

Visions on how competitive, organized, wholesale electricity markets in the future increasingly can be a key driver for efficient and secure delivery of Nordic and EU power system, energy & climate targets.

Rickard Nilsson, Senior Advisor on Market Design, Nord Pool

rickard.nilsson@nordpoolgroup.com

NordREG seminar in Copenhagen – 23rd of November 2023

Agenda:

1 – Nord Pool – who we are and what we do; and examples of how it reflects changing supply/demand fundamentals

- 2 The climate change issue and the rise of renewables
- 3 How the current European market delivers decarbonisation
- 4 Challenges ahead and what Nord Pool develops



Years Powering the Market

2023 marks 30 years since Nord Pool was founded. 30 years of powering the market.

We started solely Norway-based and called Statnett Marked.

In 1996 we pioneered cross-border power trading with a Norwegian-Swedish power exchange, establishing the Nord Pool name.

Since that world first, we have continued to shape Europe's coupled power market, providing a trusted and transparent marketplace.

We are grateful to all customers, partners and other stakeholders for their support for Nord Pool's work over the past 30 years.

Nord Pool – a HL glance

- Nord Pool offers day-ahead and intraday trading, clearing and settlement services
- More than 350 customers from 20 countries trade on Nord Pool's markets
- Operates in 16 European countries under our license and in 4 European countries as a service provider
- Nord Pool Consulting / Nord Pool Academy
- ~150 employees, 35 nationalities, offices in Oslo, Stockholm, Helsinki, London, Brussels and Tallinn







38 TWh* intraday



350 customers







Export of our expertise across the world

Nord Pool is a renowed, well known, market operator/actor/market design concept in the world. Nord Pool Consulting advises and shares its expertise with e.g. authorities, power exchanges, regulators, TSOs, ISOs, market parties, various industrial and consumer segment associations, experts and academia.

The markets we operate every single day: day-ahead and intraday

12:00 - 13:00**Day-ahead market** Based on orders and transmission capacity, prices for the Single Day Ahead **Coupling (SDAC)** are calculated simultaneously using the common European Auction-based algorithm, PCR Euphemia. Prices are calculated for each hour of the next day. Until 10:00 Until 12:00 12:00 12:45 Power transmission capacities are Buyers plan how much submitted by the transmission power they will need, system operators for each bidding and sellers how much they can provide. area in the market. 08:00 - 12:0014:00 - 15:00 Auction Prices are Buyers and sellers enter their bids Trades are invoiced closes announced and offers into the trading system. 13:00 07:00 10:00 11:00 12:00 14:00 15:00 08:00 09:00 **Intraday market** In the intraday market trading takes place every day of the year, around 14:00 - 15:00 the clock – allowing for efficient balancing of the market. Continuous trading 24 Trades are invoiced Different types of contracts open and close at various times of the day, (SIDC Continuous) with gate closure times down to 5 minutes in selected geographies. IDAs across EU+ are preliminary planned to be introduced in June 2024 **Intraday Auctions** and will consist of 3 implicit auctions per day, namely at 15 CET and 22 (SIDC IDAs) CET for all delivery periods (MTUs) of the following day, and at 10 am CET for remaining MTUs of the current day (starting from noon 12 CET).

2023 – back to more "normal" fundamentals and prices?

European Day-ahead (spot) prices January 2021 – August 2023



Spot prices (SDAC) per month 2022-2023 in a number of Nordic Bidding Zones



Spot prices (SDAC) in EUR/MWh per month 2020-2023 in number of Nordic Bidding Zones and in four nearby countries in continental Europe



Negative average spot price across the Nordics for a full day - 8th of August 2023



Spot prices and flows for hour 11-12 CET on 8th of August 2023





High SDAC price in e.g. Finland and big NTC-based CZ import & transit flows to Finland hr. 8-9, 21 NOV





In coupled markets, flows on the CZ interconnectors fluctuate based on shifting fundamentals



2023 (YTD Aug.)

NORD POOL

UK:	+ 18 TWh			
Germany:+ 9 TWh				
France:	- 27 TWh			
Nordic:	- 34 TWh			
Spain:	- 10 TWh			

Source: Paul-Frederik Back & Entso-e 2022

POOL

Agenda:

1 – Nord Pool – who we are and what we do; and examples of how it reflects changing supply/demand fundamentals

2 – The climate change issue and the rise of renewables

3 – How the current European market delivers decarbonisation

4 – Challenges ahead and what Nord Pool develops

The biggest challenge: reducing emissions

CO2 reductions require deep decarbonization, driven by electrification and 24/7 Clean Energy



The energy trilemma and the 3Ds of the energy transition

Security of supply

- Balanced energy mix
- Energy efficiency
- Integration of renewables

Competitiveness and affordability of energy

- Support to renewables
- Technological innovation
- Satisfying cost for consumers and revenues for producers

Increasing awareness on climate change

- State-led initiatives (Paris Climate Agreement)
- Corporate initiatives (RE100)
- Communities (cities, citizens)

Cleaner energy (low carbon) Optimization of natural resources

Smaller, decentralized assets Local energy production/self consumption Decentralized decision making

Innovation and breakthrough technologies Customer-centric focus New business and operating models

Why is electricity so decisive for reaching climate targets?

Electricity generation and heat production contributes around 1/3 of all CO2 emissions

Climate - Targets and challenges

- 55% reduction in GHG emissions by 2030, compared to 1990 levels
- Net zero target for 2050 carbon neutrality
- The European Green Deal set the blueprint for transformational change.

Enablers

- Electrification
- Decarbonization of electricity production (renewables, nuclear)
- Demand-side management

The rise of renewables is now clearly visible

60 GW of cheap renewables will be built in 2023 in Europe

Agenda:

1 – Nord Pool – who we are and what we do; and examples of how it reflects changing supply/demand fundamentals

- 2 The climate change issue and the rise of renewables
- 3 How the current European market delivers decarbonisation
- 4 Challenges ahead and what Nord Pool develops

How the current European market delivers decarbonization?

The merit-order and Uniform Pricing (marginal pricing) promotes carbon-free electricity production

Efficient use of interconnectors favors carbon-free generation

Intraday allows renewable assets to be managed on a 24/7 basis

Price transparency empowers consumers demand-response

The merit-order promotes carbon-free electricity production

- The merit-order plays a crucial role in decarbonising the mix
- Power plants are typically activated linked to marginal costs to meet fluctuating demand that normally is less price sensitive
- Power plants with the lowest marginal costs are typically intermittent renewables, followed by storable hydro, then by thermal power sources, whose costs vary, e.g. via fuel prices
- RES sources also hold the lowest carbon intensity ٠

ORD

Note: Only a stylistic illustration of the fundamental concept of merit-order and Uniform Pricing (marginal pricing; supply=demand), thus not an indication of relative/absolute price levels or energy volume per generation source.

PRI

Arguments for Pay as Clear (Uniform Pricing) as superior to Pay as Bid

In theory, pay-as-bid and pay-as-clear should produce similar results

- Under pay-as-clear participants are *automatically awarded* the price of the most expensive offer accepted
- Under pay-as-bid participants have the *incentive to bid* at the price of the most expensive offer accepted

However, the picture clearly illustrates that in case of a Pay As Bid setup the incentive to provide sales ("production") bids at marginal cost will not apply.

Instead, market parties with comparatively low marginal cost supply will instead have incentives to guesstimate** the marginal cost of the plants needed to reach equilibrium and then to place their orders close to that price level.

Therefore, it can be assumed that a more speculative bidding behavior, higher price volatility, and more frequent self-dispatch contrary to expected "merit order" will occur in a Pay-as-Bid based Day Ahead Implicit Auction.

Note: **Typically not hard given acquired knowledge (and historic transparency) about that costlier supply often needs to be activated to reach "supply/demand" equilibrium in the given BZ/country. It is typically also easier in smaller, concentrated, e.g. with fewer competitors, BZs/regions or in case of a limited mix of production resources and demand/storage flexibility.

Note: The illustration and the text above it is a small abstract from an OFGEM presentation, namely https://www.ofgem.gov.uk/sites/default/files/docs/2012/10/pay-as-bid-or-pay-as-clear-presentation.pdf

Key arguments that support Pay As Clear (i.e. Uniform/Marginal Pricing)

- Provides a strong incentive to reflect levelized operating costs in bid prices
- Means that electricity typically will be produced from the cheapest generation sources
- Means carbon emitting generation will only generate electricity when necessary to meet demand
- Allows part of capital costs of investments, e.g. in intermittent RES, to be recovered (which would otherwise have to come fully from subsidies or capacity mechanisms)
- Sends a signal about both where new investment would be required and for consumption adaptations
- Allows one single price to emerge from an auction
- Is transparently published, and it is easily understandable by market buyers and sellers
- Allows a better allocation of resources across the continent by connecting electricity markets across Europe, and contributes to security of supply by ensuring electricity is produced and flows to where it is most needed
- Considerable academic literature and studies support the notion of Pay As Clear being superior to Pay As Bid
 POO

NORD

2 Efficient use of interconnectors favors carbon-free generation

- Nord Pool via the SDAC and SIDC markets enables Bidding Zone level energy trading combined with implicit allocation of capacities between BZs countries on an EU+ wide basis
- This mechanism ensures that electricity is supplied from the most cost-competitive and sustainable sources to meet the demand within a BZ and between BZs via CZC
- Therefore, these markets can maximise the use of carbon free electricity within each BZ and across borders depending on e.g. weather conditions and the level of CZC made available to these open, competitive markets by TSOs
- A deficit of e.g. wind, solar or hydro power in some part of Europe can be compensated with a surplus of such or other generation in other parts of Europe provided there is CZC made available for the markets.
- Local, regional surpluses/deficits can also partially be handled via the combination of available CZC and growing levels of local and Europe-wide possibilities for demand response, storage, batteries and the wider spectre of sector coupling.

NORD

Intraday allows renewable assets to be managed on a 24/7 basis

- Intraday is a continuous market, open 24/7, enabling intermittent renewables to balance commercial position, closer to the actual delivery of electricity, just like for all other generation sources and consumption.
- It allows the market to take into account the latest available weather forecast for upcoming delivery periods (MTUs).
- At Nord Pool, we run the most stable, reliable and performant intraday system in Europe and are heavily investing in technology to fit market participants needs
- This brings confidence to market participants: they can rely on us to hedge weather, production & consumption fluctuations
- Also in Intraday, e.g. SIDC Continuous & coming Intraday Auctions, "maximized within SoS" CZC availability is key.
- In near future CZC should ideally be available until real-time, and regardless of when that is set, Intraday (Continuous & IDAs) energy trading should naturally be based on Shared Order Book (SOB) of all active NEMOs within and linked to any given country until <u>local</u> closing of Intraday.

Year-on-year cumulative traded volumes on Nord Pool intraday

Q1-2022-Q1-2023

+109% in all Nord Pool markets

+232% in Central Europe

Price transparency empowers consumers demand-response

- Nord Pool has a key role in providing transparency and provide power system and market data and price signals to a wide and diverse audience, a task we have been carrying out and developed online and via databases and distribution services (APIs etc.) since e.g. 1997
- We established the first "UMM" like reporting of e.g. grid, and power plant outages in Europe as part of our trading rulebook already back in 1997 and have evolved it all the way to current facilitation of reporting mechanisms for market parties according to REMIT Transparency
- The market empowers consumers to drive behavioural changes and help them optimise their consumption
- Digitalisation and technology make it possible: smart meters, smart devices receive live data directly from Nord Pool, for monitoring and active load management

NORD

Agenda:

1 – Nord Pool – who we are and what we do; and examples of how it reflects changing supply/demand fundamentals

- 2 The climate change issue and the rise of renewables
- 3 How the current European market delivers decarbonisation
- 4 Challenges ahead and what Nord Pool develops

"Geopolitics...": The market should be "protected" against short-term emergency interventions (2022-) with negative, also long-term lasting, effects

- The efficient supply/demand price signals should be protected
- Market intervention ahead of the price signal can put security of supply at risk and deepen the crisis – every hour of the day the SDAC & SIDC markets help to provide a planned balance of generation and consumption, and efficient CZ capacity utilization, across EU 27 and Norway
- The surging power prices witnessed in 2022 points to clear underlying root causes, e.g.:
 - > Overall energy supply shortage
 - > Soaring gas prices
 - The green transition (phasing out stable/flexible baseloads and replacing it with intermittent RES this is one key reason for "current" price volatility while also key for decarbonization)
 - > Europe, not least Germany, has to become energy independent from Russia
 - > Limited CZ TSO transmission capacity and still fairly inflexible demand side
- It has never been more profitable to invest in new renewable production, and policy makers should therefore focus to legislate <u>predictable</u> and stable frameworks that both attracts investments at scale and locations where needed, and which reduces project lead times
- Ideally the short-term emergency interventions should <u>not</u> be mixed with long-term proposals on wholesale market re-design (e.g. EMD), which rather should focus on enhancing the ability for <u>markets</u> to efficiently deliver EU CEP & Fit-For-55 targets

Offshore RES – examples of massive plans – how to integrate via OBZ and/or HM setup in organized mainland coupled markets?

3.3.1 Maritime capacity zones and capacity maps

In order to structure grid planning and management of the large number of connection cases in this context, Svenska kraftnät has divided the three maritime spatial plans into nine *maritime capacity zones* in accordance with Figure 1.

- > The North Sea maritime spatial plan is divided into two maritime capacity zones; (1) northern North Sea and (2) the Kattegat.
- > The Baltic Sea maritime spatial plan is divided into five maritime capacity zones; (3) the southwestern Baltic Sea, (4) the southeastern Baltic Sea, (5) the central Baltic Sea 1, (6) the central Baltic Sea 2 and (7) the northern Baltic Sea.
- > The Gulf of Bothnia maritime spatial plan is divided into two maritime capacity zones (8) the Bothnian Sea and (9) the Gulf of Bothnia.

Figure 1. Maritime capacity zones.

Challenges ahead and what Nord Pool develops

We develop solutions to answer energy transition challenges: 3 examples

Integration of distributed generation

Flexibility and network constraints

Traceability of green power for consumers

- The electricity system is moving to decentralisation
- Active management of EV charging, heat pumps, storage and other smart devices is key to the energy transition and made possible thanks to digitalisation
- Nord Pool has a goal is to lower entrance barriers in electricity trading to e.g. enable more distributed sources of flexibility to access the market. Our rules allow for it.
- We also partner with start-ups: e.g. **Equigy** "the crowd balancing platform"
- In a project called Flexiswitch, we enable distributed assets and aggregators to seamlessly access wholesale markets, TSO balancing markets and local flexibility markets

	SCALE	Residential	Commercial	Large-scale/industrial
EXIBILITY SOURCES	Generation	Solar PV Micro-CHP	Medium-size CHP On-site generators Building-integrated P	Centralized power plants (gas CCGT, pumped hydro) / Industrial CHP Renewables curtailment
	Storage	Electric vehicles Home batteries	Batteries	Pumped hydropower Grid-based battery storage Large-scale mechanical storage
2	Demand- response	Electric vehicles Electric heating/ cooling (warm water boilers)	Smart buildings Heating/cooling installations	Manufacturing installations Steam/heat generators
		Procurers	Platform Market facilitator Generation asset	Providers

Flexibility and network constraints

- Massive amount of variable renewable generation can create issues to electricity networks
- Stability and commandability becomes challenging to Transmission System Operators and Distribution System Operators whose role are to develop and maintain the grid and balance power on the network
- One Network for Europe is an EU funded project from Programme Horizon 2020
- With this project, Nord Pool enables TSOs and DSOs to purchase their flexibility needs using its state-of-the-art intraday platform

Traceability of green power for consumers

- Purchasing green electricity from a supplier is becoming more and more popular
- Increasing trust in a traceability system is key to ensure that consumers are certain to be provided with clean energy on a 24/7 basis
- Nord Pool is a signatory member of the United Nation 24 CFE (Carbon Free Energy) Compact and a member of Energytag, which are organisations promoting clean energy anytime, anywhere
- We partner with a start-up **Granular energy** to advocate for a more granular and transparent clear energy certificates market by incorporating timestamped energy certificates

whitepaper-may-2023.pdf (nordpoolgroup.com)

• We also run a UK pilot with granular energy to launch a granular certificate exchange

THANKS FOR YOUR ATTENTION

ANY QUESTIONS?

Contact for follow-up questions and discussions:

Rickard Nilsson, Senior Advisor on Market Design, Nord Pool rickard.nilsson@nordpoolgroup.com