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Report No ECHOES 7.2– D7.2 Policy-maker and stakeholder consultation report

ECHOES Report

"Driving Factors Behind Energy-related Choices and Behaviour: Consensus-building and Policy Foresight"

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Driving Factors Behind Energy-related Choices and Behaviour: Consensus-building and Policy Foresight

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- Energy saving behaviours
- Pro-environmental behaviours
- Identity
- Collective processes
- Emotions
- Attitudes
- Values

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ABSTRACT

This deliverable represents a policy-makers and stakeholder consolidation report, which is built on the results of the two workshops conducted by ECHOES and is a summary of those. This report highlights the topics discussed and the main conclusions drawn from the discussions. The first workshop is devoted to foresight exercise, while the second aimed to identify the policy ideas from ECHOES that are the most relevant, impactful, and implementable to focus future refinement and study.

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All consortium partners have been involved in contributing to the foresight process.

EXECUTIVE SUMMARY

The timely and successful implementation of the Energy Union is paramount for a prospering, cohesive, and self-determined European Union. This is reflected in its five fundamental pillars of i) ensuring security of supply, ii) building a single internal energy market, iii) raising energy efficiency, iv) decarbonising national economies, and v) promoting research and innovation. Contributing to unlock the potential behind these strategic objectives through a robust, policy-prescriptive, and actionable multidisciplinary approach to energy demand and behaviour is ECHOES' main aim. ECHOES targets its efforts particularly on unfolding the energy-related behaviours, decisions, lifestyles, and manifested actions pertaining to a) smart energy technologies, b) eco-mobility, and c) buildings, and for three different social levels, the micro- (individual decision-making), meso- (cultures and lifestyles), and macro (formal social units).

The main goal of Work Package 7 (WP7) is to consolidate the scientifically-grounded knowledge obtained in the ECHOES project with respect to energy-related choices and behaviour; and to advance a set of policy-prescriptive recommendations and strategies tackling individuals' acceptance, engagement, and complicity with energy policy measures and instruments advancing the Energy Union and SET-Plan.

To reach this goal as a first major milestone of WP 7 in Deliverable 7.1, a summary of the critical knowledge gaps identified from earlier scientific work as well as a synthesis of the main findings and results obtained throughout the ECHOES project lifetime that either fully or partly addressed the knowledge gaps summarised previously were provided. This report represents a further step on the way to policy-ready recommendations which will be provided in Deliverable 7.3. The input for Deliverable 7.3 was collected from experts and user groups during two workshops conducted within the ECHOES project. The current report summarizes outcomes and the conclusions of these workshops, which will serve to inform the elaboration of a policy-oriented report merging the main findings obtained throughout the project's lifecycle, and their policy relevance.

The first workshop which was devoted to a foresight exercise elaborated future scenarios for 2050 in which ECHOES findings could be applied and exploited. Additionally, the foresight process had the objective of establishing consensus about which driving factors shall be exploited in future policy-making and what aspects need specific attention for impact maximisation when doing so. The second workshop centred around new policy measures elaborated in the ECHOES and identified among the pre-selected eight policies a top three of the most promising which according to workshop discussions are ready to be implemented.

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INTRODUCTION

The impact that a timely implementation of the Energy Union will have on the European society is significant, and largely dependent on its acceptance by the European population as well as their meaningful engagement and co-participation. While the main pillars of the Energy Union have been clearly defined, implementing the necessary policy programmes, choosing the most efficient policy instruments, and putting emphases on the best-suited mechanisms, needs a deeper understanding of individual and collective energy-related choices and behaviour to ensure that the Energy Union comes to life in the most efficient and effective way possible.

The ECHOES project therefore harnessed its multi-disciplinary research agenda to facilitate and catalyse a more holistic and multidisciplinary understanding of the main driving factors influencing particular energy related choices and behavior under three distinctive – yet interrelated – technological focal areas: a) smart energy technology, b) electric mobility, and c) buildings. These technological foci will significantly influence the economic and environmental development of the European Union. ECHOES' role in that respect is focused on providing the necessary knowledge base regarding peoples' perceptions and consumers' choices, in order to support more robust, better informed, and actionable policy measures and strategies advancing the increased penetration of said technologies.

By doing so, ECHOES aims to unlock the policy potential of an integrated social science perspective bound by central socio-cultural, socio-economic, socio-political, and gender issues that influence individual and collective energy choices and social acceptance of the energy transition; thereby fostering the implementation of the European Strategic Energy Technology Plan (SET-Plan) and supporting the policy and decision-makers and stakeholders with comprehensive information, data and knowledge about how the Energy Union and adjoining programmes and legislation can best be implemented. ECHOES strategic objectives to operationalise this overarching goal include:

Objective 1 – Creating understanding

ECHOES a) developed a new paradigm for energy related behavioural research through the introduction of energy collectives as a bridge between different perspectives and disciplines, b) implemented an outstanding empiric research agenda collecting and analysing data from 31 European nations and through different data gathering techniques, and c) distils the policy relevant findings in an unprecedented multi-evidence based synthesis process.

Objective 2 – Tackling cross-cutting issues through multi-disciplinary expertise

The ECHOES approach tied the disciplines of psychology, sociology, political science, social statistics and economics together, to comprehensively foster understanding of the cross-cutting issues related to socioeconomic, gender, sociocultural, and socio-political aspects of the energy transition. The disciplines challenged each other's assumptions and methods, and jointly developed a coordinated approach breaking down the mono-disciplinary silos hampering in-depth understanding of energy choices and energy related behaviour, which is impossible to get from a single-discipline perspective. Through this multi-facetted research agenda, the ECHOES project established a new perspective on the topic of energy related behaviour and achieved a real breakthrough on how Europeans' engagement with the energy transition and related policy measures can be improved.

Objective 3 – Provision of policy-ready recommendations

ECHOES aims at the provision of theoretically sound and empirically supported policy-ready recommendations about how best to design impact maximising energy policies and programmes, and how to increase their acceptance among the European population.

The main goal of Work Package 7 (WP7) is to harness the scientifically-grounded knowledge obtained in the ECHOES project with respect to energy-related choices and behaviour; and to advance a set of policy-prescriptive recommendations and strategies tackling individuals' acceptance, engagement, and complicity with energy policy measures and instruments advancing the Energy Union and SET-Plan.

To reach this goal, a first major milestone of the WP7 was reached in Deliverable 7.1, where a summary of the critical knowledge gaps identified from earlier scientific work in ECHOES as well as a synthesis of the main findings and results obtained throughout the ECHOES project lifetime that either fully or partly addressed the knowledge gaps summarised previously were provided. These have been organised following the three main technological foci of the ECHOES project, that is: smart energy technologies, electric mobility, and energy-efficient buildings and three identified levels of decision-making in the energy related topics namely micro-, meso- and macro. Deliverable 7.2, "Driving Factors Behind Energy-related Choices and Behaviour: Consensus-building and Policy Foresight", is a further step to policy-ready recommendations which will be provided in Deliverable 7.3. This deliverable represents a policy-makers and stakeholder consolidation report, which is built on the results of the two workshops conducted by ECHOES and represents a summary of those, highlighting the issues discussed and the main conclusions drawn from the discussions. The main workshops were held on 4th of December 2018 and 9th of May 2019 both in Brussels to assure the highest potential participation of policy-makers and other mentioned stakeholders. The foresight exercise consisted of a several workshops and discussion groups both internal and external to ECHOES.

The workshops targeted representatives from NGOs, national and European policy-makers, and representatives from the affected markets (e.g. retail, housing, white goods, car industry). The main objective of the workshops was to jointly explore how to translate the knowledge obtained in ECHOES into actionable and impact-maximising policy measures addressing the three main technological foci of the project while maintaining relevance for each of the three social levels outlined above. The first workshop conducted a Foresight Process which was actually a culmination of series of internal workshops and was based on inputs of results of discussion groups during ECHOES General Assembly in Rome. Together with the participants, a guided discussion aimed to derive the priority topics for supporting a sustainable Energy Union from a social-science perspective was held. The second workshop continued the foresight exercise and initiated an active interaction with the participants on the EU energy policy options identified within ECHOES and presented the relevant background information for the subsequent discussion and opinions' collection through sli.do. During the second workshop, a block informing about the overall ambition and objectives of the research project ECHOES was included, and the participants were provided with exclusive first-access to the preliminary results of the ECHOES project, while scientific leaders within ECHOES gave short presentations targeted at sharing their most insightful, critical, and policy-relevant findings.

The main outcomes and the conclusions of these workshops aim to inform the elaboration of a policy-oriented report merging the main findings obtained throughout the project's lifecycle, and their policy relevance; so as to maximise their impact and utility.

1. WORKSHOP 1: FORESIGHT EXERCISE

This section describes three scenarios of Europe's possible energy futures for 2050 developed within the ECHOES project and sketches the process of the scenario development. The foresight process carried out in ECHOES aims at scrutinising the result of the scientific outcome of other ECHOES tasks and using those findings to foster the energy transition and advancement of a European Energy Union. Additionally, the foresight process has the objective of establishing consensus about which driving factors shall be exploited in future policy-making and what aspects need specific attention for impact maximisation when doing so. To reach this goal, several additional workshops and discussions groups were held with internal and external experts.

We understand scenarios as a set of future configurations which are coherent, probable and possible. This implies that the number of potential combinations of hypotheses has been reduced because some of them are self-exclusive while others seem not desirable considering the European Commission's policy priorities. In addition, the research focus of the ECHOES project also marks the character of the scenarios described below, approaching the energy transition from a perspective of social values and discussing social and psychological drivers rather than technological or market-related factors.

1.1 METHODOLOGY

The foresight exercise carried out in ECHOES is largely based on the "morphological analysis" technique, which was developed by the French CNAM-LIPSOR1. Velte et al., 2006, define this technique as follows: "Morphological analysis aims to explore possible futures in a systematic way by studying all the combinations (of hypotheses) resulting from the breakdown of a system".[2]

The process of "breaking down" or "deconstruction" the system into different "components" or variables in the ECHOES project started by establishing the system boundaries, that is, defining which is the topic of analysis, what must be integrated in the system that will be "deconstructed" and where are the limits or what is to be left out of consideration. Once the system boundaries where defined, key variables were identified. These are the central factors that are expected to impact and modify the system or scenario field previously defined. Those include parameters, variables, developments, trends and events that were considered in the scenario building process. With the key variables identified, the most probable set of hypotheses for each of those variables were defined, setting up the framework for the three scenarios that will be described below.

The methodological approach follows the sequence of work depicted in Figure 1.

[1] CNAM-LIPSOR: Conservatoire National des Arts et Métiers- Laboratoire d'Investigation en Prospective, Stratégie et Organisation

[2] Velte, D et al. (2006). The EurEnDel Scenarios, Europe's System by 2013. Berlin. Institut für Zukunftsstudien und Technologiebewertung (Werk -stattBerichte 80)

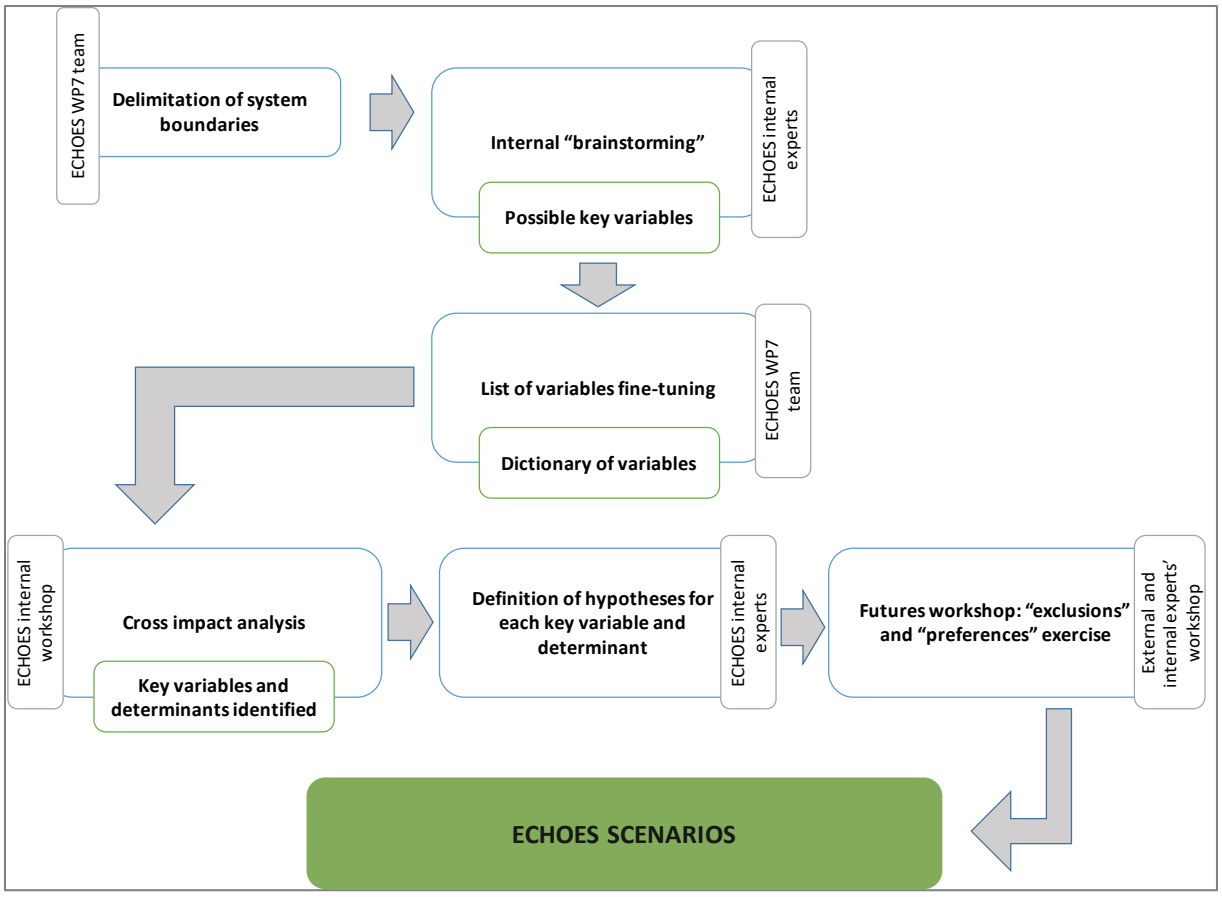

Figure 1: Work sequence of ECHOES foresight process

The foresight process started with the **definition of the "ECHOES system",** or definition of the system boundaries, by reviewing all project outcomes and cross-relating them using a system approach. The information was analysed related to the three ECHOES technology foci and the three ECHOES decision-making levels, considering that the foci constitute what we call "niches", in which important changes are taking place and the decision-making levels are part of the "socio-technical regime" that is also evolving in parallel.

The ECHOES system included different parameters that were classified in socio-cultural, policy and governance, technical and economic fields. Additionally, as depicted in Figure 2, the level of relevance of each parameter with regards to the three ECHOES technology foci was defined.

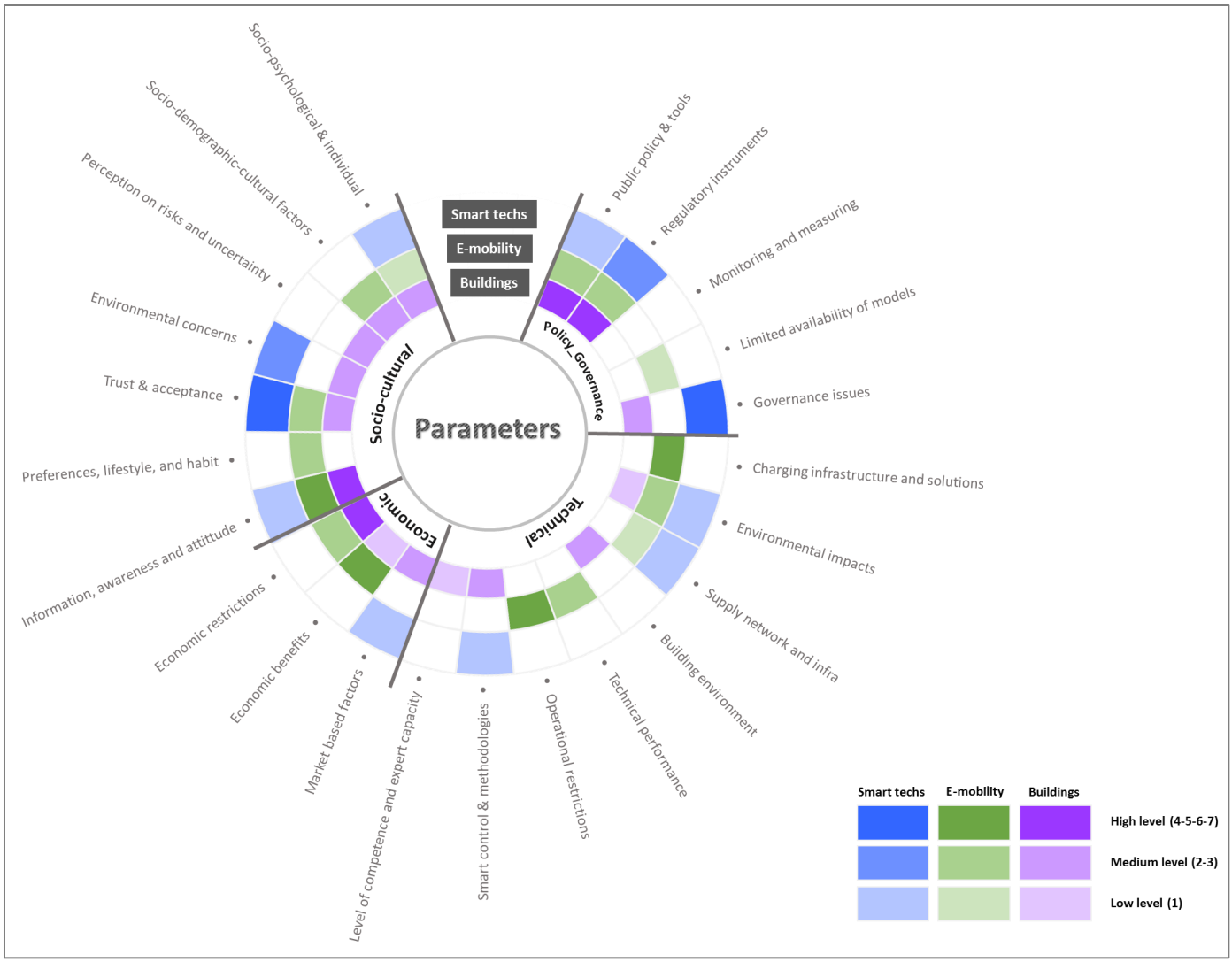

Figure 2: Graphical representation of the ECHOES system

This exercise allowed to design an internal survey for **identifying the drivers or variables,** which represent "neutral" elements, that will impact on the "ECHOES system" in the coming years. The survey focused on the three ECHOES technology foci and collected a first list of trends and factors that are likely to shape the future evolution of the three technology foci and the decision-making processes related to them. All those variables were compiled in the **"Dictionary of Variables"** which was refined in several feedback loops with the ECHOES project partners.

The next step consisted of analysing the relationship between the variables, with the help of a **cross-impact matrix** in which the variables are placed in rows and columns in order to work out systematically whether there are any causal relationships between them. A first workshop with internal experts was organised in order systematically analyse the relationship of influence between two certain variables. The degree of influence was assessed under the following criteria: no direct influence, low direct influence, medium direct influence, high direct influence or potential direct influence. The output of the cross-impact analysis was the identification of the key drivers and

determinants. Key drivers are highly influential factors largely controlled by the actors involved in the system, while determinants represent highly influential factors which may act as motors or restraints

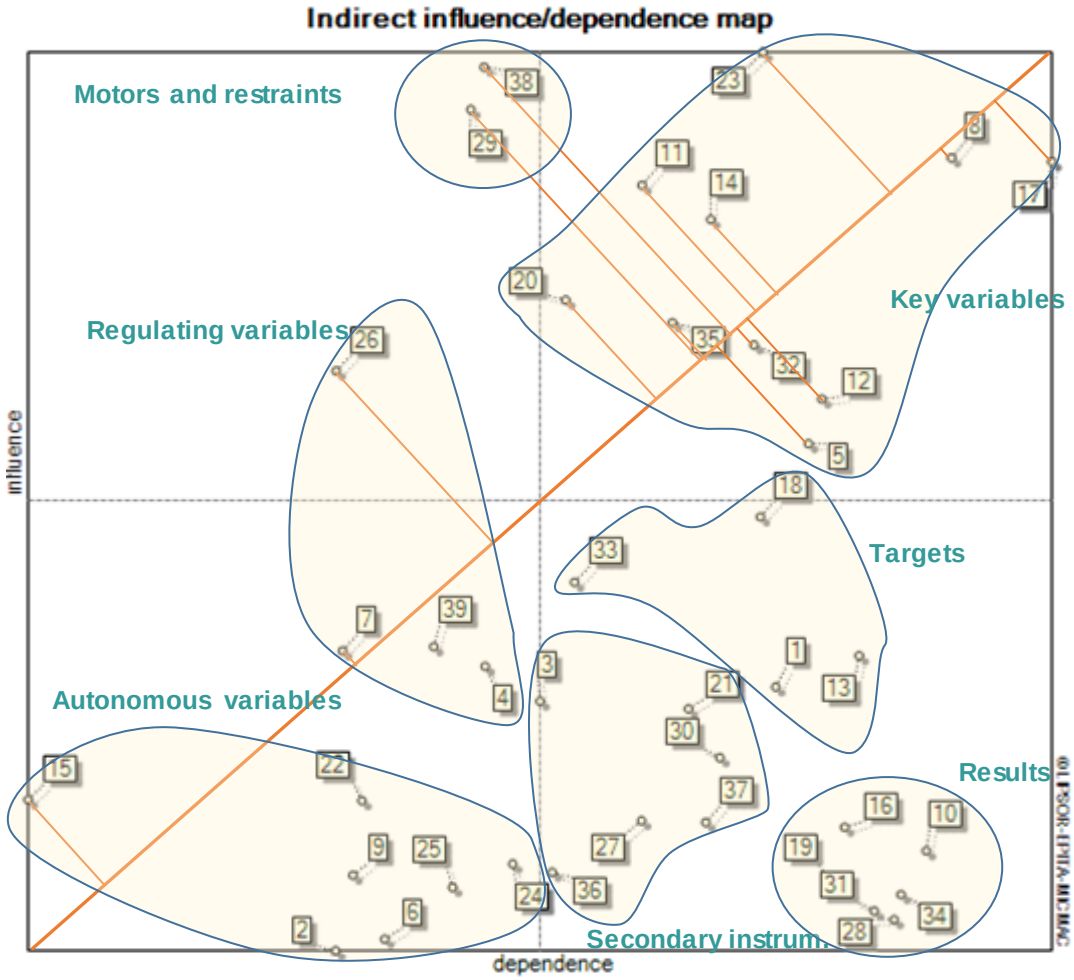

Figure 3: ECHOES variables clustering

The results of the cross-impact analysis Figure 3 show that the key variables are mainly related to social and psychological issues (6/10), followed by political, economic, technological & environmental variables, represented by one key variable each. In the case of motors and restraints, two variables were identified. The detailed description of each variable and determinant can be found in Annex I and the variables corresponding to each of the numbers represented in Figure 3 are displayed in Table 1.

Table 1- List of identified key variables and determinants

Key variables	Determinants (motors and restraints)	Regulating variables	Targets	Secondary instruments	Results	Autonomous variables
23. Social identity and social context	38. National energy cultures	39. People's perception of environmental crisis	18. Collective efficacy	3. Effectiveness of public policy and regulatory instruments	16. Preferences in the occupancy and use of buildings	15. Ageing of the European population
11. Identity	29. Technical feasibility of new technologies	7. Affordability of new energy technologies	33. Digitization of energy services	30. Smart Grid deployment	10. Monitoring and evaluation of energy consumption and feedback	2. Integrating consumption perspective to GHG emission accounting
14. Stakeholder involvement		4. Public policy respect for diversity of lifestyles	1. Legal prescriptions / directives related to energy efficiency	21. Social innovation affecting values and habits	19. Social feasibility of new technologies	9. Carbon tax
8. Sustainable community energy systems		26. Gender equality	13. Awareness raising for energy and climate targets	37. Building environment - urban density and geometry	34. Decarbonization of transportation	22. Digital natives
17. Rising of more sustainable lifestyles				27. Emotions as drivers of energy-related behaviour	31. Charging infrastructure	6. Online monitoring systems of power plants

35. Monitoring and measuring- climate data				36. Funding for environmental protection	28. Awareness and personal attitude to make informed decisions: the willingness to invest	24. "Visibility" of a purchase / investment decision in social networks
32. Mobility as a service (MaaS)						25. Energy-related competence
12. Social norms						
5. Spatial planning regulations						
20. Trust in privacy and data security						

The identified key variables and determinants (see

) represent “components” of a system which could develop in different directions and these different dimensions are formulated as “hypotheses”. The **formulation of the hypotheses** for each key variable or determinant were developed independently from each other in order to avoid a 'predetermination' of possible constellations. Therefore, a group of experts within the ECHOES research group worked independently in the formulation of the different hypotheses and sketched two or three possible hypotheses that represented the possible evolution of the key variables and determinants. The aim was to find two or three differentiated, plausible and easy to understand hypotheses of how each key variable or determinant will look like in Europe in 2050.

An example of the hypotheses used for the scenario building can be seen in

Table 2 and the list of all the hypotheses formulated and used in the scenario building are collected in Annex II.

Table 2- Example of hypotheses used for scenario building

Key variable/determinant: K. National energy cultures		
Hypothesis K1: National energy cultures disappear, while international lifestyle groups emerge	**Hypothesis K2: National energy cultures become an instrument of nationalism**	**Hypothesis K3: National governments shape energy cultures to influence energy behaviour**
In the absence of impressive events in the field of energy - which in the past led to the formation of national memories that shaped/individualised national energy cultures - national energy cultures are disappearing. The significance of the national element is blurring due also to the increasingly converging international (at least within the EU) framework conditions. Instead of national energy cultures, comparable lifestyle groups are emerging across nations, which can be characterised by their attitudes and behaviour and become the primary addressees of policy measures (promotion, awareness-raising…).	As consequence of the raising of nationalism in Europe, “National energy cultures” are becoming an emotionally and historically charged identity anchor and brand, promoted by nationalist governments. Politics instrumentalizes energy supply as the core of national autonomy and the basis of national survival. Accordingly, propaganda closely interweaves key events in energy history, as well as national achievements in technology and infrastructure, with social memory and common social norms. The sustainability and climate-friendliness of the national energy culture plays a secondary role here.	National governments act to influence the energy behaviour of citizens by means of regulations and addressing their expectations and aspirations. Low-energy lifestyles are propagated by climate-aware national governments, rewarded/punished accordingly (regulations, tax systems, individual CO_2-budget). The resulting adapted behaviour of citizens is branded and marketed as a "national energy culture".

Once all the hypotheses were formulated a major workshop in Brussels in December 2018 was organised to analyse, along with external experts, all the hypotheses one by one and to define exclusions and preferences. The “exclusions” represent incompatible pairs of hypotheses whereas the “preferences” mean that a certain pair of hypotheses could work well together. The preferences and exclusions that were determined during this workshop

were further analysed by the ECHOES research group and the sets of possible solutions with the highest degree of coherence were calculated.

The table below shows various set of hypotheses gathered in potential scenarios and presents the results of the "preferences" and "exclusions" exercise. The combinations that gather the highest number of "preferences" (indicated in the table below in brackets), as defined by the experts during the Brussels' workshop, are the most interesting ones. Each letter and number represents a manner of coding the different hypotheses (see Annex II for a detailed description of each hypothesis), for instance, G1 refers to the hypothesis "All electric and integrated mobility", L3 refers to the hypothesis "Fast techno-economic development and superior user experience by new technologies" and the hypothesis D3 refers to "High energy efficiency and full system integration".

1. **G1; L3; A2; B2; B3; C1; D3; E3; H2; I1; J1 (11 – Scenario 1)**
2. C1; K3; A2; B3; D3; E1; G1; G2; H2; I1 (10)
3. I1; L3; B3; C1; D3; F1; F2; F3; G1; J1 (10)
4. L3; D3; F1; F3; G1; G2; I1; I3; J1 (9)
5. E1; K1; K2; K3; A2; B3; C1; F2; F3 (9)
6. **F3; L3; B3; C3; E1; E2; E3; I1; J1 (9 – Scenario 2)**
7. **H1; K2; A2; B1; C2; C3; G3; I2; J2 (9 – Scenario 3)**

Scenarios n.1, 2, 3, 4 and 5 are very similar sets of combinations which did not permit to obtain differentiated scenarios, so two "second-best" scenarios, with 9 preferences each were selected out of possible combinations (34 potential set of combinations). The same analysis was carried out to select the most appropriate combination of hypotheses for each scenario in order to avoid incongruent combinations. The scenarios highlighted in bold are the set of combinations that have been used for describing ECHOES' future scenarios.

1.2 THE ECHOES' SCENARIOS

Before describing the future scenarios of the European energy transition, it should be pointed out that every scenario exercise is carried out within a given social, economic and political context that it is based on past events and developments and present trends. The ECHOES project has been carried out in a period of political uncertainty at the European level, along with the advancement of technological developments: the raising of nationalism in many European countries, the United Kingdom withdrawal from the European Union, the climate emergency, the unstoppable digitalization of societies.

How will Europe look like in 2050? To conduct this scenario exercise it has been assumed that in 2050 the European Union will still be a reality, that climate change will be a real emergency for the European society and policy, and that the influence of digital technologies on citizens' behaviour, lifestyles and jobs will change the social norms to a high extent. European population will be considerably older, and many other aspects of Europe will be different in 2050. The first scenario shows a coordinated and integrated European Union, strongly aligned with the international climate policy, where the citizens take the lead in the energy transition and adopt new sustainable

lifestyles. This is supported by a technology convergence, a greater energy self-sufficiently, and the coordination of cross-sectorial policies along with the participation and engagement of citizens in energy related decision-making. The second scenario represents a fragmented European Union where climate-aware national governments emerge and promote low-energy lifestyles among their citizens by means of regulation and addressing their expectations. There is a moderate coordination among EU regions regarding spatial development and energy policies but there is a lack of integrative approaches to tackle the supply of energy to local communities. Moreover, the citizen participation and public engagement shows big disparities among Member States and it becomes evident that social norms and acceptance need to be considered at early stages of the energy related decision-making process for the effective integration of policies and action plans with social norms. Finally, the third scenario shows a setback of the European integration, where the resurgence of nationalist governments instrumentalise energy supply as the core of national autonomy and the basis of national survival. Key energy transition technologies develop slowly, and the strict regulatory framework represents a barrier for technological innovation and data sharing. The weak European identity erodes the sustainable energy transition and citizens' pro-environmental behaviour is driven by the reward/punishment systems set by national governments. The public engagement in energy transition decision-making is very poor as public consultation procedures are non-existent. There is a complete lack of integration of energy systems, as well as an absence of consistent design of spatial planning and energy policies. Further sub-sections describe each of the scenarios in detail.

1.2.1 Scenario 1 - SINGLE EUROPEAN ENERGY LANDSCAPE

Growing social concern and scientific evidence have moved Member States to confront the energy and climate challenges jointly. The sheer dimension of the challenge has blurred the relevance of purely national initiatives in this field. Events that tended to shape national energy cultures and attitudes are fading memory while **new sustainable lifestyles** which are not bound to national limits have started to characterise the European population. By 2050 it is broadly accepted that the whole Europe needs to draw on each and any of the sustainable carbon-neutral energy technologies that are accepted by the different lifestyle groups.

Advanced energy management technologies are penetrating the household level benefiting from the user-centric approach that ICT technologies have added to traditional energy management systems. Absolute condition for this **technology convergence** is that industry-led technology development takes place in a manner where privacy issues and data security are a top priority. Developed solutions (products and services across different domains, including energy systems, vehicle systems, etc.) are safe, and serious problems in privacy and data security are efficiently avoided with preventive design and efforts. **Trust in privacy and data security** is therefore strong, and this supports uptake of even data-intensive solutions and data sharing (C2B (consumer-to-business) as well as B2B(business-to-business)).

Specialised providers have managed to combine technological solutions benefiting the balancing of highly volatile energy markets with the needs of industrial, commercial and finally domestic energy users. In this development, important technological breakthroughs (e.g. advanced automation systems enabled by smart technology improve experienced comfort levels in buildings, large driving ranges of EVs decrease the need of refuelling stops) have spurred progress but the main decisive factor for penetrating all societal levels has been user-centric design approach.

The **changes in attitudes** among the European population found their expression also in the form of political activism and pressure. Successful steps of the citizen movement against climate change triggered important decreases in energy supply; important but yet insufficient steps towards carbon neutrality.

A **sustainable lifestyle** is no longer perceived as a burden, but **as an opportunity**. Between 2020 and 2050, freedom of choice regarding how each individual uses his or her personal "remaining greenhouse gas budget" has

resulted in a multitude of economic and societal opportunities. The personal greenhouse gas balance is monitored on an individual basis. A high availability of emission data, growing creativity and an exceptional progress in citizens' ecological literacy have made Europe ready for a decarbonised future. Individuals and organizations (e.g., institutions, companies) adopt more sustainable lifestyles driven by the possibility to obtain material (e.g., economic) or immaterial (e.g., social status) gains and competitive advantages in the market. This greater choice in the field of individual and collective decision-making has been facilitated by the disappearance of controversies between national and EU decision makers. Feeling part of a wider community increase the **collective self-efficacy** and has pushed the energy transition forward. Obviously, Europe could have not undertaken this journey to sustainability without active support in the rest of the world.

The energy transition process and performance requirements are planned in the framework of **strong international climate policy**. Periodical screening is undertaken in relation to the design, implementation and evaluation of plans and programs. Assessment methods of energy demand and consumption, indoor and outdoor climate comfort levels and energy efficiency parameters are standardized and applied by highly qualified experts and neutral professional consortia. Data gathering is institutionally channelled and interoperable within data infrastructure with strictly defined access levels for the licensed experts and climate and energy related decision-makers. Public data generation, management and access are regulated and with different levels of aggregation depending on the scale of interventions and the protection of privacy and confidential information. The societies are no more closed communities and are subject to an enormous flow of information from all over the world and this opens up opportunities for exploring heterogonous alternatives for **greater energy self-sufficiency**, for instance, foster the reinforcement of values of social self-reliance and even autonomy in many parts of the world.

As in the rest of the world, the unique European energy landscape combines the optimal use of natural resources with highly efficient technologies paying attention to the specific local context. Examples for this are localised renewable energy co-generation schemes combining municipally-owned utility companies, energy cooperatives, self-consumption schemes or automated/smart household energy systems.

Citizen participation and engagement is one of the main **cornerstones in the planning and implementation of energy transition**. Public consultation procedures are mainstreamed throughout all the EU, and held for every major industrial, infrastructure, and policy development undertaken within local, regional, and national jurisdictions. Issues concerning societal tensions and economic impacts to local communities are addressed through in-person group consultations and followed up by a period for accepting written inputs/considerations using a standardised template. Acceptance thresholds are developed based on approval rates related to any major industrial/infrastructure development, energy strategy, or other relevant policy mechanisms directly affecting local communities' energy access and consumption, or generation capabilities.

Just as important is the **coordination of cross-sectoral policies** protecting European landscapes and natural resources. The long-term engagement of institutions and communities have managed to integrate such diverse aspects as public health and regional and urban planning as spatial planning instruments of the energy transition. In the same sense, in the field of **mobility a rich combination of services** based on adaptive rules and conditions have been deployed for different spatial scales and segment niches. Integrated public transport modes facilitate the longer trips between metropolitan and urban regions with high demand. Shared flexible transport and logistics services fulfil the needs of places and periods with lower demand.

Mobility as a service options cover almost all mobility needs, so owning a car or any other vehicle is no longer necessary; yet some people still find it attractive for leisure purposes. Subscription based service bundles provide access to all modes and means of transport and tailorable combinations within. Vehicle fleets owned by service

providers and transport operators are fully electric (cars, buses, bikes, rail, etc.). Mobility services include also car, bike and electric scooter rental and people are used to and comfortable with using them.

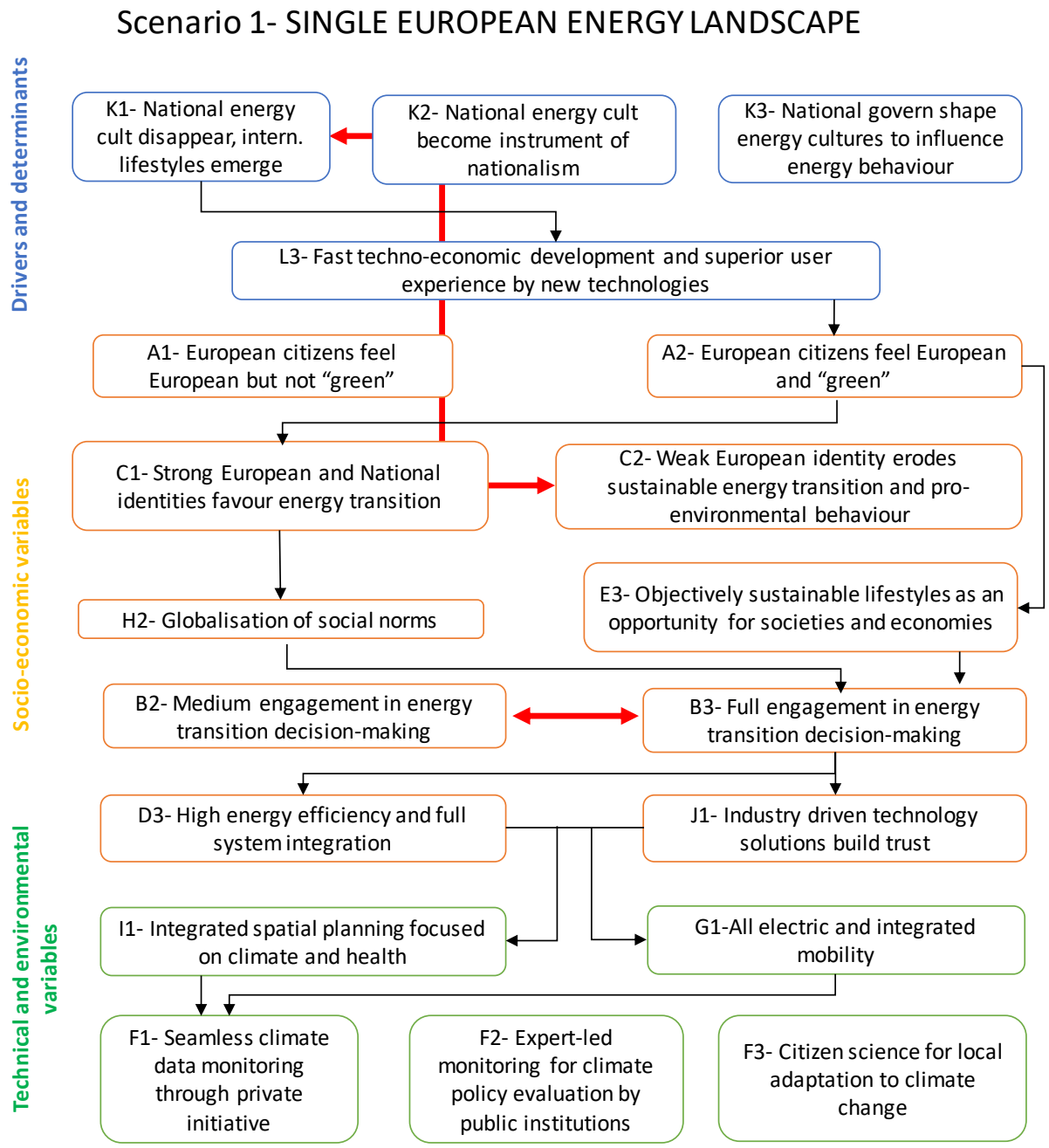

Figure 4: ECHOES Scenario 1- Single European energy landscape

The figure above is a graphical representation of how the scenario “Single European Energy Landscape” was constructed. The hypotheses linked with red arrows are mutually exclusive while the black arrows show a preferential relationship between them.

1.2.2 Scenario 2 - EU PATCHWORK

The failure of the European integration has triggered the **emergence of climate-aware national governments** that **promote low-energy lifestyles** and that act to influence the behaviour of citizens by means of regulations and addressing their expectations. Climate-friendly behaviour is rewarded, while behaviour with a negative climate impact is penalised in a specifically designed economic framework, including tax systems, regulations and individual CO_2 budget. Individuals shift to more sustainable lifestyles in response to top-down climate policies implemented by national governments, driven by the will to comply with formal regulations. This adapted behaviour of citizens is branded and marketed as a "national energy culture".

The failure of the integration process at the European level leads to the **prevailing of local identities** with negative impact on the sense of collective self-efficacy. Local minorities play a key positive role in addressing energy transition processes by promoting bottom-up changes, with different level of success. They also promote the protection and enhancement of the local resources of a specific territory but encourage, in some cases, negative forms of localism (such as NIMBYism) that defend and protect only the minority’s wealth or privileges as opposed to green growth. The originally high costs of electrifying and decarbonising the European energy and mobility system have been brought down thanks **to intelligent management techniques** that allow the users to consume electrical energy when it is most affordable, for example in high wind/solar output. Citizens’ **trust in privacy and data security is strong**, allowing the implementation of those intelligent management techniques and supporting the uptake of data-intensive solutions and data sharing. However, the widespread uptake of cheaper and more efficient hybrid renewable energy systems (consisting of two or more renewable energy sources used together to increase system efficiency, combining, for instance, a photovoltaic array coupled with a wind turbine) has also been necessary to make the energy access affordable for the largest part of the European population.

Nevertheless, an **integrated approach to supplying local communities** with their energy requirements is **not fully deployed**. Integration measures within households and between communities are emerging as niche developments, digitalisation measures are still lacking mass-scale deployment, with household automated systems, community-administered renewable energy generation initiatives, and smart appliances still seen as the exception rather than the rule. The lack of coordination among Member States and the different policy priorities of the European national governments derives on broad divergence throughout Europe (e.g. car sharing in bigger cities only). **Public transport modes are only partially integrated** and their electrification advances at different paces throughout the Members States.

Mobility as a service options cover most of the mobility needs and owning a car or any other vehicle can be avoided. The existing subscription-based service bundles provide reliable access to many modes and means of transport and tailorable combinations within. However, the full deployment of the electric car is still underway and vehicle fleets owned by service providers and transport operators are only partially electric. Consumers can choose a fully electric service subscription, if it fits to their needs, values and economic status, but this preference is not shared by all.

Important **disparities** occur between Member States with regard to **citizen participation and public engagement** on energy-related industrial or infrastructural developments. Although public consultation procedures are in place in all Member States, incidental deficiencies exist in the mainstreaming procedure for having a fully structured, mainstreamed public consultation procedure operational in all EU, leading to important disparities between Member States. As a consequence of the promotion of low-energy lifestyles by national governments and higher levels of

citizen's awareness and consciousness, a **citizen science for local adaptation to climate change** arises. Local communities and authorities share the responsibility for the local energy needs and comfort demand. Easily-customised open source tools (sensors, models and applications) for monitoring the energy performance of separate buildings and neighbourhoods are broadly accessible to citizens. The existing open access to a large amount of climate data (including temperature, albedo and heat island effects, sun exposure and sky view factor) for interested parties leads to growing number of users, ways of data utilisation and implemented adaptive solutions.

The ambitious goals of energy transition of climate-aware governments, supported by pro-environmental social norms, fostered the implementation of national policies and action plans. However, as the process of energy transition matures, it becomes evident that **social norms and acceptance** need to be considered not only during the implementation and post implementation phases, but at earlier stages of the energy related decision-making process. The fragmented European landscape shows the difficulty of transforming the economic and logistics systems even if more sustainable lifestyles are adopted and despite the fast development of new technologies. There is a **moderate coordination among EU regions regarding spatial development and energy policies.** Despite the abundant experience gained through numerous innovative interventions and the well-developed systemic research on the energy-related aspects of urban and regional development, there are still barriers to the diffusion of knowledge and experience due to the hard competition between two paradigms: the new communities sharing the economy of scope principles and solutions, and the established societal legacy of mass consumption with the economy of scale model.

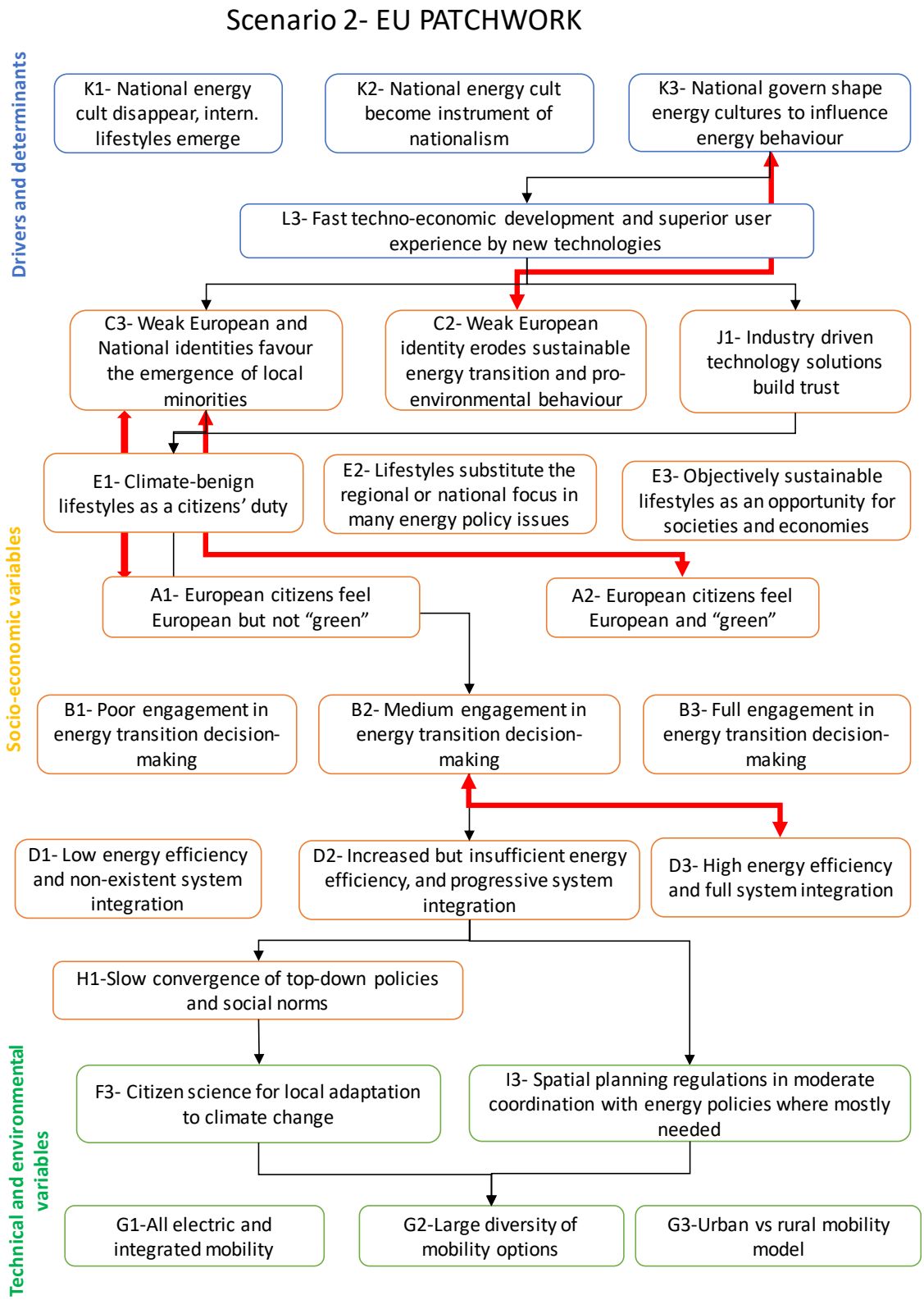

Figure 5: ECHOES Scenario 2 - EU Patchwork

The figure above is graphical representation of how the scenario EU Patchwork was constructed. The hypotheses linked with red arrows are mutually exclusive while the black arrows show a preferential relationship between them.

1.2.3 Scenario 3 - EUROPE TAKES SEPARATE WAYS

As a consequence of the resurgence of nationalism in Europe, **national energy cultures** have become an emotionally and historically charged identity anchor and brand, **promoted by nationalist governments**. Politicians instrumentalise energy supply as the core of national autonomy and the basis of national survival. Accordingly, propaganda closely interweaves key events in energy history, as well as national achievements in technology and infrastructure, with social memory and common social norms. In this framework, the sustainability and climate-friendliness of the national energy culture plays a secondary role.

The expansion of isolationism between member states constitutes an insurmountable barrier for the progression for of the **key energy transition technologies**, which **develop slowly in terms of technical and economic performance**. Moreover, the new technologies are not attractive from a user experience point of view. The user is not considered in the design of new technologies which worsens the users' experience and slows down user-driven investments. This lack of user-centric design of new technologies impacts on different technological domains: electric vehicles suffer from insufficient charging infrastructure; smart technologies do not support invisible demand response for the users but call for manual actions; energy efficiency renovation of buildings suffers from unsuccessful first cases, causing bad reputation.

The **strict regulations** that are established to prevent problems in privacy and data security pose another **obstacle for technological innovation and data sharing**. Data handling and usage is heavily regulated and involves complex processes with permissions and procedures and, consequently, companies are reluctant to develop data-intensive solutions. Consumers are similarly reluctant to adopt data-intensive solutions, but rather choose traditional safe and secure alternatives.

The local communities suffer from a complete **lack of integration of energy systems** and they depend on a central electricity grid with none or few district heating/cooling developments, non-existent community-anchored renewable energy generation schemes and poor renewable energies integration. The absolute dependency on large-scale utilities leads to increased consumer vulnerability, poor resource diversification, high price volatility and vulnerable communities at risk of energy poverty. Additionally, the poor rates of digitalisation results in low resource efficiency and inefficient system design.

This lack of integration is also observed regarding the different policies that affect the European landscapes and natural resources. The **insufficient integration between spatial planning and climate and energy policie**s constrain the bottom-up efforts of EU cities and metropolitan regions to prevent energy leakages. The controversies in the priorities of strategical planning documents, distrust to climate and energy related policy among various urban actors and blurred responsibilities represent a strong health burden for the EU citizens.

The **mobility landscape is fragmented**, with differentiated urban and rural mobility models. In the cities, there is weak competition and protectionism to mass public transport services along with taxi and specialised transfers. The mobility landscape is dominated by more accessible private fleet due to lower price and fuel or battery efficiency for both combustion and electric engines. In the rural areas, mobility services cover only small part of the mobility needs. Some consumers rely on peer-to peer sharing economy services. Others still own and use a car, and possibly offer peer-to-peer or car-sharing services.

Vehicles and fleets owned by service providers and transport operators are not fully electric. People are used to and comfortable with using shared electric vehicles, but many car owners are strongly attached to their fossil fuelled mobile property.

Societies are closed communities where the **weak European identity** erodes the sustainable energy transition and the pro-environmental behaviour of citizens and organisations (e.g. institutions and companies), which the only will to comply with the reward and punishment regulations implemented by national governments. Citizens and organisations that promote more sustainable lifestyles are considered outsiders. Social norms are aligned with top-down national policies although their consideration in earlier stages of the decision-making process is becoming an issue for policy makers. The **public engagement** in energy transition decision-making is very poor as public consultation procedures are non-existent and no standardised measure of public involvement, acceptance or opinion channelling is facilitated. Major industrial, infrastructure and energy-related developments are solely taken based on economic analyses and environmental impact assessments, without due consideration to social sustainability issues regarding user engagement, acceptability, and/or explicit rejection. Important risks appear from a poor engagement with communities directly affected by such developments, resulting in low local community acceptance rates.

The energy transition process and performance requirements are planned by each member state in alignment with the weak European climate policy. Public institutions **monitor climate data** with the support of experts. Data generation, management and access are in the hands of private companies that provide public institutions with the data.

Scenario 3- EUROPE TAKES SEPARATE WAYS

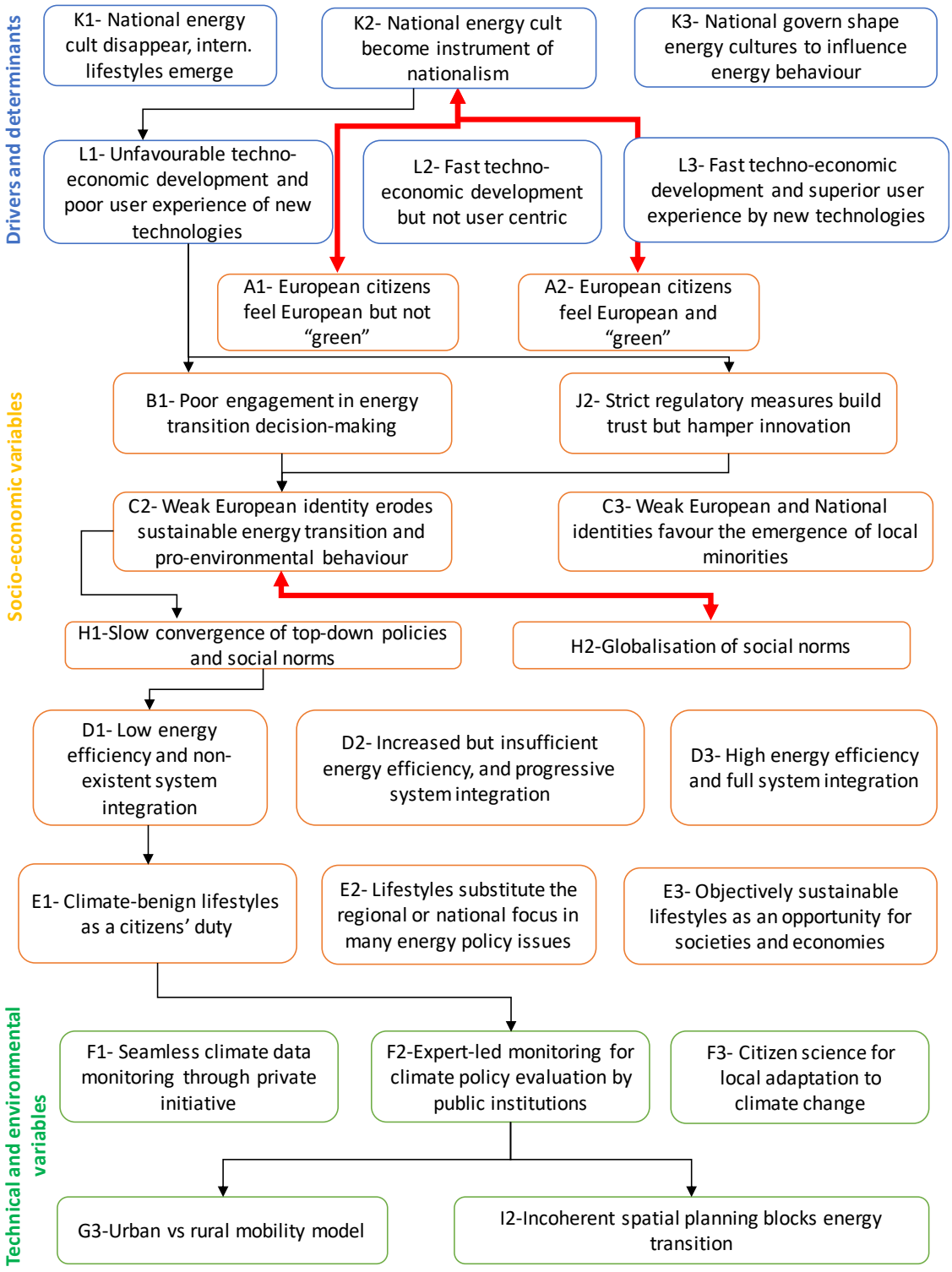

Figure 6: ECHOES Scenario 3 - Europe takes separate ways

The figure above is graphical representation of how the scenario Europe takes separate ways was constructed. The hypotheses linked with red arrows are mutually exclusive while the black arrows show a preferential relationship between them.

2. WORKSHOP 2: NEW POLICY OPTIONS DERIVED FROM ECHOES

The overarching goal of Work Package 7 (WP7) is to harness the scientifically-grounded knowledge obtained in the ECHOES project with respect to energy-related choices and behaviour; and to advance a set of policy-prescriptive recommendations and strategies tackling individuals' acceptance, engagement, and complicity with energy policy measures and instruments advancing the Energy Union and SET-Plan. WP7 will result in the realisation of three main deliverables summarising the knowledge gaps identified from earlier scientific work and synthesizing the main findings and knowledge obtained throughout the project (D7.1); estimating the potential impact of the main driving factors along with their policy implications and potential (D7.2), and evaluating the relevance of the project's scientific outcome for energy stakeholders playing a relevant role in the energy transition (market actors, regulatory bodies, environmental agencies, policy-makers, etc.) as well as its potential and utility for impact-maximising policy-making (D7.3).

While the foresight exercise workshop focused on defining future scenarios of the European energy market and reflecting on the parameters of the system in which the ECHOES system might be functioning in 2050, in the second major ECHOES workshop, the main effort was focused on the identification of the most relevant, impactful, and implementable policy ideas informed by ECHOES research that are the focus of future refinement and study also taking into account the elaborated scenarios.

This workshop initiated an active interaction with the participants on the EU energy policy recommendations identified within ECHOES scientific work, and presented the relevant background information for the subsequent discussion and opinions' collection through sli.do. During the second workshop a block informing about the overall ambition and objectives of the research project ECHOES was included, and the participants were provided with exclusive first-access to the preliminary results of the ECHOES project, while scientific leaders within ECHOES gave short presentations (~10 min. each) targeted at sharing their most insightful, critical, and policy-relevant findings. The main goal of the workshop organized in May 2019 in Brussels was to focus on new policy options that were investigated and derived from the ECHOES research activities.

2.1 METHODOLOGY

To reach the main goal of the workshop namely to identify the policy ideas from ECHOES that are the most relevant, impactful, and implementable the workshop participants were at first acquainted with the main ECHOES findings in each WP. Further on, eight policy options elaborated based on research activities conducted in ECHOES were discussed. These are preliminary general policy recommendations geared towards making regulations and policies in the energy domain more impactful in terms of their impact on consumer choices, acceptance, and market uptake. The general policy suggestions were distilled from an input template that was sent out to all scientific members of the consortium. This template asked the scientists to summarize the main results of their work in ECHOES and then reflect on how these results can be operationalized to inform policy. The authors of this document then took these recommendations and combined them into a preliminary internal policy document, also adding their own recommendations based on their work in ECHOES. From this internal document, and following internal discussions, the below list of eight **preliminary** ECHOES policy recommendations were distilled.

The preliminary policy options discussed during the workshop are the following:

1. **Competitive electricity market auctions with provisions to support smaller suppliers and RES generators (e.g. price bounds, subsidized insurance, insulated markets)**

2. **Integrate individual mobility policies and changes with broader public transport system.**

3. **Integrate EV charging infrastructure into smart energy grid and long-term electricity system planning.**

4. **Require standardized metadata and sharing protocols in new policy implementations and actions (e.g. Incorporate database of deliverables, datasets, etc. into CORDIS)**

5. **Define minimum standards for user-friendly smart-meter information provision to household consumers.**

6. **Provide legal and administrative support for collectively organized energy consumers via third party intermediaries.**

7. **Define criteria for informational / procedural / marketing actions within policies**

8. **Stress any added economic/public health benefits from climate & energy measures in policy framing**

Note that these policy options were kept at a general level, to allow for a diverse stakeholder group and interdisciplinary research team to all given input during the workshop. For each of these eight polices, a specific context as well as identified issues which can be handled with the discussed policy were provided. Further on, as a part of policy readiness exercise the participants of the workshop were asked to rank each policy using the sli.do service which allows to engage audiences and ask their opinion as well as display the results in real-time. The participants were asked whether they think a respective policy recommendation is a promising idea, or not. They could rank each of the eight policies from 1 to 5 (with 1 - Bad (No reason to investigate it), 2 - Not very good, 3 - Ok, 4 - Good, 5 - Very good (should be prioritized for further study). The top three options were identified based one the collected votes and concluded to be actionable policy recommendations of highest priority.

2.2 KEY RESULTS

The results in this section highlight the main outcomes of discussions and opinion polls collected during the workshop, these results should be interpreted as only a preliminary and partially in the context of ECHOES final policy recommendations. More specifically, the discussions and results related herein serve as inputs for the further development and elaboration of ECHOES policy recommendations that will be published in Deliverable 7.3. The ECHOES overall policy recommendations include a much broader list of suggested implementation measures and interpretation of the policies has also evolved and developed through the project due to input from various research activities since the workshop related herein took place. Thus, **the results herein are not the final ECHOES policy-recommendations**, but serve as a an initial 'measuring stick' and tool allowing the test the reaction of various stakeholders to ECHOES scientific findings and related policy elaboration as well as the readiness of the suggested measures to be introduced in a short-term.

The results relate the Likert scale scores from a live voting exercise carried out during the workshop, where all participants rated a presented policy from 1-5, with 5 being the highest and most favorable score. According to the results of the input collected during the workshop the three recommendations with the highest ranking were identified: with the highest score of 4.4/5 and 60% of participants having ranked the suggested policy as very good (or the one that should be prioritized) the policy implying integration of individual mobility policies and changes with broader public transport system is considered as the top 1. While the mass introduction of e-vehicles is often considered as a viable low-carbon mobility option, no comprehensive impact analysis on urban and inter-city mobility patterns are available. Sector-isolated mobility policies risk benefitting one particular mobility option above others and can force consumers to make suboptimal choice. So there is a need for an integrated urban and public transportation plan with diversified public transport offering with individual low-carbon mobility options. And innovative mobility options (e.g. e-car sharing) which need to be carefully integrated into broader transportation system.

The second most promising policy as identified during the workshop is also related to the transport sector which is policy number 2. It suggests integrating EV charging infrastructure into the smart energy grid and long-term electricity system planning as there is an increased need to harmonise charging infrastructure with broader grid expansion frameworks in order to accommodate mass transport electrification cost-effectively and reliably and avoid overstraining the grid. This policy received an overall rank of 4, with 71% of participants having ranked this policy as a good idea (rank 4) and 14% as a very promising (rank 5).

The third most highly ranked policy is the policy number eight according to which it is required to stress any added economic/public health benefits from climate and energy measures in policy framing. This policy received an overall rating of 3.8 with 25% of participants evaluating this policy as good (rank 4) and very good (rank 5). As shown in Deliverable 7.1 with the willingness-to-donate for carbon mitigation measure, consumers have higher acceptance and willingness to support the climate when they believe in additional benefit thereof such as, for example, job creation. The identified results confirm that there is a need to systematically highlight and streamline economic and public health concerns/issues into policy framing in order to increase public acceptance and support for climate and energy policies/measures.

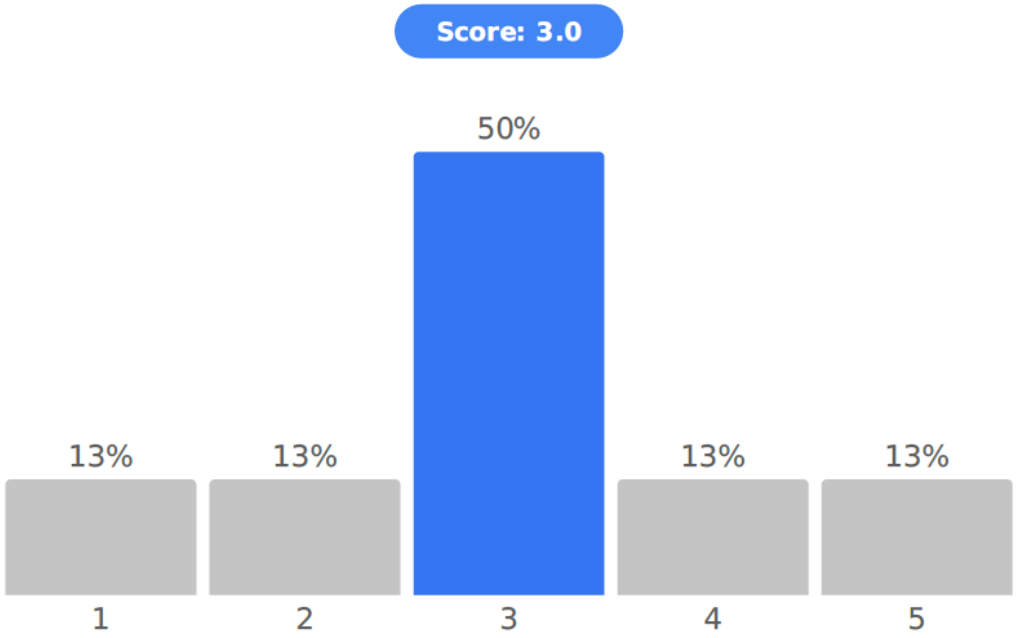

Figure 7: Vote results. Policy 1: Competitive electricity market auctions with provisions to support smaller suppliers and RES generators (e.g. price bounds, subsidized insurance, insulated markets)

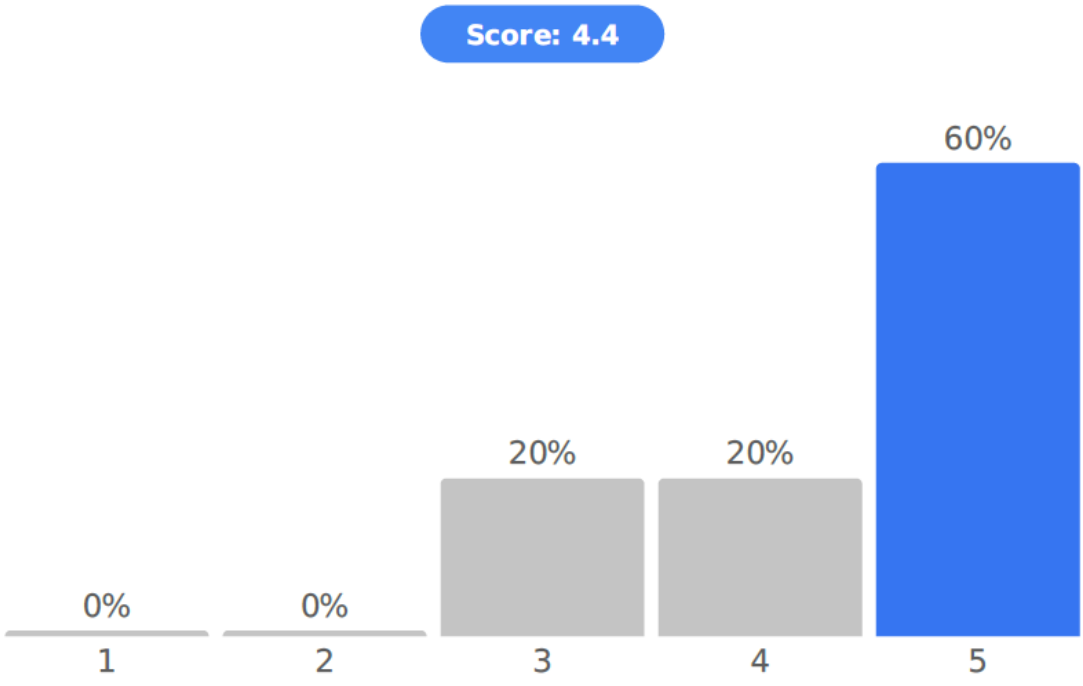

Figure 8: Vote results. Policy 2: Integrate individual mobility policies and changes with broader public transport system.

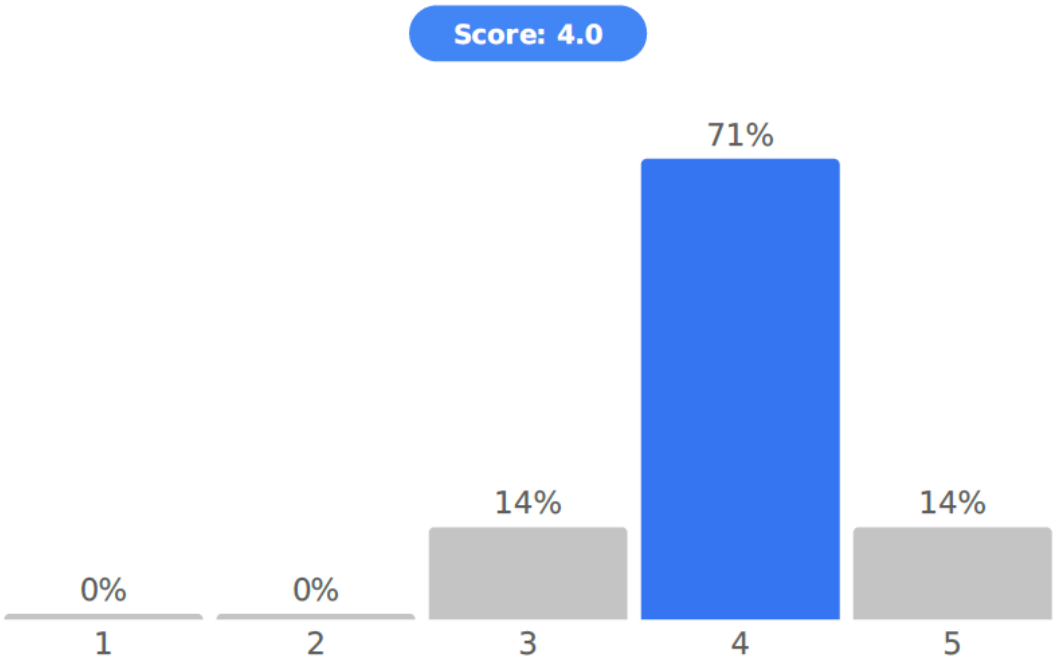

Figure 9: Vote results. Policy 3: Integrate EV charging infrastructure into smart energy grid and long-term electricity system planning.

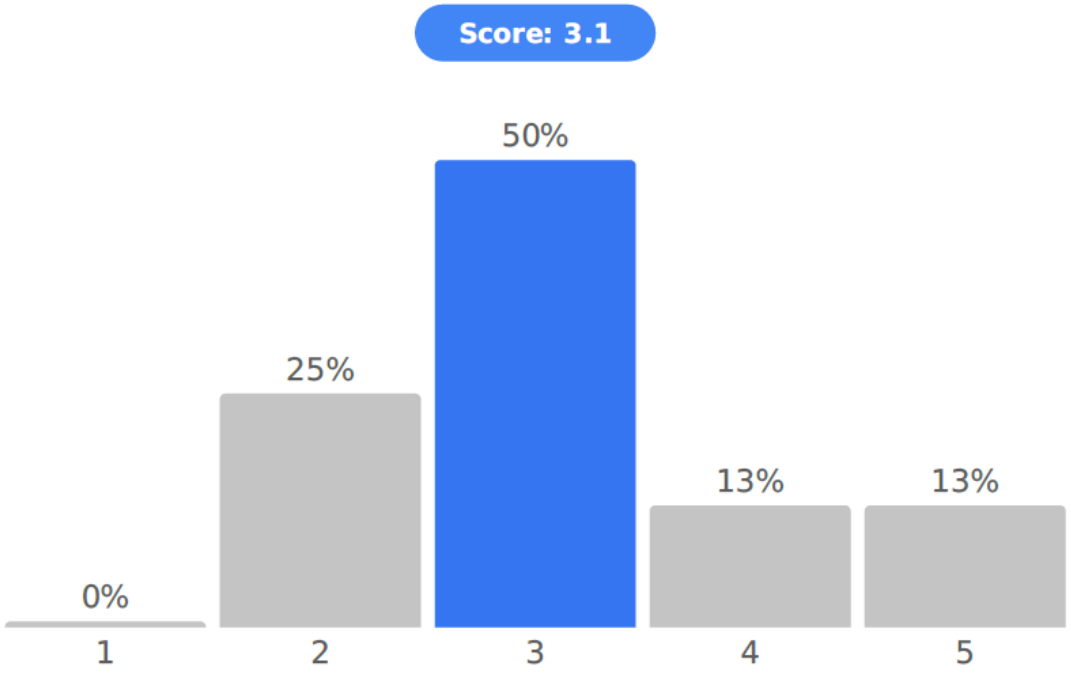

Figure 10: Vote results. Policy 4: Require standardized metadata and sharing protocols in new policy implementations and actions (e.g. incorporate database of deliverables, datasets, etc. into CORDIS)

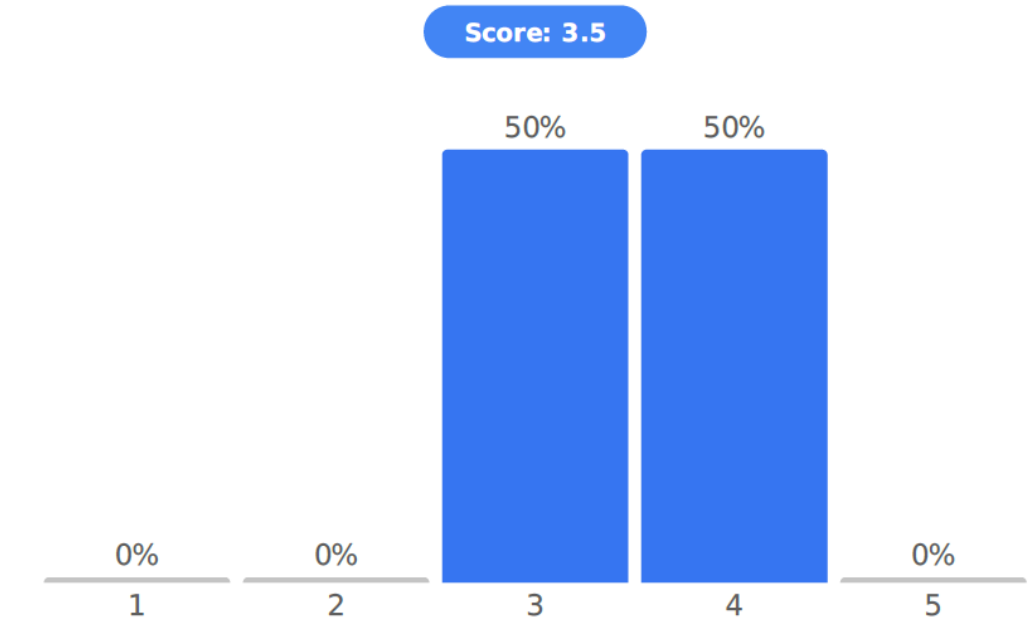

Figure 11: Vote results. Policy 5: Define minimum standards for user-friendly smart-meter information provision to household consumers.

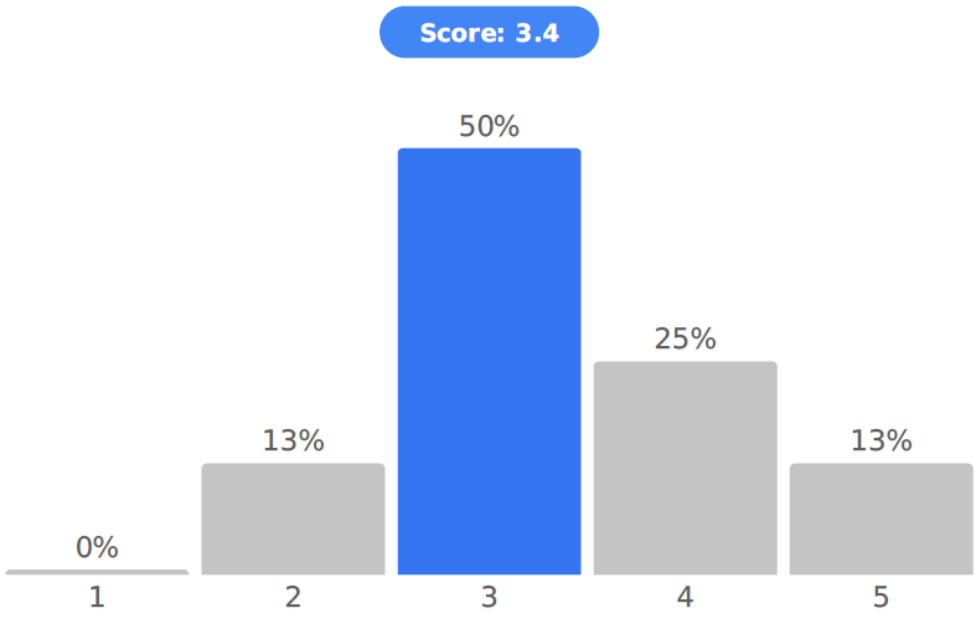

Figure 12: Vote results. Policy 6: Provide legal and administrative support for collectively organized energy consumers via third party intermediaries.

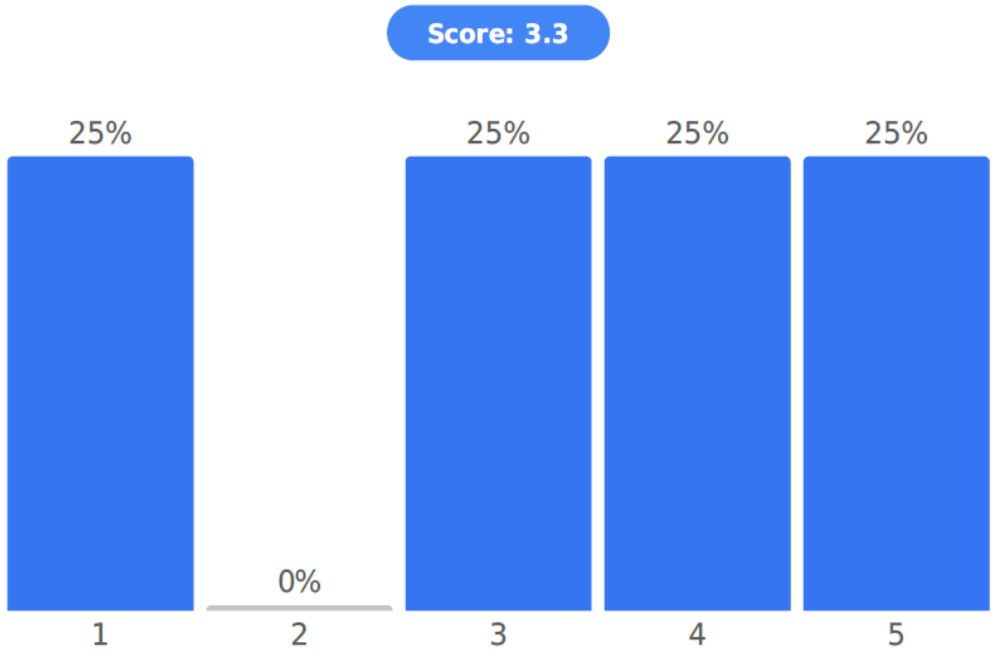

Figure 13: Vote results. Policy 7: Define criteria for informational / procedural / marketing actions within policies

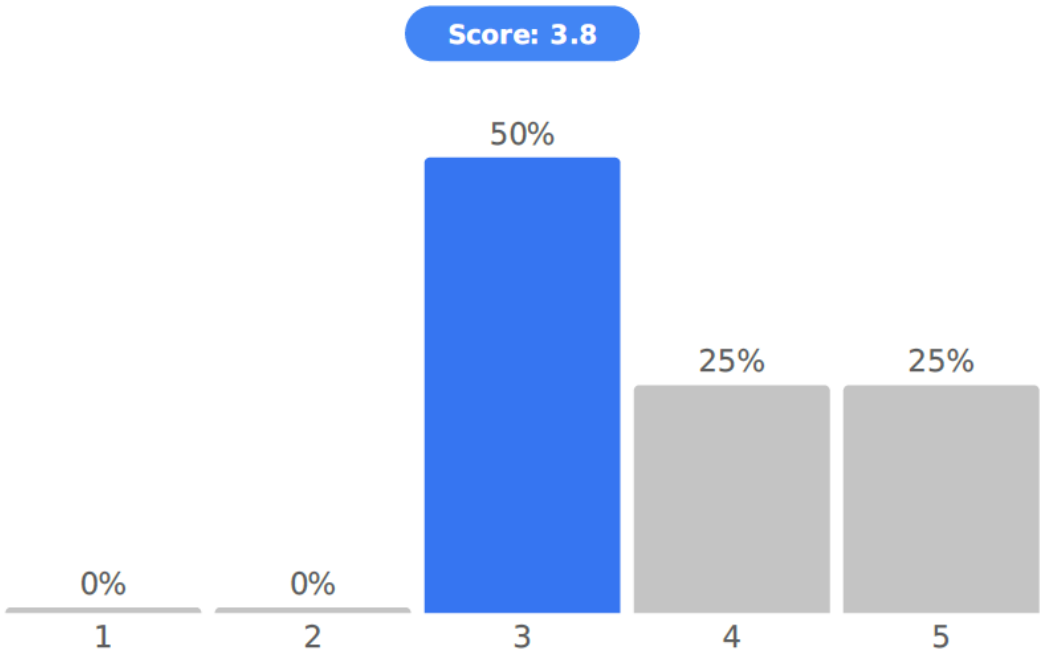

Figure 14: Vote results. Policy 8: Stress any added economic/public health benefits from climate & energy measures in policy framing

3. CONCLUSIONS

This report is based on the inputs collected during the two major ECHOES workshops and highlights key findings and conclusions of the conducted discussions.

The first workshop was devoted to a foresight exercise following the methodology of the future studies field. The workshop held on 4th of December 2018 was prepared through a series of internal workshops and discussion groups within the ECHOES project. As a result of work following the methodology defined and described in this report, three scenarios of Europe's possible energy futures for 2050 were developed within the ECHOES project, namely Single European Energy Landscape, EU Patchwork, and Europe Takes Separate Ways.

The first scenario shows a coordinated and integrated European Union, strongly aligned with the international climate policy, where the citizens take the lead in the energy transition and adopt new sustainable lifestyles. The second scenario represents a fragmented European Union where climate-aware national governments emerge and promote low-energy lifestyles among their citizens by means of regulation and addressing their expectations. Finally, the third scenario shows a setback of the European integration, where the resurgence of nationalist governments use energy supply as the core of national autonomy and the basis of national survival. The elaborated scenarios represent considerably contrasting visions of the long-term political and energy system context in Europe as well as consumers' role in the energy transition. While each scenario requires some adoption of the ECHOES policy recommendations to the respective circumstances and is plausible, it is rather discernible that in order to reach the goals set by the European Commission in the energy field, for instance, to reduce greenhouse gas emissions by 80-95%, when compared to 1990 levels, by 2050 (Energy Roadmap 2050), the Scenario with the Single European Energy Landscape seems the most promising. However, to increase the probability of this scenario coming to fruition, a strong and well-coordinated policy strategy at all the levels, from local to EU, supported by research and empirical evidence, is essential. For instance, the policy measures which imply an active role of consumers making informed decisions in terms of energy consumption in buildings, mobility choices and smart energy technologies as well as stimulate consumers participation in collective actions like collective investments in renewable energy projects should be intensified.

Further on, in the second ECHOES workshop while continuing the foresight process and sharpening our vision and reflections on the potential future social and political context, we also focused on a more short-term situation by analysing the readiness of some of the policy measures defined in ECHOES to be implemented. In this workshop we mainly aimed to receive feedback on a first iteration of the policy recommendations stemming from ECHOES scientific work by first, providing workshop participants with an overview of ECHOES key results and discussing the policy implication thereof. The policy readiness exercise conducted during this workshop engaged participants in a discussion and allowed them to rank eight identified and discussed in detail polices according to their readiness to be implemented, and applicability/impact to energy policy and regulation. The top three most highly ranked policies were chosen during the workshop. Two out of these are related to the transport and mobility sectors, suggesting that the stakeholders see a high importance of the timely necessity to make policy modification in this sector, and that ECHOES research may fill this knowledge gap. The third most highly ranked policy recommendation was the one suggesting to stress and promote ancillary benefits of climate change mitigation policy measures. Such measures, as shown in the findings reported in Deliverable 7.1, can increase significantly consumers' acceptance and willingness to support new energy measures, as such auxiliary benefits (e.g. job creation or health benefits) are more appealing and easier to understand for citizens. While introducing such a policy requires mainly increased attention to policy framing, there is high potential to increase public acceptance and support for climate change mitigation and energy transition policies/measures by doing so. While the set of policy recommendations discussed during this workshop was limited to eight options, this list does not represent the final set of ECHOES policy recommendation and it was further developed and elaborated in the project and will be presented in the final form in Deliverable 7.3. However, the input collected during the workshop demonstrated how identified stakeholders evaluate and prioritise different polices suggested in the ECHOES project. Yet, the

results of these two workshops prepare a transfer between the scientific results elaborated in ECHOES, and the policies which should be implemented in the short/medium term to support the energy transition and avoid undesired scenarios in the future.

In the ECHOES context this Deliverable will be used as an input providing additional context for Deliverable 7.3, which will elaborate policy-ready recommendations of ECHOES and will strengthen ECHOES results in terms of their applicability to current and future regulatory context while combining scientific findings of the ECHOES research activities with the practically ordinated feedback from the involved in workshops stakeholders.

4. APPENDIX

4.1 ANNEX 1: KEY VARIABLES AND DETERMINANTS

Title of Key variable/determinant	Description of Key variable/determinant
A. Social identity and social context	"That part of the individual´s self-concept which derives from their knowledge of their membership in a social group (or groups) together with the value and emotional significance of that membership."
B. Stakeholder involvement	"For people to engage in the energy transition, they must be included in the decision-making process in one way or the other, depending on the concrete topic (e.g. power plant debates), energy strategies and energy use. Stakeholders are not only an important source of knowledge, but their involvement also fosters the quality of energy solutions and the acceptance and sustainability of these solutions."
C. Identity	"Identity is the part of the definition of "who you are" which refers to groups of people or a region. If an energy technology or a project is connected to your identity (e.g., the region you live in or the group of people you feel connected to) support for that technology may increase, but so may local opposition."
D. Sustainable community energy systems	"Integrated approach to supplying a local community with its energy requirements from renewable energy or high-efficiency co-generation energy sources. It includes systems based on a combination of district heating, district cooling, plus 'electricity generation islands' interlinked via a private wire electricity system and aimed at reducing transmission losses and charges, as well as increasing the robustness of such systems."
E. Rising of more sustainable lifestyles	"New lifestyles are emerging, where the environmental awareness and the request of a healthier, more ethical and sustainable consumption patterns are essential. More sustainable lifestyles are characterized by pro-environmental attitudes, which can override the economic logics in decisions."
F. Monitoring and measuring-climate data	"The (micro)climatic data about the mean or the ratio/threshold between internal/external or indoor/outdoor temperature and also humidity important for the thermal comfort of inhabitants and thus closely related to their behaviour and energy choices at the different places (including the convenience to use electric cars according to the performance of their batteries)."
G. Mobility as a service (MaaS)	"MaaS service bundles may include electric vehicles or electric bikes as one of the transport options, and consumers get to try these vehicles as part of the service without having to invest in buying one. Same applies to sharing economy services, traditional vehicle rentals, city bike sharing programmes, etc."

I. Spatial planning regulations	"Spatial planning regulations that address the energy dimensions and impact of all types of interventions in the built and natural environment in a clear, consistent and integrated manner."
J. Trust in privacy and data security	"Privacy and data security can play a major role in decision-makers' courage to give up the control of their devices and generated data to external service providers. It can be significantly impacted, should new unsuccessful cases in media appear (e.g. the Facebook data leakage)."
K. National energy cultures	"Cultural framework giving meaning to different energy technologies and their use."
L. Technical feasibility of new technologies	"The degree to which a new technology suits users' needs, technical competences and lifestyle in efficient ways. Also refers to the technical and economic positions and spectrum of alternatives related to energy decisions in the future as well as the technology that will be necessary to adopt and bring all this together. Example from E-Mobility: An insurance agent who already spends 8h a day on the road is not easy to motivate for buying a Battery Electric Vehicle (BEV) if charging stops add another hour to his daily travel time."

4.2 ANNEX 2: HYPOTHESES USED IN THE SCENARIO PROCESS

Key variable/determinant- A. Social identity and social context
"That part of the individual´s self-concept which derives from their knowledge of their membership in a social group (or groups) together with the value and emotional significance of that membership."
Hypothesis A1 – European citizens feel European but not "green"
In 2019 the campaign "Make Europe Yourope!" started, aiming at a higher identification of the European citizens with the European Union and a higher acceptance of its policies regarding a gradual turnaround in energy policy. This policy advocates coal extraction to save the jobs in this sector as long as possible.

Climate impact from fossil energy sources increased in 2030 by 19% as compared to 2019.
Hypothesis A2 – European citizens feel European and "green"
In 2019 the campaign "Make Europe Yourope!" started, aiming at a higher identification of the European citizens with the European Union and a higher acceptance of its policies regarding a gradual turnaround in energy policy. This policy advocates a radical conversion towards a sustainable utilization of renewable energies. Climate impact from energy supply decreased in 2030 by 66% as compared to 2019.

Key variable/determinant- B. Stakeholder involvement

"For people to engage in the energy transition, they must be included in the decision-making process in one way or the other, depending on the concrete topic (e.g. power plant debates), energy strategies and energy use. Stakeholders are not only an important source of knowledge, but their involvement also fosters the quality of energy solutions and the acceptance and sustainability of these solutions."

Hypothesis B1 – Poor engagement in energy transition decision-making

Public consultation procedures are non-existent. No standardised measure of public involvement, acceptance or opinion channel is facilitated, and major industrial, infrastructure and energy-related developments are solely taken based on economic analyses and environmental impact assessments, without due consideration to social sustainability issues regarding user engagement, acceptability, and/or explicit rejection. Important risks appear from a poor engagement with communities directly affected by such developments, resulting in low local community acceptance rates.

Hypothesis B2 – Medium engagement in energy transition decision-making

There are public consultation procedures in place in all member states. However, incidental deficiencies exist in the mainstreaming procedure for having a fully structured, mainstreamed public consultation procedure operational in all EU-28. This leads to important disparities occurring between member states in regards with the level of public engagement, involvement and participation on energy-related industrial or infrastructural developments.

Hypothesis B3 – Full engagement in energy transition decision-making

Public consultation procedures are mainstreamed throughout all EU-28, and held for every major industrial, infrastructure, and policy development undertaken within local, regional, and national jurisdictions. Issues concerning societal tensions and economic impacts to local communities are addressed through in-person group consultations and followed up by a period for accepting written inputs/considerations using a standardised template. Acceptance thresholds are developed based on approval rates related to any major industrial/infrastructure development, energy strategy, or other relevant policy mechanisms directly affecting local communities' energy access and consumption, or generation capabilities.

Key variable/determinant- C. Identity

"Identity is the part of the definition of "who you are" which refers to groups of people or a region. If an energy technology or a project is connected to your identity (e.g., the region you live in or the group of people you feel connected to) support for that technology may increase, but so may local opposition."

Hypothesis C1: Strong European and National identities favour energy transition

In line with the European Roadmap 2050 we will have low carbon economy and a reduction of oil dependence. People will have both high European and National identities and will be motivated, interested and involved in pursuing shared energy goals among all EU member states. Feeling part of a wider community like the EU will increase the collective self-efficacy, favouring the energy transition. Feeling more European will be a driver of a more sustainable future, also thanks to the directives that the EU has taken over the years to ensure the transition to clean energy and consumer awareness.

Governments of each EU member state will be firmly determined not to thwart European objectives based on a hypothetical national interest, otherwise citizens would not know which identity to follow (national vs. European). In turn, European policies ensure that member states are also in agreement in helping and promoting common goals for citizens.

Hypothesis C2: Weak European identity erodes sustainable energy transition and pro-environmental behaviour

The consequences of the EU's inability to guarantee a better quality of life for all citizens will also fall on the quality of their pro-environmental behaviour. The failure of the European integration process will have as a direct consequence the resurgence of nationalisms and the expansion of isolationism between states.

The communities will act driven by a spirit of economic and social competitiveness that aims primarily to secure the greatest possible share of environmental and territorial resources and justifies conflicts over energy sources and environmental protection.

Hypothesis C3: Weak European and National identities favour the emergence of local minorities

The failure of the integration process at both the European and national levels will lead to the prevailing of local identities with a likely potentially negative impact on the sense of collective self-efficacy. Local minorities could still play a key positive role in addressing energy transition processes by promoting bottom-up changes. Also, the emerging force of localisms can promote the protection and enhancement of the local resources of a specific territory. However, the side effect of this scenario could be to encourage the emergence of negative forms of localism, such as NIMBYism, as opposed to green growth, in defence of secondary interests that only protect the minority's wealth or privileges.

Key variable/determinant- D. Sustainable community energy systems

"Integrated approach to supplying a local community with its energy requirements from renewable energy or high-efficiency co-generation energy sources. It includes systems based on a combination of district heating, district cooling, plus 'electricity generation islands' interlinked via a private wire electricity system and aimed at reducing transmission losses and charges, as well as increasing the robustness of such systems."

Hypothesis D1: Low energy efficiency and non-existent system integration

Non-existent integration, complete dependency on central electricity grid with none or few district heating/cooling developments, non-existent community-anchored RE generation schemes, large-scale energy developments and poor RE integration. Absolute dependency on large-scale utilities leading to increased consumer vulnerability, poor resource diversification, increased dependency on gas imports, high price volatility, and vulnerable communities at risk of energy poverty. Poor rates of digitalisations leading to low resource efficiency and inefficient system design. Fossil fuel-based transport sector with timid introduction of natural gas public transport and some electrification pilots, but far from any meaningful contribution in terms of lower energy use and increased efficiency.

Hypothesis D2: Increased but insufficient energy efficiency, and progressive system integration

Integration measures within households and between communities emerging as niche developments, yet lacking full institutional and commercial backing from market and political stakeholders. Important volume of building retrofits underway, contributing to appreciable improvements on energy efficiency. Digitalisation measures still lacking mass-scale deployment, with household automated systems, community-administered RE generation initiatives, and smart appliances still seen as the exception rather than the rule. Eco-mobility advances steadily through the electrification of public transport and private car-sharing platforms, yet, full deployment of the electric car still underway.

Hypothesis D3: High energy efficiency and full system integration

Energy consumption is drastically reduced due to a sharp and prolonged increase in energy efficiency measures combining a) mass-scale building retrofits, b) automated/smart household energy systems (integrating smart-metering, energy efficient, energy-generating, and grid connected smart household appliances and electric vehicles), c) localised renewable energy co-generation schemes combining municipally-owned utility companies, energy cooperatives, self-consumption schemes, energy aggregators such as community Virtual Power Plants (cVPPs), district heating/cooling, etc. High penetration of renewables at the community level with integrated sustainable energy systems operating autonomously and collaboratively in coordination with other "energy community islands", and seamless integration to a central electricity grid action as a support mechanism for reliability and capacity-provision measures at peak hours. Full electrification of the transport sector, both from a public and private domain. Sharing schemes widely accepted and increasingly utilised.

Key variable/determinant- E. Rising of more sustainable lifestyles

"New lifestyles are emerging, where the environmental awareness and the request of a healthier, more ethical and sustainable consumption patterns are essential. More sustainable lifestyles are characterized by pro-environmental attitudes, which can override the economic logics in decisions."

Hypothesis E1: Climate-benign lifestyles as a citizens' duty

Low-energy lifestyles are propagated by both national governments and the European Union. Climate-friendly behaviour is rewarded, while behaviour with a negative climate impact is penalised in a specifically designed economic framework.

Individuals shift to more sustainable lifestyles in response to top-down climate policies implemented by national governments or supra national institutions, driven by the will to comply with formal regulations.

Hypothesis E2: Lifestyles substitute the regional or national focus in many energy policy issues

The significance of national energy cultures is being blurred by the increasingly converging international framework conditions (at least within the EU). Instead of national energy cultures, groups of citizens with comparable lifestyle specific behavioural patterns and psychological characteristics emerge across countries. Because such lifestyle-groups have proven to be the better addressees for many target-oriented policy measures, regulations and subsidies have a stronger focus on lifestyle-specific target groups instead of national or regional communities.

Individuals and communities adopt more sustainable lifestyles driven by the will to voluntarily reduce their ecological footprint and pursue a healthier and less carbon intensive European society.

Hypothesis E3: Objectively sustainable lifestyles as an opportunity for societies and economies.

A sustainable lifestyle is no longer perceived as a burden, but as an opportunity. Between 2020 and 2050, freedom of choice regarding how each individual uses his or her personal "remaining greenhouse gas budget" has resulted in a multitude of economic and societal opportunities. The personal greenhouse gas balance is monitored on an individual basis. A high availability of emission data, growing creativity and an exceptional progress in citizens' ecological literacy have made Europe ready for a decarbonised future.

Individuals and organizations (e.g., institutions, companies) adopt more sustainable lifestyles driven by the possibility to obtain material (e.g., economic) or immaterial (e.g., social status) gains and competitive advantages in the market.

Key variable/determinant- F. Monitoring and measuring- climate data

"The (micro)climatic data about the mean or the ratio/threshold between internal/external or indoor/outdoor temperature and also humidity important for the thermal comfort of inhabitants and thus closely related to their behaviour and energy choices at the different places (including the convenience to use electric cars according to the performance of their batteries)."

Hypothesis F1: Seamless climate data monitoring through private initiative

All-embracing real time monitoring and measuring of climate data as part of the Earth observation on global and European level. IoT sensors implemented everywhere - from measuring/control of the indoor microclimate characteristics to the energy used for different activities and flows around the building, in neighbourhoods, city districts, cities, rural areas, regions, etc.

All data is systematically generated and ready to use at different decision-making levels; there is commercially accessible information and tools for different certification authorities and groups of decision-makers. Large-spread business intelligence promoting new solutions responding to climate and energy concerns at hot-spots.

Hypothesis F2: Expert-led monitoring for climate policy evaluation by public institutions

The energy transition process and performance requirements are planned in the framework of strong international climate policy. Periodical screening is undertaken in relation to the design, implementation and evaluation of plans and programs. Assessment methods of energy demand and consumption, indoor and outdoor climate comfort levels and energy efficiency parameters are standardized and applied by highly qualified experts and professional consortia. Data gathering is institutionally channelled and interoperable within data infrastructure with strictly defined access levels for the licensed experts and climate and energy related decision-makers. Public data generation, management and access are regulated and with different levels of aggregation depending on the scale of interventions and the protection of privacy and confidential information.

Hypothesis F3: Citizen science for local adaptation to climate change

Bottom-up adaptation and mitigation action to climate change with higher levels of people's awareness and consciousness. Shared responsibility and sensitivity of local communities and authorities to the local level energy needs and comfort demand. Easy for customization open source tools (sensors, models, applications) available for monitoring the energy performance of separate buildings and neighbourhoods as part of applied science, broadly accessible to citizens. Large data ocean (including temperature, albedo and heat island effects, sun exposure and sky view factor) with open access for all interested parties leading to a growing number of users, ways of data utilization and implemented adaptive solutions.

Key variable/determinant- G. Mobility as a service (MaaS)

"MaaS service bundles may include electric vehicles or electric bikes as one of the transport options, and consumers get to try these vehicles as part of the service without having to invest in buying one. Same applies to sharing economy services, traditional vehicle rentals, city bike sharing programmes, etc."

Hypothesis G1: All electric and integrated mobility

A balanced competitive environment and incentives accommodates a rich mix of mobility services based on adaptive rules and conditions for different spatial scales and segment niches. Integrated public transport modes supplied for the longer trips between metropolitan and urban regions with high demand. Shared flexible transport and logistics services respond to periods and places with lower and intermediate demand.

Mobility as a service options cover almost all mobility needs, so owning a car or any other vehicle is no longer necessary; yet some people still find it attractive for leisure purposes. Subscription based service bundles provide access to all modes and means of transport and tailorable combinations within.

Vehicle fleets owned by service providers and transport operators are fully electric (cars, buses, bikes, rail, etc.). Mobility services include also car and bike rental and people are used to and comfortable with using them.

Hypothesis G2: Large diversity of mobility options

Liberalized strong competition among diverse mobility options. Broad divergence throughout Europe due to different pace of transition (e.g. car sharing in bigger cities). Average level of satisfaction with public and shared mobility services in different places results in partial reliance on individual car use based on mix of fossil fuels and electricity.

MaaS services cover most of the mobility needs and owning a car or any other vehicle can be avoided. The existing subscription-based service bundles provide reliable access to many modes and means of transport and tailorable combinations within.

Vehicle fleets owned by service providers and transport operators are only partially electric. Consumers can choose a fully electric service subscription, if it fits to their needs, values, economic status, etc., but this preference is not shared by all.

Hypothesis G3: Urban vs rural mobility model

In the cities, there is weak competition and protectionism to mass public transport services along with taxi and specialized transfers. The mobility landscape is dominated by more accessible private fleet due

to lower price and fuel or battery efficiency for both combustion and electric engines. Owning a car or any other vehicle is no longer necessary.

In the rural areas, mobility services cover only small part of the mobility needs. Some consumers rely on peer-to peer sharing economy services. Others still own and use a car, and possibly offer peer-to-peer or car-sharing services.

Vehicles and fleets owned by service providers and transport operators are fully electric. People are used to and comfortable with using electric vehicles, but many car owners are strongly attached to their fossil fuelled mobile property.

Key variable/determinant- H. Social norms

"Social norms are a general way of capturing social influence on people's behaviour. They are a social standard shared by the members of a social group that prescribes appropriate, expected and desirable attitudes and conduct. Social norms are expressed both through behaviour (we observe and copy what others do) and by expressing social expectations (sanctioning violations of norms)."

Hypothesis H1: Slow convergence of top-down policies and social norms

The process of energy transition emerges from the formal decision-making level, where associated international agreements and EU policies are first transposed to national policies, then to regional, local, and community policies and action plans. With the ambitious goals of energy transition, supported by pro-environmentalist social norms, the level of acceptance of these policies and action plans was overlooked. However, as the process of energy transition matures, and the awareness of the society increases, the alignment of these practices with the social norms become more prevalent. Therefore, consideration of the social norms only during and post-implementation phases will no longer be feasible. Therefore, social norms and acceptance will need to be considered in much earlier states of the energy related decision-making process. .

Hypothesis H2: Globalisation of social norms

Although defined usually on the economic domain, one significant aspect of globalisation pertains to the real-time and global access to information. Hence, the societies are no more closed communities, and are subject to an enormous flow of information from all over the world. This is also the case regarding energy transition, policies, implementations, results, impacts, and lessons learned. Coupled with EU's joint goals of energy transition, this phenomenon is expected to drive social norms to a similar direction in a supranational and European fashion. The benefits obtained through energy self-sufficiency, for instance, foster the reinforcement of values of social self-reliance and even autonomy, not only for the regions of implementation, but for many societies through Europe. Likewise, the emphasis on the impacts of emissions and waste management in one state may trigger the pro-environmentalist social values in another state.

Key variable/determinant- I. Spatial planning regulations

"Spatial planning regulations that address the energy dimensions and impact of all types of interventions in the built and natural environment in a clear, consistent and integrated manner."

Hypothesis I1: Integrated spatial planning focused on climate and health

Strong integration of sectors based on the introduction of comprehensive interoperability between spatial planning and resource and energy management embedded in the national legislation of EU Member States. Focus of all regional and urban planning instruments on resource management, energy transition and protection of health, made possible through the long-term engagement of institutions and communities. Pro-active planning and interventions for the prevention of excessive energy consumption, energy efficiency and renewable energy sources use at all levels of governance. Implementation of energy-sensitive land use, urban and building design models, urban regeneration and retrofitting along with health-driven restoration of the quality of the urban environment. Large investments in standardized alternative energy smart grid infrastructure covering most of the EU regions.

Hypothesis I2: Incoherent spatial planning blocks energy transition

Weak integration between spatial planning and the climate and energy domain regulations constraining the bottom-up efforts to change established relations and development models and to prevent energy leakages in the metabolism of EU main energy consumers - cities and metropolitan regions. Blurred and fuzzy responsibilities, heavy procedural demands, controversies in the priorities of strategic spatial planning documents; unrealistic expectations or general distrust to climate and energy related policy among various urban actors; lack of appropriate incentives and funding mismatch - leading to controversial practices. Energy production landscapes, distribution infrastructure and utility services giving yield to few corporate bodies or relying on expensive energy import with resulting growth of energy poverty and shrinking jobs in the energy sector. Strong health burden for the EU citizens due to the external effects from policy inertia.

Hypothesis I3: Spatial planning regulations in moderate coordination with the energy policies where mostly needed

Moderate coordination among EU regions and urban areas between spatial development and energy policies in specific priority areas with good consideration of dependencies, externalities and burdens. Planning and (re)development power provided to agencies for energy transition, demonstrating the worth of alternatives to the conventional grid or development patterns. Abundant experience gained through numerous innovative interventions in the built environment with the encouragement of various types of small-scale prosumers. Well-developed systematic research on the energy-related aspects of urban and regional development, yet still existing barriers to the diffusion of knowledge and experience due to the hard competition between the new communities sharing the economy of scope principles and solutions, and the established societal legacy of mass consumption with economy of scale model.

Key variable/determinant- J. Trust in privacy and data security

"Privacy and data security can play a major role in decision-makers' courage to give up the control of their devices and generated data to external service providers. It can be significantly impacted, should new unsuccessful cases in media appear (e.g. the Facebook data leakage)."

Hypothesis J1: Industry driven technology solutions build trust

Industry-led technology development takes place in a manner where privacy issues and data security are a top priority. Developed solutions (products and services across different domains, including energy systems, vehicle systems, etc.) are safe, and serious problems in privacy and data security are efficiently avoided with preventive design and efforts.

Trust in privacy and data security is therefore strong, and this supports uptake of even data-intensive solutions and data sharing (C2B as well as B2B).

Hypothesis J2: Strict regulatory measures build trust but hamper innovation

Strict regulations are established to prevent problems in privacy and data security. This risk averse approach ensures strong trust in privacy and data security, but on the other hand it poses a barrier to technological innovation and (B2B) data sharing.

Industries are reluctant to develop data-intensive solutions, as the regulation environment is strict. Data handling and usage is heavily regulated and involves complex processes with permissions and procedures. Consumers are similarly reluctant to adopt data-intensive solutions, but rather choose traditional safe and secure alternatives.

Hypothesis J3: Trust issues hamper uptake of technologies and innovations

Actions by both industry and regulators are scarce, and the risks related to privacy and data security are real.

Industries are choosing different business approaches, but there are those who develop data-intensive solutions. Some of these succeed in terms of providing safe and secure products and services, but risks are always present, and disasters of different scale are also fairly common.

Trust in privacy and data security is compromised, and consumer behaviour varies according to individual risk tolerance.

Key variable/determinant- K. National energy cultures

"Cultural framework giving meaning to different energy technologies and their use."

Hypothesis K1: National energy cultures disappear, while international lifestyle groups emerge

In the absence of impressive events in the field of energy - which in the past led to the formation of national memories that shaped/individualised national energy cultures - national energy cultures are disappearing.

The significance of the national element is blurring due also to the increasingly converging international (at least within the EU) framework conditions. Instead of national energy cultures, comparable lifestyle groups are emerging across nations, which can be characterised by their attitudes and behaviour and become the primary addressees of policy measures (promotion, awareness-raising…).

Hypothesis K2: National energy cultures become an instrument of nationalism

As consequence of the raising of nationalism in Europe, "National energy cultures" are becoming an emotionally and historically charged identity anchor and brand, promoted by nationalist governments. Politics instrumentalizes energy supply as the core of national autonomy and the basis of national survival. Accordingly, propaganda closely interweaves key events in energy history, as well as national achievements in technology and infrastructure, with social memory and common social norms. The sustainability and climate-friendliness of the national energy culture plays a secondary role here.

Hypothesis K3: National governments shape energy cultures to influence energy behaviour

National governments act to influence the energy behaviour of citizens by means of regulations and addressing their expectations and aspirations.

Low-energy lifestyles are propagated by climate-aware national governments, rewarded/punished accordingly (regulations, tax systems, individual CO2budget). The resulting adapted behaviour of citizens is branded and marketed as a "national energy culture".

Key variable/determinant- L. Technical feasibility of new technologies

"The degree to which a new technology suits users' needs, technical competences and lifestyle in efficient ways. Also refers to the technical and economic positions and spectrum of alternatives related to energy decisions in the future as well as the technology that will be necessary to adopt and bring all this together.

Example from E-Mobility: An insurance agent who already spends 8h a day on the road is not easy to motivate for buying a Battery Electric Vehicle (BEV) if charging stops add another hour to his daily travel time."

Hypothesis L1: Unfavourable techno-economic development and poor user experience of new technologies

Key technologies for the progression of Energy Transition (e.g. RES, EV…) develop slowly in terms of technical and economic performance.

New technologies are not attractive from user experience point of view: insufficient design of new technologies worsens the experienced impacts for the users and slows down user-driven investments.

Examples can be envisioned from different technological domains: EVs can suffer from insufficient charging infrastructure; Smart technologies do not support invisible Demand Response for the users but call for manual actions; energy efficiency renovation of buildings can suffer from unsuccessful first cases, causing bad reputation.

Hypothesis L2: Fast techno-economic development but not user centric

Key technologies for the progression of Energy Transition (e.g. RES, EV…) develop fast in terms of economic and technological performance. Thus, the introduction of new technology is supported by techno-economic profitability analyses.

From user experience point of view, no worsening is caused by the introduction of new technologies. The user experience is roughly is in line with current technology, meaning no user-driven boost takes place in technology adoption.

The above developments mean that new technology is feasible to user needs, but the development is not happening at maximal speed. This can be expressed as moderate feasibility of new technologies.

Hypothesis L3: Fast techno-economic development and superior user experience by new technologies

Key technologies for the progression of Energy Transition (e.g. RES, EV...) develop fast in terms of economic and technological performance. Thus, the introduction of new technology is supported by techno-economic profitability analyses.

The user experience is significantly improved thanks to the use of new technologies. For example, advanced automation systems enabled by smart technology improve experienced comfort levels in buildings, large driving ranges of EVs decrease the need of refuelling stops. In general, systems based on new technologies work smoothly causing no extra efforts for users.

The favourable developments from both techno-economic and user experience points of view strengthen each other. Markets for technology grow, bringing down the cost of technology, improving its competitiveness. As a result, fast development of technical feasibility of new technologies happens.