Potential Interactions between Capacity Mechanisms in France and Germany

Descriptive Overview, Cross-border Impacts and Challenges

STUDY

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IMPRINT

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Descriptive Overview, Cross-border Impacts and Challenges

STUDY ON BEHALF OF
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Preface

Dear Reader,

Some fifteen years after the liberalization of European power markets, numerous stakeholders and observers have expressed doubts as to whether energy-only-markets encourage sufficient investment in generation capacity to guarantee long-term resource adequacy.

While this concern is growing in the capitals of Member States, it is not universally shared among policy makers and academics. Notably, France and Germany, the two largest electricity markets in Europe, are at different stages in the political and technical debate on future resource adequacy and market design. In France, a decentralized capacity market has been encated by law in 2010. All legal provisions have been adopted and the mechanism is due to start in the next months for a first delivery year in 2016. Meanwhile, the debate in Germany continues. The Federal Ministry for Economy and Energy published a *Green Book* in October 2014 on power market design. After a broad consultation with stakeholders, new market-design legislation could be adopted by the end of 2015.

In this context, this paper aims to provide a better understanding of the adequacy challenges and market design discussion in France and Germany. It describes in depth different proposals currently on the table, and it specifically discusses the consequences of a unilateral implementation of a decentralized capacity market in France for the French and German electricity markets, as well as its cross-border effects.

The deeper, underlying question of this paper is to what extent cross-border differences in capacity remuneration matter for the functionality of an internal European electricity market. This is a particularly important question for the debate in Germany, but also – beyond specific national choices – for other European countries contemplating the introduction of capacity remuneration mechanisms.

Yours,
Patrick Graichen
Executive Director of Agora Energiewende

Key findings at a glance

1. **Already now, Germany and France are helping each other guarantee security of supply.** Whenever there is capacity shortage in one country, prices in that country rise, favoring power plants in the other country to export. This is done automatically via market coupling.

2. **A joint German-French shortage situation is currently very rare, but may occur more often.** A cross-border challenge in security of supply arises only during days with very cold weather and very little wind in both countries at the same time. An analysis of historical weather data suggests that after 2023 this might occur about six days in ten years.

3. **The unilateral introduction of a capacity mechanism in France benefits French power generators and German consumers – but the redistributive effects are likely to be small.** Different market designs between Germany and France will generate some redistributive effects, but they are limited by the level of interconnections between the two countries (currently 3 GW) and joint market coupling with other European countries.

4. **The French decentralized capacity mechanism and the proposal developed by the German energy associations BDEW/VKU, though globally based on the same principles, differ in important respects.** The French proposal, while effectively decentralized by nature, relies significantly on regulated components, with a central role going to the TSO. Similar design elements are currently missing in the BDEW/VKU model, leaving the question open as to who would actually supervise, control and sanction this scheme in Germany.

5. **Cross-border participation in capacity mechanisms raises fundamental technical and regulatory questions.** These questions include monitoring and control issues as well as rules for delivering capacities in foreign markets without interfering with market coupling. Addressing these questions requires political and technical cooperation on both sides of the border, especially when it comes to situations of joint scarcity.

Content

Lists

List of Figures

List of Tables

Executive Summary

Market design and adequacy challenges in France and Germany

France and Germany are at different stages in the technical and political debate surrounding power market design and capacity remuneration mechanisms. While France has adopted all legal provisions that introduce a capacity mechanism, in Germany a political and technical consensus is still outstanding, both with regard to the need for a capacity mechanism, and concerning the details of a market design. Accordingly, the debate on the *missing-money-problem* differs greatly in the two countries. In France, the final consensus is that the energy-only-market cannot guarantee fulfilment of the security of supply criteria established by public authorities (i.e. loss of load expectation of 3 hours per year). The proponents of capacity markets in both countries argue that resource adequacy is endangered. However, given the different nature of the two power systems, different arguments are advanced. In France, the main justification for a capacity mechanism is the high temperature sensitivity of electricity demand. Winter peak load has been continuously growing in recent years, but the rarity of cold days has led to the insufficient utilization of peak plants. Against this backdrop, the core objective of the mechanism is to incentivize the demand-side response. In Germany, the main argument for introducing a capacity mechanism is the increasing feed-in of wind and solar power, which lowers margins on conventional generation, thus reducing incentives for its deployment. Structural differences between the French and German power sectors (in term of organization, concentration and liquidity) have also shaped the market design debate.

Stylized economic analysis of the cross-border impact of capacity mechanisms

This report discusses the potential cross-border economic impacts that would result from the introduction of a decentralized capacity market in one country (e.g. France) when a second country (e.g. Germany) chooses between three alternative market designs: an energy-only-market; an energy-only-market in tandem with a strategic capacity reserve; and a decentralized capacity market. These three market design options were selected for study because they appear most realistic for implementation in Germany. (In this connection, we rely on assessments commissioned by the German Ministry of Economics and the associated deliberations published in the electricity market *Green Book*). This economic analysis of two abstract, interconnected systems generates several theoretical insights:

→ In the short-term, the introduction of a unilateral decentralized capacity market in one country would appear to have no short term cross-border effects, as the fulfilment of capacity obligations is not directly linked to transactions in the power market. Cross-border competition would be efficient and undistorted, provided the other country does not opt for a strategic capacity reserve, as – in that case – capacities are operated and financed outside the power market, and they distort market transactions when they are activated.

→ In the long term, the unilateral operation of a capacity market appears to distort cross-border investment incentives, and may put energy producers in the country without capacity remuneration at a competitive disadvantage. However, consumers in the country without capacity remuneration could benefit from reduced electricity prices generated in the neighbouring market, without having to bear the full costs of the capacity remuneration scheme. The joint introduction of similar capacity mechanisms in neighbouring countries would lead to less distortion to competition and efficiency than divergent market designs, particularly when the explicit cross-border trade of capacity certificates is allowed. The efficiency gains in cross-border trade may, however, be outweighed by the transactional and regulatory costs arising from the practical implementation of the mechanism.

However, several conclusions obtained in the analysis rely crucially on the hypothesis of a *missing-money-problem* (i.e. a potential market failure leading to capacity inadequacy). While hotly contested, this *missing-money-problem* is usually cited as the key reason for introducing a capacity mechanism.

→ Without the *missing-money-problem*, the introduction of a capacity mechanism is wasteful, as it creates additional administrative burdens both for regulators and energy companies. If authorities desire a stricter security of supply standard, the capacity mechanism may be politically legitimate, albeit economically sub-optimal.

→ With the *missing-money-problem*, some form of market intervention is necessary to ensure long-term security of supply. Transactional and administrative costs will also increase, but they are unavoidable for ensuring generation adequacy in the country that implements the capacity mechanism. As a spillover effect, the mechanism may enhance generation adequacy in the neighbouring country. A reliance on foreign capacity for ensuring national security of supply – so-called *free-riding* – is in principle possible, but only if scarcity events are weakly correlated. Joint scarcity situations endanger security of supply in both countries and could spill over, even to neighbouring countries with capacity mechanisms, unless this situation is taken into account when setting up the capacity targets or exports are limited by regulators (which is – in principle – forbidden under current EU legislation).

Weighing the theoretical analysis against the empirical facts of the French and German power systems

The report investigates the extent to which German capacity would be displaced by the French capacity mechanism while taking the level of interconnection and cross-border flows (and potential congestion) into account. It also estimates the likelihood of a scarcity situation in one country spilling over to the other. Our analysis is not comprehensive, but provides a preliminary assessment. We conclude that under current conditions, the unilateral introduction of a capacity market would only lead to limited inefficiencies. Future developments could change this conclusion, however, such as the increased decommissioning of capacity in Germany.

a) Market integration and interconnector capacity
The level of interconnector capacity influences the impacts that would result to security of supply. When interconnection capacity is small, such that congestion occurs frequently, market distortions matter far less. This has consequences for regional security of supply, as only well coupled markets can truly back each other up.

The level of interconnection between France and Germany is currently lower than 4GW and moderately congested (about 40 percent to 50 percent price divergence). A closer analysis shows that most of the imported electricity is serving peak load, i.e. German power producers help to reduce scarcity situations in France. This puts one theoretical finding into perspective – if anything, German power exports today tend to displace French investment into peak load capacity, rather than vice versa.

b) Probability of a joint shortage situation
From a theoretical perspective, the negative spillover of a scarcity situation could occur – assuming the existence of the *missing-money-problem* – if a joint scarcity situation occurs in both countries. In such a situation, German power producers might not contribute to the extent expected by the French TSO, and French generators may even be economically incentivized to export their electricity.

The empirical analysis of joint scarcity situations performed in this study provides little support for the view that the introduction of a capacity mechanism in Germany is urgently needed to avoid the bilateral spillover of cross-border security of supply problems. As joint scarcity situations are rare, both systems can back up each other. However, circumstances may change, particularly if German power producers start to decommission capacity on a larger scale than is foreseen today. This issue could become highly relevant as Germany phases out the last of its nuclear power plants in the years leading up to 2022.

Limiting the discussion to two countries is an artificial constraint, however, especially in light of market integration in Northwestern Europe. Indeed, any long-term planning to ensure security of supply in this region needs to account for cross-border interrelationships and for how problems in one country can potentially affect its neighbours. Given the high degree of market integration and increasing cross-border trade, ring-fencing an individual power supply system is virtually impossible today.

Comparing the French decentralized mechanism with the BDEW/VKU proposal

Both the French decentralized capacity mechanism and the proposal developed by the German energy associations BDEW and VKU exhibit similar features, yet they differ in several respects. Both mechanisms are foreseen as complements to electricity wholesale markets and are decentralized in nature. Nevertheless, the BDEW/VKU proposal is based on fewer regulated components than the French mechanism. In particular, the BDEW/VKU proposal:

→ does not introduce prequalification requirements for delivering capacity certificates. The risk of a market participant defaulting – and associated liability issues – are cleared through bilateral contracts or by the stock exchange;

→ does not make use of explicit security of supply criteria, although such criteria play a dimensioning role in the French system. An implicit level of security of supply is nevertheless met in the BDEW/VKU proposal, through the penalty settlement for non-delivery;

→ foresees the implicit (rather than explicit) participation of a demand-side response;

→ relies on a market signal for announcing scarcity events (whereas the TSO announces a scarcity situation in the French proposal);

→ relies on a market-based penalty settlement (whereas the French system foresees – in some situations – an administrative penalty).

However, it must be noted that the proposal drawn up by the BDEW and VKU is far less developed than the French mechanism. Accordingly, the plans for a decentralized capacity market in Germany could undergo considerable evolution when examined more closely by policymakers – for example, during the consultation phase foreseen in the German government's *Green Book*.

Regulatory compliance of capacity mechanisms

The introduction of a capacity mechanism is considered a state aid measure by the European Union. It could also be seen – under certain conditions - as compensation for the cost of a public service obligation of general economic interest. Such measures are only permitted when they do not negatively affect the internal market. We assess the compliance of the French mechanism and the BDEW/VKU proposal with this rule on the basis of the following six criteria:

Common interest and need for state intervention: A capacity mechanism necessarily addresses a resource adequacy problem, which can only arise in the case of market failure. France has asserted there is a *missing-money-problem* while emphasizing the public good character of security of supply. German associations, by contrast, only refer explicitly to the *missing-money-problem*. In light of the EU's regulatory approval of the UK's capacity mechanism, both market failures are seen as justification for state intervention.

Appropriateness of aid: Remuneration under a capacity mechanism must be granted for the provision of firm capacity, which is foreseen under both proposals.

Proportionality of aid: The capacity mechanism may only compensate for the amount of money missing to assure adequate levels of generation/resources. Both proposals are based on the concept of a decentralized market with several capacity providers offering their certificates and many suppliers asking for certificates. The certificate prices will thus be determined in a competitive process, which should assure the proportionality of the aid.

No distortion to competition and trade: In both the French scheme and the BDEW/VKU proposal, energy markets operate independently from the capacity scheme and do not cap spot market prices. In the case of involvement in a foreign capacity mechanism, the home government is not allowed to restrict capacity exports. Both schemes advocate the free flow of electricity. In addition, the capacity scheme may not create or worsen any market power issues and must be open and non-discriminatory to any potential contributor of firm capacity. Both the French and German schemes allow in principle participation by all potential capacity providers.

Technology neutrality: The French and BDEW/VKU capacity schemes are meant to be open to all technologies. Both schemes do not discriminate between new and existing capacity and do not discriminate against potential capacity providers based on their carbon intensity. The schemes allow market entry of carbon intensive capacity providers to the detriment of the stated EU decarbonisation policy. Furthermore, the BDEW/VKU proposal may not be sufficient to comply with the regulatory requirements for the participation of a demand-side response.

Transient nature of capacity mechanisms: The capacity mechanisms should be of a temporary nature. If market failures are solved, the schemes should be abandoned. The price of capacity indicates the extent of market failure. If the price drops to zero, this indicates the disappearance of the *missing-money-problem*.

Cross-border participation in capacity mechanisms

The EU guidelines require national capacity mechanisms to be open to foreign participation. The EU Commission expects foreign participation in form of an active, explicit ability of foreign capacity providers to engage in capacity mechanisms. The EU Commission remained highly vague in its guidance document on the practical implementation of cross-border participation, leaving several issues unresolved:

Certification of firm capacity: Either the TSO operating in the country with a capacity mechanism or the foreign TSO could certify the foreign capacity.

Delivery of capacity: The core problem posed by any cross-border participation of capacity providers is the delivery of capacity. Is it necessary to deliver physically into the foreign market or is it sufficient to deliver virtually (i.e. deliver to the foreign spot market)? Virtual delivery is currently favoured in the debate, as this would not interfere with the function of market coupling arrangements.

Contribution to resolving generation scarcity problems: In the case of virtual domestic delivery, the contribution of sufficient power flows to ameliorate an emergency situation cannot be assured. If the spot market price in Country B exceeds the price in Country A, no electricity would flow and no capacity from Country B would help to resolve the scarcity problem in Country A. There is not yet a satisfactory and final view on how to organize an assured contribution.

Monitoring and validation of the delivery of capacity: In the case of an explicit physical delivery or virtual delivery to the foreign spot market via dedicated physical cross-border capacities, the foreign TSO would have sufficient information to validate the accuracy of delivery in accordance with the same rules applicable to the delivery of domestic capacity providers. If delivery is only achieved with domestic virtual delivery, the foreign TSO would not be in a position to monitor and validate actual delivery. Some form of cooperation and information exchange between both TSOs would therefore be necessary.

Interim solution: Since several issues around explicit cross-border participation remain unresolved, France has decided to implement an implicit interim solution. The final design of the system, which will be developed on the basis of a wide consultation, will tend to allow explicit foreign participation.

1 Market design and agequacy challenges in France and Germany

This first chapter gives an overview of current debate on power market design in France and Germany (1.1) and also provides background information on the market structures (1.2) and adequacy challenges in the two countries (1.3).

1.1 Market design discussion in France and in Germany

France and Germany are at different stages in the political and technical debate on power market design and capacity remuneration. France has enacted all legal provisions for a capacity mechanism in its energy market regulations. The mechanism is due to start in the next months for a first delivery year in 2017[1]. By contrast, the German debate on the necessity (and design) of a capacity market has not yet found consensus among politicians and experts. Several studies have projected adequacy problems in the mid-term in Germany and have proposed various capacity mechanisms as a remedy[2]. Other more recent studies have suggested on the contrary that an energy-only-market (EOM) design could overcome potential threats to security of supply in the power market.

In October 2014, the German Ministry of Economics (BMWI) published a Green Paper on power market design. After a broad consultation with stakeholders, new market-design legislation could be adopted by the end of 2015. It poses a key question for the stakeholder process: should the energy-only-market be the only source of revenues for generators, or should a capacity mechanism be introduced as well? The paper strongly favours a strategic capacity reserve to ensure adequate capacity for a transition period.

French and German stakeholders have different views on the necessity of implementing a capacity mechanism. This contrast reflects differences between the two power systems, different adequacy challenges and varying traditions with a view to security of supply.

France defines security of supply (SoS) as a public good and makes use of an explicit security of supply criteria (LOLE[3] of 3 hours).The French capacity mechanism aims to achieve a minimum security of supply level (though it could be economically sub-optimal), which may therefore not necessarily be reached by an energy-only-market. Germany, by contrast, lacks a common definition for security of supply and has not adopted explicit security of supply criteria in its legislation.

The debate on the *missing-money-problem* – the possibility of a market failure leading to capacity inadequacy (see section 2) – differs greatly in the two countries. France has argued that the energy-only-market cannot guarantee security of supply, which makes it incomplete given the public good nature of security of supply. The *missing-money-problem* is far more controversial in Germany: some studies have warned about imminent capacity shortages;[4] others argue that the current problem is overcapacity and

1 The NOME law is the legal basis for the introduction of the capacity mechanism and was enacted in 2010. Based on an investigation by the TSO RTE, the French government issued a decree in late 2012 specifying basic elements of a decentralized capacity market. After a period of stakeholder consultation, an exact specification of market rules was prepared by RTE and approved by the French government in January 2015.

2 Proposals include, among others, a centralized comprehensive capacity market (EWI 2012), selective capacity markets (WWF 2012, BET 2011) and a strategic capacity reserve (Consentec 2012).

3 LOLE, loss-of-load expectation, is a technical term developed to measure security-of-supply. It represents the number of hours per annum in which, over the long-term, it is statistically expected that supply will not meet demand.

4 While leading academic institutions predict a mid-term security of supply problem (e.g. EWI, 2012), the Federal Ministry of the Economy, BMWi, recently published three studies arguing in favour of an energy-only-market model for Germany (r2b 2014, connectenergy 2014, frontier 2014).

that improvements in energy-only-market can ensure long-term adequacy.

In any case, the proponents of capacity markets in both countries argue that generation adequacy is endangered. Different arguments are waged in this connection, however.

In France, the main driver for implementing a capacity mechanism is the high temperature sensitivity of electricity demand. Winter peak load has been continuously growing over the past years but the rarity of cold days leads to an insufficient utilization of peak plants. One core objective of the French capacity mechanism is therefore to reduce peak consumption by promoting demand-side response. Increasing intermittent renewable feed-in may also become an important dimension in the medium to long term.[5]

In Germany, the main argument for introducing a capacity mechanism is the increasing feed-in of wind and solar power, which forces out conventional generation. This makes thermal plants less profitable, due to a decreasing number of operational hours and lower power prices.

While proponents of capacity markets in both countries predominantly argue they are needed to ensure generation adequacy (i.e. to avoid black- or brownout situations), other arguments are made as well. It is said that capacity markets incentivise the increased use of demand response, prevent increases in market power, and, particularly in Germany, ensure redispatch against the backdrop of growing network constraints.

1.2 Power markets in France and Germany

In this section, we briefly look at the current design of the power market in France and Germany. The point we would like to emphasize is that the current energy-only-market arrangements in the two countries are similar in some senses but different in terms of market structure (number of stakeholders; liquidity of wholesale and retail markets) and in terms of load development and the deployment of renewable energy.

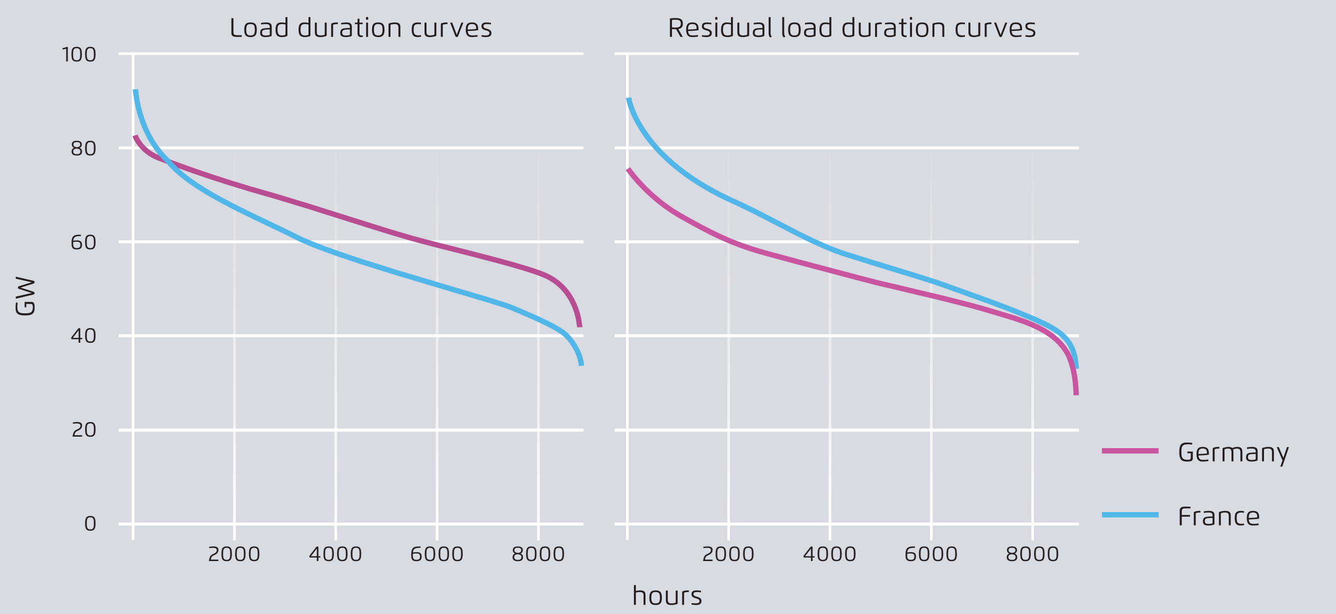
The similarities in the market design are due in part to successive EU directives, which have liberalized the mar-

5 This argument is given by RTE in its 2014 assessment. The current CRM proposal includes already some parameters that take into account this trend (re-dimensioned intermittency factor applied to RES certification, selectable peak hours for intermittency production).

Comparison of French and German power markets — Table 1-1

	France	Germany
Transmission/ Distribution	1 TSO (RTE – unbundled ITO) and 1 dominant DSO (ERDF market share of 95 percent); EDF remains owner of RTE and ERDF.	4 TSOs (Amprion, TenneT, TRANSNET BW, 50Hertz) and 900 DSOs.
Supply	Free choice of supplier; low competition in supply market.	Free choice of supplier – high competition in supply market.
Generation	Concentrated market. Several generators, main share of generation is owned by EDF.	Less concentrated market. Large number of generators, main share of capacities are held by the big four
Trading	Liquid electricity market	Very liquid electricity market
Cross-border	Intensive cross-border trading via market coupling Similar overall market structure and market design	

Load duration and residual load duration curves for France and Germany (2013) Figure 1-1



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ket since 1998 (competition in supply and trade, unbundling of transmission and generation regulated networks). Moreover, both countries have implemented a decentralized, bilateral power market structure that consists of

- → liquid spot markets with market coupling (EPEX Spot operates wholesale markets for Germany, Austria , France and Switzerland),
- → liquid OTC and bilateral forward trade, and
- → balancing markets operated by the TSOs.

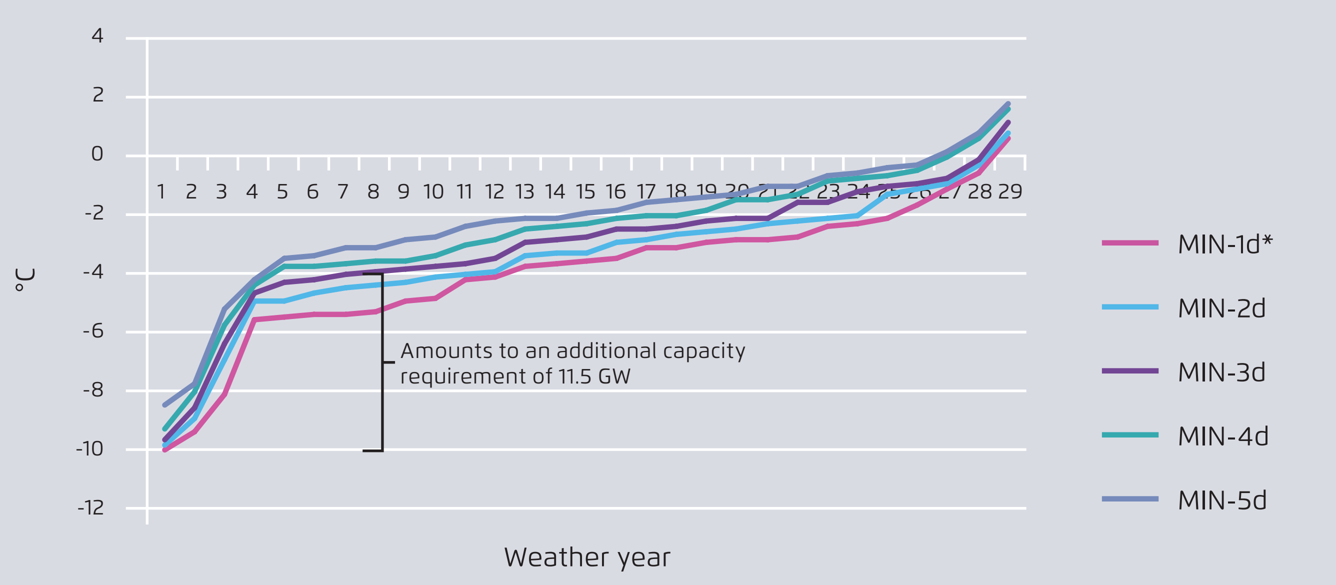
The similarities between the power markets are important for the following discussion. In particular, the market coupling has led to significant electricity trade and price convergence[6] (day-ahead prices have converged 58 percent of the time over the 1st semester of 2014), even though convergence fell sharply in 2013 (down to 48 percent) relative to 2012 (when it was 65 percent). While some market barriers remain, such as for ancillary services, giving rise to potential inefficiencies, this study will concentrate on the design of capacity markets and their potential cross-border impacts. It will therefore treat multilateral electricity trade as given and broadly efficient.

At the same time, it is also important to underline the differences between French and German power market structures. These differences are summarized in table 1-1. First, the liquidity of the French wholesale market is much lower than its German counterpart: only about 15 percent of energy sales are effectively operated on the market in

6 The examples of Ireland and Britain show that difference in market designs can be a detriment to cross-border power trade. See "The SEM Capacity Payment Mechanism and the impact on trade between Ireland and GB", presentation by J. Lawlor, ESB, 19.6.2012.

Minimum rolling temperature averages for France (days at 19h)

Figure 1-2



DNV GL *The expressions MIN-1d, MIN-2d... etc. refer to the minimal of rolling averages over 1, 2, ... days.

France. Second, the power market is more concentrated and centralized in France (1 TSO, 1 major DSO, 1 dominant generator) than in Germany (4 TSO, 900 DSO, 4 main generators), resulting in less competition in the French retail market. Third, France, unlike Germany, continues to regulate electricity tariffs (though tariffs for non-residual consumers will be phased-out by the end of 2015).

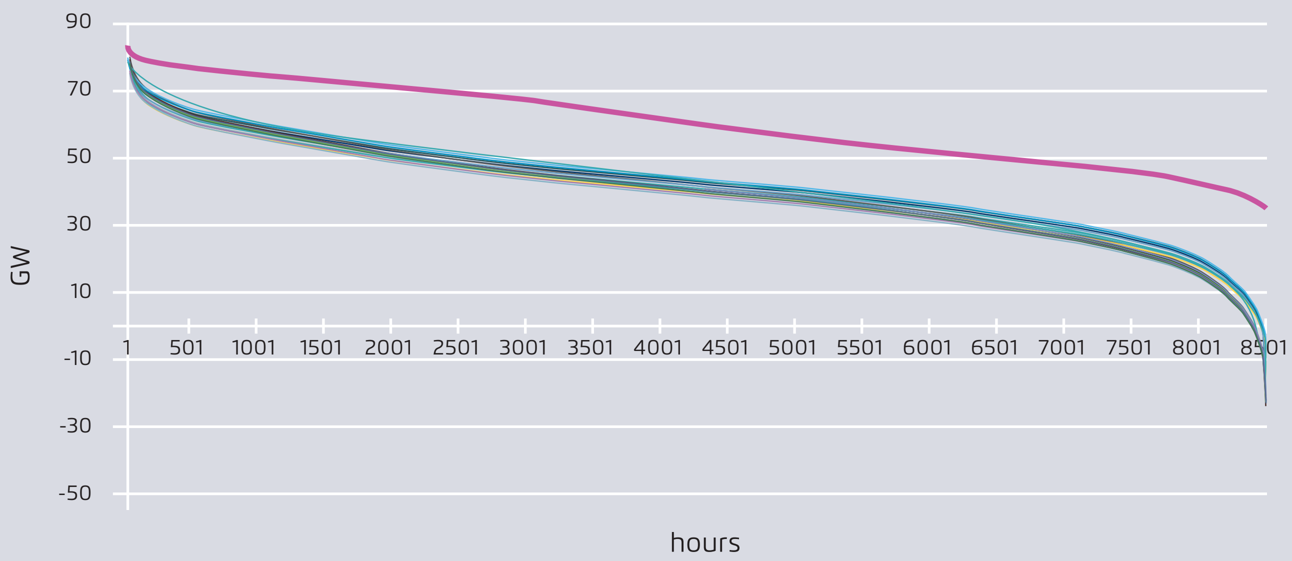
1.3 Reliability challenges in France and Germany

The differences in the two power systems and their implication for adequacy challenges are best illustrated by the load and residual load duration curves,[7] as seen in Figure 1. The left side shows the higher electricity demand in France relative to Germany – while France's GDP and population is lower than those of Germany – especially in peak time, which reflects the widespread use of electric heating in winter. The graph on the right shows the effect of renewable feed-in, which covers a larger share of demand in Germany than in France, leading to a decrease of the residual load duration curve (as it reduces the need for conventional capacity). Yet peak residual demand remains high in Germany, reflecting times of high demand and low feed-in due to low wind power and solar radiation. This leads to the need for back-up capacity in the system.

Rare peak loads in France, occurring once in a decade, and high residual load events in Germany (low renewables feed-in and simultaneously high load) are a particular challenge for the power systems: capacity required to ensure delivery is used so seldom that financing via market revenues may be very difficult. We have derived estimations on such rare events from weather data for the time period 1982-2011, as well as further information on the respective power systems. This leaves out one critical year, 2012, during which France faced a critical situation in Winter (February) due to several factors, including consistently low temperatures in France, a low renewable

7 A load duration curve shows the load in each hour of a year, ordered by size instead of chronologically. It thus highlights the requirements in terms of peak and base capacity of a power system. The term residual load refers to the load minus wind and solar feed-in. It only serves as a point of reference, since wind and solar feed-in usually occur independently of electricity demand. Conventional capacity thus serves residual load.

Residual Load Duration Curves 2023 — Figure 1-3



DNV GL; Projected residual load duration curves over 30 weather years for Germany (coloured) as well as load duration curve (pink); renewable capacities based on NEP13

feed-in in Germany and a gas shortage problem. This year has been covered in detail by both the RTE report on capacity mechanisms (2014) and the official report on capacity adequacy for 2012.[8]

Figure 1-2 shows yearly minimal temperatures for France[9] over 29 years, ordered from lowest to highest. Apart from the daily minima, we also show rolling averages for n=2, 3, 4 and 5 days for the coldest n-day periods of each year. One observes considerable differences in the yearly minimal temperatures, which lead to considerable differences in electricity demand. According to RTE (2014), each degree below 15°C today leads to an additional power demand of 2.3 GW. This means that the coldest years of the sample require an additional 11.5 GW of power in comparison to the sixth coldest, as the figure shows. Even accounting for the inevitable simplification of our analysis, the figure points to a considerable problem: very cold winters are relatively rare, but they have a significant impact on peak-load events in France.

The most recent French adequacy forecast report (2014) specifically emphasized the gradual but steady reduction of safety margins relative to the security of supply criterion, and projected that margins would be eliminated by 2016.

In Germany, the most likely cause of a potential scarcity situation is the intermittent feed-in of renewable energies. Figure 1-3 illustrates a possible scenario for the German system in 2023 on the basis of expected wind and solar capacities (forecast by German TSOs[10]), weather data and a load forecast provided by Agora (2012). These data allow us to calculate expected residual load and yearly peaks. Figure 1-4 presents the yearly maximal residual load over thirty years, ranged from highest to lowest values. The yearly results are calculated on the basis of rolling averages over periods ranging from 8 hours to 7 days (168 h). The results

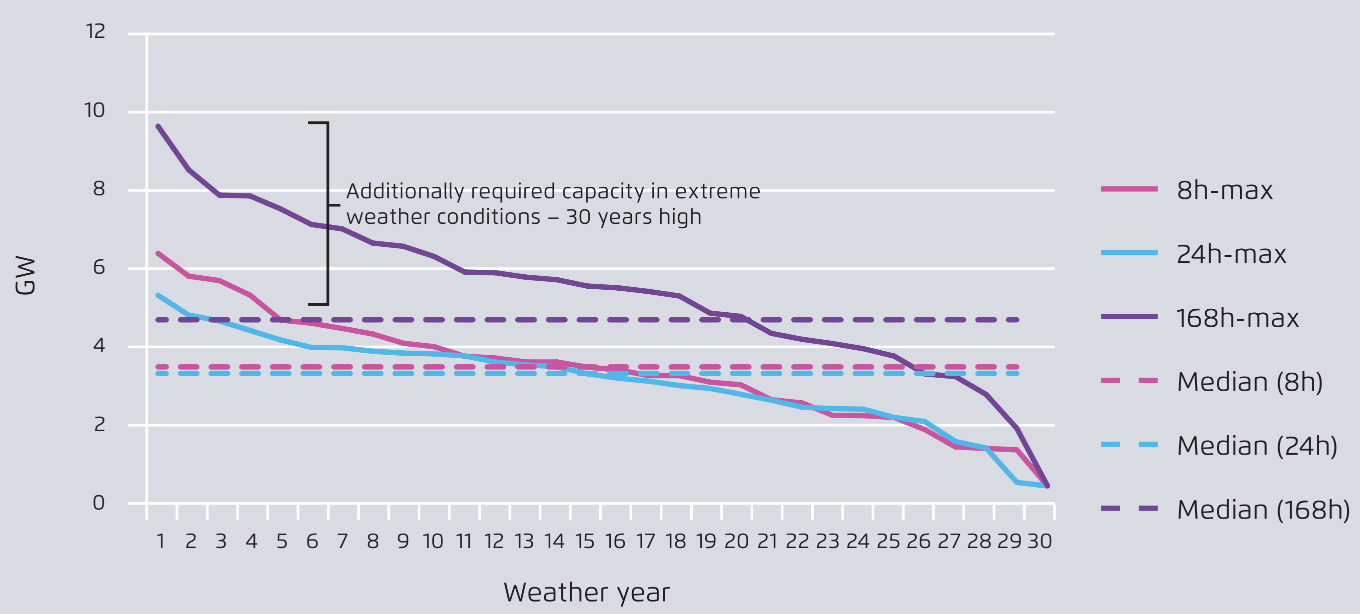
8 See RTE (2013), "Bilan électrique 2012", Paris

9 The numbers reflect temperatures at 7:00 pm, the daily peak time identified by RTE.

10 This is based on NEP2013 (Netzentwicklungsplan), the official forecast of load and generation by German TSOs.

Projected residual load peaks for Germany over 30 weather years

Figure 1-4



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are levelized so that the 30-year minimum is set to zero (at the right-hand side of the graph). The year with the highest peak demand requires an additional 4 – 5 GW of capacity in comparison with the sixth highest. This range is about twice smaller than the value calculated for France (see Figure 1-2), but still considerable.

Although long-term generation adequacy is currently a subject of political debate in Germany – the debate is discussed in the official *Green book* published by the Federal Ministry of the Economy and Energy (2014) – official reports on generation adequacy published by the TSOs and the Regulator, BNetzA,[11] are far less alarming than the corresponding reports published by the French TSO, RTE, and do not project severe capacity shortages in Germany in the near term.

In this section, we showed the structural differences between the power sectors of the two countries, both in terms of load and renewable feed-in structure. These two factors alter the profitability of conventional power plants, potentially endangering the economic viability of their operation. The economic debate on generation inadequacy – referred to as the *missing-money-problem* – and the different views taken in that debate will be discussed in more detail in the next section.

11 TSOs: BMWi "Bericht der deutschen Übertragungsnetzbetreiber zur Leistungsbilanz 2013 nach EnWG § 12 Abs. 4 und 5"; Regulator: BNetzA "Monitoringbericht 2013"

2 Stylized economic analysis of the cross-border impact of capacity mechanism

In this chapter we discuss the potential economic implications related to the introduction of a decentralized capacity market in France, while Germany implements one of the following three market design options: an energy-only-market, an electricity market complemented by a strategic capacity reserve and a decentralized capacity market. We chose to study these three designs for Germany since they are the most likely to be implemented (in line with the assessments of the German Ministry of Economics[12]). We will start with a strictly theoretical economic analysis, ignoring details of the underlying power systems (this is the content of section 3.2). The theoretical results depend on the existence of a *missing-money-problem*, a controversial issue that will be explained in section 2.1. Section 2.2 formulates the central questions we intend to answer: What are the effects of different market designs in France and Germany on electricity prices? What are the consequences for efficiency and investments? The economic analysis will be described in detail in section 2.3. The conclusions are presented in the next chapter and considered against empirical facts in the real French and German power systems. Those readers who prefer to skip the formal development of the arguments are advised to continue reading from section 3.

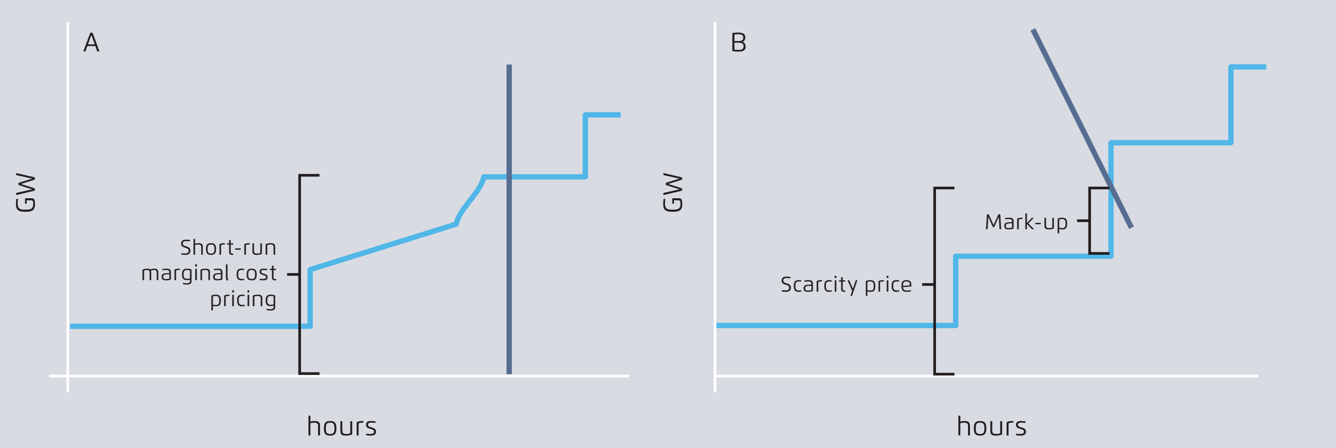
2.1 Missing-money-problem

The optimal functioning of the energy-only-market for long-term investment and resource adequacy is much debated in the academic economic literature,[13] with some arguing that it is inefficient and needs to be complemented by capacity remuneration mechanism, and others arguing that it can function well if regulatory barriers (i.e. price caps) are eliminated.

12 See the Green Paper on power market design (BMWi, 2014), r2b (2014) and frontier economics & consentec (2014).

13 For a pro position, see Paul Joskow (2008) "Capacity payments in imperfect electricity markets: Need and design", Utilities Policy 16 (3); for a contra position, see Galetovic, A, Munoz, C. and F. Wolak (2013) "Capacity payments in a cost-based wholesale electricity market: the case of Chile", IEEE Transactions on Power Systems.

Electricity price formation with inelastic demand (A, left) and elastic demand (B, right) Figure 2-1



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Proponents of the view that energy-only-markets are inadequate speak about a basic *missing-money-problem*:[14] Power plants at the fringe of the merit order – i.e. that are marginal to load covering – do not earn sufficient revenues to cover their capital cost. This problem arises due to the short-term price inelasticity of demand, giving rise to *short-term marginal cost pricing* (see Figure 2-1, A). In other words, the price of electricity is set only by the short-term marginal costs of electricity, i.e. the (variable) costs of producing an additional kWh from the existing generation park. In a scarcity situation, load cannot be served, and instead of earning a premium, electricity generators risk a black-out, a situation where customers are not served and generators do not earn money. Hence, at least for the marginal plant, the wholesale market price does not cover fixed costs, maintenance and capital costs.

Subsidy-driven renewable energy feed-in can exacerbate the phenomenon of short-term marginal pricing, since marginal power plants in the merit order, while still needed for back-up capacity, are pushed out of the market whenever production by renewable energies is strong. The resulting decline in wholesale prices reduces revenues for all generators.

Proponents of the energy-only-market argue that this is not an issue as long as generators are able to earn additional margins during periods with tight capacity margins. So-called long-term marginal cost-pricing allows plant owners to include their capital costs. In scarcity situations, flexible demand leads to a mark-up over short-term marginal costs, covering all costs in the long term (see Figure 2-1, B). In practice we should thus expect price spikes when market prices are (significantly) higher than the short-term marginal cost of production. This requires a sufficient probability and frequency of price spikes. To ensure such an outcome, proponents of the energy-only-market call for the elimination of price caps along with any rules restricting free pricing, so that generators can set the price of their offers above their costs.

14 The term was originally coined by American economists in the 1990s. For an analysis of the German case, see P. Crampton & A. Ockenfels (2011), "Is a capacity market required in Germany to guarantee system security? Two related investigations on capacity markets", University of Cologne.

Unsurprisingly, assessing the virtues of a capacity remuneration mechanism depends critically on how one views the *missing-money-problem*. As stated in section 2.1, the views on this issue differ significantly in France and in Germany (both between public authorities, academics and private companies). Answering the question whether there are *missing-money-problems* in France and Germany is outside the scope of this study. In the later analysis, we thus present two different sets of conclusions, with and without the existence of a *missing-money-problem*.

Our findings depend on the underlying hypothesis. We nonetheless hope that readers will find the analysis valuable for the general debate on the future of power market design in Central Europe.

2.2 Theoretical framework for assessing the mutual economic impact of DCM on neighbouring countries

2.2.1 Questions of interest

Before presenting a hypothetical economic model, we briefly formulate the four central questions we intend to answer as part of the theoretical framework. These questions are the backbone of the economic assessment we present in sections 2.3 and 3.

→ 1. What impact does a capacity mechanism have on price formation in the power markets? Will prices rise in the short term – or in the long term?

→ 2. How efficient do the markets work under each market design? How do the market structures impact dispatch and investment?

→ 3. What impact do the capacity mechanisms have on cross-border competition? Does a capacity mechanism distort the level-playing field?

→ 4. What distributional effects does the market design have? Who gains from the introduction of a decentralized capacity mechanism – consumers or producers – and in which market?

Those four questions can be discussed irrespective of the existence of a fundamental *missing-money-problem*. A fifth critical question, related to security of supply, depends on the belief in a *missing-money-problem* and will be dealt in its own section:

→ 5. How does the market design in the two power markets contribute to capacity adequacy? What incentives for investments in both countries do the market designs create?

A sixth relevant question for the discussion on future regulatory steps concerns reversibility:

→ 6. Are there lock-in effects from the introduction of a capacity mechanism? How would a later correction affect the domestic and the foreign power markets?

After highlighting the results in our hypothetical model, we later discuss them in light of empirical evidence, without engaging in a comprehensive quantitative or statistical analysis.

2.2.2 Stylized two-country model

In order to discuss the core question of this section, we introduce a simplified economic model of two neighbouring power markets (F and G), with cross-border trade and limited by an interconnector capacity. One market (F) introduces a decentralized capacity mechanism; the other market (G) can choose between three different market design options: an energy-only-market, a strategic reserve and a

Overview of the market design options under consideration — Table 2-1

Type	Description
Energy-Only Market (EOM)	Power market with a liquid power exchange – also known as a spot market – based on a unit-price auction. (Under the simplified setup of the model we assume that all power is traded through the power exchange, although the model can represent decentralized bilateral markets as well). There are no additional remuneration mechanisms for the provision of firm capacity.
Strategic Capacity Reserve (SCR)	A strategic capacity reserve complements power trading on the spot market; its capacities are activated and administered based on fixed rules and there is remuneration by the TSO in case the spot market price exceeds a strike price set ex-ante. The size of the SCR and the time period of operation is mandated by the regulator.*
Decentralized Capacity Market (DCM)	A decentralized capacity market complements power trading on the spot market. Customers (corresponding to suppliers in the real world) are required to contract firm capacity from generators up to their demand peak. Trade in capacity certificates is perfect so that a scarcity price emerges. Fulfilment is independent of further interaction among the contracting parties. In shortage situations, generators have to supply the system with power up to the capacity sold in the decentralized capacity market – but the power does not necessarily have to be supplied to the contracting party.

*Under real-world conditions, there are alternative activation mechanisms for a strategic reserve. For instance, the Swedish mechanism activates the strategic reserve when the power market has not been cleared. For us it is important to study an economic activation criterion, and a strike price is sufficiently simple for the analysis within the hypothetical framework.

decentralized capacity mechanism (see Table 2-1).

In both markets, renewable energy is prioritized and conventional capacities serve residual load (i.e. the remaining load) competing in a wholesale market. There is perfect competition within and between the two markets, and thus dispatch in each market is based on the respective merit order. The available technologies in both markets are not all identical. They differ in their operational and capital costs, creating an upward sloping supply curve in both markets. In this subsection we omit the transaction costs associated with the introduction and operation of capacity markets. Later we discuss their possible impact.

We take competitive cross-border trade on the spot markets as given (within the physical limits set by coupling capacity) and discuss below cross-border participation in a decentralized capacity market.

2.2.3 Interconnection and cross-country price formation

In this subsection, we recall the price-formation mechanism in interconnected spot markets, as this is an important feature of the upcoming analysis. Coupling capacity is a decisive parameter for price formation: Both the intensity of power trade and the ability to contribute to the neighbour's security of supply depend on it.

The greater the coupling capacity, the rarer the congestion. Figure 2-2 illustrates a situation where coupling capacity is uncongested:[15] both markets converge to one integrated market, as the load of the two countries and the merit orders are additive. Essentially, convergence is a consequence of arbitrage: a price difference would create incentives to sell more electricity from the low- to the high-price market, increasing supply up to the point where prices are identical.

The arbitrage argument requires sufficient coupling capacity, however. Figure 2-3 shows how limited coupling capacity can lead to divergent prices. Demand in market G is served at a rather low price, leaving cheap capacity available to serve market F. Within the limits of coupling capacity, plants from F do indeed serve market G – but the remaining load needs to be covered in G by more expensive capacity than in market F, leading to a higher price.

The fact that interconnection capacity matters for price convergence across power markets is hardly surprising. But it is worth stating, as it has strong consequences for the debate on capacity markets as well: any statement about the distortive effect of the unilateral introduction of a capacity market in one country would hold true only within the physical boundaries of the power system. If interconnection capacity is small so that congestion occurs frequently, distortions will matter far less than in perfectly connected power systems. This also has consequences for the regional dimension of security of supply, as only well coupled markets can truly insure each other against black- or brown-outs.

2.3 Analysis of the stylized two country model

In this section we present the theoretical results of the economic analysis of the three cases of our two-country model. In each case market F implements a decentralized capacity mechanism (DCM), while market G implement an energy-only-market (EOM), a strategic reserve (SR) or a decentralized capacity mechanism (DCM).

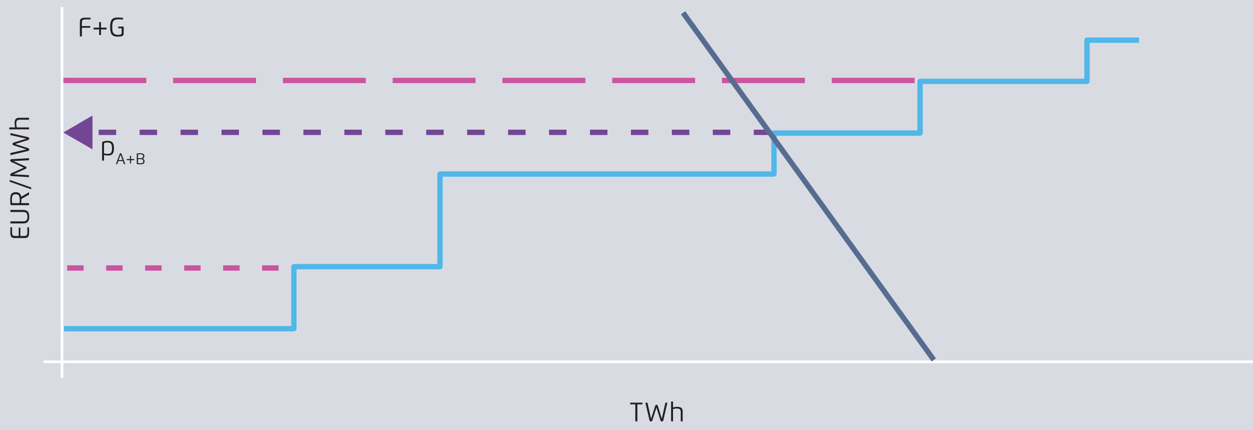
2.3.1 Generic results for the three market design cases

This subsection presents findings that are globally true both when a *missing-money-problem* exists and when it does not.[16] In theory, the price of the capacity obligation certificate should sink to zero if there is sufficient capacity available (i.e., when there is no *missing-money-problem* and the level of secure capacity is correctly targeted). Most economists assume nevertheless that the capacity target will be set above the capacity level of the EOM: ei-

15 For now we omit coupling fees, which make electricity sales from market to market slightly more expensive.

16 If the conclusion differ for the missing-money and non-missing money hypothesis, it will be indicated explicitly in the text of this section.

Price formation in markets F and G with uncongested interconnector — Figure 2-2



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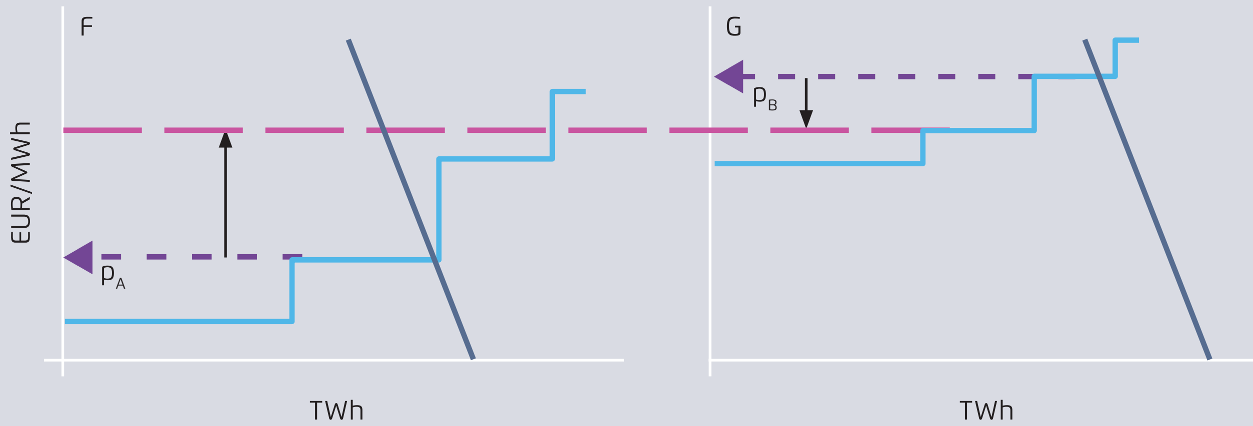
Price formation in markets F and G with congested interconnector — Figure 2-3



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ther deliberately, to ensure security of supply at a higher level than under the EOM, or unintentionally, as a form of regulatory inefficiency. In this section, we assume that the price for a capacity certificate in a decentralized capacity market is larger than zero[17] so that investment in additional capacity is incentivised. We distinguish between short-term and long-term perspectives. In the former case we analyse market performance and cross-border trade,

17 In that case, a power plant that is not in the money in the EOM will set a positive price in the DCM; a price that then benefits all capacity owners in the market. This does not preclude the certificate price falling to zero in the long-run, e.g. if peak demand (unexpectedly) shrinks over time. A price of zero in the DCM means that the scheme has no incentive effects for investors.

taking the plant structure as given. In the latter case we focus on how the structure of the two markets affect capacity investment.

Case A: DCM in market F, EOM in market G

In the short-term, no distortions in the power markets are expected.

→ **Short-term electricity prices are formed efficiently** and converge within the limits set by the interconnector capacities.

→ **Competition is not distorted** between generators in the two countries (within the limits of price convergences set by limited coupling capacity).

→ **Both electricity dispatch and prices are efficient** by virtue of the spot market structure, given the technical boundaries of the two power systems.

→ **The distribution of costs and benefits among producers and consumers is the same**, as if each market were energy only (no effect by the DCM).

In the long-term, by contrast, market distortions are expected to occur:

→ **Electricity prices form efficiently** but they are likely to decrease in market F – and to decrease in market G to the extent of interconnector capacity levels – as the CRM in France activates capacity expansion or demand-side response (reducing scarcity situations with prices above short-term marginal costs[18]).

→ **Competition:** The capacity remuneration in market F puts plants in this market at a long-term advantage over plants in market G that have to cover all their costs (including capital costs) via the EOM. This effect is reinforced by the potential decrease of electricity prices in the EOM, stemming from a reduction of scarcity situations with prices above short-run marginal costs. Thus we expect less investment in market G, with some plants being displaced from the market.[19]

→ **Certificate prices in the DCM in F** are affected by the presence of the power market in G. If capacity in G is allowed to participate in the DCM in F, certificate prices are likely to fall, reducing regulatory cost. Conversely, displacement of capacity in G can potentially reinforce a capacity shortage problem in F, leading to higher prices in the DCM.

→ **Economic efficiency:** Economic efficiency is negatively affected by the DCM, as inefficient plants in country F may prevail in cross-border competition, while more efficient plants in country G are driven out of the market.

→ **Distribution:** Customers in market F pay for capacity certificates, including certificates for some plants that export to the neighbouring market G. Thus, customers in G profit from the market arrangement (strictly in terms of decreasing energy prices and payments). But the redistributive effect benefits the generators in F.

Case B: DCM in market F, SCR in market G

Case B differs from Case A in that a strategic capacity reserve directly affects market operations in the short term as follows:

→ **Electricity prices:** The strike price sets an upper bound for prices in market G that will also affect market F as long as the interconnector is not congested. Depending on the availability of the reserve a situation as described in Figure 2-4 can occur: Instead of a higher price formed in market F the activation of the reserve in market G can restrict the price in market F to the strike price[20] instead

18 In the case of a strong *missing-money-problem*, no such scarcity situations occur, and no additional price reductions take effect.

19 In theory, this effect would not occur in the absence of a *missing-money-problem* and a well-targeted capacity level, as the capacity price would tend to zero (see remark above).

20 In the real world, the occurrence of such an incident would depend on the rules of market coupling and the activation of the strategic reserve.

of a price based on the merit order. Below the strike, prices can form efficiently and converge.

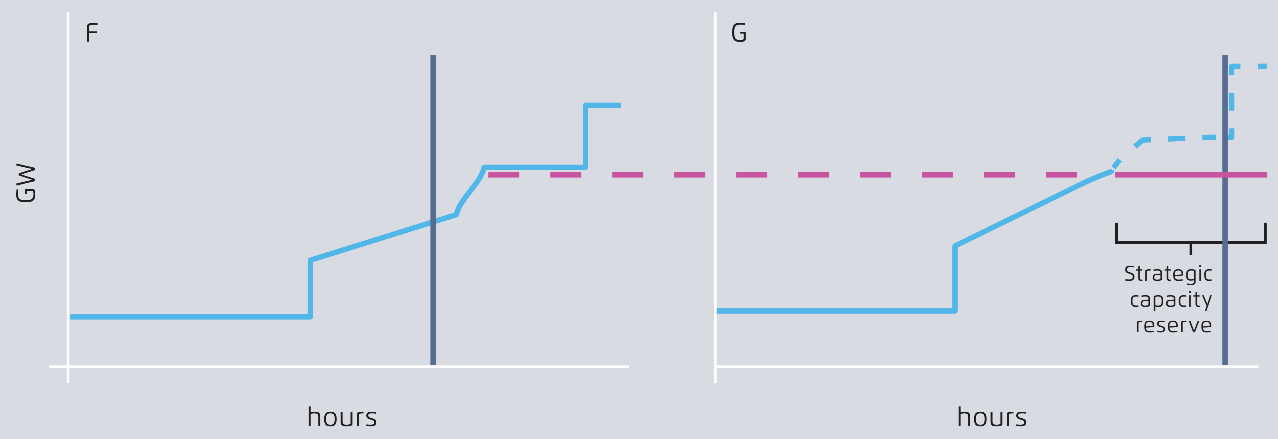
- **Competition:** Competition is undistorted most of the time, i.e. as long as prices range below the threshold set by the strike price. However, in a situation where the interconnector is congested and prices in market F rise above the strike price in country G, generators in market F can earn higher incomes than generators in market G.
- **Economic efficiency:** The market design entails efficiency losses:[21] the strategic capacity reserve is not deployed according to its cost structure, i.e. as part of a merit-order-curve, and is not refinanced via the market. Efficiency losses primarily affect market G, whose participants pay a levy to finance the strategic reserve.
- **Distribution:** Customers in market G have to pay the levy for the strategic reserve (likely to be lower, though, than the capacity certificates in market F). As long as the strike price is not reached, the distribution of benefits and costs in the electricity market are as in Case A.

21 Please note that here we strictly focus on economic efficiency - security of supply issues (and likely efficiency losses due to blackouts) will be addressed in the next subsection.

Strategic capacity reserve directly affects market operations in the long term as follows:

- **Electricity prices:** As in the short-term, a strategic capacity reserve will set an implicit price cap in market G, affecting market F; below the threshold, prices form efficiently and converge.
- **Competition:** As in case A, generators in market F enjoy a principal long-term advantage by capacity remuneration over generators in market G. The latter are put at a further disadvantage by the implicit price cap set by the strategic capacity reserve.
- **Certificate prices in the DCM in F** are affected by the presence of the power market in G as in case A: participation by capacity from G in the DCM in F will reduce prices for certificates. As long as displacement by capacity in G is offset by strategic reserve capacity, an upward pressure on prices is not to be expected.
- **Economic efficiency:** As in case A, economic efficiency is reduced by market design; generators in market F are favoured over generators in market G.

Potential price distortion by strategic capacity reserve (under assumption of non-congestion of the interconnector and sufficient reserve capacity in market B) Figure 2-4



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→ **Distribution:** As opposed to the case with two energy-only-market designs, generators in market F gain, generators in G lose. Customers in market F pay a levy that benefits customers in market G via lower electricity prices; the latter have to pay a levy for the strategic reserve that is likely to be lower than the levy in market F. Hence, customers in G may still profit from the market arrangement.

Case C: DCM in market F, DCM in market G

In the short-term, as in case A, no distortions in the power markets are to be expected:

→ **Electricity prices:** Prices can form efficiently and will converge within the limits set by coupling capacity.

→ **Competition:** There is no distortion of competition between generators in the two countries, taking into account the technical limits.

→ **Economic efficiency:** By virtue of the spot market structure, both electricity dispatch and prices are efficient, taking into consideration the technological limits of the two power systems.

→ **Distribution:** Distribution of costs and benefits is the same as with the two energy-only-markets (case A).

In the long-term, the market design is efficient; inefficiencies arise only when the two decentralized capacity markets are unconnected.

→ **Electricity prices:** Prices can form efficiently.

→ **Competition:** As both generators in market F and G receive capacity remuneration, there is a level-playing field, provided the remuneration principles are similar. This is the case when the two capacity markets are connected, when generators from market F can sell capacity certificates in market G and vice versa, provided that sufficient coupling capacity is available.

→ **Certificate prices in the DCM in F and G** will form efficiently if the two markets are connected, giving rise to an efficient cross-border price for security of supply. (If the security of supply target is over-dimensioned by either country, the resulting inefficiency is shared.)

→ **Economic efficiency:** In principle the market design is efficient, as long as cross-border participation in the capacity markets is guaranteed. (This neglects efficiency losses due to transaction costs; see the next subsection).

→ **Distribution:** Both customers in market F and G pay a capacity levy, benefiting the generators in both countries.

Some further remarks apply:

→ Some caution concerning the cross-border trade of capacity certificates is warranted: While it can enhance efficiency in theory, and is in line with the EU goal of an internal electricity market, severe technical and regulatory hurdles have to be overcome to implement it. They will be discussed in section 6.

→ The analysis conducted here hinges critically on the assumption that capacity certificates are mandatory for consumers, but do not entitle them to a physical delivery during shortages. Such an entitlement would connect the wholesale with the capacity market, possibly giving rise to further distortions.

→ Following from the assumption above, generators in market F are free to export electricity at all times, independent of capacity certificates sold in their own market. This is in line with current regulation; whether it could be defended politically once tested in times of scarcity is less certain.

→ While we assumed that certificate prices in the decentralized capacity market were non-zero, giving rise to real investment incentives, it is very well conceivable that they will fall in the long run, for example if peak demand does not develop as expected. Note, however, that a longer time period with very low prices in the decentralized capacity market might give rise to calls for its abolishment to avoid the associated transaction costs.

Concluding from the analysis so far we can say that – whatever their own merits - a market design in country G that differs from the decentralized capacity mechanism in country F creates distortions and inefficiencies. But a comprehensive evaluation must take both transaction costs and the *missing-money-problem* into consideration. We consider both issues below.

2.3.2 Transaction and regulatory costs

Transaction costs can crucially affect the economic analysis of our model and its efficiency. Under the decentralized capacity market, additional transaction costs are expected for the certification system, monitoring compliance and overall internal organization. Similar additional costs would occur under the strategic reserve regime (in order to implement the reserve capacity, monitor the market and levy financial investments).

Moreover, in both cases, regulatory costs are likely to occur from oversizing the capacity obligation. Public authorities may indeed target stricter criteria for security of supply – as with the 3-hours-a-year LOLE in France – which do not necessarily represent the economic optimum (as reflected by the value of loss load of the scarce system). A quantification of these costs is beyond the scope of this paper, but a number of studies published for Germany expect them to be substantial.[22] Once again we emphasize that if the CRM is well designed and there's no *missing-money-problem*, the price for capacity obligations should in theory sink to zero (though transaction costs would remain).

Most observers expect that the depth of market intervention is greater for a comprehensive capacity market than for a (limited) strategic capacity reserve, which is to say, that the levy on final consumers are likely to be higher in any comprehensive scheme. The reason is that a positive price in the certificate market, set by one or more plants not built in an EOM, benefits all capacity in the DCM. This does not imply that the DCM is necessarily less efficient than the strategic reserve. Whether total cost of electricity supply is higher or lower under either market design depends on the relative size of the efficiency losses in the market on the one hand and on the transaction and regulatory cost on the other. Additionally, the strategic reserve may lead to a slippery slope: as it cuts off scarcity prices, it could encourage the decommissioning of capacity on the market and an ever-increasing need for reserve capacity. Of course, these transaction and regulatory costs may be necessary if the implementation of capacity mechanisms is the only possible response to the security of supply challenges (i.e. the *missing-money-problem* situation). In this case, the transaction costs can be seen as costs for ensuring generation adequacy. A comprehensive, quantitative evaluation would have to trade off the gains in security of supply versus the total cost of electricity supply.

22 See r2b (2014) and Frontier economics & consentec (2014).

2.3.3 Impact on security of supply

Whether the different cases detailed above have an impact on the security of supply of the joint system depends above all on the existence (or non-existence) of a *missing-money-problem*. In other words, if the energy-only-market functions well (that is, if it contains no *missing-money-problem*) and shows sufficient demand elasticity and spot market reactivity, long-term marginal cost pricing can ensure a secure supply of electricity to customers. In this case, the introduction of a capacity mechanism or a strategic reserve is superfluous and leads to inefficiencies – transaction costs are lost, overcapacities are likely and prices become depressed.

If a *missing-money-problem* exists,[23] some form of market intervention is necessary to ensure long-term security of supply. Countries that rely on an energy-only-market face price spikes and eventual brown- or black-outs, while a decentralized capacity market can guarantee generation adequacy with moderate price levels. A strategic capacity

23 For a formalization of the *missing-money-problem* and the effects of capacity mechanisms on cross-border power trade, see Elberg (2014). The analysis presented here owes much to the insights of that paper.

Summary of impacts in three cases without a *missing-money-problem* — Table 2-2

<table>
<tr><th></th><th colspan="2">No missing-money-problem</th></tr>
<tr><th>Case</th><th>Market F</th><th>Market G</th></tr>
<tr><td>1.</td><td rowspan="2">→ Overcapacities likely (the closer the SoS criteria to the economic optimum, the lower the level of overcapacities)
→ Depressed wholesale market prices likely
→ Unnecessary wealth transfer from consumers to generators/aggregators
→ Transaction costs for DCM lost</td><td>→ General reduction of price due to cheap electricity imports benefits consumers
→ Some capacity is likely to be displaced, part of the market is served by F</td></tr>
<tr><td>2.</td><td>→ Price reduction and displacement apply as in case 1
→ Consumers bear (useless) cost for provision and operation of SCR</td></tr>
<tr><td>3.</td><td colspan="2">→ Overcapacity likely, with resulting system inefficiency in both countries</td></tr>
<tr><th></th><th colspan="2">Missing-money-problem</th></tr>
<tr><th>Case</th><th>Market F</th><th>Market G</th></tr>
<tr><td>1.</td><td>→ DCM ensures generation adequacy in principle
→ Spill-overs of scarcity from market G are conceivable, possibly leading to larger capacity requirements</td><td>→ MMP is reinforced by imports that reduce average prices
→ Displacement of capacity reinforces the security of supply problem (possibly mitigated by imported electricity)</td></tr>
<tr><td>2.</td><td>→ DCM ensures generation adequacy</td><td>→ Capacity outside SRC is exposed to MMP enhanced by imports
→ Size of SCR has to account for actual capacity gap</td></tr>
<tr><td>3.</td><td colspan="2">→ DCM ensures generation adequacy in both markets</td></tr>
</table>

reserve can serve as an alternative option with regard to security of supply, but it does by capping electricity prices.[24]

The specific consequences under the three cases discussed in this section are summarized in Table 2-2.

The impact of the joint system (F, G) on security of supply is of particular interest, especially in case A (DCM in country F and EOM in country G). Figure 2-2 illustrates this scenario. In that case, the security of supply risk depends on the level of correlation between scarcity events in the two countries and the level of interconnections. By design, the security of supply is guaranteed in country F, which implemented a DCM. In a shortage situation in market G, market F can contribute to the generation capacity of market G up to the level of the interconnection capacity, unless it faces a shortage itself (correlation of scarcity events).

Is this a probable scenario? It is important to note at this stage that the actual reaction to a potential black- or brown-out will depend on contingencies set up by national regulators and TSOs. By design, the decentralized capacity mechanism should mandate sufficient capacity to avoid

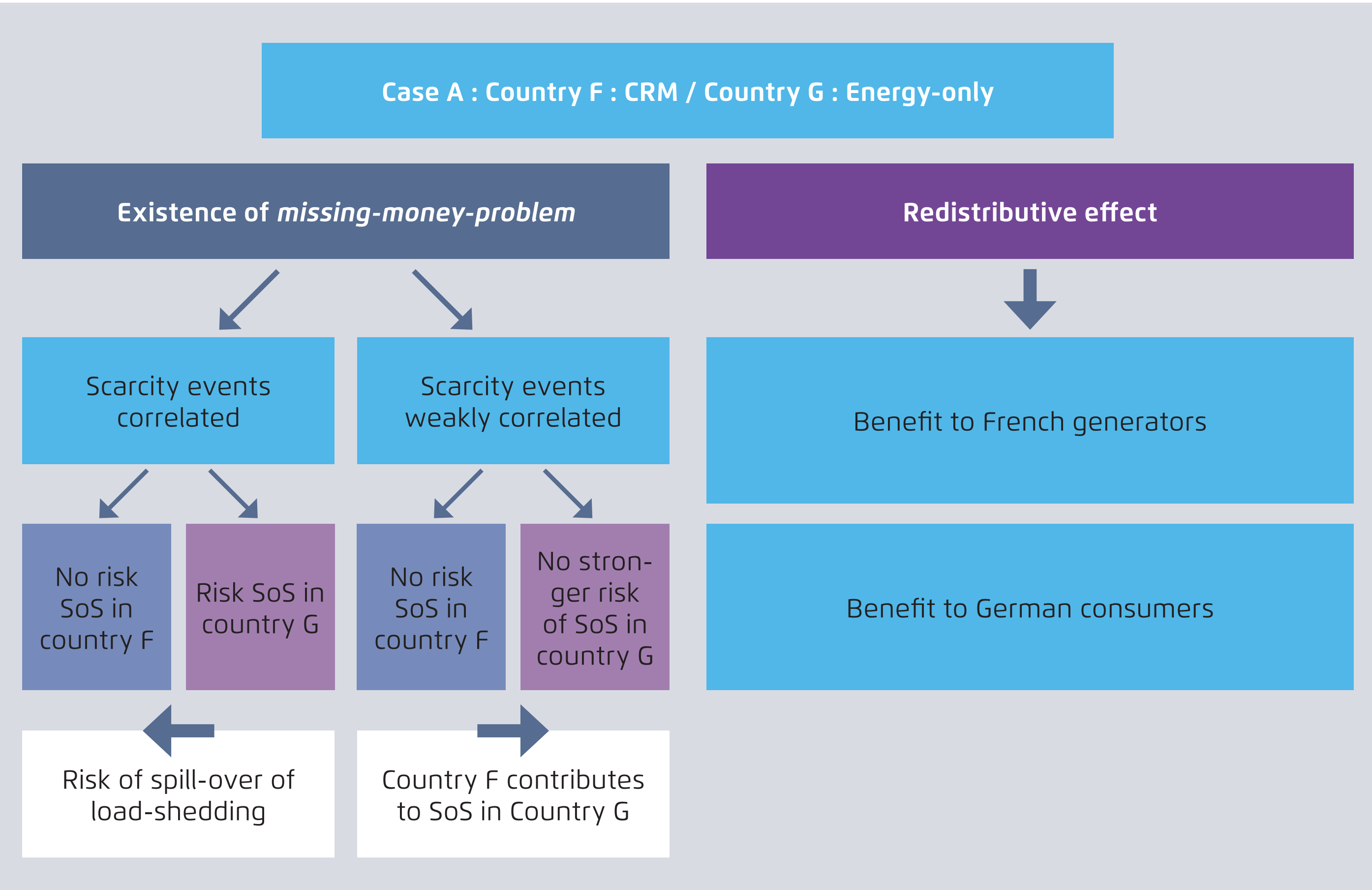
24 For a criticism of the strategic reserve, see EWI (2012).

scarcity situations in market F. In normal times, generators located in market G can contribute to serving the load in F, and vice-versa. This is no longer true with a large and correlated scarcity problem (as happens during cold winter nights with wind stills, which leads to a load peak and a low renewable feed-in). Whether a shortage in G can spill over to F depends on real-world concrete planning. In theory, it is likely because the capacity certificate in the DCM does not guarantee physical delivery in market F. Generators in F could find it more lucrative to sell electricity to market G as long as it guarantees high prices in the wholesale market. Designers of the DCM in F have to account for this situation of potential generation inadequacy in the neighbouring country. Otherwise, they must accept extremely high prices during shortages that would otherwise be avoided by the introduction of a capacity market. Given the current arrangements by TSOs and the limits of interconnector capacity, the latter case seems probable today.

The arguments are summarized in Figure 2-5 below.

Beyond the theoretical distinction between the existence and the non-existence of a *missing-money-problem*, we should also expect some form of trade-off for security of supply. Even most proponents of energy-only-markets would agree that (economic) overcapacities – capacities that increase the total cost of load serving beyond the level needed for efficiency – reduce the likelihood of scarcity situations. So it seems reasonable that a country like France has endorsed the introduction of a CRM as a tool to

Overview of mutual impact on security of supply given a *missing-money-problem* — Figure 2-5



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achieve an explicit level of supply security, even though such a policy goal is not necessarily economically optimal.[25] If the capacities needed to achieve security of supply can be financed in the energy-only-market, prices for certificates in the CRM will decrease to zero, reducing potential economic distortions to a minimum.

2.3.4 Lock-in effects of capacity mechanisms

In this subsection we briefly discuss potential lock-in effects that could arise from the introduction of a capacity mechanism. First, we ask to what extent a chosen mechanism could be altered later, or be abolished outright. Second, we investigate the implications of cross-border electricity trade.

In our analysis, we distinguish between a formal and an economic perspective. At a first glance, the lock-in effect of a decentralized capacity market is determined by the fulfilment period: DCM can be formally abolished once capacity certificates expire (e.g. after one year or two years, depending on contract duration). Similarly, after the predetermined period of operation a strategic capacity reserve can be abolished or downsized by the TSO when mandated by the regulator. Without doubt the duration of the fulfilment or operation periods is an important parameter in the design of the capacity mechanism. Apart from the abolishment, the DCM can effectively expire if the price for a certificate sinks to zero. (This possibility is explicitly foreseen in the rules of the French DCM.)

But policy makers and regulators face a basic trade-off. Up to a point, the economic effectiveness of a capacity mechanism, in particular a DCM, depends on the credibility of its persistence, and investments in generation capacity, which are generally long-term, can only be incentivised if capacity remuneration can be expected to last for some time. On the other hand, long-term guarantees of remuneration can give rise to considerable inefficiencies, as electricity demand, energy infrastructure and available generation technologies change over time, requiring new capacity targets. With its floating certificate price, the DCM is flexible, in contrast to capacity payments (as used in the past in Spain and Brazil). Nonetheless, politicians and regulators need to clarify their mid-term plans for DCM operation - including its potential abolition - and base its future or size on publicly observable energy market indices. The more predictable the DCM development is, the more credible the investment incentive will be.

While capacity investments do not receive remuneration under a strategic reserve arrangement, an unexpected abolition of strategic reserves – so that generation assets providing capacity under the scheme return to the "normal energy" market – distorts market prices and reduces return on assets. Consequently, the regulator needs to send a credible commitment signal to the market under this capacity mechanism as well.

In any case, we can say that the change from a SCR to a DCM is far less problematic than vice versa. In the former case, investors learn that the capacity previously operated under the strict conditions of the SRC will participate in the market, but that all capacity will receive a remuneration separate from the spot market. In the latter case, remuneration from the sale of certificates will be withdrawn from the market, and as part of the SCR regime, a price cap on the spot market will be introduced.

Cross-border effects of the introduction or abolition of a capacity mechanism essentially amount to the direct effects discussed in section 2.3; lock-in effects are to be expected only in the case of cross-border integration of a decentralized capacity mechanism. In the case of a DCM, the market in country G is affected via the additional capacity in market F; once the DCM is abolished, a steady decommissioning of plants in market F is to be expected, with the effects fading over time. Similarly, the strategic capacity reserve effectively caps prices in the wholesale market, thus reducing capacity investment incentives in domestic and foreign power markets. Its abolition reinstalls these incentives. By contrast, a unilateral abandonment of joint decentralized capacity scheme, where the capacity planning in two markets has been coordinated by the respon-

25 In the past, public tenders for new generation assets were launched by state authorities to guarantee that this SoS criterion was met.

sible regulators, could lead to regulatory difficulties. The remaining party in the scheme would have to adapt its planning to the new situation, possibly leading to additional costs.

3 Key insigths of the theoretical analysis and evaluation with a view to empirical facts in France and Germany

3.1 Summary and conclusions of the stylized model

Here we present the conclusions from our theoretical analysis. They are less stringent than a policy maker would expect, at least a policy maker setting up an agenda for regulatory change. The reason lies in the uncertainty of a crucial assumption: is there a *missing-money-problem* in European power markets or not? Or formulated differently: can the energy-only-market ensure a satisfactory level of security of supply? As we have shown, a number of conclusions can be drawn for both cases, but additional conclusions depend on the answer.

In section 2 we examined a scenario with two neighbouring power markets that trade electricity via an interconnector with limited capacity. One operates a decentralized capacity mechanism similar to the one planned for France and proposed for Germany by the German energy associations (BDEW and VKU): all producers can issue capacity certificates, the fulfilment criterion is plant operation, but capacity certificates are disconnected from actual power trade. For the neighbouring power market we vary three cases: no capacity element (an energy-only-market), a strategic capacity reserve (a capacity that is operated outside the market, and that is activated if wholesale prices surpass a strike price) and a decentralized capacity market such as in the first market.

Common conclusions

We have learnt that the joint introduction of a decentralized capacity mechanism creates less distortion to competition and efficiency than separate market designs in neighbouring markets (with one introducing a capacity market and the other continuing to operate an energy-only-market). This holds true in particular when explicit cross-border trade of capacity certificates is allowed. The efficiency gains in cross-border trade may be outweighed, though, by the transaction and regulatory costs of decentralized capacity markets. If one country opts for a decentralized capacity mechanism and the other for a strategic capacity reserve, generators in the latter country are in principle put at a competitive disadvantage and capacity could be displaced in the long-term; consumers, by contrast, could benefit from reduced electricity prices generated in the neighbouring market while having to bear the cost of the SCR paid for by a levy on electricity sales. A similar effect would apply when one country introduces a decentralized capacity while the other continues to operate an energy-only-market.

Conclusions depending on the existence of a *missing-money-problem*

The existence or non-existence of missing money influences conclusions about economic efficiency and security of supply. We discuss both cases separately.

→ Without a *missing-money-problem*, the introduction of a capacity mechanism is economically wasteful: it creates additional bureaucracy for the regulator and within energy companies. A decentralized capacity mechanism would probably lead to overcapacities[26] paid for by consumers in the country where it applies. If there are no overcapacities (capacity price equal to zero), transaction and regulatory costs will remain. Similarly, the strategic reserve creates additional costs to be borne by the consumer, though they are likely to be less than those of a DCM. The electricity wholesale market provides sufficient investment incentives, so security of supply con-

26 This would occur if the applied security of supply criteria – set by the regulator - are stricter than the economic optimum requires.

cerns are not an issue. (If the authorities want to secure a stricter security of supply, the capacity mechanisms may nevertheless be politically valid, while economically sub-optimal). If well designed, the capacity mechanism can have a positive impact on the development of demand-side response.

→ With a *missing-money-problem* in power markets, transaction and regulatory costs also increase. But in this case power markets are unable to ensure generation adequacy and avoid far more costly black- and brownouts. A threat to security of supply can occur if one country continues to operate an energy-only-market and if the scarcity events are correlated. A severe shortage situation can spill over to the neighbouring country even if it operates a decentralized capacity mechanism, unless exports are limited by the regulators (which is – in principle - forbidden under current EU regulation; see section 6) or the potential capacity shortage in the neighbouring country is accounted for in setting-up of the capacity market target. If scarcity events are not correlated, both power markets can help mitigate all but severe shortage problems.

An important observation is that lock-in effects of capacity mechanisms do generally not apply to neighbouring countries, i.e. their cross-border effects fade in or fade out during one country's introduction or abolition of a scheme. Regulators have to ponder the introduction of a DCM or SRC, as both instruments require some level of persistence to be effective in securing generation adequacy; however, in general they have to consider only the operation of the neighbouring power market, not its structure.

3.2 Evaluation of conclusions with a view to empirical facts

In this subsection we intend to put the theoretical conclusions in perspective by asking to what extent do they apply to the real cases of the French and German power systems? First we would like to understand the likely scope of a displacement in German capacity by French investment given a decentralized capacity market in France and an energy-only-market in Germany with possible augmentation by a strategic capacity reserve. Second we would like to understand the likelihood of a negative spill-over of a scarcity situation from one country to the other. To answer these questions comprehensively, we would have to conduct statistical and market simulation analyses with different scenarios of future capacity development. In this study we will limit our analysis to a brief discussion of two empirical observations. We find that, from today's perspective, inefficiencies arising from the unilateral introduction of a capacity market in France, while projected by our theoretical analysis, are likely to be limited. Future developments, such as massive decommissioning of power capacity in Germany, could considerably change this assessment.

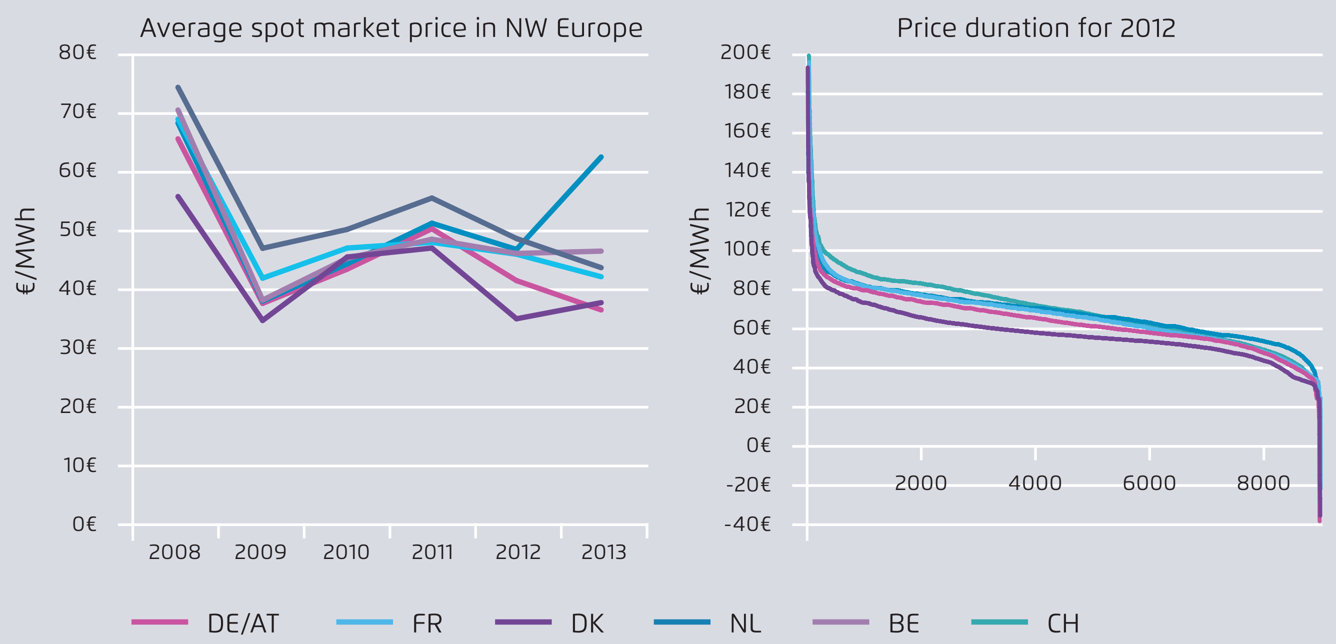
3.2.1 Market integration and interconnector capacity

The creation of an internal market for electricity is one of the stated goals of the European Union: power should be traded across borders without regulatory or physical obstacles. The state of market integration in Northwestern Europe can be assessed by the level of electricity price convergence. Today, power exchanges couple wholesale markets across large market zones, resulting in a considerable level of price convergences, as shown in Figure 13. The price duration curves for markets in Northwestern Europe differ by 10 euros or less. The left figure shows nevertheless that price convergence sank slightly in 2012, and increased again in 2013 (with the exception of the Netherlands). This development reflected situations with large feed-ins of renewable energy in the power system that drove down electricity prices in Germany and led to congested interconnectors. In section 2.2.3 we explained how situations with congestion limit the applicability of the theoretical results because of reductions in competition and prices distortions. When interconnectors are congested, considerably higher prices in one country can occur, allowing for higher returns on investment, as required under long-term marginal pricing.

As of today, France is a net importer of electricity from Germany, while Germany is a net exporter. In 2013, France imported 15.1 TWh of electricity from Germany, and exported three time less, or 5.3 TWh (Figure 3-2). A closer

Price convergence in Northwestern Europe

Figure 3-1



DNV GL (from EPEX Spot, APX, BPX, Nordpool)

look shows that most of the imported electricity serves peak load: German power producers help reduce shortages in France. As Figure 3-2 shows, the situation is quite different with regard to a number of other French neighbours. France exports large amounts of electricity to Belgium, Switzerland, Great Britain and Italy. But this does not strengthen the argument that French capacity will displace German power plants; in fact, the introduction of a capacity mechanism in France, along with the subsequent investments (and DSR activation), would impact on all its neighbours, limiting the effect on any single one.

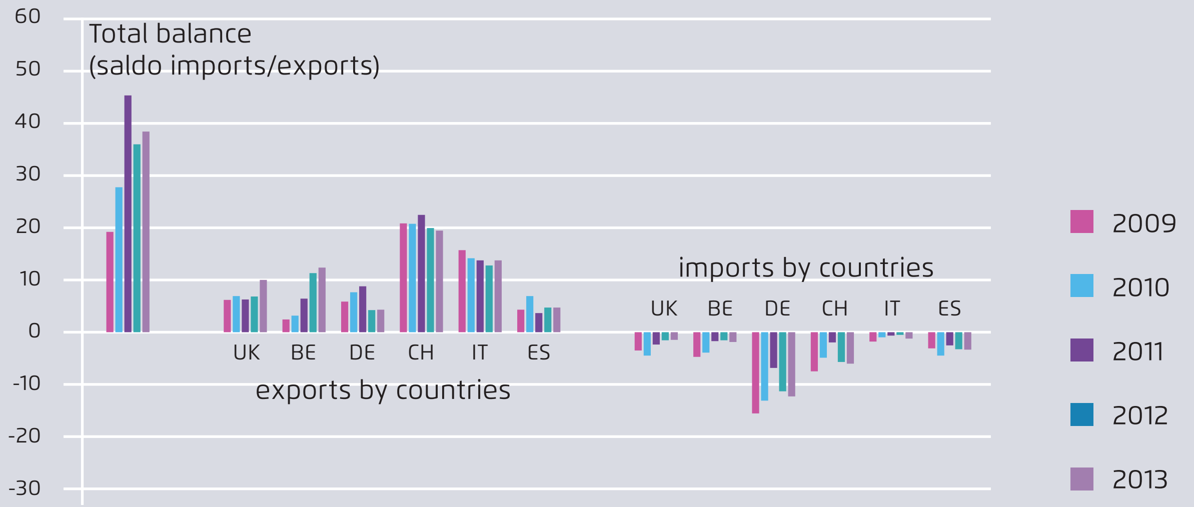
This puts one theoretical finding into perspective. If anything, German power exports today tend to displace French peak-load investments, and not the other way around. An "oversized" decentralized capacity mechanism in France could in principle change this situation. Nevertheless, the French DCM implicitly takes into account the contribution of imports in order to dimension, and in fact reduce, the capacity obligation of French suppliers. Furthermore, an explicit participation of German power producers in the French capacity market via a cross-border scheme, as planned (though not spelled out in detail), would also limit the displacement of investments.[27] In that case new investments in peak capacity in France would be limited, reducing disinvestment incentives in Germany. These effects are nevertheless limited to the magnitude of cross-border interconnection.[28]

Summarizing the arguments so far we can say that although it cannot be excluded that a displacement of capacity in Germany will occur in the mid term, the situation today is more in line with the view of r2b (2014). That is to say, we currently observe overcapacities in the German market that have given rise to a considerable net electricity export to France.

27 For a discussion of the regulatory problems associated with this goal, see 4 and RTE (2014), p. 198 ff.

28 The NTC France / Germany today is 3GW. It is projected to grow to 5GW by 2034. See German TSOs "Netzentwicklungsplan".

Electricity exports and imports of France from 2009 to 2013 (contractual exchanges) Figure 3-2



RTE 2014

3.2.2 Probability of joint shortage situation

The arguments discussed so far concern the economic part of the analysis. We now look at the issue of security of supply – the motivation for introducing the capacity mechanism. Again, evaluating possible generation inadequacies with black- or brownouts is beyond the scope of the study. What we intend to do in this subsection is to look at the argument that an energy-only-market in Germany might pose a potential risk to security of supply in France. As we have seen before, from a theoretical viewpoint that situation could occur – under the assumption of a *missing-money-problems* - given a joint scarcity in both countries.

In the past, Germany exported electricity to France whenever French electricity demand rose to extremely high levels. According to RTE analysis, the French capacity market can count only on a fraction of the total sum of import interconnection capacity in scarcity situations. Moreover, as the provisions of the decentralized capacity mechanism do not affect the wholesale market, we can expect that it will offer sufficient incentives for German producers to sell electricity to France in the event of a scarcity situation.

Today, a potential threat to security of supply could arise from a situation of joint scarcity in both countries: German power producers might not contribute to the extent expected by RTE in a period of extreme scarcity and high prices in Germany (as envisioned in Frontier 2014 to ensure the financing of generation assets). Worse, French generators may be incentivized to export their electricity in such a situation under the current conditions of the French capacity market, since the fulfilment criterion for capacity certificates does not oblige the generator to sell the electricity to domestic customers (it only obliges them to produce and sell electricity).

Consequently we should ask how probable such a joint scarcity situation is from today's viewpoint. Such a difficult situation occurred in February 2012: after a long cold spell, peak demand rose to 102.1 GW in France.[29] During this month, France was dependent on power exports, notably from Germany, to ensure power supply. In its modelling of generation security, the French TSO RTE incorporates foreign capacity, but notes the underlying problem:

29 On February 8, 2012, see RTE "Bilan électrique 2013", p. 3.

Criteria for joint scarcity situations — Table 3-1

Type	France Temp. below [°C] at 19:00	Germany Res. Load above [GW]
1	5	80
2	-4	78
3	-3	76

[...] *if no margins are available in neighbouring countries, physical interconnections may be available without any electricity being imported. The availability of foreign capacity depends on factors external to France.*[30]

Applying the criteria presented in section 2.3.3, we intend to assess the probability of a joint scarcity situation in 2023 (completion of the nuclear phase-out in Germany). Using the weather data from 1982 to 2011[31] we analyse how often a critical situation with very low temperatures in France and high residual load in Germany would occur in 2023 (assuming renewable capacities as projected in the NEP13). We are aware that the numbers we derive cannot substitute an in-depth analysis of the problem; we believe, however, that they can give us a useful preliminary indication.

We define joint scarcity situations by a two-dimensional criterion: temperatures falling below a threshold value in France and residual load rising above a threshold value in Germany. Three types of scarcity situations are defined in Table 3-1.

On the basis of these criteria, we calculate how many joint scarcity situations could occur for the two countries over the last thirty weather years. The results are presented in Table 3-2. Depicted is the number of days in the respective weather year when a joint scarcity situation would have occurred (ordered from highest to lowest), under the assumption described above. We can see that over the year 1982-2011 no day would have qualified as a type 1 critical situation; two days would have qualified as type 2 critical situations; and twelve days would have met type 3 criteria. Based on a separate analysis for 2012 we can estimate that it produced two critical situations (type 1 or 2) and six subcritical situations (type 3). In sum, over the last 30 weather years, eighteen days would have qualified for a potential joint scarcity situation in the two countries (applied to a situation corresponding to the 2023 forecasted development of the German power mix).

Number of days of joint scarcity events — Table 3-2

	Number of days with a potential joint shortage situations > 30 years (based on historical weather data)	
type of joint scarcity situation	over the 29 weather years 1982-2011	in 2012
1	0	
2	2	2
3	12	6

These results lend little support to the idea that the introduction of a capacity mechanism in Germany is urgently needed to avoid cross-border security of supply problems. Because joint scarcity situations are rare, both systems can serve as back-ups for the other. However, circumstances may change, particularly if German power producers start to decommission capacity on a larger scale than projected today, which could become acute in the final stage of the nuclear phase out in 2022. It must be emphasized that the operators of the decentralized capacity market in France have at least two options to ensure that a scarcity situation in Germany does not spill over: They can adopt the capacity target accordingly, and they can change the fulfilment criterion: any emission of a capacity certifi-

30 RTE (2014) "French Capacity Market", p. 99

31 A complete set of weather data for 2012 was not available for this analysis. Based on data of load and renewable feed-in for 2012, we conclude that this year produced two critical situations (types 1 and 2) and six subcritical situations (type 3).

cate would mandate the emitter to sell its electricity to the French wholesale market, i.e. limiting exports and ensuring imports in scarcity situations. The first case would then constitute *free-riding* on the part of Germany. The second case could lead to regulatory intervention by the European Commission, as it could be seen as a violation of free trade in the internal power market (depending on the actual implementation).

It should be emphasized that focusing the discussion to two countries in Northwestern Europe is artificial: any long-term planning for power supply security in this region needs to account for the fact that the supply system is highly intermeshed, and that supply problems in one country can potentially affect all of its neighbours, and that, conversely, all neighbours can potentially contribute to power supply in one country affected by a singular residual load peak. Given the high degree of market integration and increasing cross-border trade today, ring-fencing an individual power supply system is virtually impossible.

4 Structured comparison of the French decentralized mechanism and the decentralized proposal of BDEW/VKU

In this chapter we describe and compare the French decentralized capacity mechanism proposal, developed by the French TSO RTE (RTE 2014[32]), and the decentralized proposal developed by the German energy associations BDEW and VKU (BDEW 2014, VKU 2013[33]). The aim of this analysis is to better capture the differences and similarities between the two mechanisms. Both mechanisms have been conceived as supplements to the electricity wholesale markets and have a decentralized[34] nature. We chose to compare these two decentralized mechanisms, as they are often said to be very similar. We will nevertheless show in this chapter that they differ subtly on several points. In particular, the BDEW/VKU proposal, being less centrally regulated than the French mechanism,

→ does not introduce a prequalification requirement for delivering capacity certificates. The risk of a default of a market participant – and the associated liabilities issues – is cleared through bilateral contracts or by the stock exchange[35]);

→ does not refer to an explicit security of supply criteria,[36] whereas this criteria plays a dimensioning role in the French system;

→ foresees an implicit participation of demand-side response;

→ relies on a market signal for announcing scarcity events (whereas scarce situations are announced by the TSO in the French proposal);

→ relies on a market-based penalty settlement (whereas the French system foresees in some situation an administrative penalty).

We emphasize once more, though, that the current proposals by BDEW and VKU are far less developed than the French mechanism. Therefore it is conceivable that the details of a German decentralized capacity market could evolve as for instance during the consultation phase planned for the second half of 2015 in the German Federal Government's *Green Book*.

4.1 Design principles of decentralised capacity mechanisms

In essence, a decentralized capacity market consists of capacity certificates, sold by generators to suppliers and consumers. Suppliers and consumers "buy security of supply", i.e. firm capacity relative to their foreseeable peak load; it is important to emphasize, though, that the capacity certificate market is independent of actual electricity delivery. Sales of certificates are supposed to generate sufficient revenues to generators, ensuring a continued operation of generation assets, in particular those that are

32 RTE, Réseau de transport d'électricité, (2014) "French capacity market - report accompanying the draft rules".

33 BDEW, Bundesverband der Energie- und Wasserwirtschaft, (2014) "Ausgestaltung eines dezentralen Leistungsmarktes"; VKU, Verband kommunaler Unternehmen, (2013) "Einführung eines dezentralen Leistungsmarktes".

34 In Germany, the French system is regularly described as being centralized. But if it is true that the French power structure is effectively more centralized than the German one, the capacity obligations in this mechanism rely fully on the decentralized decision of supplier

35 The BDEW proposal foresees the possibility of introducing an ex-post control mechanism to strengthen the conformity of the market parties' behaviours. See the BDEW proposal "Möglichkeiten der Ergänzung des Dezentralen Leistungsmarkts um eine Ex-post-Kontrolle" (BDEW 2014).

36 The multiplicator for the penalty settlement nevertheless influences a certain level of security of supply.

needed during rare load peaks. Demand-response product[37] can also be remunerated under decentralized capacity markets, either explicitly (allowing DSM aggregators for offer certificates) or implicitly (by reducing the level of supplier obligation in return for compensation). The market is subject to a number of specifications:

- definition of capacity commitment of generators and DSR operators – technical prequalification of capacity, availability condition
- obligation to purchase certificates (applying to suppliers / consumers)
- penalty for non-availability of capacity (producers) or non-purchase of certificates (suppliers)
- procurement and contract period
- register and control mechanism to guarantee the compliance of the system.

These specifications address important issues concerning the definition of the capacity requirement. Generation capacity should be firm, i.e. be reliably available at any time. Variable renewable energy sources and storage may or may not be certified by basic principles (e.g. through capacity factors or declarative commitments). But while cross-border capacities can be included, their availability has to be ensured. Demand response providers who offer to reduce or shift load can be included explicitly or implicitly.

Table 4-1 gives an overview of some basic design specifications of the French and the BDEW/VKU decentralized capacity mechanism (DCM), which will be discussed in more detailed in the next section. The analysis encompasses the following aspects: the tasks of the market participants (section 4.3.1), implications for consumers and the role of the demand side (section 4.3.2), determination of required capacity (section 4.3.3), verification of obligations and non-delivery penalties (section 4.3.4), time schedule and procurement (section 4.3.5). We emphasize once again that while RTE provides exact details for the French DCM, the specifications in the German case are based on information presented in the preliminary exposition of key principles in documents provided by BDEW and VKU.

4.1.1 Tasks of the parties in the market

The comparison of the French and the BDEW/VKU mechanisms shows similarities with regard to basic functions such as determination of capacity requirements, trade of certificates, fulfilment verification and market monitoring. Apart from missing specifications (especially concerning the role of different actors) the BDEW/VKU proposal differs from the French in two aspects: the fewer options it foresees for flexible consumers and the way it fulfils the verification process.

In Figure 4-1 we directly compare the basic functions and roles of market participants within the decentralized capacity market in the French and BDEW/VKU schemes. These include the definition of capacity requirements, the obligation to acquire or sell capacity certificates, the decision on penalties for non-fulfilment or for violations of the capacity certificate acquirement, the role of flexible consumers (demand response) and market monitoring.

Below we explain the roles of the parties in each market.

In the French mechanism,

- The **TSO** (RTE) performs the following tasks:
  - Announcement of peak-days and periods (periods of fulfilment verification)
  - Announcement of key parameters of the mechanism (reference temperature, security factors)
  - Ex-post calculation of obligation and control of the fulfilment of commitments
  - Calculation of imbalances and penalty settlements for violation of capacity balance responsibility, both for producers and suppliers

37 Dispatchable load response activated under pre-specified conditions such as generation scarcity.

Overview over basic design principles for the French DCM — Table 4-1

	France	Germany
Certification principle	→ Certification based on the ability to reduce the risk of load loss during winter cold spells (peak periods) → Certification of all capacities (generator and DSM) is mandatory → Certification based on declarative commitments (self-assessment of the availability forecast) for dispatchable capacities → Non-dispatchable capacities can also choose alternatively to be certified on the basis of normative coefficients (capacity factors)	→ Certification based on the ability to provide firm capacity during shortage periods triggered by high prices in the day-ahead market (cases of shortage) → Certification of capacities is made on a voluntary basis, without prequalification
Product definition	→ Firm capacity by prequalified units during peak periods; technology factor for non-dispatchable generation (e.g. for wind and solar based plants) takes into account reduced expected availability.	→ Provision of firm capacity during cases of shortage → Definition of capacity credit and risk strategy by generators
Procurement	→ For one calendar "delivery year"; peak periods - up to 10 hours per day - are announced day-ahead by the TSO (RTE) but during period of November to March only	→ Procurement for a certain period of time that still needs to be defined in terms of months, quarters or year; shortage-periods are triggered by high energy prices in the day-ahead market (BDEW proposes to set the trigger level at 300 €/MWh).
Demand side	→ Explicit inclusion of demand side – flexible consumers have the right to sell capacity certificates the same way as generators. → Bilateral agreements between suppliers and flexible consumers represent an additional option for valuing explicitly DSR and reducing supplier obligations.	→ Consumers are not entitled to sell capacity certificates → Suppliers and flexible consumers can agree on DR contracts

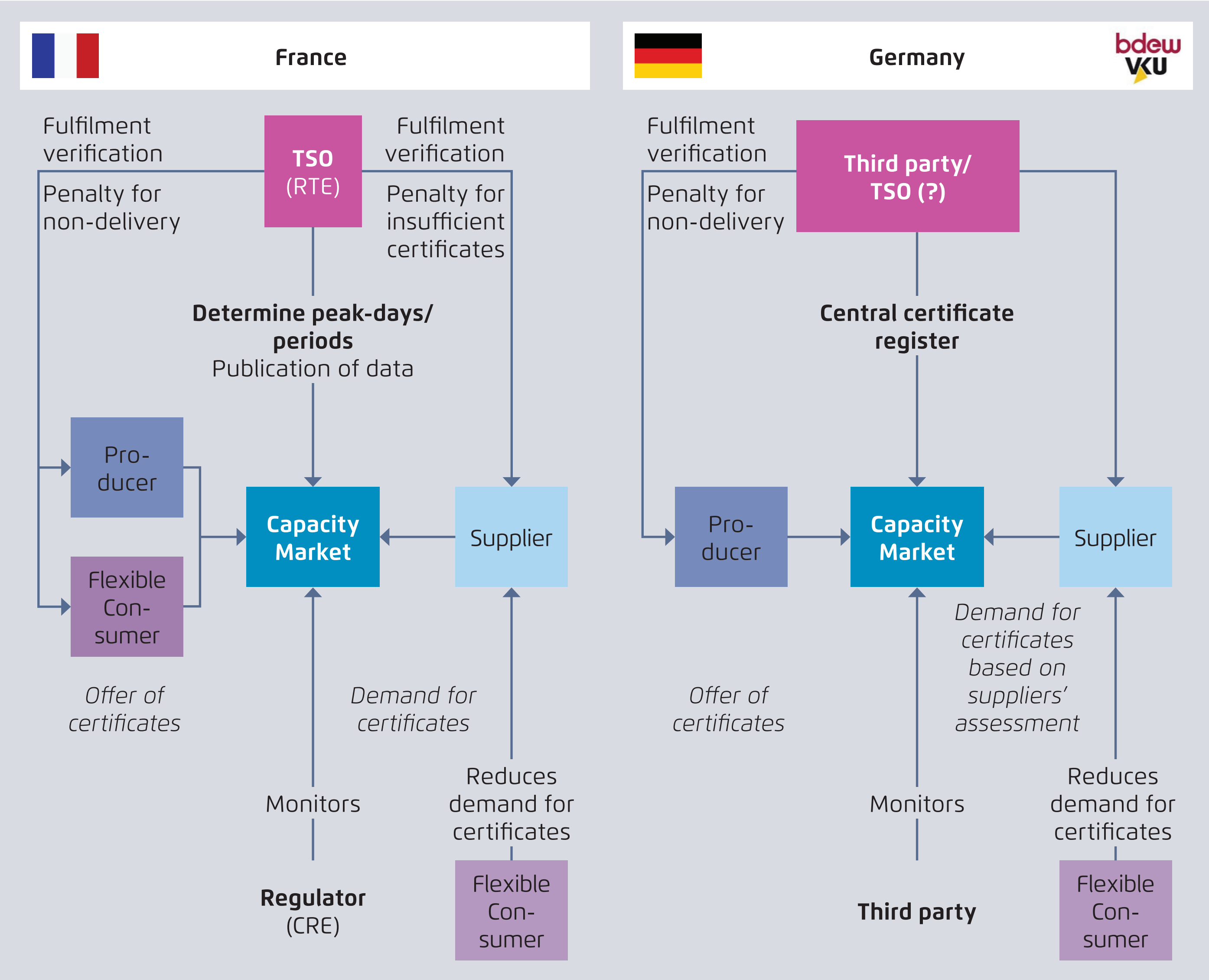
- Transparency on market data: Publication of data on capacity trades (confidential trading register); publication of data regarding certification and availability forecast (publicly certified capacities register)

→ **Producers** commit to making capacities available during consumption peaks by selling capacity certificates to the market.

→ **Suppliers** have an obligation to acquire sufficient certificates to cover consumer peaks.

→ **Regulator:** the Energy market Regulator (Commission de régulation de l'énergie, CRE) monitors the functioning of the market and proposes some provisions (including penalty price and reference market price methods).

Tasks of market participants under French and BDEW/VKU DCM — Figure 4-1



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In the BDEW/VKU proposal,

- The **TSO**s (might) perform the following (as yet undetermined) tasks:
  - Administration of a central register for capacity certificates
  - Ex-post checks on the fulfilment of commitments and obligation
  - Penalty settlements for violations of capacity balance responsibility, both for producers and suppliers
- **Producers** commit to making capacities available during consumption peaks.
- **Suppliers** (including self-supplying end-use customers) have an obligation to acquire sufficient certificates to cover consumer demand.

→ **Regulator:** Federal Cartel Office (Bundeskartellamt, BKartA) and the Market Transparency Unit are the monitoring authorities for preventing abuses in the capacity market.

4.1.2 Implications for consumers

Under both the French and the BDEW/VKU DCM, consumers who are interval metered face higher electricity consumption costs. Flexible consumers who are able to provide demand response have more options under the French DCM. While German counterparts can only set up bilateral contracts with suppliers who participate in capacity certification, French aggregators have the additional option to sell certificates in the capacity markets.

Figure 4-2 shows the roles of consumers under the French and BDEW/VKU DCM: standard consumers incur higher costs for electricity consumption because their suppliers add the costs for acquiring capacity certificates to their bills. This increases incentives for flexible consumption, which is rewarded under both schemes. More precisely, they offer the following options for consumers:

French DCM

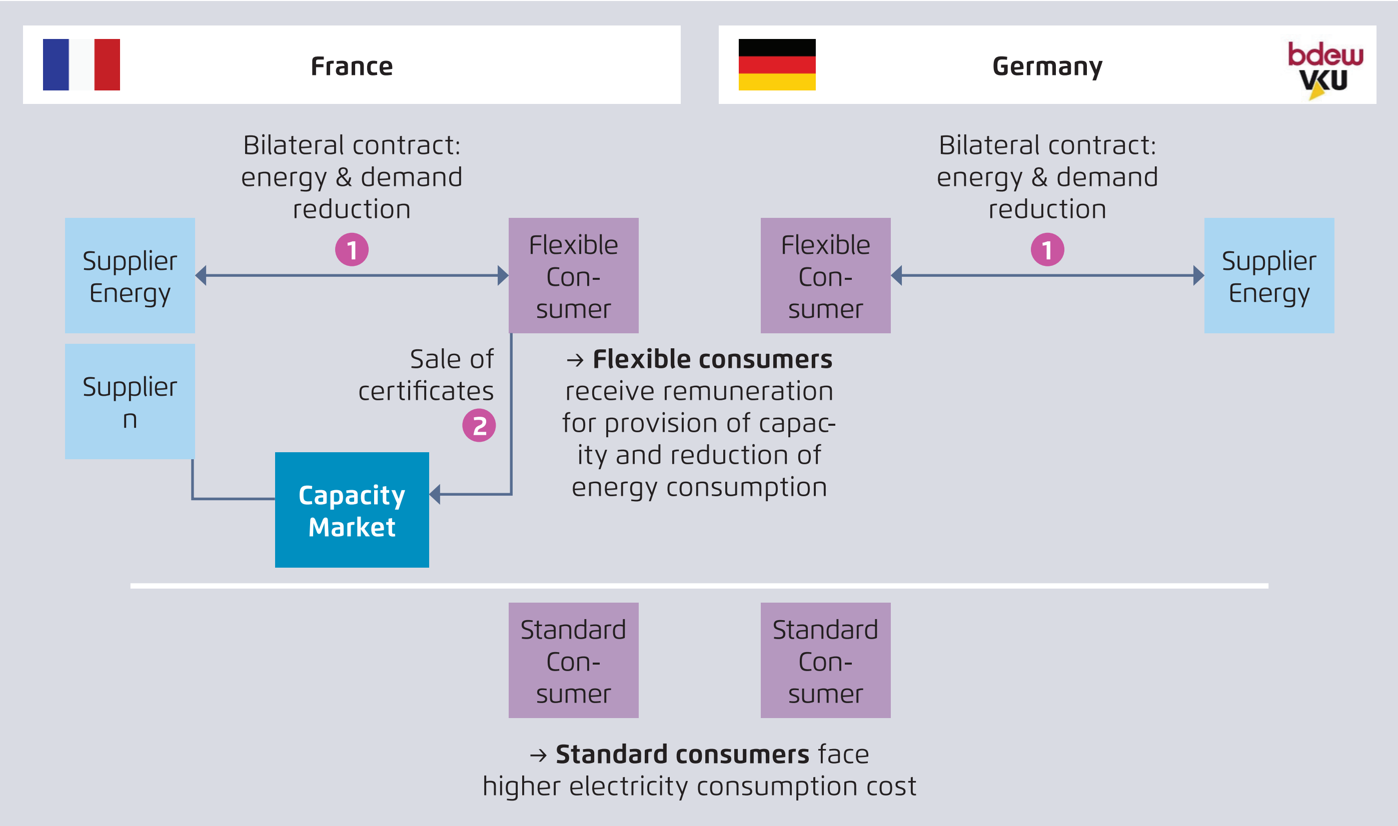
→ Option 1: bilateral contracts for load reduction between consumers and suppliers

→ Option 2: explicit participation in DCM by providing capacity reduction (sale of certificates)

BDEW/VKU DCM

→ Only one option: bilateral contracts between consumers and suppliers

Role of consumers in French and BDEW/VKU DCM — Figure 4-2



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→ Contracts can encompass not only load reduction in specific situations (demand response) but also direct load control for the supplier

4.1.3 Determination of required capacity

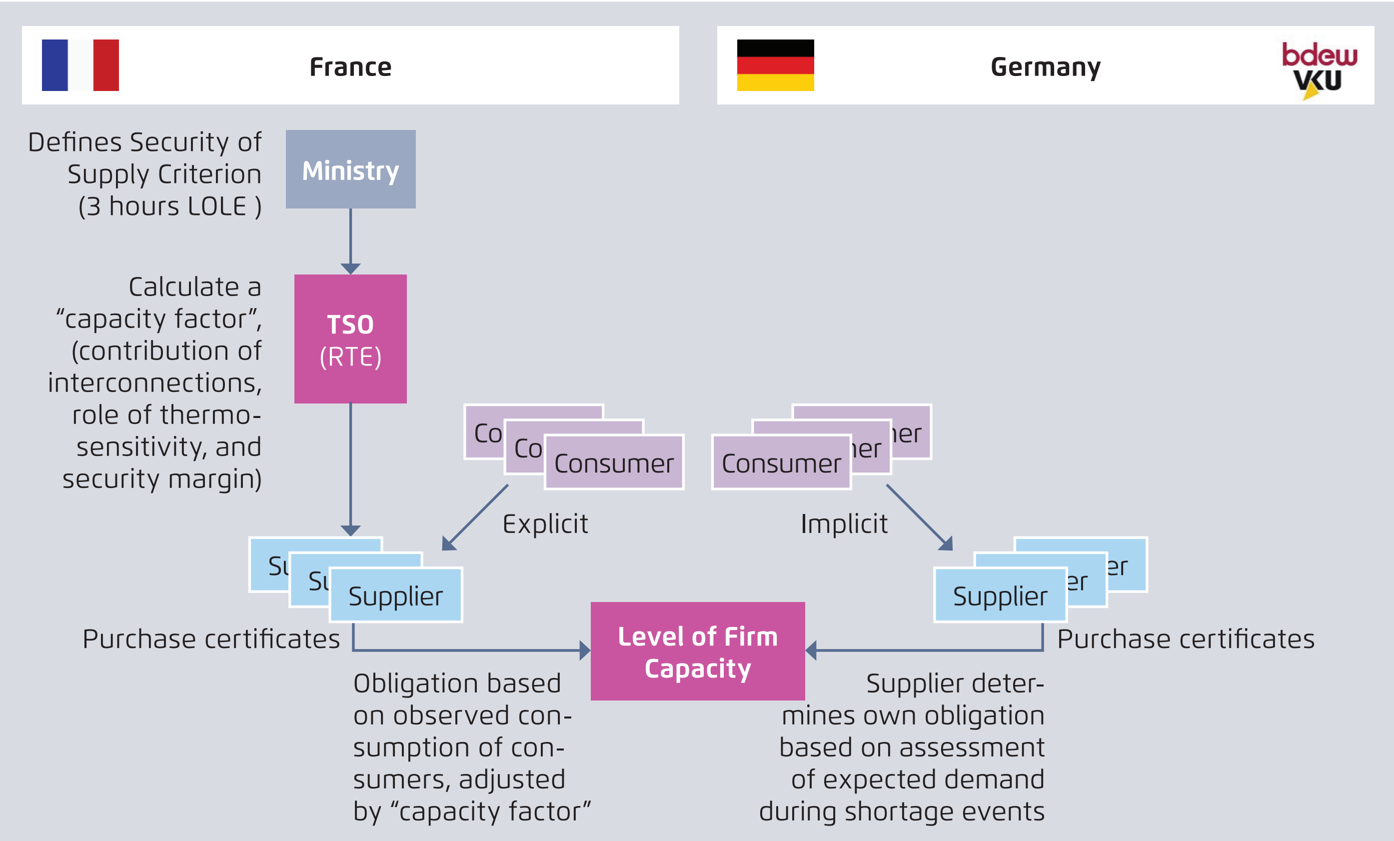
With respect to the determination of required capacity, there are subtle but important differences between the French and the German DCM. Under the French DCM, the ministry responsible for energy policy (currently the Ministère de l'Écologie, du Développement durable et de l'Énergie) defines one general security of supply criterion (LOLE of 3 hours). The capacity obligations are determined by each supplier (the mechanism being effectively decentralized), but the level of obligation is modified by a "security factor", which implicitly takes into account the contribution of the interconnector and guarantees that the overall security of supply standard in the French system (set by the public authorities) is met. By contrast, German suppliers are solely responsible for determining their own capacity requirement under peak load conditions, risking penalization if they fail to be accurate (preliminary model). No explicit SoS criteria dimension the obligations (an implicit SoS level is nevertheless reached by setting the penalty level for non-delivery, as explained in the next subsection).

The differences in the definition of capacity requirements are presented in Figure 4-3.

French DCM

→ The obligation of each supplier is based on the observed consumption of its consumers' portfolio during peak-period (measured ex-post by the DSOs/TSO); the obligation level also takes into account the temperature sensitivity

Definition of required capacity — Figure 4-3



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of the consumption

- The level of obligations of each suppliers is adjusted by a macroscopic factor, which implicitly takes into account the contribution of the French interconnectors to meet peak-demand and guarantees the consistency of the obligations at supplier level within the overall French security of supply criteria (LOLE of 3 hours)

BDEW/VKU DCM

- Required capacity is determined by a self-assessment of peak capacity by supplier

- Consumers need for security of supply is expressed by the suppliers' willingness to pay for capacity certificates

- On insufficient delivery of certificates in scarcity situations, supplier faces penalty under DCM rules[38]

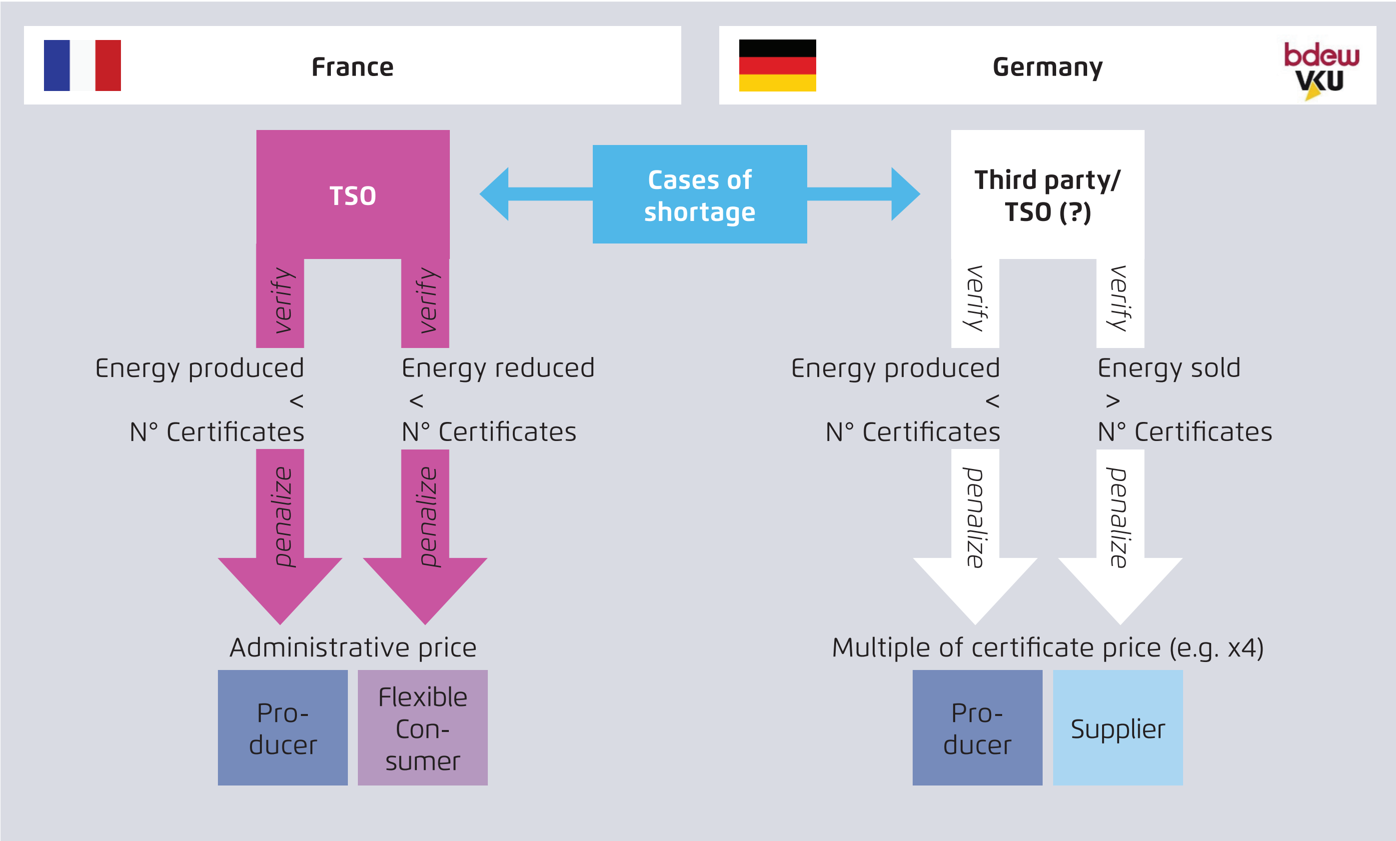
- Trade in certificates is subject to market monitoring by regulator

4.1.4 Verification of obligations and non-delivery penalties

The verification of capacity obligations and the penalization of non-delivery are key elements of any DCM. In both the French and the BDEW/VKU DCM, the fulfilment of the capacity obligation is defined as the availability of either generation or demand response in scarcity situations. Conversely, suppliers have to acquire sufficient certificates to

38 The rules presented in the documents are preliminary and partly vague. Self-assessment is susceptible to free-rider behaviour; a specification of rules would have to account for that fact.

Verification and penalty process | Figure 4-4



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cover peak load. Violation of these requirements is penalized by an administrative fee in the French DCM and a multiple of the certificate price in the BDEW/VKU DCM.

Generally, verification of obligations is to be performed by the TSO(s) based on available data and processes in place for energy imbalances. Whereas the French DCM specifies this role explicitly, the German documents are vague.

French DCM

- → Ex-post verification of obligations in scarcity situations
- → If the overall capacity certificate imbalances (of all obligated parties in France) is higher than a certain threshold (to be set, e.g. 2 GW), this imbalance is considered to pose a threat to security of supply; the penalty for non-delivery of capacity and non-acquisition of certificates is set at an administrative price (based on the annual cost of a reference peak-load capacity, to be set, e.g. 60 k€/MW), reflecting the security of supply risk posed by the responsible market participant
- → If the overall capacity imbalance is lower than this threshold, the fee for capacity certificate imbalances is based on the capacity market price; an incentive is nonetheless introduced to encourage stakeholders to respond to the market rather than to pay the fee

BDEW/VKU DCM

- → Verification of obligations in scarcity situations
- → Potential adjustment of penalties by the regulator to ensure adequate security supply level
- → Penalty for both non-delivery of capacity and non-acquisition of certificates is defined as a multiple of the certificate price (e.g. four times as much); implicit determination of security of supply.

4.1.5 Time schedule and procurement periods

A DCM time schedule includes a trading period and a delivery period for each capacity certificate. Whereas the BDEW/VKU DCM foresees continuous trading and delivery of certificates with different starting dates, the trading period in the French DCM begins after the announcement of capacity obligations; all certificates are then traded in parallel, so that fulfilment is synchronized.

There are basic differences in the time schedules between French and BDEW/VKU DCM.

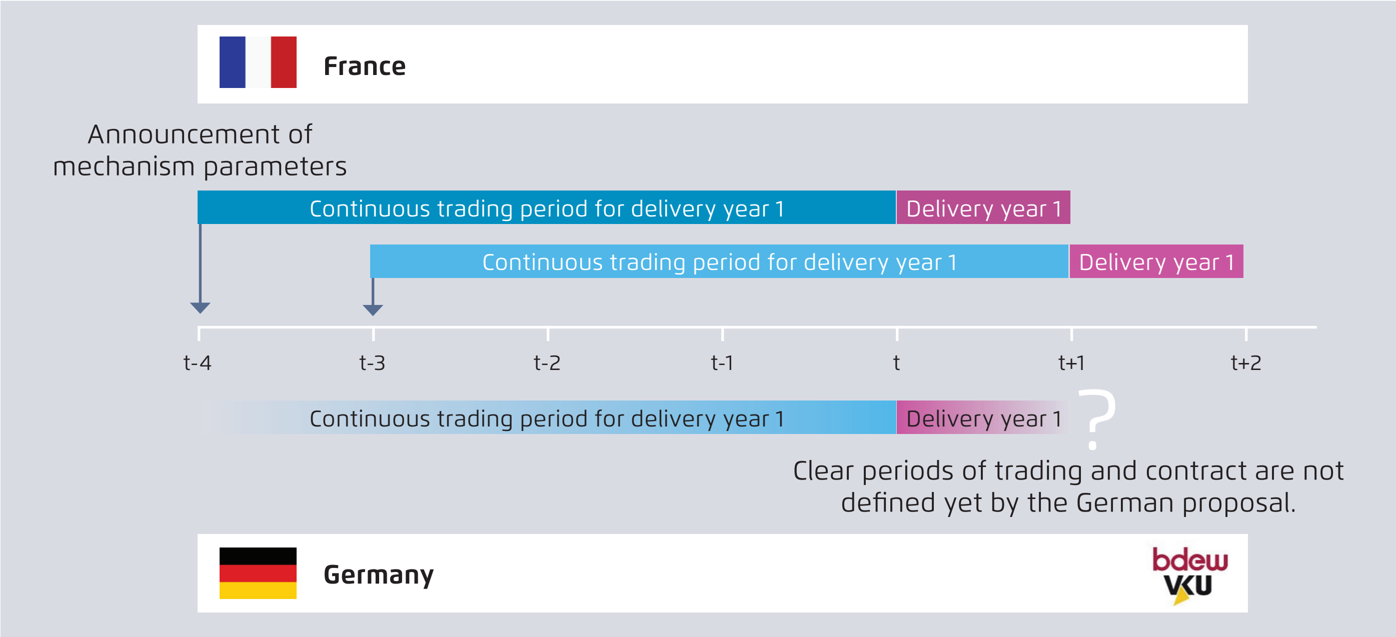
French DCM

- → Announcement of security of supply criteria by the minister
- → Announcement of capacity market parameters by RTE (reference temperature, security factor)
- → Suppliers acquire certificates based on their assessments of client consumption at peak load
- → Procurement: continuous trading period for delivery in year one (one-year certificates)
- → Fulfilment verification during delivery year for each case of shortage

BDEW/VKU DCM

- → Suppliers acquire certificates according to their time schedule and assessment
- → Procurement: no definition of trading and contract periods in the German proposal so far; an alignment to forward trading horizons is foreseen
- → Verification of capacity obligations in line with specific contract duration

Time schedule of the French and BDEW/VKU DCM — Figure 4-5



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5 Regulatory Analysis

This chapter addresses the regulatory requirements that must be fulfilled by any generation adequacy measure for approval by the State Aid Guidelines of the European Union. It refers to the Guidelines on State Aid for environmental protection and energy, 2014–2020 and to other related documents.[39] The regulatory issues around cross-border participation are dealt with in a separate section (see section 6).

5.1 Objective of common interest and need for state intervention

According to the EU guidelines, any capacity mechanism must address a generation, or resource[40] adequacy problem. Capacity mechanisms are not intended to compensate investors of stranded generation assets, nor are they intended to promote specific generation technologies.

A resource adequacy problem only arises in the event of a market failure. In all other cases, the energy-only-market in most EU countries ought to be sufficient to deliver adequate levels of generation or other capacity resources. The market failure most often cited is the so-called *missing-money-problem*. (For a comprehensive discussion of the missing-money issue, see section 3). Complimentary reasons for a market failure of the energy-only-market are often cited. The most prominent issue is the public good character of reliability and security of supply. As long as no supply disconnection can be carried out based on the perceived value of lost load by individual users, customers have to be disconnected based on technical and political criteria. (A more detailed discussion of the public good nature of security of supply is provided in section 3.)

France states that both the *missing-money-problem* and the public good character of security supply are prevalent in the French electricity market. If no additional measures are taken, capacity is expected to fall short of expected peak demand by the winter of 2015/2016.

The German associations BDEW and VKU have asserted that a *missing-money-problem* exists in Germany. In the ongoing discussion, reliability has been seen as public good, even though no explicit reference is made to a national security of supply standard. (The penalty factor - set by the public authorities – nevertheless contributes implicitly to a specific SoS level.)

In its approval of the UK capacity mechanism,[41] the EU Commission has recognised both market failures mentioned above as applicable: (1) the TSO of the United Kingdom, National Grid, has identified critical levels of generation beyond 2018; (2) in the absence of a full smart meter penetration, the Commission has accepted the notion of reliability as a public good. While both market failures are abstractly recognized as reasons for state intervention, inadequate levels of generation must be proven by the applicant country based on a detailed evaluation of the respective TSO (or TSOs).[42] Both the French and German CM proposals must prove inadequate firm generation capacity levels. Accordingly, a final assessment of the regulatory

39 See in particular the "Guidelines on State aid for environmental protection and energy 2014-2020 (2014/C 200/01), the "Communication from the Commission: Delivering the internal electricity market and making the most of public intervention" and the accompanying document "Generation Adequacy in the internal electricity market – guidance on public intervention".

40 Capacity mechanisms are not confined to generation resources. Capacity mechanisms have to be technologically neutral and should therefore be open for participation from other sources of firm capacity such as storage or demand response. (See also 4.5 Technology neutrality.)

41 On July 23, the EU Commission approved the first capacity mechanism in the United Kingdom. The decision was published on 03.10.2014.

42 The European Commission has ordered the European Association of TSOs ENTSO-E to develop a comprehensive and Europe-wide consistent methodology to assess generation adequacy.

Assessing common interests and the need for state intervention — Table 5-1

Issue	France	German proposal (BDEW/VKU)
Missing money Assessment	Claimed market failure → compliant	Claimed market failure → compliant
Reliability as a public good Assessment	Claimed market failure → compliant	Not addressed in initial proposal → n.a.

compliance can be performed only after the TSO provide its generation adequacy assessment.

Both measures are compliant with state aid regulations when inadequate levels of generation capacity can be proven.

5.2 Appropriateness of aid

The capacity mechanism is designed to remunerate the pure provision of firm capacity,[43] not the actual generation of a particular resource. Payments, therefore, occur only in the case of capacity remuneration. The capacity remuneration is granted only for those resources that can guarantee availability in the event of stressed electricity supply and help relieve the scarcity of firm capacity.

Both schemes will remunerate only the provision of firm capacity, making them compliant.

5.3 Proportionality of aid

The capacity mechanism is meant to compensate only the amount of missing money needed to assure adequate levels of resource generation. The aid is to be determined by a competitive (transparent, non-discriminatory) bidding process. The capacity mechanism is intended to guarantee that no windfall profits are generated.

The planned French and proposed German capacity mechanisms are based on the concept of a decentralized market with several capacity providers offering their certificates and many suppliers asking for certificates. When actual demand and supply are in equilibrium, the market price reflects the anticipated scarcity of generation or other resources. In this respect both schemes are in compliance with the required proportionality. The risk of a disproportionately high or low level of support is caused by over- or underestimating the security of supply criterion. This risk obviously increases with (1) the lead-time between the determination of the security of supply criterion and the actual delivery period and (2) the duration of the certificates / supplier obligations. In France, with durations of a calendar year and lead-times of four years for the certification

43 Which is to say: the commitment to deliver electricity.

Assessing appropriateness of aid — Table 5-2

Issue	France	German proposal (BDEW/VKU)
Only capacity remuneration Assessment	Yes → compliant	Yes → compliant

Assessment of proportionality of aid — Table 5-3

Issue	France	German proposal (BDEW/VKU)
Only capacity remuneration Assessment	Yes → compliant	Yes → compliant

and three years for the determination of supplier obligations before actual delivery, this risk should be manageable. In the German proposal these time horizons have yet to be determined.

Summing up, both schemes ought to be compliant with the EU requirements.

5.4 No distortion of competition and trade

No capacity mechanism should affect, or interfere with, the normal functioning of the energy-only-market (day ahead, intraday and balancing markets). In particular, the coupling of national electricity markets must not be jeopardized.

Furthermore, a capacity mechanism should not diminish the function signalling scarcity of generation (or other resources) of the *pure* energy markets. This means that price caps and / or strike prices in capacity mechanisms must be sufficiently high.

In both the French scheme and the proposal of BDEW/VKU, the energy markets (DAM, ID and balancing markets) will work independently of the capacity scheme. In Germany the trigger for an endangered security of supply is to be based on the spot market price. In France the security factor and the announcement of scarcity events by RTE encompass purely technical and meteorological aspects. Hence, the French scheme does not pose problems with regard to impacts on the "pure" energy markets. Neither is the German scheme expected to have a direct impact on the energy market. The spot market price level will trigger a scarcity situation, but it will not affect the spot market price directly. Spot markets price can and will exceed the "strike" price in cases of scarcity. This is in contrast to a strategic reserve, where the strike price automatically caps spot market prices.

The French scheme complies with the EU requirements. For the BDEW/VKU proposal a valid assessment can be provided only after more comprehensive and detailed rules are formulated.

When a generation or other resource participates in a foreign capacity mechanism, the home government is not allowed to restrict exports of capacity, either directly or through the application of excessive export charges. The limitation of exports cannot be applied even if this would escalate the generation scarcity problem in the home country.

The French scheme foresees a delivery of the certificates when a generator is available (or when the DR resource reduces load) during scarcity periods regardless of whether the electricity is consumed domestically, implicitly exported via market coupling or explicitly exported via physical transmission rights. The German proposal foresees a limitation for imports of certificates from countries with energy-only-markets when the security of supply in these countries would be endangered by these exports. However, the German proposal also advocates the free flow of electricity based on price differentials even if it worsens the supply situation in the exporting country. Whether such a ban of exports in emergency situations applies to physical energy flows only or is also applicable to the export of certificates is beyond the scope of this paper.

Both schemes are compliant with regard to the ban on export limitations for physical electricity flows. The potential export limitation of certificates for countries operating an energy-only-market as stipulated by the BDEW/VKU proposal may create a conflict with the Security of Supply Directive.[44]

The capacity scheme must not create or worsen any market power issues and must be open and non-discriminatory to any potential contributor of firm capacity (technological neutrality is dealt with explicitly in the next paragraph).

The French and German schemes are principally open to participation from all potential capacity providers with regard to the criteria set forth above. This means that bar-

44 The Security of Supply Directive (Art. 4 2005/89/EC) draws on the emergency procedures as stipulated in Art. 24 2003/54/EC and Art. 6 1228/2003. These emergency procedures address the actual flow of electricity.

Assessing impact on competition and trade — Table 5-4

	France	German proposal (BDEW/VKU)
No interference with EOM and MC Assessment	Delivery of energy via the normal EOM → compliant	Delivery of energy via the normal EOM → compliant
No distorting price caps Assessment	Complete decoupling of capacity and energy market (no strike price) → compliant	Supplier obligations will be triggered in accordance with a pre-defined wholesale price (e.g. >300 €/MWh) → compliant
Export restrictions Assessment	Not addressed in CM; free exports due to uncoupling of energy and capacity transactions → compliant	Foreign participation is ruled out in the event of insufficient capacity margin in exporting country → potentially not compliant
Market power Assessment	No barriers to entry and exit of capacity providers → compliant	No barriers to entry and exit of capacity providers → compliant

riers to market entry (and exit) are limited. One potential concern is vertical integration. In absence of truly insufficient competitive retail markets, vertically integrated capacity providers could withhold capacity from the decentralised capacity certificate market and hence create an artificially high certificate market to the detriment of non-asset backed retailers. In the long run, however, the higher price on the certificate market will attract additional market entry of existing and new potential capacity providers. The incentive given to demand-side response in the mechanisms – especially in its explicit form as foreseen by the French proposal – is likely to have a positive impact on the competition in the retail market.

Even taking into account these aspects, we cannot see any regulatory obstacles arising from market power issues.

5.5 Technology neutrality

The guidelines on state aid identify technology neutrality as one of the requirements for compliancy. All technologies that can contribute to firm capacity (e.g. generation, storage, demand response) must be eligible to participate. The qualification requirements for participation are to be based on the performance of the prospective technology and must not promote certain technologies from the onset. In addition, the capacity mechanism must give particular emphasis to the promotion of demand response. The technical characteristics and operational limitations of demand response are addressed in the qualification and participation requirements. The process for selecting capacity providers ought not to jeopardize the EU decarbonisation policy.

The French and BDEW/VKU capacity schemes are principally open to all technologies. Neither scheme discriminates between new and existing capacity. One notable difference between the two schemes is the way demand-side response is promoted: it is explicit in the French mechanism and implicit in the German scheme. If the explicit promotion of DSR is expected to be more complicated to implement and certify (to avoid the so-called baseline problem[45]), it will probably trigger more DSR than the implicit option. In this respect, the BDEW/VKU proposal is

45 That is to say, the evaluation of consumption without DSR.

Assessment of technology neutrality — Table 5-5

	France	German proposal (BDEW/VKU)
All technologies Assessment	Principally open to all technologies → compliant	Principally open to all technologies → compliant
New vs. old capacity Assessment	No difference between old and new capacity → compliant	No difference between old and new capacity → compliant
Decarboni-sation Assessment	New high carbon generation capacity can participate → compliant	New high carbon generation capacity can participate → compliant
Explicit DR Assessment	Explicit participation of DR → compliant	Implicit participation of DR → not necessarily compliant*

*The guidance document is not clear about implicit or explicit DR participation, but the reference to the Energy Efficiency Directive suggests that the explicit participation of DR is indicated here ("aggregator role").

not in line with aspired promotion of demand response via explicit participation.

Neither scheme discriminates potential capacity providers based on their carbon intensity. In this respect, the schemes may allow market entry of high carbon intensive capacity providers, possibly to the detriment of the stated EU decarbonisation policy. However, there seems to be an inherent contradiction in the European guidelines between the technology neutrality principle (no differentiation between fuels, between old and new capacities) and the decarbonisation policy. The schemes cannot achieve both goals to the same extent at the same time.

The capacity schemes are compliant except for the decarbonisation policy. If they would comply with the decarbonisation policy, they might, however, be in breach of other regulatory requirements (technology neutrality). The BDEW/VKU proposal may not be enough to comply with the regulatory requirements for demand-side response participation.[46]

5.6 Transient measures

Capacity mechanisms are designed to be temporary, that is to say, they are meant to be discontinued once the reasons for their introduction no longer apply. If market failures – due, say, to *missing-money-problems* or the public good character of reliability – are resolved, the schemes must be abandoned. Accordingly, the price of capacity can serve to indicate the extent to which a market failure still persists. When the price drops to zero, there is no longer scarcity in firm capacity.

Both of the above projected capacity mechanisms do not have any fixed end date. However, because they employ continuous trading, capacity prices can drop to zero. Accordingly, price serves as a scarcity indicator and permits

46 The EU state guidelines do not refer to the explicit participation of DR, but, based on the regulations stipulated in 3.9.3 (226) and 3.9.6 (232) of the state aid guidelines, we expect the EU Commission to require an explicit participation of DR resources.

Assessing the temporariness of capacity mechanisms — Table 5-6

	France	German proposal (BDEW/VKU)
Scheme length Assessment	No fixed end Volatile price serves as a scarcity benchmark; price may reach zero → compliant	No fixed end Volatile price serves as a scarcity benchmark; price may reach zero → compliant
Project duration Assessment	Annual obligations and certificates Allows for sufficient granularity of prices as scarcity indicators → compliant	Aligned to usual EOM contract durations (assumed annually) Allows for sufficient granularity of prices as scarcity indicators → compliant
Export restrictions Assessment	4 years Allows for construction lead times → compliant	No central determination; left for the market to decide Left for the market to decide → compliant*

*The guidance requires a forward horizon long enough to allow for construction lead times. Products evolve when there is a market need.

capacity schemes to be abandoned when the price is zero or very close to it. This is supported by the certificate and supplier obligations lasting one calendar year. Longer delivery periods could undermine the signalling function of the certificate price.

Both schemes are compliant with EU requirements.

The duration of contracts (certificates and supplier obligations) must relate to the time horizon of the scheme itself. According to the EU guideline, this duration must reflect the time needed for new investments (a lead time sufficient to build new generation or other assets, i.e. at least 2 to 4 years).

In the French scheme, capacity can be certified up to 4 years ahead of actual delivery. The supplier obligations are determined up to three years in advance, with any fine-tuning before delivery. This leaves a potential trading horizon of up to 3-4 years in advance. The BDEW/VKU scheme does not centrally determine the time of certification and supplier obligations. But it advocates an alignment of the trading horizon of the certificate market to the usual forward market horizon of the current energy-only-market (with sufficient liquidity of up to 3 years).

Both schemes are compliant in this respect as well.

6 Cross-border participation

6.1 Regulatory requirements

The EU guidelines require that national capacity mechanisms be open to foreign participation. The EU Commission expects foreign participation in the form of an active, explicit ability of foreign capacity providers to engage in capacity mechanisms. Nevertheless, the EU Commission remained highly vague in its guidance document on the practical implementation of cross-border participation. The French mechanism proposes that cross-border contribution be valued implicitly through reduced obligations for French suppliers (so as to avoid overcapacity in France). RTE attempts to work towards an explicit cross-border approach starting at the regional level to optimize economic efficiency in the mechanisms. RTE plans to launch a ten-month consultation with foreign stakeholders at the beginning of 2015. The BDEW/VKU federation aims at designing a system open explicitly to foreign participation. But at this stage, the proposal offers only very general design principles for allowing foreign participation. Several issues remain unresolved, however; these will be discussed in more detail in the next section.

Initial expectations of the EU Commission for cross-border participation Table 6-1

Issue	EU Position
Participation	Should not undermine the EU electricity target model (in particular, the market coupling of day ahead, intraday and balancing markets) while allowing explicit participation.
Certification	Unresolved, but no double participation or remuneration
Monitoring/ validation	Unresolved

6.2 Practical issues

Who certifies foreign capacity (home or foreign TSO)?
The first question addresses the certification of foreign firm capacity. In principle, the TSO operating in a country with a capacity mechanism could certify the foreign capacity. However, this raises practical questions such as:

- → How should the TSO assess the technical capabilities of the resource provider remotely?
- → Should the TSO make use of foreign technical service providers to assess these or shall it employ its own resources?
- → Has the TSO a legal or statutory mandate to require information from the capacity provider?

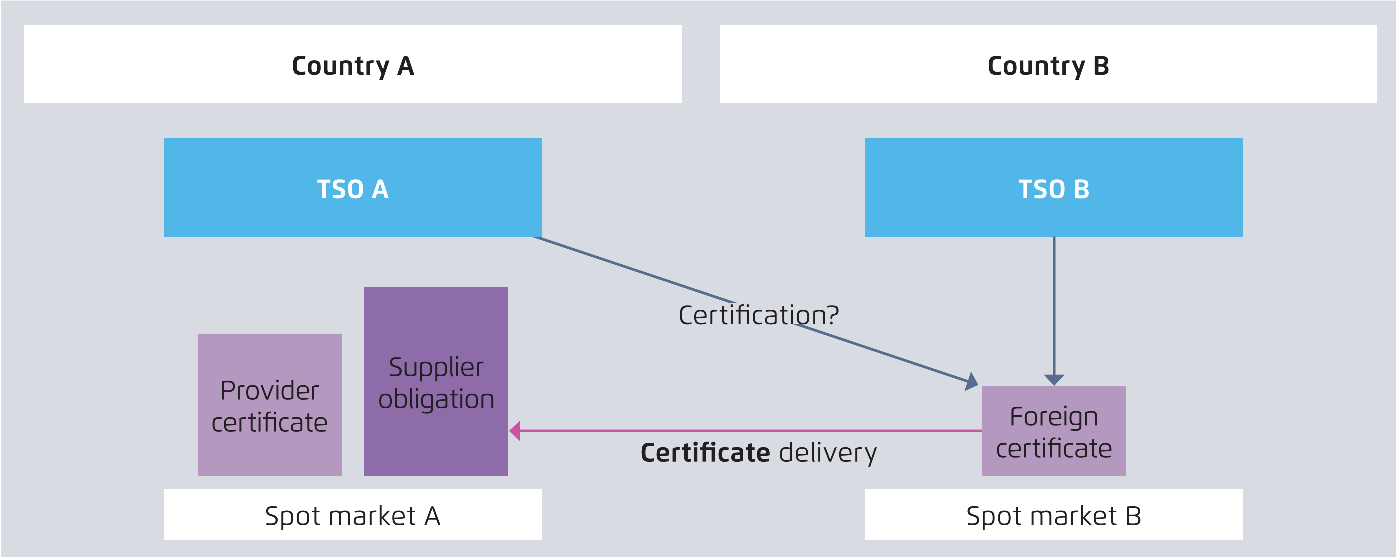
Alternatively, the certification could be performed by the foreign TSO on behalf of the TSO with a capacity mechanism. This option would raise different questions:

- → Is the foreign TSO sufficiently familiar with the qualification requirements of the capacity mechanism?
- → How can double standards on account of different interpretations / assessments be avoided and a level playing field maintained?

There are no concrete examples or proposals on the table to solve these issues. They are illustrated in Figure 7-1.

How and where is capacity delivered in case of a cross-border participation?
The next question addresses the core problem of any cross-border participation of capacity providers. How and where should foreign capacity be delivered? Is physical delivery in the foreign market needed or is virtual delivery sufficient? In the first case, the capacity provider would have to reserve physical cross-border capacity to deliver electricity physically to the certificate holder or to deliver it to

Certification of foreign capacities — Figure 6-1



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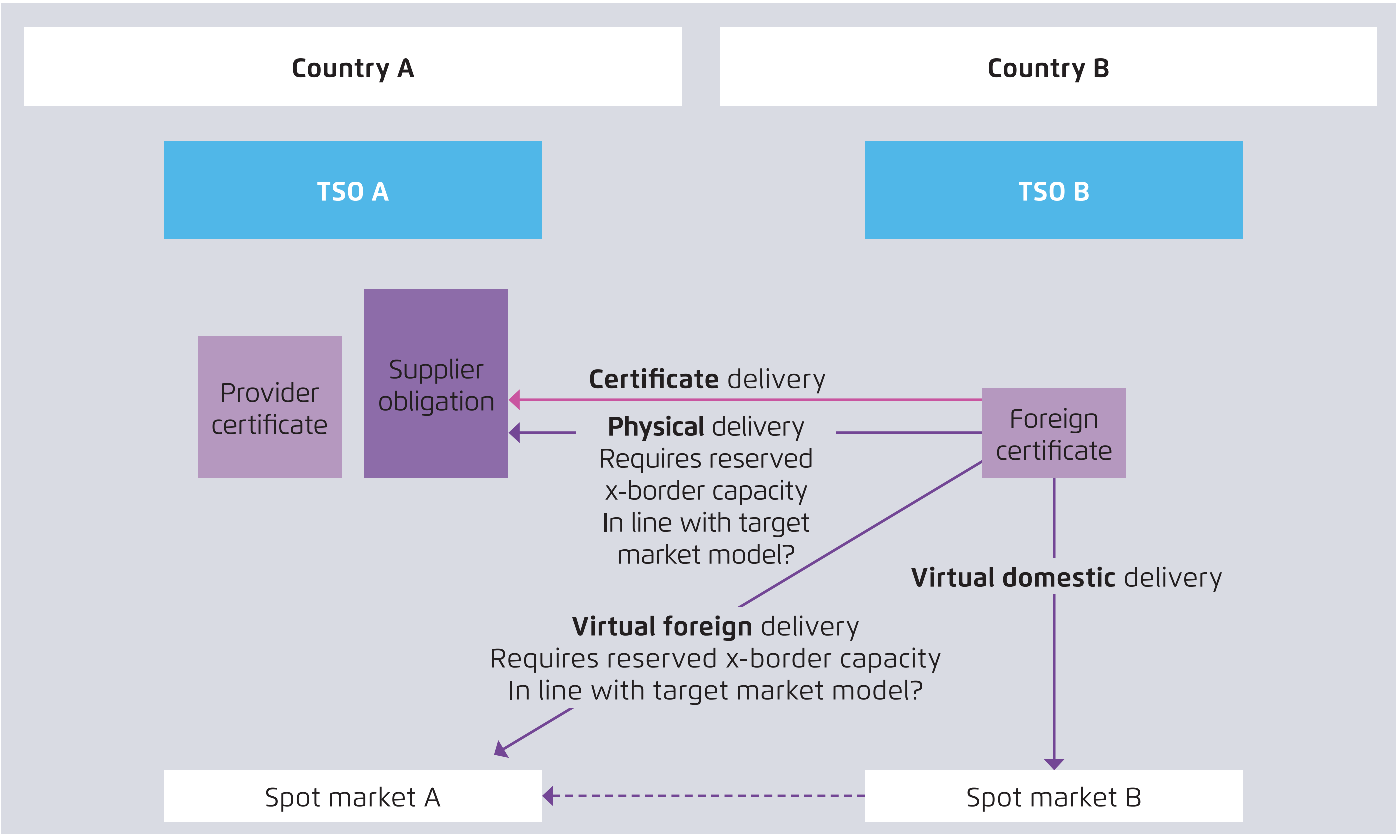
Physical or virtual delivery of capacity — Figure 6-2



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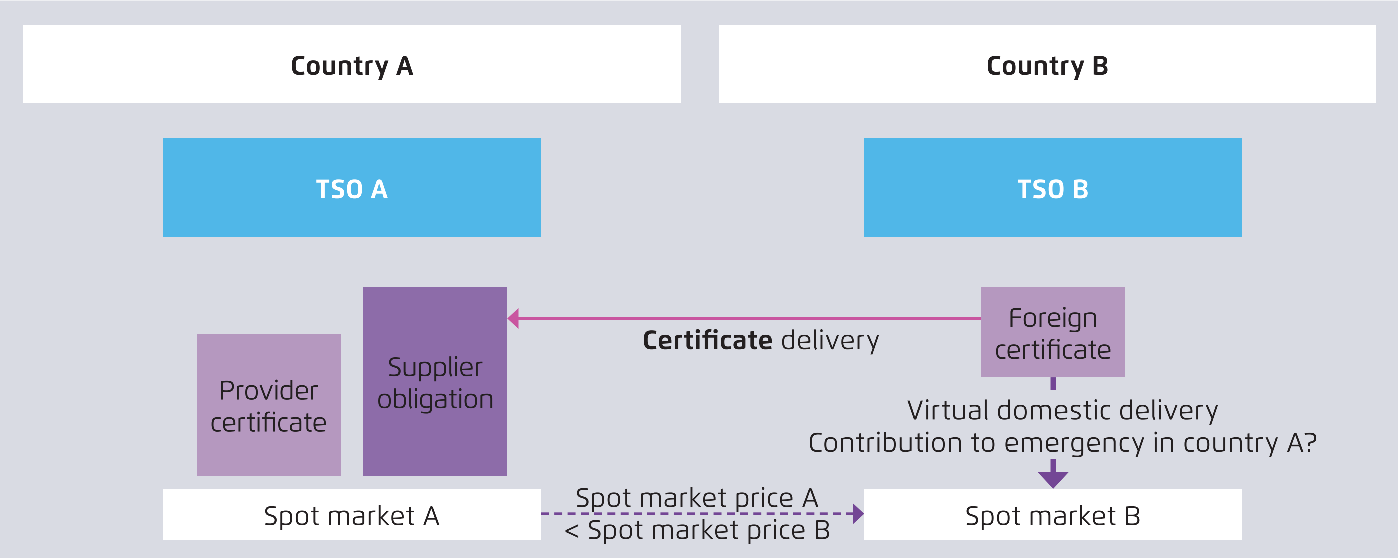
Assertion of capacity contribution in case of virtual delivery

Figure 6-3



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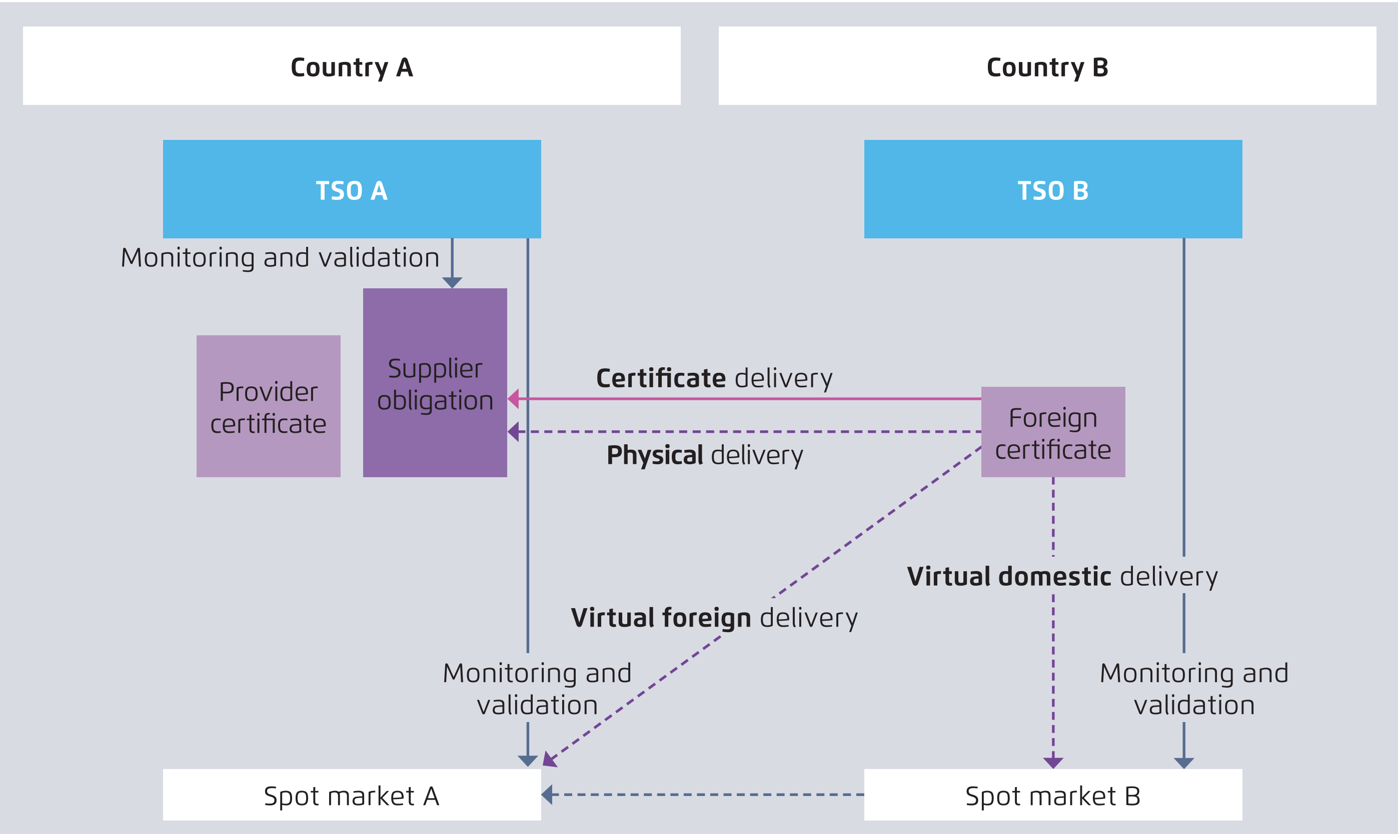
Monitoring and validation of delivery

Figure 6-4



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the foreign spot market. In the second case, it would suffice to deliver electricity to the foreign spot market. This design issue is depicted in Figure 6-2. Initially, the EU Commission suggested[47] a potential use of long-term physical cross-border capacities as a means to assure effective participation. Currently, the general view tends to virtual delivery, as this would not interfere with the functioning of the market coupling arrangements – another important design criterion for any EU compliant capacity mechanism.

How is the contribution to a generation scarcity problem by foreign provider assured in the case of a virtual delivery?
In case of a virtual domestic delivery in Country B the contribution to the emergency situation in Country A cannot be assured as depicted in Figure 6-3. If the spot market price in Country B exceeds the price in Country A, no electricity would flow and no capacity from Country B would contribute to the scarcity problem in Country A. There is not yet a satisfactory and final view on how to organise this form of assured contribution.

Who shall monitor and validate the delivery of capacity – the TSO of the capacity scheme or the TSO of the capacity provider?
Finally, there is the issue of monitoring and validating the delivery of the foreign capacity provider. Obviously this depends to a large extent on the technical solution chosen. In case of an explicit physical delivery or virtual delivery to the foreign spot market via dedicated physical cross-border capacities, the foreign TSO (Country A) would have sufficient information to validate the accuracy of delivery according to the same rules that apply to the delivery of domestic capacity providers. If the delivery is only achieved by a domestic virtual delivery, the foreign TSO would not be in the position of monitoring and validating actual delivery, as only the home TSO would have the necessary information. Some form of cooperation and information exchange between both TSOs would therefore be necessary.

47 See Generation adequacy in the internal electricity market (staff working paper).

6.3 Interim measures

Since several issues related to explicit cross-border participation have yet to be resolved, France has decided to implement an interim solution. Potential foreign capacity providers are not entitled to participate explicitly in the French capacity mechanism and are thus excluded from compensation for their contribution. Instead, supplier obligations in France are lowered based on the anticipated contribution of foreign capacities to scarcity situations. The United Kingdom has applied a similar interim solution, approved by the EU Commission provided that a long-term solution is introduced after a transition period of one year.

France intends to replace its interim solution within 1.5 years. The final design will allow explicit foreign participation. According to RTE, this explicit cross-border design must be achieved (1) without harmonizing security of supply criteria between Member States (competences of MS under the Lisbon Treaty), (2) without explicitly reserving interconnection capacities and (3) by taking into account the physical limitation of the import capacities. The implementation would be possible only if a cross-border certification or control is in place and if a cooperation framework exists for managing shortages. RTE proposes the use of implicit cross-border capacities before explicit cross-border participation is implemented.

6.4 Assessment and conclusion

Table 6-2 summarizes the assessment of both schemes in respect to cross-border participation. The assessment criteria for the French case have not been addressed, as the mechanism does not address explicit cross-border participation. The difficulty in organising cross-border participation clearly demonstrates the value of a Europe-wide synchronized approach instead of a fragmented array of potentially incompatible capacity mechanisms. Explicit cross-border participation requires a clear assignment of roles and responsibilities. Furthermore, national provisions must be aligned as much as possible to avoid fragmentation and the excessive administrative and transaction costs that accompany them.

Assessment of French and German schemes by foreign participation — Table 6-2

	France	German proposal (BDEW/VKU)
Delivery Assessment	No initial direct participation; implicit recognition of interconnector contribution. Explicit participation planned, but not yet implemented. → interim solution compliant; enduring solution unclear	Explicit participation of foreign generators under two conditions: (1) ∑foreign capacity ≤ ∑interconnector capacity; (2) no scarcity situation in exporting country → compliant, but condition 2 in conflict with "no distortion of competition/trade"
Certification Assessment	No direct foreign participation n.a.	Capacity mechanism governing body in export country (presumably TSO) to certify capacity in exporting country → compliant
Monitoring/ validation Assessment	7.4.1.5 No direct foreign participation n.a.	7.4.1.6 CM governing body (export country, presumably TSO) to monitor foreign delivery → compliant

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Vorschlag für eine Weiterentwicklung des Referenzertragsmodells und eine Anpassung der Vergütungshöhe

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How do we accomplish the Energiewende? Which legislation, initiatives, and measures do we need to make it a success? Agora Energiewende helps to prepare the ground to ensure that Germany sets the course towards a fully decarbonised power sector. As a think-&-do-tank, we work with key stakeholders to enhance the knowledge basis and facilitate convergence of views.

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