



**Accelerate poSitive  
Clean ENergy Districts**

## **Local framework and needs assessment**

Understanding the starting point and priorities  
of ASCEND Multiplier Cities

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## List of Acronyms

| Acronym | Description                                |
|---------|--|
| AIM     | Alba Iulia Municipality                    |
| ASCEND  | Accelerate poSitive Clean Energy Districts |
| CCTV    | Closed-circuit television                  |
| CEC     | Citizen Energy Community                   |
| DSO     | Distribution System Operator               |
| EU      | European Union                             |
| LHCs    | Lighthouse Cities                          |
| MCs     | Multiplier Cities                          |
| NGO     | Non-Governmental Organisation              |
| NZEB    | Net Zero Energy Building                   |
| PCEDs   | Positive Clean Energy Districts            |
| PEB     | Positive Energy Building                   |
| PV      | Photovoltaic energy production systems     |
| REC     | Renewable Energy Communities               |
| RES     | Renewable energy sources                   |
| SECAP   | Sustainable Energy Climate Action Plan     |
| SME     | Small and medium enterprises               |
| SPs     | Solution packages                          |
| TBD     | To be defined                              |
| TSO     | Transmission System Operator               |

# 1. Executive Summary

This report presents the results of harvesting workshops from 5 ASCEND Multiplier Cities (Alba Iulia, Budapest, Charleroi, Prague, and Porto). These workshops aimed to create a shared understanding of the local conditions, draft the PCED implementation roadmaps and identify capacity-building needs.

The workshops were realised on-site, using a participatory diagnostic approach, relying on maps, collective brainstorming, semi-structured interviews, and site visits. All the Multiplier Cities feature a constellation of stakeholders engaged in the project, usually with several public agencies leading PCED deployment and ecosystem coordination.

Multiplier Cities display distinct realities and maturity levels on the topic of positive and clean energy districts. In summary, Prague's PCED is a 100% new construction project in its suburbs, planning to develop on highly efficient buildings. Budapest will focus on retrofitting an existing consolidated neighbourhood, targeting an unused school that will be converted into social housing. Alba Iulia will combine new construction and renovations for energy efficiency, mostly on educational facilities. Porto will deploy solar energy production and renovations on social housing and public facilities and establish an energy community. Charleroi's PCED is part of its Porte Ouest project, seeking to depollute and repurpose a large industrial brownfield near its city centre.

Despite their different contexts, Multiplier Cities face common challenges, among others (1) insufficient funding; (2) complex stakeholder ecosystems, including multilevel local governance and significant private ownership; and (3) unfavourable regulations, particularly when it comes to energy sharing. These challenges will require different innovative approaches, solutions, and governance to reach PCED implementation.

Finally, common capacity-building needs among the Multiplier Cities include open-source digital tools, economic models, regulatory framework navigation, citizen engagement strategies and governance structures. A detailed outline of capacity building needs by Solution Package is included in the conclusions of this report.

## 2. Introduction

This document presents the main results of the harvesting workshops with ASCEND Multiplier Cities (MCs). Energy Cities have held workshops from March to June 2023 in Porto, Prague, Alba Iulia, Budapest and Charleroi. The workshops gathered the main local stakeholders engaged in the PCED deployment in each city for two days.

The workshops had different objectives. At first, they aimed at creating a shared understanding of the context of the MCs and their PCED area. To do so, we collected diverse types of information, such as the regulatory frameworks, existing infrastructure, expertise, and governance structure.

Secondly, the workshops aimed at kicking off the project at the local level, setting up a first implementation roadmap of MCs. The roadmaps highlight the main solutions the local teams aspire to deploy in their PCEDs and their implementation timeline.

Finally, the workshop also aimed to gather key information about the multiplier cities' capacity-building needs, challenges, and strengths. This information will help design the capacity-building program that will run throughout the whole duration of ASCEND.

### 2.1. Workshop Methodology

**Process:** workshop design followed a consultation process between Energy Cities, Solution Package owners and Multiplier Cities. On the one hand, the topics and expected outcomes were arranged with each Solution Package owner. On the other hand, the local priorities and sequence of sessions were decided with each Multiplier City.

**Structure:** Workshops were conceived as working sessions with the local consortia and relevant stakeholders. Over 2 days, each solution package was thus organised as a separate thematic block, usually 1.5 hrs in duration, joined by stakeholders beyond the local core group as needed.

**Methods:**

Different methods were used to facilitate discussion and tap into the knowledge and expertise of participants thematically. The main methods used were:

#### 1. Vision - Future radars

Using the "future radars" canvas (see Annexe 5.1.1) and sticky notes, participants were split into groups and asked to brainstorm and exchange on what they imagined the PCED would be like in 2030. After populating the farthest end of the "radar" with their collective

vision, participants were asked to discuss steps to get there in terms of governance changes, incentives, infrastructural milestones, behavioural modifications, etc. Easier steps would be located along the axis of the “radar”, more difficult ones on the outside. What emerged was a pathway of easier steps to achieve the desired vision.



Figure 1. Workshop materials and participants during a session in Budapest. Photos by Eduardo Blanco.

## 2. Stakeholder Mapping

Aided by a “stakeholder wheel” canvas (see Annexe 5.2.2), participants were asked to write the name of their organisations on a sticky note and locate it according to the type of entity (Public Entities and Agencies; Inhabitant associations/committees; NGOs and charities; etc.) and the kind of role(s) they played in ASCEND (responsible, validator, to be consulted, to be informed). Once all participants were identified, the exercise continued by mapping other stakeholders that may not be present. Digitalised versions of each stakeholder mapping are included in each MC’s section of this report.

## 3. SP Information Collection – Semi-structured Interview

Prior to the workshop, introductory video presentations by SP owners were made available to workshop participants. During the workshop, the sessions were primarily addressed as a semi-structured group interview. Organised by SP, they included specific questions for participants that were summarised by the facilitators in cards (Figure 1). In addition, a questionnaire on SP1 was provided to cities in advance, to gather information on data availability.

#### **4. Roadmap**

Participants were asked to plot project milestones and next steps on an A0 roadmap canvas (see Annexe 5.1.3). Formatted as a matrix with years on the horizontal axis (2023–2027, beyond) and SPs on the vertical, the canvas facilitated discussion and allowed to find interdependencies and critical paths. Digitalised versions of each Multiplier City’s preliminary roadmap can be found in this report.

#### **5. Spatial Mapping**

Throughout each workshop, an aerial photograph of the local PCED printed in A0 format was used to spatially locate the specific components of projects such as district boundaries, new buildings, land ownership, and mobility projects. Maps can be found in Annexe 5.2.

#### **6. Challenges, Solutions, Capacity needs and strengths.**

After each SP-specific session, participants plotted the main challenges, solutions and capacity building needs and strengths of their PCED in an A0 canvas (Annexe 5.1.4). The process allowed to identify, for each SP, the specific difficulties, and opportunities of the city’s road to implementation, while helping orient the capacity building programme ahead.

#### **7. Site Visit**

As part of the workshop, local partners guided a site visit to the PCED area. The tour allowed members of the core group, Energy Cities and the broader stakeholder ecosystem to get acquainted with the specific neighbourhood, buildings and facilities to be intervened.



Figure 2: Harvesting workshop in Prague. Photo by Denisa Pevná, OICT.

## 3. Main results and lessons learned

### 3.1. Alba Iulia

Alba Iulia Municipality is a Romanian city with around 74.000s. Alba Iulia's sustainable development vision outlines an inclusive, open and Smart City. Having secured over 250M€ of non-reimbursable funding in the 2007-2023 period, the city aims to become a territory where strategic urban management facilitates growth and improves living standards and competitiveness. The Alba Iulia Municipality is a signatory of the Covenant of Mayors, has a Sustainable Energy Climate Action Plan (SECAP), an Action Plan for Circular Economy, and a Resilience and Adaptation to Climate Change Plan. The city also applied for the EU Cities Mission, revealing its ambitions to achieve climate neutrality.

#### 3.1.1. Alba Iulia PCED context: discovering the Dorin Pavel School area.



Figure 3. Alba Iulia's PCED map from a workshop session. In white, the refined PCED polygon, with the Dorin Pavel School in the south-east (in green).

The PCED proposed by Alba Iulia municipality is situated in the centre-North of the city. The initial area, of approximately 22.000m<sup>2</sup>, hosted several municipal projects on energy efficiency, mobility, e-vehicle chargers, PV on public buildings, among others. However, during the harvesting workshop, it was concluded that it would be more suitable to reduce the area of the PCED for project purposes. As a result, the Municipality and Energy Cities proposed to focus on one of the areas

that concentrated most public projects, as marked on the map (Figure 3). The area includes the Dorin Pavel technical school (Figure 4), under renovation with the ambition to become a Positive Energy Building (PEB); private multifamily housing buildings; several commercial and single-family structures; and a greenfield expected to host a PEB dual education campus, currently in the planning phase. The area is adjacent to one of the main avenues of the city, where an ongoing mobility project will integrate dedicated bus and bike lanes, greening and shared mobility solutions. The current PCED site of Alba Iulia is thus an area with mixed functions, not yet integrated from an energetic point of view.



Figure 4. The utility building of the Dorin Pavel School already features PVs. Photo by Sebastián Oviedo.

### 3.1.2. Setting a vision for Alba Iulia's PCED

The vision for the Alba Iulia PCED follows the City Integrated Urban Development Strategy: a smart, accessible, and coherent city; a green city with efficient public services; a competitive and creative city; and a European cultural and touristic destination.

Similarly, the Bold City Vision of Alba Iulia provides a framework for the PCED's vision, guided by the overarching goals and ethical standards of the UN Sustainable Development Goals 2030.

At the PCED level, these ideas translate into the following:

- a **greener** neighbourhood with green public areas accessible to all citizens
- a **100% renewable energy** district which is no longer fossil dependent but relies on clean and renewable sources of energy
- a **smart mobility** neighbourhood which uses sustainable means of transportation instead of car-based mobility
- a **socially integrated and just** neighbourhood where everybody is included socially and economically.

### 3.1.3. Alba Iulia's PCED stakeholders and governance (SP 6 and 5)

#### Current framework

**Municipal leadership:** Mapping the stakeholders of Alba Iulia's PCED revealed that the coordination for the project remains within the municipality. The ecosystem comprises public agencies and businesses (see Annexe 5.2).

**Validation challenges:** Initial approval depends on the city council. However, during the workshop, participants highlighted the difficulty of additional, strict verification and auditing from regional and national levels at every step of the tendering and implementation process. Use of European funds is simpler.

**Complicated tendering:** Since fees to contest public tenders are remarkably low, contractors often dispute results, complicating and making the tender process long.

**Refined PCED boundaries:** After the project proposal included a large city area, participants refined the polygon of Alba Iulia's PCED during the workshop (see Figure 3). The area revolves around (i) the Dorin Pavel School, currently in the process of becoming a PEB; and (ii) a PEB campus for dual education, planned in the greenfield behind the school, waiting for funding approval. The area also includes private housing (multifamily and detached) and some businesses.

**Online civic budgeting:** Alba Iulia's participatory budgeting platform is used for approving funding for citizen-initiated projects, usually 4 or 5 per year. According to workshop participants, more people vote in this process than in the elections.

#### Planned actions

**Stakeholder engagement:** After the area was refined, the Alba Iulia Municipality team now has a clearer set of actors to involve in the PCED process, including the block's association of inhabitants, the businesses within the polygon, and the departments involved in the PEB campus planning.

| Alba Iulia   | Financial Validator                                    | Technical Validator                       |
|--|--|---|
| <b>SP1:</b> Digital Infrastructures and Tools for flexible energy systems and PCED                 | Building owners<br>Alba Iulia Municipality             | AIM<br>Electrica                          |
| <b>SP2:</b> Deployment of Energy Communities and Prosumers   | Alba Iulia Municipality                                | Alba Iulia Municipality                   |
| <b>SP3:</b> Deployment of energy-efficient buildings integrating RES, Storage and Frugal Solutions | Alba Iulia Municipality                                | Alba Iulia Municipality                   |
| <b>SP4:</b> Decarbonisation of Mobility and Freight Logistics, including Frugal Solutions          | AIDA<br>Alba Iulia Municipality                        | AIDA<br>Police<br>Alba Iulia Municipality |
| <b>SP5:</b> Citizen-Centric Solutions and Co-creation along the governance chain                   | Alba Iulia Municipality                                | Alba Iulia Municipality                   |
| <b>SP6:</b> Urban Developer for PCED as an Umbrella Solution                                       | Alba Iulia Municipality<br>Regional development agency | Alba Iulia Municipality                   |

Table 1. Alba Iulia's PCED Validators

### 3.1.4. Digital infrastructure and tools in Alba Iulia's PCED (SP1)

#### Current framework

**Data availability:** data is limited at the PCED and city level. The public buildings and lighting systems have electricity and gas consumption data. Data from private buildings are mostly inaccessible. Data is not standardised, centralised or available in real time. Some environmental and general consumption data are available from the national statistics platform at the city level. The city had several pilots in the past to test smart city solutions with private companies, some using open-source solutions. Some historical data is available from these experiences (for example, an air pollution hot map and mobility data). The city has a geoportal with open data with general urban data, such as zoning and urban regulation and incidents in the city reported by the citizens. City council data is available online.

**Data platform:** currently, there is no data platform. The available data is scattered in spreadsheets and national databases.

**ICT infrastructure:** the municipal buildings are connected through a dedicated optical fibre network. The city has 4G coverage and 5G in some areas. There are two private LoRaWAN networks.

### Planned Actions

**Sensors and data collection:** within the ClimAct CEE project, air quality sensors will be deployed inside the refined PCED area. In the mobility project, closed-circuit television (CCTV) systems will be deployed, and traffic and bike-use data will be collected. Furthermore, the municipality wants to deploy solutions for structured energy consumption and production data collection and visualisation in the PCED. Nevertheless, it depends on the country's evolution of the Energy Community legal framework and funding opportunities.

## 3.1.5. Energy communities and prosumers in Alba Iulia's PCED (SP2)

### Current framework

**Legal framework:** the national government made a very simple transposition of the European directives, without any local specifications or enablers. In this context, the local consortium understands the creation of energy communities as unfeasible. Furthermore, prosumers are not allowed to share energy between buildings, and public stakeholders' injection of surplus energy into the grid is not compensated or remunerated.

**Previous REC experiences:** The city has no previous experiences on the topic. At the national level, a few private stakeholders started to develop pilot projects, but they are small (jointly owned production systems, for instance).

### Planned Actions

**Renewable energy community:** Local partners will explore the possibility of creating a REC, learning from other cities. The feasibility will depend on the national legal framework's evolution.

## 3.1.6. Energy efficiency and renewable energy production in Alba Iulia's PCED (SP3)

### Current framework

**Existing energy systems:** Some public buildings in the area have solar panels for energy production. In the case of renewable production surplus, it is injected into the grid without compensation, benefitting private providers. Heating is produced at the unit scale, usually with natural gas systems. Some public buildings are using heat pumps to reduce gas consumption, like the Sports School (outside of the updated polygon of the PCED).

**Previous energy efficiency refurbishment:** Several public buildings have been retrofitted within the originally submitted PCED area, including the municipality and several public schools.

### Planned actions

**Net Zero Energy Buildings:** The Dorin Pavel school complex has 5 buildings planned to become Positive Energy. The PCED area will also receive a new dual education campus that will be PEB.

**Renewable energy production:** The originally submitted PCED area will receive new assets for solar energy production, namely in the market building and in the municipality building. The Dorin Pavel School and the PEB campus are within the redefined PCED polygon. They will be funded by public money and publicly owned. Private houses will also receive national incentives to deploy PVs.

**Energy efficiency refurbishment:** A few buildings, namely private dwellings and the Dorin Pavel school, will be refurbished for better energy efficiency.

**Public lighting:** The city will upgrade its public lighting system, changing it to LED technology and promoting system connectivity.

| Alba Iulia-SP3 Priorities                        | Planned | Opportunity        | Irrelevant |
|--|---------|--------------------|------------|
| RES for heat + electricity                       | X       |                    |            |
| Connection to District Heating                   |         |                    | X          |
| Creation of heat and electricity storage systems |         | X<br>(electricity) |            |
| Collection and use of rainwater                  |         |                    | X          |
| Other frugal solutions                           |         | X                  |            |

Table 2. SP3 Priorities for Alba Iulia's PCED

### 3.1.7. Decarbonised mobility, logistics and public space in Alba Iulia's PCED (SP4)

#### Current framework

**Dominant car presence:** Participants pointed out the dominant presence of private vehicles in public space. Mobility actions that limit private car use are thus politically sensitive, since car ownership and use are priorities amongst citizens. According to participants, the per capita car ownership curve is getting steeper, with currently 1 car for every 2 inhabitants of Alba Iulia.

**Shared mobility:** Step-ons are available in the city as a floating fleet, yet shared cars were unsuccessful given the lower taxi price.

**Difficult governance:** The municipality has little influence on the public transport system, despite subsidising it. Whereas lines are planned by AIDA, the intermunicipal development agency, the terms of concession tend to favour the private operators.

### Planned Actions

**Integrated mobility project:** Alba Iulia is building dedicated bus lanes on their main avenues. The project, which should be finished by the end of 2023, will include bike lanes, partly segregated, and partly painted. Stops will incorporate e-charging and shared bicycle stations. Greening is planned along the avenues.

**Fleet electrification:** The city will purchase 27 new electric buses, which will be added to the existing 13 currently electric ones, within a total fleet of 80 units.

**Increased bike infrastructure:** The city plans to add 19.5 km of bike lanes in the next few years as part of the National Resilience Plan. Meanwhile, a regional program will fund additional 18 km.

## 3.1.8. Alba Iulia's PCED implementation roadmap

Alba Iulia's preliminary PCED roadmap (Figure 6) showed many SP3 milestones, related to the PEB Dual Education Campus being planned.

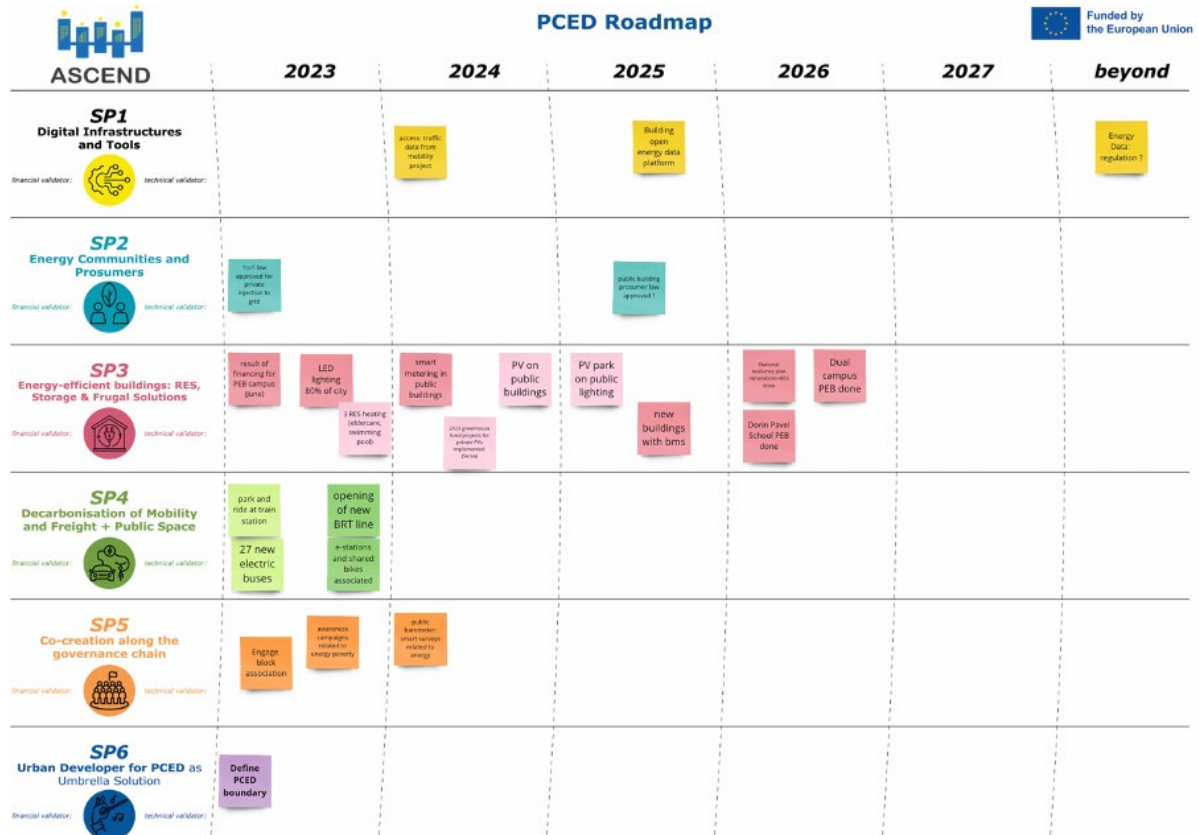


Figure 5. Alba Iulia's PCED roadmap. Lighter colours indicate steps that are beyond the boundary of the refined polygon. See larger version in Annexe 5.2.

### 3.1.9. Main challenges and capacity needs for Alba Iulia

#### **Challenges:**

- Restrictive regulations for energy: sharing between public and private buildings is currently illegal. Only public-public IS allowed if in proximity and with the same owner. Public institutions are not compensated or remunerated for injecting energy into the grid.
- Regulations and contracts favour private operators.
- People's distrust of sharing and cooperative systems.
- Availability and accessibility of data are difficult.
- Private cars are a top priority among citizens, public space is dominated by car.
- Public tender process is slow and experiences frequent blocks.

#### **Capacity building needs:**

- Data integration for smart city management platform.
- Initiation, functioning and communication for Energy Communities.
- Funding and economic models for building retrofitting.
- Urban greening and rehabilitation of historic areas.
- Streamlining of tendering processes.

## 3.2. Budapest

Located in the north of Central Hungary with a population of more than 1.7 million, Budapest is the country's cultural, educational, administrative, and service centre, as well as the main destination of international tourism. The city joined the European Covenant of Mayors in 2008; updated its Climate Strategy and Sustainable Energy and Climate Action Plan (SECAP) in 2021; and has recently joined the EU Mission: 100 Climate-Neutral and Smart Cities. To combat the rising unaffordability of housing, the Municipality of Budapest launched the "at Home in Budapest" urban development strategy in 2021. ASCEND adds to Budapest's PED portfolio, already ongoing with the Atelier project in District X.

### 3.2.1. Context: Discovering Budapest's Megyeri PCED

Budapest's PCED is in the northern part of Pest, in District IV, including institutional, residential, and industrial properties. The city is working with a provisional polygon, to be refined throughout the project.

The central building of the area is an unused school building at Megyeri road 45, to be retrofitted for efficiency, and transformed into a mixed-social or co-housing block with services and commercial use on the ground floor. The PCED includes several municipal properties, including the local cemetery, Waterworks main plant, North-Pest Wastewater treatment plant, and elderly care houses. Alongside residential buildings, a district-owned school, a kindergarten owned by the Catholic Church would also be part of the PCED.

The area's inhabitants are mostly lower-middle-class, young couples, and people in their 20s-30s, with middle-class families mostly occupying the detached houses. An important retired community is also present in the PCED area, as more institutions serving the elderly are located here.

The City of Budapest's main priorities for the PCED on Megyeri road and its surroundings are captured in SP2, SP3, SP4 and SP5.

ASCEND's area overlaps with another Horizon Europe project started in May 2023, called REALLOCATE. In harmony with the upcoming Cycle Traffic Network Plan, the project's pilot will focus on calming traffic and stimulating modal shifts to create safer and more controlled intersections in the city's peri-urban areas. Here, the focus will be on calming the Fóti-Megyeri road intersection (in front of the school) and Fóti road, between Baross and Váci road.



Figure 6. Budapest's PCED. The interior perimeters represent municipality and district facilities where intervention is easier. The rest is private. By authors over Google Maps imagery.



Figure 7. The 1930s school on Megyeri road to be retrofitted. Photo by the Municipality of Budapest.

### 3.2.2. Setting a vision for Budapest's Megyeri PCED.

The PCED vision session with the local partners of Budapest highlighted different topics, mainly:

**Greening:** The stakeholders highlighted their desire for a green neighbourhood. It should include more parks, community gardens, nature-based solutions and promote access to the Danube banks.

**Public space:** The neighbourhood should have better public spaces, designed for pedestrians and not cars, that give preferences for the small scale and that is multifunctional. Public space must have better air quality and promote health.

**Mobility:** The participants desire a city and a PCED in which more than half of daily trips are done by public transportation and where having active mobility is easy. Electric mobility should also be an option and logistics should be optimised, exploring even the Danube River.

**Energy:** Concerning energy, the participants stressed a district that has energy-efficient buildings built with local materials, with smart systems, that produce and share renewable energy. To reach efficiency, Nature-Based solutions are also explored.

**Just transition:** The PCED should be affordable and promote a social mix between social classes and ages, encouraging active engagement from all. It should also impede the gentrification process happening in the city.

**Governance:** A vision for a better local governance system to move towards the transition also emerged. In this vision, the municipality, the district, the utility companies, the private stakeholders and citizens work together to reach the city and PCED transition objectives.

### 3.2.3. The Megyeri PCED stakeholders and governance (SP 6 and 5)

#### Current framework

**Municipal Leadership:** Participants identified several actors involved during the stakeholder mapping session. Whereas the most identified entities would act as validators, implementation responsibilities fall on municipal departments. The coordinators are the Climate and Environmental Affairs and Urban Planning divisions. The city's Climate and Energy Agency will join leadership after its creation in early 2024. The municipality will hire a new coordinator for ASCEND.

**PCED Boundaries:** The provisional polygon encompasses several strategic buildings and facilities. However, it will be refined as the project evolves (Figure 6). Streets are also owned by one of these two institutions.

**Participatory planning:** The Municipality of Budapest already has tools for citizen participation. For example, they use online surveys and workshops whenever a new urban project is being designed. Furthermore, the city has a participatory budget, in which citizens can propose and vote on projects to be implemented. The PCED local district has a facilitation professional to promote citizens' engagement.

**Online participation tools:** The city has a platform where citizens can report public space problems. Some city districts also have it at their level.

**Decision-making:** Despite the city's bottom-up structure and approach, approval ultimately depends on the general assembly. Whereas the waterworks is a very proactive entity, collaboration with the cemetery might be more challenging.

**Multilevel local governance:** The PCED governance is twofold. The municipality manages the overall strategy, while the district has local and operational responsibilities. Collaboration and coordination between the two can be a potential bottleneck.

### Planned Actions

**Awareness raising:** The city aims to deploy awareness raising at the district level, aiming to reduce the citizens' environmental impacts. This will be done in close relation with local associations and the district.

| Budapest   | Financial Validator                   | Technical Validator  |
|--|---------------------------------------|--|
| <b>SP1:</b> Digital Infrastructures and Tools for flexible energy systems and PCED                 | Each public agency in the project     | Municipal Data Department  |
| <b>SP2:</b> Deployment of Energy Communities and Prosumers   | Not yet defined                       | Regulatory agency<br>University<br>Grid operator                             |
| <b>SP3:</b> Deployment of energy-efficient buildings integrating RES, Storage and Frugal Solutions | Budapest General Assembly             | Different public agencies and departments                                    |
| <b>SP4:</b> Decarbonisation of Mobility and Freight Logistics, including Frugal Solutions          | Budapest General Assembly             | BKK (Centre for Budapest Transport)<br>Budapest General Assembly<br>District |
| <b>SP5:</b> Citizen-Centric Solutions and Co-creation along the governance chain                   | Budapest General Assembly<br>District | Budapest General Assembly<br>District  |
| <b>SP6:</b> Urban Developer for PCED as an Umbrella Solution                                       | Budapest General Assembly<br>District | Budapest General Assembly<br>District  |

Table 3. Budapest's PCED Validators

### 3.2.4. Digital infrastructure and tools in Budapest's Megyeri PCED (SP1)

#### Current framework

**Data availability:** There are available data about public transportation use, traffic counting and air quality. Public buildings' energy consumption is available. Data is not yet centralised or standardised. Official census data is available at the city and district level, allowing a broad understanding of energy consumption in the district. The 2023 census updates are becoming increasingly available.

**Data platforms:** the municipality has a geoportal/data platform with all urban zoning and regulation, landscape information, building

stock, and public utility systems (power lines, etc.). This platform is not yet 3D.

**3D model:** The City of Budapest realised a digital model to assess the solar energy production potential of all the building roofs in the city. The data is open to everyone.

**Sensors:** only CCTV for traffic control and air quality monitoring systems are already in place. Smart-metre data is inaccessible.

**ICT infrastructure:** the city has several different ICT infrastructures operating, including LoRaWAN, Narrow Band and 4G. 5G technology has partial coverage and is under deployment.

### Planned Actions

**Data collection:** The city aims to structure its data collection. To reach this objective a discussion needs to be started with the district. A new department for data governance has been recently created and shall propose a framework on data governance.

**Digital twin:** the city aims to deploy and pilot a digital twin at the PCED level.

**Energy systems dashboards:** the municipality aims to deploy metering, simulation and visualisation dashboard tools. Nevertheless, they don't have clarity on the topic yet and discussions with the district are necessary.

## 3.2.5. Energy communities and prosumers in Budapest's Megyeri PCED (SP2)

### Current framework

**Legal framework:** the national government made a very simple transposition of the European directives, without any enablers or guidelines, making their deployment challenging. Without changes in the legal framework, the energy communities can only be in self-consumption. Currently, there is a ban on grid injections.

**Previous experiences:** There are a few pilot projects of energy communities, facilitated mainly by NGOs or led by the private sector. These projects are not residential. There are fewer than 5 projects at the city level, and the municipality is not related to them. The local consortium has gained experience on the subject through the ATELIER project and the technical partner, Dutch research organisation TNO.

### Planned Actions

**Renewable energy community:** the municipality wants to explore the possibility of establishing a local energy community around its production areas. Nevertheless, it requires more understanding of the legal framework and barriers. The NGOs working nationwide on the topic will be contacted to help in this task.

### 3.2.6. Energy efficiency and renewable energy production in Budapest's Megyeri PCED (SP3)

#### Current framework

**Energy retrofits:** The main municipal building to receive intervention is a school from the 1930s to be turned into social housing. Some municipal eldercare facilities in the PCED already have PVs and have been retrofitted for energy efficiency.

**Heating and cooling:** Most heating and cooling are gas-powered and individuals. However, district heating does cover some of the area—the local team will confirm exactly where.

**Electricity:** A CNG plant south of the district provides heating and electricity to parts of the district. The local team will check the specific coverage. The water facility has extensive PV production, which covers 10% of its yearly consumption.

**Energy grid ownership and management:** The TSO is Mavir (public) and the DSO is E.ON (private). Some limitations include no tax benefits, grants or subsidies for RES, and a temporary ban on injection for households has been imposed. At the same time, there is no 1:1 exchange law for public prosumers.

#### Planned Actions

**Heating and cooling:** The school will act as a pilot project for a heat exchange and heat pump system. Developed by the local potable water company, the system draws energy from the main potable water pipe that runs in front of the school. As 4 lines meet the 0.2 m/s requirements of this system, there is the potential to create heat centres for distribution in the PCED in the future.

**Electricity:** There is interest in and potential to increase renewable production on the water facilities. However, justifying the investment is difficult given the local limitations on injection into the grid. Installing PVs in the cemetery is also an option to be explored. Meanwhile, the school renovation will include the installation of PVs, adding to the existing array of elder care centres in the area.

**Energy reduction measures:** Besides retrofitting the school to create NZE housing, reduction measures will focus on awareness raising for

individual homeowners. The recently created Climate and Energy Agency of Budapest will have as one of its main tasks the creation of a One-Stop Shop, which could potentially use ASCEND's PCED as a pilot.

**Governance of renovation works:** Renovation of the school is in coordination between the City Planning Department and the Municipal Property Management company (BFVK). There is a need to develop a plan for the involvement of private home- and business owners, which could become a task for the Climate and Energy Agency.

**Governance of RES systems:** Besides the stakeholders for renovation works, workshop participants pointed out the water company and potentially the cemetery as relevant actors for implementing RES systems.

**Economic model for renovations:** EU funds are currently under revision for the school renovation. Alternatively, EIB loans are an option, yet in that case approval would depend on the central government, which might pose some challenges.

**Economic model for RES systems:** Investments in the water company premises would be self-funded, whereas RES in the school would be part of the global renovation project's funding.

| Budapest-SP3 Priorities   | Planned | Opportunity | Irrelevant |
|---|---------|-------------|------------|
| RES for heat + electricity  | x       |             |            |
| Connection to District Heating  |         | x           |            |
| Creation of heat and electricity storage systems                                | x       |             |            |
| Collection and use of rainwater ( <i>public space retention, infiltration</i> ) | x       |             |            |
| Other frugal solutions  |         | x           |            |

Table 4. SP3 Priorities for Budapest's PCED

### 3.2.7. Decarbonised mobility, logistics and public space in Budapest's Megyeri PCED (SP4)

#### Current framework

**Mobility patterns:** Inhabitants' use of cars is significant. In addition, high volumes of traffic are going *through* the district, as they make their way between the northern areas and the city centre.

**Active mobility infrastructure:** The main north-south road bordering the waterworks (Váci road) partially includes a protected bike lane. Yet, it is a regional artery in the city's bicycle master plan. On other minor roads, unprotected bike lanes are available, though unconnected.

**Budapest's modal split:** According to information from BKK, the city's modal split is 47% public transport, 35% private cars, 16% pedestrian and 2% cycling (based on passenger numbers).

**Public transport:** The area is well served through one metro line and one train station, located beyond the PCED, yet connected through several collector bus lines across the district.

**On-street parking:** On-street parking is abundant in the area. One of the issues is that it is used as a public park-and-ride for the metro by people who live in agglomerations. Parking is especially problematic on the denser apartment blocks northeast of the PCED.

**Shared mobility parking:** The city has a collaboration plan with shared mobility, including providing dedicated parking spots.

**Freight patterns:** large transport trucks use Váci road (regional road). All other streets in the area are limited to 12-ton vehicles.

#### Planned Actions

**Strategies at city level:** Although specific actions for the PCED have not been determined for mobility, a new strategic document for transport is being developed for the entire city, including plans for fleet decarbonisation. In addition, a Sustainable Urban Logistics Plan is being drafted at the municipal level. E-mobility and logistics hubs are planned for 25 locations, including one by the railway station south of the PCED.

**Danube accessibility:** One of the project's goals is to improve access to the Danube, which is currently unreachable.

**Intersection redesign:** the crossroad in front of the school is the study area for REALLOCATE, a Horizon project on improving conditions for vulnerable road users.

**Micromobility unfeasible:** In Budapest, shared bikes and step-on systems have stations. Having them in the PCED area is not in the plans since it is unviable given current mobility patterns.

**E-buses in the cemetery:** The team is exploring the possibility to incorporate electric buses for transport within the cemetery.

**Logistics:** The city has several consolidation hub projects and collaborates with logistics companies, yet there are no planned actions for the PCED specifically.

**Road standards** at the city level will be finished by the end of 2023.

**Digital modules for mobility:** modules are not planned for the moment, yet another project in the city (LEAD) is using digital twins to test and model micro-consolidation hub strategies. Access to data represents a challenge in this regard.

**Economic models:** E-buses will be funded privately, same as the consolidation hubs elsewhere in the city.

### 3.2.8. The Megyeri PCED implementation roadmap

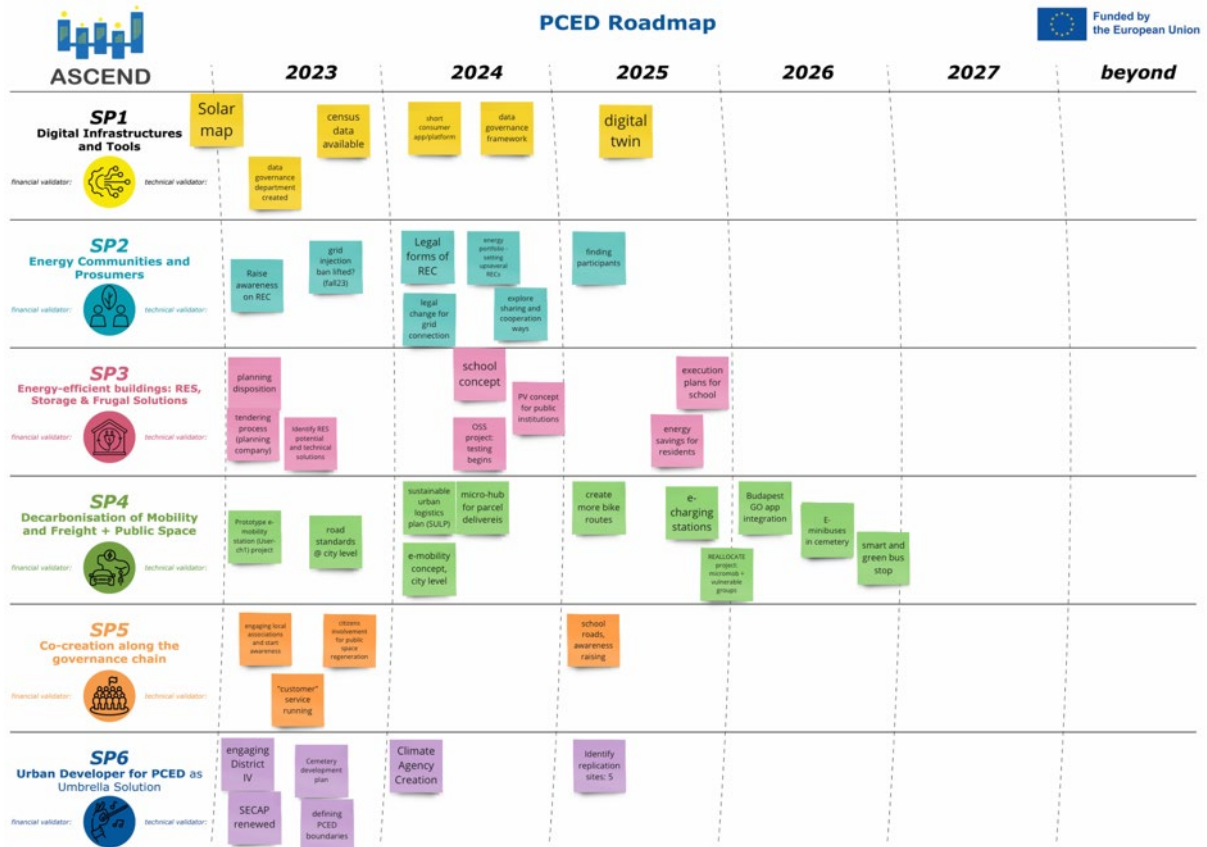


Figure 8. Budapest's PCED implementation roadmap. See larger version in Annexe 5.2.

### 3.2.9. Main challenges and capacity needs for Budapest

#### **Challenges:**

- Lack of strategy for data collection and treatment and difficulties to access data.
- Lack of digital platform and dispersion of data.
- Gathering data related to logistics.
- To promote citizen engagement in the creation of energy communities.
- Lack of a good regulatory framework for energy communities.
- Lack of incentives for citizens to shift their mobility patterns in a high car dependency context.
- Limited public spaces owned by the municipality to do projects.
- Challenge in shifting the citizens' behaviour and mindsets.
- Coordination between different stakeholders.
- Lack of funding for implementing the different solution packages (frictions between the national government and the European Commission).

#### **Capacity building needs:**

- Digital twins for energy management.
- Good practices and ready to use applications for data collection and treatment.
- Energy community business models and how to address an adverse legal framework.
- Engagement strategies with citizens joining the Energy Communities.
- Engaging the private sector in the efficiency and RES production.
- Policy support to change the regulatory environment (energy community, efficiency, and RES production).
- Technological background knowledge on energy efficiency and RES.
- Urban logistics strategic planning.

### 3.3. Charleroi

Charleroi is a Belgian city of around 200,000 inhabitants, in Wallonia. With an industrial and coal extraction background, the city still hosts several glass, steel, and chemistry industries, facing a significant challenge towards transitioning to carbon neutrality. Aligned with the European agenda for climate neutrality by 2050, Charleroi aims to reduce its greenhouse gas (GHG) emissions by 40% by 2030. To reach it, the city is a signatory of the Covenant of Mayors and has a Sustainable Energy and Climate Action Plan (SECAP).

#### 3.3.1. Charleroi PCED Context: Discovering Porte Ouest

On April 30, 2020, the Walloon Government mandated the SOGEPA (Wallonie Entreprendre) to negotiate the acquisition and reconversion of Duferco site, a former industrial area in Charleroi. In September 2021 an urban Masterplan was proposed for the 110 ha of industrial wasteland. The document identified five different axes contributing to the development of employment in Charleroi Métropole. They are:

- 1) Campuses, among which the “District Cleantech”, an economic ecosystem built around three different themes: a) energy transition, b) sustainable materials and c) circularity. The campus will be centred around two former industrial buildings that will be renovated, “La Centrale” and “Les Vestiaires”.
- 2) A “Future District”, spanning over 30 ha to host 1,500 soldiers by 2030, with the willingness to be partly open to the local population
- 3) An urban harbour
- 4) The “Phare Ouest”, a public area located around a symbolic industrial construction, the “HF4”
- 5) A system of public spaces, culture, and landscapes, emphasising the prominence of nature.

Following the master plan, On May 25, 2022, the SORESIC (“Société de Reconversion des Sites Industriels de Charleroi”) signed conventions with Duferco and Carsid to acquire some lands and buildings after their decontamination, thus initiating the site conversion and the PCED deployment.

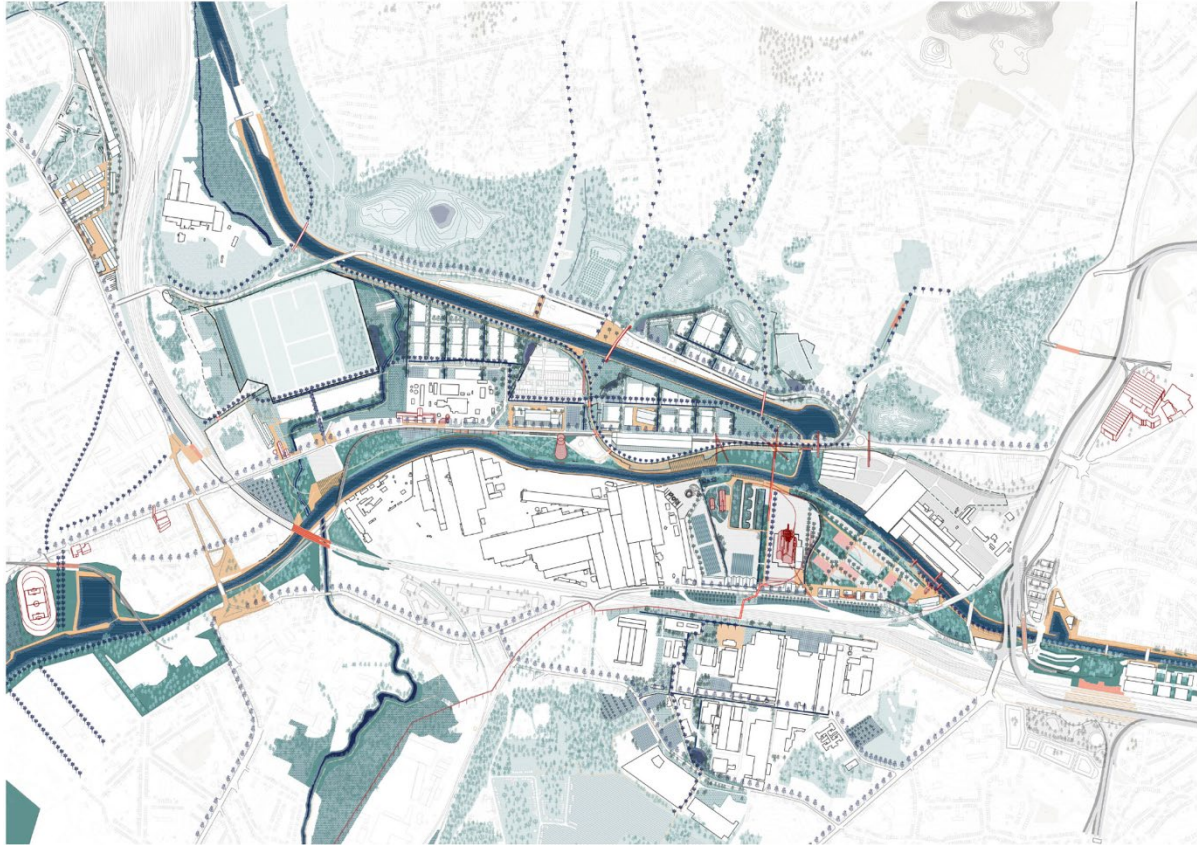


Figure 9. *Porte Ouest Masterplan*, by studio paola viganò.



Figure 10. Charleroi's PCED site visit. Photos by Eduardo Blanco.

### 3.3.2. Setting a Vision for Porte Ouest

The vision workshop in Charleroi highlighted different topics that constitute the vision for the PCED in Porte Ouest. The main topics that emerged were:

**An economic hub for clean technologies:** The district has the vision to host a Cleantech district, bringing more economic activity to Charleroi and structuring industry sectors that contribute to the energy and ecological transition.

**Public and cultural space:** The district aims to be open to the public and have quality public spaces. These should be animated with a diversity of cultural activities, bringing a new dynamic to the area.

**Active mobility:** the district should be well connected to the city and allow people to come on foot or bike safely.

**Energy efficiency and production:** the district aspires to become a reference in energy, through the industries they will host in the Cleantech area and through the works to renovate existing buildings and deploy a district heating network associated with renewable production.

### 3.3.3. The Porte Ouest's stakeholders and governance (SP 6 and 5)

#### Current Framework

**Urban orchestrator and multi-stakeholder governance:** IGRETEC, a public inter-municipal agency, is the economic and territorial developer for the Porte Ouest. Together with the City of Charleroi and SORESIC, a special-purpose society created to acquire the land of the Porte-Ouest. Within a complex ecosystem, other relevant actors at the centre of coordination include the Army and the Cleantech District entity.

**Financial Support** comes from the EU (e.g. Feder, JTF), the Belgian state (including Army), the Walloon Region (for land acquisition) and the City of Charleroi, among others.

**Decision-making:** A strategic committee including members of the City, SORESIC and IGRETEC has been appointed to make decisions on the Porte Ouest. A master plan, developed in collaboration with local and regional operators includes the guidelines for developing Porte Ouest up to 2050. As a post-industrial site, most of the Porte Ouest needs intensive soil remediation, determining the project's phasing and demands prioritisation amongst components.

**Social participation:** The city has a social participation council per district. During the master plan design, this council has been strongly consulted.

### Planned actions

**ASCEND Committee:** Besides the strategic committee, a “follow-up committee” will be created specifically for ASCEND, including the City of Charleroi and IGRETEC representatives.

| Charleroi  | Financial Validator                         | Technical Validator                     |
|--|---|---|
| <b>SP1:</b> Digital Infrastructures and Tools for flexible energy systems and PCED                 | TBD   | TBD                                     |
| <b>SP2:</b> Deployment of Energy Communities and Prosumers   | TBD   | IGRETEC<br>City of Charleroi            |
| <b>SP3:</b> Deployment of energy-efficient buildings integrating RES, Storage and Frugal Solutions | City of Charleroi                           | City of Charleroi<br>Belgian State      |
| <b>SP4:</b> Decarbonisation of Mobility and Freight Logistics, including Frugal Solutions          | City of Charleroi<br>Walloon Region<br>EU   | City of Charleroi<br>Metropole          |
| <b>SP5:</b> Citizen-Centric Solutions and Co-creation along the governance chain                   | TBD   | IGRETEC<br>City of Charleroi            |
| <b>SP6:</b> Urban Developer for PCED as an Umbrella Solution                                       | City of Charleroi<br>EU<br>FEDERE<br>SOGEPA | IGRETEC<br>City of Charleroi<br>SORESIC |

Table 5. Validators for Charleroi’s PCED

### 3.3.4. Digital infrastructure and tools in Porte Ouest (SP1)

#### Current framework

**Existing Data:** Charleroi has few available data on the PCED area. Existing data (like mobility and air quality) are dispersed, not standardised and outdated.

**Real-time data:** The city only has real-time data from smart metres for public buildings. The data cover water and energy consumption, nevertheless, these buildings are not inside the PCED area. The city also has sensors to get traffic data, but they are not operational (lacking set-up and connectivity). Air quality data from a region near the PCED can be obtained from a station regularly.

**Smart meter data:** When existing, access to smart metre data depends on the distribution company and tenants. Public buildings data can be accessed without problems. Whereas working with aggregated data is possible, tenants can also sign a document allowing unit-level collection.

**Digital participation:** The city has no dedicated application for citizen participation. However, citizens have access, via the city's website, to a portal dedicated to citizen participation, "Mon Opinion". The portal is evolving and includes several options, such as participatory budgets (currently active), the possibility for citizens to vote for projects, leave ideas, etc.

**ICT:** The city has a good 4G coverage. Optical fibre is under deployment. Currently LoraWan is used for monitoring gas and electricity consumption in public buildings, and 4G for water consumption.

**Existing Platforms:** The city has an internal geodata platform (QGIS), containing the identification of public buildings, utility networks, streets, parks, etc. Additionally, the Regional Wallonia geoportal, provides openly accessible data such as satellite images, geological maps and zoning. The city also uses the Regional Wallonia-Brussels open-data website to report general data (odwb.be). No other data platforms are available, except for regional and federal portals, e.g. WalOnMap, Geopunt.

### Planned Actions

**Sensors:** Deploy sensors to measure energy, heat and water consumption and building usage and needs. Mainly in the two buildings that are going to be renovated (*Vestiaire* and *Centrale*).

**Digital and data platforms:** They want to work with a digital platform for Energy Management and Planning, mainly related to the future energy community on electricity and heating.

**Digital twin:** The topic is under discussion and the local stakeholders have knowledge on the topic. The idea would be to test digital twins to optimise the energy and heating systems, mainly in the two buildings that will be refurbished in the cleantech area. Nevertheless, data governance must first be organised to enable data to be collected, standardised and aggregated.

### 3.3.5. Energy communities and prosumers in Porte Ouest (SP2)

#### Current framework

**Legal framework:** the national and Wallonian governments made the transpositions of the European directives, creating an enabling framework for electricity but not yet for heating. The regulations for heating are under discussion. Very recently, tariffs have been clarified through a sectoral agreement. Three different models are possible: Peer-to-peer, Renewable energy community and Citizens Energy Communities.

**Previous experiences:** The city has no previous experiences on the topic. The topic is growing in interest at the national and regional level, and a few pilots exist, e.g. Altercoop, Brupower, Wattardene.

#### Planned Actions

**Citizen's energy community:** The city has several possible projects of energy communities being evaluated at this moment. For the project area, the idea is to do a single citizen energy community that will deal with electricity, heat, and carbon-related aspects. This energy community could be enlarged to cover more than only the project site. The energy community would rely on electricity from PV production and wasted heat from industrial sites in the borders of the PCED area. A governance scheme or technical aspects are not yet defined and will be explored in the following months.

### 3.3.6. Energy efficiency and renewable energy production in Porte Ouest (SP3)

#### Current framework

**Existing buildings and NZEB:** As an industrial brownfield, the site has buildings that are being demolished. A few will be refurbished. There are no Nearly Zero-Energy Buildings (NZEB) in the city.

**Existing energy systems:** There is currently no renewable energy production on the site.

**Electrical grid:** The electrical grid is managed by a local public authority.

#### Planned actions

**Building renovations for energy efficiency:** Three main buildings will be renovated and have higher energy efficiency. They are the Vestiaire, the Centrale (funded by the local consortium) and the Rockrill buildings (funded by the city).

**New energy-efficient buildings:** Detailed plans for future buildings have not been established yet. Nevertheless, IGRETEC is developing a Charter that will provide guidelines on energy and environmental performance for all new buildings in the area.

**Energy production:** No specific renewable energy production is planned yet, but in the building design charter, guidelines to integrate renewable energy production such as PV will be included.

**District heating:** The technical and economic feasibility to deploy a district heating system using waste heat from industries in the surrounding areas is under assessment. The actual demand estimation is around 20 MW to 40 MW per year, and the availability is estimated at 80 MW to 120 MW per year. The heat network should also benefit other neighbourhoods in the future.

**Storage system:** The site will receive an electricity storage area. The project, called Bstore, aims to increase the flexibility of the national grid and avoid turning on combustion energy production systems in peak demand moments. It will not be only dedicated to the PCED but integrated into the national grid. The benefits of heat storage will also be studied as part of the ongoing study on the heating network.

**Upscaling labs:** Inside the Cleantech District, the objective is to host and catalyse the development of the sector of energetic renovation, sustainable materials and circular economy in the region. It will create impacts beyond the PCED in the future.

**Digital platforms:** The objective is to deploy a digital system to manage the electrical and heat systems. An option developed by Resolia, which is doing the feasibility studies, is the probable choice.

| Charleroi - SP3 Priorities                       | Planned | Opportunity | Irrelevant |
|--|---------|-------------|------------|
| RES for heat + electricity                       | X       |             |            |
| Connection to District Heating                   | X       |             |            |
| Creation of heat and electricity storage systems | X       |             |            |
| Collection and use of rainwater                  | X       |             |            |
| Other frugal solutions                           |         | X           |            |

Table 6. SP3 Priorities for Charleroi's PCED

### 3.3.7. Decarbonised mobility, logistics and public space in Porte Ouest (SP4)

#### Current framework

**Mobility patterns:** Charleroi is a very car-centric city. In Wallonia, more than 84% of day trips are by car. According to participants, in Charleroi, it's probably more than 90%.

**Public transportation system:** The city has a bus network and four tramway/metro lines. The region manages the system and is not very attractive for users to create a modal shift. The area is also very close to two train stations.

**Active mobility system:** The city already has a few bike lanes. Nevertheless, several projects have already been approved for funding for its expansion and integration. The train stations have integrated mobility hubs under deployment.

**Micro and shared mobility:** The city has a small car-sharing system (6 combustion cars) operated by a private stakeholder. An electric shared scooter system also exists. This one is regulated by the city (definition of operators and parking areas) and operated by three private companies (900 electric scooters). These same operators also run electric bikes, but in smaller amounts (50 to 100 bikes).

**Electric mobility:** The city plans to deploy charging stations, but the existing ones are primarily private.

**Freight and logistics:** As a former industrial area, the site is well deserved. It is flanked by roads, rails and the Sambre River. The city has a distribution hub in the city centre, but it's not yet achieving its full potential.

**Mobility public policies:** The urban mobility plan is under preparation and will consider the future needs of the PCED area.

**Public spaces and greening:** As an industrial brownfield, the area already has several areas that have been retaken by nature. There are also important portions of the land that are natural protected areas that will not be touched.

#### Planned Actions

**Public transportation:** The project area is close to one of the metro lines, and a new stop will be created near to it. The new Bus Rapid Transit line will also serve the site. There are plans to extend the bus lines working hours. There are discussions about moving one train station to a more accessible zone, benefiting the PCED. Finally, there are discussions about a boat line in the Sambre River.

**Active mobility:** The central train station will have 600 new bike parking spots delivered soon. New bike lanes will be deployed, crossing the PCED area and connecting it to other existing bike lanes. Parking infrastructure at the PCED will exist but are not yet defined.

**Freight and logistics:** Several options are open and will be explored, namely the use of hydrogen solutions for freight, new consolidation and delivery hubs and the prohibition of combustion-based delivery. There will also be a direct link between the PCED and the main road, to avoid congestion and freight traffic in the city centre.

**Public spaces and greening:** Some of the areas in which nature has regained the brownfield will be preserved. In the urbanised areas vegetation solutions will be deployed in the public space. There is one river that may be reopened, with riverbank regeneration. The Sambre riverbanks will also be renatured in some sections.

### 3.3.8. The Porte Ouest implementation roadmap

Charleroi's preliminary roadmap shows a consistent number of milestones for the duration of the project, except for SP5 (Figure 11)

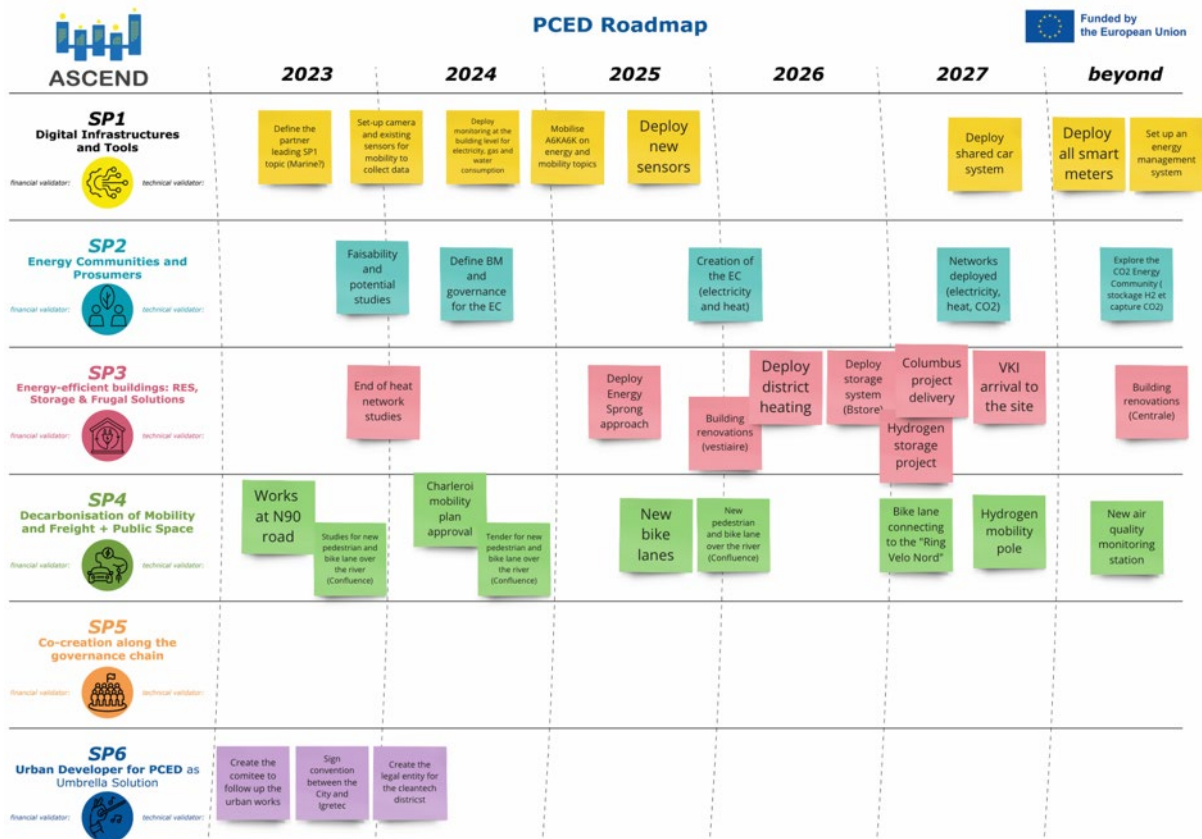


Figure 11. Porte Ouest PCED implementation roadmap. See larger version in Annexe 5.2.

### 3.3.9. Main challenges and capacity needs for Charleroi

#### **Challenges:**

- Lack of human resources specialised in data and digital infrastructure.
- Need to reinforce the digital infrastructure (sensors, platform).
- Lack of clarity in the business model and governance of the energy community mixing electricity and heat.
- Need to find complementary consumption profiles for the energy community.
- Uncertainty regarding future energy demands, particularly due to the undecided profile of industrial users.
- Funding for the deployment solutions, mostly those from SP1, SP2 and SP3.
- Shift mobility patterns in a very car-centric city.
- Engaging citizens in the co-creation process.

#### **Capacity building needs:**

- Data and digital infrastructure: opportunities and possibilities for the different SPs.
- Legal framework and business models for energy communities dealing with electricity and heat.

## 3.4. Porto

With a population of over 231,800, Porto sits in the Northern region of Portugal. As capital of the Porto Metropolitan Area, the city's centre became a UNESCO World Heritage Site in 1996. Porto hosts mainly residences and services, but it is also a knowledge- and innovation hub, as it is home to several universities, R&D centres, world-class companies, and thousands of start-ups. Porto was amongst the first five European signatories of the Covenant of Mayors in 2009. Since then, the city has been working on its decarbonisation, an effort recognised in the city's selection as part of the 100 climate-neutral and smart cities Mission. ASCEND is the first PCED project in the city and is part of Porto's bold action plan to become carbon neutral by 2030.

### 3.4.1. Porto PCED context: discovering Lordelo do Ouro e Massarelos

Located in a premium city area, the PCED of Lordelo do Ouro and Massarelos aims to create a large-scale renewable energy community with private and public entities.

This PCED has an area of more than 71 ha, where very different realities coexist: due to the location and privileged views of the river and the sea, this area concentrates some of the most expensive real estate in the city as well as some of the most prestigious institutions, as is the case of the Serralves Foundation; however, this area also hosts seven large-scale social housing developments, with over 3000 citizens in 2000 dwellings. These developments have been undergoing extensive renovation over the last few years through large municipal investments seeking to improve housing conditions.

On its path towards carbon neutrality, Porto has the ambition to transform social housing developments, as well as its other municipal infrastructure, into renewable energy hubs, contributing to the decarbonisation of the city and mitigating issues of energy poverty. In this logic, municipal infrastructure such as schools and administrative buildings in the PCED intervention area are also included as key consumption and production points. In this domain, a PV tender will be launched by the end of 2023 to install 855 kWp in three of the seven social housing districts and three of the schools included in the project have already installed 55 kWp of PV power.

Within the scope of ASCEND, data from the energy consumption of all the installations, the PV production, weather, air quality and mobility for that part of the city, as well as the carbon capture from the Pasteleira Park, will be gathered, processed, and included in the city data platform (SP1). This task will accompany creating the

renewable energy community (SP2) and the energy efficiency interventions being implemented (SP3). Building interventions and renewable production activities will be communicated with citizens engaged in the project through dedicated capacity-building processes (SP5). Co-creation sessions focused on alternative mobility options will be promoted with the PCED population (SP4).



Figure 12. Porto's PCED boundaries, still in process. By authors over Google Earth imagery.



Figure 13. Site visit of Porto's PCED, with social housing renovations in the background. Photo by Eduardo Blanco.

### 3.4.2. Setting a Vision for Porto's PCED

During the vision exercise in Porto, seven main topics emerged, helping understand the vision of the city of Porto and its PCED. These topics are:

**Greening:** The stakeholders highlighted their desire for a greener city, integrating nature and biodiversity in the public and private spaces, creating a more pleasant and healthy urban environment.

**Public space:** The discussions pointed to a demand for more qualitative public spaces that are safer, with amenities and accessible for all, designed thinking about the dwellers' needs.

**Mobility:** In this topic, we observed the vision of a city that is no longer car and fossil-fuel-dependent. This city focuses on pedestrians and cyclists, giving them priority and space. It also improves the public transportation systems and promotes mixed use of land. These changes lead to a city without pollution and where local dynamics thrive and adhere to the 15-minute city concept.

**Environmental awareness:** The project should help increase environmental awareness and make sustainable lifestyles easier for Porto residents.

**Circularity:** The participants visioned a city that adheres to the circular concept, mainly in the waste and energy topics, moving towards self-sufficiency.

**Energy:** The vision here relates to a more energy-efficient city where the buildings are better designed and constructed, consuming less energy. These efficiency measures are combined with local and distributed renewable energy production to move towards net positive energy.

**Just transition:** The participants stressed the need to be part of the co-creation of Porto's transition. The importance of fighting energy poverty, reducing inequalities and assuring housing affordability while building upon the city's cultural identity and heritage was highlighted.

### 3.4.3. The Lordelo do Ouro e Massarelos stakeholders and governance (SP 6 and 5)

#### Current framework

**Stakeholders and validators:** Different private and municipal agencies are important for the PCED implementation, like AdEPorto, Águas e Energia do Porto, E.M., Associação Porto Digital, Fundação de Serralves and Porto Ambiente. The Energy Agency of Porto (AdE-Porto) has a coordination role for the PCED deployment. Nevertheless, through its different agencies, the municipality is responsible for the technical and financial validations at the project management level. The stakeholders mapping (Figure 13) allowed to identify a diverse team for the PCED deployment that is already mobilised and meeting regularly. The mapping also highlighted the current lack of engagement with civil society stakeholders.

#### Planned Actions

**Engaging local community:** The key planned action on the stakeholders' topic is the identification of "local heroes" at the district level. Identifying and engaging with them will help the project design and implementation, unblocking potential local barriers in the future.

**Orchestrator:** The project team will continue to meet regularly to implement the PCED, under the leadership of AdEPorto. This team is also involved in Porto's transition team which is currently working on the city climate city contract. A dedicated body will not be created to orchestrate the project at the local level.

| Porto  | Financial Validator   | Technical Validator                                   |
|--|---|---|
| <b>SP1:</b> Digital Infrastructure and Tools for flexible energy systems and PCED                  | Porto municipality<br>Porto Digital                         | Porto Digital   |
| <b>SP2:</b> Deployment of Energy Communities and Prosumers   | Porto Municipality<br>AdE Porto<br>Águas e Energia do Porto |   |
| <b>SP3:</b> Deployment of energy-efficient buildings integrating RES, Storage and Frugal Solutions | Porto Municipality  | AdE Porto<br>Águas e Energia do Porto<br>Domus Social |
| <b>SP4:</b> Decarbonisation of Mobility and Freight Logistics, including Frugal Solutions          | Porto Municipality  | Porto mobility Department<br>Rede Mobi. e             |
| <b>SP5:</b> Citizen-Centric Solutions and Co-creation along the governance chain                   | Porto Municipality  | Porto Digital<br>Domus Social                         |
| <b>SP6:</b> Urban Developer for PCED as an Umbrella Solution                                       | Porto Municipality<br>ASCEND team<br>Private investors      | Porto ASCEND Core Group                               |

Table 14. Validators in Porto's PCED

### 3.4.4. Digital infrastructure and tools in Lordelo do Ouro e Massarelos (SP1)

#### Current framework

**Data availability:** Through Porto Digital, some data is available at the city level, including mobility patterns, building stock and environmental/meteorological conditions. The local consortium is working with the national DSO to access historical and current consumption data at PCED level. Still, the available data is not yet standardised/structured or accessible for external users.

**Urban data platform:** The city already has an urban data platform that is internally accessible, centralising existing data. Parts of this platform work with open-source components, namely the mobility data system.

**Energy data:** The houses have smart metering systems, but these are not accessible due to data privacy issues, and data cannot be collected without households' consent. Aggregated data can be requested by the DSO in clusters of 20 units. For public and institutional buildings, energy consumption/production data is available.

**Digital infrastructure:** The city has 5G coverage and some LoraWan infrastructure. The optical fibre network is under deployment.

#### Planned actions

**Urban data platform:** For the PCED, the project team wants to expand their existing urban data platform, integrating more data from the PCED level (energy consumption and production, air quality, meteorological data and water consumption) and making it open-source.

**Energy data:** The project aims to deploy a digital solution for real-time local energy management and planning for operating the PCED energy community. Thus, planning the digital infrastructure and data collection and treatment will be necessary. The team is exploring installing monitoring devices in target buildings to bypass the legal limits of collecting consumption data from the existing smart metres.

**Digital twins:** The city wants to explore the use of a digital twin in urban design and planning. They aim to launch a research project to test it at the PCED level in partnership with local universities (probably as a PhD/Postdoctoral research).

### 3.4.5. Energy communities and prosumers in Lordelo do Ouro e Massarelos (SP2)

#### Current framework

**Legal Framework:** Regulations for collective self-consumption, renewable energy communities (REC) and citizen energy communities (CEC) are in place. However, demanding and lengthy permitting processes have meant that few projects can be classified as REC or CEC. Self-consumption projects have been multiplying and procedures are expected to become easier.

#### Planned Actions

**Energy Sharing:** The main goal of the PCED of Lordelo do Ouro e Massarelos is to implement a large-scale renewable energy community, including private and public installations. This project will be the first of its kind in Portugal as the regulatory framework is quite recent and community energy projects are just emerging in the country.

**Digital infrastructure:** The PCED implementation will rely on digital platforms to optimise energy flows and exploit flexibility.

### 3.4.6. Energy efficiency and renewable energy production in Lordelo do Ouro e Massarelos (SP3)

#### Current framework

**Social Housing:** Porto's PCED mainly focuses on existing buildings and infrastructure that have been or are currently being renovated. Social housing has received new wall and roof insulation, windows, and water heating systems.

**Municipal Schools** recently received PV installations and were renovated for better thermal conditions.

**Serralves Foundation Facilities** are quite energy intensive. Measures were already implemented to reduce their energy demand. All the existing facilities were audited and are energy-certified.

**Existing energy systems:** Most of the buildings in Portugal do not have incorporated heating and cooling systems. In social housing, people usually use electric heaters for space heating, while municipal administrative buildings usually use AC systems both for heating and cooling. In schools, electric energy systems are usually implemented while natural gas is used for cooking and water heating. In Serralves, natural gas is used to heat the spaces and a large amount of electricity is used to provide the required ventilation levels.

**Grid management and ownership:** The Portuguese Distribution System Operator (E-REDES) owns and manages the grid.

#### Planned Actions

**NZEB:** The Serralves Foundation is building a NZEB, which will be integrated in the PCED.

**PV systems:** Combining schools and social housing, 1.06 MWp of PV capacity will be installed until mid-2024 (55 kWp are already installed in schools).

**Energy Audits:** Municipal facilities in the area are energy audited for inclusion in the city renovation pipeline. Energy audits will be performed to identify potential improvements in all schools and municipal buildings in ASCEND.

**Challenges:** Most of these interventions rely on municipal investment. Thus, alternative business models should be assessed to upscale these actions to the other parts of the city. Also, citizen engagement strategies should be carefully drafted as engaging vulnerable populations is usually harder.

| Porto-SP3 Priorities                             | Planned                 | Opportunity | Irrelevant  |
|--|-------------------------|-------------|-------------|
| RES for heat + electricity                       | X<br>(only electricity) |             |             |
| Connection to District Heating                   |                         |             | X           |
| Creation of heat and electricity storage systems |                         |             | X           |
| Collection and use of rainwater                  |                         |             | X<br>(done) |
| Other frugal solutions (behavioural change)      | X                       | x           |             |

Table 7. SP3 Priorities for Porto's PCED

### 3.4.7. Decarbonised mobility, logistics and public space in Lordelo do Ouro e Massarelos (SP4)

#### Current framework

**Public transportation:** The City of Porto has an integrated public transportation system, including metro and buses. The city public bus system currently covers the PCED. In 2022, 79% of the bus fleet was composed of natural gas, 5% was electric and the remaining was diesel. The bus fleet is expected to be fully diesel-free in the next years.

**Modal split:** The latest metropolitan mobility statistics<sup>1</sup> show that 48% of Porto citizens use private cars for daily travel, 31.6% move on foot or by bicycle, and 18.1% use public transportation.

**Active mobility:** The Municipality of Porto wants to have an extra 50 km of cycle paths. Currently, the network has 15 km, but there are still 35 km more to be connected to meet the objective expressed in the plan to requalify public space. The city's cycle paths will now be networked, which means that it will be possible to cross Porto by bicycle from one end to the other. The city already has 72 bicycle racks on the public road, with capacity for 521 parking spaces.

**Micromobility:** The city, including the PCED area, has an extensive network of soft mobility options. 2,100 bicycles and scooters are available in more than 210 sharing points across the city. An online platform shows the availability for each location.

<sup>1</sup> [http://portal.amp.pt/media/documents/2018/11/29/IMOB\\_2017.pdf](http://portal.amp.pt/media/documents/2018/11/29/IMOB_2017.pdf), pp. 176

**Digital solutions:** At the metropolitan level, the app MOVE-ME.AMP collects information from different public transport operators, allowing users to plan intermodal routes throughout the Porto metropolitan area. Additionally, the city bus company (STCP) has a system which allows users to consult bus schedules in real time.

**Planned actions:**

**Public transport:** Mobility in the PCED area will be enhanced by a nearby BRT lane which will be finished and operational in 2024.

**Active mobility:** Currently, there are no planned solutions regarding active mobility. However, the creation of the PCED digital twin is expected to provide some information on how the mobility of the area can be improved. In this setting, recommendations on active mobility solutions can be provided to the city.

**Greening:** The city is developing a new afforestation plan that includes greening the streets. When concluded, it can be included in one of the workshops being promoted with PCED inhabitants.

### 3.4.8. The Lordelo do Ouro e Massarelos implementation roadmap

Porto's PCED roadmap shows a fast-paced advancement in the first half of the project, and uncertainty about the second half (Figure 15).

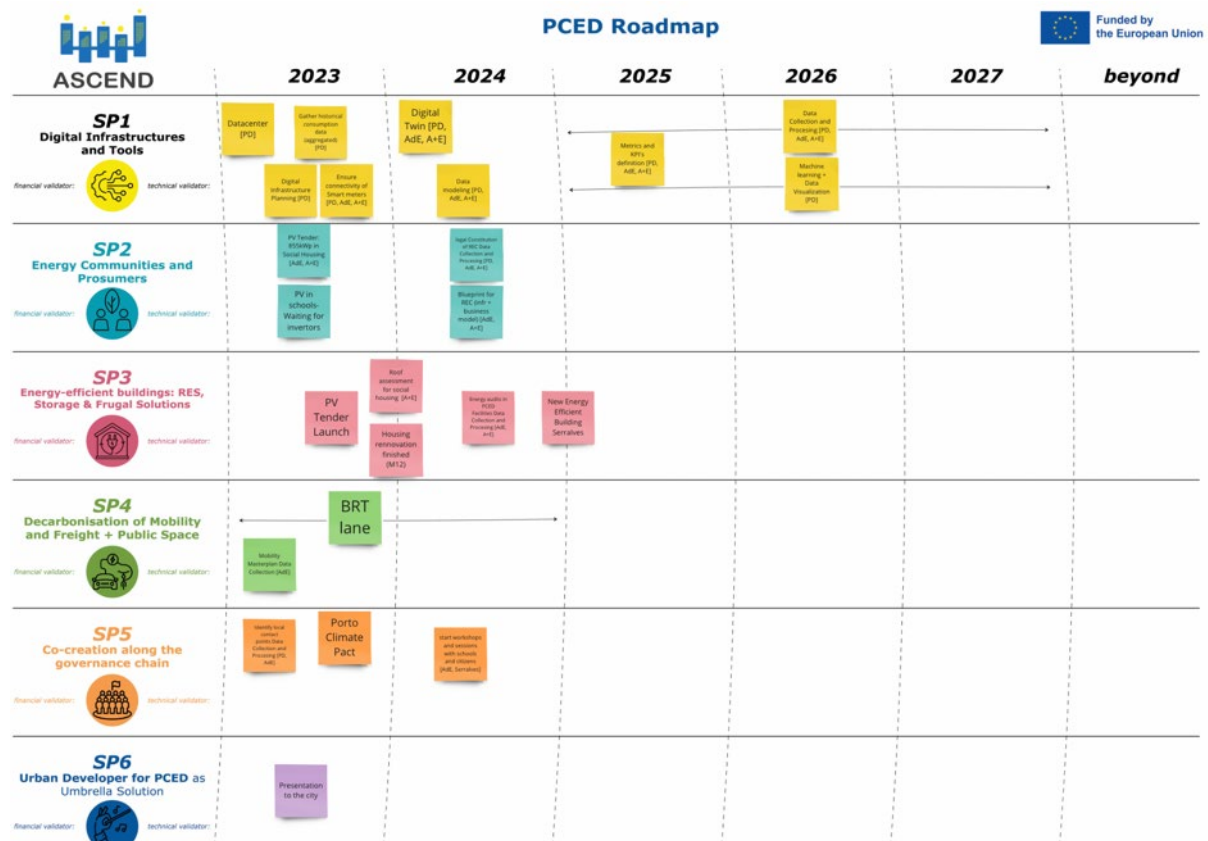


Figure 15. Porto's PCED implementation roadmap. See larger version in Annexe 5.2.

### 3.4.9. Main challenges and capacity needs for Porto

**Challenges:**

- Access to energy consumption/smart metering data.
- Engaging private investments in the energy communities and PCED other solutions.
- Regulatory framework for energy communities (creation of a legal entity and public procurement).
- Delays on the renewable energy production systems (delay for receiving the inverters).
- Traffic issues related to the French Lyceum.
- Attract and engage civil society in the project design and implementation.
- Lack of funds to implement solutions.

**Capacity building needs:**

- Digital tools for energy communities' management.
- Citizens' engagement and co-creation.
- Funding and business models for replication.
- Mobility shift on home-school travels.
- Digital twins design and deployment.

## 3.5. Prague

Prague is the capital and largest city in the Czech Republic, with around 1.3 million inhabitants. The city's economy is mainly service-oriented with financial and commercial services, trade, restaurants, hospitality, and public administration amongst the most significant activities. According to its Climate plan from 2021, Prague should invest about CZK230 billion in 69 measures aimed at reducing CO2 emissions in the metropolis by 45% by 2030 compared to 2010, aiming at carbon neutrality by 2050. Many city-level projects, such as the PCED, are based on these targets.

### 3.5.1. Prague PCED Context: Discovering Dolní Počernice

Dolní Počernice is a residential district on the western outskirts of Prague with a sufficient public transport connection to the city centre. The future PCED Dolní Počernice II will be directly adjacent to the existing development. The construction of the PCED as part of the ASCEND project is being undertaken by the Prague Development Company (PDS) and is part of their larger residential development project. There is currently a green field on the site. Prague PCED will have an area of 129,000 m<sup>2</sup> and is expected to have approximately 1,600 inhabitants. The project includes construction of a school for about 540 students. The owner of the land is the City of Prague, which is crucial for the project start. Due to many different obstacles, very complex approval procedures, and uncertainty with some legal framework, the future PCED is assumed to be built within 10 years.



Figure 16. Site visit in Prague's PCED site.



Figure 17. The Dolní Počernice project master plan, including the PCED area (north-west corner, from the road on, is not part of ASCEND). By Archum Architekti.

### 3.5.2. Setting a Vision for Dolní Počernice

The vision workshop in Prague highlighted different topics that constitute the vision for the PCED at Dolní Počernice. The main topics mentioned were:

**Greening:** The stakeholders highlighted their desire for a green neighbourhood. It should include green streets, green public spaces, and a good connection to surrounding green areas.

**Public space:** The participants wanted thriving and lively public spaces. The neighbourhood should be perceived as a nice place to

live, with a dynamic and thriving atmosphere that fosters cultural activities and citizen engagement.

**Mobility:** The vision included a neighbourhood that is well connected by public transportation to the city centre and that is designed for pedestrians and cyclists. As the district is in the outskirts of Prague, the stakeholders want it to feel mentally close to Prague.

**Energy:** Regarding energy, the participants envisioned a district that relies 100% on renewable energy and promotes low consumption habits. The energetic features should be user-friendly and integrate seamlessly with the buildings and public spaces, ensuring both comfort and aesthetic appeal.

**Just transition:** It emerged the need to design for the affordability of the houses. The neighbourhood should also foster a shared and local economy, promote a social mix, and have space for co-design with the inhabitants.

### 3.5.3. Dolní Počernice stakeholders and governance (SP 6 and 5)

#### Current framework

**Three-prong leadership:** Mapping the project's stakeholders (see Annexe 5.2) revealed various actors already engaged. Three municipal agencies and a university centre lead Prague's PCED implementation.

- PDS, the city's real-estate developer, is the main coordinator for the design and implementation planning of the project.
- Operator ICT, city data company, facilitates the interaction with the rest of the ASCEND consortium.
- PSOE, Prague renewable energy community, manages the energy communities' development and is the associated partner in the project.
- CVUT's University Centre for Energy Efficient Buildings is the technical partner and manages collaboration amongst local partners.

**Validation bottlenecks:** PDS is the internal technical validator in the planning process, but ultimate financial approval depends on City Hall. This represents a potentially significant bottleneck with over 50 committees in a complex and volatile ecosystem.

**Multi-level governance:** Three administrative levels are involved in the project: Dolní Počernice locally, Prague 14 as a district, and Prague at the municipal level.

**Civil society participation:** Through IPR (Prague's Institute of Planning), the city already has a department to promote social

participation in urban planning and projects. Nevertheless, the current approaches are more consultation based, without co-design. Furthermore, the city has an app that allows citizens to inform about urban problems around the city.

### Planned Actions

**Embedding the project for local acceptance:** Participants highlighted the importance of maximising the project’s approval amongst the residents of Dolní Počernice. There was agreement on the need to develop a strategy to ensure acceptance and embed the project in the local ecosystem by involving the Dolní Počernice administration, alongside local resident organisations, and NGOs. Attendees from IPR, expressed interest in supporting this process, while leveraging the school’s importance for locals.

**Orchestrator:** PDS is the planning coordinator of the project, but construction will be delegated through a tendering procedure. An Investment Fund will be created for the project’s implementation.

**Timeline:** The school will follow a faster timeline than the mixed-use section of the project. Zoning approval is expected in late 2025 for the school, with construction starting in 2029. Meanwhile, the zoning decision for the mixed-use development is foreseen for 2026, with works beginning in 2029.

| Prague   | Financial Validator                      | Technical Validator                                    |
|--|--|--|
| <b>SP1:</b> Digital Infrastructures and Tools for flexible energy systems and PCED                 | City of Prague                           | OICT Integrator<br>IPR                                 |
| <b>SP2:</b> Deployment of Energy Communities and Prosumers   | Prague Renewable Energy Community (PSOE) | Prague Renewable Energy Community (PSOE)               |
| <b>SP3:</b> Deployment of energy-efficient buildings integrating RES, Storage and Frugal Solutions | PDS                                      | PDS  |
| <b>SP4:</b> Decarbonisation of Mobility and Freight Logistics, including Frugal Solutions          | City of Prague<br>PDS                    | Prague Transportation Company<br>City of Prague<br>PDS |
| <b>SP5:</b> Citizen-Centric Solutions and Co-creation along the governance chain                   | Not yet defined                          | Not yet defined  |
| <b>SP6:</b> Urban Developer for PCED as an Umbrella Solution                                       | City of Prague                           | PDS  |

Table 8. Validators in Prague’s PCED

### 3.5.4. Digital infrastructure and tools in Dolní Počernice (SP1)

#### Current framework:

**Existing Data:** Prague has abundant data at the city level, having a digital operator. This data is only standardised at the scale needed for specific projects. ASCEND could be one such case.

**Existing Platforms:** Two open platforms are available at the city level. IPR, with geospatial data, and Golemio with more general smart city data. Both were represented at the workshop and will be collaborating with the local consortium.

**Digital twin:** IPR is working on a city model that could be considered “on the path” to becoming a digital twin.

**Real-time data:** Golemio does not have real-time smart city data, except for waste collection. The use of real-time sensors for ASCEND is to be determined.

**Smart metre data:** When existing, access to smart metre data depends on the distribution company, which is publicly owned. Whereas working with aggregated data is possible, tenants can also sign a document allowing unit-level collection.

**ICT:** Prague has comprehensive 5G coverage. Whereas waste collection uses LORA, Energy uses Narrow Band, but is privately owned. Deployment of ICT infrastructure at the PCED level will be decided upon as part of ASCEND.

**Digital participation:** Apps for one-way communication with citizens are available at both the city and district level. Meanwhile, the Změňte. to is the city’s e-governance portal.

**Open Source:** All open data platform APIs either are, or can be, made OS upon request—unless not financially feasible. There would be interest in using OS solutions for dashboards, for example, but *only* if it comes with **support** after implementation. More than in OS, IPR would be interested in **open standards** for data management and catalogue standardisation.

#### Planned actions

**Digital twins for participation:** During the workshop, IPR expressed interest in exchanging experiences on citizen participation for new developments using 3D models and digital twins.

**Data Platform:** At the minimum, the PCED will be integrated to the rest of the city's platforms. The development and use of PCED-specific platforms are to be determined as part of ASCEND.

**3D and Digital twins:** CFD software was used to determine passive strategies, primarily ventilation, in the PCED. A 3D model will be used for design, but not necessarily a digital twin. Meanwhile, IPR is interested in using BIM at the city level.

**Smart meters:** If energy sharing becomes part of the final energy concept (see SP3), primary aggregated smart metres and secondary ones at the unit level will be deployed.

### 3.5.5. Energy communities and prosumers in Dolní Počernice (SP2)

#### Current framework

**Legal framework:** currently, there is no legal framework specific to energy communities in the country. The EU directives have not been transposed, so an energy community is not yet allowed. Nevertheless, it is possible to have renewable production and self-consumption in the same building or through a private grid. Otherwise, sharing among buildings or doing it virtually is impossible. Nevertheless, the local framework is under discussion and may change soon. The different business models do not have specific local names in this context.

**Previous experiences:** There are no previous experiences in energy communities at the national level, but a few experiments are starting that align with the principles, for instance, with private industrial areas sharing among them.

#### Planned actions

**Energy communities:** Local partners plan to develop three renewable energy production systems, two located in buildings on the edge of the neighbourhood, around the road, and one in the school (all owned by the municipality). The produced energy will be sold to residents by a local operator and be self-consumed at the district level. Any excess will be reinjected into the grid. The details of the operation remain uncertain until the national framework is clear.

**Renewable energy production systems:** The city is still studying different technologies and production capacity scenarios. More details on the systems to be deployed will be available in the fall of 2023.

### 3.5.6. Energy efficiency and renewable energy production in Dolní Počernice (SP3)

#### Current Framework

**Existing energy systems:** The city mostly relies on compressed natural gas for heating and cooling. Meanwhile, Prague's electricity is a mixture of gas, coal and nuclear power. The provider chosen by each household determines the specific source.

#### Planned Actions

**Efficient new construction:** Whereas PDS' Project 1 (adjacent) featured "category B" buildings according to local standards, the ASCEND area will reach "category A", which are close to passive standards. Shading measures will be needed to prevent high cooling loads in the summer.

**Grid ownership:** The grid is owned by the municipality, operators are mostly public companies (majority), and providers are private companies with partial foreign ownership.

**Legal framework:** It is currently illegal to inject electricity into the grid. Grants have been put in place to switch to methane. New residential must include a specific percentage of RES.

**Digital Modules:** The project will necessarily rely on digital modules, particularly to optimise flows and model the temporal oscillations of energy in the district to store and shift surplus energy throughout the day and seasons. Participants questioned whether the project was large enough to provide flexibility benefits.

**Economic Model:** Two factors determine the project's economic feasibility, providing a 15-30% margin to invest in efficiency and RES. First is the project's development on publicly owned land. Second is the lack of need for economic profit. However, a question remains about methods to quantify the "social dividend" of the project.

**Energy concept in the making:** CVUT will provide four energy concepts by late summer 2023. In fall 2023 the selected one will go for tendering. With a centralised storage scheme, the production systems explored are:

- gas cogeneration + PVs
- district heating
- heat pump + PVs
- solar thermal + PVs + biomass
- PVs + hydrogen fuel cells + heat pumps biomethane + E trading

**Challenges:** Participants of Prague's SP3 harvesting session coincided on the following main challenges:

- No benchmarking is available for public energy-efficient rental housing, which creates financial uncertainty.
- 90% of the market is currently for sale, providing a reduced market for rental units.
- There are no public incentives or political mechanisms of support to materialise the ambitions of the climate plan.
- Of the 69 climate plan actions, ASCEND is very new, thus limiting its visibility and priority level.

| Prague-SP3 Priorities                            | Planned                   | Opportunity | Irrelevant |
|--|---------------------------|-------------|------------|
| RES for heat + electricity                       | x                         |             |            |
| <u>Creation</u> of District Heating              | x                         |             |            |
| Creation of heat and electricity storage systems | x<br>(buffering)          | x           |            |
| Collection and use of rainwater                  | x                         |             |            |
| Other frugal solutions                           | x<br>(behavioural change) |             |            |

Table 9. SP3 priorities for Prague's PCED

### 3.5.7. Decarbonised mobility, logistics and public space in Dolní Počernice (SP4)

#### Current framework

**Public transportation:** Prague has an extensive and integrated public transportation system that accounts for more than 40% of daily trips. In the PCED area, there is a main road that is served by bus lines. There is also a bus station terminus not far from the area, with several lines. There is also a train stop in the surroundings (more than 1 km from the PCED area). A local public company manages the public transportation system, the tariff is subsidised and relatively low.

**Soft mobility:** There is no infrastructure for active and soft mobility in the site area yet. A few bike lanes serve the surrounding area, but they are abruptly interrupted and not in good condition.

**Micromobility:** Shared bikes and electric scooters are available at the city level, but not yet in the PCED area. These services are private, yet parking areas are regulated by the municipality.

**Freight and logistics:** There are a few industries around the PCED and freight traffic in the main arterial road of the area. The city is developing micro-consolidation hubs elsewhere.

### Planned Actions

**Public transportation:** The current terminus will close and two mobility hubs will open inside the PCED area. A new, high-frequency line with small buses will be implemented to cover local needs.

**Digital solutions:** They are working on the concept of mobility as a service integrating all the mobility solutions in a municipal app that will allow people to plan travels, and pay for different services like public transportation, bikes and scooters.

**Soft mobility:** The neighbourhood is being designed to focus on soft mobility. The streets will be mainly pedestrian, except for the arterial ones. These last will have narrower profiles and will include bike lanes. Bike parking is planned in the public transportation station and is under discussion with the transportation company.

**Freight mobility:** The local team would like to explore banning combustion cars for delivery/logistics in the PCED area, including hydrogen-based mobility for waste management and other logistics.

## 3.5.8. The Dolní Počernice implementation roadmap

Prague's PCED schematic roadmap revealed many milestones in the near future (Figure 17). However, construction will only start in 2028.

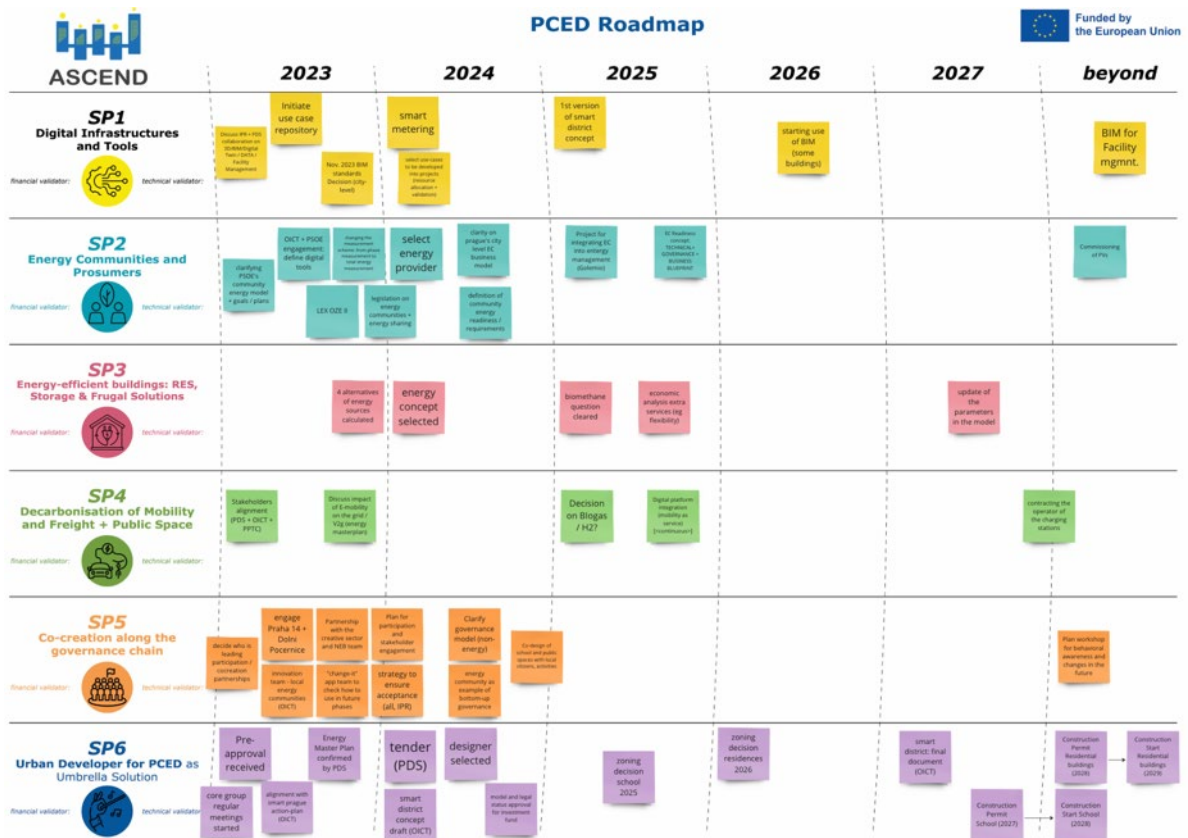


Figure 18. The Dolní Počernice PCED Roadmap. See larger version in Annexe 5.2.

### 3.5.9. Main challenges and capacity needs for Prague

#### **Challenges:**

- Real time data flows for operational control of the PCED.
- Have a clear demand for uses cases for data analysis.
- Unclear legal framework for energy communities at the national level.
- Achieve a positive balance with standard solutions.
- Willingness of residents to participate in e-mobility.
- Negotiations between the orchestrator (PDS) and the local transport company to implement mobility solutions.
- Centralised and political decision-making process in mobility topics.
- High parking ratio requirements in the local urban regulations.
- Identify a stakeholder to lead the work on citizen engagement and co-creation.
- Difficulties in the tendering process for the design and implementation.
- The City Hall being the ultimate (financial) authorisation subject.

#### **Capacity building needs:**

- Open-source standards for data and digital modules.
- Cross check of use cases for data management across ASCEND.
- Project evaluation indicators.
- Communication strategy.
- Catalogue/data of possible solutions.
- Solutions for last mile delivery and hubs for logistics.
- Solutions for end use / lifecycle of parking garages.
- Digital citizen participation tools.
- Urban project visualisation tools (VR, 3D...).
- Fundraising and PCED business models for replication.
- Computer flow dynamics model.

## 3.6. Stockholm

Stockholm is the capital of Sweden and the country's largest city with nearly one million inhabitants living in the municipality. The city stretches across fourteen islands along the Baltic Sea. Stockholm is also one of the fastest-growing metropolitan areas in Europe. Stockholm became the first European Green Capital in 2010 thanks to sustained and successful environmental work characterised by early district heating efforts and a well-developed public transport system. Stockholm is a developing city, and many areas have been shown as good examples for positive energy districts, such as Hammarby Sjöstad and The Royal Seaport. ASCEND project will continue Stockholm's work in reaching its climate targets.

### 3.6.1. Stockholm Previous PCED Experiences

Stockholm Royal Seaport is one of Northern Europe's largest urban development areas, with 12,000 new homes and 35,000 workplaces. The area runs along the waterline of the Baltic Sea, lies next door to the Royal National City Park and is just ten minutes away from central Stockholm by bicycle. Stockholm Royal Seaport will be a fossil-free, climate-positive district, and this permeates all aspects of planning and construction. All buildings in the area are low energy, and 895 MWh of solar energy was produced in 2022. The plus energy buildings in the area have a measured value of 12.3 kWh/m<sup>2</sup>.

The other area is Hammarby Sjöstad, a sustainable urban development project located in the southern part of Stockholm. It is situated on the shores of Hammarby Lake. The area is known for its innovative environmental practices and high-quality urban design. One of the key features of this area is its focus on energy efficiency and renewable energy sources. The buildings are constructed with high energy-efficiency standards; many are equipped with solar panels and geothermal heat pumps. Hammarby Sjöstad includes about 11,000 residential apartments and about 35,000 residents. Hammarby also offers a significant number of workplaces for various companies and organisations.

### 3.6.2. Stockholm ASCEND PCED Context

Despite being a Multiplier City, Stockholm has not been the target of a harvesting workshop, as defined by the Grant Agreement. With a significant experience in Positive Energy Districts, Stockholm will have a strong role in the ASCEND capacity-building program.

Stockholm will bring its know-how in European PED projects (Cities4PEDs in Loudden Trans-PED in Hammarby Sjöstad) to exchange experiences with other cities within the project team. Stockholm's

priority will be using ASCEND expertise to decide which energy system will be most appropriate for Loudden, an ongoing project, to become a positive energy district.

Stockholm's approach will be to complete Loudden's energy model and extend it to many other districts within the city. Furthermore, Stockholm will scale up Loudden's concept and exchange its knowledge and experiences with other cities nationwide.



Figure 19. Loudden district, within Royal Seaport. Source: Municipality of Stockholm.

## **4. Conclusions**

### **4.1. Different Realities**

The harvesting workshops allowed to gather detailed information on the current state and planned actions of Alba Iulia, Budapest, Charleroi, Porto and Prague on their road towards PCED implementation within ASCEND. Conceived as working sessions with local consortia and relevant stakeholders, the workshops also provided a crucial starting point for each of the Multiplier Cities to have a panoramic view of their own ecosystems and frameworks, while identifying specific challenges, potential solutions and capacity building strengths and needs. The thematic sessions based on each of the project's Solution Packages enabled a focused analysis of the different fields of action relevant to the implementation of a PCED. As such, they allowed the identification of technical aspects, governance models, stakeholders, opportunities and solutions for each PCED of the Multiplier Cities.

The insights gathered on this report reveal the vastly different realities of each of the Multiplier Cities in the project, starting with the settings chosen for their PCEDs. Whereas Prague's PCED is a 100% new construction project in its outskirts, the city of Budapest will exclusively focus on retrofitting an existing consolidated neighbourhood, targeting an unused school to tackle housing unaffordability and pilot sustainable heating systems. Alba Iulia will combine new construction and renovations, primarily of educational facilities, to increase its district's overall energy efficiency. Meanwhile, Porto will complement the ongoing renovation and PV installations on social housing and public facilities with the creation of an energy community. Charleroi's PCED is part of its Porte Ouest project, seeking to depollute and repurpose a large industrial brownfield near its city centre.

While advanced by strong and motivated ecosystems, PCED ambitions have different levels of maturity in each Multiplier City. Whereas in Porto, Prague and Charleroi ASCEND activities are directly connected to orchestrated measures currently underway, Budapest and Alba Iulia are focusing on coordinating so far disconnected interventions to realise a PCED.

## 4.2. Common Challenges and Capacity Needs

Despite the different realities and ambitions, the Multiplier Cities also feature commonalities. Besides challenges of insufficient funding or capacity, which can be addressed through different components of ASCEND, the harvesting workshops revealed significant blockages posed by unfavourable regulations. For instance, local legal frameworks impede or at least complicate the deployment of energy communities in all the municipalities. Meanwhile, the complexity of multi-stakeholder governance is common to all cities. During workshops, local partners identified an ecosystem of stakeholders that are fundamental for the project's success. In some cases, such as in Prague and Budapest, this also entails different levels of local governance that need to be articulated to achieve PCED implementation. The section below outlines the main common challenges and capacity needs per Solution Package.

### 4.2.1. SP1: Digital Infrastructures and Tools for flexible energy systems and PCED

#### **SP1: Main Challenges faced by MCs**

- Lack of available data and difficulty to access smart metres data.
- Lack of human resources specialised in data (except Porto and Prague).
- Lack of strategy for data collection and processing.
- Lack of funding to deploy sensors, data collection and platforms.

#### **SP1: Main capacity needs from MCs**

- Open-source standard and ready-to-use digital modules /tools that could be applied to the different SP.
- Developing a Digital Twin (focus on energy management).
- Digital tools for Energy Communities management.

### 4.2.2. SP2: Deployment of Energy Communities and Prosumers

#### **SP2: Main challenges faced by MCs**

- Unclear regulations and lack of national enabling frameworks.
- Citizens' engagement for the creation and participation in an Energy Community.
- Lack of funding to deploy RES production.

#### **SP2: Main capacity needs from MCs**

- Setup process and business models for Energy Communities.
- Citizens' engagement for the creation and participation in an Energy Community.
- Governance of Energy Communities.

- Digital tools for Energy Communities management

### 4.2.3. SP3: Deployment of energy-efficient buildings integrating RES, Storage and Frugal Solutions

**SP3: Main challenges faced by MCs**

- Adverse regulations for grid injection and energy sharing.
- Engaging private homeowners and businesses.
- Lack of funding for renovations and RES production.
- Complicated procurement processes.

**SP3: Main capacity needs from MCs**

- Economic models for district-level renovation.
- Solutions to engage private owners (awareness, cocreation, one-stop-shops).
- Streamlining procurement processes.

### 4.2.4. SP4: Decarbonisation of Mobility and Freight Logistics, including Frugal Solutions

**SP4: Main challenges faced by MCs**

- Car-dependent constituencies.
- Complex governance and interdependencies for mobility and public space issues (district+ regional + national levels, private.).
- High-input interventions.
- Afforestation and NBS not seen as priorities, funding unavailable.

**SP4: Main capacity needs from MCs**

- Logistics: Strategic planning and decarbonisation of last-mile delivery.
- Second life of parking facilities.
- Afforestation and NBS planning and funding mechanisms, incl. private space.
- Behavioural change strategies and other low-input solutions for mobility.

### 4.2.5. SP5: Citizen-Centric Solutions and Co-creation along the governance chain

**SP5: Main challenges faced by MCs**

- Difficulty to engage private home- and business owners in renovations.
- Getting acceptance from neighbours in the case of new construction (Prague, Alba Iulia partially).

- ∄ Embedding the project in the community and getting local support.
- ∄ No dedicated task force within consortiums, for now technically oriented project.

**SP5: Main capacity needs from MCs**

- Engagement strategies and economic models for private renovations.
- Getting acceptance from neighbours in the case of new construction (Prague, Alba Iulia partially).
- Embedding the project in the community and getting local support.
- Strengthening human-factor approaches on PCEDs.

### 4.2.6. SP6: Urban Developer for PCED as an Umbrella Solution

**SP6: Main challenges faced by MCs**

- Multi-level governance and decision-making.
- Difficulties in the tendering process.

**SP6: Main capacity needs from MCs**

- Multi-level governance for a PCED.
- Streamlining the tendering process for a PCED.

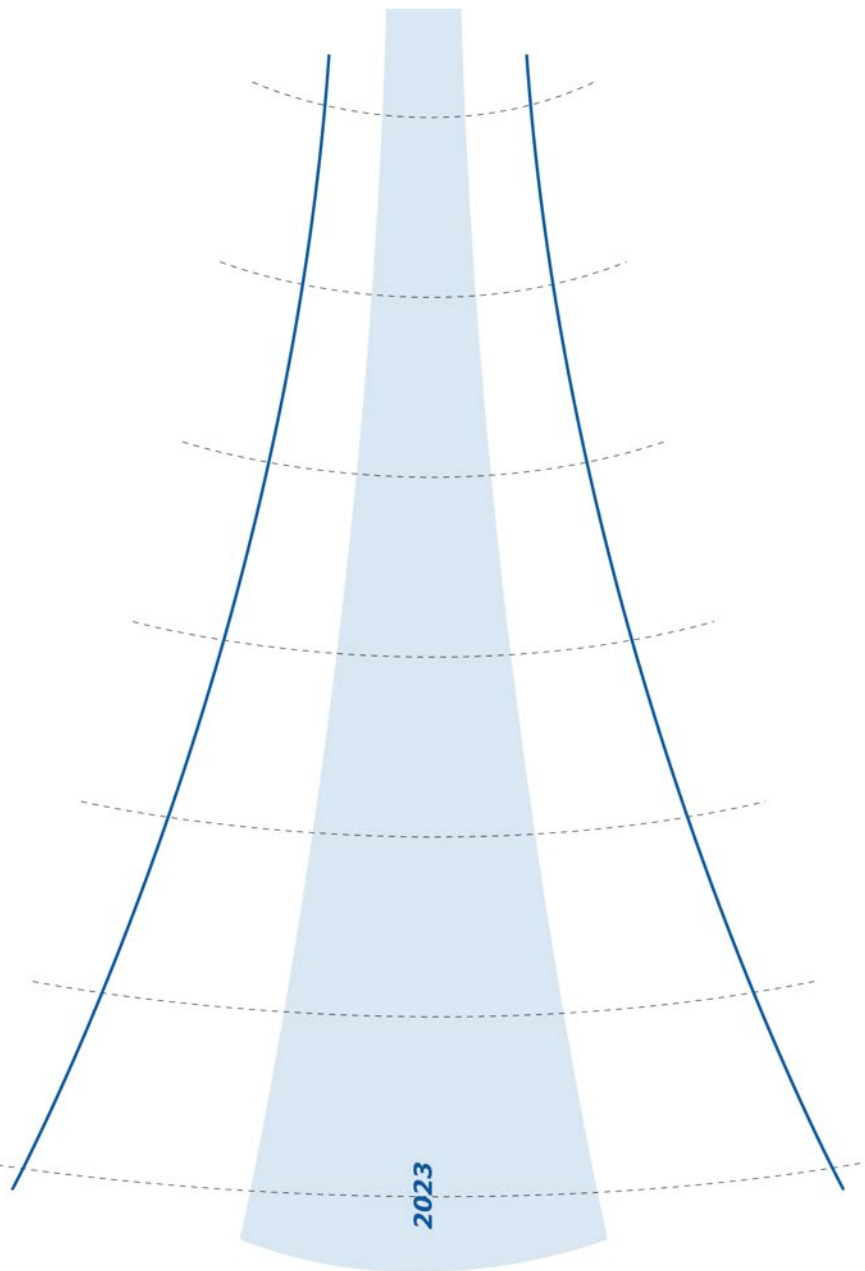
# 5. Annexes

## 5.1. Canvases

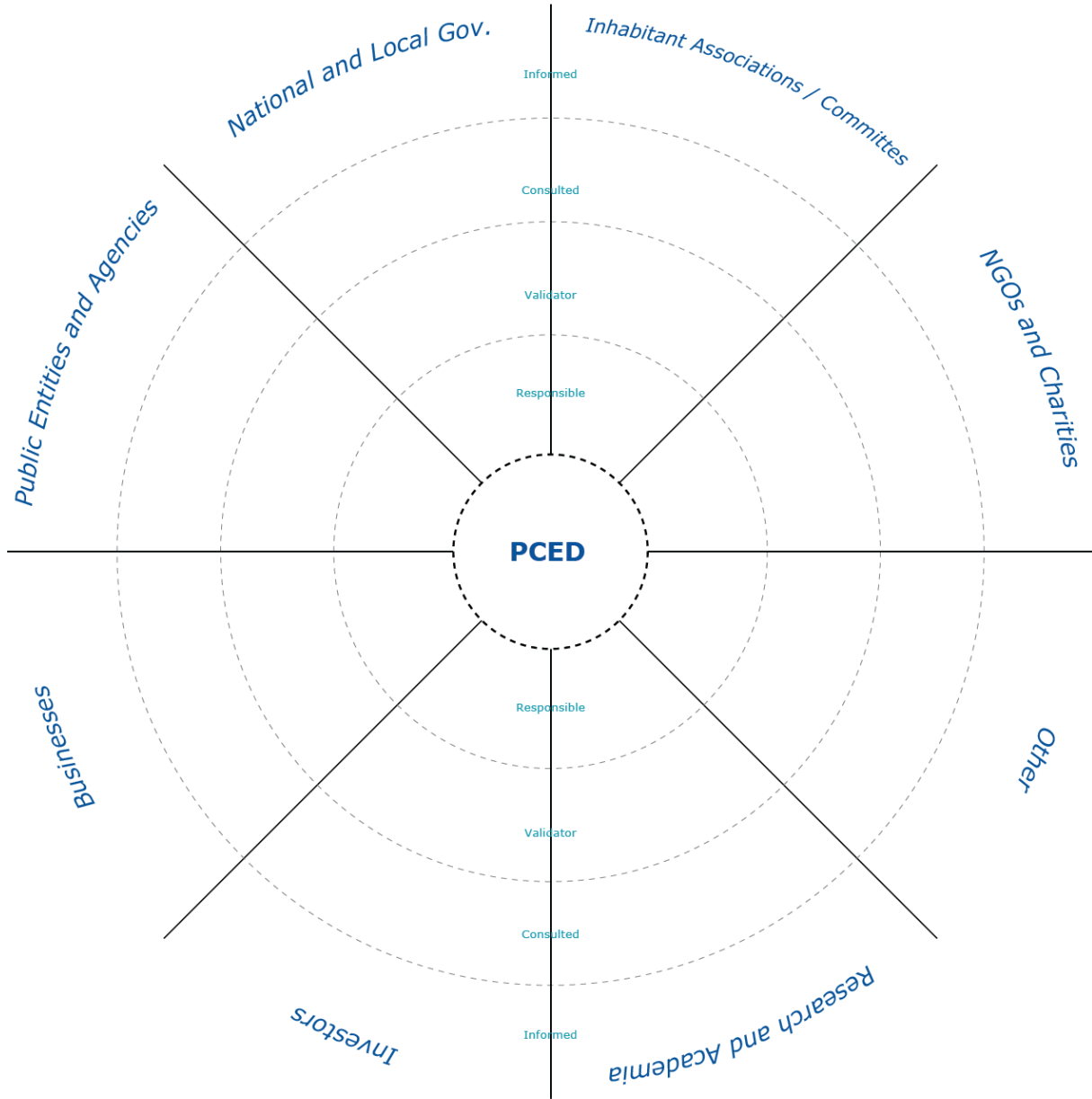
### 5.1.1. Vision Canvas



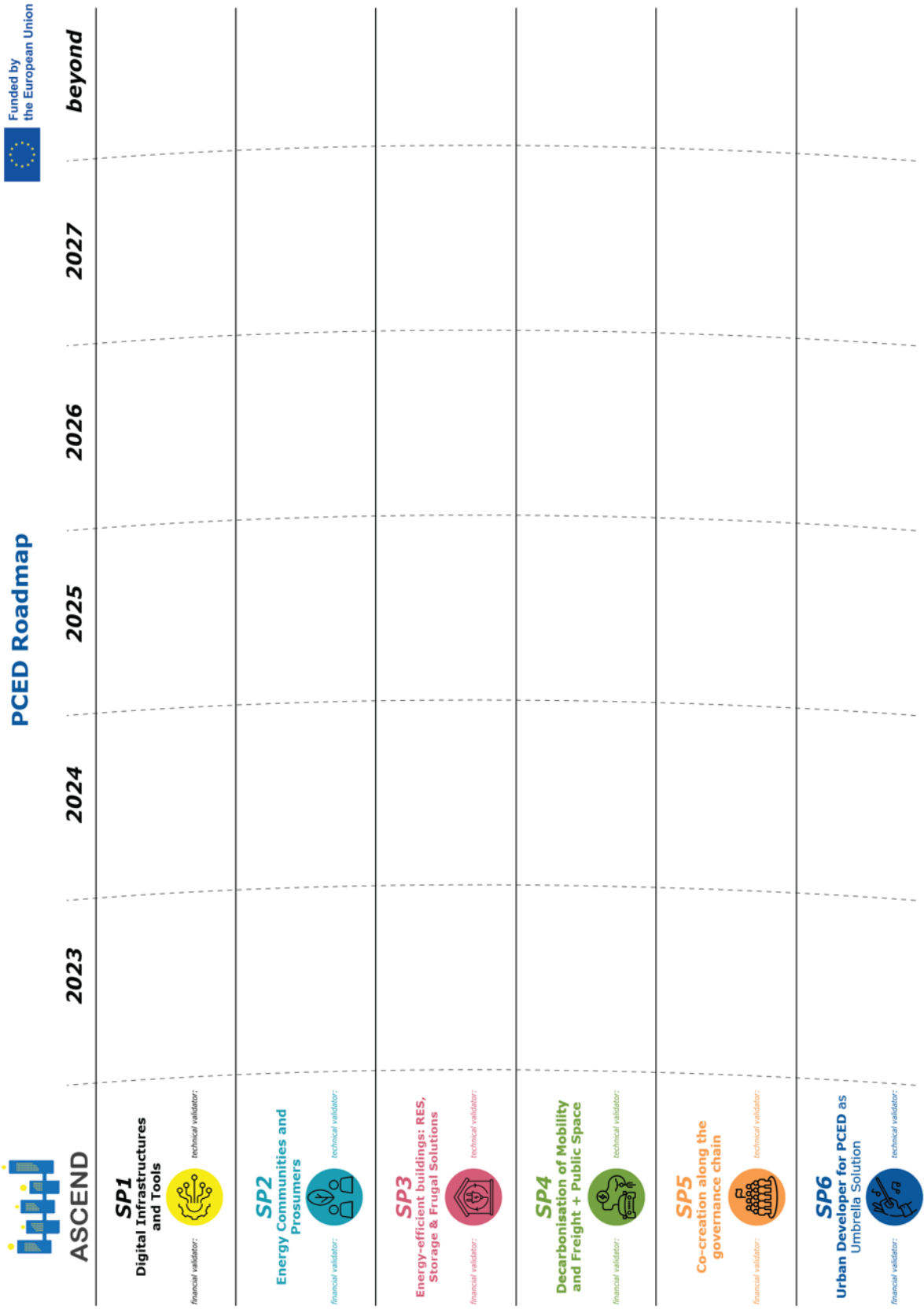
Imagining the PCED: Vision and Milestones











## 5.1.2. Stakeholder Map Canvas



### 5.1.3. Roadmap Canvas



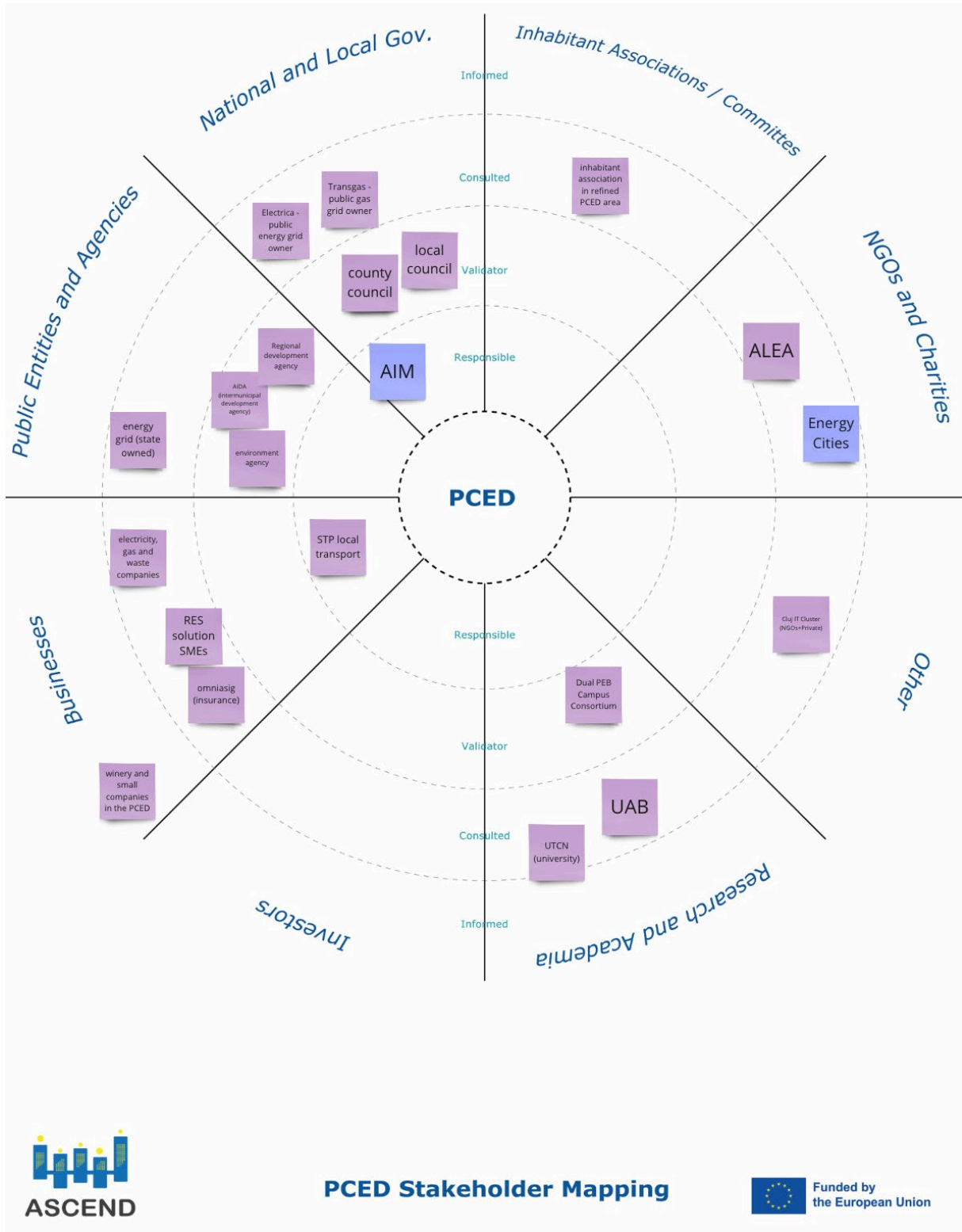
### 5.1.4. Strengths and Needs Canvas

|   |  | <b>capacity strengths</b> | <b>capacity needs</b> | <b>solutions</b> | <b>challenges</b> |
|--|---|---------------------------|-----------------------|------------------|-------------------|
| <b>SP1</b><br>Digital Infrastructures and Tools<br>                             |   |                           |                       |                  |                   |
| <b>SP2</b><br>Energy Communities and Prosumers<br>                              |   |                           |                       |                  |                   |
| <b>SP3</b><br>Energy-efficient buildings: RES, Storage & Frugal Solutions<br> |   |                           |                       |                  |                   |
| <b>SP4</b><br>Decarbonisation of Mobility and Freight + Public Space<br>     |   |                           |                       |                  |                   |
| <b>SP5</b><br>Co-creation along the governance chain<br>                    |   |                           |                       |                  |                   |
| <b>SP6</b><br>Urban Developer for PCED as Umbrella Solution<br>             |   |                           |                       |                  |                   |

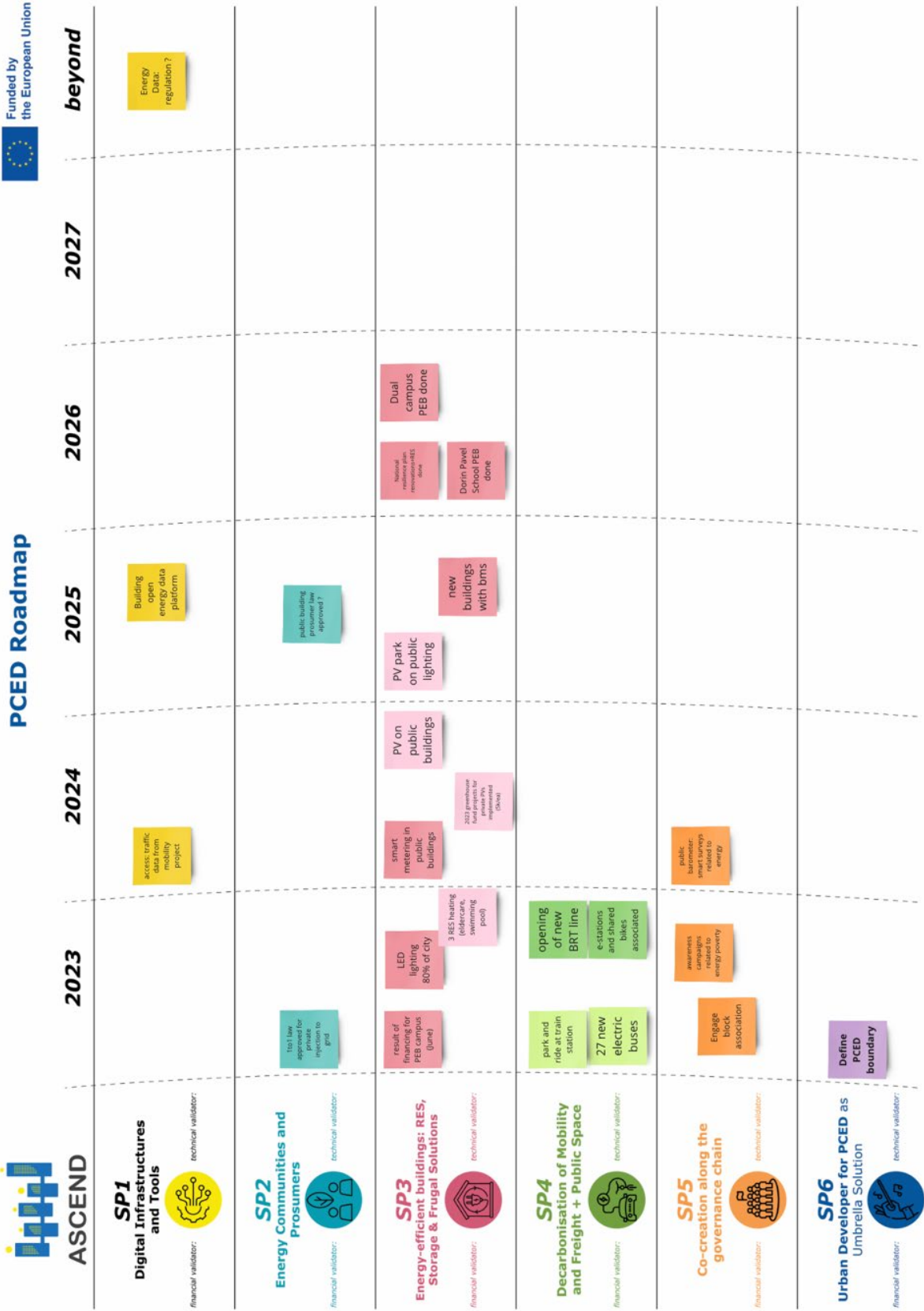
## 5.2. PCED Stakeholders, roadmaps and spatial maps

### 5.2.1. Alba Iulia





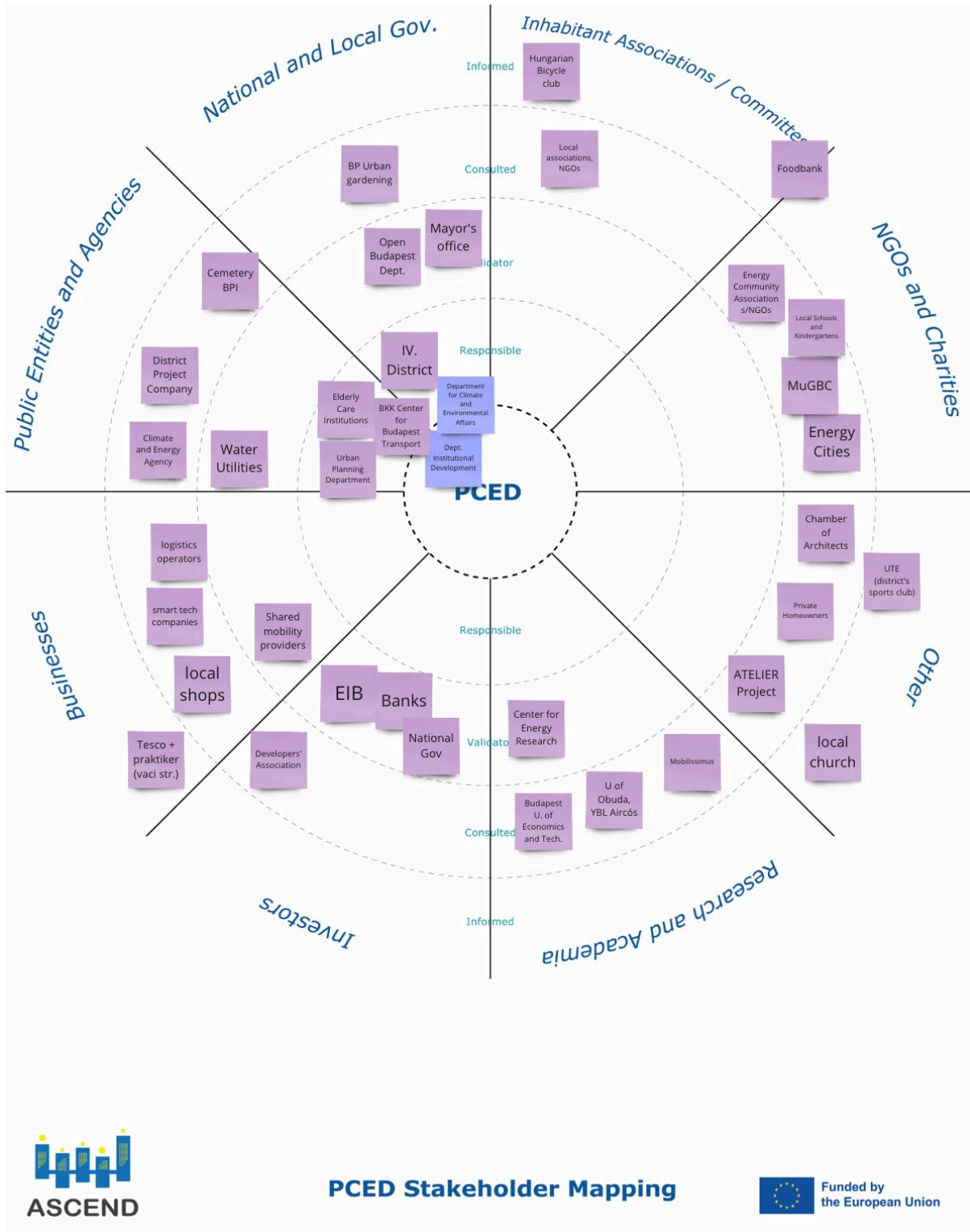
Alba Iulia stakeholder map. Digitalised from workshop canvas.



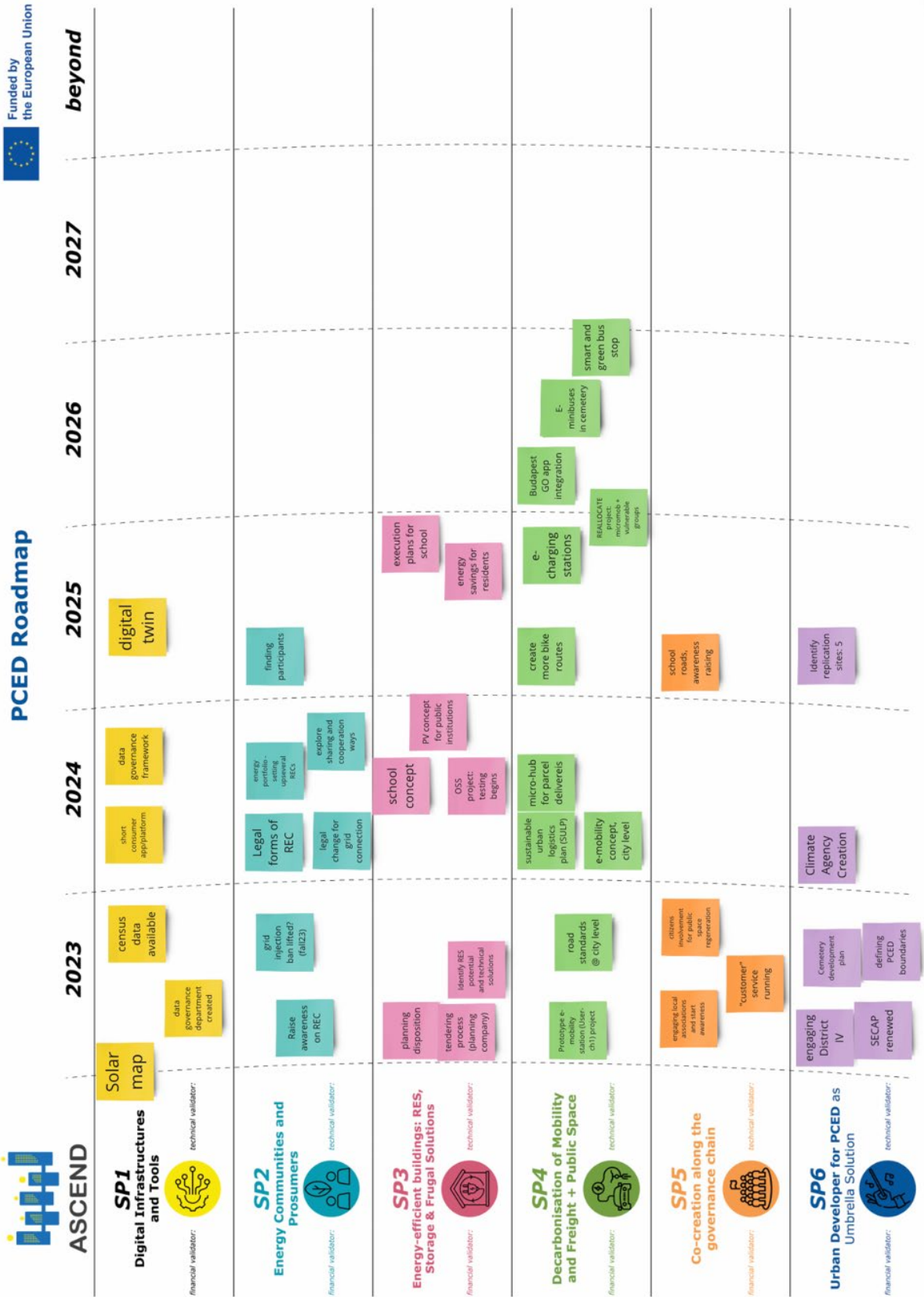
Alba Iulia preliminary roadmap. Digitalised from workshop canvas.

## 5.2.2. Budapest



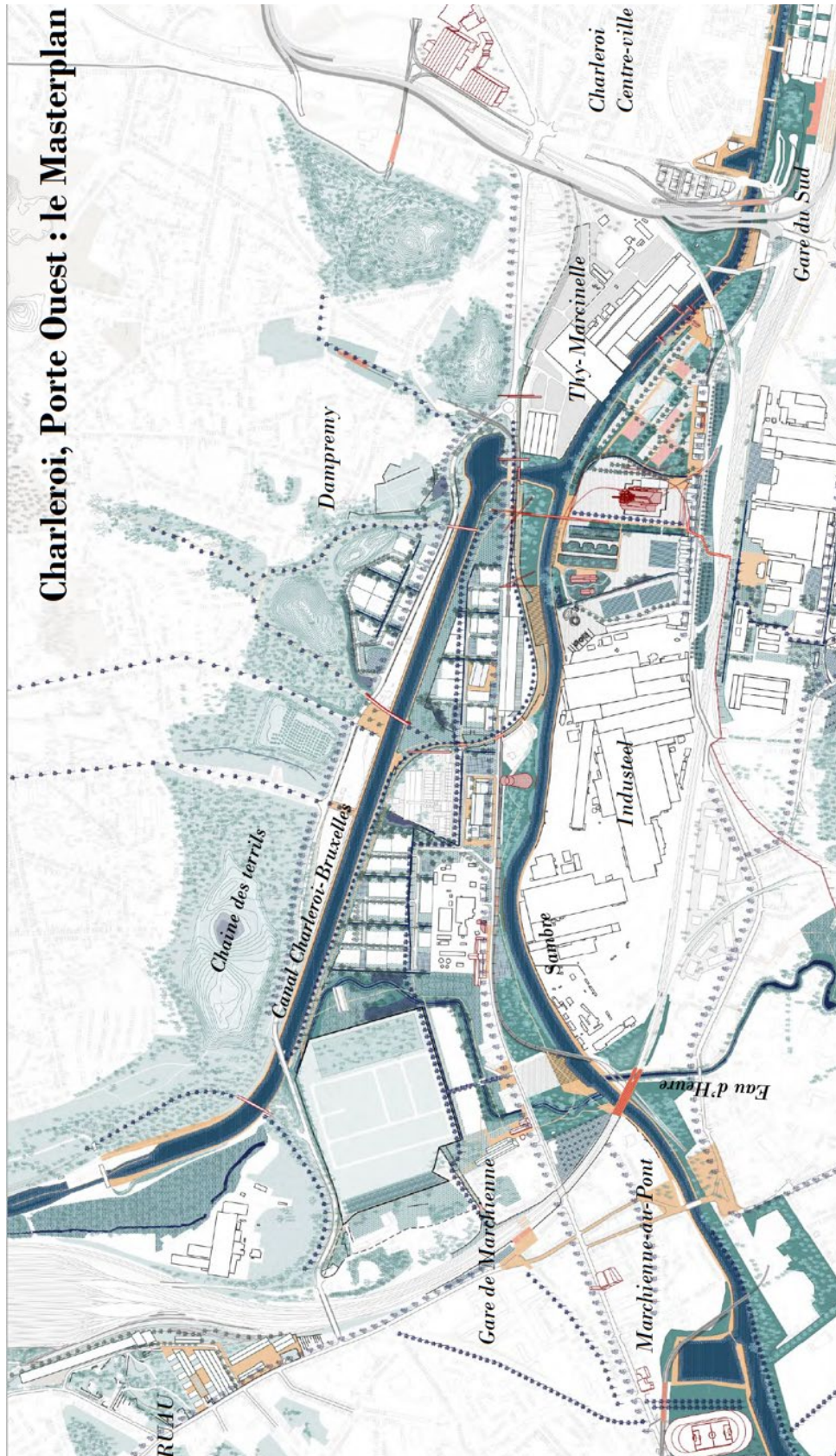


Budapest stakeholder map. Digitalised from workshop canvas.

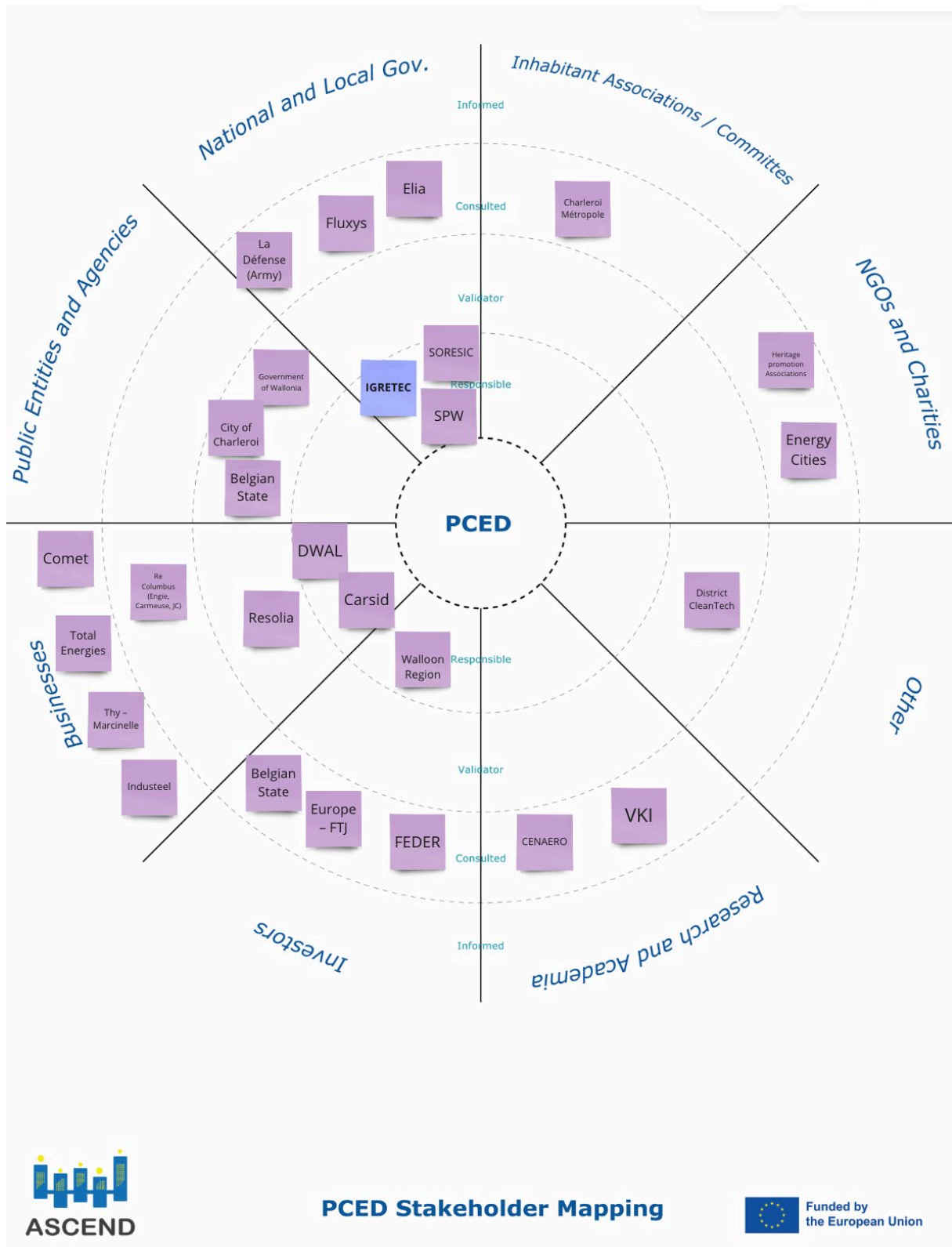


Budapest preliminary roadmap. Digitalised from workshop canvas.

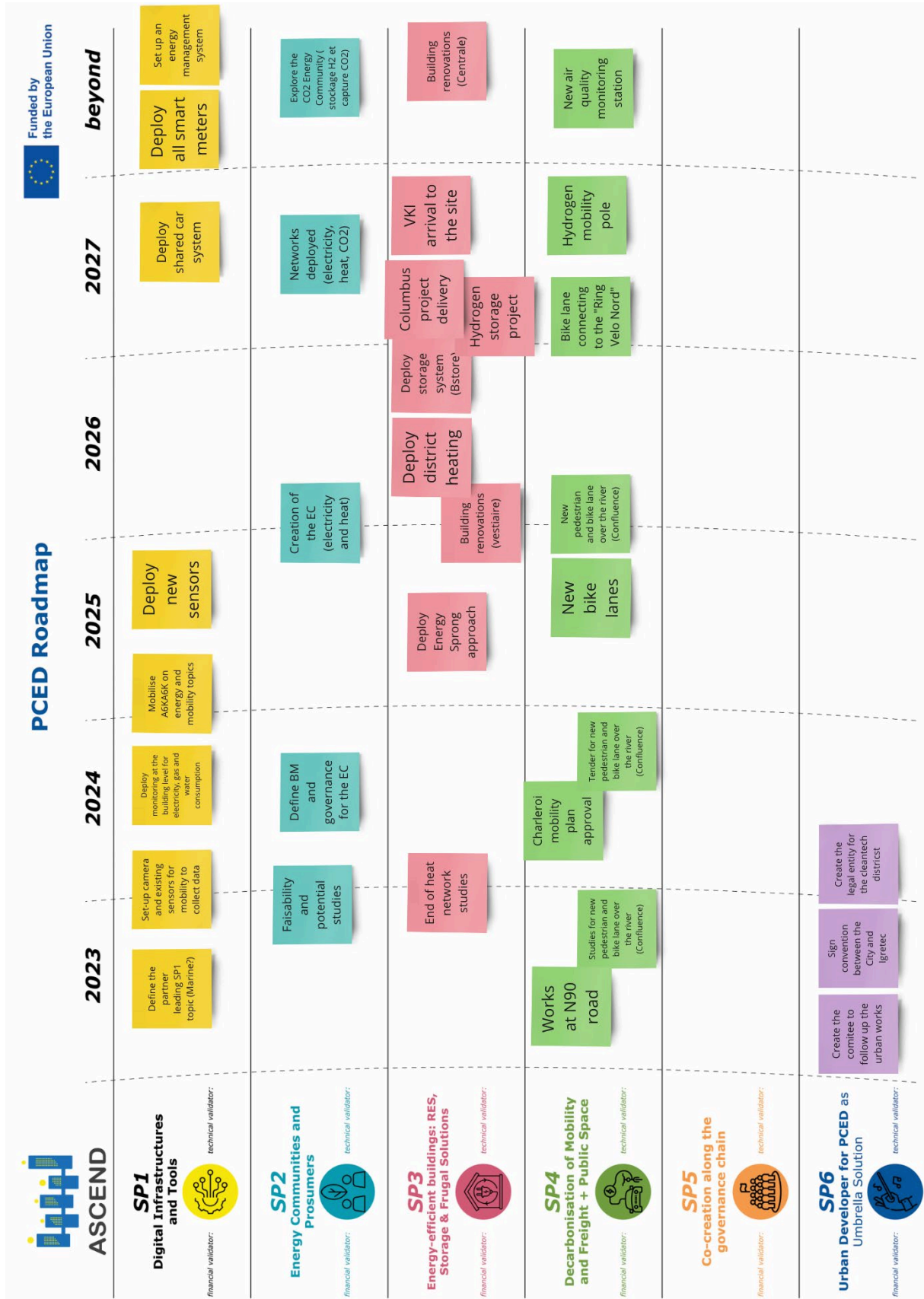
### 5.2.3. Charleroi



Porte Ouest Masterplan by studio paola viganò



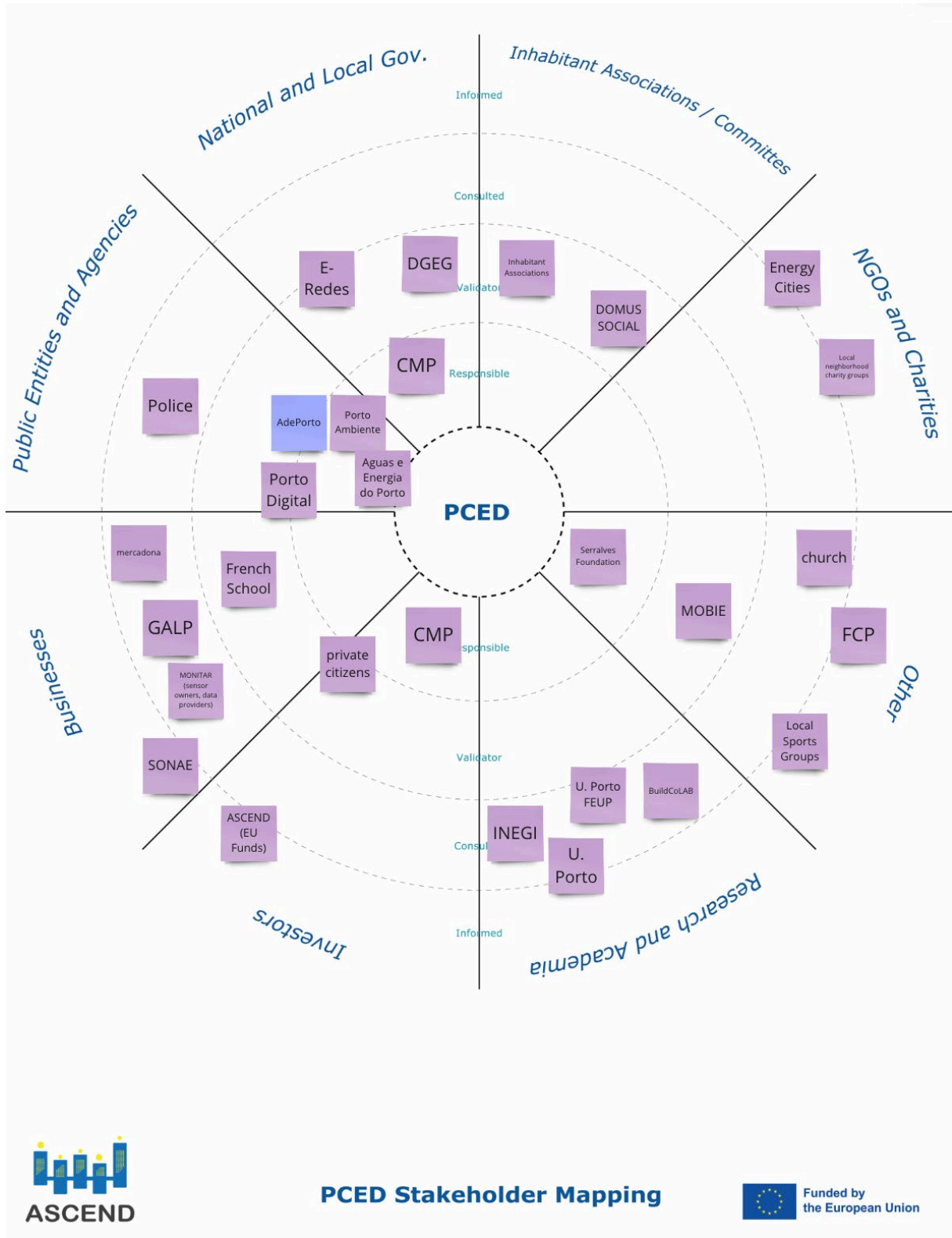
Charleroi's Porte Ouest stakeholder map. Provided by Igretec.



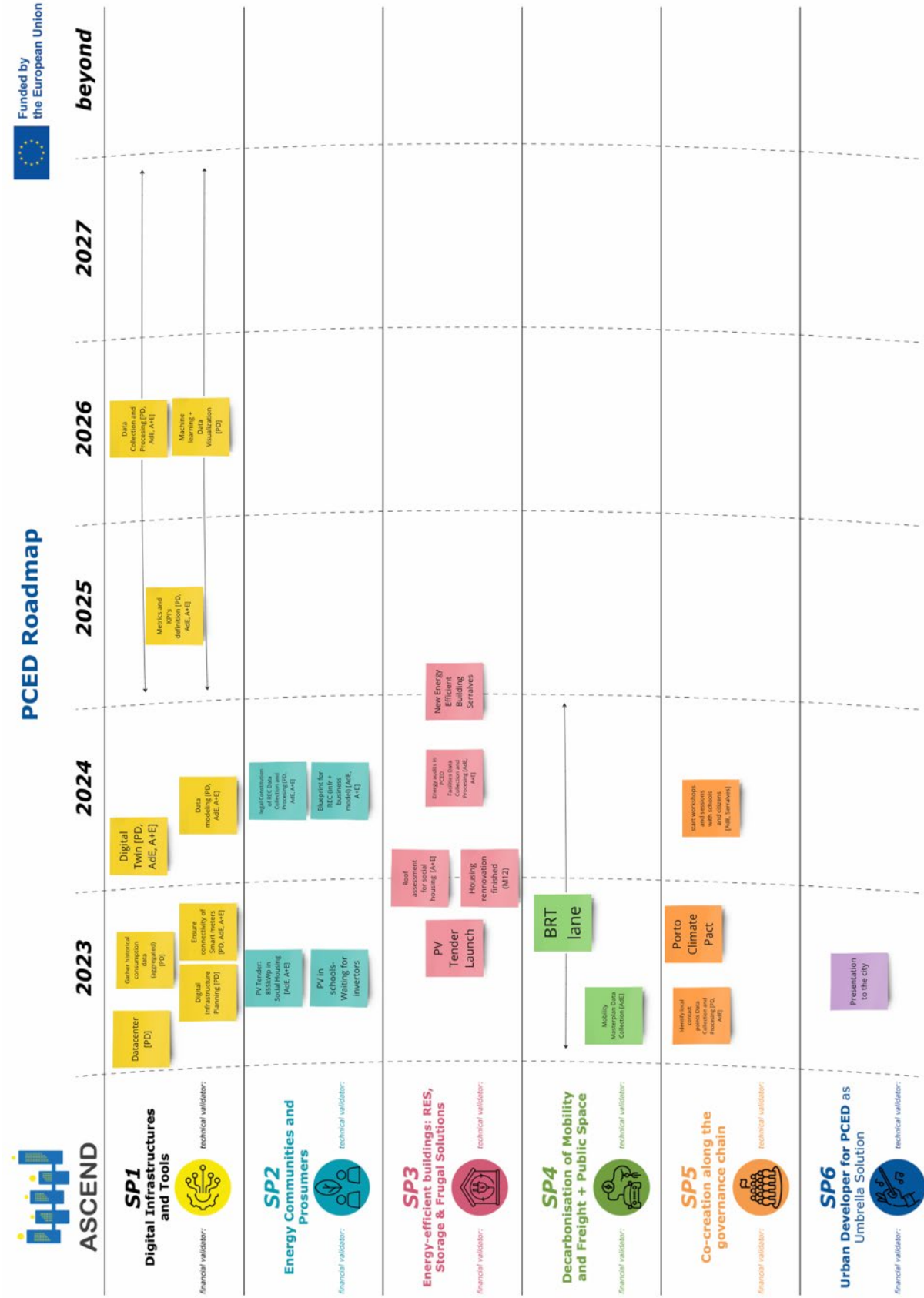
Charleroi's Porte Ouest preliminary roadmap. Digitalised from workshop canvas.

## 5.2.4. Porto





Porto stakeholder map. Digitalised from workshop canvas.



Porto preliminary roadmap. Digitalised from workshop canvas.

## 5.2.5. Prague



| LEGENDA<br>PODKLADNÉ ŽEVY   | IDENTIFIKAČNÍ PRVKY<br>E a U P b  | REGULAČNÍ ZASTAVBY  | VEŘEJNÁ PROSTRANÍ   |
|---|---|---|---|
| <ul style="list-style-type: none"> <li>černá čára: hranice území</li> <li>černá čára: hranice zastavěného území</li> <li>černá čára: hranice zastavěného území</li> <li>černá čára: hranice zastavěného území</li> <li>černá čára: hranice zastavěného území</li> </ul> | <ul style="list-style-type: none"> <li>černá čára: hranice území</li> <li>černá čára: hranice zastavěného území</li> <li>černá čára: hranice zastavěného území</li> <li>černá čára: hranice zastavěného území</li> <li>černá čára: hranice zastavěného území</li> </ul> | <ul style="list-style-type: none"> <li>černá čára: hranice území</li> <li>černá čára: hranice zastavěného území</li> <li>černá čára: hranice zastavěného území</li> <li>černá čára: hranice zastavěného území</li> <li>černá čára: hranice zastavěného území</li> </ul> | <ul style="list-style-type: none"> <li>černá čára: hranice území</li> <li>černá čára: hranice zastavěného území</li> <li>černá čára: hranice zastavěného území</li> <li>černá čára: hranice zastavěného území</li> <li>černá čára: hranice zastavěného území</li> </ul> |

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Místní územní plán, 11000 Praha 1  
Dolní Počernice  
ARCHUM ARCHITEKTI

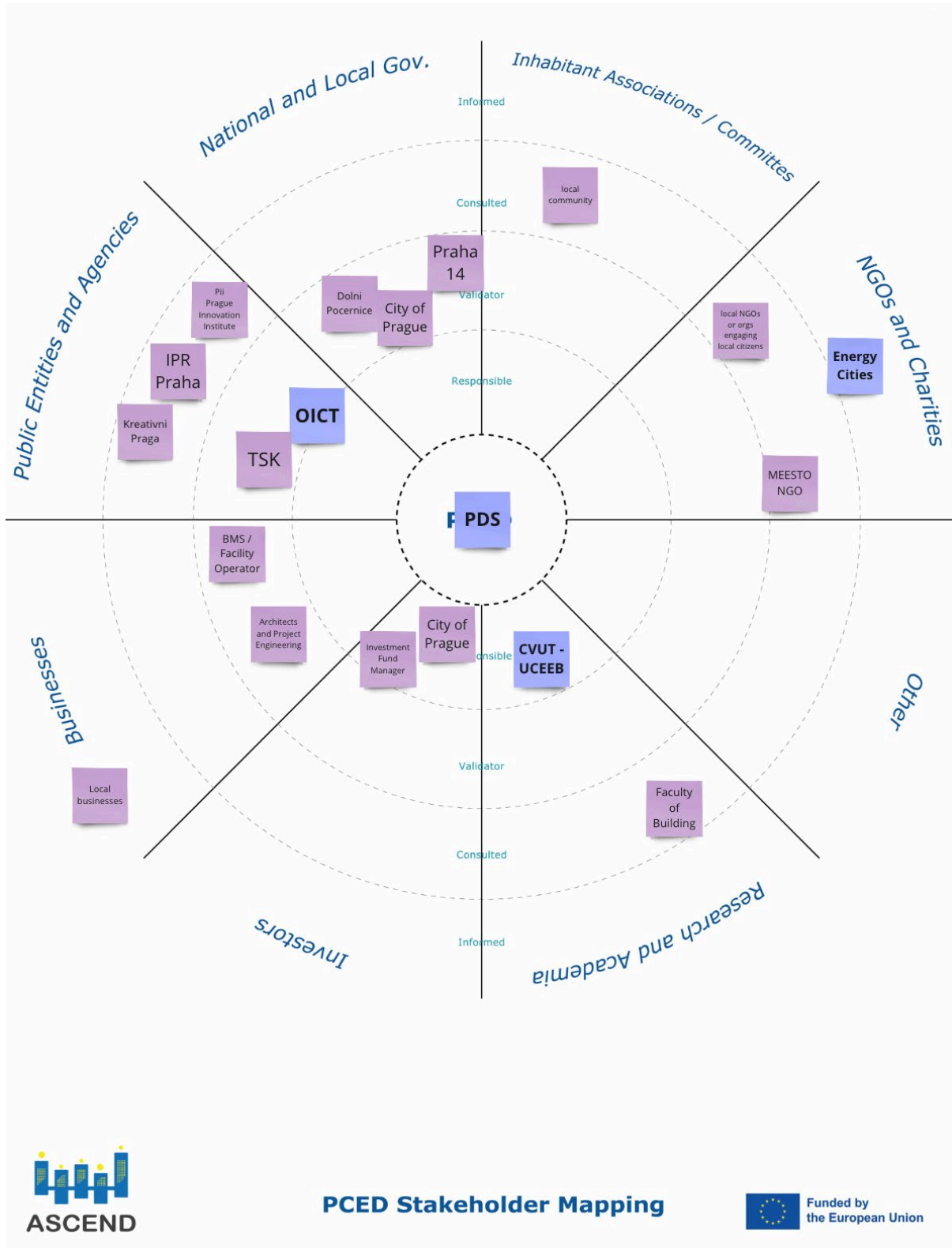
Ing. arch. Miroslav Kalaš  
Ing. arch. Štěpán Vojtek, Ph.D.  
Ing. arch. Veronika Šimková

Ing. Miroslav Kalaš

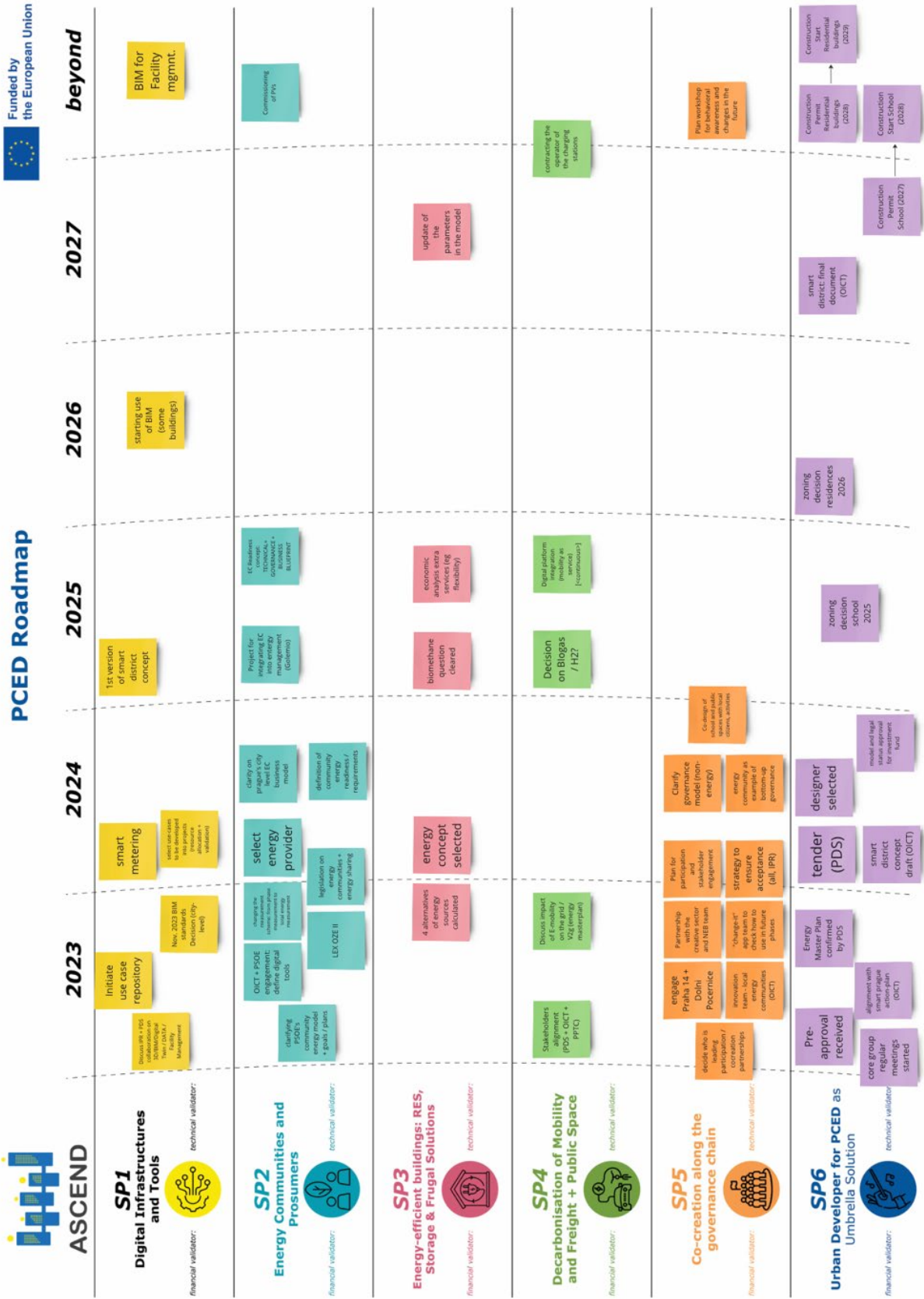
Urbanistická koncepce  
05 / 2021 STUŽENÉ B.I.I  
ARCHUM ARCHITEKTI

Dolní Počernice project master plan by Archum Architekti





Prague Stakeholder mapping. Digitalised from workshop canvas.



Prague preliminary roadmap. Digitalised from workshop canvas.



# ASCEND



**Accelerate poSitive  
Clean ENergy Districts**

