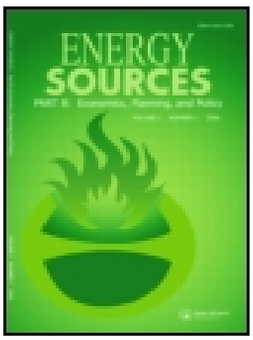

Taylor & Francis
Taylor & Francis Group

Energy Sources, Part B: Economics, Planning, and Policy

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/uesb20

Flexibility poverty: 'locked-in' flexibility practices and electricity use among students

Ingvild Firman Fjellså, Marianne Ryghaug & Tomas Moe Skjølsvold

To cite this article: Ingvild Firman Fjellså, Marianne Ryghaug & Tomas Moe Skjølsvold (2021): Flexibility poverty: 'locked-in' flexibility practices and electricity use among students, Energy Sources, Part B: Economics, Planning, and Policy, DOI: 10.1080/15567249.2021.1937403

To link to this article: https://doi.org/10.1080/15567249.2021.1937403

Published online: 16 Jun 2021.

ENERGY SOURCES, PART B: ECONOMICS, PLANNING, AND POLICY
https://doi.org/10.1080/15567249.2021.1937403

Taylor & Francis
Taylor & Francis Group

Flexibility poverty: 'locked-in' flexibility practices and electricity use among students

Ingvild Firman Fjellså, Marianne Ryghaug, and Tomas Moe Skjølsvold

Department of Interdisciplinary Studies of Culture, Norwegian University of Science and Technology, Trondheim, Norway

ABSTRACT

The article provides a widened understanding of the concept of end-user flexibility and nuances the traditional individual-oriented approach often used in discussions on low carbon transitions. The authors draw on 75 narratives from of a group of end users that is often considered to be in a very flexible stage of life, namely students. They discuss the co-production of systems connected to material, structural and social factors that extend beyond individual willingness to be a flexible energy consumer. The article stresses that flexibility is shaped by living conditions, everyday life and social norms in particular ways that makes it hard to achieve for students and others living in shared households. The authors conclude that political incentives for low-carbon transitions typically exclude social groups such as students and other vulnerable groups in society, and hence may unintentionally create and reinforce what they term 'flexibility poverty'.

KEYWORDS

End-user flexibility; energy consumption; 'flexibility poverty'; low-carbon transitions; shared households; students

1. Introduction

Climate change is said to be one of the biggest challenges of our time (EEA 2021; Kaygusuz 2010), affecting every country on every continent, disrupting national economies, and affecting lives (UN 2020). Solutions to tackle this challenge range from high-tech solutions (e.g., carbon capture and storage, solar panels, wind turbines, and battery technology) to encouragement of more sustainable choices in daily life for people in general (e.g., regarding what we consume, how we live, and how we commute) (Schwarzinger, Bird, and Skjølsvold 2019). The least efficient part of the global energy system comprises end users (Gilli, Nakicenovic, and Kurz 1996), yet there is great potential to impact carbon emissions through changes in end use (Grubler et al. 2018). However, sociotechnical changes to meet climate change is a complex issue, especially as industrial economies have become "locked into fossil fuel-based technological systems through a path-dependent process driven by the technological and institutional increasing returns to scale" (Unruh 2000, 817). In terms of end users' energy consumption, it is generally expected by policymakers and energy industry actors in Europe and beyond that that future consumers will have to be more active and flexible than they are today (Andrey et al. 2016; Ballo 2015). Such flexible consumption is understood as a key strategy to avoid power grid congestion by balancing supply and demand. This, in turn, can be achieved by reducing energy consumption during peak hours while also catering for increased electrification, for example in the form of new renewable energy production and transport electrification (e.g., Geels et al. 2017). Social science researchers who have studied schemes designed to instigate more flexible energy consumption point out that such efforts have often overlooked the heterogeneity of energy consumers, and that there tends to be a poor fit between such schemes and the practices of everyday life of consumers (e.g.,

CONTACT Ingvild Firman Fjellså Ingvild.f.fjellsa@ntnu.no Department of Interdisciplinary Studies of Culture, NTNU, Trondheim N-7491, Norway

Skjølsvold, Jørgensen and Ryghaug 2017; Schick and Gad 2015; Silvast et al. 2018; Strengers 2013; Torriti 2012).

To mitigate such concerns, scholars have explicitly studied how particular groups, such as the elderly (Barnicoat and Danson 2015) and vulnerable consumers (Shirani et al. 2020), reason about flexible energy consumption and use smart energy technologies. In this paper, we focus on different but distinct group of consumers, namely students. To our knowledge, this group has not been given much attention in previous studies of consumer flexibility. Within disciplines such as psychology, economics and political science, it has been common to study student populations as a proxy for wider populations. The generalizability of such studies may be criticized (e.g., Druckman and Kam 2011). Our interest in studying students as consumers is not to generalize from this group to the wide public, but rather to understand the specificities of students' life situation and how that relates to their energy consumption and possibilities for flexibility. We are interested in how students perceive their opportunities for engaging in flexible electricity consumption by either reducing or shifting their daily activities from peak load hours to other times of the day, which may be one way to achieve flexibility in energy consumption. Thus, the focal point of this paper is Norwegian students' energy consumption, and their experiences and perceptions of possibilities for the provision of end-user flexibility. On the one hand, examining these issues among students can generate valuable information about how this group of energy users' reasons about flexibility, as students are in a period of their life when they establish new habits and routines. On the other hand, analysis of a group of what may be "free and flexible" individuals can be a fruitful point of departure for broader discussions of inclusion, justice, and implications in low-carbon transitions, and the literature has called for work that looks more into how specific groups such as youth are affected by efforts to make energy consumption "smarter" (Robison et al. 2020).

1.1. Theorizing end-user flexibility

Flexibility provided by end-users tends to be described and understood in terms of ability to shift energy consumption away from peak load hours, which are times of the day when electricity consumption is high and the electricity grid is constrained. From a technical and economic point of view, this can be seen as means to utilize the power effectively and/or to avoid new investments in physical grid infrastructure (e.g., Lien et al. 2020). Thus, many actors have noted that understanding how to make energy consumption more flexible is regarded as increasingly important to manage electricity grids effectively and to enable wider energy transitions (Ballo 2015; Schick and Gad 2015; Smale, Van Vliet, and Spaargaren 2017; Throndsen 2017).

In discussions on how to make energy demand flexible, innovators and policymakers have tended to highlight at least three sets of tools or mechanisms as potential solutions: information, such as in the form of in-home displays (Hargreaves, Nye, and Burgess 2013); economic incentives, such as time-of-use tariffs (ToU) and critical peak pricing (CPP) tariffs (Öhrlund, Linné, and Bartusch 2019); and automation (e.g., Sæle and Grande 2011, such as direct load control (DLC). Both information and economic incentives are intended to change knowledge, awareness, and attitudes to stimulate active choices and new types of behavior concerning energy demand, whereas automation can be seen as a more technology-oriented pathway that outsources energy management choices to third parties to ensure that energy is consumed most efficiently (for a discussion, see Fjellså, Silvast and Skjølsvold 2021).

However, the three mechanisms for making energy consumption more flexible have yielded mixed results (for an overview, see Öhrlund 2020) and extensive criticism from social scientists, who have noted that they neglect the complexities of sociotechnical change and the deep temporal and contextual rhythms that shape everyday life and society (Shove 2003; Walker 2014). Furthermore, the design of the mechanisms has been criticized for being based on an understanding of affluence, technological competence, and interest as key components of human rationality (e.g., Strengers 2014), and neglecting the influence of social, cultural, and practical factors such as capital, age, and gender

(e.g., Tjørring et al. 2018). Building on such critique and empirical observations, scholars have noted that economic incentives and information-based systems tend to generate only short-term interest and change (Hargreaves, Nye, and Burgess 2013).

With regard to the above-discussed types of criticisms, Blue, Shove, and Forman (2020) call for a reconceptualization of flexibility that more strongly involves critical reflection on the temporal structuration of society, and what it would mean to change the structuration in the future. Similar calls have also been made in the energy justice literature, where aspects such as social inequality in energy supply and demand have been questioned (e.g., Ingeborgrud et al. 2020; Jenkins et al. 2016; Powells and Fell 2019). In emphasizing flexibility in the energy justice perspective, the concept of "flexibility capital" has been launched to highlight that the unequal distribution of opportunities for providing flexibility across societies (Powells and Fell 2019). Homeownership, access to large electricity loads such as those generated by floor heating and electric vehicles, as well as economic capital entail opportunities for leveraging loads for flexibility purposes, as well as opportunities for opting out. Lack of both access to such loads and economic capital leaves few opportunities to provide flexibility and few opportunities for opting out. Thus, considering the way flexibility capital is unevenly distributed across society, Fjellså et al. (2021) argue that there are also unequal options for doing "flexibility work" for end-users with various types of flexibility capital.

In the next section, we discuss more how to theorize energy demand and flexibility issues with regard to students, before outlining our methods and analyzing how the co-production of systems connected to material, structural and social factors tie into students' energy flexibility.

2. Student life and energy use

Previous studies that have focused on young people's energy consumption have looked at energy and at information and communication technologies among youths (Christensen et al. 2014; Christensen and Rommes 2019); students living in fuel poverty (Kousis et al. 2020; Morris and Genovese 2018); and energy vulnerability (Bouzarovski et al. 2013). Scholars have found that students and young people are rarely recognized as a group vulnerable to energy poverty, and many students and young people do not recognize that they live in energy-poor conditions (Bouzarovski et al. 2013; Kousis et al. 2020). Energy poverty is broadly understood as the inability of households to maintain adequate levels of energy services at an affordable cost, and is caused by the interplay of low incomes, high energy need, and high energy prices (Doukas and Marinakis 2020). However, defining energy poverty poses a scientific challenge, due to different understandings and experiences (Sokołowski et al. 2020). Worldwide, it is estimated that 1.3–2.6 billion people experience energy poverty (Doukas and Marinakis 2020). Little attention has been given to energy poverty in Norway (Bredvold 2020), which is the empirical site of inquiry in this article. This is perhaps unsurprising, as Norway is considered an energy-affluent country, where most households spend a very low share of the household budget on energy due to relatively cheap electricity prices and high standards of housing (OECD 2016). However, the increased focus on end-user flexibility, and the approaching introduction of new pricing schemes and tariffs in Norway, may change this (e.g., Skjølsvold, Ryghaug and Berker 2015**; Christensen et al. 2020 2020**).

With regard to thinking about transitions in how energy is consumed, young adulthood is arguably a particularly important phase. Gram-Hanssen (2011) notes that this phase is characterized by socialization, in which social sanctions for violating norms, such as the norms of cleanliness, are strong. Hence, it is a phase in life when people are likely to become recruited as carriers of new practices (Shove 2009), which in turn is likely to affect how easy or difficult it is for them to be flexible in their electricity consumption. Some scholars claim that growing up in affluent households is associated with high energy use as adults, suggesting that practices of consumption are 'sticky' due to lived experiences in childhood and early adulthood (Hansen 2018). In line with this, Christensen and Rommes (2019, 82) claim, in their article on information and communications technology (ICT)

and electricity use among youths, that "young people are adopting habits and practices that will be decisive for their future energy consumption." The practices that the youths engage in become embodied habits, forming their future everyday life practices. Thus, studying youths and young people may be a way of understanding future consumption and practices that will affect energy demand and flexibility.

However, student life is arguably typically quite different from that of both childhood and adult life concerning materiality, daily schedules, and social factors. A focus on materiality entails that we recognize the way material aspects of everyday life (e.g., housing conditions and available technologies) may be different for students compared with others. For example, students often live in housing of a lower standard compared with adults. Also, the temporal rhythm of students may differ from others, for example due to them having infrequent and varying time schedules of classes, part-time work, and not "nine-to-five" daily lives. Furthermore, the everyday social dynamics of student life differs from that in other life stages, for example due to poor economy and multiple students sharing living spaces while organizing separate daily lives. Thus, students are particularly interesting to study, as their everyday lives and routines might be less locked-in and structured by the requirements of society in general.

A handful of studies have focused on the way student life is linked to energy demand. For example, is has been noted that higher education constitutes an arena of invisible energy policy where the requirements that students face (e.g. concerning online presence) is part of an increasing overall energy demand in society (Royston, Selby, and Shove 2018; Wadud, Royston, and Selby 2019). Others point out that students often do not have control over or know their electricity expenses, that they have low incomes and give less consideration to electricity management than members of the general population (Cotton et al. 2020; Dulleck et al. 2019). However, the findings of social experiments in shared student housing suggest that students can both understand the concept of demand response, as well as engage in practicing flexibility in shared spaces (Higginson 2014). Also, electricity consumption in shared spaces, such as an elevator in a student dormitory, can be subject to demand-response schemes with some degree of success (Rotger-Griful et al. 2017). Students significantly contribute to energy demand, but because they often live, work, and use energy in different ways than other social groups, they are likely to be impacted by energy-related policies and developments in different ways than other groups of the public. For this reason, they are an important group to study.

In this article, elements from theories of practice, energy justice, and concepts of flexibility are combined to study end-user flexibility among students. Social practice approaches to social change, consider that social practices are important units of inquiry and analysis and that they represent a valuable aspect of sociotechnical change (Sovacool et al. 2020). In order to understand the potential for transformation of energy-related practices and flexibility among students, we use some of the insights from practice theories to study how materiality and meanings of end-user flexibility are co-produced with daily activities. Previous studies of energy consumption and flexibility have typically studied "traditional" households, consisting of one-family households (e.g., Skjølsvold et al. 2017; Hargreaves, Nye, and Burgess 2013). Such households create "internal systems" for daily activities, such as laundry and cooking. In this article, we take a different approach and examine what happens in households where multiple systems exist simultaneously. We discuss how students' daily routines relate to their work and studies, environment, living conditions, and other social factors in the organization of energy-related activities and the perception of flexibility. We address the following question: How do students' living conditions, daily life practices, and social norms affect their perceptions and abilities with regard to flexible energy consumption, both individually and collectively? Related to this, we also explore how students' ability or inability to practice flexibility relates to broader issues of energy justice, such as vulnerability to *flexibility poverty*.

3. The Norwegian context

In this article, we study aspects of flexibility among students in a Norwegian context. To situate the theoretical discussions mentioned in the preceding section, we give some brief insights into the Norwegian

context in terms of the situation for students and in terms of energy. In Norway, just under 40% of the population in the age group 19–24 years was enrolled in higher education in 2020 (SSB 2021a), which is a relatively large proportion of the population. In some European countries, such as Italy, it is common for students to live with their parents; in Norway, this is only the case for 10% of students (Keute 2018a). Students are generally less likely to own a home, compared with non-students in the same age range (Revold 2019). However, it is common for students to live with others, such as partners, children, and peers, in student homes and diverse forms of shared housing. Only 12% of Norwegian students live alone (Keute 2018a). In Norway, as in the rest of Europe, students' living expenses constitute over 90% of their total expenses (Keute 2018b). However, it is difficult to know what proportion of their expenses relate to energy consumption, for two reasons: public statistical analyses, such as Statistics Norway, often exclude students as a group in national reports on energy consumption and expenses, and energy expenses are often combined and measured as "housing expenses" that also encompass housing loans/leases and energy (e.g., Barstad, Løwe, and Thorsen 2012). Even though one-third of full-time students have additional paid work (Keute 2017), 1 in 5 students (not living with their parents) reported that to some degree they struggled financially and had insufficient economic capital (Steffensen, Ekren, and Nygård 2015).

In terms of energy, Norway is an exception case, as almost all electricity is derived from renewable energy in the form of hydropower (e.g., Skjølsvold, Ryghaug and Dugstad 2013; SSB, 2019). Consequently, electricity is also used for heating in Norway, to a much larger extent than in many other countries. Household consumption of electricity is three to six times higher than the average household's consumption in the EU (Energifakta Norge 2019). Traditionally, there has not been much need for flexible consumption, but this situation is changing with the electrification of new sectors such as transport (e.g., Ryghaug and Skjølsvold 2019). Combined with an increasing role also for variable renewable energy sources such as solar power, this is placing new strains on local distribution grids and posing challenges for them, where flexible consumption is increasingly seen as part of the solution.

4. Methodology

In this article, we empirically draw on 75 illustrations and 17 written statements from 75 students, which we collected in 2018 in order to study electricity consumption and end-user flexibility in daily life. The students were taking courses in social sciences at master's degree level and bachelor's degree level (perspective course and one-year course), at a large Norwegian university. The numbers of students in the three categories were divided as shown in Table 1.

The students varied in terms of age and life situations, and the students on the master's degree course were in general slightly older than the other students, ranging from being in their mid-twenties to mid-thirties, while the age range for the students at the bachelor degree courses (the perspective course and the one-year course) was from late teens to mid-twenties. Some of the older students at master's degree level lived in comparatively traditional households with their own families or with a few other adults, while the younger students at bachelor degree level more often lived with more people, and a few lived in their family home with their parents.

The recruitment process followed a procedure whereby students on the master's degree course and the perspective course were asked to participate in a practical task during a lecture. Based on their own experiences and their homes, they were asked to illustrate their energy consumption during an ordinary day as responses to the following four questions: (1) At what time of the day do activities

Table 1. Overview of students.

Course	Number of students	Empirical material
Perspective course	41	Illustrations
One-year course	17	Illustrations + written statements
Master's degree course	17	Illustrations

take place in your home? (2) Are some appliances on 24/7? (3) what activities would be easy to move or cut? (4) What practices would be difficult to change? The students taking the one-year course were given a similar assignment to complete on their own, as part of the course training, in which they were asked to illustrate their energy consumption and include written reflections.

Together, the illustrations produced by the students formed an interesting and quite detailed account of the daily activities in their homes. Most of the students indicated what activities happened at what time, using drawings, numbers, text, or timelines. Some included the activities they perceived were flexible (easy to shift or cut) or inflexible (hard to shift or cut), as shown in Figure 1.

When analyzing the data, we focused on the daily activities that the students indicated in their written words or illustrations were flexible or inflexible to shift or cut. We focused on three daily clusters of activities: (1) doing laundry, (2) activities to ensure personal hygiene (specifically showering), and (3) the use of information and communications technology. These activities were chosen as they were frequently mentioned in the empirical material and represented as more autonomous activities compared with other activities such as heating. As part of the analytical process, we quantified the material to gain an overview of what featured in drawings in terms of flexible and inflexible activities (the results are summarized in Tables 2, 3, and 4). In the following section and subsections, we present our analysis, focusing on how the students presented their energy-related activities and what activities they perceived as flexible or not flexible.

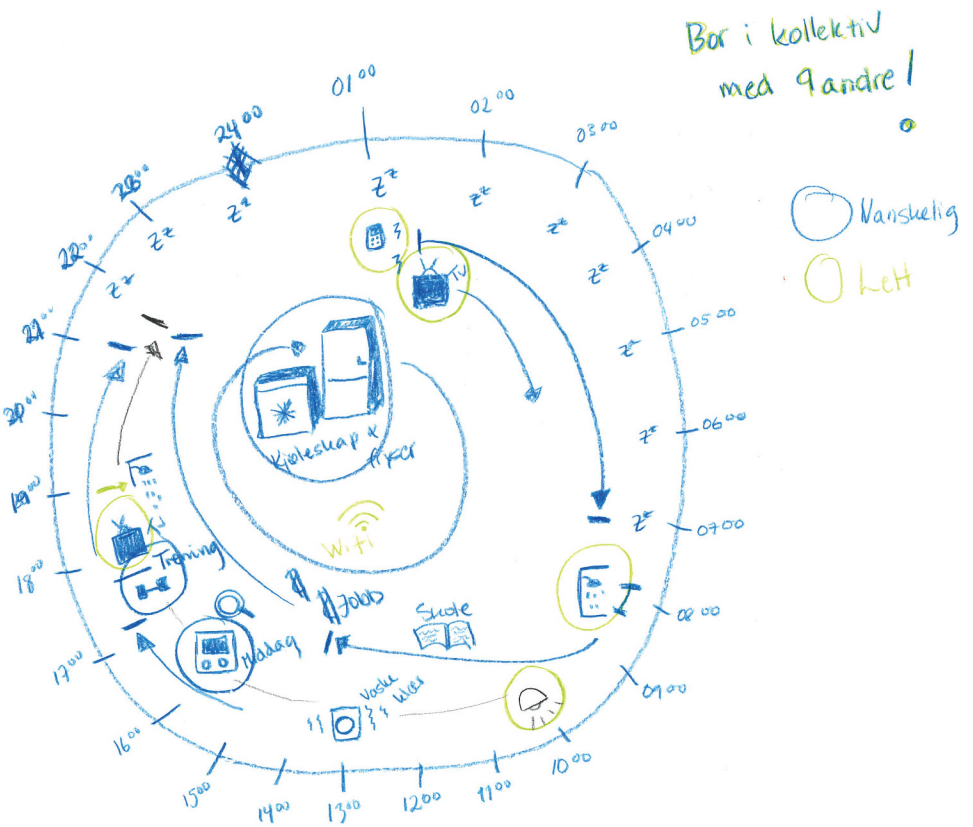

Figure 1. Example of a student's illustration of energy consumption regarding flexibility and inflexibility in daily life. The green text in the upper right part translates as 'Live in a collective with nine others!' The yellow circles (*Lett*) indicate what activities were considered easy to shift and cut (flexible) and the blue circles (*Vanskelig*) indicate what activities were perceived as complicated to shift and cut (inflexible).

5. Flexibility in daily life

Based on the empirical material, energy-related activities were divided into three categories. The first category constituted activities shaped by societal structures, such as lectures and working hours, which were set by others than the students themselves. The second category comprised activities rooted in the materiality that surrounded the students, such as the standard of their housing, its design, and its facilities, which shaped how the students organized their daily life. The third category of energy-related activities consisted of activities shaped by more personal needs and comfort, such as cooking, cleaning, and leisure activities.

Activities that the students described as impossible, hard, or complicated to change, we refer to as 'inflexible'. Typically, inflexible activities were connected to studies and work, such as electricity used to run computers. Household installations that were often plugged in 24 hours per day (e.g., fridges, freezers, hot-water tanks, and Wi-Fi routers), were also perceived as inflexible. Many of the students also noted that the preparation of food was complicated to shift or cut. Most inflexible activities were explained as hard to cut or change due to practical reasons, but others were described as possible but undesirable to change for reasons of comfort and convenience. For instance, few were willing to sacrifice having a cup of coffee in the morning or having a fully charged mobile phone in the morning. Hence, inflexibility stood out as, not primarily as an individual choice, but as structured by societal temporal and material rhythms, in line with earlier studies (Shove 2003; Walker 2014).

The typical "flexible" activities were doing laundry, washing dishes, showering, entertainment, and charging devices and appliances. The activities that were perceived as flexible and "easier" to change in terms of time, place, and length, or even to cut altogether, were rooted in more personal needs or comforts, compared with those more directly linked to societal rhythms and structures such as work hours and study timetables. We also found that the material context of the home played a different role for the students than we have previously seen for more traditional single-family or occupancy households (e.g., Fjellså et al.) because the students were more often renters, shared housing with others, and had low economic capital. The students described how they adapted to the standard of their housing, such as how cold apartments, lack of insulation, and lack of natural light were compensated by using extra heating, clothing, and electric lighting. One student explained that "Because the apartment is not particularly [well] insulated, the heating needs to be on all the time for it to be livable in the apartment." The students seemed to adapt to the shortcomings of the material context of their household, and they worked around material constraints. The data did not reveal any sign of interest or willingness to make either long-term or short-term investments in their housing to improve its standard, and there were few objections against the few cases of housing of a low standard, probably because the situation was seen as temporary and hard to change.

In the following subsections, we focus on some of the activities rooted in the students' personal needs and comforts. These activities were frequently reported as more autonomous than other activities, such as heating and cooking, which we found to be limited more by socio-material contexts. We focus on everyday activities related to (1) doing laundry, (2) showering, and (3) using ICT. These activities were perceived by many students as driven by individual preferences and needs, although the students differed in their willingness and ability to be flexible, and they raise questions of capital, social norms, morals, and safety.

5.1. Doing laundry

In Norwegian households, laundry is often done in the household and the majority of households own a washing machine (SSB 2012). However, students most often have to find a way to organize laundry as a personal activity, even when they live with others (i.e., non-family members). Many students indicated that domestic work in general, and doing laundry in particular, were flexible activities in terms of what time of day they could do it.

Figure 2 shows an illustration by a student who indicated that doing laundry (using a washing machine and tumble drier) could be moved to another time, in this case from the late afternoon or early evening to the morning.

The students' accounts of their flexibility potential concerning laundry are summarized in Table 2. About two-thirds of students indicated that they could be flexible with their laundry, while one-quarter mentioned that the activity was inflexible. Some marked their illustrations to show that they could wash less frequently, and others showed that they could do their laundry at other times of the day. In the case of the younger students (at bachelor's degree level), inflexibility was often indicated as a result of having to use washing facilities outside the home, such as a student laundry or joint laundry rooms. In that way, the inflexibility of doing laundry became particularly visible for those who had limited access to washing facilities, as the options for when they could do their laundry were very limited. Overall, the older students (at master's degree level) more often indicated that they were less flexible, including when it came to doing laundry, compared with other students.

In the written statements, one student had a general view about when domestic work should be done:

> What day or time we mow the lawn, does not matter – the same goes for running the dishwasher, doing laundry, and vacuuming. When this happens is more about when it is convenient or when we can be bothered. (Student, living with partner in a house)

The student exemplified the view that is sometimes used to describe students' flexibility potential, namely that they have a large potential but are limited by convenience and lack of incentives. Another student explained his view on the flexibility of laundry activities as follows:

> The activity [of doing laundry] can in practice be done at any time, as long as you have some minutes available in between a couple of hours so that the laundry can be moved from the washer to the dryer and then collected again afterwards. (Student in student housing, who shared a kitchen and bathroom with three other students)

All students perceived laundry as a flexible activity, subject to available time between washing and drying cycles and when the laundry was finished, as indicated in the above the quotation. Their concern was mainly with clothes turning "bad" if they were left wet in the machine for too long. They also had to adjust to the availability of the washing facilities, as they were often shared with others, such as in shared apartments or common laundry rooms. There was an aversion to doing laundry during nighttime, due to concerns related to the fire hazard of appliances left running unsupervised and the inconvenience. However, compared with other findings from research on traditional householders (Fjellså et al.), the fire hazard element was much less problematized by the students.

One student wrote that a possibility for increased efficiency with respect to laundry within the household was to arrange to do his laundry together with his roommates' laundry, so that dirty clothes were collected from all roommates and washed jointly. However, for most students, doing laundry was seen as a highly individual task and therefore the student questioned the willingness of his roommates to be part of a collective washing scheme, as he expected it to be challenging due to highly personal preferences in terms of routines for cleanliness:

> There is an element of comfort when people do their laundry, as people wash their clothing at different temperatures and with different detergents. [. . .] People are also different when it comes to how comfortable they are with wearing the same pants or shirt over again. Some like to have newly washed clothing every day,

Table 2. Summary of observations relating to laundry.

Observations	Flexible	Inflexible	Notes
Wash less	6		• Hard to move because washing is done outside the home, at a laundry
Shift time	5		• Wash during nighttime
Unspecified	12	12	• Laundry is flexible in the morning and inflexible in the evening
Tumble drier	4	2	• Only wash dirty clothes
Total	27	14	• Laundry can be done in daytime when there are no lectures

> while others can use the same shirt or pants for two or three days before cleaning them. Therefore, there are multiple factors to consider, which makes it harder [for students] to do laundry together. (Student, in shared house with five other students)

The above quotation touches on several issues of meaning, routines, and social norms of cleanliness, which is in line with previous studies that found that, on the one hand, individuals had their own definition of cleanliness, dirtiness, and the need to wash, while, on the other hand, definitions of cleanliness were shaped by culture and norms (which change over time) (Shove 2003). Thus, failure to comply with standards of cleanliness might imply a failure to sustain a central part of personal self-image (Shove 2003, 148).

In addition to finding available time outside work and study hours for doing laundry and having to be physically present in the house or laundry facility, the students had to engage in a social negotiation or contract with other householders or users of the washing facilities to find out when they could wash their clothes. Hence, the practice of doing laundry involved the capacity to navigate the system of laundry, other actors, and the materiality of the technology itself (e.g., the washing machine) and the clothes.

We found that the places in which students lived often consisted of multiple solo systems for doing laundry, which existing side by side and as part of a larger (laundry) system within the accommodation, which made flexibility more challenging compared with traditional single-occupancy or family households in which the provision for doing laundry often involves one system. Despite this, it is interesting to note that most students saw the washing of clothes as a flexible activity, which was also shaped by socio-material aspects that made flexibility more limited and 'locked-in' by various socio-technical structures, such as relations with other activities or actors co-existing in the same household. We found some similar tendencies when we studied experiences of flexibility related to showering practices.

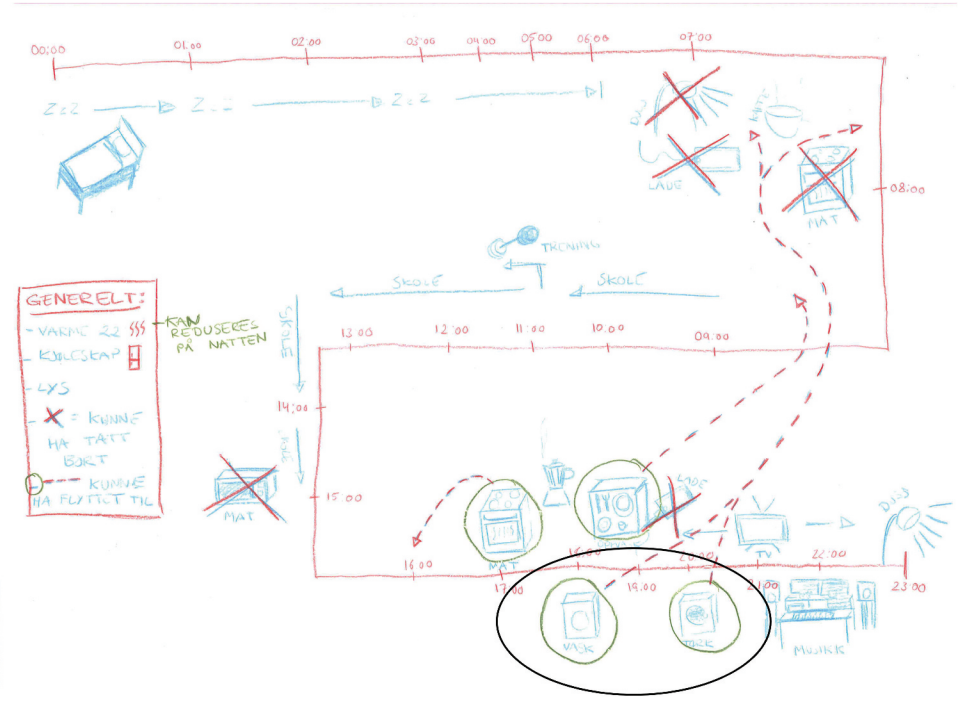

Figure 2. Student's illustration of a typical day, indicating that laundry (*vask, tørk*) was flexible and could be moved from late afternoon or early evening to morning.

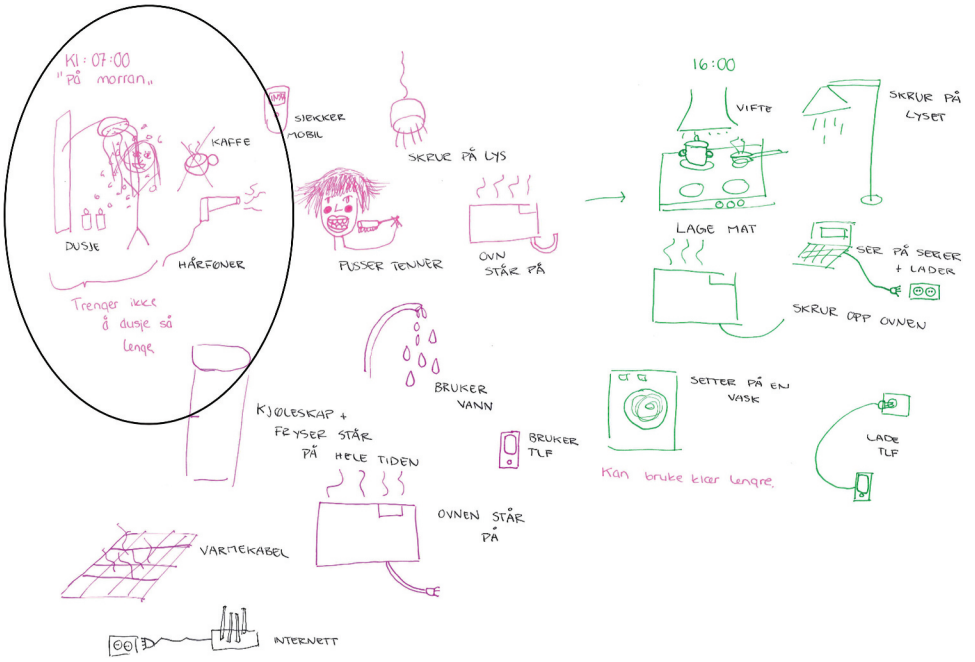

Figure 3. Student's illustration indicating that time spent showering could be reduced: "No need to shower for so long" (*Trenge ikke å dusje så lenge*).

Table 3. Summary of observations relating to showering.

Observations	Flexible	Inflexible	Notes
Frequency	3		•Twice per day: flexible in the morning; inflexible after workout
Length	8		• Hard to change habits and electricity that one is dependent upon (e.g., phone, shower, food)
Change location	4		
Change time	9	2	• Hard to cut shower time in the morning
Unspecified	8	7	• Shower in hot water a little too long
Total	32	9	

5.2. Showering

As in the case of domestic work and laundry, the students were dependent on the availability of time, physical space (bathroom), and social interaction with others, in order to perform activities relating to personal hygiene. Students who shared living spaces with others expressed that they would use the shower when it was available. Unlike domestic work, showering had a clear element of comfort and interestingly it was often followed by a moral self-evaluation. This was found both in the written statements and in the illustrations as brief comments to the timeline (Figure 3).

Some students said they could shower at other times, at other places, or for shorter periods (Figure 3) or, less frequently, that they could be more flexible about their energy consumption. This was demonstrated in writing and illustrations, which are summarized in Table 3.

One student pointed out that showering could not and should not be reduced too much, as this "could over time become socially problematic," hinting at societal norms of cleanliness and hygiene. Other students explained how showering in the morning was an important part of their morning routine to have a "fresh start" to the day and that moving the activity to other times of the day would be possible but would take away the pleasures related to the morning ritual.

Furthermore, the notion of cleanliness was ascribed more meaning than the activity of showering itself. It was infused with moral, social, and symbolic meaning, as previously suggested by Shove (2003). The moral self-evaluation penetrated the students' wording, through their use of terms such as "good," "could be better," or "being bad," when they illustrated showering routines.

One student wrote:

> I could be much better at taking shorter showers. Since I have electricity and hot water included in my housing contract, I have a tendency to take long showers because I don't need to think about how much hot water and electricity I use. [. . .] I see that I am so dependent on my routines and habits, that I am not willing to change much to reduce my electricity consumption.

Some students demonstrated a conflict between comfort and flexibility. On the one hand, they expressed awareness in terms of their flexibility potential, indicating that they had the option of taking shorter showers. They understood themselves as having flexibility competence, as they could envision a solution for becoming more flexible by changing the time, space, or length of time in which they took their showers. On the other hand, many students demonstrated hesitation toward changing their showering practices. Some clearly stated that they did not want to give up this element of comfort in their daily life. Thus, increased flexibility of shower routines would mean a reduction in comfort. For some students, not wanting to reduce their comfort level and hence being less flexible, meant they were not willing to give up something they thought that they ought to give up, particularly regarding the length of time they spent showering.

We found a similar moralistic self-evaluation in terms of the activity of charging devices during nighttime, in addition to what the students described as excessive use of indoor lighting and heating. This, too, was linked to comfort, but it was also presented as a consequence of practical considerations and convenience, such as compensating for lack of access to daylight or lack of adequate insulation in their housing.

5.3. Information and communications technology

Electricity for powering or charging information and communications technology devices (ICT), such as computers, TV, gaming consoles, and smartphones, was very important in the students' daily life (Table 4), as has been found in previous studies (e.g., Christensen and Rommes 2019). The students indicated a great flexibility potential with regard to TV and charging devices, especially charging cell phones during the night.

The multiuse of ICT devices, particularly smartphones and computers, blurred the lines between different types of use, such as for educational, work-related, social, and entertainment purposes. The multiuse situations also seemed to complicate the distinction between the flexibility and inflexibility of activities when a device was used for different purposes. The following statement is typical of the

Table 4. Summary of observations relating to ICT.

Observations	Flexible	Inflexible	Notes
Charging, nighttime	11	6	• Phone charges usually during the night; dangerous (bad habit) – Habit of needing to be available and be entertainment if bored – Charge EV (electric vehicle) during the night, inflexible
Charging	5	2	• Charge when the battery is flat – conscious user of energy
Computer, daytime	3	8	• University, work; hard to change
Computer, afternoon/ evening	6	6	• Hard to change due to homework
TV	15	4	• TV on for dog during daytime – Can cut and do homework – should be easy – The laptop serves the purpose of a TV.
Gaming console	2	1	• Do not want to move
Wi-Fi	1	1	• Always on
Total	43	28	

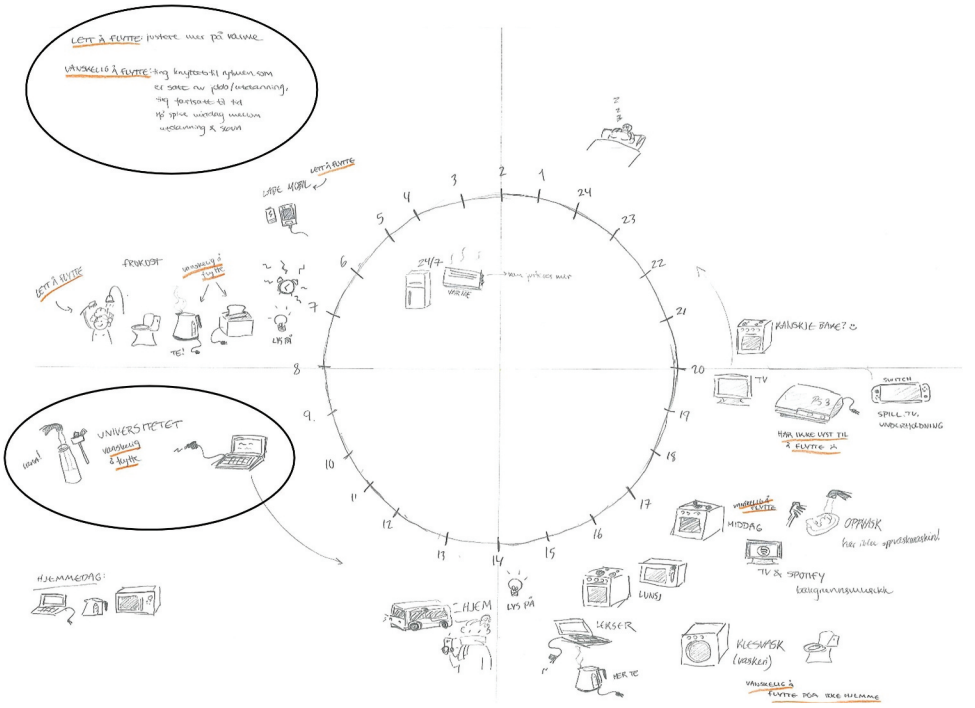

Figure 4. Student's illustration indicating that some activities are hard to move due to social rhythms: 'Hard to change: things connected to the rhythm of work/education, things that are determined by timetables. Must eat dinner between education and sleep' (*Vanskelig å flytte: ting knyttet til rytmen av jobb/utdanning. ting fastsatt til tid. Må spise middag mellom utedanning & sovn*). 'The university[:] hard to change' (*Universitetet[:] vanskelig å flytte*).

students' descriptions of computer use: "I use my computer for education, work, play, [and to] surf, and watch videos." Computers were important for students to perform in education and work situations, be entertained, be educated, be creative, and to socialize online. Therefore, reducing or changing computer use could have affected the students' academic, work, personal, and/or social life. However, a few students saw potential for flexibility with respect to the fact that they kept their computers turned on, even when not in use. One student with a desktop computer reflected on his flexibility potential as follows:

> I usually turn on the computer when I come home, and I often leave it on right until I go to bed. This is something I have done for many years, and it has become a habit. Ever since I bought a desktop computer it has become more and more a routine in my daily life that it is on, in my room when I am at home. [. . .] I can see that there is an opportunity to save energy only by changing my habit of always having my computer on.

Few students tended to find flexibility potential in their computer-related activities, as exemplified by the quotation above. Most students did not mention computers as something they could be flexible with at all, or they marked them as inflexible in their illustrations. The use of computers seemed to be regarded as especially inflexible during the daytime, as a consequence of rigid societal structures, typically related to work hours and education timetables that were outside the students' control, as shown in Figure 4.

However, the students saw a much greater potential for flexibility in their device charging practices, as they recurrently mentioned this as something they could easily change (see Figures 1 and 2). We also found that the students moralized charging practices through statements such as "Phone charges usually during the night. Dangerous! (bad habit)" and "it [mobile phone] charges at night, which is a bad habit that I will try to change so I can charge it when I am awake," as they associated nighttime charging with a fire hazard.

Some students not only moralized their charging practices, but also rationalized their choices by explaining the need for fully charged devices in the morning, despite the perceived fire hazard of nighttime charging. The convenience of a fully charged phone meant access to, for example, music, information, entertainment, making payments, and education:

> I charge my phone during the night, and then it lasts all day without being recharged. Charging the phone is not good for many reasons. Unnecessary energy is spent when having it connected to the charger for such a long time, while it at the same time is a major fire hazard. [. . .] I use it [the phone] all the time to listen to music, surf online, check the bus schedule, and a lot more. Since the phone is used so frequently during the day, I find it hard and impractical to put it down for charging in the middle of the day.

In the practices relating to ICT devices, we found that the activities linked to the direct use of the devices (such as using a laptop for university work) were less flexible than the practices that enabled their direct use (such as the charging of a laptop). TV screens can be replaced by alternative screens, while computers were inflexible because many used their computers at all times for different activities during the day, which made it problematic to turn off. The students' inflexibility concerning the use of computers seemed to be shaped by societal structures, reaching beyond the students' willingness and abilities.

6. "Locked-in" flexibility

The concept of 'lock-ins' are often used to describe mechanisms that constrain new alternatives due to path-dependence increasing returns to scale, even when alternatives are known to be cost-neutral or cost-effective (Arthur 1994). The term has also been used in studies of energy policy and climate change, such as Unruh's study of carbon lock-in, which illustrates how difficult it is to get rid of fossil fuels (Unruh 2000). One way of interpreting the introduction of flexible energy consumption, is as an effort to break the locked-in patterns of past electricity consumption, from the metaphorical societal shackles that leads to the production of peak load consumption.

In doing this, however, designers of mechanisms and incentives that seek to stimulate flexibility should be aware that as we open up new paths we might also run the risk of producing new path dependences and lock-ins. Building strong policies, investments, and tariffs in this direction without an eye to unanticipated consequences may result in locked-in pressures on individuals and social groups to participate in the energy system by providing flexibility. If done in a non-reflexive way, this might reenforce existing patterns of inequality across society, hence contributing to the further entrenchment of such patterns. For individuals who have low "flexibility capital" (Powells and Fell 2019), a path with strong incentives for providing flexibility might paradoxically result in less flexibility with respect to how to live and everyday life, despite the energy consumption becoming more flexible from the perspective of the energy system. Such dynamics might also contribute to the production of flexibility poverty.

In this article we have identified multiple ways of being flexible, and many mundane understandings of flexibility. When looking at individual activities, we found that the willingness and ability to act flexibly were demonstrated by many students. The students showed potential to be flexible in terms of how often, at what time, the place, or length of their energy-intensive activities with regard to the consumption of electricity. Individually, many students demonstrated a potential for flexibility. However, collectively, the students' flexibility potential was limited due to socio-material factors, such as housing, life situation, and limited flexibility capital. This might also be thought of as a form of lock-in. We suggest that some social groups, such as students, may be living, temporarily or permanently, in a situation of flexibility poverty, where there is little room to maneuver flexible energy consumption and the flexibility potential that does exist becomes constrained and "locked-in" by other activities and people.

Promoting end-user flexibility in the general population through a variety of flexibility mechanisms as a response to increased electrification and electricity consumption at critical peak hours may

coincide with basic needs in social groups that are vulnerable to flexibility poverty. For example, incentives intended to target owners of electric vehicles to charge their vehicles outside peak hours may create difficult situations in crowded student homes, where the possibilities to do energy-intensive activities, such as cooking and cleaning, are limited. Previous studies have demonstrated that the potential to be flexible in the household is dependent on flexibility capital, and there are different ways of doing "flexibility work" in households based on the flexibility capital (Fjellså et al.). Individuals with low flexibility capital have fewer options within the scope of flexibility work, hence leaving some with the only option of doing flexibility work manually. We found that this was the typical option for the students in our study, and hence it increased their vulnerability for flexibility poverty.

Also, students are a social group that is often sidelined as a target for energy policies and planning, which tend to target the general population. Economic subsidies for private persons are typically directed at owners of homes and vehicles, to improve energy efficiency efforts by, for example, installing solar panels, improving insulation or heating systems in the home, or by switching from fossil fuel based vehicles to electric vehicles. For instance, in Norway, the public energy authority, ENOVA supported 20,000 energy efficiency projects in Norwegian households through a budget of over EUR 33 million (ENOVA 2020). However, it is likely that relatively few of those who benefited from the support schemes were students, as only 1 in 10 students owns the house or flat in which they live (Revold 2019), whereas in the general population 8 out of 10 are homeowners (SSB 2021b). Housing standards have been found generally poorer for those who rent compared with those who own their homes (Normann 2016), and renters typically own less energy efficient technologies (Krishnamurthy and Kriström 2015). This demonstrates a distributional bias in public support, whereby some social groups – primarily private homeowners – are more favored than others.

In analyses of low-income households and poverty, it is common to exclude students based on the "specialness" and temporality of their life stage (e.g., With and Thorsen 2018). Such a view emphasizes that students are perceived as a special group outside mainstream society, potentially making it easier to overlook or dismiss students as stakeholders or as affected by energy policies. Others living in untraditional housing situations and being in temporal life situations may also be less targeted and outside the scope of policies, which are mainly targeted at the "traditional" end-users. Thus, being in an "untraditional" living or life situation may cause one to be more exposed to flexibility poverty. On the one hand, access to and ownership of housing and technology are essential to act flexibly with energy consumption. On the other hand, the absence of flexibility capital, and thus being flexibility poor, might be a steppingstone toward energy poverty, as structural dynamics and incentives increasingly applaud flexible energy investments and practices. Hence, we notice that current energy policies promoting more flexible energy use, the absence of flexibility capital, and experiences of flexibility poverty, indirectly may reinforce and cement already existing mechanisms of inclusion and exclusion in ways so that disadvantaged and vulnerable social groups are hit even harder. Thus, transitioning toward low-carbon societies and mitigating climate change through flexibility require the attention of policymakers and system developers to limit energy and flexibility poverty.

Insights into the effect of social, structural, and material factors in abilities for flexibility are key to unpacking the complexity of end-user flexibility. Thus, the inclusion of narratives, including those living in untraditional housing situations or who are in temporary stages of their life, such as students, broadens the understanding of end-user flexibility and opens discussions for potential structural and individual consequences.

7. Conclusions

In this article we have demonstrated how students perceived and understood flexible energy use in their daily life. We found that their individual energy consumption was generally understood as flexible but was limited and "locked-in" due to daily practices and schedules, other people co-existing in the same household, and systems of practices existing side-by-side. The variation in how flexible the

students understood themselves can be explained in terms of how the students gave meanings to the different activities and what those activities represented in their daily life. For some, a shower in the morning was the same as a shower at any given time, while for others it represented a morning ritual that gave them a fresh start to the day. Collectively, the students described and illustrated a situation in which they, as a group, generally had little flexibility available, and in which the flexibility they did have would directly impact their comfort levels or how they needed to reorganize their daily life, if acted upon.

In this article, we have also discussed the implications of "locking-in" flexibility on an individual and structural level. We have argued that a narrow focus on end-user flexibility may cause a lock-in of flexibility and consequently create path-dependency, thus also creating inflexibility among some social groups of end-users, especially leaving those in temporary housing or in temporary stages of life to become more exposed to flexibility poverty. In this article we propose flexibility poverty as a term to describe how some people have limited capital, capacity, time, and space to act on their flexibility, and thus have limited alternatives within flexibility work. We believe those who are "flexibility-poor" may be more exposed to a situation of energy poverty, particularly if flexibility becomes a commodity.

From an energy justice perspective, energy policy and innovations aimed at low emission transitions should not come at the expense of potentially vulnerable groups and should not create and reinforce a situation in which some social groups of end-users systematically live their daily life in flexibility poverty, irrespective of the temporality of their life stage and situation. Therefore, we encourage energy flexibility regulators to consider the importance of distributional bias in public support for energy efficiency measures and to be aware of the implications of "locking-in" flexibility.

Funding

The authors greatfully acknowledge the funding from Centre for Intelligent Electricity Distribution (FME CINELDI), funded by the Norwegian Research Council (grant number 257626), and the Norwegian Centre for Energy Transition Strategies (FME NTRANS), also funded by the Norwegian Research Council (grant number 296205). Our gratitude also goes to the anonymous reviewers and the editorial team of Energy Sources, Part B: Economics, Planning, and Policy.

ORCID

Ingvild Firman Fjellså http://orcid.org/0000-0003-4589-3749
Marianne Ryghaug http://orcid.org/0000-0003-3942-6810
Tomas Moe Skjølsvold http://orcid.org/0000-0001-6965-756X

References

Andrey, C., L. Fournié, M. Gabay, H. De Sevin, and K. Sakellaris. 2016. The role and need of flexibility in 2030: Focus on energy storage. Metis studies study S07. Publications Office of the European Union. Accessed April 9, 2021. https://ec.europa.eu/energy/sites/ener/files/documents/metis_study_s07_-_the_role_and_need_of_flexibility_in_2030._focus_on_storage.pdf .

Arthur, W. B. 1994. *Increasing returns and path dependence in the economy*. Ann Arbor: University of Michigan Press.

Ballo, I. F. 2015. Imagining energy futures: Sociotechnical imaginaries of the future smart grid in Norway. *Energy Research & Social Science* 9:9–20. doi:10.1016/j.erss.2015.08.015.

Barnicoat, G., and M. Danson. 2015. The ageing population and smart metering: A field study of householders' attitudes and behaviours towards energy use in Scotland. *Energy Research & Social Science* 9:107–15. doi:10.1016/j.erss.2015.08.020.

Barstad, A., T. Løwe, and L. R. Thorsen. 2012. *Studenters inntekt, økonomi og boutgifter Levekår blant studenter 2010* [Income, economic and study situation for students 2010] Statistisk sentralbyrå Rapporter 38/2012. Oslo and Kongsvinger: Statistisk sentralbyrå.

Blue, S., E. Shove, and P. Forman. 2020. Conceptualising flexibility: Challenging representations of time and society in the energy sector. *Time & Society* 29:923–44. doi:10.1177/0961463X20905479.

Bouzarovski, S., S. Petrova, M. Kitching, and J. Baldwick. 2013. Precarious domesticities: Energy vulnerability among urban young adults. In *Energy justice in a changing climate: Social equity and low-carbon energy*, ed. K. Bickerstaff, G. Walker, and H. Bulkeley, 30–45. London and New York: Zed Books.

Bredvold, T. L. 2020. "Where no one is poor, and energy is abundant" A study of energy poverty in Norwegian households'. Master's thesis, University of Oslo.

Christensen, T. H., F. Friis, S. Bettin, W. Throndsen, M. Ornetzeder, T. M. Skjølsvold, and M. Ryghaug. 2020. The role of competences, engagement, and devices in configuring the impact of prices in energy demand response: Findings from three smart energy pilots with households. *Energy Policy*, 137 (111142): 1–11. https://doi.org/10.1016/j.enpol.2019.111142

Christensen, T. H., and E. Rommes. 2019. Don't blame the youth: The social-institutional and material embeddedness of young people's energy-intensive use of information and communication technology. *Energy Research & Social Science* 49:82–90. doi:10.1016/j.erss.2018.10.014.

Christensen, T. H., R. Mourik, S. Breukers, T. Mathijsen, and H. Heuvel. 2014. Young people, ICT and energy – Status and trends in young people's use and understanding of ICT and energy consumption. D2.1 Technical report on the organisation and outcomes of focus groups and the mapping exercise. Intelligent Energy Europe, Aalborg University, Denmark. Accessed March 29, 2021. http://vbn.aau.dk/files/201886616/UseITsmartly_WP2_report_D2.1_FINAL.pdf

Cotton, D. R. E., J. Zhai, W. Miller, L. Dalla Valle, and J. Winter. 2020. Reducing energy demand in China and the United Kingdom: The importance of energy literacy. *Journal of Cleaner Production* 278:Article 123876. doi:10.1016/j.jclepro.2020.123876.

Doukas, H., and V. Marinakis. 2020. Energy poverty alleviation: Effective policies, best practices and innovative schemes. *Energy Sources, Part B: Economics, Planning, and Policy* 15 (2):45–48. doi:10.1080/15567249.2020.1756689.

Druckman, J. N., and C. D. Kam. 2011. Students as experimental participants. In *Cambridge handbook of experimental political science*, ed. J. N. Druckman, D. P. Green, J. H. Kuklinski, and A. Lupia, 41–57. New York: Cambridge University Press.

Dulleck, U., R. Russell-Bennett, K. Letheren, S. Whyte, and M. Brumpton. 2019. *Hug, nudge, shove or smack? Testing approaches to reducing peak energy consumption by consumers – Final report*. Australia: Queensland University of Technology. Accessed March 29, 2021. https://research.qut.edu.au/best/publications/hug-nudge-shove-or-smack-testing-approaches-to-reducing-peak-energy-consumption-by-consumers-final-report/ .

EEA. 2021. Climate change is one of the biggest challenges of our times. European Environment Agency. Accessed April 8, 2021. https://www.eea.europa.eu/themes/climate/climate-change-is-one-of .

Energifaktanorge. 2019. Energy use by sector. Accessed April 8, 2021. https://energifaktanorge.no/en/norsk-energibruk/energibruken-i-ulike-sektorer/ .

ENOVA. 2020. Årsrapport 2019. Accessed March 29, 2021. https://www.enova.no/om-enova/kampanjer/arsrapporten-2019/ .

Fjellså, I. F., A. Silvast and T. M. Skjølsvold. 2021. Justice aspects of flexible household electricity consumption in future smart energy systems. *Environmental Innovation and Societal Transitions* 38:98–109. https://doi.org/10.1016/j.eist.2020.11.002

Geels, F. W., B. K. Sovacool, T. Schwanen, and S. Sorrell. 2017. Sociotechnical transitions for deep decarbonization. *Science* 357 (6357):1242–44. doi:10.1126/science.aao3760.

Gilli, P. V., N. Nakicenovic, and R. Kurz 1996. First- and second-law efficiencies of the global and regional energy systems. IIASA Research Report RR-96-2. Accessed April 8, 2021. https://core.ac.uk/download/pdf/33895933.pdf .

Gram-Hanssen, K. 2011. Understanding change and continuity in residential energy consumption. *Journal of Consumer Culture* 11 (1):61–78. doi:10.1177/1469540510391725.

Grubler, A., C. Wilson, N. Bento, B. Boza-Kiss, V. Krey, D. L. McCollum, N. D. Rao, K. Riahi, J. Rogelj, S. De Stercke, et al. 2018. A low energy demand scenario for meeting the 1.5 °C target and sustainable development goals without negative emission technologies. *Nature Energy* 3:515–27. doi:10.1038/s41560-018-0172-6.

Hansen, A. R. 2018. Sticky' energy practices: The impact of childhood and early adulthood experience on later energy consumption practices. *Energy Research & Social Science* 46:125–39. doi:10.1016/j.erss.2018.06.013.

Hargreaves, T., M. Nye, and J. Burgess. 2013. Keeping energy visible? Exploring how householders interact with feedback from smart energy monitors in the longer term. *Energy Policy* 52:126–34. doi:10.1016/j.enpol.2012.03.027.

Higginson, S. L. 2014. The rhythm of life is a powerful beat: Demand response opportunities for time-shifting domestic electricity practices. PhD thesis, Loughborough University.

Ingeborgrud, L., S. Heidenreich, M. Ryghaug, T. M. Skjølsvold, C. Foulds, R. Robison, K. Buchmann, and R. Mourik. 2020. Expanding the scope and implications of energy research: A guide to key themes and concepts from the social sciences and humanities. *Energy Research & Social Science* 63:101398. doi:10.1016/j.erss.2019.101398.

Jenkins, K., D. McCauley, R. Heffron, H. Stephan, and R. Rehner. 2016. Energy justice: A conceptual review. *Energy Research & Social Science* 11:174–82. doi:10.1016/j.erss.2015.10.004.

Kaygusuz, K. 2010. Climate change and biomass energy for sustainability. *Energy Sources, Part B: Economics, Planning, and Policy* 5 (2):133–46. doi:10.1080/15567240701764537.

Keute, A.-L. 2017. For mye betalt arbeid går på bekostning av studietiden [Too much paid work affects study time]. Accessed October 20, 2020. https://www.ssb.no/utdanning/artikler-og-publikasjoner/for-mye-betalt-arbeid-gar-pa-bekostning-av-studietiden .

Keute, A.-L. 2018a. Hjemme bra, men borte best? Studentenes bosituasjon [Good to be home, but away is better? Students' living situation]. Accessed October 20, 2020. https://www.ssb.no/utdanning/artikler-og-publikasjoner/hjemme-bra-men-borte-best .

Keute, A.-L. 2018b. Studielån og deltidsjobb langt vanligere i Norden enn i resten av Europa [Student loan and part-time jobs are more common in the North than elsewhere in Europe]. Accessed October 20, 2020. https://www.ssb.no/utdanning/artikler-og-publikasjoner/studielan-og-deltidsjobb-langt-vanligere-i-norden-enn-i-resten-av-europa .

Kousis, I., M. Laskari, V. Ntouros, M.-N. Assimakopoulos, and J. Romanowicz. 2020. An analysis of the determining factors of fuel poverty among students living in the private-rented sector in Europe and its impact on their well-being. *Energy Sources, Part B: Economics, Planning, and Policy* 15 (2):113–35. doi:10.1080/15567249.2020.1773579.

Krishnamurthy, C., and B. Kriström. 2015. How large is the owner-renter divide in energy efficient technology? Evidence from an OECD cross-section. *The Energy Journal* 36 (4):85–104. doi:10.5547/01956574.36.4.ckri.

Lien, S. K., M. Ahang, K. B. Lindberg, and Ø. Fjellheim. 2020. ZEN case study: End user flexibility potential in the service sector. ZEN report 27, NTNU/SINTEF. Accessed March 29, 2021. https://ntnuopen.ntnu.no/ntnu-xmlui/handle/11250/2684264 .

Morris, J., and A. Genovese. 2018. An empirical investigation into students' experience of fuel poverty. *Energy Policy* 120:228–37. doi:10.1016/j.enpol.2018.05.032.

Normann, T. M. 2016. Dårligere boforhold for leiere enn for eiere [Worse living conditions for tenants than for homeowners]. Accessed October 30, 2020. https://www.ssb.no/bygg-bolig-og-eiendom/artikler-og-publikasjoner/darligere-boforhold-for-leiere-enn-for-eiere .

OECD. 2016. OECD economic surveys: Norway 2016. Accessed March 29, 2021. http://dx.doi.org/10.1787/eco_surveys-nor-2016-en .

Öhrlund, I., Å. Linné, and C. Bartusch. 2019. Convenience before coins: Household responses to dual dynamic price signals and energy feedback in Sweden. *Energy Research & Social Science* 52:236–46. doi:10.1016/j.erss.2019.02.008.

Öhrlund, I. 2020. Demand side response: Exploring how and why users respond to signals aimed at incentivizing a shift of electricity use in time. Doctoral thesis, Uppsala University.

Powells, G., and M. J. Fell. 2019. Flexibility capital and flexibility justice in smart energy systems. *Energy Research & Social Science* 54:56–59. doi:10.1016/j.erss.2019.03.015.

Revold, M. K. 2019. Færre unge kjøper bolig [Fewer young people buy housing]. SSB analyse 2019/23: Unge på boligmarkedet. Accessed October 20, 2020. https://www.ssb.no/bygg-bolig-og-eiendom/artikler-og-publikasjoner/faerre-unge-kjoper-bolig .

Robison, R., T. M. Skjølsvold, J. Lehne, E. Judson, V. Pechancová, C. Foulds, L. Bilous, C. Büscher, G. Carrus, S. Darby et al. 2020. *100 social sciences and humanities priority research questions for smart consumption in Horizon Europe*. Cambridge: Energy-SHIFTS.

Rotger-Griful, S., R. H. Jacobsen, R. S. Brewer, and M. K. Rasmussen. 2017. Green lift: Exploring the demand response potential of elevators in Danish buildings. *Energy Research & Social Science* 32:55–64. doi:10.1016/j.erss.2017.04.011.

Royston, S., J. Selby, and E. Shove. 2018. Invisible energy policies: A new agenda for energy demand reduction. *Energy Policy* 123:127–35. doi:10.1016/j.enpol.2018.08.052.

Ryghaug, M., and T. M. Skjølsvold. 2019. Nurturing a regime shift toward electro-mobility in Norway. In *The governance of smart transportation systems: Towards new organizational structures for the development of shared, automated, electric and integrated mobility*, ed. M. Finger and M. Audouin, 147–65. Cham: Springer.

Sæle, H., and O. S. Grande. 2011. Demand response from household customers: Experiences from a pilot study in Norway. *IEEE Transactions on Smart Grid* 2 (1):102–09. doi:10.1109/TSG.2010.2104165.

Schick, L., and C. Gad. 2015. Flexible and inflexible energy engagements—A study of the Danish smart grid strategy. *Energy Research & Social Science* 9:51–59. doi:10.1016/j.erss.2015.08.013.

Schwarzinger, S., D. N. Bird, and T. M. Skjølsvold. 2019. Identifying consumer lifestyles through their energy impacts: Transforming social science data into policy-relevant group-level knowledge. *Sustainability* 11 (21):6162. doi:10.3390/su11216162.

Shirani, F., C. Groves, K. Henwood, N. Pidgeon, and E. Roberts. 2020. 'I'm the smart meter': Perceptions of smart technology amongst vulnerable consumers. *Energy Policy* 144 (Article):111637. doi:10.1016/j.enpol.2020.111637.

Shove, E. 2003. *Comfort, cleanliness and convenience: The social organization of normality*. Oxford: Berg.

Shove, E. 2009. Everyday practices and the production and consumption of time. In *Time, consumption and everyday life: Practice, materiality and culture*, ed. E. Shove, F. Trentmann, and R. Wilk, 17-33. Oxford and New York: Berg.

Silvast, A., W. Robin, S. Hyysalo, K. Rommetveit, and C. Raab. 2018. Who 'uses' smart grids? The evolving nature of user representations in layered infrastructures. *Sustainability* 10 (10):Article3738. doi:10.3390/su10103738.

Skjølsvold, T. M., M. Ryghaug and T Berker. 2015. A traveler's guide to smart grids and the social sciences, *Energy Research & Social Science*, 9: 1–8. https://doi.org/10.1016/j.erss.2015.08.017 .

Skjølsvold, T. M., S. Jørgensen and M. 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. https://doi.org/10.1016/j.erss.2016.11.005

Skjølsvold, T. M., M. Ryghaug, and J. Dugstad. 2013. Building on Norway's energy goldmine: Policies for expertise, export, and market efficiencies. In *Renewable Energy Governance: Complexities and challenges*, ed. E. Michalena and J. M. Hills, 337–49. London: Springer.

Smale, R., B. Van Vliet, and G. Spaargaren. 2017. When social practices meet smart grids: Flexibility, grid management, and domestic consumption in the Netherlands. *Energy Research & Social Science* 34:132–40. doi:10.1016/j.erss.2017.06.037.

Sokołowski, J., P. Lewandowski, A. Kiełczewska, and S. Bouzarovski. 2020. A multidimensional index to measure energy poverty: The Polish case. *Energy Sources, Part B: Economics, Planning, and Policy* 15 (2):92–112. doi:10.1080/15567249.2020.1742817.

Sovacool, B., D. J. Hess, S. Amir, F. W. Geels, R. Hirsh, L. Rodriguez Medina, C. Miller, C. Alvial Palavicino, R. Phadke, M. Ryghaug, et al. 2020. Sociotechnical agendas: Reviewing future directions for energy and climate research. *Energy Research & Social Science* 70 (Article):101617.

SSB. 2012. Husholdninger med utvalgte varige forbruksvarer (prosent), etter varegruppe, husholdningstype, statistikkvariabel og år [Households with selected durable consumer goods, by various types of household (per cent)]. Statistisk Sentralbyrå. Accessed October 30, 2020. https://www.ssb.no/statbank/sq/10042556 .

SSB. 2021a. Studenter i høyere utdanning [Students in higher education]. Statistisk Sentralbyrå. Accessed April 8, 2021. https://www.ssb.no/utdanning/statistikker/utuvh .

SSB. 2021b. Boforhold, registerbasert [Housing conditions, register-based]. Statistisk Sentralbyrå. Accessed April 8, 2021. https://www.ssb.no/en/bygg-bolig-og-eiendom/statistikker/boforhold .

Steffensen, K., R. Ekren, and G. Nygård. 2015. Studenters økonomi og studiesituasjon: Norske resultater fra Eurostudent V i et europeisk perspektiv [Economic and study situation for students: Norwegian results from Eurostudent V in a European prespective]. Statistisk sentralbyrå Rapporter 2015/50, Statistisk sentralbyrå, Oslo and Kongsvinger.

Strengers, Y. 2013. *Smart energy technologies in everyday life: Smart utopia?* London: Palgrave Macmillan.

Strengers, Y. 2014. Smart energy in everyday life: Are you designing for resource man? *Interactions* 21 (4):24–31. doi:10.1145/2621931.

Throndsen, W. 2017. What do experts talk about when they talk about users? Expectations and imagined users in the smart grid. *Energy Efficiency* 10 (2):283–97. doi:10.1007/s12053-016-9456-5.

Tjørring, L., C. L. Jensen, L. G. Hansen, and L. M. Andersen. 2018. Increasing the flexibility of electricity consumption in private households: Does gender matter? *Energy Policy* 118:9–18. doi:10.1016/j.enpol.2018.03.006.

Torriti, J. 2012. Price-based demand side management: Assessing the impacts of time-of-use tariffs on residential electricity demand and peak shifting in Northern Italy. *Energy* 44 (1):576–83. doi:10.1016/j.energy.2012.05.043.

UN. 2020. Climate action: Why it matters. 13. Climate action. Sustainable development goals. Accessed April 8, 2021. https://www.un.org/sustainabledevelopment/wp-content/uploads/2019/07/13_Why-It-Matters-2020.pdf .

Unruh, G. C. 2000. Understanding carbon lock-in. *Energy Policy* 28 (12):817–30. doi:10.1016/S0301-4215(00)00070-7.

Wadud, Z., S. Royston, and J. Selby. 2019. Modelling energy demand from higher education institutions: A case study of the UK. *Applied Energy* 233 (23):816–26. doi:10.1016/j.apenergy.2018.09.203.

Walker, G. 2014. The dynamics of energy demand: Change, rhythm and synchronicity. *Energy Research & Social Science* 1:49–55. doi:10.1016/j.erss.2014.03.012.

With, M. L., and L. R. Thorsen. 2018. Materielle og sosiale mangler i den norske befolkningen [Material and social deprivation in Norway]. Rapporter 2018/7, Statistisk Sentralbyrå, Oslo and Kongsvinger.