FLEXPOSTS
FLEXIBLE ENERGY
POSITIVITY DISTRICTS

CONSIDERATIONS FOR DEVELOPING BUSINESS MODEL ECOSYSTEMS FOR POSITIVE ENERGY DISTRICTS

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Step-by-Step Approach to Establishing a Functioning Business Model Ecosystem for a PED

Here, a brief step-by-step guideline is presented. This is based on the considerations outlined in this document. It serves a checklist for practitioners and parties interested in establishing a PED.

Step 1: Define the PED Objectives and Scope

- Clarify the goals of the PED (e.g. energy positivity, decarbonisation, local resilience).
- Set geographic boundaries of the PED and identify the time frame.
- Align with local and national policy objectives on climate, energy, housing, and infrastructure.

Step 2: Identify and Map Stakeholders

- List all relevant stakeholders, including:
    - Municipal governments
    - Energy utilities and technology providers
    - Local businesses and industries
    - Housing associations and landlords
    - Households and citizens
    - Researchers and innovation partners
- Map stakeholder roles, responsibilities, and potential interests.
- Identify missing actors whose participation is essential (e.g. investors, regulators).

Step 3: Analyse Value Types and Distribution

- Identify all types of value created by the PED:
    - *Financial*: revenue from energy, cost savings, asset value
    - *Social*: public health, local employment, community engagement
    - *Environmental*: emissions reduction, air quality, resource efficiency
- Map value flows: who benefits, how, and when.
- Differentiate between direct (internal) and indirect (external) value.

Step 4: Determine Value Capture and Market Gaps

- Assess how each value type is captured (e.g. through payments, incentives, subsidies).

- Identify value that is not monetised (e.g. improved air quality, avoided emissions).
- Recognise externalities and market failures that may hinder investment.
- Attempt to resolve market failure by internalising externalities

Step 5: Set Shared Value Goals

- Facilitate agreement among stakeholders on shared goals across financial, environmental, and social domains.
- Translate goals into measurable indicators, where possible.
- Ensure goals reflect long-term commitments, not only short-term gains.

Step 6: Identify and Assess Risks

- Conduct a risk assessment, including:
    - Financial risks (e.g. investment return, cost overruns)
    - Technical risks (e.g. grid stability, equipment failure)
    - Organisational risks (e.g. stakeholder withdrawal)
    - Regulatory and market risks (e.g. policy changes)
- Design risk-sharing mechanisms, aligned with stakeholder capacities and responsibilities.

Step 7: Choose Suitable Business Model Archetypes

- Select from relevant business model types, such as:
    - Public-private partnership (PPP)
    - Community-owned cooperative
    - Energy-as-a-Service (EaaS)
    - Hybrid models
- Align model choice with stakeholder capabilities and the nature of the value generated.

Step 8: Design Governance and Ownership Structure

- Define asset ownership (public, private, or mixed).
- Clarify operational roles (e.g. who operates batteries, manages the platform).
- Create agreements and contracts that reflect value sharing, responsibilities, and performance expectations.

Step 9: Establish Monitoring and Evaluation Framework

- Develop metrics and KPIs for financial, social, and environmental performance.
- Create reporting mechanisms that are transparent and accessible to all stakeholders.
- Link monitoring results to adjustment mechanisms in governance and operation.

Introduction

Positive Energy Districts (PEDs) are a recent development in the context of energy planning and implementation. PED are defined as urban areas that, on an annual basis, produce more energy than they consume. PEDs aim to integrate energy generation, distribution, storage, and consumption within a defined district, while maintaining compatibility with wider grid systems and urban development goals. Implementing such districts involves a technical, institutional, and economic considerations (Derkenbaeva et al., 2022; Marotta et al., 2021) The JPI Urban Europe (this is the context of within which this report was created) definition of a PED is a district with net zero energy import and net zero CO_2 emissions, which is able to produce more renewable energy than it consumes, and actively manages its energy flows, including mobility and transport, within the district and with the wider energy system(JPI Urban Europe, 2018).

The FLEXPOSTS project (FLEXible energy POSitivity districTS), addresses these challenges by developing strategies for the establishment and replication of PEDs. This report, part of Work Package 3 (WP3), focuses on the business model dimension of PEDs. It examines how value is created, captured and distributed within a PED. It provides a methodological framework for selecting and designing appropriate business models.

PEDs typically involve a diverse group of stakeholders, including municipal governments, private firms, energy utilities, housing associations, and individual households. These actors contribute financial, material, and organizational resources to the PED, and in return expect to receive value, either in the form of financial return, reduced energy costs, improved environmental performance, or social benefits(Derkenbaeva et al., 2022). Because a PED can only be successfully implemented and maintained if all stakeholders perceive the benefits as outweighing the costs, the design of viable business models is important (Zapata Riveros et al., 2024).

In this report a PED is interpreted as a business model ecosystem. A business model ecosystem is a network of interconnected organizations, including suppliers, distributors, customers, competitors, and government agencies, that collaborate and interact to create and exchange sustainable value, economically, environmentally, and socially. This concept captures the interdependent nature of stakeholder participation. It also focuses on shared value creation, risk sharing, and long-term collaboration. Rather than viewing PEDs as technical systems alone, the business model ecosystem perspective considers governance structures, ownership models, and value propositions that enable coordination and commitment among stakeholders (Zapata Riveros et al., 2024).

The report identifies three primary categories of value generated by PEDs: financial, social, and environmental (Casamassima et al., 2022). These are assessed not only in qualitative terms but, where feasible, in monetary terms. The methodology accounts for the fact that not all value types can be monetized objectively, and that stakeholders differ in their valuation of specific outcomes. By mapping these values and aligning them with stakeholder incentives, the methodology supports the selection of appropriate business model structures.

The objective of this document is to provide a structured and applicable methodology for the selection of business models in PEDs.

Value generated by PEDs

Many communities and cities strive to becoming a positive energy district. In the current time, the focus on sustainability, energy-efficiency, circularity and community-well being brings the PED concept into focus of policymakers. The European Union's SET-Plan Action 3.2 on Smart Cities and Communities includes a commitment to (JPI Urban Europe & SET-Plan Action 3.2. (2020)):

"Support the planning and implementation of 100 Positive Energy Districts by 2025, towards the long-term goal of 100 climate-neutral cities by 2030."

This effort is coordinated by:

- JPI Urban Europe
- European Commission
- Member States & Associated Countries

Creating a PED requires substantial investments. These investments are mostly in physical assets (energy production, transport and storage) and often require a remodelling of the existing infrastructure by for example: making buildings more energy efficient or adapting the energy transport infrastructure to the PED demands.

PED also yield multiple value types, such as financial, social, and environmental value (Casamassima et al., 2022). These are addressed in detail below. From an economic point of view, the PED is analysed in this report as a cooperative engagement that has substantial costs and yields multiple value types. In this report, these value types will be identified, and (if possible) expressed as a monetary value. It should be considered that certain value types (such as improved air quality) cannot be objectively expressed as monetary values. This does not mean that it has no value, it merely implies that the monetary evaluation is dependent on the stakeholders (in this case: citizens and (municipal) governments) and their subjective evaluations.

Creating a PED requires that all participating entities in the PED have an economically healthy balance between value (of any type) obtained and expenditures incurred. The business model framework is a tool for supporting this goal: A business model is a system of how an entity creates, delivers and captures value.

In this section, the types of value that a PED can deliver are outlined and the problems that come with a multi- stakeholder setting, where the distribution of value types and costs incurred leads to potential allocation discussions among the stakeholders.

Market failure: the difference between value production and value capture

A business model describes how an entity creates, delivers, and captures value. In this classical definition of a business model, a clear distinction is made between creating and capturing value.

This distinction is important when analysing PEDs, which aim to reduce energy consumption, produce renewable energy locally, and contribute to wider environmental and social goals. While PEDs clearly create value social, financial, and environmental, capturing that value, particularly in monetary terms by the initiators or investors, is not always straightforward. This discrepancy can be better understood through the economic theory of externalities and market failure (Brown, 2001).

In economics, an externality is a cost or benefit incurred or received by a third party who did not choose to incur that cost or benefit. Externalities can be negative (such as pollution) or positive (such as cleaner air or increased biodiversity) (Möllendorff & Welsch, 2017). PEDs typically generate positive externalities. For example, by reducing fossil fuel use and lowering emissions, a PED improves air quality. This cleaner air benefits residents' health, reduces healthcare costs, and improves general well-being. However, these benefits are distributed across the wider community and are not directly captured as financial returns by those who invested in or developed the PED (Pearce, 2001).

This situation creates a misalignment between value creation and value capture. The PED generates real economic, environmental and social value, but that value accrues to many stakeholders who are not paying for it. As a result, developers, municipalities, or energy providers may struggle to build a viable business model based solely on the return of direct financial value from their investment. The particular challenge for PED establishment is that markets often do not fully price in positive externalities. While a PED's contribution to cleaner air may

- reduce hospital visits
- increase productivity
- increase quality of life

these outcomes do not translate into a revenue stream for the PED itself.

This creates what is known in economics as a market failure: the market does not reward those who generate positive externalities, leading to underinvestment in projects like PEDs from a purely financial standpoint. In other words, the total value created by the PED exceeds the value that can be captured through traditional financial transactions. This is a critical issue for urban planners, policymakers, and investors who aim to scale PEDs.

One solution often proposed is to internalize externalities (Costa & Ferreira, 2023; Pearce, 2001). This means adjusting market mechanisms or policies so that the full social value of a PED can be reflected in financial terms. Examples include carbon pricing, subsidies, green bonds, or value-sharing mechanisms among stakeholders. Another approach is to integrate broader public benefits into investment criteria, recognizing that the return on investment is not purely financial, but also includes health, social cohesion, and environmental quality.

While PEDs are considered effective at creating multiple value types, much of this value is in the form of positive externalities that are difficult to monetize. Recognizing and addressing this gap

is important for designing sustainable business models that support the long-term development of PEDs.

Social value

PEDs generally contribute social value to the community by

- enhancing sustainable urban living
- reducing carbon footprints
- improving air quality
- creating a sense of community participation.

Since PEDS rely strongly on participation by households (decreased energy consumption, changes in housing infrastructure, awareness and support for alternate energy sources), they create a sense of community and belonging that enhances the social structure and the quality of life within the PED. Also, the environmental improvements (listed below) increase the quality of living.

Value type and benefiting entities

Social value is a value type that is hard to monetize objectively. This value type yields most value for households and municipalities. Costs incurred for creating social value is therefore mostly invested my (municipal) governments focussing on the greater social good. Increased house prices can be an indicator of social value created as it can improve the living conditions in the PED area.

Financial Value

The financial value of a PED lies in the long term generated monetary benefits generated by the PED. These can be direct and indirect. The direct financial benefits in a PED are the measurable financial gains that flow within the PED. These are a subset of the following options:

- decreased cost of energy production by utilizing renewable energy sources
- decreased cost of energy production by using more efficient technologies
- decreased cost of energy transportation due to proximity of production and consumption
- payments for energy from consumers (households and industry)
- financial yield from excess energy sold to the grid.
- carbon credits. As PEDs prioritize renewable energy, energy efficiency, and net-positive energy production, they significantly reduce greenhouse gas emissions. These reductions can be quantified and sold as carbon credits on carbon markets.

The above sources of financial value are captured in the PED and are redistributed within the PED to the participating entities.

Indirect sources of financial value are financial benefits created by the establishment of the PED that are not necessarily captured by the PED participants. Examples are:

- Green jobs: the PED infrastructure must be built and operated, requiring employees from the PED area and thus yielding higher income in the PED area.
- Increased property value due to increased living conditions
- Economic yield due to innovation: PED often rely on technical innovation to achieve energy positivity. These innovations contribute to economic growth as they contribute to the overall efficiency of energy consumption and production and thus have spill-over effects tom the larger economy.
- Decrease of net congestion on the (inter)national level: local production, storage and consumption of energy, especially at times of peak demand and supply, decrease the load on the electricity network, thus leaving more room for other energy consumers and producers to utilize capacity. This thus leads to more efficient utilization of the energy infrastructure and can reduce the need for very costly grid extensions.
- Access to the energy grid: In a PED, the energy infrastructure should be designed such that all stakeholders have sufficient access the infrastructure to have their energy needs (both production and consumption) satisfied. The opposite is a situation where:
    - energy producers not being allowed to (fully) deliver the energy produced to the grid.
    - energy consumers, such as industry, cannot unfold their full (economic) potential due to limitations on energy consumption.

Value type and benefiting entities

Financial value is of essential importance to the establishment of PEDs as it (partly) repays the investments made for the PED creation and can potentially yield a profit. The direct financial benefits are most valuable for the PED creation as these flow directly to the PED participants. These are therefore relevant to all entities in the PED (households, industry and (municipal) government). Indirect financial benefits are generally harder to capture within the PED. Government agencies tend to see and value these financial values as they benefit the greater good (spill over out of the PED to the larger economy).

Environmental value

The value created by environmental improvements is often the main reason PEDs are initiated. The main contributors are:

- reduced carbon emissions due to net energy production, therefore decreasing the climate impact of the energy consumption within the PED.
- Increased energy efficiency and thus conserving resources.
- Reduced fossil fuel consumption due to circular strategies such as reusing waste heat from production facilities
- improved air quality because of decreased fossil fuel consumption

Value type and benefiting entities

Environmental value is a generally a non-monetary value. The carbon credits mentioned above are mostly the only exception to this rule. Environmental value is generally highly valued and one of

the main reasons for initiating a PED. The nature of environmental value is such that is has large spillover effects to entities outside of the PED: the main example being the reduced impact on the climate, which extends to the entire planet. The large spillover effects, generally make the environmental value of the PED high as it has a significant impact. It also makes the effects hard to capture within the PED. Direct value of the environmental value for the PED participants lies in the general appreciation of contributing to a better environment. This is most appreciated by households and can be used by companies within the PED to contribute to their marketing and sustainability goals. Environmental value is generally appreciated by (municipal) governments due to its contribution the to greater societal good.

Business models and their importance for PEDs

A business model describes how an entity creates, delivers, and captures value. In the context of a positive energy district, this means how each stakeholder such as municipalities, companies, households, or semi-public institutions ensures the value they receive (of any type) outweighs the costs they incur. Since PEDs require substantial investment, often have long payback times, and involve multiple actors working together, this value balance is a necessary requirement for success.

PEDs do not succeed on technology alone. Even if the technical solution is feasible, without a viable business model that aligns stakeholder interests, the PED cannot be implemented. This means that clear agreements need to be in place about who invests, who operates, who benefits, and how the value (financial, social, or environmental) is distributed.

Below, the different value types are outlined that a PED can generate: financial, social, and environmental. Financial value includes revenue from energy sales, lower energy bills, or income from carbon credits. Social value may come from improved living conditions, community participation, or job creation. Environmental value is often related to reduced CO_2 emissions or improved air quality. These values do not always benefit the same actors, and not all of them are easy to express in monetary terms. Still, for a PED to be set up, it is necessary to have a clear idea of which value is created, for whom, and how this justifies the effort and investment.

Business models are the tools used to organise this. They allow for planning and evaluating whether the PED setup is sustainable not only from a technical or environmental perspective, but also in terms of stakeholder commitment. This is especially important when public and private organisations collaborate, and when long-term commitments are required. The business model can also clarify the risks involved, and whether these risks are fairly distributed across the participating parties.

This report distinguishes between diverse types of business models, such as collaborative models, technology-driven models, and financial innovation models. These are not strict

categories, but rather ways of describing how the PED creates and distributes value. In most cases, multiple business model elements are combined. For example, a PED could use both a participatory approach to involve households, and a performance-based contract to finance and operate infrastructure.

Ownership and operational models are also part of the business model discussion. These include public-private partnerships (PPPs), community-owned cooperatives, and service-based models like Energy-as-a-Service (EaaS). Each of these comes with different cost structures, value flows, and implications for control and responsibility.

In short, business models are not optional they are a necessary condition for the successful implementation and operation of a PED. They help to organise how value is created and how this value is used to keep all parties involved and committed over time.

A PED as a Business model ecosystem and value network

A business model is mostly composed on the level of one stakeholder. It should provide a healthy balance between costs incurred and benefits obtained, otherwise the business models are considered not viable. This implies that the value created for the individual stakeholder is negative.

A PED is generally composed of multiple stakeholders (with various roles and interests) such as

- (municipal) governments:
    - providing policy and regulatory support
    - proving funding
    - orchestrating efforts of all the PED entities
- Private companies
    - Investing
    - operating the PED infrastructure (energy technologies)
    - energy prosumers
- households
    - energy prosumers
    - investing in household adaption
    - reduced energy consumption
    - PED community members
- Researchers
    - contribute to PED design
    - drive innovation
    - Increase system efficiency
- Semi-public entities such as
    - housing companies redevelop housing for increased energy efficiency

- energy utility companies

All participants are required to participate to successfully create a PED. Therefore, a PED from a value point of view is considered a **business model ecosystem:** a collaboration of stakeholders co-creating shared values, whereby the (prolonged) cooperation of all stakeholders is a necessary condition for the value creation.

Comparison to supply chain

A supply chain and a business model ecosystem are both essential to how value is created in a given context, but they are very different in how they function and in their implications for how they exist and are created.

A supply chain is the structured, often linear sequence of activities involved in producing and delivering a product or service. It focuses on the flow of materials, information, and finances - from suppliers to manufacturers, distributors, retailers, and finally, the customer. The main goal of a supply chain is operational efficiency, cost control, and timely delivery.

Supply chains can generally overcome the elimination of one of the parties in the chain: generally multiple suppliers can take over if one party should stop its operation.

In contrast, a business model ecosystem is a broader, strategic concept. It refers to the interconnected network of partners, platforms, customers, technologies, and other stakeholders that co-create value. It is not just about delivering a product but about enabling and sustaining a value proposition. Ecosystems are often dynamic and focused on innovation, adaptability, and mutual benefit.

Ecosystems generally depend on all parties in the ecosystem to deliver shared value. This applies especially in the PED context, where most activities (energy production, storage, transport, and consumption) have to occur within the PED boundaries. Therefore, parties cannot be easily exchanged. For example, if a stakeholder that facilitates energy transportation within the PED is no longer able to provide its services to the larger ecosystem, then the entire PED value proposition is at risk. The stakeholder cannot be easily replaced and is therefore essential to the continued existence of the PED. This marks a clear difference compared a regular supply chain.

Necessary conditions: value goals

Shared value goals are essential for a business model ecosystem because they align the stakeholder around a common goal, which is the basis for their cooperation (Mihailova et al., 2022).

In a PED business model ecosystem, stakeholders such as suppliers, partners, customers, developers, and even (municipal) governments have distinct roles, incentives, and priorities.

Without shared value goals, stakeholders will focus only on their individual interests. This can lead to failure to deliver the common and shared value, which is the PED.

It is important in the context of a PED that shared value goals exceed the purely financial value created. The value goals generally emphasize outcomes that benefit all participants, which are economic, social, and environmental goals.

Moreover, shared goals create trust, long-term commitment, and resilience. When ecosystem members believe in the PED concept and see value in collaboration, they are more likely to invest, innovate, and support one another.

Necessary conditions: risk sharing

Risk sharing is a necessary condition for the success of a business model ecosystem. PED's are a collaboration of multiple stakeholders, which have a long project lifetime and are especially dependent on risk sharing. In a PED, stakeholders do not operate in isolation: the PED value can only be created if the value network operates with all stakeholders. Therefore, distributing risk across stakeholders and having clear risk sharing agreements in place is necessary. If a change in the PED landscape (such as market prices of inputs, reputation, legislative) would cause a necessary stakeholder in the PED to cease its participation, the PED could stop to exist. Therefore, Risk identification and sharing agreements need to be in place to make sure that the PED will be resilient to changes in the PED environment.

Also: When risks are shared, the burden does not fall on a single stakeholder. Instead, risks are absorbed collectively, increasing PED resilience. This shared responsibility for the PED outcome in the best cases creates commitment and mutual support, which are required for PED collaboration.

Business model ecosystem categories: value drivers

Business models ecosystems can be subdivided into multiple model categories. Creating this business model taxonomy provides a structured approach to identifying the goals, aligning the stakeholders and operating of the PED. Please note that the categories are not mutually exclusive: they are intended to identify value drivers and mechanism that contribute to the creation of a PED. An effective PED design is often a combination of various business model categories. It is generally beneficial to the PED creation process if multiple categories are identified and applied.

Collaborative Models

Collaborative business models emphasize partnerships among various stakeholders, including local governments, businesses, and community organizations. This approach recognizes that no single entity can create all measures required of a PED (business model ecosystem).

Collaborative models enable and motivate stakeholders to share resources, knowledge, and responsibilities, to create efficient energy solutions.

Multi-Commodity Models

In multi-commodity business models, different sectors work together to create a PED. These models often involve integrating various energy sources and technologies, allowing for more flexible and decentralized energy production. The success of these models depends on the ability to coordinate activities among stakeholders, which leads to increased efficiency of resources within the PED.

Value Proposition Models

Value proposition business models focus on clearly defining the unique value that a PED offers to its customers. This includes not only financial benefits but also social and environmental advantages. By communicating the propositions effectively, these models aim to attract investment and motivate stakeholders to participate, which are critical for the creation of PEDs

Technology-Driven Models

Technology-driven business models use innovative technologies to optimize energy generation, storage, and distribution. These models often involve the integration of smart grids, renewable energy sources, and energy management systems, which can enhance operational efficiency and reduce costs. However, they require significant investment in infrastructure and ongoing technological development to remain effective.

Financial Innovation Models

Financial innovation models address the financing challenges often faced by PEDs. These models explore new financing mechanisms, such as public-private partnerships, community funding, and impact investing, to mobilize the necessary capital for implementation. By using multiple funding sources, these models can mitigate risks help create and sustain PED projects.

Circular Economy Model

The Circular Economy Model focuses on resource efficiency, waste minimization, and renewable energy integration within a Positive Energy District (PED). It transforms waste streams into energy or reusable materials, creating a system that reduces environmental impact and enhances sustainability.

Platform-Based Model

The Platform-Based Model uses a digital platform to connect energy producers and consumers within the PED, enabling efficient energy management and peer-to-peer (P2P) energy trading. It uses technology to create and facilitate a marketplace, that through peer-to-peer trading optimizes energy production, distribution, and consumption.

Business model ecosystems: Ownership and Operation types

The discussion before outlines the value types that are created by PEDs and how these are used to activate multiple stakeholders. The current section outlines archetypes of business models that define the ownership and operation of the assets and consequently outline a division of value streams within the business model ecosystem.

Public-Private Partnership (PPP) Hybrid Model

The most common PED ownership structure is the Public-Private Partnership (PPP) Hybrid Model, which combines elements of public and private collaboration to maximize value. Governments and private entities co-invest in renewable energy infrastructure, while community cooperatives or third-party operators manage aspects like energy distribution or peer-to-peer trading. Revenue streams include government subsidies, surplus energy sales, membership fees, and subscription-based services.

Community-Owned Cooperative Model

In a community-owned model (such as an energy cooperation), entities local to the PED (households, private companies and local semi-governmental organizations) collectively own and benefit from the value created in the PED. Operation of the assets is performed by the community or outsourced to service companies. Members

- invest collectively
- provide resources (land, roofs)
- decide cooperatively

Energy-as-a-Service (EaaS) Model

The PED infrastructure is owned by a third party, which provides energy solutions to the PED participants (households and businesses) in exchange for membership and pay-per-use fees from the stakeholders in the PED.

Hybrid Model

It should be noted that the models mentioned above are not mutually exclusive and can be combined and individually applied to (parts of) the PED.

Establish Monitoring and Evaluation Framework: KPI's

Establishing a robust monitoring and evaluation framework is necessary for ensuring that a PED aligns with the goals set by the stakeholders. It ensures that the PED remains aligned with its business model objectives and that all stakeholders remain informed and can act when necessary.

The first requirement is to develop clear and measurable key performance indicators (KPIs) for each of the three value domains. For financial performance, KPIs may include total energy cost savings, revenues from energy sales, return on investment for participating stakeholders, and overall operational expenditures. For social performance, indicators can include levels of community participation, number of local jobs created, public satisfaction surveys, or changes in housing affordability and property values. For environmental performance, KPIs might cover reductions in greenhouse gas emissions, increases in local renewable energy generation, improvements in air quality, or reductions in fossil fuel consumption.

These indicators should be defined in collaboration with stakeholders, ensuring that they reflect shared priorities and that each actor can see how their contributions are evaluated. It is also important to establish clear baselines and targets for each KPI, so that progress can be meaningfully assessed over time.

This kind of feedback loop ensures that the PED remains adaptive and resilient over time. Rather than treating the business model as static, it is understood as an evolving system that responds to actual performance data. This adaptability is particularly important in complex urban environments, where stakeholder needs and technical conditions can shift over time.

In summary, a structured monitoring and evaluation framework helps to ensure that the PED continues to create and distribute value in line with its original objectives. It supports accountability, enables learning, and builds the foundation for continuous improvement. By integrating performance monitoring with transparent reporting and responsive governance, the PED can maintain stakeholder commitment and ensure long-term sustainability.

Conclusion

This report has presented a structured methodology for developing business models that support the implementation of Positive Energy Districts. The development of PEDs requires substantial investment, long-term cooperation, and coordination among various stakeholders, including public authorities, private companies, and residents. Business models are essential in this context, as they define how value is created, delivered, and captured, and how responsibilities and risks are distributed.

While financial feasibility is a necessary condition for PEDs, this report highlights the importance of including non-financial values in business model development. PEDs generate a variety of benefits. Some of these, such as reduced energy costs or revenues from energy sales, are financial and can be monetized. Others, such as improved air quality, reduced greenhouse gas emissions, and increased community engagement, are social and environmental in nature. These non-financial values are often not directly reflected in market prices are important to the overall success and sustainability of a PED.

Many of the benefits produced by PEDs take the form of positive externalities. These are advantages experienced by people or institutions who did not directly invest in or operate the PED. For example, cleaner air and reduced emissions improve public health and benefit society as a whole. However, these effects do not generate direct financial returns for the entities that developed the PED. This disconnect between value creation and value capture represents a well-known market failure. It often leads to underinvestment in projects that provide high social and environmental value.

To address this issue, the proposed methodology includes a broader definition of value. It considers the interests of all relevant stakeholders, including governments, businesses, households, and the general public. A PED is seen not as a single entity but as a business model ecosystem. This means that its success depends on the cooperation of many interdependent entities who together create and maintain the PED. Business models must be designed to support this collaboration by distributing both value and risk fairly.

Incorporating non-financial values into business model design improves both the realism and fairness of PED planning. It helps explain why public institutions often lead PED initiatives. Their involvement is driven not only by financial return but also by public policy goals such as climate action, economic development, and improved quality of life. Recognizing non-financial value also supports the selection of suitable funding and ownership models. For instance, if the main benefits of a PED are social and environmental, public funding or hybrid models that combine public and private contributions may be more appropriate than fully private investment.

Including non-financial values in the business model also improves stakeholder engagement. People and organizations are more likely to participate in a PED if they see clear benefits, even if those benefits are not directly financial. These can include better air quality, reduced energy dependency, job creation, or stronger community networks. Increased engagement helps build

long-term trust and resilience, which are essential for the continued operation and development of PEDs.

From a policy perspective, considering non-financial value makes it possible to design more effective support instruments. Policymakers can better justify investments in PEDs by demonstrating their broader societal value. Tools such as subsidies, green bonds, or value-sharing agreements can be used to reflect and support these values in practice.

In summary, this report provides a practical approach to business model development for PEDs. It shows that success depends not only on financial viability but also on the recognition and inclusion of social and environmental values. PEDs are complex systems that create diverse forms of value. Business models must therefore be flexible, inclusive, and aligned with long-term sustainability objectives. By acknowledging the full range of value types and aligning them with stakeholder incentives, PEDs can become realistic and replicable solutions for the sustainable transformation of urban areas.

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