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Guidelines for the Integrated and Context-Sensitive Development of Positive Energy Districts (PEDs)

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European foreword

This CEN Workshop Agreement (CWA 18485:2026) has been developed in accordance with the CEN-CENELEC Guide 29 “CEN/CENELEC Workshop Agreements – A rapid prototyping to standardization” and with the relevant provisions of CEN/CENELEC Internal Regulations - Part 2. It was approved by a Workshop of representatives of interested parties on 2026-09-11, the constitution of which was supported by CEN following the public call for participation made on 2025-09-15. However, this CEN Workshop Agreement does not necessarily include all relevant stakeholders.

The final text of this CEN Workshop Agreement was provided to CEN for publication on 2026-09-29.

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Introduction

This CEN Workshop Agreement provides guidance for supporting the integrated and context-sensitive development of Positive Energy Districts (PEDs) in real urban settings. It responds to the need for a structured but flexible reference document capable of bridging research outcomes, project-based experience and practical decision-making.

The document builds on the Citizens4PED project, which investigated how PED development can be supported across different urban, institutional and socio-spatial contexts. The project showed that PED deployment depends not only on technological solutions, but also on the capacity to coordinate governance mechanisms, spatial planning processes, data systems, stakeholder engagement and equity considerations.

The purpose of this CWA is to support PED Development Readiness by helping users structure development phases, clarify assumptions, identify enabling conditions, document decision rationales and connect technical analysis with governance, participation and implementation processes. It is intended as a practical support instrument for informed and context-aware decision-making, rather than as a prescriptive methodology or performance assessment standard.

Different users may engage with the guidance in different ways. Municipalities and local authorities may use it to structure coordination across departments, policy domains and external actors. Urban planners and consultants may use it to connect spatial, technical and governance considerations during early-stage PED development. Utilities, DSOs and technical actors may use it to clarify data needs, scenario assumptions and system constraints. Researchers and project teams may use it to organise project-based knowledge into transferable development-readiness guidance. Governance actors, community intermediaries and local stakeholders may use it to support participation, decision transparency and equity-sensitive implementation.

The CWA is particularly relevant for complex or under-resourced urban settings, where limited data availability, fragmented institutional responsibilities, constrained technical capacity or social vulnerability may affect the feasibility and robustness of PED development processes.

This CWA is developed as guidance with recommendations. It provides structured, non-prescriptive and process-oriented guidance based on project results and wider State-of-the-Art knowledge. Its purpose is to support flexible implementation and informed decision-making, while preserving full adaptability to local contexts, institutional settings and regulatory frameworks.

The guidance does not introduce mandatory requirements, performance thresholds, certification criteria or contractual obligations. It does not replace existing standards, technical norms, local planning regulations or legal procedures. Instead, it complements them by helping users understand how PED-related decisions can be structured, documented, discussed and revised across different development phases.

The document focuses on PED Development Readiness rather than on location screening, regulatory compliance or performance certification. Its recommendations are intended to support reflection, coordination and traceability, without defining a single valid pathway for PED development.

As a CEN Workshop Agreement, this document responds to an immediate need for shared guidance in an emerging and evolving field. It may also serve as a reference foundation for future standardisation discussions, further research, replication activities or the development of more specific guidance, provided that such future uses remain consistent with the non-prescriptive and context-sensitive nature of the present document.

1 Scope

This CEN Workshop Agreement (CWA) provides non-prescriptive, process-oriented guidance for the integrated and context-sensitive development of Positive Energy Districts (PEDs). It supports PED Development Readiness in real urban contexts by helping users to structure, document, interpret and adapt the main phases of a PED development process.

For the purposes of this CWA, the integrated component of the guidance is operationalised as a Development Readiness Integration Workflow. This workflow provides the overarching process logic through which PED development may be structured across scoping, context analysis, objective setting, scenario development, screening, governance reflection, implementation readiness, monitoring and adaptive learning.

The context-sensitive component of the guidance is operationalised through a set of context-sensitive guidance elements developed in Clauses 6 to 11. These elements support users in adapting the Development Readiness Integration Workflow to local technical, spatial, institutional, regulatory, social, governance and equity conditions. They are intended to help users take account of data availability, stakeholder configurations, territorial constraints, policy frameworks, implementation capacities and local vulnerabilities when developing PED pathways.

The CWA is based on the practical experiences, findings and lessons learned from the Citizens4PED project. In this document, Development Readiness refers to the capacity of a local context to meaningfully progress through PED development phases by clarifying decision-making conditions, data availability, stakeholder roles, governance arrangements, scenario assumptions and implementation constraints.

This CWA is intended to be used by municipalities, local authorities, urban planners, researchers, consultants, utilities, distribution system operators (DSOs), developers, governance actors and other stakeholders engaged in PED co-design, planning, implementation, monitoring or replication. It is particularly relevant for complex, data-poor, institutionally fragmented or under-resourced urban settings, where PED development requires coordination across technical, spatial, institutional and social domains.

This CWA covers the procedural and organisational aspects that support PED Development Readiness. These include, in particular:

- the structuring of an integrated, PED-oriented urban development process, connecting energy planning, spatial planning, governance, stakeholder engagement, implementation readiness and monitoring;
- support for aligning PED development processes with climate-neutrality ambitions, through scenario exploration, carbon-related screening, complementary indicators and transparent documentation of assumptions, without establishing compliance criteria or mandatory performance thresholds;
- the structuring of cooperation between technological, spatial, institutional and social domains involved in PED development;
- the definition of a flexible Development Readiness workflow, including process phases, inputs, outputs, decision checkpoints and assumption management;
- the identification of contextual information needs, data quality considerations, proxy use, stakeholder and asset mapping, and territorial and institutional readiness conditions;
- the exploration and documentation of alternative PED scenarios, including the clarification of assumptions, boundaries, data limitations and context-specific constraints;

- the use of screening metrics and decision-support criteria, including the Carbon Neutrality Check (CNC) and complementary economic, resilience-related, governance and equity considerations, as inputs to collective interpretation rather than as compliance criteria;
- the integration of governance, participation and equity considerations into PED development processes, including attention to formal and informal stakeholders, vulnerable groups, distributional effects and decision transparency;
- the preparation of implementation-oriented action planning, including policy–technology coherence, administrative capacity, roles and responsibilities, risks, quick wins, and adaptive replication or scaling considerations;
- the establishment of monitoring, learning and adaptation mechanisms that support the revision of assumptions, feedback loops and continuous improvement over time.

Where appropriate and where sufficiently developed during the Workshop process, the CWA is complemented by illustrative supporting materials, such as examples, schematic representations, documentation prompts, case-based descriptions or non-binding guidance elements derived from Citizens4PED experience. Such materials are intended to support interpretation and application of the guidance and do not constitute mandatory tools, formats or requirements. Illustrative case annexes based on the Citizens4PED Living Labs are provided in Annex B.

This CWA is not intended to be used as a prescriptive standard, regulatory benchmark or certification scheme for PED performance. It does not define mandatory energy performance thresholds, minimum energy standards, compliance criteria, contractual obligations or binding requirements for PED planning, design, implementation or monitoring.

This CWA does not replace local planning regulations, technical norms, legal procedures, energy regulations, building codes, procurement rules or other applicable national, regional or local requirements. It also does not provide detailed technical design specifications for energy systems, buildings, infrastructures or digital platforms.

This CWA does not establish a fixed PED model, a universal PED definition, or a location-screening methodology for selecting suitable areas. Instead, it supports flexible and informed decision-making by helping users structure, document and interpret the enabling conditions, assumptions, constraints and choices that shape PED development in specific local contexts.

All references to standards, assessment schemes, tools, labels, projects or external guidance documents are informative. They are provided to support orientation and interoperability with existing knowledge and practice, without creating normative dependencies or obligations.

2 Normative references

There are no normative references in this document. All documents, standards, publications, project outputs and external initiatives mentioned elsewhere in this document are informative and are listed in the Bibliography where appropriate.

3 Terms and definitions

For the purposes of this CWA, the following terms and definitions apply. Additional explanatory entries and acronyms are provided in Annex C.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://iec.ch/electropedia>

— ISO Online browsing platform: available at <https://www.iso.org/obp/ui>

3.1 Core terms

3.1.1

Positive Energy District (PED)

urban area or district-scale transformation process aiming to combine high energy efficiency, energy flexibility, local renewable energy production and broader social, economic, environmental and governance objectives

Note 1 to entry: In this CWA, the term is used in a process-oriented and context-sensitive way. The document does not define a certification model, performance threshold or fixed PED qualification criterion.

3.1.2

PED boundary

spatial, functional, technical or organisational delimitation used to frame a PED process, scenario or assessment

Note 1 to entry: PED boundaries may refer to buildings, public spaces, infrastructures, energy flows, ownership structures, grid connections, social groups or governance arrangements. Boundary choices should be documented where they affect interpretation of results.

3.1.3

Development Readiness

capacity of a local context to meaningfully progress through PED development phases by clarifying decision-making conditions, data availability, stakeholder roles, governance arrangements, scenario assumptions and implementation constraints

Note 1 to entry: Development Readiness does not indicate that a PED has already been achieved. It indicates that the process conditions for responsible progression have been considered.

3.1.4

PED Development Readiness

Operational concept used in this CWA to support the structured progression of Positive Energy District development by connecting contextual understanding, workflow organisation, scenario building, screening and decision interpretation, governance and participation arrangements, implementation planning, monitoring and adaptive learning

3.1.5

PED pathway

context-specific sequence of actions, assumptions, scenarios, governance arrangements and implementation steps through which a district may progress towards PED-related objectives

3.2 Key operational concepts

3.2.1

Context Kit

structured collection of spatial, technical, social, economic, policy, institutional and stakeholder information used to frame PED Development Readiness

3.2.2

Scenario Builder

process or tool used to define, compare and refine alternative PED scenarios in relation to assumptions, boundaries, data availability, stakeholder conditions and implementation constraints

3.2.3

Carbon Neutrality Check (CNC)

carbon-related screening approach used to support interpretation of PED scenarios or pathways

Note 1 to entry: In this CWA, the CNC is treated as a decision-support input and not as a certification criterion, compliance tool or mandatory threshold.

3.2.4

Screening

structured interpretation of a scenario, pathway or option using selected metrics, qualitative criteria, assumptions and contextual considerations

Note 1 to entry: Screening supports decision-making and learning. It does not constitute certification, performance qualification or regulatory compliance assessment.

3.2.5

Complementary indicators

additional indicators or qualitative criteria used alongside carbon-related screening to interpret technical, economic, social, governance, resilience, participation, equity or implementation aspects

Note 1 to entry: This CWA supports transparent indicator selection but does not define standardised KPI sets or mandatory indicators.

3.2.6

Go / Refine / Pause

interpretive decision logic used to support transparent discussion of scenario or pathway readiness

Note 1 to entry: Go indicates that a scenario or action may proceed to the next phase under current conditions. Refine indicates that further clarification, adjustment, data collection, stakeholder engagement or technical analysis is needed. Pause indicates that current conditions are not sufficient for responsible progression, although the option may be revisited later.

3.2.7

Decision checkpoint

structured moment of collective interpretation in which available evidence, assumptions, stakeholder inputs and constraints are reviewed to decide whether a scenario, pathway or action may proceed, should be refined or should be paused

3.2.8

Assumption

statement used to support analysis, scenario building or decision-making where complete evidence is unavailable or where future conditions are uncertain

3.2.9

Proxy

substitute data, assumption or estimate used when direct data are unavailable

Note 1 to entry: Proxies should be documented, justified and reviewed when better data become available.

3.2.10

Implementation Readiness

capacity to translate scenarios or pathways into actionable steps, considering roles, responsibilities, funding, administrative capacity, regulatory feasibility, stakeholder commitment, risks and monitoring

3.2.11

Monitoring and learning

process through which information, feedback and experience are collected, reviewed and used to revise assumptions, decisions, actions or governance arrangements over time

3.2.12

Feedback loop

mechanism through which information generated during one phase of the PED process is returned to earlier or parallel phases for review and adaptation

3.3 Acronyms and abbreviations

The main acronyms and abbreviations used in this CWA are listed in Annex C.

4 Informative State of the Art (SoA) on PED Development Readiness

4.1 General

Positive Energy Districts (PEDs) have become a key concept in European energy, climate and urban transition agendas. They are usually associated with district-scale configurations that combine high energy efficiency, local renewable energy production, flexibility and broader sustainability objectives. However, their implementation in real urban contexts is not determined by technical performance alone. It also depends on boundary choices, data availability, governance arrangements, stakeholder participation, financial and administrative capacity, regulatory conditions and the ability to adapt decisions over time.

European policy frameworks, research initiatives and project-based experiences have contributed to the development of the PED concept, including work connected to the SET Action Plan 3.2, JPI Urban Europe, Horizon 2020 and Horizon Europe initiatives, the Driving Urban Transitions Partnership, the Joint Research Centre, IEA EBC activities and several PED-oriented demonstration projects. These initiatives provide useful knowledge, tools and examples, but they do not yet constitute a harmonised, district-scale standard for PED development.

This CWA builds on that landscape without replacing it. Its added value is to organise relevant knowledge into a practical Development Readiness perspective. The central question is not only whether a district can theoretically achieve a positive energy balance, but whether the local process is sufficiently structured to progress responsibly through scoping, context analysis, scenario development, screening, governance reflection, implementation preparation, monitoring and learning.

The Citizens4PED project provided a concrete basis for this approach by showing how PED development is shaped by the interaction between techno-energetic modelling, spatial and socio-economic analysis, governance arrangements, participation practices and implementation constraints. The project outputs are used in this CWA as evidence and illustrative material, not as a fixed model to be replicated.

This clause is informative. It provides a concise State of the Art relevant to PED Development Readiness and explains why the operational guidance in Clauses 5 to 11 is needed. It is not intended to reproduce an extensive literature review, to rank existing initiatives, or to prescribe specific standards, tools, indicators or performance thresholds.

The clause consolidates only the background information necessary to understand the scope of this CWA: the emergence of PEDs as integrated district-scale processes; the recurring gaps in existing standards and project-based guidance; the role of tools, data and indicators; and the importance of governance, participation, implementation capacity and learning. Detailed operational guidance is developed in the following clauses and in the informative annexes.

The State of the Art therefore functions as an orientation layer. It supports interpretation of the Development Readiness Integration Workflow, while keeping the normative content of this CWA non-prescriptive, adaptable and focused on practical decision-making.

4.2 Development Readiness approach

Existing standards and guidance documents provide important support for energy performance, sustainability assessment, smart city development, district heating and cooling, renewable energy communities, urban indicators and project monitoring. Many of these instruments are valuable references for PED initiatives. Nevertheless, they often address specific components, sectors or performance outcomes rather than the full sequence of decisions through which a PED pathway is framed, tested, interpreted and implemented.

At district scale, decisions are rarely linear. PED development typically requires iterative alignment between buildings, infrastructures, public spaces, energy systems, user practices, ownership structures, grid constraints, policy frameworks and community needs. In addition, many municipalities and local actors work under conditions of incomplete data, fragmented responsibilities, limited administrative capacity or evolving regulatory interpretations.

A Development Readiness approach responds to these conditions by helping users structure the process before final performance claims can be made. It supports the documentation of assumptions, the selection and interpretation of scenarios, the transparent use of proxies, the discussion of trade-offs and the identification of conditions that allow a pathway to proceed, be refined or be paused. It thus focuses on process quality, traceability and responsible progression.

This approach is particularly relevant because PED concepts are often adapted to local priorities and constraints. Attempting to impose a single fixed model, universal threshold or automatic ranking method would risk obscuring the contextual and socio-technical nature of PED development.

4.3 Key readiness gaps addressed by this CWA

The State of the Art and the Citizens4PED experience point to a limited number of recurring gaps that directly affect PED Development Readiness. These gaps are addressed in the operational clauses of this CWA.

- Scale and boundaries: many existing approaches focus on building, component or thematic level more than on district scale. PED initiatives require explicit documentation of physical, functional, organisational and energy-system boundaries, because boundary choices affect scenario interpretation, carbon-related screening and governance responsibilities.
- Cross-domain integration: technical modelling, spatial planning, participation, governance and implementation planning are often developed in parallel but not sufficiently connected. This CWA introduces an integration workflow and decision checkpoints to support coordination across domains.
- Data availability and proxy use: local actors frequently face incomplete, inconsistent or inaccessible data. Rather than excluding data-poor contexts, this CWA supports proportionate use of data-quality categories, transparent proxy documentation and progressive refinement.
- Scenario interpretation: existing tools can generate useful analytical outputs, but users still need a structured way to interpret assumptions, uncertainties, trade-offs and implementation implications. This CWA treats scenarios as learning and decision-support devices, not as automatic rankings.
- Carbon and complementary criteria: carbon-related screening is important, but it should be interpreted together with economic, technical, governance, participation, equity, resilience and implementation-readiness considerations. In this CWA the Carbon Neutrality Check is positioned as a core input to interpretation, not as a certification criterion.

- Governance, participation and equity: PED feasibility depends on actors, mandates, trust, legitimacy, affordability and the distribution of costs and benefits. These dimensions need to be visible throughout the process, rather than added only after technical options have been selected.
- Implementation and learning: many initiatives identify promising scenarios but struggle to translate them into action. In this CWA Readiness includes roles, responsibilities, funding, administrative capacity, risk management, quick wins, monitoring arrangements and feedback loops.

These gaps justify the sequence of Clauses 5 to 11, which proceed from the definition of an overarching workflow to context analysis, scenario development, screening, governance and equity, implementation readiness, and monitoring and adaptation.

4.4 Use of existing tools, standards and project outputs

This CWA recognises the value of existing standards, assessment schemes, datasets, modelling tools, guidance documents and project outputs. However, it does not mandate any specific tool, software, standard, dataset, assessment scheme or indicator set. References to such resources are informative and should be interpreted as support for orientation, interoperability and informed choice.

Users should select tools and references according to the purpose of the analysis, the maturity of the PED initiative, the available data, the competence of the team, the institutional setting and the decision to be supported. A tool that is appropriate for detailed technical modelling may not be appropriate for early stakeholder discussion; similarly, a high-level policy framework may help define objectives but may not provide the operational detail needed for scenario screening or implementation planning.

In practice, tools and references should be used to support the following functions:

- framing the local context and identifying relevant constraints;
- documenting data sources, data quality and proxies;
- developing and comparing alternative scenarios;
- screening carbon-related and complementary effects;
- supporting stakeholder communication and interpretation;
- linking scenario results to action planning, monitoring and learning.

The Citizens4PED outputs provide concrete examples, workflows, lessons learned and supporting materials for those functions, but they do not define mandatory procedures. Annexes A and B translate selected project-based knowledge into illustrative prompts and case descriptions, which users may adapt to their own contexts.

4.5 Carbon-related screening and complementary indicators

Carbon-related screening is a central element of PED Development Readiness because PED initiatives are expected to contribute to climate-neutrality objectives. In this CWA, the Carbon Neutrality Check (CNC) is used as a structured input for interpreting scenarios and pathways. It helps users reflect on whether a scenario is aligned with carbon-related ambitions and which assumptions influence that interpretation.

The CNC is not a compliance test, certification mechanism or mandatory threshold. It should not be used in isolation to declare that a PED has been achieved or that one pathway is automatically preferable. Its value lies in making carbon-related assumptions explicit and in connecting them with other decision criteria.

Complementary indicators and qualitative criteria are therefore necessary. Depending on the local context and the decision stage, they may concern costs, affordability, technical feasibility, resilience, grid constraints, governance capacity, stakeholder commitment, participation quality, equity effects, administrative feasibility, funding opportunities and monitoring capacity. The selection of these criteria should be transparent and proportionate to the intended use of the assessment.

Clause 8 operationalises this logic by linking the CNC and complementary indicators to a Go / Refine / Pause decision logic. This supports evaluation of whether a pathway is sufficiently coherent to proceed, requires further refinement, or should be paused until critical conditions improve.

4.6 Governance, participation and equity as enabling conditions

PED development is not only a technical or spatial planning exercise. It involves actors with different mandates, resources, interests and capacities, including municipalities, utilities, DSOs, housing bodies, developers, community organisations, citizens, vulnerable groups, technical experts and policy actors. Governance, participation and equity are therefore enabling conditions for Development Readiness.

Governance concerns the ability to clarify roles, responsibilities, decision mandates, coordination mechanisms, data-sharing arrangements and continuity beyond the initial project phase. Participation concerns the capacity to involve relevant stakeholders in ways that are meaningful, proportionate and adapted to local trust conditions, barriers and resources. Equity concerns the distribution of costs, benefits, risks, disruptions and opportunities, as well as access to decision-making and safeguards for vulnerable groups.

These aspects should not be treated as separate add-ons. They influence boundary choices, scenario assumptions, data interpretation, feasibility, action planning and monitoring. For this reason, Clause 9 provides guidance on governance, participation and equity reflection, while Clauses 10 and 11 connect these dimensions to implementation readiness and adaptive learning.

4.7 Rationale of this CWA structure

The State of the Art leads to a clear implication: PED guidance should not be limited to background description or performance measurement. It should help users structure decisions, make assumptions visible, compare alternatives, document uncertainties, include governance and equity considerations, and revise pathways over time.

For this reason, the remainder of this CWA is organised as a practical process framework, as illustrated in Figure 1, which represents the logical relationships between the clauses: Clause 4 provides the contextual reference layer; clause 5 introduces the overall Development Readiness Integration Workflow and the related evaluation logic; clause 6 supports context understanding through the Context Kit; clause 7 supports scenario exploration and documentation; clause 8 supports screening and decision interpretation; clause 9 addresses governance, participation and equity as transversal enabling dimensions, clause 10 supports implementation preparation and action planning; clause 11 supports monitoring, learning and adaptation, including feedback loops that may lead users to revisit earlier phases.

The annexes complement the clauses with illustrative supporting materials, case-based examples and glossary/mapping elements. They are informative and adaptable, and they are intended to support use of the CWA without creating compliance obligations.

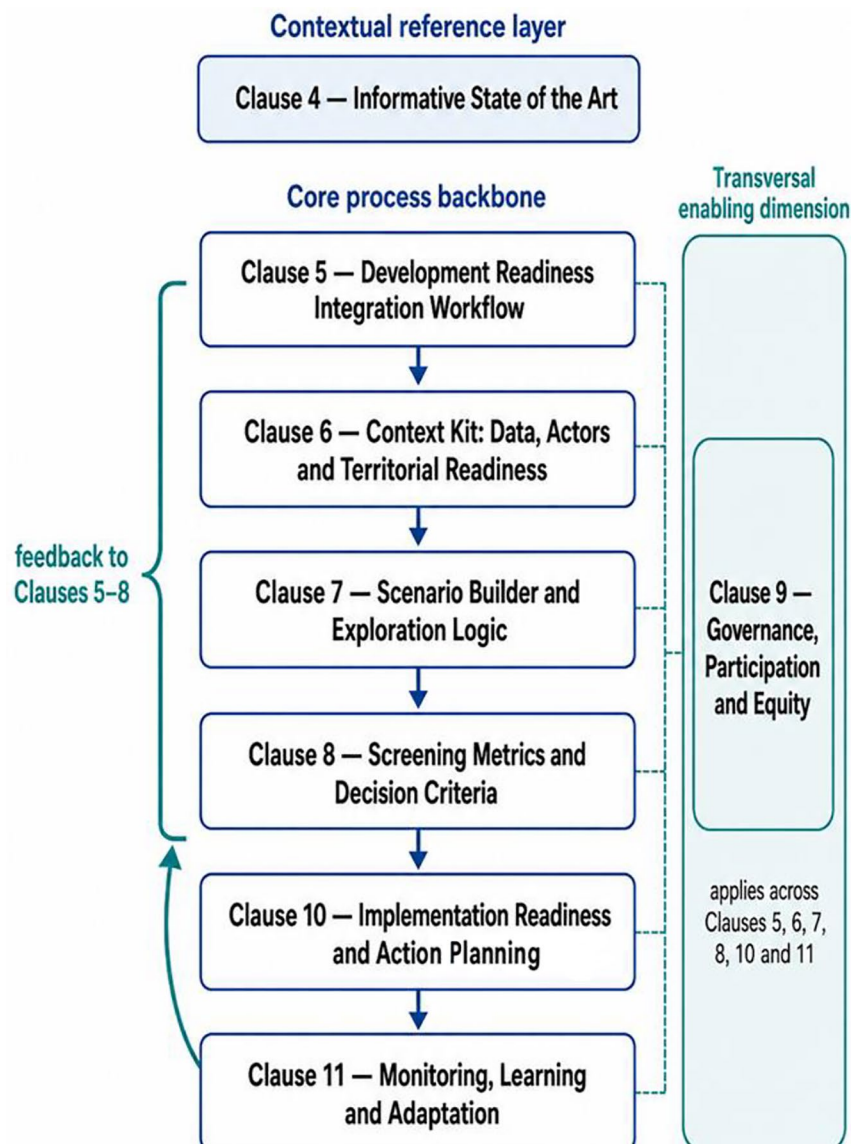


Figure 1 — Logical relationship between the State-of-the-Art layer and Clauses 5 to 11

NOTE The feedback arrow from Clause 11 to Clauses 5–8 indicates that monitoring, learning and adaptation may lead users to revisit the Development Readiness workflow, update contextual data and assumptions, refine scenarios, and reconsider screening metrics or decision criteria. It does not represent a mandatory backward step, but an iterative learning mechanism supporting continuous improvement and context-sensitive adaptation.

5 Development Readiness Integration Workflow

5.1 General

This clause describes the Development Readiness Integration Workflow used in this CWA to support the integrated and context-sensitive development of Positive Energy Districts (PEDs). The workflow provides a flexible reference structure for organising PED development processes across technical, spatial, institutional, social and governance dimensions.

The workflow is not intended to prescribe a single sequence of activities, nor to define a mandatory methodology for PED planning, design, implementation or monitoring. It is intended to support users in

structuring decision-making conditions, clarifying assumptions, coordinating actors, documenting choices and connecting technical analysis with governance, participation and implementation processes.

The Development Readiness Integration Workflow reflects the Citizens4PED experience, where PED development was addressed through the interaction of techno-energetic modelling, socio-economic and citizen engagement activities, institutional and spatial strategy analysis, and action-planning processes. It is therefore conceived of as an integration framework that supports coordination among different domains and as a context-sensitive guidance structure that can be adapted to different urban settings, planning cultures, data conditions and institutional capacities.

The workflow should be understood as iterative. Information generated in one phase may lead users to revisit earlier assumptions, refine scenarios, adjust objectives, reconsider stakeholder roles or update implementation pathways. Monitoring and learning activities may also lead to revisions of the context analysis, scenario logic or screening criteria. For this reason, the workflow supports progression, reflection and adaptation rather than linear compliance.

5.2 Concept of Development Readiness

For the purposes of this CWA, PED Development Readiness refers to the capacity of a local context to meaningfully progress through PED development phases by clarifying the conditions that influence informed and transparent decision-making.

Development Readiness does not refer to compliance with predefined technical thresholds, the achievement of a fixed performance level, or the identification of an optimal PED solution. It does not constitute a location-screening method, a certification approach or a regulatory benchmark. Instead, it describes the extent to which the main enabling conditions for PED development are sufficiently understood, documented and coordinated to support further action.

These enabling conditions may include, where relevant:

- availability, quality and fitness-for-purpose of contextual, technical, socio-economic and spatial data;
- clarity of PED objectives, boundaries, assumptions and expected benefits;
- alignment between technical options, spatial strategies, policy frameworks and regulatory conditions;
- identification and involvement of relevant stakeholders, including formal institutions, utilities, housing actors, community organisations and vulnerable or underrepresented groups;
- governance arrangements and coordination mechanisms across departments, organisations and decision levels;
- capacity to explore and compare scenarios using proportionate analytical methods;
- ability to interpret carbon-related, economic, resilience-related, governance and equity considerations together;
- availability of administrative, technical and organisational capacity to move from analysis to action;
- mechanisms for monitoring, feedback, learning and adaptation over time.

Development Readiness is therefore dynamic. It may improve as data become more reliable, assumptions are clarified, stakeholder roles are defined, governance arrangements mature, and implementation pathways become more concrete. Conversely, readiness may need to be reconsidered when major uncertainties, data gaps, institutional barriers or equity concerns emerge.

The purpose of assessing Development Readiness is not to exclude contexts from PED consideration, but to help users understand what conditions may need to be clarified, strengthened or revisited before moving to subsequent development phases.

5.3 Workflow phases and relationship with Clauses 5 to 11

The Development Readiness Integration Workflow provides the process logic through which the technical guidance clauses of this CWA may be used. The workflow phases are developed and supported through Clauses 5 to 11. They include:

- initial scoping and orientation, supported mainly by Clause 5, where the local PED ambition, preliminary boundaries, entry point, initiating actors, strategic objectives, known constraints and first assumptions are identified;
- context understanding, supported mainly by Clause 6, where territorial, technical, socio-economic, institutional, regulatory, stakeholder-related and equity-relevant conditions are documented and interpreted;
- objective-setting and evaluation framing, supported by Clauses 5, 8 and 9, where the objectives of the PED initiative are clarified and connected to a proportionate evaluation logic, without introducing standardised KPI sets, mandatory indicators or predefined performance targets;
- scenario exploration, supported mainly by Clause 7, where alternative PED development options are formulated, documented and compared in relation to assumptions, boundaries, data availability, technical options, participation conditions, policy constraints and local priorities;
- screening and decision interpretation, supported mainly by Clause 8, where scenario outputs, carbon-related insights, complementary indicators, qualitative considerations, trade-offs and uncertainties are jointly interpreted to support Go / Refine / Pause decision logic;
- governance, participation and equity reflection, supported mainly by Clause 9, which should not be treated only as a separate sequential phase, but as a transversal dimension informing scoping, context understanding, objective setting, scenario development, screening, implementation preparation and monitoring;
- implementation preparation, supported mainly by Clause 10, where selected or refined pathways are translated into actionable steps, roles, responsibilities, capacity needs, dependencies, risks, quick wins, policy–technology coherence considerations and possible action-planning arrangements;
- monitoring, learning and adaptation, supported mainly by Clause 11, where progress, assumptions, data quality, stakeholder feedback, governance arrangements and implementation conditions are periodically reviewed and, where appropriate, used to update context analysis, scenarios, screening criteria or action plans.

The relationship between workflow phases and Clauses 5 to 11 identifies the main guidance support for each phase, without implying a rigid or exclusive sequence. Users may have different entry points, depending on the maturity of the PED initiative, the availability of data, the actors already involved and the decisions to be supported. For example, a municipality may start from an existing urban regeneration plan, a housing provider may start from a renovation opportunity, a community initiative may start from an energy-sharing proposal, and a technical team may start from scenario modelling. In each case, the workflow helps users identify which contextual, technical, governance, participation, equity and implementation conditions need to be clarified before progressing.

The workflow is iterative. Information generated in one phase may lead users to revise the analysis made in another phase. Preliminary scenarios may reveal data gaps requiring further context analysis.

Stakeholder engagement may lead to revised objectives or new equity concerns. Screening may show that a technically promising option requires governance refinement or affordability safeguards. Monitoring may trigger updates to assumptions, revised scenarios or adapted action plans.

Users should therefore use Clauses 5 to 11 as an integrated guidance sequence for organising reflection, documentation and coordination across the PED development process. The sequence supports progression from framing to action and learning, while allowing adaptation to local planning cultures, institutional arrangements, data conditions, governance capacities and project maturity.

5.4 Inputs, outputs and evaluation logic

Each phase of the Development Readiness workflow may be associated with typical categories of inputs and outputs. These categories are intended to support transparency and coordination, rather than prescribe fixed formats.

Typical inputs may include:

- local climate, energy, spatial, socio-economic and building-stock information;
- policy, regulatory and planning frameworks relevant to the PED initiative;
- stakeholder knowledge, local priorities and community needs;
- technical data, energy profiles, infrastructure constraints and system boundaries;
- available modelling results, feasibility studies, plans, strategies or previous project outputs;
- assumptions, proxies and uncertainties affecting scenario development or interpretation;
- governance arrangements, administrative capacity and existing implementation mechanisms.

Typical outputs may include:

- a preliminary PED development scope and boundary description;
- documented objectives and evaluation logic;
- context analysis and readiness considerations;
- stakeholder and asset mapping;
- scenario descriptions and associated assumptions;
- screening insights, including CNC-related results and complementary considerations;
- decision rationales and identified refinement needs;
- implementation-readiness considerations, including roles, responsibilities, risks and quick wins;
- monitoring needs, feedback mechanisms and learning questions.

A key component of Development Readiness is the explicit clarification of the objectives that the PED initiative intends to pursue. These objectives may relate, for example, to climate-neutrality ambitions, energy performance, renewable energy integration, flexibility, affordability, resilience, equity, governance quality, local value creation or wider spatial strategy alignment.

The CWA does not define a mandatory list of objectives, targets or KPIs. Instead, it supports transparent objective-setting and evaluation framing. Where objectives or targets are defined by the local context, users should consider how progress towards them can be assessed through appropriate indicators, qualitative criteria or evaluation methods.

Indicators and evaluation methods should be selected according to their fitness for purpose, the maturity of the PED process, the availability and quality of data, and the intended use of the assessment. They may include technical, carbon-related, economic, governance, social or equity-related dimensions. Their role should be documented together with their assumptions, limitations and interpretation boundaries.

The emphasis is therefore placed on transparent KPI selection, not KPI standardisation. Indicators should support learning, comparison and decision-making, without becoming compliance criteria, certification requirements or mandatory performance benchmarks.

5.5 Decision checkpoints

Decision checkpoints are structured moments of collective interpretation within the Development Readiness workflow. They support users in reviewing available information, assessing uncertainties, clarifying responsibilities and deciding whether the process can progress, should be refined, or needs to be reconsidered.

Decision checkpoints may be used, where appropriate, at key transitions between workflow phases, for example:

- after initial scoping, to confirm whether the PED ambition, boundaries and relevant actors are sufficiently clear to proceed;
- after context understanding, to identify whether data gaps, institutional constraints or stakeholder issues require further clarification;
- before scenario comparison, to confirm that assumptions, boundaries and input data are sufficiently documented;
- after screening, to interpret CNC-related results and complementary indicators in relation to local objectives and constraints;
- before implementation preparation, to assess whether governance arrangements, administrative capacity, roles and resources are sufficiently defined;
- during monitoring, to determine whether assumptions, scenarios or action plans should be revised.

Decision checkpoints may support a Go / Refine / Pause decision logic. This logic is not intended as a binary approval mechanism and does not rely on predefined thresholds. Rather, it provides a structured way to interpret whether the process is ready to move forward, requires further refinement, or should be paused or reconsidered due to unresolved gaps.

In this context:

- Go may indicate that the available information, stakeholder alignment, assumptions and implementation conditions are considered sufficient to proceed to the next phase;
- Refine may indicate that the process remains promising, but specific data, assumptions, scenarios, governance arrangements, equity implications or implementation conditions should be clarified before progression;
- Pause may indicate that critical uncertainties, institutional barriers, unacceptable risks or unresolved social, technical or governance constraints prevent responsible progression at that stage. Pause

should not be interpreted as definitive exclusion from PED consideration, but as an indication that preparatory action is needed before the scenario or pathway can be responsibly revisited.

The rationale for decisions should be documented in a proportionate manner. This documentation may include the main evidence considered, the uncertainties identified, the interpretation of alternative options, the actors involved, and the reasons for proceeding, refining or pausing the process.

5.6 Assumption management

Assumption management is a core element of Development Readiness. PED development frequently takes place under conditions of incomplete data, uncertain regulatory interpretations, evolving stakeholder positions, limited technical capacity and changing market or policy conditions. For this reason, assumptions should be made explicit and periodically reviewed.

Assumptions may concern, for example:

- PED boundaries, including physical, functional, temporal or virtual boundaries;
- energy demand, generation, flexibility, storage or consumption profiles;
- participation rates, stakeholder roles or community engagement levels;
- technology performance, costs, emissions factors, tariffs or market conditions;
- data proxies, default values or benchmark assumptions used to compensate for missing information;
- regulatory interpretations, policy incentives, planning constraints or procurement conditions;
- implementation timelines, administrative capacity, financing assumptions or risk allocation;
- equity-related assumptions concerning distribution of costs, benefits, responsibilities or access to decision-making.

Users should consider documenting assumptions in a way that makes their origin, rationale, level of uncertainty and influence on decision-making visible. Assumptions may be derived from measured data, authoritative datasets, modelled estimates, expert judgement, stakeholder input, comparable cases or proxy values. Their reliability and limitations should be made transparent in relation to the intended use of the analysis.

Assumption management supports both accountability and learning. As the PED process progresses, assumptions may be confirmed, revised, replaced or discarded. Where assumptions have significant implications for scenario comparison, CNC results, complementary indicators or implementation decisions, they should be revisited at relevant decision checkpoints.

The documentation of assumptions does not need to follow a single standardised format. However, a proportionate assumption record may include:

- the assumption or proxy used;
- the reason why it was needed;
- the source or basis of the assumption;
- the expected level of uncertainty;
- the aspect of the PED process affected;

- the conditions under which it should be reviewed;
- the decision or scenario to which it relates.

Where appropriate, illustrative prompts for assumption management may be provided in Annex A.

5.7 Interoperability

In this CWA, interoperability is understood primarily as the ability to connect information, actors, tools, decisions and learning processes across the PED development workflow. It is not limited to technical or digital interoperability, although these aspects may be relevant in specific contexts.

Development Readiness depends on the capacity to make different forms of knowledge and evidence usable across domains. Technical modelling outputs may need to be interpreted by planners, policy officers, utilities, housing actors, community intermediaries or decision-makers. Stakeholder insights may need to inform scenario assumptions. Policy constraints may need to shape technology options. Monitoring results may need to update assumptions or trigger revisions of action plans.

Interoperability may therefore concern:

- data interoperability, including consistency of datasets, units, temporal resolution, spatial boundaries, metadata and data ownership conditions;
- tool interoperability, including the ability to transfer assumptions, inputs and outputs between modelling, mapping, screening, monitoring or planning tools;
- organisational interoperability, including coordination between municipal departments, utilities, housing providers, technical experts and community actors;
- procedural interoperability, including shared documentation practices, decision checkpoints, feedback loops and common interpretation moments;
- conceptual interoperability, including shared understanding of terms, boundaries, objectives, indicators and assumptions.

Users should consider what level of interoperability is proportionate to the maturity and complexity of the PED initiative. In early stages, interoperability may rely on simple shared documentation, common terminology and transparent assumptions. In more mature processes, it may involve integrated datasets, digital platforms, monitoring systems, interoperable modelling environments or formal coordination protocols.

The CWA does not prescribe specific software, data standards, platforms or integration architectures. Instead, it encourages users to consider whether data, tools and governance arrangements are sufficiently aligned to support informed decision-making. Where interoperability gaps are identified, users may consider capacity-building actions, shared documentation prompts, data-sharing agreements, coordination meetings or technical assistance.

Interoperability should also support learning over time. Monitoring results, stakeholder feedback and implementation experience should be capable of informing future updates of context analysis, assumptions, scenarios and screening criteria. In this sense, interoperability is a condition for adaptive PED Development Readiness, not only for technical integration.

6 Context kit: data, actors and territorial readiness

6.1 General

This clause describes the Context Kit used in this CWA to support PED Development Readiness. The Context Kit is intended to help users organise the information, actors, assets and institutional conditions that influence the development of a Positive Energy District (PED) in a specific local context.

The Context Kit does not define a mandatory dataset, a fixed list of indicators or a standardised assessment method. It provides a structured way to identify and document the contextual elements that may affect PED scoping, scenario exploration, screening, implementation readiness and monitoring.

The Context Kit should be proportionate to the maturity of the PED process, the availability of data, the capacities of the actors involved and the intended use of the analysis. In early phases, the Context Kit may rely on available public datasets, qualitative information, stakeholder knowledge and proxy assumptions. As the process progresses, it may be progressively refined through measured data, detailed surveys, technical studies, stakeholder validation and monitoring results.

The purpose of the Context Kit is not to determine whether an area is suitable or unsuitable for PED development. Rather, it is intended to support informed and transparent decision-making by clarifying what is known, what remains uncertain, which actors and assets are relevant, and which territorial or institutional conditions may enable or constrain further action.

6.2 Core contextual information

Users should consider collecting and documenting contextual information that is relevant to the specific PED initiative and proportionate to the development phase. Such information may concern spatial, technical, socio-economic, institutional, regulatory and environmental aspects.

- Core contextual information may include, where relevant:
- spatial and territorial information, such as district boundaries, land-use patterns, urban morphology, public spaces, infrastructure corridors, mobility connections, heritage constraints and relationships with wider city or regional strategies;
- demographic and socio-economic information, such as population, households, income levels, employment, age structure, education, household size, social housing presence, tenure structure and indicators of social vulnerability;
- building-stock information, such as building typologies, construction periods, ownership patterns, renovation status, energy performance information, protected or heritage buildings, available roofs or other surfaces for renewable energy generation;
- energy demand and supply information, such as heating, cooling and electricity demand, existing energy carriers, local renewable energy potential, energy prices, tariff conditions, metering availability, grid constraints and relevant technical infrastructures;
- climatic and environmental information, such as heating degree days, cooling degree days, urban heat exposure, local climate conditions and environmental constraints or opportunities;
- policy and regulatory information, such as planning instruments, renewable energy community frameworks, energy performance regulations, renovation incentives, urban regeneration programmes, funding schemes and relevant administrative procedures;
- social and behavioural information, such as everyday practices, energy-use patterns, willingness to participate, barriers to engagement, trust conditions, local initiatives and community capacities;

- existing plans, projects and commitments, such as ongoing renovation programmes, mobility plans, climate strategies, energy community initiatives, district heating proposals, public investments or living lab activities.

The selection of contextual information should be guided by its relevance for decision-making. Users should avoid collecting data only for completeness if such data do not support scoping, scenario definition, stakeholder engagement, implementation preparation or monitoring.

Where data are unavailable or incomplete, users may proceed with proxy information, provided that assumptions and limitations are documented in accordance with Clause 5.5 and Clause 6.3.

6.3 Data quality considerations

Data quality should be considered in relation to the intended use of the data and the maturity of the PED development process. The same data may be sufficient for early-stage orientation, but insufficient for detailed technical design, investment decisions or monitoring.

Users should consider whether available data are:

- relevant to the PED objectives and decision questions;
- spatially consistent with the PED boundary or area of analysis;
- temporally appropriate for the intended assessment;
- sufficiently disaggregated for the decision to be supported;
- derived from reliable, traceable or authoritative sources;
- comparable across cases, scenarios or time periods, where comparison is needed;
- understandable and usable by the actors involved in the decision-making process;
- accompanied by metadata, assumptions or documentation explaining how they were generated.

Data quality should not be understood only as technical precision. In PED Development Readiness, data quality also concerns usability, transparency, interpretability and fitness for purpose. Qualitative information, stakeholder knowledge and local experience may be valuable where they clarify barriers, opportunities, risks or social conditions that are not captured by quantitative datasets.

Where useful, users may apply a simple qualitative tagging of data reliability. For example, data may be distinguished between measured or authoritative data, modelled or benchmarked data, and proxy or assumption-based data. Such tagging should be used only as an illustrative support for transparency and should not be treated as a formal classification scheme or compliance mechanism.

Data limitations should be made explicit, especially where they affect scenario comparison, CNC interpretation, complementary indicators, investment assumptions, stakeholder expectations or implementation decisions. Data quality should be revisited as the PED process progresses and new information becomes available.

6.4 Use of proxies

The use of proxy data is recognised as a legitimate and often necessary practice in early-stage PED development, especially in data-poor, institutionally fragmented or under-resourced contexts. Proxy data may allow users to start the development process, explore preliminary scenarios, identify critical uncertainties and support stakeholder dialogue before more detailed data become available.

Proxy data may be used, where appropriate, for example to estimate:

- building energy demand where measured consumption data are unavailable;
- participation rates or adoption levels where no local survey has yet been conducted;
- renovation costs, technology costs or operational costs in the absence of detailed feasibility studies;
- renewable energy generation potential where detailed technical assessments are not available;
- socio-economic vulnerability where direct indicators are unavailable at district scale;
- future energy prices, carbon factors or regulatory conditions under uncertainty;
- behavioural or sufficiency-related assumptions where empirical evidence is limited.

When proxies are used, users should document:

- what proxy has been used;
- why the proxy was needed;
- the source or rationale of the proxy;
- the scale and context from which the proxy was derived;
- the expected level of uncertainty;
- the decision or scenario affected by the proxy;
- the conditions under which the proxy should be reviewed or replaced.

Proxy use should not be hidden or treated as equivalent to measured data. It should be made visible as part of assumption management. Where proxy assumptions have a significant influence on scenario results, screening outcomes or implementation choices, sensitivity checks or qualitative discussion may be considered.

The use of proxies should support progression and learning, not premature certainty. As data availability improves, proxies may be updated, validated, replaced or discarded.

6.5 Stakeholder and asset mapping

Stakeholder and asset mapping is a foundational activity for PED Development Readiness. It supports the identification of the actors, resources, infrastructures, relationships and capacities that may influence the PED process.

Stakeholders may include, where relevant:

- municipal departments and local authorities;
- regional or national public bodies;
- utilities, distribution system operators and infrastructure managers;
- housing providers, social housing agencies, building owners and condominium representatives;
- energy service companies, developers, investors and technical consultants;
- schools, universities, research organisations and training bodies;

- local associations, community organisations, parishes, cooperatives and civic intermediaries;
- tenant groups, residents, vulnerable groups and underrepresented communities;
- businesses, SMEs, commercial actors and local service providers;
- organisations managing relevant land, buildings, roofs, public spaces or energy assets.

Stakeholder mapping should not be limited to listing actors. Users should consider, where appropriate, the roles, resources, responsibilities, interests, capacities, influence, vulnerabilities and relationships of the actors involved. Particular attention should be given to actors who may control critical assets, hold relevant knowledge, influence public acceptance, represent vulnerable groups or enable implementation.

Asset mapping may include both physical and non-physical assets. Physical assets may include buildings, roofs, public facilities, energy infrastructures, substations, district heating networks, public spaces, mobility infrastructures or land. Non-physical assets may include technical knowledge, administrative capacity, trust relations, community networks, legal competences, funding access, local initiatives or institutional mandates.

Stakeholder and asset mapping should help users understand:

- who may initiate, support, block, finance, implement or benefit from PED actions;
- which assets may be relevant for energy demand reduction, renewable generation, flexibility, storage, governance or participation;
- which relationships or coordination mechanisms are already in place;
- where conflicts, dependencies or gaps in capacity may exist;
- which actors should be involved in decision checkpoints, scenario interpretation or implementation preparation.

The mapping process should remain adaptable. New actors and assets may emerge as the PED process develops, especially when scenarios become more concrete or implementation options are clarified. For this reason, stakeholder and asset mapping should be periodically revisited.

6.6 Territorial and institutional readiness

Territorial and institutional readiness refers to the extent to which local spatial, regulatory, organisational and governance conditions enable meaningful progression of the PED process.

Territorial readiness may concern, where relevant:

- coherence between the PED initiative and existing spatial plans, urban regeneration strategies, mobility plans, climate plans or energy strategies;
- availability of suitable buildings, public spaces, infrastructures or land for PED-related actions;
- presence of heritage, landscape, environmental or planning constraints that may affect renovation, renewable energy production or infrastructure development;
- connection between the district and wider urban or regional systems, including grids, mobility networks, social services and public facilities;
- existing or planned public investments that may create synergies with PED development;

- socio-spatial vulnerabilities, such as energy poverty, social housing concentration, limited affordability or unequal access to decision-making.

Institutional readiness may concern, where relevant:

- clarity of responsibilities across municipal departments, public bodies, utilities and other actors;
- administrative capacity to coordinate planning, energy, housing, social and environmental domains;
- availability of technical expertise, facilitation capacity and data-management capacity;
- access to funding schemes, technical assistance, incentives or support programmes;
- stability and clarity of relevant regulatory frameworks;
- capacity to engage stakeholders and sustain participation over time;
- ability to translate analytical results into action plans, procurement processes, partnerships or implementation pathways.

Territorial and institutional readiness should not be interpreted as a precondition that determines whether a district may or may not pursue PED development. Instead, it should be used to identify enabling conditions, barriers, dependencies and capacity gaps that may need to be addressed.

In complex or under-resourced contexts, limited readiness may indicate the need for preparatory actions, such as capacity building, data improvement, stakeholder engagement, policy alignment, clarification of responsibilities or identification of early actions. It should not automatically lead to exclusion from PED consideration.

Users should consider documenting territorial and institutional readiness in relation to the decisions that need to be made. For example, early-stage scoping may require a broad understanding of policy alignment and stakeholder capacity, whereas implementation preparation may require more detailed analysis of administrative procedures, funding conditions, asset ownership and procurement options.

Territorial and institutional readiness should also be revisited over time. Governance arrangements, funding opportunities, policy frameworks, stakeholder coalitions and technical capacities may evolve, and such changes may affect scenario selection, implementation feasibility and monitoring priorities.

7 Scenario builder and exploration logic

7.1 General

This clause describes how scenario building can support PED Development Readiness. Scenario building is used in this CWA as an exploratory and learning-oriented process that helps users compare alternative PED development pathways under different assumptions, boundaries, technologies, governance conditions and implementation constraints.

Scenarios are not intended to predict the future or determine a single optimal solution. They are intended to make choices, assumptions, trade-offs and uncertainties explicit, so that technical, spatial, institutional, social and economic implications can be discussed in a structured manner.

Scenario building may support different phases of the Development Readiness workflow, including context understanding, objective-setting, screening, implementation preparation and monitoring. In early phases, scenarios may be simple and qualitative, helping actors clarify possible directions and data needs. As the process matures, scenarios may be supported by technical modelling, optimisation tools, carbon-related screening, stakeholder input or more detailed feasibility analysis.

The scenario builder described in this clause is non-prescriptive. It does not require specific scenario types, modelling tools, calculation methods or technology options. Instead, it provides a flexible logic for documenting and comparing scenarios in a way that is proportionate to local conditions, available data and decision needs.

7.2 Role of scenarios

Scenarios support PED Development Readiness by helping users explore how different development options may perform, interact or create consequences under specific contextual assumptions. Their role is to structure learning and decision-making, rather than to produce definitive predictions.

Scenarios may be used, where relevant, to:

- clarify the implications of different PED ambitions, boundaries and development priorities;
- compare alternative technology configurations, such as energy efficiency measures, renewable generation, heat pumps, district heating, energy hubs, storage or flexibility options;
- explore different levels of stakeholder participation, ownership, investment capacity or community involvement;
- examine sufficiency-related assumptions, such as changes in comfort levels, demand reduction, behavioural practices or shared use of resources;
- test sensitivity to data gaps, proxy assumptions, energy prices, carbon factors, tariffs, regulatory constraints or implementation timelines;
- reveal trade-offs between carbon-related performance, costs, affordability, resilience, governance feasibility and equity considerations;
- support collective interpretation of options before proceeding to implementation preparation.

Scenarios should be understood as structured hypotheses about possible PED development pathways. They should make explicit what is assumed, what is uncertain and what decision question they are intended to inform.

The value of scenarios depends not only on the technical quality of the analysis, but also on the capacity of users to interpret scenario outputs in relation to local objectives, constraints and stakeholder priorities. For this reason, scenario development should be connected to the Context Kit described in Clause 6 and to the screening and decision logic described in Clause 8.

7.3 Scenario families

Scenario families are illustrative groupings of development options that can help users organise scenario exploration. They are not mandatory categories and should be adapted to the local context, the maturity of the PED process and the questions being addressed.

Scenario families may include, where relevant:

- baseline or reference scenarios, describing current conditions, business-as-usual assumptions or already planned interventions against which alternatives may be interpreted;
- energy demand reduction scenarios, exploring building renovation, envelope improvements, technical system upgrades, behavioural changes or sufficiency-related assumptions;
- renewable energy generation scenarios, exploring photovoltaic systems, geothermal resources, solar thermal, biomass, waste heat recovery or other locally relevant renewable sources;

- heat transition scenarios, exploring different heating production systems, ranging from individual and collective heat pumps, to district heating networks, low-temperature heating systems, heat recovery or hybrid configurations;
- flexibility and storage scenarios, exploring demand-side flexibility, thermal storage, batteries, electric mobility integration, load shifting or smart control strategies;
- energy community or shared-energy scenarios, exploring renewable energy communities, collective self-consumption, shared assets, virtual energy-sharing arrangements or collective governance models;
- participation scenarios, exploring different engagement strategies and stakeholder involvement in decision making;
- spatial and boundary scenarios, exploring alternative PED boundaries, inclusion or exclusion of specific buildings, infrastructures or public assets, and relationships between the district and wider urban or regional systems;
- virtual or extended PED configuration scenarios, exploring cases in which energy balance, generation, consumption or sharing arrangements are either limited to a compact physical area or depend on functional, regulatory or network-based relations;
- implementation pathway scenarios, exploring phased interventions, quick wins, first-mover actions, funding dependencies or alternative governance arrangements;
- sufficiency scenarios, exploring demand moderation, comfort-level assumptions, shared services, behavioural practices or collective arrangements aimed at reducing energy needs before or alongside technological optimisation.

Scenario families may be combined. For example, a scenario may combine building renovation, photovoltaic generation, heat pumps and a specific participation assumption. Another scenario may focus on district heating and collective governance. Another may explore sufficiency-related demand reductions and lower investment needs.

The scenario families used in Citizens4PED illustrate this diversity. The project explored, among other aspects, heat supply via district heating, individual heat pumps with PV, comfort-temperature reduction, participation rates in district heating networks, renewable energy scenarios, building retrofit and optimisation of energy hub configurations. These cases should be interpreted as examples of possible scenario families, not as a closed or recommended list.

7.4 Comparison logic

Scenario comparison should support transparent interpretation of trade-offs, sensitivities and uncertainties. It should not be limited to the identification of a single preferred scenario, nor should it rely on predefined thresholds unless such thresholds are externally defined by the local regulatory or policy context.

Users should consider comparing scenarios in relation to the objectives and evaluation logic defined in Clause 5.3. Depending on the local context, scenario comparison may consider:

- carbon-related implications, including CNC results or other carbon-screening insights;
- energy demand, renewable generation, flexibility, storage or import/export balance;
- investment needs, operational costs, affordability, financing conditions or distribution of costs and benefits;

- technical feasibility, infrastructure constraints, grid conditions, data availability and modelling uncertainty;
- policy, regulatory and planning coherence;
- governance feasibility, actor capacity, role clarity and administrative readiness;
- stakeholder acceptance, participation needs and community capacity;
- equity implications, including potential effects on vulnerable groups, tenants, social housing residents or low-income households;
- resilience, adaptability and robustness under uncertainty;
- implementation phasing, quick wins, risks and dependency on external conditions.

Scenario comparison should make explicit how results depend on assumptions. Where modelling or optimisation tools are used, users should document the input data, system boundaries, objective functions, constraints, proxy values and methodological choices that influence outputs.

Scenario comparison may be qualitative, quantitative or mixed. In early phases, qualitative comparison may be sufficient to identify critical issues, missing data or stakeholder concerns. In more mature phases, quantitative modelling, optimisation or simulation may support more detailed comparison. The level of analytical detail should be proportionate to the decision being supported.

Where optimisation tools are used, such as Pareto-based approaches, users should avoid interpreting outputs as automatic prescriptions. Pareto fronts or optimisation results can support the identification of efficient trade-offs between objectives such as cost, emissions or PED ratio, but final interpretation should also consider governance, equity, institutional capacity and implementation feasibility.

Scenario comparison should support the decision logic described in Clause 8.4. It may help users identify whether a scenario can proceed, should be refined or should be reconsidered because of unresolved technical, social, institutional or implementation constraints.

7.5 Scenario documentation

Clear scenario documentation is a prerequisite for meaningful comparison, decision transparency and learning. Scenario documentation should make explicit the purpose, assumptions, boundaries, data sources, limitations and interpretation conditions of each scenario.

Users should consider documenting, where relevant:

- the scenario title or identifier;
- the decision question or objective addressed by the scenario;
- the PED boundary or area of analysis;
- the buildings, infrastructures, actors or assets included;
- the time horizon and development phase considered;
- the technology options, demand-side assumptions or governance arrangements included;
- data sources, proxy values and assumptions used;
- relevant policy, regulatory, planning or market conditions;

- stakeholder participation or behavioural assumptions;
- modelling tools, calculation methods or qualitative assessment methods used;
- carbon-related, economic, technical, governance, equity or resilience-related outputs;
- uncertainties, sensitivities and known limitations;
- relationship to other scenarios;
- implications for decision checkpoints, refinement needs or implementation preparation.

Scenario documentation should be understandable to both technical and non-technical actors involved in the PED process. Where complex modelling outputs are used, documentation should translate key assumptions and results into a form that can be discussed by planners, governance actors, local stakeholders and decision-makers.

Documentation should also support future revision. As new data become available, assumptions change or stakeholder priorities evolve, scenarios may need to be updated. For this reason, scenario documentation should be linked to assumption management in Clause 5.5 and to monitoring, learning and adaptation in Clause 11.

The CWA does not prescribe a standard scenario format. However, illustrative documentation prompts may be provided in Annex A to support users in structuring scenario descriptions in a proportionate and adaptable way.

8 Screening metrics and decision criteria

8.1 General

This clause describes how screening metrics and decision criteria can support PED Development Readiness. Screening is used in this CWA as a structured decision-support activity that helps users interpret scenario results, identify trade-offs, clarify uncertainties and support informed progression across development phases.

Screening metrics are not intended to certify PED performance, demonstrate regulatory compliance or define whether a district qualifies as a PED. They are intended to support transparent interpretation of alternative development pathways in relation to locally defined objectives, assumptions, data availability and implementation conditions.

The screening approach described in this clause builds on the scenario logic described in Clause 7 and supports the decision checkpoints described in Clause 5.4. Screening results should be interpreted together with contextual information from Clause 6, governance and equity considerations from Clause 9, implementation-readiness conditions from Clause 10, and monitoring and learning mechanisms from Clause 11.

The CWA does not define mandatory indicators, standardised KPI sets, performance thresholds, benchmark values or aggregation methods. Instead, it supports transparent and context-sensitive selection of screening metrics and decision criteria, proportionate to the maturity of the PED process and the intended use of the assessment.

8.2 Screening approach

Screening is a preliminary and iterative assessment activity that helps users understand how different PED scenarios may perform in relation to selected objectives and constraints. It may be used at different stages of the Development Readiness workflow, from early exploration to implementation preparation.

Screening may support users in:

- comparing alternative PED scenarios in relation to carbon-related, technical, economic, governance, resilience and equity considerations;
- identifying assumptions, data gaps and uncertainties that significantly influence results;
- understanding trade-offs between different objectives, such as carbon reduction, cost, affordability, flexibility, stakeholder acceptance and implementation feasibility;
- distinguishing between options that appear promising, options that require further refinement, and options that may not be responsible or feasible under current conditions;
- informing decision checkpoints without replacing deliberation, expert judgement or stakeholder interpretation;
- identifying monitoring needs and assumptions that should be revisited over time.

Screening should be proportionate to the phase and maturity of the PED process. In early phases, it may rely on simplified calculations, qualitative criteria, proxy values or comparative reasoning. In more mature phases, it may be supported by modelling, optimisation, detailed technical studies, cost analysis or monitoring data.

The purpose of screening is not to reduce the complexity of PED development to a single score. Rather, it should help make complexity discussable by organising information around relevant decision questions.

Users should consider documenting:

- which scenarios were screened;
- which objectives or decision questions the screening addressed;
- which indicators or criteria were used;
- why those indicators or criteria were considered relevant;
- which data, assumptions and proxies influenced the results;
- how uncertainties were considered;
- how screening results informed the decision checkpoint.

8.3 Carbon Neutrality Check

The Carbon Neutrality Check (CNC) is introduced in this CWA as a core carbon-related screening metric derived from the Citizens4PED experience. It supports comparative exploration of PED scenarios by helping users understand how different assumptions, boundaries, energy demands, technology choices and supply configurations may affect carbon-related outcomes.

The CNC is intended to support climate-neutrality-oriented reasoning. It does not demonstrate formal compliance with climate-neutrality targets, certify PED performance or replace greenhouse gas inventories, regulatory reporting frameworks or official climate-accounting procedures.

The CNC may support users in:

- comparing the carbon-related implications of alternative scenarios;

- understanding the influence of energy demand, renewable generation, imports, exports, carbon factors and system boundaries;
- identifying scenarios that may require refinement due to carbon-related weaknesses or critical assumptions;
- making explicit how carbon-related results depend on methodological choices, data quality and proxy assumptions;
- linking technical scenario outputs to wider decision-making on implementation, governance and equity.

Where the CNC is applied, users should consider documenting:

- the system boundary used for the calculation;
- the energy vectors included;
- the time horizon or temporal resolution considered;
- emission or carbon factors applied;
- import and export assumptions;
- treatment of renewable generation, storage, flexibility or shared-energy arrangements;
- data sources, proxies and uncertainties;
- the intended role of CNC results in the decision-making process.

CNC results should be interpreted in relation to the maturity of the process. In early-stage PED development, CNC results may be useful for comparing broad alternatives and identifying critical issues. They should not be interpreted as definitive evidence of carbon neutrality, especially when based on incomplete data, simplified assumptions or proxy values.

Where scenarios involve virtual, functional or extended boundaries, users should pay particular attention to how the CNC boundary is defined and documented. Boundary choices can significantly affect carbon-related results and should therefore be transparent and open to discussion.

The CNC should be considered together with complementary indicators and qualitative considerations. A scenario that performs favourably in carbon-related terms may still require refinement if it presents unresolved affordability issues, governance weaknesses, implementation barriers, social risks or excessive dependency on uncertain assumptions.

8.4 Complementary indicators

Complementary indicators support interpretation of PED scenarios alongside carbon-related screening. They are intended to broaden the evaluation logic beyond energy and carbon performance, recognising that PED Development Readiness also depends on economic, governance, social, institutional and implementation conditions.

Complementary indicators are not defined in this CWA as mandatory KPIs, standardised metrics or benchmark criteria. They should be selected according to local objectives, available data, project maturity and decision needs. They may be quantitative, qualitative or mixed.

Users should consider complementary indicator families such as:

- technical and energy-system considerations, including energy demand reduction, renewable generation potential, flexibility, storage, self-consumption, import/export balance, infrastructure constraints and system robustness;
- economic and financial considerations, including investment needs, operational costs, life-cycle costs, affordability, cost distribution, financing feasibility, tariff exposure, payback expectations and capacity to mobilise funding;
- carbon and environmental considerations, including carbon-related screening, emissions reduction potential, renewable energy contribution, local environmental impacts and climate-related co-benefits;
- resilience and adaptability considerations, including robustness under uncertainty, phasing flexibility, ability to adapt to changing prices, regulations or technologies, and capacity to revise scenarios over time;
- governance and institutional considerations, including role clarity, coordination capacity, administrative readiness, policy alignment, regulatory feasibility, procurement capacity and availability of enabling mechanisms;
- participation and social acceptance considerations, including stakeholder engagement, trust conditions, participation accessibility, community capacity, willingness to join collective arrangements and presence of local intermediaries;
- equity and inclusion considerations, including distribution of costs and benefits, exposure of vulnerable groups, tenant/owner asymmetries, energy poverty risks, access to decision-making and potential impacts on low-income or underrepresented communities;
- implementation-readiness considerations, including first movers, early actions, risks, quick wins, capacity-building needs, dependency on external actors, and coherence with spatial strategies or existing projects.

The selection of complementary indicators should be transparent. Users should document why specific indicators or criteria were selected, what objective they relate to, how they were assessed and what limitations affect their interpretation.

Complementary indicators should not be automatically aggregated into a single composite score unless there is a clear and context-specific rationale for doing so. Aggregation may obscure trade-offs, hide equity implications or create a misleading impression of precision. Where aggregation or scoring is used, its assumptions and limitations should be documented.

In many contexts, qualitative indicators or structured deliberative criteria may be more appropriate than quantitative metrics, especially for governance, equity, participation, capacity and institutional readiness. Such qualitative criteria should be treated as legitimate inputs to decision-making where they are transparently documented and linked to the objectives of the PED process.

8.5 Decision logic

Screening results should inform decision checkpoints through collective interpretation. This CWA uses the Go / Refine / Pause decision logic as a non-prescriptive decision-support structure.

This decision logic does not establish thresholds, automatic pass/fail criteria or formal approval procedures. It supports users in interpreting whether a PED scenario, option or development pathway can proceed, should be refined or should be paused or reconsidered under current conditions.

A Go decision logic may be appropriate where the available evidence suggests that the scenario or development pathway is sufficiently coherent with local objectives, supported by reasonable assumptions, compatible with relevant contextual conditions, and sufficiently actionable for the next development phase.

A Refine decision logic may be appropriate where the scenario or development pathway remains relevant but requires further clarification, adjustment or validation. Refinement may concern, for example:

- incomplete or unreliable data;
- uncertain assumptions or proxies;
- unclear PED boundaries;
- weak carbon-related performance;
- unresolved cost or affordability concerns;
- insufficient stakeholder alignment;
- governance or administrative capacity gaps;
- equity concerns;
- implementation risks;
- need for additional technical analysis or stakeholder engagement.

A Pause decision logic may be appropriate where critical issues prevent responsible progression at that stage. Such issues may include major data limitations, unacceptable social or equity risks, unresolved regulatory constraints, lack of responsible actors, insufficient administrative capacity, severe financial infeasibility, or scenario assumptions that are too uncertain to support further action.

Pause should not be interpreted as a definitive exclusion of a context from PED consideration. It may indicate that preparatory action is needed before the scenario or pathway can be responsibly revisited. Such preparatory action may include data improvement, stakeholder engagement, policy clarification, capacity building, identification of first movers, financial structuring or reformulation of scenarios.

Decision logic should remain plural and transparent. Different actors may interpret screening results differently depending on their mandates, responsibilities and risk perceptions. For this reason, decision rationales should be documented, including:

- the evidence considered;
- the indicators or criteria used;
- the main uncertainties and assumptions;
- the actors involved in decision logic;
- the reasons for Go, Refine or Pause;
- the follow-up actions identified;
- the assumptions or indicators to be monitored in subsequent phases.

Where screening results reveal tensions between carbon performance, affordability, social acceptance, governance capacity or equity, such tensions should be explicitly discussed rather than hidden through aggregation. The purpose of decision logic is to support responsible progression and learning, not to simplify complex decisions into purely technical outcomes.

9 Governance, participation and equity

9.1 General

This clause describes how governance, participation and equity considerations can support PED Development Readiness. In this CWA, these dimensions are treated as enabling conditions for informed, legitimate and durable PED development, rather than as separate or ancillary activities.

PED development typically involves multiple actors, policy domains, infrastructures, ownership structures and social groups. Technical feasibility and carbon-related performance are therefore not sufficient to determine whether a PED pathway can progress responsibly. Governance arrangements, participation processes and equity considerations influence how scenarios are interpreted, how decisions are taken, how implementation can be sustained, and how costs, benefits, risks and opportunities are distributed.

The guidance provided in this clause is non-prescriptive. It does not define a single governance model, participation method, equity assessment framework, partnership structure or procurement approach. Instead, it supports users in identifying and documenting governance conditions, stakeholder roles, participation needs, equity implications and decision rationales in a way that is proportionate to the local context and the maturity of the PED process.

Governance, participation and equity should be considered throughout the Development Readiness workflow. They may influence context understanding, scenario definition, screening decision logic, implementation preparation, monitoring and learning.

9.2 Governance arrangements

Governance arrangements refer to the actors, responsibilities, coordination mechanisms and decision-making conditions that shape the PED development process.

Users should consider governance arrangements in relation to the specific institutional and territorial context. Relevant actors may include municipal departments, regional or national authorities, utilities, distribution system operators, social housing providers, building owners, universities, schools, community organisations, local residents, energy communities, technical experts, developers, investors, local associations and other intermediaries.

Governance arrangements may concern, where relevant:

- clarification of which actors are involved in the PED process and why;
- identification of public authorities, asset owners, infrastructure managers and organisations with decision-making responsibilities;
- identification of appropriate stakeholder engagement strategies;
- coordination among different sectors: energy, spatial planning, housing, mobility, welfare, social policy, climate policy and economic development;
- identification of actors able to initiate, enable, support, finance, implement, monitor or maintain PED-related actions;

- clarification of decision rights, advisory roles, operational responsibilities and accountability conditions;
- capacity to coordinate across governance levels;
- mechanisms for resolving conflicts, aligning timelines and managing dependencies;
- continuity across planning, implementation, operation, monitoring and learning.

Governance arrangements should be adapted to the complexity of the PED initiative. In early stages, informal coordination mechanisms, working groups or living lab structures may be sufficient to support dialogue and scoping. In more mature stages, more formalised coordination structures, agreements, mandates or implementation partnerships may be needed.

Users should consider whether governance arrangements are sufficiently clear to support the current development phase. Where responsibilities are fragmented, mandates are unclear or coordination capacity is weak, the PED process may require additional preparatory actions before moving towards implementation.

Governance arrangements should also be assessed in relation to public-interest safeguards and equity impacts. Where private-sector proposals, energy-service models, investment schemes or shared-energy arrangements are involved, public actors may need sufficient capacity to interpret options, protect vulnerable groups, ensure transparency and maintain strategic control over long-term public objectives.

9.3 Participation principles

Participation is a process-integrated activity supporting legitimacy, learning, local alignment and implementation feasibility. It should not be treated only as a communication exercise or as a one-off consultation.

Participation may support PED Development Readiness by:

- identifying local needs, priorities, constraints and everyday practices;
- revealing barriers that may not be visible through technical analysis alone;
- improving the relevance and interpretability of scenarios;
- supporting trust-building and social acceptance;
- clarifying the roles and expectations of residents, users, owners, tenants, local organisations and other affected groups;
- identifying vulnerable or underrepresented actors whose interests may otherwise be overlooked;
- strengthening the capacity of local actors to engage with energy, climate and spatial transition processes;
- supporting feedback loops between technical analysis, governance decisions and local experience.

Participation should be adapted to the local context, the actors involved and the decision questions at stake. Relevant participants may include formal stakeholders, informal groups, residents, tenants, owners, schools, local associations, parishes, social services, SMEs, community organisations, energy community actors, housing providers and other intermediaries connected with everyday practices and local needs.

Users should consider the following principles when designing participation activities:

- early involvement, so that relevant actors can influence problem framing, objectives and scenario assumptions before key decisions are locked in;
- clarity of purpose, so that participants understand what can be influenced and how their input will be used;
- accessibility, so that participation does not exclude groups with limited time, resources, language skills, digital access or institutional familiarity;
- continuity, so that engagement does not stop after initial consultation but supports implementation and monitoring where appropriate;
- feedback, so that participants can understand how their contributions affected decisions or why some inputs could not be adopted;
- proportionality, so that participation methods remain feasible given available resources, capacities and project maturity;
- avoidance of symbolic participation, where engagement is organised without meaningful influence on decisions.

Participation does not require the same level of intensity in all contexts or phases. In some phases, information-sharing and targeted consultation may be appropriate. In others, co-design, living labs, stakeholder workshops, community assemblies or collaborative action planning may be more suitable. The choice of method should depend on the purpose of participation, the vulnerability of affected groups, the complexity of decisions and the capacity of actors to remain involved over time.

Where participation is limited by time, resources, trust conditions or institutional barriers, such limitations should be documented. Participation gaps may affect Development Readiness and may indicate the need for further engagement before decisions are finalised or implementation actions are launched.

9.4 Equity considerations

Equity considerations are integral to PED Development Readiness. PED development may generate benefits, costs, risks and responsibilities that are unevenly distributed across social groups, places and actors. If these distributional effects are not considered, PED initiatives may reinforce existing inequalities, reduce legitimacy or undermine implementation.

Equity considerations may include, where relevant:

- distribution of investment costs, operational costs, savings, revenues and benefits;
- affordability of proposed interventions for households, tenants, owners, public bodies or community organisations;
- exposure of low-income households, social housing residents, tenants, elderly people, students or other vulnerable groups to energy poverty or transition-related burdens;
- ability of different groups to participate in decisions and access information;
- ownership and control of energy assets, renewable generation, storage, district heating or shared-energy arrangements;
- risk that better-resourced groups capture benefits while disadvantaged groups bear costs or remain excluded;

- implications of renovation, energy prices, tariffs, procurement models or investment schemes for vulnerable users;
- intergenerational equity and long-term responsibility for climate, energy and infrastructure decisions;
- accessibility of capacity-building tools, technical assistance or support mechanisms.

Equity should be considered both procedurally and substantively. Procedural equity concerns access to information, participation and decision-making. Substantive or distributional equity concerns how costs, benefits, risks and responsibilities are allocated.

Users should consider equity implications during context analysis, scenario building, screening, decision checkpoints, implementation preparation and monitoring. Equity should not be postponed until implementation, because key distributional effects may already be shaped by early decisions on boundaries, scenarios, technologies, ownership models, financing mechanisms or governance arrangements.

Where the PED initiative involves energy communities, collective self-consumption, shared assets or commons-based arrangements, users should consider who can participate, who can invest, who can benefit, who carries risk, and how rules for access and benefit-sharing are defined.

Where equity risks are identified, users may consider refinement actions such as adapting scenarios, improving participation, introducing targeted support, clarifying benefit-sharing mechanisms, engaging social intermediaries, adjusting phasing, or strengthening public oversight. Such actions should be understood as enabling conditions for legitimate PED development, not as additional compliance requirements.

9.5 Decision transparency

Decision transparency supports trust, accountability and learning throughout the PED development process. It helps actors understand how decisions were made, which evidence was considered, which assumptions were used, which alternatives were discussed and why certain options were advanced, refined or paused.

This CWA does not prescribe formal decision logs or audit procedures. However, users should consider documenting decision rationales in a proportionate way, especially at key decision checkpoints.

Decision transparency may include documentation of:

- the decision or interpretation made;
- the actors involved in the discussion;
- the scenarios or options considered;
- the data, assumptions, proxies and uncertainties reviewed;
- the CNC results or complementary indicators considered;
- governance, participation and equity concerns raised;
- the reasons for Go / Refine / Pause decision logic;
- dissenting views or unresolved issues, where relevant;
- follow-up actions, responsibilities or monitoring needs.

Transparent decision documentation should be understandable to the intended users. It should not be so burdensome that it discourages participation or slows down the process unnecessarily. The level of detail should be proportionate to the importance of the decision, the maturity of the process and the potential social, financial or institutional consequences.

Decision transparency is particularly important where decisions affect vulnerable groups, public assets, long-term infrastructure choices, public expenditure, community energy arrangements or distribution of costs and benefits. In such cases, users should consider how decision rationales can be communicated to affected actors in an accessible form.

9.6 Partnership and procurement options

PED implementation may involve different partnership and procurement arrangements, depending on the local context, legal framework, ownership structure, technology options, financing capacity and governance objectives.

This CWA does not recommend specific contractual models, partnership structures or procurement procedures. Such arrangements are subject to applicable legal, regulatory, administrative and financial conditions. The purpose of this subsection is to support early reflection on how partnership and procurement options may affect PED Development Readiness.

Users should consider, where relevant:

- whether implementation requires public procurement, public-private cooperation, community-led initiatives, utility involvement, housing-sector partnerships or research/practice collaboration;
- which actors may own, finance, operate or maintain energy assets, buildings, infrastructures or digital systems;
- how responsibilities, risks, revenues and benefits may be allocated;
- whether proposed arrangements are compatible with public-interest objectives, affordability and equity considerations;
- whether vulnerable groups, tenants or low-income households can access benefits under the proposed model;
- whether public administrations have sufficient capacity to evaluate, negotiate and manage partnership or procurement arrangements;
- whether procurement or partnership choices may limit future flexibility, interoperability, monitoring or adaptation;
- whether early actions or pilot projects can be structured without locking the process into unsuitable long-term arrangements.

Partnership and procurement considerations should be connected to the action-planning activities described in Clause 10. They may also influence scenario design, screening interpretation and monitoring needs.

Where partnership or procurement options are uncertain, users may consider identifying alternative pathways, clarifying legal and administrative constraints, consulting relevant expertise, or postponing irreversible commitments until sufficient Development Readiness conditions are in place.

10 Implementation Readiness and action planning

10.1 General

This clause describes how PED Development Readiness can be translated into implementation-oriented action planning. Implementation Readiness refers to the capacity of a PED initiative to move from analysis, scenario exploration and screening towards coordinated, feasible and context-sensitive action.

Implementation Readiness does not mean that all technical, financial, governance or social uncertainties have been fully resolved. Rather, it means that the main conditions for responsible progression have been sufficiently clarified, including policy–technology coherence, administrative capacity, roles and responsibilities, risks, early actions and adaptation needs.

The guidance provided in this clause is non-prescriptive. It does not define a mandatory action plan format, project management method, procurement model, financing mechanism or implementation sequence. It supports users in identifying the conditions that may enable or constrain action, and in translating scenario and screening insights into proportionate next steps.

Implementation Readiness should be understood as iterative. Actions may start with limited commitments, pilot activities, data-sharing arrangements, stakeholder engagement, technical studies or quick wins. As information improves and capacities mature, actions may be revised, expanded or connected to wider spatial, energy, climate or regeneration strategies.

10.2 Policy–technology coherence

PED implementation requires coherence between technical options and the policy, regulatory, spatial and institutional frameworks within which they are expected to operate. A technically promising scenario may not be actionable if it is misaligned with planning rules, energy regulations, ownership conditions, incentive schemes, procurement procedures or institutional responsibilities.

Users should consider whether proposed PED options are coherent with, where relevant:

- local, regional or national energy and climate strategies;
- spatial plans, urban regeneration frameworks, mobility plans, climate adaptation plans or strategic development programmes;
- regulations and incentives related to energy performance of buildings, renewable energy generation, energy communities, district heating, self-consumption, storage or grid connection;
- heritage, landscape, environmental or planning constraints;
- public investment programmes, funding schemes, subsidy mechanisms or technical assistance programmes;
- ownership structures, housing arrangements, condominium rules, social housing governance or land-management conditions;
- existing or planned infrastructure investments, including energy networks, mobility systems, public facilities or digital infrastructures.

Policy–technology coherence should be assessed in relation to the specific implementation pathway under consideration. For example, a heat-pump-based pathway, a district-heating pathway, a renewable energy community pathway or an energy-hub pathway may each depend on different rules, actors, assets and administrative procedures.

Where misalignment is identified, users may consider refinement actions such as adapting the scenario, clarifying regulatory interpretations, identifying alternative governance arrangements, phasing interventions, seeking technical assistance, aligning with existing plans, or revisiting the PED boundary.

Policy–technology coherence should not be interpreted as a requirement that all enabling conditions already exist. In many contexts, implementation readiness may include the identification of policy gaps, institutional barriers or regulatory uncertainties that need to be addressed before or during implementation.

10.3 Administrative capacity and capacity building

Implementation Readiness depends not only on technical feasibility, but also on the capacity of responsible organisations to coordinate, evaluate, implement and sustain the PED process. Public administrations may play a decisive role in connecting policy domains, enabling stakeholder participation, managing procedures, safeguarding public interests and ensuring continuity between planning, implementation and monitoring.

Users should consider administrative and organisational capacity in relation to the current development phase and the complexity of the PED initiative. Relevant capacity dimensions may include:

- availability of staff and time to coordinate the process;
- ability to work across departments and policy domains;
- access to technical, legal, financial, planning and facilitation expertise;
- capacity to interpret data, modelling outputs, CNC results and complementary indicators;
- ability to engage with utilities, DSOs, housing providers, developers, community actors and technical consultants;
- experience with innovative planning instruments, energy communities, public-private cooperation or participatory processes;
- capacity to manage data-sharing, procurement, funding applications or partnership arrangements;
- ability to communicate decisions, uncertainties and trade-offs to stakeholders;
- ability to maintain monitoring and learning processes over time.

Capacity gaps may affect the feasibility of implementation even when scenarios appear technically or economically promising. Where such gaps are identified, capacity-building actions may be considered before or alongside technical development.

Capacity-building actions may include, where appropriate:

- training for municipal staff, housing providers or community intermediaries;
- interdepartmental coordination mechanisms;
- technical assistance from specialised agencies, research institutions or consultants;
- peer learning with other municipalities or PED initiatives;
- development of shared data-management practices;
- facilitation support for stakeholder engagement;

- legal or procurement advice;
- support for interpreting modelling and screening results;
- gradual development of monitoring and feedback capacities.

Capacity building should be proportionate to the local context and should not be treated as an additional requirement detached from implementation. It is an enabling condition that may improve the robustness, legitimacy and continuity of the PED process.

10.4 Action planning

Action planning supports the translation of PED objectives, scenario insights and screening results into sequenced and actionable steps. It connects strategic ambition with operational progression.

An action plan may include, where relevant:

- the PED ambition or development objective being pursued;
- the scenario or pathway selected for further development or refinement;
- the actions needed to move to the next phase;
- the actors responsible for initiating, supporting, financing or implementing each action;
- the resources, data, permissions, partnerships or capacities required;
- the expected timing or sequencing of actions;
- dependencies between actions;
- risks, uncertainties and assumptions affecting action planning;
- expected short-term outputs and longer-term outcomes;
- monitoring and feedback arrangements.

Action planning should remain flexible. In early stages, an action plan may be limited to scoping activities, data collection, stakeholder engagement, technical studies or first-mover commitments. In more mature stages, it may include detailed implementation steps, funding applications, procurement preparation, partnership arrangements, pilot projects or monitoring activities.

Users should consider distinguishing between:

- preparatory actions, such as data improvement, stakeholder mapping, policy clarification or feasibility studies;
- enabling actions, such as capacity building, governance arrangements, funding identification or partnership development;
- technical actions, such as retrofit measures, renewable energy installations, heat-transition interventions, storage or flexibility measures;
- participatory actions, such as living lab activities, co-design workshops, awareness campaigns or community engagement;

- institutional actions, such as interdepartmental coordination, regulatory alignment, public decision-making or procurement preparation;
- monitoring and learning actions, such as data collection, feedback sessions, assumption review or performance tracking.

Action planning should not lock the PED process into a fixed pathway prematurely. Where uncertainty remains significant, modular or phased action plans may help users progress while preserving flexibility.

10.5 Roles and responsibilities

Clarifying roles and responsibilities is essential for Implementation Readiness. PED development often involves multiple actors whose responsibilities may overlap, evolve or remain unclear across phases. Lack of role clarity may delay implementation, weaken accountability or create unrealistic expectations.

Users should consider identifying, where relevant:

- who initiates the process;
- who coordinates the process;
- who provides data;
- who owns or controls relevant assets;
- who has decision-making authority;
- who provides technical analysis or modelling;
- who engages stakeholders and communities;
- who finances or co-finances actions;
- who implements technical measures;
- who operates and maintains assets or systems;
- who monitors results;
- who communicates progress and feedback;
- who represents vulnerable or underrepresented groups.

Roles and responsibilities may change across phases. For example, a municipality may coordinate initial scoping, a housing provider may lead renovation-related actions, a utility or DSO may provide infrastructure data, a community organisation may support engagement, and technical experts may support modelling or screening.

Users may consider using simple role-allocation tools, such as responsibility tables or simplified RACI-type matrices (Responsible, Accountable, Consulted, and Informed), where appropriate. Such tools should remain illustrative and adaptable. This CWA does not prescribe a formal role-matrix method.

Role clarification should be connected to governance arrangements described in Clause 9 and to action planning in Clause 10.3. It should also be revisited when new actors join the process, scenarios change, implementation pathways become more concrete or monitoring reveals new responsibilities.

10.6 Risks and quick wins

Risk identification and the recognition of possible quick wins can support realistic and adaptive PED implementation. Risks help users understand what may prevent or delay progression. Quick wins can help build trust, demonstrate value, mobilise actors and maintain momentum.

Risks may concern, where relevant:

- data gaps or poor data quality;
- uncertain assumptions or weak scenario documentation;
- regulatory uncertainty or planning constraints;
- lack of responsible actors or unclear mandates;
- insufficient administrative or technical capacity;
- limited funding, affordability constraints or financial exposure;
- low stakeholder engagement or lack of trust;
- social resistance, participation fatigue or unequal access to decision-making;
- heritage, ownership, procurement or infrastructure constraints;
- dependence on external actors, incentives, tariffs, market conditions or political decisions;
- equity risks, including unequal distribution of costs and benefits;
- implementation delays or loss of continuity between project phases.

Risks should be documented in relation to the decisions they affect. Users should consider whether risks can be accepted, mitigated, monitored, transferred, reduced through phasing or addressed through refinement of scenarios or action plans.

Quick wins may include, where appropriate:

- data-sharing agreements;
- stakeholder workshops or living lab activities;
- energy awareness or capacity-building initiatives;
- preliminary audits or technical studies;
- pilot renovation actions;
- small-scale renewable energy installations;
- public-building demonstrations;
- identification of first movers;
- alignment with ongoing urban regeneration, mobility or climate projects;
- creation of coordination groups or shared dashboards;

- clarification of responsibilities or funding opportunities.

Quick wins should not be selected only because they are easy to implement. They should contribute to learning, trust-building, capacity development or future implementation readiness. Where possible, quick wins should be connected to longer-term PED objectives and monitoring arrangements.

10.7 Replication and scaling

Replication and scaling are understood in this CWA as adaptive learning processes. They do not imply copying a fixed PED model, technology package, governance arrangement or case-study solution from one context to another.

PED replication should consider which elements of a process are transferable and which depend on local conditions. Transferable elements may include workflow structures, documentation practices, decision checkpoints, scenario-building logic, stakeholder engagement principles, assumption management, or monitoring approaches. Context-dependent elements may include technologies, boundaries, regulatory interpretations, ownership models, funding conditions, social dynamics or institutional capacities.

Users should consider, where relevant:

- which parts of the PED development process can be reused or adapted;
- which assumptions are specific to the original context;
- which enabling conditions need to be present or developed in the receiving context;
- whether data, governance capacity, stakeholder structures and policy frameworks are comparable;
- whether equity implications differ across contexts;
- whether the implementation pathway depends on unique actors, assets, funding or regulatory conditions;
- what lessons can inform other districts, municipalities or projects without becoming prescriptive models.

Scaling may occur within the same district, across neighbouring districts, at city scale, or through transfer to other municipalities or regions. Scaling may involve broadening stakeholder coalitions, expanding technical systems, connecting to wider spatial strategies, institutionalising monitoring practices or integrating PED-related principles into policy and planning frameworks.

Replication and scaling should be supported by documentation and learning. The purpose of documenting implementation experience is not to define best practices to be copied, but to clarify what worked, under which conditions, with which assumptions, and with which limitations.

11 Monitoring, learning and adaptation

11.1 General

This clause describes how monitoring, learning and adaptation can support PED Development Readiness over time. Monitoring is understood in this CWA as a process for generating information, interpreting progress, revisiting assumptions and supporting adaptive decision-making. It is not limited to technical performance measurement.

Monitoring, learning and adaptation help connect implementation experience with earlier phases of the Development Readiness workflow. They may lead users to update contextual data, revise assumptions, refine scenarios, reconsider screening criteria, adjust governance arrangements or modify action plans.

The guidance provided in this clause is non-prescriptive. It does not define a mandatory monitoring framework, reporting format, KPI set, monitoring frequency or evaluation method. Instead, it supports users in designing proportionate monitoring and learning arrangements that are coherent with local objectives, data availability, institutional capacity and implementation maturity.

Monitoring should be understood as part of a continuous learning process. Its purpose is not only to verify whether expected results have been achieved, but also to understand why certain outcomes occur, which assumptions remain valid, which barriers persist, and which adaptations may be needed.

11.2 Monitoring dimensions

Monitoring may address multiple dimensions of PED Development Readiness. These dimensions should be selected according to the objectives of the PED initiative, the maturity of the process, the available data and the intended use of monitoring results.

Users should consider, where relevant, monitoring dimensions such as:

- technical and energy performance, including energy demand, renewable energy generation, self-consumption, flexibility, storage performance, import/export balance, heating and cooling systems, grid interactions or energy efficiency measures;
- carbon-related performance, including CNC-related variables, emissions factors, energy-carrier changes, carbon-related scenario assumptions or progress towards locally defined climate-neutrality ambitions;
- economic and financial conditions, including investment progress, operational costs, affordability, funding availability, tariff exposure, distribution of costs and benefits or financial feasibility assumptions;
- implementation progress, including completion of preparatory actions, technical studies, pilot activities, procurement steps, partnership arrangements, first-mover commitments, quick wins or phased interventions;
- governance and institutional capacity, including role clarity, coordination mechanisms, administrative capacity, interdepartmental cooperation, continuity of responsible actors and capacity-building needs;
- participation and stakeholder engagement, including participation continuity, diversity of actors involved, stakeholder feedback, trust-building, involvement of intermediaries and responsiveness to local needs;
- equity and inclusion, including distributional effects, accessibility of benefits, affordability for vulnerable groups, tenant/owner implications, energy poverty risks and access to decision-making;
- data quality and assumptions, including updates to data sources, validation of proxies, revision of assumptions, emergence of new uncertainties or availability of more reliable information;
- learning and adaptability, including lessons learned, changes in scenarios, revision of action plans, feedback from users and capacity to respond to changing regulatory, market or institutional conditions.

Monitoring dimensions should not be treated as a fixed checklist. Users should select and adapt them according to the decision questions that monitoring is intended to support.

11.3 Monitoring approach

The monitoring approach should be proportionate to the PED initiative and its stage of development. In early stages, monitoring may focus on process conditions, data improvement, stakeholder engagement and assumption review. In later stages, monitoring may include technical performance, carbon-related results, implementation progress and social impacts.

A monitoring approach may include, where relevant:

- the objectives or questions that monitoring is intended to address;
- the dimensions to be monitored;
- the indicators, qualitative criteria or evidence sources to be used;
- the actors responsible for collecting, interpreting and communicating information;
- the data sources and assumptions involved;
- the expected frequency of monitoring activities;
- the decision checkpoints or feedback moments where monitoring results will be discussed;
- the actions that may be triggered by monitoring results.

Monitoring should be linked to the evaluation logic described in Clause 5.3 and the complementary indicators described in Clause 8.3. However, the CWA does not require a standardised monitoring matrix or predefined KPI set. Monitoring indicators should be selected according to local objectives, available capacities and the intended use of the results.

Qualitative monitoring may be appropriate for governance, participation, equity and learning dimensions. Such monitoring may include stakeholder feedback, workshop outcomes, interviews, meeting records, community observations, implementation notes or reflective reviews. Quantitative monitoring may be appropriate for energy, carbon, economic or implementation-progress dimensions, where reliable data are available.

Users should avoid monitoring arrangements that are too complex for the local capacity available. A limited but well-used monitoring framework may be more effective than a comprehensive framework that cannot be maintained.

11.4 Frequencies and data sources

Monitoring frequency and data sources should be selected in relation to the purpose of monitoring, the type of information needed and the capacity of the actors involved.

Some monitoring activities may require regular or periodic data collection, for example where technical performance, energy consumption, generation or implementation progress are being tracked. Other monitoring activities may be linked to decision checkpoints, project milestones, stakeholder meetings, funding cycles, regulatory changes or revision of action plans.

Users should consider, where relevant:

- whether monitoring should be continuous, periodic, milestone-based or event-based;
- which data sources are available and reliable;
- whether data can be collected automatically, manually or through stakeholder input;

- whether monitoring data are sufficiently disaggregated for the intended decision;
- whether data ownership, privacy, access or interoperability issues affect monitoring;
- whether qualitative feedback is needed to interpret quantitative results;
- whether monitoring frequency is realistic given local capacity;
- whether monitoring results can be used in time to inform decisions.

Possible data sources may include:

- metering data, where available;
- energy bills or consumption records;
- technical studies, simulations or updated modelling outputs;
- building or infrastructure data;
- public datasets or municipal databases;
- stakeholder surveys, interviews or workshops;
- living lab activities and community feedback;
- implementation records, procurement documents or project reports;
- policy, regulatory or funding updates;
- monitoring outputs from related plans, such as climate, energy, mobility or urban regeneration strategies.

Where monitoring relies on proxy data or qualitative information, users should document limitations and review conditions. As more reliable data become available, monitoring arrangements may be refined.

11.5 Feedback loops

Feedback loops are the mechanisms through which monitoring results inform learning, revision and adaptation. They help ensure that PED development remains responsive to changing conditions, new evidence and stakeholder experience.

Feedback loops may connect monitoring results to:

- Clause 5 Development Readiness Integration Workflow, by revisiting workflow phases, decision checkpoints, evaluation logic or assumptions;
- Clause 6 Context Kit, by updating contextual information, data quality, proxy use, stakeholder mapping or territorial and institutional readiness;
- Clause 7 Scenario Builder, by revising scenario assumptions, boundaries, technology options, participation assumptions or implementation pathways;
- Clause 8 Screening Metrics and Decision Criteria, by updating CNC inputs, complementary indicators, trade-off interpretation or Go / Refine / Pause decision logic;

- Clause 9 Governance, Participation and Equity, by adapting governance arrangements, participation methods, equity safeguards or decision-transparency practices;
- Clause 10 Implementation Readiness and Action planning, by updating action plans, roles, responsibilities, risks, quick wins, capacity-building needs or replication pathways.

Feedback loops may be formal or informal, depending on the local context. They may take the form of review meetings, stakeholder workshops, technical updates, decision checkpoints, monitoring reports, living lab sessions, internal coordination meetings or public communication moments.

Users should consider documenting feedback loops in a proportionate way, including:

- what monitoring result or feedback triggered review;
- which assumption, scenario, decision or action was affected;
- which actors were involved in interpretation;
- what revision or adaptation was agreed;
- what remains uncertain;
- when the issue should be revisited.

Feedback loops should support learning rather than blame. Unexpected results, delays, data gaps or implementation difficulties should be treated as sources of information for improving the PED process, provided that they are documented and discussed transparently.

11.6 Updating assumptions, scenarios and action plans

Monitoring and feedback may lead to updates of assumptions, scenarios and action plans. Such updates are part of adaptive PED Development Readiness and should not be interpreted as failure of the original process.

Assumptions may need to be updated when:

- measured data become available and replace proxies;
- energy demand or generation differs from expected values;
- costs, tariffs, carbon factors or market conditions change;
- stakeholder participation differs from initial expectations;
- policy or regulatory conditions evolve;
- implementation barriers emerge;
- equity impacts differ from anticipated effects;
- governance capacity or actor responsibilities change.

Scenarios may need to be refined when monitoring shows that boundary assumptions, technology choices, participation rates, demand-reduction assumptions, implementation timelines or cost assumptions are no longer realistic or sufficient.

Action plans may need to be adapted when:

- first-mover commitments change;
- new funding opportunities or constraints arise;
- roles and responsibilities need clarification;
- quick wins have been completed or are no longer relevant;
- risks increase or decrease;
- stakeholder feedback reveals new needs or concerns;
- capacity-building actions are required;
- implementation phases need to be resequenced.

Users should consider maintaining a clear relationship between updated assumptions, revised scenarios and adapted action plans. Where changes affect decision rationales or screening interpretation, they should be discussed at relevant decision checkpoints.

11.7 Reporting and communication

Reporting and communication support transparency, trust and continuity in PED development processes. They help ensure that monitoring results, lessons learned, assumptions and adaptations are accessible to relevant actors.

This CWA does not prescribe a reporting format. Reporting and communication should be adapted to the intended audience, the sensitivity of the information and the maturity of the PED process.

Users should consider how to communicate:

- progress made and actions completed;
- monitoring results and their limitations;
- assumptions revised or confirmed;
- scenario or action-plan updates;
- governance or participation changes;
- equity concerns or safeguards;
- risks, delays or unresolved issues;
- next steps and responsibilities.

Different audiences may require different communication formats. Technical actors may need detailed datasets, modelling updates or monitoring tables. Public authorities may need decision summaries, implementation updates and risk information. Community actors may need accessible explanations of what has changed, why it matters and how they can remain involved.

Communication should avoid overstating certainty. Where results are based on assumptions, proxies or incomplete data, this should be clearly explained. Transparent communication of uncertainty can support trust and informed participation.

Reporting and communication should also support replication and scaling. Lessons learned should clarify not only what was done, but under which conditions, with which assumptions, with which limitations and with which implications for other contexts.

Annex A

(informative)

Illustrative supporting materials

A.1 Purpose and status

A.1.1 General

This annex provides illustrative supporting materials that may help users apply the process-oriented guidance set out in Clauses 5 to 11 of this CWA.

The materials included in this annex are intended to support documentation, reflection, coordination and communication during PED Development Readiness processes. They may be used, adapted, simplified, combined or replaced depending on the local context, the maturity of the PED initiative, the availability of data, the actors involved and the intended use of the guidance.

The supporting materials in this annex are:

- illustrative;
- non-binding;
- adaptable;
- not mandatory formats;
- not compliance tools;
- not certification tools;
- not intended to define thresholds, benchmarks or standardised KPIs.

They are provided to help users structure discussions, document assumptions, compare scenarios, identify refinement needs and maintain traceability across the PED development process. Their use does not imply conformity with this CWA, nor does non-use imply non-conformity.

Where users adapt these materials, they should consider preserving the underlying principles of transparency, proportionality, context sensitivity, traceability and collective interpretation.

This annex consolidates the illustrative materials into seven integrated tools:

- Development Readiness Workflow and Input/Output Overview;
- Context Kit and Data/Proxy Documentation Prompt;
- Scenario Documentation and Comparison Prompt;
- Screening and Go / Refine / Pause Prompt;
- Governance, Participation and Equity Reflection Prompt;
- Implementation Readiness and Action Planning Prompt;

— Monitoring and Feedback Loop Prompt.

These tools are not intended to be used as a linear checklist. They may be used iteratively and selectively. Development Readiness Workflow and Input/Output Overview

This tool provides an illustrative overview of how the PED Development Readiness process may be structured across phases. It supports users in clarifying the relationship between process steps, typical inputs, expected outputs and relevant clauses of this CWA.

It may be used at the beginning of a PED initiative to create a shared understanding of the process, or during later stages to review whether relevant information, actors and decision rationales have been adequately documented.

A.1.2 Illustrative workflow logic

PED Development Readiness may be understood as an iterative process moving through the following indicative phases reported in Table A.1.

Table A.1 — Illustrative input/output overview

Process phase	Typical inputs	Typical outputs	Related clauses
Scoping and initial framing	Local ambition, preliminary PED boundary, policy context, initiating actors, known constraints	Initial PED entry point, provisional scope, preliminary questions, first assumptions	Clause 5
Context analysis	Spatial data, energy data, socio-economic data, stakeholder information, policy and regulatory context, existing plans	Context Kit, data-quality notes, stakeholder and asset map, territorial readiness overview	Clause 6
Objective setting and evaluation logic	Local priorities, climate-neutrality ambitions, social and institutional objectives, stakeholder concerns	Transparent evaluation logic, selected criteria, documented rationale for indicator choice	Clauses 5, 8 and 9
Scenario development	Technical options, participation assumptions, sufficiency assumptions, spatial constraints, policy constraints, available tools	Scenario sheets, assumptions, boundaries, model inputs, scenario narratives	Clause 7
Screening and interpretation	CNC results, complementary indicators, qualitative criteria, trade-offs, uncertainties,	Screening summary, Go / Refine / Pause decision logic, follow-up actions	Clause 8

	stakeholder interpretation		
Implementation readiness	Preferred or promising pathway, role clarity, administrative capacity, funding options, risks, first movers	Action plan, responsibilities, quick wins, capacity-building needs, implementation risks	Clause 10
Monitoring, learning and adaptation	Monitoring data, stakeholder feedback, updated assumptions, implementation experience	Updated assumptions, revised scenarios, adapted action plan, learning notes	Clause 11

The sequence may vary depending on the local context. Some phases may overlap or be repeated. For example, context analysis may continue after scenarios have been developed; monitoring may begin before full implementation; and objective setting may be revised when new stakeholders or constraints emerge.

A.1.3 Development Readiness checkpoint questions

At each relevant transition between phases, users may consider the following questions:

- Are the objectives sufficiently clear for the current phase?
- Are the main assumptions documented?
- Are the relevant stakeholders and responsible actors identified?
- Are data gaps acceptable for the intended level of decision-making?
- Are proxy assumptions sufficiently transparent?
- Are governance, participation and equity issues visible in the process?
- Are key uncertainties documented and assigned for later review?
- Is the process ready to proceed, or is refinement needed before progression?

These questions are intended to support reflection. They should not be interpreted as pass/fail criteria.

Users may document assumptions using a simple structure reported in Table A.2:

Table A.2 — Assumption management prompt

Assumption	Source or basis	Reason for use	Uncertainty level	Affected scenario or decision	Review condition
			Low / medium / high		
NOTE Examples of assumptions may include participation rates, energy demand profiles, renovation levels, technology costs, carbon factors, user behaviour, regulatory feasibility, funding availability or administrative capacity.					

A.2 Context Kit and Data/Proxy documentation prompt

This tool supports the organisation of contextual information relevant to PED Development Readiness. It may help users document available data, identify gaps, justify the use of proxies and clarify the territorial, institutional and stakeholder conditions that influence PED development.

The Context Kit is not a mandatory dataset. It should be proportionate to the maturity of the initiative, the available resources and the intended use of the analysis.

Users may consider documenting information across the dimensions reported in Table A.3.

Table A.3 — Context dimensions

Context dimension	Possible content	Possible evidence
Spatial and urban context	PED boundary, land use, building stock, heritage constraints, public space, mobility connections, existing regeneration plans	GIS data, planning documents, maps, field surveys
Energy and technical context	Energy demand, generation potential, grid constraints, heating and cooling systems, renewable energy resources, storage opportunities	Metered data, simulations, utility data, energy audits, modelling outputs
Socio-economic context	Population, tenure, income, energy poverty risks, vulnerable groups, household composition, affordability issues	Official statistics, surveys, local studies, qualitative evidence
Policy and regulatory context	Planning rules, energy regulations, REC frameworks, building renovation requirements, funding schemes, procurement rules	Policy documents, legal analysis, municipal plans, regulatory guidance
Stakeholders and assets	Public authorities, utilities, DSOs, housing bodies, community groups, local associations,	Stakeholder maps, interviews, workshops, institutional records

	educational institutions, businesses, first movers	
Institutional readiness	Administrative capacity, coordination mechanisms, decision mandates, data-sharing arrangements, governance structures	Organisational charts, meeting notes, responsibility tables
Participation readiness	Existing engagement channels, local trust conditions, intermediaries, participation barriers, communication needs	Living lab notes, focus groups, surveys, community feedback
Equity considerations	Distribution of costs and benefits, tenant/owner asymmetries, vulnerable groups, access to decision-making, affordability safeguards	Qualitative feedback, vulnerability data, policy analysis

Where data are used to support PED decisions, users may document their quality and limitations. A simple A/B/C classification may be used, as reported in Table A.4.

Table A.4 — Data-quality and proxy documentation

Quality level	Indicative meaning	Examples
A — High	Measured, authoritative, calibrated or independently verifiable data	Metered heat or electricity data; official statistics; validated network data; official tariff sheets
B — Medium	Modelled, benchmarked or partially calibrated data adjusted to local conditions	Building demand estimated from archetypes and adjusted to local stock; PV yield calculated with a recognised tool and checked against local conditions
C — Low / Proxy	Proxy, assumption or indirect estimate used due to data gaps	Participation rate based on comparable cases; demand profile inferred from standard profiles; cost or efficiency value taken from literature

The classification should not be used to exclude data automatically. Instead, it should help users understand which decisions can be supported by the available evidence and which decisions require caution, refinement or further validation.

Users may consider adding a short note explaining why the data are sufficient for the current phase, or why further data collection may be needed before progressing as reported in Table A.5.

Table A.5 — Data/proxy documentation prompt

Data item or proxy	Intended use	Source	Quality level	Method or assumption	Main limitation	Possible improvement
			A / B / C			

Users may clarify the territorial, institutional and stakeholder conditions that influence PED development as reported in Table A.6.

Table A.6 — Stakeholder and asset mapping prompt

Actor or stakeholder	Role in PED process	Assets, resources or mandate	Potential contribution	Possible constraints	Engagement status
					Not contacted / informed / engaged / active / first mover
NOTE Assets may include roofs, buildings, land, energy infrastructure, data, funding capacity, community trust, technical expertise, legal authority or communication channels.					

A.3 Scenario documentation and comparison prompt

A.3.1 General

This tool supports the transparent documentation (Table A.7) and comparison (Table A.8) of PED scenarios. It may help users clarify what each scenario assumes, which objectives it addresses, which technical and social conditions it depends on, and how it differs from other options.

The tool does not prescribe which scenarios should be developed. Scenarios should be selected according to local objectives, available data, stakeholder priorities, technical feasibility and decision needs.

Table A.7 — Scenario documentation sheet

Field	Illustrative content
Scenario ID and title	Short identifier and descriptive name
Scenario purpose	Objective or question addressed by the scenario
PED boundary considered	Physical, functional, dynamic or virtual boundary, where relevant
Main technical components	Retrofit level, PV, heat pumps, district heating, storage, flexibility, energy community arrangements, other relevant components

Demand-side assumptions	Energy demand reduction, sufficiency assumptions, comfort assumptions, behavioural assumptions
Participation assumptions	Participation rate, actor groups involved, ownership or membership assumptions
Data inputs	Main data used, data quality, proxies
Policy and regulatory assumptions	Planning constraints, heritage rules, REC rules, grid constraints, procurement or funding assumptions
Governance assumptions	Responsible actors, coordination needs, decision mandates
Equity considerations	Possible distributional effects, affordability implications, vulnerable groups affected
Main uncertainties	Technical, financial, regulatory, social or institutional uncertainties
Expected outputs	CNC result, cost estimate, energy balance, qualitative interpretation, implementation implications
Related scenarios	Baseline, alternative scenario, refined scenario or combined pathway

Table A.8 — Scenario documentation sheet

Scenario	Main objective	Key assumptions	Main expected benefits	Main constraints	Key uncertainties	Possible interpretation
Baseline / current condition						
Scenario 1						
Scenario 2						
Scenario 3						
NOTE The “possible interpretation” column may be completed only after screening and collective discussion. It should not be treated as an automatic ranking.						

A.3.2 Scenario refinement questions

Users may consider the following questions when revising scenarios:

- Are the scenario boundaries clear and justified?

- Are technical assumptions documented in a way that other actors can understand?
- Are social, behavioural and participation assumptions explicit?
- Are sufficiency-related assumptions clearly distinguished from efficiency-related assumptions?
- Are policy, regulatory and heritage constraints visible?
- Are proxy assumptions proportionate to the decision being supported?
- Are equity risks and affordability concerns considered?
- Are scenarios comparable without hiding context-specific differences?
- Does the scenario require further technical modelling, stakeholder engagement or governance clarification?

A.4 Screening and Go / Refine / Pause prompt

A.4.1 General

This tool supports the interpretation of screening results and the documentation of decision rationales as reported in Table A.9. It is intended to help users connect carbon-related screening, complementary indicators, assumptions, uncertainties, governance considerations and equity concerns.

The Go / Refine / Pause decision logic is not a compliance mechanism. It does not define thresholds, automatic pass/fail criteria or formal approval procedures. It provides a structured way to discuss whether a scenario or pathway may proceed, should be refined or should be paused under current conditions.

Table A.9 — Screening summary sheet

Field	Illustrative content
Scenario or pathway ID	
Objective addressed	
CNC result or carbon-related insight	
Complementary indicators considered	Economic, technical, resilience, governance, participation, equity, implementation-readiness indicators
Key assumptions	
Data limitations	
Main trade-offs	Carbon performance, affordability, feasibility, participation, equity, timing
Governance concerns	Role clarity, administrative capacity, coordination, decision authority

Equity concerns	Distribution of costs and benefits, vulnerable groups, tenant/owner asymmetries, access to benefits
Interpretation	Narrative interpretation of evidence
Decision logic	Go / Refine / Pause
Follow-up action	
Review condition	

A.4.2 Decision logic guidance

A Go decision logic may be appropriate where the available evidence suggests that the scenario or pathway is sufficiently coherent with local objectives, supported by reasonable assumptions, compatible with relevant contextual conditions and sufficiently actionable for the next development phase.

A Refine decision logic may be appropriate where the scenario or pathway remains relevant but requires further clarification, adjustment or validation. Refinement may concern, for example, incomplete data, uncertain assumptions, unresolved costs, unclear governance arrangements, insufficient stakeholder alignment, equity concerns or implementation risks.

A Pause decision logic may be appropriate where critical issues prevent responsible progression at that stage. Pause should not be interpreted as definitive exclusion. It may indicate that preparatory action is needed before the scenario or pathway can be responsibly revisited.

Users may document the rationale for Go / Refine / Pause using the structure reported in Table A.10.

Table A.10 — Decision rationale prompt

Evidence considered	Main interpretation	Actor(s) involved	Uncertainty	Decision logic	Follow-up action
				Go / Refine / Pause	

Where actors disagree, the divergence should be documented rather than hidden. Different actors may assign different weight to carbon performance, affordability, technical feasibility, governance capacity or equity implications.

A.4.3 Trade-off reflection questions

- Does the scenario perform well technically but poorly in terms of affordability or equity?
- Does the scenario depend on actors who are not yet engaged or committed?
- Are vulnerable groups exposed to costs, disruptions or exclusion from benefits?
- Are results based on proxies that require validation before implementation?
- Are governance or administrative capacities sufficient for the next step?
- Would aggregation into a single score hide important tensions?

— What would need to change for a Refine or Pause decision logic to become Go?

A.5 Governance, participation and equity reflection prompt

A.5.1 General

This tool supports reflection on the governance (Table A.11), participation and equity (Table A.12) dimensions of PED Development Readiness. It may help users identify relevant actors, clarify roles, recognise participation barriers and document distributional implications.

The tool is not intended to prescribe a participation model. Engagement approaches should be adapted to local institutions, community dynamics, available resources, cultural context and the maturity of the PED process.

Table A.11 — Governance reflection table

Governance aspect	Questions for reflection	Possible evidence
Role clarity	Are responsibilities and mandates sufficiently clear?	Responsibility tables, meeting notes, institutional agreements
Coordination	Are technical, planning, social and institutional actors connected?	Coordination meetings, shared workplans, cross-sector groups
Decision-making	Who can decide what, and at which stage?	Formal mandates, decision logs, governance arrangements
Administrative capacity	Are staff, skills and time sufficient for the next phase?	Capacity assessment, workload review, technical assistance needs
Policy alignment	Is the PED pathway coherent with relevant plans and strategies?	SECAP/PAESC, urban plans, regeneration plans, climate strategies
Data governance	Are data access, sharing and responsibility arrangements clear?	Data-sharing agreements, data owners, privacy considerations
Continuity	Can governance arrangements survive beyond the initial project phase?	Long-term responsibilities, institutional anchoring, funding continuity

Table A.12 — Participation and inclusion prompt

Actor or group	Relevance to PED process	Participation barrier	Engagement channel	Safeguard or support measure	Status
		Time, trust, language, digital access, tenure, income, stigma, technical knowledge, institutional distance	Workshop, survey, intermediary, local meeting, school, association, online tool		

Users should consider not only which actors are powerful or formally responsible, but also which groups may be affected by decisions without having direct access to decision-making.

This prompt (Table A.13) may be used to support traceability, especially where decisions involve trade-offs between carbon performance, costs, participation, social acceptance and implementation feasibility.

Table A.13 — Decision transparency prompt

Decision or issue	Actors involved	Evidence considered	Concerns raised	How concerns were addressed	Remaining open points

A.5.2 Equity reflection questions

- Who may benefit from the proposed PED pathway?
- Who may bear costs, disruptions or risks?
- Are tenants and owners affected differently?
- Are low-income households able to access benefits?
- Could energy transition measures increase or reduce energy poverty?
- Are vulnerable or underrepresented groups involved in meaningful ways?
- Are financial mechanisms, incentives or compensations needed to avoid unfair burden shifting?
- Are social benefits considered alongside technical and economic benefits?
- Are equity concerns documented as decision-relevant, rather than treated as external issues?

A.6 Implementation Readiness and action planning prompt

A.6.1 General

This tool supports the transition from scenario interpretation to implementation-oriented planning (Table A.14). It may help users identify first movers, clarify responsibilities, define early actions, recognise dependencies and document implementation risks (Table A.15).

It does not prescribe a project management format or contractual structure. The level of detail should be adapted to the maturity and scale of the PED initiative.

Table A.14 — Implementation readiness check

Readiness dimension	Questions for reflection	Possible interpretation
Strategic coherence	Is the pathway aligned with local climate, energy, spatial and social objectives?	Ready / needs refinement / not yet ready
Technical feasibility	Are technical options sufficiently defined for the next step?	Ready / needs refinement / not yet ready
Administrative capacity	Are responsible public or institutional actors able to support progression?	Ready / needs refinement / not yet ready
Stakeholder commitment	Are first movers or key actors identified and sufficiently engaged?	Ready / needs refinement / not yet ready
Financial feasibility	Are funding needs, sources and affordability implications sufficiently understood?	Ready / needs refinement / not yet ready
Regulatory feasibility	Are relevant permissions, planning constraints and legal conditions sufficiently clear?	Ready / needs refinement / not yet ready
Equity safeguards	Are distributional risks and vulnerable groups considered?	Ready / needs refinement / not yet ready
Monitoring capacity	Can implementation be tracked and revised over time?	Ready / needs refinement / not yet ready
NOTE The purpose of this check is to identify refinement needs, not to produce a formal readiness score.		

Table A.15 — Action planning table

Action	Objective	Responsible actor	Supporting actors	Timeframe	Dependencies	Risks	Mitigation or support need
				Short / medium / long term			
NOTE Actions may include technical studies, data collection, stakeholder engagement, funding applications, governance arrangements, pilot interventions, regulatory clarification, capacity building or communication activities.							

Where appropriate, users may use a simple responsibility structure as reported in Table A.16.

Table A.16 — RACI-style responsibility prompt

Task or decision	Responsible	Accountable	Consulted	Informed
.....				
NOTE This table is illustrative. Users may adapt the categories or replace them with locally used responsibility formats.				

A.6.2 Quick wins and preparatory actions

Users may distinguish between different actions type as reported in Table A.17:

- quick wins, meaning feasible actions that can build trust, generate learning or unlock further engagement;
- preparatory actions, meaning actions needed before a scenario can responsibly progress;
- structural actions, meaning longer-term changes related to governance, funding, infrastructure or regulation.

Table A.17 — Actions type

Action type	Example	Purpose	Link to decision logic
Quick win	Awareness campaign, preliminary data-sharing agreement, small pilot	Build momentum and trust	May support Go or Refine
Preparatory action	Data improvement, stakeholder engagement, regulatory clarification	Reduce uncertainty	May move Pause or Refine towards Go

Structural action	Funding framework, governance agreement, infrastructure planning	Enable implementation	Supports long-term action planning
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A.7 Monitoring and feedback loop prompt

A.7.1 General

This tool supports monitoring, learning and adaptation during PED development. It may help users decide what should be monitored (Table A.18), who is responsible and how often information should be reviewed (Table A.19); how monitoring results may trigger updates to assumptions, scenarios or action plans (Table A.20).

The tool does not define mandatory indicators or reporting formats. Monitoring should be proportionate to the maturity, scale and objectives of the PED initiative.

Qualitative criteria may be appropriate where quantitative indicators are not available or not meaningful, especially for governance, participation, equity and institutional capacity.

Table A.18 — Illustrative monitoring dimensions

Monitoring dimension	Possible focus	Possible evidence
Technical and energy	Demand, generation, flexibility, storage, import/export balance	Metering, simulations, bills, technical records
Carbon-related	CNC variables, carbon factors, carbon-related assumptions	Updated calculations, emissions factors, scenario revisions
Economic and financial	Costs, affordability, funding, tariffs, investment conditions	Financial records, tariff updates, funding decisions
Implementation	Actions, milestones, quick wins, delays, dependencies	Action-plan records, progress reports
Governance	Coordination, role clarity, administrative capacity	Meeting notes, responsibility tables, institutional updates
Participation	Engagement continuity, feedback, trust, accessibility	Workshops, surveys, living lab notes, community meetings
Equity	Distributional of costs, access to benefits, inclusion of vulnerable groups, acknowledgement of diverse needs and vulnerabilities	Qualitative feedback, vulnerability data, affordability analysis
Assumptions and data	Proxies, data updates, uncertainty reduction	Assumption log, data-quality sheet
Learning and adaptation	Revisions, lessons, changes in strategy	Review notes, updated scenarios, adapted action plans

Table A.19 — Monitoring framework prompt

Monitoring objective	Dimension monitored	Indicator or qualitative criterion	Data source	Responsible actor	Frequency	Related assumption	Possible adaptation triggered

When monitoring results trigger review, users may document the feedback loop as follows:

Table A.20 — Feedback loop prompt

Triggering result or feedback	Affected process element	Assumption or scenario to update	Actors to involve	Action-plan change	Remaining uncertainty
	Clause 5 / 6 / 7 / 8 / 9 / 10 / 11				

A.7.2 Learning questions

- What changed compared with the initial assumption?
- Which scenario, action or decision is affected?
- Does the change require technical recalculation, stakeholder discussion or governance clarification?
- Does the change affect affordability, equity or participation?
- Should the decision logic be revised?
- Should the action plan be updated?
- What remains uncertain and should be monitored later?
- How should the change be communicated to technical, institutional and community actors?

A.7.3 Communication and reporting considerations

Users should consider adapting communication to different audiences. Technical actors may need detailed datasets and modelling assumptions. Public authorities may need decision summaries, risks and responsibilities. Community actors may need accessible explanations of what has changed, why it matters and how they can remain involved.

Communication should avoid overstating certainty. Where results are based on assumptions, proxies or incomplete data, this should be made clear. Transparent communication of uncertainty may support trust, informed participation and adaptive learning.

A.8 Use and adaptation of the supporting materials

The tools in this annex may be used separately or in combination. Users may consider starting with a simplified version and adding detail as the PED process matures.

For early-stage initiatives, it may be sufficient to document the initial scope, available data, main assumptions, key stakeholders and priority refinement needs.

For more mature initiatives, users may expand the tools to include detailed scenario sheets, structured screening summaries, implementation responsibility tables, monitoring frameworks and feedback loops.

In all cases, users should avoid treating the tools as formal compliance documents. Their value lies in supporting shared understanding, traceability, proportionality and context-sensitive decision-making.

Annex B (informative)

Case annexes Purpose and status

B.1 General

This annex provides concise and illustrative case annexes based on the four Citizens4PED Living Labs:

- San Paolo, Bari;
- La Roue, Brussels;
- Usquare, Brussels;
- Kahlenbergerdorf, Vienna.

The purpose of these case annexes is to show how the process-oriented guidance described in Clauses 5 to 11 may be interpreted in different urban, institutional, social and technical contexts. The cases are not intended to provide best practices, benchmarks, performance models or ready-to-copy solutions, nor do they provide comprehensive technical, financial or regulatory assessments. They are concise illustrations derived from project-based experience. Users seeking to apply lessons from these cases should consult local data, regulations, stakeholder conditions and implementation capacities before adapting any element.

The cases are based on the Citizens4PED project experience, including Living Lab monographs, energy transition frameworks, technical modelling activities, PED Action Plans and WP7 synthesis materials. The Citizens4PED Living Labs were explicitly developed in challenging contexts for just energy transitions, including social housing estates, heritage-constrained neighbourhoods, mixed-use redevelopment areas and contexts with fragmented ownership or governance arrangements.

The Citizens4PED Action Plan also notes that several aims could not be fully realised within the project timeframe, including comprehensive energy-hub deployment outside Usquare, complete data integration, uniform stakeholder coordination, regulatory harmonisation and measured proof of district-level carbon neutrality across all cases. This limitation reinforces the need to treat the cases as Development Readiness evidence rather than as final PED performance demonstrations.

The case annexes are:

- illustrative;
- non-binding;
- context-specific;
- not exhaustive descriptions of the Living Labs;
- not intended as certification examples;
- not intended to rank or compare the performance of the four areas;
- not intended to define replicable PED models independent of local conditions.

They should be read as practical evidence of how PED Development Readiness may depend on different combinations of data availability, stakeholder structures, governance capacity, regulatory constraints, technical options, social vulnerability, heritage conditions and implementation opportunities.

Each case annex follows the same compact structure:

- local context and PED entry point;
- data and assumptions;
- stakeholders and assets;
- scenario logic;
- screening and interpretation;
- governance, participation and equity;
- implementation readiness;
- monitoring and learning;
- transferability considerations.

This common structure is intended to support comparability without imposing uniformity. Each Living Lab differs in scale, maturity, available data, governance structure, technical focus and social context. For this reason, the same headings are used to make differences visible rather than to force cases into a standardised model.

B.2 San Paolo, Bari

B.2.1 Local context and PED entry point

San Paolo is a peripheral neighbourhood in Bari characterised by public housing, physical degradation, socio-economic vulnerability and a history of urban regeneration initiatives. The PED entry point is therefore not limited to technical optimisation, but is closely linked to just energy transition, public housing renewal, community engagement and the integration of PED-oriented actions into wider municipal and regional strategies.

In the Citizens4PED framework, San Paolo represents a case where PED Development Readiness depends on the capacity to connect energy transition objectives with urban regeneration, social inclusion, public-sector leadership and community-based activation. The area is relevant for testing how PED-oriented processes may be developed in contexts where social vulnerability, fragmented implementation capacity and public ownership structures strongly influence feasibility.

B.2.2 Data and assumptions

The San Paolo case relies on a combination of spatial, policy, stakeholder and technical inputs. Available evidence includes statistical and socio-economic descriptions, policy and regulatory analysis, stakeholder mapping, community mapping, energy modelling and scenario-related assumptions.

Technical modelling was affected by data limitations and by the need to use simplified or proxy-based inputs in some cases. The modelling work considered the Bari target area in relation to building power profiles and renewable energy scenarios, while the broader enabling framework considered the role of renewable energy communities, building renovation, public infrastructure and spatial strategy-making.

Key assumptions concern:

- the availability and quality of building-level energy data;
- the role of public housing buildings as possible starting points;
- the feasibility of REC-oriented development within the relevant electricity network configuration;
- the capacity of municipal and regional programmes to support renovation and energy transition;
- the degree to which vulnerable communities can be meaningfully engaged.

These assumptions should be documented transparently before using the case as a basis for further action.

B.2.3 Stakeholders and assets

Relevant actors include the Municipality of Bari, ARCA Puglia Centrale, Politecnico di Bari, local schools, parishes and parish-related community facilities, local NGOs, residents, public housing actors and other territorial stakeholders. The PED Action Plan identifies key stakeholders in Bari as the Municipality of Bari, ARCA Puglia Centrale, parish and schools, and local NGOs, with early actions including Living Lab activities in schools and parish spaces, REC groundwork, public-housing building identified as retrofit targets and street-lighting upgrades.

Key assets include:

- public housing stock;
- municipal and regional planning frameworks and related competences;
- existing social and educational infrastructures;
- potential public buildings or collective spaces;
- local institutional knowledge;
- university-based technical and facilitation capacity;
- possible alignment with regional and national funding streams.

The case shows that stakeholder and asset mapping should not be limited to energy actors. In vulnerable neighbourhoods, social intermediaries, schools, parishes and local associations may be essential for building trust and enabling participation.

B.2.4 Scenario logic

Scenario development in San Paolo may combine several PED-oriented pathways:

- deep renovation or energy upgrading of selected public housing buildings;
- renewable energy community development;
- photovoltaic deployment where feasible;
- heat pump or electrification-oriented scenarios;
- street-lighting and public infrastructure upgrades;

- integration with broader urban regeneration and mobility strategies.

The scenario logic is therefore modular rather than comprehensive. Instead of assuming one optimal PED configuration, the case supports the exploration of different combinations of energy demand reduction, local renewable production, public housing renovation, relevant social and community benefits and the capacity of institutional actors to support implementation.

B.2.5 Screening and interpretation

Screening in San Paolo should not be interpreted only through carbon or energy performance. The case requires complementary interpretation of:

- affordability;
- energy poverty risks;
- feasibility of public housing intervention;
- capacity of public actors to coordinate action;
- potential for community benefit;
- funding alignment;
- vulnerability and distributional effects.

A *Go* decision logic may be appropriate for limited, clearly scoped early actions supported by public actors and social intermediaries. A *Refine* decision logic may be appropriate for larger technical scenarios requiring better data, stronger governance or clearer funding. A *Pause* decision logic may be appropriate where interventions risk increasing injustice, imposing costs on vulnerable households or proceeding without adequate stakeholder involvement.

B.2.6 Governance, participation and equity

Equity is central in San Paolo. PED development may generate benefits only if energy transition measures are connected to affordability, housing quality, community empowerment and public-interest governance. Without safeguards, benefits could be unevenly distributed or fail to reach the most vulnerable groups.

Participation should therefore be structured through accessible and trusted local channels. Schools, parish spaces, local NGOs and public housing actors may act as intermediaries. Governance should clarify how public authorities, housing agencies, technical partners and community representatives contribute to decisions.

B.2.7 Implementation readiness

Implementation readiness depends on:

- public-sector coordination;
- alignment with municipal programming;
- access to regional, national or European funding;
- identification of first movers;
- availability of building-level and grid-related data;

- capacity to design measures that are socially acceptable and financially accessible.

Early actions should be realistic, visible and trust-building. Possible initial steps include pilot renovation actions, REC feasibility clarification, public-building energy actions, community workshops and structured data-sharing agreements.

B.2.8 Monitoring and learning

Monitoring should include not only technical and energy indicators, but also:

- participation continuity;
- affordability effects;
- perceived benefits;
- barriers to engagement;
- governance coordination;
- data improvements;
- lessons for public housing and vulnerable neighbourhoods.

A shared dashboard or periodic review process may help link implementation progress with social and institutional learning.

B.2.9 Transferability considerations

San Paolo is transferable mainly as an example of PED Development Readiness in socio-economically vulnerable and public-housing contexts. Its main transferable lesson is that PED development in such areas should be embedded in just transition, public-sector coordination and social infrastructure. It should not be transferred as a technical model or as a predefined REC solution.

B.3 La Roue, Brussels

B.3.1 Local context and PED entry point

La Roue is a garden-city neighbourhood in Anderlecht, Brussels, with a significant presence of social housing, heritage-related constraints and a strong local association. The PED entry point is linked to collective renovation, heating decarbonisation, possible energy sharing and the challenge of reconciling energy transition with heritage protection and household affordability.

The Living Lab monograph describes La Roue as a neighbourhood developed as a garden city, with dwellings dating mainly from the early twentieth century and a housing stock that no longer meets contemporary energy efficiency expectations.

B.3.2 Data and assumptions

The case combines qualitative evidence from residents and local actors, information on building typologies, energy-related constraints, social housing ownership, technical modelling and policy context. Data availability is uneven because of the mixed ownership structure, the diversity of housing conditions and the difficulty of obtaining complete building-level information.

Assumptions may concern:

- renovation depth;

- participation rates among homeowners and tenants;
- feasibility of façade insulation under planning or heritage constraints;
- potential connection to collective heating or district heating options;
- energy-sharing arrangements at building or low-voltage-grid scale;
- affordability of renovation for households.

The use of assumptions is particularly important because social willingness, ownership structure and planning rules may significantly affect feasibility.

B.3.3 Stakeholders and assets

Key actors include Collectif La Roue, Foyer Anderlechtois, the Municipality of Anderlecht, urban planning authorities, Bruxelles Environnement, residents, homeowners, tenants and nearby institutional or educational actors such as the Ceria campus. The Living Lab monograph identifies actors such as Collectif La Roue, Foyer Anderlechtois, Ceria Campus, the Urban Planning Department of the Municipality of Anderlecht, Urban.Brussels and Bruxelles Environnement.

Important assets include:

- an active local association;
- existing renovation interest;
- social housing stock;
- neighbourhood identity;
- potential collective renovation momentum;
- proximity to institutional energy consumers;
- policy frameworks for renovation and energy transition.

The case also shows that motivated local associations may be essential first movers, but they cannot alone overcome structural barriers related to cost, ownership, regulation and permitting.

B.3.4 Scenario logic

Scenario logic in La Roue may include:

- collective façade and roof renovation;
- building-level or group-level energy efficiency improvements;
- possible district heating or collective heating options;
- energy sharing within buildings or low-voltage-grid clusters;
- sufficiency-related assumptions related to heating demand;
- partial participation scenarios.

The scenario logic should explicitly account for heritage constraints, different ownership types and the difference between owner-occupied and social housing units. It may also consider phased participation, since full participation is unlikely at early stages.

B.3.5 Screening and decision logic

Screening should combine technical feasibility with planning constraints, affordability and participation realism. A technically attractive solution may require refinement if it depends on high participation rates, unresolved permits or unaffordable household investments.

A Go decision logic may apply to limited pilot actions, engagement activities or data clarification. A Refine decision logic may apply to collective renovation or heating scenarios that require more precise cost, participation and regulatory information. A Pause decision logic may apply where a pathway depends on planning permissions or ownership arrangements that are not yet clarified.

B.3.6 Governance, participation and equity

Participation is a defining feature of the La Roue case. However, participation is uneven across groups. Homeowners, social housing tenants, social housing companies, associations and public authorities may have different interests, capacities and constraints.

Equity issues include:

- different capacities to invest in renovation;
- tenant/owner asymmetries;
- possible exclusion of lower-income households from benefits;
- the risk that heritage-related restrictions increase renovation costs;
- the need to avoid shifting costs to households with limited financial capacity.

Governance should therefore support coordination between local initiative, housing actors and public authorities.

B.3.7 Implementation readiness

Implementation readiness is shaped by the ability to move from local motivation to coordinated action. Key readiness conditions include:

- clarification of planning and heritage constraints;
- technical and financial support for group renovation;
- engagement of social housing actors;
- funding mechanisms adapted to low- and middle-income households;
- definition of feasible pilot scales;
- support for local coordination.

B.3.8 Monitoring and learning

Monitoring should track both technical and social aspects:

- number and type of households engaged;

- renovation steps completed;
- permit-related bottlenecks;
- affordability barriers;
- energy demand assumptions;
- lessons from collective renovation processes;
- trust and continuity of local participation.

B.3.9 Transferability considerations

La Roue is transferable as an example of PED Development Readiness in heritage-sensitive, socially mixed residential areas where collective renovation and local association capacity are central. It should not be transferred as a standard model for district heating or group renovation, because feasibility depends strongly on ownership, heritage rules, funding and resident participation.

B.4 Usquare, Brussels

B.4.1 Local context and PED entry point

Usquare is a former barracks site in Brussels undergoing transformation into a mixed-use university and urban campus, including educational uses, student housing, public facilities and social housing components. The PED entry point is linked to redevelopment, mixed-use energy demand, institutional ownership, heritage-constrained retrofit, geothermal or district heating options, photovoltaic potential and campus-scale energy management.

Compared with the other Living Labs, Usquare presents a more institutionally structured redevelopment context. This can support coordination, data access and implementation, but also introduces dependencies on redevelopment phasing, institutional mandates and heritage constraints.

B.4.2 Data and assumptions

The Usquare case benefits from a relatively defined redevelopment framework and institutional actors, but it still requires assumptions concerning future uses, occupancy patterns, energy demand, technology choices, heating and cooling systems, photovoltaic deployment and interaction with neighbouring buildings.

Technical modelling considered retrofitted buildings, previous reliance on gas boilers and future heat-supply options including geothermal energy, CHP, gas boilers and network expansion possibilities.

Relevant assumptions may concern:

- future occupancy and mixed-use load profiles;
- energy demand from student housing, university spaces and public facilities;
- heritage-related technical constraints;
- availability of rooftops for PV;
- interaction between campus energy systems and adjacent areas;
- feasibility of energy community or shared energy arrangements.

B.4.3 Stakeholders and assets

Key actors include ULB and VUB, Société d'Aménagement Urbain, social housing companies, local associations, Ixelles municipality, technical partners and future users. The Living Lab monograph identifies SAU, the universities ULB and VUB, and social housing companies as central actors in the Usquare case.

Important assets include:

- institutional ownership and coordination capacity;
- planned redevelopment process;
- mixed-use energy profile;
- university expertise;
- possible district-scale energy infrastructure;
- potential PV surfaces;
- possible energy-management systems;
- public and social housing components.

B.4.4 Scenario logic

Scenario logic in Usquare may include:

- heritage-compatible retrofit;
- campus-scale energy management;
- geothermal and district heating options;
- PV integration;
- mixed-use load balancing;
- energy sharing between campus functions and nearby uses;
- sufficiency and demand-reduction assumptions.

The case is particularly relevant for exploring how PED-oriented thinking can be embedded in a major redevelopment process, where technical, institutional and spatial decisions are already structured through planning and project-management procedures.

B.4.5 Screening and decision logic

Screening in Usquare should consider carbon performance, cost, technical integration, phasing, institutional feasibility and interaction with neighbouring areas. Because of the campus structure, some actions may be more readily actionable than in fragmented residential contexts. However, heritage constraints, redevelopment timing and multi-actor governance still require careful interpretation.

A Go decision logic may apply where interventions are aligned with the redevelopment programme and supported by institutional actors. A Refine decision logic may apply where future occupancy, energy demand, technology mix or governance arrangements remain uncertain. A Pause decision logic may

apply where energy options depend on infrastructure or decisions outside the current redevelopment scope.

B.4.6 Governance, participation and equity

Governance in Usquare is more institutionally anchored than in some other cases, but participation and equity remain relevant. Future users, students, residents, social housing occupants and neighbouring communities may be affected differently by energy decisions.

Equity considerations include:

- integration of social housing within the energy transition strategy;
- affordability of energy services;
- access to benefits from shared energy systems;
- transparency of decisions affecting future users;
- relationship between campus governance and surrounding neighbourhoods.

B.4.7 Implementation readiness

Implementation readiness may be comparatively strong where technical decisions can be integrated into redevelopment planning. Key readiness conditions include:

- alignment with redevelopment phases;
- clear institutional responsibilities;
- data availability for future energy demand;
- integration of heritage-compatible solutions;
- coordination between universities, developers, public actors and housing providers;
- long-term governance of shared energy infrastructure.

B.4.8 Monitoring and learning

Monitoring should cover:

- energy performance of redeveloped buildings;
- actual versus assumed occupancy and demand profiles;
- performance of shared systems;
- user experience;
- affordability and access;
- lessons for campus-scale and mixed-use PED development.

B.4.9 Transferability considerations

Usquare is transferable as an example of PED Development Readiness in institutionally managed redevelopment areas with mixed uses and heritage constraints. Its transferability is stronger for campus, public-estate or large-scale redevelopment contexts than for fragmented residential neighbourhoods. It should not be treated as a model for contexts without comparable governance capacity or control over redevelopment phasing.

B.5 Kahlenbergerdorf, Vienna

B.5.1 Local context and PED entry point

Kahlenbergerdorf is a village-like neighbourhood in Vienna with heritage-protected buildings, mixed ownership and a strong focus on heat decarbonisation. The PED entry point is linked to the transition away from fossil gas, possible collective heating solutions, limited PV potential, local energy community options and the mobilisation of local owners and associations.

The case is relevant because it illustrates PED Development Readiness in a context where neighbourhood identity, ownership complexity, heritage protection and technical constraints strongly shape feasible pathways.

B.5.2 Data and assumptions

The Kahlenbergerdorf case includes technical data for district heating and electricity planning, including district heating network topology, building locations, peak power data and electricity demand for selected buildings. However, complete implementation depends on assumptions concerning building participation, ownership consent, heating demand, network feasibility, refurbishment levels and PV availability.

Relevant assumptions include:

- participation of building owners;
- technical feasibility of district heating or individual heat pump pathways;
- refurbishment timing;
- legal and ownership conditions for roof use;
- grid-level constraints for energy community options;
- long-term willingness to coordinate heat transition collectively.

B.5.3 Stakeholders and assets

Relevant actors include the local association Klimadörf, municipal services, RealityLab, e7, local owners and residents, professional experts, Vienna-related public actors, social housing bodies, the Catholic Parish, Abbey Klosterneuburg and infrastructure-related actors. The Living Lab monograph identifies Klimadörf, e7, RealityLab, REENAG, the City of Vienna, Gemeindebau Wien/Wiener Wohnen, the Catholic Parish, Abbey Klosterneuburg and Via Donau among the relevant actors.

Key assets include:

- active local association;
- strong local identity;

- previous research and roadmap activities;
- technical expertise;
- potential demonstration area;
- interest in collective heat transition.

The Living Lab monograph notes that decarbonisation efforts in the village have focused primarily on heating systems, with Klimadörf participating in projects aimed at technical, financial and organisational scenarios for transitioning away from gas.

B.5.4 Scenario logic

Scenario logic in Kahlenbergdorf may include:

- district heating network scenarios;
- individual heat pump scenarios, with or without PV;
- local energy community options;
- heat transition cooperative models;
- refurbishment-linked demand reduction;
- staged transition from pilot subareas to wider neighbourhood pathways.

The scenario logic should reflect both technical and ownership constraints. A technically promising collective heating solution may require refinement if ownership, financing, participation or governance conditions are not yet mature.

B.5.5 Screening and decision logic

Screening should combine technical performance, carbon implications, infrastructure feasibility, participation readiness, ownership complexity and heritage-related constraints. Because heat decarbonisation is central, interpretation should pay particular attention to the relationship between network solutions, individual systems and demand reduction.

A Go decision logic may apply to preparatory studies, engagement, pilot subareas or data improvement actions. A Refine decision logic may apply to collective heating or energy community pathways requiring better ownership, financing or participation clarification. A Pause decision logic may apply where infrastructure investment would depend on unresolved participation or legal conditions.

B.5.6 Governance, participation and equity

Governance depends on the ability to coordinate residents, owners, municipal actors, experts and potential energy-service providers. Local association capacity is a key strength, but it needs institutional and technical support.

Equity considerations include:

- capacity of different owners or residents to invest;
- distribution of costs and benefits in collective heating schemes;
- risks for social housing or lower-income residents;

- fair participation in decision-making;
- long-term affordability of heating transition.

B.5.7 Implementation readiness

Implementation readiness depends on:

- clarity of ownership and decision rights;
- technical feasibility of heat network or alternative solutions;
- financial models for collective investment;
- municipal and expert support;
- alignment with funding calls and legal frameworks;
- stepwise demonstration opportunities.

The PED Action Plan identifies first movers as municipal services, RealityLab and local owners or associations, with early actions including REC option mapping, EPB pathway identification, community engagement and a vision workshop of the local association Klimadörfli .

B.5.8 Monitoring and learning

Monitoring should address:

- participation of owners and residents;
- evolution of heat demand assumptions;
- feasibility of network or heat pump pathways;
- funding and regulatory changes;
- social acceptance;
- progress of demonstration or roadmap actions.

Monitoring should support adaptive decision-making, especially where investment decisions depend on gradual trust-building and participation.

B.5.9 Transferability considerations

Kahlenbergerdorf is transferable as an example of PED Development Readiness in heritage-sensitive, mixed-ownership contexts where heat transition is the main technical driver. Its main transferable lesson is the importance of combining technical scenarios with ownership analysis, local association capacity and stepwise governance arrangements. It should not be transferred as a universal heat-network model.

B.6 Cross-case synthesis

B.6.1 General

The four Citizens4PED cases (Table B.1) illustrate different PED Development Readiness conditions. Their value lies not in showing a single successful model, but in making visible how PED-oriented processes need to adapt to local social, institutional, spatial and technical conditions.

Table B.1 — Cross-case synthesis

Case	PED entry point	Main data and assumption issue	Main stakeholder condition	Main scenario logic	Key governance/ equity issue	Transferability insight
San Paolo, Bari	Just energy transition, public housing, urban regeneration, REC-oriented development	Incomplete building-level data; need for proxy assumptions and public-sector coordination	Municipality, ARCA, schools, parish, NGOs, university and residents	Modular pathways combining retrofit, REC, public infrastructure and regeneration	Energy poverty, affordability, vulnerable groups, public housing governance	Useful for vulnerable neighbourhoods and public-housing contexts
La Roue, Brussels	Collective renovation, heritage-sensitive retrofit, possible energy sharing and heating transition	Participation rates, household affordability, heritage and planning constraints	Local association, social housing company, municipality, residents and public authorities	Collective renovation, partial participation, energy sharing, heating options	Tenant/owner asymmetries, affordability, heritage-related cost barriers	Useful for garden-city and heritage-constrained residential areas
Usquare, Brussels	Mixed-use redevelopment, campus-scale energy management, heritage retrofit	Future occupancy, mixed-use demand, technology mix and phasing	Universities, SAU, social housing companies, municipality and future users	Campus-scale energy systems, geothermal/district heating, PV, load management	Integration of future users, social housing and neighbouring areas	Useful for institutionally managed redevelopment and campus contexts
Kahlenbergdorf, Vienna	Heat decarbonisation, local association, mixed ownership, heritage context	Ownership consent, heating demand, PV limits, participation in collective solutions	Klimadörf, municipal actors, technical experts, owners, parish and other local actors	District heating, heat pumps, REC options, staged heat transition	Fair cost distribution, ownership complexity, long-term affordability	Useful for heritage-sensitive and mixed-ownership heat transition contexts

B.6.2 Cross-case observations

The cases suggest several cross-cutting observations relevant to PED Development Readiness:

- PED development is shaped by institutional, social and spatial conditions as much as by technology.
- Data limitations are common and should be documented rather than hidden.

- Proxy assumptions can support early-stage decision-making when they are transparent and proportionate.
- Local associations and intermediaries may be critical, but they require institutional and technical support.
- Heritage constraints may affect both technical feasibility and affordability.
- Social housing and vulnerable households require explicit equity safeguards.
- Mixed-use and institutionally managed areas may offer stronger implementation capacity, but still require attention to participation and long-term governance.
- Scenario comparison should support collective interpretation, not automatic ranking.
- Monitoring should include governance, participation and equity dimensions, not only energy and carbon performance.

The case annexes may support the interpretation of the technical clauses as reported in Table B.2.

Table B.2 — Relationship with Clauses 5 to 11

CWA clause	Case-based interpretation
Clause 5 — Development Readiness Integration Workflow	The cases show that PED readiness follows different entry points: public housing, collective renovation, redevelopment or heat transition.
Clause 6 — Context Kit	The cases illustrate the need to document spatial, social, policy, technical and stakeholder conditions together.
Clause 7 — Scenario Builder	The cases show that scenarios should reflect local constraints, participation assumptions and implementation pathways.
Clause 8 — Screening Metrics and Decision Criteria	The cases show that CNC and complementary indicators need collective interpretation and should not be treated as compliance thresholds.
Clause 9 — Governance, Participation and Equity	The cases confirm that equity, participation and governance are transversal readiness conditions.
Clause 10 — Implementation Readiness	The cases show that action planning depends on roles, capacity, funding, phasing and first movers.
Clause 11 — Monitoring, Learning and Adaptation	The cases show that monitoring should support feedback, assumption revision and adaptive planning.

Annex C (informative)

Glossary and informative mapping

C.1 Purpose and status of this annex

This annex provides an extended glossary, a list of acronyms and abbreviations, and informative mappings intended to support the interpretation and use of this CWA.

The annex is informative. It does not introduce requirements, mandatory definitions, compliance criteria, thresholds, benchmarks or certification rules. The terms and mappings included in this annex are intended to improve readability, support interdisciplinary communication, clarify relationships with Citizens4PED outputs and help users understand how this CWA relates to selected standards, initiatives, tools and guidance documents.

The glossary in this annex is broader than the terms and definitions included in Clause 3. Clause 3 contains the core terms needed for the application of the CWA. This annex provides additional explanatory entries and contextual notes, where useful, especially for interdisciplinary users.

The informative mappings included in this annex:

- support traceability between Citizens4PED outputs and the CWA clauses;
- clarify possible interfaces with related standards, guidance documents, research projects and technical bodies;
- avoid duplication of existing standards, labels, certification schemes or regulatory frameworks;
- do not create normative references or obligations.

All references to standards, initiatives, tools, labels, assessment schemes or research projects are informative.

C.2 Extended glossary

C.2.1 Positive Energy District-related concepts

Positive Energy District (PED)

Urban area or district-scale transformation process aiming to combine high energy efficiency, energy flexibility, local renewable energy production and broader social, economic, environmental and governance objectives. In this CWA, the term is used in a process-oriented and context-sensitive way, focusing on PED Development Readiness rather than on certification or fixed performance thresholds. The Cities4PEDs definition work also highlights that PED definitions need to address system boundaries, energy services, weighting systems and context-sensitive targets .

PED Development Readiness

Capacity of a local context to meaningfully progress through PED development phases by clarifying objectives, assumptions, data conditions, stakeholder roles, governance arrangements, scenario logic, screening interpretation, implementation constraints and monitoring needs. Development Readiness does not indicate that a PED has already been achieved. It indicates that the process conditions for responsible progression have been considered.

PED boundary

Spatial, functional, technical or organisational delimitation used to frame a PED process or assessment. Boundaries may refer to buildings, public spaces, infrastructures, energy flows, ownership structures, grid connections, social groups or governance arrangements. Boundaries should be documented transparently, especially where they affect interpretation of results.

System boundary

Boundary defining which energy services, energy flows, infrastructures or activities are included in a PED-related analysis. System boundaries may be spatial, functional or temporal. Cities4PEDs distinguishes spatial and functional boundaries and notes that functional boundaries may include operational energy, user electricity, mobility or embodied energy depending on the adopted approach .

Functional system boundary

Definition of the energy functions or uses included in an assessment, such as heating, cooling, domestic hot water, lighting, plug loads, mobility or other services. A functional boundary may differ from a purely geographical boundary.

Spatial boundary

Physical or territorial perimeter used to define the area considered in a PED process. It may follow administrative limits, neighbourhood boundaries, redevelopment areas, energy network areas or project-specific perimeters.

Temporal boundary

Time horizon or aggregation period used for assessment, monitoring or scenario comparison. It may refer to hourly simulation, annual balance, project phases, implementation milestones or monitoring cycles.

PED entry point

Initial reason, opportunity or challenge through which a local context enters a PED process. Examples include public housing renovation, heat decarbonisation, energy community development, campus redevelopment, urban regeneration, heritage-compatible retrofit or climate-neutrality planning.

PED pathway

Context-specific sequence of actions, assumptions, scenarios, governance arrangements and implementation steps through which a district may progress towards PED-related objectives.

PED Action Plan

Implementation-oriented document or process that translates PED objectives and scenarios into actions, responsibilities, timelines, risks, dependencies, monitoring arrangements and learning mechanisms.

C.2.2 Development Readiness and process concepts

Development Readiness workflow

Structured but adaptable sequence of phases supporting PED development, including scoping, context analysis, objective setting, scenario development, screening, implementation readiness, monitoring and learning.

Decision checkpoint

Moment in the process where available evidence, assumptions, stakeholder inputs and constraints are reviewed to decide whether to proceed, refine or pause a scenario, pathway or action.

Go / Refine / Pause

Interpretive decision logic used in this CWA to support transparent discussion of scenario or pathway readiness.

- Go indicates that a scenario or action may proceed to the next phase under current conditions.
- Refine indicates that further clarification, adjustment, data collection, stakeholder engagement or technical analysis is needed.
- Pause indicates that current conditions are not sufficient for responsible progression, although the option may be revisited later.

This decision logic is not a pass/fail compliance system and does not define thresholds.

Assumption

Statement used to support analysis, scenario building or decision-making where complete evidence is unavailable or where future conditions are uncertain. Assumptions may concern energy demand, user behaviour, participation rates, technology costs, regulation, carbon factors, funding or governance capacity.

Assumption log

Structured record of assumptions, sources, uncertainty levels, affected scenarios and review conditions.

Assumption update

Revision of an assumption based on new data, stakeholder feedback, monitoring results or changed contextual conditions.

Traceability

Capacity to reconstruct how a decision, scenario, assumption or recommendation was developed, including data sources, actors involved, reasoning and unresolved uncertainties.

Decision rationale

Explanation of why a specific decision, interpretation or recommendation was made, including the evidence considered and the trade-offs identified.

Trade-off

Situation in which improvement in one dimension, such as carbon reduction, cost reduction, social acceptability or technical feasibility, may create limitations or risks in another dimension.

Transferability

Capacity of an approach, lesson, process element or tool to inform other contexts, with adaptation. Transferability does not imply direct replication.

Replication

Application of an approach, process or solution in another context. In this CWA, replication should be adaptive and context-sensitive rather than automatic.

C.2.3 Data, modelling and scenario concepts

Context Kit

Structured collection of spatial, technical, social, economic, policy, institutional and stakeholder information used to frame PED Development Readiness.

Data quality

Degree to which data are reliable, suitable and sufficiently documented for their intended use. Data quality may depend on source, resolution, completeness, update frequency, calibration and local validity.

Proxy

Substitute data, assumption or estimate used when direct data are unavailable. Proxies should be documented, justified and reviewed when better data become available. WP7 materials identified data proxies and participatory methods for data-poor settings as an emerging priority for PED guidance .

Data gap

Missing, incomplete, inaccessible or insufficiently reliable information that may affect scenario development, screening or implementation.

Scenario

Structured representation of a possible PED pathway or configuration, including assumptions, boundaries, technologies, demand-side conditions, stakeholder participation, governance arrangements and expected outcomes.

Scenario builder

Process or tool used to define, compare and refine alternative PED scenarios.

Scenario logic

Rationale explaining why a scenario has been constructed in a given way, including objectives, assumptions, constraints and expected implications.

Scenario comparison

Structured comparison of different scenarios across technical, economic, carbon-related, governance, participation, equity and implementation-readiness dimensions.

Scenario update

Revision of a scenario based on new data, stakeholder input, screening interpretation, implementation constraints or monitoring results.

Techno-economic model

Analytical model used to explore technical and economic aspects of energy systems, such as demand, supply, renewable generation, storage, costs or optimisation options. In Citizens4PED, WP3 developed and updated modelling tools and scenario-based analyses to support PED-related decision-making.

Simulation result

Output generated by a model or simulation tool. Simulation results should be interpreted in relation to assumptions, input data, modelling scope and uncertainty.

Optimisation

Analytical process used to identify preferable configurations according to selected objectives or constraints, such as cost, emissions, energy balance or technical feasibility.

Pareto front

Set of solutions in which improvement in one objective cannot be achieved without worsening another objective. In PED processes, Pareto-based outputs should support interpretation of trade-offs rather than automatic selection.

C.2.4 Screening and indicator concepts

Screening

Structured interpretation of a scenario, pathway or option using selected metrics, qualitative criteria, assumptions and contextual considerations. Screening supports decision-making but does not constitute certification.

Screening metric

Indicator or criterion used to support screening. Screening metrics may be quantitative or qualitative.

Carbon Neutrality Check (CNC)

Carbon-related screening approach used to support interpretation of PED scenarios or pathways. In this CWA, CNC is treated as a decision-support input, not as a certification criterion or mandatory threshold.

Complementary indicators

Additional indicators or criteria used alongside carbon-related screening to interpret economic, technical, social, governance, resilience, participation, equity or implementation aspects.

Indicator family

Group of related indicators addressing a common dimension, such as carbon, cost, energy, governance, participation or equity.

KPI

Key performance indicator. In this CWA, KPIs may support local interpretation where appropriate, but the CWA does not standardise KPIs or impose mandatory KPI sets.

Transparent KPI selection

Process through which users document why certain indicators were selected, how they are used and what limitations they have.

KPI standardisation

Formal definition of fixed indicators, methods or thresholds for uniform application. This CWA does not provide KPI standardisation.

Composite score

Aggregated score combining multiple indicators. Composite scores may support communication, but should be used carefully because they may hide trade-offs, uncertainty or equity concerns.

Affordability

Extent to which households, institutions or stakeholders can bear costs associated with PED actions without disproportionate burden or exclusion from benefits.

Implementation feasibility

Degree to which a scenario or action can realistically be implemented considering technical, financial, administrative, legal, institutional and social conditions.

Governance feasibility

Degree to which the actors, mandates, coordination mechanisms and institutional capacities required for implementation are available or can be developed.

Equity risk

Possibility that a PED action or pathway may distribute costs, benefits, risks or decision-making power unfairly.

C.2.5 Governance, participation and equity concepts**Governance arrangement**

Set of actors, responsibilities, decision-making procedures, coordination mechanisms and institutional conditions shaping the PED process.

Stakeholder

Individual, organisation or group that can affect, be affected by or contribute to a PED process.

Formal stakeholder

Actor with an official mandate, ownership role, legal responsibility, administrative function or formal decision-making power.

Informal stakeholder

Actor without formal mandate but with relevant knowledge, influence, lived experience, social legitimacy or local presence.

First mover

Actor ready or able to initiate early action, provide resources, test a measure, share data, mobilise others or support trust-building.

Participation

Involvement of stakeholders, citizens or affected groups in the PED process. Participation may include information, consultation, co-design, co-creation, deliberation, implementation or monitoring.

Citizen involvement

Forms of participation specifically involving residents, users, communities or local civil society actors.

Co-creation

Collaborative process through which different actors jointly define problems, objectives, scenarios, actions or evaluation criteria.

Living Lab

Real-life environment where stakeholders, users and project partners explore, test, discuss or co-develop PED-related processes, actions or scenarios.

Social justice

Principle concerned with reducing inequalities in access to resources, opportunities, benefits and decision-making. D1.1 frames social justice in relation to fair rules for mutual interaction, collective action against inequalities, support for marginalised individuals and proportionality in contribution to carbon reduction efforts.

Equity

Fair distribution of benefits, costs, risks, opportunities and decision-making influence across social groups, territories and generations.

Procedural equity

Fairness in access to information, participation, representation and decision-making processes.

Distributional equity

Fairness in the distribution of costs, benefits, burdens and opportunities resulting from PED-related actions.

Energy poverty

Condition in which households have difficulty securing adequate energy services, such as heating, cooling, lighting or electricity, at affordable cost.

Just transition

Transition process that addresses climate and energy objectives while considering social justice, fairness, vulnerability, distributional impacts and inclusion.

Vulnerable group

Group that may be more exposed to energy poverty, exclusion, cost burdens, climate risks or limited adaptive capacity.

Underrepresented group

Group whose interests, needs or knowledge may be insufficiently reflected in formal decision-making or technical processes.

Social housing

Housing provided, owned, managed or regulated to support access to affordable housing for eligible groups. In PED processes, social housing may be a key implementation context and equity concern.

Commons

Resource or system governed collectively according to shared rules, responsibilities and benefits.

Energy community

Collective arrangement through which citizens, public authorities, small businesses or other actors cooperate in energy production, sharing, consumption, storage or management, depending on the applicable regulatory framework.

Renewable Energy Community (REC)

Energy community based on renewable energy sources and defined by applicable European, national or local regulations.

Benefit-sharing

Arrangement through which economic, social, environmental or energy-related benefits are distributed among participants or affected communities.

Public-interest safeguard

Measure intended to prevent PED actions from generating unfair burdens, exclusion, speculative effects or loss of public value.

C.2.6 Implementation, monitoring and learning concepts**Implementation readiness**

Capacity to translate scenarios or pathways into actionable steps, considering roles, responsibilities, funding, administrative capacity, regulatory feasibility, stakeholder commitment, risks and monitoring.

Action planning

Degree to which a recommendation, pathway or scenario can be translated into concrete actions.

Action-plan revision

Update of an action plan based on new evidence, changed assumptions, monitoring results, stakeholder feedback or implementation barriers.

Quick win

Early, feasible action that can generate visible progress, trust, learning or momentum without requiring full implementation of the PED pathway.

Risk register

Structured record of risks, affected actions, likelihood, impact, responsible actors and mitigation measures.

Monitoring

Process of collecting, reviewing and interpreting information during PED development or implementation.

Monitoring dimension

Area to be monitored, such as technical performance, carbon-related outcomes, cost, participation, governance, equity, implementation progress or learning.

Qualitative monitoring

Monitoring based on narrative, participatory, observational or interpretive evidence rather than only numerical indicators.

Process monitoring

Monitoring of how the PED process is progressing, including governance, participation, coordination, decision-making and learning.

Implementation monitoring

Monitoring of action-plan progress, milestones, delays, responsibilities, dependencies and risks.

Learning loop

Process through which monitoring results, feedback and experience are used to revise assumptions, scenarios, actions or governance arrangements.

Feedback loop

Mechanism through which information generated during one phase of the PED process is returned to earlier or parallel phases for review and adaptation.

Adaptive roadmap

Implementation pathway designed to be updated over time as conditions, data, actors and opportunities change.

Lesson learned

Insight derived from project experience, monitoring, stakeholder feedback or implementation practice that may inform future action or transferability.

Living Lab continuity

Capacity to maintain engagement, learning and coordination beyond a single project activity, workshop or funding phase.

C.3 Acronyms and abbreviations

Table C.1 — Informative mapping of acronyms and abbreviations

Acronym	Meaning
CEN	European Committee for Standardization
CENELEC	European Committee for Electrotechnical Standardization

CCMC	CEN-CENELEC Management Centre
CWA	CEN Workshop Agreement
CNC	Carbon Neutrality Check
D	Deliverable
DSO	Distribution System Operator
DH	District Heating
DHN	District Heating Network
EPB	Energy Performance of Buildings
EPC	Energy Performance Certificate
EU	European Union
GHG	Greenhouse Gas
GIS	Geographic Information System
HP	Heat Pump
ICT	Information and Communication Technology
KPI	Key Performance Indicator
LL	Living Lab
LCA	Life Cycle Assessment
OPEX	Operational Expenditure
CAPEX	Capital Expenditure
PAESC	Piano d'Azione per l'Energia Sostenibile e il Clima
PED	Positive Energy District
PV	Photovoltaic
REC	Renewable Energy Community
RES	Renewable Energy Source(s)
SECAP	Sustainable Energy and Climate Action Plan
SET Plan	Strategic Energy Technology Plan
SoA	State of the Art

SUMP	Sustainable Urban Mobility Plan
WP	Work Package

C.4 Informative mapping of Citizens4PED deliverables to CWA clauses

This mapping supports traceability between Citizens4PED outputs and the structure of this CWA. It does not imply that the deliverables are normative references. Each deliverable is used as project-based evidence, methodological background or illustrative source.

Table C.2 — Informative mapping of concepts to Citizens4PED sources and CWA clauses

Citizens4PED source	Main contribution to the CWA	Related CWA clauses / annexes
D1.1 — Common language	Shared terminology on social justice, energy transition, participation, living labs, techno-economic model, energy poverty, just transition, sufficiency, PED, commons and related concepts	Clause 3; Clause 9; Annex C
D3.1 — Updated techno-economic model	Modelling background, technical features, energy system variables and techno-economic model development	Clauses 6, 7 and 8; Annex A
D3.2 — Multidisciplinary inputs considered in the model	Data inputs, technical assumptions, living lab modelling conditions and multidisciplinary model framing	Clauses 6 and 7; Annex A; Annex B
D3.3 — Description of the studied scenarios for each case	Scenario descriptions for the Living Labs and scenario-building evidence	Clause 7; Annex A; Annex B
D3.4 — Final simulation results	Simulation outputs, technical interpretation and scenario-related evidence	Clauses 7 and 8; Annex B
D3.5 — Pareto optimisation report	Pareto optimisation, CNC-related reasoning, trade-off interpretation, sufficiency-related modelling and stakeholder decision-support	Clauses 7 and 8; Annex A
D4.1 — Statistical description of the four Living Labs	Socio-economic, demographic, building, energy-price and climatic context data for the Living Labs	Clause 6; Clause 9; Annex B
D4.3 — Living Lab monographs	Local context, actors, planned projects, participation experience, challenges and replicability issues	Clauses 6 and 9; Annex B
D5.1 — Energy transition frameworks in the four target areas	Policy Canvas, Community Map, stakeholder analysis, enabling framework and policy-regulatory context	Clauses 6, 9 and 10; Annex B

Citizens4PED source	Main contribution to the CWA	Related CWA clauses / annexes
D5.2 — White paper on integration of PED Action Plans within spatial strategy-making	Spatial strategy integration, policy linkages, transition pathways and just energy/climate transition framing	Clauses 6, 9 and 10; Annex B
D6.1 — PED Action Plans for the four target areas	Implementation logic, first movers, enabling environment, action plans, monitoring, feedback loops and adaptive roadmaps	Clauses 10 and 11; Annex B
D7.1 — Guidelines for PEDs' planning, design, implementation and monitoring	Main conceptual and procedural basis for modular, flexible, context-sensitive and non-prescriptive PED guidance	Whole CWA; Annex A; Annex C
D7.2 — CEN CWA Project Plan and Proposal on PEDs	CWA scope, process rationale, pre-standardisation positioning and relationship between Citizens4PED outputs and CWA development	Introduction; Scope; Annex C
WP7 Questionnaire Analysis materials	Cross-WP synthesis, lessons learned, standards references, integration issues, decision-making and CWA proposal reflections	Clauses 5 to 11; Annex A; Annex C
KOM slides and Meeting #1 slides	Workshop positioning, Development Readiness framing, consultation roadmap, CWA scope, annex logic and decision process	Introduction; Scope; Clauses 5 to 11; Annexes A–C
Approved CEN CWA Project Plan	Official CWA title, scope, proposer, CEN/TC 465 relationship and non-conflict positioning	European Foreword; Scope; Annex C
Cities4PEDs WP2 PED Definition	Complementary source on PED definition, system boundaries, positive energy balance, context factors and definition challenges	Clause 4; Clause 3; Annex C

C.5 Informative mapping of concepts to Citizens4PED sources and CWA clauses

This mapping (Table C.3) helps users locate where selected concepts are mainly addressed in Citizens4PED materials and where they are used in the CWA.

Table C.3 — Informative mapping of concepts to Citizens4PED sources and CWA clauses

Concept	Main Citizens4PED source	Related CWA clause / annex
PED Development Readiness	D7.1; D7.2; WP7 materials	Introduction; Scope; Clause 5
Development Readiness workflow	D7.1; WP7 materials	Clause 5; Annex A

Concept	Main Citizens4PED source	Related CWA clause / annex
Context Kit	D4.1; D4.3; D5.1	Clause 6; Annex A
Data quality and proxy use	D3.2; D4.1; WP7 materials	Clause 6; Annex A
Scenario Builder	D3.3; D3.4; D3.5	Clause 7; Annex A
Scenario assumptions	D3.2; D3.3; D3.5	Clauses 6 and 7; Annex A
Carbon Neutrality Check	D3.5	Clause 8; Annex A
Pareto optimisation	D3.5	Clause 8; Annex C
Complementary indicators	D4.1; D5.1; D6.1	Clause 8
Go / Refine / Pause	D7.1; KOM and Meeting #1 materials	Clauses 5 and 8; Annex A
Governance arrangements	D5.1; D6.1	Clause 9
Participation / citizen involvement	D1.1; D4.3; WP7 materials	Clause 9; Annex B
Social justice	D1.1	Clause 9; Annex C
Energy poverty	D1.1; D4.1; D5.1	Clause 9; Annex B
Just transition	D1.1; D5.1; D5.2	Clause 9; Annex B
Policy Canvas	D5.1	Clauses 6, 9 and 10
Community Map	D5.1	Clauses 6 and 9
Enabling Framework	D5.1; D6.1	Clauses 9 and 10
First movers	D6.1	Clauses 9 and 10
Implementation readiness	D6.1; D7.1	Clause 10; Annex A
Action plan	D6.1	Clause 10; Annex B
RACI / responsibility allocation	D6.1; KOM materials	Clause 10; Annex A
Monitoring and learning	D6.1; D7.1	Clause 11; Annex A
Feedback loops	D6.1; WP7 materials	Clause 11; Annex A
Adaptive roadmap	D6.1	Clauses 10 and 11
Transferability lesson	D7.1; D5.2; D6.1	Annex B; Clause 11

C.6 Informative mapping of related references, tools and initiatives

This mapping (Table C.4) provides an indicative overview of external standards, frameworks, tools, initiatives and technical bodies that may be relevant to PED Development Readiness. The mapping is not exhaustive and does not establish normative references.

The WP7 questionnaire and related materials identified several standards and frameworks as useful background, including ISO 50001, ISO 37120, klimaaktiv, LEED for Communities, BREEAM Communities, Protocollo ITACA, GBC Quartieri, GSE and Italian CER-related guidance, while also highlighting the need to make standards more usable for urban stakeholders. The v0.9 draft already anticipates Annex C as a glossary and informative mapping to related standards, initiatives and guidance documents, including energy management and city-indicator standards, neighbourhood assessment schemes, national implementation frameworks and relevant technical bodies.

Table C.4 — Informative mapping of relevant references, tools, and initiatives

Reference, tool or initiative	Main focus	Possible relevance to this CWA	Relationship with this CWA
ISO 50001	Energy management systems	Provides background on energy management approaches and continuous improvement	Informative; not replaced or duplicated
ISO 37120	City indicators and urban services	Relevant to city-level data, indicators and monitoring considerations	Informative; not used as mandatory indicator set
ISO 37101	Sustainable development in communities — management systems	Relevant to sustainable community governance and management-system thinking	Informative; this CWA does not create a management system
ISO 37104	Practical guidance for implementing ISO 37101	Relevant to local implementation and community-scale sustainability processes	Informative; not required for CWA use
CEN/TC 465	Sustainable Cities and Communities	Relevant European technical body for sustainable cities and communities	Institutional interface; no duplication
ISO/TC 268	Sustainable Cities and Communities	Related international standardisation context	Informative interface
IEC SyC Smart Cities	Smart city systems and interoperability	Relevant for smart city systems, data and interoperability considerations	Complementary standardisation context
SET Plan Action 3.2 PED framework	European PED policy and research framing	Provides high-level PED reference background	Informative conceptual reference

Reference, tool or initiative	Main focus	Possible relevance to this CWA	Relationship with this CWA
JPI Urban Europe PED materials	PED research, experimentation and policy alignment	Supports understanding of the European PED landscape	Informative
SCIS Positive Energy Districts Solution Booklet	Practical PED-oriented guidance and project-based knowledge	Useful as a management-oriented support resource for cities and practitioners	Informative; not duplicated
MAKING-CITY	PED methodologies, toolkit and case-based guidance	Provides PED development resources and adoption-oriented materials	Informative project reference
ATELIER	PED demonstration and replication experience	Provides evidence from PED demonstration and replication processes	Informative project reference
ARV	Climate-positive circular communities	Provides project-based experience on climate-positive districts and communities	Informative project reference
IEA EBC Working Group on Cities and Communities	Urban energy transition, decision support and system integration	Relevant for dynamic decision contexts and cross-domain coordination	Informative background
klimaaktiv	Austrian energy and sustainability assessment/declaration framework	Relevant as a national implementation and assessment experience	Informative; not duplicated
LEED for Communities	Community-scale sustainability assessment	Relevant to neighbourhood/community sustainability assessment	Informative; not a compliance route for this CWA
BREEAM Communities	Community-scale sustainability assessment	Relevant to urban development sustainability assessment	Informative; not duplicated
GBC Quartieri	Neighbourhood-scale sustainability assessment	Relevant to Italian neighbourhood sustainability assessment experience	Informative; not duplicated
Protocollo ITACA at urban scale	Sustainability assessment in the built environment	Relevant to environmental and territorial assessment approaches	Informative

Reference, tool or initiative	Main focus	Possible relevance to this CWA	Relationship with this CWA
Italian GSE / CER guidance	Renewable energy communities and energy sharing	Relevant to energy community implementation in Italy	Informative; context-dependent
National and regional REC frameworks	Energy community regulation	Relevant where PED processes interact with community energy models	Informative; users should consult applicable local law
SECAP / PAESC	Sustainable Energy and Climate Action Plans	Relevant for alignment between PED pathways and municipal climate-energy planning	Informative planning interface
SUMP	Sustainable Urban Mobility Plan	Relevant where mobility, public space or transport-related energy use is considered	Informative planning interface
Urban regeneration plans	Local spatial and regeneration strategies	Relevant for aligning PED actions with urban transformation processes	Context-specific planning interface
Cities4PEDs WP2 PED Definition	PED definition, system boundaries, balance targets, context factors	Useful complementary source for PED definition and boundary issues	Informative complementary source

C.7 Relationship between Clause 3 and Annex C

Clause 3 and Annex C have different functions.

Clause 3 provides concise definitions of the essential terms used in the body of this CWA. It should remain short, operational and limited to terms needed to avoid ambiguity in applying the guidance.

Annex C provides extended explanations, acronyms and informative mappings. It may include broader terms, contextual explanations and relationships with Citizens4PED deliverables or external references. Annex C should therefore be used as a reading and orientation support, not as a normative vocabulary.

To avoid duplication:

- Clause 3 should define only the core terms required for the interpretation of the CWA;
- Annex C should provide additional explanatory entries and contextual notes;
- terms appearing only in Annex C should not automatically be treated as normative terms;
- future revisions of the CWA may move selected terms from Annex C to Clause 3 only where they become essential for the application of the document.

C.8 Use of the informative mappings

The mappings in this annex may support:

- users seeking to trace the origin of CWA concepts in Citizens4PED outputs;
- readers wishing to understand how different clauses relate to project deliverables;
- CWA participants reviewing consistency between clauses, annexes and source materials;
- municipalities or practitioners looking for complementary references;
- future standardisation discussions concerning PEDs, sustainable cities or community-scale energy transition.

The mappings should not be used to claim that this CWA incorporates, replaces, endorses or requires the listed standards, tools, labels or initiatives. Users should consult the original sources and applicable legal or technical frameworks where relevant.

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