POSITIVE ENERGY DISTRICTS

for people and the environment

cost
EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

PED EU NET

Positive Energy Districts
for people and the environment

This publication is based upon work from COST Action Positive Energy Districts European Network, CA19126, supported by COST (European Cooperation in Science and Technology).

COST (European Cooperation in Science and Technology) is a funding agency for research and innovation networks. Our Actions help connect research initiatives across Europe and enable scientists to grow their ideas by sharing them with their peers. This boosts their research, career and innovation.

www.cost.eu

cost
EUROPEAN COOPERATION
IN SCIENCE & TECHNOLOGY

Funded by
the European Union

PED
EU
NET

About PED-EU-NET. The COST Action CA19126 PED-EU-NET 'Positive Energy Districts European Network' drives the deployment of PEDs by harmonising, sharing, and disseminating knowledge and breakthroughs on PEDs across different stakeholders, domains, and sectors at the national and European level. It aims at establishing a PED innovation eco-system to facilitate open sharing of knowledge, exchange of ideas, pooling of resources, experimentation of new methods and co-creation of novel solutions across Europe. Additionally, this COST Action supports the capacity building of new generation PED professionals, Early Career Investigators as well as experienced practitioners. Its main goal is to mobilise relevant actors from and across Europe to collectively contribute to the long-term climate neutral goal.

ISBN: 979-12-210-5778-2

Citation: COST Action CA19126 PED-EU-NET (2024), Positive Energy Districts for People and the Environment, COST Action CA19126 Positive Energy Districts European Network, Brussels.

Available for download: http://www.pedeu.net

For further information or to provide feedback: http://www.pedeu.net

Lead authors: Maria Beatrice Andreucci (Sapienza University of Rome), Francesca Sabatini (University of Bologna), Giulia Turci (Municipality of Cesena, University of Bologna), Marco Delli Paoli (Sapienza University of Rome)

Contributing authors: Jozsef Kadar (The Arava Institute), Anna Mutule (Institute of Physical Energetics Riga), Juliana Zapata (ZHAW), Michelle Scacco (ZHAW), Cristi ana Croitoru (Technical University of Civil Engineering Bucharest), Nienke Maas (TNO), Emanuela Giancola (CIEMAT), Ioanna Kyprianou (The Cyprus Institute), Danila Longo (University of Bologna), Maria Nuria Sánchez (CIEMAT), Silvia Soutullo (CIEMAT), Lina Murauskaite (Lithuanian Energy Institute), Xingxing Zhang (Dalarna University), Paolo Civiero (Roma Tre University), Adriano Bisello (EURAC), Ghazal Etminan (AIT), Oscar Seco (CIEMAT), Jelena Brajković (University of Belgrade), Siddharth Sareen (University of Stavanger).

Scientific Committee: Vicky Albert-Seifried (Fraunhofer), Laura Aelenei (LNEG), Maria Beatrice Andreucci (Sapienza University of Rome), Siddharth Sareen (University of Stavanger), Michal Kuzmic (Czech Technical University in Prague), Nienke Maas (TNO), Ghazal Etminan (AIT), Jelena Brajković (University of Belgrade), Paolo Civiero (Roma Tre University), Savis Gohari (NTNU), Oscar Seco (CIEMAT), Mari Hukkalainen (VTT).

Design: Marco Delli Paoli (Sapienza University of Rome).

Date: June 2024

Version: 1.0

1

UNDERSTAND

PED challenges, opportunities and key drivers

Smart Energy Åland (Finland)
Copyright: Flexens

Most economic activities, interactions between people, and social and technological innovations take place in cities. They are the beating heart of our planet, yet also face the greatest challenges of air and water pollution, overheating, flash flooding, and health problems; which can reduce the quality of life.

Transforming cities into self-sufficient, clean energy systems transcends green ambitions. This endeavour opens a world of possibilities for a brighter, sustainable future. **Positive Energy Districts** (PEDs) are core to the envisioned positive societal impact. PEDs offer ways to both *do less 'bad' and more 'good'*.

Imagine a place where innovation meets sustainability, where innovative technologies and environmentally responsible practices reduce our ecological footprint while fostering wellbeing and local livelihoods. Such places are cities where progress is unbounded, where green is more than a colour: a way of life.

Powerful drivers of change enable such pathways. Citizen voices demanding cleaner air and better life quality have gained momentum. People are eager to enjoy green parks and experience calmer, more peaceful urban settings. Their enthusiasm powers visions of PEDs.

The journey is challenging. Hurdles include financial constraints, resistance to change, conflicts of distributive justice, and technical issues. Yet challenges characterise any worthwhile journey. Determination and adaptiveness can create solutions to overcome obstacles.

Many European cities aim to be global role models for energy transitions. Buildings are crucial to this. PEDs shift focus from individual positive energy buildings to interconnected buildings creating larger zones of surplus renewable energy production close to energy demand.

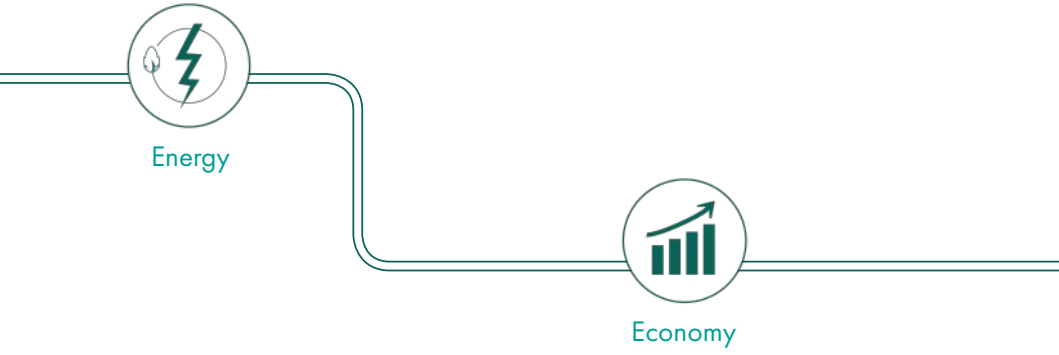
PEDs range from existing to newly built areas, posing diverse challenges. Collaborative governance requires community engagement in planning and decision-making, backed by regulatory, financial and technological solutions for PEDs to thrive. Municipalities and other urban stakeholders can only create meaningful local change with communities at the centre.

People

Environment

Turning urban areas into PEDs, from net carbon emitters to net carbon sinks, is a grand adventure. It involves reshaping infrastructure, behaviour and attitudes, seizing opportunities to embrace renewable energy, smart technologies and sustainable practices.

This marks a journey towards greener, harmonious urban futures.



Challenges

Energy Transition

Think of it like upgrading from an old, inefficient engine to a sleek, eco-friendly electric motor for an entire city, with responsibly mined materials. Shifting from traditional fossil fuel-based energy sources to renewable energy requires major shifts in infrastructure and technology.

Urban Planning and Retrofitting

Imagine transforming regular buildings into energy-efficient hubs – it's like giving a makeover to an entire neighbourhood to make it environmentally friendly. Adapting urban structures to be more sustainable is logistically and economically challenging, and time-taking!

Behavioural Change

Picture convincing an entire city to embrace energy-saving habits, like turning off lights or using public transport, to get everyone on board a green lifestyle. Encouraging residents and businesses to adopt sustainable practices and reduce energy usage can encounter resistance.

Opportunities/Drivers

Energy Transition

the shift from an energy mix based on fossil fuels to one that produces very limited carbon emissions, across all spheres of human activity, based on adopting renewable energy sources, displacing fossil fuel sources and reducing energy-intensive practices to limit overall energy demand.

Renewable Energy Sources

Harnessing energy of the sun, wind, and water to fuel the city's energy needs – it's like turning nature into a city's personal energy source.

Smart Technologies

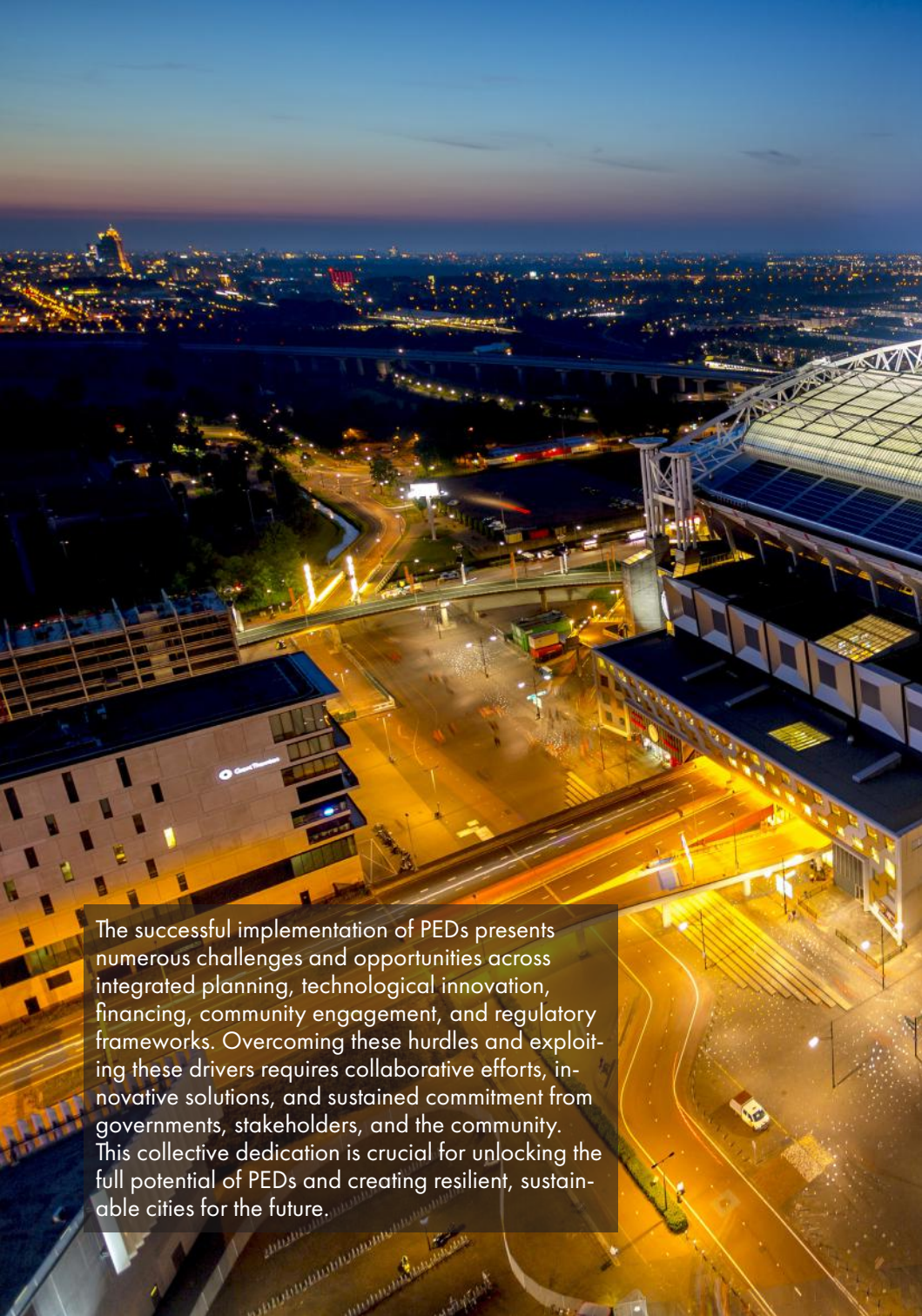
Imagine a city where every device is connected, optimising energy use – it's like turning the city into a giant, efficient computer that manages its energy intelligently.

Green Infrastructure

Envision a city adorned with lush parks, eco-friendly buildings, and electric public transport – it's like creating a city that harmonises with nature rather than exploits it.

Economic Innovation

Picture a city where green businesses flourish, creating new job opportunities – it's like cultivating a garden of innovation where the environment and local economies can thrive.



The successful implementation of PEDs presents numerous challenges and opportunities across integrated planning, technological innovation, financing, community engagement, and regulatory frameworks. Overcoming these hurdles and exploiting these drivers requires collaborative efforts, innovative solutions, and sustained commitment from governments, stakeholders, and the community. This collective dedication is crucial for unlocking the full potential of PEDs and creating resilient, sustainable cities for the future.

LIFE Platform, Johan Cruijff Arena, Amsterdam
Copyright: Johancruijffarena

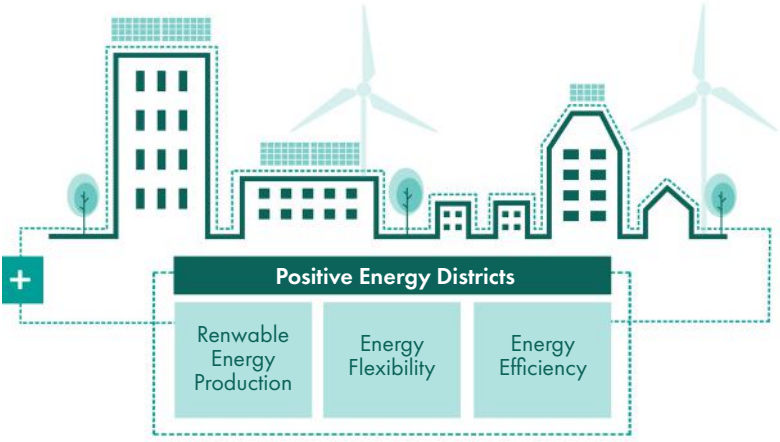
2

LEARN

A focus on energy issues and available solutions

Are you familiar with PEDs?

PEDs represent the vision Europe has for our cities toward decarbonisation within 2050, aiming for a regenerative and liveable future. They are urban areas that produce and share surplus renewable energy. Urban development promotes autonomy in various areas of the city at an energy level, such that the city is divided based on, among other factors, energy requirements. At the district scale, it becomes easier to assess and tailor the requirements for reduced energy demand, precisely delineate the potential for renewable energy generation on a local scale, and socially leverage the sense of community.



While an individual building may not be self-sufficient, grouping a set of buildings allows for a more precise and flexible alignment of energy demand with renewable resource generation, drawing upon demand response and energy flexibility through strategic deployment of smart devices and limited energy storage. Such urban innovation leads to monthly household savings on electricity, heating and cooling, and water heating, while simultaneously enhancing air quality through emissions reduction. Additionally, the surplus energy can be used, for example, to recharge electric vehicles at low dynamic tariffs, helping balance the grid.

Sustainable Development Goal 7: Ensure access to affordable, reliable, sustainable, and modern energy for all

We all depend on energy in our everyday lives! We need it to have sufficient levels of heating, cooling, and lighting in our homes to ensure a decent standard of living and help guarantee our health.

The social phenomenon of '**energy poverty**' is the lack of access to sustainable basic energy services. Even though the European Union (EU) is committed to tackling energy poverty and ensuring that vulnerable consumers have access to essential energy services and products, approximately 40 million Europeans across all Member States, representing 9.3 % of the Union population, were unable to keep their home adequately warm in 2022, while 6.9% were in arrears on utility bills.

In many cases, this situation is driven primarily by three underlying root causes, linked to high energy expenditure in proportion to the household budget, low levels of income, and low energy efficiency of buildings and appliances, although factors such as access, quality and fluctuations of energy must also be considered.

The combination of these factors can lead vulnerable households to minimise basic energy services at cost to their wellbeing.

The situation of a household can be further influenced by geographic and climate factors, household characteristics, gender, health, and specific household energy and transportation needs. As such, households with higher energy needs, which include families with children, persons with disabilities and older persons, are also more susceptible to energy poverty and to its effects. Women, and particularly those who are single parents and older women, are also predominantly affected by energy poverty, due to structural inequalities in income distribution and socioeconomic status.

Growing difficulties are not limited to low income and vulnerable citizens, who spend a disproportionately higher share of their income on energy, but also affect many middle-income citizens. Due to its personal nature, as it impacts households, and its complexity, energy poverty remains a major challenge to be further addressed in the EU, which is working to tackle its root causes through structural and targeted measures.

Innovative and energy-efficient living spaces should be designed in accordance with the energy transition, a global shift in how we generate and consume energy, replacing fossil fuels with renewable resources focused on decarbonisation and smart innovations.

La Fleuriye West, Carquefou (France)
Copyright: Construction21

However, it is essential to integrate considerations of justice and welfare from the outset. This ensures that residents' basic supplies and capabilities are not only preserved but, ideally, improved. The adoption of smart technology-driven transformations and innovations in low-carbon energy systems is increasingly being called upon to prioritise the needs of individuals, considering issues like energy poverty and other justice-related concerns. The relation between energy transition and socially desirable outcomes for a 'just transition' must be analysed in the PED focus of urban transitions.

Building renovation and energy efficiency

One of the key objectives of the EU is the renovation of buildings, both public and private, necessary to boost energy efficiency requirements and meet sustainable development goals. Under this framework, the European Commission has published the Renovation Wave strategy, which aims to double the annual energy renovation rate by 2030, reduce emissions of polluting gases, create green jobs in the construction sector, and improve living standards.

To achieve these goals, three areas of action are prioritised: tackling energy poverty and worst performing buildings; increasing the renovation of public buildings; and boosting the decarbonisation of heating and cooling systems. Improving the energy performance of buildings can mitigate potential negative social effects and maximise social benefits, notably to improve living conditions in buildings with the worst energy performance and to alleviate or even prevent energy poverty. Giving priority to the renovation of buildings with the worst energy performance allows directly

addressing energy poverty, since people affected by energy poverty and vulnerable people tend to live in such buildings.

Through energy renovation, the heating and cooling energy needs of homes can be substantially reduced and consequently the inhabitants can enjoy a proper indoor climate with affordable energy bills.

The integration of buildings and generation systems based on high efficiency and renewable systems provides the right conditions to achieve intelligent systems and low energy consumption from the point of view of both new construction and rehabilitation of existing buildings, and to promote the use of renewable natural resources in cities. Additionally, upscaling the energy renovation of buildings can generate and preserve jobs that indirectly contribute to the welfare of population. Principles of energy efficiency also apply to energy efficient household appliances, which can contribute to energy savings. Standards for energy efficiency, applied through eco-design and energy labelling rules, can bring about large energy savings to households.

Smart metering systems, which support accurate and close to real-time readings, allow users to monitor their actual energy usage throughout the day and can help in identifying people in energy poverty. As a result, they help users take control of their energy behaviour, and adjust their consumption to keep their costs in check, while they put an end to estimated bills and the grievance of back billing and tap into the benefits of dynamic tariffs leveraged using smart devices as familiarity with these functionalities becomes more widespread.

Renovating buildings to increase energy efficiency is crucial for reducing the environmental impact of the buildings' domain and addressing climate change. The initial phase of an energy audit has the role to identify areas where energy is wasted and to prioritise improvements. Professional energy assessments can help identify opportunities for improvement.
Key measures include improving insulation and sealing gaps to minimise heat loss and air infiltration. Installing high-performance windows and doors reduces the need for artificial lighting while upgrading heating, ventilation, and air conditioning systems to high-efficiency models with programmable thermostats optimises temperature control. Energy-efficient LED lighting, along with lighting controls like occupancy

sensors and daylight harvesting systems, are crucial. Replacing outdated appliances with energy-efficient alternatives is also recommended, while recycling end-of-life appliances. Implementing water-saving fixtures, passive design principles, sustainable materials, and smart building technologies further enhance efficiency. Additionally, to maximise comfort for the building occupants and promote sustainability, natural daylight can be harnessed, life-cycle assessments availed, and existing infrastructures repurposed through retrofitting. Education and training for occupants and staff play a vital role in maximizing the benefits of these measures.

The positive effects of building renovation, including on living conditions, can be maximised through integrated, participative PED initiatives, as district-related approaches, especially when energy renovation is integrated in tax incentives schemes and urban regeneration programmes. Notably, the quality of outdoor spaces matters equally: well-designed public spaces improve the liveability of districts and mitigate the effects of climate change on cities. These spaces should include vegetation and permeable surfaces, as well as water sources and shaded areas that mitigate heat islands and provide shelter for people during heat waves.

Another aspect to consider in cities is mobility, a sector with high energy consumption, primarily satisfied with oil-based fuels. **Electrifying** the vehicle fleet in districts, along with the previously mentioned energy efficiency in buildings, is crucial for reducing dependence on fossil fuels and lowering emissions in cities.

PEDs require embracing an active, integrated, and shared mobility system. Following the 'avoid, change, improve' paradigm, urban mobility system is expected to 'avoid' unnecessary travel, aligned with the 15-minute city concept, to shift mindset towards the use of active transport by bicycle or foot for short travel and of public transport for everyday commutes, and to improve connections in term of safety, efficiency, and frequency. This can be translated into practical actions aimed at reducing daily car trips by using shared mobility services (e.g., car sharing, carpooling, bike sharing), public transportation (e.g., installing smartphone applications to check real-time multi-modal transport options), and widely using bicycles including electric

ones (e.g., checking and demanding available and well-maintained bicycle lanes for daily commutes). PEDs imply a preference for electric mobility where possible: electric mobility through e-bike sharing or e-car sharing is available in many cities. While the purchase of these means is still beyond many people's reach, services such as these support the accessible adoption of these new modes of transport in cities, reducing traffic and emissions – and, consequently, reducing people's commute time and enhancing air quality.

The promotion of charging infrastructure for such vehicles should be encouraged in all districts. In public spaces through the City Councils, and for private charging points, both individuals and energy communities must be equipped with the necessary tools to encourage the installation of such facilities.

The challenges facing Europe in the energy field include issues such as increased dependence on imports, limited diversification, high and volatile energy prices, growing global demand for energy, security risks of producing and transit countries or the growing threats of climate change. To alleviate these effects, it is necessary to implement measures that encourage the diversification of energy sources, the reduction of fossil fuels and the reduction of energy consumption. Phasing out fossil fuels and replacing them with renewables is key to climate change adaptation and mitigation. The European Green Deal sets out the principle that "no one is left behind", which is of utmost importance in this context. Switching from fossil fuels to cheaper renewables for energy supply is a central element of PEDs together with energy efficiency and energy flexibility.

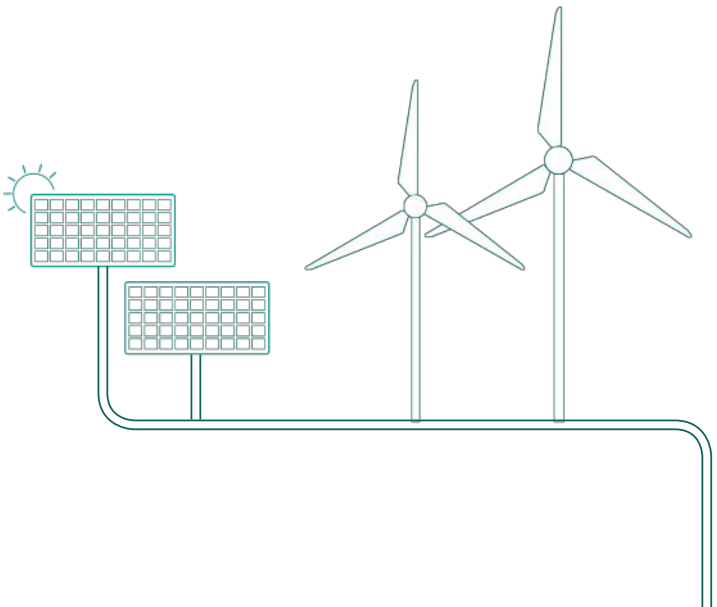
The renewable generation sources that can be implemented in the urban environment are usually solar (photovoltaic, thermal and hybrid), wind, geothermal, biomass and biofuels. To reduce the mismatch between renewable production and building demand,

energy storage systems must be implemented. These systems can be implemented on site in buildings (batteries, supercapacitors, fuel cells, etc.), or virtually using energy networks as intermediaries: pouring all unconsumed energy or purchasing energy when the needs of buildings cannot be met locally.

End-use efficiency and energy management are fundamental to addressing these aspects. Therefore, it is necessary to equip cities with demand reduction strategies and systems in buildings and districts, as well as innovative integrated management systems. Once demand has been optimised, the main mechanisms are the integration of renewable energy sources, the use of renewable air conditioning and increased energy efficiency in the generation, transport, and supply of heat, cold and electricity. In this process, access to energy and comfort for all citizens must be ensured. In addition to reducing demand through efficient design, energy generation systems based on renewable energies must be developed, and positive energy districts and cities must be created.

Renewable energy is more affordable for consumers if they can have direct access to it. Collective self-consumption schemes can overcome the limited capacity of households to access renewable energy and become active – as consumers – while producing electricity (so-called '**prosumers**'). Being a prosumer and

participating in collective self-consumption schemes bring wider non-financial benefits, such as empowerment, new skills, and social inclusion for the individual, as well as trust and cooperation within the community. Collective self-consumption schemes include energy communities and energy sharing schemes.



Energy Flexibility

The high randomness produced by renewable sources can cause greater fluctuations on the supply side, making the appropriate management of the available flexibility necessary. This management must be carried out both in generation side and demand side, facilitating the compensation produced by the lack of certainty of renewable sources. Energy flexibility provided by end-users are described in terms of ability to shift energy consumption away from peak load hours, which are times of the day when electricity consumption is high, and the electricity grid is constrained.

From a technical and economic point of view, this can be seen as a means to utilise power more effectively and/or to avoid new investments in physical grid infrastructure. Flexibility services, such as increasing generation or shifting consumption, are becoming a critical success factor in energy systems, as they can be effective tools to help manage network congestion and the intermittency of renewable energy resources. In the next few years, the provision of energy flexibility

services may give families an additional income source, which could improve their economic conditions and reduce their energy bills.

Low-income households in some countries exhibit a significant willingness to participate in demand-side management activities, aiming at reducing their energy bills, even though the non-negligible initial capital investment might be a barrier to adoption. Whether you live in a condominium or a housing complex, chances are you might produce, use, and exchange energy from renewable sources collectively, saving on the cost of installing renewable energy systems and reducing your energy bills! This is an energy community, and many cities and regions are promoting it with incentives and guidance. Check out what is available in your area!

The existing European framework provides opportunities for corporations and citizens to engage in various activities, including the production of renewable energy – both electrical and thermal. This encourages citizen participation in the electricity market, fostering self-consumption of renewable energy. The ideal would be engaging in energy communities and providing support for their effective long-term management.

This legal entity would oversee the energy services outlined by its members, who will request investments and manage renewable energy generation projects (both electric and thermal) as well as sustainable mobility initiatives, encompassing both vehicles and infrastructure.

The underlying value of flexibility depends on the location where these services are provided and may vary significantly across a country. This means that some people might be more advantaged than others, which could increase inequality among the population. In that direction, policy interventions are needed to support the deployment of specific flexible devices, like heat pumps, to sustain disadvantaged people rather than incentivising smart home appliances generically.

Schoonschip, Amsterdam
Copyright: Isabel Nabuurs

3

ACTIVATE

How citizens can contribute in the transition towards Climate Neutrality

Being climate neutral consists of emitting less harmful substances into the atmosphere – Greenhouse Gases (GHGs) – and finding genuine ways to offset the remaining emissions for a neutral balance. The European objective is to reach Climate Neutrality within 2050, aiming at decreasing GHGs in the atmosphere to mitigate the main cause of global warming, and leading towards sustainable, liveable cities at less climate risk. PEDs are a piece of the Climate Neutrality puzzle.

Actively supporting the transition entails both taking and pushing for responsible actions at individual and systemic levels respectively, and enjoying the benefits that flow to society from them. Inclusive policy-making and implementation of climate mitigation measures addresses the problems of all groups in society, including vulnerable ones, to produce a 'just transition'. We must promote energy efficiency, advocate for renewable energy adoption, and strive for equitable access, especially for marginalised communities. Creating green jobs and providing support for displaced

workers eases the transition. Creating affordable, energy-efficient housing, sustainable public transportation options, and green, adaptive infrastructures can enhance liveability. Advocacy for supportive policies and community-owned energy projects where citizens co-design processes and share ownership and control is essential.

Together, society can drive the transformation towards sustainable and inclusive PEDs. Citizen participation in this energy transition is essential and requires bringing about adequate political and legal framework conditions, greater communication and effective support for owners, tenants and residents, and the implementation of participatory mechanisms to inform, involve, engage and empower diverse citizens.

So, what can I do?

Most of what we do involves energy use, and especially fossil fuels and other non-renewable sources. Whether it is the way we commute to work or heat our homes, current energy consumption generates GHG emissions which trigger severe negative impacts

on our planet and on our life and health. Intensified droughts, wildfires and floods that destroy landscapes, crops and infrastructures are effects of GHG-induced climate change. Bad air quality related to poor ventilation in buildings can lead to health risks, and inefficient energy use and poor insulation can increase energy demand and costs. Structural changes are essential to meet the scale of the challenge, while some individual actions also help. Importantly, individuals engaging collectively to demand structural changes creates political support to enable them.

The good news is: You can make a difference!

The transition towards renewable energy, efficient and responsible energy use depends on systemic structures, our habits and informed choices. Shifting to more sustainable modes of dwelling advances climate neutrality, monetary savings, health benefits and improved life quality.

Actions to mobilise span a broad range – from simple everyday activities to political engagement for structural change! Below are inspirational tips on how **sustainable energy habits** can have wider positive impacts:

Switching off lights when leaving a room and electrical appliances when on standby saves energy.

Using LED light bulbs can reduce lighting costs substantially compared to older, inefficient ones.

Ceiling fans can effectively cool single rooms compared to power-hungry air-conditioners.

Energy efficient appliances, kept in good shape and replacing inefficient outdated models, offer both better performance and a greater return on your initial investments!

Maintaining older appliances can also help: when the rear vent of the refrigerator and the clothes dryer exhaust are obstructed by dust, motors face higher strain and consume more energy.

By joining calls for change, pushing for better standards and being vocal against wasteful luxurious consumerism, we can create political pressure to penalise energy overuse by the rich. This means critiquing growth in directions that go against sustainability, like fast fashion and frequent flying.

And what can we do as a community?

As we push towards Climate Neutrality, we are united by a common cause! Making cities more efficient and self-sufficient enhances a sense of community. Working side by side, sharing ideas to shape a common future gets people involved, creating pride in our neighbourhoods, and valuing diverse, vital role that collectively make cities vibrant. Working together, from small projects like community gardens to bigger recycling systems, each step adds up to a big difference in our everyday lives and impact. Engagement shows children the importance of respecting planetary boundaries in relatable, fun ways. Changing our cities creates places of connection and belonging. Building supportive community that care for urban environments creates greener cities and a brighter future for us all.

Do you feel these actions are easy?

Effective actions already exist, and even when outside your daily routine, they are often within reach and feasible due to incentives or new business models, leveraging community relations to share benefits widely.

Look at the following case studies...


Hunziker Areal - Zurich (Switzerland)
Copyright: Building Social Ecology

Hunziker Areal - Zurich (Switzerland)

Hunziker Areal is an ex-industrial district in the north part of Zurich City. After being dismissed, selected architectural studios, through a design competition, have redesigned the neighborhood as a dynamic and vibrant urban space where people can both live and work according to sustainability and inclusion principles.

The buildings present high energy performance standards and are designed in close relation with the outdoor green system proposing a shared use of the ground floor level as spaces for activating community life and social cohesion among residents.

ADOPTED SOLUTIONS

Energy and Built environment

- Energy certificate at neighborhood level - i.e., 2000-Watt-Society protocol;
- District-heating using waste heat from Urban Data Centre;
- 370 dwellings with different sizes according to varied residents needs;
- Multiple proximity services - i.e., coworking spaces, schools, vegetable gardens, laundries, workshops, children playgrounds, second-hand shops, etc.

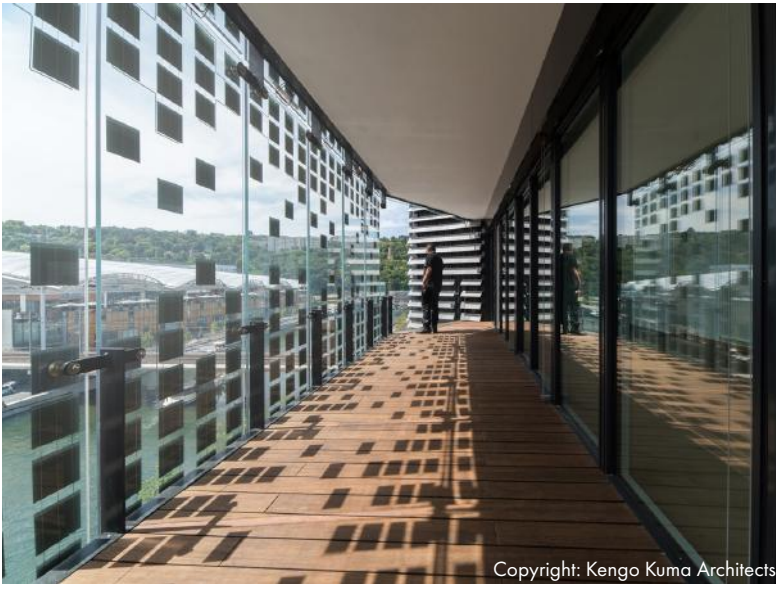
Mobility system

- Few spaces for car parking at ground level and limited time (2h. maximum);
- Availability of an underground car parking with e-charging;
- Frequent and efficient connection towards the center through public transportation - i.e., railway service, buses, e-mobility (bike sharing, scooters, etc.);
- Safe and capillary cycle lanes towards the city center.

Outdoor spaces

- Design of open and accessible open spaces that facilitating community gathering;
- Presence of vegetables gardens co-managed by local residents;
- Site-specific greening through the use of autochthonous species;
- Green façades and roofs;
- Co-creation workshop to transform with the community a parking area into a pocket-park;

HIKARI Block - Lyon (France)



HIKARI Block is the first example of an implemented positive energy district. It was built in Lyon, in 2015, in the district La Confluence. HIKARI bears the signature of the Japanese architect Kengo Kuma and is an urban block composed of buildings with residential, commercial, and tertiary use.

Mixed-use destinations, thanks to complementary consumption curves, allow to cover the entire energy demand through the local production of renewable energy.

ADOPTED SOLUTIONS

Energy and Built environment

- Mixed-use development (residential, offices, shops, services, etc.) allowing to cover the entire energy requirement through local renewable production energy;
- Building envelopes are well isolated and air circulation is guaranteed by the presence of air intakes at the buildings' corners and by ventilation chimneys;
- Cuts on the facades to improve natural lighting calculated on the solar path;
- Home sensors and smart meters, which measure consumption and the production of renewable energy in real time.

Mobility system

- Fleet of electric vehicles for car-sharing using on-site renewable energy production;
- Integrated urban data platform collecting data and service on the mobility system;
- The tram line connects 'La Confluence' to the other Lyon neighborhoods and maintains a constant flow of people for shops and leisure activities in the area.

Outdoor spaces

In the whole 'La Confluence' district:

- Space for cars is limited to make room for green spaces and sidewalks are designed with trees and vegetation;
- Public spaces are designed to retain rain, which is then used to water green spaces;
- 60% of the Saône riverfront has been converted into parks.

Centro di Evora (Portugal)

Evora City Centre is one of the pilot areas of the 'POCITYF' project, funded by the European Commission under the Horizon Programme 2020. The project aims to support the climate-neutral transition in the historical city centre also considering a series of constraints and regulations.

In Evora, tailor-made technological solutions and transformation approaches were applied in order to protect and valorise its cultural heritage as well as foster city centre liveability and accessibility.

ADOPTED SOLUTIONS

Energy and Built environment

- Building integrated photovoltaic solutions (e.g., PV glass, PV canopy, PV roofs etc.) are adopted following building codes and architectural designs, making them suitable for historical areas;
- Intelligent air quality and lighting monitoring systems are tested in eight municipal buildings (schools, theatre, market, arena and town hall) and a car park;
- Gamification platform to encourage the challenge towards the most energy efficiency building or blocks

Mobility system

- Electric vehicle sharing schemes aimed at reducing congestion in the city center resulting from the actual intense use of private cars;
- Energy management platform for the control of electric vehicles charging.

Outdoor spaces

- Smart lamp posts, with electric vehicles charging and 5G functionalities;
- City Information Platform (CIP) based on the cross-domain data from different fields (traffic, air quality, waste collection, etc.);
- *Pay-as-you-throw* systems for waste production.

Would you like to have a wider perspective on PEDs?

Below are links to real examples where communities are making a difference to enable energy transitions:

European Cooperation in Science and Technology (COST) Action PED-EU-NET Database for Positive Energy District (PED Database)
(https://pedeu.net/map/)
The tool is developed by the COST Action 'PED-EU-NET' in close collaboration with two further EU initiatives working on the PED concept - i.e, IEA-EBC Annex 83 and JPI UE - and it is still open to enlarge its horizon including new PED pilot experience in Europe and beyond.

C40 Knowledge Hub

https://www.c40knowledgehub.org/s/article/10-ways-cities-can-tackle-energy-security-and-energy-poverty

JPI Urban Europe 'PED Booklet'

https://jpi-urbaneurope.eu/wp-content/uploads/2020/06/PED-Booklet-Update-Feb-2020_2.pdf

Cities4PEDS PED Atlas

https://energy-cities.eu/wp-content/uploads/2021/11/Cities4PEDs-Atlas-Nov.-2021.pdf

EPAH ATLAS

https://energy-poverty.ec.europa.eu/discover/epah-atlas_en

SCAN ME!

Tartu (Estonia)
Copyright: SmartEnCity

4

GLOSSARY

of key terms

Keywords	Definition
Climate change adaptation and mitigation	Climate change adaptation and mitigation are like two ways of dealing with a big problem: climate change. Adapting is about finding ways to adjust to the changes that are already happening in our environment. It's like preparing for hotter temperatures or more extreme weather by building stronger houses or planting trees to provide shade. Mitigation, on the other hand, is about preventing future changes by reducing the things that make climate change worse. That means using less energy, creating less pollution, and protecting forests that absorb carbon dioxide. Both adaptation and mitigation are important ways to help us cope with climate change and make our world a safer and healthier place to live for everyone.
Climate impact	Effects on natural systems, health, ecosystems, economics, society, culture, services or infrastructure due to the interaction of climate changes or dangerous climate phenomena that occur in a specific period of time.
Decentralised energy production	Decentralized energy production is a way of generating power that doesn't rely on one big power plant far away. Instead, it happens closer to where it's used, in different places like homes, schools, or neighbourhoods. Imagine having solar panels on rooftops or small wind turbines in your community. That's decentralized energy! It gives us

more control over our energy because we can produce some of it right where we live. Plus, it often uses renewable sources like the sun or wind, which are better for the environment. So, decentralized energy helps us be more self-sufficient and reduces our impact on the planet by using cleaner, local sources of power.

Ecological footprint

Ecological footprint is a metric that measures how much nature exists, its regenerative capacity, and how much nature we use relative to it.

Energy behaviour

Energy behaviour is all about how we use and manage energy in our daily lives. It's the things we do that affect how much energy we use, like turning off lights when we leave a room, using appliances efficiently, or choosing to walk or bike instead of driving short distances. Our habits and choices, like adjusting the thermostat or unplugging devices when they're not in use, are part of our energy behaviour too. By being mindful of how we use energy, we can help save resources and reduce our impact on the environment while also saving money on our energy bills. Small changes in our daily routines can make a big difference in how much energy we use and how sustainable our lifestyle is.

SARY

Energy communities	Energy communities are like teams of people who work together to create and use energy in a smarter and more sustainable way. Instead of just buying electricity from big companies, these communities produce their own energy. They might have things like solar panels on roofs, wind turbines, or share energy from local sources. Everyone in the community gets involved by using this clean energy and sometimes even sharing it with others nearby. It's like a neighbourhood working together to create and use energy that's good for the environment and often saves money too.
Energy efficiency	Using less energy to perform the same task
Energy-efficient household appliances	Energy-efficient household appliances are like superheroes for saving electricity. They're special because they use less energy to do the same job as regular appliances. For example, energy-efficient fridges, washing machines, or light bulbs work just as well as regular ones but use less electricity. This means they help us save money on our electricity bills and also help the environment by using less power.
Energy labelling	Rating system informing consumers on the energy consumption of an appliance, among other things

GLOS

Energy poverty	Energy poverty occurs when a household must reduce its energy consumption to a degree that negatively impacts the inhabitants' health and wellbeing. It is mainly driven by 3 underlying root causes: a high proportion of household expenditure spent on energy; low income; low energy performance of buildings and appliances.
Equity	Fairness and justice, calibrated to accommodate for systemic variabilities. While equality means providing the same to all, equity means recognizing that we do not all start from the same place and must acknowledge and make adjustments to imbalances.
ICT systems	Information and Communication Technology (ICT) systems are like the brains and nerves of our modern world. They include all the devices, networks, and software that help us communicate, share information, and access the digital world. Think of your smartphones, computers, the internet, and the apps you use—they're all part of ICT systems.
Net zero	the greenhouse gases going into the atmosphere are balanced by removal out of the atmosphere
Prosumer	A 'prosumer' is someone who both produces and consumes things. In the context of energy, it means people who both make and use electricity. Imagine having solar panels on

SARY

	your roof: during sunny days, these panels make electricity, and you use that power in your home. When you make more energy than you need, you can even send it back to the electricity grid for others to use.
Renewable energy	Energy coming from natural sources that are replenished quicker than they are consumed – perfect examples are the sun and wind
Resilience	Capacity of social, economic and environmental systems to cope with a dangerous event, trend or disturbance by responding or reorganizing themselves in a way that maintains their essential function, identity and structure while maintaining the capacity for adaptation, learning and transformation.
Smart meters	Devices that record information such as consumption of electric energy, and communicate the information to consumers (offering clarity of consumption behaviour) and electricity suppliers (offering technical information)
Tax incentive schemes	Tax incentive schemes are like rewards from the government for doing certain things they want to encourage. It's like getting a bonus or a discount on your taxes for doing something good for the community or the environment. For example, if you buy an electric car or install solar panels at home, the government might give you a tax incentive. These incentives are meant to motivate people to make choices that benefit society.

Reininghaus, Graz (Austria)
Copyright: Reininghausgrnde

POSITIVE ENERGY DISTRICTS

for people and the environment

ISBN 979-12-210-5778-2