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Impact Assessment

Regulatory treatment of Customer Load Active System Services (CLASS) as a balancing service in the RIIO-ED2 price control

Division:	Energy Systems Management & Security	**Type of measure:**	Price control
Team:	DSO and Whole Systems Team	**Type of IA:**	Not Qualified under Section 5A UA 2000
Associated documents:	Consultation document	**Contact for enquiries:**	flexibility@ofgem.gov.uk
Coverage:	Full		

We are consulting on our minded-to position for the regulatory treatment in RIIO-ED2 of DNOs providing network voltage control and network management services, via the remote management of deployed network assets, to the National Grid Electricity System Operator (ESO) for its balancing services activity. This service is commonly known as CLASS.

This Impact Assessment sets out the impacts of our regulatory options on consumers, industry participants and environmental issues. We estimate that the Net Present Value reduction in customer bills (ie combining DUoS and BSUoS impacts) could range from £0.30 to £1.25 per household per year across the 30-year modelling period under our preferred option. Whilst this Impact Assessment does not determine our minded-to position, it does form a vital part of our decision-making process and should be read in conjunction with the consultation document which we have also published today.

Any enquiries related to the text of this publication should be sent to Ofgem at:
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Rationale for intervention, objectives and options

What is the problem under consideration?

Increases in intermittent generation, rising electricity demand and the development of new technologies will further increase the need for flexibility to ensure we make the best use of the energy system and keep consumer bills as low as possible. According to analysis in the joint Smart Systems and Flexibility Plan 2021, which was produced by BEIS and Ofgem, moving to a smarter, more flexible energy system could save the UK up to £10 billion per annum by 2050 (2012 prices, undiscounted).[1]

Why is Ofgem intervention necessary?

We consider CLASS as one potential enabler for realising these system savings as it can shift demand away from periods when generation is relatively scarce. Only DNOs can provide CLASS. This is because, in addition to the assets specifically required for CLASS, it involves the operation of monopoly network assets that are essential for a DNO's business as usual operation to provide a reliable system.

The current regulatory treatment of CLASS as a balancing service will remain in effect only until 31 March 2023 (ie the end of the RIIO-ED1 price control).[2] Ofgem is therefore required to form a position on DNOs providing CLASS to the ESO for the RIIO-ED2 period (1 April 2023 to 31 March 2028). Specifically, we are concerned with the regulatory treatment of DNOs providing network voltage control and network management services via the remote management of deployed network assets to the ESO for the purpose of its balancing services activity as described in the Electricity Transmission Standard Licence Conditions.[3]

[1] Ofgem (2021). Transitioning to a net zero: Smart Systems and Flexibility Plan 2021
[2] Unless the Authority revokes the Direction after consulting DNOs and giving reasonable notice.
[3] For more details, see: Licences and licence conditions

What are the policy objectives and intended effects including the effect on Ofgem's Strategic Outcomes?

By 2025, our vision is for the energy system to be on track for net-zero and delivering in the interests of consumers. This includes minimising costs and increasing levels of flexibility throughout the system, with energy consumers routinely using smart technology to shift demand.

Ofgem's objective is to protect consumers' interests now and in the future by working to deliver a greener, fairer energy system. We do this by:

- Working with government, industry and consumer groups to deliver a net-zero economy, at the lowest cost to consumers.
- Ensuring fair treatment for all consumers, especially the vulnerable.
- Enabling competition and innovation, which drives down prices and results in new products and services for consumers.

CLASS is a low carbon solution for meeting certain network requirements and balancing services, and one which customers have already largely paid for through regulatory funding of primary substation transformers which form a key part of the service. The policy objective of regulating CLASS is therefore linked to Ofgem's strategic outcomes to enable the decarbonisation of the energy system at the lowest cost for consumers.

What are the policy options that have been considered, including any alternatives to regulation?

We consider four potential regulatory options for the treatment of CLASS as a balancing service in the RIIO-ED2 price control which are described in more detail in the accompanying consultation document:

- **Option 1A:** a continuation of the current regulatory treatment of RIIO-ED1, allowing DNOs to sell CLASS to the ESO and remunerating this through Directly Remunerated Services category 8 (DRS8).
- **Option 1B:** continuing to allow DNOs to sell CLASS to the ESO, but instead remunerating this through Directly Remunerated Services category 9 (DRS9).

- **Option 2:** requiring DNOs to provide CLASS to the ESO outside of market mechanisms and thereby funding the costs through the RIIO-ED2 price control.
- **Option 3:** prohibiting CLASS's use as a balancing service entirely.

For the purposes of the Impact Assessment, we consider Option 3 as the relevant counterfactual (ie the scenario against which we will assess the impacts of other proposals). Our 2016 Direction only provides for the use of CLASS as a balancing service for the current price control period, RIIO-ED1, so in the absence of any decision CLASS would in effect be prohibited in RIIO-ED2.

What is the justification for choosing the preferred option?

We have considered stakeholder views very carefully in deciding upon our preferred option. The results of the Cost Benefit Analysis suggests that the net economic benefit of CLASS deployment is likely to be significant, including abatement of carbon dioxide emissions, and therefore it does not seem appropriate to prohibit DNOs from deploying the technology. Whilst we recognise that there is uncertainty around harder to monetise costs of CLASS, we do not believe, on balance, that these would be sufficient to undermine the NPV estimates that are presented in this Impact Assessment (which have proved robust to downside sensitivity analysis). Our assessment has also not found any evidence that the deployment of CLASS by DNOs could undermine the competitive process and outcomes in the market for balancing services.

Allowing DNOs to offer CLASS as a competitive balancing service (Option 1A) should encourage only sound investments that promote effective competition and drive down balancing costs. We believe it is right that consumers should be able to also benefit from investments in CLASS via lower DUoS charges because of the use of assets funded by consumers. We are also concerned that regulating prices (Option 1B) could distort investment decisions and market signals in balancing service provision. Mandating CLASS through the price control (Option 2) would also reduce the ESO's ability to utilise balancing services from the widest range of technologies and providers.

We propose to continue to monitor participation for uncompetitive outcomes, and move ahead with our programme of work to drive DNOs to implement robust, transparent measures to address actual or perceived conflicts of interest.

Preferred option - Monetised Impacts (£m)

Business Impact Target Qualifying Provision	N/A
Business Impact Target (EANDCB)	N/A
Expected range of economic net benefit	£157.1m – £1,752.4m

In the above table, the economic net benefit of our preferred option (Option 1A: DRS8) relative to the counterfactual (Option 3) is presented in Net Present Value terms (NPV). The results are in 2020/21 prices and NPV is discounted back to April 2023 using the HM Treasury Green Book social time preference rate (STPR) of 3.5 per cent.

Costs and benefits are modelled from the start of RIIO-ED2 in 2023/24 until 2052/53. The following monetised impacts are included in the Cost Benefit Analysis (CBA):

- The direct costs in the form of expenditure by DNOs to deploy equipment and operate CLASS as a balancing service.
- The indirect costs of CLASS through impacts on network asset health, or through impacts on network reliability.
- The benefits of CLASS, ie avoided costs of alternative balancing services technologies, including the avoided cost of carbon emissions.

We consider three illustrative deployment scenarios for CLASS to provide further insight on how costs and benefits could vary with the rate of uptake of the service:

- **Scenario A:** a conservative roll out, in which we assume that during RIIO-ED2 only one DNO (ENWL) will offer CLASS in the market for balancing services.
- **Scenario B:** a medium roll out, based on 3 of the 6 DNOs offering CLASS in the market for balancing services.
- **Scenario C:** a large scale roll out, which assumes that all 6 of the DNOs deploy CLASS in RIIO-ED2.

These deployment scenarios, as well as robust downside and upside sensitivity analysis, are reflected in the wide range of economic net benefit we present. However, in all instances the impact of CLASS is anticipated to be positive in NPV terms.

We expect our preferred option to create opportunity for greater competition in market for balancing services. Therefore, in line with government guidance, we classify it as a non-qualifying regulatory provision. We rely mainly on administrative exclusion D ("Deliver or replicate better competition-based outcomes in markets characterised by market power: Pro-competition document") on the grounds that this regulatory provision can be considered to promote competition.[4]

Preferred option - Hard to Monetise Impacts

Hard to monetise costs

With respect to CLASS, there are a number of hard to monetise costs. These include, amongst others, the potential impact of CLASS activations on network asset health and investor confidence in flexibility services. We recognise that some of these costs could manifest but, in line with our proportionality principle[5], we have only included costs within the CBA framework where we could have confidence in the data source and methodology for calculating the likely size of its impact. In any case, we undertake downside sensitivity analysis and find that our findings are robust to significant changes in the cost of CLASS deployment.

Hard to monetise benefits

The monetised impacts may also not represent the full benefits to consumers. In theory, there are additional benefits that could be quantified as part of a CBA of CLASS, but we did not include them in our analysis. The reasons for this are that they are benefits that flow from alternative use cases and, as such, are not directly relevant to a framework where we consider a counterfactual assessment of the deployment of CLASS as a balancing service.

[4] See page 33 of BEIS (2020). Better Regulation Framework Interim Guidance.
[5] Specifically, in undertaking our analysis, we have considered the scale of the expected impact, as well as the ability and cost of doing further analysis relative to the benefits such analysis may yield.

Key Assumptions/sensitivities/risks

We recognise that CLASS is a new technology and there is some uncertainty over its likely costs and benefits. This uncertainty may be greater still in scenarios where CLASS is deployed more widely, and by DNOs that have yet to trial the technology and deploy it as a balancing service.

For these reasons, we prepare alternative assumptions that could account for some of the key uncertainties in the CBA estimates. These sensitivities are summarised in the below table:

Category	Central case	Downside	Upside
Direct costs	No adjustment	+ 50%	No adjustment
Asset health costs	Not included	+ 10%	Not included
Balancing services costs	No adjustment	-2% per annum	+2% per annum
Pay-as-bid adjustment	Costs are 75% of bid price	Costs are 50% of bid price	Costs are 100% of bid price
Carbon cost	BEIS central projection	BEIS low projection	BEIS high projection

Will the policy be reviewed? Yes/No	If applicable, set review date: month/Year

Is this proposal in scope of the Public Sector Equality Duty?	No

Summary table for all options

Summary of options	Main effects on consumer outcomes	Benefits	Costs	Key considerations
Option 1A: DRS8	More gradual roll out of CLASS in RIIO-ED2. Considerable decrease in DUoS and more modest decrease in BSUoS charges.	Reduction in DUoS and BSUoS charges. Avoided carbon dioxide emissions.	Direct and indirect costs of CLASS deployment.	DNOs would be able to make profits, which would be shared with DUoS customers in line with the totex efficiency incentive rate.
Option 1B: DRS9	More gradual roll out of CLASS in RIIO-ED2. Considerable decrease in BSUoS charges.	Reduction in BSUoS charges. Avoided carbon dioxide emissions.	Direct and indirect costs of CLASS deployment.	DNOs no longer able to make profits, so cash flow impacts accrue to customers and alternative providers.
Option 2: Price control	Wider roll out of CLASS to all DNOs in RIIO-ED2. Considerable decrease in BSUoS charges, partially offset by increase in DUoS charges .	Reduction in BSUoS charges. Avoided carbon dioxide emissions.	Direct and indirect costs of CLASS deployment.	Displacement of alternative providers is assumed to be highest under Option 2: Price control as the DNOs would offer CLASS to the ESO free of charge.

Associated documents

- BEIS & Ofgem (2021). Transitioning to a net zero energy system: Smart Systems and Flexibility Plan 2021
- BEIS (2020). Better Regulation Framework Interim Guidance.
- CMA (2021). Completed acquisition by National Grid Holdings One plc of PPL WPD Investments Limited: Decision on relevant merger situation and substantial lessening of competition
- CMA (2015). Competition Impact Assessment Guidelines
- Electrical Engineering Standards Review: Independent Panel Report (2020)
- Elexon (2018). Residual Cashflow Reallocation
- Elexon (2019). Imbalance Charging, where does the money go?
- Energy Networks Association (2021). WS1B P6 Operational Distributed Energy Resources (DER) Visibility and Monitoring
- Energy Networks Association (2019). Engineering Recommendation (EREC) P28
- ENWL (2015). Asset Health Final Report prepared by University of Manchester and University of Liverpool
- ENWL (2015). Customer Survey Summary Report
- Heim, Sven; Götz, Georg (2013). Do pay-as-bid auctions favor collusion? Evidence from Germany's market for reserve power, ZEW Discussion Papers, No. 13-035, für Europäische Wirtschaftsforschung (ZEW), Mannheim
- HM Treasury (2020). The Green Book: Central Government Guidance on Appraisal and Evaluation
- Khan et al (2001). Uniform Pricing or Pay-as-Bid. Pricing: A Dilemma for California and Beyond
- London Economics (2013). The Value of Lost Load (VoLL) for Electricity in Great Britain
- National Grid ESO (2017). System Needs and Product Strategy
- National Grid ESO (2019). Firm Fast Reserve - Assessment Principles
- National Grid ESO (2019). Procurement Guidelines

- National Grid ESO (2019). Reserve and Response Roadmap
- National Grid ESO (2021). Operability Strategy Report December 2021
- National Grid ESO (2021). Frequency Risk and Control Report (FRCR)
- National Grid ESO (2021). Markets Roadmap to 2025
- National Grid ESO (2022). Grid Code (GC)
- National Grid ESO (2022). Grid Code Operational Code no. 6
- National Grid ESO (2021). Regional Development Programmes (RDPs)
- OECD (2008). Policy roundtable: monopsony and buyer power
- OECD (2012). Market Definition
- Official Journal of the European Communities (1997). COMMISSION NOTICE on the definition of relevant market for the purposes of Community competition law
- Ofgem (1999). The New Electricity Trading Arrangement
- Ofgem (2017). The Enforcement Guidelines
- Ofgem (2019). Investigation into 9 August 2019 power outage
- Ofgem (2019). Position paper on Distribution System Operation: Our approach and regulatory priorities
- Ofgem (2020). Impact Assessment Guidance
- Ofgem (2020). RIIO-ED2 Methodology Decision: Overview
- Ofgem (2020). RIIO-ED2 Methodology Decision: Annex 1 - Delivering value for money services for consumers
- Ofgem (2020). RIIO-ED2 Sector Specific Methodology Decision: Annex 3
- Ofgem (2021). RIIO-2 Final Determinations – Electricity System Operator
- Ofgem (2021). Decisions on the ESO guidance documents for 2021-23
- Ofgem (2021). Electricity Distribution Standard Licence Condition 31E: Flexibility Procurement Statements 2021
- Ofgem (2021). ESO Role Guidance
- Ofgem (2021). Next steps on visibility of distributed generation connected to the GB distribution networks
- Ofgem (2021). RIIO-ED2 Business Plan Guidance

- Ofgem (2021). Transitioning to a net zero: Smart Systems and Flexibility Plan 2021
- Regulation EC No 139/2004 Merger Procedure: Article 6(1)(b) NON-OPPOSITION (2010)
- The Electricity Safety, Quality and Continuity Regulations (2002)

1. Problem under consideration

Chapter summary

In this chapter we describe the challenges with the current regulatory arrangements, set out why we need to intervene and state our policy objectives in doing so.

1.1. The ESO procures services to balance demand and supply, and to ensure the security and quality of electricity supply across the GB system. Providers of these balancing services include generation technologies, storage, interconnectors and demand side response.

1.2. DNOs can provide network voltage control and network management services to the ESO via the remote management of deployed network assets. However, concerns have been raised by some stakeholders on whether potential negative externalities and competition impacts of these activities could outweigh any benefit. In this impact assessment, we use CLASS as the collective term to describe this set of remotely managed voltage control and network management services.

Rationale for intervention

1.3. The current regulatory treatment for CLASS is time limited and will remain in effect until the end of the RIIO-ED1 price control on 31 March 2023).[6] Ofgem is therefore required to form a position on DNOs providing CLASS to the ESO for the RIIO-ED2 period (1 April 2023 to 31 March 2028). Specifically, we are concerned with the regulatory treatment of DNOs providing network voltage control and network management services via the remote management of deployed network assets to the ESO for the purpose of its balancing services activity as described in the Electricity Transmission Standard Licence Conditions.[7]

1.4. Only DNOs can provide CLASS. This is because, in addition to the assets specifically required for CLASS, it involves the operation of monopoly network assets that are essential for the DNO's business as usual operation to provide a reliable system.

[6] Unless the Authority revokes the Direction after consulting DNOs and giving reasonable notice.
[7] For more details, see: Licences and licence conditions

Under RIIO-ED1, directly remunerated services (DRS) category 8 allows DNOs to sell CLASS to the ESO, charging it directly for the provision of the service. The net revenue (ie revenue from the ESO less the cost of investing in and using CLASS) is then shared with consumers; profits reduce consumer's distribution network charges (in the relevant DNO area) while losses increase them.

1.5. Increases in intermittent generation, rising electricity demand and the development of new technologies will further increase the need for flexibility to ensure we make the best use of the energy system and keep consumer bills as low as possible. Without this, there would likely need to be significant and costly investment in network and generation assets to manage peak demand. The costs of integrating low carbon, intermittent generation and new sources of demand like electric vehicles, would be higher.

1.6. According to analysis in the joint Smart Systems and Flexibility Plan 2021, which was produced by BEIS and Ofgem, moving to a smarter, more flexible energy system could save the UK up to £10 billion per annum by 2050 (2012 prices, undiscounted).[8] We consider CLASS as one potential enabler for realising these system savings as it can shift demand away from periods when generation is relatively scarce.

Project objectives

1.7. By 2025, our vision is for the energy system to be on track for net-zero and delivering in the interests of consumers. This includes minimising costs and increasing levels of flexibility throughout the system, with energy consumers routinely using smart technology to shift demand.

1.8. Ofgem's objective is to protect consumers' interests now and in the future by working to deliver a greener, fairer energy system. We do this by:

- Working with government, industry and consumer groups to deliver a net-zero economy, at the lowest cost to consumers.
- Ensuring fair treatment for all consumers, especially the vulnerable.

[8] Ofgem (2021). Transitioning to a net zero: Smart Systems and Flexibility Plan 2021

- Enabling competition and innovation, which drives down prices and results in new products and services for consumers.

1.9. Delivering an efficient, flexible energy system requires significant action on the distribution network. In summer 2019, we published a position paper on distribution system operation (DSO)[9] that set out our strategic objectives for reform at a distribution level. We think that by embedding these strategic objectives in our work programmes and policies on DSO, we can promote effective markets, technical innovation and coordination that is required to facilitate effective flexibility on the distribution network. These objectives are:

- Effective competition for balancing and ancillary services, and other markets.
- Neutral tendering of network management and reinforcement requirements, with a level playing field between traditional and alternative solutions.
- Strongly embedded whole electricity system outcomes.
- Clear boundaries and effective conflict mitigations between monopoly activities and market activities.

1.10. Since our DSO position paper, we have published more information on our approach to regulating DSO functions in RIIO-ED2. Our Sector Specific Methodology Decision for RIIO-ED2 set out how we will drive DNOs to more efficiently develop and use their network, taking into account flexible alternatives to network reinforcement.[10] It also revealed how we would increase adaptability of the price control to wider policy thinking in relation to changing roles, responsibilities and governance arrangements to manage perceived and actual conflicts of interest. The introduction of clearer decision-making frameworks, with independent oversight, should promote greater transparency and reduce the risk that a DNO promotes CLASS to the detriment of its responsibilities to facilitate distribution flexibility services and effectively develop its network.

1.11. In 2020, we published our Decarbonisation Action Plan.[11] One of the nine actions we set out is to support flexibility, which we consider as essential to integrating the

[9] Ofgem (2019). Position paper on Distribution System Operation: our approach and regulatory priorities
[10] Ofgem (2020). RIIO-ED2 Methodology Decision: Overview
[11] For more details, see Ofgem's Decarbonisation Action Plan

growing volume of renewable and low carbon power into the energy system. New flexible technologies can reduce the need for more generation and other new infrastructure.

1.12. As set out in our Forward work programme 2022/23, Ofgem aims to enable full chain flexibility to facilitate demand shifting, storage and interconnection to help dampen the growth in peak demand, reduce costly curtailment of renewables generation and limit the need for expensive network upgrades.[12] We see CLASS as a potential enabler of this if it can support an energy system that is more resilient, and easier and less costly to manage.

1.13. In short, our objectives for the regulatory treatment of CLASS as a balancing service in RIIO-ED2 align with:

- Our strategic narrative until 2025.
- Ofgem's priorities and objectives.
- Our DSO position paper and RIIO-ED2 Sector Specific Methodology Decision.
- Our Decarbonisation Action Plan.
- Our Forward work programme 2022/23.

[12] See Ofgem's Forward work programme 2021/22

2. Approach to the Impact Assessment

Chapter summary

In this chapter we briefly describe:

- The scope of the Impact Assessment on the use of CLASS as balancing service.
- The regulatory options under consideration for the RIIO-ED2 price control.
- Deployment scenarios we consider for a wider roll-out of CLASS to inform our understanding of potential costs, benefits and impacts in the future.

2.1. The purpose of an Impact Assessment (IA) is to help explain the impact of regulatory proposals on consumers, industry participants, and social and environmental issues. Whilst IAs do not determine a final decision, they form a vital part of the decision-making process by providing a structured framework for understanding the impacts of our most important decisions.

2.2. Section 5A (s.5A) of the Utilities Act 2000 places a duty on the Authority to undertake an IA if it is: (i) proposing to do anything for the purpose of, or in connection with, the carrying out of any function exercisable by it under or by virtue of Part 1 of the Gas Act 1986 or Part 1 of the Electricity Act 1989, or (ii) it appears to the Authority that the proposal is "important" within the meaning of s.5A. Ofgem has not reached a definitive position on whether an IA is required under s.5A. but, in any event, we have decided to carry out an IA before issuing a direction on CLASS's regulatory treatment in RIIO-ED2. This reflects the extensive nature and wide variation in the responses to the 2020 consultation, and requests from stakeholders for further analysis of the options under consideration.

2.3. Our approach to this IA closely follows the guidance set out by HM Treasury in the Green Book,[13] as well as Ofgem's own guidance on how to appraise regulatory proposals.[14] In addition, we have regard to the principles of better regulation, which advise that an IA should:

[13] HM Treasury (2020), The Green Book: Central Government Guidance on Appraisal and Evaluation
[14] Ofgem (2020). Impact Assessment Guidance

- concisely summarise the impacts, including the qualitative and quantitative costs and benefits.
- maintain a transparent process.
- be comparable to other assessments, without unnecessary detail or duplication.
- be consistent so we can compare impacts across proposals.
- follow best practice.

Proportionality

2.4. The need to support policy decisions with proportionate analysis is especially relevant to Ofgem. As an economic regulator, many of our decisions have a limited implementation time and may be affected by real constraints. The need to support policy decisions with proportionate analysis is important to Ofgem as our decision-making process is subject to time and resourcing constraints. With respect to CLASS, there is limited historical information (only one DNO has deployed the technology to date), and we face challenges in predicting future impacts given the uncertainty over, for example, the ESO's procurement requirements for balancing services and the potential uptake of CLASS amongst other DNOs.

2.5. In undertaking this IA, we have considered the scale of the expected impact, as well as the ability and cost of doing further analysis relative to the benefits such analysis may yield. We undertook an exercise, drawing on our proportionality principle, to identify costs and benefits where there was sufficient evidence to monetise the impact. We do, however, ensure that our IA:

- describes which groups of energy consumers (and other affected parties) the proposals are likely to affect.
- includes a description of the impacts (ie positive or negative impacts on any group) and the order of their magnitude (eg low, medium, high).
- considers, as appropriate, distributional impacts as well as trade-offs between groups of energy customers.

Options under consideration

2.6. As part of this IA, we consider four potential regulatory options for the treatment of CLASS as a balancing service in the RIIO-ED2 price control which are described in more detail in the Chapter 2 of the consultation document:

- **Option 1A:** CLASS is included under DRS8.
- **Options 1B:** CLASS is included under DRS9.
- **Option 2:** CLASS is required in the price control.
- **Option 3:** Prohibit.

2.7. For the purposes of the IA, we consider Option 3 as the relevant counterfactual (ie the scenario against which we will assess the impacts of other proposals). Our 2016 Direction only provides for the use of CLASS as a balancing service for the current price control period, RIIO-ED1, so in the absence of any decision CLASS would in effect be prohibited in RIIO-ED2.

Scope of the Impact Assessment

2.8. In developing the scope of our IA, we have reviewed the themes that emerged from the responses to our 2020 consultation on the regulatory treatment of CLASS as a balancing service in RIIO-ED2. This was supplemented by our own research, analysis and literature review to arrive at a list of direct and indirect impacts of all the relevant options that require careful consideration.

2.9. We then undertook an exercise, drawing on our proportionality principle, to identify costs and benefits where there was sufficient evidence to monetise the impact. However, we do not rely purely on monetisation of direct costs and benefits, but rather have considered hard to monetise impacts as part of our framework.

2.10. Ofgem aims to assess the distributional impact of our policies on different groups of consumers, particularly those that are in vulnerable circumstances. However, we do not consider such distributional impacts to be of particular relevance in this case. Any impact from the deployment of CLASS is anticipated to be benefit consumers in general, through lower electricity bills, and it is not expected that any given group of consumers (or those in vulnerable circumstances) would be adversely affected by the policy.

2.11. The full range of impacts, costs and benefits within the scope of our IA are summarised below.

Figure 1 Scope of CLASS Impact Assessment

Monetised Cost Benefit Analysis

2.12. We commissioned NERA Economic Consulting to identify the monetised values under each regulatory option using cost benefit analysis (CBA). We express the results for each option in net present values (NPV) to ensure that the net benefits for consumers are comparable, where NPV is the sum of a stream of future values (in real prices) that have been discounted (by the Green Book's social time preference rate) to bring them to today's value.

2.13. We recognise that there is considerable uncertainty in forecasting the costs and benefits of CLASS, a challenge that is often a feature of analysis in the context of energy markets. For these reasons, our quantitative assessments are presented as ranges in order to illustrate the plausible margin of error associated with these forecasts. We also undertake sensitivity analysis to reveal how options vary under certain scenarios, including a worst-case scenario where we consider a combination of assumptions that yields the lowest NPV for CLASS.

2.14. In addition, through the CBA, we have also modelled the impact of each option on different groups of stakeholders including DNOs, the ESO and other providers of balancing services. This cashflow analysis helps us to understand further the distributional impact of CLASS.

Hard to monetise costs

2.15. While we have sought to quantify all the costs that may be associated with the deployment of CLASS as a balancing service, there are several areas in which quantification is particularly complex. As a relatively new technology, there is more limited literature and evidence on the real-world financial impact of CLASS. Moreover, it is not sufficient to identify only whether a cost is associated with CLASS; we also need understand its materiality and potential scale.

2.16. In line with our proportionality principle, we have undertaken an initial assessment of whether a cost is likely to be material and therefore justify the effort that would be required to quantify its potential impact. Where we have concluded that a cost is hard to monetise, we still consider it as part of this IA to assess how pivotal it could be in the context of the wider assessment of options.

Hard to monetise benefits

2.17. We also consider hard to monetise benefits under the IA framework. We seek to identify their nature and assess the extent of benefits where possible, including the circumstances that would give rise to them. These include potential wider benefits of CLASS, eg if the service is able to reduce consumption during the winter peak and defer transformer asset upgrades. However, these benefits do not neatly fit under a framework that more narrowly considers CLASS's use as a balancing service.

Competition impacts

2.18. Considering competition is a core part of our purpose as the energy market regulator and protector of consumer interests. Our assessment includes consideration of whether an option will contribute to effective competition, including whether a proposal would have substantially different effects on different sized suppliers of balancing services or the choices made by different types of consumers. This includes, for example, the impact on new entrants to the market for balancing services.

2.19. We therefore undertake an assessment to understand if there could be any anti-competitive effects on the market for balancing services if CLASS were deployed in

RIIO-ED2 and beyond. Throughout this IA, we also cross-refer to other sections that deal with competition impacts. This helps to ensure and demonstrate that neither costs nor benefits are double counted.

Deployment scenarios

2.20. The 2016 Direction allowed any holder of an electricity distribution licence to offer CLASS as a balancing service, although to date only ENWL has deployed the technology. However, we recognise that this IA needs to be forward looking and consider how costs and benefits could evolve if more DNOs roll out CLASS. Indeed, we recognise that uncertainty over the future regulatory treatment of CLASS could be a reason why other DNOs have yet to invest in the service.

2.21. In this IA, we consider the potential implications of the rollout of CLASS under different deployment scenarios. To inform this analysis, we requested as part of the RIIO-ED2 Business Plan Guidance that the DNOs set out proposed outputs and expenditure that are associated with CLASS.[15] The final business plans indicated that three further companies (in addition to ENWL) are minded to deploy CLASS, with the remaining two having no immediate plans to invest in this service. In addition, two of the companies that are minded to deploy CLASS gave an indication of the potential capacity they might deploy (in terms of number of sites and MW response).

2.22. We have drawn on these insights to develop three illustrative deployment scenarios for CLASS to provide further insight on how costs and benefits could change under varying rates of uptake of the service. These scenarios are:

- **Scenario A**: a conservative roll out, in which we assume that during RIIO-ED2 only one DNO (ENWL) will offer CLASS in the market for balancing services.
- **Scenario B:** a medium roll out, based on 3 of the 6 DNOs offering CLASS in the market for balancing services.
- **Scenario C:** a large scale roll out, which assumes that all 6 of the DNOs deploy CLASS in RIIO-ED2.

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[15] See pp. 33-24: [Ofgem (2021). RIIO-ED2 Business Plan Guidance (ofgem.gov.uk)]

2.23. Under each of these scenarios, we have sought to identify the number of CLASS enabled sites and the aggregate range of MW response that could materialise. Where a company did not give any indication on the potential scale of a CLASS roll out on its distribution network in its RIIO-ED2 business plan, we have undertaken our own analysis to inform the illustrative scenarios. This assumes that any given DNO deploys CLASS across its primary substations at a comparable % rate to ENWL and that, in addition, the MW response of a given CLASS enabled site is comparable to the average that has been achieved by ENWL.

2.24. The below table summarises the key outputs under each deployment scenario. These suggest that the number of CLASS enabled sites could range from 260 to 2,497, and the total MW response from 150 to 2,881. These estimates are broadly comparable to the 3.3GW GB demand response that was estimated using an enhanced literature-based model.[16]

Table 1 Deployment scenarios for CLASS

Deployment scenario	Number of CLASS enabled sites	Aggregate MW response
Scenario A	260	150 – 300
Scenario B	1,378	795 – 1,591
Scenario C	2,497	1,441 – 2,881

Source: Ofgem analysis of RIIO-ED2 business plans.

[16] ENWL (2015). Customer Load Active System Services: Second Tier LCN Fund Project Closedown Report and University of Manchester (2015). Final profile modelling study.

3. Monetised Cost Benefit Analysis

Chapter summary

In this chapter, we present the results of the monetised Cost Benefit Analysis (CBA) of each regulatory option that we commissioned from NERA Economic Consulting. We conclude that:

- The economic net benefit of CLASS is expected to be positive under all regulatory options, with little variation in the NPV as CLASS is a competitive technology and would likely be procured by the ESO irrespective of assumptions on its pricing strategy.
- Estimates of NPV vary more with the level of CLASS deployment, although the economic net benefit is still positive under the three deployment scenarios that we consider. Whilst the NPV is increasing in the scale of the CLASS deployment, the average net benefit per unit of CLASS capacity reduces as the marginal unit of CLASS capacity increasingly displaces less costly alternative providers.
- In terms of distributional impacts, the total NPV reduction in customer bills would be relatively significant, with a typical customer seeing an annual bill reduction ranging from £0.30 to £2.27 per annum. However, alternative balancing service providers would lose revenue as capacity is displaced by CLASS.
- Sensitivity analysis shows that the estimates are robust, with a positive economic net benefit still anticipated under a downside scenario. This suggests that the presence of hard to monetise costs may not alter conclusions on the overall benefit of CLASS deployment as a balancing service.
- We acknowledge that the CBA is subject to limitations, in common with any modelling in the context of energy markets, but believe that the framework is proportionate to the case that we consider.

3.1. The purpose of CBA is to assess the impact of different options on social welfare. The full set of relevant costs and benefits should be valued in monetary terms, unless it is not possible or proportionate or to do so. After adjusting for inflation and discounting, costs and benefits can be added together to calculate the Net Present Value (NPV) for each option under consideration.

3.2. We commissioned NERA Economic Consulting (NERA) to identify the monetised values under each regulatory option using cost benefit analysis (CBA). We express the results for each option in NPV to ensure that the net benefits for consumers are comparable. Ofgem does not, as a matter of routine, publish supporting analysis alongside an Impact Assessment, but in this case we have elected to publish the full NERA report as a separate appendix to ensure full transparency. In this section, we summarise the findings of NERA's analysis which is also set out in further detail in its report.

Approach to the Cost Benefit Analysis

3.3. The CBA as conducted by NERA models costs and benefits from the start of RIIO-ED2 in 2023/24 to the end of RIIO-ED7 in 2052/53. The results are presented in 2020/21 prices and the NPV is discounted back to April 2023 using the HM Treasury Green Book social time preference rate (STPR) of 3.5 per cent.[17] We assume that DNOs other than ENWL would deploy and start to offer CLASS from 2023/24 according to the modelled deployment scenario.

3.4. Costs and benefits are modelled for each of the regulatory options that were set out in the previous Chapter, where Option 3: Prohibit serves is the counterfactual. In its report, NERA estimates monetisable impacts of DNOs offering CLASS as a balancing service where there is reasonable degree of confidence in the data. In the Appendix to this Impact Assessment, it sets out a detailed methodology for valuing the following categories:

- The direct costs in the form of expenditure by DNOs to deploy equipment and operate CLASS as a balancing service.
- The indirect costs of CLASS through impacts on network asset health, or through impacts on network reliability.
- The benefits of CLASS, ie avoided costs of alternative balancing services technologies, including the avoided cost of carbon emissions. It is assumed that CLASS provides secondary Firm Frequency Response (FFR), Dynamic

[17] HM Treasury (2020), The Green Book, p. 119.

Containment (DC), and optional FR (OFR) services in all deployment scenarios.[18]

3.5. The rational pricing strategy for CLASS is likely to be influenced by its regulatory treatment and, in its report, NERA makes the following assumptions:

- **Option 1A: CLASS is included under DRS8** – DNO are assumed to bid CLASS capacity as a profit-maximising price-taker. In practice, this means that bids are accepted if the market clearing price is greater than the long-run marginal cost (LRMC) of CLASS.
- **Option 1B: CLASS is included under DRS9** – each DNO bids CLASS capacity at a price equal to its LRMC, earning revenues such that DNOs break even. Under this option, prices would be regulated and set at a level that allows DNOs to recover their efficient costs and earn a reasonable margin.
- **Option 2: CLASS is required in the price control** – each DNO bids CLASS capacity at a price of zero such that its bids are always accepted. Under this option, the costs of developing and operating CLASS would be treated as allowed totex, which DNOs would recover through DUoS charges under the RIIO-ED2 price control. As such, the ESO would not be required to pay providers of CLASS for the service.

3.6. NERA also models how the impact of each regulatory option would vary in line with the deployment scenarios we set out in the previous Chapter. For simplicity, it is assumed that DNOs other than ENWL would deploy and start to offer CLASS from 2023/24 in each deployment scenario.[19] Through its analysis, NERA does not form a view on what combination of regulatory option and deployment scenario may be most likely. In addition, the analysis is agnostic as to which DNOs may deploy CLASS (with the exception of ENWL's sunk investment costs).

3.7. Finally, NERA also considers the impact of each regulatory model on the cash flows to four different groups relative to the counterfactual. These distributional impacts represent totals and averages across Great Britain (as the analysis is agnostic on

[18] Note that FFR and OFR are assumed to operate as pay-as-bid auctions, whereas DC is modelled as a pay-as-clear auction.

[19] In practice, there would likely be lags in deploying CLASS in RIIO-ED2. However, we do not expect this would have much impact on any NPV estimates as the future streams of costs and benefits would be deferred but still follow a similar profile over time.

DNO deployment) and should not be interpreted as estimates for a given license area:

- Bill impacts for DUoS customers.
- Change in BSUoS charges.
- Changes in profits for DNOs.
- Change in profits for non-CLASS providers of balancing services.

Results under each regulatory option

3.8. The below table shows that the economic net benefit of CLASS is expected to be positive under all regulatory options in a deployment scenario where roughly 3 of the 6 DNOs deploy the technology. There is very little variation in the NPV under each regulatory option as CLASS is a competitively priced technology (and therefore procured) irrespective of bidding strategy. The amount of CLASS accepted, and the amount of alternative capacity displaced, is therefore similar across the regulatory options. Dispatch of CLASS is slightly higher under Option 2 as CLASS bids into the tenders at a price of zero, rather than at marginal cost.[20]

Table 2: NPV of economic benefits under Scenario B: medium deployment of CLASS, £m 2020/21 prices

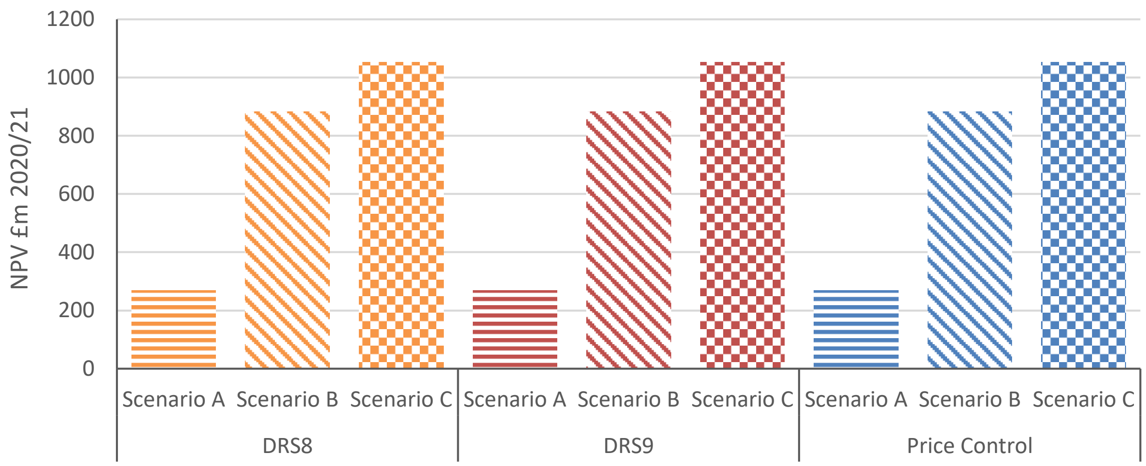
Category	Option 1A	Option 1B	Option 2
Direct Costs *(a)*	-67.9	-67.9	-67.9
Indirect Costs *(b)*	-6.6	-6.6	-6.8
Avoided Cost of Balancing Services *(c)*	944.1	944.1	944.2
Avoided Carbon Cost *(d)*	13.9	13.9	13.9
Net Benefit	**883.4**	**883.4**	**883.4**
Benefit Cost Ratio *(c + d / a + b)*	12.9	12.9	12.8

Source: NERA (2022). Impact Assessment for CLASS – Supporting Annex.

[20] This means that the indirect costs associated with the loss of reliability, and the avoided cost of balancing services, are ever so slightly higher. There are relatively few cases where other providers are assumed to be able to undercut a CLASS bid.

3.9. However, there is considerably more variation in the estimated economic net benefit under the different deployment scenarios, and this is summarised in the below figure. Whilst the NPV is increasing in the scale of the CLASS deployment, the average net benefit per unit of CLASS capacity is in fact lower in Scenario B and Scenario C as the marginal unit of CLASS capacity increasingly displaces less costly alternative providers.

Figure 2: NPV of net benefit across regulatory options and deployment scenarios, £m 2020/21 prices



Source: NERA (2022). Impact Assessment for CLASS – Supporting Annex.

3.10. We now consider the distributional impact of CLASS, which varies considerably with the deployment scenario but also the regulatory option under consideration. The impacts for each group are summarised in the below table. The allocation of cost and benefits depends on the regulatory option, which determines how much DNOs can charge for providing balancing services and how they would share profits with customers. The most notable distinction is the ability for DNOs to make profits, shared with DUoS customers, under Option 1A: DRS8. Under other regulatory options, Ofgem would limit a DNO's returns by setting prices at a level that allows them to recover only efficient costs and a reasonable margin (Option 1B: DRS9) or through determinations on allowed revenue under RIIO-ED2 (Option 2: Price control).

Table 3: NPV of cash flow impacts by group in each regulatory option and deployment scenario, £m 2020/21, £m 2020/21 prices

Category	Option 1A	Option 1B	Option 2
Scenario A: conservative deployment of CLASS			
DUoS customers	211.1	0.0	-11.8
BSUoS customers	31.1	453.4	467.4
Profits for DNOs	211.1	0.0	0.0
Profits for alternative balancing service providers	-182.2	-182.2	-184.1
Scenario B: medium deployment of CLASS			
DUoS customers	679.5	0.0	-65.7
BSUoS customers	81.0	1,439.9	1,521.2
Profits for DNOs	679.5	0.0	0.0
Profits for alternative balancing service providers	-562.1	-562.1	-576.9
Scenario C: large-scale deployment of CLASS			
DUoS customers	807.7	0.0	-128.4
BSUoS customers	204.9	1,826.7	1,969.1
Profits for DNOs	807.7	0.0	0.0
Profits for alternative balancing service providers	-782.9	-782.9	-802.4

Source: NERA (2022). Impact Assessment for CLASS – Supporting Annex.

3.11. The distributional impact for each group can be interpreted as follows:

- **Change in DUoS charges:** there would be a reduction in charges under Option 1A: DRS8, but these would rise under Option 2: Price control as the costs of CLASS would be allowed totex under the price control and, by extension, funded through an increase in DUoS charges.
- **Change in BSUoS charges:** the reduction is greatest under Option 2: Price control as all cost savings, and the reduction in provider profits due to lower prices, accrue to BSUoS paying customers.

- **Changes in profits for DNOs**: DNOs would be able to make profits under Option 1A: DRS8, which would be shared with DUoS customers in line with the illustrative totex efficiency incentive rate of 50% that NERA assumes throughout the modelling period.[21]
- **Change in profits for non-CLASS providers of balancing services:** displacement of alternative providers is assumed to be highest under Option 2: Price control as the DNOs would offer CLASS to the ESO free of charge.[22] The 30-year modelling impacts that are presented here should be considered in the context of the ESO's £1.9m million expenditure on balancing services in 2020/21.[23]

3.12. It is important to note the total NPV reduction in customer bills (ie combining DUoS and BSUoS) would be significant. The combined impact, assuming 27.1 million households in Great Britain,[24] under each regulatory option and deployment scenario is as follows:

- Under **Scenario A**, a conservative deployment of CLASS, the reduction ranges from £0.30 (Option 1A: DRS8) to £0.56 (Option 2: Price control) per household per year across the 30-year modelling period.
- Under **Scenario B**, a medium deployment of CLASS, the annual bill impact ranges from £0.94 (Option 1A: DRS8) to £1.79 (Option 2: Price control).
- Under **Scenario C**, a large-scale deployment of CLASS, the annual bill impact ranges from £1.25 (Option 1A: DRS8) to £2.27 (Option 2: Price control).

3.13. While the distributional analysis implies that the consumer benefits under Option 2: Price Control would be higher than Option 1A: DRS8, these results do need to be interpreted with caution. Under Option 2: Price Control, investments in CLASS would be subject to considerably less risk and this could result in higher levels of capacity being deployed than would be required under a competitive scenario. CLASS is still a

[21] In RIIO-ED1, each company faced different incentive rates which ranged from ~53% to 70%. Note that a higher % corresponds to a company retaining a greater share of any profit or loss.
[22] This assumes that short-run marginal cost of CLASS is effectively zero.
[23] National Grid ESO (March 2021), Monthly Balancing Services Summary 2020/21, Figure 2.
[24] Based on 27.1 million households in Great Britain. Office for National Statistics (March 2021), Households by household size, regions of England and UK constituent countries dataset. URL: https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/families/datasets/householdsbyhouseholdsizeregionsofenglandandukconstituentcountries. Visited on 13 February 2022. The figures are illustrative as it is assumed that all savings accrue to domestic customers.

relatively novel technology, and we believe that Option 1A: DRS8 provides the economic signals that are needed to reveal efficient prices and effective allocations. In addition, under Option 2: Price Control, there would be a considerable reduction in the quantify of competitively procured balancing services and this could have a determinantal effect on consumers if reduced competition results in higher prices and lower rates of innovation in the wider market. For these reasons, we contend that Option 1A: DRS8 is likely to deliver the best outcomes for consumers when all these factors are considered.

Sensitivity analysis

3.14. We recognise that CLASS is a new technology and there is some uncertainty over its likely costs and benefits. This uncertainty may be greater still in scenarios where CLASS is deployed more widely, and by DNOs that have yet to trial the technology and deploy it as a balancing service. In the latter case, cost estimates that are predicated on ENWL's roll out of CLASS could be subject to optimism bias when applied to different companies and distribution networks.

3.15. For these reasons, we asked NERA to prepare alternative assumptions that could account for some of the key uncertainties in its estimates. These sensitivities are set out in detail in the appendix to this Impact Assessment, and we summarise them in the below table. Note that the categorisation of sensitivities into a downside and upside scenario refers to their impact on the total NPV of benefits; the impact on any given stakeholder group may not follow the same pattern.

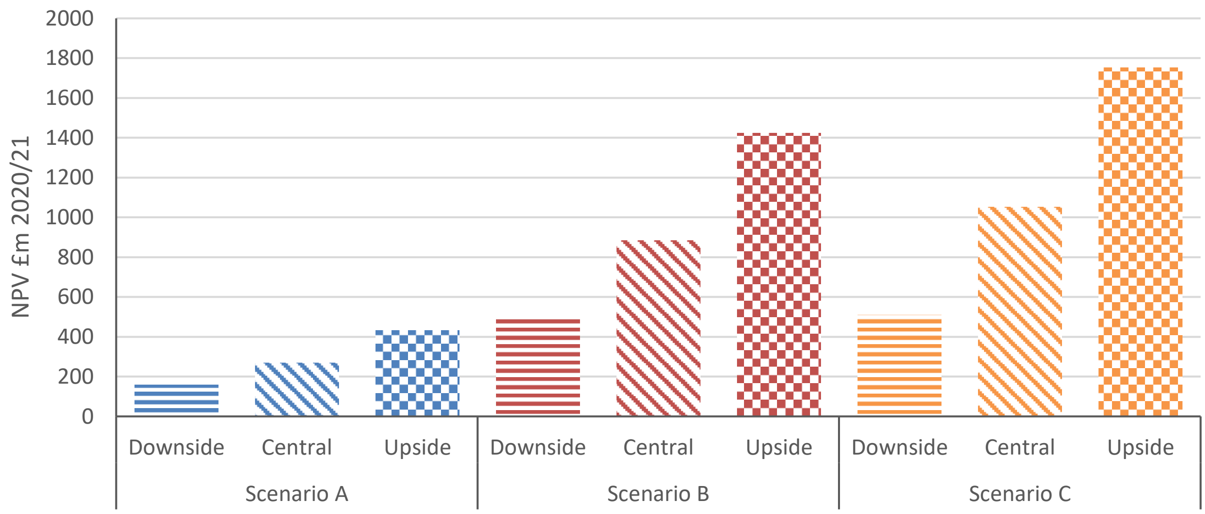
Table 4: Summary of assumptions in NERA's sensitivity analysis

Category	Central case	Downside	Upside
Direct costs	No adjustment	+ 50%	No adjustment
Asset health costs	Not included	+ 10%	Not included
Balancing services costs	No adjustment	-2% per annum	+2% per annum
Pay-as-bid adjustment	Costs are 75% of bid price	Costs are 50% of bid price	Costs are 100% of bid price
Carbon cost	BEIS central projection	BEIS low projection	BEIS high projection

Source: NERA (2022). Impact Assessment for CLASS – Supporting Annex.

3.16. The below figure summarises the results of the sensitivity analysis for Option 1A: DRS8 under the different deployment scenarios (as per Table 2, the NPV is highly similar across each regulatory option). This reveals that CLASS is expected to deliver a net benefit under all combinations of sensitivities and deployment scenarios, with BCR estimates ranging from 3.2 in a worst case (downside sensitivity, scenario C) to 32.0 in a best case (upside sensitivity, scenario A).

Figure 3: NPV of economic benefits under regulatory Option 1A: DRS8, £m 2020/21 prices



Source: NERA (2022). Impact Assessment for CLASS – Supporting Annex.

3.17. Recall that, in the downside sensitivity, the direct costs of CLASS are increased by 50% and a number of additional indirect costs are included to account for any CLASS impact on asset health and reliability (see NERA's report which we published as an appendix to this Impact Assessment for further explanation). This suggests, that were it possible to quantify some of the harder to monetise costs of CLASS (which we discuss in the next Chapter of this IA) with a greater degree of confidence, it would still seem likely that the technology would return a positive NPV when deployed as a balancing service.

Limitations of the analysis

3.18. As with any modelling of energy markets, the results of the CBA are subject to uncertainty and a number of caveats. NERA discusses a number of these in their report:

- Under Option 1A: DRS8, the model assumes DNOs have perfect foresight under pay-as-bid auctions (ie OFR and FFR). This means that they are able to submit bids at a price below competitors, but close to what they expect the market clearing price will be. However, there may be instances where DNOs bid too high such that CLASS is not chosen by the ESO. In such instances, the net benefit would be lower under Option 1A: DRS8 than the other regulatory options.
- In its report, NERA does not form a view on which combinations of regulatory options and deployment scenarios may be most likely. However, in practice, the deployment scenario may not be fully independent of the regulatory option. For example, under Option 2: Price control, Ofgem would likely need to determine a specific capacity MW of CLASS capability that each DNO must make available to the ESO, and hence this may be more likely to correspond to Scenario C: large-scale deployment of CLASS. Conversely, under Options 1A and 1B, DNOs would need to make a decision on whether to invest in CLASS and, to the extent that the investment case varies, deployment could look more like Scenario A and B.

3.19. For simplicity, the modelling also assumes that DNOs (with the exception of ENWL) would start to offer CLASS in the market for balancing services from 2023/24 under each deployment scenario. However, in practice we would not expect, for example, Scenario C: large-scale deployment of CLASS to be realised by 2023/2024 given the lead times associated with CLASS investment decisions. More importantly, the regulatory option may also influence the pace of any deployment, with Options 1A and 1B predicated on DNOs independent investment decisions and Option 2 forming part of determinations under the price control framework.

3.20. The CBA modelling that has been discussed in this section is also static in that it does not consider the dynamic effects that the deployment of CLASS as a balancing service could have. NERA does acknowledge these challenges in its report. For example, it varies assumptions on alternative providers costs as a share of tendered prices as part of its sensitivity analysis in recognition that the deployment of CLASS would lead alternative providers to adapt their bidding strategy.

3.21. The deployment of CLASS could also have knock-on impacts, or second order effects, on other energy markets. These could manifest through a number of channels:

- CLASS could, for example, displace alternative providers in the FFR, DC and optional FR markets, who then chose to bid into other balancing service markets.
- Displaced capacity could also choose to enter the wholesale electricity market, influencing prices there.
- There could also be an impact on bid levels in the capacity market, altering future outcomes.

3.22. We do not consider it to be proportionate, nor feasible, in this case to estimate outcomes in the wider energy market that would result from the deployment of CLASS as a balancing service in RIIO-ED2. However, we do conclude that the distributional impacts for alternative balancing service providers that we presented in this section need to be treated with caution. Alternative balancing service technologies may earn considerable revenues from the wholesale and capacity markets, such that the impact on balancing service revenue streams on overall profitability is more limited. In addition, the ESO’s requirement and total expenditure on balancing services could increase in the future and this may offset any decline in revenue that is attributable to the deployment of CLASS.

3.23. In short, the level of uncertainty influences our degree of confidence in projecting future market outcomes under different deployment scenarios for CLASS. With respect to Option 2: Price control, this suggests that it would be challenging to determine, on an ex-ante basis, the optimal rate of deployment for CLASS over the duration of RIIO-ED2. Options 1A and 1B, on the other hand, are likely to be more flexible to changing market developments as DNOs would be incentivised to participate in the market only when there is a strong investment case for doing so.

4. Hard to monetise costs

Chapter summary

In this chapter, we consider costs that are hard to monetise and whether they could alter the findings of the CBA with respect to preferred regulatory option for the treatment of CLASS as a balancing service in RIIO-ED2. We conclude that:

- The findings of academic studies, as well as ENWL's own monitoring and maintenance records, suggest that CLASS activations have little to no impact on the health of network assets. Whilst there is more limited evidence on the impact of voltage variations on the impact on the health of customer assets, we note that CLASS operates within the statutory limits on voltage variations and is therefore unlikely to produce any incremental cost.
- We consider that investments in CLASS will have a negligible impact on a company's allowed regulatory cost of capital, and that this conclusion is invariant with respect to the regulatory option.
- We recognise concerns that the deployment of CLASS as a balancing service could undermine investor confidence in flexibility services. However, we think these would be offset by our strategic focus on promoting investment in Full Chain Flexibility and the fact that CLASS is an inframarginal technology that can only satisfy some portion of the ESO's balancing service requirements.
- The incentive to misallocate CLASS costs to distribution network activities, so as to increase the commercial net revenues under DRS8 or DRS9, is limited by the single till approach in RIIO-ED2. To the extent that some CLASS related costs are likely to be difficult to apportion out, these are likely to be immaterial.
- Through analysis that was supported by Elexon, we find that the aggregate impact of CLASS on settlement cashflows is likely to be limited.
- CLASS, as a single technology, is unlikely to present a risk to system security. The ESO has scope to, amongst other things, reject CLASS bids if the benefits of short-term efficiency are outweighed by longer-term risks. In addition, CLASS would not appear to impact on the ability for the DNOs to effectively meet its obligations as set out under Operational Code 6 of the Grid Code.

4.1. Through this Impact Assessment, we have sought to identify and quantify all the costs that would be relevant for the deployment of CLASS as a balancing service. In practice, our analysis has been limited by a lack of robust evidence on potential indirect costs of CLASS as well as general uncertainty on their likely magnitude. We have also had to contend, in some instances, with a lack of clarity more broadly on the indirect costs associated with other balancing service technologies which are relevant to our counterfactual.

4.2. In line with our proportionality principle, we only included costs within the CBA framework where we could have confidence on the data source and methodology for calculating the likely size of its impact. However, in this section we do consider a wider set of costs that could arise through the deployment of CLASS as a balancing service. This allows us to weigh up whether these factors could be sufficient to alter the conclusions of the quantitative CBA.

Impact on network and customer asset health

4.3. Some respondents to our 2020 consultation raised concerns that CLASS might produce some 'hidden costs' due to potential detrimental impacts for network asset health, customer asset health and customers' quality of service. If there were such negative impacts, these will be ultimately borne by consumers. These include:

- deteriorating the health of network assets utilised for CLASS, resulting in more frequent maintenance and earlier replacement.
- shortening the useful lives of certain machines and household appliances.
- reducing service quality to consumers by lengthening the time taken for resistive load appliances to complete their purpose.
- service disruption and reduction of voltage stability (regardless of effect on asset health or reliability).

4.4. None of the respondents who raised these arguments presented tangible evidence that these harms were occurring.

Scope of the analysis, methodology and outline of the section

4.5. Given the concerns raised by several stakeholders, we decided to conduct a proportional examination on the potential impacts of CLASS on network asset health, customers' asset health and quality of customers' service. To investigate available evidence for the scale and materiality of these impacts, we:

- reviewed and considered the results from ENWL's trials, specifically the university conducted research commissioned to investigate the impact of CLASS on network asset health.
- requested ENWL to prepare a Technical Report outlining ENWL's characterisation of a typical, ie without CLASS, and CLASS enabled voltage profile (magnitude and frequency of variation) for high-voltage (HV) and low-voltage (LV) connections to Commercial and Industrial (C&I) and domestic customers.
- requested information from ENWL regarding any C&I and domestic customer issues associated with CLASS since its wider deployment and how these issues have been addressed.
- reviewed and assessed the Technical Report and conducted a broader literature review on the topic on the impacts on asset health of voltage variations.

4.6. To ensure the transparency of our decision making, in the following sections we:

- provide a general background on what the current regulation is related to network voltage and limits.
- summarise key findings from university commissioned research during ENWL's CLASS trials into network asset health.
- provide initial conclusions regarding CLASS's impact on network asset health.
- summarise key information and data provided in ENWL's Technical Report.
- summarise key findings from the relevant literature review and research conducted on the topic of the impact of voltage variation on customer asset health.
- summarise ENWL's recordings of any customer issues related to their deployment of CLASS and how any issues have been addressed.

- provide Ofgem's conclusions on CLASS's potential impact to customers' asset health.

Our interaction with ENWL

4.7. Ofgem has requested information from ENWL in conducting this IA to evaluate the impact of utilising CLASS. ENWL led the initial trials of CLASS techniques in 2015 and is the only DNO to have deployed the technology widely across their network. For this reason, ENWL is the only company capable of providing much of the required data and information (as it is the only subject that has access to its CLASS-enabled substations and, at the moment, to the CLASS technology).

4.8. As ENWL is the only DNO that is currently providing CLASS, it is not possible (either for Ofgem, the ESO or others) to conduct a comparative assessment by using data and information collected from other DNOs to assess the impact of CLASS on asset health. Ofgem recognises that ENWL has an active interest in the regulatory treatment of CLASS for RIIO-ED2. Therefore, Ofgem has been mindful to critically evaluate all data and information supplied by ENWL.

4.9. To ensure that Ofgem's minded-to position will be based on neutral and robust evidence, where possible, we reviewed a broader range of available literature to improve Ofgem's understanding of any potential risks posed to safe, continued operation of network and customer assets.

Background to network voltage, limits, and regulation

4.10. As CLASS operates at 33kV to 11kV or 6.6kV primary substations, it must comply with the Electricity Safety, Quality and Continuity Regulations (ESQCR) 2002, which stipulates voltage limits[25] and minimum requirements for the quality of power supply. ESQCR defines the permitted variations in voltage for low voltage and high voltage supply under Regulation 27 (3) as follows:

- a variation not exceeding 1 per cent above or below the declared frequency.

[25] See Regulation 27 of The Electricity Safety, Quality and Continuity Regulations 2002

- in the case of a low voltage[26] supply, a variation not exceeding 10 per cent above or 6 per cent below the declared voltage at the declared frequency.
- in the case of a high voltage supply operating at a voltage below 132,000 volts, a variation not exceeding 6 per cent above or below the declared voltage at the declared frequency.

4.11. Following voltage harmonisation in 1995, the declared GB nominal low voltage supply has been 230V with a permitted variation of +10%/-6%.

4.12. Several factors influence instantaneous system voltage. This includes current loading, voltages of adjacent systems, connected renewable generation, network topology and faults. With both demand and distributed generation projected to increase significantly, the LV voltage profile will become far more variable throughout the day. Typically, DNOs will automatically regulate voltage to maintain it within limits. DNOs will in some cases manually intervene, for example in response to new customers, significant changes in demand or alteration in network configuration.

4.13. Voltage profiles may differ widely across systems and geographies. However, limiting voltage variations to within the statutory limits defined by ESQCR ensures the safety and reliability of the electricity distribution system.[27]

4.14. Via this set of documentation, the allowed range of voltage limits and transients[28] to minimise adverse effects such as damaging transients, flicker, and harmonics is well established. As part of their statutory duties all licenced electricity networks must comply with ESQRC 2002. This is to ensure that changes in voltage are not perceptible to customers and compliance maintains compatibility of equipment and network safety.

4.15. The activation of CLASS is complaint (as will be further assessed in paragraphs 4.53 – 4.67) to the applicable statutory limits set out by the ESQCR and follows further

[26] Low voltage is defined as 230 volts between phase and neutral conductors at the supply terminals.
[27] Further industry guidance can be found in the Energy Networks Association's (ENA) Engineering Recommendation (EREC) P28 (2019) which provides methods for assessing voltage fluctuations on the electricity network. Additional guidance can be found in BS EN 50160, which outlines voltage characteristics of electricity supplied by public electricity networks.
[28] Transients refers to instances of momentary and short duration changes in voltage.

industry guidance. In other words, CLASS's ability to alter voltage for 11kV or 6.6kV does so within the normal voltage standards with associated limits of +6/-6% (and within +10/-6% for 230V).

CLASS effects on network asset health

4.16. To assess the impact of CLASS on network asset health, the following section will review academic studies conducted as part of the CLASS LCNF Project[29].

4.17. ENWL commissioned the studies to analyse the impact of CLASS techniques on the health of 33/11(or 6.6) kV primary substation transformer assets in two aspects – main tanks[30] and tap changers.[31]

4.18. The work has been conducted by two universities: University of Manchester (UoM), which investigated possible impacts of CLASS techniques on the health conditions of transformer main tanks, and University of Liverpool (UoL), which investigated these impacts on tap changers.[32]

Overview and key conclusions of the research by Manchester University (UOM)

4.19. UoM's research was aimed at identifying the possible impacts of CLASS techniques on the health of transformer main tanks through analysis of load and oil data. This provided information to produce thermal modelling and create any relevant modification of health indices for the assets.

[29] Ofgem ran the Low Carbon Networks Fund (LCNF) under our Distribution Price Control Review 5 (DPCR5). This price control ran from April 2010 to March 2015, when it was replaced by the RIIO-ED1 price control (2015-2023). The LCN Fund allowed up to £500m to support projects sponsored by the Distribution Network Operators (DNOs) to try out new technology, operating and commercial arrangements.
[30] A main tank is a part of the transformer that protects the core and the windings from external environmental factors and contains oil as well as insulation paper to insulate electrical infrastructure within the tank.
[31] The tap changer is a key component operated in CLASS activations. It allows for the increase or decrease of output voltage by adjusting its position to change the turn ratio of windings (coils) within the transformer).
[32] ENWL (2015). Asset Health Final Report prepared by University of Manchester and University of Liverpool

4.20. The assessment of impacts on main tank health mainly focused on the transformer tripping[33] (tested in Trial 3a) and the tap staggering[34] (tested in Trial 4), as those two operational modes that CLASS is capable of could potentially increase the current and result in higher hot-spot temperature that shorten the paper insulation life expectancy. Transformer tripping is a technique that provides a faster response than tap changing, which would enable CLASS to provide services such as Primary FFR, a service ENWL have yet to participate in. Tap Staggering is a function that would enable CLASS to participate in Reactive Power Services, again however, ENWL have not participated in this service to date.

4.21. Oil data were analysed by focusing on the oil sampled before and after trial tests, and it was concluded that it is unlikely that the change of oil test results is correlated with CLASS techniques (but rather generally attributable to either measurement inaccuracy or the movement of by-products). This is because the ageing of insulating materials is a long-term process and its indicators such as acidity, 2-FAL and moisture take years to accumulate. The study reached the conclusion that CLASS techniques are unlikely to bring any detrimental impacts on transformer operational health.

4.22. To assess the long-term thermal impacts on transformers and their vulnerability to tripping and tap staggering scenarios, over a hundred transformers were thermally modelled through simulation based on the assumed worst-case operational scenarios.[35]

4.23. The worst-case scenario for transformer tripping is when a transformer is tripped for one hour at the peak load of each month every year. The worst-case scenario for tap staggering is where a tap stagger occurs with a 150A current increase in a

[33] The term transformer tripping refers to a circuit breaker opening to de-load one of a pair of parallel transformers. This is done to increase the network impedance in order to produce a greater voltage reduction rapidly for services such as primary firm frequency response.
[34] Tap staggering is the process of adjusting the tap changers to different positions on parallel transformers to provide a method of absorbing reactive power for reactive power services.
[35] The assessment of transformer tripping was based on the worst operational scenario: one of the transformers in a substation is always tripped for one hour at the peak load of each month of every year. The assessment of tap staggering is also based on the assumed worst operational scenario that the tap stagger always happens with a 150A current increase in a transformer, during 02:00–06:00 a.m. every day in the summer months (from June to August) every year.

transformer during 02:00-06:00 a.m. every day during summer (June – August) every year.

4.24. This differs greatly to ENWL's use of CLASS to date, where CLASS activations have only performed a tap position change to vary voltage 3% or 5% to provide secondary static FFR, Firm FR and Optional FR. This does not require transformer tripping or tap staggering, which could be utilised for primary frequency response and reactive power services.

4.25. If CLASS were to be utilised for primary frequency response or reactive power services, it is also unlikely that the frequency of its use would be as frequent as test conditions. Additionally, it is unlikely that the same transformers would be utilised consecutively. Rather, the CLASS dashboard has the option to utilise different transformers across the network of primary substations.

4.26. Simulation results show that only a handful of transformers with high peak loads will have paper insulation life expectancies reduced below the expected asset life (70 years) due to the implementation of tripping.[36]

4.27. In contrast to transformer tripping, the impacts of tap staggering are negligible with all the paper life expectancies in excess of 90 years. Moreover, tap staggering can even be neglected from the system safety point of view, as there is no evidence showing the assumed worst operational scenario of tap staggering is correlated with the increase in the number of high hot-spot temperatures.

4.28. In summary, simulation results show that in the long-term worst case operational scenario. With respect to transformer tripping:

- Transformer tripping at high peak loads might cause, in limited cases, a reduction of transformer's paper life expectancies and therefore the transformer service life.
- The impacts of CLASS techniques on the transformer main tank would be minimal and are limited to only a small number of transformers with high peak

[36] The assumed worst operational scenario of transformer tripping only could cause five transformers' life expectancies to reduce to less than 70 years.

loads when implementing the frequency management service by transformer tripping.

- In spite of the minimal effects, when implementing CLASS techniques, the safe operation of the network cannot be neglected due to potential transformer alarms and trips which occur because of possible hot-spot temperature violations. Therefore, the study established a loading guide by setting a load limit, within which a certain type of transformer can be safely tripped under different ambient temperature conditions without causing any temperature violations in the substation.[37]

4.29. With respect to tap staggering, the health impacts on main tanks are negligible both in terms of paper life expectancies and a system safety point of view.

Overview and key conclusions of the research by the University of Liverpool (UOL)

4.30. UoL conducted research on the impact of CLASS techniques on tap changer health conditions. As part of the study, the UoL installed transformer monitoring systems on three selected transformers to glean valuable information on the behaviour of the tap changers and main tanks during CLASS type operations.

4.31. This was complemented by research undertaken in a laboratory setting to assess potential electrode wear[38] due to CLASS operations and any implications this would have for necessary maintenance intervals.

4.32. The key conclusions from the analysis were:

- Acoustic signatures[39] from the tap changers and the main tanks were similar to non-CLASS (ie normal) operations. This implied that there were no adverse effects on the mechanism.

[37] This is inherent to the CLASS system, where it will not allow the CLASS tripping action if the load is too high in order to prevent overloading a transformer.
[38] Electrode wear here refers to the point of contact between tap changers and the tap positions for the transformer coil. With repetitive position change, it may be expected that the motion may deteriorate the point of contact and is usually defined by the volume of material lost.
[39] Acoustic listening devices were fitted and compared the noise of the tap changer mechanism in operation. A comparison of the noise (acoustic signatures) before and after CLASS found no appreciable difference, suggesting that increased tap changing as a result of CLASS had negligible impact on the tap change mechanism.

- The analyses were also performed on the oil sampled during the trial period. The oil samples showed a residual change in the oil after CLASS tests. However, any local degradation of oil is diminished when mixing with the bulk of the oil.
- For higher current switching operations in the most onerous CLASS condition,[40] there was a significant increase in the erosion of contacts. For a doubling of the switching current above the normal, the erosion rate increases by approximately a factor of four. In this condition, higher erosion rate could affect the time interval between scheduled routine maintenance rounds for tap changers.

ENWL Asset Health Maintenance and Inspections

4.33. Ofgem contacted ENWL to enquire about any additional asset maintenance or asset replacement costs caused by CLASS during their increased roll out of the technology since 2015.

4.34. ENWL stated that as part of routine maintenance, an annual safety inspection and two-yearly detailed inspections are conducted on transformers, including a collection and sampling of transformer oil. Additionally, a primary transformer tap changer is maintained every 6 years. However, maintenance on tap changers may also be required if the total number of tap changer operations since its last maintenance exceed a fixed value of 30,000.

4.35. According to ENWL, activations of CLASS since its introduction have occurred on average 4 times per day. One activation of CLASS may typically require 5 tap operations to achieve the desired voltage reduction. An approximate calculation would suggest that the frequency of maintenance on the tap changer of a CLASS-enabled site would be every 4.1 years. However, ENWL does not enable CLASS at all sites continuously and utilisation is spread among equipped sites using the CLASS dashboard. This may increase the average time it takes for a tap changer to reach 30,000 operations since last maintenance.

[40] Most onerous CLASS conditions is defined as when one of the parallel transformers took the full load, effectively doubling the load current. Higher current switching operations may be required for faster response services such as primary response, a service ENWL have not participated in to date.

4.36. ENWL have concluded from Dissolved Gas Analysis (DGA)[41] that since CLASS's introduction, there has been no abnormal degradation of CLASS-enabled transformers or tap changers. Ofgem was provided with the results of ENWL's DGA for 2019 and 2021 across a selection of CLASS-enabled and non-equipped sites and agreed with ENWL that the results showed no observable abnormal degradation.

4.37. ENWL is currently considering extending the operations figure from 30,000 to 50,000 having not observed any abnormal degradation. Furthermore, the replacement of transformers that have reached their rated lifespan, may provide opportunity for more modern tap changer devices, such as vacuum based interrupter tap changers to be installed. These tap changers are rated for a much higher number of operations, typically more than 600,000. The increase in tap changer operation unit rating will reduce maintenance frequency and potentially maintenance costs in the long-term.

4.38. Lastly, ENWL have observed that some costs may have reduced due to new electronic relays used by CLASS that are more reliable than previous relays. This has resulted in a reduction of maintenance call outs for Voltage Control Scheme faults.

Conclusion on CLASS effects on network asset health

4.39. The rigorous analysis conducted by Manchester and Liverpool Universities provides evidence that the impact of CLASS techniques on the transformer main tank would be minimal and only limited to a small number of transformers with high peak loads when implementing the frequency management service by transformer tripping. It should be noted, however, that the analysis considers the worst operational scenario in which one of the transformers in a substation is always tripped for one hour at the peak load of each month every year, which is likely significantly higher than what might be expected if CLASS was called upon for a service like Primary FFR and differs from the current use of CLASS where tap changer positions are adjusted at a historical average of 4 time per day. As such the minimal and limited impact noted by Manchester and Liverpool Universities may not be observed for typical CLASS operations.

[41] Dissolved gas analysis (DGA) is an examination of electrical transformer oil contaminants. The process usually consists of sampling the oil and sending the sample to a laboratory for analysis.

4.40. The conclusions of these academic studies are also backed by ENWL's monitoring and maintenance records for CLASS-enabled sites. Inspections have found no observable degradation to transformer components that differs from expected aging found at non-equipped sites. The extension of maintenance intervals for tap changers based on number of operations and upgrades to modern tap changer solutions may decrease some maintenance costs, compared to both current practices and those previous to CLASS's introduction.

4.41. Ofgem considers the research from Manchester and Liverpool Universities, alongside the inspection records from ENWL, to be evidence that CLASS, as currently deployed by ENWL, likely has minimal to no impact on the health of network assets. However, how these limited and minimal costs could increase or change in the context of Scenarios B and C, a much wider deployment of CLASS technology, should be taken into consideration alongside the potential benefits of CLASS technology for customers and the electricity system. Additionally, DNOs looking to deploy CLASS should review their existing maintenance procedures to ensure that the increase of tap changer operations associated with CLASS is accounted for.

4.42. Acknowledging there may still be uncertainty in this area and that any impacts would be hard to quantify at this early stage in CLASS deployment, the sensitivity analysis conducted on the CBA found in Chapter 3 utilises the impact to network assets as part of its downside scenario.

CLASS effects on customer asset health

4.43. To assess the materiality of any impact of CLASS techniques to consumers' asset health, we requested ENWL to provide Ofgem with a technical report containing the following information:

- the configuration of the CLASS technology on its network.
- ENWL's characterisation of a typical, ie without CLASS, voltage variability (magnitude and frequency of variation) for both a C&I and domestic customers.
- ENWL's characterisation of voltage variability for users on a CLASS-enabled feeder for both C&I customers and domestic customers.

- ENWL's view, with justification and evidence, as to whether and to what extent increases in voltage variability caused by CLASS has or is likely in future to cause detrimental effects to customer assets.
- How voltage effects on C&I and domestic customers are identified and addressed.

4.44. In addition to ENWL's technical report, relevant evidence from academic literature was reviewed to further assess the materiality of any impact of CLASS techniques on consumers' asset health.

4.45. Before reviewing each of these areas in turn, it should first be acknowledged that there is limited information and data regarding voltage variation within statutory limits and how it may affect consumer appliances or equipment. Ofgem is mindful of this and that there is not opportunity for cross comparisons between different CLASS providers, with ENWL being the only operator of the technology to date. However, we have used the available evidence to review this concern and evaluate its materiality in the context of a further deployment of CLASS.

ENWL Technical Report

4.46. As of September 2020, ENWL reported that CLASS was enabled at 257 primary substations (approximately 72% of their total distribution network, covering 1.7m customers). As part of our analysis of the potential impact CLASS could have on consumer assets, we have first reviewed a technical report from ENWL that provides insight into CLASS activations and their result on network voltage.

4.47. CLASS voltage controllers installed at each of the CLASS-enabled substations are configured to deliver a defined voltage reduction versus its setpoint value. Depending on local factors, CLASS seeks to deliver either 3% or 5% reduction in voltage. As of 2020, the majority of CLASS-enabled substations were configured to provide a 5% reduction, accounting for 87% of the total enabled substations. The remainder only provide the lower 3% voltage reduction.

4.48. The number of substations considered in the analysis is limited (5 of the total ENWL primary substations that can offer CLASS). As primary substations are generally homogenous, it is unlikely that results would vary substantially outside of this selected group of substations. While data sets for a larger sample of CLASS-enabled sites would further confirm this, the available data is sufficient for providing preliminary conclusions. Should a wider deployment of CLASS occur, it may be proportional to further monitor voltage profiles across a wider sample of CLASS-enabled sites.

4.49. According to the information provided by ENWL, depending on the contracted position, which varies significantly from month to month, between September 2019 and 2020 CLASS provided a total response per activation in the range of around 28MW to up to 100MW at time of peak demand, equating to an average response per activation per CLASS-enabled primary substation of between ~110kW to 390kW.

4.50. The duration of an individual CLASS activation is determined by ESO actions. ENWL's data from September 2019 to 2020 showed that activations last for typically between 6 and 18 minutes on average.

4.51. As with total response per activation, the total number of activations during any period varies significantly, ranging from 0 activations in October 2019 to 219 activations during August 2020 (averaging 7 activations per day).

4.52. Table 5 shows the number of activations each month during the 12 months to September 2020, demonstrating the degree of variability in CLASS activation frequency.

Table 5 ENWL's CLASS activations from September 2019 – 2020

Month	Sep-19	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20
No. of activations	33	0	140	115	70	165	210	69	12	10	40	219	149
Average no. of activations per day	1.1	0	4.7	3.7	2.3	5.7	6.8	2.3	0.4	0.3	1.3	7.1	5.0

Note: No CLASS was bid into the balancing services market in October 2019.

Source: ENWL CLASS Technical Report

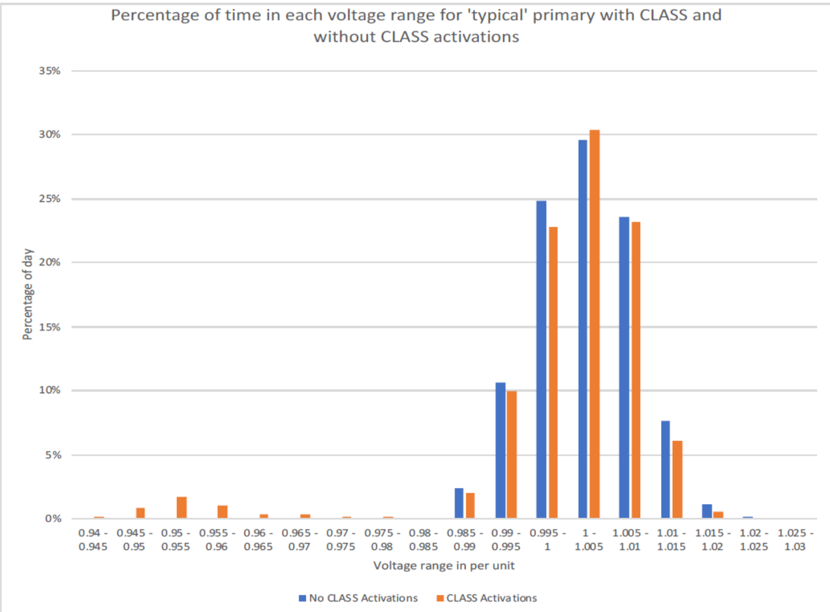
Technical report: Characterisation of system voltage at HV

4.53. With regard to characterisation of system voltage at HV, ENWL provided data from 5 primary substations over a 7-day period to capture voltages both with and without CLASS being activated during September 2020.

4.54. The data collected and presented in Figure 4 Average voltage frequency distribution for 5 CLASS-enabled primary substations (7 days in September 2020), shows that the differences between the distribution network voltages with and without CLASS are very small and within statutory limits and that system voltages are normally distributed around the nominal voltage, 11kV (1.0 pu[42]).

4.55. The data also shows that those sites with CLASS activations, averaged over the five primary substations, system voltage falls in the range 0.945 pu to 0.985 pu roughly 5% of the time, versus 0.1% without CLASS. This reflects the activation of CLASS to reduce demand within the statutory limits on voltage. The remainder of the time CLASS and non-CLASS voltages are broadly similar, representing 95% of all instances over the same period.

Figure 4 Average voltage frequency distribution for 5 CLASS-enabled primary substations (7 days in September 2020)



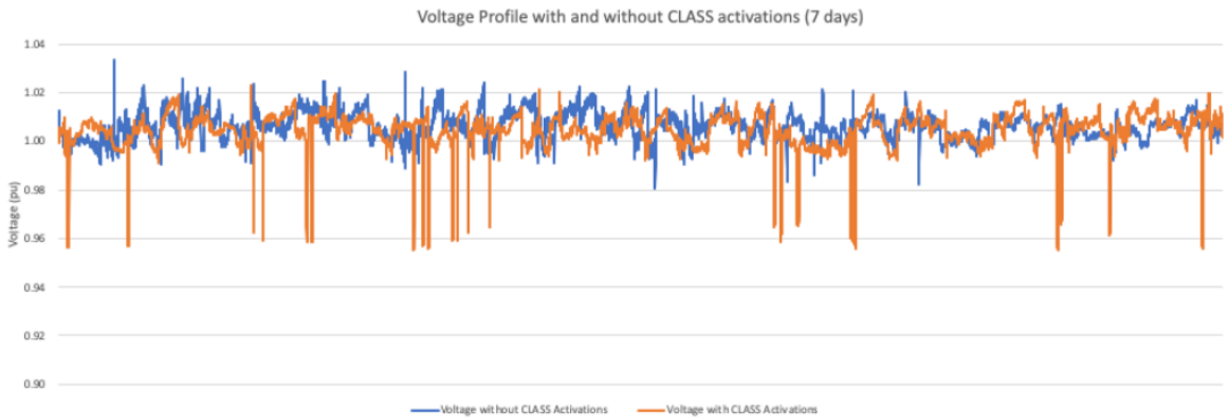
[42]pu stands for per unit, where 1.0 represents nominal voltage, 11kV.

Source: ENWL CLASS Technical Report.

4.56. Additionally, using data obtained from direct measurement of voltages at one substation, at a resolution of 0.1 seconds ENWL also produced a profile of instantaneous voltage over time. This provided a characterisation of the voltages supplied by networks over time, revealing the range (maximum and minimum) of voltages and how these vary over time.

4.57. The data shown in Figure 5 Voltage profile at a HV ENWL's primary substation with and without CLASS (7 days) – September 2020below represents a full week of captured voltages both with and without CLASS being activated over similar periods during September 2020. In all instances voltage remained within permitted statutory limits (here, 0.94 pu to 1.06 pu).

Figure 5 Voltage profile at a HV ENWL's primary substation with and without CLASS (7 days) – September 2020



Source: ENWL CLASS Technical Report.

Technical Report: Characterisation of system voltage at LV

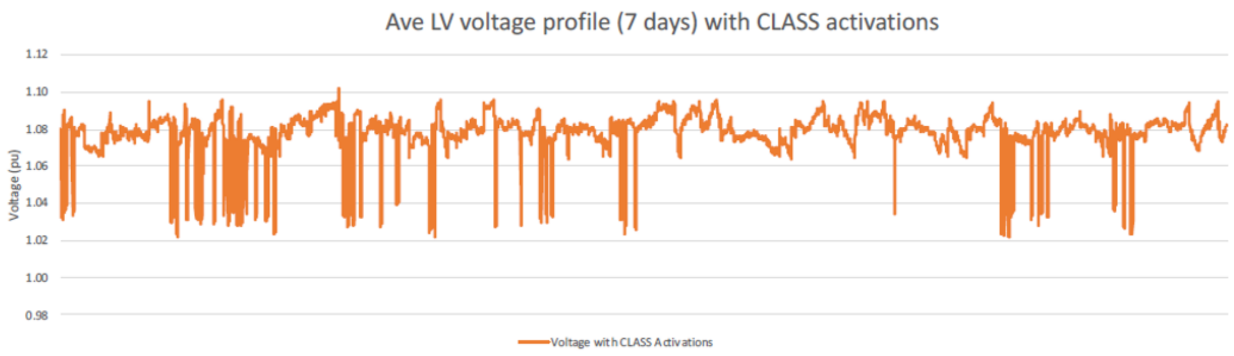
4.58. With regards to the characterisation of system voltage at LV, the report notes that the characterisation of voltages at LV with and without CLASS being active at the associated upstream primary substation are, broadly, the same as at HV.

4.59. A key difference, however, is that owing to the absence of automatic voltage regulation at the HV/LV boundary,[43] network operators will very often purposely configure the LV system voltage at the distribution substation to be above the nominal level, allowing correct regulation across the LV network throughout the seasons of the year.

4.60. ENWL provided an LV voltage profile using the data of one substation as shown in Figure 6 Voltage profile at a LV ENWL's primary substation with CLASS (7 days) . The profile is for a seven-day period (1 week of September 2020) during which CLASS was active, with approximately 40 activations. ENWL state this data represents a typical week.[44]

4.61. CLASS activations are shown to provided 5% reductions in voltage at this primary substation. In all instances, voltage remained within the statutory limits.

Figure 6 Voltage profile at a LV ENWL's primary substation with CLASS (7 days)



Source: ENWL CLASS Technical Report.

4.62. Key conclusions from ENWL's Technical Report:

- CLASS activations last for between 6 and 18 minutes on average.
- The number of CLASS activations ENWL conducted is highly variable depending on the ESO's needs, ranging from 0 activations to 219 activations within a month.

[43] Distribution transformers are typically equipped with off-load tap changers and any change to target voltage requires the transformer be de-energised – which means that they need to be switched out of service and thereby potentially interrupting supplies – prior to their being adjusted manually.
[44] The report notes that due to complexities in the analysis of large datasets, it's not possible to show the use and non-use of CLASS on the same chart.

- It is common for DNOs to operate LV feeders at the higher-end of the +10%/-6% limits for 230V. The data collected did not show occurrences of voltage reducing below the statutory nominal voltage of 230V.
- ENWL's data showed that their current implementation of CLASS techniques ensured that voltage remained within the statutory limits of either +6%/-6% for 11kV and +10%/-6% for 230V.
- This suggests that CLASS is not to the detriment of safe and reliable operation of the distribution system, which is the purpose of the statutory limits. This purpose includes ensuring that changes in voltage are not perceptible to customers and compliance maintains compatibility of equipment and network safety.

Literature review

4.63. Academic studies of voltage variation and how it may impact the health or operation of domestic appliances are very limited. We were unable to find any studies that directly comment on the voltage variation within statutory limits, as is the case with CLASS.

4.64. Of the limited academic studies on voltage variation and asset health, they typically focus on infrequent uncontrolled events that breach statutory limits, such as severe voltage sags or overvoltage surges.

4.65. While these studies are not related to the typical voltage variation caused by CLASS activations, the studies provide a broader understanding of how resistant assets are to voltage change and what type of health degradations can be observed due to improper voltage regulation. This section will briefly highlight two studies found to be informative to the broader topic of voltage management and their results:

- London Economics produced a study into the Value of Lost Load (VoLL) for electricity in Great Britain in 2013,[45] in which the cost of reduced lifetime of household appliances was calculated for a five-hour voltage sag at a depth of 86% (-14% from nominal 230V). This single event constituted a potential total cost of £1.81 in reduced lifetime for domestic appliances for a typical household. The calculation that formed this cost included the assumption that a consistent 4.3% voltage differential would reduce an appliances useful lifetime by 55%. In

[45] London Economics (2013). The Value of Lost Load (VoLL) for Electricity in Great Britain

report, it is cited that the DECC internal review team disagreed with this assumption, as if this were the case, appliances would be wearing out noticeably more rapidly than is the current norm and London Economics highlights that these results are not conclusive and that further analysis is required.

- Ofgem is aware that research is currently underway by EA Technology and Durham University, as part of the ENA CEP Project, to investigate the impact of adopting the EU voltage limits of 230V +10%/-10% on older domestic appliances. While the work is yet to conclude, the authors have expressed that any impacts from voltage variations below current statutory limits of 230V -6% will be low on most legacy domestic appliances. The exceptions are mercury and sodium lamps, that may shut off, and refrigerated food spoiling due to undervoltage at 180V.

4.66. As these studies are focused on much more onerous voltage changes outside statutory limits (higher than +10% and lower than -6% variation from nominal voltage), which is outside of the use-case of CLASS, attempting to extrapolate and apply the data from this body of research quantitively would be highly imprecise[46] and produce questionable analysis.

4.67. We were not able to find any empirical studies pertaining directly to voltage variation within statutory limits and how it may affect electrical equipment or domestic appliances. This is likely because nominal voltages and their respective statutory limits are well-established and widely understood to define the safe and reliable operating conditions for the electricity distribution system, with academics choosing to evaluate voltage impacts outside of these thresholds.

ENWL C&I and domestic customer engagement

4.68. Ofgem also requested ENWL to provide details on how they identify and address potential voltage effects on C&I and domestic customers as part of their technical report.

4.69. ENWL provided specific information on its customers' assessment, highlighting that as of September 2020, since introducing CLASS, ENWL has investigated around 50

[46] Specifically, there is no clear evidence to suggest that these results could be considered additive or proportional to other voltage variations or durations.

voltage-related customer enquiries at HV. This includes during early deployment of CLASS, where ENWL's CLASS team was proactively monitoring the roll-out. The enquiries investigated are described below:

- The majority of the investigations showed that issues attributable to system voltage were related to customer equipment being installed or configured incorrectly or inadequately. ENWL described these as issues existing with customer equipment whether CLASS was enabled or not. In these cases, ENWL assisted in correcting equipment configurations.
- In other instances, system voltage issues can be attributed to the configuration of the interface connection between the distribution system and the customer's network where these are adopted by the customer, often resulting in unwanted operation of equipment, even during routine (non-CLASS) network voltage changes.[47]
- In a very small number of cases, however, for instance where ENWL has discovered settings errors in CLASS-enabled devices, ENWL notes that it has subsequently corrected the settings or otherwise adjusted the configuration of CLASS on the relevant network.

4.70. At LV, the nature and volume of voltage-related customer enquiries have not changed in the period since CLASS became available. Furthermore, ENWL has collected no evidence nor reason to believe that the routine operation of CLASS and its effects on LV system voltages represent any problem for customers connected at LV.

4.71. According to the report, in the majority of cases, issues are characterised by customer equipment being overly sensitive or responding inappropriately to changes in system voltage. Issues are commonly associated with inappropriate tap settings on customers' transformers, the setup of voltage optimisation equipment, faulty generator switchover relays and incorrect generator under-voltage protection settings.[48] Investigations show that a combination of these issues often mean customers are operating their networks very close to the lower permitted limit,

[47] ENWL notes that in most instances it can assist customers by providing guidance on how to address the issue, thus preventing any repeat of the problem.
[48] It is worth noting that customers will have optimised their systems based on the long-standing UK practice of high (but still within limits) supply.

making their systems particularly susceptible to even routine changes in network voltage.

4.72. ENWL has also introduced new business processes, ensuring that issues are correctly captured and processed swiftly. It has made enhancements to its existing voltage complaints process to facilitate this, including amending its procedures to ensure continued compliance with EGS5 and EGS8 reporting requirements. According to these processes, where analysis of the voltage data confirms acceptable system voltage regulation is occurring on the relevant network, ENWL will advise customers of problems likely associated with the setup of their equipment. This may involve a site visit and technical consultation from ENWL without charge. In discussion with customers, ENWL may for a short period temporarily inhibit CLASS activations on an individual local substation.

4.73. During the trial stage of CLASS, ENWL also surveyed 496 domestic and 200 I&C customers to assess if there were any perceptible impacts caused by the use of CLASS techniques. The trial findings[49] evidenced that there was no statistically significant change in customers' perception of their electricity supply or any adverse effect on the performance of electrical appliances from the baseline measurement taken prior to commencing the Trials.

4.74. Ofgem does not consider customer perceptions of voltage variation caused by CLASS to be a robust indicator of potential adverse effects to customers' assets. It is unlikely that a customer would attribute the potential early deterioration of an appliance to CLASS or voltage issues. Nevertheless, customer perceptions and how potential issues are addressed are elements that should be taken into consideration more generally in terms of customers' quality of supply. With approximately 5 years of active deployment of CLASS, ENWL has not found that customers perceive any disruption or adverse impact from CLASS activations.

Conclusion on Customer Asset Health

4.75. CLASS technology as deployed by ENWL complies with The Electricity Safety, Quality and Continuity Regulations (ESQCR) 2002 and the associated technical and

[49] ENWL (2015). Customer Survey Summary Report

regulatory standards. These regulatory standards clearly define the supply characteristics for electricity supply and the permitted voltage variations which all DNOs in the UK are bound to comply with.

4.76. There is not sufficient evidence to provide a definitive conclusion on the impact that variations of voltage within statutory limits may have on customers' assets. There was no relevant evidence found to support some claims made in consultation responses that CLASS is likely to have a significant detrimental impact on customers' asset health.

4.77. It should be noted that evaluating whether customers should pay more for voltage stability within the statutory limits may set unintentional precedents. For example, other providers of balancing services may also cause voltage variation within these boundaries on the distribution network, and this would necessitate conducting a willingness to pay for voltage stability study even in those circumstances. In light of this, Ofgem considers that it would not be proportionate to conduct a willingness to pay (WTP) for voltage stability study, as suggested by some stakeholders. We believe that such a study could generate hypothetical bias, where estimates of WTP are exaggerated by the hypothetical nature of the study, and the costs of undertaking it would not be proportionate in this case.

4.78. Moreover, it should also be mentioned that, in 2020, the UK government commissioned an independent panel of experts to conduct an Electricity Engineering Standards Review[50] which highlighted that there are many arguments in favour of reviewing the current statutory limits on voltage variations, as the benefits of allowing greater voltage variations might be greater than the costs.

4.79. Acknowledging that Scenario 2 and 3 of this IA involve a much wider deployment of CLASS, the materiality of any potential costs, even where very limited, should be considered alongside the potential benefits that CLASS technology may offer to consumers and the electricity system as quantified in Chapter 3.

[50] Electrical Engineering Standards Review (2020): Independent Panel Report

Impact on regulatory cost of capital

4.80. In response to the consultation of February 2020, some respondents argued that allowing DNOs to invest in CLASS might have an impact on Ofgem's determination of the cost of capital as part of the RIIO-ED2 price control. These stakeholders were concerned that a commercial venture like CLASS would be perceived as riskier than a DNO's core activities. Ultimately this could result in investors requiring a higher rate of return as compensation for this risk premium, which would feed through into a higher Weighted Average Cost of Capital (WACC). *Determination of regulatory WACC*

4.81. The regulatory WACC is a function of a regulated company's cost of debt, where the cost of debt is derived from the borrowing costs of other companies,[51] and the cost of equity,[52] which is based on the perceived risk of the company's investments relative to the market. It is possible that investments in CLASS could affect a DNO's actual cost of equity and therefore its overall WACC.

4.82. Ofgem will determine the allowed WACC before the start of RIIO-ED2. In March 2021, we published our decisions on the finance proposals in relation to RIIO-ED2 as an Annex to the RIIO-ED2 Methodology Decision Overview document.[53] This confirmed the following 3-step process for determining the cost of capital:

- First, we will calculate the company's estimated cost of debt. The cost of debt is an estimation of the return debt investors expect from an efficiently run company. We will calculate the cost of debt using a published benchmark index of bond yields.
- Second, we will calculate the company's estimated cost of equity. The cost of equity is an estimate on the return that equity investors expect. We will estimate the cost of equity using the Capital Asset Pricing Model (CAPM).[54] In addition, we will cross check the calculated cost of equity against other regulated companies with a similar credit rating. This allows for a broader set of information to inform

[51] The cost of debt is the effective interest rate that a company pays on its current debt. Ofgem calculates the cost of debt on a pre-tax basis with reference to a trailing average index of debt costs.
[52] The cost of equity is the rate of return on investment that is required by a company's shareholders. The return consists both of dividend and capital gains (ie increases in the share price). Ofgem calculates the cost of equity on a post-tax basis.
[53] Ofgem (2020). RIIO-ED2 Sector Specific Methodology Decision: Annex 3
[54] The CAPM is a formula widely used throughout finance which calculates the expected return of an asset given its risk.

the cost of equity estimate. We will also distinguish between allowed and expected returns on equity, which reflects our view that the cost of equity should not necessarily equal the baseline allowed return because investors can also expect outperformance from price control incentives.

- Finally, we will calculate the overall WACC by using a standard formula and applying weighting to the cost of debt and the cost of equity in line with assumptions on notional gearing for the company.

4.83. In the following paragraphs we assess the materiality of the risk raised by stakeholders by considering:

- the likelihood that allowing DNOs to provide CLASS under Option 1 (DSR8 or DSR9) could have an impact on the determination of the regulatory WACC and, therefore, increase DUoS charges in RIIO-ED2.
- the size and relative riskiness of investments in CLASS relative to the DNO's regulated asset value (RAV).[55] To do this, we engaged with ENWL to understand the costs associated with CLASS.

Impact on CLASS investments on WACC determination

4.84. We consider that investments in CLASS will have a negligible effect on the company's allowed and actual WACC. Further we do not expect to the impact to vary materially under either DRS8 or DRS9 funding of CLASS as a balancing service because the materiality of the investments under both options would remain comparable. We reach this conclusion for two principal reasons.

4.85. First, the approach Ofgem uses to derive a company's allowed WACC under the RIIO-ED2 price control limits the ability of investments in CLASS to influence the allowed return. Our methodology is predominately based on analysis of real-world market benchmarks, rather than actual DNO investments. For example, we calculate

[55] The Regulatory Asset Value (RAV) is the value ascribed by Ofgem to the capital employed in the licensee's regulated business (the 'regulated asset base'). The RAV is calculated by summing an estimate of the initial market value of each licensee's regulated asset base at privatisation and all subsequent allowed additions to it at historical cost, and deducting annual depreciation amounts calculated in accordance with established regulatory methods. These vary between classes of licensee. A deduction is also made in certain cases to reflect the value realised from the disposal of assets comprised in the regulatory asset base. The RAV is indexed to allow for the effects of inflation on the licensee's capital stock.

a company's cost of debt using a published benchmark index of bond yields and assume that a DNO can borrow at a rate consistent with the benchmark index. We also calculate a company's cost of equity using the CAPM framework, which is based on estimates of the risk-free rate, total market returns and an equity beta that represents the correlation between total market returns and those of a group of comparators, ie listed UK utility networks. This benchmarking approach means that any investments a DNO proposes to make in CLASS would not be expected to impact on its allowed WACC.

4.86. In any case, the size of CLASS investments are very small relative to a company's Regulated Asset Value (RAV) and would therefore not likely to influence a DNO's WACC in practice. To understand the magnitude of the investments in CLASS, we asked ENWL to summarise the costs that they have incurred for investing in this technology under RIIO-ED1. The figures from reporting under DRS8 show cumulative expenditure on CLASS (capex and opex) of £17.6m. However, these values contrast starkly with ENWL's overall RAV, which has averaged £1.6bn (2012/13 prices) in RIIO-ED1.[56]

4.87. These figures show that the size of CLASS investments is negligible compared to the investments made in a DNO's regulated distribution network activities. In short, investor's perception of risk will be dominated by the DNOs' investment in developing and operating the electricity distribution network as the costs associated with CLASS are immaterial when set against these. This conclusion would hold whether CLASS is funded through DRS8 or DRS9 as the materiality of the investments under both options would remain comparable. In a similar vein, the impact would be proportionate to the size of each company as, whilst a larger DNO may invest more in CLASS, its RAV would also be considerably higher.

4.88. For completeness, were CLASS to be remunerated through the price control, we also consider that there is little risk investors would require a noticeably higher cost of capital. In this case, CLASS would face little revenue risk and would be treated as equivalent to investments in any other distribution network activity.

[56] Ofgem (2021). RIIO-ED1 Annual Iteration Process 2021

Impact on investor confidence

4.89. In response to the consultation of February 2020, some respondents also raised concerns regarding the impact that the deployment of CLASS as a balancing service could have on the wider investment case for flexibility services. These concerns broadly fell into two themes:

- DNOs face a lower cost of capital in part due to reduced risk from a relatively guaranteed stream of revenues from their regulated distribution network activities. If DNOs have access to cheaper finance, it may incentivise them to make riskier investments in CLASS.
- Investor confidence in flexibility services could be undermined more generally by the perception that there is reduced opportunity to invest in balancing services due to more limited revenue streams. This could, in turn, impact on the wider electricity system which would lose out from a lower number of participants who can stack across markets.

4.90. In short, the concern is that the deployment of CLASS by DNOs could crowd out or otherwise deter investment by providers of other technologies and services that may be required to meet requirements under further energy scenarios. The risk premia associated with regulatory uncertainty and heightened revenue risk could feed through to a higher hurdle rate that means more marginal investment cases are not brought forward.

4.91. We recognise that a smart and flexible energy system is essential to hitting the UK's net zero climate goals, and that this will require new investment in flexibility services. In our 2022/23 Forward Work Programme Consultation,[57] we set out how the Smart Systems and Flexibility Plan (a joint initiative between BEIS and Ofgem) and our associated Full Chain Flexibility strategic change programme intend to:

- Remove barriers to flexibility on the grid for storage and interconnectors.
- Encourage the markets and signals needed to bring forward and reward flexibility.

[57] For more details, see Ofgem's 2022/23 Forward Work Programme Consultation

- Facilitate flexibility from consumers (including products, tariffs and how we regulate smart appliances load controllers).
- Introduce the data and digital architecture required to underpin planning and markets (including greater network visibility and monitoring, cyber and data privacy).

4.92. In addition to the above, we are taking steps in RIIO-ED2 under Electricity Distribution Standard Licence Condition 31E to encourage DNOs to take a coordinated approach with other parties to the procurement and use of flexibility services.[58] This should facilitate market liquidity and investment in flexibility.

4.93. We also note that a number of factors would tend to increase the investment case for providers of balancing services or otherwise limit any detrimental impact of the deployment of CLASS:

- The ESO's requirements may increase in the future due to, for example, changes in inertia levels on the system and increased loss sizes from larger interconnectors and generation sites. Broader changes to the energy landscape, such as greater reliance on variable sources and growth of domestic demand flexibility, may also prompt greater variation in pre-fault frequency imbalance.
- CLASS would be limited in its capacity and technical capabilities, such that there would still be a need in the market for a range of diverse balancing service providers. As an inframarginal technology, providers of CLASS may be less likely to determine the market clearing price under a pay-as-clear auction for different balancing service products. Instead, the price would likely reflect the short-run marginal cost of other technologies, such as a battery, and therefore still support their deployment in the market for balancing services.

4.94. To conclude, we recognise concerns that the deployment of CLASS as a balancing service could undermine investor confidence in flexibility services. However, we note that our minded-to position would be in effect a direction on the use of CLASS in RIIO-ED2 only, such that there would be scope to review the future regulatory treatment if some of these concerns were to materialise.

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[58] For more details, see Electricity Distribution Standard License Condition 31e Flexibility Procurement Statements

4.95. We also think that are these concerns are partly mitigated by our strategic focus on promoting Full Chain Flexibility, as well as the limitations around CLASS's impact on the market for balancing services. For example, there may also be some trade-off in the use of CLASS to manage whole system solutions and more local market ones. For example, some DNOs have considered the use of CLASS as a means to fulfil the ESO's requirements around reactive power, which have a strong locational element, and if CLASS were deployed for these purposes, it may not undermine any investment case for a technology that is targeted at national balancing services.

Potential for cross-subsidy through the price control

4.96. In response to the February 2020 consultation, some stakeholders argued that procuring CLASS might result in negative externalities as the private cost to a DNO of operating CLASS may be lower than the social cost of deploying the technology as a balancing service. This could take the form of a cross-subsidy, ie a DNO recovering costs associated with the commercial provision of CLASS through its allowed revenue under the RIIO-ED2 price control that is intended to cover only the costs of developing and operating the distribution network. In such circumstances, this could mean that the price at which DNOs offer CLASS as a commercial service (the private cost) does not represent its actual costs (the social cost).

4.97. To assess the likelihood and impact of this potential externality, we first consider the treatment of regulated costs in RIIO-ED2 to understand how CLASS and regulated revenues would be recovered by DNOs. We then look at the potential scale of the cross-subsidy risk to understand how material a misallocation of costs could be to the price setting process in the market for balancing services.

Treatment of regulated costs in RIIO-ED2

4.98. This risk we consider here is only relevant to the DRS8 and DRS9 regulatory options, ie where there is a commercial cost to CLASS that would not be recovered directly through the price control. It is important to note that RIIO-ED2 will encompass a "single till" approach, ie revenues and costs from a DNO's distribution network and commercial activities will be taken into account when setting allowed revenues. This means that the commercial deployment of CLASS as a balancing service still falls under regulatory controls.

4.99. Under DRS8, DNO's can earn net revenue from the delivery of CLASS. CLASS net revenue is the gross revenue earned by participating in balancing services market (ie what the ESO has paid to the DNO that year), less CLASS specific costs incurred or allocated in that year (such as bid team costs). This CLASS net revenue is then included in a DNO's actual totex. Where the DNO has earned a positive net revenue (ie profit), this is reported as a negative value such that the DNO's overall actual totex is lower. The inverse is true if a DNO incurs a negative net revenue (a loss) from CLASS under DRS8.

4.100. The difference between the DNO's actual totex and allowed totex is then shared with its customers based on a totex efficiency incentive rate. If a DNO has, for example, a totex efficiency incentive rate of 55%, then consumers would retain 45% of the profit or pay for 45% of the loss. Because DRS8 net revenues are included in the DNO's actual totex, it shares DRS8 net revenue at the same totex efficiency incentive rate as all other actual totex costs. In RIIO-ED1, forecast net revenues from both DRS8 and DRS9 services were also deducted from opening base revenues, reducing the costs paid by DUoS customers.

4.101. Ultimately the single till approach means that a company would have little incentive to misallocate costs associated with CLASS under DRS8:

- The totex efficiency incentive rate it faces is symmetrical and equalised across DRS8 and allowed revenue in the price control. In practice, this means that any additional profit gained through DRS8 (by under reporting the costs of CLASS) would be offset by losses from higher actual totex incurred in the price control (through the inclusion of CLASS related costs).
- A company that reports efficiently incurred CLASS costs as allowed revenue, rather than through DRS8, would also push up its ex-ante net revenue forecast for CLASS, but reduce its ex-ante opening base revenues. This could in practice expose a greater share of CLASS investments to revenue risk.

4.102. We also consider that a company would have little incentive to misallocate costs associated with CLASS under DRS9. In this scenario, prices would be set at a level that would allow DNOs to recover their reasonable costs and a reasonable margin for the provision of CLASS as a balancing service. Such a methodology for price setting would be comparable to how allowed revenue is determined in the price control and therefore DNOs would be unlikely to deliberately misallocate costs.

Scope for misallocation of CLASS costs

4.103. Whilst the incentive to misallocate the cost of CLASS related investment under the price control may be weak, it could still arise in practice if costs are difficult to disaggregate. This is likely to be the case as some CLASS related costs may be genuinely difficult to separate out from other distribution network activities. These include:

- Maintenance and asset replacement costs: where the useful life of transformer assets reduce, the maintenance and replacement costs of these assets increase. It may be difficult to identify maintenance and asset replacement costs that are CLASS-related vs routine network management related.
- Staff costs: Some staff costs, such as those related to senior managers, may be difficult to separate between network and CLASS-related costs as senior managers will share their time between the two activities. Some costs attributable for CLASS will be easily identifiable, for example the cost of a bid team that solely works on CLASS. Other costs might be more difficult to separate out and, either intentionally or unintentionally, be reported as regulated distribution network activity costs. These could include costs of staff who work on both CLASS and regulated activities.

4.104. Earlier in this section, we undertook a detailed assessment of the possible maintenance and asset replacement costs associated with CLASS. From this assessment, Ofgem considers that CLASS, as currently deployed by ENWL, is likely to have minimal to no impact on the health of network assets. It follows that the risk of cross-subsidisation of these costs would also be remote.

4.105. We sought information from ENWL to help us understand the scale of CLASS staff costs that would be difficult to separate from regulated activity staff costs. In their response they explained that:

- The team responsible for CLASS are separate to the rest of the business and as such their costs are clearly identifiable and reported.
- One senior manager spends a significant amount of time on CLASS and, as such, 60% of that senior manager’s costs are apportioned to CLASS.

- Other senior staff are involved in general management oversight of CLASS, in particular the bidding strategy. This involves only a small amount of input and therefore no costs are allocated to CLASS for DRS8 reporting.

4.106. We consider that staff costs that are related to CLASS are already reported under DRS8 as part of RIIO-ED1. To the extent that some staff costs are difficult to apportion to CLASS, they are also likely to be immaterial.

Conclusion on cross-subsidisation

4.107. The incentive and magnitude associated with cross subsidisation is likely to be very low. For DRS8, we do not consider there to be a within period risk of cross-subsidisation as the single till approach means the costs of CLASS and totex allowances are treated equally. With DRS9 there could be scope for DNOs to cross-subsidise CLASS costs with actual totex allowances. However, if a company decided to misreport its DRS9 costs as allowed totex under the price control, this would lead us to set its regulated DRS9 balancing service price at a lower level, as the DNO would have lower costs to recover. Hence it would serve to undermine any incentive to cross-subsidise.

4.108. Price control determinations for allowed revenue could still be affected by misreported CLASS costs. However, it would be hard to separate all costs that may not be reported under DRS8 even if they are a consequence of CLASS. However, we expect the scale of these costs to be low, and effects on price control settlement to be further limited by a cost assessment approach which benchmarks efficient costs across DNOs.

Impact on settlement distortions

4.109. The use of CLASS may distort settlement calculations for market participants that utilise the relevant network underneath a CLASS-enabled substation. Specifically, suppliers may appear to over (or under) procure energy when the activation of CLASS serves to reduce (or increase) customer demand. As a consequence, energy would need to be transferred from the settlement periods where suppliers had originally procured it to settlement periods where customers are now consuming additional energy. Ultimately this could expose suppliers to financial risk as they would need to pay the difference in the imbalance price between the two settlement periods.

4.110. In practice, ENWL has tended to deploy CLASS to fulfil the requirements of balancing services such that there is a reduction in customer demand. If there is a rebound effect, such that "missing" consumption from a CLASS activation is shifted within the same settlement period then the overall effect on suppliers would be more muted. However, if any rebound occurs in an adjacent settlement period the effect on suppliers could be higher or lower as it will depend on the prevailing prices at the time. We also note that CLASS activations, rather than shifting energy consumption, may act to reduce it instead such that suppliers appear to more systematically over-procure energy.[59]

4.111. We consider that supplier settlement distortions could occur anytime CLASS is deployed, and as such our analysis in this section does not depend on the regulatory option that may be used to remunerate DNOs for deploying CLASS as a balancing service.

Analysis of impact of CLASS on settlement calculations

4.112. We worked with Elexon, the Code Manager for the Balancing and Settlement Code (BSC), to understand the scale of distortion associated with historical CLASS activations. The approach was as follows:

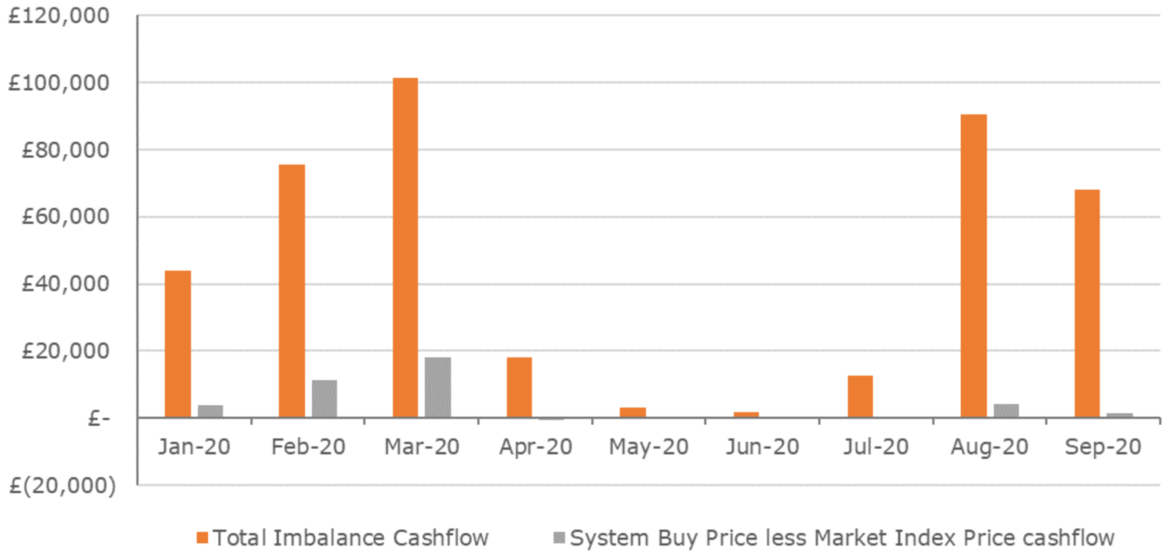
- First, we estimated the total imbalance volume (MWh) resulting from the activation of CLASS over settlement periods from January to September 2020. This was based on CLASS activations data as provided by ENWL.
- Second, we calculated the total imbalance cashflow (£) as the product of the imbalance volume (MWh) and the system buy price (£/MWh) in the given settlement period. This represents the payment that would be made to supplier in response to CLASS activations, the money for which would have come from the market through the Residual Cashflow Reallocation Cashflow (RCRC).[60]

[59] This will depend on appliances as, for example, energy consumption from light bulbs may not be expected to increase post a CLASS activation at a level that offsets the prior reduction in energy usage.
[60] The RCRC is levied on all energy market participants in line with their proportion of credited energy in the settlement period. For further information see: Elexon (2018). Residual Cashflow Reallocation

- Finally, we estimated the net impact (£) on suppliers as the product of the imbalance volume (MWh) and the difference between the system buy price and the market index price (£/MWh) in the given settlement period.[61] This provides an indication on whether the imbalance cashflow compensated for the cost of energy.

4.113. The below figure summarises the results of the analysis. It should be noted that, from April through to July 2020, electricity demand was impacted by COVID-19 restrictions. This may have had some impact on the need for CLASS activations if, for example, lower demand led to reduced inertia system or an impact on CLASS capacity which is itself a function of demand.

Figure 7 Cashflow resulting from CLASS activations



4.114. Over the 9-month period, CLASS activations would have resulted in £415,043 of imbalance payments being made to the affected suppliers. This is a relatively modest amount, by way of context the absolute sum of the Energy Imbalance Cashflow in 2018/19 was £1.4bn.[62] CLASS activations, on a pro rata basis, would account for < 0.01% of the total energy imbalance cashflow. The analysis also suggests that the

[61] The market index price is a proxy for the near real time price of energy on power exchanges. This may or may not be representative of the price the supplier paid for the energy, which will depend on the hedging strategy that was employed.
[62] Elexon (2019). Imbalance Charging, where does the money go?

differences between the system buy price and the market index price would have yielded a small net benefit to suppliers of £38,626.

4.115. Over the same period, CLASS activations (MWh) accounted for ~ 0.08% of the counterfactual Grid Supply Point[63] (GSP) take, ie the reported GSP take plus the additional volume of demand that would have arisen in the absence of CLASS activations. This compares with the average Grid Supply Point Group Correction Factor[64] of ~ 2.7% over the same period. Set against these other adjustments that are used to determine imbalances, the impact of CLASS also appears to be relatively modest.

4.116. The impact on settlement distortions may increase if CLASS were deployed by more DNOs. However, it seems reasonable to assume that the impact would be linear with respect to overall capacity. Hence even the near 10-fold increase in CLASS capacity that might occur under deployment scenario C would still result in only a modest impact on settlement distortions.

Conclusion

4.117. In short, our analysis indicates that the aggregate impact of CLASS on settlement cashflows is limited. As such it would not seem proportionate for Elexon to work with industry to develop a solution to adjusting Supplier imbalance positions via the Modification process at this stage.

Implications for security of supply

4.118. In the 2020 consultation on CLASS, stakeholders responded with concerns about the further deployment of CLASS with respect to maintaining the reliable operation of the system and security of supply. Those who raised these concerns included 3 suppliers, 3 third parties, 2 trade associations, 2 aggregators, a generator, and a renewable trade association. The concerns can be summarised into three points:

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[63] This is the point at which the Distribution and Transmission Networks intersect, and where Metering Systems measure how much electricity is imported to and exported from the Distribution Network.
[64] These are a series of mathematical adjustments made to the calculation of the total energy allocated to suppliers in each settlement period in each GSP Group, to ensure that it matches the energy entering the GSP Groups from the transmission system, adjoining GSP Groups and through embedded generation.

- Uptake of CLASS by the ESO may lead to over-reliance of a single technology platform: Stakeholders had concerns that if CLASS technology was able to obtain a significant share of supply for multiple services, then other providers and investors may lose market confidence, which will in turn reduce market liquidity and limit the amount of providers the ESO can choose from to meet balancing service needs.
- DNOs may not be able to perform their Operational Code 6.5 and 6.6[65] requirements when operating CLASS: Stakeholders had concerns that if CLASS was being utilised for balancing services, then its ability to alter voltage in response to local network voltage issues or meet its Grid Code obligations of Operational Code 6 would be diminished.
- Network assets used for CLASS including transformer components will be degraded at an increased rate: Increased utilisation of transformer components may lead to faults or disruptions if not replaced earlier. This section will not directly address this point. Please refer to Chapter 4 on asset health for a detailed evaluation of this concern.

4.119. We have considered these concerns for this impact assessment and the following section will address each point in turn.

Single Technology Platform Risks

4.120. The ESO has made it clear in discussions with Ofgem that relying on a single technology platform for a service could be considered a risk to reliable operation of the system and security of supply. The balancing services market benefits from having a diversity of technologies with differing characteristics, allowing the ESO to have access to an array of tools for balancing the system under different scenarios. Should one technology fail or become unsuitable for a particular service, having ready access to this wider selection of technologies and providers plays a vital role in ensuring continuous reliable operation of a service.

[65] Through OC6.5 the ESO issues instructions to DNOs to deliver demand reduction where it anticipates insufficient supply. OC6.6 sets out the procedures of an LFDD event, which aims to limit consequences of a major generation loss event. The DNOs can achieve this in two ways, by either disconnecting customers and reducing voltage, or just disconnecting customers alone. However, for OC6.6 there is no requirement or option for DNOs to provide demand reduction with voltage reduction in this event, instead relays are set to automatically disconnect customers in defined blocks.

4.121. 2 third parties, 2 trade associations, an aggregator and a supplier in their response to Ofgem's 2020 consultation on the regulatory treatment of CLASS specifically articulated a concern that a broader deployment of CLASS could lead to future system reliability issues due to decreased diversification of supply. The concern is that if CLASS as a technology could obtain a significant share of supply of a particular procured balancing service and investor confidence of other providers declined, this would lead to reduced diversity of service providers and market liquidity, which would place an overreliance on a single technology platform and could cause future system reliability issues.

4.122. Evaluating how diverse a selection of suppliers and technologies should be for a particular service is part of a broader objective undertaken by the ESO to ensure security of supply. However, there are no specific metrics or thresholds in place for this evaluation for all services. It is in accordance with the ESO's reasonable opinion to accept and reject bids based on a criterion of costs, efficiency and security in the short-term, while also balancing this with broader decisions on the design of services' procurement guidelines and requirements.

4.123. The ESO's regulatory framework for ensuring security of supply is composed of its license, role guidance[66] and the Grid Code,[67] alongside its commitments to other requirements and guidance outlined in the Security and Quality of Supply Standard (SQSS),[68] Frequency Risk and Control Reports (FRCR)[69] and its Procurement Guidelines for each service it operates.[70] These documents provide clear criteria by which the ESO balances cost and risk to ensure the end consumer receives efficient security of supply.

4.124. The ESO enjoys a breadth of decision-making power through its license to ensure security of supply and the reliability of the system. Its decisions are guided by Ofgem's role guidance for the ESO which aim to incentivise outcomes from three core roles: control centre operations, market development and transactions, and system insight, planning and network development. The ESO is incentivised to perform these roles as part of the Electricity System Operator Reporting Incentives arrangement (ESORI),

66 Ofgem (2021). Decisions on the ESO guidance documents for 2021-23
67 National Grid ESO (2022). Grid Code (GC)
68 For more information, see: Security and Quality of Supply Standard (SQSS)
69 National Grid ESO (2021). Frequency Risk and Control Report (FRCR)
70 National Grid ESO (2019). Procurement Guidelines

which has the effect of rewarding or penalising the ESO for how it has performed these roles. These incentives include:

- An ex-ante benchmark for balancing service costs by which future costs are compared, incentivising reduced costs below the benchmark.
- A requirement to report frequency or voltage excursions, incentivising reliable operation of the system and security of supply).
- A principle to ensure the rules and processes for procuring balancing services maximise competition where possible and are simple, fair and transparent.
- A principle for promoting competition in wholesale and capacity markets.

4.125. These incentives are interrelated and often require the ESO to exercise discretion in ensuring balance across its various priorities. For example, under its incentive to lower balancing costs, it may be an attractive prospect for the ESO to utilise a likely cheaper technology such as CLASS and fulfil all its requirements for a service. However, the ESO may determine that this would conflict with the need for the ESO to promote and maximise competition. Additionally, the ESO could determine that there are increased risks in relying upon a single provider or technology platform, which would conflict with the ESO's commitment to maintaining reliable operation of the system and security of supply.

4.126. Should the ESO determine that a single technology platform has or will achieve a significant share of the market that poses risks to the security of supply, it has the ability to reject bids from this technology and alter a service's procurement guidelines or requirements, irrespective of short-term costs or efficiency.

4.127. Ofgem has provided clear incentives through the ESO's role guidance to maintain diversified and competitive markets and is confident that the ESO is capable of assessing the cost and risk of CLASS's utilisation, as with any technology, to ensure the reliable operation of the system and that end consumers receive efficient security of supply. To be clear, the ESO has not commented that it views CLASS poses a risk as being a technology in the balancing services market.

CLASS and Operational Code 6 requirements

4.128. Operating Code No.6 (OC6) refers to a procedure that permits the reduction of demand in the event of insufficient active power generation being available to meet demand, or in the event of breakdown or operating problems (such as in respect of System Frequency, System voltage levels or System thermal overloads) on any part of the National Electricity Transmission System. The ESO instructs DNOs for the procedure to occur.[71]

4.129. There are two aspects of the Grid Code OC6 that are considered in this section, OC6.5 which is a demand control instructed by the ESO and OC6.6, an automatic Low Frequency Demand Disconnection (LFDD):

4.130. Through OC6.5 the ESO issues instructions to DNOs to deliver demand reduction where it anticipates insufficient supply. The ESO may instruct the DNOs to achieve this in three ways: (1) voltage reduction, (2) voltage and demand disconnection or (3) demand disconnection alone.

4.131. OC6.6 sets out the procedures of an LFDD event, which aims to limit consequences of a major generation loss event. Unlike OC6.5, this is an automatic, unplanned event. There is no requirement or option for DNOs to provide demand reduction with voltage reduction in this event, instead relays are set to automatically disconnect customers in defined blocks. The last LFDD event was triggered on 9 August 2019, and before that, May 2008.

4.132. Stakeholders have raised concerns that CLASS, as used commercially, could compromise the DNOs ability to respond to these instructions or to an LFDD event. In contrast, the ESO's response to the 2020 consultation did not raise this same concern and they stated their openness to further engaging with ENWL on CLASS technology to provide further confidence that CLASS would not have an impact on the reliability of system operation.

[71] National Grid ESO (2022). Grid Code Operational Code no. 6

4.133. Nevertheless, in this section we consider two possible impacts cited by stakeholders: CLASS's effects on instructed voltage reduction and CLASS's effects on demand disconnection.

4.134. The considerations with respect to voltage reduction are as follows:

- DNOs are not required to use voltage reduction as a mechanism to reduce demand in either OC6.5 (where DNOs have the option, but not obligation, to use a combination of voltage reduction and demand disconnection) or OC6.6. Therefore, a DNO participating in CLASS could deliver demand reduction entirely through demand disconnection.
- Where a DNO provides voltage reduction as part of OC6.5 and there is co-location of that instructed voltage reduction service and commercial operation of CLASS, DNOs should deliver voltage reductions beyond what has been delivered by CLASS to achieve the required level of demand reduction. In the case of instructions, the statutory voltage boundaries do not apply during an emergency event, so DNOs are not limited in reducing voltage further to deliver required demand reduction. Where DNOs are providing OC6.5 demand control via voltage reduction and demand disconnect, they must take into account any voltage reductions undertaken as part of a CLASS system so that the required level of demand reduction is delivered without disconnecting customers if required.
- The DNO could choose to carry out CLASS in different parts of the network to where it delivers voltage reduction as a part of an OC6.5 instruction. However, there is no obligation for DNOs to not co-locate CLASS and instructed voltage reduction service facilities.

4.135. The considerations with respect to demand disconnection are as follows:

- When CLASS is activated to lower voltage, then the demand reduction provided per disconnected customer will be smaller. Therefore, either more customers will be disconnected to provide the same level of response, or the same number of customers will be disconnected but with a smaller demand reduction. DNOs should take into account effects of CLASS on demand disconnection, and therefore should disconnect more customers (as far as is necessary to achieve required demand reduction) in an emergency event.

- The DNO could carry out CLASS in different parts of the network to where it delivers demand disconnection as either an instructed service or in an LFDD event. However, there is no obligation for DNOs to not co-locate CLASS and LFDD relays (or relays to disconnect customers in instructed event, and no evidence that ENWL have deployed CLASS in such a way).

4.136. In summary, CLASS does not prevent or reduce the ability for the DNO to effectively meet its obligations as set out under OC6. For this reason, we do not consider that the relationship between CLASS as a balancing service and OC6 provides a rationale to prohibit CLASS. CLASS could however affect the actions the DNO has to take to meet its OC6 obligations, so it is the DNOs responsibility to ensure that CLASS-OC6 interactions are taken into account. We do note that there may be a use-case for CLASS as part of an OC6 response, which could work to in fact reduce the number of customers disconnected in an LFDD event, which is explored further in Chapter 5.

5. Hard to monetise benefits

Chapter summary

In this chapter, we consider benefits that are hard to monetise and whether they could alter the findings of the CBA with respect to preferred regulatory option for the treatment of CLASS as a balancing service in RIIO-ED2. We conclude that:

- There may be scope to use CLASS to support the deferral or avoidance of network reinforcement, although to date no DNO appears to have considered in detail how the implementation of CLASS could help to realise such benefits.
- We recognise that an alternative use case for CLASS could be a reduced need for automated disconnection as part of DNO's OC6 obligations. However, we explain that these benefits do not fit into the framework of our Impact Assessment (which considers the treatment of CLASS as a balancing service) and the utilisation of CLASS as part of an emergency low-frequency response scheme would require an additional assessment.

5.1. In this chapter, we consider hard to monetise benefits that are relevant to our overall Impact Assessment of CLASS. In theory, these are benefits that could be quantified as part of a CBA, but we did not include them in Chapter 3. The reasons for this are that they are benefits that flow from alternative use cases for CLASS and, as such, are not directly relevant to a framework where we consider a counterfactual in which CLASS is prohibited in its use as a balancing service.

Impact on network reinforcement

5.2. Deferral or avoidance of network reinforcement is expected to play a significant role in the transition to a net zero energy system. Ofgem previously commissioned Imperial College and Carbon Trust to model the potential cost savings that could be achieved through deferred and avoided network reinforcement, which identified potential savings of up to £4-15bn cumulatively to 2050. A considerable proportion of these permanently or temporarily avoided network investment costs are expected to arise out of new flexibility opportunities.

5.3. ENWL's historic focus of CLASS is on its role in the balancing services market and to date activations have been solely utilised to offer reserve or frequency response services. However, CLASS could also offer a temporary alternative to reinforcement across distribution networks by managing voltage to reduce peak consumption.

5.4. Having the option to defer investments into network reinforcement through utilisation of CLASS may reduce costs for consumers. These will likely only be temporary delays to reinforcement and would still likely need to be addressed in the long term. The opportunity and extent of deferrals to reinforcement will vary greatly depending on the deployment of CLASS and the current state of any given network. This makes it difficult to estimate the exact benefit that could be passed to consumers. Additionally, a DNO may also reserve CLASS capacity for both participation in the balancing services market and deferring network reinforcement, something they could increase and decrease at any given time, which would further complicate estimations for what could be the optimal utilisation of CLASS for solely deferral purposes.

5.5. To date, no DNO has presented an intention to utilise CLASS for deferring investment into network reinforcements. It is unclear whether DNO's may have intention to deploy CLASS for these purposes in the future. We note that there are other voltage control management technologies that share the same principles with CLASS such as Conservation Voltage Reduction (CVR) that are being explored and trialled by DNOs, with benefits of the technologies being accrued through reductions to customer bills, reducing emissions and deferring reinforcement costs.

Support for Operational Code 6

5.6. Currently, DNOs deploy a range of technologies to manage system frequency during losses of generation in line with their obligations under Operation Code (OC6). As part of the OC6 buffer, DNOs can utilise automated load disconnection in the event of low frequency events, thus reducing the requirement for the ESO to contract more frequency response. In response to the 2020 CLASS consultation, stakeholders including the ESO, commented that CLASS could be deployed to reduce the need for automated disconnection as part of their OC6 obligations.

5.7. The most recent event where CLASS could support the current OC6 requirement is cited as 9 August 2019, where the combined loss of two large generators, as well as the loss of smaller generators, triggered disconnections, loss of power and disruption to customers. During this event, 892MW of net demand was disconnected, representing approximately 4% of national demand and affecting 1.15 million customers[72]. The value of CLASS being utilised for reducing load disconnections materialises through a decrease in the volume of lost load. In response to this event, Ofgem stated that a better response and reserve delivery would not have alone been sufficient to prevent demand from being disconnected for this event, however, at that time CLASS had not reached a deployment level sufficient to be considered for these purposes.

5.8. Stakeholders have proposed that CLASS should be considered as a new response option that would fall between existing secondary response and the automatic low frequency demand disconnection scheme (ie 49.2 - 48.8 Hz). At present there is no service in this region and when response is exhausted (or frequency falls too fast) LFDD is activated at 48.8Hz. The potential dynamic response of CLASS could be operationally attractive, allowing the ESO to scale the response magnitude as required by system conditions.

5.9. ENWL registered an NIA project titled "Enhanced LFDD" which aims to test the capability of SuperTAPP SG relays, currently the relay in use for CLASS activations, for responding to LFDD events. ENWL state that the increase in distributed generation on the network means that traditional block shedding in response to frequency events is no longer appropriate. When shedding large blocks of demand, the potential loss of embedded generation connected to the network can result in insufficient load being shed, including the possibility of disconnecting sites that could be net exporters.

5.10. To provide an indicative understanding of the quantifiable benefits that could be realised by CLASS preventing lost load during an LFDD event, we can calculate the Value of Lost Load (VoLL) of the 9 August 2019 outage as an example. For this example, we have used the VOLL that was assumed for RIIO-ED1, uprated to £22,000 per MWh in 2020/2021 prices as to be consistent with the values used in

[72] Ofgem (2019). Investigation into 9 August 2019 power outage

the Chapter 3 of this IA.[73] Assuming that the 9 August outage lasted approximately 40 minutes, where 931 MW were disconnected at the peak giving approximately 620 MWh of energy lost.[74] This can be multiplied by the VoLL to provide an approximate figure for the costs of lost load during the 9 August outage of ~ £13.5 million. A future study could be conducted to understand the optimal requirement of CLASS capacity to be held in reserve for such an event and assess the statistical probability of such an event occurring, alongside other quantifiable and qualitative benefits of avoiding disconnections to evaluate the merits of utilising CLASS for this purpose.

5.11. While recognising the possibility of using CLASS for these purposes, this impact assessment is primarily focused on CLASS's role in the balancing services market. To fully evaluate whether CLASS should be utilised as part of an emergency low-frequency response scheme would require an additional assessment that explores the full range of options and other initiatives that are available to address or reduce the risk of LFDD events, such as the Energy Networks Association's WS1B P6 Operational Distributed Energy Resources (DER) Visibility and Monitoring.[75]

[73] Ofgem (2020.) RIIO-ED2 Sector Methodology Consultation: Annex 1 - Delivering value for money services for consumers
[74] Bialek, Janusz (2020). "What does the power outage on 9 August 2019 tell us about GB power system."
[75] Energy Networks Association (2021). WS1B P6 Operational Distributed Energy Resources (DER) Visibility and Monitoring

6. Competition Impacts

Chapter summary

In this chapter, we assess whether the deployment of CLASS in the market for balancing services could be expected to result in a substantial lessening of competition. We find that:

- Providers of CLASS operate in the market for balancing services and are subject to strong competitive constraints. In practice, the technical limitations of CLASS mean that ENWL has only competed historically in a select few balancing services
- ENWL has offered CLASS to date in response and reserve services. There is no evidence that it has secured significant market power, but rather its participation has contributed to positive outcomes for consumers through greater competition and lower prices. Our prospective analysis also shows that any given DNO could not be expected to secure a dominant position in the market
- The ability and incentive of a DNO, or group of DNOs, to discriminate against potential rivals in the market for balancing services would be severely limited by, amongst other things, the licence conditions and financial incentives in the RIIO-ED2 price control. In addition, Ofgem has enforcement powers if licensees are alleged of anti-competitive agreements or abuses of a dominant position.

6.1. Ofgem's principal objective is to protect the interests of consumers, wherever appropriate by promoting effective competition. As part of this Impact Assessment, we consider whether the options under consideration for the regulatory treatment of CLASS would contribute to effective competition.

6.2. This section is structured as follows:

- First, we consider the relevant market in which CLASS operates with reference to its technical capabilities.
- Second, we review the market structure and outcomes to assess whether any given provider of CLASS could establish significant market power either now or in the future.

- Finally, we examine several theories of harm to understand whether a provider or group of providers of CLASS, may be expected to harm the competitive process in the market for balancing services.

Relevant market for CLASS

6.3. The purpose of defining a relevant market, in both its product and geographic dimension, is to identify the competitors to providers of CLASS who could constrain DNOs from lessening their product offering (eg by raising prices above the competitive level). This, in turn, allows for the calculation of shares of supply that can provide a meaningful indication of market power for the purposes of assessing the likelihood of a DNO achieving a position of dominance.

6.4. However, obtaining a large share of a particular service or group of services is not alone a competition concern, rather we need to consider the ability to abuse any dominance and the likelihood of this eventuality. The process of defining the relevant market often employs a conceptual framework known as the hypothetical monopolist test.[76] This test seeks to identify the narrowest relevant market in which a hypothetical monopolist could profitably impose a small but significant, non-transitory increase in prices (SSNIP) above the competitive level.

6.5. In 2016, Ofgem published its Direction for the regulatory treatment of distribution network voltage control services and defined the scope for system balancing services as being limited to those that are commissioned and paid for by ESO for the purposes of system operator residual balancing activity.[77] This was consistent with previous cases that have defined the market as the provision of balancing power and auxiliary services.[78]

6.6. In practice, ENWL has offered CLASS in only a select few balancing service categories in Great Britain (GB). In this section, we consider whether the relevant market for CLASS could be more narrowly defined or even consist of a number of

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[76] OECD (2012). Market Definition, page 11
[77] This was without prejudice to any future representation by licensees that additional system balancing services should be included in category DRS8, and was without prejudice to any associated direction by the Gas and Electricity Markets Authority.
[78] Regulation (EC) No 139/2004 MERGER PROCEDURE Article 6(1)(b) NON-OPPOSITION (2010) at para 21. Also: Regulation (EEC) No 4064/89 MERGER PROCEDURE

distinct relevant markets. We note, in line with CMA guidance, that we do not need to reach a precise market definition and this discussion is intended to inform our competition assessment of CLASS only.[79]

Background to the electricity system operator and the market for balancing services

6.7. The ESO is the electricity system operator for GB. Through its regulatory framework, it has a number of defined roles that include balancing electricity supply and demand in real time and maintaining system frequency and voltage within statutory limits.[80] The ESO's incentive framework encourages it to deliver value for money for energy consumers across GB and includes, for example, an evaluation of its outturn performance against an ex-ante balancing costs (£m) benchmark.[81]

6.8. As the single buyer of balancing services, the ESO has monopsony power insofar as it would have scope to reduce the price paid below competitive levels by withholding demand,[82] but this potential buyer power is tempered by the obligations it faces to procure services in line with the requirements of the system that mean the overall, demand is in practice inelastic with respect to price. It should also be noted that, in procuring balancing services, the ESO is technology neutral.[83]

6.9. The ESO outlined, in its System Need and Product Strategy, that there were more than 20 balancing services that providers could choose from, each with different technical requirements and routes to market.[84] More recently, the ESO has focused on standardising market arrangements, rationalising the volume of services and simplifying processes and contracts. This is intended to facilitate market participation, secure access to fast and flexible sources to balance the system, react

[79] See page 4 of CMA (2015). Competition Impact Assessment Guidelines, stating it is not necessary to have a formal market definition.
[80] Ofgem (2021). ESO Role Guidance
[81] Ofgem (2021). RIIO-2 Final Determinations – Electricity System Operator
[82] OECD (2008). Policy roundtable: monopsony and buyer power
[83] The ESO undertakes its role of residual balancer in accordance with its licence obligation that it shall not discriminate in its procurement and use of balancing services after having taken into account relevant price and technical differences. See Condition C16 Procurement and use of balancing services paragraph 2.
[84] National Grid ESO (2017). System Needs and Product Strategy. See page 29

to rapid shifts causing imbalance and to ensure capability to fulfil the Security and Quality of Supply Standard (SQSS).

6.10. Notwithstanding the transformation that is underway in the balancing services market, we consider the following broad categories of balancing services which could be a relevant market(s) for providers of CLASS:

- **Reserve services:** Firm Fast Reserve (FR), Optional FR, Short Term Operating Reserve (STOR), and Reformed Reserve services.
- **Response services:** Firm Frequency Response (FFR) (Dynamic and Non-dynamic), Dynamic Containment (DC), Dynamic Moderation (DM), and Dynamic Regulation (DR).
- **Reactive power services:** Obligatory Reactive Power Services (ORPS), Enhanced Reactive Power Services (ERPS), and reformed Reactive Power services.
- **Stability services**: Inertia, Dynamic Voltage Support, and Short Circuit Level.
- **System security services:** including SO to SO trades.
- **Other services:** including restoration services, such as black start.

6.11. Broadly speaking, the ESO procures balancing services via two routes: on an ex-ante basis through bilateral agreements and competitive tendering, or in real time through the Balancing Mechanism (BM). Within these routes, different balancing services may have their own distinct procurement processes, timelines and payment methods. It should be noted that DNOs are not signatories to the Balancing and Settlement Code and, as it stands, would not be able to offer CLASS in the BM.[85]

Technical capabilities of CLASS

6.12. An activation of CLASS reduces the voltage set-point at a primary substation. A 1% voltage reduction corresponds to roughly a 1.3% decrease in power consumption.[86]

[85] Balancing Mechanism parties are responsible for the import or export of energy, and on that basis can participate in the Balancing Mechanism. Unbundling rules set out in art. 35 of the Directive (EU) 2019/944, prevent a DNO from having an energy account, as generation and supply assets need to be separate from network owners. Therefore, DNOs are not allowed to provide real time services in the Balancing Mechanism.

[86] These figures are based on averages recorded by ENWL in their operation of CLASS, and considers CLASS activations at primary substations that are distributing to mainly domestic consumers.

Recall that while the impact on power consumption associated with controlled voltage changes at a single primary substation is relatively small, multiple CLASS-enabled primary substations can be activated simultaneously and provide aggregated ability to change power consumption that can then be supplied to the ESO to support the balancing of the wider transmission system. The fast response time is in line with the ESO's technical requirements for a range of balancing services.

6.13. To date, ENWL has used this functionality to offer reserve (Firm FR and Optional FR) and response (Static Secondary FFR) services to the ESO. While CLASS is primarily designed to activate rapidly and hold the adjusted voltage level for a short duration (approximately 30 minutes), it is possible for different groupings of primary substations to be activated sequentially, providing an extended duration of delivery.[87] Additionally, CLASS can be configured to set tap positions on each transformer at different positions, rather than in parallel, creating a circulation of reactive power between transformers. This operation, known as 'tap staggering', allows for CLASS to offer reactive power services to the ESO (although we note that ENWL has not bid into these markets to date).

6.14. However, we recognise that some of the ESO's balancing services cannot be satisfied by the CLASS technology. For example, black start requires energy generation without external transmission system input, which is not within the technical capabilities of CLASS. Below we summarise whether CLASS has the technical capabilities of meeting balancing services that are expected to form part of the ESO's requirements over the course of RIIO-ED1 and RIIO-ED2. This has been informed by discussions with ENWL and the ESO. This helps to inform our understanding of the product market for CLASS, which we turn to next.

[87] For example, 4 groups of primary substations with 100MW of capacity each, could be activated sequentially for 30 minutes at a time in order to provide a 2-hour response duration for 100MW.

Table 6 ESO Balancing Services in RIIO-ED1 and RIIO-ED2

Service		CLASS eligibility	CLASS participated	RIIO-ED1	RIIO-ED2
Response Services					
Fast Reserve (FR)	Firm FR	Meets requirements	Yes	Ceased operating 2020	No
	Optional FR	Meets requirements	Yes	Yes	Yes
Demand Turn Up		Meets requirements	No	Yes	No
Super SEL		Not eligible	No	Yes	Yes
Short Term Operating Reserve (STOR)		Meets requirements	No	Yes	Yes (reformed)
Negative Slow Reserve		Expected to meet requirements	No	No	Yes
Reform Reserve	Quick Reserve	Expected to meet requirements	No	No	Yes
	Slow Reserve	Expected to meet requirements	No	No	Yes
Response Services					
Fast Frequency Response (FFR) - non-dynamic		Meets requirements	Yes (secondary FFR only)	Yes	Yes
Fast Frequency Response (FFR) - dynamic		Meets requirements	No	Yes	No
Weekly Auction trials		Meets requirements	No	Trialled between 2019 and 2020	No
Dynamic Containment (DC)		Meets requirements	No	Began operating Oct 2020	Yes
Dynamic Moderation (DM)		Meets requirements	No	No	Expected 2022
Dynamic Regulation (DR)		Meets requirements	No	No	Expected 2022
Reactive Power Services					
Obligatory RPS		Meets requirements	No	Yes	Yes
Reformed Reactive Power services		Expected to meet requirements	No	No	Expected 2025

Note: The final two columns, labelled 'RIIO-ED1' and 'RIIO-ED2' are to distinguish the time period in which the services were available or are expected to be available.

Product market

6.15. The relevant product market comprises all those balancing services which are regarded as interchangeable or substitutable by the ESO with regard to their characteristics, prices and intended use.[88]

Demand-side substitution

6.16. Demand side substitution refers to a situation where, following a SSNIP, the ESO would be able to switch away from the services of a hypothetical monopolist provider of given balancing service, such as FFR, to make such a SSNIP unprofitable. If these conditions hold, then the ESO would be able to source close substitutes that would negate the pricing power of a hypothetical monopolist. This is one of the main competitive constraints that firms face in the market for balancing services.

6.17. As noted in the previous discussion, the ESO procures balancing services across broad categories that include reserve, response and reactive power. Within these categories, the ESO specifies technical requirements for individual services (such as response time) as well as the capacity it intends to tender for in a given timeframe (eg MW per year). CLASS has historically been offered in response and reserve services, and the below table summarises the requirements for various existing and new services under this category.

[88] Official Journal of the European Communities (1997). COMMISSION NOTICE on the definition of relevant market for the purposes of Community competition law

Table 7 Response services technical requirements

Response service	Description	Response time, duration
Non-dynamic Secondary FFR	Increase output for frequency restoration	30 seconds, hold for 30 minutes
Dynamic Primary FFR	Increase output for frequency containment	10 seconds, hold for 20 seconds
Dynamic Secondary FFR	Increase output for frequency restoration	30 seconds, hold for 30 minutes
Dynamic High FFR	Decrease output for frequency containment	10 seconds, hold indefinitely
Dynamic Containment (DC)	Fast-acting frequency response designed to operate post-fault	Full delivery: 1 second (but no faster than 0.5 seconds)
Dynamic Moderation (DM)	Rapid response to maintain frequency within operation limits	0.5 seconds, continuous (30 mins for energy limited assets)
Dynamic Regulation (DR)	Pre-fault service to slowly correct continuous small deviations in frequency	2 seconds, continuous

Source: National Grid ESO. Frequency response services

6.18. We consider that there is a high degree of demand side substitution within categories like response services. The ESO has an overall requirement for response services and has discretion to switch demand between individual services and indeed replace them with new products (like DC, DM and DR). In addition, there are low to no search frictions for the ESO when procuring; the services are tendered frequently via auction and there is only one monopsonist buyer. Overall, we consider that auctions are an effective means of determining market clearing prices and promoting competitive outcomes.

6.19. At a higher level, there is less scope for demand side substitution as different categories of services that the ESO procures serve quite distinct purposes:

- **Reserve services** are used by the ESO to resolve unforeseen fluctuations in demand or generation through access to additional sources of flexibility.
- **Response services** support the ESO to ensure that system frequency remains within +1%/-1% of 50Hz.

- **Reactive power services** allow the ESO to ensure voltage levels on the system remain within a given range, above or below nominal levels.

6.20. For example, in the event of a hypothetical monopolist instigating a SSNIP in the market for frequency response the ESO could *not* procure more voltage support instead. The system requirement would remain unchanged and, given the ESO's obligations, its demand would be quite inelastic with respect to any price change.

6.21. Finally, while CLASS is not able to participate in the BM, we do not consider it to be appropriate to exclude the BM for the purpose of defining the relevant market. The ESO can procure both real-time and ex-ante balancing services to supply the residual demand and is likely to choose the more economical route if a SSNIP were instigated in the ex-ante market. This scope for demand side substitution across the BM and ex ante services demonstrates that the BM would act as a competitive constraint for any hypothetical monopolist provider of CLASS.

Supply-side substitution

6.22. Supply-side substitution refers to a situation where, following a SSNIP, rival suppliers would be willing and able to switch production to the relevant services in the short term without incurring significant additional costs or risks. If these conditions hold, the provision of sufficient supply in the relevant market for balancing services would have a disciplinary effect on the hypothetical monopolist. This is another of the main competitive constraints that firms face in the market for balancing services.

6.23. Individual balancing services, within categories like response and reserve, have their own technical requirements. We have considered whether these should be considered as distinct markets, but a range of technologies can deliver each of these products with minimal investment and lead times and there is little differentiation between providers (eg CLASS does not necessarily offer better frequency response).

6.24. We have also considered the degree of supply side substitution across balancing services as a whole, ie the ability of different providers and technologies to switch provision across response, reserve, reactive power and other categories. The technical characteristics differ more markedly between these categories. For example, response services require providers to respond within so many m/s in order to qualify and not all technologies can do so fast enough. However, we consider that there is a sufficient range of technologies, such as batteries and pumped storage, that operate across the full suite of services that could be offered by a hypothetical monopolist provider of balancing services.

Conclusion

6.25. We have identified some limitations to demand side substitution with respect to the ESO, which could give consideration to viewing services like response, reserve and reactive power as individual relevant markets. However, we have also highlighted that different providers and technologies can compete across multiple product categories in providing these services to the ESO. Furthermore, the undergoing reform of the balancing market is serving to reduce barriers to entry and promote further competition among providers to the benefit of consumers. For these reasons, we consider it appropriate that the relevant product market for CLASS is residual balancing activity as per our previous 2016 Direction.

Geographic market

6.26. The relevant geographic market comprises the area in which operators of CLASS are involved in the supply and demand of balancing services, and face conditions of competition that are sufficiently homogeneous and which can be distinguished from neighbouring areas because the conditions of competition are appreciably different in those areas.[89] This geographic market could be local, regional, national or international.

6.27. Earlier we set out that the ESO procures services to balance demand and supply and to ensure the security and quality of electricity supply across the GB system. It follows that the relevant geographic market for providers of CLASS may be delimited by GB as it is subject to the same regulatory arrangements and conditions of competition. Indeed, all providers of balancing services to the ESO are connected to the GB electricity transmission system and able to compete within that geographic area. In procuring, for example, reserve services the ESO would likely see the

[89] Official Journal of the European Communities (1997). COMMISSION NOTICE on the definition of relevant market for the purposes of Community competition law

services offered by a provider on one part of the network as interchangeable with those of one connected to a different part of the network.

6.28. In consideration of whether the geographic market for CLASS could be larger than GB, we note that interconnectors do allow for trade flows between GB and other geographic markets. The Trans-European Replacement Reserves Exchange (TERRE) project may also open opportunities for the exchange of balancing energy across national borders by creating a harmonised playing fields for market participants.[90] However, we understand that the UK no longer has access to the TERRE market, although the ESO and European transmission system operators have begun to explore other options for cross-border exchange of balancing services. Even if the exchange of balancing energy across borders were to become more prominent, the GB ESO will remain the sole buyer of CLASS and, therefore, we do not consider that the relevant geographic market is wider than GB.

6.29. There may also be some balancing services that have a more local or regional geographic market. For example, reactive power services have a strictly locational requirement, with providers required to produce or absorb reactive power close to the point of their connection, so there is little to no demand-side substitution between different areas. This means that a hypothetical monopolist of CLASS could have scope to sustain profitably a SSNIP of reactive power services above the competitive level at a local level, as the transmission system is divided into 19 main voltage zones. However, over the longer run this monopoly power would be undermined by the ability of other providers to connect to the local network and compete with any monopoly provider of CLASS with respect to reactive power.

6.30. In short, we think it is appropriate to consider the relevant geographic market for providers of CLASS as GB. To the extent that some balancing services have a locational requirement, limited barriers to entry would mean that supply-side substitution should be able to counteract any challenges associated with the ESO’s limited ability to switch demand to other local markets.

[90] For more information, see: European association for the cooperation of transmission system operators (TSOs) for electricity. TERRE Project

Conclusion

6.31. The relevant market with respect to CLASS is established by the combination of the product and geographic markets. We consider the relevant market to be, as previously defined in the 2016 Direction, the balancing services procured and commissioned by the ESO with respect to its incentivised system operator residual balancing role in GB. On the basis of MW capacity and speed of response, CLASS is likely to be a relevant technology option to the ESO in fulfilling its residual balancing purposes.

6.32. Having said that, we recognise that, in the case of CLASS, this relevant market poses practical challenges for how we approach our analysis:

- CLASS does not have the technical capability to provide some balancing services (such as restoration) and its ability to deliver others (such as reactive power) is currently unproven in a commercial context.
- Data limitations are such that it is hard to identify an aggregate MW and/or MVAr requirement for the entire suite of balancing services upon which to base the total market share of an operator of CLASS.
- There is not the same level of granularity in data across ex ante and real time balancing services.

6.33. For these reasons, and for the purposes of this Impact Assessment, we will focus in the next section on the calculating shares of supply within the reserve and response product markets where CLASS has operated to date. We set out in Chapter 2 that our analysis needs to be proportionate, and we do not consider the costs associated with undertaking an in-depth analysis of every product within the balancing services market to be appropriate in this case. We also note that focusing our analysis on a narrower set of balancing services is a stricter test, with any concerns over a provider of CLASS being able to exert dominance of the service more likely to manifest if the scope of the market is less extensive than balancing services as whole.

Review of market structure and outcomes

6.34. In this section, we assess the market structure and outcomes (including shares of supply and bid prices) associated with the historical participation of the providers of CLASS in the market for balancing services. In line with the preceding discussion, we focus on services within the reserve and response markets where ENWL has operated to date. We also consider how the share of supply attributable to providers of CLASS could evolve if additional DNOs were to deploy the technology in RIIO-ED2 and beyond.

6.35. This analysis helps us to assess the current and potential market power of providers of CLASS in the balancing services market, and to provide a preliminary indication of the market structure and the strength of the expected competitive constraints. The information contained in this section is publicly available on the ESO's website.[91] We have also supplemented our analysis with additional information we sourced from the ESO following its response to our request of information (RFI) and follow-up engagement.

Overview of the size of the balancing services market

6.36. This ESO's total balancing market costs can vary significantly in line with the level of transmission constraints and the response from different technologies, amongst other factors. The below table summarises expenditure by balancing services for the most recent reporting years for the ESO. Note that 2021 is a part year effect from April 2021 to December 2021 as this was the latest month available when we collated the data for this assessment. Each service category includes both ex ante procurement and the costs associated with BM activities.

[91] FFR data is available from National Grid ESO (URL): https://www.nationalgrideso.com/industry-information/balancing-services/frequency-response-services/firm-frequency-response-ffr?market-information. FR data is available from National Grid ESO (URL): https://www.nationalgrideso.com/industry-information/balancing-services/reserve-services/fast-reserve?market-information

Table 8 ESO Total balancing Market Costs by financial year

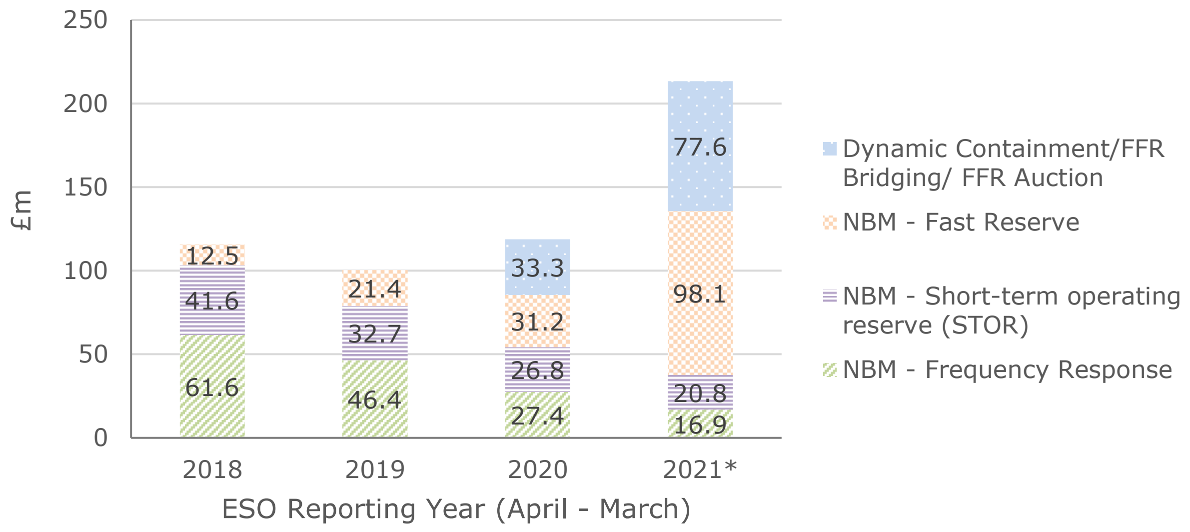
ESO Reported Balancing Services	Cost £m during ESO reporting period: April – March				
	2017	2018	2019	2020	2021 (Apr – Dec)
Energy Imbalance		-31.24 (-3%)	51.64 (4%)	102.61 (6%)	78.48 (3%)
Operating Reserve		66.8 (6%)	82.44 (7%)	182.86 (10%)	426.95 (20%)
STOR		72.74 (7%)	52.47 (4%)	39.12 (3%)	45.04 (20%)
Constraints		680.14 (58%)	714.15 (55%)	1070.06 (58%)	966.62 (45%)
Negative Reserve		5.8 (0.5%)	6.33 (0.5%)	4.31 (0.2%)	8.79 (0.4%)
Fast Reserve		91.09 (8%)	95.05 (8%)	116.18 (7%)	173.68 (8%)
Response		132.07 (12%)	151.77 (12%)	145.63 (8%)	267.45 (12%)
Other Reserve		13.66 (2%)	17.56 (2%)	22 (2%)	13.93 (0.6%)
Reactive		81.73 (7%)	64.65 (5%)	64.97 (4%)	117.62 (5%)
Black Start		48.94 (5%)	54.77 (5%)	69.23 (4%)	44.33 (2%)
Minor Components		28.22 (3%)	31.5 (3%)	33.09 (2%)	14.74 (0.7%)
Total	**999.7**	**1189.94**	**1322.32**	**1850.06**	**2157.63**

Source: Ofgem analysis of National Grid ESO MBSS data.

Note: Due to a change in reporting format, it was not possible to separate costs for 2017 by the standardised service categories used for the subsequent years. % of total expenditure given in parenthesis.

6.37. Within the context of the full suite of balancing services costs, we focus on the £m value of the Reserve and Response services that are tendered for by the ESO (excluding any services procured through the BM). Accounting for these parameters, the £m size of the services where providers of CLASS have historically competed are shown in the below figure.

Figure 8 ESO Costs of Response and Reserve Services Procured[92]



Source: Ofgem analysis of National Grid ESO MBSS tender data.

Note: Data for 2021 is for April – December

6.38. This set of services averages £111.6m annually for the full reporting years between 2018 and 2020. This accounts for approximately 8% of the ESO average total annual costs of all balancing market services.

6.39. 2021 is on track to exceed these previous years significantly. This is partly due to the introduction of new services such as Dynamic Containment and also the unprecedented rise in energy prices observed in 2021. Meanwhile, expenditure on Firm Frequency Response has been diminishing as its function is progressively being replaced by Dynamic Containment.

[92] NBM – Frequency Response: includes the following costs from the ESO's MBSS data: NBM FFR (Tendered), NBM Demand Side Response (Commercial), NBM Enhanced Frequency Response (Commercial). NBM – Short-term operating reserve (STOR): includes the following costs from the ESO's MBSS data: AS – NBM STOR availability (Tendered), AS – NBM STOR utilisation (Tendered), and AS – NB< Season/Term Reconciliation (Tendered). NBM – Fast Reserve: includes the following costs from the ESO's MBSS data: NBM Optional Fast Reserve Availability (Commercial), NBM Optional Fast Reserve Utilisation (Commercial), NBM Firm Fast Reserve Avail + Nom (Tendered), and NBM Firm Fast Reserve Utilisation (Tendered). Dynamic Containment / FFR / Bridging / FFR auction: the ESO started reporting this category in 2020, with the vast majority of costs attributed to Dynamic Containment.

Overview of CLASS historic participation in the balancing services market

6.40. Since Ofgem's 2016 Direction, only one DNO, ENWL, has offered CLASS as a balancing service to the ESO. Whilst CLASS may have the potential to fulfil the technical requirements for a number of balancing services, to date ENWL has only participated in Static Secondary Firm Frequency Response (FFR), Firm Fast Reserve (Firm FR) and Optional Fast Reserve (Optional FR).

6.41. For each of the respective services that CLASS has participated in, we have analysed post-tender report data from the ESO to assess the share of supply ENWL achieved and any noticeable impacts on the number of unique providers, technology types, and bid prices that could be attributable to ENWL's entry into the service. Our approach was as follows:

- For Secondary FFR and Firm FR, we assessed the share of supply that ENWL has achieved by determining the total MW capacity procured by the ESO and identifying the percentage that was accounted for by CLASS.
- For Optional FR, we calculated share of supply as the percentage of MWh utilised as procurement is undertaken through extended contracts, with payments based on utilisation rates.

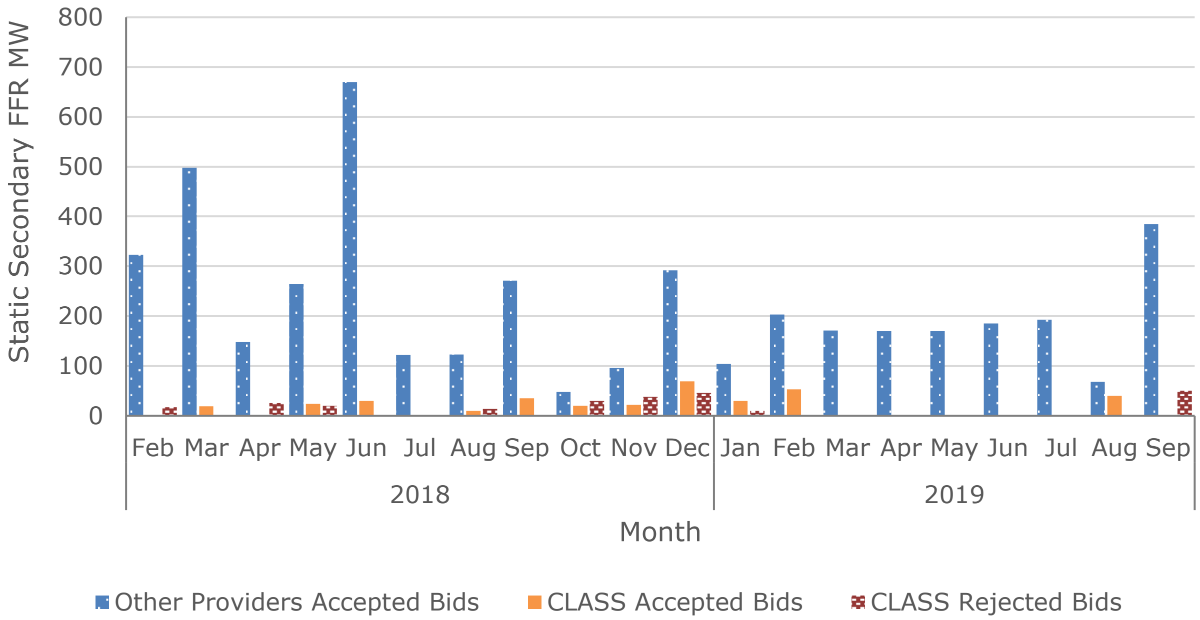
6.42. While it has been possible for all DNOs to provide CLASS to the ESO since 2016, we determined that it would be more appropriate to consider the time period where ENWL has been actively competing in the services else there would be a risk that the share of supply would be understated. For these reasons, we have assessed the share of supply for Static Secondary FFR, Firm FR and Optional FR across differing time periods and in line with ENWL's historical deployment of CLASS in each service.

6.43. In contrast, to analyse any impacts across the number of unique providers and bid prices, we have used multi-year periods that cover durations before and during ENWL's participation in each service. In order to avoid uncertainty in how individual services or different groupings of services could be defined as markets, acknowledging that most services are informally referred to as markets (eg the Firm Fast Reserve market), we refer only to the share of supply achieved by ENWL in a service, and avoid referring to these figures as being their market share.

Static Secondary FFR market structure and outcomes

6.44. We have assessed ENWL's share of supply in static secondary FFR from February 2018, when ENWL first bid into the service, up until September 2019, which at the time of writing was the last bid into the service. The below figure shows the amount of MW capacity accepted for the service by the ESO from ENWL alongside all other service providers, as well as ENWL's rejected bids.

Figure 9 Accepted MW Capacity for Static Secondary FFR



Source: Ofgem analysis of National Grid ESO MBSS tender data.
Note: Rejected capacity bids may include mutually exclusive bids.

6.45. Below we summarise the key observations from this data (all figures are for the period of February 2018 to September 2019):

- Out of 20 tender rounds, ENWL submitted bids for 14. There were only 3 tender rounds where all of ENWL's bid capacity was rejected.
- The ESO procured a total of 4,857MW for Static Secondary FFR, of which ENWL accounted for 352MW.
- The highest share of supply ENWL achieved during a single tender round was 9.1% and the lowest was 0%. In 7 out of 14 tender rounds that ENWL submitted bids, ENWL achieved a share of supply between 4% - 6%. In 4 out 14

tender rounds, ENWL achieved less than 2% and in the remaining 3, achieved more than 8%.

- On average across the period, ENWL achieved a share of supply of 7.2% for Static Secondary FFR.
- If we consider all FFR procured by the ESO (excluding the BM) during this same period, then ENWL's average share of supply was 1.6%.

6.46. There were 21 providers offering Secondary Static FFR during this same period. The below table outlines the share of supply for each of them. We have provided indicative ranges for these shares of supply to avoid identifying specific providers. Provider A had the leading share of supply with 30-40%. ENWL was a distant second with 7.2%, a share of supply that was relatively comparable with other top providers.

Table 8 Share of supply by provider for Static Secondary FFR

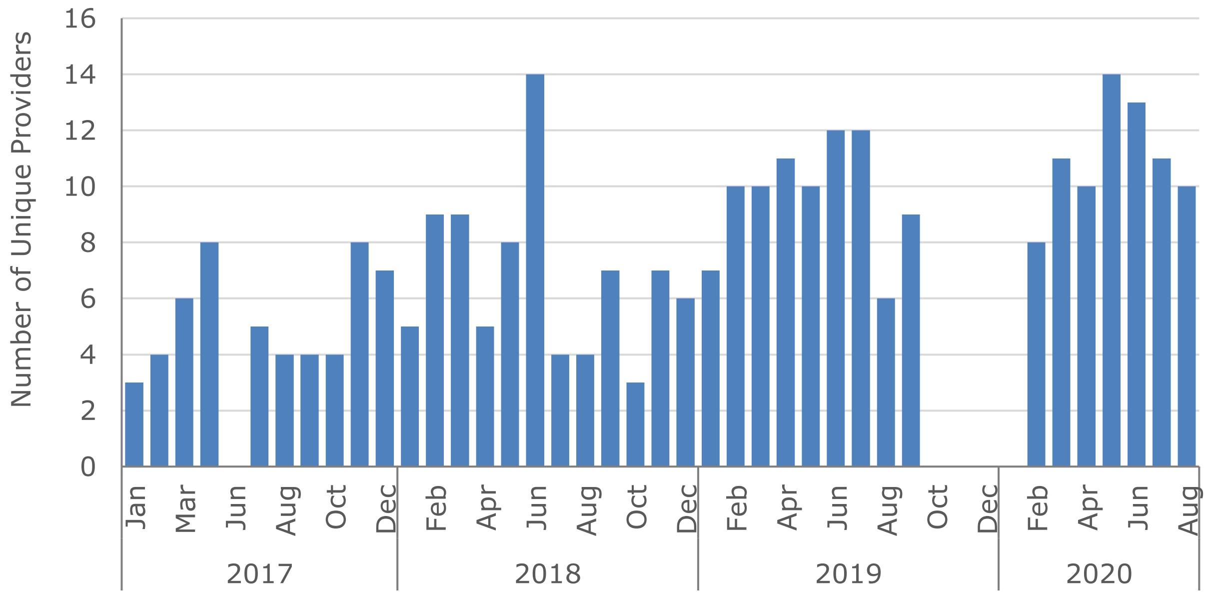
Company	Share of supply
Provider A	30-40%
Electricity North West LTD	7.2%
Provider B	5-10%
Provider C	5-10%
Provider D	5-10%
Provider E	0-5%
Provider F	0-5%
Provider G	0-5%
Provider H	0-5%
All other providers	10-20%
Total	**100%**

Source: Ofgem analysis of National Grid ESO FFR tender data.

Note: Other providers includes 12 other providers with an average share of supply of 0-5%, totalling 10-20%.

6.47. Furthermore, we collected data on the number of unique providers with accepted bids for the Static Secondary FFR service to assess whether CLASS had any negative impacts of the ability for other providers to enter the service. The below figure shows the number of unique providers that had bids accepted over the period of January 2017 to August 2020.

Figure 10 Number of Unique Providers of Static Secondary FFR (Accepted Bids)

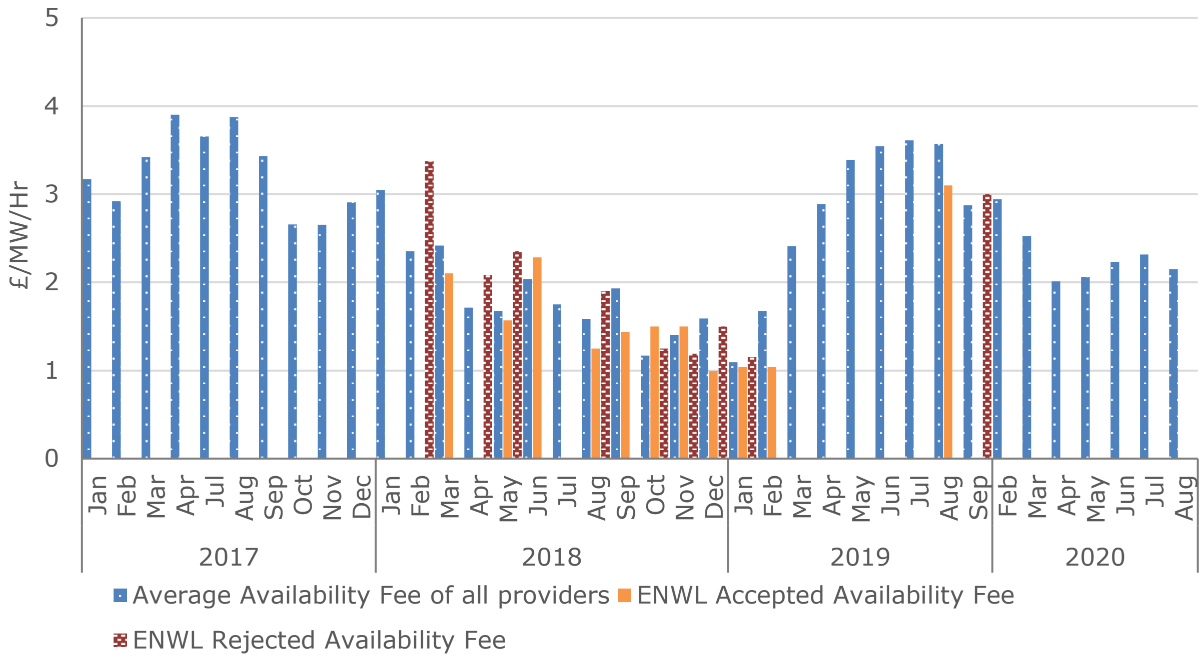


Source: Ofgem analysis of National Grid ESO FFR tender data.

6.48. There is little correlation between ENWL's entry into the service in February 2018 and the number of unique providers. In fact, the average number of unique providers with accepted bids gradually increased between 2017 and 2020.

6.49. Finally, to further understand the impact of ENWL's entry into the service, we have also analysed average availability prices of providers. Figure 6 shows the average availability prices for CLASS and all other providers per MW for Static Secondary FFR.

Figure 11 Static Secondary FFR quarterly average availability prices per MW for CLASS accepted and rejected bids and overall service accepted bids, 2017-2020



Source: Ofgem analysis of National Grid ESO FFR tender data.

Note: Only the availability prices are shown here, as nomination fees or window initiation fees are only exceptionally included in the bids[93]. Availability prices are per MW capacity bid. Months of October 2019 – January 2020 are omitted as there were no successful bids, with the requirement being met in Dynamic Secondary FFR.

6.50. The data shows that, on average, ENWL was offered at lower cost to the ESO during the period of February 2018 – September 2019, with an average availability fee of £1.62/MW/Hr. This was 28% lower than the total average accepted availability fees at £2.25/MW/Hr. We can observe that ENWL's entry into the service coincided with a decrease in availability fees, showing that CLASS's presence likely exerted downward pressure on the market equilibrium price. This demonstrates a positive outcome to consumers, with competitive pricing within the service reducing average availability fees. However, it should be noted that availability fees are not the sole determinant of the ESO's procurement in static secondary FFR.[94]

[93] FFR auction participants can specify a nomination fee and window initiation fee when submitting their bid. In practice, this is rarely informed. In 2019 and 2020 combined, market participants have submitted more than 1600 bids; only 13 bids included a non-zero nomination fee, and no bids included a non-zero window initiation fee. As a result, we focused on availability fees only.

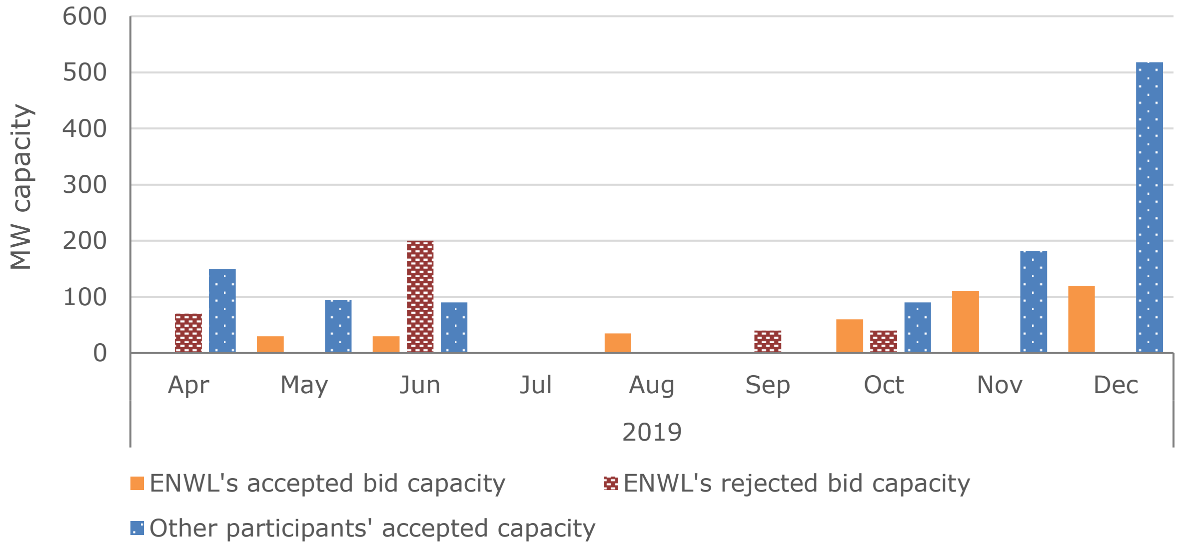
[94] For more information, see 'Assessment Principles' here.

6.51. In short, ENWL has been able to offer highly competitive pricing for this service. In addition, we have not found any evidence that ENWL has been able to influence prices to the detriment of consumers.

Firm FR market structure and outcomes

6.52. ENWL first bid into Firm FR in April 2019 and its last bid was in December 2019. The ESO last procured Firm Fast Reserve in December 2020 and has since ceased operating the service.[95] As such, to assess CLASS's share of supply for Firm FR, we have analysed data from April 2019 to December 2019. The below figure shows the amount of MW capacity accepted for the service by the ESO for CLASS alongside all other service providers, as well as CLASS's rejected bids.

Figure 12 Accepted MW Capacity for Firm FR of ENWL and Other Providers



Source: Ofgem analysis of National Grid ESO FFR tender data.

6.53. As before, we summarise the key observations from this data (all figures are for the period of April 2019 to December 2019):

- The ESO procured a total of 1,633MW for Firm FR during the period, of which CLASS accounted for 415MW.

[95] While the last procurement round was December 2019, utilisation of the capacity procured continued to March 2020.

- The highest share of supply achieved for a single tender round by ENWL was 100% and the lowest was 0%.
- On average across the period, ENWL achieved a share of supply of 25.4% in the Firm FR service.

6.54. There was a total of 4 providers offering Firm FR during this same period, and their shares of supply across the period are summarise in the below table. Provider 1 and Provider 2 had the leading shares of supply in this period, closely followed by ENWL with around 25%.

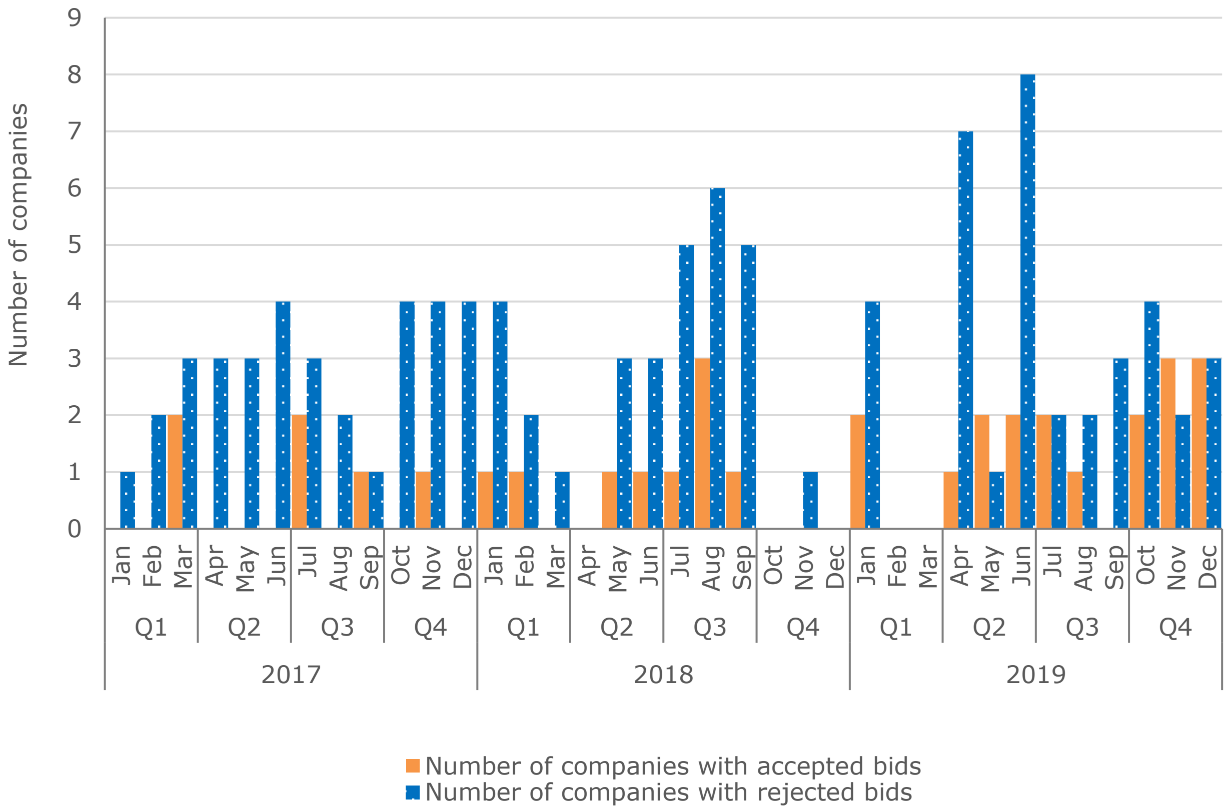
Table 9 Share of supply of Providers for Firm FR

Company	Share of supply
Provider 1	20-30%
Provider 2	20-30%
Electricity North West LTD	25.4%
Provider 4	10-20%
Total	**100%**

Source: Ofgem analysis of National Grid ESO FFR tender data.

6.55. We also collected data on the number of unique providers with accepted bids for the Firm FR service over the period January 2017 to December 2019, which is summarised in the below figure.

Figure 13 Number of unique companies with accepted and rejected bids in Firm FR tenders, 2017-2019



Source: Ofgem analysis of National Grid ESO FR tender data.

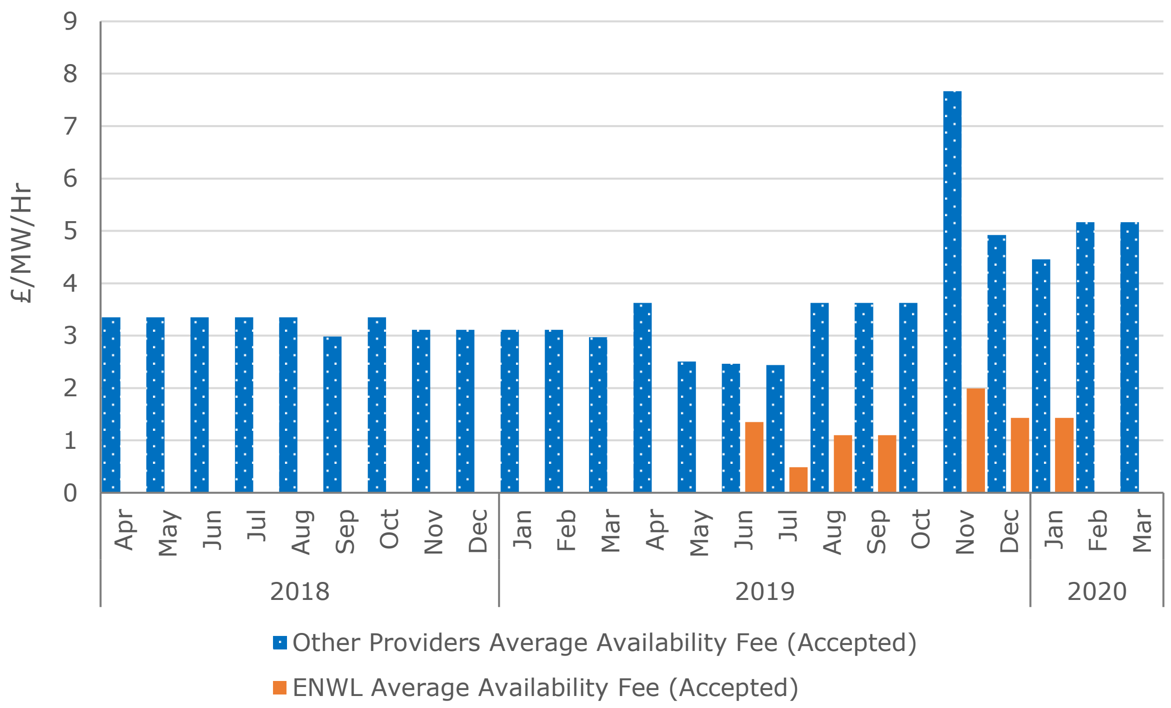
Note: the same company can have both accepted and rejected bids, and so can be counted in both categories for a given tender.

6.56. The chart reveals that the number of accepted bids ranges between 0 to 3 each month, with 1 to 8 bids being rejected. Prior to ENWL providing the service, only one provider's bid was accepted in 8 out of 12 months (for months where the ESO procured any Firm FR capacity). After ENWL entered the service, this reduced to 2 out of 7. The total number of unique providers submitting bids briefly increased when ENWL entered the services in April 2019, but then returned to similar levels for the remainder of the period that Firm FR was an active service.

6.57. It does not appear that CLASS's entry had any significant impact on the number of unique providers, in part due to the short amount of time ENWL was active in the service. It is difficult to attribute any changes to CLASS, as in summer 2019 there was a change in the procurement of Firm FR from multi to single month contracts, meaning the ESO may have already procured a portion or all of its requirement earlier. In addition, the knowledge that Firm FR would cease accepting bids in 2020 may have affected other service providers' activity.

6.58. Finally, we also analysed average availability fees of providers of the service. The below figure shows the average availability fee of providers and CLASS from 2018 until the service ceased in December 2019. Availability fees have been adjusted by MW capacity in order to compare prices. Additionally, availability fees were averaged across the duration of each contract awarded for the category of other providers. For example, if one provider had a contract for January, February and March at an availability fee of £50, and a different provider of equal size had a contract just for March at an availability fee of £30, then the average availability fee for the month of March would be £40.

Figure 14 Firm FR Average Availability Fee (£/MW/hr) Accepted Bids



Source: Ofgem analysis of National Grid ESO FR tender data.

Note: No CLASS was bid into the balancing services market in October 2019.

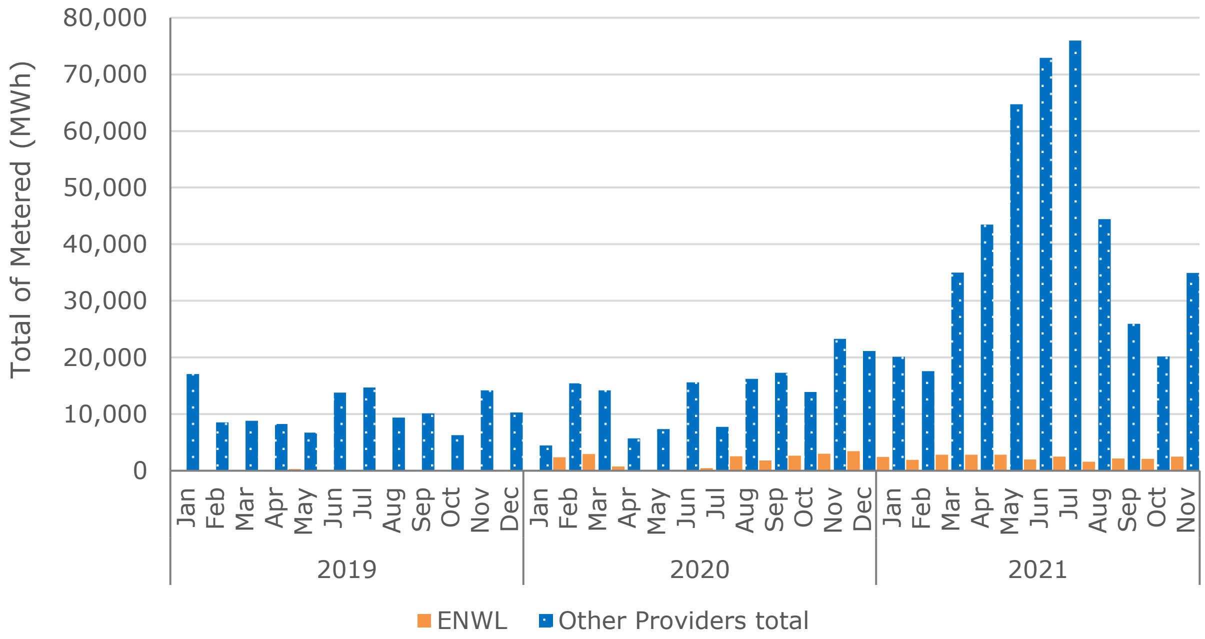
6.59. It is clear that ENWL have been able to offer CLASS at a lower availability fee than other providers and technologies in the service. While ENWL's availability fee for CLASS is lower than competitors, the late entry of CLASS into the service close to its end makes it difficult to observe any significant sustained impacts on other providers and average availability fees. However, while other provider's pricing remained relatively consistent, except for November 2019, CLASS's lower pricing at approximately 52% less than the total average price meant that cost to the ESO was lower during CLASS's participation in the service.

Optional FR market structure and outcomes

6.60. In addition to providing Firm FR, ENWL has also provided Optional FR to the ESO. Unlike Firm FR there is no tendering process to procure capacity for Optional FR, instead the ESO purchases it directly from providers through bilateral agreements.

6.61. In response to our RFI, the ESO provided data that covers January 2019 to November 2021. ENWL first offered Optional FR in the month of February 2019 and continues to offer Optional FR as of writing. We have determined ENWL's share of supply for this period by assessing the total metered MWh utilised by the ESO for the period of February 2019 to November 2021. Figure 15 below shows total metered (MWh) of ENWL and all other providers for the period.

Figure 15 Optional FR Total Metered (MWh) of ENWL and Other Providers



Source: Ofgem analysis of National Grid ESO Optional FR data.

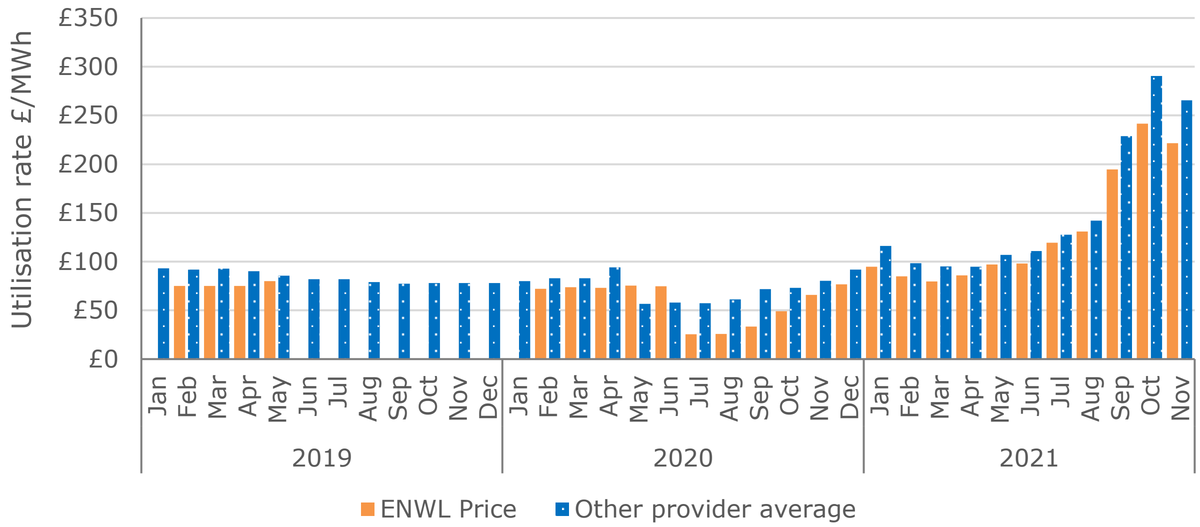
6.62. For the period since ENWL first provided Optional FR in February 2019 up until November 2021, we can see that ENWL has provided to the service in 26 out of 35 months with participation becoming relatively more significant and more consistent since February 2020. Other key observations include:

- ENWL provided 46,369 MWh out of the ESO’s total utilisation for the period of 792,317 MWh.
- This represented a share of supply of 5.9% for ENWL of the Optional FR service.
- The percentage of share of supply by month varied greatly, with ENWL covering 0% to 17% of Optional FR utilisation.

6.63. It should be noted that the number of providers offering Optional FR to the ESO is quite small, with only six providers active in the period observed. However, typically there were only 3 providers or less active, apart from two months in the period where 4 providers were active at the same time. Furthermore, since April 2021 to November 2021, there have only been two providers, inclusive of ENWL, competing in the Optional FR service.

6.64. We also analysed the utilisation rate (£/MWh) of providers in the service as provided by the ESO. The below figure shows the monthly average price of utilisation rate of ENWL compared with the monthly average of all other providers.

Figure 16 Average of Utilisation Rate (£/MWh) ENWL and Other Providers



Source: Ofgem analysis of National Grid ESO Optional FR data.

6.65. Since ENWL first participated in the service in February 2019 up until November 2021, ENWL have offered CLASS at an average utilisation rate price of £92.31/MWh. This is approximately 5% cheaper than the total average utilisation rate price for this period, at £97.24/MWh.

6.66. The previous figure shows that, when ENWL first entered the service in February 2019, there was little to no observable effect. Prices did decline gradually for the following 6 months in which ENWL did not participate. When ENWL again began participating on a more consistent basis in February 2020, we can see that the average utilisation rate prices of other providers reached recent lows of approximately £57/MWH.

6.67. However, as of late 2021, prices have increased significantly with the peak average price in October reaching approximately £290/MWh. This can be attributed to the unprecedented and unexpected rise in gas and electricity prices over the past several months.

Conclusion on market structure and outcomes in RIIO-ED1

6.68. In summary, ENWL's average share of supply during the separate periods analysed across these balancing services was as follows:

- Static Secondary FFR (Feb 2018 – Sept 2019): 7.2%.
- Firm FR (April 2019 – December 2019): 25.4%.
- Optional FR (February 2019 – November 2021): 5.9%.

6.69. Recall that we consider this approach to measuring share of supply to be much stricter test than considering ENWL's market share of the full range of balancing services. For example, ENWL's 7.2% share of supply in Static Secondary FFR, equates to 1.6% of all procured FFR services. It follows that this percentage would continue to reduce if we expanded the scope of the analysis to encompass all Response and Reserve services or even the full breadth of the balancing services market inclusive of the Balancing Mechanism.

6.70. We note that there is not a specific threshold for share of supply, market share, number of competitors or any other specific measurement for determining whether a loss of competition is substantial. From the evidence collected it does not appear that ENWL's entry into the service constituted a significant loss in competition when taking a conservative scope measuring against solely a single service. It follows that if this analysis were expanded to measure ENWL's participation out of a wider scope of services and ENWL share of supply was further diluted, that the conclusion would remain the same.

6.71. Overall, during the period that CLASS has been offered by ENWL to the ESO as a commercial service, the average availability fee (£/MW/Hr) for CLASS in Secondary FFR has been approximately 28% lower than the total average fee, for Firm FR it has been 52% lower, and for Optional FR the average utilisation rate (£/MWh) has been 5.1% lower. During this time, ENWL has been able to competitively price CLASS, most often at a level that is lower than the average prices of other providers. In addition, we have not observed any instances of predatory pricing, where a provider sets its prices in the short-term at a loss-making level to drive out competitors, which in the case of CLASS would mean prices that are close to zero in line with the very low marginal cost of the service.

6.72. Specifically, bid prices and availability fees were on average notably lower across services such as Secondary FFR and Firm FR once ENWL began participating in a service. Their lower pricing was accompanied by other providers lowering their prices as well in the case of Secondary FFR. For Firm FR, we see that while other providers didn't also lower their prices, total average cost to the ESO decreased due to ENWL offering capacity at an average price significantly lower than other providers. Lastly, for Optional FR, we can see that initially ENWL's participation in the service lowered average prices across all providers, however largely due to the unprecedented rise in energy prices during 2021, prices across providers have risen sharply. We see this analysis as providing suggestive evidence that from the perspective of cost to consumers, ENWL's entry into the balancing services market resulted in a positive outcome for consumers.

6.73. This historical analysis provides a greater understanding of how CLASS participated in the balancing services market. It reveals that ENWL's entry into the market has been a positive outcome for consumers, with increased competition in a number of product markets and evidence that prices have been reduced. It also gives an early indication as to how a greater deployment of CLASS by other DNOs may impact market dynamics and competitors. With this in mind, we turn to potential deployment scenarios for CLASS and projections for how the services may grow.

Projections of market developments

6.74. Our analysis of CLASS deployment in the balancing services market within RIIO-ED1 has led us to conclude that ENWL has not secured a dominant position across services that it has participated in nor the broader range of balancing services. However, we are mindful that our decision on the regulatory treatment of CLASS could have wider implications, as other DNOs have expressed an interest in deploying CLASS in the future. For these reasons, we consider how further deployment of CLASS among multiple DNOs could impact on competition in the balancing services market in the future.

Current baseline of ESO balancing services requirement

6.75. We have worked with the ESO to understand the total MW capacity requirement for ex ante procured reserve and response services. This baseline future requirement is subject to considerable uncertainty, and likely to grow over time, but we believe this gives an indication of the size of the potential future supply that could be fulfilled by providers of CLASS. It also allows us to evaluate what share of supply a DNO could secure in the future were it to deploy CLASS at scale. As before, we note this narrower definition provides a stricter test of potential market dominance or risks of market distortions.

6.76. The below table summarises the 2021 capacity requirements (in MW) the ESO has set out for select reserve and response services. These represent the range of services that CLASS is technically eligible for and that DNOs are able to offer to the ESO (ie it excludes the BM). The requirements are formed of averages and represent the amount of MW capacity we would expect the ESO to procure in any given tender round.

Table 10 2021 requirements for Response and Reserve balancing services

Procured Balancing Services 2021		Baseline MW Capacity 2021 (MW)
Frequency Response (MFR and FFR)	Primary	550
	Secondary	550
	High	550
Dynamic Containment		1,100
Optional Fast Reserve		600
STOR		1,300 DA (2600MW of CLASS required) 400 contracts (800 of CLASS required)
Total		5,050

Source: National Grid ESO
Note: It should also be noted that for a CLASS provider to participate in STOR, it would require, at minimum, a 2:1 ratio of CLASS capacity to bid capacity due to the long duration of response required for STOR (ie, 50MW of STOR capacity for 1 hour requires 100MW of CLASS response available.) STOR DA stands for Daily Auctions.

6.77. In the below table, we have estimated the total share of supply that DNOs could theoretically achieve out of this baseline using the three deployment scenarios set out earlier in this impact assessment. The projections assume that CLASS related capacity all comes online in one year, but in practice any roll out, under any policy option, would likely be more gradual due to lags associated with investment decision and installing equipment across a range of sites and licence areas.

Table 11 Projections of potential CLASS deployment and share of balancing services

Scenario	Estimated CLASS enabled sites	Minimum response (MW)	Maximum response (MW)	% Share of supply
Scenario A (conservative)	260	150	300	2 - 4%
Scenario B (medium roll-out of CLASS)	1,378	795	1,590.50	12 - 23%
Scenario C (large scale roll-out of CLASS)	2,497	1,441	2,881.10	21 - 43%

Note: Share of supply column is calculated taking into consideration the requirement of CLASS to have 2:1 ratio of capacity reserved for STOR.

6.78. The analysis reveals that under Scenario C, the response that all potential CLASS providers could offer may account for between 21 - 43% of the requirement for Response and Reserve services seen in Table 10. Therefore, a typical DNO with a large CLASS rollout would on average have 480MW of CLASS response to offer, representing a total share of supply of approximately 7%.

6.79. It should not be assumed that a DNO would uniformly distribute their capacity across each service; in practice they may look to focus on specific services. If we look at each service individually, it is possible for a DNO to completely meet the MW requirement of a service. For example, our calculations show that a DNO with a large network could fulfil the full baseline capacity requirement for secondary FFR, which has a total requirement of 550MW. This might suggest that, if there were tacit collusion, there would be an incentive for each DNO to choose to not compete directly within the same service, as currently many other providers are not as low-cost as CLASS.

6.80. However, we previously considered that there is a strong degree of supply-side substitution in the market for balancing services and any given DNO would face strong competitive constraints if it used its capacity to try to exert dominance in one service. There may also be regulatory and technical limitations that decrease the likelihood of a single technology platform such as CLASS being relied upon to continuously fulfil a service. In Chapter 4, we further detailed the regulatory framework of the ESO, including its procurement guidelines and requirements, alongside its broader incentives for maintaining competition and a diversity of technologies within the balancing services market.

6.81. An alternative framing for understanding how DNOs may utilise CLASS across these services is to consider the opportunity under policy option 1a (DRS8), where DNOs would have the incentive to participate in services with the opportunity for the highest return. This would align with ENWL's strategy to date, switching participation in Firm FR, Optional FR and Static Secondary FFR depending on market prices. It would be expected that DNOs would aim to achieve higher shares of supply of services offering higher returns, creating a merit order of which service a DNO may choose to offer CLASS capacity. This may result in single DNO's achieving markedly higher shares of supply in particular services if able to provide competitive pricing.

6.82. Under both policy options 1a and 1b, we may not expect DNOs to provide CLASS for the STOR service. Due to CLASS's MW capacity response decreasing after 30-minutes of the new tap changer position being set, to provide a stable response for a duration longer than an hour (typically ~4 hours for STOR) requires cycling through at least two groupings of substations. This limits a DNO to offering 50% of potential MW capacity response held by CLASS for STOR, whereas for shorter response duration products such as FFR, a DNO is able to offer more of its capacity. Depending on the outcome of reforms currently being conducted by the ESO, it may be possible that a STOR type service could become more attractive for CLASS providers in the future.

6.83. Under policy option 2 (price control), the ESO would have full discretion in its use of CLASS capacity and would be expected to use CLASS where it was most cost-effective and secure to do so. In effect, this would be reducing the total MW capacity requirement the ESO needs to procure, leaving other providers with a reduced capacity requirement to bid into. If a new technology type were to arise that offered increased efficiency and lower cost than CLASS, we could expect the ESO's usage of CLASS to reduce.

Projections of future market structure

6.84. The baseline requirements used for this exercise of estimating potential future shares of supply draws upon the ESO's requirements in 2021. However, we need to also consider how this requirement may change and whether this could affect the potential share of supply a DNO could achieve.

6.85. As the technology mix on the system is constantly changing, the ESO recognises the need for a more competitive and accessible way of procuring balancing services. The ESO has expressed its specific vision for the future of Reserve and Response services in its recent Markets Roadmap to 2025 report, which outlines a series of reforms to the balancing services market.[96] The aim of these reforms is to lower entry barriers through the standardization of products and procurement timescales, favouring competition, and ultimately leading to cost savings for consumers. There is a particular focus on the commercial viability of future services to facilitate equal access to the market by a wide and diverse group of providers including variable generation, storage, and demand-side participants.[97] Increasing participation is expected to exert a strong constraint on future price development.

6.86. The Markets Roadmap to 2025 report provides specific insight into the expected growth and development of Reserve and Response services, but long-term future MW capacity requirements are not yet published. These developments include:

- **Response services**: A phase out of Enhanced Frequency Response and FFR monthly tenders to be replaced by Dynamic Containment, Dynamic Moderation and Dynamic Regulation. The ESO is working with stakeholders to determine how much capacity should be procured through these services, while also recognising a move to the Frequency Risk and Control Report & Methodology (FRCR).
- **Reserve services:** While most reserve volume is currently secured through the BM, new reserve services currently in development will shift large amounts of volume to non-BM reserve services.

[96] National Grid ESO (2021). Markets Roadmap to 2025
[97] National Grid ESO (2019). Reserve and Response Roadmap

- **Response and Reserve procurement**: The reform of balancing markets is moving towards the procurement of all non-BM balancing services one day-ahead through pay as clear auctions,[98] with monthly and multi-month procurement being phased out.

6.87. The recent Operability Strategy Report[99] published by the ESO outlines it's expected MW capacity requirements for 2025 after reforms have taken place. The services included cover the Response and Reserve services the ESO tenders for and procures, all of which we acknowledge CLASS may participate. To demonstrate how the ESO's requirements may change with the introduction of new services in 2025, the below table contains both requirements for 2021 and expect in 2025.

[98] Pay as clear auctions, often referred to as uniform auctions, are used by the ESO for procuring balancing services. The ESO publishes in advance (monthly or day-ahead, depending on the service) the amount of capacity, expressed in MW or GW, it intends to procure for a specific service. Providers of that specific service submit their bids. Each bid submitted should reflect the marginal cost of providing the service. The price each provider receives is determined by competition amongst providers. The ESO ranks bids in increasing order. The highest bid accepted, such that demand equals supply, determines the market clearing price. All providers that bid below the market clearing price will be remunerated at that price.
[99] National Grid ESO (2021). Operability Strategy Report December 2021

Table 12 Future ESO balancing services procurement requirements

Procured Balancing Services 2021		Baseline MW Capacity 2021 (MW)	Procured Balancing Services (Reformed ~2025)	Baseline MW Capacity ~2025 (MW)
Frequency Response (MFR and FFR)	Primary	550	Dynamic Regulation	Up to 300
	Secondary	550		
	High	550	Dynamic Moderation	Up to 300
Dynamic Containment		1,100	Dynamic Containment	Up to 1400
Optional Fast Reserve		600	Quick Reserve	Up to 1400
STOR		1300 DA (2600 CLASS required)	Slow Reserve	Up to 1400 (2800 CLASS required)
		400 contracts (800 CLASS required)	STOR (Long-term contracts)	400 (800 CLASS required)
			Negative Slow Reserve	Up to 300
Total		**5,050**	**Total**	**5,500**

Source: National Grid ESO (2021). Operability Strategy Report December 2021

Note: It should be noted that for a CLASS provider to participate in STOR, it would require, at minimum, a 2:1 ratio of CLASS capacity to bid capacity due to the long duration of response required for STOR (ie, 50MW of STOR capacity for 1 hour requires 100MW of CLASS response available.)

6.88. While not exact, the table shows how we may expect old services to be reformed by 2025 and where the former baseline requirement of MW capacity will carry over from. The ESO has indicated that existing services will be phased out and that there may be an overlap during the ESO's transformation plan.

6.89. We can see that existing Response services such as FFR will be replaced by a suite of new services, including Dynamic Containment, Dynamic Moderation and Dynamic Regulation. As these services are expected to be more efficient than their previous counterparts, it would suggest that the ESO's requirement across Response services could decrease. Whereas in Reserve services, the addition of new services such as Fast Reserve and Negative Slow Reserve may increase the category's overall MW requirement, potentially reducing MW capacity being currently procured through other means, such as the Balancing Mechanism. In total, the data shows that we may expect the baseline MW requirement for the ESO across Response and Reserve categories to increase in 2025 by up to 450MW, compared to 2021 requirements. This would suggest that the maximum total share of supply achievable by a DNO would decrease by 2025.

6.90. However, these baseline requirements are not fixed and may be altered according to the ESO’s needs. Due to a range of factors directly effecting inertia levels on the system and increased loss sizes from larger interconnectors and generation sites, the ESO’s requirements may increase further in the future. There may also be broader changes to the energy landscape, such as greater reliance on variable sources of generation and growth of domestic demand flexibility, that could prompt greater variation in pre-fault frequency imbalance. This further suggests that the maximum potential share of supply of CLASS providers could achieve may decrease over time. This does not account for considerations to unforeseen events that could increase or decrease ESO’s procurement of balancing services, such as the COVID-19 pandemic and the recent unexpected rises in global energy prices.

6.91. It should also be acknowledged that CLASS capacity is not fixed, rather it is dependent on the load connected to substations. As overall electricity consumption increases, it would be expected that increased loads on existing primary substations and any newly built primary substations would gradually increase a DNO’s available MW capacity from CLASS activations. Some of the drivers for an increase in CLASS capacity may also overlap with factors that would require the ESO to increase MW capacity procured. However, it is unclear at this early stage of CLASS deployment whether this growth would be lower than, the same, or outpace the growth in MW capacity required by the ESO.

Outlook for bid prices in balancing services

6.92. Overall, during the period that CLASS has been offered by ENWL to the ESO as a commercial service, the average weighted availability fee (£/MW/Hr) for CLASS in Secondary FFR has been approximately 28% lower than the total average fee, for Optional FR has been 5.1% lower and for Firm FR has been 52% lower. During this time, ENWL have demonstrated that CLASS is able to routinely price below the average prices of other current providers and we have found no evidence of anti-competitive behaviour, such as predatory pricing.

6.93. We note that the ESO's planned reforms to the balancing services market, which aim to increase new entrants into the market, would be expected to foster greater competition and exert downward pressure on bid prices over the long-term. This means that, while CLASS appears to be lower cost than other providers currently in the market, its competitiveness may diminish over time.

6.94. Depending on whether CLASS is offered as a commercial service (options 1a and 1b) or it is mandated (option 2), we would expect average bid prices for services to develop differently in the future. Additionally, the amount of DNO's that deploy CLASS under option 1a or 1b, as well as the speed of this deployment, will also have an impact on future average accepted bid prices.

6.95. There is also a range of other market factors that may have long-term impacts on the bid price offers for balancing services, such as the commercial decisions of other providers, system conditions being impacted by external events, changes in consumption behaviour and changes to the electricity supply mix. However, everything else being equal, we would expect that CLASS' participation within a service would exert downward pressure on average accepted bid prices and reduce costs to the ESO. This would represent a positive outcome for consumers, as reduced BSUoS charges would be reflected in customer electricity bills.

Conclusion on projected outcome of CLASS deployment

6.96. Using an estimated minimum and maximum for the total CLASS response possible from a number of CLASS-enabled primary substations, we have determined that under Scenario C, a full deployment of CLASS among all DNOs, a single DNO could on average achieve between 5 – 10% of the ESO's 2021 requirement for procured Response and Reserve services. As we expect the ESO's MW capacity requirement to grow among these services that CLASS is eligible to participate, we may also expect that a CLASS provider's possible share of supply will decrease. Recall that reserve and response are only a subset of services in the broader balancing services market and that when accounting for a wider scope of the ESO's balancing activities, CLASS providers would have a further reduced level of participation in the balancing services market.

6.97. We note that it is possible that, under policy option 1a (DRS8), DNOs would seek to participate in services that are most profitable, creating a merit order of services and a scenario where DNOs may achieve higher shares of supply in particular services. This may result in a DNO holding a significant share of a particular service, although this would be counteracted by competition between DNOs, the scope for supply-side substitution and the ESO’s commitments to maintaining security of supply through diversified suppliers and technologies.

6.98. Nevertheless, achieving a high percentage share of supply for one service or more alone is not evidence of abuse of dominance nor harm to consumers. Should abuse of dominance or anti-competitive behaviour be detected by any DNO in their use of CLASS to participate in the balancing services market, Ofgem has the power to investigate potential infringements of competition law in the energy sector. These powers are held concurrently with the Competition and Markets Authority. We further assess potential competitive distortions in the next section when we look at potential abuse of dominance.

6.99. In the future, the ESO expects their MW capacity requirement for Response and Reserve services to grow. In the long-term, this growth will reduce CLASS providers ability to achieve higher shares of supply, although we do also note that CLASS capacity may gradually grow in the future. Thus, the future share of supply of CLASS over time is uncertain as these two trends would counteract.

Analysis of potential theories of harm

6.100. In this section, we consider if, and to what extent, the provision of CLASS as a balancing service could adversely affect competition in the RIIO-ED2 period and beyond. We recognise that anti-competitive behaviour by providers of CLASS would have the potential to deter investment in the market and result in negative outcomes for consumers.

6.101. For the avoidance of doubt, we have not identified any instances of anti-competitive behaviour by ENWL with respect to its provision of CLASS as a balancing service, and nor have stakeholders provided evidence of any examples Rather, the discussion in this section is concerned with the likelihood of whether a DNO or group of DNOs that use CLASS to participate in the balancing services market could, in the future, have an opportunity and incentive to engage in anti-competitive behaviour. To help make this judgement on potential future scenarios, we consider the deployment scenarios and regulatory options that have been discussed extensively in this IA.

6.102. With reference to concerns that were raised by stakeholders in response to our 2020 consultation, and frameworks that include the CMA's Merger Assessment Guidelines,[100] we consider two broad theories of harm that could potentially lead to consumer detriment in the future:

- **Coordinated effects:** this refers to the likelihood that a group of DNOs operating in the balancing services market would act on a common understanding to limit their rivalry.
- **Foreclosure effects:** this refers to the likelihood that a DNO would be able to use their position in other markets to harm the competitiveness of its rivals in the market for balancing services.

6.103. For both these theories of harm, we assess if a detrimental impact on consumers could arise and whether this would depend on the regulatory treatment of CLASS, but first we provide a brief explanation of how procurement works in the market for balancing services.

Procurement assessment process in the market for balancing services

6.104. The ESO procures balancing services using two auction designs:

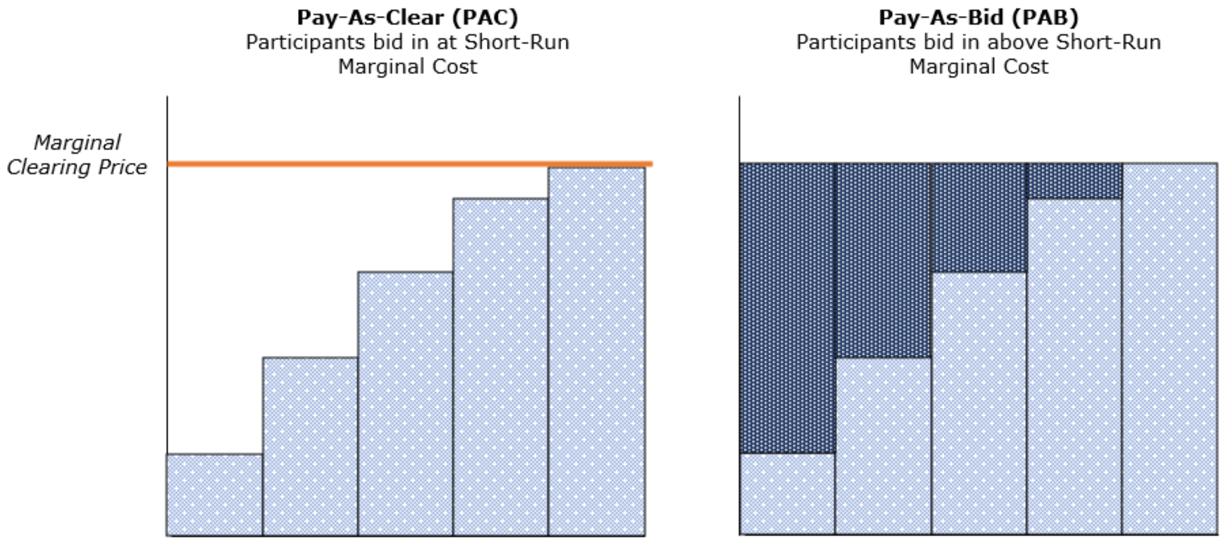
- **Pay-as-bid:** where participants receive their own price that they provide to the market and the product is purchased in the merit order (ie the cheapest products are chosen first).
- **Pay-as-clear:** where all participants receive the price of the most expensive item procured (ie the market's marginal cost).

[100] CMA (2021). Merger Assessment Guidelines (CMA129)

6.105. With respect to CLASS, we understand that the ESO's existing assessment principles for the relevant products more closely follow a pay-as-bid methodology.[101] However, the ESO has expressed in its Markets Roadmap to 2025 report that it intends to move towards pay-as-clear auctions.[102]

6.106. In a competitive market, these two auction designs should produce similar results.[103] Under pay-as-bid, participants have the incentive to bid at the price of the most expensive offer accepted. Under pay-as-clear, participants are automatically awarded the price of the most expensive offer accepted. This is illustrated graphically in the below figure.

Figure 17 Illustration of auction results under competitive markets



6.107. This result only holds true under strict conditions: (i) there is a homogenous product, (ii) there are sufficient levels of competition, and (iii) there is perfect information about the market to participants. However, in the event that participants are able to exercise market power, strategic bidding could result in inefficiency in dispatch and capacity investment and ultimately higher average prices.[104]

[101] See, for example, the Firm Fast Reserve assessment principles: National Grid ESO (2019). Firm Fast Reserve - Assessment Principles
[102] National Grid ESO (2021). Markets Roadmap to 2025
[103] Ofgem (1999). The New Electricity Trading Arrangement (1999)
[104] See discussion in Tierney et al (2008). "Pay-as-Bid Vs Uniform Pricing," Fortnightly Magazine.

Coordinated effects

6.108. In the previous section we concluded that it would be unlikely that any given DNO would be able to gain a dominant share of the market for balancing services. However, it is theoretically possible that a group of DNOs could coordinate by fixing prices, by dividing up the market for different balancing service products between them, or by allocating contracts among themselves in bidding for services. Such coordination could be either explicit, ie achieved through communication and agreement between the parties involved, or tacit and based around an implicit understanding between the parties. Either way, the result would be higher prices than would otherwise occur in a more competitive market.

6.109. We have drawn on the CMA's guidelines, and consider three conditions that would need to hold for the provision of CLASS as a balancing service by multiple companies to give rise to coordinated effects:

- The coordinating group is able to reach terms of coordination.
- Coordination is internally sustainable among the coordinating group, ie companies find it in their individual interests to adhere to the coordinated outcome.
- Coordination is externally sustainable, ie it is unlikely that coordination will be undermined by competition from outside the coordinating group.

6.110. We now consider each of these conditions in turn.

Ability to reach terms of coordination

6.111. For coordination to emerge with respect to the provision of CLASS, the companies involved would need to be able to reach a common understanding on, for example, a price below which they would not offer capacity or specific balancing services that they would not target. Such an understanding would need to be sufficiently clear to allow companies to align their actions.

6.112. We have considered a number of factors that could have a bearing on the ability of a group of DNOs to reach an understanding on the terms of coordination:

- Up to six companies could in theory deploy CLASS as a balancing service, which would tend to increase the complexity around any agreement.
- The balancing services market consists of a suite of different products, many of which do not have a locational requirement, which would create challenges around coordinating on pricing points, products and geographic markets.
- Whilst DNOs have similar business models and cost structure, their capacity to deploy CLASS would vary considerably in line with the size of their distribution network. This in turn could create difficulties in reaching a common understanding.
- The companies do have structural ties, eg through common membership of trade associations, that in theory could assist in reaching a common understanding on the terms of coordination.

Internal sustainability

6.113. For coordination to be internally sustainable, the benefit to firms to deviate from the agreement must be less than the costs of future reduced profits. The relative size of the gains and losses would vary in line with the structure of the market for balancing services. Forms of deviation could include, for example, offering discounts to the coordinated price, failing to match a price rise or targeting another firm's customers or product markets.

6.114. In the case of balancing services, there are a number of factors which may enhance a firm's ability to detect rivals' behaviour. This could serve to reduce the incentive to deviate from the terms of the agreement:

- The movement towards pay-as-clear auctions, in line with the ESO's direction of travel, can provide stronger incentives for suppliers to bid their true marginal cost.[105] However, when there is a limited number of suppliers, pay-as-clear auctions could increase the incentive for firms to coordinate and exercise market power when demand is high and close to total available capacity.[106]

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[105] See, for example, Alfred E. Kahn, Peter Cramton, Robert H. Porter, and Richard D. Tabors, (2001). "Uniform Pricing or Pay-as-Bid Pricing: A Dilemma for California and Beyond," Electricity Journal, 70-79

[106] See Heim, Sven; Götz, Georg (2013). Do pay-as-bid auctions favor collusion? Evidence from Germany's market for reserve power, ZEW Discussion Papers, No. 13-035, für Europäische

- The market is relatively stable and predictable, with demand requirements being set out in advance, and this may aid companies in detecting any deviation from coordination. Risks of coordination may be higher in repeated uniform auctions and when demand is inelastic, which mirrors the case of balancing services where the ESO publishes its MW requirements for each product in advance.[107]
- There is weak customer loyalty as, subject to meeting the requirements, the ESO is likely to treat the balancing services of one provider as interchangeable with those of another. There is also a relative absence of long-term contracts, so any gain in market share might only be transitory.
- Companies would be able to detect and respond to deviation in a timely manner as they would have the opportunity to adapt their bidding strategy in the next round of auctions. Procurement practices also tend to enhance transparency as, for example, the results of previous auctions are available on the ESO's data portal.

6.115. However, there would also be a stronger incentive to deviate in this case as the number of coordinating firms could be as high as six. The profits from coordination would be shared across a relatively large number of companies, which would lower the relative payoff from coordination when compared to the profit from deviating. This incentive could be sufficient to undermine the terms of the agreement.

External sustainability

6.116. The final consideration is whether coordination would be externally sustainable. This would require the coordinating firms to exercise a collective degree of market power, but we saw in the previous section that even under Scenario C, an ambitious rollout of CLASS, DNOs as a collective would only be able to achieve significant shares of supply in a subset of the balancing services market. Existing competitors outside of the coordinating group would be able to provide a strong competitive constraint as we have previously concluded that there is a strong degree of supply-side substitution in the market for balancing services.

Wirtschaftsforschung (ZEW), Mannheim, for a review of the literature on uniform auction and pay-as-bid auctions, collusion, and market power.

[107] Khan et al (2001). Uniform Pricing or Pay-as-Bid. Pricing: A Dilemma for California and Beyond.

6.117. In addition, with respect to dynamic competition, we note that barriers to entry are low. This implies that new business, or firms that are active in other energy markets (such as the GB wholesale market) would have an incentive and ability to bid into the balancing services market if the coordinating group attempted to set prices at a level that was higher than the competitive market.

Conclusion

6.118. In short, we consider it unlikely that coordinated effects could arise in the market for balancing services in the event of a wider deployment of CLASS. A coordinating group of DNOs (or indeed any type of providers) may struggle to arrive at the terms of an agreement as the market is complex and difficult to segregate. This struggle is greatly increased by the presence of 6 DNOs all able to provide CLASS. Whilst there may be relatively strong incentives to adhere to the terms of an agreement (if they could be arrived at), we think this would be offset by the ability of firms outside of the agreement to undermine its outcomes and compete with the coordinating group.

6.119. Ofgem has the enforcement powers, held concurrently with the Competition and Markets Authority, to investigate potential infringements of competition law in the energy sector.[108] If any illegal coordination or collusion behaviour was suspected or identified by Ofgem and/or the CMA, the relevant firm(s) could face high penalties. Ofgem also has powers under Regulation on wholesale energy market integrity and transparency (REMIT) which also helps industry to have confidence that wholesale prices are open, fair and competitive, breaches can lead to substantial fines. These should be sufficient in themself to prevent the emergence of this type of behaviour.

Foreclosure effects

6.120. Foreclosure effects refers to the likelihood that a DNO or group of DNOs would be able to use their position in other markets to harm the competitiveness of its rivals in the market for balancing services. This could be in the form of input foreclosure, where a DNO prevents or worsens the terms of access to a key input (eg a connection) to directly impact on a potential rival's competitiveness in the balancing

[108] Our enforcement guidelines describe how we will use our enforcement powers if businesses breach compliance with relevant conditions and requirements or are alleged of anti-competitive agreements or abuses of dominant positions. See Ofgem's The Enforcement Guidelines for more details.

services market. Another potential form of foreclosure that could be relevant in this case would be customer foreclosure, eg if a DNO elects not to procure distribution flexibility services from a rival competitor in the market for balancing services.

6.121. With respect to CLASS, such foreclosure effects could arise if DNOs:

- Have an incentive to discriminate against potential competitors when overseeing connections, responding to faults and procuring flexibility.
- Have an incentive to withhold and advantageously utilise information which is not publicly available to other parties competing in balancing services market. This could be information about a company’s own distribution network, including data on the competitors connected to their networks, and the transmission network through relationships with the ESO.

6.122. As with the previous theory of harm, we have drawn on the CMA’s guidelines and consider whether three cumulative conditions with respect to foreclosure effects would hold in the case of CLASS:

- Whether the company would have the ability to use its control of inputs to harm the competitiveness of its rivals.
- Whether the company would have the incentive to actually do so, ie would it be profitable.
- Whether the foreclosure of these rivals would substantially lessen competition.

6.123. We now consider each of these conditions in turn.

Ability to foreclose rivals

6.124. DNOs build, operate and maintain electricity distribution networks in their licensed geographic areas. They are regulated monopolies of services that include, for example, new connections to distribution networks within their licensed area. Whilst a small number of balancing service providers may have a choice between connecting to the transmission or the distribution network in different locations, the CMA has previously found that vast majority of customers wishing to connect to a distribution network have no option over which DNO to connect to.[109] Thus, in theory, a DNO would have the ability to foreclose potential rivals by denying them of key inputs including a new connection.

6.125. Another broader foreclosure effect could be if DNOs have the ability to compete less aggressively, eg with prices only marginally lower than rivals, to the extent that they acquire commercially sensitive information through its other roles. In the case of CLASS, we consider three main ways in which a DNO may have the ability to do this.

6.126. First, a DNO could leverage information held about its own distribution network, including visibility of network constraints and interruptions. This could give it an opportunity to improve its offering versus rival balancing services if, for example, it can improve the reliability of its balancing service. However, in practice its ability to do so may be quite limited:

- As part of our business planning guidance for RIIO-ED2, we have set out baseline expectations for DNOs as part of the DSO transition that include standard and effective processes for sharing network planning information with network users and other interested parties.[110] This will limit the degree of information asymmetry and DNOs opportunity to exploit this in its commercial decisions around CLASS deployment
- This information would be limited to each DNO’s licence areas and, to the extent that most balancing services are GB-wide, any given DNO would not be able to predict the ESO’s real-time actions in the market based on its own network conditions alone
- CLASS assets are attached at primary substation level, so access to more granularity of secondary monitoring data would not inform DNOs bidding strategies in balancing services markets or help a DNO better understand the ESO requirements in the market

6.127. Second, a DNO could use information held about its competitors, eg flexibility providers connected to its own distribution network. For example, DNOs collect information on flexibility providers assets and bidding strategies that are connected

[109] CMA (2021). Completed acquisition by National Grid Holdings One plc of PPL WPD Investments Limited: Decision on relevant merger situation and substantial lessening of competition.
[110] See appendix 4 in Ofgem (2022). RIIO-ED2 Business Plan Guidance

to their own networks as part of the distribution flexibility tendering process. In addition, if a DNO has greater DER visibility it would be able to see export levels close to real-time, which could point to a particular DER providing an FR or FFR service to the ESO for instance. In theory, DNOs might be able to inform its bidding strategy in the relevant balancing services markets by analysing its competitors' behaviour and unsuccessful bids in its own local flexibility market, and through a better understanding of the level and timing of utilisation of other generators by the ESO. Once more though, its ability would be subject to constraints:

- Only part of the information on distribution flexibility is privileged to DNOs as their licence obligations requires them to publish flexibility contracts.[111] In addition, it is limited to flexibility providers located (i) in a DNO's own distribution service area and (ii) in a Constraint Management Zone (CMZ) where those providers are tendering for flexibility.[112] These two conditions[113] make it unlikely that a DNO would be able to predict the bidding strategy of its competitor in the balancing services market
- With respect to greater DER visibility, any informational advantage would be eroded again by this only relating to a smaller subset of potential competitors that are connected to a DNO's own distribution network. We found limited evidence from third party network users in our Distributed Generation (DG) visibility call for evidence that there is benefit from access to DG data.[114] This highlights that we have limited evidence on how this information would be useful to other network users, including to inform balancing services provision to the ESO.

6.128. Third, a DNO could draw on information received from the ESO as part of its distribution network operator role. For example, sharing information relating to the ESO service need, design, pricing, and technical requirements of balancing services

[111] Standard Licence Condition 31E, among other requirements, requires distribution licensees to report on the flexibility they have procured and intend to procure. For more details see Ofgem's Electricity Distribution Standard Licence Condition 31E: Flexibility Procurement Statements 2021
[112] Constraint Management Zone (CMZ) is a geographic region served by an existing network where requirements on network security of supply are met using flexible services, such as Demand Side Response, Energy Storage and stand-by generation.
[113] A flexibility provider located in the distribution service area but outside of a CMZ will not submit bids to the DNO. Even though the number of CMZ should increase in ED2, the privileged information gained in the tenders is unlikely to grant a competitive advantage against the full market of competitors when providing balancing services.
[114] Ofgem (2021). Next steps on visibility of distributed generation connected to the GB distribution networks

procurement ahead of other participants could directly inform DNOs bidding strategies for CLASS.[115] DNOs could, in theory, then optimise the CLASS volumes and prices bid into balancing services markets better than its competitors. Service provider data[116] might give a better understanding of competitors commercial strategies and capabilities that would help DNOs optimise their own bidding and investment decisions in the balancing services market. Furthermore, this potential competitive advantage of observing transmission network conditions and service needs close to real-time could increase in a context where balancing services procurement is moving closer to real time dispatch of the services, as is expected in RIIO-ED2.

6.129. We have analysed data provided by the ESO in response to our RFI we sent and found that DNOs currently access information that is privileged, or partially privileged, and the amount is likely to increase in RIIO-ED2. We note to stakeholders that data exchange between DNOs and the ESO is an evolving piece of work, with involvement of the Energy Networks Association (ENA) Open Network's[117] focus and ongoing work on Regional Development Programmes (RDPs)[118]. The below table provides an overview of the information that is currently exchanged between the ESO and DNOs. With respect to this information, and with the exception of outage planning information, we conclude that it is unlikely that it would grant DNOs a competitive advantage in GB wide or locational balancing services market.

[115] Information on the ESO's service need include service needs and transmission network limits such as constraints, outages etc. DNOs could get this data two weeks ahead of real time with subsequent updates.
[116] Service provider data helps to determine the value of one system operator actions against another, it includes geographical data.
[117] For more details, see: Energy Networks Association. Open Networks: developing the smart grid
[118] For more details, see: National Grid ESO (2021). Regional Development Programmes (RDPs)

Table 13 Information sharing between DNOs and the ESO

Privileged information shared with the ESO	Likely to facilitate DNOs in the balancing services market
FES draft scenario	• Information on future energy scenarios is unlikely to generate an advantage. • Eventually, it might occur in the long period, but this information is privileged to DNOs only temporarily, as it circulates -widely in the market. It is also shared in a draft format (subject to change).
Third Party Works	• Information on connections technical data (size and date of a third-party asset) is unlikely to generate an advantage. • Its scope is limited to connection features of a given asset impacting on DNOs' network.
Live operational data	• Transmission system data is unlikely to grant DNOs with a competitive advantage with CLASS. • This information is limited to DNOs individual network. It would be insufficient to inform commercial and bidding strategies GB-wide. • DNOs visibility of a competitor's asset may raise some concerns in the locational balancing services, helping DNOs increase their knowledge of competitors. However, the ESO may increase the geographical scope of this information in the future.
ESO dispatch of DER for ODFM	• This data might help inform DNOs' wider strategies and understand market environment, but it is unlikely to benefit DNOs. • Information is limited to distribution connected competing assets and restricted to DNOs distribution service area.
Outage planning information	• Outage planning information could grant DNOs with a competitive advantage, directly informing the bidding strategy by adjusting the bid price to the tighter supply conditions. • The information also improves DNOs' knowledge of possible transmission outages impacting their own CLASS service provision. This helps DNOs increase their reliability, by informing on the risks of non-delivery and further support their commercial strategies.
Week 42 data	• Operational and planning data of network conditions under one-year scenario, is unlikely to inform DNOs' commercial strategies or influence CLASS prices. Information is time invariant and received once a year. • The information is unlikely to lead to a competitive advantage even with an increasing number of scenarios, in ED2.
Weekly OC2 data	• Information on outages affecting competing generators might be beneficial to DNOs' bidding strategies, as they move closer to real-time tenders; DNOs might benefit from some price advantages for the temporary reduced supply. • However, privileged information is limited to only generator outages affecting the integrity of DNOs' individual network.
Intertrip scheme data	• Circuit breaker or line flows data affecting DNOs' network is unlikely to inform commercial or bidding strategies with CLASS.

Incentive to foreclose rivals

6.130. In theory DNOs could foreclose rivals, but in practice they have very little incentive to do so. DNOs must provide connection offers whenever requested by a potential customer (other than in exceptional circumstances) and have limited ability to alter their offers to be more or less favourable to a customer due to regulatory and technical reasons. This was examined in detail by the CMA in relation to the National Grid Holdings One plc acquisition of PPL WPD Investments Limited.[119] To monitor compliance, Ofgem has an annual process that reviews the level of service that DNOs provide and in the event that discrimination in the connection process occurred, a DNO may be subject to penalties. Customers may also complain and appeal a connection decision with Ofgem, and enforcement action may be taken to ensure that regulatory obligations are met.

6.131. In addition, the RIIO-ED2 price control will include a package of measures[120] that would undermine a DNO's incentive to foreclose rivals:

- The customer satisfaction survey financial output delivery incentive (ODI-F) that monitors whether minor connection customers receive a good service that is consistent with network owners' regulatory obligations
- The time to connect ODI-F that sets penalties /rewards based on performance time to quote and time to connect metrics for minor connection customers
- The new major connections ODI-F that will incentivise DNOs to deliver quality services to customers seeking major connections in RIIO-ED2

6.132. In short, DNOs would face weak incentivise to discriminate against potential rivals in new connection offers (and other areas like fault restoration) as the cost of failing to comply with its regulatory obligations would likely outweigh any incremental gain in additional revenue from balancing services.

[119] CMA (2021). Completed acquisition by National Grid Holdings One plc of PPL WPD Investments Limited: Decision on relevant merger situation and substantial lessening of competition.
[120] Ofgem (2020). RIIO-ED2 Methodology Decision: Annex 1 - Delivering value for money services for consumers

6.133. We also discussed that DNOs may have some ability to use their informational advantage to compete less aggressively when deploying CLASS as a balancing service. However, their incentive to do so is likely to be limited in practice:

- In the previous discussion we saw that a DNO's ability to leverage this informational advantage would be severely constrained as, in the vast majority of instances, it would give them only partial insight into the behaviour of potential competitors and network conditions

- There would be non-trivial costs associated with collecting, analysing and using any informational advantage to inform a DNO's bidding strategy for CLASS. It is not clear that the anticipated benefits from doing so would exceed these costs as we have already seen that it would not yield a complete informational advantage.

Effect on competition

6.134. We have seen that a DNOs ability and incentive to foreclose potential rivals is quite limited and it follows that any harm to competitors would therefore be minimal. Our analysis of potential shares of supply also found that any given DNO would be unlikely to secure any dominant position in the market for balancing services. This would also imply that there would be limited impact on overall competition in the market as any barriers to entry for other competitors would be surmountable. For these reasons, we conclude that adverse foreclosure effects would be unlikely to arise if CLASS is deployed as a balancing service in RIIO-ED2.

Conclusion

6.135. We consider it unlikely that a DNO could secure a dominant position in the market for balancing services. It follows that a DNO would lack sufficient market power to instigate any price increase above the competitive level to the detriment of consumers. We have also found that it is unlikely that coordinated effects could arise in the market for balancing services as a coordinating group of DNOs (or indeed any type of providers) would struggle to define and adhere to the terms of any such agreement.

6.136. DNOs face weak incentivise to discriminate against potential rivals in its role as a regulated distribution network as the costs associated with such activities under RIIO-ED2 would more than offset any anticipated benefits. DNOs do have access to limited commercially sensitive information, but in practice they would have less ability and incentive to use this information. In any case, much of this advantage is expected to reduce in RIIO-ED2 as more onus is placed on DNOs to share network planning and operational data with stakeholders.

6.137. Finally, we have set out that Ofgem has enforcement powers if licensees breach compliance with relevant conditions and requirements or are alleged of anti-competitive agreements or abuses of dominant position. These provide us with the tools to respond to some of the theories of harm we have discussed here if they were to materialise in the future.

7. Next steps

Chapter summary

In this chapter, we briefly summarise the next steps for the consultation and decision on the regulatory treatment of CLASS as a balancing service in RIIO-ED2.

7.1. Our minded-to position is to continue to allow DNOs to provide CLASS to the ESO competitively, with costs and revenues included in DRS8, for RIIO-ED2 (ie Option 1A). We propose to continue to monitor participation for uncompetitive outcomes. We will also continue our programmes of work to promote Full Chain Flexibility and drive DNOs to implement robust, transparent measures to address actual or perceived conflicts of interest.

7.2. Once the consultation is closed, we will consider all responses. We will use the responses as part of our analysis for developing our final position on the regulatory treatment of CLASS in RIIO-ED2. Specifically, in our decision document we will set out the mechanism by which we will enact our policy position. However, we consider this Impact Assessment as final and do not intend to publish an update alongside our decision document.

Appendices

Index

Appendix 1 – Glossary

A

Automatic Voltage Control (AVC) relay

A component installed in transformers at primary substation to provide DNOs with the capability to remotely and automatically control the voltage output of a transformer. This is one the main components that allows for CLASS operations.

The Authority/Ofgem/GEMA

Ofgem is the Office of Gas and Electricity Markets, which supports the Gas and Electricity Markets Authority (GEMA or 'the Authority'), the body established by section 1 of the Utilities Act 2000 to regulate the gas and electricity markets in Great Britain.

B

Balancing Mechanism (BM)

The ESO's primary tool for managing the balance of supply and demand on the electricity transmission system within each half hour trading period of every day.

C

The Competition and Markets Authority (CMA)

A non-ministerial government department in the UK that considers regulatory references and appeals, conducts in depth inquiries into mergers, markets and aspects of regulation of the major regulated industries.

Customer Load Active System Services (CLASS)

A common term for remote voltage management technologies located at 33/11 (6.6)kV primary substations operated by DNOs. CLASS was an Electricity North West Limited (ENWL) innovation project that demonstrated this capability. The CLASS project, funded through Ofgem's Low Carbon Network Fund (LCNF) that operated under the previous electricity distribution price control to March 2015, showed that by remotely managing transformers and circuit breakers at primary substations to change voltage, DNOs can reduce or increase effective electricity demand and absorb reactive power.

D

Directly Remunerated Services (DRS)

Has the meaning given to it in CRC 1B (Interpretation of Part 4) of the electricity distribution licence.

DRS8: Value Added Service

Has the meaning given to it in Appendix 1 of CRC 5C (Directly Remunerated Services) of the electricity distribution licence.

DRS9: Miscellaneous

Has the meaning given to it in Appendix 1 of CRC 5C (Directly Remunerated Services) of the electricity distribution licence.

Distributed generation (DG)

Any generation connected directly to the local distribution network, as opposed to the transmission network, as well as combined heat and power schemes of any scale.

Distribution Network Operator (DNO)

A DNO is a company which operates the electricity distribution network which includes all parts of the network from 132kV down to 230V in England and Wales. In Scotland 132kV is considered to be a part of transmission rather than distribution so their operation is not included in the DNOs' activities.

There are 14 licenced DNOs that are subject to RIIO price controls. These are owned by six different groups.

Distribution System Operator (DSO)

The development of distribution system operation roles is a live and evolving policy area with various workstreams currently in progress. In general, DSO roles refer to innovative techniques and use of market-based solutions as alternatives to network reinforcement, as well as greater coordination with other network and system operators to achieve efficient outcomes in a whole system context.

Distribution Use of System (DUoS)

DUoS is a cost paid by suppliers to DNOs for the building and maintenance of the local distribution network. Suppliers then pass this DUoS charge on to energy consumers.

E

Electricity System Operator (ESO)

The entity responsible for operating the electricity transmission system and for entering into contracts with those who want to connect to and/or use the electricity transmission system. National Grid Electricity System Operator Limited is the electricity system operator in Great Britain.

Ex ante

Refers to a value or parameter established upfront (eg at the price control review to be used in the price control period ahead).

Ex post

Refers to a value or parameter established after the event (eg following commencement of the price control period).

F

Flexibility

The ability to modify generation and/or consumption patterns in reaction to an external signal (such as a change in price, or a message).

Frequency Response services

System frequency is a continuously changing variable that is determined and controlled by the second-by-second balance between system demand and total generation. The ESO is required to maintain a frequency of +/-1% of 50Hz at all times. To do this they procure frequency services to respond to fluctuations in electricity demand or generation from forecast volumes or to withstand faults to the network or connected generation. These services include Firm Frequency Response, Dynamic Containment, Dynamic Regulation and Dynamic Moderation.

I

Intermittent generation

Electricity generation technology that produces electricity at irregular and, to an extent, unpredictable intervals, eg wind turbines.

Interruption

A loss of electricity supply lasting 3 minutes or longer.

L

Licence conditions

These are the conditions under which a licensee holds its licence to operate as a gas transporter or electricity transporter and address various detailed matters including requirements to meet certain standards of performance, how the company's allowed revenue is to be calculated and procedures for modifying various documents.

Low Frequency Demand Disconnection (LFDD)

LFDD is the backup measure used by DNOs to limit the fall in grid frequency in extreme events, where DNOs disconnect customer load from the network as instructed by the ESO.

N

Net Present Value (NPV)

NPV is the discounted sum of future cash flows, whether positive or negative, minus any initial investment.

Network charges

These are charges recovered for the use of network services.

P

Price control

The control developed by the regulator to set targets and allowed revenues for network companies. The characteristics and mechanisms are developed by the regulator in the price control review period depending on network company performance over the last control period and predicted expenditure (companies' business plans) in the next.

R

Reinforcement

The installation of new network assets to accommodate changes in the level or pattern of electricity or gas supply and demand.

Reserve services

Reserve services provide additional electricity to the grid (or reduce electricity consumption) to manage unforeseen changes in demand or shortfalls in of generation. They can be distinguished from frequency response services by their slower response speeds and longer delivery durations, and by the fact that they are dispatched by instructions from the ESO rather than in response to local measurements of grid frequency. Reserve services include Fast Reserve, Optional Fast Reserve and Short Term Operating Reserve.

RIIO (Revenue = Incentives + Innovation + Outputs)

Ofgem's regulatory framework, stemming from the conclusions of the RPI-X@20 project, to be implemented in forthcoming price controls. It builds on the success of the previous RPI-X regime, but better meets the investment and innovation challenge by placing much more emphasis on incentives to drive the innovation needed to deliver a sustainable energy network at value for money to existing and future consumers.

S

Supplier

Any person authorised to supply gas and/or electricity by virtue of a Gas Supply Licence and/or Electricity Supply Licence.

T

Tap changer

A mechanism for changing the connection to an electrical transformer from one tap position to another that allows for control of output voltage under a varying load.

Third party

Within the innovation context, third party refers to any person other than network companies. It may include, for example, private companies, academics, small and medium-sized enterprises, and trade bodies. It is often used interchangeably with non-network company.

Total expenditure (totex)

Totex includes both capital expenditure (capex) and operating expenditure (opex). Totex is made up of fast money and slow money.

Transmission system

The system of high voltage electric lines and high-pressure pipelines providing for the bulk transfer of electricity and gas across GB.

V

Value of Lost Load (VoLL)

A measure of the value that domestic and SME customers' place on the security of their supply of electricity.

W

Whole system solutions

Solutions arising from energy network companies and system operators coordinating effectively, between each other and with broader areas, which deliver value for consumers.