Smart-BEEjS

Human-Centric Energy Districts: Smart Value Generation by Building Efficiency and Energy Justice for Sustainable Living

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D5.4 Guidance on Innovative Policy and Regulation Design

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Executive Summary

Policymakers wishing to develop Positive Energy Districts (PEDs) need to be mindful on how these may affect energy poverty. This awareness needs to be present not only after a PED project is developed, but already from the design phase of specific policies.

Towards this end, the present report aims to provide guidance to policymakers on how to design innovative PED policies that address energy poverty. Starting from a simple policy stages framework and two practical examples, we highlight actions at each stage of policy design that policymakers should take to include the needs of citizens, in particular vulnerable citizens, in the design of PED policies.

We propose multiple methodologies that policymakers may embrace towards this end, including adopting a systems thinking approach, carrying-out representative interviews to draft policy objectives, creating living labs to co-create solutions with citizens, and using modelling approaches that can give an idea of how policies impact environmental, economic, and social conditions in the district.

We finalize by describing interactions between the different stages of policy design, and summarising how the proposed guidance may be integrated practically into the policy design process. We suggest that the design of policies needs to be a recurring process based on cooperation and comprising multiple discussions with the population, including the validation of outputs emerging from each stage in policy design. Our aim is that this report can provide guidance to district-level policymakers looking to implement innovative PED policies that tackle energy poverty, and who are willing to embrace a cooperative, iterative process of policymaking in this domain.

1 Introduction

In this report we will consider the design of policies for Positive Energy Districts (PEDs), paying particular attention to how these policies can be designed to tackle energy poverty. The intended audience of this report are district-level policymakers who wish to adopt PED concepts, mindful of balancing the technical, and environmental objectives of PEDs with its social objectives, namely offering a good quality of life to all citizens.

Energy poverty is a widely adopted term that is used to describe the inability of households to attain appropriate levels of energy consumption conducive to a good quality of life, including being unable to afford or access enough energy for cooking, lighting, heating, and appliance use (Boardman, 2009). The drivers of this particular type of poverty are typically considered to be inefficient appliances or dwelling fabric, high energy costs, and low household incomes (Thomson et al., 2016). A range of contributory factors that affect energy needs have also been considered, such as health problems or disabilities (Snell et al., 2015). As these affect energy use and behaviours, they can be broadly categorized as a behavioural fourth driver of energy poverty (Kearns et al., 2019).

A PED on the other hand is a smart-city concept included in the European Strategic Energy Technology Plan (SET-Plan), with the explicit aim of creating 100 such districts by the year 2050. A PED can be described as a district within a city that generates more energy than it consumes on an annual basis (Hedman et al., 2021). While this definition of a PED is strictly technical and specific to reducing grid-reliance and promoting self-sufficiency, the objectives of a PED are also explicitly social as they are expected to contribute to a good quality of life and ensure the wellbeing of citizens. Specifically, social concerns such as inclusiveness, justice, and the tackling of energy poverty are considered to be fundamental to PED development (Hedman et al., 2021).

A large literature considers policies designed to tackle energy policy, which can be broadly categorised as financial interventions, measures for consumer protection, energy savings and RES interventions, and information provision (Kyprianou et al., 2019). The role of PEDs inside the energy transition theory has been explicitly considered in the Deliverable 5.3, integrating furthermore issues of tackling energy poverty. As PED principles have been set as a cornerstone of the EU energy transition plan, it is important that policymakers consider how to design policies that can support the development of PEDs, and how they might tackle energy poverty.

There is a wide variety of literature on policy design, some of which we will detail in this report. Therefore, here we do not propose a new theoretical framework, rather we offer propositions on what actions policymakers can take at each of the stages of policy design to formulate PED policies that address energy poverty. In doing so, we are informed in parallel from different disciplines active in the Smart-BEEjS project, integrating several perspectives, including psycho-sociological considerations to policymaking (Work package 3) and techno-economic assessments of PED potential (Work package 4). Our contribution is therefore in synthesising these perspectives in the mainstream policy design setting and providing step-by-step guidance to policymakers on the different stages of policy and regulation design actions relevant to the needs of each stage of the policy design framework. The aim is to address energy poverty through PED development.

The report is structured as follows. In chapter 2 we will provide a brief overview of the **policy stages framework**, the main theoretical framework we will adopt to discuss the design of PED policies. After synthesising the framework and providing practical examples, we propose three main macro-stages for policy design that emerge from the discussion, which we adopt during the remainder of the document. These are:

1. Project preparation, definition of the status quo, and policy objectives.
2. Data collection and policy assessment.
3. Modelling and policy selection.

In chapter 3 we explore each of these macro-stages for the specific case of energy poverty and PEDs. In each case, we will detail what actions need to be taken to design effective policies and suggest ways that policymakers may implement them. Chapter 4 synthesises our propositions in a structured stepwise fashion, providing specific guidance that policymakers can adopt to design innovative policies and regulations that address energy poverty through PEDs. Chapter 5 concludes the report.

2 Literature on policy-design frameworks

The policy-stage framework and practical applications:

Many policy-design frameworks exist in the literature that offer a rich conceptualization of the policy process and go beyond the "textbook" approach to policy design as discussed by Jordan & Adelle (2012). However, many of these frameworks often do not conclude in a series of concise, practical advice for policymakers and practitioners, which causes policy theory and practice to be somewhat disconnected (Cairney, 2021). As our aim in this report is to offer practical guidance to policymakers on how they might design innovative policies that tackle energy poverty through PEDs, we will adopt a simple policy-design model and describe practical applications of it. In particular, we will consider the Policy Stages Framework.

This framework encompasses different types of policy models. The conceptualization we will consider in this report is that of Hoefer (2021). In particular, he describes a 5-stage model to the policy process: agenda setting, policy formulation, policy selection, policy implementation and program evaluation. In this report we will particularly consider the first three stages as we believe these encompass the process of policy-design most precisely.

The questions that need to be answered in each of these stages are:

- Agenda setting: what issue should the policy-maker work on?
- Policy formulation: what possible policies (solutions to the chosen issue) can be developed?
- Policy selection: How can the policymaker choose a policy and with what criteria?

The policy stage framework has many benefits, the key one for our purposes being that it is simple and focuses on the practical aspects of policy design. As Hoefer describes it "It is mainly a description of what happens, rather than an explanation" (p. 1). The focus on describing the policy process also provides policy-makers as well as researchers with a generalisable model to draft policy action (Smith & Larimer, 2018).

However, as many critics point out, the framework also has the notable short-coming of being based on the assumption of rational policy-making (Hoefer, 2021), particularly at the stage of agenda-setting. Namely, under this type of framework there is the assumption that all interest groups have been considered in drafting the agenda. However, when considering an issue such as the energy transition, which is expected to have a disproportionate impact on the most vulnerable and politically under-represented, this may not always be the case. For example, neo-pluralist scholars argue that businesses have a privileged position when setting the agenda for environmental policy, and that citizen concerns take a secondary place (Judge, 1979). To accommodate for this, when we adopt this model in our discussion, we will explicitly consider the actions that policymakers should take to collect and include the needs of citizens, in particular vulnerable citizens, in the design of policies. To structure this engagement, we propose validating the outputs in each stage of policy design with the wider citizen base, while also including different stakeholder groups. The process of this validation can take different forms and have different purposes, as detailed in chapter 4.

We now discuss two practical guidelines that, although not explicitly adopting this model, reflect the same stage-by-stage approach to policy-design, adding detail on the actions that need to be taken at each stage.

The Economic Research Centre (ERC)[1] offers a comprehensive public policy design methodology which they apply in their consulting work. The process includes five stages: the preliminary and planning stage, situation analysis, data collection, policy design and involving interest groups in the policy design process. Key importance is placed in their framework on identifying interest groups and involving them from the outset of policy formulation. Methodologies such as semi-structured interviews and focus groups are to be used to collect data on the preferences, opinions, and positions of interest groups, towards the issues of the policy to be designed. Furthermore, interest groups are to be consulted again during the final policy design stage, where they play a key role in helping formulate the current situation and future desired outcomes of the policy.

Figure 1: ERC stages of policy design

[1] Economic Research Centre. (2007). Public Policy Design: Shared Vision To Reality. Retrieved June 9, 2022, from https://www.erc.lt/userfiles/about-public-policy-design-methodology.pdf

This policy design stage proposes policy modelling as a core methodology, based on the concept of systemic change (Wolfram & Frantzeskaki, 2016). This involves modelling the current and desired situations in as much detail as possible, using both inputs from qualitative and quantitative methods. Under this framework, policy is considered to follow naturally, filling the gap between current and future scenarios. Specifically, the task of policy design at this stage becomes an exercise of forming policy objectives based on the surveyed information and policy goals and identifying what actions should be adopted to reach those objectives, given the present situation. Once more, the present and future situations that are the basis for the modelling must be informed by the interaction with interest groups.

Other examples, such as that adopted by the World Bank in their Global Roadmap of Action Towards Sustainable Mobility Report (GRA)[2], take a more high-level approach, drafting action plans based on how a particular policy measures rank in terms of score when compared to others. The report proposes first scoring potential policy measures based on impact against multiple policy objectives, and then contextualizing via country-relevance scores. This highlights another important aspect of policy design: having reliable, context-specific insights on how policies are expected to perform. In our view the GRA example specifically considers the third stage of the Policy Stages Framework, policy selection. However, they further acknowledge the importance of public consultation and engagement with the public. In a similar vein to the ERC example, the role of these public consultations is to "understand the needs of affected communities, and to reduce any adverse impacts" (pg. 38). They also propose involving the public at the initial outset of the policy project and setting up a plan for continuous consultation during implementation.

It is clear from the two examples highlighted here that involvement of the public is a key requirement for the development of inclusive, effective policies. This is of course particularly important for policies that are expected to have an impact on the most vulnerable, such as the energy poor. Reaching and including this demographic is difficult, but an essential step of policy design.

Proposed stages:

Informed by the policy-stage framework and practical examples where it is applied, we identify three macro-stages[3] for policy design: **(1) project preparation, definition of the status quo and policy objectives, (2) data collection and policy assessment, and (3) modelling and policy selection**. These correspond roughly to the stages of agenda-setting, policy formulation, and policy selection. We choose to adopt these titles because, as the practical examples highlight, it is important when offering guidance to policymakers to be specific on what actions should be taken. Hence, we specify at each stage the key actions that need to be undertaken.

The bounds of these stages are also not intended to be narrowly defined, and indeed we will later discuss how the stages feed into one another, leading to an iterative policy design process. The objective of this categorisation is only to provide a logical structure to the actions that policymakers should aim to take when designing policies in the domain of energy poverty and PEDs.

[2] Sustainable Mobility For All. (2019). Global Roadmap of Action Towards Sustainable Mobility. Retrieved June 9, 2022, from https://thedocs.worldbank.org/en/doc/350451571411004650-0090022019/original/GlobalRoadmapofActionTowardSustainableMobility.pdf

[3] For simplicity, we will refer to the macro-stages simply as stages for the reminder of the report.

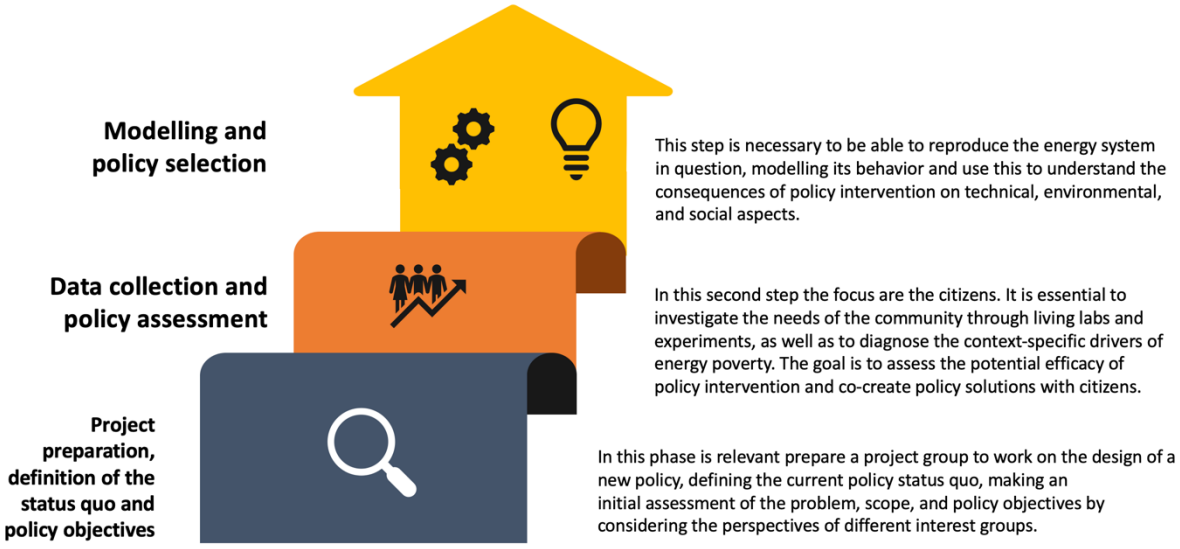

Figure 2: Macro-stages of policy design to address energy poverty through PEDs

The first stage includes all preparatory steps that must be taken, including the creation of a working group, the identification of key interest groups (with particular attention to marginalized groups), and the collection of all relevant documentation. Other important steps are the definition of the policy status quo, the formalization of the specific problem that needs to be tackled, and an initial drafting of objectives. It is important that already at this stage the opinions of key interest groups are considered, including citizens. Solutions to challenge silo-thinking, elaborated in Work Package 3, are important to consider during this stage.

The second stage includes all steps that should be taken to assess the feasibility of policy measures and collect relevant data on what aspects are important to consider. It is important to detail also what metrics should be considered and set-up data collection measures, as detailed in Deliverable 5.2 of Work Package 5. Policy makers should at this stage also carefully diagnose the drivers of the problem that they want to address (in our case, energy poverty). Co-creating potential policy solutions will be key during this stage, and a particular emphasis should be placed on the role of living labs.

Finally, the last stage includes all modelling steps that should be taken to link the current situation to the desired future scenario. This modelling can take various forms, but it's important that it is informed by the previous stages and that the interests of citizens and vulnerable groups be considered. In this report we will specifically consider energy system modelling (simulation and optimisation approaches), and techno-economic models considered in Work Package 4. We discuss the importance of including measures of energy poverty and geographical features in these models.

3 Stages of Policy Design

In the next three sub-sections we will consider each of our proposed stages of policy-design, detailing the actions that should be taken during each step for the specific case of policies tackling energy poverty through PEDs. Our ambition is not to define an exhaustive list of actions that should be taken during each stage, but rather provide general guidance on factors that may often be ignored. This guidance is synthesised in figures at the end of each sub-section, detailing for each stage the objectives, involved actors, actions, tools and methodologies, and steps for evaluation[4] that need to be taken at each step of the policy design process. These figures can be used as a sort of "checklist" by local policymakers and provide practical guidance as to how to design innovative policies to address energy poverty through PEDs.

3.1 Project preparation, definition of the status quo and policy objectives

During this preparatory stage, policymakers wishing to design innovative PED policies that address energy poverty should consider the following sets of actions:

- Identify the problem and scope of policy action, organise a project team, identify and involve interest groups.
- Assess the current policy status quo at different levels.
- Define preliminary policy objectives and evaluation metrics.

The initial preparatory steps to the development of a PED policy are likely to be similar across numerous policy domains. As highlighted by the ERC report, it is important that initially local authorities organise themselves around a specific problem or policy area that they wish to tackle. At this stage basic questions should be answered such as: what level of policy can we act on (e.g.: European Commission, National Government, or local authority)? Are we interested in creating a completely new policy, or rather fixing problems in existing policy (or somewhere between the two extremes)? And, crucially, what are the interest groups that may be affected by a policy area we are trying to act in?

It is crucial that the definition of the interest groups occurs very early in the process, and before the formal definition of policy objectives. As detailed in the playbook included in Deliverable 5.2, for the case of energy poverty and PEDs, key interest groups who need to be involved are: municipal authorities (or regional and national if relevant), citizen population (citizens living in the district), vulnerable citizens (the energy poor, other marginalized groups), energy utilities, industry and businesses. While not essential, it is highly recommended that also academic bodies be brought into the policy design process from an early stage.

Numerous methodologies can be employed to involve different interest groups. These include qualitative methods such as semi-structured interviews, focus groups or workshops. It is important that purposive sampling methods (Campbell et al., 2020) are applied at this stage. This means that for each identified group, a representative group of people be interviewed, ideally leaders of their respective groups.

It is crucial that policymakers engage in a real dialogue with interest groups, especially with citizens, and avoid relying solely on modalities of public engagement that avoid collective expressions of

[4] According to the standardised method of impact evaluation for PEDs detailed in D 5.2. Although the evaluation of a PED project will not occur during policy design, it is important that steps are taken to ensure a general consensus on the evaluation process, and procedures established for the collection of data throughout the project lifecycle.

concerns – such as surveys. Deliverable 3.5 (Advisory Report on Accelerating PED Design), details specific best-practices for the breaking of silo-thinking and involving different stakeholders in the development of PED policies. These best-practices were identified after series of interviews with stakeholders in Amsterdam, The Canary Islands, and the Lisbon metropolitan area. Adopting practices that break these silos is particularly important during the initial stages of project preparation, to involve multiple perspectives in the definition of the problem to be tackled by policy action. The full list of identified best practices from each of the case studies is reported in the Annex. They include three categories: Policies and frameworks (structural adjustments to facilitate more collaboration between stakeholders), Intermediary practices (solutions that involve new ways of communication within and between stakeholder groups), and Intergroup communications (solutions that target silos of representation and help all groups communicate on equal ground). Practical solutions may include subsidised energy consultations, public consultations, or events other than traditional meetings. These methodologies should also be replicated in the context of a living lab during the following stage when assessing potential policy actions. During this stage, the main goal of engagement is to define the problem and the scope of potential solutions, and make sure these are shared with different stakeholders.

We note the difficulty in engaging with certain interest groups, particularly at a preliminary stage. Citizens, and in particular vulnerable citizens, will be hard to involve. Accordingly, it is crucially important to engage with the vulnerable through **trusted intermediaries**. As highlighted in DellaValle & Czako (2022), intermediaries play a key role in connecting different level-actors and empowering energy citizenship across the population, particularly the energy poor. Trusted intermediaries can take many forms, but are often community organizations, charitable organizations, or trusted energy advisors. The important aspect is that that the intermediary has a strong bond of trust with the interest group we desire to reach (Amann & Sleigh, 2021).

Once these preliminary steps are taken, a diagnostic of the current policy status quo needs to be undertaken. Through documentation, desk research, or interviews with field workers or policy experts, the present policy landscape needs to be assessed. Considering different geopolitical levels and their interaction is crucial to understand what scope of actions policymakers should take. In this regard, the concept of multi-level governance is key. Understanding the different levels of policy intervention and how they interact with one another is necessary to begin to understand what is being done and what still needs to be done, particularly in relation to the energy system (Hofbauer et al., 2022).

For example, concerning energy poverty, the EU has made it a policy priority to tackle energy poverty in its Clean Energy for all Package[5]. EU countries are required to act to tackle energy poverty wherever it is identified, and vulnerable consumers must be protected. Member states are also mandated to assess the number of households in energy poverty and tackle the issue through their energy and climate plans. Therefore, the role of the EU in this regard is mostly that of setting mandates and offering support (through institutions such as the Energy Poverty Advisory Hub, or the Energy Poverty Observatory). The definition of energy poverty and identification of context-appropriate solutions needs to occur at the national and local levels. Local institutions have the important role of improving building stock, promoting innovative and collective use of energy services, and raising information, as

[5] European Commission, Directorate-General for Energy, Clean energy for all Europeans, Publications Office, 2019. Retrieved July 7th from https://data.europa.eu/doi/10.2833/9937

highlighted by a recent Energy Poverty Advisory Hub (EPAH) report[6] on inspiring local actions to tackle energy poverty.

Once the preliminary steps have been taken and the status quo of policy assessed, policymakers are advised to clearly diagnose the problem they are trying to tackle and the objectives they want to achieve. This involves setting clear problems and objectives, informed by the interaction with different interest groups, as well as the local context. Ultimately, the identification of problems and objectives will partly be an iterative process that is likely to be revisited in future stages.

For the case of energy poverty and PEDs, it is crucial when defining objectives for PED implementation that there is acknowledgement on how this might affect energy poverty in the district. Deliverable 5.3, identifies **must-read factors** to be considered in this regard, four of which should specifically be considered at the planning phase of PED policies. This report also offers practical advice to policymakers as to how to design PEDs in ways that are conducive to the tackling of energy poverty for each must-read factor. These are:

- Positive Impact Redevelopment vs. Gentrification: revitalising urban areas while avoiding negative impacts of gentrification by adopting a clear regulatory framework that is communicated to the population.
- Fair and inclusive financing for the deep energy renovation of existing districts: the adoption of alternative and inclusive financial models that promote deep energy renovation.
- Encouragement and empowerment of energy communities: adopting energy community concepts in policy design that encourage greater participation of the most vulnerable.
- Avoiding, shifting, improving transportation: adopting residential urban concepts that aim to mitigate traffic and promote suitable and accessible transport.

Finally, it is also important at this early stage to set relevant KPIs for the evaluation of a policy. As mentioned before, we will not consider during this report the stage of policy evaluation, however it is important at the policy design stage that there are clear indicators on how the success of a particular policy or intervention will be evaluated, and that these indicators be clearly communicated to citizens and wider academic community. These KPIs will also be used during later stages to select policies based on how they are expected to perform across different dimensions. Deliverable 5.2 refers in detail on the nature of the KPIs and the requirements for data collection for each one that are used to evaluate the impact of PEDs. In summary, it is important to consider three dimensions distinctly: environmental, economic, and social (including the current energy poverty context).

[6] Energy Poverty Advisory Hub (2021). Tackling energy poverty through local actions – Inspiring cases from across Europe. Retrieved July 16th from:
https://energy-poverty.ec.europa.eu/system/files/2021-11/EPAH_inspiring%20cases%20from%20across%20Europe_report_0.pdf

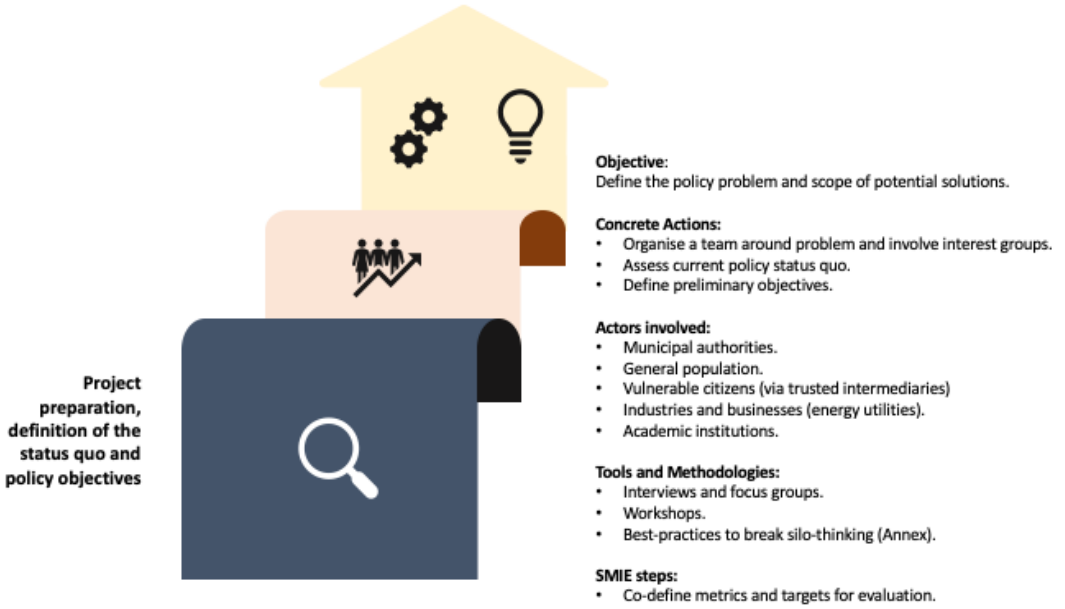

Figure 3: Guidance for innovative policy and regulation design in Project preparation, definition of status quo, and policy objective stage

3.2 Data collection and policy assessment

Once the preparatory stage has been completed, the problem been identified, and the preliminary policy objectives been outlined, the next stage in our proposed framework involves the collection of relevant data and the assessment of potential policy solutions. The main objective of this stage is for policymakers to obtain **a robust, evidence-based indication of what factors are important to consider for the development of a particular PED policy and its implications on energy poverty, as well as the potential impacts that can be expected**. Another objective of this stage is to contextualize potential policies to a specific district, to avoid "off-the-shelf" implementation of measures without understanding why they are or are not effective.

We explore three sets of actions that could be undertaken at this stage to assess the feasibility of PED policies and their impacts on energy poverty:

- Carry-our desk research to **diagnose the drivers of energy poverty** in their specific district context, and **how it intersects with PED policy**.
- Set-up living labs to **co-create and test policy** solutions.
- Assess the **potential impact of different policies** through experimentation and discussions with interest groups**.**

With regards to diagnosing the drivers of energy policy, policymakers should engage in desk research and work with local experts in the field to assess the energy poverty landscape in their district and context-specific drivers. The identification of context-specific drivers will be crucial and will inevitably inform preliminary objectives drafted during the previous stage.

The specific drivers of energy poverty can be many. As highlighted above, the literature tends to focus on energy expenses, household income, inefficient dwellings and behaviours as key drivers. However,

as highlighted by the EPAH[7] all six aspects of vulnerability should be considered: access, affordability, flexibility, energy efficiency, needs and practices. This reflects the multidimensional nature of energy poverty. They further explain that not all these factors may be relevant in every context, and the weight assigned to different factors may vary across contexts. Most authors agree that it's important to look at geography patterns, characteristics of the energy poor population, location, infrastructure, politics and government (Mashhoodi et al., 2019).

The natural question then becomes how policymakers can assess and measure the drivers of energy poverty in their specific context. Towards this end, the EPAH provides practical advice for all the challenges that policymakers might face. For example, policymakers will often have a hard time finding specific data on energy poverty at a granular level. For this, the advisory hub suggests repurposing existing data and metrics, such as that collected at advice points, helpdesks, social services, etc. However, it is important that vulnerable groups be explicitly considered, as these groups may often fail to participate in the data collection process (once more, trusted intermediaries will be key in this regard).

With regards to context-specificity, the EPAH suggests that policymakers adopt a comprehensive view of energy poverty, focusing on different indicators that assess a wide array of problems, including building stock and equipment, energy performance and efficiency, socioeconomic characteristics, thermal comfort, and wellbeing, amongst others. From here, expert opinion and interviews with relevant groups can be employed to determine if all these aspects are relevant, or some can avoid being considered. The use of metrics at this stage is crucial. When choosing indicators to assess the current state of energy poverty, it's important that policy makers adopt not only expenditure-based metrics or direct measures based on indoor temperatures, but also consensual-based indicators (based on self-reported experiences, such as indicators collected as part of the EU-SILC).

During the data collection stage, it is crucial that procedures are set-up to collect and process data related to the potential impacts of a PED project. This can mean setting-up a local observatory to monitor changes in energy poverty during the lifecycle of the project and organising meetings with representative bodies such as citizen representatives and NGOs. Other types of data related to environmental, economic, and social impacts of a PED will need to be collected (both to serve as baseline, and to assess the impact of a project after some time), so it is crucial that policymakers can set-up procedures for the sourcing of this data. Deliverable 5.2 proposes a method of impact evaluation for PED projects, detailing sources for the data required to calculate important KPI. These data sources are selected so that they are accessible for local authorities. In the Annex we detail specific data sources for the calculation of KPIs, as reported in the playbook of D 5.2.

Once the drivers of energy poverty have been assessed, baseline data has been collected and further collection procedures for impact assessment of the project established, policy makers should aim to identify a series of feasible potential solutions. These should be co-created with citizens, and their potential impacts be tested in a controlled environment to get a sense of how they might perform. Here several methodologies could be adopted. For example, to test behaviour-change solutions to tackle energy poverty, policymakers could consider behavioural lab experiments, and living labs.

Laboratory experiments are a type of behavioural experiment not held in the field. They are often framed in abstract terms and have the objective of testing a treatment on a specific population

[7]Energy Poverty Advisory Hub (2022). Bringing Energy Poverty Research into Local Practice: Exploring Subnational Scale Analyses. Retrieved July 10th from: https://energy-poverty.ec.europa.eu/system/files/2022-03/EPAH_Bringing%20Energy%20Poverty%20Research%20into%20local%20practice_final.pdf

(Chapanis, 1967). They are different from Randomised Controlled Trials (RCTs) which instead are experiments carried out in the field, usually on the target population of a particular policy.

Typically, the gold standard for pilot testing policies is considered to be RCTs (European Commission. Joint Research Centre, 2013). While we concede that they are important tools (and later in the text we suggest integrating them in living labs), we agree with Lunn & Choisdealbha (2018) that it is at least equally, and often more important for the purposes of generalising results, to additionally run laboratory experiments. This is because laboratory experiments can take advantage of tight experimental controls to carefully test the mechanisms which lead a policy to be effective or not effective. In other words, laboratory experiments have high internal validity.

An example of a laboratory experiment in the domain of residential energy use can be found in Caballero & Ploner (2022). Here, the authors test the effectiveness of two distinct types of interventions on energy management behaviours in high- and low-income households, shedding light on the importance of cognitive processes for the design of effective behaviour-change interventions. They highlight another important benefit of laboratory experiments: they are well-suited for the study of underlying psychological mechanisms. In this spirit, lab experiments and RCTs should both have a place in the policy design process, ideally in an iterative fashion. For example, several policy measures could first be tested in the lab to give an initial idea of how effective they might be and what cognitive aspects are important to consider. Promising policy measures could then test in an RCT to see if the initial results hold, which might inform further lab experiments.

Differently from lab experiments, **living labs** are grounded in the field. They are defined as open innovation and user centred spaces that foster innovative collaborations between businesses, citizens, government and academia (Bergvall-Kåreborn & Ståhlbröst, 2009). As highlighted in Della Valle et al. (2021), living labs (specifically, urban living labs) can be important policy instruments to foster local sustainable innovation and public support. In their article the authors discuss an urban living lab carried-out in the city of Trento where numerous stakeholders got together for a workshop to discuss and co-design a last mile e-mobility logistic centre. Living labs can therefore also serve as a suitable space for the co-creation and testing of technical interventions, such as efficiency improvements or the adoption of innovative modes of sustainable mobility.

As well as being hubs for the co-creation of policy solutions, living labs can help collect data that informs the current and future desired situations that are necessary for the modelling approach carried-out in the next stage. Living labs in this stage play a similar role to that of interviews, and focus groups in the ERC example highlighted in Chapter 2. However, data collection methods employed in the living labs don't necessarily need to be limited to qualitative, quantitative methods of data collection could also be employed within the context of a living lab, such as RCTs or surveys (though one-way dialogues should be avoided). If the policy-relevant population is involved in the living lab, and professional experimentalists and participation experts provide support, RCTs can provide policymakers with reliable data on how you might expect a policy intervention to perform when scaled-up. Furthermore, living labs can help re-define the problem or objectives laid out initially in the first stage. This process of co-creation of policy goals through communication and interaction with different interest groups is a key feature of living labs. Moreover, it is important that policymakers and academics working in the development of the living lab take a multidisciplinary perspective in their implementation, relying on the **systems thinking approach** (see Deliverable 3.2). This avoids narrow interpretations of the results of the living lab and prepares project leaders to coordinate across boundaries of separate academic and administrative traditions and practices (Park & Benson, 2013).

Through discussion with interest groups and the testing of potential policies, living labs can be a very effective tool to co-create policies and get a sense of how they might perform in the field. It is crucial however, to address energy poverty, that urban living labs be designed as **inclusive social spaces**. Policymakers must be mindful of not using the living lab methodology to simply promote "acceptance" of proposed solutions, but that effective collaboration is encouraged.

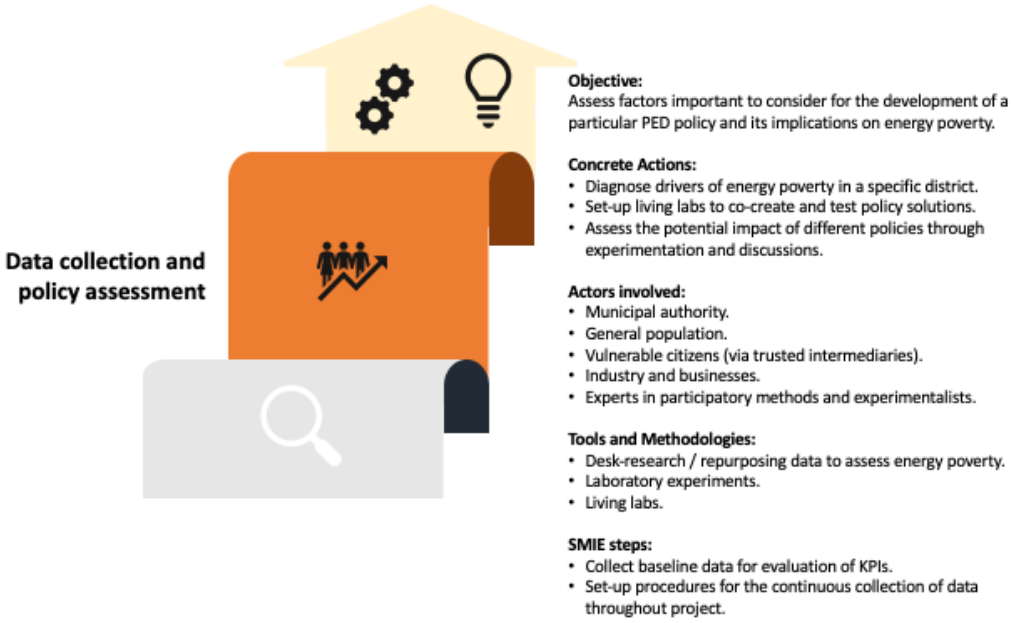

Figure 4: Guidance for innovative policy and regulation design in Data collection and policy assessment stage

3.3 Modelling and policy selection

Once policymakers have identified and assessed the efficacy of policy solutions, the final stage of policy design in our proposed framework culminates in the selection of policies to implement. Here we highlight the usefulness of using modelling approaches, combined with the co-creation of present and future desired scenarios through citizen interactions. One of the goals in this stage is to map the expected impact of policies on key indicators, and decide which policies are best suited to reach a desired future scenario. It is crucial to consider not only purely technical aspects, but also environmental, economic, and, crucially, social indicators (such as the prevalence of energy poverty). Some of the actions that policymakers should take in this stage involve:

- Utilize modelling techniques, informed by previous experimentation, to assess the feasibility and expected outcomes of policy action.
- Leverage data collected in the previous stage to model the current and future desired scenarios, paying attention to the impact metrics and objectives defined in the first stage.

In the context of positive energy districts, a key example of modelling approaches that could be adopted is energy system modelling. The main aim of these methods is to provide a simplified version of the reality focusing only on the elements that are important for the specific task. Modelling the energy system is a key aspect when it comes to investigating paths towards decarbonisation. Additionally, the relevance of such approaches relies on the fact that using these tools allows for

better planning and designing of energy systems for the future, suggesting pathways to reach desired environmental targets.

In the context of analysing energy systems, two main modelling approaches are predominant: optimization and simulation. Both the approaches have advantages and disadvantages and may be more relevant depending on the final goal of the analysis. Table 3 presents a comparison of the two modelling approaches considered in this report.

Table 1: Optimization & Simulation modelling approaches. Adapted and inspired from Lund et al. (2017).

	Optimisation Approach	Simulation Approach
Definition & Purpose	The model makes use of a mathematical formulation to find oud the optimal solution of a given problem	The model is mathematical representation of a system to reproduce and understand its behaviour, under given conditions, without looking for an optimal solution
Solving Logic	Decision are made by the optimizer based on built-in rules and problem constraints. Solving logic is usually not intuitive.	Decisions are made by the modeller who set up solving logic depending on the main purpose of the problem. Solving logic is often simpler to understand.
Technical Characteristics	Detailed modelling of the system and all its components. Normally requires long computational time to find the solution	Solving logic may be less detailed than optimisation and simpler. Model are normaly less detailed but can have a higher temporal resolution and lower computational time.
Target Users	Well suited for engineers and technical expert given its high levels of details	Well suited for a collaborative situations with the interactions of politician and citizen as well.

Given the purpose of this report, the simulation approach is particularly well-suited as it allows for the investigation also of non-optimal solutions and the to assess the consequences of specific policy choices. Additionally, the simplification of the system considered facilitates the representation of the social implications of policy measures. Nonetheless, it is important to remember that the two approaches are not independent, but they can well be used in synergy so that users can understand how far non optimal solutions are from the optimal one.

In Deliverable 4.4, the authors consider several other modelling approaches - which have been further developed during the context of the Smart-BEEjS project - to support different aspects of PED implementation, emphasizing affordability and geographical distribution. For example, the authors propose the use of agent-based models to inform building renovation uptake in PEDs, accounting for the heterogeneity of households and building owners (Akhatova et al., 2022). Conversely, to assess the potential for electrification, the PED system optimiser (Bruck, 2021) can be used by policymakers to identify effective active and passive PED solutions. These modelling approaches complement each other (Annex) to support policymakers in the selection of optimal policy solutions that are feasible in the local context and help address distributional energy justice aspects from a techno-economic perspective.

These tools should also consider environmental, economic, and social aspects to provide a more realistic overview of the situation under scrutiny. The adopted tools should allow policymakers to investigate the impacts of selected policies on all these dimensions, understand which of them could be most effective overall, and avoid unintended social consequences of PED interventions (such as increasing energy poverty for example). There are many approaches that can be used in this sense and all of them come with their advantages and disadvantages. Several studies performed detailed

literature reviews on them, including Chang et al. (2021), Horschig & Thrän (2017), Martínez-Gordón et al. (2021) & Prina et al. (2020).

The employed modelling approaches should additionally be informed by the data and objectives defined in the previous steps presented in the framework. Thus, the results derived from the data collection and assessment should be used to inform these models and allow them to depict those social aspects and implications. Crucially, these models can be parametrized to assess the impact of policy action on energy poverty in the district-specific context. In this regard, the modelling approach must be informed by the collection of data and metrics diagnosing the current energy poverty situation in the district, which is undertaken during the previous stage.

Finally, the selection of policies will necessarily be based on a balancing of different expected impacts. For this purpose, a decision-rule needs to be defined. The scoring system developed Deliverable 5.2 can provide guidance in this respect and allows policymakers to compare, rank, and select effective PED policies based on available information collected in previous stages. In this way, modelling techniques can be used to inform policy makers of which policies could be best suited to tackle energy poverty and decarbonise their specific districts.

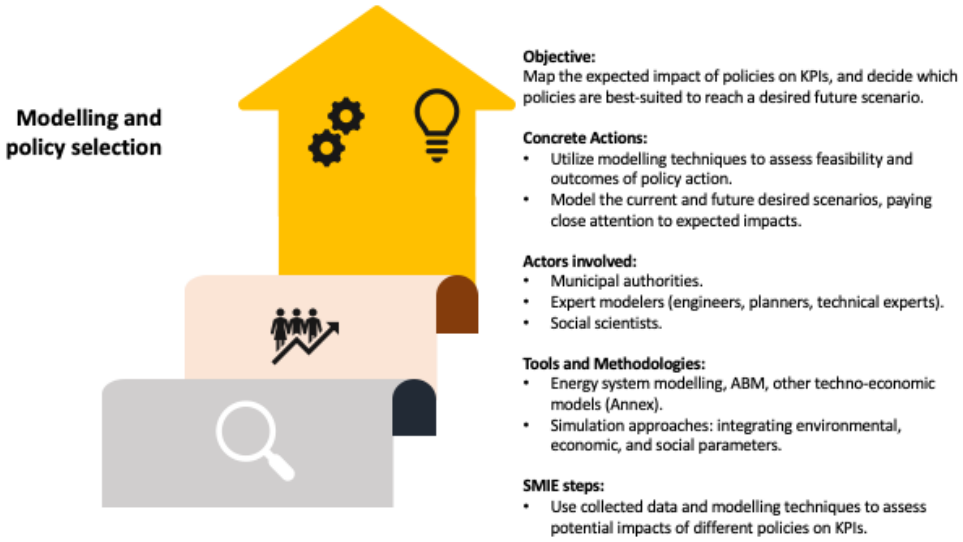

Figure 5: Guidance for innovative policy and regulation design in Modelling and policy selection stage

4 Guidance on policy and regulation design process

While the stages were presented in this report in a sequential order, in practice policy design will be an iterative process. As mentioned above, initial policy objectives drafted in the preparatory stage will more than likely be re-visited once data on the problem is collected and feasible solutions are co-created with citizens. Furthermore, results from the modelling approach can help get a better grasp of the scope of possible solutions and highlight aspects that policy actions could be at risk of neglecting (for example, the degree of energy poverty in a district). This could then motivate another round of engagement with the citizens or other interest groups, aiming to better understand and address the neglected dimension, as well as the collection of new data to improve the model.

In Figure 6 we present a process for integrating the proposed guidance into the design of innovative policies and regulations. The aim of this diagram is to provide indication to local policymakers as to what actions and outcomes they should consider in the development of innovative PED policies that can address energy poverty.

At each stage, a series of delivered outputs are presented, closely linked to the actions that need to be undertaken at each stage (Figures 3 – 5). Crucially, as we have stated numerous times during the report, meaningful interactions with the public are of paramount importance when addressing energy poverty, especially with regards to vulnerable citizens (which again, should be engaged with through trusted intermediaries). For this reason, we propose that the outputs be validated with the general population and vulnerable groups, as well as with different stakeholders that are involved in the policy design process. This validation needs to occur before progressing to the next stage in the policy design process.

This validation can have different purposes depending on the stage. In the Project preparation stage for example, the purpose will be to break silo-thinking and establish a shared consensus on policy objectives. During the Data collection and policy assessment stage, the validation will take place in living labs and have the purpose of co-creating and agreeing on a set of potential policy actions based on their expected outcomes. In the Modelling and policy selection stage, the purpose of the validation will be to agree on how potential impacts are mapped and policies ranked, leading finally to the selection of accepted policies.

It is worth noting that the provided list of actors involved in the validation is non-exhaustive, but rather aims to highlight who will be the actors that **need to be consulted** in order progress to the next stage of policy. This validation process will most likely highlight aspects that need to be re-considered, or data that should be collected, leading back to the previous stages. Furthermore, it is important to consider that the relevant actors should ideally not only be consulted at the end of each stage but be involved in the creation of the outputs themselves. This is particularly important in the Data collection and policy assessment stage, where policy solutions should be co-created and tested together with citizens and other stakeholder groups. One of the objectives of explicitly validating outputs is in fact to ensure that involvement with relevant actors takes place if this was not the case previously.

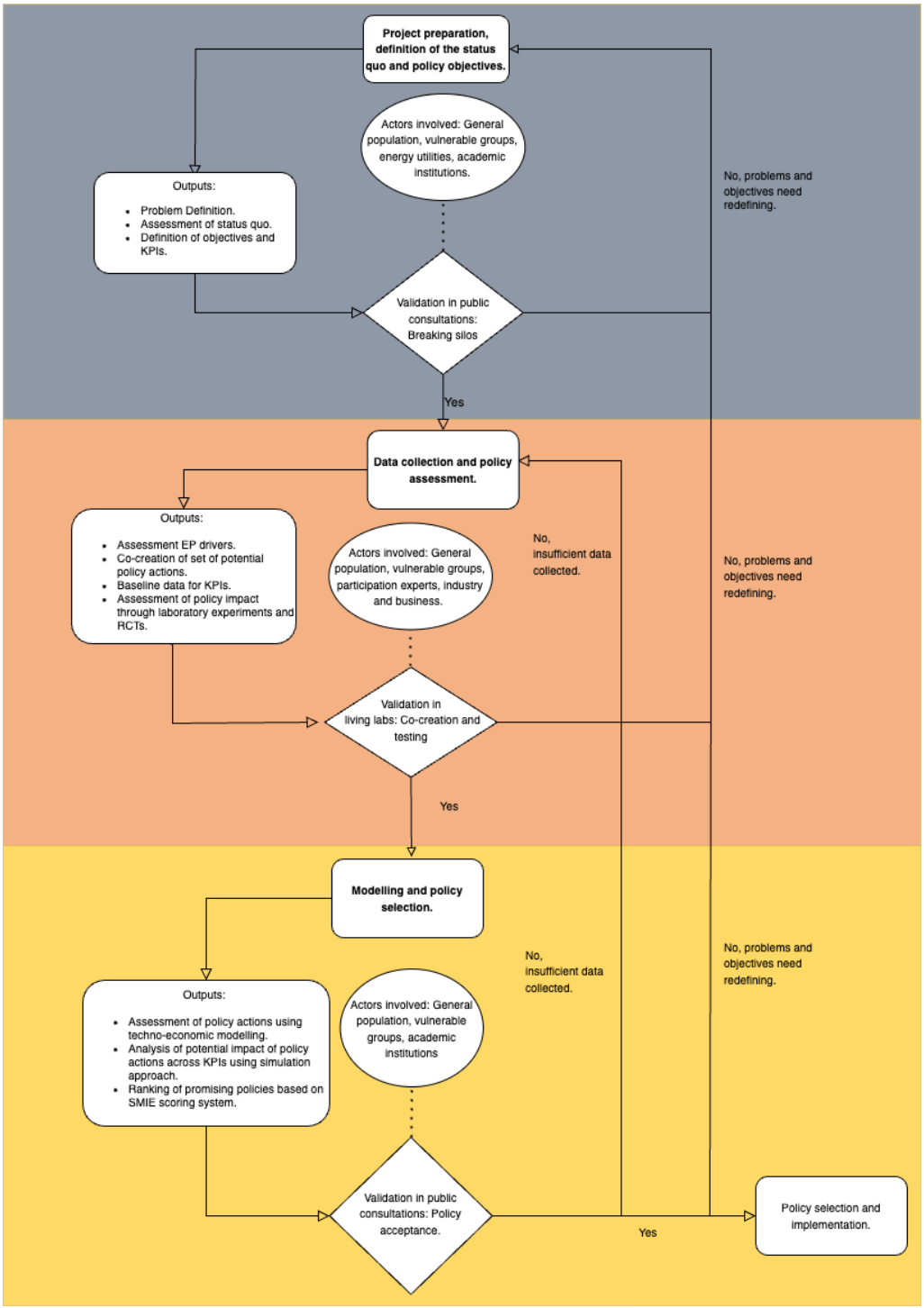

Figure 6: Guidance on innovative policy and regulation design across policy stages

Methodologically, the different stages also feed into one another. For example, data collection methods such as interviews and workshops that happen at the outset of the project to define initial objectives, should then be replicated within the living labs. This methodological overlap should not be viewed as a negative by policymakers, as it provides them with the opportunity to refine data collection methods throughout the process, enriching their understanding of how to design inclusive PED policies.

5 Conclusion

In the present report we have presented propositions for policymakers to follow when designing inclusive PED policies that address energy poverty. Starting from a simple Policy Stages Framework, we have defined three general stages of policy design that policymakers should go through when designing innovative policies, informed by the existing literature and practical examples.

Following these stages policymakers should set policy objectives, formulate, and test the feasibility of potential policy action, and select the best policies for their respective context. For each stage, we have proposed actions that policymakers should take to specifically address energy poverty when developing PEDs (informed by the outcomes of other deliverables of the project), detailing the methodologies they can adopt. At each step we have highlighted the need to interact with multiple interest groups, in particular vulnerable populations who are most at risk of suffering from energy poverty.

While this report is not intended to be conclusive, and further research should explore more deeply the methodological implementation of the approaches we highlight above, we believe it offers a useful first step for policymakers to start considering more deeply the design process of their energy transition policies. Each stage should be elaborated and contextualized to a specific district, and the actions we highlight here should be included in the final PED policy plan whenever possible. We hope that this report will encourage more policymakers to consider the needs of the energy poor and engage with them at each stage of the policy-design process.

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7 Annex

We present here the different propositions for the design of innovative PED policies that emerge from Work Packages in the Smart-BEEjS project.

From Deliverable 3.5, we report a table presenting best-practices for the breaking of silo-thinking in PED projects. These best-practices – informed by interviews with leaders in three case study areas – are particularly important for policymakers to adopt during the first stage of the policy-design process: Project preparation, definition of the status quo and policy objectives. More information on the best-practices can be found in D 3.5.

Table 2: Proposed solutions for breaking silos of representation emerging from case study interviews (see Deliverable 3.5)

Summary	**Amsterdam**		**Lisbon**		**Canary Islands**	
	Identification of silo	Best practices from participants	Identification of silo	Best practices from participants	Identification of silo	Best practices from participants
Institutional silo	• Difficulty of involving citizens • Regulations causing obstacles for local energy initiatives • Divergent goals of citizens and businesses	• (IC) Companies get in personal contact with potential citizens and snowballing from there	• Supply chain market disruption in the retrofitting market • Lack of knowledge from intermediary actors	• (IP) One-stop shop for retrofit information • (IC) Municipality as champion in engaging different sectors and stakeholders.	• Monopoly obstructs collaboration with big company to facilitate its change	• (IC) Build culture of collaboration not competition • (IP) Research institute as coordinator between stakeholders
Silo of representation	• Negative connotation of big energy companies • Citizens as lack of commitment • Citizens as lack of information and expertise	• (IP) Municipality as mediator and connector, • (PF) Local government subsidizes energy consultation.	• Negative connotation of big energy companies		• Citizen as lack of means and financial resources to become active consumers/ prosumers • Local government as bureaucratic	• (PF) Provide new resources and means of participation for citizens • (IC) Provide transparent information and training to citizens
Administrative silo	• Absence of government departments to relevant local consultations		• Disconnection from municipality departments involved that could be involved in PEDs	• (IP) Dedicate housing department as coordinator	• Disconnection of energy from water, food management	• (IC) Changing mindset of government and citizens on energy matter

Another important aspect that policymakers need to consider in the policy design process is the definition of important evaluation metrics for a PED project, especially how it stands to impact energy poverty in a district. As highlighted throughout chapter 3, different actions need to be taken during the different stages of policy design to ensure that the evaluation of PED impacts is based on indicators that are validated and communicated appropriately, and that baseline data is collected to allow for an accurate ex-post evaluation of the project. Expected impacts will also be crucially important in the selection of policies during the Modelling and policy selection stage.

Towards this end, the playbook included in Deliverable 5.2 provides guidance on how to evaluate PED projects, including standardised indicators and a score-based system that allows for the easy comparison between multiple policy options. We report here general information on the playbook and the proposed indicators for the evaluation of PED projects, but more information can be found in D 5.2.

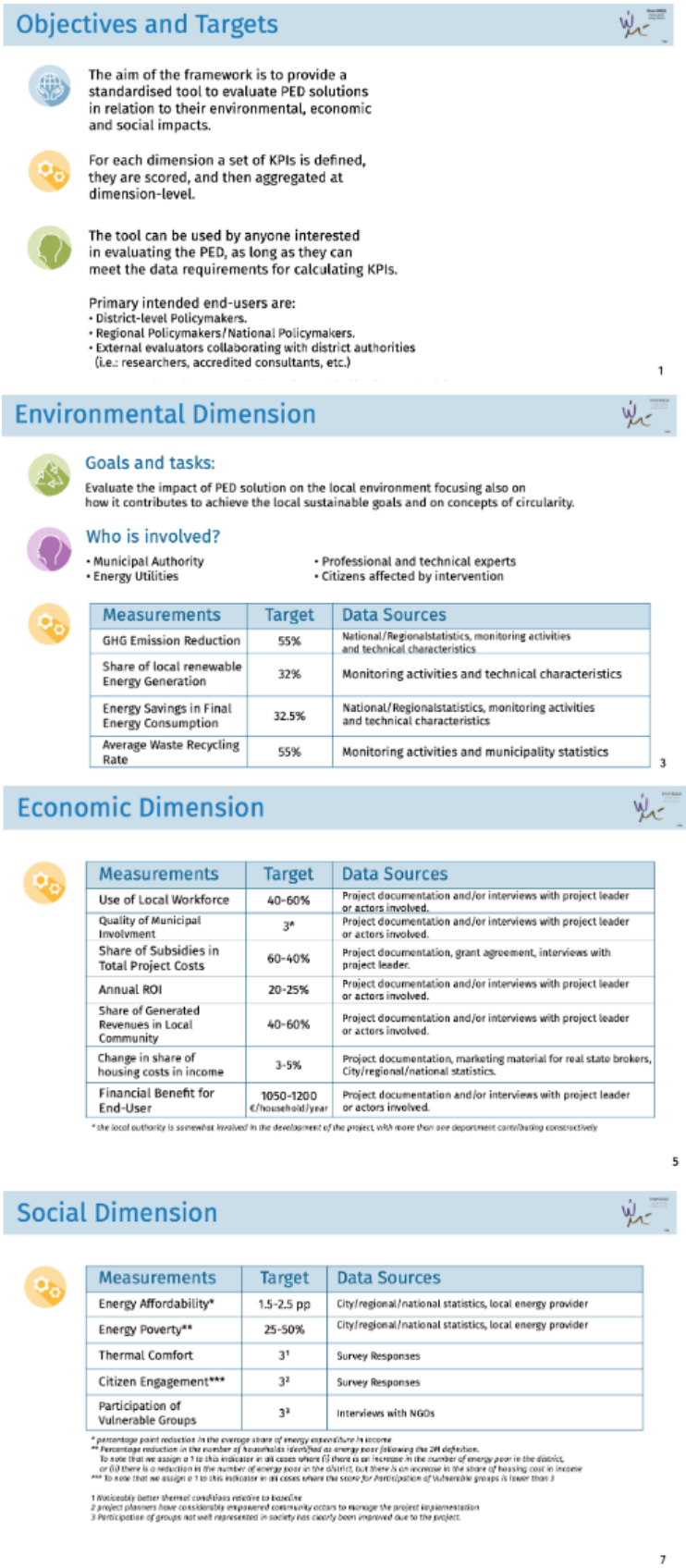

Figure 7: Playbook information, KPIs and data sources for impact evaluation of PED projects (see Deliverable 5.2)

During the Modelling and policy selection stage, it will be important to assess the feasibility of several policy actions, and map their impacts across technical, environmental, economic, and social dimensions. To support policymakers in this regard, a series of models were developed within the Smart-BEEjS project, which are discussed in Deliverable 4.4. These models share data requirements between one another and complement each other to allow policymakers to make a thorough techno-economic assessment of PED policies and understand their feasibility and expected outcomes. Here, we present an overview of the data requirements for the different models, as well as an overall perspective on how they complement each other. More information can be found in D 4.4.

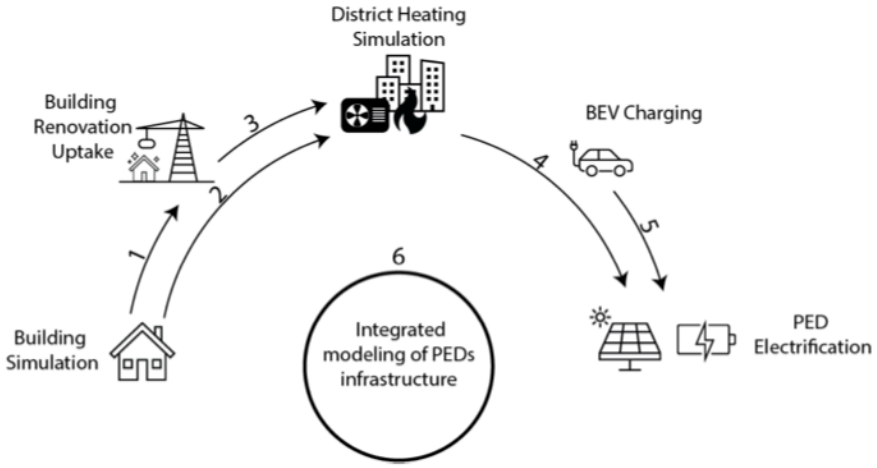

Figure 8: Integration of models and studies developed throughout the Smart-BEEjS project.

Label	Input/output
1	Building archetypes, specific costs of retrofitting measures [EUR/m2], specific final heating demand (kWh/m2/y)
2	Total Energy Demand [kWh], Hourly Load Profiles, Internal temperature (in dwellings – Comfort Level), Specific Final Heat demand [kWh/m2/year], Cost of renovation, NPV
3	Energy efficiency measures carried out in different buildings
4	District heating demand [kWh - hourly]
5	Distribution of EV charging infrastructure
6	Optimal energy supply technology portfolio in the district

Figure 8: Integration of modelling approaches developed in Smart-BEEjS project (see Deliverable 4.4)

About the Smart-BEEjS Project

Energy transition is supported in the EU by legislative developments, such as the Strategic Energy Technology Plan that aims to transfer power to consumers by decentralising the energy eco-system at the local district-level. However, this transition occurs at a time of increasing wealth inequality, energy poverty, and gender difference. Thus, the long-term vision of the Smart-BEEjS project is **to design transformational pathways** that tackle **Energy Poverty and Justice**, providing evidence and using the decentralised nature of **'Positive Energy Districts'** and **'Networks of Districts'** as the central platform of transformation, whilst recognising the economic, social and environmental challenges faced. Tackling the issue of energy injustice and poverty is an essential pillar for contributing to the **decarbonisation of our economies** without leaving large parts of the population behind.

Behind any decision or intervention – whatever the field of expertise, technological, business or policy – are **people**. Therefore, **the overarching training aim of Smart-BEEjS** is to provide, through a multilevel, multidiscipline and interdisciplinary training platform, a programme to produce the technology, policy making or business oriented **transformative and influential champions of tomorrow**; educated in the personal, behavioural and societal concepts needed to deliver the success of any technological proposition or intervention under the human-centric perspective of energy justice.

The Smart-BEEjS project recognises that the new level of decentralisation in the energy system requires the **systemic synergy of different stakeholders**, who are **inseparable** and interrelate continuously to provide feasible and sustainable solutions in the area of **energy generation and energy efficiency**. They balance attention towards technological and policy-oriented drivers from a series of perspectives:

- **Citizens and Society**, as final users and beneficiaries of PEDs;
- **Decision Makers and Policy Frameworks**, in a multilevel governance setting, which need to balance different interests and context-specific facets;
- **Providers of Integrated Technologies, Infrastructure and Processes of Transition**, as innovative technologies and approaches available now or in the near future;
- **Value generation providers and Business Model Innovation (BMI)** for PEDs and networks of districts, namely businesses, institutional and community-initiated schemes that exploit business models (BMs) to provide and extract value from the system.

In order to introduce cooperation and shared thinking, Smart-BEEjS presents a balanced consortium of beneficiaries and partners from different knowledge disciplines and different agents of the energy eco-system, **to train at PhD level** an initial generation of **transformative and influential champions** in policy design, techno-economic planning and Business Model Innovation in the energy sector, **mindful of the individual and social dimensions,** as well as the **nexus of interrelation between stakeholders** in energy generation, technology transition, efficiency and management.

The overarching aim of the project is to boost knowledge sharing across stakeholders, exploiting a human-centric and systemic approach to design Positive Energy Districts (PEDs) for sustainable living for all.

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