D1.1 PROJECT VISION

A vision for BIPED co-created during the kick-off meeting in Aarhus

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1.   BIPED Mission

This mission vision is the result of a brainstorming session organised at the kick-off meeting in Aarhus (Figure 1). It captures the wishes, ambitions and desires of the whole BIPED team, which endorsed the text to act as a guiding principle during the project's lifetime. The vision is our point of reference for years to come but it is not static nor carved in stone. To ensure its relevance, the vision will be updated based on new project results and wider developments in energy transition.

Figure 1. Partners brainstorming project vision

What are PEDs?
Positive Energy Districts (PEDs) are a key building block in the future energy paradigm for carbon-neutral cities and communities. With the rise of modern technology, local digital twins – the digital representations of a functional territory combining low- and high-velocity data with dynamic models enabling advanced analytics and artificial intelligence (AI) – play a significant role in PED development and the scaling of it, supporting decision makers, planners and communities in taking informed decisions towards a sustainable future.

Challenges in PED modelling
However, if focusing narrowly on energy and mobility topics confined to the traditional sectors, digital twins for PEDs currently lack representation of significant aspects such as local social, economic, and environmental properties, and hence, draw only part of the picture of a district or a city. Limited by data availability, lacking awareness of existing data, and siloed systems design, this shortcoming in digital twin modelling for PEDs leads to suboptimal decisions, impacting negatively ambitious efforts of sustainable development in cities and communities. This becomes even clearer when reflecting on the scalability and connectivity issues across the 80,000 municipalities in the EU27. As highly complex entities, cities and communities differ in their physical, social, economic and even cultural structures, making it challenging to replicate PEDs even in an incidental way across Europe.

BIPED focus

In view of the above, BIPED will:

- Extend local digital twins to refine a district's profile representation, guiding PED design and demonstrators.
- Support the advancement in local digital twin development via the quantitative collection, management and processing of hard and soft data across spatio-temporal hierarchies and domains.
- Boost the replication potential of PED solutions for climate-neutral cities and communities with reinforced decision-making on all governance levels, including the national and EU level.

Ambition

BIPED's overarching ambition is to bridge the gap between digital tools for long-term city planning and short-term management using the Minimal Interoperability Mechanisms (MIMs) and local digital twin technology. The ambition is to unlock a spectrum of data-driven and local digital twins, which are optimised for self-learning using data from all relevant data spaces, including energy, traffic and meteorology, as well as social and spatio-temporal data. The methodologies will take advantage of the future consolidated city network specifications combined with high-resolution near real-time data streams from the urban space, energy suppliers, and various other stakeholders (Figure 2).

Figure 2. Tackling complexity and scale in PED development[1]

BIPED aims to use digital twins for PEDs, in combination with appropriately defined MIMs, to obtain a minimum sufficient AI-based, data-driven self-learning systems for optimization of PEDs and bottom-up detailed models. On top of that, BIPED aims to provide efficient methodologies for building a hierarchy of tools that ultimately will lead to a combined bottom-up and top-down approach necessary for coherent hierarchical learning. This will improve the description of phenomena on all relevant temporal and spatial scales, on the

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[1] Image credits: Wikimedia (Gellerupparken, City Vest), Adobe stock (Cityscape of Aarhus in Denmark)

basis of which targeted interventions for smart and sustainable society can be developed anywhere in Europe. Working in an ecosystem-based approach, and linking with larger ecosystems, such as the Open & Agile Smart Cities & Communities network and the Climate-Neutral and Smart Cities Mission, ensures both longevity of the contributions from BIPED and calibration from peers across Europe, and the world.

2. BIPED Vision for Brabrand

Brabrand – Inspiring Positive Energy Use – A Beacon of Sustainable Living

By the end of the project Brabrand has been placed on the global stage as a shining example of sustainable, inclusive and prosperous urban living, where innovation harmonises with community spirit to create a vibrant, thriving district. Streets once dominated by conventional energy sources now feature a full range of renewable power sources, as solar panels adorn rooftops, and wind turbines help generate local energy.

In this transformed landscape, buildings are more than mere structures; they are living embodiments of sustainability, boasting cutting-edge energy-efficient design and seamlessly integrated green spaces. Every corner of Brabrand, both older parts and newly developed, aims to exude a sense of vitality, diversity and resilience, where residents and visitors alike have a positive experience living and working in the area.

At the heart of this transformation lies the PED, a testament to Brabrand's unwavering commitment to environmental stewardship. Leveraging the latest advancements in digital twin technology, urban data is captured and leveraged to help monitor and optimise energy flows in real-time, whilst reducing CO_2 and greenhouse gas emissions. Policy makers and city managers are better able to track progress towards green deal targets and use simulations to help make more efficient and effective data-informed decisions helping Brabrand move closer to an energy positive future.

But beyond policy, Brabrand's true essence lies in its people. Here, community engagement is not an afterthought but a way of life, as residents actively participate in shaping their shared future. From grassroots initiatives to city-wide collaborations, the local digital twin and its surrounding processes ensure every voice is heard, every idea valued, as Brabrand marches boldly towards a sustainable tomorrow.

As Brabrand becomes a model of sustainable urban living, its impact transcends its own borders, igniting a ripple effect across Denmark and beyond. Inspired by Brabrand's success, neighbouring communities and cities throughout Europe are emboldened to embark on their own PED journeys towards sustainability, drawing upon BIPED's innovative practices, newly created standards (MIMs), tools and lessons learned.

This ripple effect extends beyond mere emulation, it sparks a wave of new research, technological advancements, and collaborative initiatives aimed at accelerating progress

towards climate action goals. BIPED's pioneering use of digital twin technology in Braband serves as a catalyst for the advancement of similar initiatives across the continent, fueling a collective momentum towards a greener, more resilient future for all.

This is the vision that BIPED inspires – a Brabrand where innovation, community, and sustainability intertwine to create a sustainable urban environment for generations to come. As we embark on this journey, we envision a future where every street corner, every home, every resident reflects the transformative power of collective action.

3.   Conclusion

Our mission and vision captures the essence and motivation behind the BIPED project, and how we seek to support Brabrand in achieving the goals in its climate action plan. The vision will be revised on a regular basis to ensure it stays relevant throughout the project. To condense the vision into a working form that can be used at the start of project meetings and ensure the whole consortium and the larger ecosystem is working towards the same goal, we have created a North Star for the project.

North Star for BIPED

BIPED leverages the opportunity provided by Local Digital Twins to:

- **Co-create a Positive Energy District** in Brabrand to leverage urban data, including soft data, and accelerate achievement of local climate goals
- **Enhance public participation** – by enhancing knowledge, access to tools and information - in achieving positive energy targets
- **Foster an open technical & policy environment** with minimum interoperability standards (MIMs) to drive and scale sustainable change across Europe and beyond