

Our energy insights

The future of electricity system operations within European regions

Achieving secure, sustainable and affordable electricity for consumers is high on the European Commission's agenda. Their ambition is to form a single energy market with competition, facilitated by electricity flows that move efficiently across European borders. But how will this be achieved?

In this paper, we take a look at the changing face of Great Britain's electricity system, and the development towards European regional markets. Also outlined are the opportunities and challenges for consumers.

Four fictional scenarios called 'Going it alone', 'Collaboration', 'Regional centres', and 'Pan European' are used to explore the different options that Europe could take.

Through the scenarios it is demonstrated why a collaborative framework approach will ensure the best outcomes for consumers across Europe.

The implications of Brexit for Great Britain's future relationship with the EU on energy are uncertain. However, there is a continued role for cooperation to create a more efficient European electricity system.

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The changing face of the electricity system

The European electricity system is continually transforming. In the coming years, it will continue to change in line with the needs of consumers, businesses and government policies.

In particular, the ambition to reduce greenhouse gases has influenced GB's electricity landscape. The growth in renewable generation has changed how the electricity system functions, and how it needs to be managed.

What is changing in the electricity system?

- The increase of renewable generation and measures to reduce carbon emissions have moved GB from traditional fossil fuel generation to a mix with a larger proportion of renewable electricity sources like the sun, wind and sea.
- Consumers are expected to become more empowered and manage their electricity consumption as new technologies develop (e.g. control of appliances remotely, electric vehicles, smart metering etc.).

The way in which electricity is delivered to consumers is also evolving. Historically, the transport of electricity was from large traditional power plants directly to consumers, but it is now more complex.

Being part of large interconnected network, electricity is able to travel long distances, with cross-border flows increasing. Simultaneously, generation is connected directly to the distribution system, closer to the consumer.

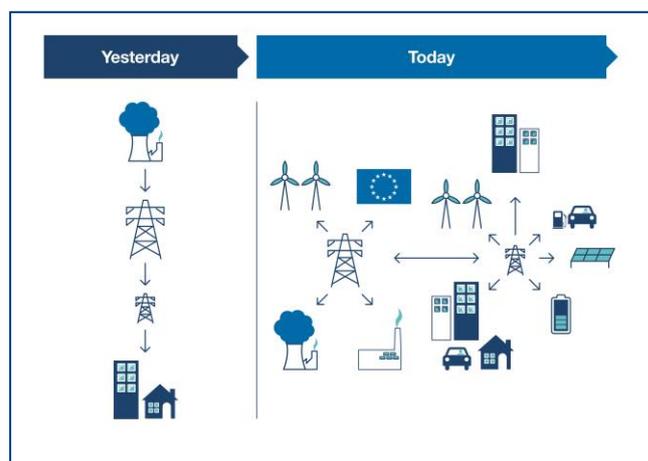
What is changing in the way electricity is transported?

- The use of Interconnectors has increased. For example, excess electricity from wind farms in one part of Europe can now be transported to another part of Europe where the wind is not blowing
- Local and consumer generation is rising. For example, consumers use electricity produced

by their solar rooftop panels or can store electricity in their electric vehicle batteries.

The management of these electricity flows is the responsibility of transmission system operators, which is National Grid in GB. Transmission system operators perform this task in collaboration with other network operators and interconnected transmission system operators in Europe.

National Grid ensures that electricity is produced and transported to all end consumers at all times to match their needs.



Brexit – what could the impact be?

Brexit could significantly impact our energy collaboration with neighbouring countries, depending on what arrangements are put in place following Brexit. The EU and GB jointly benefit from a strong degree of co-operation in energy, as it improves both market security and liquidity. The strong interdependencies on gas and electricity trade and common energy projects give a positive case for continued co-operation going forward.

It is essential that GB and the EU put in place the right arrangements, ensuring the best outcome for security of supply, affordable consumer bills and the ability to meet our low carbon ambitions.



An introduction to the European energy union and regional operations

The European Commission has the ambition to form a single energy market with strong competition, facilitated by electricity flows that circulate efficiently across borders.

Achieving the 'energy union' is one of the major ambitions of the European Union. A European energy union will ensure that Europe has secure, affordable and climate-friendly energy. This market will be achieved through stronger collaboration between European countries and a more efficient energy use across the regions.

Jean Claude Juncker, president of the European Commission's vision for the European energy union.

"I want to reform and reorganise Europe's energy policy into a new European Energy Union. We need to pool our resources, combine our infrastructures and unite our negotiating power vis-à-vis third countries. We need to diversify our energy sources, and reduce the high energy dependency of several of our Member States."

The European electricity legislation provides the framework to develop the energy union.

This legislation was introduced by the European Commission through the 1st, 2nd and 3rd energy packages. Recently, a proposal for a new package called 'Clean Energy for All Europeans' was released in November 2016.

The latest European legislative proposal: 'Clean energy for all Europeans'



The latest energy package could potentially have major implications for the energy industry in the future, including in GB. For instance, it includes a proposition to increase regional operations and cross-border co-operation within the energy market.

It calls for the creation of European Regional Operations Centres (ROCs), with enhanced decision making powers to handle some of the complex transmission system operator tasks. Responsibility such as remedial actions in case of scarcity of supply might be handled at a regional, instead of national level.

To ensure we maximise the benefits from enhanced regional cooperation for end consumers and do not increase the risk of security of supply, the allocation of responsibilities should be thoroughly analysed.



The European Commission (EC)

is the executive body for the European Union and is responsible for proposing legislation and implementing European laws



The European network of transmission system operators for electricity was formed in 2009. This governing body was created to improve collaboration between European transmission system operators. It represents 42 electricity transmission system operators, from 35 countries across Europe, including National Grid



Transmission system operation regionalisation imagined

Imagine being transported into the future, say, ten years from now, to see how the ambition for the energy union has worked out. What would those future changes mean for energy consumers and transmission system operators?

Four fictional scenarios called 'Going it alone', 'Collaboration', 'Regional centres' and 'Pan European', have been used to visualise what the future could be for the electricity system, define the threats and opportunities, and provide a view of the optimal solution for consumers.

Scenario 1: Going it alone



Imagine that the ambition to create an energy union across Europe has declined.

On the political front, several countries have elected Eurosceptic leaders. This has led to little or no collaboration on energy matters between countries, and a decreasing appetite for international harmonisation. Most European countries are 'going it alone' and have decided to ensure their secure supply of electricity through their own domestic means.

What could this mean for the electricity system?

Cross-border electricity trade and flows might not increase as expected as these are subject to bilateral agreements between Member States.

As a consequence, a higher level of generation could be produced and managed at a national level. Renewable development could be pursued and most homes equipped with solar panels on rooftops. In addition, the roll out of electric vehicles could enable people to store surplus energy generated. As national markets would be more isolated, wholesale electricity prices may rise.

What could this mean for consumers?

An attribute of 'going it alone' is that every country gets to define their own rules. Each country has sovereignty to define their own framework for electricity generation, transmission and consumption.

However, this approach could increase consumer electricity bills, as each country has access to a reduced market with less competitive prices.

In addition, with lower access to neighbouring market resources, each country could build additional domestic resources, creating over-investment at a European level or decreasing the available electricity margins. This could mean higher prices for consumers due to over investment in electricity generation or increased scarcity prices.

There are also rising concerns regarding system security due to the lack of collaboration between European countries. In this scenario, the GB market would not necessarily be able to rely on its neighbours in stressed or emergency situations - as GB would have lower access to electricity imports from other countries, compared to the other scenarios. For instance, in the past, emergency assistance from France has restored the GB system frequency to operational limits and also reduced the amount of demand control required.

This scenario could be achieved, whatever the outcome of the Brexit negotiations. All options for



future relationships on electricity currently remain open.

Scenario 2: Collaboration



Imagine a future where there are efficient cross-border electricity trade, facilitated by increased collaboration between countries.

To manage the cross-border flows efficiently, transmission system operators across Europe have increased their collaboration and harmonised standards.

What could this mean for the electricity system?

Cross-border collaboration could facilitate increased development of renewable generation. As energy systems become more interconnected, the system flexibility grows and enables sharing that complements renewable energy produced across countries.

Besides, as collaboration with neighbouring countries would allow for the best use of available flexibility facilities, cost effective delivery of secure electricity to consumers can be achieved.

Due to high penetration of local generation, transmission system operators would face the need to increase their collaboration with local distribution system operators.

As national transmission system operators are responsible for domestic secure network management, standards harmonisation and collaboration frameworks may need to be developed through multiple arrangements to support each other. European countries are working together, sharing their knowledge and expertise in electricity management.

What could this mean for consumers?

Electricity bills could stay generally competitive as collaboration with international and local entities ensures the efficient use of electricity generation.

Low carbon target achievement could be facilitated. The increase of renewable production could make electricity prices more variable.

UK and European member collaboration brings many benefits, and GB will seek to continue this. In the context of Brexit, this scenario could be achieved through agreements between GB and the European Union, or through bilateral arrangements with neighbouring countries.

Scenario 3: Regional centres



Imagine a future where the European energy union is split into different regions, made up of several countries.

Each of these new European regions will have a regional centre that will be empowered with system operation functions and decision making capabilities.

The regional centres will be responsible for defining the generation capacity, (how many power stations are needed), as well as the development of the critical electricity network infrastructure for the whole region. However, 'keeping the lights on' will remain a national responsibility, with transmission system operators in charge of managing the real-time operation of the electricity network.

What could this mean for the electricity system?

The development of regional centres aims to enable an effective system management (for



example through regional generation adequacy), leading to cost reductions.

However, the risk of stressed situations could be amplified. Multiple entities will have partial accountabilities regarding system security, with multiple hand overs. Inappropriate decision making or allocation of responsibilities could severely impact security of supply.

This scenario is, in some ways, similar to the creation of Regional Operations Centres (ROCs), proposed by the European Commission, in the new legislative proposal, 'Clean Energy for All Europeans'¹. It was released in November 2016. This development could also be seen as a transitional step towards a fully integrated system as shown in scenario 4.

The European Network of Transmission System Operators for Electricity (ENTSO-E) has already highlighted concerns about this proposal in their paper 'The Clean Energy for All Europeans package: Right level of ambition; yet better balance needed'

ENTSO-E

"By transferring inappropriate responsibilities to ROCs (regional operations centres), the European Commission creates a serious conflict with national responsibility over system security." "The consequence of the new ROC legislation would be a lower level of security of supply for Europe."

What could this mean for consumers?

Electricity activities are complex and processes are interlinked. Splitting those activities between European regional centres, and national

transmission system operators could cause inefficiencies.

Creating regional centres will therefore be costly, a cost that will probably be passed onto consumers through increased electricity bills.

This scenario might lead to additional difficulties. Whilst collaboration with Europe is beneficial, the development of regional system operators with decision making powers could lead to legal and political risks for all European countries. In particular, in the context of Brexit, GB could have lesser influence but would still be required to implement changes affecting regionalisation and the Internal Energy Market. Additionally, GB may need to implement wider European regulations.

Scenario 4: Pan European



Imagine an energy future where everything is integrated at a European level. Electricity is planned and managed in real time by one, and only one, European single entity. All national tasks related to security of

supply have been transferred to this European system operator.

What could this mean for the electricity system?

As this is a massive change in the way the electricity system operates, the process to reach this end state could take years.

The transition is expected to be long and costly to reach this new energy union state. For example, the transfer of knowledge from all European countries and harmonisation across local arrangements is necessary in order to ensure that correct decisions are made.

However, after the completion of the transition process, this project is expected to lead to a

¹ See section 'An introduction to the European energy union and regional operations



more secure, sustainable, and efficient system, where electricity flows freely across Europe.

Integration of system operations on a smaller scale has been proven as beneficial in the past. GB experienced the move from four British regional centres to one control centre. However, this has been limited to merging within one state, and integration between different states is expected to be highly complex for political reasons.

What could this mean for consumers?

After the transition period, consumers could benefit from a more integrated management of system operations and may benefit from increased security of supply. The change could be extremely costly but the final situation aims to lead to lower prices.

Collaborating in this fully integrated way is possible, but probably only if the future political situation in Europe is stable. Countries would need to agree to transfer their responsibilities regarding critical energy issues and security of supply to Europe.

For instance, in this energy union, there could be occasions where one country has to experience electricity blackouts in order to avoid a bigger impact on other countries. The related queries raised by consumers would probably be dealt with at a pan European level rather than national or local one.

While there are benefits to a more centralised management of European energy flows, with GB leaving the European Union, this scenario could bring additional risks. GB could participate or be excluded from a pan European structure. GB will need to ensure it can retain a sufficient degree of influence at a European level to be able to shape future outcomes.

Summary: The assessment of scenarios against four key criteria.

	Ability to meet green targets	Impact on electricity affordability	Framework complexity	Sovereignty
Scenario 1: Going it alone 	 Possible if GB flexibility sources are available	 Price increase due to smaller competition and back-up needs	 Simple framework as each country is 'going it alone'	 High national sovereignty on electricity matters
Scenario 2: Collaboration 	 Enabled by sharing of flexibility sources cross-border	 Competitive prices due to broader market	 Complex agreements impacting price formation	 National sovereignty with voluntary collaboration
Scenario 3: Regional centres 	 Uncertain as additional risk on security of supply arises	 Additional cost due to operational risks	 Complex separation of tasks between regional and national	 Some responsibilities transferred to regional body
Scenario 4: Pan European 	 Enabled by more efficient use of flexibility cross-borders	 High transition cost but great benefits in the long-run	 Complex transition process but simple in the long-run	 All responsibilities transferred to a pan-European body



Our view

The European regionalisation of system operations is a reality even with GB exiting the European Union.

Increasing collaboration between transmission system operators is one of the main objectives of the European Commission, set out in their paper 'Clean Energy for All Europeans'. Greater collaboration between transmission system operators will benefit consumers and should be implemented in the near future. There are multiple interdependencies between the UK and the EU energy markets and Brexit will bring a number of issues which will need to be addressed jointly.

UK Government white paper on Brexit

"These coordinated energy trading arrangements help to ensure lower prices and improved security of supply for both the UK and EU Member States by improving the efficiency and reliability of interconnector flows, reducing the need for domestic back-up power and helping balance power flows as we increase the level of intermittent renewable electricity generation"

Each of the scenarios used in this publication paints a different picture of European regionalisation, with the concerns and advantages for electricity consumers. The reality is still uncertain and might be different from those scenarios, or be a mixture of them.

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Our assessment leads to the 'Collaboration' option being the most attractive and effective way forward.

In this scenario, customers will receive electricity in the most secure and affordable way. It will also provide the most efficient and flexible framework for transmission system operators allowing them to work together and share best practices. On the other hand, the scenario of regional centres could lead to higher costs as well as legal and political risks.

What happens next?

The decision on the framework for the future regional collaboration of system operators is part of the new legislative proposal 'Clean Energy for All Europeans' released in November 2016. The new legislation is expected to take the European Commission approximately two years to be negotiated. All options for the UK's future relationship with the EU on energy are being considered. A high level of cooperation on energy matters is extremely important for continued efficient operation of the energy system across Europe.

National Grid will continue to lead the debate regarding collaboration of European transmission system operators, working with BEIS and Ofgem.

National Grid will work with policymakers and energy stakeholders through active participation in ENTSO-E, to reach the best outcomes for consumers.

