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The role of networks in the transition to net-zero

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Morag Watson

Director of Policy

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What should a post-charging reform regime look like?

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Andrew Urquhart

Head of Whole System

SSEN Transmission

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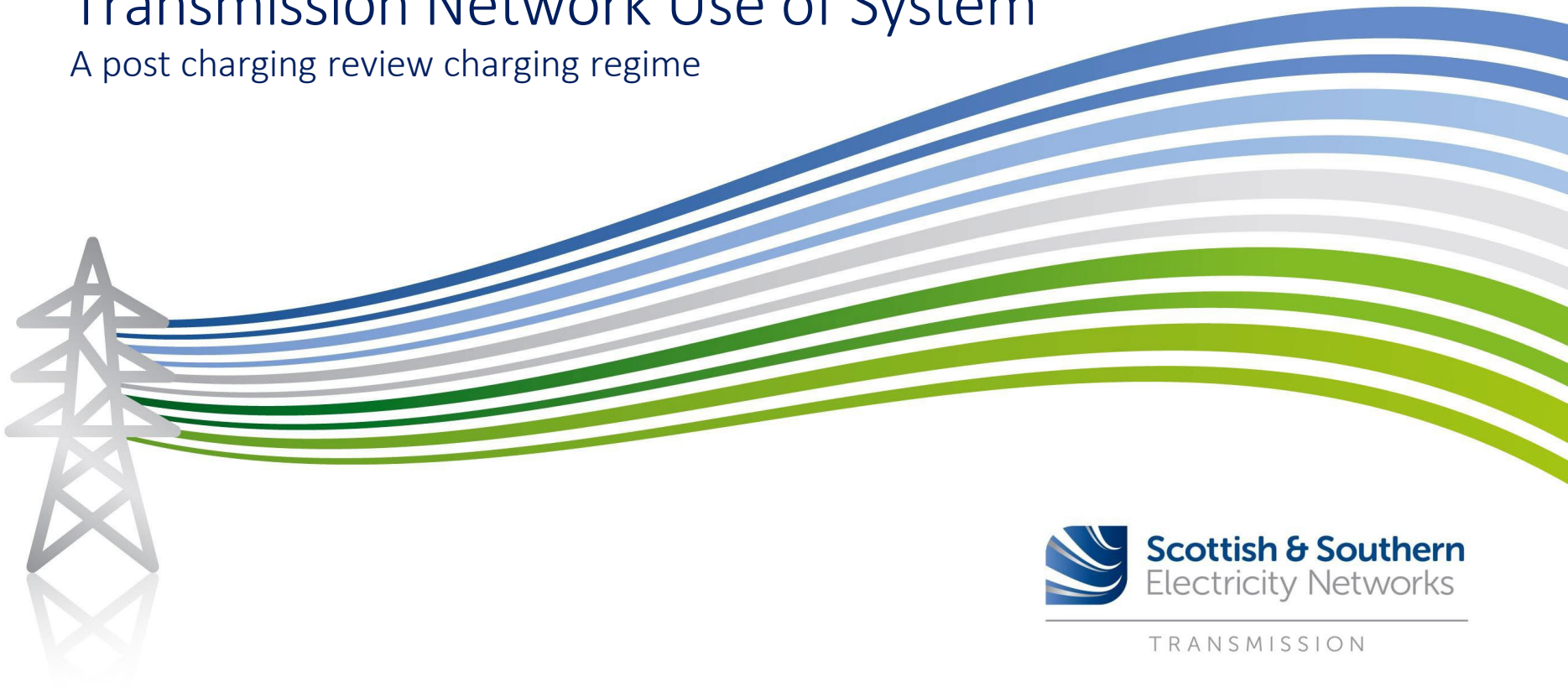
Transmission Network Use of System

A post charging review charging regime



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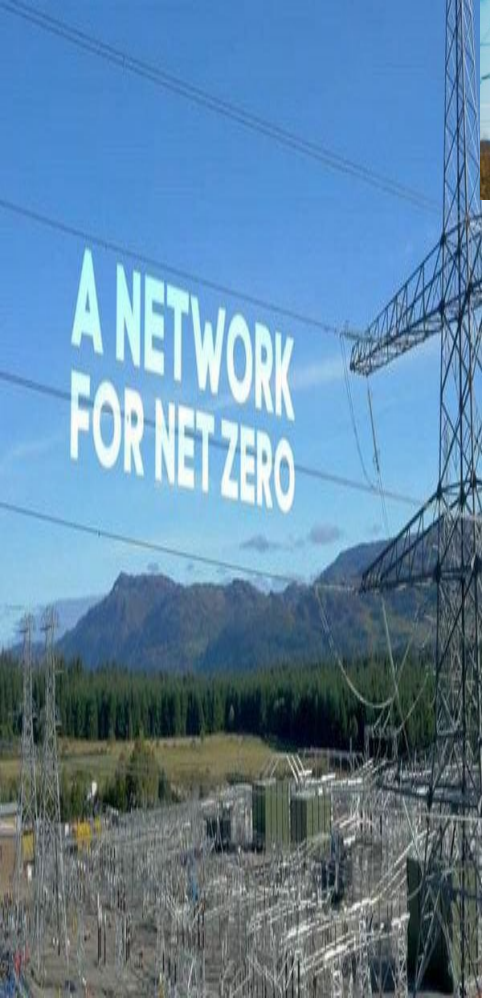

About Us

- As the Transmission Owner (TO) we maintain and invest in the high voltage 132kV, 275kV and 400kV network in the north of Scotland
- Our license area extends over a quarter of the UK's land mass crossing some of its most challenging terrain.
- Our RIIO T2 stakeholder led business plan was the awarded the Highest Confidence Reward out of all TOs.
- Agreed a baseline total expenditure of £2.16bn. to deliver a Network for Net Zero.
- Certain View delivers the capacity and flexibility to accommodate 10 GW renewable generation in the north of Scotland by 2026
- Certain View capital investment of £814 million in generation connections, regional and strategic infrastructure
- We are the world's first electricity networks company to receive external accreditation for a science-

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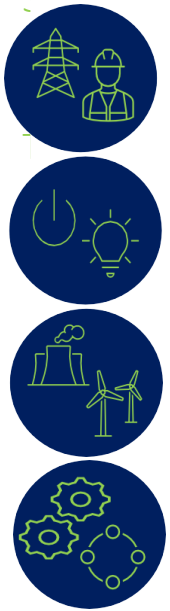
Transmission Network Use of System (TNUoS) Charges

- A charge to recover the cost of the installation and maintenance of the transmission network.
- Both generation and demand pay to use the transmission network through TNUoS.
- Generators are charged based on their declared capacity, known as Transmission Entry Capacity (TEC). Energy suppliers pay TNUoS based on the actual electricity demand of their customers.
- The Electricity System Operator (ESO) recovers the revenue on behalf of the Transmission Owner (TO)
- Detail of the charging methodology is detailed in Section 14 of the Connection Use of System Code (CUSC).
- Network charging is regulated by Ofgem.

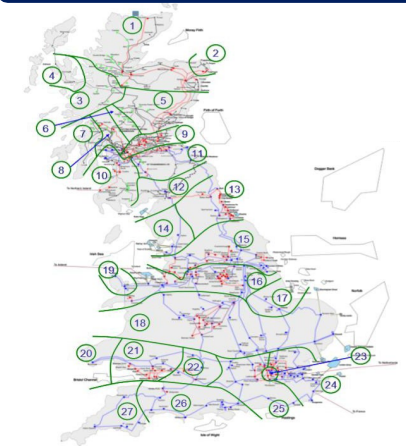


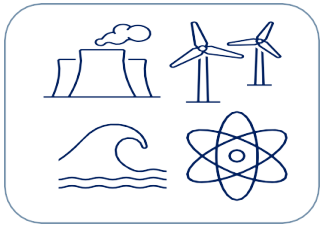
Generation TNUoS

Local Circuit &

Tariff The

The Adjustment Factor





£/ MW / kM

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Why are we involved in TNUoS

Our stakeholders have told us…

- The cost of wider TNUoS could effect the sustainability of their projects.
- Wider TNUoS is far more expensive in the north of Scotland than anywhere else in GB.
- Wider TNUoS is a barrier to entry, costs are volatile and unpredictable.

How does this affect us?

'Put simply, timing and sizing uncertainty for generation developers translates to timing and sizing uncertainty for network investment.'

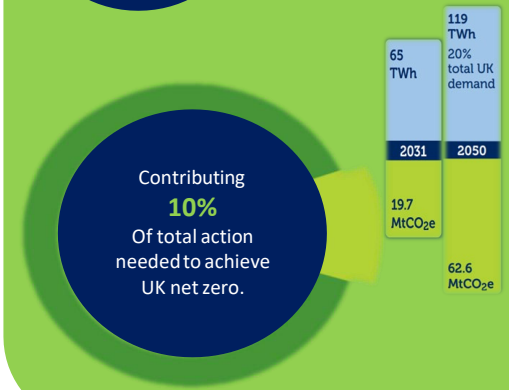
The critical importance of renewable generation required from the NoS

NoS FES tells us we need significant renewable capacity to support GB reaching net zero.

20-23GW by 2030

33-37GW by 2050

Home to 2% of the UK population



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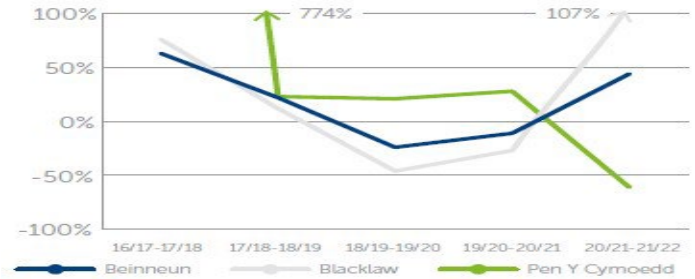
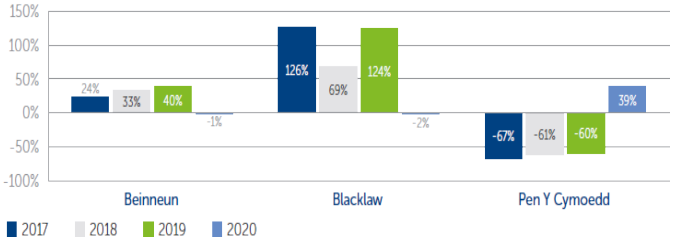
What are the current issues with TNUoS - Evidence based analysis

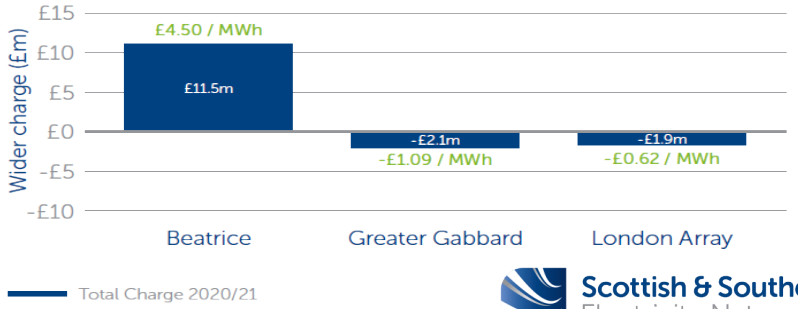
Charges are volatile



Charges are unpredictable



Disproportionately high costs



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Further Issues

Volatile TNUoS risks increasing consumer bills

Cashflow volatility & CfD bid mispricing alone

Estimated consumer cost up to **£14** per GB household by 2030

No apparent value in the locational 'signal' for generators.

Availability of energy resources (wind water sun)

Crown Estate & Crown Estate Scotland chose location of seabed.

TO decides point of connection.

Unpredictable TNUoS is in contrast to stable TO revenues

Figure 4 The maximum allowed TO charges (in 2019/20 prices)

1
1

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Our view on what is required for reform

- We welcomed Ofgems CfE. Collaboration with industry is critical.
- To ensure that consumers pay least cost whilst delivering net zero clear strategic direction for national policy will be critical.
- Any review / reform must be practically implementable.
- Reform must happen now, time is running out.

Our view is that a principle led review is critical

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Thank you for listening

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Adam Morrison

Project Director for Moray West Offshore Wind Farm

Ocean Winds

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OCEAN WINDS

Transmission Charging

A Developer's Perspective

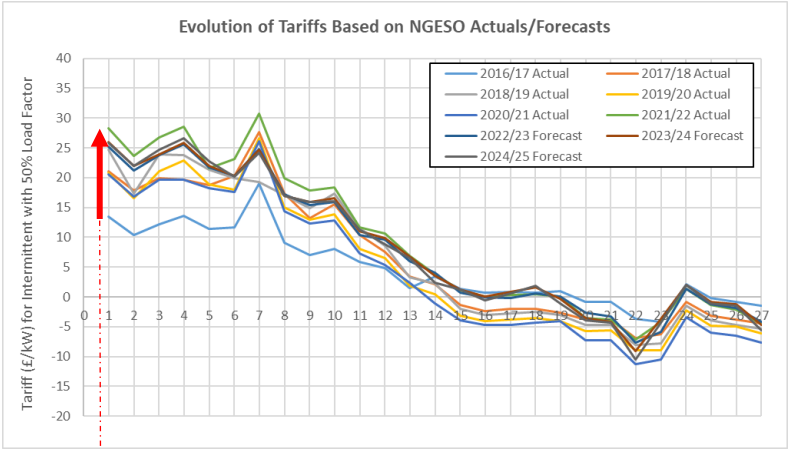
Scottish Renewables Seminar

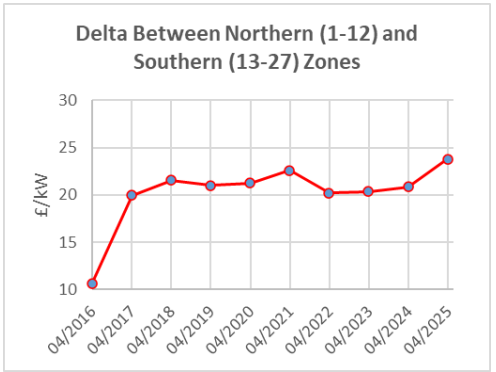
24th February 2022

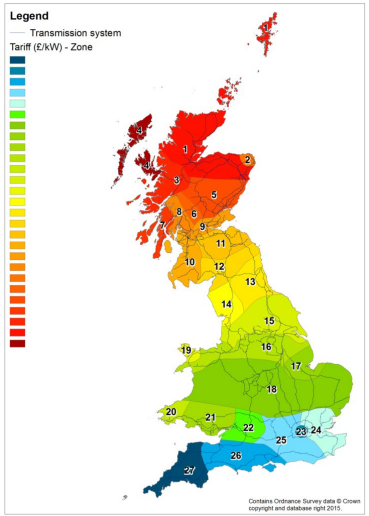
Transmission Charging

What's the problem and what is new?

- There has been a dramatic amplification (near tripling) of an already large locational signal in a matter of years.
- The strength of the combined locational signal applied to northern generation projects by TNUoS and transmission losses ("TLMs") is now in the order of £10/MWh.
- When considering established technologies such as onshore wind and fixed bottom offshore wind which will deliver the bulk of the new capacity required to meet 2030 targets, this dwarfs any other competitive considerations.
- Uncertainty is also extreme and ultimately impacts the consumer. That cost was estimated by Nera Consulting to be between £122m and £391m per year by 2030.
- We are at "peak uncertainty" just as we face a critical CAPEX challenge in order to deploy generation and network infrastructure to meet the net zero imperative.







Transmission Charging

Cost reflectivity is not a reasonable defence of the current methodology

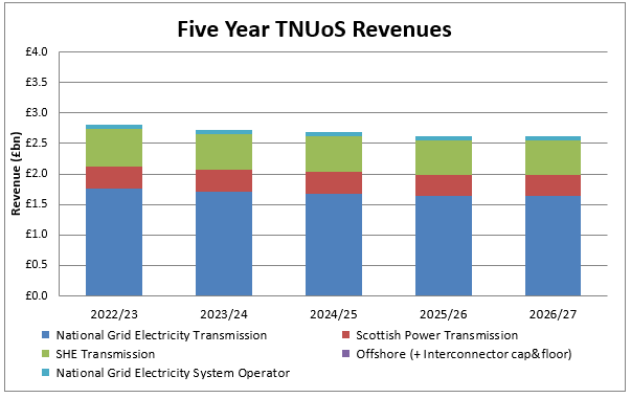
Cost reflectivity is a key defence of the existing charging methodology. However, it is incorrect to characterise the current charging methodology as cost reflective.

Top Down

- It is hard to reconcile the dramatically amplifying TNUoS tariffs that have been seen recently with the comparatively stable forecast cost of the networks.
- Generators in many TNUoS charging zones continue to benefit from negative tariffs, even where substantial network investment is known to be needed to connect projects in those zones.

Bottom Up

- The placement of the reference node has been demonstrated to have been arbitrary rather than based on any cost reflectivity test.
- There are clear flaws in the current calculation of the expansion constant which have exacerbated tariff uncertainty and led to regulatory intervention including a code modification process that is currently live.
- Cost of uncertainty ("TNUoS guesswork") is not recognised in spite of being a clear component of the cost of infrastructure financing.



Latest NGESO 5 year forecast of allowed TO revenues

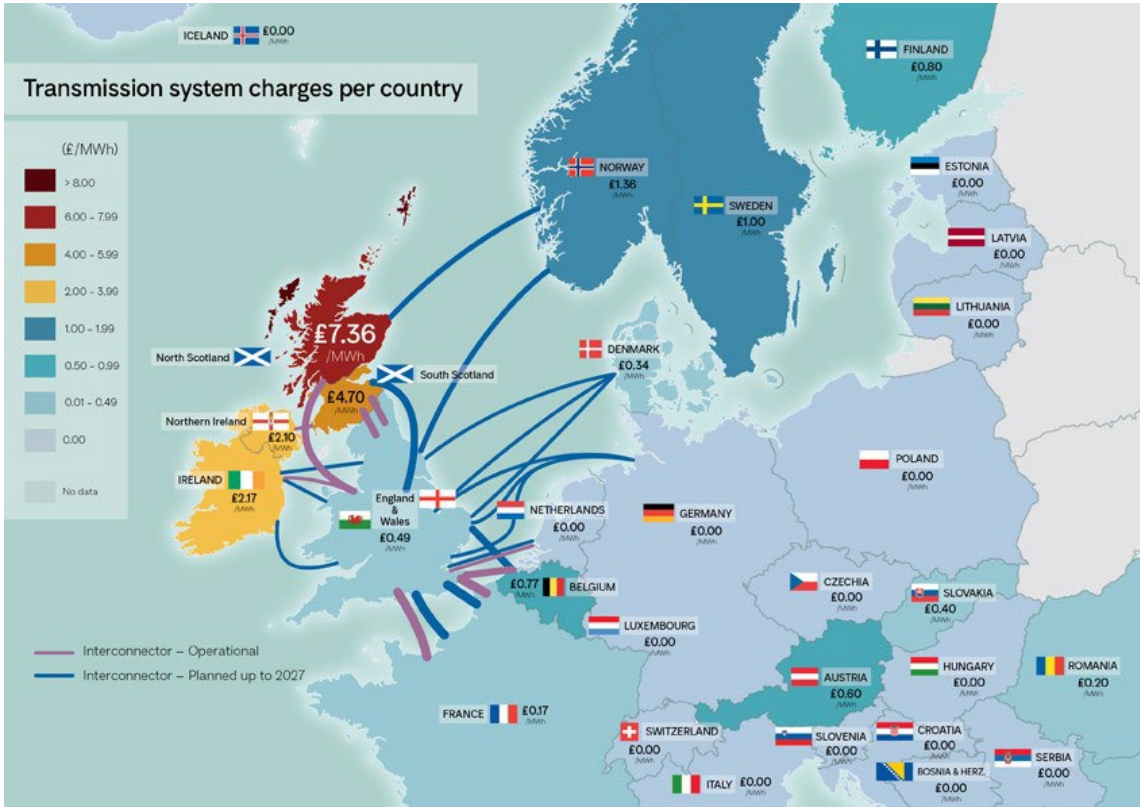
TO	Generator (wider)	Generator (local)	Total
SHET	£272,891,115	£57,295,768	**£330,186,884**
SPT	£122,772,355	£12,419,754	**£135,192,110**
NGET	-£46,504,649	£15,708,556	**-£30,796,092**
Total	**£349,158,821**	**£85,424,078**	**£434,582,902**

NGESO revenue recovery forecast for 2026/27

Transmission Charging

Competition is relevant

- Competition for capital is a material consideration and has bearing on consumer outcomes.
- In addition to the severe competitive disadvantage faced by northerly generation in absolute terms due to amplified tariffs, volatility/uncertainty is also significant.
- The cost of that uncertainty is not borne solely by generators – risk margins and cost-of-capital impacts are a consumer concern also.



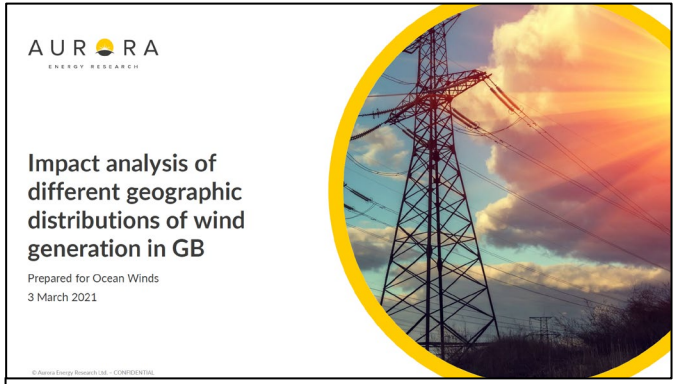
Source: “Charging the Wrong Way”, RIDG, 2021

Transmission Charging

Other factors

There are other factors which are of relevance to the effectiveness of market and regulatory design in this area:

- Demonstrable benefits of a geographically diversified renewable generation mix which are not recognised in our current market design.
- Excessive dependency on southern projects with resultant risk to 2030 targets (and beyond) and energy transition objectives.
- Unlocking of low-cost, shovel-ready renewable generation for security of supply purposes and consumer benefit.
- Investment in the transmission network nationwide to enable Net Zero.
- Investor confidence in the UK regulatory framework.



Work commissioned by Ocean Winds and completed by Aurora showed the following benefits of geographic diversity in the UK's wind generation mix:

- Reduced wholesale price volatility.
- Reduced requirement for energy balancing (resulting in lower balancing costs for consumers).
- Lower Capacity Market prices.
- Less wind capacity needed to meet Net Zero targets.

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Keith Bell

Holder of the ScottishPower Chair in Smart Grids, University of Strathclyde

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University of Strathclyde Engineering

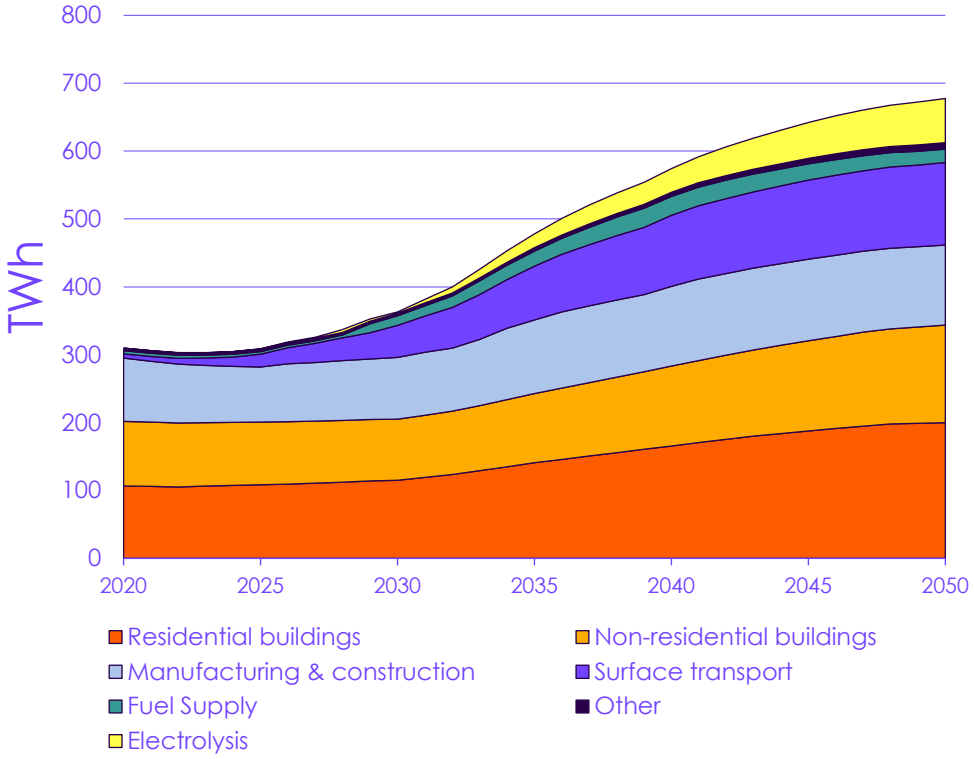
The role of networks in the transition to net-zero

Keith Bell

Holder of the ScottishPower Chair in Smart Grids,
a co-Director of the UK Energy Research Centre
and a member of the Climate Change Committee
http://www.strath.ac.uk/staff/bellkeithprof/

Presentation to Scottish Renewables event, February 24th 2022

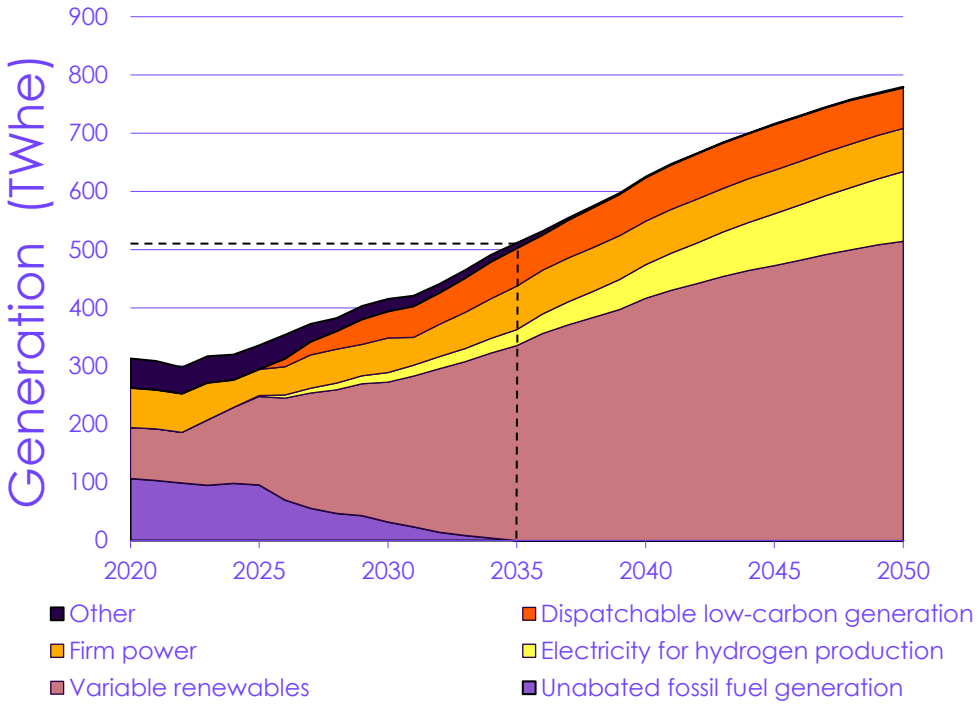
Future demand for electricity in the UK



Source: CCC Analysis

- Under the CCC's Balanced Pathway, UK electricity demand increases by 50% to 2035 and doubles out to 2050.
  - increase in electricity demand from buildings, manufacturing and construction as those sectors partially electrify.
  - new sources of electricity demand from electrification of surface transport and for the production of hydrogen.
- Electricity sector emissions reduction to date achieved almost without energy users noticing.
- Reduction of emissions in meeting demand for heat and transport will impact on end users.

Future electricity generation mix in the UK (CCC Balanced Pathway)



Source: CCC Analysis

Press release

Plans unveiled to decarbonise UK power system by 2035

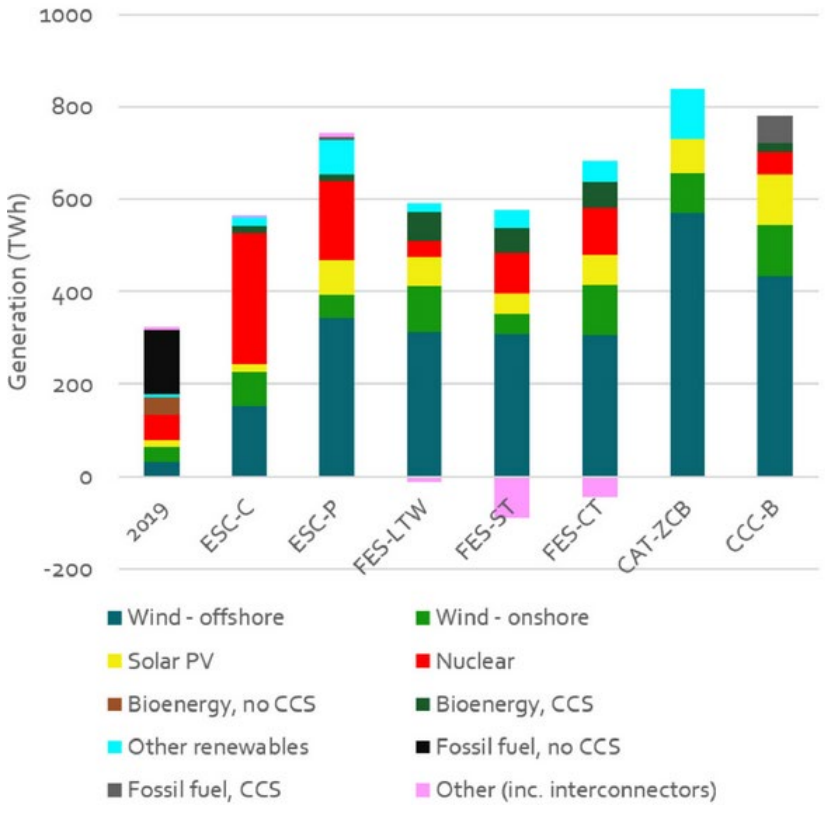
The plans will focus on building a secure, home-grown energy sector that reduces reliance on fossil fuels and exposure to volatile global wholesale energy prices.

From: Department for Business, Energy & Industrial Strategy and The Rt Hon Kwasi Kwarteng MP

Published 7 October 2021

- UK commits to decarbonise electricity system by 2035
- home-grown, green technologies such as offshore wind and nuclear energy will support the UK to transition away from reliance on fossil fuels
- it comes ahead of the publication of the government's net zero strategy as the UK prepares to host the UN COP26 climate summit later this month

Different views on the 2050 generation mix

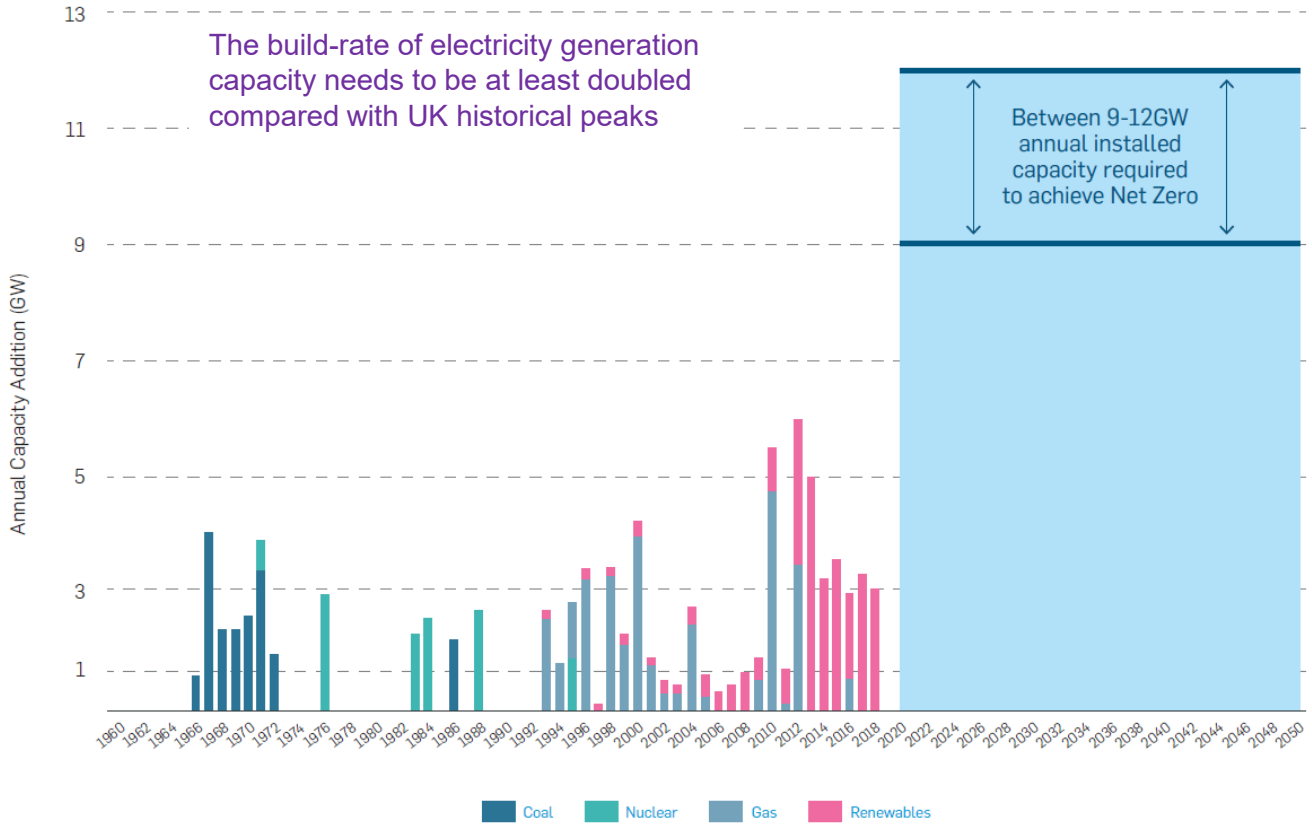


- Onshore wind capacity (assuming 30% capacity factor)
  - Between 42 GW and 17 GW
- Offshore wind capacity (assuming 45% capacity factor)
  - Between 145 GW and 39 GW
- Nuclear generation capacity (assuming 95% capacity factor)
  - Between 34 GW and 0 GW

Where will all this be?

Figure: Dixon, James, Bell, Keith and Brush, Susan (2022), Which way to net zero? A comparative analysis of seven UK 2050 decarbonisation pathways. *Renewable and Sustainable Energy Transition.*

Historical UK Generation Capacity Building Compared with Future Projections



Mapped: How the UK generates its electricity, Carbon Brief, October 2015, quoted in *Engineering Net Zero*, Atkins, January 2020

A lot of new generation capacity is needed…

…but would need even more without flexibility

Cost matters

University of Strathclyde Engineering

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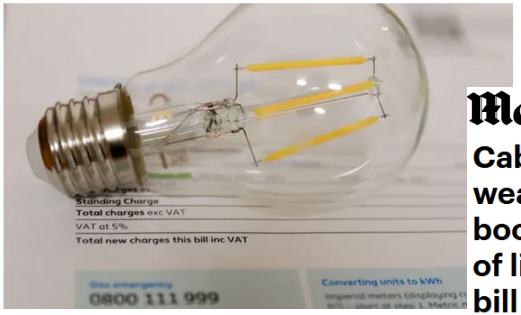
The Guardian — For 200 years — News website of the year

Ofgem

Energy bills to rise as Ofgem brings forward price cap announcement

Regulator will unveil highest-ever increase on Thursday as government considers how to protect households



Jillian Ambrose
Energy correspondent

Wed 2 Feb 2022 11.36 GMT

Mail Online — News

Cabinet ministers tell Boris Johnson to weaken Net Zero green plans and boost UK gas production to help cost of living crisis as experts warn energy bill rise threatens to DOUBLE number of families suffering 'fuel stress' to FIVE MILLION

- **Prime Minister facing pushback from Cabinet over Net Zero plans for the UK**
- **Involves revolution at home and on the streets with new boilers and electric cars**
- **Ministers are said to want attention to be paid to domestic gas production**

By DAVID WILCOCK, WHITEHALL CORRESPONDENT FOR MAILONLINE
PUBLISHED: 10:37, 4 February 2022 | **UPDATED:** 14:09, 4 February 2022

Citizens Advice response to Ofgem Consultation on the initial findings of our Electricity Transmission Network Planning Review

17 December 2021

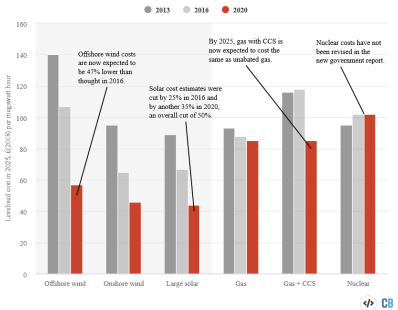
Citizens Advice response to Ofgem Consultation on the initial findings of our Electricity Transmission Network Planning Review [270 kb]

The growth in offshore renewables and the increased provision of system flexibility to support decarbonisation should be at an efficient cost for consumers. The ETNPR is an important addition to the OTNR in pursuing this objective because it can support the efficient utilisation of offshore wind in the energy system to support Net Zero through strategic investment. It should align network development in both the transitional and enduring onshore regimes with equivalent programmes offshore, to enable a consistent process of energy system development.

Good news and not so good

- Lots of low carbon electricity will be needed
- The levelised cost of energy of wind is the lowest of technology options
- Can merchant investment be relied on deliver enough as old fossil fuelled plant retires?
- Will an energy-only market suffice?
- Or do we require extra incentives for low carbon generation and penalties for high carbon?

Levelised cost of energy
UK Govt. estimates, £(2018)/MWh



https://www.carbonbrief.org/wind-and-solar-are-30-50-cheaper-than-thought-admits-uk-government

- We also need sufficiently reliable supply
- In the old days, if you developed capacity
  - you also got energy and
  - confidence in that energy being available at all the times that you need it*.
- We need a flexible resource that can fill in the gaps when it's not windy and not sunny
- Flexibility reduces need for capacity
- How do you get flexibility?
- What is it, really, and how much do we need?

How do we get enough low carbon energy at the right times?

* Miners' strikes and gas pipeline failures aside

Market and regulatory challenges

High wholesale prices
- Dependency on natural gas

Build more renewable capacity
Develop low carbon flexible resources

Uncertainty for renewables investors

Weak PPA market
High network charges
Consenting risk

AR4 under way; AR5 coming

High network constraint costs
- Lack of network capacity
- Lack of strong locational signal

Locational TNUoS isn't done very well
Distribution charging is disconnected from TNUoS
Transmission capacity has not been anticipatory

Lack of flexible demand
- Ability to provide it
- Ability to measure it

EVs and electric heat in well insulated homes not really happened yet

Half-hourly – "smart" – metering!

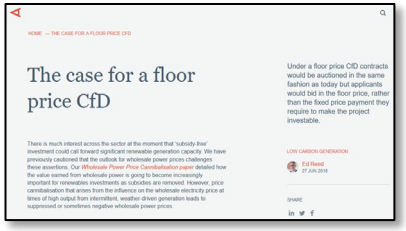
Lack of flexible/schedulable/persistent low carbon sources of energy

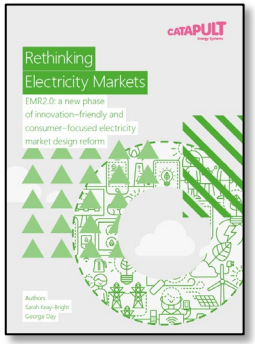
Need not really been signalled yet?

What fixes have been proposed?

All energy trades must be physically firm
- Each operator of variable renewables needs a back-up

CfD with negative price rule





Floor price CfD

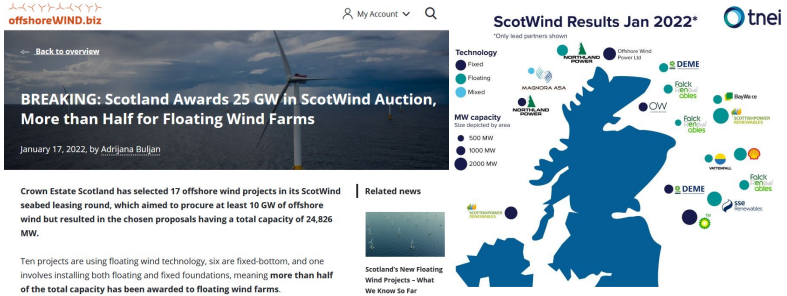
Place a low carbon obligation on Suppliers

Let energy users choose what level of reliability they want
- The market is difficult enough to understand as it is?

How would this affect
- wind investment in Scotland?
- total cost of electricity?

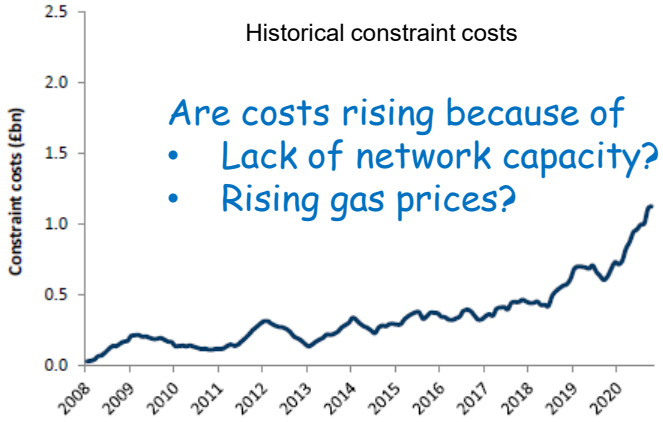
Prices must be set as a function of both time and location
- Extra volatility?
- Postcode lottery for demand?

Lack of network capacity

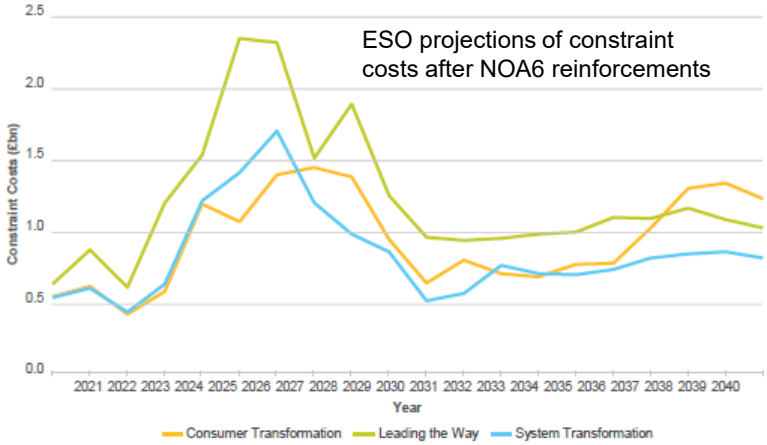


Peak Scotland-England flows could be as high as 14 GW with connection of 10 GW of new wind

- Export capability today ~6.5 GW
- With 4 × 1.4 GW HVDC links, capability grows to ~12 GW



ES MBSS data, presented by FTI, *Operation market design: Dispatch and Location*, January 17th 2022



ESO Net Zero Market Reform report

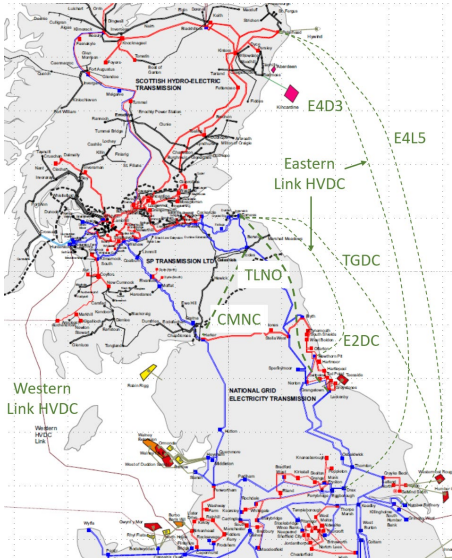
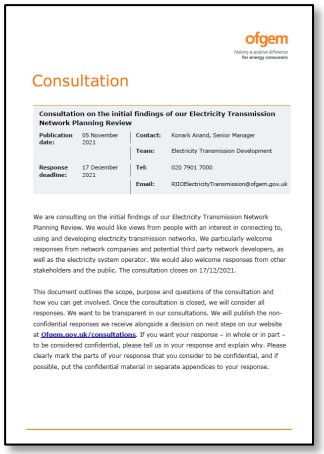


Figure: SP Transmission/NGESO

It’s not the despair; it’s the hope



ofgem

Making a positive difference for energy consumers

Consultation

Consultation on the initial findings of our Electricity Transmission Network Planning Review

Publication date:	05 November 2021	**Contact:**	Konark Anand, Senior Manager
		Team:	Electricity Transmission Development
Response deadline:	17 December 2021	**Tel:**	020 7901 7000
		Email:	RIIOElectricityTransmission@ofgem.gov.uk

We are consulting on the initial findings of our Electricity Transmission Network Planning Review. We would like views from people with an interest in connecting to, using and developing electricity transmission networks. We particularly welcome responses from network companies and potential third party network developers, as well as the electricity system operator. We would also welcome responses from other stakeholders and the public. The consultation closes on 17/12/2021.

This document outlines the scope, purpose and questions of the consultation and how you can get involved. Once the consultation is closed, we will consider all responses. We want to be transparent in our consultations. We will publish the non-confidential responses we receive alongside a decision on next steps on our website at Ofgem.gov.uk/consultations. If you want your response – in whole or in part – to be considered confidential, please tell us in your response and explain why. Please clearly mark the parts of your response that you consider to be confidential, and if possible, put the confidential material in separate appendices to your response.

“move away from the current broad scenario-based approach used in the FES to a less mechanistic approach that makes assumptions, at least for the nearer term future, that are governed more by strategic thinking”

a centralised transmission network planning process “could send clear earlier signals to users of the system (e.g. offshore wind, hydrogen electrolysis plant etc.) about where and when key parts of the [electricity transmission] network will be built, their high level design, and potential impact on network charges. This could help inform their decisions on siting, capacity etc. and could enable efficient and timely investment by those users.”

The times they are a-changin'

University of Strathclyde Engineering

What's the money being spent on?

Capacity (power)	Utilisation (energy)
Investment	Operation
Assets	Data

How much uncertainty is there in a particular arrangement?

- Can you model it?
- If you can't model it, you can't invest against it!

Stephen Nash, February 2022

On what basis?

Market-led	Coordinated
Consumer choice	Consumer protection
High risk	Low risk

Who's spending it?

Low appetite for risk	High appetite for risk
Significant resources	Minimal resources
Incumbent	New entrant
Regulated	Subject to competition

What kinds of failures might happen?
Who bears the consequences of them?

University of Strathclyde Engineering

Spare slides

Locational signals (1/2)

University of Strathclyde Engineering

1. It cannot be assumed that generation is next to demand. Electricity network capacity is needed.
2. It's not unreasonable to try to keep the total cost of energy as low as possible.
   - One element of that is the cost of the network.
   - Why not try to encourage developers to use network capacity that's already there rather than cause extra cost to be incurred by building more?
3. Renewables in Scotland, to a large extent, depend on the GB market and consumers in England to earn revenues. That requires transmission network capacity, not just within Scotland but also down through England.
4. TNUoS intends to reflect the network costs of different choices by developers
   - Developers are better placed than anyone to know the effects on total generation costs of the ability to get planning permission, the wind resources, local impacts of developments and network costs in different places.
   - Many other countries communicate locational signals via zonal or nodal pricing
5. It's true that, because generation in Scotland requires more transmission to get to the main demand centres than generation further south, TNUoS charges are higher in Scotland.

Locational signals (2/2)

University of Strathclyde Engineering

6. Having said all the above, it is fair to ask whether the current TNUoS methodology is accurate and appropriate, e.g.
   - to what extent does it give ‘forward looking’ signals?
   - are the various terms such as the ‘expansion constant’ and load factor calculated correctly?
7. Also fair to ask whether pursuit of low cost at all costs might get in the way of fast enough emissions reduction or wider economic benefits, e.g. for a local supply chain, and the difference that different actions will make.
8. One major problem is that, wherever new wind farms end up being located across GB, major network developments are needed in order to utilise the energy produced in different places.
9. These network developments are the responsibility of Transmission Owners (TOs), and planning permission will be a major risk. To what extent do these risks need to be signalled to generation developers or passed on to generation developers?
   - Ofgem has started a major review of how transmission development is done.
   - With the introduction of competition into the transmission development process for major projects (which Ofgem is pushing), we can’t be sure who the TO will be.

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Morag Watson
Director of Policy, Scottish Renewables

Andrew Urquhart
Head of Whole System, SSEN Transmission

Adam Morrison
Project Director for Moray West Offshore Wind Farm, Ocean Winds

Keith Bell
Holder of the ScottishPower Chair in Smart Grids,
University of Strathclyde

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The role of networks in the transition to net-zero

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Claire Mack

Chief Executive

Scottish Renewables

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The 2030 grid vision for Scotland

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Scottish & Southern Electricity Networks TRANSMISSION

Claire Mack
Chief Executive, Scottish Renewables

Stephanie Anderson
Head of Regulation | Network Planning and Regulation,
SP Energy Networks

Bless Kuri
Head of System Planning and Investment, SSEN Transmission

Tom Steward
Senior Regulatory Affairs Manager, RWE Renewables

Claire Jones
Head of Onshore Electricity Policy, The Scottish Government

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The Role Of Networks In The Transition To Net-Zero

2030 Grid Vision for Scotland

24 February 2022

SP ENERGY NETWORKS

Scottish & Southern Electricity Networks

TRANSMISSION

Major Energy Networks Projects: Investment Drivers to Net Zero

Major energy networks projects across Scotland, in the period to 2050, are being driven by the need to: (i) deliver new connections, both onshore and increasingly offshore; (ii) reinforce the main electricity transmission system; (iii) modernise our assets and; (iv) ensure security and operability.

Based on 2021 Future Energy Scenarios (FES):

In Scotland:

23-33 GW of onshore and offshore wind by 2030, and up to

52 GW by 2040.

Leading to a

15-23 GW transfer requirement by 2030 between Scotland and England (existing transfer capability is 'only' 6.6GW), and up to

30GW by 2040.

With the drive for Net Zero by 2050, significant increase in generation in Scotland required, in locations of low or no existing transmission network.

Investment needed for access to these resources, and existing networks need reinforced to accommodate such high levels of transfer to demand centres.

Constraint costs already significant and set to increase, with last November seeing costs of £290 m for Scotland alone – **even at current levels of generation, reinforcement is required**

Forecast constraint costs even with full suite of reinforcements at **over £1bn a year across GB by 2030.**

With high levels of renewable penetration, system operability issues must also be managed.

Consistent with our statutory duties and licence obligations, we consider integrated solutions to address multiple system needs, where it is appropriate to do so.

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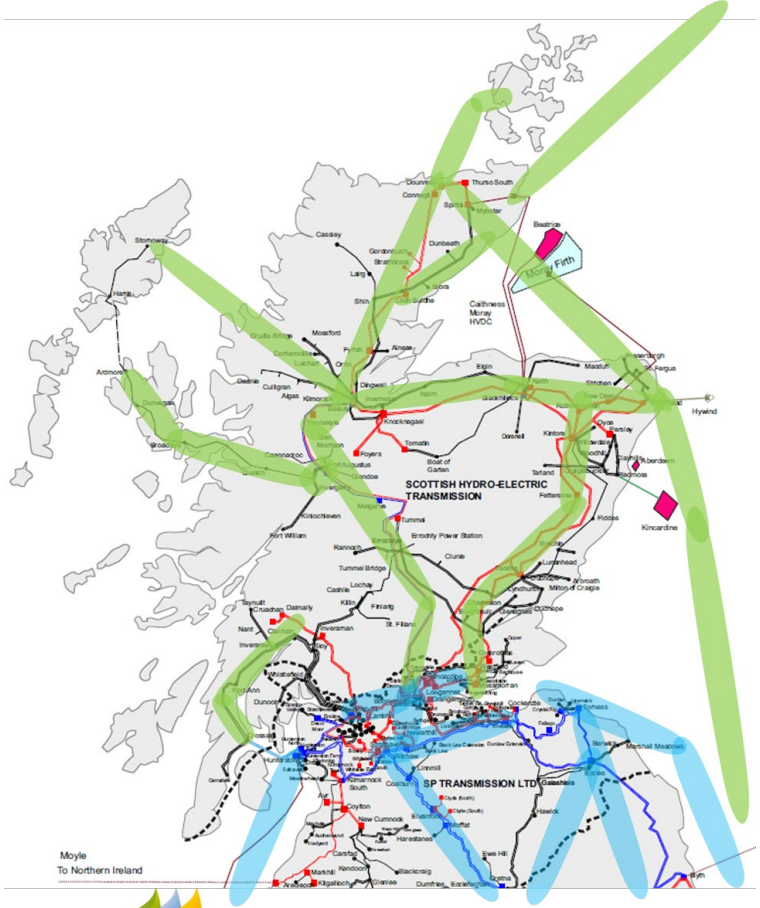
Scottish onshore grid reinforcement

- The scale and pace of the net zero transition is unprecedented
  - Renewable generation growth driving major transmission reinforcement
  - Significant storage connections activity
- Large Onshore Transmission Investments (LOTI) identified via:
  - The Network Options Assessment (NOA)
  - Outside the NOA
  - Upcoming Holistic Network Design + NOA 2021/22 Refresh
- Technical considerations
  - Pushing the boundaries of transmission technologies
  - Maintaining secure and economic system operation
- 2030 offshore wind target challenging
  - Coordination across a wide range of stakeholders necessary
  - A different approach to the connection application process
  - A different approach to regulatory investment approval



*Please note that this is an illustrative map only. For EISD and the latest updates, please refer to the most up to date NOA

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