Reforming grid charges in Germany: The case for dynamic pricing

The role of dynamic charges in reducing grid redispatch and incentivising storage

April 2026

Report Contributors

Akaysha Energy

Akaysha Energy is a leading builder, owner and operator of mega-scale Battery Energy Storage Systems (BESS) globally, which is facilitating the transition to renewable energy and increased energy security. Established in 2021 in Australia, where it operates BESS across the country, Akaysha also has a strong pipeline of projects in Germany, Japan and the US. Akaysha Energy employs more than 210 people – with offices in Melbourne, Sydney, Brisbane, Berlin, Tokyo, Portland and Houston. Akaysha Energy is expanding into the German market in partnership with Copenhagen Energy to progress a multi gigawatt BESS pipeline.

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Akaysha Energy combines market-leading expertise in energy and capital markets, project development, revenue contracting, operations and trading. This deep in-house capability maximises value across all stages of the BESS lifecycle.

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1. Executive summary

1.1 Background

This report on Dynamic Grid Fees for Battery Energy Storage Systems (BESS) in Germany (Report) considers the dynamic grid fee structure proposed by the Bundesnetzagentur (BNetzA) as part of their “General Electricity Network Tariff System” (AgNes) work program – both in the Dynamic Network Fee Charge Component (released on December 17, 2025) and then more specifically in the consideration of storage specific treatment in the Storage Network Fees: BNetzA Guidelines released on January 16, 2026.[1][2]

Increased deployment of utility scale BESS assets across Germany is necessary for the future reliability and system security of Germany’s energy system. Based on the approved scenario framework of the Grid Development Plan 2037/2045, a total of 41.1 to 94.1 GW of BESS are expected to be connected to the German electricity grid by 2045.[3]

The future structure of BESS network tariffs will play a determining role in the future economic viability of BESS deployments across Germany. This Report analyses whether the proposed dynamic grid fee component for BESS:

1. is likely to achieve the intended incentive outcome, and increase overall grid-friendly behaviour from BESS assets; and
2. whether this is likely to have any negative impact on the business case of BESS assets in Germany.

Network fees should be structured to maximise the ‘grid-friendly’ behaviour that bidirectional BESS can naturally provide. In the context of this report, grid-friendly behaviour relates to reducing grid congestion and avoiding redispatch. With the right economic incentives, BESS assets can quickly, and accurately, respond to pricing signals to reduce both upwards and downwards redispatch.

Most critically, grid fee structures need to support the long-term bankability of BESS projects. In Germany, BESS installations are developed without direct government subsidies and therefore rely on revenues from energy market trading and ancillary services, often secured through offtake agreements. As competition in these markets continues to intensify and battery prices begin to stabilise, the proposed grid fees could pose a significant risk to project margins and, ultimately, to the overall bankability of BESS projects in Germany. Without a stable and predictable fee framework, financing institutions may apply more conservative assumptions in their models or withdraw from the market altogether, threatening the pipeline of new BESS capacity at a time when flexibility assets are most needed.

The modelling undertaken by Baringa for this Report found that dynamic grid fees provide an overall increase in grid-friendly behaviour from BESS assets, while also maintaining a neutral to slight upside in the business case for BESS investments in Germany – particularly when structured under a symmetrical tariff structure.

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[1] BNetzA (2025) Dynamische Netzentgeltkomponente: Orientierungspunkte der BNetzA [Online available:: https://www.bundesnetzagentur.de/DE/Beschlusskammern/GBK/GBK_Termine/Downloads/2026/01_2026/14.01./AgNes_Orientierungspunkte_Dynamisierung.pdf?__blob=publicationFile&v=3]

[2] BNetzA (2026) Speichernetzentgelte: Orientierungspunkte der BNetzA [Online available: https://www.bundesnetzagentur.de/DE/Beschlusskammern/GBK/GBK_Termine/Downloads/2026/01_2026/30.01./Orientierungspunkte_Speichernetzentgelte.pdf?__blob=publicationFile&v=3]

[3] BNetzA (2025) Genehmigung des Szenariorahmens für den Netzentwicklungsplan Strom 2025-2037/2045 [Online available: https://www.netzentwicklungsplan.de/sites/default/files/2025-04/Genehmigung%20Szenariorahmen%202025_0.pdf]

1.2 Report findings

In respect of the future network tariff fee structure for BESS, BNetzA have proposed a new two-part tariff architecture for BESS assets that distinguishes between:

- charges with a financing function (to recover network costs), and
- charges with an incentive function (to steer grid-friendly behaviour)

This Report considers the incentive-based charges within the proposed BESS fee structure, specifically the dynamic grid fee component. The modelling undertaken by Baringa for this report considers:

1. whether dynamic grid fees are likely to drive an increase in overall grid-friendly behaviour; and
2. the impact that dynamic grid fees are likely to have on the investment case of a BESS – considering both the positive revenue upside which may be arise from dynamic grid fees, as well as the lost merchant revenue opportunities. This analysis specifically considers foregone day-ahead merchant revenues.

This Report specifically focuses on BESS assets connected at the TSO level. While there may be some overlapping findings, it has not specifically considered DSO level congestion issues nor made DSO level recommendations.

While this report does not explicitly model charges with a financing function, these remain a critical consideration alongside incentive-based charges. The two parts of the tariff structure are intrinsically interlinked and will collectively impact the investment case of BESS assets in Germany.

1.3 Next steps

The basis of this Report assumes that the broad incentivising grid tariff component proposed by BNetzA in the early AgNes Discussion Papers continue to be progressed with no material changes. This Report is not designed to retrospectively pass commentary on the conversations to date – it should be considered as a series of forward-looking recommendations to inform the BNetzA Draft Determination due for release in mid-2026.

While the modelling in this Report shows that Dynamic Grid fees are likely to both drive an increase in grid-friendly behaviour, while also maintaining the investment case for BESS, this will only be achieved with the right policy design and serious consideration of the interrelationship between the proposed fee structure and the existing markets, as well as other critical grid reform priorities such as the application of flexible connection agreements (FCAs).

The recommendations in this Report are designed to inform the critical design principles that should be considered as the work on dynamic grid fees and the treatment of BESS grid fees more broadly progresses.

2. Political and Regulatory Context

2.1 The role of BESS in the German power system

BESS are gaining strategic importance in the German electricity system. With a strong push for intermittent renewable energy sources (RES), the nuclear phase-out, and the ongoing coal phase out, BESS can provide the necessary short-term flexibility that the German power system needs.

While there is a total of 4.66 GWh (as of 26 March 2026) installed and operational battery capacity of large-scale storages in Germany, the connection queue in the transmission grid alone exceeds of 211 GW, displaying a strong investment dynamic in the German market.[4][5]

Bidirectional BESS assets are flexible in their responsiveness and can provide a range of critical services to both the energy market and transmission networks – including reducing congestion during redispatch periods. Because BESS investments can respond to price signals in near real-time, they are particularly well suited to respond to dynamic, incentive-driven price signals.

BESS can contribute to system adequacy and flexibility, reducing curtailment of renewables and dampening price volatility. However, it can also contribute to grid stress if operated purely on market price signals without consideration of local network constraints.

The absence of nodal or regional price signals in Germany has resulted in BESS responding purely to energy price signals – which is not always aligned with grid capacity. For example, charging during low wholesale prices in already congested regions may aggravate network bottlenecks. As a result, the day-to-day operation and behaviour of BESS assets falling under one of three buckets:[6]

- *Grid-friendly behaviour*: Contributing to reducing redispatch costs.
- *Grid-neutral behaviour*: Having a net-zero effect on redispatch costs.
- *Grid-unfriendly behaviour*: Contributing to increasing redispatch costs.

The challenge lies in translating the conceptual understanding of these three degrees of “friendliness” into measurable criteria and instruments that allow the steering of BESS operation without losing the investment case for BESS in Germany. This has been a fundamental driver for the BNetzA “General Electricity Network Tariff System” (AgNes) work program, and its particular focus on the most suitable grid tariff structures for BESS assets in Germany.

2.2 Current status of the AgNes discussion

BESS assets in Germany are currently exempt from grid charges for 20 years after commissioning under Section 118 (6) of the Energy Industry Act (EnWG), provided they are connected to the grid before 4 August 2029. BNetzA has indicated that this exemption will not be renewed, hence an integration of BESS in the grid tariff regime is necessary.

To incentivise BESS for grid-friendly behaviour, the BNetzA started the AgNes process in May 2025. As part of the AgNes, BNetzA is fundamentally revising the future treatment of electricity storage within the

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[4] Feggener et al. (2026) The development of battery storage systems in Germany: A market review [Online accessible: https://battery-charts.de/battery-charts/]

[5] 4ÜNB (2026) Reifegradverfahren für Netzanschlüsse an das Übertragungsnetz [Online accessible: https://www.netztransparenz.de/Portals/1/Dokumente/Presse/2026/2026-02-05_Vier_Uebertragungsnetzbetreiber_Reifegradverfahren_Dokumentation_V100.pdf?ver=GAQj0be-XjQbCsD5ZEU1cQ%3d%3d]

[6] Neon Neue Energieökonomik (2025) Netzdienlichkeit von Großbatterien [Online accessible: https://neon.energy/Neon-Netzdienlichkeit-Großbatterien.pdf]

network tariff framework. For stand-alone storage facilities, i.e. technically independent, grid-connected storage units with their own physical connection point, this marks a clear paradigm shift.

Stand-alone storage is economically understood as purely grid-connected storage that withdraws electricity exclusively from the grid and re-injects it at a later point in time, typically for energy arbitrage or the provision of ancillary services.

The overarching regulatory logic behind integrating stand-alone storage into the general network tariff system is the cost-causation principle ("Verursacherprinzip"). All grid users who trigger network costs or require network capacity should contribute appropriately to financing the infrastructure. Even though storage can reduce system costs in certain hours, it also makes use of network capacity for both withdrawal and injection. A structurally permanent exemption would therefore shift cost burdens to other consumers and undermine the Verursacherprinzip. BNetzA's approach seeks to strike a balance: storage should contribute to network financing in a cost-reflective manner, while the tariff design must avoid distorting economically efficient arbitrage and ancillary service provision.

The AgNes process also provides an opportunity to address the challenges created by the single energy price across Germany. Creating more regionally differentiated price signals can drive BESS to respond to grid needs as well as system needs and provide increased grid benefits – including reducing Redispatch.

2.3 Mechanism for grid tariffs

The application of network charges is governed by EU law under the Electricity Market Regulation. Accordingly, network charges must be cost-reflective, transparent, and ensure system security. In addition, the Regulation stipulates that network charges should neither positively nor negatively discriminate against battery storage systems.

The BNetzA proposal intends the upcoming grid tariff for storage to consist of a financing component and an incentive component. Both components are designed to ensure that the positive benefits of storage are impaired as little as possible, that financing of network costs is achieved, and that grid-friendly behaviour is promoted.

The grid tariff with a financing function is based on a capacity booked and selected by the network user, which is paid via a capacity-based network tariff. Building on this capacity element, the Federal Network Agency additionally proposes an energy price (Arbeitspreis). Based on the booked capacity, network users pay either an energy price (AP1) for storage withdrawal within the booked capacity, or a higher energy price (AP2) if the withdrawal capacity exceeds the ordered capacity. The BNetzA considers the energy price to be levied only on the difference between feed-in and withdrawal, that is, on efficiency losses.

At this stage, the grid tariff with a financing function has only been put forward for discussion by the BNetzA. For example, the four transmission system operators have proposed an alternative to the BNetzA model and advocate for waiving the energy-based charges 1 and 2 for standalone storage, instead focusing financing entirely on the capacity-based charge.[7]

Notwithstanding the open discussion on refinancing grid investments, the focus of this analysis is to evaluate how steering BESS behaviour can be achieved through grid tariffs, hence the dynamic grid tariff with incentive function is of more relevance to the upcoming analysis.

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[7] 4ÜNB (2026) Speichernetzentgelte – Konsultationsbeitrag der 4ÜNB zu den Orientierungspunkten der BNetzA [Online accesible: https://www.transnetbw.de/_Resources/Persistent/1/c/a/b/1cab488af6b245c230f1c3728689eab7ce3a7442/4ÜNB-Konsultationsbeitrag%20Speichernetzentgelte_202603.pdf]

Based on the current design proposal by BNetzA, the grid tariff with incentive function works as follows: the dynamic energy price varies for each quarter-hour depending on the load flow and congestion situation and serves as an instrument for relieving network congestion.

The dynamic energy price aims to cover the additional costs incurred by redispatch processes. For example, it amounts to [X] ct/kWh, which must be paid for electricity withdrawn from the grid when positive redispatch is required in the region. At any given time, the charges for withdrawal and injection have opposite signs, meaning that under the same conditions, electricity fed into the grid is remunerated at [X] ct/kWh. If negative redispatch is required, the charge amounts to [X] ct/kWh. If the grid is free of congestion, no charges apply.

3. Mechanism of Action of Dynamic Grid Fees

3.1 Marginal dispatch logic of BESS

In practice, BESS operators optimise dispatch decisions based on marginal revenues and marginal costs across several markets simultaneously. Their short-term optimisation problem can be simplified as the maximisation of wholesale market and ancillary service revenues, net of charging costs, degradation costs and, in the future, grid fees. Within this framework, dynamic grid fees enter directly as a time-varying marginal cost component or, in the case of negative prices for injection, as a marginal revenue component.

For charging decisions, the relevant economic condition is whether the expected future discharge price exceeds the current wholesale price plus all marginal costs, including the dynamic grid fee applied to withdrawal. In other words, a battery will charge only if the anticipated spread remains positive after accounting for the congestion-related tariff and variable costs. For discharging, the logic is symmetrical: electricity will be injected into the grid if the current wholesale price, potentially supplemented by a negative grid fee (i.e. remuneration), exceeds the expected future charging price and all marginal costs.

The central mechanism is therefore straightforward: dynamic grid fees alter the effective arbitrage spread. If congestion-related charges increase the cost of charging during stressed grid situations, the economic attractiveness of charging in those periods diminishes or disappears altogether. Conversely, if injection during congestion is remunerated because it relieves network constraints, discharging becomes more attractive. The grid fee thus modifies the marginal calculus without prescribing behaviour directly.

3.2 Internalisation of redispatch costs

The economic rationale for the dynamic energy price lies in at least a partial internalisation of redispatch costs. Under the current system, redispatch expenditures are spread across end consumers. Individual market participants do not directly face the marginal cost of congestion that their actions may contribute to. This weakens the link between private optimisation and system efficiency.

Dynamic grid fees aim to correct this disconnect by translating redispatch costs into a local and time-specific price signal. If positive redispatch is required in a given region, meaning additional generation must be activated locally to relieve congestion, the dynamic tariff increases for withdrawals and decreases, or potentially becomes negative, for injections. Charging during such a period becomes more expensive, creating a disincentive to withdraw electricity from an already constrained grid. At the same time, feeding electricity into the grid is incentivised if it contributes to relieving the bottleneck. In periods without congestion, the incentive component is set to zero, ensuring neutrality in normal operation.

3.3 Aggregated system effect

The system-level impact of dynamic grid fees depends on the responsiveness of flexible assets. If a sufficiently large share of BESS operators reacts to the signal, charging demand during congested hours will decline, while injection during relieving situations will increase. As a consequence, redispatch volumes may decrease, peak flows may flatten, and curtailment costs could be reduced.

Importantly, this system effect emerges from decentralised optimisation responding to a uniform price signal rather than from centralised dispatch instructions. The grid operator does not directly control storage operation but shapes the economic environment in which private actors optimise. The effectiveness of the mechanism therefore hinges on price responsiveness and market penetration of flexible technologies.

3.4 Preconditions for behaviourally effective price signals

In the German intraday market, price spreads regularly reach 100–200 €/MWh during highly volatile periods. If the dynamic grid fee amounts to only a few euros per megawatt-hour, it may not meaningfully alter dispatch decisions. The arbitrage opportunity would remain largely intact; the grid fee needs to be material enough to incentivise a response that may be counter to a rational energy market response.

Conversely, an excessively high congestion component could distort efficient arbitrage, increase price volatility and undermine investment predictability. Overly strong signals might discourage economically beneficial charging during high renewable generation periods.

Effective calibration therefore requires empirical modelling of dispatch sensitivity to different fee levels, which constitutes a core analytical objective of this study.

4. Impact of Dynamic Grid Fees on Dispatch Decisions / Investment case

4.1 Overview of approach

The modelling undertaken aims to evaluate the potential impact of dynamic grid fees on BESS dispatch behaviour, the degree of grid-friendliness and the relative impact on margins for typical BESS assets.

The analysis is based on historical data for the periods 2024 and 2025 and BESS dispatch simulation of a typical 2h and 4h BESS configuration[8] against historical conditions, and how dynamic grid fees could have altered those compared to purely market-based dispatch.[9]

While the term "grid-friendly" does not have a strict definition and BESS and other technologies can provide a range of services that can be deemed in support of system stability, in the context of the introduction of dynamic grid fees, we have defined grid-friendly dispatch behaviour as periods of dispatch in support of redispatch (e.g. charging during negative redispatch) and grid-unfriendly as periods with dispatch against the redispatch direction (e.g. discharging during negative redispatch).

When the BESS is idle or when there are no constraints in the system (indicated by the absence of redispatch), the BESS is regarded as grid-neutral. While the fundamental determinant of the requirement for grid-friendly behaviour is the congestion in the system itself, and detailed data on the granular resolution of grid-congestion is not readily available, the resulting redispatch interventions are a close proxy to identify periods of system constraints.

4.2 Case studies of redispatch clusters

The German transmission system is marked by a key bottleneck in North-South direction, with high volumes of wind generation (both onshore and offshore) in the North and the transmission system not being set up yet to transport all energy volumes to the demand centres in the West and South. This creates two core redispatch regions in the German system, significant volumes of negative redispatch or grid-related curtailment of renewables in the North (with offshore wind being large part of that due to the order in which redispatch is activated) and positive redispatch or upward regulation of thermal assets in the West and South.

To explore the impact of dynamic grid fees on BESS in these two regions, we identified two clusters with redispatch activity that are representative of the key bottlenecks in the system. The cluster "Büttel" represents an area with a significant amount of offshore wind generation that enters the onshore transmission system in combination with onshore wind generation in Schleswig-Holstein.[10] This cluster has shown high volumes of negative redispatch historically. The second cluster analysed is the "Ruhr" area[11], sitting south of the core transmission constraints and in the high demand areas of the Rhine-Ruhr region. This cluster experiences a high volume of positive redispatch or upward regulation of mostly thermal generation assets. While the precise location of positive redispatch south of the constraints will be function of where flexible assets are located, the cluster is representative of high volumes of positive redispatch where a BESS asset could either work to reduce redispatch requirements or add to it.

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[8] Generic asset configuration set at 50 MW with an 85% RTE (incl. aux losses) and no degradation applied.

[9] The dispatch modelling was undertaken for a generic 50 MW in this analysis is focussed on the day-ahead market but have undertaken further analysis which has shown that the key trends and outcomes do not materially change with dispatch against historical intra-day prices.

[10] Substations included are: SHN Cluster Brunsbuettel, SHN Cluster Wilster West, SHN Cluster Itzehoe West, UW Buettel, OWP UW Buettel

[11] Power plants included are: Datteln, Hamm-Üntrop, Bergkamen, Gersteinwerk, Herne, Stummhafen, Marl, Scholven, Walsum

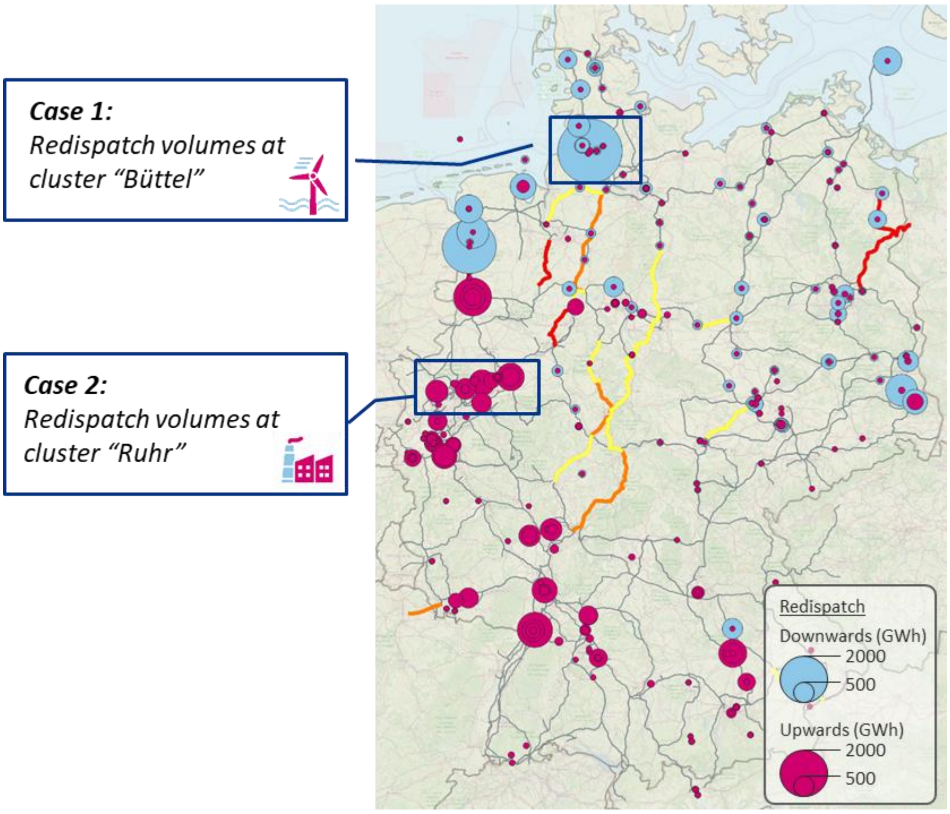

Figure 1 – Redispatch volumes and key congested lines in the German transmission system in 2024[12]

The location as well as the distribution of redispatch measures is a key determinant on how dynamic grid fees will impact the grid-friendliness of BESS assets. The below charts show the hourly distribution of redispatch periods at the two selected clusters. This visualisation shows that redispatch measures tend to last longer consecutive periods, from multiple hours to several days.

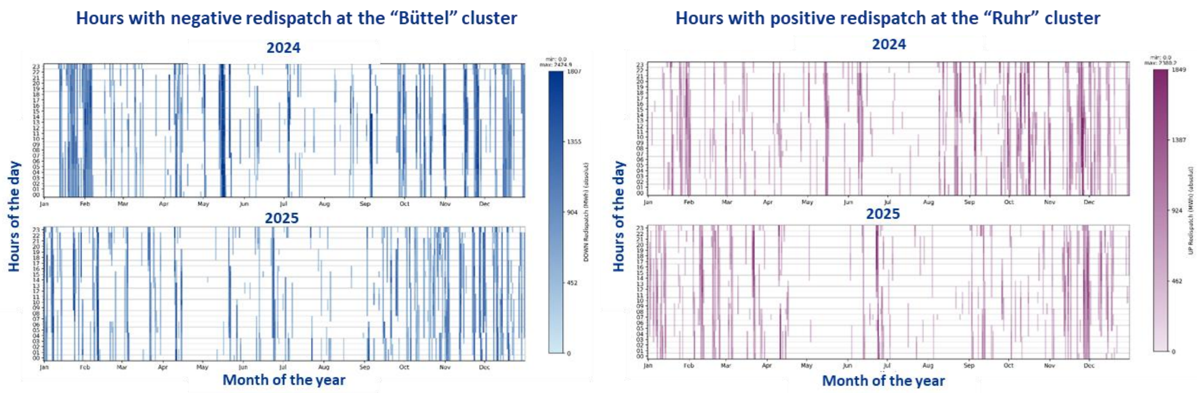

Figure 2 - Hourly distribution of Redispatch events at the modelled clusters

4.3 Defining the baseline

The first step of the analysis was to define the baselines. For these two setups were modelled for both BESS configurations and regional case studies:

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[12] Based on publicly available data from netztransparenz.de and smard.de

1. baseline dispatch against market prices without any grid fees or constraints.
2. a constrained counter-factual where there are no grid fees, but the assets are constrained to dispatch in the grid-unfriendly direction (e.g. no discharge during negative redispatch periods in the "Büttel" case)

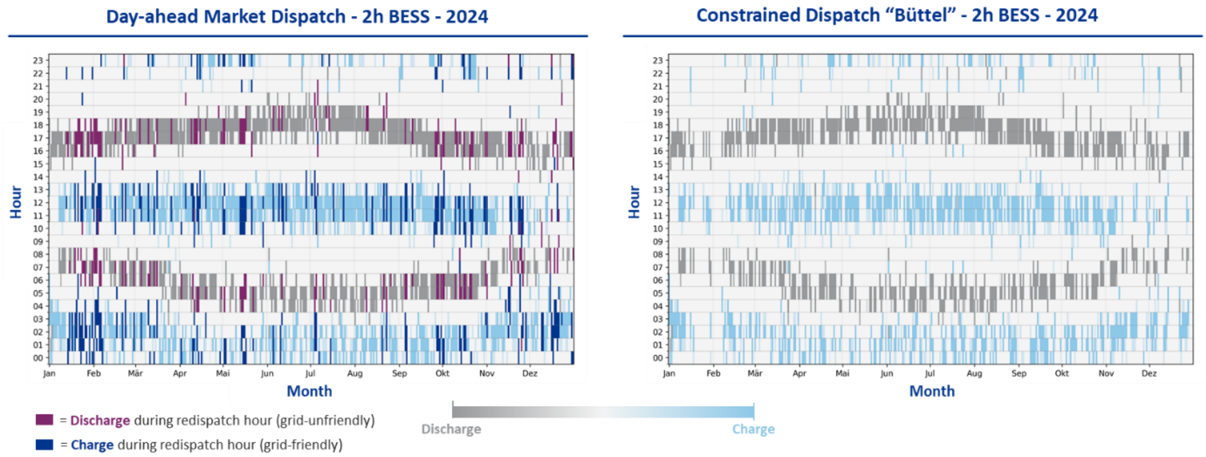

Figure 3 – Distribution of baseline and constrained BESS dispatch for a 2h BESS at the "Büttel" cluster in 2024

The results of the unconstrained baseline analysis (Figure 3 on the left) show a typical dispatch pattern for a BESS with approximately 2 cycles per day, charging during the overnight low-price periods as well as the midday periods when solar generation drives down the price increasingly, and discharge during the higher price periods in the morning ramp and afternoon and evening peaks.

The periods highlighted with the darker blue and purple colours also show the periods in which the market-based dispatch overlaps with the redispatch periods, which account for about 25% of all dispatch hours for both a 2h and 4h setup at the "Büttel" cluster during the historical period analysed.

The constrained dispatch (Figure 3 on the right) then shows the impact on the dispatch behaviour when there is a constraint imposed not to discharge during the redispatch periods. This renders the BESS essentially idle for a significant amount of time as the BESS can only charge once during the redispatch period and then has to wait until the constrained event is over. This constraint can be compared to fairly severe implementation of an FCA. The modelling shows that this would have a strong impact on BESS margin, reducing margins by 15-20% for both a 2h and a 4h asset across both modelled years.

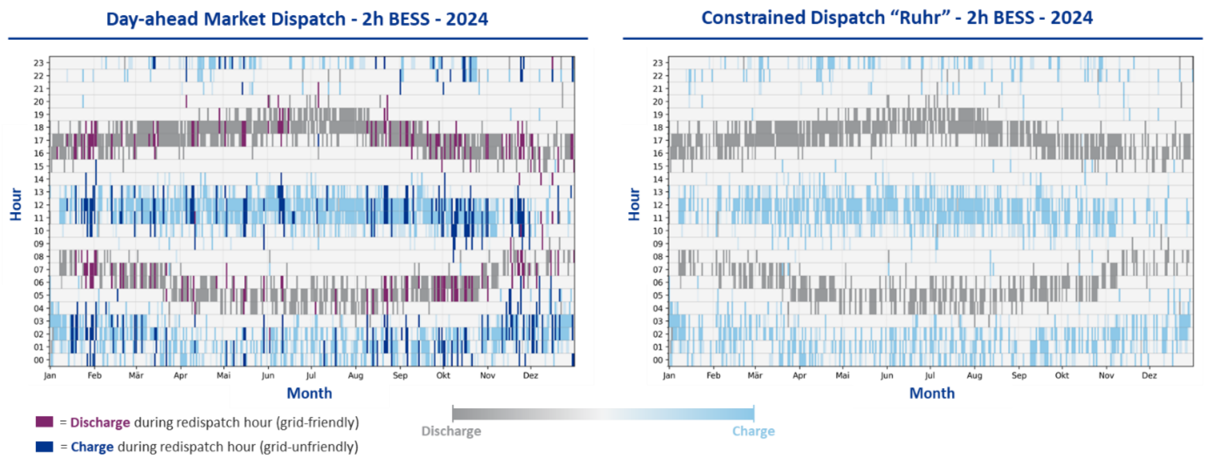

Figure 4 – Distribution of baseline and constrained BESS dispatch for a 2h BESS at the "Ruhr" cluster in 2024

The analysis of the "Ruhr" cluster shows a similar, albeit slightly less pronounced pattern, with the difference that here discharge during the redispatch periods is regarded as grid-friendly and charging (created additional load) can be regarded as grid-unfriendly. Constraining the assets not to charge during those periods also has a significant impact on BESS margins, reducing revenues by over 10%.

4.4 Introducing dynamic grid fees

There is a high degree of uncertainty on how dynamic grid fees would be implemented and the levels at which they would be set. The modelling explores a wide range of sensitivities across different types and levels to identify key trends and assess the robustness of outcomes. The core parameters are:

- application of dynamic grid fees only during redispatch periods consistent with the data for each of the two modelled clusters.
- assumption that the grid fee is known ahead of the day-ahead auction.
- three different grid fee structures were modelled:
    1. A negative (supporting) grid fee on the grid-friendly direction (e.g. a negative grid fee to incentivise charging during negative Redispatch in the "Büttel" cluster).
    2. A positive (disincentivising) grid fee on the grid-unfriendly direction (e.g. a positive grid fee to reduce discharging during negative Redispatch in the "Büttel" cluster).
    3. Simultaneous symmetric application of a negative grid fee on the grid-friendly direction and a positive fee on the grid-unfriendly direction. This is the approach currently proposed by BNetzA.
- given the uncertainty on the levels of dynamic grid fees sensitivities from 10 €/MWh to 120 €/MWh were modelled for each of the setups.

These values were kept constant throughout the redispatch periods, not modelled on period-by-period variation basis. While there will likely be a theoretical optimum with very granular variation of the grid fee, there are two core considerations:

1. the grid fee will have to be set before the day-ahead stage and therefore the system operator will not have visibility of market prices yet, and
2. a "fixed" dynamic grid fee will increase the ability of asset optimisers to model the impact which will in turn improve bankability of an asset.

4.5 Dispatch behaviour under dynamic grid fees

To assess whether dynamic grid fees are likely to incentivise grid-friendly behaviour from BESS assets, the analysis considered the average number of net grid-friendly operating hours during redispatch periods per year across 2024–2025, under the different grid fee structures and levels analysed. The net grid-friendly hours are the difference between the hours of grid-friendly dispatch and grid-unfriendly dispatch.

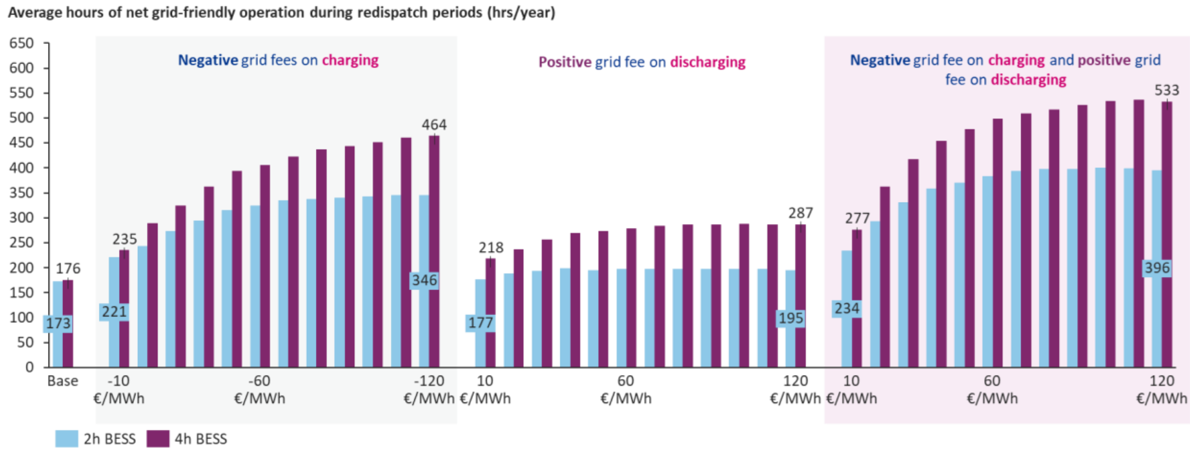

Figure 5 – Average hours of net-grid friendly operation during redispatch periods in the "Büttel" case study under different levels of dynamic grid fees

In the "Büttel" case, both the 2h and 4h BESS configurations are already grid-friendly on a net basis without any dynamic grid fees. However, the dynamic grid fees work to improve the net grid-friendly hours of the BESS under each configuration tested. The effect on the increase in net grid-friendly dispatch periods is the largest under the symmetrical application of positive and negative grid fees, with the impact being more pronounced for the 4h BESS system compared to the 2h system. The reason for this is that a longer-duration BESS is overall better placed to react to redispatch events that last longer periods with lower cycling requirements and the ability to capture more of the incentive to charge.

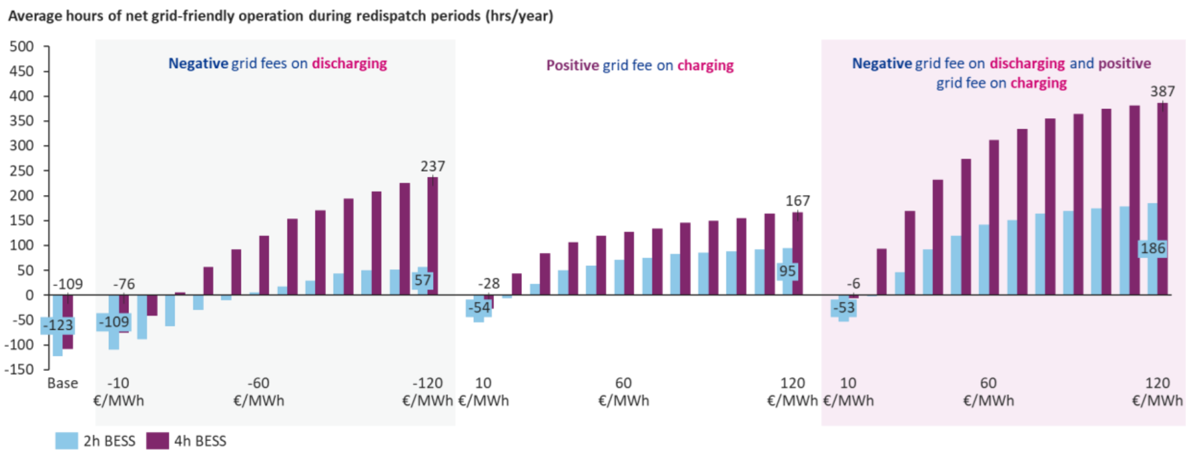

Figure 6 - Average hours of net-grid friendly operation during redispatch periods in the "Ruhr" case study under different levels of dynamic grid fees

In the equivalent representation for the "Ruhr" case, the baseline without grid fees shows the BESS asset to be net grid-unfriendly. This is because in the periods when discharge is required, the renewables (and wind in particular) that are causing the congestion and redispatch requirement tend to drive down the price. However, the application of the dynamic grid fees has an even more pronounced effect compared to the "Büttel" case. With only a moderate grid fee, the dispatch behaviour can be turned into a net grid-friendly setting, with the effect also most pronounced on the 4h system.

4.6 Impact of dynamic grid fees on BESS margins

As the second key dimension of the results, we evaluated the impact of the dynamic grid fees on the gross margins earned by the BESS. To do this, we considered the percentage change in gross margins between the baseline without grid fees and the different configurations and levels of grid fees modelled, also separating the impact on market revenue from any grid fee revenue.

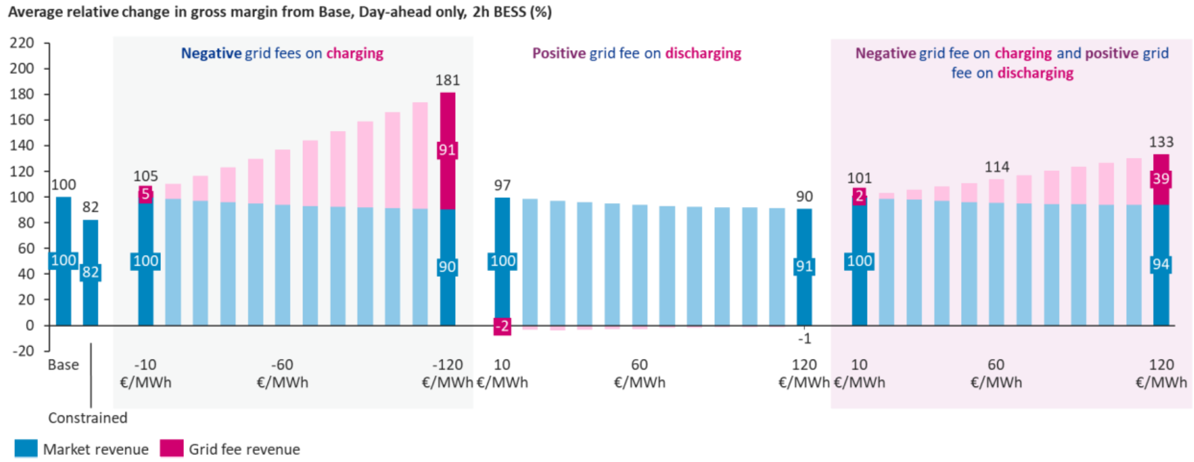

Figure 7 – Average relative change in gross margin from Base for the "Büttel" case in the 2h BESS configuration und different levels of dynamic grid fees

The results show that with a one-sided application of a negative grid fee on the grid-friendly direction there is a relatively large revenue increase from the grid-fee payments and this constitutes a more significant transfer from the system that needs to be recuperated. In the one-sided application of the grid fee on the grid-unfriendly direction there is a significant impact on margins, with relatively low net payments to the system operator. This indicated that in this setting the BESS will simply operate less and avoid the disincentivising periods. With the symmetric application of grid fees in both directions, the relative impact on gross margins is more moderate, depending on the grid fee level chosen.

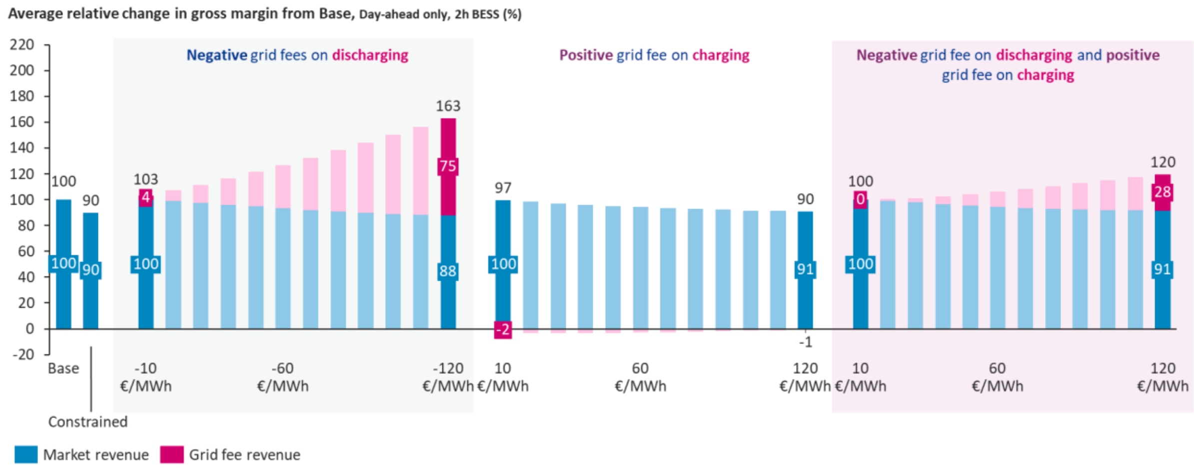

Figure 8 - Average relative change in gross margin from Base for the "Ruhr" case in the 2h BESS configuration und different levels of dynamic grid fees

The results for the "Ruhr" case show the same directional impact on gross margins as in the "Büttel" case, but the relative increase based on the symmetric grid fee application is more moderate overall.

4.7 Cost of reduced redispatch requirements

For every additional grid-friendly dispatch decision the BESS takes as a result of the dynamic grid fees, this could work to reduce the redispatch requirements at that node. The cost of the dynamic grid fees to the system relative to the net volumes of additional grid-friendly dispatch compared to the baseline without grid fees can give a first indication of the cost-effectiveness of the dynamic grid fees tested relative to redispatch costs.

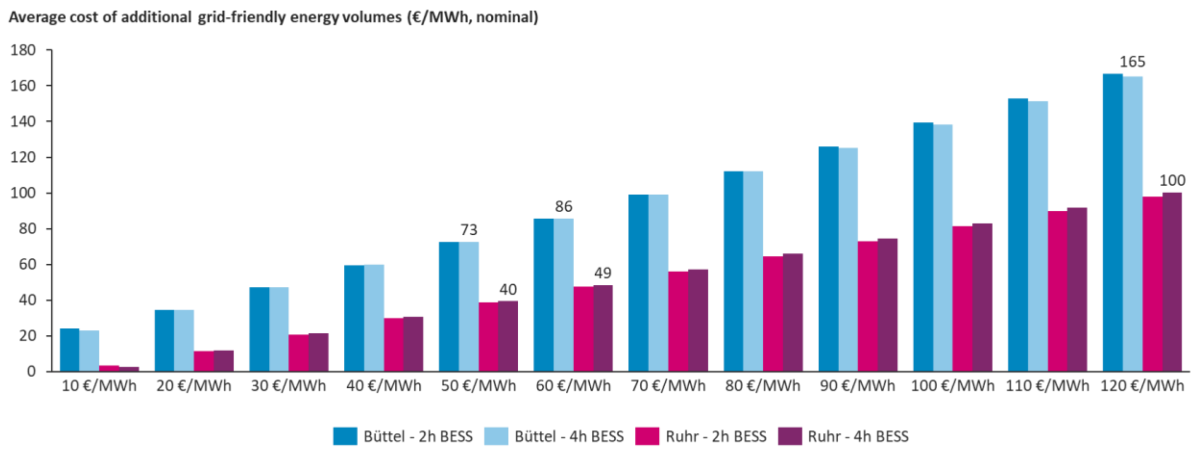

Figure 9 – Average cost of net additional grid-friendly energy volumes based on the symmetric dynamic grid fees

The results show that for the case of the application of the dynamic grid fee into both directions, there is a linear increase in the cost of additional grid-friendly energy volumes as the dynamic grid fee increases. The values are significantly lower in the Ruhr case, which reflects that overall, the dynamic grid fees have a stronger effect on improving the net grid-friendliness of BESS assets in that setting.

For the "Büttel" case, the costs of the net additional grid-friendly energy volumes can be linked to savings in redispatch costs; there is excess energy in the North that cannot be transported, the additional BESS charging works to absorb some of this energy, which in turn means that less wind generation would need to be curtailed. In terms of the wider market dynamic, this also creates additional demand during those periods, which would then work to increase market supply. As long as this additional supply is not sitting on the same side of the constraint, the BESS has saved redispatch costs.

For the situation in the South the connection with redispatch costs is less straightforward. Positive redispatch is usually not a direct remedy to network constraints but rather counteracts the energy imbalance that has been caused by curtailment of generation which in turn is responsible for the congestion. While additional generation during those periods south of the constraints can be regarded as grid-friendly, with a dynamic grid-fee incentive in the wholesale markets, this generation can displace other generation volumes in the market either side of the constraint. If it replaces market-based generation volumes north of the constraint it would directly work to lower congestion and therefore redispatch costs, if it replaces market-based generation volumes south of the constraint (e.g. thermal assets), it may not necessarily reduce the volumes of redispatch requirement, but it could work towards making cheaper redispatch sources available. This effect could be particularly significant when a significant volume of BESS can also add more flexibility to redispatch when it displaces "blocky" thermal assets.

Overall, comparing the average cost to the historical cost of redispatch interventions in Germany (see Figure 10) gives an indication that the introduction of dynamic grid fees could reduce system costs overall. Considering that there is a spectrum of redispatch costs for different assets, further analysis on the cost of marginal redispatch volumes displaced by grid-friendly dispatch would need to be considered in addition to any additional costs of remaining grid-unfriendly BESS dispatch. This could be used to validate the impact on system costs and inform the optimal grid fee level.

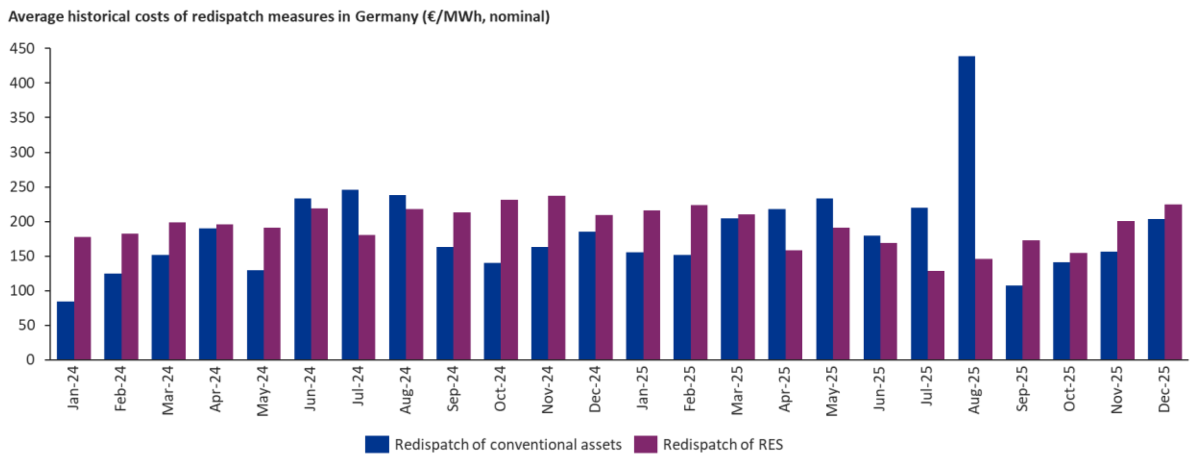

Figure 10 - Average historical monthly Redispatch costs in Germany[13]

4.8 Summary of modelling

The central results of the modelling are:

- For a BESS asset in the North (represented by the "Büttel" cluster), the baseline BESS dispatch behaviour without grid fees is already grid-friendly on a net basis, i.e. there are more periods of grid-friendly behaviour than grid-unfriendly behaviour and therefore the BESS works to reduce redispatch volumes on a net basis. The key reason for this is that the wind generation that is causing congestion and Redispatch is also on average leading to lower power prices, which creates a stronger signal for charging and for discharging
- All three types of grid fees implemented work towards increasing the net grid-friendliness of BESS dispatch, but the symmetric application of negative and positive grid fees have the largest impact
- As the level of the dynamic grid fee increases the marginal increase in net grid-friendliness diminishes, suggesting that there is a moderate optimum of the dynamic grid fee that generates the most increase in grid-friendliness in comparison to the impact on the BESS margins and the cost to the system; and
- The introduction of a negative grid fee in the grid-friendly direction can mitigate any negative impact of the dynamic grid fees on gross margins and provide a moderate upside, depending on the set level.

The cost of the net additional grid-friendly energy volumes dispatched by the BESS assets driven by dynamic grid fees can reduce net redispatch requirements. While the analysis of the impact of system costs would need to be further developed, the cost to the system of the dynamic grid fees gives an indication that this could be measure that works to reduce overall system redispatch costs compared to the counterfactual without incentivising grid fees or dispatch restrictions.

[13] Based on publicly available data from smart.de

5. Regulatory Design Options and Policy Recommendations

Based on the detailed analysis included in chapter 4[14], this chapter considers the key recommendations for BNetzA in designing effective dynamic pricing structures for BESS assets, that maximise grid-friendly behaviour, while reducing any negative impacts on the future investment case for BESS assets in Germany. These recommendations have been captured under three categories:

- Dynamic grid fee design recommendations
- Interaction with existing market signals, and
- Implementation recommendations

These recommendations should be considered as an important basis for moving beyond the current high-level policy proposal, into the detailed design of the application of these potential new tariff functions.

5.1 Grid fee design recommendations

Recommendation 1: Symmetrical pricing is critical	**Recommendation 1a:** Symmetrical pricing – as proposed by BNetzA – provides the optimal structure for dynamic grid fees in both driving the highest net improvements in grid-friendly behaviour compared to grid unfriendly behaviour, as well as creating a net neutral to slight economic upside for BESS assets. This creates benefits for the TSOs while also ensuring that the business case for BESS installations across Germany is maintained. Noting that BESS assets play a critical role in reducing grid congestion, maintaining the attractiveness of the BESS investment case is critical.
	Recommendation 1b: The upside (negative balance) for storage assets must not be capped: it compensates for lost market revenues and is the primary lever for driving grid-friendly behaviour. Capping upside at higher price points risks eroding BESS margins. Rather than capping upside, the overall symmetrical price range (floor and ceiling) should be bounded, modelling suggests diminishing behavioural returns beyond a certain price point.
Recommendation 2: Determining the level of "grid-friendliness" that is being targeted will inform the price point	**Recommendation 2a:** BNetzA and the TSOs must collectively define the target level of grid-friendly behaviour before setting the price point. The modelling demonstrates that higher symmetrical fees drive more grid-friendly hours but risk disproportionate market distortions if uncapped.

[14] Note these policy recommendations have been drafted by DWR-eco and Akaysha Energy building on the modelling analysis undertaken by Baringa as detailed in the previous chapter.

	Recommendation 2b: The price point should be calibrated so that the financial transfer from TSOs to BESS operators is commensurate with the value of avoided redispatch costs.
Recommendation 3: Grid fees do not need to be fully dynamic to incentivise an increase in grid friendly behaviour	**Recommendation 3a:** Statically-fixed dynamic grid fees (i.e. set over a fixed period rather than per 15-minute interval) can still drive meaningful improvements in grid-friendly behaviour, while significantly reducing programme complexity and forecasting-error risk. A semi-static approach also simplifies the administrative complexity of introducing dynamic grid fees – which we believe will be important for TSOs and support a faster rollout process.
Recommendation 4: Regional differentiation in pricing will be necessary for managing location differences in redispatch needs	**Recommendation 4a:** The appropriate level of regional granularity must be determined through further forecasting and modelling of the future generation mix across TSO subregions and nodes.
	Recommendation 4b: Price signals must be directionally correct: each region's fee should solve for the core redispatch direction (either upwards or downwards redispatch), not both simultaneously.
	Recommendation 4c: Once defined, regional boundaries should remain fixed for the life of the asset to eliminate regulatory risk for investors.
Recommendation 5: Dynamic grid fees should also be considered as a mechanism to reduce grid fees with a financing function	**Recommendation 5a:** The value of increased grid-friendly behaviour should also be considered as a mechanism which can be used to reduce the overall financing component of the grid tariff. By incentivising BESS to charge during periods of downward redispatch and discharge during upward redispatch, storage can contribute to a more efficient use of the network, reducing congestion and redispatch volumes, and thereby lowering system costs.
	Recommendation 5b: If the BNetzA were to decide to cap the upside of the incentive component, any excess should be netted against the financing component of the grid tariff on an annual basis, preserving the economic upside for asset operators within the overall regime.
	Recommendation 5c: As work on the Draft Proposal progresses, BNetzA should further consider the interrelationship between the financing fee component and the incentive fee component and how grid-friendly behaviour from BESS can reduce the overall fee component.

Recommendation 6: Dynamic grid fees may negate the need for flexible connection agreements	**Recommendation 6a:** Dynamic grid fees may provide an economic price signal that incentivises the same behaviour that would be managed through any limits placed on operation through an FCA. Whereas FCAs are only designed to reduce grid-unfriendly behaviour, dynamic fees can also increase the incidence of grid-friendly behaviour. Dynamic grid fees can also play a role in providing TSOs with more certainty on the behaviour of a BESS, which would also result in reducing any ramping risks, and would act as an economic "schedule freezing" tool as it will inform the optimal behaviour of a BESS over the period.
	Recommendation 6b: Notwithstanding the points above, if FCAs are progressed it will be critical that they're designed in a way that complements rather than competes with dynamic grid fees. They also need to be designed in a way that does not limit the upside potential of dynamic grid fees.

5.2 Recommendations for effective integration with existing markets

Recommendation 7: Predictability and transparency are necessary to steer effective signals	**Recommendation 7a:** For dynamic grid fees to steer behaviour effectively, signals must be predictable and transparent. At a minimum, they should be published in advance, ideally on a day-ahead basis, and based on a clearly defined and stable methodology.
	Recommendation 7b: Clarity on the calculation method will need to be provided in order to minimise bankability risks. This should include possible volatility bands and the interaction between financing and incentive components.
Recommendation 8: Dynamic grid fees must not disincentivise revenue stacking optimisation	**Recommendation 8a:** Battery storage projects rarely optimise against a single revenue stream. Instead, they rely on revenue stacking across energy arbitrage, Frequency Containment Reserve (FCR), automatic Frequency Restoration Reserve (aFRR) and other markets. If dynamic grid fees conflict with higher-value ancillary service commitments, behavioural responsiveness may be limited. The dynamic grid fee incentive signal must therefore be assessed relative to the revenue weight of FCR capacity payments, aFRR energy revenues and intraday arbitrage margins. Only if the congestion-related component meaningfully affects the net marginal value of alternative dispatch options will operators adjust behaviour. Otherwise, storage assets may continue to prioritise more lucrative markets.

	Recommendation 8b: BNetzA should also consider whether the provision of some services – such as aFRR – should be exempt from dynamic grid fees. This would reduce any downside revenue risks that BESS operators may incur for providing critical system security services that are directionally opposed to the dynamic grid fee during the same period.

5.3 Implementation recommendations

Recommendation 9: There needs to be consistency in transparency and forecasting obligations for TSOs	Forecast data of TSOs should be published in a standardised, accessible form to support developers with planning of new assets under the to be introduced grid tariff regime.
Recommendation 10: BNetzA should consider piloting opportunities	Prior to a nationwide rollout of dynamic grid fees, BNetzA, in cooperation with the TSOs and BESS operators, mandate a structured pilot programme across several representative geographic subregions. The pilot programme would help capture variations in redispatch patterns and BESS dispatch behaviour and inform the appropriate tariff settings of a dynamic grid tariff model.

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