

Workgroup Report

CMP393: Using Imports and Exports to Calculate Annual Load Factor for Electricity Storage

Overview: This modification proposes to alter the definition of Annual Load Factor (ALF) with respect to electricity storage, taking into account imports as well as exports. Here, 'electricity storage' refers to all storage that has booked Transmission Entry Capacity (i.e., pumped and battery).

Modification process & timetable



Have 10 minutes? Read our [Executive summary](#)

Have 60 minutes? Read the full [Workgroup Report](#)

Have 120 minutes? Read the full Workgroup Report and Annexes.

Status summary: The Workgroup have finalised the proposer's solution. They are now seeking approval from the Panel that the Workgroup have met their Terms of Reference and can proceed to Code Administrator Consultation.

This modification is expected to have a: **High impact** on Storage Operators, Generators, Transmission Owners, ESO, Parties Liable for TNUoS

Governance route Standard Governance modification with assessment by a Workgroup

Who can I talk to about the change?

Proposer:
Robert Newton
robert.newton@zenobe.com
07342 169677

Code Administrator Chair:
Teri Puddefoot
terri.puddefoot@nationalgrideso.com
07812 508708

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Executive summary

What is the issue?

The Transmission Network Use of System (TNUoS) charging methodology currently includes battery storage and pumped storage in the 'Conventional Carbon' generation classification. As such, battery storage and pumped storage assets face the Conventional Carbon generation tariff: $\text{Peak} + (\text{Annual Load Factor [ALF]} \times \text{Year Round Shared}) + (\text{ALF} \times \text{Year Round Not Shared}) + \text{generation adjustment}$.

In the proposer's view, using only output to calculate ALF for pumped storage and battery storage does not reflect how storage assets can import power, as well as export it. Consequently, the proposer argues that the TNUoS methodology does not accurately reflect how storage assets interact with the National Electricity Transmission System (NETS).

What is the solution and when will it come into effect?

Proposer's solution: This modification proposes to alter the definition of ALFs with respect to storage. All storage that has booked TEC would face a bespoke Storage ALF calculation, considering imports as well as exports. As other storage technologies connect to the NETS, they too will be included.

It is proposed that the tariff will read: $\text{peak} + (\text{Storage ALF} \times \text{Year Round Shared}) + (\text{Storage ALF} \times \text{Year Round Not Shared}) + \text{residual}$. The Storage ALF will be floored at zero.

Implementation date: 01 April 2025

Summary of alternative solution(s) and implementation date(s):

Two Alternative Requests were raised following the Workgroup Consultation. Both were deemed by the Workgroup to not be in scope of this modification, and the Proposer of the Alternative Requests subsequently withdrew them. These can be found in Annex 10.

Workgroup conclusions: The Workgroup concluded by majority (9/11) that the Original better facilitated the Applicable Objectives than the Baseline.

What is the impact if this change is made?

The proposed amendments to the transmission charging methodology will better incentivise competition among storage operators. They will result in more cost-reflective charges and ensure that the transmission charging methodology responds to the accelerating deployment of storage in the NETS.

Interactions

There is a potential interaction with another current modification, [CMP405](#). However, Ofgem and the CUSC panel have determined that the two code modifications can proceed independently. CMP393 proposes to alter ALFs, while [CMP405](#) proposes to alter demand charging. As such the two modifications propose distinct solutions to a similar defect.

[CMP316](#) also proposes amends to the ALF section of the CUSC. If [CMP316](#) is approved prior to CMP393, minor additional legal text amends will be required in addition to those proposed for CMP393. These legal text amends can be found in Annex 14.

The storage sub-group has CMP393 and [CMP405](#) excluded from their scope so any outputs of this are unlikely to interact with CMP393.

What is the issue?

The Transmission Network Use of System (TNUoS) charging methodology currently includes battery storage and pumped storage in the 'Conventional Carbon' generation classification. As such, battery storage and pumped storage assets face the Conventional Carbon generation tariff: Peak + (Annual Load Factor [ALF] x Year Round Shared) + (ALF x Year Round Not Shared) + generation adjustment.

In the proposer's view, using only output to calculate ALF for pumped storage and battery storage does not reflect how storage assets can import power, as well as export it. Consequently, the proposer argues that the TNUoS methodology does not accurately reflect how storage assets interact with the National Electricity Transmission System (NETS).

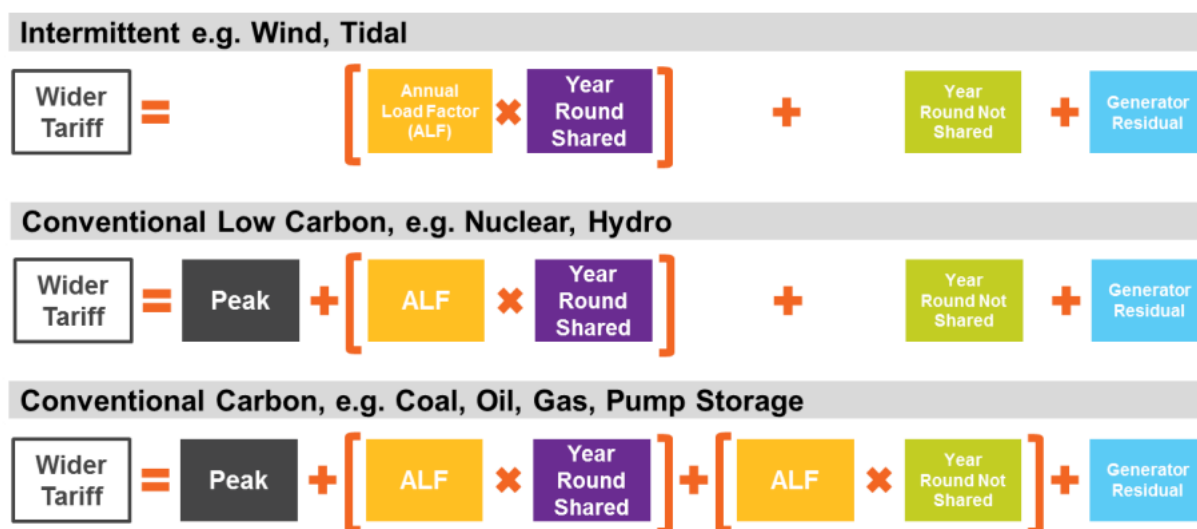


Figure 1: TNUoS Generation Classifications. See *TNUoS Guidance for Generators* (National Grid ESO, 2019), <<https://www.nationalgrideso.com/document/138046/download>>, p. 11.

For the purposes of transmission charging and ALF, battery storage was until recently treated the same as pumped storage.¹ Since 2023/24 battery storage has an assumed Generic ALF of 1.6%, while pumped storage has an assumed Generic ALF of 8.6%.²

Why change?

¹ See *Final Annual Load Factors for 2022/23 TNUoS Tariffs* (National Grid ESO: 2022), <[TNUoS Guidance for Generators](#)>, pp. 10, 14, 17.

² *Final Annual Load Factors for 2023/24 TNUoS Tariffs*, January 2023, National Grid ESO, <https://www2.nationalgrideso.com/document/275686/download>

In the view of the Proposer, current TNUoS charging arrangements for electricity storage are inconsistent with the CUSC Applicable Charging Objectives (ACOs).³ The TNUoS methodology does not reflect how storage assets import, as well as export, power. As a result, the methodology provides storage operators with an inaccurate economic signal that creates a barrier to entry, inhibiting effective competition. Charges are not cost-reflective, as they do not fully reflect how storage interacts with the NETS. Nor do charges take account of developments in transmission licensee business, as they do not reflect the increasing amount of storage connecting to the NETS.

In the view of the Proposer, storage operators should face a tariff that aligns more closely with the CUSC Applicable Charging Objectives. The tariff should incentivise effective competition in the storage sector, reflect the value of storage to transmission licensees, and take account of new strategic, market and technological developments.

The Proposer believes that the reasons for the defect can be grouped under the following subheadings:

1. Changes in Licensee Business
2. Effective Competition
3. Value to Transmission Licensees
4. Interaction with Wider Work on TNUoS

The Proposer engaged the consultancy Lane Clark Peacock (LCP) to model the behaviour of battery and pumped storage during high network loads, and to consider whether the current methodology accurately reflects this behaviour. The LCP report is in Annex 11.

1. Changes in Licensee Business

The last substantial updates to the transmission charging methodology took place in 2014, as part of Project TransmiT. Ofgem introduced a new 'Intermittent' generation classification for renewables, and split Generation TNUoS tariffs into 'Peak' and 'Year Round' components. They chose to adjust the Year Round component by ALF to provide 'a proxy of the impact an individual generator has on the costs of a system when investment is planned to manage constraint costs'.⁴ Here, ALF is calculated based on output, and no consideration is given to input. As a result, the methodology results in an inaccurate proxy of the impacts of individual storage assets on constraint costs.

Since 2014, the amount of intermittent renewable generation connected to the NETS has increased substantially, and the system need for storage has intensified. The market has responded to this need, with numerous storage operators working to integrate renewables into power networks. Other than the 2019/20 addition of battery storage to the Conventional Carbon generation classification, and the recent addition of battery storage-specific Generic ALF, transmission charging regulation has not adapted to the

³ By 'electricity storage' the Proposer refers to all storage that currently has booked Transmission Entry Capacity (i.e., pumped and battery).

⁴ *Project TransmiT: Decision on proposals to change the electricity transmission charging methodology* (London: Ofgem, 2014), p. 13.

accelerating deployment of storage.⁵ As a result, tariffs are based on inaccurate and outdated assumptions.

In 2013, National Grid Electricity Transmission undertook modelling to provide quantitative evidence of the impacts of implementing the Project TransmiT proposals. The results of this modelling substantially influenced the decision to implement TransmiT. The modelling did not consider the possible impacts of battery storage deployment on reinforcement of the electricity system.⁶ Since the Project TransmiT changes were implemented, the UK landscape for electricity storage has changed considerably, with 3GW battery storage now connected to the system, in addition to the 3GW of pump storage already deployed. In light of these changes, there is a need to update the charging methodology so that it more accurately reflects the system impacts of storage, and of battery storage in particular.

The Proposer believes that the ESO does not publish transparent information on how it calculates the contribution of battery storage to network reinforcement and how each storage project impact on the network is calculated. However, the Proposer noted that the ESO is amending its generation background, or Connection Planning Assumptions (CPA), modelling to take account of the net positive effects of storage in constrained renewable power systems in worst-case conditions.

Following Workgroup meetings and further discussion with ESO, the Proposer and LCP believe that the approach to developing Connection Planning Assumptions is as follows:

- A GB-wide dispatch of the wholesale power market is carried out.
- There are stochastic simulations of different wind and demand conditions.
- Battery assets are assumed to participate in wholesale arbitrage, as this is their main long-term revenue stream.
- In the local area of the new connection, the level of constraint is calculated in each period and the results for the most constrained 5% of hours are kept. These will differ regionally depending on the capacity mix.
- Storage will be treated differently by location and while some storage projects will be treated as OMW, others will not. It is not possible to verify this by location or battery versus pumped storage as none of the information has been published.
- Across these periods, the average generation of each technology is taken and provides the assumptions that are passed to the network operator for them to assess required reinforcements.
- Storage assets may be both charging and discharging across those periods, and so the assumption passed onto the ESO is based on their average position.
- The required reinforcements are therefore calculated to accommodate full import and export of a storage asset.

⁵ See *Final TNUoS Tariffs for 2019/20* (National Grid ESO: 2019), p. 13.

⁶ See 'Project TransmiT: Impact Assessment of industry's proposals (CMP213) to change the electricity transmission charging methodology', Ofgem, (137/13, 2013), < https://www.ofgem.gov.uk/sites/default/files/docs/2013/08/project_transmit_impact_assessment_of_cmp213_options.pdf >.

As set out in Annex A of LCP's supporting analysis (Annex 11) and following a further review session held with the ESO, the Proposer believes that this has the following implications for the treatment of battery and pumped storage in TNUoS:

- The CPA modelling of storage doesn't reflect the actual optimisation in the market as it only includes wholesale Arbitrage and doesn't include Balancing Mechanism, Balancing Services or Intraday price optimisation so has significant limitations.
- The CPA assumptions for projects isn't transparent and can't be validated but it is believed that they should be aligned.
- During the most constrained periods, storage which is assumed to already be connected may be importing or exporting and their average behaviour is considered.
- The network must be able to accommodate the maximum import and export of the additional storage, but each individual asset is understood to be a relatively minor contributor to the constraints in these periods.
- The TNUoS methodology aims to replicate these peak loading conditions on the network through two national backgrounds. The backgrounds could be considered a proxy for more granular connection planning assumptions.
- The CPA methodology provides a precedent for evaluating both storage imports and exports when considering system constraints in relation to network planning.

While the solution should seek to be aligned with the CPA methodology, that methodology hasn't been consulted on and engaged with the industry and therefore the Proposer believes this shouldn't be the basis for implementation of this modification, noting that the CPA methodology needs further work and should be done with industry. The Proposer also believes that this modification should not be delayed as a result of this.

Finally, national net zero commitments and Ofgem's statutory duty to regulate in support of net zero are a significant development in transmission licensee business. In the view of the Proposer, the current generation transmission charging methodology is outdated and by creating unduly high charges for storage operators, it is creating a barrier to the achievement of strategic decarbonisation objectives.

2. Effective Competition

In the view of the Proposer, the current methodology unduly discriminates against storage. The Conventional Carbon generation classification is for technologies that are controllable, that can easily increase and decrease their output, and that are likely to be exporting at peak times. This description does not fully capture the capabilities of storage technologies, which can import as well as export power. As Ofgem observed in justification of their decision to introduce a new tariff for intermittent generation, discrimination can arise from 'unjustifiably treating different cases alike', and different

asset classes should ‘be treated differently according to the impact they have on the network’.⁷

ESO’s CPAs assume storage has a different impact on the network from gas and coal. However, the current transmission charging methodology provides storage operators with a signal designed for coal or gas-fired generators, implicitly assuming it has the same impact on network reinforcement. The proposer believes that this does not accurately reflect how storage interacts with the NETS and is inconsistent with ESO’s approach to storage in network planning. As discussed above, while the storage deployment has increased since Project TransmiT, and while ESO have updated CPAs to reflect the impact of storage on network reinforcement, the charging methodology has not changed to reflect this. The proposer believes that the CPA methodology also doesn’t reflect the reality of storage behaviour and alignment with LCP modelling and optimisation. The Proposer therefore believes the modification fixes the current defect and the CPA methodology will need to be reviewed and aligned with storage behaviour in the long run. However, this will not be quick and should be captured in the Storage Taskforce being established and the wider ongoing TNUoS changes.

As a result, in the view of the Proposer the current charging methodology creates a barrier to entry that inhibits effective competition in the storage sector.

3. Value to Transmission Licensees

Battery storage technologies are modular and have relatively short lead times, and so can rapidly deploy in strategic locations with the right economic incentives. Transmission charging must respond to the development of this strategically important new sector. Basing storage ALF on imports and exports would ensure that the TNUoS regime responds to the changing needs of the NETS, providing storage with a more cost-reflective signal and better incentivising competition among flexibility providers. This can help ensure that the deployment of storage keeps pace with the deployment of renewable generation. The proposed generation tariff for storage would also remove a disincentive hindering operators from deploying in generation-constrained locations, where their assets can alleviate constraints, reduce curtailment, and provide stability services. While CMP393 is not primarily designed to provide a locational signal oriented towards constraint alleviation, in the view of the Proposer this outcome would provide significant value to transmission licensees.

4. Interaction with Wider Work on TNUoS

Work in this area could result in a separate generation classification for storage with respect to charging. That is not the purpose of this modification. Rather, the Proposer intends to focus on changing ALF calculation for storage within the current charging methodology.

Ofgem is conducting the [TNUoS Task Force](#), charged with improving the present methodology and conducting a longer-term review of the purpose and structure of TNUoS charges. While there is some overlap between this modification and the Task

⁷ *Project TransmiT*, p. 18.

Force, the proposed changes are not explicitly in scope of the Task Force. Ofgem stated in a call for evidence on the Task Force that ‘it is possible that other changes to the charging methodology [will be] implemented [...] outside of the Task Force processes’.⁸ This modification is therefore intended to achieve targeted change outside the scope of the Task Force process and through the standard governance procedure, in line with Ofgem’s intention to ‘move quickly’.⁹ Ofgem has already shown it is prepared to move forward with storage-related ‘quick win’ modifications ([CMP280](#), [CMP281](#)) alongside Significant Code Reviews on transmission charging. Furthermore, [CMP315 / CMP375](#) ran alongside the TNUoS Task Force, setting a direct precedent for the proposed approach.

What is the solution?

Proposer’s solution

This modification proposes to alter the definition of ALFs with respect to storage. All storage that has booked TEC (i.e., pumped and battery, as currently defined) would face an ALF calculation based on net system usage, and not export only. As other storage technologies connect to the NETS, it is anticipated that they too will be included. Storage technologies will face a TNUoS tariff with a bespoke Annual Load Factor (Storage ALF) calculation, considering imports as well as exports, with a floor at zero. It is proposed that the tariff will read: peak + (Storage ALF x Year Round Shared) + (Storage ALF x Year Round Not Shared) + residual.

Baseline ALF = Gross Generation Volume (MWh) / TEC x 24 x 365

CMP393 Storage ALF = max (0, Gross Generation Volume (MWh) – Gross Demand Volume (MWh)) / TEC x 24 x 365

Workgroup considerations

The Workgroup convened 12 times to discuss the perceived issue, detail the scope of the proposed defect, devise potential solutions and assess the proposal in terms of the Applicable Objectives.

This modification was originally joined with [CMP394](#). Workgroup meetings 1-3 had a strong focus on [CMP394](#). The proposer requested to withdraw [CMP394](#) on 22 December 2022, as they considered CMP393 to be a simpler solution to a defect identified in both code modifications – i.e., that current TNUoS charges reflect only exports, and not imports. The modification was formally withdrawn following the CUSC Panel meeting on 27 January 2023. Further meetings focused exclusively on CMP393, and the Terms of Reference were modified at the CUSC Panel meeting on 25 August 2023 solely to reflect CMP393.

Consideration of the proposer’s solution

⁸ See Ofgem, ‘TNUoS Call for Evidence: Next Steps’, 25 February 2022, <bit.ly/3PShU5X>.

⁹ See ‘TNUoS Call for Evidence’.

Discussions in initial Workgroups focused predominantly on [CMP394](#). The Workgroup discussed their initial observations including how the modifications offered a different resolution from [CMP331](#); whether conventional carbon and conventional low carbon should be referred to instead as dispatchable and non-dispatchable assets; and whether the current TNUoS model is designed to reflect constraints.

Note: [CMP331](#) was later [rejected by the Authority](#).

The Workgroup agreed that additional analysis would be required to refine [CMP394](#).

This analysis can be found in Annexes 4-5. The Cornwall Insight Analysis (Annex 4) applied only to [CMP394](#) so is no longer relevant for CMP393.

The Proposer withdrew [CMP394](#) on 15 December 2022 after coming to the conclusion that CMP393 is a simpler solution to a defect identified in both code modifications – i.e., that current TNUoS charges reflect only exports, and not imports.

The Workgroup agreed that in order to move forward with CMP393, they would require draft storage ALFs based on the proposed changes. ESO therefore conducted the necessary analysis, which can be found in Annex 6. Instead of the baseline ALF calculation of aggregated energy output, the proposed new ALF uses aggregated energy **net** output. The resulting draft storage ALFs were negative, because storage assets import more electricity from the NETS than they export due to energy losses associated with round trip efficiency.

Several Workgroup members queried the value of negative Storage ALFs. They considered that negative ALFs would be counterintuitive to a generation tariff, and they suggested that Storage ALFs should be floored at zero.

The Proposer emphasised that:

- Unlike [CMP394](#), CMP393 is not primarily about creating a locational signal. The proposed change to ALFs would apply to all storage, irrespective of location.
- The proposed change will bring TNUoS closer in line with the precedent set by Distribution use of System charge (DuoS). The DuoS methodology¹⁰ incentivises demand (including storage) to locate close to generation. In this way it rewards operators for importing and thereby avoiding reinforcement.
- The Proposer acknowledged that CMP393 is a simplified solution, as it does not distinguish between imports at peak and non-peak times. But crucially, it is an improvement on the status quo, which does not reflect storage imports at all.

Cost Reflectivity of CMP393 Proposal

One Workgroup member raised several concerns relating to the cost reflectivity of the Proposal and the inclusion of demand in the calculation of the ALF:

1. The calculation of peak and Year Round load flows are based on demand taken at peak. The TNUoS model recognises that the higher the annual load factor of a generator behind a shared boundary the lower the opportunity for sharing will be

¹⁰ <https://www.dcusa.co.uk/>

and hence it receives higher charges. The proposed solution mixed up the temporal nature of boundary flow sharing driven by the ALF calculation. This calculation seeks to represent sharing that is possible at during peak conditions. Storage demand occurs off peak so is not relevant to the peak calculation. There is thus no link between the volume of storage demand and the sharing of boundary flows at peak as such it would be inappropriate to adjust ALF.

2. The Workgroup member felt that analysis presented by the Proposer suggests that by reducing storage charges it will encourage the growth of storage behind boundaries and as a result reduce constraint cost. Storage in the current market arrangements is incentivised to export during high priced periods and import during low prices periods adjusting TNUoS rates will not change this position. The Workgroup member stated that it may make the position worse as it could encourage storage to locates further from demand centres than it might otherwise do with the market incentive to export at peak time but be constrained off by the ESO in real time.
3. They also noted that the TNUoS model does not recognise constraints, only boundary sharing and distance from demand centres at times of peak demand and assumes the TO's have built the optimum network. The TNUoS model will deliver the same charge irrespective of the number of circuits across a boundary. If there is 1 or 100 circuits across a boundary the TNUoS mode will deliver the same tariff. Much of the proposed indicated value relates to minimising constraint costs but as the TNUoS model has no knowledge of constraints it follows that adjusting the ALF will not deliver the required response and is equivalent to just reducing storage tariffs by an arbitrary [50% say] amount. The inclusion of Constraints in the TNUoS model will require a fundamental rework of the whole TNUoS model, changes to ALF include storage demand taken off peaks will not deliver a cost reflective solution or address the constraints issue.
4. The Workgroup member felt that as storage is free to follow market price it is unlikely that storage will provide any relief to managing constraint via traded market arrangements. In real time, in the balancing mechanism (BM) the ESO will be able to adjust storage generation, or any other type generation that is scheduled over peak price periods but felt that there is no link between the ALF and this ability.
5. Whilst it is believed to be the case that increased levels of storage will be helpful in low wind conditions to help meet demand and also to absorb surplus wind behind constraints the TNUoS methodology dealing with peak load flow conditions is simple not the correct vehicle.
6. The Proposer acknowledged that the proposed solution does not resolve certain Year Round system impacts. However, the Workgroup agreed that the split between Year Round Shared and not-shared was out of scope of the modification. A potential Alternative was discussed where the net ALF is applied to the Year Round Not Shared tariff and the baseline ALF applied to the Year Round Shared tariff, however this was not raised. Storage located in the south would see its benefit (negative TNUoS) would see its benefit reduced and discourage storage from being developed in areas where peak demand is highest.

The Proposer responded to these concerns as follows:

- It is believed that the concerns in 1. are addressed by the LCP analysis (Annex 11), which models storage behaviour at peak. Storage demand also doesn't occur just

in the off-peak periods only and is determined by Balancing Mechanism, cycles and other assumptions.

- The concern raised in 2. refers to the Cornwall Insight analysis (Annex 4) and is no longer relevant to CMP393.
- The Proposer disagreed with 3. on the basis that 'inclusion of Constraints in the TNUoS model will require a fundamental rework of the whole TNUoS model'. The TNUoS model already considers constraints and believes that ALF is intended to be a 'proxy for the impact an individual generator has on the system when investment is planned to manage constraint costs'. The Proposer noted that this is described in detail the LCP analysis.
- The Proposer felt that 4. again discusses storage and constraint management. CMP393 proposes to bring TNUoS ALF in line with net storage ALF and does not seek to turn TNUoS into a constraint management signal. The Proposer noted that storage can be used to alleviate constraints by importing either through the BM or through a market price signal;
- The Proposer felt that 5. focuses on constraints and discusses peak load flow conditions and noted that storage will continue to face the peak element under CMP393.
- The Proposer suggested that 6. discusses a potential option to apply storage ALF to Year Round Not Shared and Year Round Shared and suggested that whilst it was an option for the Workgroup member to raise this option as a WACM, this was not pursued.
- The Proposer went on to address concerns raised that this would send the wrong signal to storage located in England as the benefit would be reduced. The Proposer went on to state that the ESO analysis showed the charge in London would increase by £0.028/kW/year for a storage asset. The peak charge which is the main contributor of the benefit (-£3.4/kW/year would be unchanged) as the modification only seeks to provide the import benefit to the year round and non-year round where there is a high-level of renewable generation that the storage helps to reduce and shift. The Proposer believes that It is therefore fair that storage in the South doesn't receive that benefit, but still encouraged to build there to support the peak requirement and the net benefit of building storage in the South substantially outweighs any change from this modification.
- The Proposer stated that in general, while it was acknowledged that the modification is a simplification, so is the treatment of storage in the Construction Planning Assumptions (CPA), Network Options Assessment (NOA) and Electricity Ten Year Statement (ETYS). The Proposer acknowledged that work is required to improve all of the above, but the impact of storage to import and support constraint management should be recognised with regard to shared and non shared year round.

Prior to the Workgroup Consultation, the Workgroup discussed several potential alternative solutions and defined Workgroup Consultation questions. The options referred to within the Workgroup Consultation and consideration of their potential effect on the Year Round locational signal can be found in Annex 9. One of the potential alternative solutions considered whether a new generation classification for storage was required for the CMP393 solution, however the Workgroup considered this to be out of scope for the modification.

The Proposer conducted analysis of TNUoS prices using ESO's five-year forecast, using baseline and CMP393 cases. This analysis can be found in Annex 7.

Workgroup consultation summary

The Workgroup held their Workgroup Consultation between 12 May 2023 – 02 June 2023 and received 7 responses. The full responses and a summary of the responses can be found in Annex 8. Following the Workgroup Consultation, it was identified that there had been an error in part of the Proposer's solution section of the document. All respondents were contacted and given the opportunity to amend their response based on this. Out of the five respondents who replied to this, only one opted to change their response. Details of this can be found in Annex 8.

Key points from the Workgroup Consultation are summarised below:

- CUSC Charging Objectives (a), (b) and (c) were deemed to be better facilitated by the Original by four respondents, one respondent believed that the Original better facilitated objective (d), and two respondents believed that the Original better facilitated objective (e).
- Four respondents supported the implementation approach, with one respondent not supporting the implementation approach, stating that it needs to be fully clarified by the Workgroup with enough time to make changes to the ALF calculation.
- Four respondents believed that storage ALF should be floored at zero, with one respondent opposing this. There were several concerns raised regarding the potential for a negative ALF having unintended consequences on TNUoS charging such as rewarding less efficient storage systems. The Proposer later updated their solution to floor ALF at zero.
- One respondent believed that CMP393 would disincentivise storage from locating in the South, with four respondents believing this would not occur.
- Four respondents believed that storage should have its own generation classification for TNUoS, but two respondents did not.
- Two respondents did not believe that CMP393 facilitates any of the CUSC charging objectives better than the baseline.
- One respondent noted that introducing a new methodology for calculating ALFs for one type of generator could be discriminatory and noted that no clear evidence has been produced as to why the current methodology presents a defect for storage operators.
- Some respondents noted that double charging could be caused by the proposed methodology. One respondent had the view that the use of network charge (i.e. TNUoS) should not be applied to the energy losses of storage.

Alternatives

Two Workgroup Alternative Requests were raised following the Workgroup Consultation. Both were deemed by the Workgroup to not be in scope of this modification, and the Proposer of the Alternative Requests subsequently withdrew them. These can be found in Annex 10.

Post Workgroup Consultation Discussions

The two Workgroup Alternative Requests (Annex 10) were presented to the Workgroup, and after several discussions it was agreed that the two Alternative Requests were not in scope. The Workgroup expressed an interest in part of one of the Alternative Requests, which floored storage ALF at zero. The Proposer subsequently revised the Original solution to floor storage ALF to zero.

On review of the modification Terms of Reference, it was identified that some of the Terms of Reference were no longer relevant since they related to [CMP394](#), which was withdrawn. The Terms of Reference were modified at the CUSC Panel meeting on 25 August 2023 to solely reflect CMP393.

The Authority Representatives queried the locational impact of CMP393 and requested some analysis on the behaviour of storage in respect to constraint management and benefits to the NETS. This analysis can be found in Annex 11.

The Workgroup reviewed the analysis, and it was noted that the B6 boundary constraint was the only constraint considered. The Proposer stated that this constraint was chosen as it shows storage balanced between charging and discharging, which is consistent with wider storage behaviour. This constraint also allowed pumped storage to be considered on both sides of the boundary. The Proposer noted that their historic analysis supports the case that the proposed storage ALF is more appropriate than the current one, and that it is a good representation of storage load factors during periods of constraint.

One Workgroup member questioned the potential for negative charging in some geographical areas, highlighting that this could be an incentive for some storage operators. The Proposer noted that batteries can increase load if importing at times of peak. However, a Workgroup member noted that price signals do not often lead to this happening.

The Authority representative asked whether there was modelling available for constraints other than the B6 boundary. LCP Delta noted that they had only considered B6, but noted that further analysis could be done to consider other constraints if required. The Proposer confirmed that B6 was chosen so that pumped storage could be considered on both sides of the boundary, and they did not feel that further analysis was needed, as they felt they had satisfied the Authority's request for analysis on behaviour of storage.

The Workgroup discussed and agreed the legal text, agreeing to use the existing definitions in the CUSC for Electricity Generation Facility and Electricity Storage Facility, noting that the definitions apply to all electricity storage, rather than just batteries and pumped hydro. CMP393 was originally proposed to apply only to pumped storage and battery storage. Since the modification was proposed, the definition of Electricity Storage was developed through another modification. The Proposer and Workgroup agreed that the scope of CMP393 should be increased to apply to all Electricity Storage as defined, and that it should no longer only apply to a subset of storage technologies.

The Workgroup also discussed legal text interactions with [CMP316](#), which also proposes amends to the ALF section of the CUSC. If [CMP316](#) is approved prior to CMP393, minor additional legal text amends will be required in addition to those proposed for CMP393, which the Workgroup discussed and agreed. These legal text amends can be found in Annex 14.

The Proposer subsequently met the Authority bilaterally and discussed boundary analysis and connection planning assumptions. The Proposer explained that B6 was chosen to enable both historic and forward-looking analysis of storage behaviour. Pumped storage facilities flank the B6 boundary. There is no historic data of the network impacts of transmission-connected batteries trading in wholesale markets and the Balancing Mechanism. The Authority accepted this explanation as sufficient to render unnecessary further analysis of other boundaries.

The Proposer also summarised to the Authority their conversation with the ESO about connection planning assumptions, which is captured earlier in this report and in Annex A of the LCP analysis (Annex 11). The Authority noted the need for more detailed information from the ESO about how they assess reinforcement for a) battery storage and b) pumped storage.

The ESO presented their revenue analysis (Annex 12) to the Workgroup, noting that this was based on the draft tariffs. The ESO Revenue representative identified that less revenue would be collected from storage generators and therefore this would need to be collected from the adjustment tariff. The impact here being to increase the adjustment tariff across all areas as this is not reflected regionally, with differences being seen in storage types.

A Workgroup member noted that whilst the change in this modification is to look at how storage is charged a future modification may be needed to look at how storage is modelled. One Workgroup member noted that the analysis reflects that the modification is not cost reflective, highlighting that it will increase storage costs in the South. The Ofgem representative requested further examples to show tariff changes on an annual basis for pumped hydro sites and this was provided in the impact assessment in Annex 12.

The ESO provided an update on implementation costs of CMP393. The ESO representative noted that this would be a BAU activity, meaning there would be no additional costs for implementation.

Construction Planning Assumptions (CPA)

A Workgroup session focused on the interaction with the new CPA methodology that is being used to review storage connection. Limited information was provided in the Workgroup to verify how individual storage projects are treated and by location. It was identified that some storage is treated as 0MW and others are not, however the CPA methodology is not available publicly as it is project dependent. Likewise, the CPA methodology only optimises storage around wholesale arbitrage and not other markets the storage asset will operate in.

The Workgroup discussed the Terms of Reference and whether they had adequately considered interactions with the Construction Planning Assumptions. The Proposer noted that they do not believe that the CPAs affect how storage operates. One Workgroup member also noted that batteries operate differently to many other storage providers. The Authority Representative queried whether the 0MW figure for storage would be assumed as part of the CPAs and advised that an answer to this would be required to meet the Terms of Reference, however an ESO Subject Matter Expert (SME) had earlier advised that assumptions would be dependent on each project, so some storage would have a 0MW figure, but some would not. The Workgroup agreed they had therefore met this part of the Terms of Reference and were comfortable to progress with the Workgroup Vote. Some Workgroup members noted that it would be beneficial for the CPA methodology for storage to be improved, although noted that this should not delay a decision on CMP393, and also agreed that it is out of scope of the modification.

Legal text

The legal text for this change can be found in Annex 3.

Additional legal text amends that will be required if [CMP316](#) is approved prior to CMP393 approval, can be found in Annex 12.

What is the impact of this change?

Proposer's assessment against CUSC Charging Objectives

Relevant Objective	Identified impact
(a) That compliance with the use of system charging methodology facilitates effective competition in the generation and supply of electricity and (so far as is consistent therewith) facilitates competition in the sale, distribution and purchase of electricity;	Positive Our proposed amendments to the transmission charging methodology for battery storage and pumped storage will ensure that the charging methodology better reflects how storage assets interacts with the NETS. This will remove a barrier to entry, better incentivising storage operators to compete to connect and provide system services. This will facilitate competition in the generation of electricity.
(b) That compliance with the use of system charging methodology results in charges which reflect, as far as is reasonably practicable, the costs (excluding any payments between transmission licensees which are made under and accordance with the STC) incurred by transmission licensees in their transmission businesses and which are	Positive This modification will result in more cost-reflective charges. It will ensure that the transmission charging methodology reflects how

compatible with standard licence condition C26 requirements of a connect and manage connection);	battery storage and pumped storage assets import power from the NETS, as well as exporting it. As a result, charges will better reflect the impacts of electricity storage on the NETS. The methodology was last updated in 2014, and was not designed with battery storage specifically in mind. As a result of this, it does not fully reflect the way electricity storage interacts with the NETS. The modification will help to rectify this.
c) That, so far as is consistent with sub-paragraphs (a) and (b), the use of system charging methodology, as far as is reasonably practicable, properly takes account of the developments in transmission licensees' transmission businesses;	<p>Positive</p> <p>This modification will ensure that the transmission charging methodology responds to the accelerating deployment of storage in the NETS. The methodology was last updated in 2014, and was not designed with battery storage specifically in mind. Since 2014, the amount of electricity storage, and in particular battery storage, connecting to the NETS has increased substantially. The modification will help to ensure that energy storage is better represented in the transmission charging methodology.</p>
(d) Compliance with the Electricity Regulation and any relevant legally binding decision of the European Commission and/or the Agency *; and	Neutral
(e) Promoting efficiency in the implementation and administration of the system charging methodology.	Neutral
<p>*The Electricity Regulation referred to in objective (d) is Regulation (EU) 2019/943 of the European Parliament and of the Council of 5 June 2019 on the internal market for electricity (recast) as it has effect immediately before IP completion day as read with the modifications set out in the SI 2020/1006.</p>	

Proposer's assessment of the impact of the modification on the stakeholder / consumer benefit categories

Stakeholder / consumer benefit categories	Identified impact
Improved safety and reliability of the system	<p>Positive</p> <p>Removing barriers to entry for storage operators will make the network more balanced and secure, and less wasteful and carbon intensive. It will also reduce operational costs by enabling more efficient management of intermittent electricity flows in constrained regions.</p> <p>Storage assets provide a range of stability services, such as reactive power, short circuit level, and inertia. The proposed modification will enable more targeted and effective provision of these services, resulting in a safer and more reliable energy system.</p>
Lower bills than would otherwise be the case	<p>Positive</p> <p>The evolving nature of the electricity system is incentivising the ESO to provide a flexible transmission system, particularly as the move towards net zero will continue to locate renewable generation in areas of low demand.</p> <p>By ensuring transmission charges better reflect all the system impacts of storage, this modification proposal would remove a barrier to entry facing storage operators. This will support the integration of renewable generation, protecting consumers from volatile fossil gas prices.</p> <p>The code modification may also have the effect of supporting deployment of energy storage in constrained regions, where storage operators can reduce costs associated with curtailment. This aspect of the code modification should be considered in light of ongoing work by DESNZ and ESO on operational signals for flexible assets.</p>
Benefits for society as a whole	<p>Positive</p> <p>Government policy requires an electricity system that will help to deliver net zero. Encouraging the deployment of energy storage will facilitate the move to net zero, helping to integrate intermittent renewables and deliver a secure, decarbonised power system. This modification supports long-term Government aims to provide cheap,</p>

	abundant renewable electricity. It will facilitate Government's legally binding move to net zero, supporting national climate crisis mitigation goals. By removing a barrier to the development of flexibility, it will also assist efforts to protect consumers from volatile fossil gas prices.
Reduced environmental damage	<p>Positive</p> <p>This modification will result in reduced environmental damage by:</p> <p>Accelerating the decarbonisation of the GB energy system, mitigating climate crisis and driving progress to legally-binding net zero goals.</p> <p>Enabling the more efficient use of renewable energy by supporting the development of flexibility in the GB power system.</p>
Improved quality of service	<p>Positive</p> <p>This modification would better incentivise investment in electricity storage. This would support the uptake of renewable energy by balancing intermittent power flows, and by providing sources of essential system services (e.g., reactive power, inertia, frequency). This will ensure low-carbon, affordable electricity can reliably be delivered to consumers.</p>

Workgroup vote

The Workgroup met on 05 March 2024 to carry out their Workgroup vote. The full Workgroup vote can be found in Annex 15. The table below provides a summary of the Workgroup members view on the best option to implement this change.

The Applicable CUSC charging Objectives are:

CUSC charging objectives

- a) That compliance with the use of system charging methodology facilitates effective competition in the generation and supply of electricity and (so far as is consistent therewith) facilitates competition in the sale, distribution and purchase of electricity;
- b) That compliance with the use of system charging methodology results in charges which reflect, as far as is reasonably practicable, the costs (excluding any payments between transmission licensees which are made under and accordance with the STC) incurred by transmission licensees in their transmission businesses and which are compatible with standard licence condition C26 requirements of a connect and manage connection);

- c) That, so far as is consistent with sub-paragraphs (a) and (b), the use of system charging methodology, as far as is reasonably practicable, properly takes account of the developments in transmission licensees' transmission businesses;
- d) Compliance with the Electricity Regulation and any relevant legally binding decision of the European Commission and/or the Agency *; and
- e) To promote efficiency in the implementation and administration of the system charging methodology

*The Electricity Regulation referred to in objective (d) is Regulation (EU) 2019/943 of the European Parliament and of the Council of 5 June 2019 on the internal market for electricity (recast) as it has effect immediately before IP completion day as read with the modifications set out in the SI 2020/1006.

The Workgroup concluded by majority (9/11) that the Original better facilitated the Applicable Objectives than the Baseline.

Option	Number of voters that voted this option as better than the Baseline
Original	9

When will this change take place?

Implementation date

01 April 2025

Date decision required by

30 September 2024

Implementation approach

There are ESO process impacts in tariff setting and potential system impacts on the Transport and Tariff model.

Interactions

- | | | | |
|---|--|---|--------------------------------|
| <input type="checkbox"/> Grid Code | <input type="checkbox"/> BSC | <input type="checkbox"/> STC | <input type="checkbox"/> SQSS |
| <input type="checkbox"/> European Network Codes | <input type="checkbox"/> EBR Article 18 T&Cs ¹¹ | <input checked="" type="checkbox"/> Other modifications | <input type="checkbox"/> Other |

There is a potential interaction with another current modification, [CMP405](#). However, Ofgem and the CUSC panel have determined that the two code modifications can proceed independently. CMP393 proposes to alter ALFs, while [CMP405](#) proposes to alter demand charging. As such the two modifications propose distinct solutions to a similar defect.

[CMP316](#) also proposes amends to the ALF section of the CUSC. If [CMP316](#) is approved prior to CMP393, minor additional legal text amends will be required in addition to those proposed for CMP393. These legal text amends can be found in Annex 14.

¹¹ If the modification has an impact on Article 18 T&Cs, it will need to follow the process set out in Article 18 of the Electricity Balancing Regulation (EBR – EU Regulation 2017/2195) – the main aspect of this is that the modification will need to be consulted on for 1 month in the Code Administrator Consultation phase. N.B. This will also satisfy the requirements of the NCER process.

The storage sub-group has CMP393 and [CMP405](#) excluded from their scope so any outputs of this are unlikely to interact with CMP393.

Acronyms, key terms and reference material

Acronym / key term	Meaning
ALF	Annual Load Factor
BAU	Business-as-Usual
BM	Balancing Mechanism
BSC	Balancing and Settlement Code
CMP	CUSC Modification Proposal
CPAs	Construction Planning Assumptions
CUSC	Connection and Use of System Code
DESNZ	Department for Energy Security and Net Zero
DuoS	Distribution use of System charge
EBR	Electricity Balancing Regulation
ESO	Electricity System Operator
ETYS	Electricity Ten Year Statement
NETS	National Electricity Transmission System
NOA	Network Options Assessment
SME	Subject Matter Expert
STC	System Operator Transmission Owner Code
SQSS	Security and Quality of Supply Standards
T&Cs	Terms and Conditions
TEC	Transmission Entry Capacity
TO	Transmission Owner
TNUoS	Transmission Network Use of System charges

Annexes

Annex	Information
Annex 1	Proposal Form
Annex 2	Terms of Reference
Annex 3	Legal Text
Annex 4	Cornwall Insight Analysis
Annex 5	ESO data analysis on behaviour of storage at peak
Annex 6	ALF Storage analysis
Annex 7	TNUoS prices using ESO's five-year forecast analysis
Annex 8	Workgroup Consultation Responses and Summary
Annex 9	Alternative options discussed prior to the Workgroup Consultation
Annex 10	Withdrawn Workgroup Alternative Requests
Annex 11	LCP Analysis on behaviour of battery and pumped storage during high network loads
Annex 12	ESO Revenue Analysis
Annex 13	ESO Connections Information
Annex 14	Legal Text for CMP393, if CMP316 is approved first
Annex 15	Workgroup Vote
Annex 16	Workgroup Attendance Record