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Summary

The Horizon 2020 funded Energy Conscious Consumers (ECO2) project aims to improve consumers' energy efficiency through learning processes supported by the ECO2 web platform. The e-learning ECO2 platform will be built on recent knowledge on national differences in energy consumption as well as energy consumer segments in each country. In the consumers' recruitment process, national stakeholders with interest in promoting energy consciousness will be considered. Consumer segmentation will be used to increase the effectiveness of recruitment and to facilitate the e-learning processes. The present document (Deliverable 6.1) provides an introduction to consumer segmentation in the energy market of the nine countries engaged in the ECO2 project. Moreover, the document contains practical guidelines for consumer recruitment in these nine countries as well as metrics for monitoring the use of the ECO2 platform throughout the project.

Segmentation Analysis

1. Introduction

This document provides an overview on energy consumption and energy consciousness in the nine European countries that form the Energy Conscious Consumers (ECO2) - consortium: Belgium, Bulgaria, Denmark, Finland, Greece, Ireland, Italy, Lithuania and Portugal. Specifically, this report represents deliverable D6.1 Segmentation Analysis and is grounded in the nine country reports provided by the ECO2 national partners. The Finnish partner, the Consumer Society Research Centre at the University of Helsinki, compiled the report on the basis of the national individual reports.

The main purpose of the ECO2 Segmentation Analysis report is to provide guidelines for consumer recruitment on the ECO2 platform. To achieve this, we synthetized background information on energy use and energy consciousness within each national frame and produced knowledge about relevant themes which will help us to provide relevant content for the ECO2 platform users. The segmentation and recruitment work package will inform consumer engagement to ensure their diversity. Ultimately, our goal is to enable fast and controlled upscaling of the pilot phase of testing the ECO2 platform. We propose practical guidelines for consumer recruitment to the ECO2 platform at the end of this report.

The comparative study on consumer segmentation is built on country reports provided by the nine ECO2 consortium partners. The country reports were based on the information and materials produced by national organizations monitoring energy consumption and organizations promoting energy consciousness, previous and ongoing EU projects (such as ENERGISE, ENTRANZE, NATCONSUMERS, ODYSSEE-MURE and USmartConsumer) as well as academic studies and industry reports and studies on energy consumption and energy consciousness. In addition, the country reports were validated through national expert interviews. This interview data enriched the

reports and provided deep reflections on the national energy consciousness efforts. ECO2 partners searched for and compiled these materials.

The main challenge for consumer segmentation on energy markets is that there is no singular approach to segmentation, but rather multiple approaches; broadly, consumer segmentation can be divided into academic (theoretical) and industry (practical) approaches. First, in the existing academic literature, there are multiple established disciplines ranging from management and marketing studies to critical social sciences and social marketing. Secondly, there is a plethora of practical examples investigating consumer segments in professional 'grey' literature (see Barnett & Mahony 2011). Studies of energy consumption use segmentation on individual consumers based on their socio-demographic attributes and/or households according to dwelling characteristics. A common denominator applied in both cases is segmentation by attitudinal and motivational factors. The variety of studies on energy use and the different framings of energy consciousness lead to the quick realization that, energy use and energy consumption is a complex set of practices.

Against this background, each ECO2 consortium partner gathered evidence that outline both individual as well as household factors influencing energy consumption, as well as stakeholders who promote energy consciousness. The introductory chapter is followed by the methodology chapter, in which we document the methods and tools used to collect, validate, and analyse our data. The Segmentation Analysis chapter is divided in three sections covering socio-demographic factors influencing energy consumption, local factors, and attitudinal and motivational factors. Next, we summarize the efforts of different stakeholders and organizations in promoting energy consciousness at different levels and through different campaigns. We conclude the report with guidelines for consumer recruitment for the ECO2 platform.

We append to the report nine country reports. Each country report is divided into six parts: first, an introduction; second, a short overview on energy consumption; third a short description of socio-demographic segmentation of energy use and energy consciousness in the national frame; fourth, a description of the relevant environmental characteristics for the energy use (climate conditions, population characteristics, types of dwelling, and access to smart equipment). The fifth section describes the relevant stakeholders, which aim to increase energy consciousness in the national frame and the sixth section summarizes the main findings of the country report.

2. Methodology

D6.1 is built on country reports by ECO2 partners. The initial country reports are a summary of relevant information from previous reports and studies, such as existing literature on segmentation of energy consumption in the nine countries (studies, reports, media). Based on their searches, each partner has written a 10-15-page report summarizing the relevant content.

Furthermore, the country reports were validated through 4-6 expert interviews in each country[1]. The goal was to interview energy experts from both governmental and non-governmental organisations and gain their insight on the initial reports, and relevant segmentation in each country frame.

The country reports included in the Annex of D6.1 are revised based on the validating interviews, so that expert insights are be included in the final country reports.

3. Consumer segmentation on energy use

The ECO2 countries differ by household energy consumption. Belgium, Denmark, Finland and Ireland consume more energy for space heating in dwellings than the EU-27 average. Bulgaria, Greece, Italy, Lithuania and Portugal consume less energy than the EU-27 average. (Figure 1.). The share of energy dedicated to space heating in Denmark and Belgium are high both in absolute and relative terms compared to the other uses of energy. In Finland, the share of electricity for lighting and appliances is largest among the ECO2 countries.

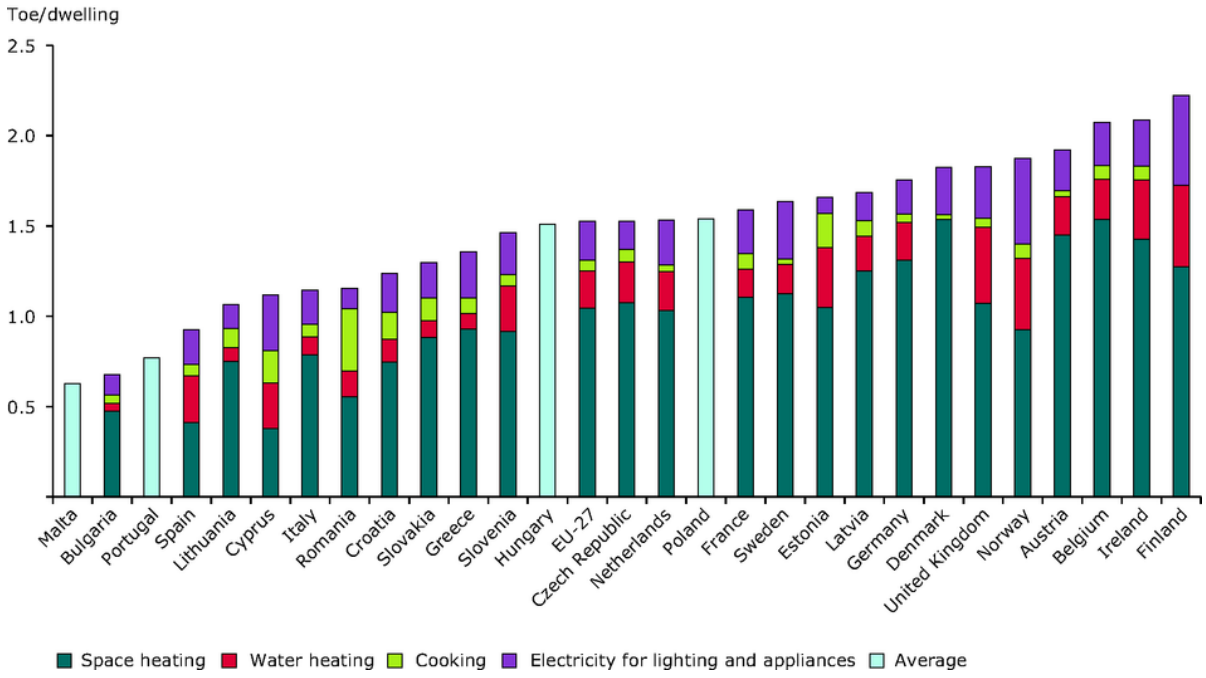

Figure 1. Energy consumption by end use in 27 EU countries (European Environment Agency 2013; ODYSSEE)

[1] In some country cases, the number of interviewees was lower: in Belgium two and in Denmark and Greece one interview each.

Heating is required at least during the winter in most ECO2 countries. In Bulgaria, Denmark, Finland, Greece, Ireland and the northern part of Italy, space heating is the most energy consuming practice (Figure 1). In Mediterranean countries, electric cooling or air conditioning is typically used during the summertime, however its proportion of total energy consumption represents only a fraction of that used for heating. In Bulgaria and Italy, the share of energy used for air conditioning has risen markedly between 2000 and 2015. (Odyssee-Mure 2018).

3.1 Socio-demographic segmentation in explaining energy use

Energy consumption is a complex practice that depends on a plethora of factors ranging from individual factors to infrastructural ones. Market segmentation has for a long time been a central tool for providing standardized solutions for different markets. However, in recent years, as consumer data has become more detailed and easily available, the markets have moved from standardized tools such as consumer clustering towards personalized, operation and individual solutions in service provision (Kirk 2012).

In energy markets, segments can be built on individual and household characteristics, factors related to the building stock, and attitudes related to the environment and consumption. National electricity markets are regulated by national energy policies with different regulations, energy pricing, taxation practices and information provision for instance. In their account on the deregulated and highly competitive UK market for energy, Simkin and Dibb (2011) see little product differentiation in the energy market, as prices drive purchases, and the product is standardized and government regulated.

In the nine ECO2 countries, the information available on energy consumer segments based on socio-demographic factors is scarce. The lack of studies can be explained first by the complexity of energy consumption as a phenomenon, and second by the fact that the unit consuming energy is a household rather than an individual. Third, as energy is an invisible commodity with little product differentiation, lack of studies on consumer segments can result simply from the apparent lack of opportunity for making distinction (Simkin & Dibb 2011).

Table 1. Socio-demographic segments in energy use by ECO2 country

Country	Gender	Age / household composition	Education	Income and Resources
Belgium		Age is linked to a high risk of energy poverty (e.g. elderly)	Low education linked to a higher risk of energy poverty	Low income of household linked to energy poverty. Living in a rental /social / public dwelling linked to a

				higher risk of energy poverty
Bulgaria	Single female households at risk of energy poverty. No gender differences in interest towards saving energy.	Young generations familiar with responsible energy use and saving. Energy poverty is a risk especially for individuals aged 65+		Low income correlates with problems in keeping the house warm.
Denmark	Gender is not a strong predictor for energy consumption.	Higher total energy consumption in households with teenagers. Old generations more sparing in their energy consumption than other age groups.	Positive correlation between the level and length of education and expected income, and therefore higher energy consumption.	Households with high income living in larger dwellings, often detached houses consume more energy. Money saving an important motivation for energy saving in the less well-off households.
Finland	Men more interested in energy than women. Women lack knowledge, although they have more environmentally friendly attitudes.	+60-year olds energy consumers are protective of the environment in their routines. Becoming a pensioner may reduce energy use as well as the opportunities to make energy renovations. Young adults have positive attitudes towards renewable energies. Households with small children consume a lot of energy.	Link between high education and environmentally friendly attitudes. Low education linked to disinterest in technology. Degree in technical field explains adoption of new innovations.	Link between high income and high level of energy use. Low level of income linked to disinterest in technology.
Greece	Gender is not a predictor for energy consumption	40-75-year olds most likely to have energy saving habits. +65-year olds consume more energy on heating, although total electricity consumption is lower in households with +65-year-old members	Education does not predict energy consumption	High income linked to investing in energy efficiency improvements. High income groups consume more energy than the low-income ones
Ireland	Women more environmentally conscious. Little variation between men and women in terms of reducing energy use.	18-35-year olds more likely to be unconcerned about the environment or think about energy use. 35+ year olds are aware of issues around energy consumptions but reject lifestyle changes. Old age groups are likely to have highly pro-environmental attitudes. Individuals +65 years old more at risk of energy poverty as they tend to live in properties with poor Building Energy Ratings (BER) and have fixed levels of income.	Individuals with high education more likely to be environmentally sensitive. High education also linked to being technologically oriented.	25 % of households estimated to be at risk of energy poverty. Energy poverty correlates with low income, being unemployed, retired or outside labour force. Individuals in the lowest and the highest income brackets least willing to sacrifice personal comfort to save energy. Lower professionals more likely to reject energy efficiency improving lifestyle changes.
Italy			High level of education correlates with interest in energy.	15 % of population not able to keep their home warm. Students living in rental apartments and low-income individuals more motivated to save energy. Homeowners have good

				knowledge and control of energy consumption.
Lithuania		Young generations more environmentally aware than the old ones.	Low level of education may correlate with low interest in energy issues.	47 % of the population save energy because of low income and bad financial situation. High level of income correlates with high level of energy consumption.
Portugal	Women more aware than men in energy consumption.	Older generations try to save more energy than younger age groups. Young men identified as a group with the most potential for energy saving. Women under 45-year-old the most aware of energy saving.	Higher educated groups have a high energy saving potential. Most educated are most likely to have interest in energy efficiency and to adopt new technologies.	

Table 1 summarizes the results from studies on socio-demographic differences in energy use and energy saving behaviours mapped in the ECO2 consortium countries.

Gender. In most of the countries, the effect of gender on energy consumption seems modest. Despite the small differences found, women are found to be more energy conserving and environmentally oriented, whereas in Denmark and Finland men were found to be interested in energy (consumption) for other reasons, e.g. electricity. Young men have been identified as the segment with the greatest energy saving potential.

Age and household composition. The effect of age was found contradictory in most of the ECO2 countries. In Denmark, Finland, Greece, and Portugal the elderly were found to be more energy sparing than other age groups. In Belgium, Bulgaria, and Ireland the elderly were found to be at high risk of energy poverty. In Lithuania, elderly was found to be the least interested in energy efficiency. In Denmark and Finland, households with children and teenagers were found to be the most energy consuming. In many countries, age differences were linked to environmental and energy awareness and interest. Age indirectly affects energy consumption needs and habits through the different life-course stages. This suggests that segmentation in terms of age might rather benefit from a reorientation in terms of the life-course stage in which individuals in a household are positioned.

Education and income. High level of education was found to correlate with energy consciousness in Denmark, Finland, Ireland, Italy, Lithuania, and Portugal. Whereas high level of education correlates with high income levels, it was found that high income is often correlated with high level of energy use. In contrast, higher incomes make energy efficiency investments possible,

potentially reducing the total energy bill. Moreover, lower levels of income were linked to energy poverty[2] and either involuntary or voluntary reduction of energy use (e.g. low indoor temperatures such in Belgium, Bulgaria, and Ireland). Different attitudes towards energy consumption for the lower income households also exist: in Lithuania, almost half the entire population saves energy because of scarce resource; in contrast, in Ireland, individuals in the lowest (and highest) income range are not willing to sacrifice personal comfort to save energy, as are lower professionals.

3.2 Local factors in explaining energy use

The local circumstances and conditions in which consumption takes place must be noticed in segmentation. The nine ECO2 countries differ by their climate, their building stock, the technologies used inside the households as well as national level housing regulations. The climate varies from cold and wet in northern Europe to mild, Mediterranean to hot and arid summers in the southern parts of the continent (Figure 2).

[2] Households spending more than 10 % of their household income on fuel expenditure to maintain certain standard intenral conditions are defined as energy poor. In many ECO2 countries, energy poverty is aprominent issue. It typically leads to inadequately heated dwellings because heating is reduced even below comfort level to save money. Inadequate or missing insulation is one part of the problem. In some of the ECO2 countries, though, energy is used abundantly as the cost is either embedded in housing costs or the costs are deemed so small they do not make a different to the household budget.

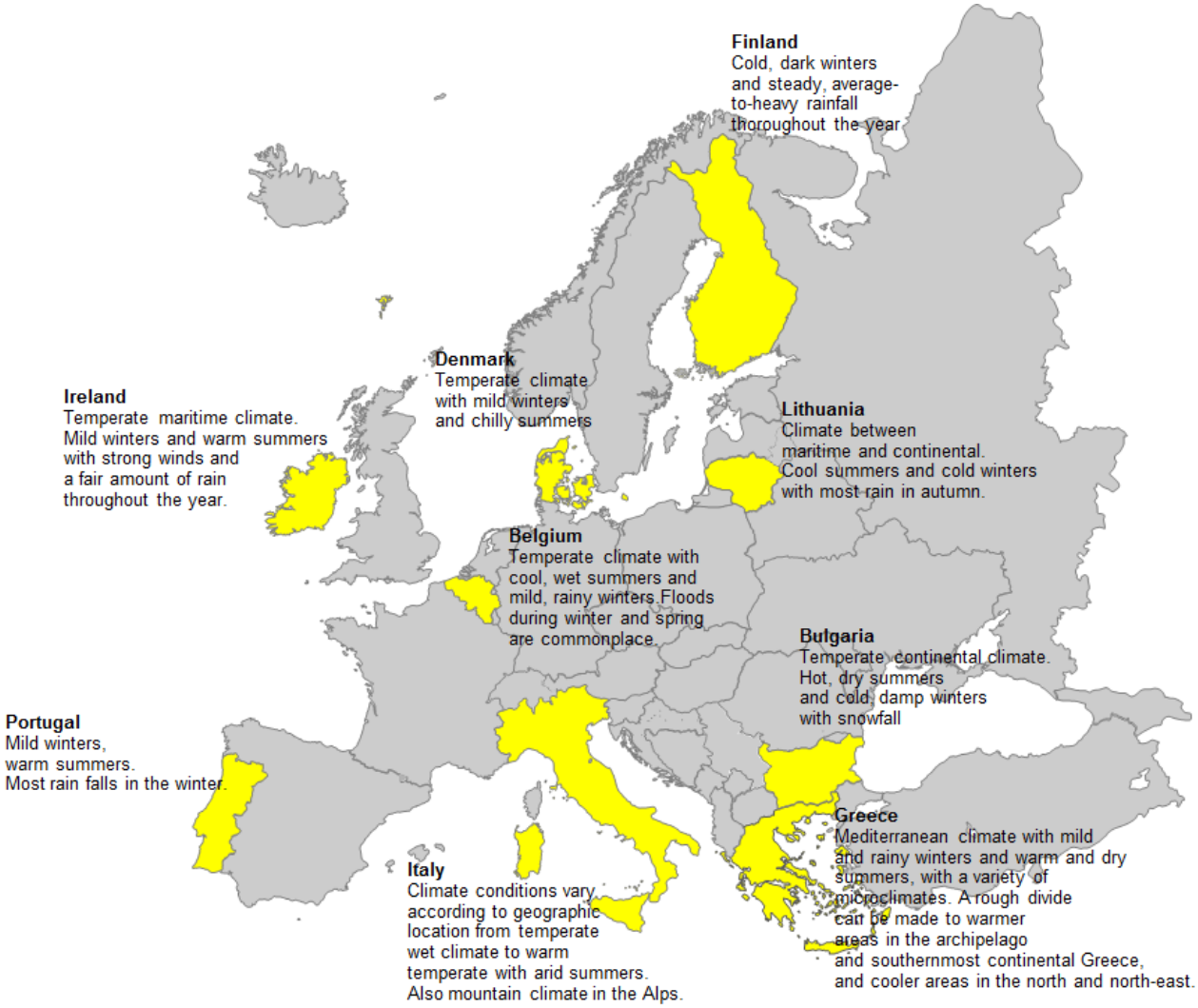

Figure 2. Climate conditions in the ECO2 countries

The characteristics of the built environment, most importantly the type, age and condition of the dwellings correlates with the level of insulation in buildings, help us understand the population's energy needs and use. More specifically, house ownership and its condition (maintenance, energy investments and renovations) impact the level of energy use by households (Table 2). In Greece and Italy, there are notable differences in the climate between regions explaining discrepancies in energy use. Climate types help us estimate the long-term impact of the weather on energy consumption. However, hot/cold waves and peaks due to severe weather conditions create at times energy demands well beyond the regular consumption patterns.

Table 2. Housing-related factors explaining energy use in the ECO2 countries

Country	Urbanization and regional characteristics	Building type	House ownership	Condition of the dwellings
Belgium	97% of the Belgian population live in an urban area.		67.3 % of houses owner-occupied 30.9 % rental apartments	A large share of houses built before 1970s
Bulgaria	15 % of the population live in urban regions 61 % in intermediate regions and 24 % in rural regions	35-40 % of the population live in apartment buildings 35-40 % in detached houses 10-15 % in semi-detached houses	81.7 % of Bulgarians are homeowners	Building stock mainly from the 1960s
Denmark	12 or 45 % of the population in rural regions 33 or 13 % in towns 55 or 32 % in cities (depending on the classification of regions). Rural regions rely on individual heating systems (oil furnaces, wood stoves, heat pumps).	44 % of households live in detached houses 39 % apartment blocks 15 % terraced houses	Half of the population lives in owner-occupied dwellings, half in rental apartments	High share of building stock (especially detached dwellings) were built in the 1960s and 1970s before the building codes were tightened. Many of these buildings haven't undergone energy renovation and have great potential for energy efficiency improvements.
Finland	Energy consciousness more prevalent in the countryside than in the cities. Consumption of energy is higher in urban areas than in rural areas for detached houses and for apartment buildings.	40 % of households live in detached houses 45 % apartment blocks 14 % terraced houses	Majority of Finns live in owner-occupied dwellings, and just 32 % in rented dwellings	High share of buildings built in the 1960s and 1970s. Maintenance taken care of. The building stock comparatively new, standard levels of insulation high and building automation widespread.
Greece	Energy poverty is concentrated in the cold climate zones in the north of Greece.		Both thermal and electricity consumption lower in rented apartments than in occupant-owned dwellings.	41.5 % of dwellings built before 1979. 3 out of 4 buildings without basic insulation, rest incomplete.
Ireland	Differences by region in the risk of energy poverty. Urban households have more consuming energy appliances than the rural households. Urban building stock tends to have a higher Building Energy Rating (BER) than comparative building stock in rural areas.	40 % detached houses 28 % semi-detached houses	Homeowners increasingly see the benefits of retrofitting, private landlords are less interested in investing in energy efficiency.	A large share of buildings built in the 1950s and 1960s. Energy loss typical for houses built 1980 and before.
Italy	Building renovations necessary in Southern regions more often than in Northern and Central Italy.	27 % detached houses 53 % apartment buildings 19 % terraced houses	80 % of the population are homeowners, 18 % live in rental apartments	65 % of buildings built more than 30 years ago.

Lithuania	68.6 % of population in the urban areas. Big city dwellers expected to be concerned with renewable energy and modern technologies. Little energy used for heating and cooling.	In multi-apartment buildings the opportunities to control energy use are few.		Building stock originates mainly from 1960-1990. Energy efficiency bad.
Portugal	Energy consumption higher in the metropolitan areas. Little energy needed for heating due to warm climate.	91 % of the buildings detached houses 9 % apartment buildings		Majority of buildings built between 1946-1999. The building stock is not energy efficient.

Urbanization and regional characteristics. Some of the differences between households within ECO2 countries can be explained by urbanization and regional characteristics of housing. In Bulgaria and Denmark and Ireland, the level of urbanization influences energy consumption. In Bulgaria for instance, the National Programme for Energy Efficiency of Multi-Family Residential Buildings is rolled out in cities. In Denmark, energy consumption in rural areas was found to be larger than in urban areas (Jacobsen 2003). In rural areas, the building stock is composed of detached houses which are bigger than flats in urban areas, impacting directly the amount of energy consumed for heating. Rural areas rely on individual heating systems, compared to public heating and natural gas grids in cities. In Ireland, the urban-rural divide can be explained by higher Building Energy Ratings (BER) in cities than urban areas. Leahy and Lyons (2010) find that the prevalence of energy-saving features such as double-glazed windows are higher in urban areas than rural areas, which may contribute in part to this divide. Davies et al. (2014) also found that rural homeowners felt more entitled to use as much energy as they wished, in contrast to urban homeowners who were more conservative with their energy use.

In Finland and Portugal, it was found that energy consumption is at a higher level in urban dwellings. Apartment buildings and detached houses in Finland consume more energy in the urban areas than rural ones, while no difference was found for terrace houses (Heinonen & Junnila 2014). In Portugal, urban energy consumption is explained by the distribution of population: urban and coastal areas are 19 times more dense than interior municipalities and rural areas, and such differences also reflect energy consumption patterns. In Lithuania, the urban majority is expected to be more interested in renewable forms of energy, whereas those living in rural settings are expected to have more diverse interests in energy and technology.

Building type and house ownership. The building type also has an important effect on energy use as well as on the authority to make decisions over energy renovations or the acquisition of technologies inside the home (e.g. home automation and Internet of Things). Building owners across Europe – ranging from apartment buildings to detached houses – operate in diverse circumstances, as the European markets have different regulations for technologies and building materials as well as different technologies available in the market (see Heiskanen & Matschoss 2017). In general, the opportunities to control energy consumption seem greater in detached

houses than in other types of dwelling. High shares of owner-occupied houses, such as in Belgium, Bulgaria, Finland and Italy, can result in higher incentives to perform renovations and to adopt energy saving technologies, should the benefits of such renovations be clearly understood by home-owners. In contrast, renovations may seem less relevant for tenants and at times also impossible to undertake due to legislation. In Ireland, landlords are less interested in energy efficiency solutions. Saving energy may seem futile for the dweller, if the energy billing is dependent of the household energy use such as in multi-apartment buildings in Lithuania. In Greece, tenants consume less energy than home owners, for instance by lowering indoor temperature. As Balaras et al. (2016) find, only 28 % of the occupants in single-family houses and 27 % of the occupants in multi-family houses set indoor temperature at 20°C, which is considered as the set-point used in normative calculations. The average (weighted) temperature reported among tenants, was 19.6°C during daytime and 16.9°C at night.

Age and condition of the building stock. By large, buildings built before 1990 suffer energy loss and need energy renovations. In Belgium, majority of homes are owned by the resident. Houses that were built before 1970 (a total 62 % of the building stock) are less energy efficient than buildings built after 1990. In Bulgaria, the building stock is mainly from the 1960s, and only 5 % of the buildings are built after the year 2000. Therefore, the building stock is in need of energy efficiency renovations. However, installation of smart energy appliances is difficult due to largely obsolete energy installations. A large part of the older building stock in Denmark, especially the part built be before the 1980s, has great potential for reducing heating energy consumption through renovations. There is central heating in majority (64 %) of the buildings. In Finland, a considerable share of buildings was built in the 1960s and 1970s. Finnish buildings are maintained and renovated, with highly performant insulation. In Ireland, a large share of the building stock was built in the 1950s and 1960s. Many buildings need energy efficiency retrofitting, a need responded to by the host of national programmes providing financial and expertise support to homeowners (see the chapter on promotion of energy consciousness).

House ownership questions are important, when renovations need to be done. In multi-apartment buildings, the party responsible for the costs of these renovations differs by country. In Finland, the apartment owners are responsible for the space heating and renovation costs collectively, whereas the housing companies make decisions on the renovations and the maintenance. In Ireland, the tenant is responsible for the energy use in the apartment, which results in the apartment owners having no interest in performing renovations. In Lithuania, the heating costs of the common areas (corridors, staircases etc.) in the apartment blocks are divided according to the apartment size to all households, which reduces the willingness of individual households to save energy. Moreover, the households in apartment blocks have few opportunities to know their individual heating energy use, as the costs are calculated according to the size of the dwelling instead of actual energy consumption. In Bulgaria, by contrast, individual households try and save energy as they can afford to heat only part of the dwelling or even not to heat the

dwelling at all to reduce the energy costs. These differences in responsibilities of renovations and energy costs influence which kind of renovations are possible for individual households.

3.3 Attitude-based segmentation

Most of consumption decisions are performed routinely and little reflected upon. Therefore, dissemination of knowledge and consumers awareness of the consequences of their consumption choices may not suffice to change consumption habits. This situation is particularly significant for those individuals who lack interest in energy issues, despite the fact that changes in energy consumption patterns might benefit their wellbeing. To promote energy conscious behaviour, additional measures such as governmental regulation, pricing, taxation and other types of incentives are needed (cf. Newton & Meyer 2013).

3.3.1 *Level of knowledge*

Based on the ECO2 country reports, the consortium countries differ according to the level of energy consciousness of their citizens. In Belgium, the population is generally aware of the impacts of energy use, but Belgians do not associate home energy use to cause CO2 emissions. The Danes generally consider saving energy important, but this attitude does not translate into action.

On the contrary, in Bulgaria, households are not energy conscious, but rather indifferent and disinterested in the energy use topic, which results in households consuming energy excessively. In Ireland and Italy, consumers lack information as well as knowledge that could enhance their understanding of energy consumption issues. In Finland, where smart metering is available, consumers consider themselves well-informed on energy issues, but at the same time most households call for better tools to understand their energy consumption.

3.3.2 *Economic, environmental, and technological motivators*

In studies of attitude-based segmentation on energy consumption or adoption of energy efficient behaviours, three main types of motivational factors usually emerge namely economic motivators, environmental motivators, and technological interest. In addition, lack of time, lack of willingness to accept a lower level of comfort, and apathy towards energy efficiency solutions have been mentioned as practical barriers hindering energy conscious behaviours.

Economic motivators have not been covered in the Belgian report, although energy poverty was considered an important theme related to social differences in energy use. The proliferation of BELESCOs (Belgian Energy Service Companies) who fund, implement energy saving projects and ‘own’ the implementations until the savings cover the costs of implementation lends support to

the importance of funding mechanisms in achieving a smooth transition to energy efficient solutions.

In Bulgaria, a widely spread practice of households not paying for all the energy used has emerged. Lately, the share of theft of electric power has increased significantly. In this situation, it could be claimed that money saving through energy use choices does not serve as an incentive for households in Bulgaria. Furthermore, the practice of stealing electricity slows down the dissemination of sustainable energy use practices.

Motivation for energy conscious behaviours may arise from dire financial situation, as has happened in Denmark, Finland, Italy, and Lithuania. In Denmark, the elderly are used to frugality and the so-called 'economically oriented money-savers' usually come from the lower income brackets. Danish families with children may own their own home and may have the resources to change their behaviour and/or afford energy renovations to their dwelling, but currently don't prioritize it because of lack of time/understanding. Similarly, in Finland, the elderly who have witnessed the energy crisis of the 70s are more energy saving in their choices. However, the frugality of the elderly may also relate to the fact that they cannot necessarily afford to spend on heating or energy renovations.

In Ireland, consumers are cost rather than energy conscious. Tenants are becoming increasingly aware of the benefits of energy efficiency investments, unlike landlords. In Italy, too, economically motivated consumers include students and poor households. These segments could benefit from information on energy conscious solutions reducing their energy budget. The consumer segment that often rises in studies on energy consumption, is the one suffering from energy poverty, such as in Belgium, Bulgaria, Finland, Greece and Ireland.

The owners of the dwellings rarely make decisions on energy renovations based on sophisticated financial analyses of different alternatives (Heiskanen & Matschoss 2017, Heiskanen et al. 2012). Rather, as in most ECO2 countries, these decisions are most importantly motivated by money saving, and only secondarily by environmental reasons. The opposite is also true: households with high incomes have the means to purchase energy saving equipment and make energy renovations, while at the same time use energy regardless of the energy bill.

Environmental and ecological reasons have been mentioned as one of the most important motivators of energy conscious behaviours in most of the ECO2 countries. In countries such as Belgium and Lithuania, some people have ecological motivations to ground their energy conscious choices, but these choices are rarely based on rigorous information of the mechanisms regarding the impacts of energy use. As the case study on Denmark shows, some consumers may be in principle, interested in energy saving for environmental reasons, but they may not make energy saving decisions in practice, because they consider them inconvenient or impractical. Finnish and Irish women stand out as more environmentally driven in their energy consuming choices.

Interest in (the latest) technological solutions also motivates energy conscious behaviour. Higher education as well as having a degree in a technical field links to individuals being technologically oriented and, by extension, their adoption of technical innovations inside the home. Such correlations have been identified for segments in Finland, Ireland, and Portugal. In previous research, pioneering users have been labelled as consumers most interested in energy efficiency services (Hargreaves et al. 2013, Wallenborg et al. 2011, Klopfert & Wallenborg 2011, Gangale et al. 2013), users of novel energy related services (Caird et al. 2008, Pierrre et al. 2011), those end users involved in new product development (von Hippel 2005), or merely as consumers different from the mass markets (Matschoss et al. 2015). Although there is little empirical knowledge on the background of this segment, the pioneering users in Finland have been identified as technology driven, middle-aged or older men with a degree in technological field and a dwelling situated outside of the metropolitan areas (Matschoss et al. 2015). Albeit the ECO2 aims to appeal to a larger consumer segment than the pioneer users, we recognize the value of the experiences they can provide to the platform, particularly in the early stages of onboarding. Particularly the adoption of technological solutions for energy efficiency presents a case for how knowledge and interest in innovations shape consumer behaviour towards ever-improved solutions.

3.3.3 *Other motivations and barriers for energy conscious choices*

Community-driven motivations. At times, communities are able to capitalize on their local, environment-based resources and take advantage of existing funding opportunities, which result in renewable energy solution such as those in Lithuania (wind-farms in Smalininkai; solar panels in Panara village; biofuel boilers in Vilkaviškis district). As part of the Finnish HINKU-project, a series of 'energy walks' are arranged where the local communities share their experiences with renewable energies, energy savings and energy efficiency; these events aim at uptake and proliferation of good practices.

Convenience and comfort are sometimes mentioned as an attitudinal barrier for adjusting everyday routines to consume less energy. Moreover, lack of resources such as time and money also limit the possibilities the households have. Lack of time was named as the most important barrier for making energy conscious choices in the country reports on Denmark and Finland.

4. Efforts in promoting energy consciousness

Figure 3 below provides a visual representation of the multiple factors influencing energy use and consumption. The previous chapter dissected issues related to climate and housing, socio-demographic and attitude-based factors. Nonetheless, energy use and consumption are deeply contextualized: in each country, stakeholders including national institutions, companies –be they state or privately owned -, together with community groups and non-governmental organizations conduct efforts to promote energy efficiency to consumers and businesses alike. Next, we analyse the stakeholders' and their efforts to promote energy consciousness through different

mechanisms, be they regulation, information and training or funding. Focusing on the stakeholders has been a deliberate strategy to create awareness of the upcoming ECO2 action-steps as well as in the hope of promoting the project to their constituents.

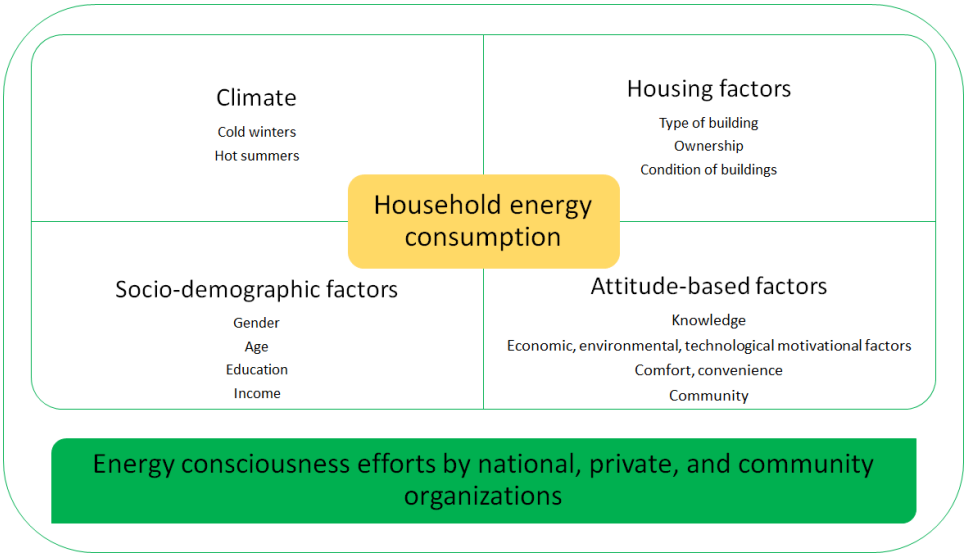

Figure 3. Individual and household factors related to energy consumption

4.1 National institutions

Across the nine European countries, ministries of energy or equivalents are the authorities responsible for drafting, implementing, and assessing the impacts of energy consumption on the environment, society, and the economy. Sustainability through renewable energies, energy efficiency and consciousness are closely connected to the goals promoted by the ministries. In close cooperation with national agencies, departments, commissions, directorate generals or authorities, such national institutions are significant agents promoting energy efficiency at all levels of governance and across varied types of stakeholders.

Some national organizations take a broad understanding of energy such as the Danish Energy Agency, Finnish Energy Authority, the Sustainable Energy Development Agency in Bulgaria for renewable energy, the Portuguese General Directorate of Energy and Geology, the Sustainable Energy Authority of Ireland or the Centre for Renewable Energy Sources and Saving which is a public organisation in Greece promoting renewable energy sources, rational use of energy and energy saving efforts. In other countries, national institutions increase awareness and regulate specific types of energies, such as the Electricity and Gas Regulatory Commission in Belgium or the Commission for Regulation of Utilities in Ireland, particularly energy and water. By increasing knowledge of sustainable and renewable energy choices, these organizations help consumers and businesses to make informed decisions about the choices available. At times, these national institutions establish funding schemes, particularly for public and private organisations. Examples

include the Energy Efficiency and Renewable Sources Fund (Bulgaria) or Lithuanian Environmental Investment Fund. The most common funding schemes target smooth transitions (of industry, build environment, grants to consumers) to sustainable sources of energy. Examples include equipment purchase and infrastructure (e.g. smart grids) for renewable energies, costs associated with the retrofitting of buildings such as thermal insulation (heating/coolers), hot water production systems, and grants and loans for consumers meeting certain criteria.

Among the national institutions, the role of municipalities in promoting energy consciousness is visible throughout the consortium Member States. Particularly encouraging is the fact that such efforts are promoted beyond capital cities, such as The Energy Agency of Plovdiv and Rousse (Bulgaria), municipality of Reggio Emilia (Italy) and Tipperary Energy Agency (Ireland). In Lithuania, there are several municipalities promoting energy consciousness for wind power, solar energy, and biofuels in Smalininkai, Akmenė, and Gražiškiai. The European Covenant of Mayors signatories also pledge their cities to implement voluntary energy objectives and all nine ECO2 countries are represented as signatories. In addition, many local efforts take place on regional scales, consolidating efforts and resources for energy consciousness. Such regional efforts comprise, but are not limited to, Wallonia (Belgium), Pazardjik Province (Bulgaria), Tampere region (Finland), and Crete (Greece).

Numerous universities and research centers lend their expertise to explore sustainable and efficient ways to produce and consume energy. Research and development organizations that focus on ways to produce energy sustainably investigate renewable energy sources as the Bulgarian Academy of Sciences, Centre for Marine and Renewable Energy in Ireland and National Technical University of Athens. Energy planning and sustainable societal transition towards renewable energies are studied at Roskilde University, Aarhus University and Aalborg University in Denmark. Civil engineering and efficiency in buildings are topics of interest at the University of Tampere (Finland) and Danish University of Technology. Additionally, energy engineering is pursued at the Energy Lab of the Dublin Institute of Technology as well as the University of Trento, New University of Lisbon and Technical Graduate Institute in Portugal, at the Lithuanian Energy Institute, while optimisation, integration and deployment of low carbon energy topics at University College Dublin's Energy Institute. The interplay between the energy and the ecological footprint are researched at the National Center for Scientific Research Demokritos and at the Center for Research & Technology CERTH (Greece), Vilnius University (Lithuania) and SYKE (Finland). The TEES lab at the University of Piraeus carries out research on areas such as energy efficient technologies, technoeconomic analysis, and evaluation of energy systems, analysis but also modelling of energy consumer and producer behaviour.

Other organizations focus specifically on studying the role of consumers in assuring smooth transitions, seeking to understand their lifestyles, household practices and behaviors that drive energy consumption, the social acceptability of new technologies such as research undertaken in Denmark (Aarhus University and Aalborg University, Danish University of Technology) or that of

the Department of Energy at the Torino Polytechnic in Italy and Vilnius University in Lithuania. Relevant research on energy consumption is also done by the University of Helsinki, Aalto University, Lappeenranta University of Technology, and University of Vaasa in Finland.

Some research organizations offer public services such as accredited for energy efficiency auditing and certification of buildings and industrial systems (Center for Energy Analysis in Bulgaria), establish industry-led collaborations in the field of integrated sustainable energy systems like the International Energy Research Centre in Ireland, and offer study programmes and training (as Kauno technologijos universitetas, Aleksandras Stulginskis University, Vilnius Gediminas Technical University in Lithuania). Besides research and development, some universities and centers are also advising on energy policy and regulations, for instance in Bulgaria or Greece.

National organizations promoting energy efficiency and consciousness to consumers and citizens include Belgian Association for the Promotion of Renewable Energies (see for instance Renouvelle magazine); Bolius and SparEnergi.dk (the later operating under Danish Energy Agency); the Finnish Energy Authority, Motiva and Sitra in Finland; Regional Energy Agency of Crete in Greece, Energy Services Regulatory Agency in Portugal (see their Energy Efficiency Promotion Plan). In addition to these public institutions, national organizations promoting efficiency include utility companies, special interest companies usually producing renewable energy, housing associations, consumer associations, NGOs, and citizen-established organizations.

- **Utility companies** manage national networks and grids for the provision of electricity (e.g. Elia in Belgium; the Danish network and distribution companies within the fields of electricity, natural gas, district heating and oil; Eirgrid in Ireland, ERSE in Portugal or local energy companies in Finland) but also provide their consumers with strategies on managing energy consumption as prescribed by the Energy Efficiency Directive 2012/27/EU
- **Renewable energy companies** aim at increasing understanding of new and alternative energy sources for businesses and consumers, while simultaneously advocating for funding and support for their constituents. Example include the Lithuanian Confederation of Renewable Resources, Biogas Biomass, Hydropower, Solar Energy, Wind Energy, Electric Vehicles Associations; Irish renewable energy co-operatives; Portuguese Association of Renewable Energies, the Belgian Valorisation of Biomass Association, Finnish Clean Energy Association
- **Housing associations** forward the interests and benefits of both tenants and owners. At times, these are organized as representing national interests (e.g. the Joint Representation of the cooperative housing associations in Denmark, the Danish Tenants Association, the Danish Council Housing Associations, the homeowners Associations in Denmark, Bulgaria and Finland). Local housing associations also promote sustainable energy consumption, such as those in Italy and Finland (ACER, Heka).
- In most of the countries covered by this report, **Consumer Protection Associations** and the like promote, besides legal counseling, advice on the rights and responsibilities of

consumers also programmes and initiatives tailored to energy efficiency. Such organisations function in Belgium, Bulgaria, Denmark, Finland, Greece, Portugal, and Italy.

- **NGOs with broader scopes** but occasionally offering concrete energy saving advice include the Marthas (home economics organisation) in Finland or E.K.PI.ZO (Consumers' Association "Quality of Life") in Greece
- **Citizens** also take active roles in increasing awareness to peers on energy efficiency. Citizen-driven organizations are far from widespread, but rather signal grassroot efforts and peer-to-peer learning about energy choices. Examples include Citizen Sustainable Energy Action Plan in Belgium, Friends of the Earth in Bulgaria and Ireland, Citizen Assembly and CRU Energy Consumers Forum in Ireland

4.2 Campaigns

Across the European countries included in this report, efforts to promote energy consciousness come in many shapes and sizes. Below we summarize the most common energy conscious themes, grouped into 8 categories.

1. **Initiatives for consumers, awareness raising and education in energy saving:** Regional Health Inspectorate of Vidin (Bulgaria); ECOHOME by The Finnish Environment Institute SYKE and Resource-wise citizen by the Finnish Innovation Fund Sitra, Savings in housing cooperatives by Sitra and Fluxio Isännöinti, The Martha organisation's project "Adjust and save" (Finland); SEAI Education Scheme for schools and teachers, Power of One, CRU Energy Consumers Forum in Ireland; "Défi Energie" in Brussels' Region (Belgium); ECO Casa, Menos é Mais, LIGAR – Energia para todos, Energia Fantasma, Fatura Amiga, Família Oeiras Ecológica, Power Quizz to develop understanding on energy efficiency issues (Portugal).
2. **National governmental programmes:** Programme to Promote Sustainable Consumption and Production (KULTU, Finland); National Research Programme 'Future Energy' in Lithuania; National Action Plan for Energy Efficiency and National Renewable Energy Action Plan (Portugal).
3. **Research projects to explore and alter energy consumption, including national projects, projects with international partners and/or EU research projects.** ITALY IN CLASS A was a 3-year national campaign made to inform and train people on the topic of energy efficiency. Modelling Energy Efficiency in Irish Industry sought to deepen understanding on the factors that affect energy efficiency in the Irish industry. Superhomes 2.0 focuses on better air quality inside the homes through cost-efficient energy efficiency measures. BeAware, a project carried out by Helsinki Institute for Information Technology (HIIT) and their partners, provided a smartphone app which turned energy consumers into active players. Smart Energy Transition (SET, Aalto University and partners) analyses the ongoing global transition towards smart energy and its impacts on the Finnish society, and the

potential benefits for cleantech, digitalization and bioeconomy. Energy Neighbourhoods put 5-12 households in countries across Europe in a competition to save 9 % energy or more in line with the 9 % target of the Energy Service Directive. ENERGISE uses a Living Labs approach across Europe to directly observe existing energy cultures in a real-world setting and to test both household and community-level initiatives to reduce energy consumption. SAVE@WORK is an EU project that supported public office buildings in reducing their energy consumption and carbon emissions by challenging them through a competition in the workplace. LOCARBO's main goal is to improve low-carbon economy policies and increase energy efficiency through promoting renewable energies and a positive change in consumers' behaviour in Europe. The EMPOWERING project helped EU consumers take measures to save energy developing a service to provide integrative information to those already present in meters and energy bills. SMARTUP is an EU funded project that will encourage vulnerable consumers in those Member States that have embarked on the roll-out of Smart Meters to actively use their Smart Meters and In-House Displays to achieve energy savings. NOVICE is a H2020 project which develops and demonstrates innovative business models for Energy Service Companies (ESCOs). ENABLE.EU is an EU project that aims to understand the social and economic drivers of individual and collective energy choices with a focus on understanding changes in household energy choice patterns. ACHIEVE is another EU project that aimed to contribute to practical (energy uses and behavior) and structural (retrofitting buildings) solutions for fighting energy poverty. The REACH project empowers energy poor households to take actions to save energy and change their habits towards energy consumption. EnergizAIR is project funded by the Intelligent Energy Europe Program of the European Commission that aims to create a renewable energy bulletin for 5 countries.

4. **Environmentally focused associations/campaigning:** comprising of international associations like Greenpeace, and WWF as well as national ones like the Finnish Society for Nature and Environment; Good Energies Alliance Ireland, Irish Environmental Network, Stop Climate Chaos and Green Foundation Ireland; Sustainable Development Initiatives (Lithuania). National NGOs have several aims, including the promotion of environmental viewpoints in society or the promotion of certain type of sustainable action on the national or local scale.
5. **Sustainability campaigns:** target specific actions and support for consumers. We identified three sub-categories, taking place at the local level, renovation, and renewable energy campaigns.
    a. **Local government /municipal initiatives:** Danish Society for Nature Conservation's 'Climate Municipality Agreement' putting municipalities at the center of sustainable change by serving as an example for their citizens through financing, energy audits, and public meetings; HINKU project "Towards carbon neutral municipality" is coordinated by the Finnish Environment Institute and Enhancing the energy consciousness of residents in rural areas, ECO2 - Eco efficient Tampere (Finland);

Tipperary Energy Agency and Energy Co-Operatives (Ireland); local renewable energy initiatives in Lithuania (wind-farms in Smalininkai; solar panels in Panara village; biofuel boilers in Vilkaviškis district); or Eco.AP (Portugal).

b. **Renovation initiatives and programmes:** are implemented as required by Article 5 of the Energy Efficiency Directive 2012/27 / EU. Funds cover, i.a. energy efficiency measures (insulation, windows replacement, renovation of common areas). Efforts are coordinated by the the Régie des Bâtiments (Belgium), Ministry of Regional Development and Public Works of Bulgaria (e.g. National Programme for Energy Efficiency of Multi-Family Residential Buildings); Hellenic Ministry of Environment, Energy and Climatic Change (Exoikonomo programme) Deep Retrofit Programme (Ireland); Apartment house renewal program and JESSICA Holding Fund (Lithuania) and Energy Certification of Buildings (Portugal). These renovation programmes focus on the financial aspects of adopting different energy efficiency technologies and provide concrete guidelines on lifehacks and retrofitting the house. In addition, financial support is granted through funds like the Residential Energy Efficiency Credit Facility (Bulgaria), Better Energy Communities Scheme (Ireland) or through different federal tax measures in Belgium.

c. **Renewable energy promotion campaigns:** Energy 21 Association (Bulgaria); solar energy for households campaign by Motiva (Finland); installation of photovoltaic panels on resident roofs (Hellenic Ministry of Environment, Energy and Climatic Change), Lithuanian Geothermal Association (LGA)

6. **Consumer awareness raising campaigns:** Nature and Progress Association (Belgium); the Consumers' Union of Finland handbook on ethical consumption, including energy saving tips; Warmth and Wellbeing Scheme is a joint energy and health policy initiative providing deep measures to people with chronic respiratory conditions (Ireland).
7. **Campaigns to alter built environment:** Utility and construction companies organize campaigns to promote their services but also advocate for responsible energy savings. These campaigns have local and commercial dimensions. Examples include Demand Side Residential Energy Efficiency through Gas Distribution Companies in Bulgaria; Association for real estate and construction sector owners and professionals (Rakli) action programme for rented apartment communities VAETS (Finland); Energy Efficiency Obligation Scheme (Ireland); "Green Protocol" (Lithuania); Energy Efficiency Promotion Plan (Portugal).
8. **Online platforms** supporting energy efficiency education/ dissemination of knowledge on energy efficiency: EnerGbg (Bulgaria), interactive map of all power plants in Lithuania, Poupa Energia simulator and Observatório da Energia portal (Portugal)

4.3 Summary on national differences

Based on the ECO2 country reports, we identify three national approaches: sectoral, layered, and compound approaches.

1) Sectoral approach is centered around public institutions, who directly engage in energy consciousness efforts. In Bulgaria, the energy sector as well as different administrative levels are covered by **agencies** (renewable energy, regional and municipal agencies). Some of these agencies are legacies of Bulgaria's participation in different EU Programmes: they have broad coverage of sustainable energy management goals covering the needs of individuals, communities, businesses, as well as refurbishing the built environment. Another large theme across many Bulgarian organizations is energy consumption for mobility. Denmark focuses specifically on consumers through research carried out in **universities**. There are multiple projects aiming at understanding the factors motivating consumers and households to adopt energy efficient solutions, the social acceptability of these solutions as well as the drivers triggering changes in lifestyle and consumption. Among the most notable initiatives to promote energy efficiency in Italy is a **national campaign** sponsored by Ministry of Economic Development and implemented by ENEA (Italian National Agency for New Technologies, Energy and Sustainable Economic Development) called Italy in Class A. Instead of more traditional outreach activities, this programme undertook an itinerant set of events and meetings with citizens along the Italian peninsula, where specialists provided information and tools for energy saving behaviours. Energy consciousness promotion in Greece is pursued by the Hellenic **Ministry** of Environment, Energy and Climatic Change, that implemented funding programmes for consumers to refurbish their households.

2) Layered approach is characterized by the collaborative efforts of multiple stakeholders working on energy consciousness in a) different levels of governance, b) across different sectors, and c) community organizations, with a specific focus on education and training. In Finland, consumer energy consciousness is actively promoted by different types of organisations. In addition to **national programmes** by the Ministry of the Environment, Sitra and SYKE, various organisations **provide education and advice** on energy efficiency and savings, from the energy companies, to the consumer union, housing associations and lifestyle supporting actors. In the Irish context predominate different **national schemes** that deal with funding renovations for the residential sectors as much as **supporting energy efficient behaviour**, in communities, at home, at work, in schools. In this regard, the Power of One campaign aimed to increase awareness of energy efficiency issues and push towards a more efficient behaviour. In an effort to model behaviour, the connection between energy and health is promoted through the Warmth and Wellbeing Scheme, a joint energy and health policy initiative that measures the health and wellbeing benefits of energy efficiency. Belgium's energy efforts are carried out by BELESCOs (Association of Belgian Energy Service Companies comprising of a mix of public and private actors). These **service companies** fund and implement energy saving projects. ESCOs 'own' the implementations until the savings cover the costs of implementation.

3) Compound approach supports individuals and local communities to adopt energy efficient solutions by weighing between different alternatives. Compared to the sectoral and multi-level approaches, which develop their own campaigns, the compound approach starts with consumer's needs and interests and provides them with the resources to achieve their energy targets. These resources are usually provided by public organisations. In Portugal, energy labels help consumers reach informed purchasing decisions when inspecting the different alternatives. Similarly, smart metering help consumers track and adjust their energy consumption patterns. In addition, organizations like ADENE and ERSE contribute information and activities for consumers, further increasing their knowledge about different products and services. In Lithuania, available renewable energy sources have successfully been valorized by the local communities as the examples of wind-farms in Smalininkai; solar panels in Panara village; biofuel boilers in Vilkaviškis district attest. The Lithuanian energy consciousness efforts combines more established programmes of ministries, funds and loans for energy retrofitting with community and local efforts.

5. Consumer recruitment in ECO2

5.1 Guidelines for socio-demographic recruitment

The consumer segmentation needs to balance composition between different areas in the ECO2 consortium countries. To ensure a balanced sample on a national level, the following attributes related to the user's background should be considered:

- Country, region/municipality
- Gender, age, education, income
- Dwelling type, household composition, house ownership
- Regional characteristics

The target for the consumer recruitment is to gain ECO2 participants both male and female, from all age groups and across educational and income level groups. The target is not to match the distribution of these characteristics within populations, but to have all groups represented on the ECO2 platform.

We found that energy consciousness and energy consumption choices are strongly limited by the building stock features. Therefore, factors such as dwelling type, household composition, house ownership and region will be considered at the subscription stage.

5.2 Guidelines for knowledge-based recruitment

Throughout the pilot and upscale of ECO2 platform, we suggest empowering users to become aware of their energy consuming appliances and support their effort in choosing between

different alternatives. In framing of the invitation to the ECO2 platform and onboarding phase, we propose ECO2 potential users to reflect upon aspects of their energy consumption:

- Recruit individuals willing to ask energy distributors and/or energy agencies or consumer associations for feedback on their energy bills.
- Recruit individuals willing to inspect their meters, if they have any.
- Recruit individuals willing to inspect their appliances on the amount of energy used (for instance, inspect appliances' specifications/ manuals). If available, complement with home energy audits. For this, the platform will allow the input of different appliance types and their energy consumption and create a visualisation of them.
- Recruit individuals who will learn about their energy source (conventional/ green energy).
- Recruit individuals who want to deepen their knowledge about daily energy consumption. These can be prompted through the ECO2 web platform, or printable stickers and signs through the house.
- Recruit individuals who, besides learning for themselves, want to share and discuss their energy conservation experiences during the last week/ days with other users on the ECO2 platform. ECO2 can invite an energy expert to answer questions that may arise. D3.1 contains user archetypes with these objectives and reflects on how they can be considered as intermediaries in the recruitment of new users. Such individuals are likely to be interested in becoming facilitators of ECO2 actions.

Looking forward beyond the on-boarding phase, a key function of the ECO2 platform is to foster collaborative and transformative learning on energy efficiency. To support such learning, facilitating community and knowledge sharing need to become a central focus point. At the level of platform design, users can establish and maintain their own spaces by sharing knowledge and connecting with like-minded through social media and group actions. Enabling the users to join those neighbourhood groups with which they resonate most gives users a chance to enlarge their community beyond their physical and social environment and be exposed to new ways of energy conservation and practices. We anticipate that such neighbourhoods are likely to form based on attributes of the dwelling they inhabit, lifestyle and life-course stage and their combinations (e.g. students in rental apartments; families in detached houses and/or apartment buildings; single-person households; elderly in detached houses and/or apartment buildings).

In subsequent phases, matters of energy consumption, the condition of the dwelling and the need for energy renovations might be addressed.

In knowledge-based recruitment, information on age and education can prove relevant in establishing whether the platform user need energy literacy actions or more result-oriented actions (such as 'smart consumer', 'making my energy' or 'no rebound') (cf. Several architypes of possible platform users outlined in ECO2 D3.1).

5.3 Guidelines for motivation-based recruitment

Our guidelines for motivation-based recruitment are composed of the following elements:

1. Recruit individuals who intentionally want to deepen their knowledge on energy saving and efficiency.
2. Recruit individuals willing to consider the whole spectrum of implications energy conservations have in terms of savings on the energy bill, environmental and ecological sustainability of the planet, personal health and wellbeing, and technology innovations.
3. Recruit individuals ready to commit to at least 1 energy saving 'challenge', for instance lower ambient temperature a day/ month, monitor that appliances and light switches are turned off when not in use, water conservation during showering challenge, waste sorting, etc.

5.4 Survey questionnaire for platform subscription: obligatory questions

A preliminary question when starting the platform subscription process, includes answering the question on which country the subscriber lives in. In further stages of the subscription process, the questions and materials are presented in the language of the respondent.

Country (OBLIGATORY)

- Multiple choice leading to the registration page in the participants' language

Region (OBLIGATORY)

- Where do you live? [city / region] preferably a drop-down menu

The survey questionnaire for the subscription of the platform contains measurements for participants' background (demographic metrics, measures for resources such as education and level of income, and metrics on dwelling) found important in the previous segmentation studies.

Information on the participant's background will be used for two purposes. First, to offer tailored contents which facilitate knowledge and materials the participant benefits from, while avoiding information overflow not suited for their life situation or living conditions. Second, to monitor ECO2 platform user composition. Should there be biases in terms of some consumer groups being totally absent, measures can be taken to contact this group via relevant stakeholders. The final goal is to enable a diverse energy consumer base to benefit from the ECO2 platform.

Gender (OBLIGATORY)

- Male
- Female
- Prefer not to say

Age (OBLIGATORY)

- 18-24
- 25-34
- 35-44
- 45-54
- 55-64
- 65+

Education (OBLIGATORY)

(0. Early childhood education)

1. Primary education
2. Lower secondary education
3. Upper secondary education
4. Post-secondary non-tertiary education
5. Short-cycle tertiary education
6. Bachelor or equivalent level
7. Master or equivalent level
8. Doctoral or equivalent level
9. Not elsewhere classified

Subjective income: What is the level of your household's income considered from the viewpoint of meeting your household's needs? (OBLIGATORY)

- Very poor
- Poor
- Insufficient
- Fair
- Good or very good

Household composition (OBLIGATORY)

- 0-12-year old children (number of persons each type)
- 13-19-year old teenagers (number of persons each type)
- 20-64-year old adults (number of persons each type)
- +65-year old adults (number of persons each type)

Type of a house: What type of dwelling do you currently live in? (OBLIGATORY)

- Detached house
- Multi-apartment building
- Terraced house /semi-detached house

House ownership: Who owns the dwelling you currently live in? (OBLIGATORY)

- I and/or my spouse
- Other relative
- Private landlord
- Private or a social company
- Other

Region: What kind of region do you currently live in? (OBLIGATORY)

- Predominantly rural
- Intermediate
- Predominantly urban

5.5 Survey questionnaire for platform subscription: additional questions

Motivational questions can be used to customize information to the ECO2 users. Questions on the context of energy use (the building, the appliances) and consumer attitudes and motivations may be used on the platform to suggest the users the most useful paths they can follow on the platform.

5.5.1 *Heating and household appliances*

Again, the context is important in mapping consumers' interests. In addition to sources of heating and household appliances, consumer motivations may be inquired as follows:

Form of heating: What is the form of heating in your current dwelling? Mark all which apply. (OPTIONAL)

Heating/air conditioning account for the majority of household energy consumption. The form of heating at use also defines, what type of energy saving solutions or energy renovations are possible in the household. The most basic options of different forms of heating are:

- District heating
- Direct electric heating
- Electric storage heating

- Oil or gas heating
- Central heating systems such as wood pellet boilers
- Ground source heat pump
- Air conditioners or air-to-air heat pumps
- Auxiliary systems like solar water heaters and solar panels
- Other

Household appliances: Which household appliances do you have? Mark all which apply. (OPTIONAL)

Household appliances at use may be mapped out at the use of the ECO2 platform. Energy companies have questionnaires for calculating energy use based on appliances at use, and it may be relevant to give the user a chance to screen the contents offered on the platform by introducing information on the appliances at household's use. The list of appliances includes the following:

- Dishwasher
- Fridge
- Freezer
- Fridge-freezer
- Electric stove
- Gas strove
- Wooden stove
- Exhaust hood
- Washing machine
- Dryer
- Steam iron
- Heated towel rail
- Vacuum cleaner
- Air humidifier
- Air purifier
- Television
- DVD player
- Desktop computer
- A laptop
- A modem
- A printer
- Floor heating
- Additional heating appliance (e.g. electric radiator heater)
- Air conditioning system

- Air conditioning system with cooling option
- Electric coffeemaker
- Electric kettle
- Microwave
- Toaster
- A sauna or a steam room

5.5.2 *Consumer values*

Motivational aspects (OPTIONAL)

Motivational aspects may be addressed at the subscription of the platform. Alternatively, a list of motivations may be used to indicate the value of certain materials or actions provided for the ECO2 platform users as they choose actions on the platform. The examples of motivations presented in *B2C Elements of value* by Bain & company (2016) can be modified to reflect different attitudes and perceptions behind personal practices. The basic functional motivations in this model are:

- Saving time
- Saving money / costs, making money
- Reducing risks and protecting from losses
- Reducing the effort needed for certain practices
- Enhancing social connections
- Valuation of reliable and trusted information
- Valuation of good organising; lack of complexity, seamless integration of different aspects of life
- Valuation of good products and services: variety in the selection, high quality in products and services, sensory feel

The basic functional motivations are thought to link to more abstract emotional values (such as well-being, reduction of anxiety, nostalgia, status) and even life changing motivations (such as giving hope, a sense of accomplishment, sense of doing good for the future generations, sense of belonging), but these seem less relevant to choosing activities on the ECO2 platform than the functional motivations.

5.6 Translating the guidelines to country-specific practices

Results from different studies using socio-demographic segmentation, descriptions of the building stock and regional differences, and accounts of attitudinal differences on energy consumption in

different national context, suggest possibilities and challenges for recruiting ECO2 platform users and contacting different stakeholders in the ECO2 partnering countries.

Considering the recruitment strategy against the field of stakeholders within each national frame, opting for existing collaboration and networks is expected to be a viable strategy. In addition, country specific strategies should respond to the national level challenges, such as energy poverty in multiple ECO2 countries, and target attention on the most volatile groups (low income groups, tenants, the young, the elderly) identified in the country reports. While starting from the existing collaborations, we also aim to forge new relationships.

Table 3 summarizes the ECO2 country-specific directions; the targeted emphasis and potential partners on a national level. In countries, where the field of stakeholders is characterized as representing the sectoral approach, approaching governmental actors may be valid. In the layered approach, a good strategy builds on the experience of the varied stakeholders in the field, and in countries representing the compound model, stakeholders are to be contacted through both governmental organizations as well as local actors with prior experiences in engaging individuals on a grassroot level. Homeowners associations, consumer associations, utility providers, and NGOs constitute umbrella-organizations with missions to address energy efficiency in every country and thus represent partners with potential interest in the ECO2 platform.

Table 3. Country-specific directions: recommended emphasis and potential partners

	Recommended national emphasis	**Potential partners facilitating recruitment**
Belgium	Countering energy poverty of low income, elderly, rental and social housing groups. Homeowners need attention as well as they make up 2/3 of total housing, considering that the building stock is by large poorly insulated.	ESCOs and local actors providing energy advice on a local level, organizations working with energy poverty, companies and municipalities providing rental and social housing; Electricity and Gas Regulatory Commission; CWaPE
Bulgaria	Alleviating energy poverty of low income and elderly groups through energy efficient practices. Most common dwelling types are apartment buildings and detached houses, consequently their residents need to be reached as need homeowners, too.	Municipalities, local housing companies, local and regional energy agencies, municipal energy efficiency network, Association of Bulgarian Energy Agencies, EnerGbg, Energy 21
Denmark	Energy saving efforts to focus on households with families and high-income. Rural populations account for a high share of total population and need to be informed.	Energy and technology forums, organizations providing advice on housing and energy use (e.g Danish Energy Agency/SparEnergi.dk, Danish Municipalities), universities with prior experiences on energy efficiency promotion (AU, RUC, AAU, DTU); Energy Forum, Ecological council, Bolius
Finland	Tailored information for men (emphasis on	Energy and technology forums, regional

	energy renovation and effect on environment) and women (emphasis on environmental awareness achieved through technological efficiency) Address energy needs of households with children and/ or high-income. Focus on urban areas and homeowners, both in detached houses and apartment buildings.	energy offices, environmental associations. Governmental and municipal organizations providing energy advice (e.g. Motiva, Green Energy Association). Local energy companies, apartment rental companies
Greece	Address the energy needs of <40 years old; Support energy saving habits of 40-75 years old. Residents in the northern part of Greece and homeowners most likely to benefit from energy efficiency practices, but residents in big cities most likely to explore and adopt energy efficiency practices	Small energy providers, energy and technology forums, NGOs working with young adults and working age population (e.g. Center for Renewable Energy Sources & Saving)
Ireland	Focus on those households at risk of energy poverty, regional dimension. Tailored information for those interested in technology and environment. Urban households and private landlords should be informed about energy efficiency opportunities such as those in ECO2	Local and municipal organizations, neighborhood associations (e.g. Sustainable Energy Authority, Energy Efficiency and Affordability Division, Electricity Association of Ireland)
Italy	Focus on population at risk of energy poverty. Additionally, efforts to support student, low-income and tenant's energy conservation efforts. Homeowners and households in Southern parts of Italy represent populations of interest for energy renovations and savings	Regional actors providing energy advice (e.g. local energy agencies and municipalities), student organizations, companies providing rental housing (e.g. ACER)
Lithuania	Tailor information particularly for homeowners living in multi-apartment buildings. Focus on energy efficiency for those at risk of energy poverty.	Renewable energy and multi-apartment associations (e.g. Lithuanian Confederation of Renewable Resources; Renewable Energy Producers Association; Public Company Housing Energy Efficiency Agency, Energy Saving Facilities)
Portugal	Tailor information particularly to young men who have high potential to save energy. Increase energy saving awareness of women over 45 years old. Energy awareness efforts should concentrate in the metropolitan areas	Technology forums, student organizations, local organizations involving women (e.g. Regulatory Entity for Energy Services, ADENE - Energy Agency, Association of Energy and Environment Agencies, Portuguese Association of Renewable Energies)

5.7 Avoiding bias in consumer recruitment

The country reports show that cities and municipalities have already undertaken many initiatives to foster energy efficiency, yet consumption is still highest in cities as they expand and gain more population. However, small towns, semi-urban dwellings and rural areas need a position in the sampling and would benefit largely from having their inhabitants' awareness raised in matter of energy efficiency. In suburban areas, the most common type of dwelling is the detached house, which give individuals much potential to implement energy renovations. Against this background, cities, municipalities and rural public organisations, as well as utility distributors, housing and

tenant associations might benefit from being informed about the ECO2 platform. Targeted recruitment can be promoted to high energy consumers, for instance households with children and those living in cities.

In the consumer recruitment, we aim at an unbiased sample. While paying attention to the involvement of volatile groups, such as the energy poor citizens and the low-income groups, who could benefit from the ECO2 platform and ultimately from energy saving the most, we will not overlook technology enthusiasts or the consumers labelled as pioneering users either.

Different stakeholders such as governmental organisations, utility companies, renewable energy companies, housing associations, consumer protection associations, NGO's with broad scopes, citizens and local communities can provide invaluable help in the recruitment of ECO2 participants. These stakeholders and intermediaries may be contacted as the recruiting proceeds and we are able to gather background information on the users of ECO2 platform. In order to engage those segments with no obvious interest in energy issues, we expect NGOs from outside the energy sector, with wide focus and mixed membership, to be of help during the recruitment. Specifically, the help needed and hope for from intermediaries, may include the promotion of the ECO2 platform through their own networks. Participation of stakeholders and individual consumers is always voluntary.

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ANNEX: VALIDATED ECO2 COUNTRY REPORTS

7. Belgium

Christophe Gouache, François Jégou and Sabrine Bibollet

Strategic Design Scenarios

7.1 Introduction

This section is a contextual document that provides an overview on energy consumption and energy consciousness in Belgium. It was conducted by Strategic Design Scenarios in order to comply with the objectives set for the segmentation analysis of ECO2 WP6.

The literature review was done scanning documents written either in English or French. The literature review focused on reports, articles, studies, surveys, etc. coming from official and/or recognized sources (energy institutions, academia, public bodies, etc.). While reviewing the literature, priority was given to the latest publications to get the most recent data, results and analysis. In some cases, older studies or reports have been used (for example on the behavioural and attitudinal segmentation) when no recent ones were available. Sources were coming from different official sources: IWEPS (Foresight and Evaluation Institute of Wallonia), FGOV (Federal Government), Eurostat, IBGE (Ministry of Environment for the Brussels Capital Region), PADDII, APERe, CEHD, FOB, CWAP and BELSPO.

The most difficult aspect of the literature review is that many studies are done on a regional level. Therefore, it requires to mixing, crossing, and comparing the different results and sources to get to a national energy profile.

In the European context, Belgium is a heavily urbanised country. It benefits from the proximity of several renewable energy producing countries. On the other hand, the country is dependent on its neighbours on energy production. The complex structure of governance sets limitations to the development of Belgium's energy system, and the rollout of smart meters is still limited to pilot projects. It is common that the citizens of Belgium are not able to estimate the amount of energy they use, nor its costs, nor the effect of home energy use to greenhouse gas emissions. Comfort is the main determinant of home temperature. Fuel poverty affects a large part of Belgians. In Wallonia region fuel poverty reaches 26 % of the population.

7.2 National frame for energy consumption

Belgium has a population of 11.2 million and a land area of 30 500 km2. Belgium is a federal state made up of three regions (the Brussels-Capital region, the Flemish region and the Walloon region)

and three linguistic communities (the Flemish-, the French- and the German-speaking communities).

In its energy strategy, Belgium has built and maintained a robust and interconnected energy, electricity and gas infrastructure, as well as a leading position in market integration and organization. Because of its central location in Europe, Belgium has access to a wide selection of major wind and solar energy production hubs, and a possibility to benefit from the energy choices of its large neighbours Germany, France and the UK.

Belgium also faces multiple challenges: Unlike other European countries, Belgium's renewable energy potential is limited. The Belgian renewable energy potential will consist mainly of onshore and offshore wind and solar photovoltaic energy; Biomass, geothermal and hydropower will contribute in lower volumes to decarbonisation. But given the small size of the country, only part of the Belgian demand could be met by a domestic renewable energy capacity. It is therefore not possible to rely solely on domestic renewable energy production to achieve complete decarbonisation.

In the current market organization, the increased amount of renewable energies in the system has raised some concerns about the profitability of conventional units, with a possible impact on the security of supply of the country. Given that there is less than a decade left before Belgium ceases its production of nuclear energy, maintaining security of supply is becoming a growing challenge.

Belgium has a quite complex government system and the energy governance follows the same complexity. In energy policy and governance, powers are divided between the federal government and the regions. Since January 2014, following the Sixth State Reform, this division is described in the following sections.

The federal responsibilities include the security of supply, national indicative investment plans for gas and electricity (in collaboration with the CREG, the federal regulator), nuclear fuel cycles and related research and development (R&D) programmes, large stockholding installations for oil, production and transmission/transport of energy (including electricity grid >70 kV), including large storage infrastructure, transport tariffs and prices, product norms, offshore wind energy.

The regions are responsible of the regulation of gas and electricity retail markets, distribution and transmission of electricity (electricity grid <70 kV), distribution of natural gas, distribution tariffs, district heating equipment and networks, renewable sources of energy (except offshore wind energy), recovery of waste energy from industry or other uses, promotion of the efficient use of energy, energy R&D (except nuclear), use of firedamp (coal-bed methane) and blast furnace gas.

The federal energy regulatory is the Commission for the Regulation of Electricity and Gas (CREG). The regional governments have set up their own regulatory institutions: in Flanders, the Vlaamse Regulator voor Elektriciteit en Gas (VREG), in Wallonia, the Commission Wallonne pour l'Énergie

(CWaPE) and in Brussels-Capital, the Brugel. In addition, municipalities have a legal monopoly on electricity and gas distribution. Nearly all municipalities have transferred the distribution of electricity to inter-municipal companies called “inter-municipalities”, which are compensated for their investments by means of income-regulated tariffs.

The three regions and the federal government work together closely on a permanent basis on energy and climate policy. This work is conducted in various co-ordination arenas, notably:

- the federal-regional co-ordination platform on energy policy ENOVER/CONCERE
- the Co-ordination Committee for International Environmental Policy (CCIEP)
- the National Climate Commission (NCC).

Due to its complex governance system, Belgium does not have a consolidated national energy strategy. However, discussions are currently taking place at the federal and regional levels, with the aim of defining Belgium's Energy Vision in the long term, with particular attention to the future energy mix and market organization. This is of particular importance in view of the decision to abandon nuclear production by 2025 and Belgium's commitment to the Paris Agreement of COP21. Belgium is also a signatory to the United Nations Framework Convention on Climate Change (UNFCCC) and a party to the Kyoto Protocol.

Belgium’s total primary energy supply (TPES)1 was 52.8 million tonnes of oil-equivalent (Mtoe) in 2014. This is 5.4 % less than in 2013 and 9.9 % less than in 2004, a decade earlier. Energy supply peaked at 60.4 Mtoe in 2010, after consistent growth for over 25 years. From 2010 to 2014, TPES declined by 12.6 %.

Fossil fuels accounted for 72.7 % of TPES in 2014, including oil (42.3 %), natural gas (23.9 %) and coal (6.3 %). Nuclear power accounted for 16.6 % of TPES and renewables for 8.0 %. Renewables are made up of mainly biofuels and waste (6.3 %), with wind (0.8 %) and solar (0.9 %).

The fossil fuel share has contracted from 75.4 % of TPES in 2004, while renewable energy has increased its share in TPES from 2.6 %. The boost in renewables is mainly due to a 124.4 % increase in the use of biofuels and waste, but also to a surge in wind and solar from negligible levels, thanks to subsidies. Belgium’s fossil fuels share in TPES was at a median level among IEA member countries in 2014, similar to Portugal’s. Belgium relies on energy imports as domestic production accounts for 23.6 % of TPES. The country imports mainly fossil fuels.

Belgium’s total final consumption of energy (TFC[1]) amounted to 40.1 Mtoe in 2014 (IEA 2015). TFC represents around 75 % of TPES, with the remainder used in power generation and other energy transformations (oil refining, iron and steel, cement). TFC has remained essentially flat since 2000, albeit with moderate fluctuations. Demand peaked at 43.5 Mtoe in 2010 and has contracted by 5.4 % since then. Industry is the largest consuming sector, accounting for 47.5 % of TFC in 2014. Demand in industry has increased by 3.6 % over the ten previous years, contracting

by only 1.3 % since 2008. Its share in TFC has increased marginally from 43.4 % in 2004. The transport sector accounted for 21.7 % and the residential sector for 18.4 % of TFC, and both have seen demand fall since 2004. TFC in households declined by 26.3 % from 2004 to 2014; its share in total TFC fell from 23.7 %. TFC in transport decreased by 2.7 % over the same period, but its share has remained unchanged.

Statistics from Eurostat (European Commission 2017) have shown that Belgian households' energy consumption has decreased since 2005. Electricity consumption by households fell at a much faster rate than the EU-28 average between 2005 and 2015 in Belgium (where the overall contraction was 27.6 %). At the other end of the range, household electricity consumption rose in a majority (18) of the EU Member States, generally by less than 10.0 %. According to Eurostat overall household electricity consumption is likely to be influenced, in part, by the average number of persons living in each household and by the total number of households, both of which are linked to demographic events. Other influences include the extent of ownership and use of electrical household appliances and consumer goods as well as the use of energy saving devices.

7.3 Socio-demographic differences in energy consumption in Belgium

7.3.1 *Socio-demographic segmentation*

On January 1st 2016, the population of Belgium was 11,267,910. That number is fairly evenly distributed between the sexes, although women outnumber men by approximately 200,000. The population density is 363 people per km^2 (2015), although the north of the country is much more densely populated than the south.

The 18-64 age group, i.e. largely the working population, numbers 6,919,768 and accounts for the bulk of the population. 2,062,561 Belgian residents are aged over 64. Within this group, 1,860 people are 100 or older. The number of people aged 18 or under is 2,285,581. The age pyramid clearly indicates an ageing population.

In 2008, there were 4,822,301 households in Belgium, of which 1,646,553 were single-person households.

The distribution of Belgium's residents by region is as follows (2016): 6,477,804 live in the Flemish Region, 3,602,216 live in the Walloon Region (including 75,222 from the German-speaking Community (2010)) and 1,187,890 reside in the Brussels-Capital Region. (Directorate-General Statistics and Economic Information 2018)

7.3.2 *Social differences: energy consumers attitudes and behaviour*

The Determining Household Profiles for More Efficient Use of Energy study (2006) has shown important differences in energy use.

Consumers choose their housing according to personal criteria depending on socio-economic or family conditions, life circumstances but also expectations closely related to their personal needs. Housing and related needs are closely associated with how consumers perceive energy. First, people who plan to occupy their homes for a long time, are more aware of energy as a tool to manage to help build a rational, safe, controlled habitat as if the habitat was a business or a refuge to create well-being. Second, those living in their homes only temporarily, tend to perceive energy at home as a source of stimulation for recreational occupations or for the operation of basic devices, which allow them to maintain their professional energy.

The study identified 6 important trends in energy use:

1. Transit: "Transit" consumers move according to circumstances and prioritize their professional activities. Energy investment issues are of little concern to them; they use the equipment and sources they find on site, but which must meet their needs.
2. Demonstration: "Demonstration" consumers invest a place not to live in a "functional" way, but to make it a place of demonstration. Depending on their aesthetic or other priorities, they will prefer certain types of development. Priority can be focused on one type of energy rather than another.
3. Management: The overriding objective is to arrange housing so that it operates rationally, "flawlessly". The investment is long term. Choices are solutions that offer reliability and the best value for money.
4. Nest: Housing is a long-term investment place; the objective pursued is personal well-being. The emphasis is on comfort according to individual priorities (heating, lighting). The energy is adapted to the personal requirements of the inhabitants.
5. Conviviality: The accommodation is a place designed to be a source of well-being for the inhabitants but also for the visitors. Everyone will find a satisfactory solution in terms of their priorities for energy use (heating, lighting ...)
6. Accessory: "Accessory" consumers who follow their loved ones without questioning the aspects of housing; they contribute very little to energy management or investment. Housing is not a priority for them.

Energy consumption is difficult to grasp. In Belgium, people often don't know where to look for information nor are they motivated to save energy (RWADE 13.08.2018). Moreover, even if consumers are aware, they do not necessarily make effective changes, even if they see a link between money saving and energy consumption (Bruxelles Environnement 03.08.2018). People spontaneously talk about cost and environmental aspects when considering the use of energy sources in general. On the other hand, as soon as the use of energy is framed home, these notions become less important. Moreover, people do not talk about the amount of energy they use, neither overall, nor by type of source (gas, electricity, etc.), nor by type of use (heating, lighting etc.). They are not able to give an even approximate quantitative estimate, whether in m3 or KW /

h. However, most respondents were not able to give an accurate estimate of the monthly or annual costs of their home energy use, either.

People who have adopted many responsible use of energy (RUE) behaviours are hardly distinguishable from others in their perception of energy. However, they are more aware of the costs of energy and are mostly able to report the amount of their monthly bill, the annual cost of their energy consumption and some may even distinguish the costs of heating and electricity. People who adopt Responsible Use of Energy behaviours in their daily lives, express different motivations: “being responsible, being civic, to manage well, being aware of the environment, an indispensable attitude, being disciplined, an obvious thing to do, the smart thing to do”.

In Belgian households, the temperature level is adapted according to the needs of the person who feels the greatest lack of heat. While most people can quantify in degrees the level of temperature necessary for their comfort, hardly anyone consults a thermometer at home. The home temperature level is determined more subjectively according to body sensations than measured with a thermometer. The level of cautiousness or the ability to adjust the heaters does not depend on the gender of the respondent. Heating constitutes the largest part of households’ total energy consumption (RWADE 13.08.2018). People consider that savings are more the result of energy renovation investments rather than daily behaviours. It is a common belief that through investment one saves energy, but it is only after several years that the financial savings become perceptible. Those who have carried out insulation or heating installation work are often unable to mention the financial amount, or the energy savings achieved as a result of the works. Insulation, boiler replacement or heating system upgrades (thermostats, etc.) are not initially motivated by energy costs, but by the need to improve comfort and convenience. The economy of operating costs is seen more as a progressive investment payback on the long term. In general, people who have made investments think that they have done what was necessary to save energy and are not looking for more rational behaviour.

One reason of lighting is to create atmosphere, in which case the lights are not necessarily turned off in unoccupied rooms. In other cases, paying attention to lighting at home is an easy way to save money and to act in an environmentally conscious way. In general, the participants of Determining Household Profiles for More Efficient Use of Energy study (2006) believe that they have acquired energy saving behaviours, but only few have monitored their actual energy consumption. It is commonly believed that it is easier to buy energy-efficient devices than to reduce the number of appliances or to learn a new way to use them. For many, energy saving means giving up unnecessary energy consumption, especially for those regard the functionality of their home.

Belgians are aware of the impact of energy use on the environment, but people almost never associate CO2 emissions with home energy use. They consider that these emissions come from the traffic and industrial activities. The environmental factor is never mentioned as a priority for

energy savings. However, the protection of the environment is seen as a bonus in this area. Most believe that it is up to governments and manufacturers to set and meet environmental standards. However, some, while sharing this view, feel it is their responsibility to participate in this effort by asking for complementary individual choices. These complementary choices are mainly aimed at eliminating unnecessary consumption (turning off the light in unoccupied rooms and reducing or closing the heating in case of absence). Some people have ecological motivations to explain their energy-saving approaches, for example, the preservation of groundwater or climate change. But the behaviours they adopt are not necessarily related to the ecological priorities they express. The most environmentally sensitive people are not much better informed than others about the nature and mechanism of the impact of their energy use on the environment. On the other hand, these people are often able to evaluate the financial amounts related to energy consumption and their bill. Energy-saving behaviours associated with ecological motivations are only rarely based on rigorous information. Most people motivated by this type of motivation are sensitive to an "idea" of ecology and respect for others and nature rather than measurable facts. Indeed, all respondents believe that their environmental action can only be anecdotal compared to global degradations. It is therefore more of behaviour resulting from education and linked to the notion of responsibility. (Determining Household Profiles for More Efficient Use of Energy 2016.)

In Belgium, there are multiple consumer segments posing a challenge when considering energy consciousness and energy saving pursuits. There are individuals from lower-income brackets who consume a considerable amount of energy due to badly insulated homes, who feel they don't have much control over their energy consumption and who still need to heat a minimum during the winter. Most of the energy poor are tenants, single-parent families and one-person households (especially in the old age groups). Additionally, there are also people with irresponsible consuming habits, such as wealthy households not caring much about the bills as they can afford excessive consumption. (RWADE 13.08.2018). In the less-consuming and more energy conscious group of consumers, there is also a small segment of eco-techno-fans, who buy and install smart meters in their homes, but this is extremely rare (RWADE 13.08.2018).

7.4 Differences related to the built environment

7.4.1 *Climate conditions and their meaning for energy consumption*

Belgium's temperate climate is characterized by relatively cool, wet summers and relatively mild, rainy winters. The snow is a relatively unimportant weather phenomenon in low and medium Belgium. Snow rarely falls before November 1st or after May 10th. The rapid melting of a thick layer of snow by heavy rains is the main cause of the relatively frequent winter or spring floods.

Winters are not extremely cold (average winter temperature ranges generally from -5°C to +5°C) but since the general insulation state of housing in Belgium is not that efficient, people still need to heat quite a lot to get comfortable indoor temperature.

Belgium does not receive a very high amount of sun hours per day and per year (compared to some other European countries) so lighting is needed all year long depending on the number and size of windows of the dwelling.

The seas thermal inertia mitigates and delays the seasonal temperature variation along the coast: the winter is milder and the summer cooler than inland (Figure 4).

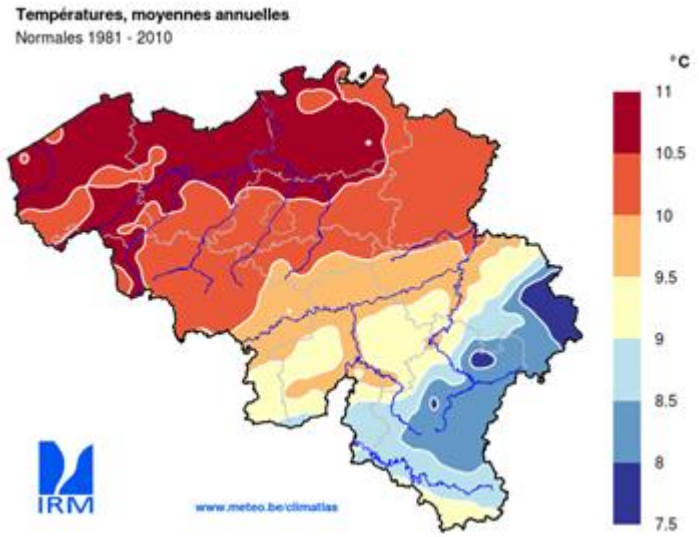

Figure 4. Annual average temperature in different parts of Belgium

7.4.2 *Population characteristics and their meaning for energy consumption*

There are several centres of dense urban population on Belgium (in dark purple). Overall, the country is characterised by high degree of urbanisation. The most rural areas (in grey) can be found mainly in the southern part of the country, while the urban areas dominate the north and the central parts. (Figure 5.)

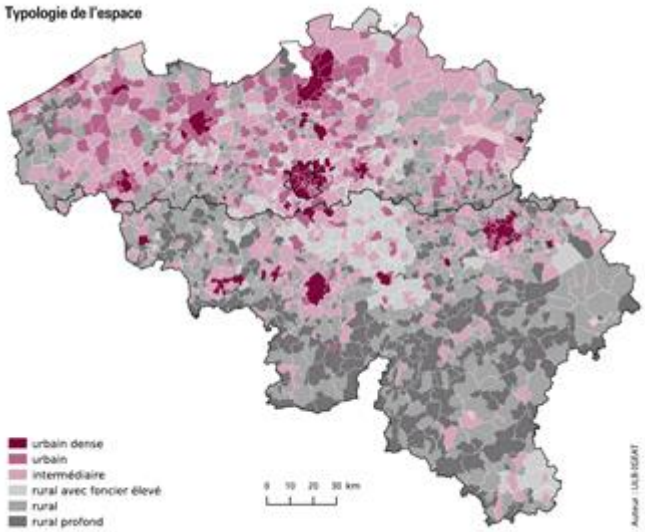

Figure 5. Degree of urbanisation in the Belgian regions (May 2015)

Fuel poverty (households spending more than 10 % of their income to pay their energy bill) is an issue in Belgium and especially in the Wallonia region (see the map of poverty below). In Wallonia, 26 % of households are in a situation of fuel poverty. And in some parts of Wallonia, around Dinant/Philippeville, Thuin and Charleroi, fuel poverty can reach up to 30-40 % of households. On a national level, 20 % of Belgians are considered energy poor (RWADE 13.08.2018).

Fuel poverty comes from different and often additional factors: low income household, badly insulated house as well as old appliances consuming a lot. In Figure 6, the least poor areas in Belgium are in blue, and the poorest areas in dark red. A typical household suffering from fuel poverty is either one-person household (39,0 % of fuel poor), aged 65 or beyond (39,7 % of fuel poor), with very low education (45 % of fuel poor), living on rent or living in social or public housing (37,4 %). In Wallonia, for the households earning less than 1000€ a month, the “energy effort level” reaches 17,8 % (the energy effort level is the share of the energy expenses in the household budget, the higher the share, the higher the effort). In this category, 69,4 % of these households are fuel poor.

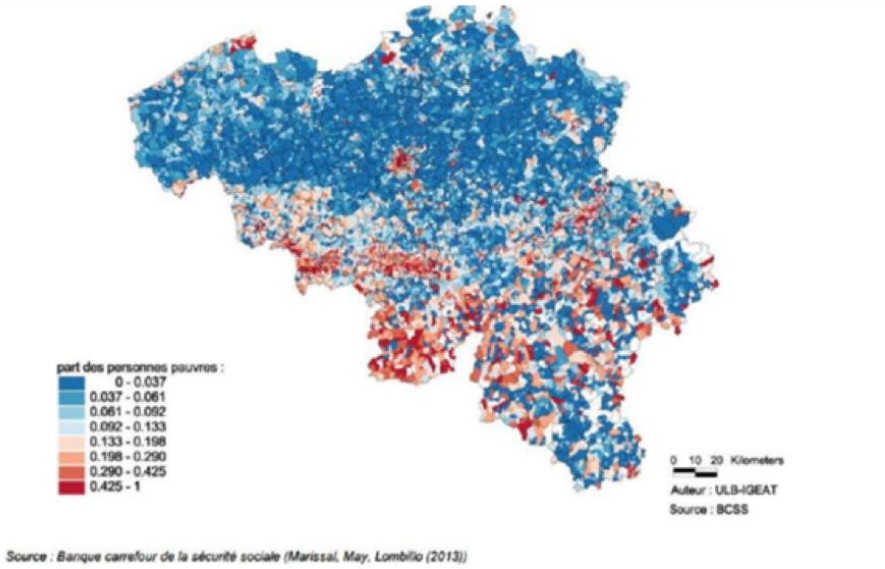

Figure 6. Degree of poverty in Belgium (Banque de la Carrefour de la sécurité sociale, Marissal, May, Lombillo 2013)

7.4.3 *Common dwelling types in the national context*

Buildings (residential and commercial) accounted for around one-third of TFC in 2013. Belgium's building stock is relatively old and has a high share of one-family houses. The turnover rate of the building stock is slow. From 1995 to 2015, the building stock grew on average by only 0.6 % per year, according to Statistics Belgium. Over the same years, the demolition rate, at 0.2 % per year, was also low by international comparison.

14 % of Belgian houses were built before 1921, 12 % were built between 1921 and 1945, 27 % were built after the Second World War and before the oil crises in the early 1970's. 35 % were built between 1971 and 2001, and 14 % were built in 2001 or after. In general, Brussels and the Walloon region have an 'older' housing stock than the Flemish region.

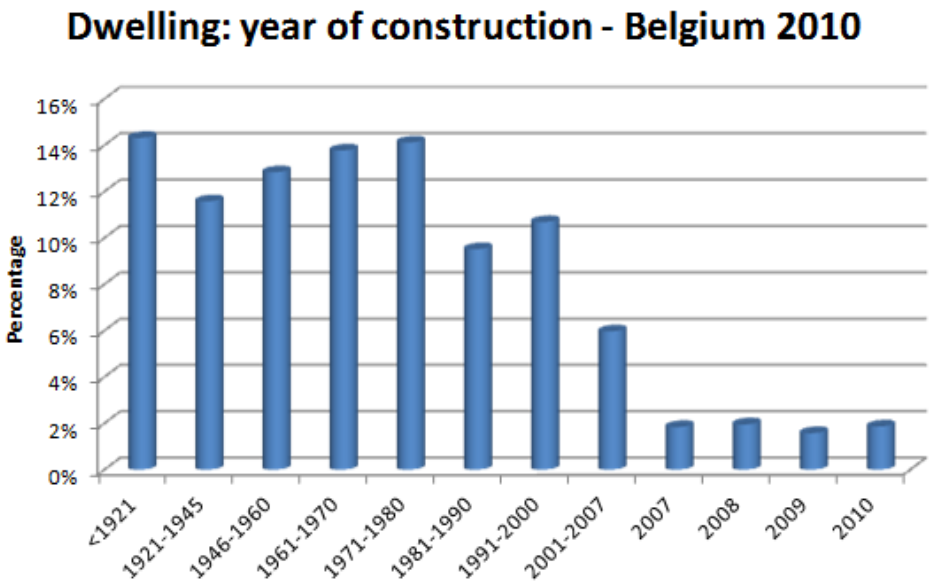

Figure 7. Age category of the dwellings in Belgium (survey results from Energy Consumption Survey for Belgian households 2012)

Belgium has around 4.5 million residential buildings. One-family buildings accounted for 65 % of the total floor area, a high share in Europe, and the remaining 35 % were multi- family buildings, according to BPIE data. Around 2.8 million residential buildings (62 % of the total) were built before 1970. And in some regions, like the Brussels Capital Region these older buildings are on average significantly less energy-efficient than those built after 1990, let alone those built according to the current energy efficiency requirements.

A third of the households in Belgium lives in an open single-family house (single-family detached home). In the Flemish and Walloon region the percentage is even higher (nearly 40 %). In Brussels, more than two third (69 %) of the households live in an apartment, studio, loft or room (Figure 8).

In general, people living in single-family homes are insulating more and installing more solar panels in their homes. These homes are usually away from the city centre and are generally inhabited by people of higher income and higher social status. (Bruxelles Environnement 03.08.2018.)

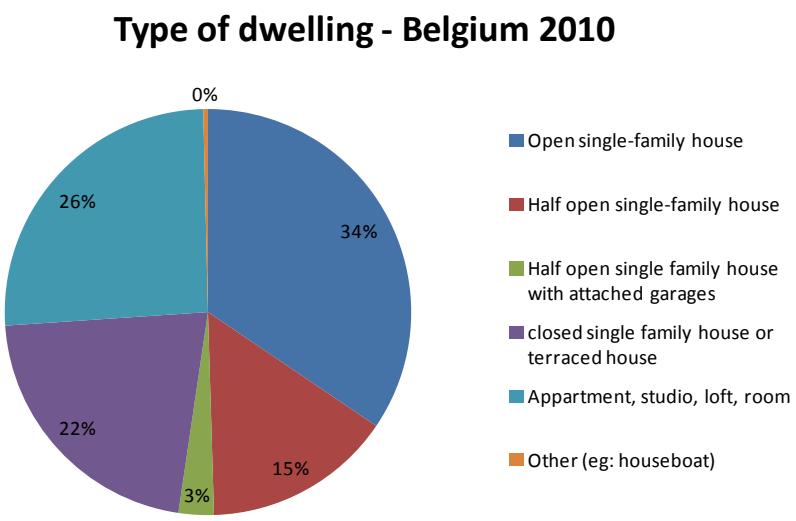

Figure 8. Distribution of dwelling types in Belgium in 2010 (Energy Consumption Survey for Belgian households 2012)

Figure 9 shows that 67 % of the households in Belgium owns (a part of) the property they live in. In the Flemish and Walloon region, the number is even higher, with 73 % in Flanders and 68 % in the Walloon region. In Brussels only 39 % owns the property, the number of households who rent is much higher.

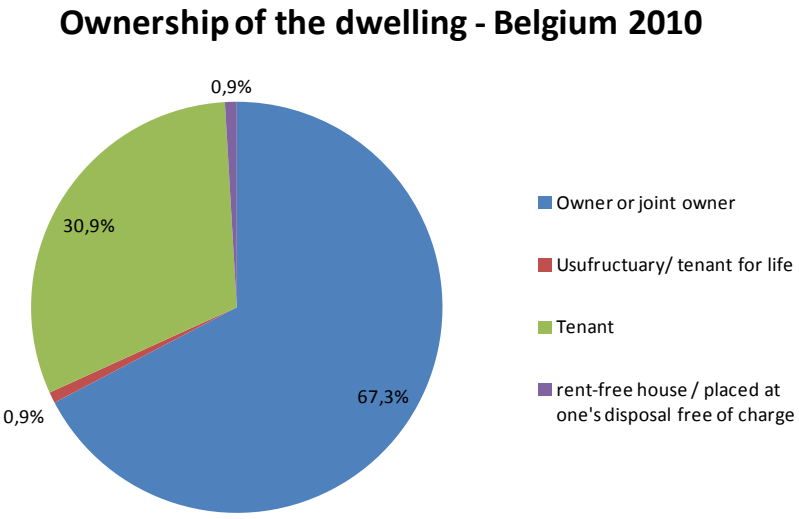

Figure 9. Ownership of the dwelling in Belgium and the regions (Energy Consumption Survey for Belgian households 2012)

House ownership has a contradictory relationship to household energy use. In condominiums, just a small share of energy consumption can be affected through household energy consumption

habits, whereas energy saving in the common parts of the building is considered difficult to carry out (Bruxelles Environnement 03.08.2018). There is also a segment of destitute house owners consuming too much energy because of the poor quality of the insulation in their homes. They need to heat a lot to reach a little bit of comfort, but while heating, the energy loss is big. (RWADE 13.08.2018.) There are also tenants consuming too much energy because of the poor state of their house, as there is no obligation for landlords nor public incentive for them to renovate the buildings. Moreover, excessive energy consumption is not only a problem of the poor or low-income homeowners or tenants, as the general observation is that the higher the household income is, the more households consume energy. (Bruxelles Environnement 03.08.2018, RWADE 13.08.2018.)

7.4.4 *Access to smart equipment*

In Belgium the competence on energy policy is shared between the federal and the regional administrations. The central government deals with issues pertaining to electricity transmission and distribution networks from 70kV up, while the section of the network below this threshold is under the supervision of regional administrations. Accordingly, no legal framework in place for rolling out smart meters, but the three Belgian regions (Flanders, Brussels-Capital, and Wallonia) have been in charge of their region-specific CBA (Cost-benefit Analysis) for the smart metering systems roll-out. In fact, the outcome of the CBA for a wide-scale roll-out was negative, but different CBAs were conducted in each region, which will support a selective smart meters roll-out (SWD 2014, 188).

Energy consumption tariffs in Belgium differ according to a legal social classification system. A segmented smart metering systems roll-out would likely target those of higher tariffs who can benefit more financially from smart meters. Smart meters have been deployed only in pilot projects; to date, approximately 50.000 smart meters have been installed. The Flemish government has, so far, supported the installation of around 40 000 smart meters for some pilot and research projects together with Eandis and Infrax (ICCS-NTUA, AF Mercados, EMI 2015). Lately, the Flanders Region has announced the official deployment of smart meters starting in 2019 but limited, for the moment, to priority target groups e.g. ‘early adopters’ that specifically request a digital meter, prosumers, households living in new buildings or carrying out renovations of buildings, and households benefiting from the replacement of existing budget meters.

In the current market model, metering is one of the responsibilities of the DSOs. DSOs buy, install and maintain the sub-meters. DSOs in Belgium tend to work together, and this cooperation resulted in the founding of 'working companies' through which working orders and metering activities from different DSOs are bundled. As a result, a handful of 'working companies' populate the Belgian DSO landscape.

7.5 Relevant stakeholders in promoting energy conscious behaviour in the national frame

In Belgium, there is a wide array of both governmental and non-governmental organisations promoting energy consciousness. Projects are rarer than continuous work of various organisations and ESCOs.

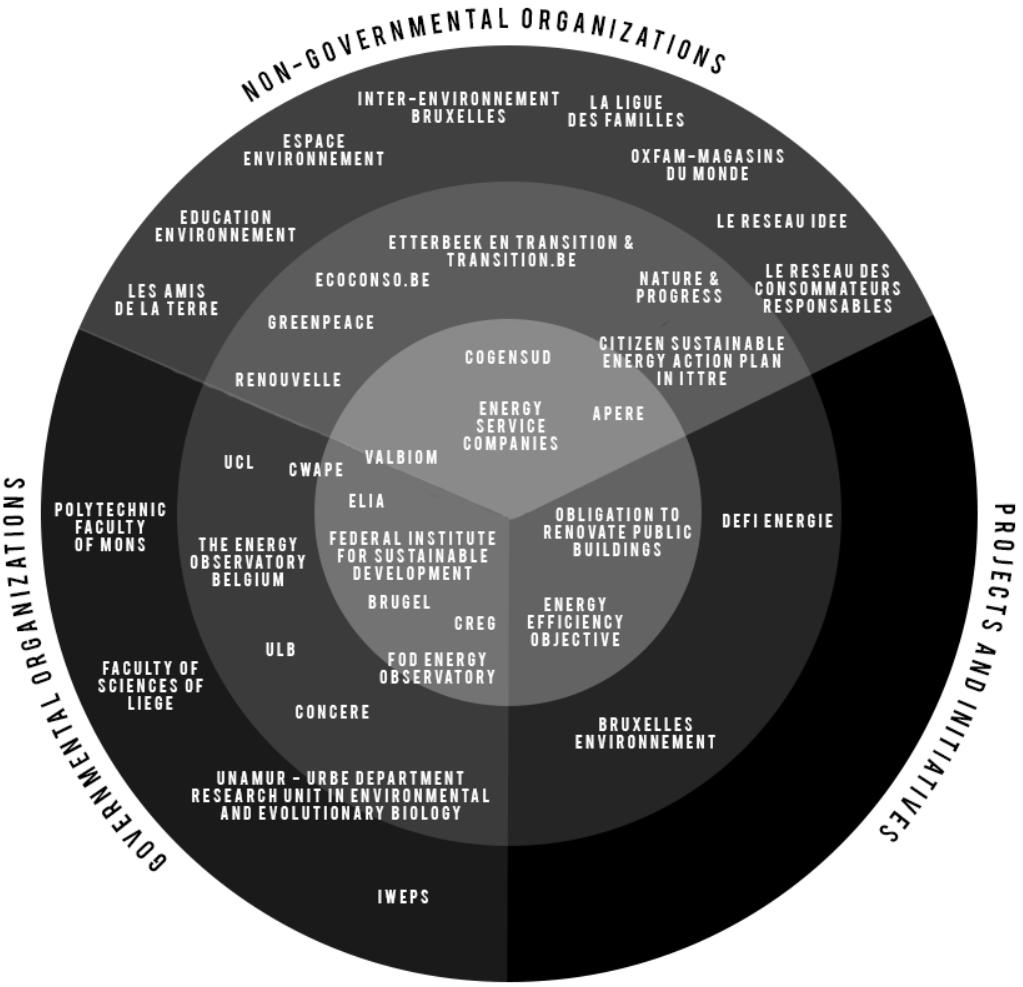

Figure 10. Belgian stakeholders with interest in energy consciousness

7.5.1 *Institutions presenting national interest for promotion of energy consciousness*

7.5.1.1 Governmental actors promoting energy efficiency / energy consciousness

BRUGEL (BRUxelles Gaz Electricité) is the Brussels regulator of the gas and electricity market.

Brussels Institute for Environmental Management (IBGE) is the administration of the environment and energy of the Brussels-Capital Region.

CWaPE provides software for Wallonia to calculate the number of attributable green certificates and makes available the list of potential buyers of Green Certificates.

The Electricity and Gas Regulatory Commission (CREG) is the federal regulatory authority for electricity and natural gas markets in Belgium.

Elia manages the electricity transmission network in Belgium but also plays a key role at the European level. As the heart of Europe, Elia is also a key player in the energy market and the interconnected electricity grid. Our company is behind several initiatives to develop an efficient, transparent and fair electricity market for the benefit of consumers. (ELIA 2017.)

The Energy Portal in Wallonia is a useful and comprehensive information tool on energy in Wallonia. It federates and values all the official information heritage available on this theme.

The Federal Institute for Sustainable Development is the driving force behind the sustainable development policy in Belgium. They have already produced a Federal Sustainable Development Plan and a Sustainable Procurement Guide that provide clues to the inclusion of sustainability criteria in government specifications under public procurement legislation.

The Federation of Renewable and Alternative Energy of Origin (EDORA) is the Walloon Federation of electricity producers from renewable and alternative sources.

FOD Energy Observatory - from the Federal Public Service Economy, Brussels

Vlaams Energieagentschap is the Flemish Agency of Energy

7.5.1.2 Universities and research institutions working on energy consciousness

The Energy Observatory Belgium

Faculty of Sciences of Liège

The Energy Cluster of the **Polytechnic Faculty of Mons (FPMs)** is a centre of expertise that brings together the activities of the laboratories of the Polytechnic Faculty of Mons active in the field of energy.

UCL - Catholic University of Louvain

Université Libre de Bruxelles (ULB) offers education and research at the Institute of Environmental Management and Territorial Planning / Faculty of Science / Ma Science and Environmental Management

UNAMUR - URBE Department - Research Unit in Environmental and Evolutionary Biology

The Walloon Institute for Evaluation, Foresight and Statistics (IWEPS) is a public scientific decision-making institute for public authorities. Since 1 January 2016, the Institute has been designated by the Walloon Government as the Statistical Authority of the Walloon Region

7.5.1.3 Other organizations promoting sustainable technologies and energy consciousness

Such services are provided by the Energy Service Companies (ESCOs). An ESCO carries out an energy project in a company, such as the installation, maintenance and management of energy saving measures in buildings, and it finances this investment itself. Thanks to this investment, the energy consumption decreases and consequently the energy bill. Then, the company pays for its new facility with some of that savings. When the installation is paid, the company becomes the full owner of the installation and continues to benefit from energy savings and a reduced energy bill. When concluding an energy performance contract (EPC) these energy savings are specified. **BELESCO**, the Belgian ESCO Association gathers the main stakeholders of Belgian energy services together. The energy service providers (Belgian ESCOs and ESCO project facilitators) are the following:

Private ESCOs:

Cofely Services GDF Suez (www.cofelyservices-gdfsuez.be)
EDF Luminus (www.luminus.be)
Green Invest (www.green-invest.be)
Imtech (http://www.imtech.be)
Johnson Controls (www.jci.com)
Siemens (www.siemens.be)
Sophia Group (www.sophia-group.be)
VINCI Facilities (www.vinci-facilities.be)
Inesco (www.inesco.be)
Spie (www.spie.be)
Veolia (www.veolia.be)
Etap (www.etaplighting.com)
Relux (www.relux.be)
Eneco (http://eneco.be)
Cres2 (www.cres2.be)
TriLED (www.triled.be)

Public ESCOs:

Eandis (http://www.eandis.be)
Infrax (http://www.infrax.be)
ESCO project private facilitators
Energinvest (www.energinvest.be)
Factor4 (http://www.factor4.be/
Ingenium (www.ingenium.be)

ESCO project public facilitators

Energinvest (www.energinvest.be)
Vlaams energiebedrijf (www.vlaamsenergiebedrijf.eu)
GRE-Liège (www.greliege.be)
efficacité énergétique FGOV

CONCERE a group created in order to reinforce cooperation between Belgian regional and federal governments regarding energy.

Energy Efficiency one of the working groups which meets regularly to reach a Belgian position on European and international energy efficiency, in general agreement with the regional and federal authorities. An important aspect of this cooperation is to achieve harmonization and transparency of the existing policy vis-à-vis other public bodies.

Greenpeace offers a ranking of electricity providers, from green to green.

The association **Valorisation de la Biomasse ASBL (ValBiom)** aims to promote and encourage the non-food recovery of biomass, with the aim of respecting the principles of sustainable development.

7.5.2 *Institutions with membership or clientele with possible interest for promoting energy conscious behaviour*

7.5.2.1 Organisations with citizens as members

Citizen Sustainable Energy Action Plan in Ittre

Belgian reference magazine on sustainable energy, **Renouvelle**, publishes its statistics monthly and offers a follow-up of the news for "consum'actors" of sustainable energy. Any citizen or professional organization that wishes to act in favour of an intelligent consumption of energy. Renewal is published by **APERe asbl** - Association for the Promotion of Renewable Energies.

The Association for the Promotion of Renewable Energies (APERe ASBL) is a Belgian association of reference in the field of renewable energies. Its website is a real database of renewable energies.

Etterbeek en transition and Transition.be is a website for citizen-based initiatives for the transition towards more sustainable lifestyles in the Brussels Capital Region

Moreover, in the Belgian context, regional and local actors are of importance in the promotion of energy consciousness. Here, connections to local actors such as neighbourhood committees, local associations and clubs, trade unions, social services and so on are pivotal. (RWADE 13.08.2018.)

7.5.3 *Energy consciousness related projects and initiatives that have gained public attention during the recent years*

7.5.3.1 National programmes and initiatives

The Government encourages energy-saving investments tax reductions (Federal Tax Measures) for energy saving investments for the details and businesses.

A measure of the **FPS Finance** in cooperation with the regional ministers and the federal minister having energy in his attributions.

7.5.3.2 Municipal and local programmes and initiatives

The regional ministry of environment, **Bruxelles Environnement**, has been carrying multiple energy saving projects and initiatives. Amongst the many actions they have led, they published in 2006 an Energy Guide including 100 tips to save energy.

Every year for nearly 10 years (2005-2014), the **Defi Energie** engaged families based in Brussels in taking the challenge of reducing their energy consumption. The goal was to help individuals reduce their energy bills by adopting a series of simple actions in their homes without loss of comfort or large investment.

7.5.3.3 Initiatives and support for energy efficiency / energy consciousness by NGOs

EcoConso is an active NGO promoting more sustainable lifestyle. Their main missions are to make available concrete, accessible, relevant, credible information on the interest and the possibilities of eco-consumption, to promote eco-consumption behaviours, to promote structural changes favourable to eco-consumption in communities and to deliver information, awareness and support services for eco-consumption to the public.

Nature & Progress is an awareness association, informing and raising awareness of the public regarding environmental and societal issues. It is a community of people who want to bring

change, a real driving force for developing new projects, and providing solutions while respecting the natural balance between Man and the Earth. It is a permanent education association, whose role is to promote and develop an awareness around the issues of society. It listens to the citizens, supports their demands and relays them to the political authorities. Their main lines of action are organic gardening, agriculture and food, eco-building: healthy habitat and responsible energy and sustainable degrowth.

GreenPeace Belgium

The **COGENSUD** association's mission is to promote the development of cogeneration in Wallonia. It provides updated information on cogeneration.

Finally, the following NGOs are aslo active actors for greater sustainability and better energy consumption in Belgium: **Les Amis de la Terre, Education Environnement, Espace Environnement, Inter-Environnement Bruxelles, La Ligue des familles, Oxfam-Magasins du monde, Le Réseau IDée** and **Le Réseau des Consommateurs Responsables.**

7.6 Final considerations

More responsible use of energy has been a growing concern in Belgium for many years. A lot of actors, at all levels, local, regional or national, are active and promote more sustainable consumption of energy in households either through incentives, tips and/or policies. The public is – relatively – quite aware of the need for better energy consumption but this does not necessarily translate into behaviour changes or household equipment and infrastructure improvements. Tips, guides and coaching for better use of energy have been around for many years, but energy remains a topic of general low interest for most people compared to other sustainable topics like food or mobility.

At national level, Belgium still faces at least the two following challenges for more sustainable energy consumption and production: a strong dependence on energy imports from neighbour countries (putting the country at risk in terms of energy access and pricing) and a complex energy governance system which does not facilitate the building of unified energy action plans or agendas.

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8. Bulgaria

Zoya Damianova and Desislava Asenova

Applied Research and Communications Fund (ARC Fund)

8.1 Introduction

This section is a contextual document that provides an overview on energy consumption and energy consciousness in Bulgaria. It was elaborated by the Applied Research and Communications Fund.

The section is based on information from previous studies in the field of energy consumption in Bulgaria, including also finished and ongoing EU projects such as ENERGISE (H2020), ENABLE.EU (H2020), ACHIEVE (Intelligent Energy Europe Programme) and REACH (Intelligent Energy Europe Programme). Statistical data from Eurostat and the National Statistical Institute of Bulgaria have been used in order to provide information for the required indicators. All sources were found through web search.

The report also includes reflections from four interviews that ARC Fund conducted in June-July 2018 with representatives of three Bulgarian NGOs - the Centre for Energy Efficiency (EnEffect), the Sofia Energy Agency (SOFENA) and the Centre for the Study of Democracy (CSD) and one Bulgarian university – the University of National and World Economy (UNWE). All organisations are experienced in the field of energy efficiency and responsible energy consumption and behavior, and are working on various national and international projects in the field.

Energy poverty in Bulgaria is a persistent and growing problem. 44 % of Bulgarian households struggle to keep their home adequately warm, and the figure is even higher for households with at least one member over 65 years old and single female households. Difficulties in keeping the home warm are partly due to low income and partly to poor insulation, other parts of houses in need of repair and heating equipment that are inefficient in terms of energy. The greatest part of household energy consumption is formed of space heating (53 %). Most Bulgarians are homeowners (81.7 %). The results of an online energy-saving competition suggest that there are no gender differences in interest in energy (Julius 2012). However, many Bulgarians seem indifferent or ignorant to the means for saving energy at home (de Almeida et al. 2008).

8.2 National frame for energy consumption

Bulgaria is a small country in Eastern Europe with a population of around 7.4 million with a high share of people (73 %) living in urban areas (National Statistical Institute of Bulgaria 2018).

A study by the ENERGISE project shows that the energy sector of Bulgaria is diverse and well-developed, with Bulgaria being one of the main exporters of electricity in Southeast Europe. It has been estimated that in the last 10 years overall energy consumption in Bulgaria has stayed relatively constant and amounted to about 35,000 GWh. However, a trend towards an increase in the household energy consumption in the country is observed between the years 2000 and 2015 with sharp peak points over the years. A factor that is assumed to contribute to this trend is the impact of climate variability on energy needs (Hajdinjak & Asenova 2018; Connel et al. 2017).

Factors that influence energy consumption of households in Bulgaria were discussed during the interviews as well. As such were mentioned the large share of energy inefficient appliances used in most of Bulgarian households and the artificially maintained low electricity prices which lead to people not having any stimulus to consume energy in a responsible way. One of the interviewees talked about the "rebound effect" that was observed after the implementation of energy efficiency measures by households in Bulgaria. What he claimed was that because of the low prices of electricity, the introduction of energy efficiency measures has resulted in households consuming more energy and this was visible from their energy bills. The "rebound effect" has also been observed after the implementation of the National Programme for Energy Efficiency of Multi-Family Residential Buildings, with results showing that the real reduction of electricity consumption of the involved households was around 9-12.5 % which was much less than the set target of a 40-45 % reduction. (EnEffect 19.06.2018, SOFENA 29.06.2018, CSD 22.06.2018, UNWE 19.07.2018).

The state of the building sector is another factor that influences energy consumption. With the highest share of Bulgarian buildings being built in the 1960s and only 5 % of Bulgarian homes being built after the year of 2000, it is assumed that building stock in Bulgaria is significantly old and do not meet contemporary requirements for energy efficiency. This, in turn, influences the level of energy consumption. The trend of energy prices rising at a faster pace than household incomes threatens energy comfort of Bulgarian households and it is not surprising that Bulgaria is falling behind the other EU member states according to indicators such as inability to maintain the house heated (as a result of the desire to reduce energy costs) and inadequately insulated houses. All these also lead to the prevalence of energy poverty among households in Bulgaria. Statistics show that in 2014 households in Bulgaria were spending on average 12.6 % of their income on energy bills, which places Bulgarian households among the most vulnerable in Europe in terms of energy poverty. (CSD 22.06.2018, Hajdinjak & Asenova 2018.)

The European Smart Metering Landscape Report from 2016 provides an overview of the current situation related to the application of intelligent metering systems in different countries in Europe. With regard to Bulgaria, the report states that there are still no official plans for a nationwide rollout of intelligent metering systems in the country. As possible reasons for this situation are mentioned the lack of clear legal framework in the field as well as the significant initial costs of smart metering installations.(Escan et al. 2016.) The Bulgarian Housing Association considers that

the application of smart technologies to manage energy consumption in residential apartment buildings in Bulgaria is difficult in the present situation in the country, since households in Bulgaria are equipped with individual meters for electricity (compared to countries in Western Europe where there are residential buildings without individual meters) and they have to be convinced of the real financial benefits of smart meters in order to invest in their installation (Georgiev n.d.).

Scarce information about the impact of socio-demographic indicators on energy consumption in Bulgarian households, as well as about the behaviour of energy consumers in the country, was found through the desk research. However, there are two ongoing EU-funded projects - ENERGISE and ENABLE.EU, both supported under H2020- that will deliver such information in the coming months. The ENABLE project aims to study the factors that determine energy choices and behaviour in several countries in Europe (including Bulgaria) and to provide a better understanding of the social, economic, cultural and governance aspects of energy decisions. As a result of a comparative analysis that is planned within the project, the sociodemographic differences in energy choices between countries with different levels of development are expected to be highlighted (ENABLE.EU 2018). Among the aims of the ENERGISE project are (i) the creation of an innovative framework to assess energy initiatives, taking into account existing social practices and cultures which affect energy consumption and (ii) the analysis of the role of household routines and changes to those routines towards more sustainable energy (ENERGISE 2018). The expected systemized outputs of both projects will provide valuable information to fill the information gaps in the field of socio-demographic differences in energy consumption and energy behaviour in Bulgaria.

8.3 Socio-demographic differences in energy consumption in Bulgaria

Desk research shows that studies about socio-demographic differences in energy consumption in Bulgaria based on gender, age, education, income and place of residence are still scarce. However, a few reports on the relationship between different levels of income and energy consumption in Bulgaria, as well as the issue of energy poverty in the country were found.

8.3.1 *Socio-demographic segmentation*

An attempt to make a segmentation of energy consumers in Bulgaria was made by Vitosha Research which in March 2017 prepared a report for the World Bank entitled “Poverty and Social Impact Analysis: Bulgaria: Assessment of the distributional impacts of Energy Efficiency project” (Vitosha Research 2017). The report is focused on the National Programme for Energy Efficiency of Multi-Family Residential Buildings coordinated by the Ministry of Regional Development and Public Works in Bulgaria and aims to study the effectiveness of the program emphasising on improving the welfare for the vulnerable population (low income and minority) groups in Bulgaria. The analysis and main conclusions were based on the results of a survey of households through

face-to-face interviews in the home of respondents, focus group discussions (FGs) and key informant interviews (KIIs).

Part of the analysis is the study of the relationship between the level of households' income and the percentage that was spent on energy bills. The targeted households were divided in three groups depending on their level of income: i) lowest income group (household with an average monthly income below 546 BGN); ii) low income group (households with an average monthly income up to 677 BGN); iii) and medium and high-income group (households with an average monthly income above 678 BGN). It was concluded that the lowest income group spend on average 27 % of their income on energy bills during the heating season, while the medium and high income group spend on average 21 % of their household income. The difference in quality of life of the target groups was also studied with the results showing that only 29 % of the lowest income group could afford to heat all the rooms in their dwellings in comparison to 53 % of the medium and high income group.

An online competition for energy saving targeting private households in European countries (including Bulgaria) was organised as part of the EU project "European Citizens Climate Cup" in 2012. The campaign encouraged participants to actively use a web-based energy management tool in order to monitor their energy consumption. 1,006 participants from Bulgaria took part in the competition, registering for an Energy Saving Account (ESA) and entering their consumption and cost data from meter readings and energy bills. Gender statistics from the competition allow to draw a conclusion about the interest of men and women in energy saving campaigns. According to statistics for Bulgaria, 49 % of the registered users were male and 51 % were female, that is to say there was equal interest towards energy saving with regard to gender (Julius 2012).

The overall opinion of the four interviewees was that a segmentation analysis of energy consumers is still lacking at the national level in Bulgaria, but would be extremely useful. It was further pointed out that surveys addressing specific questions related to energy consumption and segmentation of energy consumers in Bulgaria are planned to be conducted as part of different EU projects in the future and will provide valuable results. A brief analysis of a relevant survey results has already been implemented as part of the ENABLE.EU project showing that in terms of energy consumption and energy sources, households in Bulgaria can be divided in three groups: i) households with very high consumption of various energy raw materials; ii) a large group of households that consume moderately; iii) and a very large for Bulgaria group (around 40 % of households) that is referred as the group of the energy poor that experience difficulties in meeting their energy bills. (EnEffect 19.06.2018, SOFENA 29.06.2018, CSD 22.06.2018, UNWE 19.06.2018)

8.3.2 *Social differences: energy consumers attitudes and behaviour*

Kulinska (2017) and Kulinska & Vasileva (2015) stress the lack of sufficient number of systematic studies on consumer behaviour in terms of energy efficiency and energy poverty of Bulgarian

households. However, the desk research resulted in a few studies touch upon these topics to some extent, some of them being a result of national research while others are part of EU-funded projects.

In 2015 the Institute for Market Economics in Bulgaria analyzed the energy consumption of households connected to the grid of EVN Bulgaria, which is one of the three energy suppliers in the country. The aim of the analysis was to identify the group of consumers that face potential difficulties with paying their energy bills and to find out the reasons behind this. For the purpose of the analysis Bulgarian households (customers to EVN) were divided in two groups – customers with low and average level of energy consumption (with average monthly consumption up to 500 kWh or annual consumption up to 6,000 kWh) and customers with high level of energy consumption (with average monthly consumption over 500 kWh or annual consumption over 6,000 kWh).

Among the main conclusions that emerged in result of the analysis were the following: i) The share of households with consumption up to 500 kWh is more than twice as high as the share of households with consumption over 500 kWh; ii) The share of households with low and average consumption is lower during the heating season compared to the rest of the year as a result of the seasonal use of holiday / temporary dwellings and villas that have zero consumption during the rest of the year; iii) The share of high consumption households is about 5 % in June, but sharply increases with the beginning of the heating season in November to about 15 % and exceeds 30 % in January; iv) The average annual share of households with low and average consumption is about 85 % and the electricity consumed by them - about 61 %. The electricity consumed by households with high energy consumption is about 39 % (Staykov 2015).

Studies on energy poverty (Kulinska 2017, Center for the Study of Democracy 2017) emphasize that it is a growing issue in Bulgaria with households spending on average 12.6 % of their income on energy bills in 2014. The country is falling behind other EU member states according to indicators such as inability to maintain the house heated, disproportionately high costs for housing, inadequately insulated houses. The studies refer to Eurostat data on the ability of Bulgarian households to maintain the required thermal comfort. The data shows the effect of age on this indicator, showing that in 2016, 44 % of the Bulgarian households with one adult younger than 65 years were unable to keep home adequately warm, while the percentage for the same year for households with one adult over 65 years was 56.1 %. Data is also available for households of single male and single female. It is estimated that in 2016, 44.6 % of single male were unable to keep their homes adequately warm, while the percentage for single female for the same year was 55.7 %. (Kulinska 2017, Georgieva & Stefanov 2015, Eurostat 2018)

The low average of household income in Bulgaria is among the factors that explain the observed inability to keep home adequately warm. A common case in the country is for a household to heat only part of the dwelling or even not to heat the dwelling at all in order to reduce the energy

costs. The outdated and inefficient housing stock, combined with the inefficient energy appliances and increasing energy prices are also assumed to be among the factors that cause energy poverty in the country to grow (CSD 2014).

The energy poverty phenomenon was also studied by two EU-funded projects (ACHIEVE and REACH). Over 1,500 households in Slovenia, Croatia, FYR of Macedonia and Bulgaria were visited as part of the REACH project aiming to explore the situation with regard to energy comfort and to deliver a package of devices to save energy and water, and as well to provide advices for changing habits related to energy consumption. Around 400 households from Bulgaria were visited and were provided with 1,600 energy-saving devices (efficient light bulbs, textile shopping bag, tap aerator, etc.). Most of the visited households in Bulgaria were of 3 people on average with almost 95 m2 living space of which they heated 73 % on average. Most of the household members were over 35 years old and their dwellings had no insulation or double-glazed windows. Each household got 4 energy saving devices on the average, which would help them save 50 EUR on yearly basis. It was estimated that in total 217,000 EUR of savings could be made through the REACH project in Bulgaria. The visited household were also provided with saving tips and recommendations that are expected to contribute to a more energy conscious behaviour in the future (REACH 2018).

What one of the interviewed experts concluded with regard to energy poverty in Bulgaria was that this indicator could be very misleading. Considering the generally accepted definition of energy poverty that states that if more than 10 % of the household income is spent on energy resource costs then the household is considered energy poor, it could be claimed that even people with extremely large real estate properties and relatively low declared official income are energy poor. It is recommended that in order to have clearer picture about the level of energy poverty in the country, a national definition of the concept should be developed. (CSD 22.06.2018)

The REMODECE project (see Kulinska & Vasileva 2017) studied and analysed the current and impending electricity use by European households resulting from different types of equipment, consumers' lifestyles, and comfort levels, aimed to provide a view on consumers' attitudes and behaviour. Bulgaria was among the studied countries. Based on the results from the survey it was concluded that the researched Bulgarian households do not show a high level of energy consciousness and do not consume energy in a very efficient way (only 25 % of the respondents turn off the equipment from standby mode; 19 % of the respondents use the dishwasher at half the capacity and 2 % even use it at 25 % of its capacity; a lot of respondents admit not to care if windows and doors are open while using the air conditioning; most of the respondents declare that they are not aware of the energy efficiency class of the appliances they own; etc.). (de Almeida et al. 2008.)

In general, the Bulgarians are rather ignorant and disinterested in energy efficiency issues (CSD 22.06.2018, EnEffect 19.06.2018, SOFENA 29.06.2018). The attitudes date back to the socialist era when energy was free and was considered to be a concern of the authorities, not individuals (CSD

22.06.2018, EnEffect 19.06.2018). The young generation, however, shows signs of being familiar with issues concerning responsible energy use and energy saving (SOFENA 29.06.2018). A special characteristic of energy problems in Bulgaria is the widely spread habit of stealing energy, which also slows down the adaptation of sustainable energy use practices, as money saving does not serve as an incentive (CSD 22.06.2018).

The efforts of workplace to increase the energy consciousness of their employees may turn into energy saving at home as well. At a Bulgarian city library, a European-wide energy saving competition encouraged the employees to adopt practices that reduced the energy consumption by 24 % at their workplace. In addition, foreign companies at Bulgaria require their employees to pay attention to the ways of energy consumption. Whether this is transferred to practices at home is unclear, but it is one factor that increases energy awareness in Bulgaria. (SOFENA 29.06.2018.)

Considering energy consumers attitudes and behaviour, the interviewees shared some thoughts regarding the most common ways to save energy in the context of Bulgaria. One of them proposed consideration of a holistic approach to buildings meaning that the building should be considered as a system and in case of thorough energy retrofit it should be kept in mind that any change in one component affects another and not one type of energy saving measure should be prioritised. It also means to develop a detailed analysis and a plan about what should be improved in the building in order to optimise opportunities for energy savings. Behavioural measures as the cheapest and most effective way to achieve energy savings were also promoted. It was claimed that if consumers comply with energy-efficient ways of using appliances, replace lighting as well as the windows (or isolate them with low-cost measures) a reduction in energy use could be achieved. Most of the interviewees concluded that what is necessary for a sustainable change in consumer behaviour are much broader information campaigns, trainings, inclusion of specific programmes at schools and universities. It was emphasised that changing consumers' thinking and attitudes require much more than simply living in an energy-efficient home. (EnEffect 19.06.2018, SOFENA 29.06.2018, CSD 22.06.2018, UNWE 19.06.2018)

The interviewees also commented on the main factors and consumers' habits that lead to energy loss in Bulgaria. The misunderstanding of the benefits of energy efficiency (considering it as leading to purely cutbacks in financial spending or energy consumption), the lack of responsible attitude and organisation towards energy consumption, the lack of regulations for some appliances that are sold to households (especially those for heating) are among the factors that were mentioned as leading to energy loss in the country. One of the interviewees described the user with "problematic" (inefficient) energy consumption habits as a person with low level of awareness and lack of responsible attitude towards energy savings and energy efficiency. Those people were referred as comfort-oriented and completely indifferent to energy-efficient measures in the households. It was highlighted that sometimes, despite the implemented renovation measures (external insulation of the building, replacement of the windows, etc.) only minor energy savings are achieved by households because the habits of consumers in terms of energy

remain the same. The interviewees recommended that relevant activities and trainings should be organised among households in order to motivate them to move towards responsible consumption of energy. (EnEffect 19.06.2018, SOFENA 29.06.2018, CSD 22.06.2018, UNWE 19.06.2018)

8.4 Differences related to the built environment

8.4.1 *Climate conditions and their meaning for energy consumption*

Bulgaria has a temperate-continental climate characterised with hot, dry summers and cold, damp winters. The country has four distinct seasons. During winter (from December to mid-March) abundant snowfalls may occur. The cold weather in winter influences energy consumption of households, especially the energy consumption for heating. The heat waves that are observed in the last decade in Bulgaria, and in Europe as a whole, are expected to continue in the future, making summers warmer. This would increase the use of air conditioners in summer, which in turn would significantly increase electricity consumption. (Weather Online 2018, Climate Zone 2018, Hajdinjak & Asenova 2018, Petkova 2014).

In 2015, space heating accounts for 53 % of final energy consumption of households in Bulgaria. The other components of household energy consumption were 20 % for lighting and appliances, 18 % for water heating and 9 % for cooking (Weather Online 2018, Climate Zone 2018, Hajdinjak & Asenova 2018).

Statistics on final energy consumption in Bulgaria by sectors show that in the period 2012-2016 households were the third largest sector in terms of final energy consumption, after transport and industry, and ahead of services and agriculture. The share of household energy consumption has stayed stable for that period varying between 24-25 % of total energy consumption. The share of transport was 35 % and of industry – 28 %. The rest 13 % were distributed between services (11 %) and agriculture (2 %). (National Statistical Institute of Bulgaria 2018a.)

Operational data from the Bulgarian Electricity System Operator shows a decrease of 6.55 % in energy consumption in the period 1.1.2018 - 6.5.2018 compared to 1.1.2017 - 6.5.2017. The data are not surprising given the warm winter of 2018 compared to the colds that stifled the country at the same time the previous year (Electricity System Operator 2018).

8.4.2 *Population characteristics and their meaning for energy consumption*

According to the last census of the Bulgarian population in 2011, total number of households in the country was circa 3 million with 73 % of them living in urban areas and 27 % living in rural areas. Single-person households represented the highest percentage – 31 % of all households, while the two-person households accounted for 28 %, three-person households for 20 % and four and more person households - for 21 % (National Statistical Institute of Bulgaria 2018b).

More recent statistics of Eurostat show that Bulgaria, together with Croatia, are the only EU Member States with a decrease in the number of households in the last 10 years. The decrease rate for Bulgaria is 0.44 % per year and by 2016, the number of private households in the country has decreased to 2.7 million. The average household size has also decreased from 2.5 members in 2006 to less than 2.4 members in 2016 (Eurostat Statistics Explained 2017a).

Data on distribution of population of Bulgaria by dwelling type in 2015 shows that equal percentage (around 35-40 %) of population lives in flats and detached houses, while around 10-15 % live in semi-detached houses (Eurostat Statistics Explained 2017c). The average space for a dwelling in Bulgaria is about 72 square meters (News.bg 2016).

The urban-rural distribution of households in Bulgaria is the following: i) 61 % are intermediate; ii) 24 % are predominantly rural; iii) and 15 % are predominantly urban (Hajdinjak & Asenova 2018).

8.4.3 *Common dwelling types in the national context*

According to the 2011 census, owner-occupied dwellings prevail the housing stock in Bulgaria representing 81.7 % of all dwellings. Bulgaria is among the leading countries in the EU in regard to share of owner-occupied units without outstanding mortgage or housing loan. A study on the status and perspectives of Bulgarian housing claims that more than 50 % of apartment owners could not afford to cover their current costs due to lack of income. Numerous cases of disconnection from the district heating services, the outstanding bills for consumables and the poor maintenance of the buildings provide evidence in this regard (Georgiev 2014).

The rest 18.3 % of the housing stock are rented. In urban areas, the share of tenants is 21.8 % while in rural areas the number is 9.3 %.

The census also shows that in 2011 the total housing stock in Bulgaria was 3.9 million housing units, of which 1.22 million were vacant units. Although it could not be claimed that there is an overall housing shortage in Bulgaria, the overcrowding rate is 44.2 % which is much higher than the average at EU level – 17.3 %. The rate of severe housing deprivation in Bulgaria is also very high (13 %) compared to the EU average of 5.2 %. The main challenge that people living in severe housing deprivation in Bulgaria face are sanitary problems (lack of indoor toilet, bath or shower). Another problem is the high percentage of Bulgarian population that could not maintain comfortably warm dwelling during winter and could not keep dwelling efficiently cool during summer. (Pittini et al. 2015, Eurostat Statistics Explained 2017b.)

What is typical in Bulgaria is that detached houses constitute the largest share of the building stock (86 %), both in urban (77 %) and in rural areas (93 %). In terms of general useful living area, individual houses and apartment blocks (multi-family buildings) have approximately similar share within the country, while in urban areas the useful living area of apartment buildings prevails and accounts for 64.7 % of the share of all buildings. (Tzanev et al. 2016.)

In terms of year of construction, the highest share of residential buildings were built in the period 1960-1969 (324,480 buildings), while the lowest rate was in the period 2000-2011 – a total of 83,013 units. Most of these buildings are predominantly multifamily buildings concentrated in towns. (Tzanev et al. 2016.)

As mentioned above, the highest share of households' energy consumption in Bulgaria goes to space heating (53 % of final energy consumption in 2015). The main types of space heating in 99 % of the dwellings in Bulgaria are wood, electricity, coal and central heating. The high share of coal and wood used for heating is of concern, considering the harmful and toxic emissions associated with these fuels (including air pollution). It is also problematic that social aid is only available for firewood and coal purchases, which discourages investing in more efficient forms of energy (CSD 22.06.2018). Furthermore, the share of dwellings heated with electricity is also high and continues to rise. Electricity consumption of households increases as well. It is assumed to be a result of the introduction of newer household appliances and communication devices that despite the higher energy class than the obsolete stock, still increase the total consumption of electricity. (Tzanev et al. 2016.)

Despite the lack of statistical information on the share of insulated residential buildings in Bulgaria, a trend of increasing number of buildings being renovated in order to become more energy efficient is observed lately. The main driver in this direction is the large-scale National Programme for Energy Efficiency of Multi-Family Residential Buildings that was launched by the Ministry of Regional Development and Public Works in Bulgaria. By October 2017, 782 multi-family buildings in Bulgaria have been renovated under the Programme which equals around 94,000 residents. The renovation includes external insulation of the buildings, windows replacement, renovation of the roof and other common parts of the multi-family residential buildings. There are 612 multi-family buildings that are currently undergoing renovation as part of the Programme. Overall 2,022 multi-family buildings are involved in the Programme by now and are expected to be renovated. The improved housing infrastructure is expected to improve quality of life of residents and to ensure thermal comfort and energy savings of Bulgarian households. (Ministry of Regional Development and Public Works 2017.)

8.4.4 *Access to smart equipment*

According to the European Smart Metering Landscape Report, by 2016 there were no official plans for a nationwide rollout of intelligent metering systems in Bulgaria. There were no legislative or regulatory initiatives either. Due to the lack of clear legal framework or plan for smart metering in Bulgaria, the country has been defined as a "waverer" in the field. What characterizes the countries in this category is that they show some interest in smart metering with regard to regulations, utilities and ministry activities but corresponding initiatives have either started, are

still in progress or have not yet resulted in a regulatory push towards smart metering implementation. (Escan et al. 2016.)

However, the three energy suppliers in Bulgaria (CEZ Group, ENERGO-PRO and EVN) started installing smart meters recently aiming to reduce non-technical losses and the number of complaints about inaccurate invoices and at the same time to allow consumers to constantly monitor their consumption and take effective measures towards achieving energy efficiency of their households. EVN plans to install 550,000 smart electricity meters by 2019. CEZ Group, in turn, started an important project in 2017 aiming to install around 500,000 smart electro meters in the next five years. ENERGO-PRO has also replaced around 6 % of the total number of meters that the company serves with smart meters. (Zaharieva 2016, Escan et al. 2016.)

The significant initial costs of smart metering installations are assumed to be among the challenges that hinder their nationwide rollout in Bulgaria (El Media Energy 2018). Furthermore, the experience that the Bulgarian Housing Association has gained through its participation in the "Energy Efficient e-Houses" project (that piloted the interaction between smart devices and the users to create awareness around their energy consumption and therefore a change in their energy-use patterns) shows that the application of smart technologies to manage energy consumption in residential apartment buildings (that are the predominant form of habitation in Bulgarian cities) is practically impossible in the present situation in Bulgaria. The reason is that households in Bulgaria are equipped with individual meters for electricity and have direct access to their consumption data (unlike in Western Europe, where there are multi-storey apartment buildings that have no individual meters appliances) and home owners have to be convinced of the real financial benefit of smart meters in order to invest in their installation. The Association also concludes that the implementation of intelligent metering devices in multi-storey residential buildings could be facilitated by the development of national legislation on smart metering devices and the provision of subsidies as an incentive for utility companies and homeowners (Georgiev n.d.).

The interviewed experts also discussed the smart energy services that are available and spread among energy users in Bulgaria. It was the common opinion of the interviewees that the intelligent home is still an exception in Bulgaria and that a clear definition of what smart energy services are is necessary in order to be able to comment on them. An interviewee noted that the high price of smart energy installations is among the factors that hinder their diffusion, as well as the obsolete electrical installation in most buildings in Bulgaria, which do not comply with smart installation requirements. On the contrary, another interviewee argued that it is not the price that hinders the dissemination of smart devices and smart services among energy users in the country, but the lack of information about the benefits they offer. (EnEffect 19.06.2018, SOFENA 29.06.2018, CSD 22.06.2018, UNWE 19.06.2018). A further problem hindering the installment of smart meters is that in a large part of the old buildings the electrical installments are obsolete and therefore installing smart meters is not possible (CSD 22.06.2018).

There is no clear definition for the concept of smart energy services in the Bulgarian context (EnEffect, 19.06.2018, SOFENA 29.06.2018) and there is little of them offered for consumers (CSD 22.06.2018). There are start-up companies offering rather inexpensive smart equipment solutions, such as air-conditioning remote management but they are not yet widespread (SOFENA 29.06.2018). Smart energy solutions are almost exclusively found at new luxury houses. There are some pilot projects but their outcomes have not been analysed. (CSD 22.06.2018.)

8.5 Relevant stakeholders in promoting energy conscious behaviour in the national frame

There is a large number of public sector organisations working towards enhancing energy efficiency in Bulgaria. There are few local initiatives promoting energy conscious behaviour. The national initiatives are largely concentrated on financial support of energy renovations. There are NGOs and electricity companies offering information on energy efficiency and energy saving. Research on energy is done in Bulgarian universities and research institutes, covering various aspects of energy issues.

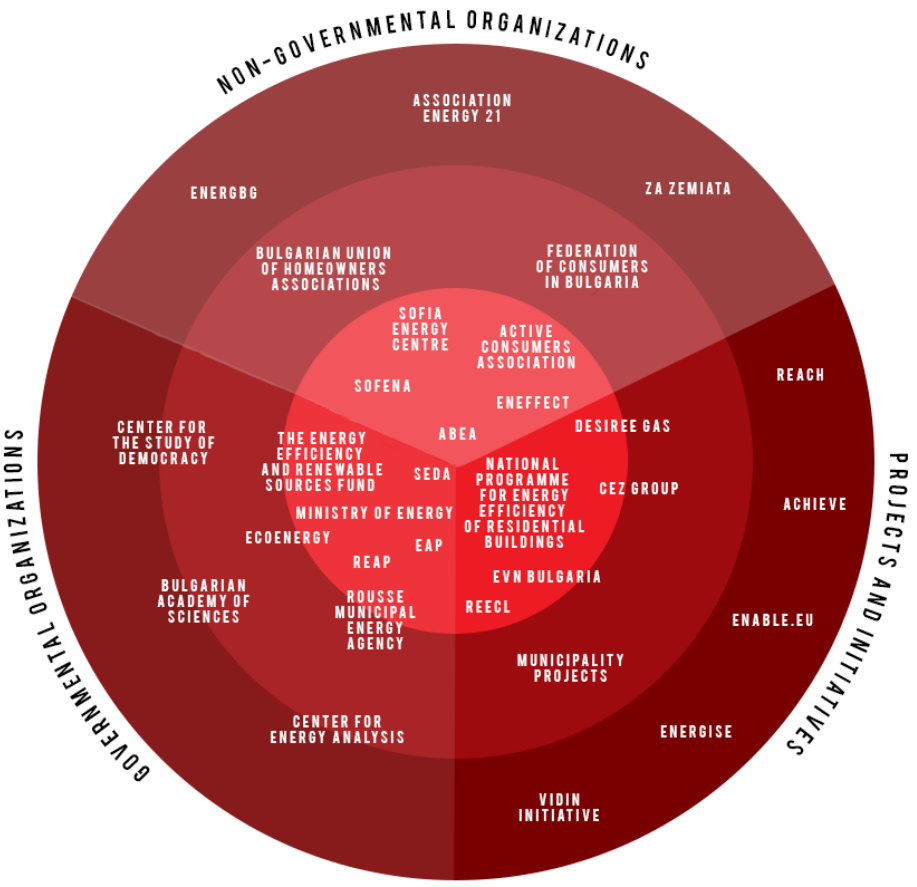

Figure 11. Bulgarian stakeholders in the field of energy consciousness

8.5.1 *Institutions presenting national interest for promotion of energy consciousness*

8.5.1.1 Governmental actors promoting energy efficiency / energy consciousness

Ministry of Energy is the main governmental body in the field of energy which main priority is to create the necessary conditions for stable economic growth in Bulgaria and to ensure lawful and advisable way of carrying out of the country's economic and energy policy. Energy efficiency is also among the priorities of the Ministry. One of its major goals is to improve energy efficiency and to reduce greenhouse emissions in accordance with the priorities of "Europe 2020" strategy. It is responsible for developing the Energy Efficiency Act of Bulgaria that addresses the state policy for increasing energy efficiency in final energy consumption and the provision of energy services. (Ministry of Energy of Republic of Bulgaria 2018).

The Energy Efficiency and Renewable Sources Fund (formerly known as the Bulgarian Energy Efficiency Fund) was established in 2005 by the Government of Bulgaria as a revolving energy efficiency fund. Financial donors to the organisation are the Global Environment Fund through the World Bank's International Bank of Reconstruction and Development, the Government of Bulgaria, the Government of Austria and the Bulgarian private sector. The main role of the Fund is to provide revolving project finance and technical assistance for public (municipalities, universities, hospitals) and private sector (businesses and residential) energy efficiency projects in Bulgaria. (CITYNVEST n.d.)

The Sustainable Energy Development Agency (SEDA) is a legal entity (successor of the executive Energy Efficiency Agency (EEA)) at state budget support that has the status of an executive agency within the Ministry of Energy. The Agency is responsible for the implementation of the state policy on increasing energy efficiency of energy end-use and providing energy services. It also promotes production and consumption of energy from renewable sources. On its website, the Agency provides energy efficiency advice for households as well as a tool for calculating energy savings. SEDA has participated and is currently participating in various EU-funded projects addressing energy efficiency – ENERFUND, ODYSSEE-MURE, Energy Path, etc. (Sustainable Energy Development Agency 2018)

The Energy Agency of Plovdiv (EAP) was established in 2000 under the SAVE II programme of the European Commission with the aim of promoting energy efficiency and renewable energy sources on regional and local levels. EAP initiates and coordinates projects aimed at reducing energy consumption and provides practical ways for individuals, communities and businesses to improve their energy management. It also develops action plans and conducts feasibility studies promoting sustainable energy development. (Energy Agency of Plovdiv 2018)

The Regional Energy Agency of Pazardjik (REAP) is an association of local authorities from Pazardjik Province that was established in 2005 under the Intelligent Energy Europe Programme. The main objective of REAP is to encourage sustainable energy development through local and regional actions for energy efficiency, renewable energy sources and sustainable mobility, with a

specific view on energy efficiency in buildings and development of sustainable energy communities. The main activities of REAP include energy audits of SMEs and buildings (residential and public), promotion of energy efficiency, renewable energy sources and sustainable urban mobility strategies, participation in energy efficiency projects, dissemination of best European practices in the field of rational use of energy, awareness raising campaigns and trainings, etc. (Regional Energy Agency of Pazardjik 2018)

The Municipal Energy Agency in Rousse was established in 2001 as a public benefit association. Its main activities are in the field of developing municipal and regional strategies and programmes in the field of energy efficiency, providing informative and consulting services to various audiences (local authorities, companies, organisations and citizens), organising training, conferences and public discussions on the topics of renewable energy sources usage, energy efficiency matters and environmental protection (European Commission The Municipal Energy Agency year; Municipal Energy Agency – Ruse n.d.).

The Municipal Energy Efficiency Network (EcoEnergy) is a non-profit organisation of Bulgarian municipalities for mutual support that has been established as an informal voluntary association of 23 Bulgarian municipalities in 1997. Its main objective is to contribute for the recognition of the energy efficiency as an important part of the sustainable energy policy in the Bulgarian municipalities. EcoEnergy contributes to increasing public awareness towards energy by information dissemination and training of local authorities and energy managers. (EcoEnergy n.d.)

8.5.1.2 Universities and research institutions working on energy consciousness

The Bulgarian Academy of Sciences is the main scientific center in Bulgaria. The Academy conducts scientific and applied research in nine specific fields, including energy (Energy resources and Energy Efficiency). The main focus of the Academy's research in the field of energy is the emerging problems of energy, the creation and application of renewable energy sources and the increased efficiency of conventional energy resources use. In result of the research activities, technological processes and materials are being developed, as well as elements and devices for the use of solar energy in households and industry. (Bulgarian Academy of Sciences 2018)

The Center for Energy Analysis is a research laboratory with university status, part of the Technical University in Sofia. The Center is accredited for energy efficiency auditing and certification of buildings and industrial systems as well as for research and projects in the field of energy efficiency and renewable energy. So far, over 160 Bulgarian and 22 international projects have been developed and implemented by the Center. They cover various fields and topics such as buildings, heating, ventilation and air conditioning systems, district heating, assessment of the potential for energy cost reduction, and techno-economic assessment of energy saving measures, development of municipal plans and programs for utilisation of renewable energy sources and energy efficiency, assessment of compliance with the requirements for energy efficiency. The

team of the Centre plays an important role in developing and updating the national energy efficiency regulatory framework. (Sofia Technical University, 2018)

The Center for the Study of Democracy is a Bulgarian research institution that includes energy sector in its study domain and that participates in EU-funded energy projects. It produces analysis of the energy sector in Bulgaria focusing mainly on energy security. (Center for the Study of Democracy, 2018)

8.5.1.3 Other organisations promoting sustainable technologies and energy consciousness

The Association of Bulgarian Energy Agencies (ABEA) is a non-government organisation which main objectives are to support its members in the preparation of suggestions for improvement of the national and local normative base in the field of sustainable energy policy and in their participation in joint energy projects. It also collaborates with the Ministry of Energy, the Agency of Energy Efficiency and the Ministry of Environment and Waters in the development of sustainable energy policies, energy efficiency policies, etc. ABEA contributes to exchange of information and dissemination of best practices and results related to energy studies and assists the local authorities in initiating and implementing energy saving and ecology projects. (The Association of Bulgarian Energy Agencies (ABEA) 2018.)

The Sofia Energy Agency (SOFENA) is a non-governmental organisation that was established under the SAVE II Programme of the EU with the aim to assist national and local authorities in developing and implementing sustainable energy policies. Its founders are Sofia Municipality, the State Energy Efficiency Agency, the Sofia district heating utility – "Toplofikacia", the big private construction company – "Glavbolgarstroy" and 14 private persons. The main activities of SOFENA are in the field of energy efficiency audits of buildings, industrial systems and artificial lighting systems. By 2016, the company has carried out over 90 energy efficiency audits and have participated in a number of national and European projects. SOFENA also provides consulting services in the field of energy efficiency, optimization of systems and processes in industrial enterprises and buildings, use of renewable energy sources and implementation of energy management systems. (SOFENA 2018)

The Center for Energy Efficiency **EnEffect** is a Bulgarian non-profit ogranisation that aims to support the efforts of central and local authorities in achieving sustainable development through more efficient use of energy and to ensure energy conservation in all spheres of public life. The Center contributes to the energy efficiency policies in Bulgaria, assists in dissemination of information and good practices representing energy efficiency and, in the initiation, development and implementation of energy efficiency projects and programmes. (EnEffect 2018)

The Active Consumers Association aims to protect the rights and interests of consumers by providing information that help consumers understand the market environment, assisting with

violated rights and interests and protecting the interests among legislative changes (The Active Consumers Association 2018).

Sofia Energy Centre is a Bulgarian consultancy experienced in energy efficiency and renewable energy projects, as well as in information dissemination and promotion of innovative energy technologies. The Centre also contributes to the development and implementation of sustainable energy policies. It assists local actors in building life-cycle assessment, provides pieces of advice on tools for improving energy performance in buildings, market assessment and practical installation of energy efficient building materials. (CITYNVEST 2018.)

8.5.2 *Institutions with membership presenting possible interest towards promoting energy conscious behaviour*

8.5.2.1 Organisations with citizens as members

Federation of Consumers in Bulgaria is a non-profit organisation that aims to ensure organised protection of the rights and interests of all Bulgarian consumers. It is the only organisation in Bulgaria which activity is exclusively directed at protection of consumers' rights and interests, including 23 Regional Consumer Unions, 96 Consumer Clubs among which are unions of energy users, of water users and of mothers in defence of child nutrition. The Federation's activities are carried out in three directions: i) protecting the economic interests of consumers; ii) assistance in providing physical safety and improving the quality of goods and services; iii) and raising awareness on the importance, opportunities and the public benefit of the Federation of Consumers in Bulgaria through education and consumer information programmes. (Federation of Consumers in Bulgaria 2018)

Bulgarian Union of Homeowners Association is a non-profit organisation that united homeowners and homeowners' associations in condominium apartment buildings. It has been established on the basis of voluntary membership, democratic governance and control. The main aim of the Union is to achieve high quality of living environment in apartment buildings based on joint efforts. It is responsible for collecting and disseminating the necessary information and training in order to perform the needed activities for maintenance, management and renovation of multi-story apartment buildings. The Union shows its interest in ensuring energy efficiency of residential buildings by disseminating guidelines for energy efficiency. It has been involved in several projects in the field of energy efficient reconstruction and renovation of apartment blocks (multi-storey buildings) in Sofia, energy audits, etc. (Bulgarian Union of Homeowners Association 2018).

8.5.2.2 Organisations producing services for housing companies

N.a. in terms of energy efficiency and energy conscious consumption.

8.5.3 *Organisations producing services for private companies and local service providers*

Please confer to the section on institutions representing national interests in promoting energy consciousness.

8.5.4 *Energy consciousness related projects and initiatives that have gained public attention during the recent years*

According to the interviewed experts, there is a lack of energy consciousness campaigns on a national level in Bulgaria. One of the interviewees stated that there are no financial resources allocated by the state budget for communication campaigns in the field of energy. The National Programme for Energy Efficiency of Multi-Family Residential Buildings was provided as an example where the programme's budget had no resources planned for a communication campaign and thus communication activities were left to the efforts and limited resources of the Ministry for Regional Development of Bulgaria and the municipalities participating in the programme. It was a common understanding among interviewees that information campaigns are most often organised as part of projects funded under the EU operational programmes and other EU funding instruments. With regard to key actors in promoting energy consciousness in Bulgaria, the interviewees mentioned the NGO sector as the most active one, followed by businesses and public administration. (EnEffect 19.06.2018, SOFENA 29.06.2018, CSD 22.06.2018, UNWE 19.06.2018)

Examples of energy consciousness related programmes, initiatives and projects on local and national level in Bulgaria are listed below.

8.5.4.1 National programmes and initiatives

The National Programme for Energy Efficiency of Multi-Family Residential Buildings was adopted by the Bulgarian government in 2015. Coordinator of the Programme is the Ministry of Regional Development and Public Works of Bulgaria. The activities under the Programme are implemented throughout the whole territory of the country, covering all 265 municipalities. The Programme provides grants for renovation of multi-family residential buildings aiming to ensure better living conditions for the residents, as well as thermal comfort and higher quality of living environment by implementing energy efficiency measures (insulation, windows replacement, renovation of common areas, etc.). Overall 2022 buildings (147 761 apartments) have been included in the Programme. So far, 313 of the buildings have been renovated and 535 are in the final phase of renovation. (Ministry of Regional Development and Public Works of Bulgaria 2017b; Ministry of Regional Development and Public Works of Bulgaria 2018)

Through the project **DESIREE GAS (Demand Side Residential Energy Efficiency Through Gas Distribution Companies in Bulgaria)**, the Ministry of Energy of Bulgarian initiated a national grant support scheme for providing a dedicated and effective mechanism to support the gasification of

Bulgarian households in compliance with the EU Energy Efficiency Directive. The aim is to promote the switch from carbon-intensive electricity to natural gas and thus to contribute to reducing energy consumption and GHG emissions in the residential sector in Bulgaria. (DESIREE GAS 2018)

The Ministry of Energy of Bulgaria with the support of the European Commission and the European Bank for Reconstruction and Development developed a **Residential Energy Efficiency Credit (REECL) Facility** that gives individuals, households, associations of apartment owners, etc. across Bulgaria the opportunity to benefit from energy efficiency home improvements by providing loans and incentives grants through local participating banks. The aim is to contribute to reducing energy bills and consumption of Bulgarian citizens. (REECL 2018)

Guidelines and tips on saving energy at home are published on the websites of the three energy supply companies in Bulgaria (CEZ Group, EVN Bulgaria and ENERGO-PRO). Moreover, two of the companies – EVN Bulgaria and CEZ Group – organise their own national campaigns for responsible energy consumption. In the end of 2013 **CEZ Group** launched an information campaign on smart and responsible electricity consumption aiming to encourage the company's customers to implement a few easy steps to save electricity at home and to actively monitor their energy consumption. Together with SOFENA, CEZ Group prepared a brochure with tips for saving electricity and distributed it to among its customers. As part of the campaign online energy efficiency promotion game and educational campaign for energy efficiency among students at primary school were conducted. **EVN Bulgaria**, in turn, implements the initiative "The Hour of Ivi and Encho. Energy and ecology lessons" since 2009. Within the initiative, EVN provides partner schools with information materials addressing issues related to energy efficiency and the safe use of home appliances, aiming to build energy consciousness thinking and habits in students at primary schools. (CEZ Group 2018a & 2018b, EVN Bulgaria 2018a & 2018b, ENERGO-PRO 2018)

The European Mobility Week takes place every September in Sofia. It is also a campaign that covers the topic of energy use for households along with the topic of using private cars and public transport (SOFENA 29.06.2018).

8.5.4.2 Municipal and local programmes and initiatives

The Regional Health Inspectorate of Vidin together with students from "Tsar Simeon Veliki" school in the city, organised in 2014 an initiative which aimed to reduce energy consumption of households. The main idea was to draw people's attention to the benefits of saving energy both to reduce their energy bills and to protect the environment. As part of the initiative, 20 households in Vidin used energy-saving bulbs for four months and monitored their electricity bills to outline generated savings. At the end of the campaign, in 80 % of the participating households, a decrease in energy consumption was reported. (Bulgarian National Radio 2014.)

Sofia along with 24 other Bulgarian towns and villages has signed the **Covenant of Mayors for Climate and Energy** which brings together thousands of local governments voluntarily committed to implementing EU climate and energy objectives. According to a Covenant of Mayors case study, Sofia is making efforts to reduce local energy consumption aiming to preserve its residents' health and wellbeing. Examples of initiatives that have been implemented by the Bulgarian capital are replacement of old, inefficient street lamps with more economical LED alternatives, promoting electric mobility through large-scale investments in modern, highly-efficient trolleybuses, tram and metro system, and making neighbourhoods smarter and more efficient through refurbishing its most energy voracious districts. (A Covenant of Mayors Case Study 2015.)

8.5.4.3 Initiatives and support for energy efficiency / energy consciousness by NGOs

EnerGbg is an online platform for energy savings at home and in the office that was developed by the ENERGBG NGO. The platform provides a household electricity calculator that allows for the estimation of specific appliance energy usage and provides tips and guidelines regarding overall energy efficiency, ways for reducing energy bills and changing energy behaviour, advice on energy efficient construction, labelling, financing models, and environmental protection. Sharing tips and good practices on energy savings and energy efficient living at home, practical steps for calculating annual electricity consumption and costs and facilitating energy-efficient behaviour. (EnerGbg 2018)

Za Zemiata (Friends of the Earth Bulgaria) is an environmental NGO that works for promoting sustainable lifestyles through cooperation with citizen groups from Bulgaria and civil society organisations all over Europe. The organisation is running campaigns and projects on various topics such as climate change, environment, food production and independence, energy efficiency and clean energy, etc. Za Zamiata has initiated an energy campaign which aims to promote energy efficiency and renewables as a sustainable alternative to conventional energy production. The main activities include insulation of social homes for children and the elderly, dissemination of information materials, solar installations, organising public discussions and trainings. So far, the campaign has covered over 4,000 people and 20 institutions across the country. (Za Zemiata 2018)

Association Energy 21 is an NGO that promotes ideas for increasing energy efficiency and use of renewable energy sources, develops curricula and other forms of training and consultancy and organises discussions, forums and conferences in the field of energy efficiency and renewable energy sources. The Association is also active in research and development in the field of energy and environmental protection. (Association Energy 21 2018)

8.5.4.4 Research

ENERGISE is an innovative consortium project with partners from 10 European countries including Bulgaria. Its main objective is to achieve a greater scientific understanding of the social and cultural influences on energy consumption. ENERGISE uses a Living Labs approach to directly observe existing energy cultures in a real-world setting and to test both household and community-level initiatives to reduce energy consumption. Within the project, 45 sustainable energy consumption initiatives that have been implemented in Bulgaria mostly as part of international/EU projects were examined. (ENERGISE 2018.)

ENABLE.EU is an EU project with 11 European partners among which is the Center for the Study of Democracy. The project aims to understand the social and economic drivers of individual and collective energy choices with a focus on understanding changes in energy choice patterns of households. Within the project, participatory-driven scenarios for the development of energy choices until 2050 will be developed by integrating the outputs of the comparative sociological research. (ENABLE.EU 2018)

ACHIEVE is another EU project with a Bulgarian partner that aimed to contribute to practical (energy uses and behaviour) and structural (retrofitting buildings) solutions for fighting energy poverty in Europe. As part of the project, a large-scale energy advice service towards low-income households facing difficulties with their energy bills was implemented based on home visits. (European Commission Intelligent Energy Europe 2018.)

Another EU project that built on the methodology developed within the ACHIEVE project is the **REACH** project. It also addresses the topic of energy poverty and includes a partner from Bulgaria in its consortium. The aim of the project was to empower energy poor households to take actions to save energy and change their habits towards energy consumption. (REACH 2018)

8.6 Final considerations

Energy poverty is a continuing issue in Bulgaria, with a high percentage of citizens not being able to ensure adequate thermal comfort in their homes. Energy poor consumers could be an interesting target group to be included in the recruitment because we can work with the municipalities. Normally this group of households receive energy vouchers for the winter season.

Although the owner-occupied dwellings prevail the housing stock in Bulgaria, more than 50 % of the apartment's owners could not afford to cover the current costs of services due to lack of income.

In Bulgaria, there are still no official plans for a nationwide rollout of intelligent metering systems. Legislative or regulatory initiatives in this regard are either missing. The significant initial costs of smart metering installations are considered the main obstacle to the nationwide rollout.

Bulgarian energy supply companies and SOFENA have organised various campaigns targeting energy consumers. SOFENA was a partner in the IIE project European Citizens Climate Cup and managed to mobilise more than 1000 citizens from the whole country to participate in the project. Similar forms of co-operation can be used in mobilising consumers for ECO2.

8.7 References

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9. Denmark

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9.1 Introduction

This section is a contextual document that provides an overview on energy consumption and energy consciousness in Denmark. It was conducted by the Danish Board of Technology Foundation.

The country report builds on information and materials produced by the national stakeholders operating in the field of energy, national energy-related statistics, previous and ongoing EU projects such as Odyssee-Mure and ENERGISE as well as news articles, academic studies and other reports on energy consumption and energy consciousness published by researchers and organisations operating in the field. The search for these materials was carried out through various web searches.

Danish electricity prices are kept high for households through, for example, taxation and by political decisions. 63.6 % of households are connected to a district heating network. A household belonging to a high-income bracket was more likely to live in a detached house and to use more electricity and heating energy. Presence of teenagers in the household also increased electricity consumption. A study on energy consumption and attitudes towards it in Denmark (Gram-Hanssen 2005) found three distinct household types. The first consists of those who try to save energy, although their motivations differ. They include elderly people who are used to scarcity, economically oriented money-savers and those concerned about environmental issues. The second group may be, in principle, interested in energy saving for economic or environmental reasons or both, but they do not act in an energy-efficient manner in practice because they consider it inconvenient or impractical. The third group do not see the need to reduce their energy consumption. In this group belong people who can afford high energy bills and who are not interested or concerned in environmental issues.

9.2 National frame for energy consumption

Denmark is a small North European country with a population of a little more than 5,7 million. He climate is temperate with wild winters (mean temperature of approx. 0,5 °C) and chilly summers (mean temperature approx. 16 °C) (DMI 2018).

As part of the EU-project(s) Odyssee-Mure, the Danish Energy Agency made a report on the energy efficiency trends and policies in Denmark. The report points out that it has been and still is

a priority for Denmark to reduce energy consumption through increased energy efficiency and energy savings, as it is seen as an important element in reaching the national long-term objective of being free of fossil fuels by 2050. Currently, nearly 40 % of the Danish energy consumption is used in buildings. Danish Governments and supporting parties have therefore set various policies in place to promote and ensure that energy efficiency measures were taken. Over the course of the last few decades, the requirements in the Danish Building Regulation have been strengthened considerably – both for new buildings that will have to uphold the standards of low-energy classes and renovation of existing buildings. Furthermore, energy labelling of buildings have been implemented into Danish law. The purpose of this has been to make the energy specifications of buildings visible and deliver reports/plans that show the potential for reducing the energy consumption of buildings (Odyssee-Mure 2016).

Additionally, the Danish network and distribution companies within the fields of electricity, natural gas, district heating and oil have since 2006 been obligated to invest in and realise energy savings efforts for the end users of energy (private consumers, households and companies) - the Energy Saving Initiative Agreement. The end users can apply for financial contributions and/or counselling for energy saving initiatives directly from their energy company or one of the energy companies partners (an energy advisor, craftsman, installation contractor and the like that has an agreement with the energy company) (Energistyrelsen 2016). However, the new Energy Agreement between the current government and all the remaining parties in the Danish Parliament will make some changes in this area. Denmark will work towards ensuring the energy efficiency goal in EU by 32,5 % in 2030, but when the aforementioned Energy saving initiative agreement run out in 2021, it will not be renewed. Instead, a new marked based agreement will be introduced from 2021-2024, which will target saving and provide funding pools to savings in energy processes in industry, services and energy consumption in buildings (Energiaftale 2018, 9). The funding pool will have a cap of 500 million DKK annually, whereas the energy companies collectively under the current Energy Saving Initiative agreement that came into effect in 2012 were obligated to ensure the energy savings in buildings and industry by providing the aforementioned financial contributions and funding of approx. 1,5 billion DKK each year. The argument for introducing the new marked based agreement is that the current agreement has been ineffective since a lot of the renovation in dwellings of the households would be made either way, but critics argue that the new agreement in actually just is a big cut back of around a billion DKK annually in the funding for very much needed energy renovation and efficiency measures (Ingeniøren 2018).

Denmark is one of the European countries with the highest electricity prices for household consumers. This is not a result of higher production costs, but rather political priorities and decisions to tax energy consumption for household consumers heavily in comparison with most other European countries. In fact, Denmark has the highest taxes on electricity consumption (for households) in Europe (Eurostat 2017a; The Danish Ministry for Taxation 2018). However, the prices are expected to be reduced significantly over the coming years due to recent political

decisions and the aforementioned new Energy Agreement. The PSO tax (Public Service Obligations) was a part of the taxes on electricity and part of that money was allocated to subsidising renewable energy and decentralised CHP (combined heat and power) production, as well as R&D in environmentally desirable energy production and energy efficiency (Energinet n.d.). However, it has been decided that the PSO-tax will be phased out between 2017 and 2022. Additionally, the new Energy Agreement lowers the taxes on both electricity and electric heating further between 2019 and 2025 (Energiaftale 2018, 7-8).

In the beginning of 2016 the heating instillation in Danish households were distributed as follows: district heating corresponded to 63.6 %, Natural gas to 15,3 %, oil-fired boiler furnaces to 10,0 % and 'other', which includes both heat pumps, electric heating and wood (pellet) boiler, to 11.0 % of household heating appliances (Energistyrelsen 2017, 38). During the last couple of years, the government and supporting parties from the opposition have sought to advance the installation of heat pumps (both in individual buildings and in district heating) through various ways like policy schemes, subsidies to develop new business models (utility company rents out heat pumps to consumers instead of selling to them) and regulation changes. As mentioned above, the latest scheme with reduction in the levies/taxes on electricity and electric heating is among other things expected to give an economic incentive to replace the oil-fired boiler with a heat pump.

9.3 Socio-demographic differences in energy consumption in Denmark

9.3.1 *Socio-demographic segmentation*

The literature on the link between socio-demographic/economic variables and energy consumption in Denmark were found to be very scarce. The found studies on this were conducted by researchers from the Danish Building Research Institute (SBi) in 2005. It was based on large and detailed database with approx. 50.000 households' electricity, water and heat consumption linked with socio-economic data about the residents and information about their dwellings. The data is almost 20 years old, which calls for new follow up studies to be conducted to understand whether those findings are still valid today.

The studies on how socio-demographic differences can explain energy consumption highlighted different aspects. The study found a correlation between the income of the households and the electricity and heat consumption – On average, the higher the income of the household is, the higher is the energy consumption (Gram-Hanssen & Petersen 2005). However, it should be noted that the level of income is also linked with place, type and size of residence as well as the number of people in the households, which all influence and explain parts of the energy consumption. On average, the households/adult(s) that live in detached houses earn more than the ones that live in terraced houses or apartments. As detached houses are often larger in terms of m^2 than the other two types, they require more energy to heat up (unless the detached house abides a much stricter building code/is low-energy class). It is somewhat the same with electricity consumption related to

lighting, which requires more electricity to light up a larger area, but by contrast lighting usually only amount to a little more than ten per cent of total electricity consumption in a household (Energistyrelsen 2014). The amount of electricity consumption is best explained by the number of people in the household – the larger the household, the higher the electricity consumption. In addition, households with teenagers have a higher total electricity consumption, as teenagers use between 20-30 % more electricity than the average adult. However, the electricity consumption per person is reduced with each additional member of a given household, as the amount of electricity consumed for appliances like refrigerators or freezers is not dependent on the number of people in a household (Gram-Hanssen 2005). The number of members in a household will often also be linked with the living space of the residence and thus also type of home. Older generations, grown up during the 2nd world war or remembering the oil crisis, tend to be more sparing in their energy consumption (Aalborg University 5.7.2018).

The study did not find a strong direct explanatory force on the relationship between the level of education and energy consumption, but studies like the one by Spar Nord and Statistics Denmark found that positive correlation between the level/length of education and expected life income (Berlingske 2014), which takes us back to the points made above. The researchers from SBi tried to examine the significance of gender as an explanatory variable for energy consumption, but to do this they had to rely on single person households. They found that women in all the three types of residence had a slightly higher heat consumption, but it was barely deemed significant. Men used slightly more electricity than women, but these numbers were also deemed barely significant. Gender could play a role in relation to energy consumption, but the dataset used were not ideal for this kind of study (Gram-Hanssen & Petersen 2005).

9.3.2 *Social differences: energy consumers attitudes and behaviour*

One of the SBi studies from 2005 based on the 50.000 household database had examined differences in Danish household's attitudes towards saving energy and how the attitudes correlate with energy behaviour. The study states that most people in principle think that saving energy is the right thing, although their reasons or motives for thinking so vary. However, not all households are successful or interested in converting the thoughts about saving energy into practice. In the study, three types of households were distinguished: 1) *The conscious energy savers*, 2) the ones that do not do anything about it (even though they in principle think they should) and 3) the ones that do not think they can or should do anything about it (Gram-Hanssen 2005, 7).

The conscious energy savers actively seek to comply with their desire to save energy. On the surface their efforts and saving results may appear the same, but their reasons for or interest in said desire to save energy varies a lot. The study found that for some, saving energy was a part of their deeply-rooted saving mentality. This mentality was more typical for elderly people that had grown up in places and times of scarcity that required saving and reducing one's consumption in

general. Other conscious energy savers were found to follow an economic rationality where any excess spending or consumption (including on energy) is considered unnecessary economic waste. Lastly, some were conscious about saving energy as part of their broad concerns about the environment and resource scarcity. These were satisfied with simply knowing that they were doing something they considered right with their beliefs, whether they were political, technical or even religious. Despite their different standpoints and motives, what they have in common is that they also understand how they can save energy in their homes (Gram-Hanssen 2005, 8).

The second household type also thinks they should save energy and are driven by economic or environmental reasons (or a mix of both) as well. What separates this type from the abovementioned is that they do not or barely do save energy in practice. They are sincerely interested in saving energy, but it is not given a high priority in their daily lives and ends up fading into the background. The reasons they give are that comfort ends up beating common sense or that they think saving energy will be difficult/inconvenient or require extra time (something energy saving practitioners do not find to be the case) The last household type do not think they can or should reduce their energy consumption. For some of them, their budget is so big that the size and cost of their energy consumption does not really matter in comparison. They do not care, worry and/or acknowledge problem with the environment and resource scarcity, which is why they do not find it necessary to try to save energy (Gram-Hanssen 2005, 9). Those who are busy with their work or family do not often have enough time to be concerned with issues such as energy saving, even if they have the financial means to renew their home or appliances. For the economically well-of part of the population, money saving is not a central incentive for saving energy, although the economic realities (i.e. difficulties in saving the energy bills) define the energy use of the poor sections of the society. (Aalborg University 5.7.2018.)

9.4 Differences related to the built environment

9.4.1 *Climate conditions and their meaning for energy consumption*

According to the latest Energy Statistic 2016 publication by the Danish Energy Agency (2017: 35), the energy consumption of households in Denmark is affected a greatly by the changes in weather. The actual energy consumption has been relatively low in warm years like 1990, 2000 and 2014, whereas the opposite has been the case in the unusually cold years like 1996 and 2010. The colder it is outside, the more energy is required to maintain or uphold the same preferred temperature.

Denmark has a temperate climate with mild winters (mean temperature of approx. 0,5 °C) and chilly summers (mean temperature approx. 16 °C) (DMI, 2018). This means that the households and residents use a lot of energy for heating their homes most of the year and especially during winter, but they do not have the same requirements cooling during summer as many of the European country further down south in the warmer climate. It is not very common for

households in Denmark to have cooling/air-conditioning systems in their homes, which means that in warmer years and especially during summertime, the energy consumption allocated to controlling the temperature in their homes is very low. According to a chart in Energy Statistics over the average energy consumption per household in a given year between 1990-2016, the latest numbers for 2016 shows the vast majority of the energy consumption (61,8 GJ / 83,3 percent) is used for heating (of space and utility water) and the remaining 16,7 percent (12,4 GJ, approx. 3440 kWh) of the energy consumption comes for electricity use for lighting, appliances and the like (Energistyrelsen 2017, 35).

9.4.2 *Population characteristics and their meaning for energy consumption*

According to Statistics Denmark, there are around 2,7 million households in Denmark. 38 % of them consist of a single person, 34 % of two people and 28 % of three people or more. This section will instead focus on urban-rural distribution of the Danish populations and its implications for energy consumption.

Depending on the authority (Statistics Denmark and Eurostat, respectively), 12 % or 45 % live in rural areas, 33 % or 13 % live in towns and 55 % or 32 % live in cities (DST 2016, Eurostat 2017b, 13). These considerable differences in the figures result from different definitions of rural and urban areas of the two organisations. However, this does not say much about the geographic area and population density of the cities, which are both important factors to take into account when assessing energy consumption, as they for instance matter in terms of whether is it economically viable to establish a collective heating system. If one was to go with the numbers from Eurostat, we would come to the conclusion that their findings indicate that a rather large share of the population lives in low-density areas (at least according to EU-standards) and may thus result in many of them having individual heating solutions instead of collective heating systems.

A Danish study from the early 2000s investigated regional energy consumption in Denmark. It found that energy consumption and thus also the burden of energy taxation was higher in the rural areas than urban ones. Additionally, the study stated that the low-income households in rural areas consume a lot more energy compared with low-income households in the urban areas. This picture was considered linked with the difference between rural and urban areas in terms of both common dwelling types and access to public heating grids and natural gas grids in respectively rural and urban areas (Jacobsen, 2003). There are mostly detached dwellings in rural areas, which are usually larger than the apartments dwelling that are more common in urban areas. As a rule of thumb, the larger the area, the higher the energy consumption required (especially for heating). In addition, it's often economically unfeasible to set up public heating and natural gas grids in rural areas because the dwellings are too scattered, which essentially forces those households to use individual heating solutions like oil boilers, electric heating, wood-burning stoves or heat pumps. The latter is now starting to prevail and penetrate the Danish because of its

technical effectiveness and the abovementioned supportive policy schemes like new, but the others have been taxed more than public/collective heating and have thus resulted in higher cost for energy consumption. The upcoming section will go further in detail regarding the dwelling types in Denmark and what it means for energy consumption.

9.4.3 *Common dwelling types in the national context*

According to the most recent numbers from Statistics Denmark, there are a little more than 2.670.000 households in Denmark, and around 44 % of them live in detached houses, 39 % of them per cent live in apartment blocks/multi-level dwellings and 15 % live in terraced, linked or semi-detached dwellings (DST 2018a). The remaining only 2 per cent live in other dwelling types like dormitories and holiday homes/cottages, which is why this section will mainly focus on the three most common dwelling types.

When examining the distribution of Danish households living in owner-occupied dwellings and rented dwellings, it is interesting to find that is approximately evenly distributed 50/50 % between the two. However, a more nuanced pattern emerges when taking other factors like dwelling types and age difference into account. The majority of the households living in owner-occupied dwellings live in detached houses (1,036,000 / 39 % of all households), whereas only 5 % of these live in owner-occupied terraced, linked or semi-detached dwellings and another 5 % live in owner-occupied multi-level dwellings. Looking at the households that live in rented dwellings, only 5 % (of all households) live in rented detached dwellings, whereas 10 % live in rented terraced, linked or semi-detached dwellings and 34 % live in rented multi-level dwellings (DST 2018b). If we look at the age-groups, then the majority of the Danish people in the age-group between 18-29 years live in rented dwellings, whereas this tendency begins to even out for the people in the age-group 30-39 (they even out statistically for the people at 34). The vast majority of the 40-79-year olds live in owner-occupied dwellings, and most of the people over 80 live in rented dwellings (DST 2018c).

When assessing the different dwelling types in Denmark and their energy consumption, it is important to take into account the period in which they were built, the building code and type of heating system. About 75 % of the building mass/dwellings were built before 1980 (DST 2018e), which means that they when they were built they did not have to comply with the strict requirements of today's building code, which among other things are to ensure energy efficient dwellings. Certainly, part of the existing building mass has been renovated over the years and become more energy efficient, but studies from researchers at SBi have shown that there still is a great potential for heat energy saving measures in the existing building stock (Wittchen et al. 2017). It's also important to take into account whether the people living in the dwellings own them or rent them, as it may influence whether they are able to initiate energy saving measures like energy renovation and/or replacing heating systems. The residents of social housing are not

able to completely decide on their own heat consumption, as the heat can be turned on or off for periods of time from outside (Aalborg University 5.7.2018).

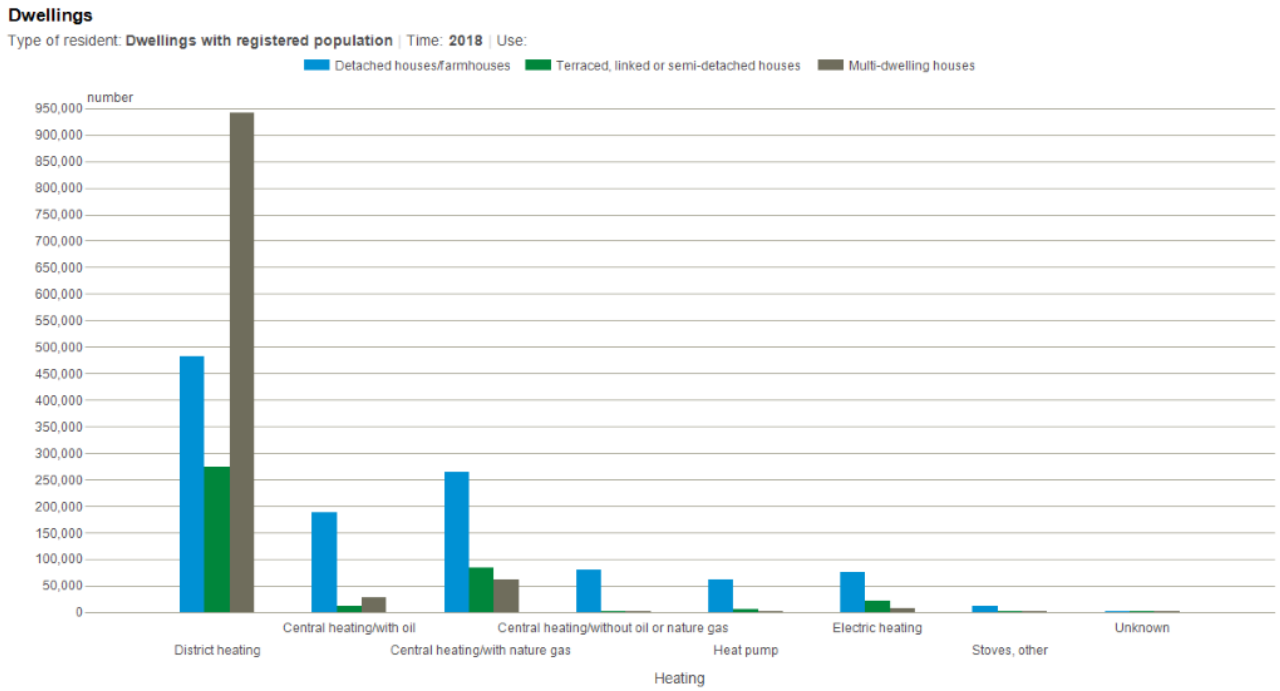

Figure 12. Dwellings and types of heating (DST 2018d)

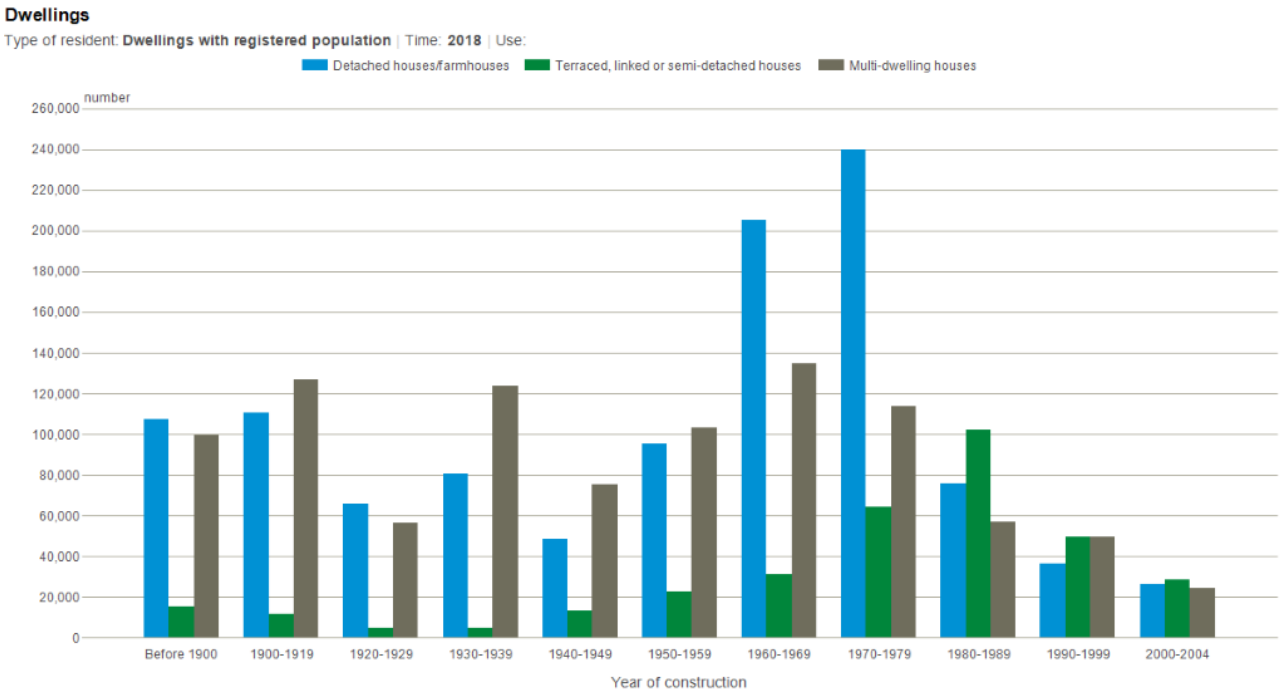

Figure 13. Dwellings and the year of construction (DST 2018e)

9.4.4 *Access to smart equipment*

Smart electricity meters have currently not been widely installed in Danish dwellings. A law has ordered all Danish energy providers/companies to install smart electricity meters in all Danish homes by the end of 2019. This is one of the measures taken to ensure the necessary (digital) infrastructure for the future smart grid. Once the smart meters are up everywhere in Denmark, it is expected that more households begin to invest in the smart equipment (Bolius 2018a, Bolius 2018b).

In 2014, the engineering company Danfoss ordered a study from the analysis institute YouGov on the share of the Danish households that had installed smart electric thermostats. The survey study found that only 6 % of the respondents had mostly smart electric thermostats installed in their homes. The study also found that 25 % of the thermostats were from before 1990 and 41 % were installed after (Installatør 2014).

9.5 Relevant stakeholders in promoting energy conscious behaviour in the national frame

Many governmental actors, commercial actors in the energy sector, educational institutions, and NGOs including those with invested interest in consumption and the environment promote environmental and energy consciousness in Denmark.

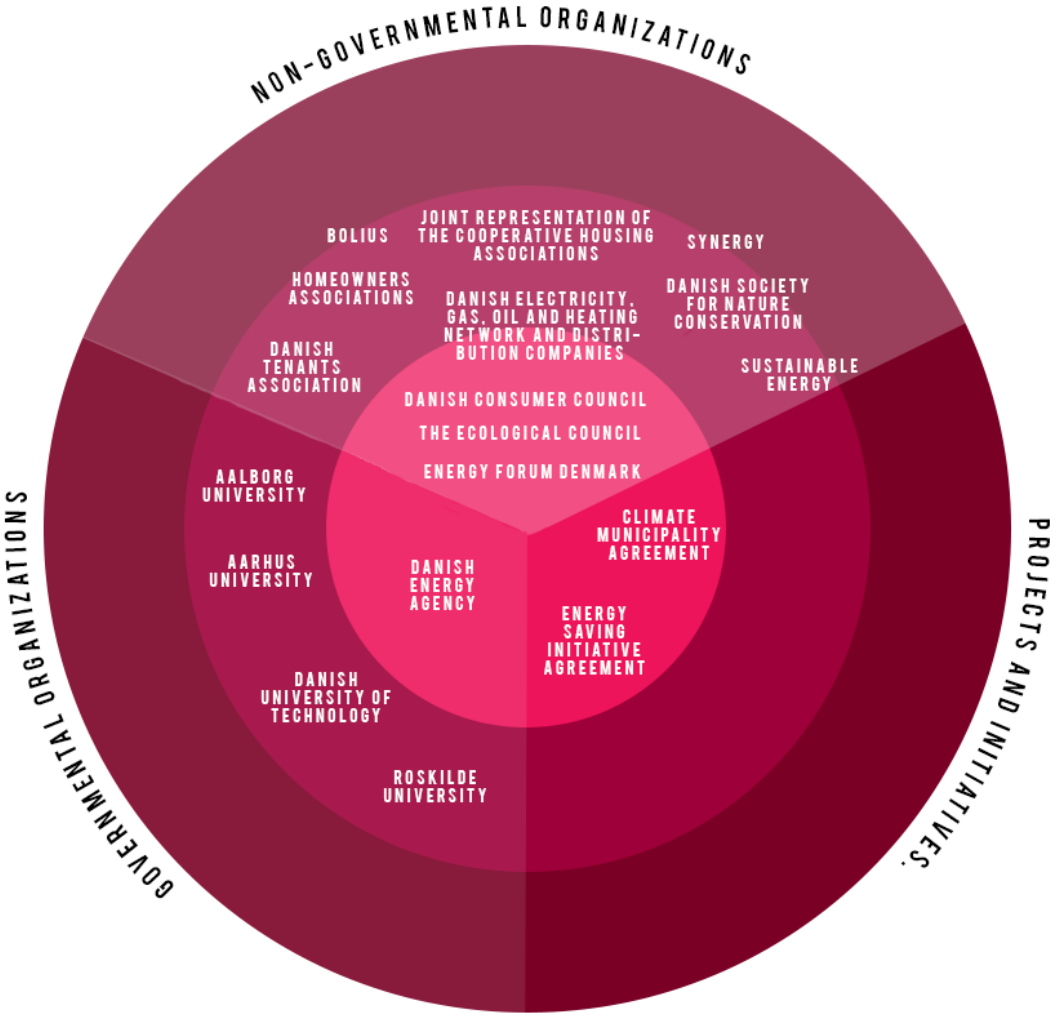

Figure 14. Danish stakeholders with interest in energy consciousness

9.5.1 *Institutions presenting national interest in the promotion of energy efficiency*

9.5.1.1 Governmental actors promoting energy efficiency / energy consciousness

Danish Energy Agency (Energistyrelsen) among other things promote energy efficiency and energy consciousness to both households, the business/industry and the public sector on its website SparEnergi.dk, where people can find a wide array of validated information and tools related to energy saving. In addition, representatives from the Danish Energy Agency also come out to public meetings and other arrangement to give talks about things like new regulation, heat technologies, subsidies and so forth.

9.5.1.2 Universities and research institutions working on energy consciousness

Many Danish universities have research institutions and groups that are working on and studying different aspects of energy consumption and energy consciousness.

At **Aarhus University (Aarhus Universitet, AU)**, the Environmental Science Institute has sustainable energy and environment as one of their research areas. Under this umbrella, they are i.a. studying the societal transition towards renewable energy provision and consumption, which also imply focusing on the required changes in lifestyles and behaviour of consumers that drive energy consumption, as well as how new technologies for energy efficiency and energy production need to be integrated in the practices and social acceptability of households.

Aalborg University (Aalborg Universitet, AAU) has the Danish Building Research Institute, which has a research unit that focuses on the energy efficiency, indoor climate and sustainability of buildings. In addition to the built environment, they also study the behaviour and practices of people, as this is also deemed important for reducing energy consumption in households. Furthermore, AAU's Department of Planning's multiple research groups are engaged in research topics like energy planning, sustainable design and sustainable transition, which can all be relevant for the ECO2 project.

The METRIK research group in the Department of People and Technology at **Roskilde University (Roskilde Universitet, RUC)** in broadly engaged in the topics of environment, energy, transport, regulation, Innovation and climate policy. The research group is i.a. studying how policies, regulation and planning is steering the modernisation and transitions to sustainable development, of which energy consumption in households is a topic of interest.

Danish University of Technology (Danmarks Tekniske Universitet, DTU) is active in many different areas of civil engineering, including building designs, energy technology, energy systems and smart grid. While the technological aspects may be focal point of most of their research and work, getting e.g. consumers and households to understand the potential of and adopt those technologies are also considered key.

9.5.1.3 Other organisations promoting sustainable technologies and energy consciousness

The Danish network and distribution companies within the fields of electricity, natural gas, district heating and oil as represented by the Danish Energy Association HMN GasNet, Danish Gas Distribution, NGF Nature Energy Danish District Heating Association, the Association of Danish CHP Plants as well as the Danish Oil Industry Association. As mentioned earlier in the report, these companies have to ensure that the energy effiency of the end energy users (households and private companies) increases annually in compliance with the Energy Saving Initiative Agreement.

Energy Forum Denmark (Energiforum Danmark) is a membership organization for people that work actively for energy efficiency and environmental improvements. Vision of the organization is to get buildings with intelligent energy utilisation and space for well-being to become the corner stone in the holistically-thought fossil-free society of the future.

Danish Consumer Council (Forbrugetrådet Tænk) represents the interest of their 75.000 personal members, 29 member organization and consumer groups. Informing their members and magazine readers.

The Ecological Council (Det Økologiske Råd) is an independent environmental organization that works for a sustainable transition of society. As a part of their work they naturally also focus on energy efficiency and energy savings.

Synergy (Synergi) – Newly established interest group that work for a more efficient use of energy in both households and industry. It's been established by Danfoss, Grundfos, *ROCKWOOL* and VELUX – companies in the cleantech industry that produce energy efficiency-solution like isolation, thermostats, thermo windows and more.

Bolius (subsidiary of Realdania) is an information centre on homes, which provide all Danish citizens with a wide array of knowledge and advices related to homes, including energy matters. Realdania is a member organization with more than 150.000 members that own private property.

SustainableEnergy (VedvarendeEnergi) is a member based environmental organization that works for a sustainable and green transition. One of the ways it does this is through its counselling service EnergiTjenesten (EnergyService) which gives information and advice about energy and energy savings.

9.5.2 *Institutions with membership presenting possible interest towards promoting energy conscious behaviour*

9.5.2.1 Organisations with citizens as members

The Danish society for Nature Conservation (Danmarks Naturfredningsforening - DN) fights and works for ensuring plentiful nature and a healthy environment for current and future generations. While DN's focus in the past have mainly been nature conservation, the focus has broadened to other areas that address climate change mitigation, e.g. renewable energy production and consumption

The Joint Representation of the cooperative housing associations (Andelsboligforeningernes Fællesrepræsentation - ABF) is Danish nationwide interest organisation that represents the interest of private cooperative housing associations. One of their interests could be to become

more knowledgable about energy consumption and make energy renovations that could increase the value of their properties, lower their energy costs and give them a better indoor climate.

The Danish Tenants Association (Lejernes Landsorganisation - LLO) works for bigger conditions, which could be for a better indoor climate and lower energy costs (and therefore consumption) for tenants.

Homeowners' Associations consists of people that own private property. Just like with the cooperative housing associations, their interests could also be to become more knowledgeable about energy consumption and make energy renovations that could increase the value of their properties, lower their energy costs and give them a better indoor climate.

9.5.3 *Energy consciousness related projects and initiatives that have gained public attention during the recent year*

9.5.3.1 National programmes and initiatives

As mentioned earlier, the bigger initiatives have been the Energy Saving Initiative Agreement with the energy companies and the stricter building code. There has also been some national public initiatives like the Electricity Saving Trust (Elsparefonden) and Center for Energy Savings (Center for Energibesparelser/Go' Energi) that have communicated and informed about energy savings and promoted energy consciousness. As mentioned, these activities have now been taken over by the Danish Energy Agency on their site SparEnergi.dk.

An additional thing to note is that as part of the Energy Agreement from 2012, the government made a strategy for energy renovation of buildings with the following 21 specific initiatives (State Of Green 2014):

1. Initiatives aimed at all building segments

1.1. Upgrade energy standards for the building envelope, windows excluded.

1.2. Upgrade energy standards for windows

1.3. Upgrade energy standards for installations in buildings

1.4. Ensure increased compliance with building regulation rules

1.5. Introduce voluntary energy classes for existing buildings

1.6. Upgrade energy standards for new buildings

1.7. Improve information and communication about energy renovation and energy efficiency in building

1.8. Target energy companies' energy saving efforts.

1.9. Ensure an effective and targeted energy labelling scheme for buildings

1.10. Ensure better data and tools decisions pertaining to energy renovation

1.11. Advance good financing frameworks for energy renovation

1.12. Present strategy for building policy.

2. Initiatives aimed at single-family homes

2.1. Advance energy renovation in single-family homes through the "BedreBolig" scheme.

2.2. Advance prevalence of alternatives for oil and gas-fired boilers based on renewables.

3. Initiatives aimed at multi-family residences, office buildings and public buildings

3.1. Advance energy renovation of larger buildings through guaranteed offering.

3.2. Advance energy renovation of council housing

3.3. Advance energy renovation of private rental properties, housing cooperatives and house-owners' associations.

3.4. Advance energy renovation of commercial leases

3.5. Advance energy-efficient public buildings

4. Initiatives aimed at strengthening competences and innovation to advance energy renovation

4.1. Strengthen development of education and competences within energy renovation

4.2. Strengthen research, innovation and demonstration of energy renovation

9.5.3.2 Municipal and local programmes and initiatives

Around two thirds of the Danish municipalities have signed the 'Climate Municipality Agreement' with the Danish Society for Nature Conservation. It obliges the municipalities to reduce their organizations' CO2 emissions by (minimum) 2 % annually over an agreed-upon period like 15-20 years. In order to reduce their emissions they initiate initiatives like energy renovations and information campaigns. Many of said municipalities state that this is a away to show action and to inspire local citizens and businesses.

In addition to trying to act as role models, many municipalities have also initiated more household-oriented programmes and initiatives like subventions to (or fully covered) energy audit by an energy advisor, public meetings about heating systems and energy renovation, as well as distributing information material and made campaigns about efficient energy use. The Horizon2020 project ENERGISE has with one of its work packages and deliverables produced a

catalogue over diverse Sustainable Energy Consumption initiatives (SECIs) across Europe. The researchers identified and described 36 SECIs in Denmark, which attest to the many different efforts made to make energy consumption more sustainable (ENERGISE 2017, 19-28).

9.6 Final considerations

This final section of the report will briefly summarise the findings on consumers segments in Denmark and reflect upon which relevant stakeholders and strategies would be most effective in reaching the different segments. While the literature on socio-demographic differences in energy consumption and energy consciousness proved to be scarce, this report shows that factors related to dwelling (dwelling type, m2 per member of household, homeowner or tenant, regional differences) influence energy consumption.

Households living in multi-level dwellings (apartment buildings) tend to have lower energy consumption (especially in heating) compared to households occupying other dwelling types, as the number of square meters per person is lower. The vast majority of these apartments also have district heating, which in many cases is the cheapest form of heating. In addition, the vast majority of the households living in apartment buildings rent the apartments, which means they are not able or allowed to initiate energy renovations in the dwelling they live in. Housing associations or landlords do not have immediate economic incentive to initiate this kind of renovations to reduce energy consumption in multi-level dwellings as the tenants would bear that cost. Therefore, energy renovations are only carried out if these measures can improve the indoor climate (thus putting off other possibly necessary renovation measures into the future), which leads to increasing rents to finance these initiatives.

In order to reach consumer segments living in rented apartments, stakeholders like the Danish Tenants Association could be approached, as they have long-standing relations to both tenants and the housing associations/landlords. Such organizations could facilitate the dialogue between the two parties, showcasing the mutual benefits of a better indoor climate and lower energy costs.

Individuals living in cooperative multi-level dwellings or apartments they own have more freedom than tenants in carrying out energy renovations in their buildings. However, such energy renovations can still be restricted due to internal rules governing the cooperative housing associations, limited options in terms of what can be done and high costs of renovations, should the owners of the other apartments in the building be unwilling to take part as well. Stakeholders including owners' associations or the joint representation of the cooperative housing associations could reach individual homeowners' and cooperative housing associations, as they already have a forum where they interact and the topic of energy renovation could be taken up.

The households living in detached dwellings in Denmark are of particular interest from the standpoint of energy efficiency as they tend to have higher energy consumption than other

dwelling types (m2 per person is higher). In addition, a vast majority of these households own the dwelling they live in, which means they both have the freedom and the incentive to renovate their home, as renovations could lower their energy cost and improve the indoor climate and value of their property. However, it has to be remembered that the segments living in detached houses are varied. Households in the middle-income bracket may have the (economic) resources to renovate their homes and even a will to reduce their energy consumption for various reasons. Still, reasons such as being busy with work or family may make saving energy feel inconvenient and require too much time. The households that are less well-off living in detached dwellings may have a bigger incentive to save energy in order to reduce their expenses, but these households may not have the means, resources or capabilities to explore the energy saving possibilities and measures. As the consumer segments living in detached dwellings are different and scattered all over Denmark, varied efforts and involvement of multiple stakeholders will be needed to reach them.

Many of the Danish municipalities are already engaged in promoting energy consciousness and energy efficiency among households and businesses in various ways as part of their climate strategies and energy plans. Even if all municipalities can communicate directly with their inhabitants (and would thus potentially be able reach all energy consumer segments irrespective of the type of dwelling, in practice, it might be difficult due to lack of internal resources and time, as well as municipal priorities. Reach-out activities in municipalities can be complemented with the efforts of the Danish Energy Agency, which is already engaged in giving households, businesses, the industry and public sector guidance on saving energy. Much of their communicative efforts go through SparEnergi.dk, where people can find updated and validated information about energy consumption and energy solutions. However, it can be anticipated that people visiting such or similar websites already have an interest in energy saving, as well as the resources (time and knowledge) to search for the right information. The less resourceful and knowledgeable ones may never search and visit the site in the first place, which in turn is a hindrance for the adoption of energy conscious habits.

It is necessary to have a supplementary recruitment strategy to reach the more volatile groups, which will require engagement of other stakeholders (such as the Danish Consumer Council, the many homeowners' associations or Realdania) that already have established relationship to these segments. A supportive approach could also be to reach the consumers through websites or magazines (e.g. Idenyt and Bolius) with housing-related content.

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10. Finland

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10.1 Introduction

This section is a contextual document that provides an overview on energy consumption and energy consciousness in Finland. It was conducted by Consumer Society Research Centre at the University of Helsinki.

The country report builds on the information and materials produced by the national stakeholders operating in the field of energy, previous and ongoing EU projects such as ENERGISE, ENTRANZE, NATCONSUMERS, ODYSSEE and USmartConsumer as well as academic studies and other reports of energy consumption and energy consciousness published by researchers and organisations operating in the field. The search for these materials was carried out through web searches as well as searches on the CORDIS data base.

Gender as well as education and income have been found to explain differences in energy consumption in Finland. In recent studies on energy consumption segments, two interesting themes arise: pioneering users of smart energy services and consumer groups representing energy poverty. The building stock in Finland is relatively new, and continuous maintenance is usually well taken care of. A common energy renovation measure for detached houses, which are in most cases owned by the occupants, is renewing the insulation and heating system of the house. In apartment blocks and terraced houses, the renovations are the responsibility of the housing company. The system of multi-household buildings management by housing and management companies affects the possibility of the residents to understand their heating energy costs, as they are included in the monthly maintenance fee. In addition, tenants have even less opportunities to see their heating energy consumption because it is included in the rent.

10.2 National frame for energy consumption

Finland is a small North European country with a population of 5.4 million. Approximately one million people live in the Helsinki Metropolitan area.

The climate is cold and winter season dark, which result in long heating and lighting seasons. High standards of living and a high density of household electronics and individual appliances may link to energy consumption – as may the electricity price that is not high enough to encourage energy saving (Mikkonen 2015).

The building stock in Finland is by comparison to other European countries newer, and the standard levels of insulation are higher and building automation widespread. There is a long

history of systematic building maintenance, which makes finding new cost and resource effective solutions to improve energy efficiency in the building stock difficult to find. In detached houses opportunities for improvement can limit to replacing of oil and resistance electric heating with renewable energy sources (ENTRANZE 2014, 6-7). However, continuous maintenance is necessary as poor insulation of windows is one factor leading to energy loss (Citizen Forum 29.5.2018).

Cultural norms in a particular society have an impact on energy consumption. Like in other Nordic countries, in Finland the indoor temperatures are relatively high (21o C) (ENERGISE 2018a), whereas the recommended temperature is below 22o C (Negawatti 2016). A peculiarity is the high number of summer cottages (Mikkonen 2015) and the household electric saunas. They can be considered a social norm and as they exist in a large part of apartments (NATCONSUMERS 2015/2016b, University of Helsinki 14.5.2018, Sitra 24.5.2018).

Finns are keen to adopt technological novelties such as heat pumps and LEDs (ENERGISE 2018a). 98 % of electricity consumers in Finland have smart meters (hourly-based remote readers), and in addition, electricity companies lend out device-specific meters (USmartConsumer 2017b). A majority of the Finnish consumers consider being well-informed regarding smart meters although at the same time the majority seems to call for better understanding on their energy consumption (Motiva 29.5.2018). Moreover, some are unwilling to act on the knowledge they have (University of Helsinki 14.5.2018, Motiva 29.5.2018). For instance, Finns are often aware of their electricity use and try to save energy, for example, by unplugging devices and turning off the lights, but they tend to ignore energy consumed by space and water heating (Citizen Forum 29.5.2018, Sitra 24.5.2018). In general, water heating and hot water use are factors leading to excessive energy use. However, there is a group of consumers willing to take energy saving measures in some things but not in others. For example, some consumers may be careful to always unplug electronic devices, but on the other hand not willing to give up flying abroad for a holiday (Citizen Forum 29.5.2018).

10.3 Differences in energy consumption in Finland

10.3.1 *Socio-demographic differences*

In Finland, studies on socio-demographic differences in energy consumption are few, as energy consumption is usually understood as something a household rather than the individual does. Moreover, in studies on energy consumption in Finland, socio-demographic features are often looked at alongside attitudinal analyses.

Gender was found a relevant factor in explaining interest towards electricity and smart energy services men being more interested in energy issues than women (Syvänen & Mikkonen 2011, Matschoss et al. 2014, Heiskanen & Matschoss 2015, USmartConsumer 2017a). According to a study on local energy services in 2011, men would also decide more often than women on the energy issues of the household, whereas women reported doing the decisions in collaboration

with someone else. Women were also more interested in purchasing energy services than men (Syvänen & Mikkonen 2011), which was explained through lack of knowledge among women in the same survey.

In a study on early adoption of sustainable small-scale energy solutions in Finland by Nygrén et al. (2015), males dominated the small data (N = 54, 48 men, 6 females), which seems to tell about electricity and energy use being a gendered phenomenon (University of Helsinki 14.5.2018, Sitra 24.5.2018). Contrastingly, USmartConsumer (2017a) project also found that conservative energy consumers were more often females. Women were also thought to be generally more interested in the protection of environment than men (Motiva 29.5.2018, Citizen Forum 29.5.2018).

The effect of age on energy consciousness was found contradictory in the segmenting studies. In USmartConsumer (2017a) analysis on Finland, the effect of age was found to be important in explaining the interest towards energy, environment and new technology. The respondents older than 60 years of age dominated the consumption critical 'independent green consumers' and the 'consumerist achievers' segments, whereas the young and middle-aged would be less protective of the environment and less active as energy consumers and more pessimistic about energy consumption and smart meters. In a study on energy poverty, age was found to be important in explaining the energy consumption as well as the deprivation in terms of energy. Households with small children use a lot of energy, and the energy costs cut a large sum of income – especially when one of the parents is taking care of the children at home. Moreover, according to the study, old people can not necessarily afford sufficient heating and becoming a pensioner may increase the relative proportion of energy costs in relation to income, even if notable renovations would not be required. Also the possibilities for getting a loan for energy renovations may be small. (Runsten et al. 2015, 29.)

The busy life stage can prevent working parents with young children from thinking and acting in an environmentally conscious way (University of Helsinki 14.5.2018).

The elderly in Finland is seen as a group for whom energy saving is important. Their routines were built on previous experiences of the 1970s oil crisis or other periods of scarce resources (Citizen Forum 29.5.2018, Motiva 29.5.2018, Sitra 24.5. 2018).

A survey on local energy services found that attitudes towards energy production and heating with renewable energy were the more positive, the younger the respondent was (Syvänen & Mikkonen 2011). Children and youngsters can be very energy conscious and active in promoting energy consciousness in their family members. (Motiva 29.5.2018)

Education and income also explained differences in energy consumption. USmartConsumer (2017a) found a connection between high education, high income and environmentally friendly attitudes (although the respondents with high education and income would also often have high annual electricity usage). Instead, low education and income were found to be linked to disinterest in technology. Heiskanen & Matschoss (2015) found a connection between energy expertise and experimentalism and having a degree on the technical field.

A part of the population is simply not interested in energy saving issues and does not think it has much to do with them. Although the characteristics of this group are unclear, it seems probable that the segment belongs to the well-of part of the population rather than those struggling with financial issues (Local electricity company 17.5.2018). The low-income households may seem not to be energy conscious simply because they cannot afford to replace their old household appliances that consume a large amount of energy with new energy efficient devices (University of Helsinki 14.5.2018).

The effect of the place of residence and household features were presented both in the studies on pioneer users as well as energy poverty (Matschoss et al. 2014, Heiskanen & Matshoss 2015, Nygrén et al. 2015, Runsten et al. 2015). The general finding in these studies is that energy consciousness is more prevalent in the countryside than in the cities, although in general, consumers living in detached houses are more interested in energy saving. In countryside, also the less well-off consumers live in detached houses, and the opportunity of saving money motivates them to be more energy conscious. In large cities living in detached houses is a solution for affluent consumer segments.

In a study on pioneers of energy use, most pioneers would live outside the metropolitan area in small towns or countryside (Nygren et al. 2015), which indicates that in sparsely populated areas the interest towards energy may be greater than in large cities (also Heiskanen & Matschoss 2015, Matshoss et al. 2015). In sparsely populated areas, energy efficient heating and renewable energy were more popular than in closely built-up areas. Of this, there was also a consensus among the experts we interviewed. Consumers living in large apartments had more often taken up new heating and energy production technologies based on renewable energy than respondents living in smaller apartments (Syvänen & Mikkonen 2011, 17).

Runsten et al. (2015) estimate that in Finland, there are 60-100 000 low or medium income households in risk of energy poverty. These households are typically low-income households situated either in blocks of flats built in the 60s and 70s that have not been renovated, or small- or medium income households living in small detached houses built before the 80s. In terms of area, the most deprived households are located in regions losing population in the Eastern Finland (Etelä-Savo, Pohjois-Karjala, Kainuu, Satakunta, Kymenlaakso, Etelä-Karjala, Pohjois-Savo) and in the North (Lapland).

10.3.2 *Attitudinal differences*

Recent attitude-based segmentations of Finnish energy consumers draw on differences in environmental attitudes, attitudes towards technology, need for different services and attitudes towards the service providers.

Three out of four consumer segments found in the USmartConsumer (2017a) survey were family-oriented, concerned about consumption and waste as well as protecting the environment. Two out of four segments found were also interested in new technologies and two out of four segments could be characterized work-oriented.

The Forerunner project could find a varied set of motivating factors such as environmental concern, interest in technology, ideas about economic benefit, ideal of self-sufficiency and the willingness to utilize excess material, promote innovations and keeping up appearances as attitudinal variables segmenting the energy consumers (Nygrén et al. 2015). Motivating factors for energy conscious behaviour that were brought up were interest in technology and the desire to keep up appearances, but also positive experiences of neighbours and acquaintances. One of the most powerful motivating factors pointed out in the interviews was the combination of economic and environmental benefits.

The "local energy services, anyone?" study found that most consumers would value positive, trustworthy and effortless experiences, whereas targeted services are relevant for some segments. The need for services differed according to type of dwelling (detached houses, block of flats, summer cottage) and consumers access to resources (time, money). Moreover, environmental benefits, promotion of renewable energy and support for local entrepreneurs motivated women and the aged more than other consumers. (Syvänen & Mikkonen 2011.)

Resource wise citizen project found seven motivational profiles based on consumer attitudes (Sitra and Palmu 2018). In the study, frugality was differentiated from resource wise consumption with environmental motives. Heating of the home was central in measuring smartness in energy consumption. In the study, it was found that green and ecological consumption were most typical for young adults living in large cities, whereas responsible ecological consumption was most typical for highly educated women over 50 years of age. Frugality, instead, was typical for less well-off middle-aged citizens living in the countryside.

10.4 Differences related to the built environment

10.4.1 *Climate conditions and their meaning for energy consumption*

Finnish climate conditions are defined by cold winters and steady, average-to-great amount of rain throughout the year. Differences in energy consumption between the years are to a rather large part due to the variability of winter temperatures and in colder winters high amounts of energy are required for the heating of spaces. All in all, heating of spaces takes up the greatest part of household energy consumption (Official Statistics of Finland (OSF) 2016a).

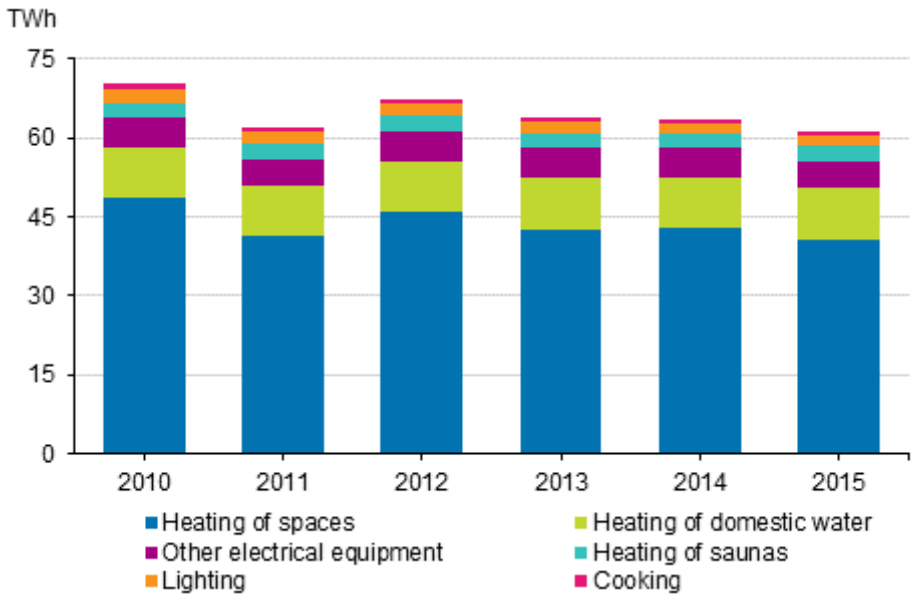

Figure 15. Energy consumption in households 2010-2015 (Official Statistics of Finland (OSF) 2016a)

In Finland, industry consumes the largest share of energy (48 %), whereas the share of transport is 18 % and the residential, services, agricultural and other sectors together account for a third of the total energy use (Gynther & Elväs 2015).

In 2016, the total housing energy consumption was 67 TWh making the overall share of housing 20 % of the total energy consumption in Finland. Of energy consumption in households, heating of spaces took 68 % and heating of water 15 %. Other electrical equipment (9 %), cooking (1 %) and lighting (3 %) took up to 13 % of housing energy consumption combined. Moreover, heating saunas took up 5 % of household energy consumption. (Official Statistics of Finland (OSF) 2017a.)

An overview on the energy consumption in Finland reveals that electricity consumption of households has increased by nearly 10 per cent from 2006 to 2011, which results from the heating of homes (increased number of heat pumps, increased secondary heat, increased mechanical ventilation and heat recovery) but also electricity consumption of household appliances that has remained the same as the reduction in consumption in lighting and TV appliances has been compensated by increases in the energy consumption of computers, dishwashers and car heating (Mikkonen 2015).

10.4.2 *Population characteristics and their meaning for energy consumption*

Finnish municipalities can be divided into three categories according to the proportion of people living in urban settlements. These include a) urban municipalities with at least 90 per cent of the population living in urban settlements (with largest urban settlement having a population of at least 15 000 persons), b) semi-urban municipalities with 60-89 per cent of the population living in urban settlements, and where the population of the largest urban settlement is between 4000 and

14 999, and c) rural municipalities with less than 60 per cent of the population living in urban settlements.

Altogether, there were 2 655 000 households in Finland. Out of all households, 43 % were single person households, 33 % two person households and 24 % households with three or more persons. The average size for a household was 2.03 persons in 2016. (OSF 2016a.) Of all the households, 40 per cent were living in a detached house, 14 per cent in a row- / terraced house and 45 per cent in a block of flats.

The average space for an apartment was 82 square meters, which equals approximately 40 square meters per person. As the number of people in the household rises, the relative space at hand decreases (1 person 60 m2, 2 persons 44.4 m2, 3 persons 33.5 m2, 4 persons 28.3 m2, 5 persons 24.5 m2, 6 persons 21.0 m2, and 7+ persons 16.8 m2). Almost one in five Finns lived in an overcrowded dwelling. (OSF 2016a.)

Studies have shown that the average energy use per household is higher in apartment buildings in urban areas than in apartment buildings in rural areas. Also, for the detached houses, consumption of energy is higher in urban areas than in rural areas. Similar difference could not be found in row-/terraced houses between the two area types (Heinonen & Junnila 2014). City dwellers have also been found to be wealthier than people living in rural areas, and their urban lifestyle consumes more goods and services and generates more emissions than the rural lifestyle (Heinonen et al. 2013).

10.4.3 *Common dwelling types in the national context*

According to Statistics Finland (OSF 2017b), 44.8 per cent of the Finnish population live in apartment blocks, 39.7 per cent in detached houses, 13.7 per cent in terraced houses and 1.7 in other houses.

A majority of households (around 1 700 000 households) lived in owner-occupied dwelling in the end of 2016. Just 32 per cent of households (854 000 households) lived in rented dwellings. Renting as a tenure status was preferred by under 30-year-olds by comparison to other age groups. The most common mode of dwelling at a later stage in life was an owner-occupied flat in a housing company. (Official Statistics of Finland (OSF) 2016a). Income level defines the tenure status. In the lowest two income deciles, it is most common to rent the apartment. In the lowest income class, just 34.4 per cent of the households owned their home and in the highest income class over ninety per cent.

The most common energy sources in households in 2016 were electric heating (34 %), district heating (29 %), wood heating (22 %), ambient energy (8 %), and light fuel oil (6 %) (Official Statistics Finland (OSF) 2016b). According to a study on local energy services in 2011, a fourth of Finnish energy consumers considered new solutions in heating or energy saving topical in the next two years (Syvänen & Mikkonen 2011).

Finns living in detached houses considered purchasing secondary heating technology as well as renovating the insulation of the building. These renewals were extremely topical those living in detached houses with oil heating. However, environmental concerns or willingness to mitigate global heating were not among the motivating factors behind performing these changes among those living in detached houses. Finns living in detached houses preferred making energy decisions independently. (Syvänen & Mikkonen 2011, 5-6.) The forerunners in terms of energy consciousness are detached house home owners, usually living in the countryside, who are interested in installing ground-source heat pumps (Motiva 29.5.2018, University of Helsinki 14.5.2018).

A specific feature about heating in blocks of flats and row-/terraced houses is that housing companies are in charge of the maintenance of buildings. Heating expenses are usually included in the maintenance fees paid by the flat owner that is charged by the housing company or the rent paid by the tenant (see Runsten et al. 2015). Therefore, the costs of heating for residents in housing companies remain hidden from the viewpoint of the resident (Local electricity company 17.5.2018, Sitra 24.5.2018, University of Helsinki 14.5.2018).

In district heated multi-family apartment buildings the occupants have little influence on the overall energy consumption (see also ENTRANZE 2014) and only a small share of the total energy consumption, 11 %, household electricity is directly controlled by the occupants and instead by the housing managers of housing companies, but their potential is still not fully exploited (Kyrö et al. 2011, Kyrö et al. 2012).

Kyrö et al. (2011) found in their study that in the district-heated apartment buildings, the apartment size had a two-way impact on the energy use, the smallest and the largest apartments being the least energy efficient. Moreover, the middle-sized apartments had the lowest consumption per resident.

Respondents living in blocks of flats or terraced houses preferred co-operative ways of purchasing electricity within the local community than those living in detached houses. Finns living in terraced houses were also considering measures on insulation. However, instead of independence, they appreciated professionals in carrying out the maintenance of the energy systems (Syvänen & Mikkonen 2011, 5-6).

The building year and the size of the apartment have a significant impact on energy consumption, as does the number of electric appliances and their energy efficiency. Especially the suburbs built in the 1960s and 1970s have either poor or extremely poor energy efficiency (Oja et al. 2013, 24, see also ENTRANZE 2014).

10.4.4 *Access to smart equipment*

According to USmartConsumer (2017b) project, 98 per cent of Finns have access to smart meters, but it is not clear how widely smart meters are used (Local electricity company 17.5.2018). Still, a full tailor-made smart energy service package is not yet available at the Finnish market (Citizen

Forum 29.5.2018, University of Helsinki 14.5.2018), instead, there are singular services and equipment. Widespread energy efficiency services in Finland include the following smart energy services and smart equipment (see Matschoss et al. 2014; Suvilehto 2012):

- Energy audits and energy guidance
- Information on energy efficiency of electrical appliances (energy companies have provided this traditionally, but there are also more recent solutions, such as the EU energy label)
- Energy advice through phone, the internet or through e-mail
- Reports on energy consumption for households (some energy companies have for a long time provided the client the data of their use of electricity and district heating on a selected timeline (consumption per hour to consumption per year). The user can compare their energy use to others and also to their own earlier energy use., and some energy companies provide online services for real-time monitoring of energy consumption)
- Smart meters and the option to monitor energy consumption online
- Feedback on energy consumption
- Loaning energy consumption meters (in at least the Helsinki region and Turku, public libraries lend out electricity meters to their patrons)
- Printed material, guide books
- Public information and campaigning

Smart energy services have been provided across sectors. The state, municipalities, and national institutions as well as energy companies have been active in providing these services. The network of local energy offices is a more recent institution operating in the field (section 5). Moreover, different NGOs have become interested in giving energy counselling (Matschoss et al. 2014).

In smart energy services, tailored solutions and services for individual cnsumers are more important than just having any kind of device (Citizen Forum 29.5.2018). Water meters and energy assistance services, such as the possibility to order an expert to perform measurements and propose useful measures, are among the most important smart services in Finland (Sitra 24.5.2018). According to a 2013 study, the interest towards purchasing smart energy services (energy audits and/or personal guidance, real time home electricity displays for monitoring energy consumption, home electricity equipment such as timing gadgets for heating and technical equipment, services for the purchase or installment of equipment enabling energy saving such as LED and heat pumps, services related to micro-production technology such as solar panels or small-scale wind power plants) was quite low. Out of these, instalment of equipment (LED and heat pumps) and installation of home electricity guiding equipment proved most interesting from consumer viewpoint. However, only 22 % and 33 % of the respondents had purchased or considered purchasing these services. (Kahma & Matschoss 2017.)

Another difficulty concerns the lack of tailor-made services: even if consumers were interested in installing a smart energy system or a PV system in their home, it is practically impossible to find a service provider to do it without significant initial exploration by the homeowner beforehand. (Citizen Forum 29.5.2018, University of Helsinki 14.5.2018.)

10.5 Relevant stakeholders in promoting energy conscious behaviour in the national frame

A wide variety of Finnish organisations work to study, change and support the Finns in their energy use behaviour. The initiatives of both governmental and non-governmental organisations as well as private enterprises and research and education institutions ensure a continuous stream of projects concerning the subjects. In many cases, the different sectors combine their efforts in these projects.

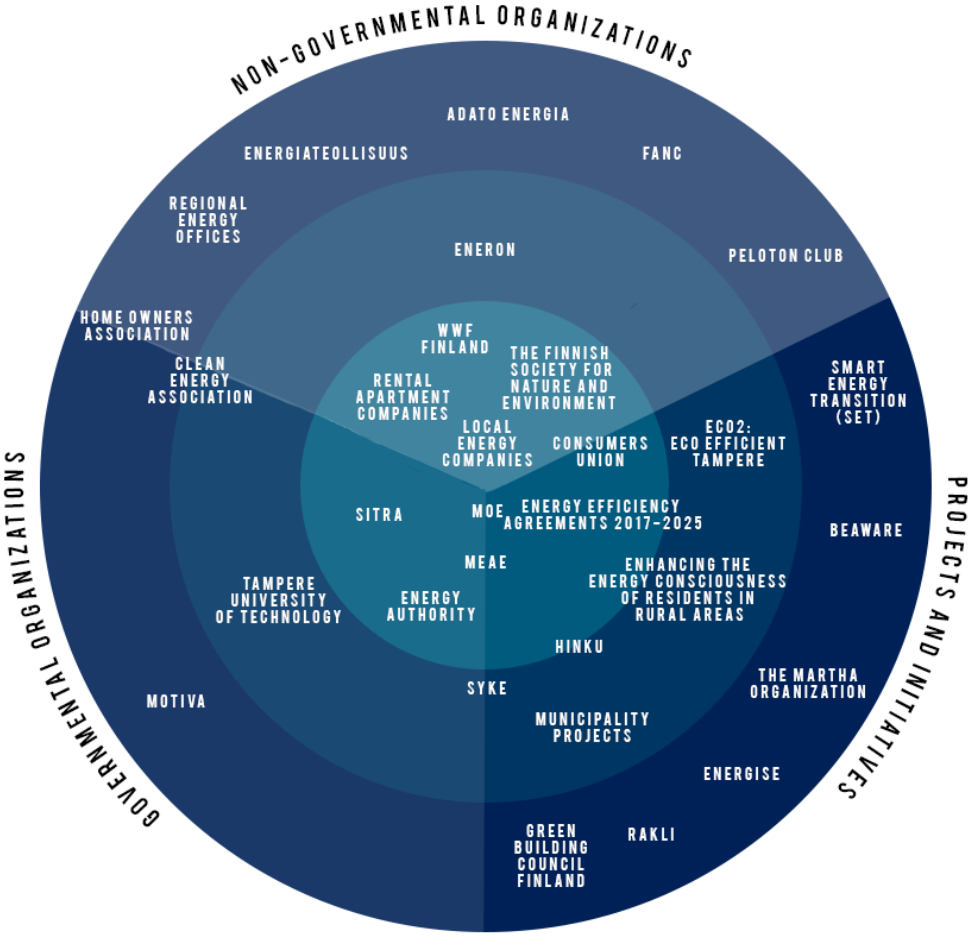

Figure 16. Finnish stakeholders with interest in energy consciousness

10.5.1 *Institutions presenting national interest for promotion of energy consciousness*

10.5.1.1 Governmental actors promoting energy efficiency / energy consciousness

Ministry of Economic Affairs and Employment MEAE (Työ- ja elinkeinoministeriö) represents Finland in energy efficiency matters within the EU and in other contexts of international

cooperation. The ministry coordinates national energy efficiency policy and monitors actively developments in the field. (See Ministry of Economic Affairs and Employment 2018)

Ministry of the Environment MoE (Ympäristöministeriö) together with the Ministry of Economic Affairs and Employment shoulder the Programme to Promote Sustainable Consumption and Production (KULTU) that includes various stakeholders such as other ministries, research institutions, organizations, and businesses together with National Technology Agency and the Finnish National fund for Research and Development Sitra. Ministry of the Environment has carried out a Programme to Promote Sustainable Consumption and Production "More from Less Wisely" that aims to reduce the environmental impacts and greenhouse gas emissions of households and the public sector (MoE 2013).

The Finnish Energy Authority (Energiavirasto) is responsible for the practical implementation of measures to promote energy efficiency. The energy efficiency unit is responsible for energy agreements, energy audits, consumers' energy guidance, communication as well as ecological design of products and energy certificates. FEA monitors and evaluates national measures towards energy efficiency.

The Finnish Innovation Fund Sitra is an independent, public foundation operating under the supervision of the Finnish Parliament. Sitra supports projects that increase the efficiency of the economy, improve the level of education or research and study future development scenarios. Through its recent projects, Sitra has promoted efficient use of energy in the built environment and reductions in greenhouse gas emissions.

10.5.1.2 Universities and research institutions working on energy consciousness

Finnish Environment Institute (SYKE) is a multidisciplinary research institute solving topical issues that have an impact on the environment. SYKE has a specific Centre for Sustainable Consumption and Production.

Tampere University of Technology (Tampereen teknillinen yliopisto) has active research on civil engineering. The department of civil engineering is focused on heating expenses and best practices in energy efficiency in buildings.

In addition, relevant research on energy consumption is being done for instance by the University of Helsinki, Aalto University, Lappeenranta University of Technology, and University of Vaasa. Some of these projects have been enumerated in energy consciousness related projects and initiatives section.

10.5.1.3 Other organizations promoting sustainable technologies and energy consciousness

Motiva Oy is a government-owned company carrying out practical work in promotion of energy saving and the use of renewable energy sources. Motiva provides information on sustainable choices in the fields of living, building, renovating, heating options and mobility. Motiva has a

networks of energy consultants operating across the nation. The services of Motiva include sharing online information related to energy use, tools and tests for evaluating the benefits of different solutions in energy saving, online consulting and consulting events, support for the network of local energy consultants.

Finnish Association for Nature Conservation FANC (Suomen luonnonsuojeluliitto) is the largest NGO for environmental protection and nature conservation in Finland. FANC acts as an intermediate between different environmental organizations, provides training and education, and puts forward initiatives and issue statements to keep Finnish nature viable and diverse. FANC sees potential in betterment of energy efficiency in buildings, which they campaign for by providing guidance on concrete measures. FANC owns and manages its own EKOenergy label, which is the only eco label for energy in Finland. FANC has in recent years carried out an energy guidance project.

Finnish Clean Energy Association (Lähienergialiitto ry) is an NGO consisting of clean energy companies, renewable energy sector associations, clean energy experts and prosumers. The organization has a goal of making renewable energy use as possible for Finns as well as helping clean energy industry grow. Lähienergialiitto focuses on renewable energy, smart energy solutions and energy efficiency and promotes these through disseminating information, organizing events and seminars, lobbying and carrying out development projects (Lähienergialiitto 2018).

The Consumers' Union of Finland (Kuluttajaliitto) is a non-governmental organization promoting the interests and rights of consumers nationwide. It tackles issues related to the rights of a consumer, economy, foodstuffs and ethical consumption. Kuluttajaliitto offers counseling in questions about consumer protection, advertising, living and ethical consumption.

The Finnish Home Owners' Association (Omakotiliitto) is an NGO promoting the benefits of Finns living in detached houses. The association consists of 256 local associations across the country. The association provides information and counseling to help the membership to keep up their residence and close environment. One of the goals for the NGO is to promote consciousness on renovations, reparations and building, as well as building contracts.

10.5.2 *Institutions with membership or clientele with possible interest for promoting energy conscious behaviour*

10.5.2.1 Organisations with citizens as members

Local energy companies are obliged by the EED directive to provide counselling on reducing energy use for their clients. The reports on the practices of individual companies are listed on the web pages of Motiva.

Rental apartment companies and associations, including student housing, usually have compiled their own guides for energy efficient housing. 32 rental apartment companies and funds have joined the energy efficiency agreement (see more information Motiva 2018b).

Helsingin kaupungin asunnot Heka Oy (the social housing services of the city of Helsinki) encourages its tenants to engage in tenant democracy activities, through which they can have their say in, for example, decisions on upcoming renovation projects.

The 14 regional and 1200 **local Martha unions of the Martha organization** (Marttaliitto) with around 50 000 members. The NGO provides advice in home economics for its members in cooking, gardening, chores and handicrafts. Moreover, the organization organizes events and cultural leisure pursuits.

The 15 regional associations of the **Finnish Association for Nature Conservation FANC** (Suomen luonnonsuojeluliitto) formed by 160 local associations working for bottom-up nature preservation. The organization is open for anyone interested in the nature and environmental issues. Currently, FANC has 30 000 members and the youth association The Finnish Nature League (Luonto-Liitto) 7 000 members.

The 20 **local associations of The Finnish Society for Nature and Environment** (Natur och Miljö) as well as their central organisation are active especially in the Swedish-speaking parts of Finland (Åland and parts of the southern and western coast). The organisation has in total approximately 3100 members.

The 256 **local associations of the Finnish Home Owners' Association** (Omakotiliitto) across the country inform and give guidance to their membership on home renovations and reparations in buildings.

The multiple **national and local consumer associations of Consumers' Union of Finland** (Kuluttajaliitto) organizing events on varied themes in local settings. Most events offer consumers information and guidance on how to deal with topical consumption related problems.

WWF Finland is an independent part of the international WWF network. In 2017, WWF Finland had 192 000 supporters and volunteers. WWF Finland works for protecting nature in Finland and the surrounding areas as well as in developing countries, strives for decreasing the environmental impact of human activities and offers environmental education and communication.

10.5.2.2 Organisations producing services for housing companies

Eneron Oy provides cloud-based tools to real estate owners and housing companies for smart property and energy management. The purpose is property portfolio management, but energy efficiency is seen as a key factor in good property management.

Finnish Clean Energy Association (Lähienergialiitto) will produce ten YouTube videos on the latest solutions in the field of energy and renewable energy targeted especially for housing companies, property owners, builders and renovators. These videos on small wind turbines, bio-boilers, small hydro power plants, heat-storing fireplaces, convection and pellet stoves, heat pumps, biogas and micro-chp power plants, hybrid heating, smart heating, geo energy systems, solar electricity

systems, and solar heating are published in cooperation with private companies and lobbyists of specific technologies (Lähienergialiitto 2018).

10.5.2.3 Organisations producing services for private companies and local service providers

Adato Energia Oy, owned by Finnish Energy, provides information and communication services for the actors in the energy industry; energy companies, electricity and district heating companies and network construction companies as well as energy administration organizations and authorities.

Finnish Clean Energy Association (Lähienergialiitto) has as its members associations, companies and individuals interested in promoting renewable energy. The objectives of the association are increasing the proportion of renewable energy sources to 50 % of energy consumption during 2020s, increasing smart energy efficiency and increasing employment, business and export.

Motiva has a **network of local energy consultants**. Motiva also gives consumers counselling on Asiaa energiasta (about energy) Facebook page, where the energy consultants answer questions on energy consumption.

Peloton Club started out as a project of **Sitra** but was continued afterwards as an initiative of the think tank Demos Helsinki. In the initial project, so-called energy gatekeepers, or individuals in position to make decisions guiding energy consumption, were trained to influence the choices and behaviour of the public. Currently Peloton Club provides tools and networks for startups working with resource wise and low emission solutions to issues connected to food, housing and transport.

Regional energy offices provide energy **counselling to the residents, municipalities and enterprises** and coordinate energy projects. The aim of the offices is to promote energy efficiency and the use of renewable energy. There are seven regional energy offices in Finland (e.g. Ekokumppanit & Valonia).

Finnish Energy (Energiateollisuus ry) is a branch organization for the industrial and labour market policy of the energy sector. It represents approximately 260 companies that produce, acquire, transmit and sell electricity, district heat and district cooling and offer related service. The organization supports energy decisions that mitigate climate change and supports development directing Finland towards low-emission energy-efficient solutions. Finnish Energy owns Adato Oy, which is a company providing energy companies training, communication and information services.

10.5.3 *Energy consciousness related projects and initiatives that have gained public attention during the recent years*

10.5.3.1 National programmes and initiatives

Energy efficiency agreements 2017-2025 are a part of the energy and climate strategy of Finland. Their purpose is to promote efficient energy use to fulfill the international energy efficiency requirements. Voluntary agreements are preferred in energy efficiency work over new legislation. The framework agreement has been signed by the Ministry of the Environment, the Ministry of Economic Affairs and Employment and Rakli (2018b).

Kuluttajaliitto has published a **handbook for an ethical consumer** in 2009, including examples on how to save energy in everyday life (Kuluttajaliitto 2009).

Ministry of the Environment and the **Ministry of Economic Affairs and Employment** shoulder the Programme to Promote Sustainable Consumption and Production (KULTU) that engages various stakeholders such as other ministries, research institutions, organizations, and businesses together with National Technology Agency and the Finnish National fund for Research and Development Sitra. Ministry of Environment has carried out a Programme to Promote Sustainable Consumption and Production "More from Less Wisely" (2013) that aims to reduce the environmental impacts and greenhouse gas emissions of households and the public sector. Moreover, Ministry of Environment has supported varied experiments under the KULTU-project.

Motiva launched a **campaign for solar energy for households** in early spring of 2018 (Motiva 2018a). The purpose is to promote the acquisition of solar panels of individual households and to provide information and advice on solar energy production.

The Finnish Environment Institute (SYKE) carried out a project **ECOHOME: Education, training tools and services to enhance sustainable household consumption** (2013-2014). The project developed tools, training and practices to communicate household specific greenhousegas (GHG) emissions, and to tackle the emissions in housing and everyday lifestyles. These tools were meant for house owners and managers in major renovations as well as housing companies (SYKE 2015).

The Finnish Innovation Fund Sitra has a focus area **Resource-wise citizen** (2016-2018) on promoting a change towards sustainability by encouraging Finns to make sustainable choices in everyday way of live, travel, eating and consumption, and by helping companies to develop competitive and sustainable products and services. During the funding programme, Sitra studied the readiness of ordinary people to change their habits. They collected information on the impact of everyday life decisions and carried out experiments promoting sustainable way of life. Targeted for the citizens, resource-wise citizen has published a list of 100 smart ways to live sustainably and an "Is your lifestyle good or bad for the environment?" online test to help them to reflect on the sustainability of their lifestyles. (Sitra 2018a.)

Sitra has previously supported and carried out varied projects focusing on changing energy behaviour. These include a survey on local energy services, promoting own energy production and group purchasing of local energy, promoting user-oriented energy renovation services, and studies on pioneer users of smart energy services and renewable energy (Sitra 2012).

Sitra and Fluxio Isännöinti carry out a project "Savings in housing cooperatives" (Säästöä taloyhtiöissä). In the project, the housing cooperatives try energy and water saving actions that are possible to carry out with small investments, as well as actions aimed at overcoming challenges of managing a housing cooperative. The 11 participating housing cooperatives carry out 14 different small experiments concerning saving energy and water, waste management and communication (Sitra 2018b).

10.5.3.2 Municipal and local programmes and initiatives

HINKU project "Towards carbon neutral municipality" is coordinated by SYKE. The involved municipalities (39 in 2018) are committed to reducing their greenhouse gas emissions and encouraging local businesses and residents to climate friendly actions. One of the initiatives within HINKU is organizing solar panel joint purchase possibilities for individual households.

Maaseudun asukkaiden energiatietoisuuden edistäminen (Enhancing the energy consciousness of residents in rural areas) is a project aimed at providing the rural area residents living out of the reach of district heating grid/network with information on renewable energy, different forms of heating and enhancing energy efficiency. The project is carried out by Centria University of Applied Sciences, Finnish Forest Centre and two rural development associations and local Leader action groups. The project takes place in the countryside in Central and Northern Ostrobothnia. The residents of the area are offered information on the forms of a Facebook site, seminars and being available of local fairs and other events (Centria 2018).

The city of **Tampere** ran a project called **ECO2 - Eco efficient Tampere** from 2010 to 2015. The purpose of the project was to unite different actors of the city to create an energy efficient city. There are several subprojects, services and initiatives handling the same themes and offering also consumer guidance in the Tampere region, including, for example, a free building and housing energy advice service **Rane** (2018) and **Ecofellows Ltd**, which produces information, consultation, training and expert services focused on sustainable lifestyle in the Tampere region. The company is owned by the city of Tampere, Tampere Region Solid Waste Management and Tampereen sähkölaitos (the electricity agency in Tampere) (Ekokumppanit 2018). In 2015 – 2017, Ecofellows ran an ERDF project **TARMO+ Low Carbon Housing Tampere Plus** (2018), aimed at housing cooperatives that plan structural renovations to their buildings in Tampere region. The project helped the cooperatives to find solutions that led to low carbon intensity/emissions and low costs.

The Covenant of Mayors EU programme has been signed by ten Finnish cities or towns, although only the city of Oulu has signed the continuation covenant. The covenant requires the cities to reduce their climate warming emissions by 20 % by the year 2020, and the continuation covenant requires their greenhouse gas emissions reduced by 40 % by 2030. The initiatives concerning individual residents and households include providing climate counselling to residents (Covenant of Mayors 2018).

Various **towns and cities** have their own projects promoting and assisting in energy efficient choices. For instance, the town of **Lappeenranta** offers its residents a net-based service for

examining the potential for renewable energy solutions for their house and for finding contractors that provide renewable energy systems and energy efficient solutions for residence buildings (GreenReality 2018).

10.5.3.3 Initiatives and support for energy efficiency / energy consciousness by NGOs

Green Building Council Finland is an association for promoting knowledge and expertise in sustainable development in real estate and construction industries, founded by actors in these fields. GBC Finland promotes environmental and energy efficiency for all levels of real estate and construction business, including the owners and occupants of the built environment (GBC Finland 2018).

Rakli is an association for real estate and construction sector owners and professionals. It is one of the responsible actors in the energy efficiency agreement in the real estate sector. Rakli manages the action programme for rented apartment communities (VAETS) (Rakli 2018a).

The Finnish Society for Nature and Environment has a current project focusing on the questions that residents of detached houses and summer cottage owners have on environmentally friendly heating options, aimed at the Swedish-speaking population in Finland. Questions are answered on their website, a Facebook group and in person – voluntary residents who have chosen an environmentally friendly energy production option open their homes in certain dates to show it to those interested and tell about their experiences (Natur och Miljö 2018).

The Martha organisation carried out a project "Adjust and save" (Säädä ja säästä) providing energy counselling for the membership in 2010. The aim of the project was to increase consumers' energy consciousness, disseminate basic knowledge on energy efficiency and other factors affecting climate change, such as waste. The counselling was available nationally and locally through energy advice hotline, advisory meetings, Martta magazine, and the organisations webpages.

10.5.3.4 Research

BeAware is a project carried out by **Helsinki Institute for Information Technology** (HIIT) and other European partners. The project developed Energy Life system utilizing wireless sensors, and a smartphone application turning energy consumers into active players (see BeAware 2009).

ENERGISE is a consortium research project by the Consumer Society Research Centre at the University of Helsinki and nine other partners. ENERGISE studies the current energy cultures by adopting a Living Lab approach. In the project, 27 Finnish experiments and initiatives targeting the energy use of residents or homeowners were listed as examples of good practice, alongside with examples from 29 other European countries (see ENERGISE 2018b).

Smart Energy Transition (SET) is a consortium research project by Aalto University School of business and seven other universities/research institutes and four other organisations. SET

analyses the ongoing global transition towards smart energy and its impacts on the Finnish society, and the potential benefits for cleantech, digitalization and bioeconomy. Moreover, SET studies examples of emerging smart energy business models and ecosystems (SET 2015). SET has published a list of 100+ energy experiments carried out in Finland during the recent years (Smart Energy Transition 2017).

10.6 Final considerations

- **The building stock in Finland is new, the standard level of insulation high and building automation widespread in Finland as compared to other European countries.** The long history of systematic building maintenance may make finding cost and resource effective solutions to improve energy efficiency in the building stock difficult to find. (ENERGISE 2018a.)
- **Ownership of the apartment** decides for how much of the energy costs are visible for the consumer. Housing companies instead of individual inhabitants have an important role in deciding for the renovations in blocks of flats. Heating, which makes a large part of the household energy consumption, is usually included in maintenance fees paid by the flat owner.
- **The type of house is an important segmenting factor.** Households living in detached houses have more power over their energy consumption than households living in blocks of flats or terraced houses. Individual and household segmenting factors (gender, age, education, income, and region) are important when explaining the differences in energy consciousness and interest towards energy issues.
- Recent studies on energy consumption and energy consciousness have addressed **two interesting segments: the pioneering users** (usually men, middle-aged or older, with education from the field of technology, living in detached houses in the countryside) **and the energy poor consumers** (pensioners and old people living in the countryside in old houses).
- **Motivational profiling could be a useful tool in consumer recruitment aside metrics on tenure status and apartment ownership.** Some recent studies such as Sitra and Palmu's report on motivational profiling of Finnish consumers (Sitra & Palmu 2018) represent a versatile idea of consumer motivations.
- **There are official networks promoting energy consciousness that could help in engaging the consumers.** Governmental organisations and NGOs in Finland have produced a wide selection of guiding material and different queries, based on which the consumer can evaluate the household energy consumption.
- **The campaigning for energy consciousness by environmental organisations and other organisations is less systematic than campaigning by energy-focused actors.** The existing networks should be used when recruiting consumers for the pilot phase of ECO2 as well as the subsequent recruitment.

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11. Greece

Sotiris Papadelis

HEBES Intelligence

11.1 Introduction

This section provides an overview on energy consumption and energy consciousness in Greece. It was conducted by HEBES Intelligence. The country report builds on: a) materials produced by relevant national stakeholders involved in the field of energy, and b) academic studies and articles related to energy consumption and energy consciousness that are published by researchers and organizations operating in the above field. The research was carried out mainly through web searches, searches on academic publishing websites, as well as in consultation with university laboratories that explore energy consumption and energy consciousness patterns.

The findings point towards an increase in interest for finding ways to conserve energy due to the effects of the economic recession on the disposable income, and a decrease in energy consumption, especially heating, due to economic issues. Those with high income are the most likely to invest in energy efficiency improvements. However, they also consume a greater amount of energy than lower income brackets. The age groups between 40 and 75 years are the most likely to embrace energy saving habits, while over 65-year-olds consume more heating energy. A literature review suggests that environmental awareness correlates with interest in reducing energy consumption (Sardianou 2007). Both thermal and electricity consumption is lower in rented apartments than in occupant-owned dwellings. There are findings that suggest that energy poverty is more common among detached house residents. As a rule, the insulation of houses is either insufficient or completely missing. The main heating system installed is central heating in 50.8 % of dwellings and an autonomous heating system in 48.6 % of the homes with 0.6 % of dwellings in a district heating system. A third of homes also have a secondary heating system such as, for example, a fireplace or portable heaters installed.

11.2 National frame for energy consumption

Greece is located in Southern Europe with a population of approximately 10 million. Over 3 million people live in its capital, Athens, which is also the largest city in Greece. The residential sector consumed 26.6 % of the total final energy in 2015, compared to 24.4 % in 2013 (European Commission 2017).

The long-term economic recession has heavily impacted energy use while altering trends related to energy consciousness. For instance, in order to reduce heating costs, lowering indoor temperature is a usual measure that occupants undertake, even if that leads to thermal comfort deterioration. As Balaras et al. (2016) find, only 28 % of the occupants in single-family houses and 27 % of the occupants in multi-family houses set indoor temperature at 20°C, which is considered

as the set-point used in normative calculations. The average (weighted) temperature reported among tenants, was 19.6°C during daytime and 16.9°C at night.

In addition, the economic recession in conjunction with the increase of heating oil prices due to taxation have led 25 % of the multi-family houses and 9 % of the single-family houses to turn off their central heating systems, while only 11 % and 8 % of the above categories (respectively) operate their heating systems continuously, with the rest operating it for less than 8 hours.

Lastly, another practice found that is commonly adopted by households relates to isolating certain rooms for lowering their energy bills. Consequently, only 33 % of single-family houses and 43 % of multi-family houses heat their entire dwellings, while the rest isolate specific indoor areas.

11.3 Socio-demographic differences in energy consumption in Greece

11.3.1 *Socio-demographic segmentation*

Only a few studies that include a clear socio-demographic disaggregation and are related to energy consumption have been conducted so far. Sardianou (2007) estimated the energy conservation patterns of Greek households through the development of an empirical model to investigate the main determinants of those patterns. The results show that socio-economic variables such as gender, educational level or marital status are not able to predict energy-conserving behaviour. At the same time, the analysis indicated that the consumers with higher incomes and those who own their houses are more likely to invest in energy efficiency improvement interventions.

“In most cases, consumers regard energy conservation as a sacrifice, in the sense that it requires a decision to restrain some energy consuming activities. The concept of approaching energy conservation as an investment is not widespread." (University of Piraeus, 2.7.2018.)

The national “Survey on the energy consumption in households” (Hellenic Statistical Authority, 2013) was conducted during October 2011 and September 2012 in representative samples from all four Greek First-level NUTS regions (EL3: Attiki, EL4: Aegean islands and Crete, EL5: Northern Greece and EL6: Central Greece). Among other aspects, the survey explored the frequency of certain energy conservation actions, such as:

- adjusting the heating thermostat to 18-20 °C during the winter period,
- adjusting the cooling thermostat to 26-28 °C during the summer period,
- using room thermostat’s auto-mode function for the cooling system,
- regularly performing maintenance of heating/cooling/air conditioning system,
- using laundry/washing machine at full load,
- opening windows, skylights, roof openings during the night in the summer for natural cooling,
- using awnings and other shading systems during the sunshine hours in the summer for sun protection,
- consulting energy labels when buying a new electrical appliance.

The results from the survey are indicative of the household percentages that choose (or not) to adopt measures leading to energy savings (Figure 17).

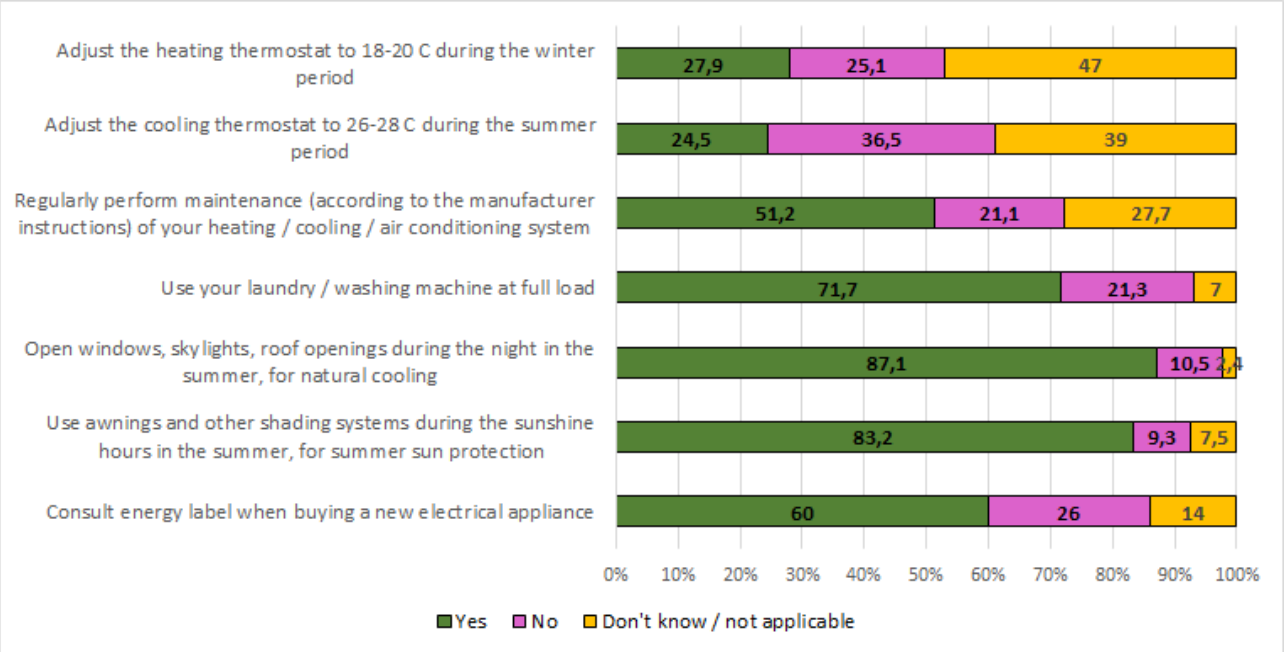

Figure 17. Behavioural practices towards efficient use of energy

Spyridaki et. al (2018) analysed the empirical data from the national "Survey on the energy consumption in households" and found that:

- As income increases, households tend to adopt energy conservation behaviours less frequently.
- Ages between 40-75 years constitute the cluster which is more likely (70 %) to adopt over half of the aforementioned energy conservation measures.
- Households with at least one member over 65 years old consume – on average – 8 % more thermal energy compared to households with no members over 65. In contrast, electricity consumption tends to be 17 % lower in households with at least one member aged over 65 compared to households with no members over 65 years old.
- Thermal consumption in rented dwellings has been found to be lower by 52 % in comparison to owned dwellings and by 47 % compared with dwellings that are provided for free. Electricity consumption in rented dwellings was 11 % lower compared to owned dwellings and by 1 % compared with dwellings provided for free.

Assessing the impact of the economic recession on electricity consumption patterns in Greece, Dagoumas and Kitsios (2014) find a lag in the effect of the first on electricity consumption. That implies that people change their habits and lifestyle only after some time in order to respond to the current economic conditions.

The increase in energy prices, in conjunction with lower household incomes due to the current economic downturn taking place in Greece for the past decade, has multiplied the number of vulnerable households and has exacerbated the issue of energy poverty in the country (Corovessi

et al., 2017). Using data from the National Statistic Authority and conducting a quantitative analysis on the fuel poverty in Greece, Atsalis et al. (2016) find a dramatic increase in fuel poverty levels since 2010; from 9-13 % in 2008, Greek households suffering from fuel poverty rose to 20-25 % in 2013 according to an expenditures-based approach. In addition, detached houses were found to suffer more from energy poverty; compared to apartments, energy poverty was identified at double rates in detached houses (Papada & Kaliampakos 2016).

11.3.2 *Social differences: energy consumers attitudes and behaviour*

Through conducting surveys in order to identify public perceptions around renewable energy sources, Ntanos et al. (2018) find a positive attitude towards renewable energy systems. The majority of the respondents proved to have a good knowledge of wind and solar technologies while their willingness to pay for a wider penetration of renewable energy sources into the country's electricity mix was estimated at 26.5 Euros per quarterly electricity bill.

Environmental awareness was also found to play an important role when it comes to the determinants of energy-conserving behaviour. Sardianou (2007) found that the diffusion of environmental information is a strong predictor of energy-conserving actions. This proves that strong pro-environmental attitudes predispose towards energy-conserving intentions.

"A large part of the interest for energy conservation in Greece comes from the effects of the economic recession on the disposable income. This could mean that ECO2 users would be interested primarily in low cost solutions or solutions with short payback period and in the scope of existing financial support schemes. At the same time, there is a need for the provision of guidance regarding the available options for improving energy efficiency, and the concept of energy efficiency overall. The most important financial support scheme for conservation measures is "Εξοικονομώ κατ' Οίκον". However, it is indicative of the way energy efficiency investments are approached in Greece that consumers go to their accountants to devise proposals for funding." (University of Piraeus 2.7.2018.)

11.4 Differences related to the built environment

11.4.1 *Climate conditions and their meaning for energy consumption*

The Greek climate conditions are characterized by a great variety of micro-climates and local variations. The Regulation for Buildings Energy Efficiency (2010) provides a disaggregation of the Greek territory in different climatic zones (Figure 18) according to the number of heating days. Papada and Kaliampakos (2016) show that when moving from the warmer zones (A and B) to colder climatic zones (C and D), the probability of being energy poor increases. Climatic zones C and D present high rates of energy poor households, exceeding 70 % and 80 % respectively (if the ratio of actual energy expenditure to before-tax income exceeded 0.10, the household was considered energy poor).

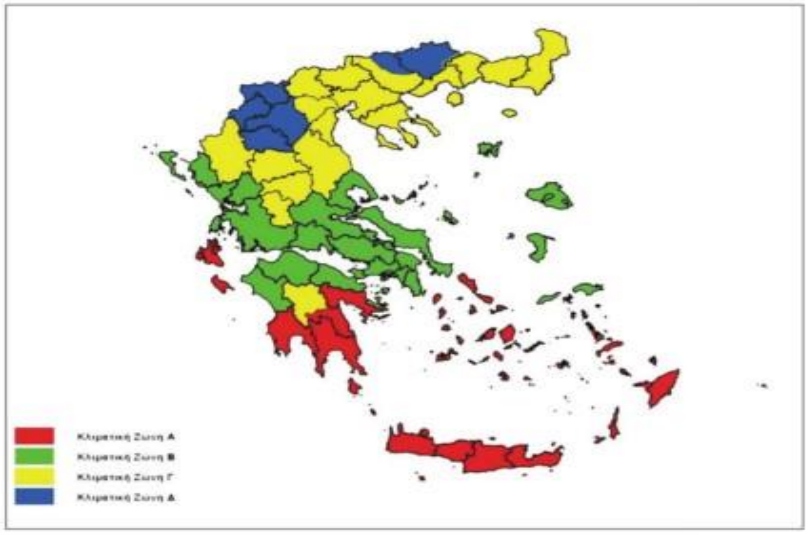

Figure 18. The four climatic zones of the Greek Territory

A further classification of the building stock based on the dwelling type (single-multi) and on the climatic zone they belong to, is provided in Table 4:

Table 4. Distribution of households by climate zones (number of buildings)

Number of single apartments	681	056	706	73
Number of multi-apartments	57	524	73	3

In terms of the energy consumption, every household consumes on average 13,994 kWh to cover its energy needs. 10,244kWh are used for thermal energy, while the rest for electricity consumption. Furthermore, space heating (63,7 %) and cooking (17,3%) account for 81 % of the total annual energy consumed, while oil and electricity are the fuel types that cover 44,1 % and 26,8 % of the energy needs respectively (Hellenic Statistical Authority 2013).

11.4.2 *Population characteristics and their meaning for energy consumption*

More than 4 million households exist in Greece. Among them 25.7 % has one member, 29.5 % has two members, while 19.8 % consists of three members (the rest being 4 members and above). 78.33 % of the population lives in urban areas with the rest (21.67 %) residing in rural ones. According to the survey from the Hellenic Statistical Authority (2013), energy consumption is significantly affected by the degree of urbanization of the area in which the household is located. Table 5 presents the annual average thermal energy and electricity consumption of a household by degree of urbanization.

Table 5. Percentage distribution of annual total energy consumption

	an areas	l areas
Thermal energy (kWh)	3	23
Electricity (kWh)	0	0

The graph below (Figure 19) presents a total energy consumption distribution by fuel type and degree of urbanization.

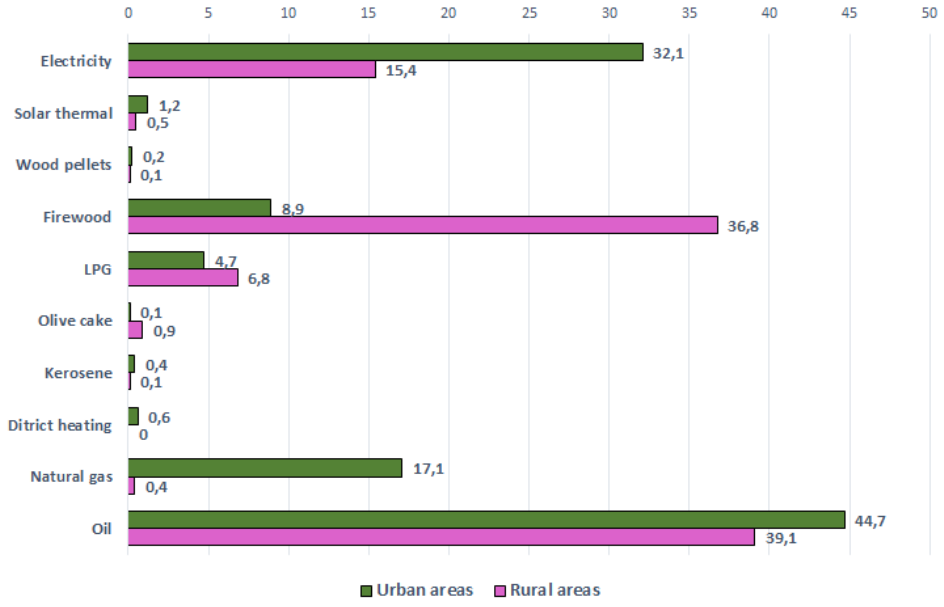

Figure 19. Total energy consumption distribution by fuel type and urbanization degree

11.4.3 *Common dwelling types in the national context*

According to the Hellenic Statistical Authority (2015), the total number of buildings in Greece amount to 4.1 million of which more than 2.9 million (79 % of the building stock) are used exclusively for residential purposes. The average dwelling surface is 84.8 m2. Moreover, 23.6 % of households live in dwellings with surface area up to 60 m2, 41.7 % with area between 61-90 m2 and 34.7 % in dwellings with area bigger than 90 m2.

A large part of the Greek residential fleet (41.5 %) has been built before 1979 (implementation year of the first building energy performance regulation for insulation measures) and even before 1960. As a result, 2.7 out of the 4 million buildings in Greece are deprived of basic insulation measures, while the rest are characterized of incomplete insulation (Center of Planning and Economic Research 2014). When insulation is present, it can be found in:

Table 6. Type of thermal insulation

Type	%
Ceiling / roof	38.5
Floor	2.9
Façade	77.8
Inner surface of walls	31.3
Supporting structure	18.3
Elsewhere	0.5
Do not know	1.4

Finally, 98.9 % of dwellings have some type of space heating system/equipment. During the winter (either 2010-2011 or 2011-2012), 50.8 % of households used a central heating system as their main heating system, while 48.6 % used an autonomous heating system (with 0.6 % using district heating). In terms of supplementary space heating systems, three out of ten households use supplementary heating systems with 32.3 % of them using fireplace, 28.2 % air conditioning split units and 26.5 % portable electric heaters. For domestic hot water production, 74.5 % use an electrical thermosiphon system, 37.6 % a solar thermosiphon system and 25.2 % a system linked to the central heating system (boilers) (Hellenic Statistical Authority, 2013).

11.4.4 *Access to smart equipment*

No data available.

11.5 Relevant stakeholders in promoting energy conscious behaviour in the national frame

The Greek field of energy consciousness stakeholders is relatively narrow. The largest part of the players on the field consist of governmental organisations. The NGOs supporting energy conscious behaviour comprise consumer organisations, while initiatives and programmes are led by governmental organisations. Various research institutes do research in fields related to energy issues.

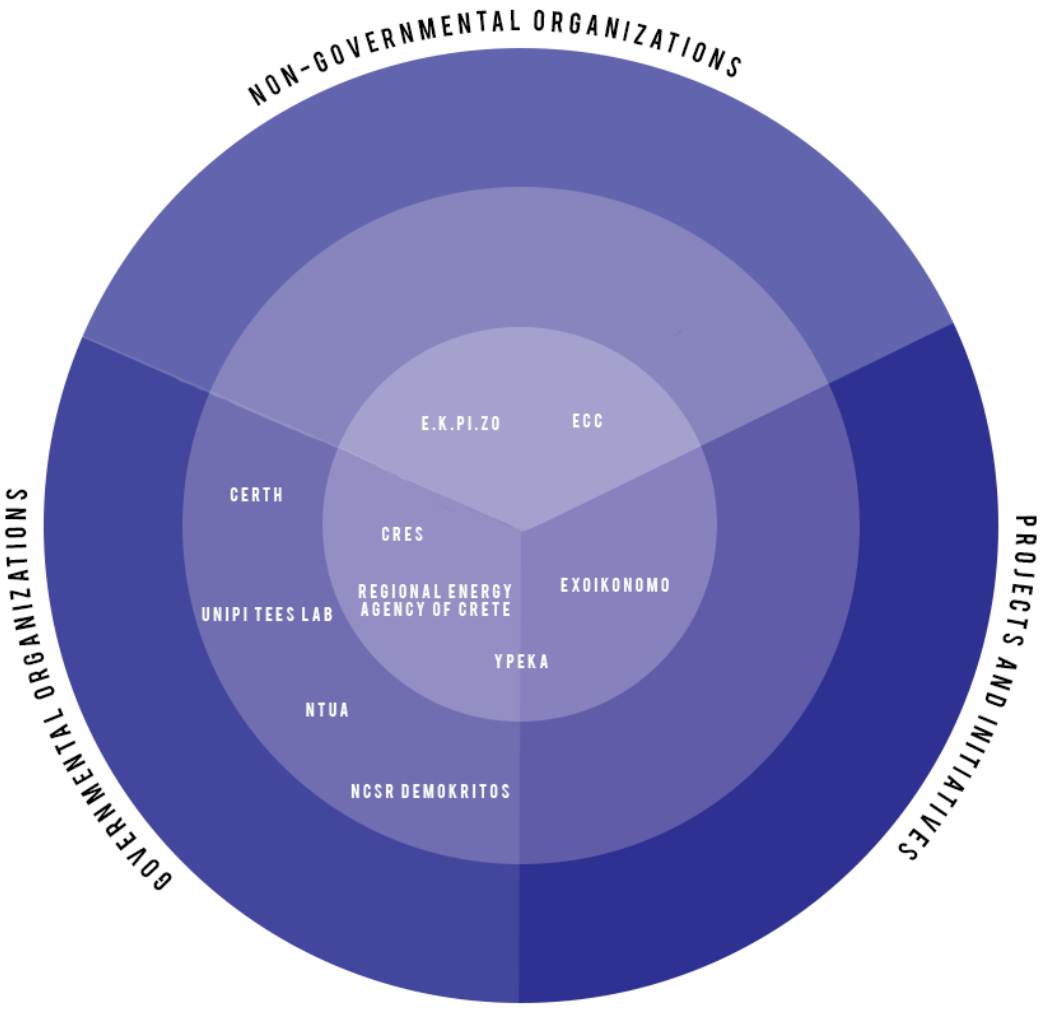

Figure 20. Greek stakeholders with interest in energy consciousness

11.5.1 *Institutions presenting national interest for promotion of energy consciousness*

11.5.1.1 Governmental actors promoting energy efficiency / energy consciousness

Ministry of Environment, Energy and Climatic Change (YPEKA): Represents Greece in energy and environmental matters with the EU and in other contexts of international cooperation. Among others, its strategic objectives are to improve energy efficiency and ensure the provision of reliable energy products and services.

Center for Renewable Energy Sources & Saving (CRES): The Centre for Renewable Energy Sources and Saving (CRES) is the Greek organisation for Renewable Energy Sources (RES), Rational Use of

Energy (RUE) and Energy Saving (ES). It is a public entity, supervised by the Ministry of Environment and Energy and has financial and administrative independence. Its main goal is the research and promotion of RES/RUE/ES applications at a national and international level, as well as the support of related activities, taking into consideration the principles of sustainable development (CRES, n.d.)

Regional Energy Agency of Crete: Founded in 1993 within the framework of implementing regional energy policy and in pursuit of establishing Crete as preferential area for extensive applications of Renewable Energy Sources in Europe and in Mediterranean the Regional Energy Agency of Crete (among others) promotes (through information, dissemination, awareness) projects, technologies, good practices and related applications and organizes training programmes, seminars, technical visits, conferences and to raise awareness of citizens, consumers and energy users(Regional Energy Agency of Crete, 2013).

11.5.1.2 Universities and research institutions working on energy consciousness

National Center for Scientific Research "Demokritos" (NCSR "Demokritos"): It is the largest multidisciplinary research center in Greece, with critical mass in expertise and infrastructure in the fields of Nanotechnology, Energy & Environment, Biosciences, Particle and Nuclear Science, Informatics and Telecommunications (NCSR, n.d.).

Center for Research & Technology (CERTH): One of the leading research centres in Greece and listed among the TOP-20 E.U. research institutions with the highest participation in competitive research grants. CERTH has important scientific and technological achievements in many areas including Energy and the Environment (CERTH, 2018).

EPU-National Technical University of Athens (NTUA): The oldest establishment in Greece to offer decision support services on energy policy issues at urban, regional, national and international level. Its core areas include: energy policy, energy planning, energy efficiency, renewable energy sources and environmental policy models (EPU-NTUA, n.d.).

TEES lab – University of Piraeus: TEES lab stands for Technoeconomics of Energy and Environmental Systems laboratory. TEES lab operates within the Department of Industrial Management and Technology of the School of Maritime and Industrial Studies of the University of Piraeus (UNIPI), one of the oldest and most prestigious business schools in Greece. TEES lab is a multidisciplinary scientific unit that carries out research on areas such as Energy efficiency technologies, technoeconomic analysis & evaluation of energy systems, analysis and modelling of energy consumer and producer behaviour (TEES lab, n.d.).

11.5.2 *Institutions with membership presenting possible interest towards promoting energy conscious behaviour*

European Consumer Centrer (ECC): The European Consumer Centre of Greece (ECC-Greece) was first launched in 2005, under the auspices of the General Consumer Secretariat of former Ministry of Development and Competitiveness. It operates as contact point for providing information to consumers as regards the requirements applicable relating to consumer protection and the contact details of associations or organisations, from which consumers may obtain practical assistance.

E.K.PI.ZO (Consumers' Association "Quality of Life"): EKPIZO was established in 1988 with the aim of protecting consumer rights and improving quality of life. It is a non-governmental, non-profit making association with more than 24,000 members and is supported by subscription fees and subsidies from the EU or other public institutions. Its policy areas include legal, economic, financial, insurance, health, food, environment, safety and consumer education issues.

11.5.3 *Energy consciousness related projects and initiatives that have gained public attention during the recent years*

The most important effort that supports energy conservation measures is called "Εξοικονομώ κατ' Οίκον" and is implemented by the Hellenic Ministry of Environment, Energy and Climatic Change (YPEKA) in financial cooperation with the EC. For households that meet certain criteria (e.g. income, property, and energy class related) they are eligible to receive interest free loans as well as variable grants. The energy conservation measures include thermal envelope interventions, external shading, upgrades of heating and domestic hot water production systems (e.g. energy efficient boilers, solar collector etc.). Another YPEKA program running since 2009, invited consumers to install photovoltaics on their roofs leading to approximately 45,000 installations having a cumulative capacity of 349 MWp. However, a feed-in-tariff cut (in 2013) in conjunction with a retroactive levy has resulted in a slowdown of interest for more installations (Balaras et al. 2016).

11.6 Final considerations

There are two main takeaways from the data presented in this section:

- A large part of Greek consumers are interested in finding ways to conserve energy. However, the measures most likely to be adopted are the ones that have either low initial costs or very short payback periods.
- There are no established organizations and communication channels that systematically communicate credible information on energy efficiency and conservation in Greece. In most cases, people get information through discussions in dedicated forums such as http://www.michanikos.gr/ (the Internet community of engineers), http://www.monachos.gr/ (for HVAC engineering issues) or http://www.energ.gr/ (mainly

for heating and cooling). A secondary source of (peer-to-peer) information is Facebook, where one can find groups sharing information on home improvements.

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12. Ireland

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12.1 Introduction

This section is a contextual document that provides an overview on energy consumption and energy consciousness in Ireland. It was conducted by the Department of Business Information Systems, Cork University Business School, University College Cork, Ireland.

The publications cited in this literature review were primarily sourced from national databases and digital libraries on energy consumption in Ireland. The list of cited publications includes official reports by public sector institutions with responsibility for collating statistics on Ireland's energy consumption and demographic trends, as well as academic and practitioner literature on energy consumption. For instance, we draw on findings from reports published by the Sustainability Energy Authority of Ireland, the Department of Communications, Climate Action and Environment and Ireland's Central Statistics Office. In addition, the literature review also draws on Irish data from the H2020 funded project NATCONSUMERS which aimed at raising consumer awareness on energy as a daily life concerns, and provoking direct actions by making consumption visible and summarizing it into tailored tips for energy consumption.

The findings point towards recent trends in energy consumption and energy consciousness in Ireland. While the literature review indicates some positive changes, such as a growing awareness of energy efficiency among Irish consumers and improvements in the Building Efficiency Ratings of certain property types (e.g. apartments in urban areas), there remains some disconcerting trends. For instance, the literature review suggests that energy poverty still constitutes as a considerable threat for Irish consumers, with more than a quarter of Irish households currently at risk of energy poverty (SEAI, 2017a). This points to the real need for new interventions to improve energy efficiency in Ireland going forward; in particular, interventions targeted at those most at risk of energy poverty. The findings suggest that education and transformational learning will be essential for improving energy consciousness. For instance, a survey conducted by SEAI (2017a) showed that 42 % of Irish consumers felt that they do not have enough information or do not know where to get information around how to reduce energy use through energy efficiency investments. Similarly, Healy and Clinch (2004) suggest that that over half of Irish households are unaware of the energy saving benefits that could by realized by retrofitting their homes. The remainder of the report points to additional findings around energy consumption and energy consciousness in Ireland.

12.2 National frame for energy consumption

The Republic of Ireland is a small country located in Western Europe with a population of around 4.7 million, 1.35 million of whom live in the nation's capital Dublin city.

Energy consumption in Ireland is primarily characterised by seasonal peaks during winter and troughs during the spring and summer months. For instance, the highest rate of energy consumption typically occurs during the months of December and January, followed by a gradual decrease in energy consumption between February and June; the rate of energy consumption then begins to gradually increase again between July and November, before reaching the annual peak in December and January (NATCONSUMERS, 2016a). Irish residents' estimated level of energy consumption was considered average compared to other Europeans (Tyndall National Institute, 11.05.2018, Sustainable Energy Authority Ireland (SEAI), 15.05.2018), but, on the other hand, not as good as the most progressive European countries (International Energy Research Centre (IERC), 18.05.2018, ENERGISE 30.05.2018). There was a sense that many Irish residents may not see the connection to their individual energy consumption and issues such as climate change. In addition, when other urgent concerns require attention, energy consciousness is typically forgotten in households (ENERGISE 30.05.2018). The Irish consumers have only recently started to gain energy consciousness with the introduction of building regulations (IERC 18.05.2018).

As regards weekly energy consumption trends, the NATCONSUMERS project found that the overall level of energy consumption in Ireland tends to be lower on weekdays and higher on weekends. In particular, the highest rate of weekly energy consumption occurred on Sundays. The lowest rate of electricity consumption was seen on Mondays, while the energy consumption rate rose to a slightly higher level on the other weekdays. Overall, Ireland represented the biggest deviation from the average daily energy consumption trends of all European countries surveyed by NATCONSUMERS (2016a) i.e. Ireland recorded the smallest consumption share ratio at night, and the highest in the late afternoon and early evening. Meanwhile, the peak time of the evening energy consumption in Ireland occurred at around 5-6 pm. This was followed by a downward tendency in energy consumption during the night until around 3-4 am and a small peak in energy consumption in the morning.

The NATCONSUMERS (2016a) report also provides useful insights into the typical profiles of energy consumption across different households in Ireland. Socio-demographic segmentation was applied to a database consisting of smart metre data from around 4000 Irish households; in turn, this data was used to create five separate CHAID models for five load curve-based segments (see Figure 21).

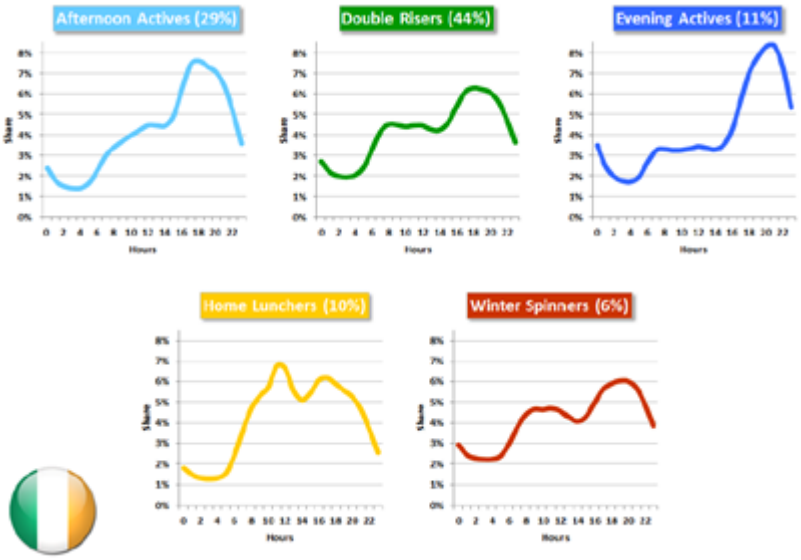

Figure 21. Load profile segments, daily share Ireland, 5 cluster solution, hierarchical clustering (NATCONSUMERS, 2016a)

Based on this profiling, three primary types of consumption patterns were identified in the NATCONSUMERS (2016a) report: (i) household profiles who record a big peak of energy consumption in the afternoon (i.e. Afternoon Actives) or in the evening (i.e. Evening Actives), (ii) households who records a small morning peak and an average afternoon/evening peak (i.e. Double Risers), and (iii) householders who record a strong bi-modality in their consumption, with two peaks of rather similar magnitude (i.e. Home Lunchers). The results from the NATCONSUMERS (2016a) report show that Irish households typically recorded a higher peak in forenoon energy consumption than afternoon energy consumption. Based on this finding, the report suggests that this forenoon peak indicates the presence of a household member who is based at home throughout the day. This additional profile segment is referred to as “Home Lunchers”. The Irish data also points to the presence of another profile segment referred to as “Winter Spinners” who record higher energy consumption rates, potentially due to the use of electric heating.

Ireland currently has higher level of energy usage per dwelling than the EU average (RTÉ, 2018). This statistic has been attributed to the inefficient insulation and heating systems of Irish households, and national weather conditions (Davies et al., 2014). Space and water heating is an important reason for energy loss (SEAI 15.05.2018). In light of these challenges, the Irish government has set an ambitious target of improving energy efficiency by 20 % by 2020 (DCCAE 2017). In order to reach this national target, the government has set aside significant amounts of capital to support businesses, households, and public sector organisations in implementing energy efficiency measures. In particular, the government has focused their efforts on ensuring that investments in building renovations can make to positive contribution towards a low carbon energy future for Ireland (DCCAE 2017). However, since first launching the energy efficiency incentive scheme, the government has conceded that the provision of attractive financing options is not enough to motivate people to undertake energy efficiency upgrades and further measures are needed to encourage behavioural change and action (DCCAE 2017). Similarly, Davies et al.

(2014) found that based on the results of their Irish Lifestyle Survey, less than 5 % of respondents had availed of grants or subsidies in the last five years.

The Sustainable Energy Authority of Ireland's report on "Behavioural insights on energy efficiency in the residential sector" (SEAI 2017a) points to a number of attitudinal and behavioural trends in sustainable energy consumption in Ireland. Based on their survey of Irish households, the SEAI found that 71 % of household owner-occupiers in Ireland consider energy efficiency an important issue worth addressing (SEAI 2017b). However, the results suggest that consumers have different drivers for making investments in energy efficiency. For instance, 61 % of consumers said their decision to invest in energy efficiency was primarily driven by a desire for comfort, while 41 % said that their decision was primarily driven by how easy it was to arrange the process (SEAI 2017b). In addition, Hyland et al. (2013) suggest that there is a positive relationship between BERs and property value at the time of sale, a factor which SEAI (2017b) found that 54 % of consumers stated was an important driver for making investments in energy efficiency. Figure 22 provides an overview of 8 Irish consumer segments in the residential sector based on a survey conducted on behalf of the SEAI (2017a).

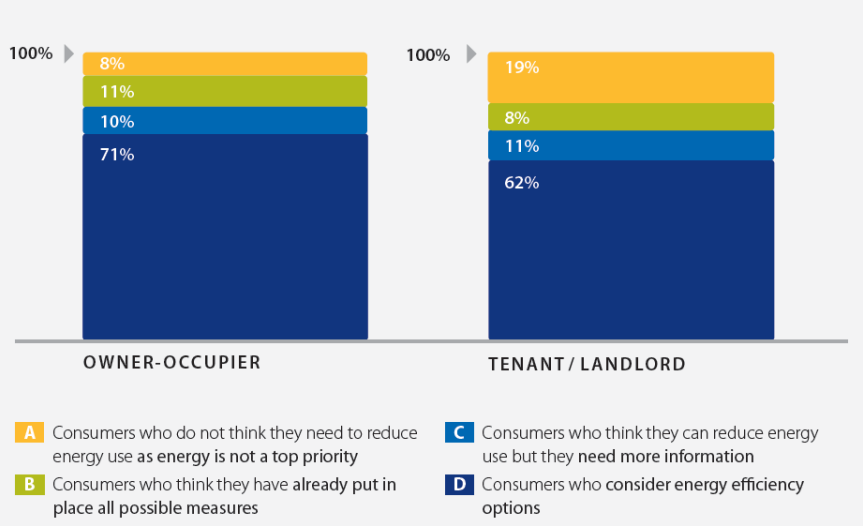

Figure 22. Consumer segments in the residential sector (SEAI, 2017a)

The SEAI (2017a) find that homeowners are increasingly aware to the benefits that can be accrued by completing retrofits of their property to increase energy efficiency. Retrofitting was seen as the most or one of the most important ways for households to save energy (IERC 18.05.2018, ENERGISE 30.05.2018). However, changes are needed in the techniques of doing the retrofits (ENERGISE 30.05.2018). The availability of information and local opportunities to undertake retrofits were identified as important factors for increasing the householder's interest in undertaking retrofits to increase energy efficiency. However, private landlords were found to be less likely to invest in energy efficiency due to split incentives (i.e. tenants are responsible for the energy bills while landlords are responsible for investment in the property) and short-term tenancies (DCCAE 2016). The SEAI contend that targeted subsidies could potentially address this challenge, as well as well as setting minimum standards for energy efficiency in the rental sector.

Another concerning issue centres on the statistic that over 25 % of Irish households could be at risk of energy poverty (SEAI 2017a). For the most part, energy poverty in Ireland is driven by the poor BER of many properties, particularly those in significant need of renovation. For instance, Healy and Clinch (2004) find that damp housing conditions (including mould on walls, floors and ceilings) and the presence of condensation on the walls, ceilings and windows is strongly associated with energy poverty in Ireland. This also points to a significant public health issue given the adverse effect that such conditions can have on the wellbeing of inhabitants. The SEAI and DCCAE both assert that households at risk of energy poverty could benefit from specialised grant and pilot programmes to increase energy efficiency. For instance, those at risk of energy poverty could benefit in particular from investments in "attic and cavity wall insulation, ventilation, draught proofing, lagging jackets, energy efficiency light bulbs and energy advice" (DCCAE 2017, 11).

As pointed out by the SEAI (2017c), energy prices in the Irish market have fallen by 1.8 % in real terms since 2010 which represents a smaller decrease in energy prices compared to other European countries in the OECD (average fall of 4.1 %) and the United States (average fall of 17 %). The SEAI (2017c, 45) suggest that a primary reason why Ireland's energy prices continue to remain higher than the OECD Europe and US average is due the country's "heavy dependence on imported oil and gas as these were the main drivers of global energy prices over this period". For instance, DCCAE (2017) assert that oil accounts for 34 % of residential fuel consumption, which is due in part to rural households' reliance on oil fired boilers for space and water heating. Consequently, the Environmental Research Institute (2015) suggest that Ireland is vulnerable in terms of its energy security due to import dependency (88 % of its energy requirements are imported), low fuel diversity (oil makes up 59 % of total final consumption), and volatile energy prices.

In order to address Ireland's heavy dependency on fossil fuels such as oil and gas, the DCCAE (2017) suggest that Irish households must first invest in upgrading their building fabric to the best possible standard. They assert that deep fabric upgrade would help households move away from fossil fuels to more renewable technologies while maintaining levels of comfort. In addition, they suggest that grants for heat pumps and insulation would help encourage homeowners to make changes in the long run. However, Davies et al. (2014) point to a number of behavioural challenges which impede the ability of homeowners to make energy efficiency changes, this includes: low visibility of energy consumption in the home; unconscious routines in heating practices; and rising societal expectations for higher, standardised indoor temperatures. In addition, the segment that is most dependent on carbon intensive fuels are the poorest households, who are not only energy poor but income poor in general (Tyndall National Institute 11.05.2018). Empirical evidence can be found between income, employment status, energy poverty, and low building energy rating (SEAI 15.05.2018). Harold et al. (2015) study of gas consumption in Irish households found that demand side management stimuli such as smart metering can help reduce daily household gas use on average.

12.3 Socio-demographic differences in energy consumption in Ireland

12.3.1 *Socio-demographic segmentation*

Gender

Lavelle and Fahy (2015) found that women were more likely to consider themselves environmentally sensitive when it comes to energy consumption. In their descriptive analysis, they found that 57 % of women and 43 % of men were categorised in the "True-Greens" group. However, Lavelle et al. (2012) found that there was little variation between men and women in terms of reducing their energy use (46 % of female respondents reported that they had reduced energy use in the last month, while 44 % of male respondents reported that they had reduced energy use).

Age

According to the Interactions Research (2017) report, people with an older age profile are most likely to have highly pro-environmental attitudes, actions, and aspirations, while those aged 18-35 are more likely to be unconcerned about the environment or think about energy use. People aged 35+ were categorised as "distracted believers", in that they are aware of issues around energy consumptions but reject lifestyle changes. In addition, the Department of Communications, Climate Action, and Environment (DCCAE 2016) found that individuals in the 65+ age group are more at risk of energy poverty as they tend to live in properties with poor Building Energy Ratings (BER) and have fixed levels of income.

Education

Interaction Research (2017) and Lavelle and Fahy (2015) assert that people with a college or university degree are more likely to be environmentally sensitive in their energy consumption or categorized as moderately green. People with a college or university degree are also more likely to be categorized in the technology fan segment.

Income

The CSO (2017d) stated that the average gross household income in Ireland is nearly €1,100 per week. This represents an increase of 7.1 % compared to the €1,026.77 figure recorded in 2009-2010. In addition, differences between the gross household income levels of the highest and lowest income households in Ireland has lessened since 2009-2010. The unemployment rate has also lowered in recent years, and in 2016 12 % of females, and 13.7 % of males were unemployed.

The SEAI (2017a) asserts that low income groups (i.e. unemployed, retired, other not in labour force) are most vulnerable to energy poverty, while Davies et al. (2014) find that individuals in the lowest income brackets were the least willing to sacrifice personal comforts to save energy. Similarly, an Interaction Research (2017) report commissioned by the SEAI found that people categorised in the C1 social class (i.e. lower professionals) are more likely to reject lifestyle

changes that would improve energy efficiency, despite acknowledging that there are issues around energy consumption.

The Irish are cost conscious rather than energy conscious (Tyndall National Institute 11.05.2018). Low and middle income households are probably motivated to save energy by the possibility to also save money, while the high income brackets value comfort over money (SEAI 15.05.2018). This suggests that cost is a greater driver of energy consumption than environmental awareness for those in lower income brackets.

Place of Residence

According to the CSO (2017e), 611,877 people owned a house outright (up 8 % since 2011), 535,675 people owned a house with a mortgage (down 8.1 % since 2011), while 467,111 people were in rented accommodation (up 4.7 % since 2011). The SEAI (2017c), also state that overall final residential energy demand (adjusted for weather variation), increased by 6.5 % (annual average growth of 3.2 %) between 2014 and 2016. Figure 23 illustrates the final residential energy demand in Ireland between 1990 and 2016. SEAI (2017a) estimate that around 1 million Irish homes need energy efficiency improvements, and in many cases deep level interventions.

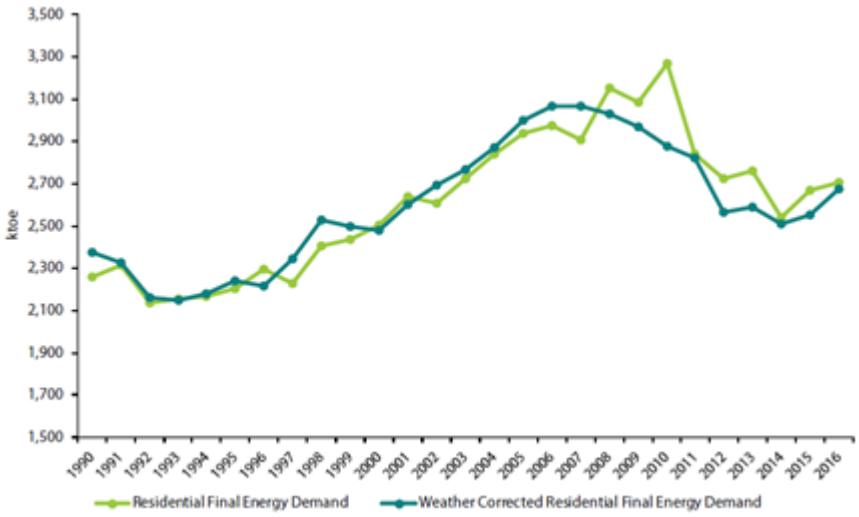

Figure 23. Residential Final Energy Use by Fuel (SEAI, 2017c)

The SEAI (2017c) note that the main driver for increased residential energy consumption was the increase in total floor area of the housing stock. They assert that the total floor area of all occupied dwellings increased by 103 % between 1990 and 2016 as the total number of dwellings increased by 74 % and the average floor area per dwellings increased by 17 %. Moreover, the SEAI (2017c) note that population growth was a primary driver of the increased number of dwellings and a reduction in the average number of people per dwelling.

12.4 Differences related to the built environment

12.4.1 *Climate conditions and their meaning for energy consumption*

According to Met Éireann (2018), Ireland's national Meteorological Service, the country's average annual temperature is around 9°C. The mean daily maximum in the summer reaches around 19°C while the mean daily minimum is about 2.5°C in the winter months (Met Éireann, 2018). However, the middle and east of Ireland generally records slightly higher temperatures than other locations in the country. The highest total duration of daily sunshine is usually recorded in the southeast of the country. Strong winds tend to be more frequent in winter than in summer. Finally, Met Éireann (2018) state that average rainfall levels in Ireland varies between about 800mm and 2,800mm. Rainfall tends to be at its highest level in the winter months and at its lowest level in the early summer months.

Overall, Ireland experiences more moderate temperatures compared to other European countries at similar latitude. Nevertheless, seasonal weather changes during the year still have a significant impact on energy usage in Ireland. Harold et al. (2015) assert that weather is the most influential factor on household's daily gas consumption in Ireland; in particular, they found that rainfall had a significant impact on Irish household demand for natural gas. Temperature also has an effect on heating usage; according to the SEAI (2017c), temperatures were milder in 2016 which resulted in 6.5 % less heating degree days being recorded. However, above average levels of heating usage were still recorded between the months February and May and again in the month of November, while heating usage was at an average level for the rest of the year.

12.4.2 *Population characteristics and their meaning for energy consumption*

McLoughlin et al. (2012) suggest that there is a strong relationship between household appliances and total domestic energy consumption in Irish households. In particular, they find that tumble dryers, dishwashers and electric cookers had the greatest influence on maximum electricity demand. The study conducted by Leahy and Lyons (2010) points to some of the factors which effect the ownership of high energy consuming appliances in Ireland. The authors suggest that the occupants of apartments and bedsits are most likely to own a tumble dryer as they may not have access to a garden to dry their clothes outdoors while, households with a large number of residents are more likely to own a tumble dryer, dishwasher, or deep freezer. In addition, Leahy and Lyons (2010) found that if household disposable income increases by 10 %, the probability of a dishwasher being present in the household increases by 18 %

Leahy and Lyons (2010) also suggest that households located in urban areas are more likely to have more high energy consuming electrical appliances than their rural counterparts. According to the CSO (2017f), the urban population of Ireland stood at 2.9 million (63 % of the population) in 2016 while the rural population totalled 1.8 million (37 % of the population). The total urban population of Ireland increased by 4.9 % since the last census in 2011, whereas the rural population recorded a more moderate increase of 2 %. Based on these statistics, Ireland's

population can be categorized as predominantly urban and seems to become increasingly more urban overtime.

In addition, there is a noticeable difference between urban and rural areas in terms of Building Efficiency Ratings. According to the CSO (2018), urban properties in Dublin tend to have a higher Building Energy Rating (BER) that properties in other Irish counties. For instance, the CSO (2018) state that in Q4 of 2017 Dublin County accounted for the highest percentage of properties with "A" and "B" rating, at 24 %. This may in part be due to the lower average age of properties in Dublin county (27 years) compared to the national average of 32 years in the rest of the country. In particular, properties located in Dublin, postal district 18 recorded the highest proportion of combined "A" and "B" rating for Dublin county at 39 %. In contrast, Offaly, Limerick City and Roscommon recorded the lowest percentage of properties with "A" and "B" rating at 7 %. Figure 24 presents estimates on the Irish regions most at risk of energy poverty (SEAI 2017a). The province of Ulster in Northern Ireland is estimated as having the highest level of energy poverty, followed by counties in the Connaught province (excluding Galway City and County), and Munster province (excluding Cork county). Meanwhile, Leahy and Lyons (2010) find that the prevalence of energy-saving features such as double-glazed windows are higher in urban areas than rural areas, which may contribute in part to this divide. Davies et al. (2014) also found that rural homeowners felt more entitled to use as much energy as they wished, in contrast to urban homeowners who were more conservative with their energy use.

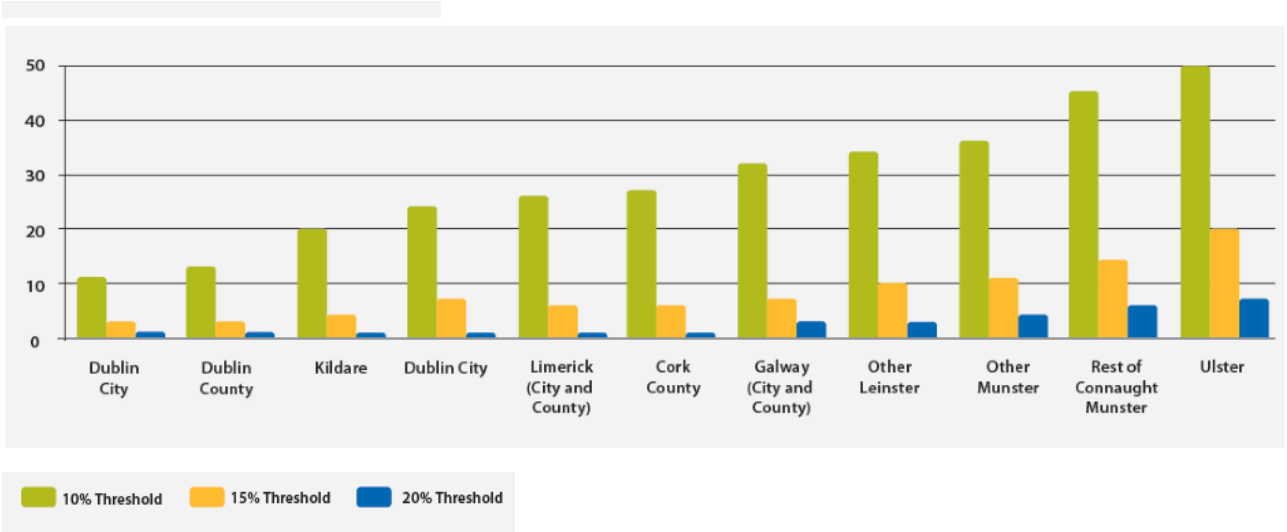

Figure 24. Bottom-up estimate of energy poverty in Ireland (SEAI, 2017a)

12.4.3 *Common dwelling types in the national context*

The CSO (2017e) assert that in 2016, detached houses accounted for 40 % of dwellings in Ireland, whereas semi-detached houses accounted for 28 % of households. Apartments accounted for a lower percentage of dwellings nevertheless, results from the 2016 census show that apartments are continuing to grow at a faster rate than any other type of accommodation type in Ireland.

Energy loss of the dwellings is usually due to poor insulation and draught caused by windows and doors in need of repair. Inadequate orientation of houses, for example large windows facing north, is another part of the problem. (SEAI 15.05.2018.) Harold et al. (2015) found that Irish houses built pre-1981 demand comparatively more gas daily than houses built post-1981. The SEAI (2017c) in contrast assert that 94 % of new houses built between 2015 and 2017 were A rated. However, Davies et al. (2014) caution that despite the recent improvements in BER, household electricity consumption continues to expand as households are becoming larger and accommodating fewer people. This means that on a whole, energy consumption is only decreasing incrementally. House owners who have received SEAI's 'better energy homes' grant are supported in their efforts of improving their house by insulating or updating the heating controls of their home, which makes these home owners more advanced in energy efficiency matters than their peers. To be eligible to the programme, the house of the home owner must be built in or before the year 2006. (SEAI 15.05.2018)

The Department of Communications, Climate Action, and Environment (DCCAE 2016) and Economic and Social Research Institute (ESRI, 2015) state that people in rented accommodation are twice as likely live in a house with a BER of E, F, or G, which means that they are more at risk of energy poverty. Similarly, Leahy and Lyons (2010) find that rented accommodation and local authority housing are less likely to have double glazing and other energy efficiency measures.

There is a large number of buildings dating back to the 1950s and 1960s with a poor BER and are in need of major retrofitting to improve energy efficiency (IERC 18.05.2018, ENERGISE 30.05.2018). The share of new buildings constructed in the last ten years is low, and there are approximately 800,000 households using oil (IERC 18.05.2018).

Finally, the NATCONSUMER (2016a) report suggests that across all five Irish load-profile segments, the variable of "household size" (i.e. the number of people living in a household) was the most decisive socio-demographic factor impacting annual energy consumption volume. This was followed by the variable "number of bedrooms in the dwelling" (i.e. the surface area of the household). Other variables listed in the report that can potentially affect yearly energy consumption volume include: dwelling type and the number of economically active people in a household (NATCONSUMERS 2016a). Similarly, McLoughlin et al.'s (2012) study of smart metre data from Irish households found that dwelling type, number of bedrooms, head of household age, household composition, social class, water heating and cooking type all had a significant influence over total domestic electricity consumption. Leahy and Lyons' (2010) study of Irish households suggests that the methods of space and water heating employed by homeowners also has a significant impact on domestic energy usage, over and above that of electrical appliances. Meanwhile, Davies et al. (2014) also point to statistics which suggest that space heating, domestic hot water, and appliances and lighting account for the highest level of home energy end-use within Irish households.

12.4.4 *Access to smart equipment*

The adoption of smart home equipment in Ireland is low relative to some other European countries; however, adoption is expected to increase in the future. A recent survey carried out by the marketing firm iReach Insights (2018), suggests that around 10 % of Irish homeowners have installed smart equipment (i.e. devices for controlling lighting and heating in the household using a smartphone or computer) in their home, and a further 34 % are likely to implement smart home technology in future. According to the survey, the primary motivation for using smart equipment is convenience, with 83 % of respondents noting that the use of such technology 'makes life much easier' (iReach Insights, 2018). However, attitudinal barriers to the adoption of smart equipment in the home remain; 45 % of survey respondents said they fear that potential hackers could steal data from smart home equipment to analyse patterns around their daily habits while, 36 % expressed concern that smart home equipment could be used by hackers in an attempt to spy on them (iReach Insights, 2018). 48 % also stated that smart home equipment is too expensive; nevertheless, 49 % of respondents believe that such technology offers more advantages than disadvantages (iReach Insights, 2018). Finally, 18 % of those surveyed by iReach Insights said they use an "Intelligent Voice Assistant" such as Apple's Siri, Amazon's Alexia, or Google's Assistant to control their lighting, heating, while 68 % state that such apps are useful for improving energy efficiency (iReach Insights, 2018).

The Commission for Energy Regulation (CER, 2017) have launched an initiative to rollout around 2.3 million electricity smart meters in Irish homes and businesses across the country over the coming years. These new smart meters will replace the mechanical meters currently installed in most Irish households with the aim of increasing energy efficiency. Customers of Irish energy providers such as Energia1 and Bord Gáis Energy2 can also avail of the free installation of smart thermostats such as Hive Active Heating and Netatmo in order to improve their energy consumption. These offers are advertised to customers online as innovative means to monitor energy. There seems to be a growing appetite for investments in energy conscious technology; for instance, the DCCAE (2016) assert that at the end of 2015 119,705 households had availed of supports to upgrade their homes through the use of energy efficiency measures. Paper bills are a more effective way of increasing energy consciousness than electronic billing. Consumers are more likely to study a bill sent to them by post than to sign in on their email or a web-based service to learn about their energy consumption (SEAI 15.05.2018).

When introducing energy saving appliances, there is a risk of rebound by a prolonged use of the energy consuming device, for example leaving a water boiler or light on for a long period of time, or the saved money might be transferred into an increased consumption of other energy consuming activities (Tyndall National Institute 11.05.2018, ENERGISE 30.05.2018).

There are different interpretations to what smart energy services are. For example, combined heat and power and district heating are listed as important smart services (Tyndall National Institute 11.05.2018), as well as community energy schemes, such as district heating project at Cloughjordan community (ENERGISE 30.05.2018). There are good experiences in gas energy saving

by smart heating controls from the UK that might be of use in Ireland, too, but there is little practical evidence of them in the context of Ireland (SEAI 15.05.2018).

12.5 Relevant stakeholders in promoting energy conscious behaviour in the national frame

A central organisation in the field of energy consciousness is Sustainable Energy Authority of Ireland (SEAI) which among its activities runs several individual projects. However, there is a representation of various organisations over the field of public, private and non-governmental sector. There are also intersectoral services and initiatives.

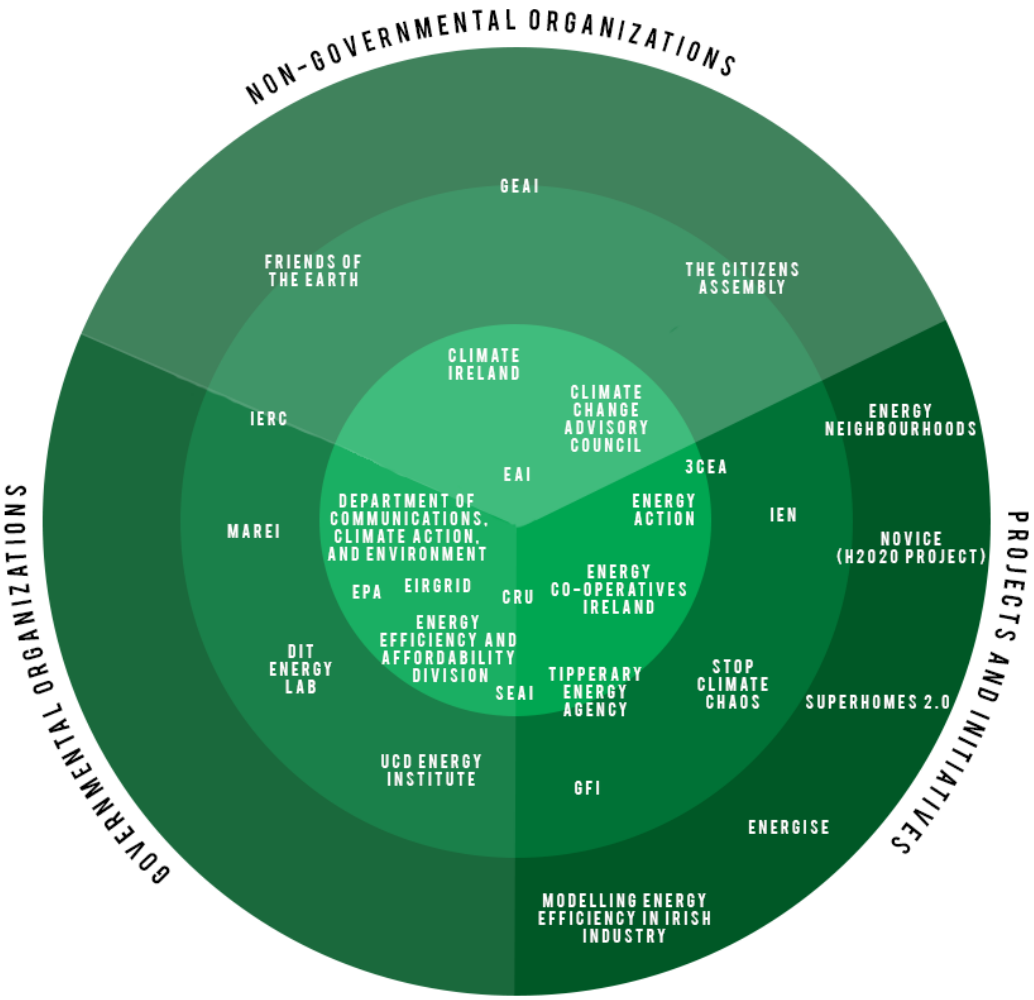

Figure 25. Irish stakeholders with interest in energy consciousness

12.5.1 *Institutions presenting national interest for promotion of energy consciousness*

12.5.1.1 Governmental actors promoting energy efficiency / energy consciousness

Sustainable Energy Authority of Ireland (SEAI) is Ireland's national sustainable energy authority. Their vision is to leading Ireland's transition to smarter and more sustainable energy activities through grants, promoting energy efficiency, and educations. https://www.seai.ie

Department of Communications, Climate Action, and Environment is a government department responsible for communications, Climate Action, Environment, broadcasting, energy, natural resources and postal services. It is headed by Minister Denis Naughten and Minister of State Seán Kyne. www.dccae.gov.ie

Environmental Protection Agency is an independent public body established under the Environmental Protection Agency Act, 1992. The EPA is at the front line of environmental protection and policing and aim to ensure that Ireland's environment is protected by monitoring changes in environmental trends to detect early warning signs of neglect or deterioration. https://www.epa.ie/

Commission for Regulation of Utilities (CRU) is Ireland's independent energy and water regulator and has a wide range of economic, customer protection and safety responsibilities. The strategic objectives of the CRU and its Mission, Vision and Values will remain focused on protecting the interests of the public in terms of safety, energy security and consumer rights. https://www.cru.ie/

The Energy Efficiency and Affordability Division is responsible for drafting and implementing policy measures to help Ireland reach a target of a 20 % improvement in energy efficiency by 2020. This represents a primary energy saving of 31,925GWh. https://www.dccae.gov.ie/en-ie/energy/topics/Energy-Efficiency/Pages/default.aspx

12.5.1.2 Universities and research institutions working on energy consciousness

International Energy Research Centre (IERC) is an industry-led collaborative research centre in the field of integrated sustainable energy systems, and is jointly funded by the Irish government and industry members. http://www.ierc.ie/

University College Dublin (UCD) Energy Institute aims to deliver world-class energy research and to make a significant contribution to the optimisation, integration and deployment of low carbon energy. http://www.ucd.ie/energy/

Centre for Marine and Renewable Energy (MaREI) is the marine and renewable energy research, development and innovation Centre supported by Science Foundation Ireland. It combines the expertise of a wide range of research groups and industry partners, with the shared mission of solving the main scientific, technical and socio-economic challenges across the marine and renewable energy sectors. http://www.marei.ie

Dublin Institute of Technology (DIT) Energy Lab is a leader in science and engineering energy research in Ireland with an associated staff of fourteen academics, four full time researchers, fifteen full and part time PhD researchers and three MPhil researchers. http://www.dit.ie/dublinenergylab/

12.5.2 *Institutions with membership presenting possible interest towards promoting energy conscious behavior*

12.5.2.1 Organisations with citizens as members

Friends of the Earth campaigns for environmental justice and sustainability. We believe in sustainable development - meeting the needs of the current generation without compromising the ability of future generations to meet their needs. https://www.foe.ie/

The Citizens' Assembly is an exercise in deliberative democracy, placing the citizen at the heart of important legal and policy issues facing Irish society today. With the benefit of expert, impartial and factual advice the 100 citizen members will consider the topics below, and any other matters that may be referred to them. https://www.citizensassembly.ie/en/

12.5.2.2 Organisations producing services for private companies and local service providers

EirGrid is a state-owned company that manages and operates the transmission grid across the island of Ireland. The grid also supplies the electricity distribution network. This powers every home, business, school, hospital, factory and farm on the island. http://www.eirgridgroup.com

Climate Ireland provides informational support and advice to help organisations, sectors and government to adapt to the now inevitable consequences of climate change https://www.climateireland.ie/#!/

Electricity Association of Ireland (EAI) is the authoritative voice of the electricity industry on the island of Ireland. Their members comprise the main producers, suppliers and distributors of the electricity upon which the island depends. EAI's vision is a sustainable future powered by electricity. https://www.eaireland.com/

Climate Change Advisory Council is an independent advisory body tasked with assessing and advising on how Ireland can achieve the transition to a low carbon, climate resilient and environmentally sustainable economy. http://www.climatecouncil.ie/

12.5.3 *Energy consciousness related projects and initiatives that have gained public attention during the recent years*

12.5.3.1 National programmes and initiatives

Better Energy Communities Scheme programme assists energy efficiency community projects through capital funding, partnerships, and technical support. The scheme seeks to encourage communities to band together to become more active and aware of the energy they use and their potential for working together to reduce it. https://www.seai.ie/grants/community-grants/

SEAI Education Scheme engages with schools and teachers across Ireland to help teach students about saving energy at school and at home, sustainability and climate change. https://www.seai.ie/teaching-sustainability/

Power of One campaign was launched in September 2006 with the aim of boosting energy-efficient behaviour. The campaign aimed to increase awareness of energy efficiency issues and push towards a more efficient behaviour. The campaign targeted energy consumption including use of natural gas, electricity and transport fuel (petrol and diesel) both at home and at work. https://www.esri.ie/pubs/WP280.pdf

CRU Energy Consumers Forum continue to engage through its Energy Consumers Forum, with Non-Governmental and charitable organisations active in tackling poverty to ensure the views of these bodies inform CRU decision-making on consumer issues.

Energy Efficiency Obligation Scheme mandates energy suppliers to support energy efficiency projects in businesses and homes across Ireland. https://www.seai.ie/energy-in-business/energy-efficiency-obligation-scheme/

Deep Retrofit Programme aims to establish how best to support deeper levels of renovation in the residential sector, with a view to gaining practical experience of how to develop a residential energy efficiency offering post-2020 https://www.seai.ie/grants/home-grants/deep-retrofit-programme/

Warmth and Wellbeing Scheme is a joint energy and health policy initiative providing deep measures to people with chronic respiratory conditions and including a specialised research project to measure the health and wellbeing benefits of energy efficiency https://www.seai.ie/grants/home-grants/warmth-and-wellbeing/

12.5.3.2 Municipal and local programmes and initiatives

Energy Action was established in 1988 as Ireland's first community-based energy project to address the problem of fuel poverty in Dublin. https://energyaction.ie

Energy Co-Operatives Ireland supports community based renewable energy co-operatives at every stage of their development, guiding them through the legal process of setting up a co-operative, advising them on their dealings with state agencies, introducing them to our network of

co-operatives where they can learn from best practice examples, helping them communicate their message locally and nationally. http://www.energyco-ops.ie/

Tipperary Energy Agency has been successfully supporting Tipperary to reduce its energy demand for 20 years. The agency has a proven ability in enabling people, communities and the public sector to become more sustainable in their energy use. https://tippenergy.ie/

3CEA is a non-profit, independent energy agency working primarily in Carlow, Kilkenny and Wexford. They have a voluntary Board of Directors drawn from the private, public and community sectors. As an independent agency our job is to help you reach your energy goals. http://3cea.ie/

12.5.3.3 Initiatives and support for energy efficiency / energy consciousness by NGOs

Good Energies Alliance Ireland (GEAI) is the only non-profit Environmental NGO in Ireland with a principal focus on Energy. GEAI works through research, advocacy, education and campaigning to influence public opinion and decision-makers in Ireland against on-shore unconventional hydrocarbon development and towards practical policies on energy sources and uses that respect the environment, the planet and people. https://ien.ie/good-energies-alliance-ireland/

Irish Environmental Network, or IEN, is made up of 30 nationally active Irish Environmental NGOs. Our groups represent a broad range of environmental issues including everything from wildlife conservation to climate change. In addition, the Environmental Pillar is made up of 26 national environmental non-governmental organisations (NGOs) who work together to represent the views of the Irish environmental sector. https://ien.ie/

Stop Climate Chaos is a coalition of civil society organizations campaigning to ensure Ireland does its fair share to tackle the causes and consequences of climate change. Current members include development, environmental, youth and faith based organisations. https://www.stopclimatechaos.ie/about/

Green Foundation Ireland (GFI) is an educational charity with a vision of society which promotes ecology and a sustainable future for all. They encourage participation by people and communities in finding practical local responses to intractable problems. https://www.greenfoundationireland.ie/

12.5.3.4 Research

Modelling Energy Efficiency in Irish Industry is a project run by the Environmental Research Institute in University College Cork which sought to deepen the understanding of the factors that affect the achievement of greater energy efficiency in Irish industry. https://www.ucc.ie/en/eri/projects/modenergeffirisind/

Energy Neighbourhoods is the award winning Intelligent Energy Europe (EU Commission) project involving 16 partners from across Europe, including Tipperary Energy Agency. In each country 5-12 households formed an 'Energy Neighbourhood' and competed to save 9 % energy or more in line

with the 9 % target of the Energy Service Directive. https://tippenergy.ie/projects/energy-neighbourhoods/

ENERGISE Project is a H2020 funded project coordinated by the National University of Ireland Galway that aims to adopt a Living Lab approach to directly observe existing energy cultures in a real-world setting and to test both household and community-level initiatives to reduce energy consumption. http://www.energise-project.eu

NOVICE (H2020 Project) is coordinated by the International Energy Research Centre and aims to develop and demonstrate an innovative business model for Energy Service Companies (ESCOs) that will provide energy savings to buildings and demand response services to the grid after renovating buildings or blocks of buildings. http://www.ierc.ie/wp-content/uploads/2017/09/Novice-Datasheet.png

Superhomes 2.0 is an International Energy Research Centre project aims to support the existing SEAI-funded Superhomes deep retrofit scheme that helps homeowners to achieve more comfortable, healthier homes with better air quality through cost-efficient energy efficiency measures. http://www.ierc.ie/wp-content/uploads/2017/09/Superhomes-2.0-Datasheet.png

12.6 Final considerations

The literature review identifies a number of important consumer segments that could benefit from improvements in energy efficiency going forward. This includes consumers located in certain rural areas of the country, and those living in detached and semi-detached homes. In particular, consumer segments at risk of energy poverty should be targeted, including those in rented accommodation with a BER of E, F, or G, people aged 65+, the unemployed, those not in the labour force, and lone parent families (DCCAE 2016). These segments could be reached through communication strategies targeted at local communities, energy providers, and in collaboration with public bodies such as the SEAI and Department of Communications, Climate Action, and Environment. There is also considerable potential to promote the use of smart home equipment among Irish homeowners who current do not avail of such technology. Public awareness campaigns in collaboration with energy providers (e.g. Energia and Bord Gáis Energy) and various other organizations (e.g. the International Energy Research Centre) could help reach this segment. However, it is acknowledged that certain groups may be difficult to reach during recruitment including elderly people who are affected by the digital divide and dispersed groups such as the homeless community and members of the Irish traveller community.

12.7 References

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13. Italy

Giovanni Pede and Maria Vittoria Fontanesi

Sinergie Società Consortile a Responsabilità Limitata (SINERGIE)

13.1 Introduction

This section provides the results of the literature review on energy consumption and energy consciousness in Italy conducted by SINERGIE. The references used include online sources and official reports issued by national authorities, EU projects such as EMPOWERING, NATCONSUMERS and others, as well as articles from national, the most widespread daily business newspaper (such as Il Sole 24 Ore) or essays ("Green Economy in Italian Regions", which appeared on the online magazine EyesReg) and links to websites where relevant data could be found.

In Italy, 15 % of the population suffer from inability to keep their homes adequately warm, due to high energy prices and low energy efficiency of the buildings. There are significant regional differences in the practices of heating the homes in the wintertime. In Northern areas, 98 % of the population heat their homes every day during the winter, while in the South only 62 % feel the need for daily heating. On the contrary, the air conditioning equipment is more widely spread in the Southern regions. The time spend with heaters turned on is longer in the Northern parts of the country. However, buildings are in the greatest need of renovation in the South. Autonomous heating is the most common form of domestic space heating (66 % of dwellings) and hot water (74 % of households) production. Wood is a source of heat production for one fifth of the households. A majority, 80 % of Italians own their home. Four types of consumers in relation to their motivation to understand how to reduce their energy bill were recognized in the EMPOWERING project in Italy. Those with difficulties to understand energy bills and those with interest to save energy mostly in economic reasons include students and people suffering from energy poverty, while the part of population with high income and often high education are interested in the energy performance of their home in general. Those whose motivation for reducing energy is mainly environmental are militant in the civil society, highly educated people and people with interests related to outdoor activities and sports.

13.2 National frame for energy consumption

In Italy, energy efficiency is a matter of increasing attention due to the importance it plays as an essential component of the new national energy strategy. Italy's energy needs are strongly linked to the use of traditional non-renewable sources (oil, natural gas, etc.), the majority of which are imported from abroad. This increases the energy vulnerability of Italy and, therefore, a strategy to

include new sources of production is strongly needed, taking into consideration the fact that Italy makes little use of coal and does not produce energy from the nuclear source.

With regard to energy efficiency, Italy presents high performance compared to other EU countries. Energy intensity in Italy amounted to 100 toe (tonnes of oil equivalent) per million of EUR of GDP in 2015, strongly below the EU-28 average of 120 toe per million euros of GDP.

The primary energy consumption is about 150 Mtoe, while the final energy consumption is about 116 Mtoe (2015 data). Heat is the most important part, representing the 45 % of the total energy consumption. Transport is the sector with the highest consumption (34 %), followed by the residential sector (28 %) and industry.

“Energy saving refers to all the techniques to decrease the consumption of energy necessary to human activities. Saving can be obtained both by modifying energy processes so that there is less waste, both by transforming energy from one form to the other in more efficient ways like: recovery energy from plants, products or systems and from productive processes; high efficiency cogeneration plants; production and consumption of hydrogen if it represents an improvement in energy efficiency in comparison to conventional fuels, savings consequent to conditioning and building insulation with interventions on casings and plants, including heating pumps” (Economia Solidale Trentina 13.07.2018).

Since 2015, Italy reached its objective related to the Europe2020 strategy to increase the percentage of energy produced from RES.

With the regard to biomass, its widespread use has been favoured by low costs compared to fuels of non-renewable origin and by a most advantageous tax treatment (excise tax and VAT facilitation on pellets). Public incentives had a low impact on investments in new plants, thus there is still a large diffusion of old equipment (open fireplaces, stoves and conventional boilers). In 2016, biomass contributed to 27 % of the total consumption for heating in the residential sector. The high emission factor of the biomass park is largely due to old equipment for which it is still necessary to promote a renewal, although even the most modern technologies emit more of the traditional gaseous fuels. Therefore, the goal of supporting renewable energy must be reconciled with the need to avoid negative environmental impacts, through the introduction of stringent performance requirements of the equipment.

Solar thermal plants are majorly diffused on the residential sector. It represents a mature technology, but cost barriers are still present. This is confirmed by the decrease in the number of installations, despite the conspicuous number of public incentive available at regional and national levels.

Heat pumps installations, despite their major installation costs compared to other solutions are increasing. This is due to high energy yields, allowing also costs saving, and to the high diffusion of

the technology in new buildings. In the renovation of existing buildings, the diffusion is due to the possibility to substitute all old cooling and heating equipment with unique equipment.

The Italian national energy strategy 2017 (SEN2017) recognises, among others, the consumers' scarce awareness on potential benefits of energy savings as a barrier for the achievement of its objectives. For this reason, the definition of a strategy to diffuse domotic technologies, smart metering and the digital technologies will be central for the active participation of end users. Action to increase consumers' awareness on energy savings and avoid, at the same time, the 'rebound effect' of increasing consumption will be strengthened with specific training and education programmes. A system to integrate energy customer feedbacks with real-time communication and the establishment of energy communities with shared saving objectives will be evaluated.

By 2021, all new or renovated buildings must be nZEB. This means that the balance between produced energy and consumed energy should be near zero, minimising consumption for heating, cooling, lighting, ventilation and production of hot water. To date, according to a study realised by POLIMI (Politecnico di Milano), the nZEB buildings realised in Italy amount to 650–950, of which the 93 % are residential buildings. Almost all have been realised in Trentino Alto Adige, Lombardia and Veneto regions. (Politecnico di Milano 2017.)

Throughout its history, Italy has shown some cultural and economic differences among its regions. This trend is confirmed when looking at the political attention on and cultural awareness of energy efficiency issues. A first indicator could be the presence, among the regional laws, of laws foreseeing obligations related to energy efficiency interventions, RES installations and energy audits in new and renovated buildings. Legambiente e-lab observatory and National Council of Architects (E-lab di Legambiente e del consiglio nazionale degli architetti 2016) classified all regions according to the presence of such obligations. Figure 26 below shows the most attentive regions to energy efficiency (brighter green) and the less attentive ones (different green scale with grey indicating the worst).

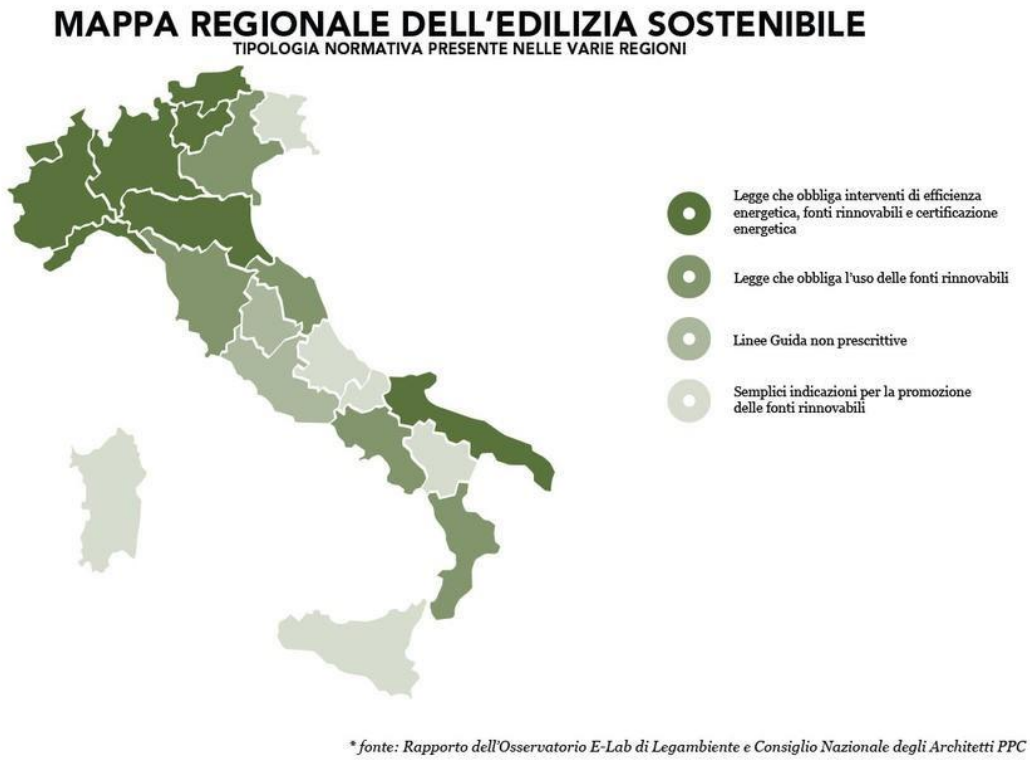

Figure 26. The distribution of legislation concerning energy efficiency in Italy (E-lab di Legambiente e del consiglio nazionale degli architetti 2016)

The result could be confirmed also by a study held by AISRe (Italian association of regional sciences) developing a 'Green Economy Index' to classify Italian Regions according to their objectives and attention to sustainable development. Also, green businesses, including RES energy production and environmental-friendly personal behaviours are more typical for the regions most attentive to energy efficiency (see Eyesreg 2018).

The Italian retail gas and electricity market will be fully liberalised from 2019, completing a process initiated in 2007 aimed at the complete opening of the markets, removing price protection and promoting the free competitions of energy providers making available to consumers a plurality of offers.

As of 2016, Enel dominated the Italian retail electricity market, with a market share of 35 %. Edison is the second largest supplier, with 5 % of the market, followed by Eni (4 %) and Gala (4 %). These four companies account for nearly half of the retail market sales. In 2016, regulated electricity tariffs still included around 60 % of the Italian population, with around the 40 % entering on the free market. Two main macro-segments are, therefore, still recognisable in the Italian energy market: Mercato Libero (Free Market) and Maggior Tutela (Protected Market).

The transition through the liberalised market will increase the need of energy information and awareness services, limiting the potential market failures connected to information asymmetry due to the lack of knowledge on the customer side, which will pose a challenge for the consumers.

The difference with existing situation will consist in the fact that, while in the protected market ARERA periodically propose a reference price which companies that sell gas and electricity are obliged to join, in the free market operators can apply the price that they prefer. It is essentially the consumer who decides which vendor or type of contract to choose according to their needs, habits and consumptions. The governmental authority ARERA has decreed the role of consumer associations as facilitators for the transition to the market, giving them the precise task of informing end users and helping them in finding the best suppliers according to their needs.

13.3 Socio-demographic differences in energy consumption in Italy

13.3.1 *Socio-demographic segmentation*

According to the EU Energy Poverty observatory 1 person out of 7 (around 15 % of the population) is unable to keep their home adequately warm in Italy. The percentage is higher than the average EU percentage. The problem is due to high energy costs and low building efficiency. Together with Ireland, Italy has the third most expensive electricity in the EU, after Denmark and Germany. Concerning gas prices, Italy is on a third position, after Sweden and Portugal. It is no coincidence, perhaps, that as many as 9.1 % of Italian households have had problems to pay energy bills. Italy is also among the countries with the highest percentage of wet homes, with losses and repairs to be made to roofs and fixtures (23 %, six out of 28 member states in EU).

13.3.2 *Social differences: energy consumers' attitude and behaviour*

Within the EMPOWERING project, funded by the CIP Intelligent Energy Europe Programme in 2012, energy consumers of two Italian cities (Reggio Emilia and Turin) have been engaged by the local utility in order to develop an innovative service of ‘informative billing’ addressed to change consumers behaviours to save energy. Citizens have been asked through a Focus Group and a deep survey if they understand their energy bills and what kind of informative services they find useful to understand their consumption and how they can improve their behaviours. The survey involved 51 district heating customers located in Reggio Emilia, 405 electricity customers in Turin and 58 district heating customers in Turin. District heating was an important issue to be investigated as, in Italy, district heating bill is issued per building. This does not allow customers to directly see differences on their bill adopting ‘virtuous’ behaviours given that they have to pay a share of the total bill.

Referring to the bill on the electric energy, involved customers found it difficult to understand the volume of energy consumed. For the district heating service, users found that it is difficult to understand how the share is calculated. In addition, customers wished more and better contacts with the energy utility. Referring to the satisfaction, the percentage of satisfied energy users ranged between 23 % (Reggio Emilia) and 26 % (Turin). Considering only the district heating users,

the percentage of dissatisfied users in Turin was higher. The dissatisfaction level relates to the high costs and lack of transparency of the bill.

The problem of the lack of transparency is a regulatory issue that cannot be solved by the energy utility. Utility as well as customer representatives, can help to understand the bill providing additional information on consumption trends and forecasting of future consumption as well as advice, recommendations and online self-help tools provided to users separately from the official bill.

In a later stage of EMPOWERING, further analysis carried out with energy consumers allowed to identify four different groups of energy customers according to their logic of action in adopting energy efficient behaviours:

Economically motivated consumers are mainly interested in reducing their energy bills. This group includes fuel poor households and students. They also more often rent their flat rather than own it.

Although fuel poor households and students have their own specificities, they have in common several elements beyond the will to reduce their energy bills: energy appears for them to be a transparent object of everyday life, of which users are not always aware in spite of its cost. Users have a difficulty understanding their energy bills and especially explaining the reason for an increase, since the detail of the price (fixed part for subscription, taxes, etc.) and the value of consumption in kWh are out of reach for them. It is therefore the variations in euros that interest them.

These users also appear to misunderstand existing tariffs/types of contracts, which could lead to economic savings (e.g. having a base/peak tariff allow to have access to cheaper energy in base load hours). In addition, users having an economic rationale often do not know what are the usages and the equipment that consume the most energy in the dwelling, which limits their realm of action when trying to reduce their energy bills. In fact, this group is in great demand of energy savings tips.

Economically and ecologically motivated consumers see energy savings as means to achieve both objectives, reducing the energy budget and having less impact on the environment. Self-esteem is important for these users: eco-gestures bring personal satisfaction. The group consists of a heterogeneous set of consumers.

Although the level of knowledge on energy is more important for this group than for economically motivated consumers, they still are in strong demand of advice. In addition to personal economic motivation, the users express a certain concern for environmental issues such as climate change. However, their knowledge on these subjects is less specific and precise than for users in the ecologic or energetic rationales.

In summary, these users are more responsive to awareness rising on energy savings than users in the economic logic. The perception of comfort is deemed to play a key role, either as a barrier or a lever to integrate more energy efficiency and sobriety at home and in everyday life. This group can potentially give an impulse to involve fuel poor households in awareness raising campaigns based on contest and collective dynamics.

Energetic consumers are mainly owners of their dwellings and are part of the managerial social class or highly educated part of the population.

They try to manage their energy consumption better, in order to have a sensation of better control over their dwelling which is seen as an energetic environment. They have a good knowledge of their consumption and can measure them in kWh and sometimes give the price in euros/kWh. In addition, they understand the issues associated with network stability, balance of demand and supply, energy management and base load/ peak load hours. They are already very aware of the subject of energy savings.

Energy bills are insufficient for them in terms of energy monitoring. They frequently adopt solutions to self-monitor their consumption. Most users in this group have largely invested in energy efficiency, whether it is to install a more efficient heating system or to insulate their home or building. They are very interested in new energy technologies, such as smart meters that will allow more frequent and accurate billing.

Ecologically motivated consumers would like to be coherent between their energy consumption and their environmental values. Here, energy is part of a more global environmental domain: reducing/recycling waste, water savings, soft mobility. Individual energy savings are a part of a collective ecologic goal. This explains why users are keen to be compared with their peers. Climate change, nuclear waste, pollution appears also as concerns and sources of motivations to pursue their quest of reducing energy consumption to the strict necessary. In addition, climate change is a very well understood concept. Consumers in this segment are mainly students, highly educated people, militant in civil society and environmentalist organisations and people interested in outdoor activities and sports. They are people who take care of the Common Good (Economia Solidale Trentina 13.07.2018).

Like users in the energetic rationale, some users in this category have invested in energy efficient equipment or energy performance building envelope, and would like to verify the actual performance of these solutions. They are also actively trying to use renewable energy.

The EMPOWERING project also identified the following barriers and levers to greater energy savings in their Deliverable 6.3:

1. Strong belief in material investment (insulation, equipment, etc.) more than in behaviour

2. Social norm is an important determinant of behaviour (*Notion of comfort strongly linked with social norm).*
3. Energy consumption is strongly affected by the period of life users are in (*For example, the presence of children in the home changes the perception the user has of its margin of action for reducing its consumption).*
4. Habits of energy sobriety amongst users benefiting from the social electricity tariff (*For these people, it is the cost of energy, its weight in the overall household's budget that brings users to think about energy savings, not the inverse. In consequence, they have very different energy consumption practices).*

Also, in the validation interviews, educational differences were identified as an important factor in explaining differences in energy use. An EU project manager and a consultant stated that "In Italy there's still a huge difference within the energy consumption between the upper classes more educated and the poorest ones that, due to lack of economic means and lack of awareness, go on using traditional and energy demanding appliances and tools" (Augentes, 26.06.2018). Moreover, an expert working for an energy utility operator, stated that "Inhabitants' behavior and lifestyle can even double or reduce energy consumption in homes by half. People consuming most energy are generally older citizens and those who have no real perception of the problem. The most problematic energy use habits are ~~in~~ the failure to optimize the thermal and electrical systems, in the outdated lighting system, in not leaving the devices in stand-by, in the lack of maintenance of the systems, in the lack of thermal insulation and finally an unaware use of the appliances." (Dolomiti Energia 02.08.2018)

13.4 Differences related to the built environment

13.4.1 *Climate conditions and their meaning for energy consumption*

It is possible to identify the following climate areas in Italy:

- Alps: high mountain climate with wet summers;
- Po basin and Northern Adriatic coast: temperate wet sub-oceanic weather;
- Ligurian and Tyrrehenian coast: warm temperate with wet winters and dry summers;
- Apennines: temperate cold and wet weather;
- Southern Adriatic and Ionian Coast: temperate hot weather, locally torrid with wet winters and long dry summers;
- Sicily and Sardinia: from temperate hot weather with dry summers to arid.

Energy consumption habits are different, especially regarding the house heating source. As reported in ISTAT survey on energy consumption of Italian households, the number of hours in which heating plants are turned on is different from Northern regions to Southern regions. In particular, there are differences in the kind of used plants, with the Alpine and Appennine regions'

habitants using wood stoves more than other heating sources. Additionally, there is a strong difference on the diffusion of cooling systems: they are almost absent in Alpine areas, less diffused in Northern Italy and very diffused in Southern regions (with Sardinia showing the highest diffusion).

13.4.2 *Population characteristics and their meaning for energy consumption*

Rural population in Italy was reported at 30.9 % of the total population in 2016, according to the World Bank and ISTAT indicators. Population density is 206 people per Km^2. The 17.8 % of the total population live in urban agglomerations of more than 1 million habitants. Population living in rural areas may be more likely to access to renewable sources and biomasses than urbanised people. District heating is diffused in bigger cities of northern Italy.

13.4.3 *Common dwelling types in the national context*

80 % of Italians own their house, 18 % live in rented dwellings. 53 % of the population live in a flat, 27 % in a detached house and the 18.7 % in semi-detached houses. Renting is more diffused in metropolitan cities than in islands, and it is especially diffused in Northern Italy. Differences exist in the energy bills paid by Northern and Southern citizens: heating is the major component of the energy bill in the North, while electric energy is the major component in the Islands (Sicily and Sardinia). The average heating bill paid by a citizen of Northern Italy is higher (around 14€ more per month) than the one paid by a citizen living in the South. Southern regions show a higher necessity for building renovation (11.8 %) than Northern regions (8.4 %) and Central Italy (8.9 %).

According to ISTAT (2014), the national statistics bureau, households are responsible for a large part of national energy consumption.

65 % of Italian buildings have been built more than 30 years ago (Dolomiti Energia 02.08.2018). Most households live in a dwelling equipped with heating systems, while only 30 per cent of households have cooling systems. Autonomous heating is the most diffuse system both for space heating (66 %) and hot water (74 %). Autonomous heating is mostly diffused in Southern Italy, while centralized heating in the North. 20 % of households use wood for heating. Wood consumption is higher (40 % of households) in mountain areas, especially in Umbria and Trentino Alto Adige (50 % of households). The heating systems of the dwelling remain turned on every day during the winter season for 87 % of families, with significant territorial differences (98 % in Bolzano and 62 % in Sicily). The heating systems are used on average, for about 8 hours per day, more in the afternoon (almost 4,5 hours) than in the morning (2,5 hours) or during the night (about 1 hour). On average, households of Northern Italy keep the system turned on 2 hours more than Southern households.

21 % of households have made investments to reduce home heating costs, 15 % for hot water and 10 % for a cooling system. Moreover, there are wide territorial differences in the diffusion of air conditioning equipment (only 1,5 % of families living in Valle D'Aosta against the 50 % of those living in Sardinia).

Mobility (namely use of private cars) is one of the major sources of energy consumption (Omar Livoni 18.07.2018 and Dolomiti Energia 02.08.2018).

13.4.4 *Access to smart equipment*

Smart meters show a good diffusion in all the national territory. Italy was the first European country to introduce electric smart meters for low-voltage end users on a large scale. Since 2001, the number of smart meters installed to monitor electricity consumption is more than 35 million. For the gas sector, the substitution of traditional meters with smart meters for the residential sector started in 2013 and is still ongoing. The governmental objectives is to substitute the 50 % of gas smart meters class G4-G6 by 2018, having completed the installation of smart meters for higher gas class consumption.

The distribution network infrastructure is owned by Distribution System Operators (DSOs) and contracts are to last until 31/12/2030. There are 110 DSOs in the country. The DSO provides the billing invoice for the energy transport and distribution to the Retailer, while the Retailer provides the billing for the effective energy consumption to the end user. The DSOs manage and own the smart metering infrastructure.

13.5 Relevant stakeholders in promoting energy conscious behaviour in the national frame

There are organizations promoting energy efficiency of both public buildings (schools) and housing in Italy. There is research done by two universities on sustainability issues, and a variety of companies and NGOs offering advice on both firms and consumers on different aspects of energy, for example, on energy saving or technological matters. Italy has taken part on several EU projects and carried out national projects related to the subject.

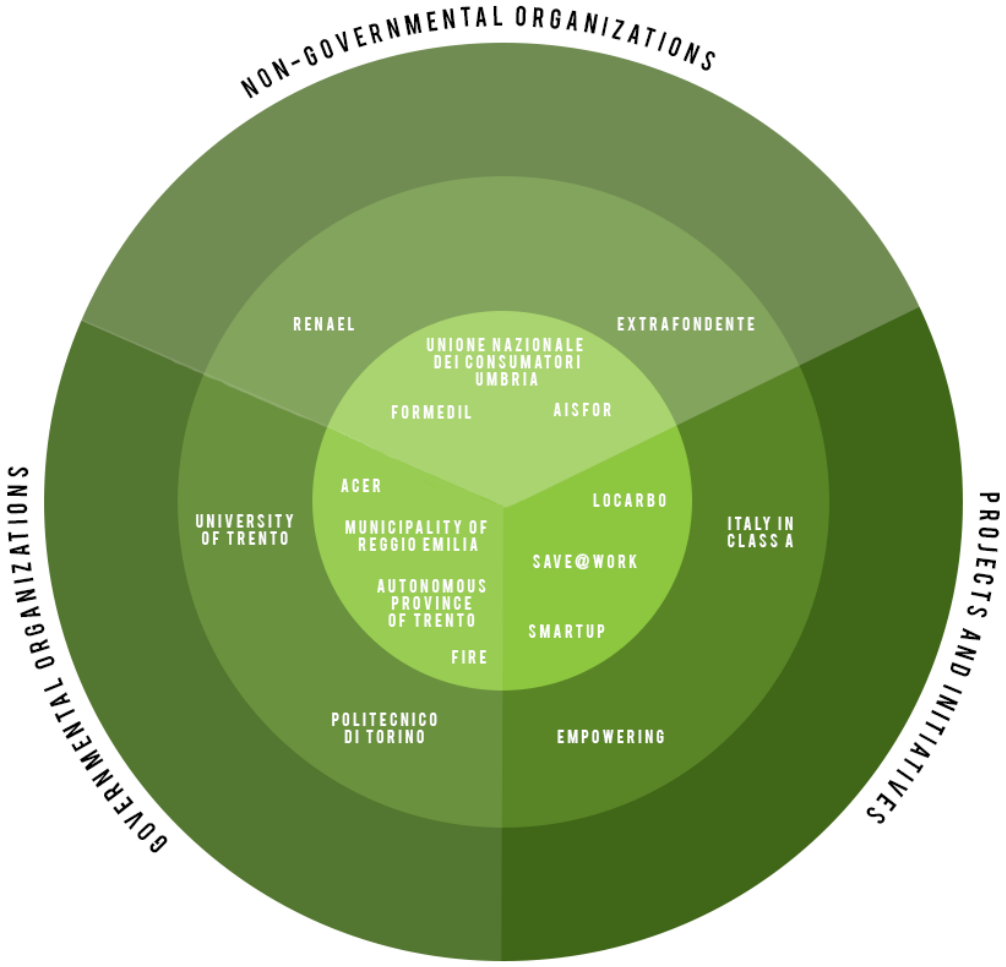

Figure 27. Italian stakeholders with interest in energy consciousness

13.5.1 *Institutions presenting national interest for promotion of energy consciousness*

Politecnico di Torino – The Department of Energy of POLITO is strongly interested in projects aimed at promoting energy consciousness and engaging energy customers towards a more sustainable approach. Since its objective is to improve existing technology and promote innovative ones, it represents an acknowledged interlocutor when it comes to share academic knowledge and best practices in the domain of energy efficiency.

University of Trento – Located in the Trentino region, a mountain area in the North of Italy with a consolidated tradition on sustainable development and environment protection, the University of Trento has always paid attention to this topics and has recently launched “UniTrento Sostenibile”:

a hub of initiatives focused on sustainability both in terms of contents and in terms of interest structures and people (e.g. clean mobility, waste reduction, etc.). The academic offer of the University also includes a Master's Degree on Energy Engineering addressing subjects such as energy efficiency in buildings or the production of renewable energy sources with small scale plants.

RENAEL (Rete Nazionale delle Agenzie Energetiche locali) – It is the national association of local energy agencies of Italy. It was founded in 1999 in the wake of the SAVE program, an European Commission initiative aimed at fostering the creation of regional and local agencies for rational energy management, promotion of local and renewable energy sources. Their final goal is clearly to support sustainable development.

Unione Nazionale dei Consumatori Umbria – The customer association of Umbria region works on several levels to support normal customers in everyday controversies, legal issues, participation in projects, etc. They realized a project on energy conscious behaviour named EnergiAmica which consists on a game targeted especially on children: the idea is to teach them the most common applications of renewable energy sources by using a simple language, immediately recognizable images and, most importantly, a gamification strategy.

ESCOs – ESCOs are commercial or non-profit business providing a broad range of energy solutions including designs and implementation of energy savings projects, retrofitting, energy conservation, energy infrastructure outsourcing, power generation and energy supply. They help consumers in getting fundings for energy saving projects (Omar Livoni, 18.07.2018).

13.5.2 *Institutions with membership presenting possible interest towards promoting energy conscious behaviour*

ACER (Azienda Casa Emilia Romagna) – A social housing company of the Emilia-Romagna region, with branches in each city in order to acquire a solid presence on the territory and negotiate more effectively with local authorities. It deals with real estate management and the provision of technical services. One of the main challenges for ACER is energy saving in buildings, therefore it provides knowledge and support in the following areas: green buildings, bio-architecture, eco installation and high-tech domotic, thermal insulation, and energy redevelopment of buildings and social houses.

FORMEDIL (National Association for Education and Professional Training in the Building Sector) – It is an association of building schools of Italy, whose goal consists in supporting and coordinating on a national level the training actions of different centres specialized in the building sector. FORMEDIL is particularly interested in nZEB and it also organized several courses and meetings on this innovative topic.

Municipality of Reggio Emilia – The city of Reggio Emilia, located in the Emilia Romagna region, was a former partner of the EMPOWERING project (funded by the EU programme Intelligent Energy Europe) focused on the optimization of energy consumption by involving the residents of two apartment buildings. They also wish to engage foreigners and immigrants on energy issues and education.

Extrafondente – An association of sociologists located in Bologna dealing with public bodies and private organizations on a national and European level in the fields of social research, training and projects implementation. It worked with the Municipality of Reggio Emilia in a project on immigrants 'education.

AISFOR (Agenzia per l'Innovazione, lo Sviluppo e la FORmazione) –This agency was founded in 2005 in order to support public and private bodies through the provision of specific services to satisfy their needs in terms of innovation and development. It is a partner of the SMARTUP project (funded by Horizon 2020) to face the socio-economic problem of fuel poverty affecting a growing number of customers. The project envisions training session targeted both on operators and customers to make them know the tools available, and also to improve their energy consumption habits.

FIRE (Federazione Italiana per l'uso Razionale dell'Energia) – It is an independent technical-scientific association funded in 1987 with the goal to support and promote an efficient use of energy by supporting those working in the sector and promoting a positive evolution of the legislative and regulatory framework.

Economia Solidale Trentina – working group of the Province of Trento dealing with solidarity economy. Energy saving is part of their program and they aim to increase it through actions to raise awareness of citizens.

13.5.3 *Energy consciousness related projects and initiatives that have gained public attention during recent years*

EMPOWERING - http://iee-empowering.eu/en/

The overall aim of the project was to empower consumers by involving and informing them, helping them take measures to save energy on the basis of the information they read on their meters or on their bills. This aim can be translated in to three general objectives:

- Achieving measurable energy savings (absolute savings and peak demand reduction);
- Increasing awareness and motivation of consumers with respect to energy efficiency;

- Increasing trust between consumers and energy suppliers as a pre-requisite for increasing energy performance for mutual benefit.

SMARTUP - https://www.smartup-project.eu/

Smart-Up is an EU funded project that will encourage vulnerable customers in those Member States that have embarked on the roll-out of Smart Meters to actively use their Smart Meters and In-House Displays to achieve energy savings. Previous studies have shown that Smart Meters do not lead to energy savings in the residential sector unless households actively use them and modify their energy-use behaviour. Our project will fill this gap, as well as raise awareness on demand response services.

ITALY IN CLASS A - http://www.italiainclassea.enea.it

A 3-years national campaign made to inform and train people on the topic of Energy Efficiency. It was sponsored by the Ministry of Economic Development and realized by experts and professionals from ENEA (Italian National Agency for New Technologies, Energy and Sustainable Economic Development) who were engaged on an itinerant set of events and meetings with citizens along the Italian peninsula. The final goal of this initiative, which was addressed to Public Administration, SMEs, citizens, students and banks, was to make people aware on the importance of energy efficiency and provide them with the necessary tools to realize it in their everyday behaviour.

LOCARBO - https://www.interregeurope.eu/locarbo/

LOCARBO is an in EU interregional cooperation project involving seven partners from different member States (among which there are also the Basilicata Region and the Province of Potenza in Italy). Its main goal is to improve low-carbon economy policies and increase energy efficiency through the use of renewable energies and a positive change in consumers' behaviour. This is done by involving partners form a bottom-up perspective.

SAVE@WORK - https://www.saveatwork.eu

As the name of this project suggests, this EU funded initiative supported public office buildings in reducing their energy consumption and carbon emissions by challenging them through a competition in the workplace. The positive outcome here depends on the level of people's involvement (more specifically, employees working in participating offices), because they are the real actors of the whole initiative. The Italian partner was AESS (Agenzia per l'Energia e lo Sviluppo Sostenibile) in Modena.

13.6 Final considerations

In conclusion to this country report and taking into account the segmentation outlined in previous chapters, we will now provide a summary of the existing consumers segments and a list of strategies which can be implemented in order to reach and involve them:

- **Geographical location** – Italian peninsula is characterized by a variety of climate areas affecting, among other things, also the level of energy consumption. Differences are not only geographical, but also normative (regional laws), economic and cultural with significant gaps in people's awareness on energy efficiency strategies. Since we are considering Italian population as a whole, the best way to address them is via intermediation of national agencies, ministerial campaigns and, in the second instance, measures adopted at a regional level according to the specificity of each territory. In particular:
- *North*: the climate area is typically continental, except for the Alpine region where weather is colder with long snowy winters. As for heating sources and people's habits, people in this area tend to use heating more often or at least longer than in the South.
- *Centre*: in general the climate is warmer than in the North, but colder than in the South. This is the most peculiar area because it includes both maritime and mountain environments, with subsequent differences in terms of energy consumption. In the Apennine regions habitants still tend to use wood stoves.
- *South and Islands:* with a mild Mediterranean climate, in the South of Italy cooling systems are almost as common as heating ones, which are used for shorter time.
- **Energy Market** – The liberalization of Italian energy market will be completed in 2019 and, with the free competition between providers, consumers will need much more awareness on the subject in order to browse different offers and understand what works better for them. In comparison to a protected market, with only few suppliers sharing quotas of customers and respecting a reference price set at a national level, the transition to a free market will lead customers to play a much more active role in the decision process. Therefore, they need to know and understand their consumption habits through a deep understanding and more awareness on the subject. In this context, **consumer associations** act as facilitators for the transition by providing the required information and helping them in the search for the most suitable energy supplier.
- **Customer motivation** – It is possible to divide customer motivations into three different types:
- *Interest in cost saving (Economic)*: Some consumers' goal is to reduce energy bills, in fact students, fuel-poor households, tenants, and in general people who need to save money are often motivated by economic reasons. However, consumers may experience difficulties in understanding energy bills and explaining the reason for an increase in costs, therefore they are in much need of information about saving "best practices" or existing contracts,

which can be provided through institutional channels or, in case of students, through effective communication campaigns led by Universities.

- *Interest in energy (Energetic)*: Some consumers aim at optimizing energy consumption to better control on their household consumption, which they know well. They are aware of the subject of energy savings, self-monitor their consumption or invest in solutions increasing energy efficiency. In most cases, home owners and more educated segments of the population are motivated by interest in energy. They can be reached through European projects, or targeted campaigns led by municipalities and local agencies aimed at providing funds for eco-efficiency measures, etc.
- *Interest in environmental issues (Ecologic):* Some consumers are driven by energy consumption and environmental values. Energy efficiency may be a part of their lifestyle, which implies a general reduction of consumption to the strict necessary in all domains of their life. Their concerns are not limited to energy efficiency but extend to the protection of our planet. Environmentally motivated consumers are likely to engage in collective actions.
- **Owners vs. Tenants** – On the one hand, people with an "economic" approach to energy efficiency (e.g. students and fuel-poor households), who are generally interested in reducing their energy bills, are often renting rather than owning the house where they live. On the other hand, users with an "energetic" rationale are usually owners, belonging to the managerial social class or to highly educated part of the population. In Italy, the vast majority of the population owns their dwelling (80 %), while only 18 % are tenants. For clear reasons, renting is much more common in metropolitan areas and large cities in the North of Italy.
- **Lifestyle** – A final segment, though a more limited one in comparison to the others listed above, is linked to the period of life in which users find themselves at the moment and, generally speaking, to lifestyle habits which can change according to certain conditions. The presence of children or old people in a household implies new needs also in terms of energy consumption because this groups of people, due to delicate physical conditions, need a constant temperature without extremes thus leading to a more indiscriminate use of heating or conditioning systems.

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14. Lithuania

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14.1 Introduction

This section is a contextual document that provides an overview on energy consumption and energy consciousness in Lithuania. It was conducted by Knowledge Economy Forum (KEF). Information about energy consumption in Lithuania was gathered through web searches. Most of the information was provided by national stakeholders, also from organisations that promotes energy consciousness and research studies and other reports of this field.

There is a need for modernization of buildings, although reparations are already underway. The residents are eligible for monetary support from the state for their renovation efforts. In apartment blocks, each household is responsible only for the maintenance of their own apartment, which sets a challenge to necessary renovations of common spaces. There is a governmental programme for renovating entire apartment blocks. The electricity consumption grows as the income increases (Vojtovic et al. 2018). However, in apartment blocks the heating costs are divided evenly to all households, which reduces the willingness to save energy. Moreover, during the heating period, the temperature is set on the building level, which means that the apartments cannot control the temperature individually. This leads to cold apartments on the top and ground floors and overly hot apartments in the middle of the building. In detached houses, solid fuel or electricity are the most common forms of heating. Although it is not clear what the least energy conscious group is like, it seems that the young generation is the most aware of energy matters.

14.2 National frame for energy consumption

Electricity consumption in Lithuania rose by 2.8 % in 2017 compared with 2016 to reach 10.76 terawatt-hours (TWh). That was the highest consumption of electricity in Lithuania since 1992.

In 2017 electricity consumption increased in all sectors, except transport – agriculture consumed 4.4 per cent more compared to the year before period, industry consumption increased 3.9 per cent year-on-year. Private residents' consumption saw an increase of 2 per cent compared to 2016 while service sector recorded 1.8 per cent rise. Consumption of the transport sector remained almost the same compared to the year ago period.

It is expected that renewable energy in Lithuania will account for 45 % of all generated energy by 2030, and as much as 80 % after 2050. Wind energy should make up the largest share of electricity generated from renewable resources – no less than 55 % in 2030 and 65 % in 2050. To boost the

development of renewable energy, the Strategy encourages energy consumers to be become energy prosumers. Some changes were made in the laws that improve the conditions for those who want to become electricity prosumers (expansion of list of technologies that can use double-sided electricity accounting, including solar power plants, wind and biomass power plants), and extends the circle of such consumers. However, there are still debates whether implemented system is suitable and cost-effective for residents and other institutions.

An important goal of strategy is the improvement of energy efficiency in buildings, known as Renovation (modernization) process. Renovation process under the Programme started in 2005. However, the activity got higher in 2010, with projects initiated just before the recession. The activity then slowed down due to the recession and increased again from 2014 and especially during years 2015 and 2016. Total cumulated number of renovated buildings over 2005-2016 was 1986 blocks (appr. 59,580 dwellings). In addition to renovation of residential buildings, 1280 education actions (seminars, trainings for flat owners and housing managers) on energy saving possibilities were implemented to residents of such buildings.

A problem with multi-apartment buildings is that each resident is responsible for their own flat and the common spaces including main entrance doors, corridors and heating pipes are not maintained to the same standard as entrance doors to the flats or flat windows (representative of an energy certification and renovation organisation, 05.06.2018). However, according to the National Reform Programme of 2017, 784 multi-apartment buildings were modernized under the Programme for the Renovation (Modernization) of Multi-apartment Building. 1 280 individual instruments reducing heat energy consumption were implemented in multi-apartment buildings at the initiative of residents. A total of 2 354 multi-apartment buildings have been renovated under the Programme for the Renovation (Modernization) of Multi-apartment Buildings (since 2005), and 12 425 individual instruments reducing heat energy consumption have been implemented in multi-apartment buildings at the initiative of residents. According to Lithuanian district heating association, heat demand for heating before renovation (modernization) was 102 kWh/m², after modernization - 59 kWh/m². Energy savings by the end of 2020 are to be about 50 GWh of final energy. There is still a great need for modernization, as both old apartment buildings (built before the year 1993) and the newest buildings perform poorly in energy efficiency (representative of “Renovacijos konsultacijos”, 05.06.2018), representative of Lithuanian Energy Institute, 18.06.2018). However, there is no international comparison data on energy efficiency in Lithuania available. In electricity efficiency, according to researchers Lithuanians do as well as Scandinavian residents (representative of Lithuanian Energy Institute, 18.06.2018).

Heating subsidies:

State of Lithuania offers assistance to residents by providing opportunities get a soft loan. Long-term loan for a block of flats the renewal will be issued with a maximum of 3 % fixed annual interest. Moreover, state will compensate all the expenses related to renovation of the home to the deprived families or persons living alone who are entitled to compensation for heating under the Law on Social Welfare.

14.3 Socio-demographic differences in energy consumption in Lithuania

14.3.1 *Socio-demographic segmentation*

There are few analyses on energy consumption and consciousness differences among various groups. In the few accounts the main findings are:

- One factor affecting energy consumption is financial situation (Vojtovic, 2018). A survey among Lithuanian residents (ESO 2015) concerning their electricity consumption shows that 45 % of the respondents save energy due to high electricity prices, and 47 % of the respondents admit saving electricity because of their bad financial situation and low income.
- Households living in multi-apartment buildings have less opportunities to know their individual energy use and so they have less incentives to reduce it (representative of "Žaliosios politikos institutas", 15.06.2018, representative of "Renovacijos konsultacijos", 05.06.2018, Vilnius Gediminas Technical University researcher 15.06.2018).
- Factors such as ratio of the registered unemployed to the working-age population, a heavy burden of housing expenses on households, at-risk-of-poverty rate, GDP at current prices and housing cost overburden rate are cointegrated with residential electricity consumption.
- Improvement of life conditions is one of the factors of greater electricity consumption (fast increase in home appliances, electronic and communication tools could be considered as the main reason of rather fast increase in household electricity consumption). (ESO 2015.)

14.3.2 *Social differences: energy consumers attitudes and behavior*

In 2014, for the first time in Lithuania, Citizens consultation was held with sustainable consumption as its main subject. In the consultation participated 100 citizens of Lithuania, selected in order to reflect demographic characteristics throughout the whole of Lithuania. An overview of the results of this consultation shows that 92 % of Lithuania's population feel responsible for sustainable consumption issues, and 50 % of the participants believe that to promote sustainable consumption, most attention must be focused to information campaigns. In

addition, 45 % of the participants agree that education is the best measure to improve knowledge of consumers about sustainable consumption. Moreover, 65 % of discussion participants considers that providing financial support to communities could encourage bottom-up initiatives. Finally, 86 % of participants voluntary would reduce their consumption.

Energy consciousness in Lithuania is closely linked to financial matters; the cost of energy raises awareness of energy use (representative of "Žaliosios politikos institutas", 15.06.2018, representative of "Renovacijos konsultacijos", 05.06.2018, Vilnius Gediminas Technical University researcher 15.06.2018). Energy renovation must also be convenient for the individual (Vilnius Gediminas Technical University researcher, 15.06.2018).

The young generation is more environmentally aware and thus also energy conscious (representative of "Renovacijos konsultacijos", 05.06.2018, Vilnius Gediminas Technical University researcher, 15.06.2018), although little is taught about energy issues at school.

It is not entirely clear who are those least energy conscious. There might be a link to lower education level and lower interest in energy issues (representative of "Žaliosios politikos institutas", 15.06.2018, representative of Lithuanian Energy Institute, 18.06.2018). Old generations (representative of Lithuanian Energy Institute, 18.06.2018), comfort-seekers (Vilnius Gediminas Technical University researcher, 15.06.2018), those who do not think they can affect – often individuals living in multi-apartment dwellings (representative of "Renovacijos konsultacijos", 05.06.2018) and the general public that does not work with energy matters (representative of "Žaliosios politikos institutas", 15.06.2018).

Motivation for energy saving is often due to a desire to save money (representative of "Žaliosios politikos institutas", 15.06.2018, representative of "Renovacijos konsultacijos", 05.06.2018; Vilnius Gediminas Technical University researcher, 15.06.2018, representative of Lithuanian Energy Institute, 18.06.2018), **having a higher education** (representative of "Žaliosios politikos institutas", 15.06.2018, representative of "Renovacijos konsultacijos", 05.06.2018) **and general interest in environmental issues** (representative of "Renovacijos konsultacijos", 05.06.2018; Vilnius Gediminas Technical University researcher, 15.06.2018).

Practical examples of other people, communicated in person (representative of "Žaliosios politikos institutas", 15.06.2018, Vilnius Gediminas Technical University researcher, 15.06.2018) and examples of experiences in other countries (representative of Lithuanian Energy Institute, 18.06.2018) work well in enhancing energy consciousness.

14.4 Differences related to the built environment

14.4.1 *Climate conditions and their meaning for energy consumption*

Lithuania is located in north-eastern Europe, on the coast of the Baltic Sea, and has an area of 65 200 km2. Lithuania has a climate mid-way between maritime and continental. The weather is changeable, summers are cool to mild and rather wet with many cloudy days. Winters are usually very cold, with temperatures dropping below zero centigrade. The mean annual precipitation varies from 540 mm (in the Middle Lowlands) to 930 mm (on the southwest slopes of the Zemaitija Uplands). The greatest amount falls in August, and on the coast in October.

The start and end of the heating season, depending on the actual outdoor air temperature, are determined by the municipal authority. The heating season usually starts in October and lasts till April or May. Given the costs of heating and inability to freely regulate home temperature, this season is nearly always controversial, with many preferring it to be as short as possible while others claiming this would be detrimental to health.

14.4.2 *Population characteristics and their meaning for energy consumption*

The current population of Lithuania is 2.88 million and the number has been decreasing in recent years. While the number of elderly people has risen (25 % of the households are over 60 years of age), the number of children under 14 years of age has decreased. Just 18 % of the population are younger than 30 years of age.

It is usually expected younger groups to be concerned with innovations (e.g., renewable energy, implementation of modern technologies in the energy system, etc.), while elderly groups are expected to be interested in energy prices and reliability of supply. However study on Lithuanian energy security shows that there are no differences in opinion on the most important aspects of energy security between different age groups in Lithuania (Augutis ir kt., 2016). As the most important aspect of energy security in Lithuanian throughout all different social groups remains 'The prices of energy resources' (Augutis ir kt., 2016). Although experts agree that younger generation is more socially oriented, so they are beginning to be more interested in fostering energy consciousness, than older generation.

An assumption is also made about the link between energy consumption and population distribution in the country. Those living in big cities are expected to be concerned more with renewable energy and modern technologies and those living small towns to be concern with diversification of resources (Augutis ir kt., 2016). However, most of the population in urban areas live in houses of blocks, where it is difficult to calculate how much energy they consume and the interest to save energy is lower.

Today, 68.6 % of the Lithuanian population live in urban areas, while in rural areas live about 33.3 % of residents. Two thirds of the country's residents populate the total area of Vilnius, Klaipeda, Kaunas, and Siauliai counties.

14.4.3 *Common dwelling types in the national context*

Most apartment buildings in Lithuania (as well as in other former Soviet states) have been built between 1960-1990. 55 % of population use district heating, 45 % have an individual heat supply. The governance of central heating services differs between towns. A majority of dwellings (mostly Soviet-built apartments) that have public central heating cannot even regulate the heat supplied to them independently. The amount of heat energy supplied can be controlled on the level of the whole multi-storey apartment block. Usually there is strong disagreement among the households over the temperature. In addition to that, apartments with outer walls may suffer from large heat losses, while the inner ones may be overheated.

Dwellings with local heating systems (mostly in villages) usually use wood, which is cheap yet labor-intensive and also electricity which is more convenient for residents, but also more expensive.

14.4.4 *Access to smart equipment*

The mass roll-out of smart metering in Lithuania is included in the National Strategy of Energy. In 2016 the pilot project of smart electricity metering for private customers was launched. Smart meters are considered important smart energy appliances (representative of Lithuanian Energy Institute 18.06.2018) However, electricity and energy renovations are largely seen as steps that need to be taken before a large campaign for installing smart meters is launched (representative of “Žaliosios politikos institutas”, 15.06.2018, representative of “Renovacijos konsultacijos”, 05.06.2018).

14.5 Relevant stakeholders in promoting energy conscious behavior in the national frame

The Lithuanian efforts to spread energy consciousness include knowledge spreading by NGOs as well as energy renovation subsidies offered by the public sector. There are also several organisations uniting companies working on renewable energy.

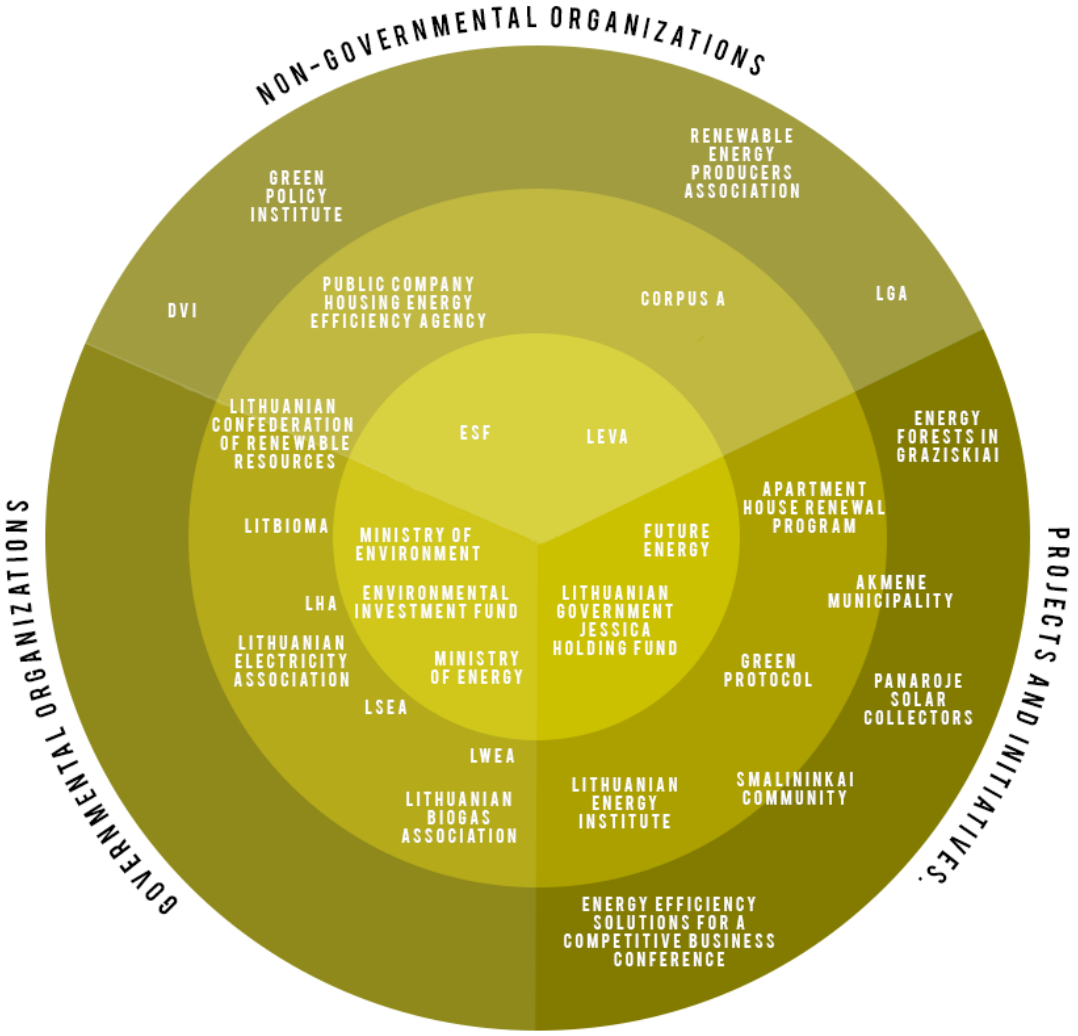

Figure 28. Lithuanian stakeholders with interest in energy consciousness

14.5.1 *Institutions presenting national interest for promotion of energy consciousness*

14.5.1.1 Governmental actors promoting energy efficiency / energy consciousness

The Ministry of Environment is the main managing authority of the Government of the Republic of Lithuania which forms the country's state policy of environmental protection, forestry, utilization of natural resources, geology and hydrometeorology, territorial planning, construction, provision of residents with housing, utilities and housing, as well as coordinates its implementation. One of the mains goals of the Ministry of Environment and its subordinate institutions are to implement the principle of sustainable development.

Ministry of Energy is another managing authority of the Government of the Republic of Lithuania which mission is to prosecute policy of government of Lithuania in fuel, electricity, thermo-energy production and supply for Lithuania economy.

Under instructions of the Ministry of Energy, **Energy Agency** deals with drafting the National Energy Strategy, other programs regarding the improvement of efficient use of energy resources and energy and use of local, renewable and waste energy resources. Also agency is responsible for the implementation of European Union financial aid in the field of the trans-European energy networks.

Other managing authorities such as **Ministry of Economy of the Republic of Lithuania, The Ministry of Agriculture of the Republic of Lithuania, Ministry of Finance of the Republic of Lithuania, Ministry of Education and Science** also play a significant role in energy consumption and energy consciousness field through addressing questions related to economy, finances, agriculture and promoting energy consciousness behaviour within the education system and beyond.

Lithuanian Environmental Investment Fund grants the subsidies to legal entities operating in the Republic of Lithuania or branches of companies established in other countries of the European Economic Area registered in the Republic of Lithuania implementing projects related to energy consciousness in the territory of the Republic of Lithuania.

14.5.1.2 Universities and research institutions working on energy consciousness

Some main universities in Lithuania play an important role working on energy consciousness. **Vilnius University** offers several study programmes related to this field, for example Environment and environmental management. Also, scientists of this university conduct studies that should help to overcome issues addressed to energy consumption. Other universities such as Kauno technologijos universitetas, Aleksandro Stulginskio universitetas, Vilniaus Gedimino technikos universitetas also contribute to this field by providing study programmes and research in this field.

14.5.1.3 Other organisations promoting sustainable technologies and energy consciousness

Lithuanian Confederation of Renewable Resources unites all Lithuanian NGOs who are working in developing renewable energy resources and spreads Green energy idea while creating conditions for it to become reality with obvious results. In order to strengthen the strategically important renewable energy market in Lithuania, the Confederation is actively collaborating with various public institutions, providing help to its members and safeguarding their interests.

The main goal of **Lithuanian Biogas Association** is to unite natural and legal persons interested in the production of biogas. To promote this activity and help all those interested in this field to seek

professional development and cooperation, to formulate a public opinion about this activity. Also Lithuanian Biogas Association coordinates the activities of the Association members, represents and defends the interests of the members of the Association, to create favorable conditions for the members of the Association, expanding mutual and international relations with similar field organizations.

Lithuanian Biomass Energy Association (LITBIOMA) involves the producers and suppliers of solid biomass and other renewable local resources, such as wood, straw, energetic willows, peat, as well as the producers and designers of solid biomass boiler rooms and other equipment, developers of plantations and academic institutions. In order to strengthen the strategically important heat and electricity production and solid biomass market in Lithuania, the association is actively collaborating with various public institutions, organizing seminars, conferences, providing help to its members and safeguarding their interests. LITBIOMA is dedicating a lot of attention towards implementation of innovations and investigative studies intended for more effective handling of local energy resources in Lithuania.

Lithuanian Electricity Association is a voluntary organization of 45 electricity production, transmission, distribution, energy supply companies, construction organizations and other associated power structures as well as individual economic operators involved in energy production, supply and power facilities design activities, which represents and defends their interests. It participates in the preparation of laws and secondary legislation of the Republic of Lithuania on the electricity sector development and governance issues. Also, arranges exhibitions, conferences, seminars, market surveys and public opinion polls.

Lithuanian Hydropower Association (LHA) promotes the development of hydropower in our country. Association represents everyone's interests preparing Lithuanian legal documents in energetic, environment and other regulation spheres. Also, arranges different seminars, conferences, trips to interesting objects of HPS in order to get acquainted with modern technologies. The arranged group of scientific search has prepared several brochures on various studies, hydropower technical, environmental, juridical questions to the Ministries and departments of the country. The members of the association have links with the media. They write articles, take part in different TV or radio shows, making hydropower popular.

The Lithuanian Solar Energy Association (LSEA) educates the public about solar energy technologies, promotes the development of solar energy and seeks favorable conditions for the use of solar energy in Lithuania. LSEA is the national section of the International Society for the Solar Energy.

Lithuanian Wind Energy Association (LWEA) creates and develops full cycle of wind power activities as ecologically clean craft of energetics using modern technologies.

14.5.2 *Institutions with membership presenting possible interest towards promoting energy conscious behavior*

14.5.2.1 Organisations with citizens as members

Energy Saving Facilites (ESF) focuses on spreading awareness of the environmental ideas: produces environmental films and TV programmes, holds presentations and lectures for visitor groups of each age. Currently the environmental programme "Start from Yourself" is produced for LRT Culture channel of the national broadcaster. The main topic covered are nature and heritage conservation, environmental activities in different communities, work of famous naturalists.

Lithuanian Electric Vehicles Association (LEVA) unites electric vehicles enthusiasts, companies operating in the fields of electric vehicles applications, conversion, and manufacturing. Main goal of this organization is to encourage Lithuanian electric vehicles industry, and to help the spread and use of electric vehicles in Lithuanian market. Also, LEVA provides information about the electric vehicles technologies, market trends, as well as contacts of electric vehicles enthusiasts, manufacturers, and companies doing retro-fitting of the regular cars.

14.5.2.2 Organisations producing services for housing companies

"Corpus A" – is one of the leaders in maintenance and cleaning services for building maintenance companies. Main offices are located in Vilnius, Kaunas, Klaipėda, Šiauliai, Panevėžys and Tauragė, and all Lithuanian residents, businesses and the public sector provide services. For their activities "Corpus A" chooses green Lithuanian energy.

Public Company Housing Energy Efficiency Agency - implements activities related to the Multi-apartment Building Renovation (Modernisation) Programme. In the near future the Agency is planning to coordinate the Programme for Energy Efficiency Improvements in Public Buildings.

14.5.2.3 Organisations producing services for private companies and local service providers

Green Policy Institute encourages Lithuanian businesses to engage into the process of green policy development, as well as strengthening and execution of green business sector. Also, institute maintains close relations with decision-makers on parliamentary, governmental and municipal levels. Also, we collaborate with non-governmental organizations and companies of the highest environmental standards.

Renewable Energy Producers Association combines the renewable energy producers and represents the interests of association members. Also, this organization provides suggestions and guidance on legislation related to renewable energy production and utilization and in other ways and instruments promote and support the production of renewable energy.

14.5.3 *Energy consciousness related projects and initiatives that have gained public attention during the recent years*

14.5.3.1 National programmes and initiatives

Apartment house renewal program - the renovation / upgrading of apartment blocks programme that was started back in 2005. Primary conditions for participation in the renovation / modernization program of apartment buildings – first, only multi-dwelling houses may be present in the program (an apartment building is a dwelling house of three or more apartments, which may include non-residential premises - trade, administrative, catering, etc.). Second, the apartment building must be built in accordance with the regulations in force until 1993.

Energy certification - Energy Performance of Buildings Certification is a legislative process regulating the energy consumption of a building. The energy performance of a building is assessed by classifying the building in the energy efficiency class (energy class buildings are classified in 9 classes: A ++, A + A, B, C, D, E, F, G). The energy performance certificate is compulsory when building, selling or renting buildings. The validity of Energetic certificate must not exceed 10 years.

An **interactive map of all power plants** in the territory of the Republic of Lithuania that use RES: http://www.avei.lt/lt/energijos-istekliai

The Lithuanian government's JESSICA Holding Fund - established by signing an agreement between the Ministry of Finance, the Ministry of Environment of Lithuania and the European Investment Bank (EIB) in June 2009. The JESSICA Holding Fund size is € 227 million. The Fund aims at providing loans and grants to residents for energy refurbishment of multi-family residential buildings and Lithuanian higher education and vocational training institutions for the renovation of student accommodation.

National Research Programme 'Future Energy' - this programme seeks to solve the most significant problems regarding Lithuania's energy security, energy efficiency and future energy production, including the development of appropriate technologies. The main objectives of the programme include the development and study of models for energy security and the energy system in Lithuania and the development of a scientific basis for future energy production, supply, and efficient consumption.

„Taupykime" initiative – it is the "5 Steps Heat Saving Program" implemented in Lithuania Since 2010, initiated by the „Mano būstas". Aim of this program is to reduce heat costs and heat consumption. This program identifies 5 main issues of the heat saving of old flats and provides their real solutions. The administrators implementing the initiative, supported by the residents, carry out work in multi-apartment buildings and implement solutions that help to save energy efficiently. However, this program should not be confused with apartment building renovation projects. www.taupykimesiluma.lt

14.5.3.2 Municipal and local programmes and initiatives

In recent years, several municipal and local initiatives have been carried out in Lithuania, here are some examples of these programmes / initiatives:

The community of Smalininkai is the first wind power plant in Lithuania that was built for community purposes. Also, this community has developed a package of documents (proposals) for the construction of wind farms (non-profit) for public purposes to change the laws in order to enable community centres to facilitate the implementation of renewable energy projects.

Municipality of Akmenė is a small in the northwest of Lithuania, which focuses on efficient management of the energy sector and can boast excellent results in implementing energy efficiency measures, such as modernization of street and public spaces lighting, foundation of solar energy and wind power parks.

Solar collectors in herbal dryer Panaroje, Varėna district taking into account the needs of the community, the specificity of the herbal economy and the production of food. A special drying house was designed to meet the requirements for technology. The area building contains the raw material preparation room, the drying room, packing and packing rooms, a special living room for employees and sanitary facilities, a warehouse is located in the attic room, technical boiler room and fan room. The construction work was carried out by contractors and the inhabitants of the centre themselves.

In the **energy forest plantations in Gražiškiai eldership, Vilkaviškis district** community took an alternative energy initiative – there were built 5 biofuel boilers in Vilkaviškis district, producing 4.5 MW of heat: three of them were schools and two were boiler houses in the city. Also, the Alvitas Community House was heated with a special straw-fired boiler, and the Keturvalakiai community set up a straw processing (briquetting) line.

14.5.3.3 Initiatives and support for energy efficiency / energy consciousness by NGOs

The Lithuanian Geothermal Association (LGA) is a voluntary scientific organization engaged in international activities, which engages in public activities of geothermal projects and programs organized by natural and legal persons. For more than twenty years, a non-governmental organization has been engaged in representing, organizing, sponsoring, promoting and implementing various geothermal activities.

Sustainable Development Initiatives (DVI) is a not-for-profit non-governmental organization (NGO) based in Vilnius, Lithuania. The areas of organisation competencies and interests are sustainable development, environment protection, social inclusion and rural development.

Organisation aims to serve as facilitators, trainers and triggers for sustainable development in the region and the country. Projects, implemented by DVI:

- LLL Grundtvig international project “Innovative Adult Education for Sustainable Rural Development” with 6 countries (2008-2010)
- EU structural support, Rural Development Programme project “Training and Education of Private Forest Owners for Sustainable Forest Management” (2009-2011)
- Nordic Council of Ministers Office in Lithuania financed our project "Nordic-Baltic NGOs’ Cooperation for Sustainable Energy" with 4 countries (2009-2010)
- They are partners in project financed by Nordic Council of Ministers Office in Latvia "Nature conservation NGOs in the Nordic-Baltic region - working together" together with other 4 countries (2009-2010)
- Also, organization takes part in Intelligent Energy Europe financed project for schools “Carbon Detectives" with other 9 European countries (2010-2011).

The goal of the **annual conference "Energy efficiency solutions for a competitive business"**, organized by "Verslo Žinios", is to bring together energy efficiency solution makers, analysts, energy companies and established contacts, eventually turning into real solutions that enable increase business efficiency, channel resources in a beneficial way and save the environment.

"Green Protocol" is an Energy Distribution Operator initiated agreement, through which the signatories of the companies and organizations confirm that they agree and commit to the implementation of environmentally friendly ideas, namely: implementing energy efficiency measures; contributing to the European and global environmental and greenhouse gas (CO2) and to encourage its employees, colleagues and loved ones to contribute to the development of an energy-saving society. At present, the Protocol has already been signed by nearly 200 companies operating in Lithuania.

14.5.3.4 Research

The mission of the **Lithuanian Energy Institute** is to perform power engineering, thermal engineering, measurement engineering, material sciences and economy research, to create innovative technologies, to perform scientific and applied research, to participate in study processes, to transfer applied scientific research results and findings to industry and business, to consult state, governmental, public and private institutions and enterprises on the issues related with Lithuanian sustainable energy development, to actively participate with higher educational institutions preparing specialists for Lithuanian science and economy. One of the largest scientific divisions in Lithuania is the Laboratory of Renewable Energy Resources in this institute. The Laboratory conducts research related to the development of the use of RESP for energy production in the country, provides guidelines for further accelerated penetration of RESP into the

national energy market in order to optimally ensure implementation of the requirements of the European Parliament and Council directives for all EU countries, carry out environmental impact studies, etc.

14.6 Final considerations

- Compared to previous years consumption of electricity in Lithuania is increasing, therefore more attention should be given to energy consumption research and promotion of energy consciousness.
- National Energy Independence Strategy, which was adopted in 2012 was adopted. Main goal of this strategy is to achieve complete independence in electricity field, to promote the use of renewable energy and to improve energy efficiency in buildings.
- Renovation (modernisation) process that began in 2005, aims to renovate heat consuming multi-apartment blocks and to implement energy saving measures during 2005-2020. Financing and implementation of projects is ensured by providing preferential loans and other state aid to owners of flats and other premises for implementing energy-saving actions. Another objective is to ensure that the residents receive information, education and training on matters of energy performance improvement and renovation (upgrading) of buildings.
- According to studies, energy consumption is related to an individual financial situation – usually energy-saving behaviour is adopted due to bad financial situation and low income. However majority of residents feel responsible for sustainable consumption issues.
- Due to relatively cold climate, heating season last for 5-6 moths, that leads to increased energy consumption.
- In Lithuania there are some institutions responsible for research in the field of energy sustainability. However, financing and monitoring of scientific research in Lithuania is quite weak.
- In Lithuania, there are many organisations that contribute to promoting energy consciousness behaviour at national or local level.

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15. Portugal

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15.1 Introduction

This is a contextual document that provides an overview on energy consumption and energy consciousness in Portugal. It was conducted by DECO in order to comply with the objectives set for the segmentation analysis of ECO2 WP6.

The country report builds on the information and materials produced by national stakeholders operating in the field of energy, reports from the International Energy Agency, the results of EU REMODECE project as well as academic studies and other reports of energy consumption and energy consciousness published by researchers and organizations operating in the field. The search for these materials was carried out through web searches.

In Portugal, women are more careful than men in their energy use habits. Older generations try to save energy more than the young ones. The use of kitchen appliances is the most energy consuming activity, while energy saving measures focus on turning off lights and appliances and using energy saving light bulbs. Although there have been several pilot projects concerning smart electricity meters, their large-scale rollout is not yet planned.

15.2 National frame for energy consumption in Portugal

Portugal is geographically situated on the west coast of continental Europe, in the Iberian Peninsula. It borders Spain to the north and east, and the Atlantic Ocean to the west and south. Major population centers include Lisbon, the capital city, Porto, Braga and Coimbra. In addition to the continental territory, Portugal includes the two autonomous regions located in the Atlantic Ocean, the islands of the Azores located to the west and Madeira to the southwest. On the continental territory, the river Tagus divides the more mountainous north from the plains of the south.

Portugal covers a total area of 92.212 square kilometers and is home to 10.39 million people. Portugal benefits from a fortuitous location, being situated in a geo-strategic position between Europe, America and Africa. The climate is marked by mild winters and balmy warm summers. The wettest months are November and December, and the driest periods typically occur between April and September (International Energy Agency, 2016a). As a result of the temperate climate, both

heating and cooling needs stay lower than in the EU in average (ADENE 11.07.2018, APREN 28.06.2018).

The most important data and statistics of the national energy balance continue to show the weight of energy imports (25.38 Mtoe), although this value has decreased by 4 % compared to 2015. On the other hand, domestic production increased by 12,7 % over the previous year, standing at 5.90 Mtoe.

Regarding to energy consumption, it was found that, by 2016, final energy consumption grew by 1.0 % compared to 2015, mainly due to the increase in of the consumption of petroleum products and electricity and in the case of primary energy consumption decreased by 1,2 % over the previous year, mainly due to the reduction of coal consumption, by around 13 %. (APA 2017.)

Although oil and oil products continue to decline, they continue to represent 42.7 % of primary energy consumption in 2016. As the second most popular source of energy, natural gas accounted for 19.9 %. Third was coal with 13.1 %, followed by biomass with 12.9 % and electricity with 10.0 %. (APA 2017.)

Portugal is one of the major final contributors to greenhouse gas emissions (19 % of the total emissions in the European Union) and the residential sector is responsible for 17 % of the final energy consumption. Moreover, the increasing number of electronic appliances and their usage time, the increment of thermal comfort needs, the vulnerability to the main energy sources (such as natural gas and electricity) growing prices and the insecurity of being highly dependent on other countries for energy supply, are some of the reasons that have led this sector to strive for energy efficiency monitoring measures. (Fonseca, 2015). Regarding electricity consumption in this sector, it corresponds to 28.2 %, which is still lower than the EU average – 29 % (POR DATA 2016a).

Electricity in Portuguese housing corresponds to approximately 43 % and the renewable energy sources has been increasing (Fonseca 2015). In 2016, 55.5 % of the electricity production was made from renewable sources and 50.5 % corresponded to hydroelectric energy (POR DATA 2016b).

Of course, and for environmental reasons, many projects, initiatives and different energy efficiency tools are also developed in Portugal with the aim of changing consumption habits and behaviours.

Within the European strategy for 2020, the following objectives were set for Portugal to reduce primary energy consumption by 25 %; 31 % from renewable sources of gross final energy consumption and 10 % from energy used in transport. At the same time, it’s intended to reduce energy dependency (which according POR DATA 2016a was 74.8 % in 2016) and ensure its economic competitiveness as well as the security of supply of energy resources.

According to the study created by APREN (2018) using renewables to generate electricity (RES-E) is the most cost-effective way to decarbonise the Portuguese economy. Renewables play a dominant role in the generation of electricity (85 % in 2030 and 90 % in 2050 in the decarbonisation scenarios), with emphasis on hydropower, onshore wind and solar PV. In the 2050's horizon offshore wind reveals as a cost-effective solution in the scenarios of greater decarbonisation. In the scenarios of greater decarbonisation, offshore wind is cost effective in 2050.

In respect, the cultural conventions in sustainable consumption, its important analyse and review existing studies, for example: the Residential Monitoring to Decrease Energy Use and Carbon Emissions in Europe (Universidade de Coimbra, 2008) that analysed the electricity consumption of twelve European countries, including Portugal, with the aim of contributing to an increase in the knowledge of the main uses of electricity, and analysed about 100 households per country.

In this study, the average annual electricity consumption per household was estimated at 2700 kWh, excluding heating and hot water equipment, the potential for reducing electricity consumption was estimated at 268 TWh per year for a number of countries studied, which would result in a reduction of 116 million tonnes of CO2. The main measures aimed to achieve this value, included the use of the best available technology in the market (such as the choice of more efficient equipment, class A + and A ++ and fluorescent lamps and LEDs), in combination with changes in consumer behaviour.

15.3 Socio-demographic differences in energy consumption in Portugal

It is difficult to find references to characterize socio-demographic differences in energy consumption in Portugal. However, through master's theses, reports and specialty websites, we were able to gather some information.

15.3.1 *Socio-demographic segmentation*

In the document "Characterization of Electricity Demand" (2018) carried out by ERSE, the number of electricity clients is estimated to increase from an average global value of about 4.88 million customers in 2017 to 4.90 million in 2018 in the liberalized market (ERSE 2018b).

Regarding the qualifications of the energy consumers, Lopes (2016) assume that the most literate groups have a higher savings potential than the average citizen, and they are more likely to acknowledge the importance of energy efficiency and are more receptive to smart grids and associated technologies.

Amongst Portuguese society, highly educated and with above average income consumers have a good proxy for early adopters of smart grid technologies. (Lopes, 2016).

In 2011, Energyprofiler, a study on the behaviour of the Portuguese in relation to energy consumption in the residential sector, was published. This study summarized consumption profiles that could serve as a guideline for the promotion of energy efficiency in domestic consumption.

According to a study based on a sample of 1019 respondents, young men up to 25 years of age are the target audience with the greatest need to overcome barriers to energy savings. Women under 45 years are more aware of energy saving alternatives and those over 45, especially in the Central and South regions, value energy consumption (ENERGAIA 2011).

15.3.2 *Social differences: energy consumers attitudes and behaviour*

The Energy Profiler study defines five profiles of residential energy consumers from "receptive to energy efficiency" to "energy efficient", based on psychosocial factors and consumer's behaviours and attitudes towards energy efficiency. (ENERGAIA 2011).

Several observations emerge:

- Low level of energy consciousness: men of all ages across the country
- High level of energy consciousness: women under 45 years old from all regions
- Energy efficiency: young men up to 25 years of age from all regions
- Most competent in energy efficiency: adults aged 45+, living in the Northern parts of Portugal
- Economic reasons are the main motivators to save energy. However, environmental reasons are highly valued by young adults, in particular by young women and women under 45 years in all Portuguese regions
- The target segment most in need of overcoming barriers to saving energy are men of all ages, but especially young men up to 25 years in all regions
- The media is the main channel of energy information for men and women over 25, but for the young audience, the Internet is the main source of information

The general energy-saving practices of the Portuguese consist of switching off the lights, turning off equipment without being in stand-by and the use of efficient light bulbs. The main motivator for reducing energy consumption is saving money, rather than environmental concerns (ZERO, 22.06.2018). The costs of acquiring more energy-efficient appliances hinder some consumers from purchasing them, even though it would lead to energy and money saving later (APREN 28.96.2018).

15.4 Differences related to the built environment

15.4.1 *Climate conditions and their meaning for energy consumption*

The end use of energy focuses on the following four areas: kitchen appliances, use of domestic hot water, space heating and the use of electric equipment. Lighting consumes only 4.5 % of energy and space cooling holds a small share.

The energy allocated to space heating per square meter in last 10 years (2003-2013) had two different trends: one between 2003 and 2009 with a slight variation around 2,0 koe/m^2 and 2,2 koe/m^2, respectively and another from 2010 onwards with significantly energy improvement values around 1,4 koe/m^2 and 1,1 koe/m^2 of energy unit consumption. The change resulted from the impact of the economic downturn and the significant increase in energy costs.

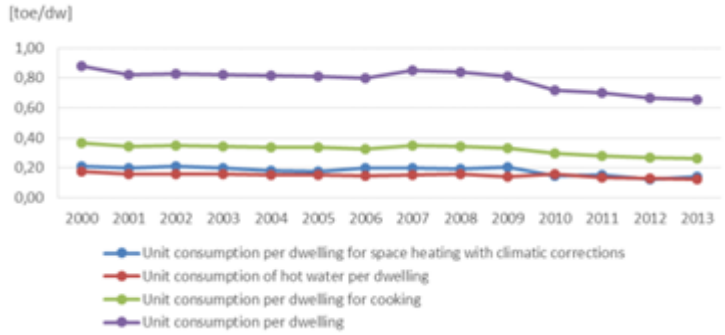

Figure 29. Unit consumption of space heating per m2 and unit consumption in useful energy per m^2

15.4.2 *Population characteristics and their meaning for energy consumption*

Between 2011 and 2016, the estimated resident population of Portugal decreased from 10.542.398 to 10.309.573 habitants, representing an annual average of 0.45 % in five years.

The population density decreased between 2011 and 2016 in 273 of the 308 municipalities that represent the national territory.

In addition, as shown on the map (Figure 30) there is a great asymmetry in the population distribution that focuses on the urban and coastal areas, as opposed to interior municipalities of Mainland. Thus, the population density was 19 times higher in urban areas than in rural areas.

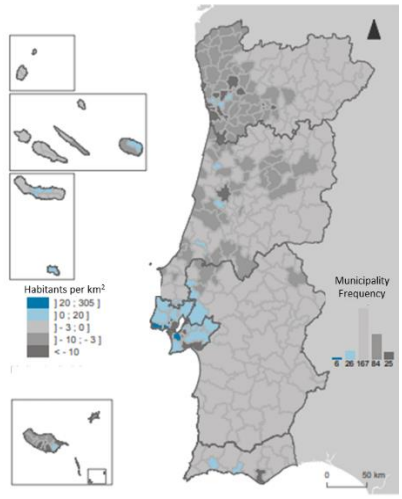

Figure 30. Population Density by Municipality 2011/2016

As one might expect, the energy consumption follows the population distribution, thus being higher in the metropolitan areas. In addition, it can also be noted that the energy consumption in 2014 is higher in the Centre (5 428 280) and Northern zones (5 132 344).

Lastly, it should be noted that electricity services vary between geographical areas, such as between zone A (district capitals and cities with more than 25 000 electricity customers), zone B (25 000 to 2 500 electricity customers) and C zones (settlements with under 2 500 electricity customers) in the quality of the services provided (ERSE 2018a; 2018b.)

15.4.3 *Common dwelling types in the national context*

According to a study carried out by the National Laboratory of Energy and Geology in Portugal, buildings represent about 30 % of total energy consumption and are still the second most CO2-intensive sector (Domingues 2014).

The Survey on Energy Consumption in the Domestic Sector 2010 investigated households with primary residences. Of these, 3 773 956 are located in the Mainland, 77 222 in the Autonomous Region of the Azores (RAA) and 80 832 in the Autonomous Region of Madeira (RAM). Results of the study showed that:

- Only 7.5 % of dwellings were built before 1946 and 10.8 % after 2000, which means that the buildings are not very efficient, because older buildings lose more energy.
- 99.9 % of the dwellings have electricity connected to the public grid and 99.4 % have access to piped water
- 95.5 % of the dwellings use gas, of which 21.1 % are connected to the Natural Gas network, 10.3 % are connected to piped Natural Gas Network and 70.5 % of the households use Natural Gas in the bottle.

According to INE (2018), 91 % of the buildings concluded in 2017 are detached houses and 9 % are apartment buildings.

Electricity is the main source of energy used in the domestic sector, being consumed in 99.9 % of households. From October 2009 to September 2010, total electricity consumption amounted to 14.442 million kWh, corresponding to an overall expenditure of over 2 billion euros. The consumption of LPG Butane Bottles was used in about 40 % of the dwellings.

In the domestic sector, there are six energy end-uses in Portugal, namely: Environment Heating, Cooling of the Environment, Water Heating, Kitchen, Electrical Equipment and Lighting (see Figure 31). The largest share of energy in the domestic sector, corresponding to 39.1 % of the total energy consumption was dedicated to cooking. Water Heating consumes the second largest share of energy corresponding to 23.5 %. By contrast, Cooling of the Environment (0.5 %) and Lighting (4.5 %) have lower levels of energy consumption in the dwellings.

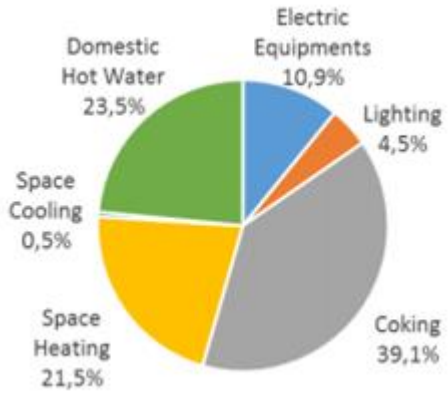

Figure 31. Distribution of residential energy consumption by type of end-uses in Portugal (DGEG 2010; ADENE 2015)

Household electricity use for appliances and lighting in Portugal ranges from 1,000–1,500 kWh, equal to Estonia, Czech Republic, Romania and Latvia. (ENERGISE, 2018).

Following the issuing of the EPBD in Portugal, several changes were introduced in the legislation. One of the main changes impacted the construction sector (with more efficient building Energy Efficiency Trends and Policies) and the introduction of solar thermal panels for domestic hot water production. Figure 32 below shows the energy evolution demands in recently constructed buildings for heating, cooling, and domestic hot water.

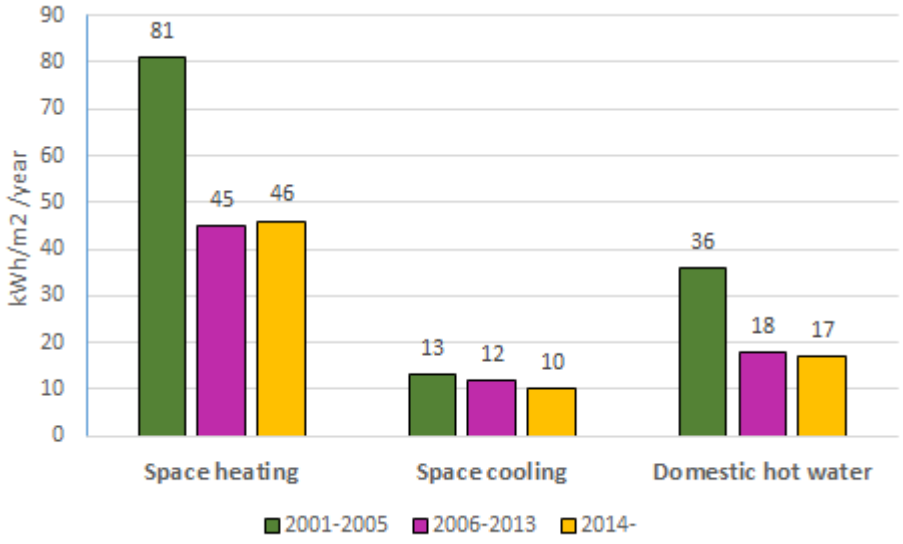

Figure 32. Energy demands by end-use by construction year (kwh/m^2)

On the other hand, the size of buildings is also very important, because larger dwellings consume more energy. The average dwelling size in Portugal is more than 100 m^2, which is among the largest in Europe (ENERGISE 2018).

15.4.4 *Access to smart equipment*

According to Lopes (2016), in 2013 several pilot programmes have been implemented by utility companies, using smart meters and energy management systems, ranging from simple in-house feedback displays to programmable systems endowed with actuation on loads. However, Portugal has not yet decided in favour of a large-scale smart meter roll-out, thus delaying the European Commission's 80 % target penetration rate by 2020 (Lopes 2016). This system is based on the assumption that customers do not receive real time data, but indirect feedback through monthly billing.

Smart grids include electricity networks (transmission and distribution systems) and interfaces with generation, storage and end-users. In Portugal, the transition to a smarter distribution grid is led by EDP Distribuição by means of the InovGrid project for the development and implementation of smart grid concepts and technology (IEA 2016a). Nowadays, 1.450.000 smart meters are installed, of which 930.000 are in self-management and the success rate of these remote services was considered to be 86 % according to data provided by EDP.

According to the functionalities of smart meter, Portugal was classified as *"dynamic movers"* who *"are characterized by a clear path towards a full rollout of smart metering, and this group together with "front runners"* involves more than 50 % of the EU countries. This happens because Cost-

Benefit analysis has not been finished yet and the massive installation has not started (USmartConsumer 2016).

Another report (ICCS-NTUA and EMI 2015) presents the cost-benefit of smart metering systems in different countries. In Portugal, the report identified six benefits for value per metering point:

- Reduction in meter reading and operations - 32.18
- Reduction in technical losses - 5.26
- Electricity cost savings - 82.00
- Reduction in commercial losses - 26.15
- Reduction in outage times - 1.08
- Avoided investment in standard meters - 22.74

In this analysis, the net benefit by metering point is 52.92€.

15.5 Relevant stakeholders in promoting energy conscious behaviour in the national frame

In Portugal there are many governmental (national and local energy organizations) and commercial actors (for example, energy providers) in the energy sector, educational institutions, and non-governmental organizations including those interested in energy consumption and in the promotion of energy efficiency.

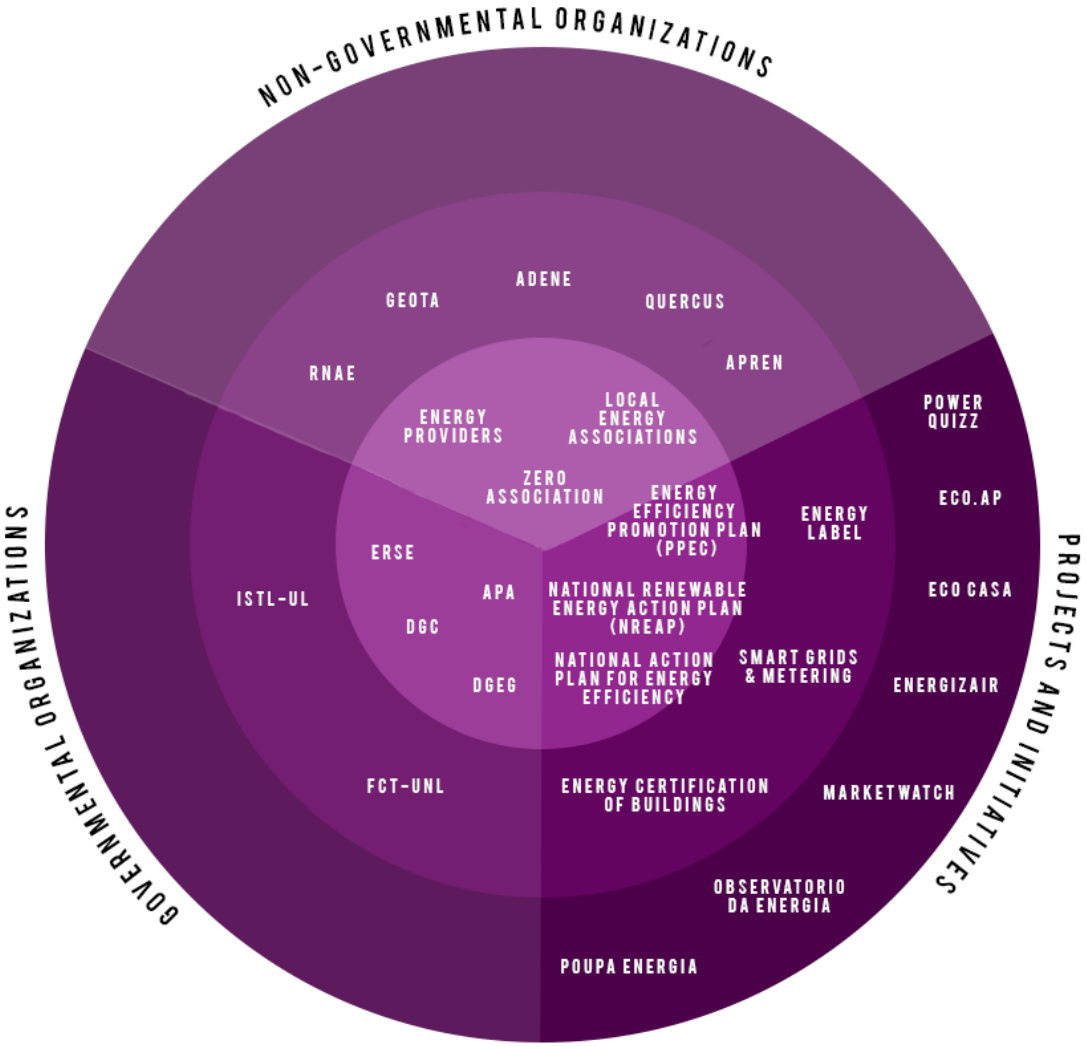

Figure 33. Portuguese stakeholders with interest in energy consciousness

15.5.1 *Institutions presenting national interest for promotion of energy consciousness*

15.5.1.1 Governmental actors promoting energy efficiency / energy consciousness

- **APA - Portuguese Environment Agency** - Contribute to the sustainable development of Portugal, based on high standards of protection and enhancement of environmental systems and integrated approaches to public policies.

- **DGC**- The role of the Directorate-General for Consumer Affairs is to contribute to the development, definition and implementation of consumer protection policy in order to ensure a high level of protection.

- **DGEG** - The General Directorate of Energy and Geology (DGEG) is the Portuguese Public Administration body whose mission is to contribute to the design, promotion and evaluation of policies related to energy and geological resources, with a view to sustainable development and to guarantee the safety of supply.
- **ERSE** - Regulatory Entity for Energy Services is the entity responsible for regulating the natural gas and electricity sectors.

15.5.1.2 Universities and research institutions working on energy consciousness

- **FCT – UNL** - The Faculty of Science and Technology of the New University of Lisbon (FCT NOVA), one of the three largest and most prestigious schools of Engineering and Sciences in Portugal.
- **ISTL – UL** –Technical Graduate Institute - is an institution of Engineering, Architecture, Science and Technology.

15.5.1.3 Other organizations promoting sustainable technologies and energy consciousness

- **ADENE** - Energy Agency is the national energy agency, private non-profit and public utility association, whose mission is to develop activities of public interest in the area of energy, efficient use of water and energy efficiency in mobility.
- **RNAE** - Association of Energy and Environment Agencies is a cooperation network made up of all municipal and regional energy and environment agencies that voluntarily decided to join the network in order to share information and experiences, as well as to foster partnerships between agencies.
- **APREN -** The Portuguese Association of Renewable Energies (APREN) is a non-profit association with the mission of coordinating and representing the common interests of its Associates in the promotion of Renewable Energies in the electricity sector.

15.5.2 *Institutions with membership presenting possible interest towards promoting energy conscious behavior*

15.5.2.1 Organizations with citizens as members

In Portugal, there are numerous associations that work in the area of sustainability and environment, such as: ZERO Association, QUERCUS, GEOTA, and others.

15.5.3 *Energy consciousness related projects and initiatives that have gained public attention during the recent years*

In Portugal, policies and measures to improve energy efficiency and energy saving originate from both the European Union and national government.

The National Energy Strategy for 2020 (ENE 2020) established a goal for reducing final energy consumption by 20 % by 2020. Subsequently, the government defined a more ambitious goal, corresponding to a 25 % reduction in primary energy consumption (30 % in the public sector) by 2020 (IEA 2016a).

In summary, we can highlight some initiatives in this area:

- **National Action Plan for Energy Efficiency (2013-2016)** aims at the reduction of primary energy and energy end-use efficiency and energy services.
- **National Renewable Energy Action Plan (NREAP)** has introduced a number of measures to promote renewable energies, in particular a pilot zone for wave technologies, solar energy technology demonstration projects, and several photovoltaics (PV) power stations in the south of the country.
- **Smart grids and smart metering.** Smart grids are power grids that automatically monitor power flows, with the ability to adjust changes in supply and demand for power. Together with smart meters, they deliver benefits to consumers and suppliers by providing real-time consumption information
- **Energy label** provide information at the point of sale about the energy efficiency of the products, making it possible for consumers to choose more efficiently.
- **Energy Certification of Buildings** aim at improving the energy efficiency of the national building and creating instruments and methodologies to support and define strategies, plans and mechanisms to encourage energy efficiency. In this scope, ADENE developed the campaign "**Certificar é Valorizar**" (www.certificarvalorizar.pt) that shows how the energy certificate of the houses is the first step to improve the energy efficiency in buildings, and "**CLASSE+**" (www.classemais.pt) for energy labelling of products related to the surroundings and common areas of buildings, such as windows.
- **Energy Efficiency Promotion Plan (PPEC)** promoted by the Energy Services Regulatory Agency (ERSE), aims to promote measures that contribute to the efficiency of electricity consumption by promoting actions for consumers.
- "**Poupa Energia**" (www.poupaenergia.pt) is a simulator created by ADENE, that enables finding the best tariff solutions and to speed up the change of electricity and gas providers.
- "**Eco.AP**" (http://ecoap.pnaee.pt) is a programme developed by ADENE to promote energy efficiency in public administration. The programme mobilizes employees and organizations to reduce their energy consumption.

- "**Observatório da Energia**" (www.observatoriodaenergia.pt) by ADENE is a reference and excellence portal with diverse and rigorous information on energy sector in Portugal.
- **Renewable electricity in the portuguese energy system by 2050** is a study developed by CENSE - Center for Sustainability and Environmental Research of the Faculty of Sciences and Technology of the New University of Lisbon (FCT – UNL), requested by APREN, which defines cost-effective paths for the transition of the electricity production sector by 2050.
- "**EnergizAIR"** (http://energizair.apren.pt) is an European project funded by the Intelligent Energy Europe Program of the European Commission, in which APREN participates and aims to create a renewable energy bulletin for 5 countries.
- "**ECO Casa"** (http://www.ecocasa.pt/) is a project launched by Quercus in 2004 and its main areas of action are energy efficiency and climate change.
- "**MarketWatch**" consists in a European Consortium integrated by QUERCUS which carries out a thorough verification campaign of equipment used by consumers in their day-to-day physical stores and online retail stores to identify manufacturers and retailers who do not comply with EU regulations depriving consumers of the energy savings that they believe are to get.

Within the scope of the Energy Efficiency Promotion Plan, there are several projects that can be highlighted. ADENE has referred in the interviews two projects: "**Menos é Mais**" (www.equacaodaenergia.pt) that intends to sensitize students to energy efficiency and the project "**LIGAR – Energia para todos**" (https://ligar.adene.pt) that aims to develop strategic policies to combat energy poverty.

DECO has also implemented several measures in recent years, such as "**Energia Fantasma**" (http://energiafantasma.pt) that aims to sensitize students to decrease consumption and "**Fatura Amiga**" (http://www.fatura-amiga.pt) that intends to help consumers understand their bill of electricity and save electricity.

Zero Association developed different projects too, for example: "**Família Oeiras Ecológica"** addresses different themes: water, sustainability, shopping and energy. In the project, the habits of the participating households (practices and behaviors they adopted) are recorded and some guidance was given in the first session. Then some documents are sent out with tips on how they could make these behaviors more sustainable. The purpose of "**Power Quizz"** was to teach schoolchildren about energy efficiency.

15.6 Final considerations

- **Portuguese climate** is temperate, and the need for space heating varies a lot from region to region.

- The electricity inside the house is mostly used in the kitchen for cooking and heating of sanitary waters.
- **Most Portuguese buildings** are old and for this reason households have low insulation, which results in higher needs for space heating.
- **Economic reasons** are the main motivation to save energy, however, environmental reasons are highly valued by young adults, in particular by young women and population under 45 years of age in all regions.
- The target audience most in need of overcoming barriers for **saving energy** are men of all ages, but especially young men under 25 years of age in all regions.
- The media is the main channel of energy **information** for men and women over 25, but for the young audience, the internet is the main information source.
- **There are official networks promoting energy consciousness** that could help in engaging the consumers. Governmental organizations and NGOs have also produced a wide selection of guiding material and different queries, on the basis of which consumers can evaluate the household's energy consumption.

15.7 References

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Project links

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