Electricity consumers at risk of marginalization in smart grids

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Preface

This report presents the summary of the project results and recommendations of the project "Smart grid – a future electricity for all?" carried out in cooperation between the department of Technology and Social Change, Linköping University and Umecon AB. The project was carried out between October 2017 to September 2021. This report is written by Ekaterina Tarasova, postdoctoral researcher, at the Division of Technology and Social Change, Department of Thematic Studies Linköping University, e-mail contact ekaterina.tarasova@liu.se.

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1. Introduction

Electricity grids need to be adapted to the changing conditions in the energy systems. They will have to accommodate larger share of intermittent weather-dependent renewable energy sources such as solar and wind energy in future. There are also demands for making electricity consumption more flexible for meeting the goal of energy efficiency. A more efficient electricity use could be achieved by, for example, flattening of daily picks of electricity use during morning and early evening hours. One strategy in climate and energy policy, smart grid development, is deemed to contribute to respond to these challenges. Smart grids, with the most well-known element of smart meters, are expected to provide opportunities to collect information on energy use on a more detailed level and manage electricity load as well as they will allow to accommodate more renewable energy. Smart grids have become an umbrella term for referring to digitalized electricity grids, comprised of a range of technologies, business models, regulations, products, and services. Sweden has been one of the first countries with extensive roll-out of smart meters already in 2009. By 2025, the second generation of smart meters that will be able to collect information about electricity consumption on an even more detailed level are expected to be deployed. When the second generation of smart meters are in place, there will be better opportunities for household users for engage with electricity consumption.

Household consumers are often central in smart grid visions. They are sometimes expected to engage with smart grids and manage their electricity load through using smart energy products and services or by becoming prosumers, contributing to making electricity consumption more efficient. There are also other potential ways of development such as, for instance, making electricity networks more efficient on a systemic level of buildings and districts without direct involvement of households, or combination of both scenarios. Smart grid users are often represented as rational actors that have economic resources and IT skills to engage with smart energy products and services. While using digital products and services for managing electricity load may be less demanding for some households, particularly, those already using digital products and services at home, it may be less familiar or challenging for others and become a burden for them. This project focuses on electricity consumers whose interests and needs may be marginalized or who can become more vulnerable in smart grids.

The project **aims** (a) to identify groups of household users whose interests and needs can be marginalized or neglected when smart grids are developed and implemented, (b) to describe barriers for these groups of electricity consumers from fully benefiting from smart grids, and

(c) to suggest strategies for reducing risks of marginalization of some electricity consumers in smart grids. This report presents an overview of the research findings and recommendations for policymakers, the energy industry, and other relevant actors, specifically focusing on identification of electricity consumers that can be marginalized or become more vulnerable in smart grids. The report also offers a speculation on how marginalization of electricity consumers in smart grids may materialize in practice, on the example of three groups of electricity consumers.

2. Project implementation

The project has been carried out as an interdisciplinary social science study. Empirical material collected in the project is semi-structured interviews with two types of actors, (a) public authorities that work with energy matters, energy industry, test environments for smart grids and housing companies that have been involved in trials of smart energy products and services, and (b) organizations that represent or work with social groups identified as potentially more vulnerable in smart grids (12 and 8 interviews respectively). In total, 20 interviews were conducted from Spring 2018 to Winter 2020. Additionally, two focus groups with electricity consumers that have recently received residence permits or have been living for a while in Sweden, one in Sikfors in September 2018 and another one in Skellefteå in December 2019, were conducted. The initial plan included organization of focus groups with other groups of electricity consumers who have higher risks of becoming marginalized in smart grids. However, that plan was terminated due to limited possibilities to organize focus groups with consumers that are less used to using digital products and services during the covid-19 outbreak.

3. Overview of the project results

- The review of the previous research on smart grid users with focus on consumers that can be marginalized or become more vulnerable in smart grids demonstrated that this literature is limited. Little attention has been paid to how exactly electricity consumers can be marginalized and become vulnerable in smart grids. Most of the previous research has focused on impacts of smart meters, smart energy products and services on elderly and groups with lower incomes. The review suggests that concepts of consumer marginalization and vulnerability in smart grids need to be further defined and discussed.

- Electricity consumers that risk becoming marginalized in smart grids identified in the previous research include electricity consumers that are elderly, with disabilities and health conditions, the ones with lower levels of income and education, sole parents, inhabitants of rural areas, tenants in rented accommodation, immigrants. Material collected for the project shows that the identified social groups are very broad and heterogeneous. Many electricity consumers in identified groups would not experience negative effects of smart energy products and services. It is not possible to make any general conclusions regarding marginalization and vulnerability in smart grids in these groups. Some social groups would be more represented among vulnerable users than others, however, belonging to a certain group is not a core of their vulnerability. It is preferrable to think in terms of conditions and circumstances that may make some electricity consumers more vulnerable and marginalized in smart grids.

- Conditions and circumstances that may make electricity consumers more vulnerable and marginalized in smart grids may occur on structural and individual levels and are summarized in the table below.

Table 1. Conditions and circumstances potentially leading to increased consumer vulnerability and marginalization in smart grids

Structural level	**Individual level**
• Policies and regulations	• Competences and knowledge (digital and energy literacy, Swedish language skills)

• Opportunities for public participation in smart grid development (political decision-making and design practices) • Access to infrastructure (broadband Internet) • Authority to install smart products and services at home	• Economic resources (access to hard- and software and the Internet connection) • Incentives and interest in energy questions and smart energy products and services

- Smart grids and smart energy products and services are expected to diffuse unevenly in society. Some groups will adapt fast to smart energy products and services while it will take more time for others. Uptake of smart energy products and services across society may differ depending on the type of accommodation of electricity consumers. Consumers that live in single-family houses are perceived to have more economic interest and opportunities to install smart energy products and services. Consumers with greater economic interest and technical and digital competences are expected to be frontrunners in adaptation to smart grids. For consumers with less economic incentives and technical and digital competences, smart grids are sometimes expected to come in a different format (products and services managed on the level of buildings, without much consumer engagement). Another difference in adaptation to smart grids is connected to interest in digital products and services and energy matters in general and smart energy products and services in particular. Presence or absence of interest in these issues will play a role for levels of engagement of household consumers in smart grids. Engagement of consumers are expected to vary from limited and no interest in smart energy products and services, to interested but with limited possibilities to use it (limited digital and energy literacy or ability to afford smart energy products or services) and to high levels of interest in smart energy products and services.

- Electricity consumers that can potentially be marginalized or become more vulnerable in smart grids are expected to be affected to different degrees. While it may be somewhat easier to adapt to using smart energy products and services for some household users, others may have much harder time to adapt to them. Electricity consumers that experience two or more conditions and circumstances that may make them marginalized and more vulnerable in smart grids are expected to be affected to a higher degree than

other consumers. Three groups of consumers were often mentioned when respondents were asked to suggest who they think can become more marginalized and vulnerable in smart grids: elderly, rural inhabitants, people with immigration background. Consumers with lower levels of education and income were also mentioned. Consumers that are at the intersection of these groups are perceived to become most vulnerable in smart grids. Groups that seem to be considered as potentially most marginalized in smart grids include elderly rural inhabitants, elderly with immigration background, and consumers with lower levels of income and education. In the next section it is presented how consumers in each of these three groups can be negatively affected in smart grids and what kind of problems they can face when smart grids are rolled out.

4. Examples of potentially marginalized groups of electricity consumers

This section presents three examples of social groups that can be marginalized in smart grids. These three groups are heterogeneous. It is not possible to consider that the entire social groups will be affected in a similar way in smart grids. Those are rather the examples of groups of electricity consumers that may experience a higher risk of marginalization in smart grids. These examples do not constitute a complete typology of groups that can be negatively affected in smart grids.

Elderly rural inhabitants

Electricity consumers in this group can be negatively affected in smart grids in several ways, depending on how the development will unfold. In the scenario when smart energy solutions are implemented on the level of buildings and districts without much consumer involvement, this group will not be affected much, if the costs of new smart meters are not put in electricity consumer bills. Elderly and households with lower income may be less economically resourceful than other social groups so any additional economic costs related to smart grids may be a burden for them. In case costs of new smart meters become a part of electricity bills, household budgets may be negatively affected as well as if consumers are asked to pay upfront for new meters. Upfront payments for new smart meters installations though seem unlikely as it was not done this way when the first generation of smart meters was rolled out in Sweden.

If the situation with smart grid development also includes introduction of flexible tariffs on electricity which is a plausible development since new types of smart meters will give opportunities to provide more detailed information on information consumption, this group may experience negative consequences in terms of increased electricity costs and limited opportunities to control these costs. If houses are improper insulated, electricity consumption is inefficient and higher than it could have been otherwise. It would hardly help electricity consumers with improper insulated houses to adjust electricity consumption to time periods during the day beyond the peaks of electricity consumption because even if electricity consumption goes down, heating during winter would still require excessive amounts of electricity, regardless time of day. Electricity heating is more common in single-family houses than in other kinds of accommodation. It may be economically unreasonable to invest in house insulation if economic value of property is low which is more often the case in rural areas.

Elderly consumers may have less opportunities to insulate houses themselves. Besides, elderly consumers living in rural areas may be cut off from services of energy advisers provided by municipalities due to limited ability to commute to centers of municipalities to meet energy advisers physically or to interact with them through digital channels due to limited digital literacy. Necessity to adjust daily routines that involves using electricity to flexible tariffs may be more burdensome for elderly electricity consumers.

Introduction of flexible tariffs may lead to increased supply of different smart energy products and services that help to reduce electricity costs and to diversification of electricity contacts with energy companies. The group of elderly rural inhabitants may not be able to take advantage of these opportunities due to limited access to high-speed Internet required for proper functioning of such products and services in some rural areas as well as less interest and engagement in these products and services due to generally less usage of digital products and services among elderly. Less interest in digital products and services may lead to lack of willingness to invest in better Internet connection.

They may also have less opportunities to benefit from choosing another deal with energy companies because much of the information and opportunities are presented on the webpages of energy companies. Phone calls to energy companies may not be an effective way to get to know about all possibilities that energy companies would have to offer. Lack of a bank ID which is more spread among elderly than in other social groups may reduce opportunities to change energy contracts by electricity consumers themselves. This group may have less access to digital devices that could be necessary for using smart energy products and services. They may also be more vulnerable to digital security threats due to limited digital literacy. Vulnerability in the group of elderly rural inhabitants in smart grids may be intensified due to harder time to overcome the problems related to matters of digitalization because living remotely they may have less opportunities to commute to centers of municipality for getting digital help, for instance, offered by the libraries.

Elderly with immigration background

Electricity consumers that are elderly with immigration background may be negatively affected in smart grids in similar ways as elderly rural inhabitants. Most of the challenges are connected to increased costs of electricity and digitalization in the energy sector. Specific challenges for this group of consumers may associate with potentially limited proficiency in Swedish language and limited knowledge of Swedish electricity markets. If costs of new smart meters are included in the electricity bills or consumers are asked to pay upfront for them, it could be an additional economic burden for households in this group as well.

If flexible tariffs are introduced, elderly with immigration background may have less opportunities to adjust to this change and to take advantage of it due to potentially limited Swedish language skills and limited understanding of Swedish electricity markets. They may be less informed about this change and its consequences and less prepared to reduce risks of paying more for the same amount of electricity than before. Since this group includes elderly consumers, it may also be more challenging for consumers in this group to accommodate their daily electricity intensive routines to new situation with flexible electricity costs. Electricity consumers in this group that live in rented apartments may be affected by the decisions of housing companies to try out smart energy products and services. For instance, it may result in increased housing bills if housing companies decide to install smart energy devices in rented apartments and costs of these installations are passed on to tenants. Although these points are not specific to people with immigration background but extends to all elderly that live in rented apartments, people that immigrated to Sweden tend to live in rented apartments to a higher extent than those born in Sweden.

If introduction of flexible tariffs give rise to development of various energy contracts, elderly with immigration background may be less able to switch to a more profitable contract for them due to potentially limited Swedish language skills and limited knowledge of Swedish electricity markets and understanding of how electricity billing is organized in Sweden. Social groups that are less economically resourceful who potentially are most interested in saving on electricity costs may be less able to profit from new energy contracts enabled by smart grids. Challenges related to using digital products and services are the same in this group of consumers as in the one above, as they are more common for elderly in general.

Consumers with lower levels of income and education

Consumers with lower levels of income and education may benefit less from smart grids. Consumers in this group may be aware of opportunities to save on electricity costs using these products and services, however, without much opportunity to invest in these products and services. Consumers with less experience of comparing different contracts may have lower chances of choosing electricity contract that suits their needs and less understanding of benefits from using smart energy products and services. Due to these factors, they may not be able to benefit economically from smart grids to the same extent as other social groups.

In case costs for smart energy products and services are included in housing bills in rented apartments, which is also a more typical kind of accommodation for consumers with lower income, chances of consumers in these groups to rent such an apartment may decrease.

Consumers with lower levels of income are also one of several groups that tend to have lower levels of social trust which may extend to adaptation of smart energy products and services. They may be less compelled to install and use smart energy products and services. For instance, if they become aware about how much data about a household is gathered through these products and services, they may not be interested in installation of these products and services as it may be associated with social control. This however may not be specific for this group.

Potential consequences

If risks of marginalization of some groups of electricity consumers are not considered in smart grid development and actions to reduce risks are not introduced, rural peripheralization may intensify as well as inequalities between consumers with different levels of income can potentially increase.

5. Recommendations

For regulatory authorities

- Launch information campaigns targeting different social groups for motivating electricity users to change energy behavior to a more sustainable one, including explanations why it matters and why change is needed, how it works and how it can improve people's lives.
- In case flexible tariffs are introduced, ensure that there are sufficient incentives for electricity consumers for adjusting their daily use of electricity.
- In case flexible tariffs are introduced, carry out an information campaign about this change that specifically target social groups that risk being marginalized in smart grids, including those with less knowledge of Swedish language and understanding of how Swedish electricity markets operate.

For energy companies

- In case costs of new smart meters are passed on to electricity consumers, make them visible in electricity bills and provide different options for consumers to pay for them.
- In case flexible tariffs are introduced, make sure that information about tariffs is available through different media and in easy Swedish (lättsvenska).

For technology/service providers (smart grid related products and services)

- Configurate smart energy products and services in such a way that they can accommodate different levels of digital competences, interest, and motivation to use them.
- Follow principles of universal design in creating new smart energy products and services which will contribute to their accessibility.
- Diversify enrolment of electricity consumers and include specifically groups that risk being marginalized in smart grids that take part in tests and trials of smart energy products and services.
- Invite organizations that represent or work with social groups that risk being marginalized in smart grids to cooperate in development of smart energy products and services.

For test environments

- Encourage focus on diverse consumer perspectives in smart grid development, including most vulnerable groups, in calls for research projects that can be carried out at a test environment.

For housing companies that test smart energy products and services

- Calculate and take into consideration how installation of smart energy products and services in apartments may affect most vulnerable groups of tenants economically as well as in terms of their access to rented apartments.

For municipalities

- Organize services of digital help and energy advisors in such a way that they are available even in remote areas, e.g., through temporary visits to these areas.
- Organize proactive programs of reaching out to consumer groups that can be marginalized in smart grids, specifically, for increasing energy literacy and raising awareness about smart energy products and service.