



MAKING-CITY G.A. N°824418



Annex I

Guidelines for Positive Energy District Design

How to Transform a district into a PED

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OBJECTIVE

The main purpose of these guidelines is to provide an approach for planning and designing Positive Energy Blocks (PEB) and Positive Energy Districts (PED) in cities. Since PEDs play a key role on energy transition in cities, this report highlights the importance of citizen participation, economic, technical, political, regulatory, and spatial issues for a sustainable urbanization. In line with this, definition of the methodology and establishing guidelines are pointed out according to the different application of scenarios to facilitate designers the identification and combination of the solutions to transform a district into a PED. In this guideline, the analyses and conceptions for defining PED boundaries in cities and selection of technologies in parallel with participative processes are intensely examined and presented.

The proposed PED methodology is targeted mainly to municipalities. Nonetheless, the process defined in this report covers citizens, designers, planners, technology providers, energy utilities, grid operators, researches, energy real estate investors, energy generators, energy service providers and public transport operators and mobility planners. The involved stakeholders will depend in the specific urban context.

MAKING-CITY PED CONCEPT

According to MAKING-CITY project, a Positive Energy District (PED) is “an urban area with clear boundaries, consisting on buildings of different typologies that actively manage the energy flow between them and the larger energy system to reach an annual positive non-renewable primary energy balance”.

PED is a relatively new concept, derived from the Positive Energy Block (PEB) concept. MAKING-CITY assumes that a single energy transition process can be accelerated if PEDs can be achieved and scaled up, due to the special features and ambition of the approach. Reaching positive balance means a step forward regarding net zero energy districts (NZED) as can obtain better impacts due to the intensive use of RES and high efficiency which can reduce remarkably CO₂ emissions. PEB is a group of at least three connected neighbouring buildings producing on a yearly basis more primary energy than what they use[1], whereas a NZEB is understood as a building that has a very high energy performance with nearly zero or very low amount of energy requirements. The NZEB energy needs are covered to a very significant extent by energy from renewable sources (RES) including energy from RES produced on-site or nearby [2]. Several NZEB forms the NZED. PED can have a combination of NZEBs and/or high efficient buildings (that do not necessarily meet NZEB requirements). However, the main difference is that PED produces more energy than what is needed to meet the district needs. In the following section the requirements for the implementation of PEDs are explained. In page 6, a methodology for PED design is stated.



REQUIREMENTS for IMPLEMENTATION of PEDS

1. Collaborative Governance – Potential implementation of PEDs according to the regulations and policies in the cities.



Collaborative governance goes beyond direct citizen engagement and moves towards the creation of networks or coalitions where discussions and negotiations can take place with a wide range of stakeholders [3]. Collaboration can start with allowing for true open planning processes where affected stakeholders, now also including companies and NGOs. Therefore, this also thrives on communicative planning ideals [4] and co-creation [5]

Collaborative governance goes beyond open planning processes, but also sees the creation of coalitions, platforms or networks for sharing and discussing policy outcomes as an ambition. Larger energy companies, energy network operators, housing associations, project developers or big companies are all examples of more professional organisations with significant financial capabilities that need to be explicitly included in PED development. These stakeholders might be engaged through establishing economic and social networks together with governmental organisations and departments. The **development of agreements, covenants and public private partnerships** can be the result and ambitions of such networks, addressing wider urban energy challenges such as large solar fields, heat networks, neighbourhood revitalisation, etc. The result is a professional community of practice able to coordinate its work in pursuing PED development.

2. Urban Planning, Land Use Planning and Urban Design - Potential implementation of PEDs according to the plans and strategies in the cities

As the integration of various interests is the central aim of urban planning and land use planning, cities can utilize them to foster and enable energy actions. On the level of strategic master planning, municipalities may use **land use plans to guide the development of urban structure in the long-term, and search locations for integrated urban functions, such as PEDs**. Moreover, surveys and impact assessments produced during land use planning can be utilized to generate knowledge about energy opportunities. Land use planning can also be utilized to bridge energy targets with implementation: local detailed plans juridically enable implementation of building projects with energy actions, and the participatory land use planning processes can be utilized for energy-related participation.



One limitation for utilizing land use planning in fostering new PEDs is that the prerequisites of municipalities to practice land use planning vary depending on the spatial planning system in each country or region. Another limitation is that land use planning can be best utilized in contexts where new buildings are being built, that is, in PEDs based on new urban development or infill building. In PEDs that include existing buildings, other planning, and policy tools, such as citizen engagement strategies, might be more applicable.

3. Citizen Empowerment – Identification of Stakeholders at an early stage and Co-designing PEDs in the cities

An important challenge for citizen empowerment is to **move beyond mere interest representation and towards value representation**; i.e. decision making moves beyond negotiating interests or about implementing a ‘product’ or ‘solution’, but is contextualized by a shared story for the future of a neighbourhood or town that the PED represents and fits into. Doing so can be a mechanism **to evolve from self-interest to working on common values** and hence, allow for a more efficient form of citizen participation. A key ingredient to support citizen empowerment by working on common values is also to **financially enable citizens to be part of PED development**. The challenge is thus to develop financial arrangement that allow and stimulate individual companies or individual households to (co)invest and financially participate. While much tends to depend on national legislation, also on a local level key opportunity exist, ranging from cheap loans, subsidies, or facilitating easy access to financial institutions.



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4. Investment and Risk Models – Identification of Innovative Business Models for PED Implementations in the cities

There is no predefined single business model for the successful development of a PED. Instead, a combination of different business models must be found for each stakeholder involved. This applies to each of the pillars of the PED energy system (energy efficiency, renewable energy production, energy system flexibility and electric mobility). For each stakeholder involved (cities, real estate developers, building owners, providers of innovative technologies, energy infrastructure operators, inhabitants...), the PED has to bring a value proposition that meets the stakeholders' needs and wishes.



5. Impact Assessment – Potential Impacts of PEDs to the city's overall Sustainable Energy Vision

In order to verify the coherence of PEDs with the needs and demand of the citizens of the city, region neighbourhood or area where the project is intended to be implemented, the interrelation among the urban challenges has to be highlighted. These challenges need to be identified with the different PED implementations in the city.

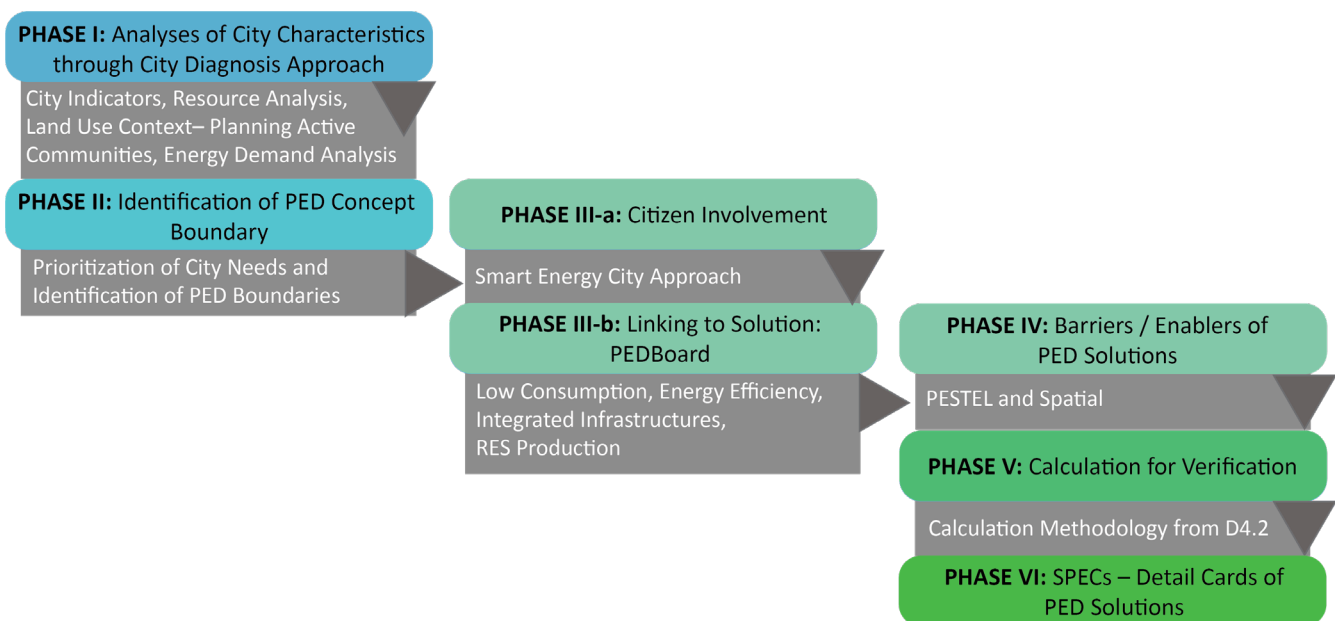
A standardized matrix could be created to assess the impact of PEDs in terms of political, economic, social, technical, spatial or legal aspects. The matrix should summarize all elements and allow to identify how each city challenge is addressed by the project elements. Since PEDs support minimizing the impact on the connected centralized energy networks, the impact assessment on the innovative integration of technologies (such as sustainable energy services solutions, storages, smart control – demand response, e-mobility, DERs ...etc.) gains importance for encouraging decentralized systems.



METHODOLOGY for PED DESIGN

The following PED Design Methodology focuses on the procedure considering the identification process of the PED concept boundary and selection of proper PED solutions peculiar to the cities. It is composed of the phases encompassing a decision-making route that underlines citizen engagement throughout this process. The procedure aims to understand what the city is looking for, described as state of play in cities (city characterization) for figuring out the priorities, objectives and needs of the cities. Therefore, the main goal is the creation of a specific plan/design/guideline for each city that may reach, understand, and try to follow the phases of the methodology and find out its needs, vision and objectives.

PED DESIGN METHODOLOGY

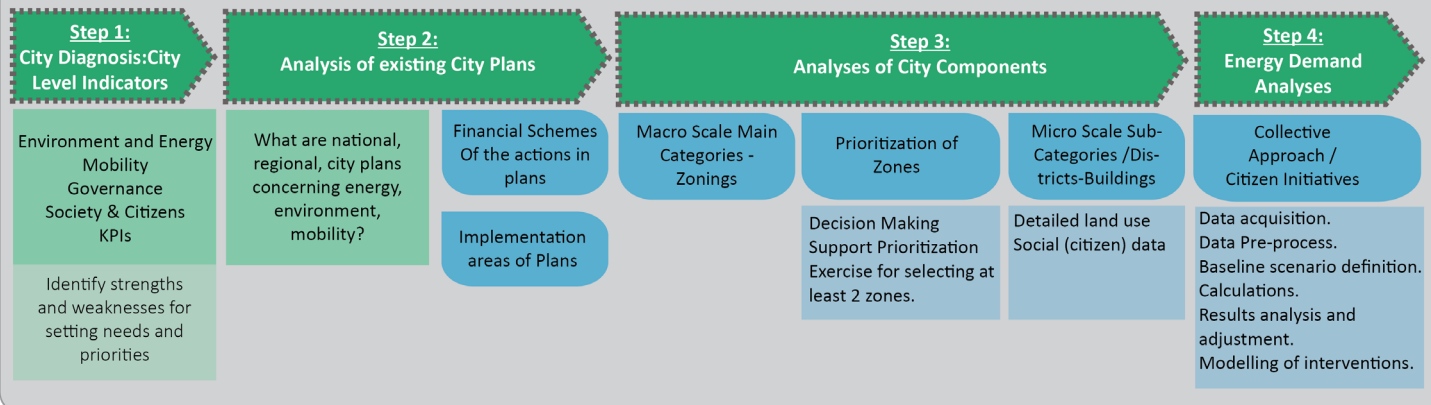


Phase I: Analyses of City Characteristics through City Diagnosis Approach

Phase I addresses main city needs in terms of energy aligned with integrated urban planning, land-use planning and urban design. This phase includes robustly local authorities, citizens, researchers, planners and designers in the process. In doing so, city characteristics and priorities are analysed under four steps:

- Analysis of the main city characteristics: Calculation of City Level Indicators
- Analyses of existing City Plans and identification of implementation areas in these plans
- Analyses of City Components
- Energy Demand Analyses

PHASE I : Analyses of City Characteristics through City Diagnosis Approach



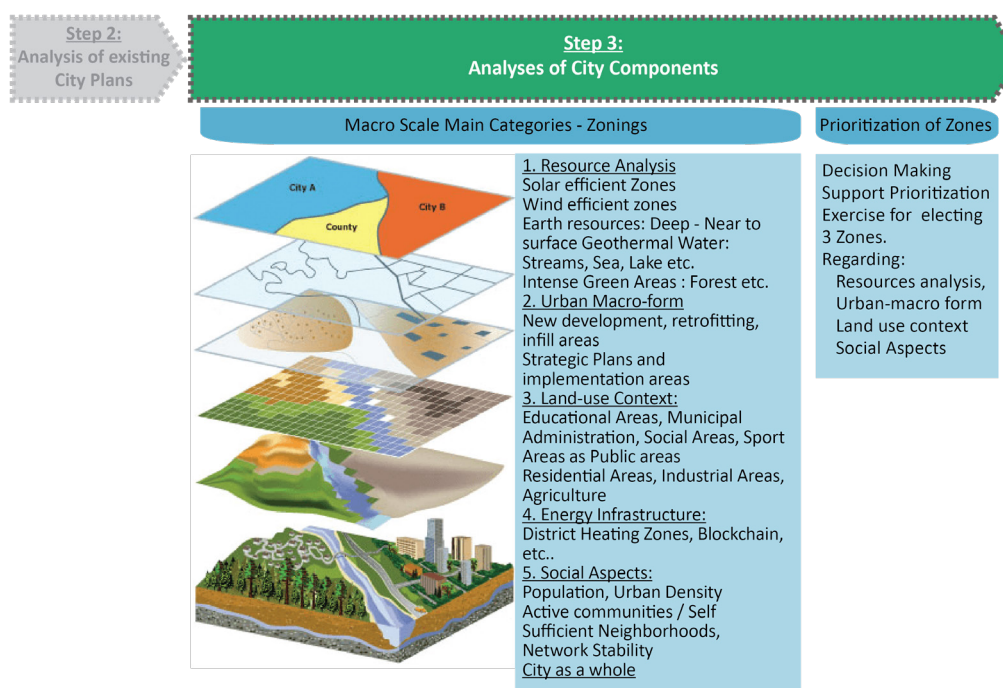
Step 1: City Diagnosis: City Level Indicators

The city level indicators are used to show to what extent overall policy goals have been reached. In the process to become a smart city, establishing a reliable metric is a key point to support cities to identify strengths and weaknesses and consequently set priorities for action.

Step 2: Analyses of existing City Plans and identification of implementation areas in these plans

A first approach the description of the plan, the implementation period, the scope of the plan, and the topics covered (energy, mobility, ICT, social) is collected. At this phase, cities can also utilize their strategic land use plans to explore opportunities for PED implementation, by taking into account the aims of the city, the energy network operators, private sector and citizens.

Step 3: Analyses of City Components



Analyses of City components play a key role for identification of peculiar and efficient PED concept boundary in cities. Until today, smart cities were particularly evaluated with energy, mobility and ICT (rarely with waste, water, too) domains. In fact, the challenge is that **local energy production and distribution, connected with digitalization**, have not previously been a part of the integrated urban planning and design approaches, while they have included many other environmental and social topics. MAKING-CITY PED Methodology underlines **energy sustainability in urban planning, land use planning and urban design** and therefore repeats deep analysis in macro/micro scale in the city/neighbourhood/district/building level. A harmonization of these diverse modes of spatial planning with energy planning is the main aspect of PED Methodology for pointing out city characterization.

Likewise, MAKING-CITY PED Methodology indicates that inclusiveness, co-creation and participatory planning shall rule the energy transition since an inclusive city is a city in which the processes of development include a wide variety of citizens and activities. These cities maintain their wealth and creative power by avoiding marginalization, which compromises the richness of interaction upon which cities depend[6].

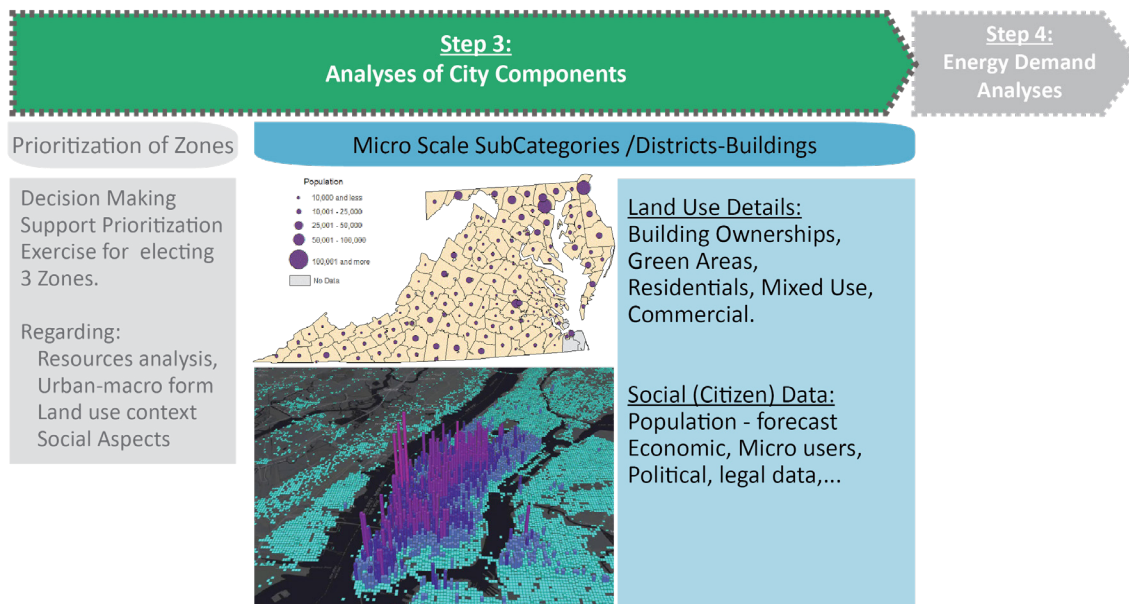
The main analyses of integrated energy planning, spatial planning and data is divided into two categories, comparatively **macro and micro scale** main categories. Macro scale main categories involve GIS based spatial data as zonings. Cities start to assess zones of efficiency for PED areas peculiar to their characteristics, climate, demography, geography in different macro scale categories listed below:

1. Resource Analysis
2. Urban Macro-form Analysis
3. Land-use Context
4. Energy Infrastructure Analysis
5. Energy Service Analysis
6. Social Structure

After all of macro-scale analysis have been realized and zones have been determined regarding resources, implementation areas of strategic plans, land-use context, energy infrastructures and social aspects (and embedded in GIS based maps as spatial data), cities and **relevant stakeholders are encouraged to construct a prioritization study to specify at least 2 most proper zones** for implementing PED according to the most **prioritized zones by overlay mapping**. Since these zones will cover large areas, next step is going through micro-scale analysis and identifying PED areas in the city. Cities will develop micro-scale analysis in the following subcategories:



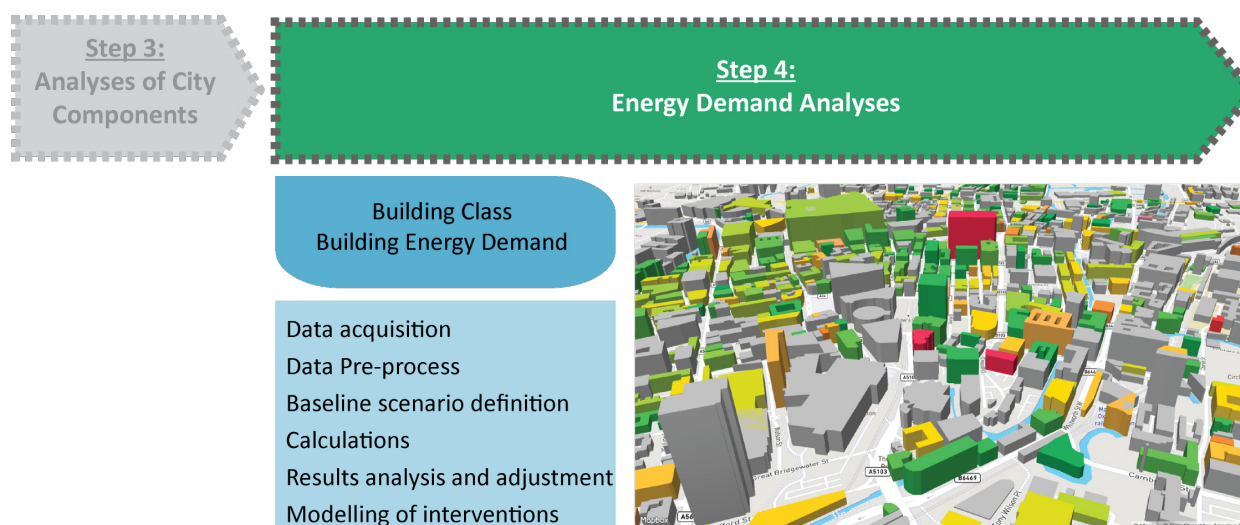
1. Land-use Detail Maps
2. Social (citizen) Data Maps
3. Energy Demand Analysis



Step 4: Energy Demand Analyses

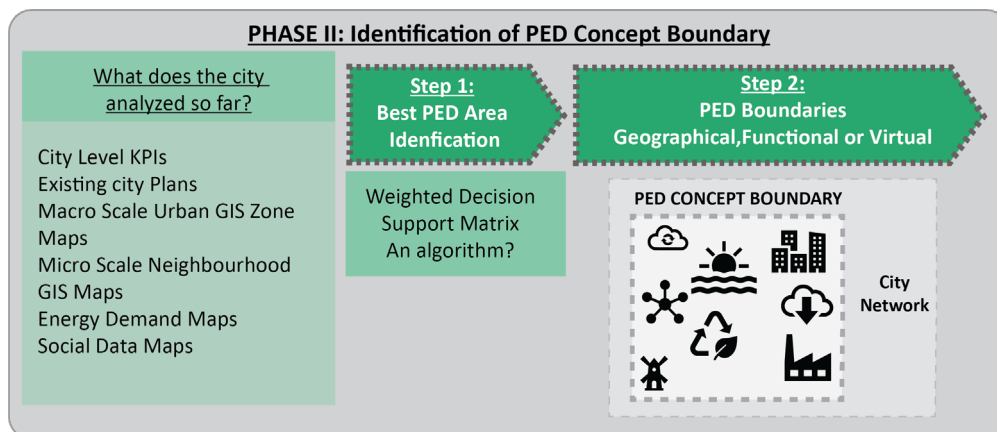
There are several bottom up methodologies and techniques for making building stock energy models to analyse energy demand, and they can be applied at any level, local (district, municipal) or national level.

This section, presents a bottom up methodology for modelling the building stock of urban districts based on publicly available data and describes the workflow from the collection of the data to the adjustment, calibration and visualization of the simulation results.



Phase II: Identification of PED Concept Boundary

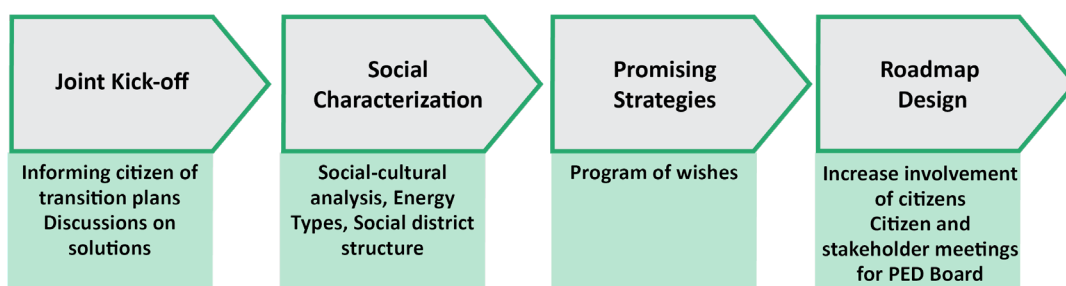
Once the city needs and priorities are identified, land use context of the city is clarified and resources are listed, the boundary for the PED concept may be formed. This phase is connected with city and district scale and accommodates the participation of the local authorities, all relevant stakeholders and citizens.



Phase III-a: Citizen Participation – Smart Energy City Approach

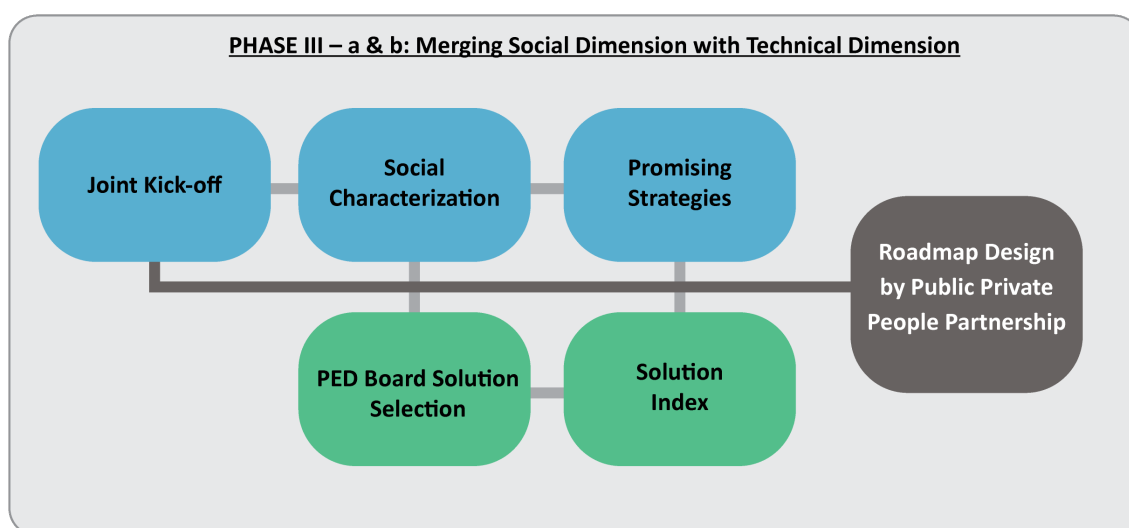
As explained by the Covenant of Mayors of the EU, “all members of society have a key role in addressing the energy and climate challenge with their local authorities”. Public participation is useful to determine needs, desires and requirements and to increase transparency. Their implication is also useful to increase citizens’ engagement with the environmental challenge.

Essential part in understanding the wider context of an existing urban district, identifying priorities and most urgent needs to address in designing and planning of a sustainable Positive Energy District, is to include the perspective of citizens and end users of the district itself. One of the methods to include the citizens in the process of involvement, being part of planning and prioritizing, is potentially the approach of Smart Energy Cities.



Phase III-b: Linking to Solution: PEDBoard

In parallel with Phase III-a Citizen Involvement, a technical study on PED technologies is realized. Within this phase, the inputs of Phase I and Phase II are evaluated by a decision-making mechanism and the particular technical and non-technical solutions are linked to the according to the data obtained from Phase I and Phase II. The solutions are classified under main solution categories of demand side, supply side and integrated infrastructures. The concept will enable the delivery of energy services, allow the management and trading of locally generated energy and grid-based energy supplies, and potentially link with other local and cloud-based services such as security/safety and e-mobility in order to progress towards energy positive districts.



Phase IV: Barriers / Enablers of PED Solutions

In this phase, impact-based evaluation is integrated in selection of solutions process and political, economic, social, technical, environmental, legal and spatial barriers, constraints, supporting factors are recognized for each selected solution. A PESTLE analysis can be performed followed by a brainstorming on how to overcome the barriers. If the results are negative to continue to the next phase, a feedback loop (a system for improving a product, process, etc. by collecting and reacting to users' comments) mechanism can be formed to find another particular solution for the PED area. The discussion is expected to be developed by an open dialogue and consensus between technical designers, citizens and local authorities.

Phase V: Calculation of PED for Verification

With the solutions selected, a PED calculation can be performed. The calculation methodology is detailed in “MAKING-CITY Guidelines to Calculate the Annual Primary Energy Balance of Positive Energy District” . If the PED balance is not positive (i.e. more energy is exported than what is imported to the district), new selections from PEDBoard must be assessed in order to achieve a PED.

Phase VI: SPEC Cards

This Phase presents the detail cards of each solution categorised in PEDBoard. The solution cards, named SPECs, involve general data, technical and graphical details, implementation time, initial investment and financial models, stakeholder mapping, integration with other smart solutions, potential for replication, expected impacts of all of the solutions. This is the main output of proposed PED Methodology, guiding cities with a detailed information on the technical and non-technical issues of solutions presented in PEDBoard.

INNOVATIVE BUSINESS MODELS FOR PEDS

The design of a new business model has as its final purpose the creation of business models that:

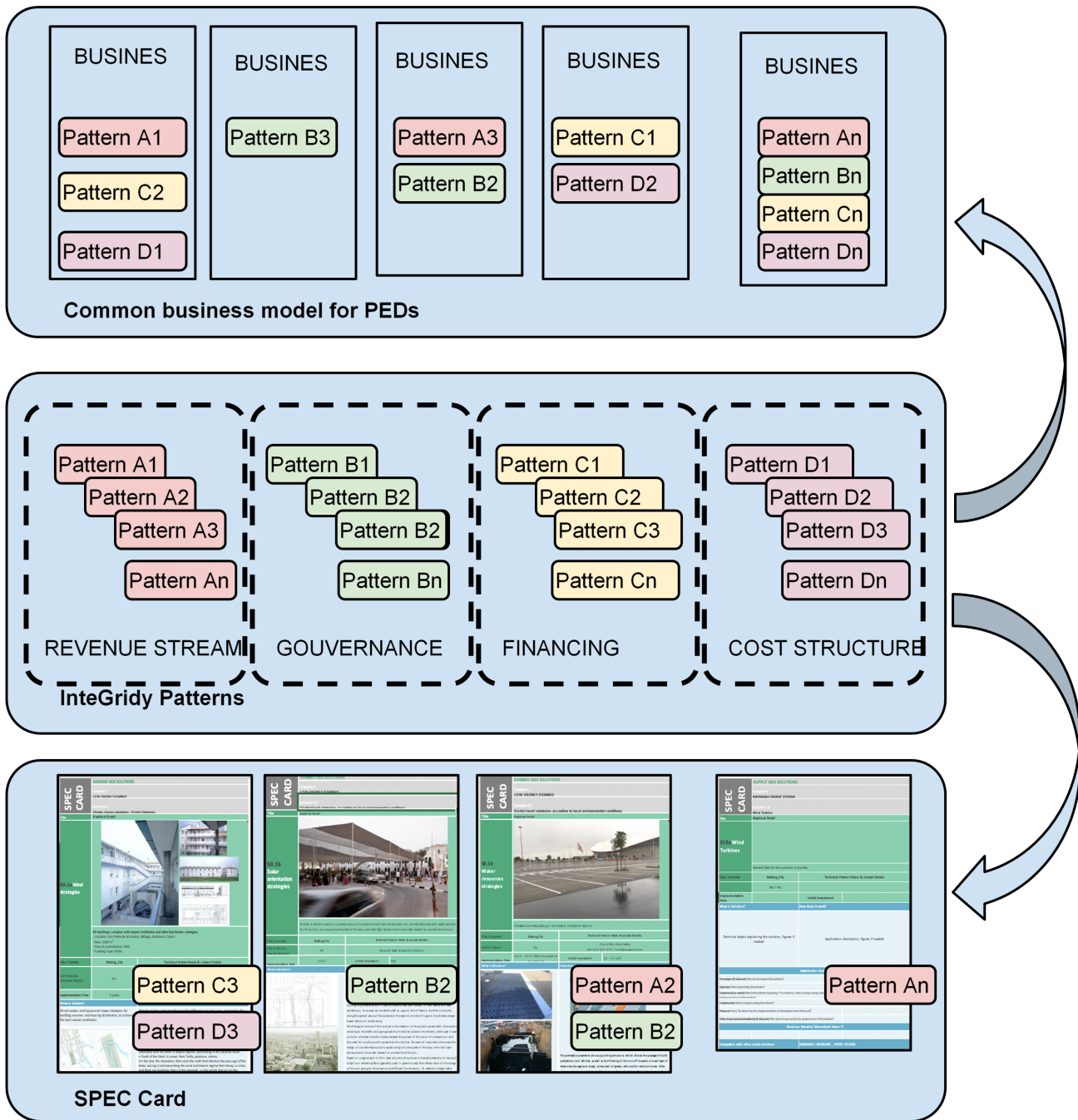
- satisfy market needs that have not been met yet
- introduce new technologies, new products or new services
- improve / disrupt / transform existing markets
- create new markets (see Blue Ocean Strategy)

To help the MAKING-CITY partners develop their business models, this method provides support on 3 levels:

- Business model guidance - Business model canvas and its 9 blocks
- Listing business model patterns (identified by the inteGRIDy project)
- Example of business model for PEDs
- Description of the common business model for PEDs based on literature review
- Tag each business model for PEDs with the business model patterns
- Tag each MAKING-CITY Spec Card with the common patterns

This will allow easy cross analysis while providing exhaustive and open information.





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