This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727470

Ref. Ares(2018)1071556 - 26/02/2018

Report No ECHOES 3.3 – D3.3 Policy Potential Analysis

ECHOES Report

An Analysis of the Potential of Advanced Social Science Knowledge in Policymaking

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KEYWORDS:
- energy policy
- social science
- electric mobility
- smart meters
- photovoltaics
- buildings
- company policy

VERSION 01

DATE 26.02.2018

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PROJECT NO. 727470 (H2020)

NUMBER of PAGES/APPENDICES: 128/0

ABSTRACT
This report presents the results of an analyses of more than 100 policy documents of the level of the EU, the Member States, and regions in Europe. General energy policies were reviewed, as well as specific policies for electric mobility, smart meter roll-out, photovoltaics, and energy efficiency in buildings. In addition, also an energy provider's policy documents were analysed. The documents were scrutinized with respect to the degree rich social science knowledge is reflected. The general conclusion is that although the consumer has made her/his way from the periphery into the centre of the policy documents, the concept of consumer decisions is – with few exceptions oversimplified and reduced to having an information deficit and being a rational economist. Barriers for a better utilization of available knowledge are described and suggestions for more elaborate policy are made.

REPORT NO. D3.3

ISBN NA

CLASSIFICATION Public

CLASSIFICATION THIS PAGE public

Document history

VERSION	DATE	VERSION DESCRIPTION
1	16.02.2018	First version for internal quality check
2	26.02.2018	Final version delivered to the European Commission

EXTENDED SUMMARY

The analysis of policy documents on different political levels conducted in this report has provided a number of interesting results. First, the consumer (in some documents referred to as "citizen") has made his/her way into policy documents on all levels. It is now a shared understanding that Energy Transitions and the Energy Union require a substantial engagement of consumers in addition to technical or governance developments. Most obvious is the move of the consumer from a passive position where he or she is responsive to steering instruments, to a central actor who is considered as a driver of transition processes and a key for innovation and change in the latest EU policies referred to as the "winter package". However, the analyses presented in this report also indicate that this marked increased interest of the consumer as an actor is not adequately nor fully reflected given the rich understanding of the complexity of human decision making as well as policy instruments addressing this complexity. Whereas this might be considered natural in the general energy policies, especially at the EU level, this tendency can – with very few exceptions – also be found at the Member State and regional level.

The main overarching assumption reflected in most analysed policy documents is that (a) consumers are important actors, (b) they lack information and given they are provided with the right information they will act accordingly, and (c) consumer behaviour is based on economic considerations, which calls for monetary incentives, subsidies and price regulations. Whereas the first conclusion is shared by the authors of this report – we consider consumers indeed a central category of the Energy Transition – the second and third assumption are – based on our knowledge and the work conducted in the ECHOES project – far too restricted to assume that they will be enough to motivate consumers and citizens to engage. The information provision assumption is based on an *information deficit hypothesis*, which states that consumers are inactive or engage in unwanted behaviour because they do not know better. Whereas information and knowledge about impacts of behaviours and alternatives as well as technologies are necessary to be able to act, they have been shown to not be sufficient to initiate action. Consumers receive a vast amount of information every day, every minute and information alone is not a strong enough trigger for change in behaviours or practices. Similarly, although consumer behaviour is embedded in an economic framework and the choice of actions and implementation of technology is to a certain degree determined by its economic payoff, human decision making is very seldom rational in an economic sense, but rather coloured by cultures, social impacts, believes, values, attitudes, behaviour of other people, the historic development of energy lifestyles and practices and the like.

The analyses show clearly that social science knowledge has a strong potential to enhance policymaking to a far larger extent than is implemented in most of the documents analysed. Whereas the authors of this report do not question the necessity of providing consumers with information about their energy use, alternative technologies, energy production, and smart appliances, we strongly doubt that this alone will stimulate strong changes in consumer behaviour. The picture is a bit more diverse for the strong rational choice assumptions underlying many policy packages. In some domains, such as the diffusion of decentralized photovoltaics, the success of economic policy measures and net regulations has proven to be a decisive factor. However, this is overshadowed by the dimension of psychological control about the stability and trustworthiness of the schemes. In other domains the over-rationalistic approach has clearly failed. The purchase of a car is far more than a basic rational choice and can be influenced by; cultural meaning of car ownership, status considerations, norms, values, group processes, trust in producers and technologies, visibility of new technologies and thus communication of normality (descriptive norms), etc. With a different angle, this is also true for smart metering. Here trust in the motives of the data handler and technological security are decisive factors, which can only partly be addressed through information campaigns alone.

From the perspective of the ECHOES project, we see the following potential for policy improvement:

- For individual decisions many other factors besides economic benefits and costs are relevant. Amongst these "other" relevant factors were; attitudes, perceived behavioural control (the feeling of capability of performing the behaviour), routines and habits (automatic activation of behavioural responses), social norms (both as descriptive norms, which is what others do, and injunctive norms, which is what others expect), values, and emotional activation.
- The energy behaviour of individuals' changes depending on whether they consider themselves as individuals or as part of a group (e.g., citizens of a country, a municipality, or the EU, but also other social groups such as technology lovers, car enthusiasts, etc.). We see a larger potential in carefully analysing which framing of the social group identification would yield the best acceptance of policy measures.
- Few policies make references to the impact of lifestyles, cultures or energy related historic developments (energy culture) on energy choices. This needs to be reflected in a more flexible approach than one-size fits all information or funding schemes. Furthermore, understanding the cultural narratives about energy use and their historical roots results in improved targeting of policy measures to the respective segments. Naturally, this becomes more relevant, the more local the policy is.
- Formal social units and individuals though sharing some characteristics of decision making also differ considerably. While some policies acknowledge the special role of, for example, public procurement, there is a larger potential in actively understanding the energy decisions of different forms of social units; from the individual to the formal units; from the consumer to companies, from governments to user organizations.
- Some technologies (especially those with high upfront investment costs such as EVs and PVs) exclude larger segments of consumers from engaging in the energy transition. Finding ways to overcome this barrier might be an important field for social energy science.

We see the following main barriers for a better integration of rich social science knowledge in policy making:

- Consumers still seem to be generally understood as rational decision makers, processing the information they are provided with and then reaching the decision that yields the (from an external perspective) most beneficial outcome. This is a strongly oversimplified understanding of human behaviour.
- The policy system in the energy sector is built in such a way that general EU policy is implemented in national law and then adapted on a local level. The initial policy documents are rather unspecific. Given the general character of the documents and their vagueness in relation to consumers, often when they are adapted to the next level down, where they should be more specific, this is often not the case as the vagueness is perpetuated.
- Policies analysed had a tendency to be general and did not include built in mechanisms that allow for targeting to different segments: regions, cultures, value orientations and lifestyles. Taking this diversity into account requires an extra analysis of "diagnosing" the consumer / social group that is being targeted.
- Policies are not good enough in acknowledging different levels of social units and tend to treat decision makers on an individual level, ignoring their social connectedness both horizontally to other decision makers on the same level and vertically to decision makers higher or lower in the hierarchy. New ways of policymaking need to be developed to reach more targeted segments.
- Social scientists tend to avoid giving clear advice on policy measures, especially in complex situations outlined in the bullet points above.

Based on the barriers identified, we suggest the following measures for a better implementation of social science in policy documents:

- To actively work with the oversimplified concept of consumers, we suggest that policy documents make explicit the understanding they have of consumer decisions. This process of defining the underlying assumptions actively – with social scientists being experts in the area – will make implicit assumptions open and allow for a more diversified approach.
- Whereas general EU level documents naturally lack the specificity that local documents should have the top-down system makes it likely that lower level documents just copy the higher level assumptions. The EU level documents thus should be supplemented with a best practice collection of local level policy which shows how the general policy could be implemented. The SmartEnergy GB document is a good example of such a best practice document.
- Methods of capturing diversity in a manageable manner need to be developed and implemented in the design of policy documents. Diagnostic tools for group identification, value orientations, lifestyles, etc. and a mapping of policy measures that have proven to be successful for a specific group need to be developed.
- Policies should distinguish between different levels of social groups and their interactions more clearly by indicating which measure is targeting which unit and why (again making implicit assumptions explicit).
- Social scientists need to develop the ability to provide clear advice (which always will include a degree of uncertainty). To be relevant, the state-of-the-art needs to be accessible in a policy compatible way, not as scientific theory.

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1 GENERAL INTRODUCTION AND OVERVIEW

1.1 Aim of the report

Social Science and Humanities (SSH) input to energy transition research has been requested now for a number of years on the national and international level. Central policy documents on the European Union level like the Strategic Energy Technology (SET) plan[1] or the Clean Energy for all Europeans Package[2] (also referred to as the Winter Package) have identified consumers – or in an even broader understanding citizens – as key actors in realizing the Energy Union and providing clean, affordable and reliable energy as well as innovation that secures the European Union's position in the world markets of the future. Activating consumers and citizens requires a substantial understanding of their life situations, contexts and lifestyles, their attitudes, values and decisions. This has resulted in increased research activity in the SSH sector, both as an integral part of technology developing projects and as part of interdisciplinary projects exploring the different SSH disciplines and the benefit of a comprehensive perspective on central themes of the energy transitions initiated in the European Union.

Reading the key policy strategy documents on the EU, Member State, but also more local levels makes it obvious, that the urge to understanding and integrating citizens in energy transition activities is strong. However, it also appears that the depth of understanding of the complexity of human behaviour and its embeddedness in culture, structures, governmental frameworks and belief systems is only superficially reflected. As a consequence, the potential of SSH knowledge seems to be utilized only to a small degree in policymaking. While this is a conclusion based so far only on our familiarity with these types of strategy documents, the ECHOES consortium felt the need to *systematically* analyse how consumers are integrated into policy documents on different levels, which assumptions about the factors influencing their decision making are directly or indirectly reflected in the documents and which policy measures are directly referring to SSH knowledge. Thus, the aim of this report is to present the results of a thorough analysis of selected key policy documents on the level of the EU, Member States and regions. In addition, a brief analysis of an electricity company's strategy documents is included to contrast policy documents with business strategies and learn, if there are differences between these sectors.

1.2 Overview of the ECHOES project

This report has been written as a deliverable in the H2020 project ECHOES[3] based on document analyses conducted as part of the project's work. It builds also on the findings of a preceding substantial social science literature analysis summarizing the state-of-the-art in the participating disciplines with respect to energy choices.[4] The next section will give an overview of the most important results of that analysis. The overarching objective of the ECHOES project is to unlock the policy potential of an integrated social science perspective of socio-cultural, socio-economic, socio-political, and gender issues that influence individual and collective energy choices and social acceptance of the energy transition in Europe (see Figure 1.1). Hereby, ECHOES aims to foster the implementation of the SET-Plan actions and support the Energy Transition, as well as the decarbonizing of Europe's future energy system. ECHOES employs the innovative theoretical concept of "energy collectives" that covers determinants of energy choices from the individual level to formal social units.

[1] https://publications.europa.eu/en/publication-detail/-/publication/771918e8-d3ee-11e7-a5b9-01aa75ed71a1/language-en/format-PDF/source-51344538

[2] https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/clean-energy-all-europeans

[3] https://www.echoes-project.eu

[4] https://www.echoes-project.eu/sites/echoes.drupal.pulsartecnalia.com/files/ECHOES_D3.1_literature_report_1.pdf

Three main theoretical perspectives are integrated into this concept, namely the perspective on:

- (1) Micro: Individual decision-making as part of collectives,
- (2) Meso: The perspective of collectives constituting energy cultures and life-styles, and
- (3) Macro: The perspective of formal social units such as municipalities, states, energy providers, or NGOs as collectives of people.

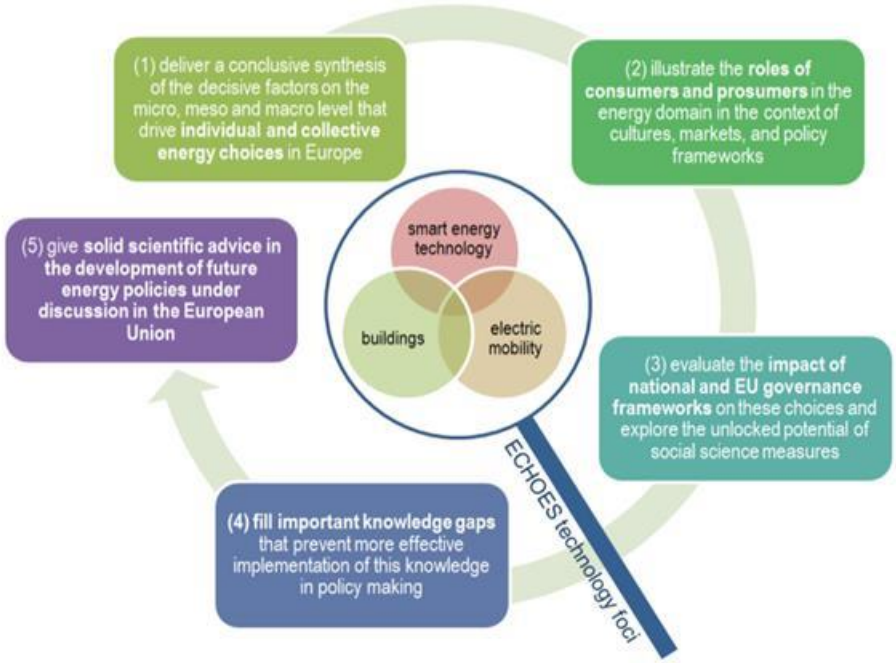


Figure 1.1: Overview of ECHOES' objectives and technology foci

ECHOES analyses the impact of energy collectives in three technological foci: (a) smart energy technologies, (b) electric mobility, and (c) buildings. The three-fold technology foci are also reflected in the structure of the policy document analysis presented in this document (where the technology focus "buildings" is reflected by two chapters: photovoltaics policies and energy efficiency policies in buildings).

The ECHOES consortium consists of 14 partners, including both research institutes and end-users. Both types of partners were involved in the analyses presented in this report. The consortium also represents a wide geographical diversity, allowing us to tap into different dynamics of collective and individual energy choices, which is again reflected in the selection of policy documents analysed.

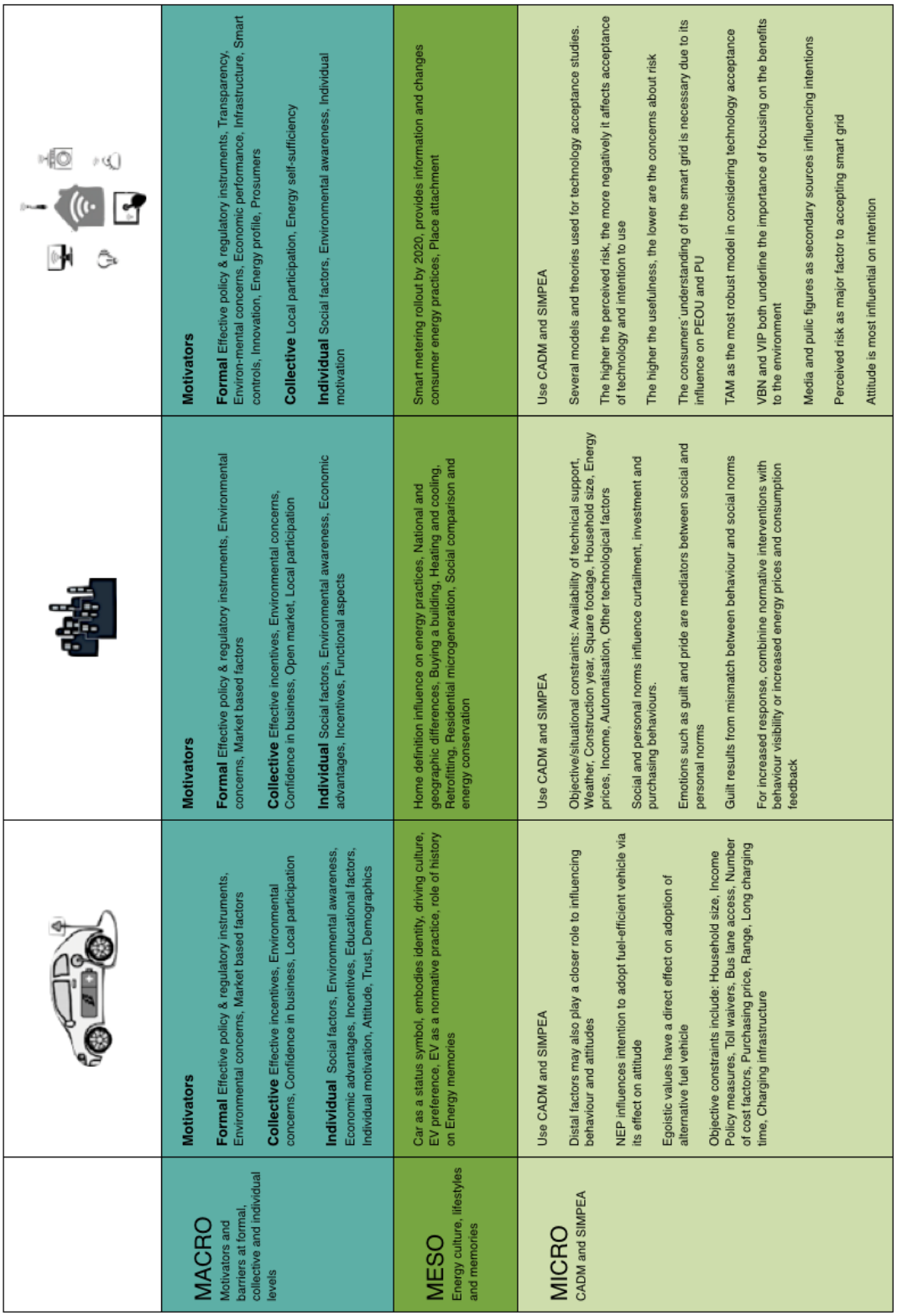
1.3 Summary of the main findings of the social science literature review[5]

Previous to this report, the ECHOES project published a comprehensive literature review summarizing the state-of-the-art in the ECHOES perspectives. Based on an initial screening of several thousand sources (and 597 sources reviewed), research from all three ECHOES research perspectives and technology foci were mapped and research

[5] This section is based on the executive summary of the literature report, Deliverable D3.1 in ECHOES.

gaps identified which will be addressed in ECHOES. This literature analysis also feeds into the policy potential report presented here.

Fig. 1.1: Relevant motivators identified in the literature study.



The overall conclusion is that there is a considerable amount of research that deals with specific technologies, problem areas, or research perspectives, but there are shortcomings related to more comprehensive and integrated analyses. The existing literature identifies factors playing a role in decision-making on the household level with respect to all of the listed issues in relation to all three foci, i.e. micro-, meso- and macro-level. However, it does so in a fragmented and disciplinary siloed way. Thus, there are gaps to fill in describing the decision-making processes from a comprehensive standpoint and with a multilevel perspective. The research identified does not allow to predict decisions in a satisfactory way, nor does it derive integrated policy or market recommendations. However, the work done already allows for policy advice to a certain degree.

The comprehensive literature study has uncovered a number of relevant factors and starting points for the work in ECHOES. Fig 1.1 above shows the main reviewing concepts and findings as an overview, distributed by analytical levels and technological foci. At the macro level, the main concept is to map motivators and barriers for each technology and for the three different sub-levels defined as different formal units. This produced an interesting overview of which factors are relevant for one specific decision-making level or technology, and which factors are of overarching importance. At the meso level, the main contribution of the literature report was to review literature on the socio-cultural aspects of energy use through the analytical lens of the concepts *energy culture*, *energy lifestyles* and *energy memories*. These place the decision-making units into a cultural and historical context and tap into explanations of energy use behaviour that go unnoticed by the individual or societal focus. At the micro level, a comprehensive review of the individual centred approach is provided, which shows how commonly used concepts such as values, worldviews, personal and social norms, attitudes, habits and routines, objective and subjective constraints and facilitators interact to determine decisions in the three technology focal areas of ECHOES. The factors received good support by the literature review, though the concepts of emotion (most importantly guilt and pride) as a driver of energy and social identity/identification were found as missing.

In general, the review of individual factors shows that most of the influences postulated have received considerable attention in past research, with some differences between the technologies in focus here. However, it remains unclear if the differences are substantial or rather circumstantial, due to a specific study advocating for a particular effect selecting only one of the three technology foci. It is for example likely that the emotional reaction resulting from mismatch between own behaviour and social norms (a feeling of guilt or shame) is not specific to the building focus, but will in the same way be found in the other technological foci. It is also interesting to note that for some technology foci, a modelling tradition related to the Comprehensive Action Determination Model (CADM)[6] is rather common (energy in buildings, electric mobility), whereas for adoption of smart energy technology, technology adoption models (TAM)[7] are more common in the literature, although also energy choices in buildings and electric mobility can be framed as problems of technology adoption and smart technology can be analysed from the perspective of the CADM. Figure 1.2 below shows an example of the relations between individual factors found supported by the literature.

The literature review furthermore explored the support for a Social Identity Model of Pro-Environmental Action (see Fig. 1.3). The model centres around three social identity variables: ingroup identification, ingroup norms, and collective efficacy beliefs. For group-based action to occur, people need to *identify* with a group. What a group stands for is determined by people's perception of the *ingroup norms* of thinking and behaviour and specific ingroup goals. As indicated by the circled "X" in Figure 1.3, ingroup identification, environmental ingroup norms, and collective environmental efficacy are supposed to interact in affecting pro-environmental responses. For instance, the effects of pro-environmental ingroup norms or collective efficacy will be catalysed by high levels of ingroup identification. The three focal social identity predictors should not only affect pro-environmental behaviour, but the very appraisal of environmental crises as well.

[6] Klöckner, C. A. (2013). A comprehensive model of the psychology of environmental behaviour—A meta-analysis. *Global Environmental Change*, *23*(5), 1028-1038.

[7] Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management science*, *46*(2), 186-204.

Fig. 1.2: Individual level relations between determinants of energy choices for the example of energy in buildings.

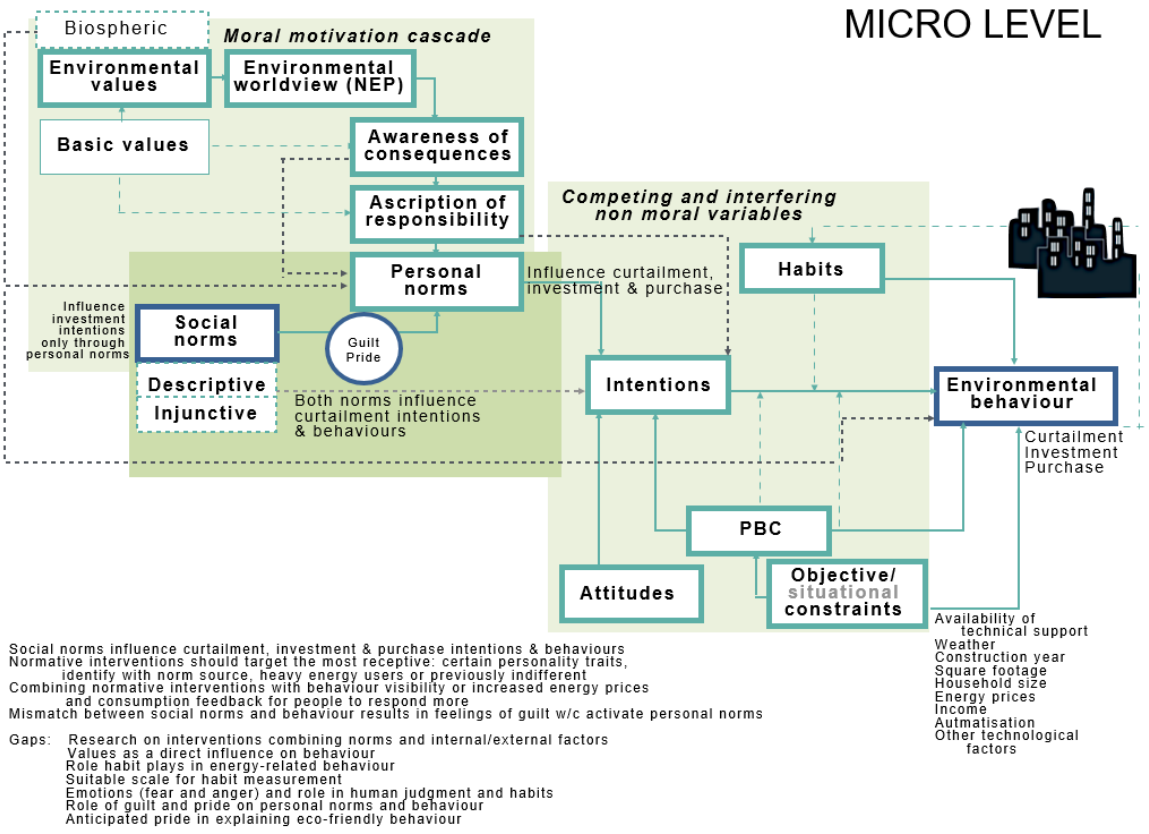
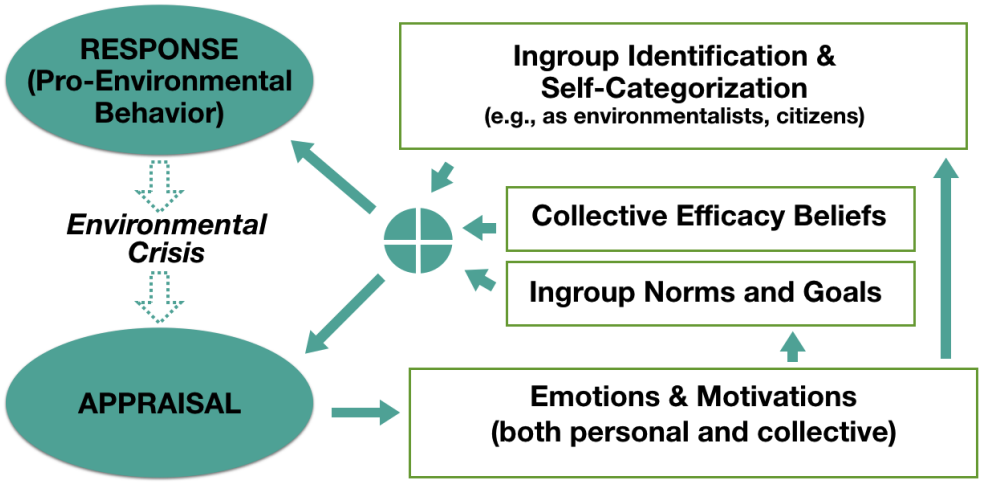
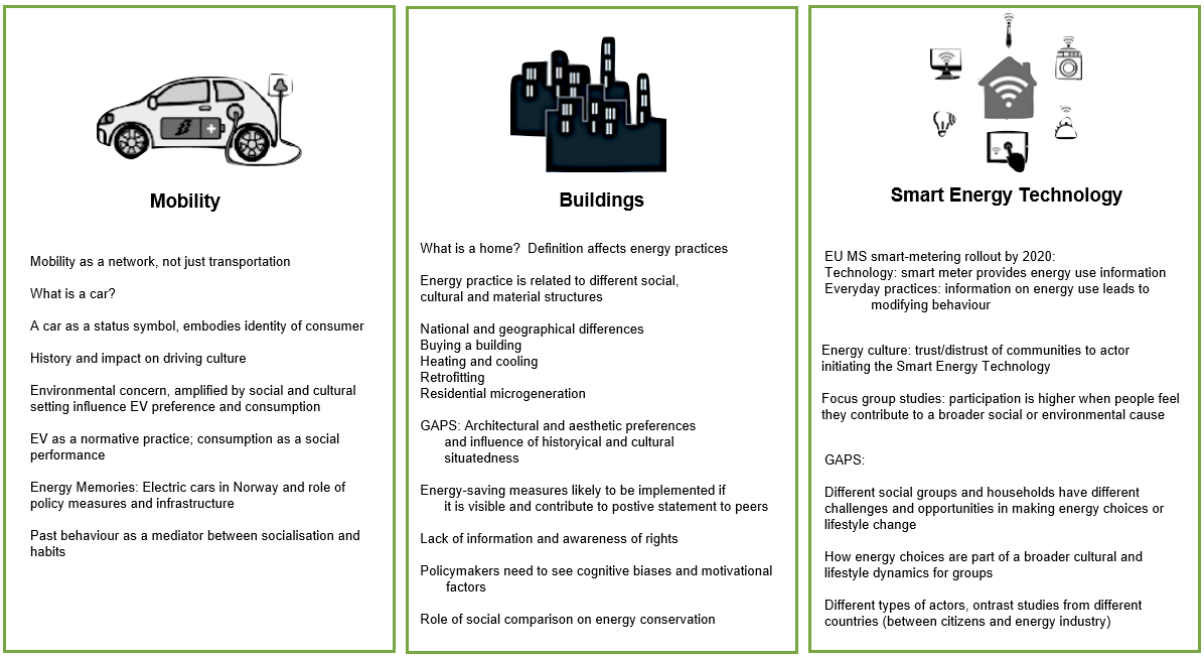


Fig 1.1: Social Identity Model of Pro-Environmental Action (SIMPEA)



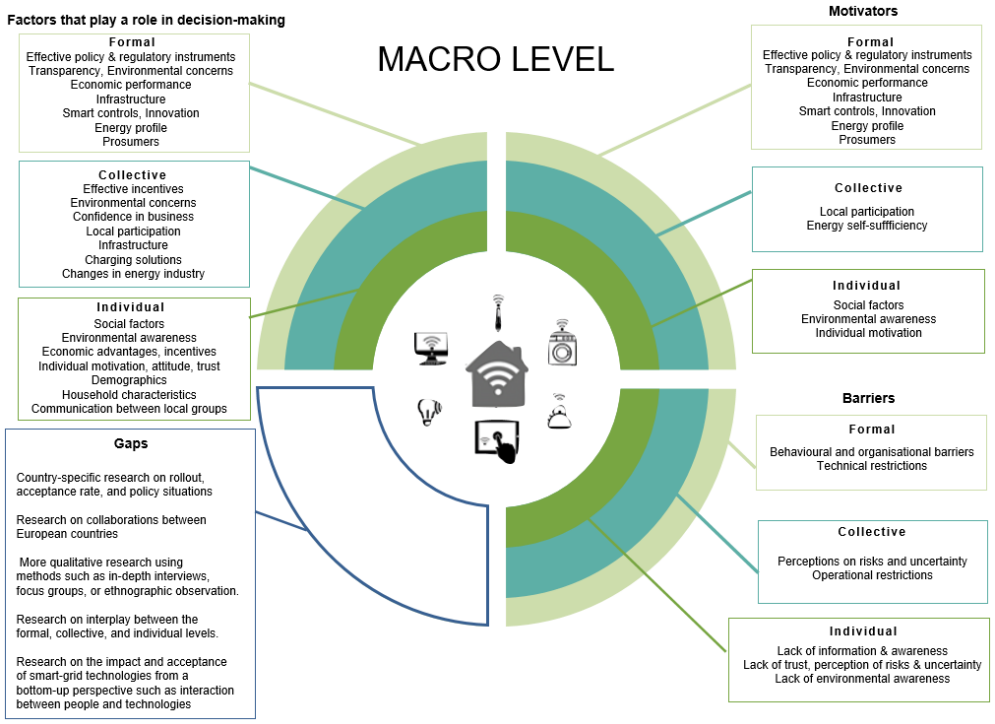
At the meso level, the key conceptual approach for reviewing the literature has been through the lens of the theoretical concepts 1) energy culture, 2) energy memories (which is a new development in the ECHOES project), 3) energy lifestyle and 4) place attachment. Here, the social and historical embeddedness of energy decisions regarding the three technology foci was the core of the analysis. Important gaps identified at the general level are that 1) there are advantages and analytical improvement of using the energy memory approach over the related concepts of energy culture and energy lifestyles because energy memories not only include the cultural and contextual rooting of the behaviour, but also the temporal/historical dimension, and 2) place attachment and place-related meanings are not investigated with respect to the energy memories development. At the technology-specific level, the main findings are presented in Figure 1.4 below.

Fig. 1.4: Meso-level themes relevant energy choices in the three technology foci.



The review at the macro level has been completed by distinguishing three sub-levels that all focus on the three technological focuses, mapping 1) factors important in decision-making, 2) barriers, 3) motivators and 4) research gaps. An important general finding is that there is a need for more research on energy choices in collective social units as well as research, which takes into account the necessary interplay between the formal, collective, and individual levels. An example of the results on the macro-level is given in Figure 1.5 below.

Fig. 1.5: Macro level determinants of energy choices for the example of smart energy technology.



1.4 Organization of the report and introduction to the analysis perspectives

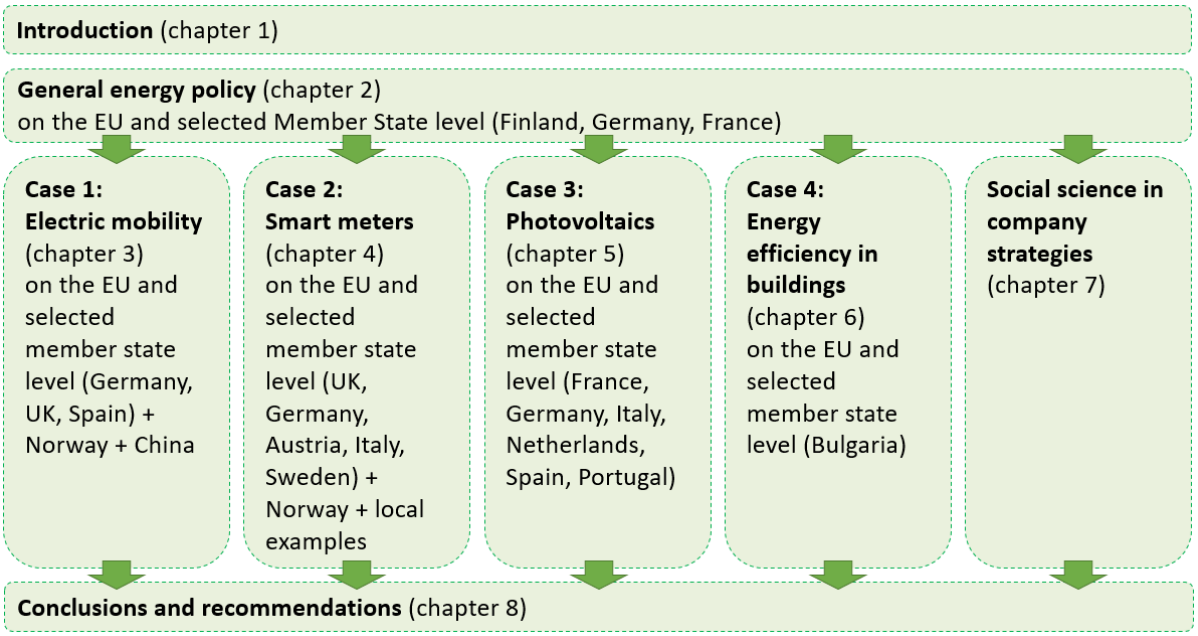
To address the question how social science knowledge and framework models are at the moment integrated in policy and strategy documents at several political levels, we decided to analyse a large selection of such documents from different levels. As a guiding principle for selection of documents – as not all documents can be included in a reviews such as the one presented here – we started with the central and most generic documents on the EU level, before breaking it down to the – from our perspective – most central member states documents and regional policy documents. Since the general energy policy documents are usually presenting frameworks and targets rather than specific measures which could reveal the understanding of consumer decision-making reflected in them, we decided to analyse four specific technology cases, all of them relevant for the three technology foci chosen for ECHOES and highlighted as important in documents such as the SET plan for example: (a) electric mobility policy as a case of diffusion of new technology to substitute a carbon intensive alternative, (b) smart meter policy as a case of diffusion of a technology assumed to change consumers' energy choice, (c) photovoltaic policy as a case of prosumerism in relation to private houses, thus a specific case of the energy in buildings focus ECHOES has, and (d) energy efficiency in buildings policy as a more general, multi-measure case.

The analyses conducted reflect the three ECHOES technology foci (smart energy technology, electric mobility, and buildings), as well as the three analysis levels (micro, meso, and macro). The analyses started with the identification of relevant cases for the technology foci, where smart meter policies, electric mobility policies, photovoltaic policies, and energy efficiency in buildings policies were selected as cases that have a high relevance for the Energy Union. Then, general energy policies on the EU and Member State level, but also technology specific documents at the EU, Member State and regional level of selected Member States or regions were identified. This resulted in an initial list of more than 100 policy documents, which was used as a starting point of the analyses. Additional documents were located in the process when they were central for the policy situation on the analysed level.

Within each case the countries and regions for the country level analyses were selected based on relevance for the selected case study and pre-existing expertise of consortium members, including language abilities to read policy documents in their original language. Even if this restricted the selection of available documents, we were

able to cover policy documents on the Member State level from eleven Member States plus Norway. In addition, policy from China and South Africa was integrated in two cases, because it was relevant for the specific case as a comparison to EU based documents. An analysis of Chinese EV-policy was added to the case of electric mobility, because China is the largest EV market in the world and the market with the fastest growth[8]. The analysis of a South-African city was added to the analyses of European smart meter policies, because it was an interesting case of consumer driven implementation, not unlike the Swedish case which was analysed in parallel. Figure 1.6 shows the structure of this document.

Figure 1.6: Structure of the report



The report is structured in different chapters, where the following Chapter 2 is conducting an analysis of the general energy related policy documents on the EU and Member State level, whereas the Chapters 3-6 present the analyses of the specific cases of energy transition technologies or fields (Chapter 3: electric mobility policy; Chapter 4: smart meters policy; Chapter 5: photovoltaic policy; and Chapter 6: energy efficiency in buildings policy). This distinction was made, because the general energy policy documents naturally remain on an abstract level and seldom become specific enough to allow a clear assessment of the consumers' position in the measurement catalogue and the concept of the consumer underlying these measures. Chapter 7 presents an analysis of an energy provider's (ENEL, Italy) strategy documents and how they include knowledge about consumer choices in the positioning of the company on the open market, which offers an interesting comparison of the similarities and differences to policy documents. The concluding Chapter 8 summarizes the findings made in the different Chapters and outlines a strategy for unlocking the potential social science knowledge has for policymaking. Chapters 2-7 were individual studies conducted by different constellations in the consortium, best suited based on their background knowledge to conduct the particular study. The conclusion section is where the individual studies are integrated into a more general assessment of the status of social science knowledge in policy documents.

[8] Kumar, P., Srivastava, K. N., & Dhar, A. (2018). Role of Electric Vehicles in Future Road Transport. In *Sustainable Energy and Transportation* (pp. 43-60). Springer, Singapore.

On all levels, the following research questions were guiding the analyses:

- Does the document make references to (drivers of) consumer behaviour? Which are they? What kind of concept about consumer decisions is reflected in the document?
- Does the document refer to core concepts of ECHOES (individual decisions in groups; identity; emotions; heterogeneity in energy lifestyles; gender-related issues; energy culture, history or memory; differences between individuals and formal social units)?
- Where is a potential for more social science knowledge? Where would such concepts really unlock new strategies?

2 ENERGY TRANSITION POLICY AND SOCIAL SCIENCE KNOWLEDGE

Large number of strategies, directives, and regulations, on both the EU and its Member State (MS) levels, envisions transition of the EU to a low carbon society. The EU level strategies and targets have been translated into national targets to reflect the situation and possibilities of each Member State to contribute to the common goal. As a result, there are numerous number of policy documents, both on an EU and its MS level and thus, it is impossible to review all of them. In this chapter, a summary of only the most important EU level documents are summarized. In addition, a few MS level cases are described to clarify the differences between different European countries.

Earlier studies[9,10,11] have demonstrated, how different practices and frameworks are in both formulating the new energy, climate and other policies, which aim at transition to a low carbon society both in the EU and its MSs. These vary from a "black-box" type to an open and collaborative type of process. In the EU and many of its MSs, the energy and climate policymaking is supported by impact assessment analyses, which are mostly quantitative scenario modelling for macro economy, energy systems and greenhouse gas (GHG) emissions. In these analyses, the social perspective is usually linked with the assessments of GDP, employment, purchasing parity, or similar macroeconomic indicators. In some cases, impacts on environment, health, and natural diversity have been considered, but it is very rare that aspects on values, acceptance, behaviour, or gender are considered in these strategy and policy documents. Therefore, the major target here is to analyse, which general policy documents consider social and human aspects, and how they are reflected. In addition, two questions are kept in mind: 1) does the policy-making include public consultation and discussion; 2) does the impact assessments of policies include the social dimension.

2.1 EU level policies

2.1.1 Europe 2020 strategy

Clean energy transition is one of the top priorities of the European Commission. This is proven by the Europe 2020 strategy[12,13] for growth and jobs for the current decade to pave the way to a smart, sustainable and inclusive future. Its overarching target is *"…to deliver high levels of employment, productivity and social cohesion in the Member States, while reducing the impact on the natural environment*". The 2020 strategy includes eight ambitious targets in the areas of employment, research and development (R&D), climate change and energy, education and poverty reduction to be reached by 2020. The target for sustainable growth includes so-called "20-20-20" targets for GHG mitigation, renewable energy and energy efficiency (Table 2.1).Thus, climate and energy policies contribute to the core objective of the Europe 2020 strategy of enabling sustainable growth.

[9] Koljonen, T., Leinonen, A., Wessberg, N., Sokka, L., Eerola, A., Pursiheimo, A. 2012. Analysing Transition Planning and Systemic Energy Planning Tools for the implementation of the Energy Technology Information System – ATEsT. Suggestions for tools and methodologies development to support SetPlan implementation. EU 7th Framework Programme. Project n:o 241382

[10] Koljonen, T., Hernandez, P.I., Kubeczko, K., Laes, E., Lechon, Y., Tomasgard, A., Velte, Virdis, M.R. How to tackle societal change in the transition to low-carbon societies? Proceedings of the 7th International Sustainability Transitions (IST) Conference 2016, September 6-9, 2016, Wuppertal

[11] Mariësse A.E. van Sluisvelda, Andries F. Hofa,b, Detlef P. van Vuurena, Pieter Bootb, Patrick Criquic, Felix C. Matthese, Jos Notenboomb, Sigurd L. Pedersenf, Benjamin Pflugerg, Jim Watson 2017. Low-carbon strategies towards 2050: Comparing ex-ante policy evaluation studies and national planning processes in Europe. Environmental Science & Policy, Volume 78, December 2017, Pages 89-96.

[12]https://ec.europa.eu/info/business-economy-euro/economic-and-fiscal-policy-coordination/eu-economic-governance-monitoring-prevention-correction/european-semester/framework/europe-2020-strategy_en#featuresofthetargets

[13] European Commission, Europe 2020 — A strategy for smart, sustainable and inclusive growth, COM(2010) 2020 final, Brussels, 2010. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:2020:FIN:EN:PDF

Table 2.2: The Europe 2020 strategy's key priorities, headline targets and flagship initiatives[14]

	Targets	Flagship initiatives
Smart growth	• Increasung combined public and private investment in R&D to 3% of GDP • Reducing school-dropout rates to less than 10 % • Increasing the share of the population aged 30-34 having completed tertiary education to at least 40 %	• Innovation Union • Youth on the move (ended in December 2014) • A digital agenda for Europe
Sustainable growth	• Reducing greenhouse gas emissions by at least 20% compared to 1990 levels • Increasing the share of renewable energy in the final energy consumption to 20% • Moving towards a 20% increase in energy efficiency	• Resource efficient Europe • An industrial policy for the globalization era
Inclusive growth	• Increasing the employment rate of the population aged 20-64 to at least 75 % • Lifting at least 20 million people out of the risk of poverty and social exclusion	• An agenda for new skills and jobs • European platform against poverty and social exclusion

2.1.2 EU climate and energy policies for 2020 and 2050

To avoid dangerous levels of climate change, the international community, including the EU, committed target of global climate change mitigation below 2 °C, which was agreed on in 2009 at COP 15 in Copenhagen[15] . To contribute to this global goal, the EU has pledged to continually reduce the amount of GHGs it emits. Towards this objective it has committed to reduce GHG emissions by 80–90% by 2050 compared with 1990 levels. In 2011, the European Union published the "A roadmap for moving to a competitive low carbon economy"[16] and the related document "Energy Roadmap 2050"[17]. Most of the EU MS have established their national low-carbon roadmaps and strategies, which often also include impact assessments. However, the low-carbon energy strategies and related impact assessments have mainly focused on technological portfolios, viability and pathways while the social changes and acceptance, political feasibility, and institutional aspects have largely been missing from the analysis.

The EU 2020 framework for climate and energy included several policy instruments to reach the "20-20-20" targets. The main policy instruments are the EU Emissions Trading System[18] (EU ETS) and the Effort Sharing Decision[19] (EDS). The EU ETS is a market based instrument to mitigate GHG emissions below the so called EU cap and all the sectors (e.g. power and heat production, energy intensive industries, air transport inside the EU), companies, and other operators included in the EU ETS scheme need to buy emission allowances or reduce their emissions per each ton of emitted CO_2. To ensure the global competitiveness of the industries operating in the EU MSs, also

[14] Eurostat 2016. Smarter, greener, more inclusive? Indicators to support the Europe 2020 strategy. http://ec.europa.eu/eurostat/documents/3217494/7566774/KS-EZ-16-001-EN-N.pdf/ac04885c-cfff-4f9c-9f30-c9337ba929aa

[15] United Nations Framework Convention on Climate Change, Copenhagen Accord, Copenhagen, United Nations, 2009. http://unfccc.int/meetings/copenhagen_dec_2009/items/5262.php

[16] European Commission, A Roadmap for moving to a competitive low carbon economy in 2050, Brussels, 2011.

[17] European Commission. Energy Roadmap 2050. Brussels, 15.12.2011 COM(2011) 885 final.

[18] See: http://ec.europa.eu/clima/policies/ets/index_en.htm

[19] *Council Decision 406/2009/EC* on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020. https://ec.europa.eu/clima/policies/effort_en

part of the emission allowances are delivered for free based on certain rules, which mostly are connected to technical references (like Best Available Technology, BAT), historical emissions, and companies' own estimations of future GHG emissions. However, the EDS decision is more based on principles of social equality, as it has set the national emission targets for the non-ETS sector (includes sectors such as transport, buildings, agriculture and waste) for 2020 according to GDP/capita expressed as percentage changes from 2005 levels. As a result of this principles, the high income MSs should have contributed more than the low income MSs, e.g. some of the high GDP MSs had the obligation to reduce GHG emissions by 20%, while the new EU MSs were even able to increase their GHG emissions by 20% by 2020. This reflects the aims of inclusive growth and social equality by avoiding too high costs of GHG mitigation of less wealthy economies. In addition to the EU ETS and EDS, the Renewable Energy Directive[20] (RED), Energy Efficiency Directive[21] (EED), Energy Performance of Buildings Directive[22], Ecodesign Directive[23], Energy Taxation Directive[24], and directives setting mandatory emission reduction targets for new passenger cars[25], light-duty vehicles and vans[26] have been implemented.

From all these the RED was probably the most noteworthy because it started a new era in national supporting systems for renewable power, heat, and transport fuels. The Renewable Energy Directive, with its binding 20% renewable target for 2020, broken down into national targets, was a core element of the 2009 EU climate and energy package. To reach the binding RES targets, new MS level supporting systems, like feed-in tariffs and green certificates, initiated massive investments in wind, solar, bioenergy and biofuels and it is highly debatable, if the social costs were too high in some countries, or have we gained more positive impacts on our welfare, energy independence, and environment. The increased use of renewables is not only motivated due to climate and other environmental impacts but also due its positive impact on regional economies and increased energy independence. Thus, a few important impacts of new supports should be mentioned, e.g. more expensive energy bills and price spikes in global food markets. The former raised concerns on "energy poverty" and the latter increased regulation on sustainability on producing so called 1st generation biofuels from agricultural products, like soya, maize, or other field crops, that could diminish the available land area for food production. To minimize the impacts of increased biofuel production to food and feed production, the shares of 1st generation biofuels were limited by the EU regulation to 7% from total biofuel use in transport (e.g. the above 7% shares were not calculated in the national RES targets).

2.1.3 Clean Energy for all Europeans by 2030

Today, the 20-20-20 policy framework can be considered history as currently the new EU and MS level climate and energy strategies and policies up 2030 are being established and framed. The 2030 climate and energy framework was adopted by EU leaders in October 2014 and the EU's Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy[27], was introduced in 2015. It complements the existing climate change and energy governance up to 2020 and guides the development until 2030. In November 2016, the so-called winter package was published, which states "Clean energy for all Europeans". It can be considered a "jumbo" package as it includes 8 legislative proposals and more than 70 different documents. It is therefore impossible to go through all of them in this context so only the overall picture is given. It is the first time in the history of the EU level climate

[20] Directive 2009/28/EC of the European Parliament and the European Council on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC, 2009.

[21] European Commission, Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC. European Commission, Brussels, 2012, Art. 3.

[22] Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings.

[23] Directive 2009/125 of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products.

[24] Directive 2003/96 of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity.

[25] Regulation 443/2009 of 23 April 2009 setting emission performance standards for new passenger cars as part of the Community's integrated approach to reduce CO2 emissions from light-duty vehicles.

[26] Regulation (EU) No 510/2011 of the European Parliament and of the Council of 11 May 2011 setting emission performance standards for new light commercial vehicles as part of the Union's integrated approach to reduce CO2 emissions from light-duty vehicles.

[27] European Commission, A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy, COM(2015) 80 final, Brussels, 2015. http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52015DC0080

and energy policy, that citizens and social aspects are put in the centre. The vision is that citizens take ownership of the energy transition, benefit from new technologies to reduce their bills, participate actively in the market, and vulnerable consumers are protected. It is stated that the package is based on energy security, solidarity and trust, and the 2030 policy framework includes real targets and actions to enhance consumer choices by giving more and transparent opportunities for civil society. It also contains a number of measures aimed at protecting the most vulnerable consumers.

The 2030 package has three overarching goals: putting energy efficiency first, enabling active consumers and global leadership on renewable energies. The legislative proposals of the 2030 package cover energy efficiency, renewable energy, the design of the electricity market, security of electricity supply and governance rules for the Energy Union. In addition, the Commission proposed a new way forward for Ecodesign as well as a strategy for connected and automated mobility. The new proposals and strategies for electric mobility and buildings are discussed in the Chapters 3 and 6 of this report. However, promotion of electric mobility is only a part of Commission's Strategy for Low Emissions Mobility, adopted in July 2016[28] and during the year 2017 several new proposals were launched, including the Communication for a socially fair transition towards clean, competitive and connected mobility for all[29], which notes that increased production and uptake of clean vehicles, alternative fuel infrastructure and modern system services making use of the data economy in the EU offers multiple benefits: European citizens will benefit from safe, attractive, intelligent, seamless and increasingly automated transport solutions, which will provide industries with new sources of growth and competitiveness. In addition, the Commission has made a proposal for the update of the on the 2009 Directive on the promotion of clean and energy-efficient road-transport vehicles (known also as the Clean Vehicles Directive)[30], which introduces a common definition of clean vehicles based on an emissions-based threshold (tank-to-wheel) for light-duty vehicles, combining CO_2 and air pollutant emissions. It also proposes new public procurement practises especially for heavy-duty transport vehicles where no legislative requirement for reducing CO_2 emissions exists yet.

The new climate and energy strategy sets three key targets for the year 2030: 1) At least 40% cuts in greenhouse gas emissions (from 1990 levels); 2) At least 27% share for renewable energy; 3) At least 27% improvement in energy efficiency. These 2030 targets are in line with the 2050 low-carbon GHG mitigation targets for the EU. However, the 2030 policy framework could be considered remarkable from the social perspective, because for the first time, the EU has set its core to energy consumers by motivating citizens participate actively in the market by investing to their own renewable energy production, and where vulnerable consumers are protected. However, the more traditional pillars, e.g. to ensure secure, sustainable, competitive and affordable energy are also in the heart of the policy framework. The burden sharing of the GHG reduction between the MSs is defined in the new Effort Sharing Regulation by following the same principles as in the 20-20-20 package, e.g. the national binding emission reduction targets in the non-ETS sector is defined according to the GDP/capita in the MSs, but this time ambition level has been risen to a much higher level (e.g. the maximum GHG reduction is 40% in the non-ETS)[31].

As discussed in Chapter 2.1.2, energy poverty and sustainability of bioenergy, could be highlighted in this context in addition to the consumer's active role. Energy poverty has many causes, mostly resulting from a combination of low income and general poverty conditions, inefficient homes and a housing tenure system that fails to encourage

[28] European Commission. A European Strategy for Low-Emission Mobility. Brussels, 20.7.2016 COM(2016) 501 final. https://ec.europa.eu/transparency/regdoc/rep/1/2016/EN/1-2016-501-EN-F1-1.PDF

[29] European Commission. Europe on the move. An agenda for a socially fair transition towards clean, competitive and connected mobility for all. Brussels, 31.5.2017 COM(2017) 283 final. https://ec.europa.eu/transparency/regdoc/rep/1/2017/EN/COM-2017-283-F1-EN-MAIN-PART-1.PDF

[30] European Commission. Proposal for a direcitve of the European Parliament and of the Council, amending Directive 2009/33/EU on the promotion of clean and energy-efficient road transport vehicles. Brussels, 8.11.2017 COM(2017) 653 final. https://ec.europa.eu/transparency/regdoc/rep/1/2017/EN/COM-2017-653-F1-EN-MAIN-PART-1.PDF

[31] European Commission. Proposal for a Regulation of the European Parliament and of the Council on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 for a resilient Energy Union and to meet commitments under the Paris Agreement and amending Regulation No 525/2013 of the European Parliament and the Council on a mechanism for monitoring and reporting greenhouse gas emissions and other information relevant to climate change. COM (2016)482 final.

energy efficiency[27]. Thus, Member States need to propose a mechanism to protect vulnerable consumers, which could be implemented through schemes such as a solidarity tariff or as a discount on energy bills. Improving the energy efficiency of buildings is one of the major tools to make energy more affordable and fight against energy poverty. To support energy efficiency improvements, the European Social Fund is used by some Member States to alleviate energy poverty, as a complement to the EUR 5.2 billion allocated from the European Regional Development Fund and the Cohesion Fund for energy efficiency investments in housing[32]. In addition, Commission will also set up an Energy Poverty Observatory to produce reliable statistics on the number of energy poor households in each MS and contribute to the dissemination of good practices.

In the 2030 framework, renewable energy is a once again a key tool for several dimensions of the Energy Union Strategy to sustain and improve growth, employment and competitiveness. However, a clearer legal framework provided by the revised RED (e.g. so-called RED2) directive[33] and this time MSs will contribute to enable the EU to reach, collectively, a share of at least 27% in the final energy consumption by 2030 (e.g. MS level binding targets are removed after 2020). The RED2 includes two central elements from the social perspectives, e.g. it enforces the possibilities of consumers to become prosumers (e.g. to produce own energy and sell the excess to the grid) and, on the other hand, it rules out unsustainable use of renewables that could have negative impacts on environment and/or welfare of the citizens. The RED2 opens access rights not only to electricity distribution grids but also to local district heating and cooling systems for producers of renewables, under certain conditions. Secondly, the sustainability criteria for biofuels are improved by requiring that (new) advanced biofuels emit at least 70% fewer GHG emissions than fossil fuels. For solid biomass and biogas used in large heat and power plants the limit is even tighter, e.g. 80% by 2021 and 85% by 2030 respectively. Those extremely tight limits rule out unsustainable use of bioenergy and biofuels, e.g. also from the global perspective, because the GHG emissions are calculated based on rules of LCA (Life Cycle Analysis), including transportation. Especially from the global perspectives, there are large uncertainties, what are the indirect social impacts of the EU's (and also other regions) RES policies and thus, the RED2 will minimize these uncertainties.

It was interesting to notice as well that the 2030 climate and energy package was linked with the Skills Agenda for Europe[34] in order to support socially fair clean energy transition and to help tackle skills challenges and address skills shortages in specific economic sectors (the so called "Blueprints for Sectoral Cooperation on Skills"). At least EUR 1.1 billion from the European Social Fund will be dedicated in the period 2014 – 2020 to improving education and training systems necessary for the adaptation of skills and qualifications and for the creation of new jobs in sectors related to energy and the environment.

2.1.4 EU climate and energy policies in the international context

At the UNFCCC 21st Conference of the Parties (COP 21) in 2015 in Paris, it was agreed on limiting the mean global temperature rise to well below 2 °C above preindustrial levels and to drive efforts to limit the increase even further to 1.5 °C[35]. The Paris Agreement requires all countries to prepare nationally determined contributions (NDCs), take measures to achieve their objectives, and report on progress. The European Union was one of the first Parties to announce its post-2020 ambition. Based on the conclusions on the above described 2030 EU climate and energy framework[27], the EU INDC (Intended Nationally Determined Contribution) commits to a binding target of at least a 40% domestic reduction in greenhouse gas emissions by 2030, compared to 1990 levels, to be fulfilled jointly by

[32] European Commission, Annex2, Action to boost the clean energy transition to the Clean Energy For All Europeans. Brussels, 30.11.2016 COM(2016) 860 final. http://eur-lex.europa.eu/resource.html?uri=cellar:fa6ea15b-b7b0-11e6-9e3c-01aa75ed71a1.0001.02/DOC_3&format=PDF

[33] European Commission. Proposal for a Directive on the promotion of the use of energy from renewable sources (recast). Brussels, 23.2.2017 COM(2016) 767 final/2.

[34] European Commission. "A New Skills Agenda for Europe: Working together to strengthen human capital, employability and competitiveness", COM (2016) 381.

[35] United Nations Framework Convention on Climate Change, Paris Agreement, Paris, United Nations, 2015. https://unfccc.int/paris_agreement/items/9485.php

the EU and its MSs, and excluding any contribution from international credits[36]. Thus, it should be noted that the EU INDC and the EU 2030 policy framework set the targets to fulfil the 2050 GHG mitigation target for the below 2 °C objective while the Paris agreement targets to the "well below" 2 °C, e.g. maximum of 1.5 °C temperature rise. The ambition level of the well-below 2 °C target is far higher meaning that by 2030 the GHG emissions should decrease even more sharply than the decided 40% reduction. This indicates that the role of citizens and decisions by the companies would be extremely important both by putting more pressure on policymaking and by accelerating transition to a more sustainable living, mobility, and consuming.

In September 2015, the 2030 Agenda for Sustainable Development was formally adopted by world leaders at the United Nations Sustainable Development Summit. The document, titled 'Transforming our world: the 2030 agenda for sustainable development'[37] consists of a declaration, a set of 17 Sustainable Development Goals (SDGs) and 169 related targets. The Agenda 2030 is a result of an inclusive process since the UN Conference in 2012, which is also known as Rio+20 conference. European Commission has shown its commitment through the Rio+20 conference and The EU support was conveyed in European Council conclusions on the 2030 Agenda[38] and in its proposal for a new global partnership for poverty eradication and sustainable development[39]. Two of the SDGs directly touch energy and climate, e.g. Goal 7: Ensure access to affordable, reliable, sustainable and modern energy for all and the Goal 13: Take urgent action to combat climate. However, it could be stated that energy and climate issues are also indirectly coupled to all the other SDGs as well, e.g. to tackle global poverty and hunger, healthy lives and economic well-being, gender equality, protect our environment, etc.

2.2 Examples of the EU and its Member States

The 2030 policy framework for climate and energy includes for the first time the Energy Union Governance regulation[40], which frames the Integrated National Energy and Climate Plans and sets out national contributions to the legally binding EU-level RES target. The Energy Union Governance foresees an iterative process between the Commission and Member States to ensure ambitious and reliable National Plans. The practices and transparency of energy and climate policymaking is very different between the EU MSs, which are highlighted by the few country examples below. In many countries, climate and energy policy-making is supported by impact assessments, which usually include quantitative scenario modelling for national economy, energy systems and GHG emissions. Publicly available impact assessments of national energy and climate policies and strategies illustrates the transparency, main focus as well as the level of ambition and/or barriers for the transition to a low carbon society. Therefore, it is worthwhile to start analyzing, do these impact assessments exist, how they are done, and what aspects or sectors are included in the analysis of the policies and strategies.

[36] Latvian Presidency of the Council of the European Union, Intended Nationally Determined Contribution of the EU and its Member States, Submission by Latvia and the European Commission on behalf of the European Union and its Member States, Riga, 6 March 2015. http://www4.unfccc.int/submissions/INDC/Published%20Documents/Latvia/1/LV-03-06-EU%20INDC.pdf

[37] United Nations (2015) Transforming our World: the 2030 agenda for sustainable development, A/RES/70/1, 25 September 2015. https://sustainabledevelopment.un.org/post2015/transformingourworld

[38] See: Council conclusions on a transformative post-2015 agenda, Brussels, 16 December 2014. http://www.consilium.europa.eu/uedocs/cms_Data/docs/pressdata/EN/foraff/146311.pdf

[39] See: A New Global Partnership for Poverty Eradication and Sustainable Development after 2015, Council Conclusions, 26 May 2015. http://data.consilium.europa.eu/doc/document/ST-9241-2015-INIT/en/pdf

[40] European Commission. Proposal for a regualtion of the European Parliament and the Council on the Governance of the European Union. Brussels, 23.2.2017 COM(2016) 759 final/2. http://eur-lex.europa.eu/resource.html?uri=cellar:ac5d97a8-0319-11e7-8a35-01aa75ed71a1.0024.02/DOC_1&format=PDF

Based on the earlier experience and analysis[41,42], it is rather evident that social dimension is mainly included by discussing economies, costs, and employment, while behaviour, acceptance, gender, and other social and human dimensions are hardly discussed or assessed in the impact assessments. In Table 2.2 below, a summary is given based on the analysis carried out in 2014-15, which is updated by the recent information. These surveys and earlier research have clearly shown that the quantitative models to support the transition to low carbon societies almost purely concentrate on physical structures, e.g. technical portfolios and future energy systems and/or macro-economic impacts of policies. Environmental impacts are more or less analysed on "stand-alone" bases, for example with the help of LCA in its different forms. Thus, the most lacking is the inclusion of the social systems in transition studies and modelling, including changes in demographics, behaviour, values, and cultures. There are both lacking methods and data, which could be considered as a serious problem, especially when quantitative modelling is used for policymaking, which is the case both on the EU and its MS level decision making. It is also apparent from the analysis of the EU Roadmap 2050 and the national climate action plans that the low-carbon innovation agenda is predominantly framed in terms of technological progress, the creation of new jobs and markets, the growth of competitive businesses (allowing a country or region to take advantageous positions in the low-carbon economy of the future), and general prosperity (translated as GDP growth).

[41] Koljonen, T., Leinonen, A., Wessberg, N., Sokka, L., Eerola, A., Pursiheimo, A. 2012. Analysing Transition Planning and Systemic Energy Planning Tools for the implementation of the Energy Technology Information System – ATEsT. Suggestions for tools and methodologies development to support SetPlan implementation. EU 7th Framework Programme. Project n:o 241382.

[42] Koljonen, T., Hernandez, P.I., Kubeczko, K., Laes, E., Lechon, Y., Tomasgard, A., Velte, Virdis, M.R. How to tackle societal change in the transition to low-carbon societies? Proceedings of the 7th International Sustainability Transitions (IST) Conference 2016, September 6-9, 2016, Wuppertal.

Table 2.2: Summary of the impact assessments carried out by the EU Member States and the EU. The table shows the major focus areas in energy and climate policymaking based on publicly available literature. Neither EU nor its MSs report policy impact assessments that consider social dimension

	EU 2030	ETS	Non-ETS	Renewables	LULUCF	Air emissions	Costs	EU 2050
Austria	(x)							x
Belgium	(x)							x
Bulgaria								
Croatia								
Cypros								
Czech								
Denmark								x
Estonia	(x)	(x)	(x)	(x)			(x)	
Finland	x	x	x	x	x		x	x
France								x
Germany	x	x	x	x				x
Greece								x
Hungary	x		x					
Ireland	x	x	x	x				x
Italy	x			x			x	x
Latvia	(x)	(x)	(x)	(x)			(x)	
Lithuania	(x)	(x)	(x)	(x)			(x)	
Luxenburg								
Malta								
Netherlands	x		x					x
Portugal	x							x
Poland	x							
Romania								
Slovakia								
Slovenia								
Spain	x	x		x			x	x
Sweden	x		x		x		x	x
UK	x		x	x		x	x	x
Commission	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**

2.2.1 Finland

Finland has rather long history in preparing and analysing energy and climate strategies and policies. The primary aims in energy policies and mitigation of emissions has been, and still is, to strengthen national welfare, improve self-dependency of energy supply, and to protect the environment and health of the society. As an example, energy taxation (e.g. CO_2 tax for fossil fuels) was introduced already in 1990 and since 1992 Finland has promoted bioenergy due to all the above aims. The way Finland is preparing the energy and climate policies and strategies has always been rather open. Minister(s) and the Government steer the preparations, and ministries are responsible for concrete preparations, including impact assessments of policies and measures. State-of-the-art and the basis for certain assessments for the future are discussed with the industries and other stakeholders, who can support future assessments by giving their own prospects on future industrial activities. However, also criticism has appeared which usually related to the debate on the assessments of energy demand, policy costs, and impacts on the national economy and employment. The impact assessments of the policies and strategies are typically carried

out by research organizations and consultant companies. The Finnish law states that the environmental impact assessment need to be carried out for every energy and climate strategy or climate plan, meaning 1-2 times per each governmental period, but the rule of practice has been that also the quantitative assessments on national economy, energy systems, and GHG emissions have been carried out.

Finland has committed to the EU level goal to achieve the low carbon society by 2050. In addition, some of the cities and municipalities have set a target to achieve carbon neutrality even much before, e.g. by 2030-2040. The latest National Energy and Climate strategy up to 2030[43] sets several concrete medium-term policies and measures to reach the national low carbon target. The strategy was launched on November 2016 and it was approved by the Parliament in spring 2017. Parallel to the new strategy, also a so-called national medium-term climate change policy plan[44] was established for the first time. Provisions on the medium-term climate policy plan have been laid down in the Climate Change Act and the plan applies to the non-emissions trading sectors, i.e. the effort sharing sector. The plan further specifies and supplements the emissions reduction actions set out in the Energy and Climate Strategy. Linkages and cross-cutting themes between the sectors are also examined, including the role of consumption and work on climate change issues done locally.

The new Energy and Climate strategies include several ambitious targets to be achieved by 2030, including:

- The share of renewable energy above 50% from final energy consumption (EU2020 target 38%, which is already reached)
- Reduce the use of mineral oil by 50% (compared with 2005 level)
- Increase the share of domestic energy sources above 55%
- Phase out of coal in energy production
- Increase the share of renewables in transport to 40% (2020 target is 20%, which is already reached).

Like in the earlier strategy works, social aspects have been discussed very little in the Energy and Climate strategy and like usually, the discussion has been about employment numbers as well as national economies. However, medium-term climate change policy plan included also some discussion on the impacts on day-to-day living, notices on acceptability of policy measures and even gender. On the other hand, new policies included concrete targets for the number of electric and gas vehicles, increased walking and cycling, and public transport, which depend on decisions of private consumers. In addition, such an increase of the shares of renewables would also require more investments on PV, heat pumps, energy efficiency, etc. in buildings, where the investors are usually individuals. For both the Energy and Climate strategy and medium-term climate change policy plan, extensive impact assessments were carried out by the research organizations in Finland[45,46]. The quantitative impact assessments were focused, like typically, mostly on technical and economic aspects. However, also impacts on health were assessed and, on the other hand, impacts of consumer choices on food, mobility, energy efficiency in buildings, etc. were shortly assessed.

[43] Ministry of Economic Affairs and Employment of Finland 2016. Government report on the National Energy and Climate Strategy for 2030. Publications of the Ministry of Economic Affairs and Employment, Energy , 12/2017. http://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/79247/TEMjul_12_2017_verkkojulkaisu.pdf?sequence=1&isAllowed=y

[44] Ministry of the Environment 2017. Government Report on Medium-term Climate Change Plan for 2030 – Towards Climate-Smart Day-to-Day Living, Reports of the Ministry of the Environment 21/2017 (in Finnish, abstract in English). http://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/80703/YMra_21_2017.pdf?sequence=1&isAllowed=y

[45] Koljonen, T., Soimakallio, S., Asikainen, A., Lanki, T., Anttila, P, Hildén, M., Honkatukia, J., Karvosenoja, N., Lehtilä, A., Lehtonen, H., Lindroos, T., Regina, K., Salminen, O., Savolahti, M., Siljander. R. 2017. Impact analysis of Finland's energy and climate strategy: Summary report. Helsinki, Prime Minister's Office. Report 21/2017 (In Finnish, English summary).

[46] Koljonen, T., Soimakallio, S., Ollikainen, M., Lanki, T., Asikainen, A., Ekholm, T., Hildén, M., Honkatukia, J., Lehtilä, A., Saarinen, M., Seppälä, J., Similä, L, Tiittanen, P. 2017. Impact assessments of the Medium-term Climate Change Policy Plan. Helsinki, Prime Minister's Office. Report 57/2017 (In Finnish, English summary).

Public debate on energy and climate issues in Finland has always been rather strong. Acceptance of nuclear energy has usually been a slightly higher than 50% among the whole population. Climate change is a topic that most of the Finns worry about and increased shares of renewable energy are highly supported. However, over the times, on-shore wind power has also been debated especially because of the doubts about negative health impacts. Recently, also the use of forest based bioenergy and biofuels are increasingly debated due to uncertainties about the real climate impacts. Also among the policy-makers, increasing number of parliament representatives and parties are putting more pressure for more ambitious climate and energy policymaking.

2.2.2 Germany

Among all the EU countries, the German "Energiewende" has been the most strongly debated national energy and climate strategy. The German Government has released a set of energy and climate targets for both the mid-term period and the target year of 2050[47]. Compared with the EU level targets, Germany has set more ambitious interim targets of 40% (2020), 55% (2030), and 70% (2040) emission reductions, which are not binding but they declare intentions and serve as a reference point[48]. In 2011, The German Government decided to phase-out nuclear energy by 2022 after the Fukushima accident. Nuclear power should be replaced by renewable electricity and Germany has a very ambitious target of reaching a minimum share of 80% renewables in the electricity mix by 2050, as specified in the Renewable Energy Act. The 2016 Climate Action Plan 2050[49] outlines the national low-carbon strategy up to 2050 and it introduces sector targets for GHG emissions. The plan has used results of several of long-term model-based scenario analyses by many different stakeholders over the last few years[50]. The plan states that the energy supply must be "almost completely decarbonised" by 2050, with renewables as its main source. For the electricity sector, "in the long-term, electricity generation must be based almost entirely on renewable energies" and "the share of wind and solar power in total electricity production will rise significantly"[51]. However, it should be noted that the German national long-term climate plans are not explicitly legislated but policies and long-term strategies are implemented via established inter-ministerial approval procedures. On the other hand, to achieve broader societal consensus for the Climate Plan 2050, Germany has consulted over 500 stakeholders within federal states, municipalities, industry, interest groups and civil society. In addition, "measurements catalogue" has been published by German ministry, which is based on the broader (public) stakeholder engagement [50, 52].

The social and political dimensions of the Energiewende have been subject to study. The survey from 2016[53] showed that 80–90% of the public are in favour for the Energiewende and that roughly half of Germans would consider investing in community renewable energy projects. According to Borchert[54], one reason for the high acceptance is the substantial participation of German citizens in the Energiewende. Studies already from 2012 showed that citizens owned nearly half of all installed biogas and solar capacity and half of the installed onshore wind capacity[55]. However, integrating such amounts as planned of new variable generation (PV and wind power)

[47] Federal Government (2010). Energiekonzept für eine umweltschonende, zuverlässige und bezahlbare Energieversorgung. Available at http://www.bmu.de/fileadmin/bmu-import/files/pdfs/allgemein/application/pdf/energiekonzept bundesregierung.pdf.

[48] Brigitte Knopf, Bjørn Bakken, Samuel Carrara, Amit Kanudia, Ilkka Keppo, Tiina Koljonen, Silvana Mima, Eva Schmid, Detlef van Vuuren. Transforming the European energy system: Member States's prospects within the EU frameworks. Climate Change Economics Vol 4, Suppl. 1, 2013.

[49] The Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) 2016. Klimaschutzplan 2050 − Kabinettbeschluss vom 14. November 2016.

[50] Mariësse A.E. van Sluisvelda, Andries F. Hofa,b, Detlef P. van Vuurena, Pieter Bootb, Patrick Criquic, Felix C. Matthese, Jos Notenboomb, Sigurd L. Pedersenf, Benjamin Pflugerg, Jim Watson 2017. Low-carbon strategies towards 2050: Comparing ex-ante policy evaluation studies and national planning processes in Europe. Environmental Science & Policy, Volume 78, December 2017, Pages 89-96.

[51] Wikipedia 2018. German Climate Action Plan 2050. https://en.wikipedia.org/wiki/German_Climate_Action_Plan_2050

[52] The Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) 2016b. Maßnahmenkatalog − ergebnis des Dialogprozesses zum Klimaschutzplan 2050 der Bundersregierung

[53] Amelang, Sören; Wettengel, Julian 2016. Polls reveal citizens' support for Energiewende. Clean Energy Wire (CLEW). Berlin, Germany.

[54] Borchert, L. 2015. "Germany between citizens' energy and Nimbyism". Clean Energy Wire (CLEW). Berlin, Germany.

[55] Morris, Craig 2013. Citizens own half of German renewable energy. Energy Transition, The Global Energiewende. 29 Oct 2013. https://energytransition.org/2013/10/citizens-own-half-of-german-renewables/

would require grid reinforcement especially from north Germany to south. The challenge has been the citizen's opposition to power lines running past their towns and villages. On the other hand, some parties and experts have argued that additional power lines are not required due to expectations for increased shares of decentralized power systems, including also self-sufficiency of electricity supply in some regions[56]. Thus, German cabinet approved for about 1 000 km of high-voltage underground cabling in October 2015 to overcome local resistance against above-ground pylons and to speed up the expansion process. According to some estimates, the underground cabling will cost between 3-8 billion euros more than the overland option and the extra expense is likely to be added to consumers' electricity bills[57]. Thus, analysis by German Government indicates that only in the best case scenario German will reach its GHG mitigation target by 2020[58].

2.2.3 France

In France, the POPE-law since 2005 (Grenelle de l'environnement) laid down long-term climate and energy targets, including (i) GHG emission reductions of 40–45% by 2030 and 75% by 2050, (ii) the share of renewables 23% by 2020 in line with the French commitment to the 20-20-20 targets, and (iii) energy efficiency. In late 2012, the French Minister for Ecology launched a public debate on the Government's above proposals for 2020 and the pledge of the French president to cut nuclear energy from 77% in 2011 to 50% of France's power mix by 2025[59,60]. In 2015, the National Low-Carbon Strategy (SNBC) was established by the Energy Transition for Green Growth (*Loi de Transition Énergétique pour la Croissance Verte*, *LTECV)*[61], which also included the same GHG targets for 2030 and 2050. The government's strategic priorities in terms of energy policy are defined in the Multiannual Energy Plan (MEP), which sets out meeting the objectives given in the law on energy transition for green growth. For the first time, all aspects of energy policy (demand, renewable energies, security of supply, infrastructures, etc.) and all forms of energy are covered by the same strategy, reflecting the strong connections between the different dimensions of energy policy.

France has a large potential for RES, especially for onshore wind but there are barriers due to social acceptance.. Furthermore, biomass production could be important in the future as France has a relatively large potential for solar energy production in the south of the country relatively large agricultural and forest areas available, which is Currently, the most of French electricity generation is based on nuclear power but its share is planned to be decreased due to increased shares of renewables[62]. However, there are differing opinions concerning the future of nuclear energy even though the public debate is not comparable with German.

The French way of energy and climate policymaking seems to be rather unique in the sense of communication with the stakeholders and public. The multiannual energy plan has been in place since March 2015, with contributions

[56] Appunn, Kerstin 2015. The Energy Transition and Power Grid. Connecting up the Energiewende. Clean Energy Wire 26.1.2015. https://www.cleanenergywire.org/dossiers/energy-transition-and-germanys-power-grid

[57] Reuters 2015. German cabinet agrees to costly underground power lines. October 7, 2015. https://www.reuters.com/article/germany-energy-power/german-cabinet-agrees-to-costly-underground-power-lines-idUSL8N12722320151007

[58] Bundesministerium fur Wirtschaft und Energie 2016. Die Energie der Zukunft. Fünfter Monitoring-Bericht zur Energiewende. *Berichtsjahr 2015*. http://www.bmwi.de/Redaktion/DE/Publikationen/Energie/fuenfter-monitoring-bericht-energie-der-zukunft.pdf?__blob=publicationFile&v=38

[59] Brigitte Knopf, Bjørn Bakken, Samuel Carrara, Amit Kanudia, Ilkka Keppo, Tiina Koljonen, Silvana Mima, Eva Schmid, Detlef van Vuuren. Transforming the European energy system: Member States's prospects within the EU frameworks. Climate Change Economics Vol 4, Suppl. 1, 2013.

[60] Mariësse A.E. van Sluisvelda, Andries F. Hofa,b, Detlef P. van Vuurena, Pieter Bootb, Patrick Criquic, Felix C. Matthese, Jos Notenboomb, Sigurd L. Pedersenf, Benjamin Pflugerg, Jim Watson 2017. Low-carbon strategies towards 2050: Comparing ex-ante policy evaluation studies and national planning processes in Europe. Environmental Science & Policy, Volume 78, December 2017, Pages 89-96.

[61] Ministry of Ecology Sustainable Development and Energy 2015. Energy Transition for the Green Growth act.

[62] Brigitte Knopf, Bjørn Bakken, Samuel Carrara, Amit Kanudia, Ilkka Keppo, Tiina Koljonen, Silvana Mima, Eva Schmid, Detlef van Vuuren. Transforming the European energy system: Member States's prospects within the EU frameworks. Climate Change Economics Vol 4, Suppl. 1, 2013.

from a wide range of stakeholders and people[63,64]. As an example, over 800 people took part in the 23 workshops, with over one hundred presentations and 70 written submissions between late March and December 2015. In addition, the public consultation process gathered over 5000 comments, which duration was one month only in the fall 2015. The MEP build upon quantitative scenarios until 2023. In addition, the MEP has defined several "ambitions and actions". As an example, for mobility the objective of electric and hybrid vehicles by 2023 is 2.4 million. In addition, the aim to increase the proportion of short journeys made on foot or by bicycle to 12.5% by 2030, and expanding car-sharing facilities and digital services to increasing the average occupancy rate of private vehicles to 1.8 or 2 people/vehicle by 2030. The ambitions and actions also include discussion on energy poverty. Based on the literature studies on policy impact assessments (see Table 2.1), discussion on energy poverty is still unique in the strategy papers in the EU MSs. However, due to coming requirements for monitoring the energy poverty, we can expect that also the other EU MSs need to somehow consider energy poverty in their future energy and climate strategies, policies, and legislation.

[63] Mathy, S., Criqui, P., Hourcade, J.C., 2015. Pathways to Deep Decarbonization in 2050 in France. The French report of the Deep Decarbonization Pathways Project of the Sustainable Development Solutions Network and the Institute for Sustainable Development and International Relations.

[64] S. Mathy, M. Fink, R. Bibas. (2015). Rethinking the role of scenarios: participatory scripting of low-carbon scenarios for France. Energy Policy, 77, pp. 176-190

3 CASE 1: ELECTRIC MOBILITY

3.1 Rationale for choosing the case and the country level examples

The transport sector is a prime source of CO_2 emissions in the EU and of high priority for a transition to a low carbon society. Electric mobility as a means to decarbonise the transport sector has been pointed out as a priority research and innovation target in the Strategic Energy Technology (SET) plan. Electric mobility is a large field including plug-in battery electric cars, plug-in hybrid electric vehicles, electric bicycles, electric motorbikes, electric busses and transporters, electric aviation, ferries, etc. However, most policy at the moment is focussing on electric or hybrid passenger cars, which is why our analyses will be limited to these vehicles primarily. Electric vehicle policy differs considerably between different member states of the EU (and Norway). We focus our analyses on three large Member States from northern, southern, and central Europe (UK, Spain, and Germany), also because they have rather different focus on electric mobility. In addition, Norway as the country in the world with the highest market share of electric vehicles and China as a fast growing market of global importance were added to the analyses to contextualize the other three analyses with two cases of successful market implementation. Furthermore, as studies like the Eurobarometer show, do citizens of different European countries vary considerably in what kind of measures they support for reducing environmental impacts and improving air quality and what kind of measures they take (electric vehicles rank far behind other measures such as using public transportation or other low emission products).[65]

3.2 EU level policy and strategy documents

3.2.1 Electric mobility - definitions

3.2.1.1 Definition of electric mobility

Electric mobility comprises all street vehicles that are powered by an electric motor and primarily get their energy from the power grid – in other words: can be recharged externally (National Development Plan Electromobility, 2009)[66]. This includes purely electric vehicles, vehicles with a combination of electric motor and a small combustion engine (range extended electric vehicles – REEV) and hybrid vehicles that can be recharge via the power grid (plug-in hybrid electric vehicles – PHEV).

Electricity as an energy vector for vehicle propulsion offers the possibility to substitute oil with a wide diversity of primary energy sources. This could ensure security of energy supply and a broad use of renewable and carbon-free energy sources in the transport sector which could help the European Union targets on CO_2 emissions reduction[67].

3.2.1.2 Benefits of electric vehicles[68]

Electric vehicles (EVs) can run on solar energy and other regenerative energy sources, as their energy in a rechargeable battery. Currently, Electric cars connected to the public power grid in Europe will use a mixture of energy sources, where solar accounts for 2 % of the energy in the public grid. According to the Green eMotion project (2011-2015) the environmental impact of EVs is mixed. However, EVs are generally more environmentally friendly than cars with internal combustion engines because of their more efficient energy exploitation, in particular when accounting for global effects like the global warming potential.

For the daily usage, EVs have extremely low noise, easy operation, swift acceleration, low production costs, and they are easier to maintain due to their less complicated mechanical motor structures. Moreover, EVs can stabilize

[65] http://ec.europa.eu/commfrontoffice/publicopinion/index.cfm/Survey/getSurveyDetail/instruments/SPECIAL/surveyKy/2156

[66] http://www.erneuerbar-mobil.de/en/node/970

[67] https://ec.europa.eu/transport/themes/urban/vehicles/road/electric_en

[68] Summaries from http://education.greenemotion-project.eu/before-you-decide/the-benefits-of-electro-mobility.aspx

the grid and store energy for other needs. In the long-run, vehicle batteries could even provide energy to the grid when needed.

3.2.2 Electric mobility and sustainable urban environment

Europe's transportation sector is a key contributor to global climate change and local air pollution, and since 1990, the CO_2 emissions from European road transport have increased by 17%. Currently, transport is responsible for about a quarter of EU CO_2 emissions and also contributes significantly to reduced air quality (particulate matter, NOx, HC and CO) and related health problems, in particular in urban areas (European Commission, 2013a)[69].

Besides the concerns of GHG emissions, traditional internal combustion engine (ICE) vehicles cause noise and local air pollution, which create adverse health impacts (OECD, 2014). Traffic related air pollution is one of the main sources of 'ambient PM pollution' and 'ambient ozone pollution', and these two risk factors can cause negative health impacts and economic costs. Based on the report of OECD (2014), the number of deaths due to outdoor air pollution fell by about 4% in OECD countries between 2005 and 2010, while, this number rose by about 5% and 12% in China and India. Therefore, governments are suggested to maintain strong regulatory regimes, particularly strict vehicle standards. Because of the enormous size of the economic cost of the health effects of air pollution, the benefits of reducing this economic cost could easily outweigh the monetary cost of investments in more ambitious programmes to reduce pollution (OECD, 2014).

Emissions from conventional combustion engines will need to further reduce after 2020. Zero- and low-emission vehicles will need to be deployed and gain significant market share by 2030. To support the transition, incentives on both the supply- and demand-side will be needed through measures at EU level, as well as at Member State, regional or local level (European commission, Clean Transport, Urban transport)[70].

Electrifying passenger cars is therefore seen as a key measure to reduce pollutant and greenhouse gas emissions from road transportation. It is also a key in the diversification of carbon-free and renewable energy sources in the transportation sector, which could help the European Union targets on CO_2 emissions reduction (ICCT white paper i). Today, approximately 0.7% of all new cars in Europe are electric, and EV sales have been increasing. However, a small number of countries account for the majority of the market; Germany, UK, France, the Netherlands and Norway made up more than 80% of the market in 2014 (White paper, 1).

Emissions from trucks, buses and coaches currently represent around a quarter of road transport carbon dioxide emissions and are set to increase by up to 10% around between 2010 and 2030. The EU will also need to introduce measures to actively curb carbon dioxide emissions from trucks, buses and coaches. Standards for this have already been introduced in other parts of the world, and Europe should not lag behind. The European Commission on Sustainable Development therefore aims to speed up analytical work on design options for carbon dioxide emission standards for such vehicles and will launch a public consultation to prepare the ground for a proposal during this mandate. The potential to introduce low or zero emission technologies differs among categories of such vehicles. For some categories – such as city buses – early adoption of zero emission technologies seems in reach and a separate zero-emission target should be explored. Public procurement is identified as a powerful instrument to create markets for innovative products and it should be used to support take up of such vehicles. Since a significant part of public procurement is undertaken by municipal and local authorities, there is particular potential for public transport vehicles, such as buses, using low-emission alternative energies. To make such public procurement even more effective, the Commission is working on the revision of the Clean Vehicles Directive, which

[69] European Commission (2013a), Commission staff working document guidelines on financial incentives for clean and energy efficient vehicles.

[70] Clean transport, Urban transport. Electric vehicles, European Commission. https://ec.europa.eu/transport/themes/urban/vehicles/road/electric_en Accessed 02.01.2018.

introduced sustainability obligations into public procurement in the EU. The options that are currently being assessed include broadening of the scope, more robust compliance requirements and procurement targets (European commission, Clean Transport, Urban transport).

The existing electricity infrastructure is generally estimated to have the capacity to accommodate widespread use of electricity in transport. Potential challenges are nevertheless foreseen at the distribution level at peak times. To address this, under Energy Union Strategy, the European Commission is working on the Electricity Market Design proposal. This proposal aims to facilitate the integration of electro-mobility by encouraging charging at times of cheap electricity when demand is low or supply high. The proposal could also reduce barriers to the self-generation, storage and consumption of renewable electricity. Consumers could thus be able to use electricity generated from their own solar panels for charging vehicles.

3.2.3 Policy drivers

Four policy drivers are identified by European Commission related to EU transport (EAFO, 2017)[71]. First, the energy supply is at risk. Currently, oil accounts for 94% of transport fuels, which causes an enormous EU import bill. The transition to electrical vehicles can be considered to be a reduction of oil imports. Second, it is urgently necessary to reduce GHG emissions. According to the White Paper on Transport 2011, the transport sector has to reduce 60% of its CO_2 emissions by 2050. A transition to zero emission passenger cars (EV as one type of zero emission vehicles) will reduce the Tank-to-Wheel CO_2 emissions by 680 million tonnes on a yearly basis (EAFO, 2017). Third, the problem of low air quality and congested infrastructure needs to be solved, so new and clean forms of mobility need to be established. Currently, the air quality in most European cities is below WHO (World Health Organization) recommendations, the transition to zero emission vehicles can reduce the emission of tailpipe pollutants such as NO_x and particulate matter (PM10 and PM2.5), reduce noise level (EAFO, 2017). Fourth, it is important to increase the competitiveness of EU industry, the growth and jobs which can be created by restoring world leadership of the EU transport industry. The global EV market is a growing market, as a net exporter of vehicles, Europe can take advantage of the marketing, and achieve economic growth and job increase.

3.2.3.1 Research and innovation

Electrification of transport is a priority for several EU level initiatives such as the Community Research Programme, the European Economic Recovery plan (2008) and within the Green Car Initiative. According to the European Commission, the policy related to battery-powered vehicles is mainly focused on technological optimisation and market development. Identified future challenges in this field therefore include charging infrastructure and plug-in solutions, improving battery reliability and durability, super-capacitors, reducing battery weight and volume, safety and cost reduction (European Commission, Clean transport, Urban transport).

Europe has traditionally enjoyed a strong position in transport-related manufacturing, and Europe is still leading in the number of patents for the improvement of internal combustion engines. Nevertheless, new technologies and innovation in the field of transportation seems to be predominant outside of the Union – a situation that is considered unacceptable. EU policy maintains that Europe should be a world leader in standard setting, and that it should maintain its position as a leader in transport-related industry. Consequently, low-emission mobility and innovation has to be an integral part of industrial policy at the member state level. Resources should focus henceforth on innovative zero- and low-emissions options and their deployment. It is important to set clear priorities and maximize synergies, e.g. between the transport and energy systems, for example by developing energy storage solutions, including next generation batteries. According to policy, Europe must develop a manufacturing base for the mass production of such solutions. Research activities should also focus on advanced bio- and synthetic fuels.

[71] EAFO (2017). The transition to a Zero Emission Vehicles fleet for cars in the EU by 2050. http://www.eafo.eu/sites/default/files/The%20transition%20to%20a%20ZEV%20fleet%20for%20cars%20in%20the%20EU%20by%202050%20EAFO%20study%20November%202017.pdf

EU investment instruments will be geared towards supporting higher efficiency of the transport system in a technology neutral way, low-emission alternative energy for transport and low- and zero-emissions vehicles. This strategy for low-emission mobility also aims at providing the necessary certainty to investors. The Investment Plan for Europe is identified as being crucial to support these policy objectives. The focus has been on mobilising the necessary private and public investment, increasing the risk absorption capacity and the certainty of delivery when providing support to projects that face difficulties in accessing long-term finance. This support can also include setting-up platforms and other related activities to help cities pool and leverage finance, as well as the provision of technical assistance through the European Investment Advisory Hub.

The electrification of transport is part of the larger Smart grid transition. As such, part of the EU policy is a focus on digital technologies as having great potential for optimizing the transport system and opening up new opportunities for manufacturing and services. Digital technologies also support the integration of transport with other systems. In order for this to be successful however, regulatory frameworks that incentivize the development and market uptake of such technologies would be necessary. As would standards ensuring interoperability across borders and ensuring data exchange and data protection.

3.2.3.2 Financial schemes/projects

The European Commission supports a 41.8 million euros, Europe-wide electromobility initiative, Green eMotion, in partnership with forty-two partners from industry, utilities, electric car manufacturers, municipalities, universities and technology and research institutions. The aim of the Green eMotion initiative is to exchange and develop expertise and experience in selected regions within Europe and to facilitate the market roll-out of electric vehicles in Europe. The Commission will make 24.2 million euros available to finance part of the initiative's activities. The transport-related envelope under the European Structural and Investment Funds totals EUR 70 billion, which includes EUR 39 billion for supporting the move towards low-emission mobility. This in turn includes EUR 12 billion for developing low-carbon, multi-modal sustainable urban mobility. The Connecting Europe Facility offers EUR 24 billion. A significant portion of Horizon 2020's transport research and innovation programme amounting to EUR 6.4 billion is focused on low-carbon mobility (European Commission, Clean transport, Urban Transport).

3.2.4 Social science perspective inclusion

3.2.4.1 Market stimuli: focusing on monetisation approach

The European Clean Vehicle Directive presents two options for accounting energy and environmental impacts: The first one is setting technical specifications for the performance of the vehicles with respect to energy and environmental impacts. The second option gives the opportunity to use these impacts as award criteria (EC, 2013b) [72][73]. A method of calculating lifetime operational costs for energy consumption, CO_2 emissions, and pollutant emissions of vehicles is defined by the directive, and this monetisation approach internalises external costs of transport, a long-term objective of EU policy (EC, 2013b) Based on this method, more energy efficient and cleaner vehicles have lower lifetime operational costs, which give them opportunity to enter into passenger car market.

The method of calculating lifetime operational cost provide a monetary encouragement for consumers to transit to electrical passenger cars, while, as far as we understand, the policy document does not mention how consumer perceives this method.

3.2.4.2 Consumer-centred thinking

The benefits of adopting low-emission passenger car for European citizens and consumers are mentioned in the European Commission Staff Working Document: A European Strategy for Low-Emission Mobility (2016). The implementation of low emission vehicles in the Member States will lead to improvements in air quality, the reduction

[72] European Commission (2013b), Report from the commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions.

in noise levels, lower congestion levels and improved safety. Consumers will benefit from more efficient, less-energy consuming cars. Consumers will also benefit from better infrastructure for alternative fuels, better links between modes of transport and better safety and fewer delays thanks to roll-out of digital technologies (EC, 2016)

Raising consumer awareness by car labelling

An important measure to help car manufacturers to meet their specific CO_2 emission targets is the Car Labelling Directive. It requires EU Member States to ensure that relevant information is provided to consumers, including a label showing a car's fuel efficiency and CO_2 emissions (EC, 2016).

The implementation of car label system aims to raise consumer awareness on fuel use and CO_2 emissions of new passenger cars which may influence consumers' choice in favour of cars that use less fuel and emit less CO_2. Better information will allow them to make informed choices for their daily mobility needs. For example, car labelling will be reviewed, and the respective benefits of alternative fuels will be made clearer.

The evaluation of the Car Labelling Directive shows that the Directive was successful in increasing consumer awareness of the fuel economy and CO_2 emissions of new passenger cars. However, the report identified a number of issues limiting the effectiveness of the Directive. There was a lack of consistency across the member states, as not all employed the EU energy label logo and classifications varied from one member state to the next. Information regarding fuel efficiency and CO_2 emissions was found to be insufficiently clear, and there was no information on air pollutant emissions, the latter being of increasing interest in urban areas. Moreover, the scope of the directive was limited to new cars, whereas the majority of vehicles in circulation are not new, and there were no specific requirements set out for alternative fuel vehicles to guide potential buyers or function as a point of comparison with traditional combustion engine cars.

Raising consumer acceptance

In January 2013, the European Commission adopted a European Alternative Fuels Strategy to address the decarbonisation of the transport sector and air quality objectives, and also energy supply security and EU industry competitiveness. One of the four priority fields is to addressing consumer acceptance. In order to achieve this target, the European Commission implement several measure, such as setting up together with the CEN/CENELEC a fuel compatibility labelling system to reassure confidence of users when using alternative fuels, developing a methodology of price comparison of alternative fuels and create a platform to promote the use of this methodology in Member States, setting up an Alternative Fuels Observatory (EAFO) as a reference website for user information (EC, 2016).

3.2.5 Structural measures

Policy documents regarding electrification of transport on the European level tend to depart from an assumption that electric vehicles of sufficiently good quality are already available to the public. User acceptance is emphasised as a key feature of successful transport electrification. Nevertheless, this user acceptance is approached in an instrumental manner. Thus the most important barriers to electrification of the transportation systems in Europe are identified as pertaining to 1. price, 2. status quo bias, and 3. range anxiety/concerns with charging and battery longevity (Green eMotion)[74].

Education

The documents assume that the status quo bias relies at least in part on an information deficiency. Public and consumer education is identified as a possible solution to the status quo bias and other hesitance regarding EVs (Green eMotion). A first step to consumer acceptance is the awareness of the advantages of electromobility by the

[74] Green eMotion Project Results, European Commission (2015). http://www.greenemotion-project.eu/upload/pdf/deliverables/Project-Results-online.pdf

public and by the local policymakers. Customer awareness is a particular problem for electric and fuel cell vehicles. Potential users are assumed to be largely unaware of the low maintenance costs associated with EVs as well as many of the purchase incentives already put in place. Identified policy measures therefore include increased information in general, and providing more consumer information about vehicle emissions through car labelling, as well as improving testing of new EVs in order to gain public trust. Information is thought to drive consumer choice (European Commission, Urban Transport).

Financial reasoning

Price is another barrier associated with the transition to electric modes of transportation. EU policy clearly identifies tax instruments as being "very effective to incentivise consumer behaviour" (European Commission, Urban transportation). The European commission criticises EU member States for applying contradictory tax incentives that discourage low-emission mobility, including fossil fuel subsidies and tax schemes for company cars. These schemes therefore, must be reviewed in order to ensure positive financial incentives for low-emission vehicles and energy for transport both for private citizens and companies. This however, is handled on a country specific level (EU commission). Direct price incentives for EV purchases are also mentioned, as well as indirect financial incentives such as parking advantages (Green eMotion).

Convenience and feasibility

Perhaps the most clearly identifiable challenge to a large scale transition to electric transportation concerns the infrastructure. This pertains to psychological elements of social acceptance on the one hand, as it concerns the perceived "normality" of zero emission vehicles and thus affect the sense of feasibility of having such a vehicle. In the policy documents however, this is most of all identified as an infrastructural, systems and physical challenge. In other words, policy calls for a much wider network of EV charging, both publicly and in private homes (green eMotion).

EV ready buildings are a good way to ensure that new buildings are prepared for a later installation of chargers at low costs. Installation of home chargers should be supported, but also public charging infrastructure is needed whereas the locations have to be thoroughly evaluated according to target groups needs and economical requirements. Importantly moreover, on the Europe-wide level, is that users must also be able to find and use those chargers across borders. There is no standard distribution grid in Europe, and this is emphasised as negatively impacting the roll-out of EVs. Grid planning rules will need to adapt, as the consequences of EVs in the specific regions are likely to vary in the absence of a standard grid in Europe. There is a need for an ICT system that allows roaming, meaning that EV drivers can use public charging infrastructure independent from the owner or operator. Standardized interfaces e.g. for connecting chargers, are crucial (Green eMotion).

3.3 Breakdown to the Member States

3.3.1 Germany

Electric mobility has been a research and policy issue already relatively early with pilot projects in the 1990s, such as the large EV pilot on the German Island Rügen between 1992 and 1996, where 60 electric vehicle prototypes were tested in a real world setting. However, the electric mobility strategy gained momentum because of three developments after the millennium: (1) general climate change mitigation policy in the national Integrated Energy and Climate Program[75] and mobility policies require a substantial reduction of CO_2 emissions in general and other transport related emissions such as particle matter in the German cities, (2) the Mobility and Fuel Strategy[76] and the High Tech Strategy[77] of the German Government formulated the need to reduce dependency on fossil fuels and increase and stabilize Germany's role as a leader in high tech developments, and (3) the worldwide financial

[75] http://www.bmub.bund.de/fileadmin/bmu-import/files/english/pdf/application/pdf/hintergrund_meseberg_en.pdf

[76] http://www.h2euro.org/wp-content/uploads/2013/09/German-Mobility-and-Fuels-Strategy.pdf

[77] https://www.bmbf.de/pub/HTS_Broschuere_eng.pdf

crisis stimulated the German Government to implement substantial funding for research and innovation activities connected to e-mobility[78], especially in the Second Economic Stimulus Package implemented by the German Government.[79] Based on this history, electric mobility in Germany is located in the domain of four ministries: (1) the Federal Ministry of Economics and Technology (BMWi), (2) The Federal Ministry of Transport, Building and Urban Affairs (BMVBS), (3) the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), and (4) the Federal Ministry of Education and Research (BMBF). Two important platforms have been established to monitor and guide the implementation of electric mobility in Germany: the National Platform for Electric Mobility (NPE)[80], which is a platform where government, industry, research, and worker unions meet, and a more internal coordinating body for the activities of the German ministries (Gemeinsame Geschäftsstelle Elektromobilität, GGEMO).

Three strategy documents, which have been central in the development of electric mobility in Germany will be analysed in more detail here with respect to how consumers are represented: The National Development Plan for Electromobility (NDP), which was published in 2009[81], the German Governmental Program for Electromobility (Regierungsprogram Elektromobilität) published in 2011, and the law for electric mobility, which has been implemented in 2015.[82] In addition, an important instrument for stimulating consumers has been implemented in 2016, namely a premium of 4000 Euro per BEV and 3000 Euro per PHEV, financed 50% by the German Government and 50% by the industry.

Like all electro-mobility strategy documents in Germany, also the NDP does not put a strong focus on the consumers. Most focus is put on technological developments in the areas battery and efficiency (with the main aim to develop and secure Germany's status as a leading technology nation in this domain), plans for securing physical resources, standardization of technology across countries to secure exportability, electric grid development for integrating electric cars (also as a stabilizing moment in grids with high degrees of regenerative energy), safety issues (especially fire safety), business models, and education of future electric mobility experts. Despite this relative lack of the consumer perspective, there are nonetheless a number of references to consumers in the document:

- The underlying assumption is that higher investment costs of electric vehicles pose a major barrier, which has to be addressed. Interestingly, the document assumes that this barrier might not only be addressed by reducing the costs but also by giving users of electric mobility other non-monetary benefits, such as free or prioritized access to parking spaces, access to bus lanes, etc.
- A very interesting reference to consumers and car use is made on page 9 of the document where it is assumed that driving a car involves an emotional association between the driver and the car. This is not further elaborated, though.
- The document outlines the consumer furthermore as a potential risk for the diffusion of electric mobility, because consumers might be either negative to electric cars (because of costs, safety and range) or because they might have unrealistic expectations (what they might be is not elaborated).
- The document states further, that consumers need to be included in the process and that trust is important for acceptance of the technology. Trust shall be established by transparency, dialogue with consumers and incentives for uptake of EV. User contacts will mostly be realized through large-scale demonstration projects and user behaviour is one of the key performance indicators in these pilots

[78] Interestingly, the German policy papers mention electric bicycles explicitly as part of the strategy from the start.

[79] http://www.vergabebrief.de/wp-content/uploads/2009/05/Runderlass_RP_I.pdf

[80] http://nationale-plattform-elektromobilitaet.de/en/

[81] http://www.bmub.bund.de/fileadmin/bmu-import/files/pdfs/allgemein/application/pdf/nep_09_bmu_en_bf.pdf

[82] http://www.gesetze-im-internet.de/emog/EmoG.pdf

(especially charging behaviour). Charging behaviour is expected to be influenced by flexible tariffs that reward charging in off-peak hours.

- In an economic perspective, the document states that consumers require access to charging infrastructure with user friendly billing systems.
- Furthermore, the document assumes that there is a danger of consumers developing an impression that EVs are not environmentally friendly and that this has to be actively argued against.
- Finally, the document differentiates between individual consumers and larger social units such as municipalities or companies, where procurement rules are targeted to make them pilot users for electric mobility.

The Governmental Program for electric mobility builds in many ways on the NDP with respect to the focus. Also here the consumer is relatively absent and industry, standards, technological development and education are the main pillars. However, there are some new consumer related insights in this document not mentioned in the earlier NDP document. Mainly, the need for visibility and experiencing of electric mobility for the consumer is highlighted. The document assumes that electric mobility will not diffuse without it being visible in everyday traffic and that measures are necessary to make that happen. This is mainly thought to be achieved by making public actors (e.g. municipal fleets) to adopters of the technology. Lighthouse projects and "shopping windows" (Schaufenster) projects should also contribute to first hand experiences with EVs. The idea that non-monetary incentives could be more important than monetary is further developed, indicating that especially early adopters often are not sensitive to monetary incentives.

The law about electric mobility (Emob Gesetz) is the formal implementation instrument for these non-monetary incentives, as it creates special number plates for EVs and defines the options that municipalities have for granting EVs access to parking, bus lanes, pedestrian and environmental zones, etc. As it is a juridical text, it describes little about the underlying assumptions, but indicates that there is an interest to stimulate EV use for trips into the city centres, which is a new aspect.

In general, the German EV strategy is not referring primarily to the consumer, but where it does it demonstrates an understanding of the consumer drivers as follows:

- Economic factors are relevant, higher costs drive consumers away
- Technical costs (range, safety) are important
- Visibility and first-hand experience are relevant
- Information and trust are important and need to be actively worked for
- Early adopters might be less sensitive to monetary incentives, non-monetary incentives are necessary
- (potentially false) Consumer beliefs might be a risk for diffusion of EVs
- Emotional aspects if car ownership and driving need to be taken into account
- Private households and companies differ in decision making and need to be stimulated in different ways.

With these assumptions, the concept of consumer decisions is rather detailed as compared to other countries' documents. Some of the aspects are in line with what ECHOES also would assume: The impact of visibility can be attributed to social norms for example, the differences between consumers and public procurement resonate well with the macro perspective in ECHOES. However, we see a potential in integrating the particular role of identity (which role does it play that electric mobility diffusion is framed as contributing to strengthening German interests?), culture (here particularly the cultural role of Germany as a car producing nation), and a deeper understanding of the emotional factor.

3.3.2 UK

The Electrification of mobility has been recognized by the UK government as a strategy to reduce the dependency on fossil fuel import and mitigate climate change (Office for Low Emission Vehicles, 2013). With around 2.69 million registrations in 2016, the UK is Europe's second-largest new car market and accounted for one fifth of new cars registered in the EU, of which alternatively fuelled vehicles (AFVs) experienced a strong uplift in demand, up 22.2% across 2016. Plug-in hybrids and petrol electric hybrids, in particular, experienced significant growth, with demand up 41.9% and 25.1% respectively. Meanwhile, more than 10,000 motorists chose to go fully electric in 2016 – up 3.3% on 2015 (UK Automotive Sustainability Report, 2017).

The UK government has a wider program of support for electric vehicles – delivered by the Office for Low Emission Vehicles – including grants for cars, vans, taxis and motorcycles, infrastructure schemes, and consumer outreach (Department for Transport, 2017). The UK government's guidance for electric mobility is documented in its strategic plans: (1) *Low Carbon Transport: A Greener Future, A Carbon Reduction Strategy for Transport* (*Department* for Transport, 2009); (2) *Driving the Future Today: A strategy for ultra-low emission vehicles in the UK (*Office for Low Emission Vehicles, 2011); and (3) *Making the Connection: The Plug-In Vehicle Infrastructure Strategy* (Office for Low Emission Vehicles, 2013). These documents, along with the government's package of policy measures in *Investing in ultra-low emission vehicles in the UK* (Office for Low Emission Vehicles, 2015) and *Proposed ULEV measures for inclusion in the Modern Transport Bill* (Office for Low Emission Vehicles, 2017), have been the central guidance for the development of electric mobility in UK, which will be analysed here regarding to how consumers are stimulated.

Direct marketing mechanism

Underlying assumption: the prices of consuming product and services should reflect the full costs that they impose on society, and carbon costs should be reflected in the products and services (Department for Transport, 2009).

Price signalling*:* Based on this assumption, the UK government has been sending price signals through fiscal measures. Starting from 1997, the government set out 1997 *Statement of Intent on Environmental Taxation*, and in 2001, the government reformed vehicle excise duty (VED) to ensure that the level of tax paid reflects the emissions of the vehicle. The UK government introduced Plug-in Car grants and Plug-in Van grants which covers 20%-35% of the eligible cars or vans' list price up to a value of 5,000 or 8000 pounds at the point of purchase (Department for Transport, 2009).

Infrastructure support**:** The UK government has been making efforts focusing on incentivizing the uptake of EVs, such as investments in charging infrastructure, and supporting national EV technology innovation. The government's strategic plan for electric mobility projects is that EVs will account for 5% of car registrations by 2020 (Office for Low Emission Vehicles, 2013).

Indirect social incentives

The UK government also introduced series of programs to rise consumer's perception of electric vehicles. These initiatives are different from previous mentioned marketing mechanisms, because these are not monetary-driven.

Demonstration by public sector*:* The UK government introduced *Innovation Platform programme* in June 2009 (Department for Transport, 2009). Over the following eighteen months, more than 340 electric-drive vehicles were trialled in several UK regions. Members of the public would be users in the trial, and research was carried out to look at the way the vehicles are used and charged on a daily basis, as well as investigating the perceptions of these vehicles by users and the public (Department for Transport, 2009).

Flagship cities: the UK government introduced the *Go Ultra Low City Scheme*, a platform that offers 40 million pounds of funding four cities. The funding invests in various EV incentives such as bus lane access, electric car sharing support, charging infrastructure investments, parking policies, and public EV fleets (Office for Low Emission Vehicles, 2014). This scheme aims to improve overall driving experience by offering free parking or access to bus lanes to stimulate the customers. In addition, the UK government hopes to attract international attention and so positively influence inward investment decisions (Office for Low Emission Vehicles, 2014).

Consumer perspectives in policy document

Consumers' need: People's purchasing is regulated by their needs, this is considered as fundamental assumption in the policy documents, they will consider the type and lengths of journey they want to make and the other demands they have of their vehicle, not least price. Very few people are willing to accept reduced convenience relative to a traditionally fuelled vehicle (Office for Low Emission Vehicles, 2013). Moreover, consumers could feel the great pressures on city infrastructure by increasing in urbanisation. 'Consumers are likely to think hard about what sort of vehicle they need to get around, its cost and local impact' (Office for Low Emission Vehicles, 2013).

***Consumer acceptance*:** Some of the benefits from the move to ULEVs (improved air quality, and new jobs and growth) are societal rather than individual benefits and there can be a challenge in helping consumers understand how suitable new technology can be for them (Office for Low Emission Vehicles, 2013). In the policy programmes, the Innovation Platform program and Go Ultra Low City Scheme gives consumers great examples of using electric vehicles and aim to improve consumers' acceptance of electric vehicles.

Decision making process: Car purchasing is usually associated with rational choices and long-term investment, and in the policy document (Office for Low Emission Vehicles, 2013), this perspective is addressed. As ULEVs are a new kind of technology, consumers tend to do much more thorough research and information gathering comparing to traditional fuelled cars. In the document, two information sources are identified as the most important: online forums and test drives (Office for Low Emission Vehicles, 2013). These two sources could influence consumers' decision making largely.

***Purchasing barriers*:** The policy document also identified some potential purchasing barriers of electric car.

(a) The first one is concerned with information sources, such as insufficient or inaccurate information, negative or inaccurate media information, and concerns over the 'unknown' (including imagined sub-optimal performance, potential battery degradation or low residual value) (Office for Low Emission Vehicles, 2013).

(b) The second barrier is about higher upfront purchase prices relative to traditionally fuelled vehicles. Even though some consumers tend to compare lifetime running costs with upfront purchase price, but this is only small fraction of consumers. Therefore, a key area of benefit for ULEVs – lower running costs – may not be given sufficient weight by the average consumer (Office for Low Emission Vehicles, 2013).

(c) The third barrier is about the 'range anxiety'. The general concerns about the distance a pure electric vehicle can travel on one charge can be a huge barrier. This is linked to a limited ability to drive long distances, which further linked to safety and punctuality. In this circumstance, high levels of knowledge about and trust in the charge point network (which can facilitate longer distances and lower anxiety levels) are therefore critical for drivers of battery electric vehicles (Office for Low Emission Vehicles, 2013).

***Consumer communications**:* the UK government realized that consumers require clear and consistent messages from government that must be joined-up with industry activity, so that consumers are able to develop a clear understanding of the issues (Office for Low Emission Vehicles, 2013). For example, in the Northern Ireland PIP scheme, the government used multiple communication channels to engage with consumers and industry, including

the development of a successful multi-day event, a strong website and smart phone app, and the use of social media (Office for Low Emission Vehicles, 2013).

(a) From the perspective of mainstream media communication, the UK government finds that there is a degree of scepticism towards the ULEV agenda in elements of the mainstream media. 'This situation can be an inevitable part of the introduction of a new technology but there is a role for the Government, and for the industry, to engage with opinion formers and provide accurate information for the car-buying public. Some media reporting has been based on outdated misconceptions about the technology, its implications and its potential' (Office for Low Emission Vehicles, 2013).

(b) In the policy document by OLEV (2013), the consumer awareness of electric mobility is addressed. The UK government realized that awareness amongst the public of Government support for ULEVs, including through the Plug-in Grants and funding for infrastructure, is low. 'The wider and so more effective dissemination of information could be expected to further support ULEV up-take in the UK. Indeed, the social research being published alongside this document demonstrates the very positive impact of the consumer incentive in consumer purchase decisions where those consumers were aware of it' (Office for Low Emission Vehicles, 2013).

(c) From the perspective of communication from car dealer to consumer, there is 'a key issue for the car industry is ensuring that dealerships are equipped to provide advice to prospective purchasers. ULEVs represent a new technology not only to consumers but also to dealership staff and it can take more time to take a customer through the sales process. Knowledgeable sales and aftercare staff are important to the long-term success of the market' (Office for Low Emission Vehicles, 2013).

Consumer education: The Office for Low Emission Vehicles (OLEV)'s website provides useful information for consumers, including guidance and calculators for EV and charging infrastructure incentives.

3.3.3 Spain

The transportation sector in Spain represents 40% of the country's energy use (80% of which is goods transportation), 36,200 tonnes of petroleum, and is therefore a bigger contributor to emissions than the residential and the industrial sectors. The transportation sector moreover, bases itself almost exclusively on fossil fuels. The Spanish context offers little policy on electric mobility[83]. In Spanish policy, the focus of sustainable transportation lies primarily with other areas than electric mobility. Rather, the main emphasis is on establishing speed limits, low emission zones within cities, regulating parking and car access in cities, and promoting car sharing. Electric cars are not very popular in Spain, with a total of 2300 vehicles being sold in 2015. In order to bridge the gap between the current situation and the desired 7-10% electrified mobility in 2030, the hybrid car is emphasised as a good alternative, as it requires much less infrastructural changes. Currently, in Spain, EV renewal is at 0.3%.

Part of the strategy for promoting alternative energy vehicles in Spain, relates to a promotion of Spanish industry. It is stated that Spain has the knowledge and experience needed in car manufacturing as well as with alternative energy technologies in order to respond to the "technological and industrial challenge of alternative energy vehicles on the European level" (2015).

We have looked at several official documents dealing specifically with this issue, "Spanish strategy for sustainable mobility and local governments", "Estrategia española de movilidad sostenible", "Estrategia de Impulso del vehículo

[83] Estragegia Española de vovilidad sostenible. Ministerio de fomento. http://www.fomento.es/nr/rdonlyres/149186f7-0edb-4991-93dd cfb76dd85cd1/46435/estrategiamovilidadsostenible.pdf

con energías alternativas (VEA) en España (2014-2020) (2015)[84][85], "A sustainable energy model for Spain in 2050. Political recommendations for the energy transition" (2016)[86]. The latter is a recommendation document carried out by the consulting firm DELOITTE.

Infrastructure support

The idea with heavy goods transport is to shift 40-60% of this from trucks to electrical train. There is a desire to promote greater electrification of transportation however, but the documents identify a variety of factors that work as barriers to this being realized. There is a lack of charging infrastructure in urban areas.

There has been little incentive to change infrastructure in cities to accommodate charging stations. Thus in actuality, having an electrical car is only a possibility for people who own their own freestanding property with garage where they can charge it.

Moreover, apartment buildings with assigned garage space for residents may have an ill-equipped electrical installation, thus creating high costs for the individual who wants to install charging facilities. Issues with tariffs and distribution are also mentioned in the case of apartment blocks.

Price signalling

There is, however, a system of incentives: 5,500 euros direct aid in purchase, plus 750 euros to dispose of the old car. 1,500 euros tax exemption of the matriculation tax compared to a similar combustion engine car, and 400-500 euros circulation tax exemption over 10 years. According to the MOVEA plan initiated by the "Ministerio de economía, industria y competitvidad" (ministry of economy, industry and competitivity), a plan of 500 euros subsidies for private cars and 18,000 euros for buses and trucks is put in place.

Consumer education

Electrical cars are more expensive than fossil fuel vehicles, and range anxiety is pointed to as a problem that can be remedied with more research into batteries and engines. Recommendations are for hybrid cars to be promoted as a bridging technology between conventional cars and electrical vehicles, as they require less infrastructural change and feel more familiar.

Regional specificity

In Spain, the province of Catalonia has been particularly involved in the promotion of electric mobility[87]. In Catalonia, the rate of EV renewal is 0.4%, slightly higher than the national average. The Catalan Institute of Energy (ICAEN) has published regulatory bases for granting aid to facilitate the installation of electric vehicle infrastructures. The aim is to expand the charging network for interurban routes thus making Catalonia an attractive region for EVs. This initiative is part of PIRVEC, the action plan for the deployment of charging infrastructures for EVs in the region, endowed with 864,750 euros in subsidies and 90,000 euros for pilot developments of fast charging stations.

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[84] La estrategia Española de movilidad sostenible y los gobiernos locales (2010). http://www.redciudadesclima.es/files/documentacion/2a7fb70e4f9cfdd19fbd05d0240327b0.pdf

[85] Estrategia de Impulso del vehículo con energías alternativas (VEA) en España (2014-2020). (2015) Ministerio de economia industria y competitvidad.

http://www.minetad.gob.es/industria/es-ES/Servicios/estrategia-impulso-vehiculo-energias-alternativas/Documents/Estrategia-Impulso-Vehiculo-Energ%C3%ADas%20Alternativas-VEA-Espa%C3%B1a-2014-2020.pdf

[86] Un modelo energético sostenible para España en 2050 Recomendaciones de política energética para la transición (2016). https://www.sne.es/images/stories/recursos/actualidad/espana/2016/DELOITTE_Un_modelo_energetico_sostenible_para%20Espana_en_2050.pdf

[87] Catalonia's new and ambitious map of electric vehicle charging stations (2017) . https://www.energynews.es/english/catalonias-new-and-ambitious-map-of-electric-vehicle-charging-stations/

The plan is formulated as a triangle, where the bottom represents domestic charging infrastructure where priority will be given to facilities located in multi-family dwellings or community car parks. These will offer slow charging power at around 3kW, which means that the contracted power need not be increased. The middle of the triangle offers charging at intermediary power, for densely populated or frequented areas where cars will typically be stationed for a few hours only. And the top is the most electricity demanding fast charging stations. The latter, fast charging stations will make up a strategic network for long intercity routes and specific uses. Both the fast and the intermediary charging stations (at 50kW and 20kW respectively) will be public and accessible to any EV user and be activated by smartphone (Energynews.es; Institut Català d'energia, 2016[88]).

In 2016, the Catalonian municipality (generalitat) implemented 11 fast-charging places on strategic points in the Catalan road network or in densely populated areas. The aim is to reach 100 such fast charging spots, 400 semi-fast charging, and 25000 linked points (slow charging) by 2019 (Energynews.es).

Consumer perspectives in policy documents

There is no reference to consumers, with the exception of the barriers concerning home charging. The documents display a typical *barriers-motivators* way of thinking: Facilitating electric vehicles by financial means, information about financial benefits and possibly then by infrastructural change. There is, however, some focus on social acceptability being boosted by the environmental advantages of the vehicles, and a desire to diffuse alternative energy vehicles among younger drivers by introducing them at driving school level, where practical information concerning driving an electrical car and more generally of energy efficient driving can be progressively amplified. More specifically however, the objective of the Electrical mobility strategy is to incentivise purchases of electric vehicles by making them "financially competitive to fossil fuel cars", and provide visibility and an image of the "technical-economic advantages of alternative energy cars" (Strategy 2015).

From 2019 on, however, the new OPEL CORSA will be entirely manufactured in Zaragoza and the model is 100% electric – this is bound to shift public opinion in Spain.

3.3.4 Norway

Passenger transport is an important source of CO_2 emissions in Norway. The country has a poorly developed railway system, and in combination with the country's relatively low and decentralised demographics, this means that Norwegian passenger transport is heavily dependent on cars.

Electric mobility is an important research and policy issue in Norway[89]. Ambitious goals have been set for the decarbonisation of mobility, and the country is widely considered a frontrunner in electric mobility, having the highest distribution of electric vehicles for personal use per capita in the world (Tietke, et al. 2016)[90]. The government has set out the following goals relevant to electric mobility (Spilde and Skotland, undated)[91]; New ferries are to be low- or zero emission, new cars and light cargo vehicles shall all be zero-emission vehicles by 2025. New city buses shall be, either zero emission vehicles or run on biogas by 2025, and by 2030, new heavy transport vehicles, 75% of long distance buses and 50 % of all new trucks on the market shall be zero emission vehicles. Nevertheless, it is estimated that a complete electrification of the transport sector is estimated to be possible by 2040 at the earliest,

[88] Institut Català d'Energia (2016).
http://icaen.gencat.cat/web/.content/50_Actualitat/51_noticies/2016/arxius/20161230_DOGC_ajutsPdRVE_cas.pdf

[89] Klima- og energistrategi - Oslo commune. Byrådsavdeling for Miljø- og samferdsel (2016).
https://www.oslo.kommune.no/politikk-og-administrasjon/miljo-og-klima/miljo-og-klimapolitikk/klima-og-energistrategi/

[90] Tietge, U., Mock, P., Lutsey, N., and Campestrini, A. (2016) Comparison of leading electric vehicle policy and development in Europe. White Paper.

[91] Spilde, D. and Skotland, C. (n.d.). Hvordan vil en omfattende elektrifisering av transportsektoren påvirke kraftsystemet? NVE.
https://www.nve.no/Media/4117/nve-notat-om-transport-og-kraftsystemet.pdf

yet more likely in 2050. This would include also service vehicles and goods transportation (NVE YEAR). Electric buses will be phased in to many cities toward 2020.

In the following, we have examined 5 policy documents regarding electric mobility. The documents deal with both the national context; National Transport Plan (2017)[92], ENOVA mandate paper, and regional settings; Oslo, Bergen and Trondheim. This is relevant in Norway, as the different regions are free to set goals and enforce regulations regarding electric mobility.

Infrastructure support

The environmental agency ENOVA provides substantial financial support to enhance charging infrastructure for electrical cars along the main roads in Norway. Their monetary support has so far contributed to the building of 230 fast chargers and has enabled a network of fast charging station in the biggest cities.

Price signalling

Norwegian national directives state that electric vehicles are exempt from a one-time purchase tax and VAT (to be maintained atleast until 2020), plus benefit from a 50% off on taxes for company cars. Concrete incentives and regulations are left to the municipalities, but zero emission vehicles shall pay maximum 50% of the fees that conventional vehicles do for parking, ferry transport, and toll roads (Nasjonal transportplan, 2017).

Electrification of goods transportation and long haul trucking is in its pilot stages. There are still less incentives on electrical commercial trucks and campers, due to the taxation system on these. In the national budget of 2017, the cash-back for wrecking of commercial trucks was increased with 13,000 NOK on the condition that the truck being wrecked is fossil fuel and the one replacing it is zero emission.

Consumer education

Information schemes are in place, as a collaboration between the directory of roads and ENOVA as well as the motor industry, which provides environmental information with the sale of new cars, such as information concerning fuel costs and the “drawbacks” of purchasing cars with higher emissions. The road directory also carries out controls to make sure that dealerships uphold the demands put on environmental and energy labelling when selling new cars.

Regional specificities

Oslo has the highest EV density of any global capital, and the city promotes itself as the electric vehicle capital of the world. The municipality aims to phase out fossil fuel cars by 2030 and replace these by zero emission vehicles. Most of the phasing out however, is planned around increasing the collective transport system’s capacity, and arranging for and encouraging bicycling and walking. The municipality has as a main goal to install so-called ‘energy stations’ around the city to enable infrastructure running on biogas, hydrogen and electricity (Oslo miljø).

In Bergen too, the plans are to reduce car transportation by 10% by 2020, and 20% by 2030[93]. In order to encourage zero emission mobility, zero emission vehicles should always have preferential arrangements than traditional fossil fuel vehicles. Concrete tools and incentives include varying toll charges on vehicles according to their environmental measures, increased toll charges during rush hours, differential toll charges for designated low emission zones as

[92] Nasjonal transportplan NTP. Samferdelsdepartementet. (2017). https://www.regjeringen.no/no/tema/transport-og-kommunikasjon/nasjonal-transportplan/id2475111/

[93] Grønn strategi – Klima- og energihandlingsplan for Bergen. Byråd for Klima, kultur og næring (2016). https://www.bergen.kommune.no/bk/multimedia/archive/00271/Rapport_Gr_nn_Strat_271539a.pd

well as fossil fuel free zones in central areas where collective transportation and the transportation of goods cannot be avoided.

In Trondheim, the country's fourth largest city, electric vehicle driving is incentivised by free passing through toll stations and exemptions for rush traffic, access to the carpool lane, reduced yearly taxes, free charging in most public charging stations, and free transportation on ferries[94].

Consumer perspectives in policy document

It appears clearly that electrifying passenger transportation as well as, to a lesser extent, goods transportation, is an important goal. Consumers specifically however, are not mentioned. The incentives used are either financial or deal with convenience (free parking, carpool lane access etc. as an issue of convenience in addition to money). We can infer that customers are assumed to be motivated by financial gain/benefits, as well as by "preferential" treatment compared to drivers of fossil fuel cars. Environmental and energy labelling is explicitly stated to contribute to people purchasing cars being more able to take environmental effects into consideration when purchasing cars. Consequently, we see a logic according to which people will act more in accordance with environmental policy given the information to do so.

3.3.5 China

Since China is one of the fastest growing markets for electric mobility solutions, we also analysed Chinese policy documents on this issue. According to the China Association of Automobile Manufacturers, in October 2017, the production and sales of new energy vehicles totalled 92,000 and 91,000, representing an increase of 85.9% and 106.7% respectively over the same period of last year. From January to October, sales of new energy vehicles reached 517,000 and 490,000, up 45.7% and 45.4% respectively over the same period of last year. Among them, the production and sales of pure electric vehicles were 427,000 and 402,000, up 54.7% and 55.9% over the same period of last year; the production and sales of plug-in hybrid electric vehicles were 90,000 and 88,000, up 14% and 11.2% respectively[95]. In terms of the manufacture, approximately 375,000 electric vehicles (EVs) were manufactured by Chinese OEMs in 2016, which accounts for 43 percent of EV production worldwide.

The Chinese government has spent billions of dollars on subsidies to promote electric cars, while in 2017, the country has reduced its subsidies for the vehicles by 20%, and hopes to eliminate the subsidies entirely within a decade. Big incentives have led to major growth, but also some accusations of cheating on green government programs. The Chinese government's guidance for electric mobility is documented in its strategic plans: (1) Guiding Opinions of the General Office of the State Council on Accelerating the Popularization and Application of New Energy Vehicles (Office of the State Council, 2014)[96]; (2) Circular on Financial Support Policies for NEVs' Popularisation and Application in 2016-2020 (MIIT, 2015)[97]; and (3) Announcement on exemption of new energy vehicle purchase tax (Ministry of Finance , State Administration of Taxation, MITT, 2014). These documents will be analysed here regarding to how consumers are stimulated.

Direct marketing mechanism

Underlying assumption: To establish a long-term stable development of electric mobility policy, both market-driven and government support is needed.

[94] Klimaplan for Trondheim. Miljøenheten i Trondheim kommune. (2017). https://www.trondheim.kommune.no/klimahandlingsplan/

[95] 'Production and sales of new energy vehicles increased rapidly year-on-year' Ministry of Industry and Information Technology (MIIT), 16 November 2017, http://www.miit.gov.cn/n1146312/n1146904/n1648362/n1648363/c5912390/content.html

[96] http://www.gov.cn/zhengce/content/2014-07/21/content_8936.htm

[97] http://www.miit.gov.cn/n1146285/n1146352/n3054355/n3057585/n3057590/c3617158/content.html

***Price signalling**:* More than 40 cities issued local policies to subsidize individual consumers, mostly by matching the central government subsidy amount. Subsidies to electric vehicles (EVs) were nearly RMB 110,000, and plug-in hybrid electric vehicles (PHEV) about RMB 65,000/unit.

Tax incentives. From September 1, 2014 to December 31, 2017, pure vehicle electric vehicles, plug-in hybrid electric vehicles and fuel cell vehicles are exempt from vehicle purchase tax. The government continue to implement the car consumption tax policy to encourage the consumption of new energy vehicles.

***Infrastructure support*:** Local government are encouraged to improve urban planning and building high-speed charging network, including the construction of charging facilities and supporting power grid construction. The resident parking spaces should establish charging facilities as the mainstay of the city public parking spaces, temporary parking spaces, and highway service area.

Government guidance: Local governments should take the main responsibility for the popularization and application of new energy vehicles. They should formulate specific implementation plans and work plans in line with the reality of local economic and social development, clarify the work requirements and the progress of time, and ensure the accomplishment of various objectives and tasks.

Market competition: The local governments are urged to make corresponding plans for the promotion and application of new energy vehicles to promote the formation of a unified, competitive and orderly market environment. Local governments need to establish and standardize market access and encourage social capital to participate in the production of new energy vehicles and charging and operation services.

Indirect incentives

***Demonstration by public sector**:* The use of public service vehicles as a breakthrough point to promote the use of new energy vehicles, public institutions to expand the procurement of new energy vehicles by demonstrating the use of social confidence, reduce the cost of purchasing and using, leading personal consumption, a virtuous circle.

Flagship cities: In 2009 the Chinese government (Ministry of Science and Technology, Ministry of Finance, Ministry of Industry and Information Technology and NDRC) introduced the "Ten cities, one thousand vehicles Program", which shall help to encourage the public and private use of electric cars through demonstration projects in these cities. In this plan, 1,000 vehicles will be introduced every year for three years in these ten cities.

Encourage investment and financing innovation: The government support the exploration of bus, taxi, official car financing of new energy vehicles leasing operation mode in the field of public services. In the field of personal use, leasing, vehicle sharing, vehicle rental and mortgage purchase of new energy vehicles are supported.

R&D support: The Chinese government strongly support the R&D of new energy vehicles in a significant and visible way during the 10th government five-year plan (2001-2005), especially in its applied research program called "863". The R&D program supported three key technologies (three verticals): fuel cell, pure electric and hybrid technologies as well as the three key technology areas (three horizontals) of power engine, drive and battery (Tagscherer, 2012).

Consumer perspectives in policy document

Product development: The manufactures are encouraged to combine production with research to produce innovative products. The manufactures should strive to break through the key core technologies, strengthen business model innovation and brand building, continuously improve product quality, reduce production costs, ensure product safety and performance, and provide consumers with quality services.

After-sale service improvement: The Chinese government encourage and support capital to enter the service areas of construction and operation of new energy vehicle charging facilities, vehicle rental, and battery rental and recycling. New energy vehicle manufacturers to improve the level of after-sales service and speed up brand cultivation.

Limitation

In general, the direct consumer incentives are not mentioned in all three documents. The underlying assumption is that if the government support is strong enough and the manufacturers provide good enough products, the consumer will purchase the electric vehicles actively. However, any products or service, especially ones involving new technology like electric vehicles, need ***marketing communication*** and certain level of ***consumer education*** to increase consumers' acceptance for the new products. There is also very limited concern of ***consumers' need*** in these policy documents. Because of the large subsidy amount provided by the Chinese government, and a free licence plate (very attractive to consumers in Beijing, where the winning probability in Beijing's license plate lottery is very low), individual consumers were quickly motivated to buy these the electric vehicles. However, the charging facilities were far from ready.

The policy documents about Chinese electric vehicle shows strong support for domestic car manufacturers, and this is one of the most important reason that most electric cars are sold in China are mainly locally-branded models that are cheaper and have a shorter range than those offered by foreign automakers such as Tesla and Nissan Leaf[98]. This is beneficial for domestic car manufacturers, but at the same time, limited the customer scope. Consumers who want to buy high quality imported car or have special brand loyalty to certain foreign brands will choose not to buy the electric cars.

[98] https://www.reuters.com/article/us-usa-autoshow-china-electric/chinas-anti-teslas-cheap-models-drive-electric-car-boom-idUSKBN14V1H3

4 CASE 2: SMART ELECTRIC METERS

4.1 Rationale for choosing the case and the country level examples

Smart electric meters are not per se a technology that impact energy use positively, however, hopes are connected to a smart-meter roll-out that the additional electronic communication options between the meter and the electricity utility as well as the extended amount of information available make add-on technologies likely that in turn would impact energy awareness and energy use of consumers positively. Furthermore, smart energy meters that can measure and communicate energy use in frequent intervals are a prerequisite for flexible consumer tariffs that adjust the prices according to fluctuations of demand over the course of a day. The EU expects energy use and emission reductions of up to 9%[99] by implementation of smart meters and smart grids, which requires changes in consumer behaviour to be realized. This makes smart meters an interesting case study for a social science approach because it allows for exploring the underlying assumptions about consumer energy choices.

The roll-out of smart meters is prioritized by the EU (wherever it is economically feasible). However, on the Member State level, support for or opposition to smart meters varies substantially. Also, the dominating tariff structure and historical development of smart metering technology is different between Member States. This lead us to include a rather large selection of country cases, including states with a dominating critical position to smart meters (Germany and Austria), but also countries with a more positive general attitude (Italy and Sweden). Some of the analysed countries are characterized by a strong dominance of spot-pricing tariffs where the price follows the energy stock prices over a day, which would benefit a lot from smart meters that can measure and report the energy use at a specific point in time (Norway) and countries, where energy tariffs are based on average prices.

Finally, the analyses are complemented by some regional cases, some of them outside the EU, where for example the bottom-up implementation of smart meters was initiated by consumers to control that their energy providers actually deliver accurate energy bills.

4.2 EU level policy and strategy documents

4.2.1 Smart meters and the EU Smart Meters Roll-out Programme

What are "smart meters"? – Definitions

The most common definition of a smart meter in European legislation is "an electronic system that can measure energy consumption, adding more information than a conventional meter, and can transmit and receive data using a form of electronic communication" (e.g., EC, 2012a[100]). The definition is complemented in explanation to the regulation with the statement that smart meters help consumers to adapt their energy usage in time and volume to the market situation, and thus showing the relevance of smart meters to consumer behaviour and actions.

Smart meter roll-out

Following to the energy market legislation in the 2009 Third Energy Package (Directive 2009/72/EC of 13 July 2009[101]), the EU has started a smart meters roll-out programme, according to which the Member States are required to ensure the implementation of smart meters. Subject to a positive cost-benefit analysis, the countries' roll-out target is to reach equipment of 80% of consumers with smart meters by 2020. According to a benchmarking report (EC, 2014b), as of 2014 the member states have committed to rolling out at a total potential investment of €45

[99] https://ec.europa.eu/energy/en/topics/markets-and-consumers/smart-grids-and-meters

[100] EC (2012a) European Commission Recommendations of 9 March 2012 on preparations for the roll-out of smart metering systems (2012/148/EU).

[101] EC (2009a) European Commision Recommendation of 9.10.2009 on mobilising Information and Communications Technologies to facilitate the transition to an energy-efficient, low-carbon economy C(2009) 7604 final

billion, including 200 million smart meters for electricity and 45 million for gas. That would help to equip by 2020 almost 72% of EU consumers with electricity smart meters and 40% with gas smart meters. At the moment, all but five (Belgium, Bulgaria, Hungary, Latvia and Lithuania) of the EU-27 Member States have established the legislation for electricity smart meters roll-out in own scopes, including a legal framework, timeline and technical specifications (EC, 2014b[102]).

4.2.2 Social sciences perspective inclusion to the documents

Active participation / behaviour change

The main reasoning for the smart meter roll-out was based on ensuring the active participation of consumers in the electricity supply and gas supply markets while benefitting the individual consumer and the market itself (EC, 2012a). This underlying the roll-out premise has become the first insight into the social sciences perspective in the current policies: with the emphasis on active participation a significant change in behaviour on individual level and change of traditional culture of passive participation in the market is expected from the customer. However, this statement of a social perspective in the reasoning is weakly supported throughout the policies. In the following paragraph we will characterise the main social sciences insights and approached directly or indirectly tackled in the documents on the EU level.

Customers: the centre of the energy transition

Most of the documents within the EU smart technologies policies imply directly or indirectly to the importance of social sciences perspectives in policies development and implementation. The most often repeated insight on this importance is stating the customers' interests and participation being in the heart of the energy market transition (i.e., SET Plan, Energy Union Package, Directive 2009/72/EC and Directive 2009/73/EC). This statement though is rarely elaborated further into importance of taking into account the customer individual perspective. For example, in the Energy Efficiency Plan 2011 (EC, 2011a[103]; EC, 2011b[104]) the European Commission commits to researching consumer behaviour and purchasing attitudes and pre-test alternative policy solutions on consumers to identify those which are likely to bring about desired behavioural change. An EC staff Working paper on demand flexibility (EC, 2013c[105]) asserts that the "Member states [who do not roll-out smart meters] should ensure that consumers feel encouraged to individually invest in smart metering systems, assured that they will be able to recover their investment in the short term in a clear financial and contractual perspective of participation in demand response", appealing in such way to consumers' economic response. The benchmarking report on smart meter roll-out (EC, 2014b) mentions among other lessons learnt the need to take the consumers on board from the beginning, and stating the necessity to address social sciences perspective in developing a communication strategy, trust and confidence in relationships, information feedbacks, and more active participation. Moreover, the working paper on Impact Assessment (EC, 2011d[106]) accompanying the Energy Roadmap 2050 provides a somewhat broader range of issues to address. Although the paper fails to state the social sciences perspective in policy options comparison explicitly, the suggested measures often include hints on its actual consideration during the scenario development. Among other points, the following aspects are mentioned: overcoming the barrier of population aging for the introduction of changes (influence of demographic factors on the uptake level), public acceptance and local

[102] EC (2014b) Benchmarking smart metering deployment in the EU-27 with a focus on electricity. COM(2014)356.

[103] EC (2011a) Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Smart Grids: from innovation to deployment. COM(2011) 202 final

[104] EC (2011b) Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Energy Efficiency Plan 2011. COM(2011) 109 final.

[105] EC (2013c) Commission Staff Working Document. Incorporing demand side flexibility, in particular demand response, in electricity markets. Accompanying the document Communication from the Commission "Delivering the internal electricity market and making the most of public intervention". SWD(2013)442

[106] EC (2011,d) Impact Assessment. Commission Staff Working Paper. Accompanying the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Energy Roadmap 2050. retrieved at November 23,2017 from https://ec.europa.eu/energy/sites/ener/files/documents/sec_2011_1565_part1.pdf; https://ec.europa.eu/energy/sites/ener/files/documents/sec_2011_1565_part2.pdf

opposition to the land energy-developments (incl. transition lines) (addressing the acceptance and sociological perspective), enforcement of customer behaviour with smart meters.

Smart meters as sole driving force for behaviour change?!

However, the social sciences perspective, if mentioned, is left on the level of general phrases with a rare elaboration on particular features to address and measures to implement. At the same time, when it is done, there is a certain consistency between the documents.

First and foremost, holding customers in the centre of the market transition and realising the need of customers' empowerment, smart technologies and smart meters in particular are seen to be the main approach to achieve it. It could be seen in the historical perspective that from the beginning smart meters were presumably seen mostly as a structural measure to facilitate and support behaviour change. In the 2010 Blueprint for an integrated European energy network (EC, 2010b) smart meter roll-out was seen as a well-functioning energy services market which gives real choices for energy savings and efficiency, and as a mean to accommodate new types of demand (EC, 2010b), implying to providing technical support for customers' individual choices in their behaviour.

Proposal for the Directive of the European Parliament and of the Council on common rules for the internal market in electricity 2016/0380 (COD): Putting consumers in the heart of the energy market, pinpointing that consumers of most member states have little to no incentives to change their consumption behaviour (entry point). However, most of the emphasis is on structural (market) measures, such as real time price signals and entitling the consumers with the right to request a smart meter from the provider. Smart meters are seen as the measure to foster active energy culture. One more emphasised factor is information provision. Therefore, a gap is in rationalising individual and collective behaviour overlooking the psychological and sociological factors. In the EC's communication on options to move beyond 20% GHG emission reductions (EC, 2010a[107]; 2010b[108]) smart meters in particular are said to be proven to increase end users' awareness. This notion is taken up in the EC's communication on Energy Roadmap 2050 (EC, 2011c[109]) where one of the focuses is given to consumer empowering through introduction of the smart meters, access to capital and business models.

This approach of smart meters is seen to be the main instrument for consumers' (and prosumers') activation and therefore behaviour choice has been repeated in multiple policies in energy sector and has become the ground of smart metering policies. The EC's Recommendation on the Data Protection Impact Assessment Template for Smart Grid and Smart Metering Systems (EC, 2014a[110]) explains smart metering as a tool for decision making as it encourages recharging at 'off-peak' periods and optimizing recharging. The Directive on Energy Efficiency (EU, 2012a[111]) mentions the importance of smart metering to decrease customer dissatisfaction (complaints) and encourage or facilitate own regulation of energy use. The SET Plan (EC, 2014d[112]) and Report on SET Progress (EC, 2016b[113]) state engaging the consumer as one of the main themes of future development and list smart

[107] EC (2010a) Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Analysis of options to move beyond 20% greenhouse gas emission reductions and assessing the risk of carbon leakage. COM(2010) 265 final

[108] EC (2010b) Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Energy infrastructure priorities for 2020 and beyond - A Blueprint for an integrated European energy network. COM(2010) 677 final

[109] EC (2011c) Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Energy Roadmap 2050. COM(2011) 885 final

[110] EC (2014a) Smart Grid Task Force 2012-2014. Expert Group 2: Regulatory Recommendations for Privacy, Data Protection and Cyber-Security in the Smart Grid Environment. Data Protection Impact Assessment Template for Smart Grid and Smart Metering systems. Retrieved at November 20, 2017 from https://ec.europa.eu/energy/sites/ener/files/documents/2014_dpia_smart_grids_forces.pdf

[111] EU (2012a) Directive 2012/27/EU on Energy Efficiency

[112] EC (2014d) Strategic Energy Technology (SET) Plan. Towards an Integrated Roadmap: Research & Innovation Challenges and Needs of the EU Energy System.

[113] EC (2016b) Integrated SET Plan Progress in 2016. Transforming the European Energy System Through Innovation.

technologies and smart meters among the technologies that would activate consumer and prosumer, and enable them being more efficient. It is explained to be through creation of more opportunities for the consumer to be more active and providing the information.

Functional requirements

The ERGEG Guidelines of Good Practice (ERGEG, 2011) Report on common functional requirements for smart meters (EC, 2011e[114]) among other points state the following meters' functionalities:

- "Provides readings from the meter to the customer and to equipment that he may have installed;
- Updates these readings frequently enough to allow the information to be used to achieve energy savings;
- Provides these readings in a form easily understood by the untrained consumer, and with calculations enabling final customers to better control their energy consumption, e.g. in terms of cost, as averages, as comparisons to other periods, etc." (p. 5)

This shows the main focus of the smart meters functionalities related to consumer communication to be on data provision that would allow to make decisions. This policy approach for behaviour change, has limited potential, not least because it to a certain degree confuses data or information provision, enabling, incentifying, and influencing. Although distinguished in some of the documents, in others it is often presumed that installing smart meters would provide consumers with data and those would then change their behaviour to more active and energy-efficient. Although possessing the data on own consumption may be supportive in stimulating consumption changes, it does not guaranty these changes.

Pro-active involvement of individuals and collective social units

While looking at the reasons and goals of smart metering, one could connect policies on demand response (DR) management with facilitating consumers (and prosumers) active participation on the market. The EC's staff Working Paper on demand response flexibility (EC, 2013c[115]) argues that DR programmes increase consumers' active participation and distinguishes price-based and incentives-based DR programmes; SET programme (EC, 2014d) proclaims encouraging the people's pro-active position among its 10 actions; Directive 2009/72/EC and Directive 2009/73/EC state the need for active customers participation, etc.

Although not defined explicitly, this active participation and demand response and most likely seen to be managing consumption by shifting peak hours, or shifting consumption in general to a cheaper timeslot, decreasing consumption through changes in equipment and behaviour patterns, etc. Exact actions expected to be taken by consumers are practically omitted in all the policy documents, but from the social sciences perspective it can be linked to changing individual behaviour, and in sociological perspective with increasing the scale of implementation, changing energy lifestyles and energy cultures.

Moreover, some of the documents expand the understanding of activating consumers into a pro-active position of individuals and society on the energy scene. Such, EC Communication on making the internal energy market work (EC, 2012b[116]) in its action plan assumes enhancing effectiveness of regional Initiatives and increasing their contribution to the integration of the energy market as one of the keys to achieve the enforcement of the latter. The

[114] EC (2011e) A joint contribution of DG ENER and DG INFSO towards the Digital Agenda, Action 73: Set of common functional requirements of the SMART METER. FULL REPORT. Retrieved at November 23, 2017 from https://ec.europa.eu/energy/sites/ener/files/documents/2011_10_smart_meter_funtionalities_report_full.pdf

[115] EC (2013c) Commission Staff Working Document. Incorporing demand side flexibility, in particular demand response, in electricity markets. Accompanying the document Communication from the Commission "Delivering the internal electricity market and making the most of public intervention". SWD(2013)442.

[116] EC (2012b) Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Making the internal energy market work. COM(2012) 663 final

latest Proposal for the Directive on common rules for the internal market in electricity (EC, 2016c[117]) tackles community energy, energy cooperatives and initiatives to increase engagement of the consumers (individually and as a group) on one hand, and to influence consumer behaviour on the other (e.g. through facilitating the uptake of new technologies and consumption patterns). Also the SET Plan (EC, 2014d) considers participation of communities in the energy transition and smarter energy system being important (e.g. for enhancing the technologies uptake). There are three major points to note.

- First, the policies recognise the power of collective social units (as in ECHOES macro-level framework) to actively participate in the energy market. They acknowledge possibilities to make decisions on the levels different than individual of formal.
- Second, although not tailored to smart meters in particular, the policies indicate the sociological factors influencing individual behaviour, such as higher engagement. At the same time, no explicit explanation or reasoning is given for it, leaving the idea rather abstract, and not indicating any particular measures to advance or facilitate this influence.
- The third point was found in the SET Plan only and deals with the statement of Theme 9 "Development and demonstration of holistic system optimisation at local/urban level (Smart Cities and Communities)" on the need to distinguish between communities of different kinds (e.g. rural vs. urban, different shape and scale of the community, opportunities to generate renewable energy, etc.). Although generalising smart technologies and not addressing smart metering in particular, this insight might be an entry (so far weak) point to address energy lifestyles, cultures, and memories constituting the differences between the communities.

Social acceptance

Social acceptance is taken into consideration in most of the documents addressing smart technologies and smart metering systems. Here, the documents usually emphasise the importance of social acceptance in general phrases for technology dissemination, and, more rarely, list shortly the ways to achieve it (see for example, EC, 2010b, EC, 2014d, etc.). Achieving public acceptance is usually linked to the same aspects considered below as instruments of influence. However, in somewhat contradiction to the community-based approach, all of these instruments are focused mostly on influencing an individual consumer and rather individual behaviour change.

4.2.3 Structural measures

Structural measures for customer engagement and activation, technologies adoption and benefitting from them constitute the base of the EU policies for smart technologies and smart metering. There are three main groups of structural measures being mentioned in the documents.

[117] EC (2016c) Proposal for the Directive of the European Parliament and of the Council on common rules for the internal market in electricity 2016/0380 (COD)

Economic measures are the most often mentioned instruments of influence and count multiple options.

- Use of market signals, that with the information provided by the smart meters shall apply to the individual personal 'cost-benefit analysis' of energy use patterns and therefore stimulate shifting the loads, decreasing consumption, etc. (e.g., EC, 2012a; EC, 2016;EC, 2011c[118]; EC, 2012b, EC, 2014d etc.). Such, consumers are given a power over own energy costs through smart technologies with market mechanisms and an informed choice (EC, 2012b). EC's staff Working Paper on demand response flexibility (EC, 2013c) considers demand response as a result of market signals or acceptance of consumers' bids only. Interestingly, the document sees Industries to be the most responsive customers.
- Fiscal incentives and subsidies assume that financial help can facilitate better adoption of the smart technologies and smart meters the costs of the purchase or use will decrease for consumers (EC, 2012a; EC, 2011c; EC, 2012b; EU, 2012; EU, 2013[119]etc.)
- Economic incentives are presumably other monetary incentives, open business opportunities, and other ways of the consumers to take advantage of their new role in the energy market (EC, 2012a; EC, 2011c). Such, for example, EC's staff Working Paper on demand response flexibility (EC, 2013c) suggests fast costs recovery as an instrument influencing the consumer behaviour (e.g. in making a purchase decision).

Institutional measures being mentioned in the documents concern setting recommended functional requirements to smart meters, ensuring the compliance with consumers' rights, (e.g. data protection and privacy, to be considered below), exploiting synergies between different actors' actions for better results, coordinating actions or market players, dealing with uncertainties, removing the barriers in regulations (EC, 2012a; EC, 2013b).

The EC communication on International Energy Market (IEM) and public intervention (EC, 2013b) mentions traditional passive role of customers and need for consumption patterns change for energy efficiency and local energy sources, and suggest a range of institutional measures, focusing however on providing recommendations to the authorities. The document in its vast part is devoted to advancing decision making processes for formal social units (authorities) and therefore could be seen as facilitation on the macro-level according to the ECHOES framework. Regarding employment of smart technologies and demand response, the decision on public intervention is recommended to assess and embrace trade-offs, make use of synergies, include certain principles, equal consideration of all the actors, implementing Cost-Benefit Analysis (CBA), introducing competition for lower costs, and focus on the 'right measures' for the right problems. The decision is supposed to be rationalised and not completely focus on economic performance. Thus, the document itself was created by the Commission's as an action towards better decision making in smart technologies area on the macro-level within the Union.

Technological measures for wider roll-out of smart meters refer to introduction of technologies (innovations) that would facilitate better functioning of smart meters and thus energy system in general (see e.g. EC, 2012a or SET: EC, 2014d) and their higher acceptance due to increased and/or better functionality (e.g., EC, 2012a). For example, developing of the meters functions, increased qualities of the meters, or new reliable Information and Computer Technologies solutions could contribute to technology improvements, and therefore stimulate higher acceptance. Eco-design is one of the technical solutions indicated in EU policies on energy efficiency and demand flexibility (EC, 2011b; EC, 2013c). Although not directly addressing smart metering roll-out, eco-designed technologies

[118] EC (2011c) Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Energy Roadmap 2050. COM(2011) 885 final.

[119] EU (2013) Regulation (EU) No 347/2013 of the European Parliament and of the Council of 17 April 2013 on guidelines for trans-European energy infrastructure and repealing Decision No 1364/2006/EC and amending Regulations (EC) No 713/2009, (EC) No 714/2009 and (EC) No 715/2009.

oriented on ease of reuse and recycling, dematerialisation or material substitutions, and prolonged lifespan have a potential to tackle wider acceptance.

It is clear that accepting smart metering (a technological structural measure) as the main instrument of consumer behaviour change towards a more active role in the energy market, the EU policies emphasise structural measures to promote and increase acceptance of smart meters themselves. Thus, the consumer is taken to be central to the system with the focus given to his or her behaviour and the choices he or she makes. At the same time, one could say that this process of making choices is seen rather as a rational decision making, based on a deliberate analysis of economic, institutional, and technological factors with the assessment of costs and benefits. Arguably, it is rather an over-rationalised vision of a consumer behaviour.

Below we consider non-structural instruments and measures suggested or mentioned in the EU policies, and their relationship to this over-rationalised view.

4.2.4 Information provision

Information provision shows to be the most prominent among non-structural measures to influence consumer behaviour in the context of smart technologies and smart metering policies. This might be explained by the conceptualised empowerment for an active consumer participation through giving a well-informed choice. Thus, the information to be provided becomes the main point of the promotions and influence strategy. However, there are several information focuses that are suggested throughout the EU policy documents on smart technologies and smart metering.

Consumption information

First and foremost, the information about own consumption is to one or another degree discussed in all relevant documents. Directive 2009/72/EC and Directive 2009/73/EC (EC, 2009b[120]; EC, 2009c[121]), lying in the base of the smart technologies roll-out, state the need of giving consumers the right to access own consumption and costs data, and clear and comprehensible information about it. As formulated in the SET Plan (EC, 2014d) consumers can better understand and get motivated to adapting their behaviour based on direct feedback from smart meters or in-home displays, or indirect feedback coming from enhanced billing. Moreover, the EC communication on options to move beyond 20% GHG emission reductions (EC, 2010a) states that smart meters are proven to increase end users awareness, and therefore the information provided by smart metering systems is also considered to be an instrument of awareness raising. Thus, the major policies highlight the provision of more clear, more thorough, more timely, more trustworthy, more empowering information provision to stimulate behaviour change. The ERGEG Report for the EC (ERGEG, 2011[122]) and the SET Plan (EC, 2014d) underline the necessity of customer-(user-) friendly information provision. The SET Plan (EC, 2014d) is the only document that explicitly states that this information should be "tailored to each consumer in order to trigger a change in consumer behaviour and practices" (p.6).

Information on smart metering in general

Second, the policies focus as well on providing information on smart metering itself to promote it and facilitate the roll-out. From the early years of the smart technologies policies in the EU, provision of transparent information was seen as a means to ensure acceptance. For example, the EC's Blueprint for an integrated European energy network (EC, 2010b) introduced the "Smart grids transparency and information Platform". The European Commission Recommendations on preparations for the roll-out of smart metering systems (EC, 2012a) notes the need to raise awareness of smart metering and states the obligation of the states in collaboration with industries to disseminate

[120] EC (2009b) Directive 2009/72/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC

[121] EC (2009c) Directive 2009/73/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC

[122] ERGEG (2011) Guidelines of Good Practice (GGP) on regulatory aspects of Smart Meters for electricity and gas (Ref. E10-RMF-29-05)

information. The Working paper on demand flexibility (EC, 2013c) argues that the state should suggest innovative information provision solutions being one of the main ways to encourage consumers to invest in smart meters. Some policies state the need to have a special focus on adequate information provision to the vulnerable consumers (e.g., EC, 2012b). The benchmarking report on smart metering (EC, 2014b) summarises the point of providing information on smart metering the most comprehensively: "An intensive communication effort is required to help consumers understand their rights, the benefits of installing smart meters and participating in demand response programmes. Consumers should be informed about the functionalities, what data will be collected, and what these data will be used for" (p. 9). Worth to note, however, that information measures are often referred as the means to get emotional response (as consumers 'developing trust and confidence' in EC, 2014b). However, these measures, as will be discussed later, could have just a limited effect.

Third, some documents mention the need to provide consumers with information on their new role on the market. It could be found fragmentary in the Recommendations on preparations for the roll-out of smart metering systems (EC, 2012a), or the benchmarking report on smart metering (EC, 2014b). The SET Plan (EC, 2014d) summarise it as the necessary to better explain to consumers their new role, rights, obligations and opportunities.

Transparency

Necessary to say, that one of the most emphasised requirement to information provision stated in the policies is creation of transparency. It is mentioned to be one of the ways to empower consumers through transparency of metering data (e.g., ERGEG, 2011), transparency in billing (e.g., EC, 2012b), or transparency in market incentives (EC, 2013c).

4.2.5 Measures linked to information provision

In order to promote smart metering among consumers, the EU policies suggest or mention a range of measures that could be linked directly to information provision through defining different channels of dissemination.

Expert advice

First, expert advice to consumers is often listed among the measures to empower them and facilitate their active role in the market. Expert advice is suggested, for example, in the Directive on Energy Efficiency (EU, 2012), the Energy Roadmap 2050 (EC, 2011c), and the SET Plan (EC, 2014d).

Labelling and eco-design

Second, the main outline of the promotion strategy for smart technologies for energy efficiency in the Energy Efficiency Plan (EC, 2011b) is based on giving a well-informed choice including labelling and eco-design. The labelling schemes are also supported in the EC's staff working document on demand response flexibility (EC, 2013c) within its appliances based response programmes, and in the SET Plan (EC, 2014d). It is assumed that labels would help consumers in making choices, referring to awareness and active participation rising. Although not directed on labelling of smart meters per se, appliances labelling is supposed to play a supporting role to exploiting the benefits of smart meters and might indirectly impact their acceptance or even dissemination.

Good practice

Third, examples of good practice, exemplary and demonstration projects are often seen to facilitate the raise of awareness on smart metering and address the behaviour factors. Some documents list this measure among those empowering the consumer (EU, 2012; EC, 2010b). The Recommendations on preparations for the roll-out of smart metering systems (EC, 2012a) note the need to oblige the states in collaboration with industries to disseminate examples of good practice. Creating a guidance on the best practice is also mentioned in the EC Communication on making the internal energy market work (EC, 2012b), but it does not elaborate on which aspects of the guidance would address the behavioural factors, nor who would be the addressee of such guidance. Thus, it is unclear, whether the policies assume good practice and exemplary projects to bear informative character or trigger any other aspects of behaviour or decision making as well.

Energy simulation and modelling in education

The fourth channel is mentioned only in the EC Recommendation on mobilising information and communications technologies to facilitate the transition (EC, 2009a), and comprises encouraging the use of energy simulation and modelling in the education and training of professionals. Although this measure in the document is tackling smart technologies in general rather than smart metering in particular, we find it to be the only minor mentioning of the formal educational component for information provision.

4.2.6 Other factors and measures

Other measures mentioned in the EU policies that could be considered as an insight from the social sciences perspective, have usually little to no details and are provided fragmentarily in a few documents only.

Consumer satisfaction and trust

The Communication from the EC on Making the internal energy market work (EC, 2012b) considering smart grids asserts that the passive behaviour of consumers is caused by inefficient consumer protection, lack of transparency or consumer-friendly information, which "all engender low consumer satisfaction and trust". This, to a fair degree, could be translated to the smart metering systems, which could be confirmed by the statements of the Benchmark report on smart metering systems (EC, 2014b; EC, 2016a[123]). However, apart from information provision, the policies suggest no particular measures addressing emotional, perception, or other psychological factors.

"User friendly" tools, interfaces and standards

In order to facilitate the dissemination of the smart meters some of the documents suggest development and introduction of 'user-friendly' tools and interfaces (ERGEG, 2011; EC, 2012b). The Benchmark report on smart metering (EC, 2014b) details this as a measure to stimulate consumers' involvement by providing them with "appropriate, user-friendly tools and mechanisms for making choices, and attractive incentives to reward their participation" (p.8). It is however unclear, what is meant in the policies by 'user-friendliness', and whether it assumes addressing psychological and cognitive factors of use and perception, and nudging the actions towards wider and more effective use of smart meters.

Additionally, the EC Recommendations on preparations for the roll-out of smart metering systems (EC, 2012a) suggests introducing a minimal standard for the customer value of smart meters. The general description of that standard assumes simplicity and user-friendliness of the tools as well.

Complaints handling

The Directives concerning common rules for the internal electricity and gas markets (EC, 2009b; EC, 2009c), addressing smart grids and technologies in general, state the need of speedy and effective complaints handling as a way to increase the public acceptance. This measure could be also considered for smart metering systems.

Further "engagement measures"

Wider consumer involvement is considered in several documents to be a tool of both their engagement into an active role on the market, and promoting smart technologies and smart metering systems in particular. The forms of such involvement however do not have an explicitly described structure. The suggestions count public engagement campaigns (EC, 2014d), engagement of consumers as stakeholders (EC, 2016a), providing consumers with appropriate tools and incentives for active participation (EC, 2014b), public consultation and citizens' forums (EC, 2012b). Although, the policy documents assume that wider involvement would facilitate a more active position and acceptance of smart meters, it is not clear which implications of involvement would act in favour. The assumptions could vary from more information provision and tangible personal experience to the impact

[123] EC (2016a) Impact assessment support study on "Policies for DSOs, Distribution Tariffs and Data Handling"

of the social group. Nevertheless, in absence of background explanations it is not possible to draw a conclusion on the perspective taken by the policymakers in this measure justification.

Data protection and security

Data protection and consumers information security is one of the major aspects of all EU regulations on smart metering. However, it is mostly seen as an obligation to ensure the fulfilment of human rights on privacy and security of personal data. “The internal energy market needs to ensure protection of consumer privacy when providing access to data for running business processes” (EC, 2014b). While a big emphasis in the policies is made on technical and institutional aspects and solutions for data protection, the social sciences perspective is rarely taken into account for both reasoning and implementation. However, the EC Recommendations on preparations for the roll-out of smart metering systems (EC, 2012a) notes the need to increase public acceptance through developing trust and enhancing transparency ("For the purposes of optimising transparency and the individual’s trust, Member States should encourage use of appropriate privacy certification mechanisms and data protection seals and marks"). Moreover, the EC’s Working paper on demand flexibility (EC, 2013c) explicitly touches data protection and privacy as a concern for consumers of all levels, which can limit their interest and lower the effect of incentives, while the Working paper on Data Protection Impact Assessment Template for Smart Grid and Smart Metering systems (EC, 2014c[124]) states that data protection is strengthening confidence of consumers, employees or citizens. As nowadays the data protection aspect constitutes one of the biggest challenges for smart meters uptake in the general public (see for example, public protests in the Netherlands), in our view too little attention is paid on the policies to data protection measures as instruments to facilitate public acceptance.

4.2.7 Gaps

Several conclusions could be drawn from the general outlook of the EU policies on use of social sciences perspective for smart technologies and smart metering in particular.

First of all, introduction of smart technologies and smart meters is considered to be a structural measure to facilitate consumers’ behaviour change toward energy efficiency and taking a more active role on the energy market.

At the same time, for initiating and facilitating both behaviour change that smart meters are intended for, and promotion of smart metering system themselves, the policies focus first on structural measures. When the social sciences perspectives are taken into account, the priorities in measures are given to information provision. Such, envisioned by the policy-makers, a consumer would be inclined to change his or her behaviour when given an informed choice. The main barriers to achieving the policies’ goals are seen to be lack of trust and transparency. The main facilitator on this way is seen to be a provision of understandable, trustworthy, timely information provision via several channels in a user-friendly interface. One could say that although structural incentives and information are very important in forming behaviour, from a social sciences point of view it would be an over-rationalising of individual behaviour and decision making processes. As proven in multiple empirical studies (for the details please refer to the Report No ECHOES 3.1 – D3.1), external information provision, and even knowledge accumulation, do not guarantee change of energy-connected behaviour towards making more environmentally-friendly energy-related decisions.

It is also clear that the individual perspective is adopted for the most of the relevant policies. It might be explained by three main reasons. First, the current energy market policies are constructed with a consumer in the focus (see for example the Energy Union Package), and therefore it is intuitive that most of the ‘soft’ measures would be oriented towards individual consumers. Second, the EU policies provide the general framework agreed upon, while leaving some significant freedom in choices to the state due to respect to their sovereignty. Thus, it limits the possibilities to construct the EU policies regarding social, corporative and governmental interventions. Third, the

[124] EC (2014c) European Commission Recommendation of 10 October 2014 on the Data Protection Impact Assessment Template for Smart Grid and Smart Metering Systems (2014/724/EU)

policies as it was expected, conceptually do not distinguish the macro-, meso- and micro-levels, and the absence of the clear framework highlighting collective behaviour and decision making could undermine their consideration.

Furthermore, the existing social sciences implications in the EU policies on smart metering systems often lack explicit justification. Only rare studies supplementing the policy documents include psychological or sociological factors in the overall outline of the issues being considered. Such, for example, the documents of the 'satellite' to the policies Smart Grids Task Force are focused on technical, economical and institutional solutions, while rarely taking "softer" perspectives. At the same time, the underlying assumptions about possible drivers of consumers' energy choices or consumer models are not discussed. This lack of clearly stated justifications for the stated policies brings us in the analysis to the point, where it is hard to identify the implications of the statements in the documents, their theoretical or empirical background, and therefore the ECHOES level they could be referred to. Such, for example, considering the targeted energy behaviour change by the vast group of the consumers (i.e. change of their choices, lifestyles and attitudes to more energy-efficient and pro-active), the policies however are constructed in a way that these changes would be rather unique for each consumer, without obvious preferred patterns of their shifts. Thus, it is unclear, whether we could refer these policies foci to the meso-level of energy lifestyles and energy cultures, or to micro-level of individual energy behaviour. In the same manner, considering consumer in the focus of the policies with the discussed above features, one might assume, that the perspective is taken mostly on the individual behaviour change (i.e. micro-level perspective in the ECHOES framework) but over-rationalise the behaviour determination factors. However, the premises theoretically might be applied to decision making of a group of individuals (i.e. the ECHOES's macro-level perspective in its strata of individual decision-making).

Due to these constrains, clear indication of particular possible measures, that could be derived from ECHOES findings and used in the EU policies, is cumbersome. At the same time, the weak consideration of social sciences perspective in the policies in general allows to conclude on the overall high potential of ECHOES findings to contribute to future policies development. Such, for example, the following could be possible:

- Development of incentives and stimuli for smart meters adoption and consequent energy behaviour change based on moral motivations (addressing values, personal and social norms), influencing habits and attitudes, implying to emotions and social identities;
- Adopting sociological perspective addressing collective behaviour in patterns of energy lifestyles, energy cultures, and energy memories. We admit that on the EU level, due to extreme heterogeneity of possible lifestyles, cultures, and memories, it would be impossible to suggest particular measures. At the same time, the Union's policies have a potential for suggesting frameworks and recommendations in this area to the member states' internal policies elaboration.
- Considering the decision making level, the EU policies could expand the recommendation of the decision making framework for the governmental formal social units, while addressing the collective and individual decision making through incentives based on the drivers and barriers identified within the ECHOES project.

Identification of the prospects and opportunities for the suggested above areas and some particular solutions, however, would require close cooperation with EC representatives and policy-makers, as the picture of the underlying argumentation for the current and planned policies needs to be clarified.

Considering the opportunities of the ECHOES project to contribute to the policies development, at least two entering points are seen:

- Climate Change and Energy Framework 2030 (EC, 2017[125]), currently under active development close to its final stage, states Energy efficiency to be one of the key strategies to achieve the targets. Smart grids are listed among the main technical solutions, while the customer focus is not emphasised, and social sciences perspective is not taken into account. That represents, in our view, a large gap, and could become a point of the beneficial use of ECHOES findings.
- In its Communication on Energy infrastructure priorities for 2020 and beyond (EC, 2010b) the Commission commits to developing a dedicated policy and project support tool that would work for a better communication and information provision to decision makers and citizens that potentially could increase acceptance. The ECHOES findings could contribute to the tool development.
- ECHOES findings could contribute to the current Smart Grid Task Force activities through introduction of the social sciences perspective track.

4.3 Breakdown to the Member States

The following chapter is devoted to considering several cases of smart metering policies in some of the EU countries. While each case has specifics that have to be discussed, we omit the general factors and conclusions made for the policies on the EU level that are repeated for the country cases.

4.3.1 UK

The UK government has committed to the goal of installing 53 Mln gas and electricity smart meters in all households and small businesses by 2020, with the main roll-out planned for 2015-2020. To achieve that, the government has established a central change programme and had appointed the Office of Gas and Electricity Markets (Ofgem) to manage the first roll-out phase completed in March 2011. Since 2011 DECC (Department of Energy and Climate Change) has been managing the implementation of the smart meter roll-out programme, with advice and expertise provided by the Ofgem. By the end of 2016 over 4,9 million smart meters were installed in the UK households and businesses.

In 2012 the DECC adopted The Modifications into the UK Regulations on the Standard Conditions of Electricity and Gas Supply Licences (DECC, 2012[126]). These modifications obliged the licensees to take measures on provision of customers with information (including on costs and benefits), avoid misleading information, ensure the absence of inconvenience and unwelcome marketing to a customer, use plain and intelligible language, identify and meet needs of special customer groups, obtain the views of the customers, entail verbal communication with customers, create a positive image, etc.

The detailed requirements to the consumer approach in the document concern the scope of information that has to be provided by the licensees. The provided information should cover the procedure, purpose, features and advantages of smart meters, the use of smart meters (including advise to ensure informed judgement), and the sources of additional and impartial information. Thus, the governmental policies focused on assigning responsibilities for approaching consumers to ensure energy behaviour change and increased acceptance of smart meters. One could also say that the policies' premises were founded on information provision as the main instrument to ensure informed choice and achieve the goals. The DECC Report on Small-scale Behaviour Trials

[125] EC (2017) Climate Change and Energy Framework 2030. Retrieved at November 20, 2017 from https://ec.europa.eu/clima/policies/strategies/2030_en#tab-0-1

[126] DECC (2012) Department of Energy & Climate Change's Policy Paper of November 30, 2012. Smart Meters: Modifications to the standard conditions of electricity and gas supply licences. Retrieved at December 7, 2017 from https://www.gov.uk/government/publications/smart-meters-modifications-to-the-standard-conditions-of-electricty-and-gas-supply-licences

Synthesis (DECC, 2015[127]) lists the most effective support interventions, counting among them information provision, use of motivational devices, and raising consumers' confidence in the own actions' relevance and simplicity. Thus, although the legislation formally includes consideration of both individual and business consumers, the social sciences perspective is focused on the individual level, tackling information provision, user-friendliness of aids, awareness of consequences and somewhat emotional response.

However, as a result of the modifications adoption, the major licensees assigned to the responsibilities, had founded a separate independent organisation, Smart Energy GB (Smart Energy GB, 2016a[128]), that would lead the national campaign to approach consumers. The organisation is governed by main stakeholder organisations (including consumers). The company is not the only organisation responsible for the consumers' engagement, but it has this task in its main focus and activity. Further, we consider the Smart Energy GB plans and activities to represent the major outlines of the British smart energy consumer-focused policies.

Theoretical implications

In one of its main publications (Smart Energy GB, 2016b[129]), Smart Energy GB states the main theoretical premises to the follow-up plans and actions. Focusing on the individual behaviour factors, it states the need to identify not only what has an impact on consumers' behaviour, but also how, where, when, and why these impacts occur.

The Report (Smart Energy GB, 2016b) focuses in ECHOES terms mostly on micro (individual) level of behaviour change. The models adopted by the organisation approach (modified MINDSPACE behaviour change model with elements of the COM-B model), assumes importance of motivations, opportunities, and capabilities of individuals for their behaviour, but also recognises the irrational and biased nature of human behaviour. It sets the scene addressing the factors that would tackle rational behaviour choice, maps consumer's "journey and attitudes", accounts for biases, implements research and analysis based on which designs tools and techniques. Thus, comparing to the EU policies outline, the organisation admits that the connection between energy behaviour and its financial implications "serve as a catalyst of change" (p.7), but considers it to be just one of the factors. The attempt to make energy "visible" using smart meters and change energy behaviours therefore implies also to making energy more tangible, acquiring confidence in taking control over energy, reducing disengagement with energy companies, decreasing worry trends, getting positive emotional response, etc.

The organisation applies a 'journey' framework of consumer engagement to address the stages of the process and the respective characteristics of the context or actions to be taken.

[127] DECC (2015) Smart Meter Small-scale Behaviour Trials Synthesis Report 6.0. R. Pocock, J. Harper, D. Chong Ping, J. Jesson, DECC, London: Department of Energy & Climate Change, 2015, pp. 58-59.

[128] Smart Energy GB (2016a) Annual report and accounts. Year ended 31st December 2016

[129] Smart Energy GB (2015b) Smart energy for business. Our approach to engaging microbusinesses in the smart meter roll-out. August 2015

The journey includes five stages (Smart Energy GB, 2015a[130]):

- Ensuring that the consumers receives information about smart meters roll-out via the standard communication channels (media, social media, advertising, etc.).
- Encouraging the consumer into deciding to the install by ensuring that consumer understands the message and recognise the benefits.
- Contacting and setting up the installation, providing more detailed information on meters, benefits of use, and the instalment procedure
- On installation of the smart meter, giving clear instructions the consumer by explaining how it works and how the behaviour will affect the usage (Positive experience of installation is also regulated by the Smart Metering Installation Code of Practice, SMICoP, 2015)
- Using the smart meter to facilitate and encourage long term behaviour change

The main objectives of consumer engagement that the organisation states are:

- Gaining consumer's confidence in installation of a smart meter
- Raising consumer's awareness of the use of smart meters and use and understanding of the information they provide
- Increasing consumers' willingness to use smart meters to change their behaviour
- Assisting vulnerable consumers in realising the benefits of smart meters

Thus, the organisation expands its responsibility from promoting smart meters to enabling consumers to exercise control over their energy behaviour. Thus, as in the EU case, the social sciences perspective in smart meter policies has two foci: smart meters dissemination and use of smart meters for energy behaviour change.

Smart metering for energy behaviour change: drivers and interventions

Based on the four development principles (nudging, habit-forming interventions, addressing changes towards long term and sustainable behaviour, cost effectiveness of interventions), Smart Energy GB tested a number of interventions on their configurations (e.g. channels, language and tone of voice), effectiveness and credibility, in order to facilitate energy behaviour change using smart meters. Three Themes for the planned interventions were identified for more thorough development (Smart Energy GB, 2015a). Each of the Themes combines application of several of the instrumental principles of the interventions aiming at synergetic increase of the effect.

- ***Theme 1*** "Out of the box": aimed at creating positive installation experience (being excited about smart metering system in the house and creating a commitment feeling to form habits). The interventions include priming with a teaser welcome package, and completing an installation checklist.
- ***Theme 2*** "Companion": aimed at providing a tangible feedback and social norming, includes a consumption information tool with understandable graphics that provides reassurance, benchmarking, and personalised tips.
- ***Theme 3*** "Looking to the future": aimed at supporting long term interest, and taps into perceived usefulness with personalised energy saving ideas to decrease the consumer's energy costs.

Such, the main focus of interventions is on tackling the information provision, cognitive biases and limitations, perceived behavioural control, creating personal norms, emotional response, social norming, building habits. Considering the barriers to the energy behaviour changes, the analysis regarding the stage "using and benefiting

[130] Smart Energy GB (2015a) Smart energy for all. Identifying audience characteristics that may act as additional barriers to realising the benefits of a smart meter. July 2015

from the smart meter" – identified difficulties in use, in understanding the information, in using the information, and in choice of the deals were identified being the main obstacles (Smart Energy GB, 2015a).

Promoting smart metering systems: drivers and barriers

Along with pinpointing the high importance of communities and community actions to facilitate individual behaviour change, the organisation's approach includes the following instrumental principles of the interventions to engage consumers into smart metering roll-out (Smart Energy GB, 2016b[131]):

- Pinpointing the perceived benefits (convenience, cost savings incentives, control over energy consumption)
- Addressing perceived hassle and inconvenience
- Creating positive and informative experience with installers (choice of the contact persons),
- Providing information that is clear and personally relevant
- Making it easy to tap into existing behaviours
- Getting consumers into a favourable mindset
- Providing consumers with practical tools
- Maximising face-to-face interactions
- Using easy to use tools in digital and physical forms
- Using engaging and easy understandable graphics
- Providing easy benchmarks against people similar to a consumer
- Providing tangible feedback
- Providing more advanced and personalised hints
- Meeting expectations (supporting 'joy of use' and avoiding disappointment)
- Avoiding information overload.

These instrumental principles, although grounded on a different framework, to a fair degree reflect the motivations and drivers of individual behaviour on the micro-level of the ECHOES framework. The covered behaviour factors include objective and situational factors (facilitators and constrains), perceived behaviour control (in perceived ease of the process), forming habits (tapping into existing behaviour), social norming, tackling values and awareness of consequences, emotional response and social identity. Moreover, the instruments expand especially on dealing with cognitive constrains (biases, perception features, limitations).

Elaborating the action strategy, Smart Energy GB has been researched specifically the barriers to consumer engagement, publishing the results in 2015 (Smart Energy GB, 2015a). The main organisation's approach was to keep the programme being a mass engagement campaign, but address the audience in groups, according to their specific characteristics. Thus, research (incl. desk research, consultations, focus groups, questionnaires) was implemented to segment the audience, according to the characteristics that could become or cause a barrier. Such, the focus characteristics for segmentation were demographics and personal characteristics; personal, property or access to media circumstances; media consumption patterns, and who and what are the audience is supported or

[131] Smart Energy GB (2016b) A smart route to change. The application of behavioural science in supporting Great Britain's smart meter roll-out and changing the way we use energy for the better. July 2016

influenced by. The barriers were classified and considered based on when during the customer engagement journey the obstacle occur.

Barriers for the consumer engagement into the roll-out:

- Ensuring the consumer is aware of smart meters: the message is not reaching the consumer (e.g. probably because the audience has not been segmented and a general message is ineffective).
- Encouraging the consumer into the deciding to install: the message is not adequately understood, or the message does not resonate with the consumer
- Contacting and arranging for the installation: perceived difficulties of the establishing the appointment – physically and emotionally
- On installing the smart meter: difficulties of effective information being provided

Then, the main barriers (sole or grouped) as the reasons for an obstacle for a specific audience segment were characterised by the 'specific engagement needed'. For instance, the limited effectiveness of certain channels (e.g. TV, digital) was identified for age group 75+, fears of interaction for people with mental illnesses, possibility of necessary higher energy consumption due to poor insulation for people with low income, etc. The barriers analysis was further used for elaborating engagement strategies and design of the campaign elements.

This barriers consideration, although mostly focused on the individual behaviour, in our view nevertheless, tap into the meso-level of the ECHOES framework. Due to the segmentation of the audience by specific characteristics, the organisation might have identified groups with particular lifestyles (e.g. elderly people, young people living in shared apartments, blind or partially sighted, etc.) and even cultures (e.g. immigrant groups) that have influence on their energy behaviour. Thus, the strategies developed targeted to these groups to a fair degree could have a sociological perspective on consumer engagement. It is rather unclear, whether energy memories perspective might have been included into analysis, as it is not stated explicitly, but might have been considered as an implication to some of the segmentation.

Macro-level: Engaging small businesses and local communities

Smart Energy GB is actively working in the local communities and consumer organisations, supporting grassroots movements through bid funds, regional support, and campaign training support to local organisations that contribute to engaging into smart metering. The organisation recognise importance of communities for individual behaviour change, and therefore mostly considers them rather as a communication channel and a partner in the strategy, than a target audience. Thus, no explicit strategy apart from financial incentives is publically described for engaging these formal and informal social groups.

More focus in the Smart Energy GB's policies and activities is given to businesses, and more specifically to microbusinesses (MB). In its report dedicated to MB (Smart Energy GB 2015b), the organisation considers separately from the individual consumers only those microbusinesses that use other than domestic premises for their activities. Smart Energy GB acknowledged that many factors can influence their attitudes and decisions on installing a smart meter, pinpoint that MB often do not understand their energy use, and takes the main responsibility for making the microbusinesses aware of smart meters and making a decision to install it. Pursuing this goal, the organization identifies the main facilitating factors and barriers as follows:

Facilitating factors increasing uptake:

- Expected decrease in energy costs
- Comply with environmental values
- Receiving more accurate billing
- Decreasing the complexity of current smart meters for the user

Main barriers:

- Problems to self-identify eligibility or possibility of installing a smart meter
- No time prioritised for the smart meter request
- Lack of awareness or belief in benefits
- Perceived disruption to business as usual
- Confusion of advanced metering with smart metering
- Inadequate handover processes and insufficient post-installation support
- Lack of follow-up flexibility
- Inconveniences of installation, concern over remote disconnection.

The organisation is working on enhancing the motivations and overcome the obstacles to expand MB engagement, through two main approaches (Smart Energy GB, 2015b):

- Extending the message intended for domestic consumer to microbusinesses, aimed to overcome obstacles related to understanding, relevance, prioritisation, and usage.
- Extending the range of channels to reach microbusinesses and leverage third party influence and support, engaging on a number of levels, and providing variety of information in depth and detail. The approach has three pillars: targeting specialist (business) media, partnering with business advisory organisations to cascade the information (as a trustworthy network, and as a provider of a variety of communication channels tackling different motivations), and partnering with organisations that can provide direct communications channels (for data sharing, variety of channels, synergies).

Such, the approach to microbusinesses transfers the issues of individual behaviour change (information provision, building trust, perceived control, etc.), adding on the solution that are specific to businesses (formal and informal business network). It is clear, that the chosen approach of Smart Energy GB to micro-businesses is based on the fact that this type of formal social units is more prominently run by individuals and the decision making is more inclined to be similar to the individual behaviour models. On one hand, due to considering multiple similarities this approach is beneficial as for tackling non-rational factors of decision making, on the other hand, the differences are not that explicitly presented and dealt with.

Main Actions to fulfil the policies

Based on the theoretical implications and identified approaches to individual and MB consumers, Smart Energy GB (2015a) designs and conduct engagement programmes, run each year. As at 2016 the following main programmes are being implemented (Smart Energy, 2016a):

- The Core Campaign, implemented on national level, using appealing to emotional response cartoon characters Gaz & Leccy, conveying the benefits of smart meters offering a control over gas and electricity. It's role is information provision to raise awareness and understanding of smart meters, as well as the key benefits.
- The Estimation Nation Campaign aimed to address an audience with low interest category showing the need for smart meters. It uses every day scenarios to ensure relevance and ease of understanding, as well as involving famous people. Thus, the campaign is tacking habits forming, perceived behavioural control and personal norm creation through applying the social impacts, information provision, and tapping into cognitive features.
- The Educational Campaign is aimed at educational content provision to interested consumers. It is focused on emotional response building confidence, providing information, and elaborating trust.
- The Patriotic Campaign appeals to the non-energy related values, building a personal and social norm on patriotism feeling. The programme also involves famous people and opinion leaders to enhance social impact effect.

Other programmes of 2016 included the For All Campaign, the Language Campaign, the Prepay Campaign, the Microbusiness Campaign, and the Smart Future Campaign. Most of them are using the principles and instruments that have been already mentioned.

The campaign and its programmes uses multiple mass media channels including TV, radio, digital, press, and out of home (OOH), as well as branded digital channels (social media, commercials and ad banners, a videogame). Other channels include working with and training networks and communities, leading stakeholder dialogues, presentations and expos. Depending on the stage of the campaign, particular programme, and the roll-out timeline, the messaging content, format, and media mix are changing to increase the effectiveness of engagement. The programmes involve famous and popular personas, opinion formers, uses specialised imagery, conveys messages in 7 languages, appeal to multiple emotional responses and non-energy attitudes (e.g. patriotism), different values creation (no environmental though) and highlight different benefits to different audience groups.

Effects of the policies so far

The effects of the actions carried out by Smart Energy GB are monitored twice a year tracking public attitudes toward smart metering systems. According to the first Outlook 2017 (Smart Energy GB, 2017[132]), the policies and actions have an overall positive effect. Such, more people are claiming to use their smart meters to save energy. Levels of Satisfaction with smart meters remain consistently high, and close to 90% of consumers feel they have a better idea of their energy spending. Knowledge about and understanding of smart meters is growing steadily, although not equally among different audience groups. There is also a growing number of people who would like to have a smart meter. At the same time, the novelty of smart metering does not wear off, and even more, the longer a consumer has the smart meter, the more likely he or she feels to be able to make informed choices.

Gaps

The case of the UK represents one of the most thorough and elaborate cases of including social sciences perspectives in smart metering roll-out, and might be energy transition in general. One of the main policy-making factors that contributed to that, in our opinion, could be initial assigning responsibilities to engaging consumers, and the following establishment of an executive organisation. While the policies and actions, linking to the ECHOES framework, pay attention to all three level: macro-, micro- , and meso-, it is clear that the main focus is given to the individual behaviour change (micro-level).

Such, on the micro-level, a behavioural model is adapted to design an approach to consumer engagement, and the principles and factors taken into account cover most of the aspects considered in ECHOES. However, worth to

[132] Smart Energy GB (2017) Smart energy outlook. February 2017

note, that motivation factors (especially the moral motivation cascade) are considered in much more limited scope than barriers. It could be due to the fact that the approach of Smart Energy GB is trying to understand and advance how energy behaviour change is done (or not done) rather than why. Therefore, it might be beneficial to look more into moral motivations, and address environmental value creation.

On the meso-level, a great work of audience segmentation based on their features and barriers is addressing the sociological approach to consumer engagement. Even more, the implemented analysis demonstrates the meso-level approach already in action, tailored to specifically smart metering systems. However, some more attention might be given further to energy memories forming specifics of the audience for engagement policies making.

On the macro level, the Smart Energy GB's approach pinpoints the similarities between individual consumers and microbusinesses, and approaches the later respectively. However, the differences between the two groups are not addressed that explicitly, and therefore more attention could be paid to the implications of these differences for the policies. Additionally, as of now, medium and large businesses, as well as other formal social units in their decision making are not considered in Smart Energy GB's activities. However, it is indeed a responsibility that was not assigned neither to energy providers in the UK legislation, nor to Smart Energy GB by its founders, Nevertheless, taking into account the fruitful use by Smart Energy GB frameworks on micro- and meso-levels, it would be interesting to see how the organisation might tackle engaging formal social units on the macro-level.

4.3.2 Germany

Description of the policy – general

The core policy for the introduction of smart meters is the Act on the Digitisation of the Energy Transition (BNA, 2016[133]). The official German policy at the moment is avoiding using the term "smart meter". Instead, a distinction is made between a "modern measuring device" (moderne Messeinrichtungen) and an "intelligent measuring systems" (intelligente Messsysteme).

A modern measuring device is defined as a digital electricity meter that

- Reflects the real energy consumption and the real time of use, and
- Can be securely integrated into a communication network with a Smart-Meter Gateway (the switching device between a meter and communication network that collects, processes, encrypts and sends data).

An intelligent measuring system consists of two components:

- A modern measuring device, and
- A Smart Meter Gateway.

According to my-smart-energy.eu[134] the German government has not yet clearly decided how to proceed with smart metering in terms of a roll-out. Based on mostly negative cost-benefit analyses, the current policies and the near future policies most likely would exempt consumers with a relatively low consumption, or equip them with "adapted" systems with fewer functionalities (Ennöckl, 2017[135]). The 2016 Act on the Digitisation of the Energy Transition (BNA, 2016), referring to a brochure by the Federal Association of Energy and Water Management, states that the data from the smart metering systems in many cases is not required for network operation, arguing that the efficient and stable control of an intelligent distribution network does not require a complex smart meter infrastructure. Measuring points, which are defined and installed by network operators at critical points on the grid level, are generally superior to the collection of data from final consumers. Thus, it is assumed that it helps to ease the burden

[133] BNA (2016) Stellungnahme der Bundesnetzagentur zum Gesetz zur Digitalisierung der Energiewende" (BT-Drs. 18/7555)

[134] http://my-smart-energy.eu/my-country/germany#country-area

[135] Ennöckl (2017) SMART METER – Anrechnung der digitalen Standardzähler (DSZ) an die Einführungsquote der intelligenten Messgeräte zur Schaffung einer konsumentinnenfreundlicheren Lösung, Universität Wien, Institut für Staats- und Verwaltungsrecht, July 2017. https://www.arbeiterkammer.at/service/studien/konsument/Smart_Meter.html Accessed on December, 22, 2017.

on distribution system operators and, ultimately, consumers if the processing and use of high volumes of data is limited to those cases where it is network-relevant and truly necessary for the network.

Nevertheless, the Act on the Digitisation of the Energy Transition (BNA, 2016) established a limited smart meter roll-out to occur in 2016, with the first round focused on large electricity users (10,000 kWh per year). Starting from 2017, the installation of intelligent measuring systems was expanded to consumers who have agreed on a reduced network charge for a controllable consumption device (e.g. a heat pump), and prosumers with the installed capacity between 7 and 100 kW (BNA, n.d.[136]). Instalment of 15.8 million intelligent measuring systems is expected by 2032.

Social sciences perspective inclusion

The Act on the Digitisation of the Energy Transition (BNA, 2016) mainly deals with information and data protection and management requirements including the types of data that need to be provided to users including, e.g., historic consumption data. Due to the regulatory nature of the document, no further explanation is provided. Based on relevant research, conclusions might be drawn on whether the regulations on data and their presentation are suitable to trigger consumers' behaviour change. In the document itself, no further explanation is provided on the expected motivation cascade.

Data protection overall plays a significant role in the German smart metering policies. Very detailed regulation of data protection and privacy is also given in the Meter Operation Act (Bundestag, 2016[137]). The official policy documents focus on data protection as a citizen right, and not as a way to promote or support intelligent measuring systems. At the same time, the official website of the Federal Power Grid Agency in its smart meters FAQ section[138] includes extensive explanation on the data protection and privacy sector, showing acknowledgment of the importance of this information for increasing public acceptance.

As one of the measures for information provision to consumers, the Federal Power Grid Agency has established a Smart Meters FAQ section on its website[139], answering the most popular questions about intelligent measuring systems themselves, the scope of the roll-out programme, installing procedures, as well as the rights and obligations assigned to the main actors.

The cost-benefit analysis for the comprehensive use of smart metering in Germany (Ernst & Young, 2013[140]) differentiates between the country side and cities due to, among others, demographic and infrastructural differences as well as use and consumption habits of household customers. Thereby, energy cultural and energy lifestyle aspects (meso-level) are directly addressed in the economic assessment. A classification of groups of consumption classes is done for the household level even though statistical difficulties are acknowledged. The report differentiates households and business customers, but claims this distinction to be statistically challenging as well. An impact analysis is undertaken along different functions of smart metering systems and different actors according to their role in the market. However, "end consumers" are not further differentiated in detail. The role of different actors is thereby partly discussed but not broken down to specific motivational factors which may be correlated to the motivation cascade in the ECHOES micro level perspective. Interestingly, the mostly highlighted demand response and thus energy savings expected to result from consumption information are not particularly emphasised

[136] BNA (n.d.) Moderne Messeinrichtungen und intelligente Messsysteme. Bundesnetzagentur official website. Retrieved at 20.12.2017 from https://www.bundesnetzagentur.de/DE/Sachgebiete/ElektrizitaetundGas/Verbraucher/NetzanschlussUndMessung/SmartMetering/SmartMeter_node.html

[137] Bundestag (2016) Messstellenbetriebsgesetz vom 29. August 2016 (BGBl. I S. 2034), das durch Artikel 15 des Gesetzes vom 22. Dezember 2016 (BGBl. I S. 3106) geändert worden ist

[138] ibid

[139] https://www.bundesnetzagentur.de/DE/Sachgebiete/ElektrizitaetundGas/Verbraucher/NetzanschlussUndMessung/SmartMetering/SmartMeter_node.html

[140] Ernst & Young (2013) Kosten-Nutzen-Analyse für einen flächendeckenden Einsatz intelligenter Zähler. http://www.ey.com/de/de/industries/power---utilities/power-and-utilities_ey-studie---kosten-nutzen-analyse-smart-meter

in the overview of potential impacts (Ernst & Young, 2013, 114ff). Instead, variable tariffs are assumed to increase awareness on energy consumption on household level. The potential for load management is discussed to be facilitated through smart meters for households and businesses. Load management is further differentiated into load increase, load decrease and load shift while only the latter is considered for households, assuming that the potential for the other types of load management is negligible on the household level. The potential for load shift on the household level is said to depend on parameters such as household income, apartment size, electricity consumption, and the specifics of individual devices including their frequency of use. These aspects are to some extent considered in the quantification of load shift potentials. Different ways to present data to customers are discussed, while displays on household level, and real-time information via internet or smartphone are supposed to have the highest potentials to stimulate load shifts. The cost-benefit analysis quotes research on the different potentials for load shift due to 1) information and feedback, 2) tariffs and 3) automation (in the order of increasing potential). The assessment further quotes a study on smart homes stating that 66% of all Germans with internet connection would be interested in smart home solutions as part of a range of value added services. The highest interest was observed for educated younger people with high-income in multifamily households. Comfort is stated to be an important aspect in relation to smart home solutions. Overall, stated value added services for end consumers somehow related to smart meters include energy saving, security (break-in prevention through, e.g. presence simulation, also addressing the individual security perception), and personal assistance to elderly or handicapped persons (e.g. smart-home based communication with nursing services).

Gaps and ECHOES knowledge application

The roll-out programme at the moment does not target at all consumers in general, at the same time obliging consumers selected according to the criteria to install “intelligent measuring systems”. That to a fair degree reduces the necessary level of efforts of the authorities to promote smart metering systems. However, as the focus in the roll-out programme is on prosumers and consumers with high level of consumption, more attention could be paid to the effects of smart metering systems for changing energy behaviour. Here, the social sciences perspective becomes significant. On one hand, micro-level behavioural models could provide insight on constructing the policies targeting high energy consuming individuals. Sociological meso-level considerations would be beneficial to target high-consuming individuals, and individual prosumers as social groups, suggesting the measures addressing their energy lifestyles. Macro-level studies might be useful for policymaking targeting prosumers and collective consumers in their energy-related decision making processes.

4.3.3 Case Study: Austria

Description of the policy – general

In Austria, general considerations on smart meters are included in the Electricity Sector Act of 2010 which defines a smart meter as “a piece of technical equipment that records actual energy consumption and period of use without delay and allows for bidirectional data transmission and remote meter reading”. In relation to time-of-use tariffs the act established the option to define transparency requirements at a later point in time. The act further established that clear and understandable information about electricity consumption and overall electricity costs shall be provided to consumers (free of charge), and defined the rules of data collection and billing procedures. It obliges system operators to respect the consumer's wish not to have a smart meter. Besides other details on data provision to consumers, quarter-hourly values should be made available upon a consumer's wish through a customer-friendly web portal, free of charge, respecting specific data protection and management, as well as consumer information requirements. The regulator shall inform consumers about smart meter roll-out and its status, including the costs, the network situation, data protection and data security, the current developments at the EU level (as far as known), and about consumption trends at consumer installations with smart meters. The act states that the regulatory authority (e-control) may issue an ordinance detailing the minimum requirements for the granularity and format of information to be submitted with the aim to achieve understandable information that is suitable to increase efficiency. In this context, the regulator was required to integrate consumer representatives, the Data Protection Authority and the Data Protection Council in the development of such ordinance as far as possible. Accordingly,

the e-control released the Smart Meter Requirements Ordinance (E-Control, 2011a[141]) which defines the technical requirements of smart meters, as well as corresponding explanations (E-Control, 2011b[142]). In the ordinance, besides technical requirements, data protection is addressed. The explanations contain some more "consumer comfort" related explanations further discussed below.

According to the EU framework and equally foreseen in the Electricity Sector Act, a cost-benefit analysis was carried out by PricewaterhouseCoopers (PwC) on behalf of e-control in order to assess whether smart meters should be introduced in Austria. The positive assessment provided the basis for deciding on the smart meter roll-out as defined in the Smart Meter Roll-out Ordinance (Intelligente Messgeräte-Einführungsverordnung) of 2012 (currently under review). This ordinance also includes requirements for informing consumers on the introduction of smart meters.

Social sciences perspective inclusion

Of the mentioned documents, primarily the non-regulatory ones are of higher interest regarding the consideration of social sciences perspectives. While the Electricity Act and related regulations/ordinances have, by nature, a strongly technical character, the PwC study provides some information on expected behaviour changes. Provided that this assessment set the ground for the actual roll-out decision, it can be perceived as an implicit part of the policy documents. Regarding information provision the PwC study articulates, comparably to the other documents, that knowledge of the own consumption would be a precondition for the expected behavioural change and for the actual realisation of the smart meters' potential. The study goes beyond this mere statement by specifying suggestions on how the information provision and usability of smart meters should be implemented but without any explicit explanation on how the provided options are expected to impact consumers' behaviour. The assumption is made that the availability of consumption information, the way how this information is presented, and the location and the medium of information transfer need to be adapted to consumer requirements in order to generate advantages for consumers. Therefore, and due to the low level of households' and small companies' knowledge on their specific energy consumption, a successful communication is stated to be highly complex. A mix of current and historic consumption information and an easy-to-understand presentation are suggested. Thereby, the cognition part of information provision is strongly emphasized.

The analysis of potential impacts in the PwC study builds on assumption of specific behaviour changes, e.g. reduction of stand-by consumption. To this end, besides information provided by smart meters, also general information on energy saving options would be required. No specific assumptions are provided on why or how these changes are expected to be triggered. However, the report refers to some studies on potential saving effects which show a wide spread. At the higher end, these studies state savings potentials of above 10%. Quoting the monitoring section of the Austrian Energy Agency as well as an impact assessment of the UK's DECC (DECC, 2009[143]), the study assumes that savings of 3.5% of the electricity consumption on the individual consumer level could be achieved. For gas, a consumption reduction of 7% was assumed. The specific measures that customers are assumed to implement are supposed to be measures with low costs for the consumers (no or low investment need). Differences between households and (small) businesses are acknowledged, in particular regarding their different options for saving measures (e.g. in production processes which do not apply to households). Thus, the macro level perspective is addressed in addition to the micro-level (individual household level decisions). A load shift due to Peak/Off-Peak price signals was computed assuming that 30% of consumers would use these offers[144] based on economic considerations. The study thereby goes beyond the direct behavioural impact of information provided to consumers by including market offers. In this context, social practices such as cooking and heating are supposed

[141] E-Control (2011a) Verordnung der E-Control, mit der die Anforderungen an intelligente Messgeräte bestimmt werden (Intelligente Messgeräte-AnforderungsVO 2011 – IMA-VO 2011)

[142] E-Control (2011b) Erläuterungen zur Verordnung der Energie-Control Austria, mit der die Anforderungen an intelligente Messgeräte bestimmt werden, Intelligente Messgeräte-AnforderungsVO (IMA-VO 2011)

[143] DECC (2009) Impact assessment of a GB-wide smart meter roll-out for the domestic sector.

[144] Here, equally the DECC study, "Impact assessment of a GB-wide smart meter roll-out for the domestic sector", 2009, was referenced.

to have hardly any potential for being shifted to other periods during the day. Therefore, a load shift would hardly apply to gas consumption which is primarily used for these activities.

The explanations to the Smart Meter Requirements Ordinance (E-Control, 2011b) refer to some "consumer comfort" aspects which go beyond the mechanical logic of "data provision triggering behaviour response". The technical possibility of a remote activation and deactivation of the meters is explained to lead to advantages when tenants change; the deactivation can be done at the time when leaving the premise (e.g., an apartment) while the meter can remotely be activated immediately when the new occupants move in. This may be coordinated by phone avoiding the need for on-site appointments which may involve waiting times. Thereby, also conflicts between former and new occupants could be avoided. This feature could be traced to the behavioural model in the ECHOES micro-level framework as a perceived behaviour control element, and in particular as a perceived ease of use, potentially increasing acceptance of smart meters. In addition, having a more direct impact on the functioning of the meters would address the need of consumers for control and their fear of loss of control which was discussed by Kranz et al (2010)[145]. While this study associates the (perceived) loss of control with smart meter introduction itself, the mentioned gain in control may constitute a counter-effect, partly compensating fears. Another feature mentioned in the explanations equally addressing the ease-of-use but also reliability is the argued reduced need for manual gathering of meter data along with lower errors in billing and subsequent corrections. This is equally stated by the PwC study. Other aspects, which are labelled as consumer protection and social impacts, again refer to data provision by the possibility for timely control of consumption and subsequently consumption reduction.

Gaps and ECHOES knowledge application

Specific social sciences considerations are rare in the relevant documents. The major share, in particular the complete regulatory documentation, primarily established detailed requirements on data gathering, protection and provision and the specific technical requirements of smart meters as well as the procedure and targets for the smart meter roll-out. The most specific considerations are included in the PWC cost-benefit analysis by explicitly stating assumption on the impact (i.e. energy consumption savings) of smart meter introduction. However, explanations of the underlying considerations or evidence for these assumptions are limited. It needs to the acknowledged, though, that specific studies on customer response to smart meters are limited which was even more true at the time when the here presented documents were established. Broader considerations on psychological or sociological knowledge on behaviour, data needs, response to information etc. are, however, lacking.

4.3.4 Norway

Description of the policy

Over the next ten years, investment plans in the Norwegian distribution grid and regional grids amount to more than 10 billion Euro. According to the Norwegian Water Resources and Energy Directorate (NVE) investment costs differ hugely between companies (NVE, 2016[146]; NVE, n.d.[147]). Production and consumption trends imply that a substantial share of the grid investments will be made in order to avoid bottlenecks that are expected to occur only few hours each year. Hence, the full load hours of these grid assets are likely to be low. In such cases, the use of local flexibility resources, including end user flexibility, emerges as an economically attractive alternative to grid investments (THEMA, 2015[148]). It is assumed that consumer flexibility can contribute to improved price formation in spot markets, increased supply of system services, and potentially reduced local grid investments and operation costs. Therefore, flexibility´s value in the power system on long and short term should be emphasized in future activities. According to the report, the main goal should be increased knowledge on how market design and

[145] Kranz, J., Gallenkamp, J. & Picot, A. (2010) Power control to the people? Private consumers' acceptance of Smart Meters. South Africa: Proceedings of the 18th European Conference on Information Systems (ECIS).

[146] NVE (2016) Advanced Metering System (AMS) Status and plan for installation per Q2 2016, report no#79

[147] NVE (n.d.) Hvordan vil en omfattende elektrifisering av transportsektoren påvirke kraftsystemet, NVE notat https://www.nve.no/Media/4117/nve-notat-om-transport-og-kraftsystemet.pdf

[148] THEMA (2015) THEMA-Rapport 2015-37 Teoretisk tilnærming til en markedsløsning for lokal fleksibilitet

regulation must develop to exploit demand response efficiently. However, products and services on today´s market generally target larger consumers (not households) such as municipalities and the commercial building stock.

In order to facilitate development of the demand response flexibility in Norway, a smart meter technologies are considered within the major policies. Currently, there are some smart home products on the market, such as Lyses "Smartly" products, but so far, these do not include the possibility for the consumers' home networks to automatically react to price signals. Although some solutions are under development, at the moment the end user flexibility is perceived to be more relevant for the grid as a whole if the changes would be based on smart meter data and price signals (NVE, 2015[149]). Therefore, it has been decided that the currently used electricity meters are to be changed to smart meters before the end of 2019. However, even though as of January 2017 over 31% of the smart meters had been installed, the process is going considerably slower than previously anticipated and is increasingly lagging behind. The NVE is investigating the reasons for the lag and possible actions to implement. At the moment, the NVE's explanations are framed around the nature of the process: it is a time consuming and expensive project that requires major technological and organisational changes for the electricity providers (Smarte målarar, 2017[150]).

Therefore, it is clear that the major social science perspective implications in the Norwegian case are based on the attempt to influence consumer's energy choices in order to contribute to solving of technical complex problems.

Tariffs development as a factor of smart meters effectiveness

Considering smart meters as a tool of behaviour change, Norwegian policies imply largely an economic rationale of the users. Thus the policies are on investigation the impacts of tariffs structures that would provide an effective market pricing signal and trigger behaviour change. However, finding optimal and, perhaps consequently, easily communicated pricing models in electricity grids is challenging (THEMA, 2016[151]) – investments in the electricity grid happens in leaps and the network can to some extent be defined as a public good. Consequently, it is difficult to map the willingness to pay for it. Hence, the implementation of scarcity pricing and interruptible load contracts (ILC) is currently being explored (THEMA, 2016). However, as it is the net power need that conditions the dimensioning of the electricity grid. The challenge is to avoid local bottle necks in the distribution grid. (Smart strøm, 2016[152]). In order to do so, the use of net effect based pricing models provides a potential main contribution.

Currently, Eidefoss is the only Norwegian electricity provider that has implemented effect tariffs for all their customers, including those of second home owners. Eidefoss installed smart meters with weekly updates in 2006 and in 2009, and effect based tariffs to all customers. Moreover, the NVE's study shows that on an aggregated level no changes in the consumption patterns had been noted amongst the customers (THEMA, 2015). It might be a demonstration of the overall conclusion for the smart metering case: relying on the economic and market incentives for consumers' behaviour change does not bring the necessary results due to over-rationalising consumers, and therefore shall be accompanied by incentives of other nature.

Other factors for flexibility and smart meters dissemination

Research and demonstration projects that have been carried out so far for policies development, have tested different aspects of user flexibility and the general finding has been that the use of smart meters in households show a reduction in use of both energy and power load, but that end users find it difficult to differ between power load and energy. However, the studies also show that the effect is mainly caused by general consumption

[149] NVE (2015) Report no# 7, THEMA-Rapport nr 7 – 2015, NVE, Forbrukerfleksibilitet og styring av forbruk – pågående aktiviteter, http://publikasjoner.nve.no/rapport/2015/rapport2015_07.pdf

[150] Smarte målarar (2017) AMS, NVE Report 2017 (printed).

[151] THEMA (2016) Teoretisk tilnærming til en markedsløsning for local fleksibilitet, THEMA Report for NVE, 2016. http://publikasjoner.nve.no/rapport/2016/rapport2016_38.pdf

[152] Smart strøm (2016) ZERO memorandum. Smart strøm – neste skritt for de smarte, grønne forbrukerne., THEMA, 38-2016. https://www.zero.no/wp-content/uploads/2016/05/Smart-strom-neste-skritt-for-de-smarte-gronne-forbrukerne.pdf

reductions rather than load shifting (NVE, 2015). Increasing the end users flexibility based on net power load has so far been challenging. One major challenge may lay in the communication of the power based tariffs (Smart strøm, 2016), but it has also been suggested that simply communicating price as a motivating factor may not actually motivate end users to be more flexible. As an example, an explorative study showed that using smart meters to communicate other motivators for flexible end use of the grid as a whole (net effect) may be more effective, such as contributing to net security and safety ensuring access for all households (Löfström, 2014[153]). This conclusion could be of a specific use for the future policies, considering the fact that the sensibility and risk of breakdowns in the distribution grid increases as a consequence of that Norway's use of electricity enters new domains (EVs, local production, storage et cetera) (Regjeringen, 2016[154]). Overall, it could be stated, that the research on effective inclusion of social sciences perspectives for development of Norwegian policies for behaviour change is being implemented, but at the moment the results are not conclusive and particulate enough. The major interest of the motivation factors however stays in the field of effective information provision, communication matching the cognition aspects, and implying to a positive emotional response when it comes to perception of safety and security.

In order to facilitate flexibility growth, public acceptance and wider dissemination of smart meters, Norway has chosen to leave it open for end users to choose their own add-on functionalities and communication solutions based on their own data collected by their smart meter. These add-ons include a variety of feedback communication solutions in the form of continuous information and visualisations using either displays, applications or web portals; as well as automated steering services and safety and security systems (Energimeldingen, n.d.[155]). These add-on functionalities are not part of what is generally offered to the end users without extra costs. Currently, these solutions are being tested and evaluated in research projects and living labs. However, at the moment a wider users engagement (and increased flexibility as well) is problematic, especially because the mentioned add-on services are not included in the pre-default functions of already installed (or soon to be installed) smart meter. Without add-on services, the smart meter installation may actually mean that the end user experiences less control and receive less information than before, as the new meters do not even require the manual read-off of the meter that was previously required from them. (Löfström, 2014). At the same time, and perhaps consequently, it has been suggested that there should be an increased focus on achieving this engagement especially amongst potential prosumers.

Gaps and ECHOES knowledge application

Generally, the case of Norway represents the transition from perceiving energy consumers and smart meter (potential) user as economically driven rational entities, to individuals with versatile and complex motivations. Such, although at the moment the main focus is given to market price signals as incentives for behaviour change, background research for future policies development, white and green papers includes other behavioural factors into investigation. Nevertheless, referring to the ECHOES framework, the main attention is still paid to individual (micro-) level, and the structural factor, information provision and cognition, and emotional response within it. Thus, on the individual level, more attention could be recommended to be paid to moral motivations cascade implying to working with environmental values, personal and social norms, influence habits and social identities.

At the same time, minor to no attention is paid to meso- and macro-levels within the smart metering policies. Therefore, the potential of policies development could be found in addressing collective behaviour in patterns of energy lifestyles, energy cultures, and energy memories, as well as in recommending of the decision making algorithms and frameworks for municipalities and neighbourhood communities for the decisions of smart meters deployment and the choice of exact functionalities set.

[153] Löfström, E. (2014) Smart meters and people using the grid: exploring the potential benefits of AMR-technology. Energy Procedia, 58, 65-72.

[154] Regieringen (2016) Meld. St. 25 (2015–2016). Kraft til endring, energipolitikken mot 2030, p 184 f, paragraph 14.3.2.

[155] Energimeldingen (n.d.) Kraft til endring, energipolitikken mot 2030 - consumer as a centre of the smart meter/grid programme. https://www.regjeringen.no/contentassets/31249efa2ca6425cab08130b35ebb997/no/pdfs/stm201520160025000dddpdfs.pdf

Moreover, the Norwegian policies are focusing more on the smart meters use for behaviour change (as a factor of demand flexibility), than on the promoting smart meters themselves. It might to a certain degree hinder the dissemination of smart meters and therefore impede fast achieving the ultimate goal (demand flexibility for technical solutions). In that view it could be recommended to develop a more structured strategy of smart meters promotion, using social sciences perspectives.

4.3.5 Italy

Description of the policy – general

Italy was one of the first countries implementing a large scale roll-out of smart metering systems, starting in 2001. Although initially the decision was dictated by the cost efficiency of the programme, since its beginning the attention has been shifted to the resulting increase of service quality for different stakeholders (Bettenzoli et al, 2017[156]). Such, by 2008 the instalment percentage was nearly 100%. The architectural configuration of the current smart metering systems ('first generation') is based on the 2000's requirements of improving metering effectiveness, introducing service level agreements, and support the mandatory adoption of Time-of-Use energy pricing. However, the smart meters of the first generation are currently undergoing physical and functional obsolescence. As a consequence, the distribution companies, following the requirements of Legislative Decree 102/2014, need to replace the current meters. In 2017, E- distribuzione (the main DSO on the Italian market) has started a programme aimed at replacing 32 Mln smart meters with the meters of the new generation, as well installing of nearly 9 Mln new smart meters.

The new type of smart metering system received the name "Second generation" ("SM2G") and aimed at customer service improvements, increasing accuracy of metering, and overcoming consumptions estimation. In the consultation document 416/2015/R/eel from 6 August 2015, the state authorities provided the guidelines for defining the functional specifications of the SM2G. Such, new generation smart meters shall have an additional functionality that would allow the provision of validated measurement data on a daily basis, with improvements in balancing and settlement, and providing consumers with much more detailed information regarding the use of electricity. Moreover, the new system infrastructure combines two communication channels, one of which ("chain 2") provides non validated "raw" metering data directly to the customer in nearly real time (within seconds) (Bettenzoli et al, 2017).

Social sciences perspective inclusion

The policies show that such improvements are expected to facilitate energy efficiency promotion and raising awareness for consumer behaviour change. According to Resolution 87/2016/R/Eel, the new smart meters will provide multiple benefits and would become a useful tool for consumers who, in addition to monitoring their precise energy consumption, will have the opportunity to increase their energy awareness and make choices in line with their habits, lifestyle and sensitivity to environmental issues. Thus, it is evident that, similar to policies on EU level, the instalment of a smart metering system itself is perceived to be a measure to promote energy behaviour change as a result of an informed choice. The fundamental customer-focused features of the new generation measuring system show how the improved information provision is supposed to facilitate energy efficiency in individual behaviour (extracted from E-distribuzione Guide, 2017[157], and analysis of Bettenzoli et al, 2017):

[156] Bettenzoli, E., Cirillo, D., De Min, M., Lo Schiavo, L., Pitì, A. (2017) The Italian Case on Smart Meters in the Electricity Market: a New Wave of Evolution is Ready to Come. The ICER Chronicle, Edition 6, p. 12-22.

[157] E-Distribuzione Guide (2017). Retrieved at December 4, 2017 from https://www.e-distribuzione.it/it-IT/Lists/DOCUMENTIRETE/Guide%20Utili/Open%20Meter_Una%20guida%20su%20cui%20contare.pdf

- Enabling consumers to verify how much electricity has been consumed and recorded by the meter, divided into different time slots.
- Enabling consumers to examine the daily consumption trend in detail through the measurement data in 15 minutes intervals.
- Giving consumers an opportunity to know the actual power consumption at all times on the average for every quarter of an hour and on the day maximum.
- Enabling providers to send customers timely bills, presumably decreasing the bill.
- Introduction of a PLC (Power Line Communication) channel for provision of the metering data to the local home automation device of the customer (exclusively at the request of the customer).
- Multiple channels of consumption information provision: display, advanced dashboard, smart appliances, or optionally downloadable in form of dataset and graphics, or online on the website or in a smartphone app.
- Multiple types of information representation to the consumer becomes available, such as for example visualization of daily energy curves, active power, contractual information and alerts with the customisable sampling frequency (Bettenzoli et al, 2017).
- The advanced dashboards and automated systems (appliances) can receive information from other players of the energy market, couple them with the consumer's data in order to make customers aware about the current advantages of a responsible energy use.
- Third parties are enabled to provide customers with the feedback on their consumption behaviour, both in real time or attached to the invoice reports, aiming at increasing customers' awareness and habits change.

The list of the measures demonstrates that the main customer focus (in social sciences perspective) in the Italian smart metering policies is given to enabling behaviour change through enhancing the informed choice situation. Multiple technological developments in smart metering are aimed at provision of more timely, more accurate, and more understandable information and suggest several options for channels and representation forms, depending on consumer preferences. It confirms the EU level policies tendency of strongly rationalising the consumers' behaviour assuming a rational and possibly deliberate decision making.

Much less attention in the Italian smart metering policies is given to customer-focused measures that would promote smart metering systems themselves and the SM2G roll-out in particular. The existing incentives aimed at the customers mostly comprise structural (economic and institutional) measures.

For example, Resolution 87/2016/R/eel (AEEGSI, 2016[158]; 2017[159]) suggests incentive mechanisms for recognising the costs associated with the replacement of SM1G with new systems in order to ensure timely, effective and progressive deployment of the SM2G benefits. Another structural measure concerns new contract types becoming available to consumers – more flexible pre-paid contracts and more customised schemes of Time-of-Use prices and real-time-pricing regime. This measure is seen in the policies on one hand as facilitating the acceptance due

[158] AEEGSI (2016) Delibera 08 marzo 2016 87/2016/R/eel. Specifiche funzionali abilitanti i misuratori intelligenti in bassa tensione e performance dei relativi sistemi di smart metering di seconda generazione (2G) nel settore elettrico, ai sensi del Decreto legislativo 4 luglio 2014, n. 102

[159] AEEGSI (2017) Delibera 10 Aprile 222/2017/R/eel. Smart metering di seconda generazione (2G): decisione sul piano di messa in servizio di e-distribuzione S.p.a.

to increased service quality (AEEGSI, 2015[160]), and on the other, providing more incentives to enhance load shifting with consequent savings on the electricity bills.

Thus, it is assumed that mostly the recognition of the economic benefits against the costs would stimulate consumers to accept the new meters. In addition to that, service quality and "convenience" of contracts have been taken into account for policymaking. However, in our view the core of the measures still reflects a strongly rational consumer whose behaviour is dictated mostly by deliberate and thorough evaluation of costs and benefits.

The contracting measures were illustrated in the stakeholder consultations to meet the interest of consumer associations. In fact, in 2016, the E-distribuzione launched a series of public consultations, the outcomes of which were taken into account in the follow up Resolution 222/2017/R/eel. However, although the consultations included customer associations, they focused mostly on technical aspects of smart metering, and seem to have preferred and emphasised the industrial parties' opinions.

Gaps and ECHOES knowledge application

There were close to no consumer-aimed measures taking the broad social sciences perspective in the Italian smart metering policies. The existing measures are focused on structural aspects (with technical, economic and institutional factors) of behaviour change. As in the EU level policies, it is not clear, whether the policies adopt an individual decision making perspective (macro-level) or an individual (micro-) level for constructing the approaches to consumer behaviour change. Nevertheless, in both options one could say, that sociological and psychological factors were mostly overlooked in the current policies. It might be beneficial for the current SM2G roll-out programme to include moral motivations, habits, attitudes, emotions and social identities aspects into the incentives construct of the policies. At the sociological level, the benefits could be found in addressing energy lifestyles and cultures, but foremost the energy memories on the background of already succeeded roll-out programme for the first generation meters.

On the other hand, the minor attention to consumer-focused measures in the policies might be connected to the fact, that the current Italian policies concern replacement of the existing smart meters with the systems of the new generation. Thus, as the devices by nature are not new for the customers, but only broaden the functionalities, raising the awareness and acceptance might be less of a problem for policymaking. Therefore, more empirical research might be needed to investigate the acceptance challenges of the SM2G among the population itself, and then then the ways to advance it.

4.3.6 Sweden

Description of the policy

Initiating the nationwide deployment of smart meters in 2003 (first wave roll-out ended in 2009), Sweden was one of the first European countries to introduce smart meters on a large scale. The roots of the roll-out programme could be found in the deep dissatisfaction of the Swedish consumers with the network operators and energy retailer companies, and the consequent perceived necessity to establish direct connection between energy consumption and billing. In the start-up phase, the demand of hourly readings only applied to consumers over 63A, which in practice means that most of the households were not included in the initial roll-out. Initially, the roll-out of smart meters was not paired with other specific demands of functionality than providing correct measurements (monthly for below 16A customers and hourly for those from 16A and up). Requirements on accurate monthly invoices based upon actual meter readings was fully in force in July 1st 2009 for all residential customers. More correct electricity bills had become beneficial for the market and enable better planning on the distribution system, but it also strengthened the consumers' position on the market. It was assumed that more accurate information would motivate

[160] AEEGSI (2015) Delibera 22 dicembre 2015 646/2015/R/eel. Testo integrato della regolazione output-based dei servizi di distribuzione e misura dell'energia elettrica, per il periodo di regolazione 2016-2023.

households to conserve energy and also make them more active on the market and stimulate them to switch between providers (Vissa elmarknadsfrågor, 2002[161]).

The initial regulations on smart metering were based on the obligatory monthly readings of the electricity consumption for each meter in June 1st 2009, and were later replaced by hourly readings in Oct 1st 2012. The hourly measurements requirement was paired with the obligations to introduce hour-based tariffs to the customers, however in practice the access to hourly measurements has been made available to customers without offering them hourly-based tariffs. Moreover, as the first meters are now about to be outdated in terms of functionality and performance, a new generation of even more advanced meters will be required to meet the future demands of digitalisation. The first wave of smart meters is expected to be replaced by the early 2020s. Hence, preparation for a second roll-out wave are currently being made (EI, 2017). Sweden´s three biggest Distribution System Operators - E.ON, Ellevio and Vattenfall - are in the planning stage for their second wave deployments. It is estimated that around 5 million next generation meters will be installed in Sweden before 2025 (Swedishsmartgrid, 2016[162]).

Social Sciences Perspective

In general, the Swedish case is interesting from the social sciences perspective, as the initial roll-out was caused by consideration of consumers' perception of the electricity system and in order to deal with the multiple complaints from consumers to the electricity companies. And although it was expected that the roll-out would bring the consumers (and later prosumers) to a more active participation on the market and facilitated handling technical issues of the grid, these were not the primary reasons of the programme. Indeed, as is for now it is seen that the advantages for consumers are based on a better oversight of their energy consumption, more accurate billing, and decreased switching times and improved data handling processes. However, to achieve more active participation and encourage consumer to lower their energy consumption, the accurate invoices are tried to be accompanied by the increased awareness.

Therefore, already in 2012 the Swedish Coordination Council for Smart Grid has started addressing the behavioural aspects of working with consumers, and stated the following six major challenges (Swedish Coordination Council for Smart Grid, 2012[163]):

- Understanding consumers' adaptation period to new market possibilities
- Creating attractive incentives to activate early adopters
- Differentiation of incentives for different costumers needed (considering motivations based on economy, environmental concerns, simplicity, independence etc.)
- Finding the optimal price formation for influencing demand response
- Effective provision of information and knowledge about own consumption patterns and possibilities for change
- Development of attractive offers from supplier or third parties (bundled with other services)

Thus, although the structure of tariffs and other market and economic aspects are perceived to be important for the incentive structure, the psychological factors are equally considered. From this list one could see attention to moral motivations cascades, perceives behaviour control and ease of use, addressing information provision and cognition aspects etc. However, the stated challenges do not find the answers in the current official policies documents.

[161] Vissa elmarknadsfrågor (2002) Proposition 2002/03:85

[162] Swedishsmartgrid (2016) Planera för effect. Retrieved at January 5th, 2018 from http://swedishsmartgrid.se/wpcontent/uploads/2016/04/1418219647sou2014_84_webb.pdf

[163] Swedish Coordination Council for Smart Grid (2012) Smart grid promotion policy and activity in Sweden. Presentation on the Sweden day, October 23, Smart City Week 2013. Retrieved on December 10, 2017 from http://swedishsmartgrid.se/wp-content/uploads/2016/04/swe-day-smart-city-week-23-okt-k-widegren.pdf

Nevertheless, some of them are addressed in communication with the public through the online "Smart forum"[164]. Moreover, the Big Three (three major electricity providers) develop online services - websites where customers are able to see information on their consumption.

Effects of the policies and follow-ups

As a result of the initial roll-out, the electricity companies' direct communication with its customers, and therefore the acceptance and trust to electricity companies increased as the electricity bills became more accurate (Personal communication, 2017[165]). Such, the initial goal was met by the policies. However, although Swedish households have indeed become more active as customers on the electricity market (e.g. changing supplier), Swedish households have not been as active in adjusting their electricity use based on the access to new pricing models and smart metering data as had been anticipated (Personal communication, 2017). In that view, a recent report from the Swedish Energy Markets Inspectorate (EI, 2017[166]), was prepared for the Swedish Government to "be used as a basis for making decisions on what demands should be put on the functionality of smart meters in order to facilitate a transition to a sustainable energy system which includes micro production and help customers become more active" (personal communication, 2017). However, the formal decisions are still to be made. Among other measures, the report suggests seven requirements to smart meters that are supposed to increase end users possibility to control their own electricity use and to increase flexibility (EI, 2017).

Gaps and ECHOES knowledge application

Although the smart metering roll-out programme is in the second wave stage, the reasons for the current actions differ from the initial intentions. From the social science perspective, the current objective is to engage consumers into more active participation on the market, vs. the previous achieving the higher satisfaction with the electricity system. Therefore, comparing to the Italian case, where minor attention to consumer-focused measures could potentially be enough, the Swedish second wave roll-out might require more elaborate policies of consumer engagement. At the same time, the investigation of the effective measures has not yet been comprehensively reflected in elaborated policies, and in that view insights from ECHOES project's findings could be used. Such, on the individual (micro) level, more attention shall be paid to development and addressing personal and social norms, social identification, and habits. On the meso-level, customers' segmentation is needed to identify and develop policies to tap into energy lifestyles, culture, and memories. On the macro-level connected to formal decision making, structured approach to identification of significant impact factors and elaboration of "decision making" frameworks for the formal units and individuals within them could be useful for smoother and faster dissemination of smart meters of the new generation.

4.4 Breakdown to regions and local social units (examples)

4.4.1 Customer Advice Center Germany (Verbraucherzentrale)

The German Customer Advice Center Germany (Verbraucherzentrale) takes a critical position on the introduction of smart meters in households (Verbraucherzentrale, 2017[167]). Besides providing general explanations on smart meters, their functioning, advantages and risks, in particular the cost aspect is highlighted. Data protection risks, going along with the potential use of personal data for marketing and criminal activities are mentioned while acknowledging that high data protection requirements are put in place. The Center neglects cost advantages for households, arguing with additional costs for the introduction of smart meters and the current absence of variable tariffs and compatible devices. An average household with up to four members and an annual consumption of 3,600

[164] http://swedishsmartgrid.se/in-english/

[165] Personal communication 2017-12-21 kl 10-11,30 CET with Marielle Lahti and Albin Carlén at the Swedish Smartgrid Forum. http://swedishsmartgrid.se/in-english/

[166] EI (2017) R2017:08, Funktionskrav på elmätare – författningsförslag, Swedish Energy Markets Inspectorate/Energimarknadsinspektionen

[167] Verbraucherzentrale (2017) Erste Strom-Kunden müssen den Einbau von Smart-Meter-Geräten zahlen. www.verbraucherzentrale.de Accessed on December, 5th, 2017

kWh would need to pay about 40 EUR as compared to 13 EUR for measuring services per year. In addition, several hundreds of Euros might be required if substantial changes to the measuring infrastructure are required.

The Advice Center therefore considers consumers' motivation from the perspective of economic costs and benefits. The sociological and psychological factors such as emotional benefits of taking control over the own energy consumption are not mentioned in the considered sources. At the same time, the nature of the organisation being an advisory agent, could partially justify this perspective which provides cost-benefit analysis (CBA) as a primarily considered factor for decision making, addressing the macro-level (as in the ECHOES framework). However, as it is studied within the ECHOES project, the perspective shall not stop with CBA only.

4.4.2 Workers' Chamber Austria

The Austrian Workers' Chamber equally takes a critical perspective and provides specific information as well as a template for the refusal of the "smart" functions of smart meters (Arbeiterkammer, 2017a[168]). The refusal in particular relates to data protection aspects. The Chamber provides general information on the smart meter introduction and the options that may be chosen by consumers.

The chamber demands the following (Arbeiterkammer, 2017b[169]):

- A reduction of the targeted introduction share of 95% by 2019 in private households which is considered over-ambitious (which indeed is currently under revision)
- Consumers are informed timely on the introduction, the function and options for smart meters
- No increase of measuring fees
- No limits to the refusal of smart meters apply (this "opt out" option was foreseen to be limited to a certain share of consumers)
- The use of the "opt out"-option should include the traceable deactivation of all "intelligent" functions, in particular data storage. The remote transfer of, e.g., annual billing is however perceived as advantage for customers due to the increase of comfort and reliable billing.

The Chamber commissioned a legal study by the University of Vienna on the right of consumers to refuse a smart meter ("opt out"). The background was that the current legislation would allow this refusal for only up to five percent of households. The study concluded, that the right to refuse smart meter functions founds on current data protection legislation and must not be constrained (Ennöckl, 2017).

In this perspective, the Chamber considers citizen's rights to be a primary aspect for decisions on regulatory level. From the social sciences perspective, it addressed the macro-level processes; the stated demands loosely provide a framework for regulatory decisions.

4.4.3 City of Polokwane, South Africa

City of Polokwane in Limpopo province, South Africa, has launched its own smart metering systems roll-out programme in 2017. The premises of that decision were found in two major factors: significant losses of the municipality and providing companies due to illegal connections, and the large share of citizens' complaints on unreliable billing system. The programme is focused mostly on water and electricity smart metering and assumes

[168] Arbeiterkammer (2017a) "Smart Meter" – Die Ablehnung („Opt-Out"). https://www.arbeiterkammer.at/service/musterbriefe/Konsumentenschutz/datenschutz/Smart_Meter_ablehnen.html Accessed on December, 22, 2017

[169] Arbeiterkammer (2017b) FAQs zum Smart Meter https://www.arbeiterkammer.at/beratung/konsument/Datenschutz/FAQs_zum_Smart_Meter.html Accessed on December, 22, 2017.

instalment of usual and pre-paid smart meters, starting from the district of Nirvana and moving to other areas of the city (Polokwane, 2017[170]) covering the whole municipality by 2022.

It is important to note that in this case the smart metering roll-out has been caused by consideration of consumers' acceptance of the current system, and a high negative (probably including emotional) response. That brings up the importance of the social perspective for the policies to be formed.

Similar to all other smart metering policies, Polokwane hopes to empower consumers, raise their awareness of own water and energy consumption and thus stimulate behaviour shift towards conservation practices due to rational decision based on cost savings.

The policymaking on the programme is still in progress, however the initial conclusions on inclusion of other social sciences perspectives could be made. Such, for example, the programme uses a pilot district roll-out to test public acceptance of the programme (Polokwane, 2017), considering it as awareness raising and experience creation. Moreover, an stakeholders consultations with the public are being implemented to include individual consumers' perspective, and along with the media release – to create familiarity with the project avoiding negative emotional response in the future when installers would come to people's homes (Polokwane, 2017). These measures imply to consideration of individual consumers on micro-level (in ECHOES framework). Implying to the meso-level, the policy separates serial defaulters from the general consumers, and address their energy practices by installing on their premises the prepaid smart meters immediately.

As the municipality's policy is still in the stage of elaboration, it is early to make conclusions on the gaps in it. However, focusing on the ECHOES framework, at the moment more attention could be paid to formation of personal and social norms, attitudes, habits, and structural incentive (channels and contents of information provision), as well as addressing energy lifestyles, cultures and memories among different social groups.

4.5 Conclusions on the social science perspective in the smart meters case

The predominance of information provision, and consequently data management, protection, and presentation can be generalized for close to all analysed documents and mostly address the individual. Information provision mostly contributes to the "mechanical" assumption that data input leads to behaviour change without establishing the underlying motivation cascade. The information provided mostly refers to current and historic energy consumption and corresponding costs which most apparently address the rational and, explicitly, economic dimension of behaviour. The intention "saving money spent on energy" may be the most likely one directly addressed by the two data elements "energy amount consumed" and "related costs". Other potential motivations such as environmental values may equally be served by information provision but are not explicitly stated. The assumed motivation for behaviour change therefore mostly stays on the level of individuals or companies. The ECHOES review, however, suggests that the contribution to a broader scope may equally be an important behavioural driver. Whether this perspective is equally addressed ultimately depends on the specific information provided to consumers in the context of smart meter introduction. A typical contribution to this broader motivation would be to provide information on the need for energy efficiency and climate change in general, addressing the element of awareness on consequences in the moral motivations cascade.

The lack of the level of detail in explicitly addressing the way how information can effectively be presented to consumers such that the information is well received and used may simply be perceived as a lack in policymaking, indicating a potential failure to address consumers appropriately. From another perspective, the existing policies only cover a first step and provide the basis in exploring how users may be involved in the energy transition by

[170] Polokwane (2017) MEDIA RELEASE – City of POLOKWANE Launches Smart Metering. Polokwane's official website. Retrieve at December 20, 2017 from https://www.polokwane.gov.za/SPX%20News%20Article/MEDIA%20RELEASE%20%E2%80%93%20City%20of%20POLOKWANE%20Launches%20Smart%20Metering.aspx

demand response – the major argument for smart meters on consumer level. Technical requirements, such as prescribed connections to external energy monitoring and management devices, provide important room for a further development which will primarily evolve on the market. An important next step coming after “manual observation and reaction” is the automation of demand (and production) response. The market share of corresponding products is still low and service offers are still at the initial phase, at least for the household level. In the end, additional, connected devices “behind the meter” and related services are likely to take over the leadership in addressing specific consumer needs and motivations.

5 CASE 3: PHOTOVOLTAICS

5.1 Rationale for choosing the case and the country level examples

Like electric mobility, the diffusion of photovoltaics is a highly prioritized focus of the revised SET plan. A PV implementation plan was endorsed by in November 2017 by the SET-plan steering group[171], which aims at a global leadership of the EU in photovoltaics. The price for photovoltaic modules have dropped drastically and are projected to drop further within the common years[172], which make the technology both economically interesting as it becomes independent of subsidy and relevant as an investment for individual consumers / house owners. That being said, it needs to be acknowledged that installing a PV panel on one's house is still connected to a substantial upfront investment which restricts its feasibility to the wealthier sections of a population in absence of financing models that help lower income households to finance the initial costs. Nonetheless, PV installations owned by consumers have seen substantial growth in many European countries, which make them a relevant case of prosumerism in the energy sector. However, the analyses below also show how responsive the market developments are for changes in legislative frameworks. To explore these issues further a selection of countries with high PV diffusion and lower PV diffusion was made, as well as countries with stable regulatory frameworks as compared to countries with frameworks that had been adjusted.

5.2 Introduction to the case

This section of the report documents the high relevance of citizen engagement – and a supportive regulatory framework - for the uptake of photovoltaic systems in six European countries. It will show in a comparative analysis how countries with a rather stable support framework have experienced a continuous growth of individual and collective citizen investments in PV, even in times when PV was not yet fully competitive with other sources of electricity generation and required subsidies. To the contrary, drastic changes in the regulatory environment and support schemes immediately provoked a down-turn in an emerging, and therefore still vulnerable sector. With the strongly falling costs of PV, it can be expected that the future will develop along slightly different lines, without the need for public subsidies. However, from the point of view of governance of the energy transition, it may still be wise to anchor this transition in findings from social sciences, in order to assure that "citizen energy" can grow in a sustainable way and benefit a larger part of the EU population.

5.3 Definitions

Photovoltaics (PV): refers to the production of electricity by using solar energy as fuel. The most important characteristic of PV, which makes it different from most other energy technologies, is its scalability, which permits the commercial exploitation of large-scale plants and small-scale – generally roof-top – installations, as well as the integration of PV solutions in products and buildings.

Citizen engagement: refers to the financing and operation of generally small-scale PV systems by households, as well as the joint exploitation of larger installations by groups of citizens, also referred to as "community solar".

Prosumer: energy consumer (household or enterprise), who produces part of the energy consumed

Self-generation: electricity produced on the premises of any type of consumer (household, commercial, industrial).

5.4 Trends in PV deployment

The six countries analysed in this report have all established more or less ambitious policy objectives for PV deployment for the next decades, as shown in Table 5.1. However, as shown later on in the country analysis, some

[171] http://www.etip-pv.eu/fileadmin/Documents/SET_Plan/4._SET_Plan_Implementation_Plan_PV.pdf

[172] http://www.fvee.de/fileadmin/publikationen/weitere_publikationen/15_AgoraEnergiewende-ISE_Current_and_Future_Cost_of_PV.pdf

of the countries have not consistently supported citizen investment and engagement in PV, leading to a slow-down of new installations in some parts of Europe right at the time when PV was embraced on the world markets, thanks to a steep drop in costs, which IRENA[173] and many other experts expect to continue over the next years. Contrary to these developments in the worldwide market, some European Countries, among them Belgium, Germany, Italy and Spain, registered a strong decline in new PV installations as shown in Figure 5.1.

Table 5.1: PV development in the EU Member States

Country	Installed capacity (MW)	2020 Objective (MW)	2025 Objective	2030 Objectives	2050 Objective
France (2Q 2017)	7,399	8,000	20,200 (2023)		199,000
Germany (2016)	42,450	52,000		170,000	122,000
Italy (2016)	19,265	22,280			
Netherlands (2017)	2,000	5,500		20,000 (2035)	
Portugal (4/2016)	496	670			
Spain (12/ 2016*)	4,674	8,367			
Total EU	**94,349.4**				

**grid connected, another 55 MW are stand-alone systems*
Source: For installed capacity in major markets: Masson (2016)174and IRENA RENEWABLE CAPACITY STATISTICS 2017, for smaller PV markets: EurObserver Photovoltaic Barometer and national sources: Netherlands "Nationale Energieverkenning 2017175", Germany: Fraunhofer-ISE176

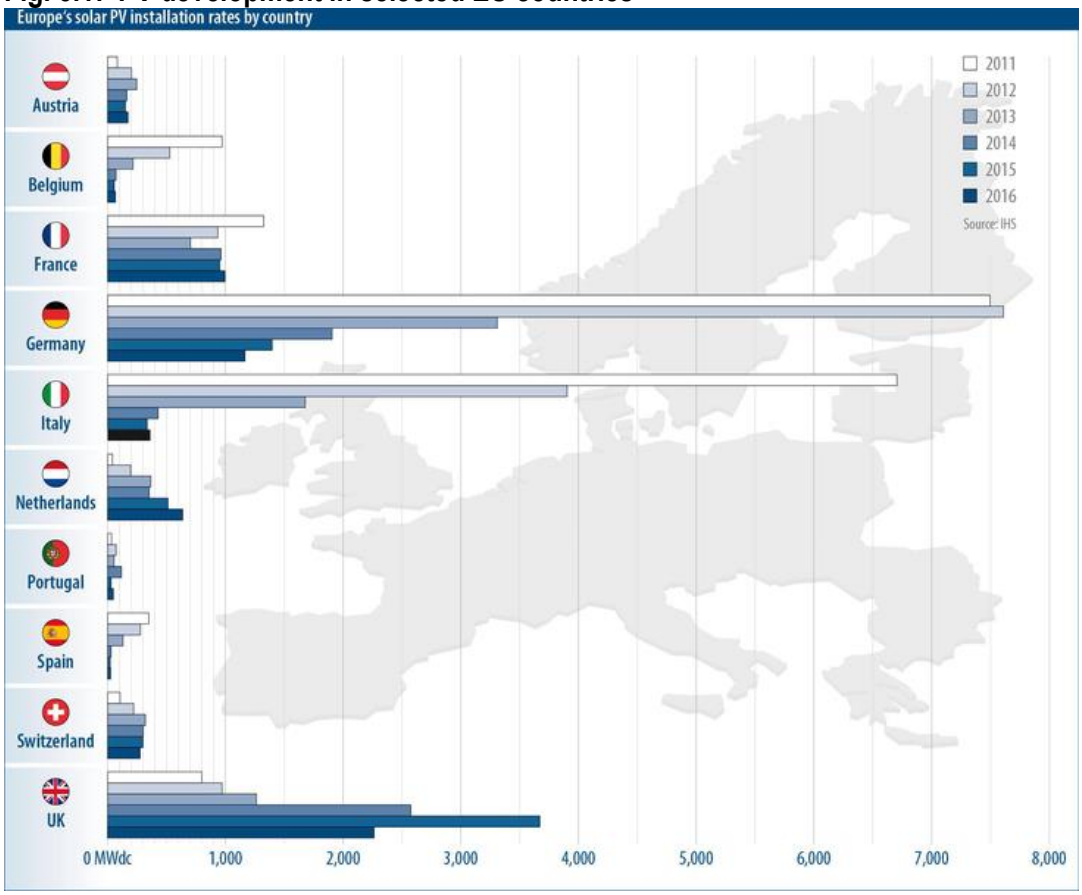
[173] IRENA (2016),The power to change: Solar and wind cost reduction potential to 2025".

[174] IEA-PVPS (2016), "A_Snapshot_of_Global_PV_-_1992-2015"

[175] ECN 2017, Nationale Energieverkenning 2017", https://www.ecn.nl/publicaties/PdfFetch.aspx?nr=ECN-O--17-018

[176] https://www.energy-charts.de/power_inst.htm

Fig. 5.1: PV development in selected EU countries



Source: ©PV Magazine[177]

In the following, we explain how regulatory changes and the lack of consideration of social science aspects have contributed to the decline in PV installations in some Member States and to a more stable growth in others.

5.5 Social sciences perspective inclusion in support policy for PV

Policymakers on EU level have started to recognize the importance of citizens for the successful implementation of the energy transition since the Commission paved the way for stronger citizen engagement in the energy field with the 2015 communication on Delivering a New Deal for Energy Consumers[178]. The most recent EU energy policy initiative – the CleanEnergy4AllEuropeans Package – specifically puts the consumer "at the heart of the energy system", and the EU Council has endorsed this legislative package. After the EU Council decision supporting a reorganization of the electricity market at the end of 2017, the Estonian presidency recognized that the "EU electricity market has been transformed by digitalisation, renewables and active consumers and we need new rules to fit the new reality".[179]

[177] *https://pv-magazine-usa.com/2016/06/21/europes-solar-forecast-partly-shaded/*

[178] http://www.europarl.europa.eu/RegData/etudes/BRIE/2016/573896/EPRS_BRI(2016)573896_EN.pdf

[179] Kadri Simson, Minister for Economic Affairs and Infrastructure of the Republic of Estonia http://www.consilium.europa.eu/en/press/press-releases/2017/12/19/creating-a-modern-electricity-market-council-agrees-its-position/

The role of consumers and self-producers is discussed in several of the legislative proposals composing the Clean Energy Package, which comprises revisions of the present regulations on energy efficiency, renewable energy, the design of the electricity market, security of electricity supply and governance rules for the Energy Union.

The strong governance required to successfully implement the Clean Energy Package is expected to bring benefits to the EU citizens by means of "better information on the implementation of the Energy Union and its associated policies"[180], since it is the declared goal of the Energy Union to deliver "secure, sustainable, competitive and affordable energy" and a "fair deal" to the European consumers. The governance proposal recognizes that the role of the consumer needs reinforcement in EU energy policy and the periodic reports to be elaborated by the Member States should inform about progress in renewable energy production by communities and self-producers.

The objectives defined in the governance regulation is reinforced by the revised renewable energy directive (RED), which explicitly supports self-production of energy (heat and electricity), while the revised Energy Efficiency Directive (EED) and the Energy Performance for Buildings Directive pay special attention to individual consumer choice, which is presently not guaranteed in all Member States, given the established infrastructure, for example, outdated heating networks, and the equipment of the building stock. The RED lists a series of options to empower energy consumers and put them on equal footing with the established market actors, opening the door to aggregation of demand and production sites, although the final provisions of the revised directives are still under negotiations.

Although political support seems to be growing, up to the date this paper was written, the "EU has no specific legislation on prosumers, self-generation or self-consumption"[181] nor a consensus on quantitative objectives. The EU Parliament has twice requested an EU definition for "prosumers". The Commission's proposal for a revised renewable directive, which is part of the legislative "package", aims to resolve this situation by recognizing the right to self-consume and to sell excess production "without being subject to disproportionate procedures and charges that are not cost-reflective"[182]. It also recognizes the important role of shared self-production or community energy for the energy transition. Discussion is still ongoing, though, about the concrete type of interaction between PV owners and the market, since the regulator, ACER, insists that "self-generators pay their fair share of network and system costs and that, for similar reasons, net metering is avoided"[183], whereas the consumer organization BEUC, for example, sees the need for a "simple and reliable framework", which is adapted to the possibilities of an energy producer, who does not work on gigawatt scale, as the traditional utilities do[184].

Also, the European institutions and Member States still need to elaborate consensus in the field of renewable energy objectives for 2030, since the Commission's proposal set the objective at 27%, without binding targets for the Member States, while the EU Parliament's technical committee ITRE recommends a 35% share and the upholding of national quotas.

5.6 National analysis

The national case studies presented below explain the importance of a stable and favourable legal framework for the blossoming of citizen engagement in energy production by means of PV.

[180] European Commission (2016a), „Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the Governance of the Energy Union"

[181] Šajn, N. (2016), „Briefing November 2016 Electricity 'Prosumers', EPRS European Parliamentary Research Service

[182] SolarPower Europe (2016), „The Winter Package: what does it mean for solar?"
http://www.solarpowereurope.org/fileadmin/user_upload/documents/Policy_Papers/Winter_Package_information_pack.pdf

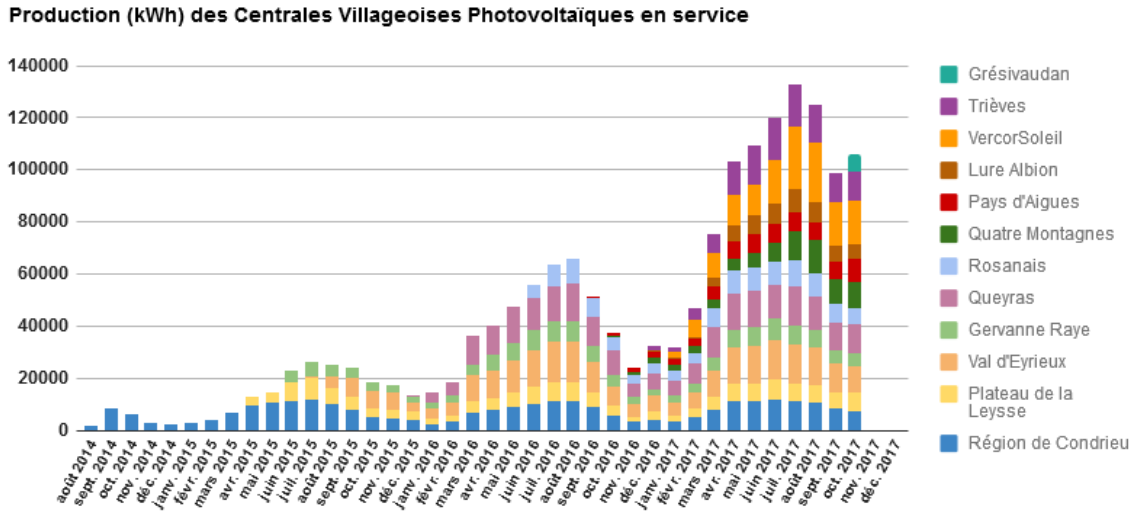
[183] https://www.acer.europa.eu/Official_documents/Position_Papers/Position%20papers/WP%20ACER%2001%2017.pdf

[184] http://www.beuc.eu/publications/beuc-x-2016-001_jmu_welcome_culture_for_solar_self-generation.pdf

5.6.1 France

In 2016, France announced increased investments in PV for the next years. The country foresees to achieve 20,200 MW of installed PV capacity in 2023 and has published a calendar of new calls for tenders totalling 4,350 MW between 2016 and 2019. The latest figures available on installed PV capacity, referring to the end of June 2017, show that mainland France had 7,014 MW of installed PV power[185], while its overseas territories reached 385 MW. Around 776 MW of all the cumulative power on the mainland is represented by small PV systems not exceeding 3 kW. According to the French Ministry for Ecologic Transition and Solidarity[186], the regions with the highest amount of installed solar power are Nouvelle Aquitaine (1,796 MW), Occitan (1,516 MW), Provence-Alpes-Côte d'Azur (986 MW) and Auvergne-Rhône-Alpes (728 MW)[187]. Although progress in PV deployment has been slightly slower in 2017 than in 2016, the French PV deployment strategy is progressing well, since it includes the novel instrument of "participative financing"[188] through companies that are jointly owned by local economic actors and engaged citizens. These community projects are enabled by the **French Law on Energy Transition and Green Growth**, which promotes this direct involvement of collectives in the financing and management of renewable energy projects[189][190]. On this background, citizens in the French region of Auvergne-Rhône-Alpes have initiated the "Centrales villageoises photovoltaique", a community concept for PV, which, in August 2017, had created 20 local, citizen-participated companies in 25 locations with 91 solar installations totalling 866 kW of capacity. Their combined production reaches 1.05 GWh/ year and the constant growth of production since 2014 is shown in Figure 5.2 below.

Fig. 5.2: Production (in kWh) in citizen-participated PV plants in Rhone-Alpes



Source: [Centrales Villageoises Photovoltaique]

The French law on the energy transition is supporting the engagement of local collectives and private investments in renewable energy by measures such as purchase obligations to finance renewable electricity that is self-generated and consumed by individuals and businesses. The law seeks to mobilise local actors, companies and

[185] Bellini, E. (2017), "France registers 233 MW of new PV capacity in first half of 2017", PV Magazine, https://www.pv-magazine.com/2017/09/04/france-registers-233-mw-of-new-pv-capacity-in-first-half-of-2017/

[186] https://www.ecologique-solidaire.gouv.fr/solaire

[187] http://www.statistiques.developpement-durable.gouv.fr/publicationweb/40

[188] https://www.ecologique-solidaire.gouv.fr/des-projets-exemplaires-financement-participatif-dans-territoires

[189] https://www.ecologique-solidaire.gouv.fr/des-projets-exemplaires-financement-participatif-dans-territoires

[190] http://www.photovoltaique.info/Acteurs-de-l-investissement.html

citizens to improve the efficiency of the energy system by creating "energy positive territories" and by introducing mechanisms to foster demand side participation (demand response) by individual households and aggregators[191].

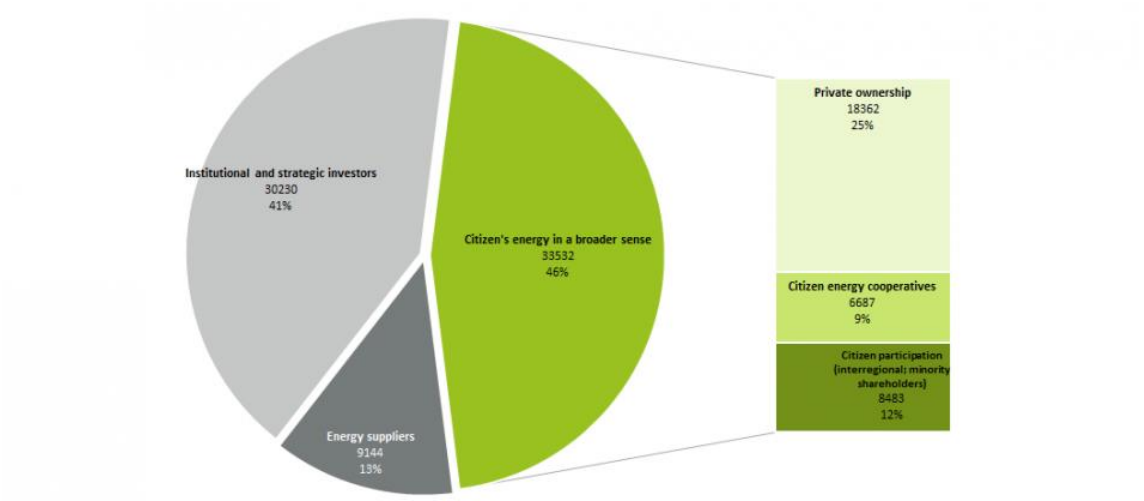
The French legislation also addresses specifically the problem of energy poverty in the country and includes two measures to combat this specific form of poverty, i.e. the introduction of an energy cheque for the 4 million poorest households (decree published on 10 May 2016) and the use of 30% of financing from energy-efficiency certificates for the prevention of fuel poverty.

5.6.2 Germany

Germany foresees an increase of 600 MW of PV capacity per year according to the most recent update of the Law on Renewables (EEG). Experts[192] have observed that the present growth rate is too low to achieve the overall targets of the German Law on Energy Transition ("Energiewende"), which would require adding an average of 4 - 5 GW of PV annually up to 2050. Small PV systems (of less than 10kW), which are typically installed in households, make up about 15% of all PV systems installed in the country.

The "Energiewende" was conceived as a participative project from the very start and this participation is not limited to renewable projects, but even allows for referenda on city level to decide on the purchase of the local distribution grid by the public authorities, as celebrated in Hamburg and Berlin. Citizen investment in renewable energy in Germany started in 2010 after the approval of the federal law on renewable energy (EEG) and since then, a variety of investment options for citizens in renewables have surged, so that observers and trend analysts now strive to find a common definition of the concept of "citizen energy" (Bürgerenergie). If interpreted in a broad sense, citizens owned about 46% of all renewable installations in Germany in 2012 (see Figure 5.3).

Fig 5.3: Shares of ownership of installed renewable energy capacity in 2012 (megawatts and percent).



Source: © Trend Research/Leuphana 2013[193].

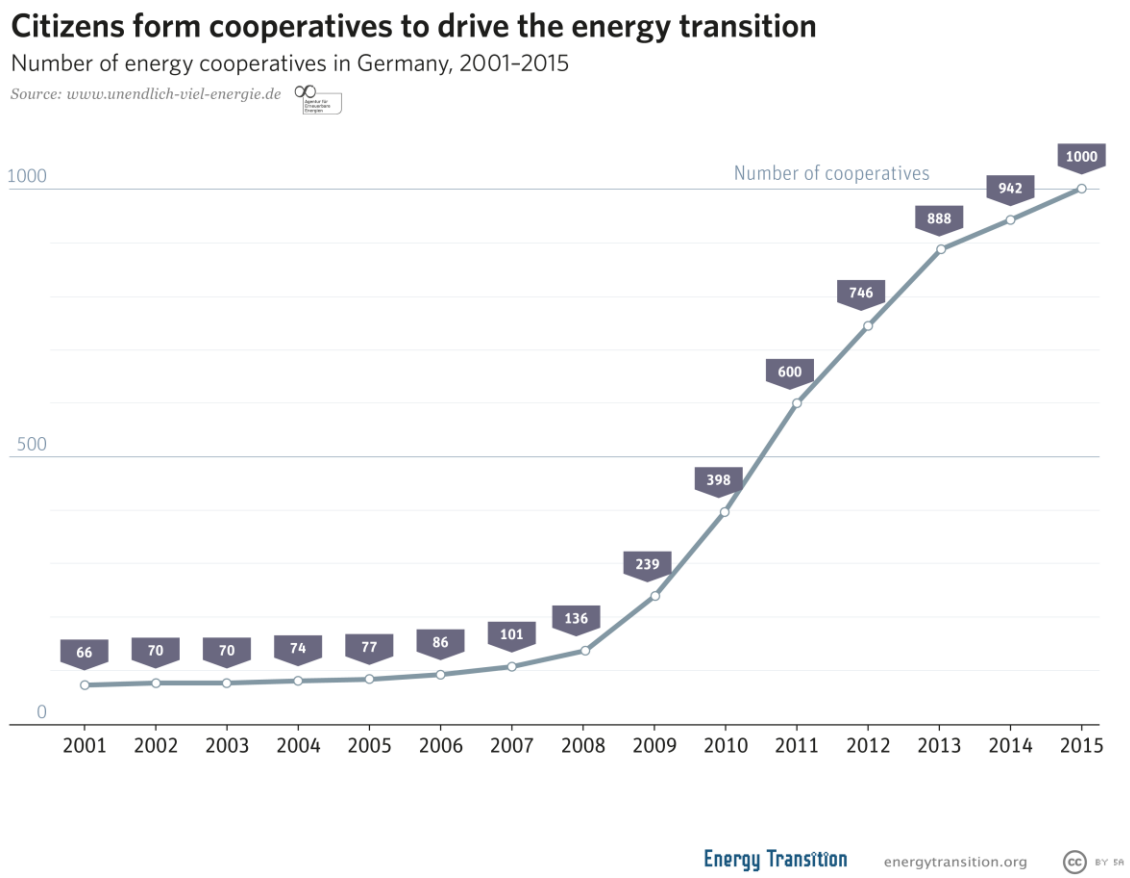
Figure 5.4 shows the rapid growth of renewable energy cooperatives in Germany in the years 2008 to 2012, after a rather slow uptake in the earlier years of implementation of the EEG.

[191] IEA (2016), „Energy Policies of IEA Countries. France. Review 2016"

[192] Wirth, Harry (2017), "Recent Facts about Photovoltaics in Germany", Fraunhofer ISE

[193] Trend:research GmbH and Leuphana Universität Lüneburg (2013), "Definition und Marktanalyse von Bürgerenergie in Deutschland"

Fig 5.4: Number of energy cooperatives in Germany, 2001 - 2015



Source: © Global Energy Transition, a project of the Heinrich Böll Foundation

In 2013, the number of new energy cooperatives created in Germany dropped to 109, however, and in 2014, to a mere 29, and at the same time the willingness of established cooperatives to invest in new renewable projects also decreased considerably[194]. The trend break has been explained by substantial changes made by the Federal Government in 2013 and 2014 to the EEG, rendering investments in PV and wind projects more laborious and risky and thus creating a high level of uncertainty among potential investors[195]. Müller at al. suggest that the cooperatives need to develop new business models and new fields of activity in order to establish themselves permanently as relevant actors in the energy market.

5.6.3 Italy

Italy approved at the end of 2017 the country's new 10-year energy strategy, which is closely aligned with the EU's CleanEnergy4All proposals, seeking to place the consumer at the centre of the new energy model and to facilitate consumer participation in the energy market as individuals, through aggregation of demand, or via energy communities. The new strategy explains that joint efforts among administration and citizens not only refer to the quantitative targets for renewables, but also to the market rules for implementation, which need to consider environmental constraints and the characteristics of each territory. Furthermore, it highlights the relevance of implementing authorization and administrative processes facilitating investment choices to unlock the remaining

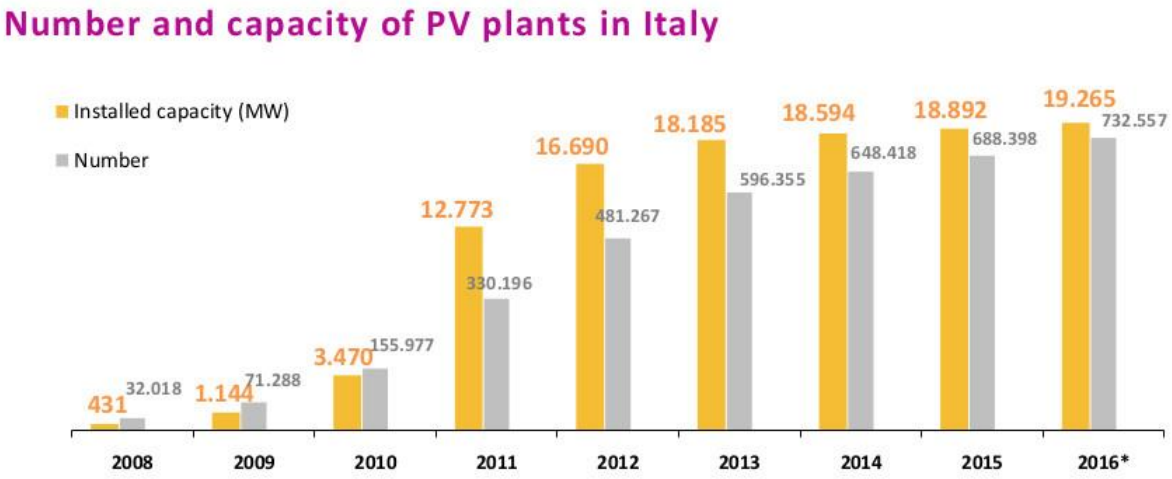
[194] Morris, C. (2015), "Few new German energy co-ops in 2014", https://energytransition.org/2015/02/few-new-german-energy-coops-in-2014/

[195] Müller, Jakob R., Holstenkamp, Lars (2015), „Zum Stand von Energiegenossenschaften in Deutschland"

PV potential, whereas investments related to energy efficiency are often blocked by a lack of awareness among consumers.[196]

Italy's investments in PV experienced a set-back in 2014, after the introduction of the "Spalma-Incentivi" Decree, which modified the national subsidy scheme retroactively, with negative effects for the owners of PV systems. In 2016, however, the household PV market was back to growth, due to changes in the regulatory environment, which channelled fiscal incentives towards small and innovative PV systems, sustainable house building and renovations, and introduced a new policy in self-consumption for the commercial sector[197] that also enabled market-uptake of small-scale storage systems.

Fig. 5.5: New PV installations in Italy 2008 -2016



Source: http://www.qualenergia.it/articoli/20170503-fotovoltaico-sulla-domanda-elettrica-l-italia-non-piu-la-prima-

91% of the Italian PV systems are small-scale (less than 20 kW), and this number grew 96% in the case of the newly installed systems in 2016[198]. 79% of the systems are residential with a small size of about 5 kW. The high percentage of PV rooftop systems deployed in Italia is now also driving the electricity storage market, with sales of 5,000 units expected by the end 2016. Mayr (2016) explains that the key drivers for development of the storage market are the uptake of rooftop PV, subsidy schemes, and regulation. The net-metering scheme in Italy worked against the uptake of storage, but the main barrier was regulation: "Until April 2015, PV system owners were at risk of losing their right to incentives when installing battery storage. Now that this issue has been resolved and along with a tax deduction scheme subsidising 50% of the costs in place, the Italian residential storage market is finally making significant progress." However, according to the specialized press[199], the historical changes to the subsidy schemes and the lack of transparency on the side of state operator GSE have provoked a large number of complaints from PV owners, which are to be resolved by the setting up of a user-friendly ICT platform no later than 2018.

Although the Italian market is characterized by individual, small-scale PV systems, a strong cooperative movement is also present, especially in the Italian Alps, where over 77 cooperatives produce renewable electricity for 80,000

[196] Gazzetta ufficiale della Repubblica italiana (2017), "Strategia Energetica Nazionale 2017"

[197] Bellini, Emiliano (2017a), Italy installed 369 MW of new PV systems in 2016, https://www.pv-magazine.com/2017/03/02/italy-installed-369-mw-of-new-pv-systems-in-2016/

[198] Benedetti, L. (2017), „PV 2.0 – Italian Focus", https://es.slideshare.net/gserinnovabili/pv-20-italian-focus-luca-bendetti-gse

[199] Qualenergia (2016), „Incentivi fotovoltaico, perché quei ritardi nei pagamenti GSE?"

citizens in 110 small municipalities[200].The trend could be linked to a long tradition of cooperative ecosystems as those found, for example, in the region of Emilia-Romagna[201]. Furthermore, the municipalities in Italy are supporting the drive towards renewables by increasing production capacities and subscribing to 100% renewable tariffs. According to a recent survey[202], the number of municipalities with at least one plant supplying renewable energy has increased from 356 to 804 in the last 10 years and 39 municipalities have gone "100% renewables".

5.6.4 The Netherlands

The Dutch National Action Plan Solar (NATIONAAL ACTIEPLAN ZONNESTROOM 2016 or NAZ) foresees a growth of installed capacity in 2023 of 10 GW instead of the earlier projected 4 GW in 2020, which amounts to 7% of the total electricity demand in 2030. The NAZ specifically promotes measures to provide sufficient room for innovations to encourage consumers to use their own generated electricity. The plan lists a series of barriers to citizen engagement in PV and proposes measures to overcoming them. The barriers and measures most closely related to consumer behaviour and concerns are summarized in table 5.2.

Table 5.2: Barriers and solution to household PV investment in the Netherlands

Barrier	Measure to overcome them
Lack of standarization of registration procedure	Grid operators elaborate procedure for registration and network connection
Quality problems due to lack of knowledge of installers on PV systemas and roofing	Push training and certification processes for installers
Consumers consider the high purchase and installation costs to be a major obstacle	Although the 15% government subsidy ran out in 2013 and was not renewed, price drops in the markets have made PV systems more affordable
Lack of information: The consumer group following the 'early adopters' has questions about how to purchase a solar energy system, how much it yields and what the options are for financing, relocation and insurance	Set-up of a web portal targeting homeowners, tenants, as well as small and medium-sized companies to provide this information
Consumers preoccupied with phasing out of net-metering scheme by 2020	Government agrees with industry on transition strategy to recover consumer confidence
Opposition to PV in cities due to aesthetics	Promote roof- and building-integrated PV with lower visual impact and improved asthetics

Source: NATIONAAL ACTIEPLAN ZONNESTROOM 2016

The main tool for attracting household investment in PV is a net-metering scheme, "salderingsregeling", which was recently extended by the Parliament to 2030 in order to provide a stable environment for further private investment. The benevolent legal environment is showing success, according to market analysts[203], which estimate that small private consumers, like households, medium & small businesses, and schools contributed about half of the impressive 35% growth rate in installed PV capacity in 2016 (500 MW). In 2013, lobbying led to the inclusion of a tax rebate on solar power for cooperatives to allow consumers without a suitable roof to participate in renewable

[200] https://ec.europa.eu/easme/en/news/energy-cooperative-projects-celebrate-10-years-un-s-international-day-cooperatives

[201] http://www.yesmagazine.org/new-economy/the-italian-place-where-co-ops-drive-the-economy-and-most-people-are-members-20160705

[202] Zanchini, E. Et al (2016), „Comuni Rinnovabili 2016", Legambiente, with support from ENEL Green Power.

[203] PV Europe 2017, "Holland Solar: Up to 1 GW of new PV installations – stable investment environment", http://www.pveurope.eu/News/Solar-Generator/Holland-Solar-Up-to-1-GW-of-new-PV-installations-stable-investment-environment

energy production[204]. The so-called "Energy Agreement"[205] set the objective of enabling one million small-scale users to produce renewable energy for their own energy needs by 2020. In 2015, researchers had already identified about 500 renewable energy cooperatives in the Netherlands[206]. Hufen et al (2015) have observed that these initiatives are largely citizen-driven and that the role of government in this trend is relatively small.

5.6.5 Spain

The Spanish electricity market regulation has seen several important changes since 2013[207], with adverse effects on renewable development, which is reflected clearly in the slow-down of new PV installations in the country (see Figure 5.7). The "reform" applied by the conservative government in Madrid aimed at reducing the costs of the electricity system that are "borne by the consumer" and removed the subsidy scheme for PV and other types of renewables, which had been in place since 2007, with retroactive effect. The overly lengthy legislative text only considers the consumer in its role as contributor to the financial sustainability of the electricity system, and does not contemplate citizen participation in any other form.

The changes introduced in 2013 to the PV subsidy scheme jeopardized the economic calculations, on which investments in renewable were based and led to the sale or closure of plants throughout Spain, and not only in the PV sector, in those cases, in which the loan acquired to finance the project could not be renegotiated. The PV sector was, however, specifically affected by the "sun tax" legislation[208] introduced in 2015, which imposed restrictions on self-consumption and obliged these installations to pay grid access fees (as any other electricity consumer) and additional taxes both on production and installed capacity (in case of battery use), except for installations below 10kW[209]. Due to the unsecure regulatory environment, the market has not yet recovered, and in 2015 and 2016, only 49 and 55 MW of new capacity was added and most of this new capacity was for self-consumption purposes[210].

[204] Lyson, Erik (2016), "Dutch Association for Solar Energy: National update on the Netherlands" http://www.solarpowereurope.org/fileadmin/user_upload/documents/Strategy_Committee/Holland_Solar_Presentation_SPE_17May16.pdf

[205] Raad SE (2013) Energieakkoord voor duurzame groei. Sociaal Economische Raad, Den Haag

[206] J. A. M. Hufen, J.A.M. and Koppenjan, J. F. M. (2015), „Local renewable energy cooperatives: revolution in disguise?", Energy, Sustainability and Society 20155:1

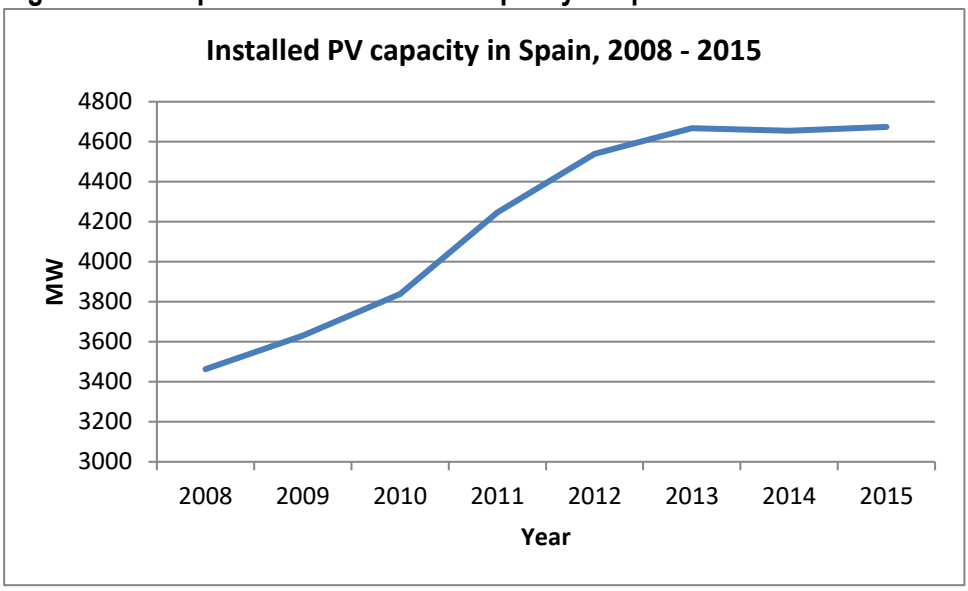
[207] Real Decreto-ley 9/2013, de 12 de julio, por el que se adoptan medidas urgentes para garantizar la estabilidad financiera del sistema eléctrico

[208] Real Decreto 900/2015

[209] Pujol, D. (2016), „Impuesto al Sol – Actual normativa RD 900/2015", https://www.e-zigurat.com/noticias/impuesto-al-sol/

[210] UNEF Unión Española Fotovoltaica (2016), "Informe anual 2016"

Fig. 5.6: Development of installed PV capacity in Spain 2008 - 2015



Source: own elaboration based on data from UNEF (Spanish Photovoltaic Association)

However, in a rather surprising turn, the Spanish government initiated an auction in 2017, allocating permits for 3,909 MW of solar capacity, which will be generated in large plants in the coming years.

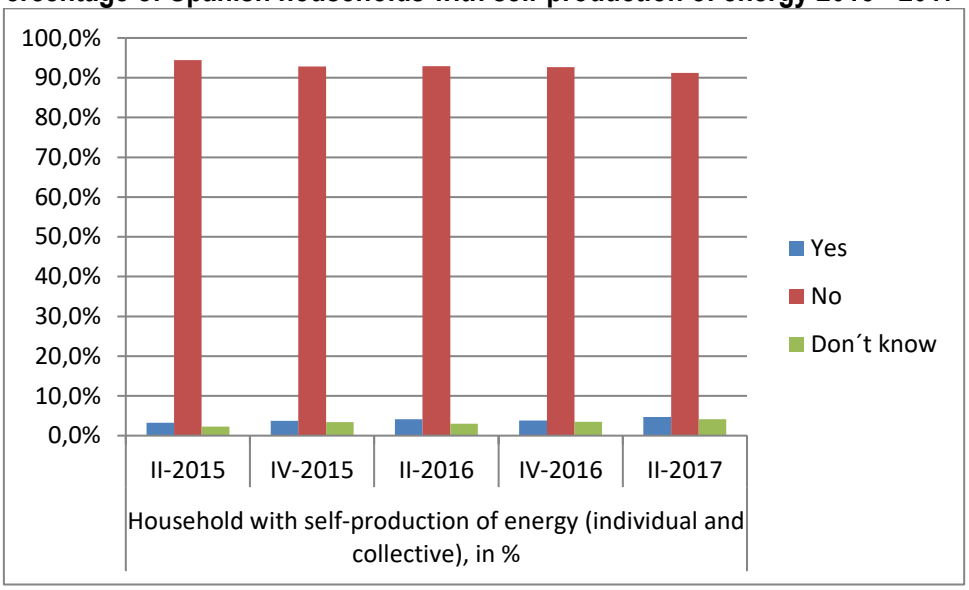
The «suntax» decree also outlawed shared self-consumption from PV systems, but this provision was removed in June 2017 by the Spanish Constitutional Court after a complaint filed by the Catalan government. At present, technical hurdles for connecting shared systems to the network remain[211], but Holaluz, one of the new retailers offering renewable energy, recently announced the successful completion of a shared residential system composed of 7 solar panels and a battery in Rubí, Cataluña[212]. Presently, 160 shared PV installations have been officially notified in Spain, according to the ethical bank Triodos[213]. However, the percentage of households using self-production presently remains below 5%, as shown in figure 5.7.

[211] http://www.eleconomista.es/empresas-finanzas/noticias/8410591/06/17/Autoconsumo-compartido-legal-pero-inviable-de-momento.html

[212] https://blog.holaluz.com/producir-tu-energia-es-legal-holaluz-monta-la-1a-instalacion-de-autoconsumo-compartido/

[213] https://revista-triodos.com/autoconsumo-casa-por-el-tejado/

Fig. 5.7: Percentage of Spanish households with self-production of energy 2015 - 2017



Source: own elaboration based on CNMC household panel

There are nevertheless positive developments in forms of collective actions. Despite of - or thanks to – the existing regulatory uncertainty, the new renewable energy cooperatives in Spain have been gaining members and clients continuously over the last years. This can be seen as an indicator that part of the Spanish population is keen to manage their energy and confronts the large, traditional utilities by searching for ways to «fight» the solar tax. The most successful of these cooperatives is SomEnergía, originally based in Cataluña, which was founded at the end of 2010 and is close to reaching 40,000 members and handling almost 60,000 contracts. The cooperative has developed a unique and innovative business model, which makes it possible to finance small-scale renewable projects and even a 2.2 MW PV plant, which came online in August 2016. The cooperative has so far mobilized 2.831.100 € of small-scale citizen investment for the self-production of 4,812,870 kWh of renewable energy.

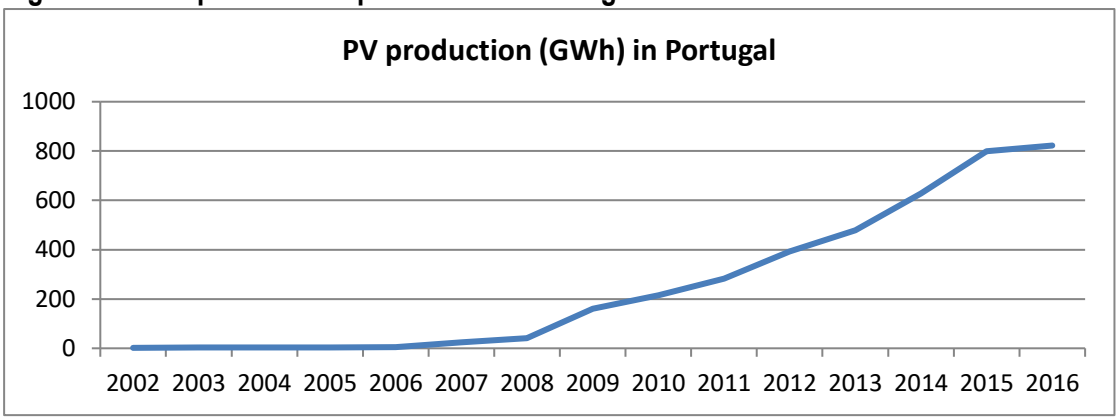
The new cooperatives generally start out as retailers selling exclusively renewable energy and, in a later stage, develop investment opportunities in renewable generation. This citizen movement is now echoed by many municipalities in Spain, 700 of which, representing about 12 million inhabitants, have already signed contracts for 100% renewable energy[214], although mostly with traditional energy providers that offer green tariffs.

5.6.6 Portugal

Portugal is the EU Member State closest to reaching 100% renewable electricity production, achieving 95% coverage in the first half of 2016. Figure 5.8 shows the strong increase of PV production in Portugal in recent years.

[214] http://www.eldiario.es/economia/ayuntamientos-espanoles-contratar-electricidad-renovable_0_601240670.html

Fig. 5.8: Development of PV production in Portugal 2012 - 2016.



Source: own elaboration based on data from Direção Geral de Energia e Geologia

The steady growth in PV in Portugal – as opposed to developments in Spain, for example - is attributed to a law approved in 2014[215], which authorized self-consumption of electricity produced in PV systems of up to 250 kW, as well as the possibility of selling surplus energy at market prices minus 10%. The law simplified the procedures for registering the self-production activity on a dedicated internet portal (SERUP) with specific interfaces for citizens and companies and is embedded in the wider strategy to obtain higher levels of efficiency in the Portuguese energy system. The legal support to self-consumption enabled the installation of 2,929 small-scale solar systems (of less than 1.5 KW) in 2015 only[216]. Another 6,067 installations were added in 2016[217]. These new installations presently represent a combined capacity of 7,022 kW, with the largest part corresponding to household investments. The total capacity installed primarily for self-consumption in Portugal has now reached 50,393 kW.

The Portuguese regulation obliges to install a smart meter along with the PV system, which increases the cost of the system for the self-consumer, but also offers the opportunity for introducing additional services for PV users. Likewise, smart inverters help PV users to better understand their individual consumption patterns and to observe shifts in consumption behaviour, which help to identify the potential effects of user behaviour under a scenario of widespread PV deployment.[218]

[215] Decreto Lei n. 153/2014 http://www.apisolar.pt/images/stories/Legislacao/Decreto-Lei_153-2014_20Out.pdf; explanation and interpretation https://www.magnuscmd.com/go-solar-portugal-self-consumption-systems/

[216] http://www.apisolar.pt/pt/noticias/fotovoltaico

[217] https://www.publico.pt/2017/02/20/economia/noticia/mais-de-oito-mil-portugueses-produzem-luz-para-autoconsumo-1762590

[218] The real-life examples described here have been facilitated to the ECHOES project team by Karl Moosdorf, CEO of the Portuguese solar company Miravolt, for which we are very grateful.

Some real life examples of behavioural effects connected to PV installation in conjoint with a smart metering device:[219]

- An **undesired rebound effect**, leading to increased electricity consumption in the household, since the user feels that the energy consumed is now "clean" or "for free".
- The **detection of abnormally high consumption rates** related to reasons other than energy: this was the case of a household, in which the husband was on a business trip when an unusually high consumption of 2,000 kW was recorded by the system. The reason for this was the switching on of all outdoor lights by the wife, since, with the lights on, she felt safer while she was alone in the house. After being alerted to this and after the return of the husband, the family switched to LED for outdoor lighting and the problem was resolved.
- **Detection and quick repair of defective appliances**: one of the PV users suddenly had a continuous consumption of 400W – 24h per day. So he checked his household and found that the fridge was broken. Without the PV control system he would not have known this and the fridge would have consumed considerable amounts of energy without anyone knowing.
- **Transfer of electricity consumption from night to day-time**: for a self-consumer, it is interesting to transfer as much electricity demand as possible (such as electric heating or pool pumps) to daytime hours, when the PV system has the highest production. This «selfish» behaviour can pose a problem for network management due to reduced demand during night times, unless new grid management solutions, including storage systems, are deployed.

5.7 Conclusions on the social science perspective for citizen engagement in PV

The empirical data presented here clearly shows the willingness of citizens to invest in photovoltaics and to contribute to the financing of the energy transition, either individually or through collective action. The analysis also shows that a stable legal framework is a prerequisite for continued citizen engagement in the transition. Subsidies, which played an important role in the early development of PV, will probably no longer be necessary in large parts of Europe in the coming years, but clear and simple rules for citizen participation in the energy market will continue to play a decisive role, as citizens cannot be expected to display the same type of behaviour as large, established market actors.

A closer observation of developments in the PV market, as reported for Portugal, indicates that citizen participation will lead to formerly unknown challenges for the management of a sustainable energy system in the form of load-shifting to day-time hours and, possibly, undesired rebound effects, but also in the form of a learning process leading to a more rational use of energy. Understanding and managing these new challenges will require a stronger contribution of social science findings than ever before in the history of energy.

[219] Although these are not taken from policy documents we still consider them interesting to be included in this report because they show the richness of expected and unexpected outcomes of technology implementation.

6 CASE 4: BUILDINGS

6.1 Rationale for choosing the case and the country level examples

Buildings are responsible for 40% of energy consumption and 36% of CO_2 emissions in the EU. While new buildings generally need fewer than three to five litres of heating oil per square meter per year, older buildings consume about 25 litres on average. Some buildings even require up to 60 litres. Currently, about 35% of the EU's buildings are over 50 years old. By improving the energy efficiency of buildings, we could reduce total EU energy consumption by 5-6% and lower CO_2 emissions by about 5%[220]. Since many of such buildings are in ownership of citizens, it is highly relevant to focus on consumer decision-making when addressing this lack of energy efficiency upgrades and study how the consumer is conceptualized in the EU and country level policy strategies in this sector. In this domain, only one country case is analysed in detail, namely Bulgaria, which is characterized by a relatively large fraction of low income citizens living in privately owned housing. This analysis is complemented by a selection of local cases of city rehabilitation.

6.2 Institutional framework

6.2.1 The EU 20-20-20 goals

The EU 20-20-20 goals were probably the major marker of an unparalleled paradigm shift towards a carbon-free, climate friendly European economy and society. By 2020, the EU set as its goal to reduce its greenhouse gas emissions by at least 20%, increase the share of renewable energy to at least 20% of consumption, and achieve energy savings of 20% or more. Through achievement of these targets, the EU addresses the challenges of climate change and air pollution, decreases its dependence on foreign fossil fuels, and vows to keep energy affordable for consumers and businesses.

In order to meet the targets, the 2020 Energy Strategy sets out five priorities, two of which are directly related to the building sector:

- To make Europe more energy efficient by accelerating investment into efficient buildings, products, and transport. This includes measures such as energy labelling schemes, renovation of public buildings, and eco-design requirements for energy intensive products;
- To protect consumer rights and achieve high safety standards in the energy sector. This includes allowing consumers to easily switch energy suppliers, monitor energy usage, and speedily resolve complaints.

The 2010 Energy Performance of Buildings Directive[221] and the 2012 Energy Efficiency Directive[222] are the EU's main legislation instruments covering the reduction of the energy consumption of buildings and completion of the goals related to the building sector.

[220] European Commisson (2018) Official website. Available at https://ec.europa.eu/energy/en/topics/energy-efficiency/buildings

[221] Energy Performance of Buildings Directive (2012) Available at http://eur-lex.europa.eu/legal-content/EN/ALL/;ELX_SESSIONID=FZMjThLLzfxmmMCQGp2Y1s2d3TjwtD8QS3pqdkhXZbwqGwlgY9KN!2064651424?uri=CELEX:32010L0031

[222] Energy Efficiency Directive (2012) Available at http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1399375464230&uri=CELEX:32012L0027

Under the existing Energy Performance of Buildings Directive:

- Energy performance certificates are to be included in all advertisements for the sale or rental of buildings;
- EU countries must establish inspection schemes for heating and air conditioning systems or put in place measures with equivalent effect;
- All new buildings must be nearly zero energy buildings by 31 December 2020 (public buildings by 31 December 2018);
- EU countries must set minimum energy performance requirements for new buildings, for the major renovation of buildings, and for the replacement or retrofit of building elements (heating and cooling systems, roofs, walls and so on);
- EU countries have to draw up lists of national financial measures to improve the energy efficiency of buildings.

Under the Energy Efficiency Directive:

- EU countries make energy efficient renovations to at least 3% of buildings owned and occupied by central government
- EU governments should only purchase buildings which are highly energy efficient
- EU countries must draw-up long-term national building renovation strategies which can be included in their National Energy Efficiency Action Plans.[223]

As mentioned above, the Energy Performance of Buildings Directive requires all new buildings to be nearly zero-energy by the end of 2020. All new public buildings must be nearly zero-energy by 2018. EU countries have to draw up national plans to increase the number of nearly zero-energy buildings. However, the latest European Commission progress report from 2014[224] found that EU countries had to significantly step up their efforts to take advantage of the opportunities presented by nearly zero-energy buildings.

6.2.2 2030 Framework for climate and energy

With high probability of achievement of the 20-20-20 goals, EU countries have agreed on a new 2030 Framework for climate and energy[225]. The strategy is designed to send a strong signal to the market, encouraging private investment in clean energy technologies, based on thorough economic analysis that measures how to cost-effectively achieve decarbonisation by 2050 (reducing greenhouse gas emissions by 80-95% compared to 1990 levels).

The targets for 2030 are set as follows:

- A 40% cut in greenhouse gas emissions compared to 1990 levels
- At least a 27% share of renewable energy consumption
- At least 27% energy savings compared with the business-as-usual scenario (currently, the ITRE Committee at the EP has agreed to propose a 40% legally binding target)

To achieve these goals, significant investments need to be made in new low-carbon technologies, renewable energy, energy efficiency, and grid infrastructure. Because investments are made for a period of 20 to 60 years,

[223] European Commisson (2018) National Energy Efficiency Action Plans and Annual Reports. Available at:

[224] Overview of Member States information on NZEBs Background paper – final report (2014) Ecofys by order of: European Commission. Available at https://ec.europa.eu/energy/sites/ener/files/documents/Background%20paper%20NZEB.pdf

[225] A policy framework for climate and energy in the period from 2020 to 2030 (2014) Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Available at http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52014DC0015

policies that promote a stable business climate which encourages low-carbon investments must start being made today.

Energy Roadmap

The European Commission's 2011 Energy Roadmap[226] set out four main routes to a more sustainable, competitive and secure energy system in 2050: energy efficiency, renewable energy, nuclear energy, and carbon capture and storage. The analysis lead to the conclusion that decarbonising the energy system is technically and economically feasible, the increasing the share of renewable energy and using energy more efficiently are crucial, the early infrastructure investments cost less and are very important for the transition, and a common European approach is expected to result in lower costs and more secure energy supplies when compared to individual national schemes. The 2011 Energy Roadmap paved the way to the concept of the Energy Union.

6.2.3 Energy Union

The Energy Union[227] means making energy more secure, affordable and sustainable for the citizens in the EU. It aims to facilitate the free flow of energy across borders and a secure supply in every EU country, for every European citizen. New technologies and renewed infrastructure will contribute to cutting household bills and creating new jobs and skills, as companies expand exports and boost growth. Its goal is to lead the EU to a sustainable, low carbon and environmentally friendly economy, putting Europe at the forefront of renewable energy production, clean energy technologies, and the fight against global warming.

The Energy Union strategy builds further on the 2030 Framework for Climate and Energy and the European Energy Security Strategy[228].

[226] Energy Roadmap 2050 (2011) Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Available at http://eur-lex.europa.eu/legal-content/EN/ALL/;ELX_SESSIONID=pXNYJKSFbLwdq5JBWQ9CvYWyJxD9RF4mnS3ctywT2xXmFYhlnlW1!-868768807?uri=CELEX:52011DC0885

[227] Energy union and climate (2018) Official website of the EC. Available at https://ec.europa.eu/commission/priorities/energy-union-and-climate_en

[228] European Energy Security Strategy (2014) Communication from the Commission to the European Parliament and the Council. Available at http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52014DC0330&qid=1407855611566

The Energy Union is made up of five closely related and mutually reinforcing dimensions:

- Security, solidarity and trust: diversifying Europe's sources of energy and ensuring energy security through solidarity and cooperation between EU countries
- A fully integrated internal energy market: enabling the free flow of energy through the EU through adequate infrastructure and without technical or regulatory barriers
- Energy efficiency: improved energy efficiency will reduce dependence on energy imports, lower emissions, and drive jobs and growth
- Decarbonising the economy: the EU is committed to a quick ratification of the Paris Agreement[229] and to retaining its leadership in the area of renewable energy
- Research, innovation and competitiveness: supporting breakthroughs in low-carbon and clean energy technologies by prioritising research and innovation to drive the energy transition and improve competitiveness.

Since the Energy Union strategy was launched in February 2015, the Commission has published several packages of measures to ensure the Energy Union is achieved. The Commission also publishes regular reports on the progress of the Energy Union, the most recent in November 2017.[230]

6.2.4 Clean Energy for All Europeans

On 30 November 2016, the European Commission presented a new package of measures[231] with the goal of providing the stable legislative framework needed to facilitate the clean energy transition – and thereby taking a significant step towards the creation of the Energy Union. Aimed at enabling the EU to deliver on its Paris Agreement commitments, the 'Clean Energy for All Europeans' proposals are intended to help the EU energy sector become more stable, more competitive, and more sustainable, and fit for the 21st century.

With a view to stimulating investment in the clean energy transition, the package has three main goals:

- Putting energy efficiency first
- Achieving global leadership in renewable energies
- Providing a fair deal for consumers

The package includes 8 different legislative proposals (each with a linked impact assessment) covering:

- Energy Efficiency
- Energy Performance in Buildings
- Renewable Energy
- Governance
- Electricity Market Design (the Electricity Directive, Electricity Regulation, and Risk-Preparedness Regulation)
- Rules for the regulator ACER

[229] The Paris Protocol – A blueprint for tackling global climate change beyond 2020 (2015) Communication from the Commission to the European Parliament and the Council. Available at https://ec.europa.eu/clima/sites/clima/files/international/paris_protocol/docs/com_2015_81_en.pdf

[230] Third Report on the State of the Energy Union and its annexes (2017) European Commission. https://ec.europa.eu/commission/publications/third-report-state-energy-union-annexes_en

[231] Clean Energy for All Europeans (2016) Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee, the Committee of the Regions and the European Investment Bank. Available at: http://eur-lex.europa.eu/resource.html?uri=cellar:fa6ea15b-b7b0-11e6-9e3c-01aa75ed71a1.0001.02/DOC_1&format=PDF

As with all legislative proposals under the EU's ordinary decision-making procedure, the proposals in this package are currently being discussed by the co-legislators – the European Parliament and the Council of the European Union. The Presidents of the European Commission, the European Parliament and the Council publicly declared in December 2016 that this package should be seen as a priority in the months ahead.

6.3 Social sciences perspective in the relevant policy documents

Certainly, the social science perspective and the potential input to the implementation of the policies in the area of energy efficiency of buildings cannot be expected to be elaborated in detail in the strategic plans and framework policy documents; however, there are clear implications for the potential for cooperation in these field throughout the EU policy agenda and direct guidance concerning the role and expected attitudes of the formal social units. The concrete actions should, however, be designed at Member State and regional/local level, institutionalized in the form of implementation programmes, which should be focused on the meso- and micro-level. The goal of this chapter is to outline the specific areas of potential intervention (as identified through the official communication of the EC) within the overall policy framework and to provide the basis for the subsequent analysis of the implementation at national/local level.

6.3.1 The Energy Union

Most of the legislative instruments serving as foundation of the EU building policies imply the importance of social sciences perspective. Stating that customers' interests and participation are at the heart of the European energy transition and attracting private investments, and assuming that end-user investment is the key for the sustainable renovation of the building stock are probably the most notable accents of this importance (i.e., SET Plan, Energy Union, Clean Energy for All Europeans package). As it could be expected in a framework document, this statement is not elaborated into specific activities considering direct input from the SSH perspective and requiring concrete proactive initiatives to influence user behaviour, which should be detailed at the implementation programmes level. For example, in the third review of the State of the Energy Union, it is declared that "now is the time to mobilise all of society – citizens, cities, rural areas, companies, academia, social partners - to take full ownership of the Energy Union, take it forward and engage in developing the solutions of the future", which relates, directly or indirectly, to the three ECHOES perspectives of analysing the decision making process at the individual and organizational level.

Focus on energy poverty

Apart from analysing the relation between the transition to a low-carbon economy and the economic growth, the investment and innovation potential, only the topic of energy poverty (with measures defined predominantly in the building sector) drives specific action oriented towards end beneficiaries: "A pilot awareness-raising campaign has been launched and will be rolled out in four Member States (Czech Republic, Greece, Portugal, and Romania) in the course of the next year. The campaign focuses on increasing the awareness of energy-poor consumers of their rights and will provide consumers with energy-saving tips and information on low-cost energy efficiency improvements". Elaborating on that, it specifically provisioned that the campaign aims to highlight the benefits of energy efficiency and switching, and directly involve the formal social units as influencers of the user behaviour. It is supported by the Observatory of Energy Poverty, with the goal, among others, to serve as a hub to disseminate good practices to key stakeholders and to be a source of information on energy poverty for the wider public. In a look towards coal and carbon-intensive regions, the Commission states that it "intends to work in partnership with the stakeholders of these regions, to better target European Union support, encouraging exchange of good practices, including discussions on industrial roadmaps and re-skilling needs and promoting synergies / joint cooperation". This example is one of the most detailed declaration on intent to involve insight from social studies and humanities in the implementation of energy policies; however, specifics on the expected user response to this effort and the tools to reach it are not outlined.

The local level as change driver

A positive example is also the coherent relation to local level of governance in the process of delivering the enabling policy and financial framework. The promotion of investment supporting "cross-sectoral, innovative projects that can serve as testbeds for new business models" within the overall context of the EU Urban Agenda[232], is set to be a priority in 2018. Cities are crucial for the modernisation and decarbonisation of the building stock, being a major source of greenhouse gases. At the same time, as centres of innovation and growth and engines of economic development, are also a part of the solution. They are recognized as key players in the effort to decouple greenhouse gas emissions and resource consumption from economic growth and help national economies become more knowledge-based and competitive, which implies direct relation to the social science perspective at macro level, but also implicitly recognizes the feedback loop from individual behaviour and also the influences between different governance levels, respectively different agglomerations of formal social units.

Engagement of all parts of society

In the third report on the state of the Energy Union, it is explicitly stated that "it will only be successful if all segments of society come together and move in the same direction". The responsible EC Vice-President Maros Šefčovič has visited 17 Member States, discussing with governments and national stakeholders the state of implementation of the Energy Union. Meetings with young people, citizens affected by the energy transition, inventors, social partners and civil society, mayors and other politicians is said to provide positive examples of how the energy transition is achievable in practice. The Commission declares that it will continue to secure the participation of all levels of society, young people in particular, and create stronger connections between European, national and local efforts. It will also "provide opportunities to launch a transparent and constructive dialogue among all concerned parties on the draft integrated national energy and climate plans which Member States are requested to deliver in early 2018". In conclusion, it is stated that the Commission will strive that "society as a whole and all European, national, regional or local stakeholders concerned to engage actively in the energy transition and contribute to its success". This approach represents proactive behaviour at the macro level, but also willingness to stimulate the meso- level interactions, provoking interactions between (group of) stakeholders representing different energy cultures.

However, in general, the social sciences perspective, when mentioned, is most often addressed with general guidance to national authorities, rarely elaborating on particular features and implementation measures. This is particularly valid in the analysis of the leading directives relevant to the building sector – the Energy Efficiency Directive and the Energy Performance of Buildings Directive.

6.3.2 The Energy Efficiency Directive

The Energy Efficiency Directive, although not entirely dedicated to the building sector, has comparatively stronger relations to the social science perspective. In *Article 4 Building renovation* the Member States are required to establish a long-term strategy for mobilising investment in the renovation of the national stock of residential and commercial buildings, both public and private, including a forward-looking perspective to guide investment decisions of individuals, the construction industry and financial institutions and an evidence-based estimate of expected energy savings and wider benefits (for the society). These requirements clearly define the general goals of the macro level approach at nation state level, also implicitly triggering consideration of the individual/corporate investment behaviour in the development of the implementation programmes. *Article 5 Exemplary role of public bodies' buildings* suggests that member states may consider cost effective measures as deep renovations and measures for behavioural change of occupants, to achieve the required amount of energy savings in eligible buildings owned and occupied by their central government. Member States shall encourage public bodies, including at regional and local level, to demonstrate the exemplary role of government buildings, presumably paving the way for private investment, which is another, very explicit, relation to the formal social unit impact on individual behaviour. *Article 16. Availability of qualification, accreditation and certification schemes* assumes that by 31 December 2014, certification and/or accreditation schemes and/or equivalent qualification schemes, including, where necessary, suitable training programmes, become or are available for providers of energy services, energy

[232] Urban Agenda for the EU / FUTURIUM (2018) Official website of the EC. Available at https://ec.europa.eu/futurium/en/urban-agenda

audits, energy managers and installers of energy-related building elements and member states will ensure that the schemes will provide transparency to consumers. Moreover, Member States shall take appropriate measures to make consumers aware of the availability of qualification and/or certification schemes. These scheme by definition support the individual decision making process and can have implications both on the micro-level, as a tool "feeding" the communicative exchange within the collectives, and at the meso-level determining values and attributes of various lifestyle patterns.

6.3.3 The Energy Performance of Buildings Directive

The practical implementation of the concept of Nearly Zero Energy Buildings, as one of the main aspects of the Directive, is generally expected to command a strong focus on social science input. Without streamlined market interventions and behaviour change campaigns, it is difficult to assume that such radical change in the current design and construction practice will convincingly win over the stakeholders in the entire value chain in the sector. However, signals of intention to attract inputs from social sciences are somewhat weaker compared to the Energy Efficiency Directive. For example, *Article 9 Nearly zero-energy buildings* obliges Member States, giving a leading example, to develop policies and take measures such as the setting of targets in order to stimulate the transformation of buildings that are refurbished into nearly zero-energy buildings, and to develop national plans in order to achieve these targets. The national plans should include, among others, information on the policies and financial or other measures for the promotion of nearly zero-energy buildings, including details of national requirements and measures concerning the use of energy from renewable sources in new buildings and existing buildings undergoing major renovation. This, obviously, makes a connection to the formal social unit level of influencing the end user behaviour, leaving vast open space for interpretation by the Member States. Additionally, *Article 11 Energy performance certificates*, requiring the establishment of a system of certification of the energy performance of buildings, requires that the energy performance certificate shall provide an indication as to where the owner or tenant can receive more detailed information, including as regards the cost-effectiveness of the recommendations made in the energy performance certificate. Again, Member States are requested to encourage public authorities to take into account the leading role which they should play in the field of energy performance of buildings. A measure with potential for serious impact on the micro- and meso-level, the information contained and the targeted use of the Energy performance certificates (EPC), is not defined precisely so the analysis of the implementation and potential input from the SSH perspective is again referred to the national level.

6.3.4 Clean Energy for All Europeans package

The communication on the Clean Energy for All Europeans package is specifically directed to the shifting of the focus towards citizen-centred policies (built around the "energy efficiency first" principle), opening large field for cooperation with SSH expertise. In the case of building renovation – by far the most prominent field of intervention, the expectation for attracting SSHs is explicit: the goals are for "creating the **right market conditions** for increasing the rate and level at which buildings are renovated… a stable framework with a long-term perspective and vision towards the decarbonisation of buildings, which will lead to the transformation of the EU building stock while **creating growth and jobs**." A clear signal to the formal social units, which has to design the right programmes to influence end user behaviour, intensifying the social interactions on the topic at all levels under consideration.

This notion is further developed by the updates of the **Energy Efficiency Directive** with a clear view to "attracting private investment and supporting the emergence of new market actors; to enable tailor-made policies that take account of national specificities", and continued attention to improving metering and billing of energy consumption for the end consumers. Furthermore, the updates to the **Energy Performance of Buildings Directive** focus on the national long-term building renovation strategies (providing a direct field for interaction with SSHs) and introduction of ICT smart building systems, thus providing opportunities for empowerment of the dwellers. Of course, stimulating the market through attracting private finance is in the core of the proposals, exemplified by the Smart Finance for Smart Buildings' initiative.

6.3.5 Delivering a New Deal for Energy Consumers

Probably the strongest reference to SSHs, this communication from 2015 gives clear directions for interpretation of the energy efficiency policy approach, defining the vision for the Energy Union "with citizens at its core, where citizens take ownership of the energy transition, benefit from new technologies to reduce their bills, participate actively in the market, and where vulnerable consumers are protected". In relation to the building sector, this message is translated through outlining barriers and setting priorities for policy measures targeting empowerment of consumers to behave proactively, establishing conditions for improved information provision, and giving consumers a wide choice of possible actions, including through making smart homes and networks a reality.

Translating into specific conclusions, these provision explicitly tackle the micro-perspective of the ECHOES project – e.g. through accurate information provision, metering data stimulating proactive behaviour (and also through protection of privacy and sensitive data); the meso-perspective is also actively targeted through support of collective or community schemes through reliable intermediaries. As a special focus is given to the link between research, innovation and industry for developing international competitiveness in smart home and smart grid technologies, as the cooperation between all market players is deemed particularly important.

6.3.6 Structural measures

Structural measures for customer engagement and active consumer behaviour are well in the focus of the European legislation and policy instrument design in the area of energy efficiency of buildings. As it is exclusively declared in the third report on the state of the Energy Union, given the huge investment needs in building renovation, private sources of funding have to be mobilised on a much greater scale. To build trust and help project developers and investors better assess the risks and benefits of energy efficiency investments, the De-risking Energy Efficiency Platform (DEEP)[233] was launched in November 2016 by the Energy Efficiency Financial Institutions Group (EEFIG, www.eefig.com), with the support of the European Commission. It is the largest EU-wide open-source database containing data of over 7,800 projects, showing that energy efficiency is financially attractive. Furthermore, an Underwriting Toolkit for financial institutions (www.valueandrisk.eefig.eu) was launched in June 2017 to help banks and investors scale up their deployment of capital into energy efficiency by providing a framework for assessing the risks and benefits of such investments. Last year, the Commission also announced the Smart Finance for Smart Buildings Initiative[234] to boost investment in the energy renovation of Europe's building stock. The initiative, being developed in cooperation with the European Investment Bank, will allow Member States to combine different sources of public and private funding in order to provide households and SMEs access to tailor-made refurbishment loans, which directly targets the micro level ECHOES perspective. Another initiative to be launched this year is an advisory platform for urban investments. This platform, under development by the Commission in partnership with the European Investment Bank, will build on already existing structures under the European Investment Advisory Hub. It provides urban authorities acting as project promoters and/or beneficiaries with tailor-made advisory services and financing possibilities, which provides impetus for the formal social units' impact on individual decision making at the local governance level.

At national level, these investments are streamlined by the requirements of the above mentioned directives. This is especially valid in respect to the national renovation plans stipulated by Art. 4 of the Energy Efficiency Directive, requesting (a) an overview of the national building stock based, as appropriate, on statistical sampling; (b) identification of cost-effective approaches to renovations relevant to the building type and climatic zone; (c) policies and measures to stimulate cost-effective deep renovations of buildings, including staged deep renovations; (d) a forward-looking perspective to guide investment decisions of individuals, the construction industry and financial institutions; (e) an evidence-based estimate of expected energy savings and wider benefits. Additionally, Art. 20

[233] De-Risking Energy Efficiency Platform (DEEP). An open-source initiative to up-scale energy efficiency investments in Europe through the improved sharing and transparent analysis of existing projects in Buildings and Industry. Web address: https://deep.eefig.eu/

[234] More information available at https://ec.europa.eu/energy/en/topics/energy-efficiency/financing-energy-efficiency

stimulates the establishments of Energy Efficiency National Funds providing financing and technical support to maximise the benefits of multiple streams of financing.

Specific instruments relevant for the development of financing stimuli are also foreseen, including the energy certification of buildings and the promotion of the energy services market. It is especially considered that in the development of energy services the member states should target (a) disseminating clear and easily accessible information on: (i) available energy service contracts and clauses that should be included in such contracts to guarantee energy savings and final customers' rights; (ii) financial instruments, incentives, grants and loans to support energy efficiency service projects. As for the for the energy certification of buildings, it is assumed that the certificates shall contain information about incentives of a financial or other nature and financing possibilities. A major part of this is the regulation of energy audits, as *Article 8 Energy audits and energy management systems*, promoting the availability to all final customers of high quality cost-effective energy audits. Member States shall also develop programmes to raise awareness among households about the benefits of such audits through appropriate advice services, with the notion of creating "incentive and support schemes for the implementation of recommendations from energy audits and similar measures". The introduction of specific technological solutions for energy efficiency in the building sector is also regulated by the Directive, especially in *Article 14 Promotion of efficiency in heating and cooling.* All these provisions confirm the strong focus of the Directive towards the micro- and meso- decision making level, promoting generation and distribution of specific data and information and design of specific tools which influence both the small-scale energy collectives and their values and the energy practices and material culture in difference lifestyle patterns.

There is also a specific focus on financing and support mechanisms in the Energy Performance of Buildings Directives, targeting the national and regional level of influencing the decision making process. Article 10 Financial incentives and market barriers explicitly states the importance of providing appropriate financing and other instruments to catalyse the energy performance of buildings and the transition to nearly zero-energy buildings. National or regional financial support programmes with the aim of increasing energy efficiency in buildings, especially of existing buildings, shall be developed and promoted by the member states with support from the EC. The effectiveness, the appropriateness of the level, and the actual amount used, of structural funds and framework programmes that were used for increasing energy efficiency in buildings, especially in housing, as well as the effectiveness of the use of funds from the EIB and other public finance institutions are subject to evaluation by the EC. Other supporting tools and methods, as for example the energy performance certificates (with guidance on issuing and displaying) are also regulated in order to promote the sustainable uptake of the measures, which, as noted above, leads to direct impact at the micro- and meso-level.

6.3.7 Information provision

Information provision is one of the most important horizontal measures to influence investment behaviour in the building and real estate sector. The general strive towards strategies for attracting private financing using the leverage factor of public funds requires a well-informed market and active civil movement putting the efficiency topic high on the public, political and media agenda. The provision of high quality and transparent information is specifically targeted by both directives in discussion, although the focus is on passive provision of information rather than on actual engagement in communication activities. However, these activities stimulate all levels of influence on the behaviour and purchasing decisions of the citizens, which is why they are attracting much of the attention.

Consumer information

Again, the Energy Efficiency Directive is more elaborate in terms of requesting specific information services to the end users. *Article 12 Consumer information and empowering* programme requires that Member States shall take appropriate measures to promote and facilitate an efficient use of energy by small energy customers, including domestic customers. These measures may be a part of a national strategy and shall include one or more of the following elements:

***Article 12 Consumer information and empowering*:**

(a) A range of instruments and policies to promote behavioural change:

- fiscal incentives;
- access to finance, grants or subsidies;
- information provision;
- exemplary projects;
- workplace activities.

(b) Ways and means to engage consumers and consumer organisations during the possible roll-out of smart meters through communication of

- cost-effective and easy-to-achieve changes in energy use;
- information on energy efficiency measures.

Subject to implementation at national level, these requirements provide open field to stimulate the micro- and meso-level, with considerable level of specification of the actions expected.

Concerning the interventions on the formal social unit level to stimulate the exchange within different stakeholders' groups, according *Art. 17 Information and training*, Member States must ensure that information on available energy efficiency mechanisms and financial and legal frameworks is transparent and widely disseminated to all relevant market actors. Member States must encourage the provision of information to banks and other financial institutions on possibilities of participating, including through the creation of public/private partnerships, in the financing of energy efficiency improvement measures. They are also requested to establish appropriate conditions for market operators to provide adequate and targeted information and advice to energy consumers. The Commission, on its side, will encourage the exchange and wide dissemination of information on best energy efficiency practices in Member States.

***Article 18 Energy services* adds up to the topic, insisting on**

(a) Disseminating clear and easily accessible information on:

- available energy service contracts and clauses that should be included in such contracts to guarantee energy savings and final customers' rights;
- financial instruments, incentives, grants and loans to support energy efficiency service projects;workplace activities;

(b) Encouraging the development of quality labels, inter alia, by trade associations;

(c) Making publicly available and regularly updating a list of available energy service providers who are qualified and/or certified and their qualifications and/or certifications in accordance with Article 16, or providing an interface where energy service providers can provide information;

(d) Supporting the public sector in taking up energy service offers, in particular for building refurbishment, by

- providing model contracts for energy performance contracting which include at least the items listed in Annex XIII;
- (providing information on best practices for energy performance contracting, including, if available, cost benefit analysis using a life-cycle approach;

(e) Providing a qualitative review in the framework of the National Energy Efficiency Action Plan regarding the current and future development of the energy services market.

Specific focus on provision of transparent and reliable information and expert advice to the end user is also provided in *Article 9 Metering* and *Article 10 Billing information*, as both topics are rightfully envisaged as the founding block of informed investment decisions.

The Energy Performance of Buildings Directive also tackles the information needs and delivery through a specific article (*Article 20 Information*), which stipulates that Member States will take measures to inform the owners or tenants of the different methods and practices to enhance energy performance, provide information on energy performance certificates and inspection reports, and on cost-effective ways to improve the energy performance of the building and on available financial instruments. Specific requests for provision of information are developed in relation to energy performance certificates (*Article 11*), including in regard to the cost-effectiveness of the recommendations for renovation measures.

This long list of provisions is particularly impressive, as it is the most detailed recommendation on the design of the implementation programmes, explicitly requiring strong focus on provision of information, advice and consultation to the end user, thus directly stimulating the exchange in both small scale energy collectives and at the meso-level, providing various tools for establishing and/or supporting practices, cognitive norms, and material culture of different lifestyles and proactive stakeholders' constellations.

Training and education

An often underestimated topic with significant relevance to social sciences input, training and education are understandably regarded as important part of the energy transition and specifically addressed in the discussed policy documents. In the Energy Efficiency Directives, the already mentioned *Art. 17 Information and training* commits the Commission to review the impact of its measures to support the development of information platforms, involving, inter alia, the European social dialogue bodies in fostering training programmes for energy efficiency. Member States are requested to involve local and regional authorities, promote suitable information, awareness-raising and training initiatives to inform citizens of the benefits and practicalities of taking energy efficiency improvement measures. Specifically, Member States should encourage training programmes for the qualification of energy auditors (*Article 8*) and provide that "where necessary, suitable training programmes, become or are available for providers of energy services, energy audits, energy managers and installers of energy-related building elements" (*Article 16*), which again leads directly to support of the micro- and meso-level of decision making and the actions requested from the member states to vitalize this type of social interaction.

At the institutional level, in Article 20 Information of the EPBD, Member States are requested to "ensure that guidance and training are made available for those responsible for implementing this Directive". Such guidance and training shall address the importance of improving energy performance, and shall enable consideration of the optimal combination of improvements in energy efficiency, use of energy from renewable sources and use of district heating and cooling when planning, designing, building and renovating industrial or residential areas. Additionally, in the process of certification of buildings by independent experts (*Article 17*), Member States are requested to make available to the public information on relevant training and accreditations.

It is clear that energy efficiency in the building sector commands a strong focus and serious attention is paid to the development of regulatory and financial enabling conditions for the transformation of the sector. Being the main instrument of consumer behaviour change towards a more active role in the building renovation market, the structural policy tools and the non-structural measures try to create broad space for using input from social sciences and humanities in a coherent manner. In some areas, there are very specific and detailed guidance notes, which is definitely a strong point and a major stimulus for further development. However, at the same time, there are some significant deficiencies: the process is rather one-sided, based on passive provision of information rather than on active engagement and interactions with the relevant stakeholders. There are no implications for strategic planning of the marketing and communication activities based on intensive interactions and using the potential of SSH, and unfortunately there is no institutional basis to sustain such cooperation. The specific activities in this direction are understandably left to the initiative of the national (and, in some cases, local) level of governance, but there are no

quality criteria or institutionalized quality assurance mechanisms for monitoring of the outcomes of the potential multidiscipline approach and collaboration (with the partial exception of the monitoring reports on the building renovation strategies).

6.4 National Case Study: Bulgaria

Since the EU level documents delegate the implementation to the Member States, this implementation will be studied with the example of Bulgaria in the following sections.

The energy efficiency policies in Bulgaria in the building sector are implemented through the following strategic planning documents and implementation programmes:

- National Energy Efficiency Action Plan (NEEAP) 2015-2020
- National Plan for Improving Energy Characteristics of Heated and/or Cooled Buildings - State Property Used by State Administration 2016-2020 (Annex 1 to the NEEAP)
- National Long-Term Program to Promote Investments for Implementation of Improvement Measures of the Energy Characteristics of Public and Private Buildings in the National Residential and Commercial Building Fund 2016-2020 (Annex 2 to the NEEAP)
- National Plan for Nearly Zero Energy Buildings 2015-2020
- National Housing Strategy until 2030 (draft version, not publicly available)
- National Energy Efficiency Programme for Multifamily Residential Buildings (ongoing, financing secured for 2016 and 20017, no final date)

6.4.1 National Energy Efficiency Action Plan (NEEAP) 2015-2020

The National Energy Efficiency Action Plan (NEEAP) 2015-2020 is the leading strategic document which adopts the requirements of the Energy Efficiency Directive (Directive 2012/27/EC) and the Energy Performance of Buildings Directive (Directive 2010/31/EU). It has specific chapters dedicated to the implementation of these requirements, which also refer to secondary legislation acts and implementation programmes. In respect to the Energy Efficiency Directive, the NEEAP contains specific relation to the identified potential areas for involving input for social sciences and humanities. As an example, alternative measures for proving the execution of the individual energy saving targets of the obligated persons (Art. 7) include introduction of voluntary standards, labelling and, most notably, education, training and consultancy, which, in principle, pertain directly to the micro- and meso-level of the ECHOES perspective. The billing and invoicing, providing reliable and transparent information for the end consumer, are declared as already regulated (by the referenced Law on Energy Efficiency) and no further interventions are planned, despite tangible social tensions regarding the transparency of the heating energy bills and the legal actions against the clients by the district heating companies[235]. Articles 12 and 17 of Directive 2012/27/EC are specifically addressed as they are also providing alternative measures for proving energy savings, as mentioned above. The energy distributors and companies and the local level of governance are identified as main sources of information.

[235] Reference sources: http://www.ombudsman.bg/news/4562; http://btvnovinite.bg/article/bulgaria/izravnitelnite-smetki-za-parno-tazi-godina-shte-oparjat-potrebitelite.html (in Bulgarian)

A number of methodologies for calculation of the effects are developed and in process of approval by the National Sustainable Energy Agency, including:

- Methodology for assessing energy savings when applying a behavioural change program to realize energy savings by sending home energy consumption reports and accessing an online platform;
- Methodology for estimation of energy savings in the organization of quizzes and competitions with thematic focus "Energy Efficiency for Children";
- Methodology for assessment of energy savings in organizing an energy efficiency competition for Bulgarian households;
- Methodology for assessment of energy savings in the implementation of information campaigns on "Energy efficiency in the home" focusing on final energy consumption;
- Methodology for Assessment of Energy Savings in the Implementation of Training Program "Energy Efficiency in Schools";
- Methodology for assessment of energy savings in the organization of energy consultation - provision of a report on the energy consumption in households for a certain period of time;
- Methodology for assessing energy savings in the provision of electronic invoices and messages.

These methodologies are declared of being developed by “energy and/or fuel traders and their organizations, energy efficiency consultants, scientific organizations and higher education institutions”; unfortunately, despite being a perfect field of interaction, in the document there is no direct evidence of social science experts being involved. However, an evaluation of the quality, the experts involved and the process of preparation would only be possible after the official publication of the methodologies. In general, there is no direct guidance on the implementation of education, training and consultancy activities, and no monitoring and quality assurance mechanism. A number of relevant stakeholders are left without notice.

A very detailed description of the education, certification and accreditation process for experts and companies providing energy audits is available in the NEEAP, including even an outline of the training programme. However, there is no mentioning of qualification and training initiatives for other occupations related to the implementation of energy efficiency measures in buildings at any other level, and no other interventions in the vocational training and education system are provisioned. In the area of energy services, there is a sufficient description of the ESCo and EPC regulations and market situation in Bulgaria, but despite marking a significant potential, there is no intent or specific measures planed for market development and stimulation, which is a potential impact area of social sciences and stimulation of viable interactions, especially at the meso- and macro- (e.g. municipal) level.

As related to Directive 2010/31/EU, the implementation is mainly referred to the National Plan for Improving Energy Characteristics of Heated and/or Cooled Buildings - State Property Used by State Administration 2016-2020 (Annex 1 to the NEEAP) and the National Long-Term Program to Promote Investments for Implementation of Improvement Measures of the Energy Characteristics of Public and Private Buildings in the National Residential and Commercial Building Fund 2016-2020 (Annex 2 to the NEEAP), which will be analysed later. Additional focus is put on the role of the local authorities, specifying the obligation to develop and report a local energy efficiency plan, and noting the benefits of the Covenant of Mayors. However, specific goals and priorities in relation to social sciences and citizens’ and market uptake of the measures are not provisioned in the document. A number of structural measures is outlined, including mainly locally accessible financing sources, but without a coherent financial framework and evaluation for their possible contribution.

6.4.2 National Plan for Improving Energy Characteristics of Heated and/or Cooled Buildings - State Property Used by State Administration 2016-2020 (Annex 1 to the NEEAP)

The plan refers to the obligation according Art. 5 of Directive 2012/27/EC, requiring each country to ensure at least 3% renovation rate for the state-owned buildings. According to the Law on Energy Efficiency, the officially approved goal for Bulgaria is significantly higher - 5%. It specifically states the willingness to demonstrate the exemplary role of the public authorities, where the input of social sciences at the macro-, meso- and micro-level can be significant.

The plan specifies eight measures for achieving the goal, including the following ones with potential for interactions with social science perspective:

- Elaboration of energy efficiency programs for ministries, agencies and district administrations for the buildings occupied by their subordinate central administration (…). The programs include, in addition to energy-saving measures for buildings and workplace activities, an increase in the administrative capacity to implement energy efficiency projects and to perform energy management in the operation of buildings. Each program must ensure the monitoring of the results and provide for appropriate measures if the progress of its implementation is unsatisfactory;
- Promoting new technologies in the implementation of energy saving measures in state-owned buildings;
- Analysis of the implementation of the energy efficiency programs of the central administration within the scope of the plan.

Unfortunately, there is no information about already existing programmes of the specified institutions, which could be analysed, and examples for promotion of innovative technologies in state owned buildings are rare (the situation is additionally complicated by the fact that the Operational Programmes, under which many of the renovations are executed, do not stimulate innovations, require lowest cost measures and subsequently, proven technologies). In terms of involved actors, there is no direct evidence of intention to involve social sciences expertise. Despite the declaration that one of the expected indirect benefits will be the strengthening of the exemplary role of the buildings owned by public authorities, there is no indication of public awareness and communication measures to achieve this goal.

6.4.3 National Long-Term Programme to Promote Investments for Implementation of Improvement Measures of the Energy Characteristics of Public and Private Buildings in the National Residential and Commercial Building Fund 2016-2020 (Annex 2 to the NEEAP)

The Programme refers to the implementation of Article 4 of Directive 2012/27/EC, and is obviously the major planning instruments supporting investment in the energy efficient renovation of the building stock – thus implying significant potential for relations to the social science perspective. It has set as its major goal “Creating a sustainable model of energy efficiency management in Bulgaria through the implementation of effective, integrated and sustainable policies, flexible financial mechanisms and successful practices to achieve high national level of energy savings with care for people and the quality of their lives, the carbon emissions in the atmosphere and the preservation of Bulgaria's energy resources”, suggesting an ambition for human-centred approach.

There are four specific goals:

- Attracting private capital to increase energy efficiency by ensuring the proper functioning of the internal market in energy efficient services for end-users in buildings;
- Increasing the energy efficiency of buildings from public and private national housing and commercial building stock to a high national level of energy savings, through the mass implementation of measures to improve the energy performance of buildings in a cost-effective method and with high performance efficiency technologies;
- Implementation of effective national monitoring of the energy and environmental characteristics of buildings in Bulgaria, applying the achievements of Bulgarian science and successful European and world practices in the field of energy efficiency of buildings;
- Develop a national mechanism for a sustainable end-use behavioural model for energy efficiency in buildings.

The ambitious and convincing goals (strongly suggesting direct input from social sciences) are to a significant extent matched by outlined implementation mechanisms. The specific measures proposed include:

- Elaboration of energy efficiency programs municipal administrations and acceptance by the municipal councils of municipal energy efficiency programs (…) *The programs include, in addition to energy saving measures for buildings, but also workplace activities and increased administrative capacity to implement energy efficiency projects and energy management in the process of building operation. Each program must ensure the monitoring of the results and provide for appropriate measures if the progress of its implementation is unsatisfactory;*
- Updating integrated urban regeneration and development plans to include specific investment projects;
- Training and education activities and control activities to increase administrative capacity in implementing energy efficiency and renewable energy measures;
- Expansion of the activity of the municipal energy centres / expert units with activities for monitoring the results of implemented energy efficiency projects on the territory of the respective municipality;
- Implementation of the National Program for Energy Efficiency of Multifamily Residential Buildings in Bulgaria. Development of a concept for financing the National Energy Efficiency Program of Multifamily Residential Buildings in Bulgaria at the next stage of the program development with an emphasis on market principles of financing;
- Continuing training for users, builders, architects, engineers, energy efficiency consultants, building installers and installations in buildings to promote affordable energy efficiency mechanisms within the financial and legal framework in Bulgaria;
- Inclusion of residential buildings in the obligatory certification scheme for energy efficiency as well as other legislative changes leading to a more correct and effective implementation of the European energy efficiency legislation in Bulgaria;
- Introduction of energy management in the central government departments, in the regional administrations and municipalities;
- Development and implementation of a National Program for a Sustainable Behavioural Model of End Users for the Efficient Use of Energy in Buildings;
- Change in tax policy, tied to building tax with energy performance: Low-energy buildings have a higher tax, and buildings with a higher energy-efficient energy consumption class have a lower real estate tax.

However, in many of the cases there is no clear financial framework and planned investment for the execution of the activities in the allocated time frame. Within the allocation of responsibilities, there is no direct evidence of planned interaction with the social science and humanities perspective (excluding some vague definitions as "competent partners"), despite the obvious ambition to instigate behaviour change and to stimulate private investment. There is no sign for any activities on the design and preparation of the most of the programmes and instruments listed above, and especially on the development of a National Program for a Sustainable Behavioural Model of End Users for the Efficient Use of Energy in Buildings, which could a significant tool promoting insight from social sciences and humanities in the deployment of the policies and motivation of investment decisions using the micro- and meso-level ECHOES perspective.

The specification of measures is (rather awkwardly) followed by a list of barriers. Among technical and financing issues, the information, communication and training and education fields are rightly identified as existing barriers. It is assumed that "energy efficiency is not recognized as a major problem for consumers as energy costs are often low compared to the cost of many other factors. Most consumers believe that the expected energy savings do not justify the time and effort required to obtain sufficient information to decide on applying for funding for the implementation of energy saving measures. A number of studies show that households regularly underestimate the benefits of implementing such measures, while overestimating the time, cost and effort involved. In this respect, it is necessary for consumers to receive the relevant information exhaustively together with assurance that the proposed measures, including the monitoring and control mechanisms, ensure the achievement of the expected results and benefits identified in the audits and investment projects." Moreover, "The majority of participants in the process of financing and implementing energy efficiency projects lack the necessary training and knowledge of the subject. Suppliers, manufacturers and bankers do not have the skills to adequately promote energy efficiency products to their customers. A targeted, long-term and comprehensive training program is needed to create a critical mass of energy efficiency experts." Unfortunately, these very adequate analyses are not related explicitly to any of the specific measures described above (although an implicit link is presumably existing), and there are no financing framework or measurable results indicated in the process of overcoming the barriers (in general, the Programme suffers the deficiency of a very vague financial framework, without any evaluation of the capacity of the existing and planned financing instruments). Here, again, there is significant potential for involvement of SSH expertise in the process of design and implementation of the programmes and measures targeted to overcome the above-listed barriers, but there is no institutional framework or specific guidance to facilitate the process.

6.4.4 National Plan for Nearly Zero Energy Buildings 2015-2020

The Plan, developed in execution of the requirements of Art. 9 of Directive 2010/31/EU, is unfortunately the weakest point of the system of strategic tools supporting the implementation of the policies of energy efficiency in buildings, in terms of stimulating input from the social sciences and humanities. Chapter 7 of the Plan, entitled "Policies, Financial Mechanisms and Measures to Increase the Number of Buildings with Nearly Zero Energy Consumption", does not reach the ambition stated in the title and is restricted to a list of potential financing sources, again without clear evaluation of their capacity and impact potential and differentiation of specific goals. A significant number of measures (19) are identified without specifying the needed investment and specific impact, and unfortunately, several of the measures are already behind schedule with no indication to be executed in foreseeable future. Despite intermediary goals for implementation of the plan, so far there is no report on the achieved results and corrective measures taken.

6.4.5 National Housing Strategy until 2030 (draft version)

A National Housing Strategy until 2030 is in process of development, as a draft version has been prepared and discussed within an open expert platform. A number of implementation programmes (8) influencing directly the investment behaviour of the end users is proposed but the document is still in internal discussion and not available publicly, so no final analysis can be provided at this stage. However, this document will serve as a major platform for integration of SSH expertise in the energy efficient renovation of the building stock and provision of new social housing, presumably at NZEB level, so it will be in the focus of the ECHOES attention.

6.4.6 National Energy Efficiency Programme for Multifamily Residential Buildings

The National Programme for Energy Efficiency of Multifamily Residential Buildings (NP) is the biggest social initiative in Bulgaria for many years now. Starting with some distrust among the citizens despite the proposed 100% public grant for energy efficient building renovation, 3 years, in January 2018, projects in more than 800 buildings are already implemented and more than 2,000 have already signed framework agreements for financing. The expected energy savings for all buildings of which energy audits have already been carried out amount to a total of more than 900 GWh per year. The interest of the citizens seeing the implemented projects in buildings near their homes is growing and the number of the applications submitted for funding under the Programme already has exceeded 4,000. However, this is less than 10% of all eligible buildings, and in general, despite the enormous investment of 1 billion Euro for just 2 years, only a minor part of the population is directly benefitting from the programme.

Being by large and far the most tangible effort in the area of energy efficiency and definitely forming the image and appreciation of building renovation for most of the Bulgarian citizens, the programme is dramatically missing one crucial parameter – the communication with the end user. Despite the enormous investment, there is no single cent dedicated for a systematic communication campaign and, at central level, all communications are run by the responsible team at the Ministry of Regional Development and Public Works (MRDPW) within its regular budgetary restrictions and limited working staff. The local authorities, which are the main implementing actors, are required to conduct local communication campaigns, but with no additional budget or methodologic guidance. There is no systematic monitoring of the results and no guidance to the end users for the exploitation of the buildings after the renovation measures. Additional advice on energy efficiency products and services is practically unavailable.

Currently, discussion in experts groups are ongoing with the focus to propose pathways for development of the programme into a more sustainable financing mechanism. However, there is no tangible progress, as the momentum has grown and the public expectations are in favour of continuation of the 100% grant financing. Among other issues, this is a result of lack of communicational planning and involvement of the social science perspective, which now proves to be an insurmountable barrier for the sustainable continuation of the efforts. It is firmly believed that the continuation of the NP, if there is such, should be accompanied by systematic, coherent communication campaign with a long-term vision and clear indication of the investment perspectives and benefits gained by the end user, which has to be conducted at both national and local levels. The collaboration with the national media should focus on the long-term development of the program and the gradual realization of the necessary changes, while the local authorities should be provided with the necessary resources to interact actively with the citizens (under the methodological guidance of MRDPW) in order to strengthen the confidence, attract new housing associations and ensure the quality and sustainability of the measures, including information on the use and maintenance of the renovated homes. This will provide a broad platform, integrating all three levels of the ECHOES perspective, overcoming the serious deficiencies at the micro-level – through influencing the decision-making process in small local collectives, and at the meso-level, through promoting new energy culture and association with values pertaining to the effective energy management and use of buildings.

As a conclusion, it can be stated that the strategic documents at national level correspond to a significant extent to the requirements of the relevant EU directives, opening a vast field for interaction with expertise from the social sciences and humanities. There is clear understanding that the barriers in front of viable end user interest and investments in energy efficiency in buildings are rooted in information and communication deficiencies, which paves the way for the design the corresponding measures and instruments. However, this is where the major insufficiencies appear: the existing implementation programmes rarely touch upon the end user perspective and are largely designed in a top down approach, underestimating the need for streamlined communication activities and direct interaction with the local communities and opinion leaders. In cases where new initiatives in this direction are proposed within the latest planning documents, there is no clear financial and institutional framework, analysis of the stakeholders and monitoring scheme – and unfortunately no indication for start of the programme design activities. Although the local level of governance is rightly recognise as important change driver, there is no mechanism to support or provide methodological guidance to the municipal authorities, which could provide a promising open space for interaction with the social science expertise.

6.5 European examples for integration of social science input for promotion of energy efficiency policies at regional and local level of governance

Source for this section: Passive House Regions with Renewable Energy (PassREg) project financed under Intelligent Energy Programme[236]

6.5.1 The City of Hannover

Hannover's success story began as early as 1998 with the completion of a row of terraced Passive Houses in Hannover's new Kronsberg district, built for the EXPO 2000. At around the same time, the regional climate protection fund, proKlima, was established via the municipal energy supplier, enercity Stadtwerke Hannover AG, and the Hannover City Council. The fund channels over € 3 million annually in direct subsidies, consulting, and quality assurance for Passive House new builds and retrofits with the provision of renewable energies, which institutionalize the macro level perspective of influencing investment decisions. The effect of this fund on the local economy has been remarkable: for every euro spent in subsidies, an estimated € 12.70 flows back into the region.

Involving the business community: the key to sustainability

In 2007, Hannover Municipality decided to reduce its CO_2 emissions by 40%. This was accompanied by the „Passive House Resolution" of the City Council and its decision for utilization of "ecological standards for building construction in the municipality's sphere of influence". In connection with this the same year the Climate Alliance Hannover 2020 was founded. Its objective is to unite the efforts of some 80 public institutions and private companies for implementation of this strategic task. The partners are representatives of the industry and services sectors in Hannover, of the municipal administration, the energy and other utilities, etc. The Hannover City Council and Stadtwerke Hannover AG city energy utility again joined forces and became the major drivers of the new association, which on September 12, 2008 launched the ambitious Climate Protection Action Programme for the period 2008-2020. According to the programme by 2020 the CO_2 emissions in the City of Hannover will be reduced by 40% as compared to their 1990 level. The implementation of the programme is performed in the framework of three main networks, which are the pillars of the Climate Alliance Hannover 2020 – the Energy Efficiency Network, the Partnership for Climate Protection and the Opinion Leaders' Network. These activities created strong discourse for environment-friendly corporate activities and created distinguished energy culture and practices, relevant to ECHOES meso level.

Additionally, in order to support its efforts to mitigate CO_2 emissions and achieve more efficient energy use, Hannover Municipality established close operating collaboration with the business community and in particular with the SMEs in the region. Already in 2006 the campaign "e.coBizz" was established by the Climate Protection Agency Hannover and proemobolito support the SMEs with an energy consulting programme. The City also established a local public-private partnership for sustainable development Ecoprofit. It is based on a tripartite co-operation between the municipality, the local companies and experts and is oriented towards raising the knowledge and preparedness of the enterprises for curtailing their energy consumption and reduction of the volume of solid waste as a result of the production processes. As a special highlight zero e:park, the development of which was supported by the proKlima fund, stands as a particular highlight. This carbon-neutral district in Hanover-Wettbergen comprises 300 Passive House residential units, complemented by the use of solar-thermal energy. A widely successful concept, future home owners may buy land in this area on the condition that they build to the Passive House Standard – but plots are already sold out, evidencing the effect of the small local community values to the individual investment decision making.

6.5.2 The Brussels Capital Region

In contrast to Hanover's long-running history with energy efficiency, the Brussels Capital Region underwent rapid change, going from zero to front-runner in less than ten years. As of 2014, over one million square meters of passive buildings had been built or retrofitted in Belgium, particularly in Brussels Capital Region, including single-family

[236] More information is available at www.passreg.eu

homes, apartment buildings, offices, kindergartens and schools. Thousands of building professionals, occupants and users throughout Belgium have now been directly influenced by the Passive House Standard. In January 2015, the Passive House Standard became part of the official construction regulation, making it the reference standard for all new builds and deep retrofits, which reflects the macro-level process of formal social units exercising direct impact on individual decision making.

However, this did not come without active involvement of all stakeholders. In Brussels, the Exemplary Building Programme, known as BATEX, popularised the Passive House Standard as the preferred low energy building solution. The programme granted subsidies through a series Passive House design competitions for residential buildings and a wide variety of both public and commercial buildings. BATEX, which ran from 2007 to 2014, was complemented via additional training, support and widespread stakeholder engagement, all of which quickly brought Passive House into the mainstream. Free consultation was available to anyone interested, directly targeting the individual decision making process – as a part of a local, quickly becoming mainstream – new energy culture.

6.5.3 Heidelberg's Bahnstadt

Another striking example of forward-thinking planning is Heidelberg Germany's new city district, the Bahnstadt. The Bahnstadt is rapidly becoming a highly respected model for the implementation of high sustainability standards in urban development and was honoured with the 2014 Passive House Award in the "Passive House Regions" category. Established on the site of a former freight yard, the area will eventually provide housing for 5,500 people as well as office space for 7,000.

The City of Heidelberg made the Passive House Standard mandatory for the entire Bahnstadt development, making it one of the largest Passive House sites in the world. The 116 hectare district includes a student campus, offices, industry, retail, leisure, housing and associated services, supplied by a district heating network based on woodchip-fed combined heat and power. As such, the area is net zero in terms of annual carbon emissions – all heating and electricity needs are supplied entirely via renewable sources.

However, this exemplification of the ECHOES macro level is not sufficient by itself. The City of Heidelberg also offers subsidies to aid the ultra-low energy development of the region, for example, by providing € 50 per square metre for residential Passive House buildings – up to a maximum of € 5,000 per unit, thus providing structural measures for implementation of the policies and consultation to the end users. As a result, the development has been so well received, the second phase of construction was accelerated by two years. Public and private investment through 2022 has been estimated at € 2 billion.

6.5.4 The City of Frankfurt am Main, Germany

The City of Frankfurt is committed to climate protection based on the PH Standard and renewable energies. It is one of the 19 German municipalities participating in the "Master Plan for 100% Climate Protection" programme, set by the Germany Federal Ministry for Environment, Nature Conservation, Building and Nuclear Safety. These municipalities are each developing a master plan to reduce greenhouse gas emissions by 95% by the year 2050 and to point the way towards a climate neutral society. Frankfurt's plan calls for the use of PH Standard in the building sector section and sees the city being fully supplied by renewable energies by 2050.

Such exemplary actions institutionalizing the macro level of guiding investment decisions in the building sector are however nothing new for the city of Frankfurt, which has started to build its own energy culture from as early as 1991. The current building policy today consists of two main pillars: the Climate Protection Concept and the Passive House Act. The Climate Protection Concept covers a wide range of measures for reducing CO_2 emissions, including among other things an integral concept for communication relating to climate protection, a quality standard for energy-efficient renovations in Frankfurt, quality assurance by means of energy passports, an ecological rent index, capacity building campaigns for multipliers, and financial support - "Frankfurt's Passive House Loan", giving tools and communication arguments for small group discussions and individual decision making.

The second fundamental pillar is the Passive House Act. The City Council of Frankfurt decided that all municipal buildings, whether new or refurbished, and whether owned or newly rented, as well as all buildings belonging to the city's own associations must be realized to the PH Standard. It also stipulates the use of renewable energies for new non-residential buildings. As of 2014, more than 100,000 m^2 of PH floor area have been built in a wide variety of buildings. The municipal housing association, AGB Holding Frankfurt, proudly calls itself "The Passive House builders" – a tag line that stands as a testimony of the city's dedication. These activities show a strong dedication to the ECHOES meso-level approach, creating lifestyles and identities within various areas – local administration, businesses, professional communities, and new home owners.

6.5.5 Antwerp: large-scale city development through market support policies

With its Climate Plan (2011), the city of Antwerp has committed itself to using energy and resources sparingly and sustainably, and moreover to achieve CO_2 neutrality in 2050, the city leads by example and designs all municipally owned buildings to the PH Standard including schools and kindergartens. Antwerp also steers the private market towards highly sustainable projects by formulating appropriate preconditions and procurement criteria in competitions and contracts, exemplifying the macro level of influence.

Nieuw Zuid, a new mixed residential quarter in the south of the city, is a prime example of the type of development being promoted. The realization of this project is currently in progress and entails 2,000 dwellings, offices, amenities, and a large park. A large part of the area, around 16ha, is owned by a private developer. As agreed upon by the city and the developer, all buildings must be designed to PH level with a maximum heating demand of 15 kWh/m^2/year. Nieuw Zuid is also the starting point for the development of a city-wide heating network, and a district heating plant at the edges of the park will 'feed' the network, providing heating and hot water. In this case, it was the explicit choice of the city and the developer to create a win-win situation: the city can realize its climate goals and gradually develop a collective heating network while the developer can market a product with added commercial and financial value in the short and long term. The overall development has also another added value: it creates local identity and culture of the inhabitants, thus influencing their own decisions pertaining to the energy use in their dwelling and working places.

6.5.6 The Region of Tyrol, Austria

Tyrol's success story begins with Austria's ratification of the Kyoto Protocol in 2002. On this basis, each of the nine federal states developed its own climate protection strategy. Tyrol cemented Passive House and renewables into their strategy for climate protection via attractive housing subsidies and Passive House promotion. Large scale Passive House projects have also shown the way. Neue Heimat Tirol, the regional social housing company, has been instrumental in this light with exemplary projects that provide quality passive housing to low-income citizens. The Lodenareal in Innsbruck, for example, comprises 354 flats built to the Passive House Standard and complemented with renewables in the form of solar collectors and a wood pellet boiler.

However, this top-down, institutionalized approach demonstrating the macro perspective is not sufficient by itself. Various subsidies are developed provincial (regional) level in Austria, mostly linked to housing support, especially concerning thermal insulation, use of biomass for heating and solar energy for space heating and domestic hot water production, but also for energy consulting and issuing of Energy Performance Certificates (EPC). A special role in the process is dedicated to the advice and consultancy network of Klimaaktiv, which provides direct consultancy and advice to the end users. Thanks to this micro-level approach, the expenditures for housing renovation are quickly increasing (28 %), due to particularly attractive subsidies.

6.5.7 Putting it all together: long-term energy planning in Cesena, Italy

Exemplifying the ECHOES macro approach, the Municipality of Cesena has accepted a "Structural Plan" in accordance with the environmental targets of the council's political programme for 2014-2019 so as to guarantee sustainable urban development and improve the citizens' quality of life. The municipal Structural Plan envisages

zero use of new territories and instead of this focus on nearly zero energy buildings, social housing, sustainable mobility, and architectural quality.

Additionally, the Sustainable Energy Action Plan drafted in 2011 following the endorsement of the Covenant of Mayors, considered the energy retrofitting of existing buildings and construction of new according to the A class as priority actions. The challenge is therefore the reaching of nZEBs supplied with renewables based on the PH Standard, both in the residential and commercial/services sectors in line with the targets set by the EU for 2020. The involvement of all relevant stakeholders, including the youth, is set as an obligatory condition, which is an evidence for the understanding of the importance of creating new energy culture and promoting new practices, transformed into concrete actions.

Our children are our future: raising awareness in schools

Energie per la Città s.p.a., an in-house company of the Municipality of Cesena, is developing a series of events and training courses aimed at children, teachers, parents, educators and those involved in education. This is linked with communication activities and awareness-raising in Cesena's primary schools and in public events addressed to citizens. The project's main objective is to communicate what the City Council concretely realized in the last years, through the action of "Energie per la Città", on renewable energies (particularly photovoltaic) and energy saving, and in this way to raise the awareness on these issues so that they can spread further, creating a greater confidence of the importance of daily choices in this regard.

6.5.8 Latvia: Specializing in sustainable energy financing

The Latvian Environmental Investment Fund (LEIF) was established on April 28, 1997. The Ministry of Environmental Protection and Regional Development of Latvia owns 100% of the Fund's shares, demonstrating the influence potential of a formal social unit at the national level. The Fund has worked on the development of different environment protection and environment friendly projects from the idea until its implementation for over 15 years. Its activities are directed to reach maximal environment improvement supporting commercial activities in public and private sector, stimulating financing for project realization of environmental and business infrastructure developments. Since 2010, the Fund provides supervision of the implementation and post-implementation monitoring of projects co-financed by the Climate change financial instrument (Green investment scheme - co-financing approximately € 200 million).

However, as in previous examples, the top-down approach is not enough: direct interaction and impact on the micro- and meso-level are crucial for the success of the policies. LEIF's partners include private enterprises, public utilities, local authorities, associations and research centres. Working on a lot of energy related projects, the Fund has amassed remarkable experience and a wide network of contacts. It works in close collaboration with many local authorities regarding project development and project management, event and trainings organization and knowledge transfer actions, forming new energy cultures for the local communities. This has enabled the introduction of a sustainable ESCO scheme for renovation of the multifamily residential buildings with distributed ownership. In its essence, this is an extremely complex task, for the success of which the national communication programme "Let's Live Warmer" played a decisive role, promoting the benefits of energy efficiency and building renovation - once again showing the importance of communication activities (based on extensive social science expertise) on the on-field programme implementation and success.

6.5.9 Zagreb: Building local capacity through European projects

City of Zagreb has a proven track record of implementing energy efficiency projects on the local and EU level, and its energy experts are regularly participating in professional seminars, workshops and educational activities related to the field of energy efficiency and RES. The technical employees in public buildings have undergone one day training courses on energy management in buildings and have been given instructions for further maintenance of the technical systems. Employees of the municipal departments have attended five day course and have acquired the title of energy manager. Usually these persons are the local contacts for the national energy efficiency programs

and the development of information systems for energy management. This has created a vibrant energy culture and stimulated a number of innovative practices for the local administration, which has enabled Zagreb to implement over 100 individual RES and refurbishment projects in public buildings, demonstrating the importance and viability of the ECHOES meso level approach.

6.5.10 The breakthrough: the first certified PH in Bulgaria as a result of long-term sustainable policies

"Sun" kindergarten, located in the city of Gabrovo, is the first certified passive building in Bulgaria and the first and only public building designed and constructed to the Passive House Standard as of 2018. The key for the success of the project was the political will and determination of the Mayor of the city Mrs. Tanya Hristova, who had to overcome a number of administrative, financial and technical barriers in order to achieve the goal set at the beginning, exemplifying the influence power of the formal social unit. However, following a long tradition of successful energy efficiency projects in the past two decades, the city is now proudly claiming the leadership in low-energy building practices in the country – and promoting an energy culture distinguishing it from other medium-sized cities in the country, attracting new business and fighting to keep the young and educated people through new attractive employment opportunities in the field of sustainable energy.

As the very first of its kind, the "Sun" kindergarten is drawing the attention of many professionals in the building sector in Bulgaria. The process related to construction, engineering, architecture and city planning was followed and controlled cautiously by the municipal experts. Trainers from the Technical University – Gabrovo and the local Vocational High School of Architecture and Construction took part in a specialized course conducted by Passive House Institute. A number of regional building forums, trainings and study visits were conducted along with other capacity building events related to energy efficiency in buildings. "Sun" kindergarten is also presented at major national conferences and events with the participation of the main partners in the project – the Center for Energy Efficiency EnEffect and the Municipal Energy Efficiency Network EcoEnergy, providing stakeholders' input from all relevant field of knowledge and exploiting opportunities to disseminate project's results and impact to potential replicators. Thus, the creation of local energy culture was strongly influenced by a single demonstration project, paving the way for the practical adoption of NZEB standards at the level of local energy efficiency and urban planning.

7 SOCIAL SIENCE IN COMPANY-STRATEGIES

7.1 Rationale for selection of this case

Energy utilities might utilize social science knowledge in a different way than policymakers. To explore this assumption, one of the ECHOES user partners (ENEL, Italy) described their use of social science knowledge and assumptions in their strategies. In the context of smart grids, consumers play a crucial role in the changes towards low carbon energy scenarios. They are expected to evolve from being passive recipients of energy services into more active participants in the energy market, shifting to more efficient and sustainable energy consumption behaviours. To this aim, ENEL has developed solutions to empower customers with improved information exchange that enable innovative services to the end users.

7.2 Active Demand and Demand Response customer's engagement in ENEL

Several use cases and functionalities have been developed and implemented through projects and trails, ranging from customer awareness and rationalization of the energy use to the validation of the Active Demand products. In particular, in order to validate the technical solutions developed while getting insights into how customers can be more actively involved in the energy system management, different initiatives, exploring different levels of customer engagement, were launched over the years in collaboration with other partners, both at the national and European level. In the following paragraph, four examples are given: Enel Info+, Energy@Home, ADDRESS and ADVANCED (ISGAN 2014[237] and ISGAN, Smart Grid Casebook, 2017[238]).

Enel Info+: The distributor company of Enel developed a local meter interface referred as Enel Smart Info that fully leverage on the smart metering infrastructure and expertise, which makes consumption and generation data available to its customers, allowing the development of a platform for a bidirectional communication with the DSO and enables solutions for Active Demand and Demand Response services. In particular, the company launched in 2012 the Enel Info+ project, a large scale trial in Southern Italy, where the use of the Enel smart info device was tested under real operating conditions. Both residential and small commercial customers were provided with higher quantity and quality information on their electricity energy consumptions, addressing customer awareness and paving the way forward for a more active participation to the management of the electricity energy system.

Energy@home: In the context of enabling in-home energy management solutions, the company has also launched in 2012 the Energy@home pilot project where a domestic platform for the provision of value added services based upon information exchange was tested in Central Italy, having the smart info as bridge between the devices in the Home Area Network (HAN) and the DSO's communication systems.

ADDRESS: Another project is ADDRESS, where technological and commercial solutions enables residential Active Demand. This was a large scale FP7 research project coordinated by Enel with the vision to allow domestic and small commercial consumers flexible load optimization, embedded generation and storage of energy.

ADVANCED: One more example is the FP7 funded project ADVANCED (Active Demand Value and Consumers Experiences Discovery) launched also in 2012 with the aim to develop actionable frameworks enabling residential, commercial and industrial consumers to participate in Active Demand.

Potential flexibility from customers is considered one of the largest untapped energy resources, mainly due to insufficient consumer awareness regarding energy consumptions and the potential benefits of a smart energy use

[237] International Smart Grid Action Network – ISGAN (2014), "Spotlight On Demand Side Management", International approaches and lessons learned in Demand Side Management.

[238] International Smart Grid Action Network – ISGAN, Smart Grid Casebook (2017), "Spotlight On Customer Engagement and Empowerment", International approaches and lessons learned in Customer Engagement and Empowerment.

in consideration of network constraints. Paving the way forward the implementation of active demand solutions, the objective of the solutions developed by Enel[239] has primarily been to establish a direct link between the electricity energy utility and the final customers, improving their consumption awareness and enabling their active participation to the electricity market. While enabling exploitation of flexibility from customer engagement in a secure and reliable manner, the expected benefits can be summarized as follows.

Expected benefits

- More efficient and sustainable energy use (energy consumption reduction and shifting to off-peak hours).
- New advanced in-home energy services enabled (automatic load management, coordination of consumption and generation).
- New competitive market based on distinctive services opened to several market players (service providers, retailers, aggregators, TelCos).
- Additional resources to manage the electricity energy system been enabled (better balancing of energy consumption and generation, load shedding, peak shaping, etc.).
- More efficiency and sustainability of the whole system (through energy consumption reductions, load shifting when renewable production is higher, etc.).

The benefits of Active Demand for the key stakeholders and its impacts on the electricity system considering the potential contribution to system stability and efficiency were analysed through the projects mentioned above. This was also done comparing the different AD solutions applied in Europe and enhancing them by the investigation of socio-economic and behavioural factors with direct involvement of real consumers.

Privacy issues, also in relation to data collection and processing, have been addressed, always in agreement with the customers. Moreover, customer opting out has been guaranteed and participation stated on a voluntary basis with no cost for the involved customers.

7.3 Involvement of customers

Involvement of customers, especially during the testing phases of technologies, is always a challenge for the companies in the energy sector and project developers in general. Examples of this problem have been documented in the case of energy consumption pilots and field tests, especially in the case of demand side management technologies (IEA, 1998[240]). Experiences have suggested that recruitment should be an important part of the trial plan and should be organized in order to achieve participation targets. When a utility company like Enel wants to try a new technology, priorities need to shift from a focus on cost control to a broader emphasis on consumer friendliness and added value to the consumer (WEF, 2010[241]).

Adopting these three concepts are important to guide the recruitment processes:

- Customer knowledge and understanding of active demand technologies and its principles.
- Customer acceptance and willingness to participate in the consumer programs.
- Informed customers making informed decisions.

[239] ENEL distribuzione (2011), "Description of test location and detailed test program for (limited) prototype field test, simulations and hybrid tests". Address project.

[240] IEA (1998) "Techniques for Implementation of Demand Side Management Technology in the Marketplace: Final Report". DSM-IEA, International Energy Agency.

[241] WEF (2010) "Accelarating Successful Smart Grid Pilots" World Economic Forum in partnership with Accenture, Geneva, Switzerland.

In projects like Enel Info+, Energy@home and ADDRESS, Enel ensured program participation through a proactive communication campaign to educate, inform customers and create awareness of the technology concerned.

According to the World Economic Forum (WEF) report Accelerating Successful Smart Grid Pilots (WEF, 2010), one of the common misconceptions about consumers was "that businesses are being greedy and evil and that smart technology will deliver cost increases" (p.36). Therefore, in a project like ADDRESS, providing information to the costumers in a way that is beneficial for them, in that it builds trust and understanding between the consumer and the utility.

The WEF also recommends the adoption of a multi-channel communication effort to reach the required consumer base. Using different media to demonstrate the benefits of the project will be more effective in reaching wider segments of consumers. According to the IEA (2004)[242], the INDEEP Analysis Report, of the Implementing Agreement on Demand Side Management Technologies and Programs, conducted a survey on DSM programs which shows that 93% of the programs employed marketing methods such as direct mail, advertising or personal contact. The report argues that for many cases a broad marketing campaign using a variety of marketing and communication methods were necessary to ensure higher participation rates. Several communication methods are used together, and so therefore it is difficult to attribute success or effectiveness to one or two of the various methods used. Active Demand principles and technologies can be considered an "ambiguous product" due to the subjective nature of experiences that a participant might have after the trial, and in those cases advertising has been found to have a stronger impact (Deighton and Schindler, 1988; Hoch and Ha, 1986). Whilst advertising is a proven marketing tool, from a research perspective, care should be taken in how the advertisement messages are relayed across, making sure that information is presented as objectively as possible avoiding over-selling and broad claims. This is especially important when consumer acceptance needs to be assessed throughout the trial. Community based initiatives and groups can be a good source of access to consumer recruitment. Additionally, they are important mediums for organizing forums and public events for participants to voice concerns about the technology to be tested. Social media is another way to enhance interaction between the project and the participants. These techniques have been used at the beginning of the recruitment process to raise awareness the participation in the programs and project trials.

For the projects mentioned above the possibility to provide incentives for participating in trials have been explored. The survey by the IEA (2004) shows that marketing incentives were used in most of the INDEEP programs, however, the report indicates that whilst cash incentives and rebates can be effective tools for recruitment, they are not necessarily a guarantee. Programs with the highest participation rates had used a combination of an incentive and a good marketing campaign. The INDEEP study states that there is not a single strategy that can be designated as the most effective, as it ultimately depends on the project at hand, the type of technology promoted and the length of the pilot project. Furthermore, monetary incentives do not wholly reflect the actual motivations for taking part in technology trials. For example, in the Enel Info+ project, the company found altruistic concerns among some participants, with householders citing environmental reasons related to global warming and the welfare of future generations. This was however coupled with concerns related to maintaining comfort in their homes, lowering their electricity bills and a general interest in the technology itself.

In order to successfully activate consumers in the Enel Info+ project, Enel carried out information sessions, first involving local authorities and then customers. Meetings with mayors and a meeting with local consumers associations have been arranged to present the Enel Info+ project, to establish a successful collaboration and to explain the potential benefits of recruitment. More focused meetings have been also arranged with participants for them to know the project details. Considering the lack of customer knowledge and awareness on electricity consumption and potential benefits from their active interaction with the energy system, a step by step customer engagement approach has been adopted. The LV customers have been initially equipped with the Smart Info Display and are therefore receiving basic feedback on their consumption. The rationale was to get customers used

[242] IEA (2004) "INDEEP Analysis Report 2004" Task I for Implementing Agreement on Demand Side Management Technologies and Programmes. IEA-DSM, 2004. Available at: http://dsm.iea.org

to a new technology, thus avoiding rejection of additional technologies and services. Prosumers received an additional smart info device to manage both production and consumption metering data.

First results highlighted a remarkable use of the display, pointing out prosumers as the most active. Observed customers found it helpful to be informed of tariff bands once they had real time power monitoring. Small commercial consumers were shown to be particularly interested in these capabilities.

Flexibility enabled through customer engagement is generally a challenge to maintain in the period following initial recruitment. A web portal and a dedicated help desk were designed and implemented to provide general information about the project and continuous technical support. Additionally, on the basis of the abovementioned investigations, participants received quarterly reports (e.g. evaluation of their level of consumption, also compared with the one observed in the previous year as well as with the other participants, the neighbours having similar sized households, etc.).

In the case of the Energy@home project, 13 initial users were involved in the trial since 2012 in order to validate the technology and to collect the necessary information to fine tune the developed functionalities and improve the customer experience. These enhanced engagement opportunities supported the plans to extend the number of customers involved by 50, prosumers were included too. From the beginning of the project initial feedback shown positive consumer expectations for living with the technology and enhanced their awareness of energy consumption by specific appliances. The developed solutions have generally been found to be easy to use with a remarkable frequency of use. Customers also highlighted interest in overload notification and control, together with functionalities for in-house energy generation.

7.4 Recommendations and Lessons Learned

Active demand is not fully in place in Italy and a regulatory framework is still missing. As a matter of fact, pilot projects, as those described above, have been launched to pave the way for the implementation of the active demand solutions, from technological, commercial and regulatory standpoints.

According to the experience of the ADDRESS project at the European level together with the ongoing national experiences in Italy, recommendations and lesson learned can be formulated regarding the involvement of customers and the necessary actions to be performed to fully enable Active Demand in Europe.

Three main challenges to the massive deployment of Active Demand solutions can be identified as Active Demand implies a complex, multi-stakeholder system and requires several tools/devices to work together. Therefore, Enel is still on the way toward Active Consumers who fully participate in the management of the electricity system. For Active Demand to be successful, a gradual implementation should be carried out by first adopting solutions for monitoring to raise customer awareness and involvement, then in-home control to get customers used to technology, and finally full interaction with the electricity system to cover the whole AD chain.

Social, cultural and everyday contexts shape people's energy consumption, behaviours and adoption of energy related technologies. The acceptance by consumers of Active Demand principles and technologies in their homes is a key success factor for its diffusion in the market and the eventual transition of current electricity provision systems into smart grids. With the focus on individuals, the literature on the diffusion of smart metering technologies suggests that issues such as privacy influence their social acceptance. Consumers might be reluctant to reveal information about their private life or their daily habits. Moreover, they might be unwilling to forgo control over their energy consumption and the independence of their energy related decisions and choices. From a more social and collective approach, the view is that energy related behaviours are determined by an array of collective norms, values and beliefs, family structures and other institutional settings that shape energy related actions and decisions regarding energy technologies. These include the climate, the system and market of energy provision, energy

sources and fuel mix, the lifestyles of households and household size, daytime and night-time patterns, and regulation.

Recommendations and lesson learned

- Participation in active demand programs is voluntary; therefore a deep understanding of the benefits and implications from flexibility and adaptability of the consumptions (both from customer and a whole system perspective) should be addressed while maximizing the utilization of the technology. All contextual issues, as regional context, age, social conditions, are important and the full range of benefits has to be communicated to appeal to a range of customer values including not only financial benefits but also environmental benefits. Moreover, contracts and agreements with customers need to be understandable and transparent, and, as general principle, consumer privacy and data must be protected. However, alongside recruitment, a real challenge is to keep customers on board: for this reason, the provision of technical support and frequent communication following technology installation are fundamental principles for continued involvement in managing the electricity system.
- As a general principle, consumers must be free to opt in and out, with clear rules on the ownership and protection of data needed. Moreover, rules and mechanisms for verification and measurement of AD product delivery, fair allocation of costs and benefits among all the involved players, with a fair competition have still to be established and guaranteed for Active Demand to be put in place.
- Active Demand can be used to contribute to solve network operation problems, thus representing an additional source for electricity System Operators. However, collaboration and coordination is necessary among system operators and aggregators, therefore, responsibilities have to be clearly set out and regulation updated to include fixed costs associated to the services provided to enable AD and to purchase AD products specific to the country.

7.5 Analysis done in other countries and sociology studies

Studies have compared energy provision and consumption across different countries (Lenzen et al, 2006[243]; Zhang, 2004[244]). A study focusing on the structures shaping energy consumption compared the UK and Sweden, looking at energy sources, utilities and regulation, as well as lifestyles (Pyrko & Darby, 2009[245]), whilst another study compared user behaviour in Norway and Japan (Wilhite et al, 1996[246]), showing differences in the cultural significance of energy use patterns related to space heating and lighting, as well as bathing rituals.

According to scholars in the sociology of practice (Warde, 2005[247]; Shove and Pantzar, 2005[248]), generally practices are composed of three main elements: the material and/or technical surroundings through which activities are facilitated or made possible, the meanings of different elements of practice and the competence or tacit knowledge associated with a practice. If we are to view the various energy related activities in the domestic realm as a practice (for example, laundry), we can start to distinguish the various technologies and appliances relevant to each, the knowledge required and acquired for taking part in this practice and the associated meanings. Therefore, the acceptance and adoption of AD technologies will depend on how far active demand principles such as information

[243] Lenzen, M, Wier, M, Cohen,C., Hayami, H., Pachauri, S., Schaeffer, R. (2006). A comparative multivariate analysis of household energy requirements in Australia, Brazil, Denmar, India and Japan. Energy 31(2-3): 181-207.

[244] Zhang, Q. (2004). Residential energy consumption in China and its comparison with Japan, Canada and USA. Energy & Buildings, 36: 1217-1225.

[245] Pyrko, J. & Darby, S. (2009) Conditions of behavioural changes towards efficient energy use – a comparative study between Sweden and the United Kingdom. Proceedings of the June 2009 ECEEE Summer study, Cote d"Azur, France.

[246] Wilhite, H. Nakagami, H. Masuda, T., Yamaga, Y. & Haneda, H. (1996). A cross-cultural analysis of household energy use behaviour in Japan and Norway. Energy Policy, 24: 794-803.

[247] Warde, A. (2005). Consumption and theories of practice. Journal of Consumer Culture, 5(2): 131- 153.

[248] Shove, E. & Pantzar, M. (2005). Consumers, producers and practices: understanding the invention and reinvention of Nordic walking. Journal of Consumer Culture, 5: 43-64.

and load shifting can be integrated into household energy practices, and the extent that knowledge of AD principles and information on energy consumption integrate the different energy practices within the home.

Studies and innovation in energy technologies often assume a linear diffusion of technologies into society, neglecting the social contexts influencing actions and behaviours, and where economic rationality is the overriding factor for the adoption of technology and energy related behaviour changes. In the case of the ADDRESS project, the factors influencing the adoption and use of AD principles and technologies were studied in depth.

8 CONCLUSION

The analysis of policy documents on different political levels conducted in this report has provided a number of interesting results. First, the consumer (in some documents also the broader concept "citizen") has made his/her way into policy documents on all levels. It is now a shared understanding that Energy Transitions and the Energy Union require a substantial engagement of consumers in addition to technical or governance developments. Most obvious is this move of the consumer from a passive position to a central actor in the latest EU policies referred to as the "winter package". This moves consumers from being responsive to steering instruments to being considered a driver of transition processes and a key for innovation and change. However, the analyses presented in this report also indicate that this strongly increased interest in the consumer as an actor does not adequately reflect and address the complexity of human decision making. This might be considered natural in the general energy policies, especially at the EU level, since they only specify the framework for policymaking on the Member State level. However, this tendency can – with very few exceptions – also be found at the Member State and regional level.

The main overarching assumption reflected in most analysed policy documents is that (a) consumers are important actors, (b) they lack information but (c) provided with the right information, they will act accordingly, and (d) consumer behaviour is based on economic considerations, which calls for monetary incentives, subsidies and price regulations. The first conclusion is shared by the authors of this report – we consider consumers indeed a central category of the Energy Transition. The remaining assumptions are – based on our knowledge and the work conducted in the ECHOES project – far too restricted to engage consumers and citizens sufficiently. The information provision assumption is based on an *information deficit hypothesis*, which states that consumers are inactive or engage in unwanted behaviour because they do not know better. Whereas information and knowledge about impacts of behaviours and alternatives as well as technologies are necessary to be able to act, they have been shown not to be sufficient to initiate action. Consumers receive a vast amount of information every day, every minute and information alone is not a strong enough trigger for change of behaviours or practices. Similarly, although consumer behaviour is embedded in an economic framework and the choice of actions and implementation of technology is to a certain degree determined by its economic payoff, human decision making is very seldom rational in an economic sense, but rather coloured by cultures, social impacts, beliefs, values, attitudes, the behaviour of other people, the historic development of energy lifestyles and practices and the like. This indicates that the policies would from our perspective benefit strongly from taking a more comprehensive perspective on human decision making, which will be elaborated further in Chapter 8.1. However, a more detailed conclusion about the results will be presented first.

The analysis of the general energy policies at the EU level clearly document the change in perspective which recently occurred. From representing the consumer in a peripheral, rather passive position in the 20-20-20 strategy, which mainly outlines technology pathways, the picture has changed almost completely with the more recent winter package, where the consumer is put explicitly in the centre of the energy transition. Keywords such as citizen participation, prosumerism, the protection of vulnerable consumers, security, solidarity, and trust reflect clearly that the consumer is given a new role in these documents. If this development was stimulated by the perceived need of the EU to connect closer to its citizens or the realization that the cuts in CO_2 emissions necessary to reach a 2 degree or even 1.5 degree targets will be impossible to reach with technological improvements alone, can be discussed. However, the "old" market and technology focus still shines through, when measures focus mainly on market design (economic assumptions), network regulations, and education (information deficit).

On the national level, general energy policies are usually based on quantitative impact assessments, which are reducing the consumer dimensions to economic numbers (discussing economies, costs, and employment, while behavior, acceptance, gender, and other social and human dimensions are hardly discussed or assessed in the impact assessments). The national documents clearly show that they are lacking the inclusion of the social systems in transition studies and modelling, including changes in demographics, behavior, values, and cultures. Furthermore, they often lack methods and quantitative data to realize this more comprehensive evaluation. Finland is a rather typical example of this approach, where consultants assess the impacts of different policy options, mentioning consumer choices such as food, mobility or energy efficiency investments, but do not engage in a more

substantial analysis of the determinants of these behaviors. Germany on the other hand is an example where the energy transition ("Energiewende" in German) has to some extent managed to become a societal topic engaging consumers, especially as energy producers in energy collectives or as individual households. In France, the general energy policy is developed in a more participatory manner, by involving citizens and stakeholders broadly in the multiannual energy plan. If this process has led to the prominently anchored energy poverty issue in the energy plan might be discussed.

The analysis of policies in the different technological cases studied in this report partly mirror the results from the general analysis, however, there are also some interesting peculiarities to be noted. The understanding of consumers and consumption seems to be more elaborate in the case of electric mobility, possibly because this is an area that relatively recently has entered the policy arena, in a time when consumers already were on their way to the focus of policy makers. However, also here the dominant policy moments target information provision and the economic framework. The main driver of electric mobility policy is apparently not even the consumer, but strengthening the EU's position in a key market for the future. Nevertheless, in this picture the consumer is a key actor in several ways: (1) the uptake of electric mobility demands an acceleration of purchases of electric vehicles, (2) the use of electric vehicles puts demands on user behavior to stabilize the electricity net when charging larger numbers of electric cars, and (3) the consumer's acceptance for using electric vehicle batteries as decentralized storage facilities in a grid with high percentages of regenerative energy sources is important. This has resulted in a richer picture of the consumer in the documents. On the one hand, economic measures and incentives are discussed to overcome the assumed barrier of price premiums for electric vehicles. Here too, providing information is considered a key mechanism, especially information comparing different engine types (e.g., energy labels). On the other hand, the policy documents also reflect that other aspects need to be considered: They assume a "status quo" bias, favoring established technology, even if inferior to new technology. This bias is assumed to be overcome by increasing visibility of electric vehicles and the opportunity to try them. Also the aspect of convenience is explicitly acknowledged, for example when the availability and usability of infrastructure is discussed. Furthermore, range anxiety as a psychological barrier is recognized, sketching that the provision of charging infrastructure needs to be visible and simple to use. Finally, the policy documents about electric vehicles clearly acknowledge the role of social processes and influence. What is also interesting in many electric vehicle documents is the identification of public bodies as pioneers of electric mobility (via public procurement) to make electric vehicles visible.

On the Member State level, many of these considerations are mirrored. Germany has – very likely due to its strong car industry – an extraordinary focus on standardization and education of future experts for electric mobility, but otherwise takes a similar approach. Interestingly, the only policy document found in the analysis that explicitly acknowledged the role of an emotional response to a product was an electric mobility document from Germany. The German documents also highlight the role of trust in regulations and infrastructure and the need to address misconceptions about electric vehicles among consumers actively. The UK documents are similar in the general approach, taking mainly a rational choice perspective. However, also here the importance of demonstrator projects, visibility and the role of opinion formers (as well as – and this is unique in the documents – gatekeepers like car sellers) is highlighted. The Norwegian electric vehicle policy (one of the most successful in the world) is strongly focusing on measures increasing economic payoff, convenience, providing life-time benefits, and information.

The smart meter case revealed that other consumer motivations become very relevant, namely motivations to adopt smart meters (or resist them), trust and emotional encouragement. Also interesting is the underlying argument in most smart meter documents that smart meters coupled with feedback technologies will motivate consumers to restrict or reorganize their energy consumption. Implicit is – again – the hypothesis that information will enable and motivate consumers to take action. Which actions consumers should take, how that could be assisted in such decisions and how this would be transformed into a new energy culture remains unclear though. What is also specific for smart meter policies is the explicitly mentioned need to segment consumers into different groups (corresponding to the ECHOES lifestyle approach). Naturally, the issue of data security and protection and thus trust in the providing company are very prominent in smart meter policies. The UK smart meter policy (or more precisely the strategy employed by the organization SmartEnergy GB) can be regarded as the most elaborate implementation of social science knowledge in any of the studied documents. It starts out with the notion that

financial motivations are important, but only one out of many. It also outlines the following aspects: making energy more tangible, acquiring confidence in taking control over energy, reducing disengagement with energy companies, decreasing worry trends, and getting positive emotional response. The strategy is to achieve that by a comprehensive plan including nudging, habit-forming interventions, addressing changes towards long term and sustainable behaviour, and cost effectiveness of interventions. The focus is both on the adoption and the use phase of smart meters. It structures the actions along three themes: (a) "Out of the box" aimed at creating positive installation experience (being excited about smart metering system in the house and creating a commitment feeling to form habits). The interventions include priming with a teaser welcome package, and completing an installation checklist. (b) "Companion" aimed at providing a tangible feedback and social norming, includes a consumption information tool with understandable graphics that provides reassurance, benchmarking, and personalised tips. (c) "Looking to the future" aimed at supporting long term interest, and taps into perceived usefulness with personalised energy saving ideas to decrease the consumer's energy costs. Being aware of the social role, consumers are addressed as groups and segments, also focussing on small businesses. There is also a component in the package that employs patriotic motives (they will benefit the national interests, strengthen the position of the UK) to trigger adoption and use of smart meters, an approach that is well backed up by the ECHOES focus on identification with social groups such as the country. The German smart meter policy is mostly characterized by a critical approach where consumer benefits are mostly seen in the comfort. The Austrian smart meter policy reflects the main assumption already outlined above that information triggers action. However, here low-cost actions will be promoted to achieve the action implementation. An interesting case is the smart meter policy in Sweden, where the initial drivers were coming from consumers being unsatisfied with the measurement quality of the old meters.

In the photovoltaics case it became very obvious, how (in)stable frameworks affect consumer engagement in local energy production. In countries where the framework is perceived as stable and predictable, higher rates of uptake can be found. It is also interesting that consumer behaviour is better understood by analysing the inverter data, which also highlights the need to focus on the potential for rebound effects.

The building case revealed that policy in this area is targeting both the individual (house owner) level and the organizational level, thus the macro level outlined in ECHOES. Formal social units such as governments, energy providers, or building companies are repeatedly named in the documents as important actors that need to be sensitized (e.g., about energy poverty issues). The importance of transparency, dialogue and interaction between stakeholders is in the centre of many documents also tapping into the domain of energy (or better building) cultures. As in the case of electric mobility, the special role of public action (e.g., governmental buildings) in setting examples and defining a new culture is acknowledged. Also in these documents, the general assumption about the consumers is that lacking information, empowerment, and funding opportunities leads to inaction. The latter is addressed by an elaborate network of structural measures to link consumers to funding options. Also parallel to electric mobility there is a special focus on training gatekeepers and key personnel for the technical implementation of the measures. In the analysed Bulgarian documents, the general strategies are broken down into national policy, without adding much specificity.

The final analysis in this report regarded an electricity provider's view on the consumer and displayed in some ways an interesting contrast to public documents. Not surprisingly, the company's policy is very much focused on the *relation* between the company and the consumers. Also the company has an underlying concept of the consumer as a rational information processing unit to some degree, which leads to the notion that informed consumers will make informed decisions. However, the strategy does also treat information provision as a currency of trust and understanding between consumer and company. Continued technical support and clear rules for data handling are identified as key for this development of trust in the relationship. Furthermore, the company acknowledges that the consumers need to be taken on a journey first adopting solutions for monitoring to raise customer awareness and involvement, then in-home control to get customers used to technology, and finally full interaction with the electricity system to cover the whole active demand chain. From a more social and collective approach, the view is that energy related behaviours are determined by an array of collective norms, values and beliefs, family structures and other institutional settings that shape energy related actions and decisions regarding energy technologies. The cultural significance of energy use patterns related to space heating and lighting, as well as bathing rituals is mentioned in

the strategy. Thus, the company displays a strong interest in social science input in developing the relation they have with their consumers.

8.1 Potential for Social Science knowledge in policymaking and strategies

The conclusions presented above display clearly that social science knowledge has a strong potential to enhance policymaking to a far larger extent than is implemented in most of the documents analysed here. Whereas the authors of this report do not question the necessity of providing consumers with information about their energy use, alternative technologies, energy production, and smart appliances, we strongly doubt that this alone will stimulate strong changes in consumer behaviour. The picture is a bit more diverse for the strong rational choice assumptions underlying many policy packages. In some domains such as the diffusion of decentralized photovoltaics, the success of economic policy measures and net regulations has proven to be a decisive factor. However, this is overshadowed by the dimension of psychological control about the stability and trustworthiness of the schemes. In other domains the over-rationalistic approach has clearly failed. The purchase of a car is far more than a rational choice, impacted by culture, status considerations, norms, values, group processes, trust in producers and technologies, visibility of new technologies and thus communication of normality (descriptive norms), etc. With a different angle, this is also true for smart metering. Here trust in the motives of the data handler and technological security are decisive factors, which can only partly be addressed through information campaigns alone.

From the perspective of the ECHOES project, we see the following potential for policy improvement:

- The ECHOES literature study has found that for individual decisions far more factors than economic benefits and costs are relevant. Among the most relevant factors were attitudes, perceived behavioural control (the feeling of capability of performing the behaviour), routines and habits, social norms (both as descriptive norms, which is what others do, and injunctive norms, which is what others expect), values, emotional activation. Some of these factors have been found mentioned in some documents. The most integrated concept is certainly attitudes, which – although not always referred to as attitudes – is represented by referring to the consumers evaluations of different behavioural options. Perceived control, however, is much less represented. Here it is not alone important to make behaviour easier objectively, but also acknowledge that perceived control is a subjective concept and only partly related to objective control. The policy to provide examples and demonstrators is certainly a good start to change perceived control. Experiencing a technology first hand gives the feeling of mastery and control, if the experience is successful. A factor almost absent in policy documents are routines and habits. Although many policies aim at change of consumer behaviour they ignore the inertia that lies in habitualized behaviour, which makes consumers unreceptive to new information. Different value orientations of consumers are also not prominent in the policy documents, though value orientations differ both within and between countries as well as between different social groups. Interestingly, different value orientations can be linked to energy behaviour (one can for example save energy for very different reasons) and the congruence of communication to the prominent values in a person is important for how this information is received. Finally, emotional activation is a strong driver of action (both in the positive and negative emotional spectrum). This is hardly recognized in the policy documents. Taking into account the emotional response to a technology is, however, decisive for the acceptance and connection (and thus use) of it.
- The ECHOES literature study further found indications for that the energy behaviour of individuals changes depending on if they consider themselves as individuals or as part of a group (e.g., citizens of a country, a municipality, or the EU, but also other social groups such as technology lovers, car enthusiasts, etc.). Identification processes trigger a different decision mode where the “we” becomes stronger than the “I” and group norms can make it possible to implement behaviour even if they lead to a loss on the individual level but lead to a gain on the collective level. This line of thought was only found once in the documents, namely when the UK smart meter policy discussed the potential of patriotic motives to strengthen uptake. We see a larger potential in carefully analysing which framing of the social group identification would yield the best acceptance of policy measures.

- Few policies make references to the impact of lifestyles, cultures or historic development (energy culture) on energy choices. However, research on energy practices clearly shows that energy behaviour is embedded in a cultural context and that different groups of the population are diverse with respect to the patterns of their energy practices. This needs to be reflected in a more inclusive approach than one-size fits all information or funding schemes. Furthermore, knowing the cultural narratives about energy use and their historical roots opens for a better targeting of the policy measures to the respective context. Naturally, this becomes more relevant, the more local the policy is.
- The ECHOES analyses in the literature report showed clearly that formal social units and individuals though sharing some characteristics of decision making also differ considerably. While some policies acknowledge the special role of, for example, public procurement, there is a larger potential in actively understanding the energy decisions of different forms of social units from the individual to the formal units; from the consumer to the companies to the governments to the user organizations.
- Finally, analysing the policy documents indicated that some technologies (especially those with high upfront investment costs such as EVs and PVs) potentially exclude larger segments of consumers from engaging in the energy transition. Finding ways to overcome this barrier might be an important field for social energy science.

8.2 Barriers for implementation of the knowledge

In the analysis, some barriers for a successful implementation appeared.

We see the following main barriers for a better integration of rich social science knowledge in policy making:

- Consumers still seem to be generally understood as rational decision makers, processing the information they are provided with and then reaching the decision that yields the (from an external perspective) most beneficial outcome. This is a strongly oversimplified understanding of human behaviour.
- The policy system in the energy sector is built in a way that general EU policy is implemented in national law and then into local measures. Therefore, the initial policy documents remain rather unspecific. However, in the implementation the general character of the documents and vagueness with respect to consumers is often translated down to the next level and thus perpetuated where it should be more specific.
- Policies analysed had a tendency to be general and not having mechanisms built in that allow for targeting to different regions, cultures, value orientations and lifestyles. Taking this diversity into account requires an extra loop of “diagnosing” the consumer / social group that is targeted.
- Policies are not good enough in acknowledging different levels of social units and tend to treat decision makers on an individual level, ignoring their social connectedness both horizontally and vertically. New ways of policymaking need to be developed to reach more targeted measures.
- Social scientists tend to avoid giving clear advice on policy measures, especially in complex situations outlined in the bullet points above.

8.3 Suggestions for more efficient implementation of social science

Based on the barriers identified in the last section, we suggest the following measures for a better implementation of social science in policy documents:

- To actively work with the oversimplified concept of consumers, we suggest that policy documents make explicit the understanding they have of consumer decisions. This process of defining the underlying assumptions actively – with social scientists being experts in the area – will make implicit assumptions open and allow for a more diversified approach.
- Whereas general EU level documents naturally lack the specificity that local documents should have the top-down system makes it likely that lower level documents just copy the higher level assumptions. The EU level documents thus should be supplemented with a best practice collection of local level policy which shows how the general policy could be implemented. The SmartEnergy GB document is a good example of such a best practice document.
- Methods of capturing diversity in a manageable manner need to be developed and implemented in the design of policy documents. Diagnostic tools for group identification, value orientations, lifestyles, etc. and a mapping of policy measures that have proven to be successful for a specific group need to be developed.
- Policies should distinguish between different levels of social groups and their interactions more clearly by indicating which measure is targeting which unit and why (again making implicit assumptions explicit).
- Social scientists need to develop the ability to provide clear advice (which always will include a degree of uncertainty). To be relevant, the state-of-the-art needs to be accessible in a policy compatible way, not as scientific theory.