Primacy Rules Framework

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Reference 2	

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1	Primacy Rules
2	Amended by Baringa with Working Group comments

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Introduction

About ENA

Energy Networks Association (ENA) represents the owners and operators of licences for the transmission and/or distribution of 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.

As the voice of the energy networks sector, ENA acts as a strategic focus and channel of communication for the industry. We promote interests and good standing of the industry and provide a forum of discussion among company members.

We help our members to:

- Create smart grids, ensuring our networks are prepared for more renewable generation than ever before, decentralised sources of energy, more electric vehicles and heat pumps. Learn more about our Open Networks Programme.
- Innovate. We're supporting over £450m of innovation investment to support customers, connections and more.
- Be safe. We bring our industry together to improve safety and reduce workforce and public injury.
- Manage our networks. We support our members manage, create and maintain a vast array of electricity codes, standards and regulations which supports the day-to-day operation of our energy networks.

Together, the energy networks are keeping your energy flowing, supporting our economy through jobs and investment and preparing for a net zero future.

About Open Networks

Britain's energy landscape is changing, and new smart technologies are changing the way we interact with the energy system. Our Open Networks programme is transforming the way our energy networks operate. New smart technologies are challenging the traditional way we generate, consume and manage electricity, and the energy networks are making sure that these changes benefit everyone.

ENA's Open Networks programme is key to enabling the delivery of Net Zero by:

- opening local flexibility markets to demand response, renewable energy and new low-carbon technology and removing barriers to participation
- opening data to allow these flexible resources to identify the best locations to invest
- delivering efficiencies between the network companies to plan and operate secure efficient networks

We're helping transition to a smart, flexible system that connects large-scale energy generation right down to the solar panels and electric vehicles installed in homes, businesses and communities right across the country. This is often referred to as the smart grid.

The Open Networks programme has brought together the nine electricity grid operators in the UK and Ireland to work together to standardise customer experiences and align processes to make connecting to the networks as easy as possible and bring record amounts of renewable distributed energy resources, like wind and solar panels, to the local electricity grid.

The pace of change Open Networks is delivering is unprecedented in the industry, and to make sure the transformation of the networks becomes a reality, we have created three workstreams under Open Networks to progress the delivery of the smart grid.

2024 Open Networks programme Workstreams

- Network Operation
- Market Development
- Planning and Network Development

Our members and associates

Membership of Energy Networks Association is open to all owners and operators of energy networks in the UK.

- Companies which operate smaller networks or are licence holders in the islands around the UK and Ireland can be associates of ENA too. This gives them access to the expertise and knowledge available through ENA.
- Companies and organisations with an interest in the UK transmission and distribution market are now able to directly benefit from the work of ENA through associate status.

ENA members

ENA associates

- Chubu
- EEA
- Guernsey Electricity Ltd
- Heathrow Airport
- Jersey Electricity
- Manx Electricity Authority
- Mutual Energy
- Network Rail
- TEPCO

Executive Summary

As the capacity of dispatchable generation falls, replaced by variable forms of generation such as wind and solar, the National Energy System Operator (NESO) is increasingly relying on flexibility from assets connected to the distribution network. At the same time, Distribution Network Operators (DNOs) are being tasked with increasing the utilisation of their networks through the use of flexibility procurement and curtailable connections.

This is leading to situations where the NESO is trying to dispatch positive flexibility (generation turn-up or demand turn-down) and negative flexibility (generation turn-down or demand turn-up) from assets on parts of the distribution Network that are at their import or export limits. In order to keep the distribution network within its operating limits, the DNOs – under their Distribution System Operation (DSO) role – will be effecting positive or negative flexibility, either through procured flexibility services or through the automated action of an Active Network Management (ANM) system(or alternative manual action). These ANM systems in particular are expected to unwind any action that the NESO attempts to take, by increasing or reducing the curtailment of assets in order to keep the network within its limits.

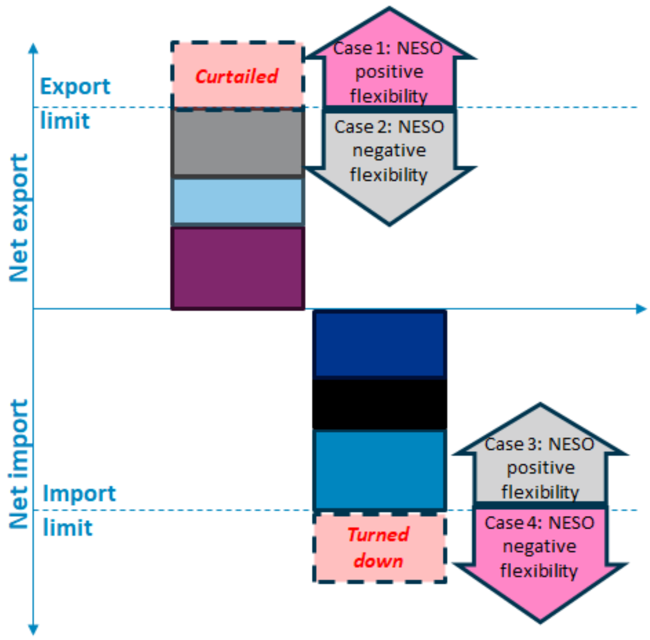
At a high level, there are four possible primacy rules that could apply, as summarised below.

Primacy rule	Description
No primacy	This describes the case where neither NESO nor the DNO has primacy. Where conflicts arise, the NESO and DNO will take the necessary actions to ensure its network or system requirements are met. For example, if the NESO were to dispatch generation turn-up from one asset, the DNO's ANM system could curtail the generation of a second asset in the same group, unwinding the action, leaving no net change in the export from the group. ***This is the default state where no formal primacy rules are put in place and is described to establish the baseline for the options below, it is not explored as an implementation option.***
DSO primacy	If a NESO flexibility action would cause an issue for the distribution network, or would be unwound by the DNO (see the 'No primacy' rule), the DNO informs the NESO of the conflict. The ***NESO then excludes the flexibility service provider from its DA flexibility procurement activities and/or the real time dispatch queue*** and secures its required flexibility from another source.
NESO primacy	For specific combinations of NESO service and distribution constraint, the ***DNO can take actions to enable the NESO to secure flexibility from a constrained part of the network***. Where mitigation is technically feasible, the DNO takes such action (e.g. headroom creation) on behalf of the NESO. These mitigating actions can result in additional levels of curtailment, or deliberately leaving available headroom unutilised. As such, these actions may necessitate compensatory payments to be made to customers facing curtailment.
Joint primacy	This has been referred to in previous work from the Primacy group. The idea being, the DNO and NESO agree which primacy rule should apply at a given constrained location, based on the relative costs and benefits of each rule. It is assumed that appropriate compensation is provided to ensure that the selected rule is of mutual benefit to all parties. This report sees this as an option within NESO primacy, "Joint primacy" can be summarised as **"NESO Primacy with compensation".** As such, Joint Primacy is, at a whole system assessment view

	functionally the same as NESO primacy and gives the same overall CBA. Therefore this report does not report on “Joint Primacy”.

There are two types of conflict that need to be considered:

- NESO flexing ***into a*** distribution network constraint;
- NESO flexing ***away from*** a distribution network constraint.



This leads us to four cases relating to NESO and DSO flexibility conflicts, described below.

Flexibility conflict use cases

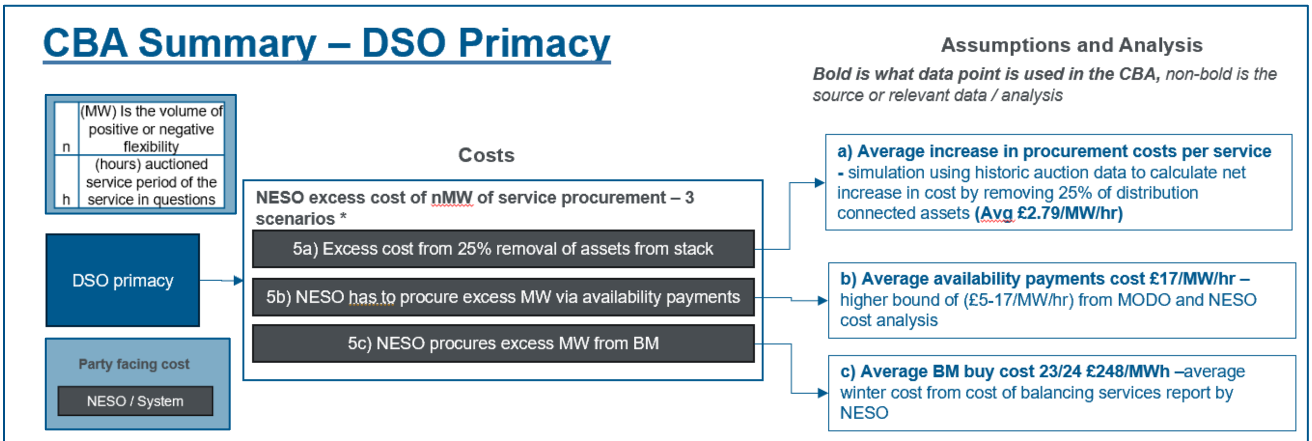
This work has focused on the comparison of DSO primacy with NESO primacy, although the current baseline, 'no primacy', is referred to in this report as a common point of reference. As such, the CBA is comparing the relative costs and benefits of the NESO primacy and DSO primacy rules.

	NESO positive flexibility		NESO negative flexibility	
Export-constrained distribution network: DNO/ANM is, or is close to, effecting negative flexibility	**Case 1**		**Case 2**	
	Conflict case: DNO counters NESO action with negative flexibility to manage thermal constraint		**Conflict case:** DNO counters NESO action with positive flexibility to absorb newly-created headroom, reducing the curtailment of customers in the area	
	DSO primacy: NESO opts out of dispatching positive flexibility from the area	**NESO primacy:** NESO can only dispatch positive flexibility if headroom has first been created on the constrained distribution network	**DSO primacy:** NESO opts out of dispatching negative flexibility from the area, so the DNO takes no action and no curtailment reduction occurs	**NESO primacy:** NESO dispatches negative flexibility, and the DNO ensures that is does not release the newly-created headroom to customers being curtailed
Import-constrained distribution network: DNO is, or is close to, effecting positive flexibility	**Case 3**		**Case 4**	
	Conflict case: DNO counters NESO action with negative flexibility to absorb newly-created headroom, reducing demand turn-down in the area		**Conflict case:** DNO counters NESO action with positive flexibility to manage thermal constraint	
	DSO primacy: NESO opts out of dispatching positive flexibility from the area, so the DNO takes no action and no demand turn-down reduction occurs	**NESO primacy:** NESO dispatches positive flexibility, and the DNO ensures that it does not reduce demand turn-down in response or release the newly-created headroom to customers being curtailed	**DSO primacy:** NESO opts out of dispatching negative flexibility from the area	**NESO primacy:** NESO can only dispatch negative flexibility if headroom has first been created on the constrained distribution network

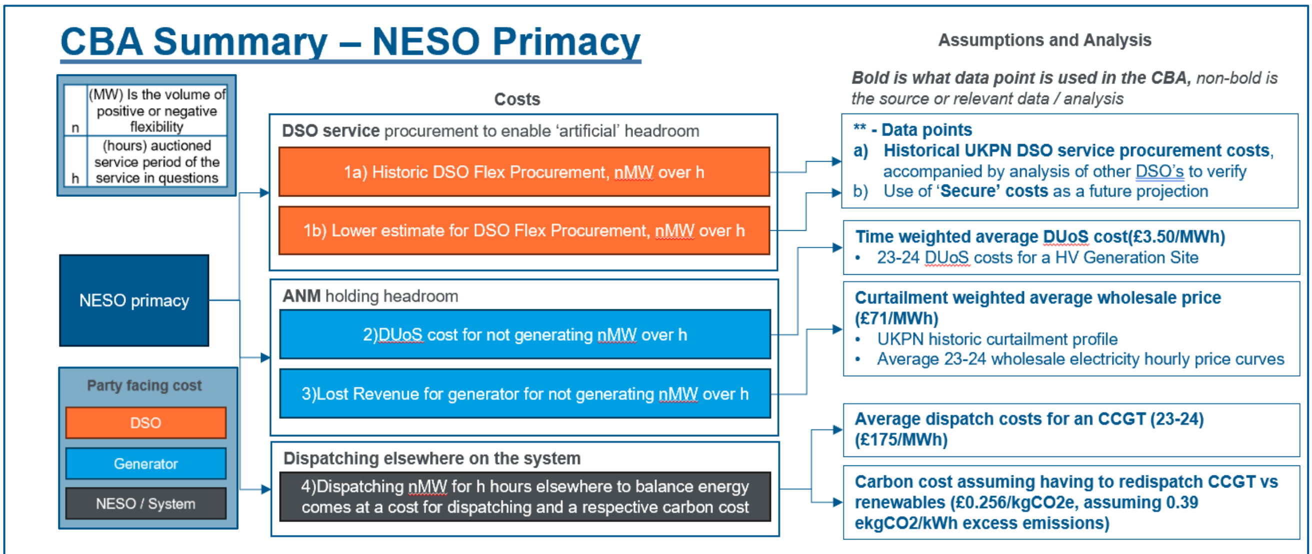
Cost Benefit Analysis (CBA)

A 'CBA Summary Document' accompanies this report. It describes the analysis undertaken to understand the overall costs and benefits of applying different primacy rules to these different cases, and to understand who bears the costs and receives the benefits.

The specific costs and benefits depend on the type of service that the NESO is procuring, the cost of procuring those services through other means, and the cost of any DSO actions needed to enable ESO primacy. The CBA and the underlying drivers for the cases described above are summarised below.



*Due to the complexity in deciphering what the NESO action would be under DSO primacy, 3 scenarios have been modelled to understand what the range of costs could be, depending on the specific considerations of the conflict case



** DSO Service costs		Positive Flex Generation Turn Up	Negative Flex Generation Turn Down	Positive Flex Demand Turn Down	Negative Flex Demand Turn Up
Volume weighted average price (£/MWh)	£/MWh	398	677	446	419
Secure costs	£/MWh	154	0	0	206

Summary of the cost flows for each type of primacy rule.

<table>
<tr><th></th><th>Case 1 and 4</th><th>Case 2 and 3</th></tr>
<tr><td>Conflict case</td><td>Conflict case 1: DSO counters NESO action with negative flexibility to manage thermal constraint
Conflict case 4: DSO counters NESO action with positive flexibility to manage thermal constraint</td><td>Conflict case 2: DSO counters NESO action with positive flexibility to absorb newly-created headroom
Conflict case 3: DSO counters NESO action with negative flexibility to absorb newly-created headroom</td></tr>
<tr><td>Primacy rule with optimal CBA</td><td>Optimal approach: <u>DSO primacy</u>
DSO primacy leads to the best net benefit on a whole system basis. The actions required to enable NESO primacy (holding additional curtailment during the service window, and paying for rebalancing from elsewhere on the transmission network) create significant additional costs. Whilst DSO primacy imposes costs on the NESO, these costs are lower than those under NESO primacy under any reasonable price assumptions considered. For example, costs scaled over a year show for Case 1 under DSO primacy (where the NESO has to go to the BM to achieve response) amount to ~£26 million, compared to ~£40 million under NESO primacy.</td><td>Optimal approach: <u>NESO primacy</u>
NESO primacy leads to higher net benefits in this case:
Compared with DSO primacy, NESO primacy does not require any additional flexibility or curtailment to avoid unwinding the NESO action
However, both DSO primacy and NESO primacy result in more curtailment than would occur under ‘no primacy’
Whilst there is no difference between DSO primacy and NESO primacy in terms of the opportunity cost of curtailed assets, they do have different implications in the compensation that curtailed assets might be entitled to:
Under DSO primacy, the NESO actions that would otherwise create headroom are no longer taken. Even though this results in more curtailment (compared to ‘no primacy’) it is unlikely that curtailed assets would expect or be entitled to compensation
Under NESO primacy, the headroom is being created, just as it would be under ‘no primacy’. The DNO is preventing that headroom from being released to curtailed customers. Depending on how DCUSA and customer connection agreements are interpreted, this may required compensation to be paid to those customers.
Even if compensation were paid under NESO primacy, this would not change the whole system CBA, since it would represent a transfer of revenue to the curtailed customers from the NESO or DNO, and would not change the overall benefit of the approach.</td></tr>
</table>

Summary of CBA results per case

In the cases where a NESO action moves the loading of the local network ***away from*** a constraint, thereby alleviating it, there is little cost incurred by the DNO facilitating that action through **NESO primacy**. On the assumption that ANM systems can be modified to allow this, both technically and at reasonable cost, there would be justification for enabling these use cases.

In the case where a NESO action moves the loading of the network ***into*** a constraint, thereby exacerbating it, it is **unlikely that NESO primacy will make economic sense**. The creation of additional headroom on the distribution network itself creates a cost for either the DNO or the curtailed party. Furthermore, this would result in a drop in the overall generation capacity on the system, which NESO would be obliged to address at a system level. This would either be by redispatching an asset elsewhere on the system or by increasing its reserve requirement. Given that the purpose of this use case is to secure generation turn-up for NESO services such as reserve, this approach appears self-defeating. As such, **DSO primacy** is likely to be the most suitable approach in these cases.

There are edge cases which need to be analysed where specific needs mean this situation may not apply. One such example would be the NESO procuring inertia from a distribution asset in a constrained area. By turning up a high-inertia asset and turning down a low-inertia asset under the same constraint, the NESO will be able to secure inertia whist not changing the net import/export from the constrained group. Implementing such an approach would present technical challenges for the ANM and broader commercial and regulatory challenges. However, this could be implemented in a number of ways:

1. Better data would allow NESO to turn up a high inertia asset with reasonable confidence that the ANM will respond by turning down a low-inertia asset (based on an understanding of the mix of generators in a given Curtailment stack).
2. NESO could explicitly initiate high-inertia turn-up *and* low-inertia turn-down from behind a constraint in order to ensure the required change in inertia is delivered. This approach would effectively remove the need to modify the ANM.

Implementation

Implementing these primacy rules will require, at a minimum, improved data, and likely changes to systems and process. Additional work will therefore be required to understand the detailed implementation requirements, and the costs associated with implementing these primacy rules.

The accompanying CBA pack includes more detailed process flows that describe how NESO primacy and DSO primacy would work in practice. Improved data or system capabilities will be required in a number of areas ahead of the implementation of these primacy rules:

- **Improved understanding of FSPs at risk of conflict:** The need for primacy rules only arises if the NESO is attempting to dispatch flexibility from FSPs within a constrained part of the distribution network. The NESO currently gathers information regarding the connection status of FSPs (i.e. whether they themselves have curtailable connections), but not whether those assets are in a distribution zone shared with assets under curtailable connections. The NESO needs to develop a more complete picture of where its distribution-connected FSPs are, and whether those locations are at risk of constraint. The DNOs also need to have sight of when NESO actions are bringing the distribution network to its import or export limits. DNOs need to develop a complete picture of where NESO services are procured and dispatched. This data should flow bi-directionally.
- **Curtailment monitoring, forecasting, and data sharing:** Primacy rules are only triggered when a constraint is active (e.g. when ANM is actively curtailing an asset). There is a need for the DNO and NESO to understand the probability that curtailment will be in effect. From the NESO's perspective, this forecast would ideally be provided ahead of the day-ahead auction, which would cover most services now being procured via the Enduring Auction Capability, and be reliable enough to make a decision about whether to accept bids and offers into the auction. This time period could be different for some services procured at different time frames. It would also be beneficial to have a continuous loop of data exchanges within-day so that the both parties have the information required.
- **ANM enhancements:** If NESO primacy is to be applied, this will require modifications to the way that ANM systems work. In the case of a NESO action flexing *away from* a constraint, the ANM would be required to pause its action to avoid unwinding. How this would be achieved in practice needs to be determined but could come in the form of creating headroom on the ANM, as discussed previously.

Whilst additional work would be required to understand the system, process and data enhancements needed to implement individual rules, we can make some initial observations, as summarised as follows:

Use case implementation requirements

Use Case	Change needed	Change required
NESO primacy for positive flexibility from import-constrained networks		ANM is not yet widely used to manage import constraints. Conflict cases are therefore most likely where there are procured DSO services. It is technically possible that the DNO might unwind the dispatch of demand turn-down in response to a NESO action. However, DNOs do not typically monitor constraints in such a real-time way, and do not adjust DSO dispatch with this level of granularity. It is expected that the use of ANM on import-constrained networks will become more common. In this case, agreed primacy rules will be required, just as they would be for export-constrained networks.
DSO primacy for NESO flexing *into* a distribution constraint		This requires the DNO to inform the NESO that a local network will be constrained over the required delivery window. The DNO needs to be able to make a forecast of constraint location-level curtailment for the subsequent day, and to communicate this forecast to the NESO. The more accurate the forecast, the more confidence the NESO can have about relying on flexibility from that part of the network. With this curtailment forecast, NESO has a number of options: 1. If it deems the risk of conflict low enough, it could proceed with its procurement and dispatch of flexibility, accepting that there is a risk of this action being unwound 2. If the forecast comes early enough (i.e. ahead of the day-ahead auction) it could prevent some providers from placing bids or offers into the NESO auction. It could allow bids and offers to be placed, but retain the right either not to dispatch these assets (in the case of dispatchable reserve services), or to ‘disarm’ assets (in the case of automated services such as frequency response). It may do this based on an evolving view of the curtailment risk as the delivery window approaches, assuming that DNOs continually update and communicate this forecast to the NESO. There frequency of data exchanges will impact how this can be implemented, DNO’s can update their forecasts based on data received from NESO but depending on when it’s received the ease of forecast updates changes.
NESO primacy for negative flexibility from export-constrained networks		Whilst this has a positive CBA case, its implementation relies on ANM being instructed not to unwind NESO actions. This is not how ANM systems currently operate, so some change would need to be made to their design. Further investigation is required to understand the functional requirements, whether this can be implemented technically, and the cost of making such changes.

Conclusions

Despite a degree of uncertainty around the prevalence of DSO-NESO conflicts, and the costs of the primacy rules under each Use Case, it appears possible to identify the preferred Primacy rule in each case.

- Where NESO primacy requires the creation of distribution headroom ahead of time, this is unlikely to be the optimal approach unless either DSO flexibility becomes significantly cheaper, or if the cost to the NESO of accessing alternative forms of flexibility becomes significantly more expensive. Under these cases, DSO primacy appears to be the preferred approach.
- Where a Use Case does not require headroom creation ahead of time, NESO primacy appears to be the optimal solution, since it does not create additional variable cost for the DNO or distribution-

connected customers. However, there remain questions around the regulatory and contractual changes required to enable NESO primacy in these cases, relating to the treatment of curtailable assets when there is headroom on the local network.

Both DSO primacy and NESO primacy require investment in order to enact them. This includes improved data, forecasting and information sharing between parties. In some cases it also involves making changes to ANM systems to allow them to adjust their notional headroom based on NESO actions, as well as changing the Principles of Access to prioritise some assets over others. Further work is required to understand the technical changes required to allow for data sharing between NESO and DNO, and the costs involved. Additional data is required to understand the prevalence of DSO-NESO conflicts, and hence the value that implementing these primacy rules could create. Changes to NESO systems would also be required to enable them to receive Day Ahead and closer to real time data from DNOs.

Apart from the data and system improvements needed to implement these primacy rules, we also need to consider the impact that these rules will have on curtailable customers. There is a risk for existing and future distribution-connected flex providers that their flex revenues are below expectations. They may be connecting 'firm', and therefore assuming their firm access means their energy and flex is treated at full value. But for the reasons discussed above, this is not necessarily the case. Engagement with these stakeholders is required to ensure they understand these risks, and to ensure that the establishing of ANM zones, and the implementation of primacy rules is done in a fair and transparent way.

Glossary

Active Network Management (ANM): Active Network Management (ANM) is a system or approach used in electricity networks to dynamically monitor and manage the flow of power and the operation of grid assets in real-time. It enables better utilization of network capacity, optimizes the performance of distributed energy resources (DERs), and helps avoid or delay costly infrastructure upgrades.

Curtailable connection: grid connection that allows the network operator to temporarily reduce or interrupt electricity supply or generation to manage grid constraints or maintain system stability.

Flexible asset: A resource, infrastructure, or technology capable of adjusting its operation to support the balance of supply and demand, manage grid constraints, or respond to market signals.

Flexibility service providers (FSPs): Entities or organizations that offer services to adjust electricity consumption or generation in response to grid needs, helping to balance supply and demand, manage network constraints, and maintain system stability.

Inertia: Inertia, as maintained on the electricity system by NESO, is the kinetic energy from rotating generators that stabilizes the electricity system by resisting sudden frequency changes.

LIFO: 'Last In First Out', describing the order in which curtailable customers are curtailed, based on the order in which they connected. Early-connecting customers are only curtailed once those connecting later have been fully curtailed.

Negative flexibility: Refers either to generation turn-down or demand turn-up, as both decrease the generation-demand balance on the system

Primacy: Primacy rules establish a hierarchy among different types of network services or flexibility options. When multiple options are available, the service or flexibility with higher primacy takes precedence and the other service may be curtailed.

Principles of Access: The rules describing the order in which curtailable or flexibly-connected customers can be curtailed by the DNO via the ANM system. LIFO is the most common implementation of these principles.

Positive flexibility: Refers either to generation turn-up or demand turn-down, as both ***increase*** the generation-demand balance on the system

Technical limit: A site under a Technical Limit has non-firm access to the network (i.e. may have their output curtailed), until the transmission reinforcement works identified for their connection have been completed. Technical Limits are a temporary measure, lasting until potentially the end of the 2030s.

Qualification: Qualification processes and rules are used by DNO/NESO to work out whether a service provider is capable of providing certain responses.

Stackability: Stackability rules allow multiple types of network services or flexibility options to be stacked to address a single issue or network need. They define how different services can be used simultaneously to maximize benefits.

Introduction

Until relatively recently, the National Energy System Operator (NESO) and Distribution Network Operator (DNO) performed distinct, and largely independent roles. With its responsibility for balancing the electricity system, the NESO would secure turn-up and turn-down services to ensure that demand and generation were balanced in real-time. This flexibility was delivered primarily, if not exclusively, by large generation and storage assets connected to the transmission network. The DNO, by contrast, was responsible for maintaining the distribution network, managing outages, reinforcing and reconfiguring the network to accommodate changes in demand and new connections. Importantly, the DNO would ensure that there was enough network capacity to allow the peak demand to be met.

A number of trends have changed this relationship:

- The numbers and capacity of generation and storage connected to the distribution network has been increasing steadily
- The proportion of dispatchable generation (e.g. coal-fired power stations) on the transmission network has been reducing, replaced by variable, non-dispatchable forms of generation (e.g. wind and solar)
- As a result, the NESO has been increasingly relying on flexibility from distribution-connected customers.
- DNOs are increasingly incentivised to reduce the volume of reinforcement being undertaken on distribution networks. Flexibility is being used to manage peak demand and peak generation. This can take the form of procured services or flexible connections. The more dynamic, real-time management of the distribution network now falls under the functions of Distribution System Operation (DSO).

As a result, the NESO is procuring flexibility from distribution-connected assets that may also be providing flexibility services, or may be sited in a constrained area of the network. There is a risk that NESO and DSO actions conflict with each other, meaning that rules are required to determine how such conflicts are resolved.

The ENA Open Networks Primacy working group was established to investigate such potential conflicts. This report has been commissioned to:

- Identify the NESO and DSO services or ‘actions’ that may give rise to a conflict
- Define ‘primacy’ rules that can alleviate those conflicts
- Carry out a whole system Cost Benefit Analysis (CBA) to identify the overall impact of each primacy rule, including the impact on each network actor
- Consider how the primacy rules interact with pre-existing access rights and obligations of network actors
- Define the information and control flows between network actors required to enact each of the primacy rules
- Develop a governance framework, and identify triggers for implementing or modifying the primacy rules.

Primacy

Defining primacy

Primacy rules establish a hierarchy among different types of network services or flexibility options. When multiple options are available, the service or flexibility with higher primacy takes precedence and the other service may be curtailed. Primacy is about establishing the processes to use assets responsibly and in a way that doesn't cause conflicts**.** In the context of flexibility service providers (FSPs): FSPs may offer flexibility services to more than one third party, and that the services offered are in conflict with each other. For example, FSPs may be offering generation turn-down to a DNO and generation turn-up to the NESO. In any given delivery window, it is not possible for the FSP to deliver both turn-up and turn-down. As such, a rule is required to determine whether – in this situation – the DNO or the NESO has 'primacy'.[1]

Primacy vs stackability

One point to clarify is the distinction between 'primacy' and 'stackability'. Both these concepts relate to the ability of FSPs to offer multiple services, so there is a risk of conflation in their usage. For the avoidance of confusion, we make the following distinction:

Table 1 Stackability vs Primacy

	Stackability	Primacy
Summary	Concerns whether two services can be offered by an FSP in a single delivery window.	Concerns which system operator can dispatch a service in the event that two services conflict
Timing	Applies at the **procurement or pre-procurement** (i.e. eligibility) stage which includes the eligibility of units with curtailable connections to prequalify for services	Applies at the **operational dispatch** stage (i.e. within-day or day-ahead)
Who the rule applies to	Applies to the **FSP** looking to offer multiple services. Not affected by the actions of other FSPs.	Applies to the **system operator (or other 3rd party)** looking to dispatch the flexibility service. May not only consider a single FSP, but also the interaction between different FSPs.

We provide further detail on how these distinctions apply in practice throughout this report. But in short:

- **Stackability** rules tell a FSP whether they are allowed to offer two services for the next, say, 1-month period, or whether they need to choose which service to offer.
- **Primacy** rules apply in real- or near-real time, and define how the system operators are allowed to dispatch a service.

[1] We focus on conflicts that arise between the NESO and a DNO. Other third parties, such as suppliers and aggregators, could have flexibility agreements with FSPs, and may need to be brought under the primacy framework in the future.

In principle, the application of stringent stackability rules could minimise the numbers of occasions on which primacy rules are required (by avoiding situations where a FSP might be expected to offer two conflicting services). Conversely, lax stackability rules may increase the frequency of such conflicts, requiring primacy rules to be enforced more often.

It should be noted, however, that even the most strict stackability rules will not ***eliminate*** the need for primacy rules. The main reason for this is that stackability rules apply to individual FSPs, whereas primacy rules need to consider cases where the dispatch of one FSP affects the flexibility of other FSPs.

NESO-DSO primacy rules

In defining primacy rules that work technically, we need to consider why the DNO needs flexibility. In most cases this will be because the local network is constrained. If the NESO attempts to take a flexibility action that exacerbates that constraint, the DNO must take an action to avoid the network breaching its thermal limits (i.e. the firm capacity of the substation). Whilst the local network will comprise a range of asset types (demand, generation and storage on flexible and non-flexible connections), from the perspective of the NESO, this network can be thought of as a single 'group asset' with a maximum export level.

This leads us to two observations:

1. Primacy rules should apply to *all* assets in a constrained area simultaneously, rather than individual FSPs.
2. We need primacy rules to describe the mitigating or enabling actions that are needed for them to work in practice.

At a high level, there are four possible primacy rules that can apply, as summarised below.

High level primacy rules

Primacy rule	Description
No primacy	This describes the case where neither NESO nor the DNO has primacy. Where conflicts arise, the NESO and DNO will take the necessary actions to ensure its network or system requirements are met. For example, if the NESO dispatched generation turn-up from one asset, the DNO's Active Network Management (ANM) system could curtail the generation of a flexibly-connected asset in the same group, unwinding the action, leaving no net change in the export from the group. ***This is the <u>default state</u> where no formal primacy rules are put in place.***
DSO primacy	If a NESO flexibility action would cause an issue for the distribution network, or would be unwound by the DNO (see the 'No primacy' rule), the DNO informs the NESO of the conflict. The ***NESO then excludes the flexible asset from its dispatch queue***, and secures its required flexibility from another source.
NESO primacy	For specific combinations of NESO service and distribution constraint, the ***DNO can take actions to enable the NESO to secure flexibility from a constrained part of the network***. Where such mitigation is technically feasible, the DSO takes such action (e.g. headroom creation) on behalf of the NESO. Assets obliged to change their output to enable such action may be compensated by the DNO or NESO, depending on how this rule is implemented.
Joint primacy	This has been referred to in previous work from the Primacy group. The idea being, the DNO and NESO agree which primacy rule should apply at a given constrained location, based on the relative costs and benefits of each rule. It is assumed that appropriate compensation is provided to ensure that the selected rule is of mutual benefit to all parties. This report sees this as an option within NESO primacy, "Joint primacy" can be summarised as **"NESO Primacy with compensation".** As such, Joint Primacy is, at a whole system assessment view functionally the same as NESO primacy and gives the same overall CBA. Therefore this report does not report on "Joint Primacy".

Applying primacy rules to conflicting actions

The purpose of this report is to evaluate the costs and benefits of different primacy rules in addressing different conflicts between the NESO and DSO. We first need to define which actions are included in the scope of this report.

NESO and DSO actions in scope

DSO actions

DSO actions include any flexibility the DNO uses for the purpose of managing its network – most commonly to address network constraints. DSO actions can be grouped into two types: ANM and procured services.

ACTIVE NETWORK MANAGEMENT (ANM)

'ANM curtailment' is one mechanism by which the DNO can effect negative (or positive) flexibility. Flexibly-connected customers are those that do not have unfettered access to the network, but instead have an obligation to accept curtailment when the network is constrained. A FSP in an ANM stack can have its output curtailed when required to manage a network constraint.

An ANM system does not require real-time manual control by the DNO. Rather, it monitors the real-time export (or import) across a network asset (e.g. a substation), and instructs one or more flexibility-connected customers to vary their output in order to ensure that the export (or import) does not exceed the firm capacity of the network asset.

ANM is also used in order to keep the flows within Technical Limits agreed with the NESO to manage a transmission constraint.

PROCURED DSO SERVICES

DSO services enable the enactment of both positive and negative flexibility to manage network constraints and optimize distribution operations. DNOs all have independent positions with regard to whether they are pursuing all of the below services, or just some.

DSO Service List:

- **Peak Reduction:** This service focuses on lowering power demand or generation during peak periods, often through long-term energy efficiency measures. By reducing electricity consumption or generation at critical times, DNOs can alleviate strain on the network and avoid reinforcement costs.
- **Scheduled Utilisation:** Flexibility delivery is pre-agreed and scheduled in advance, benefiting providers that cannot operate in real-time. This service is typically employed to manage seasonal peaks or during planned network maintenance.
- **Operational Utilisation:** This near-real-time service allows DNOs to adjust demand profiles based on actual network conditions. It is particularly effective for managing network faults or outages without incurring high availability costs.
- **Operational Utilisation with Scheduled Availability:** In this hybrid model, DNOs pre-procure the ability to adjust outputs during abnormal network conditions. Payments are utilisation-based, ensuring cost-effectiveness while addressing short- to medium-term forecasts.
- **Operational Utilisation with Variable Availability:** This service offers flexibility to refine capacity requirements closer to the event, based on long-term network constraint forecasts. It balances cost and service precision by only compensating for utilised flexibility.

DNOs are at varying levels of development in adopting and using these services. Generation turn-up and demand turn-down often remain the most frequently procured actions, commonly delivered under the old version of a service – the 'dynamic' product. Though this varies across different DNO's depending on their needs. These actions now align closely with the scope for Operational Utilisation, which has similar day ahead procurement with real-time responsiveness. Some more analysis of the costs and volumes of DSO services procured historically can be found in the 'CBA Summary Document'.

NESO actions

NESO 'actions' refer here either to actions taken through the Balancing Mechanism (BM) or through procured services. These include system balancing services (i.e. frequency and reserve services) and transmission constraint management services.

Figure 1 shows the summary of services which were considered in scope, and whether they had available data to understand the auction stacks from the NESO portal. For the services in scope, but without data available (Orange), assumptions were used to map available data to these services, until data becomes available. For these services, it is thought data will become available in the next 12 months.

NESO service data was used to understand the impact of DSO primacy. This full process is summarised in the 'CBA Summary Document'.

Service Area	Service	Data Available in SMP?	In Scope?
Frequency	Balancing Reserve	Yes	Yes
Frequency	Static Firm Frequency Response	Yes	Yes
Frequency	Dynamic Containment	Yes	Yes
Frequency	Dynamic Moderation	Yes	Yes
Frequency	Dynamic Regulation	Yes	Yes
Thermal	MegaWatt Dispatch	Yes - But not the auction stack	Yes – but using assumptions to calculate costs in CBA
Frequency	Quick Reserve	No	Yes – but using assumptions to calculate costs in CBA
Frequency	Slow Reserve	No	Yes – but using assumptions to calculate costs in CBA
Stability	Long Term Stability Y_4	Not Planned	No, likelihood of conflict low because of long term markets
Stability	Stability Pathfinders	Not Planned	No, no data and programme to develop future services, low volumes procured, low likelihood of conflict
Voltage	Voltage Pathfinders	Not Planned	No, no data and programme to develop future services, low volumes procured, low likelihood of conflict
Restoration	Distributed Restart	Not Planned	No, very low volumes procured, low likelihood of conflict
Restoration	Electricity System Restoration Events	Not Planned	No, low volumes procured, low likelihood of conflict
Voltage	Reactive Power Long Term Markets	Not Planned	No, likelihood of conflict low because of long term markets
Thermal	Constraint Management Intertrip Service	Not Planned	No, low volumes procured
Stability	Mid-term Stability	Not Planned	No, likelihood of conflict low because of long term markets
Voltage	Reactive Power Mid Term Market	Not Planned	No, likelihood of conflict low because of long term markets
Voltage	Reactive Power Short Term Market	Not Planned	No, no data
Stability	Short Term Stability D-1	Not Planned	No, no data
Thermal	Local Constraints Market	Not Planned	No, still a work in progress
Thermal	Constraints Collab Project	No	No, still a work in progress

Figure 1 - List of NESO Services considered in scope

In principle, we could consider combinations of in-scope DSO and NESO actions in turn, define primacy rules for each, evaluate the costs and benefits, and lay out a preferred solution. However, it is more practical and insightful to group these services together, and develop primacy rules based on those consolidated Use Cases.

Consolidated Use Cases

Throughout this report we will describe two types of action:

- **Positive flexibility** refers either to generation turn-up or demand turn-down, as both ***increase*** the generation-demand balance on the system
- **Negative flexibility** refers either to generation turn-down or demand turn-up, as both decrease the generation-demand balance on the system

The individual NESO and DSO actions all differ from each other in a number of ways, including their value to the system operator, the types of asset that can deliver the service, the timing of procurement and dispatch, and the commercial structures. However, for the purpose of developing and evaluating primacy, the key factor determining which rules make sense is whether the NESO is securing positive or negative flexibility, and whether the distribution network is import- or export-constrained.

It should be noted that most NESO services are structured to allow providers to provide either positive flexibility, negative flexibility, or both (i.e. a symmetrical response). This allows us to consider the positive and negative component of these services separately, which is important since the nature of the conflict with constrained distribution networks is different depending on the direction of flexibility being dispatched.

Put simply, there are two types of conflict that need to be considered:

- NESO flexing ***into a*** distribution network constraint;
- NESO flexing ***away from*** a distribution network constraint.

These two situations are summarised in Figure 2, with **Cases 1 and 4** relating to the NESO flexing ***into*** a distribution constraint, and **Case 2 and 3** relating to the NESO flexing ***away from*** a distribution constraint.

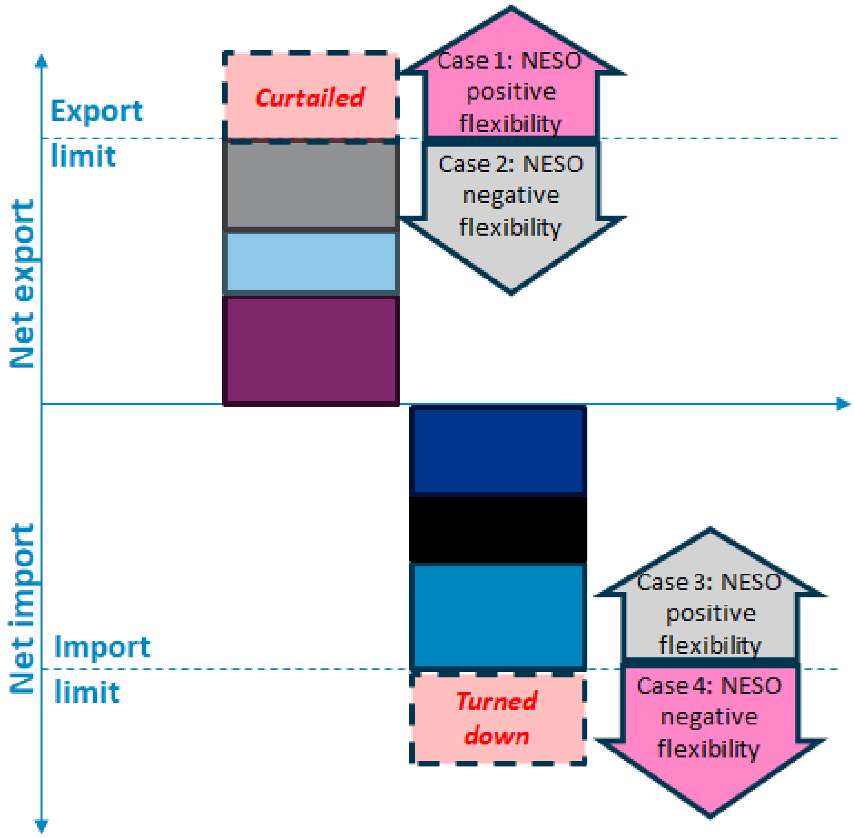


Figure 2 – Illustration of flexibility conflict use cases

NESO flexing *into* a distribution network constraint

In the first case it is clear why a conflict arises. If the NESO were to try to secure generation turn-up from an already export-constrained part of the distribution network, this would exceed the network's thermal limits. In order to avoid this breach, the DNO must counteract the NESO action through a generation turn-down action. This is most likely to be through the actions of the ANM system. Note that the NESO may procure generation turn-up from one asset (e.g. a gas engine with a non-curtailable connection), while the DNO's ANM system may counter this by turning down a different asset (e.g. a flexibly-connected solar farm). This case illustrates a number of issues:

- The **NESO** will not be receiving the change in output it expected to see;
- The **gas engine** will (rightly) assert that it has delivered the required flexibility, and expect to be paid by the NESO for its services;
- The **solar farm** will experience additional curtailment, reducing its revenue.

In effect, the DNO already has 'primacy' in this case (i.e. '**No primacy**'), which is to say that its right to maintain network integrity supersedes the NESO's right to procure unfettered flexibility. It is, however, an inefficient form of primacy since the NESO is paying for an outcome it does not receive. One solution is for the DNO to notify the NESO when such cases will – or are expected to – arise, allowing the NESO to go elsewhere for its flexibility. This is defined in this report as **'DSO primacy'**. This is usually better for the NESO and the solar farm and for the consumer when considering whole system costs, but would effectively exclude the gas engine from providing this NESO service (at least while the constraint was in effect).

Depending on the specific service that the NESO is trying to procure, there may be ways of avoiding the conflict. Assuming that the distribution constraint cannot be exceeded, this can only be done by first creating headroom on the distribution network. For example, this could be done by curtailing the solar farm ahead of time, and instructing the ANM not to use up the headroom created. This would allow the gas engine to offer turn-up balancing services to the NESO by operating within that newly-created headroom (again, with the ANM instructed to allow this to happen). This would almost certainly require functionality to be added to ANM systems, as this is not a mode of operation that is used today. This is an example of **NESO primacy**, where the DNO acts on behalf of the NESO to create the conditions to allow it to procure flexibility from an otherwise constrained part of the network.

NESO flexing *away from* a distribution network constraint

In this case, it is less clear why there is a conflict. If the NESO wishes to secure generation turn-down from an export-constrained part of the network, doing so would not risk exceeding the thermal limits of the network. On the contrary, it would reduce the thermal loading of the network.

However, the potential conflict arises if the DNO is already securing generation turn-down from that part of the network. This is most likely to occur where there is an ANM scheme operating. If the ANM scheme is curtailing one or more curtailable assets, when the NESO triggers the turn-down of another asset on the same part of the network (e.g. a firm generator), the ANM will 'see' this as additional headroom. Its own logic will then reduce the curtailment of one of the curtailable assets to compensate. This is consistent with both its design, and also the rules by which these assets agree to curtailment when they connect.

As before, this is effectively a case of the DNO having primacy, but with the NESO being unaware that such a situation is in effect. As before, the NESO would not receive the flexibility it expected to see, and the gas engine would (rightly) expect to be compensated for delivering turn down. The solar farm, having previously been facing one level of curtailment, ends up experiencing ***less*** curtailment, so sees an ***increase*** in its revenue.

As before, a formalised **DSO primacy** rule would have the DNO notify the NESO that this situation was likely to occur, allowing the NESO to go elsewhere for its required flexibility. This would be better for the NESO, and would mean that the solar farm did not receive its extra revenue. However, it would effectively exclude the gas engine from the NESO market while the constraint was biting, which it may not have realised was a possibility when it first connected.

The **NESO primacy** rule in this case is more straightforward than in the 'flexing into the constraint' case. At the time of instructing generation turn-down, the NESO could also inform the DNO that this was occurring. The DNO would then instruct the ANM not to fill up the created headroom. Note that whilst this is relatively simple in principle, it would still require ANM functionality beyond that which exists today. This is considered further in the Implementation section of this report. There would also be additional complexities in enacting this for aggregated assets due to visibility.

Summary of DSO and NESO Primacy under each Use Case

We have identified four cases relating to NESO and DSO flexibility conflicts, as summarised in Table 2.

Table 2 Flexibility conflict use cases

<table>
<tr><th></th><th colspan="2">NESO positive flexibility</th><th colspan="2">NESO negative flexibility</th></tr>
<tr><td rowspan="3">Export-constrained distribution network: DSO/ANM is, or is close to, effecting negative flexibility</td><td colspan="2">Case 1</td><td colspan="2">Case 2</td></tr>
<tr><td colspan="2">Conflict case: DNO counters NESO action with negative flexibility to manage thermal constraint</td><td colspan="2">Conflict case: DNO counters NESO action with positive flexibility to absorb newly-created headroom, reducing the curtailment of customers in the area</td></tr>
<tr><td>DSO primacy: NESO opts out of dispatching positive flexibility from the area</td><td>NESO primacy: NESO can only dispatch positive flexibility if headroom has first been created on the constrained distribution network</td><td>DSO primacy: NESO opts out of dispatching negative flexibility from the area, so the DNO takes no action and no curtailment reduction occurs</td><td>NESO primacy: NESO dispatches negative flexibility, and the DNO ensures that is does not release the newly-created headroom to customers being curtailed</td></tr>
<tr><td rowspan="3">Import-constrained distribution network: DSO is, or is close to, effecting positive flexibility</td><td colspan="2">Case 3</td><td colspan="2">Case 4</td></tr>
<tr><td colspan="2">Conflict case: DNO counters NESO action with negative flexibility to absorb newly-created headroom, reducing demand turn-down in the area</td><td colspan="2">Conflict case: DNO counters NESO action with positive flexibility to manage thermal constraint</td></tr>
<tr><td>DSO primacy: NESO opts out of dispatching positive flexibility from the area, so the DNO takes no action and no demand turn-down reduction occurs</td><td>NESO primacy: NESO dispatches positive flexibility, and the DNO ensures that it does not reduce demand turn-down in response or release the newly-created headroom to customers being curtailed</td><td>DSO primacy: NESO opts out of dispatching negative flexibility from the area</td><td>NESO primacy: NESO can only dispatch negative flexibility if headroom has first been created on the constrained distribution network</td></tr>
</table>

Outage cases

As part of this report we also consider the interaction between NESO flexibility and outage actions taken by the DNO. An outage on the network affects the ability of the NESO to access flexibility from a FSP in one of two ways:

1. The FSP may be taken off supply, meaning that it is unable to import or export, and is therefore unavailable to provide flexibility
2. The network may be reconfigured during the outage, meaning that the Grid Supply Point (GSP) through which FSP flexibility takes effect is changed.

We consider two types of outage:

- **Planned outages:** Where the DNO takes a network asset offline (e.g. for repairs), with prior knowledge that this is going to occur and, typically, the ability to choose when this occurs
- **Unplanned outages:** Where a network fault is unanticipated, and the DNO takes action to restore the network to its intact state.

Whilst both types of outage affect the ability of the NESO to dispatch FSP flexibility, the DNO only has any real choice over the planned outage. We have not identified any meaningful primacy rules that would apply in this case.

For planned outages, however, the DNO does have some discretion as to the nature and timing of its actions. In principle, therefore, primacy rules could apply to ensure that these planned outages are carried out in a way that maximises the whole system benefit. However, this level of analysis is outside the scope of this report.

Cost Benefit Analysis

Cost Benefit Analysis approach

We have carried out a Whole System Cost Benefit Analysis (CBA) to assess the overall benefit of each primacy rule under each case, and how each primacy rule affects individual parties on the system. The scope of the CBA is limited to the costs of the flexibility actions themselves, including:

- Procurement costs for the NESO and DNO
- Lost revenue/opportunity costs for the connected customers.

Implementing these primacy rules will require new data, processes and systems to be implemented. Establishing, operating and maintaining these will require the NESO and DNO to incur additional costs. These are excluded from this CBA. The CBA is, therefore, intended to indicate where there may be a benefit of implementing a given primacy rule. Additional analysis will then be required to determine whether the investment required to bring it into effect is economically justified.

For the CBA, we have established a ***notional baseline*** under which the network is not constrained. The NESO procures its flexibility as if the local network were not at its thermal limit. It has access to all distribution-connected flexibility providers, and those FSPs are able to offer their services unencumbered. Note that this baseline cannot exist in reality, since these local networks are constrained. It is, however, a useful baseline to use to illustrate the relative cost impacts of the different primacy rules.

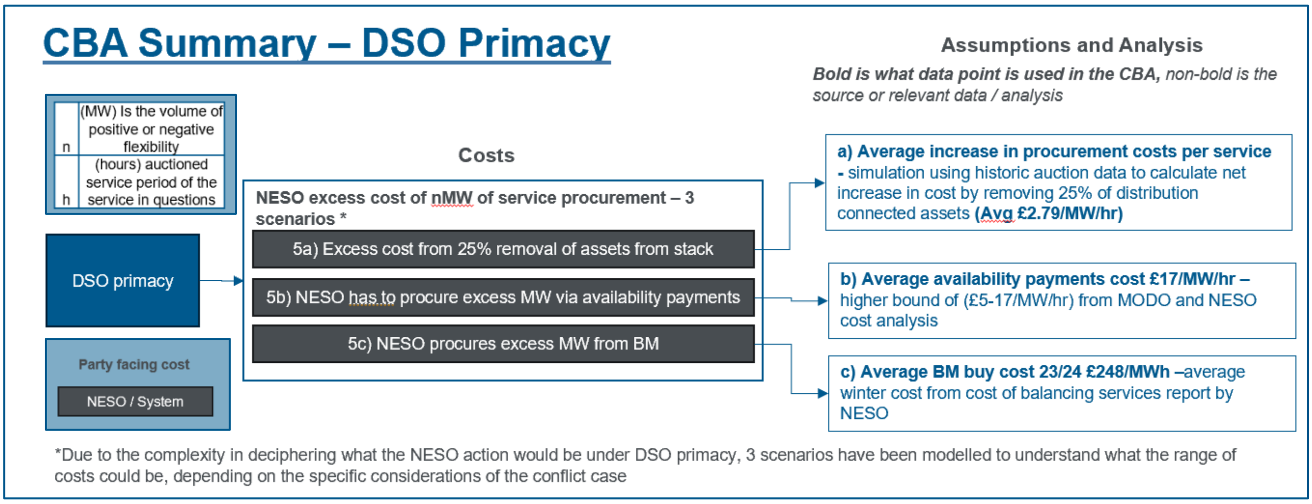
We have considered the cost of the different primacy rules under the four cases identified earlier in this report. 'DSO primacy' rule is common to all four cases: the NESO is informed that the network is constrained, and that the flexibility it requires from the distribution-connected assets in the local area is not available. As such, the NESO must secure an equivalent volume of flexibility from elsewhere on the system. The cost of this primacy rule is driven by the relative cost of that additional flexibility compared to the cost of the distribution-connected flexibility.

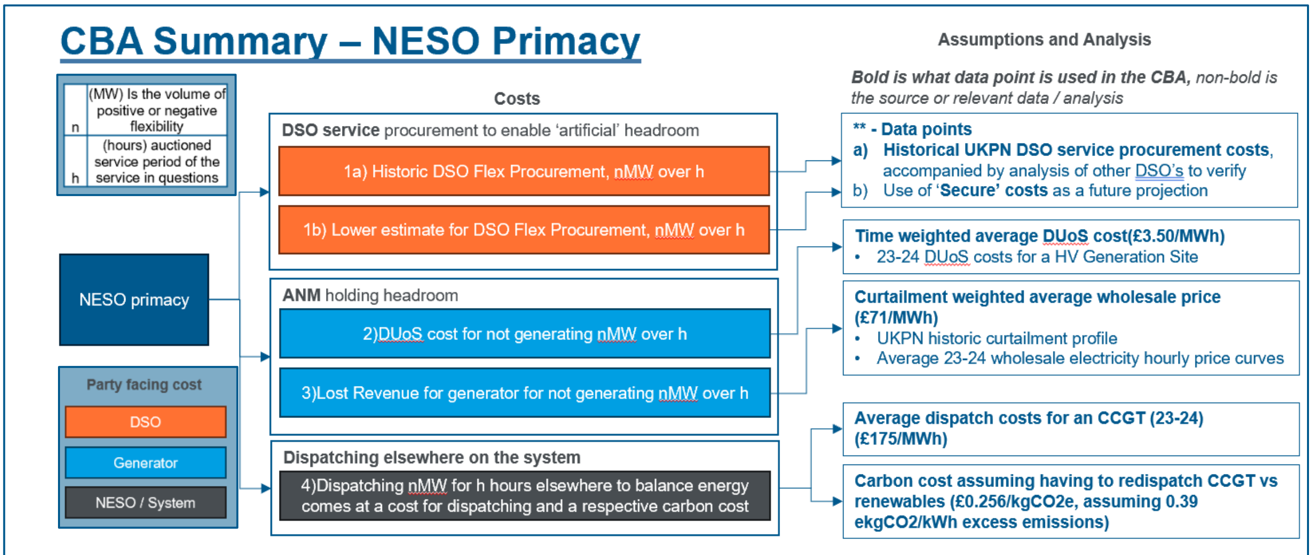
Because there are parallels between Cases 1 and 4, and between Cases 2 and 3, at a high level there are two situations the CBA needs to consider for 'NESO primacy':

- **Cases 1 and 4 –** NESO taking an action that will exacerbate the thermal constraint: In this case, the action cannot be taken without first creating the required headroom. Ahead of the delivery window, the NESO must secure turn-down to create headroom. It can then use that headroom to dispatch assets for balancing services. The cost of these cases are driven by the cost of securing that turn-down, and the length of time for which the headroom needs to be held.
- **Case 2 and 3 –** NESO taking an action that reduces the thermal constraint: In this case, the NESO should be able to secure turn-down. The only barrier is the automated action of the ANM system. Provided this unwinding action can be prevented, there should be no additional cost associated with

NESO primacy in this case. There will be additional system and process changes required but, as discussed, these are outside the scope of our analysis.

A more detailed description of the CBA assumptions is in Figure 3 and a summary of how these relate to the cases of conflict is in Figure 4.





** DSO Service costs		Positive Flex Generation Turn Up	Negative Flex Generation Turn Down	Positive Flex Demand Turn Down	Negative Flex Demand Turn Up
Volume weighted average price (£/MWh)	£/MWh	398	677	446	419
Secure costs	£/MWh	154	0	0	206

Cost Benefit Analysis results

The results are summarised in the 'CBA Summary Document'. These cases largely consider conflicts at distribution thermal limits. Under technical limits or cases where NESO has specific stability needs (e.g. inertia) the primacy rule that makes sense technically and could be altered because of actions at the point of implementation of the rule being different. For the four core cases of conflict, the CBA revealed that NESO primacy is preferable in some cases, and DSO primacy in others.

	Case 1 and 4	Case 2 and 3
Conflict case	**Conflict case 1:** DNO counters NESO action with negative flexibility to manage thermal constraint **Conflict case 4:** DNO counters NESO action with positive flexibility to manage thermal constraint	**Conflict case 2:** DNO counters NESO action with positive flexibility to absorb newly-created headroom **Conflict case 3:** DNO counters NESO action with negative flexibility to absorb newly-created headroom

Primacy rule with optimal CBA	**Optimal approach:** DSO primacy
	
	DSO primacy leads to the best net benefit on a whole system basis. The actions required to enable NESO primacy (holding additional curtailment during the service window, and paying for rebalancing from elsewhere on the transmission network) create significant additional costs. Whilst DSO primacy imposes costs on the NESO, these costs are lower than those under NESO primacy under any reasonable price assumptions considered. For example, costs scaled over a year show for Case 1 under DSO primacy (where the NESO has to go to the BM to achieve response) amount to ~£26 million, compared to ~£40 million under NESO primacy.
		Optimal approach: NESO primacy
		
		NESO primacy leads to higher net benefits in this case:
		• Compared with DSO primacy, NESO primacy does not require any additional flexibility or curtailment to avoid unwinding the NESO action
		• However, both DSO primacy and NESO primacy result in more curtailment than would occur under 'no primacy'
		• Whilst there is no difference between DSO primacy and NESO primacy in terms of the opportunity cost of curtailed assets, they do have different implications in the compensation that curtailed assets might be entitled to:
		    • Under DSO primacy, the NESO actions that would otherwise create headroom are no longer taken. Even though this results in more curtailment (compared to 'no primacy') it is unlikely that curtailed assets would expect or be entitled to compensation
		    • Under NESO primacy, the headroom ***is*** being created, just as it would be under 'no primacy'. The DNO is preventing that headroom from being released to curtailed customers. Depending on how DCUSA and customer connection agreements are interpreted, this may required compensation to be paid to those customers.
		• Even if compensation were paid under NESO primacy, this would not change the whole system CBA, since it would represent a transfer of revenue to the curtailed customers from the NESO or DNO, and would not change the overall benefit of the approach.

Figure 4 - Summary of CBA results per case

Impact on different customer types

The whole system CBA shows the overall cost and benefit of the different primacy rules, including how each rule creates costs or benefits for different network users. However, when considering the feasibility of implementing these rules, we also need to consider how these rules might conflict with network users' existing connection agreements. Potential conflicts we have identified include:

- **Non-curtailable customers on a constrained network:** Such customers will have secured a distribution connection with full access rights. This means that they have the right to export at their maximum capacity (provided the network is intact). They may also reasonably expect such access to extend to the ability to offer flexibility services to the NESO, just as they would if they were connected to the transmission network. The emergence of a constraint on the network means that the value of their flexibility to the ESO may be significantly diminished.
    - Without an explicit primacy rule, their flexibility will be unwound by the ANM system, meaning that the NESO will be expected to reduce the perceived value of that flexibility;
    - Under DSO primacy, the NESO will opt not to procure from the asset at all, since the DNO will have informed them of the conflict;
    - Under NESO primacy, the asset will be able to provide flexibility for most NESO services (although not generation turn-up for managing transmission constraints). However, either the DNO or NESO will be responsible for paying for creating the required headroom. It is reasonable to expect that this additional cost will reduce the perceived value of flexibility from this asset.
    - Regardless of the primacy rule, then, non-curtailable assets sited behind constrained parts of the distribution network are expected to see the value of their flexibility reduce. This is a risk that they may not have been made aware of at the point of connection, and indeed may be something they remain unaware of. This risk needs to be better communicated, and may need to be factored into the decision to opt for ANM-managed zones rather than reinforcing the network.
- **Curtailable customers being curtailed for headroom creation:** NESO primacy requires that the DNO instruct the ANM to create headroom to allow the flexibility service provider to deliver its flexibility. Under such circumstances, there will be curtailable customers under curtailment whist there is technically headroom on the constrained network. Their level of curtailment will not be higher than it would otherwise be (i.e. if the NESO were not procuring flexibility, or if DSO primacy were implemented). However, DNOs will need to verify that these customers' connection agreements allow curtailment when the network is not actually fully constrained. Even if this is contractually permitted, it may be seen not to be within the spirit of the curtailable connection agreement.

Summary of Cost Benefit Analysis findings

In the cases where a NESO action moves the loading of the local network ***away from*** a constraint, there is little cost incurred by the DNO facilitating that action through **NESO primacy**. On the assumption that ANM systems can be modified to allow this, both technically and at reasonable cost, there would be justification for enabling these Use Cases. Further consideration will be required to any compensation that would be appropriate for curtailed customers in this situation. Whilst they would not face any ***additional*** curtailment compared to a DSO primacy rule (where the NESO would go elsewhere for its required flexibility), NESO primacy in this case would result in their curtailment remaining in effect while there was headroom on the local network. Depending on their flexible connection agreement, it may be appropriate for them to be compensated, in which case they would be net beneficiaries from this arrangement, with the DNO or NESO incurring some cost for covering that compensation payment.

In the case where a NESO action moves the loading of the network *into* a constraint, it is unlikely that NESO primacy will make economic sense. The need to create headroom throughout the delivery window creates the need for a significant increase in the volume of flexibility being dispatched. Whether this is absorbed by the curtailed party, or paid for by the DNO or NESO as a procured service, this represents a significant additional cost. As such, **DSO primacy** is likely to be the most suitable approach in these cases. This could change in the future, but would require a number of things to transpire:

- The cost of headroom creation would need to fall. Currently, the flexibility that the DNO is procuring is relatively expensive, including demand turn-up. It is possible that these costs fall in future as the number of flexible assets connected to the distribution network increases, and as more automation is introduced to demand-side flexibility (e.g. EV charging).
- The cost to the NESO of securing alternative forms of flexibility would need to increase. This could arise if flexibility on the transmission network reduced, and if embedded flexibility became the main source for providing NESO services. If the NESO had fewer alternative options for meeting its requirements, this lack of liquidity could push up the cost of DSO primacy relative to NESO primacy.

The only exception to the above could be the use of embedded flexibility to increase inertia on the system. The NESO could secure generation turn-up from a high-inertia generator on an export-constrained part of the network (effectively flexing ***into a*** constraint). The DNO (or its ANM system) would then trigger negative flexibility in response to keep the network within its thermal limits. Provided that this negative flexibility came from a low-inertia source (e.g. wind, solar, or demand turn-up), the net result would be of benefit to the NESO. This can be seen as a variant of **NESO primacy**, where the DNO is obliged to curtail particular asset classes to enable the NESO to increase system inertia.

However, this could be implemented in a number of alternative ways:

1. Better data would allow NESO to turn up a high inertia asset with reasonable confidence that the ANM will respond by turning down a low-inertia asset (based on an understanding of the mix of generators in a given Curtailment stack).
2. NESO could explicitly initiate high-inertia turn-up *and* low-inertia turn-down from behind a constraint in order to ensure the required change in inertia is delivered. This approach would effectively remove the need to modify the ANM.

Implementation and governance

Implementation – data exchange and processes

Ideally, primacy rules should be based on specific conflict conditions, requiring DNOs and NESO to collaborate on conflict forecasting by collecting real-time data. The process flows, included in the Appendix, show an example of data sharing where curtailment and service forecasting could support day-ahead decisions on what primacy rule should be used.

Successful implementation of these rules requires a number of prerequisite conditions to be met:

- Technology to allow the implementation of ANM headroom creation is possible. Headroom is created by the DNO by modifying the triggering thresholds for ANM activations to a lower level of power measurements and removing the associated points from the total – this was discussed with technical working group representatives and is possible technically
- Data sharing mechanisms between NESO and DNO/DSOs is sufficient (in accuracy and timing) to allow for primacy rule actioning
- DNOs and NESO know the assets providing distribution and system services
- DNOs can forecast curtailment at day ahead
- NESO can forecast service requirements at day ahead

There are some NESO service-specific considerations that may need to be taken into account when implementing primacy rules:

- The process flows presume NESO services are procured in Day Ahead auctions. The two services in the CBA which are not auctioned in this way are SFFR and MW dispatch.
- MW Dispatch is already implementing an example of DSO primacy, where DNO's give a risk of conflict 'unavailability report' which NESO get 3 weeks up to day ahead. This allows the NESO to use this in their planning for services. DSO can make a unit unavailable to the NESO in that day. The DNOs can update circa every 15s via an 'unavailability flag' (NGED), so the DSO update it at real time for transmission / thermal constraints.
- SFFR is auctioned week ahead, but is being phased out, and being replaced by Dynamic product suite and hence specific considerations for this will not be considered.

Implementation requirements

The CBA analysis give a strong indication of the preferred primacy rule for the different Use Cases. The available data on the frequency of conflicts, the costs of mitigation is limited. Furthermore, additional work will be required to understand the detailed implementation requirements, and the costs associated with implementing these primacy rules.

The accompanying CBA pack includes more detailed process flows that describe how NESO primacy and DSO primacy would work in practice. We can also identify a number of areas where improved data or system capabilities will be required ahead of the implementation of these primacy rules:

- **Improved understanding of FSPs at risk of conflict:** The need for primacy rules only arises if the NESO is attempting to dispatch flexibility from FSPs within a constrained part of the distribution network. The NESO currently gathers information regarding the connection status of FSPs (i.e. whether they themselves have curtailable connections), but not whether those assets are in a distribution zone shared with assets under curtailable connections. Both NESO and DNOs need to develop a more complete picture of where distribution-connected FSPs and flexibly-connected customers are, and whether those locations are at risk of constraint.

- **Curtailment monitoring, forecasting, and data sharing:** Primacy rules are only triggered when a constraint is active (e.g. when ANM is actively curtailing an asset). There is a need for the DNO and NESO to understand the probability that curtailment will be in effect. From the NESO's perspective, this forecast would ideally be provided ahead of the day-ahead auction, and be reliable enough to make a decision about whether to accept bids and offers into the auction. It would also be beneficial to have forecast updates within-day so that the NESO can adjust its dispatch decisions accordingly.
- **ANM enhancements:** If NESO primacy is to be applied, this will require modifications to the way that ANM systems work. ANM systems across the country and between DNOs are different. There would be differing levels of enhancements required to enable headroom to be held. There may also need to be full time staff to manually configure settings in the control room, which would come at cost for personnel and training.
    - In the case of a NESO action flexing *away from* a constraint, the ANM would be required to pause its action to avoid unwinding. How this would be achieved in practice – both technically and commercially – needs to be determined. From a technical standpoint, it would likely require the ANM instructing curtailable assets not to adjust their setpoints from the start of the NESO instruction.
    - In the case of the NESO securing additional inertia from a distribution asset, this would require the ANM to curtail a low-inertia asset to keep the network within its thermal limits, whist not undermining the NESO's overall level of inertia. This involves the ANM deviating from its predefined curtailment logic.
    - Interactions within the Local Constraints Market (LCM) are already seeing the Case 2/3 conflict cases which could provide use cases to test the implementation of NESO primacy.

Whilst additional work would be required to understand the system, process and data enhancements needed to implement individual rules, we can make some initial observations, as summarised in Table 3.

Table 3 Use case implementation requirements

Use Case	Change needed	Change required
NESO primacy for positive flexibility from import-constrained networks		ANM is not yet widely used to manage import constraints. Conflict cases are therefore most likely where there are procured DSO services. It is technically possible that the DNO might unwind the dispatch of demand turn-down in response to a NESO action. However, DNOs do not typically monitor constraints in such a real-time way, and do not adjust DSO dispatch with this level of granularity. It is expected that the use of ANM on import-constrained networks will become more common. In this case, agreed primacy rules will be required, just as they would be for export-constrained networks.
DSO primacy for NESO flexing *into* a distribution constraint		This requires the DNO to inform the NESO that a local network will be constrained over the required delivery window. The DNO needs to be able to make a forecast of constraint location-level curtailment for the subsequent day, and to communicate this forecast to the NESO. The more accurate the forecast, the more confidence the NESO can have about relying on flexibility from that part of the network. With this curtailment forecast, NESO has a number of options: 1. If it deems the risk of conflict low enough, it could proceed with its procurement and dispatch of flexibility, accepting that there is a risk of this action being unwound 2. If the forecast comes early enough (i.e. ahead of the day-ahead auction) it could prevent some providers from placing bids or offers into the NESO auction. It could allow bids and offers to be placed, but retain the right either not to dispatch these assets (in the case of dispatchable reserve services), or to 'disarm' assets (in the case of automated services such as frequency response). It may do this based on an evolving view of the curtailment risk as the delivery window approaches, assuming that DNOs continually update and communicate this forecast to the NESO. There frequency of data exchanges will impact how this can be implemented, DNO's can update their forecasts based on data received from NESO but depending on when it's received the ease of forecast updates changes.
NESO primacy for negative flexibility from export-constrained networks		Whilst this has a positive CBA case, its implementation relies on ANM being instructed not to unwind NESO actions. This is not how ANM systems currently operate, so some change would need to be made to their design. Further investigation is required to understand the functional requirements, whether this can be implemented technically, and the cost of making such changes.

Downstream investability

Downstream investability for parties in the energy market as a result of primacy rules will depend on how they are implemented. If NESO primacy facilitated actions that maintain or even improve DER revenues (e.g., through compensation for curtailment or changes to DCUSA / SCR which impact curtailment limits), this could enhance the financial attractiveness of DER projects. However, uncertainty in how primacy rules will be applied – particularly if DSO primacy leads to increased perceived curtailment – could deter investment in DERs in constrained areas due to perceived risks of revenue instability.

In the case where DSO service flexibility could be used to create headroom, this could drive demand for distribution flexibility services, particularly in areas where constraints are common. This presents opportunities for service providers to secure contracts. The relatively high cost of DSO-procured flexibility currently could limit market growth unless costs decline with scale and automation.

The uncertainty around primacy rules – particularly the distinction between NESO and DSO primacy – could complicate financial modelling and reduce the predictability of returns on DER investments. The potential for "negative flexibility" obligations (e.g., curtailment triggered by the DNO in NESO primacy) adds an additional layer of operational complexity for DER operators.

The value of providing flexibility is closely tied to the timing and location of the response in relation to NESO/DSO needs, as well as the level of market saturation. This will continue to be a key factor influencing the investability of DER projects, especially where flexibility revenues are critical to their commercial success.

If the cost of flexibility decreases due to automation and scaling of DERs, and if regulatory frameworks ensure fair compensation for curtailed assets, both DERs and flexibility providers could see increased investment. Coordination between NESO and DNOs to clearly define obligations and compensation mechanisms could reduce uncertainty and make investments more predictable.

Regulatory and commercial changes required

As well as the technical requirements for implementing Primacy rules, a number of regulatory and commercial changes are expected to be needed. We have identified the following potential areas of change:

- **Licence conditions, Grid and Distribution Codes, Connection and Use of System Code (CUSC) and Distribution Connection and Use of System Agreement (DCUSA):** The implementation of both DSO Primacy and NESO primacy will impose additional responsibilities on DNOs and the NESO to each other and to connected customers. Operator licences and codes may need to be updated to codify those new obligations. Required changes may need to include:
    - Obligations on the DNO to produce accurate curtailment forecasts, and to communicate those to the NESO (or make the live data available through an OpenData portal)
    - Modifications to NESO's procurement principles to allow connection of customers to be consistent with delivering an optimal whole-system outcome.
    - Obligations on the DNO towards connecting customers, including curtailable connections, but also towards non-curtailable customers who may ultimately be sited in a constrained area
- **Commercial and contractual changes:** DNOs and NESO may need to review their connection and service agreements with customers to account for Primacy rules. This could include:
    - Changes to future or existing curtailable connection agreements to allow the DNO to change the Principles of Access in line with NESO Primacy rules (e.g. holding headroom or deviating from the curtailment stack), with appropriate compensation as required.
    - Changes to NESO service agreements to allow the NESO to block bids and offers under constrained conditions, to opt not to dispatch these assets, or to disarm their dispatch
    - To account for any compensation that may be required under the implementation of one or more of the Primacy rules, such as for those customers who may face additional curtailment, or who may be curtailed under circumstances that go beyond their original connection agreement.
- **Regulatory incentives:** Although beyond the scope of this report, consideration may need to be given to the ways in which the DNO and NESO are incentivised to implement Primacy rules. For example, in order for the DNO to provide the NESO with live curtailment data and curtailment forecasts, investment in their capabilities will be required. Furthermore, some interpretations of NESO primacy could see the DNO or NESO facing additional costs (e.g. in compensating curtailed customers). Whilst doing so may be in the interest of the whole system, it may be necessary to create regulatory measures to ensure that incentives on each operator are aligned.

Governance and enhancement triggers

An evolving governance strategy for primacy rules is essential due to the rapid transformation of the sector. It's important that the ENA and working group adopt an adaptable structure to implementing primacy rules because:

1. **It will enable implementation to evolve adapting to technological advances:** The energy industry is integrating new technologies, such as advanced ANM technologies, and digital grid management tools, at an unprecedented pace. A flexible governance approach allows for the rules to keep up with these innovations, ensuring efficient use and management of new resources.
2. **Addressing changing market conditions:** As market dynamics shift—driven by changes in energy demand, decarbonisation goals, and regulatory updates—primacy rules must adapt to reflect these conditions. This prevents outdated rules from hindering the market's ability to respond to new challenges and opportunities.
3. **Ensuring whole-system optimisation:** With increasing interconnections and dependencies across the energy system, governance must evolve to support whole-system benefits, such as enhanced resilience, cost-effectiveness, and environmental sustainability. Static governance and rules may create inefficiencies or conflicts between different parts of the system, whereas dynamic governance can better align with overall system goals.
4. **Responding to Uncertainties and Risks:** The energy transition involves uncertainties, such as fluctuating fuel prices, regulatory shifts, and climate impacts. An adaptable governance framework allows for timely adjustments to primacy rules, enabling the industry to respond more effectively to unforeseen risks and maintain system reliability and security.

The process throughout the production of this report, has revealed the suggested next steps for establishing a governance process which will work moving forward.

- **Establish a Structured Review Framework:** Regularly assess the effectiveness of primacy rules to ensure they align with whole-system goals. This framework should include periodic evaluations, stakeholder feedback mechanisms, and transparent reporting on outcomes.
- **Set Outcome-Based Metrics:** Define clear metrics to evaluate whether primacy rules are delivering expected benefits across the system, such as cost efficiency, reliability, and flexibility service provider / connected customer feedback. Adjust these metrics as needed to reflect evolving energy system priorities.
- **Implement Adaptive Governance:** Maintain flexibility in governance processes to allow for adjustments to primacy rule processes based on observed impacts, emerging technologies, and market changes. This could involve piloting new variations e.g. moving from day ahead to real time primacy decisions, to assess their effects before broad implementation.
- **Encourage Stakeholder Collaboration:** ENA will continue to foster ongoing collaboration with distribution network operators (DNOs), NESO, and other stakeholders. This collaboration, through the Technical working group, can help ensure that the primacy rules are effectively coordinated across the whole energy system and incorporate diverse perspectives.

Conclusions and next steps

Despite a degree of uncertainty around the prevalence of DSO-NESO conflicts, and the costs of the primacy rules under each Use Case, it appears possible to identify the preferred Primacy rule in each case.

- Where NESO primacy requires the creation of distribution headroom ahead of time, this is unlikely to be the optimal approach unless either DSO flexibility becomes significantly cheaper, or if the cost to the NESO of accessing alternative forms of flexibility becomes significantly more expensive. Under these cases, DSO primacy appears to be the preferred approach.
- Where a Use Case does not require headroom creation ahead of time, NESO primacy appears to be the optimal solution, since it does not create additional variable cost for the DNO or distribution-connected customers. However, there remain questions around the regulatory and contractual changes required to enable NESO primacy in these cases, relating to the treatment of curtailable assets when there is headroom on the local network.

Both DSO primacy and NESO primacy require investment in order to enact them. This includes improved data, forecasting and information sharing between parties. In some cases it also involves making changes to ANM systems to allow them to adjust their notional headroom based on NESO actions, as well as changing the Principles of Access to prioritise some assets over others. Further work is required to understand the technical changes required, and the costs involved. Additional data is required to understand the prevalence of DSO-NESO conflicts, and hence the value that implementing these primacy rules could create.

We have identified a number of areas where additional capabilities, or additional investigation, may be required to implement these primacy rules:

- **Data improvement:** Key to understanding the need for a primacy rule is establishing whether FSP delivering NESO services are behind distribution constraints, and how often those constraints are active. In order to implement primacy rules efficiently, a near real-time view of these constraints is needed so that the NESO can anticipate conflicts and procure alternatives efficiently. Curtailment forecasting is also going to be important, since the NESO needs to understand the risk of curtailment at day-ahead in order to plan effectively.
- **New ANM functionality:** A number of the Use Cases show a positive case for 'NESO primacy'. Enabling this requires the ANM system to avoid unwinding these actions. However, this is not how ANM is currently designed. The challenges and costs associated with making these changes are an unknown, so require further investigation.
- **Developer flexibility revenue impact:** There is a risk for existing and future distribution-connected flex providers that their flex revenues are below expectations. They may be connecting 'firm' (i.e. non-curtailable), and therefore assuming their firm access means their energy and flex is treated at full value. But for the reasons discussed above, this isn't the case. Engagement with these stakeholders is required to ensure they understand these risks, and to ensure that the establishing of ANM zones, and the implementation of primacy rules is done in a fair and transparent way.

Figure 5 shows an example next steps roadmap.

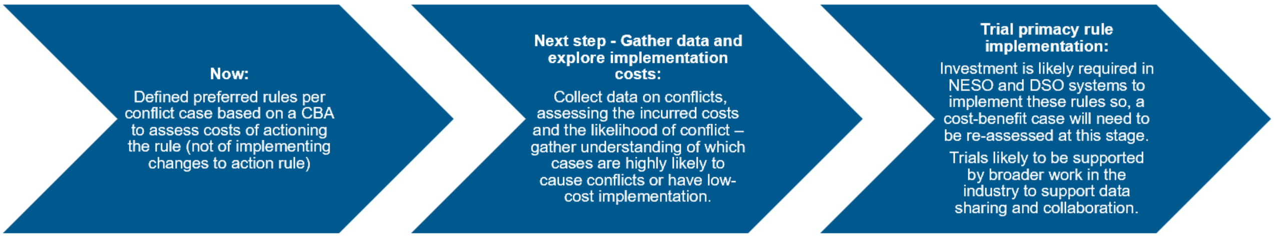


Figure 5 - Indication of next steps as a result of this work

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