



## **D 4.3 Synthesis Report on the case study “From Consumer to Prosumer”**

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## The project in brief

The Energy Union Framework Strategy laid out on 25 February 2015 aims at fostering a cost-efficient energy transition able to deliver secure, sustainable and affordable energy to all European consumers. It has embraced a citizen-oriented energy transition based on a low-carbon transformation of the energy system. At the end of the day, the successful implementation of the Energy Union will materialise in a change in energy production and energy consumption choices. Such choices are heavily shaped by particular economic prerequisites, value systems, gender-based preferences, efficiency of governance and the maturity of civil society. The ENABLE.EU project attempts to understand the key drivers of individual and collective energy choices, including in the shift to prosumption (when energy consumers start to become also energy producers). The project will develop participatory-driven scenarios for the development of energy choices until 2050 by including the findings from the comparative sociological research. As differences between European countries remain salient, ENABLE.EU will have a strong comparative component. The final aim of this project is to contribute to more enlightened, evidence-based policy decisions, to make it easier to find the right incentives to reach the twin goals of successful implementation of the Energy Union and Europe’s transition towards a decarbonised energy system. To reach this final aim, ENABLE.EU will seek to provide an excellent understanding of the social and economic drivers of individual and collective energy choices with a focus on understanding changes in energy choice patterns. Results will be disseminated to relevant national and EU-level actors as well as to the research community and a wider public.

## Introduction

This report provides findings from a case-study on ‘prosuming’ in Italy, Norway, Serbia, the UK and Ukraine. In the international context of climate change there is an imminent need for a ‘green’ transition of the energy system in the EU region, as well the security of supply, competitiveness and energy equity. As a result, renewable energy sources have consolidated an important role in the management of national energy systems. EU policies have acknowledged the importance of engaging and involving consumers in this process, in order to foster sustainable energy consumption and to empower consumers to become their own managers of their energy needs (Mengolini 2017). This transition has led to an increase in households that invest in their own solar energy systems that produce electricity for their own consumption, as well as enabling selling of excess produced electricity into the electricity grid – making household owners of such systems prosumers instead of consumers.

The literature on electricity prosumers and decentralised energy systems is young and mostly centred on technical and economic aspects of electricity prosuming (e.g. Zhang, Yan and Su 2015; Di Giorgio and Liberati 2014; Lampropoulos, Vanalme and Kling 2010). However, there is to date limited literature that explores the prosumer perspectives and experiences (e.g. Westskog 2018; Olkkonen, Korjonen-Kusipuro and Grönberg 2017; Micheals and Parag 2016) and even less that address cultural, social and gendered aspects of prosuming (e.g. Megolini 2017) or who use qualitative methods (e.g. Westskog 2018). Previous literature on other aspects of energy consumption and smart technology suggest that gender relations play a significant impact on individuals and households’ energy choices and consumption (Strengers 2014; Wilhite 2014; Wilhite 2008; Henning 2005). Therefore, it is argued that more work is needed to integrate the gender perspective in energy research and energy policy, respectively. In the light of this, the aim of this report is to contribute to this mission, by providing a mapping of the prosuming as a phenomenon and the gender ideologies related to it. This synthesis report provides an overview of electricity systems and the role prosumers are playing in it in the case study countries Italy, Norway, Serbia, the UK and Ukraine. Following this, the report presents findings from a mapping of gender perspectives on prosuming, covering gender representation in the media, advertisement and in policies and regulation for prosuming in the case-study countries. When it comes to energy systems of household space, the roles of men and women are often gendered. Consequently, the way in which prosuming and decentralised Household Solar Power Plants (HSPP) are presented anticipates on these different gender roles. Finally, the report presents findings from interviews and diaries of household prosumers on their motivations, experiences and gender relations concerning being prosumers in the case-study countries. The purpose of the analysis provided in this report is to understand how the relations between gender, energy practices and choices may differ within and across households, as well as societies, and the implications this may have. This report emphasizes the importance of producing knowledge that highlights social and cultural factors needed to advance people/gender sensitive policymaking, which can facilitate people’s choice of investing in environmentally friendly energy solutions and practices.

# 1. Contextualising the Prosumer

The concept of prosumer is a new concept in the energy field that denotes a consumer who both consumes and produces electricity:

Customers who produce electricity primarily for their own needs, but can also sell the excess electricity. Prosumers are connected to the distribution network with small and medium installed capacity (Eurelectric 2015, quoted in Mengolini 2017, 12).

This report focuses on residential prosumers, as defined above, who have invested in solar energy systems on their property that produces electricity for their own consumption but are also connected to the main electricity grid supply and who sell excess produced electricity to the main grid supply. In addition to residential prosumers, the main categories of prosumers are:

- Community prosumers who produce electricity for their own consumption within housing associations; foundations, and who are not commercial actors.
- Commercial prosumers such as department stores, warehouses, office buildings who produce electricity for their own consumption, but whose main business is not electricity production.
- Public prosumers such as public institutions and government buildings who produce electricity for self-consumption (Mengolini 2017, 12).

Prosumers are hybrid consumers/producers, which mean that generally they are connected to main electricity grid services and thus both consume main grid electricity, their own produced electricity and sell excess produced electricity back to the main grid.

The residential prosumer focused on in this report has a significant role in the development of a future energy system in line with a green transition in the EU region. Within EU policy consumers are acknowledged as fundamental to achieving the energy transition successfully and in a cost-effective way (European Commission 2016). A mainstay of EU policies has therefore been to empower consumers to act, meaning providing consumers information, protection and alternatives that enable them to achieve more sustainable energy consumption, lower costs and opportunities for becoming suppliers and managers of their energy needs (European Commission 2015). Further, several EU-countries like Germany and UK have had extensive support schemes (feed-in tariffs) to increase renewable electricity production (mainly PVs) as a part of their policy for decarbonization (Inderberg et al 2018). An underlying objective of empowering consumers to become prosumers is to advance the expansion of renewable energy systems to decarbonize the energy sector, reduce grid losses and congestion, and not least: “accelerating, transforming and consolidating the EU economy’s clean energy transition thereby creating jobs and growth in new economic sectors and business models” (European Commission 2016).

Prosuming has been enabled by new technological innovations such as micro-generation, smart metering, energy management systems that allow for more communication and integration between decentralised and centralised electricity systems supply. However, as stated by Da Silva, Karnouskos and Ilic (2012), there is no guarantee that new services and technologies will be used, or even accepted, by their users:

Therefore, in order for end-users to embrace these services, a good understanding of the needs, background, and required learning curve are necessary, otherwise the services risk being improperly or insufficiently used, abandoned, and may even become a road-blocker for future meaningful efforts to engage the prosumers.

Also, Michaels and Parag (2016) emphasise the importance of “understanding prosumer motivations, recognizing non-economic barriers for engagement such as norms, comfort and practices, as well as identifying opportunities and platforms for engagement.”

Previous literature has pointed to some challenges of assuming that economic incentives alone will be enough to increase the number of prosumers to a significant level. It is necessary to understand prosumers willingness to take an active part in their energy needs and change towards more environmentally friendly energy consumption. In addition, technological advancement of and development of smart grid systems have given rise to concerns about privacy issues. Da Silva, found in their survey (Europe, Egypt and Australia) that electricity consumers want information that enables them a better understanding of their energy behaviour. Electricity consumers also have particular preferences for obtaining such information on mobile phones, which is a device already integrated into their daily life practices. The survey also found that participants are willing to engage with their community and share their production surplus, with an aim to help the community or reduce their overall electricity costs. This resonates well with the findings of Westskog and Winther (2014) which shows that people adhere to different logics in their energy choices; for example people may act upon market principles as a basis for their energy behaviour or refer to the needs of the greater community as a rationale for their energy behaviour reflecting their role as citizens. The findings of Da Silva’s survey also re-established the issue of privacy concerns and consumers unwillingness to share information about their routines but also indicated that privacy was negotiable in exchange for other benefits. The issue of privacy was also found to be a significant barrier in the study of Michaels and Parag (2016) in Israel. Though the findings of the Israeli study also related to energy institutions overseeing energy transition (smart metering etc) particular to the Israeli context, the study shows how a green transition comprising of prosumers relate to individuals trust in governments and the energy sector.

A Finnish study (Olkkonen, Korjonen-Kuusipuro, and Grönberg 2017) examining the relations between prosumers and energy companies found that prosumers sought reciprocity in the relationship and wanted to be acknowledged (both financially and otherwise) as co-producers. One of the most interesting findings of the study was that the energy company’s attitude and actions toward prosumers affected the way prosumers consumed energy. The study showed that prosumers may choose to use the leverage they have and deliberately withhold excess energy instead of selling it to the grid if they feel that they are not acknowledged, which might contribute to negative behaviour in the form of energy extravagance.

### **Prosuming and Gender Relations**

The literature on electricity does not address gender and gender relations but assumes the prosumer to be a neutral term. Despite most of the referenced studies being surveys that produce findings based on gender and age, this is rarely presented or discussed in the results. The Finnish study (Olkkonen, Korjonen-Kuusipuro, and Grönberg 2017) comments on a gender bias in their sample. They conducted interviews with 12 households, but only one of the interview participants was a woman:

The gender bias was due to men’s higher involvement and interest in energy issues in the selected case—they had initiated the solar panel acquisition in their homes and, thus, they were more prone to act as interviewees.



This lacuna in the literature concerning gender issues is reflected also in other scholarship in the field of energy where gender issues are regarded as irrelevant (Standal, Winther and Danielsen forthcoming). However, issues of willingness to take an active role in household energy management, take use of new energy technologies, and economic opportunities to invest in such technologies are not equal among men and women.

Energy politics has mainly been perceived as an economic and technical issue, coupled with policies of industrialization and national security where gender has been assumed to have little relevance. As stated by Kaminara (2015,1); “when policymakers make decisions with respect to energy issues, they often do so considering that those decisions affect women and men in the same way.” As noted by several (Standal, Winther and Danielsen forthcoming; Kaminara 2015; Henning 2005; Clancy and Roehr 2003), the widespread perception that the global North and especially Scandinavia are gender equal has led policymakers to assume that energy policy decisions affect women and men in the same way. Standal; Winther and Danielsen (forthcoming) and Clancy and Rohr (2003) also pinpoint how gender issues in energy use and policies matter for the global North. Through available studies in the field of gender and energy, the authors show how gender matters for household energy consumption, energy policy and for agenda setting and work in the energy sector. Some examples illustrate this. Women generally have lower income than men, and those at lower income levels usually consume less energy than those at higher levels (Clancy and Roehr 2003). Women consume more electricity at household level, because they do the majority of energy related domestic work (Carlsson-Kanyam and Rätty 2008). Women do often have the responsibility for energy conservation by reducing their use of energy appliances and men for technical decisions and investment in thermal insulation of homes (Clancy Roehr 2003) and measures to reduce energy use in households may lead to a greater work burden for women, because it may complicate their domestic work chores (Carlsson-Kanyama and Lindén 2007). Further, men more than women favour nuclear power and fossil fuels, while women largely favour renewables (Clancy and Roehr 2003). Elnakat and Gomez (2015) explore whether there is a difference between the energy use of families dominated by females and males, based on a survey of single-family residential households in the U.S. Their review of previous studies supports the notion that traditional gender-based division of labour is still prevalent in most countries. Drawing on the survey data they find that households led by women consume more natural gas, due to their preference for warmer temperatures for both space heating and water use. The study concludes that the relationship between gender and sustainability should be better understood and conservation policies should promote the engagement of female occupants, given their determinant role in the daily routines of operating home appliances, as well as their influence on the behaviour of children and other family members. Several studies provide evidence on different thermal sensation of women, especially regarding air-conditioning, claiming that females are more sensitive to fluctuations in temperature in comparison to men (e.g. Schellen et al., 2012, or Karjalainen, 2012). One possible solution is applying technology that enables personalized heating and cooling. Using an optimal mix of ventilation, humidity, heat conduction and radiation can improve personal comfort, while energy consumption can be decreased by up to 40-60%, depending on the ambient air and the thermal conditions required (Vesely and Zeiler, 2014).

Brounen et al. (2013) show that women are less aware of the energy consumption of their dwellings than men. In another study, Henning (2005) illustrates the importance of gendered household zones and negotiation processes between men and women. The pellet burner is often installed in single-family houses equipped with a boiler room such that the burner easily fits the energy system that has already been installed. Secondly, the pellet burner is most often placed in the male zone of the house, where it is not subject to gendered negotiations and adjustments. However, the pellet stove is often placed in the living room, where it may conflict with norms for tidiness and



how the room is decorated. The installation needs to be negotiated between men and women and often meet requirements in excess of energy efficiency or environmental concerns. In other words, installation of a pellet stove involves negotiating gendered household zones and boundaries and may lead to conflicts.

However, the findings above should be considered with caution, as there are also studies that found no evidence on existing differences between the attitudes of male and female consumers towards energy consumption and renewable heating solutions (e.g. Michelsen and Madlener, 2017; Tabi, 2013). Other studies (Hargreaves et al. 2010) suggest that there are gender and age-specific styles of engagement with the devices and what they are communicating. Men in households have typically taken responsibility for managing the physical, infrastructural and large financial commitments whilst women have jurisdiction over the furnishings, fittings, domestic routines and childcare. In her ethnography on the adoption of domestic renewable energy technologies in Swedish households, Henning (2005) shows that government strategies (such as subsidies), as well as the engineers designing such technologies (in this case pellet stoves and household solar PV systems) tend to emphasize technological development over the users’ preferences and social practices. When Swedish policy-makers assumed that subsidies for rooftop solar system and switching from oil heating to pellet stoves would lead to a transition towards de-carbonisation, they did not take into account that aesthetics and gender roles posed a significant barrier to a green transition, by which we mean increased renewable energy replacing fossil fuels. Henning (2005) demonstrated that Swedish women tend to “control” the kitchen and living room spaces, and resisted implementing new technologies that broke with their ideas of an attractive home even when subsidies and reduced cost made such a switch profitable.

This case-study briefly touches upon another gendered aspect of the green transition, namely the gendered bias of job segregation in Science, Technology, Engineering, and Mathematics (STEM) sectors. Clancy and Roehr (2003) illustrate how gender matters within other areas than households’ negotiations over energy technologies and practices. They argue that the energy sector has a clearly masculine image that attracts more male, compared to female, workers. The perception that the type of work performed in this industry involves heavy labour is a factor that may discourage women from applying for work in the sector. Although energy companies increasingly acknowledge that women’s competencies are complementary to those of men, and are valuable for developing a more balanced and efficient organisation, female workers remain a minority within the sector. In some of the case-study countries (Norway and Ukraine) several of the prosumers interviewed had invested in solar systems because one of the residents (mostly men) worked in the energy sector and thus had keen interest and skills in the technology at hand. A previous study on prosumers in Norway describe men (and a very few women) who work in the energy sector or with particular technical interest and skills as one of the major prosumer groups (Winther, Westskog and Sæle forthcoming). This has as in the Finnish case (Olkkonen, Korjonen-Kuusipuro, and Grönberg 2017) led to higher involvement by men who feel confidence and interest, while their female partners are less engaged in the process. It is outside the scope of this paper to have a thorough discussion on balancing the gender representation in STEM and outcomes for a green energy transition. However, the International Renewable Energy Agency (IRENA) has found renewable energy employment to be more gender equal than the energy sector at large. As an example, IRENA’s own survey covering 90 companies in 40 countries reported that women represented an average of 35% of the workforce (compared to about 20-25% of the energy sector as a whole) (IRENA 2018). Though a promising number, it is still lower than OECD average of women employment rate, and certain countries have more gender disparity in energy sector employment than others (see also Standal, Winther and Danielsen forthcoming and Clancy and Rohr 2003).

## 2. Methods

The main objective of this case-study is to explore social, cultural and gendered aspects of individual and household’s energy choices in relation to becoming prosumers in Italy, Norway, Serbia, UK and Ukraine. This case-study has thus aimed at identifying the main motivations for a consumer to become a prosumer, how this choice could affect the energy practices of families and what are the main barriers that can be encountered, and how gender and other cultural and social aspects play in. To explore motives, energy practices from such a perspective warrants a qualitative methodological approach that provides a “thick” description (as formulated by Geertz 1973) as a way of understanding the cultural context and meaning that people place on actions, words, and things. Qualitative methodology’s openness to nuances and suitability for drawing on linkages from a broad set of data allows contextual understanding and explanations through closeness with the interviewed prosumers. This provides opportunity to study people’s action and accounts in relation to energy in everyday contexts. For that purpose, the case-study combines four qualitative methods of data collection conducted in each case-study country:

- Mapping of prosuming in the national energy system
- Mapping of gender ideologies in prosuming in media and advertisement
- Semi-structured interviews with prosumers
- Diary notes made by prosumers

The methods are discussed in more detail below.

In addition to a range of established methods of qualitative methods, the case-study spans over several countries in the EU. The case-study consists of the following partners; CICERO (Norway), ISINNOVA (Italy), Economics Institute (Serbia), London School of Economics (LSE) (UK), and CGS21 (Ukraine). Center for International Climate Change in Oslo (CICERO) has led the case-study work and coordinated the collection of data. The case-study countries are selected to cover characteristics regarding several criteria: centralised and decentralised energy production from renewables; high and low public trust in main governance institutions in the country; energy poor and energy rich countries; countries with reported governance deficits in the introduction and use of renewables. The collection of data and analysis from the selected case-study countries will provide valuable knowledge on how to address opportunities and challenges to advance a green energy transition in Europe.

### 2.1 Mapping

The first phase (September – November 2017) of the case-study involved mapping prosuming and gender ideologies concerning prosuming in each of the five case-study countries. First, the mapping consisted of providing a general **overview of prosuming within the national electricity systems** in the case-study countries, including **policies and regulations** concerning prosuming. Second, the mapping consisted of collecting and presenting an overview of **gendered presentations in promotion material for HSPPs** and gendered presentations in **media coverage of interviews with prosumers and prosumer policies and regulations**. As far as possible obtaining material from promotion material and media coverage was done systematically using different web search services, however this differed from country to country depending on services available. The number of

promotion material and media coverage also differed extensively as residential prosumers is a new phenomenon in Norway and Serbia, while well-established in the UK and Italy.

### 2.2 Interviews and Diaries

The second phase (January – March 2018) of the case-study involved conducting semi-structured interviews and collecting diary notes from 10-12 residential prosumer households in each case-study country. As the objective was to learn about both households’ motivations and experiences as well as the significance of gender in this process, the case-study design focused on recruiting hetero-sexual couples who were residential prosumers and the interviews were set up in order to talk to the woman and man alone. An overview of the interviews and main characteristics of the prosumers interviewed is given in the table below:

Country	No. of households	No. of interviewees	Average age group	Households in rural	Households in urban and sub-urban areas	Interviewees with higher education
<b>Italy</b>	10	20	50-60	-	-	7
<b>Norway</b>	14	24	50-70+	8	6	17
<b>Serbia</b>	10	19	30-40	6	4	5
<b>UK</b>	14	28	60-70+	7	7	17
<b>Ukraine</b>	18	34	30-40	8	10	16

An effort was made to interview prosumers across age groups, different socio-economic positions and geographical residence to include different perspectives and experiences. The sample of informants in each case-study country ranges from 30-75 years old, low and high education, and a great diversity in type of occupation. However, the prosumers interviewed share some characteristics: All the prosumers in this study owned their own house and a solar system, and they sold excess produced electricity back to the main grid (except Serbia). The vast majority of the informants belong to similar socio-economic group in terms of steady jobs and financial means to buy a house and invest in solar systems, though there were also a few examples of unemployed and a student. The majority of prosumers interviewed also had higher education. Most of the informants interviewed lived in family settings. In Ukraine and Serbia, the average age group of the prosumers interviewed were younger, between 30-40, while in the other case-study countries, the average age group of the interviewed were above 50+.

Each interview lasted about 1-1,5 hrs and was semi-structured in order to allow the prosumers to raise topics and concerns relevant to them, however each case-study partner followed the same interview-guide to collect comparable data across the countries. The interview was structured as follows:

- Questions on occupation, age, education, main interests, etc.
- Questions on location of the house, size, family members, etc.
- Questions about motives to become prosumers
- Questions about energy habits and management of the solar system
- Questions about gender

Most interviews were conducted in the prosumers’ house, which allowed us to also look at the solar PV systems, the inverters and ask the informants to show us how they checked information concerning production. This was also a good way to explore who in the household kept track of this information and how inverters were placed. A few interviews were carried out per telephone to avoid

unnecessary travel. The research design aimed for interviews with couples, but in a few cases interviews were conducted with families who only consisted of one adult residential prosumer. In Norway one extra interview was also conducted with a family who had very recently purchased a house with a solar system even though they had not moved in yet. This was done in order to elicit information on families who become prosumers through buying a new home.

The case-study design also included asking the prosumers who participated in the study to fill out a daily diary form and notes for a week. The diary notes were distributed seven days in advance of the interview and consisted of a table to fill out daily. In addition, there was space for informants to provide additional information in terms of family discussions on energy or other things they found relevant. These diary notes focused on energy use practices and family discussions on energy. In the diary notes it was asked specifically for who in the household did the laundry, made the dinner and checked electricity production of the solar systems (see Appendix 3). Some informants chose not to fill out diaries, or the scheduled date of the interview came before they had time to fill out making this sample smaller than actual prosumers interviewed.

The recruitment of prosumers deserves particular attention. As discussed in the next section all prosumers who participated in the case-study were given information about the study and their rights as research participants prior to the interviews. However, in several of the countries it was difficult to find and recruit prosumers and it was necessary to use several strategies to successfully conduct sufficient interviews. The use of social media and the respective research partners’ web pages were used to give information and recruit informants, which worked successfully in Norway and Ukraine. Another main strategy was to contact companies who install HSPPs or government institutions who have registries over prosumers to help out in the recruitment. In most cases companies and institutions did not provide help in order to ensure customer privacy, but in Norway several companies and the Norwegian Solar association spread information about the study and how to participate through emails and social media posts. In Serbia, four companies provided their database. In some cases, personal contacts and meetings (such as seminars/conferences) were important in order to recruit prosumers (Norway, Italy and Serbia). In the UK, the previous household survey in the ENABLE.EU project was also used to recruit informants. This was not an option in countries that have a low number of prosumers such as Norway, Serbia and Ukraine.

In addition to the challenges concerning finding sufficient prosumers for interviews, Serbia encountered another difficulty as though legislation grants ‘natural persons’ (legal term distinguishing individuals from legal person who may be a private business or organisation) rights to be electricity producers under the condition that the electricity production is a renewable energy sources and do not exceed 30 kW. However, this has not worked out in practice as the law is not harmonised yet. Hence the sample of interviewed in Serbia are not prosumers in the true sense as, though they have invested in HSPPs, they cannot sell excess produced electricity to the central electricity grid supply.

To ensure that not only the informants most dedicated to the environment or technology would be participating, some of the research partners (CICERO, LSE) also provided participating prosumers with gift cards. CICERO has led a Norwegian case-study in prosumers before and has good experiences with this type of remuneration.

## 2.3 Ethical Considerations

As stated above all prosumers recruited for this case-study were provided detailed information on their rights as research participants, the objective of the study, and guarantees of anonymity (see Appendix 3). We also explained the details and objectives of the study in each interview and asked

for verbal or written confirmation of their consent to participate. Each case-study partner has complied with their respective national and research institution’s ethical guidelines and data management plans. As the leading institution, CICERO is obliged to follow the guidelines of the National Committee for Research Ethics in the Social Sciences and the Humanities (NESH) in Norway, and as such these guidelines are applicable to all the case-study partners. NESH guidelines assert that all participants receive adequate information, give their consent to participation, and are anonymized throughout the research process from gathering of data through to publication, and that data is stored safely with password security, only allowing the relevant researchers access. CICERO has obtained approval from the Norwegian Center for Research Data (NSD).

### 3. Background: An Overview of Prosuming in the Case-study countries

Energy provision and distribution systems differ from country to country, depending on historical regulation of energy systems, government control of energy supply and the climatic environment. An overview of prosuming in Italy, Norway, Serbia, the UK and Ukraine will be provided in the following section.

Energy systems are often still perceived as a public good provided by the state. Hence, when households produce their own electricity, as is the case with prosuming, this can be seen as a break with conventional energy supply (Schleicher-Tappeser 2012). The abovementioned countries have parallel as well as differentiating policies and regulations for prosuming, regarding legislative frameworks, reorientation of the civil society, support of local authorities, financial regulations, etc. Furthermore, the geographic characteristics of countries also affect the development of the solar energy market. The following section will discuss the development of national energy policies and domestic energy access, production and use in the different case studies.

#### 3.1 Prosuming in Italy

Renewable energy sources (RES) have become a stable component of Italy’s sustainable development. RES are now widely used in Italy both for electricity and for heat production, due to the spread of more efficient technologies and the reduction of production costs of RES-powered plants. Concurrently, public incentive schemes and dedicated services, such as tax credits and the net-metering service were provided to operators and citizens.

Whereas hydraulic sources have been prevalent in RES, the electricity production from PV plants has started to rise rapidly in recent years as illustrated in Figure 1 below.



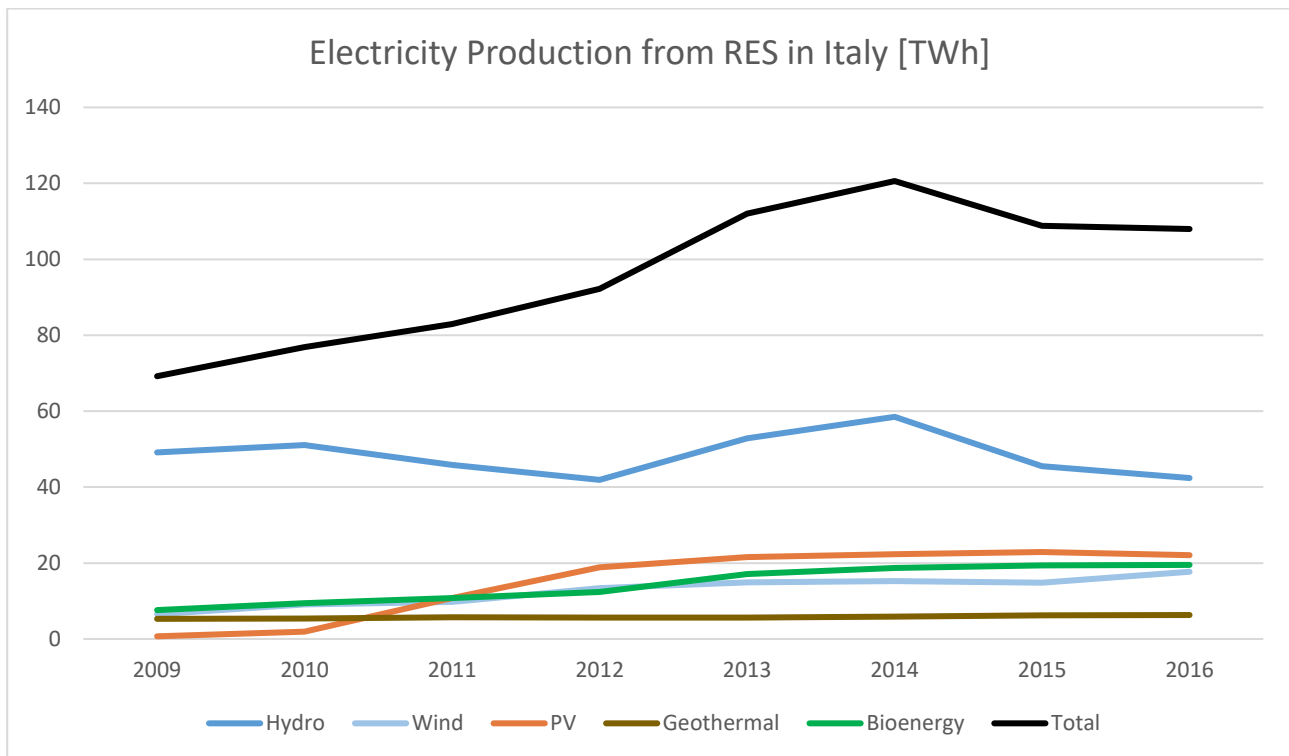


Figure 1- Electricity Production from RES in Italy. Source: Terna 2016, <http://www.terna.it/it-it/sistemelettrico/statisticheeprevisoni/dati statistici.aspx>

In 2001, the Ministry of the Environment, in collaboration with the Regions, launched a financing scheme to enable and encourage the installation of photovoltaic plants connected to the electricity distribution network: the program was called "10,000 photovoltaic roofs". Unfortunately, this program did not have the same success in Italy as in other European countries (Inderberg et al. 2018). The financing scheme was too complex and lacked concrete action plans. Moreover, a clear national energy strategy for the reduction of greenhouse gas emissions was absent. The regulations of photovoltaic systems changed and different ranges of capacity eligible for incentives were defined in relation to the type of plant (below or above 500kW).

This led to the launch of the *primo conto energia* (first energy account) in 2005, which included very generous feed-in tariffs to PV installations between 2005 and 2011. The original 2005 capacity target for PV of 100 MW was reached in nine days (IEA 2016). The new formula, however, included a number of limitations, mainly due to the absence of specific guidelines and to the fact that, even though the requirements were met, the requests for application were not guaranteed because of the existence of an annual cap to the maximum number of requests to be accepted. The capacity target was increased to 500 MW the following year and entirely removed for the second phase of the support scheme, *secondo conto energia*, which started in 2007.

The *secondo conto energia* aimed to considerably simplify the procedures and redefine new incentives and targets; aiming for 3000 MW of PV capacity by 2016 and included incentive grants for large and small plants, and additional incentives for plants in schools, hospitals and municipality buildings.

Downward adjustments to the tariff under the third phase, *terzo conto energia*, in 2010 did not significantly slow down the market. The classification of photovoltaic systems changed and different ranges of capacity eligible for incentives were defined in relation to the type of plant. Moreover, taking into account the significant reduction in the cost of photovoltaic components, it was



foreseen to gradually decrease the incentive tariff. The *terzo conto energia* applies to plants with more than 1 kW capacity, coming into operation starting from January 2011, lasting for 20 years.

The *quarto conto energia* implemented a tariff reform in mid-2011, which introduced lower support levels, subject to regular decreases over time and an annual cap to control support costs. The announcement of reform led to an unprecedented rush of investors to register their installations under the much more generous *secondo conto energia*. This happened as a result of a legal loophole that was introduced by the Parliament, which remained open until June 2011 (IEA 2016). Installed capacities more than tripled in that year and extended to about 13 GW by the end of 2011. The targeted volume for 2020 had been 8.0 GW.

In an effort to contain costs, the fifth and final *conto energia*, introduced by Ministerial Decree of 6 July 2012 included provisions to cap annual support payments to solar PV at EUR 6.7 billion annually. This cap was reached in June 2013 and the system has been discontinued. Today, the *conto energia* scheme has been replaced by the possibility to deduct up to 50% of the cost of the plant as building refurbishment costs and maintaining the possibility of selling extra energy produced through the Net Metering Service. These possibilities together with the self-production make the investments in PV technologies a cost-effective choice.

Since January 2009, The National Energy Service Operator, GSE, is in control over the management of the Net Metering Service. This service is activated at the request of interested parties. The electricity generated by a prosumer, in an eligible on-site plant and injected into the grid, can be used to offset the electricity withdrawn from the grid. GSE pays a contribution to the customer based on injections and withdrawals of electricity in each calendar year and on their respective market values.

As can be seen from the graph in Figure 1, since the closure of the Fifth Energy Account in 2013, the number of plants and the corresponding installed capacity have been growing much more slowly. Another trend that it is worth noting is the average size of the plants that is continuing to decrease over the last years.

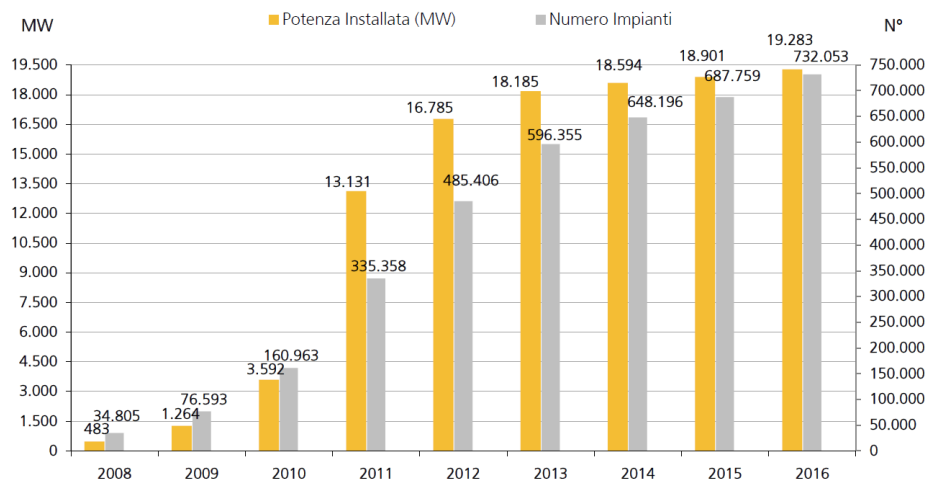


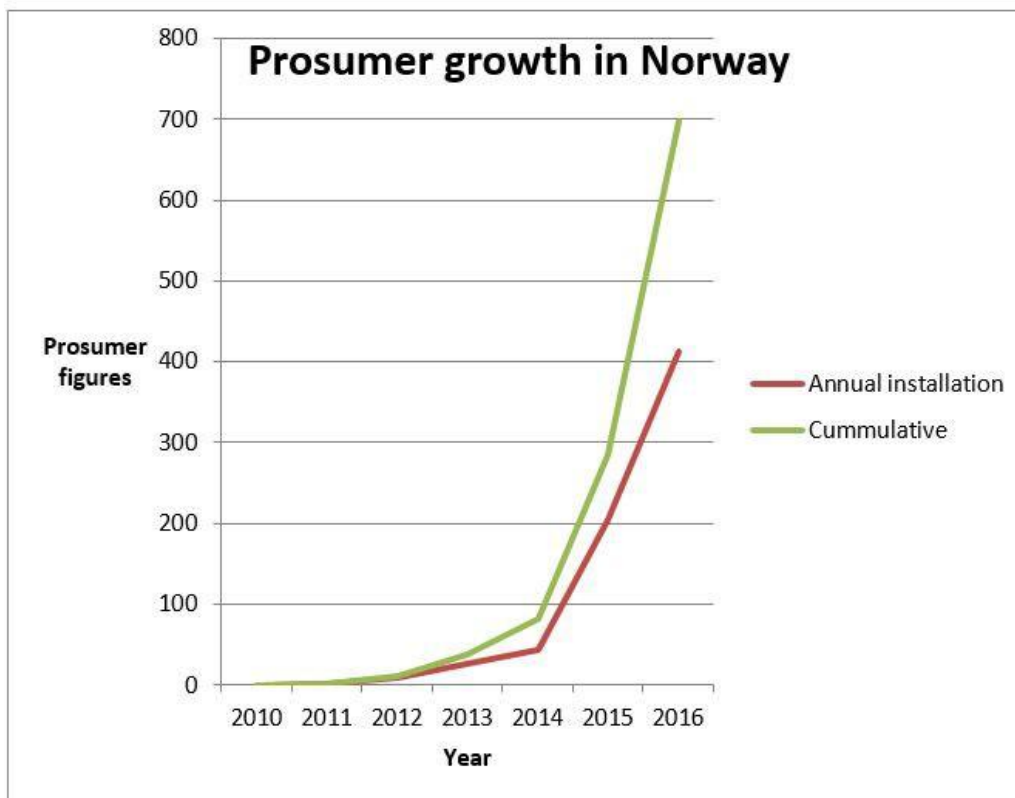
Figure 2: Number of plants (grey) and total installed capacity (yellow) in Italy in the last years. Source: *Rapporto Statistico Solare Fotovoltaico 2016*, GSE, <http://www.gse.it/it/salastampa/news/Pages/Pubblicato-il-Rapporto-Statistico-2016-sul-solare-fotovoltaico.aspx>

At the end of 2016, the number of photovoltaic plants installed in Italy amounted to 732,053, corresponding to 19,283 MW of capacity. About 85% of the 44,294 plants installed in 2016 are attributable to the household sector. In brief, 53% of the total energy produced from PV plants in Italy

in 2016 (22,104 GWh) was generated by the industrial sector, 22% from tertiary, 14% from domestic households and 11% from agricultural.

### 3.2 Prosuming in Norway

Electricity generated from solar energy and prosuming constitute a new frontier in the Norwegian electricity system and energy market, and the estimated number of prosumers is only about 700, which is significantly less than Norway’s neighbouring countries Sweden and Denmark (Inderberg, Tews and Turner 2016). Still the number has ‘radically’ increased (from almost zero) since about 2012, as shown in the table below:



Figur 3-Prosumer growth in Norway (Inderberg, Tews and Turner 2016)

Despite a rapid increase of the number of prosumers since 2015, there are multiple reasons that explain why the numbers are low compared to neighbouring countries. The main reason is that most of the electricity produced in Norway is already renewable (about 95% is the electricity produced is from renewable hydropower, Sæle and Cherry 2017:12). Hence, the need to decarbonize the energy sector is less than in most other countries in Europe. Further, the general perception has been that the climatic conditions of long winters with little sun and cold temperatures makes solar PV technology a less suitable option. In economic terms, recovery of costs of installations of solar household systems range from 10-15 years, because most of the household electricity consumed is not during the sunny parts of the year, and because the tariff for selling excess produced electricity to the main grid is low. Prosuming in Norway is not just new in a timing perspective, but also involves a radical conceptual

break with people’s general understanding and the historical tradition of the Norwegian electricity system as a ‘public good’. Historically (until 1991), the electricity system has been a government service and fully operated and controlled by the Norwegian state. For households to produce their own electricity and become more independent from the energy utility companies is therefore a new issue (see Westskog et al 2018 for a discussion). Today, the energy system is deregulated, but the state is still in control over the transmission grid. The transmission grid is owned and operated by the state-owned transmission system operator Statnett, while there are (in 2012) 136 district system operators – or energy utility companies that engage in electricity generation and distribution of electricity for sale. Some of which are owned by municipalities.

There were no regulations concerning prosuming in Norway (such as exemption from license to generate electricity or tariff structure for prosuming), until March 2010, when the Norwegian Water Resources and Energy Directorate (NVE) issued ‘light regulations’ that were to consider as recommendations of how to handle prosumers by DSOs rather than strict regulations. Before 2010, no formal regulations for prosumers were set in place, but some informal arrangements existed between prosumers and utility companies. In 2010, the Norwegian Water Resources and Energy Directorate issued light regulations meant to facilitate the opportunity for private households with small-scale solar systems to feed electricity into the main grid. Residential owners of solar plants were thus exempted from the regulations of metering, calculation of power distribution and billing of grid services (Inderberg, Tews and Turner 2016:58). However, the prosumer was not a well-defined concept and provided no formalized rights. From 2017, the Norwegian Water Resources and Energy Directorate adopted amendments to the 2010 regulations. The new regulations provide a clearer definition of the prosumer (producer/consumer, and cap of 100 kW for prosumers’ feeding of electricity into the grid), as well as stronger emphasis on prosumers rights to exemption from other tariffs regardless of which energy utility company the customer is affiliated with. The formal requirements for proper installation of HSPPs has also been helped by the mandatory roll-out of smart meters in households (by 2019), which allows two-ways communication on production and consumption with grid operators. The utility companies have the overall responsibility to manage and install the smart meters, overseen by the NVE.

As the up-front costs of solar systems are still high in Norway, several small-scale subsidy schemes have been set in place to develop the HSPP market. On national level, the state-owned organisation Enova provides economic support for households who take certain measures to change the energy profile of their house towards energy efficiency and low carbon transition. Enova is owned by the Ministry for Oil and Energy and financed through the ‘Energy Fund’ and tax on electricity consumption to fulfil their mandate to promote a green energy transition in Norway. Included in this, is the possibility for support for buying solar PV systems. Enova refunds 10,000 NOK (approx. 1065 Euro) of the cost of purchase. In addition, the scheme provides economic support in relation to the capacity installed: 1250 NOK per kW installed up until 15kW. The two support schemes together can provide up to maximum 28,750 NOK (approx. 3060 Euro). If combined with other energy efficient installation and upgrading, the economic support may be extended. The Enova support scheme cannot be combined with other similar support schemes. Some municipalities have their own support schemes, which are similar to Enova’s or which focus mainly on simplifying the process through information, easier permits from the planning requirements and cooperation with commercial solar system providers.

### 3.3 Prosuming in Serbia

Serbia fulfils most of its electricity demand from domestic production. Electricity production in Serbia is dependent on approximately 70% coal, while the remaining 30% is mostly generated from hydropower. However, Serbia also produces electricity from other RES, of which hydropower and biomass energy is the most significant. The potential for the exploitation of solar energy in Serbia is not negligible. The number of hours of solar radiation in the country is between 1,500 and 2,200 hours per year.

The electricity market in Serbia is dominated by the national power utility company Elektroprivreda Srbije, Power Industry of Serbia (EPS), which owns all large generation capacities and supplies most consumers. In 2009, the Serbian government set targets for increasing investment in RES in the National Renewable Energy Action Plan (NREAP). The legal framework of NREAP has provided incentive measures, such as feed-in tariffs for increasing the share of RES. Since the system feed-in tariffs started to be implemented in 2010, there has been a continuous growth of new capacities for production of electricity from RES.

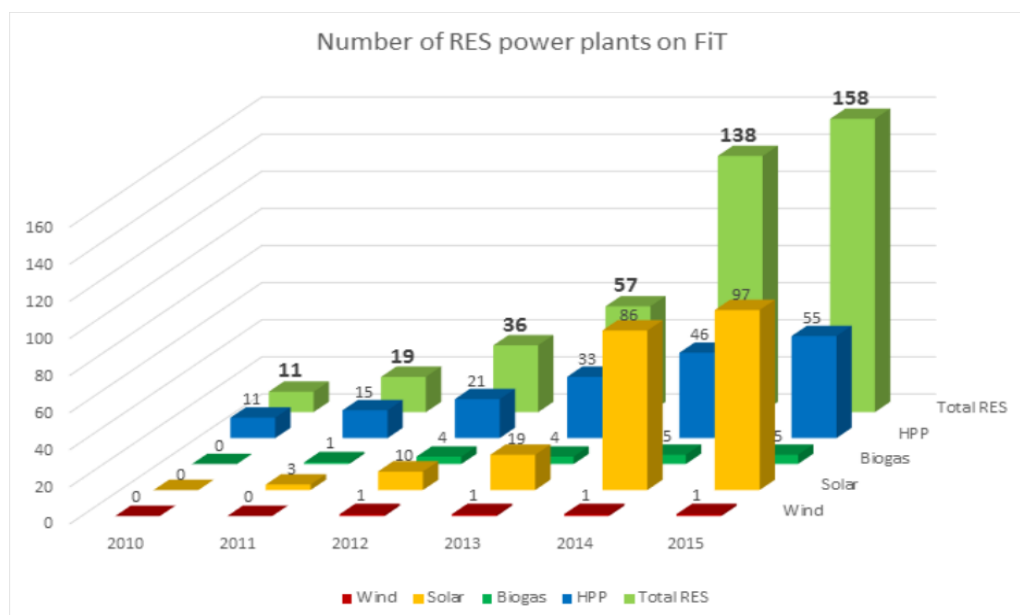


Figure 4-Installed RES power plants from introducing feed-in tariffs (The Ministry of Mining and Energy 2016)

The key priorities of these incentives have been to follow a strategy enabling: 1) Energy security through reliable, safe, efficient and quality of energy supply; 2) The development of the energy market, through competitiveness in the energy market on the principles of non-discrimination, publicity and transparency; 3) Comprehensive transition to sustainable energy, by the creation of economic and financial conditions for increasing the share of energy from renewable energy sources. Within the framework of Incentive Measures for the Usage of Renewable Sources for Electricity supply, the public company “EPS Supply” is obliged to buy electricity from privileged producers, and to take over balance responsibility.<sup>1</sup> According to the Energy Law of the Republic of Serbia (Official Gazette of the Republic of Serbia, No. 145/2014), Article 70, paragraph 5:

... status of the privileged producer, temporary status of the privileged producer and status of producers from renewable sources can also be acquired by a natural person producing

<sup>1</sup> [www.eps-snabdevanje.rs/obnovljivi-izvori](http://www.eps-snabdevanje.rs/obnovljivi-izvori)

electricity from renewable sources from only one power plant, with an installed power of up to 30 kW, under the conditions provided in para. 1-3. of this Article.

The legal term ‘natural persons’ refers to individuals (as opposed to ‘legal persons’, which may be private business or organizations). In summary, the law states that individuals and their households can become a privileged electricity producer/prosumer and thus sell electricity to the EPS. However, in practice there are no households that have been granted to become privileged producers/prosumers at the time of this study. The main reason why these regulations are not is the lack of specified complementary regulations, as well as the fact that there is no supplier on the market who would be willing to sign a contract with a ‘natural person’. According to estimates from available data, there are only about 385 households who have HSPPs in Serbia.<sup>2</sup> Households with solar systems are using the electricity only for their consumption and do not have the opportunity to sell/transfer excess production to the electricity transmission network unless they register as company, and thus becomes a legal entity. In addition, the capacity of the HSPP (to be deemed as legal entity) should be between 5-30 kW. The state offers only the purchase of energy from privileged producers if they acquire a legal status, but does not offer additional financial incentives for the installation of PVs with higher capacities. The data show that HSPPs are mainly installed in secondary homes (cabins), where there is no access to the electricity network in the area. Households located in cities predominantly choose solar collectors for water heating.

### **3.4 Prosuming in the United Kingdom**

Electricity in the UK is mainly derived from gas, coal, nuclear power. At the moment, gas and nuclear are the two dominant sources, while the use of coal has decreased significantly since 2012. In contrast, electricity from wind, solar, and bioenergy have increased rapidly.

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<sup>2</sup> Data on the approximate number of households with built-in solar panels on their roofs is obtained via a search engine for business entities in Serbia (Yellow Pages). References from all available (active) websites of companies dealing with the sale and installation of solar panels.



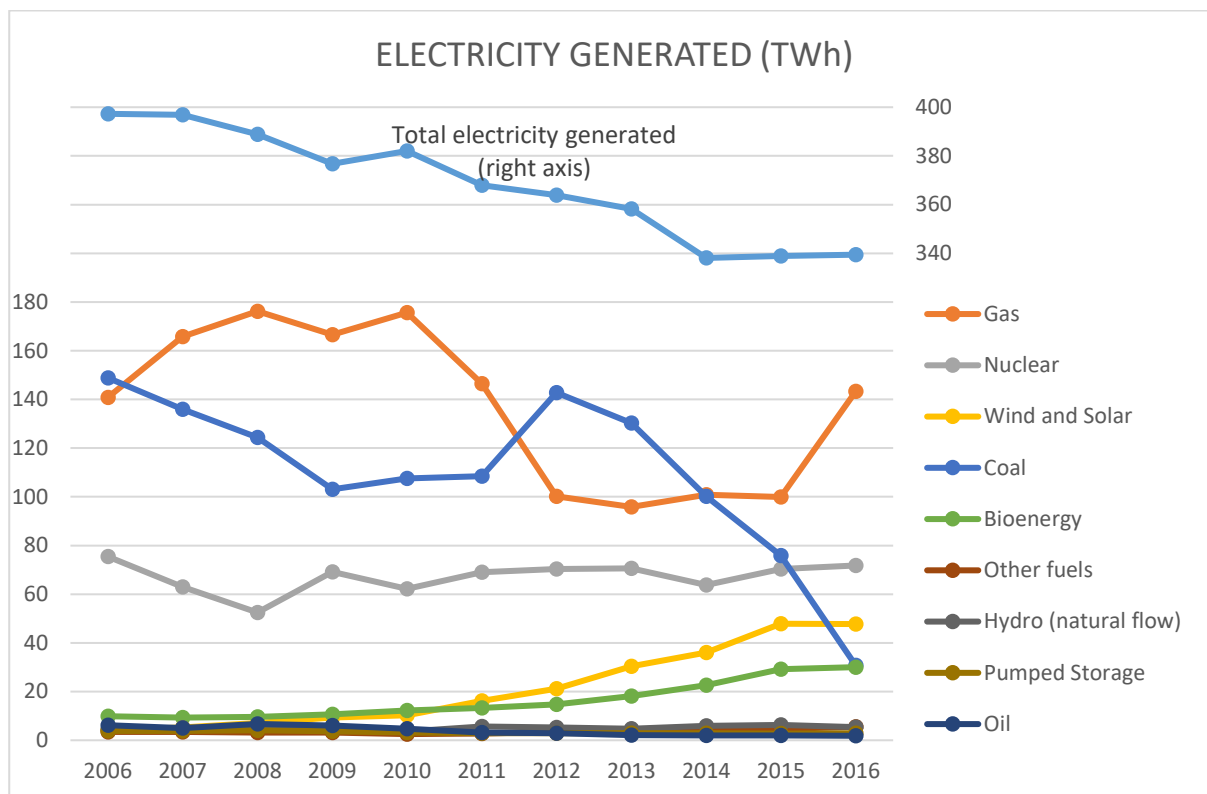


Figure 5- Electricity generation in UK, 2017. Source: Department for Business, Energy and Industrial Strategy

Since 2010 the generation of wind and solar energy has been on the rise, as a result of the government support, including feed-in tariffs.

As Norway, the retail market for electricity in the United Kingdom was liberalised in the 1990s (1999), allowing domestic and non-domestic consumers to choose their electricity suppliers among a variety of companies. The Department for Business, Energy and Industrial Strategy (BEIS), is currently responsible for all energy matters. The National Grid Electricity Transmission plc (NGET) oversees the energy transmission system, as electricity moves from the generating sites to high-voltage electrical substations across the country. Electricity is then distributed to the end-users by 14 licensed distribution network operators, each of which operates as monopolist in a specific area, under the supervision and regulation of the Office of Gas and Electricity Markets. Finally, energy suppliers licensed by the Office of Gas and Electricity Markets sell the electricity to the end-users. The suppliers' market is dominated by a handful of companies known as the “Big Six” – Centrica plc (parent company of British Gas), E.ON UK, Scottish and Southern Energy (SSE), RWE npower, EDF Energy and Scottish Power – that cater for most of the domestic demand in the country. In the last few years, a vast array of independent energy suppliers has appeared in the national energy landscape, after complaints on competition issues and market power. These include private companies, as well as cooperative suppliers, and energy companies owned by local authorities. Some of these have chosen to specialise in green energy provision.

Also, prosuming is a growing phenomenon in the UK, fuelled not only by environmental and energy saving concerns, but also in large part by financial and economic consideration, thanks to the incentives and subsidies offered by the government. The government has provided legal framework



for prosumers and supporting scheme with the Energy Act of 2008<sup>3</sup>. The feed-in-tariff scheme is one of the policy tools that the UK government has adopted to achieve the objective to increase energy derived from renewable sources, as is stated in the European and Global commitments agreed to in the last decade and the more recent targets that were set in the Paris Agreement in 2016. While government support for prosumers started relatively late, only in 2010, it has been gradually catching-up in the UK. Trends in the installed capacity and number of installations specifically for solar, are shown in the Figure below. The peak in installations from 2012-2015 correspond to announcements of changes to the tariff scheme.

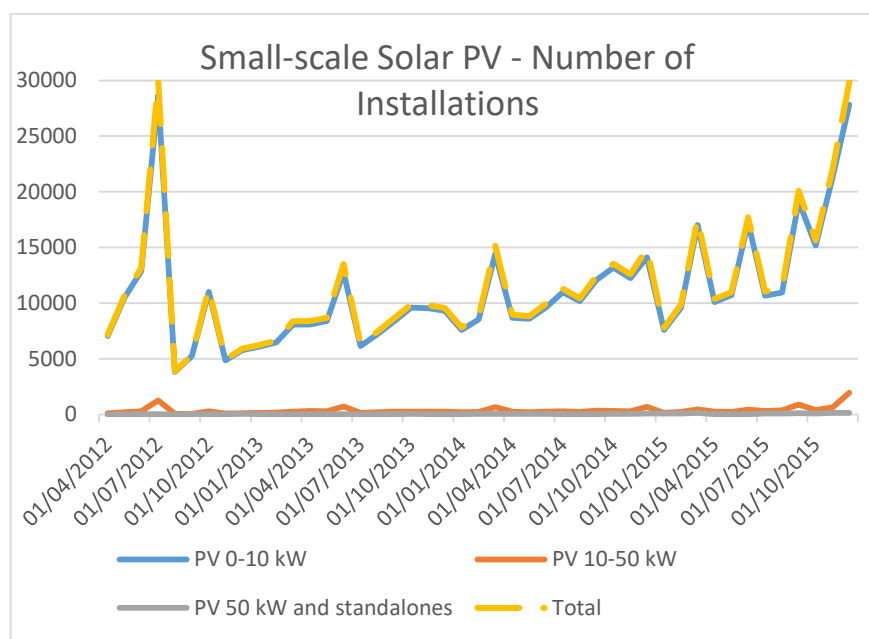


Figure 6 - Small-scale solar PV installations. Source: Pipeline Statistics from DECC

The feed-in-tariffs were offered to the new installations and some eligible installations which occurred before the implementation of the policy, and were to be paid for a 20-year period (initially 25 years for solar PV, later reduced to 20 in 2012 to harmonise it with the rest of the eligible technologies). The technologies currently eligible for the Feed-in Tariff scheme are solar PV, wind turbine, hydroelectric, micro combined heat and power (CHP), and anaerobic digestion, although most of the small-scale generation in the country come from solar PV. Generation tariffs depend on the technology and the capacity installed, and the period of installation, and – in the case of solar – on whether each monthly deployment cap has been reached. The export tariff is paid on the actual electricity exported to the grid if the generator has an appropriate export meter or smart meter, otherwise the tariff is paid on the assumption that 50% of the electricity generated is exported. And prosumers benefit even further through savings on the electricity bills, as they do not buy electricity from the energy supplier when they are using the one they generate themselves<sup>4</sup>.

Before the 2016 reform, it was estimated that the annual return for an investment in solar PV for an average household would be around 10%, and the savings and revenues generated would be able to repay the PV in around 5 to 15 years. These estimates clearly vary depending on a wide range

<sup>3</sup> [http://www.legislation.gov.uk/ukpga/2008/32/pdfs/ukpga\\_20080032\\_en.pdf](http://www.legislation.gov.uk/ukpga/2008/32/pdfs/ukpga_20080032_en.pdf)

<sup>4</sup> <http://www.energysavingtrust.org.uk/renewable-energy/electricity/solar-panels/feed-tariffs>



of factors, from the energy use pattern of the households, to the characteristics of the house and of the PV system, to the tariffs and costs at the moment of the installation. Aware of the challenges posed by an evolving energy system and the growing role of prosumers, the UK is currently exploring new solutions to improve flexibility and ensure the balance of the energy system.

### 3.5 Prosuming in Ukraine

The basis of Ukraine's electric power industry is the Integrated Power System (IPS) of the country, which provides centralized electricity supply to consumers, and provides international export, import, and transit of electricity. The IPS consists of power plants (large-medium and small-size) owned by energy generating companies as well as of the transmission networks of the National Power Company UKRENERGO that are operated by regional power supply companies. UKRENERGO is responsible for operational and technological control of the Integrated Power System (IPS). The Wholesale Electricity Market (WEM) of Ukraine is an orderly system for the sale-purchase of electrical energy. The WEM operates on a "single-buyer model" and is thus not fully liberalized<sup>5</sup>. The regulatory and legislative framework of the market operations is formed by the Parliament, the President and the Cabinet of Ministers of Ukraine.

Ukraine is one of the top nuclear energy producers in Europe and more than 50 % of produced electricity is sourced from nuclear energy (IEA 2015). Ukraine also has subsidised production of coal as an important source of energy. Below is an illustration of Ukraine's main energy sources for electricity in the period 1990-2012 (IEA 2015):

**Figure 10.1.4** Electricity generation by source, Ukraine, 1990-2012

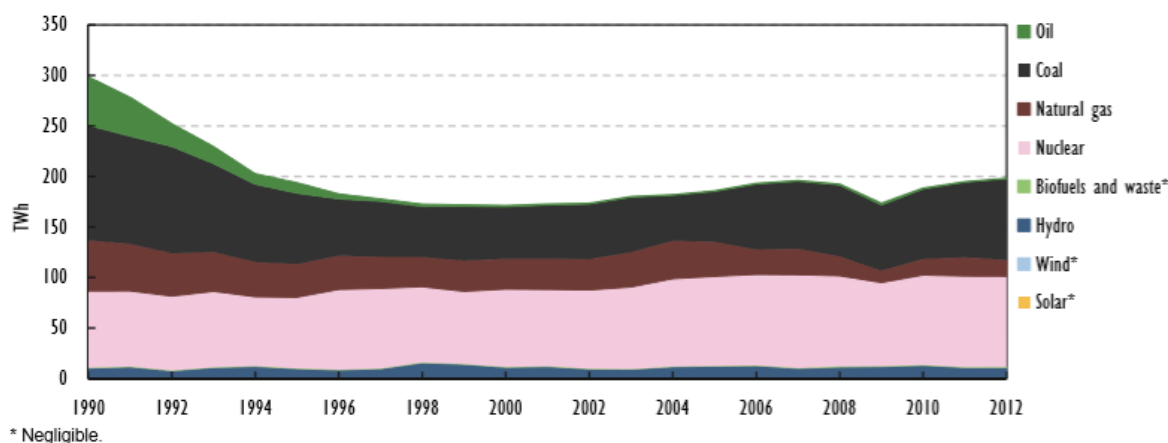


Figure 6 - Electricity generation in Ukraine. Source: International Energy Agency (IEA) 2015

As a result of geopolitical, economic, humanitarian and energy challenges, Ukraine has made efforts to transform its energy sector. These changes include new legislation and regulation set in place for

<sup>5</sup> The single-buyer model first appeared in developing countries in the 1990s. To relieve capacity shortages while conserving scarce public resources, governments in several countries authorized private investors to construct power plants to generate electricity and sell it to the national power company. The private power plants sell their output through purchase agreements that protect investors from market risks (<http://siteresources.worldbank.org/EXTFINANCIALSECTOR/Resources/282884-1303327122200/225Lovei-1211.pdf>).

a liberalization of the energy sector (especially within the gas sector), energy efficiency, and comprehensive framework for the development of RES through the National Renewable Energy Action Plan, which aims at achieving a 11% share in final consumption by 2020. The geography of Ukraine shows a great potential for the solar energy market development, thus the potential of solar energy in Ukraine is high enough for the wide application of solar equipment.

In 2009, the “green tariff” (feed-in tariff) policy was introduced in Ukraine through the Law of Ukraine on Electric Power Industry. The Law provides two key incentives for the owners of HSPPs with capacity up to 30 kW: First, private households can generate electricity from solar and wind energy without the appropriate license (as is necessary for power companies); Secondly, the feed-in tariff rate is tied to the official euro exchange rate. The introduction of the green tariff became a powerful stimulus to the development of industrial and individual PV generation in Ukraine, and the number of prosumers is rising. In the third quarter of 2017, 688 Ukrainian families moved to solar energy self-production, which is 42% more than in the second quarter of 2017. In general, since the beginning of 2017, 1200 households installed solar power stations, which is one and a half times more than in the past year. In total in Ukraine, there are now 2323 families with solar power plants with the total capacity of 37 MW and almost 35 million Euros invested. For those who installed HSPPs in 2017 (capacity not more than 30 kW), the feed-in tariff is 18.09 eurocents/kWh till 2030. Local authorities also support transition to solar energy, for example, in the Lviv region, about 20% of interest rate costs are returned from the regional budget to a household as a loan on solar panels. Similarly, in Zhytomyr region, which has high ambitions for becoming a hub of solar energy, the local authorities reimburse up to 20% of the loan to residents who have acquired HSPP in the region. Prosumers in Ukraine thus gain energy independence, savings on feed-in tariffs for electricity and heating, as well as the liquidity of cash investments in the construction of HSPPs, which today is a real alternative to banking and real estate mechanisms in the field of savings.

## 4. Results: Mapping of gender

The following section provides the results of the mapping of gender ideologies in the representation of prosumers in the case study countries; Italy, Norway, Serbia, the UK and Ukraine. The purpose of this mapping is to explore how gender is presented and perceived in society and is complementary to the interviews with prosumers presented in section 4.0. In general, energy policies in Europe are formulated in a gender-neutral way, which assumes that men and women have the same perspectives, needs, experiences, values, resources and aspirations concerning domestic energy access, production and use (Standal, Winther and Danielsen forthcoming; Kaminara 2015). In contrast to energy policies, solar energy companies and media journalists may through promotional material and media interviews choose to present prosumers and technology in other ways highlighting the topic as male or female domains to reach target audiences or reflecting general opinion. This analysis is based on a selection of campaign material for HSPPs, media articles presenting interviews with prosumers and media articles on policies and regulations of prosuming in the case-study countries. As the analysis shows, promotional campaigns and media articles of prosumers are often presented in ways that reflect different gender roles of men and women. The presentation of gender roles in relation to prosumers, are in line with Henning’s (2005) analysis on household space as gendered where women and men exert unequal influence on decisions to implement new technology in certain areas of the house (impacting on the uptake of domestic renewable energy technologies in Swedish households). We found that women are generally presented less often than men in promotional campaigns and media articles on prosuming. When women are presented, women are more often associated with the ‘inside’ and private sphere or their environmental concerns, while men are associated with technological aspects and embracing a wider spectrum of motivation and skills than women (technical, financial, environmental). This has ramifications for how solar systems is valued in society and feminization of certain types of energy and masculinization of others (Ryan 2014), which has implications for women and men’s ability to adopt new technology and change their energy consumption practices towards more environmentally friendly lifestyles. As highlighted in the UK there might be an emerging shift of this gendered representation of prosumers as household solar energy becomes more ‘mainstream’ and large (sometimes international) companies target new customers. These companies (e.g. IKEA and E.ON) do not only inform potential prosumers on environmental and financial benefits of their household solar products, but also portray other values such as cultural diversity and equality.

### 4.1 Gendered Presentations in Promotion Material for HSPPs

The extent of promotional campaigns and advertisement for solar PV systems for households vary across the case-study countries. In the more ‘mature’ markets in Italy and UK advertisements are common, while in Norway and Serbia the market is small and potential customers have to actively search for solar companies’ promotional offers and information on the web or similar. In Norway, there have been a few promotional campaigns for national or local government subsidy schemes, grid companies’ pilot projects that have attracted new prosumers, as well as media coverage on prosumers and new solar companies. In Serbia, the promotional material we have found derives from the Energy Portal, a business web portal on clean energy, which contain official documents and publications on renewable energy sources, often portraying larger solar systems. The samples used for mapping

gendered presentations thus include both advertisements, web-portals for information on subsidy schemes and other promotional material.

In general, the promotional material for HSPPs collected in this study are presented in neutral and technical language with no associations to gender roles. As exemplified in the below illustration taken from the webpage of the subsidy scheme ‘Oslosola’ (‘the Oslo sun’) of the Oslo (Norway’s capital) municipality, the information presented provides basic information and useful links to apply for financial support for installation of HSPPs:

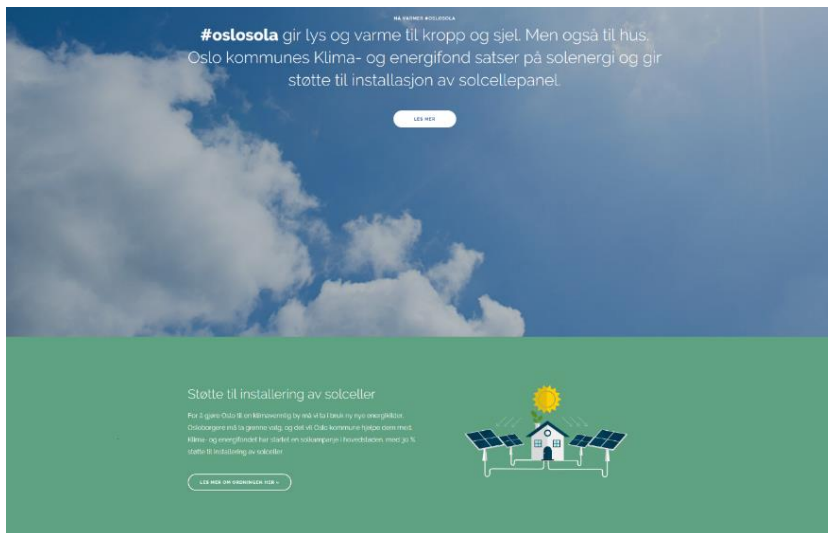


Figure 7: the ‘Oslo sun’ campaign website

The text is kept in a normative voice linking solar PV solutions to a more climate friendly energy future:

#theoslosun provides light and warmth for body and soul. But also for houses. The Oslo municipality’s climate- and energy fund is aiming for increased solar energy and provides support for installation of solar panels (author’s translation).

The message of environmental protection and solar energy as climate friendly is a recurring theme in several promotion campaigns, though how it is presented and the focus it has vis-à-vis other aspects vary. Below is an illustration from ENVERT (webpage) in Ukraine:

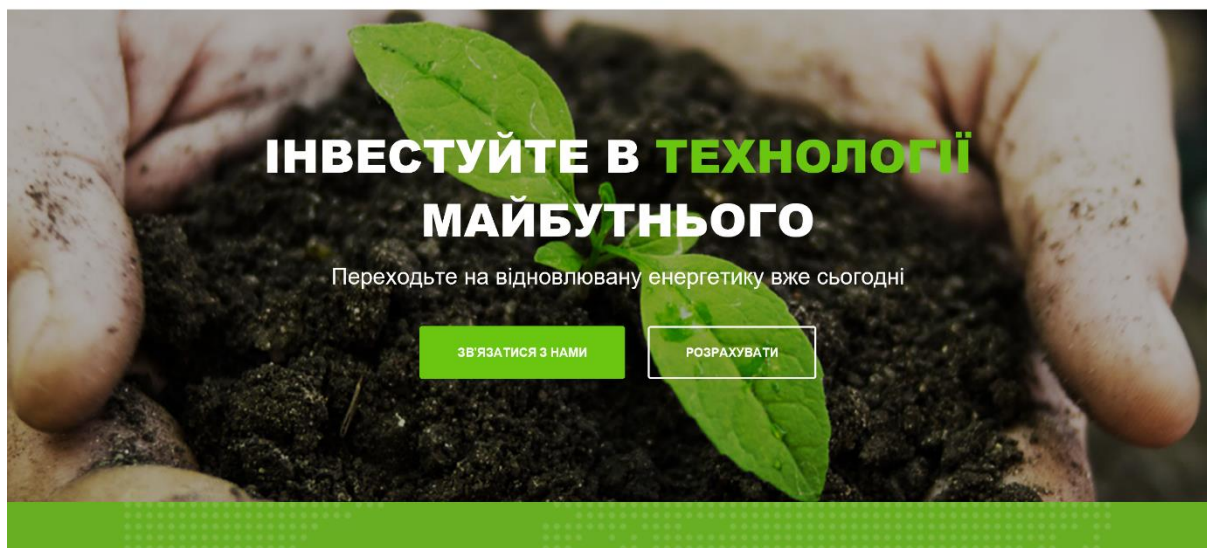


Figure 8- Digital Facsimile <https://www.envert.pro/ua/>

The title states: Invest in the technologies of the future. The illustration highlights care for nature and ENVERT puts emphasis on how they deliver clean energy solutions for the building sector (both private homes and larger structures).

Another general trend in the promotional material collected is to include the message of the potential savings that these installations will guarantee together with values of environmental protection. Several promotional campaigns mainly aim at involving citizens and encouraging them to make the right choice according to the specific characteristics of their homes and the advantages and benefits of using solar energy. Here also, the promotional material is presented in gender neutral language, highlighting financial benefits. The previous TV campaign (2009) of the Italian solar company the Beghelli Group is a good example:



Figure 9 - Digital Facsimile <https://www.youtube.com/watch?v=yrA-J5B0HIs>

The TV clip shows daily life scenes of a small family with a son. By putting a coin into the electric



plug to have the right to use the power, the family receives more back due to sun that can be capitalized and transformed into electricity. The campaign also highlights how instructions and guidelines can be obtained on how to install a last-generation PV system at homes without worrying about bureaucratic practices, design and installation because Beghelli will take care of the entire procedure. The campaign brings the attention of the audience to the opportunity to save money thanks to the incentives available in the Energy Account. The message is clear: “Beghelli Golden Roof will reset our bill and, once the payment of the financing has been completed, the energy produced will “weight in gold”!”

Whereas most of the promotional material present gender neutral images and language, several have illustrations of men working on installations of solar systems. Paragraphs referring to “experts”, “specialists”, and “advisers” are almost always accompanied by pictures of men. Pictures of people with the solar panels on the roof are also limited to male figures. The illustration photo (not an advertisement) illustrates the trend:



An example can be found in the web page presenting the company Solar Plants’ (UK) customer testimonials. The customer testimonials portray interviews with male customers, who discuss technical and financial issues in rich details, as well as their day-to-day experience with prosuming and the installation process. Women are only referred to as “wife” and no woman speaks nor appears in the videos.

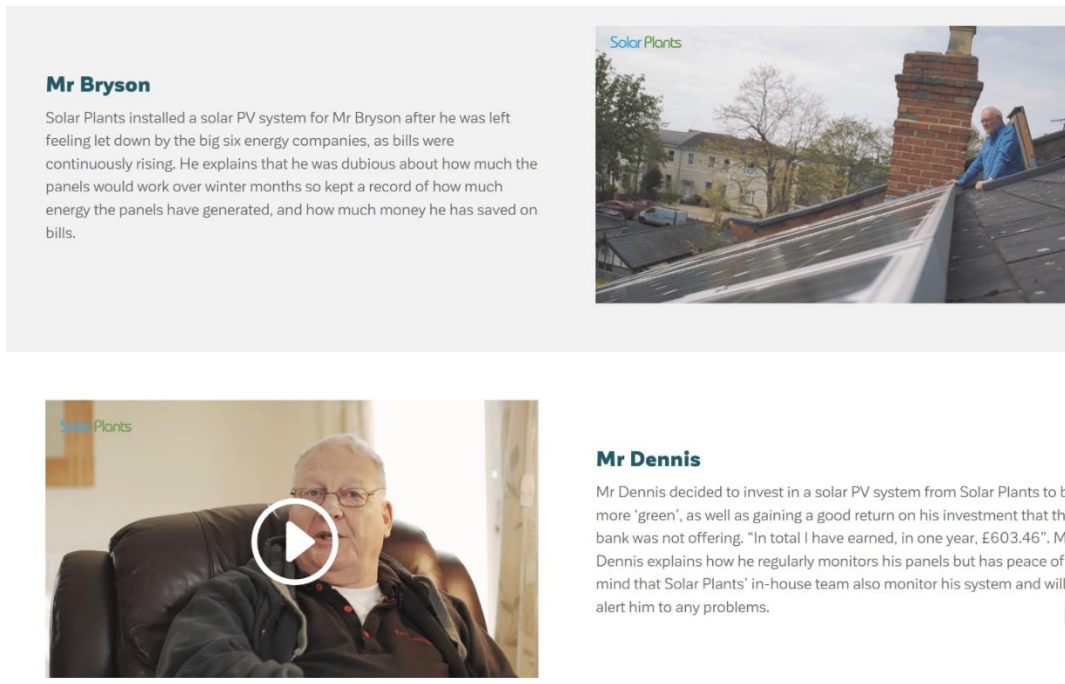


Figure 10- Digital Facsimile <https://www.solarplants.org.uk/testimonials/>

As suggested in the illustration above, the advertisement speaks to the male consumer/prosumer who interacts with a male engineer/technician. Hence, when potential prosumers seek promotion material for HSPPs they may well encounter misbalanced gendered presentations.

However, a new line of advertisements differs from the general trend as they portray values of diversity and equality in their aim to attract new customers. The recent established solar company Otovo (based in Norway) is an example. They have brought significant changes to the household solar market as they have advertised household solar solutions that require less engagement from the prosumer, as well as offering financial credit and electricity in the same package deals.





Figure 11- Digital facsimile <https://www.otovo.no/>

Their webpage has centred the title: We make solar electricity easy. More information is provided below using neutral drawings. The cartoon like drawing of the prosumer and engineer has a ponytail giving the image of a woman.

Two of the advertisements from the UK also differ from the general technical and financial focus as they are more family oriented, portray homely values and speak to the consumer more personally. An illustrative example is the IKEA campaign; “Bring a little sunshine into your home”. This campaign advertises their collaboration with Solarcentury, one of the main solar companies in the UK. The campaign webpage presenting the collaboration and products, contains mainly environmental and economic messages, but IKEA and Solarcentury also presents their products through case families. One family is presented in a video showing a (Asian origin) middle-class family in everyday life. The children, a young boy and girl, run around doing activities that require energy such as brushing their teeth, playing videogames etc. Their family’s prosuming experience is told in the background:

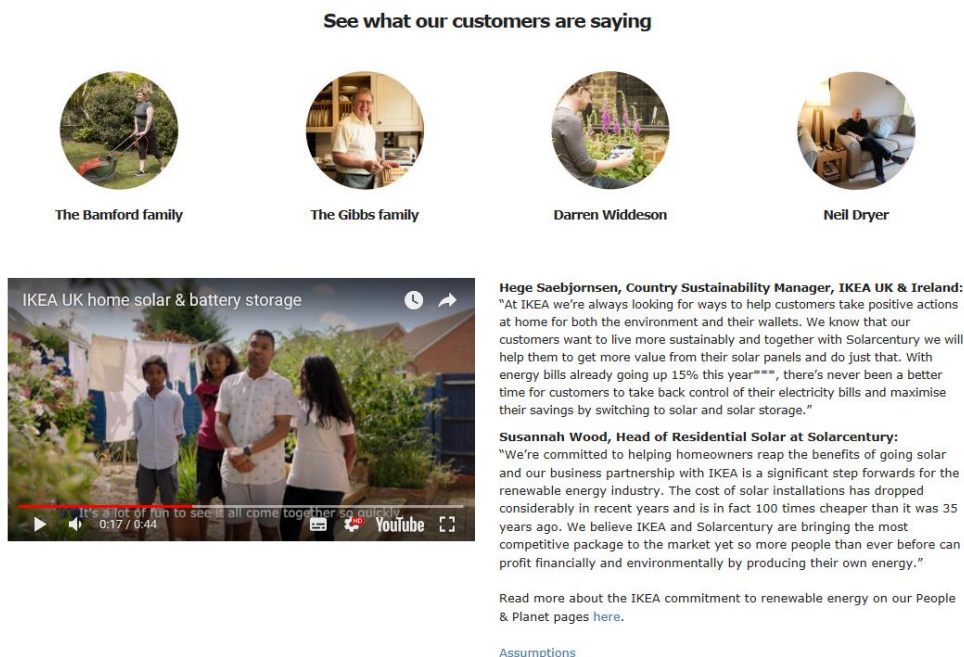


Figure 12- Digital facsimile <https://www.ikea.com/gb/en/ikea/solar-panels/>

The other prosumers' stories are presented in short paragraphs, and include a same-sex couple; and a family where the focus is only on the woman prosumer, and another family of Asian origin. The campaign highlights IKEA's attention to diversity and gender-balance, explicitly including young people, families of different ethnic groups and family constellations, and presenting women prosumers as well as female experts. Recently, they have invested in campaigns to increase their appeals to younger generations and more environmentally concerned customers. Apart from this campaign the Solarcentury website has less gender balance and diversity.

The same family-oriented and multi-cultural campaign material can be seen in an advertisement of E.ON, one of the “Big Six” utilities in the UK, promoting the use of solar energy and storage. E.ON 's promotional campaign also showcases images portraying harmonic family situations:

## Save Solar Energy for rainy days

Use 100 percent of your solar energy: Store electricity in the E.ON SolarCloud, a kind of savings account for your electricity. You can pull it back out of your E.ON SolarCloud at any time - and provide your home with it.

[Read more about E.ON SolarCloud](#)



Figure 7- Digital Facsimile <https://www.eon.com/en/x-gorillaz-campaign-solar-tomorrow-is-on.html>



### Energy according to your needs

With E.ON Aura, you can generate 70 percent of your electricity needs. If you do not consume your self-generated solar power, but instead feed into the grid, you will receive a feed-in tariff according to legal requirements.

[More about E.ON Aura](#)

Figur 8- Digital Facsimile <https://www.eon.com/en/x-gorillaz-campaign-solar-tomorrow-is-on.html>

The images show families with children carrying out various activities and games which relies on the use of electric light. The campaign thus targets also customers who are younger than the average prosumers interviewed in the UK for this study.

From the material analysed from all the case-study countries, only one advertisement had a clear gendered presentation. A billboard commercial in Sicily advertising for solar household systems from an Italian company illustrated their point with a nude woman kneeling over a photovoltaic panel. The message on the billboards presented a suggestive invitation to "spend time" with the girl, while at the bottom right a message recalls the attention of the reader to the real product: "Hey! Let's talk about PV panels!" Due to protests the billboards were quickly removed accompanied by a formal apology of the company's owner. Sexually suggestive and offensive advertising relating to promotion of products that target male consumers is not rare, though we have not found similar advertisements for HSPPs, which generally seem to speak to the consumers' technological, environmental or financial motivations.

The promotion material and advertisements generally seek to reach their target audience, which reflects what images and gendered or non-gendered way are used. Obviously, the billboard of the naked woman in South of Italy was either a way to create attention by provoking, or they generally do not see women as their target group of consumers. On the other end of the spectrum IKEA and E.ON put emphasis on values of cultural diversity and equality in their attempt to reach potential customers. As will be discussed in the results of the interviews with prosumers, a significant target group for solar companies in Norway are people working in the energy sector or who have specific interests in solar technology. This might explain the very technical presentation of solar promotional material in Norway. However, the market for solar household systems in Norway is expanding and 'new' type of prosumers follow the lead of the 'techno-savvy' pioneers (Westskog et al. 2018), which also will influence promotional material.

## 4.2 Gendered Presentations of Household Prosumers in Media Coverage

This report has also considered the gendered representations of prosumers who have been interviewed in newspapers and magazines in the case-study countries. An overview of the focus on articles is presented in the table below:

Table 1 -Overview media interviews with prosumers in the case-study countries

Interviews with prosumers	Main focus on men prosumers	Main focus on women prosumers	Main focus on the family unit as prosumers
Italy	5	4	-
Norway	7	1	7
Serbia	2	-	2
UK	3	1	9
Ukraine	11	2	2
Total	28	8	20

As the table show there is a focus on the male prosumer across the countries. In addition, though 20 interviews present the ‘family’ in headlines and preamble, women (and children) are seldom present in the article text or pictures and it is almost exclusively men who are presented in relation to the technical aspects or together with the technical components such as the panels and inverters.

Overall, it can be noted that interviews with prosumers focus on the technological advancements and innovative aspects of domestic solar systems, as well as environmental and economic benefits. In particular, many media sources showcase how easy, unobtrusive and convenient the technology is. The presentation of prosumers varies between providing readers entertaining stories of forward-looking families who have become prosumers with sketching homely atmosphere images and information on details up-front costs, tariffs and subsidy arrangements, and savings on energy consumption, spot prize on electricity production (sold to the transmission grid) of implementing HSPPs.

Despite a focus on detailed technical and financial information, and family settings, most articles present the prosumer as men. The male dominance is stronger whenever technical and financial issues are discussed – the voice of technical, economic or policy experts, representatives of businesses, associations, or charities, or politicians are generally represented by men, while women are consulted on environmental motivations or portrayed in relation to home aesthetics. On the same line, the pictures used more often show men prosumers, but all the installers, suppliers, experts and workers illustrated are men, and men are portrayed together with solar panels, inverters etc. The interview with the Norwegian family described in Box 1, is an illustrative example of this trend.

### **Box 1: Media source from Norway, Bergens Tidende: Interview with the ‘Andersen’ family**

This article is a long feature article of the family Andersen living in the larger Bergen area on the rainy west-coast of Norway. The family has installed a large and complicated energy system primarily based on solar energy. The article presents the family Andersen and their interest in producing renewable and climate friendly energy for household energy use. In the interview the focus is almost exclusively on Mr. Andersen who is portrayed as the *primus motor* and manager of the energy system. In the interview Mr. Andersen gives a detailed explanation about their ecological motivation and how they try to live an environmentally friendly life. He further discusses the solar system, how he manages it, what it cost, their experiences and expectation. Notably, his wife is only referred to with three comments. These comments nonetheless show her detailed knowledge of and interest in the solar system. In addition to Mrs. Andersen having less voice in the article, the majority of the photos show Mr. Andersen and the photos of Mr. Andersen portray him together with the solar panels, the inverter and when checking the production on his computer. In contrast, the two photos where Mrs.





Figure 15 - Digital Facsimile Bergens Tidende 14.07.17

Andersen is present are with her husband and herself, and one only of her in the garden. The photos of Mrs. Andersen are taken from a distance, while the photos of Mr. Andersen are taken up close allowing the reader to get a better impression of him, rather than her. Hence, the female prosumer is kept in the background.

As the example above illustrates, the focus on prosumers in media interviews generally portray gender roles where men are more interested in technological aspects and men speak for the family unit. In images men are more regularly portrayed in basements, control rooms and other technical spaces. Furthermore, many articles also include interviews with technical, economic or policy experts, representatives of businesses, associations, or charities, or politicians – all of whom are men. Women are presented in relation to ‘softer’ and more ‘feminine’ aspects such as home aesthetics and environmental motivations of prosuming. This might be seen as an expansion of perceptions of conventional gender relations where women are seen as the family’s care work provider and men as breadwinners

(with technical and financial skills) (Bhattacharya 2017; Fraser 2017). Oppositely, men are portrayed as technical experts, they are more often represented and their voices are dominant in the discourse on renewable energy. Hence, it can be stated that HSPPs are perceived as a more masculine energy source (e.g. Ryan 2014).

It is interesting to note that the material from Ukraine and Serbia appear to be somewhat more gender balanced. The first media articles of prosumers in Ukraine feature women. In Serbia also, the material seems more balanced though the number of articles found is negligent. In the UK, two articles contradict the trends described above. In the first one, the focus is on the family unit, but the woman is the one speaking for the family and providing technical and financial details. In the second one, the focus is on a woman prosumer, who is also a technical expert and an innovative pioneer in the field, being the first person in the UK to install solar panels on her roof and pushing the electricity provider to let her sign the first contract in which a household could sell electricity to the grid.

### 4.3 Gendered Presentations in Media Coverage of Policies and Regulations for Prosuming

There were quite few articles in the case study materials on media covering policies and regulations of prosuming. Political articles merely relate to parliamentary elections (e.g. in relation to the Norwegian parliamentary election 2017) and provide summaries of statements from the political parties concerning their view on the green shift and their strategies and support schemes in promoting RES. Hence, they are directed to readers that are interested in their political statements regarding to energy policy. Regulatory articles were more devoted to the promotion of the application of renewable energy sources and incentives to promote usage of renewables. In media coverage of

policies and regulations for prosuming in Italy, Norway, Serbia and Ukraine the topic is presented in neutral and technical language with no associations to gender roles. However, in the articles from the UK, men are more often represented as the experts.



## 5. Results: Prosumer Interviews and Diaries

### 5.1 Prosumers in Italy

The interviews with household prosumers in Italy were conducted in rural and urban parts of the regions Emilia Romagna, Toscana, Lazio, Marche and Campania (Central and Central-southern Italy). The prosumers interviewed were generally from middle-class families, had higher education, 50-60 years, and lived in and owned a house, though four also lived in apartment buildings.

The prosumers interviewed stated that the main motivations for investing in HSPPs were environmental and financial. All but two (women) listed the environment as a driver for the investment. It appears that the ones more committed to environmental aspects had common characteristics: Several have employment related to environmental themes (environmental consultant, researcher and also teachers); others stated to be interested in sustainability aspects (one of them indicated sustainable mobility as main interest); several had strong interest in nature and outdoor nature activities (e.g. fishing, trekking). Some of the prosumers interviewed are also engaged in voluntary work or politics and thus have a strong interest for society in general. Some of the prosumers interviewed asserted that their choice to invest in HSPP was particularly driven by their strong commitment to reduce their carbon footprint, saying in one case that it was a way to “do an ethical choice with minimum efforts”. The other main motivation was the opportunity to decrease the cost of household energy consumption, though only two (women) listed this as the only reason.

The experiences of being prosumers among the interviewed were mainly positive. Some prosumers highlighted the positive effect of how the process of becoming prosumers had increased their awareness of energy consumption in the household, stimulating other energy efficiency actions. Several also highlighted how being a prosumer led to savings on energy consumption and money. Some of the prosumers had experienced minor problems, and five (25%) stated that they had only negative experiences. This number is higher than for the other case-study countries, where the vast majority had mostly positive experiences and only minor problems concerning bureaucracy. Several had experienced problems related to bureaucracy and/or problems with the utility company. This was seen as the main impediment. Sometimes regulatory restrictions caused delays in the installation process. Several also complained of poor quality work by technicians doing the instalments. Finally, in a few cases the prosumers had encountered resistance from neighbours, which had delayed the installation phase.

The interviews also revealed how gender was an important social and cultural factor in the process of becoming prosumers in Italy. The motivations and final decision to become prosumers was generally made by the families together, most often the husband/wife/partners, and sometimes other relatives in joint family buildings. The investments concern the family economy and thus necessitate a joint decision. However, among the prosumers interviewed in Italy, men seemed to be more at ease with and interested in the technological aspects and for these reasons they gathered information, kept contact with the installation company and relevant institutions (e.g. utility company and building permits). It was also men who primarily took decisions concerning the technological aspects of the solar systems. Men also had more prior knowledge concerning regulations and incentives of prosuming in general. Women’s lack of involvement in the technical and bureaucratic process can be partly explained by personal lack of interests and skills, however, the prosumers interviewed also expressed how household space in their homes were gendered. Indeed, most of the persons interviewed didn’t hesitate to specify that women are the ones who seem to have the main

say over kitchen and living room, and in general has more decision-making power over inner sphere of the house. On the other hand, men mostly take care of the surrounding countryside (most of the households are independent houses in rural areas), as well as the garage and tool shed. Women and men thus have different decision-making power over different household space and roof-top solar systems falls into male dominated household space.

Though women were less involved directly in the process of becoming prosumers, the Italian women prosumers interviewed had modified their habits to shift their load of energy consumption to daytime after becoming prosumers more so than men. This coincides with women’s care work responsibility in the family. We asked all prosumers interviewed to fill diary notes of electricity-related domestic activities, which revealed who in the household did what. Both men and women (and to some extent children) turn off the light before going to work/school and the amount of time showering has little gendered differences (men shower a little less measured in minutes), but with very few exceptions women did the laundry and prepared dinner. Tumble dryers were only used by one family and operated by the woman prosumer interviewed. Of the prosumers interviewed in the study as a whole, Italy has the clearest gendered division of labour concerning washing of clothes and preparing dinner. There was also a gender division in who monitored the production of solar electricity of the HSPP. In four of the families both men and women monitored the electricity production, while in four families it was only men who did it. In the remaining two families, no one kept tabs on the production. The majority of the prosumers monitored the process using a display, while a few used an application, a computer or their electricity bill for checking.

Despite finding gendered differences in how women and men related to the solar technology, gender was not perceived as relevant to becoming and being a prosumer by the majority of the interviewed. To elicit information on how prosuming, and gender and other social and cultural factors was perceived by the interviewed, we asked them to describe the average prosumer. Only five of the prosumers interviewed described the average prosumer explicitly as a man and two described the average prosumer as a woman. The vast majority of the prosumers interviewed did state, however, that gender is irrelevant. Despite this affirmation the majority perceived men to be more interested in technology (including solar) than women. Several, felt that women are more interested in environmental aspects, while men are motivated by the energy technology and financial aspects. Most described an average prosumer as someone who have favourable economic conditions, though five stated economy as irrelevant. Some also described the average prosumer to be a person from 40 years old and upwards and someone with a high social standing. Most also expressed that the most suitable type of residence for prosuming was a separate house in rural or sub-urban surroundings.

Among the Italian prosumers interviewed in this study, the motivations for becoming prosumers converge towards financial and environmental reasons, indicating that prosuming is attractive beyond special interest in technology. This explains why gender is seen as irrelevant for prosuming, even though most of the prosumers interviewed perceived men to be more interested in the technology. However, the differences in interest and skills towards the technology and the gendered divisions of care work labour and household space in the families interviewed reveal that women and men do not relate to the technology and electricity in the same way.

## 5.2 Prosumers in Norway

The interviews with household prosumers in Norway were carried out in rural and urban parts of the regions Oslo and Akershus, Østfold, Vest-Agder, Telemark, Rogaland and Hedmark (Southern and

Central-southern Norway). All the prosumers interviewed in Norway lived in separate houses and were from middle-class families. Most also had higher education and the majority were from 50 and upwards.

The main motivation listed by the interviewed prosumers were environmental aspects. They perceived solar energy as emission free energy and an important part of the needed ‘green shift’ (non-fossil energy transition). Those prosumers who had been less involved in the process in their family, often women, mentioned the environment as a decisive factor for saying yes. The electricity generation in Norway is almost completely derived from hydropower (95% (Sæle and Cherry 2017:12)), but several of the prosumers interviewed argued that as we sell and buy back electricity from Europe there is no guarantee that the electricity reaching their home is renewable and therefore they opted for solar. Several also argued strongly for the need to help develop the Norwegian solar market to facilitate the green shift energy transition. It was also mentioned how solar panels is a very visible statement in this regard. As neighbours and friends see it from the outside of the house, it becomes more ‘normalized’ in the public setting and thus were by some preferred over other energy efficiency measures.

Though environmental aspects and values were the basis of the motivations, several of the interviewed prosumers in Norway also had a strong interest in the technological aspects of producing solar electricity in their home. Eight of the prosumers interviewed, constituting almost half prosuming families in the Norwegian study, worked in the energy sector. Several also worked directly with solar, either in the industry, as planners and vendors of solar systems, or with energy consulting. These findings have also been confirmed by previous studies on prosumers in Norway, which show that those motivated by technological interest constitute a significant group of the prosumers (Westskog et al. 2018; Winther, Westskog and Sæle 2018). The strong technological interest was shared among both men and women working in the sector, though the ratio men/women working in the sector was 8/2. Technological interests were not mentioned by women not working in the sector, while the interviewed men not working in the sector saw the opportunity to gain experience with solar technology as an important motivation.

A third important factor mentioned as motivation to invest in HSPPs were economic aspects. The up-front costs of installing a HSPP is high in Norway and all the prosumers interviewed had several years before the solar systems would be profitable for them, but many highlighted the long-term perspective. They argued that the panels last for a long time and that electricity consumption and prices would likely go up in the future. As several of the interviewed prosumers had acquired solar panels at a discount through their workplace or had the expertise to install the panels themselves they could reduce costs and the repayment period. All of the prosumers had also benefitted from subsidy schemes from Enova or the Oslo municipality. Many mentioned the high upfront cost of the investment as a barrier for solar to reach a ‘critical mass’. One of the prosumers interviewed, who works in an environmental NGO, was motivated by solar energy as a visible medium to promote new and more environmentally friendly technologies. However, he had only decided to become a prosumer when Otovo Solar (Norwegian solar company) had launched a campaign where private homeowners could lease the panels for a small monthly fee. He stressed that without being a ‘good economic’ case he did not want to promote it, because otherwise it would only be perceived as something for the wealthy environmentalist and not for general people.

The decision to invest in solar system was taken collectively between men and women in all the families interviewed. One of the prosumers, who runs a company selling HSPPs elaborated on the decision-making process. As the decision to invest in such a system impacts family economy it necessitates joint decision. However, such decisions often include a negotiation of different household priorities. Some of the women prosumers interviewed had been reluctant to invest in solar

systems, as they understood that this came at the expense of other things they might wish to prioritise. As described in Box 2 below this negotiation entails a negotiation also of gendered household space; Mrs. Hansen had originally hoped they could renovate the kitchen, which was cancelled when they instead acquired a solar system.

In two of the families, the decision-making process included several co-residents or family members. In one case the interviewed prosumers lived in a collective and the matter had to be taken up in resident meetings, in another case the prosumer interviewed had tense discussion with his son as the solar panels were installed on the roof of the family farm and the son was soon to take over the management. In addition, the son (trained as a carpenter) had built the farm buildings and was sceptical towards the changes needed to install the panels, as well as possible leakages from the solar collectors included in the solar system. Such cases provide useful illustration of the social complexities behind the decision to become prosumers.

As shown above, the process of becoming a prosumer and investing and implementing HSPPs include several family members, whom often have diverse priorities. However, our findings show that though the decision to invest in a solar system was taken jointly, it was almost exclusively the men that drove the process of becoming a prosumer. With the exception of the two women working in the energy sector, it was the men who brought investing in solar systems on the agenda, took care of the practicalities and bureaucracy, kept contact with the installation company and decided on technical aspects. As prosuming is a relatively new phenomenon in Norway, potential prosumers have to search thoroughly to find information on regulations and subsidies, as well as finding suitable electrician and installation companies that have relevant experience and products. In this process, the proper documentation has to be secured to be permitted to sell back excess electricity to the grid.

Several of the women prosumers explained their choice of leaving the process and practicalities to their husbands or partners, because solar energy was ‘his thing’. The argumentation was that their partners had the interest and motivation to drive such a process and therefore their contribution was not necessary.

In four of the households men had not only taken care of practicalities, but also done much of the instalment of the solar panels themselves, which also saved them a significant cost, and enabled time to get acquainted with the technology. The connection from the PV solar system/ inverter to the fuse box has to be carried out by a certified electrician company and documented, but otherwise, if skilled, one can install the panels on the roof by one’s self. This also illustrates the competence of the prosumers interviewed, which makes it difficult for a partner who does not have experience within technology to be equally engaged. This finding was further confirmed in the interviews conducted with the two women working in the energy sector. Within their families, it was they who had driven the process and their partners were not involved. One of the women was married to a man also working in the energy sector, but as the panels were acquired through her workplace and she had the most interest in becoming a prosumer, he had only helped in relation to his specific technological expertise and she had driven the rest of the process.

In common for most of the prosumers interviewed was that it was a specific occasion or event that propelled the decision to become prosumers. Several of the prosumers interviewed were motivated and had given thought to the idea for several years, but it did not materialise into anything before a specific event or occasion. For several, the idea came into being after meeting with other people who could provide knowledge and experience of solar technology. The earlier mentioned prosumer (with panels on his farm roof) became involved in the building of a low carbon house in his community (the building was on his land) and thus he became acquainted with a local solar energy company that later also planned and installed his own solar system. As the market for HSPPs is still new and small in Norway there are few companies that provide products and/or have competence and



experience. This is especially the case outside the larger cities.

In Norway, the major part of household's electricity consumption is related to heating of people's houses in the cold seasons (October – April). In practice this means that average households consume the electricity from the transmission grid during the cold season and overproduce electricity, which is sold to the transmission grid, in the summer season. Several of the prosumers interviewed used firewood for heating and/or had air-to-air heating pumps. It was interesting to note that several of the prosumers were committed to reducing electricity consumption for environmental reasons. In one of the family's interviewed minimizing electricity consumption had become a major hobby and they had done a number of measures to reduce the use of electricity; changed windows, isolated all walls, as well as minor changes and general carefulness of using energy in daily life. Their aim was also to become self-sufficient with electricity by producing the same amount of electricity as they used during the year. Still, many of the prosumers interviewed stated that it was difficult to reduce their electricity consumption as they did not 'use more than they needed' and that they wanted to have a comfortable lifestyle (e.g. high indoor temperature in cold winter months). The diary provided us with information on the gendered division of labour in the household related to electricity consumption during the week before the interview. In general, women did most of the energy-related daily housework such as cooking dinner and washing clothes. This was especially notable concerning handling laundry, which almost exclusively was done by women, whereas cooking was more equally distributed among couples.

The diary also provided information on practices to reduce electricity consumption. Several households had habits of turning off the light before leaving for work during the day and those who were focused on being energy efficient only showered for a few minutes at a time, and never daily as they had internalised routines and practices to avoid using excess hot water. The diary notes also provided information concerning discussions over energy use in some of the families, especially when the couple had different routines and conscience concerning electricity consumption. Women were more prone to turn off lights before leaving for work. We found little difference in time spent on taking showers.

A point we wanted to explore was if becoming a prosumer would change the habits and choices concerning electricity consumption. As mentioned, several already had internalised routines and values of using as little electricity as possible, whereas others felt it would be impossible to change their practices. Though the prosumers interviewed had not changed their view on and values concerning electricity consumption, several had tried to shift the load to the times when it was optimal for the solar system to produce sun. As the washing of clothes was more often done by the women interviewed they were the ones who also changed this practice. It was interesting to note that even though several of the women did not monitor the electricity production, they had other ways of finding the optimal time. Some checked the weather forecasts or checked the inverter. One of the families had the inverter installed in the washing room and it was therefore convenient to check before putting on a washing machine. Some had also grown accustomed to the sound of the inverter, revealing if it was optimal timing or not.

It is important to note that it was not possible for all to shift the load to daytime or wash only during sunny days. Several of the women, and some of the men interviewed, were home during daytime (because they worked in the proximity or from home or worked night shift). For them it was easy to shift the load to daytime. Only one said it felt stressful to do all chores at daytime as then they should be doing work outside in the garden or the farm. It was also pointed out, that it was easier when they reached a certain age and did not have toddlers. With small children, the washing could not have waited for sunny days, but would be daily. Families with new washing machines had grown accustomed to using delayed start to do the washing at times when the solar system produced

electricity.

As described above, many families who choose to become prosumers already are interested and reflexive of their electricity consumption so the shift from consumer to prosumers does not result in major changes of practices or values. Still, most of the families were aware of and focused on trying to use most of the electricity they produced themselves (rather than selling it to the grid) and thus had changed certain habits, especially washing and drying of clothes to the daytime if possible. Some of the families who did not see the point in doing this also stated that they thought the price they received for the electricity they sold to the grid was equal to the price they paid so there would actually be no point. In general, it is more profitable to use the electricity you produce yourselves as the prices you get for selling excess electricity is lower, but this was nevertheless the perception of some of the prosumers interviewed.

To properly understand how gender relations intersect with decisions over energy, and to know if the process of become a prosumer is unique regarding gender, we asked informants about practices and decision-making concerning house renovations and specific spaces in their home. Here also, husband and wife took the decisions jointly, but generally, it was men who carried out the practical work or kept contact with craftsmen. However, it was often women who took the initiative for renovation of kitchens or bathrooms. To understand decision-making process and gender relations better we inquired if certain spaces in the household was ‘gendered’ as found by Henning’s study in neighbouring Sweden (2005). The men and women interviewed in Norway were reluctant to describe particular household spaces as gendered as this contradicted with their view of the family as gender equal. When spaces were considered to belong to either of the spouses/partners; men had workshops in the basement or in the garage, while women were seen as managers of the kitchen or washing room. Such separations would often be mentioned jokingly, but some of the women interviewed also said that if they needed tools from their husbands workshops they felt they had to ask. Two of the women were also artisans and thus had their own workshops, which they saw as separate from their husbands’. The way household spaces were gendered and the effect this has on implementation of new technology was also revealed in the negotiations that had taken place over renovations or instalment of solar systems. In some instances, as described in Box 2, there were negotiations concerning household space, especially when it concerned the interior of the house e.g. kitchen or living room.

The diary notes also provided us with hands on information on different practices of men and women concerning interaction with the technology. The informants checked off on how often and who in the family monitored the electricity production of the solar system. Some households kept track on the inverter, but most used a web-based solution (App or web link). There was a prevalence of men monitoring the electricity production of the solar system. From the dairy notes we found that men in total had checked the electricity production 37 times (see also Table 3 in section 5.1) and women had checked 18. However, of the 18 times women checked 13 were the same woman. The diary notes thus illustrate that few of the women prosumers interviewed in Norway check the electricity production (only three)

These data are not compatible with general patterns of monitoring, however, as the interviews were done in February 2018 it was still snowy and most systems did not produce any electricity (the winter 2017/2018 has been exceptionally long and with exceptional amounts of snow). Therefore, many of the men did not monitor the system this time of year. If the study had been done in summer the ratio of men and women monitoring would be even more skewed. This topic was also raised during the interviews and apart from one of the women prosumers interviewed, who works in the energy sector (the other woman prosumer who works in the energy sector did not fill in dairy notes), the women prosumers did not keep track of electricity production, or did so very rarely. For the



women who checked, the inverter was placed in a convenient place (the washing room and the garage). Some women had tried to install an App for monitoring, but did not succeed, and later did not bother as they could ask their husbands. However, several of the women did know about the production through their partners/husbands, and several of the men kept statistics of the production. We also asked about monitoring of electricity consumption and who paid the electricity bills. Of the 14 families interviewed, 8 families stated that the husband paid the electricity bill, and 4 stated that the wife paid the electricity bill (two did not answer). Only the households who were focused on reducing electricity consumption checked regularly their consumption, and most often this was also done by the men and not women. However, as many have automated bank solutions for paying regular bills, not everyone had a clear overview of their electricity consumption and costs.

We asked all our informants if they could describe a ‘typical’ prosumer to see how they related to perceptions of prosuming regarding gender, knowledge, age and financial situations. Most of the informants described a prosumer as themselves; Mr. and Mrs. O stated that they thought typical prosumers were often retired (as themselves) as they then had time and money to prioritise this; while Mrs. A described a typical prosumer as a man with particular technological competence and environmental interest (like her husband). However, most did speak of a ‘he’ who was environmentally conscious and who was above 40 and therefore had economic means to take the investment. The reason for stating ‘he’ was according to several informants that women often lacked the interest in technology needed to take such a decision. Still, all informants also stated that women could, if they wanted to, as they believed women were just as competent as men. Mr. L and Mr. H planned and sold HSPPs and had a clear idea of the typical prosumer. They stated it was a majority of men, but also a significant share of women. Mr. L also explained that he saw two main prosumer groups at promotion meetings etc.; those who were only environmentally motivated; and those who were motivated primarily out of interest with the technology (but also environmental reasons). In the first group there were several women who were very eager and drove the process. In this group there were also more (men and women) who brought their partner/spouse along to the meetings. In the latter group of technologically interested, it was mostly men and they did not so often invite their spouse/partner with them.

### **Box 2: Mr. and Mrs. Hansen in Oslo**

Mr. and Mrs. Hansen provide an illustration of the ‘typical’ prosumers of this study. They are a middle class couple in their 40s with teenage children and live in a detached house in Oslo. Mrs. Hansen works in the care sector and Mr. Hansen works in the energy sector. As he previously had worked with a solar company he had expertise in solar technology and he could order panels through acquaintances. In 2016 they decided to invest in solar PV system for their roof. As with many of the families interviewed in this study it was Mr. Hansen that made all the inquiries and gathered information about the solar system and regulations concerning building permits and prosuming in general. Mrs. Hansen endorsed the idea as they both are focused on the environment, but she also had her qualms about the project, as it would mean that a longed for renovation of the kitchen would have to be cancelled. She also worried about what the neighbours would say and think of them in terms of making such an unusual and costly investment. She worried that they would be labelled “environmental idiots” who “tossed money out the window” to make an environmentalist statement towards friends and neighbours. In addition, she worried about the aesthetics and lack of household space. In the end it was her husband’s engagement and motivation that convinced her:

Of course his engagement has had great significance, I can’t say otherwise. But I think it is ok now, I don’t regret that we did it... And I thought it was fine with the inverter eventually when we hid it [in the hallway closet]. When I understood that the closet was lost, then I thought, ok, then I will have to hang some [clothes] downstairs. Now at least it is in a closet.

Mr. and Mrs. Hansen also did a round with their neighbours as they are part of a housing association. They only received positive feedback so the process went without any hurdles. For Mrs. Hansen it was appreciated that this was his strong wish, and that it was in line with their environmental values, and that it was simple and did not result in any extra work. She did not engage in the process of becoming a prosumer and she did not monitor the production of electricity from the solar system. In her view, becoming a prosumer required not only environmental motivation and money to spend, but also knowledge and skills:

Interviewer: Would you say that being a prosumer is for everyone?

Mrs. Hansen No, I think perhaps it isn’t. It is easy in many ways, no bother, but you must have the interest [in the technology] in the first place, because it requires something more of you than a lot of other things I think.

The need for skills in the role as prosumer coincided well with Mr. and Mrs. Hansen’s experience of becoming prosumers. As household solar PV systems are not common in Norway the company that installed them needed Mr. Hansen’s advice and had made mistakes and had to redo some of the work. This had only been discovered as Mr. A had extensive knowledge on solar systems. As the illustration of Mr. and Mrs. A show, the decision to invest in your own solar system requires negotiation between the family members. In this negotiation there is often other competitors like kitchen renovation. The narrative of Mr. and Mrs. Hansen also show how the engagement with the system is not always shared by family members in a household. Mr. and Mrs. Hansen describe themselves as environmentally conscious and have for that reason also sold their car and live without one, but it still is Mr. Hansen’s technological interests that has driven the process of becoming prosumers.

## 5.3 Prosumers in Serbia

The sample of interviewed ‘prosumers’ in Serbia differs from the other case-study countries. As noted

in section 2.3, the article 70, paragraph 5 of the Serbian Energy Law, which entitles citizens (natural persons) to become prosumers, is not yet implemented in practice. For that reason, those interviewed in Serbia have invested in HSPPs, but do not meet the definition of prosumers as they cannot sell surplus produced electricity back to the grid.

The majority of the interviewed ‘prosumers’ in Serbia were between 30-39 years old, thus younger than the average age of the interviewed prosumers in Italy, Norway and UK. Four families of the interviewed were middle class, two families were more affluent, and four families were from a lower socio-economic position as they were retired and thus have low income opportunities. The level of education among the sample also varied, but 11 of the prosumers interviewed had university education. The interviews were conducted with 10 families who had installed HSPPs across Northern, Eastern parts of Serbia and in Belgrade. Six families had installed the solar systems on their private house and four had installed it in their secondary homes (cabins). The latter group are respondents who own cottages that do not have a connection to the electricity and distribution network.

The motivations for becoming a ‘prosumer’ in Serbia also contrast with those of the other case-studies. Most of the families interviewed are off-grid (not connected to centralized grid supply). For four families the main motive for investing in solar energy was to electrify their secondary homes, which do not have means of centralized electrification. The motivation thus relates to having a comfortable stay and access to electric light, television, fans, charging of mobile phones etc. One of the ‘prosumers’ interviewed stated that he enjoys spending time in nature by his cabin and to motivate his family to spend time with him there he decided to electrify the cabin with solar energy. In addition, some of the families interviewed were not satisfied with the conditions for access to the distribution network offered by the national power utility EPS, both in terms of costs and service. For some of the interviewed the investment in solar allowed a more efficient supply, as well as independence from national electricity distribution.

Though lack of electricity provision or acceptable conditions of provision, were the main motivations, the second most listed motivation was financial reasons in order to save money on electricity consumption. Several of the interviewed ‘prosumers’ also highlighted the use of RES as an important motivation. An interest in solar technology was also mentioned in this regard. One of the women interviewed also emphasized that her motive to support her husband in this idea was for safety reasons, to avoid using gas. Their children were traumatized when a gas explosion occurred in a neighbouring house and thus this influenced her motivation for investing in solar energy systems.

The interviews with Serbian ‘prosumers’ show that there are gender differences in how women and men relate to the process of becoming prosumers. In most of the families (8 out of 10 families interviewed) it was the husband/male partner or other male relatives who took care of the practicalities in the process (e.g. bureaucracy, contact with vendors etc.), though with support from the family. Investments are related to the household economy and therefore require a joint decision. Among the families interviewed, men seemed more interested in technological aspects and for this reason they collected information and maintained contact with a solar panel installation company. Men also had more previous knowledge about regulations, incentives and in general important information on this topic. To some, it is a hobby, and they had knowledge about this for a long time before acting on it. One of the men interviewed is a graduate automation and mechatronics engineer. He made and installed the solar panels in his household all by himself. However, in two of the families it was the woman prosumer who had taken care of the entire process out of personal interest and one household was a woman prosumer who lived alone at the time of the installation. As described from Norway, there was often a certain event that sparked the decision to become a prosumer, such as meetings with other people who could provide knowledge and experience regarding solar technologies. The lack of women's participation in the technical process can be partly explained by

the lack of interest and skills

All of the interviewed ‘prosumers’ stated that they were satisfied with their HSPP. The positive experience was related to their environmental motivations and their independence from the public distribution network. They also felt that they had acquired sufficient information and quality products concerning their investment. One of the ‘prosumers’ interviewed noted that the warranty of an installed solar panel was 15 years, but the panels has functioned beyond this time-frame. The off-grid houses have installed both solar panels and batteries for electricity supply in the evenings or cloudy days. It was noted that quality batteries are expensive and some had experienced minor problems with battery capacity.

A major focus of this study is how becoming a prosumer affects everyday practices and perspectives of electricity consumption. A majority of the prosumers stated that they were careful and responsible in their electricity consumption. Some of the ‘prosumers’ interviewed planned their activities differently in order to maximise on the sunny hours. Only a very few reported to have opportunities to shift energy related activities and the load to daytime. However, the context of Serbia is different to that of the other case-study countries as several have batteries for storing the energy for using in the evenings. This requires a different attention to electricity use as they cannot rely on supply of more electricity than they produce themselves. Several of the interviewed ‘prosumers’ in Serbia were careful that light and appliances were turned off when not in use to ensure that they did not consume more than they produced and always had access to electricity when they needed it. Especially in the evenings and winter precautions were made to minimize electricity consumption. In addition, batteries are depleted by overuse (unless load-limiters are installed) and unless they have installed inverters (which are always necessary if you sell excess produced electricity to the transmission grid), several appliances do not work or will harm the HSPP. The interviewed ‘prosumers’ with batteries thus made sure that only suitable appliances were used. Five of the families interviewed are also connected to the central transmission grid. These families were less inclined to minimize their electricity consumption as they have access to the energy needed regardless of their own production.

To understand the context of gender relations and the effect on the process of becoming prosumers and energy practices in the household we explored how and whether the household space among the ‘prosumers’ interviewed was gendered. A little more than half of those interviewed stated that both partners were equally involved in household decisions in all areas, but slightly less than half stated that women exercise more control over decisions and activities in the kitchen space. The Diary provided us with additional information on the gender division of labour in the household in relation to electricity consumption during one week. In all households, both genders pay equal attention to turning off the light before going to work. According to the information obtained from the diaries, there is also no significant difference in the use of shower, men on average use shower for 15 and women for 20 minutes during the week. Generally speaking, women did most of daily housework related to energy use. In most households, both partners participate in the preparation of dinner during the week, although women more often participate in this activity than their male partners. In three households, women are the only person involved in the preparation of food. In one case, where a man lives alone, he does not prepare food. An activity in which gender division is expressed is the use of a washing machine. Many of the respondents have a washing machine, and they are mostly used by women. Only one family used the laundry dryer, and the woman was the one who used it. On the other hand, monitoring electricity production is mainly an activity performed by a man. Although, in two households this role is performed by women. As a reason why men are more involved in this process, women have indicated that their partners have an interest and motivation to lead such a process and that they will not interfere with it. Most prosumers followed the production from the

panels by using the display on the inverter.

Notes in the diary provided information on the different practices of men and women in interacting with technology. The results show how often and who in the family monitors the electricity production of the solar system. Most households monitored production and consumption through a converter or display. It was found out that men in total checked electricity production 29 times, while women only six times. The two women mentioned earlier who had driven the process to install household solar panels in their families, were also the ones who monitored electricity production.

In several households, a discussion on energy production / consumption in households was conducted during that week; about the way other people use solar energy, more precisely for what they are using it; about thermonuclear power plants; biogas; etc.

We asked respondents about the monitoring of electricity consumption and who paid bills for electricity. Out of 10 interviewed families, five families reported that husband pays electricity bills, and 3 said that the woman pay electricity bills, while in two households this is done by both husband and wife. Only households that were focused on reducing electricity consumption regularly checked their consumption, and most commonly that was performed by men, not women.

To correctly understand how gender relations interweave with energy decisions and to know if the process of becoming prosumer is unique in terms of gender, we have asked about practices and decision-making about renovating houses and specific spaces in their home. Here both men and women made decisions together, but mostly men performed practical work or had contact with handymen. However, women were often the ones who took the initiative to renovate the kitchen, rooms, bathrooms and decorative activities inside the house.

More women than men think they dominate in the kitchen and accompanying tasks, such as cooking and cleaning. Garage and all activities regarding using tools and repairs were usually stated by men. Regarding the decoration and renovation of the house, the decisions were most often a joint process of consultation between couples due to a common family budget.

All interviewed families reported sharing their experience with the installation of solar panels and solar energy consumption with neighbours, friends, and colleagues. Respondents suggested that the majority of people are generally interested in learning more about solar panels. In many cases, most of the neighbours in weekend settlements showed interest and some had become influenced to invest in HSPP. Women stated that they discussed the topic when being asked or when the topic naturally appeared in the conversation.

To further explore social and cultural factors that enable or limit people in becoming prosumers we asked the interviewed ‘prosumers’ to describe an average prosumer. Most of the people interviewed described a typical prosumer as a person with higher education, ecological awareness and good financial means. In addition, most described the typical prosumer as a cabin owner, highlighting that they are the pioneers driving the process towards solar household electricity production. Several also pointed out prosumers are often retired people who have been abroad for work migration. They then have both the financial means and experience or awareness (from abroad) of the possibilities to produce electricity with small decentralised solar units. Among the interviewed prosumers in Serbia, five were retired. About half of the ‘prosumers’ interviewed did not find gender relevant to becoming a prosumer, but they nonetheless pointed out a general opinion that men are more interested in this field and that an important driver of motivation is interest in pursuing this technology and trends of being modern and forward-looking. However, it was also stated that ecological awareness is the most important driver and thus include men and women. More than half of the interviewed consider the main driver of women to be the financial aspects of becoming a prosumer. It is necessary to highlight the ‘prosumers’ perspective of prosuming in the context of



Serbia, which differs from the other case-study countries in terms of not having the regulations to become prosumers fully in place. Although all the ‘prosumers’ interviewed were satisfied with their experiences of producing their own electricity from solar energy, and most of them wanted to upgrade their systems or include solar collectors for the heating of sanitary water they were less positive towards prosuming regulations within the current national context. This was explained by how the regulations on prosumers (at this point) only allowed those who have a registered company, as a legal entity, the status of being privileged producer. The state, as an incentive measure, offers only the purchase of energy from privileged producers if they acquire this status, but does not offer additional financial incentives for the installation of PVs with higher capacities. The interviewed prosumers who were familiar with the government’s incentive program for solar systems, thus felt that the right to become a privileged producer is only open for rich citizens and that for a long time there will be very limited number of places to apply for becoming one. All the interviewed prosumers had installed solar panels only for their personal use, because, in order to gain the status of a privileged producer, they must increase capacity and register a company, which automatically requires significantly higher costs.

### 5.4 Prosumers in the United Kingdom

The sample of interviewed prosumers in the UK came from several regions across the UK (excluding Scotland). In our sample, prosumers tended to be of about retirement age and live mainly in detached or semi-detached homes in residential areas, with few cases of terraced houses. They ranged from 37-82 year old, and seemed to be predominantly middle or high income households. Interestingly, most of the households had at least one person with technical and/or financial expertise through their previous or current employment.

Prosumers generally described interest in solar panels as evenly split between partners, but responsibility for gathering information or installation was generally on the part of the partner who handled household finances or maintenance, which in most, although not all, cases was the man. Several prosumers of both genders expressed interest in reducing energy costs and modes of self-sufficiency. Some of the more enthusiastic prosumers were interested in environmentally friendly technology; these were men.

The prosumer’s interest in energy markets generally in the UK was varied, although all looked favourably on reducing carbon emissions, and reducing dependency on fossil fuels. Nuclear energy was mentioned in seven interviews, about split between those with a generally neutral if cautious outlook, and a minority of strong opinions either in support or against. A few interviewees held stronger concerns on the environment and energy and discussed topics such as fracking and the structure of energy markets in depth, however these were in the minority.

Although environment was brought up by 16 participants as a primary or secondary motive, the remaining 12 interviewees did not mention environmental issues when discussing their motivation, or suggested that environmental issues did not play a role in the decision. Interestingly, in six of the 14 households, one partner was environmentally motivated and one was not. In these cases, environmentalism was balanced by gender: three men and three women were not environmentally motivated while their partners were the opposite.

For those who noted the environment as a main motivation, the notion of ethics and morality was frequently also mentioned, in terms of a felt responsibility to use less electricity or to live more sustainably. These respondents also mentioned solar panels as part of a more holistic approach to



decrease their carbon footprint and help the environment. In these cases, they have also adopted other energy efficiency technologies, such as light bulbs and double-glazing, put an active effort in being “frugal”, and they often volunteer with or donate to environmental charity. Producing their own electricity seems to be seen as a source of pride or community spirit: people felt that they were “reducing the communal energy burden”, and doing their bit for the next generations, often referring specifically to their children or grandchildren.

Financial incentives were discussed in every interview, and both male and female prosumers framed solar panels as a smart investment. One prosumer said that “solar panels are a better investment than the stock market” with regards to returns and security. However, the more recent installations did not benefit from equally high feed-in tariffs. In particular, many interviewees suggested that they would not have installed the solar panels at the current feed-in-tariff rates and two interviewees stated that the panels would not pay themselves off. These were interesting cases to note, as on the one hand environmental concern was the primary motivator so the prosumer was satisfied with their choice anyway. In the other case, there seemed to be some regret in installing the panels due to the loss in investment. This investment not only referred to financial returns from energy production, but to household improvements. Several prosumers had considered solar panels for a long time but installed them quickly after learning that solar energy tariffs were about to be reduced.

Some prosumers also discussed an interest in solar PV technology among their motivations for installing panels. This interest was specifically among male participants: seven of the fourteen men suggested technology as a motivation for installation. On the other hand, many female participants expressed reluctance or even fear of adopting new technology. Partners who discussed this had often also installed other technology-based energy and environmental devices in their homes, such as the Nest (smart thermostat), or energy efficient or LED light bulbs, or had undertaken renovations for home energy efficiency.

Discussions around self-sufficiency came up in some interviews, although it was rarely explicitly mentioned as a motivation to install solar panels.

The impact of gender on the decision-making process towards becoming prosumers varied between households. In more cases it seemed that the man was the key driver behind the decision, although men were often more reticent in acknowledging it. In two particular cases, out of the fourteen interviewees the men had come from scientific and technical professional backgrounds and had a keen interest in the technology which was not shared by their wives. However, it is also worth noting that in these cases the husbands were the main financial providers in these families and seemed to manage large financial decisions. In other cases, the decision came from both partners, generally who both worked, and was seen as a sound financial investment. In another case the decision and the entire installation process was undertaken by a single elderly woman before meeting her current partner. This could indicate that although the gender aspects in the decision making seems to suggest that more men were drivers of the decision than women, this is actually strongly tied with financial agency to take the decision to install solar panels. As previously noted, all but 5 of these couples were of retirement age, with 6 out of 14 couples in their 70s and 80s where this trend seemed to be stronger. In the younger couples, the decision tended to be made more evenly between the couple, viewed by both as a sound investment.

Women did on the whole appear less interested in the new technology aspect. More than one woman expressed dislike, discomfort, and lack of familiarity with solar PV technology. One participant also noted a level of gender bias from solar panel installers who preferred to discuss the technical aspects with her husband. However, in case where women worked in banks or accounting, they were the ones who dealt with the financial aspect. Again, it is to be noted that in most households at least one of the partners, more often the man, had a relevant background in finance (e.g. banking,

insurance, accounting) and/or technical fields (e.g. IT, engineering, construction), therefore making them a sort of “expert” that is or might be expected to deal with the decision and installation process because of their expertise. The research on and contact with solar installers was more often undertaken by the male partner. They also were more likely to have organised the paperwork and files, and most commonly referred to them and offered to show them during the interviews. In almost all cases, it was the man who showed us the meter (usually in the garage or in a cupboard indoor), inverter (in the loft), panels, and provided detailed figures on costs, savings and bills, and energy consumption and production.

Men tended to be responsible for executing household maintenance and repairs, but women were generally responsible for suggesting maintenance tasks and for day to day tasks. This was not universal across all participants, especially in cases where one partner was physically disabled or spent more time in the home (e.g. because one has already retired while the other is still working), or was the original sole owner of the house. However, on the whole women seem to take care more of the day to day chores, and men would implement big changes, investments, maintenance and reparations, or activities that were not habitual. Women notably made more references to taking care of family members.

Prosumers generally identified positive experiences with their solar panels and installations. The process of researching to installation was generally quite fast, taking only six to eight weeks in some cases. None of the households we interviewed had a battery, although many stated that they were interested, but waiting for the costs to decrease and/or the technology to improve. Aesthetics factored into the decision in some cases; one household in particular with an East-West roof specifically decided to only install on the rear of the house "in order not to be an eyesore in the street". The aesthetics was more often mentioned by women, although not exclusively. While some prosumers noted technical issues soon after installation, these were mainly small and quickly fixed by the installation companies. Some of these issues included, non-standardized smart meters, smart meters which do not work properly with solar panels, deficiency in information on the lifespan of solar panels, and in several cases the installers of the solar panels had gone bankrupt and there was significant uncertainty over the value of the warranty if repairs were needed.

Most prosumers said that original estimates of production and returns were conservative, and that their solar panels had “exceeded expectations”. Several interviewees expressed a feeling of satisfaction at knowing that they were producing energy on sunny days, in terms of the financial savings and the benefit to the environment, and some went as far as to mention feelings of joy and pride. These feelings are linked to different aspects of the system, including financial, environmental, and technological. The differences in terms of gender often mirrors those already explained in the motivation section.

Some interviewees took a keen interest in monitoring electricity generated but many claimed they tended to “almost forget” the solar panels were there, as no additional maintenance or work was required; according to the different experiences of the participants, it seems that the novelty effect was particularly strong in the first six months or so after the installation and it tended to wear out after the first summer, and then the PV system was just doing its job (see also Hargreaves, Nye and Burgess 2010). Individual participants noted that cleaning panels and keeping birds away were the main physical maintenance issues, but that these had relatively simple and lasting solutions. Many prosumers mentioned that they had self-cleaning panels, and most of the prosumers in general mentioned that they had never needed to have their panels cleaned, even if they had had them for years.

In some other few cases, the interviewee stated that the solar PV panels were unlikely to pay themselves off in terms of generation and savings over their lifetime. The timing for installing the

panels, the corresponding feed-in-tariffs, and the choice of panels and installers were important factors for the economic return. Although the cost of the technology was significantly higher in earlier installations (2012 to 2014), the financial gains were also higher. The interviewees in general were aware of this change and often stated that the current rates were much lower.

In most households there was a traditional split of labour with women taking charge of most domestic activities. There were some exceptions, notably in a case where the wife was unwell and the husband had taken over most tasks, or in a case where the woman was still working while the man had already retired and therefore had more time to look after the house and carry out domestic chores. In terms of energy use this meant women were generally using more energy for cooking, cleaning and other domestic tasks than men. As most households were of retirement age, they were generally composed of only the two members of the couple, with adult children and grandchildren visiting from time to time. When asked about roles in the household, a quite traditional distribution of roles could be noted. More women than men felt that they dominated the kitchen and associated tasks, such as cooking and cleaning. More women were also interested in decoration, but again in some cases this can be linked to their profession and hobbies, as many were artists or musicians. The garage and tool shed were usually claimed by the men. The solar panels did not appear to enter in either sphere of influence. Outside of these activities and spaces, most interviewees felt that the rest of the house was evenly shared, with a few exceptions such as offices or gardens used more by one or the other, but with no clear gender differences. With regards to home improvement and renovations, decisions were most commonly a joint consultation process between the couple, although one person might take on more responsibility managing the project.

A focus in this study is also the effect becoming a prosumer has on a household's and individuals' energy practices. When asked about changes in behaviour after becoming a prosumer, there were mixed responses. Some couples had changed their behaviour in order to maximise the use of energy from the solar panels, for instance timing the dishwasher or washing machine and charging devices such as laptops and mobiles during peak daylight hours, whilst others had not. This can be linked back to the experience of prosuming, where interviewees would either take a keen interest in the energy generated or alternatively “almost forget” the PV system was there. Generally, individuals who were adjusting their schedule to maximise the use of solar energy, were those who were already quite engaged environmentally (such as an interviewee who had also bought some land to plant a forest), or already financially conscious, such as the couple who before presuming had timed use of electricity to avoid the higher prices of electricity at peak hours, as illustrated by this interviewee statement: “it's our energy consciousness that made us get the panels in the first place, it's that way around”. These households also showed a good awareness of the energy consumption of different appliances, especially by men, and revealed that they do not think that having a smart meter that provides real-time information would change much in their habits, exactly because they are already energy conscious and taking actions in that respect. The other households similarly said that a smart meter and real-time data are unlikely to cause any change, this time simply because they are not willing to shift their habits, and just want to use energy when they need it or feel like it. One household discussed how they decided to purchase the panels because they have a swimming pool in the garden that they mainly use during the day in summer, and solar energy would therefore be very suitable for the purpose.

Information collected through the diaries corroborate this general picture. According to the information reported in the diaries, there is no relevant difference in the use of the shower and the attention in turning off lights. Not many of the respondents own or use a tumble dryer – and there is no apparent gender split in the few cases where the use of this appliance is reported. In most households the two partners take turns in preparing dinner during the week or cook together, although

women seem to be involved in this activity more often than their male partners, and in some cases (at least 3) the woman is the only one who reported making dinner during the week in which the diary was compiled. Nevertheless, we also encountered at least one case in the opposite direction, with the man being the only cook in the week. A clearer split appears in the use of the washing machine, mainly by the woman of the household, and in checking the electricity production, mainly the man. Nonetheless, for both activities we found at least one exception.

When asking interviewees who they perceive as the typical prosumer, a variety of answers were provided, but recurring factors were liquidity/disposable income and owning their own home. Most interviewees initially stated they did not have a fixed image of who a typical prosumer would be, but speculated most prosumer households would be of retirement age and well off, as they would have less financial burdens, more disposable income and would be interested in reducing their financial outgoings. This was also highlighted in conversations outside of the interviews, with one example of a conversation with a local cafe owner on the way to one of the interviews, who remarked that houses with solar PVs could be found in the more 'affluent' side of town, “where the money is”.

Men and sometimes women would often shy away from talking about stereotypes and describing behaviours which embodied stereotypical roles, and alternatively taking pride in behaviours which opposed stereotypical role. Such as one male interviewee highlighting his role in the kitchen: “I prepare dinner, that's me - I do have my uses”. When prompted about men or women being the key drivers, the responses were mixed, although most cases tentatively suggested that the decision could be driven by the man if financial, while women may take more interest in the environmental aspects. When asked about the gender difference in motivations, eleven responses split evenly between men and women did not clearly indicate a general preconception about men or women having different motivations, with multiple respondents suggesting that motivation would vary by the individual. The remaining seventeen participants suggested that there were differences in motivation between men and women. One participant suggested “a woman would probably be more interested in the theoretical benefits, whereas a man would be more interested in the practical issues as to whether spending the money is actually going to be a good investment or not”. A recurring response was that men might be more interested in the technology or women in the future and the environment although this was often tentatively suggested. This is well illustrated by one interviewee who did not note any differences in motivation, but when asked to comment on whether men or women are more interested in the technology stated: “I have no idea and wouldn't dare comment”. Many households were unwilling to generalise and to fall into stereotypes, and rather preferred to discuss specific cases of people they know, such as neighbours, friends and colleagues, or family.

## 5.5 Prosumers in Ukraine

As in Norway, the market for household solar PV systems is relatively new in Ukraine and the first intense period of installations began in 2016, continuing into 2017 and 2018. What is quite different from e.g. Norway is that instalment of solar PV systems is perceived as an economic investment on par with savings of bank investments. As mentioned in section 2.5, there has been a rapid increase of prosumers in Ukraine since 2017 due to the introduction of a green tariff.

The interviews conducted with prosumers in Ukraine were spread across 11 of Ukraine's regions; Kyiv, Zhytomyr, Rivne, Volyn, Ternopil, Lviv, Ivano-Frankivsk, Transcarpathian, Odesa, Poltava, Kharkiv. The interviews were conducted with 34 prosumers from 18 households. In two of the households the woman prosumer did not want to be interviewed, while in the rest of the interviews



both spouses/partners are interviewed. As in Serbia the sample of informants in Ukraine has a lower average age than Italy, Norway and the UK. Most of the prosumers interviewed are between 30-40 years old. Most of the prosumers interviewed have high education and often of technical nature with further significant experience in electricity, IT or other related sectors. Also, several of the prosumers interviewed have hobbies that include interest in construction, innovations, renewables and environment. Among the interviewed prosumers 7 women are housewives (4 of which have higher education). As in the other case-study countries the majority of prosumers interviewed have their own detached house, though two of the families have installed the solar system on their summer house. Most of the prosumers also live in a city or suburban location.

As mentioned, passive income and saving money was mentioned as the main motivation to become a prosumer by those interviewed. HSPPs were considered as more attractive investment in comparison with bank deposit because of stability concerns and higher interest rates in foreign currency. Being a prosumer was also seen as a way to stabilise the family economy from overspendings due to constantly increasing energy prices. For some of the prosumers interviewed the electricity bills were often to zero level during sunny period of the year (given that installed capacity is in average around 10 kilowatt). Six of the prosumers (five men and one woman) have also listed professional or technical interests as a motivation. As in the case of Norway, a significant proportion of the prosumers in Ukraine work within related themes. Among the early prosumers there are many representatives from private and state owned enterprises, which provide services in electricity supply etc. Several families had also installed the solar systems on their own using guides from internet and with support from relatives with technical skills. Environmental reasons were only mentioned by a few of the interviewed prosumers. An important driver for the families living in rural locations was stability of electricity supply. As they experience irregular availability and quality of services from the central transmission grid, solar has become means to have reliable electricity. The motivations for becoming prosumers were fairly gender balanced, with the exception of professional interest. Women also mentioned more frequently that money saving was a major reason.

The process of becoming prosumers in Ukraine involves becoming acquainted with information from several sources in order to successfully understand the legislation, connection requirements, receive the green tariff and contact with solar installation companies and electricity supply (utility) enterprises. Such information is available on national and local government webpages (e.g. State Agency on Energy Efficiency and Saving, National Energy and Utilities Regulatory Commission of Ukraine), as well as state banks. Many have also heard about prosuming and green tariff from TV shows. In most cases it was the men prosumers interviewed who had driven the process of finding the information and taken care of practicalities in the process, though in a few cases women had been the initiators (one worked in the energy sector). In most of cases decisions on technical aspects of solar systems were taken by the husband, which in turn relays often on recommendations from Internet, relatives and neighbours with existing experience of solar exploitation. Despite women generally being less engaged in the process than men, in six of the families it was the woman prosumer that was the legal owner of the solar systems. In most cases the decision to become a prosumer was taken jointly by the couple.

The interviewed prosumers in Ukraine generally had positive experiences of being a prosumer. As most of the interviewed prosumers had relatively short experience (1-2 years) they spent a significant amount of attention to the daily operational mode of the system, and monitor the production on PCs or inverters. They were most satisfied with the financial benefits, and it was highlighted how the green tariff is fixed to EUR exchange rates and thus less vulnerable to national currency fluctuations. Several also pointed to how becoming a prosumer had increased their knowledge and awareness concerning energy consumption in the household, alternative

sources/solutions to household energy needs, as well as awareness of environmental concerns. Despite mostly positive experiences the interviewed prosumers also related problems concerning bureaucracy in the process. Some had encountered problems of obtaining permits from regional and district electricity utility companies. In addition, some stated that the experience and skills concerning prosuming was a deficit at the utility companies and that there were technical limits in the distribution networks. The distribution network is old and not adapted to modern household energy use in some places. It is also therefore not adapted to connecting prosumers solar systems to the grid. Several also listed other problems and deficiencies of the system:

- that loans from domestic banks were expensive;
- low efficiency of state and local support programmes for energy efficiency and renewables; in Ukraine, a prosumer could obtain higher “green tariff”, provided that all equipment is of domestic production, but if even some smaller parts are imported, no such incentive would be given;
- lack of information about solar energy in local media, TV and newspapers; increase of feed-in fees in 2016, which should be paid to regional and district electricity supply enterprises for connection to the grid by a household;
- production and consumption balance is considered as wrong approach for solar energy promotion, because prosumers lost incentives for switching to double- or three-zone metering unit in order to limit peaks of electricity consumption in morning and evening hours;
- despite GPS-modem system of metering, most of interviewed prosumers have to visit the regional electricity supply company once per month to sign a balance sheet on produced and consumed electricity to become eligible for payments under green tariff.

One family even had an accident with their solar system. Due to a problem with their inverter in the summer house, they reported that the electrical appliances in their summer house were damaged. After this experience they had stopped using the solar system altogether. This illustrates the potential safety issues concerning HSPP and the need for technical expertise to avoid problems and health hazards.

As shown in Box 3, the prosumers in Ukraine were very engaged in debates and rights of prosumers, which they highlighted both in the interviews and diary notes collected. Some interviewed prosumers declared their intentions to install additional PVs to produce more electricity and earn more money.

This study also has the aim to better understand how becoming prosumers changes their energy practices in the household. Several of the interviewed prosumers stated that the installation of a solar system has led to substantial changes in energy management. Having faced the possibility to obtain regular passive income, most of households started to evaluate consumption and look for additional options to reduce electricity use through energy efficient measures, including LED-lamps, smart meters and growing attention to family members’ electricity use. Some families have reported the change in daily mode of operations in terms of washing, however, some have claimed that state policy on promotion of solar power does not include issues, which might limit differences between evening and morning peaks. The production and consumption of electricity in the prosuming households is calculated based on average balance. It means that there are no financial incentives for shifting the time of using e.g. the washing machine from daily to nightly operation.

All the interviewed families also reported that they shared their experience of prosuming and new awareness of energy consumption with neighbours, friends, colleagues and ordinary people. In many cases, such prosumers became pioneers in their inhabitations with respective period of intensive interest from relatives, neighbours and even ordinary travellers. Some prosumers have decided to use PVs as one of the main business activities and promote their solar system on social media or relevant



websites.

The energy practices of families interviewed also reflected gender roles in the households. As stated earlier, all the families monitored the electricity production of their solar systems, as well as consumption. They mostly use display on the invertors, some have also applications for PC or smartphone with the possibility to see on-line production intensity. Moreover, all prosumers have special metering units for calculating produced electricity and GPS module for remote data transfer. In general, these activities were undertaken by men. The diary results indicate that the electricity-related housework e.g. washing and drying clothes (tumble dryer) and cooking dinner, on the other hand, is performed by women. This shows that women and men relate to electricity in different ways.

The interviewed prosumers in Ukraine also considered solar power and electricity as the sphere of male interests and responsibility. However, at the same time quite often women were legal owner of the house and respective solar system and pay substantial attention to the economic aspects and ecological consequences. In some cases, there were strong divide between women and men's interest to the solar systems in the families interviewed. In two cases the woman prosumer even denied to participate at the interview, because they were not interested in PVs and regarded them as a hobby of their husbands. Also, in many cases women insisted on the presence of their husbands during interviews and answered with simple words on questions, where it was expected to gain a broader picture. This was especially evident in families where the couple were in their 50s or older.

Different gender roles were also reflected in the interviewed prosumers description of the ‘average prosumer’. Most of the interviewed stated that the average prosumer was between 25-50, had middle to high income, and most likely a man. Income level was stressed the most as HSPP still have high up-front costs in Ukraine; “They are mostly men of average age (around 40 years), who have higher than middle financial incomes or additional incomes that allows them to buy SPPs because they are not cheap” (Male prosumer, Zhytomyr region). Several, also pointed to how prosumers often had entrepreneurial skills and thus an interest in making investments that were profitable. It was suggested that a prosumer often were persons who had their own business (mostly men) as can be seen in the quotes below:

I have read literature about HSPP in Internet and feedbacks on forums, so given the above, an average prosumer comes from middle class and are of middle age, they usually work, have some financial savings and consider ways of investing those money, because SPP is not a very cheap investment in Ukraine; they usually calculate everything very carefully, have clear business plan on pros and cons, payback period. Those persons can have their own business, and are in most cases of male gender. The dominant motive is the financial one in Ukraine so far (Male prosumer, Rivne region).

They are usually representatives of the middle class, entrepreneurs or people who have saved money and want invest them for additional profits. Top- managers and engineers from electricity companies were the first who installed SPPs. Women can be prosumers if they are entrepreneurs, because they are able to count money (Prosumer, Ternopil region).

As the quotes above illustrate, prosuming is linked to people of middle class who are enterprising and ambitious and most often are men. Some of the interviewed prosumers also stated that the ‘average prosumer’ is a person with a technical education or interest, as well as people who have a general desire for making positive changes in society (in terms of environmental aspects). Another important aspect mentioned, which is also related to income level, is that one needs to own a house in order to become a prosumer, as this is not possible for people living in flats.

### ***Box 3: Diary quotes from Ukraine***

The use of diaries provides some illustrations of prosumers’ experiences, priorities and perspectives on prosuming. All interviewed prosumers in the case study had the opportunity to fill in their own thoughts and any family discussions concerning energy in the household. On the whole, few of the prosumers in the study filled in additional information (in the UK and Norway, weather conditions were noted, in addition to special energy related incidents or disputes within the family concerning consumption). The case of Ukraine was, however, an exception as several of the prosumers used the diary form to vent their perspectives on the need for more government focus on prosumers. Below are excerpts from three prosumers:

**Prosumer from Kyiv:** “Prosumers need support from the state in [terms of] better conditions for loans, preferences for prosumers and combating corruption in district electricity network companies to avoid bribes. We would like to increase the household solar plant capacity up to 50 kilowatts, but as for today no official permit is possible.”

**Prosumer from Odessa:** “HSPPs is a very safe system and one does not require special knowledge to use it. Prosumers need support to gain affordable loans and downstream networks should be modernized, and their capacities should increase in order to enable more HSPPs for supply and sale of electricity; PVs are expected to decrease in prices twofold and the use of rotation gear would help to increase production.”

**Prosumer from Kharkiv:** “Ukraine needs educational programmes for schools for children with regard to ecological projects, clean energies, promotion of eco-friendly and healthy life style; alternative energies should be promoted among private households and condominiums; the state should be more interested in promotion of HSPPs and support prosumers in installation issues; the state should simplify procedures of HSPPs’ connection to electricity network, in particular, for multi-apartment houses; in order to promote green energy, it would be rationale to cancel personal income tax and military tax on incomes from “green tariffs” (author’s translation).

## 6. Summary, Analysis and policy recommendations

This report has shown that prosuming through HSPPs is becoming more common. However, there is a significant potential, which is, unfortunately, still underutilised. Italy and the UK are leading countries when it comes to household solar installations, and the market in Ukraine and Norway is emerging. In Serbia, few households have installed HSPP, and the regulations on prosuming are not in place yet meaning that HSPPs are being used as off-grid solutions or as an addition to central electricity supply. By drawing on qualitative methods, this report has explored the motivations and experiences of prosumers to highlight social and cultural factors that may enable or limit individuals' choice to become prosumers as discussed below.

An important focus in this report has been the motivations that drive individuals and household's decision to invest in HSPPs and become prosumers. As to be expected, the motivations differ according to national contexts, but centre around financial and environmental reasons. In the UK, Italy and Ukraine financial motives were common (often together with environmental aspects), while in Norway, where HSPPs have high up-front costs and revenues from selling power production are more uncertain, environmental reasons take more priority and financial benefits are rather seen in a long-term perspective. As noted earlier there are no households in Serbia that sell excess produced electricity back into the transmission grid, as the legislation granting citizens license to do so is not yet in place, because of lack of specified complementary regulations, as well as because there is no supplier on the market who would be willing to sign a contract with a 'natural person'. However, the general findings show that support schemes like feed-in tariffs seem to be of utmost importance for the growth in the number of prosumers, based on the comparison between our case countries. In the UK and Italy, and more recently in Ukraine, support schemes have been in place and resulted in a more mature prosumer market (at least for the UK and Italy). This result resonates well with the study by Inderberg et al. (2018), which points out to the importance of feed-in tariffs have had for the development of the prosumer market in Germany and the UK compared to the small-scale support system in Norway where the numbers of prosumers are rising, but not to the same extent.

Another finding of importance is that the average prosumers identified generally have middle-to high income and higher education. This is also supported by other studies (Westskog et al. 2018). In addition, people who have occupations and interests related to energy and technology constitute a significant prosumer group in Norway, Ukraine and to some extent in the UK (see also Westskog et al. 2018; Winther, Westskog and Sæle 2018). This might constitute a challenge in making HSPPs and prosuming attractive and affordable to lower income groups, as well as to groups with less interest or skills in technology. As women on a general level have lower income than men and are less represented in Science, Technology, Engineering and Mathematics (STEM) education and occupations, this might also constitute a barrier for them to invest in this type of solution. This calls for actions to provide subsidies and minimize the needed skills necessary to become prosumers. As an example, the establishment of the Norwegian solar company Otovo Solar, and their approach towards simplifying the process to become a prosumer and lowering costs generated an increase in the number of prosumers and defined new prosumer 'identities'. A striking finding was also that almost all the prosumers interviewed in this study (across all the case-study countries) live in a detached or semi-detached house that they own. This is correlated with income, but also in some contexts reflects the difficulties for residents of multi-apartment buildings to obtain permits to become prosumers (see also Westskog, Winther and Sæle 2018).

This study also asked the interviewed prosumers to share their experiences of being prosumers. Across the case-study countries, the prosumers interviewed were generally satisfied with

being prosumers and had positive experiences. The positive aspects of being a prosumer were usually related to financial benefits and environmental benefits. Several, often women, also highlighted that HSPP was a care-free investment, as once installed it did not require any work or special attention. However, although the interviewees were satisfied with their choice to become prosumers, several had encountered challenges related to bureaucracy, such as permits or dealing with utility companies. In Ukraine and Serbia, some of the interviewed prosumers pointed to deficits in the legislation or distribution networks that posed limitations on prosumers. As noted earlier, in Ukraine, the distribution networks in some locations are dated and thus have technical problems in incorporating HSPP, as well as energy consumption from the modern household (see also Box 3).

## 6.1 What Difference does Gender Make?

This report has also paid specific attention to how gender roles and relations affect the decision and the process of becoming prosumers, as well as energy practices in the households. This study views gendered roles and relations, as culturally and socially embedded and enacted. The implication for gendered studies of household energy practices is that it is important to be attuned to the different values and identities that shape men and women’s roles and practices concerning energy, and how energy decisions are negotiated within households when making energy investments. Gender aspects are important for understanding how and why energy practices and behaviour may differ within and across households and societies and what social, economic and environmental implications this may have. Energy policies are often formulated in a gender-neutral way that assumes that men and women have the same perspectives, needs, experiences, values, resources and aspirations concerning domestic energy access, production and use (Standal, Winther and Danielsen forthcoming; Kaminara 2015). The underlying assumption is that men and women will respond to and benefit equally from such policies. However, as discussed in section 1.2, research shows that the motivations for and barriers to taking up energy-saving technologies are also gendered because gender roles and relations influence the social acceptability and behavioural responses to energy saving policies and uptake of environmentally friendly energy investments (i.e. Strengers 2013; Henning 2005).

As shown in the material from all case-study countries, the decision-making on investments were done by the couples together, but it was men who in general drove the decision and process of becoming prosumers. In many cases, this was attributed to men’s role as more interested and/or skilful in aspects relating to solar technology. There were a few exceptions of women working in the energy sector who drove the choice and process themselves. In the UK, it was found that men who drove the process of installing HSPP were also tied to financial agency. Among the interviewed prosumers in the UK, men who were the main economic providers of the households (more often for retired or older couples) also managed financial decisions of the household, including the choice to invest in the HSPP.

The tendency of men to drive the process of becoming prosumers was, in some contexts (i.e. Norway), also applicable to other investments concerning the ‘hardware’ of the house, such as house renovation of the building structure, refurbishment of kitchens etc. In these cases also there was a pattern of gendered division of labour where women were most active in interior design choices, while men undertook the practicalities (doing it themselves or being an intermediate with craftsmen). Although ideas of masculinity and femininity in relation to household decision-making were difficult to discuss among most of the interviewed prosumers, it was nonetheless noted that, in many households, different gender roles of women and men form different responsibilities (e.g. such as cooking and cleaning vs. renovation) and gendered household spaces (e.g. kitchens, washrooms)

where women and men have different decision-making power, so that the HSPP and solar PV in general was perceived as a ‘masculine’ technology, belonging to men’s domain. This was reflected in the general view of the ‘average prosumer’ as a man with financial means and often education, noted by the majority of interviewed prosumers. As an illustration of the gendered divisions of labour and engagement with the HSPP, we asked the interviewed prosumers to fill in the number of times they checked their electricity production, distinguishing between men and women. In the journal notes, each household noted the amount of time both husband and wife/partners checked the electricity production the last seven days. Though some families monitor their production more closely than others and not all households filled in the journal notes, the numbers in total indicate the general difference between men and women in how they engage with the HSPP. Men check the electricity production on their computers or Apps, significantly more than women do.

Table 2 – Total of times Electricity Production was checked last Seven Days

Country	Men (in total)	Women (in total)
Norway	37	18 (13 by same person)
Italy <sup>6</sup>	-	-
Serbia	29	3
UK	13	4
Ukraine	20	10

These findings are supported by previous study on households’ adoption of smart energy technology. When such technologies are implemented in households, it is usually technology interested men who initiate the process and utilize the technology first. Later the men try to implement new rules and practices for reducing energy consumption, sometimes leading to intra-household conflict (Skjølsvold, Jørgensen og Ryghaug 2017). However, most of the interviewees also deemed gender irrelevant in the decision to become prosumers and the main motivations across the case-study countries relate to financial and environmental reasons, which we did not find to be clear-cut gendered in the same sense as solar PV technology.

An essential aspect of prosuming is also related to any changes that occur in individuals and households’ energy practices after becoming a prosumer. Here also, gender roles and gender relations matter as the gendered division of labour in the households mean that women and men do not engage with energy consumption in the same way, and they have different experiences and needs. Taking a gendered perspective on energy practices reveals that there are different perceptions, value judgements and practices between men and women. One obvious example concerns energy poverty. In general, more women than men fall below the poverty line also in the global North (Clancy and Roehr, 2003). This restricts households’ energy choices and reduces the ability to use heating and cooling equipment and to cook, which may affect women more than men. A study from Germany found that elderly with small pensions, a category where women form the majority, spend such a considerable amount of their income on heating that they can be considered energy poor (Schultz and Stiess 2009). Using diary notes provided by the interviewed prosumers, it was possible to gain insight into the gendered division of labour within the household concerning energy use, as well as energy behaviour for men and women. In the journal notes, each household noted the amount of time both

<sup>6</sup> In Italy, the number of times checked per week was not recorded, but in 4 families both men and women checked, in 4 families only men checked and in 2 families they did not check the electricity production.



husband and wife/partners did energy-related activities (laundry and cooking) the last seven days. Though the average amount of times families do laundry vary and not all households filled in the information, the results found strongly indicates that across all case-study countries women perform the majority of several of the energy-related everyday domestic tasks such as cooking and laundry:

Table 3 - Gendered Division of Labour in the Household, total number of times of activities done last seven days

Country	Household chores	Women (in total)	Men (in total)
Norway	Washed clothes in washing machine	30	5
	Dried clothes in tumble drier	9	0
	Made dinner	34	21
Ukraine	Washed clothes in washing machine	13	4
	Dried clothes in tumble drier	2	0
	Made dinner	14	7
Italy	Washed clothes in washing machine	37	2
	Dried clothes in tumble drier	1	0
	Made dinner	42	6
UK	Washed clothes in washing machine	19	4
	Dried clothes in tumble drier	2	2
	Made dinner	44	32
Serbia	Washed clothes in washing machine	26	3
	Dried clothes in tumble drier	3	0
	Made dinner	28	14

Families also noted down the number of times they turned off the lights before going to work and the number of minutes showered. Here we did not find any major gender differences. This information reveals the importance of a gender focus in understanding energy practices on the household level to inform policies. To maximize the use of solar systems (without battery solutions) it is necessary to shift the main load of consumption from evenings to daytime when the sun is shining. However, this is contingent on household members to be home during the daytime. In the case of Norway, where the spot prize for excess electricity sold back to the transmission grid is low, the profitability of the HSPP is significantly less if the prosumer does not utilize the electricity for consumption. Among the prosumers interviewed, several were retired and in Serbia, some of the women were housewives, which allows for more flexibility in shifting the energy-related domestic tasks to the daytime. There is a need for reflection concerning incentives for shifting the main load of energy use to the daytime as this often concerns work that befalls women, and women’s prioritisation of domestic work is unpaid labour, often complicit in feminization of poverty (Bhattacharya 2017; England 2005).

As stated earlier, gender is often found to be a relevant aspect underlining diverse considerations related to energy and environmental problems. Although this is a characteristic that could be considered an individual feature, it plays a higher role at the societal level since in different societies women might have different roles within household decision-making processes. For instance, the role of women in a particular society can be a cultural discriminant at local and national

levels (Aldred and Jungnickel, 2014). Regarding the shift from consumers to prosumers, gender plays a noteworthy role, considering that men and women interact differently with technologies in the household. Depending on whether the head of the household is a man or a woman, the household's approach towards energy sources and own energy production could be different. As noted in Box 2 and the family Hansen, the decision to invest in HSPP is often debated within the household as the costs are weighed against other alternatives and subject to the priorities of the different household members. Several of the interviewed prosumers (i.e. Norway) have shared how it was the determination and will of one person (most often the man) in the household that decided in favour of HSPP.

Men and women's engagement with solar technology and prosuming is also embedded in how HSPP and prosuming are presented in the public eye. As shown in this study, the masculinity attributed to solar energy is also very much present in how journalists and advertisers 'sell' prosuming as a 'family' thing, but where the technical aspects almost exclusively are an issue of men. This has ramifications for how HSPP is valued in society and feminization of certain types of energy and masculinization of others (Ryan 2014). Re-producing the gender roles and gendered divisions of labour concerning energy, which excludes women from the technical sphere, has implications for women and men's ability to adopt new technology and change their energy consumption practices towards more environmentally friendly lifestyles.

## 6.2 Conclusions and Policy Recommendations

Using a qualitative approach to understand cultural contexts and social arrangements that shape energy practices and choices, this study points to several aspects of importance to design energy policies and direct energy investments for prosuming in ways that are gender-sensitive, as well as socially, economically and environmentally sustainable. As discussed above, the results confirm the importance of support schemes such as feed-in tariffs for the growth in prosumers based on the comparison between our case countries. A case in point is the UK, where the subsidy scheme has been heavily reformed in recent years and a recession in the demand for HSPP has pushed many installers to go out of business or quit the solar sector. This hints to the importance of keeping up momentum to increase the number of prosumers and to foster work opportunities in the “green” energy sector.

In addition, the results show the importance of establishing prosuming in legislation, which grants prosumers rights to sell excess produced electricity to the transmission grid, and ensure well-established routines for this process to limit transaction costs (see also Winther, Westskog and Sæle 2018). Further, several prosumers identified bureaucratic challenges in becoming prosumers, which also might constitute a significant barrier for making HSPP attractive, highlighting the need for consumers to receive adequate support in the decision-making process and in the transition to becoming prosumers. Also, this study has looked into how gender plays a role in the process when couples become prosumers, as well as how this affects everyday use of energy. Below, we have outlined the main recommendations based on the findings of this case-study:

- 1) Our results show that the motivations for becoming prosumers are quite varied; financial benefits; environmental aspects; technological interest; security etc. This urges the importance of a varied promotion of this technology both underlining economic and environmental issues as well as creating interest among people interested in the technological elements.

- 2) Key aspects to enable and foster prosuming are simplification of the bureaucracy, support in the assessment of the suitability of solar to the household’s circumstances and selection of the products and installers, as well as minimisation of the burden linked to registration and monitoring of the systems on the part of prosumers (Westskog, Winther and Sæle 2018).
- 3) In all our case study countries, the prosumer interviewed seem to have middle- to high income and higher education than average population. Hence, there is a challenge in making HSPP also affordable to lower income groups: integrating the technology in apartment blocks and urban areas when planning new housing areas is one way of making the technology available also for a wider group of the population. Subsidies, tax reductions or feed-in tariffs are important measures to decrease up-front costs for lower income households. In addition, reducing transaction costs are important to make the technology more accessible. Providing opportunities for low-income households to become prosumers can also be a measure to reduce energy poverty where this prevails, as it is being done in the global South (Standal, Winther and Danielsen 2018).
- 4) Gender also matters for the agenda-setting work of the energy sector and energy science more broadly. Gender should thus be a concern for policy-makers seeking to design and implement socially, economically and environmentally feasible and sustainable energy policies as it may have consequences for the equity, efficiency and effectiveness of these policies. As noted, lack of financial means, skills and education may be a barrier for women to engage in or opt for HSPP.
- 5) Learning from this case-study, governments can exploit the experiences of the case-study countries and combine different policy tools to enable consumers access to prosuming. Such policy tools could include initial investment by government-supported green banks or HSPP loans, feed-in tariffs, information campaigns about the benefits and basics of solar technology and policies, assistance with the screening process for solar energy companies and products, and normalisation of solar panel aesthetics.
- 6) In addition to measures to promote solar PV directly, it is important to also provide financial incentives and support investment for supporting technology like batteries to store the electricity produced during the day, as well as in research to improve the quality of the products.

### References

- Bhattacharya, Tithi (ed.). 2017. *Social Reproduction Theory. Remapping Class, Recentring Oppression*. London: Pluto Press.
- Brounen, D., Kok, N., Quigley, J.M. 2013. “Energy Literacy, Awareness and Conservation Behavior of Residential Households.” *Energy Economics*, 38: 42-50
- Clancy, J.S and Roehr, U. 2003. “Gender and energy: Is there a Northern perspective?” *J. Energy for Sustainable Development* VII, no. 3: 44-50.
- Carlsson-Kanyama, Annika and Anna-Lisa Lindén. 2007. “Energy Efficiency in Residences: Challenges for Women and Men in the North.” *Energy Policy* 35, no. 4: 2163-2172.
- Da Silva, Per Goncalves; Stamatis Karnouskos, and Dejan Ilic. 2012. “A Survey towards Understanding Residential Prosumers in Smart Grid Neighbourhoods.” Conference...
- Diekman, Amanda; Erica Wesigram, and Aimee Belanger. 2015. “New Routes to Recruiting and Retaining Women in STEM: Policy Implications of a Communal Goal Congruity Perspective.” *Social Issues and Policy Review*, 9, no 1: 52-88.
- Elnakat, A. and Gomez, J. D. 2015. “Energy Engenderment: An Industrialized Perspective Assessing the Importance of Engaging Women in Residential Energy Consumption Management.” *Energy Policy*, 82: 166-177.
- England, Paula. 2005. “Emerging Theories of Care Work.” *Annual Review of Sociology* 31: 381-399.
- Hargreaves, Tom, Michael Nye and Jacquelin Burgess. 2010. “Making Energy Visible: A Qualitative Field Study of how Householders Interact with Feedback from Smart Energy Monitors.” *Energy Policy* 38, no. 10: 6111-6119.
- Henning, Anette. 2005. “Equal Couples in Equal Houses: Cultural Perspectives on Swedish Solar and Bio-pellet Heating Design”. In *Sustainable Architectures: Cultures and Natures in Europe and North America*, edited by S. Guy, and S.A Moore, 89–104. New York: Spoon Press.
- IEA. 2015. Eastern Europe, Caucasus and Central Asia: Energy Policies beyond IEA Countries. OECD/IEA. [http://www.iea.org/publications/freepublications/publication/IDR\\_EasternEuropeCaucasus\\_2015.pdf](http://www.iea.org/publications/freepublications/publication/IDR_EasternEuropeCaucasus_2015.pdf)
- IEA. 2016. Energy Policies of IEA Countries: Italy 2016 Review. OECD/IEA. <http://www.iea.org/publications/freepublications/publication/EnergiePoliciesofIEACountriesItaly2016Review.pdf>
- Inderberg, T.H., Tews, K., Turner, B. 2018. “Is there a Prosumer Pathway? Exploring household solar energy development in Germany, Norway, and the United Kingdom.” *Energy Research and Social Science* 42: 258-269. <https://doi.org/10.1016/j.erss.2018.04.006>.
- IRENA. 2018. Renewable Energy and Jobs. Annual Review 2018. [file:///C:/Users/karinat/AppData/Local/Packages/Microsoft.MicrosoftEdge\\_8wekyb3d8bbwe/TempState/Downloads/IRENA\\_RE\\_Jobs\\_Annual\\_Review\\_2018.pdf](file:///C:/Users/karinat/AppData/Local/Packages/Microsoft.MicrosoftEdge_8wekyb3d8bbwe/TempState/Downloads/IRENA_RE_Jobs_Annual_Review_2018.pdf)
- Karjalainen, S. 2012. “Thermal Comfort and Gender: A Literature Review.” *Indoor Air* 22: 96–109.
- Lampropoulos, Ioannis; Greet M. A. Vanalme and Wil L. Kling. 2010. “A Methodology for Modeling the Behavior of Electricity Prosumers within the Smart Grid.”
- Mengolini, Anna. 2017. Prosumer Behaviour in Emerging Electricity Systems. PhD diss. Politecnico di Torino.
- Michaels, Lucy and Yael Parag. 2016. “Motivations and Barriers to Integrating ‘Prosuming’ Services into the Future Decentralized Electricity Grid: Findings from Israel.” *Energy Research & Social Science*, 21: 70-83.
- Michelsen, Carl Christian and Reinhard Madlener. 2017. “Homeowner Satisfaction with Low-carbon Heating Technologies.” *Journal of Cleaner Production* 141: 1286-1292.
- Moore, Henrietta L. 1988. *Feminism and Anthropology*. Cambridge: Polity Press.
- Olkkonen, Laura; Kristiina Korjonen-Kuusipuro, and Iiro Grönberg. 2017. “Redefining a Stakeholder Relation: Finnish Energy ‘Prosumers’ as Co-producers.” *Environmental Innovation and Societal Transitions*, 24: 57-66.
- Schellen, L., Loomans, M.G.L.C., de Wit, M.H., Olesen, B.W., van Marken Lichtenbelt, W.D. 2012. “The Influence of Local Effects on Thermal Sensation under Non-uniform Environmental Conditions:

- Gender Differences in Thermophysiology, Thermal Comfort and Productivity during Convective and Radiant Cooling.” *Physiology & Behavior* 107: 252–26.
- Schleicher-Tappeser R. 2012. “How Renewables will Change Electricity Markets in the Next Five Years.” *Energy Policy* 48, 64-75.
- Skjølsvold, Thomas M., Susanne Jørgensen og Marianne Ryghaug 2017. “Users, Design and the role of Feedback Technologies in the Norwegian Energy Transition: An Empirical Study and some Radical Challenges.” *Energy Research & Social Science* 25: 1-8
- Strenger, Yolande. 2014. “Smart Energy in Everyday Life: Are you designing for Resource Man?” *Interactions* 21, no. 4:24-31.
- Tabi, A., Hille, S.L., Wüstenhagen, R. 2014. «What makes people seal the green power deal? — Customer segmentation based on choice experiment in Germany.” *Ecological Economics* 107: 206-215.
- Vesely, Michal and Wim Zeiler. 2014. “Personalized Conditioning and its Impact on Thermal Comfort and Energy Performance: A Review.” *Renewable and Sustainable Energy Reviews* 34: 401-408.
- Westskog, H., T.H. J. Inderberg, H. Sæle, T. Winther. 2018. (In Norwegian) Strøm fra Folket? Drivkrefter og Barrierer. CICERO Report 2018:04
- Westskog, H. and Winther T. 2014. “Electricity Consumption: Should there be a Limit? Implications of People’s Attitudes for the forming of Sustainable Energy Policies.” *Consilience: The Journal of Sustainable Development* 11: 97–114.
- Wilhite, Harold Langford. 2014. “Sustainability as Social Practice: New Perspectives on the Theory and Policies of Reducing Energy Consumption”, In Stewart Lockie; David Sonnenfeld & Dana Fisher (ed.). *The Routledge Handbook of Social and Environmental Change*. Routledge.
- Wilhite, Harold Langford. 2008. *Consumption and the Transformation of Everyday Life: A View From South India*. Palgrave Macmillan.
- Winther, T., Westskog, H. og Sæle, H. forthcoming. “‘Like Having an Electric Car on the Roof’ Domesticating PV solar Panels in Norway.” Submitted to *Energy for Sustainable Development*.
- Zhang, Ni; Yu Yan, and Wencong Su. 2015. “A Game-theoretic Economic Operation of Residential Distribution System with High Participation of Distributed Electricity Prosumers.” *Applied Energy*, 154: 471-479.



## **Appendix 1 - Abbreviations**

<b>EPSC</b>	Elektroprivreda Srbije, Power Industry, Serbia
<b>IPS</b>	Integrated Power System, Ukraine
<b>HSPP</b>	Household Solar Power Plant
<b>NREAP</b>	National Renewable Energy Action Plan, Serbia
<b>NVE</b>	Norwegian Water Resources and Energy Directorate
<b>PV</b>	Photovoltaic
<b>RES</b>	Renewable energy resources
<b>STEM</b>	Science, Technology, Engineering, and Mathematics
<b>WEM</b>	Wholesale Electricity Market, Ukraine

## Appendix 2 – Information to Interviewees

### Request for participation in research project

«*ENABLE.EU - Social and cultural factors driving energy choices and behaviour*»

#### Background and purpose

We have gained finance from EU to conduct a study of prosumers in (... name of country), to learn what are their motivations to become prosumers, how does this affect their energy practices and the barriers they are facing, and how gender and gender roles, as well as other social and cultural factors play into this. For this purpose we wish to conduct interviews with prosumers to learn from their insights. The study will be conducted in Italy, Norway, UK, Serbia and Ukraine. (name of institutions) will conduct the study in (name of country) We hope you will consider being interviewed for this study. We have recruited informants through (Facebook, organizations, government institutions etc.). We will interview 10-12 households that are prosumers, and since gender and gender roles play a significant part in the study, we wish to interview men and women of the household separately. We will therefore be two interviewers who can do the interviews simultaneously to minimize the time spent of the households being interviewed.

#### What does participation in the study imply?

The interview will take approximately 1 – 1,5 hour. We prefer to conduct the interview in your home to get an impression of the solar PV system and your everyday energy routines. In some cases, we can do the interview other places also if that is preferred. We have made a guide for the interviews that we use, but it is also space for you to bring up issues beyond this, which is of interest to this study. The questions will focus on your motivations to become prosumers, how this has affected energy practices in the household and barriers you have encountered as prosumers. In addition, we will focus on how gender and gender relations have been significant for this. We will take notes during the interview and will request your permission to do sound recording. We will ask for this before the interview starts and will inform you that this is only for internal use in the project and that the recording will be deleted after the project is completed. All households participating will receive a gift card of (...sum in local currency), will be handed over once the interview is finished.

#### What happens to the information concerning you?

All personal information will be treated confidentially and all participants in the study is anonymized throughout the research process and publications. Sound recordings will be deleted after the completion of the project. The project group has access to interview material, but cannot share this outside the group. List of names and contact information used in the recruitment phase will be deleted after interviews unless we ask for permission to contact you again before the completion of the project. No personal information is stored together with sound recordings or interview notes. The project is anticipated to be completed November 2019.

#### Voluntary participation

It is voluntary to participate in the research study and you can withdraw at any time without giving a reason. We will contact you to ask if you would like to participate in an interview. It is the researchers (...names of researchers and their contact info/phone(email) who will contact you.

This study is registered with (...institution that gives ethical clearance or similar).

Best regards,

Name

Institution

## Appendix 3 – Template Diary Form for Interviewees

### Diary Notes (one for each day of the week)

Date:

Type in the coloumns to the right	Woman	Man	Child/Children
Turned of the light before going to work?			
Showered during the day (in minutes)?			
Washed clothes in washing machine?			
Dried clothes in tumble dryer?			
Prepared dinner?			
Checked electricity production of the solar PV system on the inverter?			
Checked electricity production/consumption on PC/App/display?			

Have you discussed energy use or energy production within the family today? If you have, what have you discussed?

.....

Anything you would like to add or write about?

.....