Exhibit 2: AQUIND competition analysis

PRIVATE AND CONFIDENTIAL

Copyright

Contents

AQUIND competition analysis

Background

Cross-border interconnection provides a route for electricity trading between markets, increasing access to connecting markets and increasing the size of the traded energy market. Opening up markets allows participation from a larger number of market participants (buyers and sellers). This enables new entrants to drive efficiency and benefits through competitive pressure on incumbent generators.

The impact of the AQUIND interconnector on competition depends on:

1. The existing market arrangements in GB and France.
2. The measures AQUIND puts in place to allocate capacity between the two markets.

Transferring power between markets, flows on AQUIND interconnector will act as either wholesale market demand (consumption) or supply (generation) in each market.

This document

We have applied two methods of competition analysis to assess the impact of AQUIND on competition:

1. Residual Supplier Index analysis (RSI)

The RSI analysis considers whether AQUIND will increase the ability of the largest energy supplier in GB and France to significantly influence market prices. This is an assessment of pivotality. The analysis focusses on the position of EDF Energy in GB and Électricité de France in France (referred to together as EDF in this document), as the largest supplier in both markets.

The analysis shows that the introduction of AQUIND interconnector, along with the proposed capacity holding limits included as part of the exemption application, will not increase the opportunities for EDF to influence market prices in GB or France. The introduction of AQUIND marginally reduces the number of hours in the modelled years when EDF is the pivotal supplier.

2. Herfindahl-Hirschman Index (HHI)

This simple HHI assessment, based on 2015 data, considers the impact of AQUIND on generation market share in GB and France. The analysis shows that AQUIND will have an insignificant impact on market concentration in GB and France.

The remainder of this Exhibit provides an overview of the relevant markets, followed by an analysis of the impact of AQUIND Interconnector on competition (RSI and HHI).

Market overview

The analysis below, and throughout this Exhibit, is dated, but EDF is still the pivotal supplier as of 2019, and therefore the previous findings for the RSI still hold. Similarly for the HHI analysis, the changes in the market concentration have not changed significantly in the recent years to warrant further analysis.

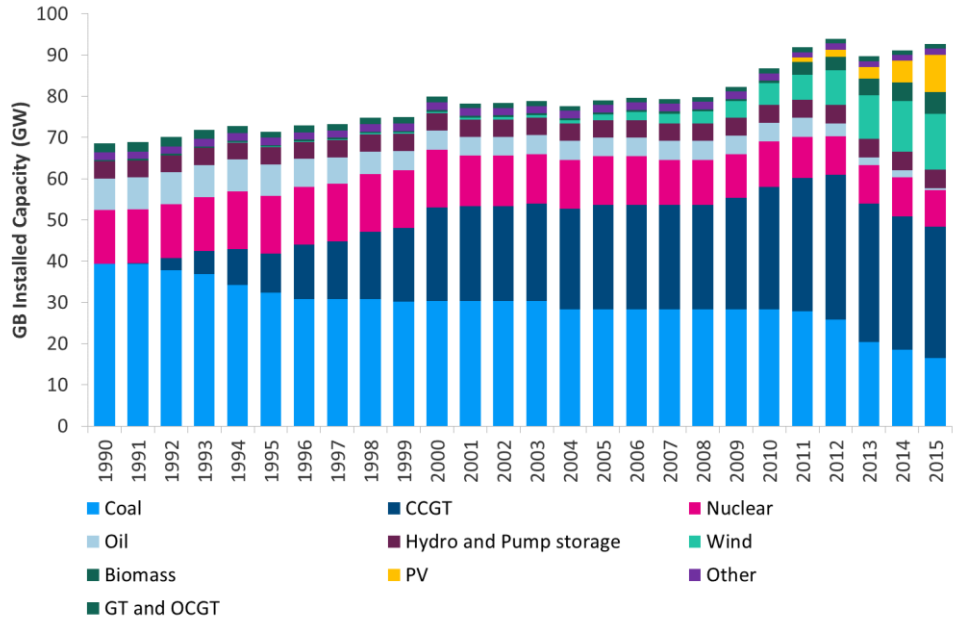
GB market overview

The GB power market is characterised by competition between the "Big 6" vertically integrated generation and supply companies. Recent developments have seen market entry from smaller market participants in generation and supply, looking to take a share of more active consumer market and the move towards renewables and small embedded generation.

Wholesale power trading in GB takes placed between generators and suppliers on a non-mandatory and bilateral basis. End-use customers in GB have full choice over their energy supplier.

Since privatisation in 1990, energy supply has transformed in GB from coal and nuclear dominance to a more diversified generation mix today (see Figure 1). Since 2011, total thermal capacity in GB has fallen, replaced by renewables in the form of solar-PV, wind and biomass-fired generation.

Figure 1 Evolution of capacity in the GB market since privatisation[1]

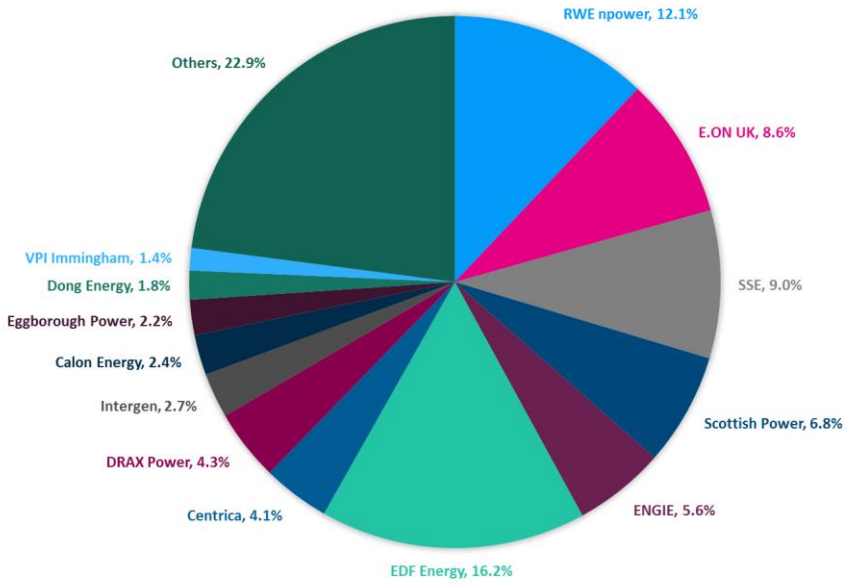


Compared to other European Member States, generation ownership in GB is highly diversified. As shown in Figure 2, at the time of writing, EDF had the largest market share but represents just 16% of the total market. Measured on installed capacity, the next 2 largest market shares are held by RWE npower and SSE. The 6 largest generation companies own approximately 58% of the total market with the remainder made up of a number of other smaller generators, most notably Drax Power with 4.3% of the market.

[1] Source: DECC Digest of UK Energy Statistics 2015

The British market is unusual in terms of the large degree of foreign ownership in the market. Apart from Centrica (the downstream arm of the original British Gas) and SSE, the dominant shareholders of the main companies are located abroad. E.ON and RWE npower are subsidiaries of German companies, and EDF Energy is a subsidiary of Electricité de France (EDF). ENGIE UK's portfolio and trading operations are owned by the French multinational ENGIE (known as GDF Suez prior to April 2015) and the Japanese Mitsui Group. Scottish Power was acquired by the Spanish utility Iberdrola in 2007.

Figure 2 GB capacity market share[2]



French market overview

The French market is characterised by the large state owned utility company EDF. Although market liberalisation has seen EDF's market share reduce in recent years, the French market remains one of the most concentrated markets in Europe.

At the time of writing, the French capacity mix is dominated by a large proportion of nuclear power stations providing over 75% of total generation (over half of French installed capacity in 2015). Renewables in France continue to grow at steady levels in recent years but still remains a small proportion of the overall capacity mix. The remaining capacity mix includes nearly 20% of capacity from hydro power with fossil fuels making up around 15% of installed capacity in 2015.

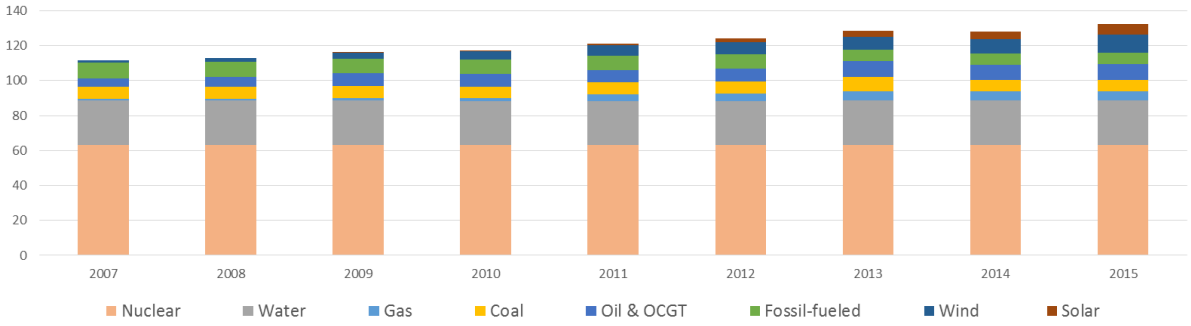
Generation in France is highly concentrated with 98% of power generation from three companies, and at the time of writing:

- **EDF** had the largest generation fleet, with 63 GW of nuclear power plant. It is the only nuclear power plant operator in France. EDF's generation assets also include 20 GW of hydro and 15 GW of other thermal plants.
- **Engie/GDF Suez** is the second largest generator in terms of capacity: it owns roughly 10 GW of electricity generation capacity, 50% of which is comprised of wind and hydro.

[2] Source: DECC Digest of UK Energy Statistics 2015

- **E.ON/Uniper** owns 1.2 GW of new coal capacity; 0.8 GW of CCGT plant; and a small quantity of wind and solar capacity.[3] Five of E.On/Uniper's coal units closed in 2015 as a result of the EU LCPD.

Figure 3 French capacity (GW) mix by fuel type 2007-2015[4]



[3] Source RTE and Uniper. E.On/Uniper coal generation at Emile Huchet 6 (595 MW) and Provence 6 (595 MW); Gas generation plants Emile Huchet 7 and 8 (414 MW each). Sourse Uniper: https://www.eon.com/content/dam/eon-com/Investoren/cmd/Uniper_Equity_Story_Appendix.pdf

[4] Source: RTE website http://clients.rte-france.com/lang/an/visiteurs/vie/prod/realisation_production.jsp

Residual Supply Index

AQUIND have carried out competition analysis using the Residual Supply Index (RSI) to establish whether the project could have a detrimental impact on competition in GB or France. Whilst this analysis was carried out on modelling from 2017, the key principles and results remain appropriate for this Request for Exemption given the relatively small changes in market fundamentals over this period.

The analysis considers whether AQUIND will increase the ability of the largest energy suppliers in GB and France to significantly influence market prices. This is an assessment of pivotality. The analysis focusses on the position of EDF Energy in GB and Électricité de France in France as the largest supplier in the both markets.

The analysis shows that the introduction of AQUIND interconnector will not increase the opportunities for EDF to influence market prices in GB or France. The introduction of AQUIND marginally reduces the number of hours in the modelled years, where EDF is the pivotal supplier.

The background to the analysis, along with the assumptions, methodology and results are set out in this section.

Background to the RSI

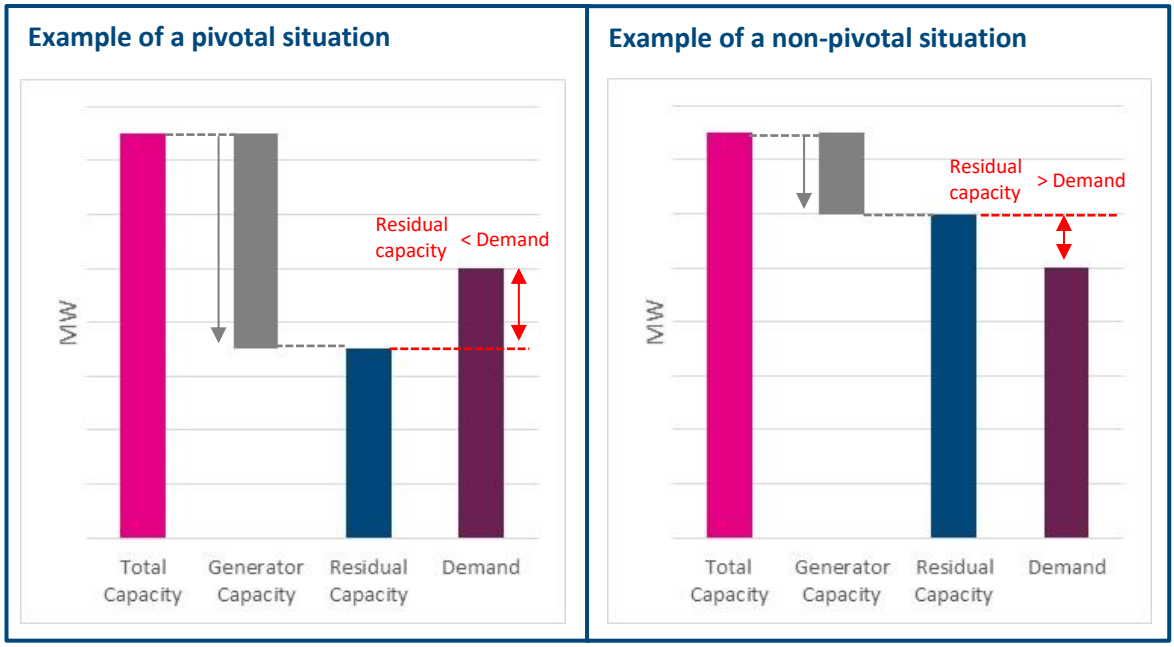
The RSI measures a firms' potential to exercise market power in the spot market by examining if demand could be met across a year without the capacity of the specific generating company.

RSI is calculated by dividing residual capacity by demand, where residual capacity is calculated by subtracting a firm's uncontracted capacity from total capacity. When the RSI is greater than 100%, other suppliers in the market, i.e. other than the firm under investigation, have sufficient capacity to meet demand. If the RSI falls below 100%, then the specific generating company is required to meet demand and therefore this company is considered a pivotal player in the market[5].

Figure 4 illustrates an example of a pivotal and non-pivotal situation. Figure 4 only indicates a snapshot of pivotality for a single hour. The hourly calculations are then assessed over the year to establish the total number of hours for which a company indicates pivotality – this provides the RSI estimate.

[5] Note that using a threshold of 100% only accounts for demand and not reserve capacity requirements.

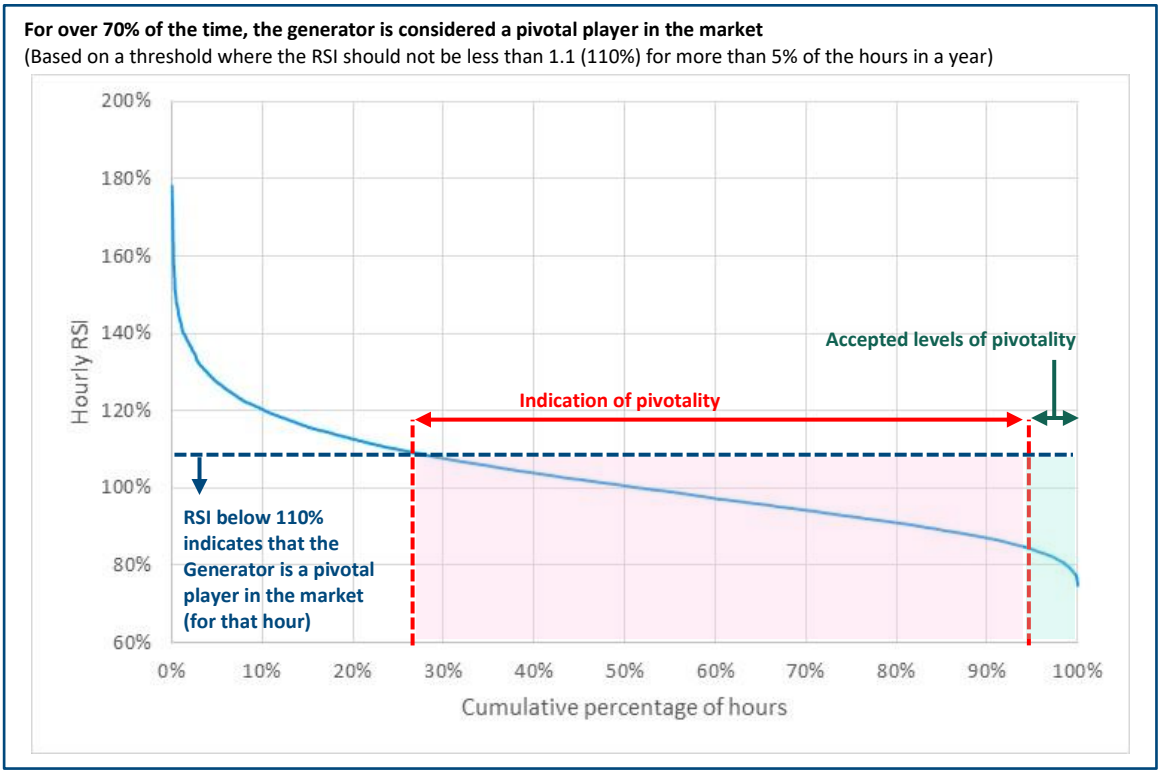
Figure 4 Theoretical example of a pivotal and non-pivotal situation



There is no consensus on the critical RSI value. The California Independent System Operator (CASIO) developed the RSI and suggested that it should not be less than 1.2 (120%) in peak conditions, or less than 1.1 (110%) for off-peak conditions, for more than 5% of the hours in a year[6]. An RSI value lower than this threshold for a sustained number of hours over the year, indicates that a firm can influence the market price. Figure 5 presents an example in which the RSI exceeds this threshold.

[6] These thresholds are also applied by other organisations (for example, London Economics).

Figure 5 Illustrative example of a generator with sufficient capacity to influence market price



Limitations of this analysis

Competition theory notes that there is no perfect analytical measure of concentration. All measures, including the RSI, have some shortcomings:

- They do not take account of a firm's incentive to exercise market power.
- They do not account for unexpected new entrants on the supply side or changes to demand. For example, greater demand side participation and customer responsiveness may increase the elasticity of demand for electricity and thus weaken any market power that can be exerted by large generators.
- In its simple application, the RSI assumes that all of a participant's plant is technically capable of meeting demand. Also it is preferable to use uncontracted capacity rather than total capacity, but it might not be straightforward to determine how much capacity is uncontracted.

Methodology

The definition of the RSI is as follows:

$$RSI = \frac{Total\ Supply - Largest\ Seller's\ Supply}{Total\ Demand}$$

Where:

Total supply = (Maximum generation capacity - Plant outages)[7] + Total net import

[7] This is equivalent to the total generator availability

For the purposes of this analysis, the largest seller's contracted capacity has not been taken into account as this data is not publically available. As the focus of this study is the change in RSI as a result of AQUIND interconnector, we do not consider this to have a significant implication on the study. This approach is conservative as it assumes a greater value for the 'Largest Seller's Supply' than actual uncontracted supply would be in practice (i.e. if this was reduced due to contracted inflexibility).

We have taken into account the non-flexible nature of renewable generation on the system, and in the portfolio of EDF in GB and France. This means that the calculation of Total Supply is comprised of:

- Total available capacity for all non-renewables capacity (taking into account planned and unplanned outages).
- Generation output for renewables (wind and solar).

The same distinction is applied for EDF's share of capacity ('Largest Seller's Supply') in GB and France. This distinction in common in RSI calculations as it accounts for the non-flexible nature of renewables in the calculation of RSI.

Baringa Market Modelling

In order to understand the short- and longer-term impact of the interconnector on market competition, the RSI is calculated for three spot years – 2025, 2030 and 2035 – using Baringa's 2017 analysis for AQUIND.

'Total Supply' and 'Total Demand' are determined on an hourly basis through Baringa's hourly pan-European wholesale power market dispatch modelling. Results from the market model have been extracted under the a2017 Reference Case which represents Baringa's central view on the evolution of the European power markets. Within this scenario, governments continue to pursue a balanced energy policy, attempting to meet the sometimes competing demands of security of supply, competitive market structure, and environmental sustainability. For each of the following scenarios, we have extracted hourly data for the years 2025, 2030 and 2035:

- Reference scenario, without AQUIND Interconnector (counterfactual).
- Reference scenario, with AQUIND Interconnector.

The dominant firm in France and GB is Électricité de France (EDF) and hence its generation represents the 'Largest Seller's Supply' in this RSI analysis[8]. To calculate the future market share of EDF in France and GB, we have considered the market share by technology in today's market. The following methodology was applied to calculate EDF's future market share in the two countries:

1. EDF's overall market share, by fuel type and by country, was established for 2016.
2. Larger generating plants (~100MW and above) under EDF's ownership were matched up with the relevant generators in the Baringa market model.
3. EDF's overall market share, net the larger generating plants identified through the generator matching exercise, was used to establish its market share for smaller plants.
4. Finally for any new generating plant, it was generally assumed that EDF would retain similar market shares as for 2016, by fuel type and country.

[8] Note that EDF Energy (in the UK) and EDF (France) are assumed to be the same company since the former company is affiliated to the latter.

The Baringa market model is used to project the hourly generation availability for each generator by fuel type. For reference, the generation availabilities, by fuel type for the years 2025 are presented in Figure 6 and Figure 7. Both countries are characterized by growing levels of intermittent wind and solar generation in the future. The effect of reducing flexible generation on the network means that a smaller portion of the total supply can be relied upon to meet demand.

Figure 6 Generator availability in France, 2025

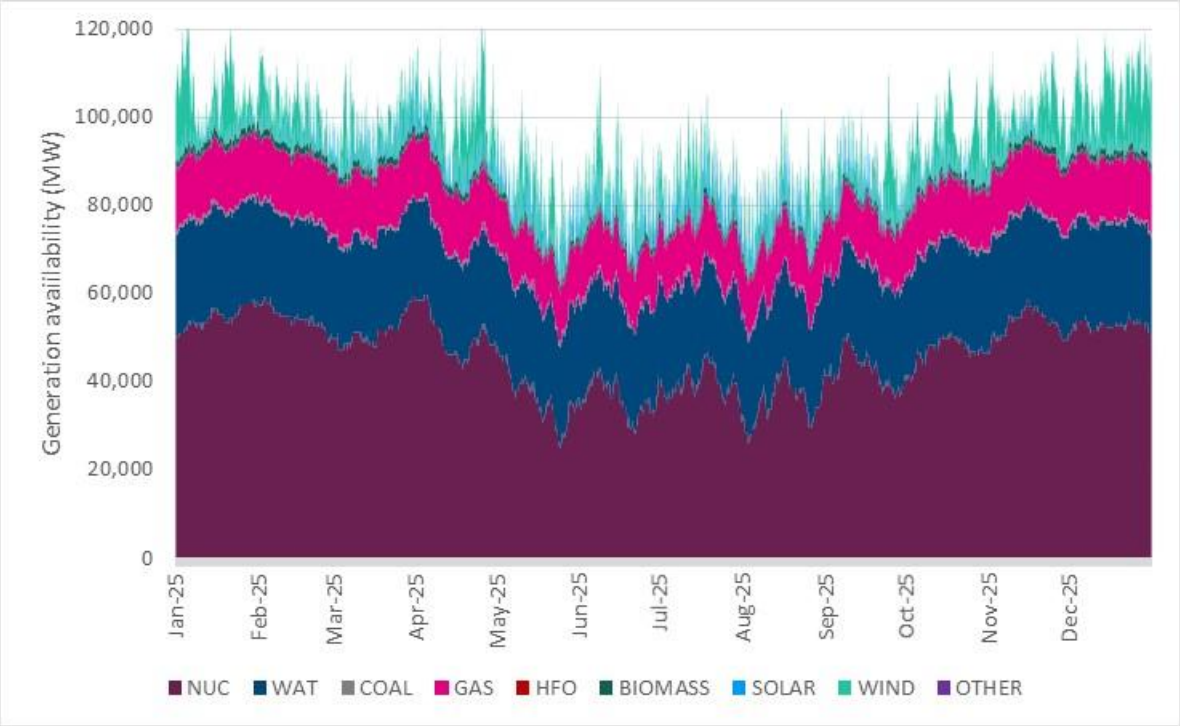
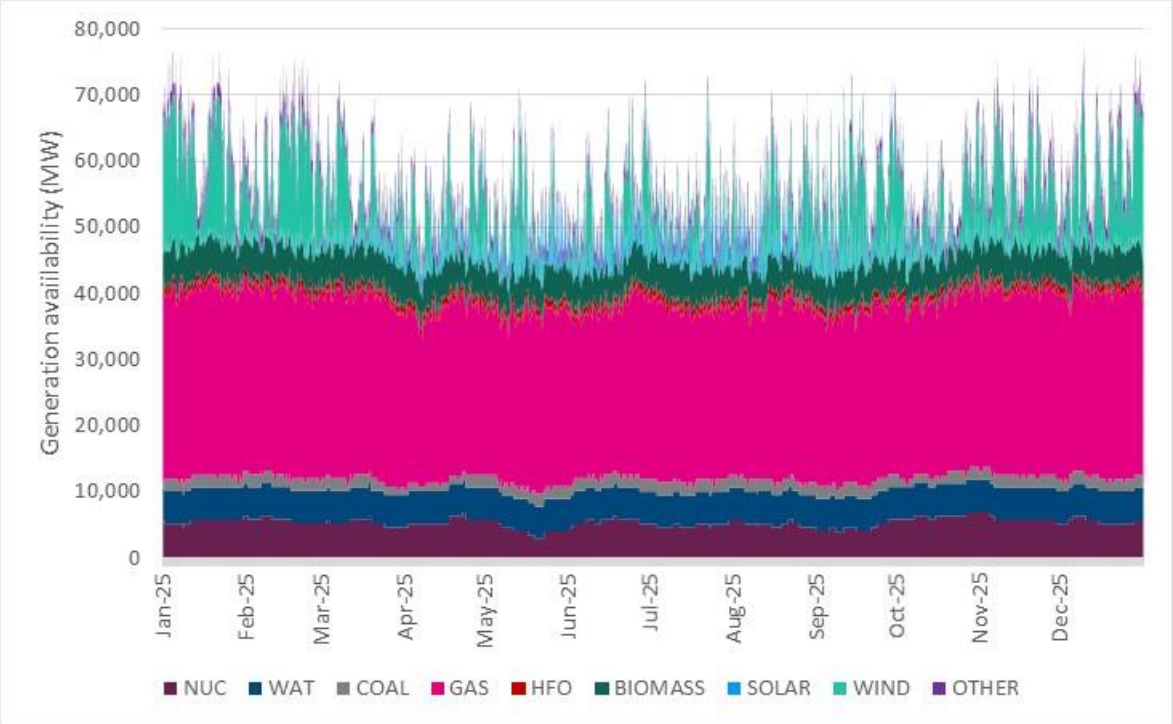
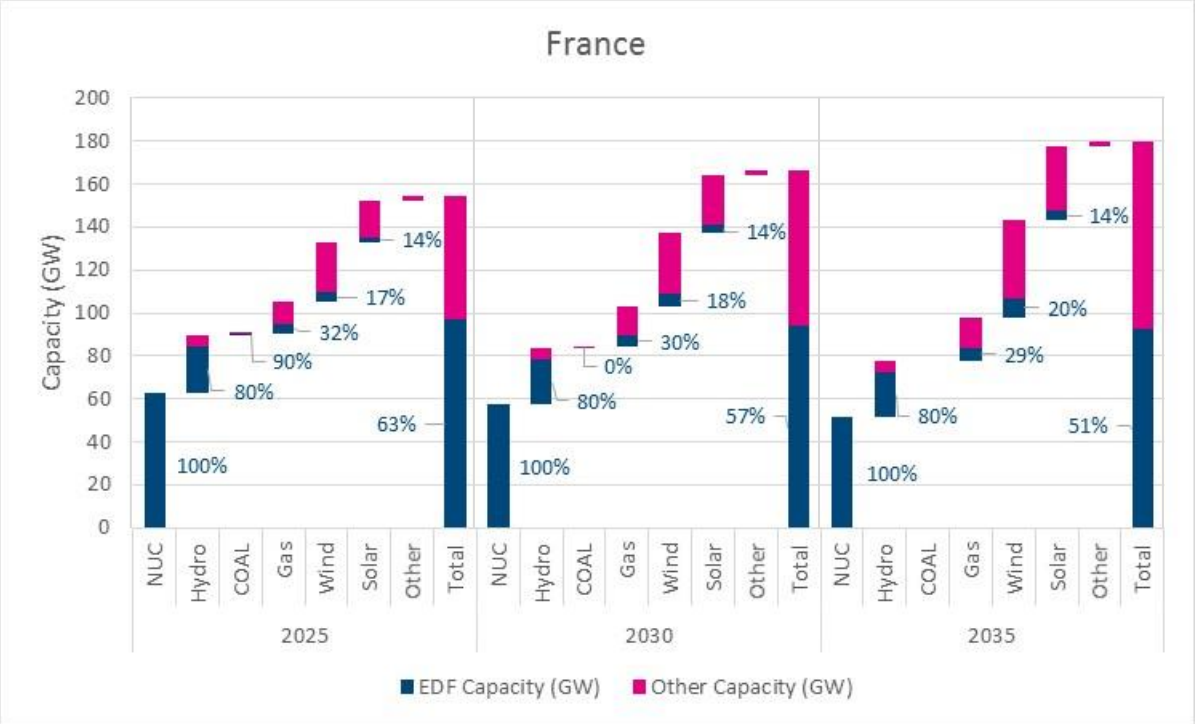


Figure 7 Generator availability in GB, 2025



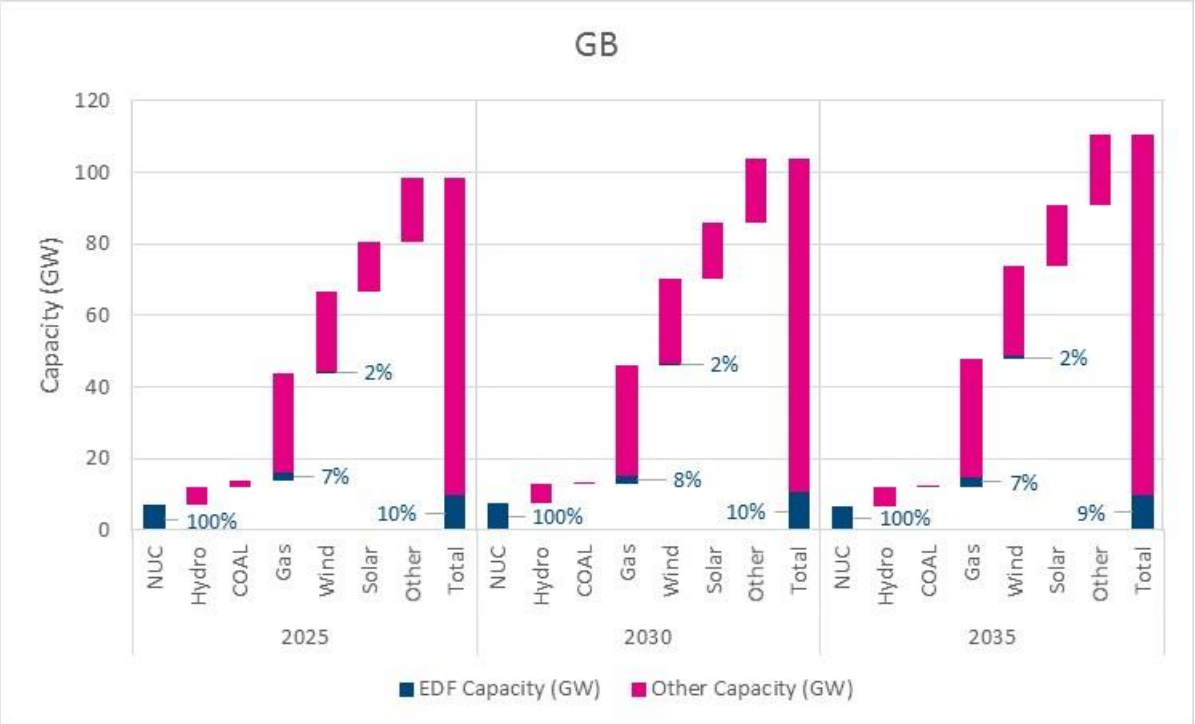
By mapping EDF's generator ownership directly to the model, it is possible to establish the expected hourly generation availability of the EDF generators. Figure 8 and Figure 9 indicate the projected market share for EDF by fuel type for each of the chosen spot years. EDF's total capacity is shown in Figure 10 and Figure 11.

Figure 8 EDF's projected market share by fuel type in France (by capacity)



*Percentages indicate EDF's market share by fuel type

Figure 9 EDF's projected market share by fuel type in GB (by capacity)



*Percentages indicate EDF's market share by fuel type

Figure 10 EDF's projected share of total capacity in France (MW)

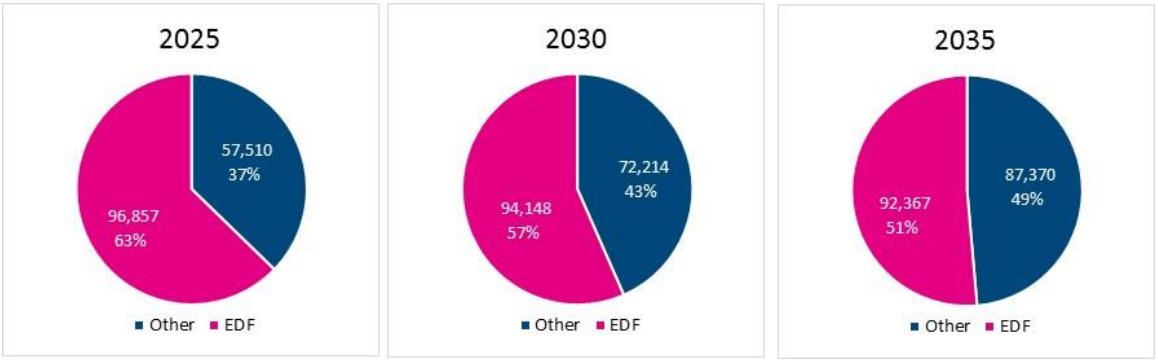
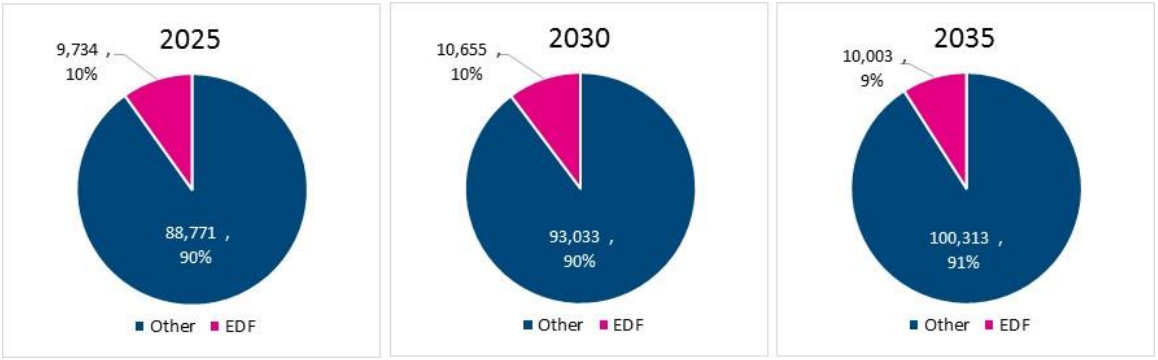


Figure 11 EDF's projected share of total capacity in GB (MW)



At the time of writing, all nuclear power plants in France are owned by EDF, amounting to 63 GW of capacity in 2025. EDF's market share in France is therefore significant, with the company projected to own approximately 63% of France's generating capacity in that year. EDF currently own over half the coal and oil-fired power plants in France, however these are expected to be phased out by 2025. EDF's market share in 2025 is therefore expected to be lower than in 2016. Between 2025 and 2035, EDF's market share is projected to further decrease as nuclear capacity in the country reduces, while solar and wind generation increases.

Compared to other European Member States, generation ownership in GB is highly diversified. The GB power market is characterised by competition between the "Big 6" vertically integrated generation and supply companies (including EDF Energy). Recent developments have seen market entry from smaller market participants in generation and supply, looking to take a share of more active consumer market and the move towards renewables and small embedded generation. EDF's market share of total capacity in GB is therefore lower, projected to be only 10% in 2025. This is expected to remain relatively steady in 2030, with a slight reduction in 2035 due to the decommissioning of older nuclear power plants.

RSI Analysis

Compared to the total market size in GB and France (>150 GW in 2025 in France and >90 GW in GB at the time of writing), the introduction of AQUIND represents a relatively insignificant change. The overall impact on the RSI should therefore be small. When AQUIND Interconnector is importing, total available supply in the importing country will increase, in theory, improving the RSI of that country. In practice, the allocation of the cross-border capacity will determine the impact of the project on the RSI.

For example, in an extreme scenario, if EDF was able to export power from GB to France, via the interconnector, then the 'Largest Seller Supply' would increase in France. The same theory applies if EDF was to export power from France to GB (i.e. the pivotally could reduce in GB as a result).

Capacity ownership assumptions

The capacity ownership assumptions for the AQUIND capacity are therefore critical to the competition impact. AQUIND's Request for Exemption does not include an exemption from Third Party Access and as such, all capacity will be competitively allocated through regulated capacity products. This approach is wholly consistent with the allocation mechanism used on any other regulated interconnector. We conclude that this removes the opportunity for any one party to use AQUIND's capacity in an anti-competitive way.

To test the impact of the way capacity could be allocated on AQUIND, this RSI analysis is therefore conducted under three scenarios, for which varying shares of interconnector capacity are allocated to EDF:

- 0% AQUIND total capacity allocated to EDF
- 20% AQUIND total capacity allocated to EDF (note that this is based on a limit of 20% import capacity for any party with a dominant market share in the importing market)
- 100% AQUIND total capacity allocated to EDF

The main analysis assumes that the interconnector users respond to market price signals (i.e. if prices in France are lower than prices in GB, then GB will import power from France; and vice versa). Whilst in practice, we would expect market participants to respond to price signals, we have also considered a sensitivity whereby we relax this assumption.

The capacity limits imposed in the RSI calculation mean that EDF can own up to 20% of the total available multi-year import capacity to France – i.e. 20% of 1660MW (where 1660MW is 80% of 2075MW). If the interconnector is not fully utilised, we still assume that EDF owns this volume of capacity as this will have already been allocated.[9]

It should also be highlighted that the scenario, in which 100% of the AQUIND Interconnector capacity is allocated to EDF, is simply a theoretical. This case however, provides a representation of a hypothetical worst case scenario.

Results of the RSI analysis

CASIO has suggested thresholds to indicate whether a firm can influence market price. The following threshold has been applied to provide an indication of market concentration:

- The RSI should not be less than 1.1 (110%) for more than 5% of the hours in a year

Table 1 and Table 2 indicate the number of times the RSI falls below this threshold.

[9] For example, if AQUIND is only utilised 50% for a specific hour, flowing 1000MW, we assume that EDF is still allocated 320MW of capacity as this has already been awarded through the multi-year capacity auctions.

Table 1 RSI for EDF – France

EDF allocation of AQUIND capacity	Scenario	Time when RSI is below 110% (indicating pivotality)					
		2025		2030		2035	
		No.	%	No.	%	No.	%
0%	Without AQUIND	8756	99.9%	8720	99.5%	8592	98.1%
	With AQUIND	8756	99.9%	8720	99.5%	8581	98.0%
	% Change	*0.0%*		*0.0%*		*-0.1%*	
20%	Without AQUIND	8756	99.9%	8720	99.5%	8592	98.1%
	With AQUIND	8756	99.9%	8720	99.5%	8581	98.0%
	% Change	*0.0%*		*0.0%*		*-0.1%*	
100%	Without AQUIND	8756	99.9%	8720	99.5%	8592	98.1%
	With AQUIND	8756	99.9%	8720	99.5%	8583	98.0%
	% Change	*0.0%*		*0.0%*		*-0.1%*	

Table 2 RSI for EDF – GB

EDF allocation of AQUIND capacity	Scenario	Time when RSI is below 110% (indicating pivotality)					
		2025		2030		2035	
		No.	%	No.	%	No.	%
0%	Without AQUIND	391	4.5%	448	5.1%	376	4.3%
	With AQUIND	268	3.1%	312	3.6%	288	3.3%
	% Change	*-31.5%*		*-30.4%*		*-23.4%*	
20%	Without AQUIND	391	4.5%	448	5.1%	376	4.3%
	With AQUIND	293	3.3%	335	3.8%	303	3.5%
	% Change	*-25.1%*		*-25.2%*		*-19.4%*	
100%	Without AQUIND	391	4.5%	448	5.1%	376	4.3%
	With AQUIND	395	4.5%	459	5.2%	399	4.6%
	% Change	*1.0%*		*2.5%*		*6.1%*	

Impact in France

In France, the RSI is nearly always below 110%, even without the AQUIND Interconnector, reflecting the significance of EDF's existing generation market share. There is a slight improvement in the future due to the assumption that EDF experiences a small reduction in market share in 2030 and 2035. This improvement is insufficient to bring the RSI to the required thresholds.

The impact of AQUIND Interconnector on market competition in France is minimal for two reasons:

1. Imports into France do not occur frequently as power prices are typically higher in GB[10]
2. EDF's market share is already considerable and hence the effect of a 2GW interconnector is small. Even if the full 2GW of interconnector capacity was allocated to EDF, this would only result in a marginal increase in their overall market share for importing scenarios.

Impact in GB

In GB, EDF has a lower market share than in France, and as a result, the RSI is higher than 110% for the majority of time. This indicates that EDF is not a pivotal player in the market. In 2030, the RSI assessment falls marginally beyond the threshold when considering the cases without the AQUIND Interconnector (i.e. the RSI falls below 110% for more than 5% of the year). EDF's growing market influence in 2030 can be attributed to the introduction of new nuclear generation (i.e. Hinkley Point C) which increases EDF's capacity by just over 3GW. EDF's market share reduces again in 2035 due to the decommissioning of some of its existing nuclear plant.

A higher RSI, coupled with a smaller generating capacity, means that the impact of the AQUIND Interconnector is more evident in GB than in France. The AQUIND Interconnector introduces (up to) 2GW of additional supply to the country and therefore inherently improves the RSI.

- Assuming that EDF is not allocated any of the interconnector capacity, the RSI improves for each of the three spot years.
- If 100% of the interconnector capacity is allocated to EDF, the RSI generally decreases and the number of times that the RSI falls below 110% increases. It is noted that this particular case is not realistic as the rules set out in the exemption application would not allow EDF to utilise 100% of the interconnector capacity.

Figure 12 and Figure 13 present the RSI duration curves under each of the chosen spot years for France and GB, assuming no AQUIND Interconnector capacity is allocated to EDF. These graphs reiterate how the overall impact of the AQUIND Interconnector is small (and is therefore non-distinguishable between the 'with' and 'without' case for AQUIND). Figure 14 and Figure 15 also highlight how allocating different levels of interconnector capacity to EDF has a minimal effect on the general results. This is primarily due to the size of the interconnector (2 GW) with respect to that of the entire French and GB markets.

[10] During the year, results indicate that flows from GB to France (via AQUIND) occur for 5 hours in 2025, 34 hours in 2030 and 135 hours in 2035

Figure 12 RSI duration curve for France (assuming 0% of interconnector capacity allocated to EDF)

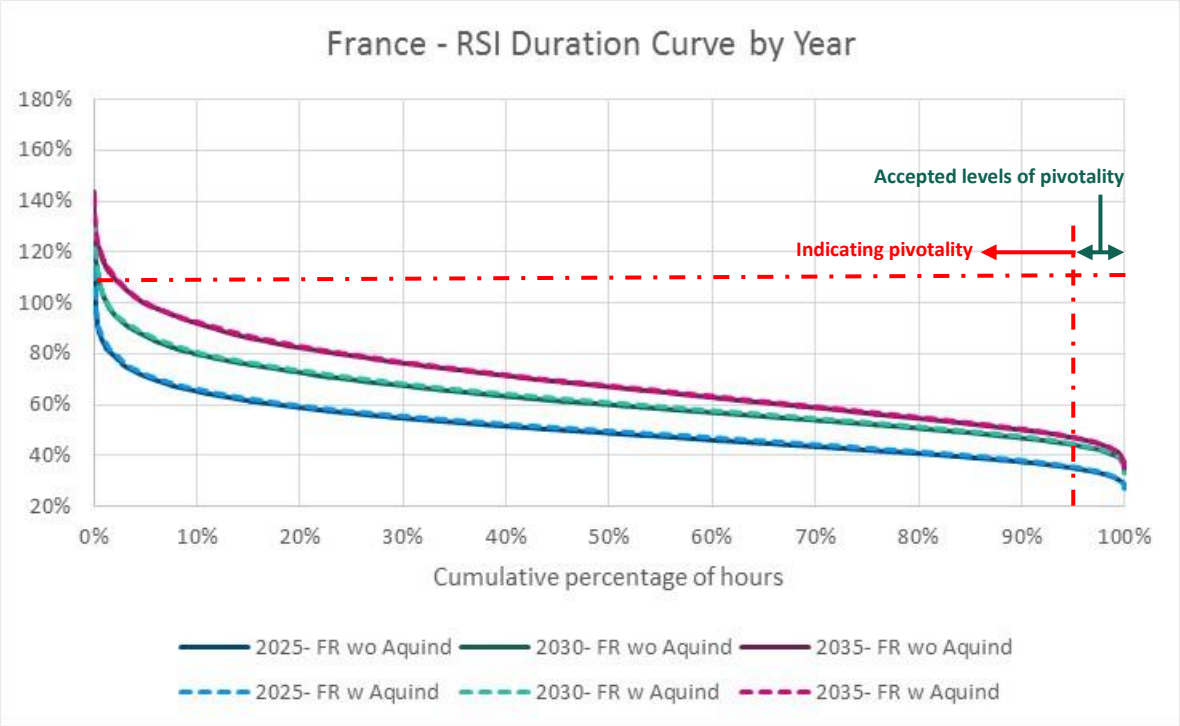


Figure 13 RSI duration curve for France (assuming 0% of interconnector capacity allocated to EDF)

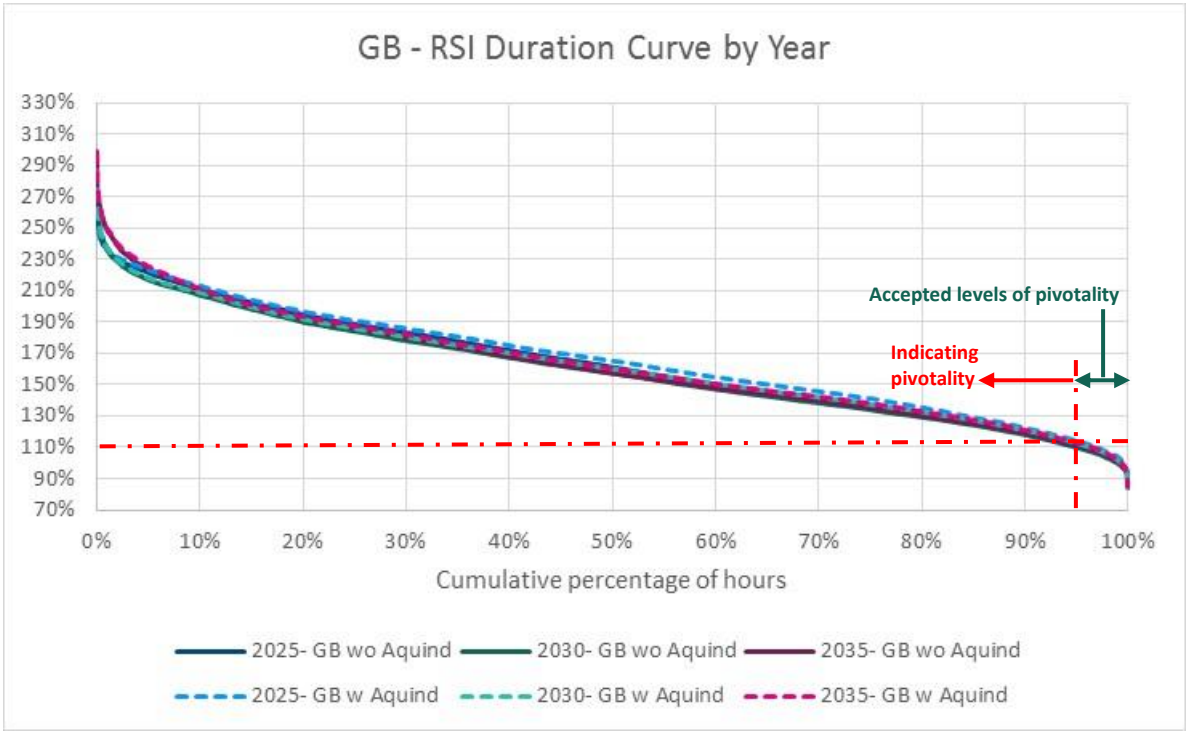


Figure 14 RSI duration curve for France with varying levels interconnector capacity allocated to EDF, 2035

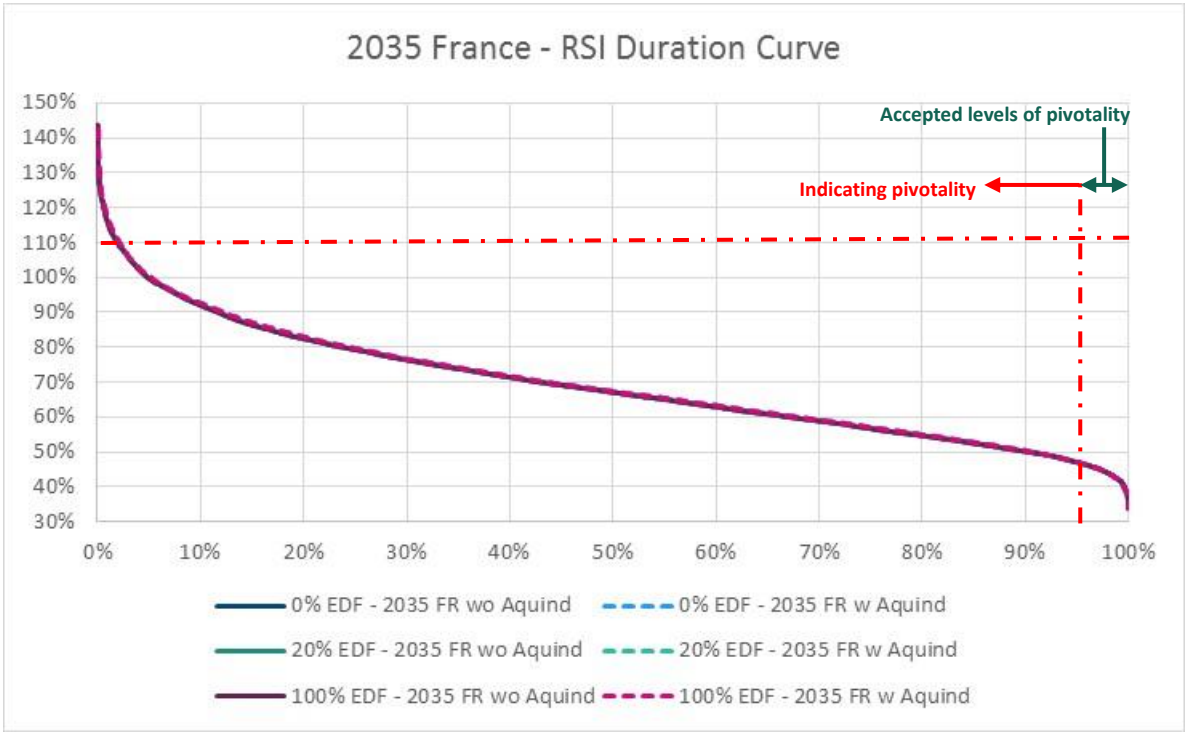
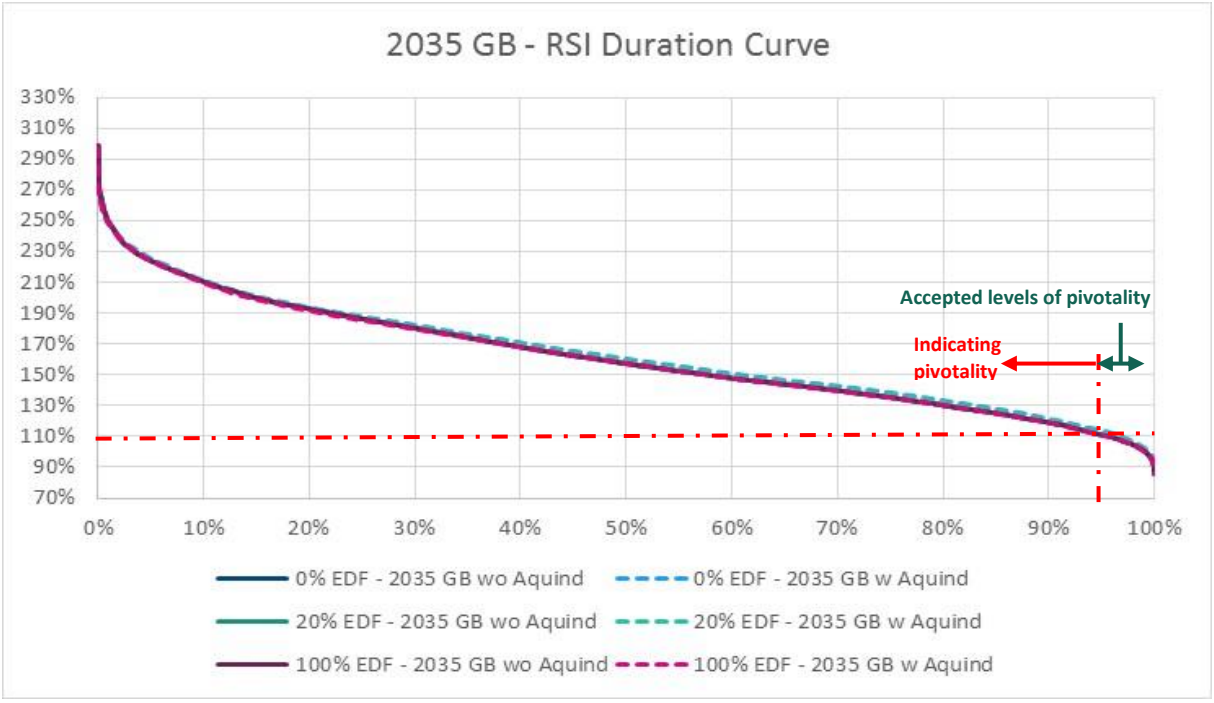


Figure 15 RSI duration curve for GB with varying levels interconnector capacity allocated to EDF, 2035



Sensitivity analysis

In the above analysis, the impact of the AQUIND Interconnector is based on the actual flows derived from the Baringa market model. This assumes that flows over the interconnector adhere to market price signals. If a market participant were to disregard this principles for strategic gain, for example by purchasing explicit capacity in the direction against the economic direction, the full available interconnector capacity, rather than actual flows, should also be taken into account when calculating the RSI.

A sensitivity study was conducted in order to determine the impact of the RSI if price signals and flow direction were disregarded (i.e. 2GW of interconnector capacity is available for import throughout the year in either country regardless of price signals). Note that this is considered a theoretical study and in reality it is highly unlikely that a market participant would choose to export power against market prices. Table 3 and Table 4 present the results of this sensitivity analysis.

Table 3 EDF's market concentration in France (sensitivity)

EDF allocation of AQUIND capacity	Scenario	Time when RSI is below 110%					
		2025		2030		2035	
		No.	%	No.	%	No.	%
0%	**Without AQUIND**	8756	99.9%	8720	99.5%	8592	98.1%
	With AQUIND	8756	99.9%	8720	99.5%	8581	98.0%
	% Change	*0.0%*		*0.0%*		*-0.1%*	
20%	**Without AQUIND**	8756	99.9%	8720	99.5%	8592	98.1%
	With AQUIND	8757	99.9%	8724	99.6%	8595	98.1%
	% Change	*0.0%*		*0.0%*		*0.0%*	
100%	**Without AQUIND**	8756	99.9%	8720	99.5%	8592	98.1%
	With AQUIND	8760	100.0%	8739	99.8%	8659	98.8%
	% Change	*0.0%*		*0.2%*		*0.8%*	

Table 4 EDF's market concentration in GB (sensitivity)

EDF allocation of AQUIND capacity	Scenario	Number of times when RSI is below 110%					
		2025		2030		2035	
		No.	%	No.	%	No.	%
0%	Without AQUIND	391	4.5%	448	5.1%	376	4.3%
	With AQUIND	268	3.1%	312	3.6%	288	3.3%
	% Change	*-31.5%*		*-30.4%*		*-23.4%*	
20%	Without AQUIND	391	4.5%	448	5.1%	376	4.3%
	With AQUIND	299	3.4%	344	3.9%	320	3.7%
	% Change	*-23.5%*		*-23.2%*		*-14.9%*	
100%	Without AQUIND	391	4.5%	448	5.1%	376	4.3%
	With AQUIND	422	4.8%	495	5.7%	459	5.2%
	% Change	*7.9%*		*10.5%*		*22.1%*	

The sensitivity analysis indicates that, even if the full 2GW of interconnector capacity was made available to EDF at all times (with 100% capacity allocated to EDF), the impact on the RSI in the French market is insignificant. In the case where EDF's allocation is restricted to 20%, there is no overall impact on the RSI.

The results for the GB market indicate a higher level of sensitivity to the availability of the interconnector capacity. The change is more significant in 2035, if 100% of capacity was allocated to EDF. In this case, the impact of the interconnector is sufficient for the RSI to fall below 110% for 5.2% of the year. Table 5 indicates that under this scenario, the impact of the AQUIND Interconnector is to reduce the RSI for each of the three spot years.

Table 5 EDF's market concentration in GB (sensitivity)

EDF allocation of AQUIND capacity	Scenario	Number of times when RSI is below 110%					
		2025		2030		2035	
		No.	%	No.	%	No.	%
40%	Without AQUIND	391	4.5%	448	5.1%	376	4.3%
	With AQUIND	323	3.7%	380	4.3%	347	4.0%
	% Change	-17.4%		-15.2%		-7.7%	

HHI – Market concentration analysis

Market shares or concentration ratios are a simple yet useful tool to show the concentration of a market at a given point in time. The AQUIND Herfindahl-Hirschman Index (HHI) analysis has been undertaken as follows:

- First, we examine the current market structure and market concentration in GB and France.
- Second we consider the impact of the AQUIND Interconnector on the GB and French market concentration, as measured by the HHI. This simple analysis use the 2015 IFA interconnector flows as a proxy for the impact of the AQUIND Interconnector on generation in GB and France. This impact is measured by comparing the HHI before and after the interconnector flows are taken into account.

HHI

There are a number of ways to measure market concentration in a market. For this analysis we have used the Herfindahl-Hirschman Index (or HHI).

The HHI measures the concentration of the relevant market at a given point in time by calculating the sum of the squared market shares of all market participants in a market. HHI analysis can be read as follows:

- An HHI value below 1000 suggests an un-concentrated and highly competitive market
- An HHI between 1000 and 1800 indicates a moderately concentrated market
- An HHI above 1800 indicates a highly concentrated market.

The level of 1800 is often considered to be the threshold for an acceptable level of competition. HHI values are calculated with respect to both generation capacity and with respect to energy generation.

HHI analysis, as with any measure of concentration, provide a useful measure for comparison but also present a number of shortcomings:

- They do not take account of a firm's incentive to exercise market power.
- They do not account for potential changes to supply (i.e. possible new entrants) or changes to demand (i.e. demand side responsiveness). A change to customer responsiveness may, for example, reduce market power as customers become more responsive to electricity prices (increasing customer elasticity of demand).
- Where an HHI is applied to capacity (compared to generation) this may not take into account the technical capacity of each market participant's generation.

For the purposes of this analysis, we have estimated the HHI in GB and France on the basis of energy generation rather than installed capacity, which avoids having to make assumptions on what capacity is technically available. The analysis is based on a static assessment for 2015.

We have first considered the current market concentration in GB and France for 2015. We have then introduced a theoretical interconnector, based on the actual flow profile for 2015 of the exiting IFA interconnector, to evaluate the impact of a new interconnector on market concentration in GB and

France. This simple analysis provides a view on the likely impact of the AQUIND Interconnector on competition based on the projected prevailing flow direction on the interconnector.

Market share

Market share is a direct input to the HHI metric. Market share can also be used in isolation to consider the extent to which a market participant may be in a dominant position. The relevant national authorities seldom define a threshold to express dominance as the specific conditions of the market, and the extent to which dominance is present, are not universal. For example, it is also important to assess the market share of one firm compared to others, ease of market entry and market barriers and the overall company size.

In European anti-trust procedures, the European Commission considers that "if a company has a market share of less than 40%, it is unlikely to be dominant". This provides a useful metric to consider the impact of AQUIND on market share in GB and France. In making any assessment of dominance however, we require an assessment of the product market – i.e. the extent to which there are substitutes for the product, in this case GB-FR cross-border capacity – and geographic market – i.e. the market area for which competition impacts should be evaluated.

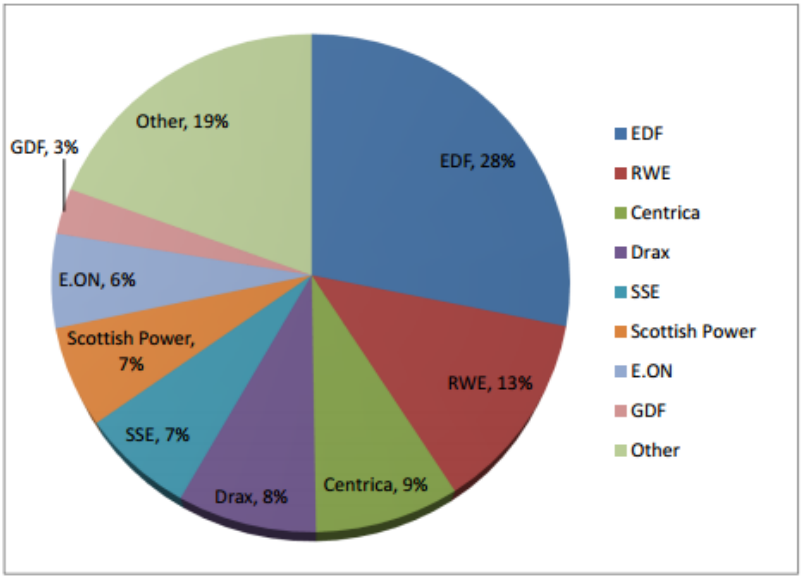
GB market concentration

The GB generation market is characterised by a number of market participants. At the time of writing, EDF had the largest share of the GB generation market and is expected to hold this position going forward. As demonstrated in Figure 16 below, Ofgem's HHI analysis for the GB wholesale market reveals low GB market concentration.[11] The total HHI is calculated by Ofgem as 1,267. This value sits well inside the 1800 threshold and is close to the 1000 threshold which is considered to represent an un-concentrated, competitive market.

The Ofgem analysis shows that EDF holds the largest market share by metred volume (28%) based on the 2015 analysis. The second highest market share by metred volume is RWE (13%) followed by Centrica (9%) and Drax (8%). Whilst we recognise that market share alone is not a perfect measure of market dominance, the market share of EDF is well below the broad 40% threshold as defined by the European Commission (as explained above).

[11] This information was included in Ofgem's 2016 national report to the European Commission which can be found here on the Ofgem website.

Figure 16 2015 wholesale electricity market share in GB based on metered volume[12]



France market concentration

The French electricity market is dominated by EDF and therefore any estimate of the HHI for France results in a value well in excess of 1800 indicating a highly concentrated market.

In France, at the time of writing, EDF held a dominant position in the wholesale electricity market with over 98% of generation capacity owned by three companied: EDF, GDF Suez and E.On/Uniper. Assuming that the remainder of French electricity is generated by small market participant, with a total generation market share of less than 2.5%, an approximation of the HHI for France is shown in Table 6 below.

Table 6 French electricity market HHI 2015

	Market share	HHI
EDF	90%	8100
GDF Suez/Engie	5%	25
E.On/Uniper	2.5%	6
Other	2.5%	0
Total	100%	8131

RTE report French generation for 2015 of 547GWh.[13] In 2015, over 75% of French electricity was generated from nuclear energy, of which all the nuclear capacity is owned by EDF. Table 7 provides a breakdown of French total generation in 2015 by fuel type as reported by RTE.

[12] Ofgem analysis. See footnote 2.
[13] RTE: http://www.rte-france.com/sites/default/files/presentation_des_seef_2015.pdf

Table 7 Estimated electricity generation in France 2015

Electricity generation	GWh	Percentage of total generation
Nuclear	416,797	76%
Coal	8,646	2%
Oil	3,810	1%
Gas	21,924	4%
Hydro	59,079	11%
Renewables	36,510	7%
Total	546,767	100%

Introduction of AQUIND Interconnector

Impact of AQUIND on the GB market

The GB generation market currently benefits from low market concentration as demonstrated by the HHI analysis above. Low market concentration in GB is expected to continue going forward as new markets participants continue to grow their market share, decrease the market share of the Big 6 energy suppliers.

For GB, AQUIND Interconnector will provide an opportunity for additional market participants to compete with the incumbent GB suppliers. Based on current market share analysis, we do not consider any party in the GB generation market to benefit from a dominant market position.[14] We have however considered what impact the addition of the AQUIND Interconnector would have on market concentration as a result of the AQUIND Interconnector.

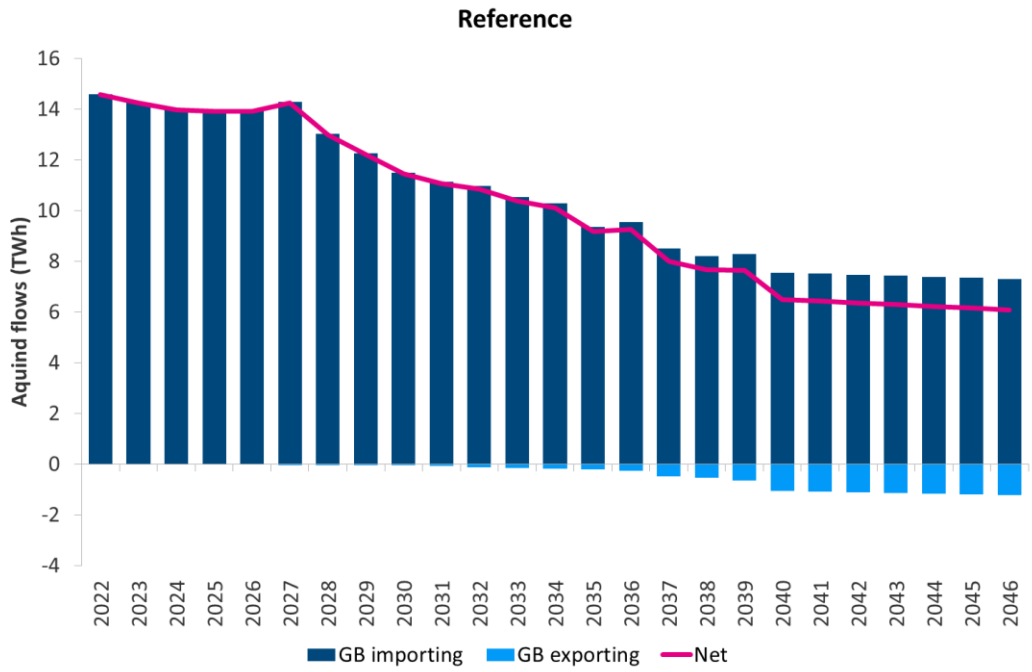
For this analysis we have used the 2015 IFA annual energy flows, as a proxy for AQUIND, along with 2015 data on market concentration in GB, to consider what impact an additional GB-FR interconnector would have on the GB generation market concentration.

In 2015 the net flow on IFA resulted in 14.4TWh of imports into the GB market.[15] This was a result of 14.6TWh of flows in the direction of France to GB and just 0.18TWh of flows in the direction GB to France. This economic flow pattern, with the GB price exceeding the French price resulting in GB imports, is expected to prevail as the GB price continues at a premium to the French price in the AQUIND modelling. Figure 17 below presents the AQUIND modelling results under the Reference case which shows this trend.

[14] Even EDF, with a 28% market share based on 2015 analysis, has a market share well below the broad thresholds identified by the European competition authorities.

[15] ENTSO-E data source: https://www.entsoe.eu/db-query/exchange/detailed-electricity-exchange

Figure 17 AQUIND utilisation, Reference case 2017 analysis for AQUIND[16]



Whilst the analysis of 2015 is a single year analysis, we can see from the analysis above that this is not unrepresentative of the flows projected for AQUIND for a significant proportion of the interconnector operation.

We have assumed that the 14TWh net GB imports displace other generation in GB. As AQUIND is likely to provide baseload power imports to GB, for the purposes of this analysis, we assume that the IFA 2015 flows will predominately displace coal and gas generation in GB. By calculating the market share of market participants responsible for gas and coal generation in GB, along with the ratio of coal and gas as a proportion of total GB generation, we can calculate the change in market share as a result of GB imports from France.

For GB, our analysis concludes that the introduction of an additional interconnector with a flow pattern aligned with IFA would have an insignificant impact on GB generation market concentration. The analysis results in a change in the GB HHI from 1,267 to 1,278. This confirms the position, as qualitatively set out earlier in this section.

Impact of AQUIND on the French market

In France, the direction of flows seen on the IFA interconnector in 2015, and as projected for AQUIND as shown in Figure 17, would result in additional demand in France. We assume that this demand would be met by swing generation in France which we assume to be thermal capacity such as gas or coal.

EDF's thermal capacity in France totals 12.2GW which makes up 70% of the total thermal capacity in France (total thermal capacity as assumed by RTE was 18GW in 2015).[17] For the purposes of this analysis, we assume that the remaining thermal capacity in France is shared between the other main generation companies GDF Suez/Engie and E.On. In practice, other small market participants are

[16] Source: Baringa analysis

[17] http://clients.rte-france.com/lang/an/visiteurs/vie/prod/parc_reference.jsp

responsible for a proportion of French thermal generation. As these market participants in total only hold a small share of the total generation market in France (less than 2.5%), we assume that the change in thermal generation market share would have an insignificant impact on total generation market concentration and therefore discount changes to market share for these parties in our analysis.

The additional generation as a results of IFA exports is therefore assumed to increase the generation output of EDF, GDF Suez/Engie and E.On proportionate to their assumed thermal generation capacity in 2015. We have calculated the resulting HHI for the French generation market to show how this changes with the addition of the 2015 IFA flows. As expected, the impact of IFA flows on total annual French generation has a negligible impact on the French generation market HHI. This simple analysis shows that the HHI reduces slightly from 8131 down to 8040. This is largely a results of the EDF share of the thermal generation market in France being far smaller than its share of total generation market. Assuming the additional generation required to meet French demand through the interconnector is met through thermal generation, this will act to reduce EDF's overall generation market share.

Table 8 French electricity market HHI with additional exports

	Market share	HHI
EDF	89.5%	8005
GDF Suez/Engie	5.3%	28
E.On	2.8%	8
Other	2.4%	0
Total	100.0%	8040

Mitigating measures

Strategic withholding of capacity

In addition to the impact of an interconnector on market share, HHI and RSI, it is important to consider the extent to which a new interconnector could result in market abuse more generally.

Capacity allocation rules for cross-border electricity interconnectors are designed to ensure transparent and non-discriminatory access to capacity. Competitive capacity allocation following these principles should facilitate cross-border trade, and through competition pressure through capacity auctions, reduce the risk of any one party gaining significant share of the interconnector capacity.

For all cross-border infrastructure, the risk of market manipulation, and in particular the opportunity to strategically withhold capacity is a key concern for policy makers.

Strategic withholding of capacity is a form of market abuse that in theory can be exercised with respect to cross-border interconnector capacity. Strategic withholding of capacity could in theory occur where a market participant was in a position to withhold cross-border capacity in a manner that benefitted exiting generation portfolios in the connecting markets – for example by reducing supply to an importing market thereby artificially increasing the market price. Where that same party held a significant market share of the generation market, and the loss of revenue through withholding capacity was not significant, this type of gaming action could result in additional wholesale market profits for the withholding party portfolio.

Strategic withholding of capacity is typically more of a concern for a market with high market concentration. The result of such activity would be a transfer of social welfare from consumers to producers in the importing market due to higher wholesale market prices as results of a reduction in supply of power. Further, this type of market gaming would result in less efficient level of trade between markets, as economically efficient trades would not be exercised.

Strategic withholding of capacity in respect of cross-border electricity is typically alleviated through conditions on the re-sale of capacity when capacity is not used. Use-it-or-lose-it or Use-it-or-sell-it provisions force capacity holders to either nominate and use cross-border capacity rights, or make lose the right to these rights for re-sale to other market participants.

We conclude that as all of AQUIND's capacity will be made available through competitive, regulated products, we do not foresee any opportunity for any market participant to use AQUIND's capacity to make anti-competitive gains in either GB or France.

Index

Big 6	Big 6 GB energy suppliers
CACM	Capacity Allocation and Congestion Management
CMG	Congestion Management Guidelines
EDF	Electricité de France
ENTSO-E	European Network of Transmission System Operators
FCA	Forward Capacity Allocation
FR	France
GB	Great Britain
GWh	Gigawatt hour
HHI	Herfindahl-Hirschman Index
IC	Interconnector
IFA	Interconnexion France-Angleterre
RTE	Réseau de Transport d'Électricité
Solar-PV	Solar Photovoltaics
TSO	Transmission System Operator
TWh	Terawatt hour
UIOLI	Use-it-or-lose-it
UIOSI	Use-it-or-sell-it