Energy Efficiency (2023) 16:75
https://doi.org/10.1007/s12053-023-10153-1

ORIGINAL ARTICLE

# Flexibility for whom? Householder and stakeholder perspectives on justice regarding the introduction of dynamic grid tariffs in Norway

**Tanja Winther** · **Øyvind Sundet**

Received: 2 January 2023 / Accepted: 14 August 2023 / Published online: 5 September 2023


**Abstract** This paper presents the results from a qualitative research project in Norway on a forthcoming change in electricity grid tariffs. As a form of Demand Side Management to avoid capacity constraints in the grid, the new tariff seeks to reduce consumption peaks by incentivising householders to even out electricity use and shift to nighttime. We examine the perspectives of 13 representatives from grid companies as well as 22 householders and study the process of developing the tariffs, in which the researchers took part at certain times. We draw on previous studies on experts' perceptions of end-users, social practice theory, and energy justice, and we employ the concept of flexibility capital to examine the situation of the participating households. The findings partly confirm results from previous studies showing that experts may have a simplistic view of end-users and by observing an unequal distribution of flexibility capital across the studied households. However, the study contributes to the field by observing a link between householders' sentiments towards the new tariff and their respective levels of affluence and flexibility capital. Then, we explicitly address justice perspectives related to the tariff's introduction as perceived by grid companies and householders and find that both groups voice a need to acknowledge the situation of different kinds of end-users. We discuss the results from an energy justice perspective and observe that details in the design of a DSM mechanism may dampen its negative effects.

T. Winther (✉) · Ø. Sundet
Centre for Development and the Environment, University of Oslo, Oslo, Norway
e-mail: tanja.winther@sum.uio.no

**Keywords** Electricity use · Dynamic grid tariffs · Demand Side Management · Flexibility capital · Households · Distribution System Operators · Energy justice · Gender · Social costs · Everyday life

## Introduction

This paper presents the results from a qualitative research project on a forthcoming dynamic pricing model for transport of electricity (grid tariffs) that was introduced to households in Norway in the aftermath of the research. This kind of model is often referred to as demand or capacity pricing. We are particularly interested in examining the justice implications of the new tariff as expressed in in-depth interviews with householders and stakeholders, respectively. We were able to engage with stakeholders in the development of the new tariff, and observation of this process also forms part of the analysis.

In current energy policies and the smart grid literature, there is considerable trust in 'user flexibility' administered through Demand Side Management (DSM) as a strategy to handle current and future challenges in electricity systems (e.g. Ballo, 2015; Fjellså et al., 2021b; Powells et al., 2014; Shove & Cass, 2018). Incentives such as the dynamic grid tariff under study are introduced to reduce peak loads by motivating customers to modify their electricity use in periods with bottlenecks in the electricity system, whether these problems derive from supply scarcity or capacity problems in local or regional electricity grids (Darby & McKenna, 2012). Seen from the system side, there are two main ways of compelling customers to shift electricity consumption to reduce peak loads: by encouraging them to actively adjust their own consumption (e.g. in response to dynamic prices) or through automated DSM, which implies installing technologies for automatic control of energy use such as the timing of water boilers (Adams et al., 2021).

However, a growing body of social science literature has pointed to the unintended consequences and social costs such regimes may produce. Different types of households have different capacities to respond to incentives promoting flexibility (Adams et al., 2021; Calver & Simcock, 2021; Fjellså et al., 2021a; Powells & Fell, 2019). This observation concerns energy justice (Fjellså et al., 2021b; Jalas & Numminen, 2022; Jenkins et al., 2016) because it has to do with the distributional implications of energy interventions (Jenkins et al., 2016).

In the face of dynamic electricity pricing, some groups, such as students who tend to be tenants, may be at heightened risk of energy poverty, as captured in the term *flexibility poverty* (Fjellså et al., 2021a). Automated DSM may also come at a social cost considering the significant amount of *flexibility labour* that such technology can inflict on end-users, 'assuming them to be unbothered by the alteration to household energy practices' (Adams et al., 2021, p. 8).

Several of the mentioned contributions build on the notion of *flexibility capital*, proposed by Powells and Fell (2019, p. 56), which draws attention to end-users' varying capacity to shift their energy-use practices in time or space to make the whole system more flexible. The concept of flexibility capital will also be central in the present analysis of households' capacity to shift electricity use. Similar to Jalas and Numminen (2022), we will employ the framework of energy justice to examine flexibility measures. Hence, we will also analyse procedural and recognitional justice, which tend to be linked with distributional aspects (Jenkins et al., 2016). The novelty of our study is that we (i) examine empirically how householders' flexibility capital is linked with their perceptions of a new flexibility measure (dynamic grid tariff) and (ii) explicitly address justice perspectives related to the tariff's introduction as perceived by grid companies and householders.

The study is based on 35 in-depth interviews with selected households and representatives from grid companies (DSOs—Distribution System Operators) in Norway in 2020–2021 when a new pricing model for electricity transport (grid tariffs) was being developed. The new grid tariff consisted of an energy-based component (kWh), including time-of-use charges, and a demand based component (month max kWh/h). In addition, we attended meetings with a group of DSOs during a period of 1 ½ years. Our participation in these interviews and meetings, where we often conveyed perspectives taken from households, implies that we were partly involved in developing the new tariffs, as we discuss below.

The "Literature review and analytical lens" section provides a short literature review and presents our analytical lens. The "Setting the scene: a flexibility measure (grid tariff) introduced in a context with dual dynamic price signals" section describes the Norwegian electricity context in which the new tariff was introduced. There is a strict separation between electricity supply (market) and transport of electricity through the grid (monopoly) in Norway. With the introduction of dynamic grid pricing, Norwegian households would therefore be subject to dual price signals, and few studies have accounted for such situations (see Öhrlund et al., 2019 for treatment of Sweden). In the "Methods" section, we describe the methods. The "Results" section presents the findings from stakeholder and household interviews. In the "Discussion" section, we discuss the findings, while we end with the section "Concluding remarks". Appendix conveys the information we presented to households during the interviews and more details on the tariffs' components.

## Literature review and analytical lens

We employ a combination of social practice theory, energy justice perspectives, and recent lines of thinking about flexibility in electricity use. Here, we also draw on works that have examined how ‘experts’ (engineers, developers) envisage end-users in smart grid systems and the role users are expected to play as imagined by experts. This will provide an important backdrop for analysing user- and stakeholder perspectives on the justness of the new grid tariffs in Norway.

The cluster of approaches referred to as social practice theory has become established as a fruitful way to understand home energy consumption (Godin et al., 2020; Gram-Hanssen, 2010; Gram-Hanssen, 2014; Halkier et al., 2011; Shove, 2003; Shove & Walker, 2014; Wilhite, 2013; Winther & Wilhite, 2015). Practice theory suggests that energy consumption is not an end in itself, but a result of people engaging in everyday practices, which in turn are constituted by material and socio-cultural elements (e.g. social norms) and performed on a regular basis, i.e. when doing laundry, cooking dinner, or charging and driving electric vehicles.

## Flexibility from a system perspective and imaginaries of end-users

From an electricity system perspective, ‘flexibility’ is associated with aggregated consumption and mechanisms to reduce demand when supply is constrained or likely to be so in the future (Powells & Fell, 2019). Policy makers and energy providers (and some researchers) tend to regard flexibility as a technical capacity of the energy system, a resource to be tapped into from end-users (Blue et al., 2020; Fjellså et al., 2021b; Løgstrup et al., 2013). However, this notion of flexibility serves to ‘detach the timing of supply and demand from the socio-temporal organisation of society’ (Blue et al., 2020, p. 932). According to practice theory, it is precisely the socio-temporal organisation of society that should form a starting point of the analysis of flexibility.

The development of smart grid systems and developers’ (experts’) envisioning of end-users are dominated and shaped by technological innovation and language (Ballo, 2015; Løgstrup et al., 2013). Furthermore, there seems to be a discrepancy between how the smart grid is communicated to ‘an imagined public’ and the developers’ own concerns: (over)selling consumer advantages to increase public acceptance while under-communicating the potential benefits of the system (Ballo, 2015). These observations are echoed in the conversations with the DSOs studied here. As we will show, balancing system optimisation with consumer acceptance presented an uneasy tension in the DSOs communication efforts.

While authorities and the ‘techno-epistemic network’ (Ballo, 2015, p. 10) in Norway promote consumer participation, critical scholars argue that users lack channels for engagement in the smart grid transition, leading to a renewed grip on users by the grid/system (Rommetveit et al., 2021, p. 6). This aspect has relevance when we analyse the process of developing grid tariffs and procedural justice.

In sum, this literature highlights the important role of *technological innovation* in the development of smart grid systems in Norway. In addition, *economic rationality* forms a central principle for cost redistribution in the flexible electricity system, where different types of consumption are punished or rewarded (Fjellså et al., 2021b). This rationality implies that ‘the energy system is represented as fair when its tariffs reflect the “actual cost” of flexibility’ (ibid, p. 107). Regarding fairness from a system perspective largely resonates with the accounts of our interviewed DSO representatives.

But who are the users as imagined by system developers? As noted above, perceptions of the economically rational consumer dominate developers’ imaginaries. This is embedded in the motivation for introducing dynamic grid tariffs, where shifting prices are expected to make people shift electricity use. In an early study of DSM in Australia, Yolande Strengers (2010) found that when responding to DSM, people’s motives were rarely financial, but rather a perceived social responsibility to act, and this finding has been confirmed in later studies (Öhrlund et al., 2019). In contrast, Strengers (2014) observes that developers’ vision of the archetypical end-user remains that of ‘resource man’ who will use the technology and respond to it in the prescribed, desirable ways (see also Adams et al., 2021; Ballo, 2015; Nyborg, 2015). The idea of economically rational customers remains strong. In a review article, *What do experts talk about when they talk about users?* Throndsen (2017) detected three main user narratives in the literature: (i) appeals to economically rational and active individuals (responding to price signals), (ii) promotion of automated technology to avoid the ‘problem’ with active users (Adams et al., 2021 for a critique of automation), and (iii) social science narratives which often compare imagined users with real users. In many ways, the present study follows the third narrative, and will therefore, in line with many scholars, criticise the former two narratives for being overly simplistic and neglecting aspects of justice.

## The three tenets of justice

With reference to the fixed capacity of a given energy system, Powells and Fell (2019) consider the distribution of costs and benefits as a zero-sum game. Thus, benefits tapped by flexible end-users (those with high flexibility and financial capital, see below) will be *at the cost* of non-flexible groups. Other scholars contend that all consumers may win in the future (get access to affordable electricity) if the need to make future investments in transmission and distribution is avoided or reduced (Calver & Simcock, 2021, p. 4). This last narrative reflects the way authorities and DSOs in Norway presented the new tariff model.

Calver and Simcock (2021), applying a framework of energy justice developed by Sovacool and Dworkin (2015), [1] argue that the introduction of DSM may both increase the risk of injustice but also contribute to the opposite result: more justice. Here, they note that the design of a particular flexibility measure may increase or impede justice (Calver & Simcock, 2021). This is important and follows science and technology studies as well as social practice theory in that a given set of socio-technical configurations matter to their social outcomes.

In the present work on the potential effects of a new grid tariff and the perceptions of involved stakeholders and end-users, we relate to the three tenets of energy justice that have lately become established in social science energy literature: distributional, recognitional, and procedural justice. Here, we follow Jenkins et al. (2016) who build on McCauley et al. (2013), Sovacool and Dworkin (2014), and others. The discussion above regarding a potential distribution of costs between users today and in the future concerns *distributional justice*. Jalas and Numminen (2022) capture distributional justice primarily in monetary terms in their analysis of flexibility capital. Furthermore, the energy justice framework brings attention to *recognitional justice* by asking whose interests are accounted for in the design of the intervention—and whose are ignored. This question often draws attention to vulnerable groups and whether the particularities of their situation have been accommodated (Jalas & Numminen, 2022). In the just cities literature, this tenet of justice is also referred to as *diversity* (Fainstein, 2014, pp. 9–11), which draws attention to citizens' different positions and needs. In cases where some groups are not recognised as legitimate stakeholders, there is increased risk of injustice. Finally, procedural justice regards decision-making processes. From the mentioned work of Rommetveit et al., 2021, and the observed lack of channels for conveying users' views and engagement, one may expect that decisions about the new tariff might primarily be made by developers and DSOs and not by consumers or bodies representing their views. However, in the present study, the researchers at some point served as brokers between developers (DSOs) and end-user interests in a way that provided opportunities to convey user perspectives and also focus on the DSO–householder relations (c.f. Powells et al., 2014, p. 51). Work on DSM among communities with long-term collaboration between a DSO and end-users has also shown that inclusive processes and partnerships may yield positive results that reduce peak demand (Morris et al., 2018). This contrasts somewhat with the way Løgstrup et al. (2013) and their knowledge about Danish end-users' practices were bypassed in the process of developing a DSM regime. In the "Discussion" section, we will return to whether the process under study could be described as more participative and 'socially robust' than conventional DSM design processes, to follow Ballo (2015) use of Gidden's notion.

## Flexibility from a social practice perspective

Authors anchored in social practice theory call for a conceptualisation of flexibility that builds on work that has problematised the concept of demand (Rinkinen et al., 2020; Shove & Walker, 2014; Wilhite et al., 2000) and scrutinised the temporal organisation of everyday life (Southerton, 2006). Along such lines, Powells and Fell (2019, p. 56) suggest a definition of

[1] Sovacool and Dworkin (2015) refer to eight principles of energy justice: availability, affordability (max 10% of income spent for energy services), due process, good governance, sustainability, intragenerational equity, intergenerational equity, and responsibility.

energy flexibility that considers householders' ability to shift energy use in time and space according to a given mechanism such as capacity pricing. To this, we would add that people's *willingness* to modify their energy related practices also form part of their degree of flexibility. In the literature, different studies have examined which kind of social practices are more likely than others to be flexible. Without going into detail, it has been shown that practices such as doing the laundry or charging an electric car, which are relatively open to rhythmic improvisation (*detached*) and which do not require a high degree of co-presence of other things or people (*few coupling constraints*), are more flexible than, e.g. cooking and eating dinner (Blue et al., 2020, pp. 933–936; Shove & Cass, 2018, p. 9; Powells et al., 2014, pp. 47–48; Røpke & Christensen, 2013, pp. 53–55). When presenting our findings, we will account for which practices our interviewed householders considered to be most open to temporal changes.

## Who can be flexible and what are the possible repercussions of DSM?

An important premise when looking into flexibility and questions of fairness and justice is that people are positioned differently within social practices and have unequal access to material and human resources and thereby agency (Sewell, 1992, p. 21). Many factors may affect individuals' degree of energy flexibility in response to an external signal: bodily capacity, affluence, gender, time (occupation of the house during daytime gives more flexibility), household composition (fewer members give more flexibility), materiality of housing and infrastructure, and information provision/skills/understandings (Calver & Simcock, 2021, pp. 5–6; Torriti & Yunusov, 2020). The limitation on flexibility for elderly and people with chronic health conditions has been noted by Calver and Simcock (2021), who observe that most studies on flexibility have attempted to quantify the effects on consumption (with varying results), some also mapping the redistribution of energy costs on different socio-economic groups (e.g. Yunusov & Torriti, 2021). However, they argue there is a striking lack of research on how people's adaption to DSM measures impacts their well-being.

The gendered organisation of everyday life may also have implications for flexibility (Gram-Hanssen et al., 2017). In the UK, Denmark and Norway, doing the laundry is more often women's responsibility (Sæle & Aasen, 2021; Shove, 2003; Tjørring et al., 2018). In contrast, the charging of electric vehicles in Norway is more often performed by men than women (Sæle & Aasen, 2021). Studies have shown that men tend to have a greater interest in smart meters and monitoring energy consumption than women (Standal et al., 2019). Though the picture is evidently mixed, women more often undertake the actual time shifting of domestic practices to save energy (Mechlenborg & Gram-Hanssen, 2020) and adjust the rhythm of domestic life when having solar panels on the roof (Standal et al., 2019). In a study on demand-side responses, Johnson (2020) found that in many cases it was women who performed the work to adjust household routines, using the term 'flexibility woman' as a counterpoint to the archetypal 'resource man' as envisioned by developers (Strengers, 2014). Similarly, in a Norwegian study where householders were asked hypothetical questions regarding a future flexibility regime, Fjellså et al. (2021b) point to the uneven distribution of 'flexibility work' this would create for householders and the risk of more women (than men) adjusting daily practices to shifting prices.

## A model for mapping unequal distribution of flexibility capital

Powells and Fell (2019, p. 57) introduced the term flexibility capital by building on Bourdieu (1986) concept of capital, which includes economic capital as well as social and cultural forms of value which, under certain circumstances, may be convertible into economic capital. In the context of current energy systems Powells and Fell, drawing on earlier works by Powells and Bulkeley (2013), suggest that people's ability to be flexible can be considered as a form of capital: 'In our view, smart energy systems create the conditions for flexibility to be valued and, as a result, the flexibility of energy users is effectively "capitalised"' (Powells & Fell, 2019, p. 57). The concept of flexibility capital has been operationalised in previous studies (Adams et al., 2021; Fjellså et al., 2021a, b) and will also be applied in the present study.

In smart energy systems, flexibility capital may vary across different dimensions, and as an example,

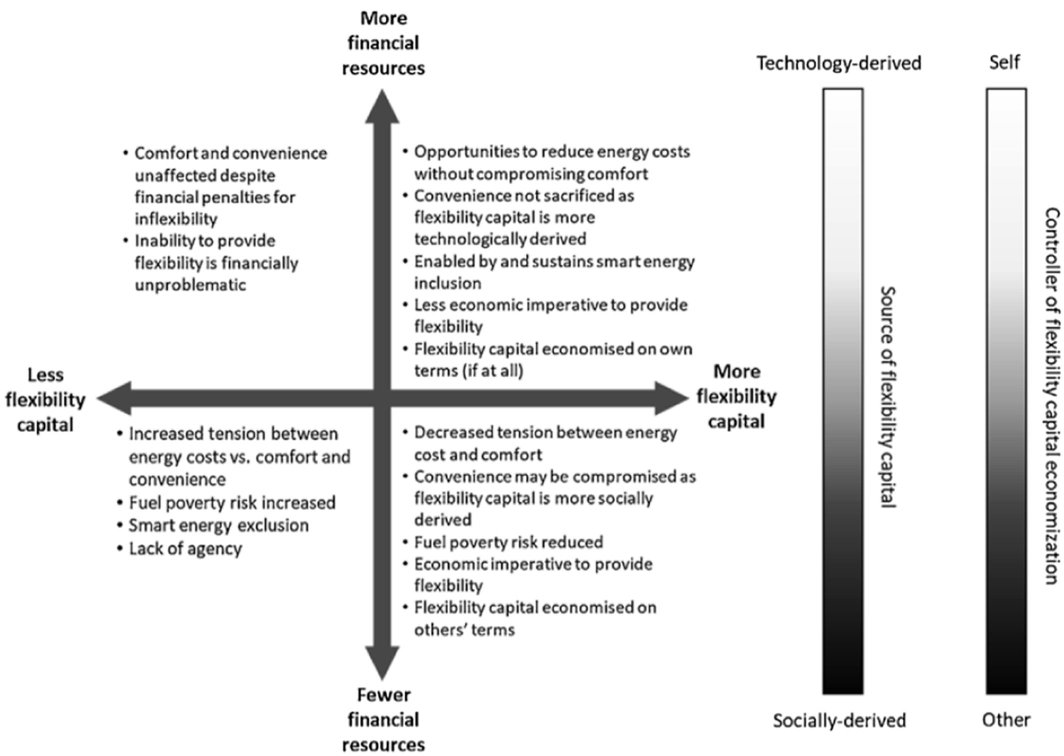


**Fig. 1** Generalised representation of the interaction between flexibility capital and financial resources (affluence), retrieved from Powells & Fell, 2019, p. 58

Powells and Fell (2019) focus on the relationship between affluence and flexibility capital. In their model (Fig. 1), affluent householders with flexibility capital will benefit from a given DSM mechanism, whereas non-affluent people (with flexibility capital) will respond to the mechanism by making adjustments in daily energy use, potentially jeopardising their comfort and convenience. This is so because affluent groups are more likely to have access to technologies 'that can act as buffers between their daily practices and the flexibility valued by the grid' (ibid, p. 57).

Among groups with less flexibility capital, the ones possessing more financial resources will experience the same level of comfort and convenience as before, but with higher economic costs for maintaining existing practices. Those with little flexibility capital and fewer financial resources are likely to experience higher economic costs, less comfort and convenience, and an increased risk of fuel poverty (ibid.). We will employ this model in the analysis of flexibility capital among our interviewed householders and examine their responses to the new tariff.

## Setting the scene: a flexibility measure (grid tariff) introduced in a context with dual dynamic price signals

The setup of the Norwegian electricity sector is important for understanding households' ability and willingness to shift electricity use in response to the new grid tariff. Historically, Norway has been one of Europe's largest producers of renewable energy, with hydroelectric power being the dominant source of electricity production. For decades, electricity was cheap, abundant, and easily available to both households and industry (Inderberg, 2015; Ryghaug & Sørensen, 2009). Consequently, most Norwegian homes depend on electricity for space heating, while other types of systems, such as hot water for space heating, have not been a policy priority (Ryghaug & Sørensen, 2009). While many households use wood for heating, Norwegian homes remain highly dependent on electricity consumption for their well-being. Another implication of the country's abundant access to hydropower is that electricity policies have mainly sought to achieve profitability and cost-effectiveness (Ryghaug & Sørensen, 2009; Skjølsvold et al., 2013).

The electricity sector was deregulated in 1991, with important consequences for the setup of relations in the sector. On the one hand, households were included in the electricity market from the start and now had to select their electricity supplier/retailer/provider, which could be physically located in any part of Norway. This market is mainly governed by the Norwegian Competition Authority, whose main mission during the initial phase was to encourage households to change suppliers to ensure that the market was functioning well. In 2013, about one-quarter of Norwegian households had a supplier other than the main one in their local area (i.e. their 'previous supplier' before deregulation), and the domestic electricity market was considered to be 'mature' (Winther & Bouly de Lesdain, 2013).

The types of contract households have with their supplier matters to the degree they are exposed to fluctuations in the market. The types of contracts range from the price being linked with spot market to a fixed price for a longer period of time, or other types of contract. In 2021, as many as 74% of Norwegian households had an electricity contract linked to the spot market accommodated by Nord Pool AS, the pan-European power exchange (The Consumer Council of Norway, 2022). With the introduction of Automatic Smart Metering from 2019 and onwards (measuring household consumption in real time), the price per kilowatt hour that most people pay to their supplier follows the hourly prices. These developments have increased many electricity consumers' exposure to shifting market prices, also during a single day. When electricity prices in southern Norway started to increase significantly in 2021, and continued to rise in 2022, a Facebook campaign with 600,000 followers demanded that the government reduce the electricity price.[2] In March 2022, the government introduced a support scheme for electricity consumption.

The above accounts for an important contextual element in the present study: with the introduction of a dynamic grid tariff, Norwegian customers would be exposed to dual dynamic price signals, which may overlap or contradict each other (see Öhrlund et al., 2019 for a treatment of this situation in Sweden). Hence, in addition to fluctuating market prices, the customers would be subject to dynamic pricing through the new grid tariff (cost of transport), to be paid to their local DSO.[3] Previously, the grid tariff depended on measured energy consumption (kWh) and included a fixed, monthly sum equal for all customers. The new, dynamic grid tariff consisted of, first, a *capacity/demand component*, graded according to a customer's maximum consumption (in practice, average of three max hours during a month, kWh/h). Second, the new tariff included an energy component (kWh) which among many DSOs had a *time-of-use* element, defining low prices in some periods (night-time, summer season) and higher prices during day-time/winter season (for details, see Appendix).

## Methods

### Semi-structured interviews and participation in stakeholder meetings

The material is based on 35 semi-structured, in-depth interviews with 13 stakeholders (grid companies/DSOs) and 22 households in Norway and the researchers' participation in multiple stakeholder meetings over 1 ½ years. The new regulation would oblige DSOs to introduce the principle of capacity pricing in their local areas. Each DSO was relatively free to decide on the details in its own tariffs. In 2019, a group of DSOs initiated a project, ForTa, as a forum to discuss these matters and test how the new tariff would affect different customer groups' costs according to their timing and levels of consumption (kWh). The testing was done in the local area of the

[2] The campaign was called "We who demand cheaper electricity" (in Norwegian) (9) Vi som krever billigere strøm | Facebook.

[3] The local DSOs handle the distribution of electricity and install electric meters. The authorities obliged them to develop and introduce dynamic grid tariffs to households. DSOs are recognised as natural monopolies and regulated by The Norwegian Water Resources and Energy Directorate (NVE) which caps each DSOs return based on its technical and economic performance.

DSO Lede AS, whose main office is in the city of Porsgrunn in southern Norway. Researchers at SINTEF Energy were engaged to lead the project, and the authors of this article were engaged to conduct qualitative research among Lede's customers. We also participated in a series of ForTa meetings[4] and in individual meetings with staff at Lede AS, where we discussed results from household interviews, particularly regarding how people responded to the suggested model and what kind of information they would like to receive. Finally, we scanned a major newspaper in Porsgrunn, *Varden*, in the time preceding and following the introduction of the new tariff (July 2022) to see if and how its introduction would be received by the local public.

**Table 1** Profiles of the 13 interviewed stakeholders

| Code | Gender | Role |
|---|---|---|
| S01 | M | Technical/strategy |
| S02 | M | Technical/strategy |
| S03 | M | Technical/strategy |
| S04 | M | Technical/strategy |
| S05 | F | Customer management |
| S06 | F | Customer management |
| S07 | M | Technical/strategy |
| S08 | F | Technical/strategy |
| S09 | M | Technical/strategy |
| S10 | F | Customer management |
| S11 | M | Technical/strategy |
| S12 | F | Customer management |
| S13 | M | Supplier of smart home technology |

### Recruiting participants for interviews

We conducted 13 online interviews with representatives from five DSOs across Norway in November–December 2020 and one supplier of smart technology. They were selected among the DSOs taking part in the ForTa project and in a co-joining research project, FlexEffect, in which DSOs participated as practitioners. We mainly spoke with staff on the technical/strategic side of the companies, who were engaged in developing their own grid tariffs, but also with four staff engaged in customer management. One interview was conducted in spring 2022, when the new regulation for pricing had been finalised. During the stakeholder interviews, we asked about the driving forces and potential effects of the new model, the details of their own model and the basis for calculation of prices. We probed their views on the tariff in terms of fairness, what types of households might or might not respond in a desired way, who would get a higher/lower cost, and who has access to automatic control of heating devices, electric cars and appliances. We asked about the distribution of income and costs deriving from different groups of customers in their geographical area (households, business, industry, etc.) and the procedures they follow when customers do not service their bills. We ended the interviews by asking whether they perceive electricity to be a market good or common property. In Table 1, we list the interviewed stakeholders, their gender, and their role in the company (DSO or other).

To gain insight into householder perspectives, we conducted in-depth interviews with 22 households in September and October 2021, mostly in people's homes (Table 2). Eleven of the participants lived in the city of Tromsø in northern Norway, and were self-recruited through another research project, iFlex.[5] These interviewees had taken part in an experiment/research study with highly shifting, total electricity prices on selected days. Here, they were notified by SMS one day in advance of 'experiment days', when they could choose to adjust their electricity use. This practical experience seemed valuable as a starting point in conversations about forthcoming changes in grid pricing, inviting

[4] A range of Norwegian DSOs took part in the ForTa project (2019–2023), which was funded by the DSOs themselves. The aim of ForTa was to establish a forum for discussing the design of the forthcoming new model for capacity pricing and simulate potential effects on household electricity consumption. The meetings were primarily organised online due to the pandemic.

[5] iFlex was led by Statnett, the central grid operator (transmission lines) in Norway. The study included surveys in addition to running the experiment, and their survey 2021 questionnaire included a question on whether people could/would be contacted in a forthcoming qualitative study (ours) that included a home visit. One hundred sixty-one of the survey participants responded positively, and from this list we made a selection of 15 households based on their proximity to the city of Tromsø (where we would conduct the interviews). As additional criteria, we wished to obtain a spread in participants' gender, age, size of dwelling, and annual income.

**Table 2** Profiles of the 22 interviewed households

| | Code | Gender | Age | Household | Occupation | HH annual income (NOK) | Dwelling | | |
|---|---|---|---|---|---|---|---|---|---|
| Tromsø | T01/F | F | 29 | Single | Employed | 500,000–799,999 | Apartment | Owning | 30–49 sq. m |
| | T02/F | F | 75 | Single | Retired | 800,000–999,999 | Apartment | Owning | 60–79 sq. m |
| | T03/M | M | 59 | Couple with adult son | Employed | 1,000,000–1,499,999 | Apartment | Owning | 60–79 sq. m |
| | T04/M | M | 48 | Single | Administration | 500,000–799,999 | Apartment | Owning | 50–59 sq. m |
| | T05/F and M | F + M | 55 | Couple | She: social support | 800,000–999,999 | Detached house | Owning | 120–159 sq. m |
| | T06/F | F | 66 | Couple | Retired | 500,000–799,999 | Detached house | Owning | 120–159 sq. m |
| | T07/F | F | 59 | Single | Employed | 500,000–799,999 | Terraced house | Owning | 80–99 sq. m |
| | T08/F | F | 82 | Couple | Retired | 800,000–999,999 | Detached house | Owning | Above 200 sq. m |
| | T09/F | F | 30 | Couple | Freelance | 800,000–999,999 | Semi-detached house | Owning | 50–59 sq. m |
| | T10/M | M | 48 | Single | Employed | 500,000–799,999 | Semi-detached house | Renting | 50–59 sq. m |
| | T11/M | M | 28 | Couple | Employed | 500,000–799,999 | Terraced house | Owning | 60–79 sq. m |

**Table 2** (continued)

| | Code | Gender | Age | Household | Occupation | HH annual income (NOK) | Dwelling | | |
|---|---|---|---|---|---|---|---|---|---|
| Porsgrunn | P01/M | M | 35 | Single | Employed | Did not state | Apartment | Owning | 90 sq. m |
| | P02/F | F | 68 | Single | Retired | Minimum pension | Terraced house | Owning | 90 sq. m |
| | P03/F | F | 70 | Single (widowed) | Retired | 700,000 | Detached house | Owning | 240 sq. m |
| | P04/M | M | 60 | Couple | Employed | 1,800,000 | Detached house | Owning | 250 sq. m |
| | P05/M | M | 26 | Couple | Employed | Did not state | Terraced house | Owning | 147 sq. m |
| | P06F | F | 61 | Single | Part-time employed | 450,000–500,000 | Apartment | Owning | 65 sq. m |
| | P07/M | M | 51 | Single with son (12) | Student | Did not state | Terraced house | Renting | 100–150 sq. m |
| | P08/F | F | 29 | Couple with two young children (3 and 6) | Employed | Did not state | Detached house | Owning | 180 sq. m |
| | P09/F | F | 55 | Single living with adult son (28) | Social support | Did not state | Detached house | Owning | 220 sq. m |
| | P10/M | M | 45 | Single with two children (9 and 14) | Employed | Did not state | Flat in detached house | Renting | 120 sq. m |
| | P11/M | M | 36 | Couple with two children (9 and 11) | Employed | 1,850,000 | Detached house | Owning | 260 sq. m |

answers based on practical experiences rather than (only) on hypothetical situations.

The other group of interviewed households (11) resides in Porsgrunn. They did not participate in a pilot but were among the ordinary customers in Norway that would later be subject to the new grid tariffs. We received assistance from a female trainee at Lede, who recruited eight participants through an open announcement on Porsgrunn municipality's Facebook group. Another three households were recruited through the trainee's own informal network, where a criterion we used was to include less affluent households.

Each of the participating households received a gift card worth 500 NOK. This compensation was announced ahead of recruitment and was considered important for attracting people without a particularly keen interest in energy. Nonetheless, and despite our efforts to recruit different types of households, we presume that the self-recruited participants have a higher interest in energy and technology than what is common in Norway.

In Appendix, we account for the type of questions asked and information provided during the household interviews. All the household interviews and most of the stakeholder interviews were recorded, transcribed, and analysed using NVivo. We started the coding by following the interview guide, which was informed by social practice theory and the study's overall question: who might be flexible electricity users? Then, we looked at the relationship between householders' degree of flexibility (drawing on the notion of flexibility capital) and their responses to the new tariff, because it showed some interesting trends. The

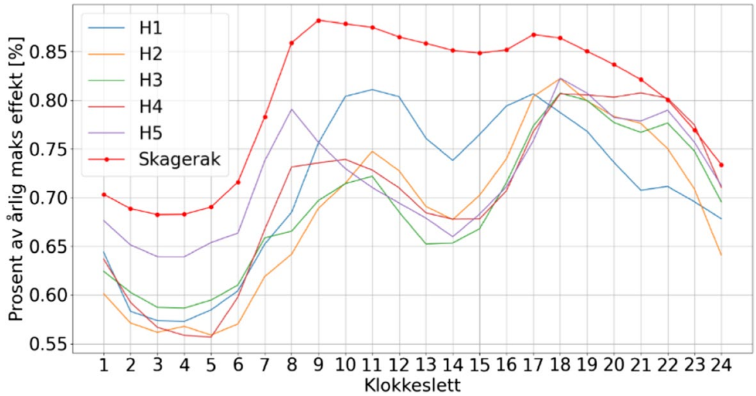


**Fig. 2** Examples of day load curves on a weekday in January 2021. Figure developed by SINTEF Energy based on a selection of approximately 20 customers in each of five different groups of households (H1 low consumption, H5 high consumption) (The notions H1 to H5 refer to customers with different amounts of annual consumption. To illustrate the type of homes these groups might represent, the following was assumed: small apartments up to 10,000 kWh (H1), apartments 10–15,000 (H2), terraced houses 15–20,000 (H3), detached 20–40,000 (H4), and large consumers 30–40,000 (H5).) and estimation of aggregated consumption in the area (red curve, 'Skagerak'). The curves indicate the percentages of measured power compared to annual maximum power. 'Klokkeslett' in Norwegian refers to the hour of the day

number of interviewees is low, and these indicative results may be more thoroughly examined in future studies.

## Results

### Stakeholder perspectives

Here, we present results from the in-depth interviews and meetings with representatives of DSOs as they were anticipating a new regulation/model for grid tariffs that would be based on a principle of capacity pricing. In addition to asking them about their rationale for introducing the new tariff and their expectations regarding householders' responses, we probed them on questions of fairness. As noted, the DSOs had some freedom to develop the details in the grid tariffs, and as we will show, their viewpoints were multifaceted, ranging from a focus on cost-effectiveness and political neutrality to the social effects of the new tariff.

#### *What is the distribution of costs imposed on the grid?*

A general principle mandated by authorities is that the costs imposed on the grid by a given group of customers (e.g. households, businesses, public buildings) should be reflected in the level of income derived from that group. In practice, as explained by our DSO participants, it is a difficult task to attribute costs to specific customer groups. For example, one transformer may be used by both households and industry. Another aspect is the timing of peak consumption for different consumer groups. Consumption during peak times results in higher costs than consumption at other times. Figure 2 illustrates average daily load curves for different types of households in the local area of one DSO during a weekday in January, as compared with the aggregated load curve for the grid area shown in red (also including other customer groups). Households tend to have their peak in the afternoon, whereas other groups (businesses, public buildings) peak earlier during the day.

It was not discussed in the meetings how these curves would translate into a distribution of the costs imposed by each customer group. Also, the DSOs were preoccupied with developing similar tariffs across Norway, so the particularities of the local load curves and distribution of costs appeared to be toned down to achieve harmonisation. In sum, there is a gap between the 'ideal' or mandated distribution of costs and what is achieved or even known in practice. This unclarity has some justice implications, as we discuss in the "Concluding remarks" section.

*Perceptions of their role as DSOs and rationale for the new tariff*

The participating DSOs primarily explained the rationale for introducing dynamic grid tariffs by referring to efficient resource use, today and in the future: ‘To the power system, it is obvious that evening out [consumption] will ensure that we use the capacity in a better way’ (S04/M). Many expressed anticipation of further electrification and increasing demand such as battery-driven ferries and battery factories, highlighting their need to be prepared for this kind of development. When speaking generally about the new tariff, the engineers and customer managers had somewhat different types of concerns. Stakeholders employed in technical/strategic positions tended to highlight the importance of developing a cost-efficient, ‘rational’ system that does not discriminate between different types of end-users or end-use. Their language often conveyed a technical focus.[6] Conversely, interviewed DSO representatives working with customer management focused consistently on the customers’ potential reception of the new tariff. They regularly receive many calls and emails from customers who do not understand the electricity system (e.g. where to give notice when relocating) or inquire about high tariffs.

Several DSO stakeholders highlighted that they are politically neutral. When probed on the question of how to deal with social and political aspects, they referred to authorities outside the electricity sector:

Our role is not to be a socially involved actor with a goal to promote equality, we must treat everybody in the same way, and we try to achieve the cheapest possible price and product for all, that is our role, to try to keep costs down. (S03/M)

It is not our role to hand out electricity for free, as it is not the role of Rema 1000 (food chain) to hand out food for free. There are social programmes to handle that part. (S07/M)

According to these views, socio-political concerns should be handled through other mechanisms such as taxes and social programmes. However, several stakeholders, also among those working on the technical side, took end-users into account, and some observed a tension between accommodating for their situations/reactions and making the tariff effective (evening out consumption):

We must do it in ways that are customer friendly, and which provide just prices to people... it should give [customers] appropriate incentives [to even out their consumption], so this has to be balanced. (S04/M)

In this quote, we find that ‘just prices’ may refer both to the principle of fair distribution of costs (echoing authorities) and to expectations of what customers themselves may perceive to be just. They also expressed concern for negative effects that the new tariff might produce: ‘It is an important principle not to punish the customers when this is not necessary’ (S02/M). As we elaborate below, the DSOs’ concern regarding social effects increased as the details in the new tariff were developed.

*Communicating the new tariff: what kind of end-use should be promoted as flexible?*

Stakeholders’ anticipations regarding how flexibility among householders might ‘be tapped’ was modest, as several ‘barriers’ to flexibility were noted during meetings and interviews. Some also expressed concern for potential protests that the new tariffs might trigger in the media. The stakeholders agreed about the importance of advising consumers *not* to run their appliances during nighttime to avoid the risk of fire. In relation to space heating, a customer manager noted that the ToU tariff might confuse customers about setting the indoor temperature at night. For years the DSO had encouraged their customers to save electricity, she said, i.e. by reducing heat consumption at night, but ‘now we are to turn upside down what we have worked with the last 30 years regarding lowering temperatures at night. Here it is completely opposite…’ (S10/F).

The stakeholders expressed most trust in technologies as mediators of customers’ flexible electricity consumption, either through control systems for regulating heaters/hot water boilers or through control of EV charging, washing machines and so on. However, they acknowledged the high costs of such equipment (hence, disproportionally accessed by affluent

[6] For example, they tended to refer to the need to increase consumers’ ‘utilisation time’, which concerns the relationship/ratio between energy consumption and maximum consumption. If an end-user consumes 1 kWh every hour for a year (8760 h), they will consume 8760 kWh and have a utilisation time of 8760 h or a ratio of 1.

consumers), which requires professional installation and maintenance. Ultimately, most stakeholders agreed that the most important message to convey would be to encourage EV owners to charge their cars during nighttime.

The most important thing in the future is to get a fair tariff and make sure people charge EVs, which are very flexible, in a smart way. Also, it should be easy to use electricity. (S04/M)

However, previous experiences had shown the DSOs that the promotion (communication to the public) of a new tariff as being particularly suited for EV charging could cause public protests: one DSO had previously run a pilot offering customers a cheap night tariff, but due to complaints the DSO decided to not appeal specifically to EV owners in their marketing. This should be interpreted contextually: in Norway, EV owners had received financial benefits (tax exemptions etc.) for years, sometimes triggering protests from groups dependent on driving conventional cars. Thus, one issue the DSOs tried to solve was how they could create a tariff to encourage EV charging at nighttime, without making it appear as a benefit specifically for EV owners.

*Concern for distributional effects and recognition of different types of end-users*

When discussing the details of the new tariff, many stakeholders explicitly referred to social and distributional aspects. For example, one DSO asked the technical researchers working with the ForTa project to map the financial effect of the new tariff for different types of households, ranging from small apartments to large, detached houses. The estimations indicated that a very high proportion of their customers would pay less than today's tariff, whereas consumers who have a higher demand for capacity would pay more. When commenting on this, the DSO representatives stated that this would be a *fairer* tariff than today.

Also, when setting the schedule for high and low prices (day-night, winter-summer), the stakeholders brought up issues such as what kind of households would be able to shift consumption. Here, they referred to different socio-economic groups, daily rhythms, degree of time constraints, and access to technology for automatic control. They were particularly worried about people living in old houses with the only option of using electricity for heating in the winter and about people without access to technology.

It requires a lot of work not to be penalised during the expensive parts of the day. So it takes a lot of work to avoid the extra charges and that is the unjust aspect of this – that there are those who can't afford to have an electrician simply come and fix it. Those who might already have an economic problem are penalised economically, and it is this aspect that is very unjust. (S09/M)

As noted in the "Literature review and analytical lens" section, the motivation for introducing dynamic grid tariffs is that end-users will change consumption patterns based on shifting price signals. This was also an expressed anticipation among the participating stakeholders, i.e. when the ForTa group was discussing the potential effects of having a high grid tariff at the same time as high prices in the electricity market (typically daytime during winter). Here, one DSO participant exclaimed enthusiastically that this double effect on the total price would certainly motivate consumers to postpone electricity use. However, the DSO sought instead to balance economic incentives with social diversity and potential effects of the tariff. Discussions about the relative difference between day and night prices reflected this dilemma. In an early phase, the DSOs indicated that day prices would be considerably higher (up to 100%) than night prices. When the new model for capacity based grid tariffs came into operation (July 2022), most of the DSOs chose a 'soft' ToU regime, typically 15–17% difference between day and night. Lede AS avoided time-of-use prices all together. This happened in a context with increasing electricity prices in the spot market in southern Norway from autumn 2021, which spurred heated public and political debates. During meetings and in an op-ed in the Norwegian press (Winther & Sundet, 2021), the authors warned against making the ToU price ratios (day/night, summer/winter) too big. In spring 2022, the DSOs engaged in a separate dialogue with other sectors (housing associations, user representatives, solar business, etc.) and developed a joint proposal for the new model to the authorities, which was largely included in the regulation (Inderberg et al., in progress).

In sum, the material shows that the stakeholders embodied shifting positions during the interviews and in the process of developing new tariffs. The focus on cost-effectiveness is instructed by the central regulator, while the recognition of different groups' situations and public acceptance probably derives from the DSOs permanent presence in the local area, creating many life-long customer relationships. The DSOs may very well have an underlying fear of local resistance and exposure in the local press. However, as noted, the tariff became softer than initially envisioned, and we found no signs of protest in the local newspaper. Rather, it was the high and volatile electricity prices in the market that received public attention. It is possible that the presence of us researchers in the process, explicitly focused on the customer perspective, influenced the conversations, as one stakeholder confirmed (S02/M). Whatever the case, the stakeholders' balancing of these opposing concerns appears as a challenging endeavour.

## Householder perspectives

We now present the interviewed householders' perspectives on the new tariff. As noted, half of them (11) had taken part in an experiment with highly shifting prices, whereas the other half (11) had not, though all Norwegian households are somewhat exposed to fluctuating prices in the electricity market (part 3). In each interview we started by asking about daily practices and then presented the main components of the forthcoming grid tariff, before turning to aspects of justice, if this had not already been brought up by the householders themselves. We first summarise the results regarding what kind of practices the interviewees think might be more likely to change, and we present findings on the sources for their (degree of) flexibility capital. We then analyse interviewees' perceptions of the new tariff in relation to their flexibility capital and how they relate the tariff to aspects of fairness.

### *Distribution of flexibility capital*

Our interviewees painted a picture of some practices being more flexible than others. Most of them considered the use of dishwashers, washing machines, and tumble dryers to be flexible, but they considered using these machines during nighttime to pose a risk of fire. Many understood the charging of electric vehicles (EVs)[7] to be a relatively flexible activity that may effortlessly be moved to nighttime—a time when the transportation of electricity would be at its cheapest with the new tariff. Beyond this, most interviewees doubted they had other possibilities to shift their own electricity use. Cooking, particularly dinner, was often understood as locked into habituated mealtimes such as work hours or evening activities.

When we look at who may have the capacity to respond to dynamic pricing in a flexible way, we draw on the notion of flexibility capital, proposed by Powells and Fell (2019). They argue that *affluence* matters, and they discuss the relationship between affluence on the one hand and 'flexibility capital' on the other. Based on our interviews we now seek to unpack what flexibility capital means in the studied context. We find four sources for flexibility that are unequally distributed across the studied households. First, interviewees who had *loosely organised everyday time-spaces*, e.g. without conventional work hours, hobbies, parenting activities, or care work outside the home, the households understood their energy usage as more flexible compared to those with time-squeezed daily rhythms. Second, *people who had access to technologies for controlling appliances and heaters* experienced more flexibility than others. Some people used the built-in timer function in their modern washing machines to delay start-up time, e.g. starting at 5 am in the morning when the spot market prices are low and hanging up the clothes after bringing children to school in the morning (P08/F). Nobody referred to automatic control of hot water boilers, which are otherwise presumed by the DSOs to be relevant for 'tapping flexibility'.

A third source of flexibility relates to some people's (mostly men's) *pre-existing habituation to monitoring real-time consumption*. Such monitoring requires access to and interest in regularly checking technical devices. Most of our male interviewees (e.g. five out of six men in Porsgrunn)[8] used various apps to regularly monitor their consumption in relation

[7] Four of our 22 interviewees owned an EV, including one hybrid.

[8] In Porsgrunn, none of the interviewed women used an app. In the case of P08/F, the woman reported that her husband regularly uses an app. Among the five households who did not use an app, there were four women and one man (who had used an app previously).

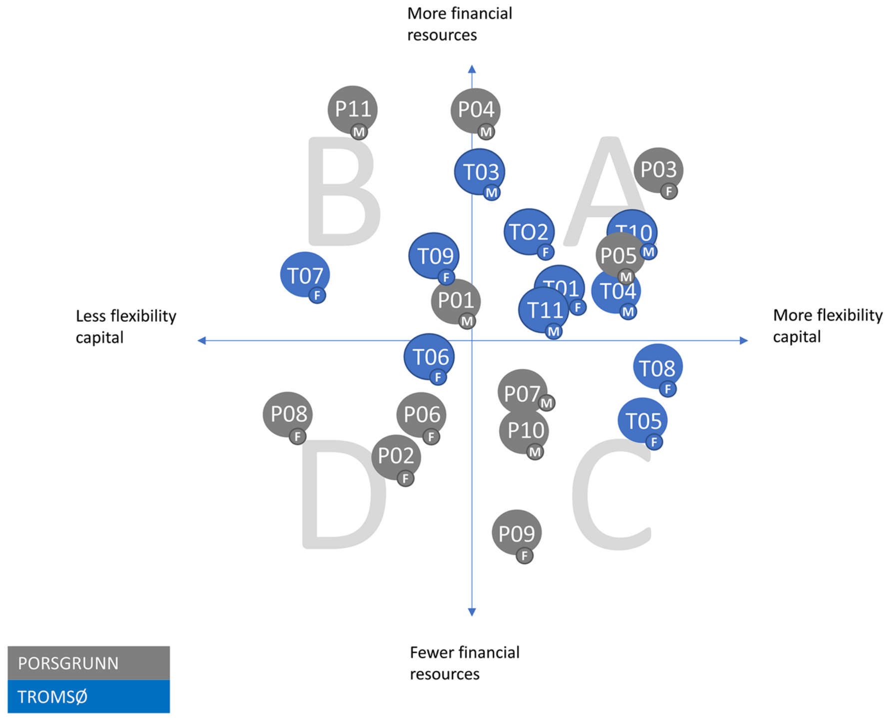


**Fig. 3** Relative distribution of financial resources and flexibility capital across the 22 studied households. P (grey colour) and T (blue colour) refer to the two geographical locations, Porsgrunn and Tromsø. F and M refer to the gender of the interviewee

to shifting electricity prices in the spot market. This experience seems to make them more positive than other groups towards monitoring and adjusting consumption according to the proposed ToU tariff.

A fourth, observed source of flexibility concerns *people's own perception that saving or rescheduling consumption is desirable and/or actual options in their lives*. Some interviewees (T01/F, T06/F, T07/F, T10/M, P02/F, P08/F) did not see a potential for saving/shifting, partly because they understand their energy use as locked into time-spaces and partly because they have already done what they could to reduce electricity use.

As noted, affluence is also an important source of flexibility, partly because having a constrained economy can be a barrier to responding to flexibility measures without compromising one's comfort. In addition to affluence and as a proxy (because there may be other factors hindering or enhancing flexibility), we denote people's degree of access to the four sources as their flexibility capital.[9] In Fig. 3, inspired by Powells and Fell (2019), we illustrate the relative distribution of affluence and flexibility capital across the studied households.

Financial resources were evaluated based on stated income and household composition. For instance, with equal pay, we assume that a family of four has a tighter economy than a family of two. If income was not explicitly stated, we based the appraisal on how interviewees talked about their finances. We underline that Fig. 3 is meant as an illustration and based on results from a qualitative study of a limited number of households. The figure does not represent people's positions in absolute terms, but rather our interpretations of the relative distribution of participants across the material. The reason for plotting householders in the figure will become clearer when we later look at their responses to the new tariff.

[9] We acknowledge that there may be more sources of flexibility (and lack thereof) than the ones explored in the present discussion, such as type of building and bodily capacity. Because we are interested here in the relative distribution of flexibility capital (and affluence) in our material, we disregard shared

Footnote 9 (continued)
aspects that may serve to reduce flexibility across the material, such as social conventions for eating dinner.

*Sentiments towards new tariff and perceptions of fairness*

Generally, the new tariff added confusion to an already complicated pricing system which many of our interviewed householders struggled to comprehend. Beyond this, we observed that eight informants responded with frustration, five with optimism, and the remaining nine appeared lukewarm in their responses. Among the frustrated interviewees, 6 of 8 resided in the Porsgrunn area which, contrary to Tromsø, had experienced higher electricity prices. In Porsgrunn, we also intentionally recruited 3 low-income households. Here, the new tariff was often perceived as 'yet another thing to worry about' (P01/M). The informants who responded with frustration typically had fewer financial resources and/or relatively little flexibility capital (groups C and D). For some, the frustration was connected to a possible loss of comfort and/or convenience:

When you already use energy frugally, should you postpone the cooking? No! Could I postpone other things? Sit at home freezing? No! (T06/F)

For others, the frustration was linked to worries about financial implications. One of our informants (P10/M) assumed that the changes would mean higher prices (later his attitude changed when he realised that the new system might in fact save him money). Some frustrated interviewees (P02/F, P09/F, T05/F and M) also questioned the grid company's intentions for changing the tariff. They assumed that changes in pricing were made with the sole purpose of 'milking customers' and increasing the grid companies' income and were not convinced by our explanations of the rationale behind the new tariff as a means to redistribute grid costs. A similar lack of trust in DSOs was observed in another study from Norway (Wethal, 2020, p. 8).

Furthermore, the idea of exploiting cheaper nighttime energy seemed counterintuitive in the cases of space heating: 'It seems strange to be encouraged to heat the house at nighttime' (P01/M). 'I can put [the heat pump] on at night, but what would be the point of this?' (P08/F). Embedded in these statements is a perceived contradiction: why heat the home when you are asleep and do not need it? As anticipated by the stakeholder DSO representative on the customer side (above), some interpreted the call to shift energy use to nighttime to be at odds with a more general norm to save electricity.

The five householders (three men and two women) who expressed optimism and even excitement when introduced to the new tariff were highly affluent and/or possessed a high degree of flexibility capital (mainly falling into group A). Importantly, these individuals had already habituated the concept of time-of-use pricing. Most of them were leveraging smart technology, closely monitoring the fluctuating electricity prices and enthusiastically modifying their energy usage accordingly—engaging in energy-shifting as a sport. For instance, when explaining how the capacity component of the new tariff would be determined by the previous month's maximum hour of consumption, one of our informants eagerly replied '…that one hour – I think it will be fun!' (P05/M). Many of them commented, though, that they would need an app to display the total price (shifting market prices and ToU tariffs) for the monitoring to be advantageous in the future.

The remaining nine informants' reactions can be placed between the two extremes. Some of these informants also paid close attention to fluctuating energy prices (via apps) and were used to the notion that timing matters in terms of energy use and pricing. The 'positive' and 'neutral' householders did not express distrust in the grid company, in contrast to what we observed among some of the frustrated interviewees. It seems that householders' initial degree of trust influences their reactions to proposed changes in grid tariffs.

The results indicate that there is a relationship between the interviewees' sentiments to the new tariff and their access to flexibility capital and financial resources. We illustrate this relationship in Fig. 4. The colour of the external circles indicates participants' attitudes towards the new tariff: different shades of red denote frustration/negative reception of the new tariff; shades of green denote positive attitudes, while neutral participants (lukewarm) do not have an external circle. We see that interviewees with negative attitudes about the new tariff (shades of red circles) are distributed across groups C, D, and B and are therefore more likely to experience loss of comfort (C), higher costs (B), loss of comfort/well-being/risk of energy poverty (D) than the most resourceful group (A).

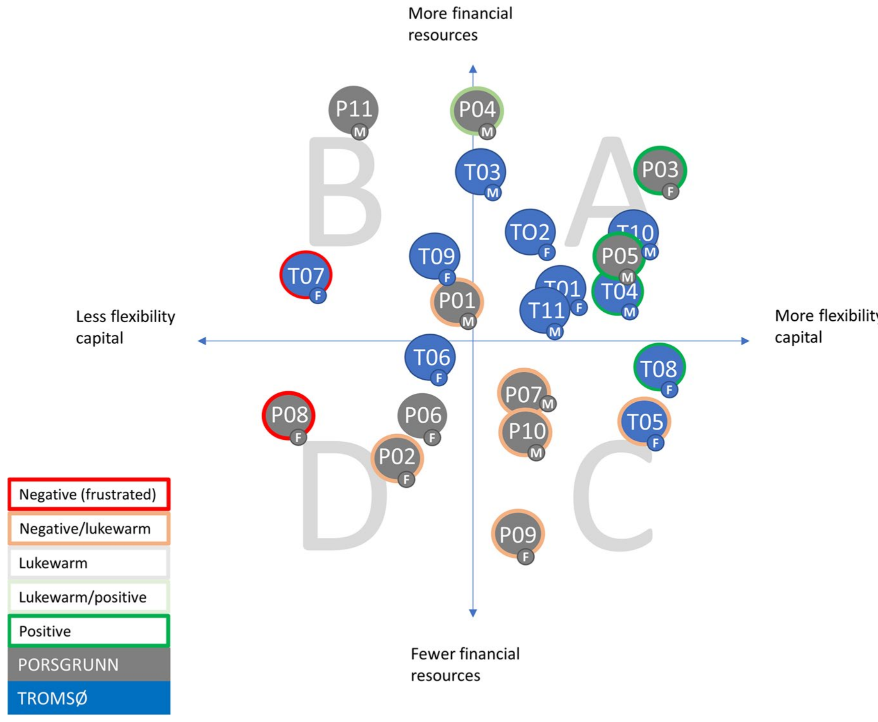


**Fig. 4** Relative distribution of financial resources and flexibility capital across the 22 households and indication of the interviewees' sentiments towards the new tariff

Relatively irrespective of their sentiments towards the new ToU tariff, most interviewees perceived it as a penalty rather than a reward. Interviewees with low flexibility capital expressed this most clearly, but also the 'excited' households brought up the penalising effects of the tariff, particularly when talking about other households' ability to respond. Higher prices during daytime were often referred to as 'punishment' since they were understood to make specific practices more expensive rather than motivating behaviour change; 'there is a reason why you have the consumption you have' (P01/M). Moreover, they felt that lower prices at night were difficult, if not impossible, to take advantage of. All in all, most informants did not consider the associated inconveniences and/or discomfort in shifting specific activities across time and space to be worth the money saved.

When asked explicitly to reflect on the fairness of a ToU element and how this may affect various groups, most interviewees identified who they thought would be the losers and winners of such a system. They expressed concern for households with small children who 'need to do things at specific times' (P03/F) and poor people who are already living with a minimum level of consumption. For instance, this retired widow voiced particular concern over potential detrimental effects on the latter group's quality of life:

This may have harmful implications; maybe some people will get lonely. Socially isolated because they cannot have guests, they end up grumpy and angry if the guests use too much electricity. (P03/F, retired widow)

Furthermore, some considered it unfair that such a tariff would only benefit people with access to specific technologies: 'People who have access to control systems will win' (T03/M). Overall, the cheap night price was considered particularly advantageous to people with EVs. The unfairness in this was tied, by some informants, to objections to more general policies that have given privileges such as tax exceptions for EV owners. One interviewee (P02/F) who had previously fought against a decision to install EV charging stations in her housing cooperative (due to the increased cost for all) was critical of introducing more incentives to a group who is already being 'carried on a silver platter' by the government.

Most informants were sceptical when told how the graded component would be calculated. At the time, the suggested reference for setting the price was the hour during the previous month with the measured, maximum demand (max kWh/h).[10] Our interviewees understood this to be an arbitrary and discriminatory form of measurement. It was argued that this one-time measurement was not a good indication of an individual household's typical max demand. Also, it could potentially be decided by one-off events or even random mishaps. Many were particularly concerned about special occasions demanding peak loads, such as hosting the extended family for Christmas.

However, the idea of a graded capacity component was almost unanimously judged as just by our interviewees. We may have encouraged such a reaction by presenting figures illustrating how small consumers living in a flat would fare with the new tariff (lower bill than today) compared with large consumers in detached houses (higher bill than today). Nonetheless, the shift from a fixed, monthly amount to a graded amount linked to a customer's maximum demand was understood as a just measure and generally welcomed.

## Discussion

### Summary and analysis of the findings

The results presented in this paper in many ways confirm what previous social science studies on DSM and user flexibility in smart grid systems have shown. The imaginaries and perceptions that 'experts' have of end-users may not reflect reality (Ballo, 2015; Fjellså et al, 2021b; Nyborg, 2015; Öhrlund et al., 2019; Winther & Ericson, 2013), and access to financial resources and flexibility capital is not evenly distributed among households (Fjellså et al., 2021a; Powells & Fell, 2019; Trotta et al., 2020). These observations are important in a justice perspective because they imply that the benefits and costs of introducing DSM may, unintentionally, render some groups more vulnerable than before.

As seen from the energy system side, DSM mechanisms such as dynamic grid tariffs are expected to give householders' economic incentives to shift their consumption from peak hours to periods during the day when the system is less constrained. Our interviewed DSO representatives largely expressed such expectations, though acknowledging several barriers to flexible energy use, including the risk of fire. They also expressed awareness that different households may be positioned differently in response to time-of-use tariffs. As the introduction of the new tariffs approached, DSO representatives agreed that the most important type of shift consumption (Jalas & Numminen, 2022) would be the charging of EVs, which can be done in a safe and automated manner during nighttime. Here, however, they faced a public relations dilemma as they did not want to give the impression that EV owners were the sole winners in the new regime. As to other types of automation (e.g. for control of water boilers), some DSOs expressed more trust in such regimes than trying to make householders respond actively to shifting prices. However, they realised that only a fragment of Norwegian households had installed such equipment (see also Sæle & Aasen, 2021, p. 17), which they considered to be relatively expensive and not for all. The effects of unequal access to automation may, in turn, reinforce existing injustices, as noted by Adams et al. (2021, p. 8).

To a large extent, our DSO stakeholders recognised the complexity involved in foreseeing the implications dynamic tariffs would have on different types of end-users. The results from the household interviews, which we sometimes conveyed to stakeholders during the process, also illuminated some of the variety involved and the many 'barriers' to flexible electricity use. Nonetheless, the overall idea of giving the customers economic incentives to shift consumption remained strong, which confirms that the vision of an economically rational end-user remains strong despite the evidence that end-users have a whole range of concerns beyond financial matters (Throndsen, 2017).

An interesting question that appeared during the process of developing the ToU component of the tariff concerned what an appropriate ratio (difference) between day and night prices would be. Here, some DSO representatives argued that the effect would be largest if the difference were relatively high. As described in the "Results" section, one person regarded the 'double effect' of simultaneously high market prices and high grid tariffs as an advantage. As researchers, knowing the potential harm a high ratio might have on inflexible and poor households, we argued for a low ratio. From the literature, we

[10] The reference was later modified to be the average of the 3 h with maximum demand as measured during the previous month.

find support for our stance in a study conducted in a similar context of double price signals (Sweden) by Öhrlund et al. (2019). They found that 'the size of the financial incentive that a price signal provides does not have that much influence on householders' willingness to engage in demand response' (Öhrlund et al., 2019, p. 236). In relation to this matter, Trotta et al. (2020, p. 11) distinguish between two different perspectives to account for people's responses to price signals. From an economic perspective, a stronger price signal will lead to more consumption shifting. A sociological perspective would, in addition, pay attention to the symbolic effect a price signal may bring in giving 'meaning to perform certain practices in other ways or at other times' (ibid. p. 11). In other words, a difference in prices between day and night (irrespective of the size of the difference) may signal a norm regarding when electricity use is most desirable/responsible and when it is not. Due to the potential, negative impacts a high price ratio may have on inflexible and vulnerable consumers, this calls for a modest price ratio.

The language used by our DSO representatives often reflected their technological concerns. They can be regarded as members of the 'techno-epistemic network' that Ballo observed in Norwegian smart grid development, in which technological innovation is a main driving force for smart grid development (2015 p. 10). But where Ballo's study sought to account for an observed discrepancy between what the DSOs are communicating to the public and their real concerns as electricity systems, our analysis has looked instead at the relationship between the DSOs and their presumed public/real customers. The results showed that during the interviews with the DSO representatives, they often shifted perspectives back and forth. Predominantly, they had a system focus—cost effectiveness, reduced peak loads, equal treatment of all customers, and a conception of the 'end-user' as technologically interested and economically motivated person (cf. Strengers' notion of 'resource man'). Yet at times, they also expressed sympathy with the situation of different kinds of end-users (elderly people, households with children).

Our findings confirm that DSM mechanisms may induce considerable efforts on the part of householders (Powells & Fell, 2019) and that such 'flexibility work' also has gendered implications (Fjellså et al., 2021a). This relates to Johnson's (2020) concept of (real) 'flexibility women', launched in response to the (imaginary) 'resource man'. In Norway, dishwashing/laundry is more often undertaken by women than men, whereas the opposite is the case for EV charging (Sæle & Aasen, 2021). Our households described these two types of practices as the most flexible, which follows social practice theory in that they appear as relatively detached from specific times and decoupled from other things or people (Shove & Cass, 2018, p. 9). However, the act of starting the washing machine is also connected to co-joining practices associated with the laundry such as hanging up clothes, leaving them to dry, folding them and putting them away. Here, the flexibility work performed by women (more often than men) involves a double workload: doing a given task such as laundry (and associated practices) and finding a suitable time for doing so when the price is low. In contrast, because EVs tend to come with a smart control system that acts as a technical buffer to tap potential benefits, the flexibility work here performed by men (more often than women) is relatively quick, easy and does not compromise convenience. More generally, and resonating with the unequal effects automation may have, this serves to illustrate Powells and Fell's point that wealthier groups can delegate the flexibility work to technologies and benefit from DSM regimes, while other groups may experience both social and economic costs.

## Contribution to the literature

In the present study, we have sought to operationalise the concept of flexibility capital (Powells & Fell, 2019) to explore the potential unintended and unwanted social consequences of DSM measures. In addition to the many factors that may affect people's flexibility known in the literature, we observed two 'new' sources of flexibility (or lack thereof): householders' pre-existing habituation to monitoring real-time consumption in the spot market, and people's subjective perception that saving or rescheduling consumption is desirable and an actual option in their lives.

Another contribution has been to analyse how the distribution of affluence and flexibility capital among the interviewed households combines with their perceptions of the new tariff. Though our material is limited to 22 households, we see a tendency for those with high affluence and flexibility capital to have more favourable sentiments towards the dynamic tariff than other groups. This is visualised in Fig. 4, which illustrates what kind of end-users 'fit' the visions of the DSM mechanism and who the new regime may ignore. As to the interviewed households with low affluence and limited flexibility capital, we find three main causes for their deep worries.

First, their frustration concerned the prospect of getting and coping with a higher bill in the future. Second, they felt forced to become involved in yet another regime for electricity, which they already experience as a complex and partly incomprehensible field. Third, they became uncertain of what price signal to follow (market vs grid tariff) and what kind of electricity use that would be responsible (saving or shifting). Some of the most frustrated participants also expressed mistrust in the DSO and/or 'electricity companies' more broadly, whose main goal, they perceived, is profit. These findings illustrate how introducing capacity pricing, particularly in the context of complicated pricing models and uncertainty (volatile energy prices), may create or fuel frustration and mistrust, especially amongst less resourceful households. We therefore sympathise with Trotta et al. (2020, p. 10) who argue that DSOs could give end-users the option to enrol voluntarily in dynamic prices to protect vulnerable households from negative effects. These effects, we have seen, also include psychological stresses. It is a limitation in this study that we did not discuss health aspects with participants, which is otherwise important to well-being and the potential effects associated with new tariffs (Calver & Simcock, 2021).

Thirdly, our study has explicitly examined aspects of fairness and justice regarding the dynamic price tariff as perceived by stakeholders as well as householders. As noted, the new tariff included a monthly, graded capacity component based on a customers' measured demand (max hour, kWh/h) which had previously been a fixed monthly sum equal to all householders. In addition, the new tariff had a consumption-based component that would be cheaper during nighttime. Previously, this component had not included a ToU element.

Overall, the two groups largely agreed that the introduction of a graded capacity component would be more socially just compared to the previous, flat monthly amount paid by all households. Both groups believed that the new tariff would result in a fairer distribution of costs (cf. distributional justice). But if we look more closely at their arguments, an interesting difference appears. To stakeholders, the perception of fairness largely refers to the principle embedded in the new regulation mandated by authorities: the price should reflect the costs a given household imposes on the system. According to householders, it seems fair that if you live in a large, detached house and demand higher capacity than others, you will be asked to pay a higher monthly amount than if you live in a smaller flat. A difference between these two perspectives on the graded capacity component relates to recognitional justice: stakeholders (as informed by their mandate) did not consider who the different end-users are beyond their level and timing of electricity consumption. To follow Jenkins et al. (2016, p. 177), this strategy may be regarded as 'injustice as non-recognition' as it did not recognise the specific needs of particular social groups (ibid.). In comparison, the householders associated the fairness of the graded tariff with householders' different levels of affluence, stating that more privileged groups should pay more than others, both because they impose more costs on everybody's bill and because they are in a position to contribute more than others.

However, regarding the day and night prices (ToU), both householders and stakeholders did pay considerable attention to different types of households, to what extent they might respond to the prices and what the social costs might be. Much in line with the literature, they considered people on a tight schedule, living in old houses with electricity as the only source of heating, lack of access to automatic control, and/or with a low level of affluence to be most vulnerable. In the context of discussing this part of the new tariff, both groups acknowledged diversity (Fainstein, 2014) and people's diverse capacities to adapt. Hence, recognitional justice (Jalas & Numminen, 2022; Jenkins et al., 2016) was explicitly brought to the table by both groups. From an energy justice perspective and the fact that electricity services are necessary for households (e.g. Sustainable Development Goal no. 7), we argue that recognitional aspects deserve more attention when designing dynamic grid tariffs.

## Concluding remarks

This study gives some nuance to the observation that there is a lack of channels for voicing consumers' viewpoints in the development of the Norwegian electricity system, which can be interpreted as a lack of procedural justice (Rommetveit et al., 2021). The case we have presented included a relatively long process with discussions among DSOs and researchers about a suited design of the new tariff. It also reflected stakeholders' recognition of different kinds of users. As such, the case might be an illustration of how a system primarily driven by technological innovation and economic considerations may be developed in a relatively inclusive and socially robust way (Ballo, 2015) to accommodate for the needs and abilities of a variety of real end-users. In the studied project, DSO staff representing the customer side was underrepresented. Strengthening the role of this group and examining the situation of different types of end-users in the local area appear as crucial steps when designing tariffs to improve procedural, recognitional, and distributional justice. The studied case illustrates the importance of not regarding DSM in a universalistic manner (e.g. leading to efficient resource use or more injustice) but paying attention to the details in the socio-technical system and different kinds of real end-users when designing flexibility measures.

The signs that the locally based DSOs realise that households differ and that they try to accommodate for such variation when developing their tariffs lead us to suggest that appreciation of the importance of social aspects might be considered as part of the DSO mandate. This could enhance the prospect of encouraging flexibility in a balanced way where it does not deteriorate householders' well-being and yet motivates people to save energy and use it at times when the pressure on the supply system is low.

The issue of justice in the forming of grid tariffs touches on a range of unsettled questions regarding distribution of costs. Is it a matter of redistributing costs among today's consumers? This is the perception expressed by our householders, which follows Powells and Fell (2019) model of a zero-sum game. Alternatively, as perceived by our DSOs, the issue can be presented as a win-win narrative in which everybody will gain on reduced requirements for investments in the future (cf. Shove & Cass, 2018). A further complication relates to the distribution of costs between householders and other types of end-users such as businesses, industry, and the public sector. As seen, the participating DSOs did not have a clear picture of the costs imposed by different customers groups on the system. We will not attempt to answer these questions, but simply conclude that these inquiries add to the factors of cost uncertainty, which serves to blur a discussion of justice.

In a wider picture the presence (or absence) of politics and policies to mitigate potential, regressive outcomes of DSM will also affect justice outcomes of DSM (Calver & Simcock, 2021). DSM tends to be handled and studied within a single sector, but energy poverty scholars (Boardman, 2013) and others have argued that one needs to pay more attention across sectors, to 'invisible energy policies' (Royston et al., 2018) to address injustices in energy. Hence, policies outside the electricity sector, e.g. social security, income tax, housing, and transport, may potentially affect the distribution of justice outcomes following the introduction of DSM.

## Appendix. Questions asked and information presented during household interviews

### Sequence and type of questions asked

We first invited people to describe a typical day, how they use electricity, and to what extent and how they monitor their own consumption (e.g. apps, website, looking at the invoice). If more than one person lived in the household, we asked who would normally attend to monitoring electricity consumption and paying the bills. We also asked about their ability and willingness to modify or delay certain types of electricity use during the course of a workday or on weekends.

Then, we turned to the new model for grid tariffs and presented an illustration of what the new model for capacity pricing might look like in practice (elaborated below). This material drew on Lede's ongoing development work at the time and estimations made by SINTEF Energy of how the new tariffs would affect different segments of Lede's household customers.[11] At a later point in time, Lede maintained the structure of the tariffs, but modified the design.

[11] The estimations were based on a selection of 34,519 of the total of approximately 200,000 consumers in Lede's area.

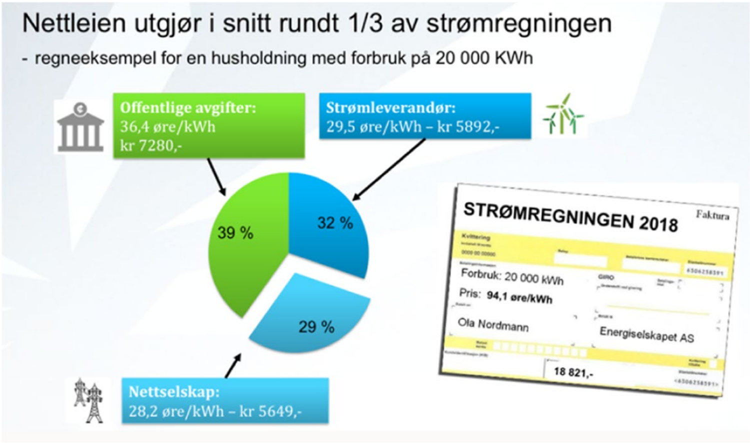


**Fig. 5** A typical electricity bill and its components, shown to household participants during the interviews

We ended the interviews by asking interviewees to reflect on the new tariff in terms of fairness and how it may affect different types of households.

Information presented about the new tariffs

We shared a figure that indicated the composition of a typical electricity bill: about one-third goes to their local DSO for servicing electricity transport, including maintenance and connection to the grid, and one-third goes to the selected electricity supplier in the market (in the example assuming a unit price of 29.5 øre/kWh). Public taxes make up the last part of the bill. We clarified that we wished to discuss the new grid tariffs only in regard to consumers' payment to the DSO (Nettselskap). We also explained the structure of the current tariff: the sum to be paid to the DSO is comprised of a fixed monthly amount (independent of the level of consumption) and an 'energy part' which depends on the consumed amount of energy (øre/kWh) Fig. 5.

We then shared two figures (Figs. 6 and 7) to illustrate the purpose of the new model for grid pricing, one showing the current situation, 'My electricity

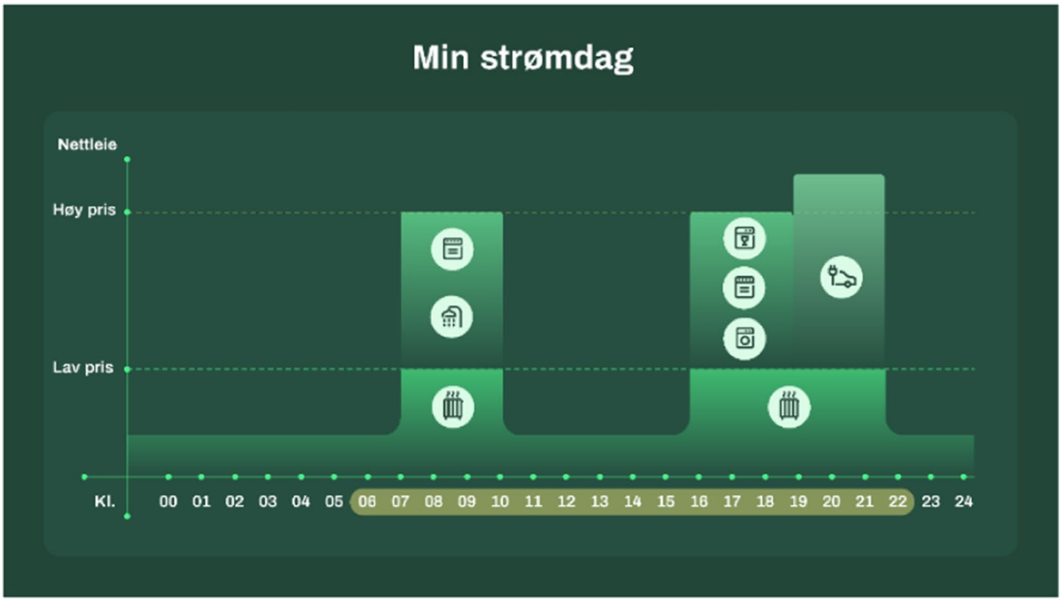


**Fig. 6** My electricity day

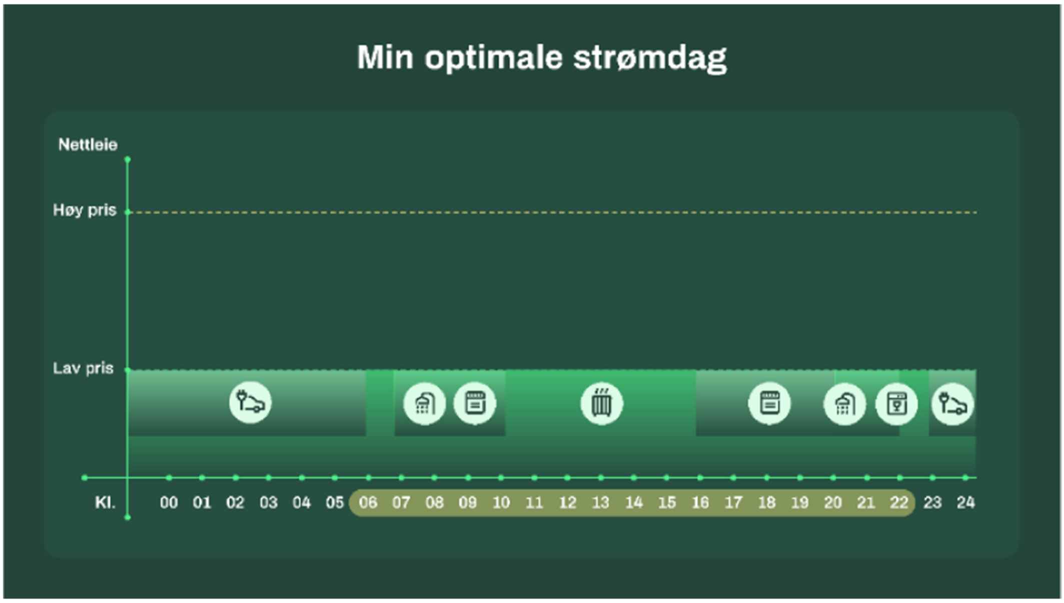


**Fig. 7** My optimal electricity day

day' (*Min strømdag*), which has one peak in the morning and one in the afternoon. This we compared with a figure showing an ideal day, as seen from the DSO: 'My optimal electricity day' (*Min optimale strømdag*). This shows a flat (even) level of consumption during the 24 h of the day. We explained the authorities' intention to make consumers even out electricity use in order to reduce the need for investments in the grid in the future. As the figure suggests, consumers might achieve this by using different appliances successively rather than at the same time. However, to avoid increased risk of fire, the DSO did not advise people to run appliances at nighttime, when they only recommend EV charging, automatic control of hot water boilers etc.

To motivate such a shift in consumption, we explained, the DSOs considered introducing a low price (*Lav pris*) during nighttime and a high price (*Høy pris*) during daytime (from 0600 to 2200 h). In the literature this is referred to as time-of-use (ToU) tariffs. The prospect of this change triggered reflections on what kind of consumption the interviewees thought they might change, if anything at all.

To people who signalled a particular interest in the topic, we also shared a figure showing load curves for different types of customers, provided by the DSO (see the "Methods" section).

The new tariff also comprised a 'capacity component' as a second mechanism for making people even out electricity consumption. This would replace the fixed, monthly payment which is the same amount for all consumers, we explained. It would also be graded, and hence vary among consumers.[12] The basis for calculating the amount to be paid would be the customer's own peak consumption the previous month. Technically, the reference envisioned by Lede at the time of the interviews would be the measured *hour during the month* when the customer had the highest level of consumption (kWh/h).[13]

To handle the graded capacity component and invoicing in practice, while motivating consumers to 'learn' from their previous consumption, the DSOs introduced the notion of 'steps' which would cluster

[12] This component was also referred to as the 'fixed component' (fastledd) for a while, also at the time of our interviews, but DSOs are avoiding using the term to avoid causing confusion because the amount may vary from month to month.

[13] Later, this was changed so that the reference for payment (capacity component) became the average of the top three maximum hours, i.e. the 3 h with the highest level of electricity consumption, measured on three different days.

**Fig. 8** Financial illustrations of three energy-consumption profiles before and after the implementation of the new tariff

| **SMALL APARTMENT**<br>*Yearly consumption ca 4 300 kWh* | **Current tariff** | **New Tariff** | **Change in cost compared to current tariff** | **Step, capacity component** |
|---|---|---|---|---|
| **No change in consumption** | 3 405 kr/year | 2 133 kr/year | 38% reduction | Under 3 kWh/h |
| **New EV, daytime charging** | 4 056 kr/year | 3 803 kr/year | 6% reduction | Step 3-6 |
| **New EV, nighttime charging (22-06)** | 4 056 kr/year | 3 364 kr/year | 14% reduction | Step 3-6 |

| **TERRACED HOUSE**<br>*Yearly consumption ca 17 000 kWh* | **Current tariff** | **New Tariff** | **Change in cost compared to current tariff** | **Step, capacity component** |
|---|---|---|---|---|
| **No change in consumption** | 5 387 kr/year | 5 406 kr/year | 0.4% increase | Step 3-6 / 6-9 |
| **New EV, daytime charging** | 6 037 kr/year | 6 941 kr/year | 15% increase | Step 3-6 / 6-9 / 9-12 |
| **New EV, nighttime charging (22-06)** | 6 037 kr/year | 6 196 kr/year | 3% increase | Step 3-6 / 6-9 / 9-12 |

| **LARGE DETACHED HOUSE**<br>*Yearly consumption ca 48 000 kWh* | **Current tariff** | **New Tariff** | **Change in cost compared to current tariff** | **Step, capacity component** |
|---|---|---|---|---|
| **No change in consumption** | 10 047 kr/year | 12 834 kr/year | 28% increase | Step 3-6 … 21-24 |
| **New EV, daytime charging** | 10 697 kr/year | 14 369 kr/year | 34% increase | Step 6-9 … 24-27 |
| **New EV, nighttime charging (22-06)** | 10 697 kr/year | 13 778 kr/year | 29% increase | Step 6-9 … 21-24 |

groups of customers in terms of their peak consumption the previous month. At this point in time, Lede envisaged that the differences between each step would be 3 kWh/h, so that people with a small peak consumption, i.e. maximum hour, between 0 and 3 kWh/h, the previous month would get the lowest price. Higher peak consumption (3–6 kWh/h, 6–9 kWh/h, etc.) would be charged higher prices.[14]

It became clear during our first set of interviews in Tromsø that many people would have wished to see calculation examples in terms of how the new tariff would affect them and other groups financially. For the second round of interviews in Porsgrunn, we therefore presented interviewees with estimated examples, worked out by SINTEF Energy, on how the changes in tariffs would affect the DSO bill of different types of customers. The calculations also estimated what it would cost to acquire and use an electric vehicle (EV) with the former and new grid tariffs. The engineers anticipated that EV charging for an hour would imply consuming 3 kWh/h (assuming normal charging with 16A), and this factor also partly informed the setting of steps of the same amount (motivating EV owners to charge their cars during nighttime).

As a result, we presented financial examples of three randomly selected energy-consumption profiles (low, medium, high) from a larger dataset on how the annual bill from the DSO would be affected by the new

[14] In monetary terms, all customers initially paid a fixed monthly amount of 287.40 NOK per month. The monthly rates for the new capacity component to replace the fixed amount would be graded: 152 NOK (maximum hour 0–3 kWh/h), 248 NOK (3–6), 344 NOK (6–9), 439 NOK (9–12), 540 NOK (12–15), etc. Later, the steps were changed to 5 kWh/h.

tariff (Fig. 8). Assuming customers would not change their consumption profiles, this illustrates that the customer with low consumption living in a flat would get a reduced (38%) annual bill compared with today, the customer in a terraced house would pay a similar amount as before, while the customer living in a big, detached house would pay more (28%) than before.

**Acknowledgements** This research derives from three projects: 'Flexeffect – Flexible electricity use in households: barriers, opportunities and effects', project no 295704, funded by the Research Council of Norway (RCN); 'Include – Research centre for socially inclusive energy transitions', project no 295704, funded by the RCN; and 'ForTa', funded by a group of Norwegian grid companies (DSOs). We would like to thank all members of the Flexeffect group and our project leader Karina Standal for wonderful collaboration. We are also indebted to Hege Westskog who initiated the project.

We are grateful to the DSO representatives as well as to the householders who participated in the interviews. Janet Stephenson contributed her ideas in an early phase of this work, and we are grateful to four anonymous reviewers for their comments and suggestions. We would also like to thank our colleague Hanne Sæle at SINTEF Energy for fruitful and long-term collaboration and input on a previous version of this paper, as well as Ivan Schytte and his colleagues in Lede Nett AS and other members of the ForTa project. Connie Stultz proofed the English language.

**Funding** Open access funding provided by University of Oslo (incl Oslo University Hospital).

### Declarations

**Competing interests** The authors declare no competing interests.



## References

Adams, S., Kuch, D., Diamond, L., Fröhlich, P., Henriksen, I. M., Katzeff, C., Ryghaug, M., & Yilmaz, S. (2021). Social license to automate: A critical review of emerging approaches to electricity demand management. *Energy Research & Social Science, 80*, 102210. https://doi.org/10.1016/j.erss.2021.102210

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

Blue, S., Shove, E., & Forman, P. (2020). Conceptualising flexibility: Challenging representations of time and society in the energy sector*. *Time & Society, 29*(4), 923–944. https://doi.org/10.1177/0961463X20905479

Boardman, B. (2013). *Fixing fuel poverty: Challenges and solutions*. Routledge.

Bourdieu, P. (1986). The forms of capital. In J. Richardson (Ed.), *Handbook of Theory and Research for the Sociology of Education Greenwood Publishing Group, Incorporated* (pp. 46–61). Greenwood Publishing Group.

Calver, P., & Simcock, N. (2021). Demand response and energy justice: A critical overview of ethical risks and opportunities within digital, decentralised, and decarbonised futures. *Energy Policy, 151*, 112198. https://doi.org/10.1016/j.enpol.2021.112198

Darby, S. J., & McKenna, E. (2012). Social implications of residential demand response in cool temperate climates. *Energy Policy, 49*, 759–769. https://doi.org/10.1016/j.enpol.2012.07.026

Fainstein, S. S. (2014). The just city. *International Journal of Urban Sciences, 18*(1), 1–18. https://doi.org/10.1080/12265934.2013.834643

Fjellså, I. F., Ryghaug, M., & Skjølsvold, T. M. (2021a). Flexibility poverty: 'Locked-in' flexibility practices and electricity use among students. *Energy Sources, Part B: Economics, Planning, and Policy, 16*(11–12), 1076–1093. https://doi.org/10.1080/15567249.2021.1937403

Fjellså, I. F., Silvast, A., & Skjølsvold, T. M. (2021b). 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

Godin, L., Laakso, S., & Sahakian, M. (2020). Doing laundry in consumption corridors: Wellbeing and everyday life. *Sustainability: Science, Practice and Policy, 16*(1), 99–113. https://doi.org/10.1080/15487733.2020.1785095

Gram-Hanssen, K. (2010). Residential heat comfort practices: Understanding users. *Building Research and Information, 38*(2), 175–186.

Gram-Hanssen, K. (2014). New needs for better understanding of household's energy consumption–behaviour, lifestyle or practices? *Architectural Engineering and Design Management, 10*(1–2), 91–107.

Gram-Hanssen, K., Mechlenborg, M., Madsen, L. V., & Hansen, A. R. (2017). Gender and ethical consumption of energy in smart homes. *Journals of Consumer Ethics, 1*(2), 111–119.
Halkier, B., Katz-Gerro, T., & Martens, L. (2011). Applying practice theory to the study of consumption: Theoretical and methodological considerations. *Journal of Consumer Culture, 11*(1), 3–13. https://doi.org/10.1177/1469540510391765
Inderberg, T. H. (2015). Advanced metering policy development and influence structures: The case of Norway. *Energy Policy, 81*, 98–105. https://doi.org/10.1016/j.enpol.2015.02.027
Inderberg, T. H., Palm, J., & Matthiasen, E. H. (in progress). Flexible electricity consumption policies in Norway and Sweden: Implications for energy Justice
Jalas, M., & Numminen, S. (2022). Prime-time access for whom? Rhythms fairness and the dynamic pricing of infrastructure services. *Local Environment, 27*(10–11), 1355–1371. https://doi.org/10.1080/13549839.2022.2040468
Jenkins, K., McCauley, D., Heffron, R., Stephan, H., & Rehner, R. (2016). Energy justice: A conceptual review. *Energy Research & Social Science, 11*, 174–182. https://doi.org/10.1016/j.erss.2015.10.004
Johnson, C. (2020). Is demand side response a woman's work? Domestic labour and electricity shifting in low income homes in the United Kingdom. *Energy Research & Social Science, 68*, 101558. https://doi.org/10.1016/j.erss.2020.101558
Løgstrup, L., Nelson-Burk, M. M., Moshleh, W. S., & Gunn, W. (2013). Designing anthropological reflection within an energy company. *Ethnographic Praxis in Industry Conference Proceedings, 2013*(1), 116–128. https://doi.org/10.1111/j.1559-8918.2013.00011.x
McCauley, D. A., Heffron, R. J., Stephan, H., & Jenkins, K. (2013). Advancing energy justice: The triumvirate of tenets. *International Energy Law Review, 32*(3), 107–110.
Mechlenborg, M., & Gram-Hanssen, K. (2020). Gendered homes in theories of practice: A framework for research in residential energy consumption. *Energy Research & Social Science, 67*, 101538.
Morris, P., Vine, D., & Buys, L. (2018). Critical success factors for peak electricity demand reduction: Insights from a successful intervention in a small island community. *Journal of Consumer Policy, 41*(1), 33–54. https://doi.org/10.1007/s10603-017-9366-8
Nyborg, S. (2015). Pilot users and their families: Inventing flexible practices in the smart grid. *Science & Technology Studies, 28*(3), 54–80. https://doi.org/10.23987/sts.55342
Öhrlund, I., Linné, Å., & Bartusch, C. (2019). Convenience before coins: Household responses to dual dynamic price signals and energy feedback in Sweden. *Energy Research & Social Science, 52*, 236–246. https://doi.org/10.1016/j.erss.2019.02.008
Powells, G., & Bulkeley, H. (2013). *Flexibility as socio-technical capital (Briefing Note No. 10), DEI Briefing Note Series*. Durham University Energy Institute.
Powells, G., Bulkeley, H., Bell, S., & Judson, E. (2014). Peak electricity demand and the flexibility of everyday life. *Geoforum, 55*, 43–52. https://doi.org/10.1016/j.geoforum.2014.04.014
Powells, G., & Fell, M. J. (2019). Flexibility capital and flexibility justice in smart energy systems. *Energy Research & Social Science, 54*, 56–59. https://doi.org/10.1016/j.erss.2019.03.015
Rinkinen, J., Shove, E., & Marsden, G. (2020). *Conceptualising demand: A distinctive approach to consumption and practice*. Routledge.
Rommetveit, K., Ballo, I. F., & Sareen, S. (2021). Extracting users: Regimes of engagement in Norwegian smart electricity transition. *Science, Technology & Human Values*, 016224392110528. https://doi.org/10.1177/01622439211052867
Røpke, I., & Christensen, T. H. (2013). Transitions in the wrong direction? Digital technologies and daily life. In *Sustainable practices: Social theory and climate change* (pp. 49–68). Routledge.
Royston, S., Selby, J., & Shove, E. (2018). Invisible energy policies: A new agenda for energy demand reduction. *Energy Policy, 123*, 127–135. https://doi.org/10.1016/j.enpol.2018.08.052
Ryghaug, M., & Sørensen, K. H. (2009). How energy efficiency fails in the building industry. *Energy Policy, 37*(3), 984–991.
Sæle, H., & Aasen, M. (2021). *Ny nettleiemodell for norske husholdninger*. SINTEF Rapport.
Sewell, W. H. (1992). A theory of structure: Duality, agency, and transformation. *American Journal of Sociology, 98*(1), 1–29.
Shove, E. (2003). Converging conventions of comfort, cleanliness and convenience. *Journal of Consumer Policy, 26*(4), 395–418.
Shove, E., & Cass, N. F. (2018). Time, practices and energy demand: Implications for flexibility [Monograph]. https://eprints.lancs.ac.uk/id/eprint/130369/
Shove, E., & Walker, G. (2014). What is energy for? Social practice and energy demand. *Theory, Culture and Society, 31*(5), 41–58. https://doi.org/10.1177/0263276414536746
Skjølsvold, T. M., Ryghaug, M., & Dugstad, J. (2013). Building on Norway's energy goldmine: Policies for expertise, export, and market efficiencies. In E. Michalena & J. M. Hills (Eds.), *Renewable energy governance: Complexities and challenges* (pp. 337–349). Springer. https://doi.org/10.1007/978-1-4471-5595-9_20
Southerton, D. (2006). Analysing the temporal organization of daily life: Social constraints, practices and their allocation. *Sociology, 40*(3), 435–454. https://doi.org/10.1177/0038038506063668
Sovacool, B. K., & Dworkin, M. H. (2014). *Global energy justice*. Cambridge University Press.
Sovacool, B. K., & Dworkin, M. H. (2015). Energy justice: Conceptual insights and practical applications. *Applied Energy, 142*, 435–444.
Standal, K., Talevi, M., & Westskog, H. (2019). Engaging men and women in energy production in Norway and the United Kingdom: The significance of social practices and gender relations. *Energy Research & Social Science, 60*, 1–9. https://doi.org/10.1016/j.erss.2019.101338
Strengers, Y. (2010). Air-conditioning Australian households: The impact of dynamic peak pricing. *Energy Policy, 38*(11), 7312–7322.

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

The Consumer Council of Norway. (2022). *Sårbare strømkunder*. De mest sårbare strømkundene betaler de høyeste prisene https://fil.forbrukerradet.no/wp-content/uploads/2022/03/rapport-sarbare-stromkunder-2022.pdf

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), 283–297. https://doi.org/10.1007/s12053-016-9456-5

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

Torriti, J., & Yunusov, T. (2020). It's only a matter of time: Flexibility, activities and time of use tariffs in the United Kingdom. *Energy Research & Social Science, 69*, 101697. https://doi.org/10.1016/j.erss.2020.101697

Trotta, G., Gram-Hanssen, K., & Lykke Jørgensen, P. (2020). Heterogeneity of electricity consumption patterns in vulnerable households. *Energies, 13*(18), Article 18. https://doi.org/10.3390/en13184713

Wethal, U. (2020). Practices, provision and protest: Power outages in rural Norwegian households. *Energy Research & Social Science, 62*, 101388.

Wilhite, H. (2013). *Energy consumption as cultural practice: Implications for the theory and policy of sustainable energy use* (pp. 60–72). Power, Practices, Technologies.

Wilhite, H., Shove, E., Lutzenhiser, L., & Kempton, W. (2000). The legacy of twenty years of energy demand management: We know more about individual behaviour but next to nothing about demand. In *Society, behaviour, and climate change mitigation* (pp. 109–126). Springer.

Winther, T., & Bouly de Lesdain, S. (2013). Electricity, uncertainty and the good life a comparison of French and Norwegian household responses to policy appeals for sustainable energy. *Energy and Environment Research, 3*(1), 71.

Winther, T., & Ericson, T. (2013). Matching policy and people? Household responses to the promotion of renewable electricity. *Energy Efficiency, 6*, 369–385.

Winther, T., & Sundet, Ø. (2021). *Folks betalingsproblemer kan øke*. Nationen.

Winther, T., & Wilhite, H. (2015). An analysis of the household energy rebound effect from a practice perspective: Spatial and temporal dimensions. *Energy Efficiency, 8*(3), 595–607.

Yunusov, T., & Torriti, J. (2021). Distributional effects of Time of Use tariffs based on electricity demand and time use. *Energy Policy, 156*, 112412. https://doi.org/10.1016/j.enpol.2021.112412