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D6.1 - Ecosystem analysis for Positive Energy Districts

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Abbreviations and acronyms

Acronym	Description
EE	Energy Efficiency
EIP-SCC	European Innovation Partnership on Smart Cities and Communities
PEB	Positive Energy Block
PED	Positive Energy District
RES	Renewable Energy Sources
SCC	Smart Cities and Communities
TWG	Temporary Working Group
SECAP	Sustainable Energy and Climate Action Plan
SET-Plan	Strategic Energy Technology Plan
WP	Work Package

Executive Summary

The Positive Energy District (PED) concept is the core of the MAKING-CITY project. A PED is defined as “a district with annual net zero energy import and net zero carbon emissions, working towards an annual local surplus production of renewable energy” in the European Strategic Energy Technology Plan (SET Plan).

Within the MAKING-CITY project, the development of PEDs is based on the integration of various technologies, ranging from buildings’ energy retrofitting and integration of renewable sources to the design, adaption and upgrade of heating and cooling systems and the deployment of storage & transfer systems. Altogether, the use of these technologies should allow the district to have an annual net zero energy import and net zero carbon emissions, working towards an annual local surplus production of renewable energy.

Interactions between stakeholders involved in the district is also a key aspect to be taken into account to reach the objectives of a PED. For instance, the SET Plan has identified the development of sustainable business models that consider the whole process of building, operating and maintaining PEDs and engage all actors among owners, city authorities, real estate developers and operators of the energy infrastructure as a key challenge. Societal innovation, social entrepreneurship and citizen participation are also key to spur the deployment of PEDs within an integrated urban transformation process.

That’s why this first deliverable in WP6 “Exploitation and Business Models” focuses on mapping stakeholders involved in PEDs and analyses their individual interests and their interactions, representing the PEDs’ ecosystem. It is based on the three PEDs developed in MAKING-CITY’s Lighthouse cities Oulu and Groningen.

This mapping is intended to provide a framework to be used during the course of the project, for the development of detailed business models in the Lighthouse cities and for replication activities in Follower cities and beyond. It is the first step to facilitate the identification of relevant business models applicable to each individual stakeholder of the PED ecosystem. Put altogether, such individual business models should make the PED concept replicable and sustainable from a business point of view.

The analysis of the interactions between the different stakeholders active in a PED has been done based on the well-known Value Proposition Canvas approach. It has however been enriched to take into account not only the satisfaction of customers’ or users’ needs but also the impact on the broader ecosystem, since those impacts have to be understood and controlled in order to reach the PED’s objectives. Indeed, synergies and positive externalities are expected by the implementation of the PED concept.

Such approach will help designing innovative business models specific to the PED concept by linking all stakeholders involved in or impacted by the implementation of a PED solution.

This approach has been implemented by interviewing project partners active in Groningen’s and in Oulu’s PEDs. 16 interviews were conducted in total. They were asked:

- ▶ Who are their direct customers or users, and who are the other stakeholders positively or negatively impacted by their activities?
- ▶ For each of them, what jobs are they trying get done, what basic needs are they trying to satisfy? What are their pains before, during, and after getting the job done? Which gains are they expecting?



- ▶ Which products or services would help targeted customers or users satisfy their needs? How these products or services relieve existing pains or generate gains for them?
- ▶ What is the impact of the implementation of these products or services on other stakeholders?

As a result of this analysis, it appears that setting up positive energy districts is a very complex project which involves several stakeholders, each with its own interests and constraints. It requires a high degree of coordination.

Cities are playing a leading role in this process, as confirmed by the strong measures implemented by Groningen and Oulu.

Groningen's and Oulu's stakeholders also confirm the active role of citizens as key for the successful implementation of a PED.

Furthermore, the present report shows the great diversity of stakeholders involved in PED design and implementation. Each member of this value chain brings some added value, not only to its targeted customers or users, but also to other stakeholders impacted by the new services or products developed.

Keywords

Business Model, Value Proposition, Customer analysis, Ecosystem, Positive Energy District, Smart City



1 Introduction

1.1 About the MAKING-CITY project

1.1.1 An H2020 project based on the PED concept

Launched in December 2018 and coordinated by the CARTIF Technology Centre, MAKING-CITY will address and demonstrate advanced procedures and methodologies based on the Positive Energy District (PED) concept for 60 months.

A PED is defined as “a district with annual net zero energy import and net zero carbon emissions, working towards an annual local surplus production of renewable energy” in the European Strategic Energy Technology Plan (SET Plan). Derived from the Positive Energy Block (PEB) definition established by the European Innovation Partnership on Smart Cities and Communities (EIP-SCC), a PED is a delimited urban area composed of buildings with different typologies and public spaces where the total annual energy balance must be positive. Therefore, the district will have an extra energy production that can be shared with other urban zones. The total energy balance is the energy taken from outside the district minus the energy delivered inside the district. In line with the previous definitions, MAKING-CITY has adopted the following definition of a Positive Energy District: *“A Positive Energy District is an urban area with clear boundaries, consisting of buildings of different typologies that actively manage the energy flow between them and the larger energy system to reach an annual positive energy balance”*. [1]

Even if all energy carriers can be considered as potential energy inputs and/or outputs, only primary energy units make a suitable calculation of energy flows to establish the total energy balance. Finally, achieving PEDs means that the amount of energy delivered by the district must be higher than the amount of energy supplied from outside.

1.1.2 Energy transition towards a City Vision 2050

For a successful PED implementation, the MAKING-CITY project is considering a series of key sectors and applications which will ensure a long-term vision for energy transition. A structural shift from a system mainly based on finite energy sources such as fossil fuels, towards a system using more renewable energy sources is considered as energy transition. This significant change also leads to a better management of energy demand in addition to an increase of energy efficiency.

Currently, city energy plans for energy transition are designed within a 2030 horizon, which can be considered as a mid-term strategy (part of the 2030 Climate & Energy Framework in Europe). Nevertheless, learning from the past to plan the future of cities for more than the next few years appears to be a real need. In MAKING-CITY, the City Vision 2050 is used as a longer timescale to address the urban energy system transformation towards low-carbon cities, bringing appropriate energy planning tools as well as reconsidering municipal organisation (creation of City Planning Offices for instance).

The implementation and/or replication of the PED concept developed by the MAKING-CITY partners include the following applications, besides the social innovation and citizen engagement activities organised in the cities:

- Initiate retrofitting buildings to maximise infrastructure performance;
- Increase renewable sources to produce self-sufficient green energy,
- Design, adapt and upgrade heating and cooling systems,
- Deploy storage & transfer systems to anticipate energy demand peaks,
- Set up public charging stations to boost electric mobility.



They will be applied in two Lighthouse cities, Groningen (NL) and Oulu (FI), and 6 Follower cities, Bassano Del Grappa (IT), Kadikoy (TR), Leon (ES), Lublin (PL), Poprad (SK) and Vidin (BG).

The technologies selected in the project are mature or already on the market.

1.2 Purpose of this report and target group

The present deliverable D6.1 is the first contribution of the MAKING-CITY project to the identification and development of business models for Positive Energy Districts (PEDs).

Its purpose is to map the stakeholders involved in PEDs, their individual interests and their interactions: this represents the PEDs' ecosystem. It is based on the three PEDs developed in MAKING-CITY's Lighthouse cities Oulu (one PED) and Groningen (two PEDs).

The aim is to facilitate the identification of relevant business models applicable to each individual stakeholder of the PED ecosystem. Put altogether, such individual business models should make the PED concept replicable and sustainable from a business point of view.

This mapping is intended to provide a framework to be used during the course of the project, for the development of detailed business models in the Lighthouse cities and for replication activities in Follower cities and beyond.

The target group of this public deliverable includes:

- ▶ MAKING-CITY partners, especially those involved in lighthouse and follower cities, and more generally in replication activities,
- ▶ Other Smart Cities and Communities (SCC) projects,
- ▶ Every stakeholder interested in business model concepts applied to districts and cities.

1.3 Contribution partners

The main author of this deliverable is R2M Solution.

Partners involved in the project's Lighthouse Cities, Groningen and Oulu, have contributed to this deliverable.

They participated into WP6 monthly calls during which the approach for this deliverable was discussed.

They contributed to a Business Model workshop held on 16 May 2019 in Groningen at the occasion of a project meeting.

They were then interviewed one by one, according to the methodology presented in Chapter 4 of the present report. Detailed lists of stakeholders interviewed in Groningen and in Oulu are presented in Table 1 and Table 2. The outcomes from the interviews are presented in Chapter 5 (Groningen) and Chapter 6 (Oulu).

1.4 Relation to other activities in the project

The present deliverable D6.1 is part of the work package 6 (WP6) of the MAKING-CITY project "Exploitation and Business Models".

As depicted in Figure 1, WP6 is structured along two main workstreams:

- ▶ Business model workstream (left-hand side of Figure 1): the purpose of this workstream is to identify and develop business models adapted to the PED specific concept. Starting with the identification of stakeholders involved in PEDs and an analysis of their interactions (D6.1), a PED-readiness evaluation tool will be developed (D6.2) and used to conduct a market analysis



(D6.3). A method for municipalities to adopt efficient innovation management practices and increase their PED-readiness levels will be proposed (D6.6), as well as a set of financing solutions for PEDs (D6.7). The outcomes of the workstream will be captured into a business model implementation handbook delivered at the end of the project in order to enable cities to successfully implement MAKING-CITY business models (D6.4).

- Exploitation workstream (right-hand side of Figure 1): the purpose of this workstream is to identify the project's exploitable results and in particular the KEY exploitable results; and for each of them, develop an exploitable plan (D6.8), IP arrangements (D6.5) and a business plan (D6.9).

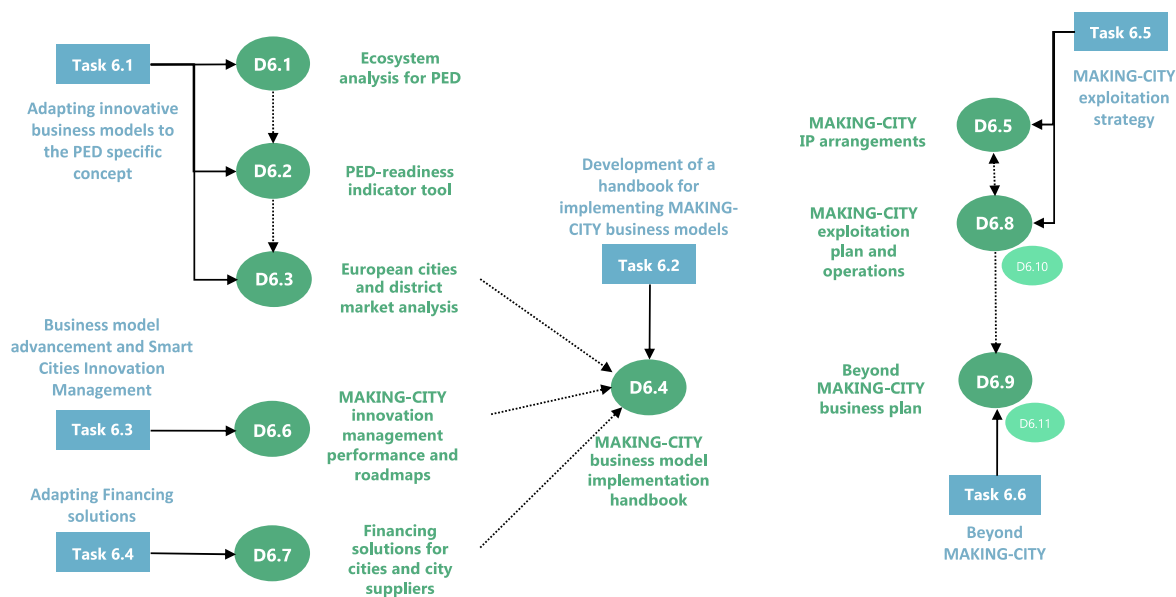


Figure 1. Detailed relations between D6.1 and other MAKING-CITY activities

Given its cross-cutting nature, WP6 is linked to all other WPs in the project, as illustrated by Figure 2. WP6 intends to support and serve other WPs towards effective delivery and exploitation of results.

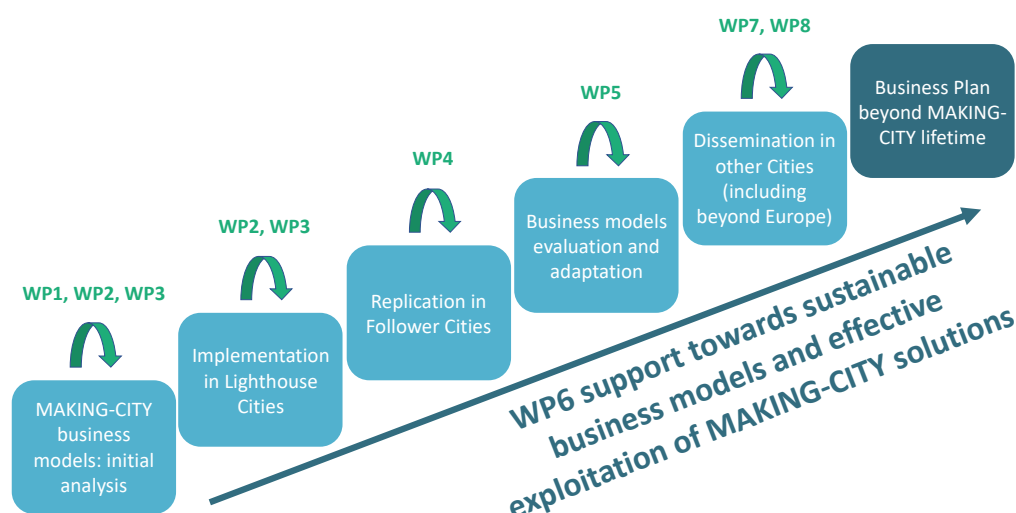


Figure 2. Activities in WP6 and links with other MAKING-CITY WPs

Business models are explicitly mentioned in various parts of the MAKING-CITY project, since identifying and developing suitable business models will be key in the success of MAKING-CITY.

D6.1 has been fed by interactions with WP2 and WP3, with regards to the conceptual design of the lighthouse PED interventions in Oulu and Groningen. Attention has also been paid to the interactions between the newly developed City Urban Planning Department and the stakeholders involved in PED (WP1).

D6.1 is the basis for all other activities in WP6. It is also supporting the guidelines for PED design in WP4, in particular regarding the PED ecosystem analysis to be applied to Follower cities.

Interactions with other SCC projects have also been implemented through WP8. During the first year of the MAKING-CITY project, these interactions have mainly consisted in receiving experience feedback from more advanced projects participating in the Cross-SSC01 group. Future interactions should also consist in providing MAKING-CITY's experience feedback to others, especially within the task force on business models and finance.

2 European policy context with regards to PED business models

2.1 PED definition according to SET-Plan

The Temporary Working Group of the European Strategic Energy Technology (SET)-Plan on Action 3.2 “Smart Cities and Communities” published in June 2018 its Implementation Plan “Europe to become a global role model in integrated, innovative solutions for the planning, deployment, and replication of Positive Energy Districts” [2]. This work was led by the Joint Programming Initiative (JPI) Urban Europe.³

The TWG 3.2 Implementation Plan defines a PED as a district with annual net zero energy import⁴, and net zero CO₂ emission working towards an annual local surplus production of renewable energy. The defining aspects, or “building blocks” of PEDs are:

- ▶ A PED is embedded in an **urban and regional energy system**, preferably driven by **renewable energy**, in order to provide **optimised security and flexibility of supply**.
- ▶ A PED is based on a **high level of energy efficiency**, in order to keep annual local energy consumption lower than the amount of locally produced renewable energy.
- ▶ Within the regional energy system, a PED enables the use of **renewable energy** by offering **optimised flexibility** and in managing consumption and storage capacities on demand. **Active management** will allow for balancing and optimisation, peak shaving, load shifting, demand response and reduced curtailment of RES, and district-level **self-consumption** of electricity and thermal energy.
- ▶ A PED couples **built environment, sustainable production and consumption**, and **mobility** to reduce energy use and greenhouse gas emissions and to create added value and incentives for the consumer. E.g., PEDs facilitate increased EV charging capability within the district and ensure that the impact of EVs on the distribution will be minimised by using local generation where possible.
- ▶ A PED makes optimal use of elements such as **advanced materials, local RES and other low carbon energy sources** (e.g. waste heat from industry and service sector, such as data centres), **local storage, smart energy grids, demand-response, cutting edge energy management** (electricity, heating and cooling), **user interaction/involvement** and ICT.
- ▶ PED should offer **affordable living for the inhabitants**.

PEDs will be implemented in newly built and retrofitted districts or districts with a mix of both.

2.2 SET-Plan vision of business-related challenges to deploy PEDs

Key challenges and needs for deploying PEDs have been identified in the TWG 3.2 Implementation Plan [2] (Figure 3). Most of these challenges are non-technological, business-related ones. They include for instance:

- ▶ The large-scale deployment of PEDs requires the development of **sustainable business models** that consider the whole process of building, operating and maintaining PEDs and engage all

³ <https://jpi-urbaneurope.eu/>

⁴ Electricity generated by dedicated renewable energy systems in the region as well as biomass which is supplied to the PED is not necessarily regarded as import into the PED.

actors among **owners, city authorities, real estate developers and operators of the energy infrastructure.**

- The transformation pathway towards PEDs requires a structured, integrated and innovative approach embedded within the city's overall vision and based on a **co-creation process involving all relevant stakeholders**. In this regard, open innovation pipelines from research to market and society, with living labs, innovation playgrounds and urban prototyping will be useful instruments for developing integrated innovative solution for PEDs
- **Strong leadership of public sector** is essential to lead the transformation process and respond to the emergence of PEDs besides stimulating innovative public procurement and its ability to push innovation to lead market strategy targeting the development of **investible PED projects**.
- The deployment of PEDs is expected to impact the whole energy market and its related technological, financial and regulatory aspects. Key aspects correspond to new innovative energy solutions and corresponding new roles such as **prosumers**, the complex regulatory framework and the resulting investment risks that require **credible and robust investment concepts** and **access to new financing schemes**.
- **Societal innovation, social entrepreneurship and citizen participation** are aimed to spur the deployment of PED within an integrated urban transformation process.



Figure 3. Key challenges and needs for deploying PEDs as identified by SET-Plan TWG 3.2 [2]

In order to pave the way for **100 PEDs by 2025**, the TWG 3.2 Implementation Plan [2] introduces six interlinked modules along a circular pathway towards PEDs (Figure 4):

1. European positive energy cities,
2. PED labs,
3. PED guides and tools,
4. Replication and Mainstreaming,
5. PED Monitoring and Evaluation and
6. Innovation Actions for PEDs.

The MAKING-CITY project (as well as its sister project +CityxChange⁵) is one of the Innovation Actions contributing to module 6.

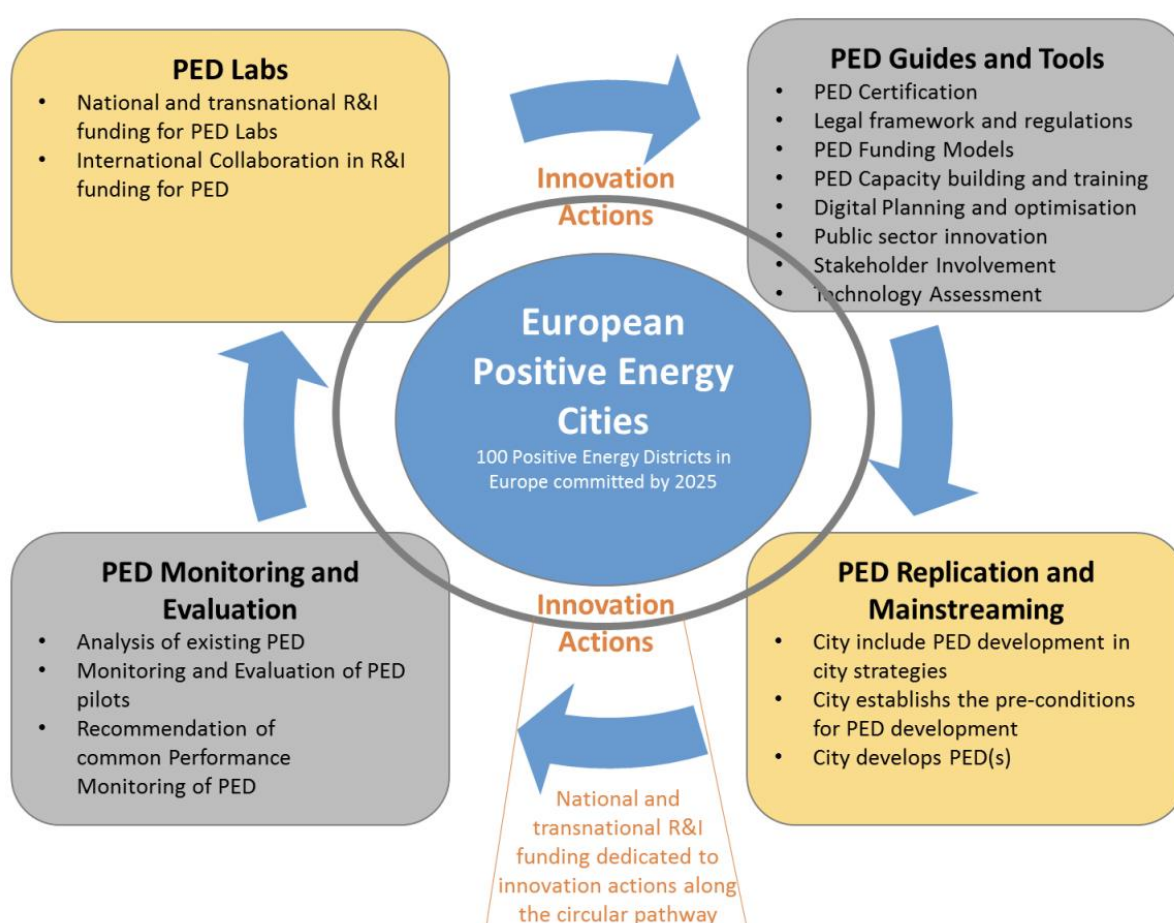


Figure 4. Pathways to Positive Energy Districts in Europe put forward by SET-Plan TWG 3.2 [2]

Contributors to such pathways to PEDs will include stakeholders involved in the whole value chain:

- **Cities** have been identified as the stakeholders who need to take a leading role in the integrated and holistic planning of PEDs in line with their long-term urban strategies.
- PEDs require an open innovation model for their planning, deployment and replication. As energy efficiency and RES, onsite and on the district level, are becoming standard practice in

⁵ <https://cityxchange.eu/>

society, **energy providers**, **mobility providers** and **real estate developers** are in need of **new business models**.

- ▶ **Investors** will need to develop **new models** for **risk sharing**, **cooperative innovation** and **participatory funding pipelines**.
- ▶ **Citizens** will take on a new role as **prosumers** with active participation in energy trading.
- ▶ **Academia** will need to provide robust **documentation**, **monitoring** and **evaluation**, development of solutions for the medium-to-long term, and secure **capacity building** and **education** of the next-generation positive energy professionals and citizens.

Furthermore, still in the framework of SET-Plan TWG 3.2, JPI Urban Europe, in its Booklet of Positive Energy Districts in Europe **¡Error! No se encuentra el origen de la referencia.**, has listed the stakeholders that are decisive for PED implementation. Stakeholders' engagement is of the utmost importance for replication and mainstreaming of PED, as characterized by technological, spatial, regulatory, financial, legal, environmental, social and economic perspectives which usually belongs to different actors, including:

1. **Investors**,
2. **Funding agencies**,
3. **Cities** as facilitators or incubators,
4. **Industries** as solutions providers,
5. **Academia and research**,
6. **Citizens** as prosumers.



3 Introduction to business modelling, value proposition and customer analysis

3.1 Standard approach to business modelling

A methodology traditionally used is that of the Business Model Canvas (BMC) which describes a business model as “the rationale of how an organization creates, delivers and captures value.” A well-known image from the business model generation community that describes this approach is shown in Figure 5. [4]

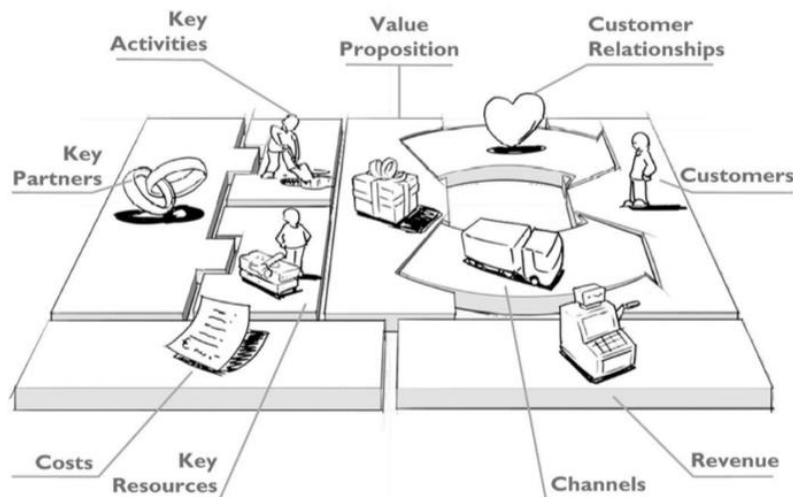


Figure 5. Business Model Canvas [4]

The starting point for canvas development and business model work is a clear definition of what is being offered, to who, and for what purpose. This topic is treated by the business model generation community as the so-called Value Proposition Design [5]. The Value Proposition Design Canvas is depicted in Figure 6 where the value proposition (product or service) is on the left and customer segment is on the right. It actually is a focus on two building blocks of the business model canvas as illustrated by Figure 7. The principle of the Value Proposition Canvas is to focus on the “fit” between what is offered and what customers actually need.

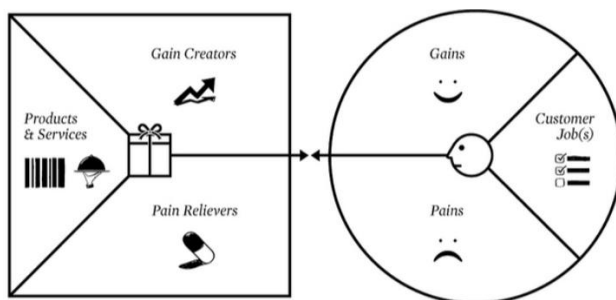


Figure 6. Simple Value Proposition Design Canvas [5]

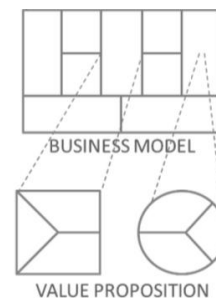


Figure 7. Relation between Business Model and Value Proposition Canvases [5]

3.2 Existing business modelling concepts in the context of smart cities and circular economy

According to recent literature reviews, the concept of business model in the context of smart cities needs clarification for each stakeholder of the smart city ecosystem. [6] [7]

The number of scientific papers devoted to business models in smart cities is still low, and the subject is still new. There is no ready-made theory for city business models. When cities want to use business models, a new way of thinking and approach to city development is needed.

In the context of cities, business models have to be defined not only for private or for-profit entities. Public and non-profit entities should also have a business model since they also “create, deliver and capture value”. [8] In their case, the business model canvas can be adapted by adding to the cost structure and revenue streams the social and environmental cost and benefits (Figure 8). For instance, business models of public services have been analysed in the case of SmartSantander. [9]

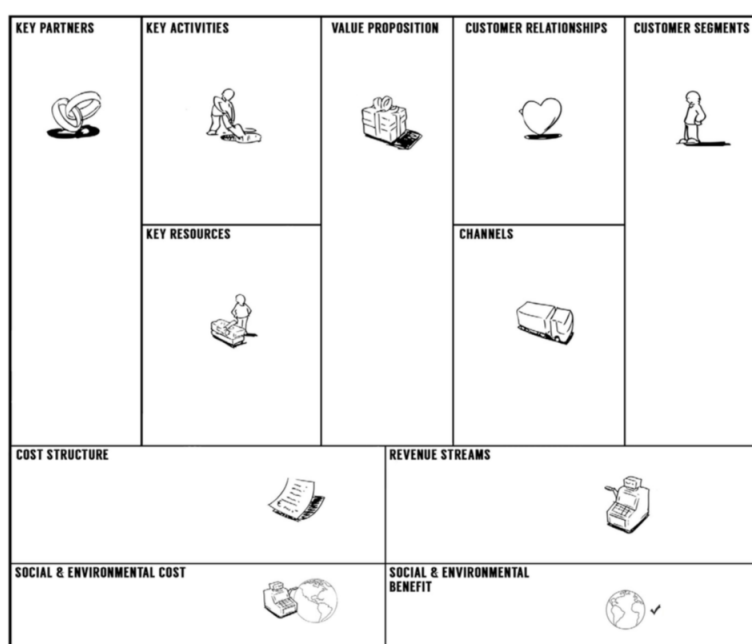


Figure 8. Business Model Canvas for non-profit organisations

In a circular economy context, which is in some way a comparable to the context of the smart city, the business model concept has also to be adapted. For instance, an ad hoc canvas has been developed to take into account the broader impacts generated by organisations (positive impacts, being then social, economic or environmental; negative impacts such as waste generated, negative consequences on health and nature, etc.), as illustrated by Figure 9. [10]



Figure 9. “Circulab board”, the tool to ecodesign the business models [10]

These various approaches have inspired us in developing an ad-hoc method to represent business models in the PED context.

4 Ad-hoc method to represent business models in the PED concept

4.1 Introduction to the method

A PED is not an organisation as such, delivering products or services to customers or users. Rather, a PED is a concept built through the cooperation of several organisations, being them public (city, public service operators, etc.) or private (real estate investors, building managers, etc.). Therefore, business models for products or services delivered by each stakeholder involved in PEDs should be defined in such a way the PED concept works, is scalable and replicable, and delivers benefits to the city, the citizens and the environment.

At this stage of the MAKING-CITY project, it is proposed to support the identification of business models in the lighthouse cities, with a view on replication in the follower cities and beyond, by:

1. Mapping the stakeholders involved in PEDs: some of these stakeholders are partners in the MAKING-CITY project; some are subcontractors (such as technology developers); others are totally outside the project (such as electricity grid operators). An approach to map these stakeholders is presented in Section 4.2.
2. For each of them, identifying the value proposition, customer analysis and impact on the broader environment and on other stakeholders thanks to an ad-hoc methodology developed for PEDs, as introduced in Section 4.3.

This approach has been developed by R2M Solution in its role of WP6 leader. Iterations with MAKING-CITY partners, in particular those involved in the lighthouse cities demonstrations (WP2 and WP3), and culminating at a business workshop organised in May 2019, have been undertaken in order to improve and validate the approach.

The method was then implemented through a series of semi-structured interviews carried out between June 2019 and September 2019 with the stakeholders involved in MAKING-CITY lighthouse cities' PEDs, as presented in Chapters 5 (Groningen) and 6 (Oulu).

4.2 Stakeholder mapping developed for PEDs

The stakeholder mapping developed for Positive Energy Districts is represented on Figure 10.

This representation is made of four layers regarding the stakeholders active or present in the district, plus some stakeholders not necessarily present or active within the district's boundaries:

► **Stakeholders active or present in the district:**

- **Layer 1:** The City itself is represented at the top of the mapping, as the main body in decision-making and implementation processes of PEDs. The City performs, in general in cooperation with contractors:
 - The planning and the design of PEDs,
 - The optimisation and monitoring of energy flows, and corresponding data management,
 - Citizen engagement actions.



- **Layer 2:** Public service operators are key players in PEDs. Not necessarily all of them are involved: their participation depends on the technological choices and available energy sources within the PED:
 - *Electricity grid operator:* The electrification of many energy usages, the hosting of distributed electricity generation capacities and the growing involvement of consumers in power markets make the electricity grid operator a pivotal player in the design and implementation of PEDs.
 - *Heat network operator:* If heat network exists in the district, or if there is a potential for such network, then the heat network operator is likely to be a central player in the PED design and implementation.
 - *Gas network operator:* If gas network exists in the district, then the gas network operator might be involved in the PED design and implementation. Existing gas networks have more and more available capacity, freed up by the decrease in conventional gas consumption. These networks are likely to take a growing role in energy transition projects by hosting and distributing gas from renewable sources (syngas, biogas or hydrogen).
 - *Public transport operator:* Since the transport sector represents a major share in energy consumption, the public transport operator(s) active in the district is likely to be involved in the PED design and implementation.
- **Layer 3:** The following service or product providers, in general from the private sector, have a strong role in PEDs:
 - *Real estate investors:* Especially for new districts, but also possibly in existing districts, real estate investors have a crucial role to play in the implementation of a PED. They will often bear extra costs at the development stage of the buildings, in order to implement energy-efficient technologies contributing to the positive energy balance of the district, for which they would be paid back during the exploitation phase of the buildings.
 - *Building and infrastructure owners:* Similarly, with a stronger focus on existing districts in which they would retrofit the buildings or infrastructures they are owners of, they would make energy choices and bear the corresponding costs during the renovation phase. Building owners may include non-profit social housing corporations and purely commercial building owners. Each serves different target groups and have different interests.
 - *Building and infrastructure managers:* This role may be played by the same entity owning the building or infrastructure, but it can also be played by a different entity. Building and infrastructure managers are those who are exploiting and operating the energy-efficient technologies implemented at their premises.
 - *Energy service providers:* They are in general providing energy from outside the district's boundaries and have customers inside. Therefore, the implementation of PEDs might have a negative impact on them, since they will be selling less energy to their customers. They have therefore a strong interest to diversify the services they are offering and to find new business models

related to the development of PEDs. Energy cooperatives or communities may play the role of energy service providers.

- *Energy generators*: This role may be played by entities playing other roles in the district such as the inhabitants or the building managers, or it may be played by specific entities. Renewable Energy Communities, or Cooperatives, might be involved here. Anyway, this role is crucial since the positive energy balance of the district depends on the energy generation which can be done within its boundaries.
- *Technology providers*: This category includes the providers of different technologies which can be installed at building or district level, such as energy generation, conversion and storage technologies (heat pumps, batteries, BIPV, etc.).
- *Telecommunication operators*: They might be involved in the concept of Positive Energy Districts especially regarding the IT infrastructure necessary to implement energy data exchanges.
- **Layer 4**: Citizens, either individually or through representative bodies, are players in the PED, being them active or passive:
 - *Inhabitants / owners*: Inhabitants are energy consumers, and may be energy producers (for instance, if their house is equipped with solar panels). Especially when they are owning their house or apartment, they are the ones choosing the energy technologies to implement in the case of a renovation for instance. When buying an apartment or a house, they also consider the energy performance of the dwelling. Furthermore, depending on cultural aspects, they are more or less involved in the district-related decisions. Citizen Energy Communities might be involved here.
 - *Inhabitants / tenants*: Even though not owning the dwellings they are living in, tenants are concerned by energy technologies since they are in general paying the energy bills. They may be keen paying more for the dwelling if it is energy-efficient.
 - *Companies and workers*: A district includes in general not only inhabitants but also businesses (like shops or offices) involving workers. Workers might not be interested in energy bills, but certainly appreciate a comfortable working space. Companies are interested in energy bills, and are increasingly interested in actions enhancing their reputation regarding climate issues.
 - *Transport users*: They might also be impacted by the development of PEDs. For instance, development of e-mobility might be incentivised in order to use the excess energy generated by the buildings in the district and/or to provide flexibility services when charging.

► **Stakeholders not necessarily present in the district:**

- *Policy makers at European, national and regional levels*: Those policy makers, above the level of the city, might be involved in regulatory or economic incentives for PEDs.
- *Funding agencies*: They might be involved in finance services for the development of PEDs.



- *Energy markets:* By definition, the PED delivers surpluses of energy (in general in the form of electricity, and possibly in the form of gas or heat). These energy surpluses have to be sold to consumers or to resellers, out of the district's boundaries. This can be done through organised markets (for instance power exchanges) or through bilateral contracts with specific stakeholders. Naturally, energy trading can also occur within the boundaries of a PED.

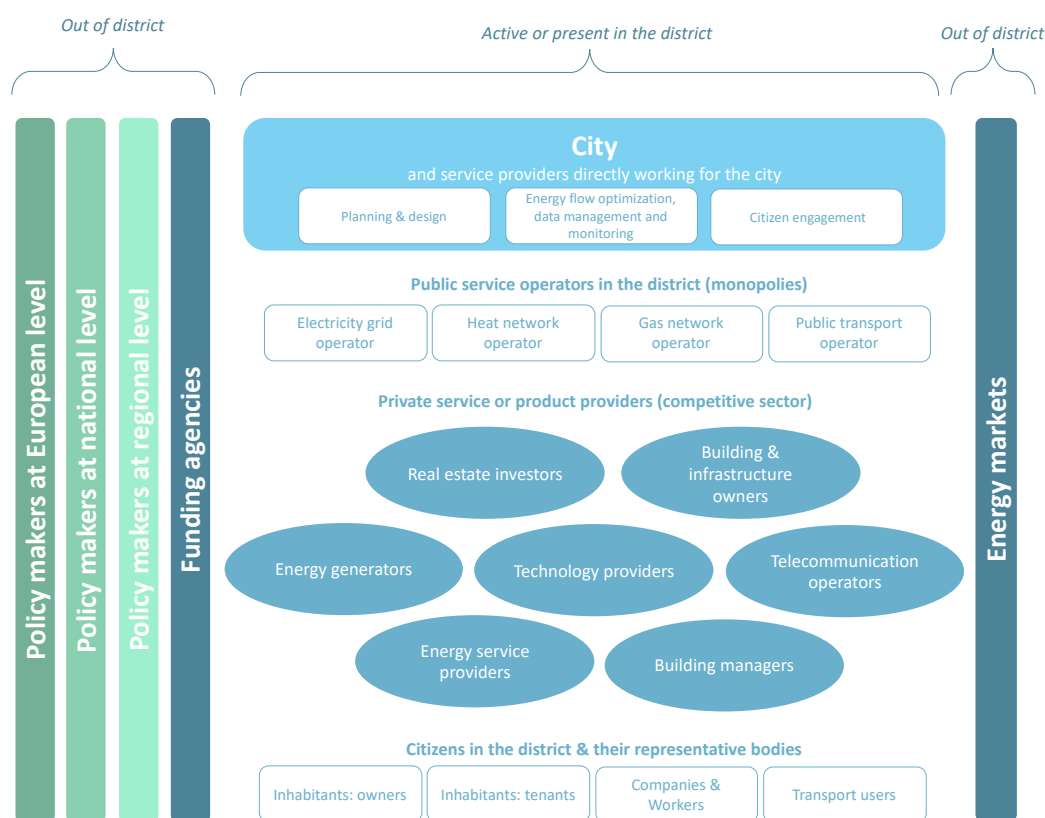


Figure 10. Stakeholder mapping in PEDs

4.3 Value Proposition Design modelling developed for PEDs

For each of the stakeholders involved in PEDs and listed in the previous section, it is proposed to model their value proposition as represented on Figure 11.

This canvas is inspired from the standard value proposition canvas represented on Figure 6. As such, it considers achieving fit between value propositions and customer's needs and jobs-to-be-done and helps them solve their problems. Here, "customer" should be understood with a broad meaning: customers may also be users of public services or citizens seen as taxpayers by the municipality.

However, given the synergies and positive externalities which are expected by the implementation of the PED concept, it is proposed to add a new dimension to this canvas: not only the direct customers or users have to be considered, but also the impact on other stakeholders and on the broader environment. Such approach will help designing innovative business models specific to the PED concept by linking all stakeholders involved in or impacted by the implementation of a PED solution.

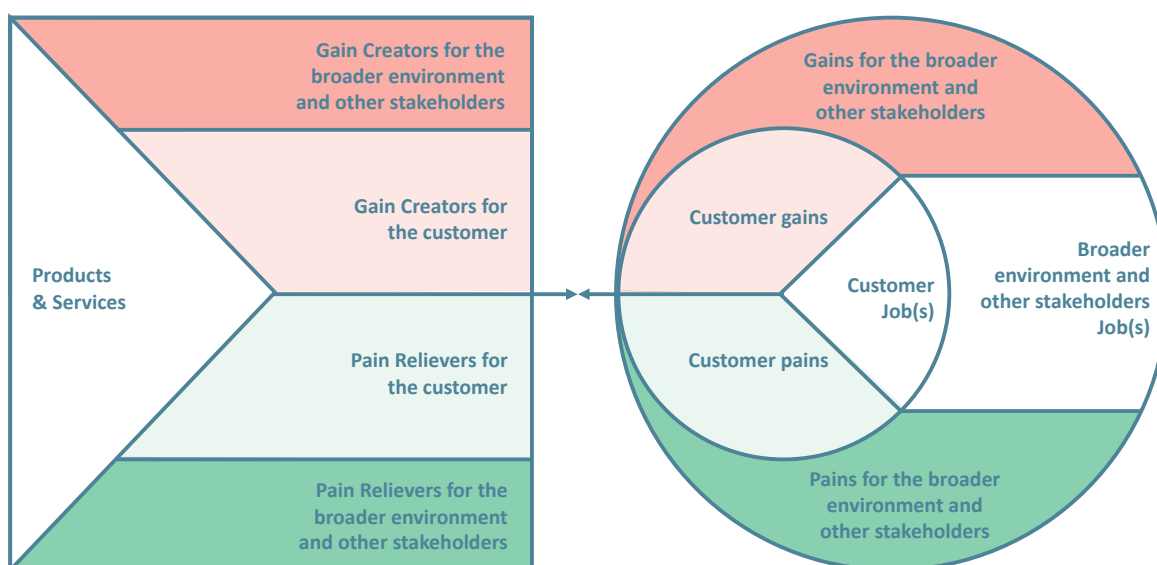


Figure 11. Ad-hoc canvas for value proposition, customer analysis and impact analysis

For each PED solution, the following approach should be undertaken:

- ▶ First, consider within the stakeholder mapping proposed in the previous section (Figure 10) who the stakeholders involved in the solution are:
 - Direct customers or users targeted by the value proposition, and
 - Other stakeholders (positively or negatively) impacted.
- ▶ Second, sketch out the profile of these stakeholders:
 - Direct customers or users:
 - What functional, social or emotional jobs are they trying get done? What basic needs are they trying to satisfy?
 - What are their pains before, during, and after getting the job done? How are current solutions underperforming for them? What do they find too costly, or not efficient enough? What are their main difficulties, challenges and risks?
 - Which gains are they expecting? Which outcomes, benefits or savings would satisfy them – even beyond expectations? What would increase the likelihood of adopting a solution?
 - Other stakeholders impacted:
 - What jobs are they trying to get done, which are impacted by the jobs the targeted customers or users are trying to get done? Is their ability to satisfy their needs impacted?
 - Which pains do these stakeholders have in relation with the jobs that the targeted customers or users are trying to get done?
 - Which gains do these stakeholders have in relation with the jobs that the targeted customers or users are trying to get done?

► Third, sketch out the value proposition:

- Towards direct customers or users:
 - Which products or services would help targeted customers or users get either a functional, social, or emotional job done, or help them satisfy basic needs?
 - How these products or services relieve existing pains for the targeted customers or users? For instance, by generating savings, fixing underperforming solutions or putting an end to difficulties and challenges encountered? (e.g. make things easier, helping them get done, eliminate resistance, ...)
 - How these products or services generate gains for the targeted customers or users? Do they produce outcomes the targeted customers or users expect or that go beyond their expectations? Do they outperform current solutions that delight the targeted customers or users? Do they make adoption easier?
- Towards other stakeholders impacted:
 - How should the services and products considered be designed so as to take into account the other stakeholders impacted?
 - Are the services or products considered relieving or removing existing pains of these stakeholders, or, on the contrary, creating or increasing pains?
 - Are the services or products considered creating or increasing gains of these stakeholders, or, on the contrary, removing or decreasing existing gains?

4.4 Summary of the method

Figure 12 summarizes the 3-step methodology to be undertaken in order to analyse the PED ecosystem in the lighthouse cities for each action considered.¹⁴

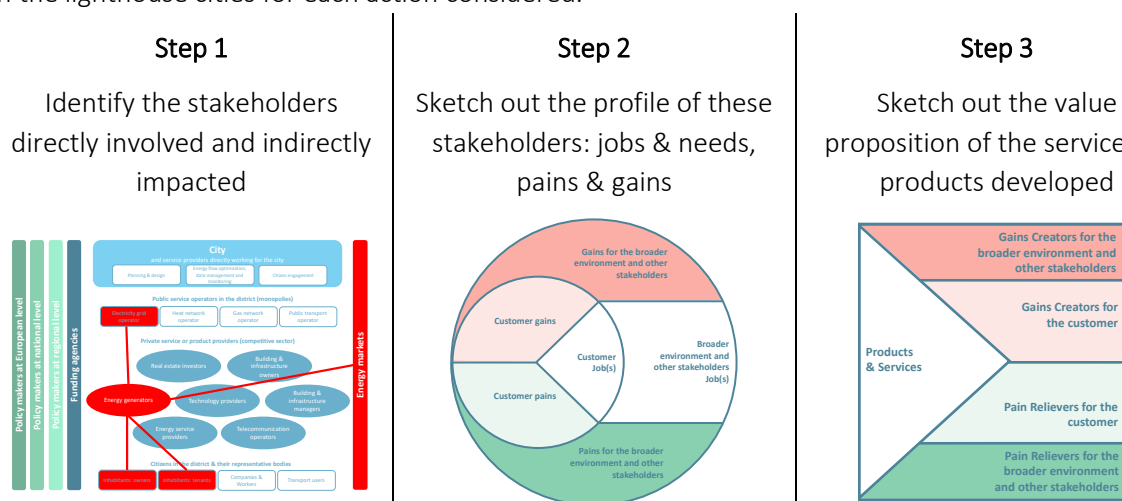


Figure 12. Summary of the methodology

¹⁴ The red boxes in the left-hand side of the figure are for illustration purposes. They may not correspond to an actual group of stakeholders involved in a given PED solution.

The approach to implement this methodology in MAKING-CITY has been the following:

- ▶ MAKING-CITY partners leading one or several actions contributing to the implementation of PEDs in Oulu and Groningen, i.e. WP2 and WP3 partners, were individually contacted by email by the WP6 leader.
- ▶ They were invited to follow the following process:
 - Book a slot for a one-hour phone interview, using the Calendly application (<https://calendly.com>),
 - Start filling a questionnaire in attachment, corresponding to the above value proposition canvas and presented in Annex 1,
 - Send the questionnaire back to WP6 leader before the phone interview.
- ▶ Then, their answers were discussed during the phone interview, and in some cases the questionnaire was filled in or completed during the interview.
- ▶ After the interview, the questionnaire was completed or modified by WP6 leader according to the discussion held, and was sent back to the interviewee, who was invited to validate it.

The list of the partners interviewed can be found in Table 1 and Table 2 (see next chapters).



5 Value proposition design for PEDs in Groningen

In this Chapter, we apply the methodology developed in Chapter 4 to Actions contributing to the PEDs in Groningen.

Naturally, only actions which have been decided so far are listed. Other actions, if any, would be addressed during the next year(s) and integrated in upcoming activities and deliverables.

5.1 Context in Groningen

Groningen was chosen as one of the two “Lighthouse cities” involved in MAKING-CITY due to its current urban energy transformation strategy. In the Netherlands, natural gas remained for decades the main energy source to respond to the national energy demand. However, reiterated earthquakes caused by the gas exploitation activities seriously damaged houses and revealed a need for sustainable alternatives.

To achieve this energy transformation, the city council of Groningen adopted in 2011 a Master Plan which aims at making Groningen energy neutral by 2035. “Groningen Energises 2015-2018” completed this political willingness followed by the 2017 “Next City” plan and its core objective of turning the city of Groningen into a real-life lab for energy transition. As member of the Global Covenant of Mayors for Climate and Energy, Groningen committed to reduce by 70% its gas emissions in 2030 while establishing a sustainable use, consumption and energy production.

Groningen North and Groningen South are the two districts selected to implement the PED concept developed in the MAKING-CITY project. Several infrastructure typologies are represented in both urban areas: residential buildings bordering a university campus, industrial and tertiary blocks, public facilities... Part of the residential area in Groningen North was built in the 1960’s while the vast majority of Groningen South is relatively new, constructed around the 1980’s.

Overall, the PED implementation in Groningen North and Groningen South involves the retrofitting of residential buildings (floors, roofs, fronts, windows, smart thermostats and sensors to real-time measuring of energy consumption...) in order to maximise infrastructure performance. Solar panels will be installed on the roofs of some buildings and parking lots. In addition, solar thermal panels will support geothermal heat pumps which are directly connected to the geothermal district heating system. The surplus of thermal energy produced by some residential buildings will be stored and used during energy demand peaks. On the other hand, biogas technology will be used to collect and “digest” -under high pressure and thanks to bacteria-, waste and wastewater produced by public sport and catering facilities.

A special focus will be made on cycling and electric mobility. For instance, an existing cycling lane will be converted into a “SolaRoad” by the integration of solar panels in its surface able to produce around 60,000 kWh yearly. Moreover, smart charging stations for electric vehicles will be installed and directly connected to the current grid.

Figure 13 shows in a simplified manner the main components of the two PEDs developed in Groningen (North and South-East).



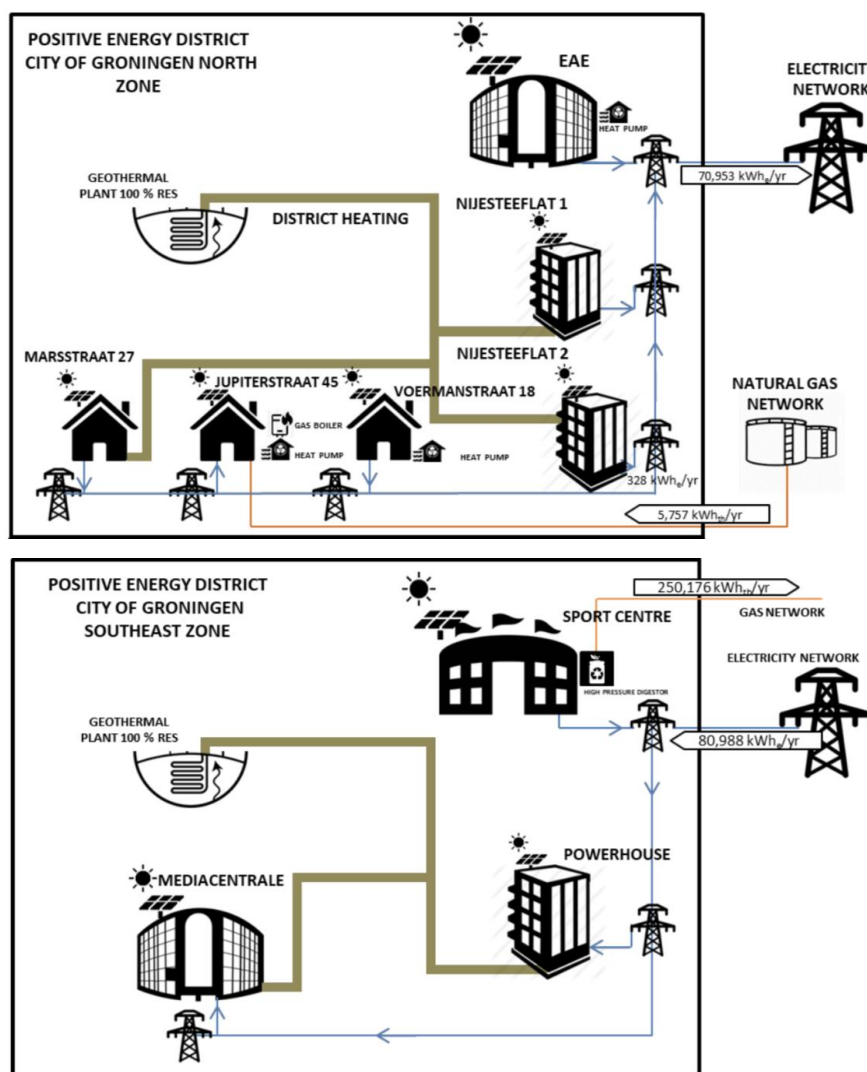


Figure 13. Simplified representation of Groningen PEDs¹⁵

5.2 Identification of partners contributing to Groningen's PEDs

Semi-structured interviews were conducted by R2M Solution with the partners involved in Groningen PEDs. Those interviews were based on a questionnaire prefilled by interviewees, which was then reviewed and completed during the phone interviews. The questionnaire was based on the methodology presented in Chapter 4 (Ad-hoc method to represent business models in the PED concept):

- ▶ Identification of the stakeholders directly involved and indirectly impacted,
- ▶ Assessment of the profile of these stakeholders: jobs & needs, pains & gains,
- ▶ Sketch of the value proposition of the services or products developed.

¹⁵ This is an original figure, which would need to be updated. For instance, within PED North, geothermal plant has been replaced by heat provided by data centres. Furthermore, the amounts of energy have changed since then.

The questionnaire used to prepare the interviews is presented in Annex 1.

Table 1 shows the partners who were interviewed.

Partners	Role in the project	Persons interviewed	Date of the interview
3-GRO	Municipal regulatory authority responsible for overall governance of the city: policy-making, granting of subsidies and permits	Jasper Tonen	20/08/2019
3a-WAR	Heat network operator. Use of water as a heat carrier: sustainable heat supply, heating district network & thermal energy storage	Joep de Boer	13/06/2019
4-TNO	TNO is conducting many activities in the project. In Groningen, TNO supports PEDs' planning and design, supports citizen engagement activities and ensures optimisation of heat consumption and production at building level.	Joram Nauta, Marc Hamburg	20/08/2019
5-GPO	Community-owned energy cooperative. In charge of citizen engagement actions. Leading the retrofitting of private houses in Groningen.	Joep Broekhuis	19/06/2019
6-SEV*	Responsible of the workstream "Business Models and Financing" including early replication, business concepts, citizen engagement, optimizing business models & acceptability by all stakeholders, etc. Involvement in local dissemination, communication and capacity building.	Mark de la Vieter	17/06/2019
7-WAM	Owner of part of the real estate in the MAKING-CITY project (Mediacentrale and PowerHouse). Implementation of energy-efficiency measures and renewable energy sources in these buildings.	Bart Jager	08/07/2019
8-NIJ	Housing corporation in the city of Groningen with approximately 13,500 rental properties	Han Folkerts, Henrik Prosman	21/08/2019
9-CGI	Provision of energy platform, integration of new solutions and protocols into a central and secure data environment	Gerard van de Kamp	26/06/2019
10-SB	Provision of technology for real-time monitoring of energy consumption and production, and monitoring services for better energy management of buildings	Tuan Anh Nguyen	26/06/2019
11-RUG*	Research predominantly targeting the process of planning in Groningen and other cities	Christian Zuidema	27/09/2019
12-HUAS*	New approaches, smart energy systems, inclusive business models, integrated building products and IT tools co-developed in a Living Lab setting	Rob Roggema and Cyril Tjahja	21/06/2019

Table 1. List of Groningen partners interviewed



* Partners 6 (SEV), 11 (RUG) and 12 (HUAS) have been interviewed, but the questionnaire developed is not applicable to their role in the project:

- ▶ SEV is directly responsible of no action in Groningen PEDs. Instead, SEV is supporting the Groningen ecosystem in a transversal manner. Actions in Groningen have been grouped into workstreams; SEV will be responsible of the first workstream, namely “Business Models and Financing”. This includes early replication, business concepts, citizen engagement, optimizing business models & acceptability by all stakeholders, etc.; in short, it is linked with the in-between work needed to come up with replication plans. SEV is also involved in actions involving local dissemination, communication and capacity building.
- ▶ RUG is responsible for one action as building owner (Action 5: New high-performance Energy Academy Europe). However, in practice, RUG’s role in the project mainly consists in research work predominantly targeting the process of planning within both Groningen and other consortium cities. RUG contributes to the development of an enhanced understanding, best practices and more general methodologies and guidelines on (1) defining an urban energy planning department, (2) long term energy plans and visions, (3) energy and climate action plans, (4) PED development and indirectly, (5) the development of social innovation through new social practices and business cases.
- ▶ HUAS’ role in the project is to focus on how innovation is handled in the neighbourhood. HUAS investigates how people respond to take those measures in their direct environment. HUAS implements co-creation & co-ownership approaches, social acceptance, inhabitants’ behaviour. HUAS contributes to the “Business Models and Financing’ workstream.

Therefore, SEV, RUG and HUAS will be privileged partners in WP6. Thanks to their presence in Groningen’s local ecosystem, they will facilitate the links between WP6 and Groningen stakeholders.

5.3 Actions led by the Municipality of Groningen (GRO)

5.3.1 Identification of actions, direct users and impacted stakeholders

The **Municipality of Groningen** is involved in technical and in non-technical actions.

Technical actions led by the Municipality can be grouped as follows:

- I. Actions directly related to the Sport Complex (building owned by municipality), aiming at developing RES production in the building:
 - ▶ **Action 6:** New high-performance Sport Complex Europahal. The building has already been built and is open to the public. This action is the umbrella to the following ones.
 - ▶ **Action 11d:** PV on the roof of the Sport Complex.
 - ▶ **Action 20:** PVT in Sport Complex.
- II. Other actions to develop RES production in the PED South-East (not directly related to the Sport Complex):
 - ▶ **Action 15:** Floating solar pontoons.
 - ▶ **Action 16:** SolaRoad on existing bicycle lane
 - ▶ **Action 31a:** High pressure waste digester.
- III. District Heating in PED North and South-East, in close collaboration with WarmteStad:
 - ▶ **Action 27:** Geothermal District Heating. This is not developed in this section but in section 5.4 where Warmtestad’s actions are described.

IV. Urban Platform, in close collaboration with CGI:

- **Action 35:** Open urban platform adaptation. This is not developed in this section but in section 5.9 where CGI's actions are described.

Although **citizens** are not directly involved within these actions, they are the most important stakeholders targeted by the City. The other stakeholders impacted or involved in the City's actions are mainly the following, as illustrated on Figure 14:

- **Policy makers at national level** have ambitious climate goals to which the City of Groningen contributes;
- **Funding agencies** are called to fund energy transition investments;
- The local **heat network operator**, Warmtestad, was created by the City and the local water company to move from a natural gas-based system to a renewable heat system;
- **Real estate investors** have to comply with strict rules set by the City for new buildings;
- **Innovative technology providers** are encouraged to demonstrate innovative solutions in Groningen.

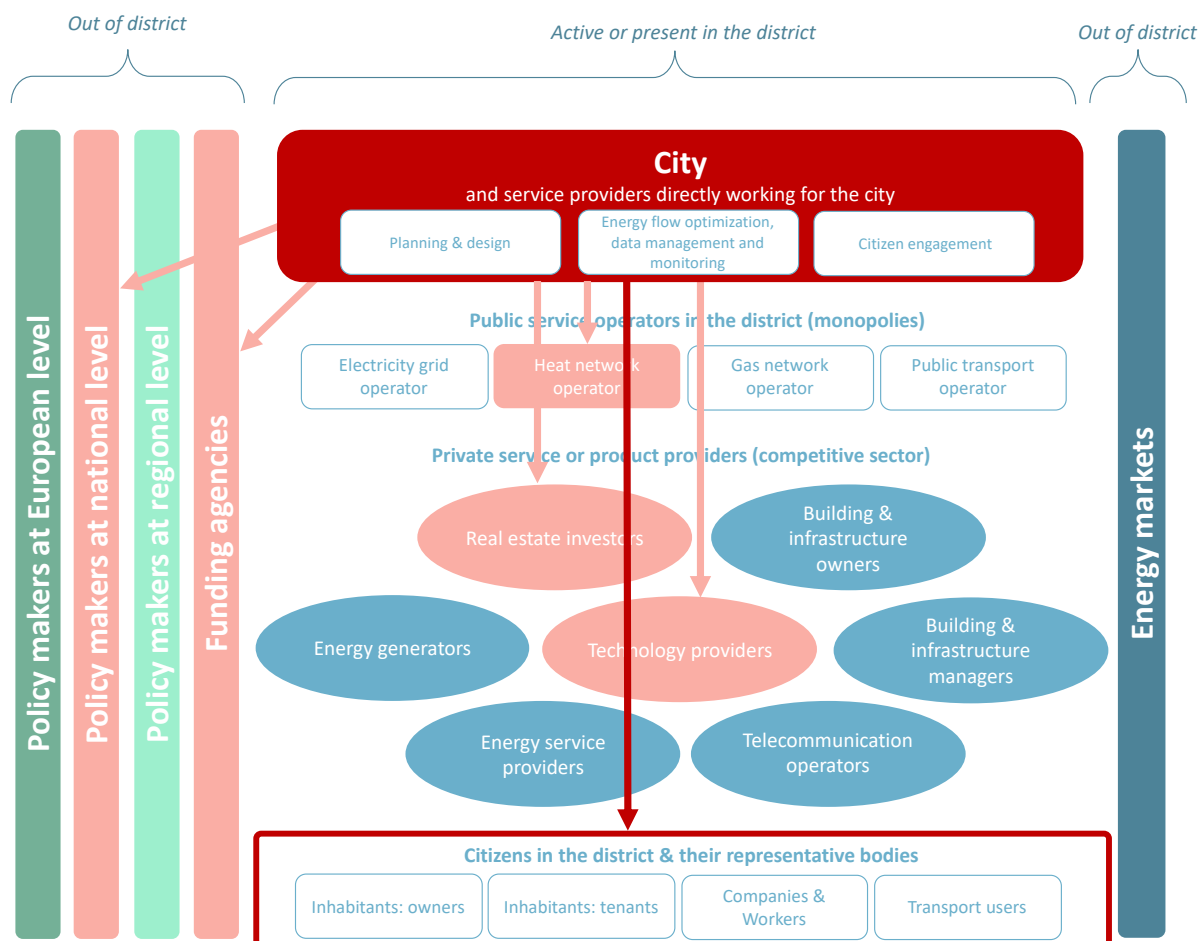


Figure 14. Stakeholders involved and impacted by the Municipality of Groningen's actions

5.3.2 Value proposition towards direct users and other stakeholders impacted

In the City almost every citizen wants to stop using 'Groningen' gas that is extracted from the nearby gas fields and is causing local earthquakes. That's why the Municipality is working towards carbon

neutrality by 2035. This can be stimulated with rules, subsidies, awareness campaign, etc. It is proposed that the City of Groningen can supply 30% of its energy within its own borders, 30% should come from energy savings and 40% from renewables beyond its own borders (preferable in the surroundings or from wind at the Waddensea).

Although the amount of RES is growing and good progress is being made, the City remains very dependent on national regulations and is for instance not allowed to alter the current energy system (for instance, to substitute the gas grid in favour of a heat grid). Building and house owners have the right to hold on to the current system.

In addition, the solution to energy transition is not straightforward: First, there is not one single solution, whereas the current system is simple one-direction, one source (for heat). Second, there is a great diversity in building types and ownership. Third, people will also be asked to contribute, but this can be a major pain. A significant share of the local citizens cannot or are not willing to invest in an 'improved' system. An improved system is in this case a sustainable low CO₂ impact system. In many cases (unless insulation measures are also taken) there is no improved comfort for the houses, thus the gains are not always clear. Also, the current system (despite being fossil) is very efficient and secure.

In order to make change possible multiple factors play a crucial role:

- ▶ Currently, there is no regulation in place to oblige building owners to change the energy system. Proper national rules are needed to get the mandate to alter the gas grid on a large scale.
- ▶ Before the above-mentioned decisions can be made it is necessary to have proper financial constructions in place to make sure that every building owner is capable of implementing the changes. A major risk concerning a system change is energy poverty. Gas prices will rise, but some people will be unable to finance some of the needed changes. It is very well possible that different constructions are needed depending on the situations of the building owner. Energy service contracts could for instance take over this difficulty: building owners would refund the investment to the service provider gradually.
- ▶ A thoroughly thought to energy approach is needed that is still dynamic. A district energy approach can be the tool to reach this.

Policy makers at national level are crucial for the success of the transition at local level. The current gas grid in the Netherlands is a superb and extremely effective energy system to provide heat to households and other buildings. The Netherlands is also very dependent of the financial benefits the gas reserve provide. But a lot of local governments want to change the energy system into a more sustainable one. Regulations protect the gas grid and although this is slowly shifting it is currently nearly impossible to implement an alternative system that can financially compete with the current system.

In the Netherlands, the national government subsidizes renewables, which have a certain minimal impact. Producers receive financial compensation for the renewable energy they generate. Production of renewable energy is not always profitable because the cost price of renewable energy is higher than the market price. The difference in price is called the unprofitable component. SDE+ compensates producers for this unprofitable component for a fixed number of years, depending on the technology used and amount of energy generated. Goal is to increase the share of renewables.

From a stakeholder point of view the national government can break or make the transition.

The City of Groningen has a special role in relation to heat grids. Some years ago, the City and the local water company founded the company WarmteStad, from which both parties have a 50 percent share. WarmteStad is the local heat grid operator and owns the system that is connected to the Sport Complex and other buildings in this area. Also, the heat grid in the North PED will be owned by WarmteStad.



Innovative technologies are also welcome in Groningen, as for instance the SolaRoad, since energy awareness is very well spread amongst Groningen citizens. Demonstration of innovative technologies can be done in Groningen within the MAKING-CITY project and life-cycle analysis (LCA) carried out based on experience feedback. The City of Groningen is very interested in demonstrating external benefits such as double use of space.

Figure 15 summarizes the value proposition of the Municipality's main actions.

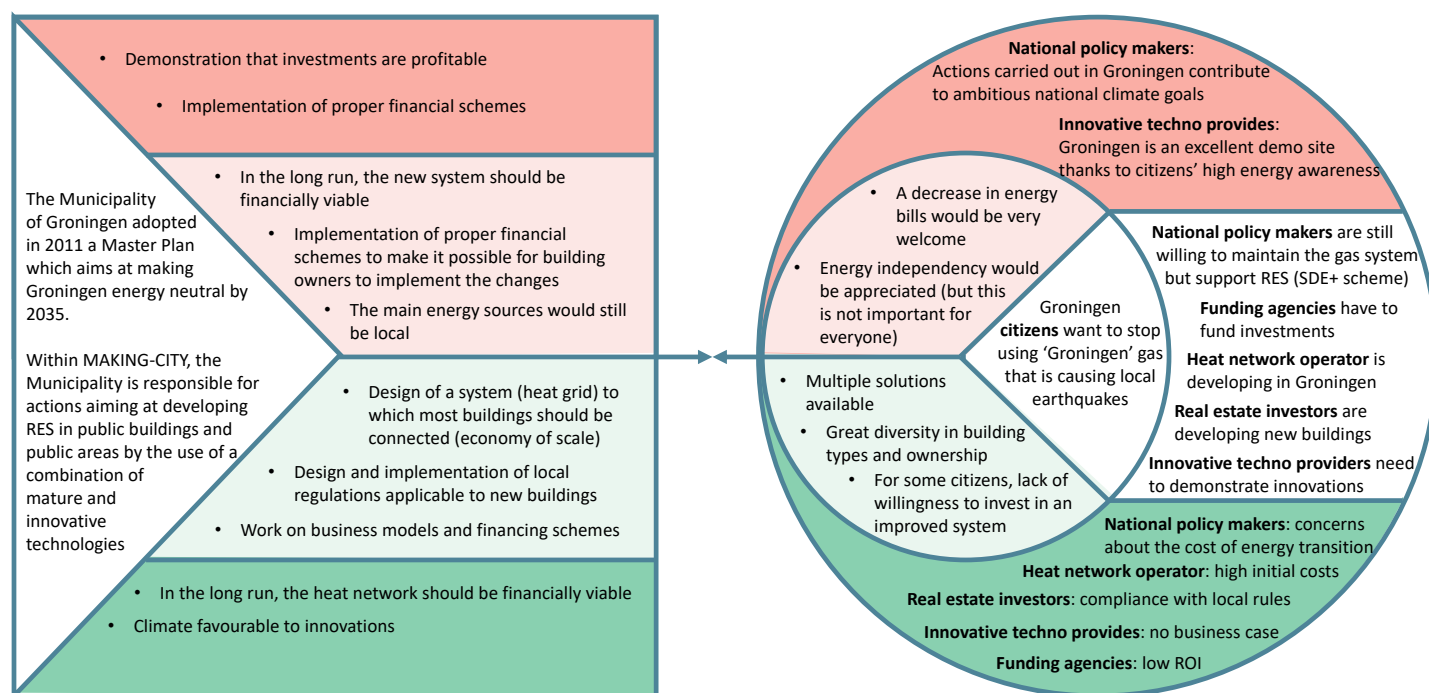


Figure 15. Value proposition canvas for Municipality of Groningen's actions

5.4 Actions led by WarmteStad (WAR)

5.4.1 Identification of actions, direct users and stakeholders impacted

WarmteStad is the **heat network operator** in the City of Groningen. Within the MAKING-CITY project, WarmteStad is currently leading two actions:

- **Action 39** (in PED North): for the Highrise (two existing residential buildings from the 70s), adjustment of high temperature district heat grid for using low temperature connection. Here, the users are the **tenants of the apartments**, the buildings being owned by the housing association Nijestee. The heat distributed via the district heating network is provided by a renewable source (waste heat from a data centre).
- **Action 40** (in PED South-East): for the PowerHouse (new apartment complex), connection to the low temperature district heat grid. Here, the users will be the **owners/inhabitants of the apartments**. The heat distributed via the district heating network is provided by a renewable source (geothermal combined with heat pumps).

Stakeholders impacted by WarmteStad's actions, other than the direct users of the service, are the **City of Groningen**, **building & infrastructure owners** and **real estate investors**, as illustrated by Figure 16.

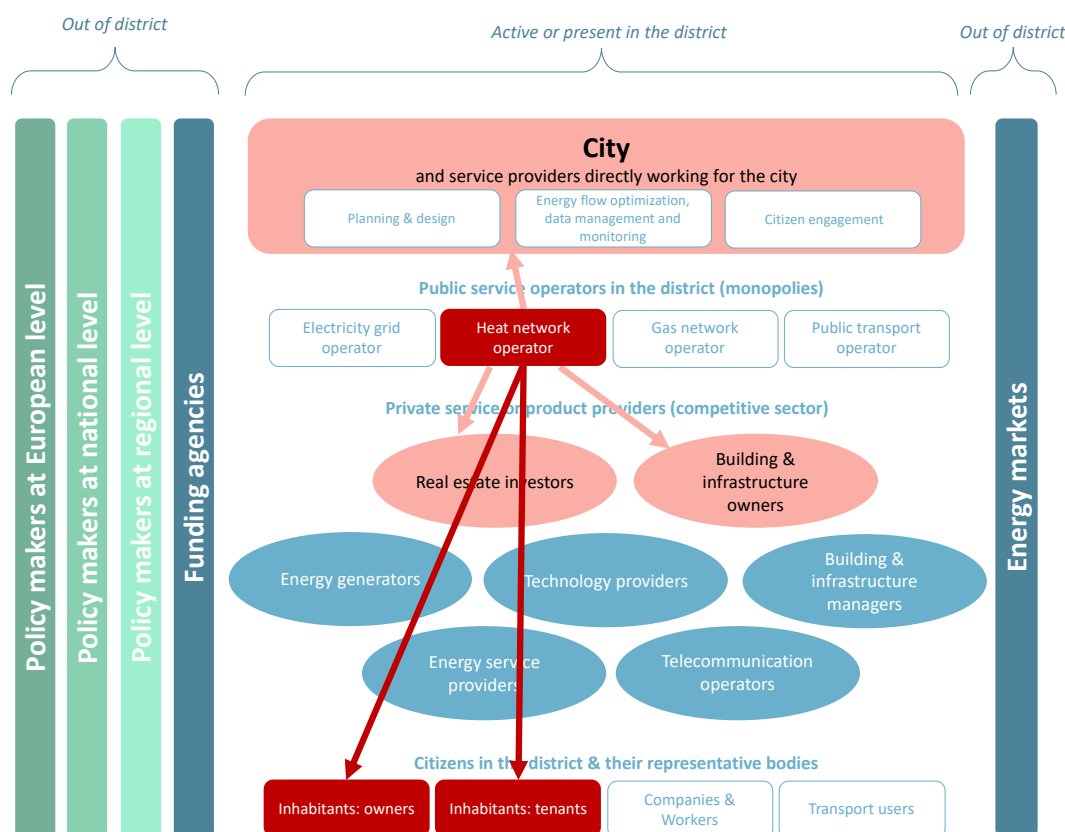


Figure 16. Stakeholders involved and impacted by WarmteStad's actions

5.4.2 Value proposition towards direct users and other stakeholders impacted

The basic need of the users is to heat (and possibly cool) their apartments. They want to have a comfortable house with an acceptable heating bill.

District heating has the advantage to have moderate costs, and heat is provided by a renewable source (waste heat from a data centre). However, most tenants may not really mind about the technology which is used. It comes with no hassle whatsoever, no complicated technologies in the house, doesn't take up any significant space and most important doesn't cost more in comparison with the standard heating solution with natural gas. Cooling (Action 40) is an extra feature which in general is much appreciated.

In Highrise (Action 39), the switch from the previous gas boiler installed on the rooftop to district heating causes no change in the apartments; there will therefore be no major changes for the inhabitants. They will receive bills from heating company instead of housing association. Bills will not increase – tenants will even pay less. Next to heating, WarmteStad provides also for a means of cooling the apartments. WarmteStad expects that most of the clients from PowerHouse (Action 40) will appreciate the comfort of this system since there are hardly any house in the NL which have a standard cooling system.

In Highrise (Action 39), the owner of the buildings is Nijestee, the housing association (partner 8 in the project). Nijestee has made a performance agreement for the energy efficiency of their houses with the municipality and national government. Therefore, they are looking to implement energy efficient technologies and renewable energy sources. The pains for the housing companies are that their primary

objective is to offer affordable housing costs to their tenants. This objective is in direct conflict with high and too often uneconomical investments which are needed to save energy for heating. The gains for the housing companies are that WarmteStad produces heat with a low fossil footprint at an acceptable price level for their tenants which harmoniously combines their primary objective with the performance agreements on energy efficiency.

The Municipality of Groningen has set Energy-Efficiency standards as a strict obligation for obtaining building permit for new buildings.

Regarding Powerhouse, district heating is a clear advantage from the City's point of view which has set strict Energy Efficiency targets for new buildings. Real estate investors are obliged to satisfy these standards, but they should be rewarded by a higher price for selling the apartments to inhabitants. In turn, inhabitants (owners of their apartments) will benefit from a sustainable & local heat source, with a stable price (regulated tariff).

The loss of connecting to a heat grid is that customers can no longer choose the energy company for their heating solution whereas in the common situation with natural gas they can.

The value proposition of WarmteStad's actions can be summarized as presented by Figure 17.

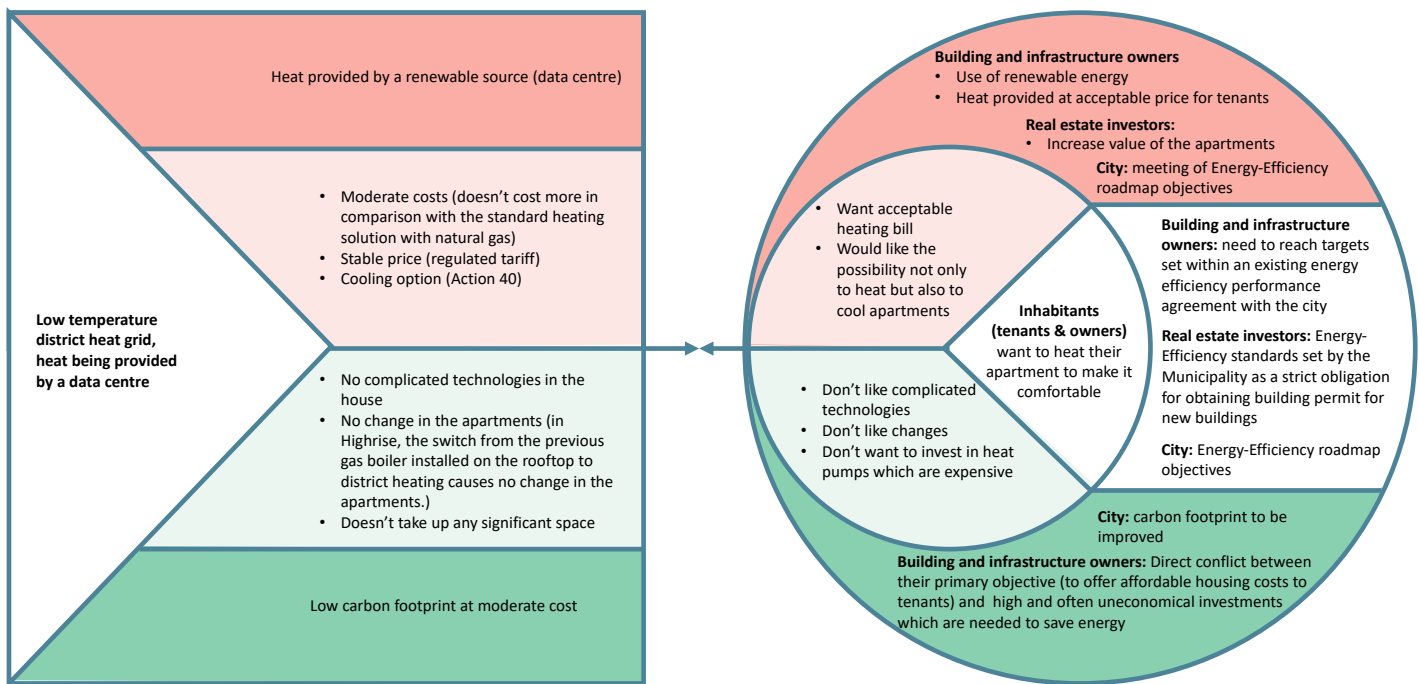


Figure 17. Value proposition canvas for WarmteStad's actions

5.5 Actions led by TNO

5.5.1 Identification of actions, direct users and stakeholders impacted

TNO is a major research organization in the Netherlands. Within MAKING-CITY, TNO is conducting many activities, not only by supporting the Groningen PEDs' design and implementation but also by contributing to cross-cutting actions in the project. In the present report, we are focusing on the following contributions from TNO:

1) **Support to Cities in planning and design:**

- By selecting the best PED locations, formulating their objectives and vision and organising collaboration between stakeholders, thanks to the Positive Energy District Planning tool. This tool can be seen as an umbrella under which other tools are used.
- By modelling and simulating of energy flows at district level in order to evaluate how and to what extent the planned measures are able to achieve the goal of creating a PED in each district. This corresponds to **Action 32** (Modelling, simulation, adapting & validation of planned innovations). Here, TNO is using its Energy System SIMulation (ESSIM) tool.

These activities indirectly serve **Regional policy makers** and **all stakeholders to be involved in the PED**, as illustrated by Figure 18.

2) **Support to Cities in citizen engagement activities** thanks to a participation tool for social innovation. It facilitates citizen engagement, participation and formulation and adoption of sustainable solutions (e.g. by **individual citizens** and **local initiatives**) and seeks alignment with **all public and private partners active in the project** to realize community benefits, leading to a sustainable eco-system in collaborations, solutions/value(s), investments and costs. This is illustrated by Figure 19.

3) **Technology provider to building managers**, for the optimization of heat consumption and production. It is based on HeatMatcher, a software and architecture solution to optimize the heat consumption and production within a heat system (at building level). **Action 9** consists in the implementation of HeatMatcher within PED North in the two buildings of Nijestee (**Action 1**) to combine the thermal flows of geothermal district heating (**Action 27**), PVT (**Action 17**), heat pumps (**Action 25**) and thermal storage (**Action 29**). **Action 10** consists in its implementation within PED South-East in Mediacentrale (**Action 4**) to combine the thermal flows of PVT (**Action 21**), heat pump (**Action 26**) and heat storage (**Action 30**) of this building. **Heat network operators** are stakeholders possibly impacted by the use of this technology, as well as **building owners, inhabitants (owners and tenants)**. This is illustrated by Figure 20.

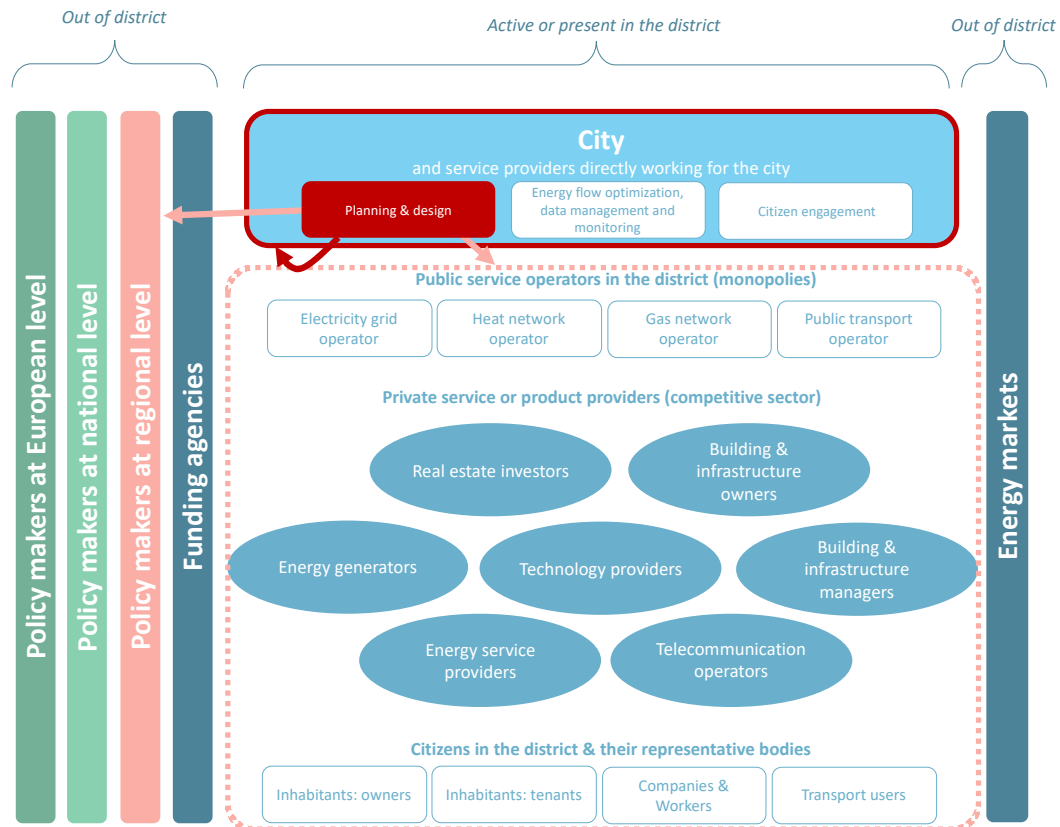


Figure 18. Stakeholders involved and impacted by the use of TNO's support to PED planning

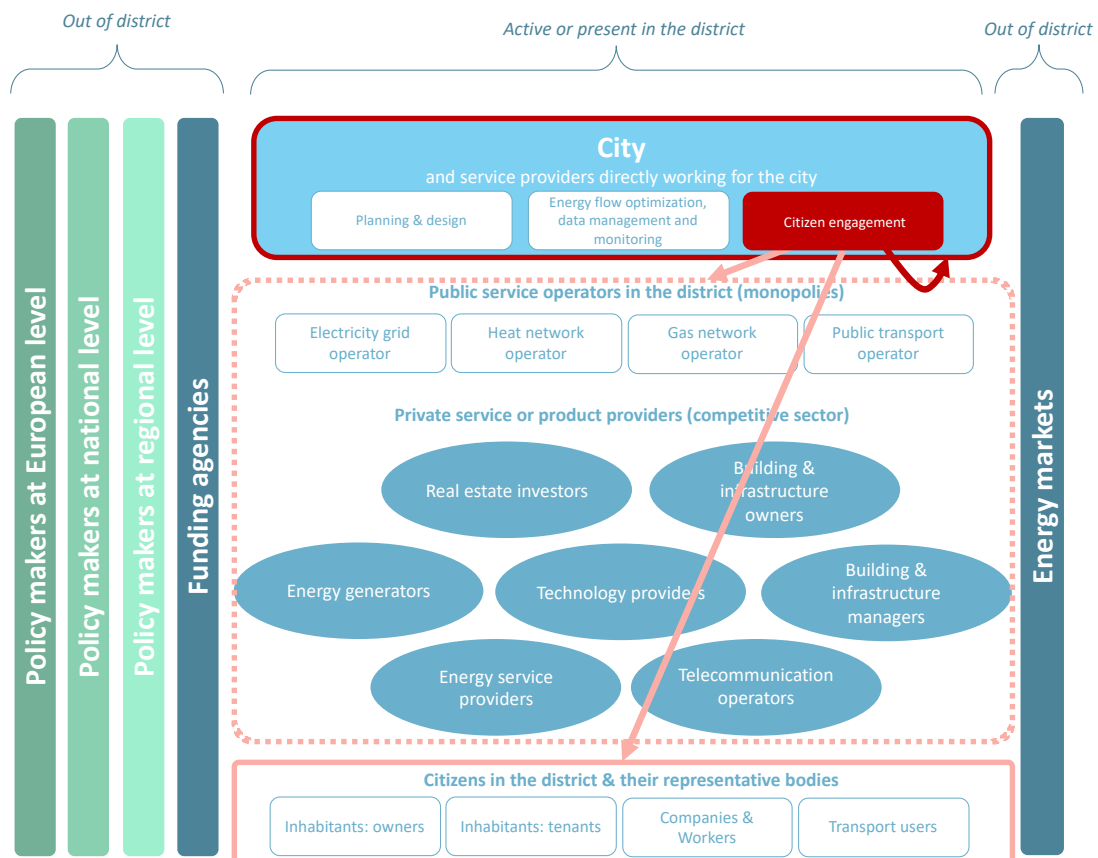


Figure 19. Stakeholders involved and impacted by the use of TNO's participation tool

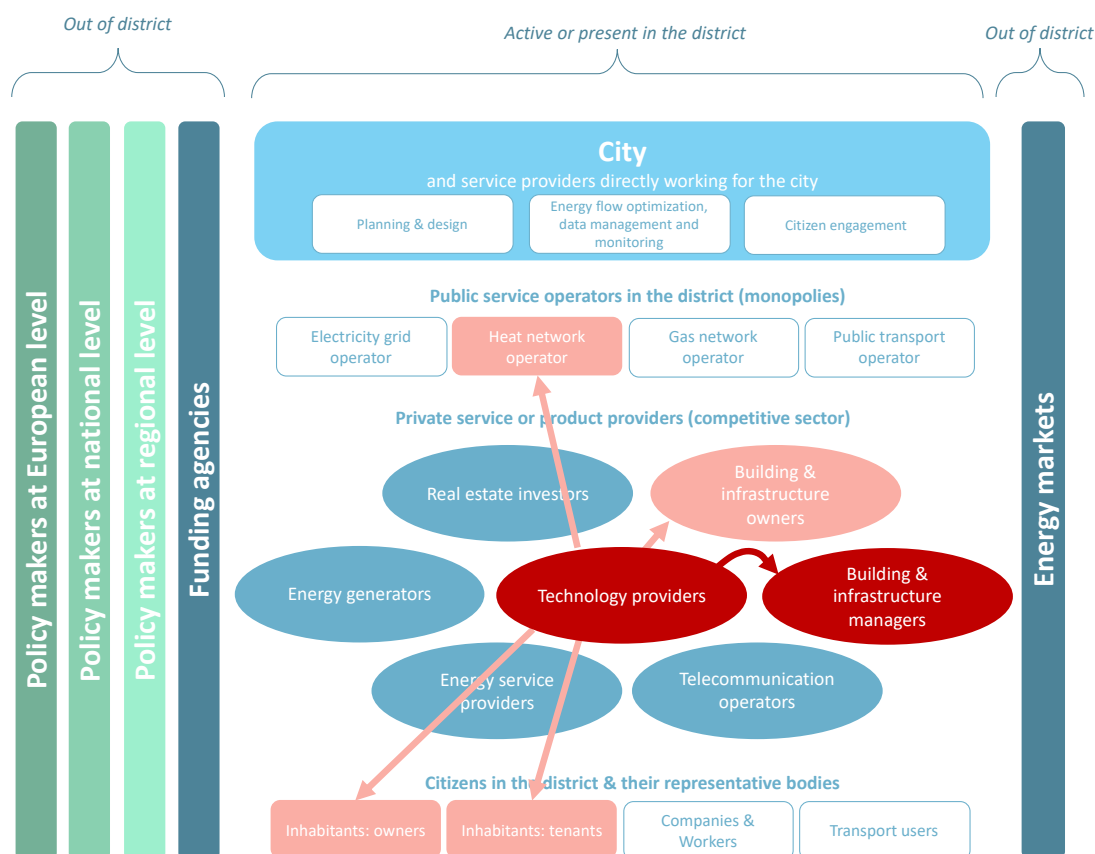


Figure 20. Stakeholders involved and impacted by TNO's HeatMatcher

Other activities might be carried out by TNO, depending on decisions to be taken regarding the exact design of the interventions. For instance, TNO might use its PowerMatcher tool (market-based control algorithm for balancing demand and response in a smart grid environment) in case there is a need to optimize different sources of power. This would be instrumental if a large battery was installed in the PED North – which is not decided yet (Action 28 pending). TNO might also be involved in Action 38 consisting in installing IoT infrastructure that allows for project-wide monitoring and controlling the available appliances and devices that are part of the pilots. But this action is not confirmed yet. Since the implementation of Actions 28 and 38 is uncertain at this stage, they are not considered in the present report.

Finally, TNO considers applying its Urban Financial Model (UFM) in the framework of MAKING-CITY. The UFM intends to support policy makers and private partners in aligning their activities within a neighborhood and seek for mutual benefits, thanks to quantitative insight in cash flows. The ultimate idea is that such win-win activities and alignment opportunities stimulate sustainable investments. This approach, being transversal to the project, is not considered in this report.

5.5.2 Value proposition towards direct users and other stakeholders impacted

Contribution 1) Support to PED planning & design

TNO's Positive Energy District Planning tool is designed to help cities in selecting the best PED locations, help formulate their objectives and vision, facilitate the organization of collaboration between stakeholders to make the realization of PED a success. The planning tool helps identifying barriers for implementation, discussing the counter actions needed to reach the ambitions.

The PED Planning tool supports the city authorities and relevant key stakeholders in the process of organizing, facilitating, planning, designing and realization of future PEDs. By guiding this process with methods like citizen engagement, or collective visioning, adding information and examples, this planning tool will be valuable from the beginning till realization.

Furthermore, TNO's Energy System SIMulation (ESSIM) tool allows modelling and simulating hybrid energy systems based on the Energy System Description Language (ESDL) in which all the actors in an energy system can be described. Simulation includes geospatial and time aspects (seasonal or daily demand/supply profiles). It sees interactions between networks of different energy carriers (electricity, gas, heat, hydrogen, biomass, gas, oil) and of energy storage.

The selected units (houses/buildings) will be modelled as well as the underlying network topology in each district and the result will be combined with the information available regarding energy demand patterns of the units involved as well as the energy production that is made available either to the PED or is produced within the PED.

Based on the results of the simulations the planned activities for the interventions will be fine-tuned to optimise the PED NORTH and SOUTHEAST.

Figure 21 summarizes the value proposition of TNO's planning and design activities.

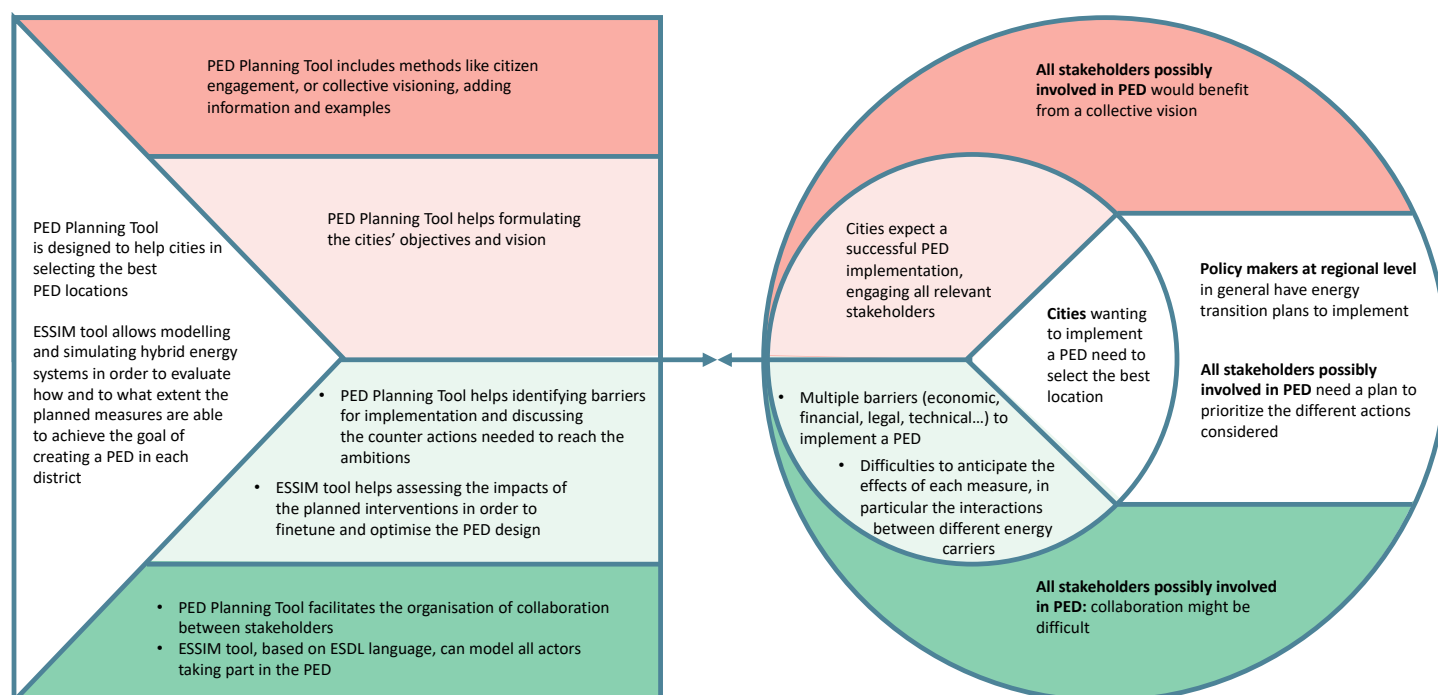


Figure 21. Value proposition canvas for TNO's support to PED planning & design

Contribution 2) Participation tool for social innovation

TNO's participation tool facilitates citizen engagement, participation, formulation and adoption of sustainable solutions (e.g. by individual citizens and local initiatives). It seeks alignment with policy makers and private partners to realize citizen/community benefits, leading to a sustainable ecosystem in collaborations, solutions/value(s), investments and costs.

The tool enables cities and their partners to carry out citizen engagement activities in a structured way.

It helps to create:

- a systemic approach focused on defining and realizing sustainable solutions in the energy transition on a neighbourhood scale that matches policy of the city council, and
- a systemic approach to enhance well-being through neighbourhood improvements (additional value outcomes).

Figure 22 summarizes the value proposition of TNO's participation tool for social innovation.

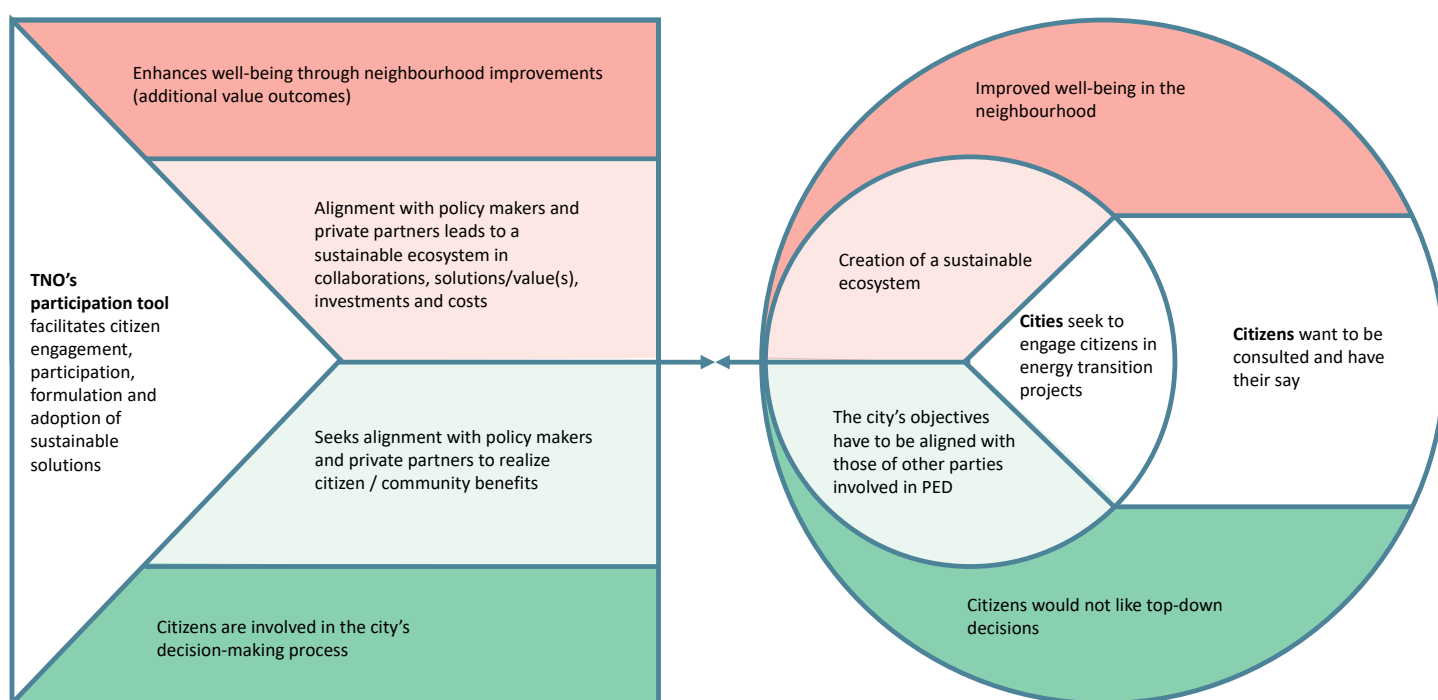


Figure 22. Value proposition canvas for TNO's participation tool for social innovation

Contribution 3) HeatMatcher

HeatMatcher is a software and architecture solution to optimize the heat consumption and production within a heat system. In other words, it is an innovative smart thermal grid controller to coordinate multiple energy producing and consuming components to determine the optimal balance between producers and consumers of heat and cold. This involves choosing the most optimal heating source in order to increase use of renewable energy and/or reduce the operational costs. It supports buildings managers and owners in optimizing their heat system, controlling costs and maximizing the use of renewable energy sources.

Figure 23 summarizes the value proposition of the PED planning tool.

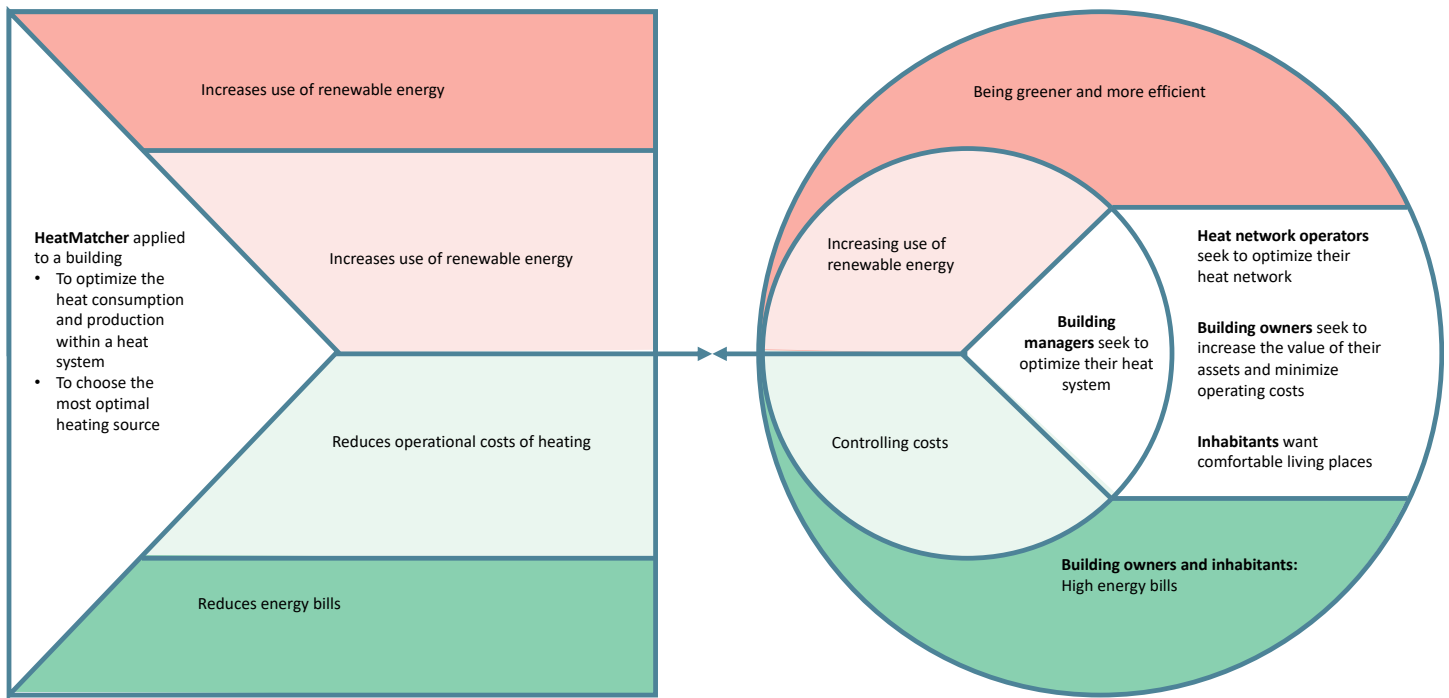


Figure 23. Value proposition canvas for TNO's HeatMatcher

5.6 Actions led by Grunneger Power (GPO)

5.6.1 Identification of actions, direct users and stakeholders impacted

GPO is a non-profit organization launched 7 years ago. The cooperation of GPO represents all citizens of Groningen. Currently GPO has more than 2,000 members. These people also live in the North PED and are both owners and tenants. GPO used to own their own energy company, but the companies split up in the past. Still until today, people can come to GPO for a new energy contract.

GPO started with advising citizens in having rooftop solar panels, who united into a small clean energy company to which people could buy 100% sustainable energy. It then grew based on rewards to members inviting new members to join. Benefits are invested into new local green energy projects for the benefit of the quality of life in the neighborhoods and of the circular economy. The founders of GPO noticed that the (energy) market was regulated by two parties; the government and (commercial) companies. Both parties controlled what happened on this market together. The people did not have a say in anything. GPO wants to mobilize people to be the third party that regulates this market. As a whole, the people have more leverage than as individuals. The final goal is to create a market where the three parties act together and benefit together.

GPO is mainly in charge of citizen engagement activities, to empower the people in Groningen to be in charge of their own energy future. GPO is working hand in hand with the municipality.

Within the MAKING-CITY project, GPO is leading the following actions:

- ▶ **Action 2:** Retrofitting of three terraced private houses (360 m2)
- ▶ **Action 11:** PV in roofs and parking lot
- ▶ **Action 13:** BIPV in terraced houses (0.51 kWp)
- ▶ **Action 18:** PVT in terraced houses (1.76 kWp)
- ▶ **Action 19:** Ridge Boiler in terraced houses

- **Action 23:** Acoustic Air heat pump in terraced house (20 kW)
- **Action 24:** Acoustic Hybrid heat pump in terraced house (5 kW)

GPO is also contributing to **Actions 7 and 8:** Advanced Energy Metering. Other contributions are made to the citizen's engagement activities.

In short, GPO is at the same time an **energy service provider** and a **representative body of inhabitants (owners)**, as represented on Figure 24. The main stakeholders they are targeting are their members themselves (inhabitants/owners). The figure also shows stakeholders impacted by their actions: those are mainly **tenants**, but also possibly the **electricity network operator**, the **gas network operator** and more generally the **energy market** (out of the district).

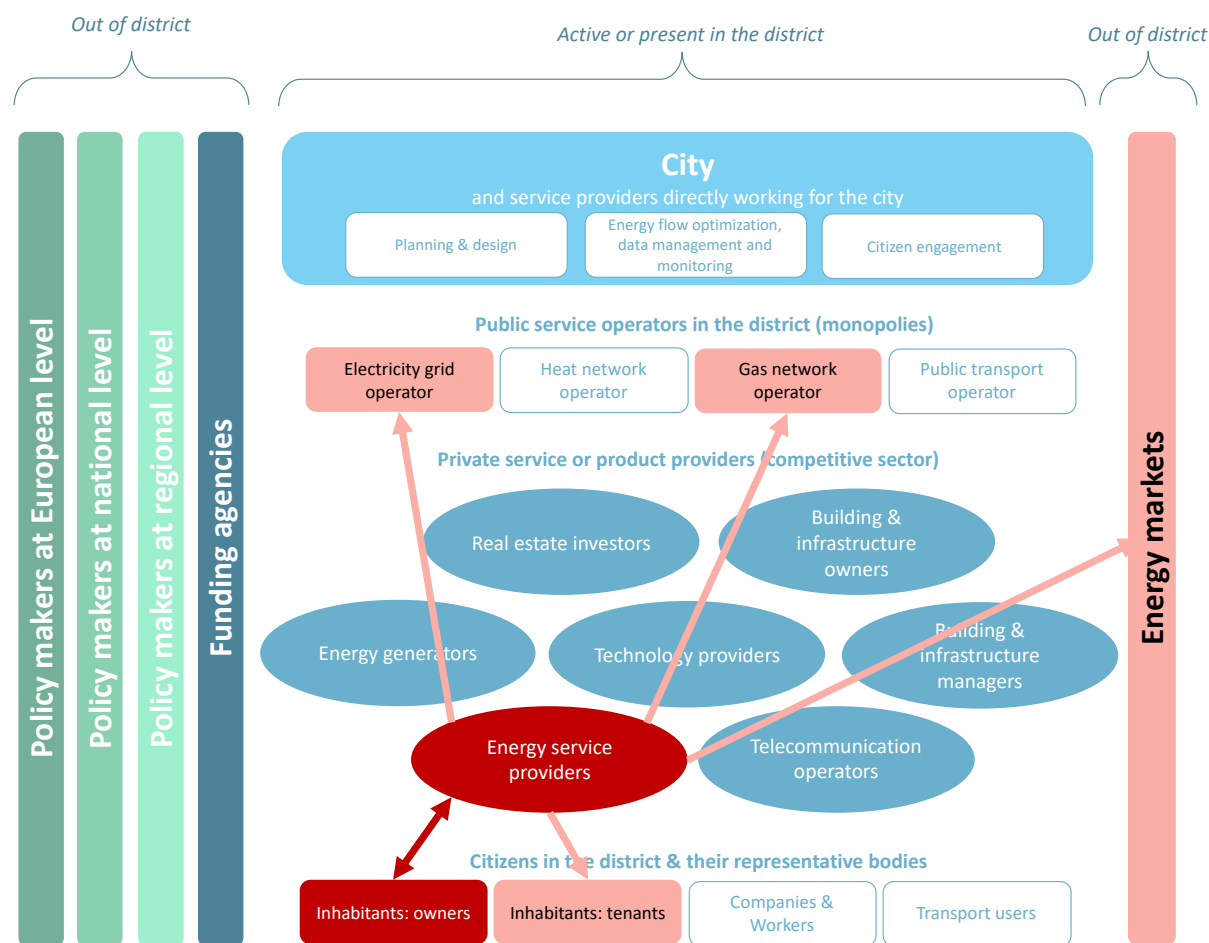


Figure 24. Stakeholders involved and impacted by Grunneger Power's actions

5.6.2 Value proposition towards direct users and other stakeholders impacted

The inhabitants (owners of their apartment or houses) want to retrofit their homes to become more sustainable. They want to invest in their homes with the following objectives:

- (I. financial) to decrease their energy bill, or
- (II. sustainable) to decrease their energy use and therewith their CO₂ emission, or
- (III. comfort) to change their living situation.

In the North district, most houses are from the 60s and 70s with little isolation. In the first place one would not think to this district for being a PED. But for 4-5 years there has been a group of very active and engaged people focusing on energy use and consumption. These people are making the whole district moving towards this direction.

However, people do not own a lot of savings to invest in their homes. When people move to another house, the banks will not add more money to the mortgage, so people cannot invest on the moment they move into a new home.

Usually, Dutch people heat up their homes using natural gas, which is pumped up from underneath Groningen. When this gas resource was found, the Dutch created an infrastructure connecting all households to the gas grid. From the 00's, earthquakes caused by drilling strike the province of Groningen. Drilling for gas becomes less popular, so an alternative heating solution was sought. Newbuild houses can be isolated very well and only have an electricity connection. However, the majority of the houses in the Netherlands cannot be heated up using only electricity (too expensive, too many investments or too few isolation). Richer people living in new homes will only use electricity, which tends to become cheaper in the future. People living in the older homes, need to use gas, which will become scarce and therefore expensive, which means that energy poverty can become a problem in Groningen, specifically in the older houses. The challenge is to give the people in older houses a payable alternative to use less gas and become more sustainable.

Since the investments that are being discussed in MAKING-CITY are quite innovative, the techniques did not have proven themselves yet. People are not willing to take the risk. That's why GPO wants to find the best combination between innovations. Experience feedback from previous projects is being used by GPO which is gathering people to discuss about these experiences (cost, comfort, noise...) in order to convince broadly about the benefits based on experience feedback. GPO intends to mobilize everybody in the neighborhood, in order to show that innovations work, try to scale up the innovative renovation package in order to make it become cheaper and less risky.

Furthermore, people do not know where to start. That's where GPO jumps in. GPO provides advices about how to make a plan, who to talk to, which company to contact, etc.

GPO has also projects with companies; and with tenants (for instance from housing association Nijestee): tenants can rent solar panels together with their apartments.

Cultural aspects: Dutch people are quite direct, they want to have their say, want to see results first. In the Northern part of the country, the trust in national government is very low because of the gas situation. In Groningen, decisions are not taken in a top-down manner, instead inhabitants are consulted, and they want to find themselves in the decisions.

Remark: The homeowners are paying themselves for the retrofitting of their houses. Supporting retrofitting is not a usual activity for GPO which is mainly focused on citizen engagement activities. There is no third-party investment business model which is implemented.

The value proposition of GPO's actions can be summarized as presented by Figure 25.



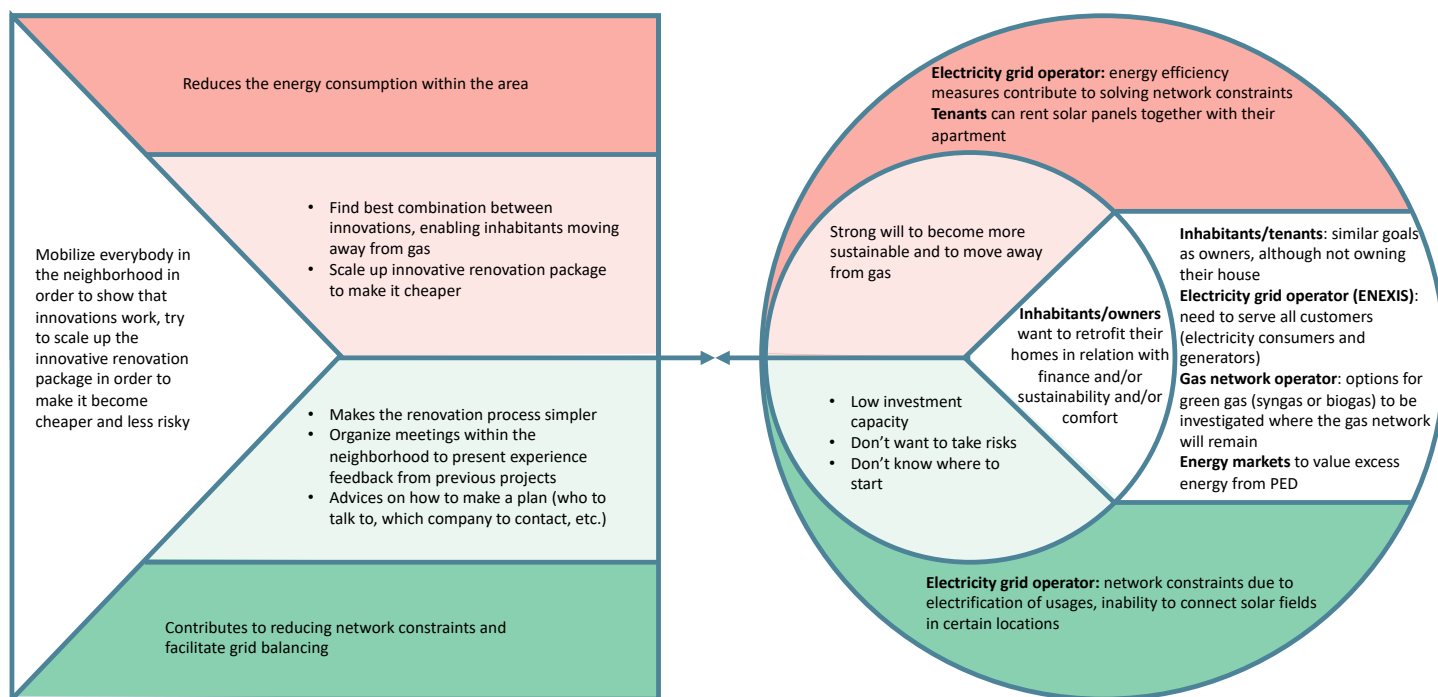


Figure 25. Value proposition canvas for Grunnegeer Power's actions

5.7 Actions led by Waarborg Mediacentrale (WAM)

5.7.1 Identification of actions, direct users and stakeholders impacted

Waarborg Mediacentrale (WAM) is the owner of part of the real estate in the MAKING-CITY project (Mediacentrale and PowerHouse). WAM provides real estate and carries out some technical measures within the following actions:

- ▶ **Action 3:** New Powerhouse apartments
- ▶ **Action 4:** Retrofitting of the office building-Mediacentrale
- ▶ **Action 7:** Advanced energy metering in PowerHouse and in Mediacentrale
- ▶ **Action 10:** HeatMatcher for Mediacentrale
- ▶ **Action 21:** PVT in Mediacentrale
- ▶ **Action 26:** Geothermal heat pumps in Mediacentrale
- ▶ **Action 30:** Thermal storage in Mediacentrale
- ▶ **Action 33:** Smart charging stations

WAM is at the same time **Real estate investor**, **Building & infrastructure owner** and **Building & infrastructure manager**, as illustrated by Figure 26. WAM's targeted users within MAKING-CITY are:

- ▶ **Companies and workers (tenants).** In Mediacentrale (building owned by WAM), office spaces are rented to companies. This is the same for the ground floor office space in PowerHouse.
- ▶ **Inhabitants (owners).** In PowerHouse (building currently being built by WAM – will be finished by end 2019 or beginning 2020), apartments have been sold to future inhabitants. There is also one company which bought 20 apartments (out of 80 in total) to rent them to some tenants.

Energy service providers are likely to be impacted by WAM's actions. In Mediacentrale, WAM is their customer: WAM is buying energy and charge the tenants. In Powerhouse, house owners will have their own individual contracts with energy company.

In addition, other buildings in the surroundings may benefit from the excess energy generated by the PED through **energy markets**.

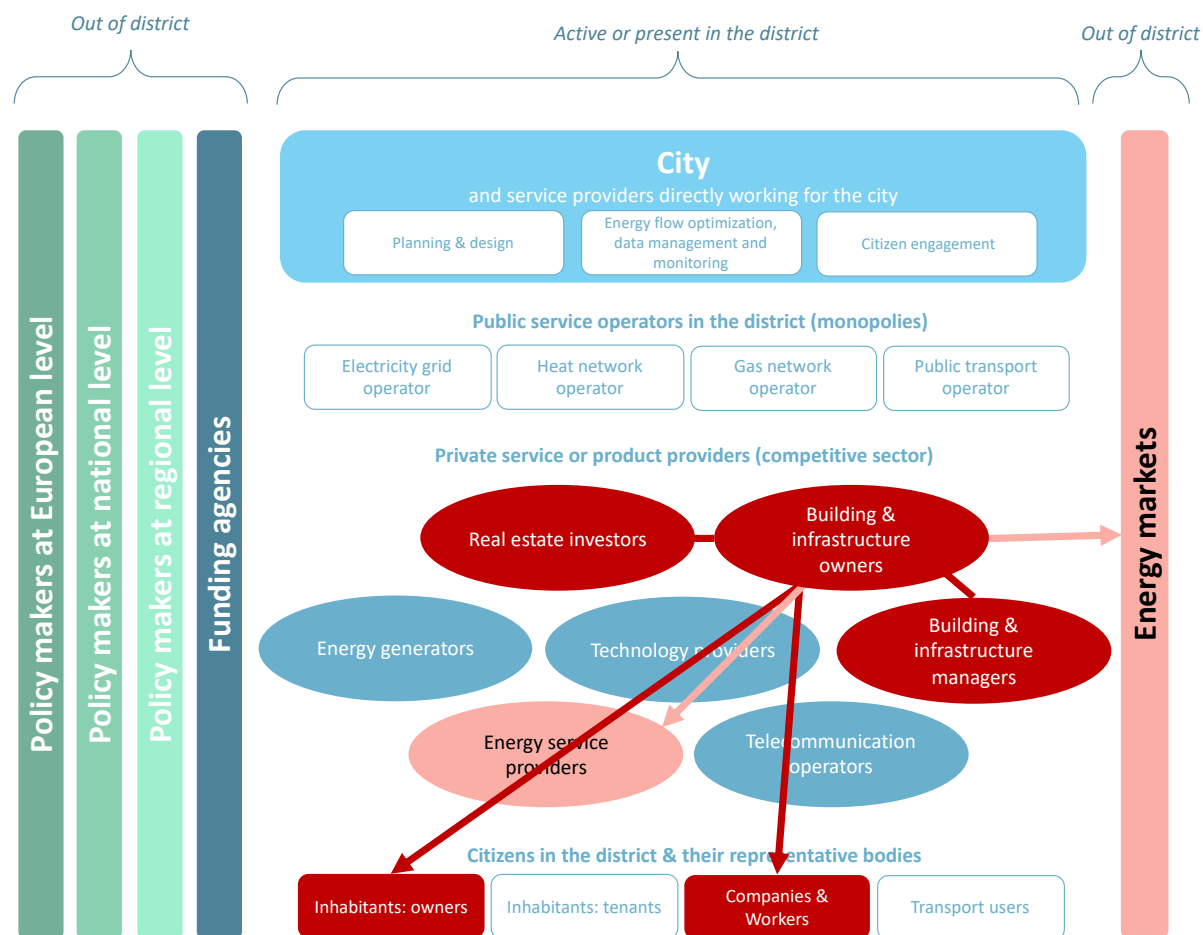


Figure 26. Stakeholders involved and impacted by Waarborg Mediacentrale's actions

5.7.2 Value proposition towards direct users and other stakeholders impacted

In Mediacentrale, there is a community environment, companies can do their business better there than in other buildings. It's a nice working space providing high level of comfort to tenants. Energy, environment and more generally sustainability issues are important to most companies working there. They certainly communicate about being part of a PED, this corresponds to their values and this is good for their reputation.

Powerhouse apartments have all been sold. In Groningen demand for apartments is high. Powerhouse is attractive for inhabitants, it's a nice neighbourhood with a park, stores and a train station. For inhabitants, the connection to the warm water system is a great advantage because gas is more and more unpopular (because of the earthquakes). Energy performance is generally important in inhabitants' point of view.

The effects of the actions undertaken so as to implement the PED concept are not known yet. Anyway, the Mediacentrale will never generate more energy than it consumes, as most office buildings in which there is a high level of activity (contrary to others like sport complex and residential buildings).

The value proposition of WAM's actions can be summarized as presented by Figure 27.

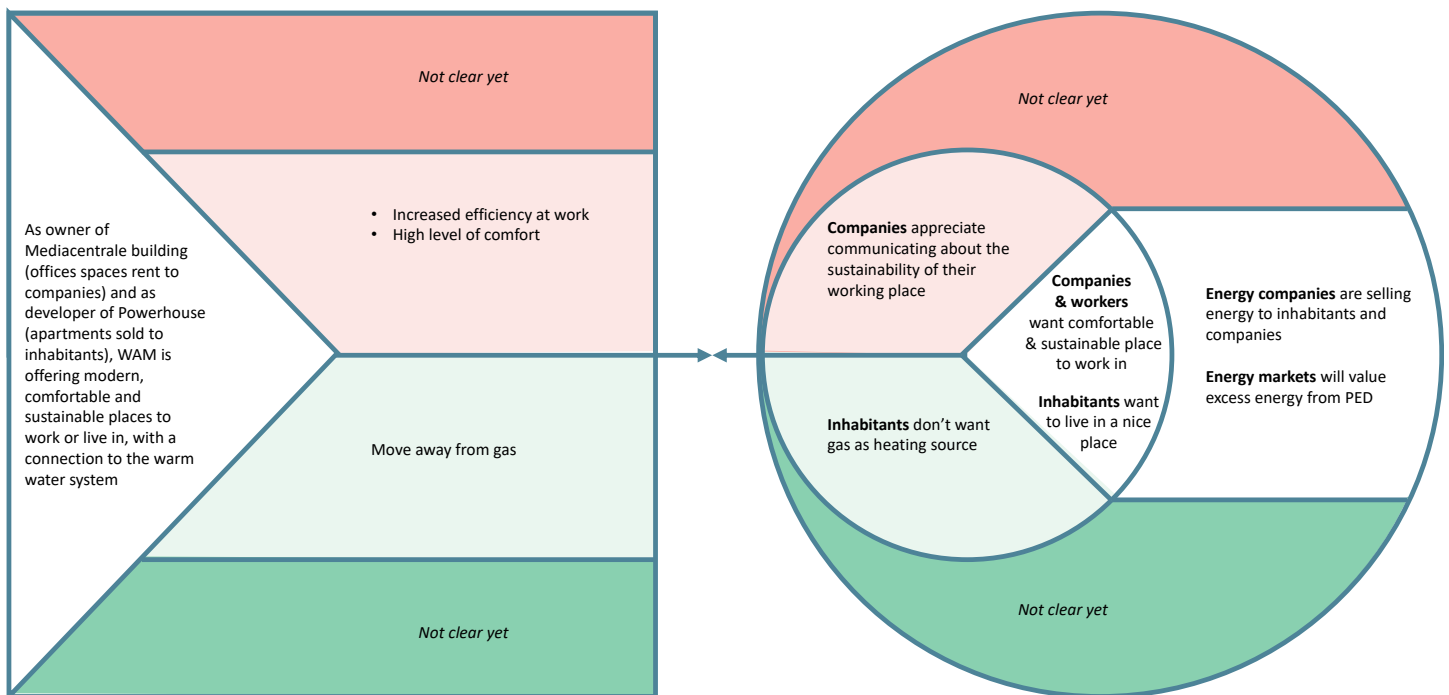


Figure 27. Value proposition canvas for Waarborg Mediacentrale's actions

5.8 Actions led by Nijestee (NIJ)

5.8.1 Identification of actions, direct users and stakeholders impacted

Nijestee is a private non-for-profit organisation. It is a social housing corporation that develops houses for people with a small budget and also rents out these houses and maintain them. Nijestee partners with construction companies to build houses.

Nijestee is the owner of two multi-family residential buildings named Highrise, located in Groningen's North PED. Within MAKING-CITY, the following actions are conducted by Nijestee in relation with these buildings:

- ▶ **Action 1:** Retrofitting of the two Highrise buildings including façade, floor and roof insulation and demand-based ventilation,
- ▶ **Action 9:** HeatMatcher for Highrise¹⁶,
- ▶ **Action 11a:** PV in roofs and parking lots in Highrise,
- ▶ **Action 12:** BIPV in Highrise,
- ▶ **Action 17:** PVT in Highrise,
- ▶ **Action 25:** Geothermal heat pumps for Highrise,
- ▶ **Action 28:** Neighbourhood electro storage facility,
- ▶ **Action 29:** Thermal storage in Highrise¹⁷.

¹⁶ NIJ will do further research to the use of Heatmatcher when NIJ has more ways of supplying heat to our tenants. Since NIJ only can use the heat from Warmtestad, there is, according to the Heatmatcher team, no use in installing the Heatmatcher system.

¹⁷ NIJ is currently discussing this point with the municipality of Groningen. NIJ is looking for their share in executing this point.

In Figure 28, Nijestee is therefore considered a **building owner** and **building manager**. **Tenants** are the direct beneficiaries of Nijestee's actions. The **heat network operator** (in this case Warmtestad) is a stakeholder impacted by Nijestee's actions.

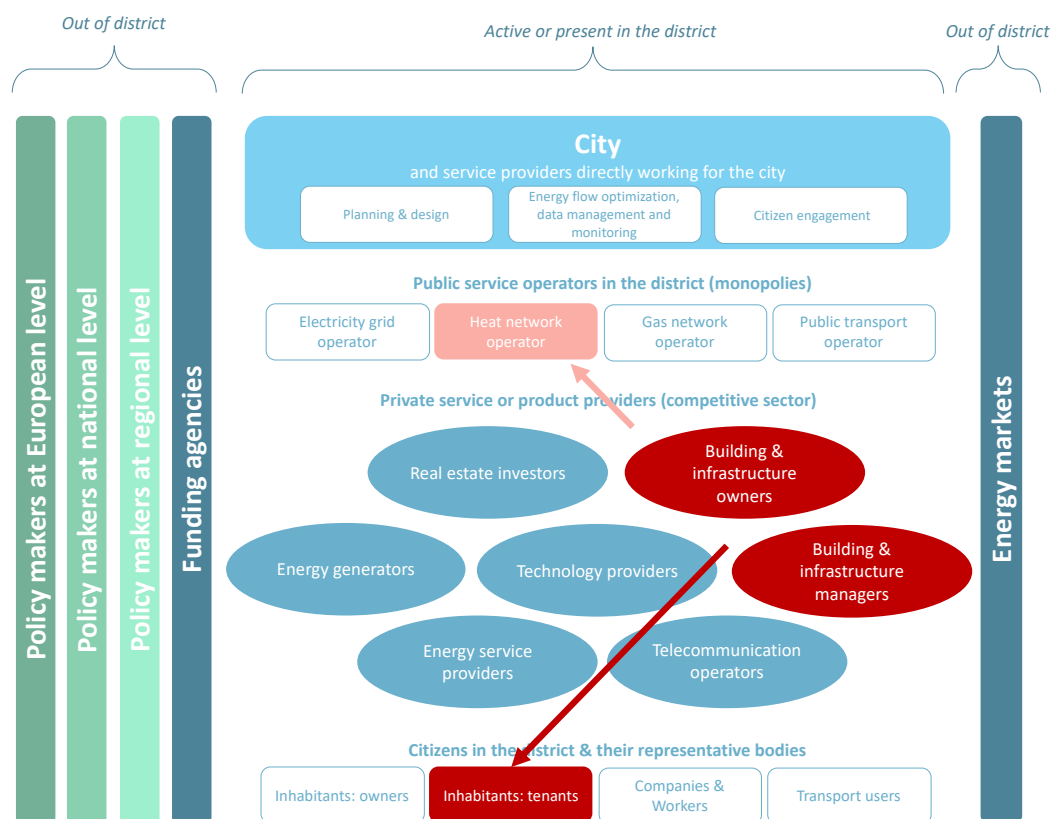


Figure 28. Stakeholders involved and impacted by Nijestee's actions

5.8.2 Value proposition towards direct users and other stakeholders impacted

Nijestee aims at renting out affordable (social) houses for people with not a lot of money. Nijestee tries to do this at the lowest possible rent and also to take energy costs into account.

Within MAKING-CITY, Nijestee's actions all aim at reducing energy costs, which is for the benefit of tenants, either directly (in relation with energy consumption in apartments) or indirectly (in relation with energy consumption in shared areas: elevators, lights in lobbies and corridors, etc.). In some way, Nijestee is also a beneficiary of the actions since energy in buildings will be better managed.

Nijestee's tenants are modest families. They wish to have comfortable houses with affordable energy costs. Energy bills are pains to them, especially in those buildings where there is collective energy system. In this case, individual bills might not correspond to individual consumption. For instance, some tenants have very high energy costs, but the reason is not always known. It can be due to own energy consumption or to the collective aspect.

In buildings where there is a collective system, the retrofitting will include individual energy meters for each apartment. Therefore, tenants will get a clear overview of their energy consumption in the house, so that what they pay for energy is also the real amount of energy they use.

It is expected that energy bills will decrease thanks to the retrofitting and the introduction of individual meters.

The heat network operator, Warmtestad, should be impacted by Nijestee's actions. Thanks to these actions, NIJESTEE contributes to Warmtestad's growth (increase of heat demand from heat network). NIJESTEE will get rid of the 2 gas boilers currently installed in each building.

The value proposition of Nijestee's actions can be summarized as presented by Figure 29.

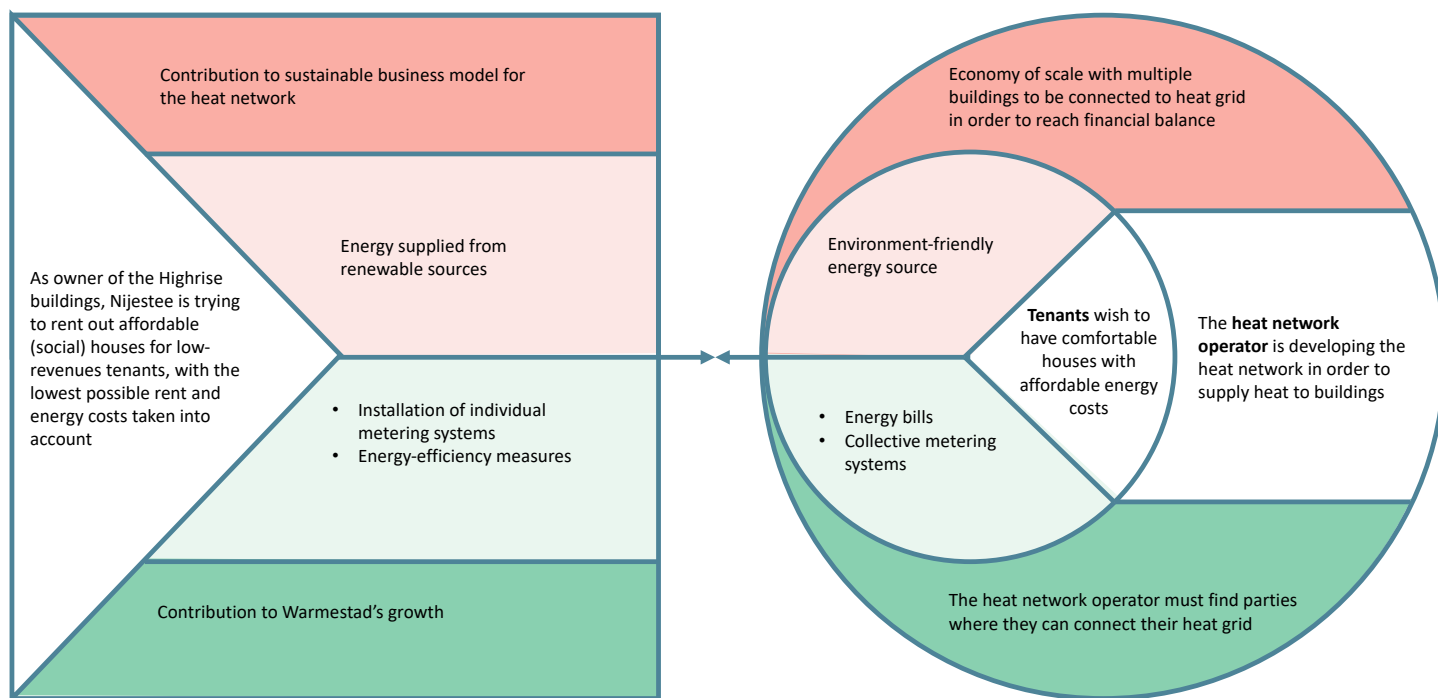


Figure 29. Value proposition canvas for Nijestee's actions

5.9 Actions led by CGI Nederland (CGI)

5.9.1 Identification of actions, direct users and stakeholders impacted

Within the project, CGI collect the data, process it and enable others to use it. To be able to do so, they use their Urban Data Platform. On Figure 30, they are therefore identified as **Service providers for the City: Energy flow optimization, data management and monitoring**. Their direct customer is therefore the **City** itself and possibly the **other service providers working for the City**. CGI is leading the following actions:

- ▶ **Action 8:** Demand Response
- ▶ **Action 34:** Connection of the charging stations to the local demand response system
- ▶ **Action 36:** Energy data monitoring
- ▶ **Action 37:** Integration of new services to the data platform

These actions aim at collecting data and making them available for others to create new services. For instance, favorable conditions are created for demand response (DR) to emerge, but no DR program is developed in the framework of the project. The project is not directly connected with the network operator nor with energy markets. This is however something to be considered, since the excess energy generated by the PEDs has to be valued somehow.

Stakeholders possibly impacted by CGI's actions include **Electricity grid operator**, **inhabitants** and, to some extent, **transport users** who may provide flexibility to the grid operator, which would be enabled by the data platform.

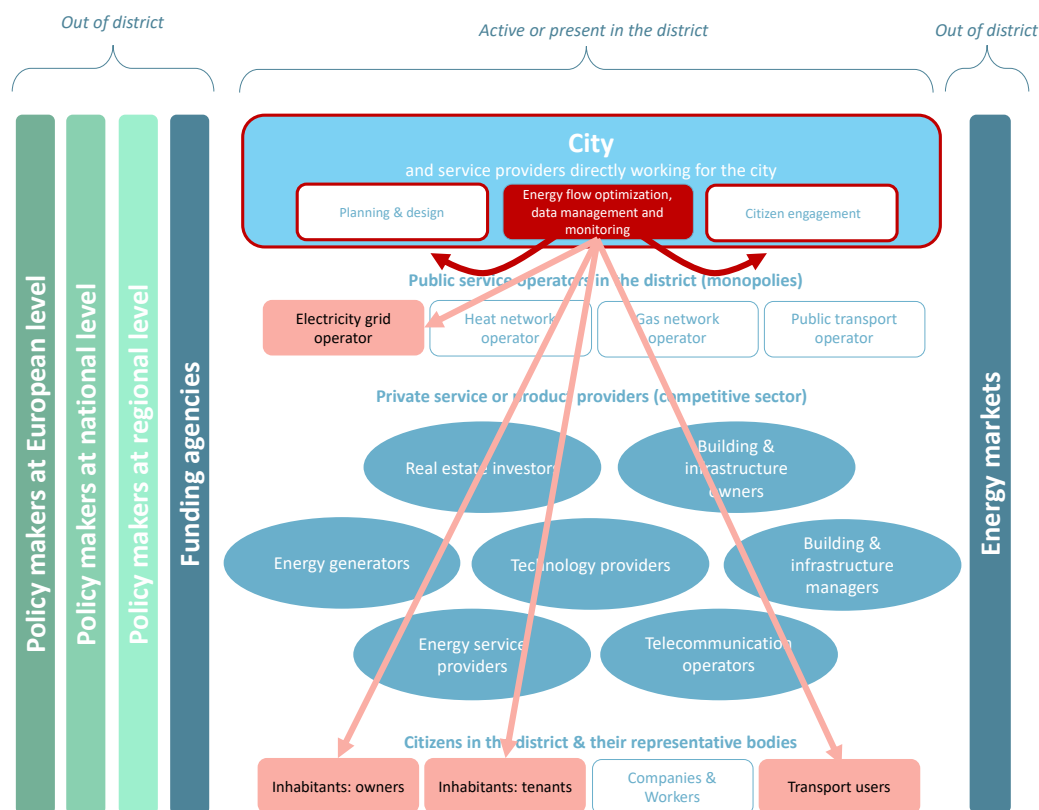


Figure 30. Stakeholders involved and impacted by CGI's actions

5.9.2 Value proposition towards direct users and other stakeholders impacted

The Municipality of Groningen wants to create a smart city around three pillars: People, Planet, Prosperity. In this aim, they need data to help design policies. Usually, cities are struggling to obtain such data. The city is expecting to have a monitoring tool with real time data for decision making. Data is expected to be aggregated at different levels (building, district, etc.).

CGI's platform provides the data insights to make decisions regarding investments and measurements towards a low carbon city, thus achieving the execution of the city's energy transition policy.

Electricity grid operators could benefit from this platform if data and models were shared with them to support their forecasting & planning processes and more generally to balance the grid. This would allow a better use of existing infrastructure and would avoid or postpone the need for new infrastructure.

Inhabitants would indirectly benefit from such platform which could be useful to address issues such as increasing energy bills, air pollution and more generally health. Air pollution in Dutch cities is a big problem. The platform would facilitate the achievement of sustainability projects, thus contributing to improved living environment at affordable costs.

Transport users (including public transport with e-buses) would benefit from the deployment of EVs which would be facilitated thanks to such data platform; in particular, EVs may provide flexibility to grid operators.

The value proposition of CGI's actions can be summarized as presented by Figure 31.

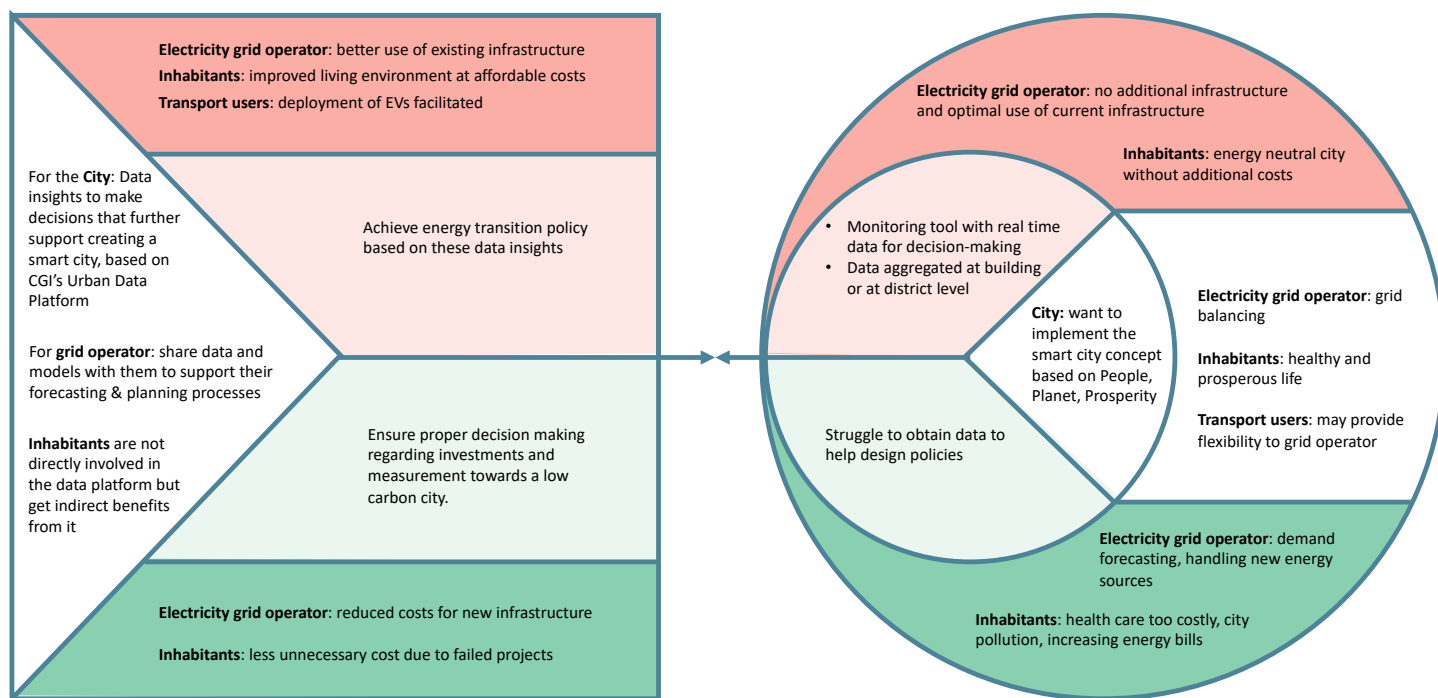


Figure 31. Value proposition canvas for CGI's actions

5.10 Actions led by Sustainable Buildings (SB)

5.10.1 Identification of actions, direct users and stakeholders impacted

Within the project, SB is a **Service provider for the City: Energy flow optimization, data management and monitoring**. SB is leading **Action 7** (Advanced energy metering). SB is responsible for collecting the consumption and production data. Based on the data needed, SB will specify the most suitable hardware solutions (meters, sensors) and will select hardware providers. SB will ensure the hardware devices installed provide the required data, all in the same way. SB provides the software tool to collect the data, and performs, to some extent, data analysis.

The main users targeted are the **policy makers (cities)**.

Building owners and **building managers** are also targeted, since devices have to be installed in the buildings themselves. For large organizations like Nijestee and Waarborg, contact persons are energy managers: at organization level, they have energy efficiency targets (for instance, decrease of energy consumption of 2% per year). The other stakeholders impacted are mainly **inhabitants**. The **electricity grid operator** might also be positively impacted since the provision of data may enable peak shaving.

Remark: SB collects information from the buildings and CGI uses their data and other data from the city.

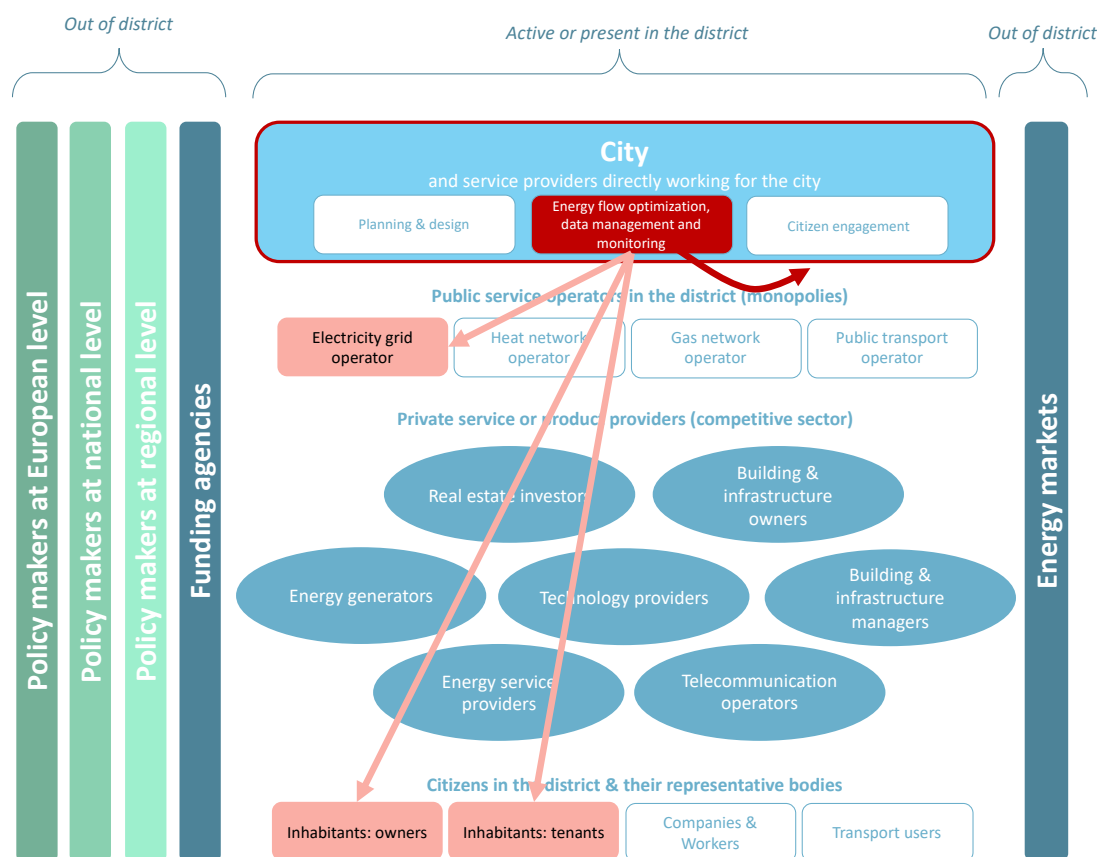


Figure 32. Stakeholders involved and impacted by Sustainable Buildings' actions

5.10.2 Value proposition towards direct users and other stakeholders impacted

Cities need to collect a lot of data. They need reliable data, accessible through a good platform in the way they want. Cities need to have ways to communicate and engage their community and citizens in the progress of realizing PEDs.

Cities, as well as building and infrastructure owners, need to make the right decisions in order to reduce the energy consumption at their premises (houses, buildings, neighbourhood, districts, and city). They need to have fair and clear ways to evaluate the efficiency of the sustainability projects that they invest.

Presently, in general policy makers & energy managers in organisations do not have enough data to do necessary data analysis to have information needed. They are not sure if they have enough information to make such decisions. They do not have a data-driven way to evaluate such projects. When data is available, it is in general in a fragmented way: it is impossible to see the whole picture; independent systems are used for energy consumption, for energy production and for energy storage (EV charging stations). They do not have effective and convincing ways to engage the community and citizens. Or if they have some ways, it is very time consuming for them to get their jobs done.

They are expecting solutions which would enable data-driven and fact-based decisions, for the sake of energy efficiency and also for enabling demand response and optimization at different scales (building or district). They also expect some simplification, by having a single platform gathering data from different sources, thus enabling better analyses.

The proposed solution consists in choosing the right hardware devices, enabling the provision of the data needed by cities and energy managers. Data is provided through a single platform integrating data related to consumption of each type of device, production, charging stations, storage. Data-driven decision-making is therefore enabled. Simple dashboards are provided. Citizen engagement is facilitated. For instance, cities can send to citizens weekly emails with the most interesting insights. Communication with citizens will be based on facts.

Inhabitants need to reduce their energy bills. Saving opportunities are estimated in a range of 10 to 20 €/month for a family. Thanks to the proposed solution, inhabitants can be provided with data to prove energy saving potential. They are therefore incentivized to change their daily behaviour and to invest in a more energy-efficient devices (for instance, washing-machines), since they can evaluate the payback period. They are informed about the consumption of each of their devices (fridge, lamps, washing-machine, etc.), which makes them aware of savings potential and which supports peak reduction.

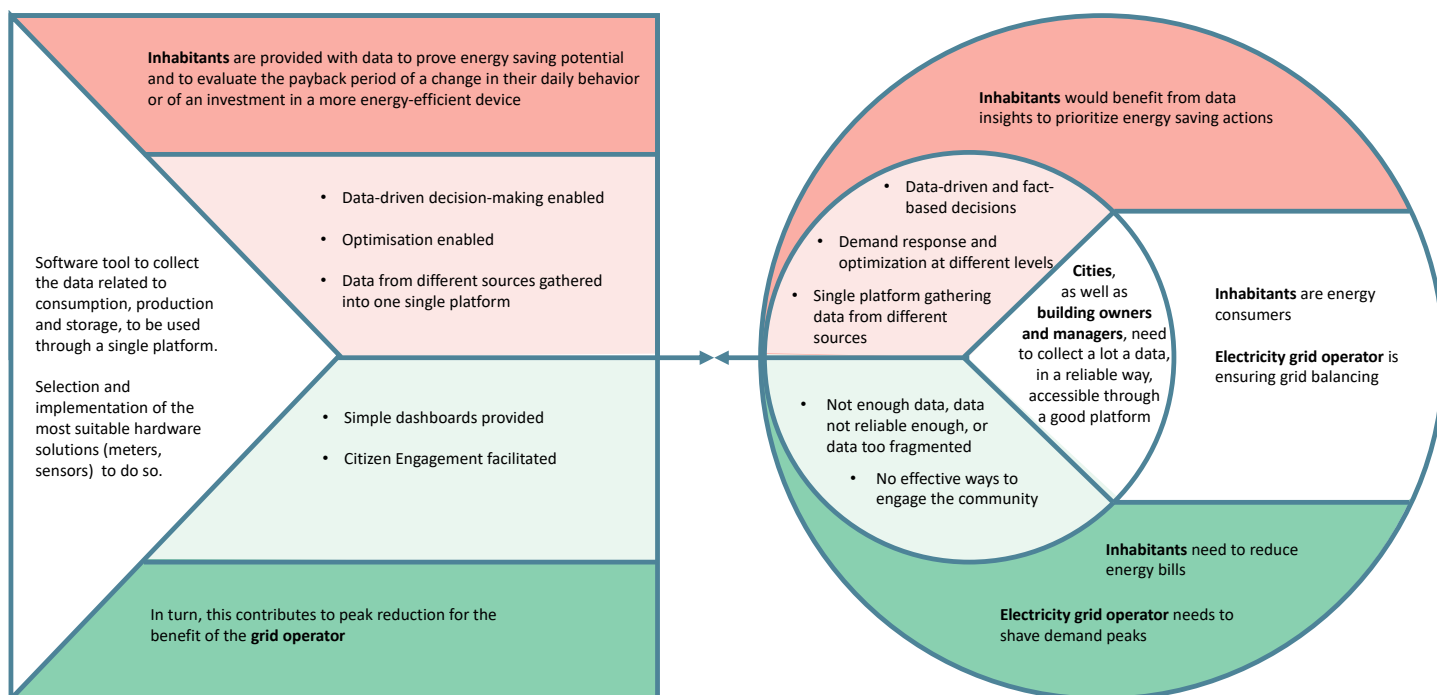


Figure 33. Value proposition canvas for Sustainable Buildings' actions

6 Initial value proposition design for PED in Oulu

In this Chapter, we apply the methodology developed in Chapter 4 to Actions contributing to the PEDs in Oulu.

Naturally, only actions which have been decided so far are listed. Other actions, if any, would be addressed during the next year(s) and integrated in upcoming activities and deliverables.

6.1 Context in Oulu

Oulu was chosen as one of the two “Lighthouse cities” involved in MAKING-CITY due to its current urban energy transformation strategy. The city council of Oulu adopted in 2012 the Sustainable Energy and Climate Action Plan (SECAP) targeting a 20% reduction of Oulu’s carbon gas emissions by 2020. Actions such as improving public water management, increasing renewables as energy sources, or developing biogas plants, are expected to achieve this objective. More recently, the 2018 “Light of the North” strategy was adopted reinforcing the willingness of the city to act for sustainable urban energy transformation.

In Oulu, the district of Kaukovainio was selected to implement the PED concept developed in MAKING-CITY. Located 3 km away from the city centre, this urban area gathers nearly 4,700 inhabitants and is mainly dominated by high-rise buildings and individual houses. The PED approach aims at revitalising the district by attracting more residents and families, fostering a community spirit, advancing equality between population groups, and promoting sustainability.

Overall, the PED implementation in Kaukovainio will be driven by the 2012 Master Plan for “land use, environmental, and transport” which is based on open meetings gathering residents, key players and Oulu representatives. Firstly, the retrofitting of residential buildings (windows, home energy controllers to monitor air quality and the energy consumption...) will allow to maximise infrastructure performance.

Furthermore, geothermal technology and solar panels will support the existing heating district system. One other innovative feature is the installation of geothermal heat pumps and thermal energy storage boreholes at the earth of the Arina shopping centre. Coupled with solar panels covering the roof of this building, the tanks will assure a seasonal energy storage: on summer, the extra energy produced will be redistributed into the district network (heating and hot water), or stored for winter energy demand peaks.

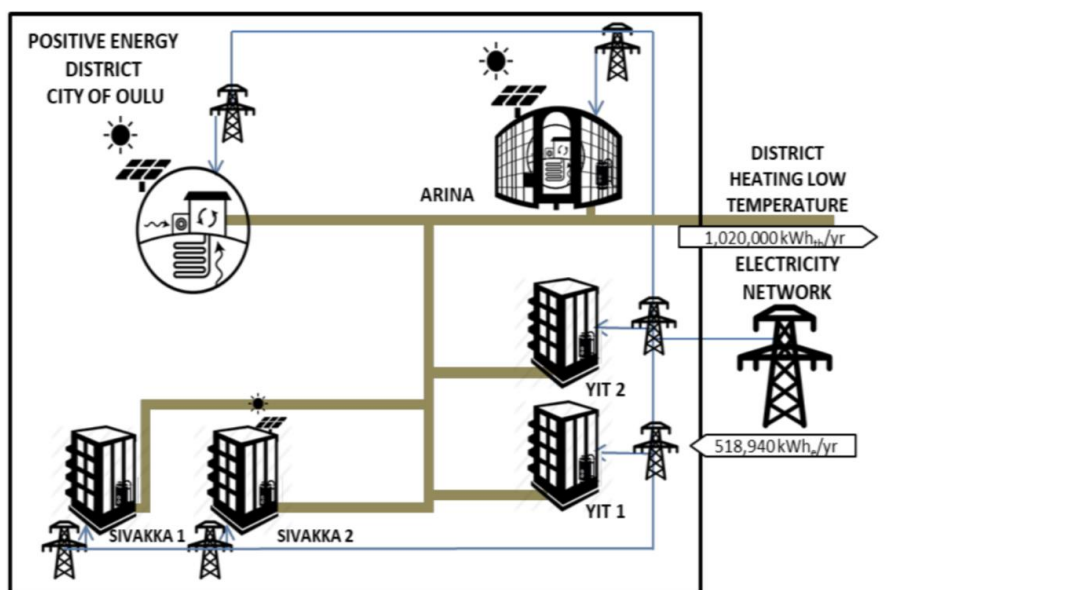


Figure 34 shows in a simplified manner the main components of the Kaukovainio PED developed in Oulu.

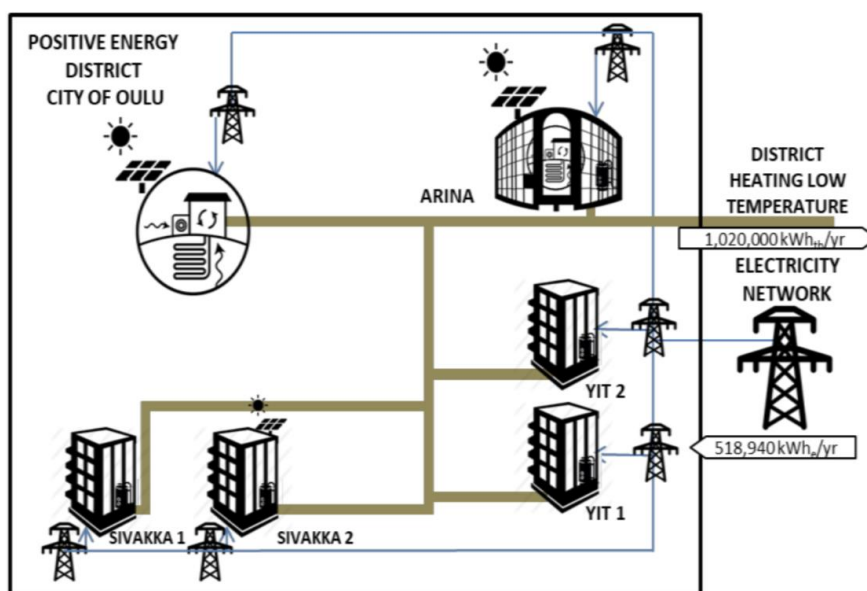


Figure 34. Simplified representation of Oulu PED¹⁸

6.2 Identification of partners contributing to Oulu's PEDs

In a similar manner than what was done with Groningen stakeholders, semi-structured interviews were conducted by R2M Solution with the partners involved in Oulu PEDs. Those interviews were based on a questionnaire prefilled by interviewees, which was then reviewed and completed during the phone interviews. The questionnaire was based on the methodology presented in Chapter 4 (Ad-hoc method to represent business models in the PED concept):

- Identification of the stakeholders directly involved and indirectly impacted,

¹⁸ This is an original figure, which would need to be updated. The amounts of energy have changed since then, but the basic idea is the same.

- Assessment of the profile of these stakeholders: jobs & needs, pains & gains,
- Sketch of the value proposition of the services or products developed.

The questionnaire used to prepare the interviews is presented in Annex 1.

Table 2 shows the partners who were interviewed.

Partners	Role in the project	Persons interviewed	Date of the interview
13-OUK	Municipal regulatory authority responsible for overall governance of the city: policy-making, granting of subsidies and permits	Samuli Rinne	08/07/2019
14-UOU	Development of long-term urban planning methodology fostering PED replication; Study the diverse energy stakeholders' ability and interest in influencing the PED's results; Stakeholder salience analysis	Sari Hirvonen-Kantola	17/06/2019
15-OEN	Leading energy company in Northern Finland, conducting actions linked with local heating plant and district heating network to improve the functioning and the efficiency of the heating system in Oulu	Reijo Pantsar and Mikko Ojala	20/06/2019
16-SIV	Housing company owned by the municipality of Oulu, conducting energy renovation actions in one residential building and construction a new, energy efficient building	Heikki Pohjola, Raimo Hätälä and Kari Puotiniemi	27/06/2019
17-YIT	Construction company building two new private houses in Kaukovainio, making use of innovative technologies	Kristina Vähäkuopus	09/08/2019

Table 2. List of Oulu partners interviewed

6.3 Actions led by the Municipality of Oulu (OUK)

6.3.1 Identification of actions, direct users and stakeholders impacted

The **Municipality of Oulu** is involved in technical and in non-technical actions.

Technical actions are related to the improvement of public lighting by using IoT technologies and monitoring:

- **Action 36:** Smart lighting, power LED,
- **Action 37:** LoRa (Long Range) wireless network and activity sensors to optimize the lighting level.

Non-technical actions, not listed here, include policy innovation actions, business models, new regulations and standards, social awareness, and capacity building.

The main stakeholders targeted by the Municipality of Oulu are the **inhabitants**, being them **owners** or **tenants** of their dwellings. Inhabitants aim at having a comfortable life, feeling at least some kind of independency, feeling being meaningful for some others or for something, being social to suitable extent and in suitable situations.

The **City's staff**, especially the municipality's employees working in energy and environment, are considered as a kind of stakeholder impacted by the City's actions. Municipalities have obligations from the law but still have some freedom of choice. This freedom has to be used to serve people in a pragmatic manner; this is what the municipality's staff is expecting.

Companies active in the city are a secondary target. They form an intermediate layer that citizens need (for providing goods and services, and also jobs), that's why the city may be working at attracting companies, but the primary target of all city's actions is citizens.

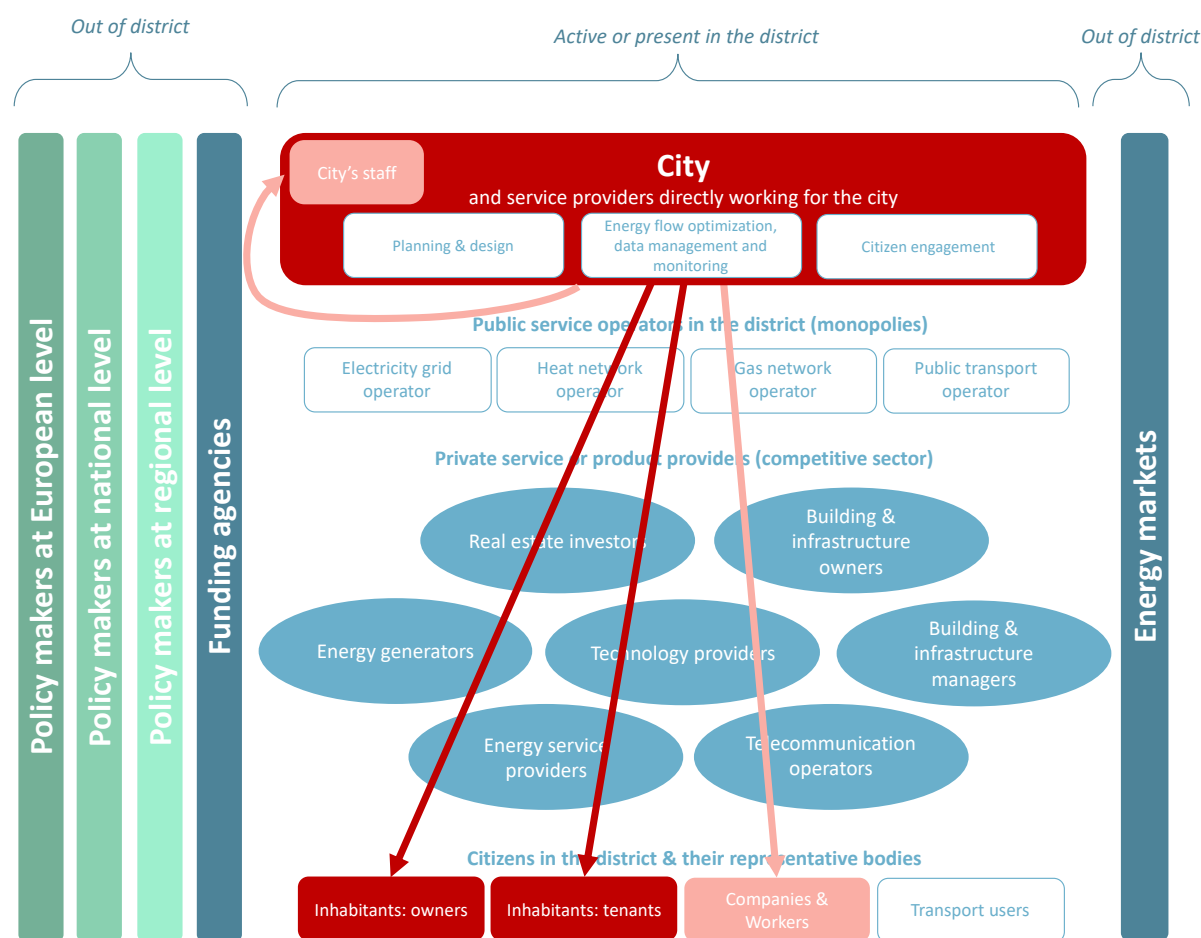


Figure 35. Stakeholders involved and impacted by the Municipality of Oulu's actions

6.3.2 Value proposition towards direct users and other stakeholders impacted

Naturally, there is a big diversity within citizens regarding their energy and environment behaviour. In general, they aim at maintaining the excellent delivery security, affordability, "non-visibility" and environmental values; weights between those objectives vary a lot between individuals.

In Finland, there is a good starting point since the electricity sector has little CO₂ emissions; district heating is well spread, very efficient and is partly based on wood. Wood is also a traditional and quite important heating source in detached houses. Local resources are appreciated, for instance wood from forests growing here. Ground source heat pump is the main heating source for new detached houses. Solar panels are developing – but they cannot be self-sufficient in winter.

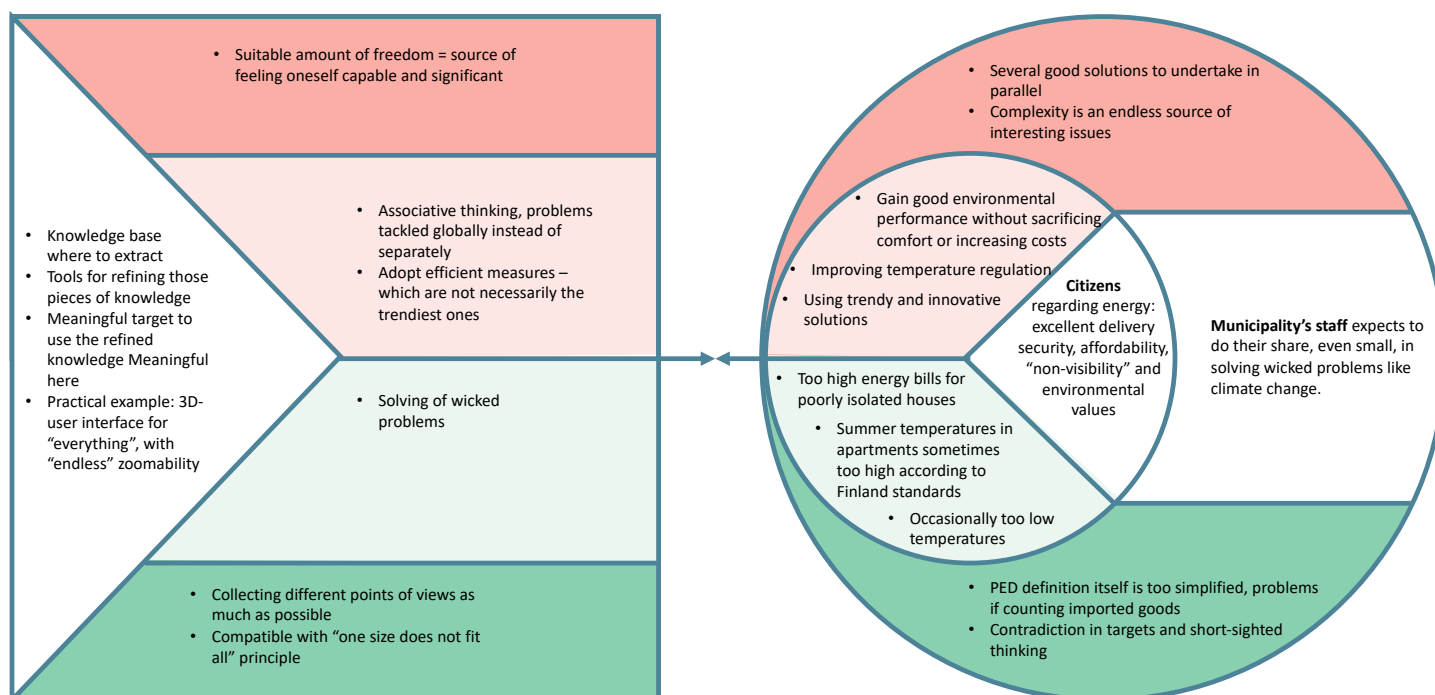


Figure 36. Value proposition canvas for Municipality of Oulu's actions

6.4 Actions led by the University of Oulu (UOU)

6.4.1 Identification of actions, direct users and stakeholders impacted

UOULU contributes to the MAKING-CITY project through two main contributions:

- 1) Development of long-term urban planning methodology fostering PED replication. To enable the replication and scale-up of the Positive Energy Blocks and Districts, UOULU works on the alignment of the urban plans with the energy strategies (WP1) and ecosystemic business models (WP6), and proposes a Simple Rules toolkit regarding the urban planning activities (WP1, WP5). UOULU conducts a causal layered analysis, analysis on the spatial planning systems' capacities to transmit strategic aims to implementation (WP4). As such, UOULU is considered on Figure 37 as a **Service provider for the City regarding planning and design**.

Regarding UOULU's first contribution, the targeted stakeholders are **Cities** (the City of Oulu, but also other Lighthouse and Follower cities). Impacted stakeholders include **Electricity grid operator**, **Heat network operator**, **Technology providers**, **Real estate investors**, **Building and infrastructure managers**, **Inhabitants** (owners, tenants).

- 2) Study the diverse energy stakeholders' ability and interest in influencing the PED's results. Smart home data-based feedback platform will be piloted and the impacts of environmental and social awareness on energy consumption will be assessed (WP2). As such, UOULU is considered on Figure 38 as a **Service provider for the City regarding citizen engagement**. This second contribution corresponds to the following Actions in Oulu PED:

- **Action 7:** Smart building/home energy controllers - Visualisation units to study human behaviour in building 1
- **Action 14:** Smart building/home energy controllers - Visualisation units to study human behaviour in building 2

Stakeholders targeted by UOULU's second contribution are **Inhabitants**, being them **owners** or **tenants** of the dwelling they are living in. Impacted stakeholders include **Electricity grid operator**, **Heat network operator**, **Technology providers**, **Real estate investors**, **Building managers**.

UOULU will also conduct a stakeholder salience analysis, where governmental actors, public organisations, companies and other related associations are surveyed and categorized depending on the stakeholders' ability and interest in influencing the project. The end goal is to have a clear understanding of who the stakeholders are, what their stake is, what their influence will be and how likely they are to use their influence. This study, being transversal to the project, is not considered in this report.

UOULU being involved in Oulu's local ecosystem, responses to the questionnaire have been based not only on UOULU's own opinions and experiences, but also on the knowledge of other Oulu stakeholders' viewpoints.

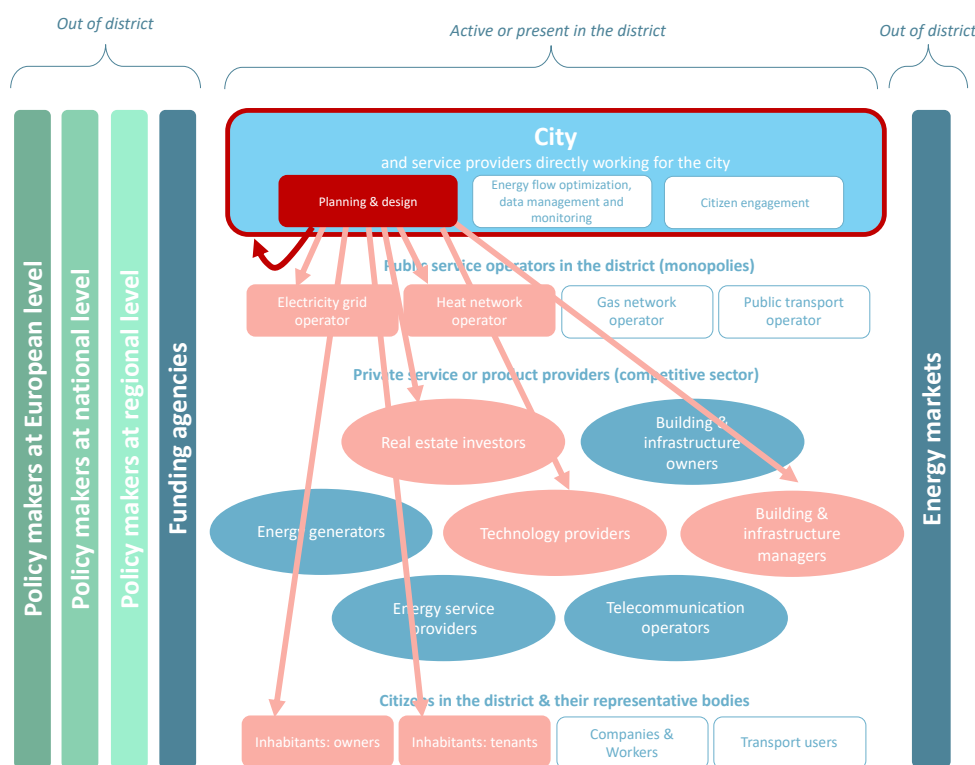


Figure 37. Stakeholders involved and impacted by University of Oulu's first contribution

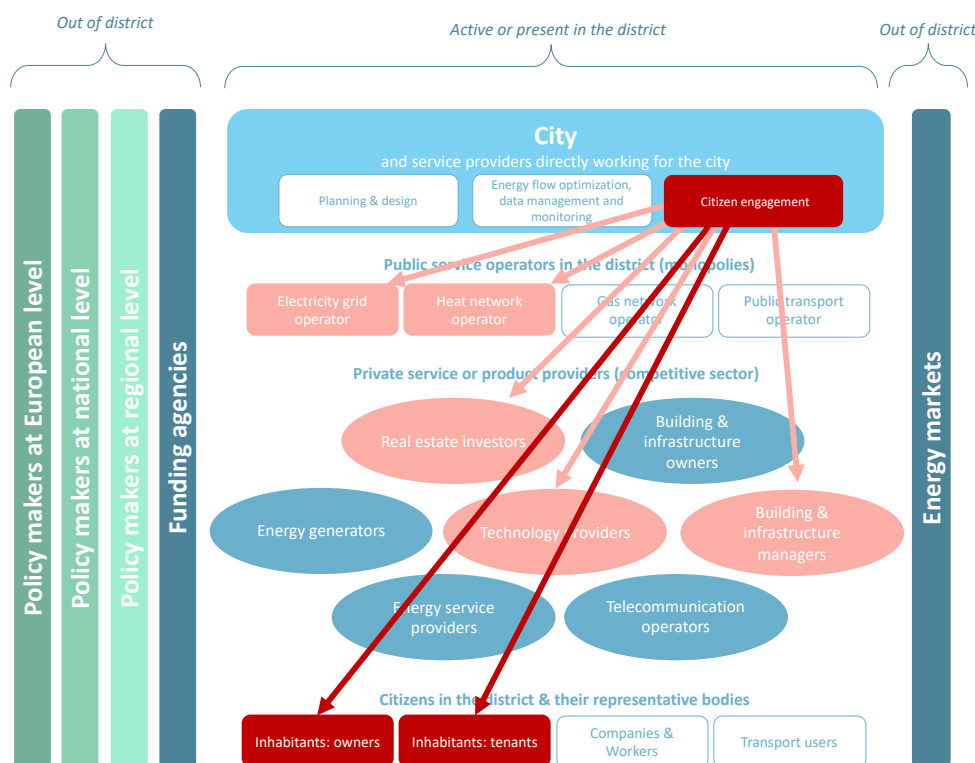


Figure 38. Stakeholders involved and impacted by University of Oulu's second contribution

6.4.2 Value proposition towards direct users and other stakeholders impacted

Contribution 1) Long-term urban planning methodology fostering PED replication

Cities seek to enable the development and implementation of a first PED, and to foster the replication of PEDs. In Oulu context, land use planning is very important in any urban planning. Everything to be replicated needs to take into consideration land-use planning context. Choosing PED location really is difficult, because it depends on the planning context (the question to be answered is: What kind of PED solutions can be implemented in each site?). The methodology developed is to be used by cities, in Finland and beyond.

By implementing a PED, Cities are expecting a reduction in their CO₂ emissions.

Cities are likely to experience the following difficulties before, during and after the implementation of a PED:

- ▶ Before: the integration of all the stakeholders needed to develop and implement the PED,
- ▶ Before: finance of the investments on infrastructure,
- ▶ During: place branding, to create the prerequisites for the building project to get going,
- ▶ After: leadership for the scale up and replication of PEDs.

Regarding the other stakeholders impacted:

- ▶ The electricity grid operator and the heat network operator aim at building a regional system enabling flexible demand response, with diverse sources of energy. In the project, UOULU develops long term urban planning methodology fostering PED replication. As the output,

UOULU will describe potential operational models for the city to consider. This would benefit the heat network operator to build the flexible system for the city area.

- In the electricity grid and the heat network operators' point of view, it is necessary to identify in which geographical contexts PEDs would have the best impact, but also where there are practical prerequisites (future needs for infrastructure investments, urban plans, geographical circumstances, ongoing or future planning and citizen engagement processes).
- In Oulu, the local energy company is city-owned but operates as a business. The PED location should be optimized from the point of view of district heating (which is, in Oulu, the main element for the PED): integration on flow or return pipe, temperature of the water, ability to generate electricity, etc. Thanks to the ongoing project amendment, the PED solution in Oulu will be more decentralized than initially planned. Instead of one huge heat pump in the shopping mall, there will be several, smaller heat pumps in different buildings, which is a more replicable concept.
- With the PED solution to be implemented in Oulu, the electricity grid and heat network operators get new chances to utilize different sources for energy. The heat network operator wants to have the water cold in some parts of the network.
- Real estate investors have difficulties to explain new services' gains for future buyers. When they build apartments, it is difficult for them to price new apartments to be sold. Being in PED, it should be easier, thanks to branding of Kaukovainio (the city tries to help the area to have a positive image). They will get new opportunities to brand their premises.
- Building and infrastructure managers: Depending on the PED solution, there are possibly huge needs for infrastructure investments (heavy negotiation processes). With the initial centralised PED solution, there was a need to build a parallel pipeline to the central district heating (specific pipeline for the PED). With the new decentralized solution, there is no need for such heavy infrastructure investment. It is therefore more replicable.

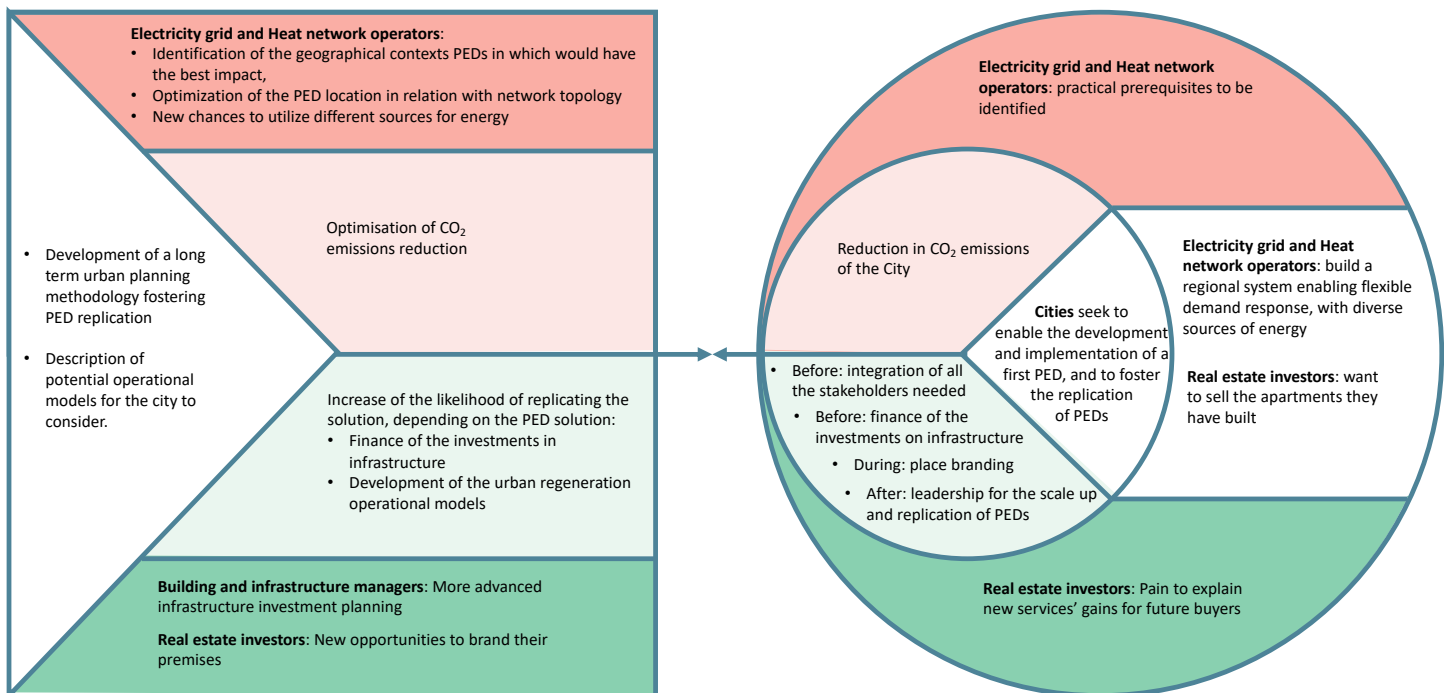


Figure 39. Value proposition canvas for University of Oulu's first contribution

Contribution 2) Smart home data-based feedback platform

For most citizens, today, the demand to monitor and improve consumption is low, but this is expected to grow. Younger people being more and more interested in energy transition, there should be more interest in such app. Today, energy companies provide comparable online apps, but existing apps are focused on kWh, which is not very pleasant for users. They expect a simple, pleasant, easy-to-use and customized interface.

A prototype for a smart home data-based feedback application for tablets will be piloted in the Oulu PED. The purpose is to test motivational factors of consumer engagement. A simple, pleasant, easy-to-use interface for users will be developed. It will enable testing which kind of information will have the best impact on residents' behaviour. In a first stage, UOULU will set up the app. Residents will then choose some options (what information set they found the best etc.). Then, user interface will be modified, slightly tailored, focused on the information each particular resident found the most interesting or useful.

In the application, multiple choices will be set on which environmental indicator the consumer will be informed about whether it is global warming related, or the environmental impact on land use issues, any toxicity level increases, or air quality. The application will help the inhabitants to interpret the effect of their actions. Users will choose the indicator(s) they are the most interested in.

The application will offer the inhabitants optional ways to follow their energy consumption. Having found the motivational way, the application helps the inhabitants to reduce their energy consumption and decrease their costs.

Regarding the other stakeholders impacted:

- ▶ Electricity grid and heat network operators aim at building a regional system enabling flexible demand response, with diverse sources of energy.
- ▶ Real estate investors have difficulties to explain new services' gains for future buyers. Having such an app for the inhabitants should make it easier.
- ▶ Technology providers get new opportunities to test novel solutions and integrate them in the central district heating network.
- ▶ Electricity grid operator, heat network operator, real estate investors and building managers (Sivakka) are involved in discussions with UOULU researchers developing the app.

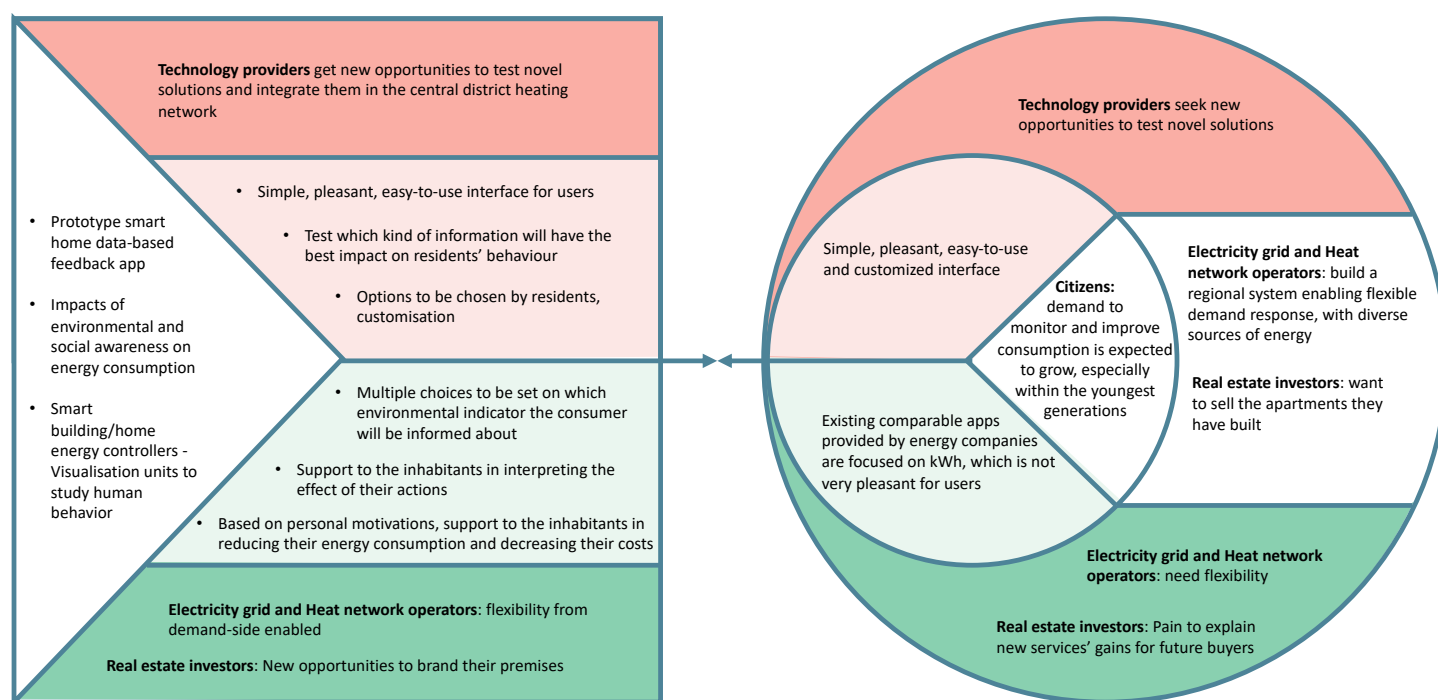


Figure 40. Value proposition canvas for University of Oulu's second contribution

6.5 Actions led by Oulun Energia (OEN)

6.5.1 Identification of actions, direct users and stakeholders impacted

Oulun Energia is the leading energy company in Northern Finland. It is the mother company of several daughter companies, for instance for managing the electricity grid, or for ensuring energy sales. It is the mother company which is involved within MAKING-CITY. The mother company is managing itself the heat network as well as the energy generation facilities (heat and electricity).

Oulun Energia has some competitors in the area with regards to electricity sales. By contrast, in accordance with EU and national regulations, electricity grid management is a monopoly. Heat network management is not a monopoly by law; but in practice, there are no competitors.

Within the project, Oulun Energia is leading actions linked with local heating plant and district heating network (intervention V). Overall, those actions aim to improve the functioning and the efficiency of the heating system in Oulu, which is the main business of the company. These actions are the following:

- ▶ **Action 29:** Low-Temp regional transfer pipeline
- ▶ **Action 30:** 71 kWp in power plant
- ▶ **Action 31:** Advanced heat pump in the local heating plant (high COP 3.5) - 250 kWt
- ▶ **Action 32:** Heat recovery from return pipeline to DHW
- ▶ **Action 33:** Phase transfer liquid heat tank in local heating plant – 500 kWh
- ▶ **Action 35:** Control system in local heating plant

Furthermore, Oulun Energia is involved in two other actions – which are less in line with the company's regular business:

- ▶ **Action 44:** Business model for charging stations
- ▶ **Action 54:** Thermographic and energy production mapping for end-user engagement.

However, Action 44 currently is under discussion. Some changes might be implemented in the framework of the project amendment which is being managed by the municipality of Oulu. Furthermore, Action 54 is of high interest for Oulun Energia, as social awareness and data generating action which contributes enabling new business models involving, for instance, demand response, control and optimization. But it will be kicked-off later during the course of the project, in cooperation with the University of Oulu.

Therefore, the last two actions are not considered in this report, which is focused only on the heating system-related actions.

On Figure 41, Oulun Energia is represented with multiple roles:

- ▶ Service provider to the city for Energy flow optimization, data management and monitoring,
- ▶ Electricity grid operator,
- ▶ Heat network operator,
- ▶ Energy generator,
- ▶ Energy service provider.

Oulun Energia's direct customers are **Building & infrastructure owners and managers**, and **inhabitants being owners of their dwellings**.

Inhabitants of rental units (for instance, tenants in Sivakka rental houses) are impacted stakeholders: they are not direct clients, but the building owners / managers (like Sivakka). **Energy markets** are also impacted because of the sale of excess energy from the PED.

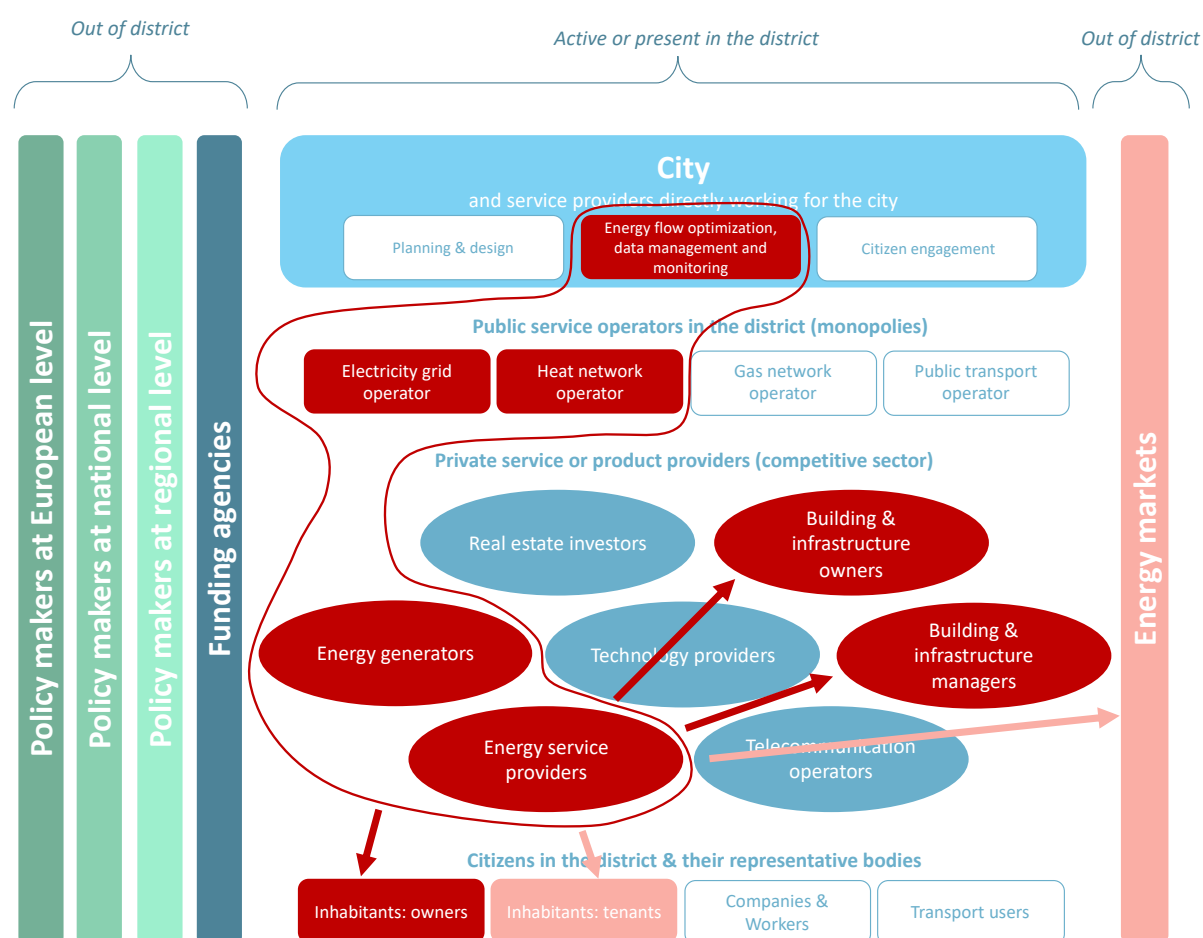


Figure 41. Stakeholders involved and impacted by Oulu Energy's actions

6.5.2 Value proposition towards direct users and other stakeholders impacted

Building and infrastructure owners and managers need heat and electricity to satisfy sufficient living conditions and comfort for the tenants. Inhabitants who are the owners of their house also want comfortable living conditions.

Currently energy costs are a major part of the yearly total costs for building owners / managers. Also, environmental and energy efficiency directives are getting more restricting. In addition, environmental values are getting more important for energy consumers. The current energy solutions are somewhat underperforming in terms of energy efficiency and use of waste energy. The risks and challenges for the current system are keeping up with changing energy regulations and customer needs.

Customers are expecting a more energy- and cost-efficient energy solution. A green solution, which would cut yearly energy costs would satisfy the customer and increase the likelihood of adopting the solution. Inhabitants want improved living conditions, more cost-efficient energy and greener energy solutions.

Oulun Energia is offering complete, optimized and greener heat and electricity solutions for building owners and managers. These solutions can generate savings, improve living conditions of their inhabitants, and promote green values. For building owners and managers energy production and distribution is optimized and their reputation improved by promoting clean energy solutions.

For tenants, the energy bill is included in the rent. This does not facilitate awareness about energy consumption.

Excess electricity is sold on the national electricity market. Excess heat (from the shopping mall) is used in the city heat network operated by Oulun Energia. It supports balancing the network.

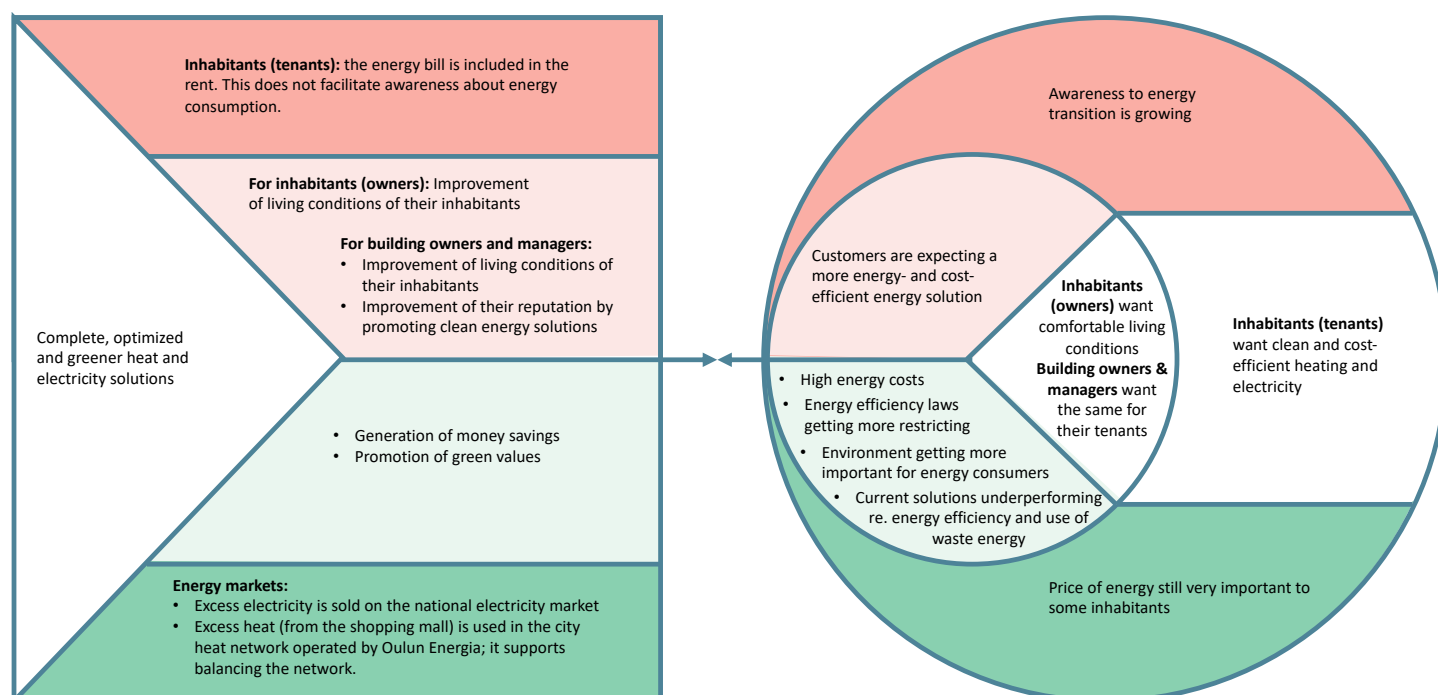


Figure 42. Value proposition canvas for Oulu Energy's actions

6.6 Actions led by Oulun Sivakka (SIV)

6.6.1 Identification of actions, direct users and stakeholders impacted

Oulun Sivakka is a housing company owned by the municipality of Oulu. On Figure 43, Sivakka is considered both as a **building owner** and a **building manager**.

Their direct customers are **tenants** who are living in the apartments owned by Sivakka.

Within MAKING-CITY, Sivakka is responsible for the following actions:

- ▶ **Action 1:** Residential building 1 - New insulation windows (retrofitting of existing building)
- ▶ **Action 2:** Heat recovery system from AC and sewage water in building 1
- ▶ **Action 8:** Residential building 2 – Construction of a new, energy-efficient building
- ▶ **Action 10:** Heat recovery system from AC and sewage water in building 2.

The **district heating operator** is a stakeholder impacted by Sivakka's actions. The electricity grid operator (which is owned by Oulun Energia, itself owned by Oulu municipality) is not taken into account here. At the moment, there is no activity foreseen with an impact on this operator.

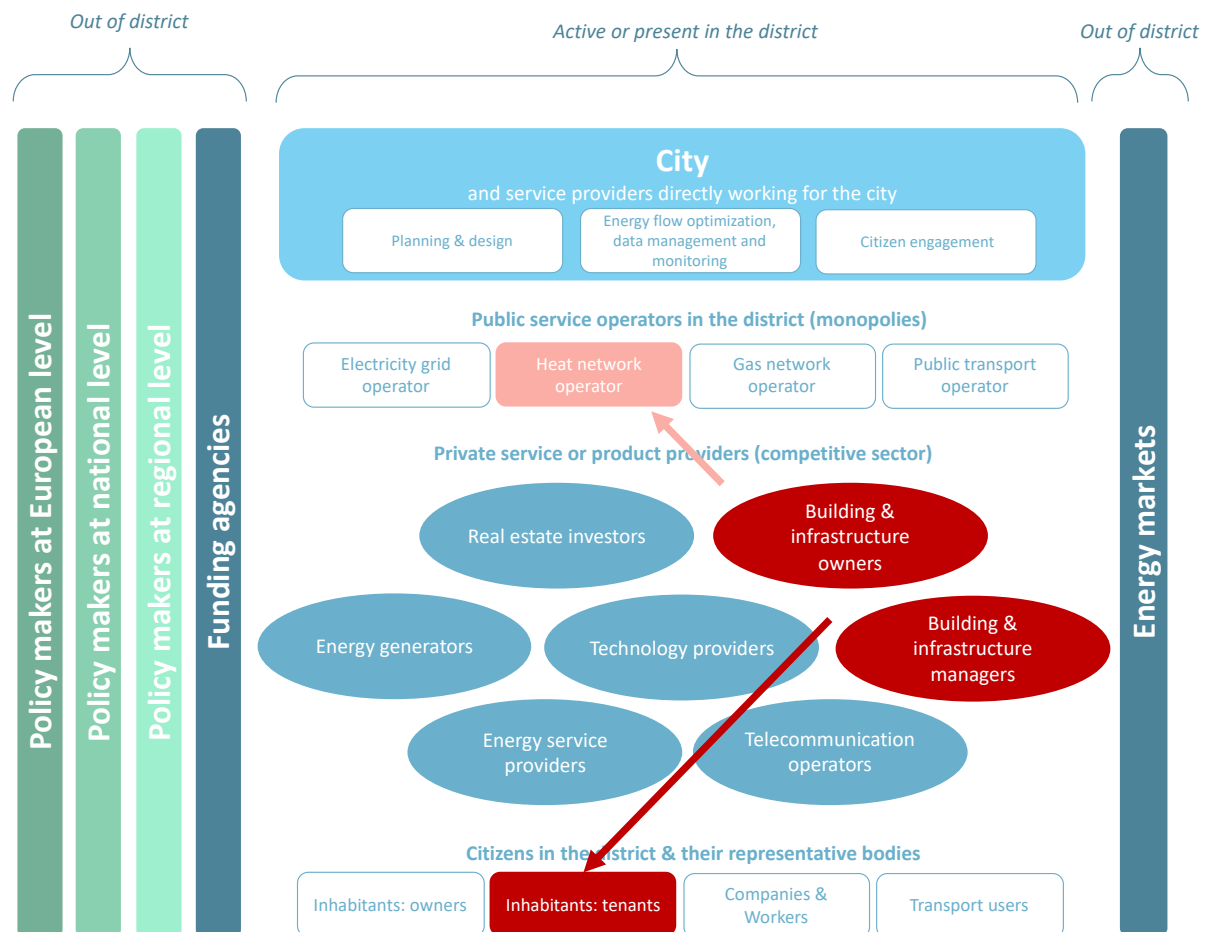


Figure 43. Stakeholders involved and impacted by Oulun Sivakka's actions

6.6.2 Value proposition towards direct users and other stakeholders impacted

Tenants would like to have stable and warm indoor air round the year. Current solutions are working pretty well for them.

Sivakka is paying for the heating of the apartments. The heating bill is included in the rent, however any variation in the energy bill directly impacts tenants (the rent is modified accordingly).

Regular solutions are quite high-quality and energy-efficient in new buildings. Any savings beyond that are welcome.

Easy implementation and maintenance combined with reasonable payback time increases the likelihood of adopting a solution.

The district heating operator is selling heat to customers and they are trying to optimize the heat network. In this case, the client of the district heating operator is Sivakka. Tenants are not in direct contact with the district heating operator.

Keeping the heat network in balance and minimizing heat losses of the network is one of the main challenges for the district heating operator. All members benefit from well-balanced and fully working heating systems. Customer saves energy and money, and the network of the operator is working more efficiently.

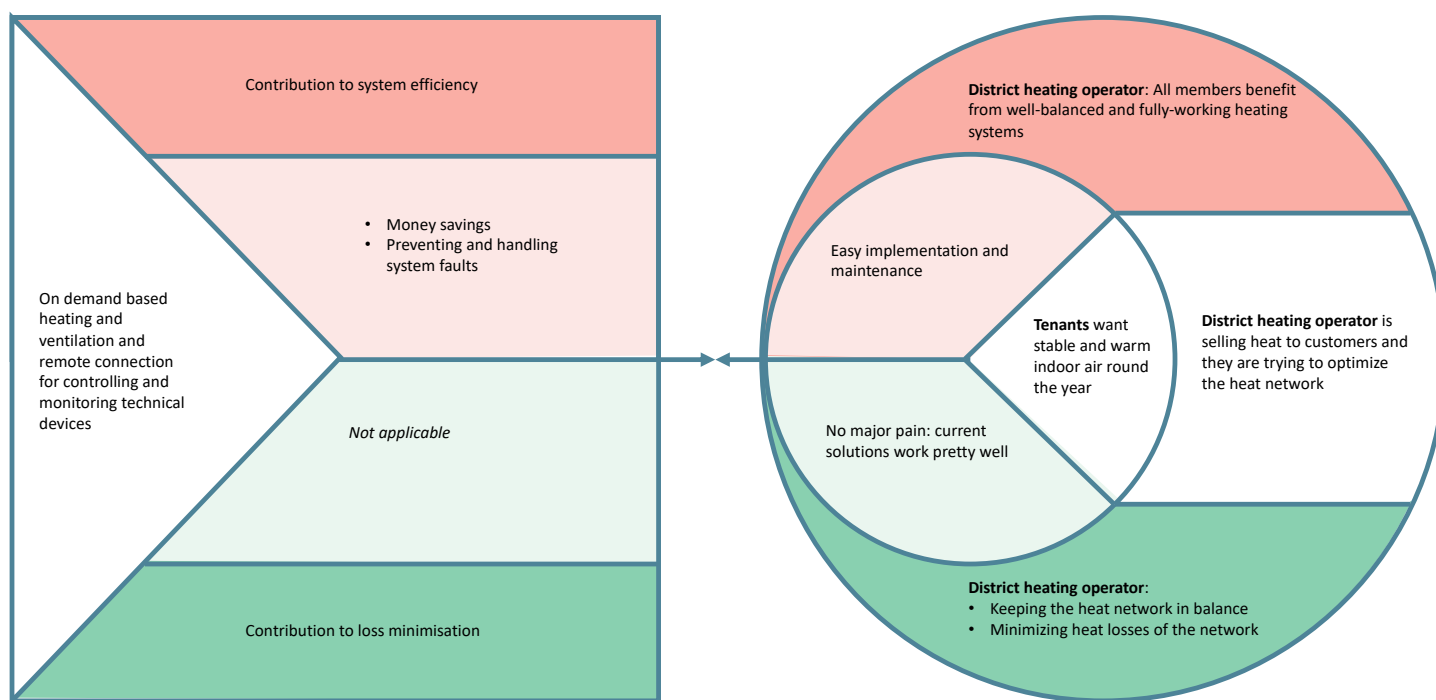


Figure 44. Value proposition canvas for Oulun Sivakka's actions

6.7 Actions led by YIT

6.7.1 Identification of actions, direct users and stakeholders impacted

YIT is the construction company building two new private houses (2,500 m² each) in the framework of MAKING-CITY. This corresponds to [Action 15](#).

These buildings will be equipped with a heat recovery system from AC (Action 16) and will be connected to the district heating (Action 17) and the control system will optimize the energy consumption versus storage capacity and will collect the necessary data for verification and performance analysis (Action 18). The buildings have been designed by YIT architects in such a way that the equipment foreseen in Actions 16, 17 and 18 will be feasible (YIT is not in charge of these actions).

On Figure 45, YIT as a construction company is represented as a **Real estate investor**. Once the buildings built, YIT will sell the apartments and office/shop spaces either to **inhabitants** or to **other real-estate investors** who will in turn rent the apartments to **tenants**.

Energy service providers, **technology providers** and **infrastructure owners** are the other stakeholders impacted by the action.

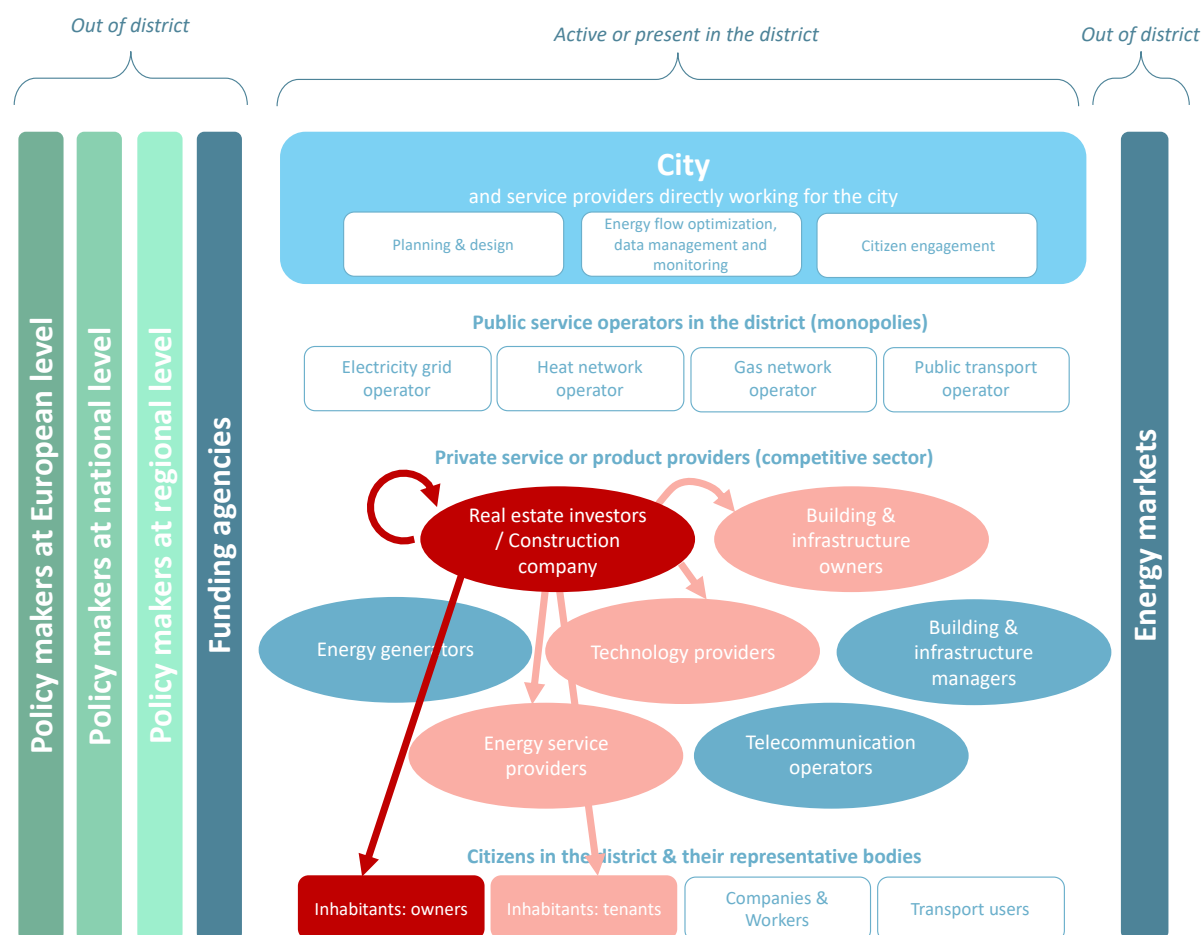


Figure 45. Stakeholders involved and impacted by YIT's actions

6.7.2 Value proposition towards direct users and other stakeholders impacted

In the Kaukovainio PED area the housing stock is old and outdated (no lifts for example) so new buildings are needed.

Risks for inhabitants are mainly related to the value of the apartments (old and new) and for investors also the risk of not finding tenants. The pains include having to look for an apartment (time cost), organizing financing (time cost and actual cost) and often selling the old and outdated apartment (time cost and actual cost).

Gains include better standard of living and the increase in the value of the apartment.

Also, in Kaukovainio PED's case one of the gains can be the knowledge of being a part of the more energy-efficient future. Still, this is not enough to justify higher prices for the apartments. At the moment, YIT is setting quite low prices in order to attract customers to this area in which no new buildings have been built for years. More buildings should be built soon in the area; prices might then go up.

Good location of the building makes everyday life easier plus living in a new and modern building is easier. New housing stock brings new services to the area which in turn improves general living conditions in the area.

New housing stock employs energy service and technology providers and infrastructure owners and may even affect public transport, etc.

Also, new services may arise as new/more people move to the area. In the short term, new services and new equipment should have some impact on energy service providers & technology providers. In the longer term, the growth of population in the area will have an even bigger impact, since infrastructure will have to be adapted (electricity grid, bus lines, roads, heating network...) to be able to handle new customers. In particular, energy-efficient houses should attract younger people to live there, infrastructures will have to be adapted to their needs.

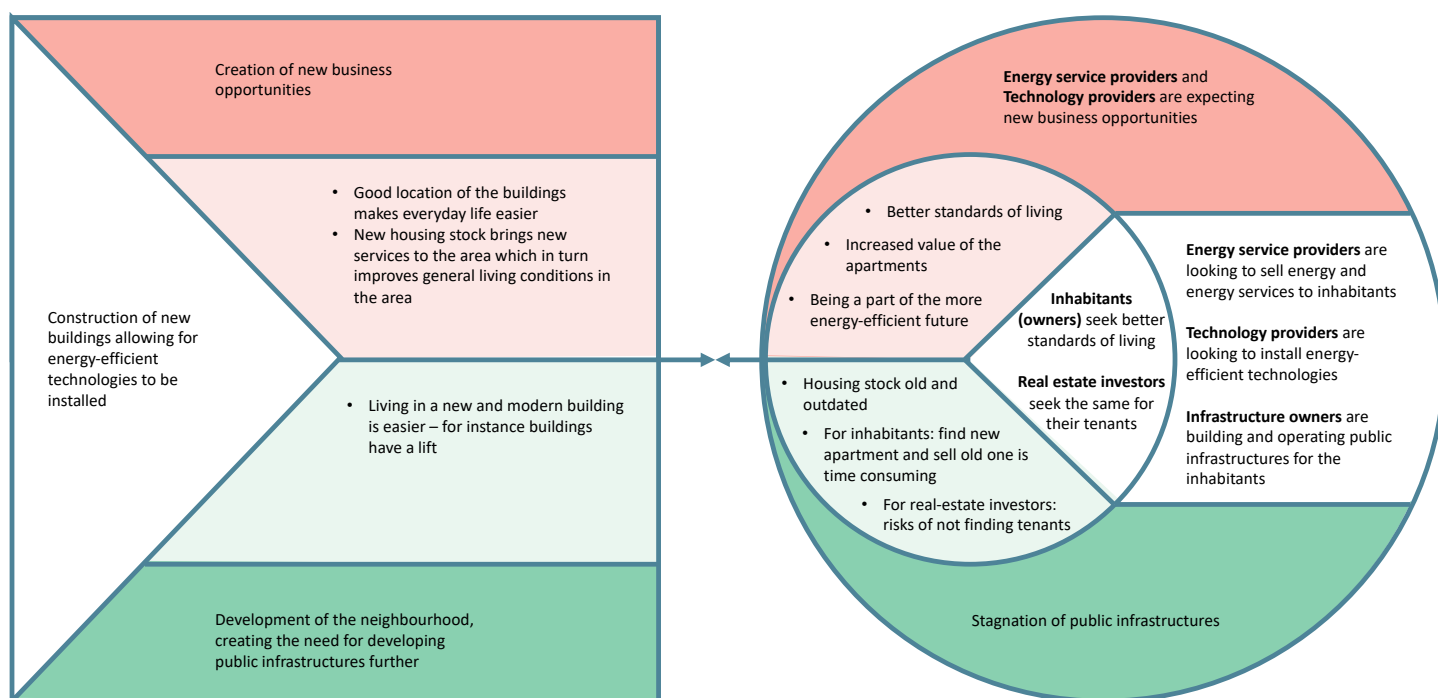


Figure 46. Value proposition canvas for YIT's actions

Conclusions

Setting up positive energy districts is a very complex project. It involves several stakeholders, each with its own interests and constraints. It requires a high degree of coordination.

The TWG 3.2 Implementation Plan of the SET Plan [1], referred to in Chapter 2 (European policy context with regards to PED business models), has anticipated the leading role of cities in this process. It is confirmed in the Lighthouse cities of the MAKING-CITY project:

- ▶ The City of Groningen has set a clear goal: it is to become CO₂-neutral by 2035 and to reduce the use of natural gas. Furthermore, the City is the co-founder and co-owner, together with the local water company, of the heat network operator WarmteStad (which is also participating in the project) – the heat network being instrumental to the energy transition of Groningen in general, and to the implementation of PEDs in particular. With regards to the development of new buildings, the City of Groningen has set strict Energy Efficiency targets that real estate developers have to apply.
- ▶ The City council of Oulu has set clear goals in its SECAP adopted in 2012 and its “Light of the North” strategy adopted in 2018 towards sustainable urban energy transformation. The City owns Oulun Energia, which is itself the owner of the heat network operator in Oulu – the heat network being here also a major asset to which most buildings in the PED will be connected. The City of Oulu also owns the housing company Oulun Sivakka which is in charge of renovating one existing building and constructing a new one in the PED area.

The TWG 3.2 Implementation Plan of the SET Plan [1] also anticipated the active role of citizens for the successful implementation of a PED. This is again confirmed in Groningen and Oulu:

- ▶ In Groningen, the following aspects related to citizens’ mindset are favourable to the development of PEDs:
 - Every citizen wants to move away from the current energy system based on gas. Earthquakes caused by gas extraction have been the trigger to this will. Therefore, citizens’ awareness to energy transition topics is high.
 - Decisions are usually not taken in a top-down manner, instead inhabitants are consulted, and they want to have their say and to find themselves in the decisions. Some of them are for instance involved in the Grunneger Power (GPO) cooperation (also a partner in the project).
 - Several partners are supporting the City of Groningen in citizen engagement activities (TNO, SEV, HUAS, GPO).
- ▶ In Oulu, and more generally in Finland, there is a big diversity within citizens regarding their energy and environment behaviour. However, there is a good starting point in Finland since the electricity sector has little CO₂ emissions; district heating is well spread, very efficient and is partly based on wood. Wood is also a traditional and quite important heating source in detached houses. For most citizens, today, the demand to monitor and improve consumption is low, but this is expected to grow with the youngest generations.

Furthermore, the present report shows the great diversity of stakeholders involved in PED design and implementation. Each member of this value chain brings some added value, not only to its targeted customers or users, but also to other stakeholders impacted by the new services or products developed.



This report has set the scene with regards to the positioning of each of these stakeholders with regards to the PED design, implementation and operation. For instance:

- ▶ Real-estate investors and building owners aim at offering nice living places to inhabitants or nice working places to companies and workers, while keeping energy costs under control; in turn, participating in a PED allows increasing the value of the buildings;
- ▶ Technology providers support the implementation of innovative technologies allowing efficient production, use and storage of energy at building or district level;
- ▶ Contractors support the cities in data management and monitoring in order to support fact-based decision-making, with also a positive impact on energy operators and building owners and managers;
- ▶ Research centres and universities are mainly involved to support cities in the planning and design of PEDs.

Next steps will include the development of business models and financial schemes that will support each link of the value chain and allow exploiting synergies occurring in positive energy districts. Such business models might include third-party investment (for instance energy service contracts), leasing (for instance of renewable energy equipment), crowdfunding, local energy markets, energy cooperatives, open-data models, etc.



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Annex 1 - Questionnaire supporting the semi-structured interviews with Groningen and Oulu partners

Ecosystem analysis in Lighthouse Cities

Questionnaire to WP2 & WP3 partners

This questionnaire targets all partners involved in the PEDs to be developed in Groningen and in Oulu.

The purpose is to analyse the PED ecosystem in line with the WP6 presentation given in Groningen on 16 May 2019.

Comments expressed during the meeting have been taken into account.

Your details

Your first name & name: _____

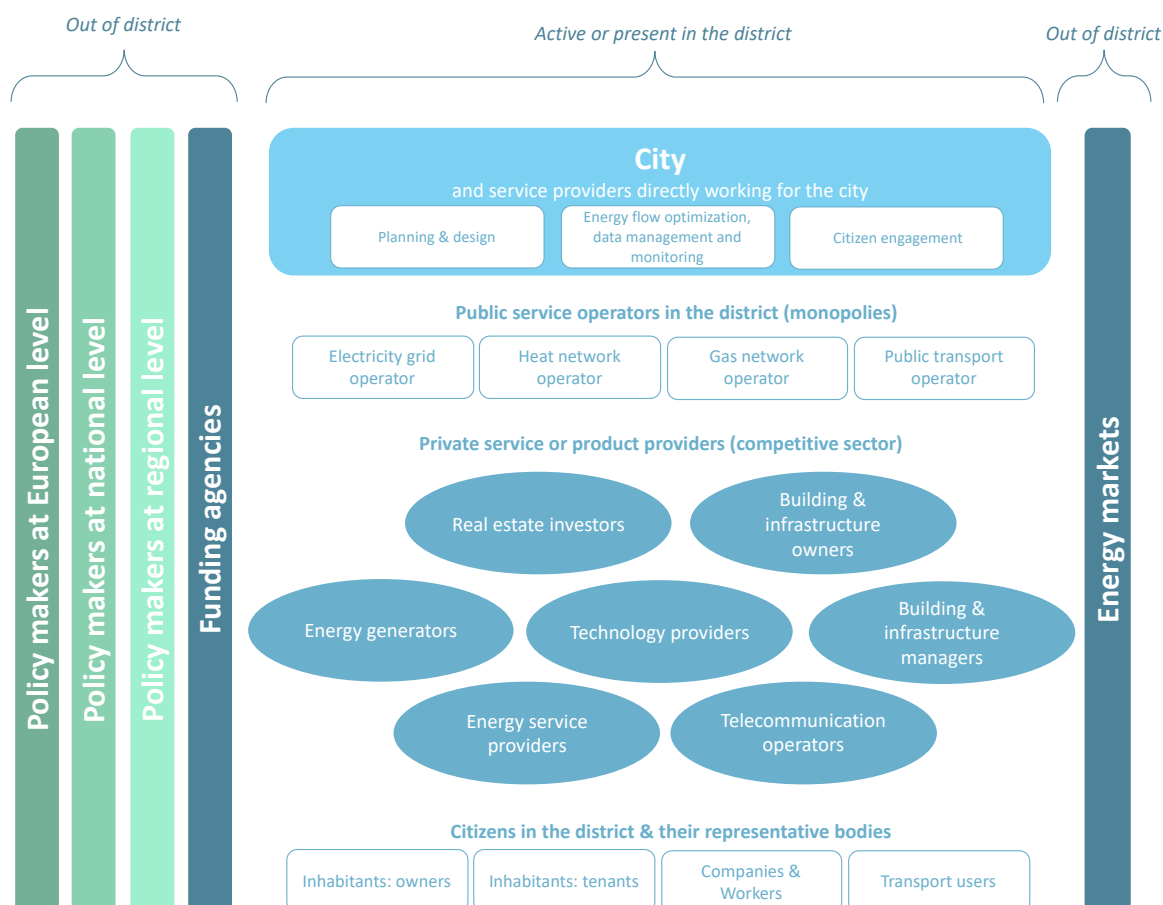
Partner (number & name): _____



Stakeholders in PED ecosystems

> The following picture represents the PED ecosystem framework as presented at the project meeting in Groningen.

> Comments expressed during the meeting have been taken into account.



Which of these stakeholders do you represent?

> Your answer should be focused on your role in the MAKING-CITY Lighthouse Cities' PEDs development (not on your organization's competencies in general)

> You may tick several boxes

City and service providers working for the city

- ☐ City administration
- ☐ Support to city: Planning & design
- ☐ Support to city: Energy flow optimization, data management and monitoring
- ☐ Support to city: Citizen engagement

☐ Other: _____

Public service operators in the district (in general monopolies)

☐ Electricity grid operator

☐ Heat network operator

☐ Gas network operator

☐ Public transport operator

☐ Other: _____

Private service or product providers (competitive sector)

☐ Real estate investors

☐ Building & infrastructure owners

☐ Building & infrastructure managers

☐ Energy generators

☐ Energy service providers

☐ Technology providers

☐ Telecommunication operators

☐ Other: _____

Citizens in the district & their representative bodies

☐ Inhabitants: owners

☐ Inhabitants: tenants

☐ Companies & Workers

☐ Transport users

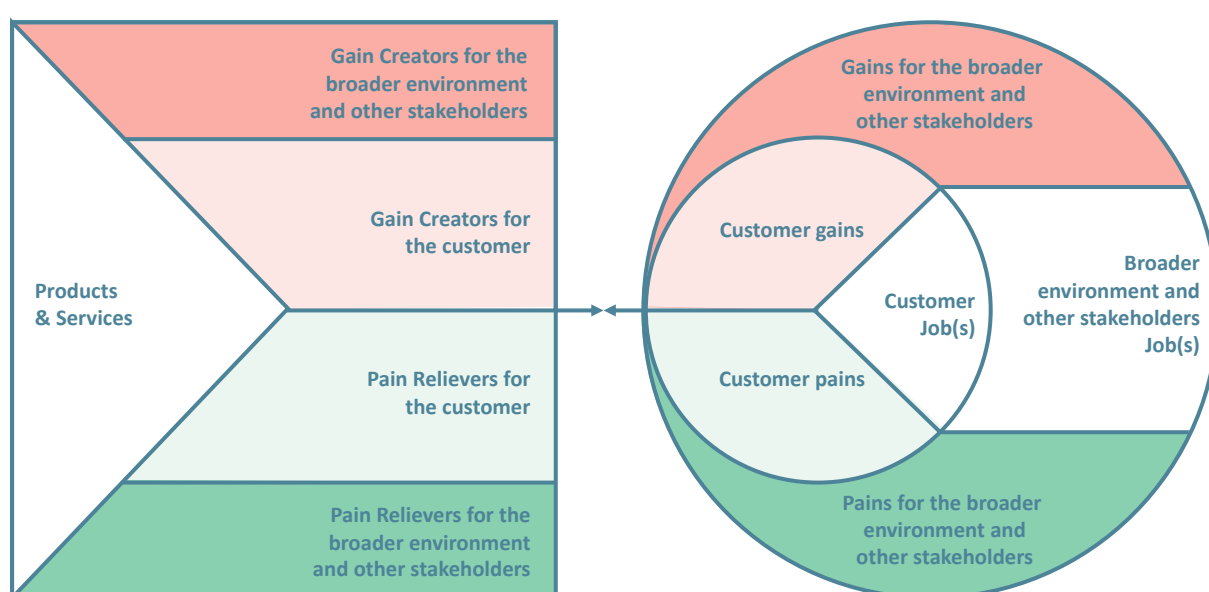
☐ Other: _____

Any comment?

Your actions: value proposition and customer analysis

> The following picture represents the value proposition design canvas as presented at the project meeting in Groningen.

> Its purpose is to identify, for each action, not only the value proposition and the customer targeted, but also the impact on the other stakeholders within or outside the PED boundaries, in order to identify synergies and to stimulate the development of business models in such a way that the PED concept works, is scalable and replicable, and delivers benefits to the city, the citizens and the environment.



Which action(s) are you leading, or are you contributing to, in the Lighthouse Cities PEDs?

Please provide the title and number of your action(s)

> For the following questions, you may have different answers in case you are leading several actions targeting different customers.

Direct customers or users targeted

Who are they?

> Please name them from the stakeholder mapping on page 2

What functional, social or emotional jobs are they trying get done? What basic needs are they trying to satisfy?

What are their pains before, during, and after getting the job done? How are current solutions underperforming for them? What do they find too costly, or not efficient enough? What are their main difficulties, challenges and risks?

Which gains are they expecting? Which outcomes, benefits or savings would satisfy them – even beyond expectations? What would increase the likelihood of adopting a solution?

Other stakeholders impacted

Who are they?

> Please name them from the stakeholder mapping on page 2

What jobs are they trying to get done, which are impacted by the jobs the targeted customers or users are trying to get done? Is their ability to satisfy their needs impacted?

Which pains do these stakeholders have in relation with the jobs that the targeted customers or users are trying to get done?

Which gains do these stakeholders have in relation with the jobs that the targeted customers or users are trying to get done?

Value proposition towards direct customers or users

Which products or services would help targeted customers or users get either a functional, social, or emotional job done, or help them satisfy basic needs?

How these products or services relieve existing pains for the targeted customers or users? For instance, by generating savings, fixing underperforming solutions or putting an end to difficulties and challenges encountered? (e.g. make things easier, helping them get done, eliminate resistance, ...)

How these products or services generate gains for the targeted customers or users? Do they produce outcomes the targeted customers or users expect or that go beyond their expectations? Do they outperform current solutions that delight the targeted customers or users? Do they make adoption easier?

If relevant, value proposition towards other stakeholders impacted

How should the services and products considered be designed so as to take into account the other stakeholders impacted?

Are the services or products considered relieving or removing existing pains of these stakeholders, or, on the contrary, creating or increasing pains?

Are the services or products considered creating or increasing gains of these stakeholders, or, on the contrary, removing or decreasing existing gains?