CMP405

DEMAND CREDITS

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AGENDA

1. The purpose of CMP405 and how it fits with TNUoS
2. External analysis to support CMP405
3. Problem statement
4. Storage demand credit design options
5. Conclusions and next steps

THE PURPOSE OF CMP405 AND HOW IT FITS WITH TNUOS

PURPOSE OF CMP405

CMP405 is intended to improve the TNUoS locational signals for storage assets in high renewables areas

Purpose

The purpose of CMP 405 is to improve the TNUoS locational signals for storage assets in areas of high renewables resource in particular, by recognising the contribution that the demand from storage makes to relieving transmission constraints and so reducing the need for transmission network infrastructure. Therefore, **it is focussed only on the demand for electricity from storage**, it does not propose to change the approach taken to the generation of electricity from storage

How?

CMP 405 proposes to do this by correcting two specific defects:

- Firstly, remove the current 'floored at zero' approach for storage demand charges to allow the negative demand charge (payment) already calculated by NG ESO's 'transport model' to be used to determine a credit for demand from storage.
- Secondly, change the charging base for storage demand credits. This would require moving from storage demand being charged wholly as 'peak demand' on Triad, to a charge based on a measure of annual consumption or Maximum Import Limit (MIL).

These changes would only change the approach to charging storage in areas of high renewables resource (where demand charges are negative i.e. would elicit a payment), it does not change the approach to storage in high demand areas as the locational signals in these areas are not affected by the floored at zero approach.

How it fits in with wider market design

As this relates to TNUoS this mod is only about locational signals that relate to network build. It is not about any wider consideration of the most appropriate location for storage, which are addressed through other areas of the market design

TNUOS PURPOSE AND OBJECTIVES

CMP405 seeks to improve locational signals to storage improving the cost reflectivity of the TNUoS charge to storage

Purpose

TNUoS is designed to serve two purposes: firstly to provide users with a price signal that reflects the incremental cost, or benefit that user causes for network investment, and secondly to recover the costs of installing and maintaining the transmission network in GB

How?

TNUoS tariffs aim to be reflective of the long-run incremental cost of the network, to provide a useful signal for users to make efficient decisions about where and when to use the network – NG ESO TNUoS in 10 mins

What needs to be taken into account in changing the existing charging methodology?

Changes to TNUoS are consider against the relevant CUSC objectives summarised as:

a) Facilitates effective competition in the generation and supply of electricity
b) Results in charges which reflect, as far as reasonably practicable, the costs incurred by transmission licencees in their transmission businesses (Cost reflectivity)
c) So far as consistent with a) and b) as far as reasonably practicable, properly takes account of the developments in transmission licencees' transmission businesses
d) Compliance with the Electricity Regulation and any relevant legally binding decisions of the European Commission and/or Agency
e) Promoting efficiency in the implementation and administration of the system charging methodology

Key objective for CMP 405

Ofgem also considers its primary duty to protect the interests of existing and future gas and electricity consumers

This includes their interests in GHG emissions reduction and security of supply, storage helps both

TNUOS EVOLUTION

TNUoS generation charging has adapted to account for the impact of intermittent generation on the network, demand charging has not yet been adapted in the same way

TNUoS demand charges – Key milestones

Current approach to TNUoS (1993/94)

Cost reflectivity approach introduced but only considers peak demand as a driver of transmission investment costs

Scotland included in TNUoS charging methodology (2005)

In line with the introduction of integrated England & Wales and Scoltand electricity market arrangements

Project Transmit implemented (2016)

The cost of network to relieve transmission constraints is added to the TNUoS charging methodology as a second driver of investment cost. This was only applied to generation

Targeted charging review (2021)

Changes to the 'residual' charging base made negative demand charges (demand credits) possible, though these are currently not applied as charges are floored at £0/MWh

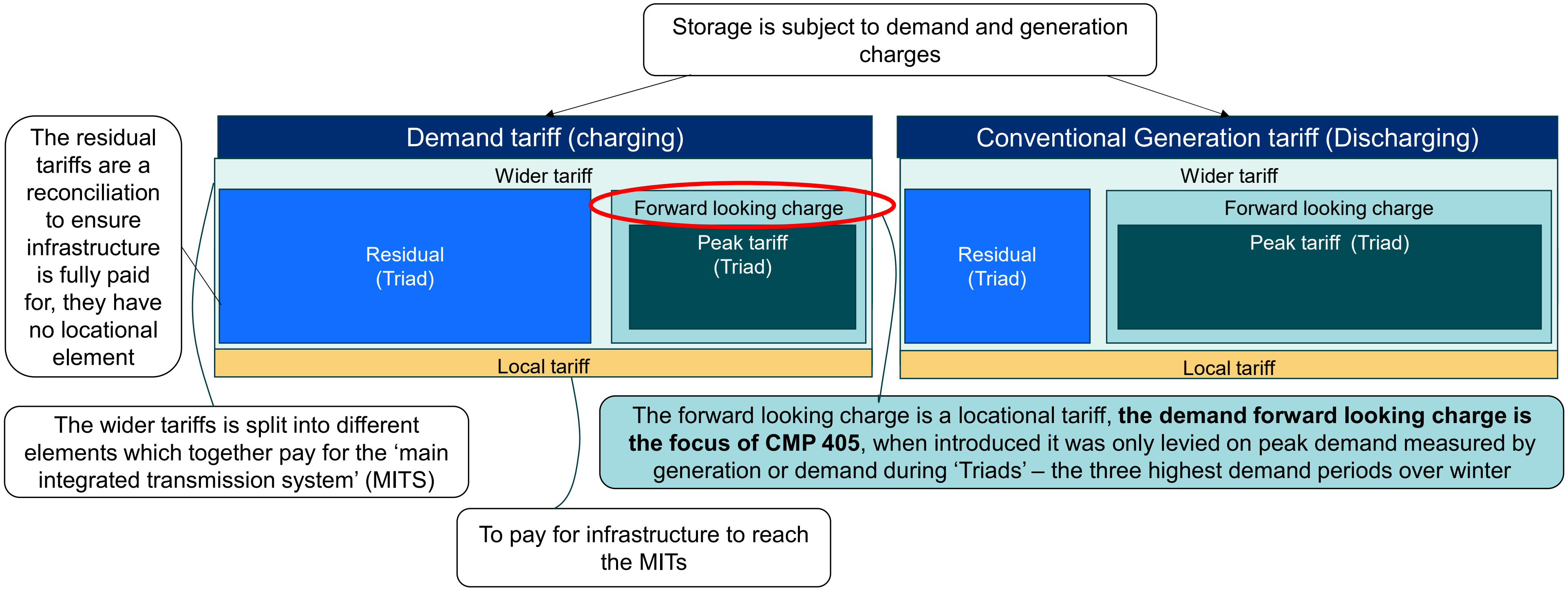
"[the modification] recognises that managing constraints efficiently is becoming increasingly important in driving transmission investment. This is an improvement on the existing methodology which only considers one driver of investment" – Ofgem's Project Transmit: Decision on proposals to change the electricity charging methodology

CMP 405 to introduce a 'demand credit' for storage located in negative demand charge zones would extend the inclusion of the cost impacts of network to requirements to relieve constraints to the demand side of TNUoS charging for storage. This would make it consistent with the approach to the generation from storage

TNUOS CHARGING TARIFF BREAKDOWN

The locational aspect of the TNUoS charging methodology is the focus of CMP 405

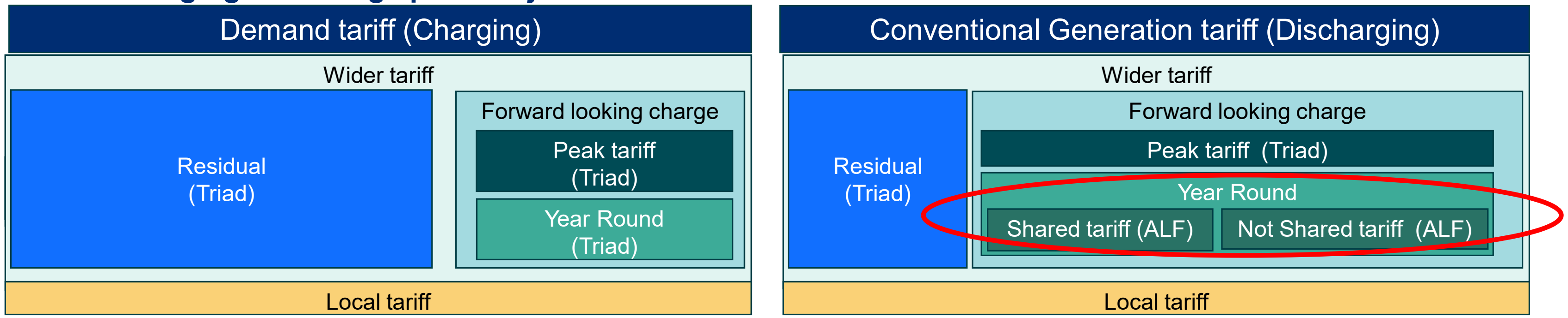
Transmission charging for storage – as introduced in 1993/94



TNUOS CHARGING: PROJECT TRANSMIT

Project Transmit adjusted the TNUoS generation charging methodology to reflect the cost of transmission infrastructure to relieve constraints as well as meet peak demand

Transmission charging for storage post Project Transmit



- Project Transmit was introduced against a background of the 2020 EU Renewable Energy Targets, requiring high levels of intermittent renewables to connect to the system
- To recognise the change in the anticipated capacity mix, an update was made to the decision making process to determine transmission network infrastructure requirements as set out in the Security and Quality of Supply Standard (SQSS). It was changed to include both:
  - Demand security criterion – to ensure peak demand is met (as previously); and
  - **Economy criterion – to determine requirements to relieve transmission constraints to allow intermittent renewable generation to meet demand. The relationship between constraints and network build is introduced into the model by the various Scaling Factors**
- To ensure that TNUoS remained cost reflective, TNUoS charging was then updated to maintain consistency with the updated approach to determining transmission network build requirements
- This change to the charging approach was implemented via a 'year round' charge (red circled) split into a 'shared tariff' for less congested areas where network is sized for all generation, and a 'not shared' tariff if intermittent generation is >50% where network is sized for individual generators
- For storage the generation charge is multiplied by its annual load factor (ALF) for both tariffs on the expectation that it is just as likely to notify to generate during unconstrained and constrained periods. **The demand tariff remained based on use during Triads.**

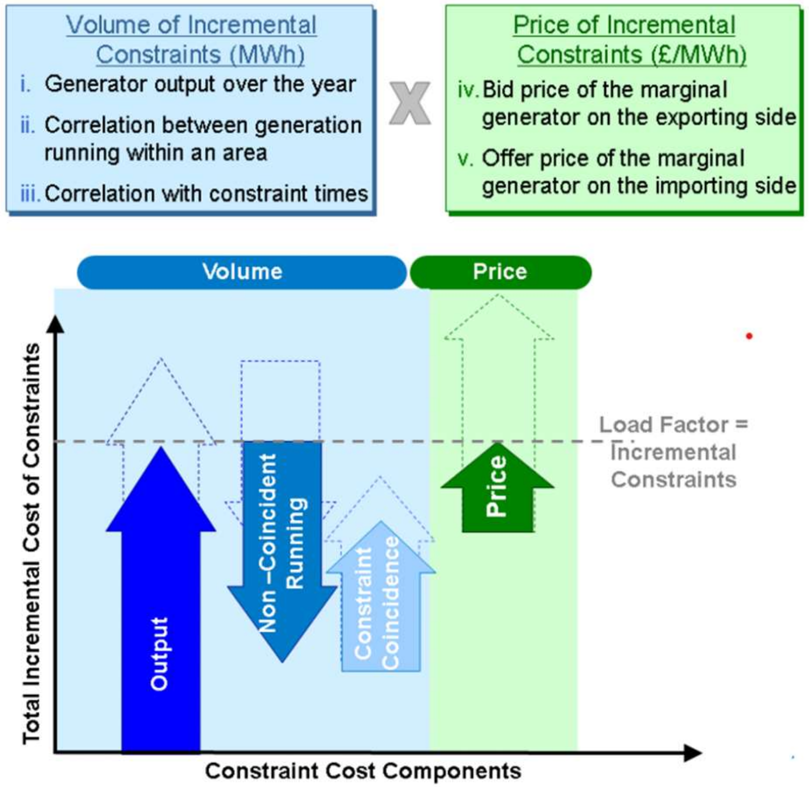
NETWORK INVESTMENT VS CONSTRAINTS

Ofgem's decision on CMP268, implementing TransmiT, recognised that increases, or reductions in constraints correspondingly cause more, or less cost of network investment

> *"Post-CMP213, the charging methodology was required to reflect that system investment and operation has to efficiently balance longer-term costs, such as the use of infrastructure investment, with short-term network costs through system operation, such as constraining off generators." (p1, Ofgem decision CMP268)*

CAUSES OF HIGHER/LOWER CONSTRAINTS

The cost of constraints caused, or avoided, is a function of incremental volume multiplied by price of constraints



Annual Load Factor (ALF) was introduced as a useful proxy for the incremental cost of constraints

The higher the ALF, the higher the correlation with other forms of generation, and so the greater the need for transmission investment to reduce constraints. As if all generation is operating at the same time more capacity is needed to export it from the region.

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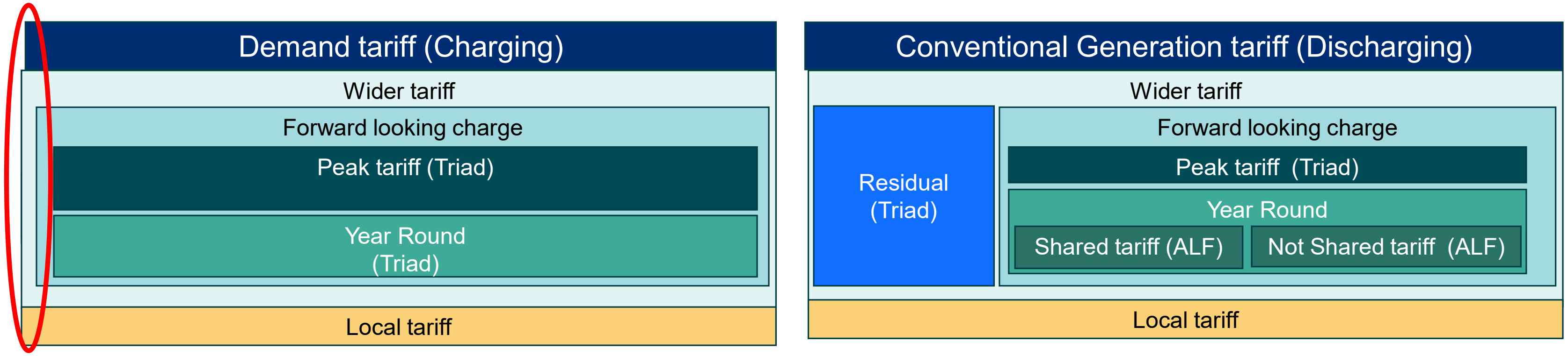
TNUOS CHARGING: TCR

The targeted charging review (TCR) removed the demand residual charge from storage

Transmission charging for storage post Project Transmit and TCR



- Theoretically demand TNUoS charges have always been floored at zero, however, in practice negative charges were not possible until the TCR, as previously both the residual and forward-looking charges were levied on Triads and as the residual was always higher than the forward-looking charge it cancelled out any benefit
- The TCR made two changes to the Demand Residual charge which mean it no-longer cancels out negative demand charges, making negative demand charges possible:
  - Only apply to 'final demand' meaning it does not apply to demand from storage demand to avoid double counting
  - No longer charged on Triad peak demand but became a fixed charge per site
- A zero residual charge for storage and lower residual charge for other demand meant that the forward-looking charge could be greater than the residual, in zones where the transport model calculates this to be negative (a payment) the overall TNUoS charge would be negative
- As a result Ofgem revisited its decision to floor the demand TNUoS charge at zero, Ofgem decided to retain it as it was concerned about incentivising demand during peak periods.
- This would likely be less of a concern if demand had been updated to charge the Year-Round tariff on load factor as was done for generation charging.
- At the time, Ofgem recognised the deficiency of the floor at zero solution and anticipated the floor at zero approach "*…may only be temporary, because it is subsequently superseded by other TNUoS reforms.*" (para 3.31, Ofgem decision CMP343)

DCLF ICRP MODEL

The DC load flow investment cost related pricing (DCLF ICRP) model calculates negative TNUoS charges for year-round demand charges

How the 'transport model works

- TNUoS locational charges are calculated using the DC Load Flow Investment Cost Related Charging Pricing (DCLF ICRP) 'transport model'.
- The model calculates the cost of to the network of adding an additional MWh of generation or demand at a particular location (node).
- This cost is compared to a central node, so locations that require less network than the central node receive in negative charges (payments), those requiring more network receive positive network charges
- the further away the demand or generation is from the central node the higher the network charge/payment
- The highest potential demand payments are in Scotland where there is high wind resource and relatively low demand

Implications of its calculations

- The transport model shows that according to NG ESO's methodology for calculating the costs of network build demand located in areas of high renewables resource reduces the cost of network build, hence the negative charges
- The biggest contribution to this is demand located in Scotland where there is high wind resource and relatively low demand
- Moving away from charging the 'year round' charge on peak demand and onto demand during times of constraint would better align with the intentions of the tariff calculation and avoid concerns over incentivising additional peak demand

Forecast peak and year round tariffs for demand 2022/23

Demand Zone		2022/23 April	
		Peak (£/kW)	Year Round (£/kW)
1	Northern Scotland	-3.116462	-27.428739
2	Southern Scotland	-3.215416	-18.599220
3	Northern	-4.063048	-7.542140
4	North West	-1.585722	-4.140701
5	Yorkshire	-3.215572	-1.813832
6	N Wales & Mersey	-2.412292	-1.988324
7	East Midlands	-2.487282	1.150504
8	Midlands	-1.419253	1.634158
9	Eastern	1.249970	-0.069565
10	South Wales	-3.583402	5.305982
11	South East	3.790322	-0.265553
12	London	5.603960	1.059458
13	Southern	1.809885	3.419941
14	South Western	0.780133	6.380386

Source: NG ESO Forecast TNUoS Tariffs for 2022/23, August 2021,Table 21

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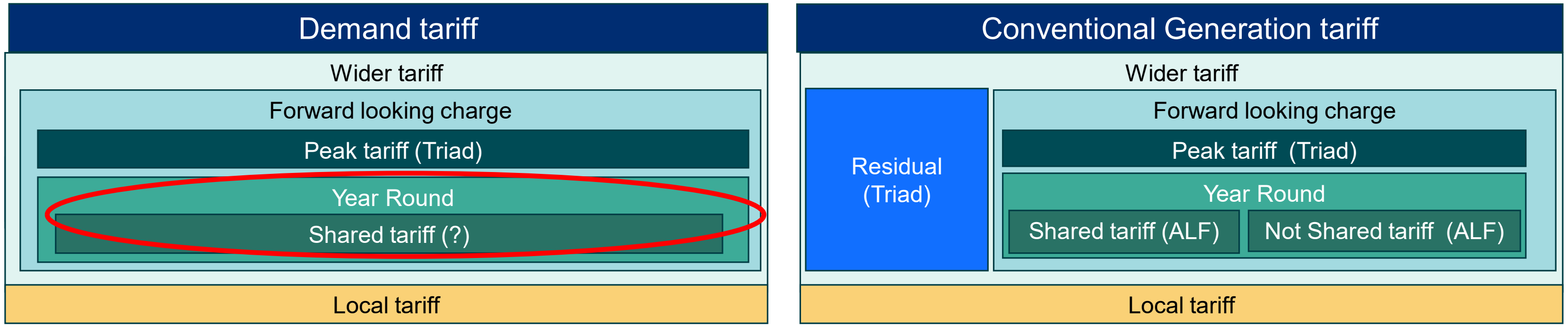
TNUOS CHARGING: CMP 405

CMP 405 would make the year round charge for demand more consistent with the year round charge for generation

Transmission charging for storage post Project Transmit, TCR and CMP405



- CMP405 would change the charging base of the year round for storage from peak demand, measured by 'triads' to a metric that better reflects the contribution of demand from storage to relieving constraints in negatively charged areas
- There are different ways in which the tariff could be introduced e.g. whether it should mirror the generation tariff of ALF based on the last 5 historic years, or whether it should be more strongly linked to the contribution storage makes to reducing constraints
- **This is a key point for discussion with the CMP405 working group**

CURRENT APPROACH TO TNUOS FOR STORAGE

There is currently no recognition of the contribution that storage makes to reducing transmission constraints

Charging

- Is charging during all constraints
- Is more likely to charge during constraints, but sometimes charges during unconstrained periods
- Charges at the same rate during constrained and unconstrained periods
- It is more likely to charge during unconstrained periods but sometimes charges during constraints
- Never charges during constraints

Our hypothesis is that charging for longer duration storage will occur more frequently during transmission constraints as there will be a positive correlation between low wholesale electricity prices and transmission constraints

This is the effective demand locational signal in the existing TNUoS charging regime

Discharging

- Never generates during constraints
- It is more likely to generate during unconstrained periods but sometimes charges during constraints
- Charges at the same rate during constrained and unconstrained periods
- Is more likely to generate during constraints
- FPNs to generates during all constraints

This is the effective generation locational signal in the existing TNUoS charging regime

IS CMP405 NEEDED?

Storage in Scotland is currently charged as if it exacerbates constraints, if this is not the case it the current TNUoS charging approach provides inaccurate locational signals to storage

How much does storage charge during constraints?	What is the <u>net</u> impact of storage on constraints?*	What is the most appropriate overall TNUoS impact?
1 It never charges during constraints	It makes transmission constraints worse	**No change** to current regime, net cost paid by storage
2 Charges at the same rate during constrained and unconstrained periods	It has little to no impact on transmission constraints	**Change TNUoS**, an approach similar to generation e.g. ALF may be appropriate
3 Is more likely to charge during constraints, but sometimes charges during unconstrained periods	It reduces transmission constraints	**Change TNUoS**, an approach that accounts for the contribution to constraints management might be appropriate

We have commissioned modelling from Frontier and LCP to consider this question

*This assumes that the generation charging structure is appropriate for storage

WIDER CONSIDERATIONS

CMP405 is a first step towards wider locational charges for demand in high renewables areas

Why only apply CMP405 to storage and not all demand?

- CMP405 is a first step is extending demand credit to demand more widely. The reason to confine it to storage in the first instance is:
  - There are a lot of considerations in relation to different types of demand that mean it may be better addressed as part of the wider TNUoS review
  - It would not be appropriate to put storage into the wider review because long duration storage final investment decisions will happen before the outcome of any wider review is known – the need for a policy to enable investment by 2024 is noted in the draft strategic policy statement for Ofgem from DESNZ
  - Storage is a unique type of demand that is subject to generation TNUoS charges and demand TNUoS charges and so the inconsistency in approach to both charges is particularly distorting locational signals for storage

EXTERNAL ANALYSIS TO SUPPORT CMP 405

SCOPE OF THE EXTERNAL ANALYSIS

SSE Renewables has commissioned analysis from Frontier/LCP to provide an evidence base to support the implementation of CMP405

Frontier and LCP are assessing the theoretical basis for demand credit with quantitative modelling analysis to support the theoretical assumptions where relevant.

The qualitative analysis will consider:

- The rationale for a demand credit and how well it fits with the TNUoS charging methodology and Ofgem's objectives
- The design options for a demand credit including the pros and cons of each option

The purpose of the quantitative modelling is:

- to calculate the proportion of time storage of different durations relieves constraints in Scotland (B2 and B6)
- calculate the impact of additional storage on system costs and consumer costs
- explores how the results are sensitive to different assumptions around the development of the power system, and how they may vary for different types of storage

The analysis considers many aspects that would ordinarily be included in a cost benefit analysis (CBA) to test the rationale for a demand credit, however, its focus is to help determine the design of the demand credit so it is not a full cost benefit analysis. A full CBA would be more appropriate once there is one or more clear design options.

MODELLED SCENARIOS AND SENSITIVITIES

LCP has modelled the operation of storage under a range of scenarios and sensitivities to test the findings of the modelling under different future scenarios

Counterfactual scenario

Counterfactual scenario: An adapted version of the FES System Transformation (ST) with:

- a 5 year delay in offshore wind build
- an "optimised" network build
- No new long duration storage

Sensitivities

- **High Wind:** The ST scenario with an optimised network to efficiently accommodate the higher wind build
- **Low wind:** The ST scenario with an 8 year wind delay and an optimised network to efficiently accommodate it
- **High Network Build:** Counterfactual with higher network build (from the High Wind sensitivity)
- **Low Network Build:** Base case with lower network build (from the Low Wind sensitivity)

Contribution to transmission constraints management

- An additional 1 MWh of 1, 2, 4, 8, 12, 16, 23 and 48 hours duration storage was added to the counterfactual to test operation during constraints. This approach is in line with the approach taken under the NG ESO transport model

System and consumer costs analysis

- **Factual scenario 1 (FS1):** CF with LDES included in line with the Leading the Way scenario.
- **Factual scenario 2 (FS2):** CF with equivalent GW of shorter duration storage to the LDES included in FS1

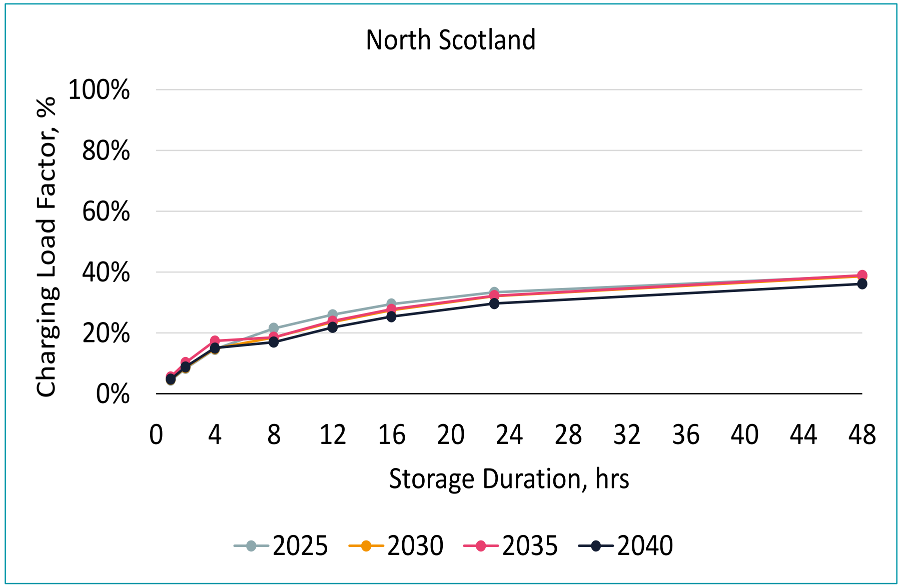
Outputs

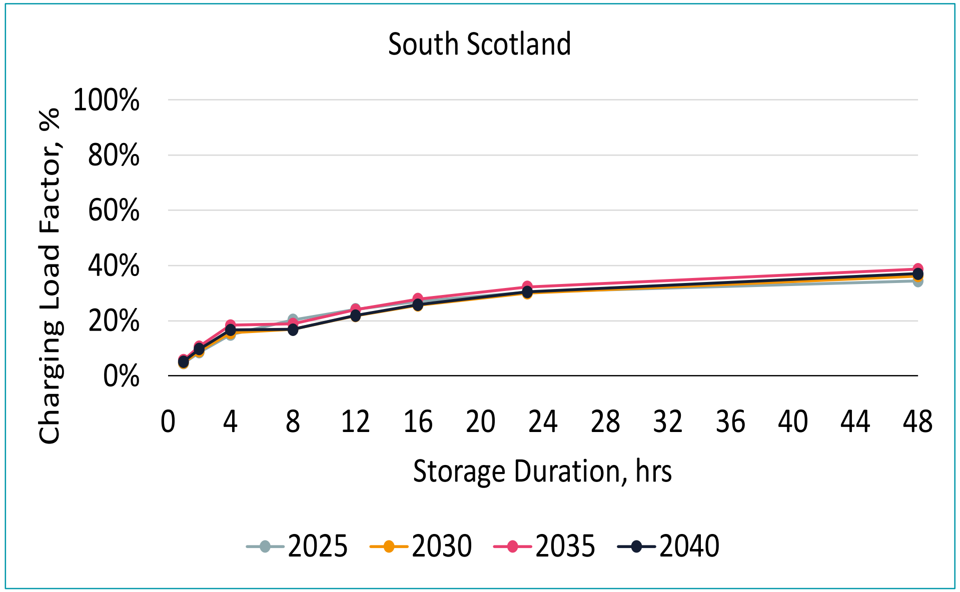
- The proportion of constraints are relieved by different durations of storage (LF for charging during constraints)
- The impact of addition short and long duration storage on system and consumer costs
- Additional wind utilisation

An NG ESO FES scenario was chosen due to its transparency. A five year wind delay to the ST scenario was used in the counterfactual scenario to better reflect the proportion of wind seen in cost optimised scenarios that also reach a net zero electricity system by 2035. Without this delay zero prices are seen around 50% of the time, this would lead to very high support costs for wind that Government would be very unlikely to agree to.

DRAFT RESULTS FROM THE ANALYSIS (1)

The longer the storage duration the higher the modelled load factor

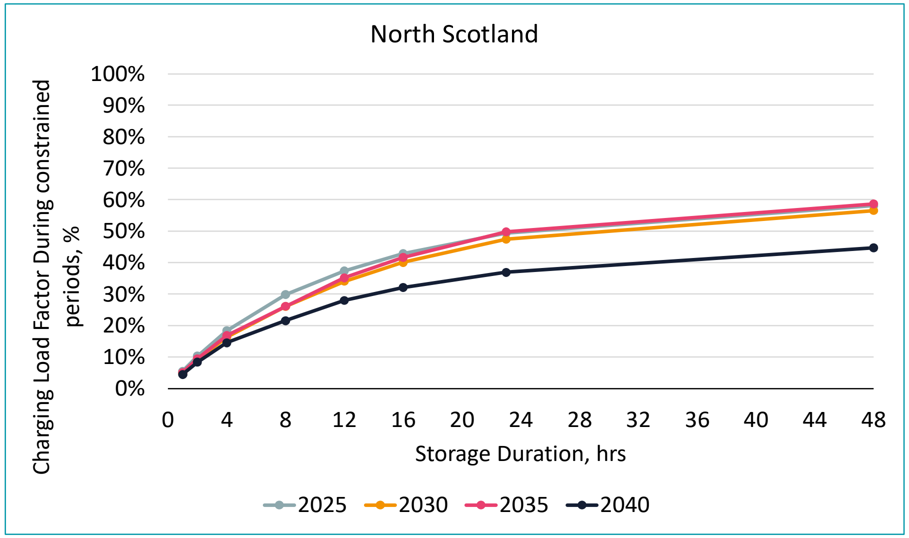


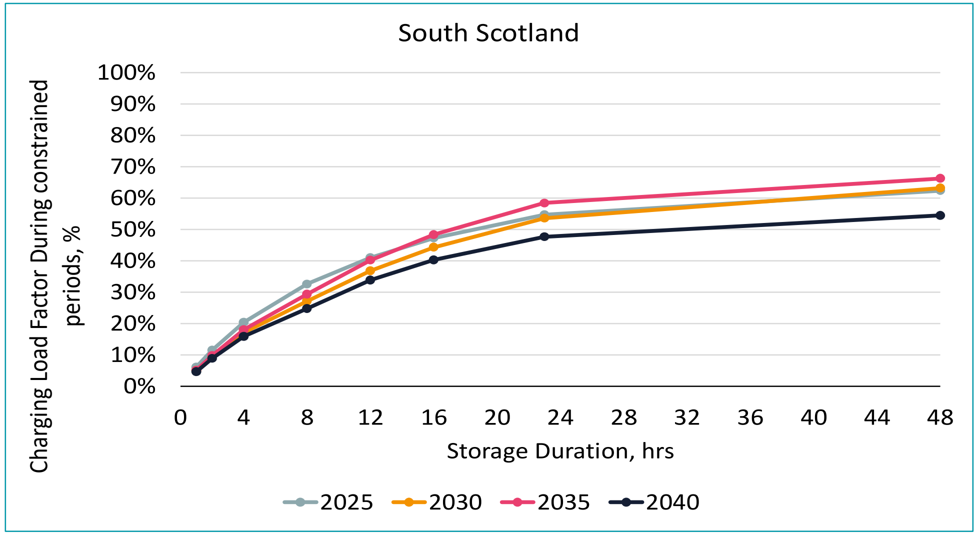


- Load factors for longer durations show higher load factors are they are more able to charge for sustained periods of excess wind
- Load factors for Southern Scotland are slightly higher than Northern Scotland as they are able to discharge slightly more frequently

DRAFT RESULTS FROM THE ANALYSIS (2)

Storage with 23 hours plus duration can relieve constraints around half the time

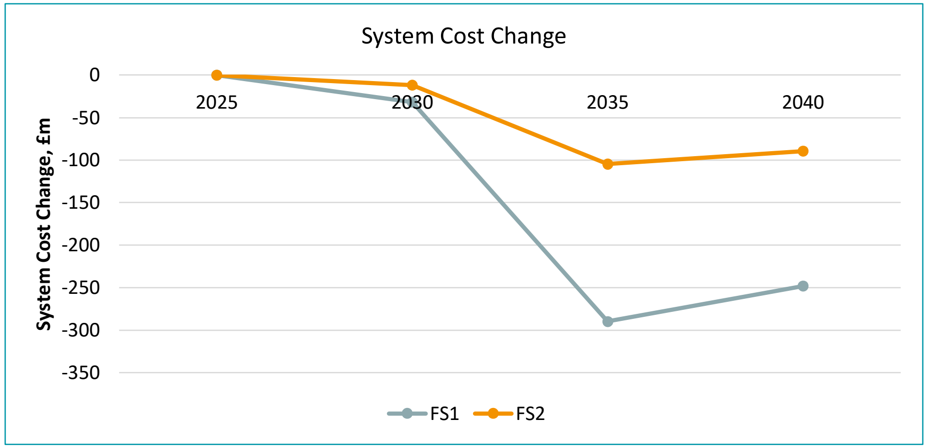


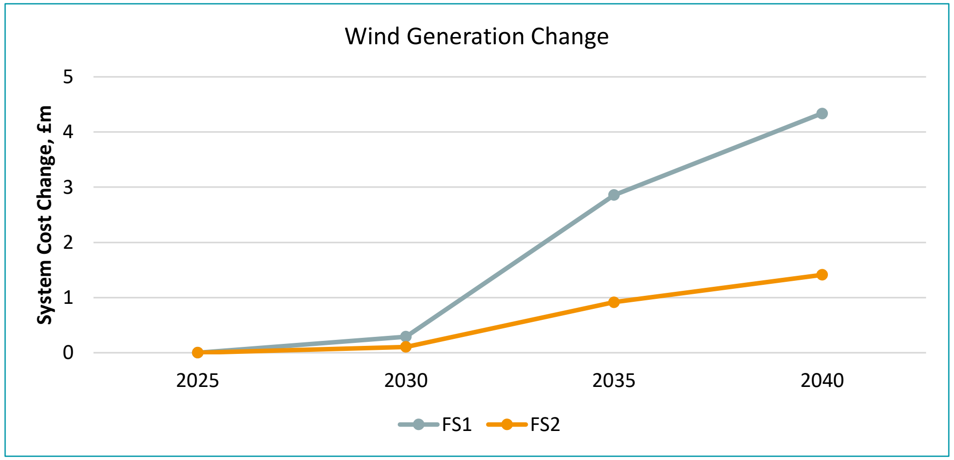


- The longer the duration of the storage asset the higher its load factor during constraints
- For shorter duration assets, the LF during constraints is broadly the same as the LF of the asset i.e. no correlation with constraints
- For longer duration assets, the LF during constraints is more than the LF of the asset i.e. a positive correlation with constraints
- Projects in southern Scotland has a higher LF during constraints, this reflects the higher LFs of these assets

DRAFT RESULTS FROM THE ANALYSIS (3)

Additional storage in Scotland leads to a reduction in system operational costs and increased utilisation of the wind resource





- For long duration storage (FS1) system operational costs are reduced by around £250million from 2035 and once it's operational around 3TWn of additional wind is utilised
- The system operation costs still reduce for the equivalent capacity of short duration storage (FS2) but the reduction is lower as its response cannot be sustained during periods of high wind. It also utilises less wind.

THE PROBLEM STATEMENT

SUMMARY OF THE PROBLEM

Our analysis is expected to conclude that existing TNUoS charges distort the locational signals to storage and demand credits would provide a more cost reflective charge

Problem statement

TNUoS locational charges are applied to both the demand and generation from a storage asset. Our analysis shows that charging (demand) helps relieve transmission constraints and discharging (generation) contributes to transmission constraints. The overall impact is broadly neutral for shorter duration storage technologies and longer duration storage provides a net benefit. TNUoS charging is intended to be cost reflective and so it would be expected that the charging structure would reflect this impact on transmission constraints and ultimately transmission network build decisions.

However, the current TNUoS charging methodology is applied in different ways for generation and demand, such that the generation tariff accounts for the contribution storage makes to transmission constraints, but the demand tariff does not. This results in the locational signals to storage being skewed to the generation impact, overstating the overall impact of storage on constraints.

The intention of TNUoS is ensure that investors take the locational impact of networks into investment decisions. If these locational signals are distorted this could lead to inefficient investment decisions. This is particularly pertinent now for long duration storage as the Government has signalled its desire to bring forward long duration storage via a revenue stabilisation mechanism with the intention that the first projects can reach financial investment decision by the end of 2024. Numerous studies have shown the benefits that long duration storage can bring to the electricity system and our own analysis shows a reduction in system operational costs of around £200-300/million a year and utilisation of an additional 3TWh of wind that would otherwise be wasted.

There are a number of pumped storage hydro projects being developed in Scotland. TNUoS is a significant factor in the financial viability of such projects and so it is important that investment signals from TNUoS appropriately reflect the contribution that long duration storage makes to constraints management. This will avoid distorting investment signals to these projects which could lead to inefficient outcomes for the electricity system leading to higher costs to consumers.

Defect

Due to how demand is charged, tariffs have lost the signal of a negative; Year Round; Demand locational charge to encourage Storage to locate closer to Generation and import when intermittent generation is operating.

We welcome comments on the problem statement or defect?

STORAGE DEMAND CREDIT – DESIGN CONSIDERATIONS

DEMAND CREDIT DESIGN CONSIDERATIONS

Option	Description	Advantages	Disadvantages
Volume-based credit	Credit set ex post based on annual (pumping) volume (MWh)	• Simple to implement, including for new plants as set ex post. • Annual volume likely to have some relationship with contribution to relieving constraints	• Volumetric-based charges could distort dispatch • Need to convert a £/kW Year Round charge into £/MWh charges
Capacity-based (MIL)	Credit set based on MIL	• Simple to implement for new plant, and is non-distortionary	• Does not reflect the impact of different types of storage plant on constraints and avoided network costs
Capacity-based (ALF)	Credit set based on MIL x ALF	• Is similar to the TNUoS year-round generation charge methodology for Conventional Low-carbon plant and is relatively simple. Non-distortionary.	• Differentials in charges may inaccurately reflect the contribution to avoiding network costs and therefore may distort investment in different storage assets.
Capacity-based (constrained ALF)	Credit set based on MIL x ALF during constraints or other de-rating factor	• Consistent with approach to application of sharing factors for Intermittent plant generator TNUoS charges. • Better reflects the contribution of different storage plant to avoiding network costs. Non-distortionary.	• Practically, difficult to set value of constrained ALF for new plant ex ante, and may require modelled values until observed data available. • Risk that if system deviates significantly from optimal expansion path of network, then observed constrained ALF may also not reflect value of storage in optimal system. May require modelling an optimised constrained ALF

Source: Frontier draft report on the case for CMP405

CONCLUSIONS AND NEXT STEPS

KEY MESSAGES

Frontier and LCP’s analysis suggests that a demand credit would provide a more cost reflective locational signal to storage assets

- CMP405 focuses the TNUoS demand charge for storage only
- It was Project Transmit tht introduced the link between TNUoS charging and transmission constraints, however, demand charges (unlike generation charges) were never fully adapted to account for this
- It is only since the implementation of the Target Charging Review in 2021 and the lifting of the demand residual for storage that the floor of £0/MWh has affected TNUoS demand charges for storage in practice
- Even if storage is net neutral to constraints i.e. the benefit during charging is cancelled out by the cost during discharge, this suggests a demand credit is required to avoid distorted locational signals from the existing charge on generation from storage
- The modelling performed by LCP supports our hypothesis that there is a positive correlation between charging and constraints in Scotland for longer duration storage and the longer the duration the better this it, it also identifies wider system benefits of more storage in Scotland
- It is necessary that any change happens now to ensure appropriate locational investment signals in time for the Financial Investment Decision (FID) for long duration storage projects in 2024 in line with Government ambitions
- CMP405 would be a first step in addressing locational transmission charging for demand in high renewable resource areas, currently an area of high interest to policy makers
- There are different options for the design of the demand credit and we welcome ideas on the approach to propose

NEXT STEPS

- We are happy to take any queries on the approach to the external analysis following today's discussion
- We will take away any comments questions made for further consideration
- We welcome the sharing of potential design ideas
- An external report is due in September, a working group meeting will be scheduled to coincide with this