GRID CONNECTIONS

Work needed to complete Europe's grid harmonisation

I n March, the European Parliament approved new EUwide electricity market rules designed to increase consumer choice, boost access to renewables and cap power subsidies. This package of legislation has since been hailed by the European Commission as a new dawn in the creation of the bloc's much-vaunted Energy Union.

While the rules are significant – and they remove administrative and legal barriers between the national power systems and markets of the 28 EU member states – they do not ultimately create the seamless electricity system that the Commission wants. For this to happen, more work is required to forge these countries' national grids into one unified system, with pinch-points between national borders removed so that power can flow more freely in technical and capacity terms.

Synchronising Europe

As for the technical synchronisation of European grids, an important step was taken in May, when the European Network of Transmission System Operators (ENTSO-E) announced that an agreement was now in force to allow the grids of Estonia, Latvia and Lithuania to operate under the same technical standards as 26 countries elsewhere in continental Europe, which form Europe's largest grid bloc. The Baltic states want this integration to happen by 2025.

As it stands, their grids are part of the post-Soviet BRELL system, which also includes Russia and Belarus, making them dependent on a control centre in Moscow and supplies from the Russian electricity system.

The Baltics, all part of the EU since 2004, have already taken steps to link their grids with their fellow member states, with asynchronous connections through the LitPol Link between Lithuania and Poland; the NordBalt link between Lithuania and Sweden; and Estlink 1 and 2

Vester Hassing substation

and HVDC converter station

in northern Denmark for the

Photo: Jacob Hylling Poulsen

Konti–Skan interconnector

between Denmark and

Sweden



Europe has never been closer in terms of its physical electricity connections. But could geopolitical instability jeopardise even closer alignment? *Keith Nuthall* reports.

> between Estonia and Finland. Studies and plans are being developed to ensure enough power interconnections are in place to make this change a success, and that includes shoring up the effectiveness of existing links with Russia and Belarus. A special consideration is Kaliningrad, the Russian exclave bordering Poland and Lithuania, whose grid is currently synchronised with Lithuania's, a situation that would change from 2025. An ENTSO-E note said a possible AC or modern HVDC interconnection between Kaliningrad and Poland is to be investigated, which would boost power stability in the region.

> The move would expand Europe's dominant continental power grid regional group. Ukraine and Moldova are currently working to synchronise their grid with the technical standards of the 26-strong bloc – and there are additional plans to link it to the grids of Libya, Egypt,

Jordan, Lebanon and Syria. But outliers remain. Britain – whose status as a future EU member state remains uncertain – operates its own grid that is not synchronised with the continent, although it has significant, and ever-expanding, interconnectors.

On 31 January, a new 1 GW interconnector with Belgium came online, following a 1 GW connection launched in 2012 with the Netherlands and an older 2 GW link with France. There is also a 1 GW connector with Northern Ireland, which operates its own independent grid with the Republic of Ireland. Also, a separate Nordic group of synchronised grids covers Finland, Sweden, Norway and the island portion of Denmark (including Copenhagen). Meanwhile, Cyprus and Iceland remain electrical as well as geographical islands, though Malta has an interconnector to Sicily.

Peak demand

However, the key investments underway that will make this network of power connections work are in capacity. The European Commission has long-standing targets to ensure that EU member states have interconnectors to other countries that can supply 10% of peak demand by 2020 and has added a new target of 15% by 2030.

In a November 2017 policy paper, the Commission admitted that many member states had work to do if they wanted to hit those targets. Of these, it stated Britain, Spain, Poland (and predictably Cyprus), would miss the target by 2020 – although Bulgaria, Germany, France, Ireland, Italy, Portugal and Romania, while below 10% in 2017, would likely deliver. All these countries would have additional work to do if they wanted to meet the 15% goal.

While some nations have significantly higher interconnection rates already (for instance Lithuania's 88%, Luxembourg's 109% and Slovenia's 84%), the EU has continued to invest in and promote infrastructure developments that boost cross-border transmission capacity.

A key method for achieving this is through the EU's Projects of Common Interest (PCIs) programme, the named developments of which currently have access to €5.4bn from the EU's Connecting Europe Facility (CEF). This fund, which is designed to encourage private investors to sink cash in alongside public money, will be renewed with more resources for the EU's next medium-term budget of 2021 to 2027. PCIs may also benefit from accelerated planning and permit granting, a single national authority for obtaining permits and streamlined environmental assessment processes.

The Commission continues to update its list of such projects every two years, with the latest update due by this autumn. Infrastructure projects highlighted in the new draft list include a Portugal-Spain interconnector, where environmental impact assessments are awaited. This is important, because Spain is one country that has not met EU interconnection targets.

Outside the EU

Indeed, one priority highlighted by the Commission as a solution has been better power links between Spain and France, with the new list including a Biscay Gulf interconnector, for which tendering for contracts was set to begin in April. Feasibility studies are also listed for two other France-Spain interconnectors: the Aragon-Atlantic Pyrenees and the Navarra-Landes projects.

Another set of useful interconnectors cited in the new list would link Italy's grid with other countries outside the EU, notably Montenegro, Tunisia and Switzerland, as well as with EU member state Slovenia. Meanwhile, a cited third interconnector between Estonia and Latvia, now under construction, will boost power flows within the Baltic states as they prepare to desynchronise their grid from Russia.

Also, with Brexit potentially severing Ireland's physical link with the increasingly integrated EU energy market, the new list includes a planned 'Celtic interconnector' between Ireland and France – undergoing initial design and pre-consultation.

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Ironically, given that Brexit still seems more likely to happen than not, the UK is still pursuing additional interconnectors with its erstwhile EU neighbours, with a listed 'Nautilus' second interconnector with Belgium undergoing feasibility assessment. A new connection with the Netherlands of 1.5 GW is also being assessed for feasibility and an Ireland-Wales link undergoing subsea surveys. Irish grid connections should be secured this year for another Ireland-Wales project, known as the MAREX Organic Power Interconnector.

Finally, a potential interconnector between the UK and

The 26 - Europe's dominant continental power grid regional group

Albania, Austria, Belgium, Bosnia & Herzegovina, Bulgaria, the Czech Republic, Croatia, peninsular Denmark, France, Germany, Greece, Hungary, Italy, Luxemburg, Montenegro, the Netherlands, North Macedonia, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Switzerland and Turkey

> Iceland is listed, which is the subject of ongoing consultations between the two governments and anticipated recommendations from a UK-Iceland energy taskforce. Iceland remains outside the EU, but as a member of the European Economic Area (EEA), can participate in the CEF.

Smart grids

As for the smart grid projects - which have been subject to a separate consultation – the new draft list includes using smart grid technologies to bring greater efficiency to the power interconnections between Croatia and Slovenia, including the 400 kV TESLA loop, which links to other European countries. The problem is that power connections between Croatia and Slovenia were built when they were both part of Yugoslavia and were not designed to be operated by two national transmission groups.

While they have collaborated closely since securing independence in the 1990s, they have decided that smart grid tech will help them handle this power transfer work more efficiently, notably by tackling overvoltage problems.

Another smart grid project listed also suggests using new tech to improve interconnection collaboration - in this case between Czech Republic and Slovakia - both part of Czechoslovakia until 1993. A smart grid project listed called Danube InGrid would bring new tech to power exchanges between Slovakia and Hungary. And a smart energy data project called Data Bridge would exchange electricity information between Estonia, Latvia, Lithuania, Denmark and France.

As can be expected, the costs of these projects, especially collated, are high. The total projected investments going forward from 2017 for 105 electricity-focused EU Projects of Common Interest, as estimated by the EU Agency for the Cooperation of Energy Regulators (ACER), was over €49bn.

Looking ahead, ENTSO-E is laying the technical and regulatory groundwork for closer integration of European national grids, notably leveraging these new connections to create a predictable market in energy transfers. This work implements EU regulation 2017/2015 on electricity balancing, which mandated an EU-wide set of technical, operational and market rules to govern these cross-border electricity sales.

Even within synchronised grids, clear technical rules and procedures are needed to ensure that predictable amounts of electricity are available when it is needed and can be delivered in an efficient and effective manner. As a result, ENTSO-E has released more detailed guidance for consultation, including on how bids to offer balancing power capacity must be framed and submitted, with a goal of releasing final rules by December.

Frequency limits

The importance of ensuring that this technical harmonisation and capacity augmentation was highlighted by an incident on 10 January, when the frequency of power supplied via the continental Europe grid dropped to 49.8 Hz from its standard 50 Hz. While that might not sound like much, this was the largest deviation since a fall to 49 Hz in 2006. Should this regional grid's frequency drop to 47.5 Hz (or rise to 51.5 Hz) all connected generation and devices would automatically disconnect causing major supply disruptions.

In this case, said an ENTSO-E note, reserves from across Europe were quickly tapped and some industrial customers in France lost supplies (they had contracts allowing this to happen), bringing the frequency back up to normal levels. It had been caused in part by problems affecting four interconnectors between Germany and Austria.

Commenting in Brussels in May on the importance of solidifying Europe's collective grid, Laurent Schmitt, ENTSO-E secretary general, said: 'The next energy system will be one of innovation to connect physical infrastructures across sectors, geographies, communities and prosumers to ensure alignment of physical constraints with real-time market transactions. Grid operators are key in enabling this transformation towards a system of systems that keeps the lights on at least possible cost for customers while mitigating climate change.'