SVENSKA KRAFTNÄT

Balancing market outlook 2030

2026-06-09

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CHAPTER 1

Introduction

UPDATED

Initial words

The introduction of flow-based capacity calculation and a 15-minute market time unit has posed challenges to the balancing process for balancing responsible parties (BRPs) and their customers. Reduced transmission capacity available in the balancing timeframe limits the ability to transfer and activate balancing bids across some bidding zones.

At the same time, improvements have been observed through the growth of balancing bids in all Swedish bidding zones together with adjustments in the market design. Efforts to further improve the market and reduce the financial risk for BRPs will continue in close cooperation with our stakeholders.

Moving forward, a holistic perspective is key. The end-to-end balancing process - across all market timeframes – together with the capacity allocation process is from now on inseparable.

This report is not intended to provide an entire new outlook, but rather an updated version of the published report Balancing Outlook 2025–2030 including data up to December 2025.

I hope that this report provides valuable insights for both new and existing market participants.

Anna Jäderström
Director Balancing Markets

UPDATED

About this report

Welcome to Svenska kraftnät's outlook for ancillary services!
Sweden's climate targets are accelerating electrification and increasing electricity demand. This transition is reshaping market conditions, including the supply and demand for ancillary services.

The purpose of this report is to provide information and insights about recent and future developments of ancillary services in Sweden, including market design reforms, historical development of demand and prices for different products, as well as projections of future demands. The aim is to further enable market actors to identify viable business cases and to make investment decisions for ancillary services provisions.

This report provides updated data for the outlook and builds on the first edition published in December 2024. It serves as a smaller update, concentrating on developments observed in the 2025 data. Updated pages are indicated with a yellow symbol "UPDATED".

The report presents historical data up until and including December 2025 and projections for the next five years. The future is, however, by its very nature uncertain. This means that forecasts will always be associated with errors in hindsight. Svenska kraftnät strives to be transparent regarding these uncertainties in order to provide market actors with full information about possible future developments. Hence, the forecasts presented in this report should be considered the best estimates currently available, but they can all be subject to change.

A closer look on 2025 is also provided separately. Due to the intensity of market design changes for mFRR and imbalance settlement and the associated challenges and subsequent further development, a more detailed evaluation is beyond the originally intended scope and purpose of this report.

We hope that this report paves the way for further stakeholder engagement in the ancillary services markets!

UPDATED

Svenska kraftnät's strategy and market design

The transmission system operators are in the centre of the development of the electric power system and market. Svenska kraftnät's updated strategy towards 2030, highlights the changes needed to support the development of both the system and Svenska kraftnät's role within it.

The future electricity market has been identified as a development area that requires extra attention in order for Svenska kraftnät to meet long-term goals and objectives. A key part of this is to develop market design that creates the conditions for market participants to make efficient operational decisions and long-term investments in adequacy and flexibility. It should also provide incentives for the capabilities needed in a more volatile power system. In this context, the development of ancillary services markets is an important part of enabling Svenska kraftnät's ambitions.

Market integration

Market integration provides efficiency by allowing trading and sharing resources between countries. The integration of balancing markets in the Nordic region has generated socioeconomic benefits. It is important that any further integration with continental Europe is implemented in a way that delivers additional value to Sweden and the Nordic region.

Competition

Competition is vital for market efficiency. By removing entry barriers, providing equal access and low transaction costs for different actors, competitive markets can be promoted.

Efficient cost allocation

In order to create system efficient incentives for market actors, costs and benefits need to be appropriately allocated to the actors providing benefits or causing costs. This should also support reasonable conditions for market participants, including transparent and balanced price signals.

Key takeaways

Here are the key takeaways from Svenska kraftnät's outlook on the future of the balancing market and the demand for ancillary services.

1

The balancing market is evolving rapidly, where the overall demand for ancillary services is expected to grow over the next five years. A diversified range of technologies and an efficient market design will be crucial to meet this growing demand.

2

Increased demand for resources that are located geographically close to the imbalances. This is driven by the grid reaching full utilization, at least in one direction, particularly for frequency restoration reserves (FRR). Consequently, the need to secure day-ahead capacity for aFRR and mFRR will also increase.

3

The current balancing model is under review. This includes reassessing how we dimension our reserves (aFRR and mFRR) as well as exploring the incentives and mechanisms to help the power system to be balanced.

CHAPTER 2

Background

Why do we need ancillary services?

Grid capacity and wholesale energy market
Svenska kraftnät plays a critical role in allocating capacity for the electricity market by setting limits that ensure stability and reliability across the grid. This capacity allocation allows market participants to engage in energy transactions, to a large extent through the power exchange (via NEMOs). Svenska kraftnät's capacity allocation uses factors such as forecasted demand and production, grid constraints, and energy availability from different sources.

Power system characteristics
Depending on the outcome in the wholesale energy market, specific technologies are called upon to either produce or consume electricity, shaping the grid's characteristics during each market time unit (MTU). This results in varying system properties, such as available flexibility and inertia.

"Ancillary services have always and will always be needed"

The outcome on the wholesale energy market, where production is planned to meet demand, does not always reflect real-time conditions. Sudden shifts in weather can swiftly alter consumption or generation from wind and solar, leading to discrepancies between forecasted and actual production. Similarly, unexpected technical interruptions, such as failures in high-voltage cables (HVDC), grid infrastructure, or in large production or consumption units, can disrupt the planned energy flow. These unforeseen changes require rapid response measures to rebalance supply and demand in real time. Ancillary services will always be needed as long as consumption and production are not required to match each second. Further, the alternative would be that each market actor is required to maintain reserves for all eventualities, which would risk large volumes being withdrawn from the markets as a precaution.

"Markets for ancillary services enable cost and resource efficiency, the alternative being that each market actor is required to keep reserves of their own"

By establishing separate markets for different ancillary services, the TSO enables efficient resource allocation to meet specific demands. Each market targets a distinct service, allowing technologies with different strengths to contribute where they are most effective as well as enabling strong competition through transparent markets.

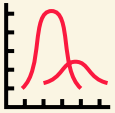
Balancing the power system requires several steps

A part of Svenska kraftnät's system responsibility as the TSO in Sweden is to ensure that the grid is stable and balanced all year round. Achieving this requires a series of steps that must function together to ensure everything runs as efficiently as possible.

Terms and conditions for balance responsibility
In addition to Svenska kraftnät's system responsibility, market participants are responsible for managing their own balance. By establishing clear terms and conditions for balance responsibility, market participants can be incentivized to align with the power system's needs and penalized when they cause imbalances according to the polluter pays principle.

Market design
Offering your flexibility to Svenska kraftnät should be easy. Continuous improvements in market design and functionality aim to lower barriers for entry to ancillary service markets.

Technical requirements
Developing and establishing clear technical requirements will enable more technologies to participate in the market. This approach also enhances the quality of reserve delivery and ensures that resources meet the power system's needs effectively when activated.



Dimensioning reserves & forecasting imbalances
Svenska kraftnät plays a crucial role in determining reserve requirements for capacity products and forecasting imbalances for energy products in each bidding zone. By providing accurate projections, Svenska kraftnät ensures that the power system receives the necessary resources to maintain balance while keeping the market informed of current demand, enabling actors to supply their resources accordingly.

UPDATED

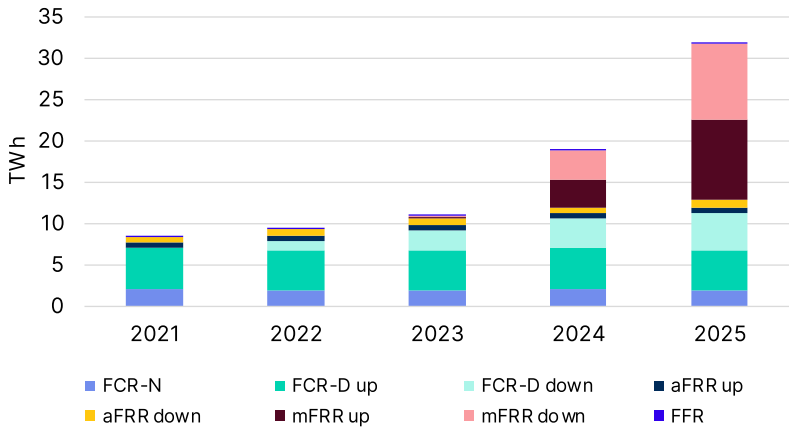
Development of capacity volumes until 2025

The yearly cost of balancing capacity has increased since 2021, mainly due to increased demanded volumes on several markets, but also due to resulting, initially higher price levels.

Rising balancing capacity volumes – why?
Several factors set the demanded volumes. Most important are:

- **Introduction of the mFRR capacity market.** Until October 2023, mFRR was only an energy activation market. By the end of 2024 procured volumes were increased to enable mFRR EAM with ACE-based balancing per area
- **Larger share for Sweden as part of Nordic FCR requirements.** The way each country's share is calculated has changed during the years, resulting in a larger share for Sweden.
- **New HVDC cables.** Affects the size of actual reference incident in Nordic area and thereby increases the need for volume in some products.
- **Focus on improved frequency quality.** There has been a trend in worsening frequency quality, especially in hourly transition, which needs to be handled.

Procured volumes – Capacity markets, TWh



PROCURED VOLUME:
+273 % since 2021

Procured volume of balancing capacity is calculated in **TWh** since each MW procured has to be available for one hour. Actual activation time, in case of activation, varies from seconds up to 15 minutes. Only a small share of the procured volume is activated.

UPDATED

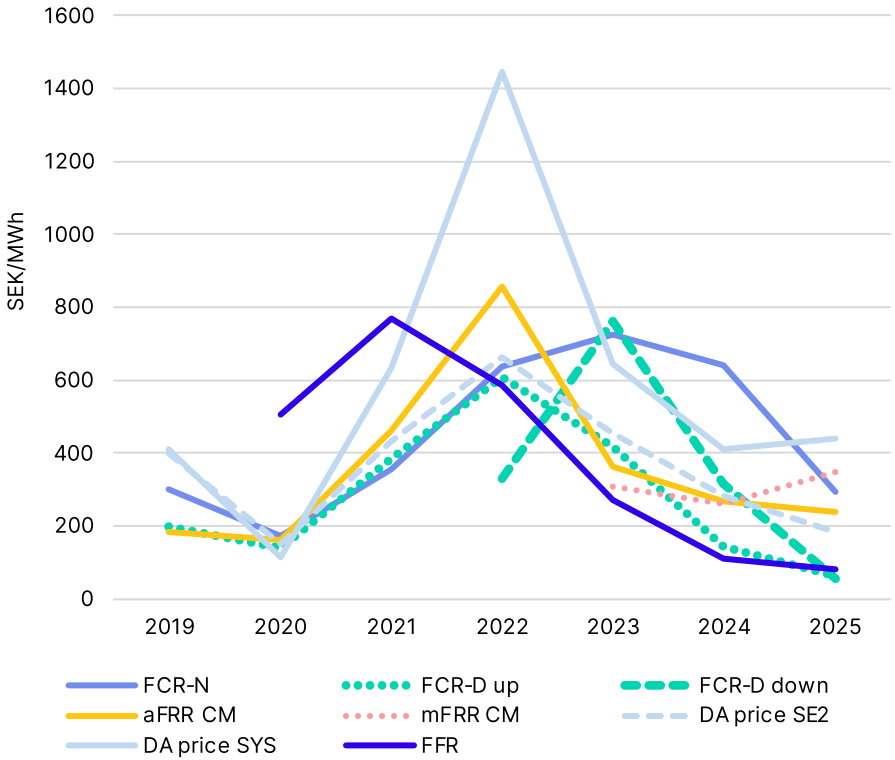
Development of capacity prices until 2025

Though price levels initially spiked when the demand was increased for FCR-D and mFRR CM, the overall trend since 2022 is decreasing and stabilized price levels. Why?
Important factors – among other things:

- **Falling spot price.** The spot price generally affects price of up-regulation products, as this reflects the opportunity cost for dispatchable up-regulation/production.
- **Larger supply – increased competition.** Market liquidity has gradually increased, especially for the FCR-D products in the wake of the increased demand, and due to the common mFRR CM market with Denmark and Finland since end of 2024. However, local market concentration per bid area can still be high with few actors and low liquidity.
- **Weaker correlation to spot price for new resources.** Energy storage and other new resources participating on ancillary services markets show less dependency to low or volatile spot prices. This means supply volumes and pricing are more stable, also during hours with e.g. low spot price and low availability of dispatchable production

PRICES:
Decreasing price levels due to increased supply

Average prices capacity markets, SEK/MWh



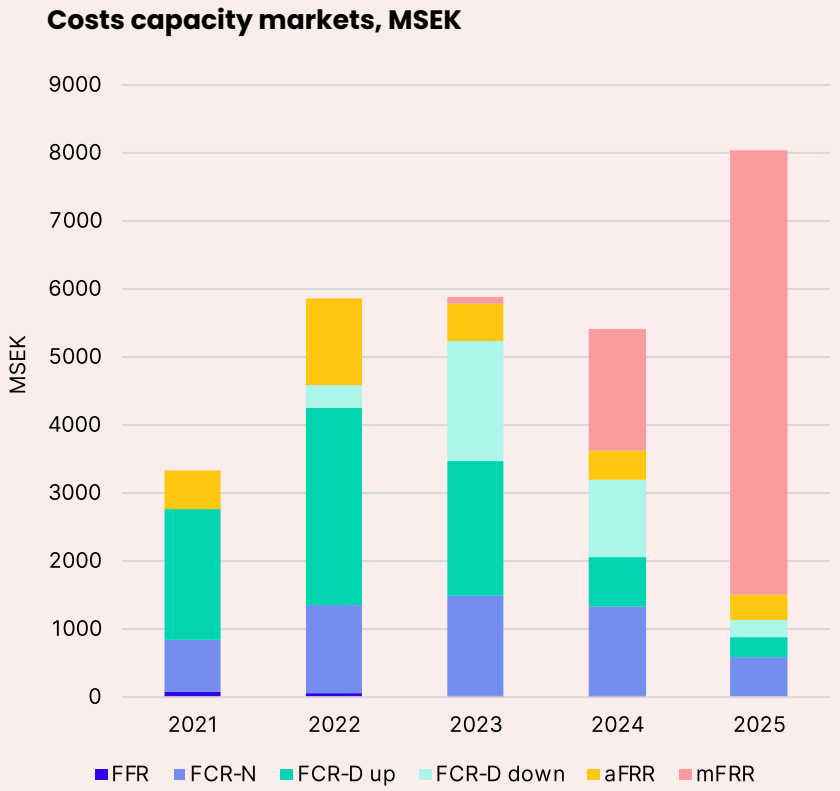
UPDATED

Development of balancing capacity costs

RECALL:

PROCURED VOLUME:
+273 % since 2021

PRICES:
Decreasing price levels due to increased supply



CHAPTER 3

Outlook 2030

UPDATED

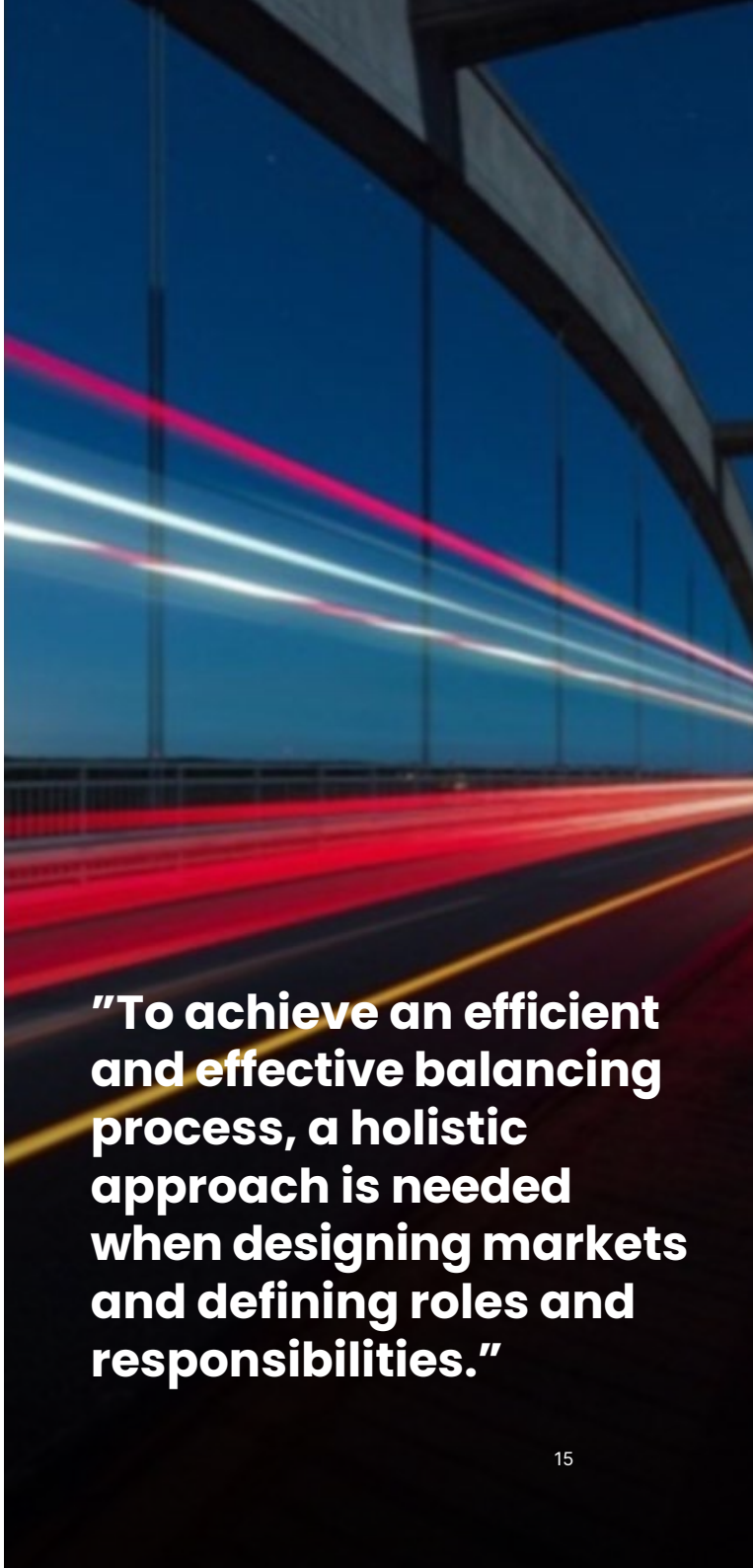
Market development and integration

Electrification is identified as key in order to meet climate goals, and the electricity demand is foreseen to increase significantly as a result. Simultaneously, the generation mix is changing with larger shares of wind power and solar power production.

This development affects balancing of the power system, with an increasing complexity and variability in the resource mix and increased uncertainties. The balancing process includes several markets and incentivising instruments. To achieve an efficient and effective balancing process, a holistic approach is needed when designing markets and defining roles and responsibilities. Svenska kraftnät has initiated a work aiming at creating a more coherent way of balancing, where the different components that an efficient way of balancing consist of, are well aligned.

From a welfare perspective, there are gains in sharing balancing resources between regions and countries. Netting balancing needs over larger areas across bidding zones can also be efficient. This presupposes transfer capacity being available for balancing purposes, highlighting the importance of an adequate capacity allocation for all market time frames. Expansion of the flowbased market coupling methodology to encompass intraday and balancing markets aims at providing necessary tools to accomplish this.

Changes in market design create new conditions for market actors to adapt to. Although changes might be efficient in the long-term, it can be motivated with temporary mitigating measures shielding market actors from short-term effects difficult to fully predict before implementation. During recent years, several significant market design changes have been implemented, including flow-based market coupling in the day-ahead time frame, 15 minute MTU and ISP, and mFRR EAM. Svenska kraftnät has occasionally performed corrections of imbalance prices as a mitigation action.



Ancillary service market overview and outlook

Svenska kraftnät procures different ancillary services through separate markets. The table below provides an overview of existing products and the corresponding capacity and energy activation markets.

Fast frequency Reserve	Frequency Containment Reserves			Frequency Restoration Reserves		
FFR Annual procurement	FCR-D up CM	FCR-D down CM	FCR-N CM	aFRR up CM	mFRR up CM	mFRR up EAM
				aFRR down CM	mFRR down CM	mFRR down EAM

The coming sections provide an outlook for each ancillary service that is structured into three parts. The first part introduces the product and the market, the second offers a highlight view of current trends in the market, and the third presents an outlook of estimated future changes.

INTRODUCTION

- Introduction of the product
- Dimensioning process
- Market setup

KEY HIGHLIGHTS

- Historical volumes and prices
- Prequalified capacity
- Number of BSPs

OUTLOOK 2030

- Estimated future volumes
- Description of uncertainties
- Market development

CM – Capacity market
EAM – Energy activation market

FAST FREQUENCY RESERVE

FFR

UPDATED

INTRODUCTION AND SUMMARY

What is FFR?

The fast frequency reserve (FFR) is designed to stabilize the frequency in the event of a disturbance in the Nordic synchronous area at low levels of system inertia. FFR has the fastest response time of all ancillary services at 0.7 to 1.3 seconds for full activation, for a duration of 5 to 30 seconds. The response time varies depending on the frequency deviation, where the larger the deviation the faster the response.

FFR is a product that only provides upwards regulation and ensures that FCR is capable of frequency regulation at low levels of system inertia.

Planning

Dimensioning process

The FFR volume is dimensioned based on the total Nordic system inertia and its forecasted levels as well as the reference incident in the Nordic synchronous area.

Distribution of the Nordic FFR need is determined by a key factor based on the yearly total generation (TWh) and consumption (TWh) in each control area. The key factor is also based on each TSOs contribution to system inertia and size of reference incident.

Securing capacity

FFR annual procurement

FFR is a Nordic product with common technical requirements. Procurement of FFR is made on a national level.

There is an annual procurement of FFR, where contracts are signed for a period from April to April. The supplier provides a contractual price for a given volume. The capacity remuneration depends on the call-off volume using the marginal price.

Activating energy

Weekly call-offs

During the delivery period, hourly capacity call-offs are made twice a week. On Mondays for Tuesday to Friday, and on Fridays for Saturday to Monday.

The hourly call-off volume is dependent on the forecasted system inertia in the Nordic synchronous area and can therefore vary throughout the year.

During activation, all bids that are called off are activated. There is no remuneration for FFR energy activation.

TSO	Share 2025
Svenska kraftnät	38%
Energinet (DK2)	3%
Fingrid	21%
Statnett	38%

FFR – KEY HIGHLIGHTS UPDATED

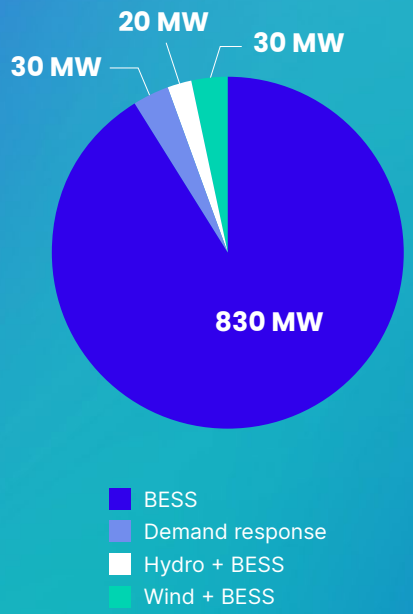
Prequalified capacity Q4 2025

910 MW

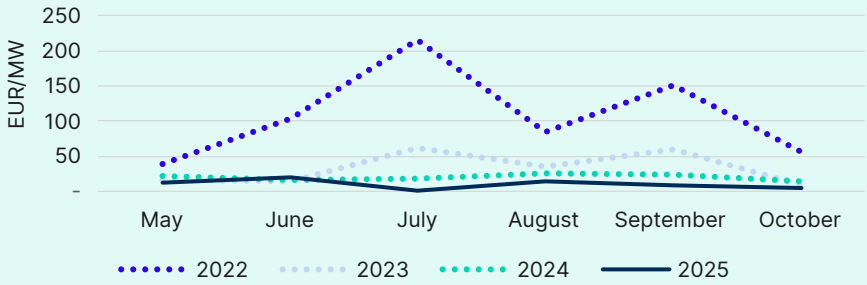
With a fixed annual demand, prequalified capacities compete during the procurement phase

Annual procurement – 113 MW

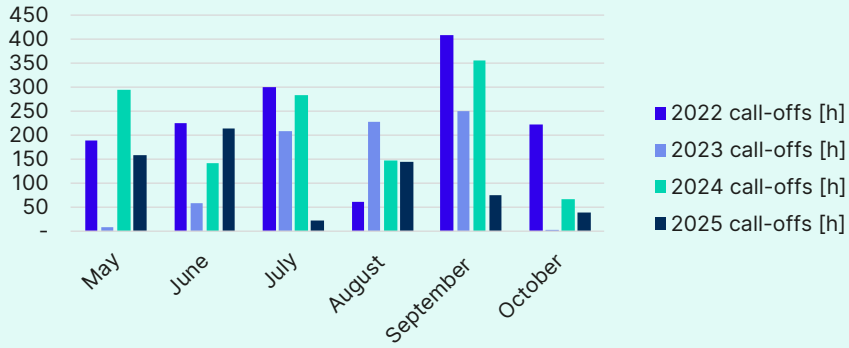
Trending technology is BESS +510 MW added since 2024 which is an increase of 160 %



Historical prices



Number of call-off hours



Falling prices due to improved competition

New actors: Increased number of providers 2025 and a maturing market has led to increased liquidity and lower marginal prices as a result.

FFR – OUTLOOK 2030

The dimensioning of FFR is based on the forecasted levels of system inertia and the reference incident in the Nordic synchronous area.

As the transition to a higher proportion of renewable energy sources continues, the number of hours with low levels of system inertia is forecasted to increase. Consequently, the forecasted hours with a need for FFR in the Nordic synchronous area is projected to increase.

The forecasted FFR need varies greatly depending on the future production mix of the Nordic power system.

The most significant change in FFR need is seen between the 2035 EP and SF scenarios, ranging from close to 0 to 2.5 times of today's FFR need. This highlights the uncertainties in forecasting the FFR need during the ongoing technology shift as a result of the energy transition.

Investigation of dynamic FFRThe forecasted number of hours below 150 GWs each year in the Nordic synchronous area, which is indicative for the procured FFR volume, will most likely put more stringent requirements on the design of the FFR product moving forward.

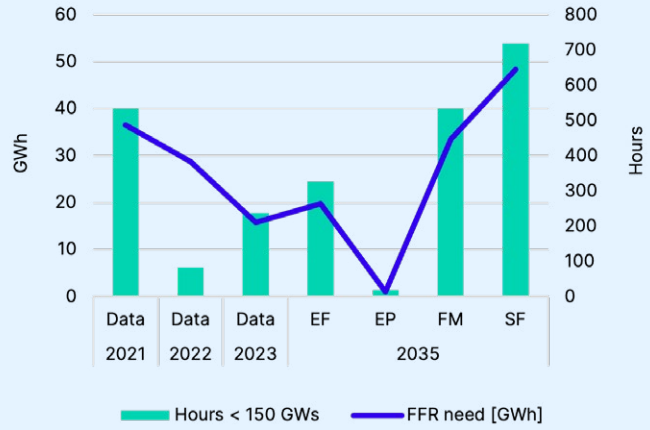
The integration of advanced technologies, such as battery storage and demand-side response mechanisms, will play a crucial role in meeting these forecasted needs. These technologies can provide rapid response capabilities, effectively supplementing the FFR requirements.

A possibility is to introduce a new type of FFR product, dynamic FFR. Technical pre-conditions for dynamic FFR are currently under investigation in a Nordic joint project.

Transition to D-1 market
The current FFR market is intended to transition from annual procurement with weekly capacity call-offs to a capacity market with hourly trade the day before delivery (D-1). A new IT platform for procurement of FFR on the new D-1 market is preliminarily planned for 2027.

Updated information:
The transition to the D-1 market is currently estimated to take place in 2028. Ongoing work related to FFR is underway and will be published shortly.

Estimated yearly FFR need



Scenarios

- SF – Small-scale renewables: Decommissioning of existing nuclear power and construction of renewable power sources
- FM – Mixed: Operational extension of existing nuclear power
- EP – Electrification plannable: Operational extension of existing and construction of new nuclear power
- EF – Electrification renewables: Decommissioning of existing nuclear power and construction of renewable power sources

FREQUENCY CONTAINMENT RESERVE
– DISTURBANCE UPWARD

FCR-D upward

INTRODUCTION AND SUMMARY

What is FCR-D upward?

Frequency containment reserve for disturbance is designed to stabilize the frequency in the event of a disturbance in the Nordic synchronous area. FCR-D responds automatically if the measured frequency deviates from the normal band (49.9 – 50.1 Hz). It has the second fastest response time of all ancillary services, treading closely behind FFR.

FCR-D upward is automatically activated upwards if the frequency drops below 49.9 Hz. Full activation is reached at 49.5 Hz, which protects the Nordic synchronous area against disturbances such as the loss of a large power producing plant.

Planning

Dimensioning process

The dimensioning of FCR-D upward is based on the actual reference incident in the Nordic synchronous area and may therefore vary throughout the year. The maximal Nordic demand is dimensioned for Oskarshamn 3, 1450 MW.

Svenska kraftnät's share of the Nordic volume requirement is determined by a key factor based on the yearly total generation (TWh) and consumption (TWh) in each control area.

TSO	Share 2025
Svenska kraftnät	38%
Energinet (DK2)	3%
Fingrid	21%
Statnett	38%

Securing capacity

FCR-D upward capacity market

FCR-D upward is a Nordic product with common technical requirements. Svenska kraftnät procures capacity according to the Swedish volume requirement on the common Swedish-Danish (DK2) FCR capacity market. Procurement is performed with hourly trade on two complementary auctions the day before delivery (D-1).

Since February 2024 accepted capacity bids are remunerated according to the marginal price (pay-as-cleared).

Activating energy

Pro-rata activation

During activation, all accepted capacity bids are activated proportionally (pro-rata) according to the frequency deviation.

There is no remuneration for FCR-D energy activation.

TSO-TSO TRADE

Some FCR can be exchanged between the Swedish-Danish market and the other TSOs in the Nordic synchronous area, Statnett and Fingrid. This trade is performed on the second auction. If the offered export from Statnett/Fingrid is competitive in relation to bids on the Swedish-Danish market, capacity can be imported to fulfill the national requirement. Similarly, additional capacity can be procured on the Swedish/Danish market to be exported.

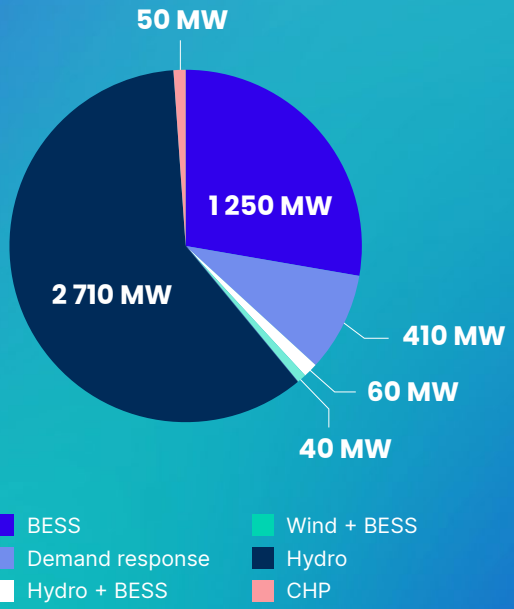
For operation safety reasons a minimum of 2/3 of the total Swedish FCR requirement must always be procured within Svenska kraftnät's control area.

FCR-D UPWARD – KEY HIGHLIGHTS **UPDATED**

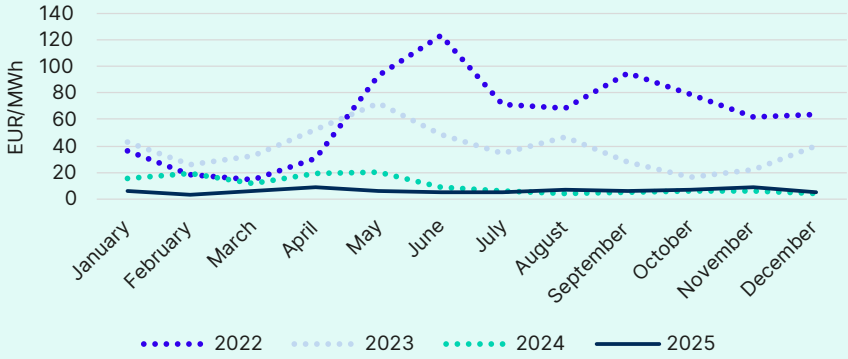
Prequalified capacity Q4 2025

4 510 MW

Trending technologies are BESS & Demand response



Historical prices



Pay-as-Cleared. The way the market prices are calculated changed from pay-as-bid to the more efficient price setting strategy pay-as-cleared, or marginal pricing, in February 2024.

New actors (e.g. BESS) lead to improved liquidity, stronger competition and thereby lower prices.

Spot price is the opportunity cost for plannable power-producing actors (e.g. hydro power) when it comes to up-regulation. A lower spot price leads to lower opportunity cost, and thereby a lower price of up-regulation.

HOW MANY BSPs ARE QUALIFIED?

24 BSPs

+2 added 2025
+8 added 2024
+2 added 2023

Falling prices driven by increased pre-qualified volumes and new technology types

UPDATED

FCR-D UPWARD – OUTLOOK 2030

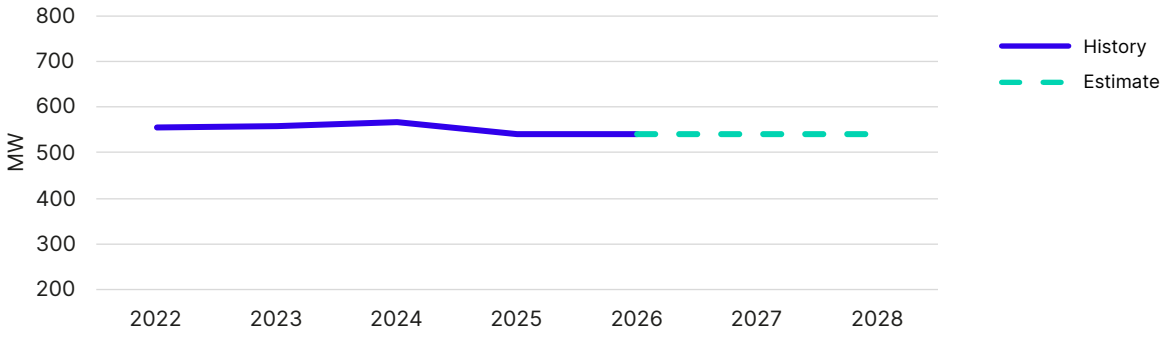
Dimensioning of FCR-D upward is based on the actual reference incident in the Nordic synchronous area and may therefore vary throughout the year. The chart below shows the estimated maximum hourly need of FCR-D upward in Sweden.

In the estimated need of FCR-D upward it is assumed that there will be no changes in the Nordic reference incident, Oskarshamn 3 of 1450 MW, until 2030. This could possibly change in the future if new large generation units are built. However, Svenska kraftnät does not forecast any changes until 2030. In the coming five years, potential minor changes in the Swedish FCR-D upward need will rather depend on the sharing key between the TSOs in the Nordic synchronous area.

Based on 2024 data of generation and consumption, the Swedish sharing key will increase from 37.4% to 37.75% in 2026. There are no available predictions of what the TSO shares will be in the future.

In September 2026, the Nordic TSOs will introduce a limitation on how much static FCR-D upward may be procured. The volume limit will consist of a fixed component and a dynamic component. The fixed volume limit will initially be set at 50% of the total Nordic volume requirement for FCR-D upward. The dynamic volume limit will be determined on an hourly basis based on the share of rotational energy in the system. A future possible introduction of dynamic FFR will most likely have an impact on the need of dynamic FCR-D. Hence, a higher share of static FCR-D could be allowed. It is however too early to draw any conclusions.

Estimated FCR-D upward need 2026-2030



Static and dynamic FCR-D
Entities that have difficulties in complying with the dynamic requirements, for example activation and deactivation performance and dynamic stability, can provide a type of FCR-D called Static FCR-D. The main difference from dynamic (regular) FCR-D is a grace period of 15 minutes where the entities are not required to deactivate and/or be able to perform a second activation.

FREQUENCY CONTAINMENT RESERVE
– DISTURBANCE DOWNWARD

FCR-D downward

INTRODUCTION AND SUMMARY

What is FCR-D downward?

Frequency containment reserve for disturbance is designed to stabilize the frequency in the event of a disturbance in the Nordic synchronous area. FCR-D responds automatically if the measured frequency deviates from the normal band (49.9 – 50.1 Hz). It has the second fastest response time of all ancillary services, treading closely behind FFR.

FCR-D downward is automatically activated downwards if the frequency exceeds 50.1 Hz. Full activation is reached at 50.5 Hz, which protects the Nordic synchronous area against disturbances caused by for example a fault on an exporting HVDC interconnection.

Planning

Dimensioning process

The dimensioning of FCR-D downward is based on the actual reference incident in Nordic synchronous area and may therefore vary throughout the year. The maximal Nordic demand is dimensioned for full export on any of the two subsea interconnectors Nordlink and North Sea Link.

Svenska kraftnät's share of the Nordic volume requirement is determined by a key factor based on the yearly total generation (TWh) and consumption (TWh) in each control area.

TSO	Share 2025
Svenska kraftnät	38%
Energinet (DK2)	3%
Fingrid	21%
Statnett	38%

Securing capacity

FCR-D downward capacity market

FCR-D downward is a Nordic product with common technical requirements. Svenska kraftnät procures capacity according to the Swedish volume requirement on the common Swedish-Danish (DK2) FCR capacity market. Procurement is performed with hourly trade on two complementary auctions the day before delivery (D-1).

Since February 2024 accepted capacity bids are remunerated according to the marginal price (pay-as-cleared).

Activating energy

Pro-rata activation

During activation, all accepted capacity bids are activated proportionally (pro-rata) according to the frequency deviation.

There is no remuneration for FCR-D energy activation.

TSO-TSO TRADE

Some FCR can be exchanged between the Swedish-Danish market and the other TSOs in the Nordic synchronous area, Statnett and Fingrid. This trade is performed on the second auction. If the offered export from Statnett/Fingrid is competitive in relation to bids on the Swedish-Danish market, capacity can be imported to fulfill the national requirement. Similarly, additional capacity can be procured on the Swedish/Danish market to be exported.

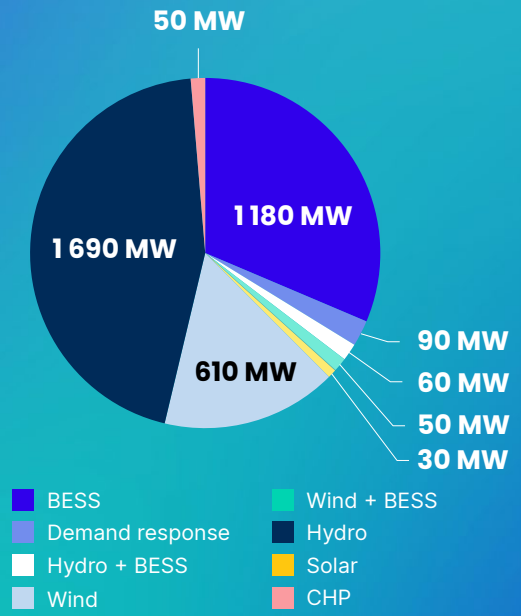
For operation safety reasons a minimum of 2/3 of the total Swedish FCR requirement must always be procured within Svenska kraftnät's control area.

FCR-D DOWNWARD – KEY HIGHLIGHTS UPDATED

Prequalified capacity Q4 2025

3 760 MW

Trending technologies are BESS & Wind power

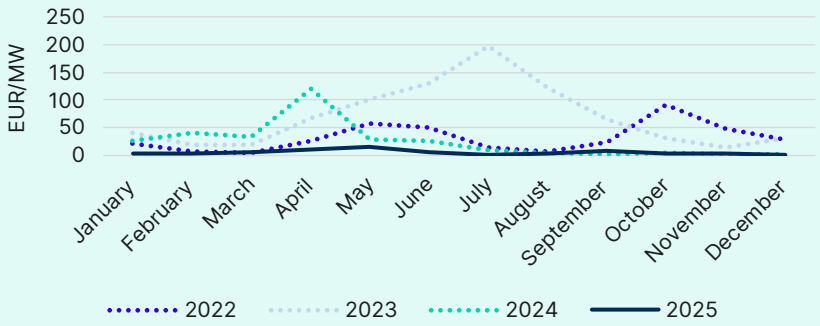


HOW MANY BSPs ARE QUALIFIED?

25 BSPs

+3 added 2025
+8 added 2024
+6 added 2023

Historical prices



Market ramp-up
The FCR-D down market started in 2022 to handle over-frequencies in the Nordic power system, for example in the event of a fault on an exporting HVDC interconnection.

Since the market started the procured volume has been ramped up quarterly. In 2025 Svenska kraftnät will procure the full volume corresponding to the Swedish share of the Nordic dimensioning.

Falling prices due to improved competition and marginal pricing

Pay-as-Cleared. The way the market prices are calculated changed from pay-as-bid to the more efficient price setting strategy pay-as-cleared, or marginal pricing, in February 2024.

New actors (e.g. BESS and Wind Power) lead to improved liquidity, stronger competition and thereby lower prices.

UPDATED

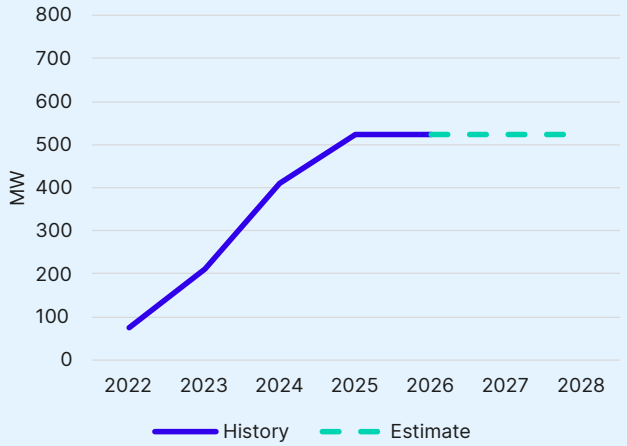
FCR-D DOWNWARD – OUTLOOK 2030

Dimensioning of FCR-D downward is based on the actual reference incident in the Nordic synchronous area and may therefore vary throughout the year. The chart below shows the estimated maximum hourly need for FCR-D downward in Sweden. In the forecasted need for FCR-D downward it is assumed that there will be no changes in the Nordic reference incident of 1400 MW, full export on any of Nordlink or North Sea Link, until 2030. It is possible that this will change in the future if a new large industry is connected In the coming five years, potential minor changes in the Swedish FCR-D downward need will rather depend on the sharing key between the TSOs in the Nordic synchronous area.

Based on 2024 data on generation and consumption, the Swedish sharing key has increased from 37.4% to 37.75% for 2026. There are no available predictions of what the TSO shares will be in the future.

In the future, similar to FCR-D upward, a limitation on static FCR-D downward will be introduced. At the present, there is no forecast for when this limitation will be implemented for FCR-D downward. A future possible introduction of dynamic FFR will most likely have an impact on the need of dynamic FCR-D. Hence, a higher share of static FCR-D could be allowed. It is however too early to draw any conclusions.

Estimated FCR-D downward need 2026–2030



FREQUENCY CONTAINMENT RESERVE – NORMAL

FCR-N

INTRODUCTION AND SUMMARY

What is FCR-N?

Frequency containment reserve for normal operation is designed to stabilize the frequency within the normal frequency band (49.9-50.1 Hz). FCR-N should respond automatically if the measured frequency deviates from 50.0 Hz, with full activation.

FCR-N is a symmetric product including both upward and downward regulation. FCR-N is designed to be fully activated upwards when the frequency is 49.9 Hz or below and fully activated downwards when the frequency is 50.1 Hz or below.

Nordic Requirement
600 MW

Planning

Dimensioning process

The dimensioning of FCR-N is based on historical imbalances in the Nordic synchronous area. The dimensioning is yearly re-evaluated by the Nordic TSOs.

Svenska kraftnät's share of the Nordic volume requirement is determined by a key factor based on the yearly total generation (TWh) and consumption (TWh) in each control area.

TSO	Share 2025
Svenska kraftnät	38%
Energinet (DK2)	3%
Fingrid	21%
Statnett	38%

Securing capacity

FCR-N capacity market

FCR-N is a Nordic product with common technical requirements. Svenska kraftnät procures capacity according to the Swedish volume requirement on the common Swedish-Danish (DK2) FCR capacity market. Procurement is performed with hourly trade on two complementary auctions the day before delivery (D-1).

Since February 2024 accepted capacity bids are remunerated according to the marginal price (pay-as-cleared).

Activating energy

Pro-rata activation

During activation, all accepted capacity bids are activated proportionally (pro-rata) according to the frequency deviation.

Activated FCR-N energy is remunerated according to the imbalance price, which is based on activated mFRR energy.

TSO-TSO TRADE

Some FCR can be exchanged between the Swedish-Danish market and the other TSOs in the Nordic synchronous area, Statnett and Fingrid. This trade is performed on the second auction. If the offered export from Statnett/Fingrid is competitive in relation to bids on the Swedish-Danish market, capacity can be imported to fullfil the national requirement. Similarly, additional capacity can be procured on the Swedish/Danish market to be exported.

For operation safety reasons a minimum of 2/3 of the total Swedish FCR requirement must always be procured within Svenska kraftnät's control area.

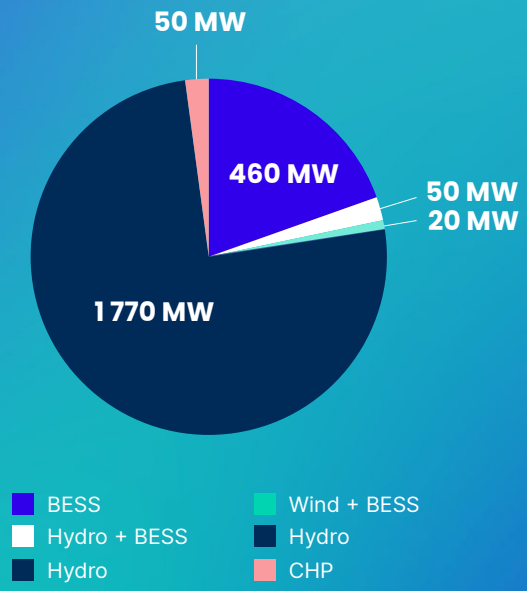
FCR-N – KEY HIGHLIGHTS UPDATED

Prequalified capacity Q4 2025

1 980 MW

Trending technology is BESS

+340MW added since 2024 which is an increase of 280%.

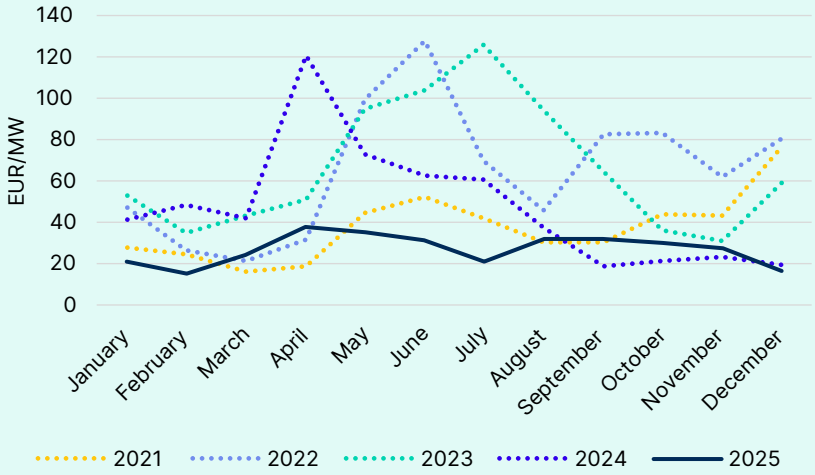


HOW MANY BSPs ARE QUALIFIED?

23 BSPs

+6 added 2025
+8 added 2024
+2 added 2023

Historical prices



Less correlation with FCR-D

Pay-as-Cleared. The way the market prices are calculated changed from pay-as-bid to the more efficient price setting strategy pay-as-cleared, or marginal pricing, in February 2024.

Hydro Power still dominates FCR-N, although an increasing share of BESS is entering the market.

Less correlation with FCR-D. Historically FCR-N, which requires the ability of regulation both up and down, has correlated with the market showing the highest price of FCR-D up and FCR-D down. Introduction of new actors in FCR-D has made this correlation less obvious.

UPDATED

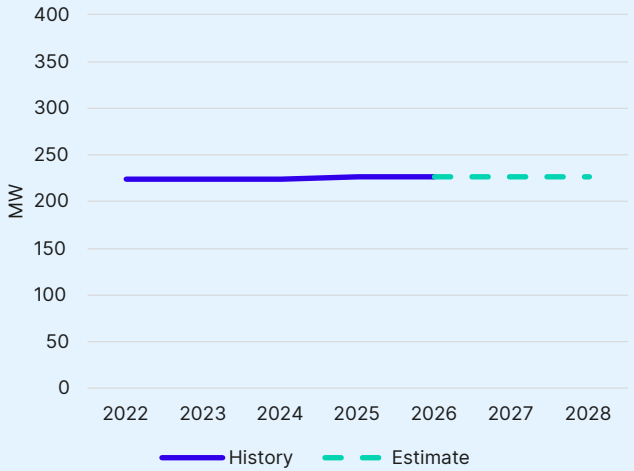
FCR-N – OUTLOOK 2030

Dimensioning of FCR-N downward is based on historical imbalances in the Nordic synchronous area and the Nordic volume requirement of 600 MW has been stable for the last years.

The chart below shows the estimated hourly need of FCR-N in Sweden. In the estimation it is assumed that the dimensioned Nordic FCR-N need will not change until 2030. However, there are some uncertainties to this estimation. There is an ongoing Nordic re-evaluation of the future FCR-N dimensioning. The future FCR-N need will depend on the dimensioning and activation of the FRR products. It is too early to draw any conclusions of the impact on the future FCR-N need. Therefore this uncertainty is not included in the estimation.

Based on 2024 data on generation and consumption, the Swedish sharing key has increased from 37.4% to 37,75% for 2026. There are no available predictions of what the TSO shares will be in the future.

Estimated FCR-N need 2026-2030



AUTOMATIC FREQUENCY RESTORATION RESERVE

aFRR

What is aFRR?

Automatic frequency restoration reserve is designed to restore the frequency after a disruption. aFRR is activated automatically if the frequency deviates from 50.0 Hz. It is the faster reserve of the two frequency restoration reserve types with a required full activation time of 5 minutes.

aFRR is activated through a central control signal from Svenska kraftnät to the BSP when the frequency deviates from 50.0 Hz. aFRR upwards and downwards are procured as separate products.

Nordic Requirement
250/325 MW

Planning

Dimensioning process

The dimensioning of aFRR is based on historical frequency quality in the Nordic synchronous area. The dimensioning is currently done on a monthly basis.

Svenska kraftnät's share of the Nordic requirement is determined by a key factor that is based on our share of short-term imbalances, which may be subject to changes in the future.

TSO	Up	Down
Svenska kraftnät	39%	38%
Energinet (DK2)	10%	11%
Fingrid	20%	20%
Statnett	31%	31%

Securing capacity

aFRR Capacity Market

Since December 2022, aFRR is procured hourly through a Nordic capacity market the day before the delivery period (D-1), with bids submitted by bidding zone and hour. Svenska kraftnät procures capacity according to the Swedish volume requirement.

Accepted capacity bids are remunerated based on marginal price (pay-as-cleared). The entire volume requirement on the capacity market is remunerated, regardless of how much energy is actually activated during real-time operations.

Activating energy

Pro-rata activation

There is not yet an energy activation market (EAM) for aFRR. Instead, all accepted bids from the capacity market are activated proportionally (pro-rata) to cover the need for aFRR energy in real-time.

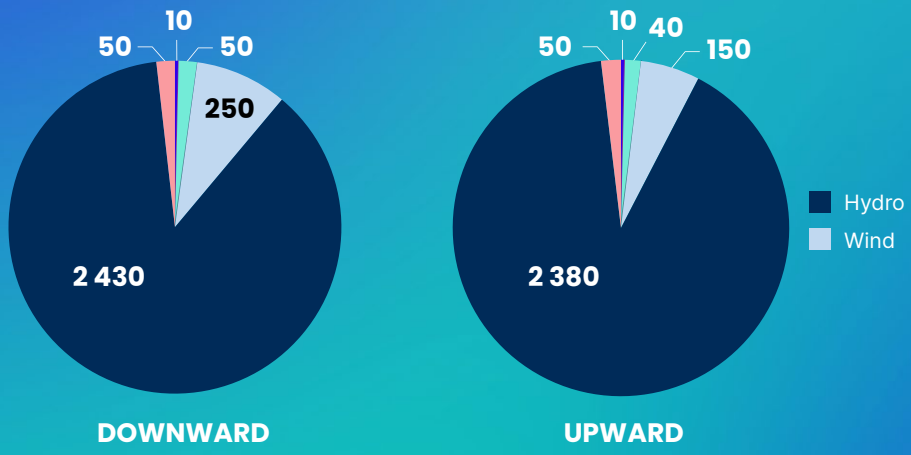
Activated aFRR energy is remunerated according to the imbalance price, which is based on activated mFRR energy.

The introduction of an aFRR EAM will take place when Svenska kraftnät connects to the European aFRR balancing platform PICASSO.

aFRR – KEY HIGHLIGHTS UPDATED

Prequalified capacity Q4 2025

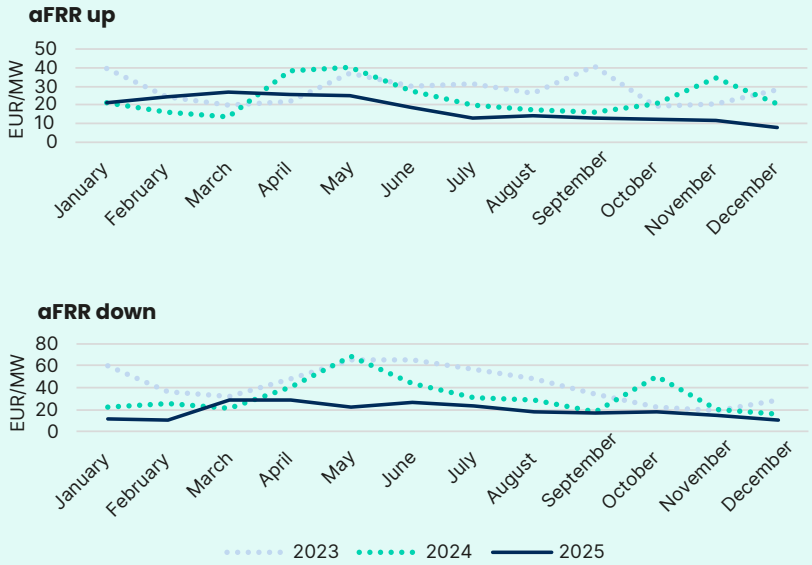
2 630 MW up
2 790 MW down



HOW MANY BSPs ARE QUALIFIED?

5
BSPs

Historical prices



Prices are affected by season and Nordic exchange

- There is a seasonal pattern in aFRR prices. Prices usually rise as the flexibility of hydro power decreases during the spring flood. This is true for both aFRR upward and downward, but to a larger extent for aFRR downward. In 2025, the seasonal price pattern has weakened due to low price levels in DK2 and Finland and increased imports from these areas, where hydro is not the dominant technology
- The price level is generally higher for aFRR downward due to higher reliance on national capacity to a satisfy demand. Conversely, import of relatively cheap capacity from primarily Norway largely satisfy the national demand for aFRR upward, causing a lower price level.

UPDATED

aFRR – OUTLOOK 2030

aFRR Capacity market

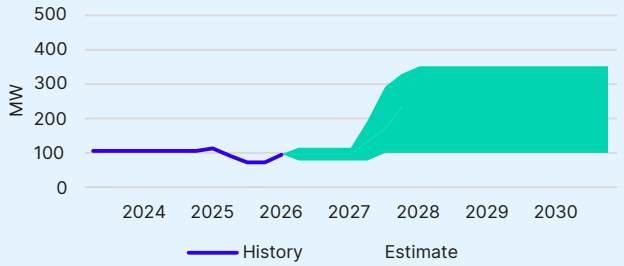
Since the introduction of a Nordic aFRR capacity market in December 2022, the national Swedish demand has remained largely unchanged. The maximum national hourly demand currently sits at 97 MW for aFRR upward and 124 MW for aFRR downward. During the week demand varies between hours and between days, resulting in procured hourly volume ranging from 66 to 72 for aFRR upward and 84 to 106 MW for aFRR downward.

Further ahead Svenska kraftnät is planning to join PICASSO and thus transition to area control error (ACE) based aFRR. Demand is then expected to increase further as ACE-based aFRR will be dimensioned on imbalances per bidding zone instead of frequency quality.

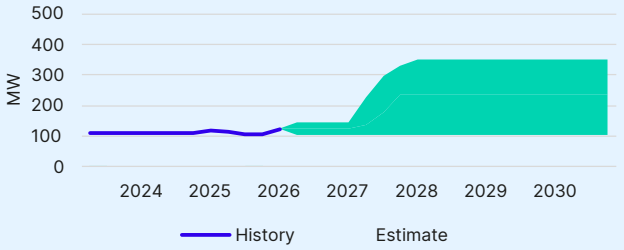
The volume of aFRR energy bids needed to be secured through the capacity market is not known at this point, as it depends on availability of energy activation bids. Nonetheless, it is safe to assume an increase in demand going forward with estimated future demand ranging from 120 MW to 350 MW. The green area in the graphs on the right reflects the uncertainty range.

Estimated maximum hourly capacity demand 2025–2030

aFRR upward



aFRR downward



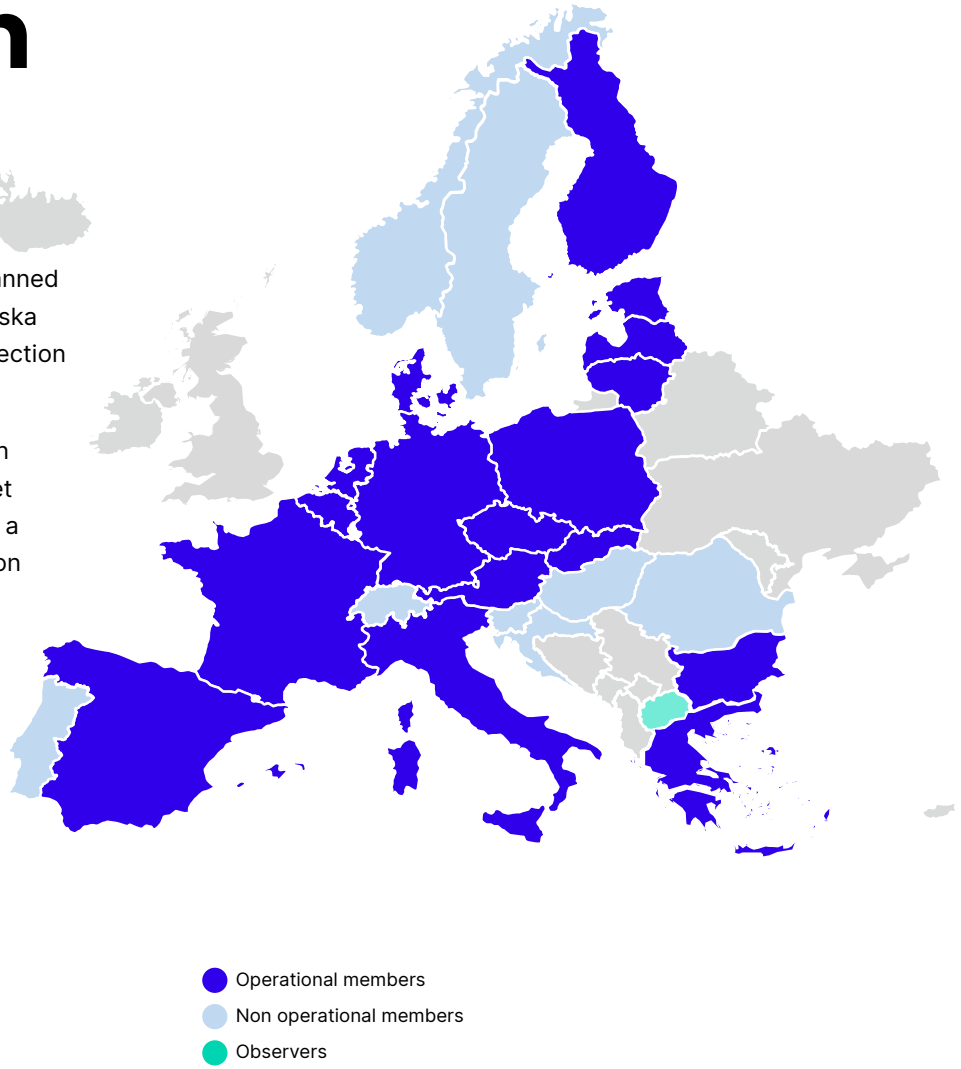
UPDATED

aFRR – OUTLOOK 2030

aFRR Energy activation market – PICASSO

About Picasso

- PICASSO (Platform for the International Coordination of Automated Frequency Restoration and Stable System Operation) is a European market platform for the exchange of aFRR balancing energy.
- As of December 2025, seventeen countries (20 TSOs) are currently connected – with more planned to connect in 2026.
- As for the Nordic TSOs, Energinet connected to PICASSO in October 2024 and Fingrid connected in March 2025.
- Svenska kraftnät and Statnett are planned to connect at a later stage – for Svenska kraftnät, the estimated time for connection is Q4 2027.
- The connection to PICASSO will mean that an aFRR energy activation market is introduced in Sweden, which gives a possibility to combine mFRR-activation with aFRR-activations based on imbalance with the aim of reducing cost of activating balancing energy.



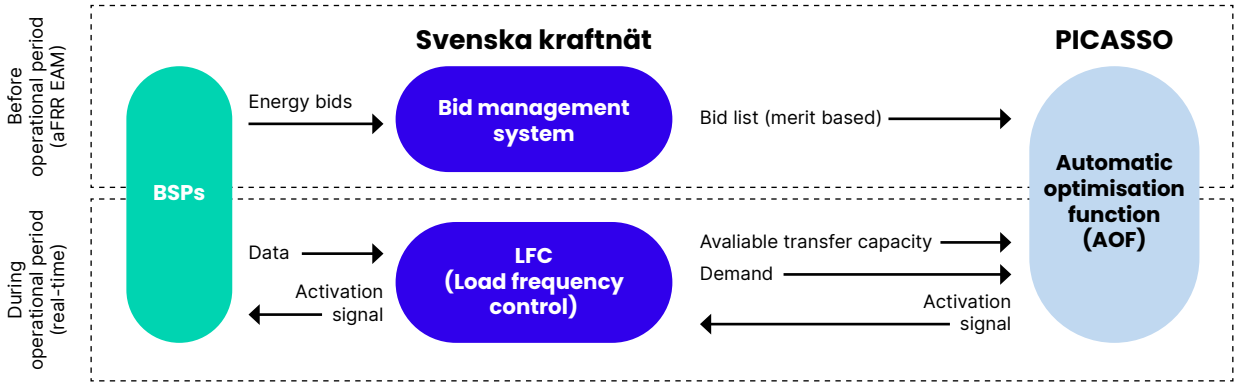
UPDATED

aFRR – OUTLOOK 2030

aFRR Energy activation market - PICASSO

Introduction of an aFRR EAM and ACE balancing

- When the aFRR energy activation market is introduced, the activation of energy during operations will then change from pro-rata activation of all accepted CM bids, to merit-based activation. This means that the bids with the lowest prices are activated first – similar to how mFRR is activated today.
- The balancing will be based on the area control error (ACE) for each bidding zone instead of the current method which is based on the frequency in the entire Nordic region.
- The calculation of the imbalance price will also change – from being based solely on activated mFRR energy, to be based on both activated mFRR and aFRR energy. The implementation of the European methodology will be adapted to Swedish market conditions.
- At the latest when Svenska kraftnät connects to PICASSO, new BSPs will be able to connect to the aFRR market.
- The updated aFRR process after PICASSO connection can be described as follows:
  - Before the operational period BSPs will send in energy bids to the aFRR EAM.
  - After the bidding period closes, Svenska kraftnät will send the bids (in merit order) to PICASSO, together with the aFRR demand for the operational period as well as available transfer capacity.
  - PICASSO will optimize the demand and available bids from all connected TSOs, taking into account available transfer capacity.
  - In real-time, PICASSO will continuously send activation signals based on ACE for each LFC-area.



MANUAL FREQUENCY RESTORATION RESERVE

mFRR

UPDATED

INTRODUCTION AND SUMMARY

What is mFRR?

Since the go-live of mFRR EAM in March 2025, the Manual Frequency Restoration Reserve (mFRR) is activated to reduce the imbalance in each bidding zone towards zero. This area control error (ACE) based balancing is mainly proactive, since area imbalances can be forecasted for the pending operational time period, and offset by scheduled activation of mFRR.

In the previous frequency based balancing model, the main objective for mFRR was to restore the Nordic system frequency to 50 Hz.

mFRR for upward and downward regulation are procured in separate products, which are activated separately.

Planning

Dimensioning process

The required volumes of mFRR reserves are dimensioned to manage:

1. The largest failure scenario, and
2. Continuous normal imbalances

This dimensioning applies to both upward and downward regulation for each bidding zone, considering available transfer capacity (ATC) between bidding zones. Updated volume requirements are communicated on a quarterly basis.

While the mFRR energy activation market (EAM) is a common Nordic market, each TSO must have sufficient balancing resources in its control area.

Securing capacity

mFRR Capacity Market

In addition to voluntary mFRR energy bids, there is also an mFRR capacity market (CM) to ensure access to further energy bids available for each bidding zone. mFRR CM has daily auctions the day before the delivery period, and accepted capacity bids means an obligation to submit corresponding volumes of energy bids to mFRR EAM.

Capacity demand and bids are submitted per bidding area, and the demand can also be satisfied by bids from other areas by reservation of transmission capacity.

Accepted capacity bids are remunerated based on marginal price (pay-as-cleared).

Activating energy

mFRR Energy Activation Market

mFRR EAM is since March 2025, an automated Nordic energy activation market with quarter-hour resolution, consisting of Nordic bids. The need for mFRR balancing energy for each bidding zone is based on an imbalance forecast generated before each quarter-hour. An Automatic Optimization Function (AOF) matches needs with available bids, considering ATCs. The AOF has a scheduled activation that runs every quarter-hour and initiates direct activations in response to incidents.

Compensation is provided for the activated energy based on the marginal price. Bids must be submitted no later than 45 minutes before the delivery period, and bids are activated during the operational phase.

It is possible to participate solely in the energy activation market.

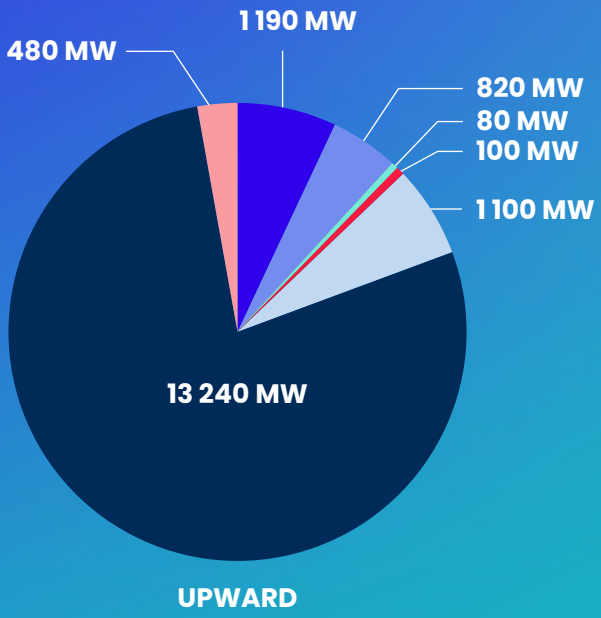
mFRR – PREQUALIFIED VOLUMES UPDATED

Prequalified capacity Q4 2025

17 010 MW

Trending technology is Wind power

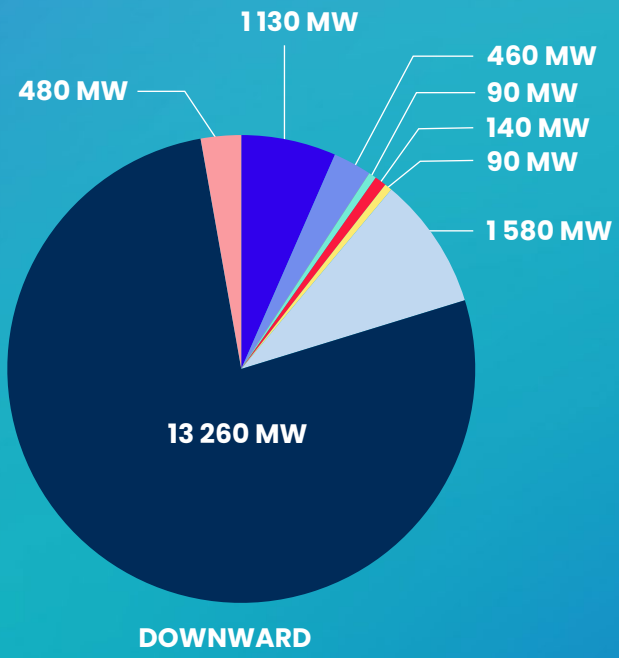
+739 MW wind power added since 2024 which is an increase of 200 %



UPWARD

17 230 MW

Trending technology is Wind power



DOWNWARD

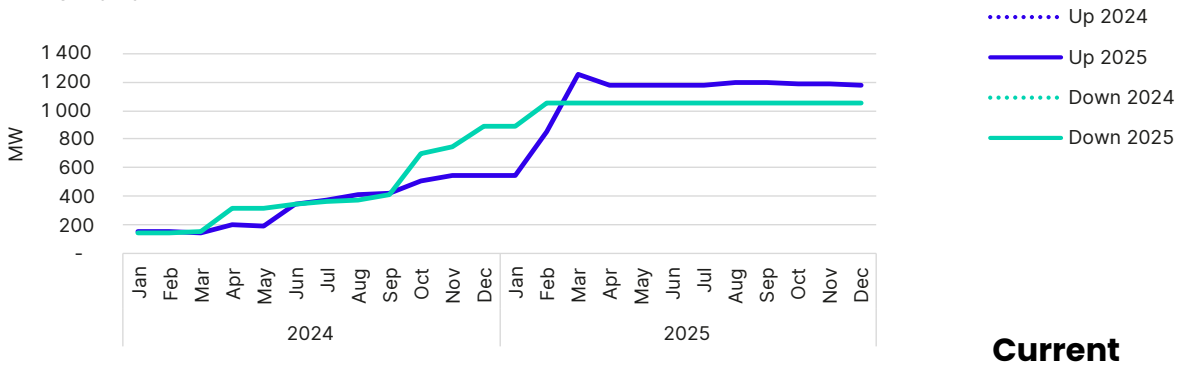
BESS | Demand response | Wind + BESS | Nuclear | Solar | Wind | Hydro | CHP

UPDATED

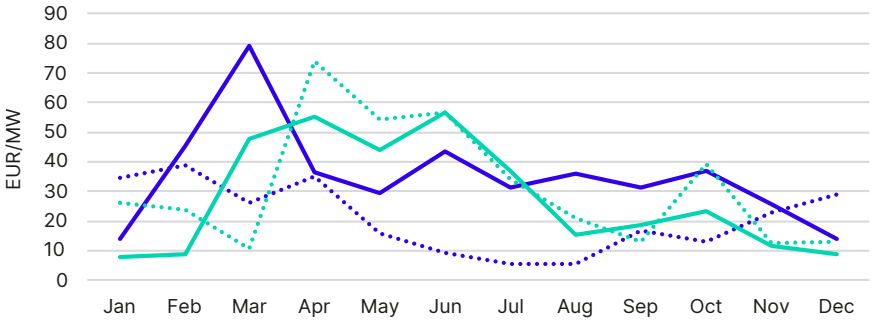
mFRR – KEY HIGHLIGHTS

mFRR Capacity market

Demand 2024-2025



Historical prices 2024-2025



Current max volume
Up: 1 300 MW
Down: 1 155 MW

New emerging market: Swedish mFRR CM since October 2023

- The national mFRR capacity market started on 18 October 2023. Since then, the demand has been gradually increased to cover current needs and has also been aligned with future requirements for automated mFRR EAM.
- Volume demand and bids are submitted per bidding area, and part of local demand can be covered by bids from other areas by reservation of transmission capacity. There is a corresponding marginal price per bidding zone, where differences in price mainly occur due to limitations in transmission capacity. There are significant seasonal variations in the overall price level so far.
- Since 19 November 2024, Sweden is part of a common, trilateral mFRR capacity market with Denmark and Finland.

HOW MANY BSPs PARTICIPATE?

24 BSPs

+12 added 2025
+5 added 2024

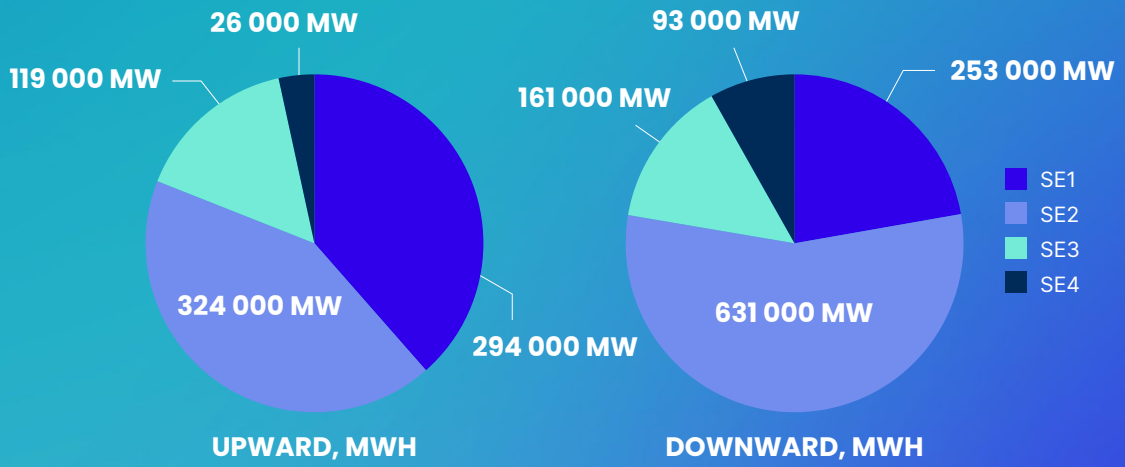
mFRR – KEY HIGHLIGHTS UPDATED

mFRR energy activation market

Activated energy in Sweden 2025

Total activated energy 2025

Up: 763 GWh
Down: 1 138 GWh

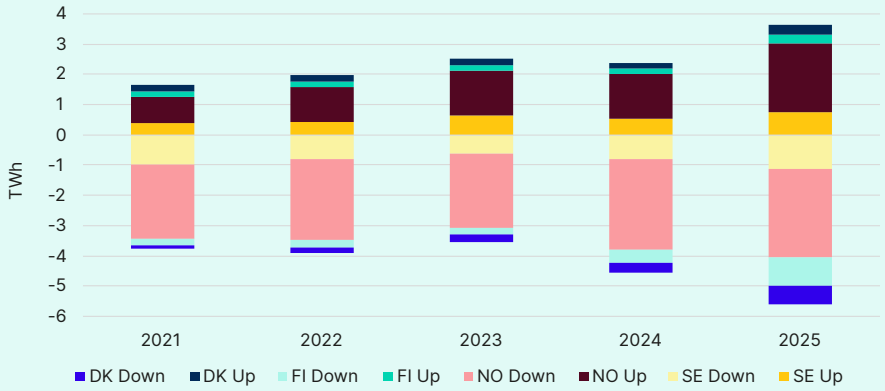


HOW MANY BSPs ARE QUALIFIED?

24 BSPs

+8 added 2025
+3 added 2024
+2 added 2023

Activated energy in Nordic area 2021-2025



More local mFRR-activations needed

The go-live for the mFRR EAM took place in March 2025. The mFRR ancillary service is essential for balancing the Nordic power system and is used to reduce the imbalance in each bidding zone towards zero. This ACE-based balancing per area requires available reserves for each area, also in Sweden.

The implementation of flowbased market coupling enables more trading on the day-ahead market by increased allocation of cross-zonal capacity (CZC). Correspondingly, less CZC then remains for intraday and balancing markets. More local mFRR-activations are needed when available CZC is limited. The above diagram shows a corresponding increase of activated balancing energy in all Nordic areas from 2021 to 2025.

With the introduction of mFRR EAM, the demand on the mFRR capacity market was increased to support the local availability, including allocation of CZC.

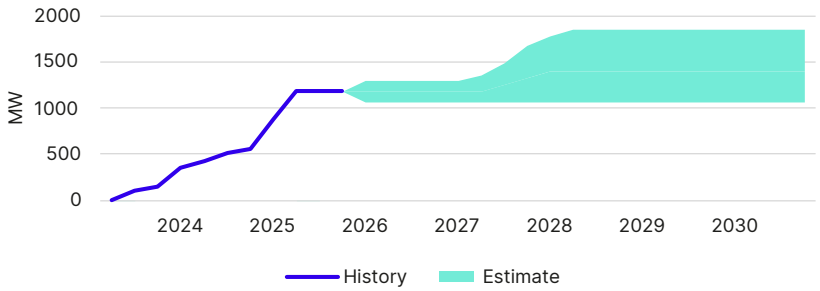
UPDATED

mFRR – OUTLOOK 2030

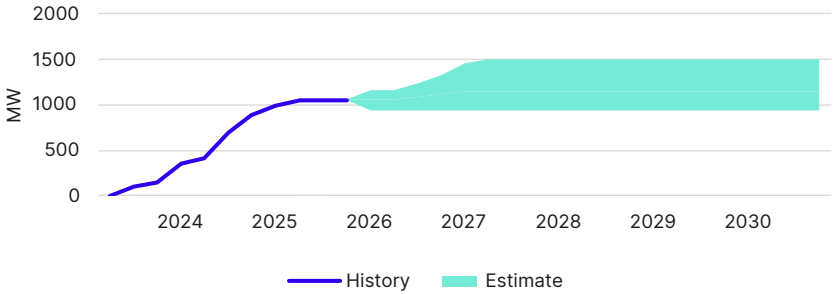
- The diagrams to the right show average procurement and indicative range for future mFRR capacity demand.
- In general, the capacity demand amounts to the volume requirements from the FRR dimensioning. Those total volume requirements for each bidding zone will evolve over time, depending on historical imbalance data as well as current reference incidents. When voluntary energy bids are abundant, the capacity demand may be a lower share.
- The capacity procurement was gradually increased during 2024 and beginning of 2025 in preparation for the projected demand on start-up of automated mFRR EAM, but also to support current needs of locally available balancing capacity. The actual demand has then been more stable during the second half of 2025.
- The capacity demand is expected to further increase in the coming years, to cover the actual and evolving need in the ACE-based balancing model, and possible changes in availability when connecting to European market platform for the exchange of mFRR balancing energy, MARI.

Estimated capacity demand 2026-2030 - Average procurement and forecast

mFRR upward



mFRR downward



FRR Dimensioning: In the ACE-based Nordic balancing model, reserve requirements for each LFC-area will depend on historical imbalance data as well as current reference incidents. Normal, stochastic imbalances are managed by a combination of mFRR and aFRR. Scheduled activation of mFRR is considered for the forecasted area imbalances and aFRR covers the actual remaining part. Reference incidents are managed by direct activation of mFRR. Thus, these reserve volumes will vary on a daily basis and evolve over time.

UPDATED

mFRR – OUTLOOK 2030

mFRR energy activation market - MARI

About MARI

- MARI (Manually Activated Reserves Initiative) is a European market platform for the exchange of mFRR balancing energy.
- The MARI project started in 2017 and consists of 32 European TSOs from 29 countries.
- Technical go-live of the platform was in September 2022.
- As of April 2026, 13 countries (16 TSOs) are currently connected – more are planned to connect in 2026.
- The Nordic TSOs are planning to connect together in Q1 2027.

Introduction of a European mFRR EAM

- The automated Nordic energy activation market for mFRR (mFRR EAM) was an intermediate step for connecting to MARI.
- The Nordic and European mFRR EAM platforms are based on the same algorithm but the Nordic algorithm has undergone further developments since go live.
- With MARI, European mFRR bids can be activated for balancing the Nordic region as well as local bids can be activated for needs on the continent.
- The floor for upregulation bid prices and the ceiling for down regulation bid prices will no longer be the spot price.

MARI status update

- Initially there has been low activity on the MARI platform due to few connected TSOs with low mFRR demand.
- When more TSOs connect in the near future the mFRR demand, activations and liquidity will increase.
- Through MARI, the least expensive European mFRR bids can be activated to balance the system, which will increase the economic surplus of the region.

CHAPTER 4

Financing of ancillary services

Cost allocation

Ancillary services are financed through three mechanisms. Yearly updated price lists for the grid tariff and BRP fee are decided by the board of Svenska kraftnät.

The grid tariff – everyone who is connected to the transmission grid pays a tariff for transporting energy. This fee finances the ancillary services needed for handling disturbances and incidents in the power system.

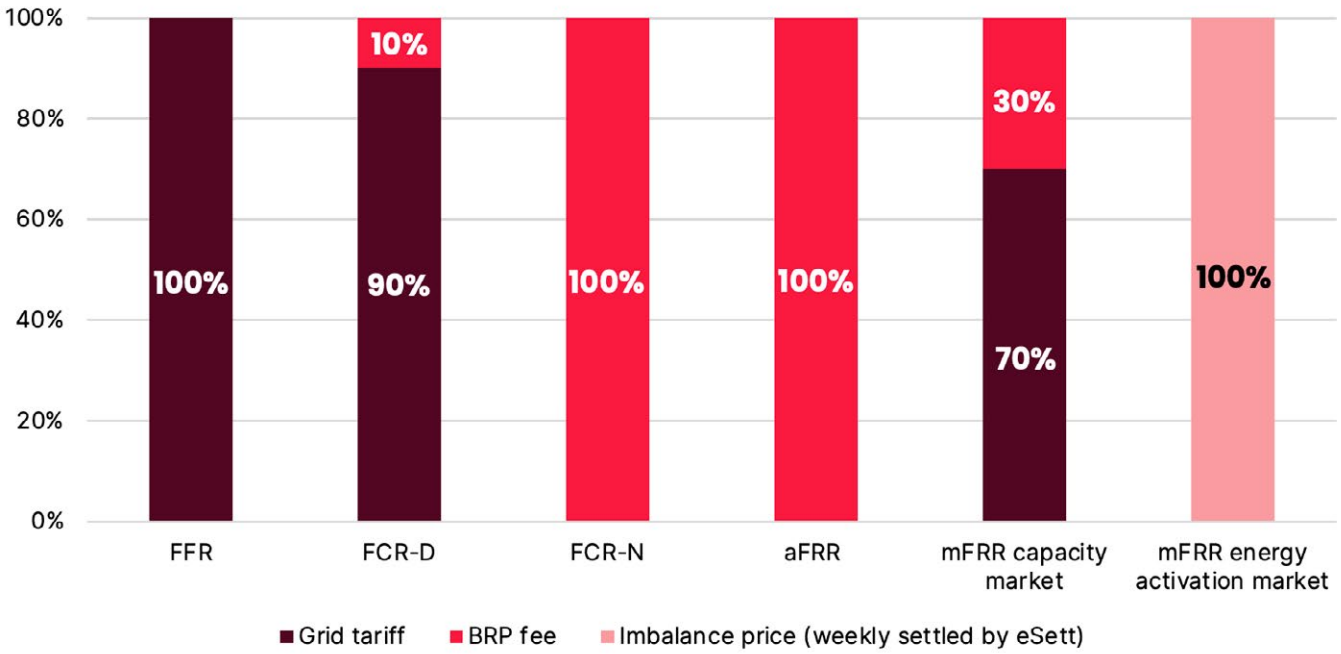
BRP fee – each BRP pays for reserves needed for balancing. The BRP fee has different components such as an imbalance fee based on the BRP's imbalances, a fixed fee for administration and a component based on the size of the BRP portfolio.

Imbalance price – Polluter pays principle. The actual energy activations of mFRR energy are covered by the BRPs that had imbalances for the specific ISP. The imbalances are settled weekly by eSett.

OUTLOOK:
The imbalance price in the future will be based on both mFRR and aFRR energy activations. The imbalance price shall give correct incentives for the chosen balancing model.

How different ancillary services are financed

In the chart below the cost allocation between grid tariff, BRP fee and imbalance price for each ancillary service market is shown. The allocation is valid for year 2025.



Cost allocation principle for balancing capacity
The costs for procurement of balancing capacity are split between the grid tariff and the BRP fee. The allocation principle is to use polluter pays towards the BRPs when adequate and related to the possibility to plan and trade into balance, and to socialize costs for services that do not derive from the BRP's performance.

Consequently, ancillary services to manage unforeseen events and disturbances in the power system are covered by the grid tariff. Ancillary services for imbalances caused by forecast errors or normal mismatches between production and consumption are covered by the BRP fee.

More information and contact

We hope this report has provided some new insights and we look forward to Your feedback to keep improving the format and content. Please send your feedback to balansmarknad@svk.se.

Contact
More information on ancillary service markets can be found on our webpage svk.se/aktorsportalen/bidra-med-reserver.

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