PED Action Plans for the four target areas

CITIZENS4PED

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Authors	Grégoire Wallenborn

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Acronyms table

ARCA	**Agenzia Regionale per la Casa e l'Abitare**
COBRACE	**Code Bruxellois de l'Air, du Climat et de la maîtrise de l'Energie**
EPB	**Energy Performance of Building**
EPC	**Energy Performance Certificate**
KLIEN	**Klima- und Energiefonds**
NGO	**Non Government Organisation**
OIB	**Österreichisches Institut für Bautechnik**
PDUR	**Programmatic Document for Urban Regeneration**
PED	**Positive Energy District**
PNRR	**National Plan for Recovery and Resilience**
PUI	**Integrated Urban Plan**
PV	**Photovoltaic**
REC	**Renewable Energy Community**
RES	**Renewable Energy source(s)**
RTLP	**Regional Territorial Landscape Plan**
SME	**Small and Medium Enterprises**
SPD	**Single Programming Document**
SUMP	**Sustainable Urban Mobility Plan**
UHI	**Urban Heat Island**

1 Introduction

The PED Action Plan serves as a management tool designed to guide the development of Positive Energy Districts (PEDs) and support stakeholder groups in initiating and sustaining PED processes. The framework presented here represents an idealized approach, which would require significant time and resources beyond the scope of the Citizens4PED project. Consequently, this document synthesizes the development of PEDs in the four Living Labs – La Roue and USquare in Brussels, Kahlenbergerdorf in Vienna, and San Paolo in Bari – while highlighting the gaps between the ideal framework and what was feasible within the project's constraints. The plan is structured around enabling governance, baseline and vision, modular pathways, short-term commitments, and an adaptive roadmap, and it should be revised periodically to remain relevant.

Each living lab is summarized using common lenses:

- Stakeholders and policies (Policy Canvas / Community Map).
- Technical enablers ad constraints (grid, REC rules, EPB/heritage, mobility).
- Spatial strategies and pathway implications (where available, e.g., Bari).
- Actionable steps and what couldn't be delivered (process limits/time/data).

2 Enabling Framework (Governance and Partnerships)

2.1 Initiator Commitments (first movers and early actions)

The enabling framework focuses on governance arrangements, partnerships, and procedural devices that support early action and long-term alignment. The first step consists in forming an interdisciplinary and transdisciplinary team composed of engaged actors with diverse profiles, including representatives of public authorities, network operators, social housing bodies, educational institutions, civil society, and local enterprises. Activities are deliberately organized as open and permeable so that new stakeholders can join the process at any time. Early stages should deliver visible, concrete results in order to consolidate trust and expand participation. The overall process is iterative: actions are periodically updated in light of information, data, and experience brought by additional stakeholders.

The operational layer translates this principle into early commitments and actionable steps. It starts with the explicit identification of the first movers—the actors ready to act immediately—and the formalization of their commitments. Such commitments typically encompass pilot projects (for instance, energy retrofitting of buildings, the formation of a renewable energy community, or preparatory studies for a district heating network), data-sharing initiatives to unlock evidence-based planning, and local awareness campaigns to encourage participation and demand-side practices.

With the "first movers", i.e. the identified voluntary stakeholders, a first dashboard is established in order to circulate information and the first results. The rules of governance are also set up (*enabling framework*). Early actions must deliver tangible results to maintain momentum and attract

additional stakeholders. All activities need to be conceived as open so that new stakeholders can join the process. In this perspective, what is described below need to be seen as an iterative process, in which activities are regularly updated with information brought by new stakeholders.
In sum, the first step is to identify and document the "first movers": those ready to act now.
Commitments may include:

- Pilot projects (energy retrofitting, energy community, district heat network…)
- Data sharing initiatives
- Local energy awareness campaigns

La Roue (Brussels)

- First movers: local association, and to a lesser extent social housing company and municipality of Anderlecht**.**
- Early actions: collective façade renovation pilots; exploration of electricity sharing within buildings and low voltage grid; local awareness activities.

USquare (Brussels)

- First movers: ULB/VUB campus actors**,** local associations, Ixelles municipality.
- Early actions: heritage-constrained energy retrofits**,** PV on suitable roofs, mixed-use load management scenarios; preliminary DH network options.

Kahlenbergerdorf (Vienna)

- First movers: municipal services**,** RealityLab**,** local owners/associations.
- Early actions: mapping REC options limited by grid levels; identification of EPB pathways under Viennese legislation ; community engagement threads; a vision workshop of local association “Klimadörfl”.

San Paolo (Bari)

- First movers: Municipality of Bari**,** ARCA Puglia Centrale, parish/schools, local NGOs.
- Early actions: Living Lab in schools and parish**;** REC groundwork (substation geometry advantage); short-list of public-housing deep-retrofit candidates; street-lighting upgrades**.**

2.2 Enabling Environment: Policy-Strategy Alignment

The enabling environment is defined by the articulation between local/regional policies, incentives, funding opportunities, capacity-building measures, and network building. For policy–strategy alignment, the Action Plan invites the mapping of regulations and incentives pertinent to PED pathways (including zoning and heritage rules and subsidies), the identification of gaps, and the maintenance of a policy-opportunity tracker to anticipate regulatory shifts. Funding strategies should scan opportunities at the European, national, municipal, and private levels. Capacity-building actions ought to target citizens, SMEs, and municipal staff. Network building is supported by a PED

ecosystem map that visualizes stakeholders' influence and resources and by facilitation of cross-sector partnerships (for example, between energy providers and housing associations).

The enabling environment for PED development was shaped by local and regional policies, funding mechanisms, and capacity-building initiatives. Brussels benefited from the Renolution strategy and COBRACE regulations, which promote energy retrofits and EPB compliance. Vienna offered strong REC frameworks supported by a national law (Renewable Energy Expansion Act), national grants and building codes, while Bari integrated PED objectives into metropolitan spatial strategies and leveraged European and national funding streams. Across all cases, capacity-building actions and network development were essential to foster collaboration among municipalities, utilities, housing associations, and civil society.

Brussels

- REC rules and tariffs: virtual sharing via smart meters; distribution fee discounts (–51% within one building, –26% same low voltage cabin, –8% same high voltage cabin); Local Energy Community model allows third-party ownership/right of use.
- Renolution/COBRACE policies drives renovations, EPB certificates, public exemplarity, support via facilitators and subsidies.

Vienna

- REC framework: virtual sharing; membership open to private/legal entities/municipalities; 28–64% network-charge reduction depending on grid level; strong national support by KLIEN grants.
- EPB/Building codes: OIB guidelines; Vienna Building Code and Energy Efficiency Act; various subsidies; many citizen programmes.

Bari

- REC rules: virtual sharing with sliding feed-in premium on shared kWh; 55% social-return threshold for premium revenues; perimeter bound to primary substation areas; regional policies recognize RECs of high social/territorial relevance.
- Spatial strategies relevant to PED: PDUR (2011)**,** Metropolitan SUMP (2024)**,** RTLP strategic scenario, Metropolitan Strategic Plan (Axis 10 PED flagship**),** SPD 2026–2028 (REC helpdesk, greening, UHI mitigation).

Funding and capacity highlights (cross-cases)

- **Brussels:** regional subsidies, facilitation services (EPB, shared energy), Renoclick for public buildings.
- **Vienna:** national/regional KLIEN grants, REC agency support; EPB tool landscape; district funds.
- **Bari/Apulia:** ERDF/ESF+ (2021–27), PNRR programmes (PINQUA, PUI, mobility), REC support and "energy income" instrument for installers; municipal commitments in SPD.

2.3 Monitoring and Feedback Loops

Monitoring and feedback loops constitute the final component of the enabling framework. Early indicators should combine quantitative and qualitative measures. They typically include stakeholder-engagement metrics (attendance and pledges), pilot energy balances (photovoltaic yield and shared electricity), retrofit pipelines (number of units and EPC classes), social participation with attention to vulnerable groups, and policy uptake (REC applications and permits). Channels for feedback include regular workshops, school and parish meetings in Bari, campus-based sessions at USquare, facilitator clinics in Brussels, and community mapping and meetings of the association “Klimadörfl” in Vienna. Results are used to iterate pathways and to inform learning at the policy and programme levels.

3 Foundational Elements (Baseline and Vision)

3.1 Community and Stakeholder Insights

The foundational layer comprises a structured baseline and a co-created vision. The baseline synthesizes community maps, stakeholder analysis, and policy canvases. It identifies actors, roles, capacities, and motivations; clarifies the opportunity structure created by regulations and incentives; and locates potential conflicts and leverage points. In La Roue, the garden-city morphology and the high share of social-housing units intersect with heritage constraints, which condition the design of retrofits and onsite generation. Residents have already initiated retrofits, and there is interest in district-heating solutions and local renewables, within a governance arrangement that hinges on the municipality, the housing company, and residents. USquare, a former barracks transitioning to a mixed-use campus, requires a careful orchestration of multi-use load profiles, gradual deployment of rooftop photovoltaics on suitable buildings, and exploration of low-temperature district heating, all while preserving heritage values. Kahlenbergerdorf displays a mixed ownership structure and a sizable stock of heritage buildings. Here, heat decarbonization is the key priority, rooftop photovoltaics are less dominant than in the other sites, and REC feasibility is mediated by grid-level constraints; social processes facilitated by RealityLab are essential to bridging owners’ perspectives. San Paolo is a large public-housing district with socio-economic fragility. The strong roles of the social-housing provider, parish, and schools, the alignment of multi-scalar spatial strategies, and the favourable substation geometry make RECs promising, although the district requires carefully designed mechanisms to deliver a just transition.

Each Living Lab presented thus distinct socio-spatial characteristics and governance dynamics. La Roue is a garden-city neighbourhood with a high proportion of social housing and heritage constraints, requiring careful coordination of retrofit strategies. USquare, a former military site transitioning into a mixed-use campus, faces challenges related to heritage preservation and multi-use energy management. Kahlenbergerdorf combines mixed ownership and heritage buildings, emphasizing heat decarbonization and REC feasibility under grid limitations. San Paolo, characterized by socio-economic vulnerability and large public housing estates, integrates PED objectives into broader urban regeneration strategies and emphasizes social equity. The district exhibits a strong

institutional presence through ARCA, the parish, and local schools, which play a pivotal role in community engagement and governance. Its development is framed within multi-scalar spatial strategies, including the Regional Ecological Network, the Regional Territorial Landscape Plan, and the Sustainable Urban Mobility Plan. The technical configuration of the electricity grid, notably the presence of a single primary substation serving the area, creates favourable conditions for the establishment of a Renewable Energy Community. At the same time, the socio-economic context underscores the necessity of designing mechanisms that ensure a just transition, addressing affordability and inclusion.

Despite these differences, all cases share a long-term vision centred on carbon neutrality, energy sovereignty, affordability, resilience, and participatory governance. This vision is operationalized through three axes: renewable energy deployment, energy efficiency improvements, and energy sufficiency measures. Strategies include rooftop photovoltaic installations, low-temperature district heating, EPB-compliant retrofits, and behavioural changes to reduce energy demand.

Across the four cases, several co-benefits emerge as salient outcomes of PED development. These include the reduction of energy bills and mitigation of energy poverty, as well as improvements in public space and urban mobility, particularly evident in Brussels and Bari. In Bari, additional benefits encompass cooling strategies and the alleviation of urban heat island effects. Community identity is strengthened through cultural initiatives, such as the mural projects in San Paolo, while local employment opportunities are generated through the operation and maintenance of energy hubs and associated infrastructures.

In summary, the steps for establishing the baseline and vision are the following:

- Synthesize data from community maps (Physical and social mapping of each district), stakeholder analysis (Identification of actors, roles, capacities, and motivations), and policy canvas (Mapping of policy environment (opportunities, constraints, instruments).
- Identify common priorities, conflicts, and leverage points across the four urban areas.
- Specify co-benefits from a PED in the neighbourhood (e.g. reducing local pollution, social cohesion, image of the neighbourhood)

3.2 PED Vision and Scenarios

This set of actions define shared long-term goals (e.g., carbon neutrality, energy sovereignty, liveability, equity) based on the three axes:

- Long-term goals (shared): carbon-neutrality trajectory**,** equity and affordability**,** sufficiency (behavioural change and infrastructure dimensioning), resilience (storage/flexibility), and co-ownership/participation**.**
- Axes and examples**:**
    - RES**:** rooftop PV (all), wind (where feasible), low-temperature DH (USquare/Bari hub pathway).
    - Efficiency: EPB compliance/retrofits (COBRACE/Vienna codes/Italian EPBD transposition).

- Sufficiency: modal shift (SUMP in Bari), demand-management in campus/residential settings; cooling behaviour shifts.

The vision should also highlight synergies/trade-offs from multi-objective optimization scenarios. The scenarios are based on co-created narratives and shared value propositions for each PED.

The vision shared across the four sites is articulated along three axes and a set of long-term goals. The axes are the expansion of renewable-energy sources (for example, distributed photovoltaics and, where feasible, wind and low-temperature district heating), the systematic improvement of energy efficiency (through EPB-compliant retrofits, efficient systems, and, where appropriate, smart-grid functionality), and energy sufficiency (through behavioural change, modal shift, and demand-management practices). The goals concern trajectories toward carbon neutrality, the consolidation of energy sovereignty and affordability, the enhancement of resilience through storage and flexibility, and the institutionalization of participatory and co-ownership arrangements. The plan explicitly highlights the need to consider synergies and trade-offs across these axes via multi-objective optimization and to translate them into shared narratives and value propositions tailored to each neighbourhood.

Across the four Living Labs, the anticipated co-benefits of PED development extend beyond energy performance to encompass social, environmental, and economic dimensions. A primary benefit is the reduction of household energy bills, which contributes to alleviating energy poverty and improving affordability for vulnerable groups. In Brussels and Bari, interventions are expected to enhance the quality of public spaces and urban mobility, fostering more inclusive and sustainable neighbourhoods. Bari additionally stands out for its potential to mitigate urban heat island effects through cooling strategies and greening measures, which complement energy-efficiency actions. Cultural and social identity is reinforced through place-making initiatives, such as the mural projects implemented in San Paolo, which strengthen community cohesion and local pride. Furthermore, the deployment and operation of energy hubs, along with associated maintenance activities, create opportunities for local employment and skill development, thereby linking energy transition objectives with socio-economic regeneration.

4 District Transition Pathways (Flexible Long-Term Framework)

This layer outlines adaptive, long-term transformation paths. The district transition layer transforms the vision into adaptive, modular, long-term pathways. It draws on scenario-based roadmapping and breaks down long-term scenarios into short-, medium-, and long-term phases, with milestones deliberately tied to policy windows such as funding cycles and regulatory changes. Three generic families of pathways illustrate the logic: technology-driven pathways emphasize scaling of renewables and storage; policy-driven pathways align measures with national and European goals and local regulatory timelines; and community-driven pathways foreground co-ownership models and behavioural campaigns.

4.1 Modular Pathways

The typology tested in Bari is adapted to all cases and comprises four architectural options: per-dwelling, per-building, energy hub, and REC-based approaches. Comparative analysis suggests that the energy-hub pathway is the only architecture capable of approaching carbon neutrality by 2040 on its own, because it combines local renewable generation, storage optimization, and low-temperature thermal networks under an integrated energy-management system. It is therefore best suited to contexts such as USquare, where loads are compact and governance is cohesive, and to selected clusters in Bari; it is more challenging in La Roue and Kahlenbergerdorf, where loads are more dispersed and heritage constraints are stringent. REC-based configurations emerge as strong enablers in all three countries: they benefit from network-fee discounts in Brussels, network-charge reductions in Vienna, and a sliding feed-in premium coupled with advantageous substation geometry in Bari. However, as heating is often individualized or organized at the level of a single building, REC architectures typically require either virtual PED imports of renewable electricity or deeper renovation efforts to achieve strict neutrality. Per-building solutions are practical in La Roue (for instance, building-scale photovoltaics and heat pumps within heritage rules) and in USquare (block-scale retrofits), though their emissions reduction is moderate and conditional on permitting feasibility and heritage derogations. Per-dwelling solutions tend to have the highest per-unit costs and offer limited systemic optimization; they are valuable as stepping stones in a staged strategy towards community-level arrangements.

Phasing translates these insights into time-sequenced actions. In the short term, audits, photovoltaic deployment on available and compliant roofs, the formation of pilot REC groups, the alignment with facilitation services (for example, the Brussels shared-energy facilitator, the Apulian REC helpdesk, and the Vienna REC agency), and the adoption of “soft-governance” charters are prioritized. In the medium term, building-level retrofits, storage pilots, energy-management system trials at campus or district scale, and slow-mobility and cooling measures are advanced. In the long term, energy hubs are developed where contextually appropriate, REC membership is scaled across substation areas (notably in Bari) or across low- and high-voltage topologies (in Brussels), and integration with city strategies is consolidated (for example, Vienna’s mobility and Climate Roadmap actions and Bari’s municipal programming).

4.2 Uncertainty Management

Uncertainty management is embedded through the identification of pivot points—moments when strategic choices are deliberately revisited in light of new information. These pivot points include heritage-permitting outcomes, enhancements in grid hosting capacity, and access to funding windows. Adaptive planning tools such as backcasting and scenario testing allow the plan to respond to changes in policy, technology, or stakeholder dynamics. No-regret actions are also specified: energy audits, compliant rooftop PV, smart-meter data protocols, school, parish, and campus engagement, improved street-lighting efficiency, and measures that improve mobility safety and the continuity of bicycle networks.

5 Short-Term Commitments (Living Lab Approach)

5.1 Living Lab Continuity Plan: Agreement with stakeholders on how to keep the PED Living Lab active.

Short-term commitments are formalized through Living Lab continuity plans and charters that specify roles, immediate actions, monitoring arrangements, and mechanisms for incremental institutionalization. Voluntary agreements are sought from a core group of committed stakeholders—municipalities, utilities, cooperatives, social-housing providers, universities, and community associations—to implement pilot projects such as building retrofits paired with photovoltaic systems, to experiment with governance devices such as a dedicated PED task force, and to adopt data-sharing protocols that support transparent monitoring. Where appropriate, light formalization such as Memorandums of Understanding is used to promote sustained cooperation and to articulate responsibilities in "Living Lab charters".

USquare's charter aligns ULB/VUB, the municipality of Bru xelles, and developers around a campus REC, photovoltaics and storage, the deployment of an energy-management system adapted to mixed uses, heritage-compatible retrofits, and tests of low-temperature district heating options. La Roue's charter would organize the municipality of Anderlecht, the housing company, residents, and schools to pursue REC formation within single buildings (benefiting from the higher fee reduction) and across low-voltage clusters (with the corresponding lower discount), to maintain a façade-renovation pipeline, to work with the district facilitator for engagement, and to share data with the energy regulator. Kahlenbergerdorf's charter brings together the municipal renewal department, RealityLab, and owners to pilot local RECs at grid levels 6–7, to plan EPB upgrades, to deliver community training, and to optimize tariff structures that reflect network-charge reductions. San Paolo's charter commits the municipality, ARCA, the parish, and schools to establish a REC nucleus within the area served by the designated primary substation, to advance deep retrofits in the public-housing stock (supported by the municipal programming pipeline), to develop climate-shelter and greening measures, and to continue modernizing street lighting.

5.2 Iterative Feedback Loops

The Action Plan incorporates embedded reflexivity as a core principle, ensuring that processes are subject to regular evaluation and systematic re-planning. This approach enables adaptive governance and responsiveness to emerging challenges or opportunities. Stakeholder workshops are convened at regular intervals to review progress, update scenarios, and renegotiate commitments where necessary. These sessions serve as critical spaces for deliberation, fostering transparency and reinforcing collaborative decision-making.

Digital tools, including participatory platforms, are employed to maintain engagement between formal meetings and to facilitate continuous interaction among actors. Such tools support asynchronous contributions, broaden inclusivity, and enhance the traceability of decisions.

Quarterly reviews are organized within each Living Lab to consolidate monitoring efforts. These reviews draw on shared dashboards that present key indicators, including REC membership growth, volumes of shared electricity (kWh), changes in energy performance certificates (EPC) following retrofits, and participation metrics. The dashboards also integrate policy feedback loops, channeling insights to relevant institutional bodies such as the Renolution programme in Brussels, the REC agency in Vienna, and the focal points responsible for the Single Programming Document and the Sustainable Urban Mobility Plan in Bari. This iterative structure ensures that technical progress, social engagement, and policy learning remain tightly coupled throughout the PED development process.

6 Roadmap Structure

6.1 Flexible Roadmap Components

The roadmap consists of three layers. The strategic layer articulates the vision, the selected pathways for each Living Lab, and the adaptive triggers that prompt reassessment (notably permitting decisions, funding milestones, and grid constraints). The tactical layer enumerates short-term projects, stakeholder pacts, and Living Lab governance arrangements, including lists of pilot retrofits, REC installation plans, trials of energy-management systems, connections to slow-mobility networks, and urban-greening and cooling measures. The monitoring layer organizes key performance indicators with attention to energy balance and the share of renewables, shared electricity volumes within RECs, EPC shifts at the building scale, network losses and curtailment risks, participation rates and inclusion of vulnerable groups, and the drawdown of funding.

6.2 Visualization

Visualization is an essential support to planning and communication. A dynamic roadmap template is recommended, combining a Gantt-type representation of milestones over the short, medium, and long term with scenario sliders that reflect key uncertainties. An overlay of policy and funding windows (for example, the timing of Brussels' Renolution cycles, Vienna's grant calls, and Bari's municipal and national programming calendars) helps align project pacing with institutional opportunities.

7 Cross-Case Comparison

Three comparative findings deserve emphasis. First, REC feasibility and economics are favourable in the three regulatory contexts considered, though with different enabling mechanisms. In Brussels, distribution-fee discounts favour electricity sharing at the building and low-voltage scales. In Vienna, network-charge reductions and clear legislation support REC formation, with grid-level geography defining perimeters. In Bari, the sliding feed-in premium and the substation-based perimeter combine with a social-return condition to make RECs attractive and socially oriented. Second, the energy-hub architecture has strong potential where compact loads and cohesive governance exist, as in USquare and, selectively, in San Paolo; it is more difficult to realize in La Roue and Kahlenbergerdorf due to dispersed loads and heritage constraints. Third, heritage and EPB

obligations shape the space of feasible interventions. In Brussels and Vienna, derogations are sometimes necessary but are supported by facilitation services and subsidies; in Bari, EPBD requirements are transposed nationally, public-housing retrofits are funded, and the RTLP and urban-regeneration frameworks guide the siting of renewables to protect landscape quality. Across all four cases, social-equity and engagement concerns are paramount. Bari and La Roue, in particular, require inclusive governance instruments that foreground vulnerable households. Schools and parishes in Bari and campus governance in USquare have proven to be effective gateways for participation and learning.

8 What was not possible (and why)

Several aims could not be realized within the project's temporal and organizational constraints. Comprehensive energy-hub deployment was not feasible outside USquare, where campus governance facilitates coordination; hubs elsewhere would require new district infrastructure, major capital expenditure, and complex permitting beyond the project horizon. Comprehensive data integration could not be achieved because of heterogeneous municipal and utility datasets, privacy and access constraints, and limited time, which necessitated reliance on proxies, interviews, and partial monitoring. Uniform stakeholder coordination proved unattainable given differences in governance timing (for example, Brussels' permitting cycles versus Bari's municipal programming windows) and asynchronous workflows across work packages; these were mitigated by adopting a guideline approach but remained imperfect. Regulatory harmonization across Italy, Belgium, and Austria was neither desirable nor possible; REC and EPB frameworks differ substantially, and the Action Plan therefore adopts a non-prescriptive stance. Finally, rigorous, measured proofs of district-level carbon neutrality were not attainable within the timeframe, especially where REC pathways preserve individualized heating and deep renovation is incomplete; in such cases, qualitative scenario scoring and pathway comparison were employed.

9 Next steps (actionable)

Immediate next steps are organized along four lines. First, each Living Lab should publish a concise charter that formalizes roles, delineates the scope of twelve-month pilots, and specifies key indicators. Second, REC pilots should proceed in each context with appropriate granularity: single-building pilots that expand to low-voltage clusters in La Roue; a campus-scale REC with an energy-management system in USquare; a local REC at grid levels 6–7 in Kahlenbergerdorf; and a REC nucleus within the designated primary-substation area in San Paolo. Third, retrofit pipelines should be aligned with regional strategies and regulatory cycles—Renolution in Brussels, Vienna's laws and grant calls, and Bari's municipal programming—with systematic tracking of EPC upgrades at block level. Fourth, monitoring through shared dashboards and quarterly reviews should be continued and strengthened, with the explicit objective of feeding learning and evidence into the forthcoming pre-standardization process and into future iterations of this Action Plan.

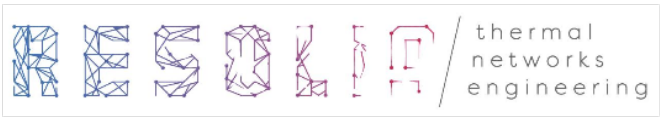
Citizens4PED TEAM

Coordinator:

ULB IGEAT	Université Libre de Bruxelles (ULB)

Partners:

e7 ENERGY INNOVATION ENGINEERING	e7 Energy Markt Analyse GmbH (e7)
VUB VRIJE UNIVERSITEIT BRUSSEL	Brussels Institute for Thermal-fluid systems and clean Energy (BRITE) for Vrij Universiteit Brussel (VUB)
Anderlecht 1070	Anderlecht Municipality – Division: Sustainable development (Anderlecht)

	Brussels Environment Division: Air Climat, Energy Sustainable Buildings (Bruxelles Environnement)
	Resolia Engineering bureau Sustainable & efficient thermal networks (Resolia)
	Arteria technologies engineering bureau (Arteria)
	Realitylab consultancy bureau (realitylab)
	FH Technikum Wien (FHTW) University of Applied Science Vienna
	Bari Municipality
	Politecnico di Bari
	ARCA Puglia Centrale

RSE Ricerca Sistema Energetico	Ricerca Sistema Energetico
UNI UN MONDO FATTO BENE	UNI

CONTACT

Project Coordinator:

Université Libre de Bruxelles

Grégoire Wallenborn | gregoire.wallenborn@ulb.be

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