SUMMARY

STUDY OF SELECTED MEASURES IN THE NORWEGIAN ELECTRICITY MARKET

A report to the Norwegian Ministry of Petroleum and Energy (OED) on reducing consumer burden due to high energy prices in 2022/2023

AFRY MANAGEMENT CONSULTING AND MENON ECONOMICS

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Preface

On behalf of the Norwegian Ministry of Petroleum and Energy (OED), Menon Economics and AFRY Management Consulting have assessed various policy proposals on how to reduce consumer burden due to high energy prices in 2022/2023.

Geir Brønmo (AFRY Management Consulting) and Even Winje (Menon Economics) have been the responsible partners and led the project. Piotr Śpiewanowski (Menon Economics), Katrine Holm Reiso (Menon Economics) and Petter Krogh Nilsen (Menon Economics) have been project associates. Quality assurance has been provided by Kristoffer Midttømme (Menon Economics).

We would like to thank OED for an exciting assignment.

This is the english summary from the published report "*Utredning av utvalgte tiltak i det norske kraftmarkedet*". The entire report in is available in Norwegian on our website www.menon.no

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September 2022

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Summary

AFRY Management Consulting and Menon Economics have conducted a study for the Ministry of Petroleum and Energy (OED) on policies that can reduce the risk of electricity shortages and reduce electricity customers' exposure to high and/or highly fluctuating electricity prices. For the latter, the main focus has been on policies that reduce household expenses.

The study was prompted by the exceptionally high electricity prices and low water levels in the hydropower reservoirs in Norway's southernmost price areas (NO1, NO2, and NO5) during 2021 and 2022. Norway's electricity market, closely integrated with the Nordic region and Europe, is influenced by rising electricity prices in these areas. This surge was primarily attributed to Russia's gradual reduction of gas exports to Europe. Concurrently, Southern Norway's hydropower plants experienced significantly lower than usual water inflow due to a relatively dry period. These factors collectively resulted in extreme electricity prices in the Norwegian market. In contrast, the northern price areas (NO3 and NO4) experienced minimal impact from these events due to relatively normal inflow levels and transmission network bottlenecks in both Norway and Sweden.

High electricity prices in European markets activate all available production resources, encouraging energy conservation and efficiency. This collective response diminishes the risk of energy rationing. However, such elevated prices also have substantial distributive impacts, including increased risks of energy poverty, inflation, and bankruptcies, especially among vulnerable businesses. The EU Commission advocates for national compensation strategies to address these issues. The key challenge is to devise and execute cost-effective measures that shield consumers from extreme expenses while maintaining adequate resource availability during the energy shortage period in both Norway and across the continent.

In the Nordic region, the high share of hydropower in the energy mix introduces additional complexities. The fluctuating nature of inflow means that supply security hinges on two key factors: the strategic management of reservoir water levels over time and the ability to trade power with neighbouring countries. In times of heightened uncertainty and progressively deteriorating conditions, managing these reservoirs becomes increasingly challenging. Furthermore, the ongoing war and the energy crisis in Europe have escalated uncertainties regarding the potential for energy imports.

The Ministry of Petroleum and Energy has tasked us with evaluating various strategies to mitigate the vulnerability of Norwegian consumers to escalating electricity costs and the risk of strained supply due to low water levels in reservoirs. We approach this assignment from a fundamental perspective, as many of the proposed measures entail permanent alterations to the current market structure. However, we also consider how these measures could be implemented as temporary solutions in the present situation.

In the following sections, we detail our analysis of the six key measures outlined by the Ministry of Petroleum and Energy.

Measure 1: Minimum requirements for reservoir filling before the drawdown season contribute to increased supply security, though their effect on electricity prices remains uncertain.

This measure explores different methods to ensure that producers conserve more water in the reservoirs during or before the drawdown season, without imposing explicit limits on export capacity. Reduced production, however, naturally leads to a decrease in net exports, potentially resulting in the need for imports if sufficient water is preserved. There are several possible variations of this measure, each involving regulatory actions

designed to limit production. The goal of these regulations is to maintain reservoir levels above a specified threshold.

To evaluate the impact of maintaining reservoir levels above a specified minimum threshold in each price area on a weekly basis throughout the drawdown season, we utilized AFRY's power market model, BID3. Simulations conducted across various weather scenarios suggest that this measure can effectively reduce the risk of a tight supply situation. However, it is also likely to increase the variability in electricity prices. During the conservation period, electricity prices are projected to be higher compared to the reference scenario, although the overall effect on the average price over time remains uncertain.

Reservoirs serve multiple functions within the power system, ranging from multi-year storage facilities like Blåsjø, to intake reservoirs that facilitate short-term production fluctuations within a day. This diversity makes it challenging to devise measures that are universally applicable and effective. Although various proposals for such measures have been put forward, none have been precisely defined.

In the summer of 2022, the government urged producers to conserve water to increase the filling levels in the southern region. Additionally, the Norwegian Water Resources and Energy Directorate (NVE) now requires regular reporting from these producers. This approach could be considered a "soft" implementation of the measure, provided it influences producers to modify their behaviour. However, a move towards further formalization of this measure would entail more complexities.

If feasible, this type of measure won't address the issue of high energy prices directly, but it could potentially reduce the likelihood of Norway facing a strained supply situation.

Recent remarks from the European Union indicate that such measures are more compatible with the European Economic Area (EEA) Agreement than other options, such as limitations on export capacity (as in measure 2). However, it's important to note that the EU's acceptance of these measures is likely contingent on their specific design and implementation details.

Measure 2: Limiting power exports or introducing an export tariff contributes to reducing prices, but the effect on supply security is low – and close dialogue with neighbouring countries is necessary.

The second measure aims to limit exports in order to mitigate prices and reduce pressure on the water reservoirs.

Our analyses using the BID3 model reveal that imposing mandatory restrictions on export capacity can slightly decrease power prices in Norway. However, substantial limitations are needed to meaningfully alleviate pressure on the water reservoirs. The study shows that halving the export capacity on the NorNed cable and the newer connections to the United Kingdom and Germany results in a modest price drop in Norway. Nevertheless, the net export then shifts to other international connections and timings, leaving the reservoir levels largely unchanged.

We also performed a sensitivity analysis with more extensive limitations on export capacity, extending to additional countries beyond the initial test. This scenario leads to higher reservoir levels and a more significant reduction in Norway's electricity prices. However, it also results in considerable water loss, particularly in years with high rainfall. These findings suggest that intense and long-term restrictions are necessary to substantially impact minimum reservoir levels. This, in turn, reduces market flexibility and leads to welfare losses.

Furthermore, it's crucial to consider how Norway's trading partners might respond to an export restriction. Their reactions could significantly impact Norway's ability to import electricity, especially in critical situations. This underscores the need for careful consideration and international cooperation when implementing such measures.

An alternative approach to limiting exports could involve introducing an export duty. However, due to the structure of the electricity market, it's not feasible to implement an export duty that generates revenue for the Treasury. The closest equivalent would be a "brake duty," which acts as an artificial loss component. This duty would effectively halt exports when the price difference is less than the cost of the duty and allow flow on the connections when the price difference is greater. Such a duty would likely have a dampening effect on prices.

Our quantitative analysis using the BID3 model indicates that over time, the impact of a moderate export duty is somewhat like that of a moderate limitation on export capacity. However, this measure tends to have a greater effect on prices than on the exports themselves, and consequently, on supply security. While it's conceivable that exports could be restricted by implementing an export duty that is carefully calibrated to specific price levels and connections, it falls outside the scope of this report to analyse such a scenario in detail.

For this variant as well, it's essential to consider the potential reactions of Norway's trading partners to an export restriction and how their countermeasures might impact Norway's ability to import electricity. Any interventions in international trade, such as restrictions on exports, would likely only be acceptable under World Trade Organization (WTO) and European Economic Area (EEA) agreements if they are deemed necessary to mitigate the risk of supply failure and are intended as temporary measures.

The Nordic power systems are intricately interconnected, meaning that supply issues arising from low reservoir levels in Norway can also affect neighbouring countries. Conversely, limitations on Norway's export capacity could impact the supply security of other Nordic countries. Therefore, the effectiveness of export restrictions is likely to be enhanced if they are implemented through close dialogue and cooperation with neighbouring countries.

Measure 3: Utilization and expansion of the network will reduce price differences - there are limited opportunities in the short term, but already planned measures will improve the situation.

In 2021 and 2022, notable price disparities were observed between the northern and southern regions of Norway and Sweden. The north has experienced a considerable surplus in production in recent years, largely due to the development of wind farms in Northern Sweden. However, the existing capacity of the transmission network has been inadequate to prevent bottlenecks between different market regions, particularly between the north and south. As a result, the northern areas have been less impacted by the power prices prevalent in Europe.

In alignment with our assignment, we have examined how alterations in transmission capacity within Norway and the broader Nordic region influence power prices and supply security. This assessment considers both the current state of affairs and more typical circumstances.

For our analysis, we utilized the BID3 model to simulate scenarios where we first enhanced the transmission capacity from northern to southern Norway, and then between different price areas in the Nordic region under various weather conditions. These simulations revealed that increasing transmission capacity generally results in more uniform power prices across the different price areas within Norway. However, it's noteworthy that prices tend to rise more in the northern regions than they decrease in the southern regions.

An important observation from this analysis is the reduction in water loss, particularly in the north and during years with higher rainfall. Additionally, the enhanced transmission capacity offers improved opportunities to leverage the flexibility of hydropower across Norway. This flexibility is beneficial for overall supply security, provided the resources are managed effectively.

Our model simulations, which are based on the 2022 power system, indicate that there are limited opportunities for significantly increasing transmission capacity in the short term. However, these simulations can still offer valuable insights into the general effects of enhanced transmission capacity.

While expanding the transmission network is a time-intensive process and unlikely to alleviate the current strained situation, there are potential solutions for better utilization of the existing network. One such solution is flow-based market coupling, which is expected to be introduced in 2023. Additionally, technological upgrades that can be integrated into the existing network might enable quicker capacity increases compared to constructing new networks.

System operators in Norway and Sweden are actively engaged in both large-scale development projects, aimed at increasing the physical capacity between the north and south during the 2020s, and in operational and technological initiatives to optimize network capacity utilization. These efforts are anticipated to increase the transmission capacity available to the market.

We do not see that the expansion of the domestic network could be in any significant conflict with Norway's international agreements.

Measure 4: A maximum price on power in the wholesale market could pose significant challenges for the security of supply.

This measure proposes setting a maximum cap on wholesale electricity prices, restricting power producers from selling electricity above a pre-established price, irrespective of current market conditions. Our analyses suggest that while a cap on wholesale electricity prices could potentially reduce consumer prices in the short term, aligning with the measure's intent, it presents significant long-term challenges for supply security.

In scenarios where the energy situation is already strained, either domestically or internationally, the impact on supply security becomes particularly problematic. If reservoir utilization and trade are not meticulously managed, it's highly probable that a situation necessitating rationing could emerge. Essentially, this measure could intensify the existing challenges, leading to more severe outcomes without additional interventions or actions.

The implementation of a price cap in the wholesale electricity market faces challenges primarily due to the disruption it causes in the link between market pricing and reservoir management. As the market price nears the set maximum price, or "price ceiling," producers lose their incentive to conserve water. In essence, when the maximum price becomes binding, producers are motivated to maximize production.

Additionally, setting a cap on prices at proposed levels could diminish consumers' motivation to save power and invest in energy efficiency measures. An equally crucial point is that a maximum price regime hinders the assurance of supply security through proactive trade. Norway is an integral part of the interconnected Nordic power system, which has substantial transmission capacity to the rest of Europe. In situations where the maximum price is lower than the prices in trading partner countries, Norway would become a net exporter, regardless of the domestic resource situation. This outcome could lead to a substantial reduction in the allocation and efficiency benefits that the power market typically offers, thereby significantly increasing system costs without guaranteeing sustained access to affordable electricity for consumers.

Implementing a permanent price cap on electricity in Norway, resulting in consistently lower prices compared to the rest of Europe, could lead to significant market distortions. One primary effect would be on industrial actors for whom electricity is a critical input factor. These businesses would be incentivized to either relocate to Norway or establish new operations there, driven by the prospect of lower electricity costs. This shift could lead to an increased demand for power within Norway.

Concurrently, the attractiveness of investing in power production would diminish due to reduced profitability, potentially necessitating subsidies to maintain a balance between power supply and demand. However, such market interventions leading to competitive distortions might likely clash with state aid regulations and not be possible to implement in practice.

Measure 5a-5c: Measures in the end-user market reduce electricity customers' price exposure but vary significantly in cost-effectiveness.

The end-user electricity market encompasses both household and commercial entities who procure electricity either through a supplier or a broker. Following discussions with our client, our investigation has primarily centred on strategies directed towards household consumers, without a specific focus on price regulation for business entities. Nevertheless, the core insights regarding market dynamics are largely applicable and can be extrapolated to both groups of customers.

Our analysis in the end-user sector is concentrated on three key proposed interventions: the implementation of a price cap regime, the establishment of a dual-rate pricing structure where standard consumption is priced lower than excess or 'luxury' consumption, and the creation of a fund that issues direct cash payments to electricity consumers, independent of their actual consumption levels. Each of these measures has the potential to provide financial relief to consumers, though they differ significantly in terms of administrative management and cost-effectiveness. The first two measures are notably similar in that they offer support directly linked to electricity consumption.

a) Implementing a **maximum price in the end-user electricity market** guarantees more affordable and predictable costs for consumers, thus effectively addressing the objective of mitigating the distributive effects of high prices on power. This measure is particularly efficient in terms of control, directly aligning with the goal of providing financial relief in the face of soaring electricity costs.

   However, it's important to note the correlation between energy consumption and income level. Generally, households with higher incomes tend to consume more electricity, implying that such households would benefit more from this measure. This trend is supported by findings from the SSB's (Statistics Norway) research conducted for the energy committee, which demonstrates a clear link between income levels and electricity usage.

   In other words, the measure achieves its overarching purpose, but provides larger transfers to those who initially have high purchasing power compared to those who have less.

   Introducing price caps in the end-user electricity market entails efficiency costs that need to be carefully balanced against the potential benefits in terms of distributional gains. Setting a maximum price level can significantly diminish incentives for conserving electricity and investing in energy efficiency improvements. The adverse effects of these distortions tend to escalate over time, particularly if the price cap is implemented as a permanent fixture.

In a long-term scenario, a permanent price cap could lead to a sustained shift towards increased electricity production, at the cost of neglecting conservation and efficiency measures on the consumption side. It's crucial to note that, unlike a maximum price in the wholesale market, a price cap in the end-user market does not directly impact the incentives of hydropower producers regarding the management of water resources. Instead, any adjustments by producers would be indirectly influenced through changes in consumer behaviour.

Maintaining price signals in the wholesale market means that implementing a price cap in the end-user market is less likely to significantly affect supply security, as long as there is ample trading capacity and access to controllable energy resources in Norway and among its trading partners. However, during periods of high strain, such as the current situation, the introduction of a price cap might lead to a slight increase in the risk of rationing. This potential increase is due to the changes in consumer behaviour that a price cap might induce. The decision to implement such a price cap should be based on a thorough assessment of these factors.

b) **A two-tier pricing system in the electricity market** ensures predictable costs for standard consumption and guarantees that such consumption is priced lower than luxury or excessive use. This system provides an advantage in terms of adapting to different income levels and social profiles, offering flexibility in its application. However, the challenge with a dual-pricing system lies in its complexity, especially in defining what constitutes normal usage. It is considerably more demanding to establish compared to a straightforward price cap. The existing electricity subsidy scheme, where holiday homes are typically excluded, can be seen as a simplified version of this system, primarily differentiating usage based on property type.

A two-tier pricing system in the electricity market moderates both the advantages and disadvantages associated with price regulation. Compared to a uniform maximum price applicable to all levels of consumption, a two-tier system is likely to have less of a distorting effect on consumer behaviour. However, it also reduces the predictability of costs and the impact on purchasing power for electricity customers. The degree of difference between the normal and luxury consumption rates in such a system largely depends on how it is designed. Irrespective of whether additional measures are implemented to ensure that luxury consumption is consistently priced higher than normal consumption, a two-tier pricing system will inevitably result in distributional and efficiency effects related to higher levels of consumption.

The implementation of a two-tier pricing system results in conflicting effects on consumption: it makes luxury consumption more costly, while normal consumption becomes cheaper. Therefore, the total impact on electricity consumption will largely depend on the specific definition of 'normal consumption' and the proportion of consumption that falls under the maximum price regime.

c) **Cash payments to electricity customers**, independent of their actual electricity consumption, can help increase households' purchasing power during periods of high electricity costs. While this method is less effective in directly shielding households from high electricity prices, it ensures more efficient resource utilization and maintains incentives for electricity saving and investment in energy efficiency. This approach is particularly beneficial in periods when maximum price levels might suppress market price signals.

The design of cash payments offers considerable scope and flexibility to address the distributional challenges highlighted in the context of the price cap. A well-thought-out design can provide good predictability for actual expenses. Payments can be adjusted in line with market price developments of electricity and possibly linked to historical consumption, although this could overcompensate those with higher incomes. Alternatively, payments can be means-tested to target those who need it most, or implemented as a flat-rate payment. Another option is to include the transfer as part of taxable income.

If the goal is to minimize the distributive effects of extreme prices within the economy, cash transfers emerge as the most suitable option among the measures we have analysed, particularly from a socio-economic standpoint. This preference stems from the considerable flexibility the measure offers in its implementation approach, coupled with its minimal distortionary effects on the behaviour and decision-making of both producers and consumers.

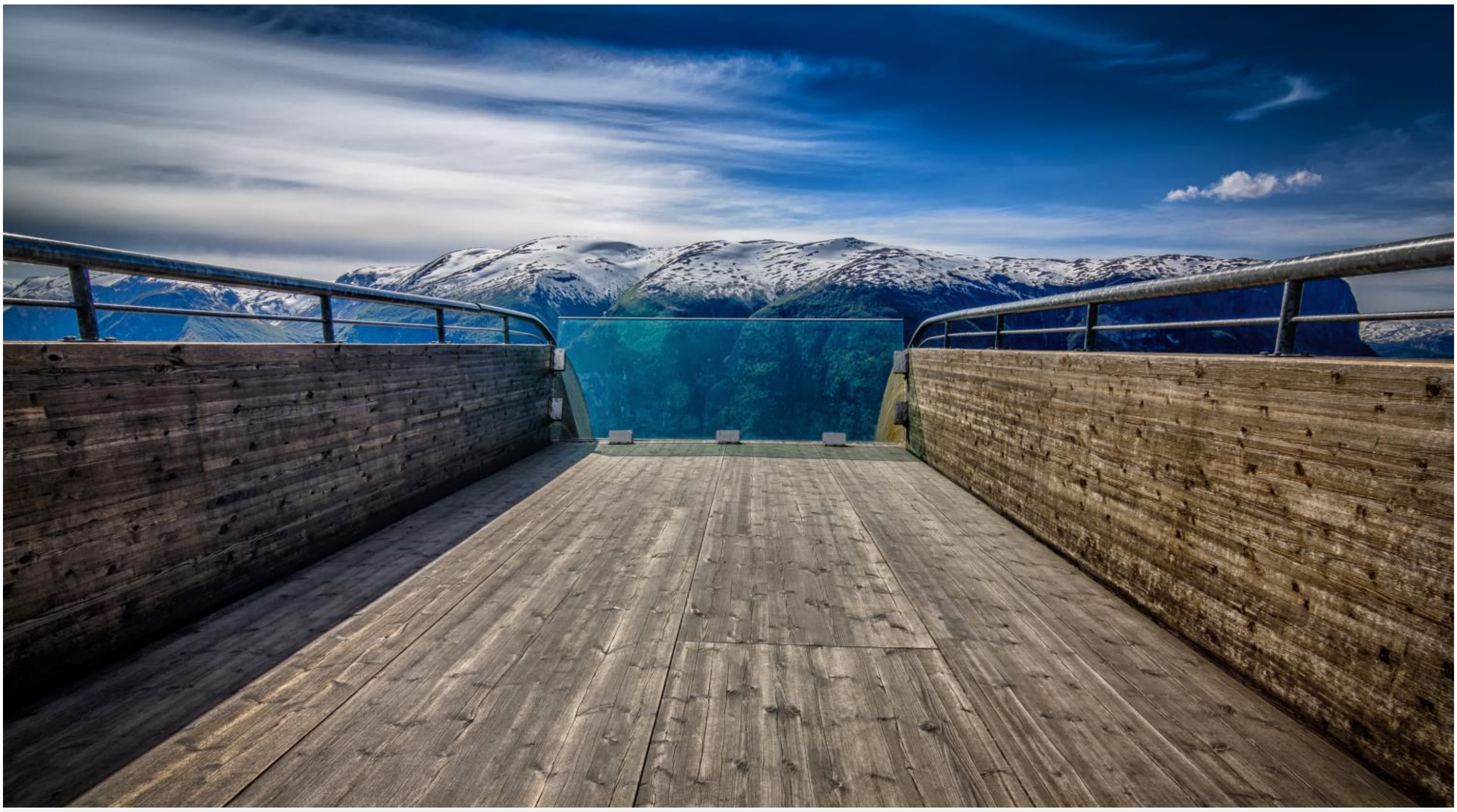
If the objective is to mitigate the distributive impacts of extreme prices in the economy, cash transfers stand out as the most favourable measure from a socio-economic viewpoint among those we have evaluated. This is because cash transfers allow for considerable flexibility in implementation and exhibit minimal distortionary effects on the adaptation behaviours of both producers and consumers.

Measure 6: Establishing a state-owned company for the sale of electricity is not necessarily more efficient than stricter regulation.

There are several challenges in the current end-user electricity market, with many customers finding it difficult to navigate among power suppliers and various types of agreements. A state-owned company could potentially offer more transparent and predictable agreements, which may reduce costs for customers who do not actively switch suppliers and serve as a benchmark for both end-users and competitors. However, considering the present market challenges and the fact that new legislation is being developed to address these issues, establishing a state-owned entity in the electricity market is deemed inappropriate at this stage.

The heightened focus on the electricity market, along with the introduction of new regulations for price information and marketing, is expected to improve market transparency and efficiency. This enhancement will likely lead to an increase in the number of customers switching suppliers. Should further intervention be necessary, stricter regulatory measures are anticipated to be more effective and less intrusive than the establishment and operation of a competitive state-owned company. The possibility of introducing a monopoly arrangement poses considerable legal risks and, importantly, risks of socio-economic inefficiency in the long run, and is therefore not advised.

There are no clear signs of significant market failure in the spot price market despite challenges like subscription structures. Some market players are offering relatively simple agreements with transparent and predictable surcharges. The surcharge on the market-leading agreements is so low that a state-owned company likely wouldn't be able to offer better terms than what the market already provides without subsidizing the electricity. In the case of fixed-price agreements, there is a certain degree of market failure, but this is linked to the extreme market situation currently. The lack of supply of this type of contract is largely due to the high risk associated with future market developments. A state actor could offer fixed-price agreements during volatile periods, but this would require substantial capital, carry high risk, and need a significant risk premium, assuming the company operates on commercial principles without state support. It's expected that the supply of fixed-price agreements will increase as electricity prices stabilize.



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