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After the grace period: Economic and political challenges when electricity markets face the investment phase

Report to the projects Energy Industry Analysis and The Environmental Policy Game

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Abstract

Against the background of the 2002-2003 price spikes in the Nordic electricity market and the debates that this triggered, this paper discusses investments in new energy generation. While the Nordic case is characterised by specificities related to hydropower it also raises the more general challenge of capacity-expansion under a de-regulated market economy.

Key Words

Deregulation, energy, capacity, investment, price spikes

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Introduction

De-regulation of electricity industry in Europe has tended to start with a grace period of energy surplus inherited from the previously expansive co-ordinated economies and further amplified by better resource utilisation from extended international trade. The regulatory challenge has therefore primarily been to allocate existing generation to consumers in an efficient way . However, as energy demand increases, due to economic growth, the challenge of providing new capacity surfaces.

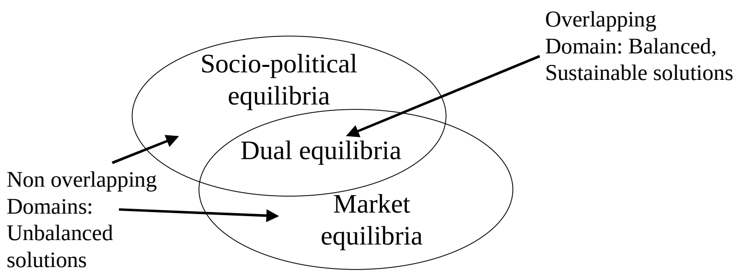
The Nordic region, which has been a pioneer in internationalising and deregulating electricity, is now approaching this stage, ahead of most of the rest of Europe, which is still enjoying the grace period. UK, the other pioneer in de-regulation, has under the lengthy phase of captive customership and amazingly high prices indicating some degree of oligopolistic control, been able to expand its generation capacity, and is therefore still enjoying a capacity surplus. Against the background of the 2002-2003 price spikes in the Nordic electricity market and the debates that this triggered, this paper discusses investments in new energy generation. While the Nordic case is characterised by specificities related to hydropower it also raises the more general challenge of capacity-expansion under a de-regulated market economy (Magnus and Midttun 2000). This challenge has surfaced prominently in the international debate, following extensive blackouts and price hikes both in Europe, USA and New Zealand. This paper therefore also discusses how the Nordic investment challenges of today shed light, on more generic challenges that may become more general European challenges of tomorrow.

Economic and Socio-Political Equilibria

Given the prominence of the energy sectors as general infrastructure, price formation and availability potentially figure high on the political agenda. We shall therefore take a broad political and economic view, where the socio-political acceptability and not only economic efficiency is of concern (Parsons & Smelser 1966, Dietz & Burns 1992, Freeman 1984, Zafirovski 2002)

The difficulty posed by the deregulated electricity market, particularly as the market reaches scarcity and new capacity becomes profitable, is that the economic and political equilibria may not always overlap. The market process may generate prices that politicians find unacceptable, while such prices may be necessary to trigger new investment (Besser J.C et al., 2002). There may, in other words, be a set of economic equilibria that fall outside of the socio-political domain and a set of socio-political equilibria that fall outside of the economic domain (figure 1).

Figure 1. Economic and Socio-Political Equilibria



Some pure economic market solutions with a high degree of economic efficiency may imply socially unacceptable distributive effects and not qualify on the social criteria. On the other hand, solutions where the economic realities are neglected would be examples of unilateral socio-political equilibria where economic efficiency conditions are not met.

It has been recognised that the Norwegian electricity market development was coming dangerously close to the social equity limits, given the price hike last winter and the following broad discussion about ways out of the Nordic energy scarcity situation. We can distinguish between four main paths:

- Firstly, solutions have been sought along an endogenous market path, with strong elements of commercial and technological innovation. This path implies that solutions are sought through creative re-combination of resources in the interface between supply and demand-side, involving alternative heating, flexibilisation of industrial consumption, energy saving etc.
- Secondly, a set of solutions have been debated that involve Government intervention in establishment of energy generation, and or modification of operation of hydro-dams to secure reserves for extreme climatic conditions.
- Thirdly, various strategies for energy supply via grid-interconnections have been proposed. The argument here is that further internationalisation of electricity supply will serve to stabilise supply and prices.
- Fourthly, initiatives to stimulate joint Nordic programmes for diffusion of new renewable technologies

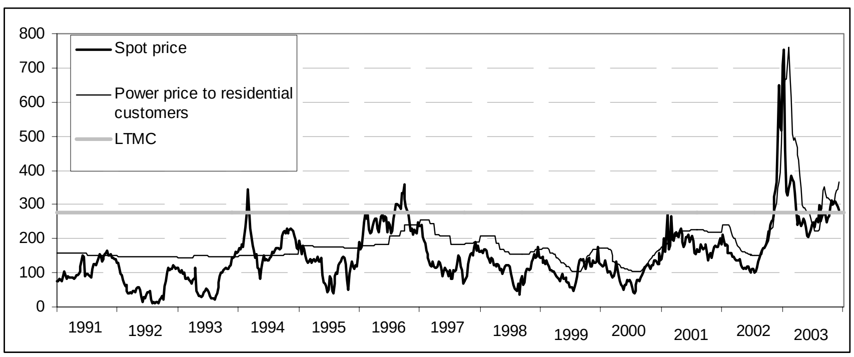
All these paths have strengths and weaknesses and also have different applicability to the Continental European markets. Referring both to the current Norwegian experiences and to potential Continental applications, we shall sketch some of the challenges and possibilities that each path represents with respect to solving the investment/supply challenge under socially acceptable conditions. But first a brief overview of the Nordic price spike episode.

The winter 2002/2003 Nordic price spike

The Nordic price spike arose in the autumn 2002 (figure 2) against the background of an extremely dry year in the Nordic area. Aggregate inflow to Norwegian reservoirs in the period from week 31 to week 52/2002, was only 56 percent of normal. This was the driest autumn since the inflow statistics was established in 1931. In addition to the dry weather conditions, the autumn of 2002 was colder than normal. These conditions led to a rapid withdrawal of water from hydropower reservoirs. As scarcity increased, spot and futures prices rose gradually.

From the beginning of August 2002 to mid-January 2003 wholesale electricity prices increased with more than 600 percent from around 15 Euro/MWh to 100 Euro/MWh. Since mid-January, prices have gradually decreased and seem to stabilize at a lower level during summer 2003. For a discussion on the Norwegian situation, see Johnsen (2003).

Figure 2 Spot electricity price for Oslo in the period 1991 – 2003, weekly average, NOK/MWh. Source: Nord Pool



The price spike seen from a political viewpoint

Politically and socially, this situation was described as a “power crisis” and strongly focused in media and the public debate. The supply scarcity and price spikes were painful for consumers without substitution possibilities or hedged prices and the Norwegian Minister of Oil and Energy had to take serious critique from public opinion for distributive effects of the exuberant prices. The exposure of the public to spot prices in the electricity market through short-term contractual arrangements greatly contributed to this.

As a consequence, the Norwegian electricity industry had a dramatic fall in consumer confidence and the sector has been under extensive public critique. According to investigations undertaken by the Norwegian Electricity Association (EBL), the media wrote more, and dominantly negatively, about the sector in one month during winter 2003 than in the whole preceding year taken together, Pladsen (2003). As calls came for stronger political market interference, one might argue that one was close to reaching the limits of political equilibrium conditions. The “crisis” was seen as necessitating public engagement and politicians, the regulator (NVE) and the system operator (Statnett) asked for consumption reductions in order to get more water stored in the hydropower reservoirs.

Public opinion in Sweden and Finland, that were also exposed to the same underlying spot prices have been more protected by price “cushioning” policies by electricity industry in somewhat less competitively exposed end-user markets. Furthermore Swedish and Finnish customers are less dependent on electrical heating, due to more use of flexibly fuelled water based heating systems than in Norway, where electricity takes a dominant share of the heating market.

The price spike seen from an economic viewpoint

From a purely economic perspective, the situation appeared somewhat less dramatic, but still raised considerable concern. It was recognised that the market had managed to solve the scarcity and had proved robust enough to stand the test. There was market clearance, although admittedly at unprecedented high prices (800 NOK/MWh) due to pretty inelastic demand. Nevertheless, these prices were far lower than the price cap set in other commercial markets as for instance in the US where price caps of $1000/MWh or some 7000 NOK/MWh are applied. Economic theory for prices of commodities with storage predicts price spikes in periods when the harvest is low, see Deaton and Laroque (1996). As water may be stored in hydropower reservoirs, this theory applies for electric markets dominated by hydropower. Thus, some price spikes should be expected since the inflow or the hydropower system’s harvest, varies heavily with weather.

The Nordic market, in many ways, functioned as expected, the high prices stimulated thermal power generation in Denmark and Finland. During 2003, Norwegian and Swedish power generation was 30 TWh lower than in 2002 and Danish and Finnish electricity generation was 15 TWh higher than in the previous year. A large fraction of this generation growth was exported to Norway and Sweden. In addition, the Nordic net import of electricity from continental Europe was almost 15 TWh higher than in 2002. This has brought electric power to Sweden and Norway and kept prices lower than they otherwise would have been.

Furthermore, political appeals and price signals worked, and over the 10-week period from week 49/2002 to week 6/2003, Norwegian consumption was reduced with 2.25 TWh or 8 percent (figure 3). About 40 percent of the reduction was made by electric boilers, which in most cases have changed from electricity to fuel oil. Another 25 percent of the reduction was made within the power intensive industry. A number of companies within this industry have found it profitable to reduce output and instead sell the contracted power in the market. The rest of the reduction, 35 percent, was undertaken by ordinary consumers, households, private and public service sector and small manufacturing firms.

Figure 3 Aggregate Norwegian power consumption (temperature corrected figures), GWh/week. Source: Nord Pool

However, the fairly short period of prices above long-term marginal cost (LTMC) for hydro- or gas based generation (approximately 250 NOK/MWh or higher), indicated that the time was not yet ripe for investments in new generation capacity.

Flexible decentralisation

Coming out of the Nordic price hike is an experience, especially from Norway, of a potential for flexible de-centralisation, indicating that the answer to the price hike challenge may not only come from the centralised energy system itself, but rather from alternative approaches. In attempts to opt out of the high price electricity market, Norwegians have turned to extensively increase in bio-fuelled heating, and have also taken increased interest in energy saving technologies such as heat pumps. A wave of investment of small-scale local hydro has also emerged as decentralised alternatives to traditional, centralized large-scale supply sources. Finally, rental of mobile oil or gas fired back-up power turbines was high on the agenda last winter. There is an international lease market for such equipment, which may limit price spikes if applied.

Relevance for other energy markets

Many of the continental European electricity markets are still in the grace period, as they were liberalised in a situation of large overcapacity. However, some of them have met short periods of price spikes: the Netherlands during some periods for reasons of transitory rules, Spain during the winter 2001-2002 for hydro reasons, Germany in December 2001, France and Germany during heat episode of summer 2002 and New Zealand in 2001 and 2003 for hydro and fuel scarcity. These developments can broadly speaking, be said to reflect normal functions of the electricity market. However, spectacular price spikes and crises have also previously arisen under deregulated market regimes in California for reasons of bad market design combined with volatility from hydropower and natural gas prices, lack of reserve capacities and possibly some deficit of investment in generation and in transmission mainly due to environmental protection plans. Some have, therefore perceived the spiking prices as an invitation to re-think electricity market design also beyond the Nordic context.

Policy Approaches

In principle, there are several approaches to coping with scarcity and investment challenges described above. Approaches may be characterised both along a technological and a governance dimension (figure 4). Along the technological dimension, some approaches implicitly or explicitly assume the context of the established large scale technological systems, while others rely on complementary de-centralised technological development. Along the governance dimension, some approaches imply use of co-ordinated governance, while others imply governance through competitive markets. Solutions to the scarcity and investment challenges may, however, also arise endogenously in large firms and industrial groups that command dominant market positions, denoted by II b where market competition tends towards oligopoly. We shall briefly review some of the most prevalent policy approaches under each of the four (or five) configurations

Figure 4 Policy Approaches

		Technology dimension	
		Large scale centralised	Small scale de-centralised
Governance dimension	Governance through market competition	I	III
	Co-ordinated governance	II a By government II b By ind. groups	IV

Policy of competitive exposure of large technical systems (Ia)

A simplistic implementation of competition in a large-scale technical system represents the first step of de-regulation. The buildup under coordinated governance, under the previous regime, has tended to produce a centralised large-scale technological system with considerable overcapacity when the electrical growth, in many cases, flattened out at the end of the seventies. Under such new market conditions, there seems to be a perception among some regulators, systems operators and power companies that in decentralised competitive markets, the players lack incentives to invest in new capacity because of the large general price risk, difficulties to analyse specific risks and lock-in problems with long lead-times and payback horizons. The implicit assumption being that one continues to be confined to large scale technical solutions only.

From a pure market-perspective one might conceive of adequate competitive solutions as there will always be a demand-supply balance, given the right price (Hunt S., 2002). However, from a socio-political point of view, the worry is that pure laisser-faire market governance would impose extreme price volatility and even possible shortages, given inelastic instantaneous electricity demand (Hugues W.R. et Parece A., 2002). Part of the social and political concern would be with the large transfer of wealth from consumers to producers while capacity is added in response to shortages. This could violate the social equilibrium conditions (figure 1) and create a real problem of social acceptability, as shown by the social controversies after the recurrent price spikes in some American States in 1999-2001 and above all the Californian crisis, as well as in Norway last winter.

Under type I policy conditions we would, therefore, expect the typical cyclicality of heavy industrial adaptation because of uncertainties of the volume of new capacities that would be installed under competitive uncoordinated investments and the sensitivity of prices to small changes in overall capacity in both directions (Ford, 1999): During peak periods under scarcity, one would fear the high price spikes, while after uncoordinated investment one might expect strong downward reaction of the market price with prices falling under the average costs as soon as new capacities are available on the markets. Entrants investing in merchant plants in the UK and in some of the Northeast US markets, with consecutive bankruptcies after a downward price turn, have harshly experienced the low end of the market. It may be argued that the type I policy approach is more cost-efficient than the type II, but it is likely to be much more volatile and more politically risky.

Policy of Reversal to Investment Coordination (II a)

The challenges from the perceived negative effects of competitive exposure under large scale technical lock in have lead to calls for stronger elements of co-ordinated intervention in the market economy.

Even under fairly liberal de-regulated market economy, reliability has in part been considered a public good, to be provided by the system operator in real time. In complement of the supply of this public good there are debates around the supply of “capacity adequacy” during peak which could be considered either to be manageable under market logic or to be provided as a public good (Besser et al., 2002; Joskow, 2002; Turvey, 2003). In this second case diverse solutions are conceivable: a Pigouvian treatment with capacity payments on every transaction, a Coasian solution with capacity obligations during extreme peak hours (Bowring J. et Granlich R., 2000) combined with a capacity market as a flexibility instrument (as discussed in the USA in the definition process of the Federal Energy Regulatory Commission's Standard Market Design proposal), or else a governmental coordination for guaranteeing the level of reserve capacity by auctioning for long-term contracts (IEA, 2003).

Moreover in some European countries there is a move to allow public authorities to programme and auction out long-term contracts with guaranteed price for the installation also of base load equipment. These are typically countries where the technological paradigm in electricity remains focused mainly on large-scale technical systems, in particular because of the persistence of the nuclear option.

The economic rationale is the supply of a collective good that is defined in terms of energy security (including limiting gas import dependency on the long run). This is the case in France where such measures were included in legislation in 2000 and the recent Belgian legislation. After the Californian crisis, the new European Directive on electricity and gas markets, which was passed in June 2003 includes a provision allowing and inviting Member States to adopt such an institutional devices to cover reliability and control the risk of dependence on foreign energy sources (European Commission, 2001). This is confirmed by the draft Directive on energy security accepted by the European Council of ministers in December 2003 which enforces this possibility for the Member States.

With the coordinated approach to investment this model may avoid the volatility of the previous approach, but possibly at some efficiency expenses. In particular auctioning instrument for peak equipment and base–load development reduces the scope for endogenous market function in the long term, could create overcapacity and therefore depress the market price. Moreover, it could likely to create incentives to free-riding by agents ready to invest by their own but choosing the unrisky long-term contracts by the bidding process (Oren S., 1999).

Policy Coordination of Investments in Grid Interconnection (IIa)

The perceived challenge of underinvestment under competitive exposure has also led to proposals for stronger grid interconnection, especially between regions with complementary resources and/or complementary supply/demand patterns.

European power markets are currently not very integrated. There are numerous transmission constraints all over Europe, including the Nordic area which has exhibited extensive price differences over the last years. It can be argued that grid upgrading and new transmission connections may help to stabilize prices during peak periods. Increased grid capacities may as well mitigate market power problems in certain regions. Accompanied with harmonized access rules, tariffs and balancing arrangements, a grid expansion path may have certain benefits that could motivate governmental support.

However, the necessary transmission investments would be large and need heavy subsidies. Because of the complex grid configurations and physical interactions, dimensioning of the necessary investments would also need detailed planning, evaluation and licensing procedures. The experiences in the Nordic area over the last years has also shown that the presence of transmission capacity may not guarantee the utilization of the capacity, as transmission capacities between countries runs the risk of being under-utilised when congestion occurs within the individual national grids.

Policies of decentralised flexible small-scale and demand side solutions (III)

Coming out of the Nordic experience, especially from Norway, is an insight that competitive solutions need not necessarily be sought within the large scale technical system as there appears to be a strong potential for flexible, de-centralized solutions:In attempts to opt out of the high price electricity market, Norwegians have turned to extensive increase in bio-fuelled heating, and have also taken increased interest in energy saving technologies such as heat pumps. A wave of investment of small-scale local hydro has also emerged as decentralised alternatives to traditional, centralized large-scale supply sources. As several of these solutions are provided at the local level, without need of specialised transmission, such solutions have the advantage of competing against the sum of power and grid prices.

Together with heavily increased power import from Sweden and Denmark, savings, in response to price signals, contributed to reduce the severe scarcity caused by the autumn 2002 drought in Norway and Sweden. The various activities were not only capable of limiting the consequences of the drought but they may as well resolve a potential future investment problem in the Nordic region.

Both households, large metal factories as well as small and medium sized industry reduced their consumption. In particular, the behaviour of metal industries is interesting because these industries had long-term contracts with politically fixed prices. Still, this industry reduced consumption and earned good money selling the power back into the spot market, thus actively contributing to the general power supply.

The price hike also led to creative exploration of alternative large scale peak power supply. Several parties planned to rent mobile plants or large ships for connection to the main grid in order to deliver electricity during the drought. The lessons learn from the Norwegian experience may be that the volatility challenges from the competitively exposed large scale policy approach may be at least partly resolved under a broader market conception. The answer to the price hike challenge may, in other words, not only come from the centralised energy system itself, but rather from supplementary de-centralised approaches, both with respect to reducing peak power demand–side (IEA, 2003; Oren, 1999) as well as to increasing volume on the supply-side.

Renewables and energy efficiency policies as partly unintended price hike solutions (IV)

Support for so called new renewable energy, which is now taking on quite sizeable proportions on the European agenda, could potentially contribute extensively to European energy supply. In addition come energy efficiency approaches which contribute to lowering demand. While the technologies in focus are generally small scale, the mode of governance is coordinated, as financing typically comes from public budgets or specialised levies and access rights. These policies can therefore be classified in our typology as coordinated small-scale technical solutions (IV).

Support schemes for the promotion of renewables and CHP for electricity generation have been extended in a number of countries motivated by environmental protection, i.e. to the preservation of a public good, in particular climate stability. However, such schemes have also been motivated by innovation policy and the need to bring forward a generation of new energy technologies for a sustainable future.

The European Commission has also been very active in these fields, and is trying to coordinate a variety of national support schemes including a range of instruments like feed-in tariffs, exchangeable quotas and bidding for long-term contracts. Taken together, these governmental support schemes for diffusion of new renewable technologies could have a significant effect on the development of new capacities in European electricity markets. The ambitious goal of increasing European electricity supply for renewables from 12 to 22% by 2012 could contribute extensively to boost electricity supply capacity (European Commission, 2001) . This would clearly help to postpone price hikes, but also obviously postpone the period where the market signals would reveal to the ordinary market players the profitability of investing in new equipment or to enter by invest in generation units.

Endogenous market coordination and negotiated governance as a policy strategy (IIb)

It could be argued that there is yet a policy option for price hike control within the market governance model, even under large scale technology lock in, namely that of oligopolistic coordination under a negotiated political economy. One could see signs of oligopolistic configuration in several European markets as mergers and acquisitions concentrate the markets in the hands of a few large actors.

The horizontal concentration movement in some countries like Spain, Sweden and Finland, Germany, may be interpreted as a classic response of the market to a risk exposure. In France the defence of a strong vertical and horizontal integration is clearly linked to the will to preserve the capability to invest in highly capital intensive equipment.

A club of large actors may firstly seek to stabilise prices at a higher average level than the competitive solution. However, such a club would also have an interest in stabilising the system performance within the social equilibrium space, knowing that excessive price spikes might call for regulatory intervention. The club could therefore be motivated to supply necessary capacity to secure smooth performance and would not have to take the competitive market effects of some over-capacity due to coordination of a gentleman's agreement type.

An implicit or explicit "gentleman's agreement with policy makers or society would then be not to push the price too high, in return for which government would not press for stronger regulatory intervention.

Concluding Remarks

If pursued simultaneously, the policy approaches outlined above are obviously going to have complex interaction effects. Whether the policy process will allow this to be taken into consideration is, however, another matter. By way of conclusion we shall first explore some of the policy-interdependencies, and then briefly address the issue of the policy process.

One of the early lessons learnt from the California experience was that market based regulation under a centralised, large scale system did not go well together with plan-based peak price cap intervention. While social equilibrium conditions were clearly violated by the market outcomes, this mode of policy intervention served to aggravate the situation. Price signals did not pass through to consumers and markets were not cleared.

The Nordic price hike was not met by price cap interventions, but did, as pointed out above, lead to calls for coordinated investment in generation and grid interconnections. Obviously these initiatives, if implemented, could have cumulative effects that might lead to over-investment. As alternative co-ordinated economy interventions they would firstly have to be judged up against each other. The effects of grid investments would, furthermore, have to be evaluated against the background of price and capacity developments in neighbouring markets.

Most importantly, however, both the grid investment and the generation capacity investment strategies would tend to undermine private, market based investment, as they are likely to maintain prices under the long term marginal cost threshold. Use of public investment strategies for price hedging purposes could therefore easily imply a permanently sustained public investment role. Furthermore, in the context of an integrated market, such investments would have to be coordinated by all involved countries, unless one country alone should be willing to carry the burden of total system investment costs.

Less demanding, in terms of international policy coordination, is the options of decentralised and demand side solutions, beyond the large centralised large scale technical paradigm. The advantage for many of these approaches, are that they compete against the combined grid and generation costs. Institutional facilitation of such measures, therefore, remains among the most attractive and recommendable policy-measures to be undertaken. A more realistic threat of substitution from de-centralised solutions would possibly implicitly cap central system prices and thereby help maintain the social equilibrium.

There are also links between the decentralised investment strategies and environmental policy, which has a high priority in many national agendas as well as on the EU level. Environmental policy motivated support for new renewable technologies could, under an innovation perspective, be justified as a learning curve investment to close the gap between immature technologies and the market's willingness to pay. As already mentioned, this would clearly help to postpone price hikes, but also obviously postpone the period where the market signals would reveal to the ordinary market players the profitability of investing in new equipment or to enter by invest in generation units. The large environmental externalities, as well as international coordination already achieved on investment in new renewable, would seem to make this strategy more attractive than publicly financed conventional investments in generation capacity.

At the end of the day, while de-regulation and competitive exposure of electricity industry still remains a dominant European policy concern, a balance will have to be struck against two other dominant policy objectives, namely that of environmental greening and that of security of supply. While the fluctuations derived from a lock in to the large scale technical system - when it approaches scarcity - is clearly undesirable from a societal point of view, a more stable, but possibly fairly high price of decentralised energy supply investment and demand side management might be more socially attractive as it would both allow less public investment in learning curves for new renewables and also limit consumption and hence the burden on security of supply. The grace period may, therefore, be over also for energy consumers, who, under the initial phase after deregulation, with a power surplus, experienced prices at low short term marginal cost levels.

However, the ambitious European environmental agenda also demands a complementary "green" innovation approach, to secure tomorrow's renewable energy technologies. If publicly coordinated green energy investments are made at a rate sufficient to make up for the consumption increases and the scrapping of old large scale facilities, one might temporarily get back to a lower price scenario.

Nevertheless, strong forces in Europe are still backing the large-scale technology paradigm. The argument being that the scale and scope of replacement of Europe's aging energy generation capacity, cannot be adequately met by decentralised approaches alone. The challenge for this position remains, however, to strike a balance with the dominant market paradigm, which maintains competitiveness while not violating the boundaries of social acceptance.

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