By e-mail to: connections@ofgem.gov.uk

Ofgem
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10th May 2023

Dear Ofgem

Ofgem Open Letter: Future Reform of Electricity Connections – Capgemini Invent response

Capgemini Invent welcomes the opportunity to share our views on Ofgem's consultation regarding the 'Future Reform of Electricity Connections'.

Capgemini Invent is the consulting, innovation, and digital business of Capgemini. Capgemini is Europe's largest supplier of systems and technology services to the Energy and Utilities Sector. HFS Research have placed Capgemini second globally in their list of business and technology service providers to utilities. Every year we publish the World Energy Markets Observatory (WEMO)[1], the 24th Edition of this was published in October 2022. The report consists of 600 pages of detailed analysis and insights on world energy trends, with a focus on security of affordable energy within the global context of a series of successive crises that impact supply, pricing, and consumer behaviour.

We also provide wider services that cover net zero consumer strategy, development of new market services, smart metering implementation, consolidation, harmonisation and digitalisation of retail market codes and wholesale markets. Furthermore, in 2022 we established the Energy Markets 2030+[2] working group, which involved collaborating with senior cross-industry representatives over a 10-month period to define the future energy system. This has produced a compelling vision for the future that is based on a broad consensus of how the energy system should work.

Our response to the open letter draws heavily from insights and energy market expertise gained in our work across UK market functions in both gas and electricity. Our experience covers a wide range of services relevant to the consultation, including support to numerous energy network and central market clients in business and technology transformations, leading regulatory submissions, and contributing to operating model and governance changes at the organisational and industry level.

In responding to the questions outlined in the consultation, we have provided key observations and recommendations:

- The impacts electrification has on electricity network connection processes is not unique to the UK. Many nations are grappling with the same challenges and are adopting a wide variety of approaches to increase the pace of renewable generation connections. We believe that studying the approaches adopted globally will provide an excellent learning opportunity and enhance review quality.
- Reinforcing all levels of the network is a no regret investment that needs to be progressed now. Upgrades should be made on a proactive basis, with coordinated, whole system planning.

It is essential that the review considers the whole energy system and is not assessed in isolation to other reviews undertaken (e.g., REMA etc.). The energy system is fundamentally linked, and therefore the full flow of energy, money, data and agreements must be taken into consideration. This will help ensure that outputs meet the intended purpose and do not incur transitional 'debt' and result in unnecessary future reworking.

We have outlined these considerations in more detail in 'Appendix 1' and welcome you to review our thoughts and opinions on this topic. I hope you find these insights and suggestions helpful and if you would like to discuss any areas of our response, please do not hesitate to contact Michael Taylor[3], Tom Carr[4] and/or Ranbir Singh[5].

Yours sincerely,

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[1] Capgemini (2022), World Energy Markets Observatory Report 2022
[2] https://www.capgemini.com/gb-en/insights/expert-perspectives/defining-a-unified-vision-of-the-uk-energy-market-in-2030-part-1/
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Executive Summary

The Electricity connections process is a critical part of the UKs energy transition and, alongside electricity network reform, is a pace setter of our collective decarbonisation effort. The recent surge in news stories quoting transmission connection times in excess of a 15-year wait are deeply concerning. If this is not addressed, it is highly unlikely that the 2035 target for decarbonising the power system, or 2050 to decarbonise the economy will be achieved. As such, we are extremely supportive of Ofgem raising its review into the electricity connection process.

In our response to the open letter, we have provided observations and recommendations within this executive summary which is broken into the following key considerations:

- Connection Process Issues
- Network Reform
- Review Approach
- Case Study – Australia
- Case Study – Texas
- Case Study – Norway

Our response includes three case studies, exploring how different nations are managing the impacts of electrification on its network connection processes. The purpose of including these case studies is not to suggest that the approaches should be adopted in the UK, but to highlight the different frameworks adopted elsewhere, such that learnings can be accounted within the review of the UKs connection process.

Connection Process Issues

Whilst we recognise that the First Come-First Serve (FCFS) approach may have been appropriate in delivering connections in a targeted manner in the past, the current issues observed, notably the queue formation, demonstrate that it is not fit-for-purpose to deliver electrification within the required timeframes.

The formation of the queue and the size of it, indicates that the market is distorted, with demand outstripping connection capacity. Furthermore, there is a distinct lack of queue prioritisation, resulting in potentially higher priority projects being delayed at the expense of lower priority activities.

The queue length is compounded by the application process, which allows for investors to speculate on prospective projects, to ensure their place in the queue. Furthermore, there is a little scrutiny at the point of connect application which can result in applications being submitted for projects that have critical dependencies, such as planning permission. This results in ‘zombie’ projects populating the queue, holding back high priority projects, reducing accuracy of generation capacity projections, and further complicating network planning.

We were pleased to see National Grid ESO recent statements outlining greater scrutiny on project progress, noting projects that are not progressing would be removed from the queue. However, we believe further central management is required to ensure connections are provided to the appropriate projects at pace.

Network Reform

The upgrading of the electricity network is a critical part of enabling electrification and of the UK meeting its net zero targets. We acknowledge the positive work that Ofgem is progressing in this space through its review of Future System and Network Regulation and Local Energy Institution System Governance yet would highlight the interdependencies these workstreams have on the connections process reform and each other.

As such, we would like to re-enforce our position outlined in our previous consultation responses that each review should be conducted with the whole system in-mind. The energy system is fundamentally linked; therefore, it is critical that central reform workstreams have clear holistic oversight and the cross-dependencies are well understood. Failure to do so increases the risk of transitional ‘debt’ and would likely result in future reworking.

Network planning will be a critical element of defining a successful connection process and will likely need to differ for both transmission and distribution. At the distribution level, much of the planning and connection prioritisation will likely be driven by the customer, or on their behalf by local governing organisations to ensure the electricity system delivers regional requirements. Whilst at a transmission level, network planning and connection prioritisation will likely need to be owned by the System Operator, to ensure system resilience. At all levels of the network, central coordination of network planning and connection prioritisation will be necessary to ensure capacity is delivered in the right places, it cannot be left for the market to determine.

Whilst network expansion will require a close interplay with connection planning, we strongly believe that network reinforcement should be de-coupled from the connections process. Reinforcing all levels of the network is a no regret investment that needs to be progressed now. Upgrades should be made on a proactive basis, with coordinated, whole system planning, to reduce risk of asset redundancy and increase connection speed.

Integrating a sophisticated network of sensing, monitoring and control infrastructure will be an essential part of developing a smart, flexible, and resilient system. We believe that connection process review presents an opportunity to introduce additional rules to ensure that field operations for connections include the integration of monitoring/sensing technologies where available and applicable.

Review Approach

The approach to the electricity connections reform review will be critical in driving the right outcomes in the near, medium, and long term. The outputs should include a robust mechanism for identifying where projects are required to ensure that investment is targeted in the areas which will deliver the greatest impact, whilst maintaining system resilience. Furthermore, the review will need to determine the regulatory and process management frameworks, as well as the success criteria. To achieve this, we propose that the review should address the following questions for both the transmission and distribution systems.

- What will be market's role and responsibilities?
- How much will be centrally governed?
- How strict will the rules be?
- Who are you building for?
- What is the purpose?
- Who is the user?

At the transmission level, it is likely that central governance will be required to take a leading role, as the primary objective will be to ensure connections locality supports overall system stability. As such, right-to-left system planning may be the most appropriate approach. Working backwards from the desired end-state would promote clear market signals which would help unlock investment into targeted project delivery. Furthermore, the rules in place will need to be robust, to ensure projects remain on track and deliver the indented outcomes.

Management of the transmission connections will require close oversight of the ESO/FSO and with support from the regulator, to ensure projects are delivered to time and specification. We have been encouraged by the ESO's recent announcement to target connection time reduction of 10 years but believe this will require significant support to achieve.

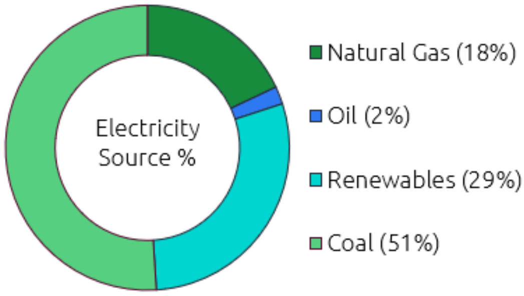
At a distribution level, connection priority will need to be determined in conjunction with the consumer, or organisations/public bodies representing consumer interests. However, the distribution network owners will have a key role to ensure connected assets do not compromise system stability.

The impact electrification is having on network connection speeds is not unique to the UK, with many nations across the global experiencing similar challenges. We believe that Ofgem's review of electricity connection processes should consider how other nations have responded to capitalise on the successes and failures observed elsewhere. To this end, we have provided three case studies, outlining how Australia, Texas and Norway have responded.

Case Study – Australia

Energy Mix

According to the Australian government's Department of Climate Change, Energy, the Environment and Water (DCCEEW), fossil fuels contributed towards 71% of total electricity generation in 2021.



Electricity generated by renewables has increased significantly from around 10.5% in 2010 to 29% in 2021, which has predominately been driven by solar, wind and hydro. Solar generation has seen the sharpest increase with total generation going from approximately 30,000 GWh in 2014/15 to over 60,000 GWh in 2020/21.

Regulation and Control

In Australia, there are three overarching laws which are relevant to the national regulation of energy markets:

- **National Electricity Law (NEL)** – Establishes the governance framework and key obligations for the National Electricity Market (NEM), including the Australian Energy Market Operator (AEMO) role and functions, as well as the regulation of access to electricity networks. It is supported by the National Electricity (South Australia) Regulations. The National Electricity Rules (NER) are made under the NEL and determine the operation of companies and their participation in the competitive generation and retail sectors. The rules also govern the economic regulation and electricity distribution and transmission networks and ultimately govern the overall operation of the NEM

- **National Energy Retail Law (NERL)** – Regulates the supply and sale of gas and electricity from retailers and distributors to customers and is supported by the National Energy Retail Regulations. The National Energy Retail Rules (NERR) are made under the NERL and provide detailed information about consumer protection measures and model contract terms and conditions. They also include the governance of the electricity and gas services to retail customers, which encompasses customer connections, retail competition, and basic terms and conditions for retail contracts.

AEMO is the principal system and market operator in Australia, responsible for managing the electricity and gas systems and markets across Australia. It also aims to incentivise efficient operation and use of gas and electricity for the long-term interests, whilst promoting market investments.

With regards to control, the ownership of electricity and gas networks varies across Australia based on the region and is either publicly, or privately owned as the following examples illustrate:

- Privately Owned Electricity Networks – Victoria and South Australia
- Government Owned Electricity Networks – Tasmania, Western Australia, Northern Territory, Queensland
- Gas distribution providers all privately owned, with exception of the ACT's, which is half government owned

The electricity network in New South Wales (NSW) is unique, as it has a mixture of ownership, whereby one electricity network is privately owned, two are 50.4% privately owned and one is fully government owned.

Renewable Energy Zones

The AEMO defines Renewable Energy Zones (REZs) as high-quality resource areas where clusters of large-scale renewable energy projects can be developed using economies of scale. This includes both onshore renewable energy zones and Offshore Wind Zones (OWZs), all of which are subject to the same regulatory processes.

The AEMO outlines four distinct ways in which the REZs and the Variable Renewable Energy (VRE) development opportunities within them are reviewed and prioritised. These are as follows:

- **REZ Candidates** - refers to a specific region or area that is being considered for designation as a Renewable Energy Zone (REZ). REZs are strategic locations identified by the government where renewable energy generation projects, such as wind farms or solar installations, are planned to be developed at a larger scale
- **Social License** - refers to the acceptance, approval, or support of a project or activity by the local community and stakeholders. It is the understanding that a project or organisation has the permission and trust of the community to operate in a manner that aligns with their values, expectations, and concerns
- **REZ Development Overview** - refers to the process and key aspects involved in the establishment and development of Renewable Energy Zones (REZs) in the country. REZs are designated areas where renewable energy projects are prioritised to support the transition to clean and sustainable energy sources.
- **REZ Scorecards** - refers to the method REZ progression is tracked and measured

It should be recognised that REZs are controlling access to the connections queue, in the same way that the stage 3 of the proposed connections reform sets out in Ofgem's open letter.

Connections Process
As mentioned previously, Australia's electricity and gas network ownership models vary at a regional level, for both transmission and distribution. This inevitably leads to some degree of variation with regards to connection processes, some of which employ 'First Come First Serve' models which align to the existing framework in the UK. This generally follows the below process steps outlined by AEMO:

- **Pre-feasibility** – Applicants consider the feasibility of their project and begin discussions with the connecting Network Service Provider (NSP), landowners and relevant government authorities
- **Enquiry** – Applicant submits a connection enquiry to the connecting NSP to confirm information required and determined most suitable connection point
- **Application** – The Applicant submits an application to connect to the NSP, including information stipulated in the enquiry response
- **Completion** – Finalisation of market registration and commissioning of the facility, involving both AEMO and the NSP

However, the NSW government employs a slightly different approach for the connections process and specifically how it links to their REZ. The following key areas outlined:

- **Strategic Planning** – Working with local communities, government entities and other parties to develop a strategic, upfront land-use plan and ensure a robust approach to electricity infrastructure development
- **Technical and Regulatory Design** – Viewed that new renewable energy projects more successful if delivered through a competitive tender process, which requires parties to demonstrate the validity and benefits of their approach (e.g., local employment opportunities, compatibility with agricultural land uses etc.)
- **Community Focused**:
    - Holistic Engagement – With communities to understand local expectations and realise the on-the-ground benefits
    - Benefits Sharing – Working with the Consumer Trustee, generation and storage proponents, key organisations and local communities to ensure the economic benefits of REZs are shared
    - Economic Opportunities for Landholders – Help to facilitate new and diversified income streams for landholders that host electricity infrastructure
- **Coordinating Projects**:
    - Long-Term Energy Service Agreements (LTESAs) – Consumer Trustee will run competitive tender processes to offer LTESAs to project developers and provide minimum revenue certainty for private investment in new renewable energy generation, firming and long-duration storage
    - Access Schemes – To coordinate and encourage investment in REZs and to realise the objectives of the Electricity Infrastructure Roadmap and its enabling legislation

Summary
The approach of using REZs has played a key part in identification and prioritisation of appropriate areas for renewable energy generation investment. The clear investment signals have resulted in a strong market response, having attracted a high volume of project submissions.

However, the implementation of these projects and speed of connection is still an ongoing issue, for many of the same reasons observed in the UK. Whilst available space is not an issue in Australia, there are stringent land rights laws in place, notably those that protect regions of cultural significance to the indigenous population. Furthermore, there have been instances where the investment into intermittent generation has outpaced electricity network infrastructure investment, such that the network is outdated and unable to connect in-flight projects. This was observed in the West Murray Zone in 2019, where AEMO declared a 'system strength gap', stalling progress of 1.7GW of installed and commissioned generation; 1.2GW of committed renewable generation projects; and 3.0GW of projects within the application phase. This put at risk over $6bn of investment and 5,000 jobs.

In 2020, Clean Energy Council (CEC) and AEMO brought together NSPs and industry stakeholders to address concerns around delays and the increased connection complexity in connections, through the Connection Reform Initiative (CRI). The CRI aimed to provide solutions within four main areas:

- Access standards
- Information asymmetry and modelling
- Batching of the connection process
- Providing post-financial close predictability for developers

Solution outputs within these target areas were consolidated into a collective delivery roadmap, outlining when review recommendations would be implemented.

The first phase of the CRI activity focused on introducing collaborative, cross-industry ways of working, simplifying regulatory change processes and introduce a more flexible approach to minimum standards to better reflect network capability. At the time of writing, it is unclear how effective the deliverables have been following implementation.

The CRI roadmap recently went through its second iteration in May 2023, with the emphasis shifting from ideation/planning to implementation, along with overall adaptation of the initiative in response to the evolving industry needs. Furthermore, phase 2 of the CRI roadmap includes the creation of a Streamline Connections Process (SCP) workstream, which focuses on identifying streamlining opportunities across the end-to-end connections process.

The SCP is an evolution of the work conducted in phase 1 to investigate how ‘batching’ of connection applications could be applied to reduce the risk of rework where nearby projects become committed.
However, the initial assessments concluded that it would not be possible to introduce connection ‘batching’ until wider changes to the connection process had been progressed. As such, the workstream was rebranded into the SCP.

Thus far, the delivery team for this workstream has conducted an end-to-end review of the existing connections process. This initial deep dive has resulted in nine streamlining initiatives across the enquiry, pre-application, application, registration, and commissioning stages of a connection. The ideation stage was followed by an open Expression of Interest (EOI) which incentivise volunteer organisation and projects to participate in trials. This has led to a total of seven trials being taking forward into phase one for the ‘SCP Program of Trials’ initiative.

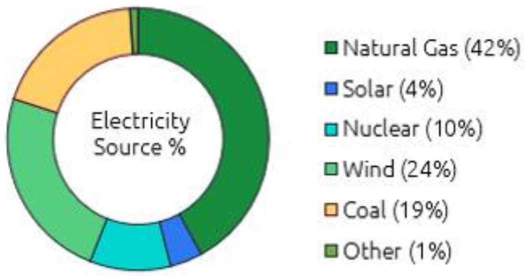
The purpose of the trials is to test alternative processes within a regulatory sandbox, to identify process streamlining opportunities. At the time of writing, the trials have not been completed, as such we are unable to comment on whether it has been successful.

It should also be recognised that whilst Australia is experiencing similar issues to those observed in the UK, and hence the reason for them introducing the CRI, it has still managed to dramatically increase the energy transition pace, through the implementation of 15 projects in 2022, which increased renewable energy capacity by 2.1GW.

Case Study – Texas

Energy Mix

In 2021, 61% of the electricity generated in Texas came fossil fuels sources, of which 19% was attributed to coal. This represents a significant shift from a predominantly coal baseload (40%) in the early 2000s. To achieve this, there has been a widescale adoption of Liquefied Natural Gas (LNG) and renewable generation which accounted for 42% and 28% respectively of electricity generated in 2021.



Renewable generation has predominately been driven through the mass roll out of wind farms. Wind accounted for 24% of the total electricity source of generation for Texas in 2021, which is a significant increase in comparison to 2011 where it only account for 9% of the fuel mix. Texas is currently ranked top of the US states in terms of installed wind capacity and electricity generation by wind turbines.

Although solar only accounted for 4% of the energy supply in 2021, it is viewed as a priority growth area for the state of Texas, as on average a square meter in the state can expect to receive between 1500 and 1900 kWh of solar radiation per year. Indeed, it is envisioned that this solar could account for 8% of the energy by summer of 2023.

Regulation and Control

Texas primarily operates an independent grid managed by the Electric Reliability Council of Texas (ERCOT), who maintain a separate set of rules from the Federal Energy Regulatory Commission (FERC). It also operates a unique energy market where power generators are paid for both energy production and capacity. However, the Texas wholesale market only trades energy, and there is no capacity market. As a result, there is an incentive for generators to sell electricity when demand and prices are high, but there is no direct reward for availability.

Texas has four power grids in operation, but ERCOT covers 75% of the state territory and 90% of the population. The other grids are Western Electricity Coordinating Council (WECC), Southwest Power Pool (SPP) and South-eastern Electric Reliability Council (SERC) which all operate across multiple states and are subject to federal regulation, unlike ERCOT.

Competitive Renewable Energy Zones

As mentioned above, Texas has made considerable advances in the deployment of wind turbines. This transformation was initially driven through the Competitive Renewable Energy Zones (CREZ), which were specific investment areas located across Texas and the Texas panhandle that had been identified as resource rich, high wind areas.

The CREZ approach was introduced by ERCOT as part of a study recommendation which concluded in 2006, which outlined the significant potential of wind as a renewable energy source in Texas. The purpose of the CREZ initiative was to target investment into wind generation assets and network infrastructure, for which it was extremely successful. All CREZ projects were completed by 2014, providing more than 18.5GW additional generation capacity, at a cost of approximately $7bn.

The overall CREZ process was delivered through the following stages:

- **Planning and Design** – This initially involved the identification of suitable, high wind potential regions, which were determined by the Public Utility Commission of Texas (PUCT). Upon completion, the PUCT issued an interim order which designated five areas as CREZ and requested that ERCOT and stakeholders develop transmission plans

- **Bidding Process** – The PUCT was also given responsibility for allocating construction projects to Transmission Service Provider (TSPs) who were selected through a competitive tender process, considering factors like cost-effectiveness, technical expertise, and speed of delivery. ERCOT were responsible for overseeing the competitive tender process of the generation projects within the CREZ. These were assessed based on technical feasibility, economic viability, and grid compatibility

- **Construction** – The selected TSPs commenced construction of the transmission infrastructure. Projects were modified by TSP and ERCOT if obstacles were encountered during construction. Simultaneously at this stage, developers began to construct wind farms in the CREZ zones in preparation for interconnection with the grid

- **Connection Process** –Developers were requested to submit interconnection requests to ERCOT, indicating their intent to connect their wind projects to the CREZ transmission infrastructure. Once approved and interconnected, the electricity generated by these wind projects became part of the ERCOT grid.

Connections Process
Since the conclusion of the of the CREZ initiative, the process for connecting new generation projects to the electrical grid in Texas is managed through the ERCOT interconnections process. The interconnection process is competitive, with ERCOT awarding connection placement based on technical feasibility and potential project impacts. The interconnection process includes the following stages:

- **Feasibility Study** – The process is initiated by the prospective generator who is required to submit an Interconnection Request (IR) to ERCOT. This then triggers an initial feasibility study which aims to determine whether the interconnection is technically viable whilst also providing some initial cost and timeline estimates

- **System Impact Study** – A system impact study is conducted to evaluate the potential impact of the new connection will have on system stability, reliability, and performance to ensure network resilience is not comprised

- **Facility Study** – A facility study is conducted to assess project specific design and engineering requirements, including equipment requirements, protection systems and other technical factors.

- **Interconnection Agreement** – Following study approval, ERCOT will allocate the prospective generator an Interconnection Agreement, which outlines to the rights, responsibilities, and obligations of both parties regarding the interconnection. The agreement also includes technical requirements, operational procedures, and timelines for completing the interconnection process.

- **Construction and Testing** – Once the Interconnection Agreement has been finalised, the prospective generator is able to commence construction. Once complete, the generator must conduct testing to demonstrate the facility can operate in accordance with the interconnection agreement.

- **Commercial Operation** – Following completion of construction and accompanying testing/inspections, ERCOT verifies compliance with the installation agreement and grants permission for the generator to connect to the grid and start feeding electricity.

In addition to the stage's referenced in the interconnection process, connection applications are also evaluated based on either reliability need, or economic benefit, each of which have differing success criteria:

- **Reliability Projects** – Projects that are required to reliably serve load, to improve system stability, these are typically evaluated based on cost and effectiveness

- **Economic Projects** – Projects evaluated based on production costs savings. If expected annual production cost savings resulting from a project are greater than the incremental annual revenue requirements charged to consumers, the project meets the economic criteria

Summary
The CREZ programme is widely recognised as being extremely successful, establishing Texas as the largest wind power producer in the United States. It demonstrates how economic opportunity can be leveraged to stimulate mass roll out of low carbon technologies, even in regions which are renown for low net zero sentiment.

The integration of network infrastructure planning and development alongside generation project planning played a key role in mitigating delays and interoperability issues. Whilst the CREZ programme did not face the same land right challenges present in the UK, the principle of tighter integration between network planning and asset planning would lend the UK greater certainty on the projects being progressed.

Whilst Texas have seen successes in large scale project deployment under the CREZ programme, small-scale renewable energy projects, have faced challenges. These have been due to limited capacity and technical constraints within local distribution infrastructure and the existing transmission network, with the highest impacts reported affecting the connection of new solar projects.

ERCOTs interconnection process contains a significant number of controls to ensure connection projects are suitably prioritised and those that progress contribute to overall system resilience. The UK would likely benefit from adopting several of these measures, particularly those that focus on ensuring project applications meet system success criteria. However, the process is lengthy and somewhat inflexible, which reduces central agility in responding to external developments.

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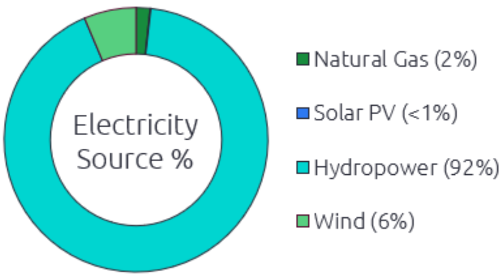
Case Study - Norway

Energy Mix

Norway has an almost entirely renewables-based electricity system, with renewable resources accounting for 98% of generation in 2020, of which hydro is the dominant source at 92%.



Norway has historically been a net exporter of electricity to neighbouring European countries, providing a record 20.5TWh of net exports in 2020, making it one of the largest power exporters in Europe. Norway is therefore well-integrated in the Nordic and European electricity markets.

Its energy demand is already highly electrified; in 2019, electricity covered almost half of the country's total final consumption (TFC), the highest share among IEA member countries.

Regulation & Control

The Norwegian energy market is regulated by several governmental authorities and frameworks. This includes:

- **Ministry of Petroleum and Energy (MPE)** – The MPE is responsible for overall energy policy and sets the strategic direction for the Norwegian energy sector. It formulates energy-related laws and regulations and oversees their implementation
- **The Norwegian Energy Regulatory Authority (NVE)** – The NVE is an independent regulatory body responsible for regulating the electricity and gas markets. It ensures fair competition, monitors market behaviour, and sets rules for grid access and pricing
- **Norwegian Water Resources and Energy Directorate (NVE)** – NVE is a government agency under the MPE. It regulates and supervises the energy sector, including electricity production, transmission, and distribution. NVE grants licenses, monitors compliance, and promotes efficient and sustainable energy use
- **The Electricity Act** – The Electricity Act provides the legal framework for the electricity market in Norway. It promotes competition, efficient resource utilisation, and renewable energy development. The act defines the roles and responsibilities of market participants, such as producers, distributors, and consumers
- **The Renewable Energy Act** – The Renewable Energy Act sets out the legal framework for promoting renewable energy sources in Norway. It includes measures to incentivize and support renewable energy projects, such as feed-in tariffs, green certificates, and financial support mechanisms.
- **Nord Pool** - Norway is a part of the Nord Pool electricity market, which is the largest power exchange in Europe. Nord Pool facilitates electricity trading and price discovery through a transparent and competitive market platform
- **Network Tariffs** – The transmission and distribution of electricity in Norway are regulated through network tariffs. These tariffs are set by the NVE and determine the charges levied by grid operators for the use of their networks

Norway follows a market-based approach to network development, whereby network investments and expansions are primarily driven by market demand and regulated by the NVE. Network operators submit investment plans to the NVE, who assess the need, cost-effectiveness, and consumer impacts prior to granting permission.

How the Energy Mix will change

Norway have set a net zero target of 2050, with 2030 emissions reduction target of at least 55% below 1990 levels in its updated Nationally Determined Contribution (NDC). To achieve this, increased electrification will be needed across all sectors to meet Norwegian climate targets, which will require additional renewable generation capacity, such as continued expansion of hydro capacity (including upgrades of existing plants).
The share of wind in Norway's electricity system has increased tenfold in the last decade, accounting for 6.5% of total electricity generation in 2020, making it the second-largest electricity generation source in the country. However further expansion has been held up by resistance from local communities.

The Norwegian government has ambitions to significantly increase offshore wind capacity and supply chains targeting licensing 30 GW of installed capacity by 2040. This is almost as much as the hydropower capacity currently (at 33GW) and can be expected to be distributed around the >100,000km long Norwegian coastline. There is significant potential for further expansion with one estimate citing up to 338GW of total potential capacity. However, the current wind capacity is 4.7 GW, all of which is onshore, with two offshore demonstrator turbines installed.

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In March 2023, the Norwegian government issued the licenses for two offshore wind parks - Sørlige Nordjø 2 (bottom fixed offshore wind, 1.5GW) and Utsira Nord (floating offshore wind 1.5 GW) but has yet to create a licencing framework for offshore wind. As we articulated in our report "Creating offshore winners"[6], there is significant uncertainty associated with how the remaining 23 GW of capacity will be licensed and much for the Norwegian government to do to meet this goal.

Unlike many other countries, Norway's ambitions for expansion in offshore wind capacity is not focussed on decarbonation but driven by a range of economic goals. Principally, their aim is to sustain Norway's competitive advantage of having reliable, affordable renewable energy for energy intensive manufacturing and industry (e.g., fertilizers, aluminium etc.), in the face of a rapidly expanding renewable sector in Europe. For example, the power from Sørlige Nordsjø 2 will not be going through hybrid cables and integrated into the European power mix but sent directly onshore for use in industrial facilities. Norway is also aiming to sustain this leading position with a view to export electricity to Europe and to export their offshore wind skills to support wider global decarbonisation and deliver growth to the Norwegian economy.

Expanding the Norwegian national grid (or assisting Sweden in reinforcing its grid) will be needed to support an increasingly intermittent energy mix. This will ensure that surplus generation in the north of the country can be transmitted more easily to the south of Norway and European neighbours. Increased use of flexibility mechanisms to balance the grid will also be needed, with existing hydro storage capacity providing a good base.

Connections Process

Connections to the Transmission network are managed by Statnett, the Norwegian TSO. Connections requests can come from Grid Operators (equivalent to TOs and DNOs) or end consumers:

- **Grid Operators** – for connection of new facilities or an increased load in existing customer facilities at lower voltage level
- **End-consumers** – to connect directly to the transmission grid when connecting major power exchanges (in the order of 300 MW and upwards)

Statnett assess requests against the forecasted capacity increases provided by Grid Operators. Generally, capacity is reserved for growth for four years, with a new assessment every other year. There are milestones throughout the process for expected maturity of projects. Reservation of capacity takes place on a first-come, first-served basis, as in the UK, with a queue formed by the time of submission of an order that meets the requirements for reservation.

Summary

Decarbonisation of the Norwegian power system is all but complete, decarbonisation of the Norwegian economy is progressing and has been for many years, with a similar gradual trend of electrification of demand. As such, we can presume that there are not a huge number of projects in the connections queue and lead times are not as long as in the UK. This steady flow of projects likely means that the use of a first-come-first-served queue has not led to the issues experienced in the UK where inappropriate projects are holding up appropriate projects. Additionally, there are milestones in place to check progress of projects in the queue, which helps to avoid a large queue of low-quality projects building up and impeding others.

However, the ramping up of offshore wind capacity installation will likely put the Norwegian connections process under pressure. This will be exacerbated by the ongoing debate across Norway into how to mitigate and avoid the large price volatility across the country which will likely seek to install transmission capacity across bidding zones between the south and north of Norway as a solution to reduce volatility.

In the absence of a clear signal from the Norwegian government and /or Statnett on where capacity will be built and connected, there is a risk that an unmanaged proliferation of connection requests will overwhelm the connections process, in the same what the has been experienced in the UK. Statnett do forecast increases in capacity as explained above, but this needs to be a directive activity, assessing whole system needs, not simply aggregating requests from grid operators. Integrating the connections process to future auctions for wind will additionally avoid the same issues befalling the UK today through ensuring connections application do not hold up the construction of new wind farms.

[6] https://www.capgemini.com/no-no/insights/research-library/creating-offshore-winners/

Conclusion
Whilst none of the approaches outlined in the above case studies can be considered a 'silver bullet' solution to be replicated in the UK, we would like to draw attention to some key aspects, which we believe warrant further consideration within Ofgem's review:

- Whilst it is too early to determine the successes of Australia's CRI, we believe the approach of bringing together multi-discipline industry representatives to tackle a shared challenge is an extremely positive approach. In 2022, we hosted the Energy Markets 2030+ series which brought together senior industry representatives to workshop energy transition solutions. We observed first-hand how powerful bringing together a diverse set of senior experts to create a shared industry vision can be, as such we strongly recommend adopting a similar approach to this review and other linked reviews.

- The initial output of the CRI included targeted regulatory change and increasing flexibility of standards to better reflect network capabilities at connection locations. Targeted regulation changes may allow for near-term streamlining of existing processes and reduce deployment barriers for future initiatives. In our opinion, Ofgem's review should also look to targeting areas of regulatory blockers in the near-term, to ensure future recommendations can be implemented efficiently.

- Progressing specific solutions in isolation of wider reform initiatives can result in 'sunk' effort, where cross-review dependencies block implementation. This was observed under the Australian CFI, whereby work undertaken to introduce connection 'batching' was abandoned due to wider reform cross-dependencies. This emphasises the importance of adopting a whole system approach and maintaining holistic oversight of all in-flight reviews.

- Leveraging regulatory sandboxes, or derogations, can be an effective tool at quickly testing process changes to identify near-term improvements and efficiencies. This model appears to have been adopted for in the Australian SCP, whilst the outcomes of this first tranche is currently unknown, similar fail-fast methods could be employed within the UK energy regulatory landscape. Whilst we recognise there is a UK energy regulatory sandbox, it is relatively slow to implement, with derogations often taking over 6 months for approval. Further consideration should also be given to policy led sandboxes, where certain rules that are deemed blockers to policy objectives can be suspended for a specific period. These should be complemented with the appropriate level of impact assessment prior to implementation.

- The pace of regulatory change needs to increase to support efficient implementation of reform recommendations. We recognise the work Ofgem is progressing through the Energy Code Governance Reform, we believe there needs to be a greater emphasis on removing regulatory blockers in the near-term. This will require a concerted effort from Code Managers/Administrators in conjunction with Ofgem.

- The introduction of REZ (Australia) and CREZ (Texas) have been extremely successful in targeting investment into intermittent generation options. However, where investment zones are progressed without equivalent investment into network infrastructure, as seen in Australia, it can result in significant delays to renewable generation project delivery. As such, it is critical that network reinforcement is delivered at pace and in-line with planned connectivity.

- Opening transmission connection and reinforcement work to competition allowed for rapid implementation of network upgrades to support the role out of the wind turbines in CREZ. Whilst there are risks with introducing competition into the transmission space, the benefits observed elsewhere indicate that it may warrant further considerations as part of the electricity connection review.

- Norway is currently on track to encounter many of the same connection issues that are prevalent in the UK. Whilst its First-Come-First-Served model has worked to date, primarily due to the modest project pipeline, it is unlikely to cope well with the volume of planned offshore wind investment. Similarly to the UK, there is significant appetite from industry to expand the offshore wind capacity, targeting an ambitious target of 33GW capacity in 2040, from 4.7GW today (a 7-fold increase in 17 years). This is a similar transformation to the UK's own aspirations, 50GW of offshore wind by 2030 from 10GW today (a 5-fold increase in 7 years). However, developers and investors are waiting for the Norwegian government to give a clear steer on the pipeline for these projects which is delaying expansion of the sector, while the rest of Europe rushes ahead.

- The Norwegian and UK governments should pursue similar solutions to provide clear requirements to industry of where offshore capacity is needed. This should also include modelling the impact of projects to inform grid expansion, integrating connections process with auctions, and bolstering existing performance milestones to manage projects through their connections process to avoid delays.

- We encourage Ofgem to engage with their Norwegian counterparts as they progress these reforms, understanding how they are responding to these challenges, sharing knowledge on approaches being taken in the UK and collaborating to identify successes and failures that can be learnt from.

As demonstrated in the above case studies, other countries have already trialled more radical reforms to their connections process, such as the Stage 3 controlled access style REZ and CREZ in Australia and Texas. In both cases, these measures were not sufficient to curb delays, as demonstrated in Australia with the delay of 5.9 GW of in-flight projects in the West Murray Zone in 2019 due to lack of dependent grid reinforcement. This suggests that more transformation change, as suggested in Stage 4 style reforms, may be required to implement planned and coordinated connections, based on whole system modelling. We believe that we should build on global learnings to accelerate our reforms, ensuring we do not make mistakes observed elsewhere.