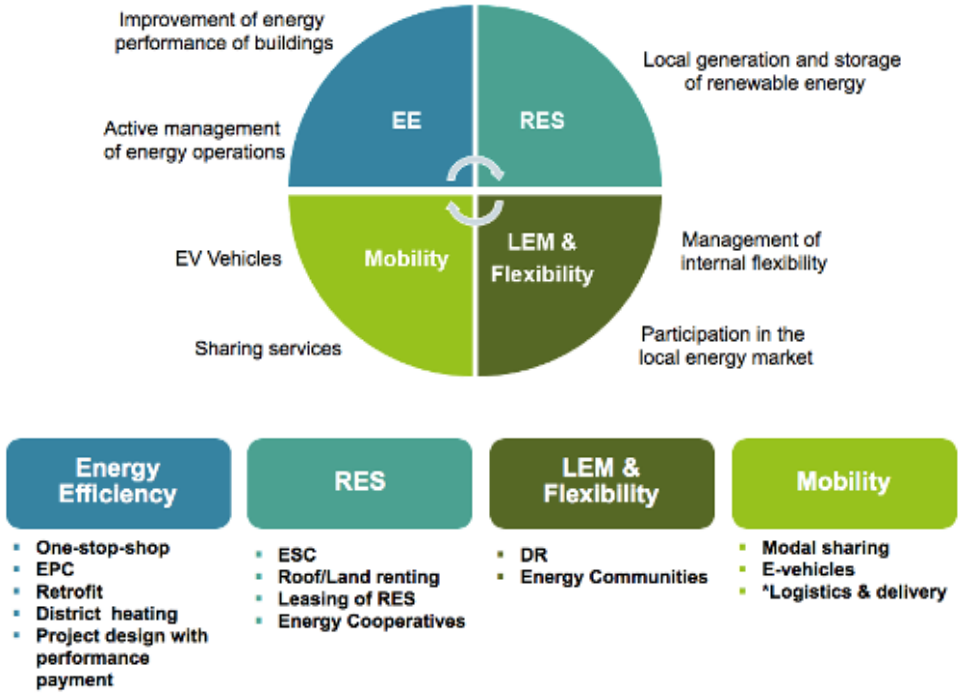

Figure 2 Examples of typical business models that can be used in PEDs

4.2.1 Energy Efficiency

Some potential business models for energy efficiency worthy of consideration for PEDs include the following:

- **One-stop-shop:** Single actor offering full-service: consultancy, independent energy audit, renovation work and financing. Players: Is particularly suitable for a public building, social and (in some cases) individual housing, ESCO and others.
- **EPC:** ESCO is contracted by property owners to improve energy efficiency. It receives a performance-based remuneration. Players: public buildings, commercial and industrial facilities + ESCO.
- **Financing for retrofit/building:** Local authorities have a leading role in setting up innovative investment schemes. A variety of solutions is already established and can be chosen according to the situation. Players: Building owners, ESCO, local authorities, financial institutions and others.
- **District heating:** Access to renewable heating or cooling. It can be combined with local heat and cold production (based on heat pumps, biomass, geothermal, solar or waste energy). Players: Building owners, facility managers, private companies – Public authorities.
- **Project design with performance payment:** the design team will take a systemic view of the building project to consider integrated energy efficiency solutions. Players: building owners, facility managers – specifically suitable for new buildings.

4.2.2 Renewable Energy Sources

- **Energy Supply Contract:** A third party provide 100% RES to PED. Players: Retailer & general consumers.
- **Roof/Land renting**: Lease of the roof or land for the deployment of RES (PVs) Players: Commercial, industrial, public, large buildings areas/spaces, ESCO…
- **Leasing of RES equipment:** Building owners can use a RES without having to buy it (owned or financed by another party): Players: Building owners/managers, equipment providers, ESCO…
- **Energy Cooperatives:** Non-profit entity for energy production and consumption. Consumers are both members and co-owners: financing collective renewable energy projects to produce their own energy.

4.2.3 Local Energy Markets and Flexibility

- **Demand Response:** Market actor explores local energy flexibility (aggregator). There are a variety of market models which are highly dependent on local regulations and tariff schemes. Players: Aggregators, Medium consumers, DSO, BRPs...
- **Energy Communities:** Providing a highly open and integrated P2P/B2B local energy and related services market. Controlled by shareholders or members that are natural persons, cooperatives, local authorities, including municipalities, or small- and microenterprises. Players: consumers, producers, grid managers, service providers.

4.2.3 Mobility

- **Modal sharing:** Complement available transportation alternatives: on-demand short-term e-car/e-bike / e-scooter rentals by a private fleet operator or a public entity. Players**:** General users, private companies, public authorities.
- **E-vehicles:** electrical public transport (provided by the municipality or private consortium. When technology allows for it*, smart charging (SC) or vehicle-to-grid (V2G) can complement the demand response from buildings. Players: E-vehicles owners, general users, public authorities, private entities, grid managers*
- **Logistics & freight services:** Different solutions are available for freight logistic services, minimising emissions and transit of heavy vehicles in certain areas. Players: Delivery and logistic companies.

4.3 Business Models to engage stakeholders

Energy is normally not the highest topic on the agenda in most board meetings. But making a greater profit or identifying new sources of revenue is often the priority. Many householders often do not think very much about the energy they use until it is time to pay the bill or they need to renew their arrangement with an energy supplier. However, saving or making more money is of interest to many stakeholders. Therefore, one important opportunity to gain interest from PED stakeholders is by

helping them to identify the business models that can enable them to capture value, either by reducing costs or creating new revenue streams.

Co-operative ownership models where, e.g. groups of residents, local organisations and small business owners can become "Prosumers "(i.e. becoming providers of renewable energy and energy services and being energy consumers) can be effective as a way of engaging with a wider range of local stakeholders. The process involved in establishing energy co-operatives can be valuable for engaging with citizens and raising awareness about energy issues whilst providing economic opportunities for induvial to invest in and benefit from sustainable energy activities in their areas.

What are the challenges and barriers that were encountered?

4.4 **Gaining trust is critical to success**. Innovative business models require new ways of doing things and with new ways come new, or different, risks. Business-as-usual is familiar and fear of change can be a barrier to the adoption of new ways of doing things. To gain the commitments needed to adopt new business models and approaches it is necessary to articulate and provide information about the prospective benefits and incentives.

New forms of partnerships may be needed to capture value. E.g. a common scenario can be where a business in the district has excess process heat as a by-product of an industrial process and another group needs to heat its homes and buildings. The investment in infrastructure required to capture that potential win-win opportunity is likely to need repaying over many years. For such a model to work, there may be long-term heat purchase agreements entered. Without trust between the parties involved and in the proposed technical solutions, it can be challenging to get all the necessary agreements to facilitate the investments required.

The **innovation required may be technical** (e.g. a more efficient heat exchange technology), or contractual (e.g. a form of profit-sharing contract). Providing successfully worked examples from places with remarkably similar conditions and actors involved can help gain trust and may succeed in reducing the concerns of those who will need to be involved.

5 Vision and Objectives

How to keep stakeholders involved?

5.1

Urban transformation takes time, and it can be a challenge to find ways to keep the wide range of stakeholders that are needed to be involved in PEDs engaged throughout the process. Energy issues are not always seen as important enough for stakeholders to actively engage with, especially over prolonged periods. Therefore, it is important to gain insight early on into the respective driving forces of those involved. It can be useful to consider helping the stakeholders understand and articulate "WIIFM" or *What's In It For Me?* This can make it easier to communicate why working to create a PED can be in their interests and help frame discussions about how PED ambitions can align with their goals and strategic objectives.

One useful way to concretise an organisation's commitment is through obtaining Letters of Intent from senior decision-makers that commit their organisation to participate in the PED project process. This can be an essential step to gaining the required commitment from each core stakeholder to contribute with necessary resources for the duration of the process.

Creating an environment to set the vision of the project

5.2

The drivers for engaging in the PED process can be quite different, depending on the stakeholders involved. For some, it can be the chance to contribute to something considered innovative and positive for society at large or something that benefits their own neighbourhood. For others, it can be the chance to make new local connections and identify new profitable business and investment opportunities. Therefore, it is useful to create an open climate in meetings where no questions are seen as too stupid, and each participant is made to feel that their contribution is valuable.

From the outset, it is important to explain to the participants what contribution is expected from them and how the results of the dialogue process and vision development will be used. It is also important to create a sense of shared "ownership" of the process and of the results.

At the Uppsala Business Park living lab, in the early workshops, a joint vision for the outcome of the process was developed with the core stakeholders and articulated as: the (co-creation) process shall result in:

"A well-developed roadmap, which has a high degree of buy-in from stakeholders, for how UBP can become a PED".

With this shared ambition in place, the remaining workshops and other activities could be channelled towards this shared ambition.

How could Digital Twins assist in this process?

The Built Environment and use of Digital Tools

5.3

Digital models and tools are now widely used by those working with the built environment. The use of BIM, 3D models and virtual environments is now commonplace to communicate with stakeholders and city planning authorities. Environmental design tools that can assess energy performance, solar irradiation, wind, daylighting, comfort, regulatory compliance, and CO2 emissions are also common. They can be valuable when aiming to create positive energy buildings and places.

Digital twins have the potential to bring all these aspects together with real-time operational data and can be potentially especially useful during the communication of options with stakeholders during the design phase. They can also provide performance feedback to users and other stakeholders during the operational stages.

During our literature review on PEDs and Digital Twins, we found the following papers refer to the potential for using digital twins when engaging with stakeholders:

1. **Digital Twin for Accelerating Sustainability in Positive Energy District: A Review of Simulation Tools and Applications [1]:**

"PEDs are defined as energy-efficient and energy-flexible urban areas with surplus renewable energy production and net-zero greenhouse gas emissions. Active information exchange and analysis will be necessary so that they would enable balancing and optimisation of energy flow across the PED, integration of mobility, communication, and trading between peers, as well as engaging more stakeholders. The digital twin environment will facilitate interaction and collaboration between all stakeholders involved in a PED's life cycle by enabling integrated data, information, knowledge, and decision-making capabilities."

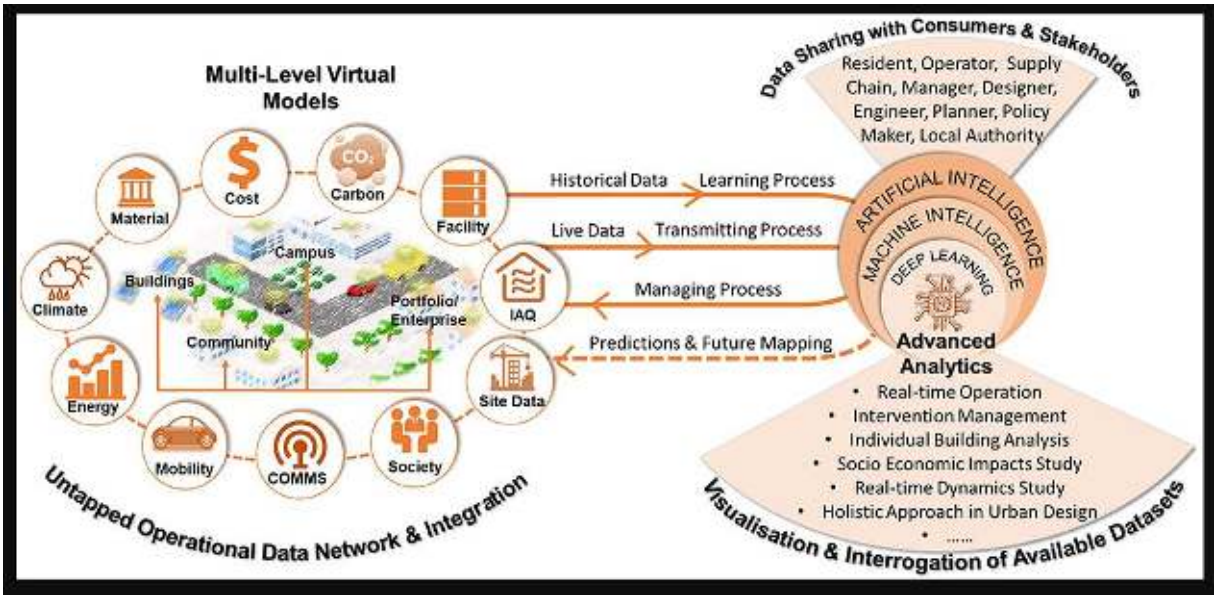

Figure 3 Overview of the application of Digital Twins in PEDs [1]

2. **Creating Zero Carbon Communities: The Role of Digital Twins [3]:**

"Digital twins have a significant role in understanding and managing the complex integration of multiple assets and systems that characterise community-scale projects."

"To realise the potential of community-scale projects requires tools that can help planners, designers, managers, and users make the right decisions across a complex set of possible actions and investments. Digital twins can provide the complex modelling, analytical, and simulation capabilities needed. They can also support the needs of diverse user groups, including citizens and other service users.

Community-scale initiatives also include bounded, complex environments like islands, university campuses, airports, and large real estate developments. Such projects represent an important upward scaling of climate action within individual sectors to a more holistic view encompassing integrated energy systems and broader behavioural and social changes. Community-scale projects are where more general policy objectives and practical programmes for transformation can come together."

Results from Task 2.2 Surveys

In WP2, Task 2.2 explored the use of Digital Twins in early area development for potential PEDs, divided into refurbishments in existing areas and existing building information and green/brown field developments without or with little data on buildings and infrastructure in early area development. The potential for the use of Digital Twins in stakeholder engagement, options appraisals and communications for neighbourhood scale energy / spatial planning was investigated. We concluded that supporting PED development could be a useful role for urban /neighbourhood scale Digital Twins.

DTCC's team engaged with those working on PED's, digital twins and/or urban development to explore how DTCC's collaborate with digital twin cities could be aligned to support PED developments. They aimed to draw some conclusions about what information should be available in the form of a district/city dashboard in the early area development phase to inform the stakeholders and, consequently, impact their decision-making. The results of DTCC's investigations are summarised in an additional appendix to be released shortly.

6 Summary and General Remarks

6.1 Summary of experience from the stakeholder process and vision development at UBP.

Below are our reflections from the stakeholder engagement process and vision development while preparing the co-created roadmap for the living lab PED at Uppsala Business Park.

6.1.1 Stakeholder dialogue

All places have a history, or background story, and this is also the case for energy systems. It takes time to gain trust. During the process, it was important to bring to light and understand the stakeholder's background "stories", as these can provide clues to the overarching story and help to show ways to address barriers and how to move forward together.

An experienced team from White with a background in sustainability, renewable energy, zero-energy buildings, and stakeholder engagement processes was assigned to lead the process at UBP.

During the dialogue process with key stakeholders, it became known that Klövern (now Corem) who is the main property developer in the area, a few years ago worked on a business model and long-term energy strategy for the area. But at that time this strategy was not universally bought into by the other property owners and businesses at UBP. This history meant that some of the actors became reluctant to collectively engage in actions for the common PED vision and future of UBP.

The stakeholder engagement and dialogue process created a trusting environment that enabled this shared history to come to light during the one-to-one interviews with representatives of some of the key stakeholders.

The status as a JPI Urban Europe research project also helped to create a less confrontational environment where ideas could be explored and shared without the parties having to make too firm commitments (or incurring significant expenditure, other than time) on the process. It enabled a fresh start to a dialogue that had stalled.

6.1.2 Engaging a Trusted Intermediary

Developing a district/area energy strategy requires the services of an energy specialist who should be independent, i.e. not associated with an energy company or technology supplier (who normally have their own priorities). There are multiple energy users in the district, so it is reasonable to share the cost for conducting the energy analysis. In the case of UBP it wasn't easy to get the major stakeholders to agree on how to share the costs for such studies, particularly as previous attempts to develop an agreed energy strategy had failed.

Where there are multiple stakeholders, it is important from the outset to create trust and commitment to a participatory, co-creative process that can result in a realisable strategy with a wide degree of acceptance. Developing the strategy requires a trusted partner/intermediary with energy and stakeholder engagement expertise, creativity, passion, and pragmatism. It is essential that they also have experience in delivering similarly challenging and complex planning processes.

The dialogue process that was facilitated for the key stakeholders at UBP was essential for understanding their motivations and challenges and was a necessary part of the process of developing the co-created PED roadmap for UBP. It can be important to understand the history of the area and the stakeholders' situations and aspirations to move forwards. The process leader/intermediary needs to take the time to listen and engage with the key stakeholders, collect stories, and have the skills required to do the detailed work necessary.

Finding an intermediary with all the necessary key competencies and identifying the funding for that role can be a significant challenge to widespread PED development. In the PED-ID project, the funding from the national agency in Sweden (Energimyndigheten) covered 50% of the costs. Still, the remaining co-funding of the intermediary role (that in the case of UBP was taken by White Arkitekter) had to be provided by the PED-ID project partners. This is not a sustainable solution, and in similarly complex future PED projects, other ways to fund the process-facilitator / trusted intermediary role need to be found.

It is of interest to note that the role of intermediary organisations in urban transition is also referenced in the research paper: "City Engagement in the Joint Programming Initiative Urban Europe and the Role of Intermediary Organisations in R&I Policies for Urban Transition", where it states:

> *"Wolfram et al. (2019) argue that deficits of effective intermediation are widespread, and the intermediation gap needs a dedicated response for urban transition. In the literature, the role of intermediary organisation has recently been discussed as an effective promoter and developer of connecting visions, strategies, activities, and stakeholders." [6]*

6.1.3 Other District Development models

It is useful to compare the process of stakeholder engagement for developing a PED in an urban district with multiple stakeholders to the process of forming Business Improvement Districts (BIDs). A Business Improvement District is a defined area in which (in the UK model) a levy is charged on all business ratepayers in addition to the business rates bill. This levy is used to develop projects that can benefit all local area businesses. https://www.gov.uk/guidance/business-improvement-districts

6.1.4 Motivated Core Partners

In UBP, there were three key actors who, all from the start, had an interest in UBP becoming a PED pioneer. The main real estate developer wanted to create an innovative and attractive district with a low carbon profile. The local municipality with ambitious climate policies and engaged and experienced representatives. White Arkitekter is a leading Swedish architecture and urban planning consultant with a 2030 goal of working 100% on carbon-neutral developments. The opportunity and funding provided by the JPI Urban Europe project provided the catalyst to bring these parties together. But a key role was also played by local actor STUNS, https://energi.stuns.se/en/ who originally identified the opportunity at Uppsala Business Park and initiated the dialogue between the three key actors.

Klövern had the resources needed to bring consultants from the state utility Vattenfall into the UBP project. Vattenfall's role was to assess the geothermal potential in the area. As a large utility with many different business interests relating to energy, Vattenfall's involvement was seen as a positive development and gave access to wider areas of knowledge and expertise.

6.1.5 Aligning ambitions

Uppsala is a city in Sweden with a long history of climate action and is seen as being at the forefront when it comes to making progress on tackling climate change. This meant that there was an elevated level of awareness amongst the local stakeholders and in the municipality of the need to address the energy situation. The engagement from the main developer was also a positive essential factor since, although the municipality has its own political goals, policies, and climate ambitions, there are not yet any statutory instruments that can require the creation of a PED. Investment in the necessary infrastructure to create a PED at UBP will come entirely from the private sector actors, so it is important to find a way to align climate goals and municipal political ambitions with the commercial interests of the main stakeholders.

6.1.6 A Regulatory Sandbox

Existing regulations and legislation can at times be a barrier to the innovations required to deliver new business models. A "regulatory sandbox" is a concept that enables businesses to evaluate innovative products, services, or business models. Within such a sandbox, regulatory obligations are partly not applicable. There have been discussions about creating a regulatory sandbox for UBP that would enable some of the planning and legislative requirements to be relaxed to make it easier to deliver the PED ambitions.

However, this relaxed approach mustn't create such unique circumstances that it would be impossible to replicate and create a situation where the lessons learnt from PED pilot projects are not transferable to other places. Therefore, it is important to strike the right balance between what regulations to hold on to and what areas to relax.

As well as Local Authority involvement, national actors (such as Energimyndigheten and Boverket in Sweden) should also be engaged when the sandbox approach is used on pilot projects so that important lessons learnt can have the opportunity to influence national policies.

6.1.7 An integrated approach to Spatial and Energy Planning

When new areas are being planned or existing areas redeveloped, an integrated approach to energy and spatial planning is a tool for realising PED ambitions and Sustainable Development Goals.[3]

However, we have found that the awareness of energy issues related to area master planning is sometimes not very high amongst the consultants who are normally tasked with leading the development of the area masterplan. There is also rarely an enforceable requirement from planners or local authorities that "Bioclimatic" design approaches should be used, nor that the master planning process should take careful consideration of form, orientation, massing etc. to minimise energy use and CO2 emissions, e.g. by enhancing the use of solar energy, natural ventilation, and daylight.

[3] Stoeglehner, G. Integrated spatial and energy planning: a means to reach sustainable development goals. https://rdcu.be/cJzmJ.

In the compliance note CN1. of the BREEAM Communities assessment methodology (see chapter 3.3 on BREEAM in D4.1 report: Criteria catalogue for Positive-Energy-Districts), it states that the energy strategy should include the certain actions as a minimum, and this includes recommendations for reducing energy use and associated emissions beyond baseline levels through implementation of energy-efficient measures including:

- site layout
- use of topography
- shading
- solar orientation
- use of daylighting
- wind management
- use of natural ventilation.

These are all measures that should be addressed at the master planning stage if energy demand from buildings is optimised. Suppose the energy strategy for a PED is developed solely by an energy specialist without engaging with the master planning process. In that case, opportunities for applying bioclimatic[4] approaches and optimising conditions for the use of both passive and active renewable energy technologies (such as building-integrated PV) can be missed.

The benefits of taking an integrated approach towards energy and spatial planning should be highlighted with the master planner at the start of the PED development process so that opportunities to influence the spatial plan are not missed.

In the case of UBP the master planning architect was approached and was positive to engage during the PED roadmap development. However, the additional work that might have been required to revisit, and potentially amend the masterplan, to improve energy efficiency and contribute towards the PED goals, was not within the original master planning architect's brief.

It would have helped the process if optimising the energy and environmental design opportunities of the masterplan had been included in the master planner's brief. Either because it was required under local planning guidelines, or because the developer had requested it when appointing the master planner.

Traditionally spatial planning and energy planning have been treated as separate disciplines, and awareness of the opportunities afforded by taking an integrated approach to energy and spatial planning is still quite low. But as the need to find economically viable ways to improve energy efficiency in the built environment and the awareness of the need to use local renewable energy sources grows, we envisage that ways to bring the two disciplines closer together will be found. This may be accelerated as the use of digital tools and methods in the planning and design of the built environment becomes more commonplace.

[4] Bioclimatic Design https://www.usgbc.org/articles/bioclimatic-design

6.1.8 Other barriers

Heritage

Many of the existing buildings in the Uppsala Business Park are from the mid-late 20th'Century. As such it was assumed that there would not be any heritage constraints as many of the buildings that would be affected were from 1960's. However, further investigations showed that in 1971 the main Pharmacia building at UBP had been awarded the Kasper Salin Prize for architecture. Several other buildings were identified as having architectural merit. Where a building is considered a unique example of its time or of high architectural merit, it can mean that there are more constraints on how it might be refurbished or retrofitted with energy-efficient improvements. It may be more difficult to gain planning permits to install solar panels on the building or upgrade the windows and facades with more energy-efficient solutions. Therefore, before any strategy is proposed for upgrading existing building assets or adding solar collectors within a PED, it can be essential to identify any heritage constraints and propose solutions that are not considered detrimental to the heritage values.

Legislative issues

One issue that arose in connection with UBP is that private companies do not normally have a right to place electrical infrastructure in the public realm. It might be necessary to relax the rules governing infrastructure in the public realm if new connections are to be possible between the buildings at UBP.

Taxation and other legislation in Sweden in relation to the opportunities for generating and sharing energy between "prosumers" is also something that was a challenge to the main developer. There have recently been new regulations governing "Energidelning" (energy sharing) and the full implications of this legislation are still being explored.

7 References

[1] *Zhang Xingxing, Shen Jingchun, Saini Puneet Kumar, Lovati Marco, Han Mengjie, Huang Pei, Huang Zhihua, Digital Twin for Accelerating Sustainability in Positive Energy District: A Review of Simulation Tools and Applications, Frontiers in Sustainable Cities Volume 3 , 2021. https://doi.org/10.3389/frsc.2021.663269*

[2] *Y. Cronin, V. Cummins (2019). Recommended Innovation and Best Practice Stakeholder Engagement, EirWind Project Deliverable D4.2 Report, MaREI Centre, ERI, University College Cork, Ireland.* https://doi.org/10.5281/zenodo.3948436

[3] *E.Woods, B.Freas. "White Paper - Creating Zero Carbon Communities: The Role of Digital Twins", Published 4Q 2019 and commissioned by Integrated Environmental Solutions (IES). Accessed by: https://www.iesve.com/support/white-papers/digital-twin-white-paper.pdf*

[4] *Department for Levelling Up, Housing and Communities and Ministry of Housing, Communities & Local Government. Business Improvement Districts: Information and guidance on Business Improvement Districts. Published 8 November 2014: https://www.gov.uk/government/organisations/department-for-levelling-up-housing-and-communities*

[5] *Stoeglehner, G. Integrated spatial and energy planning: a means to reach sustainable development goals. Evolut Inst Econ Rev 17, 473–486 (2020). https://rdcu.be/cJzmJ*

[6] *Meyer, S., Hawlik, R. (2021). City Engagement in the Joint Programming Initiative Urban Europe and the Role of Intermediary Organisations in R&I Policies for Urban Transition. In: Bisello, A., Vettorato, D., Ludlow, D., Baranzelli, C. (eds) Smart and Sustainable Planning for Cities and Regions. SSPCR 2019. Green Energy and Technology. Springer, Cham. https://doi.org/10.1007/978-3-030-57764-3_19*

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

PED-ID

This project has received funding from the European Union's Joint Programme Initiative Urban Europe programme.