RESULTS AND RECOMMENDATIONS 03/2023

The Flexeffect project: Flexible electricity use in Norwegian households and the introduction of new grid tariffs

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Purpose of the research

The Flexeffect project is funded by the Research Council of Norway and aims to obtain comprehensive knowledge about the effects of various policy instruments aimed at households to even out power peaks in the electric grid. Flexeffect has investigated how such measures for increased flexibility in electricity consumption affect households' practices around electricity use, motivation to save electricity and investment in new technology. The project has also explored attitudes and understandings related to new grid tariffs. In addition, the consequences for different groups of households of instruments to promote increased flexibility have been examined, and an analysis has been made of which groups were taken into account when designing the new regulation for grid tariffs in Norway that was introduced on 1 July 2022.

The new grid tariff is intended to encourage households to even out their electricity use in order to avoid or reduce the need for future investments in the electricity grid. To achieve this, a monthly amount was introduced that is graded based on the customer's own maximum consumption in the current month, as opposed to a fixed sum equal for all households as it was previously. The customer's maximum consumption is measured on the basis of an average of the three hours of maximum consumption, kWh/h. The higher the maximum hour, the higher the monthly payment. In addition, grid owners can choose to introduce a time-differentiated energy component (øre/kWh), for example making it more expensive to use electricity on weekdays from 06:00 to 22:00 than at night or during weekends.

Background and participants

The results presented in this report are based on findings from the research project Flexeffect (NFR 2019-23), which was led by CICERO. Flexeffect is a collaborative project between the research partners CICERO – Centre for Climate Research (project owner), the Fridtjof Nansen Institute, the Centre for Development and the Environment at the University of Oslo (UiO) and SINTEF Energy Research AS, as well as the user partners the Norwegian Consumer Council, Renewables Norway, the grid company Elinett, Kongsberg Municipal Property, the Norwegian Water Resources and Energy

Directorate and Viken County. The Flexeffect project is also affiliated with the Include Research Centre for Socially Inclusive Energy Transitions.

The project began in the fall of 2019 and ended in the summer of 2023. Participating researchers: Karina Standal, Marianne Aasen, Tom Julsrud, Ingrid Christensen and Mikkel Vindegg (all CICERO), Hanne Sæle (SINTEF Energy Research AS), Tor Håkon Jackson Inderberg and Eivind Hjort Matthiasen (the Fridtjof Nansen Institute), Jenny Palm (Lund University, Sweden), Janet Stephenson (University of Otago, New Zealand), Øyvind Sundet, Tanja Winther, Hege Westskog and Iris Leikanger (Centre for Development and the Environment, University of Oslo).

For more information about the project:

- FLEXEFFECT – Flexible electricity use in households: barriers, opportunities and effects (cicero.oslo.no)
- Flexible electricity use in households: barriers, opportunities and effects (Flexeffect)

About the research

Flexeffect has made use of several well-established research methods, such as interviews, focus group interviews, surveys, observation and document analyses. The analysis has focused on three thematic areas: 1) households' perceptions of and opportunities for evening out electricity use, including their understandings of instruments and their purposes, 2) households' and municipalities' motivation and opportunities to invest in new energy technologies to even out electricity use, and 3) the introduction of measures to promote flexible electricity use among households in Norway and Sweden.

The new grid tariff, introduced in Norway 1 July 2022, has been the starting point for the sub-projects in the Flexeffect. An overview of the sub-projects is given in Table 1 below.

Table 1 - Overview of studies and choice of methods in the Flexeffect project

Sub-project		Methods	Period	Place
1	Consumer perceptions about technology, the new grid tariff, energy issues in general and energy practices and opportunities for flexible electricity use	Survey (n 1000)	October 2020	Norway
2	Consumers' perceptions and understandings of new grid tariffs, as well as energy practices and opportunities for flexible electricity use	Focus group interviews (n 27)	October – November 2021	Norway

Sub-project		Methods	Period	Place
3	Households' opportunities to change their electricity use, everyday impacts and their perceptions of energy justice in connection with new grid tariffs	Household interviews (n22), primarily conducted in people's homes	September and October 2021	Tromsø and Porsgrunn
4	The grid companies' reasons and motivation for introducing new grid tariffs as well as their perceptions of energy justice	Interviews (digitally) with selected representatives of grid companies (primarily participants in the projects Flexeffect and Forta) as well as other relevant actors (n13)	November and December 2020	Norway
5	Smart home solutions in private homes: User experiences from participants in pilot study of automatic control system for electricity use	Household interviews (n17)	November 2022	Porsgrunn and Skien
6	The municipality as energy pioneer: a study of Vestsiden Junior High School in Kongsberg	Interviews with relevant stakeholders (n14)	March-August 2020	Kongsberg
7	Grid tariffs in Norway and Sweden: implications for energy justice	Interviews with relevant stakeholders (n29) and document analysis (84 responses)	2021-2022	Norway and Sweden

Overall, the research has employed energy justice as a framework. This framework highlights the importance of studying which groups are recognised as affected in the design of measures, the distribution of costs/benefits from flexible electricity use in households and society, as well as the decision-making process for the design of new grid tariffs.

What we have found out

Overall, the results show that many consumers understand and agree with the purpose of new grid tariffs and consumer flexibility. At the same time, the design of the grid tariff is difficult to understand and adapt to in everyday life. There are competing signals and considerations that must be taken into account.

The need for information is great, as the electricity market is perceived as complex and many do not know about the grid companies or know what the difference is between the grid companies and the power companies. The grid companies advise against the use of household appliances at night due to

this posing a fire hazard. This was highlighted by households, who therefore saw few opportunities to change the timing of their consumption in a meaningful way.

Furthermore, many have expressed concern that the new grid tariff may have unfortunate and unfair distributional effects. Consumers take into account several factors related to new grid tariffs, e.g. household composition, work situation, etc., than what is within the grid companies' current mandate for the design of the grid tariff.

Our findings also show that it is challenging for consumers to adopt new technology to increase their flexibility. Doing so both has a financial cost and requires resources in the form of time, knowledge and interest.

Another important factor is that electricity use and related practices are linked to the division of labour in the home, which is partly shaped by gender roles. The interviews with households show that changing electricity use related to household chores (e.g. laundry) will result in more work for women, while men to a greater extent than women take on the task of adopting new technology.

The findings from the Flexeffect project show that there are major costs for consumers associated with changing consumption as intended, and it is a prerequisite that households have the knowledge, time, work, interest and financial resources to bring about changing habits and have opportunities to invest in technology that supports this. Consumers perceive the electricity market as difficult to understand, and the new grid tariff is no exception. Many also have a lack of trust in the electricity market (and by extension, grid companies). In addition, the energy cost crisis has led to increased criticism of the power system and how it is regulated.

The Flexeffect project also finds that although consumer considerations are mentioned in the political process for introducing new grid tariffs (the consultation processes), consumers are poorly represented in the design. It is mainly actors from the power sector, particularly grid companies, who have provided input during the consultation process. The consumer considerations included in the consultations also tend to be weak and general. Dimensions such as system needs have been given more emphasis than consumer needs, not least consumers' ability to adapt. No studies or other forms of knowledge building on vulnerable actors were carried out. There is a danger that input given in relation to particular consumers (e.g. vulnerable households) is not in line with their values, opinions or needs in the design of the tariffs.

As key points, the Flexeffect project finds that:

- Although the majority of informants agree with the principle that it is right to even out electricity consumption and that those who use the most power should pay the most, the new grid tariff is perceived as difficult to understand and adapt to (distrust of the power system, ambiguous price signals, lack of information and tools, etc.).
- Households with limited resources and little flexibility (time) expressed a high degree of frustration in connection with the new grid tariff, especially if price differences between day and night are introduced.
- Consumers need good and simple information and demand tools that can provide insight into their consumption, so that they can equalize their energy use (e.g. display).

- The grid tariff can exacerbate inequality. Some consumers have the option of continuing existing consumption or investing in technologies that lower their costs, while others do not have that option and must spend a larger portion of their household budget on energy costs. Here, particular groups may be especially unfortunate (low-income households, for example). If the cost of using power increases, inequality may also increase. Furthermore, strong measures for evening out electricity use can reinforce gender inequality, since the division of labour in the home is largely gender differentiated.
- There is scope for increased flexibility in electricity use when investing in new technology, but this potential requires financial resources, time and labour on the part of the consumer. Effective use of such systems requires technical knowledge that cannot be assumed to be present in the majority of Norwegian households today. It is reasonable to assume that such an investment will be easier and have a greater effect on consumers in the public and business sectors than for private customers.

The new grid tariff largely shifts the responsibility of power flexibility from the production side to the consumption side. At the same time, no tools are given to household consumers that can provide them with real-time information about how they are doing in relation to their power consumption. Instead, household consumers themselves will have to seek good solutions from commercial operators.

Implications

Based on the findings from the Flexeffect project, we see that there is a great need for information targeted to consumers, as well as simple tools that can give all households the opportunity to understand their own power consumption. With the introduction of the new grid tariff, Norwegians are now exposed to double price signals, which do not always coincide (e.g. timing of spot prices vs. changing consumption to even out the load in the grid). It is important that the tariff system is kept as simple as possible and that it is clearly explained to households. **We therefore recommend introducing measures that can reduce transaction costs for households:**

- Provide simpler signals that warn of high simultaneous power consumption in real time. Several people in the study asked for signals that could give warnings when you risk moving to a new price threshold for grid tariffs, such as a barometer you could install in the kitchen or an app on your phone that could send an alert.
- Make user-friendly technology available through information and financial support for all electricity customers. For example, reading equipment for the HAN port on smart meters will be able to help households monitor and adjust their own electricity consumption.
- Do something about the complex electricity market: There is a need to re-establish trust in actors in the electricity market. Guidance on both the grid tariff and consumers' opportunities to adapt should come from a neutral actor without commercial interests.

The findings from the Flexeffect project also show that caution is needed if grid tariffs are revised or new instruments for flexible electricity use are introduced later. Although the grid tariff is envisaged as an opportunity for better distribution of the costs of using capacity and provides little change for consumers with small and steady electricity use, this may change if the grid tariff in the future moves from today's "compromise solution" to clearer financial incentives to even out electricity consumption. People's opportunities to adjust their electricity use are unevenly distributed, and there is a danger that those with the lowest incomes and least opportunities to change their electricity consumption will suffer financially. **We therefore recommend:**

- The difference between high and low prices during the day and across seasons should not be too great, in order to avoid adverse effects and possible fire hazards.
- Measures that require increased use of smart management technology in households should be treated with caution. The use of this could increase transaction costs and contribute to inequality based on socioeconomic status and between genders.
- More knowledge is needed about which households are vulnerable to measures that promote flexible electricity consumption and whether existing or future support schemes capture these to avoid increased inequality. Representation of these groups should be included in future processes.

Current publications

A synthesis of the project results is published in the report:

- Standal K. et al. (2023): Forbrukerfleksibilitet: Et kunnskapsgrunnlag for å forstå husholdningers oppfatninger og muligheter, CICERO, Report no. 8/2023

Research articles from the project:

- Inderberg, T.H. I., Palm, J., Matthiasen, E. H., Flexible electricity consumption policies in Norway and Sweden: Implications for energy justice. Energy Research & Social Science, 110, 103466 (2024). https://doi.org/10.1016/j.erss.2024.103466
- Inderberg, T.H. I., Leikanger, I., Westskog, H., Institutional context, innovations, and energy transitions: Exploring solar photovoltaics with hydrogen storage at a secondary school in Norway. Energy Research & Social Science, 101, 103147 (2023). https://doi.org/10.1016/j.erss.2023.103147.
- Winther, T., Sundet, Ø. Flexibility for whom? Householder and stakeholder perspectives on justice regarding the introduction of dynamic grid tariffs in Norway. Energy Efficiency 16, 75 (2023). https://doi.org/10.1007/s12053-023-10153-1

Other relevant publications from the project:

- Include Resultater og anbefalinger 03/2022: Ny nettleiemodell for norske husholdninger
- Include Results and Recommendations 01/2021: Municipalities as energy pioneers: a study of Vestsiden Secondary School in Kongsberg
- Sæle H., Aasen, M., Ny nettleiemodell for norske husholdninger: Strømvaner, oppfatninger om ny prismodell for nettleie og motivasjon for å endre strømforbruk. SINTEF 2021:01468

A full list of publications can be found on the project website:

- FLEXEFFECT – Flexible electricity use in households: barriers, opportunities and effects (cicero.oslo.no)