The Voice of the Networks

Energy Networks Association

Open Networks Project
Workstream 2, Product 2
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Queue Management:
Update roadmap & scenarios from 2018 WS1 P11

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Related Documents

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Reference 2	

Change History

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1 Introduction

1.1 The ENA and Open Networks Project

Energy Networks Association (ENA) represents the "wires and pipes" transmission and distribution network operators for gas and electricity in the UK and Ireland. Our members control and maintain the critical national infrastructure that delivers these vital services into customers' homes and businesses.

The Open Networks Project is a key initiative to deliver Government policy set out in the Ofgem and BEIS Smart Systems and Flexibility Plan, the Government's Industrial Strategy and the Clean Growth Plan. The Open Networks Project is working in collaboration with Ofgem, BEIS, 10 of UK and Ireland's electricity network operators and other key stakeholders.

1.2 Purpose

The aim of this document is to further improve network connections processes for flexible resources, including but not limited to energy storage, facilitating the continuing transition to a low carbon economy and support Action 1.6 of the Smart Systems and Flexibility Plan alongside other delivered and planned industry outputs.

Following a Call for Evidence in 2018 on the Treatment of Flexible Resources, Open Networks agreed to present real example connection scenarios to help articulate the varied offerings available and allow recommendations to be made which improve the existing processes that make up or support Interactivity and Queue Management. The initial approach drew together three focus areas which were identified as areas for further improvement and are presented in Figure 1.

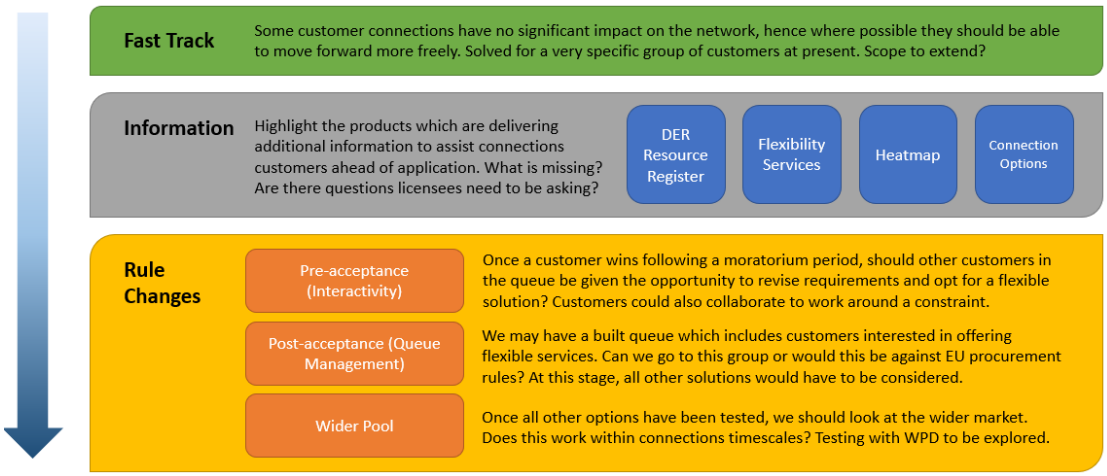

Figure 1: High level approach

Some of the Interactivity and Queue Management associated recommendations have been tested through the similarly named Consultation which came to a close in early 2019. The feedback has been used to inform this document and will be progressed through Workstream 2, Products 2 and 3 looking at Queue Management and Interactivity respectively.

2 Worked Examples

A small selection of new connections for Low Carbon Technologies, energy storage and other Distributed Energy Resources are presented, highlighting some of the key developments to date and facilitating development of industry recommendations to improve the network connections for flexible resources including energy storage.

2.1 Domestic Customer – Low Carbon Technologies seeking connection to the LV Network

2.1.1 Single domestic customer installing storage with existing rooftop PV.

In recent years there has been a significant increase in the connection of low carbon technologies, particularly photovoltaics, by the domestic customer. This is expected to increase GB wide, but more quickly in Scotland due to most developers choosing to install domestic scale renewables to help meet the more demanding new building regulations for properties planned after 2015. In addition, the industry is predicting a significant upturn in LV connected small scale Energy Storage over the coming years.

Traditionally connections have complied with Engineering Recommendation (EREC) G83 and EREC G59 which facilitate the connection of all generation, including Energy Storage. However, some industry participants consider that the requirements of these ERECs can sometimes be seen as a barrier to connection due to the application timescales and the potential high costs imposed for witness testing small scale domestic Energy Storage schemes. The Guaranteed Standards of Performance (GSoP) timescales for providing an LV generation quote/response are traditionally 45 days and whilst it is uncommon for a small LV connected scheme to be witness tested there was evidence nationally where schemes as small as 1kW had the requirement for a witness test included within the customer's quotation. There was also the uncertainty as to when to apply the requirement for an Export Limitation Scheme (ELS) in addition to the inconsistencies that exist around the requirements for witness testing.

To improve the process, a "Fast Track" process was introduced in 2018 for single phase connections where the customer:

a) has an existing PV installation (or other DG type) that conforms with EREC G83 requirements, and wishes to install a battery storage device via a separate EREC G83 type tested invertor; or
b) wishes to install both a new PV (or other DG type) scheme and battery storage device via two separate EREC G83 type tested invertors.
c) has an installation compliant with the requirements of ENA EREC G100 and guarantees export is limited to 16A per phase

If all the criteria are met the customer would be given approval to connect within an agreed timeframe which would be no greater than 10 days. This approach facilitates a decrease in the offer and connection queue timeframes, allowing domestic storage to connect more quickly.

While the EREC G59 update allowed for a simplified connection procedure, and reduced response times when compared with a standard EREC G59 application, it was a short term solution. To more radically affect the pre and post acceptance processes for connection of storage and other low carbon technologies, two new standards are to come into effect on the 27th April 2019. G98 replaces G83 and G99 replaces the G59 standard. The new standards are designed to ensure networks can maintain performance and stability as we move to a smart grid architecture. New specifications for larger generators and storage will reduce risk and enable improved network optimisation which may facilitate new connections while smaller domestic level projects will be subject to the more integrated "Fast Track" process. The procedure will be incorporated in the updated EREC G99 as the Integrated Micro Generation and Storage procedure and referenced in the updated EREC G98.

Relevant Learning

From the 27th of April, G98 will replace G83 and G99 replace the G59 standard. Within EREC G99, the Integrated Micro Generation and Storage procedure will outline the Fast Track Application Process which was introduced in EREC G59. The Integrated Micro Generation and Storage procedure will apply to single generator sites where the total aggregated capacity of the generator and storage devices is between 16A and 32A per phase. The Integrated Micro Generation and Storage Procedure is applicable to generators with a maximum output 16A and the storage device with a maximum output 16A. If either the storage device or the generator exceeds this limitation, the Integrated Micro Generation and Storage Procedure will not apply. While EREC G98 will not include the Integrated Micro Generation and Storage Procedure, it will be referenced and outline that for customers with an existing Micro-generator (which conforms with the EREC G83 or EREC G98 requirements) who are looking to connect new storage, the connection will be via Clause 6.2.2 of EREC G99. Note that the Integrated Micro Generation and Storage Procedure does not apply where the total aggregated capacity of the Micro-generators (both non-Electricity Storage and Electricity Storage) installed on the customer site is less than or equal to 16A per phase. In circumstances where the total aggregate capacity of the Microgenerators and storage is less than, or equal to 16A per phase, only EREC G98 will apply.

While this new Integrated Micro Generation and Storage Procedure and "Fast Track" process should improve the application process and remove some of the perceived barriers to connection while in the queue, there is not yet a consistent communication procedure in place which ensures customers make the correct application and understand the "Fast Track" process. Across all publicly available material, DNOs have sought to simplify the connection process with a series of interactive process maps, yet the availability of the "Fast Track" option is not universally clear.

The criteria set for the process was based on historic evidence and multiple factors including safety, network stability and network reliability. However, as the impact of small scale storage and other low carbon technologies becomes clearer and supporting work within the ENA Open Networks Project and industry trials progresses, it may be prudent to review to consider extension of the "Fast Track" process.

2.1.2 Several hundred domestic customers looking to install PV with Storage.

In Scotland, the impact of the new building regulations introduced in 2015 are filtering through to the electricity network connection process. Most developers choosing to install domestic scale renewables to help meet the new building regulations which is changing their application to the local DNO. In some areas there are export constraints, thus as the housing estate applications are now including generation requirements, this can alter the cost and timescale of their connection.

In one case the scheme is subject to Transmission constraints and cannot be connected until 2021. Thus, their development could be impacted due to being held in the connection queue due to upstream constraints. However, with the availability of flexible connections, a proposed solution could be derived to work around the constraint. A timed flexible connection has been proposed looking at the diversity in demand across the seasons.

Timed export connection offers the customer the possibility of connecting to the network but exporting only during certain periods of the day or week only. The examples some DNOs currently support is where the majority of generation in an area is PV and so during non-daylight hours other types of generation such as wind can be allowed to export freely.
While such solutions are available to domestic customers, the contractual arrangements for an entire multiple dwelling development are complex. In addition, the property is owned by a Scottish Council and will be occupied by tenants. Therefore, agreeing a commercial contract is at present unprecedented. The typical contract is with the occupant, yet this is deemed unfair

as the occupant could not be expected to maintain a timed connection they had not agreed to. The local DNO could have a unique contract with the council, but the DNO would have no means of policing and managing should they fail to operate within the agreed contract parameters.

Relevant Learning

While flexible connections (which are now being offered by all DNOs and TOs) have the potential of advancing the uptake of storage and low carbon technologies, there are some commercial arrangements requiring development. This should consider the management of such domestic level flexible connection agreements in the longer term. Scottish networks are expecting to see such examples increase over the coming years and assuming similar housing standards are adopted in England and Wales in the future, this scenario could be replicated across GB.

The example case could be improved by advancing an available flexible resource in the connection queue to support is such a resource exists. If the reinforcement in progress is the most cost effective solution, could flexibility in the short term be used to work around the constraint for a new connecting party who cannot fully adopt a flexible connection which would effectively work around the constraint? If so what is the cost to the GB consumer and what would the charging structure look like? An alternative would be the facilitation of a peer to peer energy trade which offsets the import or export at the time of the constraint, yet again the process required to facilitate such movement in the queue is not part of the present Queue Management rules. To ensure consistency, any approach would have to be documented.

2.2 Non-Domestic Customers – Generator or Storage looking for a new connection to the HV or EHV network where there is a constraint

2.2.1 North of England generator seeking connection to a network with more than thirty schemes in the queue.

In the North of England; a section of one of the DNO networks following a peak in applications for connections of generation it was identified that a statement of works should be triggered. In total there are over 30 applications for connection held within the statement of works application (SOW) to National Grid. Applicants range from small sites (500kW-5MW) connecting to the 11kV network, through to larger customer sites (up to 100MW) connecting to the 132kV network.

Following a review from National Grid (NGET) the SOW has identified a potential overload of the existing super grid transformers (SGTs) feeding the area. The SOW identifies that following a replacement of all SGTs the constraint is eliminated; however, the replacement work will take 4-6 years to complete when co-ordinated with existing work programs.

The customers held within the reinforcement queue would have been told they would need to wait until the transmission reinforcement work has been completed. However, the schemes behind the transmission constraint where accepted on traditional firm or non-firm contract terms, thus an opportunity to explore flexible options with the connections customers existed.

Position	Export	Import	Technology	Connection Voltage
---- Transmission Constraint ----				
1st	10MW	0.4MW	Gas Generation	33kV
2nd	1MW	0.1MW	Photovoltaic	11kV

3rd	5MW	0.4MW	Gas Generation	11kV
4th	49.9MW	49.9MW	Energy Storage	33kV
…	…	…	…	…
29th	99.8MW	99.8MW	Energy Storage	132kV
30th	10MW	5MW	Energy Storage	33kV

*Table 1: North of England Statement of Works queue**

**Due to this being an ongoing connection reinforcement scheme the queue details have been redacted for commercial sensitivity reasons. The above table is indicative only.*

Through the use of flexible contracts, it has been proposed to connect customers via an active network management system (ANM), which will monitor the reverse power flows and control the output of generators to stay within safe operating limits. This area is also likely to incorporate a number of different flexible connections options where cost and timescale of ANM implementation are prohibitive. E.g.

- Timed connection offers – Where different generation sites within the queue are not sensitive to a timed connection it may be possible to stagger the output of applicants within the queue to reduce the level of reverse power flows e.g. allowing Solar sites to run during the day and gas peaking plants at night.
- Intertrips – Some sites may be fitted with intertripping scheme such that under specific pre-defined abnormal running conditions the generation is automatically tripped off.
- Export limitation – Some sites which have demand onsite may be allowed to connect utilising export limitation devices to reduce their impact upon reverse power flows to the network.

Relevant Learning

In a similar way to the example presented in Section 2.1.2, the situation could be improved by advancing an available flexible resource in the connection queue to support if such a resource exists. This area could be an ideal candidate for peer to peer trading (more specifically the trading of capacity) if a demand site was to enter into contract with a generator site. Assuming the demand site could guarantee to net offset the export from the generator then this generator could be exempt from the original constraint. Currently there have been no suggestions of any customers who would like to discuss this type of option in this example.

Again, the process required to facilitate such movement in the queue is not part of the present Queue Management rules. To ensure consistency, any approach would have to be documented.

2.2.2 Planned or in construction schemes looking to connect to the distribution network where there is a transmission constraint.

The South West Active Network Project (SWAN) has been developed to meet the contractual requirements of the South West Operational Tripping Scheme (SWOTS) agreements made with National Grid Electricity Transmission (NGET) in May 2017.

These agreements which fall within the Appendix G Mod App alternative to the Statement of Works (SOW) process, stipulate the need for suitable monitoring and control of connecting generators at 8 Grid Supply Points (GSPs) in the SEPD license area currently under 'Materiality Limits'.

The SWAN ANM system will specifically allow 76 (planned/in construction) projects to connect to the D network to avoid T reinforcement driven by N-3 situations, providing an additional 1.36GW's of renewable generation to the region. This will decrease the reliance on fossil fuels within the local areas and enable a more flexible, controllable smart-grid implementation across almost 50% of the region.

The ANM system is being developed as a 'centralised' solution, with minimised remote equipment installation in favour of a more secure, centrally hosted control system which reduces cost and increases system security and replicability. The ANM system will manage N-3 situations from the onset, however it also carries the inherent ability to monitor and manage other constraints which may develop over time, on both the T and D networks. This will enable faster, more cost efficient connections for new generation within the SWANs zone where the cost of flexible connections is greatly reduced thanks to the pre-existing system.

The ANM system also carries the inherent ability to manage flexible demand and storage services, such as the CMZ process, where DSOs can contractually secure DSR or power injection from D-connected storage devices. This is a key foundation of DSO functionality and as such provides a distinct element of future proofing against DSO transition impacts to the network and its connected customers. It also enables faster, more cost effective connection to service providers – as the management system and some of the monitoring requirements will be pre-installed.

Relevant Learning

Active Network Management solutions are a valuable tool in the transition to a smart grid architecture. In the case above, the use of ANM removed perceived barriers to the progression of projects within the connection queue and allowed customers to avoid transmission system reinforcement.

The example and centralised solution discussed offer DSOs the ability to defer and potentially avoid traditional reinforcement, offering the UK customer base more cost effective network operation and the potential for reduced investment requirements in future. Additionally, they offer DNOs the opportunity for reduced costs in transitioning to a DSO, offering the UK customer base the potential for reduced investment requirements in future. As DNOs continue to develop the ANM solutions, they should support the reduction of interactivity queue complexity and support improvement of the queue management process.

2.2.3 Energy storage customer in the south of England seeking a connection where there is interactivity.

In the south of England there were four new connection requests which were all provided with the same point of connection onto the 132kV distribution network. In order to facilitate the connection the existing outdoor busbar required extension at the Grid Supply Point (GSP). New AIS switchgear would then be installed to allow the generator to connect via a new circuit. Whoever connects first would trigger this extension with any subsequent applications paying second comer charges.

In addition to the interactivity on PoC, there was a thermal export constraint which was lower than the circa 145MW export requested.

Position	Export	Import	Technology	Connection Voltage
---- Distribution Constraint ----				
1st	20MW	1MW	Photovoltaic	132kV
2nd	25MW	1MW	Gas Generation	132kV
3rd	49.9MW	1MW	Gas Generation	132kV

4th	49.9MW	49.9MW	Energy Storage	132kV

*Table 2: South of England Interactivity queue**

**Due to this being an ongoing connection reinforcement scheme the queue details have been redacted for commercial sensitivity reasons. The above table is indicative only.*

In this situation, the accepting customer would have to bear their portion of the busbar extension and new AIS switchgear cost, split between the customer and DNO in alignment with the Cost Apportionment Factor (CAF) and High Cost Cap (HCC). As there is no guarantee another scheme would progress, the customer would have to be able to proceed without relying on any second comer payment.

Relevant Learning

This situation could result in none of the four schemes progressing with an offer acceptance due to the business case risk. To reduce this risk a consortium could be created, enabling customers to put agreements in place which make the connection more financially viable and reduce the risk on any single scheme. Today DNOs do support such consortiums and facilitate their setup as requested, yet due to timescales, cancelation rate and the additional commercial complexities there are limited examples of successful progression.

Peer to peer trading (more specifically the trading of capacity) could improve the success rate and de-risk investment in the future. The facilitation of such a market should increase the stacked value for investors, potentially improving the return on investment for the connecting party and wider energy actors. Such trades are being considered by industry demonstration projects which are working closely with the Open Networks Project to enable a timely and coordinated approach. This example should be reviewed by such projects and considered with stakeholders taking part in the associated trials.

3 Recommendations

1. Information

Provision of information is important across the entire connections process, but one particular recommendation centres around the "Fast Track" process. Across all publicly available material, DNOs have sought to simplify the connection process with a series of interactive process maps, yet the availability of the "Fast Track" option is not universally clear.

It is recommended all DNOs review the information currently available on their website or through relevant portals and improve clarity, providing the customer with visibility of the "Fast Track" offering. ***Track through Monitoring Implementation.***

2. Review of EREC G99 Fast Track Criteria

The criteria set for the process was based on historic evidence and multiple factors including safety, network stability and network reliability. However, as the impact of small scale storage and other low carbon technologies becomes clearer and supporting work within the ENA Open Networks Project and industry trials progresses, it may be prudent to review to consider extension of the "Fast Track" process.

It is recommended that this is passed to the ***ENA G98 & G99 working group*** to investigate how we can extend to include a greater number of connections today and ensure we are catering for RIIO-ED2.

3. Domestic Flexible Connection Rules

While flexible connections (which are now being offered by all DNOs and TOs) have the potential of advancing the uptake of storage and low carbon technologies, there are some commercial arrangements requiring development, particularly for domestic customers. This should consider the management of such domestic level flexible connection agreements in the longer term.

It is recommended that this example is presented to the ***Ofgem Access and Forward-looking Charging SCR***. The charging rules and access arrangements are key to the definition of any rules.

4. Queue Management Rules

Could flexibility in the short term be used to work around a constraint for a new connecting party who cannot fully adopt a flexible connection which would effectively work around the constraint? If so, what is the cost to the GB consumer and what would the charging structure look like? To ensure consistency, any approach would have to be documented.

It is recommended that this is investigated and managed by ***ENA Open Networks WS2, Product 2 – Queue Management***.

5. Peer to Peer Trading Facilitation Testing

Facilitation of a peer to peer energy trade which offsets the import or export at the time of the constraint could support the removal of perceived barriers in the queue, yet the process required to facilitate such movement in the queue is not part of the present Queue Management rules.

The ***T.E.F. demonstrator projects***, in particular TRANSITION to simulate and physically trial, passing findings onto the Queue Management working group in 2020 and beyond. Link with WS1 P6 of 2019.

6. Post Moratorium Rules

Post moratorium the customer is given the option of a restudy and are withdrawn if there is no response within a defined time period. The customer cannot maintain their position and make a change to their application to work around the identified constraint. Thus, there is an opportunity to adapt the current rules and ensure valid schemes are given the opportunity to progress.

It is recommended that this is progressed and managed by ***ENA Open Networks WS2, Product 3 – Interactivity.***

4 Worked Examples

The recommendations outlined in Section 3 are presented in Figure 2. This roadmap provides the proposed delivery timeline for the resolution of significant development of the recommendation actions and highlights its owner. While some of the findings are to be presented to groups outside of Open Networks to take forward, the project will manage the interaction and maintain touch points throughout 2019 and 2020, assisting visibility of developments and feeding outputs into future product scoping as required.

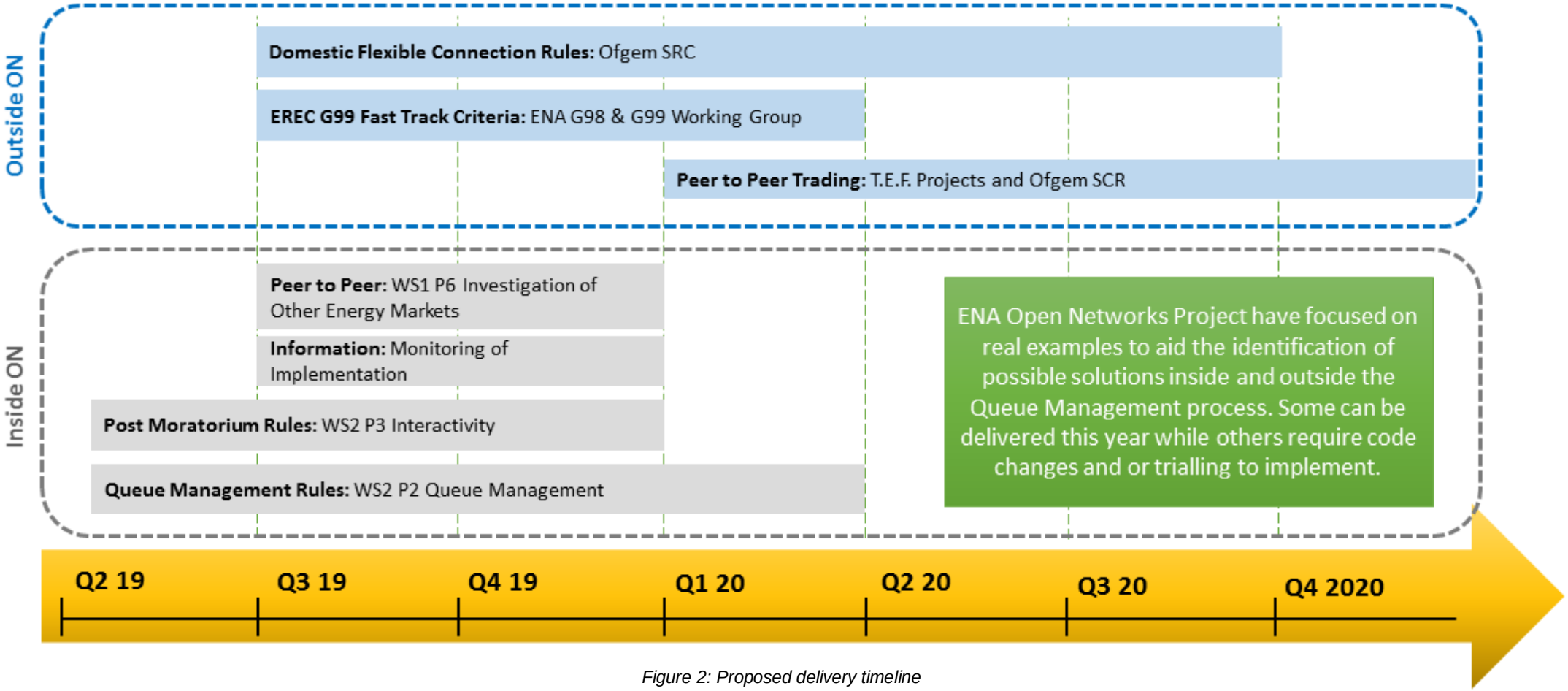

Figure 2: Proposed delivery timeline