

Positive Energy Districts in Europe: one size does not fit all

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Abstract—The success of decarbonisation will largely depend on how the policies on energy transition are introduced, implemented, and subsequently received by the targeted entities. This study uncovers possible ways of enabling a regulatory framework for achieving Positive Energy Districts (PEDs) based on the local context with a human-centred focus. We address the four prerequisites of the PED pathway and discuss cultural configurations to explore how they affect the energy transition in three of the case studies – Amsterdam, Vienna, and Lisbon – to demonstrate differences in their contexts. The analysis in this study is based on the primary data, collected via semi-structured interviews conducted with stakeholders from the observed regions. The interviews were a foresight exercise, where the participants proposed desired pathways towards the development of PEDs. Based on their different cultural configuration context, we posit that distinct approaches in energy transition are essential for the effective formation of PEDs. We argue that policy interventions on decarbonisation should be tailored to different situations and bringing the cultural perspective into policy design is one way of incorporating the differences in contexts. As the policies are implemented at different governmental levels, future research on to what extent the differences in cultural configurations play role in multi-level governance in decarbonisation will be important.

Keywords—decarbonisation, policy, positive energy districts, culture

I. INTRODUCTION

The EU’s Strategic Energy Technology Plan (SET-Plan) has set out a goal to create 100 Positive Energy Districts (PEDs) in Europe by 2025. PEDs are “energy-efficient and energy-flexible urban areas or groups of connected buildings which produce net zero greenhouse gas emissions and actively manage an annual local or regional surplus production of renewable energy. They require integration of different systems and infrastructures and interaction between buildings, the users and the regional energy, mobility and ICT systems, while securing the energy supply and a good life for all in line with social, economic and environmental sustainability [1].” With some of the first PEDs being already implemented in the region including Hunziker Areal, Schoonschip, and Samsø Island among others [2], further progress is expected with a horizon of 2040.

As complex systems, PEDs require transformation of the current energy system towards decarbonisation. This transformation implies creating pathways for transition over time, which depend on several factors, such as geographical scales, contextual factors, or past implemented policies, and are expected to vary across contexts [3,4]. Derkenbaeva et al. [3] investigate possible pathways towards decarbonisation in several regions in the European Union (EU) and the United Kingdom (UK) addressing four themes that are considered as prerequisites for achieving PEDs. These prerequisites are participation and collaboration between stakeholders, techno-economic development, business models, and equity and energy poverty. Based on the analysis of interviews conducted in each observed region, the authors compare the current regional energy system with the desired future system, and present desired pathways for each prerequisite.

The findings of [3] suggest that the studied regions share a similar vision of the future energy system across the four prerequisites, however, pathways to achieve it differ based on regional contextual features and should be approached with a human-centric focus; that is, citizens and local actors such as business and users of local services require different types of information, incentives, and social conditions to be convinced in creating PEDs. For instance, it is found that citizens respond differently to having a renewable energy built in their vicinity depending on specific elements of policymaking such as actors’ roles, timing or the institutional room of maneuver given to the actors [5]. Also, the perception of top-down decision making is found to create opposition [6]. The human-centric focus is highlighted as the most important in developing PEDs which is to be facilitated through regulatory and policy advancement [7]. This human-centric necessity raises the need to consider Europe’s heterogeneous cultural context of each locality. It is found that people’s approach in solving a common problem or achieving a shared goal, or how they respond to changes within an organisation differ depending on the local culture they are likely accustomed to [8,9,10,11,12]. This study, therefore, complements the earlier work of Derkenbaeva et al. [3], aiming to uncover different human-centred approaches of enabling locally proposed regulatory frameworks for achieving PEDs based on the local cultural context.

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This study argues that the cultural framework can be applied to the case of creating PEDs. It is because stakeholders' willingness to cooperate and thrive in response to government policy depends on their perception of how to behave within an organisation or other collective environment. This is expected to differ by the culture that most of the people in the region follow. Unsurprisingly, in the interviews conducted in different regions [3], stakeholders' approaches in choosing pathways to achieve the common prerequisites differed, depending on their understanding of the local community's pattern of dealing with government regulations and initiatives [3]. To make sense of this, we introduce four configurations that allow for greater understanding of how different cultures may require different choices in policy instruments to effectively deliver PEDs: *Market, Machine, Family, Pyramid*. In this report, we demonstrate how the choices of policy interventions in delivering PEDs differ depending on the cultural context of a region, but do not claim to be able to predict how successful a policy intervention will be in a particular case. The specific dimensions other than culture are also important in the success or failure of an intervention, but we explore and focus on the tendencies that appear in relation to culture.

The remainder of this study is structured as follows. Section II introduces a conceptual framework of this study including discussion of prerequisites of PEDs and the concept of culture. Section III briefly presents the research design that is followed by the discussion of distinct approaches of policy design for decarbonisation in Section IV. The paper is concluded by summarising the key insights of the study and outlining potential future research directions in Section V.

II. BACKGROUND

In order to understand how policy interventions can assist the creation of PEDs, we address the four prerequisites of the PED pathway introduced in [3] and present the cultural framework that highlights different contextual factors of each region.

A. Prerequisites

The complexity and novelty of PEDs as an energy system and the drivers and barriers of enabling the transition require *participation and collaboration* by all the stakeholders (e.g., citizens, experts, local businesses and users of services) from the beginning of the transition including the start of discussions about the future PEDs and throughout its development [13]. This transition on the other hand, will require an economic justification for the relevant investment and environmental and social justifications for the deployment of relevant technological solutions [14]. The *techno-economic utilisation* ensures local accountability and the use of appropriate solutions allowing, for example, long-term building efficiency and inclusion of future needs such as sustainable mobility. The novelty of the concept allows different sustainable *business models* [15]. These business models are often oriented towards product-service solutions (PSS) that have a potential to minimise environmental impact of both consumption and production [16].

The development of such transitions requires promoting a higher level of quality of life for the residences and users of the district, mitigating and eliminating at the same time negative effects of energy (or other type of) poverty [13]. In the UK, for example, in 2014 and 2022, changes in energy prices were found to leave poorer households more vulnerable

because they tend to live in less energy efficient houses and were financially restricted. This could mean that an energy transition might have the greatest negative impact on poorer households through changing energy prices [17] if the policy does not consider appropriate mitigation actions. Energy transition initiatives may also lead to gentrification [18], or increase inequality between regions that have varying levels of infrastructure and relevant services [19]. Therefore, *equity and energy poverty* are factors that are required to be considered in this transition. The above four angles of attention – participation and collaboration between stakeholders, techno-economic development, business models, and equity and energy poverty – are considered as central issues to be addressed in the policy interventions for decarbonisation as *prerequisites* for achieving the goals of PEDs.

B. Culture

To effectively consider the four prerequisites, we introduce two dimensions of culture (Power Distance and Uncertainty Avoidance) that vary a lot across Europe [8]. These two dimensions are expected to have a significant influence on how people would respond to the policy measures implemented in order to deliver a PED.

Power Distance is closely related to how people may respond to changes in regulations and interventions supporting new energy initiatives. The Power Distance of a society refers to how dependent a subordinate is on a boss or authority. In a culture with small Power Distance, subordinates feel comfortable to approach and contradict their bosses, whereas in a culture with large Power Distance, there is considerable dependence of subordinates on bosses. Motivation of citizens to take part in energy transition initiatives may differ depending on the Power Distance of the culture, because people will have different preferences or expectations as to who should initiate the changes required to realise the transition. For instance, in societies with large Power Distance, people may not feel empowered to take initiative in tackling social challenges such as energy transition, which means a top-down approach will work. Literature finds that high Power Distance has a negative effect on how much gender-diversity improves firm performance [9] and on a nation's capacity to develop green technology [10].

Uncertainty Avoidance of a society refers to the "extent to which the members of a culture feel threatened by ambiguous or unknown situations" [8]. The changes needed to be made by stakeholders in order to achieve energy transition, including changing habits, investing in or engaging with new technology, and collaborating with new partners, involve much uncertainty. Different cultures have varying unwritten rules regarding such uncertainty [20] and this is likely to affect the acceptability of different types of interventions. For example, uncertainty-avoiding cultures show a preference for specialist knowledge, while uncertainty tolerant cultures tend to believe in common sense. It is suggested that a country with a strong Uncertainty Avoidance tendency will be less accepting to new technology [19,20], possibly requiring endorsement from experts. Therefore, the Uncertainty Avoidance of a culture is likely to have implications for how policy communication and process of integration works better in a specific region.

Power Distance and Uncertainty Avoidance have been used in many studies as dimensions that measure how people understand organisations [6,12]. Based on a study across over

40 country branches of a multinational, each country was scored with respect to Power Distance and Uncertainty Avoidance [8]. With the two dimensions categorised to high and low, four configurations of culture – the market, family, machine, and pyramid – were defined as presented in Fig. 1.

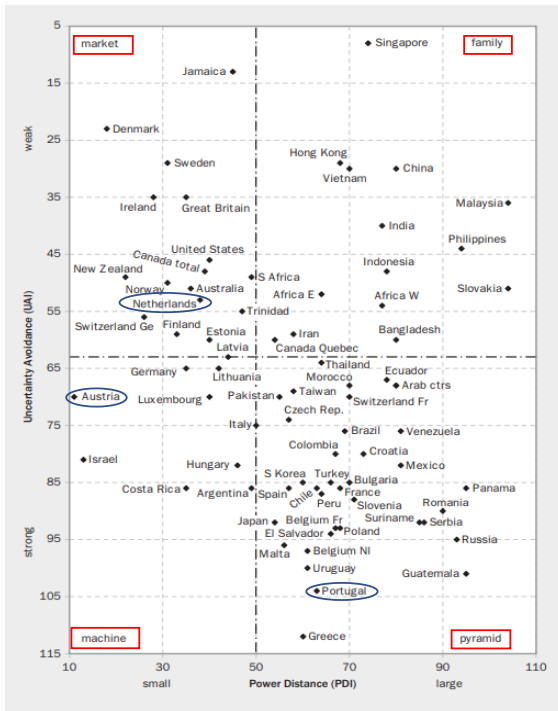


Fig. 1. Countries by cultural configurations [8]

Market

A market driven cultural configuration is one where people often do not feel a strong sense of inequality between those who have authority and those who do not, and are comfortable with getting into uncertain situations. With such a culture, it can be expected that citizens are often driven by their own perceptions of “what is in it for me”, to take steps towards a sustainable energy future that fits the values of them and the people they relate to. In these regions, the goal of energy transition will rely on market and consumer pressure and adaptation of business practices.

Machine

Centred on expertise and procedure, people of the machine cultural configuration tend to respond well when there are transparent and reliable procedures that use the expertise of professionals. In such a group, people do not feel alienated from those with power, as they can use a prespecified process of interaction and influence, and they do not like to take steps that have much uncertainty. Regulation that clearly originates from participatory mechanisms that raise the needs or demands of citizens, which have been detailed and operationalised by experts is expected to work in these cultures. For instance, government regulations on building energy efficiency based on sound research would be an affective intervention in regions with the “machine” culture.

Family

The people who belong to the family configuration of culture feel a wide gap exists between those with authority and those without, yet they are comfortable with situations that exhibit uncertainty as they can rely on the social network of

their community. In this setting, people may not feel the responsibility to strive for energy transition goals, because it is perceived as the responsibility of the collective community in the form of the local authorities to set and implement policies to achieve these goals [10]. Therefore, in this cultural configuration, it can be expected that communities take innovative steps towards energy transition goals, if they see the need or benefit of the goals at community level (e.g., equity and energy poverty mitigation) and at the same time a trusted leader exhibits initiative and confidence in the benefits of such efforts, allowing their quick adoption of change.

Pyramid

People living in a pyramid cultural configuration, live in different levels of authority not socialising much across levels. Most often they are not comfortable with taking action where the consequences are uncertain, aiming to operate inside their level of pyramid – e.g., professional or societal groups [20,19]. For a population where such a culture is dominant, to take actions towards energy transition, requires detailed and specific directives or regulations set forth by an authority, for instance, the different levels of government, reassuring benefits at the common level of the pyramid (e.g., social benefit or business benefit) and maintaining responsibility of authorisation at their layer of authority.

C. Conceptual framework

To achieve the desired positive energy system by 2040, decarbonisation policies will be necessary to accelerate the transition. Looking at the four prerequisites, each through the prism of the four culture configurations, is envisioned to contribute to the discussion of how each of the prerequisites can be realised through *context-appropriate* policy interventions (Fig. 2). With this study, we demonstrate a range of examples of differences in local culture in three regions, Amsterdam, Vienna, Lisbon, to effective policymaking promoting energy transition.

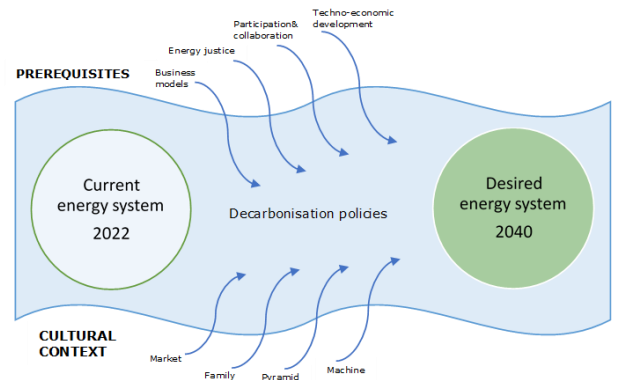


Fig. 2. Conceptual framework

III. RESEARCH DESIGN

The four prerequisites of the decarbonisation pathway are important elements in developing PEDs. However, these prerequisites are unique for different cultural contexts. These two aspects – the prerequisite and the cultural context – need to be addressed concurrently in the policies on decarbonisation. To do so, we use the original data of a foresight report on energy transition towards decarbonisation in eight regions in the EU and the UK [3], focusing on three of those regions: Amsterdam, Vienna, and Lisbon. The foresight report includes a discussion of the current state of the

energy system and the desired energy system under the perspectives of the four prerequisites. Furthermore, it offers possible desirable pathways to achieve the proposed desired state in each region.

The analysis in this paper is based on the primary data, collected via semi-structured interviews conducted with stakeholders from the observed regions. The interviews were a foresight exercise, where the participants proposed desired pathways towards the development of PEDs [3]. Interviewed groups of stakeholders included citizens, policymakers, industry representatives, technology experts and researchers, and representatives of environmental non-governmental organisations (NGOs). We use the findings of the foresight report to further uncover possible choices of the policy instruments and propose further how they can be approached for the observed regions under the context of the local cultural configuration [8], highlighting the human-centric nature of the transition policies. It is important to note that in this study, we introduce the culture referring to the general context of the region, while we do not address individual cases. Bringing the four prerequisites and the cultural context of the regions together, we then offer approaches for decarbonisation policies intervention in the three regions. The research flow is shown in Fig. 3.

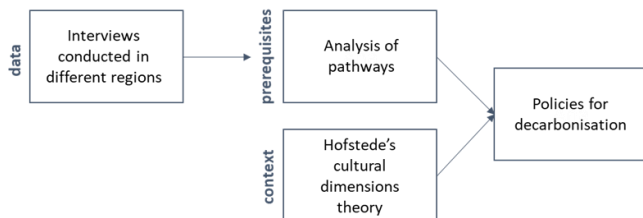


Fig. 3. Research flow

IV. ONE SIZE DOES NOT FIT ALL: POLICIES FOR DECARBONISATION

The cases of Amsterdam, Vienna, and Lisbon are categorised in a distinctive cultural configuration quadrant (Fig. 1) in which Amsterdam is categorised in the cultural configuration of “market”, Vienna – of “machine”, and Lisbon – of “pyramid”. Based on their different cultural configuration context, we observe distinct approaches in the energy transition.

A. Policies to improve collaboration between stakeholders

Collaboration between stakeholders working in all levels of the government and businesses, and in particular, the active involvement of citizens, is considered as an important prerequisite to achieve the desired positive energy transition.

The views of energy experts in Amsterdam coincide with what is expected of people in a “market” configuration. The momentum of change is expected to come from citizens or communities who act according to their individual interests and values. Community-level initiatives are crucial to inform further actions from the government. Furthermore, the national government is expected to facilitate the change led by citizens, by providing flexible regulations, and all levels of government is expected to provide information and expertise, and to stimulate communication among citizens and between different stakeholders, such as citizen-businesses. Larger businesses are expected to contribute by consulting citizens, sharing information, and adjusting their role to better align with the goals of citizens and government, allowing and often

facilitating a more decentralised energy system. Therefore, in cultures similar to that of Amsterdam, citizens are expected to be the momentum of change with the government assisting their collaboration and communication with businesses that can share necessary expertise and technology.

In the case of Vienna, characterised as the “machine”, expertise and procedure are important in pursuing change. Industries, which hold a lot of the information and expertise needed for change, are thus, given a large role. Specifically, utilities, real estate, and transport industries, are emphasised as important actors adjusting their priorities and adopting measures towards decarbonisation. Furthermore, the interviewees mentioned that government officials should be trained to create appropriate structures to involve citizens in the transformation to future energy systems.

In the case of Lisbon, with a “pyramid” cultural configuration, the main focus of change is put on politicians and officials working in the national and local government. The national and local government must work together to provide the appropriate policies and financial schemes, the national government setting clear energy transition goals to municipalities. It is also highlighted that researchers, government, and businesses can exchange knowledge to learn about experiences and best practices from all over Europe to transfer their knowledge to the design of the schemes.

B. Policies on advancing techno-economic solutions

Techno-economic solutions for energy transition often are based on two approaches. On the one side, policies might be designed in a way that would motivate citizens to engage in the energy transition voluntarily, for example, by offering a governmental financial support (e.g., subsidy) or a one-time payment as a reward for implementing recommended energy efficiency measures. This kind of policies are expected to encourage citizens to participate in the energy transition along the government (i.e., the municipality) being a partner, not a “boss”. On the other side, policies might take an obligation approach, following which citizens would be expected to comply with a specific standard (e.g., passive houses). This kind of policies works as deterrent, as penalties would potentially be imposed if they fail achieving the standard. Therefore, it might often encourage citizens to engage more in the energy transition but only because they would be motivated to avoid paying fines. In such cases, the government must take a leading role in execution of policies.

In Amsterdam, the interviewees suggest that techno-economic policies would need to take a motivating manner where people get some incentives for implementing energy efficient measures. The cultural configuration that describes Amsterdam is where people want to feel a strong sense of equality. If there are incentives and economic benefits offered to promote equality, citizens of Amsterdam might take more initiative and actively engage in the energy transition. Therefore, for this and similar cases that represent the “market” culture, it is meaningful to design the policies in a way that citizens make a voluntary decision to engage in decarbonisation while being treated equally to other stakeholders (e.g., getting the same information, being able to make decisions and choose), and offered financial benefits (e.g., incentives, subsidies).

In the case of Vienna, the same policy will work better if it is designed following its cultural configuration – “machine”, that is centred on expertise and procedure. The

techno-economic policies on decarbonisation are expected to be based on scientific facts and reliable procedures proved by energy experts and offer a balance between incentive and deterrent. Importantly, there should be a step-by-step plan that meets the energy needs of citizens and addresses certain expected results.

In the case of a “pyramid” cultural configuration, however, there is an expectation that policies will be compulsory to follow. Citizens and businesses often feel that the municipality is responsible for introducing policies and actions and it is preferred to receive top-down guidance from the central government. Despite that, the implementation requires to respect local layers of bureaucracy, creating multiple levels of gate-keeping type of authority as the level of distance from authority creates mistrust across the different layers. The obvious danger of this approach, however, is the dilution of techno-economic benefit across these layers of authority.

C. Policies on creating attractive business models

Attractive business models for the energy transition are the ones that are not about profit but creating a liveable environment for citizens. Therefore, a human-centric approach in designing policies on energy business models should be prioritised. To create attractive business models, cultural configurations of different localities must be understood and considered.

In market-type culture as Amsterdam, energy consumers derive much more value from their role in initiating of and participating in energy projects, where they can engage with neighbours and have influence on larger societal decisions such as where the communities’ energy comes from. In this cultural configuration, it is important for citizens to have the right to make their own decisions, while the government is seen as an advisor and a responsible body for financial, technical, and regulatory solutions. Citizens expect the municipality to communicate with them in an equal position with regards to energy transition decisions, so that citizens’ opinions are considered. Therefore, business models that are initiated bottom-up and supported financially by the government (i.e., national or local (regional/the municipality)) are the ones that will appeal to energy consumers.

In machine-type culture as Vienna, business models are expected to serve as an evidence-based guidance for decarbonisation, where the innovative solutions will be prominent. Interviewees mentioned that there are businesses that are driven by competition and excellence in the field of innovation that are highly valued by citizens. Thus, the business models in a machine-type culture are expected to be designed based on the expertise of professionals and led by the partnership of public-private entities.

In pyramid-type culture as Lisbon, energy business models with economic returns are envisioned to be important for accelerating decarbonisation. In order to encourage a building owner to invest in energy efficient measures, the regulations should be mandatory (with a partial financial support from the government (national or local)) to make the community to be more active in the energy transition by contributing their financial resources. Therefore, the government is expected to take a leading role in creating attractive energy business models and make it mandatory for citizens to participate.

D. Policies on achieving an inclusive transition

The insight shared by stakeholders on inclusivity and affordability in the energy transition appeared to be affected more by the significance of the problem in the region and the types of stakeholders interviewed rather than the cultural configuration of the region. Stakeholders in Lisbon mentioned a wide variety of solutions to tackle the issue of equity and affordability in energy transition, compared to Amsterdam and Vienna – regions that are comparatively less affected by energy poverty.

The interviewees in Lisbon suggested that improved knowledge about vulnerable groups and district-level government’s involvement in retrofitting houses occupied by lower income households as the most important actions needed to achieve a more inclusive energy transition. Public consultations, especially face-to-face communication with citizens, were suggested as a way to understand citizen concerns about the affordability of energy. Further, inclusion of vulnerable groups in community initiatives is also emphasized as a way to achieve equity. The awareness among policymakers on the issue of energy poverty is also suggested as a crucial factor. Finally, increasing building energy efficiency, with the proactive involvement of the district government, is suggested to be a major change that needs to happen to alleviate energy poverty. The policy interventions discussed by the stakeholders in Lisbon emphasize expertise and the role of the district government and policymakers, which are characteristic of the “machine” and “pyramid”.

The interviewed stakeholders in Vienna were focused on awareness raising and economic benefits as a way to achieve equity in energy. Fostering the ability of lower income households to utilise energy efficient technology as well as to use energy efficiently through behaviour change was suggested as ways to protect the energy-vulnerable. Using public funding to be used on vulnerable sections of the population and decreasing tax burdens were also noted as solutions to alleviate energy poverty. In Amsterdam, stakeholders acknowledged that much of the tax benefits and economic incentives concerning the use of renewable energy or energy efficient measures do not consider equity as a factor, targeting only homeowners and excluding older people. As a solution, awareness campaigns can give the vulnerable population more information on energy efficiency in the house. Stakeholders in both Amsterdam and Vienna suggested shared mobility as initiative that can achieve more equity. Interestingly, the two regions, Amsterdam expected to be a “market” configuration and Vienna – a “machine”, suggested interventions expected to work in the “market”, with emphasis on awareness, and “pyramid” – with focus on tax and subsidy schemes.

V. CONCLUSION

This study aims to uncover possible ways of enabling a regulatory framework for achieving PEDs based on the local context with a human-centred focus. We address the four prerequisites of the PED pathway introduced in [3] and discuss different cultural configurations of the three case studies that represent the “market”, “machine”, and “pyramid”. The cases are not meant to be compared with one another, but rather demonstrate various examples of how the concept of culture can inform the policy design. Our set of Europe-wide cases illustrates that a culture-aware approach

can contribute to the likelihood of successfully achieving PEDs. However, every case has its unique particulars that cannot be captured by society-level construct such as culture, and should be given due consideration as well.

This study significantly contributes to the existing literature on policies for energy transition [5,22,23,24] by addressing the prerequisites for achieving the goals of PEDs and incorporating the prism of the culture in designing policy interventions for decarbonisation. Bringing the cultural perspective into designing the policies is one way of incorporating the differences in contexts, and thus, presenting policy interventions that are tailored to different situations.

However, this study has only focused on a city level, and the government has been referred to the municipality of the cities in this context, unless otherwise specified. As the policies are implemented at different governmental levels, it will also be essential to investigate to what extent the differences in cultural configurations play role in multi-level governance in decarbonisation. Therefore, future research on a more comprehensive framework for policy design for decarbonisation based on the combination of multi-level governance concept and the concept of culture is promising.

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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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