HEINRICH BÖLL STIFTUNG
BRUSSELS
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Author: Simon Skillings, Director, Trilemma UK Ltd & Lead Specialist – Energy Systems, E3G

Updating Europe's energy networks: Lessons from the UK experience of independent system operation

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SYSTEM CHANGE

New approach for system planning

The current institutional design for EU electricity grid planning and operation was established for a different set of challenges from those we face today. Changes in supply and demand were relatively slow, allowing time for new network to be built to meet evolving system need. Services needed to ensure system operability were provided by a fleet of fossil-fired power generators.

The ongoing energy system transition has created an entirely new paradigm. Renewable generation is being built at pace and scale, seeking new grid connections and forcing fossil fuel generators to close. New resources, such as demand response and storage, are increasingly required to maintain operability, and electricity demand is expected to increase significantly over the next decade.

Also, the need for a fossil gas network will gradually diminish whilst new demands for hydrogen will emerge, primarily to help some emission-intensive industries decarbonise and to offer long-duration energy storage for back-up power supplies.

Co-ordinating these changes in supply, demand and network cost-effectively is a major challenge. The core role of network planning is now to anticipate future system need rather than simply decide the best way to deliver known requirements. Much new network will be needed, in addition to better use of existing assets. This is already placing significant pressure on the planning and permitting processes.

The need for new institutions

Coping with these changes requires existing institutions to work together and in different ways. However, questions are being raised about the ability of existing institutions to adapt and whether new institutions are required.[1]

- Is the emergence of grid connection bottlenecks across most EU countries suggesting that reform is necessary to avoid delaying the transition?
- Can current processes deliver cost-effectiveness by ensuring we are investing in the right mix of assets?
- Is there an inherent bias towards investment in new network arising from the profit motivation of Transmission System Operators (TSOs)?
- Is the process too complex with gas and electricity grid operators on both the transmission and distribution grid levels undertaking similar tasks, but on separate timelines and with limited co-ordination?

The UK government recently took the decision that an independent cross-sectoral system operator and planner was required, and the National Energy System Operator (NESO) was established in 2024. Experiences from the first year of operation are now emerging, shedding new light on the opportunities and challenges presented by an independent system operator and planner in tackling the energy system transition.

1 For example, Conall Heussaff/Georg Zachmann: Upgrading Europe's electricity grid is about more than just money, February 2025.

The EU is currently considering how simplification of the regulatory framework can help remove administrative hurdles and promote investment. This paper sets out some emerging learnings from the UK experience and considers the opportunities for a more streamlined electricity planning process across Europe.

UK EXPERIENCE

NESO functions

NESO was established on 1 October 2024 and undertakes those activities traditionally associated with system operators, such as balancing supply and demand and managing new connections to the transmission network. However, it also undertakes additional roles to support the energy transition, and the regulatory framework has been updated to reflect these new requirements. For example, it has developed an enhanced energy insights capability to support policy making by the regulator and government. Also, it is coordinating the delivery of the data sharing infrastructure for the energy sector. However, the most significant changes from the previous regime relate to planning activities. The path to the creation of NESO is set out in Box 1.

Box 1: the creation of NESO

System operation and planning was integrated with network ownership when the Great Britain (GB) power system was liberalised. The government first introduced business separation requirements in 2013 to address conflict of interest concerns that the system operator would take decisions that would increase profits for the network business. In 2019, the government and regulator implemented formal business separation of electricity system operation functions within the National Grid Group. This included separate licences, distinct governance, different staff and ringfencing of information.

The net-zero delivery agenda raised further concerns over the role of system operation beyond those related to conflict of interest. It required new and enhanced roles and functions, including network planning and development, competition to fulfil specific system needs, co-ordination (both across energy sectors and regional decarbonisation), and developing engineering and data standards.

The regulator undertook a review of system operations.[2] It concluded that net zero required a step-change in whole system coordination and planning, and recommended that: new functions should be undertaken by those with the necessary expertise and capabilities; greater co-ordination was required; and key strategic decisions needed to be informed by whole-system insight and impartial technical advice. The government concluded that the electricity and gas system operators already possessed many of the qualities required to fulfil these functions and creating a new organisation from scratch would take time, as well as constitute unnecessary duplication.

However, the business separation provisions introduced to manage conflicts of interest would require an overhaul to allow electricity and gas system operation to be effectively integrated. Moreover, concerns remained that an organisation structurally embedded within a network company would not be able to effectively discharge the new functions.

It may choose not to engage in a topic because of potential conflicts, the government and regulator may be tempted to verify the advice given, and industry parties may change their behaviour towards the system operators based on a perception of conflicts of interest.

The government therefore concluded that residual concerns about conflicts of interest meant that the system operators could not effectively discharge the new functions and it needed to create an independent system operator and planner. It consulted on detailed proposals for a publicly owned, not-for-profit entity, funded through a charge on energy consumers, in 2021.[3] The decision to go ahead was made in 2022, and the necessary enabling legislation was included in the 2023 Energy Act.

The Strategic Spatial Energy Plan

The government has commissioned NESO to produce a Strategic Spatial Energy Plan (SSEP) for Great Britain. The first version, focusing on electricity generation and storage and hydrogen assets, will be published in 2026. The SSEP will be updated regularly, with later iterations to include fossil gas. It will set out the optimal locations, quantities and types of energy infrastructure envisaged over the next 25 years, and will be used to develop a Centralised Strategic Network Plan (CSNP), which will identify the energy networks needed to support these supplies and demands.

2 Ofgem: Review of GB energy system operation, January 2021.

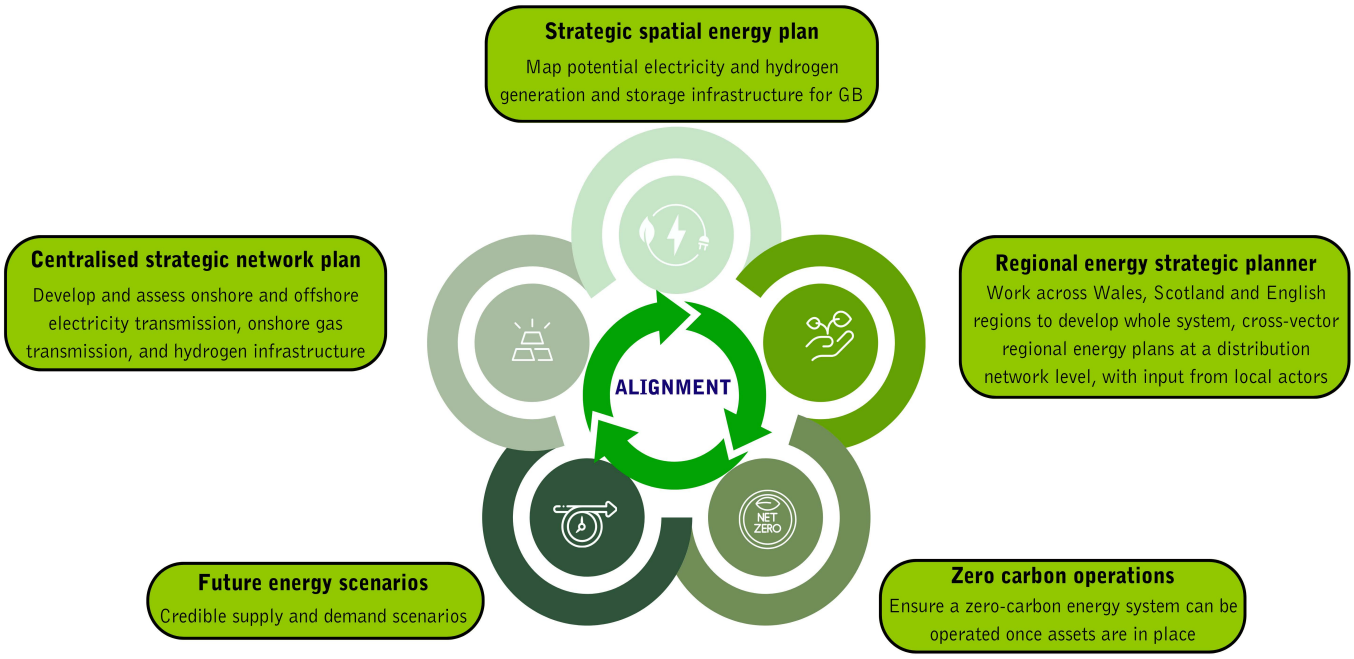
3 UK Department for Business, Energy & Industrial Strategy/Ofgem: Proposals for a Future System Operator rolee. Consultation outcome, July 2021.

The CSNP will be a whole system plan, addressing the interactions between fossil gas, hydrogen and electricity, and the first iteration is due to be published at the end of 2027. Given the importance of the offshore network design for onshore network requirements, an offshore design must be agreed by mid-2026 to allow this timescale to be met.[4]

NESO has also been appointed to establish Regional Energy Strategic Plans (RESPs) aimed at ensuring coherence between local ambitions, distributed demand growth, embedded generation and ambitions at the GB level. The first set of regional plans is due in 2027 and will primarily drive investment in distribution networks. RESPs will feed more granular, bottom-up data into the SSEP to ensure that the CSNP triggers sufficient transmission investments, considering the demands at the transmission/distribution interface.

These processes are illustrated in Figure 1.

Figure 1: Interactions between NESO's strategic planning activities (Source: NESO)



Source: NESO. Design: Aleyna Naz Coskun & Joan Lanfranco.

EMERGING IMPORTANCE OF STRATEGIC SPATIAL PLANNING

The process of producing an SSEP is now underway, and whilst there is still a long way to go, some insights of the potential benefits are beginning to emerge. These point to three key areas where a spatial energy plan can ensure a successful energy transition: permitting speed and fairness, timely policy decisions and the delivery architecture.

1. Permitting speed and fairness

The SSEP will be fundamental to anticipatory investment and will do three things:

- Establish the requirement for new network in anticipation of future needs.
- Create the option for energy development in certain areas by providing grid connection capacity.
- Foreclose the option for energy development in other areas by limiting grid connection capacity.

4 This gives relatively little time for TSO members of the EU North Seas Energy Co-operation (NSEC) to work with NESO to co-ordinate offshore plans, and strong political direction will need to be provided at the NESC heads of government summit in January 2026. See also, Simon Skillings: Making the most of North Sea renewables: recommendations for EU and UK energy infrastructure policies, November 2024.

It was originally conceived to help accelerate the deployment of network infrastructure. The need case will be approved by the economic regulator at the system level, avoiding assessments for individual projects. Also, strong guidance will be given to the planning process regarding the alignment of need case, system configuration and design with national priorities, environmental management and economic efficiency,[5] thereby restricting planning reviews to purely local matters.

Achieving this goal requires that alternative energy systems pathways with different environmental and nature impacts are considered and discussed with relevant stakeholders, allowing a clear understanding of nature/cost trade-offs to emerge. The political prize is that it will provide a strong narrative to those affected by local impacts (development or absence thereof) that their treatment has been fair in the national context and alternative system choices would have created worse outcomes for the country.

Proposals for specific energy developments (including networks) will still need to be produced by project developers, including TSOs, and assessed by the Regulator and Planning Authorities. However, delivering a sense of fairness through transparent system-wide analysis will be critical to creating the political conditions that allow faster grid planning and permitting, and ensuring that challenges are restricted to a narrow focus on local routing choices.

2. Timely policy decisions

The nature/cost trade-off is an example of the many policy decisions that must be taken by the government to enable the SSEP to be produced. For example, future demands for electricity will depend on heat, transport and industrial electrification strategies, and future demands for hydrogen will depend almost entirely on policy choices. Also, governments must decide how much to rely on innovative nascent technologies that have great potential but whose delivery at scale remains unproven.

The SSEP must separate technical from policy issues, identify the policy decisions that must be taken to enable the plan to be produced and present information to the government such that timely decisions can be made. NESO will achieve this through producing a series of 'pathways'[6] that involve different policy choices. For example, one pathway might look to restrict land use and the development of onshore renewables, whilst another might consider maximising renewable development to promote growth and export opportunities.

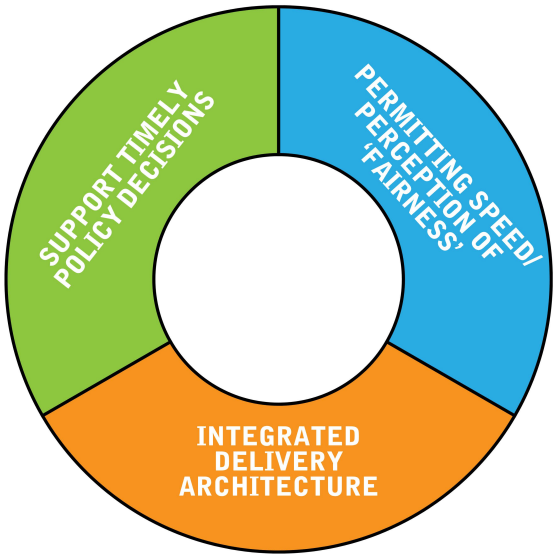
The government must then select a pathway as the basis of the plan that is informed by the alternatives presented. As a result of this choice, the government will make the important and necessary policy decisions that enable efficient anticipatory investment to proceed.

3. Delivery architecture

Once agreed, the SSEP establishes a whole system vision for the future where delivery in all aspects must be aligned. It therefore creates a clear picture of what must be delivered, where and by when, and informs the delivery ecosystem that is needed for this to happen. It is up to NESO to ensure the energy system can operate efficiently once the assets are in place (see Figure 1). However, there is a much broader task for the government and regulator to ensure all assets appear as planned.

This is especially important for emerging technologies. The UK government has already published a Clean Flexibility Roadmap, setting out how it will ensure delivery across the whole range of system flexibility, including demand-side response, short and long duration storages, and low carbon firm dispatchable power plants.[7] Once published, the SSEP will establish a complete picture of the assets that will be required, and this will provide early warning of the gaps in the overall delivery architecture that must be filled.

Figure 2: Outcomes that institutions must deliver to support energy transition



Source: Author. Design: Aleyna Naz Coskun & Joan Lanfranco.

5 UK Department for Energy Security and Net Zero: Accelerating electricity transmission network deployment: Electricity Networks Commissioner's recommendations, August 2023.
6 Note that these 'pathways' are different from 'scenarios'. Each pathway should consider a range of uncertainties and identify ways to minimise potential downsides.
7 UK Department for Energy Security and Net Zero: Clean Flexibility Roadmap, July 2025.

A spatial energy plan is an inevitable requirement for a transitioning energy system dependent on the rapid expansion to the energy network. It is likely to play an increasingly central role within the regulatory and market framework. For example, the UK government has decided that the SSEP, alongside the connections policy, is sufficient to ensure efficient asset location without the need to introduce locational wholesale prices.

Early experience from the UK suggests there are three outcomes that will result from a successful spatial energy plan that all EU countries should look to achieve:

- Permitting speed and fairness
- Support for timely policy decisions
- Drive of delivery architecture

This is illustrated in Figure 2, and these outcomes will be a measure of the success of the institutional frameworks across the EU that it must aim to deliver.

THE SITUATION IN EUROPE

Member State level

The institutional arrangements for system planning and operation are inevitably more complicated in the EU than in the UK. This is due to subsidiary requirements giving control over certain issues to individual Member States (for example, those relating to energy mix). The core system planning and operation functions are undertaken by TSOs who own the network (electricity or gas) and whose priorities are determined by economic regulators. There is often one TSO per country, and they are usually whole, or part, government owned.

Individual TSOs are responsible for creating Network Development Plans aligned with their country National Energy and Climate Plans (NECPs), which currently cover the period out to 2030. EU regulations also require Member States to prepare strategies for delivering mid-century emissions targets,[8] although these do not have a formal role in energy system planning.

Much of the impact of the energy transition will be felt at the local network distribution level. There is a risk that plans produced by TSOs and fed into the EU planning process (see below) will fail to reflect the real-world changes that are happening at the local level. It is important that processes are updated to ensure that local/regional needs feed into national and EU-level planning and operation through a regular and streamlined process.

EU level

Co-ordination at the EU-level is delivered by the European Network of Transmission System Operators for electricity and gas (ENTSO-E and ENTSO-G), as defined in the TEN-E Regulation.[9] They combine Member State plans (with adjustments to ensure compliance with EU-level targets) to produce Ten Year Network Development Plans (TYNDPs). These are used to identify strategically important EU-level network enhancements that will improve security of supply and the operation of the EU internal energy market, and help meet climate targets – so-called Projects of Common Interest (PCIs).

PCIs are identified on a regional basis, with national regulators and the EU Agency for the Coordination of Energy Regulators (ACER) checking that the TEN-E Regulation has been applied correctly by the ENTSOs. ACER provides an opinion on the draft regional PCI lists before they are finally adopted by the European Commission. This is a lengthy process. For example, ACER and the European Commission may take up to three months each to produce their opinion or approval, and the ENTSOs are given three months to adjust the Cost Benefit Analysis (CBA). Overall, these procedural steps take up to 18 or 27 months, depending on whether the CBA methodology requires an update. In addition, the ENTSOs are required to consult all stakeholders and consider input from Member States.

8 Regulation (EU) 2018/1999 of the European Parliament and of the Council on the Governance of the Energy Union and Climate Action, 11 December 2018.
9 Regulation (EU) 2022/869 of the European Parliament and of the Council on guidelines for trans-European energy infrastructure (TEN-E Regulation), 30 May 2022.

Despite this complexity, and the importance of the TYNDP in underpinning PCI selection, it is not mission based, or indeed a plan, but rather a collection of different infrastructure projects. There has been an ongoing debate in the EU about the governance of energy infrastructure planning and management. The challenge for the EU is the same as for the UK. The complexity and urgency of the energy transition demand national and cross-border energy infrastructure for electricity, gas and hydrogen to be well planned and delivered quickly. EU legislation requires ENTSO-E and ENTSO-G to jointly undertake infrastructure planning; however, ACER has repeatedly criticised the lack of a truly coordinated approach. Moreover, regulators and researchers often criticise the lack of (data) transparency, and the limited consistency between EU climate and energy targets with energy infrastructure scenario building and planning processes.

The report prepared by Mario Draghi for the European Commission[10] identified the delivery of energy grids as critical to EU competitiveness. He called for more EU-level planning and better coordination of National Development Plans, alongside improved central governance needed for decisions and market functions of cross-border relevance. He also argued for a European Coordinator for permitting to help reduce cross-border project delivery timescales. These process recommendations were in addition to the requirement for a massive increase in EU funding for grids. This increased funding was reflected in the most recent draft of the Multilateral Financial Framework, which reinforces proposals set out in the EU Action Plan for Grids.[11]

Introducing strategic spatial planning

Strategic spatial energy planning does not form a core element of the EU energy system planning process, although TSO plans are inevitably based on some view of the future energy system, including demand trajectories. Also, it has not been prominent in debates relating to the future of grid planning in the EU. However, early experience from the UK suggests that it is vital if the EU is to accelerate planning and permitting processes and deliver a low-cost energy transition at pace.

The European Commission has issued guidance to deliver anticipatory grid investment covering planning issues,[12] and Member States are already obliged to identify 'acceleration areas'[13] under the Renewable Energy Directive. Spatial energy planning is, therefore, already implicit in the EU's approach to creating grids fit for the future. Industrial competitiveness and simplification agendas have raised the need to increase speed in grid planning. Also, the recent blackout in Iberia has focused attention on the importance of interconnection and the need for improved transparency and oversight of grid operators – a call echoed by ACER in its proposals for the EU Grids Package.[14] Moreover, spatial planning can provide an effective vehicle to ensure local distribution-level needs are incorporated into national and EU plans.

The EU should now consolidate its approach to grid planning and ***focus on how the production and integration of long-term spatial energy planning can be embedded within the policy framework***, with a view to delivering the benefits outlined in Figure 2. The best institutional setup to deliver such plans will need more detailed assessment and will depend on political choices by Member States and EU institutions. However, it is likely that some improvements will be required both at the national and EU-levels to ensure the bodies responsible for planning can deliver the benefits. The European Commission should identify how to take the opportunity for reform as it considers the Energy Union Taskforce, the EU Grids Package, the simplification of the Governance Regulation and the re-opening of the TEN-E Regulation.

The evidence from the UK demonstrates that the solution does not lie with improvements to grid governance alone. Member State governments must be prepared to update planning laws and regulatory mandates. They must also respond promptly when effective spatial planning requires policy decisions to be made, and work with the regulator to ensure the right delivery framework is in place.

10 European Commission: The Draghi Report: The future of European competitiveness, September 2024.

11 European Commission: Grids, the missing link. An EU Action Plan for Grids, COM(2023) 757, November 2023.

12 European Commission: Commission Notice on a guidance on anticipatory investments for developing forward-looking electricity networks, C/2025/3291, 6 June 2025.

13 Designated land, sea or inland water areas where renewable energy deployment is expected to have no significant environmental impact, allowing for much faster, streamlined permitting procedures.

14 ACER: Position on improving and simplifying the legal framework on European grids, September 2025.

RECOMMENDATIONS

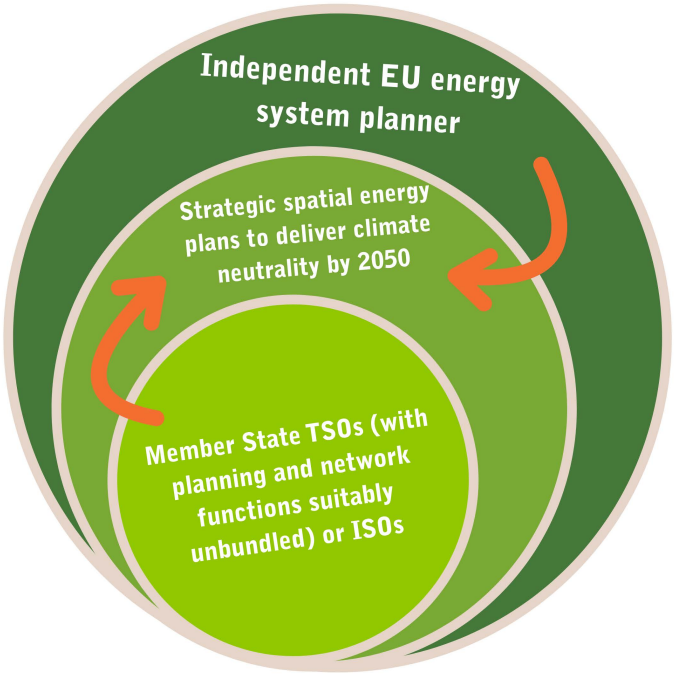
- **Member States should be required to produce spatial energy plans that set out the policy choices that it will take to achieve climate neutrality by 2050.** This could be introduced as a revision to the Governance Regulation (due in 2026) or integrated into a revised TEN-E Regulation. These plans should explore options to address societal concerns that currently delay infrastructure permitting and demonstrate why the chosen plan strikes the right balance for the national interest. They should also include evidence of the policy actions that are being taken to ensure timely delivery.

- **A single strategic planning entity should be created at the EU-level (the Independent EU Energy System Planner – IEESP) combining functions currently undertaken by ENTSO-E and ENTSO-G, as well as those envisaged for the European Network of Network Operators for Hydrogen (ENNOH).**[15] The IEESP should review these Member State plans and propose revisions that will reduce costs, improve security of supply and help deliver climate targets via enhanced resource sharing between Member States. The revised plans, once approved by the European Commission, should be aggregated to produce an EU strategic spatial energy plan, which would form the basis for the TYNDP and the identification of PCIs. The independent status of the IEESP should significantly reduce the time that the European Commission and ACER need to review the plan.

- It is not necessary to mandate the adoption of independent system operation and planning by Member States given that conditions vary widely, although **the European Commission should establish dialogues to discuss the most effective institutional arrangements to manage system change**. However, it is important to enforce basic unbundling requirements that remove potential conflicts of interest between planning and network ownership functions of TSO.

These recommendations are summarised in Figure 3 below.

Figure 3: Recommendations to make strategic spatial planning central to the EU energy transition



Source: Author. Design: Aleyna Naz Coskun & Joan Lanfranco.

15 It is probably most practical to build this body around the current ENTSO-E organisation (the way NESO was built around the Electricity TSO) given the predominant role of electrification in the future energy system.

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