

Positive Energy Districts

Planning Guide

Supporting practitioners from ambition to
action

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Disclaimer

This guide offers practical insights based on project experience and is intended as a reference for early-stage decision-making.

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Colophon

This 20-page guide introduces Positive Energy Districts (PEDs) as a practical approach for cities dealing with growing pressure on energy systems, spatial development and infrastructure capacity. The guide translates insights from practice into a clear and accessible format that supports early decision-making, without presenting a fixed model or step-by-step solution. It is intended as a practical reference rather than a technical manual.

The guide is written primarily for urban practitioners, including city officials, municipal departments, planners and project leaders working on energy transition and area development. It is also relevant for developers, energy companies and other partners involved in district-level projects who work closely with cities.

The content is structured to move from understanding to action. It starts by explaining what a Positive Energy District is and what it can enable at district scale. It then introduces the concept of PED readiness, highlighting the organisational, spatial, technical, policy, social and financial conditions that influence whether a PED can realistically move forward. The final part focuses on turning ambition into action, with attention to selecting a suitable area, understanding local conditions and identifying key actors involved in shaping a PED in practice. Together, these sections support cities in navigating early-stage decisions without prescribing a single pathway.

This guide was developed as part of the ATELIER project, a Horizon 2020 research and innovation project focused on Positive Energy Districts in European cities. ATELIER explores how PEDs can be planned, implemented and scaled in real urban contexts, with Amsterdam as one of the living labs. The guide builds on insights from ATELIER project documents, workshops and practical experiences, with a strong emphasis on feasibility, coordination and learning from practice rather than idealised models.

To maintain a clear and practice-oriented narrative, references are collected in a dedicated references section at the end of the guide for readers who want to explore specific topics in more depth.

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Positive Energy Districts

What is in it for you?

Cities across Europe are experiencing increasing pressure on their energy systems. Electricity demand continues to grow, while existing grids are reaching their limits. At the same time, cities are expected to deliver new housing, renovate older districts, support the electrification of mobility and manage rising energy costs. These tasks overlap within the same urban areas, which makes planning and implementation more complex.

This can lead to bottlenecks. Housing projects face delays because new grid connections cannot be guaranteed. Developers wait longer for permits. Different departments work on solutions within their own field, but the overall system remains difficult to manage because the underlying capacity issues do not change.

Positive Energy Districts (PED) offer a practical way for cities to work within these conditions. By organising part of the energy system at district level, cities gain more control over how much energy is produced, stored and used locally. This helps to relieve pressure on the wider grid and creates space for new developments.

Strengthening local energy production and consumption

A PED increases a city's independence from external energy markets. Local production and balancing reduce exposure to volatile prices and international energy supply risks. By building more capacity within the district itself, cities can plan with greater confidence and reduce their reliance on factors they cannot influence.

The benefits of a PED



Grid capacity

Reducing pressure on the electricity grid by using local generation and storage

Making new development possible in areas with limited grid capacity

reducing the need for costly grid upgrades through flexibility and smart control



Resilience

Achieving more stable and predictable long-term energy costs

Increasing resilience by relying less on external energy markets

Creating more stable energy conditions for local users



Spatial integration

Using existing heat, electricity and mobility infrastructure more effectively

enabling better planning by linking energy, mobility and spatial decisions early

Supporting coordination between local stakeholders at district level

What is a Positive Energy District?

A Positive Energy District (PED) is an area where multiple buildings work together around energy, instead of each building acting on its own. Within a PED, energy is used more efficiently, renewable energy is produced locally, and energy is managed at district level rather than per building.

A PED always remains connected to the wider energy system. It is not an isolated energy island, but an active part of the grid. By organising energy across several buildings, a PED can reduce peak demand, make better use of local energy sources and support the overall functioning of the energy system.

The aim of a PED is to contribute to climate neutrality

by combining energy efficiency, local renewable energy production and flexibility at the scale of a district. How this is done depends on local conditions and choices.

A PED does not have a fixed size. It can start with a small group of connected buildings and grow over time as more buildings and systems are added. This is shown in the illustration below, moving from a block towards an entire district.

Positivity can be realized at different scales

It can begin with one block, expand to a neighbourhood, and later operate as a district-wide system, with additional benefits emerging as more buildings are connected.



PEB
Positive Energy Block



PEN
Positive Energy Neighbourhood

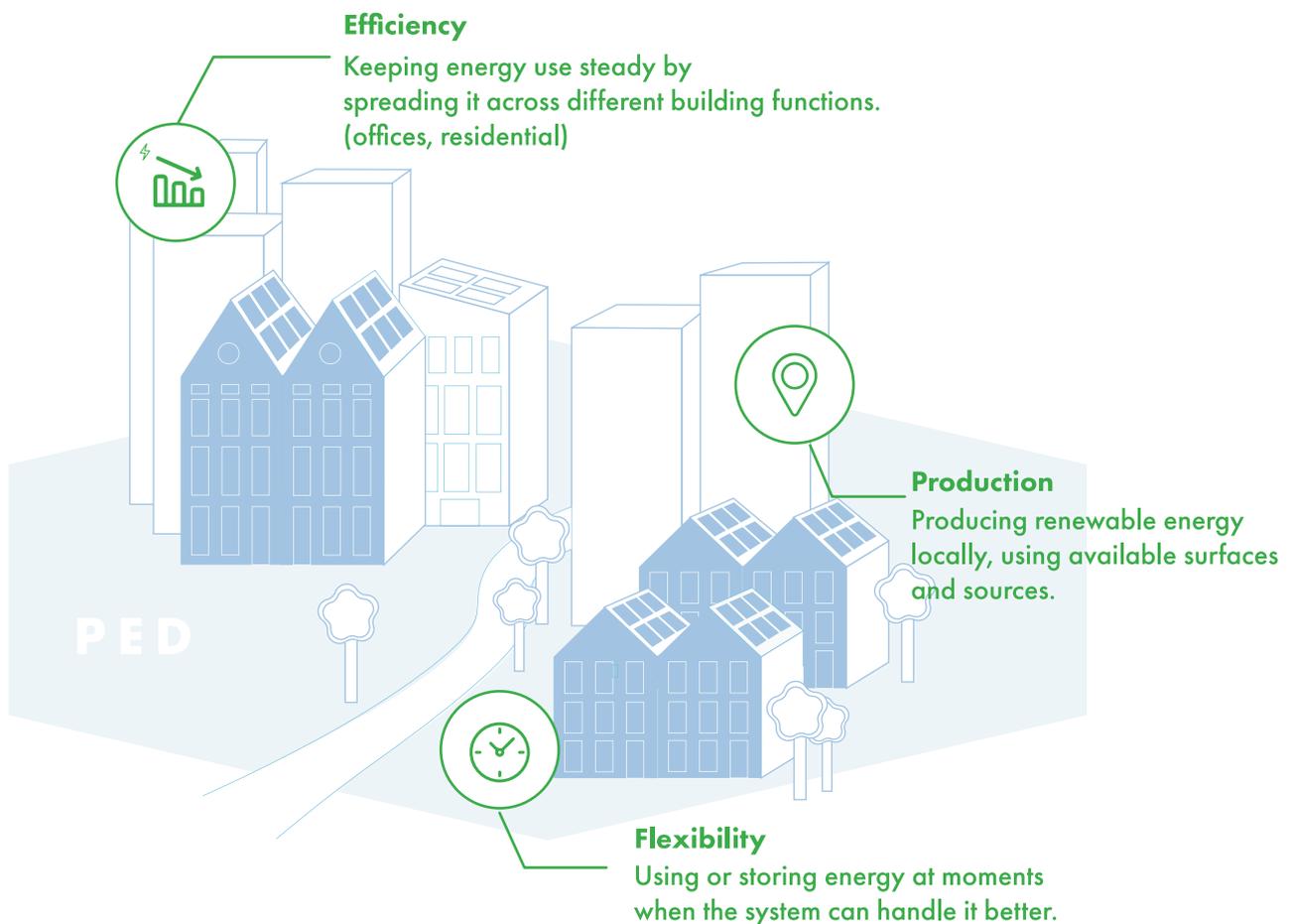


PED
Positive Energy District

The three Functions of a PED

Neighbourhoods usually contain a mix of homes, offices and other buildings. These buildings use energy at different moments of the day and for different purposes. A Positive Energy District works by using these differences to its advantage. Energy is produced locally, used where possible within the district, and shifted in time when demand is higher or lower. By doing this across multiple buildings, a PED helps the energy system run more smoothly and reduces pressure on the grid.

This is done through three functions that together make the district more efficient, flexible and easier to manage.



How a PED comes together

A PED comes together by looking at three things. You choose the parts that make sense for your situation, you check what the area can handle, and you involve the people who shape daily life and development. These three steps help you see what is possible in your district and which setup is the most practical for you. The next pages show each step.



Stakeholders
Who do you involve?



Components
What solutions you use?



The Area
Which area is most suited?

The Components

The modularity of a PED

There are many ways to make a PED. The goal is simple: combine solutions so the area produces more electricity and heat than it uses. A PED is made of different energy elements, and cities choose the mix that fits their district, local plans and energy system.

The example on this page is only one of many possible configurations. A PED can be built from a wide range of components, and cities can combine them in different ways depending on their district, infrastructure and goals. On page 18 you will find a more detailed overview of the full set of components and how they can work together.



The Stakeholders

Who should be involved?

A PED involves a few key groups. Each looks at the area from a different angle and helps shape the final setup, within existing spatial, technical and governance contexts. Land owners focus on what can realistically change on the site. Energy experts look at energy demand, grid capacity and heat options, as well as technical, regulatory and system-related constraints, including existing energy networks and supply strategies. Area planners connect these insights to zoning, public space, timelines, renovation cycles and city objectives. Local users explain their needs, as they live or work in the area and influence how energy is used in daily life.



The Area

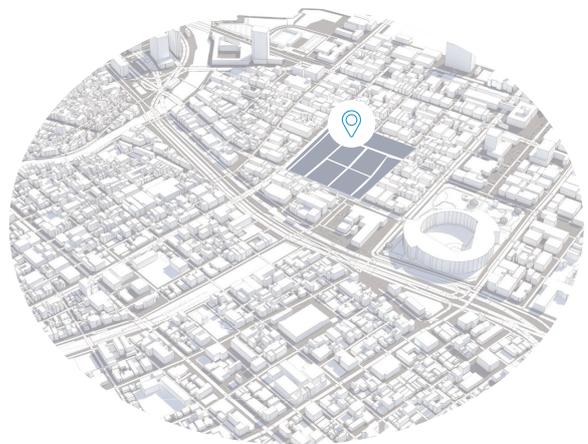
What you need to check

Every area has different characteristics. Before choosing where to start a PED, it helps to look at a few basic aspects: how the area is structured, which networks and buildings are already there, and who owns, uses or manages them. These checks help you understand whether a PED is realistic in this area, and what kind of PED could emerge given the local spatial, technical and institutional conditions.



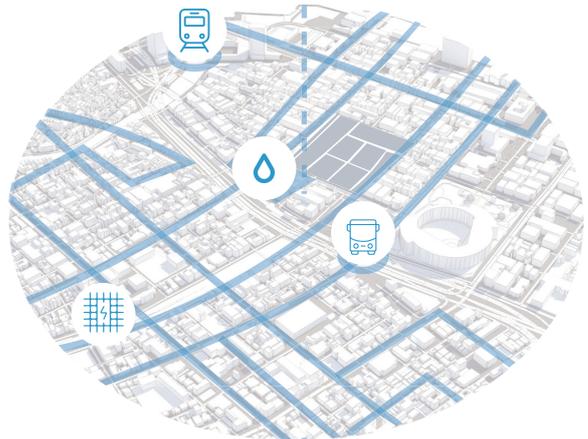
The place

what the area looks like and how it works
This helps you see how space, density and functions shape what is possible for a PED in this area.



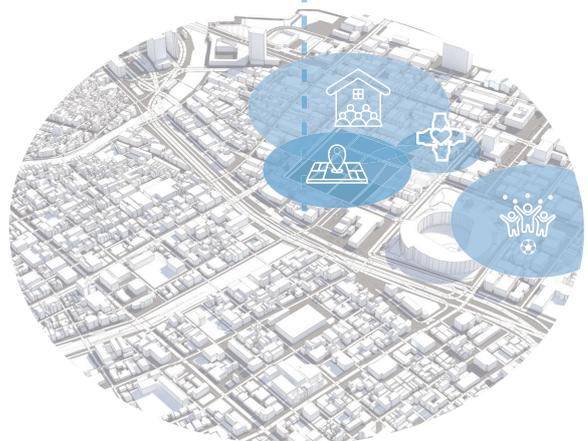
Existing infrastructure

What already powers and connects this area
This map shows a hypothetical situation with energy, water and transport lines that are there. This helps you understand how existing networks may support or limit a PED.



People and ownership

Who is here, who owns what, and who is active
This helps you understand who you need to talk to, and how ownership and use may influence what is feasible. This map shows a community, a developer on the brownfield and a stadium close to the area.

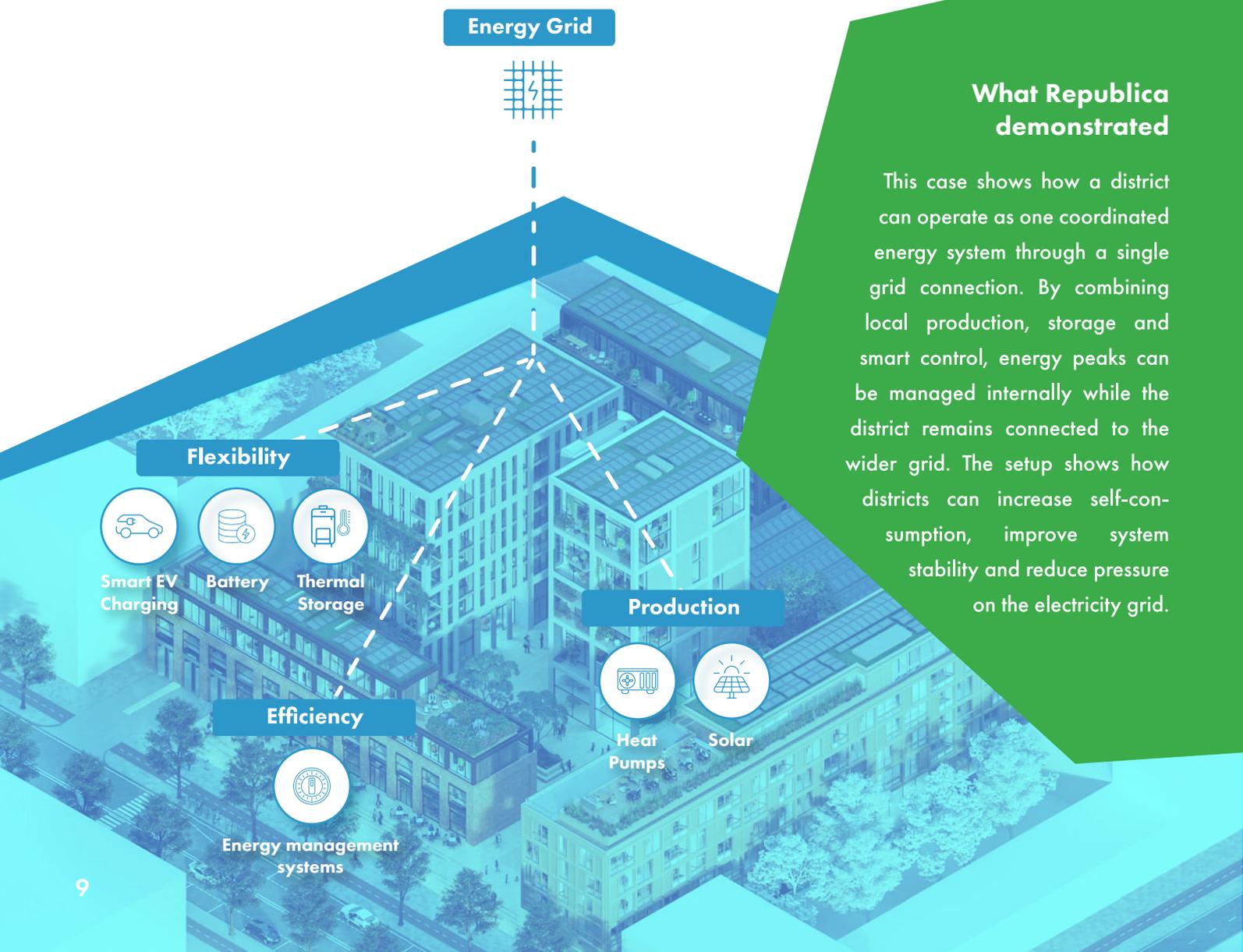


Where the solution became reality

PED Amsterdam Republica

All elements in the district are linked to one connection point on the regular electricity grid. This connection ensures that the district remains fully part of the city's wider energy system. It allows the area to export electricity when local production is higher than local use, and to import electricity when demand exceeds what the district can produce. In practice, this means the area functions as one coordinated energy system while maintaining a stable link to the city network.

In Amsterdam's Republica district, this approach is already being put into practice. Republica combines solar production, battery storage, heat pumps and an energy management system to balance local demand and supply. The single grid connection enables the district to manage peaks internally, reduce strain on the wider network and operate more efficiently as a whole. The setup shows how districts can increase self-consumption, improve system stability and still rely on the external grid when needed.



What Republica demonstrated

This case shows how a district can operate as one coordinated energy system through a single grid connection. By combining local production, storage and smart control, energy peaks can be managed internally while the district remains connected to the wider grid. The setup shows how districts can increase self-consumption, improve system stability and reduce pressure on the electricity grid.

PED Bilbao Zorrotzaurre

PED Bilbao Zorrotzaurre shows how a district-scale energy approach can be embedded in a large urban redevelopment area. The PED is part of the wider Zorrotzaurre transformation, where the city uses the district as a testing ground for sustainable energy concepts that can later be applied elsewhere.

Instead of focusing on individual buildings, the district approach coordinates efficiency measures, local renewable production and flexibility across multiple development phases. A low-temperature district heating concept forms the backbone of the system, linking different areas and allowing heat to be shared at district scale. The system is designed to combine geothermal energy, river heat recovery and other local heat sources, supported by thermal storage and smart control.

The PED remains connected to the city's energy networks, while using local optimisation to balance demand and supply. By developing shared infrastructure step by step, the system can grow alongside the area's redevelopment without requiring all investments upfront.

What Zorrotzaurre demonstrated

This case shows that a PED can be integrated into an ongoing redevelopment process, rather than designed as a standalone energy project. By working at district level, efficiency, flexibility and local production can reinforce each other within one coordinated system. Shared energy infrastructure allows the PED to scale over time, while the final configuration is shaped by local conditions instead of a predefined technology mix.



What do you need for a PED

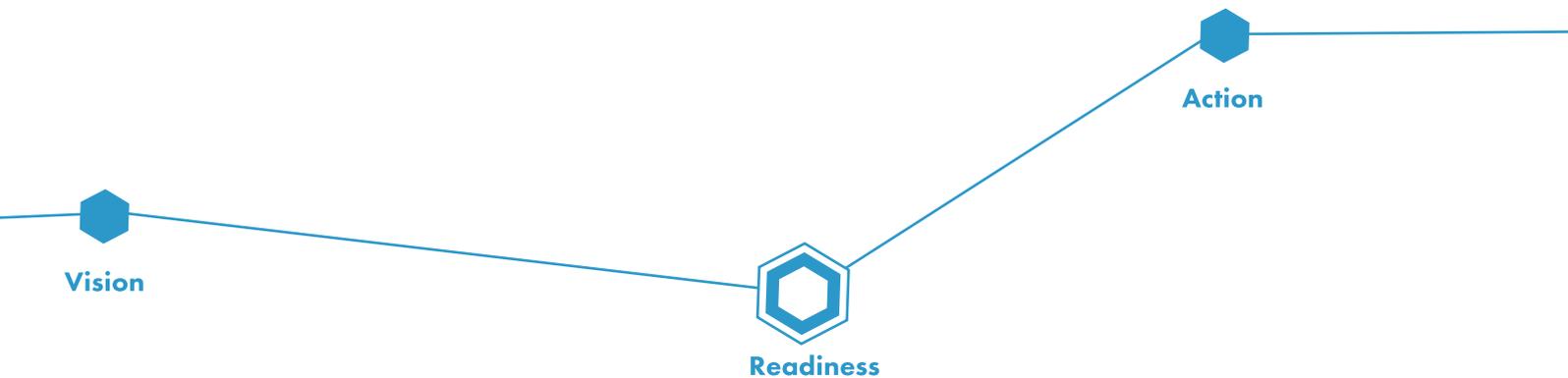
Are you ready?

Starting a PED requires more than technical potential. It depends on whether the city organisation is ready to act. A PED can be initiated by different actors, such as a developer or a municipality. Regardless of who initiates the process, the city plays a critical role in shaping the conditions under which a PED can move forward.

Readiness means that there is a shared understanding of the starting position, clarity about roles, and alignment across relevant city departments. When views are aligned early, cities can make informed choices, avoid conflicting decisions, and reduce delays during implementation. It also becomes easier to explain internally why a PED is relevant and what is needed to move from ambition to action.

Misalignment between city departments and external organisations is common and does not need to block progress. What matters is recognising these differences early, so cities can make informed choices and adjust their approach during the development process. A PED does not have to be initiated or led by the municipality. The city is involved in coordination and decision-making as a PED develops.

The six readiness dimensions on the right help clarify what needs to be in place before moving forward.



Dimensions of a Coordinated PED

Financial

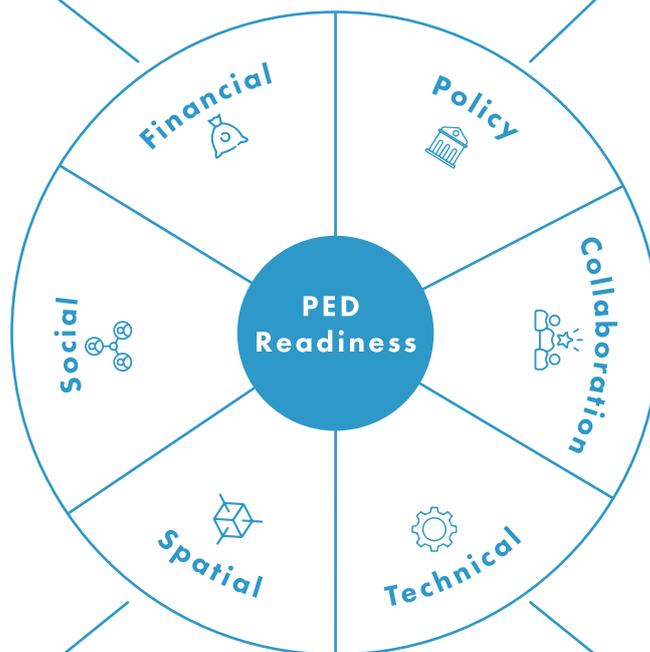
Tenders, calls and budgets must point in the same direction, otherwise they block PED actions. Aligned funding makes it easier to start early, avoid conflicting requirements and attract co-financing.

Social

Departments must understand who is active in the area and how to work with them. Shared social insight makes it easier to involve residents and organisations at the right moment and build support.

Spatial

Energy and heat systems depend on available space, infrastructure and the timing of urban development. Mobility patterns and access also shape where energy systems can be placed and how districts function. Shared spatial insight helps align energy, mobility and redevelopment plans, and prevents late or unrealistic design changes.



Policy

Regulations must make it possible to realise a PED. This means that tenders, planning rules and internal procedures steer toward the same development choices. When these rules are aligned, departments know what actions are allowed, decisions become consistent, and partners gain certainty to move the district forward.

Collaboration

Departments need a shared coordination point so they can align energy, heat, mobility and spatial planning. This prevents parallel processes and gives partners a clear point of contact.

Technical

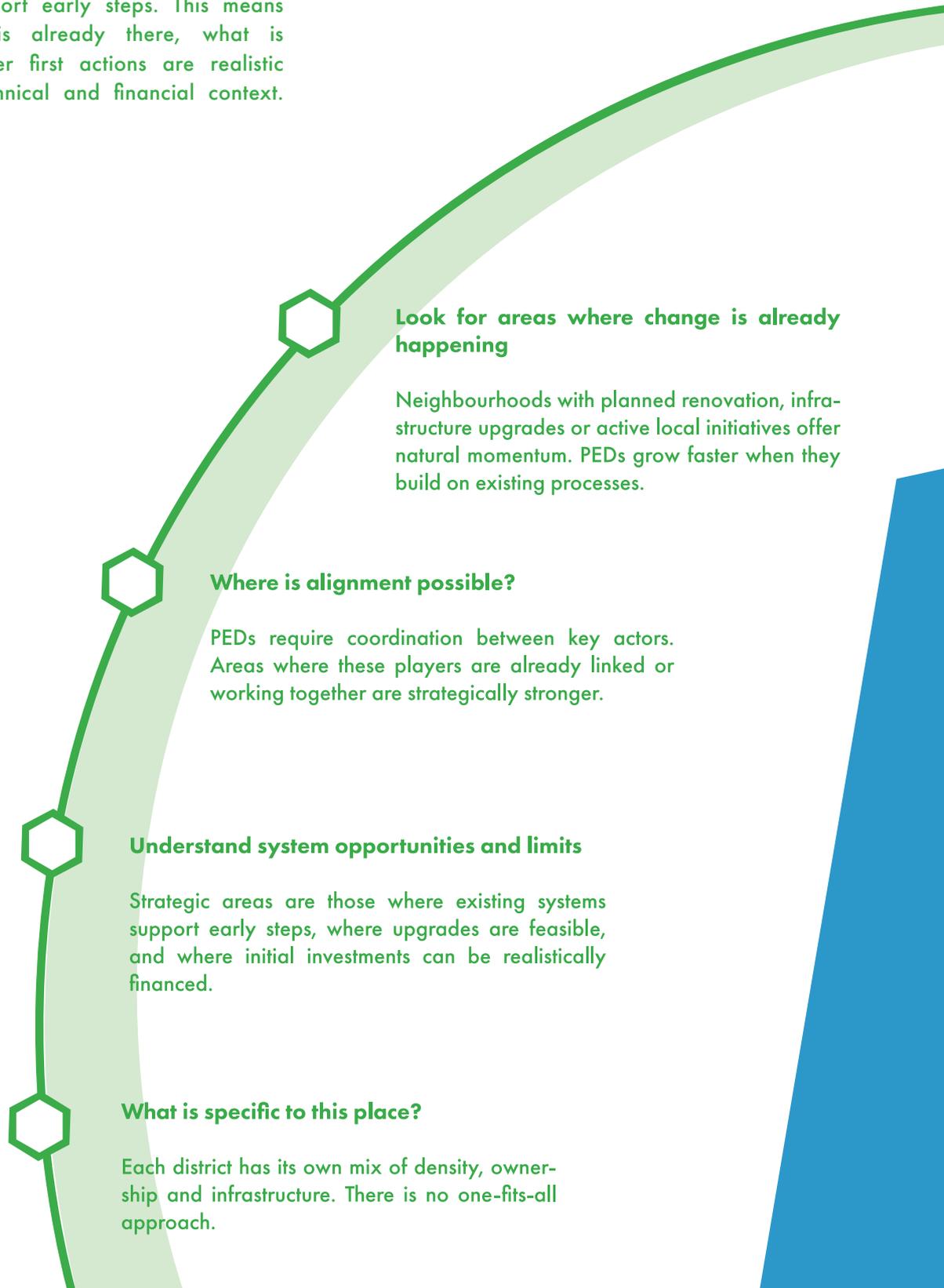
Departments need the same picture of demand, renovation needs and local production potential. Shared technical assumptions make planning practical, reduce confusion and speed up decisions.

Turning vision into reality

Choosing the right area, or working with what you have

There are two different situations. One where there is freedom to select a suitable area for a PED, and another where a specific area is already given. These situations are not the same and come with different constraints.

In both cases, cities still need to assess whether the area can support early steps. This means understanding what is already there, what is changing, and whether first actions are realistic given the spatial, technical and financial context.



Existing neighbourhoods

Strategic advantages

- Strong social structures and established daily patterns
- Existing infrastructure can be upgraded
- Renovation cycles create opportunities to integrate energy improvements.

Strategic challenges

- Fragmented ownership and slow decision-making
- Existing infrastructure making upgrades technically and organisationally complex.
- Interventions must fit within what already exists.

Focus early on

- Renovation timelines, ownership structures and regulatory requirements for upgrades.
- How existing electricity and heat networks can align with new PED components.
- Early engagement with residents and property owners, as this determines pace and feasibility.

New development

Strategic advantages

- More freedom to integrate heat, electricity and mobility in a coordinated way.
- Clear ownership structures; working with one or a few developers speeds up decision-making.
- Easier to design for low demand and high energy performance from the start.

Strategic challenges

- High upfront investments in network upgrades, heat systems and flexibility options.
- Zoning procedures, planning cycles and development phasing may slow the process.
- Uncertainty about future demand and user behaviour

Focus early on

- Align spatial planning and the energy concept from the beginning (electricity, heat, mobility).
- Decide who owns and manages energy and mobility assets after completion.
- Financial feasibility: business cases for heat networks, storage and flexibility.



Making it collaborative

A PED is not built by one actor. It grows when the people who shape buildings, infrastructure, heat, mobility and public space work toward the same goals. Collaboration is not an extra step in the process. It is the structure that holds everything together.

Cities work with many different actors: utilities, housing associations, developers, local organisations and municipal departments. Each brings different responsibilities, data, resources and timelines. A PED works when these pieces align and when decisions connect across sectors and scales.

Not every stakeholder has the same motivation or capacity, prioritise those who are open to experimentation and can contribute to implementation



Who to involve first?

The first actors to involve are the municipal teams responsible for heat, energy, buildings, mobility and planning. They set the conditions for what is possible in an area: system capacity, renovation strategy, spatial limits and timing.

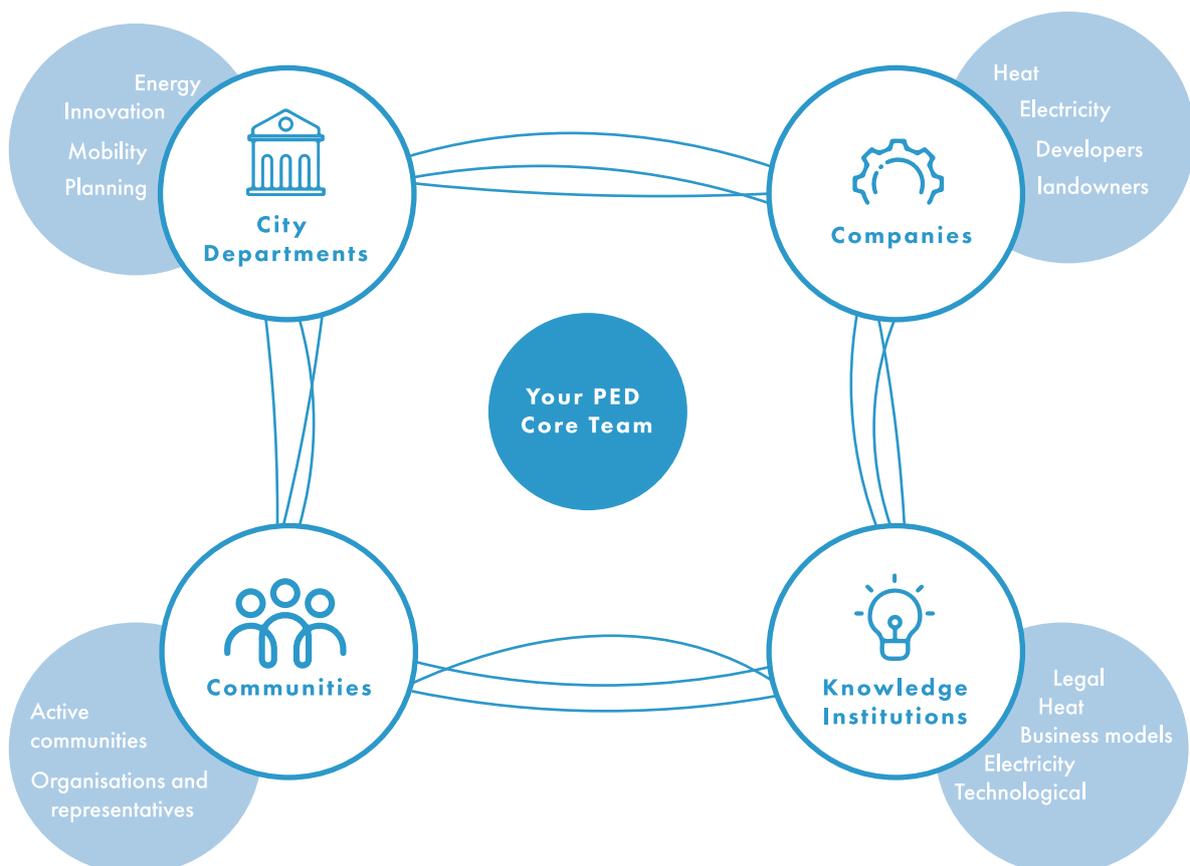
Next to the municipality, you need the grid operator, the heat supplier and the main landowner or developer. These actors determine the starting point and remove the earliest barriers.



Build your core team

A PED needs a small team that connects heat, electricity, mobility and buildings. This team keeps decisions aligned, avoids contradictions between departments and partners, and helps plan actions in the right order.

These actors influence the systems, rules and timing that shape early decisions. When they work together, a PED can be designed with realistic system capacity, better renovation planning, and clear steps for implementation. It also prevents departments and partners from working with different assumptions or making choices that block each other later.



Designing your PED

How components work together

A PED is a system made up of components that reinforce each other across three core functions: energy efficiency, flexibility and local renewable production. These functions shape which combinations are realistic in each district.

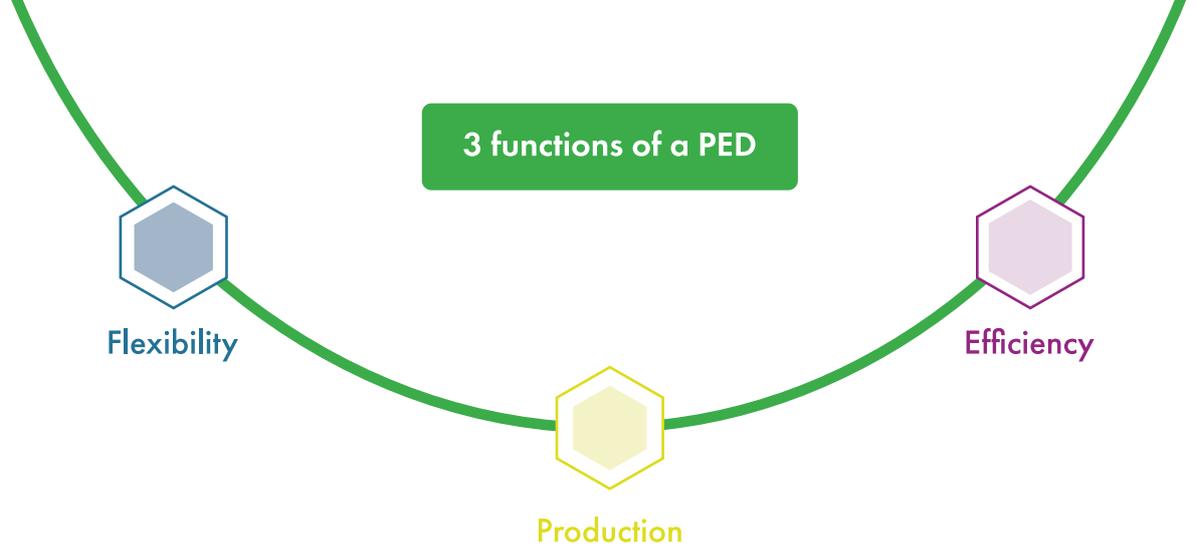
The starting point is efficiency (shown in purple). Renovation, insulation and building performance set the baseline for a PED. Higher efficiency lowers energy demand, widens the range of viable system combinations and reduces the overall scale of the system that needs to be designed.

Flexibility (shown in blue) determines how stable the energy system can operate over time. Storage, smart charging and energy management shift loads across hours and seasons. This flexibility shows how much variation the district can absorb when production and demand do not align.

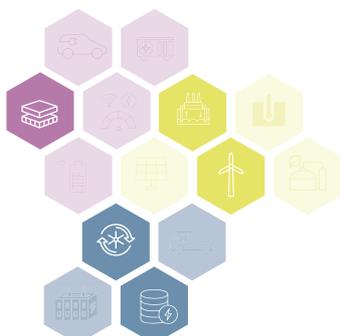
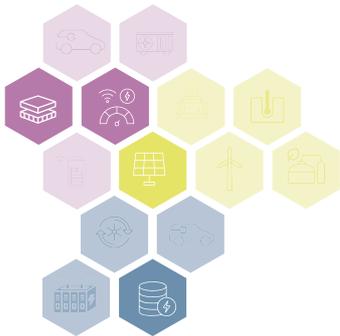
Production (shown in yellow) fills the remaining energy needs. Local sources such as solar, waste heat, wind or heat networks provide part of the district's energy. Which sources are viable depends on local spatial and technical conditions, as well as timing and ownership.

A PED is built by selecting combinations across these three functions. Each colour represents a wide range of possible components, which can be mixed depending on what the district allows in terms of space, building stock, infrastructure and ownership. Existing neighbourhoods may rely more on renovation-driven efficiency improvements or heat networks, while new developments can integrate electric systems, storage and mobility solutions more easily from the start.

Together, the colours help you read how the district works as a system. Efficiency sets the baseline, flexibility stabilises the system, and production fills the remaining needs. The right balance always depends on local context.



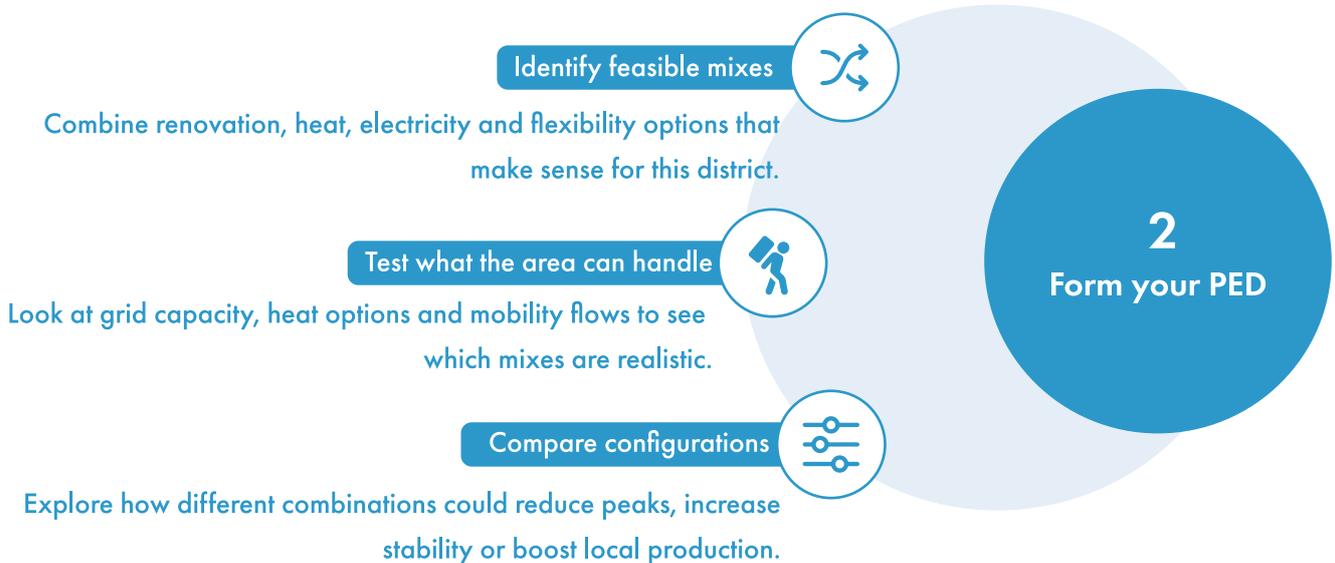
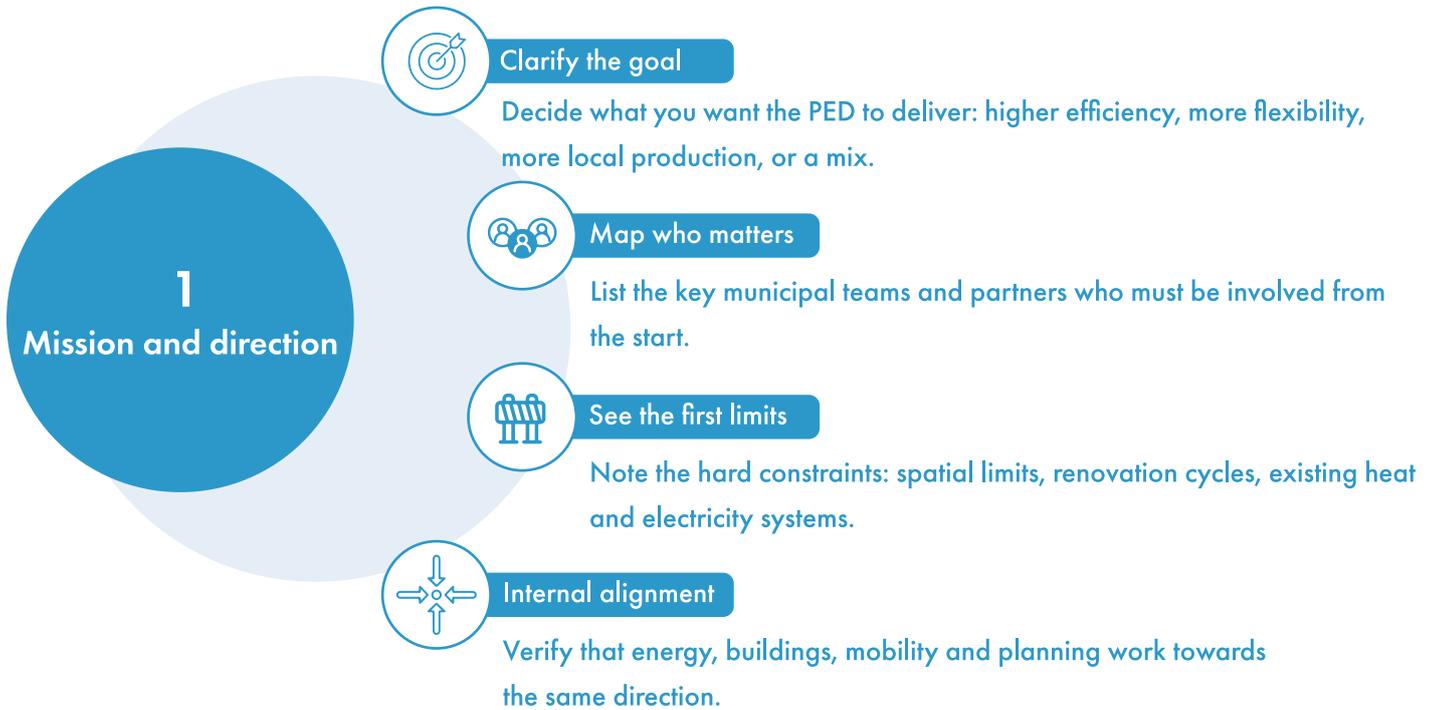
Each colour groups components by their primary role in a PED system

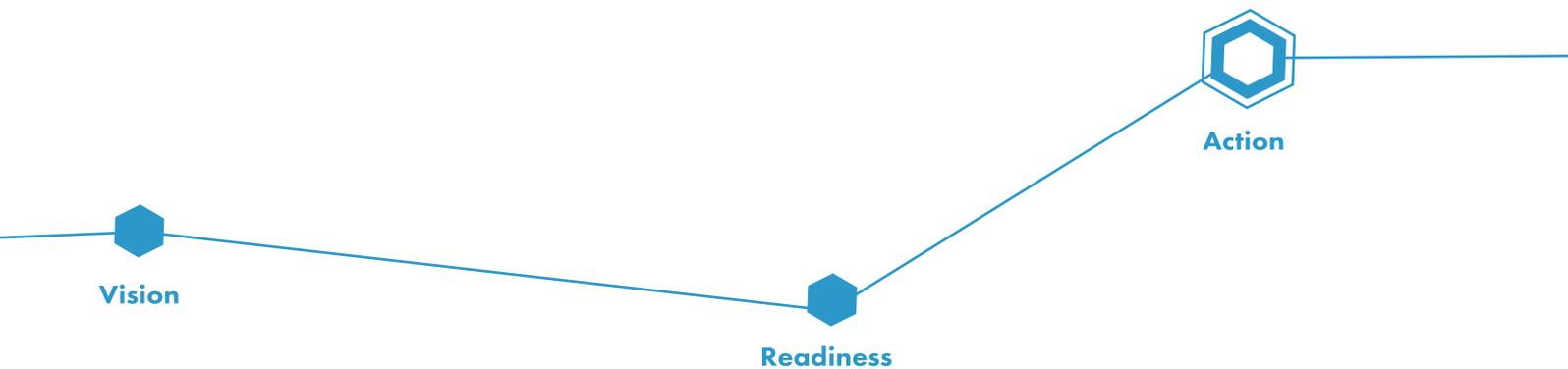


Each example configuration highlights a different balance between efficiency, flexibility and production.

Your first PED

The three moves for your first actionable PED step





3 Operationalise your first steps



Choose who moves first

Decide which actor must take the first step, often the municipality together with grid and heat supplier and the main landowner or developer.



Make the decision explicit

Define which formal decision is needed now: zoning change, renovation programme, investment commitment or technical study.



Check feasibility

Test whether this step is financially and legally realistic using a financial assessment and business-case check.



the first concrete action

Turn this into a pilot, pre-design, feasibility study or cooperation agreement that unlocks the PED.



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