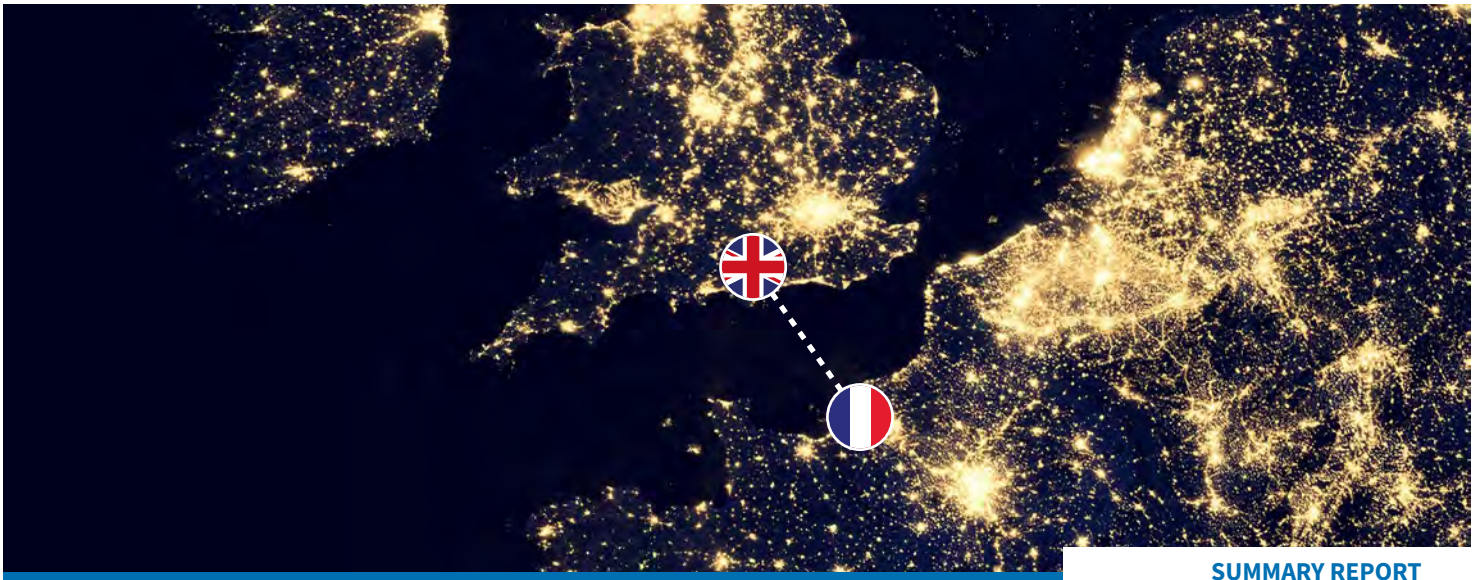


SUMMARY REPORT

AQUIND Interconnector:

Supporting a cost-efficient transition to Net Zero for France

As France is working its way through the Covid-19 pandemic, there seems to be growing consensus among policymakers and industry that a "green recovery" is required in order to achieve France's net-zero emission target by 2050. However, the growing financial strain on the economy and on individual consumers means that a cost-efficient transition to meet this target is ever-more critical.

AQUIND Interconnector, a proposed 2 GW electricity transmission cable connecting Great Britain and France, can play a role in enabling France to reach its net zero target, while stimulating French industry. Commissioning in 2024, our modelling shows that AQUIND Interconnector is expected to deliver over €600m of social welfare benefit, while also improving security of supply at a time when new energy supply risks are emerging.

€5.5bn

of benefit for French producers between 2025 and 2050

€0.6bn

of net social welfare in France between 2025 and 2050

€1.4bn

of private investment by 2024 (including 750 new jobs) across France and Great Britain

France is stepping up its decarbonisation targets…

In June 2019, French lawmakers voted an ambitious target to cut greenhouse gas ("GHG") emissions into law and set France on a path to become carbon-neutral by 2050, in line with the 2015 Paris climate agreement. This represents a significant step-up in French ambitions to address climate change and replaces an earlier 2015 target to reduce GHG emissions 75% by 2050 (relative to 1990 levels).

These ambitions are also expected to drive economic growth. In a joint statement with the German Government, French Government highlighted that the European Green Deal (a roadmap to achieving the 2015 Paris climate agreement) "*represents a starting point to a modern growth strategy*".[1]

Yet the approach adopted for this transition is critical; a net zero carbon economy should be delivered at least cost to consumers, while also maintaining reliable supply of electricity at all times.

…but the Covid-19 pandemic has led to greater financial strain on the economy and the management of the aftermath will be critical to delivering net zero.

1 French and German Governments (2020), Common Statement on the European Green Deal and a European Recovery Plan

As France embarks on this transition to net zero, the economy and industry are facing ever greater financial strain and uncertainty.

A survey by McKinsey shows that in June, as many as 83% of French consumers expressed some concern regarding the future of the economy. Around one third of consumers also reported income loss and reduced spending, unsurprising given the recent increase in unemployment.[2]

As France looks to recover from the effects of the pandemic and its aftermath, parties across the EU have expressed their strong interest in a green recovery. For example, the head of the European Central Bank ("ECB") recently indicated the possibility of using its €2.8tn asset purchase scheme to pursue green objectives.[3] In addition, the updated InvestEU budget has set aside €20bn to be invested in sustainable infrastructure.[4] In August, the French government announced that 30bn€ of the 100bn€ Recovery plan would be allocated to the green transition, while specifying that each pillar of the plan should contribute to the green transition.[5]

However, delivering on commitments to achieve net zero targets may become more challenging going forward due to price volatility and traditional sources of energy becoming cheaper than low carbon technologies in some cases.

As a result of the concerns over increasing pressure on the economy and the increased cost of decarbonisation, it is now ever more vital that the net zero target is delivered in a way that is cost-efficient for industry and consumers alike.

Electricity interconnectors: introduction

Electricity interconnectors, which are transmission wlinks that enable electricity to flow between two regions, have long been recognised for their multiple and significant benefits. In this summary report, we set out how interconnectors – and, more specifically, AQUIND Interconnector – help to increase social welfare in the economy, support the transition to a low carbon system, enhance the security of supply, and deliver wider macroeconomic benefits.

Contribution to social welfare

Interconnectors allow the export of electricity when domestic prices fall below that of connecting countries. Similarly, interconnectors import electricity when domestic prices exceed the prices of connecting countries.

French electricity prices are often cheaper than the prices in connecting countries (with the exception of Germany). Indeed, in 2018, French prices were lower than GB prices by approximately €15/MWh on average.[6] This differential is driven by a fundamentally different generation mix between the two countries, with France relying on a mix of nuclear, hydro and renewables, while GB uses a mix of gas, coal, nuclear and renewables. This structural difference in the generation mix is expected to persist in the long term and drives what is known as the "**intrinsic value**" of interconnectors.

Hence, greater interconnection means the French power market is able to access additional demand in connecting countries, particularly when there is excess electricity being produced in off-peak periods. This results in an overall increase in social welfare for the economy.

Transition to a low-carbon energy system

Interconnectors support the integration of renewables in the European energy system, allowing low carbon electricity to be imported or exported more easily. This benefit arises because the output from variable renewable generation is not entirely correlated between countries. For instance, wind conditions vary significantly across different places. This means that the production of low-cost renewable energy in one country can often be exported to benefit its neighbours.

As France and other European countries progress towards a low-carbon energy system, the volatility of renewable output, and in turn wholesale electricity prices, will increase. This would increase the value that interconnectors provide, as greater interconnection flows would reduce the volatility of energy prices, thereby reducing the risk and cost to generators, suppliers and consumers. This, in turn, creates additional value to the economy, and is known as the "**extrinsic value**".

Enhancing security of supply

One of the key challenges in the transition to a low-carbon energy system is the need to maintain energy security, i.e. having access to sufficient sources of electricity to meet customer demand in all time periods. With a growing penetration of variable generation in France (such as

2 EC (2020), Business and consumer survey results for June 2020 (link); and McKinsey (2020), Survey: French consumer sentiment during the coronavirus crisis
3 Financial Times (2020), Lagarde puts green policy top of agenda in ECB bond buying.
4 EC (2020), InvestEU Factsheet.
5 French Government (2020), Presentation of the recovery plan.
6 ACER Market Monitoring Report 2018 – Electricity Wholesale Markets Volume.

wind and solar capacity), as the system transitions to net zero, the energy system needs to be able to manage increasingly volatile supply and demand balance. The French Multiannual Energy Plan (PPE) forecasts an increase in renewable generation capacity by over 70% by 2023, compared to 2014 levels.[7]

Interconnectors help alleviate this challenge by diversifying the electricity sources the French energy system is reliant on. This means interconnectors provide France greater access to other energy resources, particularly during times when the French energy system is facing "system stress".

Additionally, interconnectors can also contribute to security of supply by providing balancing services to system operators to support the stability of the energy system. These services are known as ancillary services and will be more critical as variable renewable generation increases.

Wider macroeconomic benefits

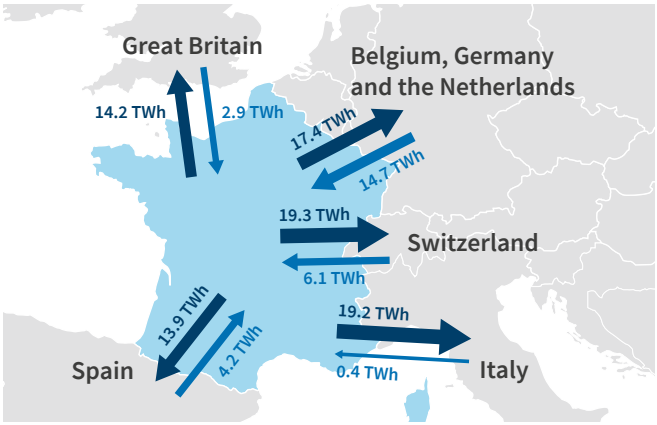
Interconnector investments are large-scale infrastructure projects that can help stimulate the economy and create new jobs during the planning, development, construction and operation stages. In turn, these investments may then propagate further through the economy, as the initial spending triggers additional economic activity in adjacent supply chains (known as "multiplier effects").

In particular, academic studies have estimated these multiplier effects to be "*considerably larger in recessions*",[8] suggesting that in times of economic difficulty, each Euro of investment and each Euro of export revenue would stimulate an even greater amount of additional output in other areas of the economy.

The role of AQUIND Interconnector in increasing French interconnection capacity

France has historically been well interconnected with its neighbours. In 1986, it established its first interconnection link with Great Britain ("GB") via an undersea Direct Current ("DC") cable. French cross-border interconnection capacity has been rapidly strengthened such that by late 2015, it represented more than 10% of national capacity. This is well ahead of Europe's target to achieve 10% electricity interconnection by 2020.[9]

FIGURE 1: INTERCONNECTION FLOWS ACROSS FRENCH BORDER IN 2019



Recreated from CRE (2019),Penser L'Énergie de Demain

The French economy has benefited significantly from interconnectors, with French producers being able to achieve strong net export balances of over 55.7 TWh in 2019.[10] More broadly, these high cross-border flows indicate the presence of persistent price differentials between France and neighbouring countries, suggesting that there is scope for further economic efficiency gains.

Two interconnectors between France and GB are already under construction (ElecLink and IFA 2), each of which would provide an additional 1 GW of capacity.

Several other projects are also under planned development. One of these is AQUIND Interconnector, a proposed link with a net capacity of 2 GW to connect the South Coast of England with Normandy, due to become operational in 2024.

In this context, the energy team of FTI Consulting and Compass Lexecon ("FTI-CL Energy") have been commissioned by AQUIND to estimate the value that AQUIND Interconnector is expected to generate from the start of its operation through to 2050.

In the remainder of this summary report, we set out how AQUIND Interconnector is expected to generate benefits to the economy in France during the transition to net zero, enhance the security of supply, and deliver wider macroeconomic benefits amidst the economic difficulties of the Covid-19 pandemic.

We assume that the impact from the UK's withdrawal from the EU does not impact the underlying need for greater interconnection.[11] As such, this impact has not been modelled.

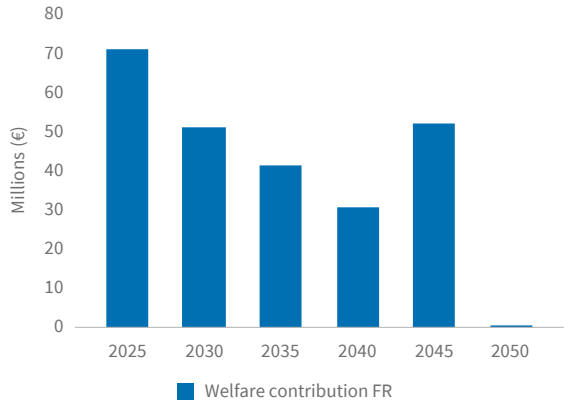
7 French Government (2020), The Multiannual Energy Plan.
8 NBER (2015), How powerful are fiscal multipliers in recessions?
9 CRE (2016), Electricity and gas interconnections in France (link); and EC (2014), Communication from the Commission to the European Parliament and the Council.
10 CRE (2019),Penser L'Énergie de Demain.
11 We consider that in the worst-case scenario, trading frictions might occur. This will impact both prices and volumes but should result in a minimal net impact on economic benefits.

Supporting the French economy by increasing social welfare benefits

We have undertaken new analysis that models the French, GB and the wider European energy markets from 2025 to 2050, by forecasting hourly wholesale electricity prices and volumes with and without AQUIND Interconnector, to quantify the benefits of the project.9

Our analysis shows that AQUIND Interconnector could increase social welfare in France by over €600mn in Net Present Value ("NPV") between 2020 and 2050, assuming it becomes operational in 2024.

FIGURE 2: AQUIND SOCIAL WELFARE CONTRIBUTION TO FRANCE PER YEAR



Source: FTI-CL Energy analysis

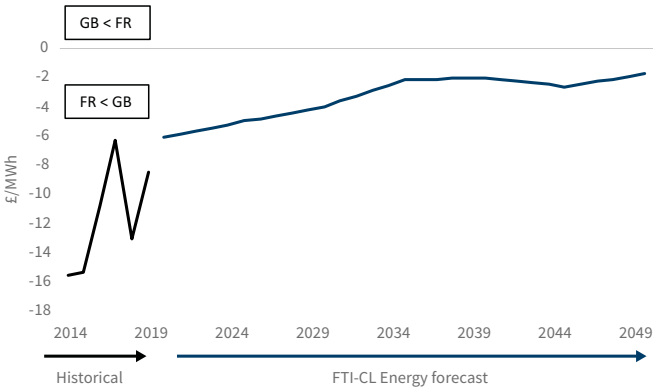
These sources of value are driven by intrinsic value, that is the structural difference in wholesale electricity prices between GB and France (and would likely be significantly greater in practice when taking into account extrinsic value).

Wholesale power prices in France and GB are driven by the following:

- Commodity prices (such as coal, gas and CO2). These affect the short-run marginal costs of power plants and, in turn, their offers in the market.
- Supply and demand of electricity. Higher demand leads to higher cost generation being supplied. Likewise, the deployment of lower cost generation technologies (such as wind power) tends to reduce electricity prices.
- Policy and regulation, which can influence demand and supply. For example, policies that target specific generation types such as offshore wind would impact the generation mix and, in turn, power prices.

Between now and 2050, GB average prices are expected to continue to exceed French average prices. However, over time, the average price differential is expected to decline due to very high levels of renewables penetration both in France and in GB, with the retirement of some of the low-marginal cost nuclear capacity in France, as well as with the increase of interconnection capacity.

FIGURE 3: ELECTRICITY PRICE SPREAD BETWEEN FRANCE AND GREAT BRITAIN



Source: FTI-CL Energy analysis

AQUIND Interconnector would allow French producers greater access to the higher-priced electricity market in GB, bringing French power prices closer to the higher levels in GB. With more electricity being exported at more expensive prices, we estimate that French producers could benefit by as much as €5.5bn in NPV between 2025 and 2050. However, this would conversely mean that consumers in France would face higher electricity costs. The resulting accelerated price convergence between France and GB electricity markets would also erode away some of the congestion revenues that would otherwise have been earned by other French interconnectors.

On balance, from a wider social-economic welfare perspective, the benefit of AQUIND Interconnector is material. The benefits to producers significantly exceed the costs to consumers by around €1.8bn in NPV terms. Accounting for the decrease in revenues earned by other French interconnectors, this reduces the NPV of the net benefit by a further €1.2bn. Considering all French stakeholders together, AQUIND Interconnector delivers a positive net social welfare surplus of €0.6bn in NPV terms.

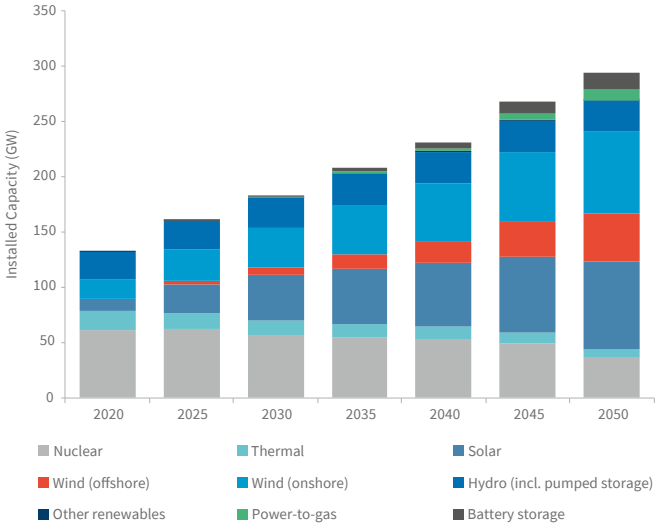
Supporting the transition to net zero by 2050

The significant expected producer value from AQUIND Interconnector is driven by greater interconnector flows, as GB and France become better able to share the output from their growing fleets of renewable resources.

In our analysis, renewables generation is expected to increase to 43% of gross electricity consumption in France, and to 62% in GB, in 2030. This is expected to increase to 77% in France, and 75% in GB, in 2050, as both countries progress towards their respective net zero targets.

In France specifically, nuclear energy will continue to be the main source of low carbon electricity, but its share of total generation is expected to decline. It is anticipated that significant investment in onshore wind and solar capacity will continue from 2030 through to 2050.

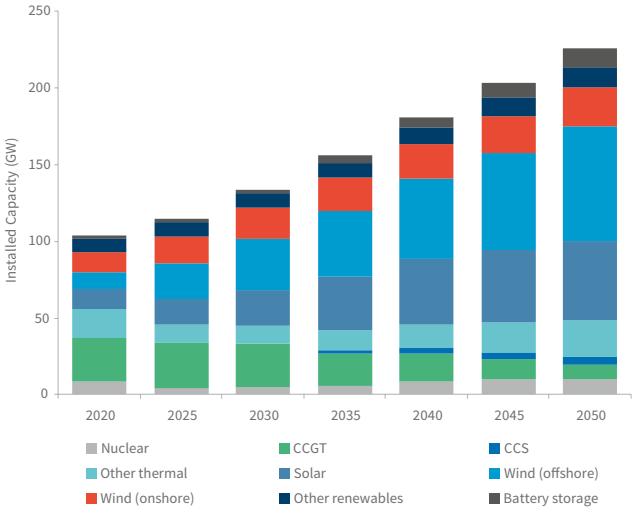
FIGURE 4: INSTALLED ELECTRICITY CAPACITY BY SOURCE (FRANCE)



Source: FTI-CL Energy analysis

In GB, it is expected that renewable capacity will exceed 50% of installed generation capacity by 2030. The existing carbon price floor mechanism is anticipated to persist at current level (€40/t) until the implied carbon price from the EU ETS begins to increase beyond this price. This would then lead to a convergence of carbon prices (especially given that the UK has stated that any future system post-Brexit "will be at least as ambitious as the EU ETS"). [12]

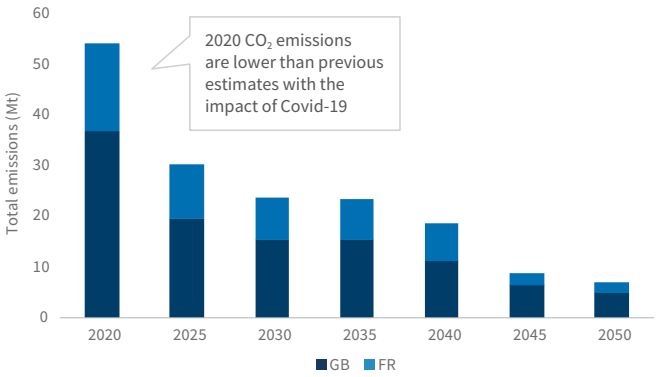
FIGURE 5: INSTALLED ELECTRICITY CAPACITY BY SOURCE (GREAT BRITAIN)[11]



Source: FTI-CL Energy analysis

The scenarios developed for this analysis show that CO2 emissions would gradually decline between 2020 and 2050, in line with the phase out of coal generation and the ambitious increase in renewables generation. By 2050, some residual CO2 emissions are nevertheless expected to remain due to a relatively low carbon price trajectory.

FIGURE 6: TOTAL CO2 EMISSIONS FROM ELECTRICITY NET GENERATION

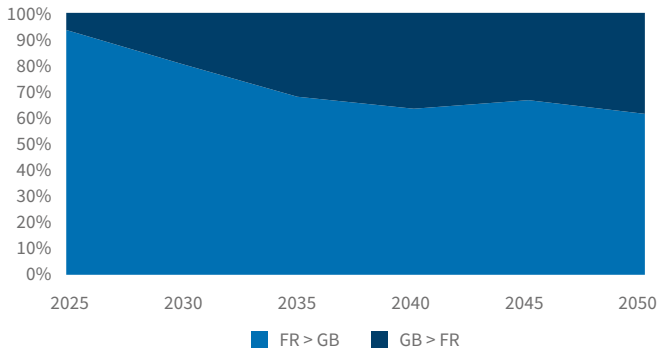


Source: FTI-CL Energy analysis

AQUIND Interconnector would allow the expected increase in renewable capacity in both GB and France to translate into a greater flow of renewable electricity across the two countries. Indeed, as net zero efforts gain momentum, France would benefit from increased import and export capacity to optimize the use of variable renewable energy at times of excess or shortage. The additional flow would consequently erode energy price volatility, reducing the level of risk faced by suppliers, generators and consumers. Our calculations show AQUIND could create up to €610mn in net social benefits for France.

12 GOV.UK (2020), Meeting climate change requirements from 1 January 2021.

FIGURE 7: FLUX À TRAVERS AQUIND (%)



FTI-CL Energy analysis

Contribution to security of supply

Interconnectors such as AQUIND Interconnector contribute to France's energy security by allowing greater energy supplies to be imported into the energy system. This is particularly crucial during periods of so-called "system stress", when France might have insufficient generation available to meet the country's needs. Indeed, RTE has recently warned against a possible security of supply risk in winter of the 2021-2022 period. Increased interconnection may help mitigate risks such as these.[13]

For example, the relatively cold winter in 2016/2017, combined with numerous long-lasting planned outages in nuclear power supply (which led to the lowest nuclear power availability in 10 years), resulted in system tightness with a high winter demand for electricity combined with a suppressed supply. However, with France having established strong interconnection links with its neighbours, the country was able to import the electricity required to meet its domestic demand, avoiding any effect on security of supply and inflation in electricity prices. Indeed, in that winter, France became a net importer of electricity for the first time since February 2012.[14]

Additionally, with both GB and France progressing towards net zero, a higher penetration of renewables is likely to increase the pressure on the electricity grid by, for example, causing larger or more frequent disturbances to frequency, or by reducing inertia.[15] This tends to increase the need for flexibility so that the system operates in a stable and secure manner.

Interconnectors can play a role in "system balancing" to provide this flexibility. They help facilitate better coordination of flows, dissipating the impact of variable generation over a larger area. This in turn, reduces the overall cost consumers have to pay for ancillary services to maintain system stability. The additional benefit to system balancing has not been quantified for this report.

Supporting the economic recovery from Covid-19

The ongoing Covid-19 pandemic has created significant pressures in the economy. As part of ongoing efforts to stimulate the economy, the French Government is committed to pursuing investments, particularly in the infrastructure space. While a significant proportion of planned investments are Government-led or subsidised, there is an even greater need for private sector investment, as this would create jobs and economic value without increasing the strain on public finances.

At the same time, there are growing calls to focus on investments that will drive a "green recovery". At the European-level, the European Commission's ("EC's") Green Deal remains at the top of the agenda. The French and German governments have jointly stated that the EC's Green Deal "*provides an encompassing framework for a recovery plan aiming to stimulate the economy in a sustainable and innovative way*".[16]

They further remark that economic recovery "*must be modelled in a climate- and nature conservation compatible way*".[17]

Therefore, plans from private firms, such as AQUIND, to invest in large infrastructure projects are valuable now more than ever. AQUIND Interconnector would support the recovery in three different ways:

— First, AQUIND Interconnector would serve as a stimulant to the French economy and to French businesses, helping them to rebound from the Covid-19 crisis. The interconnector itself would contribute an initial investment of €1.4bn across the UK and France and create up to 750 jobs between 2021 and its commissioning in 2024. In addition to this, the impact that the interconnector would have on the wholesale power market would generate €5.5bn profits in NPV for French electricity producers. This in turn would help these producers increase their own investments and expand their business, generating further increases in national output and creating more jobs through 'multiplier effects' in the supply chain.

13 RTE (2020), Provisional Report 2020 - Study on the Security of Supply 2020-2030.
14 European Network of Transmission System Operators for gas (2017), Winter Review 2016/2017.
15 This effect will be increased by the reduction of nuclear capacity in the long term.
16 French and German Governments (2020) Common Statement on the European Green Deal and a European Recovery Plan.
17 French and German Governments (2020) Common Statement on the European Green Deal and a European Recovery Plan.

— Second, AQUIND Interconnector would provide this stimulus without any direct spending from the Government. It would also likely increase business profits and provide additional tax revenue at a time when French public debt may extend well above 100% of GDP by year-end.

— Third, AQUIND Interconnector would deliver these benefits while being an integral part of the green recovery agenda on the path towards net zero and helping the country to meet its obligations and responsibilities to its future generations.

Appendix: Summary of modelling methodology and assumptions

AQUIND Interconnector creates welfare benefits as a result of enabling electricity to be transported between GB and France and thus optimise the use of resources over a larger geographical footprint. In particular, the changes in the cross-border flows have an impact on the wholesale power prices in the two connecting countries, which help reduce GB wholesale electricity prices.

This appendix presents the key assumptions behind the modelling results presented in this report.

Modelling tool and overall approach

To estimate the impact of AQUIND Interconnector, we have used our FTI-CL European power market dispatch model, which runs on the commercial modelling platform Plexos® using data and assumptions constructed by FTI-CL Energy. The model covers all of the European power market and constructs supply in each price zone based on individual plants and their characteristics. Zonal prices are found as the marginal value of energy accounting for generators' bidding strategies. The analysis also takes into account the cross-border transmission and interconnectors and unit-commitment plant constraints.

In this analysis, we have modelled 6 spot years (every five years from 2025 to 2050), to estimate the wholesale price outcomes across Europe with and without AQUIND Interconnector. The present value of the benefits has been calculated using a 3.5% discount rate.[18]

Our analysis does not consider the specific impact on greenhouse gas emissions. Instead, we focus on the economic benefits of additional interconnection capacity on the GB-FR border assuming the delivery of such policies and commitments.

Scenario definition: Europe

There are three key sets of assumptions underpinning our modelling: commodity prices, demand levels and policy and regulation. Each is considered below in turn.

1. Commodity prices

Coal and gas prices, in the short-term, are assumed to remain at low levels (due to Covid-19) until gas markets rebalance. In the longer-term, prices converge to the World Economic Outlook (WEO) New/Stated Policies scenario, reflecting the reference long term global gas market which reaches around €25/MWh by 2050.

CO2 prices are assumed to increase steadily over the period as a result of a reform of the EU ETS to align it with the EU increased decarbonisation ambition, reaching 28€/t in 2030 to around 90€/t by 2050.

2. Demand and supply levels

Annual demand growth, following a recovery from a Covid-19 dip, is expected to be moderate in the medium-term with electrification being offset by energy efficiency measures. This would be accelerated in the long term with further electrification of transport, heat and industry.

Demand flexibility would be developed further with the development of demand response and storage, from short-term storages (batteries or load shifting) to long-term storage (hydrogen production).

Installed renewables ("RES") capacity for 2030 would be aligned with national 2030 targets reflected in each countries' National Energy and Climate Plan.

Phase out of **coal** would continue as expected, and nuclear plants would be retired once they reach the end of their lifetime with extensions for some and with some **new** nuclear projects developed in selected countries.

Carbon Capture and Storage ("CCS") is considered in our modelling and develops slowly as we assume the absence of dedicated support.

3. Regulation and structure of the power market

Renewables investment is continued to be incentivised through national tenders to meet the NECP targets.

Capacity mechanisms are expected to continue to ensure security of supply amidst increase in RES.

18 This is consistent with the social rate used for public investments.

Scenario definition: France

France is expected to rebalance its generation mix with a relative decrease in nuclear capacity and a significant increase in RES capacity while meeting its NECP targets. Our assumptions on the future generation mix include:

- Gradual decline of nuclear energy in line with PPE;
- Planning over 35 GW **onshore wind capacity** by 2030 and 50-80GW by 2050;
- Planning a 30-80 GW **offshore wind capacity** by 2050; and
- Planning over 44 GW **solar capacity** by 2030 and 40-250 GW by 2050.

Scenario definition: GB

GB is expected to increase the use of renewable energy to decarbonise its electricity, heat and transport. Our assumptions on the future generation mix include:

- Supporting new **nuclear capacity** at Hinkley Point C and two additional sites by 2050;
- Planning a 15-30 GW **solar capacity** by 2030 and 25-55 GW by 2050;
- Planning a 17-25 GW **onshore wind capacity** by 2030 and 20-40 GW by 2050; and
- Planning a 30-55 GW **offshore wind capacity** by 2030 and 40-85 GW by 2050 (providing a third of electricity by 2030).

The Carbon Price Floor is also assumed to be maintained at 40€/t until EU ETS starts to increase beyond this threshold.

Scenario definition: interconnector investments

The development of other interconnectors in Europe is likely to interact closely with the value of AQUIND Interconnector. In this modelling, we have aligned our assumptions on interconnector build-out with the published information on expected commissioning dates, published guidance from relevant authorities (e.g. RTE's SDDR), as well as an understanding of the challenges that specific links face in progressing their development. Since we only modelled spot years, our assumptions focus on whether or not specific links have been operational before each of the spot years.

- Between France and GB, in addition to ElecLink and IFA2, one more new interconnector (other than AQUIND) of 1.4GW is assumed to be built before 2030, and another 1.4GW before 2040.
- Greenlink, NSL and Viking Link are assumed to be operational before 2025.
- NeuConnect is assumed to be operational before 2030.
- NorthConnect and Nautilus are assumed to be operational between 2030 and 2035.

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