October 2024

Let's learn from best practice overseas and make it a GREAT grid upgrade.

Introduction

We can have a grid upgrade that is good for consumers, communities, and the environment, but here in the UK, sadly the discussions about how to achieve this leave much to be desired, focusing solely on pylons, and terms such as NIMBY, blocker and obstructionist are bandied about all too liberally. It is essential instead to have a serious national conversation about how to achieve a **great** grid upgrade.

A Clean Power 2030 review[1] is under way. Work on the national Strategic Spatial Energy Plan[2] has been commissioned. And the Planning and Infrastructure Bill will, in due course, wend its way through Parliament.

Let's make sure that we learn from the many other countries which recognise that there are many ways to upgrade the grid.

Take the USA. It is a requirement that the existing grid be upgraded before new infrastructure is built. Look also at Germany – pylons are a last resort, and high voltage direct current undergrounding is preferred. And see how our North Sea neighbours are creating an integrated offshore grid instead of the damaging and expensive point-to-point approach of the UK.

To ensure the best outcome, three things need to change:

i. **Pylons the last resort.**

National Policy Statements (England) should favour upgrading the existing grid, offshore integration, and HVDC undergrounding ahead of overhead lines (i.e. removing the strong starting presumption in favour of pylons).

ii. **Follow Treasury guidance for best outcomes.**

Treasury Green Book guidance must be adhered to by transmission operators and enforced by Ofgem, the Planning Inspectorate and the Secretary of State. It is mandatory, after all.

iii. **Compensation - NOT benefits.**

There must be full compensation for homeowners and businesses when grid projects go ahead. Transmission operators must have 'Discretionary Purchase Schemes', as other Statutory Undertakers do. ‘Community benefits’ must be in addition to compensation, not instead of it.

The UK has so much to learn. We should aim to be a leader, not a laggard.

1. Nuts & bolts - use what we have

If you were told you could double transmission capacity[3] without building a single new pylon, you would choose that, surely?

The United States recognises that the most efficient, cost-effective, and least damaging way to upgrade the grid is to optimise the existing grid before building new infrastructure.

In May this year, an Order known as Federal Energy Regulatory Commission 1920[4], was launched. This Order mandates the use of Alternative Transmission Technologies (ATTs) such as dynamic line ratings, advanced power flow controls, advanced conductors and transmission switching before building costly and damaging new infrastructure.

Reconductoring alone offers huge benefits. New technologies enable two to three times more power to be carried over existing infrastructure. It has been found to be a particularly promising, viable and '*cost-effective, implementation-ready solution that is deployable to scale*'[5].

Also in the United States, in California a private developer proposed converting an existing 500kV line to HVDC instead of building a new 180-mile line as originally proposed by the System Operator. This alternative proposal would re-use existing towers, conductors and insulators and increase the capacity from 1.3GW to 3.5GW. Costs, environmental and planning barriers would all be materially reduced.

Why would you not choose a solution that allows you to build additional capacity into the existing system to 'unlock otherwise stranded clean energy, especially sources available near existing grid infrastructure, helping meet electricity demand and contributing to grid decarbonization'?

This approach should be made a mandatory requirement here, and National Policy Statement EN-5 must be updated to reflect a requirement to use existing infrastructure first.

2. Going underground (HVDC)

If you could keep communities happy, and reduce costs by using the most up-to-date undergrounding technology instead of pylons, you'd choose that option, surely?

Unlike in the UK, in Germany preference is given by law (in the Federal Requirements Plan) to underground cables[6]. Germany favours underground cables to mitigate public opposition, protect natural landscapes, and address concerns about the visual and environmental impact of overhead lines.

High-voltage direct current (HVDC) transmission lines are often the chosen technology. HVDC benefits include reduced transmission losses, greater stability and control, lower strength EMF, fewer cables, and cost effectiveness over long distances. HVDC cables require far less space and narrower trenches than High Voltage Alternating Current (HVAC) and cause considerably less disruption to residents during installation.

The German approach has been essential in gaining public support for large-scale infrastructure projects. Prysmian Group[7], for example, uses powerful ±525 kV HVDC underground cable technology. Amprion (a German transmission operator) takes an innovative approach which demonstrates that the use of one 525kV plastic-insulated cable system carrying 2GW of power, can reduce the trench size still further. Cable-ploughing is also an effective way to reduce costs and physical damage and speed up undergrounding.

Here in the UK, two reports published in 2024 demonstrate that underground HVDC is a very cost-effective solution, better than overhead lines.

The first was the East Anglia Network Study[8] for the National Energy System Operator[9]. It found a £600m saving in an option using underground HVDC instead of overhead lines if a completion date of 2034 was selected instead of 2030. Given that an independent report[10] for the county councils of Essex, Suffolk and Norfolk established that the regional grid has sufficient capacity

until 2034, it surely makes sense to select the most cost-effective and more popular option instead of the reviled and damaging overhead line proposal?

The second was a National Grid document[11] for Eastern Green Link. It found that overhead line technology was 'not considered to meet the identified need for additional transmission system capacity'. Reasons given included:

- Power flows on AC transmission system circuits cannot be controlled to the same extent as can be achieved using HVDC connections.
- The required capacity HVDC links over the proposed distance have comparable capital costs, but much lower lifetime costs than the alternative onshore AC option in this case.
- …delivery of an onshore solution with a long route length, carries much higher delivery risk than the HVDC reinforcement proposals.
- The use of overhead lines is not considered to be feasible because they cannot be delivered by 2030.

One of the criticisms of HVDC is that it is best for long distance point-to-point connections without mid-way connection points. Amprion has overcome this in Germany and is constructing the world's first hybrid, multi-terminal HVDC link, between Lower Saxony and Baden-Württemberg.

If you have heard previously that undergrounding is five to ten times more expensive than pylons, that is because it relates to High Voltage Alternating Current (HVAC) undergrounding, as preferred by National Grid. Not only is AC undergrounding expensive, but it is also extraordinarily destructive, requiring a construction swathe 120metres wide[12] (sometimes up to 220metres).

And finally, it is little known that **underground cables do not always require planning consent**. It is for A Secretary of State to decide whether a proposal should be designated as a nationally significant infrastructure project. Protections for the environment, heritage and communities are needed but undergrounding could be significantly faster than overhead lines.

Underground HVDC should be the preferred option, not overhead lines.

3. Offshore coordination

If you could halve transmission infrastructure, save £2 billion (in the North Sea alone) and reduce harm to the environment and communities, you'd choose this approach. surely?

Study after study has highlighted the benefits of an integrated offshore grid.

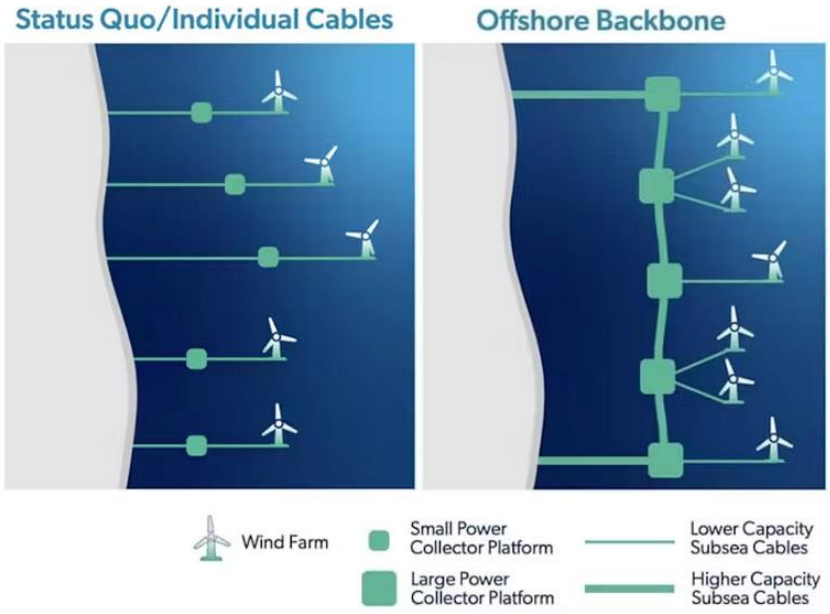
Government even refers to one of these studies in National Policy Statement EN-5, stating, *"The coordinated approach is likely to provide the highest degree of consumer, environmental and community benefits."*

Yet despite this, our UK offshore model still runs on a **point-to-point** or **radial** approach. Every offshore wind farm or interconnector operates in isolation. That's bad for consumers, the environment, and communities and bad for the operation of the grid.

An integrated offshore grid would connect offshore wind power in the North Sea, keeping it offshore as long as possible. Wind farms would be linked to energy islands and interconnectors. Landing points should be at brownfield sites close to where power is consumed. In the East of England this saves £2billion versus the current piecemeal approach & reduces overall infrastructure by 50%.

Details of the £2bn saving and other benefits were set out in National Grid ESO's 2020 report, and this year an academic study [13] confirmed cost savings through integration. Integration savings were previously set out in the 2015 Integrated Offshore Transmission Project East[14]. This report built on the Crown Estate's and National Grid's 2011 Offshore Future Network Transmission System review. It was reported[15] that in 2011, "*National Grid has shown an offshore network would be more cost effective, reduce the number of cable landing sites and minimise onshore reinforcement requirements*". (Curiously, this study has disappeared from all previously published links on the Crown Estate, National Grid, and other pages).

Lest there be any remaining doubt about the benefits of offshore integration, this approach is also being considered in East Coast United States. Here, ten states and the U.S. Department of Energy[16] are working on a potentially transformative solution which coordinates wind power offshore. This schematic[17] illustrates perfectly how an integrated approach reduces infrastructure:



As here in the UK, there is plenty of research that indicates that an offshore grid would help to reduce challenges of building transmission lines on land and reduce costs.

This includes the Atlantic Offshore Wind Transmission Study[18], which found that offshore coordination results in:

- Reduced curtailment, reduced usage of higher-cost generators, and contributions to reliability.
- Greater grid reliability (by enabling resource adequacy and helping manage the unexpected loss of grid components (contingencies)).
- Benefits outweighing the costs, often by a ratio of 2 to 1 or more. Offshore networks with interregional interlinks provide the highest value.

A second study by Brattle[19] found that, "*starting proactive planning for these long-term offshore wind generation needs now likely will save U.S. consumers at least $20 billion and reduce environmental and community impacts by 50%. Doing so will also support the timely achievement of policy goals, increase reliability, lower development, and investment risks, increase energy independence, and improve climate resilience." And it notes an "urgent case for proactively and holistically planning transmission solutions for the nation's increasingly ambitious offshore wind goals.*"

For full integration, HVDC switches will be required, in case of grid failure. In Germany, Amprion is already cracking on with the job of planning for coordination offshore with research into these switches. The company recognises the huge number of benefits of integration, saying grid operators can, *"respond to the congestion situation flexibly when integrating the power from offshore wind farms. If the offshore grid integration systems are not fully utilised, additional transmission capacity can be provided thanks to the offshore interconnectivity. This lets onshore grid congestion be defused or remedied effectively, avoiding the need for redispatching."*

Given that the UK now has around 15GW of offshore wind, but apparently needs to achieve 50GW to meet targets, there is simply no option but to coordinate offshore. Every point-to-point project that is connected simply brings more environmental and socio-economic damage, and great cost to consumers.

There is no excuse for our government not to ensure that all necessary steps are taken for early coordination of more wind farms into offshore platforms and/or interconnectors (as with the offshore hybrid assets programme).

4. Pylons, the last resort

If you knew all of the above and that pylons are not as cheap as government and National Grid would have you believe, you would insist that they are the last resort, surely?

Pylons must be the last resort, only considered once all the options above have been exhausted.

Pylons are not cheap

Pylons projects, contrary to public belief and official pronouncement, are not cheap.

Our own analysis[20] shows that one project, the 180km Norwich to Tilbury[21] proposal, will cost between four and eight times more than National Grid's stated cost.

That is because:

- When compared with other overhead line projects, Norwich to Tilbury is unusually cheap – despite it being National Grid's longest and riskiest project.
- Socio-economic and natural capital impact has not been presented as it should be under Treasury Green Book guidance.
- Contrary to Green Book guidance, instead of the required 40% contingency, only 10% contingency has been included.
- Biodiversity Net Gain costs have not been included and, depending on how 10% net gain is achieved (voluntary agreements, compulsory purchase or purchase of statutory credits), it could cost hundreds of millions of pounds.
- Community Benefits have not been included. Government has not published details of how the benefits scheme will work but, based on proposals under the previous government, 'pounds for pylons' will cost hundreds of millions of pounds.

What's wrong with new pylons?

- Millions of trees and hedgerows will be uprooted.
- The setting of heritage assets will be destroyed and countryside views painted by Constable, Munnings & Gainsborough will be lost.
- Power lines kill birds (including 177 swan deaths in just one incident)
- Houses become unsaleable without huge discounts; mortgages refused.
- Businesses, including farms and tourist businesses affected.
- Damage to soils & farmland, reducing food security.
- A motorway grade haul road the entire length of the project requires millions of tonnes of aggregate.
- A swathe of destruction 40- to 80-metres wide for pylons and over 120-metres wide for the underground sections in the National Landscape and Waveney Valley
- Concrete for the 550 pylon bases; steel for the 550 pylons
- Countless HGV movements
- Soil carbon release

Less intrusive towers

In the rare scenarios when pylons are the only appropriate technology, steps MUST be taken to minimise their impact. For example, TS Conductor (a US company part-owned by National Grid) builds strong, lightweight, 'low sag' conductors which allow three times the power transmission of traditional conductors. If new towers are needed, the TS Conductor technology requires fewer and shorter pylons. Not only does that reduce the impact, but it also saves money and builds in more capacity for the future. TS Conductor is developing compact pylons for direct-current overhead lines.

National Grid must move on from using the same, 50-metre high, lattice towers it has been using for seventy years.

Costings must be transparent and like-for-like, and follow Treasury Green Book guidance.

5. Compensation

If your business or home is financially impacted by a national infrastructure project, you expect compensation, right?

When a transmission project takes place, residents, landowners, and business owners must be compensated for any financial impact arising from grid infrastructure.

So-called 'Community Benefits' barely scratch the surface and will be resisted. Benefits are not compensation.

Full equivalence must be paid both inside and outside the draft orders (online and offline). No-one should be out of pocket.

National Grid must be required to have a Discretionary Purchase Scheme[22] as other Statutory Providers do.

Conclusion: let's be leaders not laggards

We call for the adoption of modern grid-enhancing technologies, offshore integration, and underground HVDC cables to avoid the negative impacts of pylons. These alternatives are cheaper, better for the environment, and more popular with communities.

The nation's grid needs upgrading. Yet it must be done sensitively, in the best way possible for communities, consumers, and the environment.

Our own region faces 180km of pylons (with two short stretches of AC undergrounding) across the three beautiful counties of Norfolk, Suffolk, and Essex. These new pylons will cause terrible harm to our region's wildlife and habitats, history and heritage, landscapes, and businesses. The project, proposed by National Grid Electricity Transmission, is already causing huge heartache and mental health issues.

We are fed up with hearing that pylons are the only way or the cheapest way. That is simply not true. Better and cheaper ways include an integrated offshore grid, underground HVDC cables and upgrading the existing grid.

We seek a revision of the National Policy Statements, enforcement of adherence to Treasury Green Book guidance and full compensation for those affected by grid projects.

We need a GREAT grid upgrade that's good for everyone and the environment.

Essex Suffolk Norfolk Pylons action group

www.pylonseastanglia.co.uk

pylons180@gmail.com

Queries to Rosie Pearson

SOURCES

[1] Clean Power 2030 | National Energy System Operator (neso.energy)

[2] Strategic Spatial Energy Plan: commission to NESO (publishing.service.gov.uk)

[3] How US utility companies could double electric transmission capacity by 2035 (techxplore.com)

[4] Explainer on the Transmission Planning and Cost Allocation Final Rule | Federal Energy Regulatory Commission (ferc.gov)

[5] GridLab_2035-Reconductoring-Technical-Report.pdf (2035report.com) and https://www.smart-energy.com/industry-sectors/energy-grid-management/how-advanced-conductors-solve-four-key-grid-challenges/

[6] Amprion-Innovation-Report.pdf

[7] German HVDC cable projects - Prysmian Group

[8] https//www.nationalgrideso.com/document/304496/download East Anglia Study 2024

[9] National Energy System Operator (NESO) | National Energy System Operator

[10] n2t-the-hiorns-report (suffolk.gov.uk)

[11] Paragraph 5.02. https://www.nationalgrid.com/document/151426/download

[12]Layout1 (nationalgrid.com)

[13] download (neso.energy) & Benefits of an integrated power and hydrogen offshore grid in a net-zero North Sea energy system (Published in Advances in Applied Energy 7, 2022, 100097

[14] download (neso.energy)

[15] Connection_arrangements_for_offshore_renewable_generation_consultation_paper_-_March_2013.pdf (uregni.gov.uk)

[16] Atlantic Offshore Wind Transmission Action Plan | Department of Energy

[17] Source: Offshore wind farms connected by an underwater power grid for transmission could revolutionize how the East Coast gets its electricity (theconversation.com)

[18] Atlantic Offshore Wind Transmission Study | Wind Research | NREL

[19] The Benefit and Urgency of Planned Offshore Transmission: (brattle.com)

[20] Reports - Pylons East Anglia

[21] Norwich to Tilbury | National Grid ET

[22] your-property-and-our-road-proposals.pdf (nationalhighways.co.uk)