





## **White Paper on PED Reference Framework for Positive Energy Districts and Neighbourhoods**

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## 1 Summary

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The PED Programme is a mission-oriented transnational R&I funding programme<sup>1</sup>, which results from the European SET Plan and is being implemented by the JPI Urban Europe<sup>2</sup>. It has the ambition to realise a holistic implementation process towards 100 Positive Energy Districts and Neighbourhoods in Europe, including technological, spatial, regulatory, financial, legal, ecological, social and economic perspectives in order to provide sustainable urban development as well as quality of life and affordability in the urban environment. As a basis for such implementation measures, a common **reference framework for Positive Energy Districts and Neighbourhoods** has been elaborated with the aim to anticipate the various dimensions and aspects related to the realisation of PEDs.

This reference framework aims at aligning different approaches towards the implementation of energy and climate strategies in the urban context in order to both, consider different pre-conditions, and create a joint vision at the same time. As the PED Programme aims at a strong involvement of supporting countries and stakeholders on national level, it has the ambition to ensure this involvement also in the process of developing the PED Reference Framework.

Therefore, an outline of a PED Reference Framework (version 1.0) had been developed along those lines and put forward for national consultations and reflections. The respective national consultations aimed to perform a ‘reality-check’ of the identified PED Reference Framework with key stakeholders, raise awareness for the holistic strategy pursued in the PED Programme, and prepare national actors for joint implementation measures.

Within these national consultations, the PED Reference Framework proposed by the PED Programme Management has been discussed and acknowledged widely. As a result, the reference framework definition for PED/PENs is as follows:

*“Positive Energy Districts are energy-efficient and energy-flexible urban areas or groups of connected buildings which produce net zero greenhouse gas emissions and actively manage an annual local or regional surplus production of renewable energy. They require integration of different systems and infrastructures and interaction between buildings, the users and the regional energy, mobility and ICT systems, while securing the energy supply and a good life for all in line with social, economic and environmental sustainability.”*

Furthermore, important questions have been raised during the national consultations, including issues concerning calculation methodologies, system boundaries as well as focus and ambitions of the PED programme. In particular, questions regarding the three main functions, the target of PED/PENs, guiding principles and enablers have been picked up and further discussed by national stakeholders.

In addition, it became apparent that there is a need for closer cooperation with other SET Plan actions. As an example, the energy flexibility function in the PED Reference Framework is closely linked to the flexibility concept defined in the implementation plan of SET Plan Action 4 (*“Increase the resilience and security of the energy system”*).

**On the basis of this “White Paper” and PED Framework version 2, the PED Programme invites experts and representatives of “problem-owners” to discuss and co-create strategies and structure of operationalizing the proposed PED Framework.**

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<sup>1</sup> <https://setis.ec.europa.eu/implementing-integrated-set-plan/smart-solutions-consumers-ongoing-work>

<sup>2</sup> <https://jpi-urbaneurope.eu/ped/>



## 2 Aim of the PED Framework

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The PED Programme has the ambition to realise a holistic implementation process towards 100 Positive Energy Districts and Neighbourhoods including technological, spatial, regulatory, financial, legal, ecological, social and economic perspectives in order to provide sustainable urban development as well as quality of life and affordability in the urban environment. As a basis for such implementation measures, a common **reference framework for Positive Energy Districts and Neighbourhoods** has been elaborated with the aim to anticipate the various dimensions and aspects related to the realisation of PEDs.

There is a wide range of different approaches towards implementing energy and climate strategies in the urban context, a fact evidenced not least by mapping and consulting activities of the PED Programme, such as compiling the “Booklet of Positive Energy Districts in Europe”<sup>3</sup>, the PED Programme Cities Workshop<sup>4</sup>, collaboration with H2020 Lighthouse projects, and consultations with stakeholders on national and European levels.

A joint PED Reference Framework aims at aligning these different approaches in order to both, consider different pre-conditions, and create a joint vision at the same time. As the PED Programme aims at a strong involvement of supporting countries and stakeholders on national level, it seeks to ensure this involvement also in the process of developing the PED Reference Framework.

One crucial reason for this involvement is that our priorities need to correspond to those of urban practitioners and to global as well as European energy and urban policies, in order to allow for viable implementation processes, which take account of national/geographical diversity and different pre-conditions for PED implementation in the European context. This is why the process of formulating a PED Reference Framework:

- (1) strongly builds upon wide stakeholder consultations and dialogues;
- (2) connects to ongoing policy and strategy debates, in particular the implementation of Agenda 2030 SDGs, the Urban Agenda for the EU or the National Energy and Climate Plans;
- (3) considers results and learnings from first PED-related projects and other projects with regard to sustainable urbanization (e.g. H2020 Lighthouse projects or JPI Urban Europe ENSCC projects).

The outline of the PED Reference Framework has been developed along those lines and put forward for national consultations and reflections.

These national consultations pursued the following aims:

- to perform a ‘reality-check’ of the identified PED Reference Framework with key stakeholders,
- to raise awareness for the holistic strategy pursued in the PED Programme, in the national R&I communities, related sectoral policy fields and in cities, if possible going beyond those actors already involved in the programme and project support alignment with national Smart City, energy transition and sustainability strategies programmes as well as urban policies and cities’ strategies
- to prepare national actors for joint implementation measures.

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<sup>3</sup> [https://jpi-urbaneurope.eu/app/uploads/2019/04/Booklet-of-PEDs\\_JPI-UE\\_v6\\_NO-ADD.pdf](https://jpi-urbaneurope.eu/app/uploads/2019/04/Booklet-of-PEDs_JPI-UE_v6_NO-ADD.pdf); this current version will be updated regularly

<sup>4</sup> <https://jpi-urbaneurope.eu/news/short-review-ped-programme-cities-workshop-towards-a-european-positive-energy-cities-network/>



### 3 PED Framework (version 2.0; after national consultations)

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#### 3.1 Background and Motivation

In our globalised world, cities are the hubs of communication, commerce and culture. They consume more than two-thirds of the world's energy and account for more than 70% of global CO<sub>2</sub> emissions. **Urban areas are among the main originators of climate change**, as urban activities are major sources of greenhouse gas emissions.

What our cities do individually and in union can therefore set the agenda for a sustainable future. Being on the frontlines of global climate change in this way, cities are also well-positioned to play a leadership role in **driving global action** to address it.

The Implementation Working Group on Smart Cities<sup>5</sup> of the Strategic Energy Technology Plan for Europe (SET Plan)<sup>6</sup> was established in October 2018 with the mission to bring about 100 urban districts or neighbourhoods in Europe by 2025<sup>7</sup> with a clear commitment to sustainability, liveability and going beyond carbon neutrality by becoming energy positive. Such “**Positive Energy Districts/Neighbourhoods**” (PED/PENs) could be new developments, but should also implement ambitious solutions for urban district renewal. About 20 European countries are currently participating in this initiative, which also involves problem owners, as well as key stakeholders from industry.

#### 3.2 Framework Definition of PED/PENs and their functions in the regional energy system

##### 3.2.1 Functions of PEDs/PENs in the regional energy system

In honouring the economic, cultural and climate-related diversity of European countries and cities, a definition for such PED/PENs should not be just an algorithm for calculating the input and output of energy, but rather a framework, which outlines the three most important **functions of urban areas in the context of their urban and regional energy system**. The first obvious requirement is that PEDs should ultimately **rely on renewable energy only (energy production function)**, which is one of the main contributions towards climate neutrality. Secondly, they should make energy efficiency as one of their priorities in order to best **utilise the renewable energies available (energy efficiency function)**. Thirdly, as urban areas are bound to be among the largest consumers of energy, PED/PENs need to make sure that they act in a way which is **optimally beneficial for the energy system (energy flexibility function)** (see Figure 1).

Based on such a basic framework, cities should be able to **optimise the different functions and guiding principles against one another**, in order to find a balance, which can best represent the renewable energy resources available in their respective climate zone, together with their specific ambitions and needs.

When developing PEDs, the specific situation of the city should be taken into account (e.g. density, type of buildings, available local renewable energy resources).

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<sup>5</sup> <https://jpi-urbaneurope.eu/ped>

<sup>6</sup> <https://setis.ec.europa.eu>

<sup>7</sup> [https://setis.ec.europa.eu/system/files/setplan\\_smartcities\\_implementationplan.pdf](https://setis.ec.europa.eu/system/files/setplan_smartcities_implementationplan.pdf)



## PED Framework: Functions of PED/PENs in the regional energy system

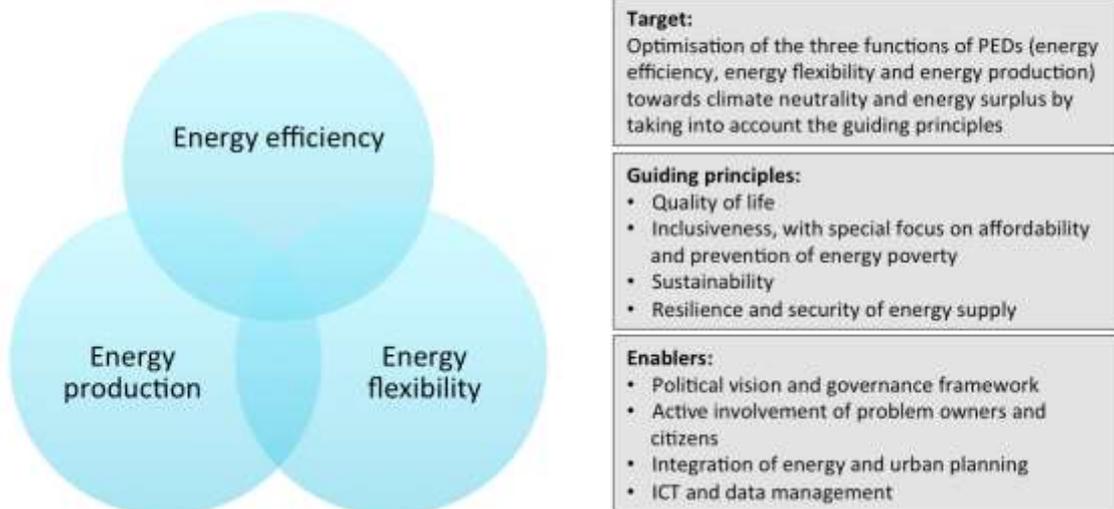


Figure 1: Functions of PED/PENs in the regional energy system

### 3.2.2 Framework Definition of PED/PENs

Therefore, a framework for PED/PENs could be defined as follows:

“Positive Energy Districts are energy-efficient and energy-flexible urban areas or groups of connected buildings which produce net zero greenhouse gas emissions and actively manage an annual local or regional surplus production of renewable energy. They require integration of different systems and infrastructures and interaction between buildings, the users and the regional energy, mobility and ICT systems, while securing the energy supply and a good life for all in line with social, economic and environmental sustainability.”

### 3.2.3 Additional description of the PED framework and its functions

The three main functions, the target, guiding principles and enablers are described more in detail below.

#### 1. Energy Efficiency Function

The aim is an optimal reduction of energy consumption within the PED/PENs, balancing out the needs of the different sectors, building infrastructure, the use of energy, settlement typology, as well as transport and mobility. Due to its relevance, not only new urban development areas but also the existing building stock needs to be addressed. As an example, mixed use settlements could be an effective instrument towards minimizing transportation needs. "Grey energy" will be considered via a life cycle approach and by assessing the energetic and ecological footprint of goods and services. Resource efficiency will be another important focus.



## **2. Energy Flexibility Function**

The main roles and functions of PEDs regarding energy flexibility are

- to actively contribute to the resilience and balancing of the regional energy system with the optimal benefit for the regional energy system in mind. With urban districts/neighbourhoods being among the main consumers of energy in the energy system, demand side management, sector coupling and storage are among the main instruments to achieve this goal.
- to manage any interactions between the urban district/neighbourhood and the regional energy system such as to enable carbon neutrality and 100% renewable energy in the local consumption and an additional surplus of renewable energy over the year.

## **3. Energy Production Function (locally and regionally)**

Locally and regionally produced renewable energy will enable a substantial reduction of greenhouse gas emissions and ensure economic viability. Nevertheless, the local production of renewable energy is highly dependent on local and regional conditions and additionally on the chosen transformation paths for the transition of the regional and European energy system. In particular, the use of waste heat is encouraged.

### ***3.2.3.1 Target of PED/PENs***

Each PED/PEN will have to find its own optimal balance between energy efficiency, energy flexibility and local/regional energy production on its way towards climate neutrality and energy surplus, and will have to do so, by taking into account the guiding principles listed below.

### ***3.2.3.2 Guiding Principles for PED/PENs***

The development of PED/PENs should respect four guiding principles to make them attractive for cities and citizens:

- Quality of life
- Inclusiveness (with special focus on the affordability and prevention of energy poverty)
- Sustainability
- Resilience and security of energy supply

### ***3.2.3.3 Enablers for PED/PENs***

The development and implementation of PED/PENs will rely on the following enablers:

- Political vision and governance framework
- Active involvement of problem owners and citizens
- Integration of energy and urban planning
- ICT and data management



### 3.3 Outlook towards PED implementation

For the application of the PED Framework, the following three-level approach will be used (Figure 2):

- (1) Development of a PED framework definition by the PED Programme,
- (2) Refinement and application of the PED Framework in the local and national context
- (3) Development of certifications and labels for PEDs by regional, national and European Standardisation and Certification Bodies.

## PEDs: Framework, Methods, Certifications and Labels Three Level Approach



Figure 2: Three-level approach towards the application of the PED Framework

## 4 Description of the process towards a PED Framework

The draft version of the PED Reference Framework was developed by the PED Project Management team as a basis for national consultations. This happened in consultations with urban stakeholders as the “problem-owners” and the PED Stakeholder Group. In particular, the process included the following steps:

- Draft PED definition in the SET Plan Action 3.2 implementation plan,
- Consultations with city representatives and other urban stakeholders in various countries, in particular collecting input at the PED Programme Cities Workshops (3 April 2019, Vienna), at the Mission Innovation Week Austria and in national expert workshops in the participating countries,
- Collaboration with EERA JPSC and SCIS: an EERA JPSC working group has developed a draft PED definition, reviewing and considering definitions from current projects and programmes and bringing in particular R&I perspective; collaboration included workshops on the PED definition on 6 May (Brussels) and 24 June 2019 (Copenhagen),



- Consultations within the PED Stakeholder Group in webinars and at the PED Stakeholder Group Meeting (19 June 2019, Brussels)<sup>[1]</sup><sub>SEP</sub>
- Consultations with SET Plan Action 3.2 Steering Committee at the SC Meeting on 26/27 June 2019, Copenhagen

The process of national consultations regarding the first version of the PED Reference Framework (version 1.0) resulted in written feedback from Austria, Belgium (Brussels Region and Wallonia), Denmark, Finland, France, Germany, Norway, Sweden, The Netherlands and Turkey.

Furthermore, the draft version of the PED Reference Framework was been discussed at a dedicated workshop (9. October 2019, Namur) with participation of Swedish, Italian, Portuguese, Austrian and European stakeholders.

## 5 Feedback and key lessons from national consultations

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### 5.1 General remarks on PED Reference Framework

#### **Accelerating the climate and energy transition is the main objective, regardless of the starting point**

According to several pieces of feedback in the consultation process, the most important aim of the PED Programme is to accelerate the climate and energy transition, regardless of the starting point in a specific district, city or country. Therefore, due to variations in the respective starting points, the PED Reference Framework needs to be broad and should leave room for national adaptations.

#### **PED Reference Framework should leave room for the specifics of neighbourhoods, cities and countries**

When developing Positive Energy Districts or Neighbourhoods, the specifics of the cities should be taken into account, such as density, type of buildings or access to renewable and waste energy.

Due to different planning cultures and ownership structures, there is no one-fits-all strategy regarding the implementation and replication of the PED/PEN concept. In particular, the very different legal frameworks require different approaches and strategies.

#### **Nearly-zero energy buildings and net-zero energy districts as starting points for PED/PENs**

The European initiatives regarding nearly zero-energy buildings (NZEBs) could be seen as one of the starting points and prerequisites for the realization of PED/PENs. Any energy consumption beyond the needs for these buildings, would make it almost impossible to provide a sufficient energy supply with renewables produced onsite.

Already in 2012, an in-depth study financed by the European Commission provided guidance to EU countries and the European Commission itself to ensure nearly zero-energy requirements become the norm for any new building in the EU.

The next necessary steps, shifting from individual buildings to the neighbourhood level, were taken by innovative frontrunner cities and project developers, funded by European funding programmes such as Concerto or the Smart Cities Initiative within Horizon 2020.



In this context, the realization of the PED concept could be seen as the next step towards an even higher ambition, regarding both, the energy standards, and the further minimization of CO<sub>2</sub> emissions.

### **Openness for different technologies, no limitations on specific solutions**

As mentioned before it is important that the PED Reference Framework (and also further national PED definitions) leave sufficient room for the specifics of a neighbourhood, a city or a country to choose the most effective and efficient alternative to fossil fuels. All solutions should be welcome - as long as they are clean and sustainable.

### **PED conceptualisation is “work in progress”, building on running projects and existing initiatives**

The implementation of the PED concept is work in progress. There are no pre-defined or guaranteed recipes for success. However, it is obviously recommendable to build on already existing innovation projects and elements of PEDs.

Cities have already set up a multitude of local initiatives which touch upon important aspects of the PED concept, although they do cover all the dimensions of a holistic PED definition. Those initiatives can be considered steps towards PED realisation, in spite of being at different levels of maturity.

### **Holistic concept and the consideration of systems perspective in all planning phases**

The PED concept is not about merely putting together different technologies. Rather, a holistic concept and the consideration of the systems perspective are decisive in all planning phases.

In this context, the need to experiment with integrated initiatives and projects, which gather all aspects of the PED concept, should be underlined. Such pilots should not only include new solutions for energy production but also legal, regulatory and social innovation and their integration into the local eco-system. The objective should be to build up PEDs from this holistic perspective.

### **Energy aspects are usually not sufficiently integrated in urban planning processes**

In many cities, the necessary legal and strategic frameworks for the realization of PED/PENs are not yet in place. Very often, there is also a lack of a planning culture in city administrations or the personnel resources available might be insufficient.

In particular, the transformation of large (brownfield) areas to climate neutral city districts has a big potential for the development of PED/PENs but needs cooperation between administration, industry and research. Especially in case of heterogeneous ownership structures, cooperative planning processes are indispensable.

### **Cooperation between citizens, businesses and public sector is prerequisite for the realization of PED/PENs**

The implementation of PEDs requires the cooperation of many stakeholders, where those, who invest into construction of, and supply for, the built environment, are the main problem owners. In addition to the citizens, these are (a) city administrations, (b) the real estate industry and (c) energy suppliers in particular.

The involvement of these stakeholder groups varies from country to country, also depending on the national legal and regulatory context. The starting points for national PED initiatives and realisation of PEDs are therefore different, with city administrations and the construction sector as first target groups.



### **Local energy suppliers and network operators play a decisive role and are important enablers or disablers for innovative energy concepts**

In European countries, very different ownership structures regarding heating (or cooling) networks can be observed. In some countries (e.g. Germany, Austria, Denmark, Switzerland) district heating is mostly supplied by public utilities. In other countries like France district heating networks are typically operated by private companies through a concession.

Thus, depending on ownership structures and legal frameworks, different approaches for cooperation between public and private stakeholders are needed. The viability of innovative energy concepts depends on the right mix of strategies, know-how and on the ambition of decision makers in city administrations and local politics.

### **Policy frameworks are needed on different political levels**

In order to be able to realise climate-neutral districts and neighbourhoods like PED/PENs, there is a need for adequate policy frameworks and financial instruments. These frameworks will yet have to be created at different political levels, both at national and local, and to some extent, at regional level. The design of such frameworks depends on the competences of the various political and administrative hierarchies and needs to be different in each country.

In this context, capital and larger cities that do not only have the legal status as municipality, but also as a region, province or federal state, have more legislative powers themselves and therefore more options to shape the policy frameworks to their needs than might be available for other cities.

### **Resilience und vulnerability of cities, security of energy supply**

Special attention should be given to the resilience and vulnerability of cities. In particular, the combination of the increasing complexity of urban systems, the interweaving of networks and the expected effects of climate change increase the vulnerability of cities.

The associated risks need to be studied systemically, taking into account cities' physical, functional and socio-economic vulnerability and the interactions and feedback loops at different spatial and temporal scales. Anyway, when it comes to risks, reducing dependence on energy imports helps to increase the security of energy supply.

However, energy autonomy on city scale is not the aim of the PED programme if this contradicts the guiding principles of cost efficiency and affordability, and gets into the way of the flexibility dimension of urban districts in the (renewable) regional energy system.

### **Citizen participation and communication strategies**

Citizen participation and appropriate communication processes are important success factors for the realisation of PED/PENs. This will support acceptance for new technical solutions and stimulate necessary changes in personal lifestyles.

Several countries would appreciate a further know-how exchange regarding this topic and jointly work towards an integrated approach of combining social aspects with the physical goals and efforts.

### **Provision of finance as a meta-enabler for PED/PENs**

Appropriate financing is a meta-enabler for the development of PED/PENs. Its importance is on equal level with legal and regulatory frameworks and suitable business models.



Yet, it will be important to address the financing requirements of all key stakeholders. Otherwise, the realisation of such holistic concepts might fail.

Nowadays, it is relatively easy and inexpensive - at least for the three main stakeholder groups (cities, real estate sector, utilities) in most of countries of the European Union - to obtain the necessary finance, due to the current economic environment and low interest rates.

However, this is only valid if the underlying business models are economically viable. Therefore, a predictable policy framework (including future energy and CO<sub>2</sub> taxation) will be an important enabler for ambitious projects.

### **Connecting the PED Programme to an innovation approach is challenging**

SET Plan Action 3.2 is much more than a (transnational) R&D research programme. Indeed the initiative has very concrete and measurable objectives - implementation of > 100 PEDs by 2025 - with a strong focus on replication.

These objectives cannot be achieved through R&D activities alone. Rather, various support and programme measures are required, which must be developed on the basis of a dedicated innovation strategy. The experiences from national innovation programmes could serve as the starting point for the development of such a strategy.

### **Regulatory sandboxes, living labs and testing environments**

Regulatory sandboxes, living labs and testing environments are tools for testing new technical solutions in a real life environment. In particular, this seems to be important in the PED context.

Approaches in European countries regarding such instruments are different and no uniform definition exists yet. By way of example, Germany has recently developed a dedicated strategy for regulatory innovations, called „Regulatory Sandboxes Strategy“. Another example is the innovation strategy of the National Regulatory Authority for the energy sector in UK.

Such best practice examples could be possible blueprints for regulatory sandboxes and other testing environments regarding the PED initiative.

## **5.2 Feedback on specific aspects of PED Reference Framework**

### **Energy efficiency first**

Among the functions, or dimensions, of the reference framework, energy efficiency should be always the first priority („energy efficiency first“), as the space needed for the generation of renewable energy will always be limited in an urban environment. Technologies and solutions employed could be various and should not be restricted to certain sectors.

### **Local or regional energy production**

Renewable energies can enable a substantial reduction of greenhouse gas emissions if they replace fossil fuel based energies. Nevertheless, the production of renewable energy is highly dependent on local and regional conditions, and on economic viability.

As an example, photovoltaic systems have the potential to substantially increase the share of renewables in the local electricity mix, whereas wind energy mainly appears in the regional context. Furthermore, the use of waste heat or geothermal energy could play an important role in many locations.



## **Energy flexibility**

The energy flexibility function is closely linked to the flexibility concept defined in the implementation plan of SET Plan Action 4 (*"Increase the resilience and security of the energy system"*). This concept refers to the important role, which urban areas have as the largest consumers of energy (apart from industrial production sites) in the future renewable energy system. The design and behaviour of PEDs will be a decisive enabling factor of any local and regional energy system.

Similarly, local and regional energy systems are the foundation of a secure and resilient European energy system, enabling the participation in inter-regional exchange of energy as well as in sharing responsibility to maintain the overall system, thus enabling a sustainable use of local and global resources.

These aspects represent the "flexibility" function in the PED Reference Framework. However, no in-depth discussion of the term was undertaken therein. Instead, reference has to be made to the implementation plan of Action 4, in which detailed explanation is provided as to why flexibility is so essential to address the challenges of future energy systems.

Therefore we refrain from a more detailed definition and concretization of the term "flexibility" and instead refer to the discussion and work in connection with SET Plan Action 4 and the Knowledge Community of ERA-NET Smart Energy Systems.

## **Sector coupling and cross-sectorial integration**

Until now, energy infrastructures, such as e. g. electricity or heating systems and networks, have mostly been operated and optimized separately. However, there is a lot of technical and economic potential in taking advantage of synergy effects between the different sectors and networks. Due to the high density of infrastructures in comparison to rural areas, this is especially true in the urban context.

Sector coupling will become increasingly important in the near future. One example for technologies which enable sector coupling are heat pumps. They can convert energy back and forth between power and heat and are used frequently in urban areas, not the least at larger scale in district heating networks. The political discussion in some countries about the use of so-called „surplus“ renewable electricity also refers to this potential. The Joint Programming Platform Smart Energy Systems has already initiated a dedicated Working Group „Storage and Cross Energy Carrier Synergies“, which could be an interesting partner to further develop this discussion with regard to PEDs.

## **Links between local, regional and European energy systems and their interactions are of crucial importance**

Local energy systems and networks should act as an integral part of the respective regional, national and European energy systems and markets. The interrelation and interaction between these different levels must be analysed and the strategic role of PEDs designed in a way, which gives urban areas a clear and specific role to play. Without this, an optimisation of urban energy systems would not be possible, neither in technical nor in economic terms.

## **New business models, future role of „citizen energy communities“ (CEC) and „renewable energy communities“ (REC)**

As part of the Clean Energy Package, the European Commission introduced two new legal concepts, the so called „citizen energy communities“ (CEC) and the „renewable energy communities“ (REC). CECs and RECs constitute new types of entities regarding membership structure, governance requirements and purpose, and they strongly relate to the current national energy market frameworks.



For example, electricity sharing could enable members or shareholders of CECs to obtain electricity from power generators within the community without being in direct physical proximity to the generating installation and without being behind a single metering point. Where electricity is shared, the sharing would not be subject to network charges, tariffs and levies related to electricity flows.

Furthermore, the new rules aim at allowing citizen energy communities to become distribution system operators either under the general regime or as 'closed distribution system operators'. Once a citizen energy community is granted the status of a distribution system operator, it could be treated as, and be subject to, the same obligations as a distribution system operator.

The possibilities of CECs and RECs depend mainly on the implementation of the European directives into national legislations. Many associations and organisations, including those of civil society, have already looked into the possibilities and limitations of the new legal frameworks.

### **More open definition of “urban areas” is needed**

According to the feedback received from the national consultations, the definition of “urban areas” might be too demanding. Therefore, in the updated version of the PED Reference Framework the term „urban areas“ was replaced by „urban areas or groups of connected buildings“, which would complement define PENs as “Positive Energy Blocks”.

### **Definition of district or neighbourhood size**

The size of a district or neighbourhood was not defined in the PED Reference Framework, due to the various conditions in different Member States. However, it may be appropriate to create a definition of the size of a PED/PEN at national level. At least it can be said that a PED/PEN will be a group of connected buildings (respectively, more than one building).

### **Definition of system boundaries and the terms “local” and “regional”**

It should be noted that also the definition of the terms “regional” and “local” has been left open on purpose. In particular, the sizes of regional and local energy systems vary depending on national and regional circumstances.

Furthermore, the complexity of energy systems and networks might require system boundaries of various subsystems to be defined differently sector by sector. Various functional boundaries must be taken into account, depending on existing networks and infrastructures and their underlying physics. Thus, there will also be differences in the definition of system boundaries between regions and countries, depending on interconnections with neighbouring regions or countries.

### **Existing building stock as main challenge for achieving climate neutrality in cities**

The PED/PEN concept has so far almost exclusively been implemented in new urban development areas. However, the biggest challenge for achieving climate neutrality in cities presents itself in the existing building stock. The challenges in this respect are even more diverse, especially regarding social and organisational aspects.

### **Green and blue infrastructures are important building blocks for climate change adaptation strategies on district and neighbourhood level**

Green and blue infrastructures have an important role to play in PED/PEN concepts and many cities have already developed and endorsed citywide strategies regarding such infrastructures.



However, they usually do not have access to practical tools for quantifying the benefits of these infrastructures. Therefore, the development, validation and piloting of such tools should also be supported by the PED programme.

### **Developing the role of mobility in the PED Reference Framework**

A large part of our energy is consumed in the mobility sector, and therefore CO<sub>2</sub>-reduction in local mobility is a major challenge in the development of climate-neutral districts and neighbourhoods.

New technical and organisational solutions for sustainable urban transport will be conceptualised and tested in real life conditions. Furthermore, appropriate solutions for sustainable city logistics will be developed.

Finally, calculation methods are needed in order to determine and allocate the energy consumption and CO<sub>2</sub> emissions and their reduction potential. Initial approaches for such assessments have already been developed in certain countries and could be used and adapted for others.

### **Tackling affordability of housing and fighting energy poverty as main aspects of inclusiveness**

Affordability of housing and energy poverty has become a widely recognised challenge in the EU. The issue of energy poverty has recently been addressed in a report by the Joint Research Center of the European Commission estimating that more than 50 million people in Europe were experiencing energy poverty already in 2018.

This publication looks at the emerging trends in the efforts to tackle energy poverty and could therefore serve as a useful starting point for further discussion regarding inclusiveness and energy poverty in the PED/PEN context.

### **Proper consideration of user behaviour and peoples lifestyle**

Changes in user behaviour and personal lifestyle are essential for realising the PEN/PED concept. During the implementation phase of PED/PENs, behavioural changes will be monitored (regarding comfort issues, mobility behaviour, etc.) and addressed with the users in a co-creative setting with awareness raising as an important element.

The related fields of research require new innovative concepts such as the living lab approach, which can be used comprehensively and further developed in this context.

### **More focus on business cases and models**

The PED programme has a clear mission of implementing 100 PED/PENs in Europe by 2025. For this reason, the national consultations have emphasized the importance of suitable business models, which should be investigated in a dialogue with the main problem owners.

## **5.3 Feedback regarding calculation methodologies and system boundaries**

### **Framework conditions for calculating a PED/PEN**

The calculation of energy consumption and related CO<sub>2</sub> emissions in PED/PENs requires a common agreement on the system boundaries. Unfortunately, European countries have very different starting conditions where the production and uses of renewable energies are concerned. In addition, European energy market have become transnational, and this the exchange of electricity across national borders must be taken into account as well.



Therefore the PED Reference Framework does not contain any specifications regarding the evaluation and calculation of energy consumption or CO<sub>2</sub> emission. Rather, the corresponding (methodological) questions will be left open for more detailed definitions, which will be developed together with regional and national problem owners.

#### **Accurate calculation of CO<sub>2</sub> emissions is complex**

Due to the interdependences of the regional, national and European energy systems and markets, the characteristics of fluctuating renewable energy production needs to be properly considered.

A review of current calculation methods will be undertaken, which will include an hour-by-hour approach, as well as a marginal power plant approach, in order to take into account the fluctuating nature of renewable sources. Calculation methods based on annual averages would not fit this requirement, as they would not take into account whether local electricity production in a PED/PEN replaces electricity from coal- or gas-fired power plants or from renewable sources.

The necessary methodologies and calculations tools are currently not available in most countries. Therefore, integrated optimisation methods and practice-orientated planning tools for the evaluation of energy concepts on the basis of an hourly resolved marginal power plant analysis will be developed.

#### **Life cycle analysis (LCA) principles and approaches**

The PED Reference Framework clearly states that embedded (grey) energy will be taken into account when implementing a PED concept. In addition, several national statements emphasised that LCA principles should be used to address the energetic and ecological footprint of goods and services.

Challenges in the PED context include the adaptation and simplification of existing LCA methods for practical use. In some countries there are already initial approaches to calculating embedded energy in district and neighbourhood concepts. These methodologies should be adapted to be used in other countries.

#### **Import of fossil fuel from outside the boundaries of the PED/PEN - how to deal with the transformation phase?**

The switch from fossil fuels to renewable energy sources is only possible step by step. In this context, transformation strategies have been developed in recent years at various levels (European, national, municipal) that differ from country to country.

Therefore, concepts will be needed, describing the transition process from fossil to renewable energies in PED sites during the transformation phase towards 100% renewable energy. This is particularly relevant regarding the transport sector, but also for innovative energy concepts with natural gas-fired CHP plants. For strategic and certification purposes a methodology will be developed to assess the remaining share of fossil fuels in a PED/PEN in terms of energy and CO<sub>2</sub> balancing.

## **5.4 Feedback regarding focus and ambitions of the PED Programme**

#### **Challenge of creating energy neutral neighbourhoods is already immense – in some countries no particular focus on producing more energy than consumed**

The goal of reducing CO<sub>2</sub> emissions to zero and additionally even achieving a local energy surplus is quite ambitious. Not all countries or cities already see themselves in a position to achieve this goal or request it



from project developers (e.g. through binding requirements in zoning plans, urban development contracts or similar).

In contrast, achieving a local energy surplus or net zero CO<sub>2</sub> emissions are the central goals of many national programmes and initiatives. Thus, different levels of ambition within the European PED programme will be inevitable.

For example, the Netherlands make it clear in their statement that they do not focus on positive energy districts in the sense that a district should produce more energy than it uses. However, they do not exclude it either but place more focus on replication instead.

### **Possible increase of requirements for PED/PENs during the duration of the programme**

As mentioned above, the requirements for PED/PENs will be probably different both nationally and locally. In this respect, a balance of interests must be found between different objectives (e.g. level of ambition regarding innovation vs. possible replication). Gradually increasing the minimum requirements for PED/PENs during the duration of the programme seems to be a suitable approach for harmonizing the different national levels.

### **Overcoming legal barriers is crucial for the implementation of PED/PENs and the success of SET-Plan Action 3.2**

The PED initiative goes beyond technical innovations. Therefore, many comments have stressed the importance of a holistic and integrated approach in the conceptualisation and realisation of PED/PENs and pointed out a variety of legal obstacles for their implementation. Examples for such legal barriers are the difficulties regarding the direct exchange of renewable electricity between households or the legal classification of battery storage systems.

### **Realization of 100 PEDs is ambitious, but only the start – even more focus on replication and scaling up the energy transition**

The goal of implementing more than 100 PED/PENs by 2025 is very ambitious. Nevertheless, it must be emphasized that this is only the beginning of the initiative to make urban districts and neighbourhoods climate-neutral.

In addition to new development areas, the existing building stock represents a major challenge. Thus, the transformation of the energy system towards 100% renewable energy cannot succeed without a massive reduction of energy consumption in urban areas.

Several statements from the national consultations therefore stressed that even more focus should be placed on replication and an upscaling of the energy transition. In particular, one of the key questions raised in the Dutch feedback and for the PED initiative as a whole is:

### **How do we learn and experiment in those neighbourhoods so that all the other neighbourhoods in Europe can follow?**



## 6 Summary conclusions, recommendations and further questions

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### 6.1 Summary conclusions and recommendations

The PED initiative created by SET-Plan Action 3.2 in close collaboration with the JPI Urban Europe is a mission-oriented research and innovation programme with a keen focus on the implementation of more than 100 PED/PENs in Europe by 2025.

In this respect, the following measures are proposed and recommended to accompany the forthcoming transnational calls for proposals:

#### **Know-how exchange between national funding agencies (at programme level)**

Several participating countries are already operating integrated national research and innovation programmes which address the PED/PEN challenge (or at least important aspects thereof). Examples include the Swedish „*Viable Cities*“ programme, the Austrian R&I programme „*City of Tomorrow*“, the German research funding initiative „*EnergiewendeBauen*“ or the Dutch „*Programme for natural gas-free neighbourhoods*“.

In order to sharpen the transnational PED initiative as well as the respective national programmes, a know-how exchange between interested national programme owners and funding agencies is recommended (also addressing further organisations such as supportive agencies or institutions in charge of accompanying research).

#### **Know-how exchange between cities and city administrations**

Local politicians or city administrations are among the most important key actors for initiating PED/PENs. Cities have already highlighted their need for additional capacities in terms of personnel and know-how, the PED initiative will look into the design of direct (also financial) support mechanisms for city administrations as an important part of future transnational R&D funding.

Direct know-how exchange between city administrations is recommended as well. For this, existing city networks can be used. In a first step, regional clusters along related languages seem to be a suitable option. Regional networks could be e.g. the Nordic countries, the Mediterranean area, CEE/SEE countries and the DACH region (Austria, Germany, Switzerland).

#### **Know-how exchange between real estate developers and other industry stakeholders**

The real estate industry is an important stakeholder group, and one of the main problem owners involved in the implementation of the PED concept. However, many real estate (sub)markets are nationally orientated and highly fragmented, especially with regard to the housing industry (e. g. co-operatives and other non-profit (sub)sectors).

Due to the high complexity and fragmentation of the building sector, the know-how exchange could be initially stimulated among a few countries (e.g. between Switzerland, Austria and Germany, or between individual Nordic countries).

#### **R&I funding collaboration on energy systems and networks**

Network operators and energy suppliers need to be addressed as problem owners in the implementation of PED/PENs in similar ways as the real estate industry, especially regarding heating or cooling networks.



As the relevant R&D and implementation challenges are also being discussed within SET-Plan Action 4, a close cooperation with this initiative and the Knowledge Community of the Joint Programming Platform Smart Energy Systems will be undertaken.

### **R&I funding collaboration on buildings and on heating and cooling systems**

The SET Plan Implementation Working Group 5 on Energy Efficiency Solutions for Buildings has set up ambitious goals for the development and implementation of energy-efficient buildings, which specifically address “new materials and technologies for energy efficiency” and “cross cutting heating and cooling technologies for buildings”. Those thematic areas will be developed further for their use in PED/PENs in close collaboration with SET Plan WG 5.

### **Supportive cross-country comparisons**

Some challenges regarding the implementation of PED/PENs affect a large number of different key actors and stakeholders. The following topics and issues would warrant an in-depth cross-country comparison and identification of the most important „lessons learned“:

Cross-country comparison: citizen participation, social aspects

The following questions should be addressed in particular:

- Which projects and initiatives have been successful? Which not?
- What have been critical success factors? What are the main barriers?
- Which approaches are suitable for new urban development? Which for existing neighbourhoods?

Cross-country comparison: new innovative business models

The following questions should be addressed in particular:

- Which business models have successfully worked out? Which have not?
- Which implementation barriers regarding innovative business models have been removed so far (at national, regional or municipal level)? Which are still remaining?
- Which of them are (only) relevant for pilot projects? Which could be crucial for further replication?

Cross-country comparison: calculation and balancing of CO<sub>2</sub> emissions

The following questions should be addressed in particular:

- Which methodologies for the calculation of CO<sub>2</sub> emission are used nationally?
- Which adjustments are under discussion? (if any)
- Is the calculation of CO<sub>2</sub> emissions done on an hourly basis? Or based on annual averages? Is the marginal power plant method applied?

Cross-country comparison: standardisation and certification of PED/PENs

The following questions should be addressed in particular:

- Is there already a national certification for PED/PENs available?
- If no: What other certifications (at building or district/neighbourhood level) could be the basis for such a certification? Which aspects are already addressed/included? Which aspects are still missing? (e. g. mobility or grey energy)

Cross-country comparison: regulatory sandboxes

The following questions should be addressed in particular:

- Do regulatory sandboxes already exist at national or regional level?



- How have they been legally implemented? What have been the most important success factors? Which obstacles have still to be overcome?
- What are the most important experiences gained? What has worked out? What not?

In the context of such a cross-country comparison it is worth to mention that The Netherlands have already started a national knowledge sharing programme and platform for all Dutch municipalities working on sustainability in the built environment.

The Dutch colleagues have already identified six main topics as particularly relevant for municipalities. These topics and related key questions could be also relevant for an in-depth cross-country comparison and evaluation:

1) Organisation and coordination

*Key question(s):*

*How can a municipality support or coordinate the developments, neighbourhood by neighbourhood?*

2) Financing

*Key question(s):*

*What does the business case look like? What opportunities for finance are there? (for municipalities, for private home owners, for housing corporations etc.)*

3) Data

*Key question(s):*

*Which data are necessary to make the right decisions? (energy use, energy system, building stock etc.) This is especially relevant when you start to scale up from one or two neighbourhoods to the entire city.*

4) Technological solutions

*Key question(s):*

*What alternatives to natural gas are available? What does this mean for the building stock and for the energy system? What innovations are expected in the short and long term?*

5) Legal aspects

*Key question(s):*

*What legal opportunities do municipalities have to implement plans for sustainable neighbourhoods? What are the challenges in national and European law? (For example regarding public procurement, state aid, but also spatial planning and ownership rights).*

6) Participation and communication

*Key question(s):*

*How do you involve inhabitants in the project? What is important to them? When do they see the need to participate? What are best practices for communication and participation?*



## 6.2 Key questions to be further discussed

Following the national consultations of the PED Reference Framework and the analysis of the written feedbacks, several key questions have been identified, which should be discussed and specified in the respective national context, later also transnationally. This further discussion is foreseen for a workshop in the 1<sup>st</sup> quarter of 2020.

The following core questions are proposed which could be the focus of the planned workshop and respective prior national preparation:

- 1) What is the ultimate goal of a PED/PEN? Minimizing CO<sub>2</sub> emissions or achieving a positive energy balance? Are there conflicting interests regarding this? What is the importance of cost-efficiency, i.e. the dependency on the bias between fossil and renewable energies?
- 2) Who are the key actors and problem owners (e. g. city administrations, real estate developers, energy suppliers) in your country for the development of PED/PENS? How can they be activated? What are the main drivers and barriers for them to get involved?
- 3) Is there a need for changes in legislation and regulation? In which areas? What is needed for appropriate business models? Is there a lack of finance? For which stakeholder group?
- 4) How can mobility issues be taken into account in PED/PEN implementation? Are the approaches of front-running countries (e. g. Switzerland, Austria) also suitable for your country? Which adaptations have to be made?
- 5) How can green and blue infrastructures be considered in the PED concept? What are the barriers for their realization? How can their benefits be evaluated? (incl. the increase of energy efficiency, avoidance of heat island effect and increased demand for cooling, reduction of air pollution and noise, increase of quality of life)
- 6) Can PED/PENS increase the resilience of urban areas? What is necessary in this context? How can this be tested? What should be avoided?
- 7) What are the different (national) methodologies for calculating the CO<sub>2</sub> emissions of a PED? (e.g. using annual averages or hourly resolution and/or considering the emissions of the marginal power plant)
- 8) How can a life cycle analysis be carried out in the PED context? Which countries do already have experiences? What are the advantages and disadvantages of the different methodologies?
- 9) How can questions of sustainability (e.g. the UN SDGs) and of liveability be embedded into the PED/PEN concept?