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Wholesale & Transmission Seminar 2024

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NordREG Wholesale & Transmission Seminar
Opening remarks

30 October 2024

Helsinki and online

Antti Paananen

Chair of NordREG Wholesale and Transmission
Deputy Director General, Finnish Energy Authority

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NordREG Strategy

NordREG mission

"In cooperation, we actively promote legal and institutional framework and conditions necessary for developing the Nordic and European electricity markets"

NordREG vision

"Efficient and advanced energy markets, for the benefit of consumers towards a decarbonised society"

Strategic principles to guide NordREG cooperation

1. *Correct price signals*
2. *Active consumers*
3. *Dynamic framework enabling advanced energy markets and green transition*

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Electricity markets should be developed

- Nordic and European energy systems are becoming more complex and integrated
  - Deployment of intermittent renewables and the phasing-out of conventional fossil-fuel generation
  - Rapid technological development - electrification of demand, sector integration, energy storages etc
  - Importance of cross border transmission capacity and need for increased flexibility from all available sources
- Market mechanisms should be adjusted to meet the challenges
  - Sufficient flexibility and its participation in the market
  - Effective use of capacity
  - Maintaining a secure and reliable electricity system

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Many wholesale market topics are on the Nordic NRAs' table

- Many TSO/NEMO projects are or will be in go-live phase in coming months
  - ID auctions
  - Flow-based capacity calculation in DA
  - mFRR CM and mFRR EAM
  - 15min MTU in DA/ID

- .. while some projects have been delayed
  - Accessions to the European balancing platforms (MARI/PICASSO)

- Also changes in EU regulation keeps NRAs and stakeholders busy
  - Implementation of the EMD package and REMIT II
  - CACM2.0, FCA2.0
  - …and what else will come?

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Seminar rules

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NordREG Wholesale & Transmission Seminar Capacity Task Force: Flow-Based CCM

Jori Säntti
Chair of the NordREG Capacity Task Force

October 30th 2024

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NordReg Capacity Task Force

- Responsible for the Nordic NRA cooperation concerning different capacity –related issues
  - Discussing coordinated national decisions
  - Approving, developing and amendging the methodologies in dialogue with TSOs
  - Following the implementation of these methodologies
- The biggest task during the past years: Flow-based capacity calculation

- The F-B methodology was approved by the Nordic NRAs in 2020
  - NRAs have worked together, following the TSOs' implementation process
  - NRAs realize that some market participants have had concerns, and have heard the feedback
  - Our aim has been to ensure smooth adoption of Flow-based that delivers
    - With this aim, we built the process with the **checkpoint** and extended **parallel runs**
    - This goes substantially beyond CACM requirement
  - Balancing between NRA scrutiny and avoiding excessive postponement of go-live

- In the end, our task is making sure the methodology lives up to the regulation

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Recent development

- During spring, having followed the parallel runs and heard the market participants, NRAs had some concerns on the ID ATCE –approach and effect
  - RAM/PTDF relaxations creating Arbitrage?
  - Lock-ins? Limited capacity available for ID?

- NRAs requested TSOs to report on FB implementation and ID ATCE
  - TSOs asked to examine, if measures could be taken to alleviate the concerns

- TSOs responded in September
  - TSOs gave explanations on chosen relaxations of parameters
    - Balancing between operational security and sufficient ID capacity
  - Some of the issues are inherent to ATCE –approach, and impossible to avoid
  - Difficult to assess the situation based on NTC –data.

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Recent development

- Having assessed the TSO –report, Some NRAs concerns still remain
  - ID ATCE –issues partially remain but can be inherent to the ATCE solution itself.
  - The reduced trading possibilities on intraday may lead to **increased procurement of balancing reserves**
  - We have not yet seen FB market data

- Despite some NRA concerns prevailing, NRAs recognize that the **TSOs bear the responsibility for operational issues**

- TSOs fulfilled the last 6 months of EPR in line with the methodology and the checkpoint -process
- **Nordic Flow Based Capacity Calculation went live on 29th October**
  - **DK1/DK2/NO2** prices seemed relatively high
  - **SE3/SE5/NO1** volatility
  - The rest relatively low

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What now?

- Flow-based CCM has now been taken into use
  - Development will continue

- NRAs have required the TSOs to send a new report 6 months after go-live
  - Realized FB market data is available
  - TSOs are to report on the identified ID ATCE concerns
  - Possible NRA actions taken after examining the report

- We will hear **ACER's** as well as some **market participants'** views on Flow-based later today
- The development work of FB will continue, and NRAs will follow the process closely.

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Electricity Balancing – regulator update

30.10.2024

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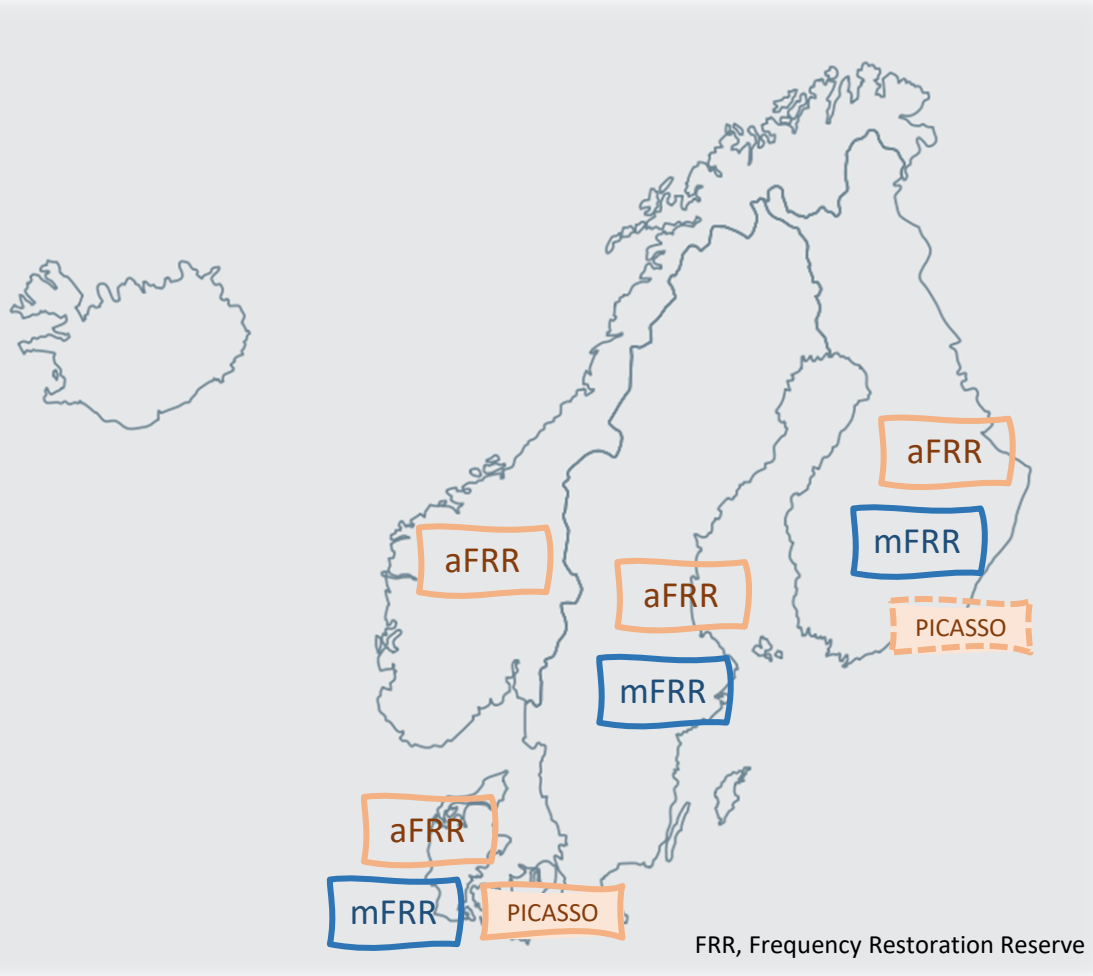
EBTF status update

Balancing capacity markets

1. new trilateral mFRR CM methodologies, EBGL 33(1) & 38(1)
   - amendment on Nordic aFRR CM methodologies
2. HCZCAM, EBGL 38(3)
   - market-based harmonisation

Balancing energy markets

3. mFRR EAM national decisions
4. European platforms MARI & PICASSO
   - derogation deadline 24.7.2024
   - national enforcements & coordination



FRR, Frequency Restoration Reserve

EBGL 33(1): Methodology for common and harmonised rules and processes for the exchange and procurement of mFRR balancing capacity for the BZs of DK, FI & SE
EBGL 38(1): Methodology for application of the Nordic CCR market-based allocation process of cross-zonal capacity for the exchange of mFRR capacity for the BZs of DK, FI & SE

EBGL 38(3): Methodology for harmonising processes for the allocation of cross-zonal capacity for the exchange of balancing capacity or sharing of reserves

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ACER-CEER Position Paper on the Challenges of the Future Electricity System

Johan Roupe, Senior Legal Adviser, Swedish Energy Market Inspectorate

30.10.2024

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ACER-CEER position paper ”Challenges of the future electricity system”

Background

- The energy system in 2030 and beyond is steering towards a transformed structure that is characterized by:
  - A larger proportion of intermittent renewable energy sources
  - Higher electricity demand
  - More small-scale and decentralized generation
  - A significant share of flexible generation, storage, and demand
- In light of this, the NRAs in ACER and CEER see a need for adapting the legal and regulatory framework to
  - Help remove barriers for this transformation; and
  - Facilitate new businesses and innovation

Purpose of the paper

- In this position paper, the NRAs in ACER and CEER propose 16 recommendations and 5 commitments that aim to help steer this transformation in the energy system
- The commitments and recommendations can be divided in to five main areas:
  - Integrated security of supply with flexibility at its centre
  - Enhanced electricity distribution networks and empowered consumers in decarbonized markets
  - Moving torwards European electricity transmission infrastructure development and cost-sharing
  - ”Efficiency first” principle also applies to existing network and generation
  - Independent regulators can help address these challenges comprehensively and strengthen Member States’ trust in the EU electricity market

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Flow based

NordREG Wholesale and Transmission seminar 30.10.2024

Finnish Energy

We represent Finnish energy

Personnel

45

Finnish Energy

14

Adato Energia Oy

The energy sector employs

about **40,000**

people

276

members

52

cooperation members

Over EUR **3.5** billion

in annual investments

about **40** %

of all investments by industry

Content

1. Experiences from the stakeholders' point of view and how has the process been?
2. What effect will the flow based have on the producers?
3. How should we move forward?

Finnish Energy's position paper 1st of February 2024:

- **Impact assessments and external parallel runs must be transparent and based on parameters that are as realistic as possible**
  - Overusing hydropower – impact on social welfare?
  - Effects on the balancing and reserve market, intraday market and the financial market
- **The functionality of the intraday market must be ensured**
  - Differences between Nordic and continent
  - Increasing renewabes -> increasing need for efficient balancing
  - Non-intuitive flow limits trading and might lead to larger imbalances – the impacts must be evaluated before go-live because the consequence might be inefficiencies and increased costs
- **Transparency and forecastability of the market guarantees the efficient operation**
  - CNEs not available in Sweden – difficult to understand the new system
  - UMMs are still at the NTC-level instead of FB
- **New parallel runs without non-intuitive flows or by significantly limiting their occurrence**

The entire process has been unusual, as it has only taken into account one part of the market (DA) in terms of socioeconomic welfare – where is the systemic thinking?

Market participants have constantly expressed their concerns, but they have not been received with seriousness

The industry is positive about better and more efficient use of the network, but there are still problems that need to be solved ~~before~~ **after** implementation

Objective: Implementation of flow-based must lead to a better market and increased socioeconomic welfare (?)

Content

1. Experiences from the stakeholders' point of view and how has the process been?
2. What effect will the flow based have on the producers?
3. How should we move forward?

Overview - key challenges

Day-ahead

- Weaker forecastability
- FB domain data constraints
- Nordic challenges
- Non-intuitivity

Lack of data

↓

Impaired forecasts

↓

Reduced flexibility

Intraday

- Transparency of ATCE calculation
- Reduced capacities
- Reduced trades
- Impact on balancing market

Reduced capacity

↓

Reduced trading

↓

Reduced flexibility

↓

Increased balancing needs

Day-ahead challenges

Weaker forecastability = Reduced flexibility

- Short term price forecasting relies on successfully forecasting:
  - Production
  - Consumption
  - Capacities (NTC)
- In current setup, TSO information and UMM facilitate NTC forecasting
- After FB go live, actors will need to forecast the FB domain
  - Forecasting FB domain is challenging due to lack of public data usable for forecasting
  - Information from TSO, such as UMM, will no longer be helpful as it is in the current setup

- It is no surprise that hydropower plays a big role in the Nordic electricity market
- Current reservoir levels in combination with the price forecasts allows to find optimal water values
- Why the optimal water values matter?
  - For correct pricing for DA, AS and ID to ensure:
    - Maximized flexibility
    - Efficient use of scarce resource – not using when there are no demand
    - Space in reservoirs to meet future increased inflows
    - Stored/saved water for times when the system needs it the most

Day-ahead challenges

Flow based domain data constraints

- Data needed for forecasting is not available - operators have to create a new network model based on FB capacity calculation without TSOs making all data available
  - Anonymous CNE/CNEC in Sweden
  - No existing list of all CNEC
  - No official network data
  - Limited information on generation shift keys (GSKs)
  - How to translate NTC UMMs into FB UMMs?
  - How to model state of serial capacitors?
  - Differences between in house vs. TSO demand and production forecasts
  - Still some errors in the domain description (for example substation to/from vs name definition), adds a layer of complexity when processing information.
  - Forecasting of Fmax?

Market participants have to simulate what TSO do, without all the TSO data. Practically an impossible task!

Day-ahead challenges

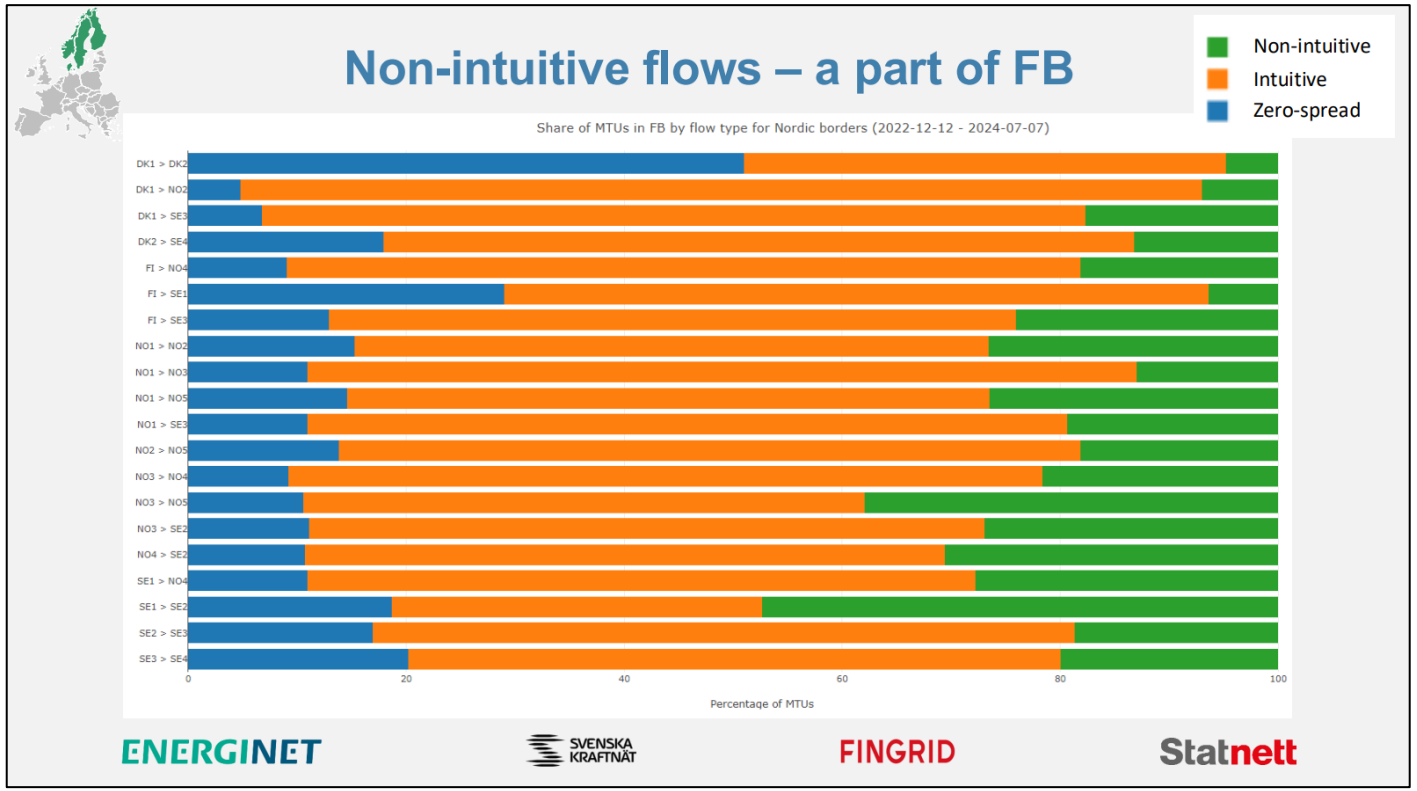
Nordic challenges

- Share of hydro power is much larger in the Nordics than in the Continent
  - large share of production relies on water valuation
- Pricing on the Continent on the other hand depends mainly on fuel and carbon prices
  - no complex reservoir optimization is required
- Smaller Nordic price areas
  - Nordic price areas are much more sensitive to network outages
  - In the Continent, network outages typically have less impact due to larger price areas with high connectivity
- No anonymous CNE/CNEC in Continent

Day-ahead challenges

Non-intuitivity

- The non-intuitivity that comes with flow based affects the confidence on the electricity markets and the electricity prices
  - Explaining flow based with simple words is a challenge without getting too technical
- Alternatives have not been fully analysed, for example, how would it look like with an intuitive patch?
  - It would likely result in less SEW than with FB nonintuitive, but how would the ID capacities look like then?
  - Could it be better on the long run?
  - We don’t know the answer, but we would have liked to see studies on this



Intraday challenges

Transparency of ATCE calculation

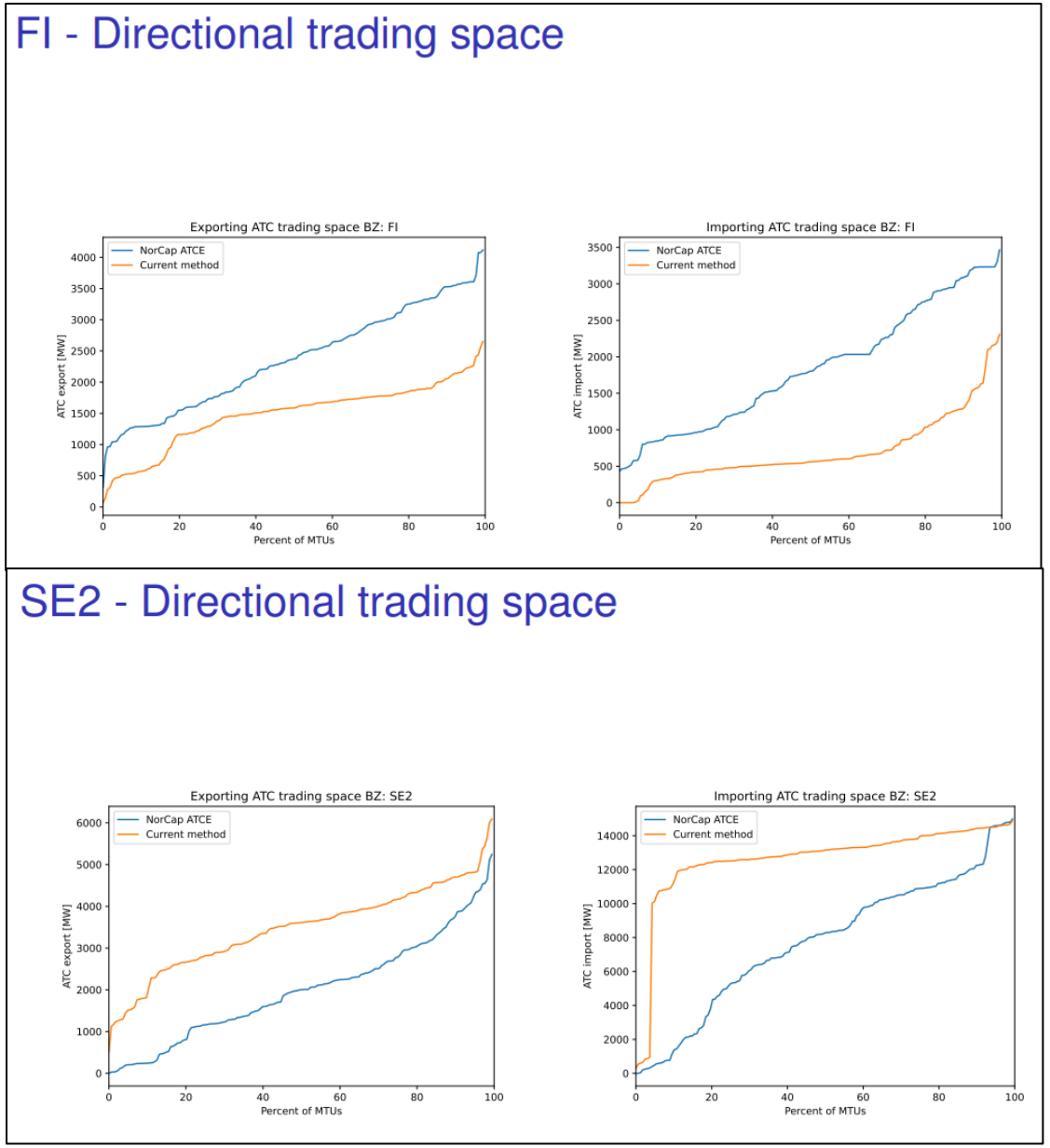
- The ATCE calculation is a transitional solution for the calculation of the ID capacities after FB DA go live until FB ID goes live
- There is available documentation explaining the general methodology of the ATC Extraction
  - With DA domain and the DA already allocated capacity (AAC), in theory it should be possible to calculate the ID capacities and get the same (or at least similar) result as published by TSO
- *We have tried replicating the calculation, but sometimes we get different values
  - In some cases, we observe that the TSO solution is infeasible for us, or the opposite, we obtain a higher capacity without violating the constraints
  - There could off course be errors in our implementation, but the given the lack of transparency of this process we are not able to verify why the differences occur

*Based on Vattenfall's presentation 2024-09-17

Intraday challenges

Reduced capacities

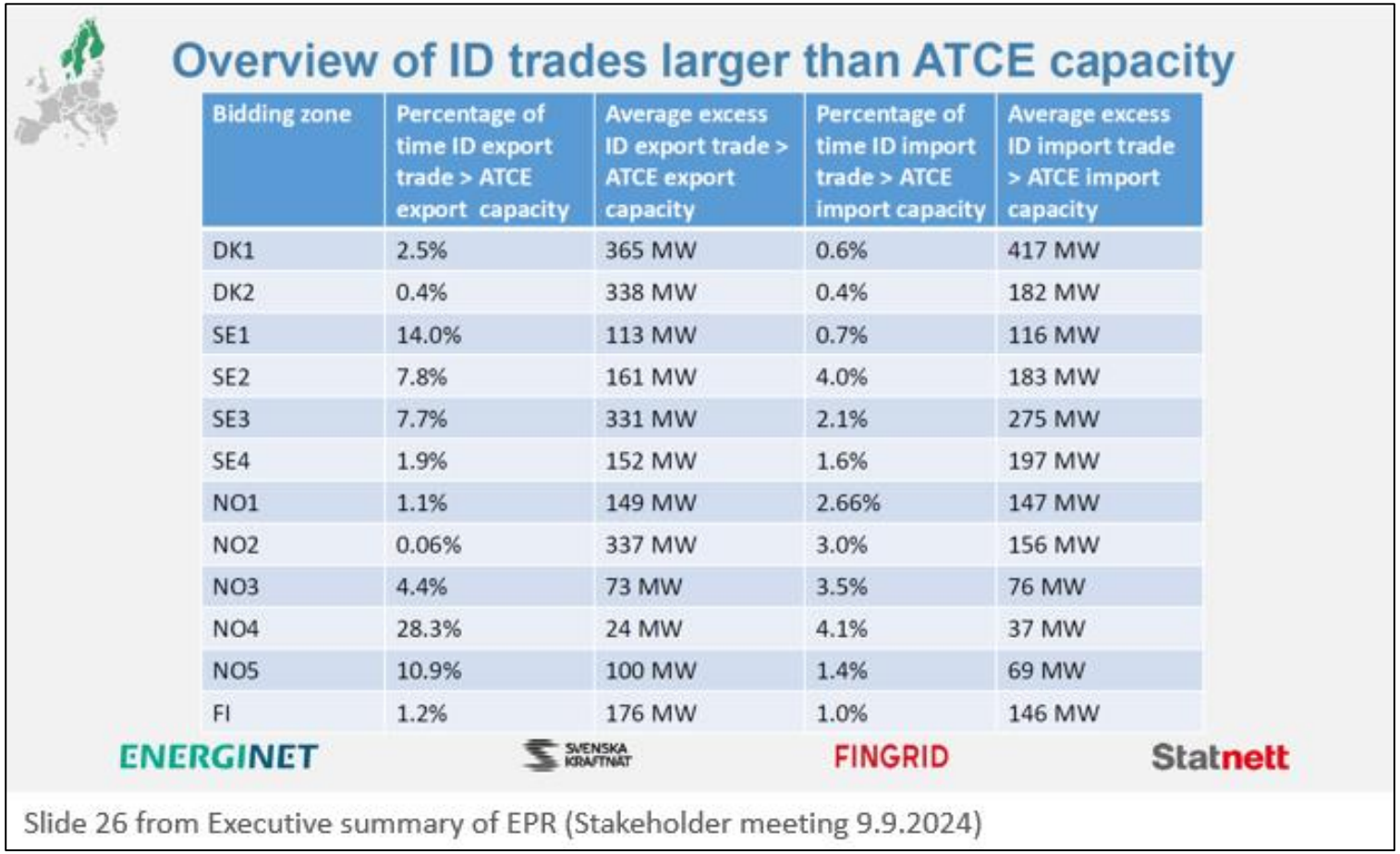
- Intraday capacities are significantly reduced in Sweden when compared to current intraday capacities
  - The Swedish cuts are the most affected by the ID capacity reductions; for the period W33/2023 to W12/2024, 70% of the hours there is no available ID capacity in the Cut 2
  - In Finland, FB enables more efficient use of the FI -> SE3 connection, which is currently under restrictions
- The ID market is key for the rapid development of intermittent renewable generation
  - Generation known for being hard to predict even on a DA level, meaning that available capacities in the ID market are key for handling imbalances caused by forecast errors
  - DA-planning are done 12-36 hours before supply



Intraday challenges

Reduced trades

TSOs provide positive overview on the available ID-trade capacities



Overview of ID trades larger than ATCE capacity

Bidding zone	Percentage of time ID export trade > ATCE export capacity	Average excess ID export trade > ATCE export capacity	Percentage of time ID import trade > ATCE import capacity	Average excess ID import trade > ATCE import capacity
DK1	2.5%	365 MW	0.6%	417 MW
DK2	0.4%	338 MW	0.4%	182 MW
SE1	14.0%	113 MW	0.7%	116 MW
SE2	7.8%	161 MW	4.0%	183 MW
SE3	7.7%	331 MW	2.1%	275 MW
SE4	1.9%	152 MW	1.6%	197 MW
NO1	1.1%	149 MW	2.66%	147 MW
NO2	0.06%	337 MW	3.0%	156 MW
NO3	4.4%	73 MW	3.5%	76 MW
NO4	28.3%	24 MW	4.1%	37 MW
NO5	10.9%	100 MW	1.4%	69 MW
FI	1.2%	176 MW	1.0%	146 MW

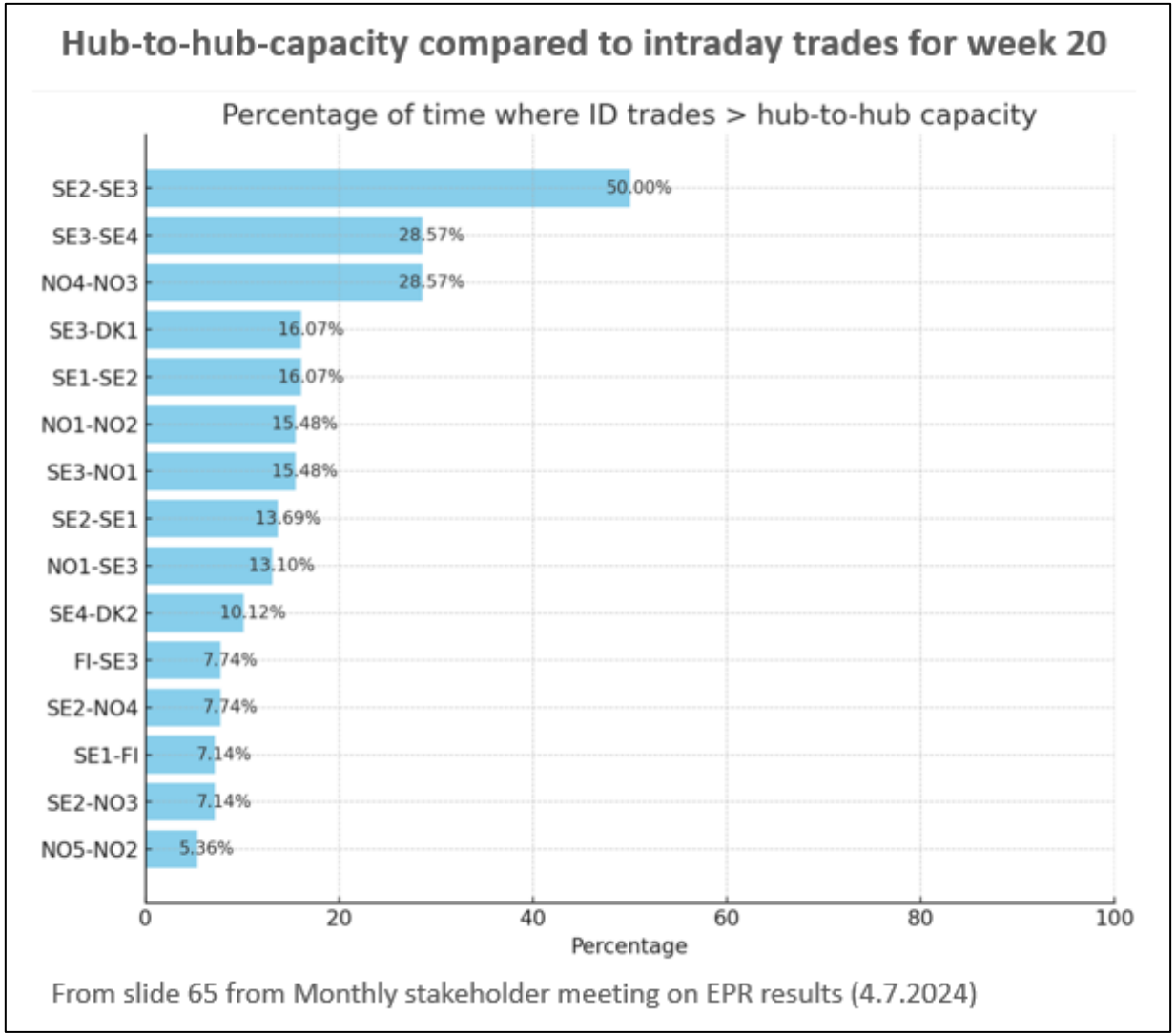
ENERGINET SVENSKA KRAFTNÄT FINGRID Statnett

Slide 26 from Executive summary of EPR (Stakeholder meeting 9.9.2024)

Intraday challenges

Reduced trades

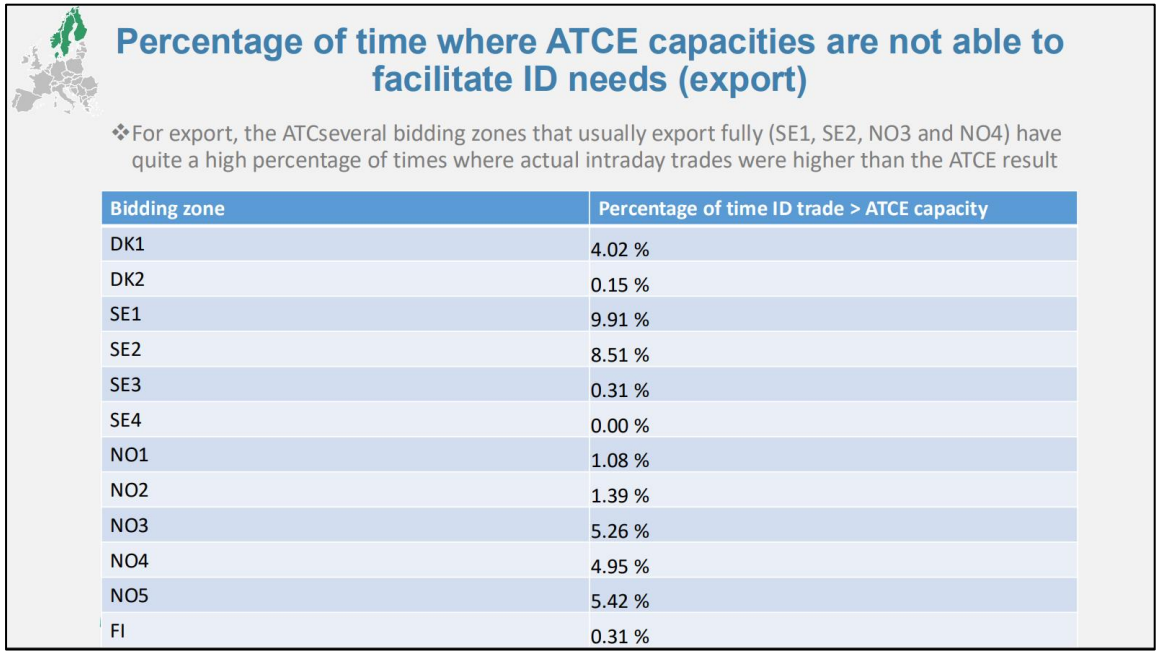
- Analysis of low intraday capacities and potential **lock-in** effects has been done by analysing **total** import and export of each individual bidding zone
  - This does not analyse the market dynamics that might occur
- **The location of the recourses and the buyers are important**
  - Capacity can be high between bidding zones but if there is not enough liquidity to fulfil the trade, no trade will occur
- To analyse this TSOs did Hub-to-Hub analysis
  - Unfortunately, they have only provided their Hub-to-Hub analysis for one week (W20)
- Need for a more comprehensive ID analysis, especially about liquidity and where the trade takes place
- NordREG 14th of October: "*We had expected the TSOs to present a thorough analysis on lock-in situations in the report*"



Intraday challenges

Reduced trades

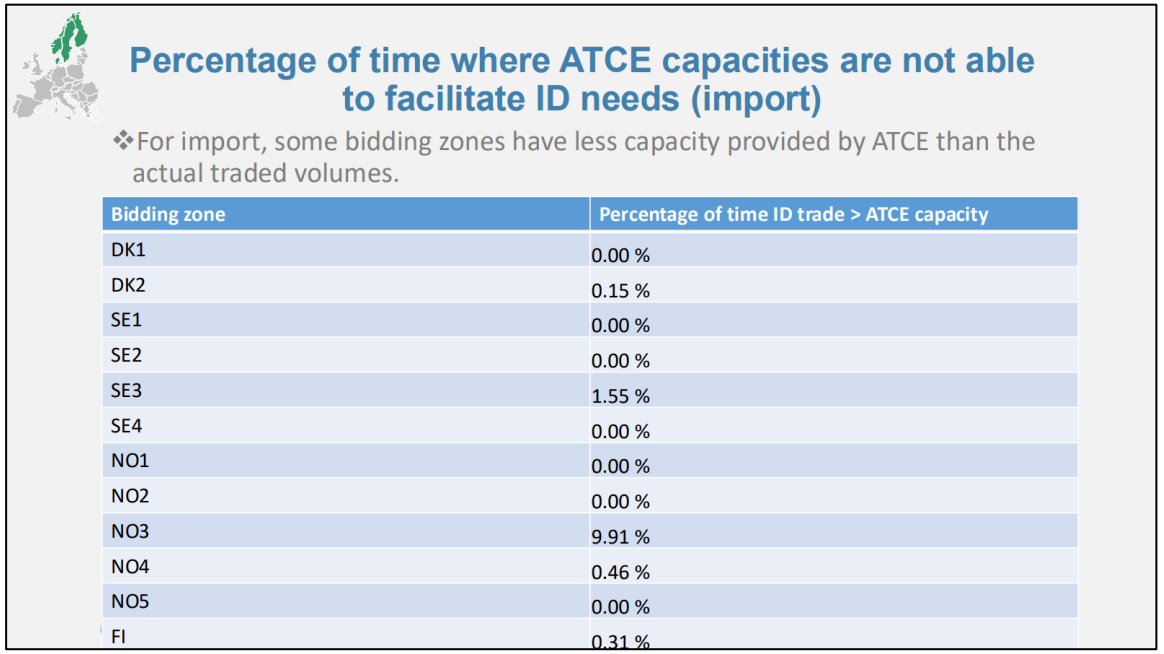
- TSO's Hub-to-Hub for W20 shows that 50% of hours ID trades are larger than Hub-to-Hub capacity for SE2 SE3 border (28% for SE3 SE4).
- TSO summary tables might be misleading, as they do not consider the areas involved in the trade, instead they look at total export/import possibilities



Percentage of time where ATCE capacities are not able to facilitate ID needs (export)

❖For export, the ATCseveral bidding zones that usually export fully (SE1, SE2, NO3 and NO4) have quite a high percentage of times where actual intraday trades were higher than the ATCE result

Bidding zone	Percentage of time ID trade > ATCE capacity
DK1	4.02 %
DK2	0.15 %
SE1	9.91 %
SE2	8.51 %
SE3	0.31 %
SE4	0.00 %
NO1	1.08 %
NO2	1.39 %
NO3	5.26 %
NO4	4.95 %
NO5	5.42 %
FI	0.31 %



Percentage of time where ATCE capacities are not able to facilitate ID needs (import)

❖For import, some bidding zones have less capacity provided by ATCE than the actual traded volumes.

Bidding zone	Percentage of time ID trade > ATCE capacity
DK1	0.00 %
DK2	0.15 %
SE1	0.00 %
SE2	0.00 %
SE3	1.55 %
SE4	0.00 %
NO1	0.00 %
NO2	0.00 %
NO3	9.91 %
NO4	0.46 %
NO5	0.00 %
FI	0.31 %

Slides 52 & 53 from monthly online stakeholder meeting on EPR results (4.7.2024)

Intraday challenges

Impact on balancing market

- Managing imbalances will be more challenging due to less liquidity
- When unpredicted events occur, causing a large imbalance, the balance responsible party will try to trade on the ID market to cover the volumes
- Vattenfall's Case Studies* confirm that balancing would have been challenging during special events
  - Import/export space was smaller than the required volumes to get back in balance without needing to activate frequency reserves
  - In some cases, the available mFRR capacity in the specific area was not enough

*Selected three hours with special events (nuclear trip in SE3/spot incident in Finland/icing on wind turbines in SE2)

Impact confirmed by NBM at latest FBMC Stakeholder Meeting

NBM
Nordic Balancing Model

Flow-Based (FB) comes with a reduction of ATC.

→ Lower ATC mean less exchange of balancing energy and higher local activation.

→ Higher reserve need in each area.

→ Higher balancing energy prices.

*From flow based stakeholder meeting 9.9.2024

Reduced Flexibility = Increased Balancing Needs

Intraday challenges

Impact on balancing market

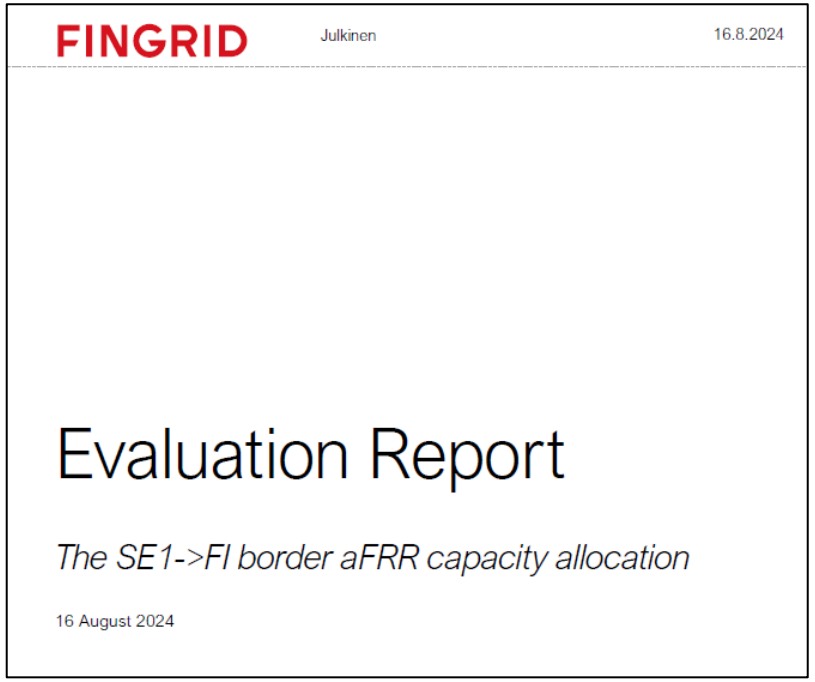
Nordic TSO response to NordREG's Letter to Nordic CCR TSOs Concerning Flow-Based implementation and ID ATCE

- *"This may result in higher balancing prices in importing areas and may also introduce higher capacity procurement costs. However, there might also, in some situations, be insufficient volumes and capacity to ensure balance at all."*
  - Why this has not been analyzed in any depth?
  - Seems misleading that the effects of this has not at all been considered in the calculations on social economic welfare
- What are the risks to introduce a model that is so close to operational security that there might be insufficient volumes and capacities leaving TSOs with "two possible mitigation measures for cross-border capacities"
  - Increase the capacity after the ID gate closure and manage the operational risks in real-time
  - Reserve more capacity for balancing before the DA timeframe
- NordREG
  - "*Our concern is that the reduced trading possibilities on intraday may also lead to increased procurement of balancing reserves and further increased capacity reservations for balancing*"

Intraday challenges

Impact on balancing market

- Report evaluates the effects on the aFRR Nordic capacity market (CM) as well as socioeconomic benefit from the opening up of SE1 -> FI border for aFRR capacity trade
- The overall net effects on Nordic socio-economic benefit were negative
- We support of following the development of capacity allocations on balancing markets and their impact on the market and socioeconomic welfares through, for instance, similar reports to this


FINGRID Julkinen 16.8.2024

Evaluation Report

The SE1->FI border aFRR capacity allocation

16 August 2024

	Diff. (mill EUR)
SDAC consumer surplus	-6.20
SDAC producer surplus	3.51
SDAC congestion income	2.54
aFRR producer surplus	-0.96
aFRR procurement surplus	1.45
aFRR congestion income	-1.89
Total benefit	**-1.55**

Table 21 – Total socio-economic benefit.

Challenges - summary

- EPR results point to increased SEW for DA and FB DA technical implementation from TSO may be almost ready. But have the needs of the stakeholders been met to guarantee a higher SEW after go live, and not only be a theorical increase?
- We are positive to a higher utilization of the network, and we believe this is crucial to reach the climate goals. However, we need to find a solution where we can at least maintain the flexibility we currently have in the market and ensure there are enough ID capacities to meet the needs of this volatile market

Content

1. Experiences from the stakeholders' point of view and how has the process been?
2. What effect will the flow based have on the producers?
3. How should we move forward?

Increase the forecastability by making more data available - More openness from TSO with the data and assumptions to facilitate forecast process

- Swedish CNECs should be public
- A list of all potential CNECs
- For Core there is a public static network model, we should also have this for the Nordics
  - There would still be parameters that will remain unknown, e.g. specific state of series capacitors, switches, transformer taps and other connections in the network – is it possible to increase transparency of these?
- UMMs translated from NTC to FB
- Increased transparency regarding GSK calculation – to forecast PTDF both network model and GSK are needed
- Are the consumption, wind and solar published on Entso-e Transparency Platform the same that are used for the calculation of the domain? If not, these forecasts should be made public
- Increase transparency about RAM calculation:
  - Fmax: Depending on CNEC the value is static or varies over time – explanation of how these are calculated?
  - AAC: Value varies, is it possible to get information how to forecast this?
  - RA: Little information how this value is calculated, more descriptions needed
  - RM: Value is static, in case this changes it would be nice to know

How should we move forward?

Further analysis of different implementation solutions should be done

- Intuitive patch -> parallel runs with intuitive patch, would intraday be better with only intuitive flows?

Follow the implications of the FB implementation also after the go-live

- NTC-parallel runs to compare FB after go-live?
- Following the functionality of ID-market
  - More Hub-to-Hub analysis
  - How will the capacity allocated to reserve markets develop?
- Following the impacts on capacity allocated on reserve markets (e.g. Fingrid's evaluation report on aFRR CM on SE1-FI border)
- Will the price differences between bidding zones get closer?

Developing the ID-solution

- Available capacity to the intra-day market in the opposite direction in the event of non-intuitive flows? Will it be aligned with the 70%-rule of the Electricity Regulation?
- Improvements to the ATCE-calculations
- There might be errors in the description of the algorithm and some parts are not clear enough – these should be fixed
- "*NordREG require the TSOs to work for implementation of flow-based capacity calculation in the intraday timeframe as soon as possible*" – We support this

Conclusions

- More collaboration between Nordic RCC/TSOs and stakeholders: understanding the needs of each other and finding solutions for the Nordic specific challenges actors face
- We believe that FB will work – but the question is that is the solution optimal?
- Bigger actors have more resources to put into FB modelling, but it will be complex – what about smaller actors?
- Transparency is a key to maintain the trust in the markets
- There are lot of work to be done to make FB more transparent - even regulators raised concerns about implementation
- Problem is not the fact that export and imports influence the price formation - the problem is that predictions of market outcome becomes challenging, and it could be difficult to explain reasons behind the outcome

Thank you

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ACER

European Union Agency for the Cooperation of Energy Regulators

NordREG Wholesale & Transmission Public Seminar

ACER slides

Martin Viehhauser

30th October 2024, 10:00-17:10, Helsinki

ACER
European Union Agency for the Cooperation of Energy Regulators

Flow-based

12:15-13:15 (Helsinki time)

Martin Viehhauser (ACER)

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European Union Agency for the Cooperation of Energy Regulators

Flow-based domain and shadow prices

- Instead of volume of cross-zonal capacity per bidding zone borders (i.e. NTC values) flow-based cross-zonal capacity relates to transmission grid constraints in the form of '**CNEC**s'
  - Critical network elements
  - ~N-1 situation

- Sensitivities to each hub shown as '**PTDF**'

- Available capacity in the such flow-based domain is provided as Remaining Available Margin ('**RAM**')

  →70% should be provided

- **Shadow price**
  - Show how much economic surplus would change by increasing the RAM for 1 MW

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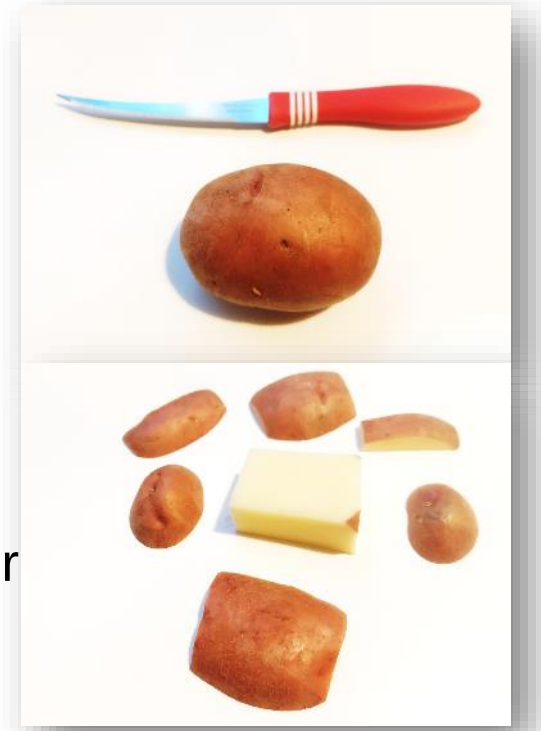
flow-based versus NTC

- In the past: bilaterally agreed cross-zonal capacity values per bidding zone border (NTC)
- CACM requires capacity calculation per capacity calculation region (CCR) to apply the flow-based approach (unless cNTC is equally efficient)
- Flow-based approach allows competition among bidding zone borders for the available cross-zonal capacities for interdependent bidding zone borders
  - Increase of economic surplus by providing the cross-zonal capacity where it is most needed
  - Facilitates the application of advanced hybrid coupling
- Improved provision of cross-zonal capacity while ensuring operational secur
- Flow-based allows for:
  - improved transparency on congestions
  - more efficient handling of congestions



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Increase of economic surplus

- 2023 external parallel run evaluation report by Nordic TSOs showed expected impact of flow-based allocation in the Nordic CCR (here)
- More efficient use of available cross-zonal capacity leads to increase of overall economic surplus in SDAC
- Dec 22 – March 23 parallel run showed increase of economic surplus through Nordic flow-based:
  - 63.3 M€ in SDAC
  - 73.4 M€ in Nordic CCR
- Shift between producers' and consumers' surplus is not a specific effect from flow-based but more generally subject to bidding zones and interconnection

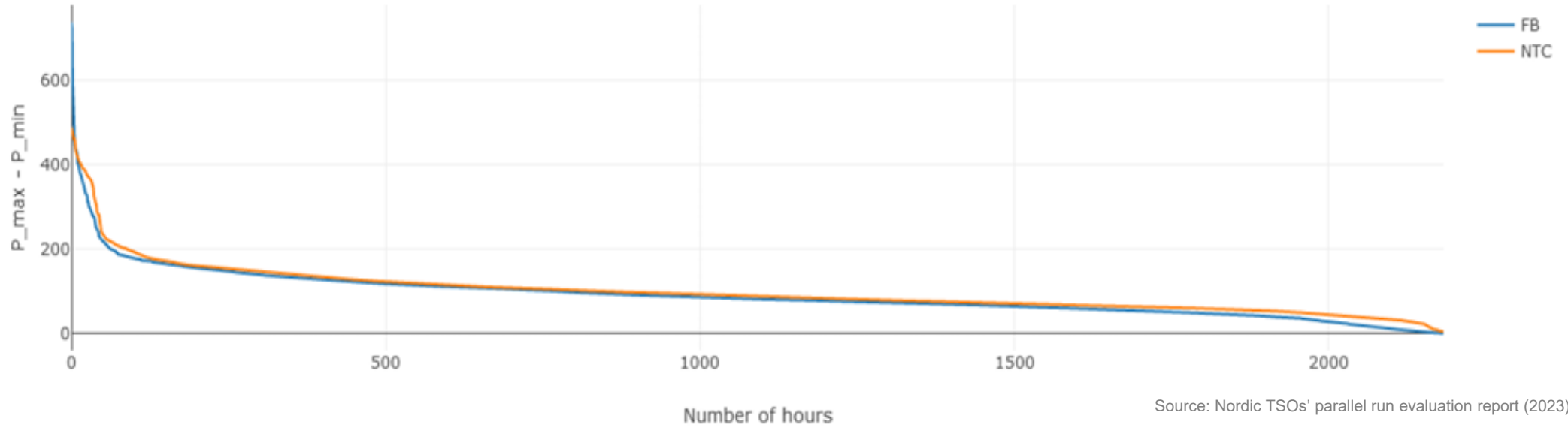
Figure 3: Welfare change for the total SDAC (top) and the Nordic CCR (bottom). Total social economic welfare change (SEW) consists of changes in consumer surplus, producer surplus, and the congestion income.

Source: Nordic TSOs' parallel run evaluation report (2023)

Increased price convergence with flow-based

- Flow-based can have an impact on price convergence
- As already observed for the Core CCR when switching to flow-based this is also shown in the Nordic parallel run

Figure 14: Duration curve for the price difference between the highest and lowest bidding zone price for each hour, for both flowbased and NTC



Source: Nordic TSOs' parallel run evaluation report (2023)

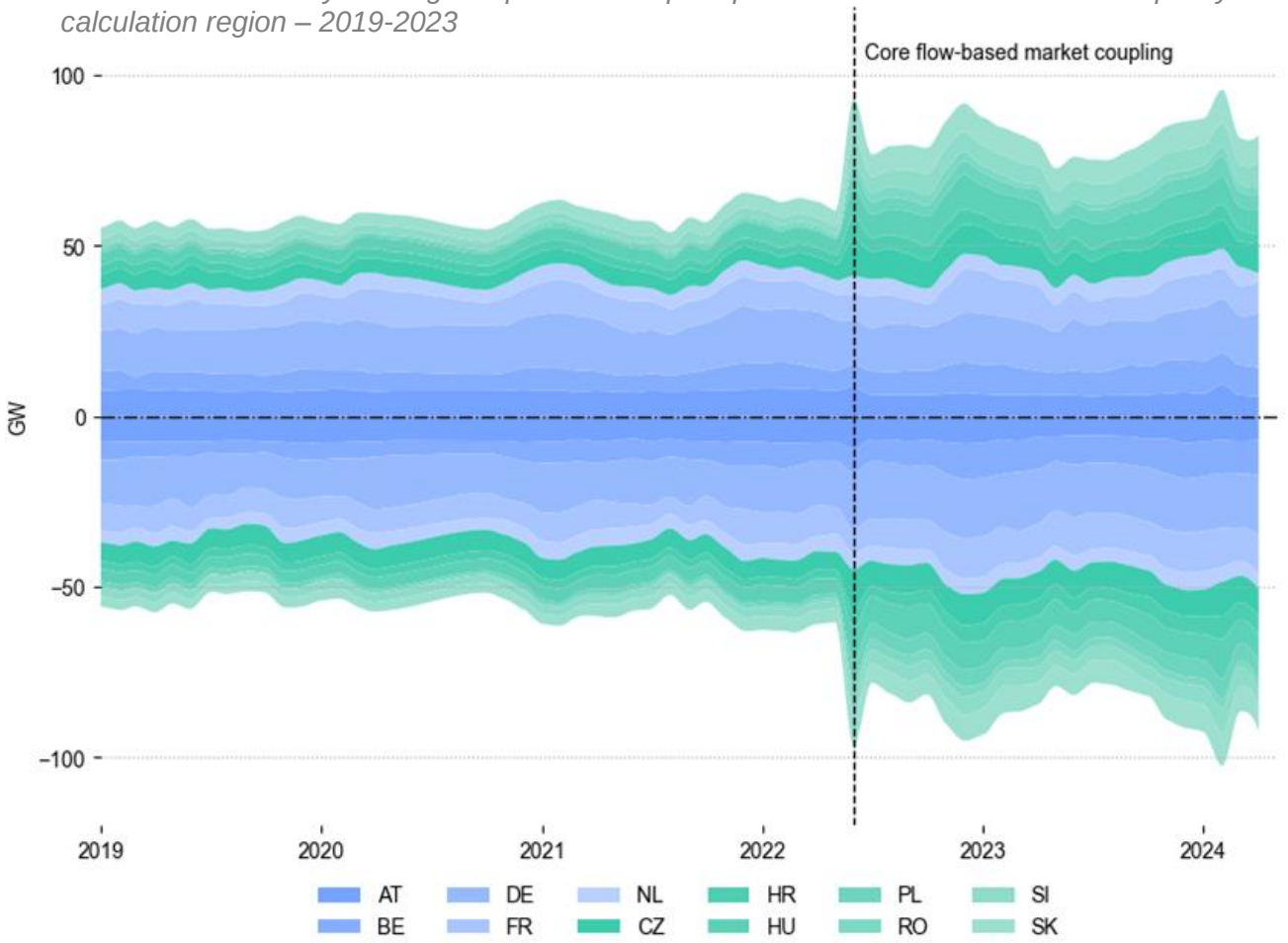
Impact of flow-based approach on possible net positions

- Possible net positions in the Core CCR significantly increased with the introduction of flow-based

- Flow-based cross-zonal capacities and allocation allows for a much more flexible use of transmission capacity and adaptation/mitigation for any possible market outcomes in individual bidding zones

Flow-based capacity calculation optimizes cross-border trading opportunities across the Core region

Evolution of monthly average import and export possibilities within the Core capacity calculation region – 2019-2023



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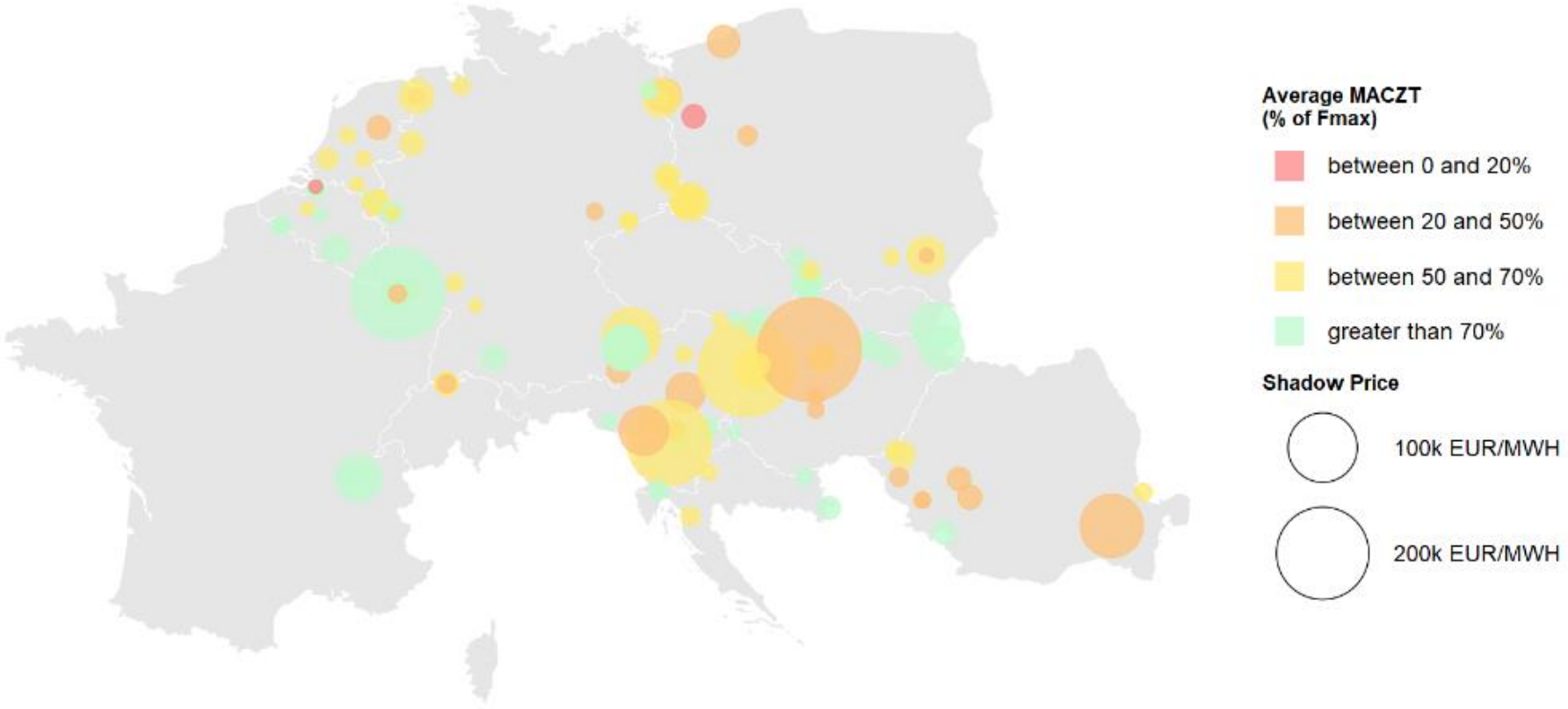
Real time monitoring of congestions

- Flow-based allows for real time monitoring and identification of most relevant market congestions
- Increased transparency could allow for timely identification of issues and adequate reactions

Active constraints in Core flow-based market coupling, weighted by shadow price and categorised by average MACZT – July to September 2024 (EUR/MWh and % of Fmax)



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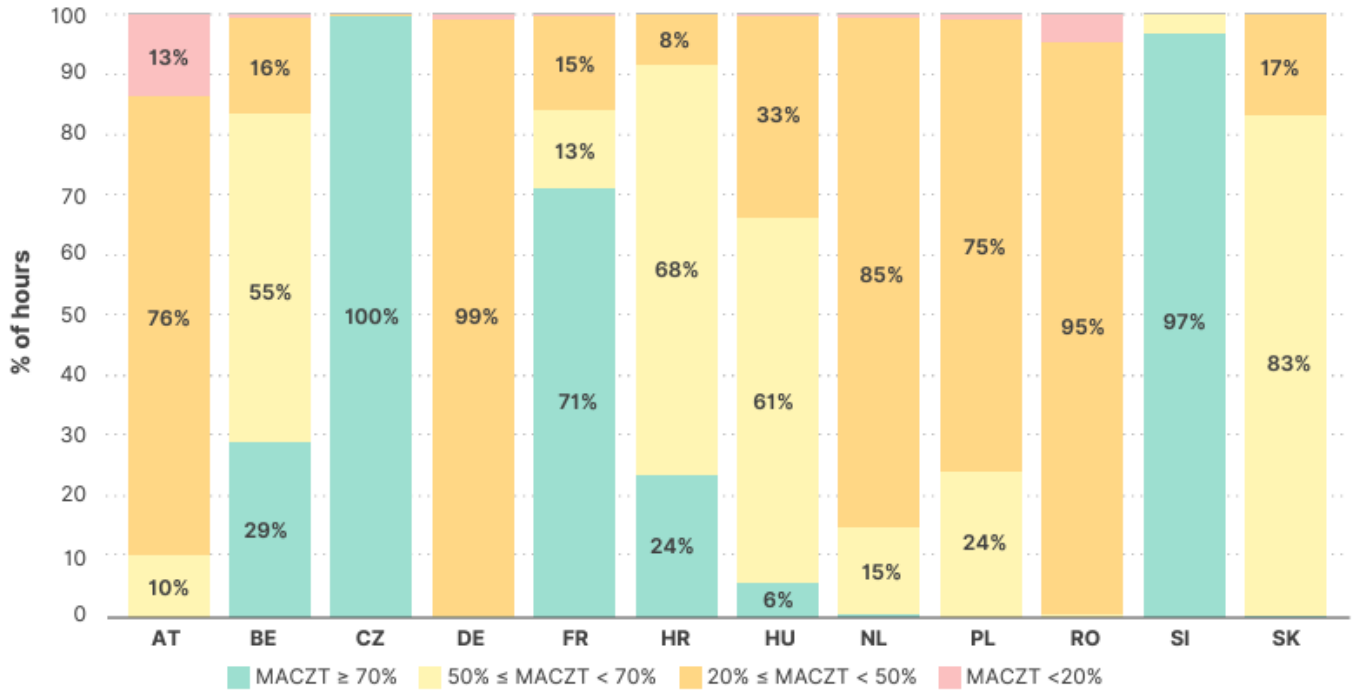
70% monitoring

- Flow-based allows for accurate monitoring of the 70% requirement
- No provision to enforce 70% minRAM on each CNEC in the Nordic CCM (compared to virtual capacity top-up in Core)

Figure 16: Percentage of hours when the minimum hourly MACZT was above 70% or within predefined ranges in the Core CCR for each Member State, considering flows induced by third-country exchanges – 2023 (% of hours)



Source: ACER calculation based on TSO data.

Note: Belgium, the Netherlands and Poland have declared allocation constraints limiting total exchanges from and/or to these Member States. Allocation constraints are monitored separately and thus not considered in this figure.

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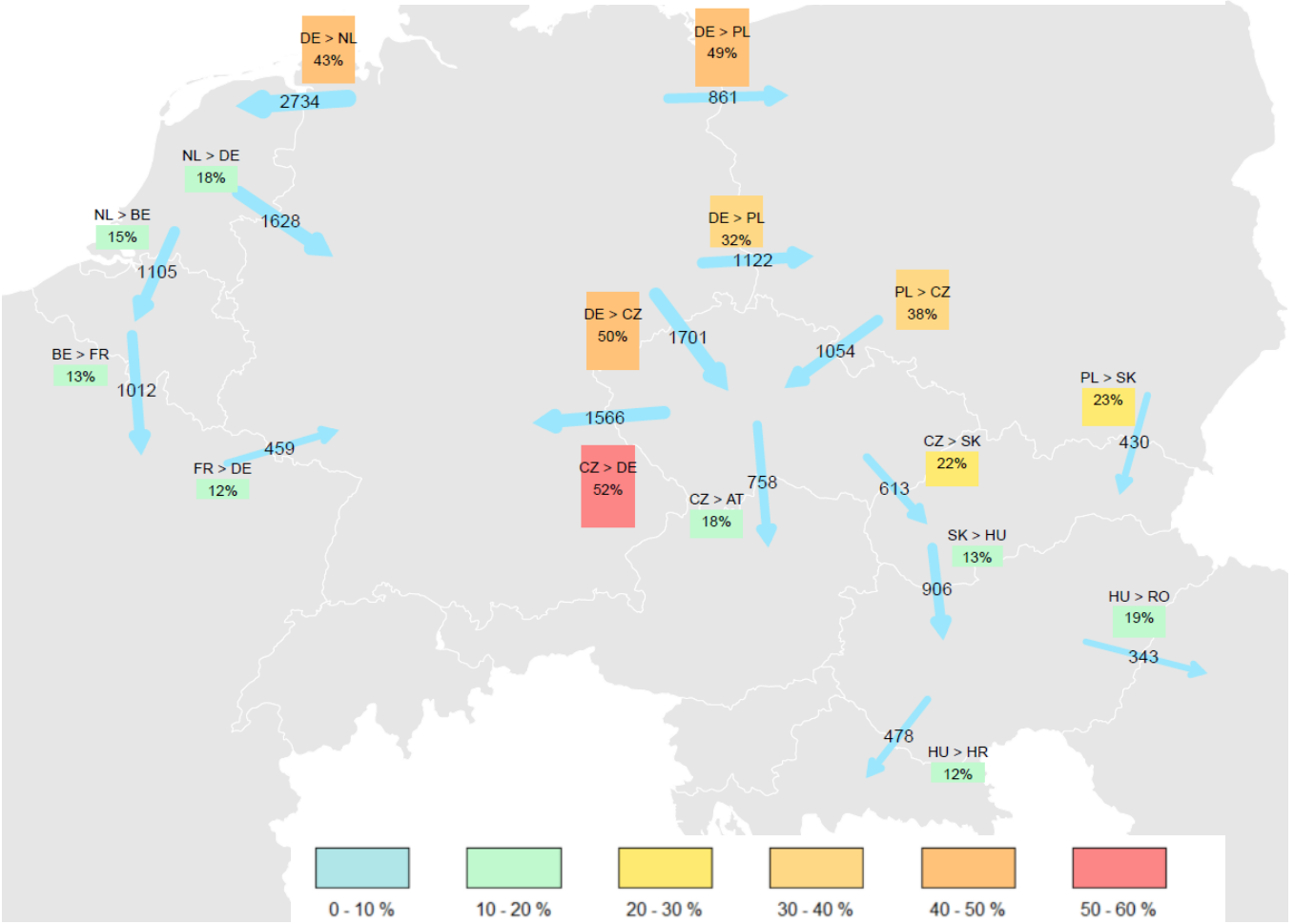
Loop flows in Core CCR

- Flow-based capacity calculation allows a forecasting of loop-flows (before any commercial cross-border exchanges)
- Such forecast allows TSOs to consider necessary remedial actions for meeting the 70% requirement

Figure 22: Average forecasted loop flows on a selection of cross-zonal critical network elements (without contingencies) in the Core CCR – 23 November 2023 (MW and % of F_{max})



Access to data

- JAO publication tool (here)
  - ‘one stop shop’ including all flow-based data (same as for Core)
  - Possible access via API
  - Test tool for Nordics parallel run (here)

- NEMOs, TSOs and regulators may also access ‘Simulation Facility’
  - Allows simulating eventual results with different input parameters to SDAC algorithm
  - With flow-based, individual CNECs can be targeted instead of BZB only

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- Physical participation: Please raise hand if you want to give a comment or ask a question. Please wait until you receive a microphone.
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Block 1: Update on regulatory processes from the NordREG task forces		
10:40-11:00	NordREG Capacity TF Update on recent development Electricity balancing - regulator update	Jori Säntti, Finnish Energy Authority Eveliina Ishii, Finnish Energy Authority
11:00-11:30	ACER-CEER Position Paper on the Challenges of the Future Electricity System	Johan Roupe, Senior Legal Adviser, Swedish Energy Markets Inspectorate
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13:45-14:15	Reserve and balancing markets – wind power experiences	Niko Korhonen, Expert, Fingrid
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16.30-16:45	Conclusion	Antti Paananen, Director, Finnish Energy Authority

DAG MÅNED ÅR

Capacity Mechanisms

- August Bech

GREEN POWER DENMARK

Capacity mechanisms are a fundemental cornerstone in securing public support for electrification

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1. Security of supply should be prioritized to ensure public support for electrification

2. Peak-load pricing theory do not account for real-world dymanics

3. The resulting ”missing money” problem should be resolved by implementing market wide capacity mechanisms

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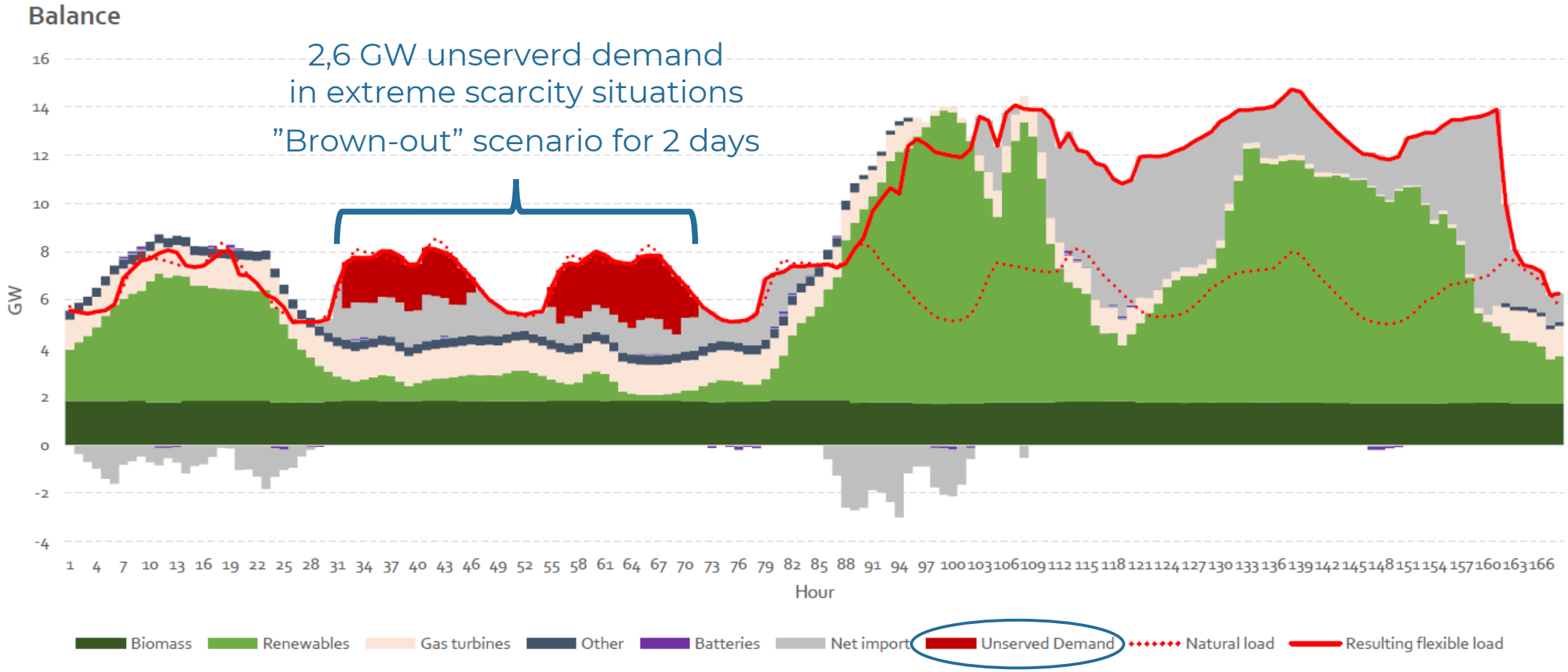
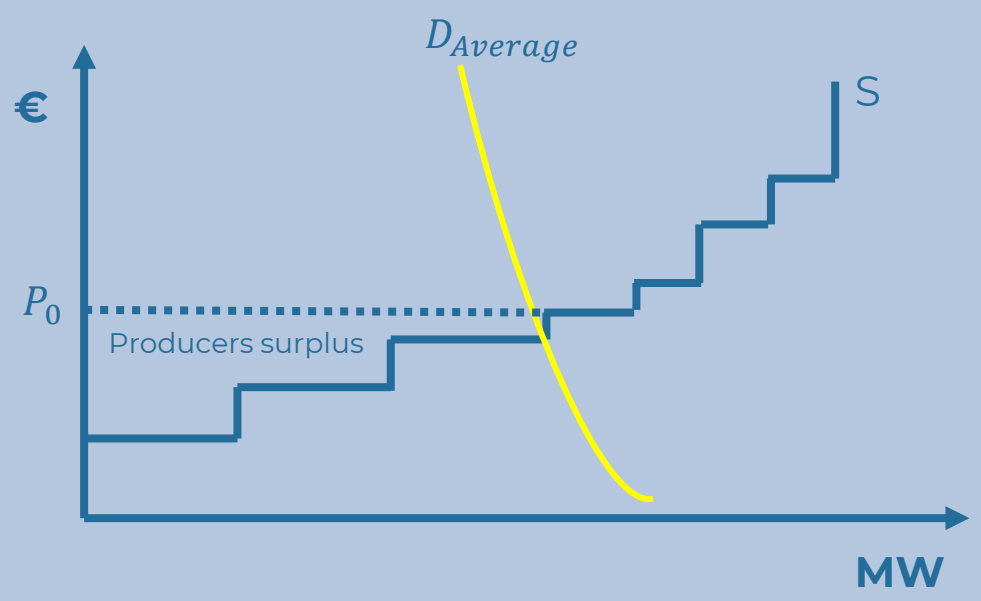
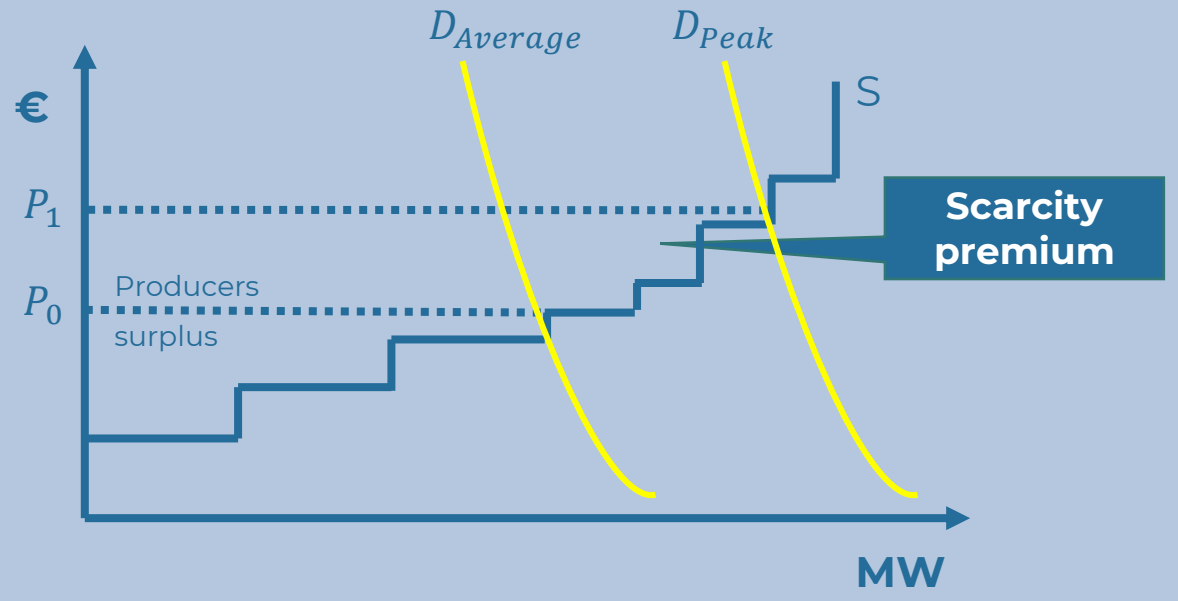
Security of supply is challenged

Forecast of worst case scenario in 2030
High demand, low wind & solar ressources



Peak-load pricing theory





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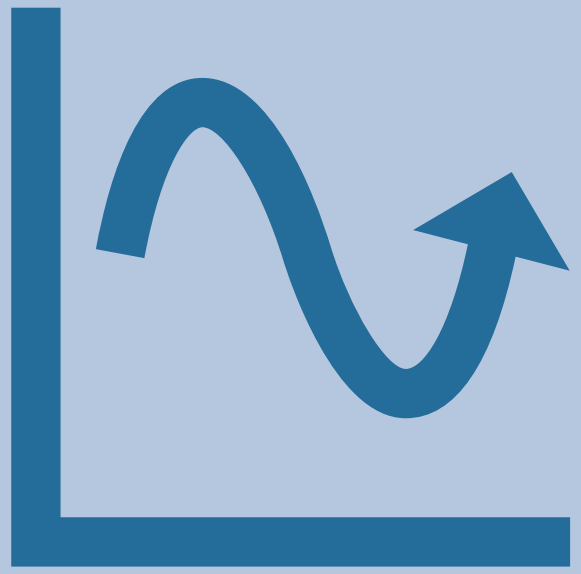
Market driven risks



Policy driven risks

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Peak-load pricing theory do not account for real-world dynamics

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850€

Highest DA price in DK in 2022/23

”180€ price cap” market situation

Source: Energinet (2024) *Redegørelse for Elforsyningssikkerhed 2024*, p. 12.

4.000€

Technical limit

By 2034:
On average: 16h/year
In extreme: 120h/year

Source: Energinet (2024) *Redegørelse for Elforsyningssikkerhed 2024*, p. 12.

11.000€

50% of danish value-of-lost-load

Willingness to pay pr MWh for not being cut off

Source: Energistyrelsen (2023) *Et dansk estimat for value of lost load*, p. 9.

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Policy driven risks

”Missing money” problem

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Inadequate energy-only market

- The regime will insufficiently reward the provision of reserve capacity from flexible and dispatchable ressources preventing them from operating profitably.
- This would lead to the premature closure of required reserve capacity and lack of investment incentives for new capacity.
- Such development would ultimately and fundamentally threaten the security of supply.

Article 22: Design principles for capacity mechanisms

1. Any capacity mechanism shall:

~~(a) be temporary;~~

(b) not create undue market distortions and not limit cross-zonal trade;

(c) not go beyond what is necessary to address the adequacy concerns referred to in Article 20;

(d) select capacity providers by means of a transparent, non-discriminatory and competitive process;

(e) provide incentives for capacity providers to be available in times of expected system stress;

(f) ensure that the remuneration is determined through the competitive process;

(g) set out the technical conditions for the participation of capacity providers in advance of the selection process;

(h) be open to participation of all resources that are capable of providing the required technical performance, including energy storage and demand side management;

(i) apply appropriate penalties to capacity providers that are not available in times of system stress.

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The solution is market wide capacity mechanisms

- Policy driven uncertainty should be accounted for directly in the energy market.

- Market wide CRMs
  - Low entry requirements
  - Cross-border participation and coordination
  - Evolving ”derating factors”
  - Permanent and futureproof solution to security of supply

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Any questions?

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16.30-16:45	Conclusion	Antti Paananen, Director, Finnish Energy Authority

11/8/2024

Niko Korhonen

Reserve and Balancing markets

Experiences integrating renewable energy to the reserve markets in Finland

FINGRID

Key figures

Transmission reliability rate of the main grid
99.99995 %

14,500
kilometres of transmission lines

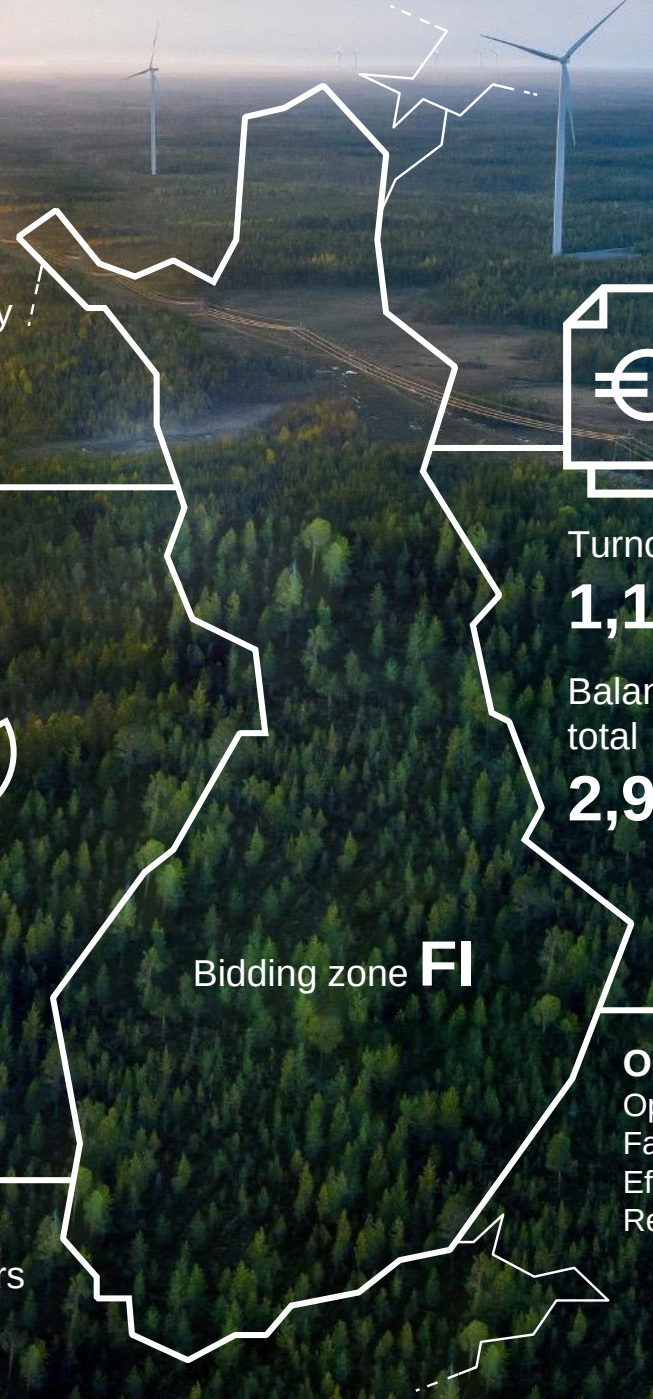
71.7 TWh
transmitted electricity

83.1 %
of total electricity transmissions in Finland

527 personnel

NPS Personnel
75

NPS Customers
45



Turnover
1,193 M€

Balance sheet total
2,900 M€

Paid income taxes
30,4 M€

Investments in the main grid
310 M€

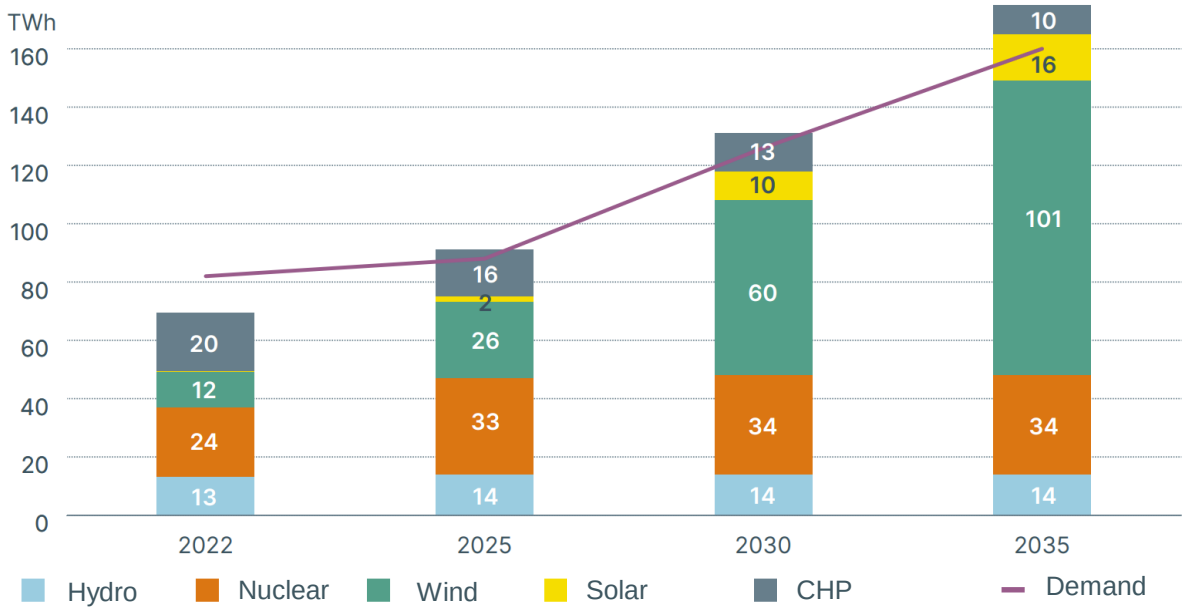
Our values
Open
Fair
Efficient
Responsible

Our vision
The energy system is clean, reliable and creates economic prosperity for Finland. Fingrid is the cornerstone of the energy system.

FINGRID

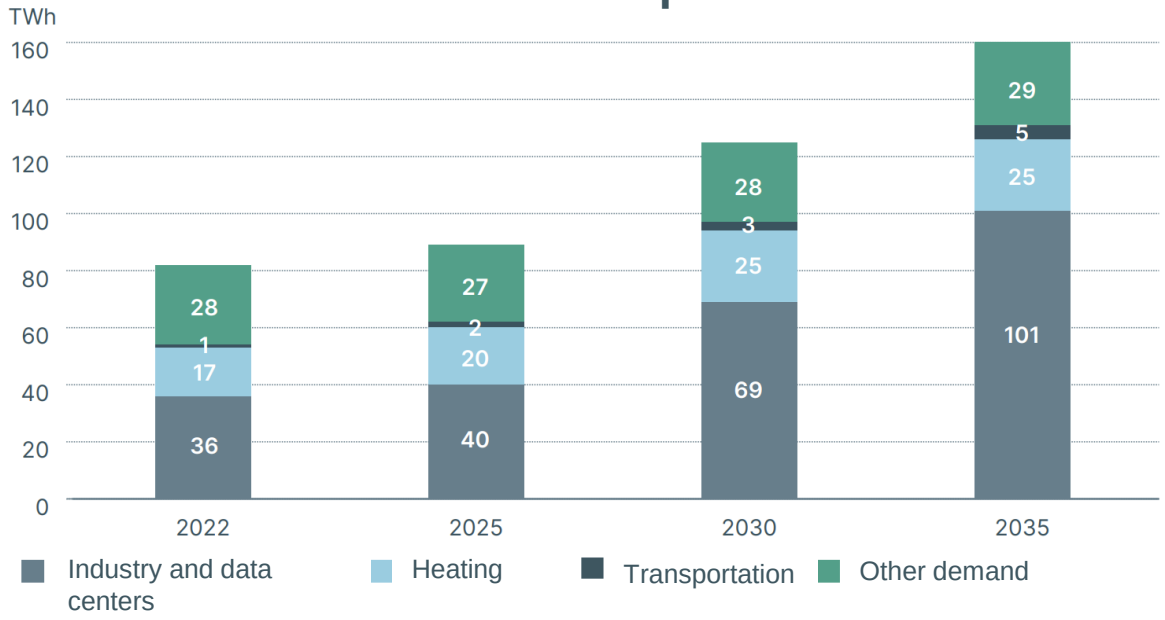
Q3 2024 estimate – significant increase in electricity production and consumption in Finland

Production



Inquiries ~400 GW / ~1100 TWh

Consumption



Inquiries ~35 GW / ~200 TWh

Link to the updated estimate published 26th Sept 2024 (in Finnish):
Sähkön tuotannon ja kulutuksen kehitysnäkymät päivitetty – Pidemmän aikavälin näkymä ennallaan

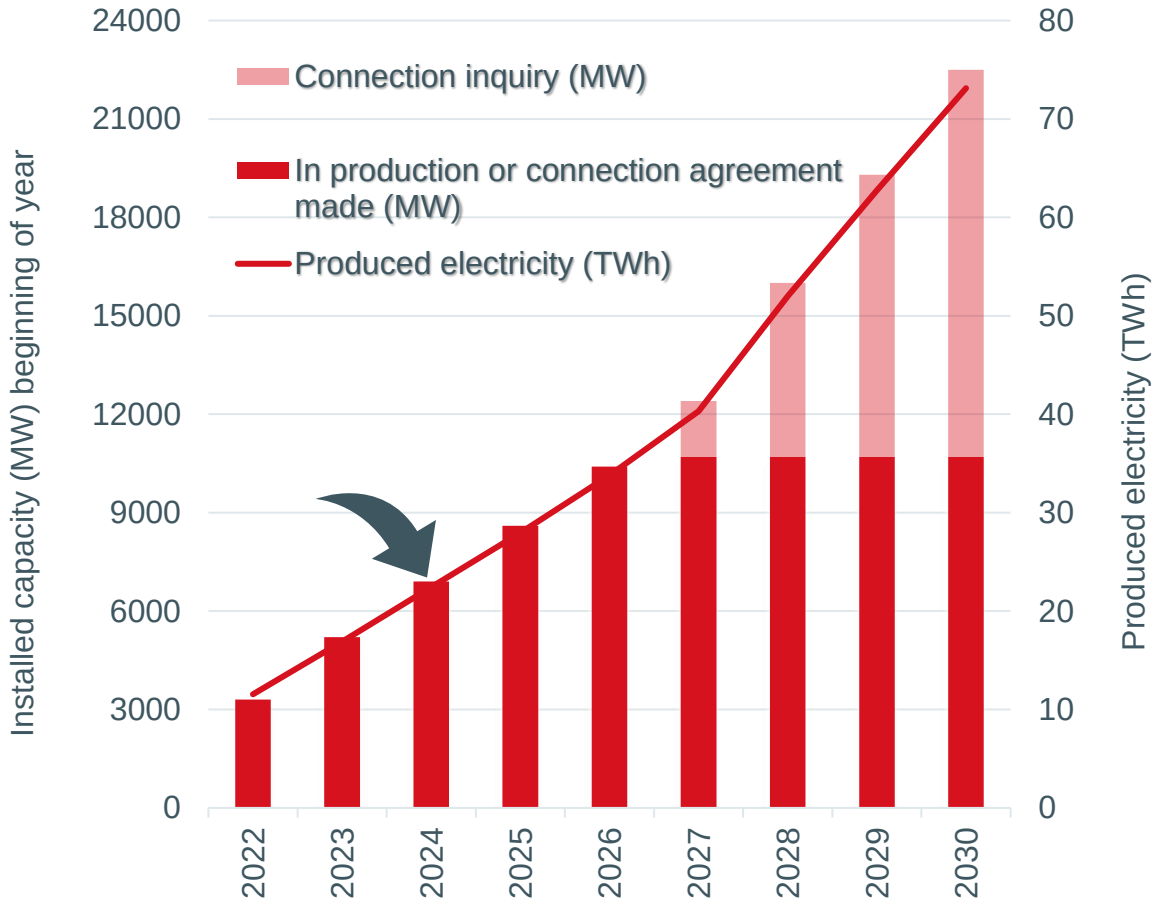
FINGRID

Wind power can be the biggest production method in Finland by 2027

"With great power comes great responsibility"
In Finland, traditional power plants have largely participated in the reserve markets, but this alone is no longer able to provide sufficient regulation at all times.

On windy days, only a fraction of wind power participates in the reserve markets.

Wind power is technically capable for the reserve markets. This opportunity is utilized more widely in Sweden and Denmark, where can be gain additional revenue streams.



FINGRID

Wind power to the reserve market pilot

Background 2022->

Energy crisis during Autumn 2022 and next winter highlighted occasionally insufficient liquidity in the reserve markets in Finland.
More resources need to be found from somewhere.

It was uncertain why wind power has not participated in automatic reserve markets despite having the technical capability. Additionally, it has started to become profitable.

Goal is to open bottlenecks and approve wind to the automatic reserves (aFRR, FCR and FFR)

Participant needs to meet the same reserve requirements as required from every reserve market participant

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Pilot participants (aFRR, FCR and FFR)

Enefit Green

FINGRID

centrica Energy Trading

PRIME CAPITAL

Turbine manufacturers

Vestas

NORDEX

Service providers

volue

Caverion

Total installed capacity in the pilot 550 MW

Pilot experiences and identified challenges joining the reserve markets

1. Wind power is suitable for automatic reserves
   (excluding FFR for now)
2. Owners are eager to invest in new production.
   No time or resources to look upon reserve market
3. The reserve markets was quite an unknown area for owners and operators
   Market entry, requirements
4. While reserve market rules are quite harmonized, there are differences between the markets in the Nordics

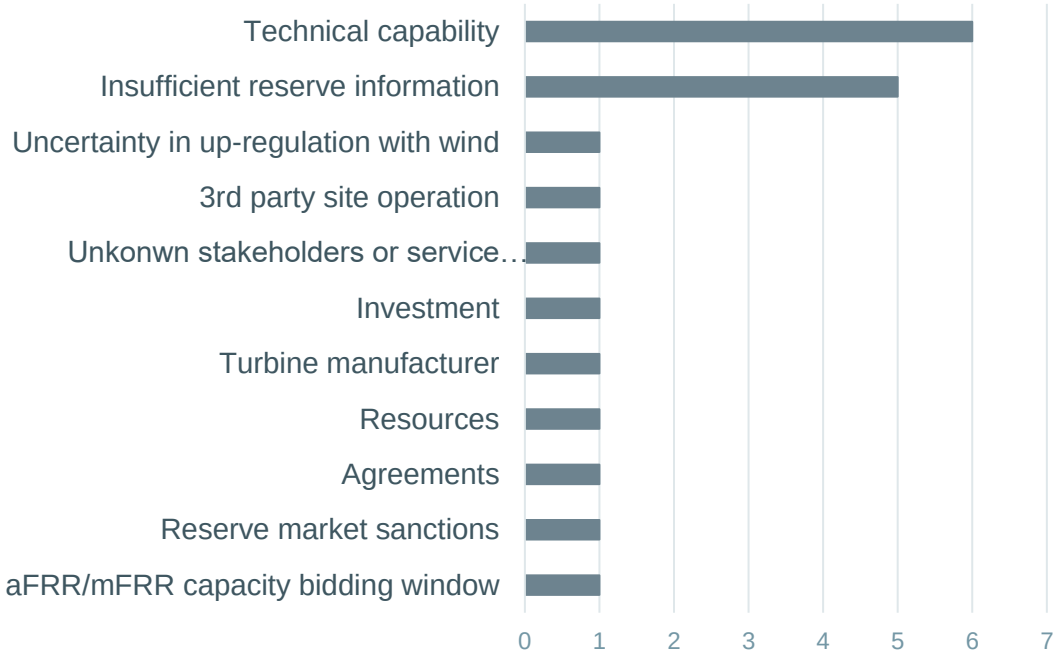
Creating new things and finding new revenue streams seems to be challenging for Finnish parties in general: trailblazers are always needed to show that something works.

FINGRID

Short survey (Feb. 2024): advantages are seen but lacking information from reserve market and wind farm capabilities

What are the biggest challenges in joining the reserve markets?

"Lack of information about reserve markets and available benefits, reserve markets is not noticed when planned power plants and operation models. "



What are the biggest benefits in joining the reserve market?

"We stay up-to-date with developments and are able to optimize returns for park owners, ensuring that new projects can be built in Finland in the future."

The responses are indicative. Query was made after Fingrid´s wind and solar webinar end of February 2024.
The respondents include 12 companies (half operate or construct parks, the rest are owners, aggregators, and service providers)

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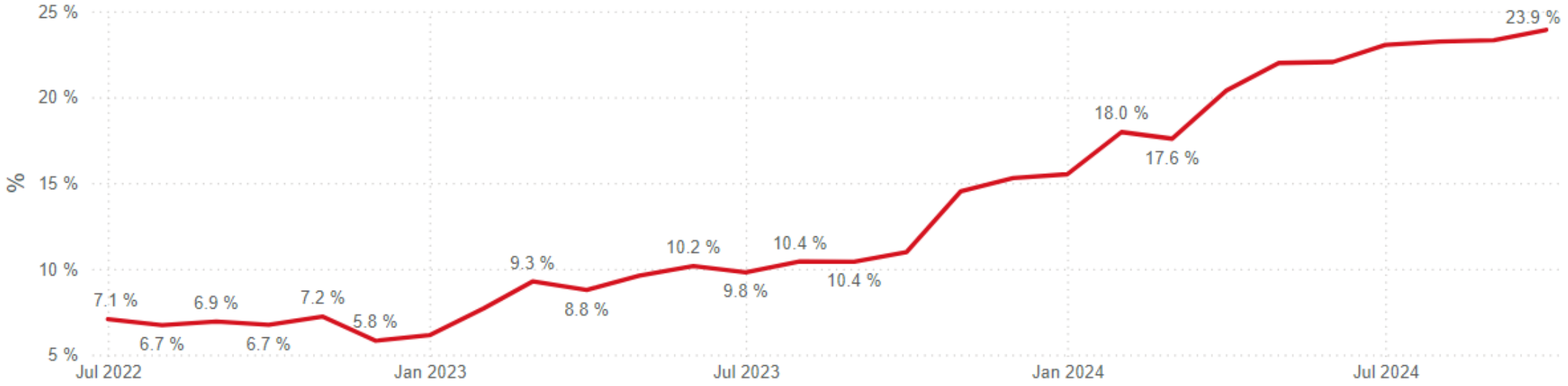
Wind participation to the Finnish reserve markets

Share of wind down-regulation bids (mFRR) from total wind production



mFRR

Dozens of wind parks

aFRR

1 in the market
3 in prequalification phase

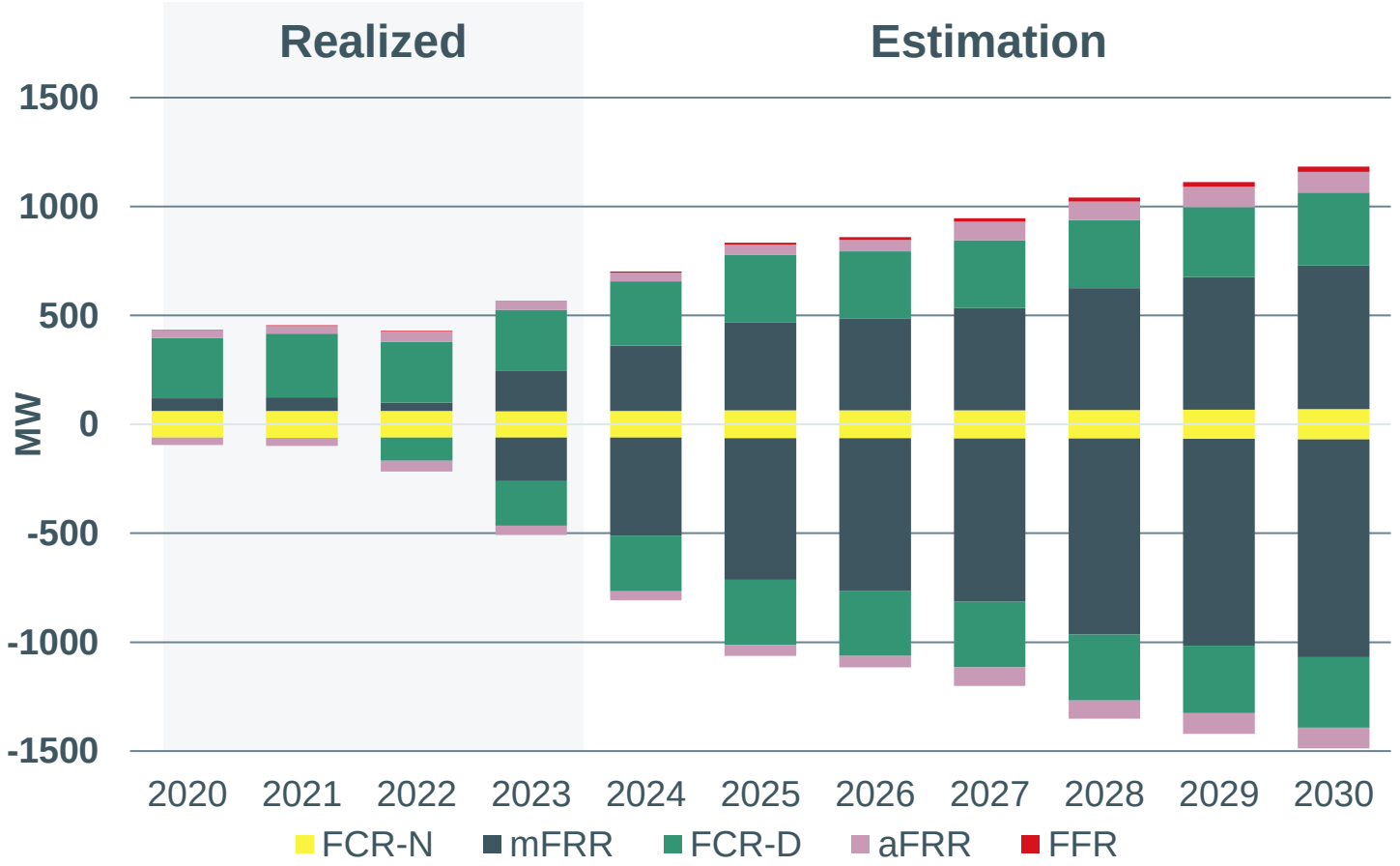
FCR-D

1 in prequalification phase

FINGRID

Need for reserve capacity will increase significantly in Finland

Capacity procurement



- **800 MW → 2000+ MW** for each hour in a year
- Down-regulation will be procured more than up-regulation in future
- Energy activation are expected to increase.

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NordREG
Nordic Energy Regulators
POWER THROUGH COOPERATION

- Physical participation: Please raise hand if you want to give a comment or ask a question. Please wait until you receive a microphone.
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13:45-14:15	Reserve and balancing markets – wind power experiences	Niko Korhonen, Expert, Fingrid
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14:45-15:15	PICASSO and aFRR	Tuomas Mattila, Expert, Fingrid
15:15-16:30	Revision of the Forward Capacity Allocation (FCA) Regulation	Martin Viehhauser, Policy Officer, ACER Jim Vilsson, Chief Economist, and Henrik Winkler Mogensen, Senior Economist, Energinet Mikko Mäki-Petäjä, Director of Financial Markets, Fortum
16.30-16:45	Conclusion	Antti Paananen, Director, Finnish Energy Authority

30.10.2024

NordREG WT Seminar 2024

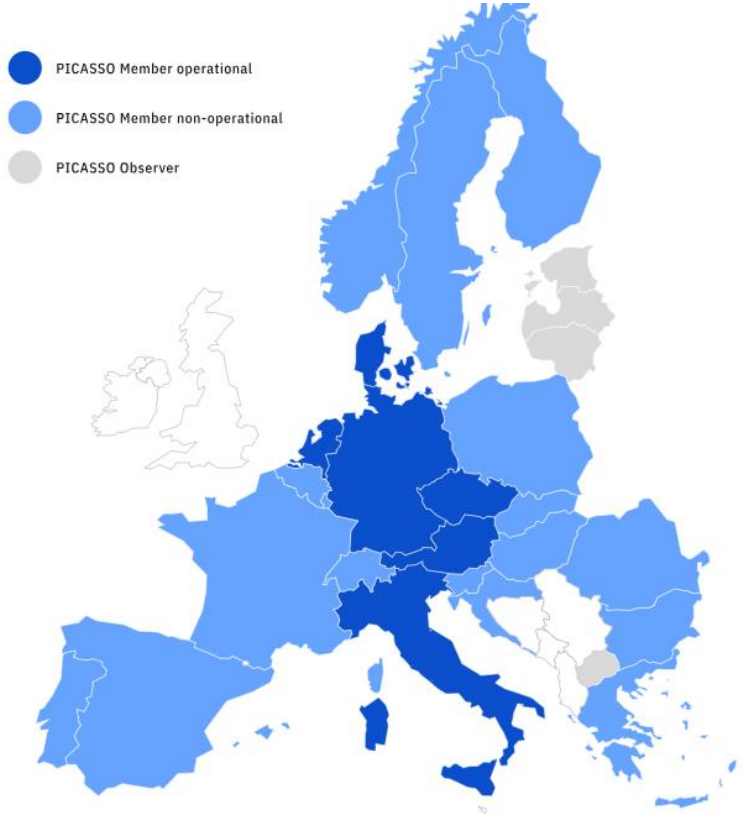
Fingrid aFRR Energy Markets & PICASSO

Tuomas Mattila, Balancing Markets Expert

FINGRID

European aFRR-Platform PICASSO

- aFRR platform pursuant to EB GL
- To exchange of balancing energy for aFRR Reserve
- Go-live of the platform 06/2022
- As of today, 9 operational TSO’s, new accessions almost monthly during next year
- 45 MEUR economic surplus for Q1/2024
- Since operations start, > 10 million market clearing (4s MTU) with 100% availability



PICASSO implementation project (as of October 2024)

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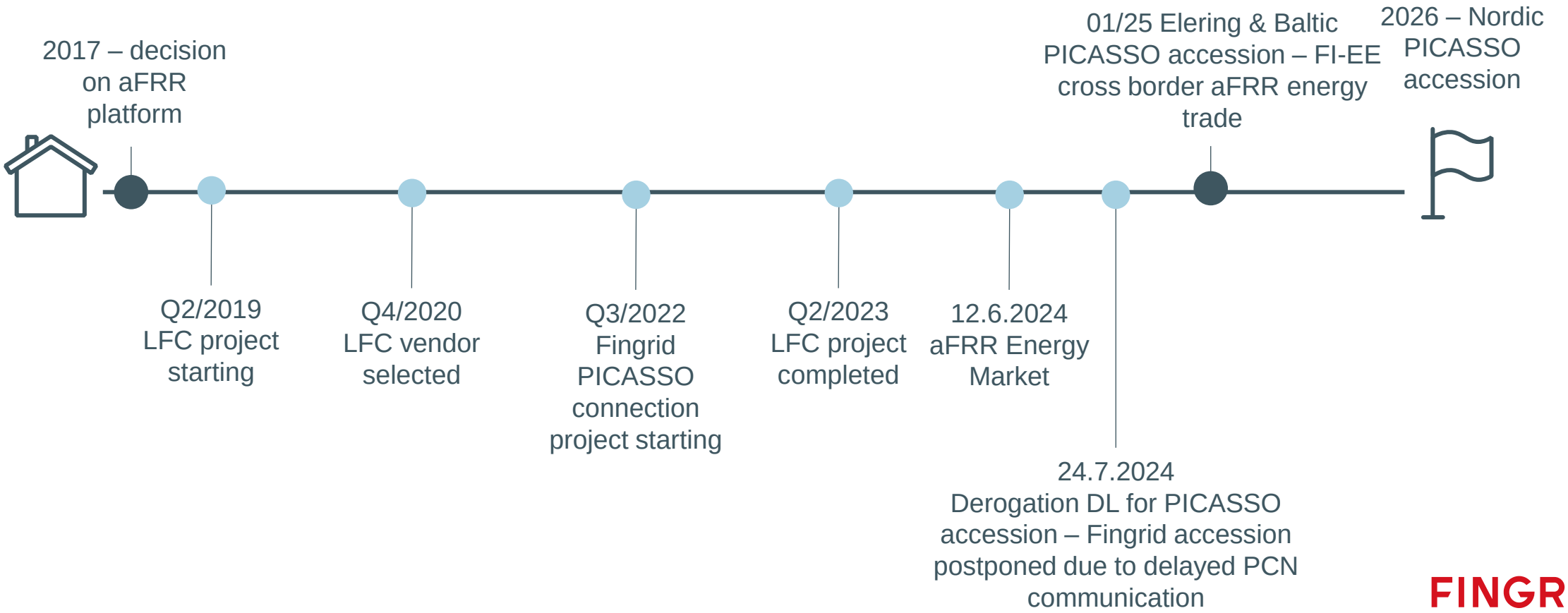
Fingrids long road towards PICASSO



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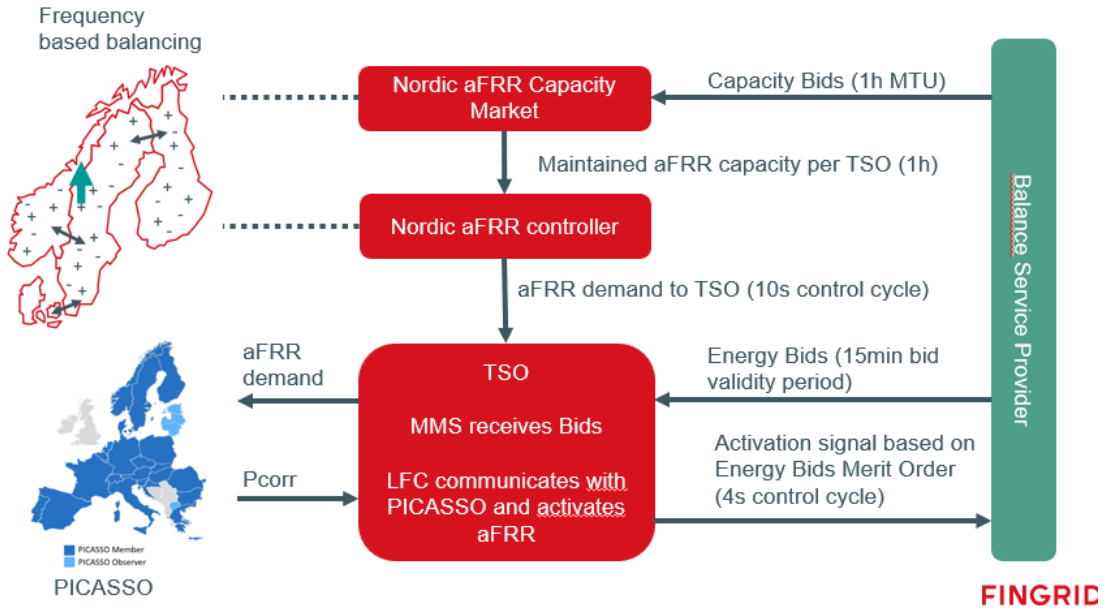
aFRR Energy Market established 12.6. in Finland

- PICASSO-ready market
- Marginal pricing, 15 min bid validity period
- Voluntary bids allowed
- Energy price included in imbalance pricing
- 10+ BSP's, certified capacity 325 MW
- Outsourced market surveillance



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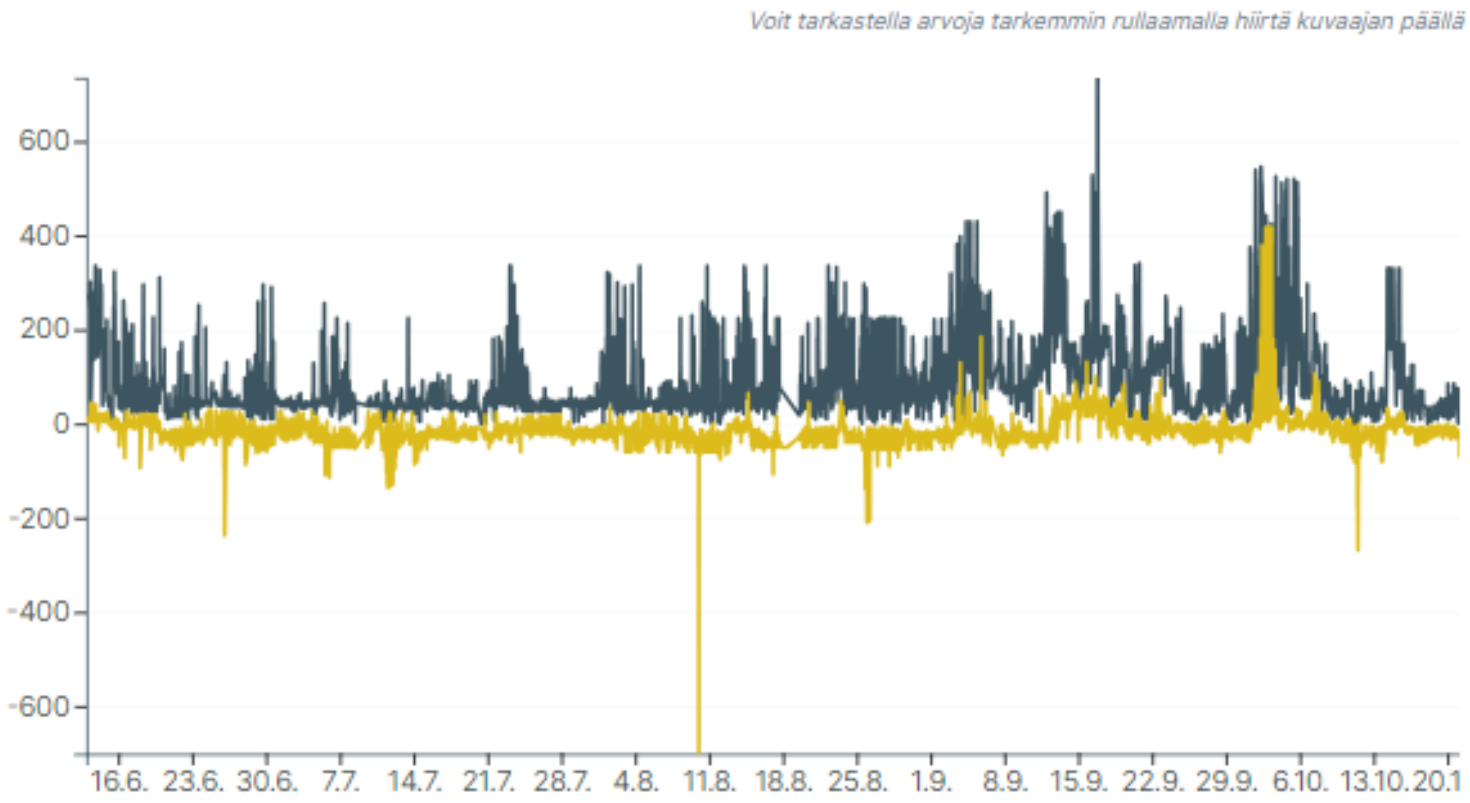
aFRR energy market price

(volume weighted average price per 15min, 13.6.-21.10.)



- Average price
  - Up 97 EUR/MWh
  - Down -18 EUR/MWh
- Notes
  - Each 4 s gets own price, 15 min average values used in imbalance price
  - No reference price
  - European price limits: +/- 15000 EUR/MWh

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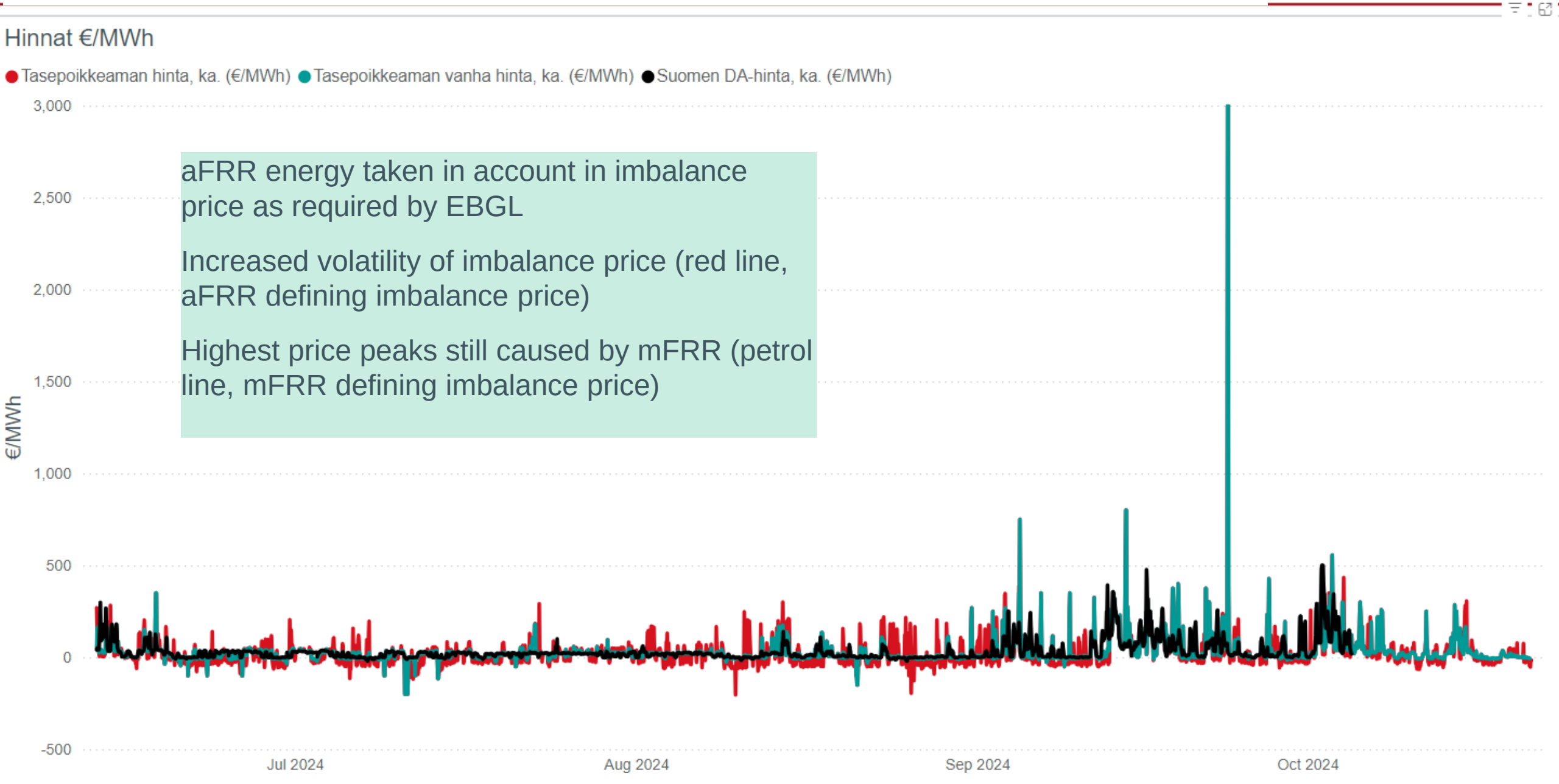
aFRR energy price included in imbalance price

6/13/2024 10/21/2024



aFRR energy taken in account in imbalance price as required by EBGL

Increased volatility of imbalance price (red line, aFRR defining imbalance price)

Highest price peaks still caused by mFRR (petrol line, mFRR defining imbalance price)

High prices mitigation

- In Europe, high price peaks of aFRR have created a lot of attention
  - European pricing methodology amended by ACER decision 09/2024, including
    - the voluntary elastic Automatic Frequency Restoration Reserve (aFRR) demand for aFRR demands larger than the dimensioned aFRR in a Load-Frequency Control (LFC) block;
    - the determination of the aFRR cross-border marginal price (CBMP) based on LFC input and LFC output signals;
    - the harmonised maximum and minimum standard balancing energy prices
- In Finland, we have not seen high price peaks, but high volatility of prices
  - When Area Control Error based balancing is taken in use at aFRR 2026, high price peaks are more likely
  - Elastic Demand of aFRR to be carefully judged – should it be taken in use or not in Finland?

FINGRID

Together towards the brave new short term markets!

Fingrid will shortly access PICASSO & fullfil the legal reguirements – the full benefits will follow when all Nordic countries have joined

European markets regulated by national regulators – important for TSO’s to get aligned and unambiguous guidance

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FCA 2.0

15:15-16:30 (Helsinki time)

Martin Viehhauser (ACER)

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Forward markets allow market participants to hedge their operations

Time before delivery

Years | Months | Days | Hours | Minutes | Seconds

Forward | **Spot** | **Balancing**

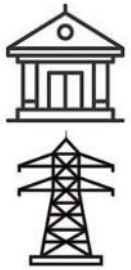
Function

> 3 years	< 3 years		
Hedge (investment)	Hedge (operation)	Dispatch	Support

Stakeholders

Power Exchange (PX)

Transmission System Operator(TSO)



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EU Electricity forward market needs reform

- EU Electricity forward market - **<u>a constant source of frustration?</u>**
- Market participants complain:
  - *Low liquidity*
  - *High collateral costs*
  - *Inadequate maturities*
- TSOs complain:
  - *Why are we forced to issue FTRs?*
  - *We're losing money on FTRs!*
- Regulators are "between the fight"

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Recent developments on FCA 2.0

- In June 2024 the revised Electricity Regulation (here) entered into force.
  - Article 9 requires the European Commission to perform an impact assessment by January 2026 addressing:
    - Frequency of allocation of LTTRs
    - Maturities of LTTRs
    - Nature of LTTRs
    - Strengthen secondary market
    - Regional virtual hubs
  - Public consultation ended on 30 September 2024
  - European Commission to adopt FCA 2.0 by July 2026

- In February 2023, ACER published a policy paper on the further development of the EU electricity forward market (here)

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Problems and possible FCA impact

Pertaining to the EU forward markets

Market fragmentation – too many markets, too many products

Hedging disincentives – harmful interventions (subsidies, CfDs, CRMs, …)

Costly counterparty risk management – high costs of collaterals

Market structure – high market concentration and supply/demand asymmetry

Vulnerability to bidding zone reconfiguration

Pertaining to cross-zonal hedging

LTTRs contribute to market fragmentation – by serving as hedging products on their own

Accessibility of cross-border hedging products – infrequent auctioning

Inadequate maturities – not matching the participants' hedging needs

LTTRs are continuously undersold – negative risk premia

NRAs/TSOs disagree on whether to support the forward market or not

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Key solution

1. Combine supply and demand across larger areas and bidding zones into a single integrated forward market

&

2. Do that efficiently

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Future developments

1. Demand for hedging to decrease

- More flexible demand, more PPAs, CfDs
- Need for more pooling across larger areas to maintain liquidity

2. Congestions to increase

- Larger price differences, more volatility, correlations up and down
- Network investments to lag behind
- Basis risk becoming more important

3. Bidding zones may need to change

- Forward market should be invariant to bidding zone change

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Why forward market (also) needs support of TSOs

1. The importance of hedging basis risk (congestion costs) is expected to increase
2. Hedging the basis risk cannot be done effectively without TSOs support (only they have physical assets to offset the basis risk)

What is the optimal way TSOs can support forward market to provide a hedge against the basis risk?

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How to integrate forward markets

- ACER analysed **several policy options** (all of them require forward capacity allocation by TSOs)
  - (a) Option 1: Border-wise FTRs (status quo in Continental Europe)
  - (b) Option 2: Zone-to-zone FTRs
  - (c) Option 3: Zone-to-hub FTRs + Virtual hub
  - (d) Option 4: EPAD coupling + Virtual hub
  - (e) Option 5: Zonal futures coupling

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Our winner: virtual hubs + Z2H FTRs?

Virtual hub + Z2H FTRs (EPADs)

1. Forward market concentrated around hub futures
   - *Covers majority of risk, keep the continuous market independent of capacity allocation, independent of bidding zone reconfiguration*
2. Basis risk covered by Z2H FTRs
   - *Most of the times covers minor part of the risk*
   - *JAO matches supply and demand for FTRs with capacity allocation*
   - *Fully equivalent to EPADs*
3. No problems with market coupling, NEMO designation, NEMO competition, MCO governance

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Existing and proposed forward market in Core region

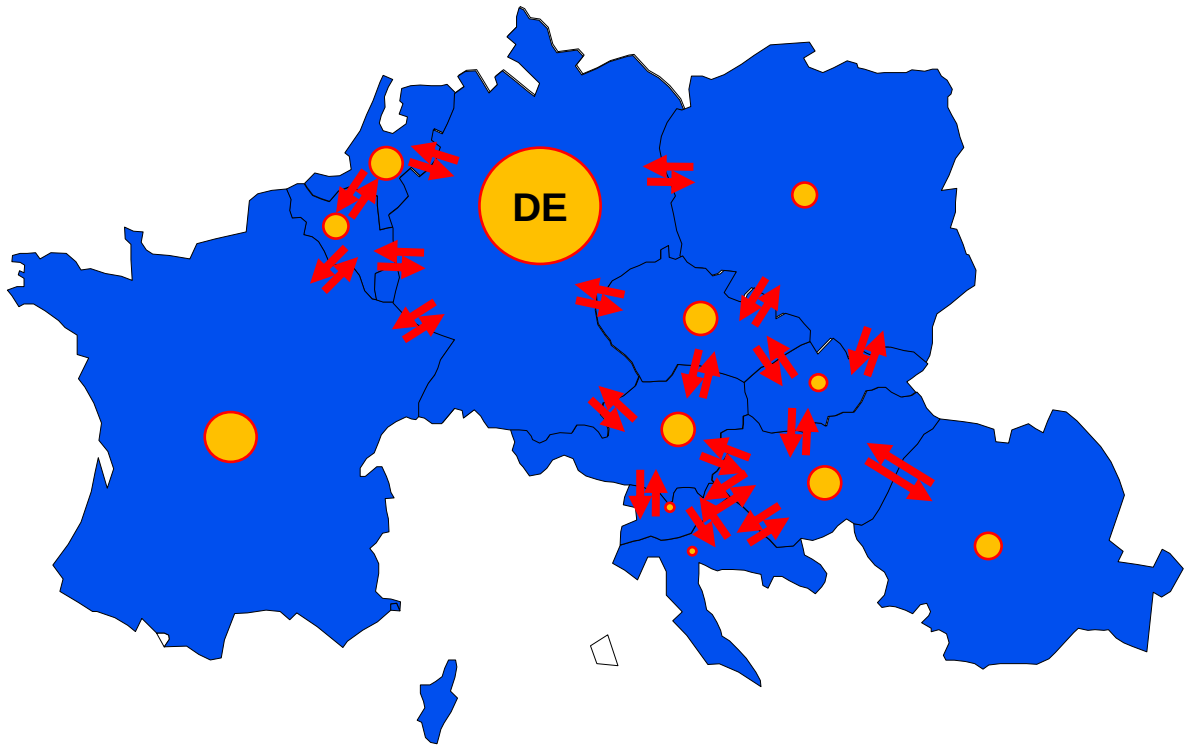
Existing design:

12 forward markets

38 cross-zonal products

→ Fragmentation

Poor liquidity



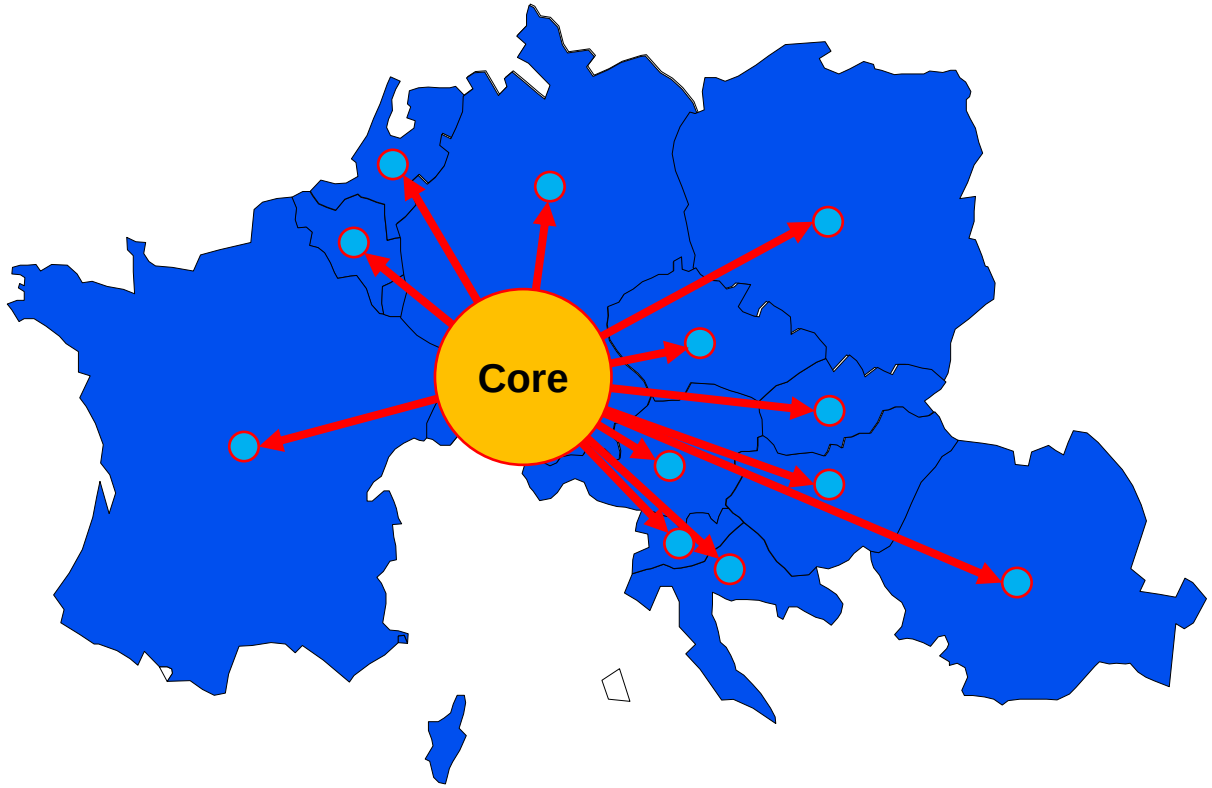
Proposed design:

1 forward market

12 cross-zonal products

→ Integration

High liquidity



Trading with Futures/Forwards

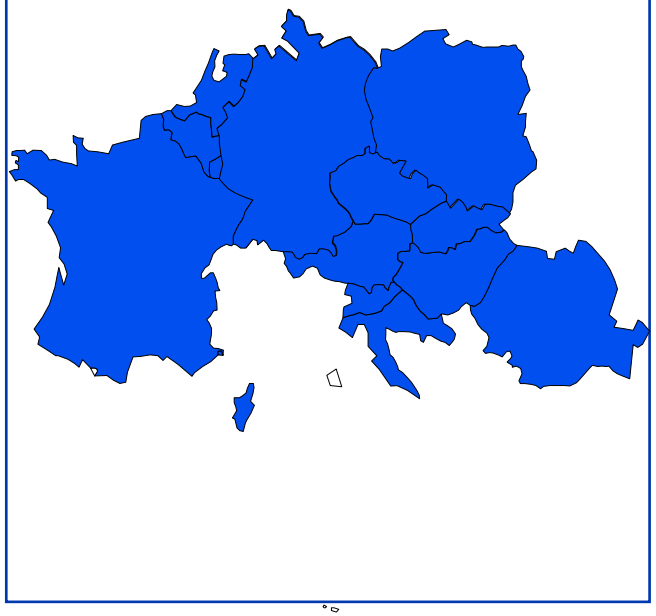
Trading with Transmission Rights

Zoom on Z2H FTRs – Hub price formation

Hub price formation

- The hub price formation would be subject to a methodology
- In the example, the hub price is computed as the volume-weighted average of the day-ahead price based on hourly volumes

Hub – Core CCR



Correlation to [%]	AT	BE	CZ	DE	FR	HR	HU	NL	PL	RO	SI	SK
Core hub 2022	96.8	95.8	97.9	98.1	92.5	94.6	94.4	95.2	71.4	89.8	94.7	94.9
DE hub 2022	93.2	95.1	97.4	100	84.5	89.6	89.8	94.9	71.9	84.6	89.7	90.9

Core hub presents better correlations for all BZs (except DE and PL) compared to DE hub

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Z2H FTRs – Hub price formation

1. The hub price formation would be subject to a methodology
   - *Proposed by TSOs, approved by NRAs/ACER*
2. As a preliminary position weighted average day-ahead price could be used
   - *Weights need to be stable, known in advance or easily forecastable (e.g. annual consumption)*
3. Only bidding zones with good network integration should be included in the hub price calculation
   - *e.g. Core and Nordic CCR*
   - *Other regions can offer Z2H FTRs towards Core/Nordic without being included in the reference price*

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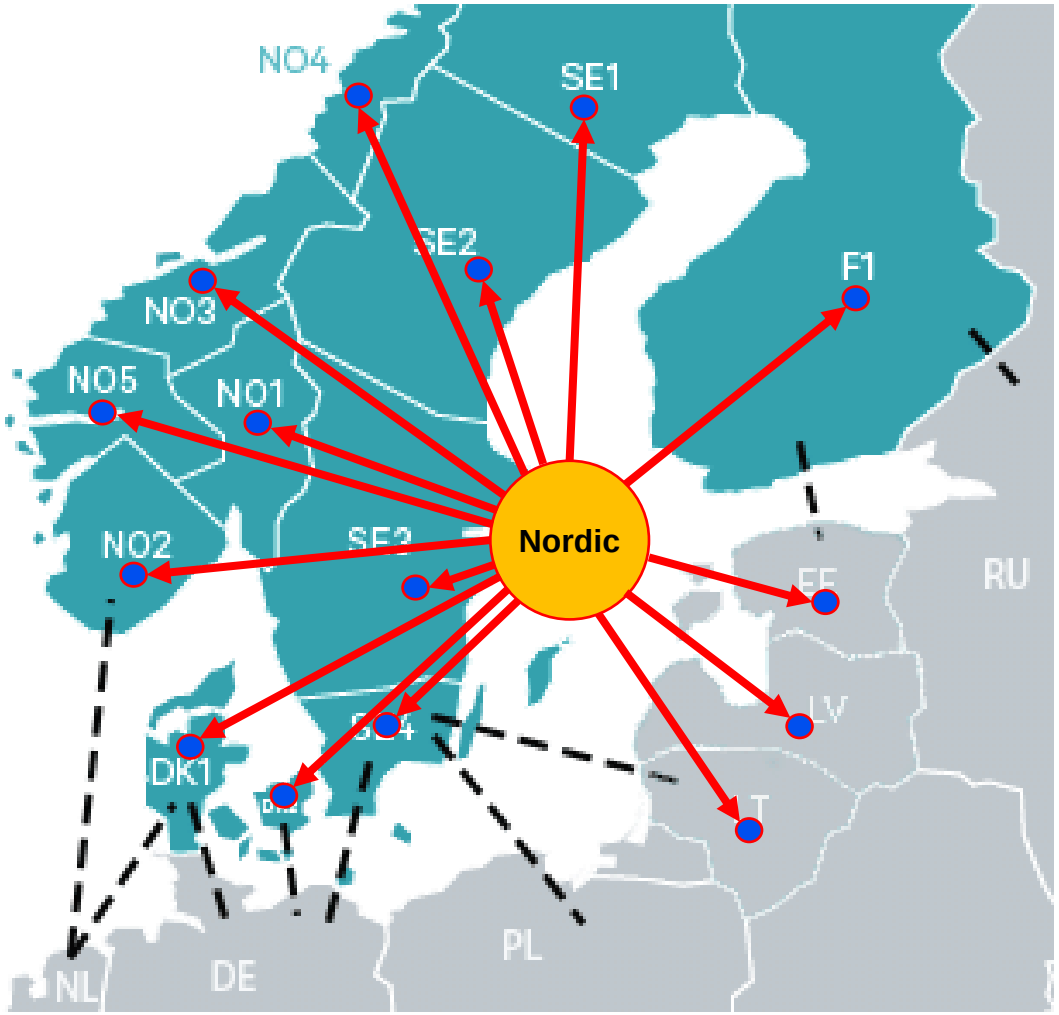
Focus on Nordic/Baltic



Nordic/Baltic hub

- *Enough supply/demand for one hub only*
- *Hub reference price does not have to include all bidding zones*
- ***Example:*** *Nordic Hub includes only highly correlated zones*
- *Z2H FTRs are offered to all Nordic/Baltic zones*
- *Balance between correlations and hub size?*

Trading with Futures

Trading with FTRs

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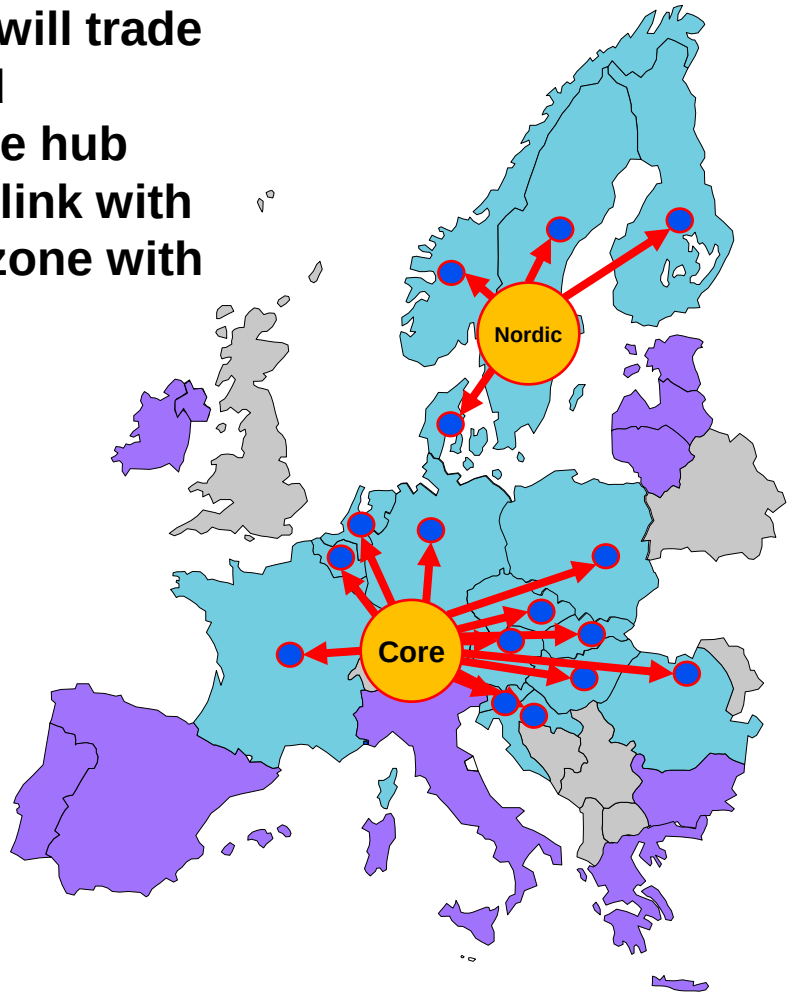
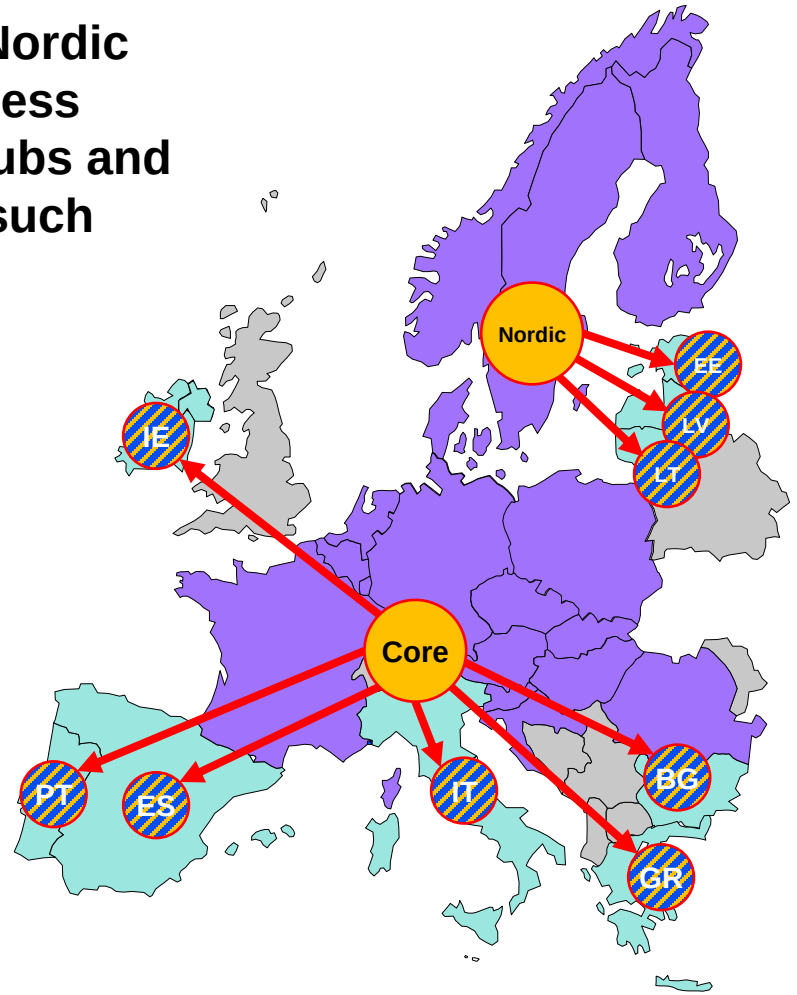
Other regions

Market participants in Core/Nordics will trade future/forward products at the hub and make the link with their bidding zone with FTRs.



Bidding zones outside Core/Nordic could also access Core/Nordic hubs and offer FTRs to such hubs.



Trading with Futures

Trading with FTRs

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Complementing proposals

1. FTR products and maturities fully equivalent to hub futures
   - *Full financial firmness, FTR obligations*
   - *Same maturities as futures (Y,Q,M) up to 3 years ahead*
2. TSOs actively adjust offered capacity to the observed correlations
   - *In times of low correlations, or high congestion costs, TSOs inject additional capacity into FTR/EPAD market*
   - *In times of high correlations, offered capacity can be reduced.*
3. JAO transfers FTR open positions to a PX of choice
   - *FTRs become EPADs and can be traded in secondary market at PXs*
4. Statistical approach to capacity calculation

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Forward market should be resilient

Given the uncertainty about future developments….

*…forward market design should be **resilient** to different preferences of MPs, future shocks, regulatory interventions, etc.*

Shocks can occur overnight, yet market design cannot be changed overnight

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Key takeaways

1. Forward market needs aggregation/pooling and cross-zonal integration/coupling
2. Forward market needs TSOs support - only TSOs can offer hedge against congestion costs (basis risk)
3. Virtual hubs + Z2H FTRs (EPADs) has important advantages over other alternative models
4. Virtual hubs + Z2H FTRs (EPADs) provides resilience to forward market
5. ACER invites Nordic TSOs/NRAs to merge/join the Swedish/Norwegian pilot projects on EPAD coupling
   - regulatory concern can be mitigated by the amount of offered capacity

Thank you.
Any questions?

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REVISION OF THE FORWARD CAPACITY ALLOCATION (FCA) REGULATION

NordREG Wholesale & Transmission Public Seminar - 30th October 2024

Jim Vilsson, Energinet

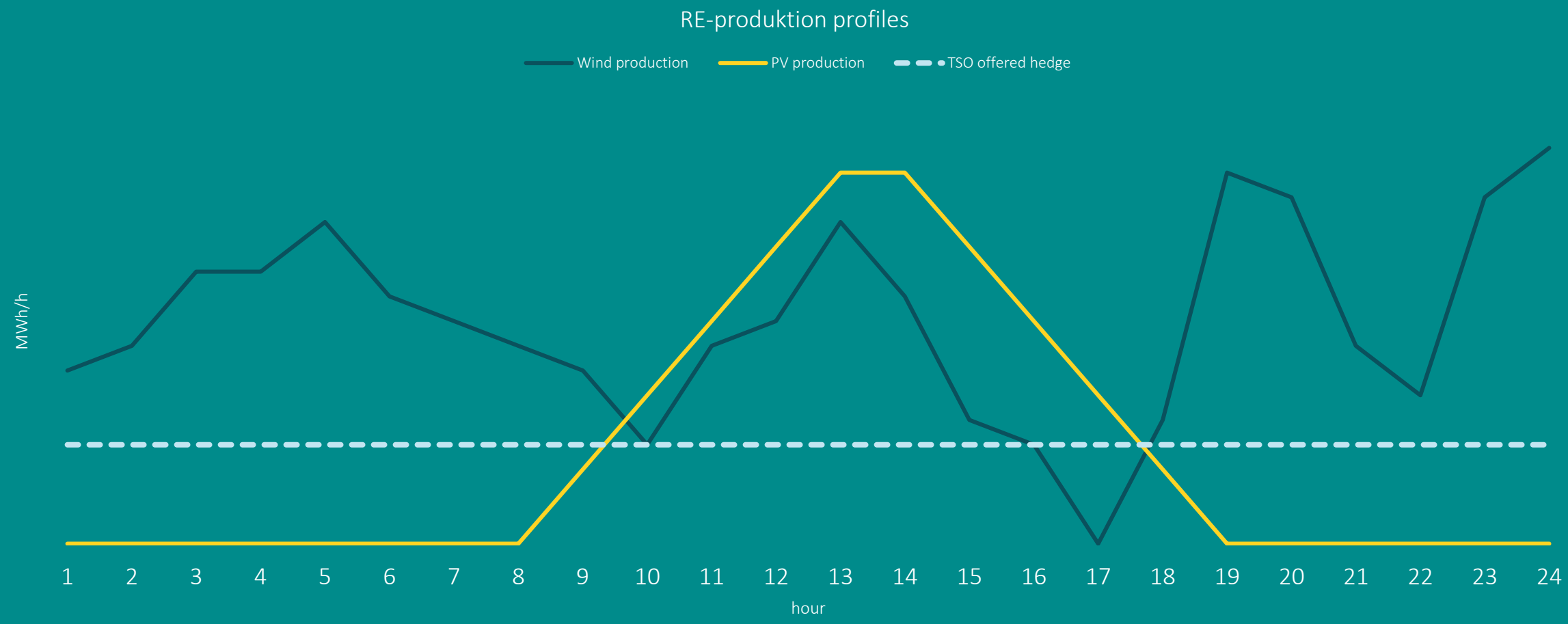
KEY PRINCIPLES FOR TSO INVOLVEMENT IN THE FORWARD MARKET

If a fundamental change to the financial power market is carried out it needs to be based on solid support from financial institutions and the following key principles

- Involvement from the TSO should be:
  - Applicable to **all renewable energy producers**, **decreasing the price risk** for these producers
  - Minimizing **TSO impact on the market**
  - Promoting **effective competition** among financial power exchanges
  - Limiting the impact on **TSOs cash collaterals, costs, credit rating, and ability to further invest in grid infrastructure**

CHALLENGE: MATCH RENEWABLE ENERGY PRODUCTION PROFILES WITH HEDGING OPPORTUNITIES PROVIDED BY TSO'S

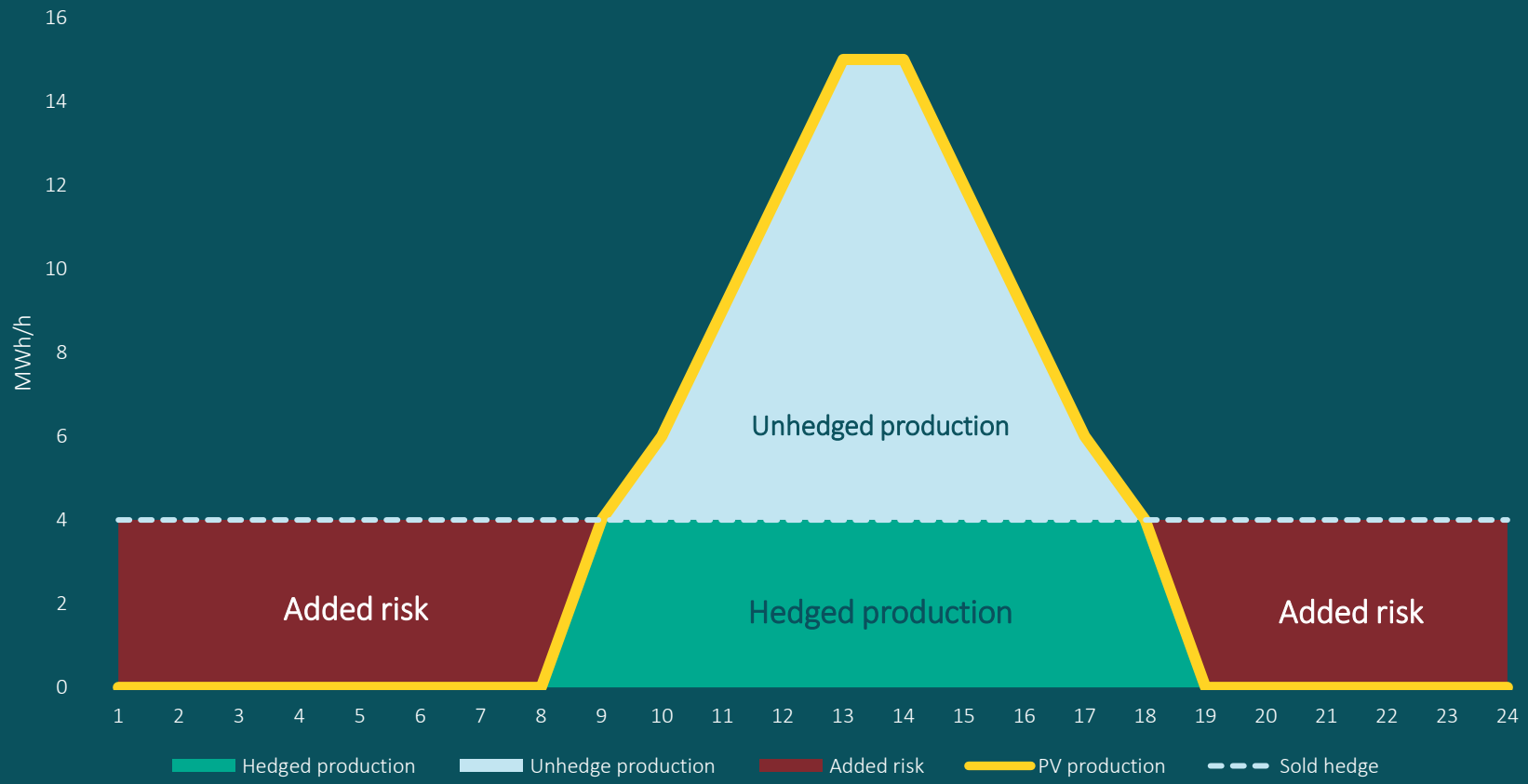
The production profiles for renewable energy sources such as wind and solar are very stochastic between MTU and day



HEDGE WITH TSO-OFFERED PRODUCTS

RE-producers with baseload hedges face issues because their production pattern is not constant, yet the hedge requires a steady electricity supply. When the sun isn't shining, they must buy power from the market, which can be costly if prices are high.

This **mismatch** between their variable production and the steady power the hedge demands can cause them to lose money, sometimes leading to default.



For this PV plant, a hedge with TSO-offered baseload will **increase the risk profile** between hour 1 and 8, and 19-24.

It will not only increase the risk for half the day, but it will also **not hedge all production** for a single hour of the day.

IMPACT ON A DIVERSIFIED MARKET

The EU financial power market is a diverse market, providing hedging opportunity for market participants.

TSO involvement in non-core TSO business should foster fair competition among the financial exchanges and the offered hedging products.

MARKET CONCENTRATION

The EU financial market is healthy with many market participants registered at the financial exchanges both in the Nordics and at EU level.

When TSO is actively taking part in non-core TSO markets, it should be at a minimum level. Otherwise, the TSO will get a dominant market position.

The Swedish Pilot (Svenska Kraftnät's auctions) have, on average, accounted for 64% of the total EPAD turnover during Q2 2024. At the same time, the EPAD turnover in continuous trading decreased for the same quarter.

CHALLENGE: INVOLVEMENT IN THE FINANCIAL MARKET CAN COME AT THE COST OF GRID EXPANSION OR HIGHER TARIFFS

- Collateral requirements for the financial power market place a significant financial burden on TSOs. In the Nordics, **collaterals amount to 300-600 million EUR**. Depending on financing possibilities, **this can come at a significant cost for the tariff-payers.**
- In addition, **full financial firmness** will increase volatility in TSO's payout to Market Participants and it can exceed congestion income. It can take many years to increase tariff to cover losses on financial derivatives.

COLLATERALS

Tariff payers incur extra costs if TSOs support the forward market, **without socioeconomic benefits**. The products are **unsuitable for hedging** solar and wind power, and TSOs **competing with commercial exchanges** have limited impact on liquidity

The collateral requirements raise **major concerns** for Energinet and most TSOs.

If such a mechanism was to be implemented, TSOs would need to assess the possibility to secure large amounts of liquidity via **credit lines**.

Such credit lines would come at a **high cost** for **TSOs** and therefore for the **tariff payers**.

Collaterals would increase **TSO debt ratio**, leading to a risk of **degraded credit rating** for some TSO's. This could reduce the possibility for TSOs to invest in the grid due to the higher CAPEX costs.

KEY PRINCIPLES FOR TSO INVOLVEMENT IN THE FORWARD MARKET

While a complete change of the financial power market may streamline offered products into TSO offered financial products, it does not fully align with the key principles

- Involvements from the TSO should be:
  - Applicable to all renewable energy producers, decreasing the price risk for these producers

    → TSO-offered baseload products can potentially add risk rather than reduce risk
  - Promoting effective competition among financial power exchanges

    → TSOs will interact at unfavourable prices, and therefore outcompete commercial financial power exchanges
  - Minimizing TSO impact on the market

    → If the TSOs get a dominant position the financial power exchanges will not compete and develop the market
  - Limiting the impact on TSOs cash collaterals, costs, credit rating, and ability to further invest in grid infrastructure

    → Financial margin calls are expensive and will likely reduce some TSOs ability to invest in grid infrastructure

FROM PHYSICAL TO FINANCIAL FIRMNESS?

In the past, TSOs were required to offer firm physical transmission capacity for production plants to hedge production, and there was a link between the hedge and the physical grid.

In today's world the hedges are no longer physical – they are financial.

As such, the need for TSO involvement no longer exists.

KEY PRINCIPLES WHERE TSOS ARE TO PARTICIPATE IN THE PURELY FINANCIAL POWER MARKET

TSO involvement in the financial power market shall align with the key principles while relying on each individual NRA to decide if TSO should be involved.

- Where NRA has decided for TSO to be involved, the measure shall :
  - Target illiquid bidding zones
  - Be implementable nationally
  - Be transparent and predictable – also on costs and tariff impact
  - Eliminate collateral and credit rating impact on TSOs

→ Simple way: Hire market makers in illiquid bidding zones if an analysis identifies baseload products are needed

NordREG Seminar

Views on Nordic Power hedging opportunities in relation to FCA revision

Mikko Mäki-Petäjä

Director, Financial Markets, Fortum

30th of October 2024

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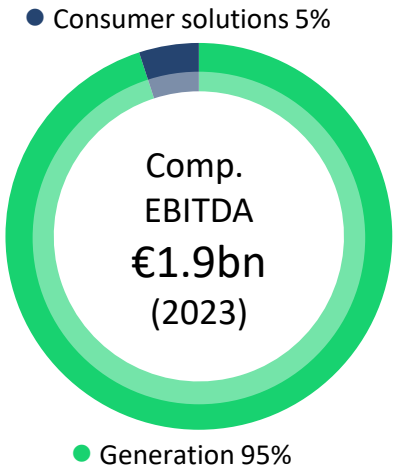
Agenda

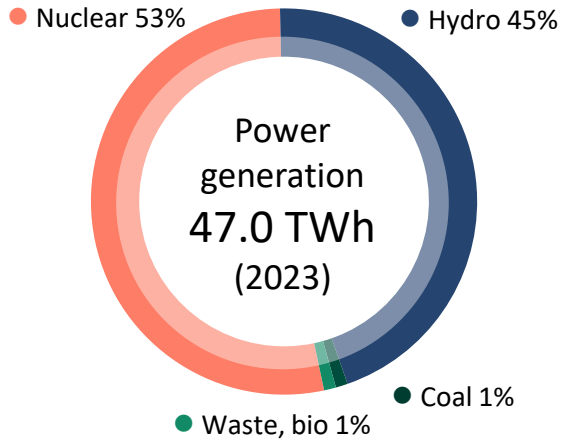
- Fortum in short
- Views on existing and new hedging instruments and markets
- Future Development topics

Fortum is well positioned as a Nordic clean energy provider

Earnings dominated by clean generation



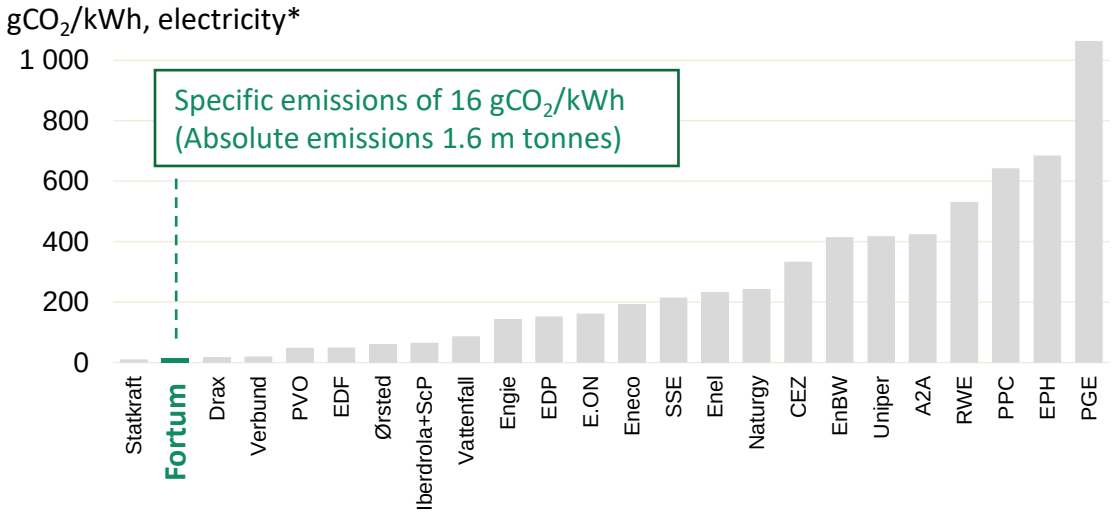
Clean power generation



Key figures (2023)		
Sales	€ bn	6.7
Comp. Op	€ bn	1.5
Comp. EPS	€/share	1.28
Total assets	€ bn	19
Personnel		5,225

Generation capacity, MW	**9,248**
Hydro	4,669
Nuclear	3,234
Wind	245
Condensing	565
CHP	535

Sustainability is part of our DNA



*) Fortum include specific carbon dioxide emissions from power generation in Europe in 2023. All other figures, except Fortum, include European power generation in 2022. For some companies the PwC figures might also include heat production.
Source: PwC, December 2023, Climate change and Electricity, Fortum

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Fortum's strategy

Our purpose is

TO POWER A WORLD WHERE PEOPLE, BUSINESSES AND NATURE THRIVE TOGETHER

STRATEGIC PRIORITIES

Deliver reliable clean energy

Drive decarbonisation in industries

Transform and develop

We help societies to reach carbon neutrality and our customers to grow and decarbonise their processes in a reliable and profitable way, in balance with nature.

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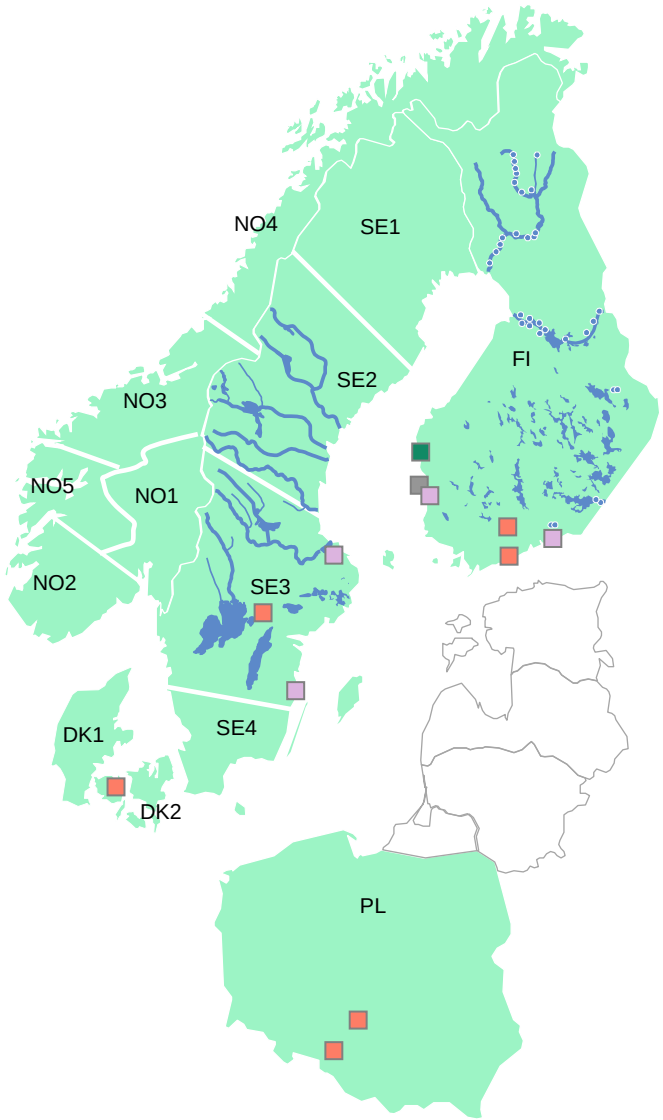
Power generation capacity of Fortum

GENERATION CAPACITY	MW
Hydro	4,669
Nuclear	3,234
Wind	245*
CHP	535
Other thermal	565
Generation capacity, MW	9,248

Figures 31 December 2023

* At the end of June 2024 wind capacity 380 MW in Finland (Pjelax)



SWEDEN, by price area	MW
SE2, Hydro	1,542
SE3, Hydro	1,558
SE3, Nuclear	1,342
SE3, CHP	6
Generation capacity	4,448

DENMARK, DK1	MW
Generation capacity, CHP	9

FINLAND	MW
Hydro	1,569
Nuclear	1,892
Wind	245*
CHP	375
Other thermal	565
Generation capacity	4,646

POLAND	MW
Generation capacity, CHP	145

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Outlook (September 2024 Investor / Analyst material)

Generation's Nordic outright (47 TWh/a):

Hedges

- For the rest of 2024: 75% hedged at 43 €/MWh
- For 2025: 60% hedged at 42 €/MWh (previously reported: 50% at 42 €/MWh)

Optimisation premium

- 6-8 €/MWh annually depending on market conditions

Tax guidance for 2024-2026:

Comparable effective income tax rate estimated to be 18-20%

Property tax in Sweden increases by € 25 million from 2025, new run-rate until and including 2030

Capital expenditure guidance:

2024: Capital expenditure, including maintenance capex of € 300 million, (excluding potential acquisitions) expected to be € ~550 million

2025 onwards: Annual maintenance capital expenditure expected to be € ~250 million (previously € ~300 million)

2024-2026: Total capital expenditure can be up to € 1,600 million (previously up to € 1,700 million)

Efficiency improvement programme:

Fortum targets to gradually reduce its annual fixed cost base by € 100 million (excluding inflation) until end of 2025 with full run rate from the beginning of 2026

Fortum expects to reduce its recurring fixed cost base by more than € 50 million by the end of 2024

Views on existing and new hedging instruments and markets

- Fortum is hedging its outright assets located mainly in 3 price areas: FI, SE3 and SE2. In addition Fortum is having e.g. fixed price retail sales flows in most of Nordic price areas
  - Exposure in price area can be hedged either with Zonal futures or System + EPAD futures or equivalent OTC products. Longer term hedging is bilateral only.
  - System price only not seen as relevant hedging instrument nowadays due to varying and relatively high basis risk over time → how to improve?
  - Large variation in hedging product market liquidity between Nordic price areas
- Any instrument increasing hedging possibilities in our main price areas will help us to reach our hedging targets in the most efficient way over tíme
  - EPAD future auctions
  - Zonal future auctions
  - Bilateral forward/swap auctions towards TSOs
  - FTR* / FTR option auctions by JAO
  - Most straighforward way for TSOs to improve liquidity is to support existing market based instruments

*value of FTR subject to available clearing/settlement structure

Views on existing and new hedging instruments and markets

- Cleared market has high importance both on price discovery and price transparency. However, bilateral OTC market needed to balance the total risk
  - Total risk – main risk classes: Market price risk vs. counterparty credit risk vs. cash liquidity risk
- TSOs to consider entering to bilateral trades with financially strong market participants with Investment Grade rating
- Swedish EPAD auctions have proven to be a decent tool to add liquidity to e.g. in SE4 and SE2:
  - Auctions helping Fortum's hedging needs especially in price areas where consumption and production not balanced
  - Even longer maturities and higher auction amounts would be beneficial for hedging purposes
  - Zonal futures could be used similarly as auction products with benefit of clearly lower initial margin requirement (EEX vs Nasdaq)
  - Bilateral settlement towards TSO as alternative for CCP clearing
  - In illiquid areas auction results tend to steer the market activity

Future Development topics

- Fortum sees as more important to support cross zonal liquidity within Sweden than between Sweden and Finland
  - Long-term best solution would be to reduce number of price areas in Sweden

- Statnets initiative to start auctioning Norwegian EPADs seen positively

- Generally Nordic Power cleared market liquidity likely to continue to be sporadic and spread over several exchanges (Nasdaq Commodities, EEX and Euronext) for a prolonged period

Future Development topics

- New EU wide governmental support mechanism (/”Central Bank for Energy Sector”) offering firm cash liquidity commitments to natural hedgers in energy sector in case of crisis situation is seen by Fortum as key enabler to improve cleared market liquidity and bring back volumes from OTC bilateral markets to CCP cleared markets

- Nordic model with system price (”HUB”) + EPADs not likely to be successful in Central Europe
  - Liquidity not likely to transfer from current main products like German Power to new virtual hub(s) as there are extensive commitments and contractual frameworks build around existing products over the time
  - Rather seen that it is important to support the existing zonal products and enable growth of their liquidity

Thank you for listening!
Questions?

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Nordic Energy Regulators
POWER THROUGH COOPERATION

- Physical participation: Please raise hand if you want to give a comment or ask a question. Please wait until you receive a microphone.
- Virtual participation: Please ask for floor in chat in case you want to give a comment or ask a question.
  - You can also ask the question directly in the chat.

Time	Topic	Presenter
10:00-10:30	Coffee and snacks	
10:30-10:40	Opening and welcome	Antti Paananen, Director, Finnish Energy Authority
Block 1: Update on regulatory processes from the NordREG task forces		
10:40-11:00	NordREG Capacity TF Update on recent development Electricity balancing - regulator update	Jori Säntti, Finnish Energy Authority Eveliina Ishii, Finnish Energy Authority
11:00-11:30	ACER-CEER Position Paper on the Challenges of the Future Electricity System	Johan Roupe, Senior Legal Adviser, Swedish Energy Markets Inspectorate
11:30-12:15	Lunch	
Block 2: Discussion on well-functioning future Nordic markets		
12:15-13:15	Flow-based capacity calculation methodology	Janne Kauppi, Senior Adviser, Finnish Energy Martin Viehhauser, Policy Officer, ACER
13:15-13:45	Capacity mechanisms	August Bech, Advisor, Green Power Denmark
13:45-14:15	Reserve and balancing markets – wind power experiences	Niko Korhonen, Expert, Fingrid
14:15-14:45	Coffee	
14:45-15:15	PICASSO and aFRR	Tuomas Mattila, Expert, Fingrid
15:15-16:30	Revision of the Forward Capacity Allocation (FCA) Regulation	Martin Viehhauser, Policy Officer, ACER Jim Vilsson, Chief Economist, and Henrik Winkler Mogensen, Senior Economist, Energinet Mikko Mäki-Petäjä, Director of Financial Markets, Fortum
16.30-16:45	Conclusion	Antti Paananen, Director, Finnish Energy Authority