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Stabilizing the EU Electricity Market: Mandatory Demand Reduction and a Lower Price Cap

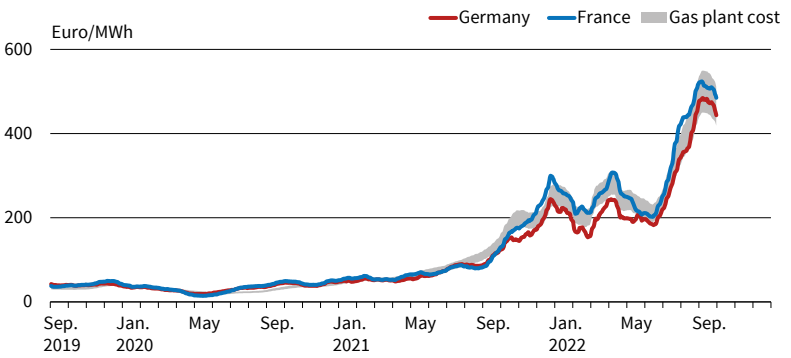
KEY MESSAGES

- **A coordinated roll-out of energy-demand reduction would create large external benefits in Europe.**
- **Lowering the price cap to €1,000 /MWh in the harmonized EU electricity market would save on costs for users, would not harm supply, and would substantially reduce the need for redistribution policies.**
- **European electricity market operators should prepare for the coming winter by adopting well-defined protocols for not only managing electricity shortage situations by rationing, but also for managing extreme spot price levels by rationing. This calls for dynamic price level targets that depend on how demand responsiveness develops during the crises.**

Electricity and natural gas are essential goods in modern society. Aware of this, the Russian strategy in the build-up to and during the Ukraine war was (and is) to use the scarcity of energy supply to blackmail Europe. Russian gas made up about one-third of EU gas consumption before the onset of the war; the subsequent reduction in supplies increased EU gas prices about tenfold compared to the long-run stable prices before 2020. As gas-fired power plants provide the variable capacity to accommodate changing electricity demand and intermittent renewable supply, rising and volatile gas prices are almost one-to-one transmitted to the wholesale electricity market. Electricity spot prices thus moved in tandem up with gas prices, as Figure 1 shows.

Figure 1

Electricity Current Market Prices



Note: Rolling 30 day mean of the day-ahead electricity spot prices in France and Germany. "Gas plant costs" present the short-run marginal cost of a typical gas plant using gas spot price, carbon price, and efficiency range from 45% to 55%. The gap between electricity-from-gas and average electricity prices arises because of hours in which renewable supply is sufficient to push gas power plants out of the supply chain.
Source: Authors' calculations.

However, the electricity wholesale spot markets are volatile, and most households and industry purchase electricity at prices that are fixed for some months, quarters, or years ahead. The forward market prices are traded in the derivatives contract markets that reflect the market's expectations of the costs of gas and electricity production. In the past, future markets provided stability for producers and consumers alike, but the crisis has removed the stability; the prices of electricity futures have risen as much as spot prices after spring 2022, and prices for 2023 even peaked above current spot prices at the end of August 2022, as Figure 2 details.

The two graphs support two observations:

- Demand for gas and electricity is very inelastic: reducing gas supplies by about one-third increases prices by a factor of 10. It is not a short-term phenomenon; it applies to 2023 equally.
- From April 2022 onwards, future electricity prices rose above the future costs of gas-based power, especially for France but also for Germany. That is, the electricity crisis deepens in these countries beyond the gas crisis (Bloomberg 2022b; Bundesnetzagentur 2022; Reuters 2022).

Both observations lead to non-standard policy recommendations. First, for the coming winter, Europe needs to reduce energy demand by more than what market prices can deliver. Second, Europe needs to protect the electricity price against "too-high" price hikes for those hours when supply cannot match demand. Below we discuss both recommendations in detail.

DEMAND-SIDE POLICIES

At the EU level, a variety of interventions have been entertained, ranging from the suspension of the markets to price ceilings and other non-market mechanisms (European Commission 2202a). The most recent proposal calls for mandatory demand reductions, interventions in excessive profits (windfall taxes), and the redistribution of those profits to consumers (European Commission 2022b). Here we highlight the importance of, and reasoning behind, mandatory energy savings.

The 2022 price hike is an unambiguous sign of a very low elasticity of demand for gas. If a reduction in supply by 30 percent increases prices by a factor of 10, the elasticity of demand is about –0.2. The hourly

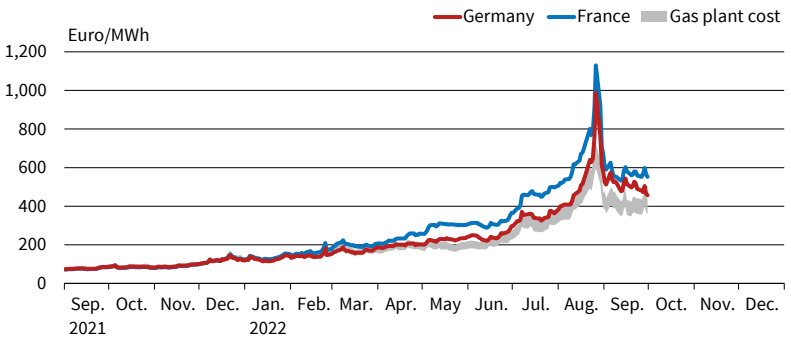
electricity spot markets show even lower values for demand elasticity during peak hours. A key reason for the low elasticity is that most consumers, firms, and households do not respond much to prices in the short term. Demand is sticky, based on behavior calibrated during previous periods when prices were low. Stickiness results in misallocation when prices deviate from the past. When prices rise as much as in 2022, it becomes efficient to nudge or force consumers into energy savings, since a sticky market on its own cannot deliver an efficient outcome.

Importantly, inelastic demand also implies an inverse effect: small reductions in demand can bring about large price drops. Suppose Europe succeeds in reducing energy demand (at constant prices) by 1 percent. Fixed supply and inelastic demand with a –0.2 elasticity means that prices would fall by 5 percent. The households and firms that initiated the demand reduction evaluate the gains from their own actions as 1 percent of energy expenditures. They do not attribute the price reduction to their own actions and consider it an external change in the market, even if it is endogenous. Stated differently, indirect aggregate cost reductions exceed direct individual cost reductions by a factor of 5. Every euro that a company or household saves on its energy bill by being frugal saves 5 euros elsewhere in Europe. The effect is akin to, but not equal to, a standard externality. The price advantage for consumers in Europe is paid for by gas producers, including Russia. It seems acceptable in these times not to include declining profits for Russia in our measure of welfare.

We now have two reasons for market intervention: stickiness at the individual level, and inelastic demand at the aggregate level, leading to a positive energy savings externality. We fully support the European Commission when her president in her speech on September 7 announced targeted policies to reduce overall energy demand by 10 percent, and peak-hour electricity use by at least 5 percent. Belgium, Germany, Hungary, Ireland, Italy, and Spain have introduced regulation whereby offices may not be heated above 19 degrees Celcius. Germany furthermore has banned the heating of private swimming pools and public areas with open doors. Such measures may appear draconian, but we believe that the social gains provide sufficient reasoning for support. Europe needs a coordinated roll-out of energy demand reduction.

Figure 2

Electricity Future Market Prices



Note: Electricity forward market prices for the year 2023 in France and Germany, and the short-run marginal cost of a gas-fired power plant with a 45–55% efficiency using 2023 forwart price for gas.
Source: Authors' calculations.

ELECTRICITY PRICE RISES BEYOND MARGINAL COSTS

Figure 2 depicts the extraordinary hike in the market's electricity price expectations. Here, we connect a significant part of the increase to higher risk premiums: the market expects frequent events where supply falls short of demand, with electricity rationing, and prices set by an administrative price cap.

Beginning in 2022, the EU set an electricity wholesale price cap of €3,000/MWh, as well as an automated rule stipulating the ceiling to increase by €1,000/MWh five weeks after each time the realized market price, at any hour in any market area within the EU, was above 60% of the current price limit. The rule was triggered in April and August 2022. A high and increasing price cap, as is the current protocol in Europe, increases the average costs of electricity – and substantially so. We thus argue for a reduced price cap for the duration of the current energy crisis.

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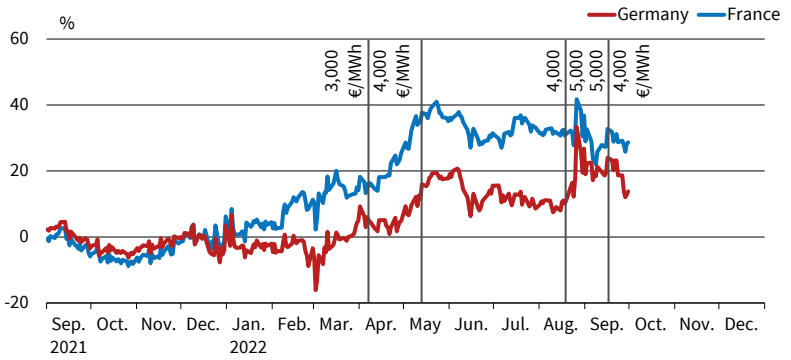
Figure 3

Risk Premium



Note: Differences between the electricity forward 2023 market prices in France and Germany, and the short-run marginal cost of a typical gas-fired power plant (cf. with Fig. 2).
Source: Authors' calculations.

Figure 3 shows the risk premium; it equals the electricity selling price minus gas-power production costs divided by the price, based on Figure 2. In France, the risk premium started to increase in spring of 2022. There were two small events with substantive consequences that we believe connect to this risk premium. First, on April 4, 2022 (vertical red line), the hourly wholesale price of electricity in France reached the current price cap, after which the EU protocol raised the price cap automatically from €3,000/MWh to €4,000/MWh (CRE 2022a). Importantly, while the event took place in one area, the price cap increase applied to the wholesale market for the entire EU, after a regulatory five weeks' delay (dashed line). The second event occurred on August 17, 2022, when prices in the Baltics area hit the EU's price ceiling, automatically lifting the cap throughout the EU to €5,000/MWh (second vertical red line) (NEMO Committee 2022). The two events proved to the market that electricity prices can rise above the gas-generated power costs.

The market anticipates that such events may happen more frequently, or over longer periods, in 2023. (CRE 2022b). The risk of having to deliver electricity while prices skyrocket demands a substantial risk premium. Importantly, the EU protocol – put on hold (on September 13, 2022, third vertical red line in Figure 2) but we do not know for how lo ng – raises the risk premium each time the market observes a supply shortage. Not only does the high price yield enormous rents for energy companies, it also risks destroying the electricity future market.

Indeed, the high prices of Figure 1 call into question the stability of Europe's integrated electricity market. Firms have sold contracts at normal price levels and now face margin calls; they must prove solvency and provide collateral, measured at over a thousand billion euros (Bloomberg 2022a), for their positions at central counterparty clearing houses (CCPs). As a response, Finnish and Swedish governments have already committed to 33 billion euros in additional loans and guarantees to avoid a "Lehman Brothers of energy industry" (Financial Times 2022). The potential for systemic risk had already been predicted earlier (Systemic Risk Council 2022b); the current market conditions prove that the optimistic views on preparedness were wrong (Systemic Risk Council 2022a).

The high prices demand a response: it is crucial to rein in expectations about how high the price of electricity will be allowed to rise in the wholesale market in the coming winter. EU decision-makers should commit to do "whatever it takes" to bring price control to the wholesale market. The sooner the EU decides what measures to take to reduce price expectations, the faster the prices of derivatives will fall. Demand rationing as discussed above is one immediate implication of this argument. But the risk premium, that is, the price gap with marginal costs, suggests a distinct electricity market crisis additional to the gas market crisis, which requires a targeted response.

EFFICIENT RATIONING

Electricity markets have been designed with the aim of efficient allocation in normal times. Part of the blueprint has been to allow for the possibility of occasional high prices at infrequent times, when peak demand combines with an unexpected cut in supply. But now the market faces a persistent supply shock, which together with inelastic demand leads to extreme price levels that are not rare events, but can become recurrent over weeks or months, before the long-term adjustments lead to a new equilibrium. Conditions, mechanisms, and incentives are different and require other rules than those in times of stable energy supply.

The ceiling price is a social contract that defines what can be charged for electricity if there is a shortage. Its level should be such that producers are compensated and thus have an incentive to invest and keep capacity for disruptive situations. The high price is acceptable when it is rarely paid, and only over short periods. The crisis caused by the Russian invasion is different because the disturbance is persistent. The ceiling price must be lowered when the frequency and length of disturbances increases, and can be lowered while keeping the same overall compensation promised to reserve suppliers. We believe a price cap of €1,000/MWh is more reasonable under the current circumstances, and it will substantially reduce the risk premium.

A common concern is that lowering maximum prices may lead to reduced supply, increasing the need for quantity rationing. The data, however, tell us this problem is insignificant. There is virtually no additional supply above €1,000 /MWh.

Despite the valuable efforts to increase demand elasticity across Europe, significant stickiness of demand likely remains. One reason is that both private and industrial consumers' technology choices have been optimized for price expectations that do not include the possibility of war in Europe. In this new

state of the world, the past choices have led to a misallocation in the market that cannot be immediately resolved. In a working paper (Reyer, Liski and Vehviläinen 2022), we show that the efficient intervention corrects for the misallocation by introducing an aggregate "demand response" through rationing not only when the market fails to clear, but whenever the market price exceeds the social value of consumption.

We calculate the social value of rationing using basic price theory, and illustrate it in a specific context, the Nordic market for wholesale electricity (see Figure 4). The supply and demand bids to the exchange contain information on the social value of rationing, and they form the basis for calculating the optimal price cap, hour by hour. The bids indicate how the demand changes in response to the shock, which is essential for the optimal adjustment of the price cap. In any given hour, if the clearing price rises above the optimal price cap, the mechanism implements the cap by an elimination procedure for the demand bids to obtain the required rationing. We quantify the mechanism using the actual bids in 2019–2022 as data.

In our working paper, we find several strong predictions for the optimal intervention. First, under persistent supply crises, the optimal price cap is only a fraction of the actual harmonized EU price cap. The rudimentary reason for the difference is that the harmonized price cap pays no attention to the welfare gains from a demand response achieved through rationing. The mechanism has no bearing on market clearing in normal times; it gained traction only after the onset of the supply crises in winter 2021–2022. The second prediction is that with a lower technical price cap, the rationed quantities remain minuscule in relation to total volumes in the market, suggesting that executing the physical rationing in regions that participate in trading should not be a major hurdle. Third, the intervention has strong distributional implications; a small demand reduction leads to a large price drop. In our stress tests, the policy leads to transfers from producers to consumers measured in billions of euros over a short period of time, although it should be borne in mind that our theory is justified by efficiency and not by redistribution objectives. Finally, the mechanism can be adopted without reforming the market clearing rules in place.

These results remind us that the price control and demand response are two sides of the same coin: when demand response is missing, the optimal policy involves price control. Put alternatively, the efforts to increase demand responsiveness are needed, but if they do not result in a significant increase in such responsiveness, price controls have their place in policy packages.

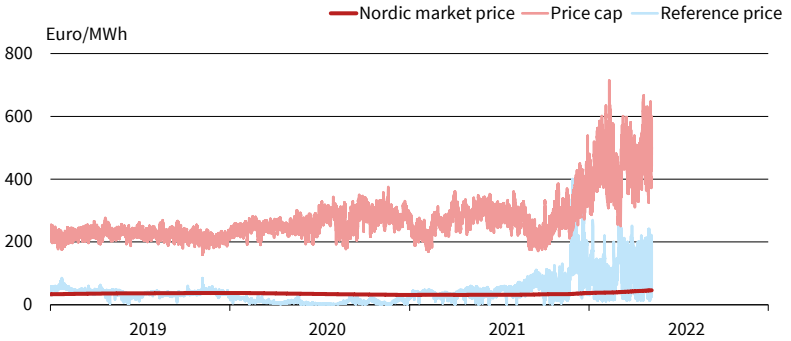
POLICY CONCLUSIONS

In these times of recurring supply shortages, the price of electricity for users should not run into the thousands of euros per MWh. Mandatory energy savings and lowering the price cap save on costs for users, do not harm supply, and substantially reduce the need for redistribution policies. We recommend that the technical price cap in the harmonized EU electricity market be lowered to €1,000/MWh to protect the integrity of the market. This price ceiling would not distort allocations to any significant degree, and it would further stabilize the forward market by reducing the system-level risks in the coming winter.

In addition to these measures, we strongly recommend that the European electricity market operators prepare for the coming winter by adopting well-defined protocols for not only managing electricity shortage situations by rationing, but also for managing extreme spot price levels by rationing. This calls for dynamic price level targets that depend on how the demand responsiveness develops during the crises. European day-ahead electricity clearing is done simultaneously with the same clearing algorithm (EUPHEMIA) for 25 countries. The first-best approach is to apply the price-control protocol at this EU-level market clearing. It is important for the EU market to remain integrated and avoid fragmentation in the name of "energy nationalism" because in that case the supply capacity in the EU is de facto reduced below the level that would be technically available to the EU member states.

Figure 4

Nordic Market Price, Price Cap, and the Reference Price



Note: Data form January 1, 2019 to May 10, 2022. The reference price is a rolling three-year average of the historical market prices.
Source: Authors' calculations.

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