



PED Energy System

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Positive Energy Districts



Overview

- Introduction
- Energy System

- What is a Positive Energy District?
- PED Goals
- Components
- Boundary
- Flexibility
- Demand, Supply and Temporal Resolution
- Renewable Energy Options
- Energy System Choices
- Technology Choices



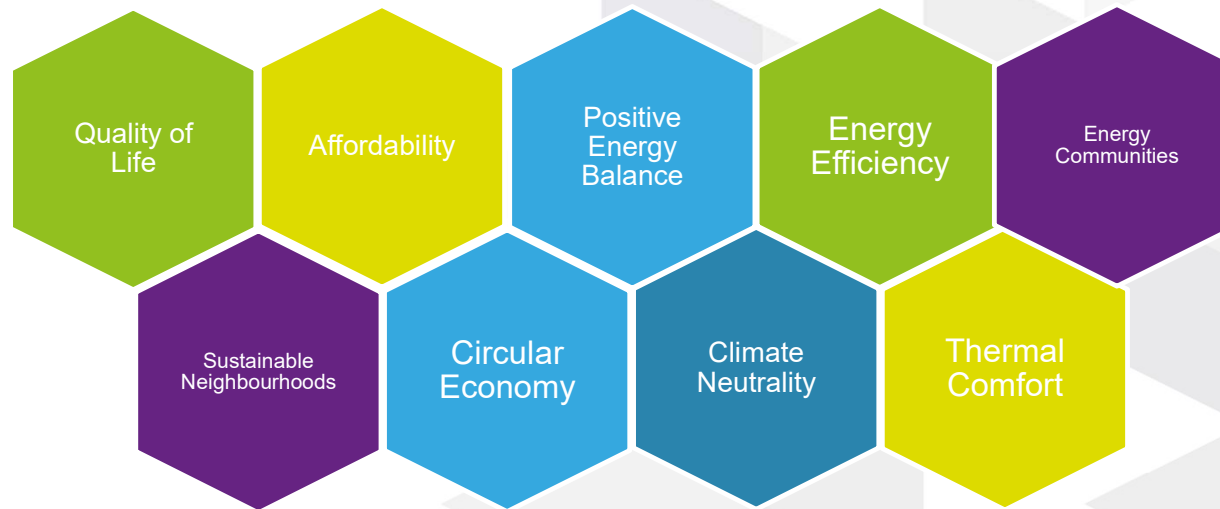
What is a Positive Energy District?



- Energy-efficient and energy-flexible urban areas
- Produce net zero greenhouse gas emissions
- Actively manage an annual local or regional surplus of renewable energy
- Interaction between buildings, the users and the regional energy, mobility and ICT systems
- Securing a good life for all in line with social, economic and environmental sustainability

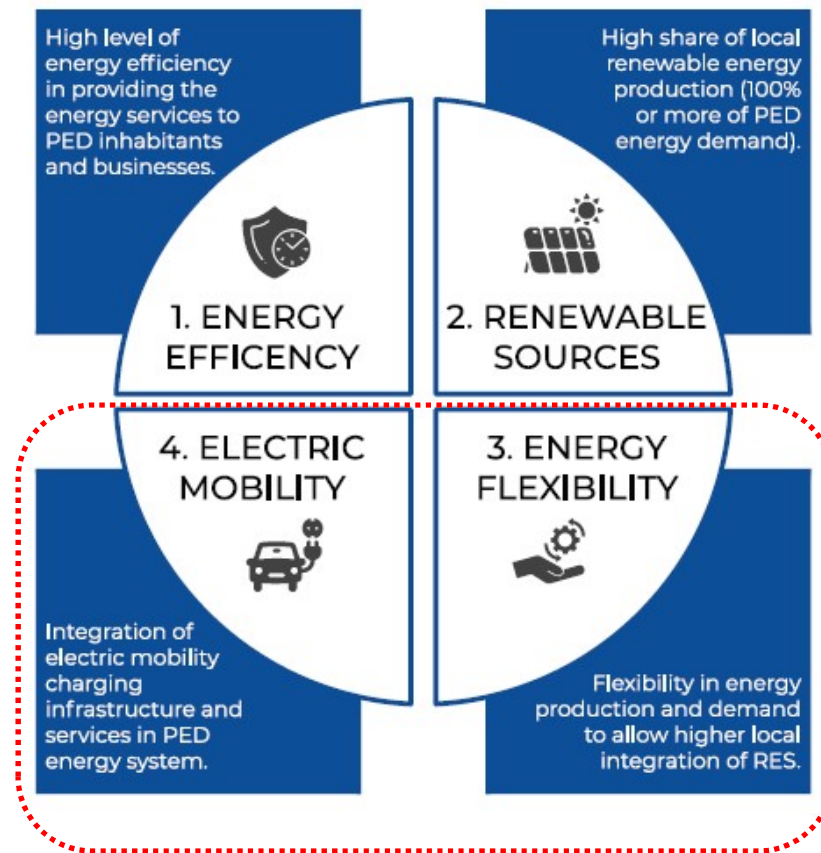
PED Goals

Achieving a **Positive Energy Balance** is one of many goals for PEDs.



PEDs provide a political push to move districts into a more sustainable direction, increasing energy efficiency, increasing building performance, addressing resource waste and reducing CO₂-emissions. Helping to deliver on national renewable energy targets and supporting the energy transition.

PED Energy System Components



Business as Usual

Energy efficiency (EE) is not new – Energy Performance of Buildings Directive (2002).

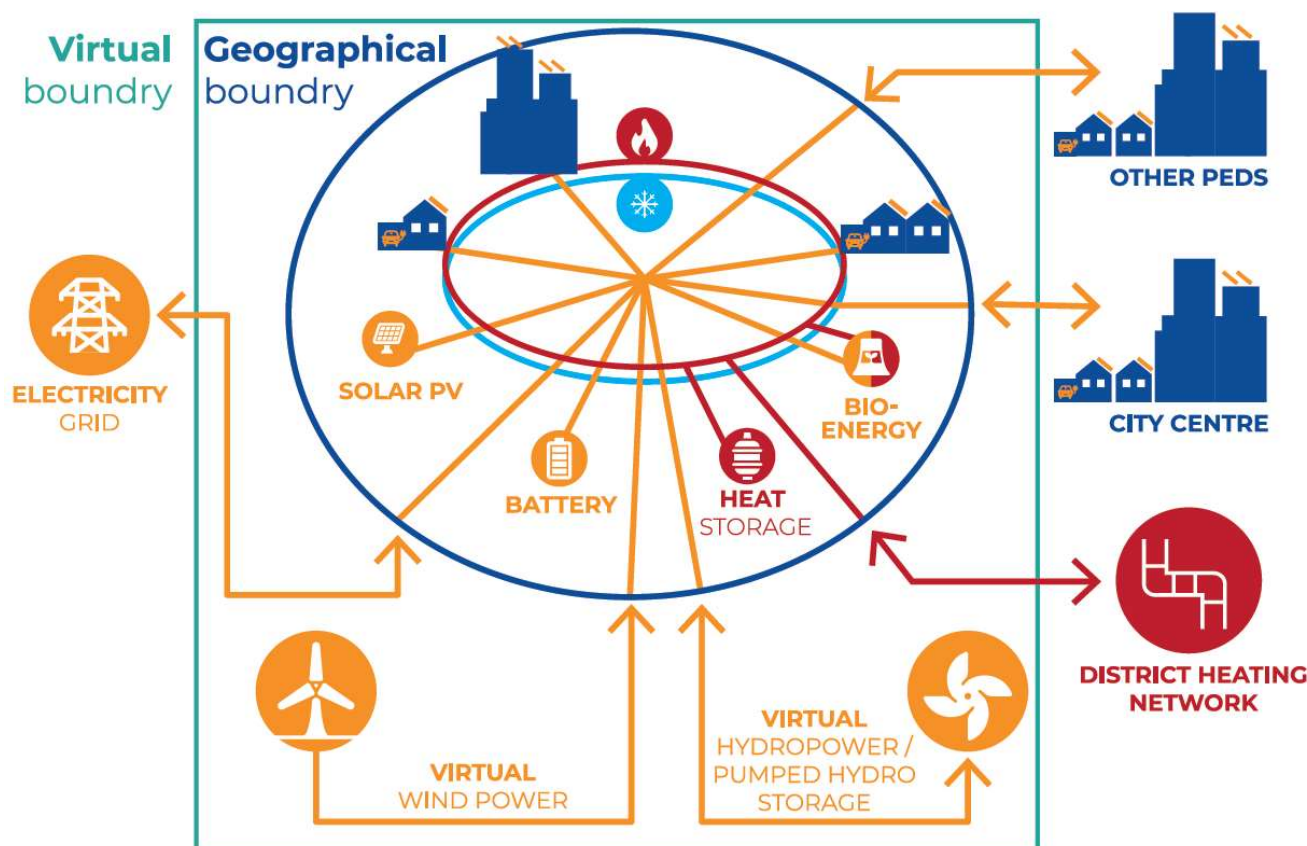
Technologies to achieve EE are well established.

Well established renewable energy system technologies (e.g. Solar PV) with positive business case.

What's new about PEDs?

Area focus + Integration + Flexibility + Social Dimension

PED System Boundary



Virtual component to all PEDs through smart-grid connection

PEDs require dynamic exchanges with regional energy systems.

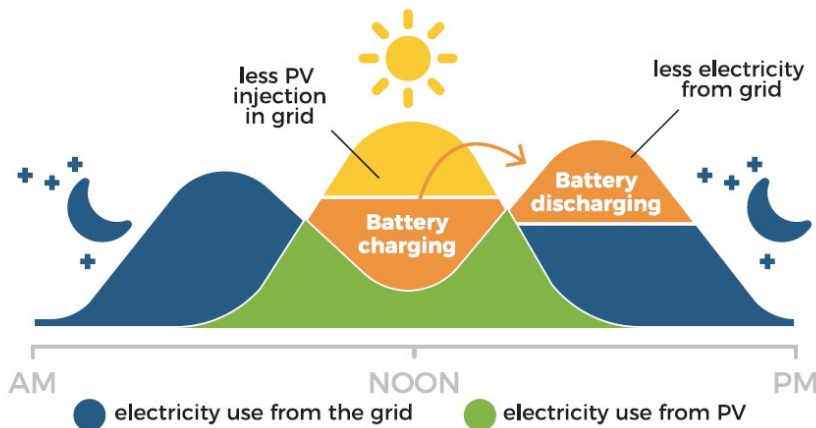
Energy autonomy is not the goal.

Energy Flexibility & Why It's Important

Renewable Energy Systems (RES) can be very weather dependant (e.g. Solar, Wind)

Flexibility addresses RES intermittency and mis-match of demand and supply

Influence of load density and diversity – e.g. Residential vs. Office



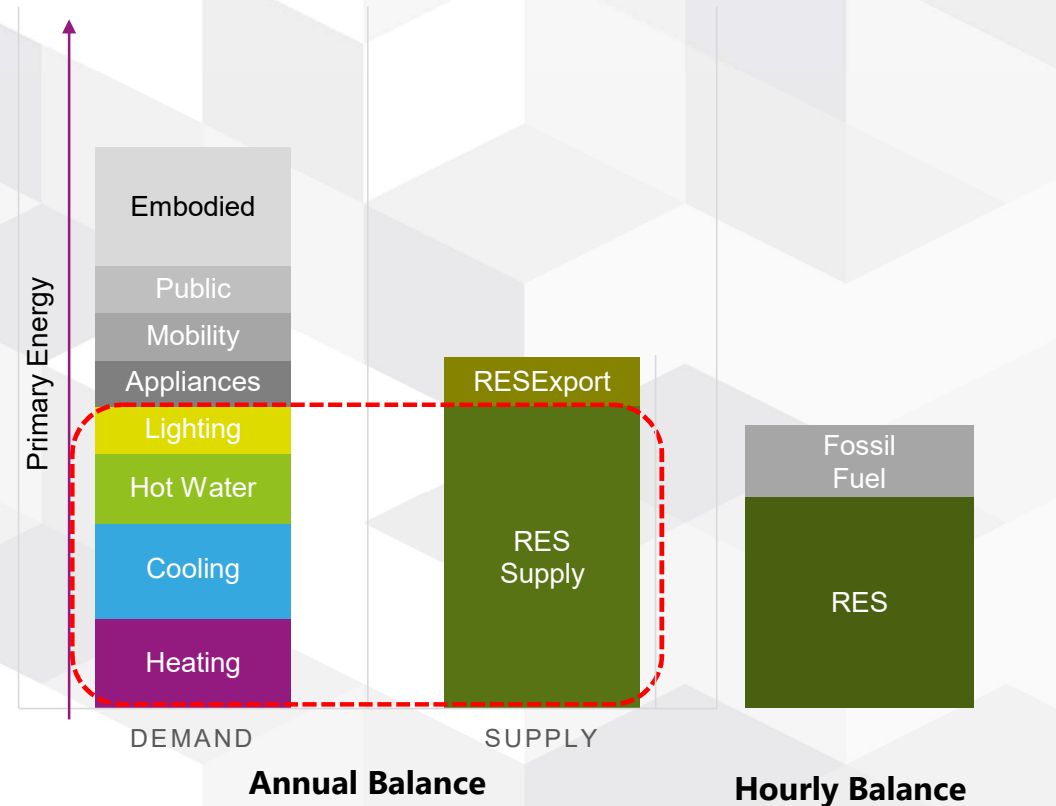
- Thermal Energy Storage (TES)
e.g. Aquifer Thermal Energy Storage, boiler vessel
- Electric Storage
e.g. Batteries, Electro-mobility
- User Flexibility
- Control Systems
e.g. Demand Side Management (DSM)

Energy System Boundary

Supply: What is included?

Traditionally only “Building Bound” energy demand sources:

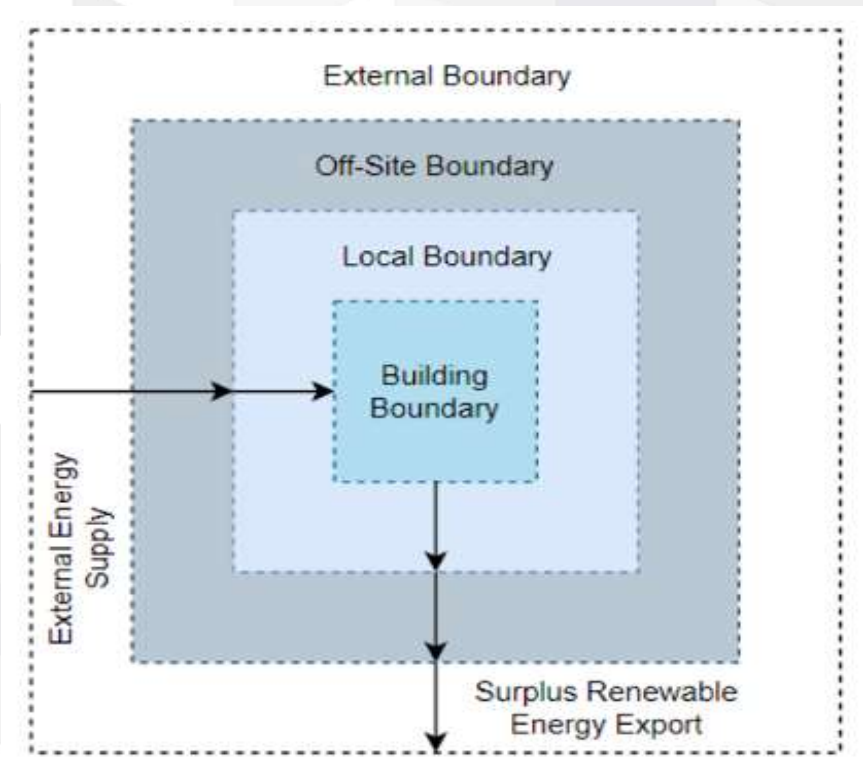
- Space Heating, Cooling
- Hot Water
- Auxiliary Power / Lighting
- Energy flexibility opportunities from building user energy and e-mobility are not considered.
- Embodied energy and the associated emissions are not included.
- Hourly balance can have fossil fuel input at some moments



Renewable Energy Options

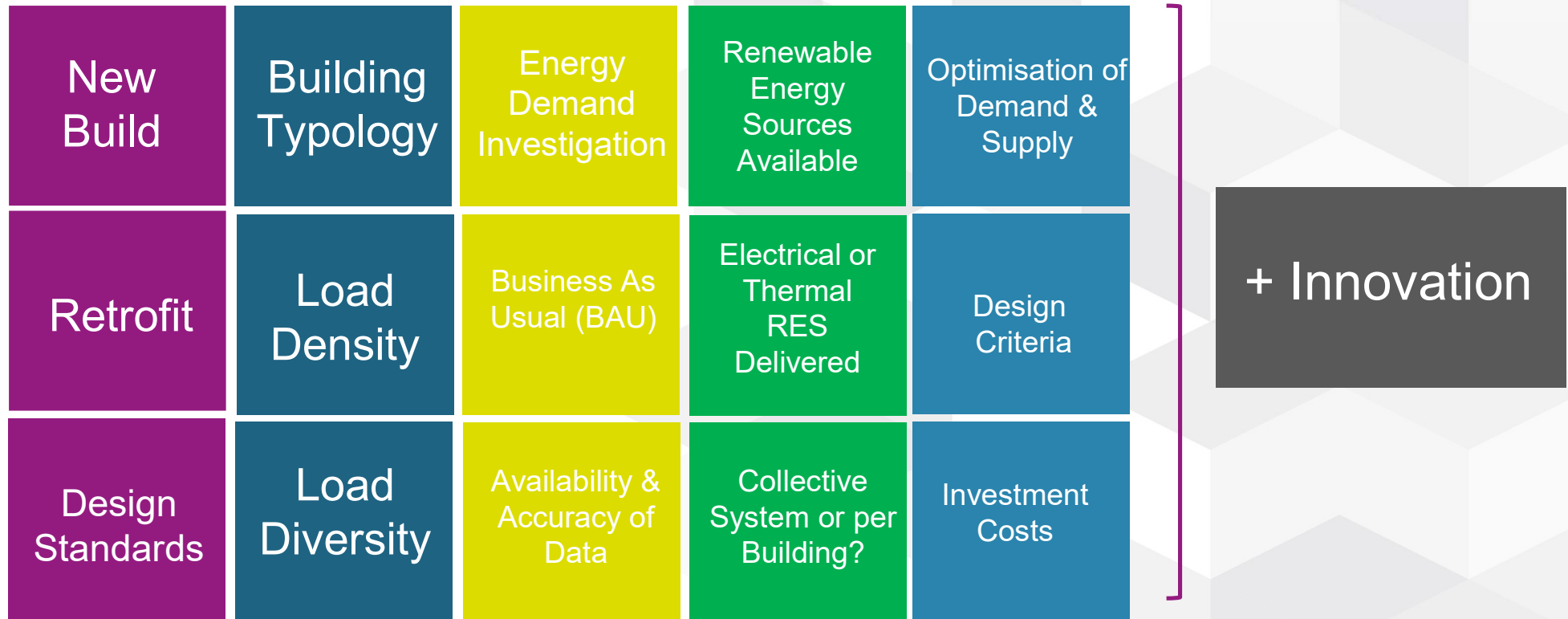
Spatial Boundaries

- Building/On-site Boundary e.g. Rooftop or Building Integrated Systems
- Local Boundary e.g. Self-Owned or Community Systems within PED Boundary (Geographic or Virtual)
- Off-site Boundary e.g. Virtual Power Purchase Agreement (PPA)
- **External Boundary e.g. Green Retail Tariffs / Renewable Energy Certificates? – Not considered as an option for PEDs**



Energy System Choices

What choices need to be made & why?



Renewable Energy Sources

Cooling

- Heat pump
- District cooling
- Air Conditioner/ chiller
- Direct cooling: water and air

Heating (LT/MT)

- Heat pump
- Solar thermal
- Geothermal
- Waste heat

Heating (HT)

- Biomass
- Geothermal
- Waste heat

Electricity

- Grid (partly RE)
- PV
- Wind
- Hydro
- Biomass
- Geothermal

Storage / flexibility option

Cooling

- **ATES**
- **Water vessel**

Heating (LT/MT/HT)

- **ATES**
- **Water vessel**
- **PCM**
- **Boiler vessel**
- **Molten Salt**

Electricity

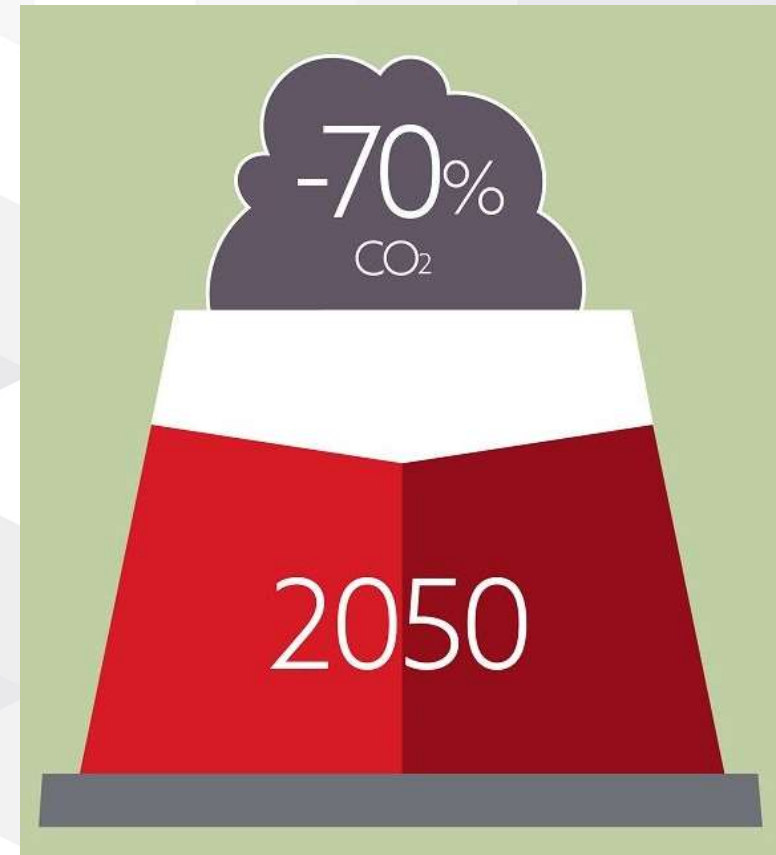
- **Stationay Battery**
- **Car battery**
- **Flow battery**
- **Fly wheel**

Flexibility

- **Demand side management**
- **Smart grids**
- **Smart charging**

Conclusions

- To achieve Europe's 2050 decarbonization challenge, a transformation of the urban systems is required.
- Positive Energy Districts (PEDs) have the potential of accelerating the decarbonization of urban areas and promoting scalability between cities.
- **High ambition levels are needed to meet this challenge.**



[4] <https://www.nepia.com/2050-longer-term-targets/>