Customers' Willingness and Ability to Offer Flexibility

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TABLE OF CONTENTS

1 Introduction

Executive summary

This report contains two evaluations related to customer acceptance of flexible consumption. First, we evaluate private households' acceptance of offering flexibility to the electricity system. Second, we discuss the possibilities and challenges identified in the municipality of Horsens regarding their acceptance of flexible consumption. The first part focuses on the abilities and willingness of consumers at Bornholm. These evaluations are based upon qualitative interviews with EcoGrid 2.0 participants in their homes, observations during technical repair work and workshops organized by Bornholm Energi og Forsyning. The second part draws on interviews with municipal actors from Horsens to introduce an organizational perspective on flexible consumption.

This report presents the final evaluation of customers' acceptance of offering flexibility to the electricity system. We distinguish between two groups of customers, namely private households and municipal actors. Our evaluation of the participants' acceptance involves two aspects, namely willingness and ability. It is clear from our past and current fieldwork (e.g. Jenle & Pallesen, 2017; Pallesen & Jenle, 2018; Pallesen & Jacobsen, 2018) that many users have developed knowledge, skills and equipment (ability), but lack interest or motivation (willingness) to act as flexible consumers. Therefore, we see acceptance as being constituted by both willingness and ability.

A key challenge when involving end consumers in the provision of flexibility is that the need for demand response is a system need—not a consumer need per se. While many consumers are highly knowledgeable about their personal heating arrangements and their electricity consumption in general, they are often largely unaware of the workings of the system. Expecting consumers to readily 'put their home at the disposal of the system', as one participant put it—or delegate control over their heat to external (most likely commercial) actors—may require some work in terms of establishing trust and make the arrangements mutually beneficial to households and aggregators alike.

In EcoGrid 2.0, the suggested arrangement takes the form of a market arrangement. This adds a series of challenges of its own. First, it implies that consumers will have to freely choose to become flexible. Second, it implies that the general value dominating the arrangement is a monetary one, i.e. quite unlike the EcoGrid setup, consumers will expect some kind of

compensation for delivering flexibility. Third, future aggregators will have to develop services or products capable of ‘adding value’ to customers, and not ‘simply’ deliver flexibility to the system.

In the following, we start by introducing the methods and data used in this report. We then present findings related to private households’ acceptance of flexible consumption: we introduce the aggregator products, the role of technicians work, and the importance of trust and the island as a socio-political context to the demonstration. We then present the findings from Horsens, discussing concerns for organizational actors faced with flexible consumption.

2 Methods

In this section, we provide a brief overview of our methods and data. Data have been produced in the course of the three heating seasons of EcoGrid 2.0.

This evaluation is based on qualitative data from multiple sources: interviews with participants in their homes, observations from the homes of consumers, interviews in Bornholms Energi og Forsyning´s (BEOF's) 'user panels', emails from participants send to BOEF following the launch of the web portal and the products, input from BOEF and log-in data from the web portal generated by Uptime (one of the nine partners of EcoGrid 2.0). Below we briefly discuss these methods—and how they frame the study of customer acceptance in EcoGrid 2.0. The majority of our data consist of interviews and observations in consumers' homes, and the aim has been to produce insights into the ways in which users act with and think about flexible consumption. Few interviews were conducted in Villa Smart (a demonstration house owned by BEOF), but the majority was conducted in the homes of consumers. All observations were conducted in the homes of consumers. The reason for adopting this approach, i.e. to study consumers in their homes, is first and foremost to get detailed and situated knowledge about the practices of consumers vis-à-vis flexibility.

Qualitative studies of customer acceptance and willingness

Qualitative methods are particularly advantageous when the objective is of exploratory nature. In general studying everyday energy consumption is not straightforward: energy is not consumed for its own sake, but rather part of nearly all mundane, daily practices, such as laundry, cooking, watching TV etc. (Shove & Walker, 2014). Different forms of qualitative studies have been used in the evaluation of other smart grid projects, such as EcoGrid EU (Pallesen & Jenle, 2018), eFlex (Nyborg & Røpke, 2013) and DREAM (Svanborg & Aarup, 2014). Qualitative methods can help explain how consumers everyday practices are related to the use of electricity and heat consumption (Gram-Hanssen, 2010).

Our qualitative approach gives insights into the ways users interact and participate in EcoGrid 2.0, how they account for their choice of products, and their motives for participating. The aggregator products (introduced by aggregators to consumers) are important to the specific "script" in EcoGrid 2.0. A script can be defined as the expectations of the system designer, designed into the system – in this situation, the smart grid.

A recent comparative analysis of 11 Danish smart grid projects (Hansen & Borup, 2017) points to three main dimensions of scripts developed across smart grid projects: (1) economic incentives, (2) automation and (3) information/visualization. According to Hansen and Borup, EcoGrid EU and eFlex include all three dimensions and therefore they provide the most complex information and feedback to consumers. In our interviews during second heating season, we asked participants that had chosen a product 1) how they made their choice, and 2)

what effects they expect their choice to have. This allows us to better grasp if and how misunderstandings occur.

The script in EcoGrid 2.0 is different (and more complex) than most other smart grid projects mentioned above because of the consumers' relation to the aggregator. Most smart grid-projects have introduced scripts that attempt to activate consumers through variable prices, e.g. EcoGrid EU. Research on how price/economic incentives make consumers able and willing to participate in smart grids has been conducted through interviews and observations taking place in consumers' homes in e.g. eFlex (Nyborg and Røbke, 2013) and EcoGrid EU (Pallesen and Jenle, 2018).

When Nyborg (Nyborg, 2015) studied the Danish smart grid experiment eFlex, she used the concept of "domestication" to explain how each household developed its own ways to integrate the new smart grid equipment within the household practices. Home visits helped Nyborg to study how everyday practices are performed and created in the smart grid (p. 58). Nyborg argues that a household consists of a number of social practices such as 'cooking', 'playing soccer', 'shopping' or 'googling' (ibid. p. 57). In activities – such as cooking - different elements are linked such as artefacts, bodily movements, meaning and know how.

2.1.1 Observations during home visits

We followed technicians working at BEOF during their service visits to participants' homes. These 'home visits' were usually organized around specific tasks, such as repair devices or install equipment. During these visits, we observed interactions between technicians and consumers as well as the repair work conducted. The visits lasted between 20 minutes and 6 hours, depending on the technician's task.

The 'home visit' was our initial strategy for collecting data in the private households, and it had a double focus. First, it allowed us to observe the technician's work as a situated, problem-solving activity evolving in a complex relationship between technician, users and technology. Second, we used the occasion to get access to participants, and interview users about their consumption practices (Shove & Walker, 2014). Arriving at participants' homes in the company of the technician made interactions with participants easier, because they were familiar with the technicians and the 'repair situation'.

As we observed the technicians work over time, we became increasingly aware of what we define the 'invisible' aspects of their work (Pallesen & Jacobsen, 2018); during the household visits, technician's did far more than simply get users back online or repair their devices. They also trained, instructed and assisted the users, and convinced some not to leave the project. Our access to different contexts over the course of the demonstration (technicians everyday work, meetings and workshops for users) gave us the opportunity to identify categories of work that are invisible, e.g. to project partners, and how the visibility of the work performed in the households changed over time. Our ethnographic study in the different contexts made it clear that the evaluation of the support work performed during each home visit could not simply be evaluated as successful in relation to bringing the household back online in technical terms.

2.1.2 Household interviews

During the three heating seasons we have conducted 75 semi-structured interviews with close to 100 consumers participating in the demonstration (see appendix 1 for an overview of the collected data). Of these, 38 interviews were conducted during the technicians' service visits. Interviews conducted during the first heating season were framed towards a detailed description of participants practices and preferences vis-à-vis flexible consumption. Based on these interviews – together with observations from service visits – we categorized ideal types of users. These were input for the work of designing products to the consumers.

Another 16 interviews (with 22 participations) were conducted in heating season two around the topic of customers' acceptance of products. These 16 interviews were conducted in the homes of the consumers or at their work place. The 22 participants were selected and recruited as a part of a specific evaluation of the products which were launched as part of the web page. The criteria for this selection was discussed and decided on with the partners in WP6 to secure that we interviewed consumers that had chosen different products. The 22 participants across 16 households had chosen the following products:

Standard (Greenwave/IBM)	4
Økonomivenlig (Greenwave/IBM)	4
Klimavenlig (Greenwave/IBM)	1
Klimavenlig Plus (GW)	2
Basispakken (Siemens/Insero)	2
Sparepakken (Siemens/Insero)	2
Miljøpakken (Siemens/Insero)	1
Fællsesskabspakken (Siemens/Insero)	0

Table 1: Selected households and products in heating season two

When we interviewed and evaluated customers' acceptance of the products, our aim was to study how they understood the products, as well as their reflections about the expected effects of a given product on their household. We asked questions like: "Now you have chosen this product, what do you think will happen?" For the interviews, we brought the product descriptions and asked consumers to describe and explain their choice. We also asked them if they considered any of the other products. If they had 'used' the products and the web portal, we asked them to explain how, e.g. asking: "Can you explain how you use the web portal?" and "How do you understand the visualizations?" (Jacobsen and Pallesen, 2018).

2.1.3 User panel and inputs from BEOF

We participated in two user panels organized by BEOF in Villa Smart. The purpose of these panels was to get inputs from consumers on the products and the design of the web portal. The

user panels were organized and managed by BEOF's project manager and we participated as observers.

2.1.4 Interviews during design of products

Together with the BEOF project manager we interviewed three consumers about an early version of the design of the web portal. These interviews gave us insights from consumers on products while they these were still being developed.

2.1.5 Emails from consumers to BEOF

Following the launch of web portal and portals, many participants contacted BEOF. To include these consumer reactions in the evaluation, we have included 68 emails (between Marts 2 and April 4) from participants in the evaluation. Mostly, these report technical issues such as login problems, missing graphs and general feedback, such as the content of the webpage. Others react to the communication of the products.

3 Private households, Bornholm

3.1 Introduction: Aggregator products

The market setup tested in EcoGrid 2.0 implies that retail electricity consumers must voluntarily choose to become flexible consumers. Meanwhile, demand for flexibility is obviously an articulation of a system need—not a consumer need—and the studies of users conducted in EcoGrid 2.0 demonstrate that flexibility remains an abstract concept to most end consumers. Therefore, EcoGrid 2.0 have tested whether generic consumer products, offered by the aggregators, could make consumers willing to let aggregators control their heat. To test this, the products developed were to add value to consumers and to translate flexibility into something recognizable for the consumer (in EcoGrid 2.0 it was not possible to offer consumers any monetary compensation).

In heating season two, three different products were tested: a CO2 product, an Economy product and a Community product. For simplicity, and because only few had chosen the Community product, two generic customer products were offered in heating season three: a CO2 product and an Economy product. In addition, a third product, Basis, allowed users to remain part of the project, yet minimizing the interventions in their household (the Basis product was set as default) (Jørgensen & Buhler, 2019). The ambition was to make it easy for users to allow aggregators to take control of the households' heat and make it valuable to users. The two generic products thus presented the following 'value propositions':

- Support the green transition: This CO2 product offers optimization of the household's energy used for heating based on CO_2 emissions.
- Optimize household costs: The Economy product offers optimization of the household's energy used for heating based on electricity prices.

The products were made 'available' in a web portal developed early in the project (D 6.1.5 products to household) to make it easy for users to make their choice. In heating season three, IBM hosted the CO2 product, and Insero the Economy product. The two aggregators were, however, not recognizable or even visible to users; i.e. the two products were presented as if offered by one single provider.

The product definition was partly based on the qualitative study of user behavior conducted in heating season one (Jacobsen & Pallesen, 2017). Based on qualitative interviews and observations, five different types of user behaviour were identified: 1) fitting heat to routines, 2) economizing routines, 3) routinized behaviour, 4) experimental behaviour, and 5) responsible behaviour. This study formed the basis for defining products as well as indicating possible value adding features in the web portal, such as consumption data, 'opt out' function etc.

Products were introduced and described to consumers via newsletters sent out by BEOF and via the web portal where they would be faced with an option to choose a product when they logged in at the beginning of heating season two. Also, the consumers were introduced to aggregator products via traditional newsletters sent out by BEOF. The newsletters described the products using written content. In heating season three the customers were asked to change products. To help them do so, the project partners changed the product introductions in newsletters from being based on written introductions to visual content which showed customers the benefits of changing products in ways that customers could relate to, e.g. how many cups of coffee would they save if changing the product etc.

Status Marts 21		**Status April 4**	
Økonomivenlig/Economy	77	Økonomivenlig/Economy	112
Klimavenlig/CO_2	15	Klimavenlig/ CO_2	20
Klimavenlig Plus/CO_2	7	Klimavenlig Plus/ CO_2	12
Sparepakken/Economy	22	Sparepakken/Economy	30
Miljøpakken/CO_2	5	Miljøpakken/ CO_2	4
Fællesskabspakken	2	Fællesskabspakken	3
Standard	347	Standard	302
Basispakken	286	Basispakken	278

Table 2: Statistics - consumer choice of products (second heating season)

During heating season two, only 25% of the participants actively choose one of the generic products (CO_2 or Economy). This means that 75% of the households got the Basis product by default. The aim in heating season three was to test whether the remaining 75% could be made to actively choose either the CO_2 or Economy product. To activate consumers in heating season three, two types of emails were designed drawing on nudge theory and cognitive psychology. Through simple and visual information, consumers were introduced to the benefits of the two products. These benefits were related to effects on the community, the environment or the household's financial situation respectively. Following two rounds of emails, 27% of the participants who, in heating season two was given the Basis product by default, actively choose a new product. This small email-intervention lead to an overall increase in the share of Economy products by 33% and for the CO_2 product the increase was 70%. In addition, the opening rate on emails framed around the environmental benefits was 16% higher than the opening rate of emails framed around financial benefits.

Overall, consumers described their choice of a generic product as rather intuitive, i.e. they were able to recognize and relate to the products (Jacobsen and Pallesen, 2018). Nevertheless, the generic products in themselves, as designed within the scope of EcoGrid 2.0, did not add value to the vast majority of the consumers. However, community, economic and environmental values are important for nearly all participants, and it is not unlikely that such generic products could be developed in other contexts, which could be valuable to consumers. Many participants

were indeed very compliant—they chose a product when asked to and accepted tests in their households.

3.2 Aggregator products and household practices

The aggregator products were designed in the second phase of the demonstration to test how to best get users interested in an arrangement supporting user flexibility. The products were designed to provide users with data and to optimize their consumption according to price signals and/or reduction in $C0_2$ emission. A general observation from EcoGrid 2.0 is that nearly none of the consumers interviewed related to flexibility in any direct way. Some consumers have developed new practices and routines from taking part in EcoGrid EU, but only rarely are these practices and routines related in any direct way to flexible consumption (Jacobsen & Pallesen, 2017). The question 'how to make consumers an active and predictable component in balancing the system' therefore remains intriguing, yet challenging. In the following, we shortly illustrate how users understand, act and accept the aggregator products that translates price signals or $C0_2$ reduction from the system.

First, most users wanted to remain passive EcoGrid participants, and they chose a standard aggregator product that did not allow the aggregator to control their heat according to price signals or $C0_2$ emissions, because they did not want any further interaction with the project besides being a part of the demonstration:

> "I have chosen "Basispakken" (…) I thought that with Basispakken I will not hurt anyone (…) I'm interested in the idea in EcoGrid, but I'm not interested in spending time on it"

User's motivations, reported during interviews, for choosing an economic product is (1) save money, and (2) learn about the household's consumption – often to be able to reduce electricity consumption. First, saving money on the electric bill is the overall motivation for the participants. They would for instance say:

> "We just want to use as little electricity as possible".

Or:

> "We would like to be able to save some money on the electricity bill".

Second, visualizations of the household consumption is also motivating for some, as a way to get feedback and knowledge about possible optimizations of the household's consumption. Users, interested in reducing their electricity bill, use data to change appliances, insulation etc. Economic reasoning is, however, not just about changing appliances and renovating the house. Some users tell that they have changed routines as part of their participation in EcoGrid EU, such as: 'we use a timer to do laundry at night'. Some associated these changed practices with a lover electricity bill. Several argued that participating in EcoGrid helped them reduce their electricity bill.

A minor group of users also chose the climate/environmental product (see table 2). These users will go far to reduce CO_2 emission, and simply accept to put on a sweater if temperature drop. However, generally participants opting for the climate product stressed that their comfort limits would have to be respected. As an example, the user we quote below knows the comfort limits

inside her house very well, and she points out how she and her husband are affected by weather conditions and the EcoGrid tests.

> "We have chosen "Klimavenlig" that lets EcoGrid turn off the heat pump…. When the wind hits us from northeast, then the extra-insulation (of the house) is not helping us – it is not top-insulated, and a house like this will never be that. Therefore – Klimavenlig Plus – I guess that is too cold – we simply experienced that it becomes too cold, but we would like to support the project and personally I think that is important that we get some experiences about how to avoid using fossil fuel. But we don't want to be cold. If we had a new house we would choose 'Klimavenlig Plus'. But we do feel when they are testing in the evening. We can feel the pipes getting cold, and with the wind, the house quickly becomes cold. We can also see it on the heat pump when they are testing."

This user will let the aggregator control her heating to support the CO_2 reduction from the household. The user explains why she cannot choose the most 'aggressive' environmental product. She does not care much for the economic aspects as long as she can support a CO_2 reduction.

Despite many participants mentioned the reduction of CO_2 as a motive for taking part in the project, only few decided to let the aggregator control their heat according to CO_2.

3.3 Abilities, willingness and technical/support work

Users' abilities and willingness are complex and consist of a mix of multiple socio-material factors. First, users differ in abilities such as education, skills to operate a PC etc. Second, the characteristics of their homes vary (type of heating appliances, insulation, number of rooms etc.). Third, their motivation (how willing are they to change behaviour), and fourth, the kind of life lived (life with kids, working at night etc.) should be taken into account when considering to make them flexible users. In other words, for households to become a resource in the aggregator's portfolio, diverse socio-material factors may need attention.

In EcoGrid 2.0, the local technicians from BEOF have played a key role in assisting and forming both the abilities and the willingness of the participants (See also Pallesen and Jacobsen, 2018). For instance, they have continuously 'pushed' the user to the personal website, explained the demonstration and assisted users in multiple ways. Below, we point to important moments during which technicians have importantly influenced the users' willingness and abilities.

Most home visits were conducted to repair smart meters or reestablish connection to the house. At other times, however, technicians were confronted with situations that were not caused by technical failures—and often, these were more complicated to repair than technical ones. These often involved 'repairing' users. To illustrate, we visited a rental apartment which had received 18 visits during the demonstration. Every time, the problem had been the same: someone had turned off the equipment. Tenants would come and go without learning the EcoGrid system and its role in the apartment. The technician had called the owner to try to prevent going to the apartment again, but now he decided to try something new: to put up small notes on the installation itself, reminding tenants not to turn off the equipment. In situations like this, it is the user who is 'fixed' rather than the technology.

A key, yet underappreciated task conducted by the local technicians, is the extent to which they communicate what the demonstration is really about to users. All users have signed contracts and received extensive information concerning the demonstration, yet many users have no idea that they have delegated control of their heat to external parties. Here too, the technicians perform a crucial task: they explain the demonstration to users, and they connect the electricity system to social practices in the private homes of users. An example from a home visit illustrates this: here, the technician must explain the very basics of the demonstration, to a puzzled participant, who never realized what she signed up for:

> Technician: … and I connect it here, because then we can better turn you on and off.
> User: turn us off?
> Technician: yes, like turn off your heat….
> User: but… but we do *not* want you to control our heat!
> Technician: well, but that is kind of what the whole experiment is about.
> User: we may have overlooked this.
> Technician: it is not like we control your heat as such. But when the grid is congested, then we buy our electricity from Sweden… or we need to produce it.
> User: I see.
> Technician: then we turn you off for a little while. And you have granted us permission to do so.
> User: ok, I see.
> Technician: over a period of say two hours, we may 'steal' 15 minutes

In situations such as these, the technicians educate users at the same time as they make them stay onboard; whereas training sessions are clearly oriented towards helping users become flexible, they also serve as motivation for the users to stay part of the demonstration. Failing equipment, disappointment in the offered functionalities or simply lack of interest prompts some users to leave the demonstration. Here, the technicians play an important role in 'convincing' users to stay onboard.

Also, in several situations during home visits we observed electricians guiding consumers not only practically about 'where' (on the website) to define the intervals, but also in terms of the specific temperatures suitable to the life lived in the home. The majority of the users do not revisit or change the temperature intervals once set by the technicians at the moment of installing the equipment.

What our observations have demonstrated is that in an otherwise automated system as EcoGrid 2.0 needs constant attention: the repair work of both technologies and users have been involved intensive work. This work was conducted by technicians and the local support team. Making consumers flexible has, in the case of EcoGrid 2.0, required much attention and work from the electricity provider, but just as importantly, they have played a crucial role in generating trust between actors, what we treat in more depth in the following.

3.4 Trust and the 'social contract'

EcoGrid 2.0, apart from providing flexible consumption, also adds to the growing digitalization of the sector. Whereas the stability of digitalized solutions are likely to increase, our observations

illustrates that often, what ties together the technical system and the user, is the intensive work of the local technicians. Mundane and everyday interactions between technicians, support team and the users continuously strengthen users' abilities to operate the system, but just as importantly, these interactions reinforces the trust users have in the local technicians, and/or BEOF.

Trust in your electricity provider may not be the first characteristic that comes to mind in relation to the energy sector, but it does appear to characterize EcoGrid-participants on Bornholm. In a situation, in which users are asked to delegate control of their heat to commercial actors, trust is likely to become a key issue. User concerns – and thus also their willingness – relates to data privacy, respect for the household's comfort, and the distribution of profits generated from trading with flexibility. Trusting that data is kept private, comfort limits are respected and profits equally distributed may not come easily.

In EcoGrid 2.0, the users' willingness to participate is premised by the trust in the increasingly personal relationship build between them and technicians. Users know they can call staff from the local energy supplier if, or when, they have a problem with the equipment. And the service is free of charge. Also, many potentially critical questions never get raised, because "we trust them". With "them", users refer to technicians and their colleagues at the local utility. This trust implies accepting that participation in the experiment may involve increased energy consumption, as illustrated in the following example: A user called one of the technicians, because he could detect an increase in the consumption in his currently empty summer house. He asked the technician to figure out if there was a problem. The technician could inform the user that the house was currently used for testing, and the test was the reason for the increase in consumption. The user simply accepted the increase in his energy consumption.

Knowing and trusting your technician eventually also related to the local setting: taking part in EcoGrid 2.0 is, for most participants, a way of supporting the island. The demonstration is situated in a very distinct geographical and cultural-political setting (Chilvers & Kearnes, 2016), which is may be representative of the rest of the country in some respects, but quite unlike it in many others.

3.5 The Bright Green Island

EcoGrid 2.0 fits into Bornholm's strategy of being a bright green island, reducing CO_2 emissions and being a platform for the development of new green (energy) technologies. Most participants associate EcoGrid 2.0 with a green transition, though they may not know exactly in what way.

When interviewed, participants usually stress the importance of the demonstration to the island: e.g. 'we want to help make Bornholm a role model', or 'I want to help put Bornholm on the map'. Their participation demonstrates a commitment to the island – not a commitment or an interest in becoming a flexible consumer. When they explain their participation, it always connects to the island: 'It is exciting that we can have this kind of project here at Bornholm. That reason alone makes me sign up', or 'we just want to support a broader recognition of the island'. Site is, in other words, crucial: the fact that the demonstration takes place at Bornholm means everything to the participants—they support the island and the local utility. Just as in the case another Danish green energy island, Samsø, the local support is first and foremost a way of securing the survival—and pride—of the island (Papazu, 2018).

This desire to support the island forms the willingness of the EcoGrid participants. It does, however, make the direct scalability and commercialization of the setup more questionable – it is not everywhere in Denmark, where consumers are so engaged in their local community. Meanwhile, it suggests that a strong anchor in local communities may be important to engage users: not only because users may be familiar with those acting as aggregators, but also because familiar narratives may be mobilized to support the idea of flexible consumption. For instance, stories of the sea cable connecting Bornholm to Sweden being cut, was often mobilized to explain the ideas of EcoGrid.

3.6 Summary

Overall, EcoGrid 2.0 have demonstrated that users accept to be transformed into flexible consumers. This finding has, in the pages above, been further qualified. To recap, the local technicians play a central role. Their work may be seen as important in at least three different ways: first, they adjust the technologies to user needs, as illustrated in previous reports. Second, they provide a high level of service and assistance, often far beyond what could be expected. Third, many users have volunteered for the demonstration to support the island – not because they are interested in energy issues or 'becoming flexible users' - being local 'islanders', the technicians are seen as an embodiment of the ties to the island and the local community, and they use these ties to engage people and sometime retain them in the demonstration.

As indicated several times, it is rather difficult to make conclusions regarding the willingness of participants. Their willingness to comply to the script may primarily be an effect of a local 'community' feeling, i.e. to support the island and help reproduce a strong identity for Bornholm. Without this local setting, it is quite likely that consumers' willingness would be different. The participants know that the setting is a demonstration project. This is an inherent challenge to the demonstration; on one hand, the project need a setting in which the households may be convinced to take part. On the other hand, this challenges the transferability and scalability of the results. However, towards the end of our interviews we asked the EcoGrid participants if they would consider engaging with an aggregator after the demonstration, and most of the participants answered that they most likely would do so if they got a good/valuable offer.

4 Municipality and municipal institutions, Horsens

This part of the evaluation contributes with an 'organizational' perspective on actor's willingness and abilities to offer flexibility to an aggregator. Interviews were conducted with the involved aggregator's main contact in Horsens municipality working in the Ejendomscenter, as well as the two janitors at Hatting school and Nim School in the spring 2019. The aggregator controls heat pumps at the test sites in Horsens, including the two schools (to learn more about the technical arrangement, see Jørgensen, Weber and Andersen, 2019). The aim here is to discuss the municipality's willingness and abilities to deliver flexibility through specific municipal institutions, such as schools or retirement homes.

Horsens municipality is a so-called 'climate municipality' and accordingly they have an obligation to reduce their CO_2 emission by 2 % every year. They do, however, aim to be even more ambitious and reduce even more than the targeted two percent. Flexibility could become a means to achieve more ambitious targets.

Access to buildings and heat pumps

Horsens municipality has a general strategy to support and develop the green transition to reduce CO_2 from their 300 buildings. The municipality conducts several projects with the concerned aggregator, Insero, who is a local company. The municipality has a particular interest in supporting a local and familiar company, and is therefore willing to let the company get access to buildings to perform their EcoGrid tests.

Insero have access to heat pumps in 13 of the municipality's buildings through their Best Green project. The Best Green solution provides large heat pumps installed in buildings located outside the district heating infrastructure in the municipality. To the municipality, the heat pump solution is an alternative to district heating. The Best Green solutions are described as hybrid solutions (see also see also Jørgensen, Weber and Andersen, 2019) where heat pumps are the main heating source, supplemented by gas. Before the heat pumps were installed, the buildings were heated by gas ovens. Best Green install, maintain and control the heat pumps and the municipality pay for each KWH used in the buildings. The municipality does not have anything to do with practicalities related to running and controlling the heat pumps – this is the responsibility of Best Green. In the selected buildings, in average 85 % of the heat is generated by the heat pumps. The hybrid solution contributes to the 2 % yearly reduction of CO_2 reduction.

Centralized decision making and the institutional context

Engaging municipalities in the generation of flexible consumption is obviously interesting, as they often own and operate many and large buildings. However, the concerns and challenges

differ markedly from those encountered among private households. For example, the municipality will be making decisions on behalf of others, i.e. employees and users of their buildings. Therefore, they may need to pay close attention to the specific institutional characteristics and needs. In the Best Green setup, three types of institutions were distinguished, namely schools, retirement homes and daycare (vuggestuer/børnehave). In general, the municipality seemed concerned to compromise the institutions' comfort. Restrictions vis-à-vis comfort levels were, however, defined in relation to types of institution:

- The ***schools*** have fewest restrictions. In general, tests were to be restricted to hours outside normal school day.

- In ***daycare/nursery*** no tests can be performed during weekdays, because children often play at the floor during daytime. Therefore, tests cannot be performed that will result in cold floors in these buildings

- ***Eldercare facilities (plejehjem)*** are taken out of the test group. People living here pay rent and heat themselves and they, contrary to the two other types of institutions, are to be seen as being 'at home'. Therefore, decisions possibly affecting their comfort cannot be taken by the municipality

Because the schools were exposed to the most intensive testing, we interviewed janitors from two schools.

Nim and Hatting school

Surprisingly, none of the janitors had been informed, that they were made flexible consumers – or that Insero were conducting tests on their heat pumps. If and how their respective institutions could provide flexibility was therefore not a familiar idea to them. Both perceived the Best Green solution as an alternative to district heating – and one school expected to eventually get connected to the expanding district heating infrastructure. In other words, Best Green was only a temporary solution. In both schools, the heat pumps replaced gas-driven heating solutions – and both janitors appreciated the electrification of the schools' heating system.

Their experiences differed some in relation to comfort in the two schools:

- School A: a few times, during very cold periods, the janitor had experienced that the heat pumps did not generate enough heat. He had been confronted by staff, i.e. teachers, who asked him to fix the problem. It is quite likely that these situations were unrelated to testing by Insero, but caused by something else, e.g. very cold weather. However, when asked about the schools heat pumps, these were the narratives provided.

  The janitor recognized that for the solution (Best Green) to be viable, it could mean brief periods in which comfort would be affected.

- School B: the janitor had not noticed that comfort had been compromised. He informed us that he had, shortly after the installation of Best Green, insisted that the comfort levels should be raised. He was very concerned about comfort levels: 'kids always

leave the doors open, so the heat must run continuously' implying that he would not accept flexible consumption during school day.

Both janitors pointed to the more dynamic and extended use of the schools: a potential flexibility would need to take into account the use of the school for other purposes that teaching Monday through Friday. Often, schools are used for other activities during evenings and weekends, and these activities would be necessary to signal to a possible future aggregator (this point was raised by both janitors, but only after having been told about the testing performed by the aggregator).

In summary

The municipality is willing to contribute to the project, but quite as in the case of the private households in Bornholm, their acceptance is not necessarily related to the idea of flexible consumption. They are happy to let the aggregator perform test in their buildings, but the main motivation seems to be 1) the support of a local company, 2) a broader interest in investigating solutions as a part of being a 'Klima kommune', and 3) a general interest in sustainability. The willingness of the municipality may however be different from that of the janitors, the users and the employees. Some indications were given that people may be less willing to accept compromises of comfort while at work – this remains however outside the scope of this evaluation.

Abilities to become flexible appear to be much more complex in the situation of municipalities than in private homes. As a central decision maker, the municipality would have to consider which types of institutions could be most suited to flexible consumption. It is not unlikely that they would have to negotiate the terms with each institution and define the conditions under which an aggregator could operate. In making such decisions, the municipality make important decisions on behalf of others, including users and employees who may be more reluctant to be made flexible.

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Appendices

Appendix1

First round at Bornholm, EcoGrid EU (2014) - 13 semi-structured interviews with project managers, electricians and consumers - Observations of training sessions in homes of consumers - An introduction for 7 new consumers in Villa Smart Methods: Semi-structured interviews, in-situ interviews, and observations Documentation: Transcribed interviews, field notes
Second round at Bornholm, EcoGrid 2.0 (August 18, 2016) -2 expert interviews in Villa Smart Methods: Focus group Documentation: Transcribed interviews
Third round at Bornholm (August 24-25, 2016) -1 expert interview in Villa Smart -1 expert interview in the home of the consumer -2 semi-structured interviews with 3 consumers -1 observation of training session Methods: Semi-structured interviews, in situ interviews, and observations Documentation: Transcribed interviews, field notes, digital photos, consumer's own documentation of consumption
Fourth round, Bornholm (September 20-23, 2016) - 8 semi structured interviews with 10 consumers - 12 home visits with electricians (two without consumers) - 5 observations of training sessions - Interviews with electrician during service Methods: Semi-structured interviews, in situ interviews, and observations Documentation: Transcribed interviews, field notes, digital photos

Fifth round, Bornholm (October 25-28, 2016) - 6 semi-structured interviews with 7 consumers - 8 home visits with electricians (two without consumers) - 5 observations of training sessions - Observation of a weekly meeting with electricians, support staff and project managers Methods: Semi-structured interviews, in situ interviews, and observations Documentation: Transcribed interviews, field notes, digital photos, consumer's documentation of consumption
Sixth round, Bornholm (January/February, 2018) - Observations of two user-panels organized by BEOF - 3 semi-structured interviews with BEOF project manager Methods: Semi-structured interviews, observations.
Seventh round, Bornholm (January 15-18, 2018) -16 semi-structured interviews with 22 consumers
Eighth round (February 25th – March 2th, 2019) -8 semi-structured interviews with 11 consumers. -3 interviews with consumers and electricians -9 home visits with electricians (one without consumers) -1 interview with project manager and support staff in their office. -3 In situ interviews with technicians during lunch and in their office Methods: Semi-structured interviews, in situ interviews, and observations
Ninth round (February/March, 2019) -1 interview with the person Horsens municipality working in the center responsible for the stock of building -2 interviews with two janitors at Hatting school and Nim School

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