WHY

D5.3

Policy briefing and Social Impact Assessment

LEGAL DISCLAIMER

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 891943.

DOCUMENT INFORMATION

Deliverable title	Policy Briefing and Social Impact Assessment
Dissemination level	Public
Submission deadline	31/01/2024
Submission date	31/01/2024
Version number	1
Authors	Panagiotis Fragkos (E3M), Theofano Fotiou (E3M), Eleftheria Zisarou (E3M) Thomas Nacht (4ER) Cruz Borges (UD), Ruth Garcia (UD) Francesco Dala Longa (TNO) Leire Astigarraga (GOI) Amanda Schibline (RGI)
Internal reviewers	Deitze Otaduy (UD)
Document approval	E3M, UD, 4ER, TNO, RGI, GOI
Scope of the document according to the DoA	Public report delivered at the end of M39. The report will include a detailed assessment of the results of the simulations carried out providing policy-relevant insights. Different aspects of sustainability will be evaluated on every Use Case including ethics aspects. An accompanying policy brief (max 10-15 pages) targeted to policy makers will also be developed, providing policy recommendations. This deliverable will be peer reviewed by policy experts.

EXECUTIVE SUMMARY

This report presents the Ethical Assessment Methodology and policy briefings developed within the WHY project, aiming to inform policy makers on how energy consumers can reduce their energy use and CO2 emission footprint from the local to the EU level.

The ethical assessment approach, characterized by an 'insider' perspective, involves a thorough analysis of social implications, effects, and consequences extending beyond mere technology acceptance or rejection. The methodology, unfolding through six systematic steps, is applied to the WHY project use cases in Maintal and Energy Cooperative. These case studies unveil varied perceptions regarding prioritizing energy services during blackouts and collaborative efforts to combat energy poverty. The accompanying semi-structured interviews emphasize collaboration between local authorities and energy communities, shedding light on challenges and determinants.

The inclusion of two policy briefings – the EU policy brief and the Local policy brief – is pivotal to inform local and EU policy makers on WHY research and provide them relevant recommendations. The EU policy brief stresses the imperative role of energy efficiency and decarbonization in the residential sector, advocating for low-carbon energy sources and clear, supportive policies combined with a strong uptake of renovation and heat pumps. Recommendations encompass incentivizing energy efficiency improvements, robust building regulations, policy tailoring to national contexts, and smart redistributive policies for a just transition. The Local policy brief focuses on disseminating key results for stakeholders in the energy transition at local scale focusing on energy communities. Recommendations span active individual participation, sustainable neighborhood planning, energy cooperative support for communities, and improved models for EU energy policies.

Ultimately, the goal of this report is to contribute significantly to the EU's climate and energy goals for 2050 based on WHY research results, emphasizing ethical considerations and providing clear policy recommendations for a sustainable and inclusive future.

TABLE OF CONTENTS

TABLE OF FIGURES

LIST OF ACRONYMS AND ABBREVIATIONS

Acronym	Long text
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
EU	European Union
EC	European Commission
EV	Electric Vehicle
CO2	Carbon Dioxide
EE	Energy Efficiency
DR	Demand Response
ESM	Energy System Model
UCM	Use Case Manager
IDEA	Institute for Diversification and Saving of Energy
REC	Renewable Energy Community
CEC	Citizen Energy Community
KPI	Key Performance Indicator

1 Introduction

The WHY project develops innovative methodologies and a toolkit for short and long-term household energy consumption modelling with the aim to improve the understanding of what, when, how much, and why energy is consumed at households. The WHY Toolkit builds on the causality chain to model the energy demand, building on associations between measurable variables. The WHY Toolkit is then linked with large-scale Energy System Models (ESM) in order to improve their representation of household energy consumption and the emergence of new business models and options, like energy communities, prosumers, decentralised power generation. The soft-linked version of the WHY Toolkit is applied and evaluated in five Use Cases, capturing a wide diversity of contexts from local micro-grid and energy community to national, European, and global level. The use cases act as a real-life proof of concept of the WHY methodology, validated through a comparison with previous studies (without the use of WHY Toolkit) to re-assess policy interventions.

The Use Cases are a key part of the WHY project ambition to create an improved and transparent energy modelling framework especially in the household's sector. The Use Cases will serve to test, validate, and demonstrate the WHY toolkit and its links to leading Energy System Models (as described in project deliverables D3.1, D4.1 and D4.2). The results of the use cases are described in detail in the deliverable D5.2 aiming to demonstrate the relevance and adequacy of the WHY toolkit to enhance the modelling of energy consumption in the residential sector at local, national, European, and global levels. The current policy report includes a detailed ethical assessment of the results of every Use Case of the WHY project. It also includes the two policy briefs developed to illustrate the policy recommendations that can be derived from the WHY research, focusing on two levels: the local level (energy community, positive energy district) and the EU level. These policy briefs are targeted to local and EU policy makers, providing policy-relevant recommendations. The report also includes the Layman's report of the WHY project.

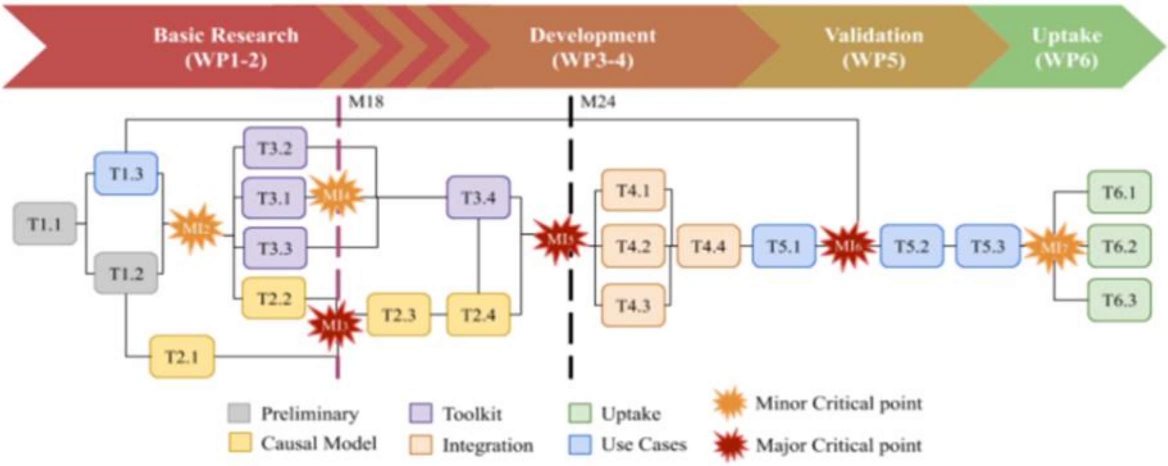


Figure 1. WHY PERT diagram

The report is structured as follows: Section 2 provides an overview of the ethical assessment methodology and the applications used in the WHY project. Section 3 includes the two policy briefs developed in the WHY project, focusing on the local and EU level respectively. Section 4 includes the Layman report of the project, while Section 5 concludes.

2 Ethical assessment methodology and applications

An interpretation of the ethics of technology as acceptance or rejection of technology places technology and society in opposition. This image does not do justice to the interconnectedness of this two spheres and call ethics for assume a different and leading role. Consequently, any ethical analysis must be based on the socio-technological drivers and relationships created by the new set of practices coming from the innovation processes and applications. In this vein, "insider", approach for ethics is necessary, an approach that is not focused on the question of whether a technology is acceptable or not, but rather on whether and under what conditions a technology can participate in responsible construction of the society.

The aim of these ethical assessment sessions, arranged from November to January, was to compare the results of the interventions carried out in the Case studies. The use of ethical evaluation systems is a widely considered practice when it comes to testing social interventions and has become particularly relevant in the case of processes related to energy transitions [1234]. Including these contrasts is not only a priority of the Consortium in terms of co-construct the knowledge with stakeholders, also addresses the commitment to carry out systematised analyses of the social aspects and social implications, effects, and consequences through the facilitation of ethical reflection spaces.

The ethical assessment sessions brought together experts mainly from academia but also engaged in practice. The fields of expertise of the participants were related to efficiency and energy-related aspects, socio-technical processes, technology (impact) assessment, actors in transformation processes and disciplines such as ethics, politics, sociology, ethics of technology, economics and ethics of business, philosophy, gender studies and human rights studies.

Among the many elements that have been contrasted, the factors that affect the investment decisions of households immersed in energy transition processes; the envision of challenges of being able to explain why significant differences are observed between Europe and some LATAM countries when it comes to establishing criteria for this transition; the proposal of possible implications and corrective measures, as well as concepts such as governance, social impacts, projections of paradigms within the Use cases are considered.

2.1 Methodology for ethical assessment

The considered methodology for the ethical assessment (EA) is based on an insider approach, focusing on the question of **whether** and under **what** conditions a technology can lead a

---

[1] van Bruxvoort, X., van Keulen, M., Corvo, L., Pastore, L., Manti, A., Iannaci, D., van Bruxvoort, X., & van Keulen, M. (2021). Framework for assessing ethical aspects of algorithms and their encompassing socio-technical system. Applied Sciences (Switzerland), 11(23), 1–16. https://doi.org/10.3390/app112311187

[2] Delacroix, S., & Wagner, B. (2021). Constructing a mutually supportive interface between ethics and regulation. Computer Law and Security Review, 40, 105520. https://doi.org/10.1016/j.clsr.2020.105520

[3] Roth, L., Lowitzsch, J., Yildiz, Ö., & Hashani, A. (2018). Does (Co-)ownership in renewables matter for an electricity consumer's demand flexibility? Empirical evidence from Germany. Energy Research and Social Science, 46(July), 169–182. https://doi.org/10.1016/j.erss.2018.07.00

[4] Manso-Burgos, Á., Ribó-Pérez, D., Alcázar-Ortega, M., & Gómez-Navarro, T. (2021). Local energy communities in spain: Economic implications of the new tariff and variable coefficients. Sustainability (Switzerland), 13(19). https://doi.org/10.3390/su131910555

responsible role in society. Moreover, the question of how technology is introduced, is considered primarily to understand the determinants of the social implications and to disentangle the typologies of the groups that are impacted by an intervention or an interaction with any eventual technology or solution.
This **insider** approach can be integrated with diverse methods such as **ethically informed foresight analysis**[5]**, social and economic impact assessment (SEIA)** approaches or **human rights impact assessment (HRIA)** and is aligned with considerations such as **Ethics-by-design**[6] paradigm which comprises a set of rules and considerations that seek to incorporate ethical principles as system characteristics. The relevance of this approach is related, among other questions, with the transversal consideration of ethics, in terms of dimension mainstreaming, has happen in the case of **Gender mainstreaming**[7]. While many of the ethical requirements are supported by legal requirements; ethical compliance cannot be subordinated to legal obligations, since ethics is concerned with the protection of individual rights such as freedom and privacy, equality and fairness, for building a better and more sustainable society[8].
Regarding the operational aspects, a 6-step methodology is proposed. The first 3 steps of the approach are conceptual and descriptive and are aimed at (1) determination of the subject, purpose and scope of the analysis and the stratification of the object of analysis, (2) description of the object of analysis, and (3) identification of impacts and stakeholders. The last three steps are the actual ethical analysis. These include (4) identification and specification of potential ethical issues, (5) analysis of ethical issues, and (6) evaluation and recommendations for ethical decision-making.

The first 3 steps of the methodology result in the contextualization of the interventions in terms for example of envisioning and determining the subject, such as technology fields, technological products, deployments of technology in a domain, and impacts of technology. Moreover, allows to determine the variety of aims for ethical analysis, and relevant parameters for determining key stakeholders of the technology, and likely and actual social, environmental and economic impacts associated with the technology.

The process of obtaining the insights has been orchestrated in terms of open and direct questions, for example in the case of the 1-3 steps in terms of:

- A review of the intervention with a fresh look
- Questioning the results mainly focused on finding the drivers of the differences between the control groups.

In the case of steps 4-6, the identification of the ethical issues associated with the subject of analysis are considered, through an analysis of the ethics literature and (potential) ethical

[5]Luciano Floridi and Andrew Strait Ethical Foresight Analysis: What it is and Why it is Needed? Minds and Machines (2020) 30:77–97 https://link.springer.com/content/pdf/10.1007/s11023-020-09521-y.pdf

[6] EU EC Ethics by design guidelines https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/ethics-by-design-and-ethics-of-use-approaches-for-artificial-intelligence_he_en.pdf

[7] Gender mainstreaming EU: https://eige.europa.eu/gender-mainstreaming/what-is-gender-mainstreaming?language_content_entity=en

[8] The ethics by design approach offers an additional tool to address ethics concerns and to demonstrate compliance with ethical standards, however its adoption is not mandatory in the EU legal framework.

issues identification as well as the consideration of the different forms of moral evaluation and ethical guidance paths, aimed at making moral decisions and solving moral dilemmas, distinguishing different methods for attaining them, and the possible involvement of stakeholders in these processes.

Examples of the questions for 4-6 steps in terms of:

- Identification and specification of potential ethical issues
- Analysis of ethical issues
- Implications of these results
- Recommendation of corrective or intervention measures

The sessions have been structured in two parts. In the first part, the WHY team gives presentations on the research objective of the project, the design of the interventions, the insights of the use case (characteristics and typology of the sample, assumptions and hypotheses...); followed by questions and answers for clarifications. In the second part, the context of the intervention was provided and the results of the intervention were discussed, followed by the compilation of the main points of the discussions in the expert plenary.

Figure 2: Vision of the participants in Ethical assessment sessions.

2.2 Application in the Maintal Use Case

The ethical assessment for the Maintal Use Case was focused on the assessment of the prioritisation of energy service in terms of considering what energy services should be prioritised under different types of blackouts.
In the first steps of the assessment, the results from the two surveys carried out were presented, focused on Spain (GoiEner customers) and LATAM contexts (Prolific sample) considering that each person rated different energy services from 1 to 10.
The considering services were:

- Ensure that drinking water is available in my home.
- Allow me to cook.
- Allow me to commute long distances.

- Allow me to communicate with my family and peers.
- Allow me to clean the house.
- Allow me to heat my house.
- Allow me to cool my house.
- Allow me to move goods.
- Allow me to work at home.
- Provide me and the family with entertainment.
- Allow me to light up my house.
- Allow me to operate a Home Energy Management system.
- Allow me to operate the washing machine, dishwasher, etc.
- Allow me to keep the food refrigerated.
- Allow me to generate hot water for the appliances.
- Allow me to generate hot water for showering and cleaning.
- Allow me to operate home security systems.
- Allow me to operate my smart home devices
- Allow me to operate ventilation.

The first consideration in the process of contextualization (steps 1-3) was related to the intention of the survey, in terms of being designed to grasp the individual concerns since the questions were considered from the point of view of residential services without taking into account essential services and avoiding the consideration of a blackout derived from an emergency. This consideration was pointed out as very relevant since was considered affecting the context of the decision in terms of moral decisions that can be collective or individual. In this vein, the experts considered that if the view was purely individual and not referring to essential services, the considerations were located under the point of view of comfort of each house, family, or individuals.
The direct open questions for assess the reasons for the different collectives' prioritizations were considered the following:

- What are the reasons that give rise to these priorities?
- What can we say?
- What do we prioritise in the short term?
- What do we not prioritise?

The results of the ethical assessment (steps 4-6) envisioned that, while the top priorities for both Spain and LATAM were ensuring the drinking water and the capability to cook, along with sustain and ensure the tele work, the smart technologies and securities facilities, were the least prioritised. In contrast, ensure to have entertainment through electrical systems was very high in Spain and LATAM.

An overview of comparative observation considered that there were no significant differences between partial blackout and total blackout which can be related with the fact that the context of a total blackout has not been understood. Moreover, the differences between the assessment of thermal comfort, were considered biased, probably due to the origin of the samples (Bilbao) and LATAM countries with not too extreme climate.

A consideration of determinants for the differences in the study, were considered in terms of the globalisation levels within societies. In these terms, in the globalised societies the proximity of family members in the environments can be compromised, as well as diaspora phenomena that make the ability to communicate with family members one of the top priorities.

Ensure telework, communications and transportation facilities and its prioritisation, was considered, from the point of view of the transportation issues and jobs precarceration, since these drivers, in LATAM were all considered as a higher priority, since the amount of people being moving for a variety of activities from work to leisure activities is higher.

Regarding the decision-making capacity between a partial blackout and a total blackout was considered from the point of view of the community synergies, since in a short-term blackout, the decisions and the priorities only affect the individual sphere, in terms of families or properties and in the case of longer blackouts, individuals transfer the decision-making capacity to the institutions, security services, to the emergency authorities which take the control.

In this vein, the considered measures were, the revision of socio-economic situation as well as the income, to be evaluated, as a cross check reference to the data, as well as the distribution of living units, in order to assess the weight of the variables of cooking/heat/ as well as security/ teleworking/ entertainment. Moreover, the consideration that there are no minimum standards for being without power at the residential level in terms of receiving financial compensations in the event of a service failure and the difficulties of separating the priorities in a context of total electrification was considered.

2.3 Application in the Energy Cooperative Use Case

In this case, the effects of a change in tariffs and the appearance of possible risk groups and the most important determinants such as economic motivations or the absence of solidarity schemes were contrasted. In this respect, it was observed that the most disadvantaged groups were the most reactive to tariff changes and the most adaptable. However, these adaptations were often made at the expense of elements such as thermal comfort or other needs, whether basic or not, and were considered not always well identified. Those considered at-risk groups were very homogenised, and a more in-depth evaluation of the parameters was considered necessary in order not to overlook their determinants, such as energy expenditure in relation to disposable income, as well as the change in disposable income.

In this sense, it was considered that the drifts in savings capacity and the generalised rise in prices that has occurred in the last two years hindering the process to obtain the social determinants throughout the whole process. Related with the question of whether it is possible to separate the effect of the price increase from the concrete intervention and observe the effects of the tariff change; the possibility of reformulating this change in a positive way, emerges since a tariff change was considered providing an opportunity for disadvantaged groups. Thus, faced with the question of reviewing whether tariff changes have an impact on social spheres, a taxonomy of impacts was proposed with a structure of five determinants.

The proposed determinants were the **added value of generating environmental awareness**, **generating participation in the energy system**, **political perspective** in terms of social premises from the political perspective of the initiatives, **the financial aspects of energy efficiency systems**, a **commitment to reducing consumption in terms of savings and austerity**, and **efforts to prevent energy poverty**.
It should be noted that the determinants were considered in opposition, since on the one hand, the measures proposed for efficiency may lead to the chronification of energy poverty and vulnerability problems for these groups and on the other hand, the horizons of energy sovereignty associated with political and ideological determinants can be considered incompatible with global participation in environmental awareness.

2.4 Application in the Energy Community Use Case

The section analyses how new energy community-based business models can make the energy communities 'better' and lead to climate neutral cities by 2030.

2.4.1 Spotlight: How can energy communities and local authorities act to alleviate energy poverty?

Energy communities are considered to have a positive social impact in alleviating energy poverty (Hoika, C et. al, 2021; Koukoufikis, G. et. al, 2023; Schwanitz, V.J. et. al., 2023). It is, however, not clear how energy communities can act together with local authorities to alleviate energy poverty. To close this knowledge gap, within the WHY project, we conducted qualitative interviews of five energy communities and four local authorities (either from municipalities or from regional energy agencies), throughout Europe, to see the challenges, approaches and enablers that exist in their local contexts. As community energy initiatives are more widespread in Northwest Europe (Kultunov, M. et.al., 2023; Schwanitz, V.J. et. al., 2023), we emphasised the importance of conducting interviews with those from Southern and Eastern European regions.

The interviewees shared diverse perspectives, considering their role (either energy community or public authority), geography, business model, interaction with local authorities, and community population and cohesion (Figure 2).

Both energy communities and local authorities interviewed mentioned challenges related to establishing community-based energy projects generally, and the inherent complexity, financial risk, and scalability barriers of developing a business model that includes the most vulnerable citizens in order to alleviate energy poverty. For example, most energy communities interviewed, regardless of their location in Europe, had a phased implementation business model where initial photovoltaics were installed on a public building, such as a school or gymnasium and either was funded by member shares or an annual membership fee. Sometimes, vulnerable citizens were eligible for free memberships to the energy community through a lottery, but more targeted inclusion at the early stages of the energy community's establishment was considered too financially risky. Because of this, many energy communities planned to include more vulnerable citizens in their second-phase projects, via renewable generation in impoverished neighbourhoods, or setting up a membership scheme that is more inclusive to vulnerable citizens. In contrast, local authority-led community energy projects typically targeted energy efficiency retrofits for social housing first and added renewable generation as a second phase. This top-down, distributive action was positively impactful on vulnerable residents' liveability, but there was less community involvement in the process.

However, the interviewees also pointed to very insightful interventions that enabled energy communities and local authorities to include vulnerable citizens and alleviate energy poverty. These enabling measures, organised by economic instruments, regulation, and information type (Rogge et. al.), reflect the diverse needs of the energy communities and local authorities.

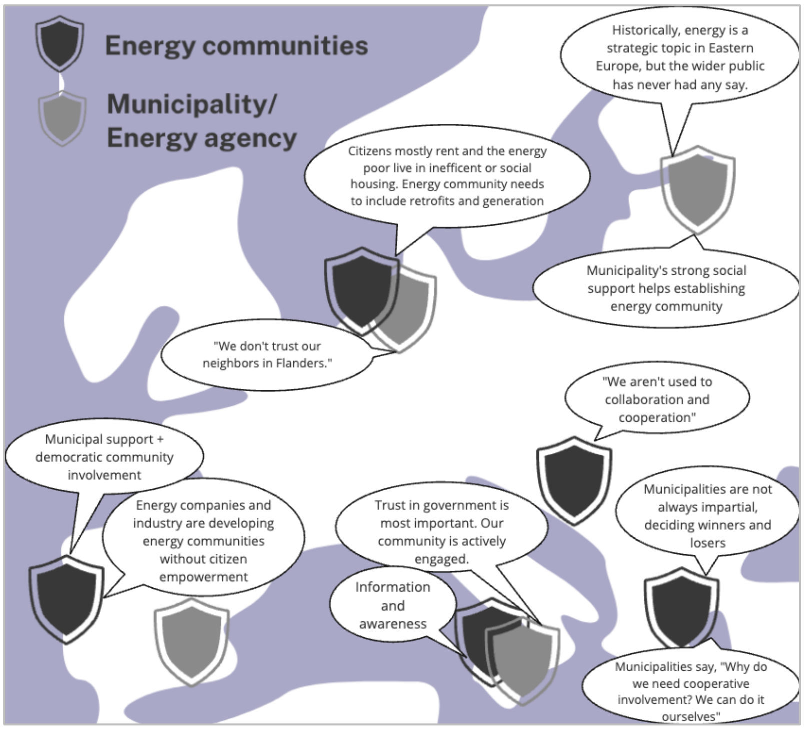


Figure 3. Diverse perspectives of energy community or public authority

Economic instruments: Public financial incentives need to be easily accessible and promoted for both the creation and operation of inclusive energy communities. Specifically, national funding mechanisms need to funnel to municipalities fairly to ensure vulnerable households are targeted. This is essential, as municipalities have a more personal connection with vulnerable households.

Regulation: Generally, both local authorities and energy communities agreed that it is most imperative to simplify the rules and regulations regarding energy communities. Transpositions of directives at the national level should encourage local authorities to be involved in the process of enabling the success of energy communities. The national level also needs to standardise documents and contracts for implementing energy communities. The major technical constraint for energy communities of national laws needs to be addressed to allow for energy sharing.

Information: Energy communities need national awareness campaigns that include simple step-by-step guides for how to develop an energy community. Specifically, there should be guides developed targeted to local authorities, such as municipalities or regional energy agencies, to engage vulnerable households to be involved in energy communities. Best practice exchanges between member states should be encouraged to facilitate cooperation to learn, replicate and share experiences.

Finally, the interview responses showed that local authorities, such as regional energy agencies and municipalities, can play a key role in bridging the gap to reduce the financial risk of energy communities to involve vulnerable citizens and increase the level of citizen awareness and trust. By providing technical, legal and administrative expertise assistance to the energy community, the local authority can enable more diverse citizen engagement in local energy community initiatives, helping the scalability and growth of the energy communities.

Figure 4. Regional energy agencies and municipalities, can play a key role in bridging the gap to reduce the financial risk of energy communities.

The insights from the interviews of both energy communities and local authorities throughout Europe enabled the WHY project to have a better understanding of the state of play of energy communities from diverse contexts. We found that energy communities are motivated to include the most vulnerable citizens, but lack the financial security to do so at scale, while local authorities have unique expertise to help bridge this and other gaps. Funding and enabling further collaborations between local authorities and energy communities would be an effective way to ensure that energy communities and local authorities can work together to alleviate energy poverty.

2.4.2 Semi-structured interviews

The most relevant questions that are being contrasted in the semi structured interviews, have been the followings:

- Policy and legislations: Covering concerns about how the legislation and in most of the occasion the lack of it, as well as the issues related with the national and regional translation of EU directives often stops the development of such initiatives and steers them towards non-diverse models with less viability and adaptability.
- Business model assessment: Covering mainly revision of the cooperative model and the so-called reflection around the cooperative models, since although the cooperative model is the prevailing one, the cooperative spirit has been lost among the members and the fact that it is used as a tool rather than as a business philosophy.
- Sustainability: Covering the replicability and scalability of the actions and project, the necessity of rescaling the activities.
- Governance: Covering the idea that governance structures need to be reviewed, expanded and also being certainly considered as a useful tool by the memberships.
- Future projections: Covering the assumption of new roles, the necessity of acknowledging the role of communities as transition agents and solidarity and justice schemes concerns.

Moreover, three more drivers are added:

- Engagement and community structures revision: Covering the reflexions around the agency, expectations, motivation and purpose of the energy communities along with the revision of the communities acting as fellowships in a transitions processes and democratization levels.
- Energy justice and energy poverty coverage: Covering justice and poverty approximation within and outer the community as the vulnerability of the social ecosystems built through around the communities.
- Political and regulatory stress: Covering energy and political sovereignty linked with political and ideological considerations of transition processes as well as the aspects in conflict such as lack of regulation.

A reflexion around comunitarism and engagement considers that, even though the prior motivation of most of the initiatives is related with collective self-consumption, a long-term projection requires from a further reflexion around business model selection, participation and governance or benefits distribution schemes. The most common situation founded within the consulted experts are the initiatives that starts in form of association, since it is considered the most flexible format when it comes to start an initiative. A cooperative is considered a longer-term option, which requires a long-term vision and an identification of cooperative elements such as trust, democratic structures, benefit sharing and solidarity schemes.

Moreover, the integration of systems for provide the capacity of offer heating and mobility services as well as the integration of other sources of energy such as biomass is considered. Within the project's projection, three trends are detected, the mobility, energy poverty alleviation and an integration with circular and local economy initiatives for develop and dynamism the local consumption. The limitation of this integration was considered hindered by the absence of knowledge, financial barriers and lack of agency in the institutions.

A critical review of the participation mechanisms was considered, since although the structures grow, participation does not grow, suffering for a stacking process. Moreover, the decision-making processes and structures, cannot ensure fully democratic processes.

The democratization levels are also considered from the point of view of the communities providing and determining the survival of a very fragile social ecosystems for example islands or very remote rural areas with these initiatives acknowledged as a communitarian initiative more than an energetic initiative.

In regard the engagement, there is an agreement regarding the consideration of having institutional actors, as a key element. The interviewed experts, considers that diverse partners/consumers are necessary but without losing the concept of collective benefit. Companies can also take different roles that are not so much related to consumption but are more related to the investment.

In regard justice and poverty coverage, elements from the difficulties of the communities for being considered as an agent of employability, development and fellowship and being considered a social initiative was considered. Also, most of the interview experts considered that is necessary to involve all the vulnerable collectives in the community, regardless of access and build the initiatives taking into consideration the vulnerable and no vulnerable members. Moreover, the consideration is related with being way from reaching energy sovereignty objectives, since the projects are very small, in this vein, the consideration of the relevance of the large initiatives involving local entities and energy communities as key emerges.

Regarding this eventual integration of projects, the interviewed experts considers that, although a mega-project can be not compatible at technical level, two models (EC and large projects) have to coexist, and for this purpose, built a legislation that protects competition, especially considering that are sharing common resources and consider constructive resistance that prioritises wellbeing is necessary.

The aspects relating to political and regulatory stress were considered with elements such as the contradictions that can occur in the translation of the norm, for example in the case of regulations that imply the integration of ECs in existing networks and those that do not, as well as cases in which there is conflict in the transfer of competences, as well as the consideration that communities palliate and assume competences when states neglect their functions.

3 Policy briefing

The section presents the two policy briefs developed in the context of the WHY project targeted to EU and national policy makers (EU policy brief) and local stakeholders and regional authorities (The Local policy brief), providing policy recommendations.

3.1 The Local policy brief: Better energy planning for urban neighborhoods

3.1.1 Introduction and Context

Energy system models (ESMs) are a set of mathematical equations that describe the energy system. Experts use these models to describe how changes in energy systems impact on society. Nevertheless, current ESMs lack accuracy in simulating the residential sector due to the large diversity of buildings. The European research project called “WHY”, financed by the European Union’s Horizon 2020 programme, developed a causal model to analyse people's day-to-day decisions when using energy at home. The international research team uses this causal model to understand people’s reactions to changes introduced in the energy market such as tariff changes, new taxes, rebates, changes in building codes, etc. These developed tools have been used to improve:

a. the assessment of household electricity consumption trends,
b. the knowledge of user behaviour in the modelling community and
c. the operation and planning of the energy distribution system.

The project's use cases assess the Fitfor55 and REPowerEU strategies, the global energy system and the creation and management of energy cooperatives and energy communities.
In particular, the local use case of Maintal addresses the challenge of transforming a municipality's residential energy system to an environmentally conscious, sustainable energy system. To be able to set up the relevant strategies and implementation plans, WHY can support municipalities and districts with very detailed simulations of household energy and water consumption already before setting up an investment. In Maintal, the WHY toolkit demonstrates one of its main strengths: the finely granulated simulation of household consumption that can be done on the very small scale of a household, up to the entire district.

The use case of energy cooperatives addresses the challenge of foreseeing the short, medium and long changes in the energy consumption when implementing different tariffs. Taking advantage of two changes on the electric tariff that were implemented in Spain the 1st of June of 2021 and the gas cap mechanism that was implemented in May of 2022, a behavioural model was built which allows to forecast both the reduction on energy consumption and the flexibility potential triggered by the change of tariff. This information is now used to design a new tariff for the clients of the energy cooperative Goiener.

3.1.2 Embrace diversity! Standardised load profiles are not representing the real people

We need to transition our energy system from an oligopolistic and fossil fuel based one to a decentralised and renewable one. In this scenario, people’s homes have to be part of the system producing and consuming energy in a variety of ways. This variety is becoming more and more diverse as new technologies, like PV panels, storage systems, heat pumps or electric charging points, enter the home ecosystem. Nevertheless, these new technologies generate interesting effects:

- Residential consumption behaviour becomes more diverse as the technical setup can differ vastly from one household to the next.
- The role of residential consumers is changing substantially from formerly passive consumers to prosumers.

Until now residential consumers were represented by simplistic aggregated consumption parameters. This has worked so far as, given a large enough number of residential consumers (for example, all the consumers in a country), the diversity of behaviours will be smoothed and a standardized profile will correctly represent the aggregated consumption. The argument also holds in urban infrastructure planning in cities and communities. In this case it is not the aggregation that was smoothing the behaviours, but the fact that the technical equipment and living situations of residential consumers were quite similar. Nowadays, this approach is not realistic anymore as the way of life, work and move around have changed at a rapid pace. Home office, online services, electric cars and more transformed our lifestyle and with it, the way we consume energy. This changes the way residential consumers need to be perceived by the system planners and in simulations.

The WHY-Consortium recommends changing planning routines from using standardised consumption values for residential consumers when assessing cities or municipalities. To highlight this issue the WHY-Toolkit was used to provide more detailed data for a technical bureau for the planning of a neighbourhood in the German city of Maintal. **The results indicated that the use of standardised consumption behaviour overestimated the thermal energy demand for heating on average by 7.5% over the entire positive energy district considered in the corresponding use case.**

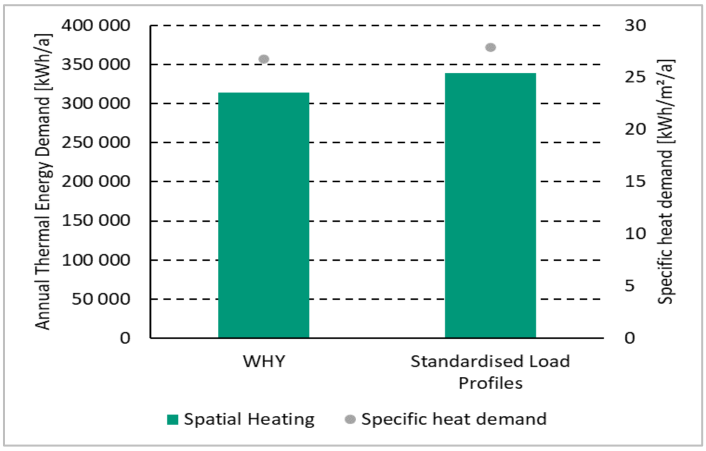


Figure 5: Comparison of the thermal energy demand for heating between the standardised approach and WHY. Source: WHY project, based on data from AlphaIC.

3.1.3 Time to unlock flexibility easily

We need large-scale integration of non-controllable renewable energy generation to decarbonize the European economy. This undertaking requires large amounts of energy storage and flexibility from the energy demand side. To date, solutions tackle this issue by the use of reversible hydroelectric power stations, large battery banks and markets to reduce the energy consumption from industrial sectors. These approaches have their own set of problems:

The lack of suitable geographical locations,

1. They are very expensive, and
2. They only solve some of the situations.

Under the current pathway defined for the energy system, the provision of flexibility from buildings and the residential sector is expected to contribute significantly in the near future.

The flexibility potential from buildings and the residential sector come from the use of residential energy equipment (such as heat pumps, energy storage and bidirectional electric vehicles charging points, etc.) or human behavioural changes. Our research shows that the potential flexibility that can be extracted from behavioural changes is small (between 1 and 9 %) and leads mostly to behaviour changes in people at risk of poverty. Nevertheless, interventions to influence energy consumption patterns of people are very cheap and fast to deploy by simply implementing a time of use or a dynamic tariff.

Taking this into account, if a change of the tariff is an action to be implemented in an area were an small number of households do not own devices able to provide flexibilities, this tariff should:

- **Be simple**. Time of use tariffs are easier to follow by humans and allow reorganising tasks at home helping to reduce its impact.
- **Be clear.** The difference between the periods have to be large enough to provide a clear incentive to change behaviour.
- **Help people that cannot change habits**. Add special provisions in the tariff system for large families and people at risk of poverty in order to reduce the impact. Prioritise providing large incentives to invest in special equipment that could solve this problem long term (like large rebates on the installation of PV panels or insulation).

In case a dynamic tariff is implemented with an appropriate machine-readable signal, then that signal can be used by battery storages, heat pumps, air conditioners and electric vehicle chargers, providing much larger sources of flexibility to the system. Therefore, the long-term solution will be the electrification of the heating and transport sectors with the inclusion of smart devices that can follow a price signal (or congestion signal in local flexibility markets).

WHY research shows that once dynamic energy tariffs are introduced, the flexibility potential from the residential sector greatly increases. Nevertheless, this solution requires an effort in the creation of local flexibility markets and the standardisation of communication protocols between home devices and Distribution System Operators (DSOs) in order to properly work. **While the Smart Grid Ready standard is a good first step**, using for example the mass of the building stock as flexibility potential requires not just a smart control of the heat pump itself, but also of every single thermostat in the building. **The next step should be the creation and enforcement of a unified standard and mandatory interoperability**.

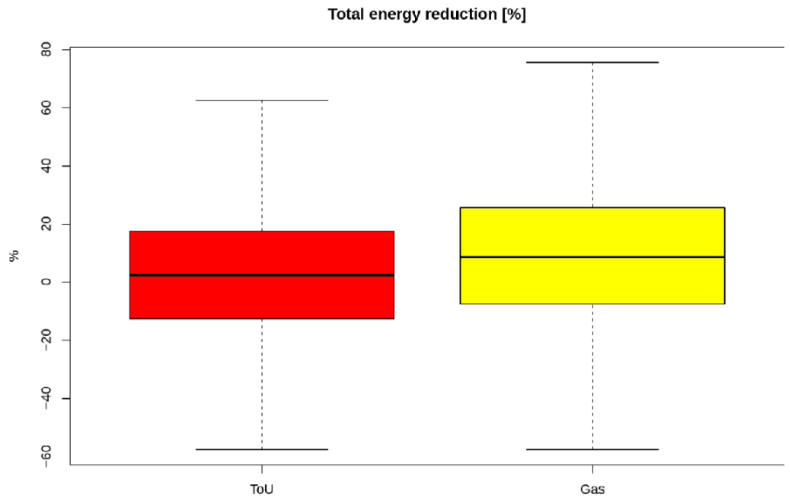


Figure 6: Comparison of the distribution of the total electrical energy demand during Time of Use (ToU) and Price Signal (Gas) tariffs. Positive values means total energy reduction. Source: WHY Project

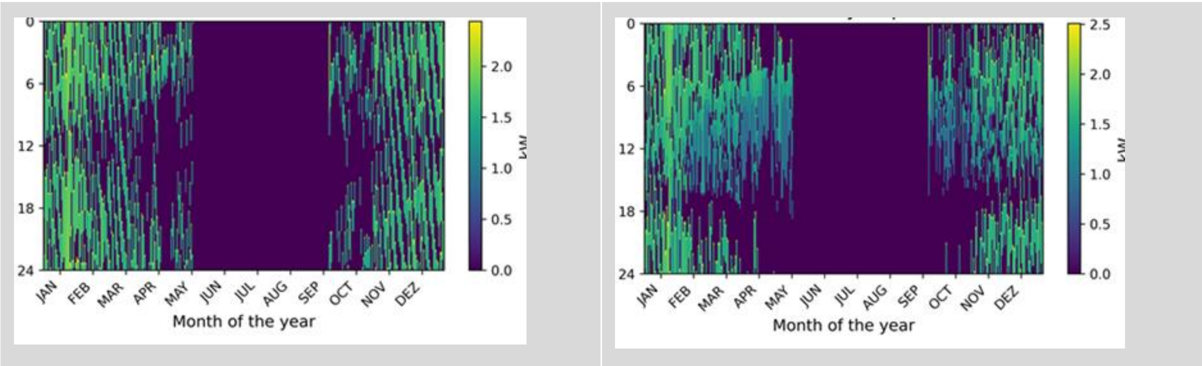


Figure 7: The figures show how much of the heating energy demand can be moved with an appropriate control algorithm, in this case optimising photovoltaic self-consumption. The right panel shows the results with the control algorithms enabled and the left panel without.

3.1.4 People are diverse so you need to take that into consideration when planning an intervention

Research has shown that people's decision making is not only based on a cost-efficient approach (Rational choice theory). Other dimensions, like previous knowledge, the self-competences, or trust on the technology, play an important role when adopting new technologies. For example, experience has shown that when certain types of persons (early adopters) are present in a neighbourhood, the adoption of technologies is accelerated.

Until now, most of the policy interventions to foster the adoption of certain technologies have been based on improving the cost-efficiency of the technology (namely, fiscal incentives or grants) and other aspects have been neglected. In WHY, an extensive research activity showed that decision-making aspects related to competence and relatedness are as important as the financial motivation when it comes to taking an investment decision related to the energy transition. This is why **it is important to contemplate actions to increase the competencies of all the stakeholders** (including sellers, installers and citizens) **when designing policy measures to foster the adoption of certain technologies**. Our results also prove that **providing messages that relate the technologies with social values** like the support to the community will lead to the improvement of living conditions and community engagement.

Taking this into consideration, we recommend policy makers to:

- **Understand**: assess your target group trying to understand its motivations beyond the financial incentives. In WHY we have prepared a toolkit for this.
- **Engage Champions**: foster the emergence of early adopters in the community that will help you naturally to diffuse the knowledge of the technology. In fact, local authorities are usually among the most relevant champions.
- **Build Competences**: help all stakeholders to acquire competences on technology. Citizens need to understand the pros and cons of the technology from reliable and trusted sources, installers need to be confident on how to proceed with them and sellers need to provide relevant and unbiased information.
- **Nudge**: provide financial incentives and carry out marketing campaigns to increase the visibility of the technology and help to increase the cost-efficiency of the technology.

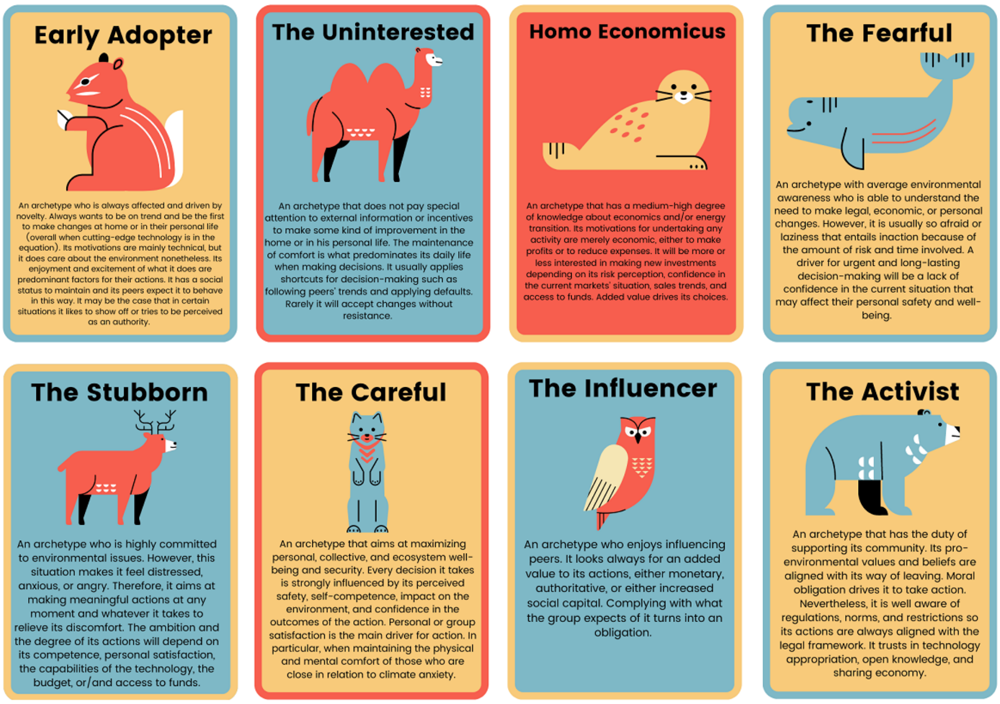


Figure 8: Final set of investment archetypes found. Source: WHY Project

3.2 The EU policy brief

3.2.1 Introduction to European context and relevance

Heating, cooling, lighting and appliance use in buildings account for around 40% of the EU's energy consumption and CO2 emissions. Heating residential buildings is responsible for about 65% of energy consumption, revealing an untapped savings potential. To align with the EU's ambitious climate and energy goals, the buildings sector must achieve net-zero emissions by 2050, based on reducing its energy consumption, improving energy efficiency and utilising low or zero-carbon energy carriers. However, in many European countries, apart from decarbonising electricity, relatively little progress has been made towards these ends.

This Policy Brief presents key lessons from the WHY project to accelerate energy efficiency and decarbonise the residential sector across new and existing homes in the EU.

3.2.2 WHY's approach and results

The WHY project investigated these demand-side issues by integrating behavioural modelling and technical building-level modelling to create the WHY Toolkit, which integrates a causal model to improve our understanding of household behaviour with an improved household-level energy service model. The WHY Toolkit is soft-linked with the established PRIMES-Buildings energy system model to assess pathways and policies to decarbonise the buildings sector in the European Union by 2050. Through this approach, WHY developed an enhanced modelling methodology based on the consistent integration of improved representation of human behaviour and technical/engineering modelling into the large-scale PRIMES model.

This can help energy planners and policymakers to develop efficient, equitable and sustainable policies to decarbonise the European building stock by 2050 alleviating potential regressive impacts, especially on low-income households (e.g. energy poverty).

3.2.3 Policy Recommendations

Importance : While the results captured during the WHY project display some key insights for the European energy future, it is also worth noting that the three years of the project were unprecedented with COVID-19, Russia's invasion of Ukraine and the preceding energy crisis. The structure of the policy brief spotlights how the WHY project results can contribute to relevant policies, while also looking at further policy recommendations that can enable the progress of the just energy transition in Europe and globally.

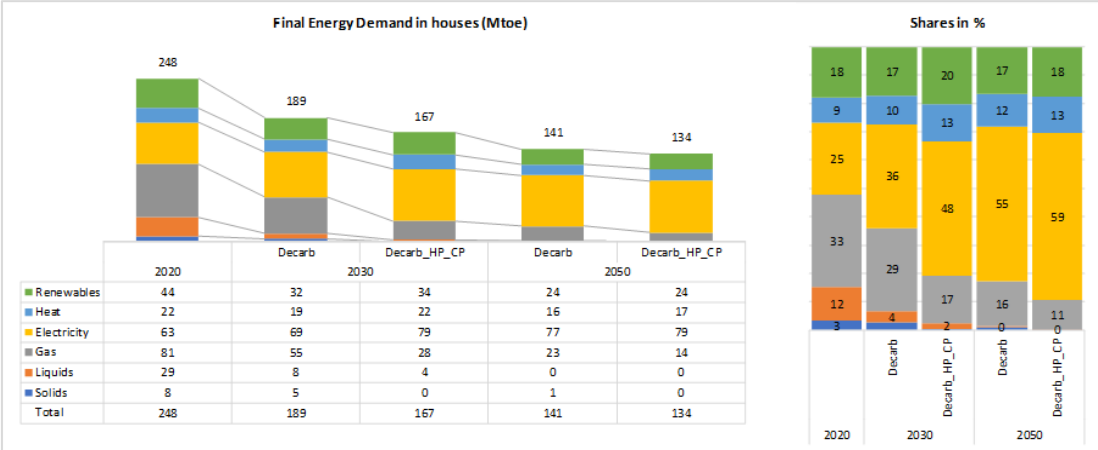
Relevance Our policy messages, based on the results of the WHY project, include guiding categories relevant to factors such as behavioural change, building-level technical change, pathways to net-zero buildings and/or a social impact assessment.

POLICY MESSAGE 1: ENERGY EFFICIENCY, COMBINED WITH TRANSITIONING TO LOW-CARBON ENERGY SOURCES, IS AN ESSENTIAL ENABLER OF THE DECARBONISATION OF BUILDINGS

The transformation of the EU buildings sector towards climate neutrality is based on two major pillars: accelerated energy efficiency and uptake of electrification, with heat pumps replacing fossil fuel use for heating.

To avoid further 'lock-in' to an inefficient, high-carbon pathway, new home constructions must not rely on energy-inefficient, fossil fuel-based technologies for heating such as heating stoves and boilers. However, this is not enough, as the required transformation must include the accelerated renovation of older existing buildings to improve their thermal insulation and reduce energy consumption. Overall, the final energy consumption of EU households declines by about 46% over 2020-2050 in a pathway towards net-zero emissions.

Although energy demand reduction is vital for enabling decarbonisation, it is critical that this is accompanied by a reduction in the carbon content of the energy consumption. In the decarbonisation scenarios developed in the WHY project, CO2 emissions from buildings get close to zero by 2050. Most of this reduction occurs from replacing natural gas or heating oil with electric-powered heat pumps and non-fossil district heating. Low-carbon technologies are also more efficient than fossil fuel energy for heating, which, coupled with efficiency measures, such as improved insulation, leads to a reduction in energy demand in European homes.



	2020	2030 Decarb	2030 Decarb_HP_CP	2050 Decarb	2050 Decarb_HP_CP
Renewables	44	32	34	24	24
Heat	22	19	22	16	17
Electricity	63	69	79	77	79
Gas	81	55	28	23	14
Liquids	29	8	4	0	0
Solids	8	5	0	1	0
Total	248	189	167	141	134

Figure 9: Fuel mix and final energy consumption outlook in the Decarbonisation scenarios for EU27 in the residential sector.

Policy recommendation: *Further provide and simplify consumer savings incentives to boost energy efficiency improvements and uptake of low-carbon energy heating appliances*

POLICY MESSAGE 2: DECARBONISING EUROPEAN HOMES WILL REQUIRE NATIONAL GOVERNMENTS TO ENSURE CLEAR AND SUPPORTIVE POLICIES TO ESTABLISH, MONITOR AND ENFORCE EFFECTIVE ENERGY EFFICIENCY BUILDING REGULATIONS.

Despite sharing a common energy policy framework (including the Energy Efficiency Directive and the Energy Performance of Buildings Directive) and set of minimum requirements, the stringency of building regulations across European countries – and the degree to which they are effectively monitored and enforced – varies substantially. This is in part due to variations in governance priorities and structures, as evidenced by the large variation of the energy efficiency of new domestic building envelopes across EU countries. Such variations in governance priorities and structures have affected the progress of new building performance and energy efficiency across the EU Member States.

To a greater extent, the countries in the EU need to significantly and timely invest in energy efficiency of residential building stocks, especially to renovate and retrofit building envelopes. The large financial resource mobilisation creates huge challenges for consumers, due to high-cost loans and relatively limited availability of financial resources for small projects. In addition, consumer behaviour in residential buildings is idiosyncratic, and often not rational, affecting the investment potential of energy efficient and low-carbon technologies. The latter options reduce energy bills but have high upfront costs and long payback periods.

Policy recommendation*: Develop and monitor a continuous roadmap for enforcement to ensure the EU member states are on track to meet the 2030 building targets.*

POLICY MESSAGE 3: ENERGY AND CLIMATE POLICIES SHOULD CONSIDER THE NATIONAL CIRCUMSTANCES TO BE EFFECTIVE AND JUST

Given the vast diversity of building types, consumption habits and energy mixes across EU countries, the results of two representative countries, Sweden and Greece, are analysed to zoom into behaviour change by examining how the different policy, climatic, socioeconomic and building construction contexts may impact the effectiveness of residential decarbonisation policies. From a policy perspective, a common EU-wide regulation does not necessarily have the same effect on different Member States and building types, as this will be impacted by the socioeconomic, climatic and behavioural factors and their complex interactions.

Sweden and Greece are considered extreme but representative cases of the EU Member States in terms of climatic conditions (which indicate their heating and cooling needs) but also socio-economic factors like household income and technical features such as building stock and technologies used. Energy needs for heating in Sweden are much larger compared to Greece mostly due to longer and colder winters, but also due to higher income. The larger availability of finance implies that Swedish households can more easily perform renovation than Greek ones. However, the extension of ETS in buildings is more effective in Greece compared to Sweden, as Sweden's households are already largely equipped with heat pumps, whereas households in Greece use mostly oil and gas boilers.

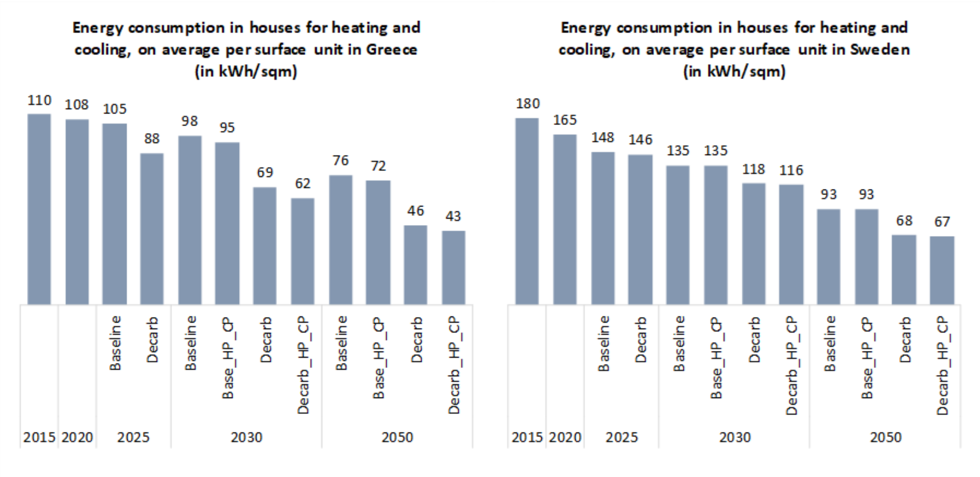


Figure 10: Energy consumption in houses for heating and cooling, on average per surface unit (in kWh/sqm) in Greece (left) and Sweden (right)

Country differences largely influence the effectiveness of climate and energy efficiency policies, especially in the residential sector.

In both EU Member States, the ambitious energy efficiency policies and the institutional measures included in decarbonisation scenarios significantly reduce energy consumption by 2050. For example, energy use for heating and cooling would decrease by 60% from 2020 levels due to accelerated renovation rates and stricter building codes. The impacts of price increases are higher in single-family households compared to multi-family ones in all countries, in line with behavioural literature, as the latter may be usually equipped with central heating systems that serve many dwellings in one building, creating difficulties in reaching an agreement on changing the central heating system with an individual one. Finally, in both countries low-income consumers spend a higher share of their income on their energy bills compared to high income, highlighting higher risks of energy poverty. Enhanced energy efficiency would decrease the share of income spent on energy purchases and increase household comfort, benefitting low-income classes most.

***Policy recommendation**: Energy and climate policies should consider the national climatic, socioeconomic, building type and age circumstances to maximise their effectiveness*

POLICY MESSAGE 4: BY USING SMART REDISTRIBUTIVE POLICIES, POLICYMAKERS SHOULD ENSURE A JUST NET ZERO TRANSITION REDUCING ENERGY POVERTY AND IMPROVING ENERGY AFFORDABILITY FOR EUROPEAN HOUSEHOLDS

When considering energy efficiency and net-zero energy targets in buildings, it is imperative to not only address the technical needs but to also ensure a just transition by examining distributional impacts for the most vulnerable consumers and households. While reforms of the Electricity Market Design and Energy Efficiency Directive are specifically defining energy poverty and reinforcing measures to protect vulnerable and energy poor households, further policy instruments can build upon this progress.

Carbon pricing is a key policy instrument to drive the transition, but it tends to be regressive, putting a disproportionate cost burden on low-income households and increasing the risk of energy poverty. In this context, redistributive policies, such as lump-sum transfer to households or targeted support to low-income consumers through the Social Climate Fund, can reduce these regressive impacts and facilitate a rapid and equitable transition of all EU households, leaving no one behind.

In combination with the redistributive policies, further support for the energy communities framework to scale and succeed also gives vulnerable, energy poor households an active role in the energy transition. Energy communities can also help understand and explore the flexibility potential across different segments of the residential sector to stabilise the energy system - largely powered by renewables- during peak loads. Demand flexibility is highly relevant from the consumer and building level to the greater energy system, represented in energy system planning and modelling. Energy communities can play an active role in supporting the transition towards net zero by developing guides to engage vulnerable households and sharing best practices.

***Policy recommendation**: Greater empowerment of energy communities can positively complement redistributive policies with active participation of energy poor*

Figure 11: Enablers to further empower energy communities to alleviate energy poverty.

4 Layman's Report

The current section includes the Layman's report of the WHY project, which is prepared by: Cruz E. Borges, Carlos Quesada Granja, Armando Aguayo Mendoza, Diego Casado Mansilla, Macarena Larrea Basterra, Idoia Mínguez Alonso, Panagiotis Fragkos, Chris Merveille, Leire Astigarraga, Axel Veitengruber, Eva Suba, Wolfgang Hofstetter, Amanda Schibline, Andrzej Ceglarz, Francesco Dalla Longa, Noah Pflugradt, Thomas Nacht

What are the reasons that lead citizens to participate in the energy transition?

Abstract

Energy system models (ESMs) are a set of mathematical equations that describe the energy system. Energy experts use these models to describe the medium and long-term impacts of different scenarios that introduce changes in energy systems. While ESMs have been quite useful in modelling energy supply, they currently do not accurately simulate energy demand, especially in the residential sector, because of the diverse range of dwellings and the disparate ways the citizens consume energy.

To solve this problem, during the WHY project a causal model has been developed to quantitatively analyse people's daily decisions regarding energy consumption and their reactions to interventions and policies such as tariff changes, new taxes, different types of incentives, etc. These tools are used to improve a) the quality of the main ESMs currently used by EU policy makers, b) the operation and planning of the energy generation and distribution system and c) the assessment of household electricity consumption trends. The project recommends including user behaviour when modelling the energy system and puts these tools at the disposal of the modelling community.

Keywords

Structural causal model, household behaviour, energy system modelling, TIMES,PRIME, social assessment, review of policy objectives, improve operation and management energy system.

4.1 Introduction

This briefing will contain the main results of the WHY project in a way that facilitates their dissemination and exploitation by the different stakeholders. Its target audience is the general public that have interest in the energy transition and policies related to it including stakeholders such as members of energy communities / cooperatives who lack the technical knowledge to perform modelling and simulations. The briefing will contain the results of different experiments/use cases in the form of recommendations related to the energy transition and improving the trust in the administration's / policies that are being implemented by the different public authorities. In particular will contain information about

- How can a group or individual person participate in the energy transition, e.g. by reducing their energy consumption, contributing to the deployment of (distributed) renewable energy in the system or at least by consuming energy more responsibly?
- How can local administrations improve the planning for sustainable neighbourhoods?

- How can energy cooperatives improve the way they support the creation and operation of energy communities?
- How improved models are helping to define more efficient and just EU energy policies?

4.2 Justification and context

Energy system models (ESMs) are a set of mathematical equations that describe the energy system. Energy experts use these models to anticipate the long-term impacts of different scenarios that introduce changes in energy systems. Although ESMs have produced useful results in energy supply modelling, current ESMs lack accuracy in simulating the residential sector. The main reason for these inaccuracies is the large diversity of dwellings and the disparate ways the citizens consume energy, which produce a wide spectrum of consumption patterns.

To address this problem, the EU funded project WHY has developed a causal model to quantitatively analyse people's day-to-day decisions regarding energy consumption and their reactions to interventions such as tariff changes, new taxes, different types of incentives, etc.

These tools will be used to improve:

- the quality of the main ESMs used by European policy makers,
- the operation and planning of the energy distribution system and
- the assessment of household electricity consumption trends.

This briefing will present the main recommendations stemming from the project in aspects like citizen behaviours best suited to foster the energy transition, the tools provided to local public administrations and energy communities to improve their activities and the results of the impact that EU legislation will have.

The project is fully in line with the priorities of the European Commission:

- One of the project's use cases will assess the Fit for 55 and REPowerEU strategies using the WHY toolkit integrated with the PRIMES Energy system model widely used for energy policy impact assessment by the European Commission.
- Another use case will assess the global energy system developments towards meeting the Paris Agreement, with a focus on Africa and Europe, in line with SDG 7.
- Two use cases will focus on developing tools to foster the creation and management of energy cooperatives and energy communities that contribute to SDGs 7, 11 and 13.
- The last use case of the project will provide tools to size and manage microgrids at a local level. This has been identified as a priority of the PCTI Euskadi 2030 in the framework of sustainable cities and is an important driver for the electrification of off-grid areas (contributing to SDG 7).

4.3 Main body

1. **How can a group or individuals participate in the energy transition, e.g. by reducing their energy consumption, contributing to the deployment of (distributed) renewable energy in the system or at least by consuming energy more responsibly?**

Individuals can actively contribute to the deployment of renewable energy and promote responsible energy consumption through various strategies.

One impactful approach is to join or support renewable energy cooperatives. By becoming a member of these cooperatives, individuals can participate in community investments and initiatives focused on reducing energy consumption (energy efficiency, energy sufficiency) and on increasing the use of energy from renewable sources.

Another effective way is to embrace self-consumption systems, such as residential solar panels. Investing in such systems enables individuals to generate their own renewable energy, reducing reliance on conventional energy sources and contributing to an overall increase in renewable energy capacity.

Adjusting energy consumption patterns is also key. Consuming energy during central hours of the day (solar hours) or at night, when stored energy can be utilised, maximises the use of clean energy. This might involve running major appliances or charging electric vehicles during peak solar production times.

Implementing energy-efficient practices and technologies at home is another crucial step. This includes using energy-efficient appliances, improving insulation, and adopting smart home technologies to optimise energy usage.

2. **How can local administrations improve the planning for sustainable neighbourhoods?**

The needs of the energy system is becoming an ever more relevant aspect of urban planning at neighbourhood scale. As decentralised energy sources, battery storages and other technologies gain importance, a more detailed consideration of consumption behaviour is necessary. But why is that the case?

First off, **the time at which the energy is consumed is getting more relevant**, since consumption of local generation and a reduction of the strain on the power grid will be of great importance to achieve the green transition where all the energy produced comes from renewable energy sources.

Secondly, **standardised load profiles do not reflect the individuality of households,** which is not an issue if you look at large numbers of households, but in the planning of neighbourhoods, this becomes an issue.

Thirdly, **households with the potential and motivation to adapt their load behaviour are not considered,** when using standardised consumption profiles.

This situation initiated the analysis of the “Maintal-Use-Case” in the WHY-project, where the city of Maintal in Germany had contracted a technical bureau in mid-2023 with planning of a new neighbourhood in collaboration with the WHY consortium. With information on the expected inhabitants of the new flats, the WHY Toolkit was used to simulate detailed electricity, heat and water consumption data for the neighbourhood.

So what does a better planned neighbourhood do for you as an individual?

Basically it allows **adapting the energy infrastructure within the neighbourhood to actually suit your individual situation and behaviour.** Ultimately this should contribute to **reducing your energy system costs** as the infrastructure is suited to the requirements in the best possible way.

Figure 12: 'A better planned neighbourhood do for you as an individual', Adobe Stock - mattegg (created using AI)

3. How can energy cooperatives improve the way they support the creation and operation of energy communities?

Energy cooperatives are actively enhancing their support for the establishment and growth of energy communities through diverse strategic initiatives.

Primarily, there is a **significant focus on engaging and educating the community.** Energy cooperatives conduct outreach programs, workshops, and information sessions to inform residents about the advantages of renewable energy, energy efficiency/sufficiency, and the cooperative model. This approach aims to raise awareness and garner support for community-led energy projects.

Another crucial aspect is fostering community participation. Energy cooperatives actively include community members in democratic decision-making processes, enabling them to play a vital role in shaping the energy future of their neighbourhoods. This empowerment strengthens community ownership and commitment to sustainable energy initiatives.

Financial backing and funding constitute essential elements of energy cooperative endeavours. Cooperatives strive to secure grants, subsidies, and partnerships to make energy efficiency and renewable energy projects financially viable. Additionally, collective investments from cooperative members contribute to funding renewable energy infrastructure.

Some energy cooperatives are delving into local energy trading platforms, enabling community members to directly buy and sell excess energy. This decentralised approach fosters community-driven energy markets, often facilitated by blockchain technology to ensure secure and transparent transactions.

Active engagement in policy advocacy is yet another strategic avenue. Energy cooperatives collaborate with policymakers at different levels to create a supportive environment for community energy projects. This involves advocating for regulations and incentives that bolster the growth of energy communities.

4. How improved models are helping to define more effective and just EU energy policies?

The enhanced Energy System Models integrating the modelling advancements of the WHY Toolkit will offer an improved understanding of the household energy consumption and the potential effects of policy interventions. **The enhanced models are used to provide novel insights into the Fit for55 package as well as the EU's climate neutrality goal by 2050**.

The model-based analysis highlights that **energy efficiency, combined with transitioning to low-carbon energy sources, is an essential enabler of decarbonising buildings**.

Decarbonising European homes will require national governments to ensure clear and supportive policies to establish, monitor and enforce effective energy efficiency building regulations.

Energy and climate policies should consider the national circumstances to be effective and just, as exemplified by the detailed analysis conducted for Greece and Sweden, two countries with very different socioeconomic contexts, climate conditions and technology uptake (e.g. much higher heat pumps uptake in Sweden).

By using smart redistributive policies, policymakers should ensure a just net zero transition reducing energy poverty and improving energy affordability for European households, e.g. through directing the revenues from carbon pricing to low-income households and other vulnerable groups in the form of lump-sum transfers.

4.4 Biographies

Deusto
Universidad de Deusto
Deustuko Unibertsitatea
University of Deusto

With a long- and well-established tradition, founded in 1886 as a higher education institution, UD has a mission and educational goal firmly grounded in academic excellence and social responsibility, aiming at generating economic sustainable growth and making positive contributions towards the construction of fairer and more inclusive and humane societies. Four research units from the university participate in the project: a) DeustoTech, the research institute of the Faculty of Engineering. It conducts applied and basic research for the development of novel ICTs applications. b) The Center of Applied Ethics (CAE) a multidisciplinary centre that seeks to analyse and foster individual and collective practices that promote social justice, peaceful coexistence, dignity, and the right of people to fully participate in the social, political and economic life of their communities. c) DeustoKabi, the Innovation and Entrepreneurship Unit. Its main objective is to support people throughout their lives, encouraging an entrepreneurial and innovative culture inside and outside the University. And d) is the Orkestra-Basque Institute Of Competitiveness that conducts transformative applied research oriented towards gaining knowledge about sustainable regional competitiveness, with a special focus on the Basque Country.

The research facility 4ward Energy Research GmbH was founded in 2010 and is a non-profit organisation in the sector of energy research, both at the national and international level. The fields of activity are manifold and cover amongst others the fields of renewable energy sources, energy efficiency, smart grids and microgrids, smart cities, energy storage technologies, simulations, etc. The staff was and is involved in numerous scientific R&D projects. The range of technical topics treated by 4ward Energy Research GmbH also translates to the specific task within projects, ranging from answering technical questions (simulations, modelling), creating economic solutions (business cases and models) to end-user involvement (workshops, co-creation processes) and dissemination and exploitation panning and activities.

E3-Modelling is a private capital company, established in Greece, as a knowledge-intensive consulting company spin-off inheriting staff, knowledge and software-modelling innovation of the laboratory E3MLab of the National Technical University of Athens (NTUA). The company specialises in the delivery of consulting services based on large-scale empirical modelling of the nexus economy-energy-environment. The experience goes back to 1990 and includes internationally renowned milestones, such as the models PRIMES and GEM-E3 and the support of major impact assessment studies and scenario building of the European Commission. The modelling and consulting services have also served numerous studies for European Governments, professional associations, and large-scale companies in the energy field. The consultation expertise of the group focuses on the design of transition in the energy market and systems, both in the demand and supply of energy, towards green and climate-friendly structures and technologies. Thanks to the modelling, the group assesses the transitions from economic, policy and implementation perspectives putting emphasis on the functioning of the system and the markets as a whole when policy instruments influence behaviours and market outcomes.

TNO (Nederlandse Organisatie voor Toegepast - Natuurwetenschappelijk Onderzoek) is one of the major applied research and technology organisations in Europe. With a staff of approximately 3000 and an annual turnover of close to a billion Euros, TNO is carrying out applied R&D on, among others, healthy living, industrial innovation, traffic & transport, buildings & infrastructure, circular economy, energy technology, and safety & security. TNO is involved in many international programmes, including especially EU-funded collaborative projects. The Energy Transition Studies group of ECN-TNO employs about 60 researchers who cover a wide variety of academic disciplines. Energy Transition Studies focuses on the political, economic, and social aspects of energy technology implementation. It possesses a broad range of different modelling tools, mostly developed in-house. These include e.g. simulation, optimization, and management models. Its EU models cover electricity markets, renewables, power generation, and fossil fuels, and enable investigating a broad range of scenarios and policy instruments, among which GHG emissions trading.

Forschungszentrum Julich pursues cutting-edge interdisciplinary research on pressing issues facing society today. With its competence in materials science and simulation, and its expertise in physics, nanotechnology, and information technology, as well as in the biosciences and brain research, Julich is developing the basis for the key technologies of tomorrow. In this way, Forschungszentrum Julich helps to solve the grand challenges facing society in the fields of energy and the environment as well as information and the brain. The Institute for Energy and Climate Research – Techno-economic Systems Analysis (IEK-3) we are investigating how a sustainable energy system can be achieved and how it would look like. To this end, we develop diverse techno-economic models with which we take an integrated view of the global energy systems in order to identify possible solutions for energy system transformation. The main focus of the department is the development of energy system models for the analysis of the transformational processes taking place in the supply and use of energy in Germany and beyond, in accordance with the political framework.

GOIENER is a non-profit citizen cooperative dealing with 100% renewable electric energy commercialization. GOIENER is concerned with the generation and consumption of renewable energy, and with the objective of reclaiming energy sovereignty. Currently GOIENER counts with around 17.000 associates and manages more than 21.000 contracts. GOIENER wants citizens to regain control over the energy and to make them aware of its importance, thus promoting responsible and sustainable consumption. The way GOIENER wants to reclaim energy sovereignty for citizens is by entering the electricity sector, which has recently been liberalised. Our activities include marketing (buying) and generating energy, since transport and distribution are still regulated by the government. Despite that being his main activity, it is not limited to that field; research is being carried out continuously at GOIENER related to finding out investment options for the deployment of renewable energy solutions.

The Renewables Grid Initiative is a unique collaboration of NGOs and TSOs from across Europe. We promote transparent, environmentally sensitive grid development to enable the further steady growth of renewable energy and the energy transition. RGI Members (23 as of today) originate from a variety of European countries (12), consisting of TSOs from: Belgium (Elia), Croatia (HOPS), France (RTE), Germany (50Hertz, Amprion and TenneT), Ireland (EirGrid), Italy (Terna), the Netherlands (TenneT), Switzerland (Swissgrid), Norway (Statnett) and Spain (REE); and the following NGOs: BirdLife Europe, Climate Action Network-Europe (CAN), Friends of the Earth Ireland, Fundación Renovables, Germanwatch, Legambiente, the Royal Society for the Protection of Birds (RSPB), NABU, Natuur&Milieu, Transport & Environment, WWF International and ZERO. RGI was launched in July 2009.

Climate Alliance is the largest European city network dedicated to climate action. Through the Climate Alliance, some 1,700 member municipalities and districts covering 26 European countries as well as a variety of regional governments, NGOs and other organisations are actively working to combat climate change. The city network was founded in 1990 with the mission to elaborate and implement local climate protection measures especially in the fields of energy and mobility and to cooperate with indigenous people to protect the tropical rainforests. Climate Alliance members commit to reduce greenhouse gas emissions by 10% over 5 years and halving per capita emissions by 2030 (baseline 1990). Co-coordinating the Covenant of Mayors Office, Climate Alliance plays a key role in technical and administrative support for European local authorities carrying out methodological work, capacity building, guidelines, and monitoring. Outside Europe, the Climate Alliance European Secretariat is also active in helping to spread the successful examples and lessons learned via the Covenant of Mayors.

5 Conclusions

The WHY project focuses on the development of methodological advancements and modelling enhancements to improve the representation of residential energy consumption through the development of the WHY toolkit and its soft-linkage with large-scale ESMs. The underexploited resource of energy behaviors presents a significant opportunity to ensure a cost-efficient transition, yet their multidimensional nature complicates effective interventions and policies. The central problem involves inaccuracies in current Energy System Models (ESMs) regarding energy demand representation in diverse residential settings. The WHY project employs the innovative WHY Toolkit, integrating a causality-based model with large-scale ESMs, providing a more accurate representation of household energy consumption applied to five diverse Use Cases from the local up to the EU and global level. The current report provides a detailed ethical assessment of the Use cases and two policy briefs focusing on the local and EU level respectively, providing recommendations relevant for local and EU policy makers.

The WHY results advance our understanding of the dynamics of energy transition at both individual and community levels, contributing to more effective and just energy policies. The emphasis on behavioural insights in planning sustainable neighbourhoods, operating energy cooperatives, and formulating EU strategies adds practical relevance and real-world evaluation of WHY results. The study provides a detailed real-world case study (Maintal-Use-Case), an "insider" approach to ethical assessments, and a unique combination of behavioral and technical models in the developed toolkit. Instead of relying solely on theoretical or simulated data, the development of real-world use cases to test and validate the effectiveness of the WHY Toolkit in a robust context, offered insights on how these tools can be utilised to address challenges related to the sustainable energy transition especially focusing on residential buildings.

The policy briefing offers comprehensive recommendations for policymakers, addressing the importance of energy efficiency, clear and supportive policies, consideration of national circumstances, and a just net-zero transition. By covering these key messages, policymakers can have a roadmap for developing and implementing energy policies that are not only effective in addressing environmental concerns but also considerate of social, economic and cultural factors, which should differentiate the energy transition pathways and strategies depending on national and local priorities and circumstances.

Moving forward, future studies could broaden the geographical scope for generalizability, expand ethical assessment methodologies, and explore challenges and success factors in scaling up community-led energy projects. Real-world case studies demonstrating the successful implementation of recommendations would enhance the practical relevance of the WHY toolkit. Ongoing collaboration with energy policymakers, regional authorities, and relevant stakeholders can ensure continuous enrichment of the analysis, aligning policy recommendations with evolving energy transition goals at the local, national and EU levels.

REFERENCES

Fotiou, T.; de Vita, A.; Capros, P. Economic-Engineering Modelling of the Buildings Sector to Study the Transition towards Deep Decarbonisation in the EU. *Energies* 2019, *12*, 2745. https://doi.org/10.3390/en12142745

Fotiou, T.; Capros, P.; Fragkos, P. Policy Modelling for Ambitious Energy Efficiency Investment in the EU Residential Buildings. *Energies* **2022**, *15*, 2233. https://doi.org/10.3390/en15062233

WHY Deliverable D1.3, D1.3 Use Case Definition: objectives, scope, variables, available at: https://www.why-h2020.eu/fileadmin/Inhalte/Dokumente/WHY_Deliverable__D1.3_1.0.pdf

Hoicka C.E., Lowitzsch J, Brisbois MC, et al. (2021) Implementing a just renewable energy transition: Policy advice for transposing the new European rules for renewable energy communities. Energy Policy 156, 112435. https://doi.org/10.1016/j.enpol.2021.112435

Koltunov, M.; Pezzutto, S.; Bisello, A.; Lettner, G.; Hiesl, A.; van Sark, W.; Louwen, A.; Wilczynski, E. Mapping of Energy Communities in Europe: Status Quo and Review of Existing Classifications. Sustainability 2023, 15, 8201. https://doi.org/10.3390/su15108201

Koukoufikis, G., Schockaert, H., Paci, D., Filippidou, F., Caramizaru, A., Della Valle, N., Candelise, C., Murauskaite-Bull, I. and Uihlein, A., Energy Communities and Energy Poverty, Publications Office of the European Union, Luxembourg, 2023, doi:10.2760/389514, JRC134832.

Rogge, K., Reichardt, K. Policy mixes for sustainability transitions: An extended concept and framework for analysis. Elsevier 2016, 45, 1620-1635. http://dx.doi.org/10.1016/j.respol.2016.04.004

Schwanitz, V.J., Wierling, A., Arghandeh Paudler, H. et. al. Statistical evidence for the contribution of citizen-led initiatives and projects to the energy transition in Europe. *Nature* 2023, 13, 1342. https://doi.org/10.1038/s41598-023-28504-4