FOR report on

Study Tour to Brussels and Oslo on

BESS
and
Financial Derivatives

June 10-19, 2022

1. Background:

1.1 The Forum of Regulators (FOR) in its 78th meeting held at Kolkata, West Bengal from 3rd to 5th March 2022 had accorded its approval to a proposal received from USAID, under its new South Asia Regional energy partnership (SAREP) Program, wherein a study tour was proposed to be conducted on Financial Derivatives and Battery Energy Storage System to Brussels and Oslo during 10th-19th June, 2022 for Chairpersons of State Electricity Regulatory Commissions.

1.2 This study tour was organized by United States Energy Association (USEA) as a part of USAID's bilateral program with the Government of India, SAREP in partnership with USAID/Washington's Energy Utility Partnership Program (EUPP).

2. Objective:

The objective of the study tour was

- to provide Indian regulators insights on the regulatory environment, strategies, and uses of financial derivatives in energy markets.
- to gain knowledge of battery energy storage system (BESS) for grid applications, specifically through policy frameworks from international best practices intended to enable R&D and utilization, current economic viability of battery technology, uses and benefits of BESS for renewable energy integration and efficient grid operation.

3. Participants:

The following Chairpersons of SERCs/JERCs participated in the study:

(1) Mr. Muthuswamy Chandrasekhar, Chairman, Tamil Nadu Electricity Regulatory Commission
(2) Justice Chintala Venkata Nagarjuna Reddy, Chairman, Andhra Pradesh Electricity Regulatory Commission
(3) Mr. Kumar Sanjay Krishna, Chairman, Assam Electricity Regulatory Commission
(4) Mr. Viswajeet Khanna, Chairman, Punjab State Electricity Regulatory Commission.
(5) Mr. Shishir Sinha, Chairman, Bihar Electricity Regulatory Commission.
(6) Dr. Badri Narayan Sharma, Chairman, Rajasthan Electricity Regulatory Commission
(7) Justice Shabihul Hasnain, Chairman, Delhi Electricity Regulatory Commission
(8) Mr. Anil Gopishanker Mukim, Chairman, Gujrat Electricity Regulatory Commission
(9) Er. Khose Sale, Chairman, Nagaland Electricity Regulatory Commission.

(10) Mr. Kharag Bahadur Kunwar, Chairman, Sikkim State Electricity Regulatory Commission

(11) Mr. Dinesh Prasad Gairola, In-charge Chairperson , Uttarakhand Electricity Regulatory Commission.

4. Schedule:

The study tour was conducted between 10th-19th June, 2022 in Brussels and Oslo. The details are as under :

4.1 BRUSSELS

13th June 2022, Monday

A site visit was conducted to Mobility, Logistics and Automotive Technology (MOBI) Battery Innovation Centre. The APX Group narrated about Power Exchange and its various products which included:

- Introduction to power market at national level
- Access and various power market regulation including role of regulatory agencies in structuring and monitoring power exchanges
- Spot market
- Other products in electricity market
- Electricity market operations, managing energy markets and power trading strategies and pricing mechanisms
- Basic concept of clearing corporation

14th June 2022, Tuesday:

The Delegation was given a presentation by Council of European Energy Regulators (CEER) on the following :

- European market infrastructure regulation (EMIR)
- Over-the-counter derivatives
- Central clearing counterparties (CCPs)
- Market transparency
- Risk mitigation techniques.

Thereafter, European Power Exchange (EPEX) made a presentation on

- Power trading on spot and derivatives markets and the regulatory framework.

4.2 OSLO

15th June, 2022, Wednesday

Norwegian Water Resources and Energy Directorate gave a presentation on

- Regulation of Norwegian power market
- Governance of BESS in Norway

By ***Ove Flataker***

Meeting with FREYR Battery

Speaker: Zukui Hu

- Overview of FREYR Battery & showcase of ESS products
- Latest advances in energy storage system manufacturing and technology
- Sustainability
    - Alignment with UN SDGs
    - Sustainable technology
    - Supply chain and logistics
    - Clean energy supply
    - Social responsibility

16th June, 2022, Thursday

A visit to the Nord Pool with a presentation as below –

The Nord Pool Power Market Model

Speaker: HaakonReiersenLeknes – Nord Pool Academy

• The basics about the energy markets and its importance
• Development of the world's first international energy market

European Day-Ahead Markets – SDAC part 1

Speakers: Hilde Rosenblad and IsidoraMicic – Nord Pool

• The integration of Europe's power markets with one algorithm, Euphemia
• Detailing European day-ahead markets: PCR, MRC, SDAC (Elspot), system price, bidding areas, price areas, transmission allocation, transparency, market data, simple and advanced models and much more.

Flexibility Markets

Speaker: Robert Gehrcke – Nord Pool Consulting

• A EU Horizon 2020 project to ensure reliable grid operation with increased variable renewable energy (VRE) by developing advanced mathematical models and algorithms

17th June, 2022, Friday

A visit to the Nord Pool wherein the following was covered

- Financial and regulatory aspects of the power market

  Speaker: HaakonReiersenLeknes – Nord Pool Academy

- Market Surveillance at Nord Pool
  Speaker: **Jon RokneBolkesjø – Nord Pool**
- Introduction to REMIT, the role of Market Surveillance, national regulators and ACER and inside information versus transparency information. Introduction to Urgent Market Messages (UMM) system

- Green Finance: Voluntary and Mandatory Markets
  Speaker: Trine Braathen – World Kinect Energy Services

  - Covering the major green markets and products, ranging from the world's largest carbon market (EU ETS), guarantees of origin (GO) and carbon offsets to feed in tariffs and the Elcert-market (Sweden-Norway)

- Site Visit to the Battery Storage Facility or Wind Farm (TBC)

5. Learnings from the presentations

The study tour has brought significant learnings for the participants. The deliberations with the experts from two largest power exchanges i.e. EPEX Spot and Nordpool along with physical visit to some of the facilities including battery manufacturer and wind farm has not only helped the participants develop a deeper understanding of the working of physical and financial markets in European context but also provided insights into some of key issues currently being faced in the Indian power sector viz. role of electricity derivatives, RE integration, grid stability, carbon market, battery technology etc

Some of the specific learnings from the study tour are summarized below:

1. Evolution of Power Market in Europe and various policy & regulatory reforms undertaken by the EU nations at various stages of development
2. Different Products in electricity physical and financial market and how these are utilized by the market participants to meet their requirements and hedge their risks due to uncertainty in the market
3. Functioning of the electricity spot and derivatives market viz. bidding, market integration, pricing methodologies, transmission corridor allocation, clearing & settlement of transactions etc.
4. Regulatory framework and institutional mechanism followed for bringing efficiency and transparency in the market. As a part of this different regulations and market monitoring mechanism and risk mitigation measures were discussed
5. Measures undertaken for reliable grid operations with increasing RE penetration. As a part of this the different balancing mechanism followed by the TSOs were discussed very pertinent to the Indian context as market based ancillary services is being considered in the country
6. Advancements in the Battery Energy Storage Systems and its implications on RE integration and operation of electricity market. Visit to FREYR battery provided insights into the development taking place in battery technology and how this can be useful for RE integration.
7. Major green markets and products ranging from the world's largest EU Emission Trading System (ETS), guarantees of origin and carbon offsets to feed in Tariff and Elcert market in Sweden & Norway.

Copies of presentations made during the visit are enclosed as **Annexure I**.

6. Feedback of Participants:

Important feedback given by the participants at theend of the study tour are given below:

 I*n general the program is useful. Gave an insight into power markets, financial derivative, trading platforms operating in developing countries and power systems of Nordpoolcountries*
.

 Such study tour will be more effective and beneficial if site visits are included along with the classes
 Meeting may break into site visits preferably RE Plants, Hydro, Solar and wind.
 A field visit to hydro power project would be useful to understand issues involved. A visit to Electrolyzer manufacturing plant may be included in future study tours.
 Nordpool and NVE visits are educative and informative.
 The program was well coordinated and useful one

Individual feedback of the participants areattached with this report, as **Annexure II**.

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Nord Pool Academy

We provide high quality **certified competence building** to a global audience

- **Standardised Certified Courses** with online material and interactive streamed presentations by leading experts:
  - The Physical and Financial Power Markets Course
  - Nord Pool Certified Compliance Course (REMIT)
  - Nord Pool Certified Day-Ahead Trader Course
  - Nord Pool Certified Intraday Trader Course
- **Digital Diploma** for all who pass course test
- **Tailor made study tours** with presentations, online course material and relevant site visits across Europe

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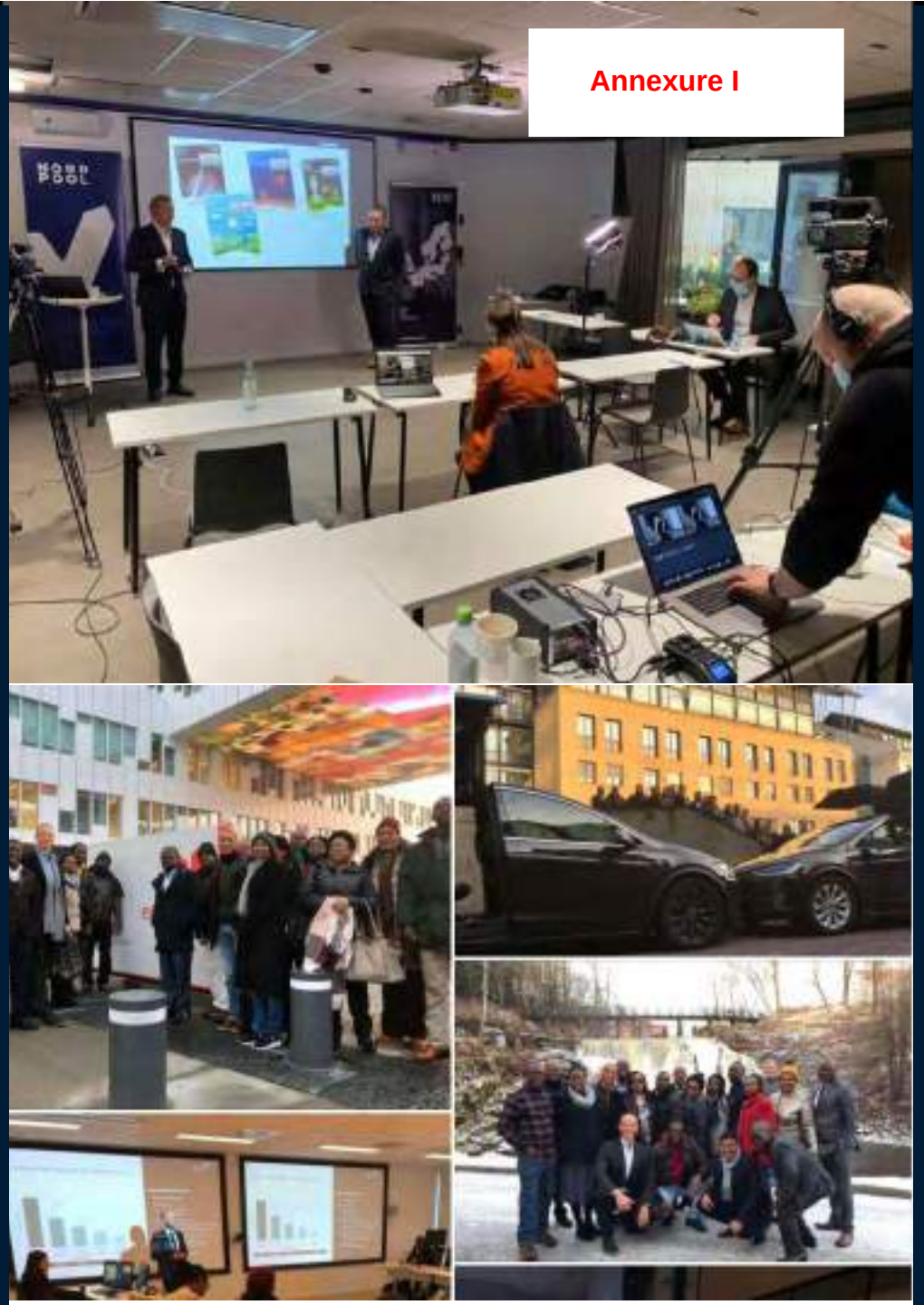
Annexure I




The Physical & Financial
Power Markets Course
NORD POOL | Academy
NORD POOL

The Physical & Financial Power Markets Course

NORD POOL | Academy

DECARBONIZATION

Cleaner energy
Low carbon and low marginal cost
Optimization of natural resources

DECENTRALIZATION

Smaller, decentralized assets
Local energy production and Prosumers
Decentralized decision making

DIGITALIZATION

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

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Who are you, the participants 15. and 16. June 2022?

- **Students (PhD, MSc, postdoc)**
- **Journalist** and information providers
- **Energy Regulatory Authorities**
- **Transmission System Operators**
- **CEO and president**
- **Head/Manager of:**
  - **Energy trading**
  - **Business development**
  - **Compliance**
  - **Risk**
  - **Transactions**
  - **Investments**
- **Software engineers; QA engineer; software developer**
- **Sales and marketing**
- **Business controller; accountant**
- **Senior commercial advisor**
- **Production planners, analyst and senior power trader**
- **Parliamentarians, their advisers and lobbyist**

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- **From >20 countries and 4 continents**
- **70 % Engineers**
- **20 % Economist**
- **10 % humanities and autodidact**
- **30 % Female (P & F : 35 %!)**
- **> 80 % are interested in attending a Post Pandemic Power Party with networking opportunities, site visits and TED-style presentations**

Online material and test of knowledge

- « Need some NETWORKING
- Visit a Power Plant, CCS Waste-to-energy plant, Hydrogen company, battery company
- TED style energy presentations
- EV and electrical boats or other aspects of electrification, flexibility markets.
- Visit a power plant
- Meet people in renewable energy industry »

«Post Pandemic Power Party»

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Cocktail for clean energy

Clean and **c**old ingrediencies

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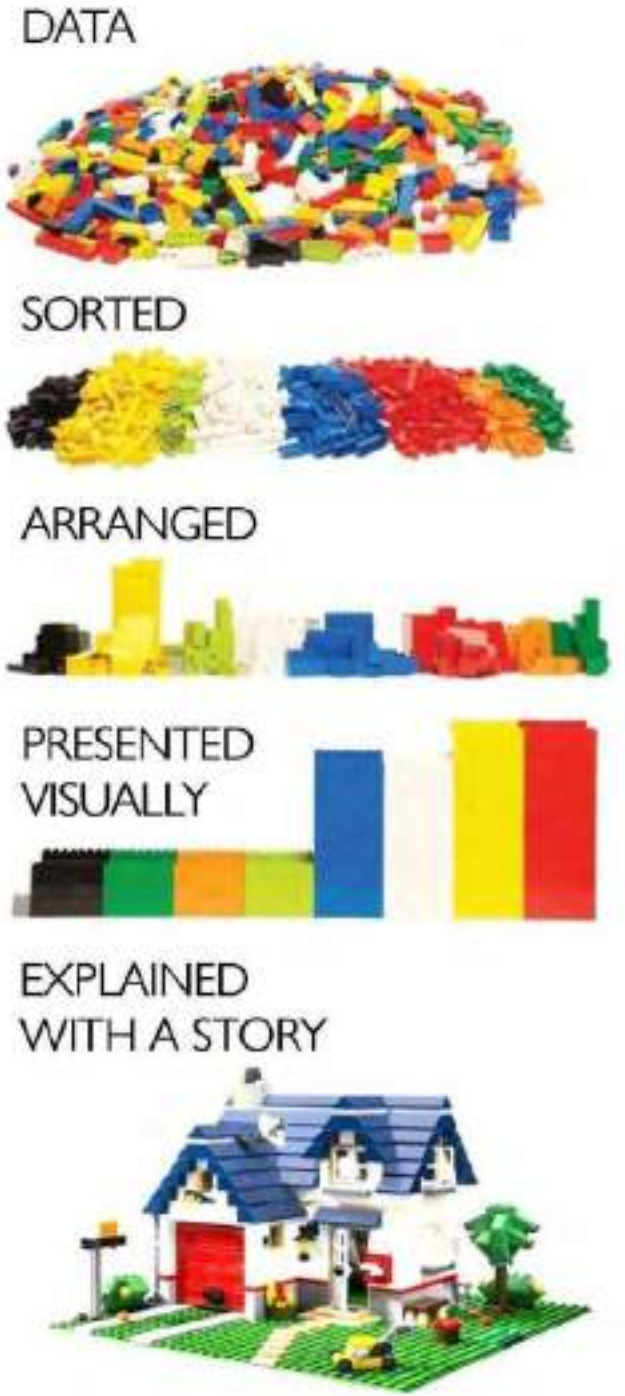
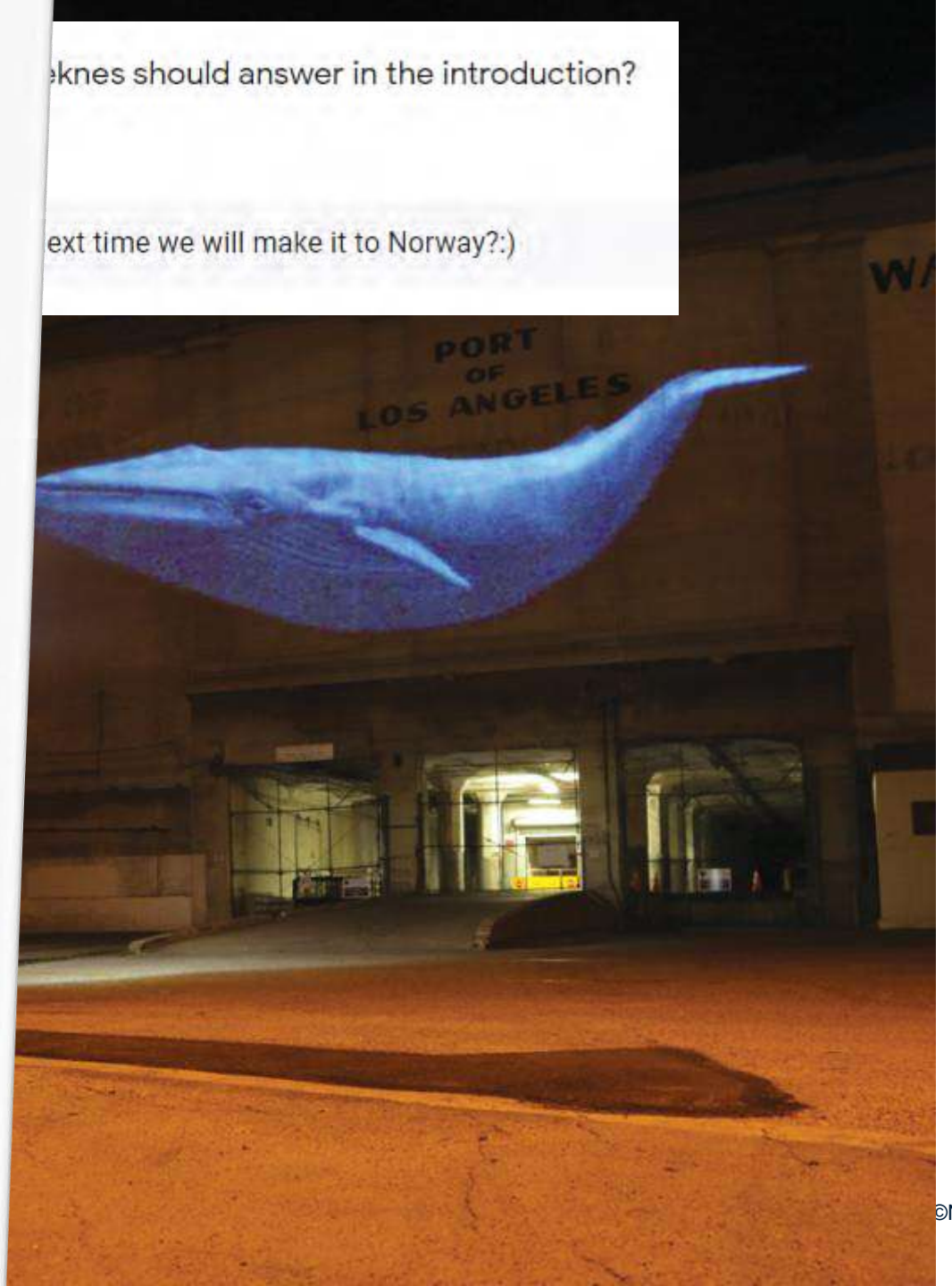


eknes should answer in the introduction?

ext time we will make it to Norway?:)



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Physical and Financial Power Markets

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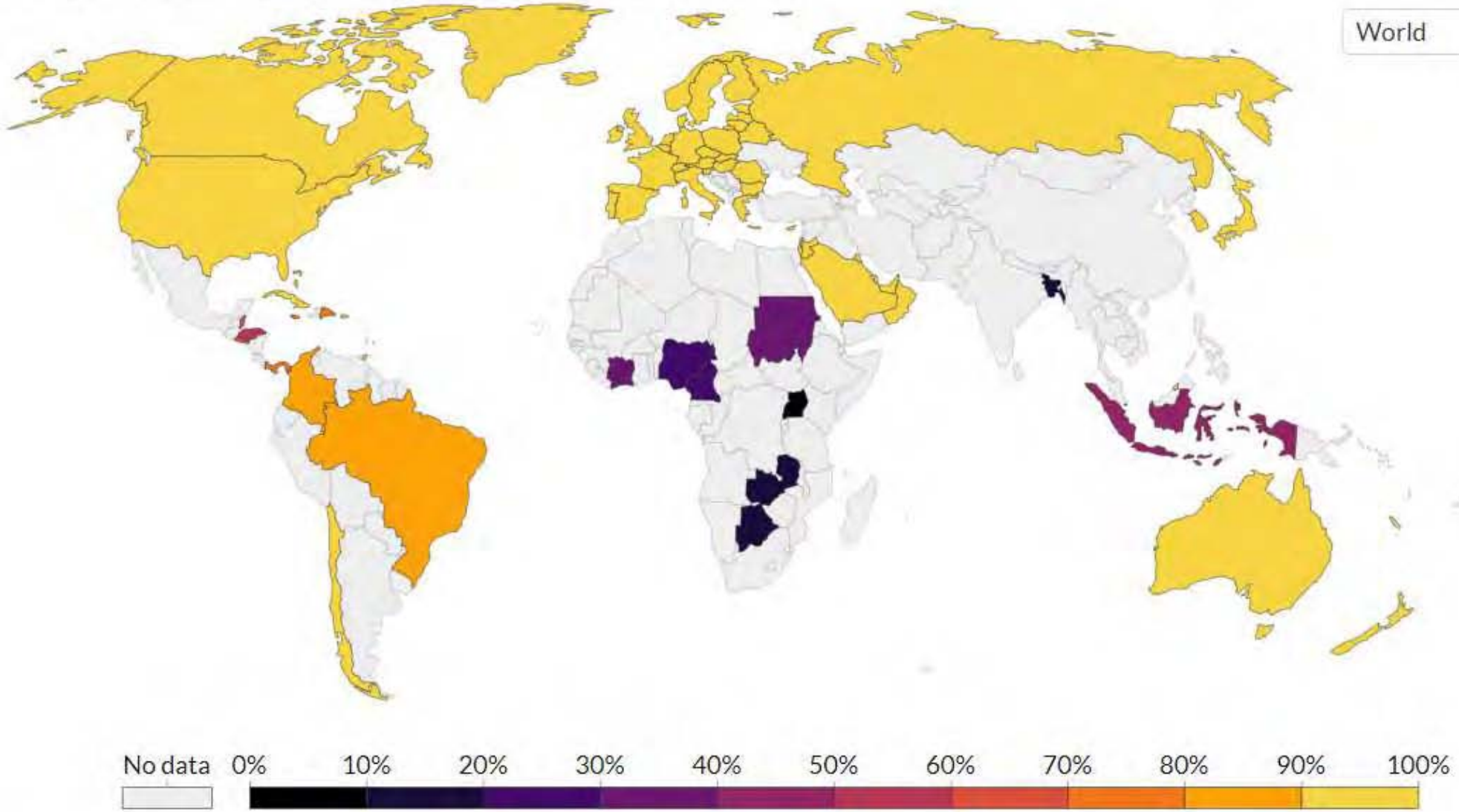
Electricity access, 1990

Our World in Data

Share of the population with access to electricity. The definition used in international statistics adopts a very low cutoff for what it means to 'have access to electricity'. It is defined as having an electricity source that can provide very basic lighting, and charge a phone or power a radio for 4 hours per day.



Source: World Bank

OurWorldInData.org/energy • CC BY

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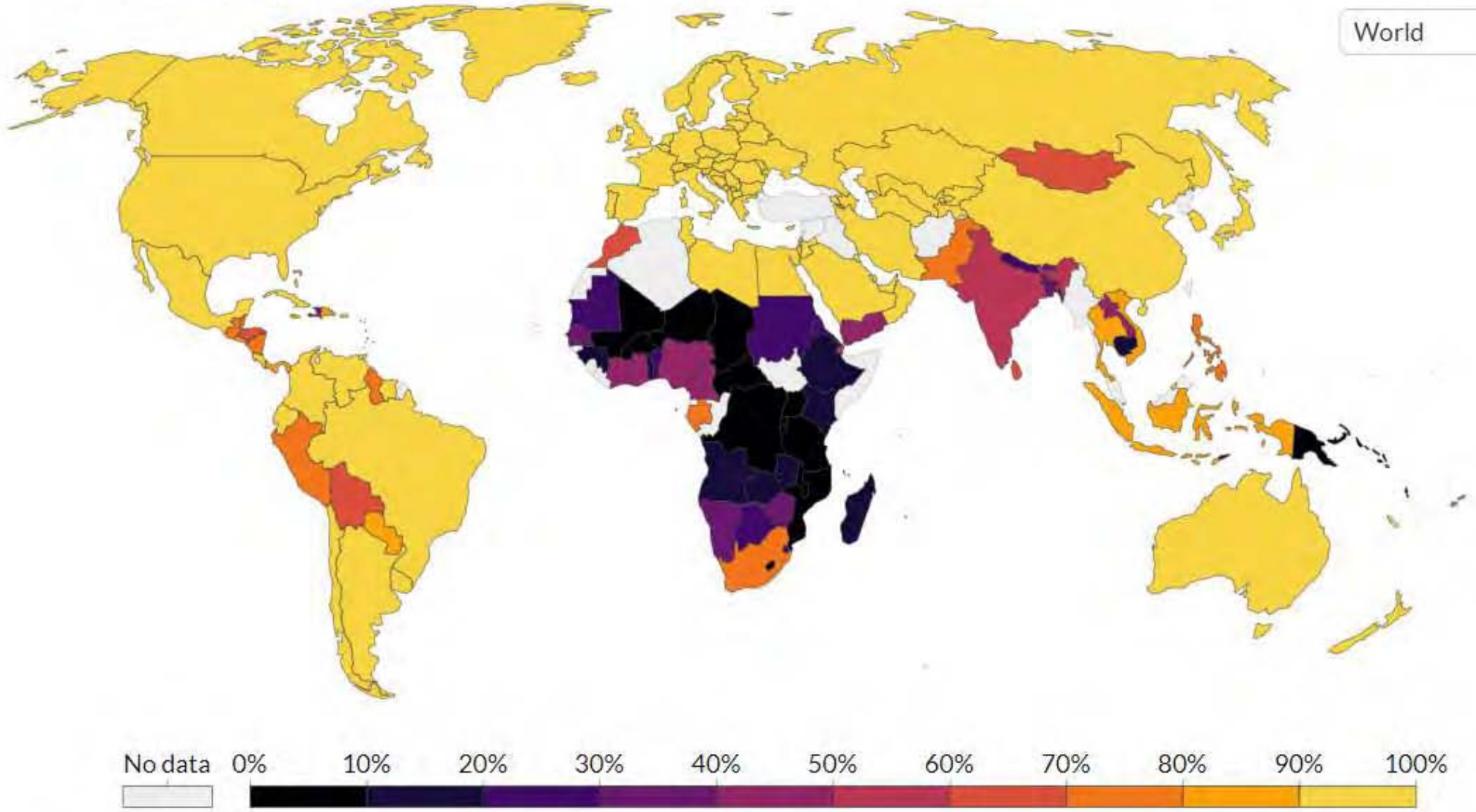
Electricity access, 2000

Share of the population with access to electricity. The definition used in international statistics adopts a very low cutoff for what it means to 'have access to electricity'. It is defined as having an electricity source that can provide very basic lighting, and charge a phone or power a radio for 4 hours per day.

Our World in Data



Source: World Bank

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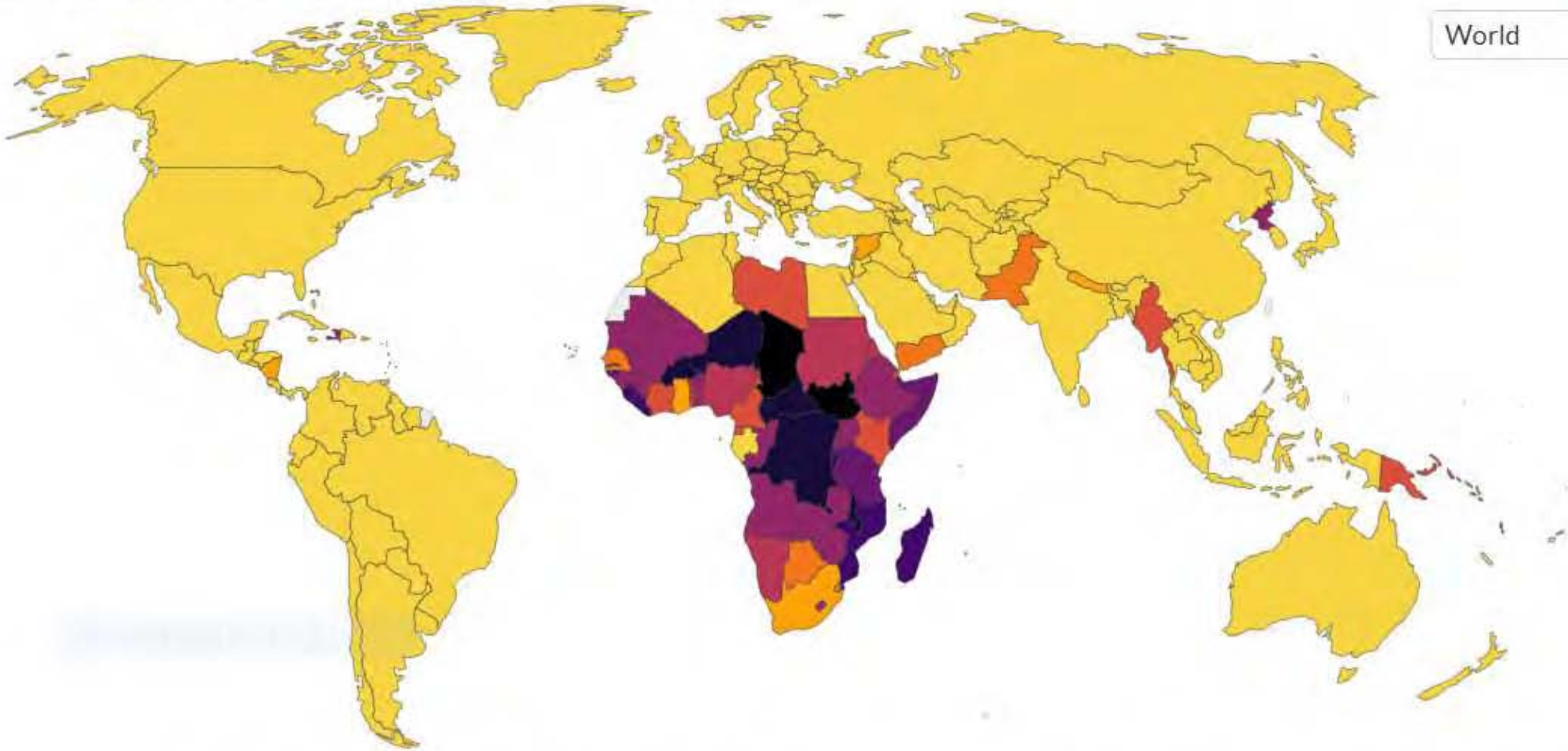
Electricity access, 2019

Share of the population with access to electricity. The definition used in international statistics adopts a very low cutoff for what it means to 'have access to electricity'. It is defined as having an electricity source that can provide very basic lighting, and charge a phone or power a radio for 4 hours per day.

Our World in Data



Source: World Bank

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DATA

SORTED

ARRANGED

PRESENTED VISUALLY

EXPLAINED WITH A STORY

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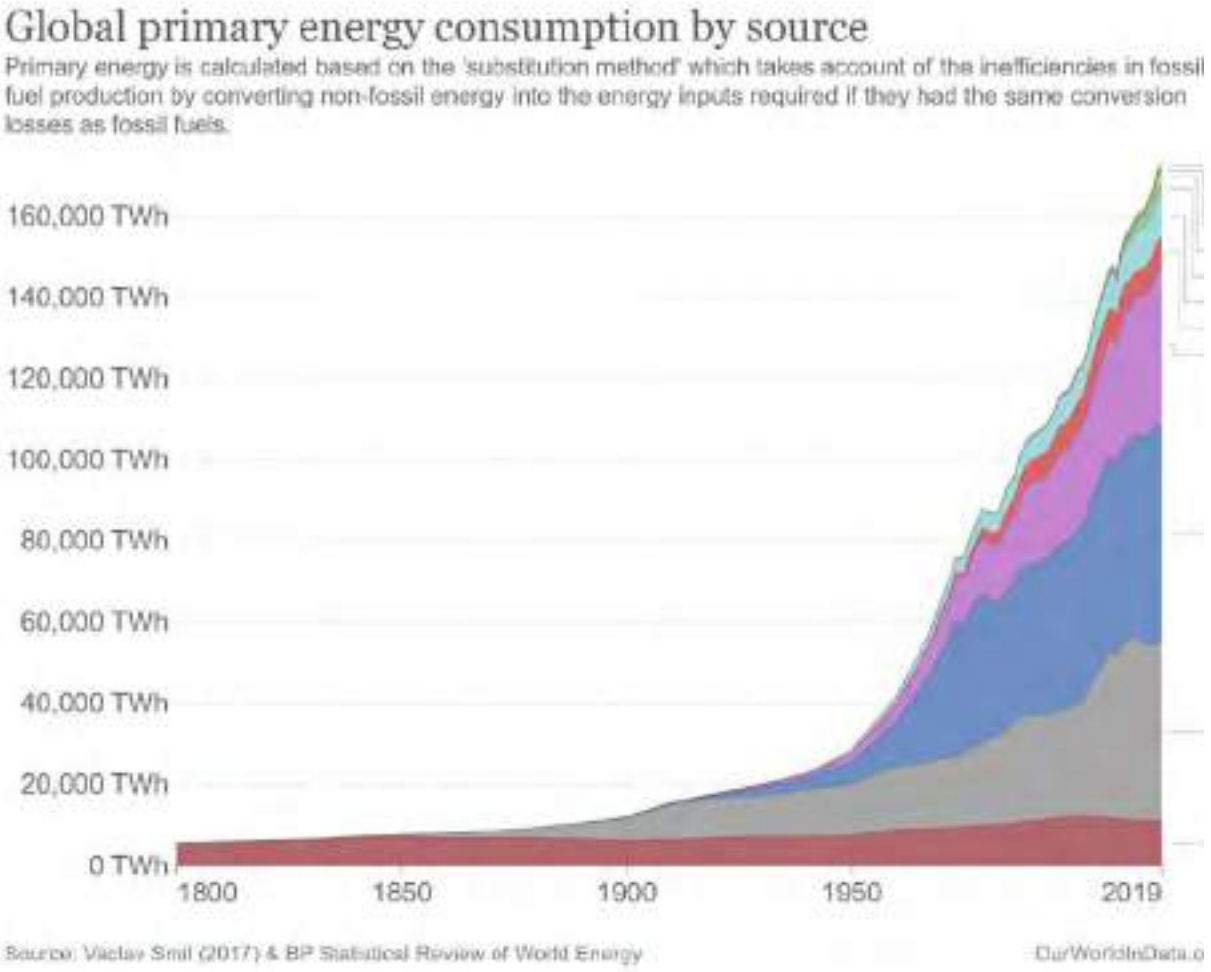
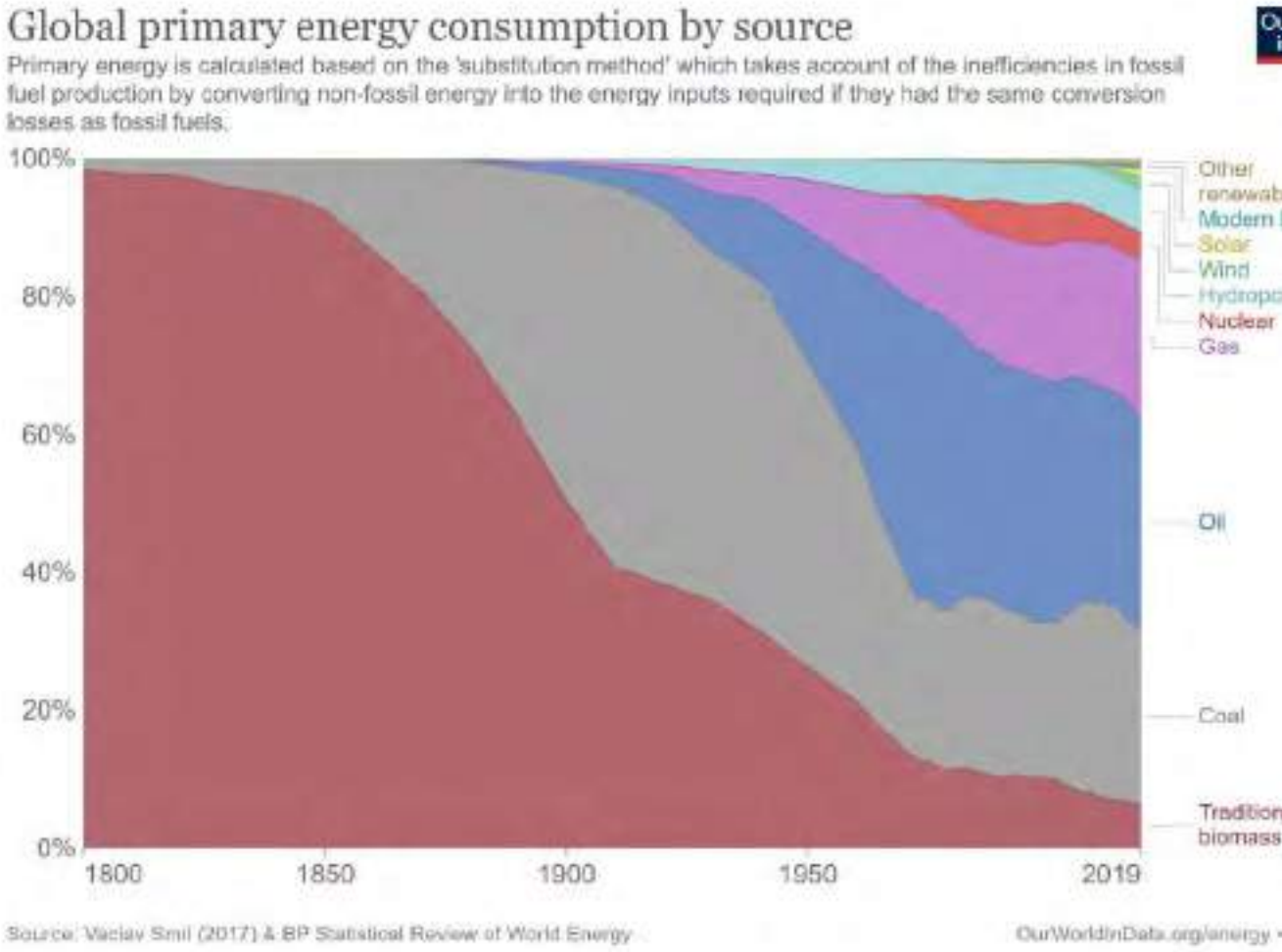
Consumption of energy by source past 200 years





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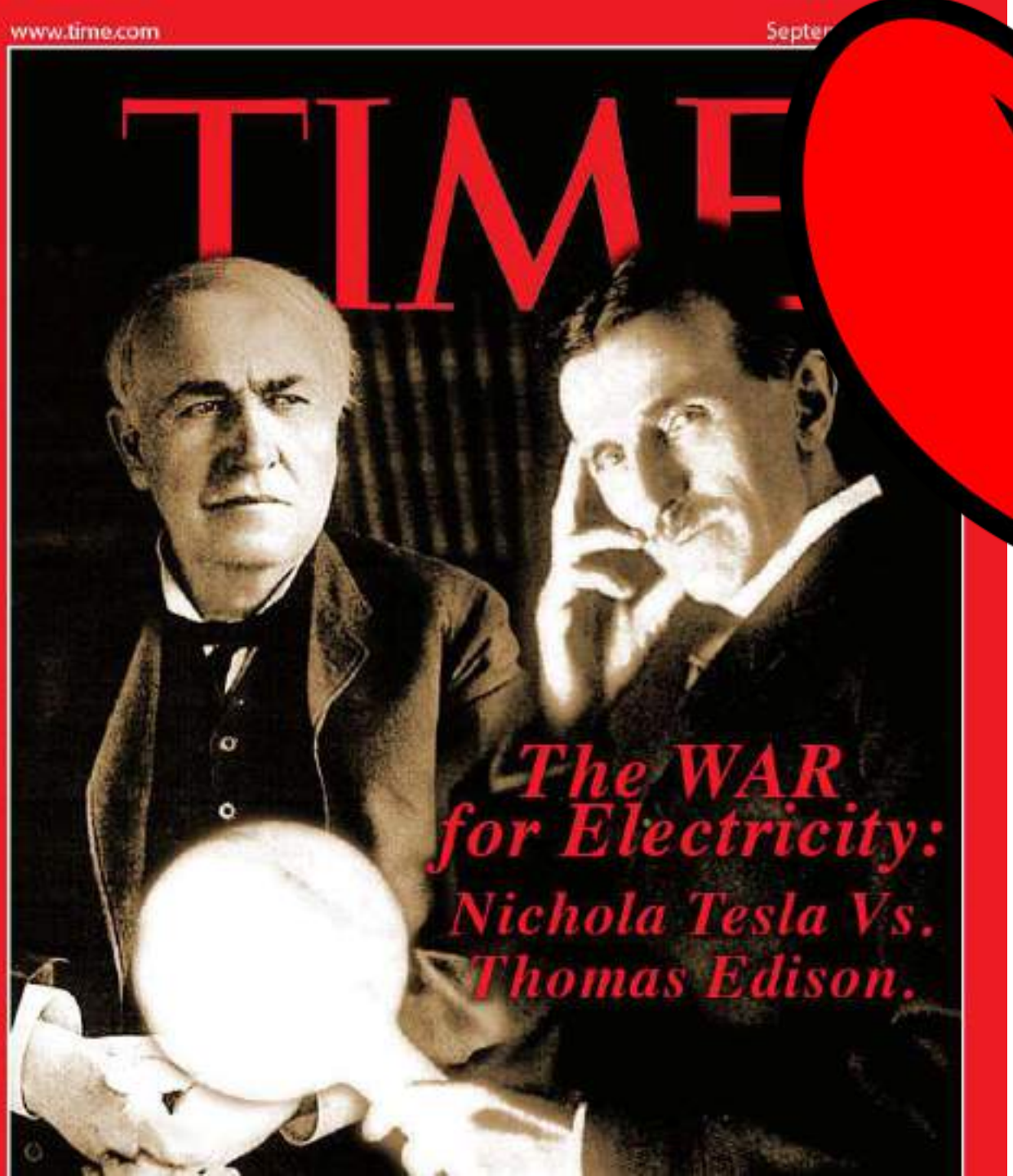
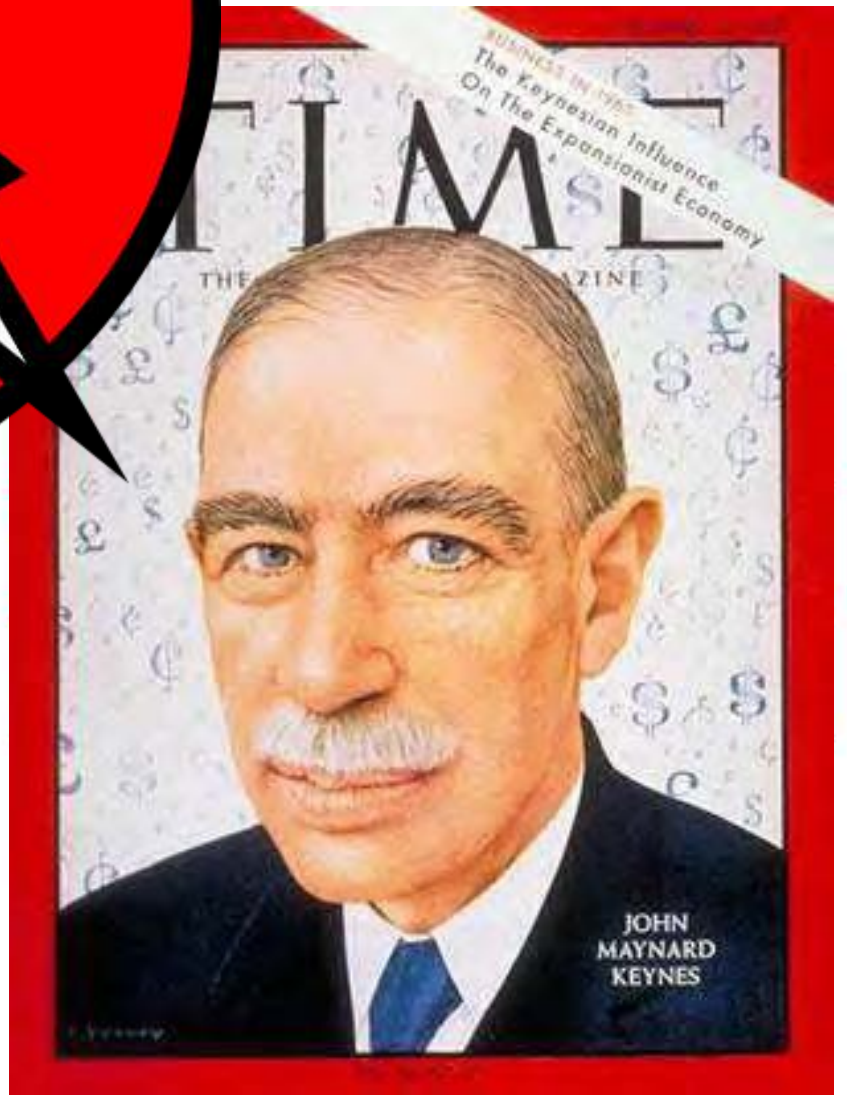
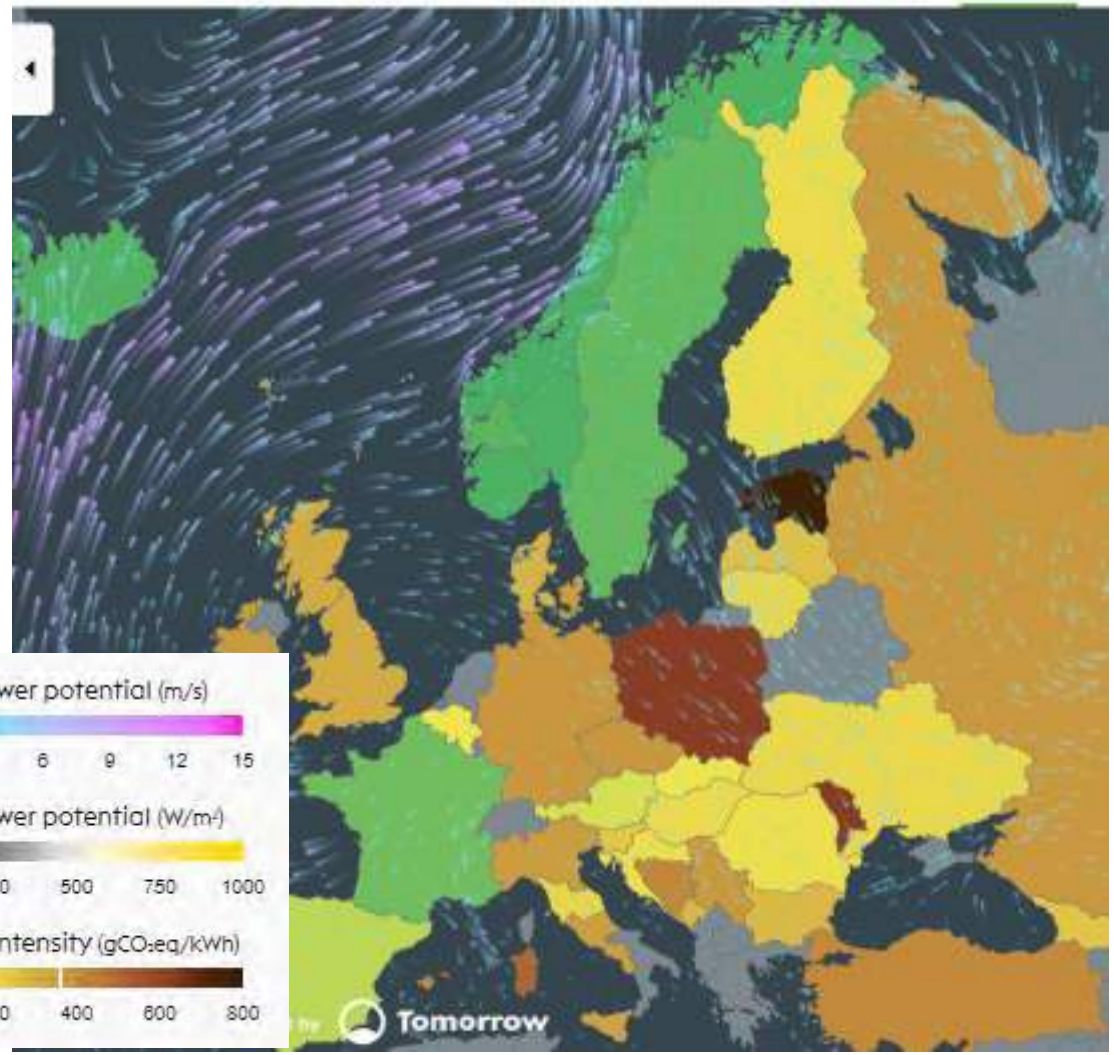
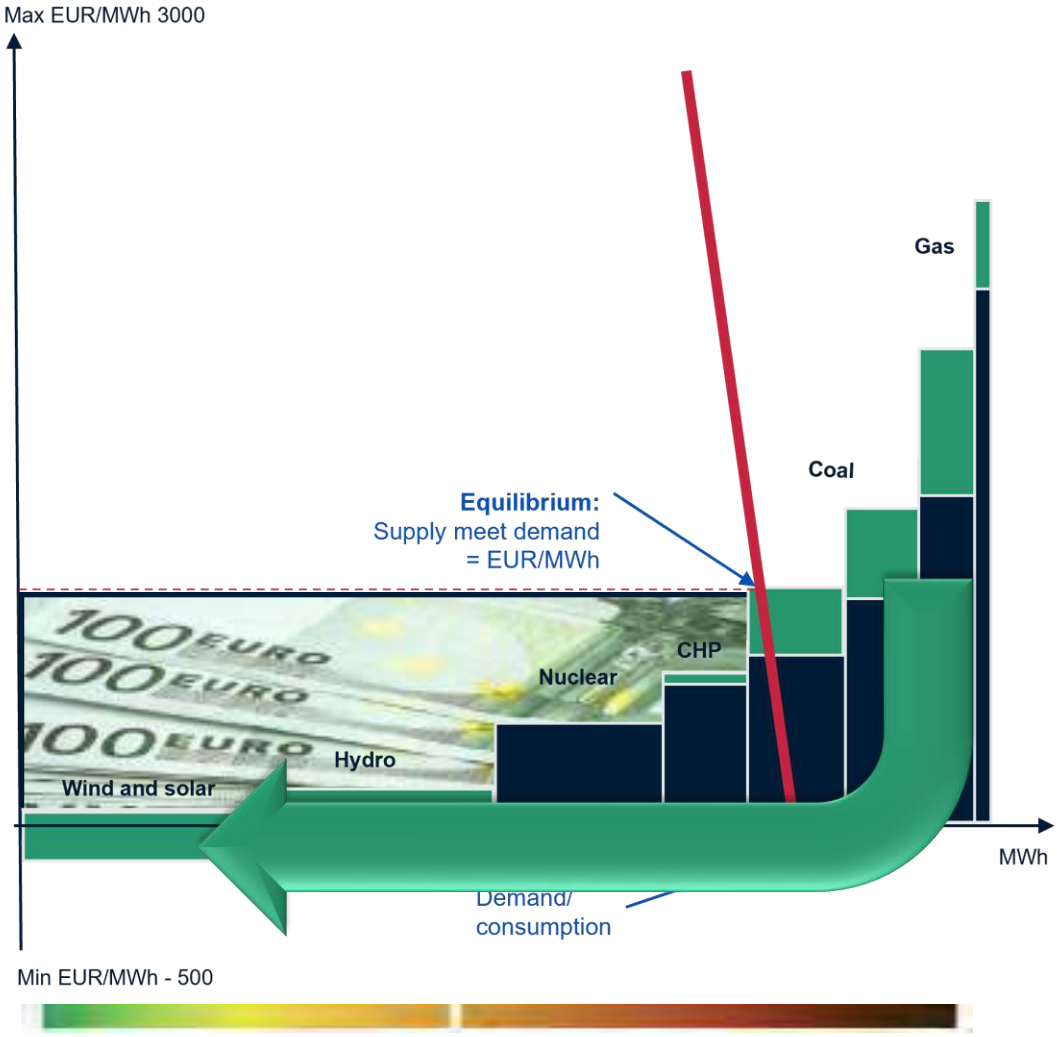
NUCLEAR
OIL
BP
COAL
MINE
IT'S IN MY BACKYARD!





Cheapest source first: Marginal Cost and the Merit Order





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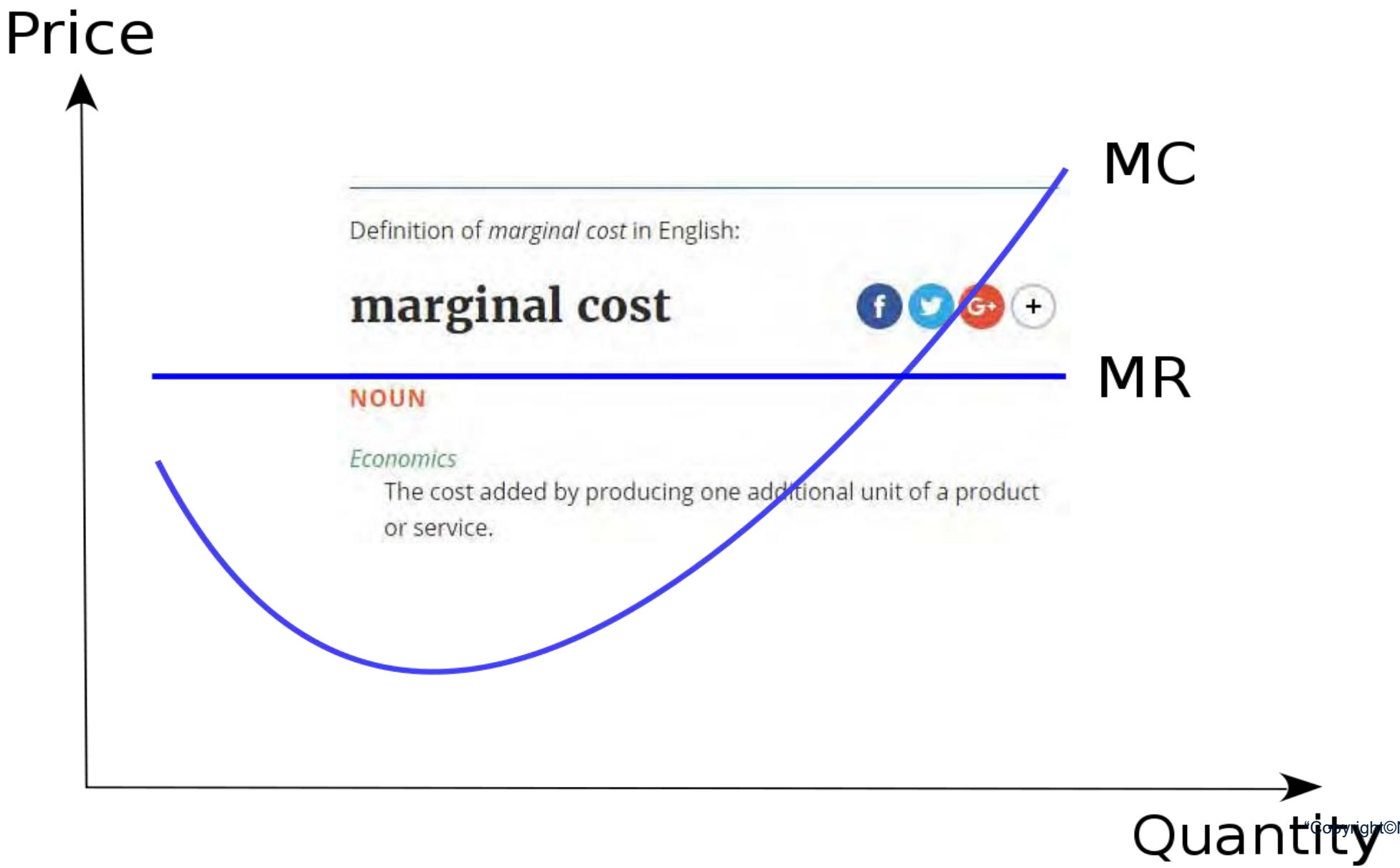
Marginal cost and the power market



Definition of *marginal cost* in English:

marginal cost

NOUN

Economics

The cost added by producing one additional unit of a product or service.

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Day Ahead price formation in practice

Factors affecting the **supply** for electricity:

- Variable costs of production
- Plant startup and shutdown costs
- EU ETS (Carbon tax)
- Climate crises
- Hydrological situation
- Wind/sun situation
- New renewable energy: Disruption
- Politics & Regulation
- Guarantee of origin (GO)
- Feed in tariffs/El-certificate market

SUPPLY

DEMAND

Factors affecting the **demand** for electricity:

- Mostly inelastic demand
- Retail volumes and delivery obligations
- Demand response
- Industrial
  - Fixed costs
  - Variable costs
  - Startup and shutdown costs
  - EU ETS
  - Guarantee of origin (GO)

TRANSMISSION CAPACITY

Available Transmission Capacity (ATC):

- Existing interconnectors
- Unavailability of interconnectors (faults, etc.)
- Euphemia/ implicit and explicit capacity/ Flow based market coupling

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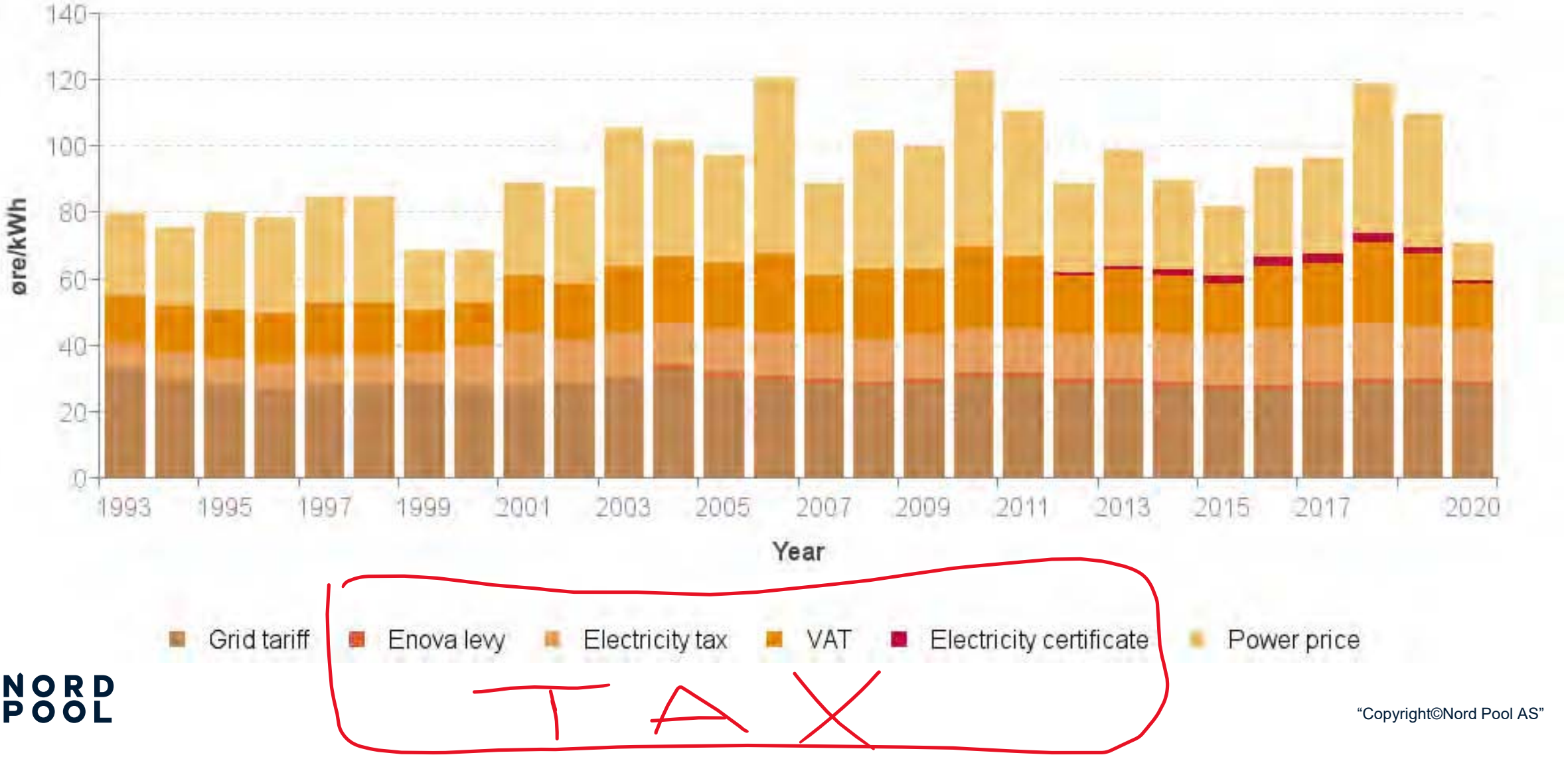
The 3 universal costs to have electricity delivered: Grid, taxes and power price



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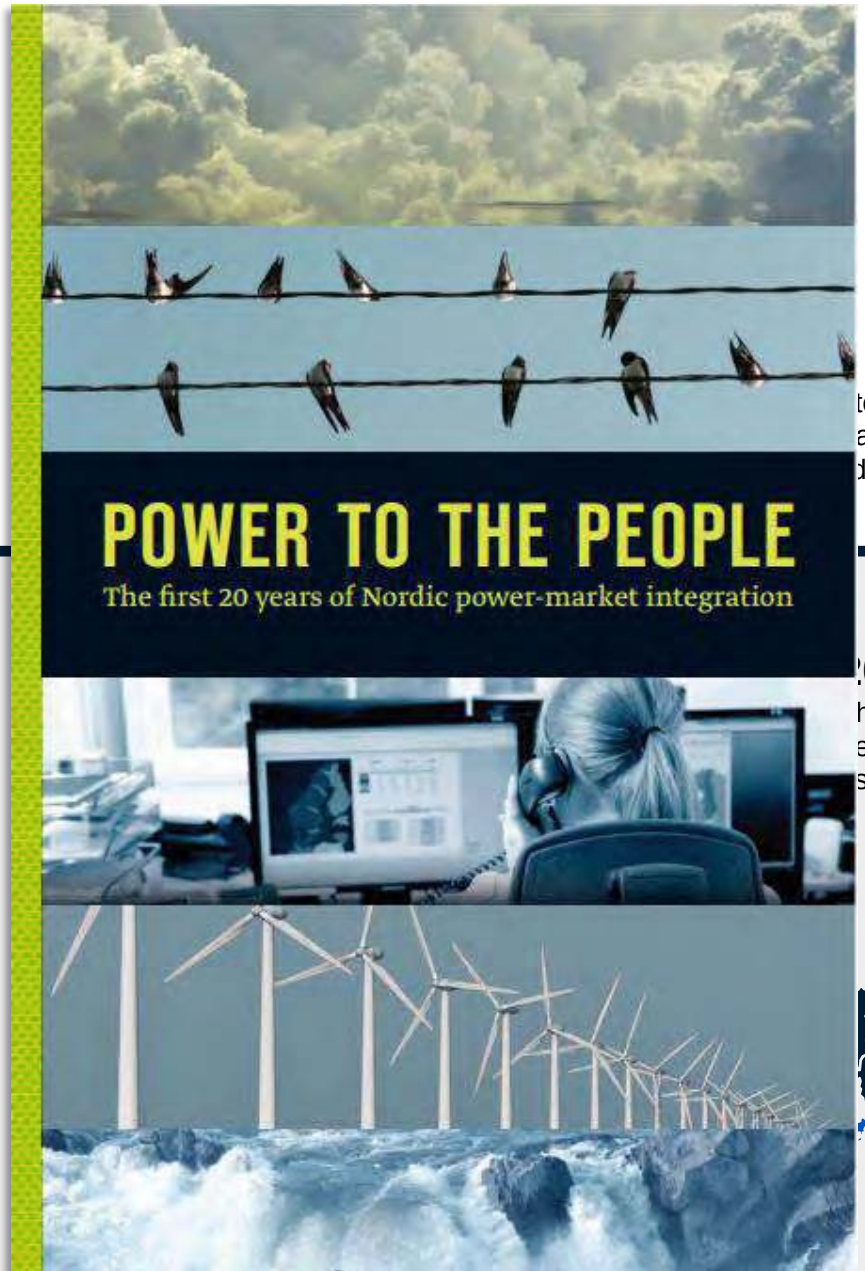
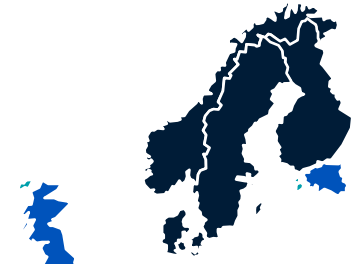
From national via Nordic to European power markets





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d

2010
UK and Estonia join Nord Pool

2014
North-western European power markets are coupled through the Price Coupling of Regions (**PCR**) project

2016
Together with **IBEX** Nord Pool opens the Bulgarian power market - and with **Cropex** the Croatian power market

2018
European intraday market go-live

2020
Euronext acquires Nord Pool

Nord Pool opens **intraday** market in **Poland**

000
he Nordic market
ecomes fully integrated
s Denmark joins

2013
Baltic completed – Lithuania and Latvia join Nord Pool

2015
Nord Pool appointed **NEMO** in 15 countries

2019
Nord Pool opens day-ahead markets in Germany, Luxembourg, France, Austria, Belgium and The Netherlands

2021
Nord Pool operate North Sea Link (1400 MW) world's longest subsea cable in operation

The Agenda: The power markets and how they are regulated

and their impact on the wider world

	Financial markets	Day-ahead	Intraday	Reserve markets
	10 years	24 hours	Intraday	Intra-hour
		Nord Pool	Nord Pool	TSO
	820 TWh	963 TWh	25 TWh	4 TWh
	System price	Area price	Continuous price	Regulated price
	Financial & physical settlement	Physical delivery	Physical delivery	Physical delivery

Physical delivery

The financial power market consists of derivatives used for e.g. hedging and speculation.

A significantly larger market than the physical, with annual trading representing multiple times yearly production.

Day-ahead is the main market, with intraday providing flexibility should variations in supply or demand occur, giving producers and consumers a marketplace to “trade themselves into balance”.

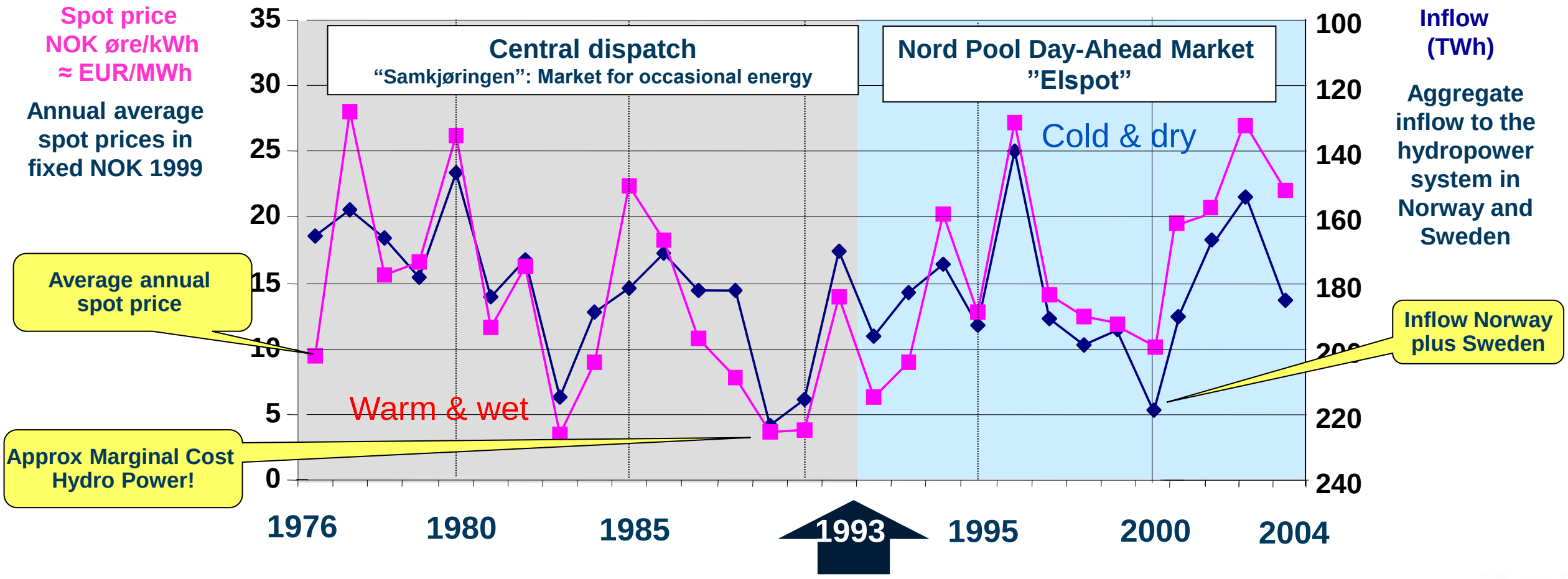
Increasing presence of speculative traders.

Imbalance at the time of intraday gate closure (1h before delivery in the Nordics) will result in penalties by the system balance responsible, the TSOs.

Intra-hour power flow is directly managed by the national TSOs in order to provide power balancing in real-time to ensure the right frequency of the grid and security of supply.

Volumes: (1) Financial markets: 2021 Aggregated of all Nordic derivatives traded on Nasdaq Commodities. (2) Nord Pool: 2021 figures.

Nordic Day-ahead (spot) prices relative to inflow 1976 - 2004



NORD POOL

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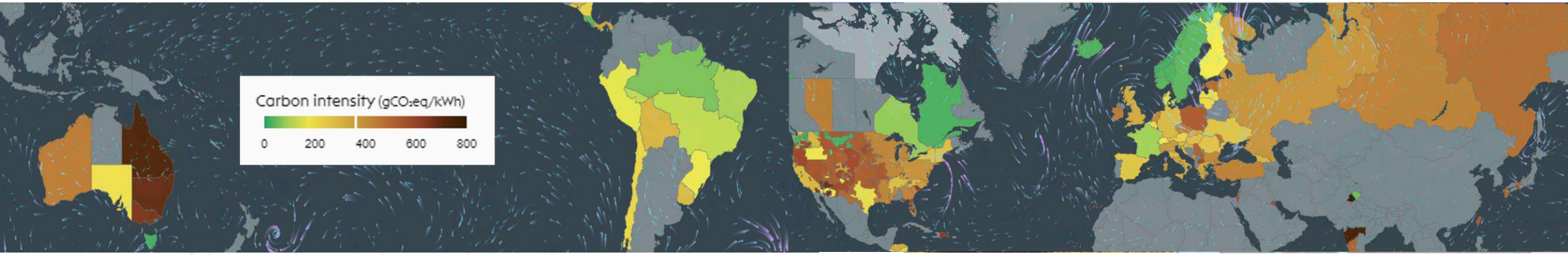
Source: Torbjørn Sletten Statkraft

System and area prices Day-Ahead (spot) 2003 – 2018



Cold & dry

Warm & wet

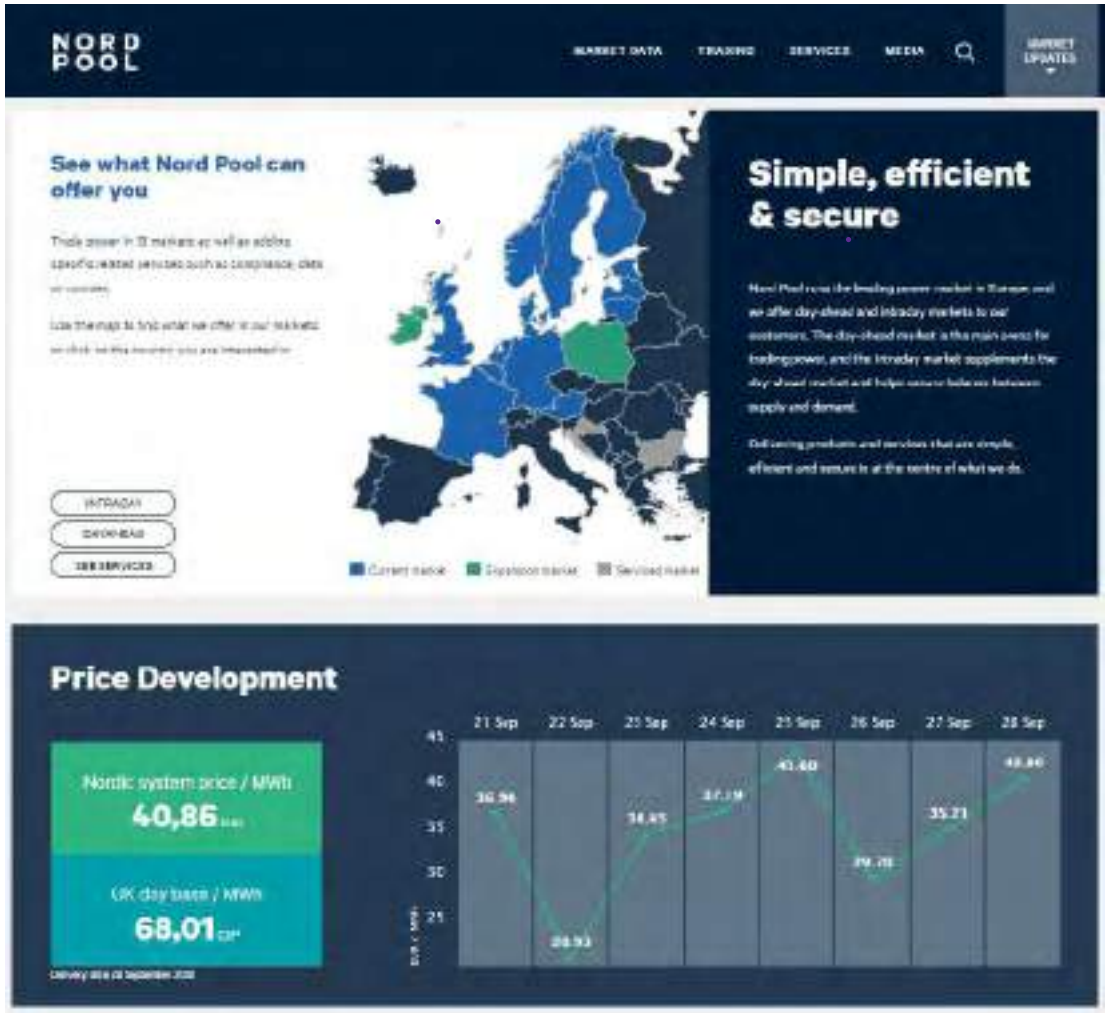
2014

PCR

NORD POOL

SYS SE SE1 SE2 SE3 SE4 FI DK1 DK2 Oslo Kr.sand Bergen Molde Tr.heim Tromso EE ELE LV LT KT LV FRE

Proof of concept



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WORLD ENERGY COUNCIL

Energy Index | Country profile | Regional profile | Maps

Energy Trilemma Index

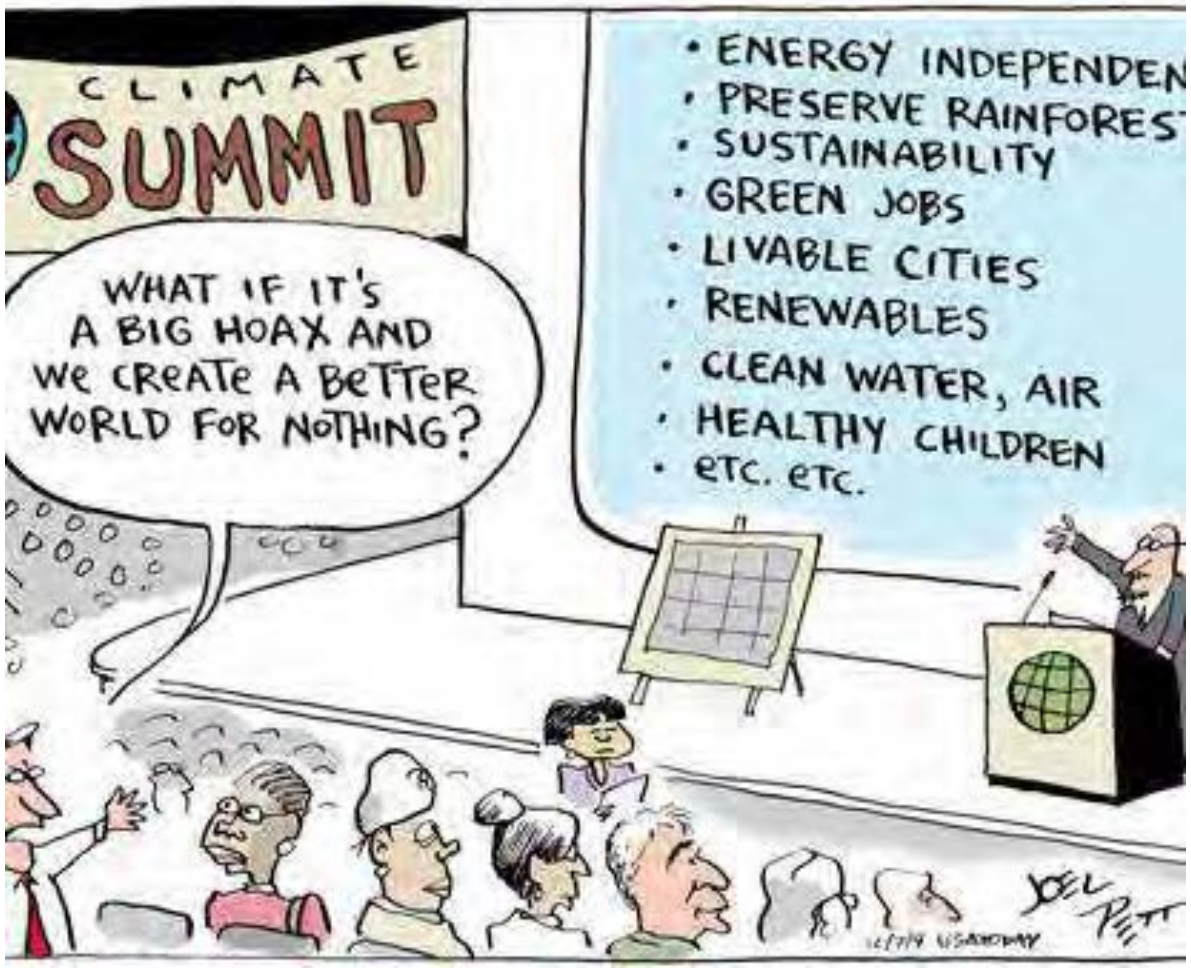
Full Report

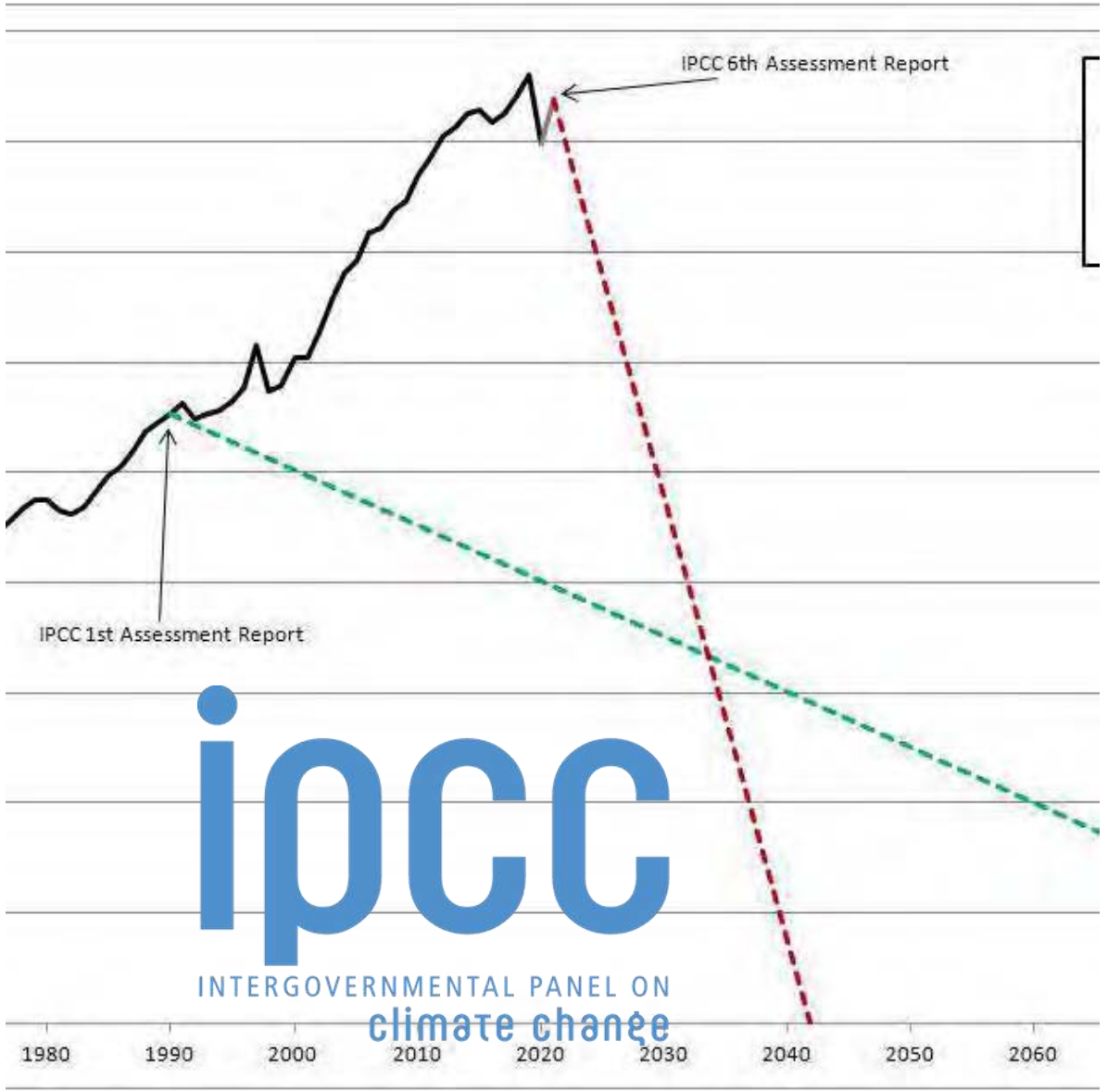
The **World Energy Council**'s Energy Trilemma Index tool, produced in partnership with **Oliver Wyman**, ranks countries on their ability to provide sustainable energy through 3 dimensions: Energy security, Energy equity (accessibility and affordability), Environmental sustainability. The ranking measures overall performance in achieving a sustainable mix of policies and the balance grade highlights how well a country manages the trade-offs of the Trilemma with "A" being the best. Use this interactive Index to assess the sustainability of national energy policies.

2021 Country rankings

Index rank	Country name	Balance grade	Trilemma score			
1	Sweden	AAA	84.2	5	19	2
2	Switzerland	AAA	83.8	24	6	1
3	Denmark	AAA	83	11	10	7
4	Finland	AAA	81.7	2	21	19
4	United Kingdom	AAA	81.7	19	9	10
5	Austria	AAA	81	16	10	12
5	France	AAA	81.1	17	16	8
6	Canada	AAB	80.6	1	12	37
7	Germany	AAA	80.4	10	15	22
8	Norway	BAA	79.6	44	17	4
9	New Zealand	AAA	79.1	28	17	18
9	United States	AAB	79	7	8	42
10	Luxembourg	CAA	76.9	54	4	15
10	Spain	ABA	76.9	26	23	21
11	Ireland	CAA	76.8	53	5	20
12	Belgium	BAA	76.3	40	15	26
12	Hungary	AB8	76.2	12	24	31

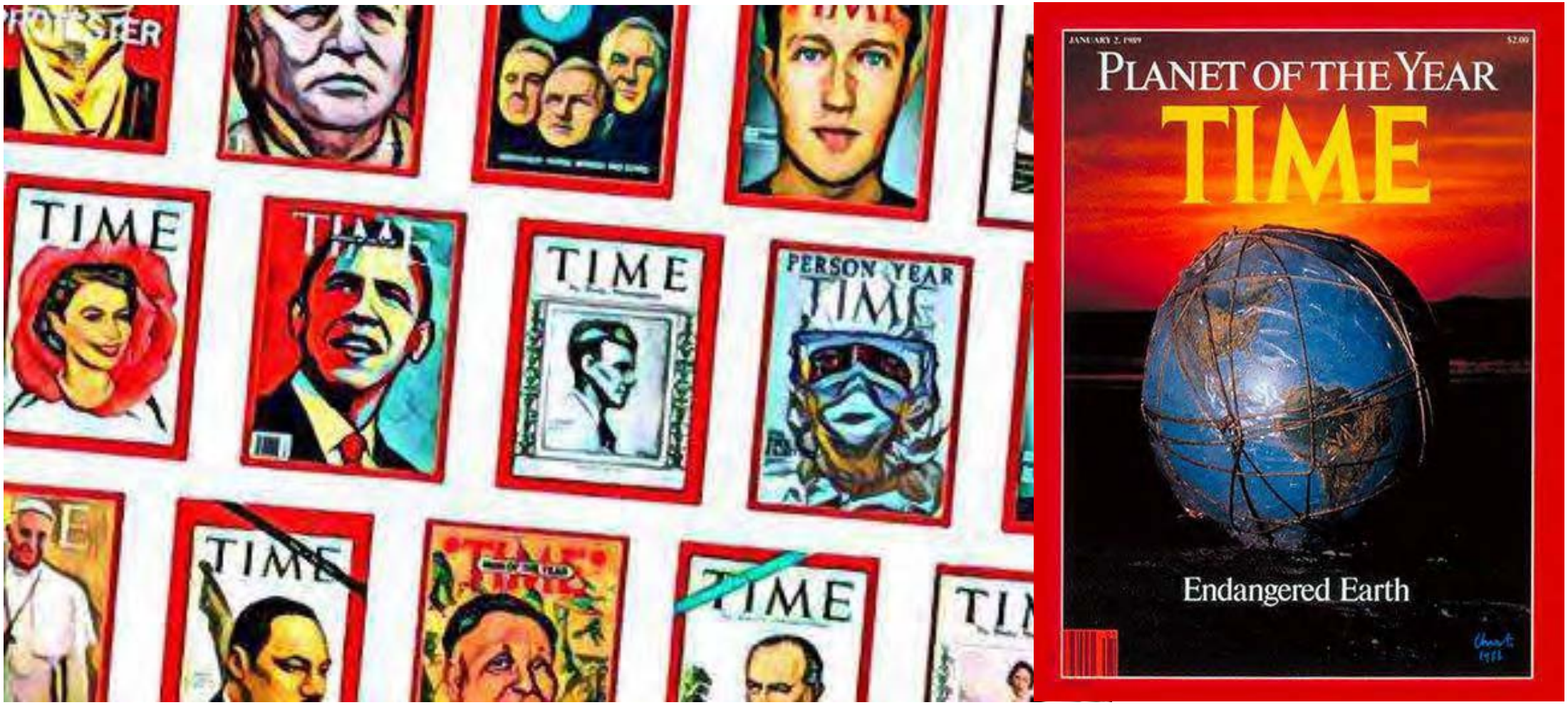
Climate reports since 1988





NORD POOL

Time travel 95 years: Front page of Time Weekly Magazine



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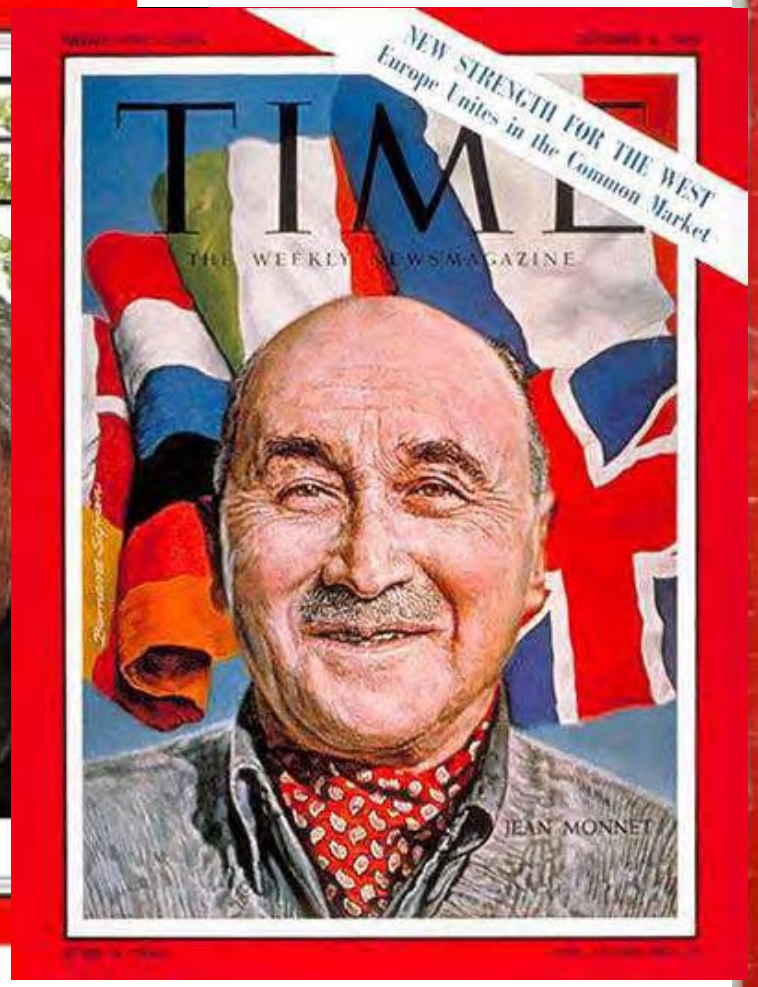
Time Weekly Magazine: Man of the year 1930s, 1940s and 1950s



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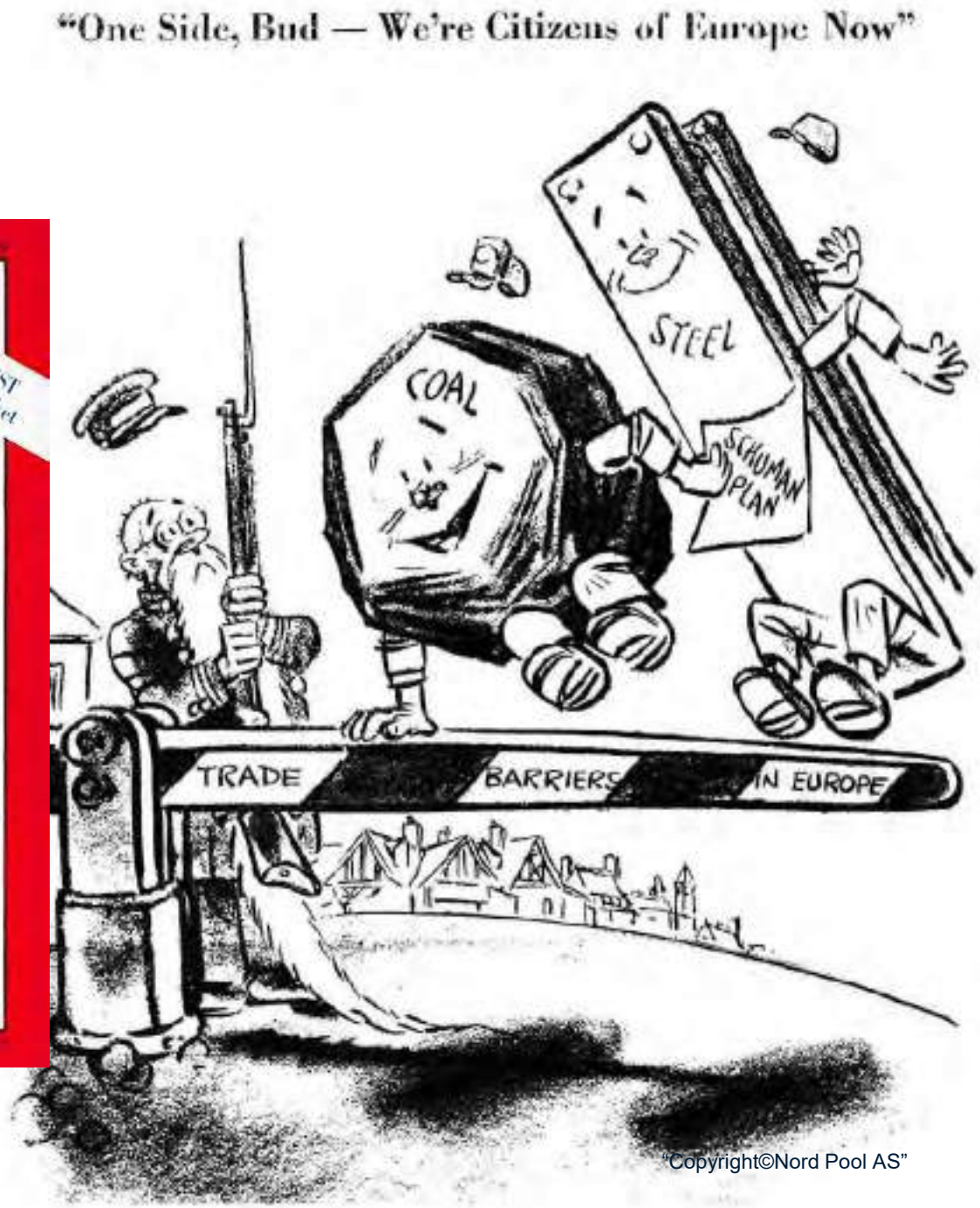
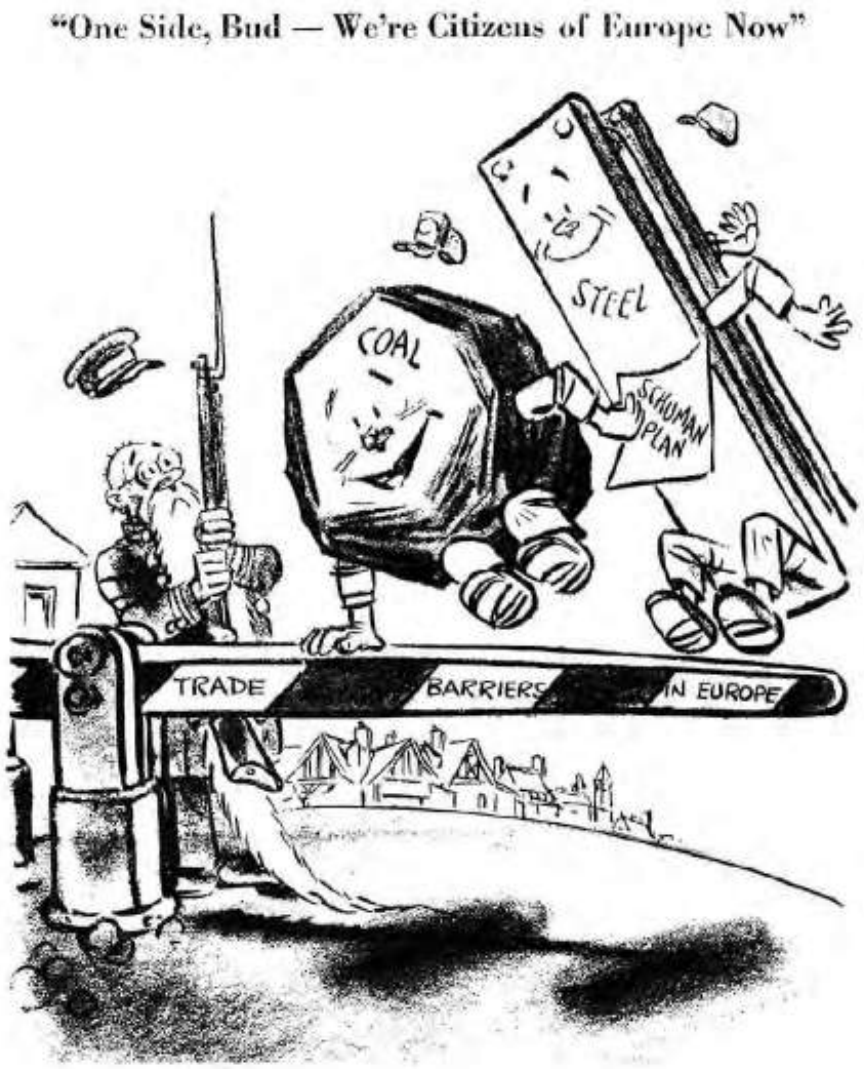
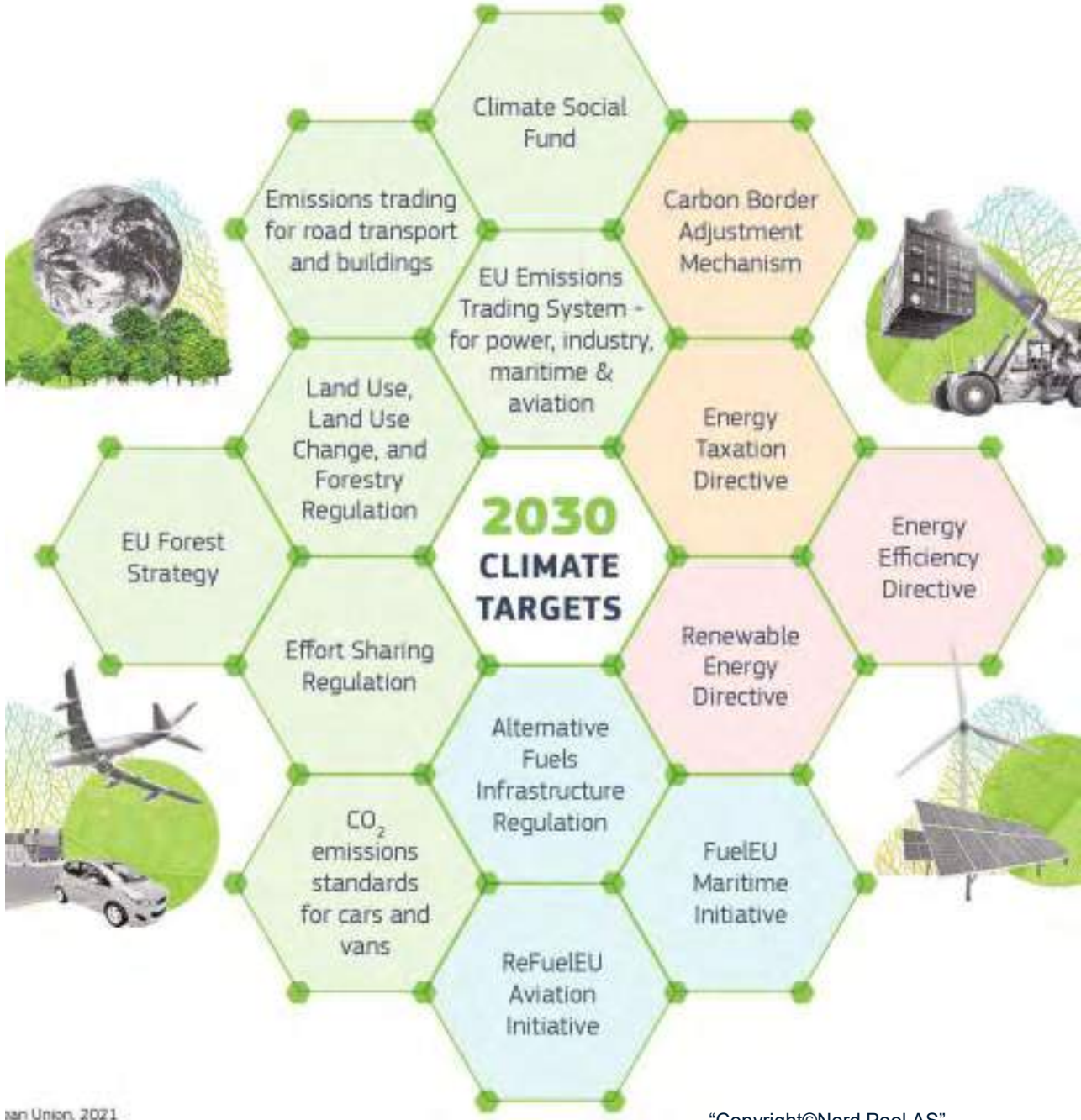


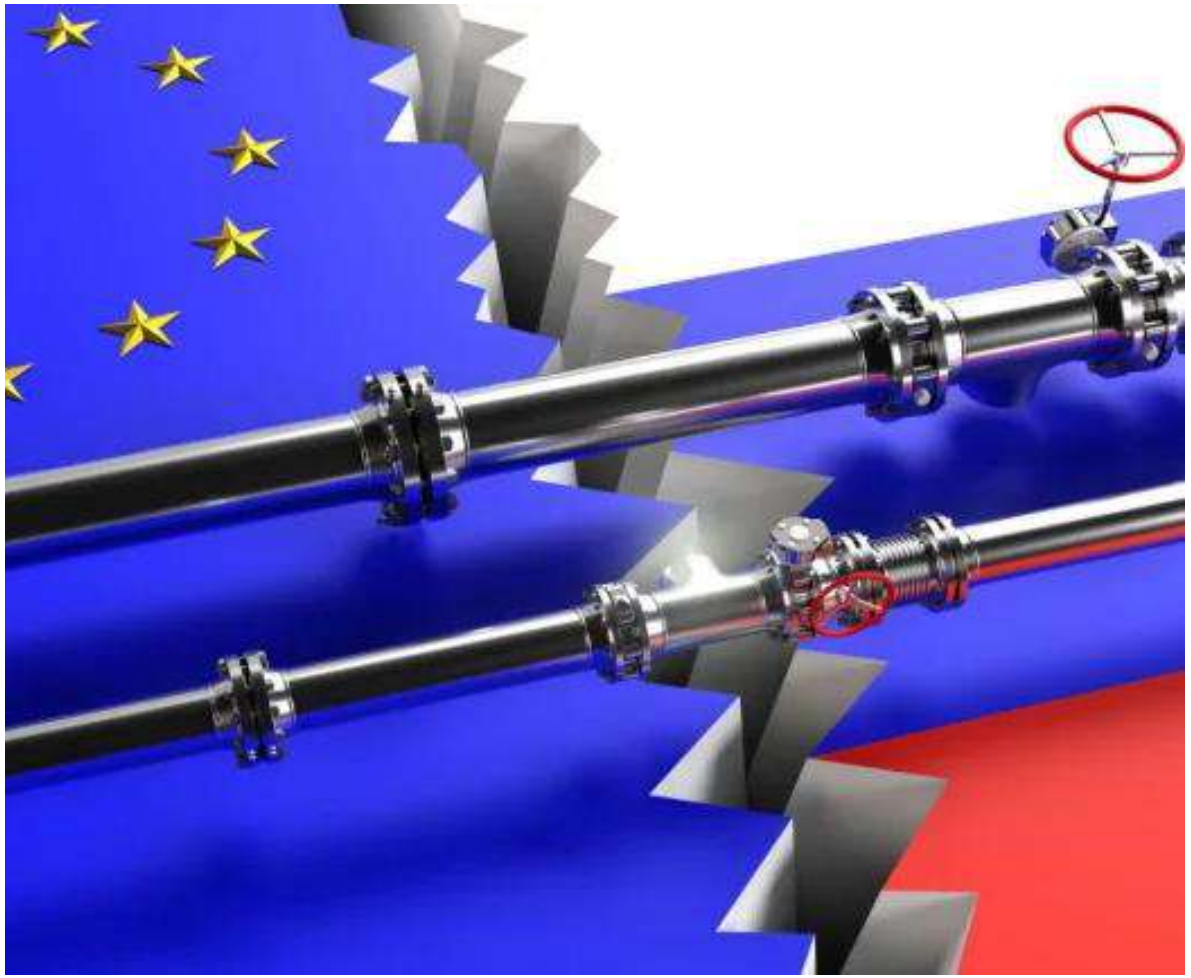
NORD POOL





NORD POOL

Trade = peace
The European Coal and Steel Community (ECSC)



NORD POOL

"Life will win over death, and light will win over darkness"


Russian defence spending
Value of Russia crude oil imports to the EU
Billions of dollars ($)
140
120
100
80
60
40
20
0
2001
2002
2003
2004
2005
2006
2017
2018
The Economist
Why Putin hates the West
Can Europe stick together over Ukraine?
What Biden can learn from Truman
The business trip is back
MARCH 26TH–APRIL 1ST 2022
POWER PLAY
The new age of energy and security
Since COVID couldn't convince governments: The green transistion is vital for security policy!


Ricardo Rey


Ricardo Rey

Fit for fiftyfive fast forward

Russian oil: EU agrees compromise deal on banning imports

1 day ago | Comments

Russia-Ukraine war

Energy price crisis

Will reduce changes of an actual energy crises

Energy crisis + Add to myFT

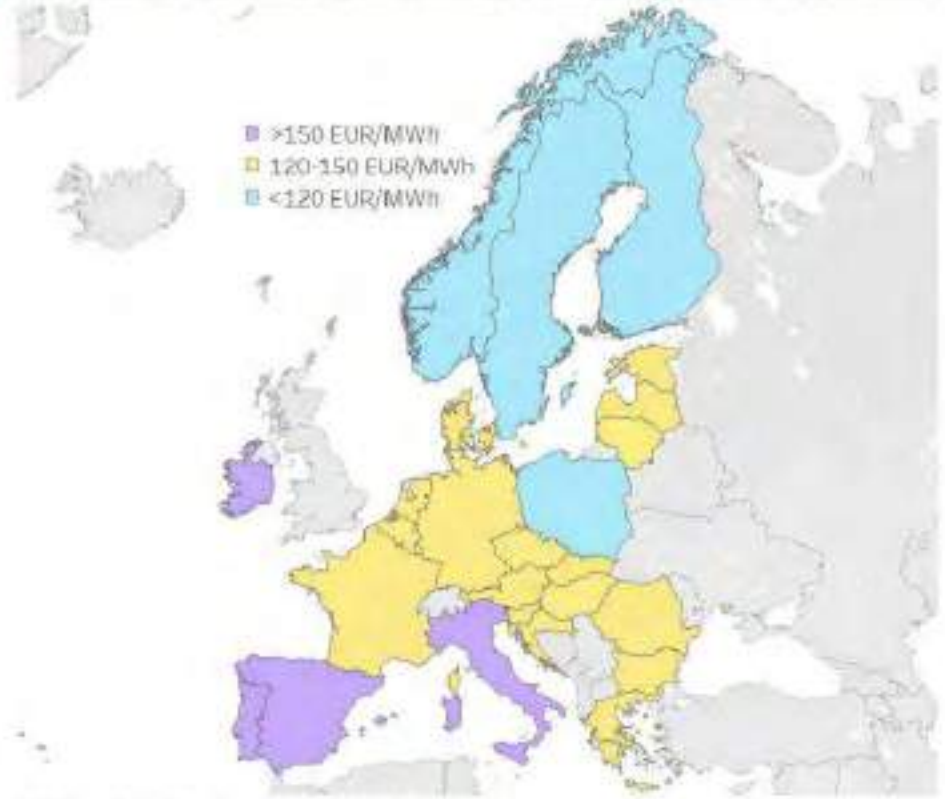
IEA chief accuses Russia of worsening Europe's gas crisis

Fatih Birol says low supplies coincide with 'heightened geopolitical tensions over Ukraine'

Fatih Birol, head of the International Energy Agency, has claimed that Russia is holding back at least a third of the gas it could feasibly send to Europe © Simon Dawson/Bloomberg

NORD POOL

Figure 2: Countries and their exposure to high electricity prices in September 2021



Source: ACER calculations based on ENTSO-E data.

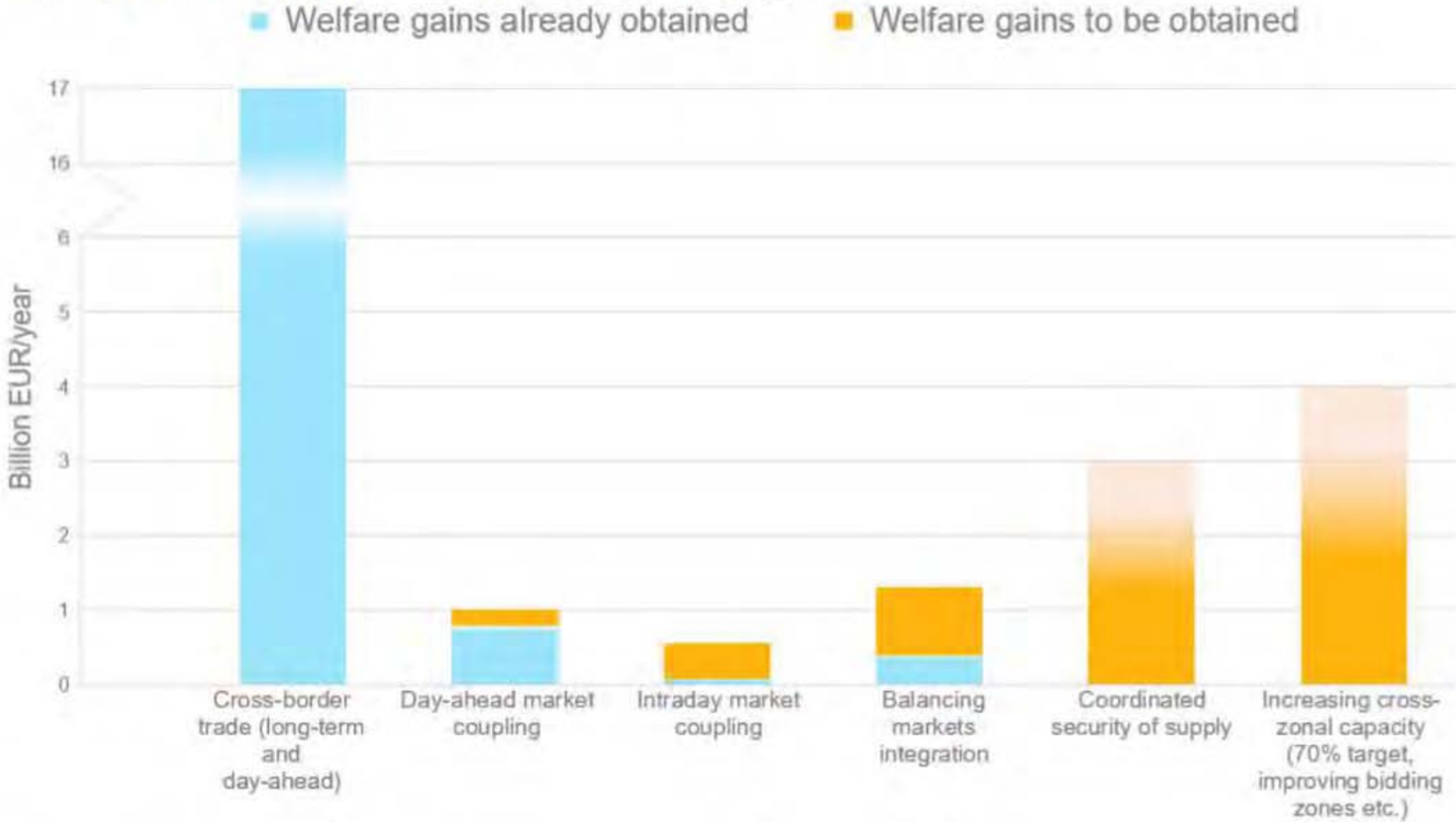
Note: The grouping and associated colouring follow country borders, noting however that Ireland and Northern Ireland constitute a single energy market. Cyprus and Malta are not considered in the figure since they do not have liquid wholesale electricity markets.

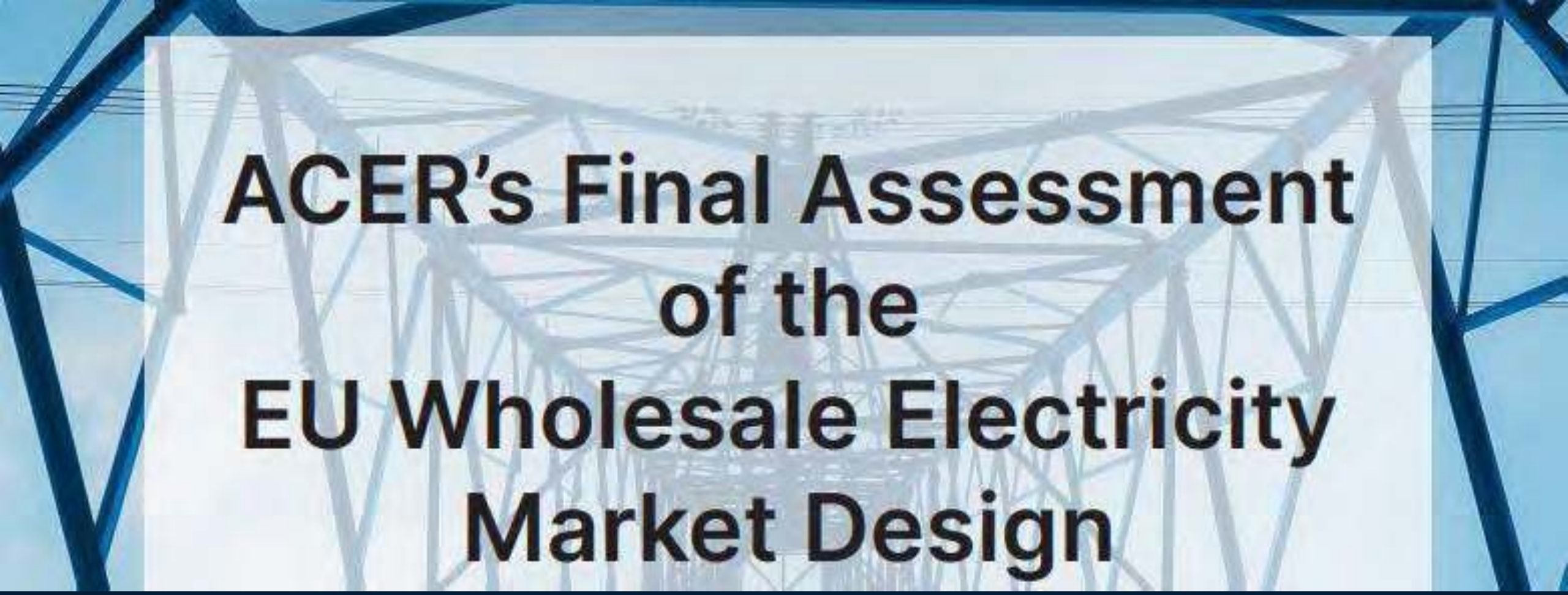
Table 1: Average day-ahead electricity prices (EUR/MWh) and average gas generation as a percentage of electricity demand in Europe (%): September 2021

	Main characteristics of the Member States pertaining to the group	Average day-ahead prices (EUR/MWh)	Electricity demand covered with gas (%)
Group 1	Highly gas-dependent and/or limited interconnected countries	167	34
Group 2	Moderately gas-dependent and/or well interconnected countries	132	14
Group 3	Limited gas-dependent countries	89	3

Source: ACER calculation based on ENTSO-E data

Figure 10: Social welfare benefits already obtained and to be obtained from various actions intended to increase EU markets integration





Click, read and learn!

https://www.acer.europa.eu/events-and-engagement/news/press-release-acer-publishes-its-final-assessment-eu-wholesale

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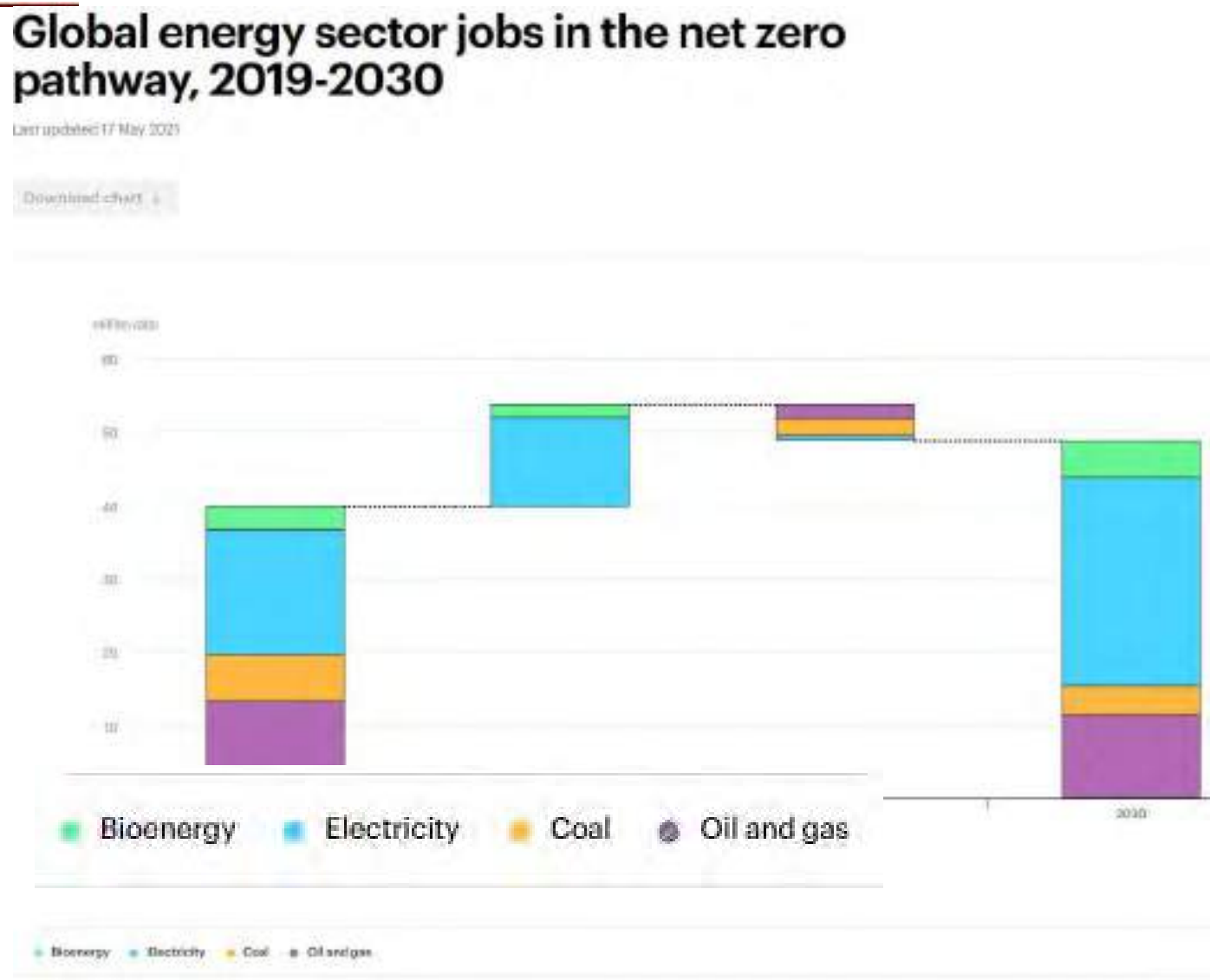
A new and better deal

NORD POOL

Clinton's economy advisor: «It's the economy, stupid»



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“Capitalists are going green, greed is good!”

OSLO BØRS | Per 17.02.2021, klokken 11:00

NORD POOL

«Old» news getting louder

ALJAZEERA News AJ Impact AJ Go Documentaries Shows Invest

EIB to cease funding fossil fuel projects by 2021

The European Investment Bank's new policy effectively … plants.

Norway's sovereign fund to drop oil and gas investments

32 minutes ago

Norway's $1 trillion sovereign … gas holdings.

…osed after lobbying by European Union

MORE ON FOSSIL FUELS

Norway's Equinor to reduce carbon emissions to near zero by 2050

yesterday

Oil, gold prices climb higher as

Hedge funds

Extinction Rebellion donor leads world's top-performing hedge fund

Chris Hohn's TCI fund, known as one of the most aggressive activist investors, made a 23% gain in 2021

Rupert Neate
Wealth correspondent

@RupertNeate

Mon 17 Jan 2022 13.58 GMT

NORD POOL

“See you in court!”

The Economist ≡ Menu | Weekly edition | Search

The Americas | Right to the power company

A Peruvian farmer takes on Germany’s largest electricity firm

The outcome of the climate lawsuit will have global implications

Jun 3rd 2021 | HUARAZ

< Share | Give

The Economist ≡ Menu | Weekly edition | Search

International | Going to court for the climate

Lawsuits aimed at greenhouse-gas emissions are a growing trend

And better science could make them more precise

Apr 23rd 2022

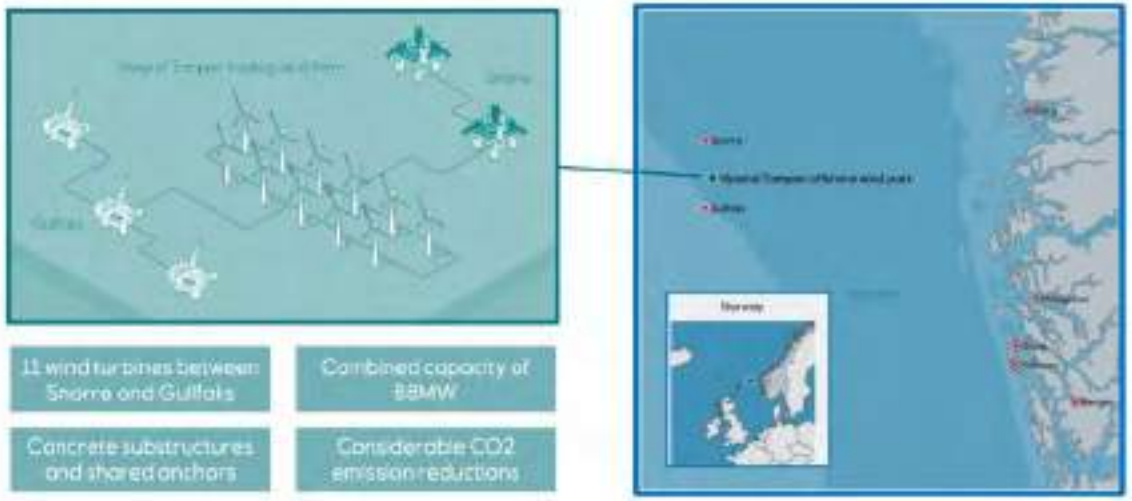
< Share

IN AUGUST 2018 ClientEarth, an environmental organisation based in Londo paid €20 ($23) for ten shares in Enea, a power company based in Poland. Th transaction bought the lawyers at Client Earth [illegible] Stoleka C, a or gigawatt coal-fired power station Enea was about to build 120km north of Warsaw. It also bought them the standing they needed to stop the company fr

NORD POOL

“When we run out of oil and gas, then what?”

Hywind Tampen –
offshore wind farm in the North Sea



equinor

Statoil

The board of directors of Statoil proposes to change the name of the company to Equinor. The name change supports the company's strategy and development as a broad energy company.

Nordic power consumption: +100 TWh to 2030

- Datacenters: +21 TWh/y
- Transportation: +19 TWh/y
- Offshore oil & gas: +10 TWh/y
- Battery production: +13 TWh/y
- Heat pumps: +7 TWh/y
- Production of hydrogen: +32 TWh/y
- Pulp & paper industry: -5 TWh/y
- Other changes: +3 TWh/y
- Total growth: 100 TWh/y

Dirty business

Global energy-related CO_2 emissions, by sector, 2014, tonnes bn

Total: 36.2bn

Source: International Energy Agency

The Economist

In order to limit global warming to less than 2°C, total emissions from global energy use across industry alone will

Dirty business

Global energy-related CO_2 emissions, by sector, 2014, tonnes bn

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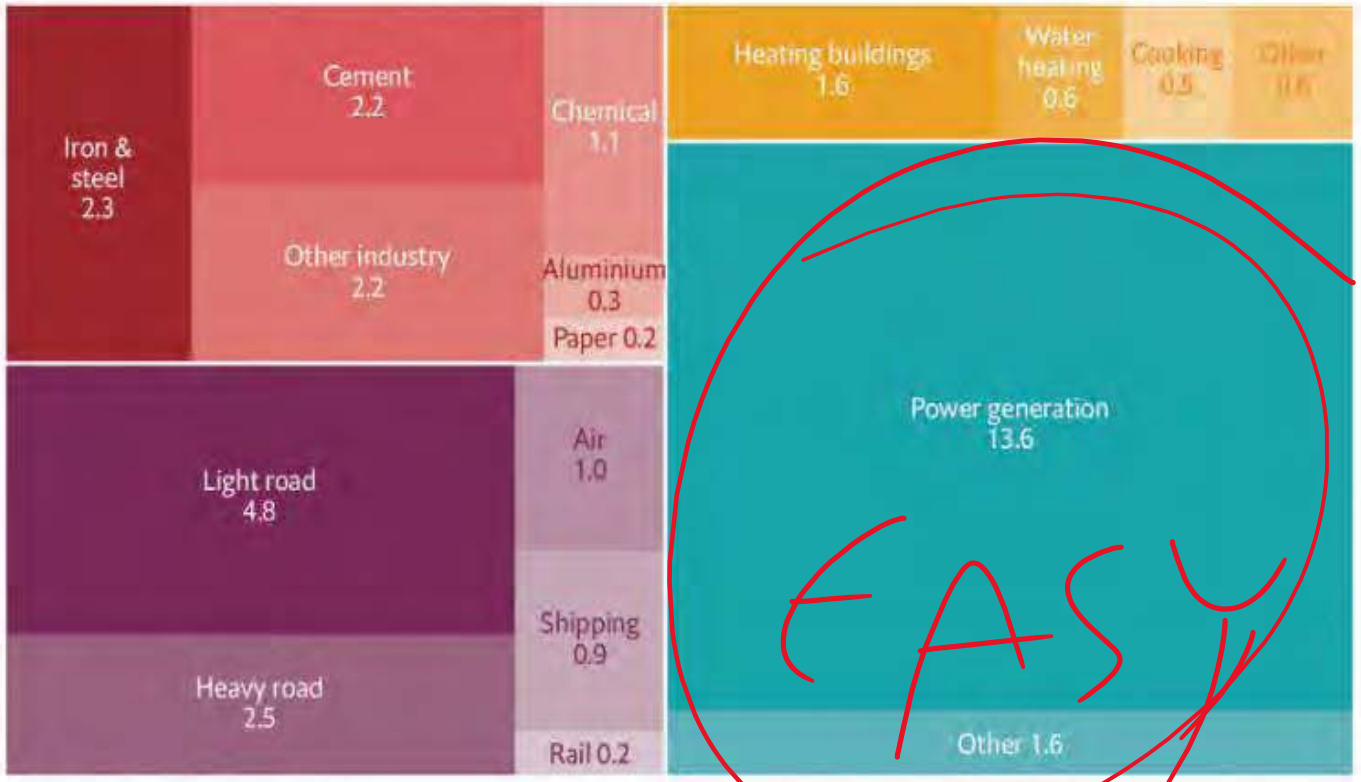


Source: International Energy Agency

The Economist

In order to limit global warming to less than 2°C, total emissions from global energy use across industry alone will

NORD POOL

Dirty business

Global energy-related CO_2 emissions, by sector, 2014, tonnes bn

Total: 36.2bn

Source: International Energy Agency

The Economist

In order to limit global warming to less than 2°C, total emissions from global energy use across industry alone will

The Economist

Technology Quarterly | Conquering carbon dioxide

What would it take to decarbonise the global economy?

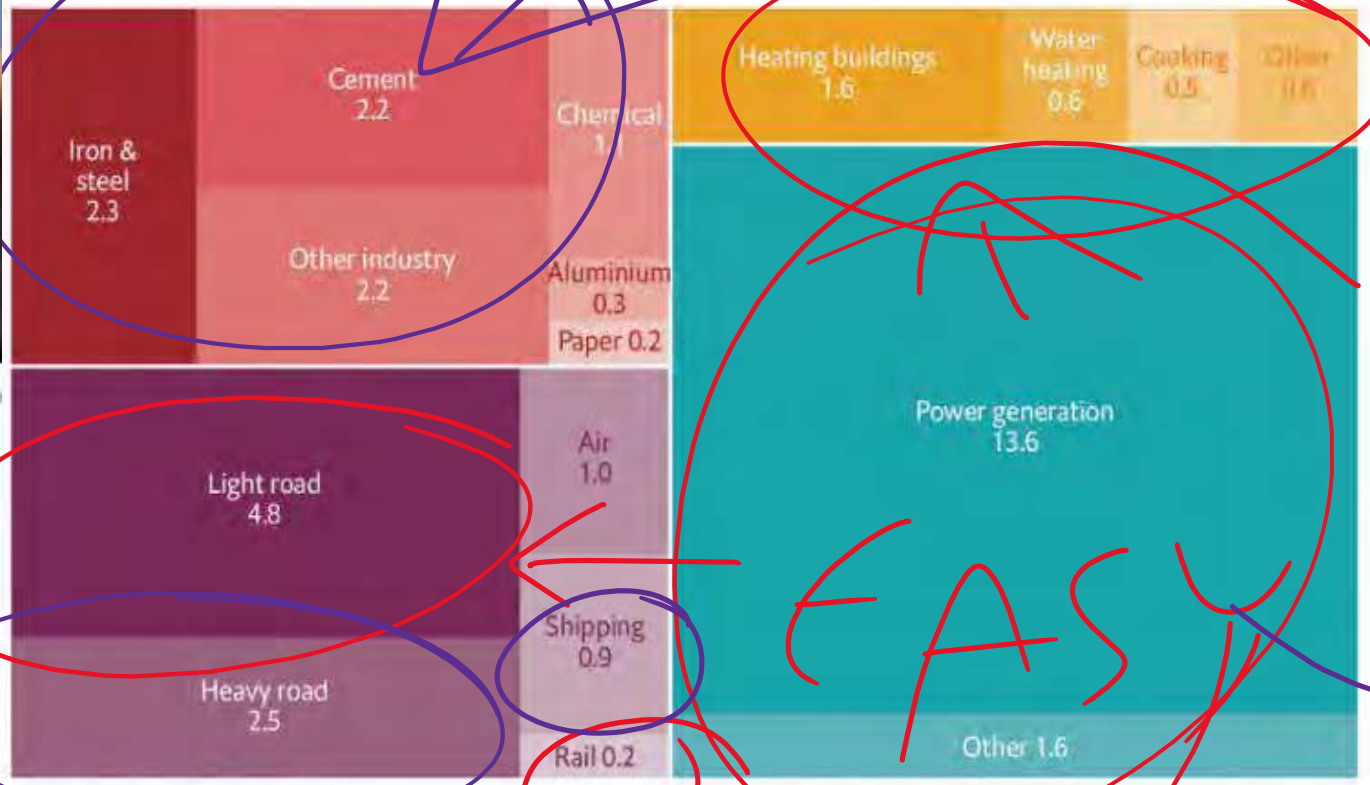
NEXT › Current edition

Martin Pei, chief technology officer, SSAB, holds an

Dirty business

Global energy-related CO_2 emissions, by sector, 2014, tonnes bn

Total: 36.2bn



Source: International Energy Agency

The Economist

NORD POOL

In order to limit global warming to less than 2°C, total emissions from global energy use across industry alone will

Carbon being shipped and burned simultaneously

40% of all products transported by global shipping are fossil fuels themselves (coal, oil, gas). 100% of international shipping relies on fossil-fuel powered ships. [-] UNCTAD (2019)

Shipping has a double-whammy fossil fuels problem.

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Production shut-ins during February 2021 deep freeze in Texas

Snøhvit LNG plant idle since October 2020 fire

Fire at Novy Urengoy processing plant in August 2021

Maintenance on the Continental Shelf

Fire at Amur gas processing plant in October 2021

Production shut-ins in September 2021 after Hurricane Ida

Ras Laffan maintenance in September 2021

Some of the reasons for the Natural gas crisis 2021 (IEA) and we have seen it before…

Feedgas issues at Atlantic LNG

Ichthys maintenance in May/June 2021

Peru LNG outage May-September 2021

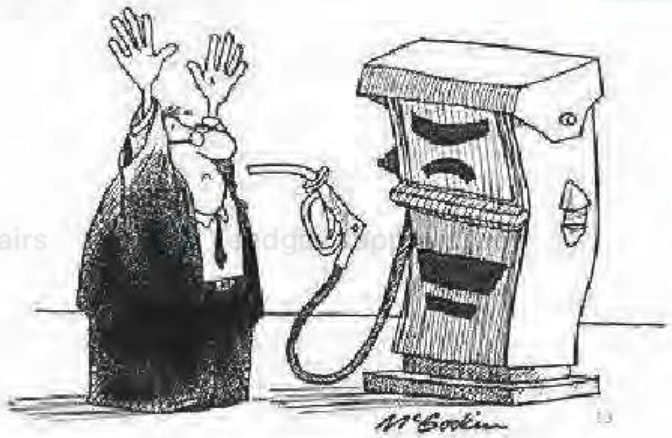
Gorgon LNG plant repairs

Fire

Maintenance

70's Crisis

- Two crisis during 1970's.
  - » 1973 Oil Crisis- Yom-Kippur War.
  - » 1979 Energy Crisis- Iranian Revolution.



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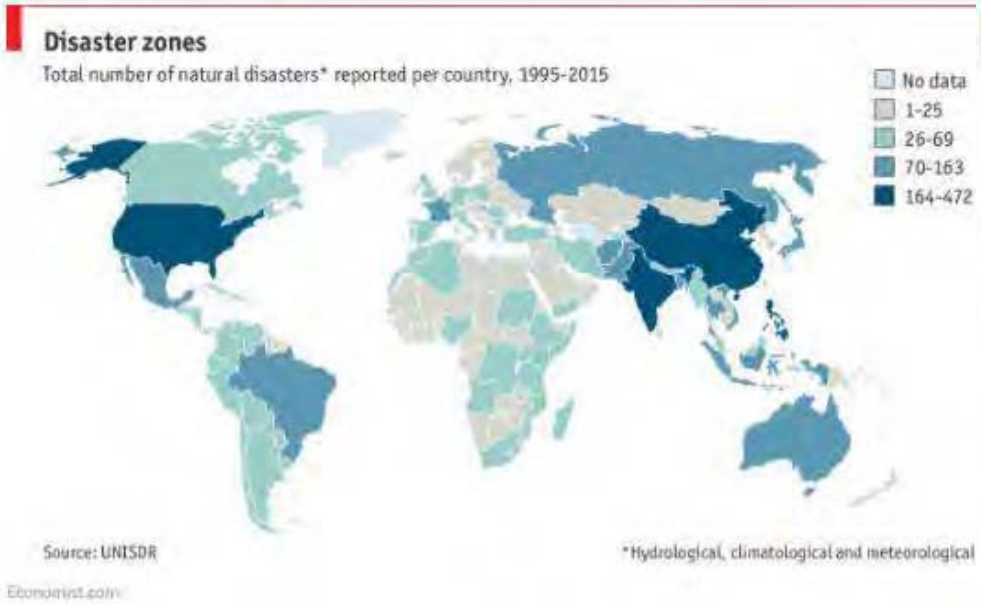
Daily chart

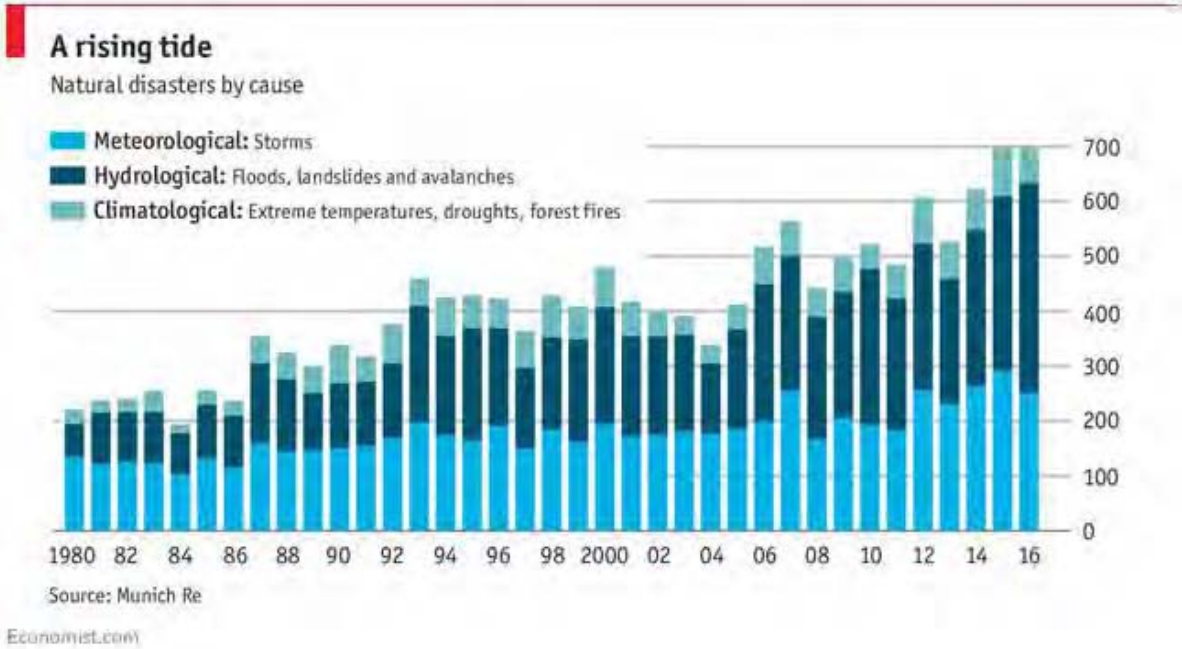
Weather-related disasters are increasing

But the number of deaths caused by them is falling

Extreme weather: *Le déluge*

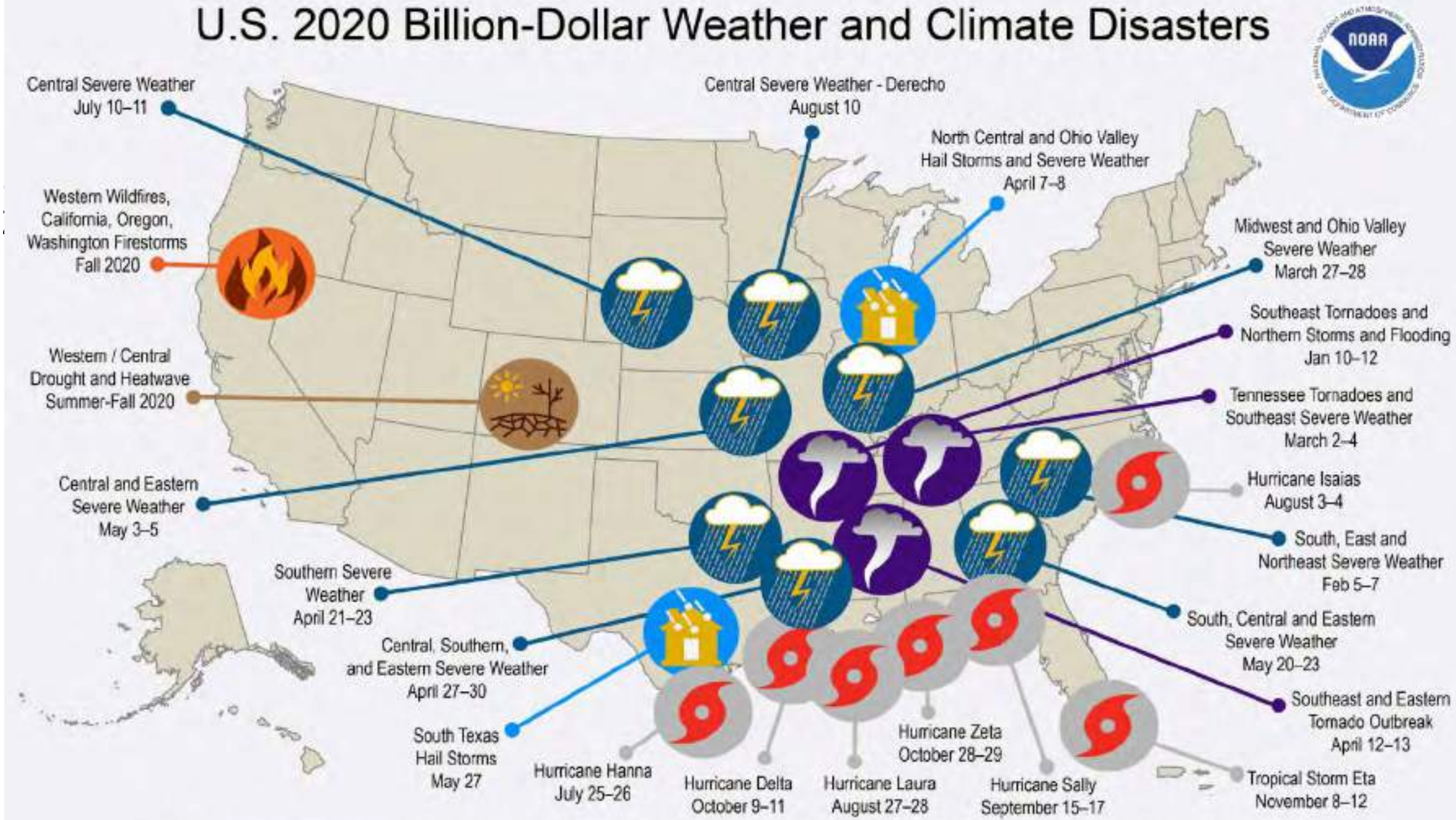
The number of natural disasters worldwide has more than quadrupled since 1970 to around 400 a year. There are six times more hydrological events, such as those in Texas or South Asia, now than in 1980. Yet fewer people are dying, thanks to improved building strength, flood-prevention schemes and other measures. To reduce deaths still further, urban planners may have to plan for more such extreme events, writes our data team





Graphic detail ›
Aug 29th 2017 | by THE DATA TEAM

U.S. 2020 Billion-Dollar Weather and Climate Disasters



*This map denotes the approximate location for each of the **22 separate billion-dollar weather and climate disasters that impacted the United States during 2020.***

Ida (2021) and Harvey (2017)

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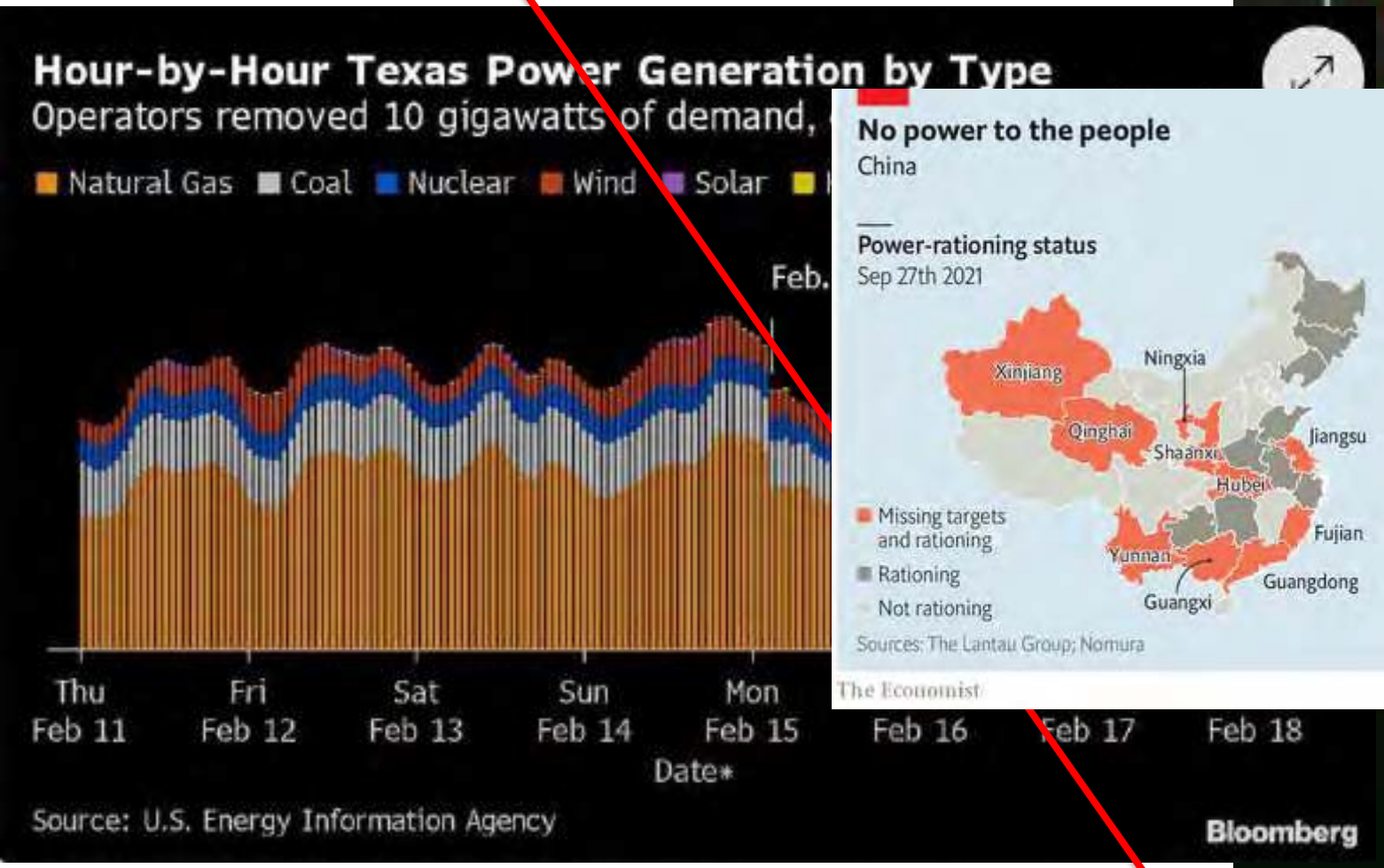
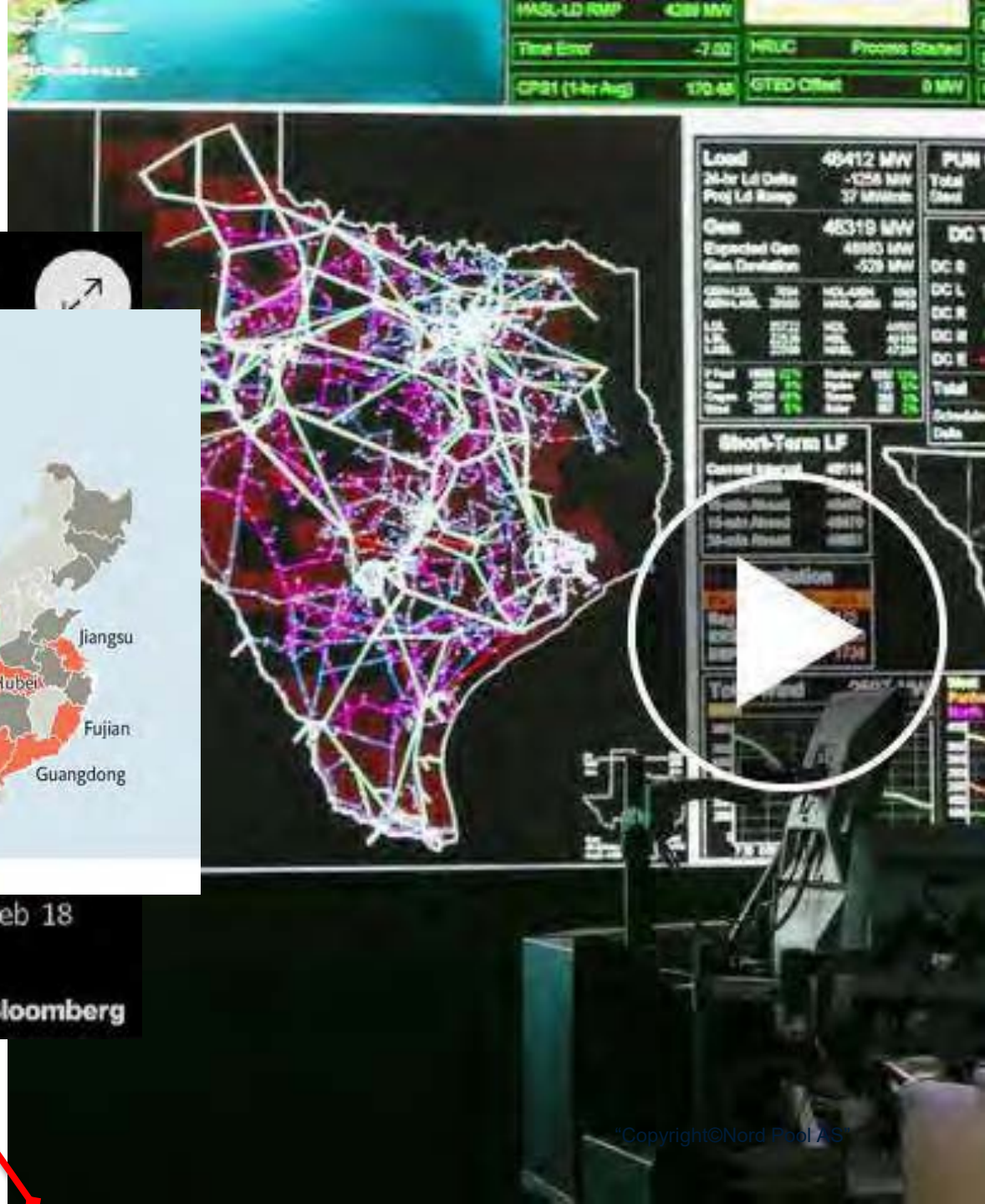
Once in a century storm
twice in a decade Texas 2011 & 2021





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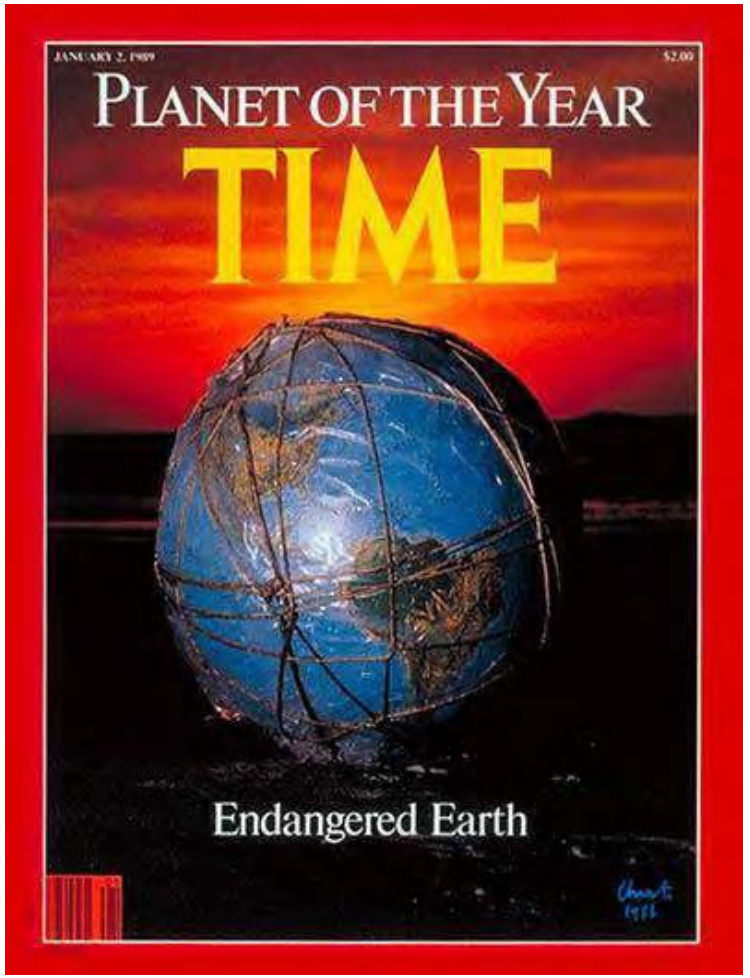
Consumers and children



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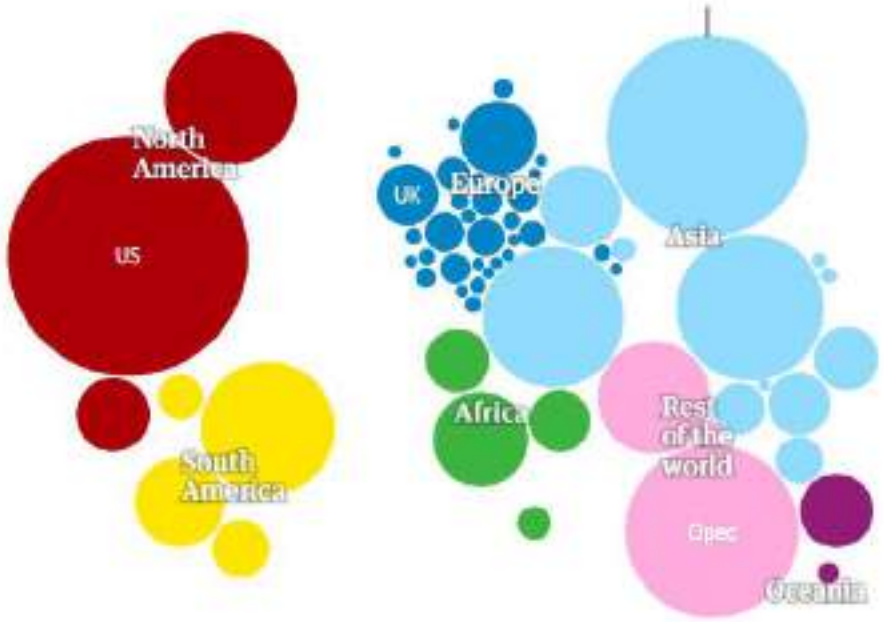
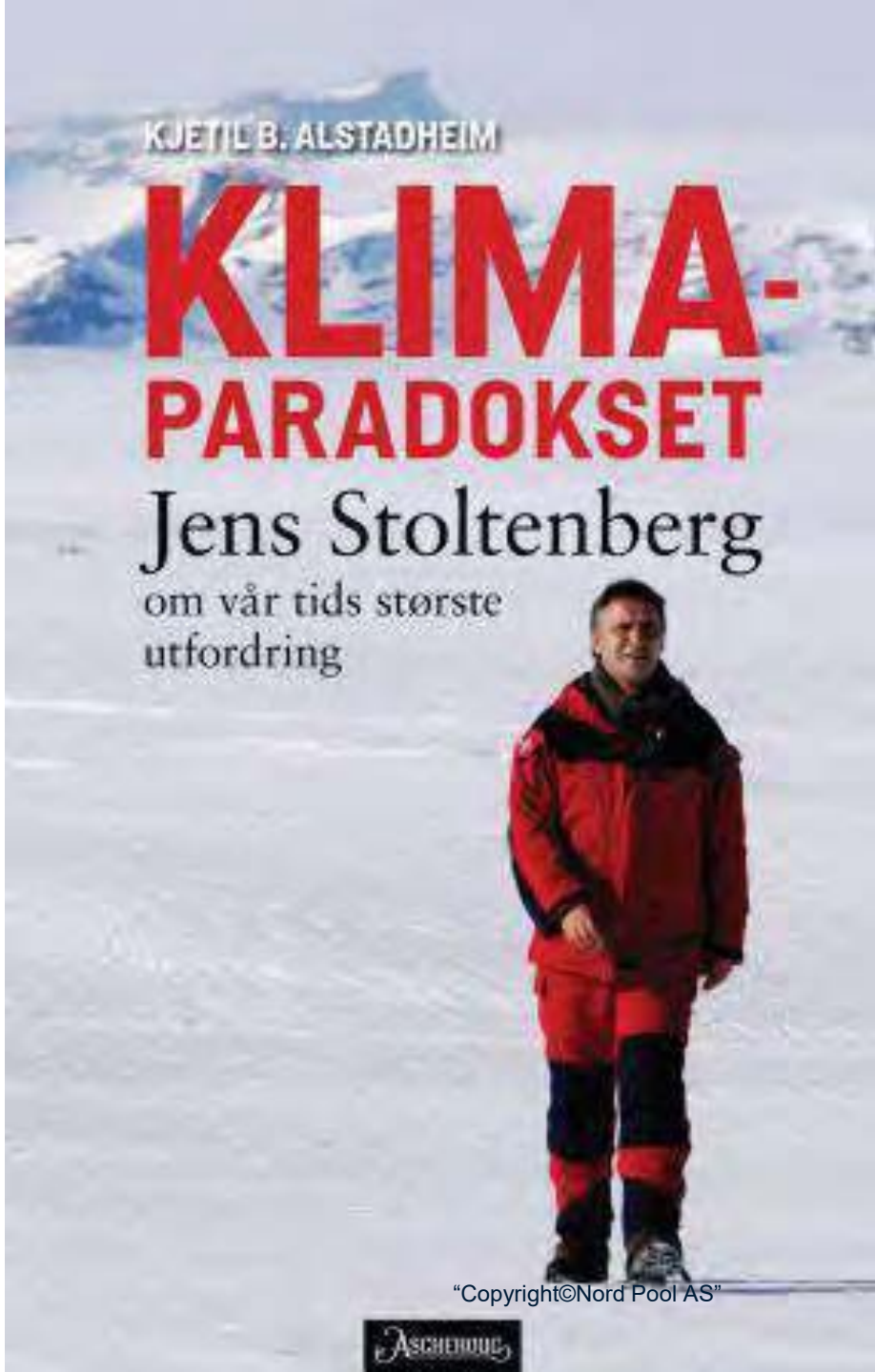
Climate paradox

$25tn in a business-as-usual scenario

In a business-as-usual scenario, researchers estimate global fossil fuel assets would be valued at over $25tn by 2036. Most would be held by the US, Russia and Opec nations.

Hover over each bubble for more information





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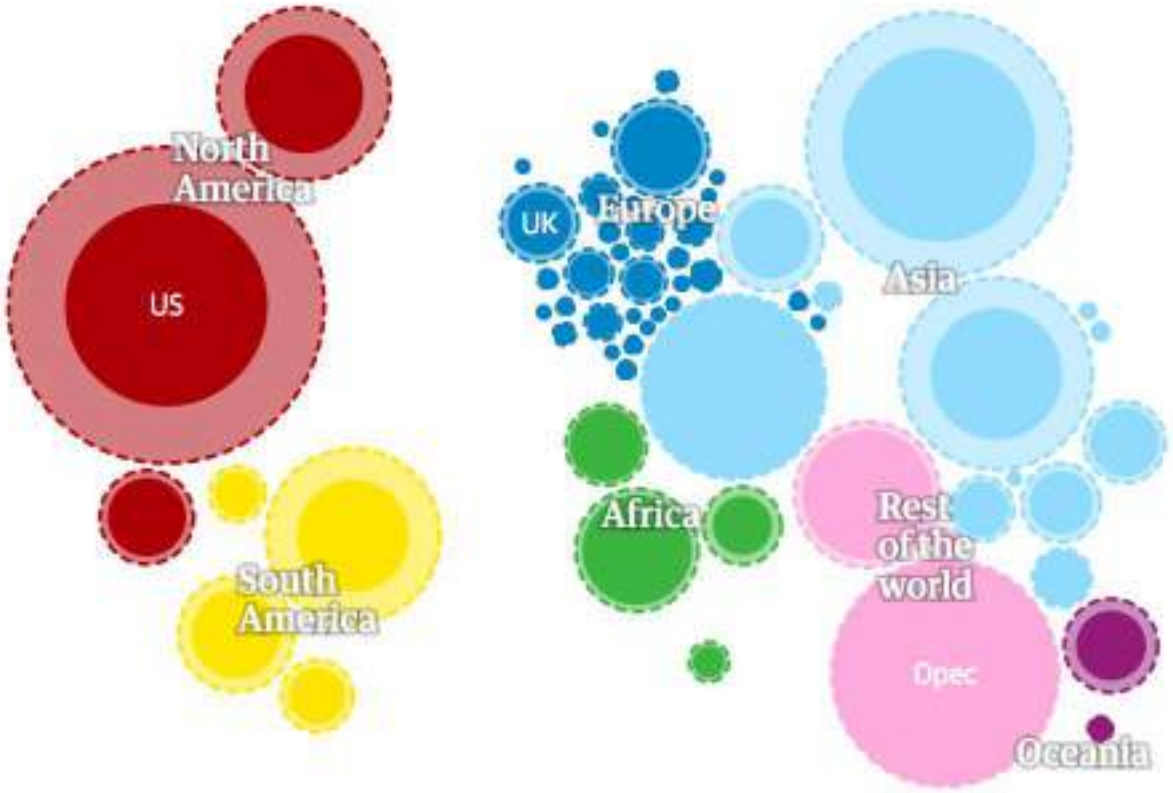
Shrinking to $14tn with net zero coming into effect

The value of fossil fuel assets is projected to fall as a result of net zero policies, which will diminish demand for oil and gas.

Estimated new value of fossil fuel assets
Stranded assets



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Computer and Computer content

NORD POOL

The Physical and Financial Power Market Course
15. & 16. June 2022,
streamed live from Oslo, Norway

Haakon Reiersen Leknes

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The Role of the TSO

Statnett National Control Center

Hans Bøhle Aarhus

Statnett

Main topics

- The power system as a technical system
  - The laws of physics in conjunction with the market
- Statnett's role as a TSO
  - Planning phase
  - Operational phase
- Operational safety
  - N-1 criteria
- The Future is Electric
  - Increased electricity demand in a low-carbon economy
  - Nordic Balancing Model

Statnett in brief

- The Norwegian TSO (Transmission System Operator)
  - Responsible for a sustainable long term energy balance
  - Maintain the instantaneous balance between generation and demand (power)
  - Regulated by the
- Statnett owns and operates:
  - Approx. 10.000 km power lines (92 % of main grid)
  - Cables to Denmark and Netherlands, Germant and UK (50%)
  - 140 transformer stations
- Part owner in Nordpool AS
- Operates and develops the Nordic power system in cooperation with the other Nordic TSOs.
- Regulated by the Norwegian Energy Regulatory Authority

The TSO challenge:
The meeting point between markets and the laws of physics

Power on a large scale can not be stored, but must be produced at the same time as it is consumed.

In a competitive market, the TSO makes sure that the system remain within the framework of the laws of physics, so that power reaches (technically) safely out to the consumers.

The construction and operation of the physical power system is based on socio-economic criteria.

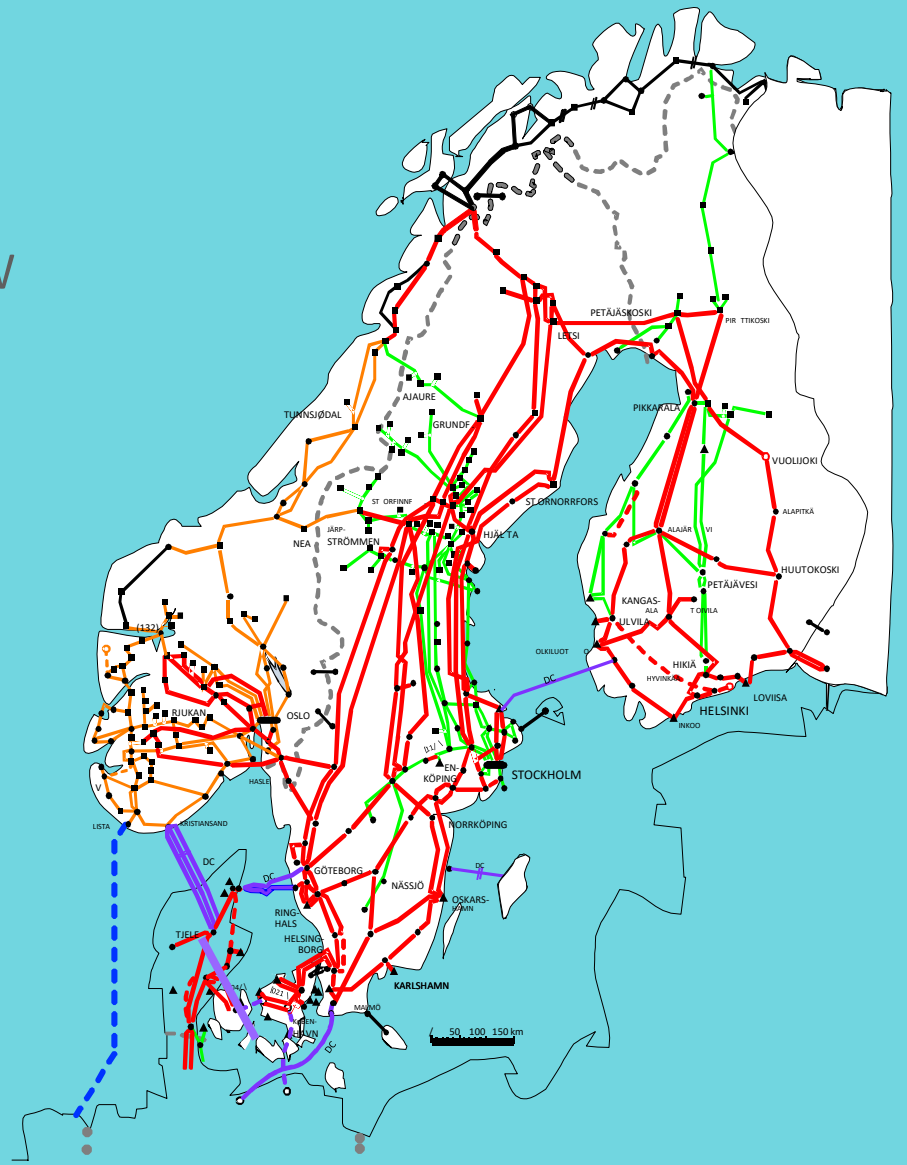
The National Control Centre of Statnett

- Maintain the balance between generation and demand of power by
  - defining *Elspot-areas* in Norway
  - defining the physical frames/limitations to the *spot-market*
  - applying the *balancing market (BM)*
  - exchanging power with other countries and make consumption forecasts
- To have operational contact with other TSOs

The Nordic system – key figures

Peak load: 69 000MW
Installed capacity: >100 000MW

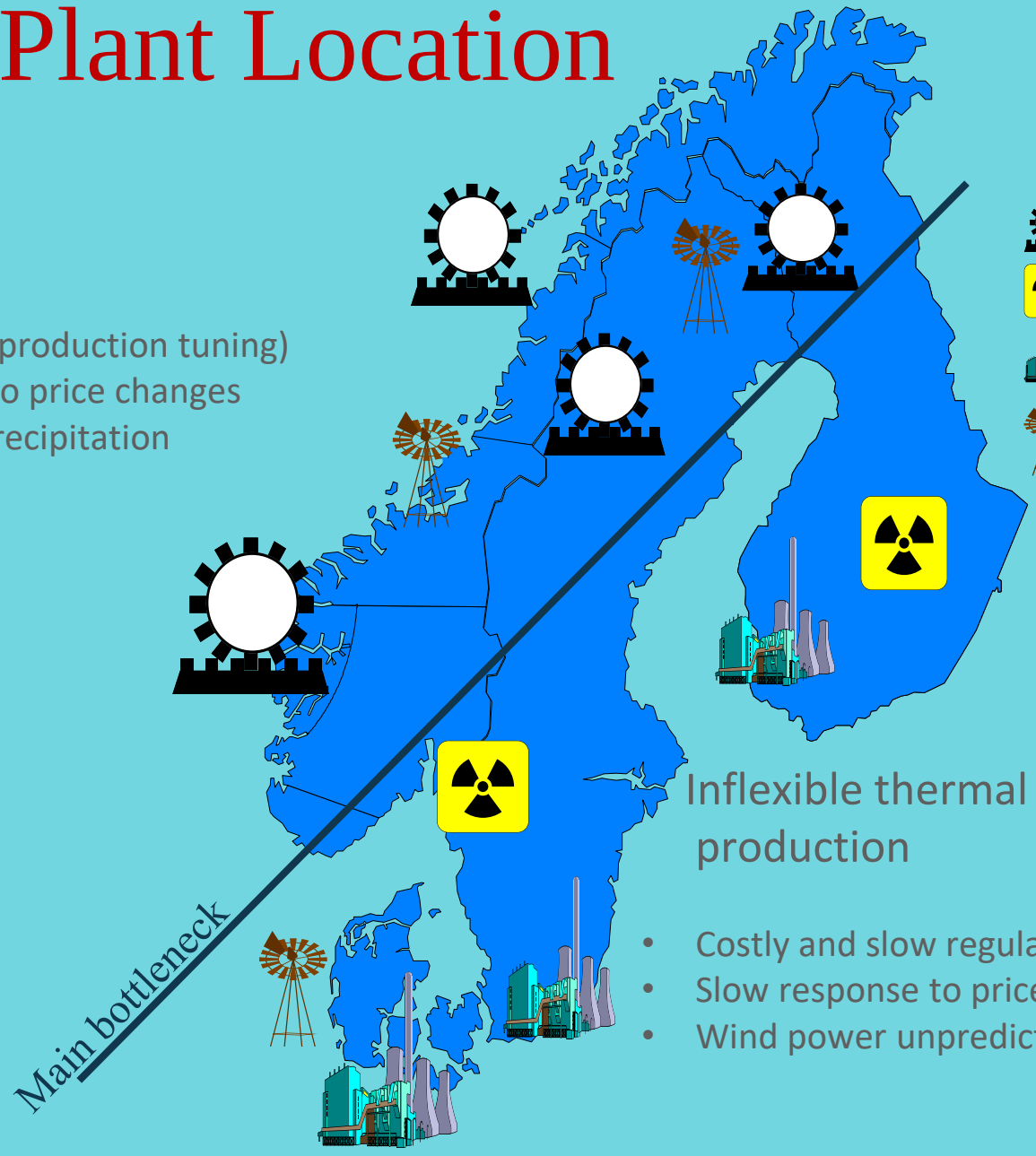
Norway:
Peak load: 26000 MW
Wind Power 4000 MW
Hydropower 33000MW



Power Plant Location

Flexible hydro

- Easy regulation (production tuning)
- Quick response to price changes
- Dependent on precipitation



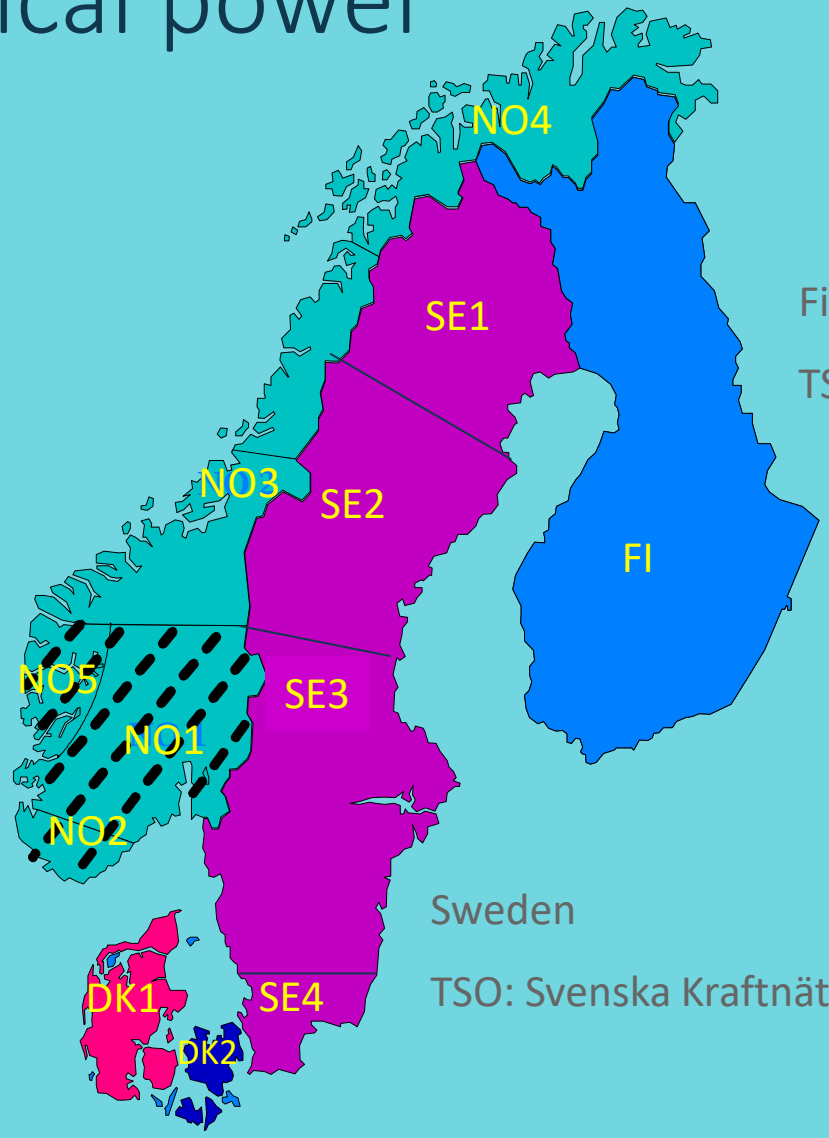
Hydro
Nuclear
Other thermal
Wind power

Inflexible thermal / wind production

- Costly and slow regulation
- Slow response to price changes
- Wind power unpredictable

Market coupling between 12 individual bidding areas for physical power

4 TSOs in the interconnected Nordic power system



Norway

TSO: Statnett

Denmark

TSO: Energinet.dk

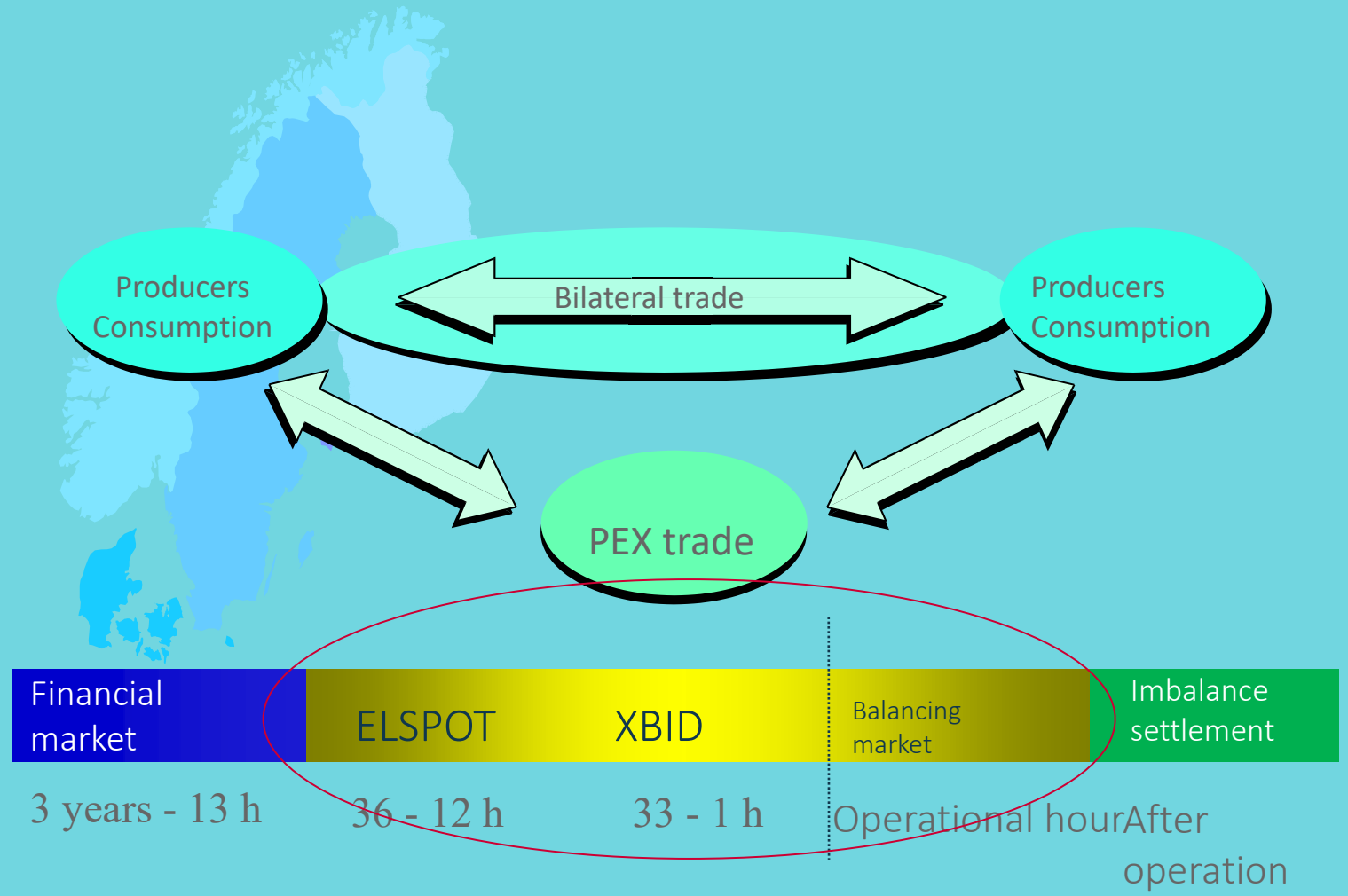
Finland

TSO: Fingrid

Sweden

TSO: Svenska Kraftnät

The market/system balancing



Balancing the system (pre operational day)

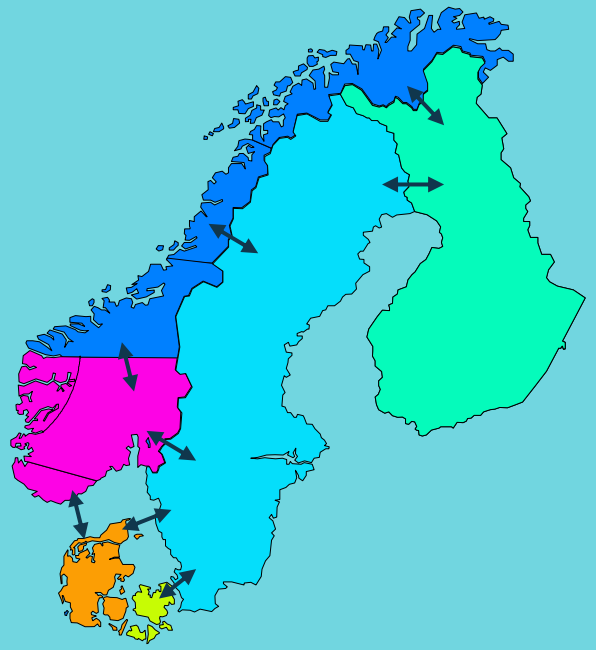
------ Season-------

TSOs define spot areas

-------Week--------

TSOs provide estimates of capacity next week

Capacity markets for tertiary reserves (RKOM)



------- Every day-------

07:30: Secondary reserves procured for next day

09:30: TSOs determine trading capacity for the next day

12:00: The players send Elspot bids to NordPool

12:45: NordPool discloses prices and flows between areas

15:00: XBID opens

16:30: Production plans submitted Statnett

18:00: Statnett purchases necessary primary reserves

21:00: Bids in balancing market sent Statnett

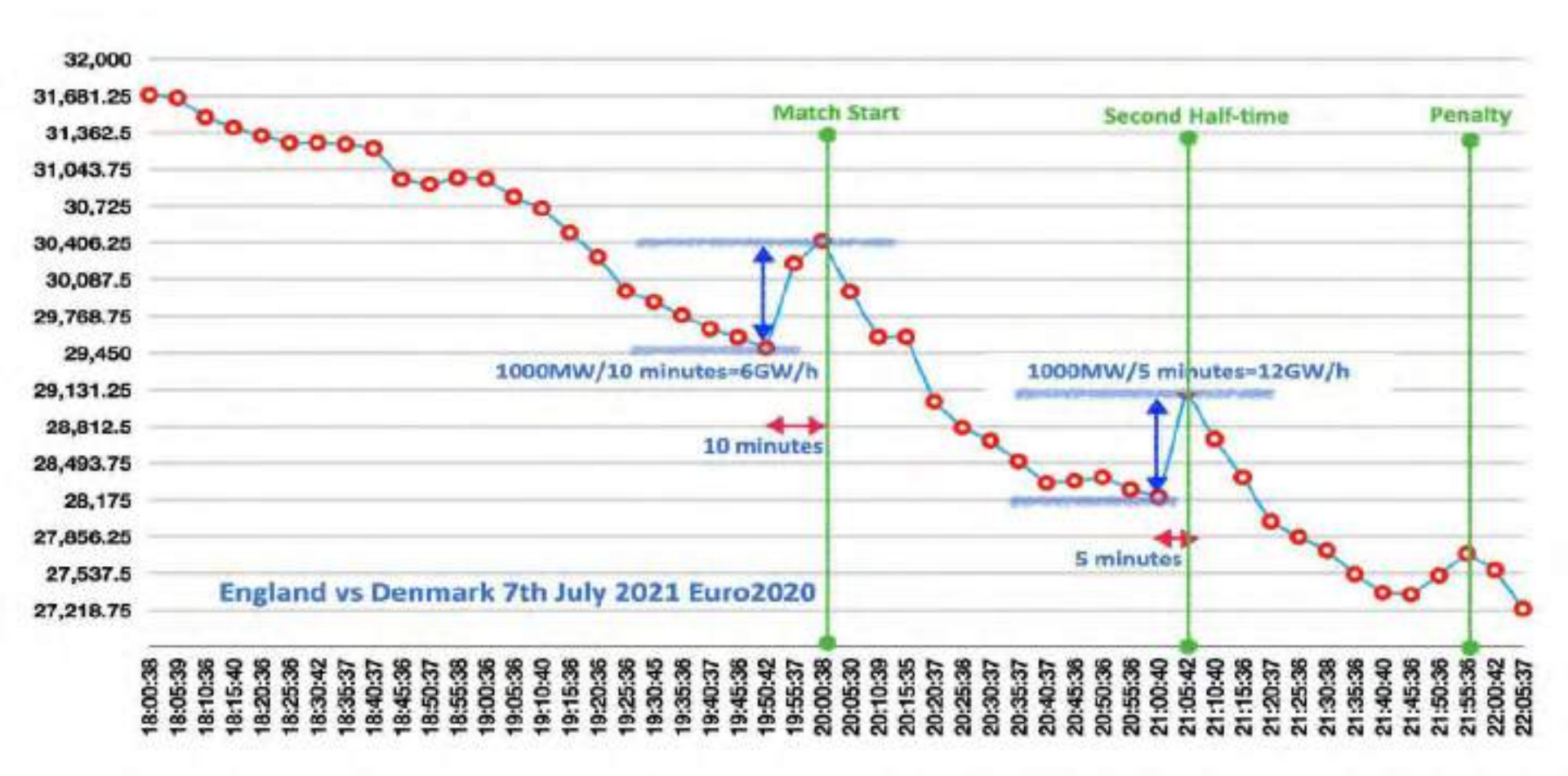
Changes in production schedules are allowed until 45 minutes before operational hour

Real time balancing

Example – Demand Surge

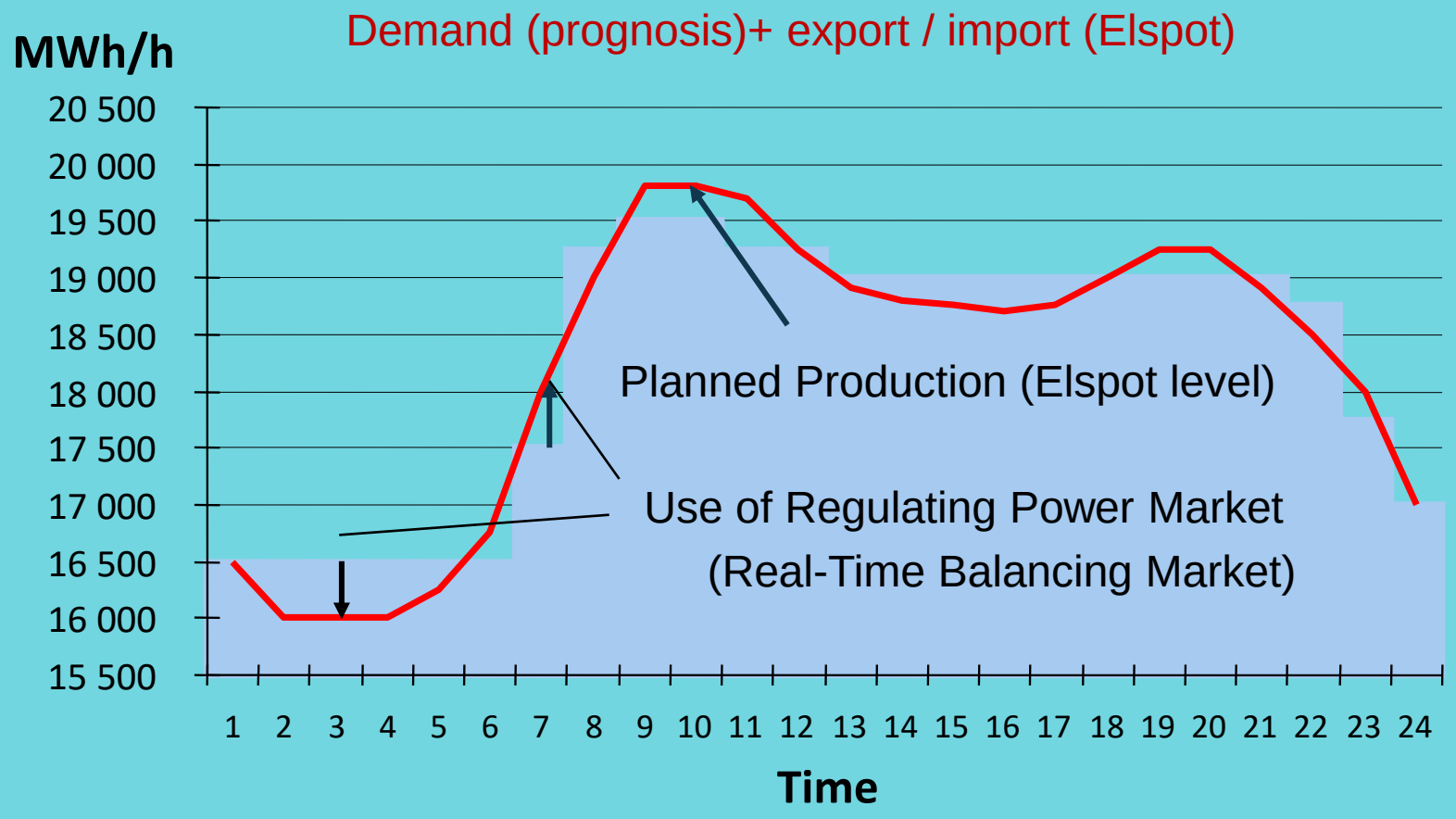
https://youtu.be/slDAvewWfrA

Recent Example – England vs Denmark



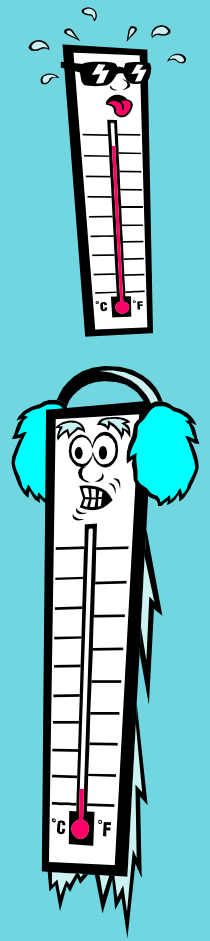
Balancing the system

Elspot ensures hourly balance in the planning phase, but while generation changes on the hour, the consumption is never constant.

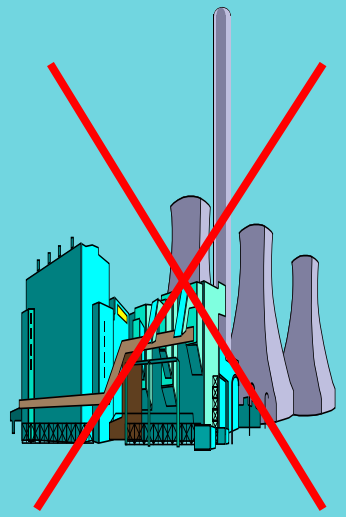


Cause of imbalance in real time

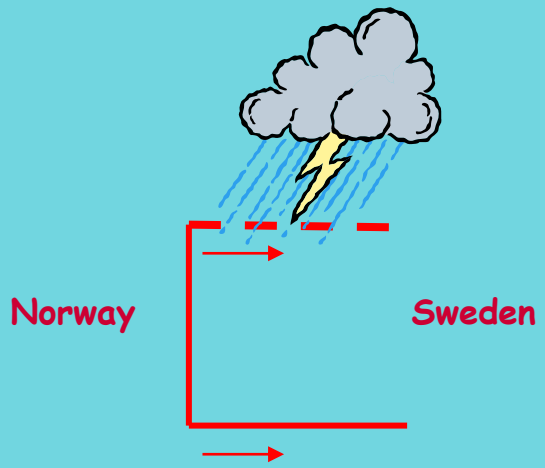
Wrong prognosis



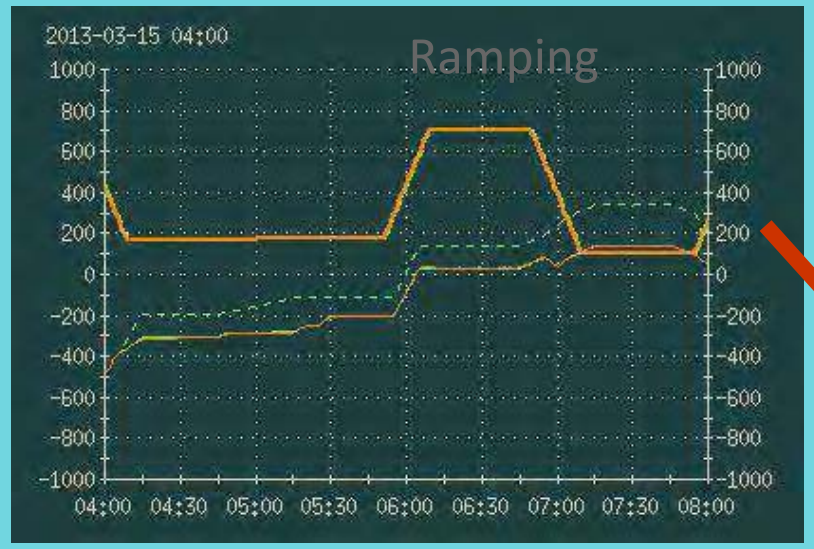
Loss of:
-consumption
-production



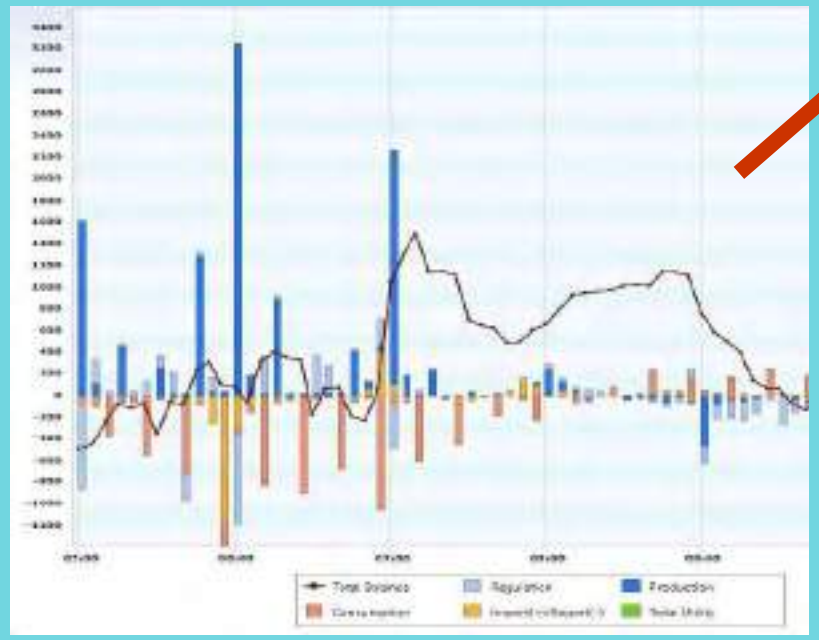
Loss of an electrical component



Cause of imbalance in real time

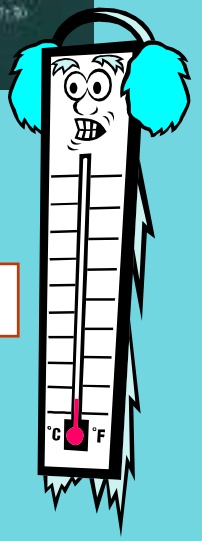


Loss of an electrical component



Wrong prognosis

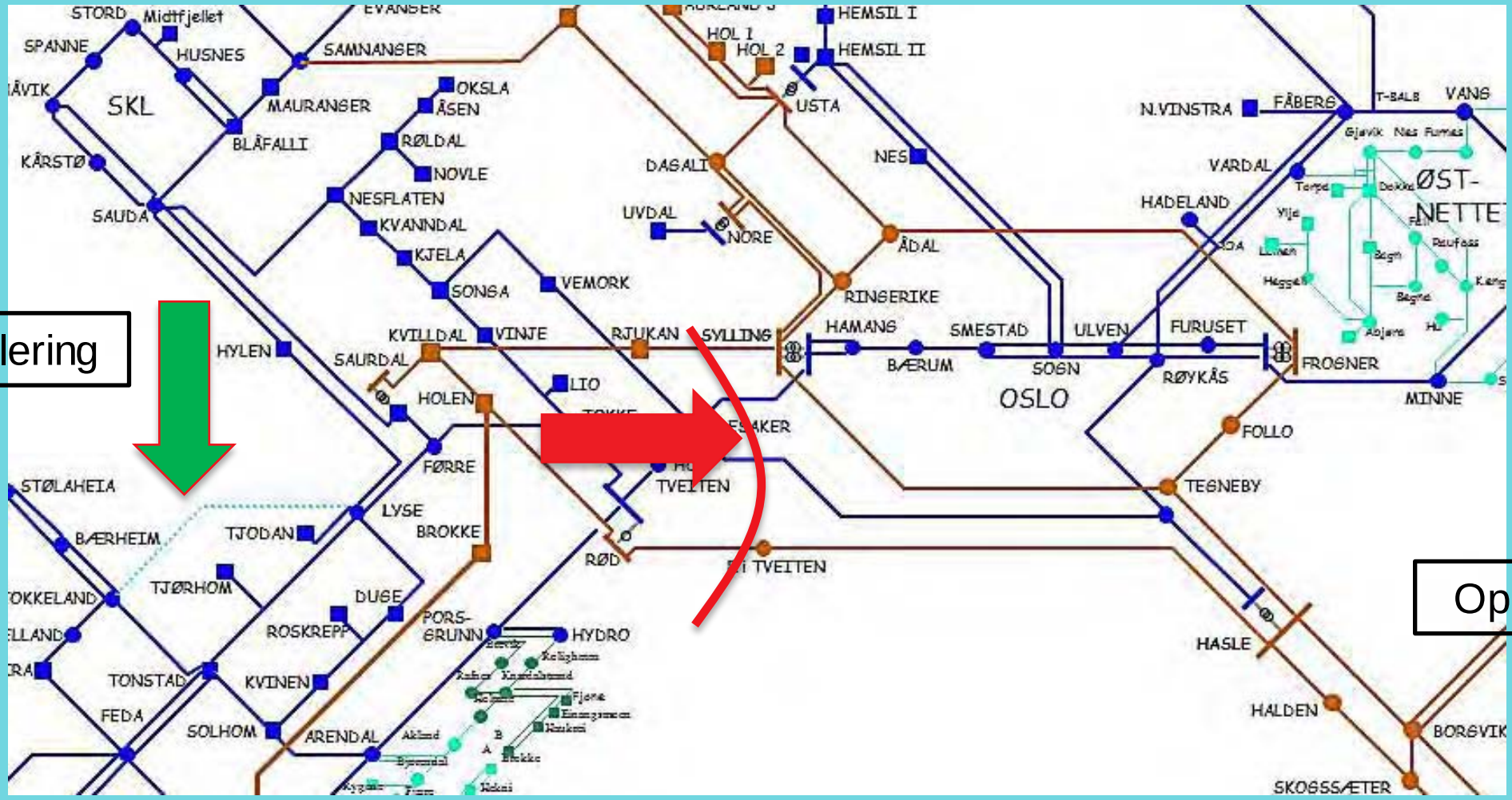
Loss of consumption or production



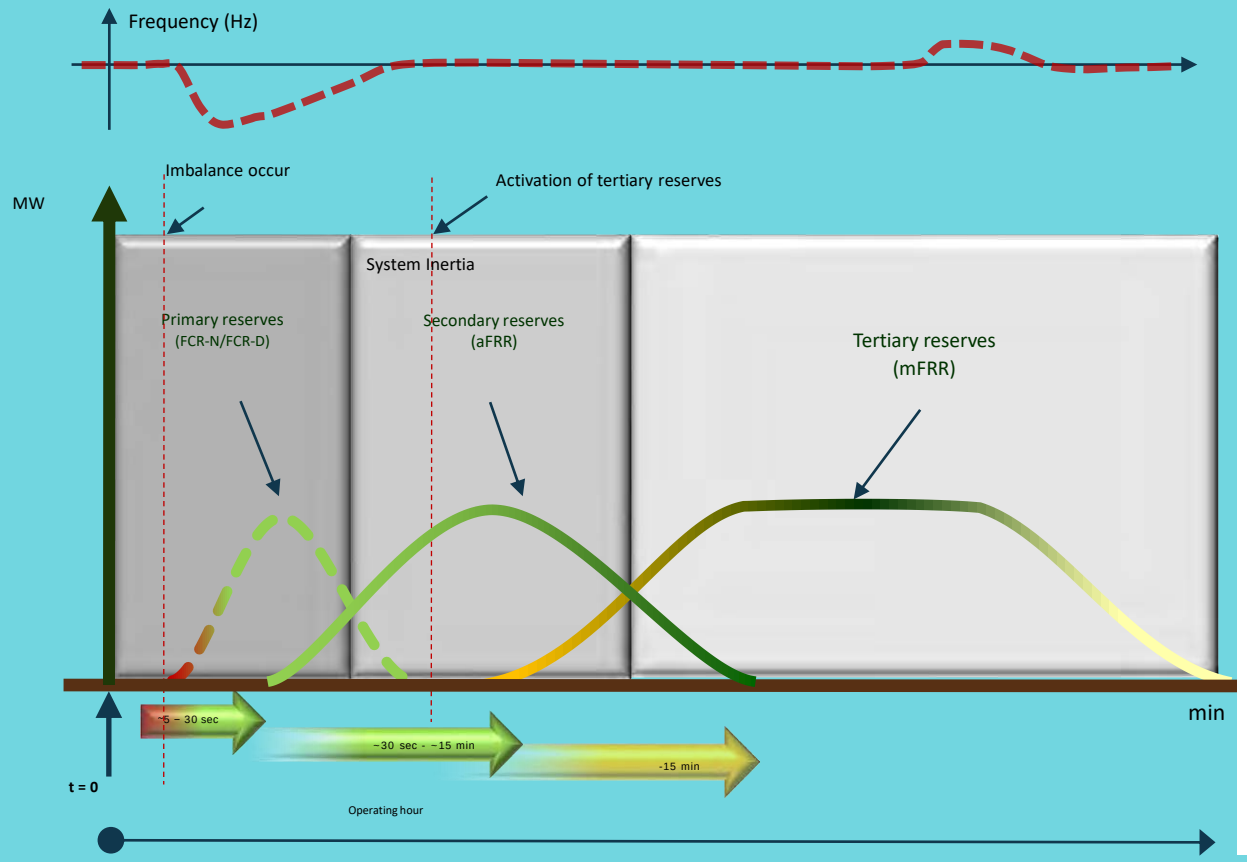
How to ensure instantaneous balance?

- Consumption = Production → 50.0 Hz
- National Control Centre will keep the frequency between 49.9 and 50.1 Hz
- Participants in the physical electricity market are responsible for their own power balance.
- In Norway we have 130 participants in this market.
- The balance responsible companies are responsible for planning in balance every hour

Congestion and bottleneck management

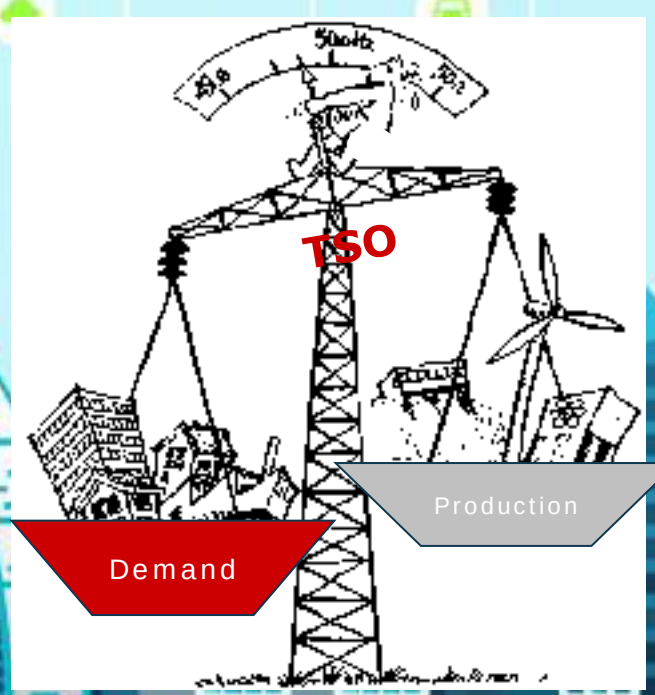


Three types of reserves



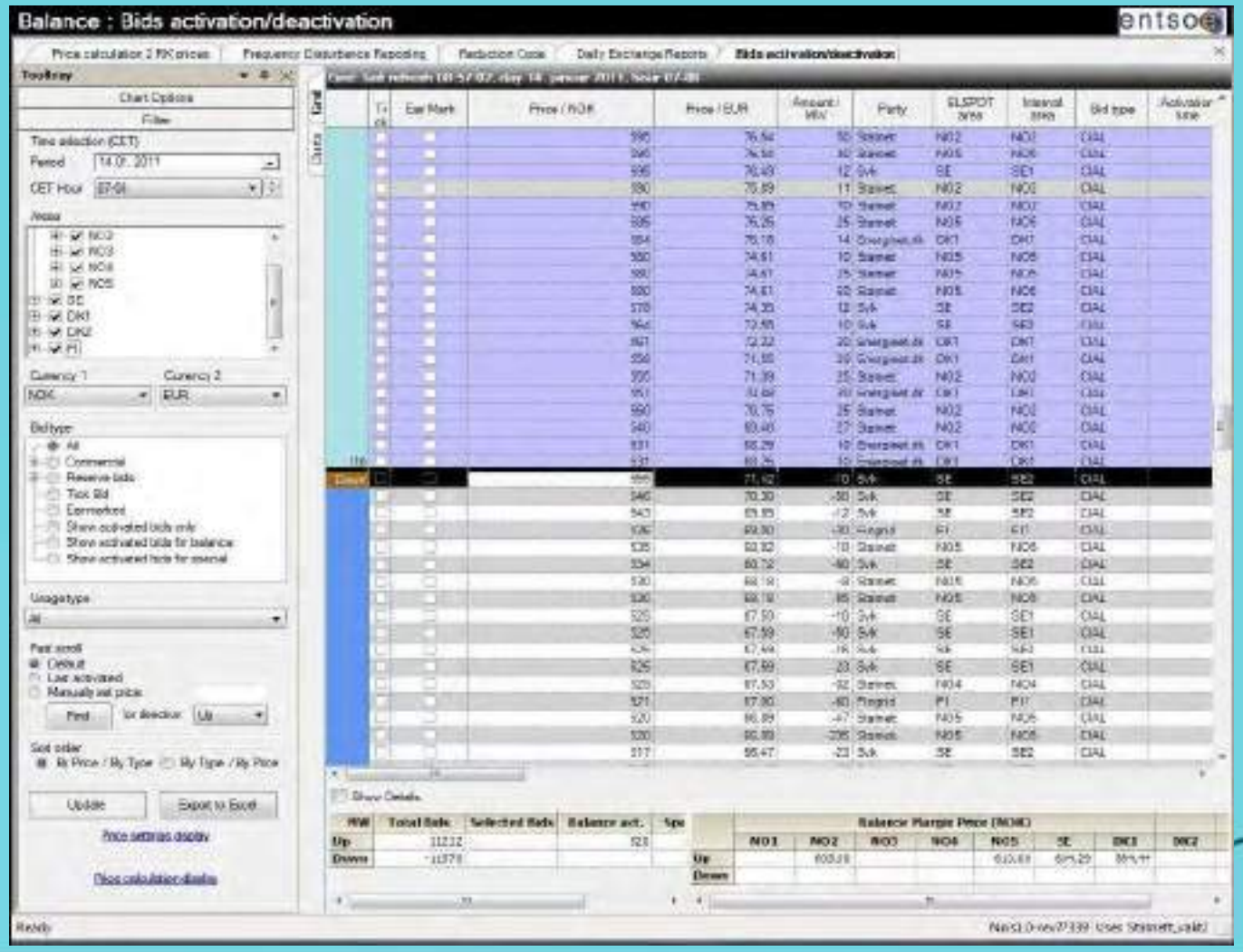
	Primary reserve FCR-N/D	**Secondary reserve** aFRR	**Tertiary reserve** mFRR/RR
Control	Automatic	Automatic	Manual
Product	Frequency activated reserve	Frequency activated reserve	Regulating Power
Acquisition	Market + Base delivery	Market based	Activation Market, Capacity Market, Bilateral agreements
Payment	Market price/ Compensation	Market price	Market price

The Nordic Balancing Market



- Bids, i.e. price/volume pairs for change of production and/or consumption (up or down)
- The TSOs use the BM to take care of the imbalances in the operational phase
  - balancing production and demand (frequency)
  - bottleneck control (local & Nordic)
  - system fault handling
- Setting a price for the participants' imbalances

Nordic Balancing Market

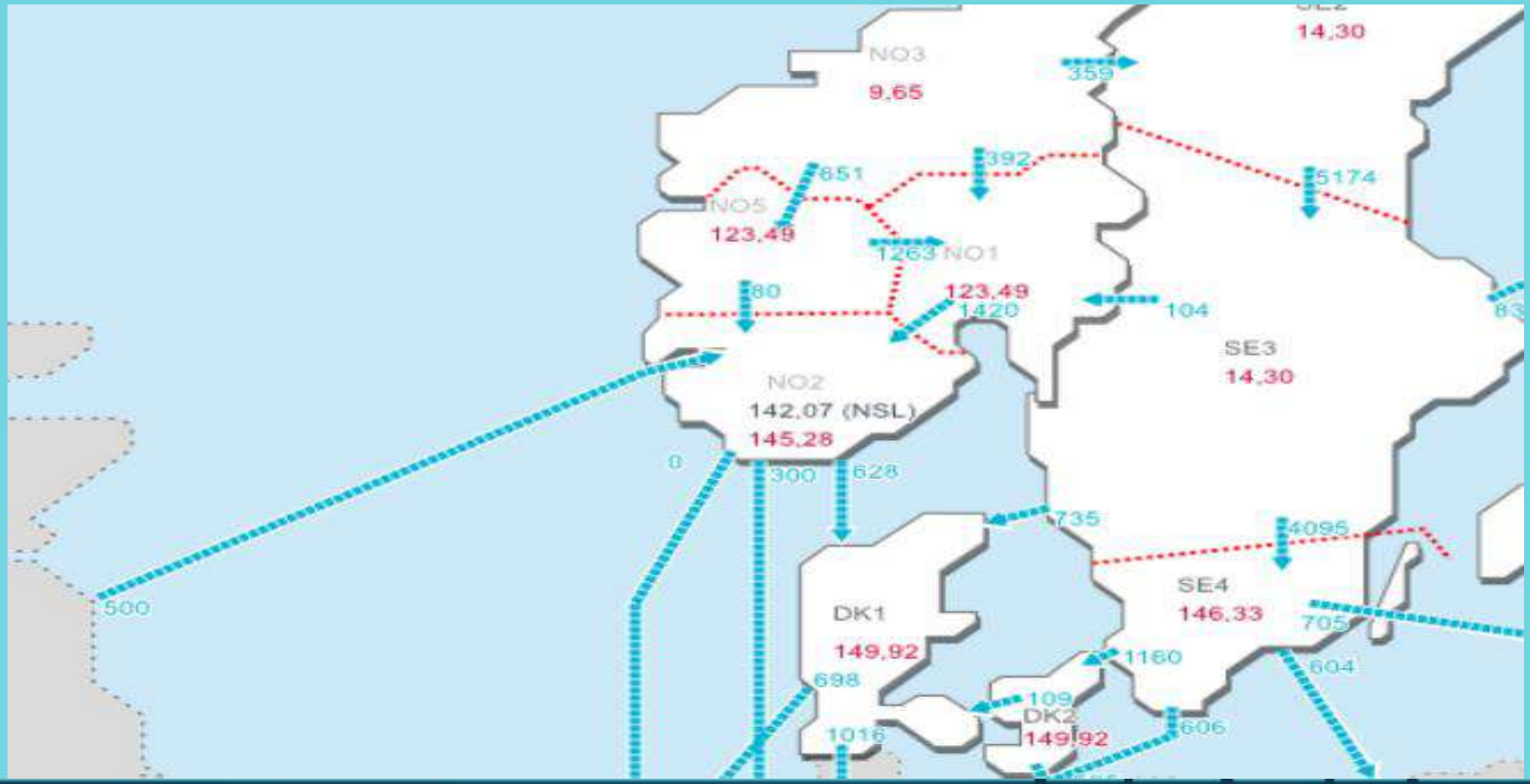


Statnett operates as a regulating agent

- Regulating up:
  - Statnett buys power on behalf of those who produce less and consume more than plan
- Regulating down:
  - Statnett sells electricity on behalf of those who produce more or consume less than plan
- Balance responsible participants' imbalances are measured, and they are made financially responsible for the imbalance

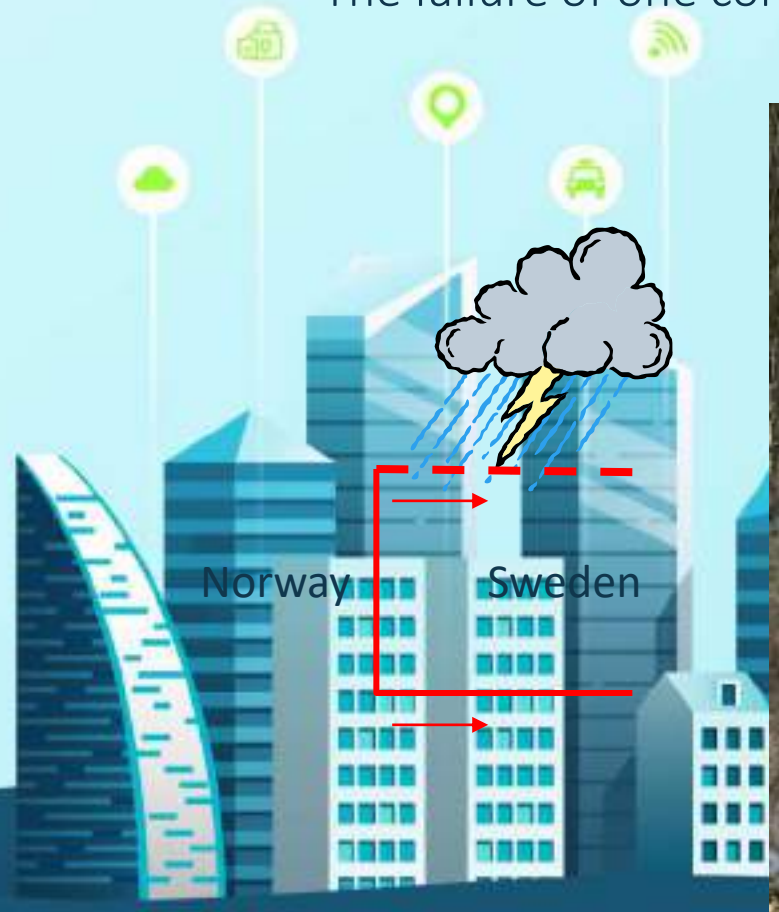
Interconnectors

Flows, arbitrage and regulation

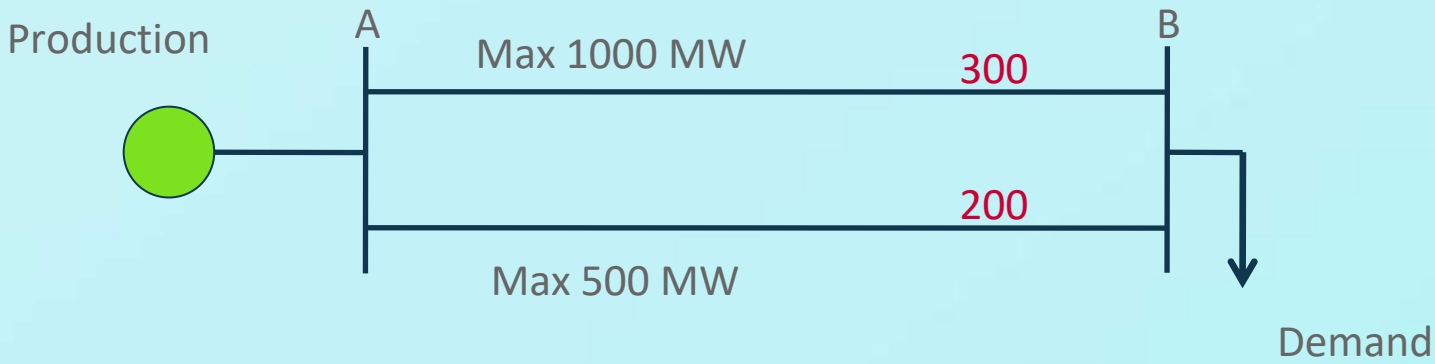


Operational safety N-1

- N-1 criteria of line failures:
  The failure of one component will not cause unacceptable problems



Operational safety / N-1 criteria



Max transmission capacity from A to B is according to N-1:

”only” 500 MW

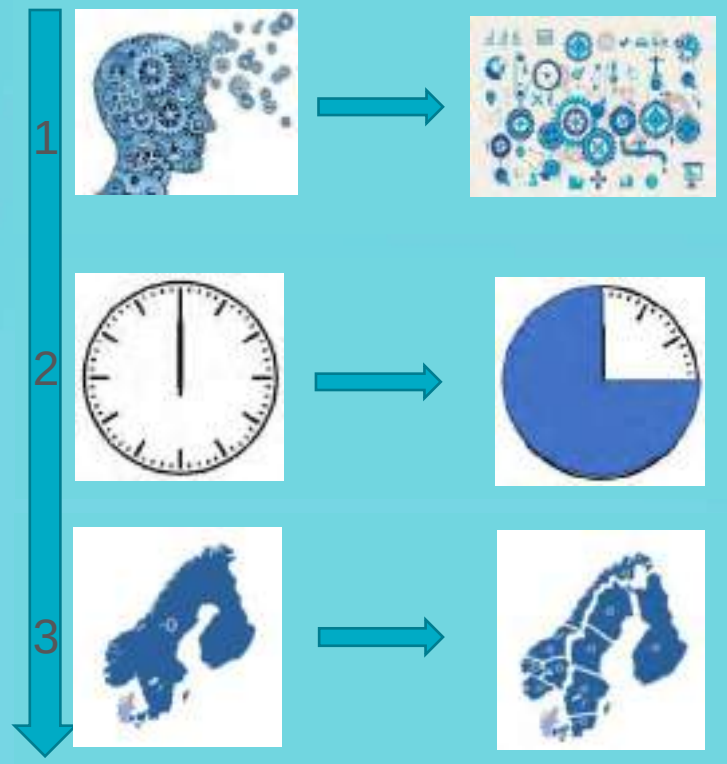
One consequence of the (N-1) reliability criterion:

Individual components are rarely utilized to their full individual capacity.

Failure Kvilldal-Rjukan

Tuesday, 4th March 2014, 09:44

Nordic Balancing Model will change everything



1

Going from manual processes based on experienced operators to data-driven automated processes is a consquence of increased complexity and demands:

- Drastic changes in control room routines
- More formalised knowledge and routines
- Better IT-tools
- Significantly improved input data

Introducing Higher time resolution

- Reduces structural imbalances, increased ramping and trade with continental markets.
- Require changes in "all" it-systems in the sector.

Balance control in each bidding zone

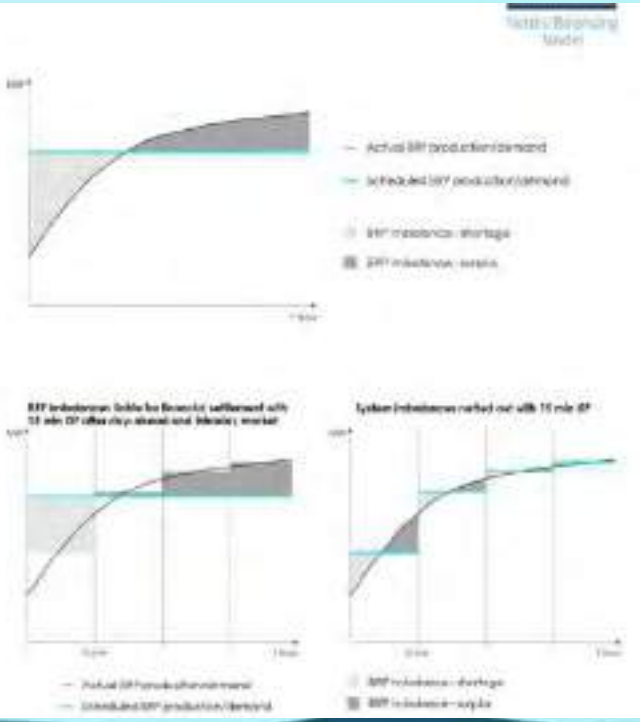
- Smaller building blocks are more manageable to balance
- Clearer areas of responsibility for wach TSO
- Good foundation for fair settlements

Shorter settlement period

Why 15min ISP

- Market model adapts to the changing power system
  - *Green transition* – increasing amount of intermittent energy

  → Incentivising maintaining the balance in more *real time* for more cost-efficient power system
- Increased possibilities for ancillary services
- Electricity market harmonization in Europe
- European legislation (EBGL, electricity balancing guideline)



Flex from EVs can be simple or advanced

Technically feasible – but uncertainty related to business models and market entries in different operating regions

1 Optimize charging for lower electricity prices

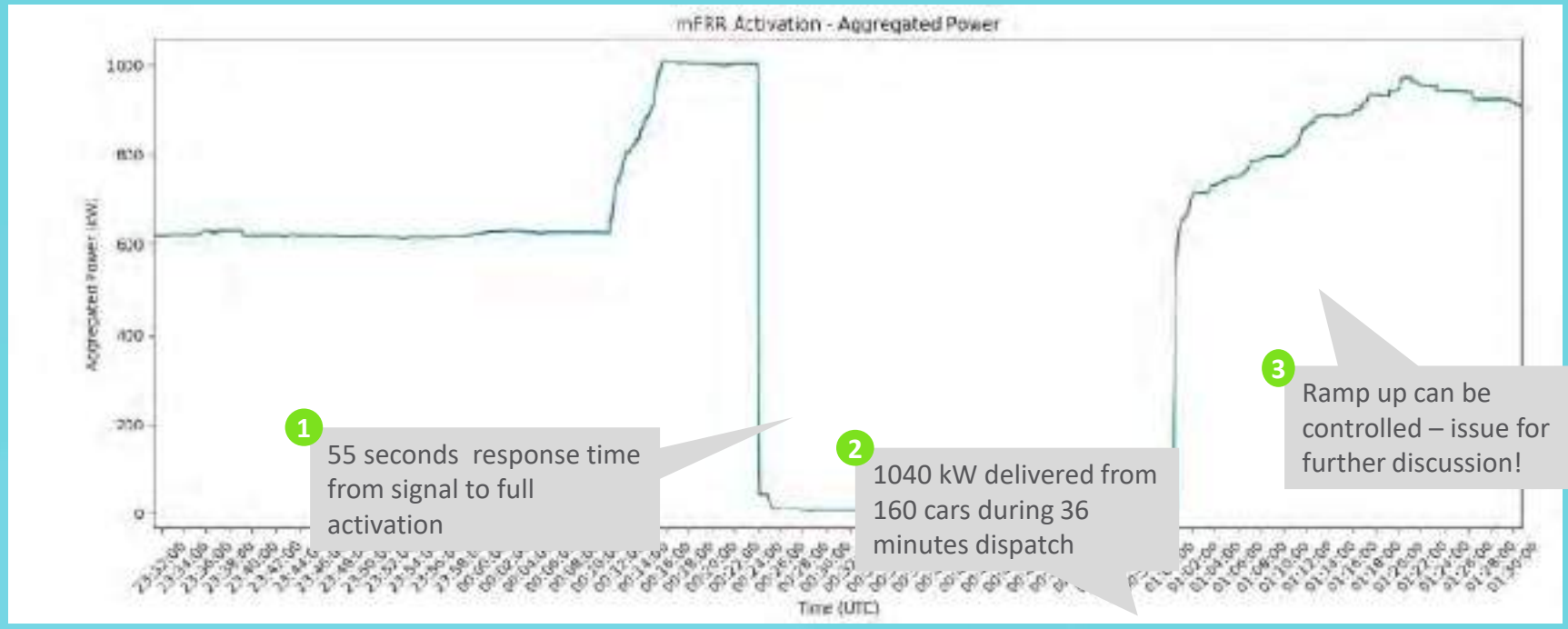
2 Delay (or start) charging for flexibility services

3 Vehicle to grid (V2G)

Several R&D and commercial pilots ongoing in Nordics (and Europe).

Already happening

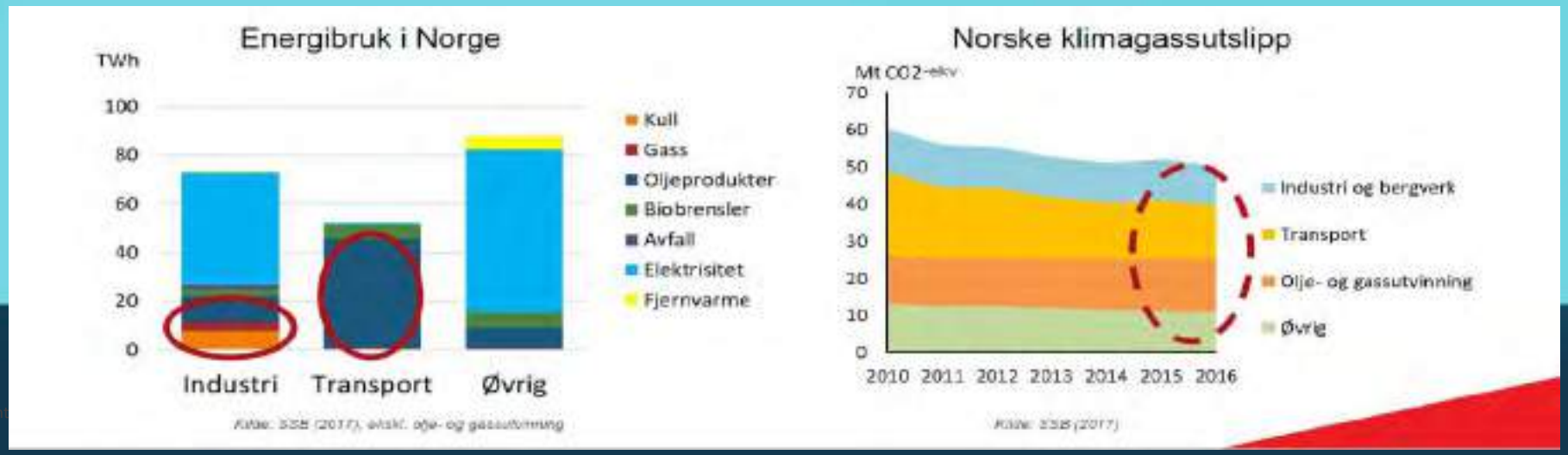
Automatic activation of 1 MW equaling 160 cars



29th of May

The future is electric

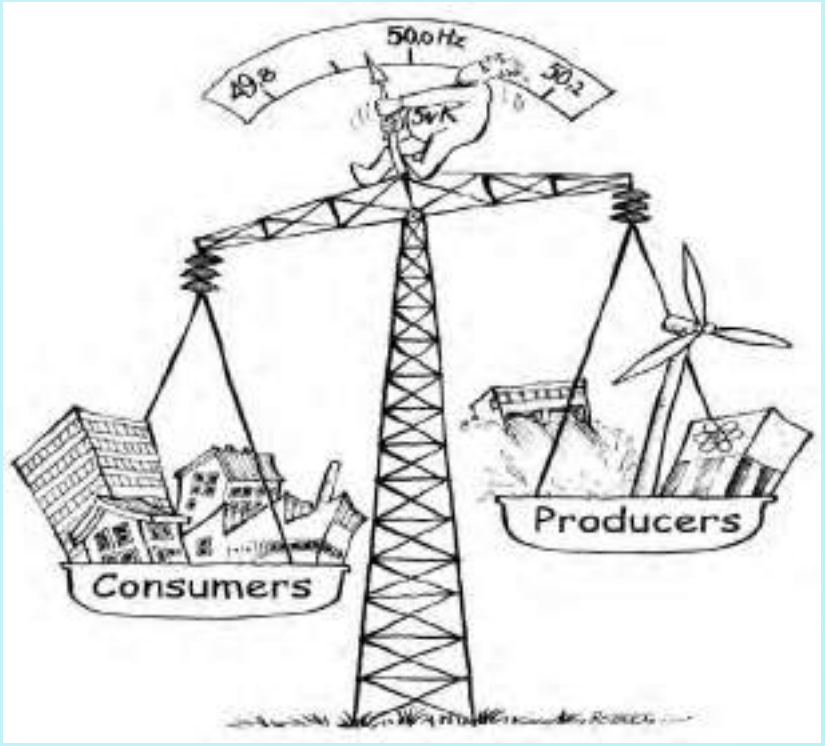
- Fossil fuels in Norway are used mainly for transport and industry
- Conversion to electricity would increase electricity consumption by an estimated 50TWh
- Total primary energy use would decrease by 80TWh
- CO2-emissons would fall dramatically



Det **grønne** taktskiftet

Questions?

- DSO - TSO



Please feel free to contact me:

hansa@statnett.no

Tel. +47 92440133

More information regarding Statnett's role as a TSO can be found at

www.statnett.no

European day-ahead markets

The Physical and Financial power markets 15-16 June 2022

Hilde Rosenblad

Senior Adviser Public and Regulatory affairs

Kristiane Granaasen Jørstad

Trading Advisor

Isidora Micic

Senior Market Coupling Adviser

NORD POOL

Agenda

Market for electricity – the power market model

The Day-ahead market

Order types

Day-ahead calculation

European Integration

Looking ahead

NORD POOL

Town Square – Bazaar – Market Place

A place where buyers and sellers meet

- Many buyers and sellers
- Gather liquidity – easy access
- Information – comparing quality and price
- Competition
- Transparent price formation

- Satisfaction
- Trust

NORD POOL

What is a Power exchange?

Market place for electricity!

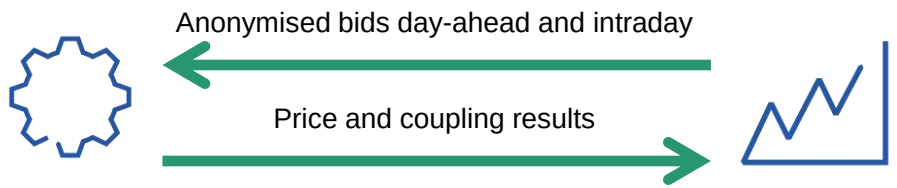
- Electricity – a commodity bought and sold
- Wholesale market
- Price representing the true market situation
- Supply and demand decide the price
- Physical or financial delivery

- Fundamental properties of electricity makes it different from other commodities:
  - Generated and consumed at the exact same time
  - Limitations in the transmission grid

NORD POOL

Two roles of a power exchange

The commercial power exchange (customers) and the market coupling operator (other market participants).



Market participants

Common European pricing algorithm and markets

TSOs

Interconnectors

Market coupling operator

Anonymised/aggregated bids and transmission capacity

Price coupling results (day-ahead)
Matched trades (intraday)

Nominations and electricity flow

Available transmission capacity

Anonymised/aggregated bids and transmission capacity

Power exchange

Customer bids

Trade confirmation

Clearing and settlement

Customer relationship management

Customers

Producers

TSOs

Companies

Industry

Role of Nord Pool

- To provide liquid, efficient and secure power markets to our customers
- To provide accurate information to the whole market, ensuring transparency
- To provide equal access to market for everyone wanting to trade power
- To be the counteparty for all trades; guaranteeing settlement and delivery

Trading of electricity – towards delivery

Financial market

Hedging of prices on exchange or OTC

Day Ahead market

The DAM is a daily auction that closes at 12:00 CET. System price and area prices are calculated for delivery each hour the following day.

Intraday market

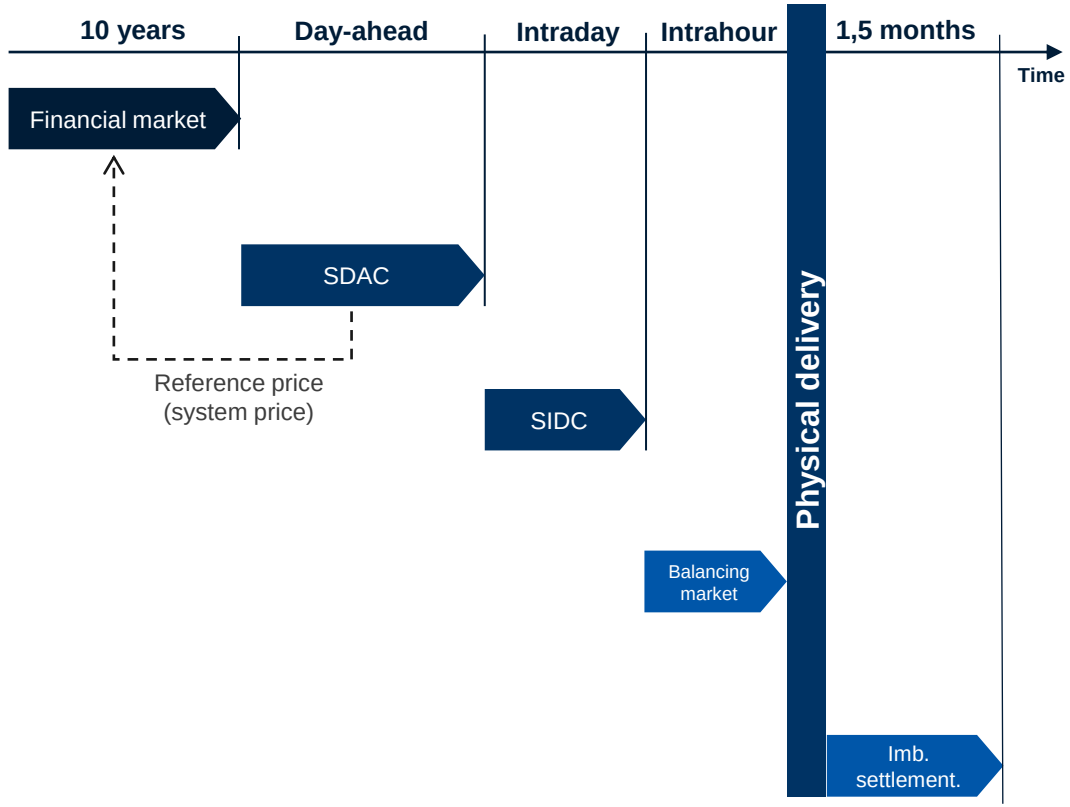
The ID is a continuous (24/7) market and closes shortly before each delivery hour.

Balancing markets

Intra-hour market for maintaining the power balance

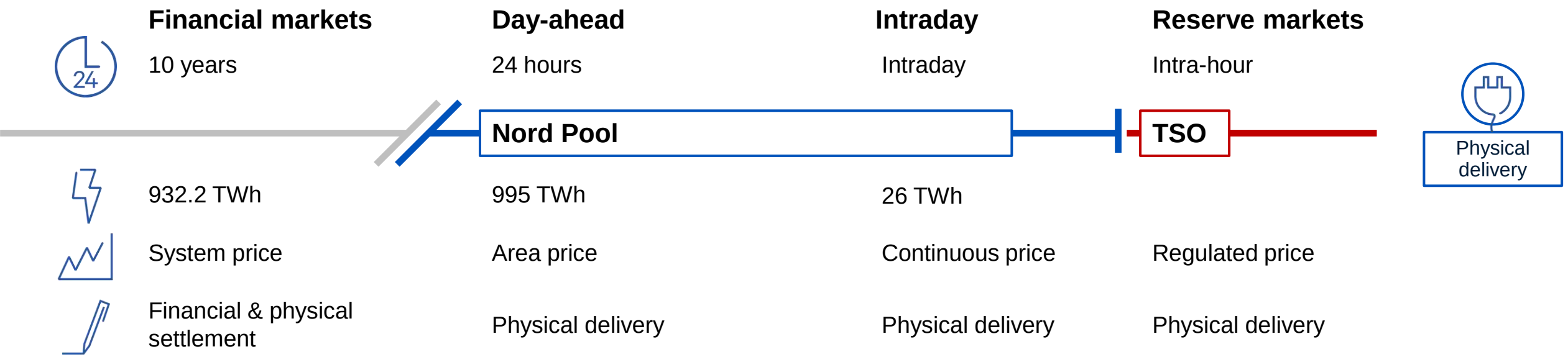
Imbalance settlement

Post-hour settlement of deliveries between market participants



Nord Pool's part in the wider electricity market

How the power markets fit together.



The financial power market consists of derivatives used for e.g. hedging and speculation.

A significantly larger market than the physical, with annual trading representing multiple times yearly production.

Day-ahead is the main market, with intraday providing flexibility should variations in supply or demand occur, giving producers and consumers a marketplace to “trade themselves into balance”.

Increasing presence of speculative traders.

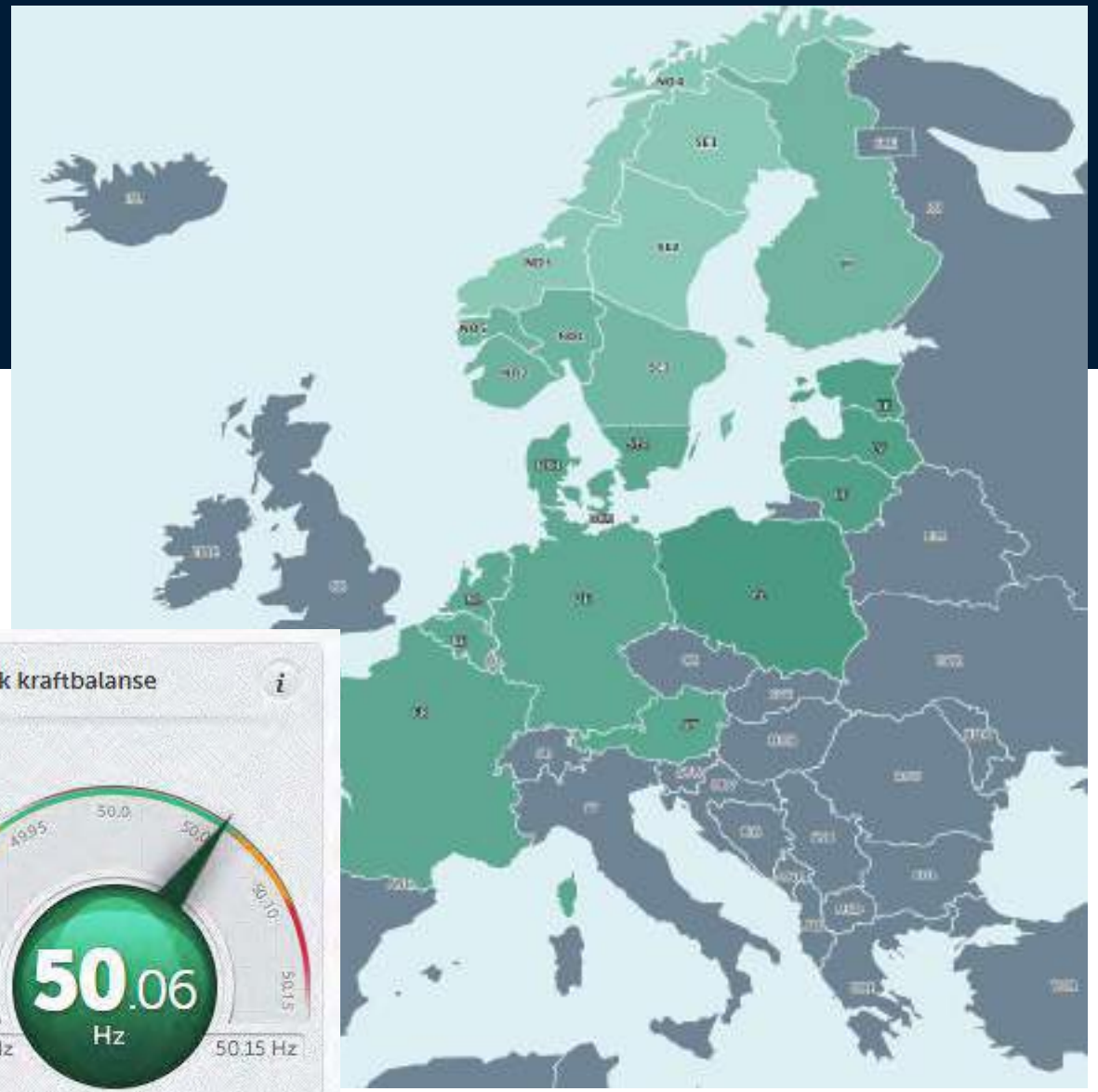
Imbalance at the time of intraday gate closure (1h before delivery in the Nordics) will result in penalties by the system balance responsible, the TSOs.

Intra-hour power flow is directly managed by the national TSOs in order to provide power balancing in real-time to ensure the right frequency of the grid and security of supply.

Volumes: (1) Financial markets: 2020 Aggregated of all Nordic derivatives traded on Nasdaq Commodities. (2) Nord Pool: 2020 figures.

The constraints

- In trading and delivery



- Time aspect: Power needs to be produced in the same second as it it used;
  - E.g. When you turn on the light, during that exact time, the same amount of power has to be produced in a powerplant.
- The Grid needs to be in balance – keeping a stable frequency at 50HZ
- There are limits to how much electricity can be transported through the electricity grid between areas and countries,
- Market divided into geographical areas – bidding zones

The Transmission System Operator - TSO

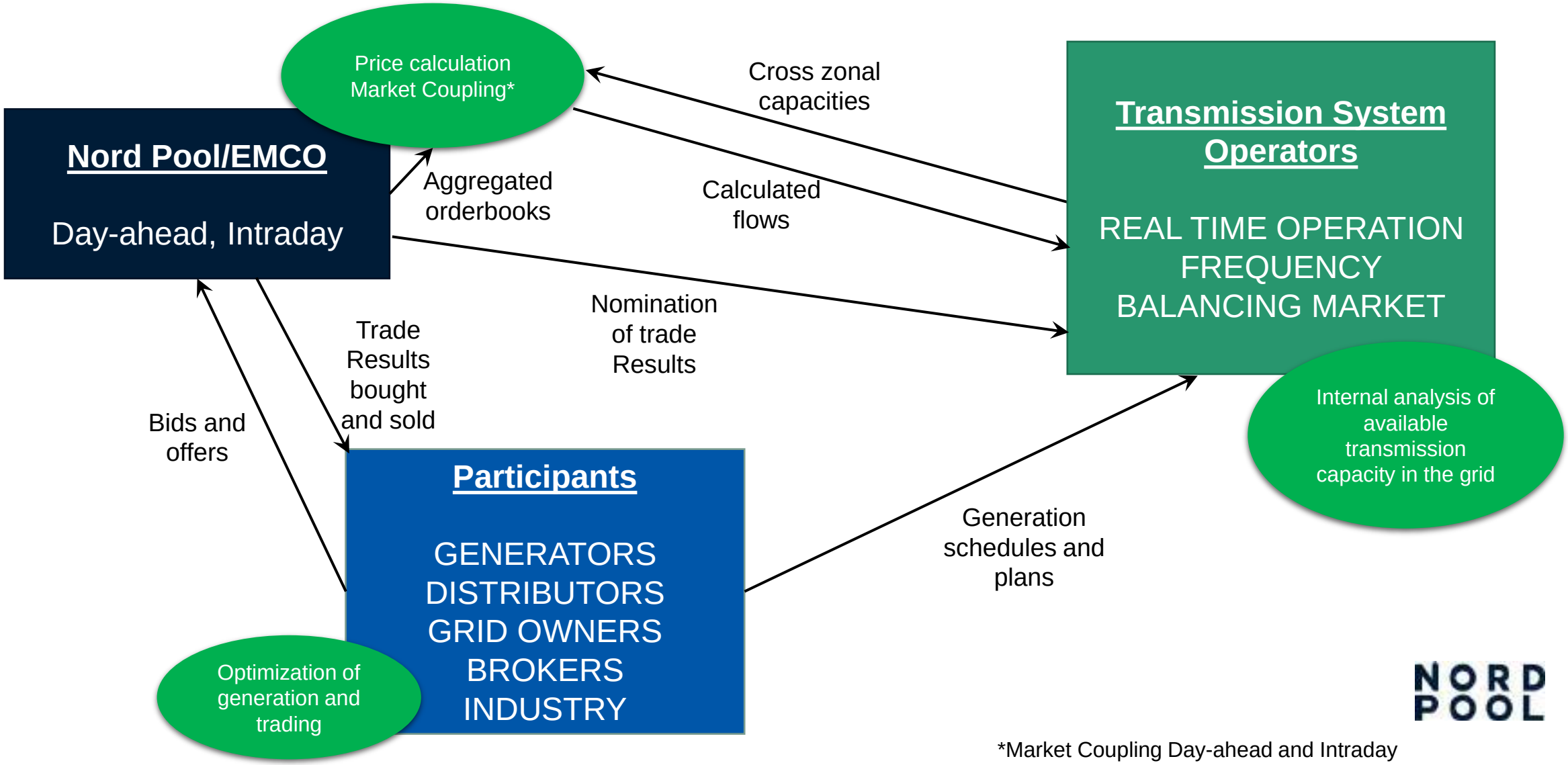
Builds, owns and runs the central power grid – the electricity distribution highway – and make sure that there is alway balance between consumption and generation – securing security of supply.

- System responsibility
- Balancing markets
- Reserves
- Imbalance settlements
- Physical exchange
- Grid Tariffs
- Grid developments

https://www.statnett.no/for-aktorer-i-kraftbransjen/tall-og-data-fra-kraftsystemet/

Roles in the power market

Byers, sellers, the marketplace and the TSOs



*Market Coupling Day-ahead and Intraday

Bidding Zone

Some countries/TSO areas are divided into two or more bidding zones;

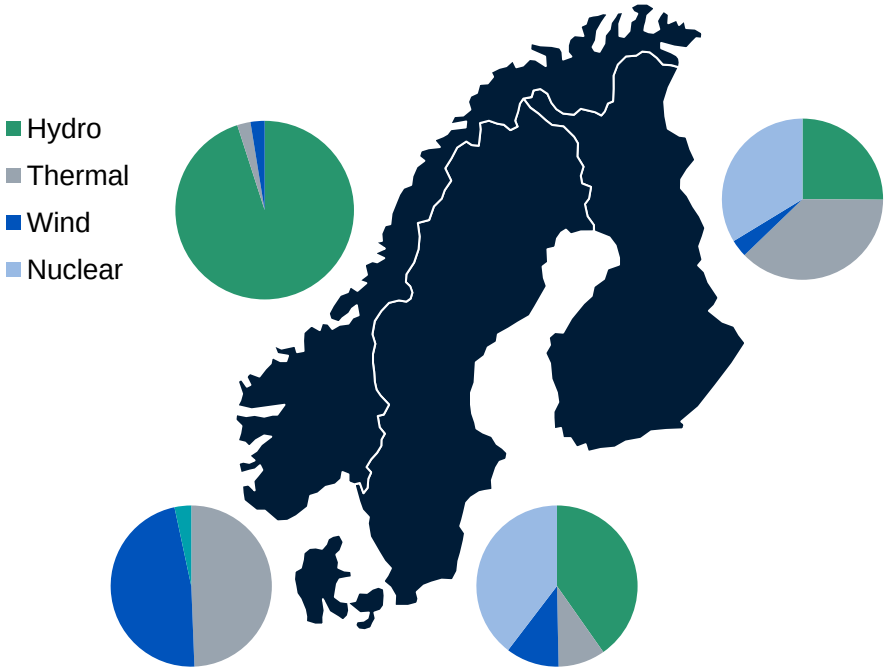
- A bidding zone is a geograpical area where there is assumend no internal congestions in the grid
- The TSOs determine the number and location of bidding zones in each country
- Bidding zone borders reflect congestions and limitations in transmission capacity.
- In Norway, Sweden and Denmark each country is divided into Bidding zones.
- Transmission capacity between bidding zones and countries are set by the TSOs and made available to the markets. Flow calculation is done implicit in the matching of orders.
  - Power flows from zones with lower price towards those with higher price.

Interactive map on https://www.nordpoolgroup.com

Cooperating across borders - the Nordic model

Connecting the Nordic countries ensures optimal use of natural resources and more stable prices

Nordic production capabilities



Connecting markets with differing production profiles provides stability to the system

Hydrology

Wet year: higher hydro production

Dry year: lower hydro production

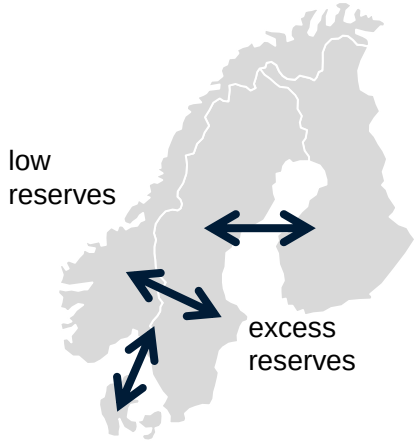
Seasons

Hydropower highly seasonal

Wind power highly seasonal

Nuclear neutral

Fossil power neutral



Daily weather

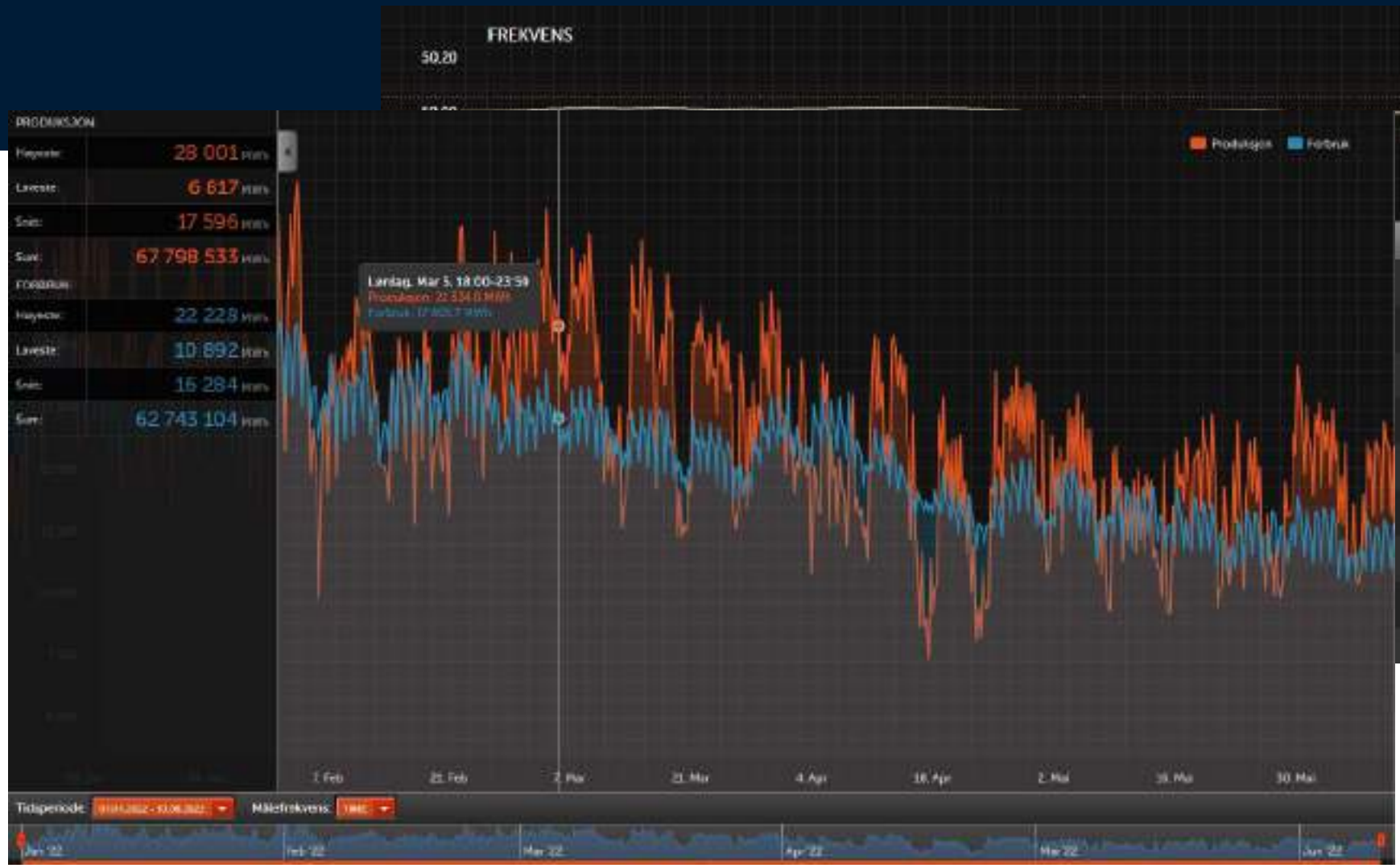
Wind power is neither flexible nor storable

All other sources are flexible

NORD POOL

Nordisk kraftbalanse

Data table continously updated for realtime information on www.statnett.no



15:41	15:42	15:43	15:44	15:45
EE	LT	LV	Total	
1 055	503	464	40 911	
-	-	-	7 659	
-	289	410	23 385	
1 055	5	13	4 145	
0	72	0	4 972	
-	137	41	750	
919	1 458	863	41 999	
-136	954	398	1 088	
			10.06.2022 15:46	

Day-ahead and intraday

The day-ahead market is the main arena for physical power trading, supplemented by the intraday market.

Day-ahead market

Auction-based

Until 10:00

Power transmission **capacities** are submitted by the transmission system operators for each bidding area in the market.

08:00 – 12:00

Buyers and **sellers** enter their **bids** and offers into the trading system.

Until 12:00

Buyers plan how much power they will need, and **sellers** how much they can provide.

12:00 – 13:00

Based on orders and transmission capacity, prices for the **Multi Regional Coupling** are calculated simultaneously using the common European algorithm. Prices are calculated for each hour of the next day.

12:00 – Auction closes

12:45 – Prices are announced

14:00 – 15:00

Trades are **invoiced**

07:00 08:00 09:00 10:00 11:00 12:00 13:00 14:00 15:00

Intraday market

Continuous trading

In the intraday market trading takes place every day of the year, **around the clock** – allowing for efficient balancing of the market.

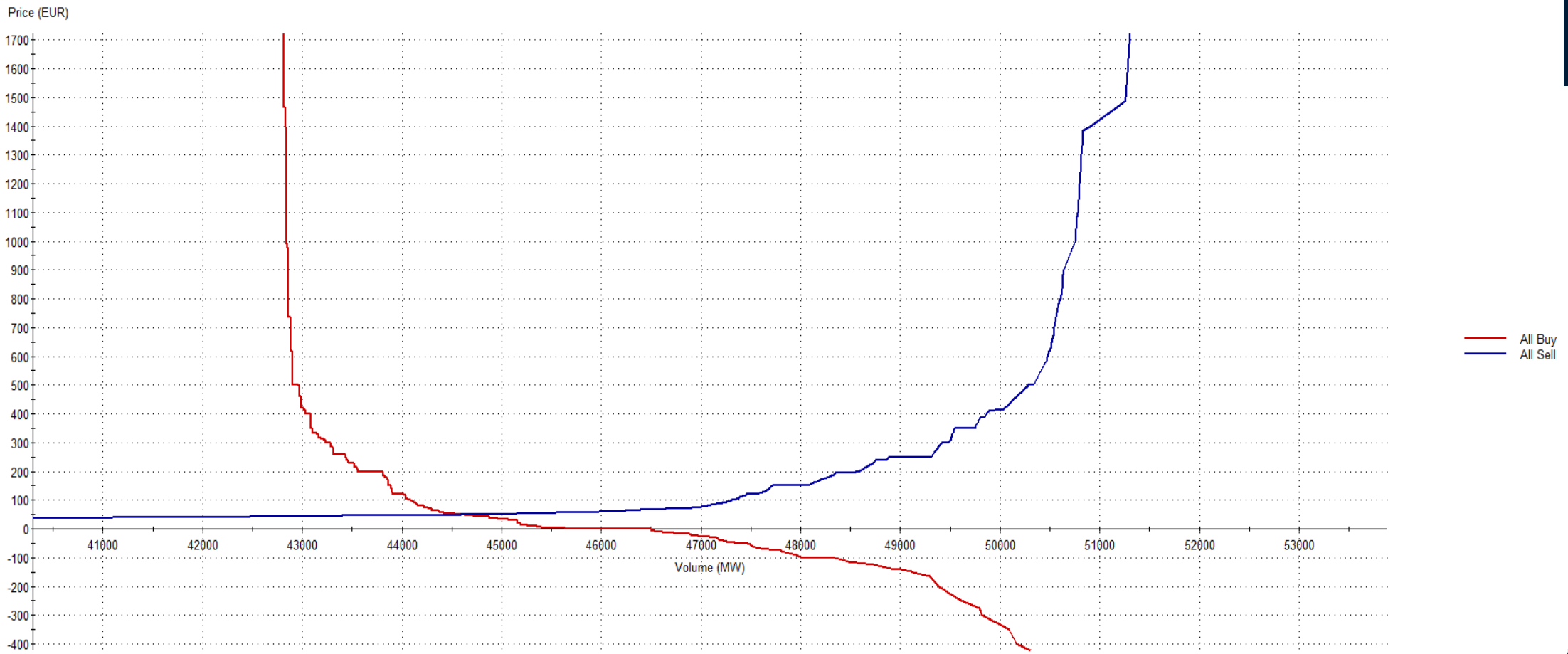
Different types of contracts open and close at various times of the day, with gate closure times down to 5 minutes in selected geographies.

14:00 – 15:00

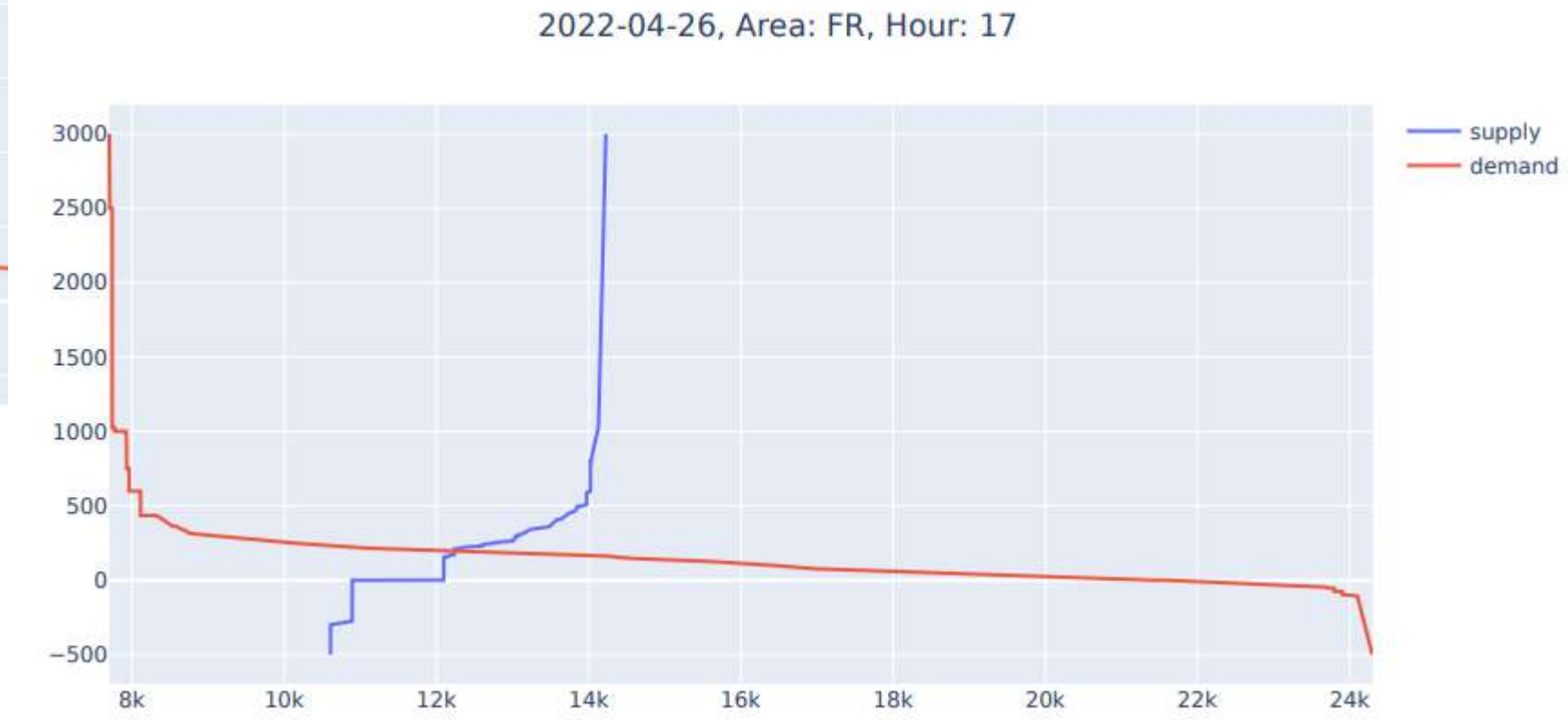
Trades are **invoiced**

The Nordic bidding curves - examples

Systemprice curves, 2019, October 8, H12

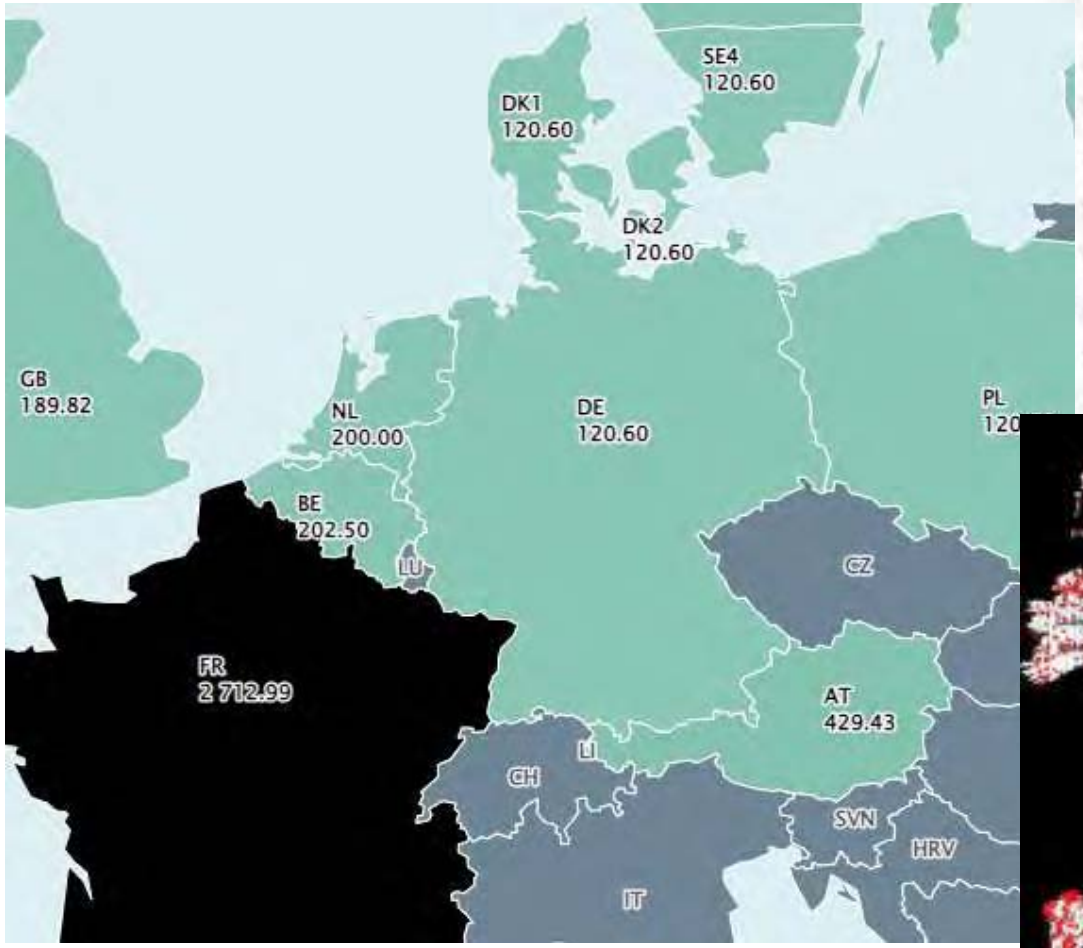


Aggregated bidding curves



Source: https://www.nordpoolgroup.com/en/market-data12/DataPortalDownloads/aggregated-market-data2/

Day-ahead prices in France 04.04.2022



EUR/MWh

	04-04-2022	03-04-2022	02-04-2022	01-04-2022	31-03-2022	30-03-2022
00 - 01	329,09	296,01	309,00	278,29	275,67	265,14
01 - 02	310,00	283,71	295,00	254,44	258,17	249,56
02 - 03	329,09	280,55	295,00	257,19	255,76	237,45
03 - 04	329,07	275,40	273,94	249,69	249,00	229,08
04 - 05	328,97	257,01	262,80	248,97	243,24	232,33
05 - 06	413,32	258,73	276,22	258,23	247,50	242,00
06 - 07	410,13	270,60	287,90	315,70	293,73	283,00
07 - 08	2 712,99	275,00	279,54	421,00	323,80	313,48
08 - 09	2 987,78	277,34	323,98	470,02	423,41	347,53
09 - 10	478,81	252,01	333,99	400,00	421,00	370,10
			333,41	348,13	324,55	377,06
			318,20	348,50	299,46	411,92
			315,60	336,56	297,99	378,52
			296,00	323,15	294,13	342,53
			289,51	294,35	287,64	348,50
			271,08	287,50	265,58	308,22
			263,21	282,69	244,27	271,02

NORD POOL

Day-ahead prices in Netherlands 22.04.2022

EUR/MWh

	23-04-2022	22-04-2022	21-04-2022	20-04-2022	19-04-2022	18-04-2022	17-04-2
00 - 01	195,20	206,00	188,55	191,00	205,00	95,90	160,2
01 - 02	185,50	187,18	179,92	189,55	192,98	81,00	139,5
02 - 03	178,53	187,01	181,08	183,10	191,14	84,00	142,0
03 - 04	161,90	179,41	178,92	183,26	190,95	81,00	123,2
04 - 05	129,90	176,09	180,50	183,38	190,00	85,25	133,5
05 - 06	122,67	189,58	199,92	197,96	200,61	92,31	139,3
06 - 07	140,77	218,07	229,76	227,24	251,27	127,21	146,2
07 - 08	154,01	239,95	258,02	249,92	291,43	144,69	144,0
08 - 09	162,84	244,10	256,25	249,90	295,43	139,97	133,3
09 - 10	80,00	221,05	232,26	209,96	255,71	147,11	100,0
10 - 11	-3,60	196,56	207,93	193,50	222,90	94,28	76,9
11 - 12	-184,84	157,41	189,90	186,71	202,04	78,72	29,6
12 - 13	-222,36	149,60	176,23	157,50	176,60	63,89	2,6
13 - 14	-217,42	102,00	167,30	156,75	177,81	59,96	-15,1
14 - 15	-214,90	100,00	167,46	147,88	159,90	45,00	0,0
15 - 16	-186,82	86,77	163,96	169,82	158,66	60,58	0,0
16 - 17	-70,10	118,97	172,01	175,79	158,89	82,92	15,0
17 - 18	49,90	167,00	185,34	196,15	190,43	121,25	66,2
18 - 19	140,00	184,90	204,96	222,95	224,93	169,94	158,1
19 - 20	188,19	209,61	220,62	249,00	239,03	240,30	182,1
20 - 21	172,50	208,97	223,61	250,00	240,01	250,73	191,5
21 - 22	169,57	209,66	220,44	239,18	223,60	250,00	194,1
22 - 23	177,91	192,00	199,71	220,10	200,00	221,23	171,4
23 - 00	171,76	177,55	193,40	201,97	184,20	202,00	168,1
Min	-222,36	86,77	167,46	147,88	158,66	45,00	-15,1
Max	195,20	244,10	256,25	250,00	295,43	250,73	194,1

Today 12:45

DAY-AHEAD: Price threshold reached - reopening order books

Predefined price thresholds have been exceeded, this means a second auction will be triggered.

As a result, All order books will be reopened at 12:50 CET for exactly 15 minutes. During these 15 minutes you can reenter your orders.

Min prices have been reached for the following bidding areas and hours: 11:00 to 16:00

Bidding area Min Hours impacted

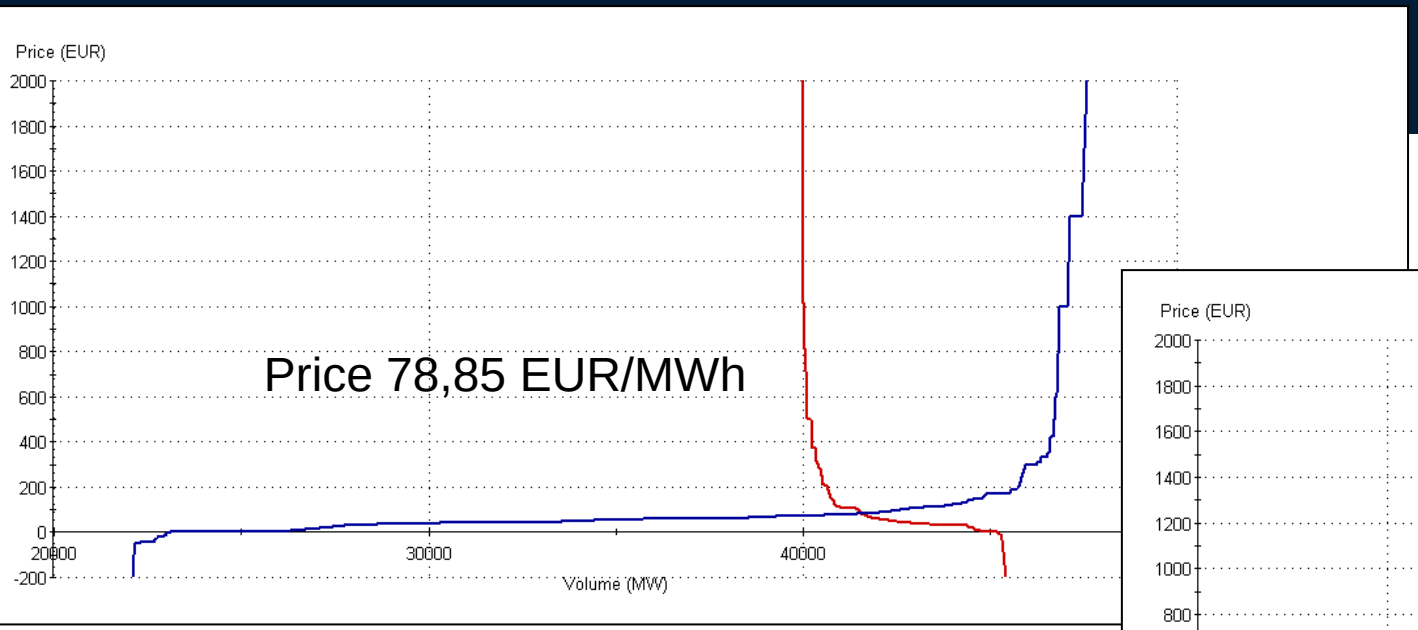
The Netherlands (NL)

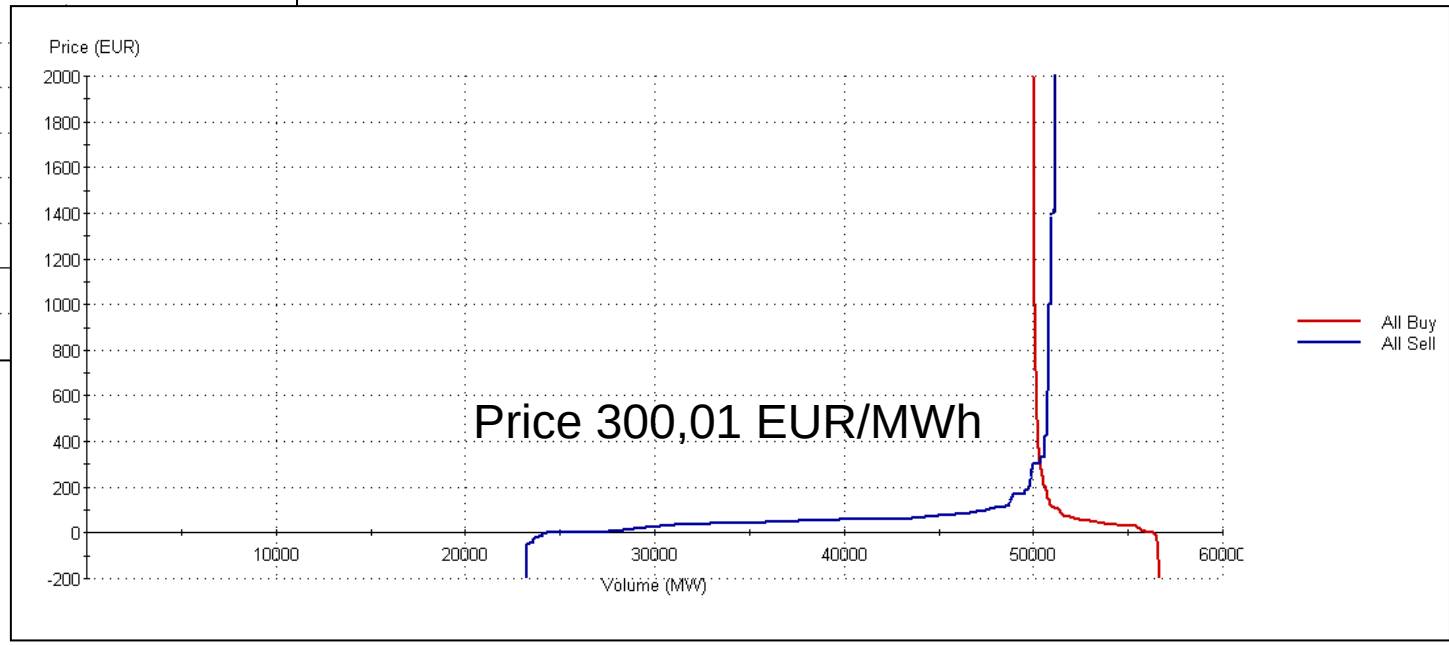
Publication of market coupling results will be delayed. Results will be published as soon as they are availsble.

NORD POOL

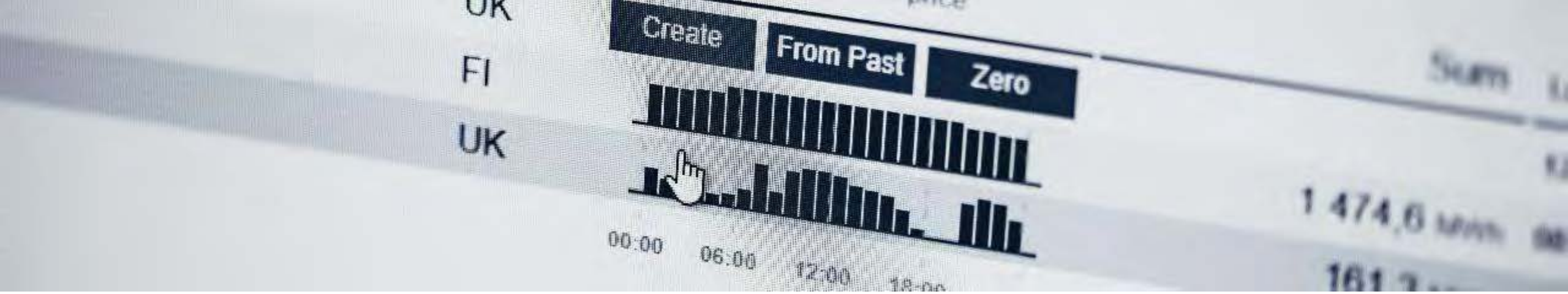
System price curves – strained market

Curves from 22 February 2010 – just for fun – H4 and H9 respectively





Order types



Who is trading Day-ahead?

Ca 300 customers from 20 countries

- Power producers
- Power consumers
- Industry

- Orders are submitted per bidding area
- Min volume is 0,1 MW (sell or buy)
- Submitting of illogical orders is prevented

NORD POOL

Day-ahead products

Brief description...

Single hourly orders

- To buy or sell – price and volume given separately for each time unit (hour)
- Participant specify price steps and corresponding volume to buy and or sell at each level of price
- Must include the min price -500€ and max price 4000€ - up to 200 price steps allowed per time unit

Block orders

- Block orders – spanning over a consecutive number of hours
- All or nothing condition
- Must specify three attributes; volume, price and duration
- Several product variations
    - Regular block orders
    - Profile block orders
    - Curtailable block orders
    - Linking of block orders
    - Exclusive groups
    - Flexible block orders

Single hourly order

- Price and volume given separately for each hour
- Each participant selects the range of price steps for the hourly bid individually – including min price -500€ and max price 4000€
- Each pair of price and volume represent a point on a curve with **linear interpolation** between the volume and price points

Price independent

Price Steps	-500.00	3,000.00
Hour 1	-93.2	-93.2
Hour 2	-93.2	-93.2
Hour 3	-93.2	-93.2
Hour 4	-93.2	-93.2
Hour 5	-93.2	-93.2
Hour 6	-93.2	-93.2
Hour 7	-93.2	-93.2
Hour 8	-93.2	-93.2
Hour 9	-93.2	-93.2
Hour 10	-93.2	-93.2
Hour 11	-93.2	-93.2
Hour 12	-93.2	-93.2
Hour 13	-93.2	-93.2
Hour 14	-93.2	-93.2
Hour 15	-93.2	-93.2
Hour 16	-93.2	-93.2
Hour 17	-93.2	-93.2
Hour 18	-93.2	-93.2
Hour 19	-93.2	-93.2
Hour 20	-93.2	-93.2
Hour 21	-93.2	-93.2
Hour 22	-93.2	-93.2

Price dependent

Sell

Buy

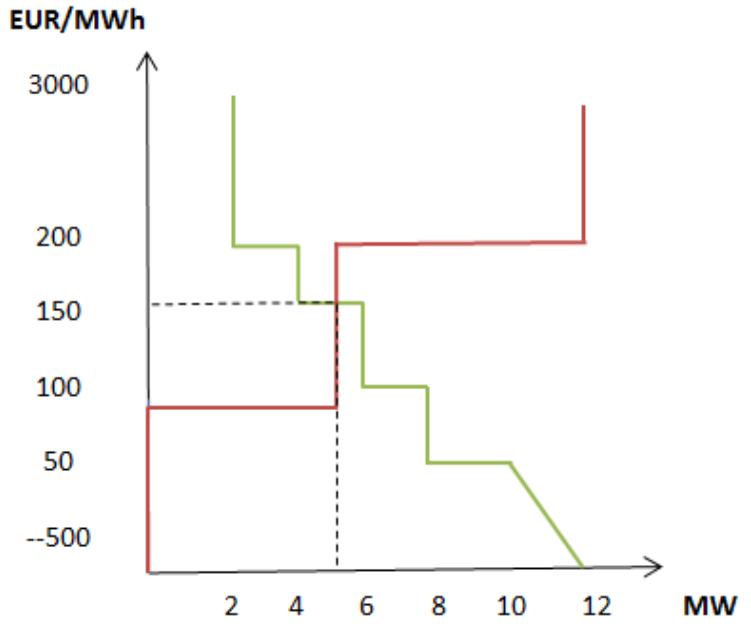
Price Steps	-500.00	156.00	158.00	160.00	162.00	164.00	166.00	168.00	170.00	172.00	174.00	3,000.00
Hour 1	42.5	26.6	26.6	26.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hour 2	42.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-24.7
Hour 3	42.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-18.5	-24.7	-24.7
Hour 4	42.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-12.4	-24.7	-24.7
Hour 5	42.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-18.5	-24.7	-24.7	-24.7
Hour 6	42.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-12.4	-24.7
Hour 7	42.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-12.4	-24.7	-24.7
Hour 8	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	-59.3
Hour 9	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	-70.7
Hour 10	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	-70.7
Hour 11	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	-70.7
Hour 12	42.5	42.5	42.5	42.5	42.5	34.5	34.5	34.5	26.6	26.6	26.6	-38.5
Hour 13	42.5	34.5	34.5	26.6	26.6	26.6	26.6	26.6	26.6	26.6	26.6	-38.5
Hour 14	42.5	26.6	26.6	26.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-38.5
Hour 15	42.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-38.5
Hour 16	42.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-16.1

Aggregation of order curves from Single Hourly orders

APower's Elspot schedule 4 MW at price 101 EUR/MWh

Price [EUR/MWh]	-500	50	51	100	101	150	151	200	201	3000
Participant X [MW]	2	2	2	2	2	2	0	0	0	0
Participant Y [MW]	4	2	0	0	-5	-5	-5	-5	-12	-12
APower [MW]	6	6	6	6	4	4	4	4	2	2
SUM BUY	12	10	8	8	6	6	4	4	2	2
SUM SELL	0	0	0	0	-5	-5	-5	-5	-12	-12

APower's Elspot schedule 3 MW if price is 200.5 EUR/MWh



Price 150 EUR/MWh - turnover 5 MW

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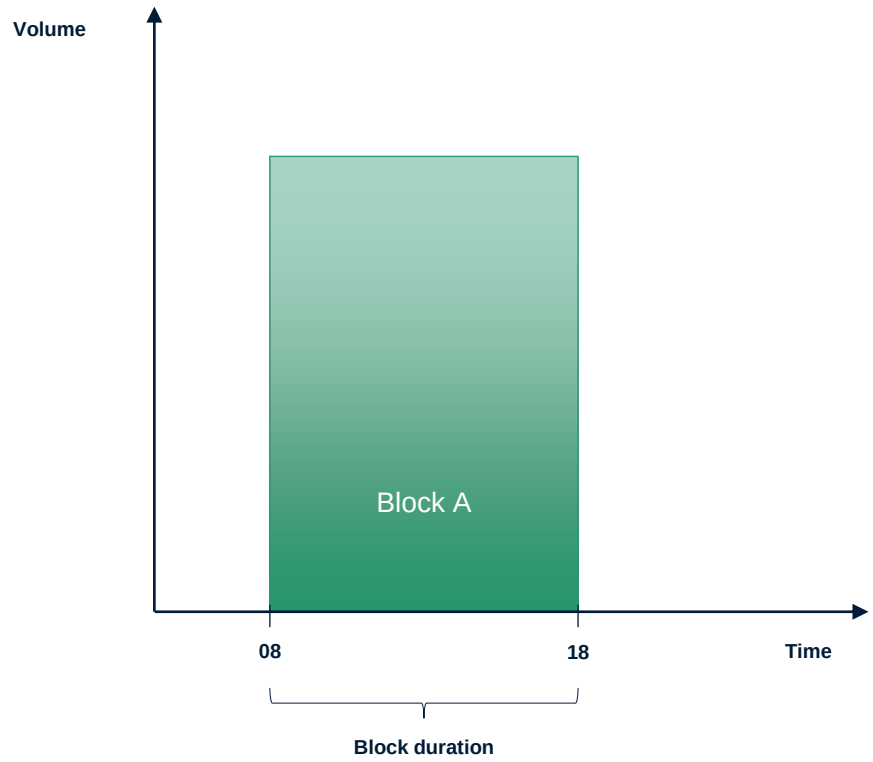
Regular block order

All or nothing volume for a set of consecutive hours

- “All or nothing” conditions for all hours within the block
- Trader must define three attributes:
  - Volume (max. 500 MW)
  - Price (-500 ≤ X ≤ 4000 €/MWh)
  - Duration (min. 3 hours) of own choice
- One trading portfolio can contain up to 50 block orders
- Price of an accepted block order is the area price of the respective bidding area
- Best suited for inflexible production or consumption

Example



Block order example

Start/ stop hour is defined by the participant.

- Bid is not activated if the order price of a purchase block is higher than the average Day-ahead area price during the specified block period.
- Bid is activated if the order price of a sales block is lower than the average Day-ahead area price during the specidified block period.

Hours 07:00 – 10:00
Volume -50 MW
Bid price = 75 EUR/MWh
Average price (07-10) = 74 EUR/MWh

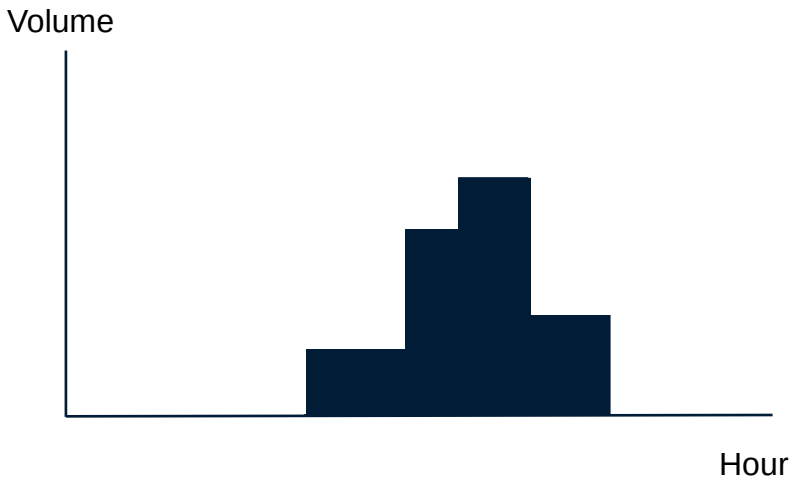
→ Not activated = Rejected

Hours 16:00 – 20:00
Volume -50 MW
Bid price = 75 EUR/MWh
Average price (16-20) = 80 EUR/MWh

→ Activated

Profile block order

- A profile block order is a regular block order where user can define the **volume to be different in each period** over the entire time span of the block.
- Weighted average price is used to decide if a block order will be activated or not



Curtailable block order and Minimum Acceptance Ratio (MAR)

From - To	Price	MAR	Volume (-882.0MW)	00:00	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00
00:00 - 07:00	185.00	100%	-63.0	-63.0	-63.0	-63.0	-63.0	-63.0	-63.0	-63.0		
00:00 - 07:00	185.00	100%	-63.0	-63.0	-63.0	-63.0	-63.0	-63.0	-63.0	-63.0		

Curtailable block orders can be partially filled according to a user-defined Minimum Acceptance Ratio (MAR):

- A block with minimum acceptance ratio of 1 (100%) is said to be fill-or-kill: it is either fully accepted of fully rejected.
- A block with a minimum acceptance ratio of 0.5 (50%) may be curtailed down to 50%
- A block with a minimum acceptance ratio of 0 (0%) is fully curtailable

Each block order has to have the same minimum acceptance ratio for all hours (also on profile block orders)

Example:
Block order with 'MAR'

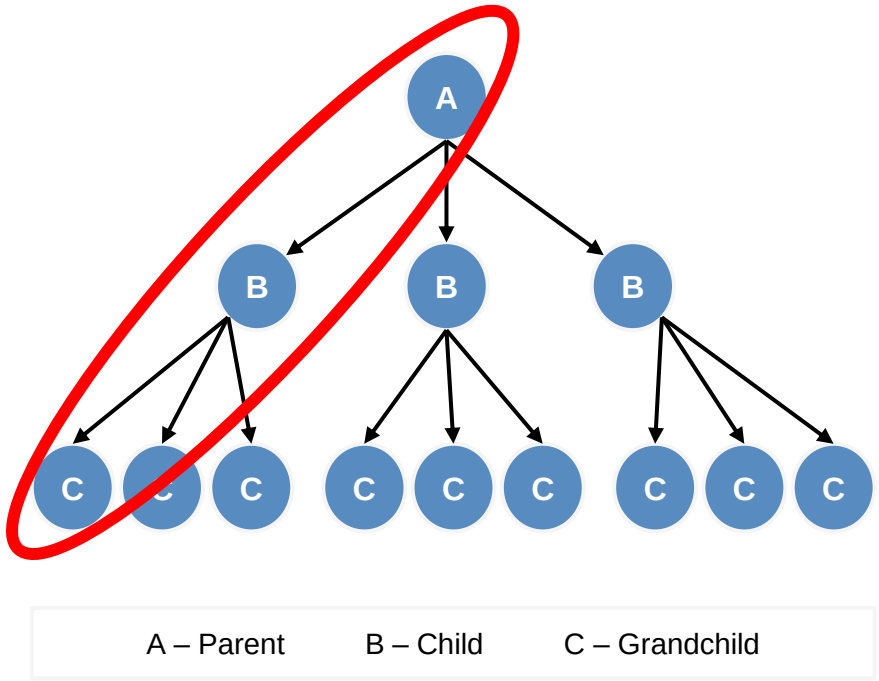
DURATION: 00:00 – 10:00
VOLUME: -50 MW
PRICE: 200 EUR
MAR(%): 80 %

In the example, the trader allows the block order to be curtailed down to 40 MW (80%) and still be accepted. This will apply for all hours.

Linking of block orders

Considering the dependency between orders

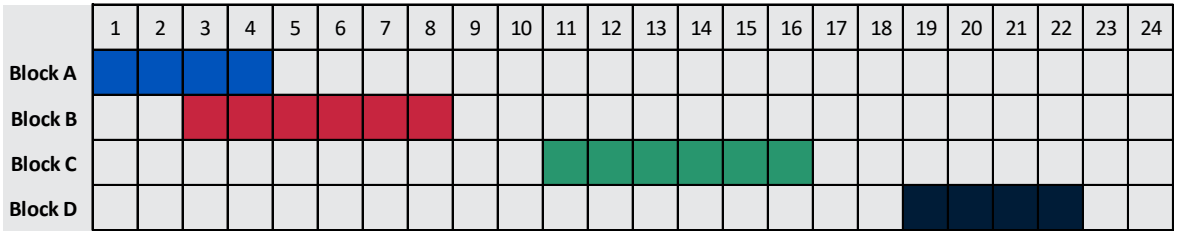
- Linked blocks are evaluated as a group:
  - The whole group can be accepted although the first block would create a loss, as long as the group as a whole is profitable
- Linked blocks are always executed in the original order: it is not possible to ‘skip’ a block
- Block orders can be linked together:
  - Normal block orders
  - Profile block orders
  - Curtailable block orders
- Possible to link altogether 13 block orders
  - One parent can have three children
  - Each child can have three grand-children



Block order – exclusive group

Optimizing time of activation – only one block will be accepted

- A cluster of sell or buy orders for which only one can be activated
- The different blocks can vary volume, price, and period
- Acceptance rules are the same as for regular blocks
- If several blocks in an exclusive group are within the user-defined price limit, the block giving the highest social welfare will be accepted
- One portfolio may contain a maximum three exclusive groups and each exclusive group can contain a maximum 15 block orders
- An exclusive group can have both profile blocks and blocks with a defined MAR



Flexible order

Optimizing time of activation

- A sell/buy order with a length of one or more hours without a mandatory time restriction
- Flexible order is activated for the period it creates highest social welfare
- Trader must define following attributes:
  - Volume (max. 500 MW)
  - Price (-500 ≤ X ≤ 4000 €/MWh)
  - Duration (1 ≤ X ≤ 23 hours)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
							-30	-30	-30	-30													
								-30	-30	-30	-30												
									-30	-30	-30	-30											
										-30	-30	-30	-30										
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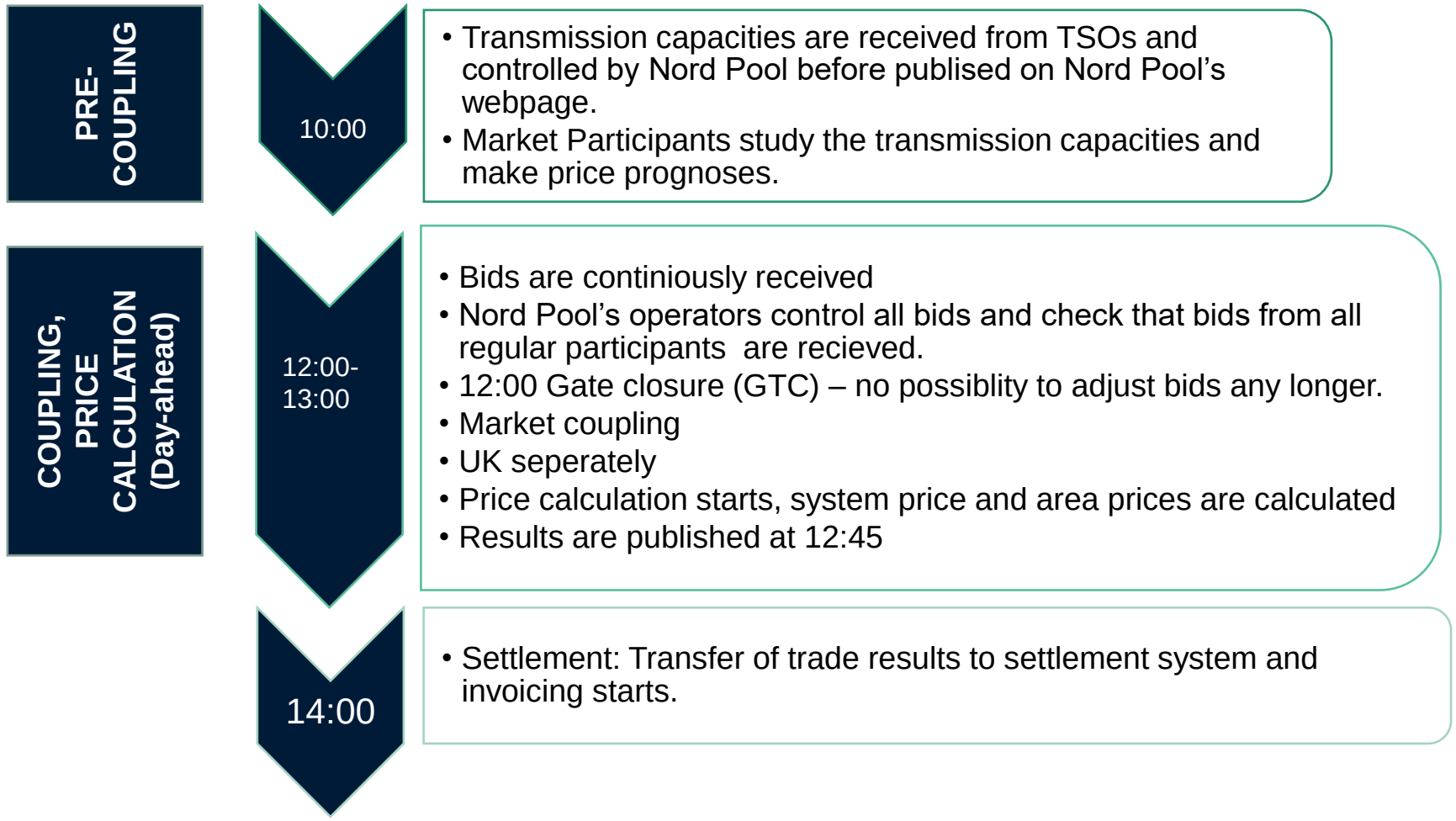
													-30	-30	-30	-30							
														-30	-30	-30	-30						
															-30	-30	-30	-30					

Reasonability check

- Service provided from Nord Pool
- Participants responsibility to submit correct bids
- Double check of all portfolios done by market operator to avoid manipulation of market
- Unintentional errors or ignorance is not considered acceptable excuses to not follow laws and regulation of the Internal Energy Market

	Area	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	BE	93.8	139.8	140.6	136.1	134.3	177.8	69.3	2.0	4.8	6.8	15.5	18.6	24.0	24.2	21.7	13.1	3.7	3.2	1.5	7.2	5.8	3.9	13.0	25.0
	NL	58.9	111.7	111.5	79.4	76.3	121.2	125.3	59.0	1.0	4.3	7.5	6.2	7.7	11.6	15.3	8.2	1.7	2.8	5.2	9.5	13.6	10.8	5.3	3.5
	NL	527.7	367.9	525.0	530.4	595.3	541.5	275.9	17.3	189.8	386.6	496.6	783.3	772.3	688.5	665.1	645.8	579.0	426.7	651.5	738.8	705.2	722.5	744.5	754.0

Business Procedures at Nord Pool



Business Procedures at Nord Pool cont.

Agenda

Market for electricity – the power market model

The Day-ahead market

Order types

Day-ahead calculation

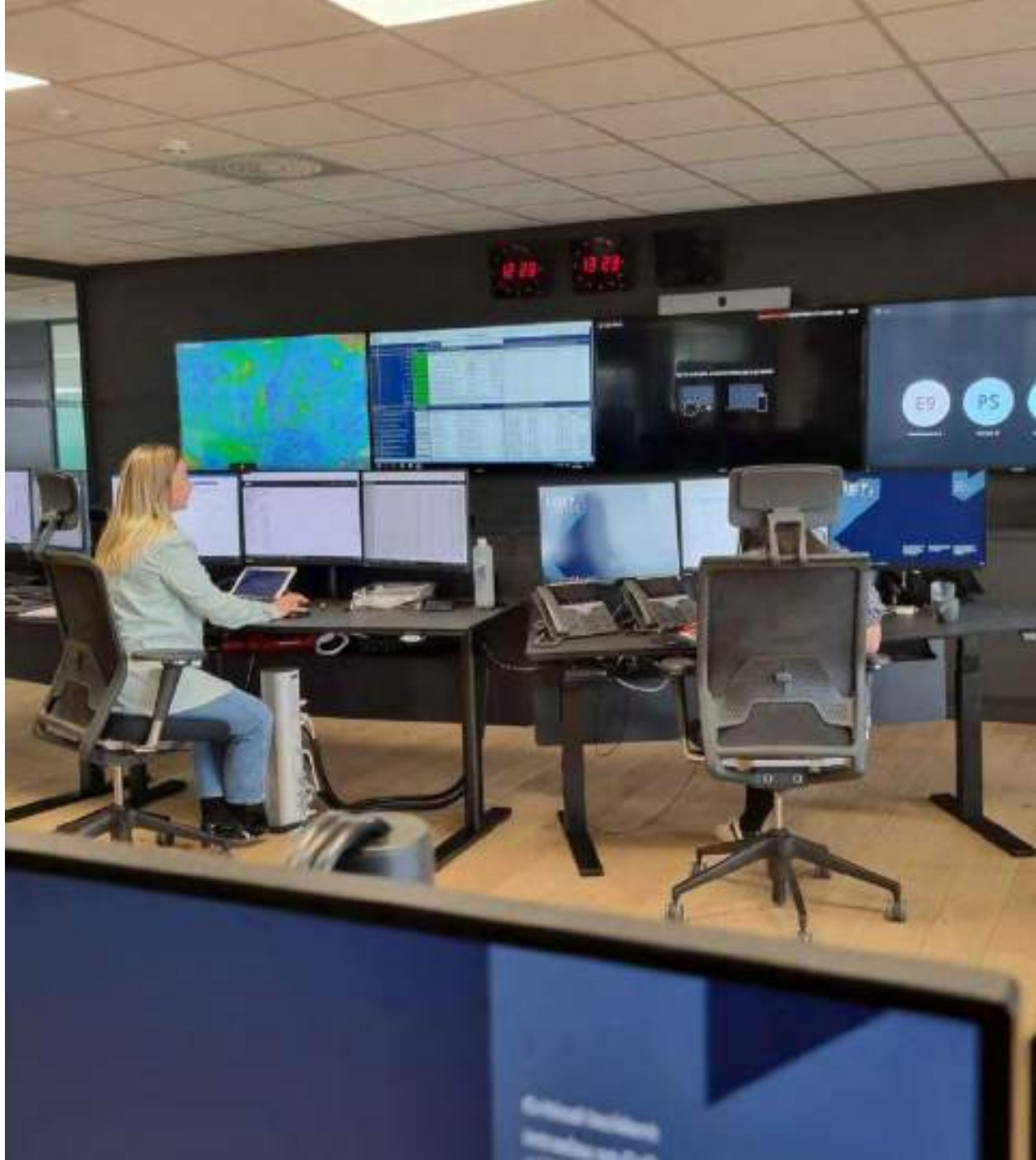
European Integration

Looking ahead

Day-ahead calculation

What does Nord Pool calculate?

- **System price**
  - Assumes infinite transmission capacity in the grid.
  - A theoretical common price in the exchange area.
  - Used as a reference price in the financial market.
- **Area price**
  - Based on available transmission capacity.
  - Bottlenecks in the grid give price differences.
- **Power flow between all bidding areas**



Area prices vs System price

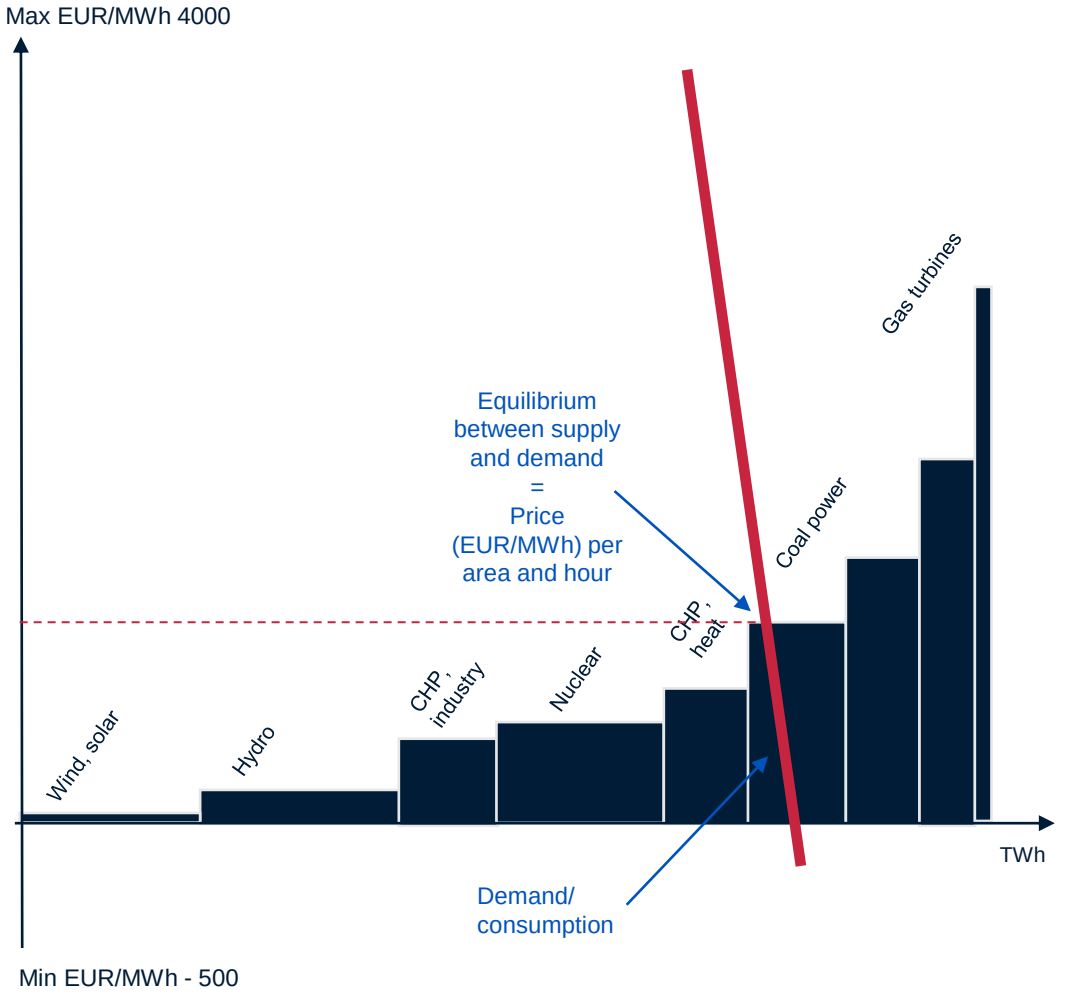
- **Area prices calculated for**
  - Each hour
  - Each bidding zone
  - Settlement prices for all volumes traded in Day-ahead

- **System price**
  - Nordic reference price
  - Synthetic benchmark calculated on
    - Nordic Day-ahead orders
    - Without internal capacity limitations between Nordic bidding zones.

Day-ahead price formation

- Day-ahead prices are calculated using an optimization algorithm called EUPHEMIA
- Optimizing social welfare
- Calculation methodology ensures that, based on the placed sell and buy orders, least-cost generation units are activated first.
- Producers bid at marginal cost (+opportunity cost)
- Last activated bid to ensure market equilbrium sets the price

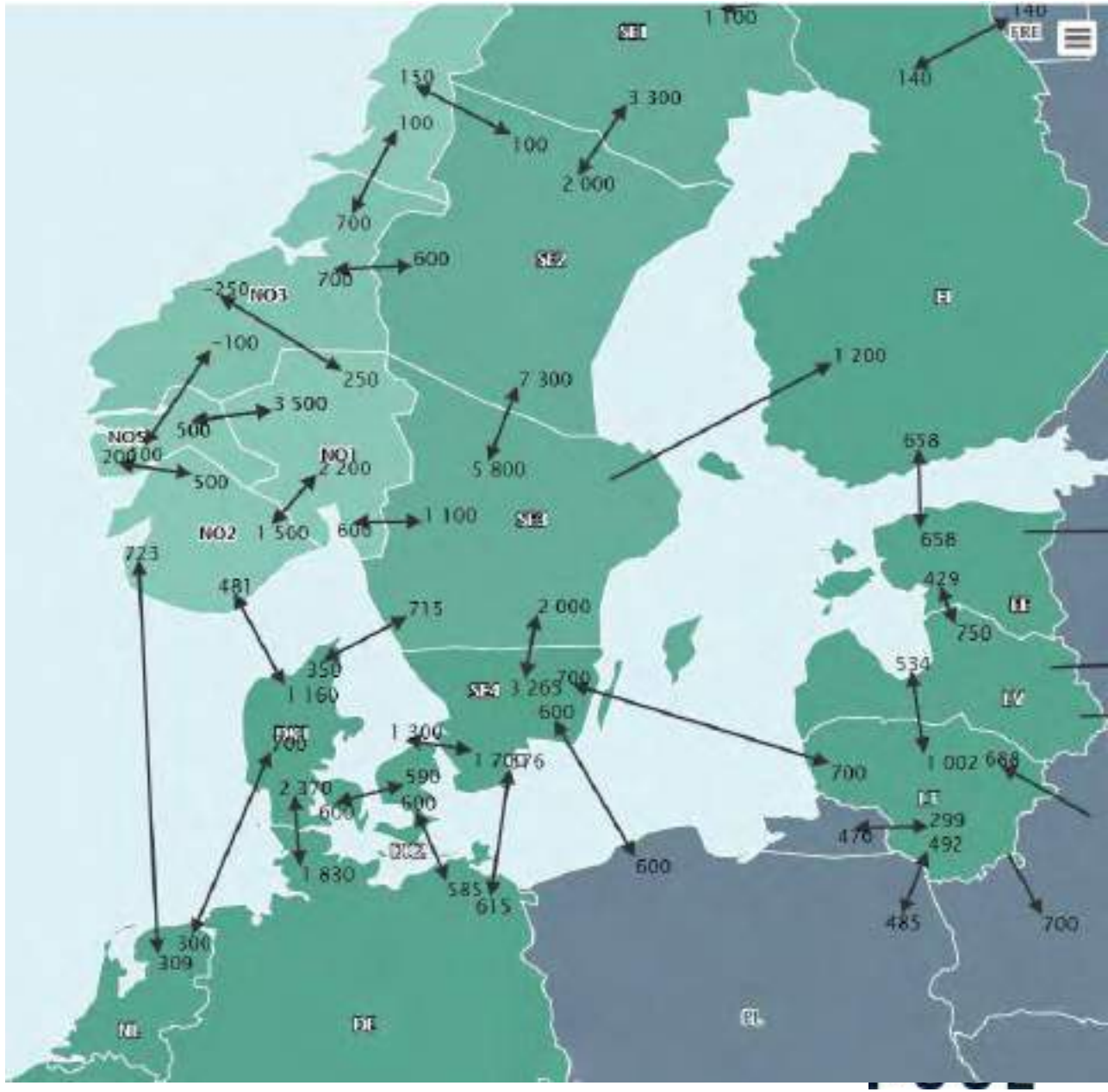
Marginal cost: cost of increasing production with one unit



Transmission capacities and implicit auction

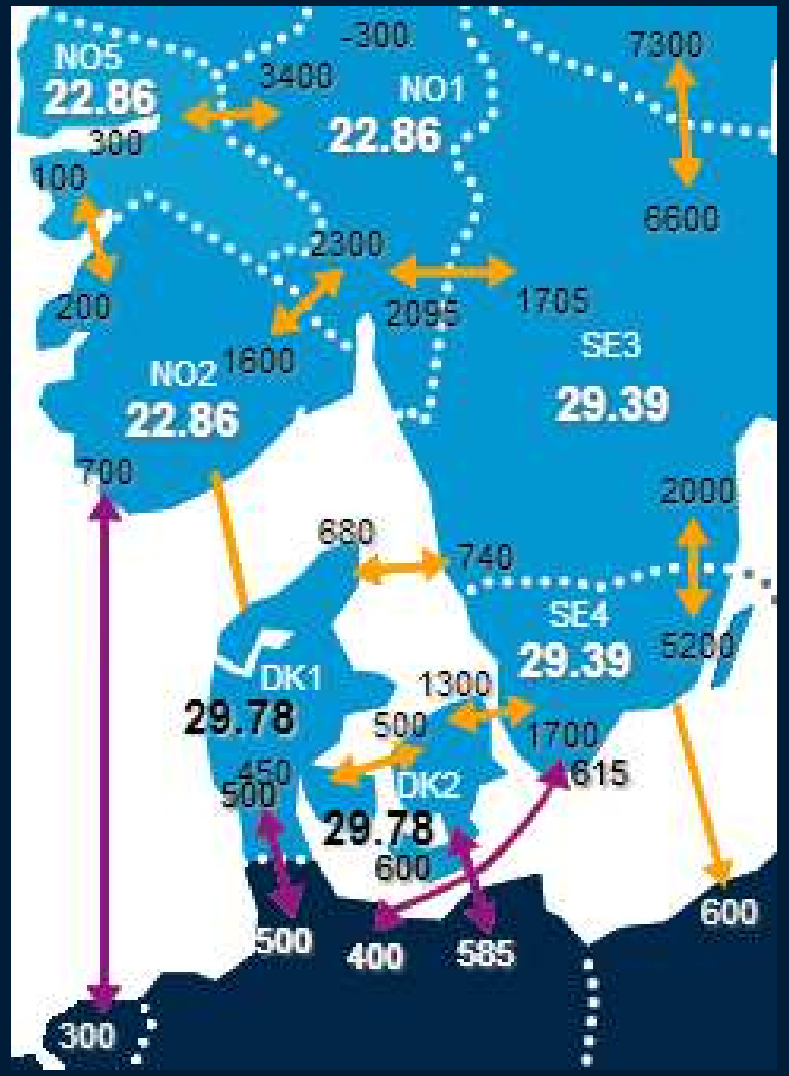
- Each morning, the TSOs determine the trading capacity between each bidding zone:
  - Trading capacities for the next day are published on Nord Pool's website at 10:00 CET
  - All trading capacity is dedicated to Nord Pool for implicit auction.

- Implicit auction, performed through the SDAC market coupling, simultaneously determines prices, sell and purchase volumes and flows between bidding zones.
  - All trading capacity is available to all market participants on equal terms
  - There are no explicit capacity auctions on these connections.



Explicit Auction:
How the European market worked before

- Daily auction of transmission capacity on each cross-border connection out of Nord Pool's exchange area
- Each participant made price prognosis and «made up their mind» on which way the power should flow
- Possibility that participant made «wrong» prognosis so that the power was flowing in the wrong direction (from high price area to low price area)
- OR: that the participants did not want to use the transmission capacity
- Not utilized transmission capacity = not socio-economic optimal use of resources



ATC (Available transmission capacity) versus FB (Flow based)

ATC:

- Based on historical data for a reference day, seasonal impact and a justified secuirty margin, TSO determines a Net Transfer Capacity (NTC) value for each direction on each border of control area.
- NTC values is the maximum allowable commercial exchange.

ATC (Available transmission capacity) versus FB (Flow based)

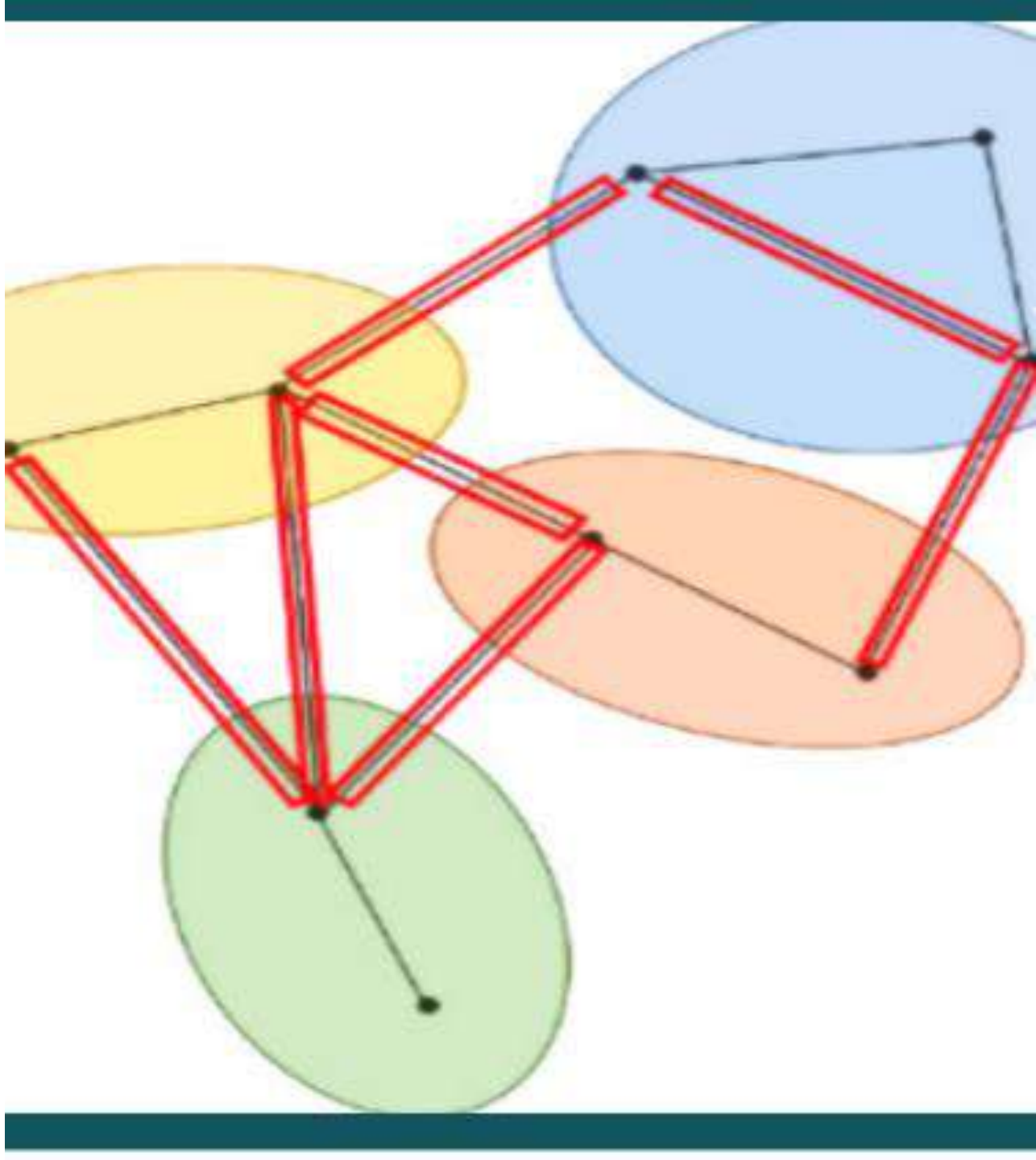
ATC:

- TSOs of neighbouring countries, coordinate bilaterally to align the NTC values on their common borders, generally selecting the lowest NTC.

- Available commercial capacity values per direction on each border.

FB (Flow based)

- Instead of supplying fixed commercial capacities, FB methodology formulates the constraints which reflect the physical limits of the grid.



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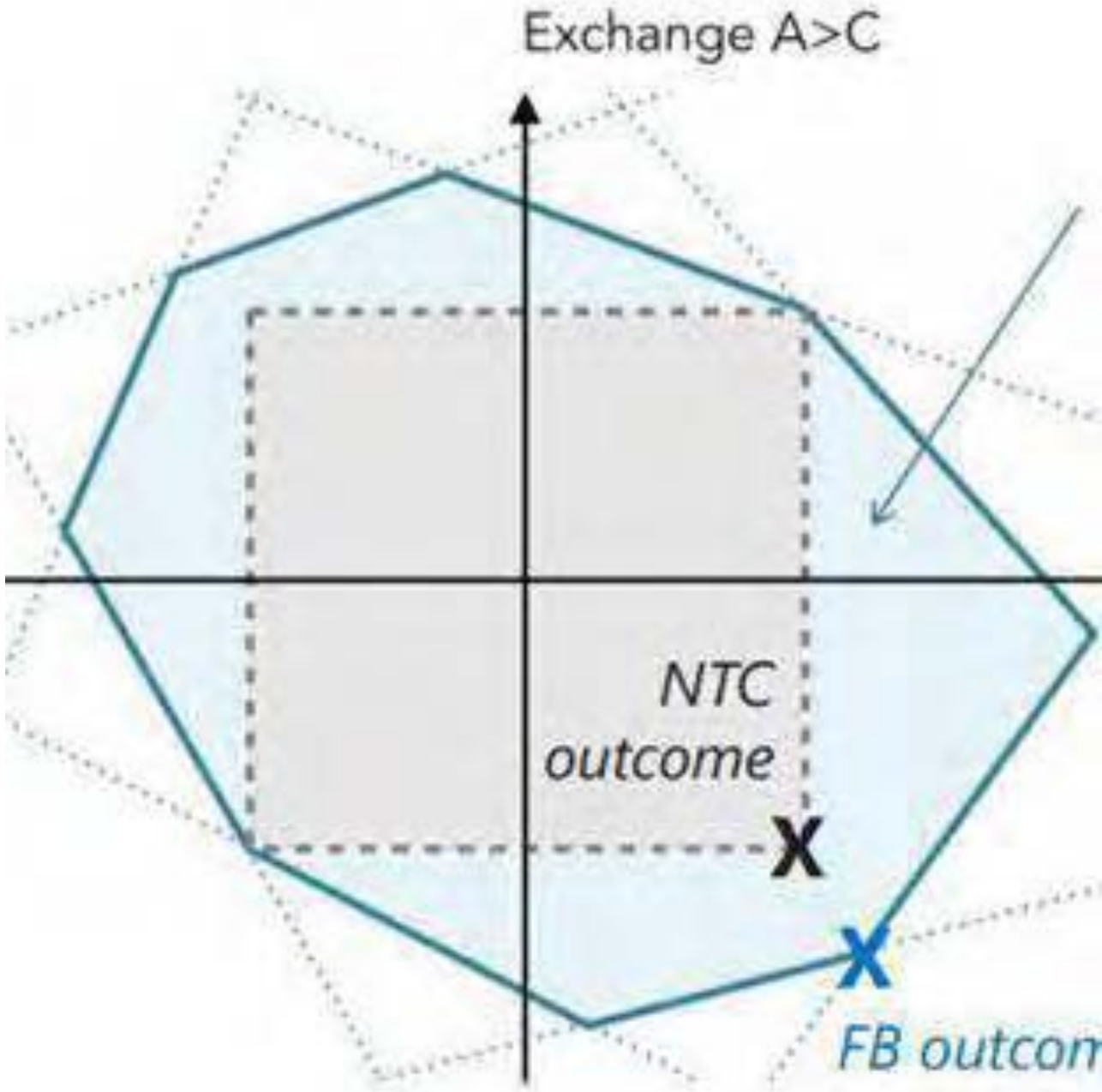
FB (Flow based) Non- inuitive flows

- Non-inuitive flow: means flow from a high price to a low price zone
- Might occur in flow based optimization when welfare economic cost of a non-intuitive flow is smaller than welfare economic benefit of relieving a congestion



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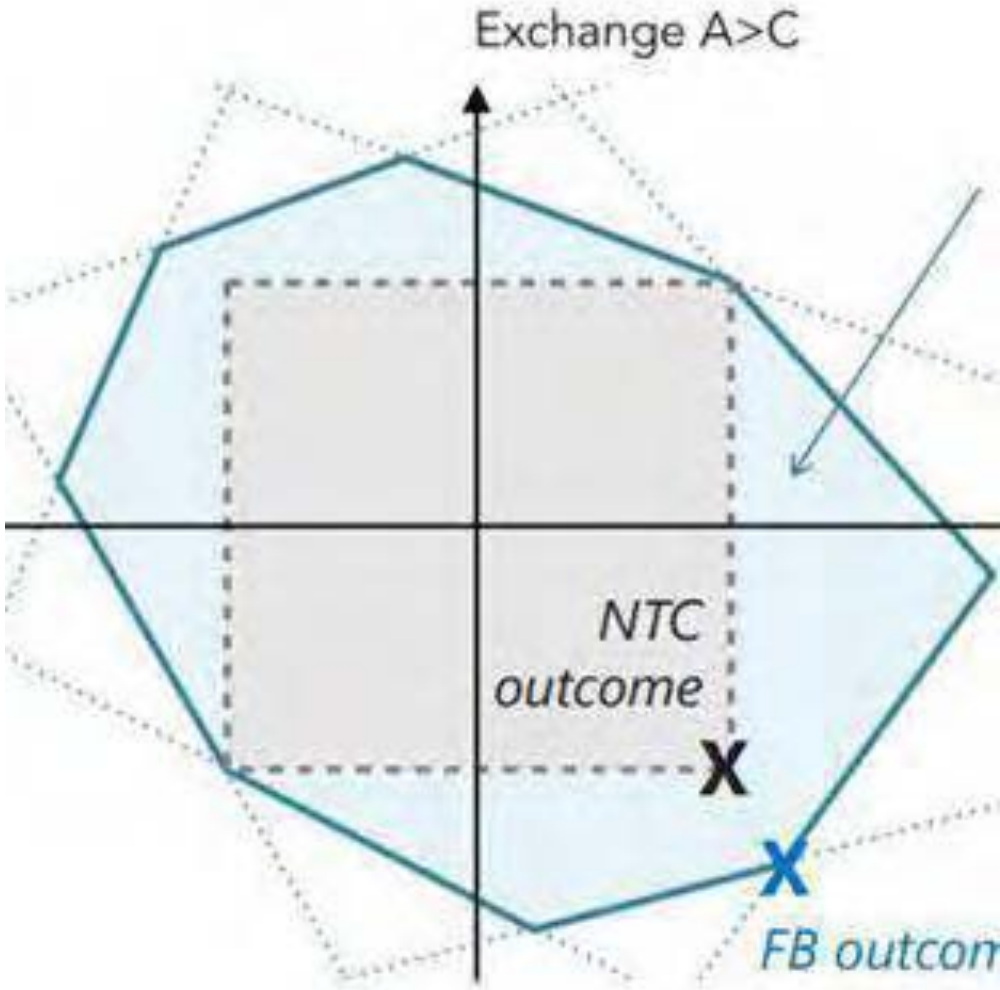
ATC (Available transmission capacity) versus FB (Flow based)

- Flow-based market coupling leads to a more efficient use of generation and transmission resources.
- FB provides a better utilization of physical limits of the grid, thus increasing the flexibility and socio-economic benefits.
- More capacity is offered to the market under FB market coupling, resulting in an overall welfare gain and increased price convergence.
- However, the flow-based solution is less transparent than the ATC mechanism.



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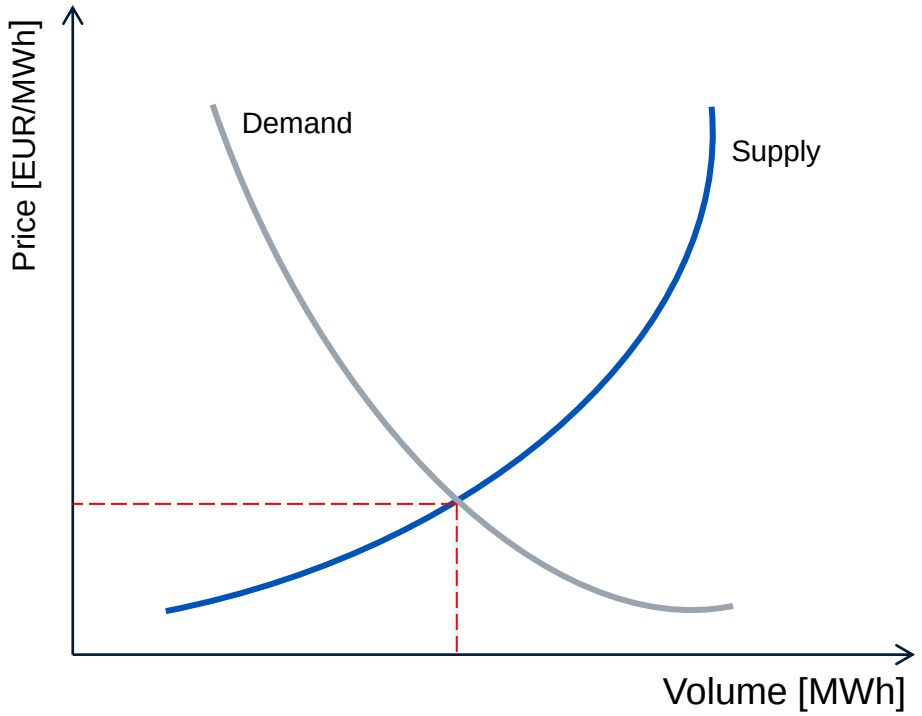
Supply and demand curves

Supply: The producers willingness to sell power (blue)

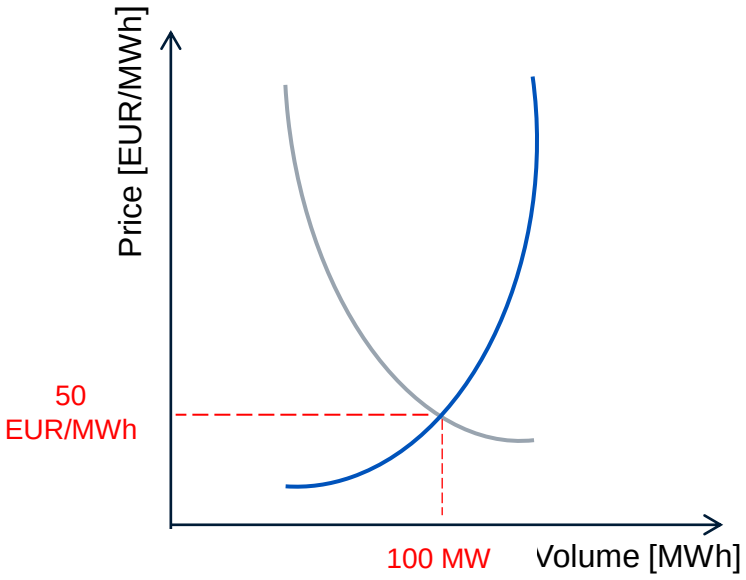
Demand: The consumers willingness to buy power (grey)



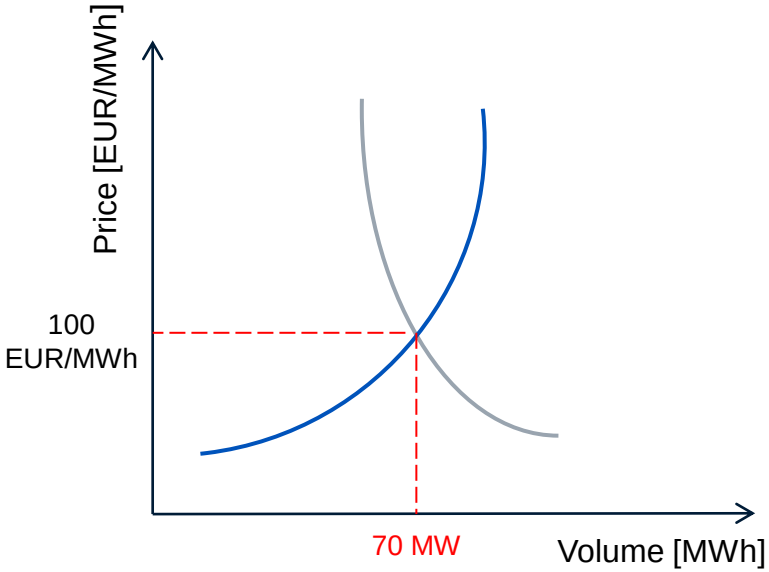
Isolated areas

No available transmission capacity between the areas

Surplus area – low price

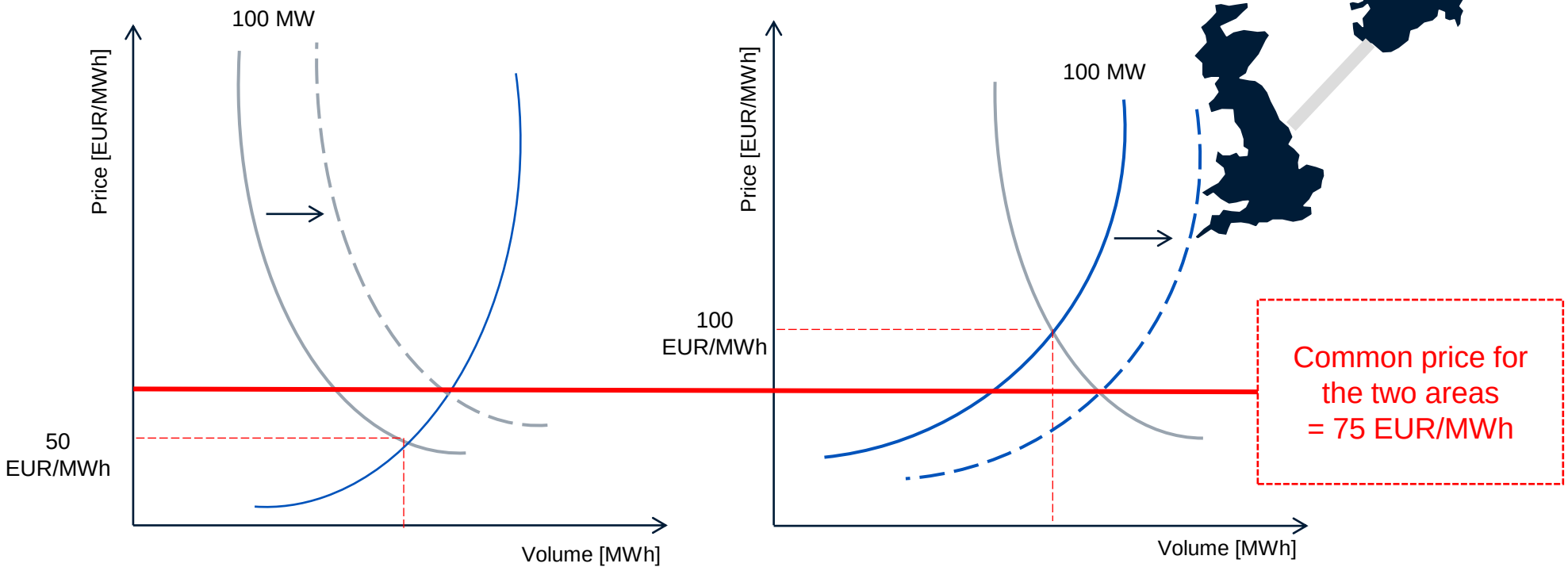


Deficit area – high price



Exchange between areas: Free transmission capacity

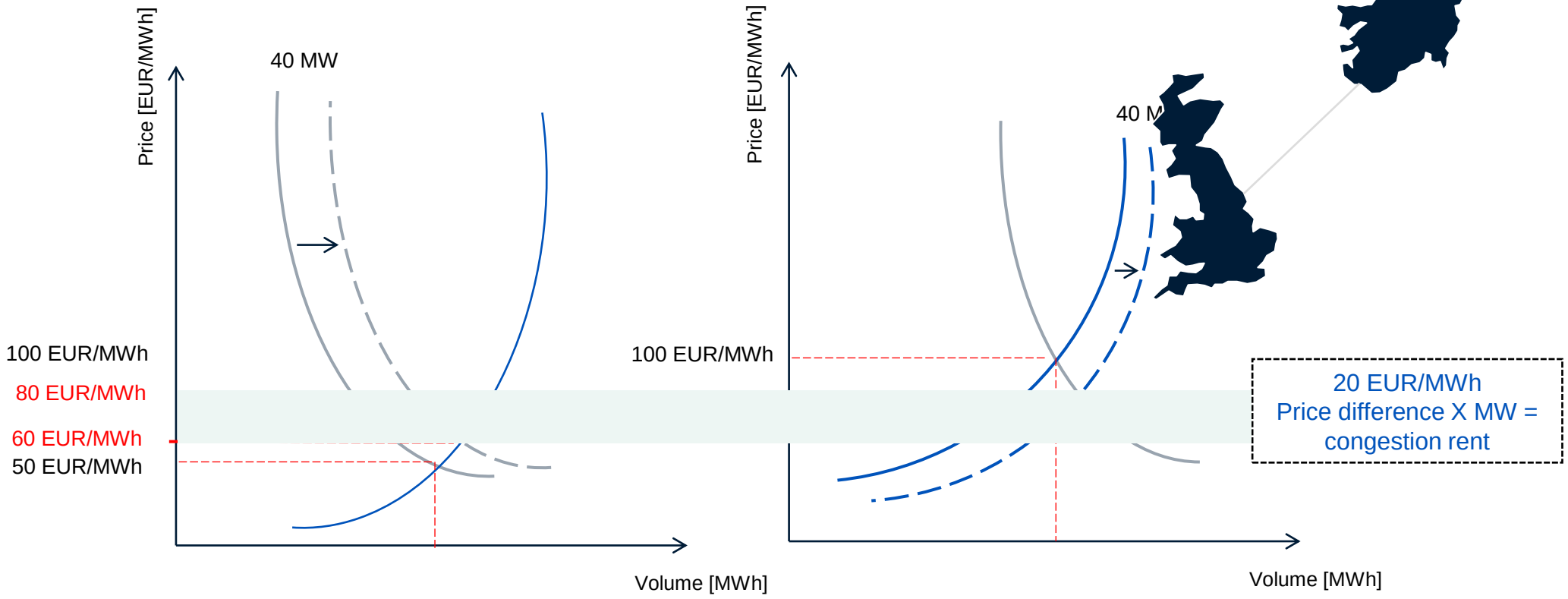
Export from low price surplus area towards high price deficit area



Exchange between areas: Limited transmission capacity

Export from low price surplus area towards high price deficit area

Not enough capacity to get the same price on both sides of the interconnector



Congestion income

- Originates in the situation where transmission capacity between bidding zones is not sufficient to fulfill the demand. Power exchange receives congestion income from the congested interconnection in following way:
- Congestion income [€/h] = commercial flow on day ahead market [MW] * area price difference [€/MWh]

- This arises from the different prices that the seller receives and the buyer pays when electricity flows from the higher price area to the lower price area. The seller acting in a lower price area receives lower price for electricity compared to the price the other party pays for electricity in the higher price area, and the power exchange receives surplus income, which it then pays to the Transmission System Operators (TSOs)

Congetion rent first month with 50 % capacity!

- Reduce 23.000.000 tons of CO2 in UK by 2030!
- Will finance 40 % of Norway internal grid upgrade
- Both countries get better SOS
- EUR 56.000.000 in bottleneck income first month 50 % MW

MONTEL
Part of the Montel Group

Language: EN Light News Market data

TSOs earn EUR 56m in "bottleneck income" from UK-Norway link

Power 01 Nov 2021 12:48 m+

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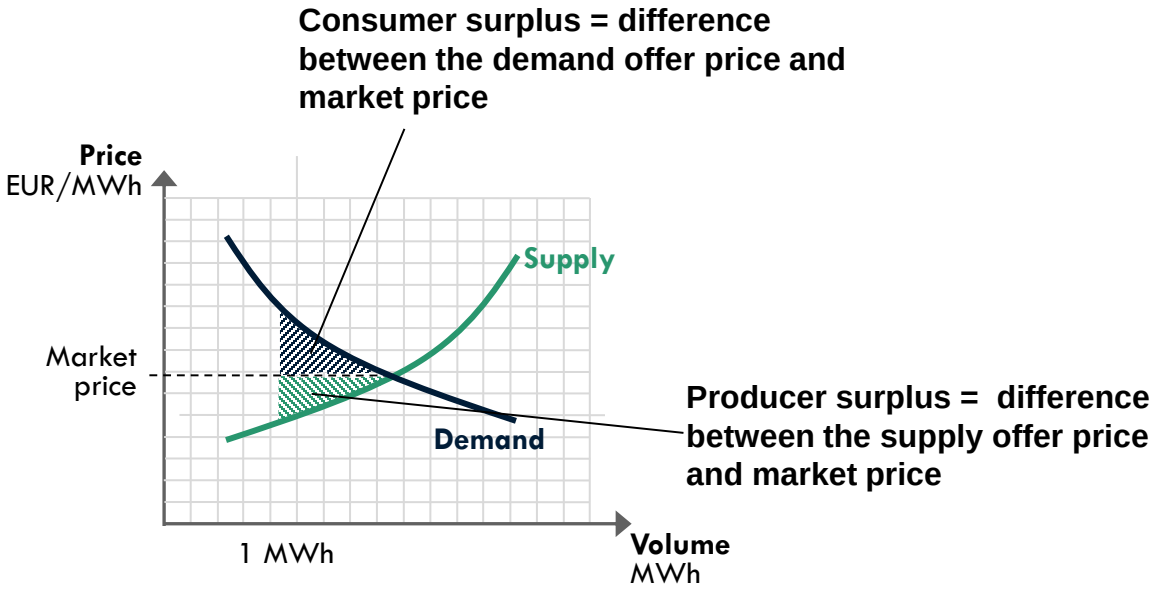
Economic approach and objective of the algorithm

- Main Objective = Maximize social welfare, while respecting all the given constraints
- **Social welfare = consumer surplus + supplier surplus + congestion rent**
- Area between the buy and sell curves represent the total economic surplus of buyers and sellers for each hour. In addition, transmission network limitations (bottlenecks) can create bottleneck income (Congestion rent)
- Another important goal of this market design is to secure the security of supply

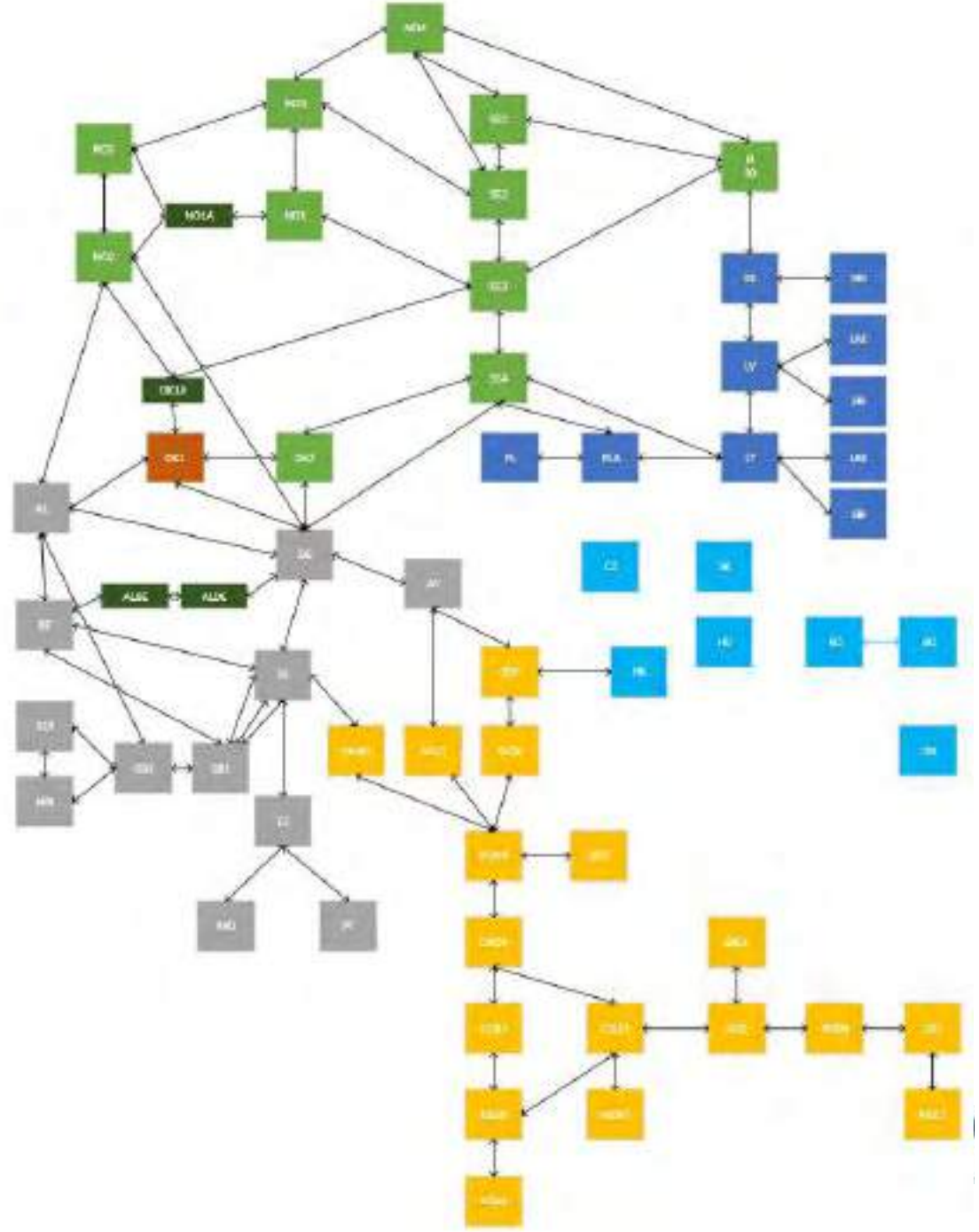


Optimising the seller and buyer surplus (while taking into account potential limitations in both orders and the transmission infrastructure) results in the maximum overall economic welfare.

The Euphemia algorithm

Optimization model

1. Balance between supply and demand in each area must be achieved.
2. Allocatioan constraints (ATCs)
3. Price conditions (Special conditions for block bids).
4. In case of price difference between two ares, ATC should be fully utilized



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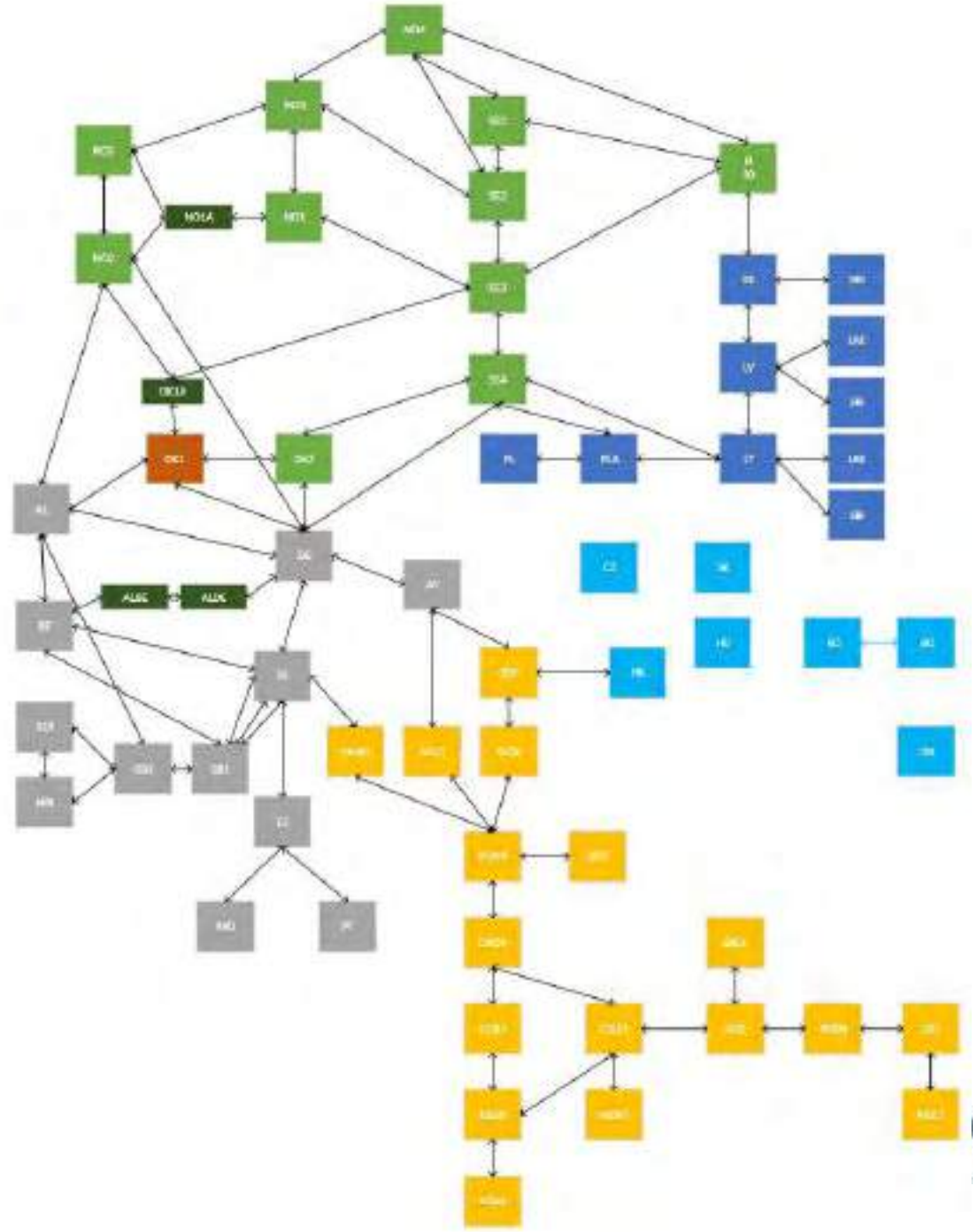
The Euphemia algorithm

EU Pan-European **H**ybrid **E**lectricity **M**arket **I**ntegration **A**lgorithm

- Algorithm currency is EURO
- Optimization time 17 min
- Price limits: min -500€ and max 3000€
- Branch and Bound technique for solving the optimization problem.

- All bidding zones are matched at the same time
- Each bidding zone can yield different price



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Euphemia algorithm

https://www.nordpoolgroup.com/492dad/globalassets/download-center/single-day-ahead-coupling/euphemia-public-description.pdf

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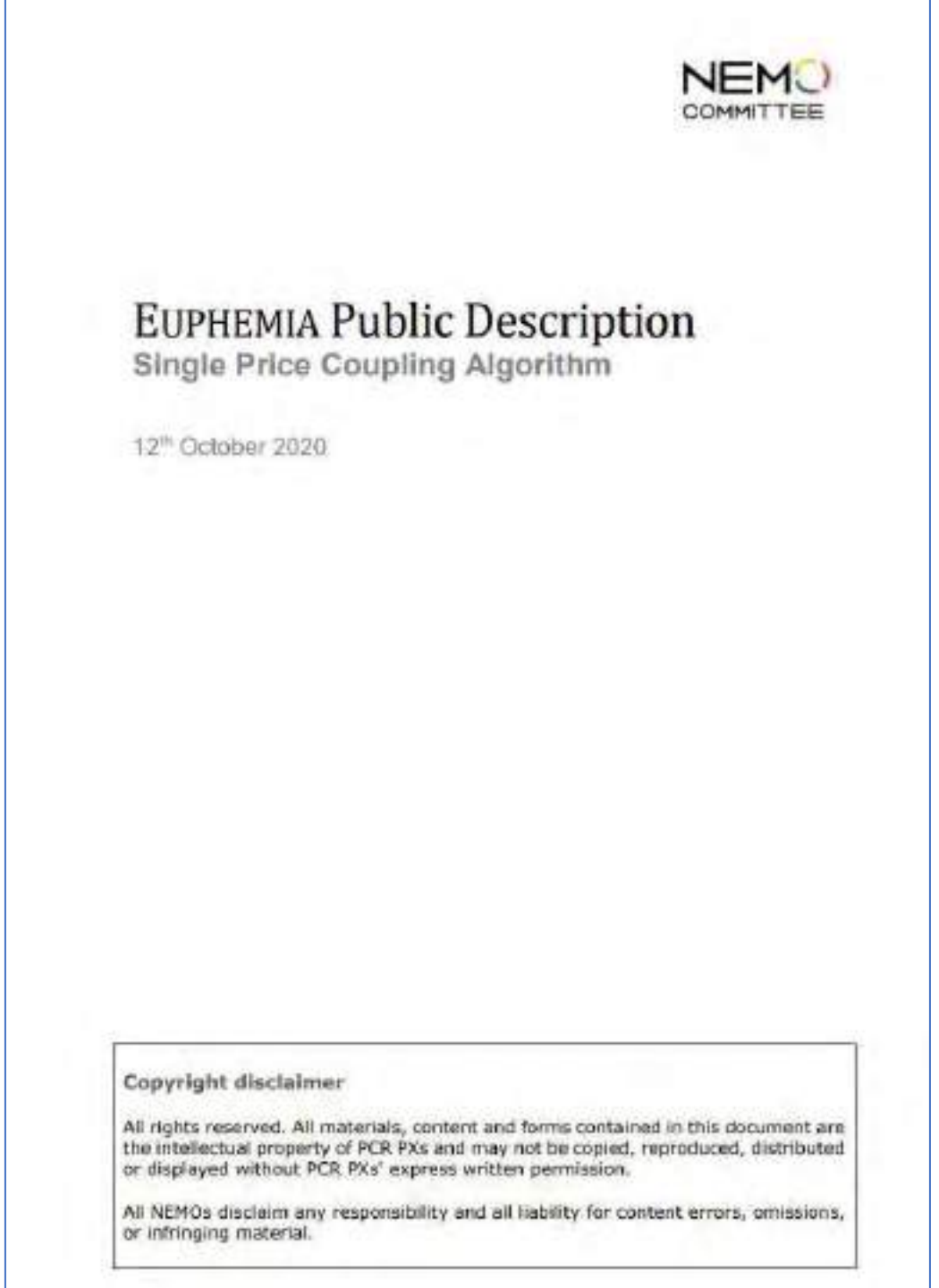


NEMO COMMITTEE

EUPHEMIA Public Description

Single Price Coupling Algorithm

12th October 2020

European integration

A common European market

- European Commission has a stated goal of harmonising European power markets. The aim is to create a pan-European market with closer connection of power markets to improve the efficient use of energy across national borders, the European Target Model for electricity market integration.
- The concept of market coupling and cross border trading was originally developed by Nord Pool and we are a driver in the European market coupling initiatives
- Close cooperation between TSOs, Power Exchanges and National Regulators across Europe

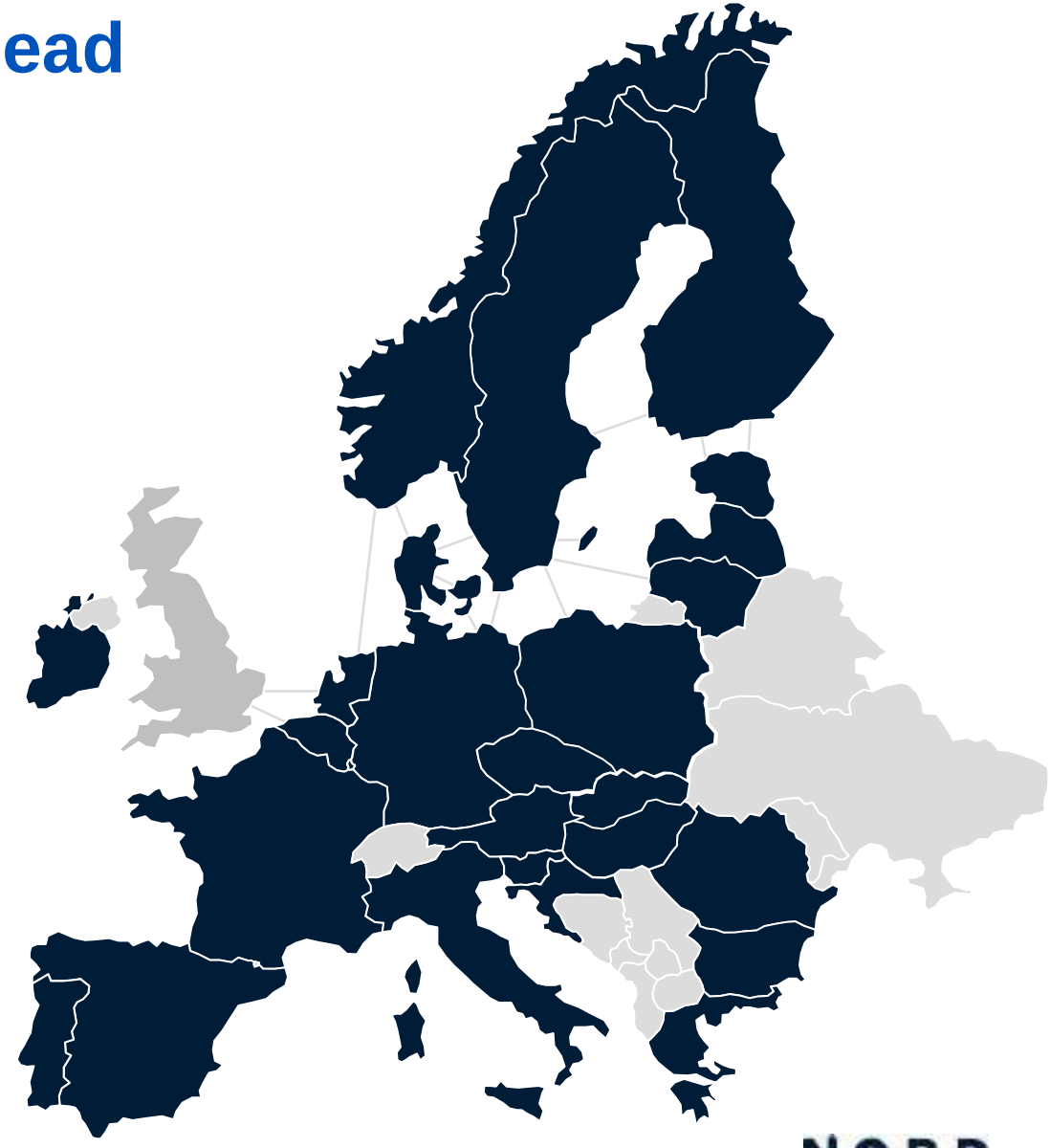
Why?

- Efficient use of transmission capacity by trading energy across borders
- A coordinated market development
- Level out electricity prices

European market integration – day-ahead

SDAC - Single day-ahead coupling

The aim of SDAC is to create a single pan-European cross-zonal day-ahead electricity market. Single day-ahead coupling is the auction process where collected orders are matched and cross-zonal capacity is allocated simultaneously for different bidding zones in the day-ahead market.



How SDAC works

- Day-ahead market coupling requires:
  - processing bids, offers, network capacities and constraints from all involved NEMOs and TSOs
  - matching them by operating one single algorithm,
  - validating and sending matched trades, clearing prices, and scheduled exchanges to NEMOs and TSOs.
- SDAC makes use of a common price coupling algorithm, called PCR EUPHEMIA, to calculate electricity prices across Europe and to implicitly allocate auction-based cross-border capacity.
- PCR EUPHEMIA matches energy demand and supply for 24 hours simultaneously.
- This process maximises social welfare and considers price limits of orders and network constraints.

A common European market

- EU regulation CACM 24 July 2015 – the European target model
  - Guideline on Capacity Allocation and Congestion Management
  - Nemo’s and MCO function
  - Single Intraday Coupling SIDC
  - Single Day-ahead coupling SDAC

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Key elements in market integration

PCR – Price Coupling of regions

- PCR is a project currently being operated by eight Power Exchanges: EPEX SPOT, GME, HEnEx, Nord Pool, OMIE, OPCOM, OTE and TGE.

- Development of a single price coupling algorithm, Euphemia. It is used to calculate electricity prices and the overall welfare and increases transparency of prices and flows across Europe.

Key elements in market integration

PCR- Price coupling of regions

- PCR is used to couple the following countries: Austria, Belgium, Czech Republic, Croatia, Denmark, Estonia, Finland, France, Germany, Hungary, Italy, Ireland, Latvia, Lithuania, Luxembourg, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden

- After Brexit, UK not included

Benefits of European Price Coupling

PCR- Price coupling of regions

The integrated European electricity market is beneficial due to increased liquidity, transparency, efficiency and social welfare

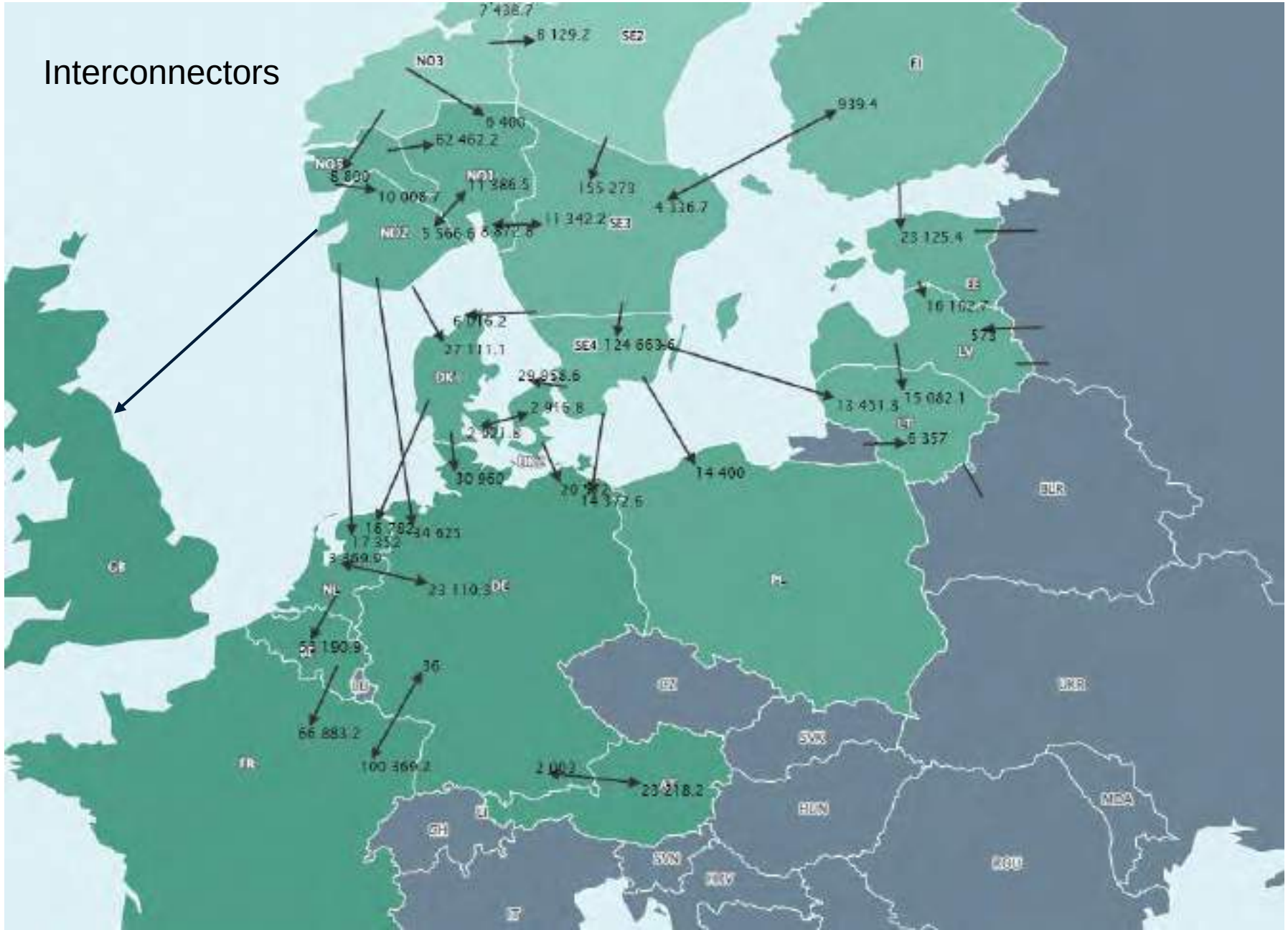
Guarantees the overall welfare and optimal use of electricity network constrains

Implicit trading removes unnecessary risks of trading cross-border capacity and electricity separately

Level out electricity prices

A coordinated market development

Interconnectors

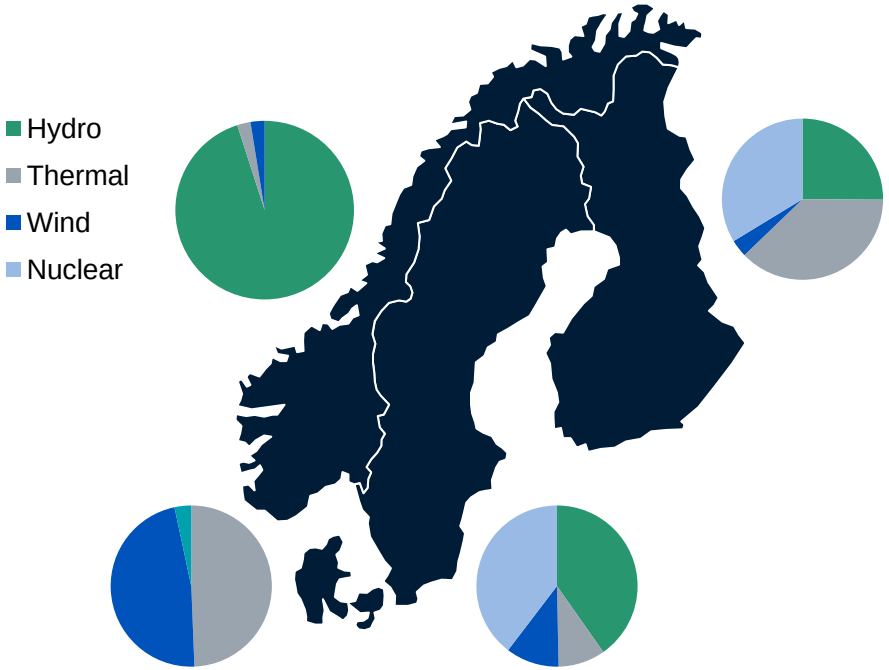


NORD POOL

Cooperating across borders - the Nordic model

Connecting the Nordic countries ensures optimal use of natural resources and more stable prices

Nordic production capabilities



Connecting markets with differing production profiles provides stability to the system

Hydrology

Wet year: higher hydro production

Dry year: lower hydro production

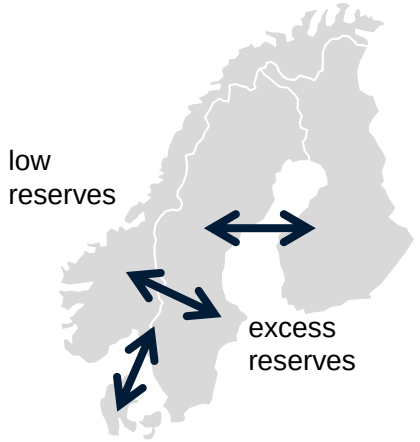
Seasons

Hydropower highly seasonal

Wind power highly seasonal

Nuclear neutral

Fossil power neutral



Daily weather

Wind power is neither flexible nor storable

All other sources are flexible

NORD POOL

Benefits of European Price Coupling

PCR- Price coupling of regions

The integrated European electricity market is beneficial due to increased

1. liquidity
2. transparency
3. efficiency
4. social welfare

Guarantees the overall welfare and optimal use of electricity network constrains

Implicit trading removes unnecessary risks of trading cross-border capacity and electricity separately

Looking ahead

Development of the Day-ahead market

Challenges ahead – Development of the Euphemia algorithm

Future roadmap – upcoming implementations

- Flow based capacity allocation
  - Nordic FB
- Quarterly time resolution
  - Move from hourly to quarterly MTUs
  - Cross matching of orders with different time units
- Various TSO requirements

Also in discussion:

- MRLVC – loose volume coupling with UK (due to Brexit)
- Co-optimization with allocatin of transmission capacity for exchange of balancing energy and reserves

ALL NEMO COMMITTEE

CROPEX epexspot EXAA GME HEnEx hupx IBEX Nasdaq NORD POOL OKTE omie opcom OTE semopx SEEPEX TGE

http://www.nemo-committee.eu/sdac

NORD POOL

Impacts of massive renewable production on wholesale markets

Current electricity market and fundamentals

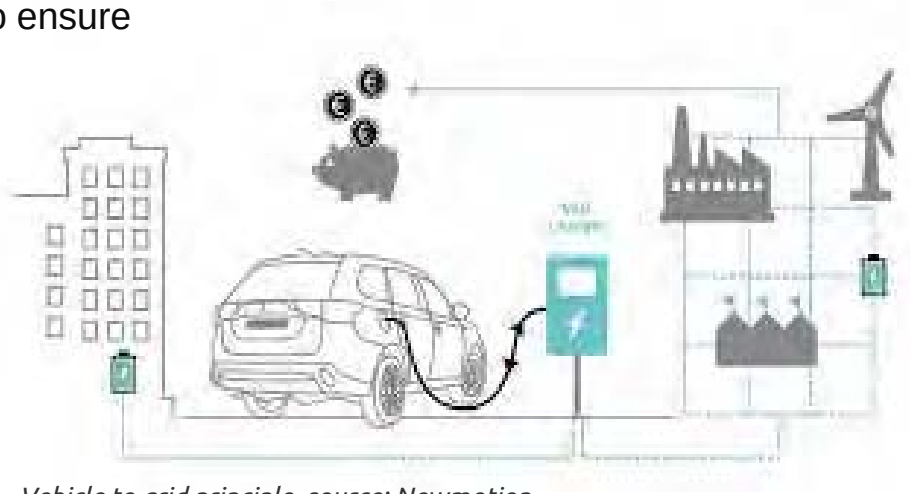
- Pressure on wholesale prices (and even **negative prices**), and **more volatility**
- Shift of volumes to short-term (intraday), more **«real time» trading**, supported by technology (big data, AI, ...)
- More **arbitrage opportunities** accross time-frames and geographies
- More re-dispatch, local congestions, grid stability issueds (both **DSO and TSO**)
- Temptation for **local markets** and/or **smaller zones**
- **New prices zones** for off-shore wind islands?
- **New kids on the block**: aggregators, virtual power plants, batteries, demand response, smart meters/building/grids, vehicle to grid, ...

The total number of hours of negative day-ahead prices in power markets, January-September 2020, source: EnAppSys

New emerging energy commodities and markets?

- **Missing-money issues** and capacity markets for non-renewable plants
- **Traceability and proof of origin** (GO or alternative solutions) to ensure green electricity is consumed
- **Flexibility** remuneration
- New **reserve products/ancillary services**
- **Complementary markets btw gas, electricity and hydrogen?**
- **Local markets** / peer to peer platforms?

Peer to peer energy platforms



Vehicle to grid principle, source: Newmotion

NORD POOL

Thank you for your attention!

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Senior Market Coupling Adviser
Isidora.micic@nordpoolgroup.com

Nord Pool Intraday –
The road to a fully connected Europe

Martin Hergot Festøy,

Service owner, cross border Intraday

The Physical & Financial Power Market,

Oslo, 19.01.2022

Agenda

- Introduction - What is continuous intraday?
- Why trade intraday?
- How does it work and how has it developed?
- Live demo of trading system

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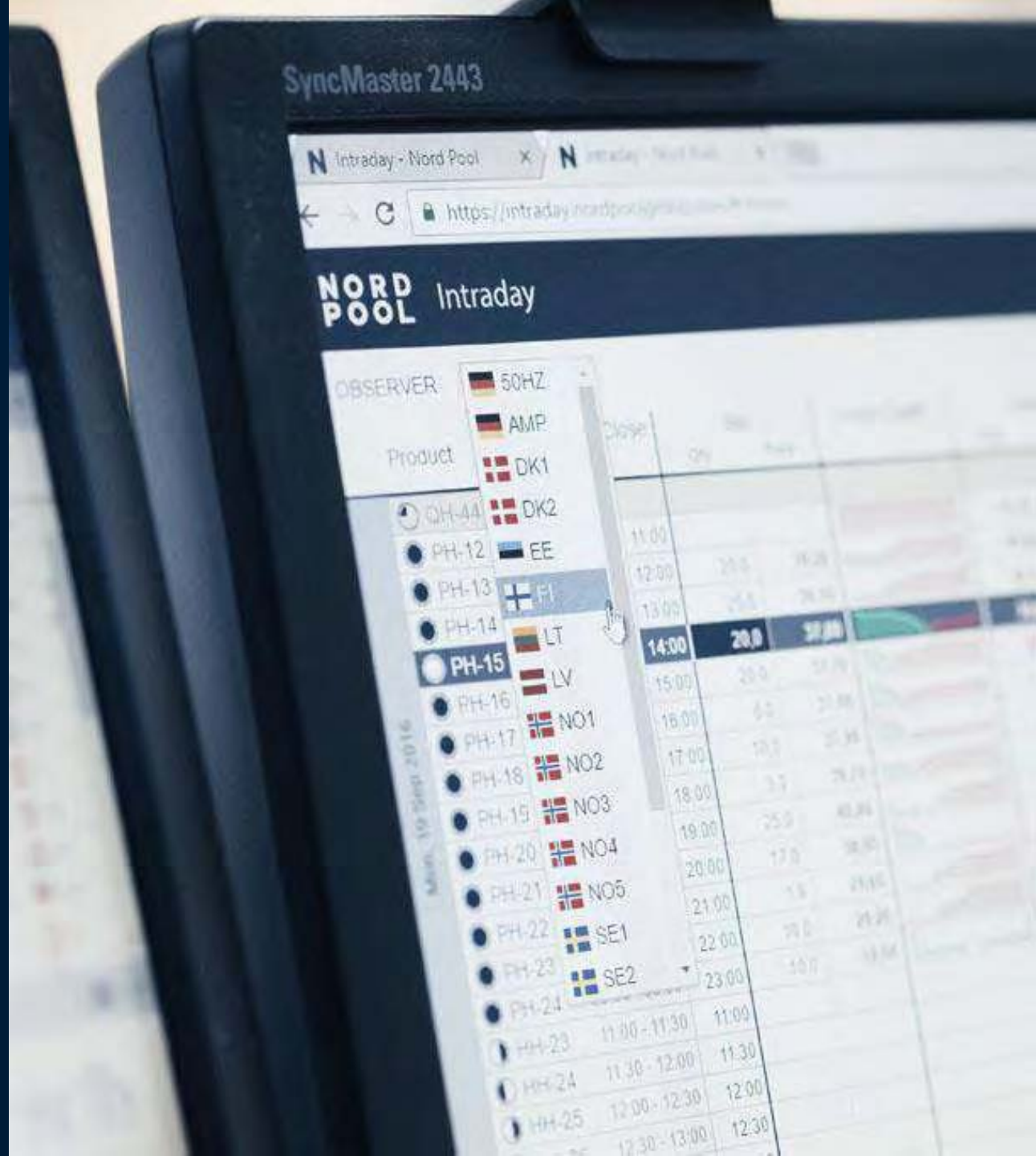
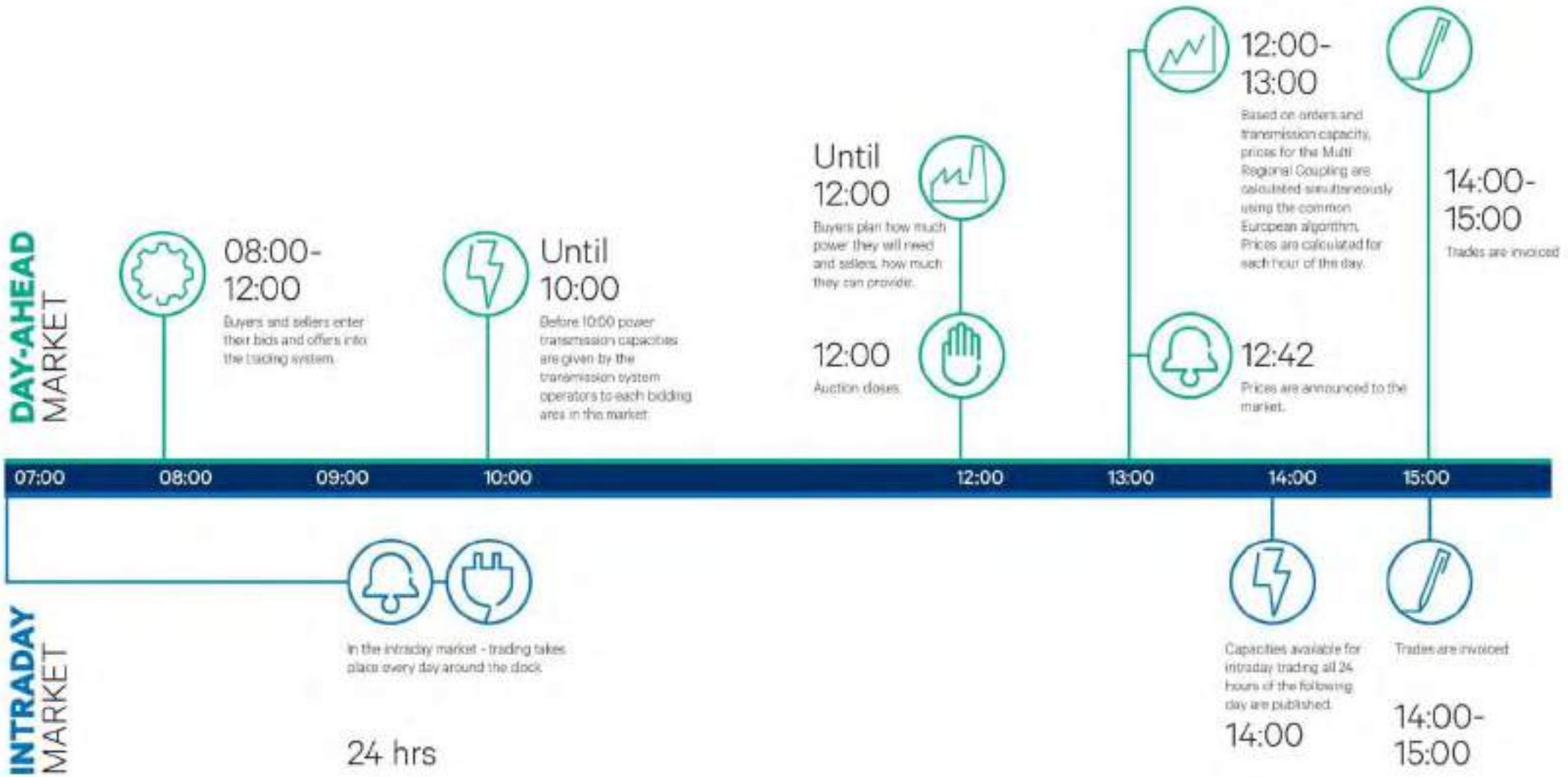


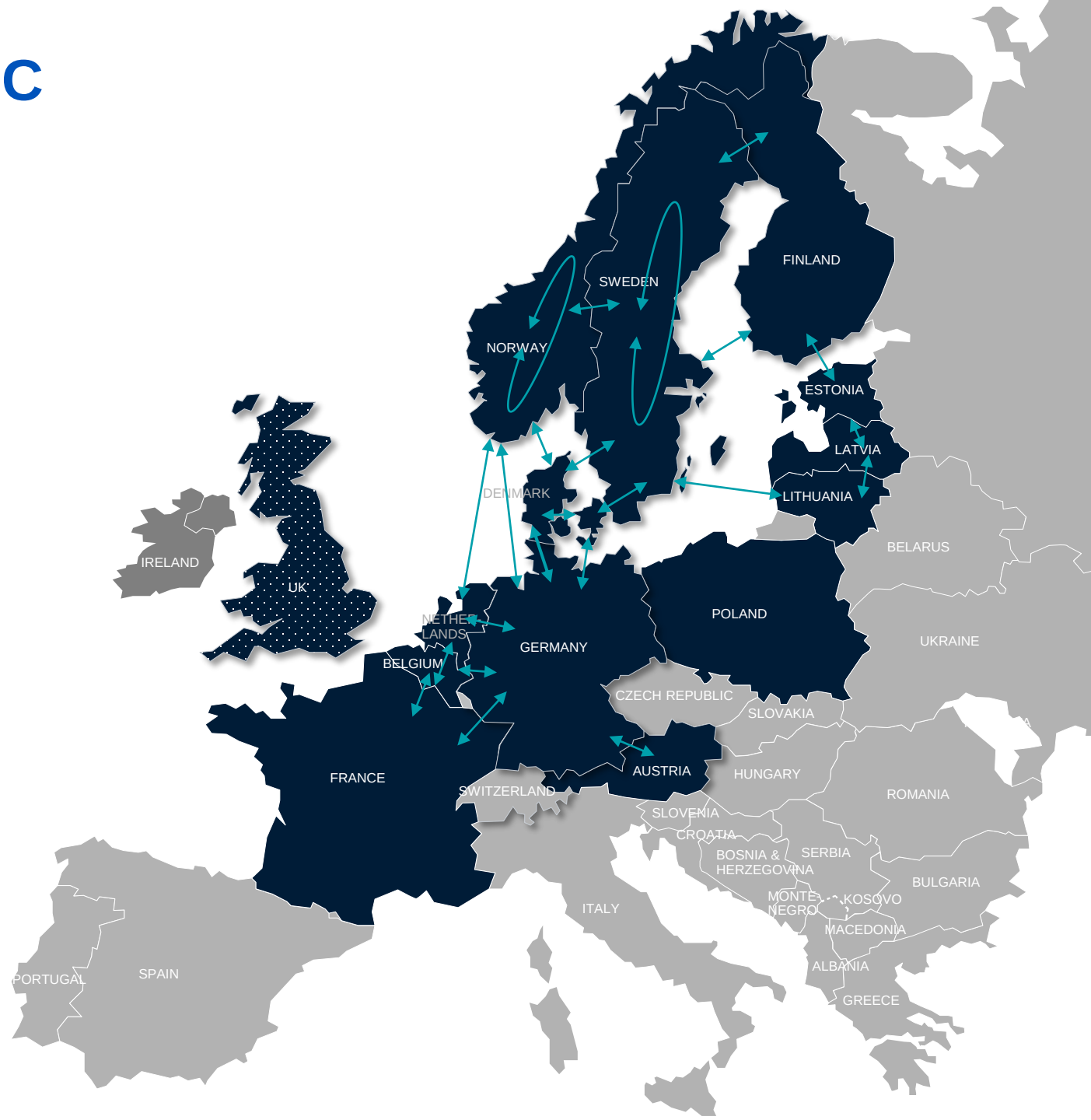
The basic timeline



NORD POOL

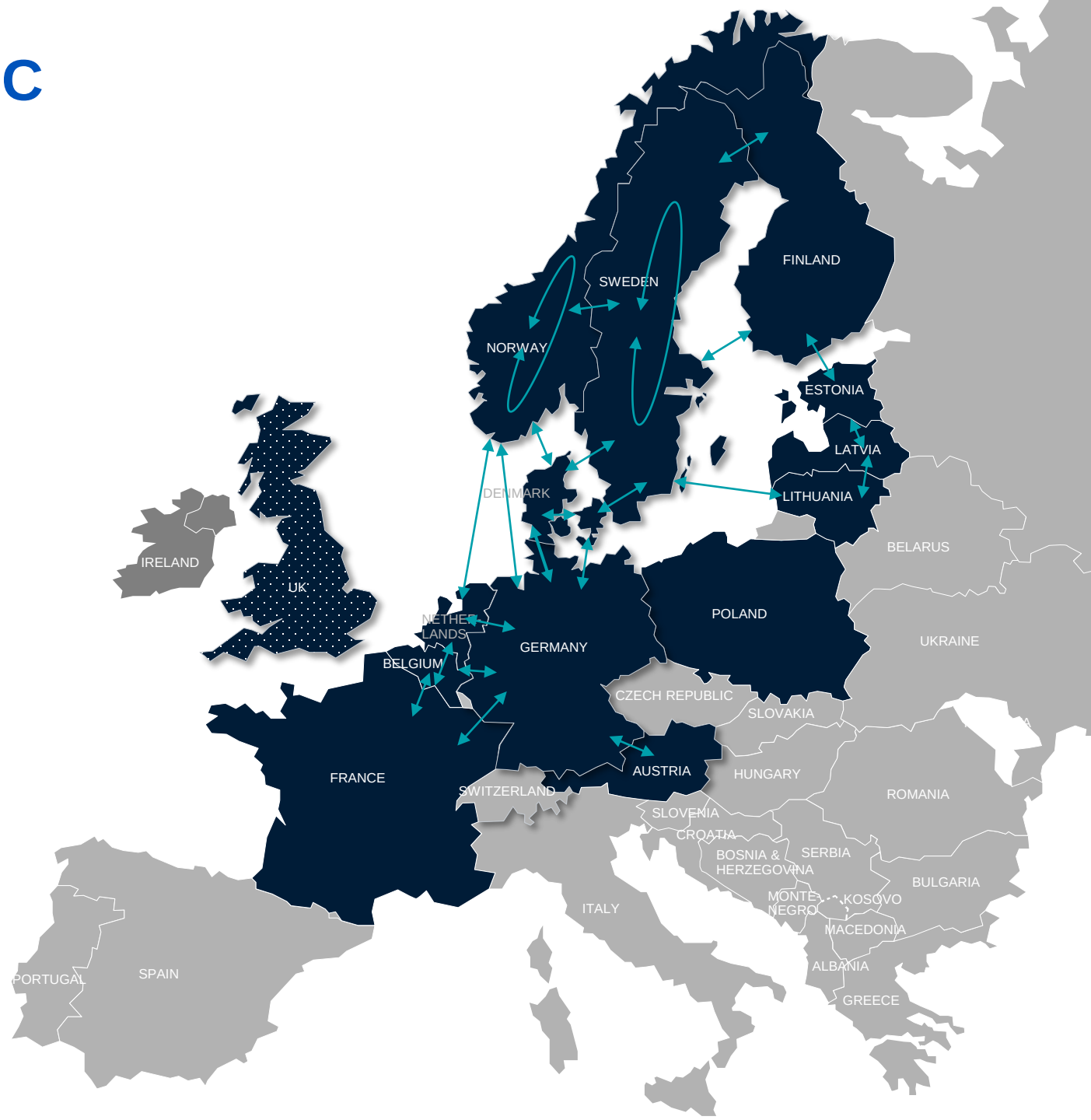
Nord Pool intraday market: ABC

- Continuous (24/7) market for buying and selling electricity closer to nomination gate closure:
  - Allows for adjustment of all buy- and sell orders done in the Day-Ahead market (DAM)
  - Possible to optimize trades done in the DAM or make better use of production/consumption that was not accepted in DAM
  - Power trading is a guessing game. The closer to delivery the more information you have.
- Trading resembles stock trading:
  - What you see, is what you get
  - First come, first served
  - Best priced orders first



Nord Pool intraday market: ABC

- The first international intraday market
  - 1999 Elbas was launched as a balancing adjustment in Finland and Sweden
  - 2004 Eastern Denmark joins Elbas
  - 2006 Elbas in Germany
  - 2007 Western Denmark joins Elbas
  - 2009 Norway joins Elbas – Nordic is complete
  - 2010 Estonia joins Elbas
  - 2013 Latvia and Lithuania – Baltic complete
  - 2018 Go-live of the XBID system



Why do we actually need Intraday?

NORD POOL

Why do we actually need Intraday?

NORD POOL

Why do we actually need Intraday?

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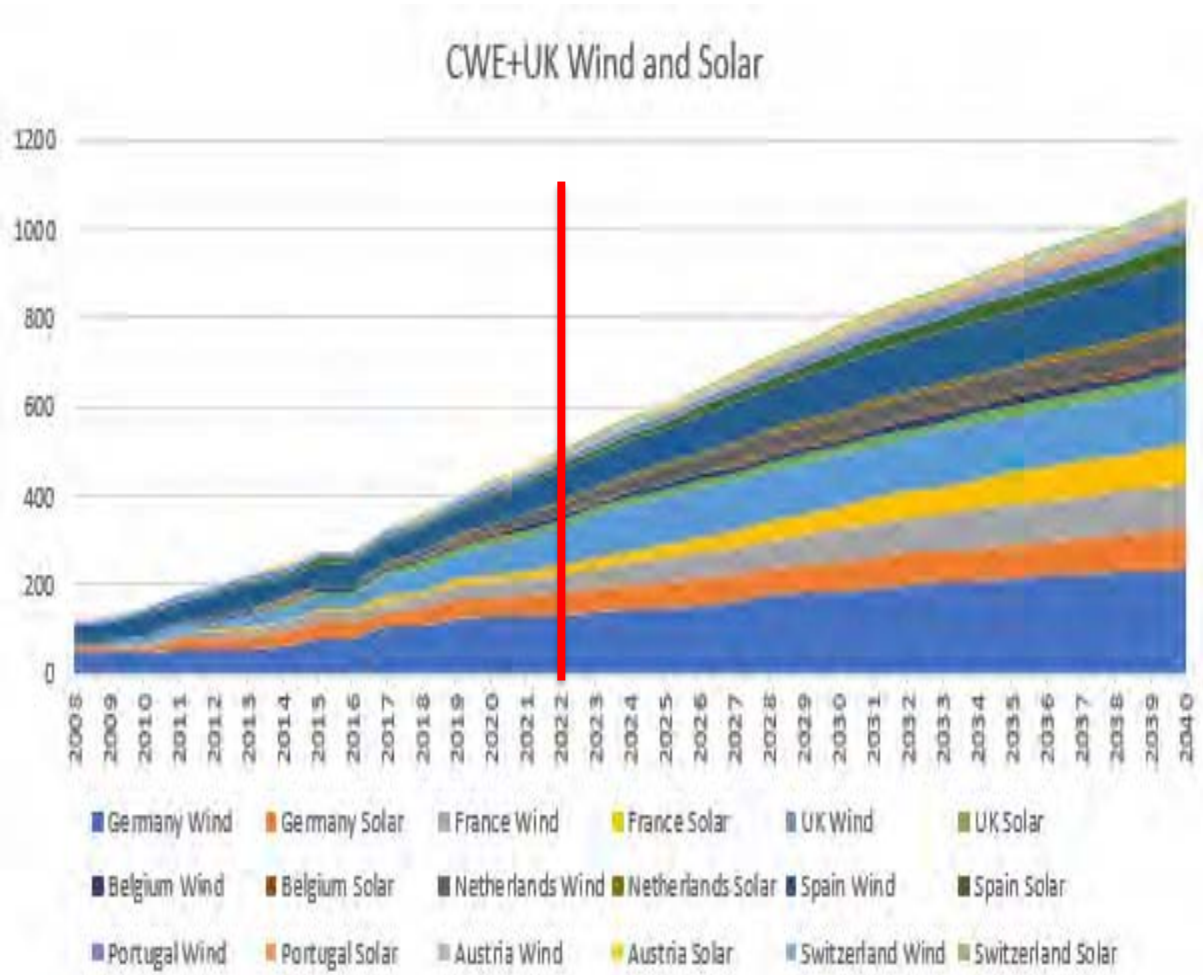
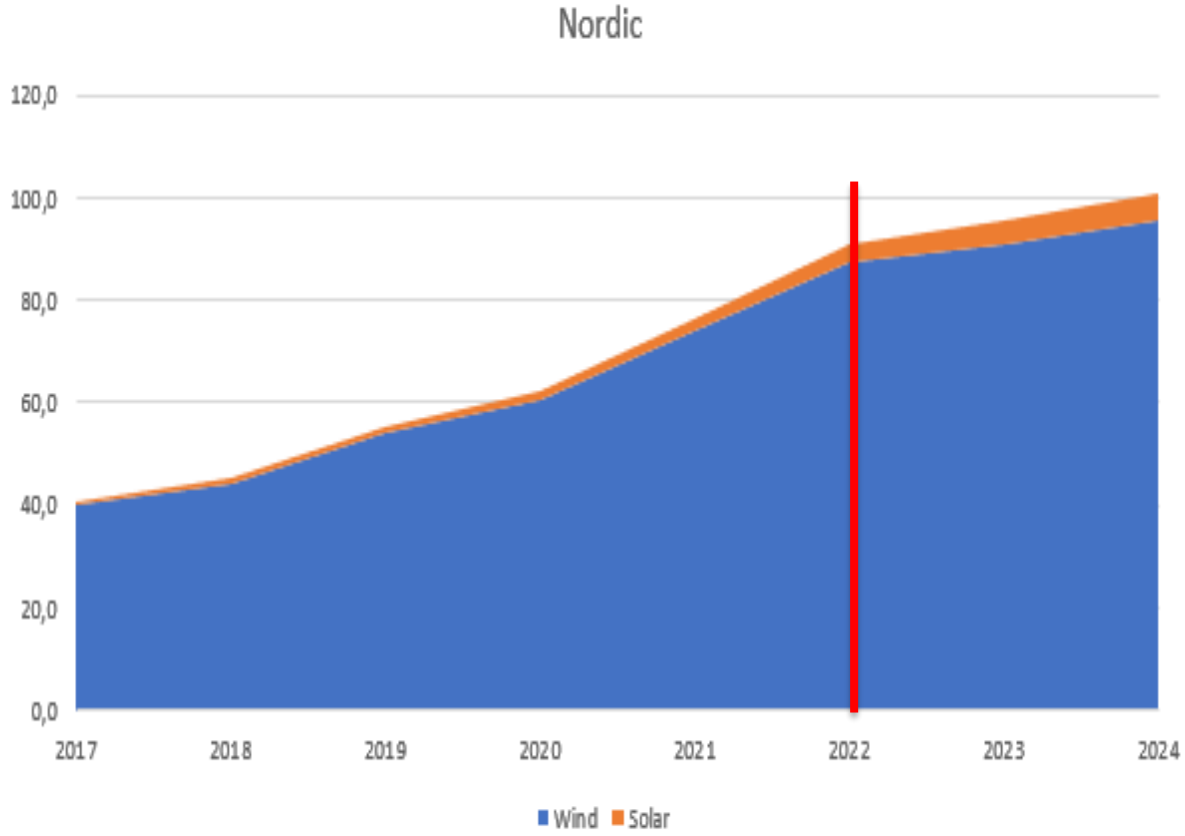
European wind and solar power (TWh)
- estimated values from 2021





NORD POOL

Balance the unexpected

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German intraday spreads widen EUR 2,000 ahead of eclipse

(Montel) German intraday power prices ranged as wide as EUR 2,000/MWh early on Friday, as the market prepared to balance a rapid shift in solar generation during a partial eclipse, Epex Spot data showed.

For 15-minute intraday contracts, the lowest price paid was EUR -998/MWh during the 08:30-08:45 CET period. The highest price reached was EUR 950/MWh for the period 10:00-10:15.

The partial solar eclipse can be seen in Germany between 09:00 and 12:00.

Germany's TSOs have forecast solar output at 14,876 MW at 09:30, dropping to 6,441 MW at 10:30, before rising to a high of 22,079 MW at 12:15 CET.

Germany is Europe's largest producer of solar power with just over 38 GW of installed capacity.

Reporting by:
Nora Kamprath Buli
nora@montel.no
10:05, Friday, 20 March 2015

MONTEL

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Sahara dust slashes German solar output by 5 GW

(Montel) German solar power delivered 5 GW less at its peak on Friday than TSOs had forecast, amid dusty conditions that disrupted analysts' models.

German solar generated a peak of 12.5 GW at 12:45 CET, compared to a predicted peak of 17.8 GW, according to EEX transparency data that cited TSO information. Norwegian weather service Nena had forecast a peak as high as 20 GW for Friday earlier in the morning.

Forecasts were complicated by concentrations of dust blown across Germany from the Sahara Desert, Andreas Gassner, a senior meteorologist at Meteogroup, told Montel.

"This morning I did expect a German PV maximum only up to 13 GW. And the extrapolations I do see in the moment are showing around 12 GW," he said in an email.

Intraday power market prices rose as high as EUR 113.59/MWh on the Epex-Spot exchange at 12.15, though the weighted average price for 12:00-13:00 only rose to a peak of EUR 68.60/MWh.

Weekend impact

Gassner said he expected dust to continue to unsettle forecasts for Saturday over Germany.

Solar was likely to deliver a maximum peak of 13 GW, though a range between 10-20 GW could not be excluded.

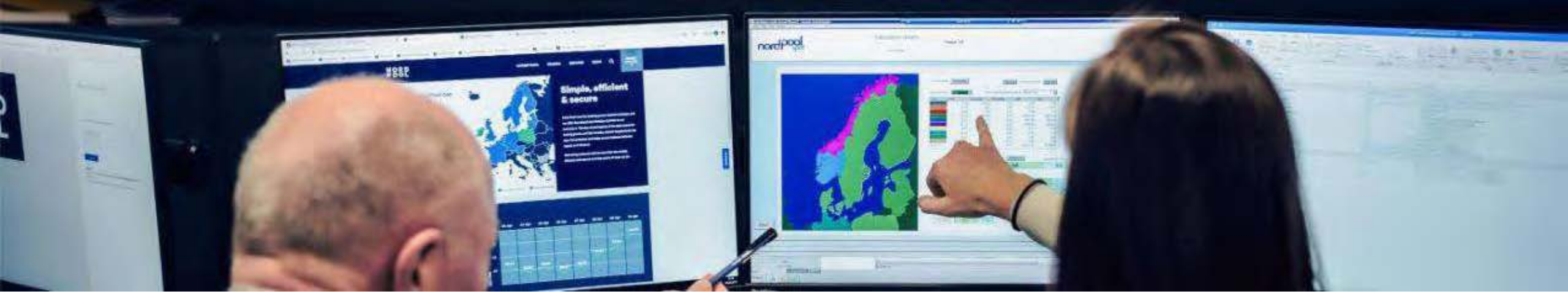
Nena forecasts a peak of 21 GW on Saturday, while Danish service ConWX forecasts a peak of 17.5 GW.

ConWX meteorologist Peter Holst, who discounted the likely impact of dust on solar earlier on Friday, said such conditions were difficult to factor into present solar production models.

"It is not something we have many incidence of," he said.

Dust concentrations are set to fall to 90 micrograms per cubic meter over areas of southern Germany on Saturday, according to a university of Athens forecast. That compares with levels about twice as high at midday today.

Gassner said he expected mostly normal conditions to return to Germany by Sunday, with dust concentrations likely to shift to Hungary. He said he expected the solar peak to reach 14 GW that day, which is line with Nena's forecast, but about 6 GW below the present forecast of ConWX.

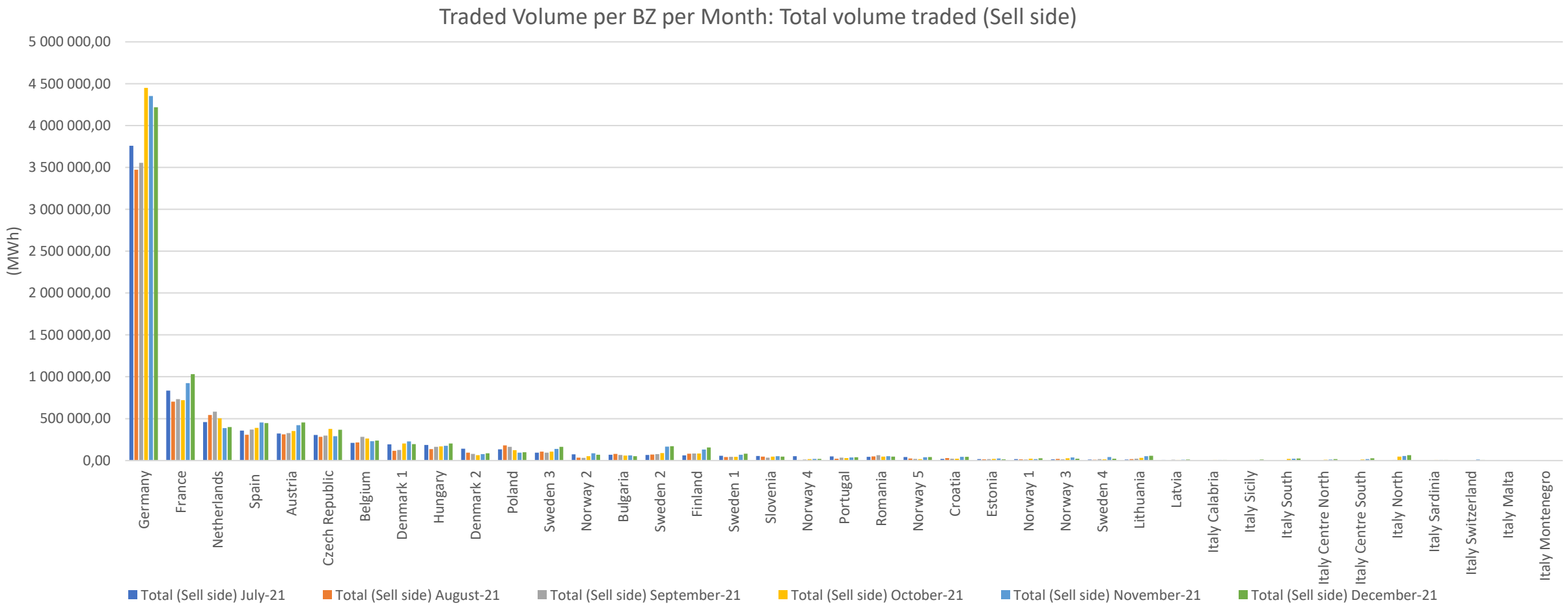


Who participates?

- Most of the parties that trade Day Ahead also trade Intraday
  - Producers
  - Retailers
  - Big consumers
- Pure speculators are more widespread in Intraday
- Also traditional market parties speculate in Intraday

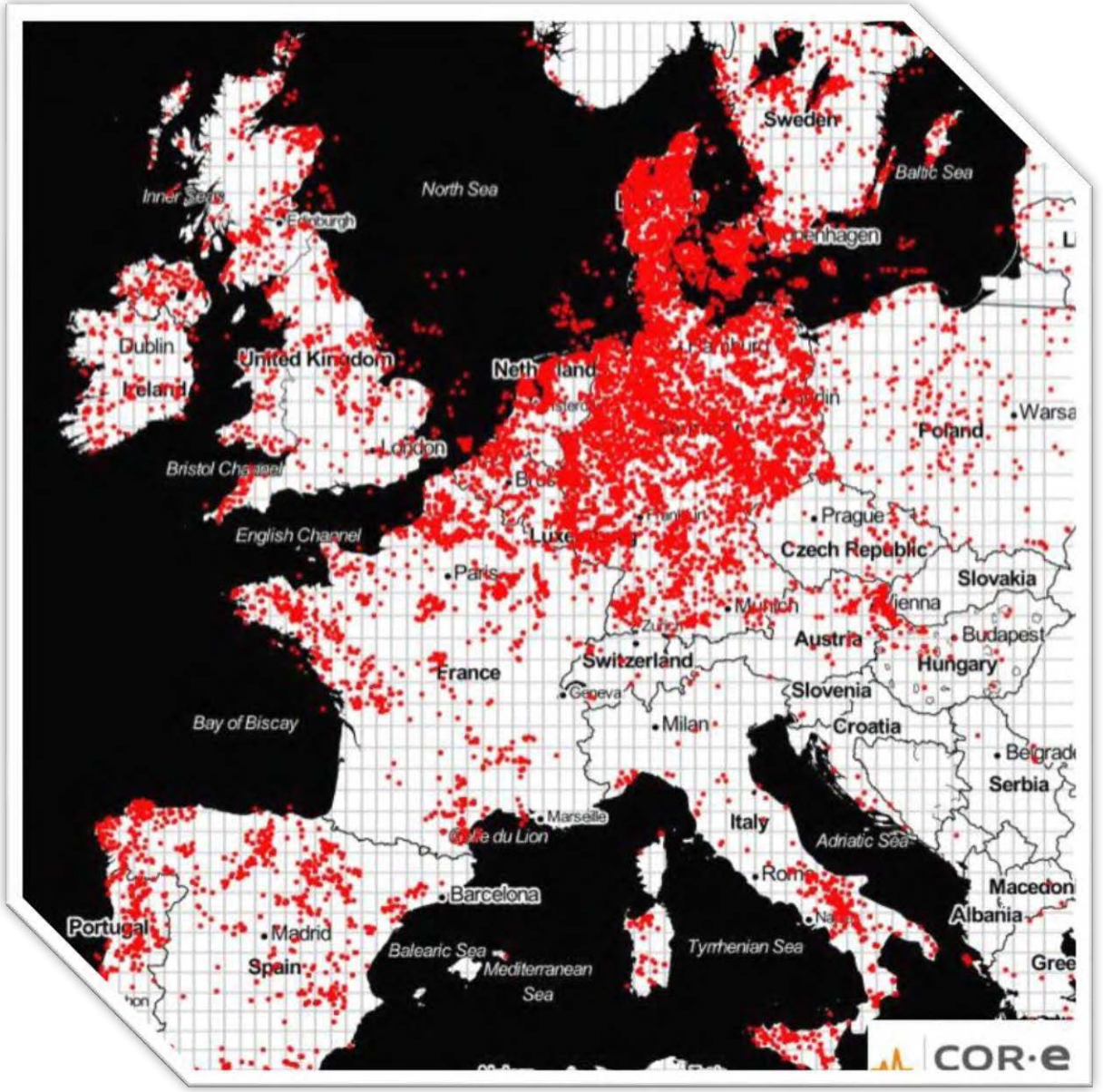
Where is the line drawn between speculation and normal trading?

Activity varies a lot between areas



Why the big difference?

- Significant recent increase in *intermittent* renewable production in Northern Central Europe
- CWE areas have trading close to delivery
- Algorithmic trading (trading robots) are prevalent in Germany
- Imbalance is comparatively more expensive in CE compared to some Nordic areas



European wind power in 2022. Source: COR-e

NORD POOL

The road to a single european ID market

NORD POOL

The acronyms

SIDC – Single Intra Day Coupling

- A cooperation project

XBID – Cross Border Intra Day

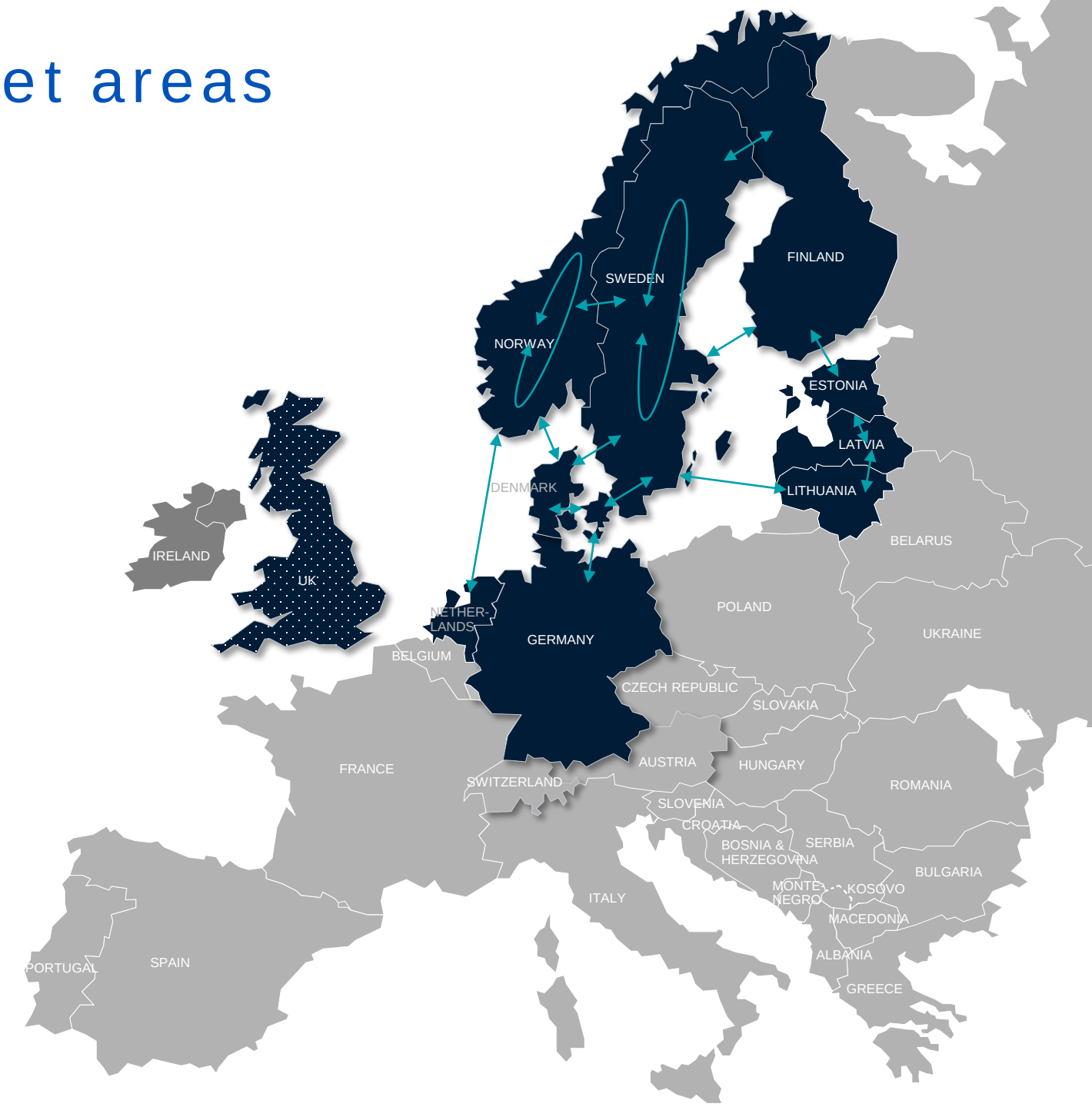
- A computer system

Nord Pool intraday market areas
Pre SIDC

Nord Pool markets, open

Nord Pool markets, not part of XBID

Capacity available



NORD POOL

Nord Pool intraday market areas
Post XBID go-live

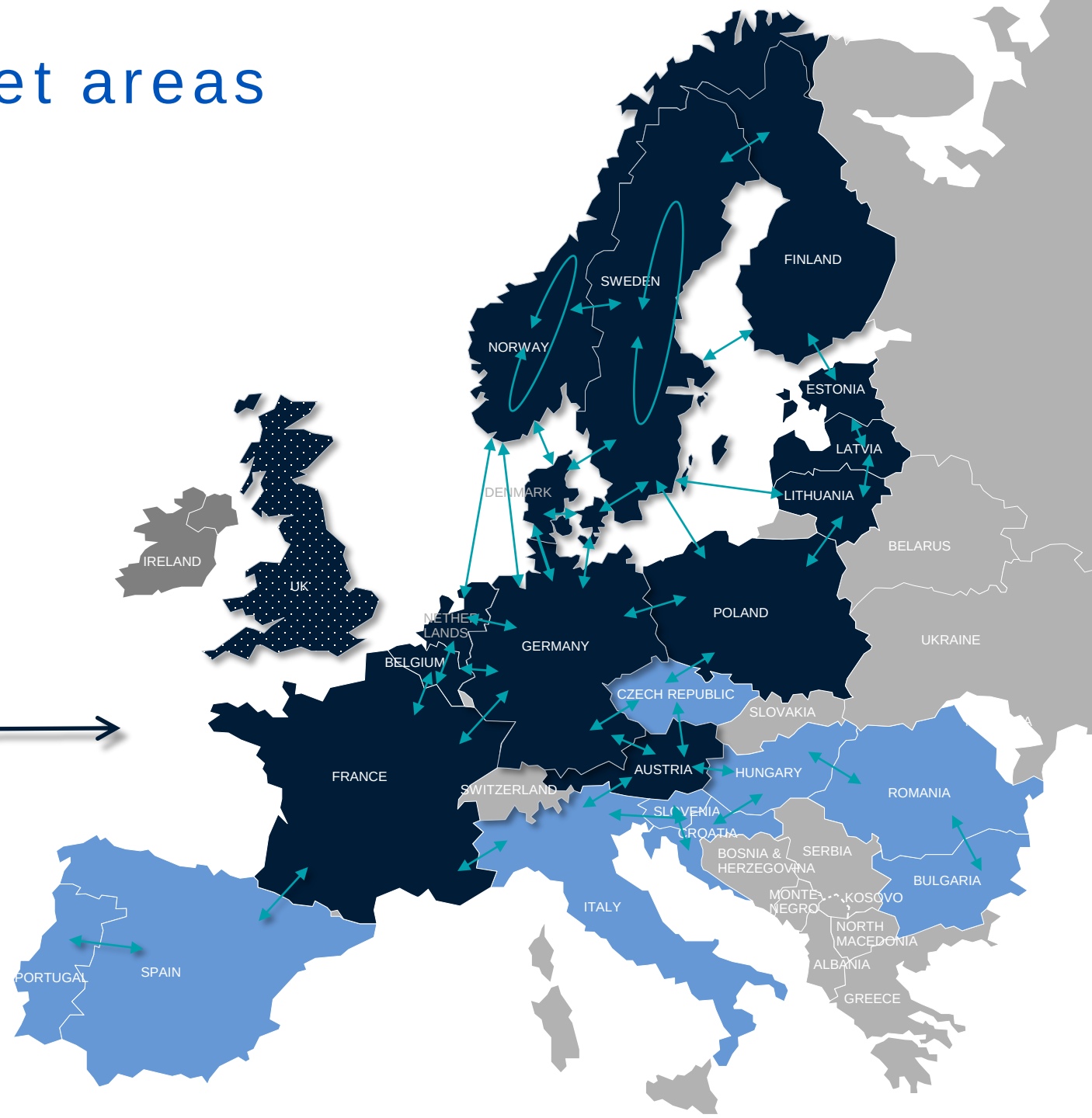
Nord Pool markets, open

Nord Pool markets, not part of SIDC

Nord Pool is not NEMO

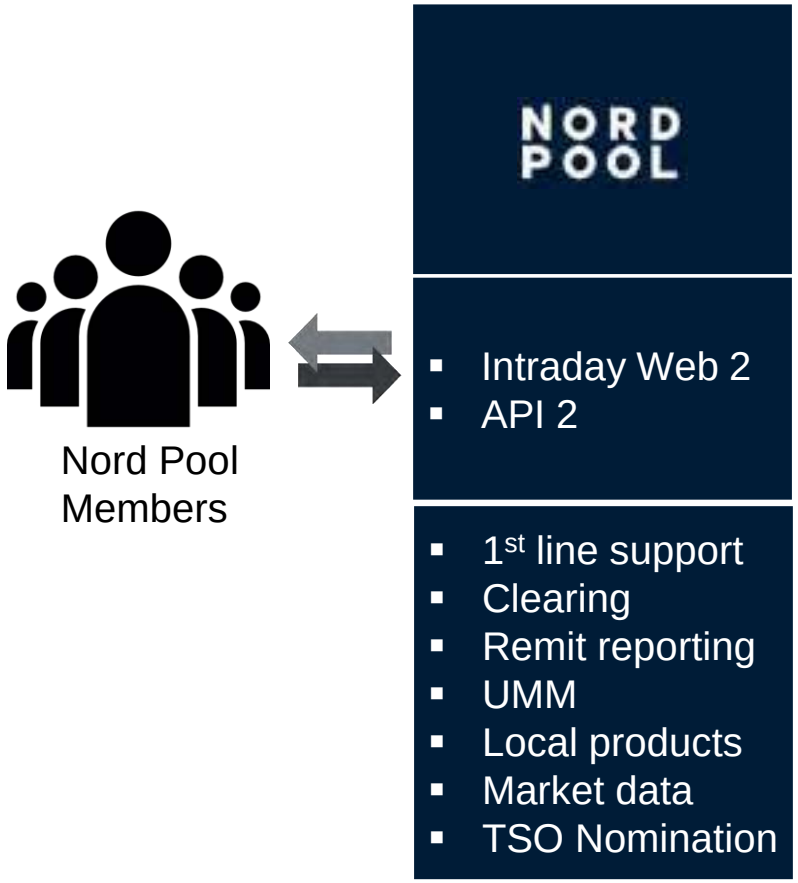
Capacity available

- ✓ Shared liquidity pool with **13** new countries, compared to Nord Pool's offering pre SIDC
- ✓ Shared liquidity pool with other PXs in Nordics, Germany, France, The Netherlands, Belgium and Austria



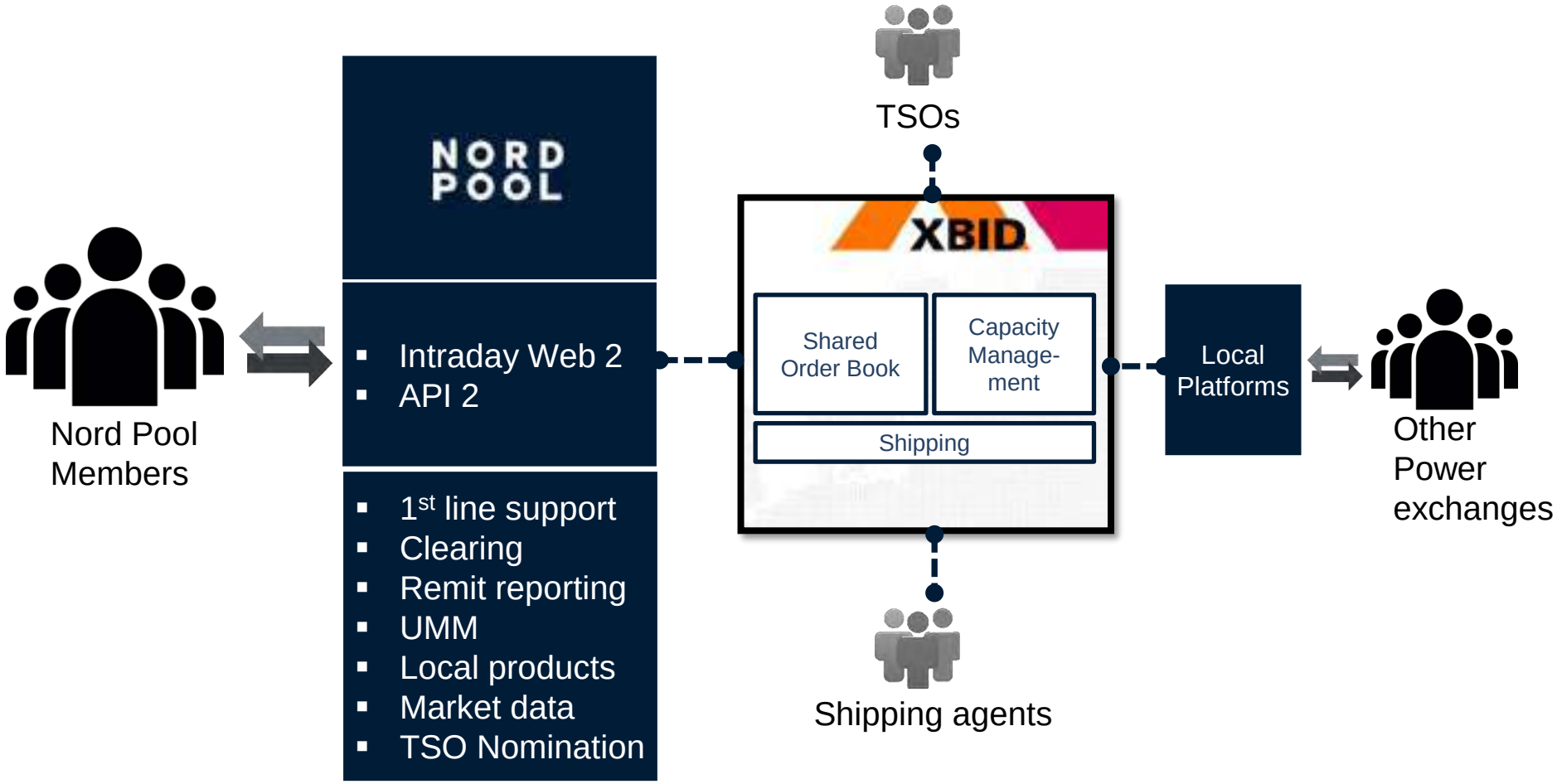
NORD POOL

SIDC – Single IntraDay Coupling



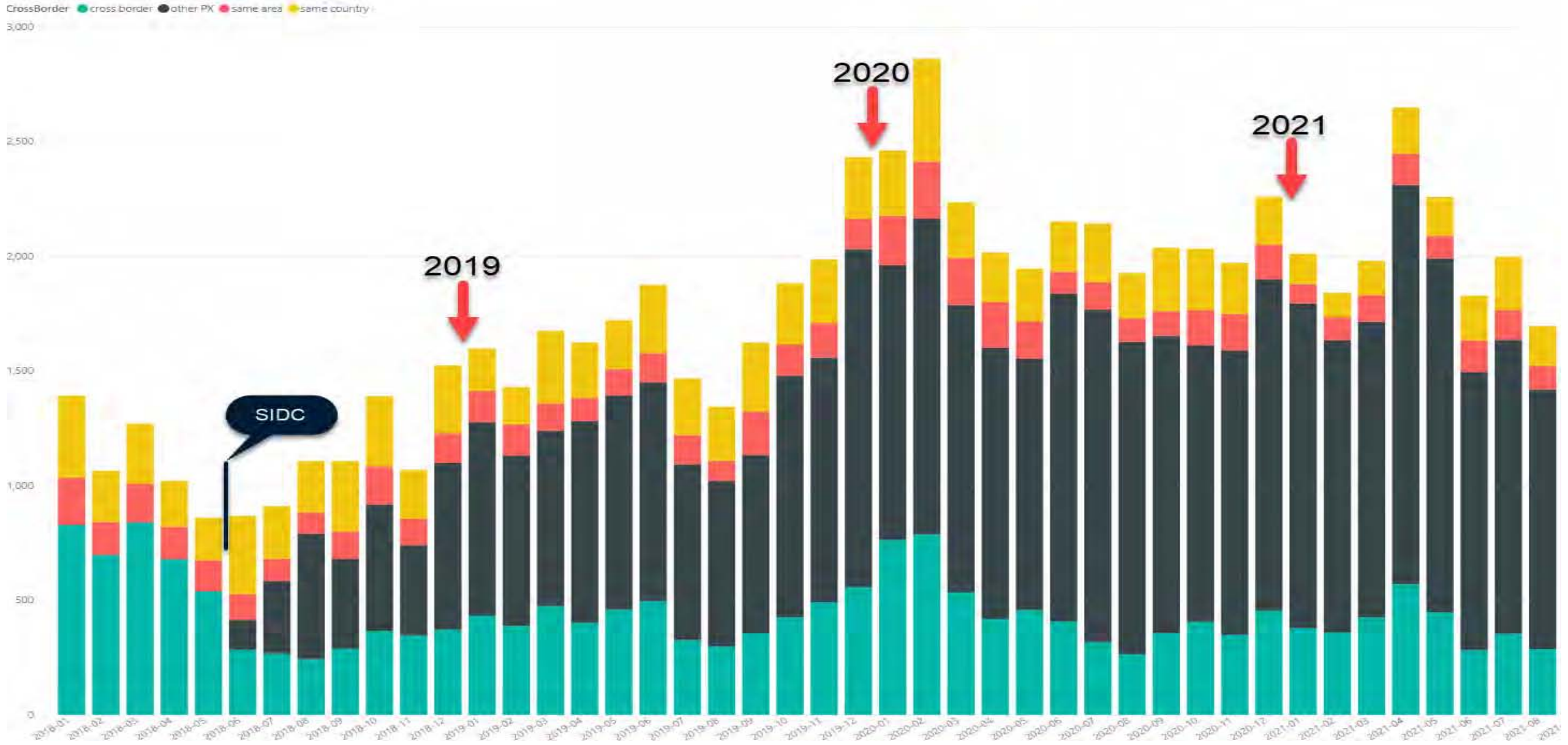
NORD POOL

SIDC – Single IntraDay Coupling



NORD POOL

Cross exchange trades are increasing

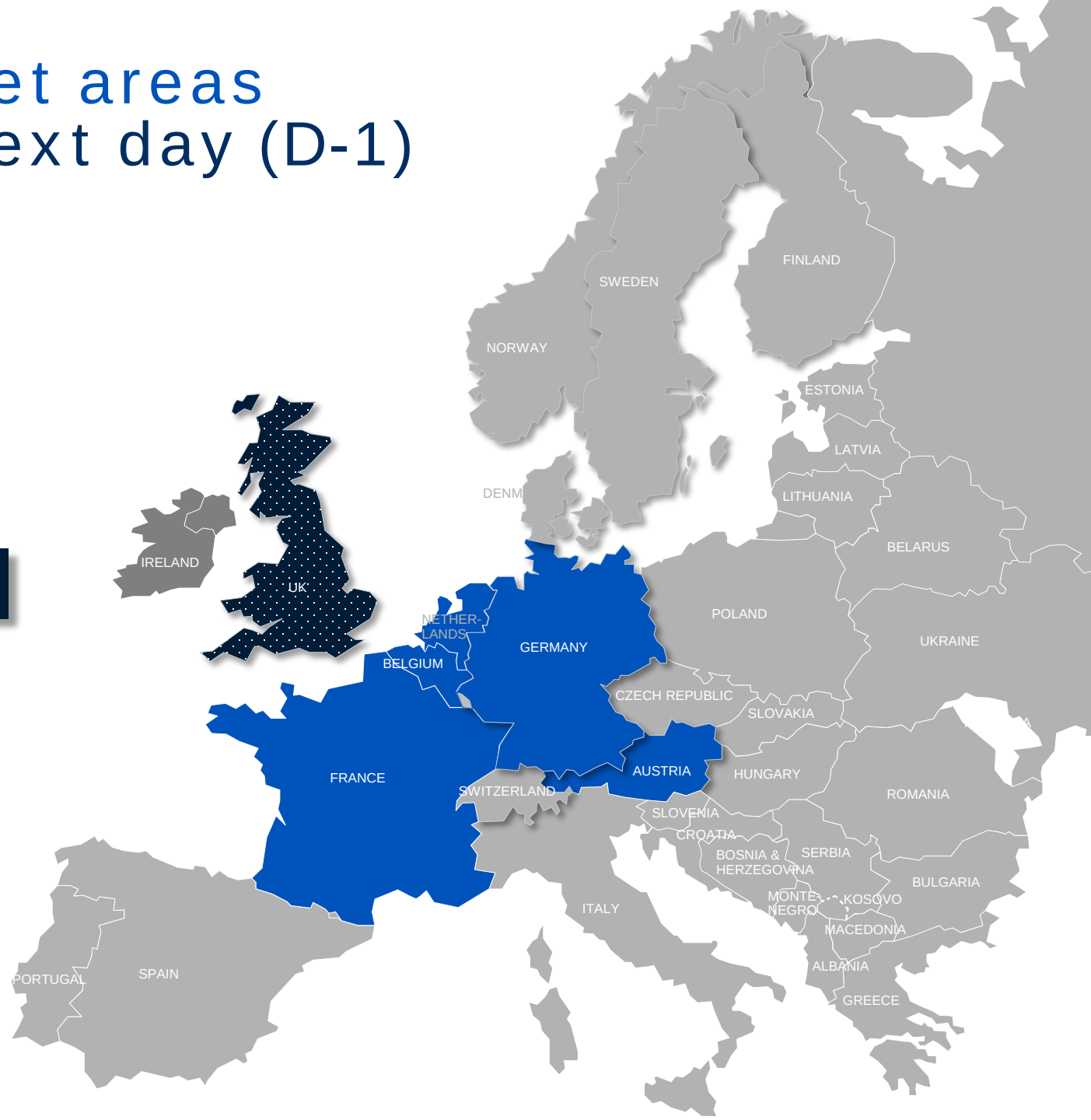


What does a trading day look like in SIDC?

Nord Pool intraday market areas
Trading availability for next day (D-1)

- Nord Pool markets, open
- Nord Pool markets open, not part of SIDC
- Nord Pool local market open

08:00:00 CET

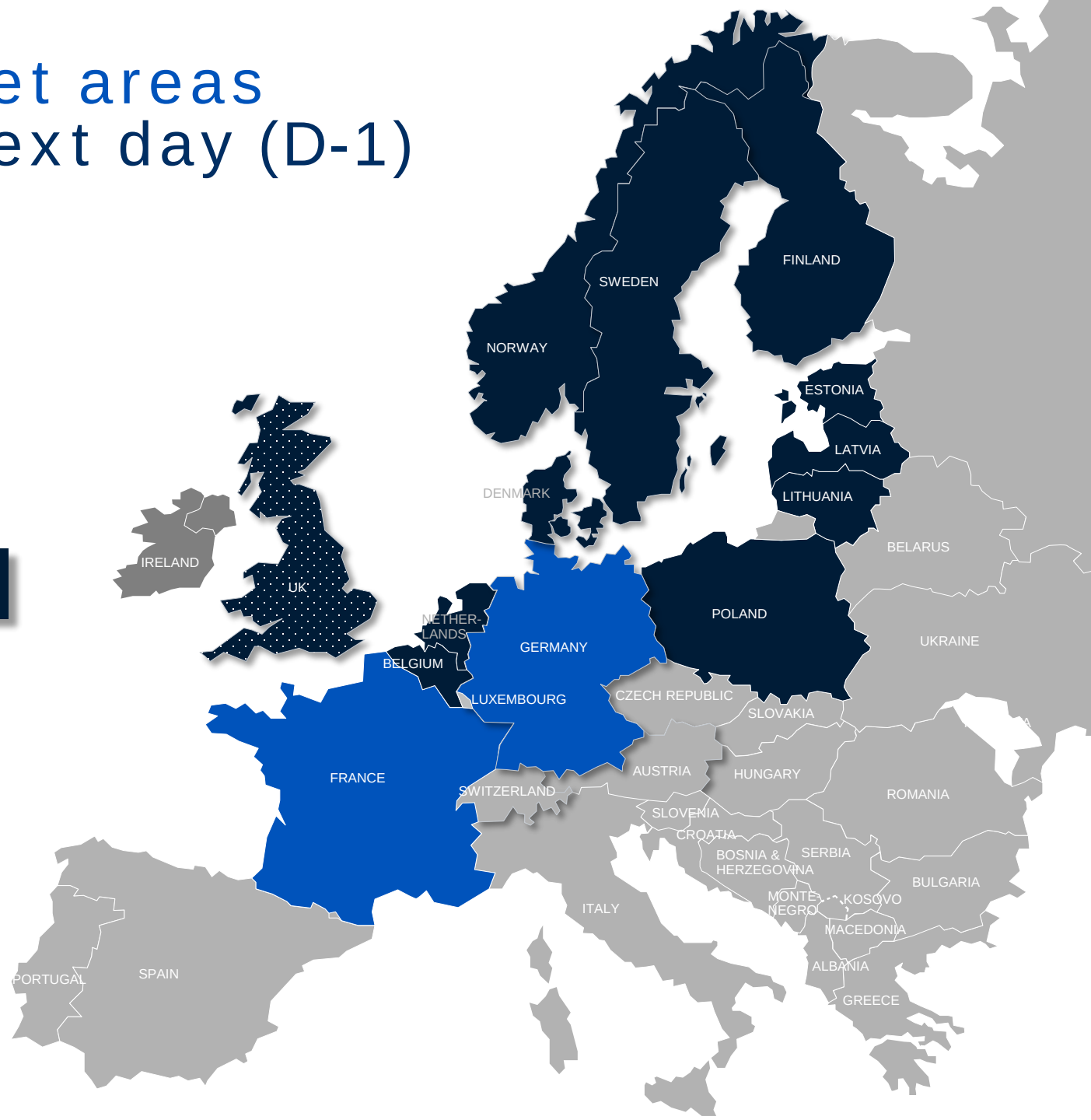


NORD POOL

Nord Pool intraday market areas
Trading availability for next day (D-1)

- Nord Pool markets, open
- Nord Pool markets open, not part of XBID
- Nord Pool local market open

14:00:00 CET



NORD POOL

Nord Pool intraday market areas
Trading availability for next day (D-1)

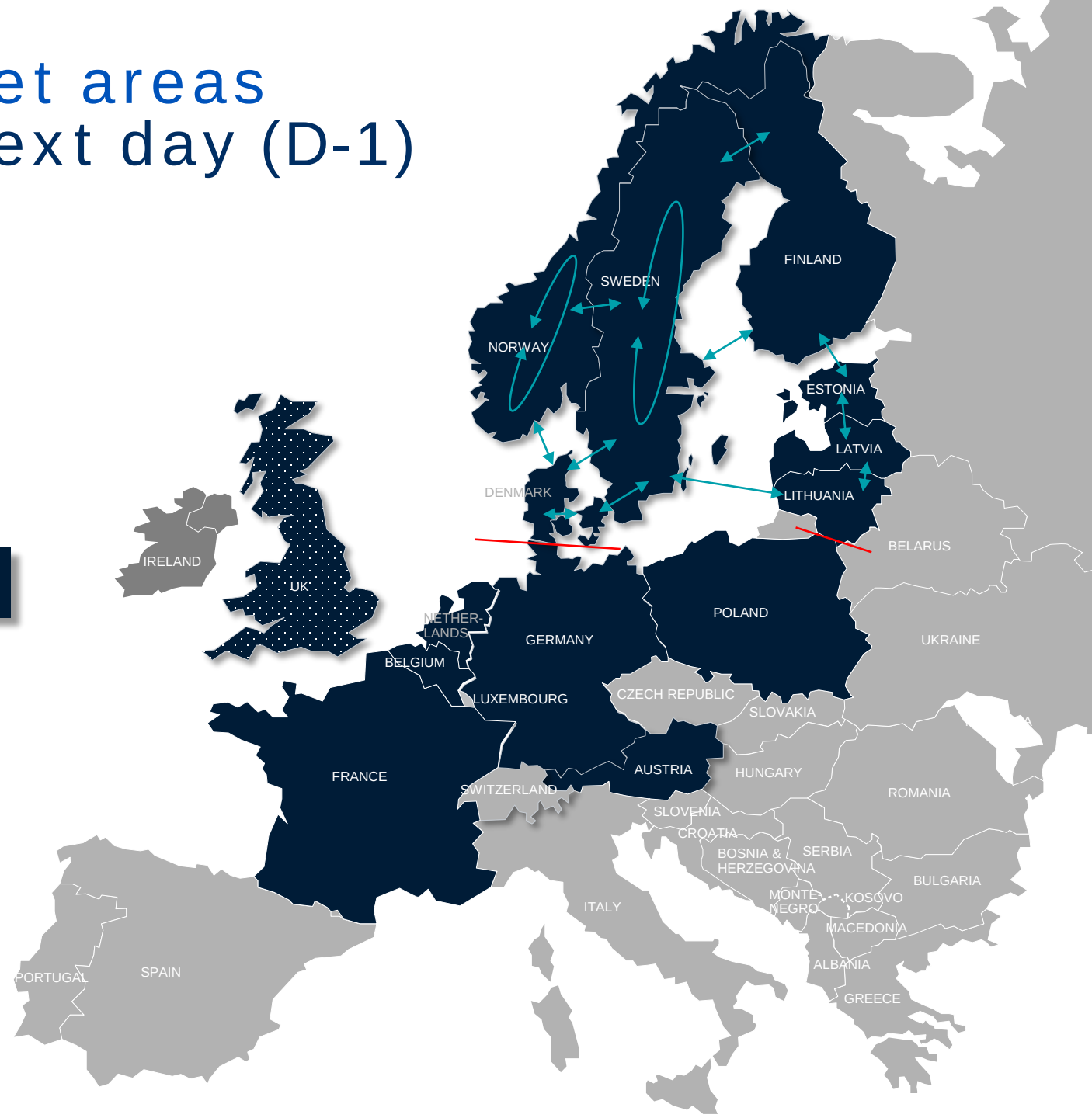
Nord Pool markets, open

Nord Pool markets, not part of XBID

Nord Pool local market open

Capacity available

15:00:00 CET



NORD POOL

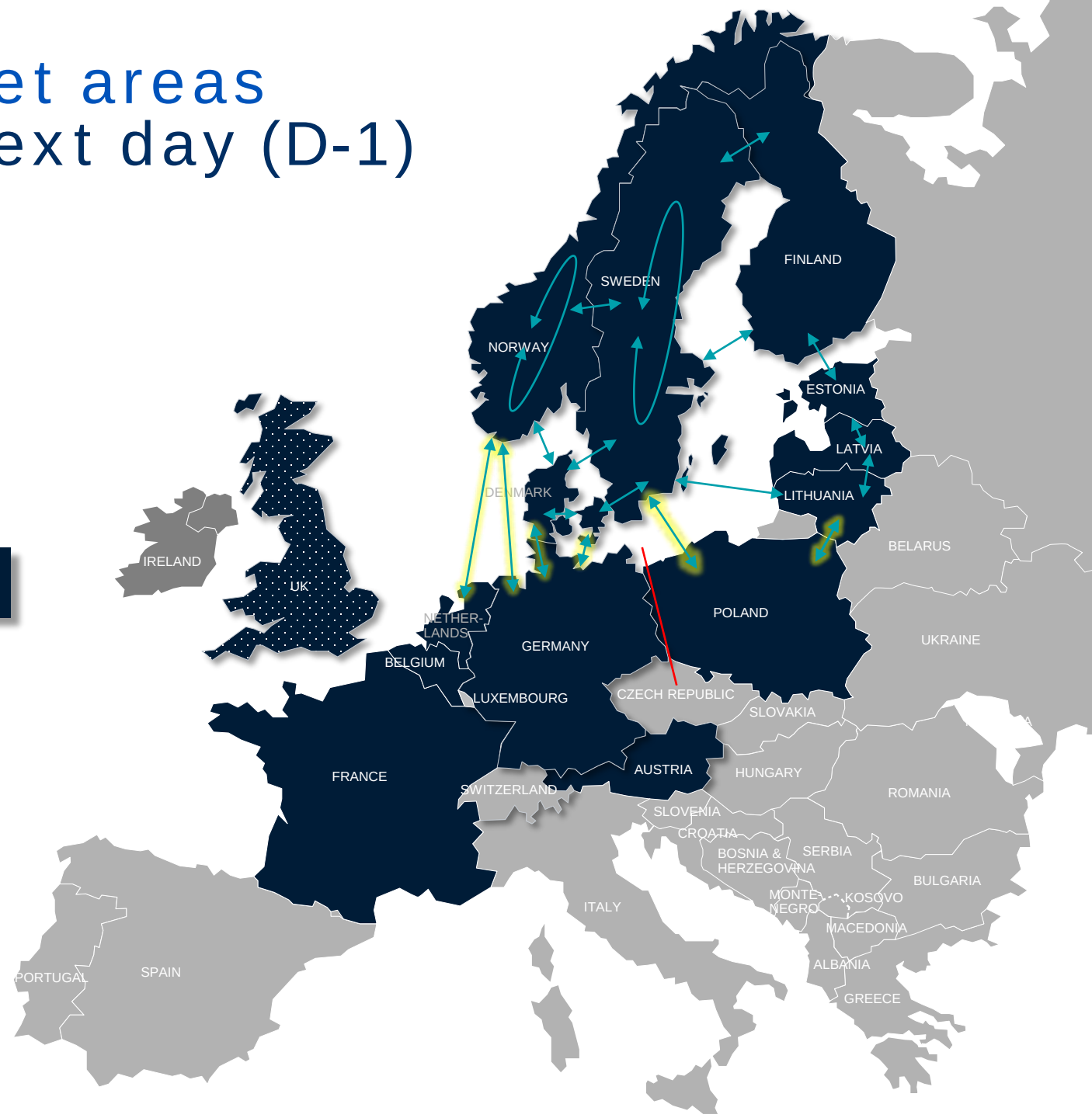
Nord Pool intraday market areas
Trading availability for next day (D-1)

Nord Pool markets, open

Nord Pool markets, not part of XBID

Capacity available

18:00:00 CET



NORD POOL

Nord Pool intraday market areas
Trading availability for next day (D-1)

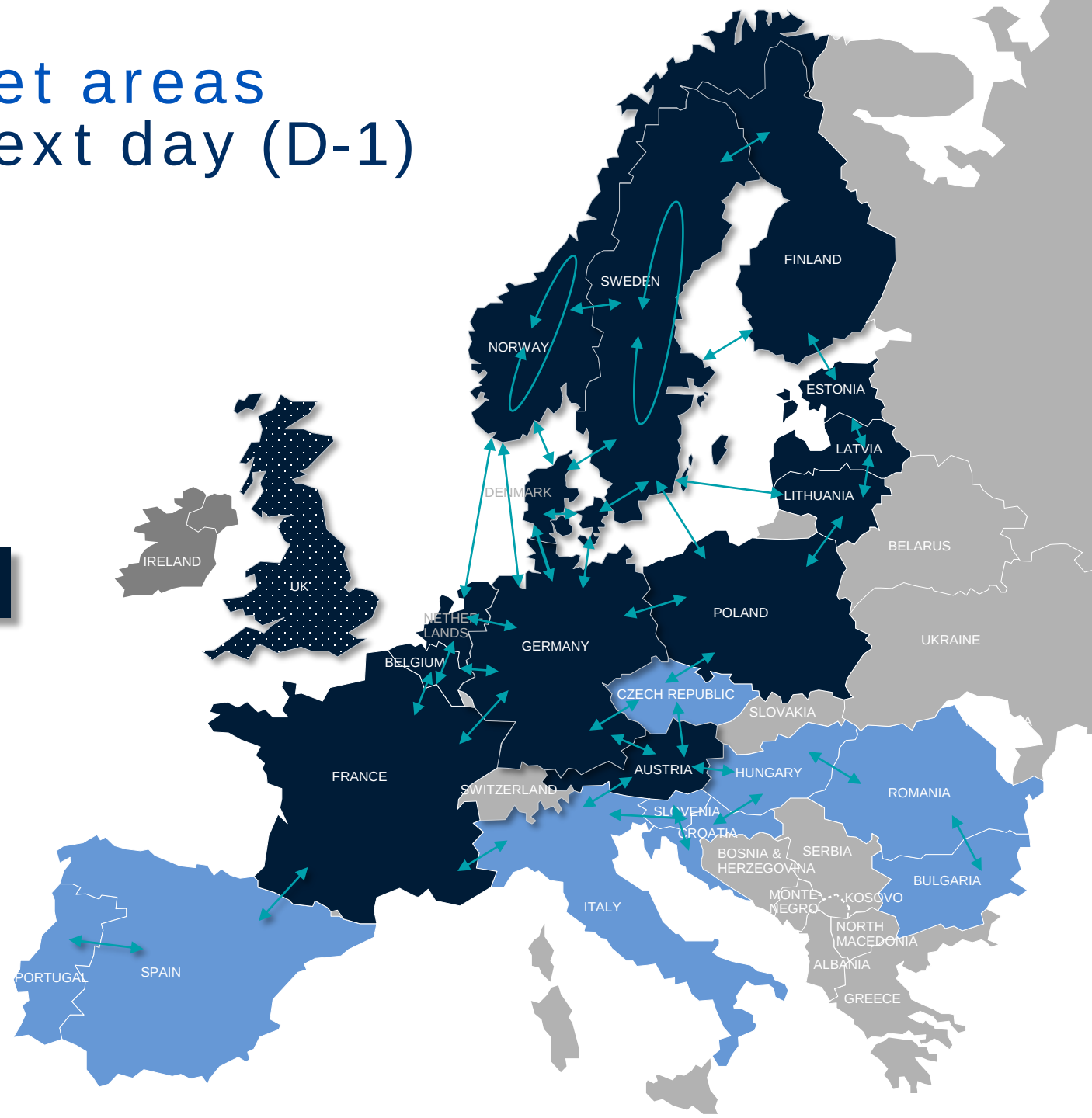
Nord Pool markets, open

Nord Pool markets, not part of XBID

Nord Pool is not NEMO

Capacity available

22:00:00 CET



NORD POOL

Nord Pool intraday market areas
Trading availability for trading day

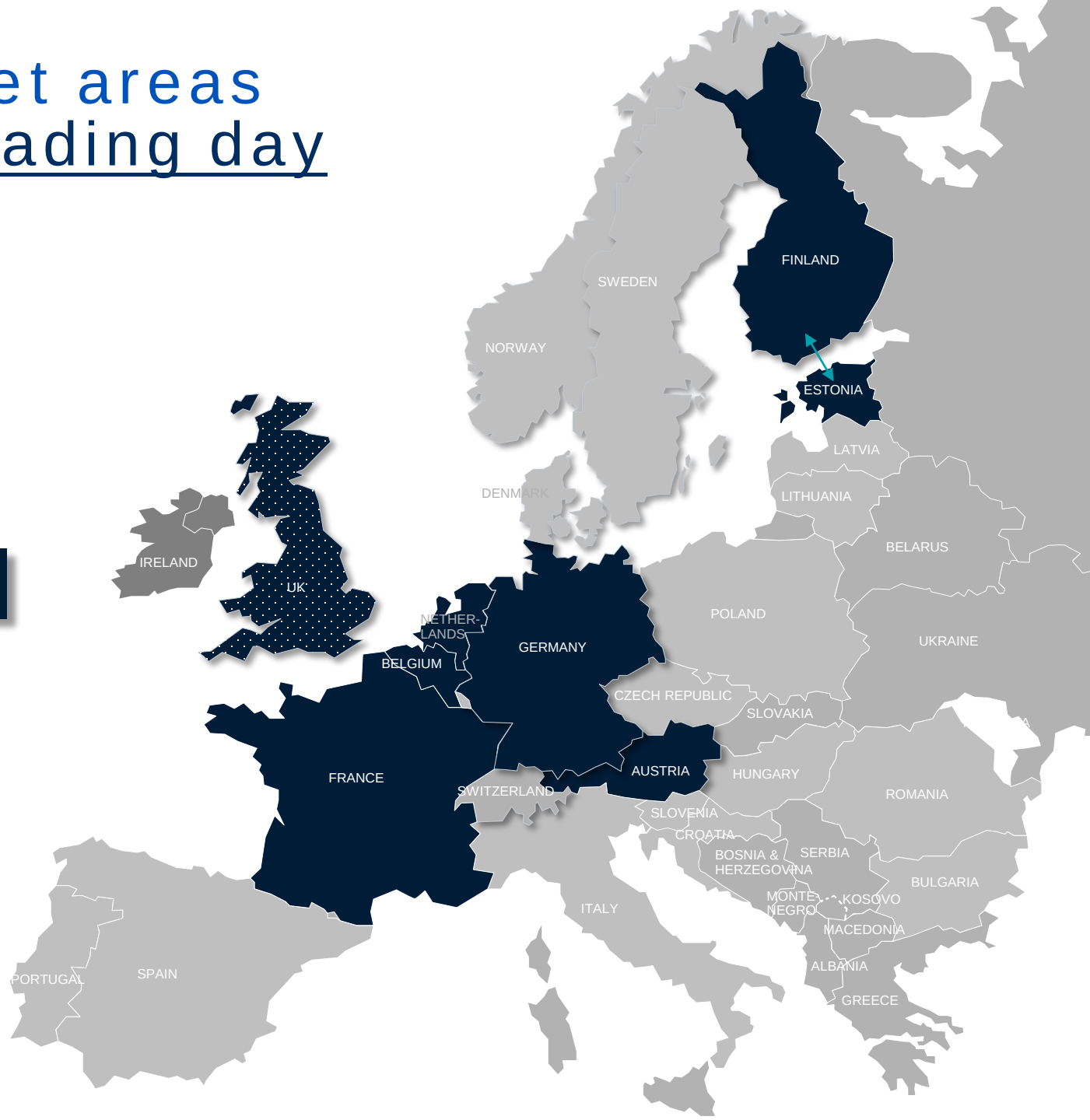
Nord Pool markets, open

Nord Pool markets, not part of XBID

Nord Pool local market open

Capacity available

D – 60 min



NORD POOL

Nord Pool intraday market areas
Trading availability for trading day

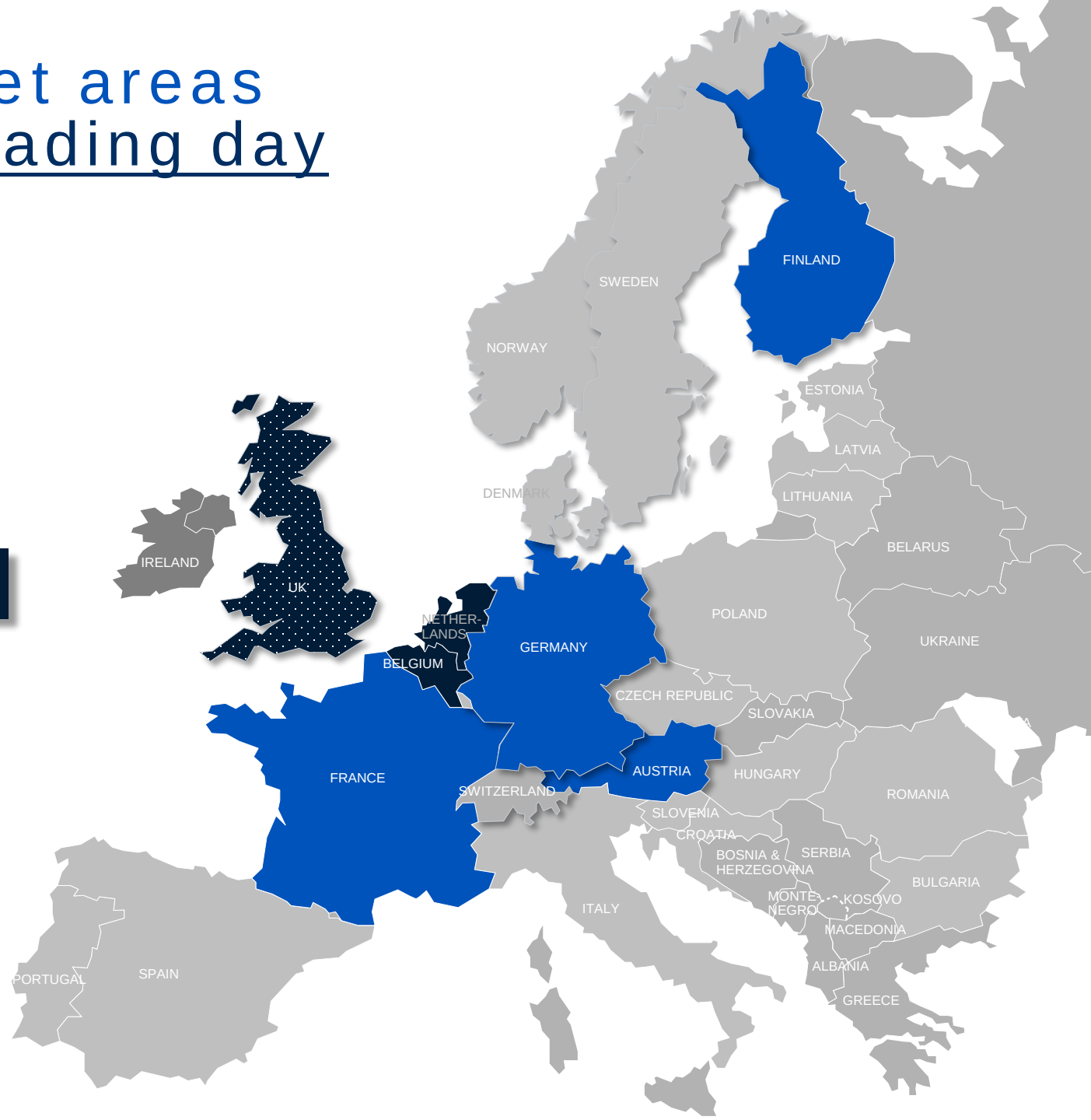
Nord Pool markets, open

Nord Pool markets, not part of XBID

Nord Pool local market open

Capacity available

D – 30 min



NORD POOL

Nord Pool intraday market areas
Trading availability for trading day

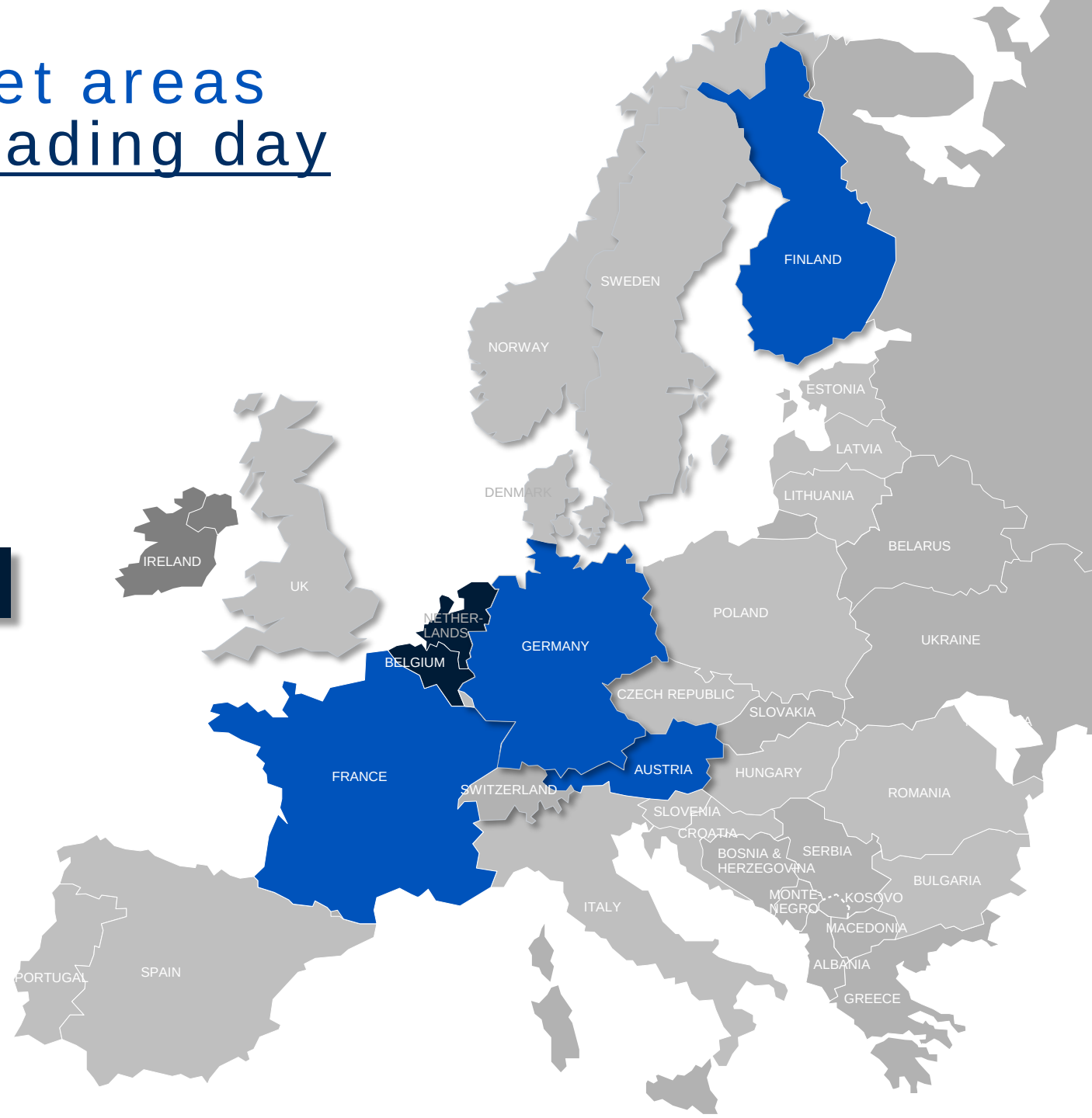
Nord Pool markets, open

Nord Pool markets, not part of XBID

Nord Pool local market open

Capacity available

D – 16 min



NORD POOL

Nord Pool intraday market areas
Trading availability for trading day

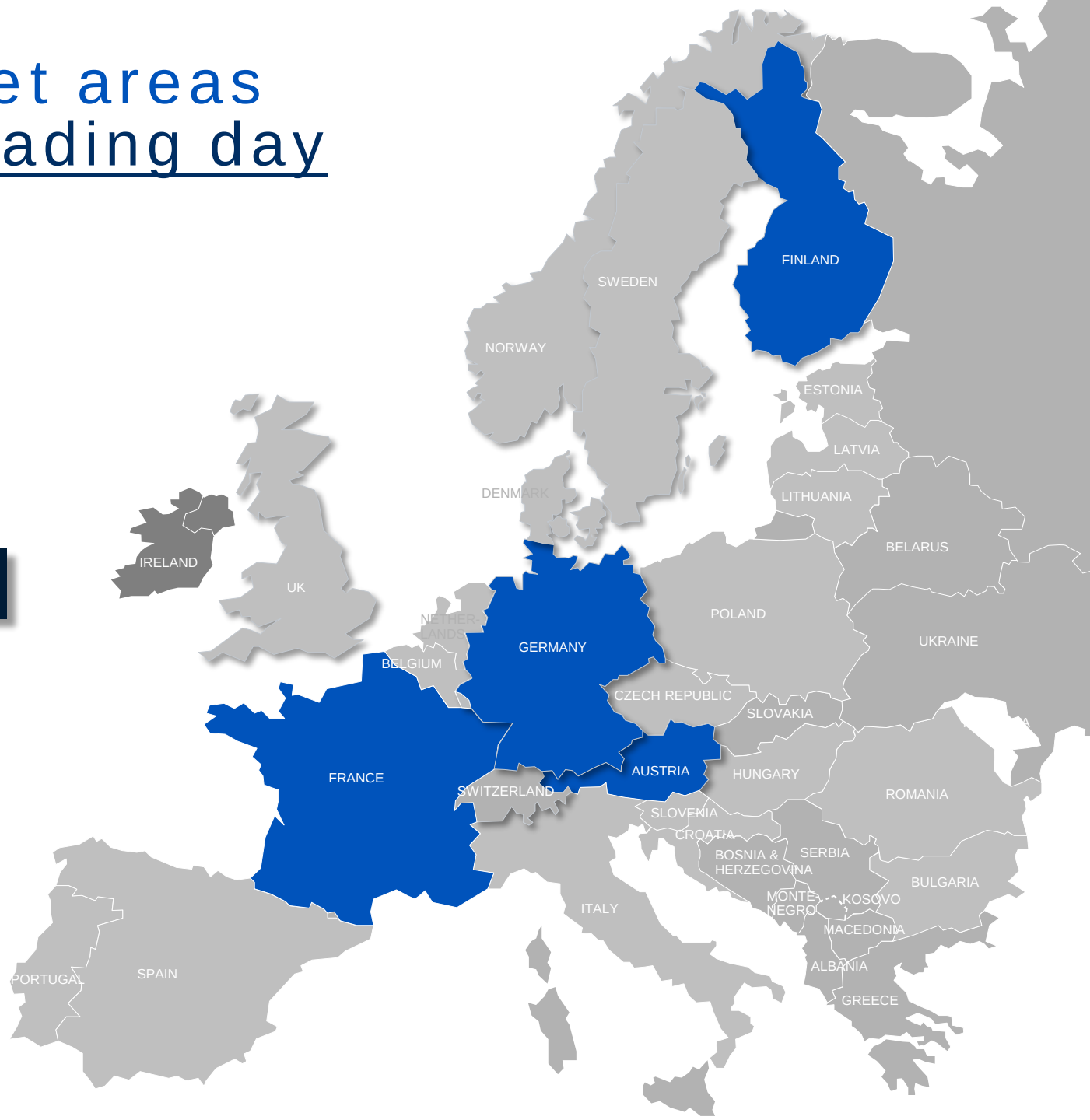
Nord Pool markets, open

Nord Pool markets, not part of XBID

Nord Pool local market open

Capacity available

D – 5 min



NORD POOL

Nord Pool intraday market areas
Trading availability for trading day

Nord Pool markets, open

Nord Pool markets, not part of XBID

Nord Pool local market open

Capacity available

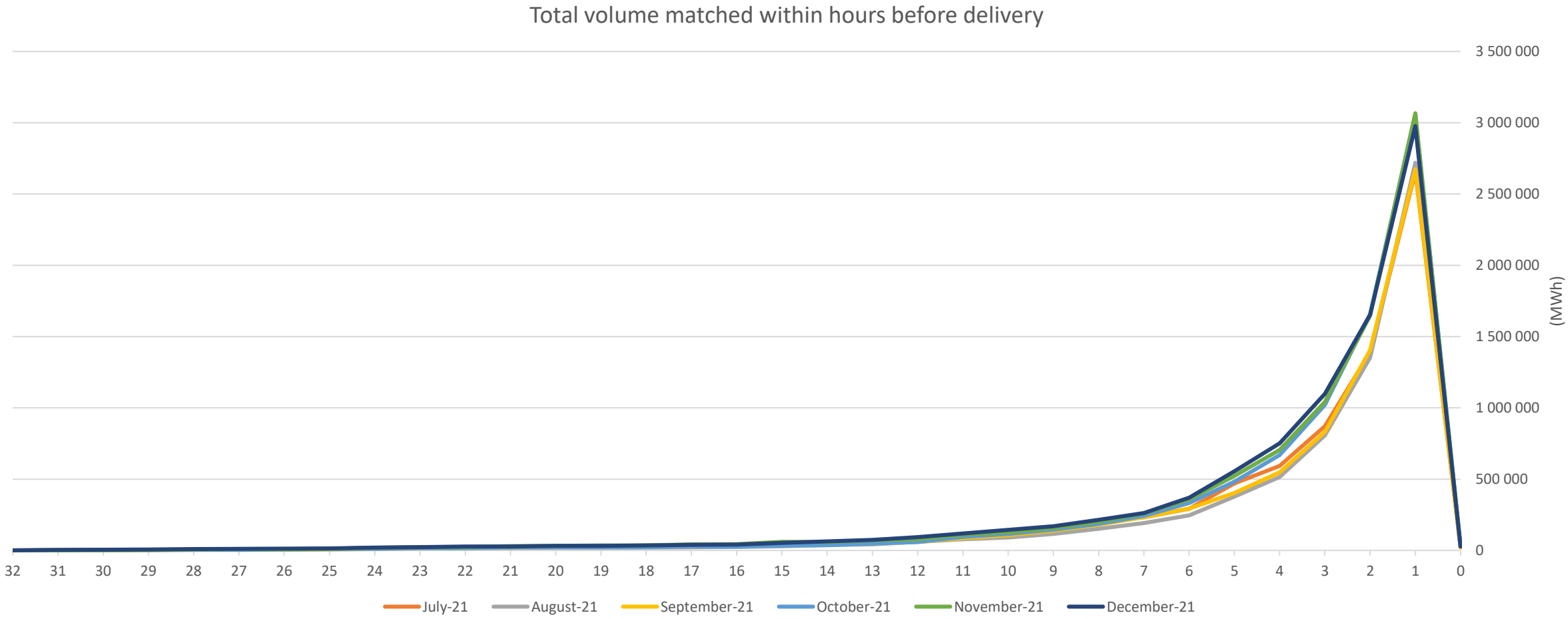
D – 0 min

NORD POOL

Nord Pool Intraday German Gate Closure

NORD
POOL

Trading increases as delivery approaches



NORD POOL

API – Will the robots take over?

Oscar Egnell

Technical Account Manager

Physical & Financial Power Market 2022

API

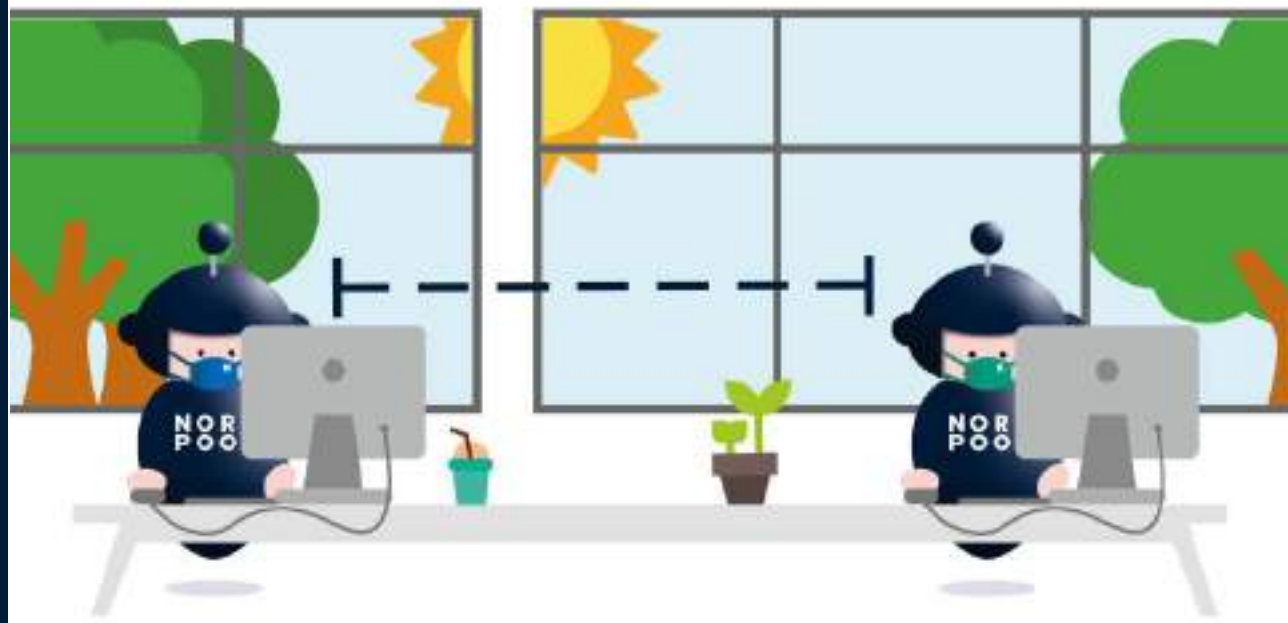
Def API ():

return{

”acronym”: ”Application Programming Interface”, ”definition”:”A set of routines, protocols, and tools for building software applications”,

”function”:”digital middleman”

}



NORD POOL

Products and Services

Nord Pool delivers day-ahead and intraday trading, clearing and settlement.

DAY-AHEAD

Our day-ahead trading platform offers single hourly blocks, block orders, minimum acceptance ratio, linking, flexi orders and exclusive orders. Through the European Day-ahead Market Coupling (SDAC) solution, customers can trade across Europe.

INTRADAY

Through the European Cross-Border Intraday Market (SIDC) solution, customers can trade 12 intraday markets in one and get access to a large intraday liquidity pool.

CASS

Nord Pool offers an efficient in-house clearing solution to all customers, with access to all data and information they require.

COMPLIANCE

We have developed our compliance services and automated reporting tools to help our customers meet obligations under REMIT and transparency regulation.

MARKET DATA

API Trading

Why trade Intraday via API

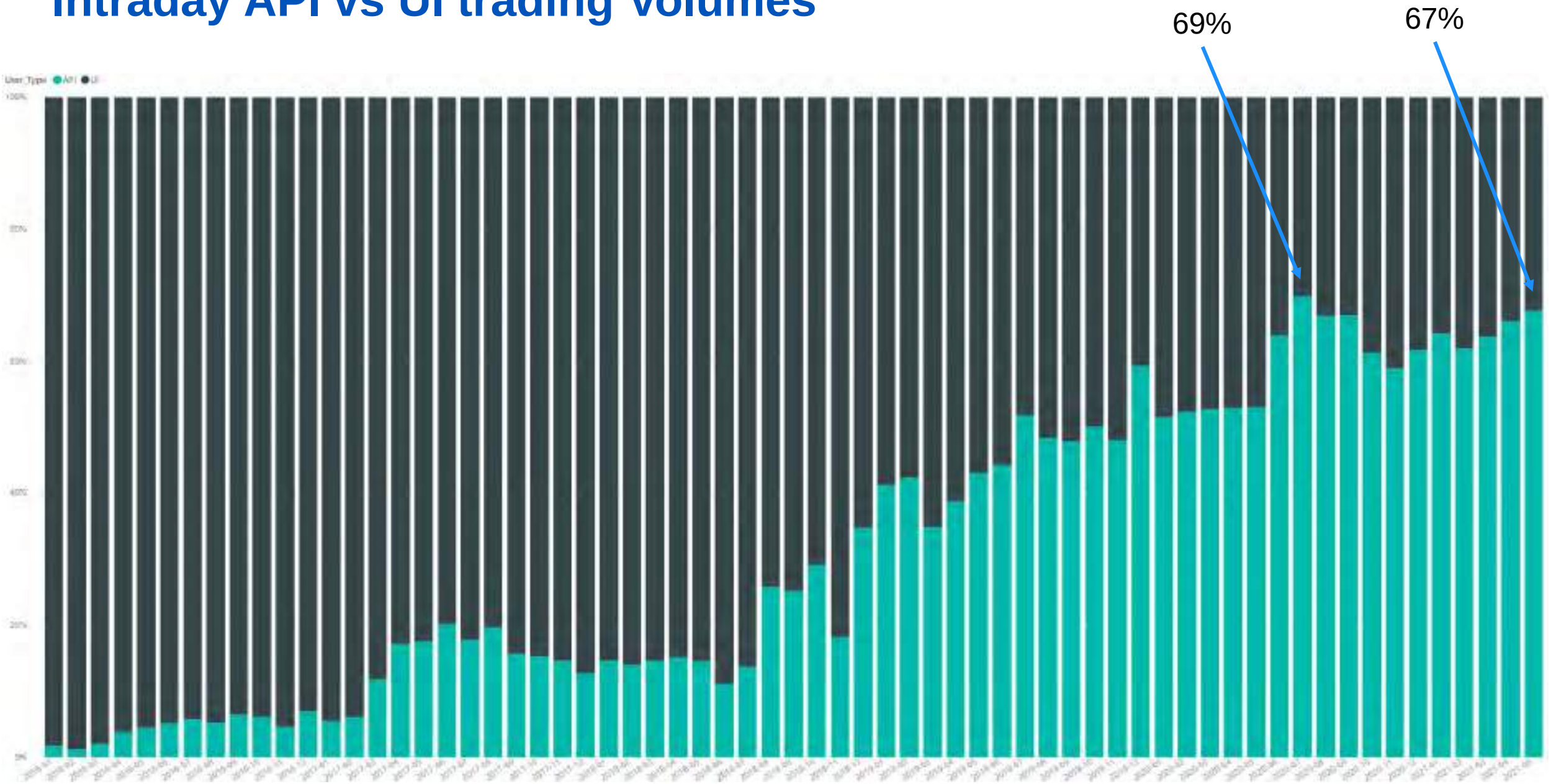
- Continuously consume large amount of data
  - Buy/Sell orders and depths – constantly changing
  - 24 products – 15 min
  - Ticker – continues list of trades
  - Cross border capacities
  - Private data such as exposure and price expectations
- Too much to handle – need to automate
  - Rule based
  - Algorithms

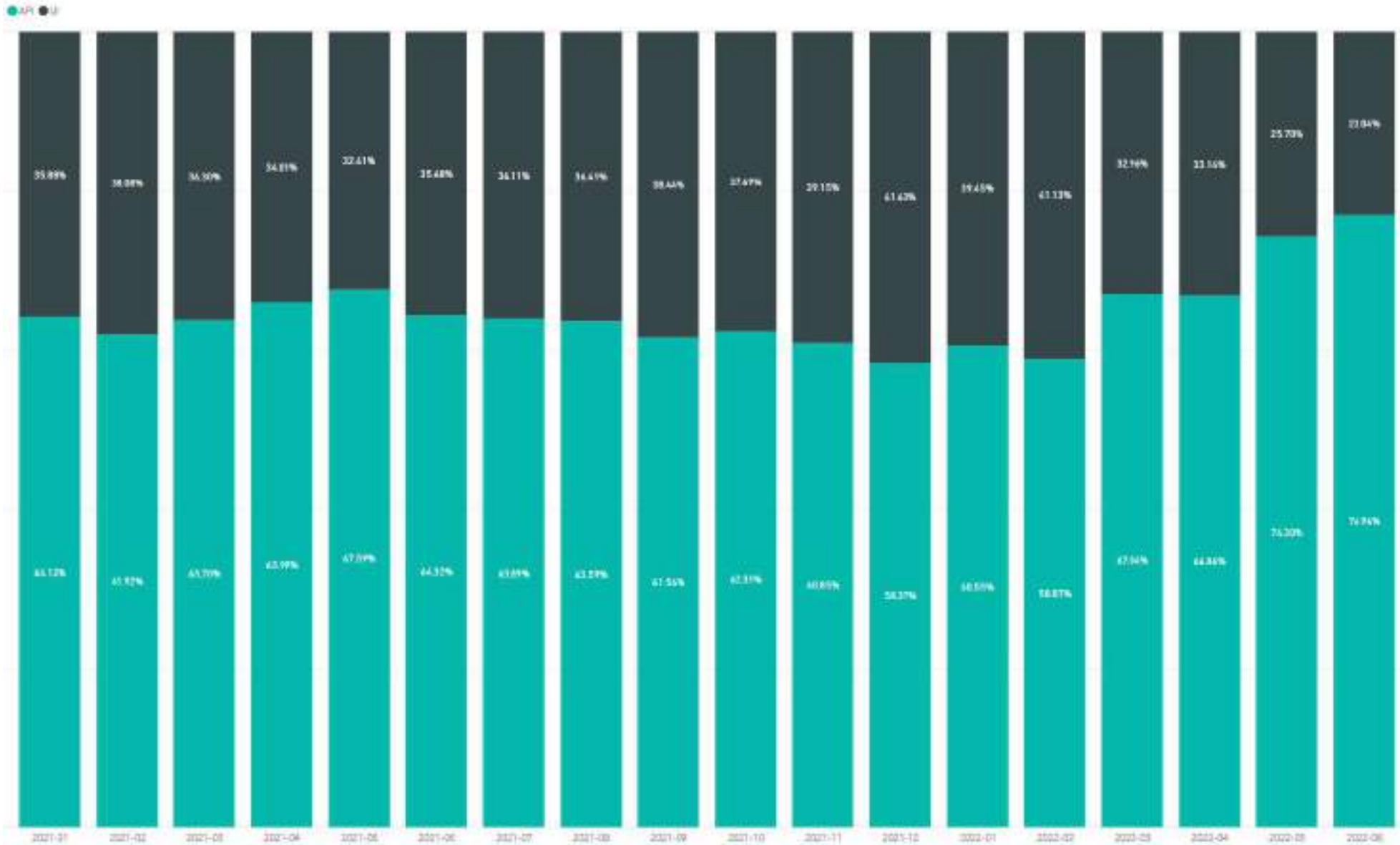
- Instead of manually placing orders - machine places them for you based on relevant information

NORD POOL

API Trading Trends

Intraday API vs UI trading Volumes




55.88%
38.08%
36.30%
34.81%
32.41%
35.48%
36.11%
36.41%
38.44%
37.49%
39.15%
41.43%
39.45%
41.33%
32.96%
33.16%
25.70%
22.04%
44.12%
61.92%
63.70%
65.19%
67.59%
64.52%
63.89%
63.59%
61.56%
62.51%
60.85%
58.57%
60.55%
58.67%
67.04%
66.84%
74.30%
74.96%

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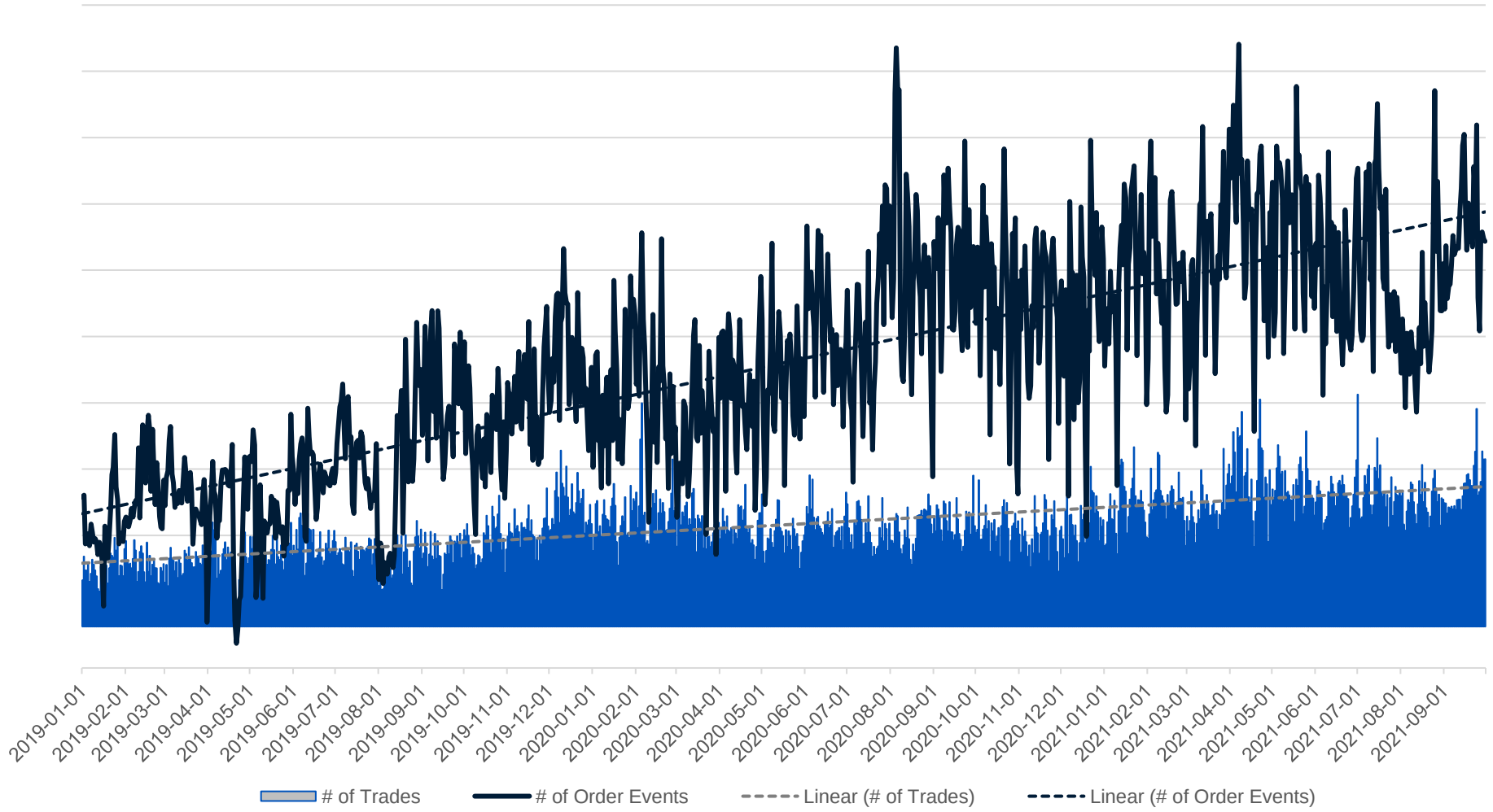
Intraday Orders and Trades



Day ahead trading

Auctions API - SDAC

Introduction · Auctions

- Simplifies the day ahead trading process

- Get – retrieve public market info and private data
- Post – submit orders
- Patch – change existing order

- Postman Collection – try it out using Postman
- Sample code in .NET or Java script

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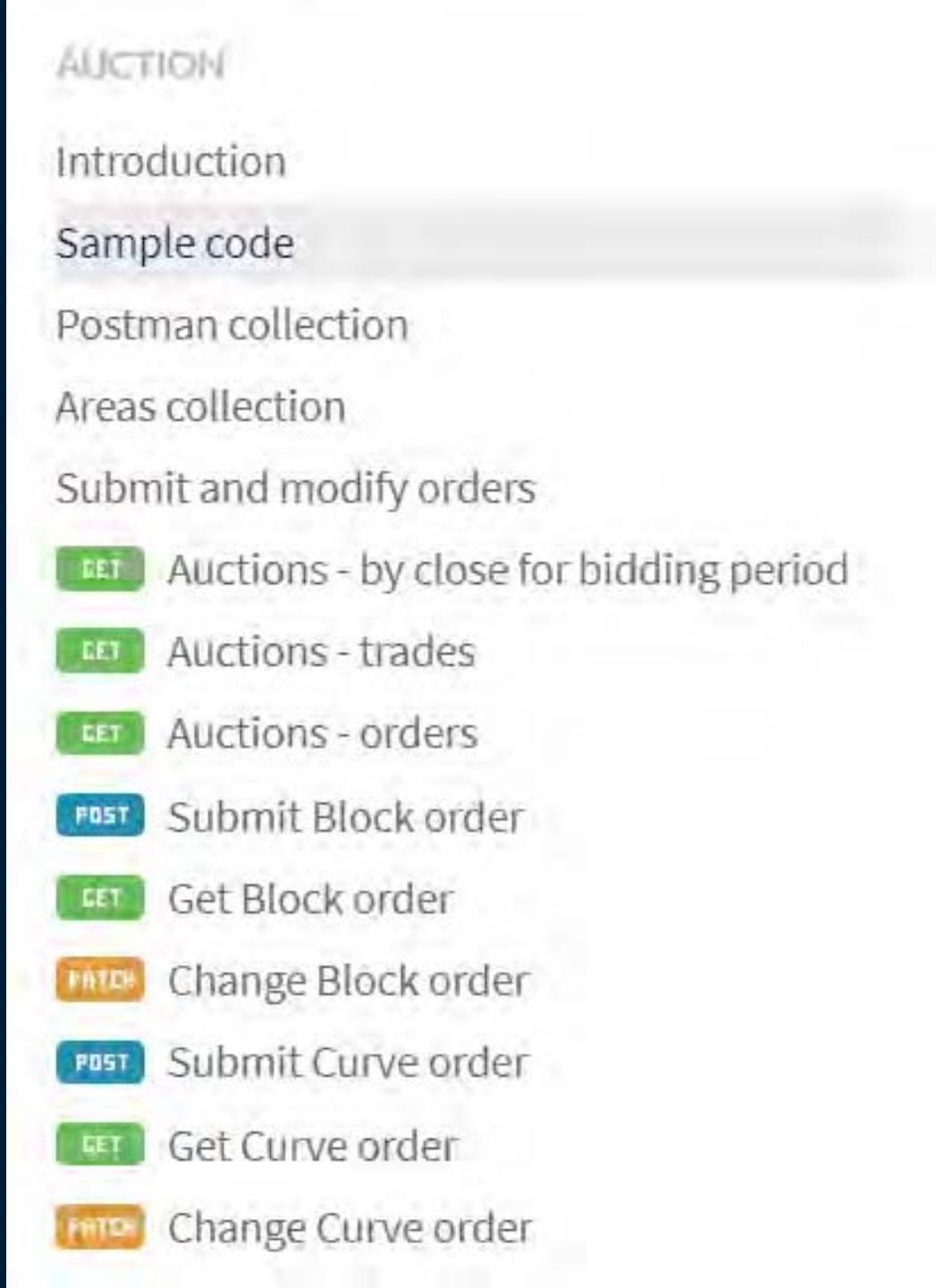
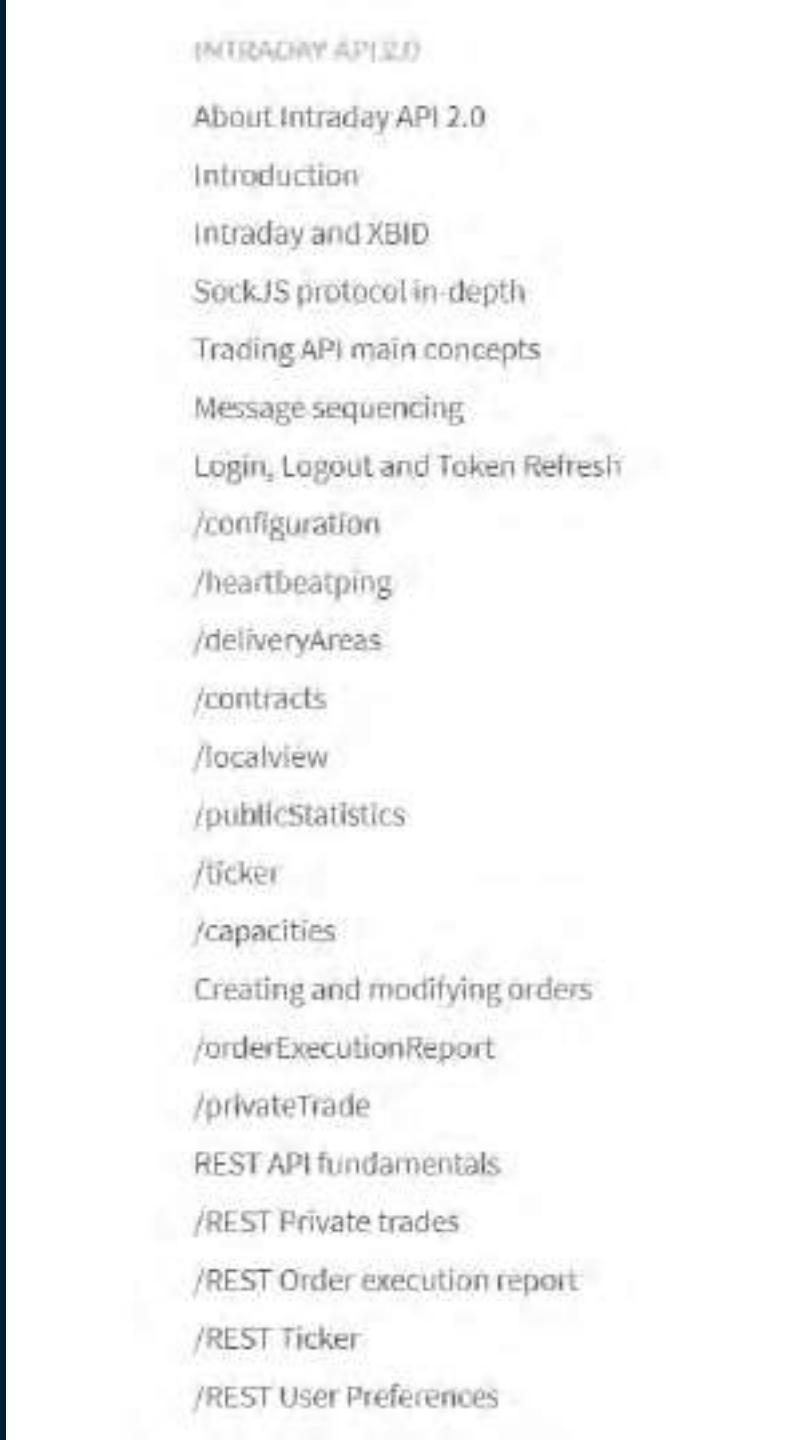


Intraday trading

Intraday API 2.0 – integrates to SIDC

[About Intraday API 2.0]

- WebSocket API
  - 2 way communication
  - Enables submission of bids
- RestAPI only for retreiving market data and private data
  - Orders and trades
  - Ticker



For Who

- ISV – Independet Software Vendor
- Members own development teams

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- Simple – Standard protocols and formats
- Efficient – Automate trading routines
- Secure – Robust and encrypted technology

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Will the robots take over?

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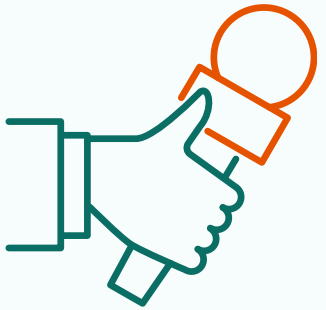
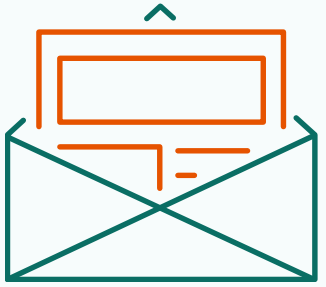
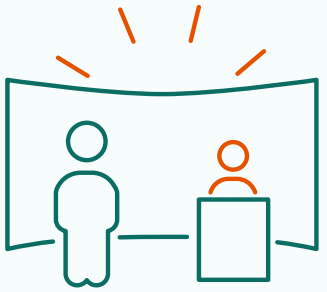
What we do:

- Energy market news, data and analysis
- API & Excel feeds
- AI forecasting
- Price forward curves
- Fundamental forecasts

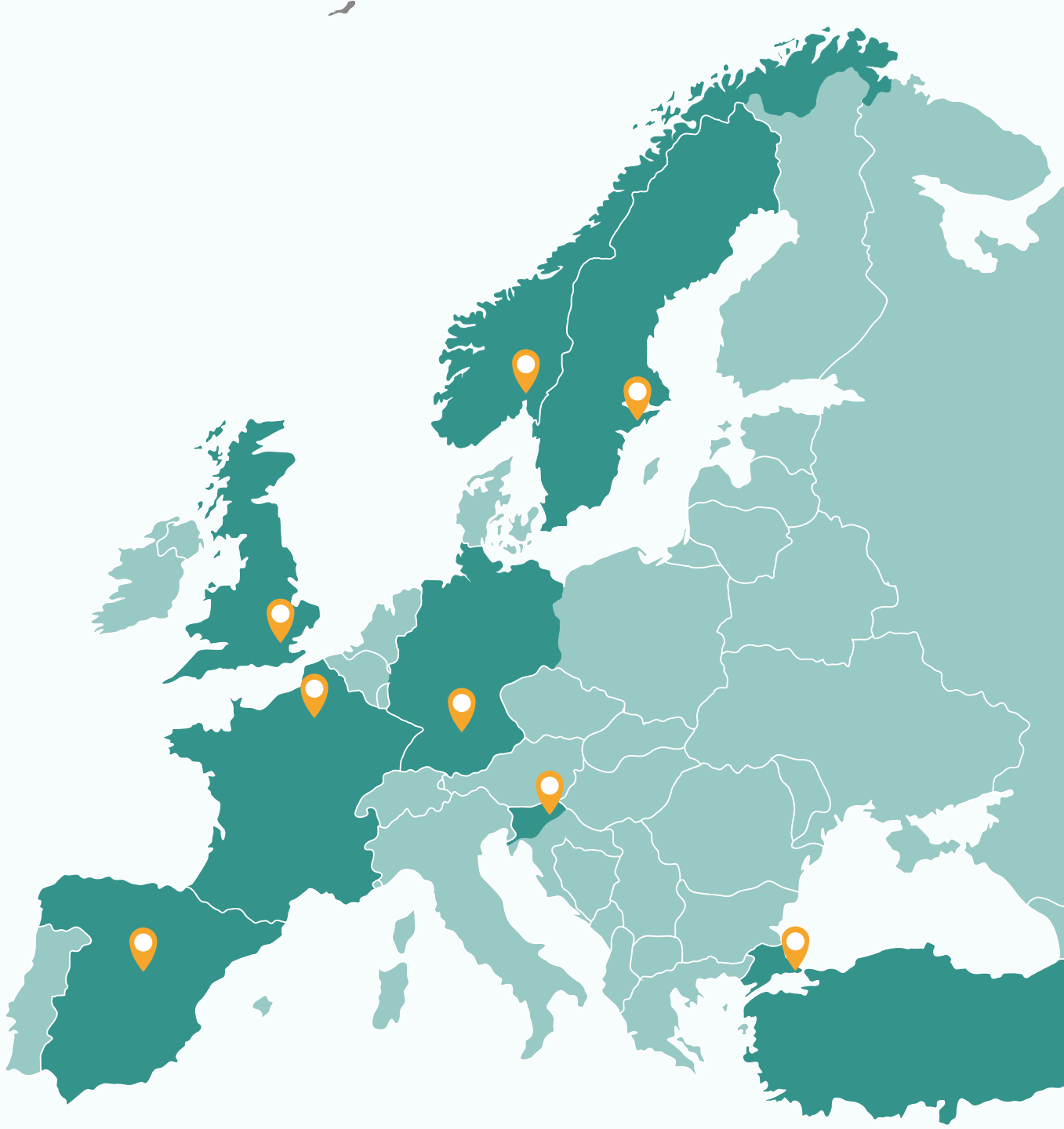
- PPA analysis
- Magazine and newsletters
- Advisory services
- Events & webinars
- Advertisement
- Consumption app







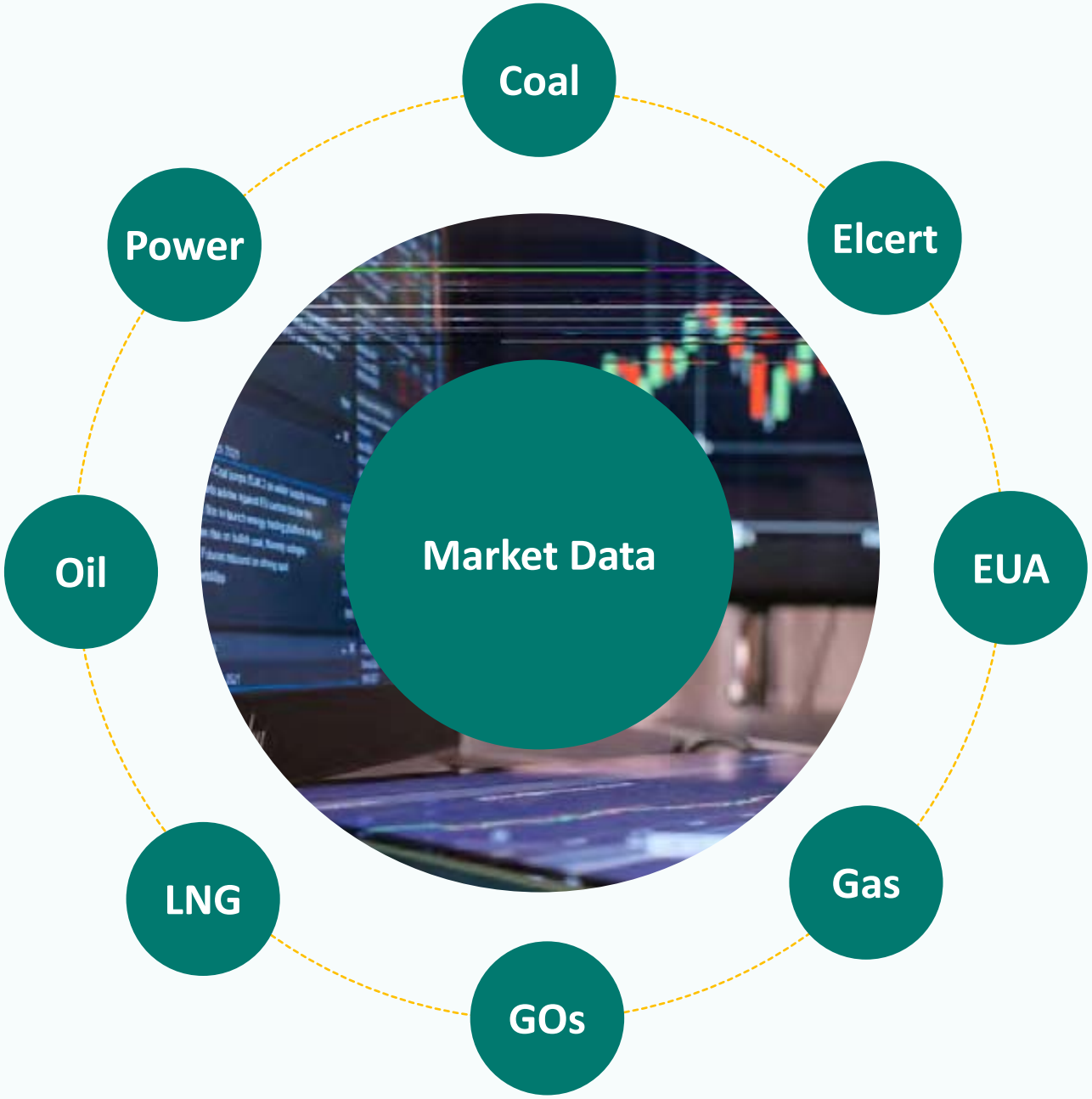
Our reach



News

Market moving news reported in English alongside local languages from our 10 European newsrooms

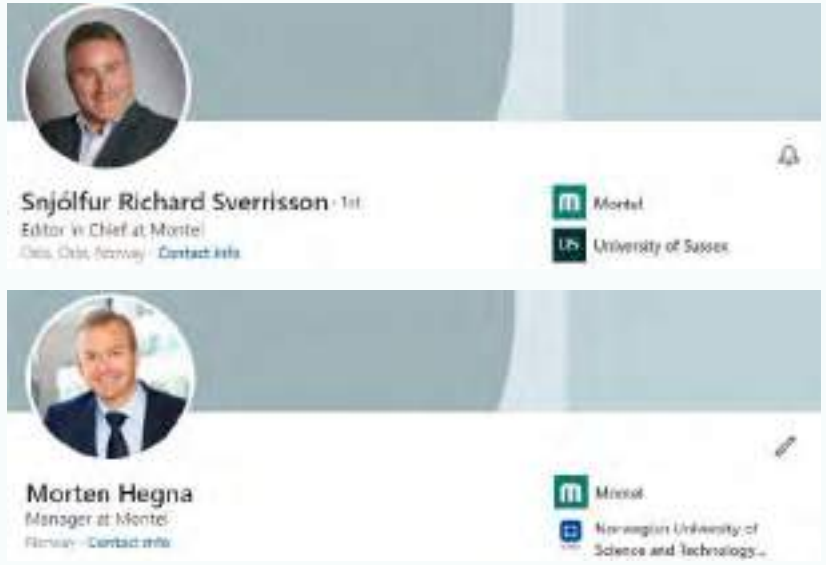
- Live reporting
- Search functionality
- Daily market summaries
- Dedicated green desk
- Web based
- No installation
- Efficient support


Coal
Elcert
EUA
Gas
GOs
LNG
Oil
Power
Market Data

Recent updates from the European energy markets

Main price drivers, financial market, physical market, TSOs, new technology, politics on a national, regional, European and global level– and the different effects Covid-19 has had on the energy markets

Richard Sverrisson, Editor in Chief, Montel and Morten Hegna, Manager at Montel



Look back at 2021

- Gas: From glut to scarcity
- Energy crisis (industrials, retailers, households, public eye)
- Carbon price surge, but gas to coal switch!
- Germany’s coal nuclear exit
- French nuclear issues
- Rapid expansion of green energy PPA

Market trends

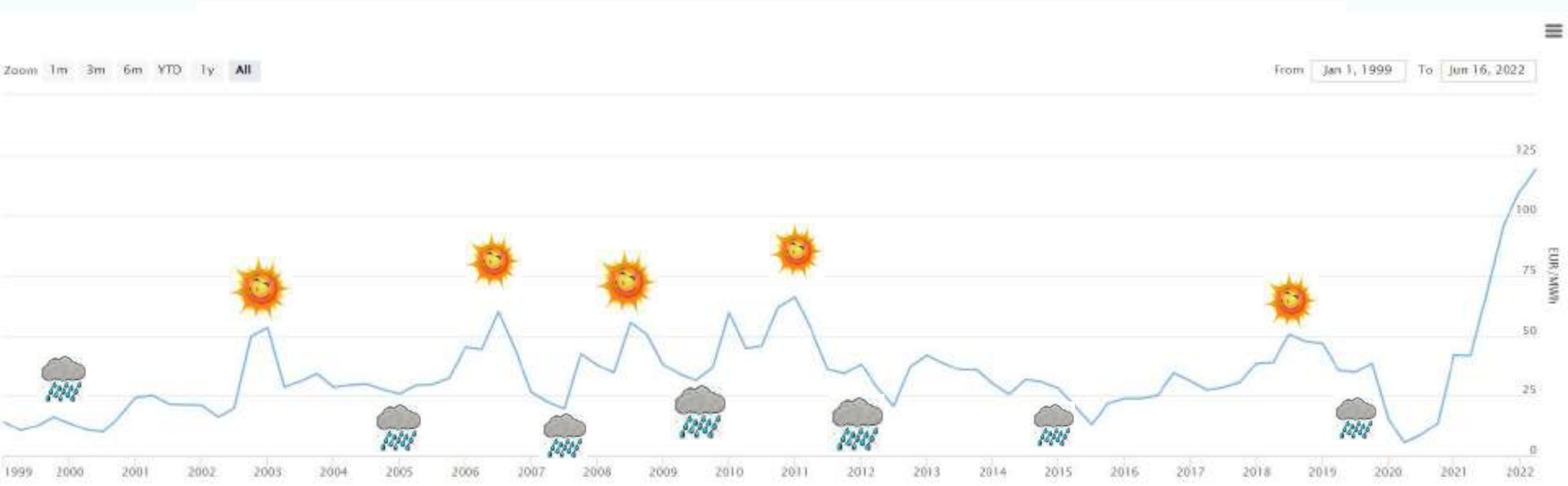
- Renewables boom accelerates during Covid (Political will, pressure from grassroots and investors)
- Oil/gas majors moving into wind and solar (BP, Shell, Equinor, Total)
- Technology firms, e.g Tibber, entering retail market (forcing others to merge, expand products to create economies of scale)
- Hydrogen
- Batteries
- Electrification of transport and heating = boost in power demand

Market trends 2022

- Energy crisis, war in Ukraine
- Coal comeback
- Market design debate – threat of intervention?
- Slow down or acceleration of renewables?


EUROPEAN SPOT POWER OVERVIEW
All figures in EUR/MWh (Except where noted)
16.06.2022
Nordic: 125.04
UK: 180.42 GBP/MWh
IE: 213.76
NL: 216.94
PL: 739.37 PLN/MWh
DE: 201.97
BE: 239.32
CZ: 206.78
SK: 221.24
FR: 272.85
AT: 204.80
HU: 232.19
RO: 236.28
IT: 276.74
RS: 245.12
ES: 170.81
TR: 2243.77 TRY/MWh

Nordic system price during 22 years




GAS
ONLY IN
RUBLES!

Montel News @montelnews · May 4

Germany's days of cheap gas are over – official
montelnews.com/news/1317887/g... #MontelNews #gas

montelnews.com
Germany's days of cheap gas are over – official | M...
(Montel) Germany will never see a return to cheap natural gas even after Russia's war in Ukraine end...

2

Montel Weekly

Russia's ruble stand-off

Montel News @montelnews · May 4

EC aims to ban Russian crude imports wit
montelnews.com/news/1317791/e... #Mo

montelnews.com
EC aims to ban Russ
(Montel) The Europe
end Russian crude o

Montel News @montelnews · 22h

German gas and coal-fired generation could jump 43% and 20%, respectively, in the fourth quarter in part due to the looming demise of the country's nuclear capacity.
montelnews.com/news/1328057/g...
#electricity #energy #gas #natgas #drybulk #nuclear

2 3

lgaria for their refusal to pay in rubles has the energy
unclear whether customers agreeing to the Kremlin's
ithout an outright embargo on gas imports. Listen to
f gas, and what a further stop in Russian flows could

tel
d Carbon Research, Energy Aspects

2018:


High gas and coal prices. Fear of reduced Belgiian nuclear power
Low levels in german rivers. Reduced nuclear power in Germany High winter prices
31 August Uptrend ends
Uptrend Dry weather Rising carbon price
Very wet forecasts
13 Sep: Einar Aas
Dry forecasts
MONTEL
2018
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
60.00
55.00
50.00
45.00
40.00
35.00
30.00
25.00
SPREAD
20
15
10
5
1.63

2019:


NPE ENOFU TBL Q1(Q1-2020)
SRMC drop
Power trader's Wet dream
New dry July Increased Carbon prices
CO2 and rain
Lifted by colder weather
2019: Still high spring price
Dry and chilly
Dry and chilly
Winter is over. Mild weather
Mild again
Very wet May Improved hyd. balance
Wet forecasts and Low gas prices
Price fall on improved hyd. bal.
MONTEL
Dec
2019
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

2019:


NPE ENOFUTBL Q1(Q1-2020)
MONTEL
Dec
2019
Feb
Mar
Apr
May
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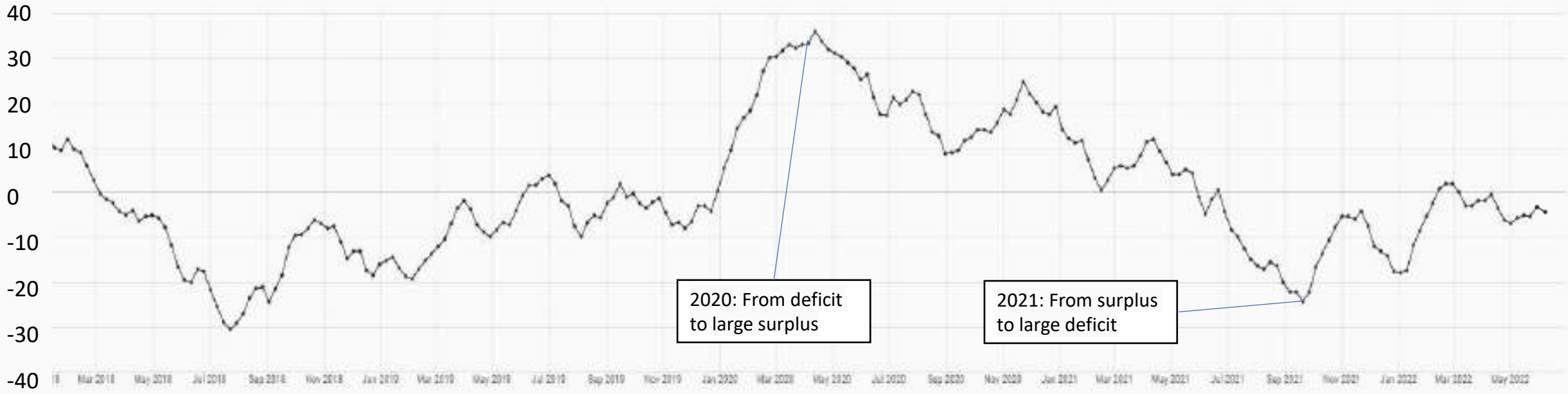
Aug
Sep
Oct
Nov
Dec

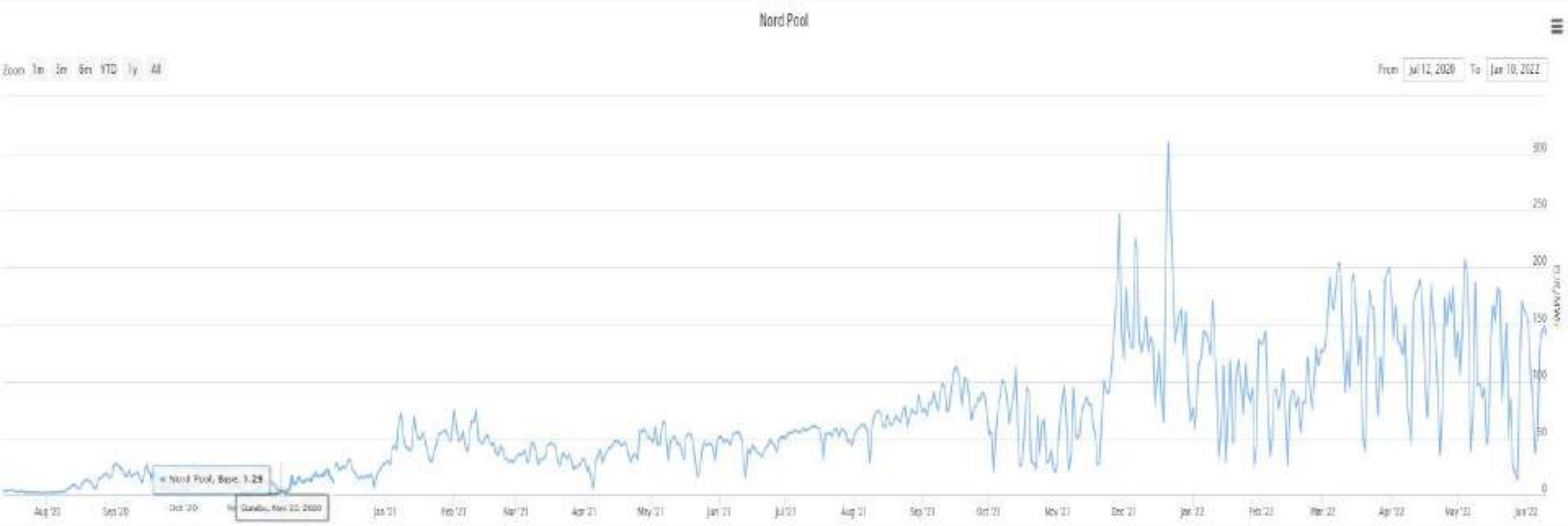
2018 to now: **Hydrological balance in TWh for Nord Pool**



2022: June


Hydrological balance in TWh for Nord Pool
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
21 Mar
28 Mar
4 Apr
11 Apr
18 Apr
25 Apr
2 May
9 May
16 May
23 May
30 May
6 Jun
13 Jun
20 Jun
27 Jun
Water reservoir filling in TWh for Nord Pool
90
80
70
60
50
40
30
20
10
0
21 Mar
28 Mar
4 Apr
11 Apr
18 Apr
25 Apr
2 May
9 May
16 May
23 May
30 May
6 Jun
13 Jun
20 Jun
27 Jun

Nord Pool system price since August 2020:



2020 and 2021: Front Month Contract at Nasdaq:

2020 and 2021: Front Month Contract at Nasdaq:

2022: Front Month Contract at Nasdaq:

Uncertainties in the

Bullish factors:

- High CO2 prices
- High gas prices
- Consumption g
- Electrification
- Hyper-scale dat
- Green steel
- Green hydrogen
- Shutdown of nuclear power
- UK link

- Dry years

h factors:

v gas and coal prices

velopment of wind and solar

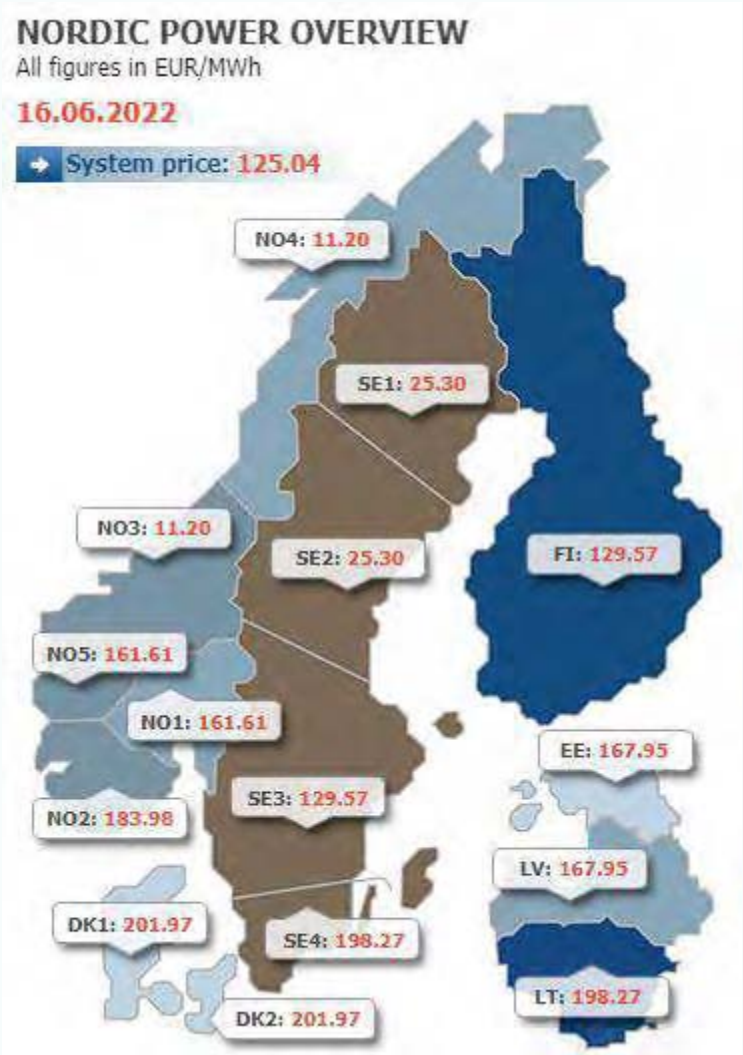
ng-term power purchase agreements

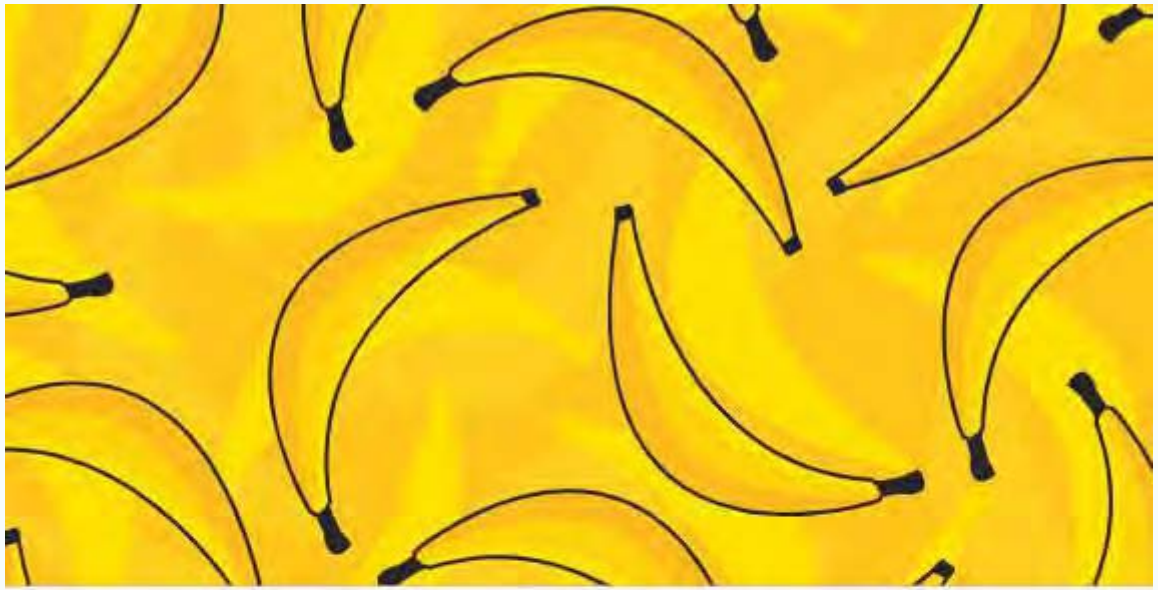
xibility solutions

- Wet years

Prediction survey in early December 2020: Nordic Power Price:
“What will be the yearly average price for:”

	2021	2022	2025
Bixia	22	31	34
Thema	22	34	37
Refinitiv	20.3	25.3	26.1
Modity	23.5	28.6	30.3
Jamtkraft	26	31	42
Shepherd Energy	14.6	26	35
Berenberg	32	52	-
Storm Geo	20	22.5	30.5
Average	22.30	29.32	33.13
Market price 28/12-20	23.40	26.00	27.00
One year after:	62.31	62.45	34.25
Market 15/06-22		115ish	32.65


NORDIC POWER OVERVIEW
All figures in EUR/MWh
16.06.2022
System price: 125.04
NO4: 11.20
SE1: 25.30
NO3: 11.20
SE2: 25.30
FI: 129.57
NO5: 161.61
NO1: 161.61
EE: 167.95
SE3: 129.57
NO2: 183.98
LV: 167.95
DK1: 201.97
SE4: 198.27
LT: 198.27
DK2: 201.97



Bananas:
Nordic firms face hedging challenges ?

Nordic power traders are finding it increasingly difficult to hedge their future price exposure due to widening area price differences, with one market participant joking there is a stronger link with the cost of bananas than to the Nordic system price.

volue

Nordic power consumption: +100 TWh to 2030

- Datacenters: +21 TWh/y
- Transportation: +19 TWh/y
- Offshore oil & gas: +10 TWh/y
- Battery production: +13 TWh/y
- Heat pumps: +7 TWh/y
- Production of hydrogen: +32 TWh/y
- Pulp & paper industry: -5 TWh/y
- Other changes: +3 TWh/y
- Total growth: 100 TWh/y

Cold comfort

Russia has completed its controversial Nord Stream 2 pipeline to Germany – will gas begin flowing in time to head off fears of a global supply crunch this winter?

Nordic power spat

Sweden's export curbs to its Nordic neighbours have sparked an unlikely row among regulators, system operators and electricity traders in a region known for compromise and consensus.

Uproar over green investment rules

Contentious EU taxonomy guidelines have pitted member states against each other, while environment groups are up in arms over the inclusion of nuclear and gas as sustainable energy sources.

Scramble for gas

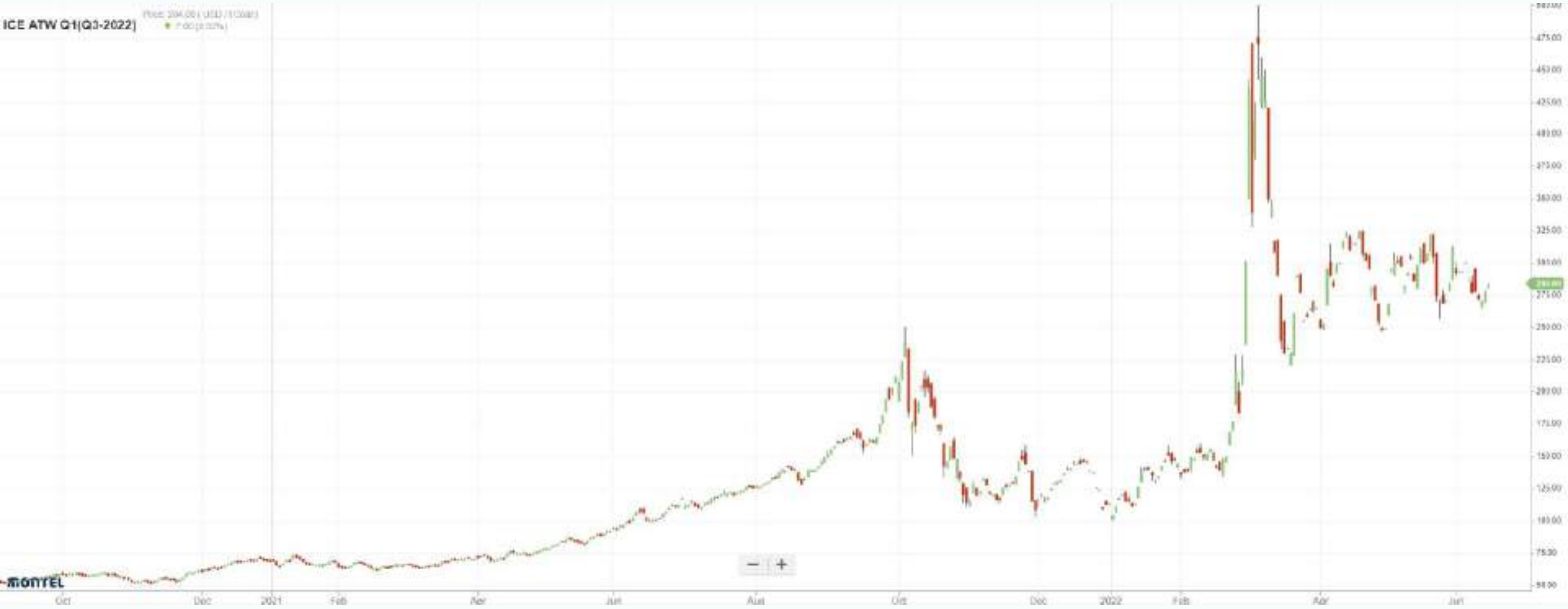
Europe is desperately seeking to replace Russian gas but ending the dependence could prolong the continent's energy crisis at the same time as accelerating the transition to renewables.

https://magazine.montelnews.com/

Commodity markets rally

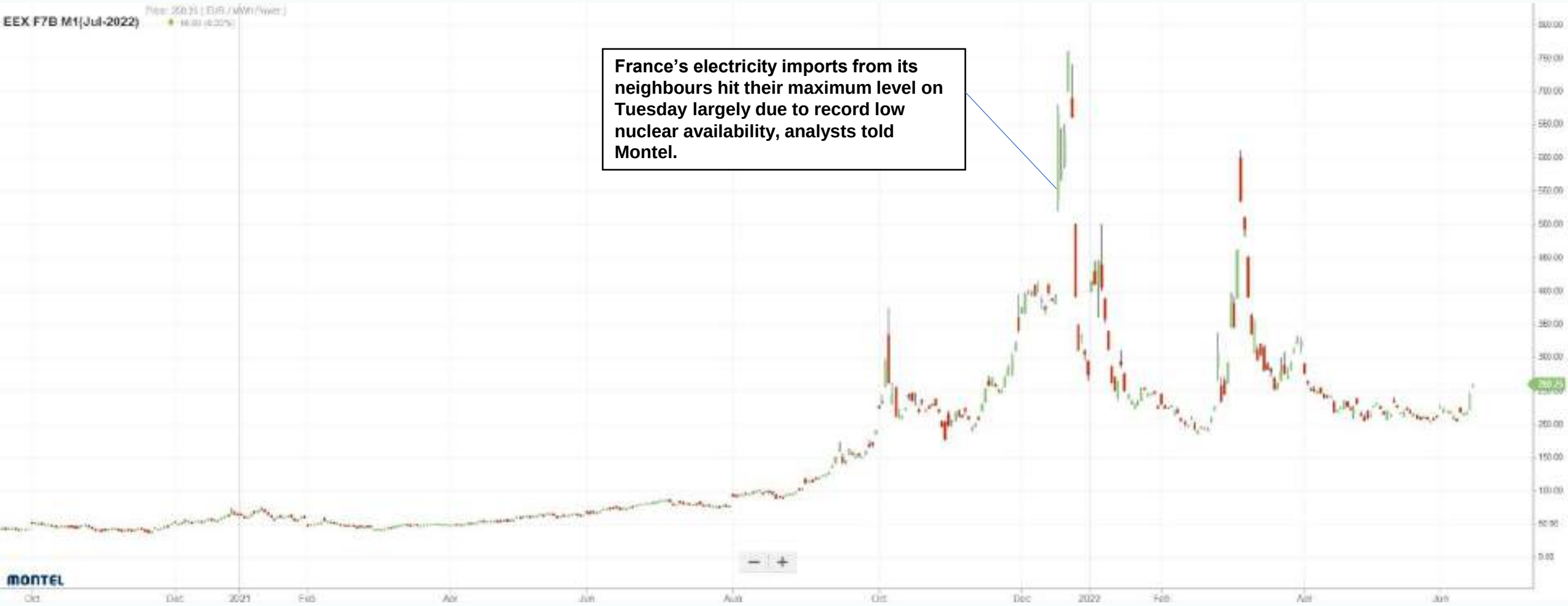
TTF, Front Month

Coal ARA Front Q

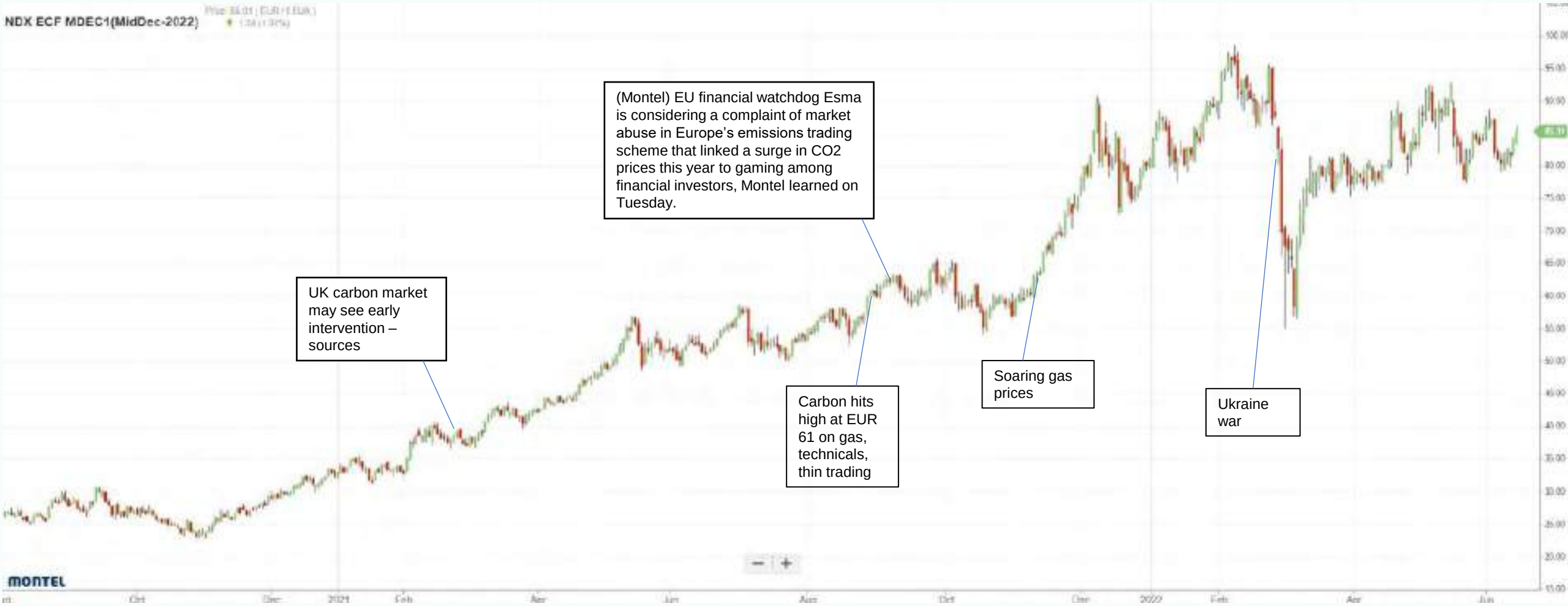


German power: Front year since 2020

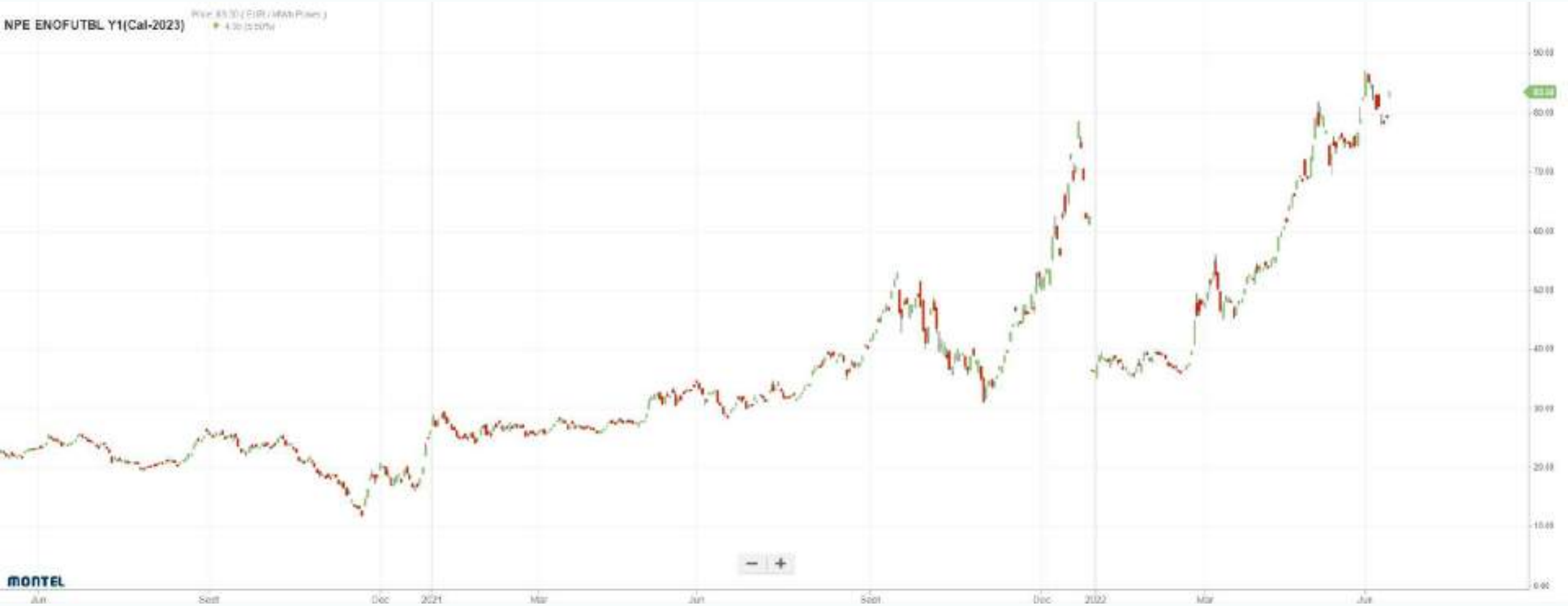
French power: M2 contract year since 2020



EU ETS


NDX ECF MDEC1(MidDec-2022)
UK carbon market may see early intervention – sources
(Montel) EU financial watchdog Esma is considering a complaint of market abuse in Europe's emissions trading scheme that linked a surge in CO2 prices this year to gaming among financial investors, Montel learned on Tuesday.
Carbon hits high at EUR 61 on gas, technicals, thin trading
Soaring gas prices
Ukraine war
MONTEL

Nordic Power: Front year from June 2020




GAS DPFC ICE TTF SETTLEMENT@2022-06-14

EPISODES

REPowerEU: "Killing two birds with one stone?"
JUNE 08, 2022

Nordic power squeeze
JUNE 01, 2022

Poland's blessing in disguise
MAY 25, 2022

Macron's nuclear push
MAY 20, 2022

Keeping out the CO2 speculators
MAY 12, 2022

Russia's ruble stand-off
MAY 05, 2022


MONTELIGENCE
Machine learning
Trading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Aareal
HYDROLOGY
QUANTIFIED


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Montel Energy Days go webinar

2022

Thank you for your attention

Morten Hegna, +47 917 57 662, mortenh@montelnews.com
Richard Sverrisson, +47 404 88 287, richard@montelnews.com

…and finally the competition

	Wednesday AI	Wednesday spot	Thursday AI	Thursday spot	Friday AI	Friday market
Germany	202	212	178	202	194	219
NP	143	127	131	125	132	127
Spread	59	85	47	77	62	92

Market Surveillance at Nord Pool

The Physical and Financial Power Market

Ieva Linkeviciute & Peder Grimstad Helset

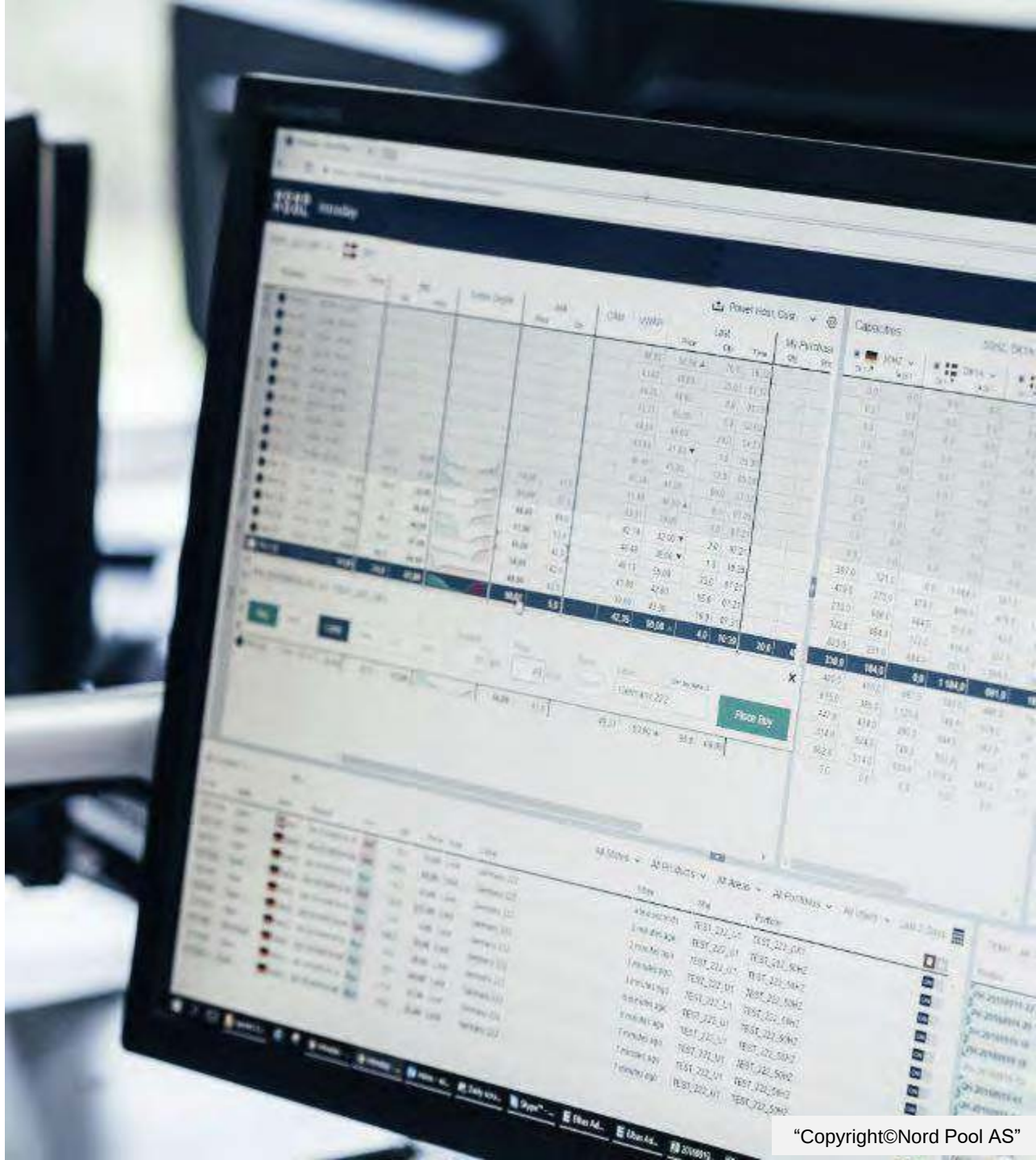
16th June 2022

Agenda

- Which regulations are relevant in the European wholesale electricity market?

- REMIT
  - Insider trading
  - Market Manipulation

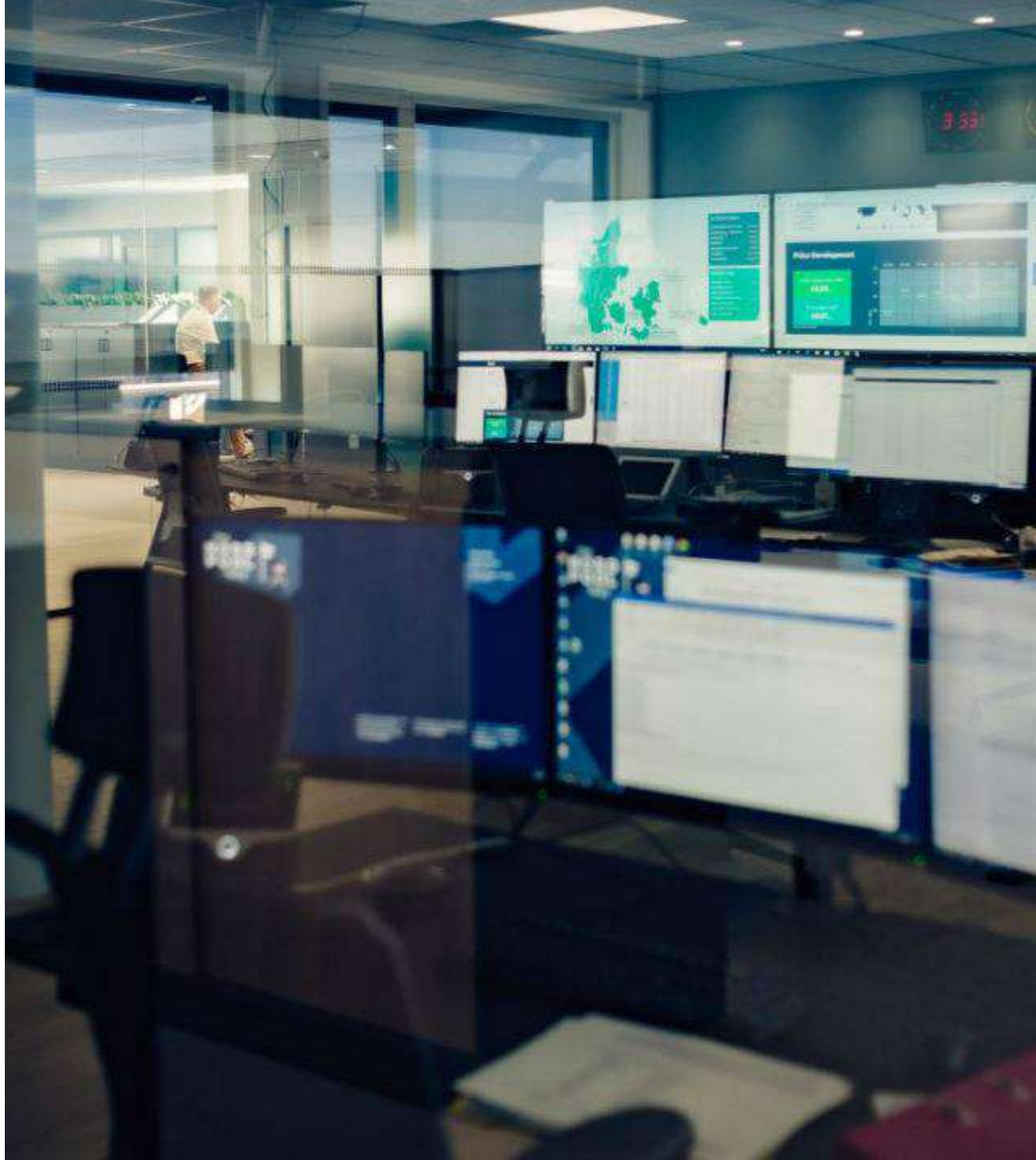
- (How do we do Market Surveillance?)



The role of Market Surveillance

We work to ensure **prices** that market participants can **trust**

- **Confidence in the market** - essential for attracting market participants and creating liquidity in the market
- We reduce the **risk of market participants** to become victims of market manipulation or to manipulate the market by negligence
- **The power market is good for our society** – We perform our tasks with the aim to create an efficient market maximising social welfare
- About **two decades** of monitoring the market



Which regulations are relevant in the European electricity wholesale market?

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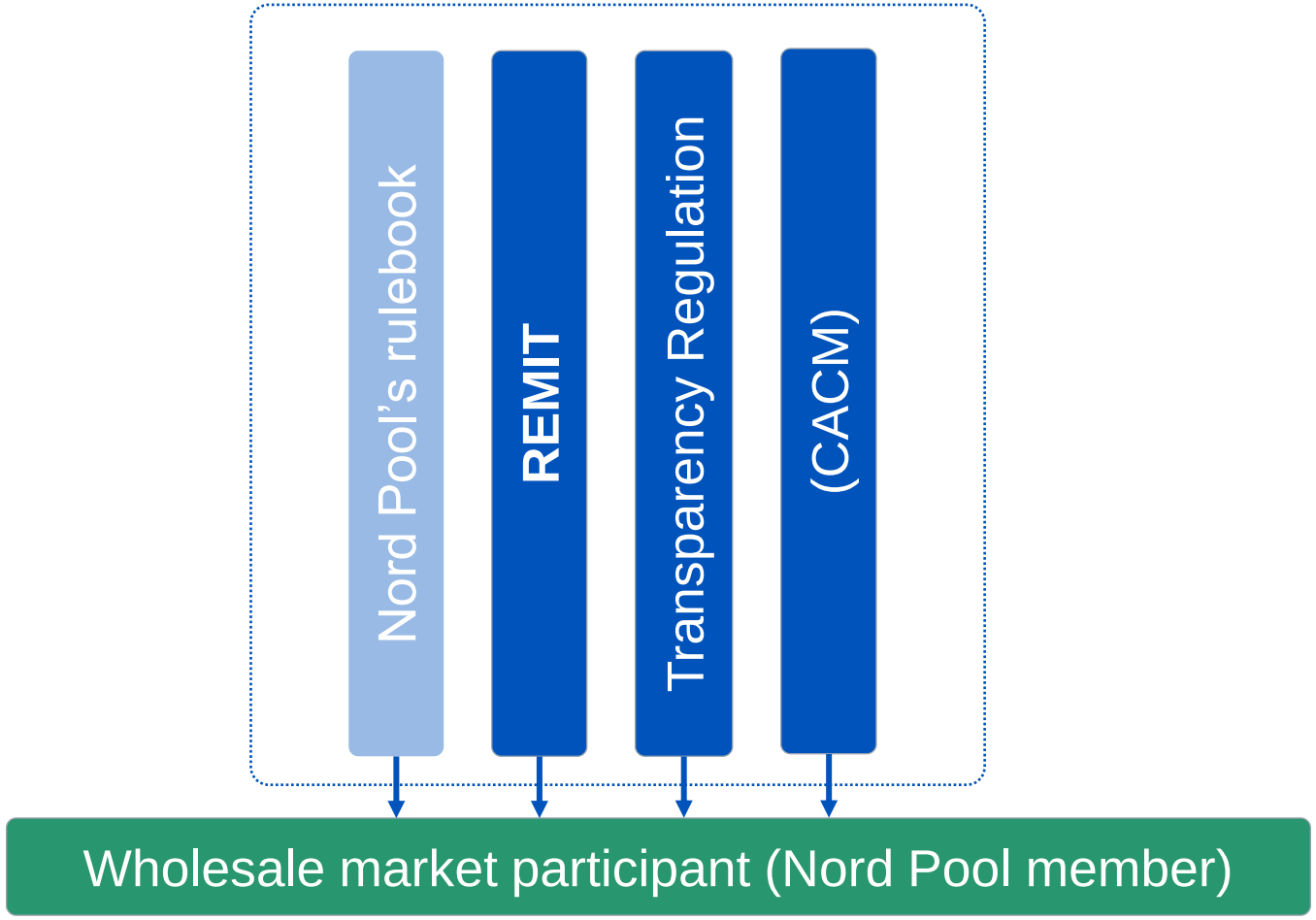
Electricity wholesale market regulation

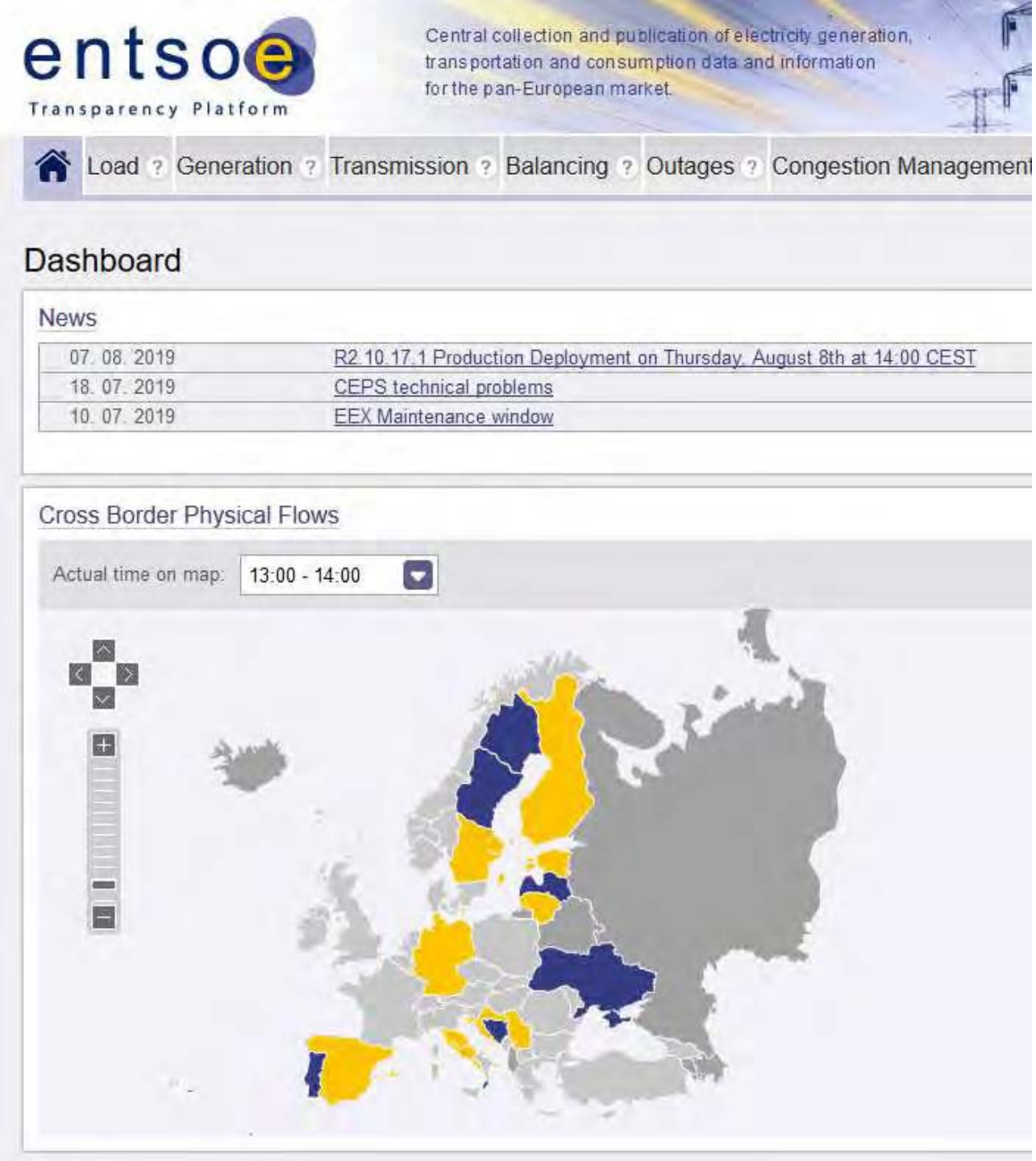


Capacity Allocation & Congestion Management (CACM)

- Common guidelines for capacity management between bidding areas
- Common grid model for the EU
  - Increase cross-border trade

- Competition between NEMOs (power exchanges)
  - Nord Pool move into continental Europe
  - Nord Pool have competition in the Nordic power market

- CACM 2.0 currently under review



Transparency regulation

Central collection and publication of a common set of data related to generation, transportation and consumption of electricity

- Oblige all market participants in the electricity market to make available a defined set of data
- This data is centrally collected and made public
- Data is available via FTP-server and API solution

- Demo of Transparency Platform

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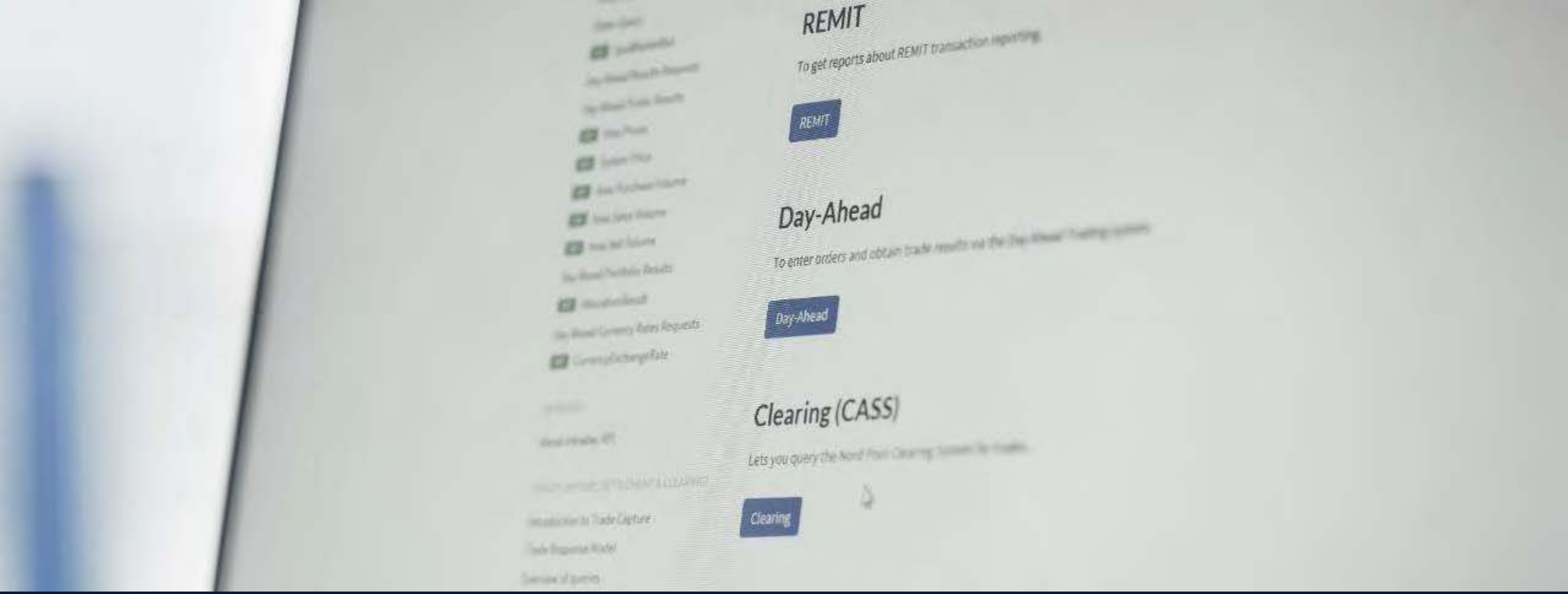

REMIT (and NEM) – the core regulation against market abuse in the European electricity wholesale market

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Background for REMIT

- Energy market monitoring was done in each country and for each sector specifically

  → **different rules and jurisdictions**

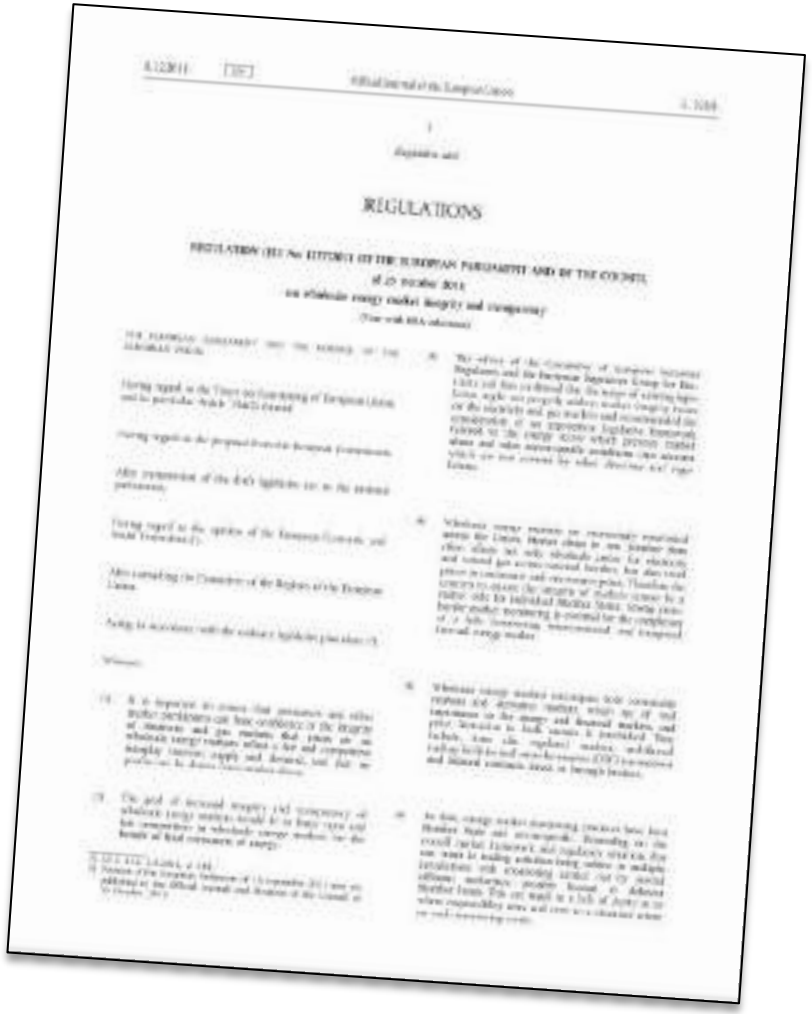
  → **countries with no monitoring**

- But the wholesale energy markets became increasingly interlinked
- Market abuse in one country will affect prices in neighbouring countries

  → **Strong cross-border market monitoring is essential** for a fully functioning internal energy market in the EU

REMIT – REgulation on wholesale Market Integrity and Transparency (2011)

- The first set of common rules for wholesale energy markets in Europe
- Electricity and gas
- Aims to ensure on European level:
  - Confidence in the market integrity
  - Prices that represent a fair and competitive interplay between supply and demand
  - No profits drawn from market abuse



REGULATIONS

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Main parties concerned by REMIT - and their core tasks

Market participants (enter into orders/transaction in wholesale energy markets):

- Register with a NRA before entering into transactions
- Report orders and transactions (usually through the trading venue)
- Publish inside information timely and effectively

NRAs (National Regulatory Authorities):

- Register market participants
- Monitor proper disclosure of inside information (often also market manipulation & insider trading)
- Enforce REMIT
  - Sanction market participants

ACER (Agency for Cooperation of Energy Regulators):

- Creates guidance on application of REMIT
- Collects all orders and transactions
- Analyses the market and publishes reports
- Detects and reports possible market abuse to NRAs based on Union-wide data
- Coordinates cross-border investigations

PPAT (Person professionally arranging transactions = trading venue)

- Monitors for market manipulation & insider trading and reports cases to the NRAs
- Reports orders and transactions on behalf of market participants to ACER
- Often supports publishing of inside information

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Nord Pool is required to do market surveillance

Requirements for performing market surveillance are outlined in **REMIT**, **energilovforskriften**, market place **license** by NVE and **CACM**

Article 15

Obligations of persons professionally arranging transactions

Any person professionally arranging transactions in wholesale energy products who reasonably suspects that a transaction might breach Article 3 or 5 shall notify the national regulatory authority without further delay.

Persons professionally arranging transactions in wholesale energy products shall establish and maintain effective arrangements and procedures to identify breaches of Article 3 or 5.

§ 8-5. Krav til rutiner for å avdekke brudd på § 8-2 og § 8-4

En fysisk eller juridisk person som gjennom sin profesjonelle virksomhet tilrettelegger for eller organiserer transaksjoner med engrosenergiprodukter skal melde fra til NVE uten ugrunnet opphold ved begrunnet mistanke om at en transaksjon innebærer brudd på forbud mot innsidehandel i § 8-2 eller forbud mot markedsmanipulasjon i § 8-4

Personer som nevnt i første ledd skal etablere og opprettholde effektive ordninger og rutiner for å avdekke brudd på § 8-2 og § 8-4.

Article 6

NEMO designation criteria

1. An applicant shall only be designated as a NEMO if it complies with all of the following requirements:

...

(g) it shall have appropriate market surveillance arrangements in place;

8. Markedsovervåkning

8.1 Konsesjonæren plikter å ha hensiktsmessige ordninger for å overvåke aktørenes opptreden i norske prisområder på markedsplassen. Disse skal dokumenteres og forelegges NVE på forespørsel.

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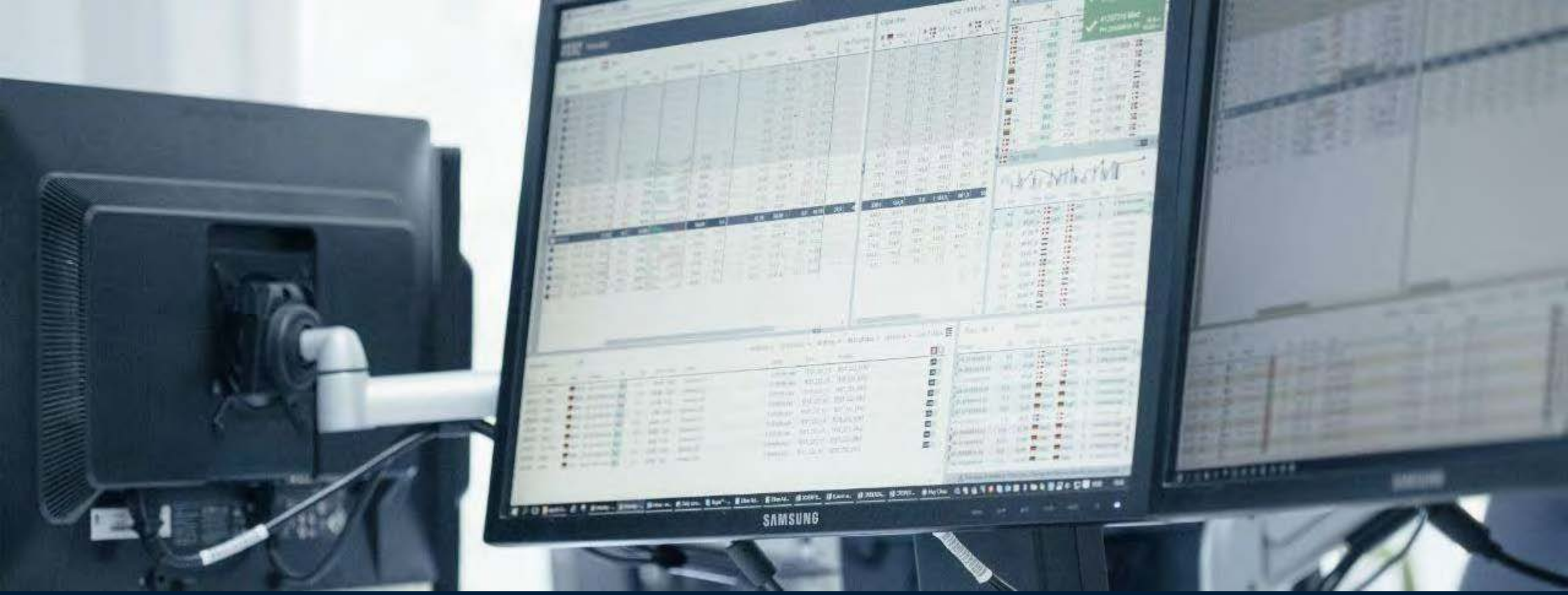


Insider trading

REMIT

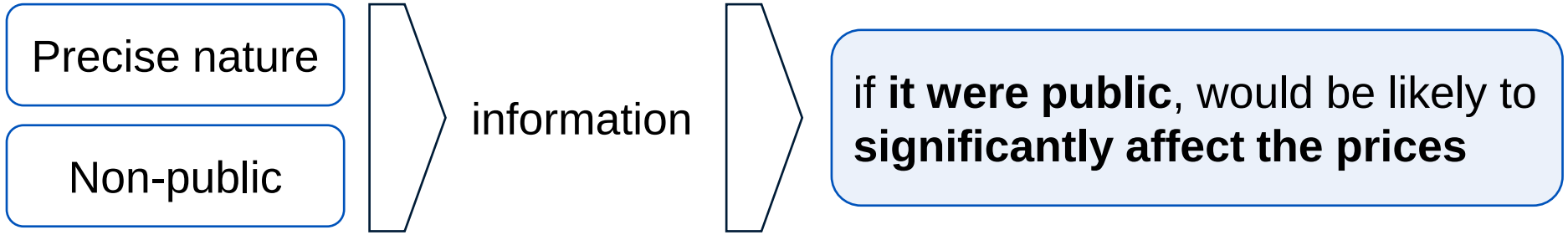
NORD POOL

Definition of inside information Art. 2

*'Inside information' means information of a **precise nature** which has **not been made public**, which **relates**, directly or indirectly, to one or more **wholesale energy products** and which, **if it were made public**, would be likely to **significantly affect the prices** of those wholesale energy product.*

REMIT recital 12:

"*Information regarding the market participant's own plans and strategies for trading should not be considered as inside information.*"



Publication of inside information Art. 4 and Prohibition of insider trading Art. 3

- Inside information **cannot be used for trading**, must be kept **confidential**, **cannot be used to give advice** on trading
- **Disclosure** of inside information related to your business needs to be **timely and effective** – through an Inside Information Platform, within one hour
- Disclosure of information may be **exceptionally delayed** in specific cases (e.g. when personnel will be laid off when a facility closes) – needs to be reported to ACER and must be kept confidential
- **Exception** to inside information: information about market participant's **own plans and strategies** for trading, e.g. a systematic method for evaluating the supply, demand, or price

Disclosure of inside information

Gets inside information about e.g. outage

Article 4

Obligation to publish inside information

UMM has to be published

NORD POOL REMIT UMM

Trader can react on the information

Article 3

Prohibition of insider trading

NORD POOL

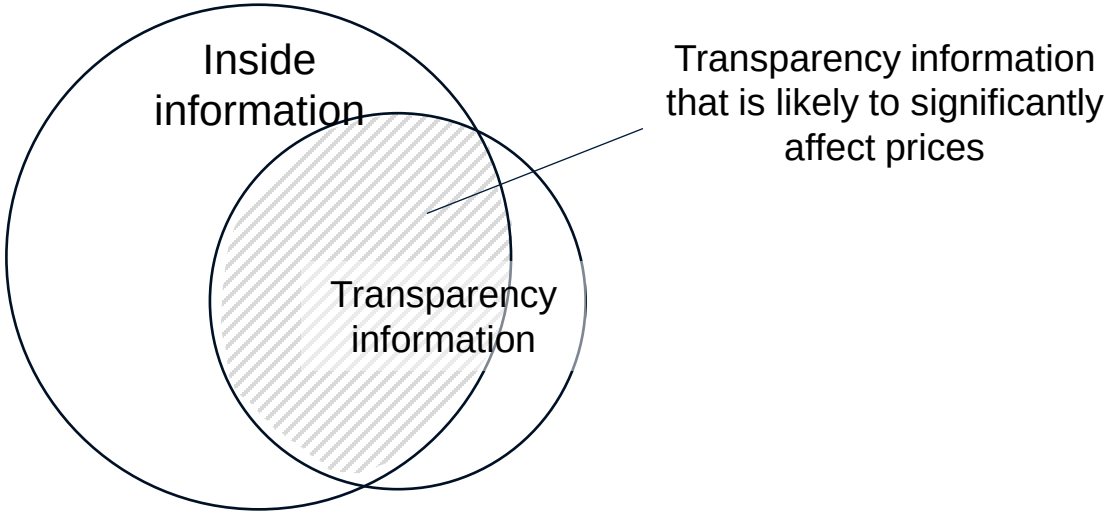
REMIT Urgent Market Messages service

- **A service to notify** the market about planned or unexpected changes to generation, consumption and transmission to get out of insider position
- Automatically **forward data** to the **ACER REMIT platform** and optional reporting to **ENTSO-E Transparency Platform**
- View real time notifications of events, disturbances and price impacts on short and long term markets
- REMIT UMM **API** available
- Available in European markets and accessible alongside
- https://umm.nordpoolgroup.com/

NORD POOL

“Inside information” or “transparency information”?

	Inside information (REMIT)	Transparency information (TR)
	Non-public information that is **likely to significantly affect prices**	**Structured** information, often **periodic**
What to publish?	Unavailability information that may significantly affect prices	Unavailability information above the thresholds
When to publish?	No later than 1 hour, trading based on unpublished information is not allowed	Usually no later than 1 hour
Where to publish?	Inside Information Platform – Nord Pool’s UMM system	ENTSO-E Transparency Platform (Nord Pool forwards to ENTSO-e TP automatically)



Information about unavailability published in Nord Pool’s UMM system can be forwarded automatically to ENTSO-E TP, if above the thresholds.

Publication of inside information (REMIT Art. 4)

ofgem Making a positive difference for energy consumers

Ofgem fines SSE £2.06 inside information abou market

Publication date
3rd September 2020

- SSE failed to publish, in a timely manner, i capacity.
- This was likely to have had a significant e
- SSE breached legal requirements on the

On 22 March 2016, SSE signed a non-binding Heads of Terms (1) agreement with National Grid (NGET) to provide 'Black Start' (2) capability at any one of three generating units at its Fiddler's Ferry power station from 1 April that year. Previously, SSE had announced that the units were likely to close from that date.

With a combined generating capacity equivalent to 3% of GB peak electricity demand, these units had (3) a significant impact on GB demand and supply, affecting wholesale prices.

Ofgem's investigation found that SSE's non-binding agreement with NGET on 22 March 2016, and its decision to retain Transmission Entry Capacity (4) for the three units on that date, reversed the likelihood that the three units would close. Consequently, the agreement was likely to have a significant effect on wholesale prices, and was therefore inside information.

SSE did not publish this information in a timely manner. Instead it waited until the 30 March 2016 to make an announcement once it had finalised the contract

The investigation found that whilst the company did consider whether it was in possession of inside information on 22 March 2016, it failed to reach the correct conclusion and publish on that date. In the course of its investigation Ofgem did not find evidence that SSE acted in bad faith.

days trading (5) without the market previously thought. It is likely this led to y than they should have.

UMM

demonstration

Market Manipulation

REMIT

Definition of market manipulation Art. 5 (1/2)

(a) Entering into transaction / Issuing order to trade → in wholesale energy product, which:

- (i) gives or is likely to give, **false** or **misleading signals** as to the supply of, demand for, or price of wholesale energy product
- (ii) secures or attempts to secure <…> **the price** <…> **at an artificial level**
- (iii) employs or attempts to employ a fictitious device or any other **form of deception** <…>

ACER Overview of the sanction decisions

Definition of market manipulation Art. 5 (2/2)

(b) Disseminating information

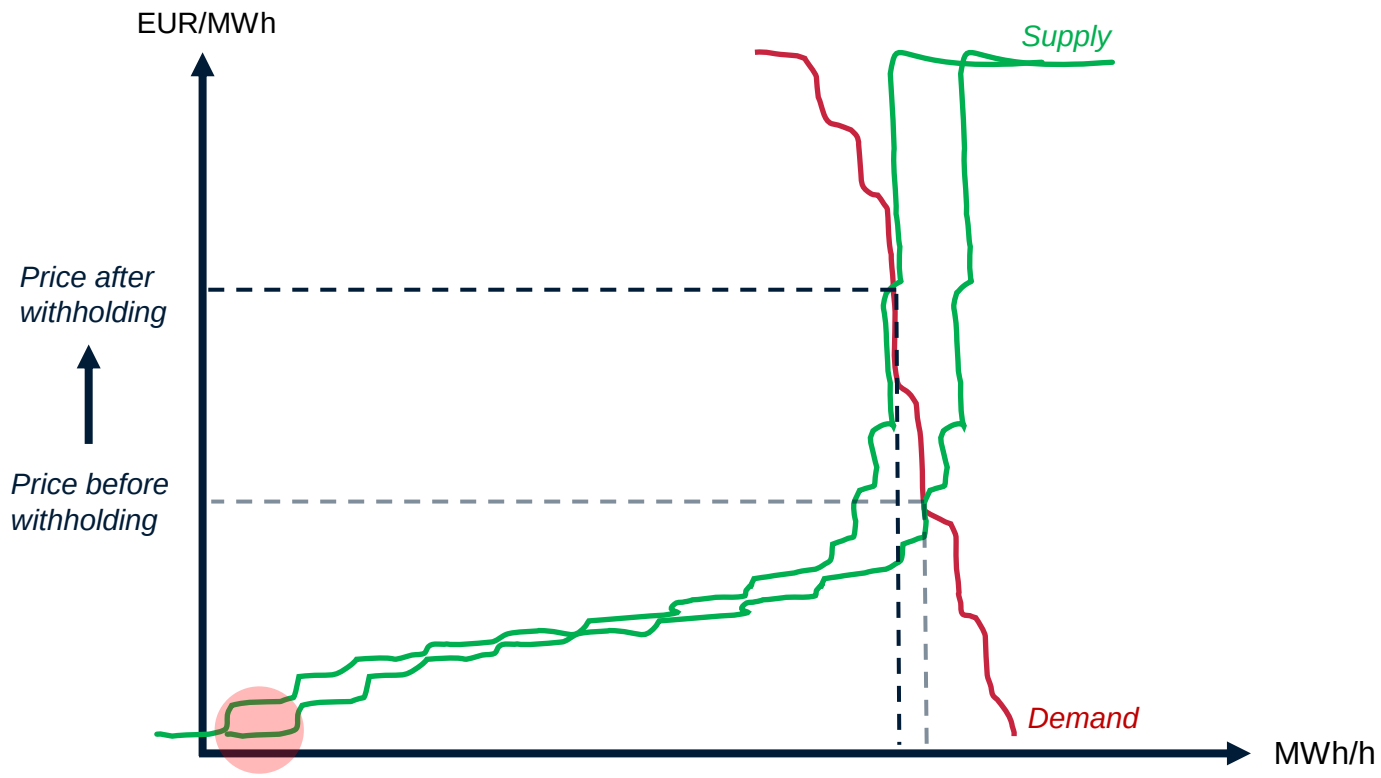
through the media, including internet, or by any other means

which gives, or is likely to give, false or misleading signals <…>

including the dissemination of rumours and false or misleading news,

where disseminating person knew, or ought to have known, that the information was false or misleading

Physical and economic withholding



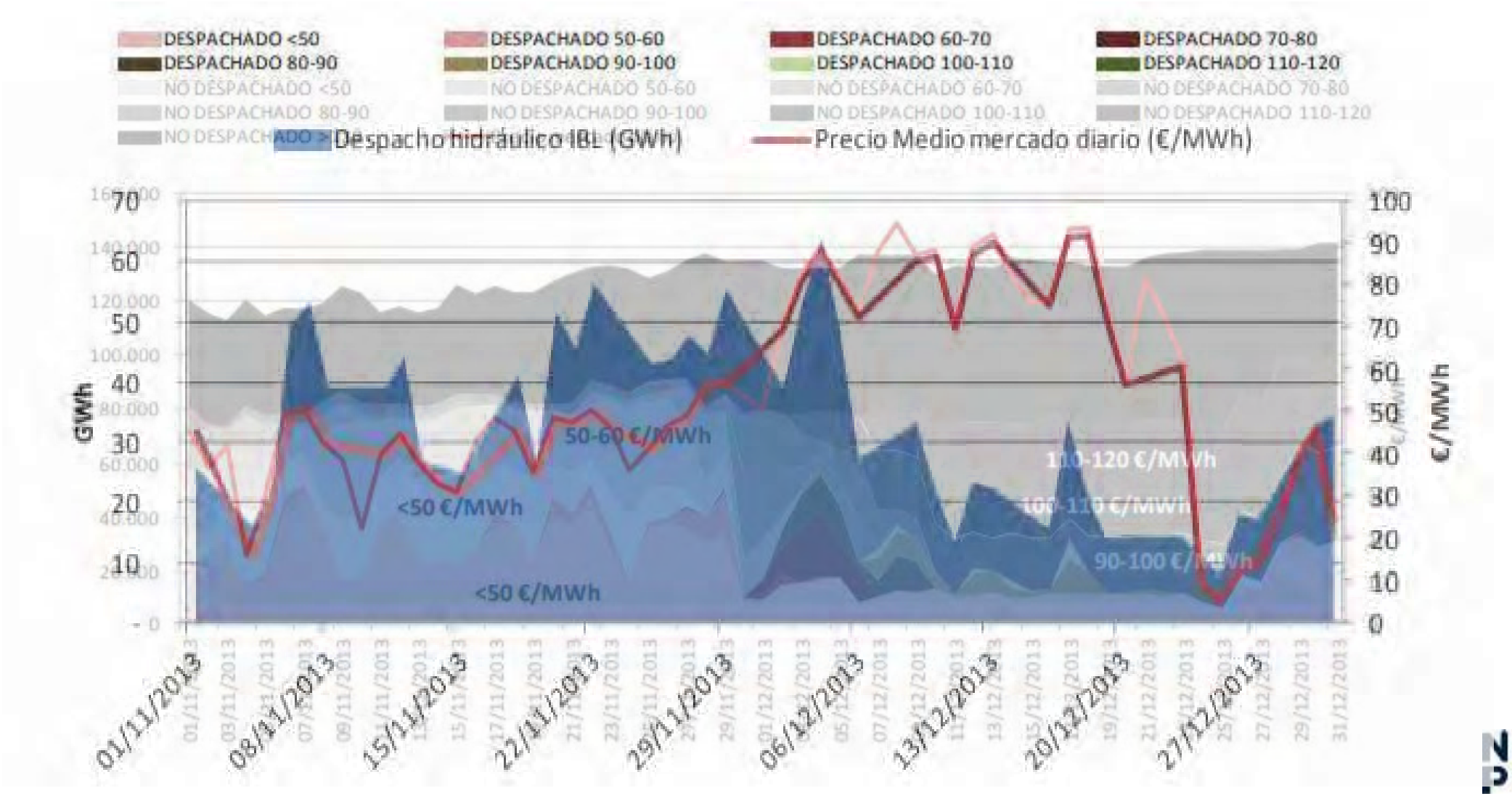
Physical and economic withholding

- Physical: not offering on the market, without justification, a power plant whose marginal cost is lower than the spot prices
- Economic: price the power plant above expected market price to avoid dispatch
- This can lead to abnormally high prices
- European electricity markets are often characterized by **large producers and low elasticity in demand** – this can make such markets vulnerable to abuse of dominant position
- **Auction market** where all participants face the same price, are **particularly exposed**


EL PAÍS
IN ENGLISH
Leading Spanish electricity firm Iberdrola accused of manipulating prices

NORD POOL

Case of Iberdrola



From https://www.cnmc.es/node/271406

Case of the Hungarian TSO (MAVIR)

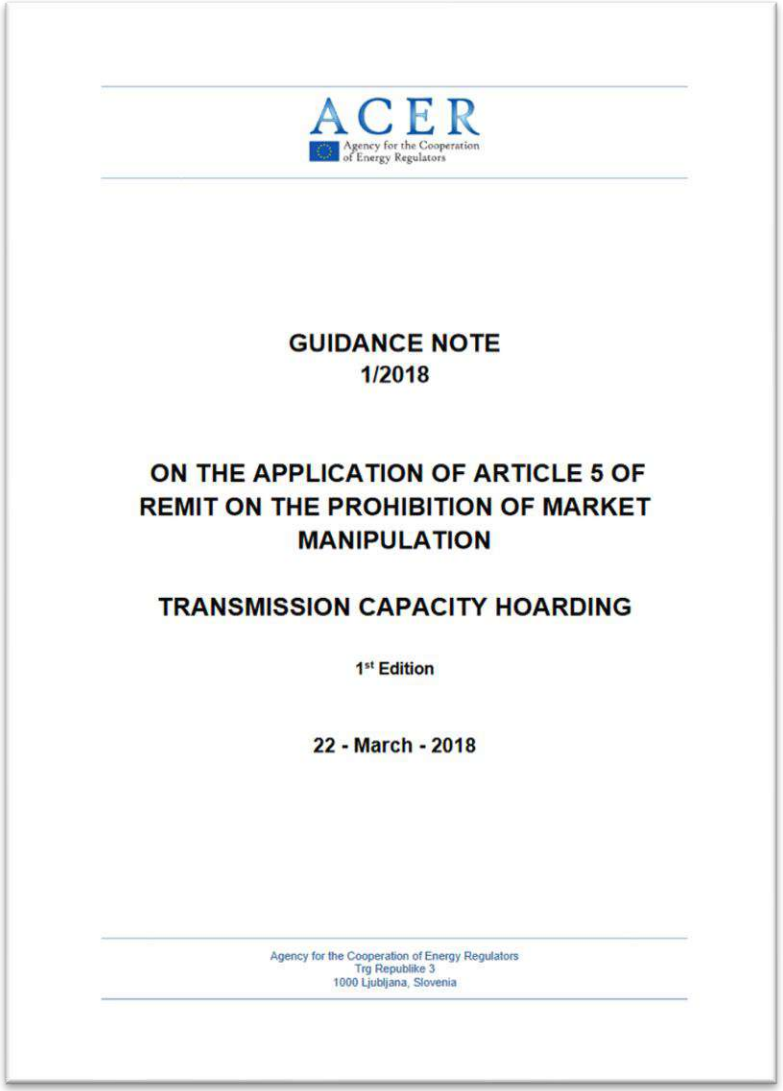
- MAVIR had submitted the wrong capacities to the day-ahead auction on the Slovak-Hungarian interconnector
- MAVIR provided 700 MW instead of 1’300 MW over 18 hours
- The actual capacity was later made available to the intraday market
- The Hungarian NRA argued that MAVIR had spread false or misleading signals and gave them a fine
- The NRA also argued that giving interconnector capacities to the day-ahead market is a transaction

→ REMIT also applies to TSOs

Transmission capacity hoarding

- Capacity hoarding means:
  - i. the acquisition of all or part of the available transmission capacity
  - ii. without using it or without using it effectively

- The intraday market with implicit or explicit transmission capacity allocation



ACER
Agency for the Cooperation of Energy Regulators

GUIDANCE NOTE
1/2018

ON THE APPLICATION OF ARTICLE 5 OF REMIT ON THE PROHIBITION OF MARKET MANIPULATION

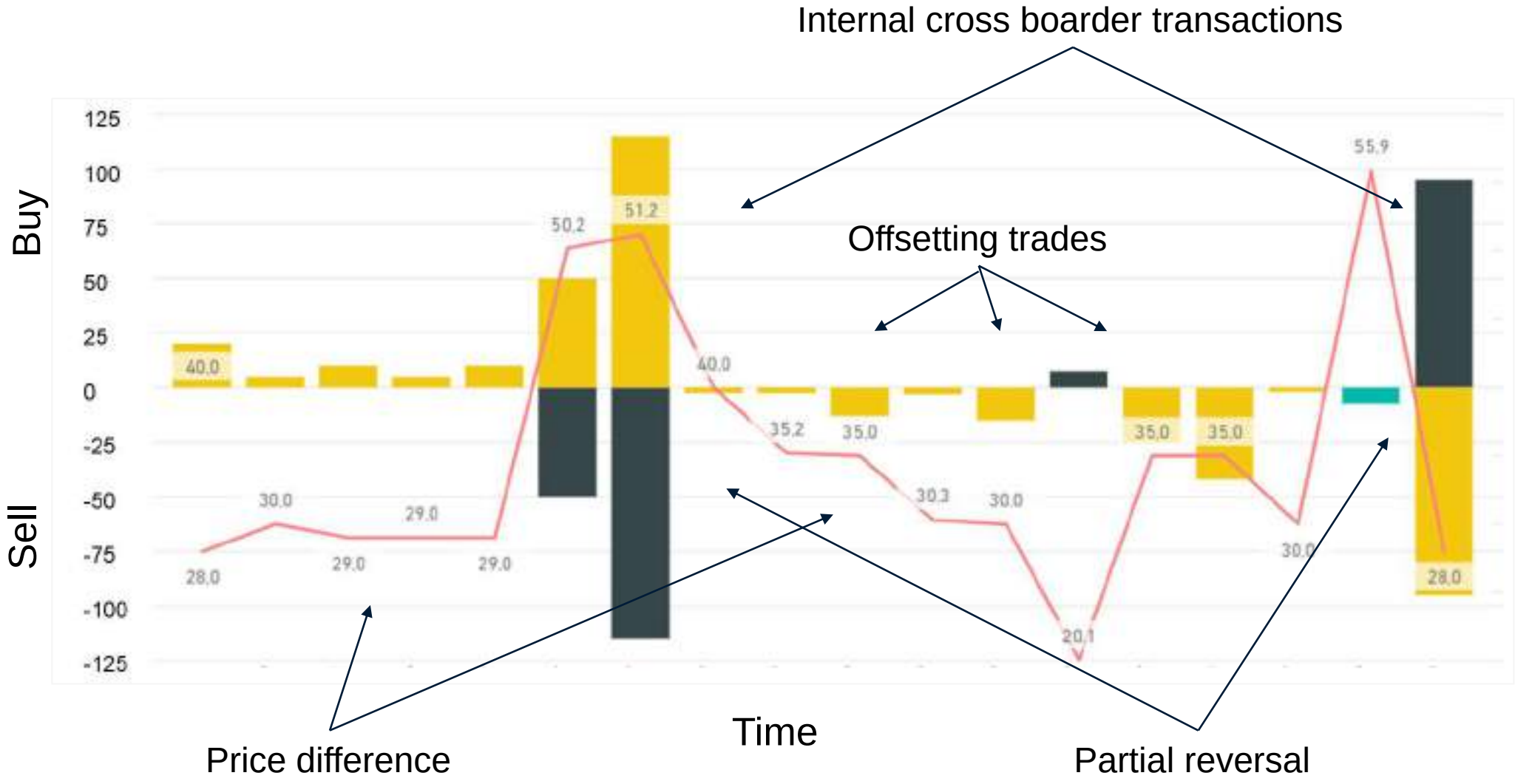
TRANSMISSION CAPACITY HOARDING

1st Edition

22 - March - 2018

Agency for the Cooperation of Energy Regulators
Trg Republike 3
1000 Ljubljana, Slovenia

Transmission capacity hoarding between “yellow” and “black” area – an example



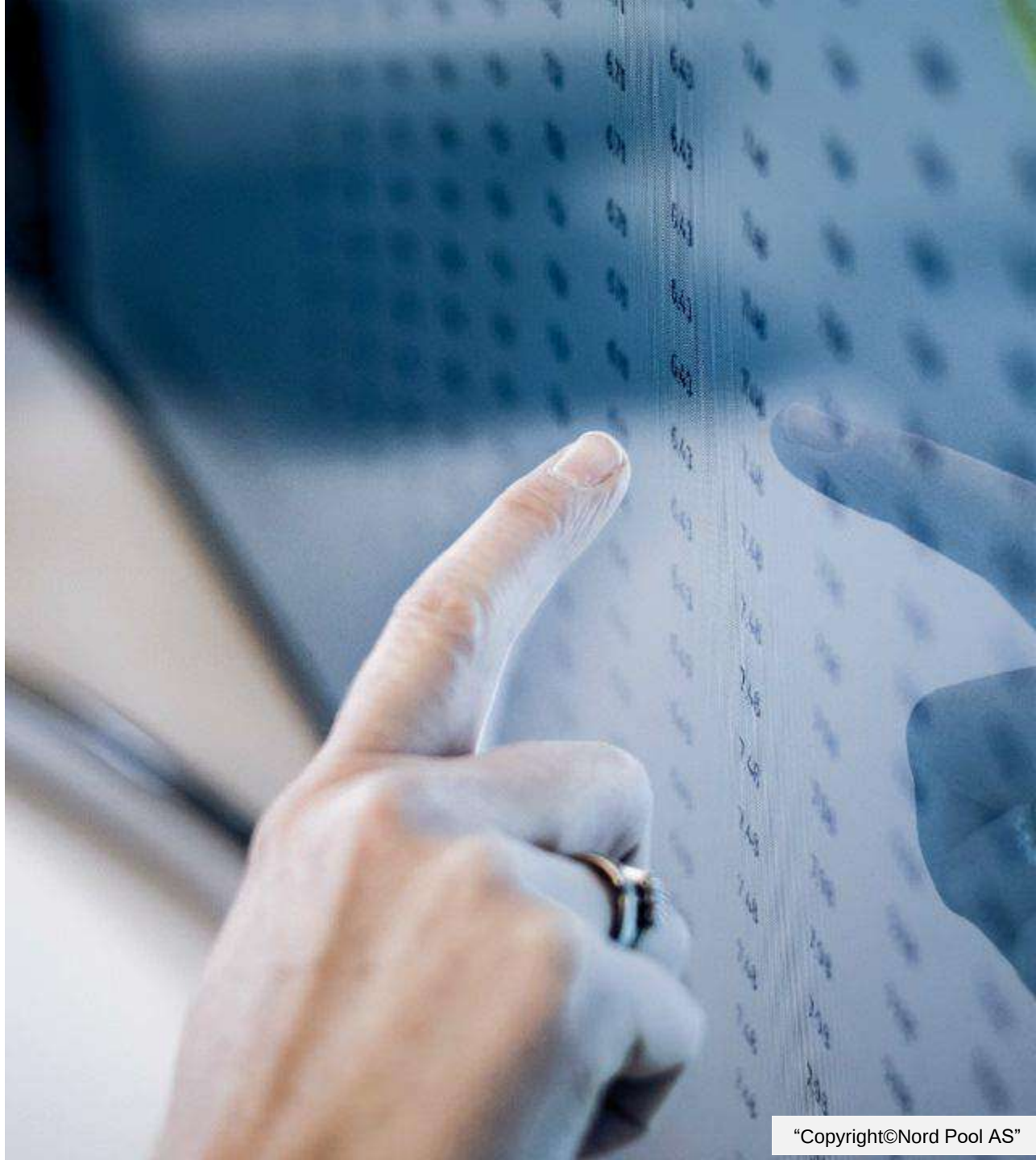
First buy, then internal cross border trade, then sell, then reverse the internal cross border trade

Cross-market manipulation

Trading in one market to improperly position the price of a product on a related market

- Nord Pool's auction prices are extensively used as **reference prices** for derivatives, hence this creates incentives for manipulating underlying prices in order to benefit in the derivative markets

- Cross-market manipulation may also be relevant between **day-ahead, intraday and other physically settled markets**, but pose a smaller risk if the relevant prices are not used as reference prices



InterGen (UK) case

Cross-market manipulation (and more)

- InterGen falsely claiming that some of its power stations would not be generating during the critical darkness peak evening period when demand is highest
- National Grid then needed to use balancing mechanisms due to the potential power shortage
- National Grid then bought the “non-generating” units from InterGen (at a high price)
- Fined £37,8M ~400 MNOK

INTERGEN HIT WITH £37.2M FINE

16 Apr 2020 National Business, Technology

Intergen – a developer, owner and operator of power projects – is being made to pay £37.2m after being found to have sent misleading signals to National Grid about how much energy it would supply during peak winter hours to make a substantial profit.

Ofgem has imposed the payments, which were reduced from £47.8m after settlement discount on the penalty levied.

The watchdog launched an investigation on the company – which is behind sites in Runcorn, Essex and Spalding – in May 2017 following an alert from another market participant that was suspicious of activity it had observed the prior October/November.

Ofgem's investigation found that InterGen staff manipulated the market during four days in winter 2016, when they "deliberately sent misleading signals to National Grid by falsely clai

Source: https://www.insidermedia.com/news/national/intergen-hit-with-37.2m-fine

Dissemination of information as market manipulation

- **Example:** Publishing erroneous information when publishing inside information
  - Updates and changes to UMMs

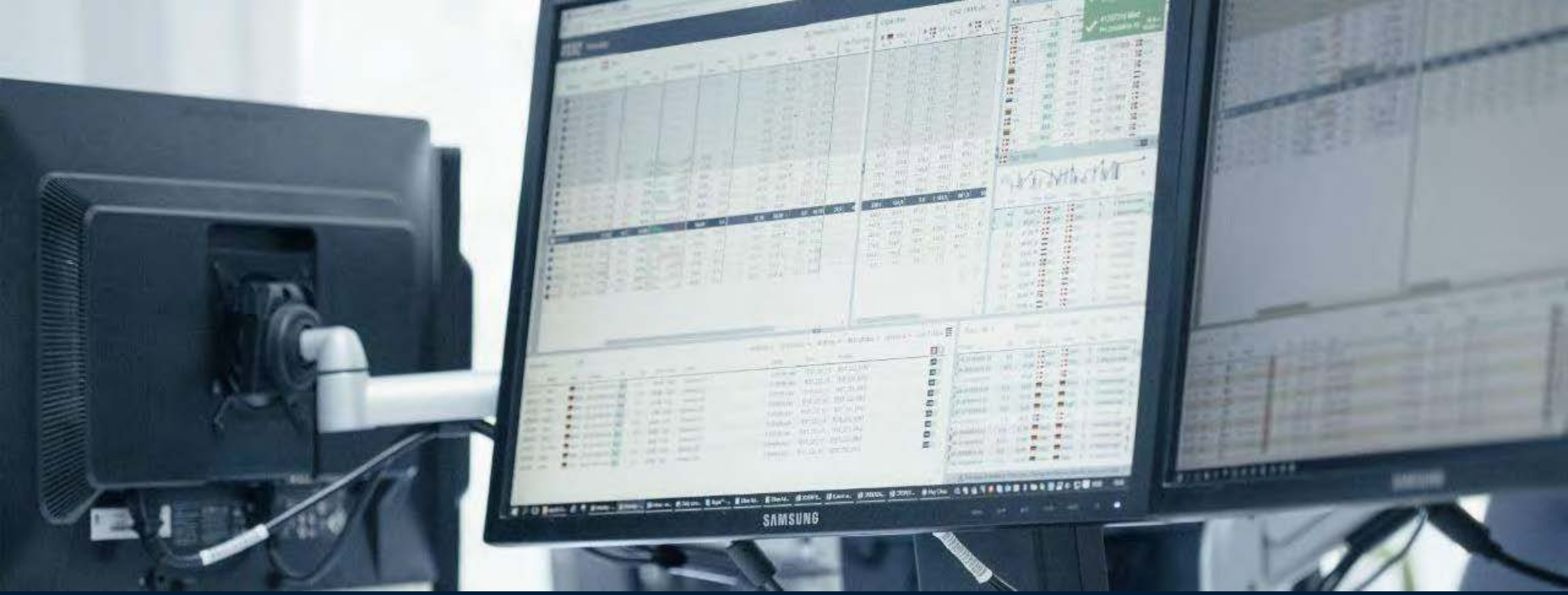
- **Example:** Spreading false rumors regarding expected outages or political decisions

Important to remember

- **No intention** is required
- **Bidding errors** can be market manipulation(1)
- There is **no requirement for** it to actually be an **impact** on supply, demand or price

Drawing by Dominik Joswig

(1) https://www.nve.no/reguleringsmyndigheten/engrosmarkedet/aktuelle-saker-engrosmarkedet/feilordre-i-dognmarkedet-kan-innebaere-brudd-pa-forbudet-mot-markedsmanipu



How do we do market surveillance?

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Market Surveillance at Nord Pool

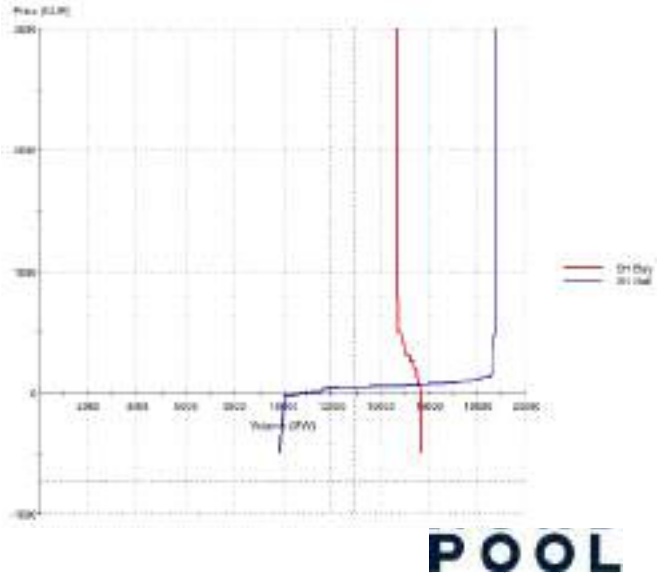
Market **monitoring and analysis**

- Monitor to discover extraordinary prices, volumes and behaviour
- Use available data to explain what we observe

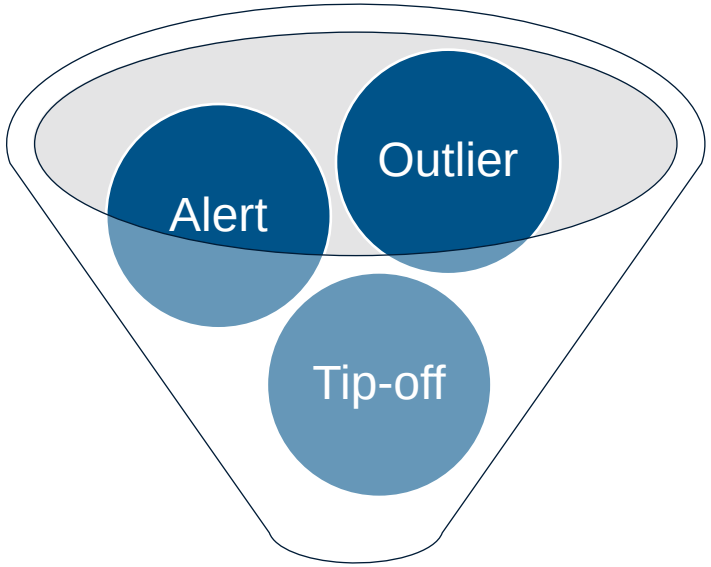
Development of alerts and checks

- Processing trading data in Python
- Visualization in Power BI

Relevant data is crucial for our work!



Market surveillance process



Incident

Analyst assessment

- Market **fundamentals** analysis: zonal configuration, prices, consumption, supply, imports/exports
- **Behaviour** analysis: type of market participant, historic bidding, unavailability

Need for further information?

Questions to market participants

Reasonable suspicion of a breach

No reasonable suspicion

Market Surveillance at Nord Pool

Working together with **market participants**

- Support on REMIT
- Bilateral meetings
- Questions to market participants about the trading practice
- **REMIT Discussion Group** about regulatory practice and market developments
- **REMIT Best Practice report**
- **Threshold for Publishing Inside Information report**

Cooperation with **regulators**

- REMIT Council Sub-group
- Ofgem STR Supervision forum, ACER forum
- Interaction related to suspected cases

Publications by Market Surveillance

Market Surveillance wish to share knowledge and be transparent

Quarterly newsletter

- Will discuss changes relevant developments in market and regulations
- Give insight into how our work is performed

YouTube-videos

- Introduction to Market Surveillance
- Capacity hoarding

Link to newsletter
Link to YouTube

NORD POOL

Any questions?

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NORD POOL

Clearing, Settlement & Risk Management

An Introductory Lecture

Lars Ingebrigt O. Rokkones

Risk Manager | Finance Department

NORD POOL

Agenda

- Nord Pools role as a CCP
- Advantages of having a CCP
- Brief recap of our markets
- Clearing & Settlement Processes
- Collateral modelling
- Risk management process
- Types of Risk
- Risk mitigation
- Breech of obligations

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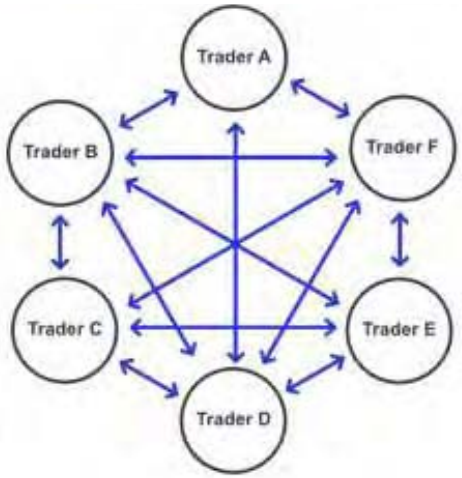
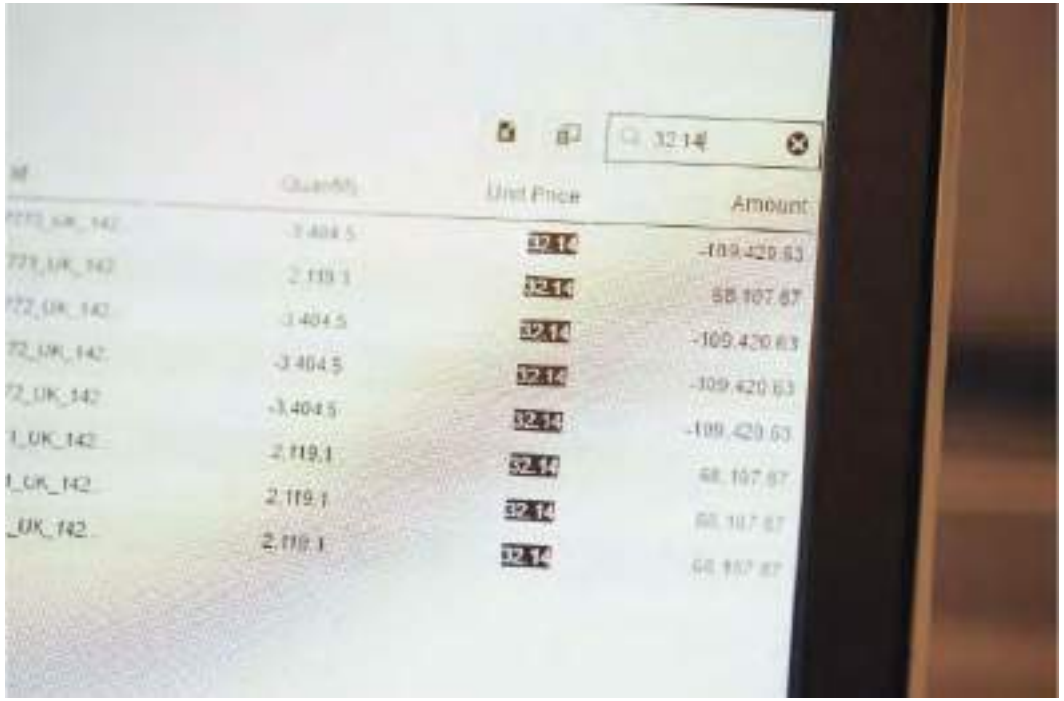
Nord Pools role as a CCP

- Intermediary - HUB
- Legal counterparty to each trading party
- Guarantees every buyer receives power and every seller their paymer
- CCP members conduct Due Diligence on one Counterparty only
- Consequences:
  - Bears the Credit Risk
  - Ensure timely cash flow from buyer to seller
  - Clear and settle trades and issue daily invoice contracts for each active trader
  - Maintain members trading records

Bilateral agreements



Central Counterparty



Advantages of having a CCP

- Efficiency with regards to…
  - Trading – one party members have to deal with
  - Liquidity – shared liquidity in the entire SDAC and SIDC
  - Netting - Reduced administrative works and costs
- Risk Management
  - Members does due diligence on one party
  - All credit & liquidity risk under one roof
- Reporting
  - Record keeping – audit requirements
  - Reporting (REMIT) - trade data, pricing and aggregated volumes published (market transparency)
- In short: Efficiency, Regulatory Oversight and Risk Control

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A brief recap - Day-ahead and intraday

The day-ahead market is the main arena for physical power trading, supplemented by the intraday market. Trades from both markets are cleared and settled by Nord Pools internal clearing department.

Day-ahead market

Auction-based

Until 10:00

Power transmission **capacities** are submitted by the transmission system operators for each bidding area in the market.

08:00 – 12:00

Buyers and **sellers** enter their **bids** and offers into the trading system.

Until 12:00

Buyers plan how much power they will need, and **sellers** how much they can provide.

12:00

Auction closes

12:45

Prices are announced

13:00 – 14:00

Market & Settlement cycle is run

14:00 – 15:00

Trades are **invoiced**

07:00 08:00 09:00 10:00 11:00 12:00 13:00 14:00 15:00

Intraday market

Continuous trading

In the intraday market trading takes place every day of the year, **around the clock** – allowing for efficient balancing of the market.

Different types of contracts open and close at various times of the day, with gate closure times down to 5 minutes in selected geographies.

13:00 – 14:00

Market & Settlement cycle is run

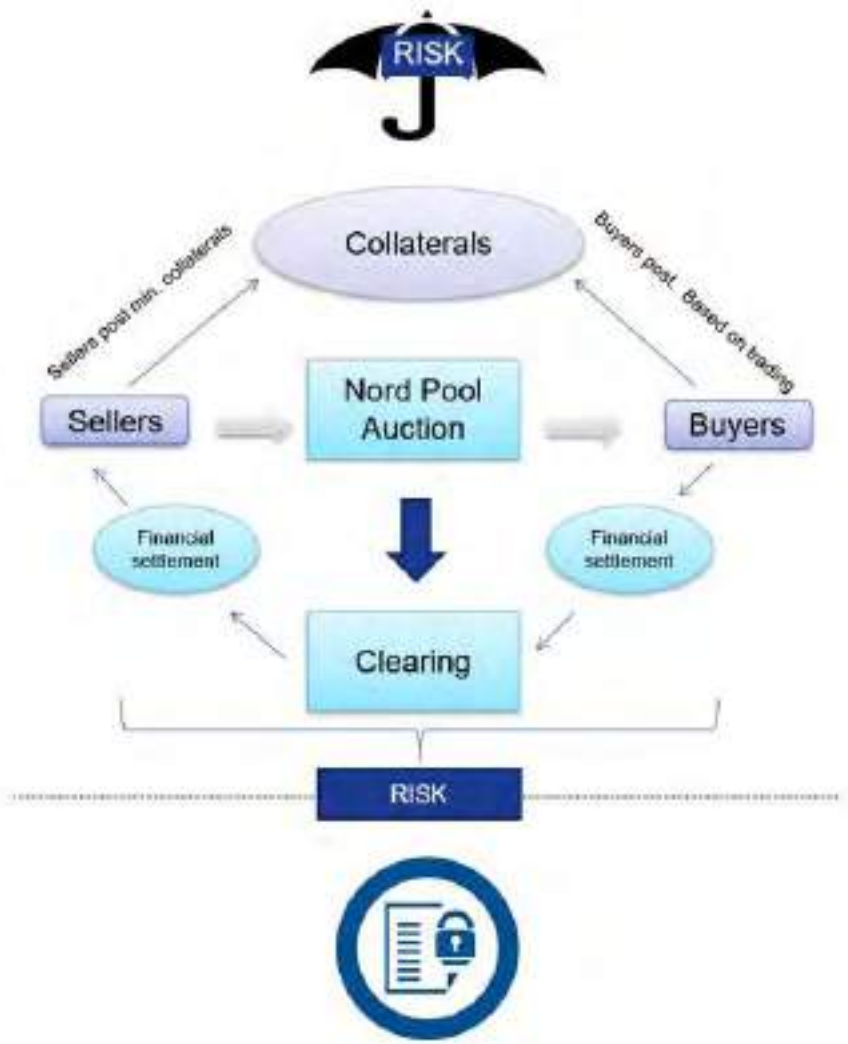
14:00 – 15:00

Trades are **invoiced**

Basic Clearing and Settlement Process

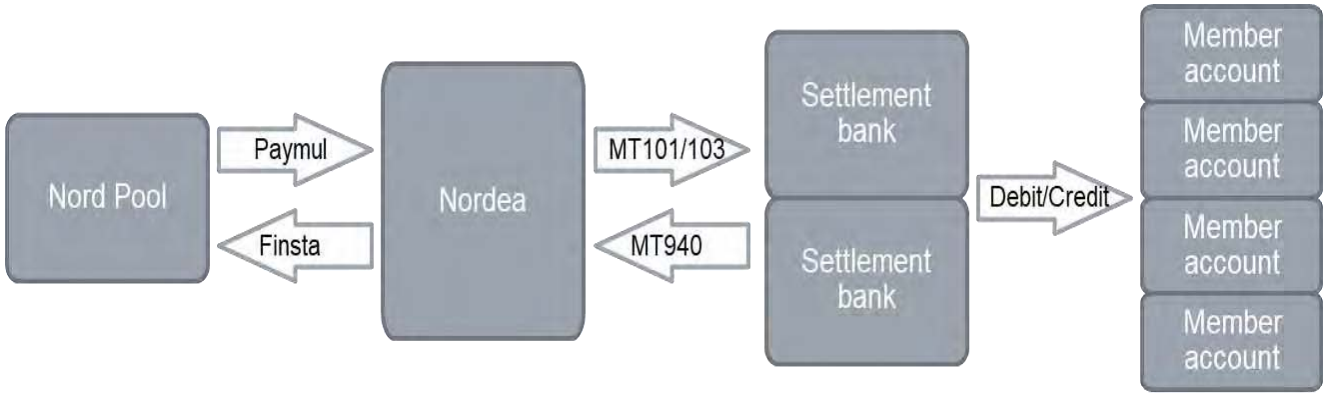
What happens between 13:00 and 15:00? Step-by-step

- Trade Results (Matched Trades) flow from our various markets into the clearing and settlement system (CASS)
- CASS runs Market and Settlement cycles
  - Check the entire file
  - Trades matched to respective participant portfolios
  - Buy & Sell volumes are netted
  - VAT and fees calculated
  - Result → Individual member invoices are produced
- Banking instructions generated (SWIFT) based on the newly created invoices in CASS
- Additional result → Trading volumes basis for collateral call



Trades are invoiced – now what?

- 550+ payments instructions
- Above the polar circle to trading houses in Switzerland
- Paymul / Finsta → EDI-standard
- MT Messages → SWIFT Protocol



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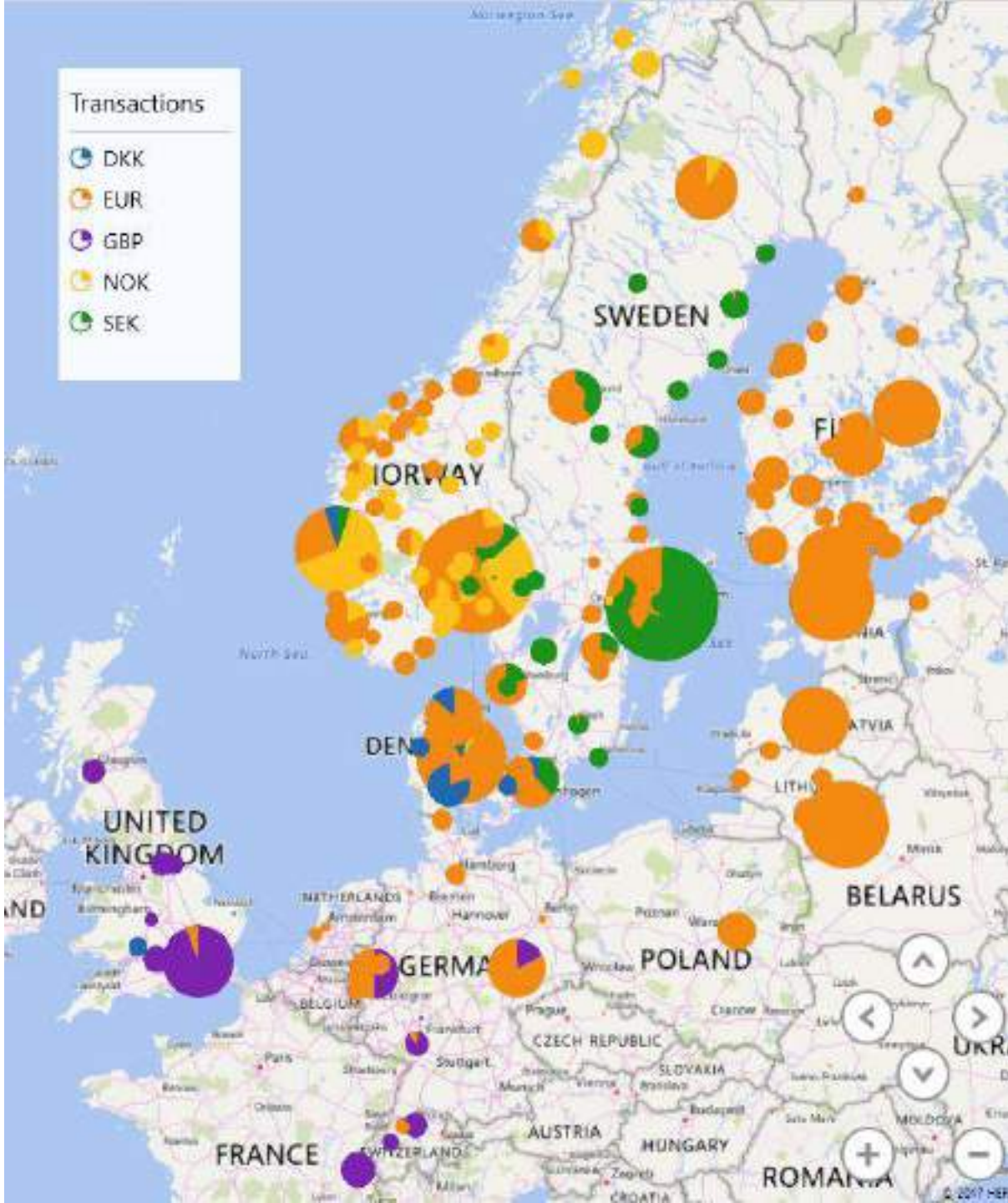

Let's talk figures

- Clears over €200 million daily (!)
- We monitor €5,9 billion in collateral (€35,4 billion including settlement banks)
- Numbers from last Friday:

Trade Total	DKK	EUR	GBP	NOK	SEK	EUR Total
Number of trades	867	181,434	2,774	2,095	3,301	191,201

Settlement Total	DKK	EUR	GBP	NOK	SEK	EUR Total
Bought amount	31,841,654	181,800,988	28,886,982	77,841,638	140,013,742	212,066,668
Sold amount	-28,391,009	-183,407,642	-30,397,711	-47,346,568	-47,814,431	-211,936,837
Bought volume (MWh)	23,033	953,739	285,724	69,720	105,422	1,408,509
Sold volume (MWh)	-20,797	-1,028,282	-291,918	-81,033	-39,669	-1,440,509
Gross volume (MWh)	43,799	1,982,021	577,743	150,753	144,991	2,879,274
Net volume (MWh)	2,266	-74,623	-6,284	8,687	65,853	-2,006

Collateral Model

- **Initial Collateral:** Base collateral in place before member can trade. Minimum € 30 000

$$\text{Collateral Requirement} = \sum \text{Max}_{1-n}\,(\text{Daily Net position (MWh)} \times \text{Risk Parameter} \times \text{Day Factor}) + \text{Max}_{1-n}(\text{Daily Settlement Position} \times \text{Multiplier})$$

- **Trading Margin:** largest day's net purchases in MWh over last 30 days * Risk Parameter * Day Factor
- **Settlement Margin:** largest cash payment over last 7 days * Multiplier.
  - **Risk Parameter** → worst case spot price, one year lookback at 99,7% confidence interval
  - **Day factor** → Discretionary parameter set by Nord Pool to account for bank holidays
  - **Multiplier** → Discretionary parameter set by Nord Pool to reflect current market conditions

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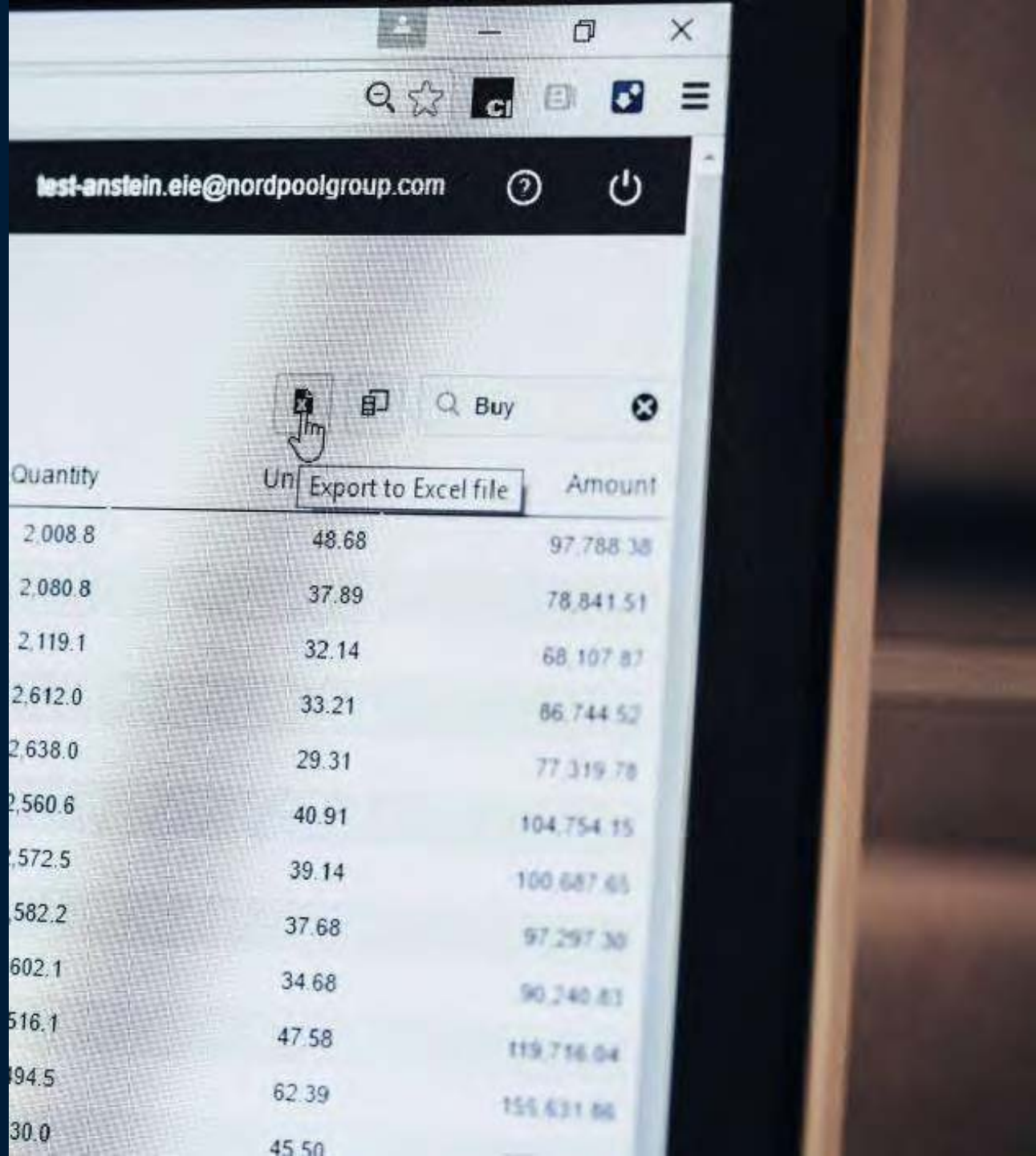
Risk Management Introduction

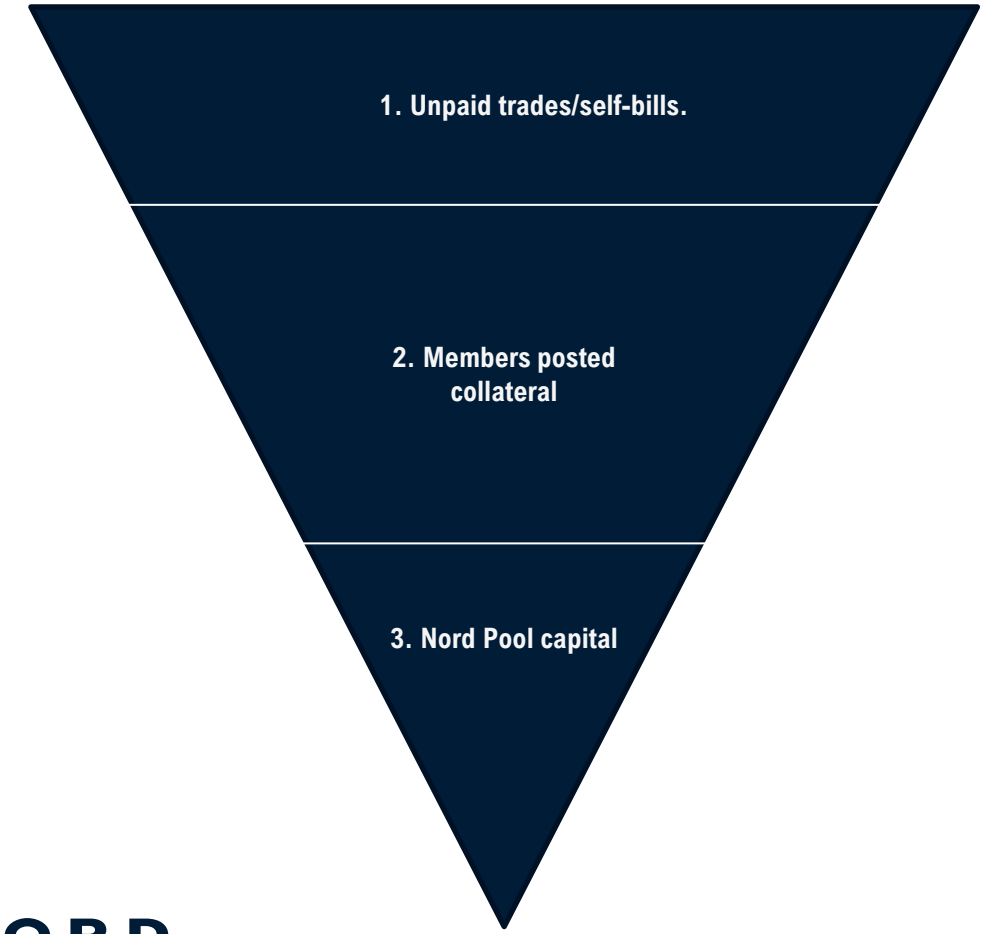
Increased market volatility → Increased demand for thorough risk management processes

- Nord Pool's Risk Management Framework clearly sets out:
  - Risk appetite and tolerances
  - Governance
  - Roles & responsibilities
  - Key processes – main focus
- Aligned with Euronext framework and based on COSO Enterprise Risk Management principles



Risk Management Processes

Default Waterfall



- Max financial exposure → 3 days worth of trading
  - Occurs with over-the-weekend trades
  - Accounted for through standard principles in the risk model.
  - Exposure increase with banking holiday
  - Solution → adjusting discretionary parameter
- Members → Required to meet collateral requirement
  - Highly liquid security instruments
  - Guarantee, LoC and/or pledged cash
- At no point in time, has Nord Pool been subject to a loss resulting from one of its members defaulting
- The method for estimating adequate capital that Nord Pool currently applies, is in line with what is applied under banking legislation

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Different Types of Risk

Credit Risk & Market Risk

- Participant failure to honor - default or bankruptcy
- Trades settled daily & collateral posted in order to mitigate
- Monitor banks (ratings, exposure / concentration).
- Market risk = foreign exchange risk. Hedged with local banks.

Liquidity Risk

- Nord Pool as cash settlement manager fails to pay a seller of power.
- Nord Pool maintains a positive net cash position: buyer debit T+1 & seller credit T+2.
- Cash & liquid on-demand guarantees / LoC.

Risk Capital

- Multiple participant & bank defaults.
- NVE requirement NP holds reserves or 'Risk Capital'. Regularly reviewed.
- Also: credit facility - unused.

Other Types of Risk

- Cross Clearing between the European CCPs
- Cybersecurity threats

CREDIT RISK MITIGATION

Established processes towards Market Participants

- Prospective members → Risk review, main focus financial strength
- All members post collaterals as security for trading
- Collaterals are calculated on a daily basis, as part of an automated process in the clearing system, ensuring that changes in trading patterns are continuously mitigated
- Automated daily settlement transactions → ensure payments are made in due time
- Pay-ins are due to Nord Pool 24 hours before pay-outs → prevent a liquidity squeeze
- Dedicated Clearing team follow up and ensure that all members meet their financial settlement and collateral requirements on a daily basis

RISK MITIGATION

Prerequisites for a Membership at Nord Pool

- Obtain, maintain and comply with all licences, authorisations and agreements
  - Applicable law to enable physical electricity trading
  - Perform obligations under the Nord Pool Rulebook
- BRP License/Agreement either directly or via an appropriate nominee
- Contact persons for membership, clearing & settlement, collateral, and trading
- Cash settlement account in a bank approved by Nord Pool
- Provide initial collateral
- Be approved in Nord Pool's risk review
  - Rating B or higher from Credit Safe,
  - or meet requirements in internal and more extensive risk review
- Proven proficiency and expertise in reference to trading in the physical market

Breeches of Obligations

- Market participant fails to upheld obligations or becomes a credit risk to the CCP
  - Repeatedly late cash settlements
  - Failing to provide adequate collateral
- Can exclude or suspend participants from trading (worst case)
  - Alternatively limit trading (milder case)
  - Alternatively add extraordinary margin call (even milder case)
- TSOs mandate to request suspension

Questions?

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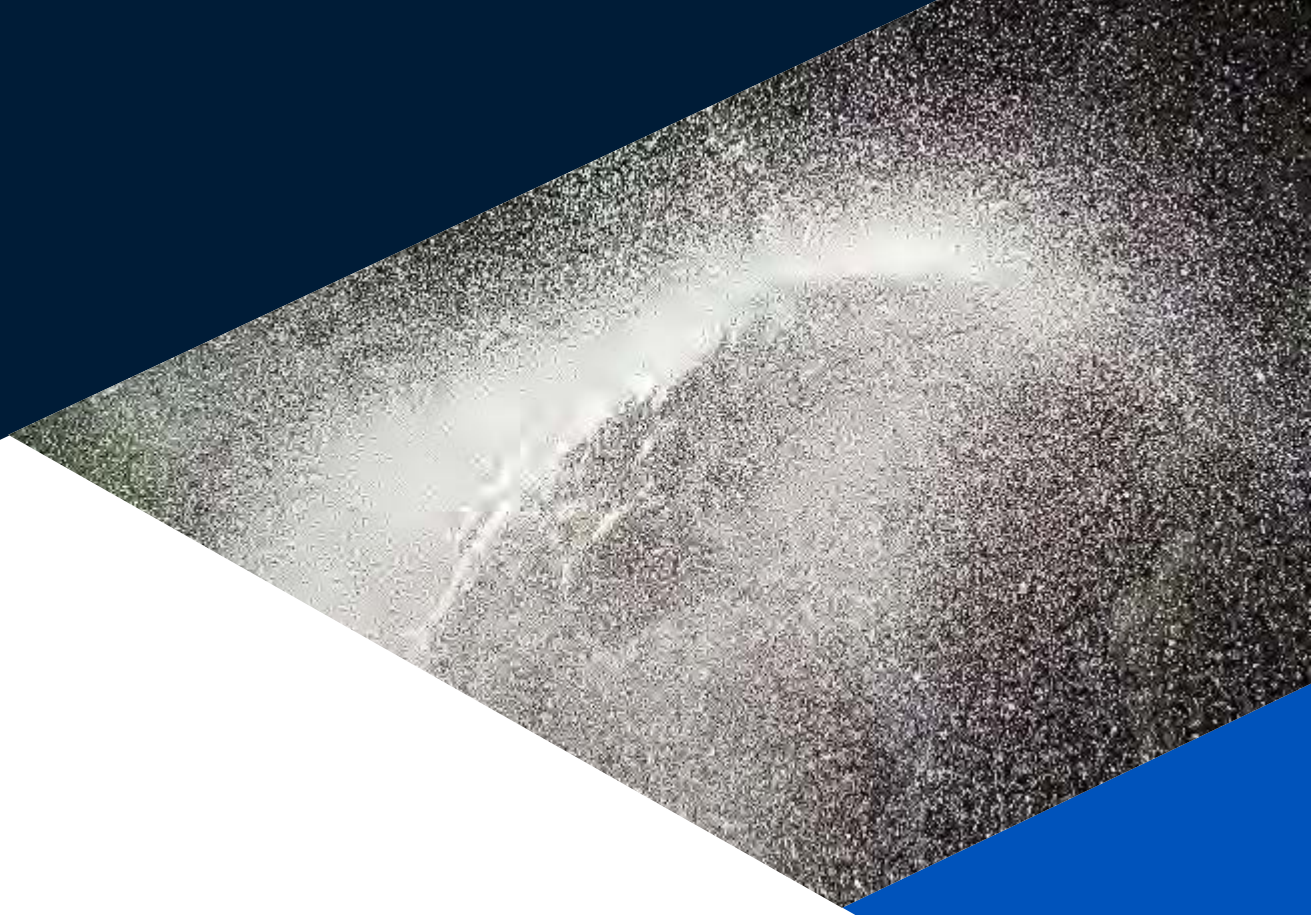
Thank you for your attention!



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Hedging of power prices and financial power markets

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AGENDA

- **Introduction to the Financial Market**
- **Financial products and hedging**
- **Clearing and settlement of financial products**
- **EPADs (Electricity Price Area Differential)**
- **Exercise**

Overview of power markets

Financial market

Hedging of prices on exchange or OTC

Day Ahead market (SDAC- Single Day Ahead Coupling)

The DAM is a daily auction that closes at 12:00 every day. System price and area prices are calculated for delivery each hour the following day.

Intraday market (SIDC/XBID)

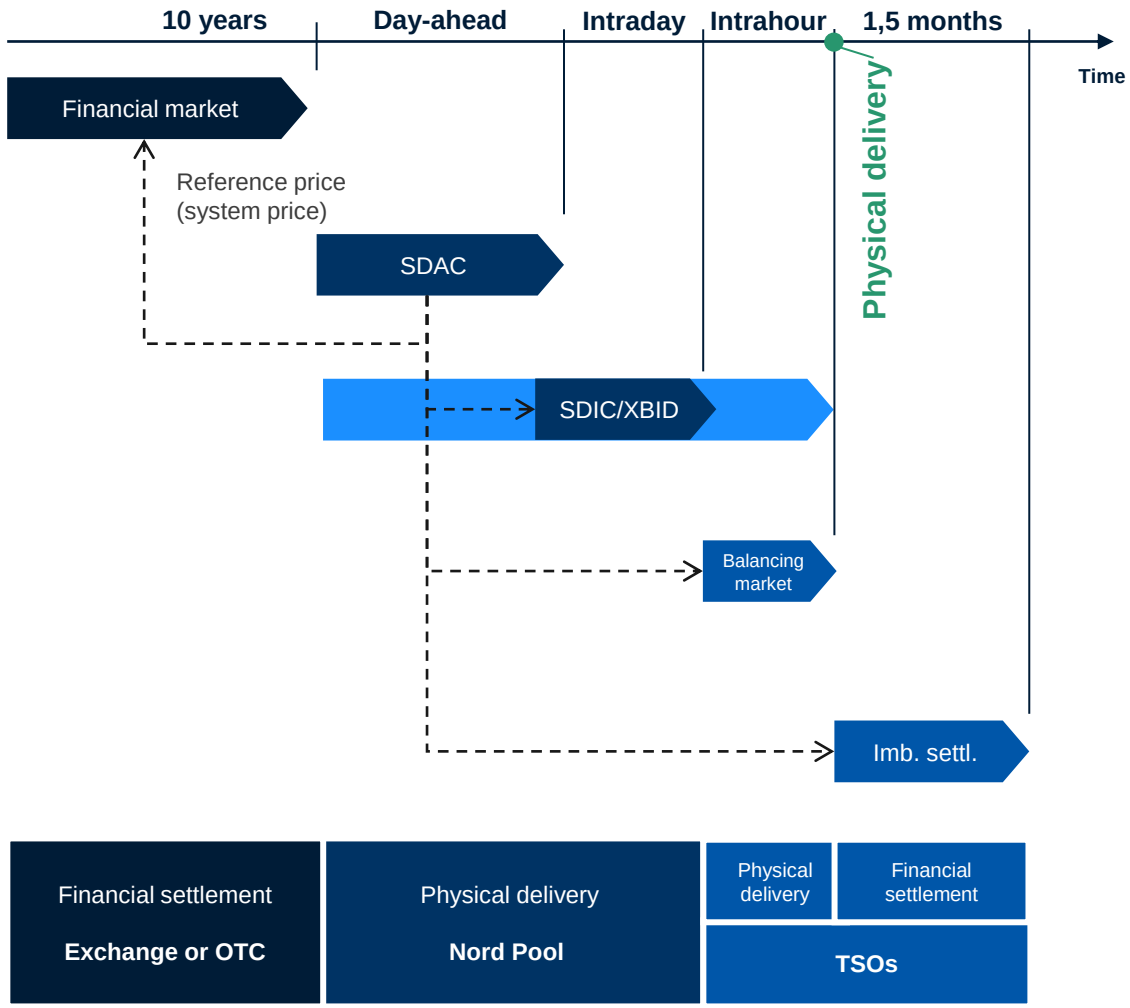
The ID is a continuous (24/7) market and closes shortly before each delivery hour.

Balancing markets

Intra-hour market for maintaining the power balance. Operated by the respective TSOs where final adjustments are made to ensure 50Hz frequency in the grid and security of supply.

Imbalance settlement

Post-hour settlement of deliveries between market participants



Today's Nordic model for trading power

Nord Pool	Other exchanges or OTC
Physical delivery	Financial settlement
Day ahead (+ intraday)	10 years ahead
Auction (deadline 12:00h) (continous trading 24/7 in intraday market)	Continous trading (8.00-17.00 Nordic)
Spot-contract	Future-contract
TSO agreement needed	NO TSO agreement needed

The combination of the 2 power exchanges forms the Nordic Model

Physical vs Financial Power Exchanges

DAY AHEAD

Nord Pool

("physical" day-ahead-auction)

+ sell and buy orders (€/MWh) for physical delivery/consumption of power for the next day
+ Nord Pool runs the auction and confirms the winning bids
+ cash-settlement and physical delivery/consumption of power the next day (=day ahead)

NEXT DAY AND UP TO

10 YEARS

Exchanges for financial power or OTC

- Futures
- EPADs
- Options

+ contracts to buy or sell power are traded now but "financial delivery" is happening in the future (max 10 years ahead)
+ "financial delivery" = financial compensation for price differences between the System price and the fixed contract price in the delivery period , but no physical delivery

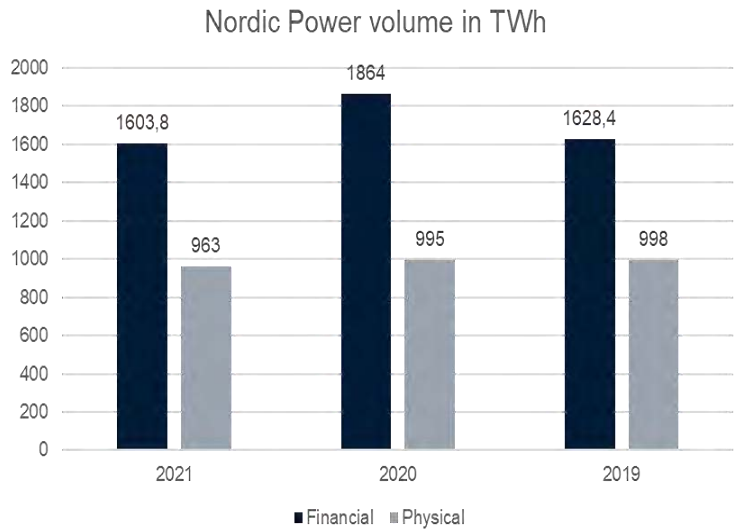
➢ **The Nordic Model:**

❖ Buy/Sell the physical electricity in the spot market and combine the spot deal with financial settled power derivatives for hedging purposes to avoid future price risks.

Brief comparison between physical and financial power markets

- **VOLUMES**

Financial market much bigger than physical for yearly volumes traded (with a rate of approx 2)



- **MEMBERS**

More or less the same players excepts for speculators that are present in the Financial market and not in the Physical (at least not in the day-ahead)

- **EUROPEAN INTEGRATION**, not for financial power.

The physical market is going towards a European integration that started already in June 2018 with the XBID project for Intraday, and continued in 2021 with the Day-Ahead. The financial power market has just competition and not integration/cooperation (with shared order book).

The decline of financial power volumes- 2019

Nordic financial power volumes drop to 21-year low – Nasdaq

(Montel) Nordic financial power volumes traded and cleared on the Nasdaq Commodities exchange plunged nearly 14.5% year on year to 814.2 TWh, the lowest level since 1998.

Trades conducted directly on the exchange fell 5% to 390.5 TWh, while the volume of cleared over-the-counter trades slumped 21.5% over the period to 423.7 TWh, data from the exchange showed on Monday.

In 1998 497,6 TWh was cleared and traded on the exchange.

Direct trades in December, meanwhile, totalled 41.6 TWh, an increase of 53% from December 2018, when volumes were subdued in the wake of Norwegian trader Einar Aas's default.

The December direct trading volume also increased from November which stood at 35.3 TWh.

In the German power market, Nasdaq saw an 71% year-on-year drop in volumes to 33.4 TWh in traded and cleared contracts, according to the exchange.

Source: Montel News
Date: 6 January 2020

The revival of financial power volumes in 2020

Nordic financial power volumes jump 14% to 932 TWh in 2020

(Montel) Nordic financial power volumes traded and cleared on the Nasdaq Commodities exchange rose 14% year on year to 932 TWh in 2020, recovering from the 21-year low hit in 2019, amid record low prices.

Trades conducted directly on the exchange climbed 30% to 506 TWh, while the volume of cleared OTC trades edged up 0.5% over the period to 426 TWh, data from the exchange showed on Tuesday.

Nordic power prices fell to record low levels in 2020 amid a swelling hydrological surplus and a higher wind power output due to renewables expansion in the Nordic region.

The Nordic system price averaged only EUR 10.93/MWh last year, down from EUR 38.94/MWh in 2019, according to figures from the Nord Pool exchange.

In the German power market, Nasdaq saw a further decline in volumes to 23.9 TWh, down from 33.4 TWh in 2019, which was a 71% drop from 2018.

In December, Nasdaq saw direct trades on the Nordic market of 50.5 TWh. This was down from 62.1 TWh in November but up from 41.6 TWh in December 2019.

Source: Montel News
Date: 5 January 2021

The decline of financial power volumes - 2021

Nordic financial power volumes hit 23-year low in 2021

(Montel) Nordic financial power volumes traded and cleared on the Nasdaq Commodities exchange slumped to their lowest point since 1998 last year, falling 14% to 801.9 TWh, it said.

Trades conducted directly on the exchange slid from 506.2 TWh in 2020 to 440.7 TWh last year, amid a very volatile autumn with record high prices, it added in a statement.

The volume of cleared OTC trades dived 15.2% over the period to 361.2 TWh.

In December, Nasdaq saw order book trades in the Nordic market of 29.4 TWh, a steep decline from 50.5 TWh in December 2020.

In 1998, 497.6 TWh was cleared and traded on the exchange, while a 21-year low of 814.2 TWh was hit in 2019.

German volumes dive

In the German power market, meanwhile, Nasdaq saw traded and cleared power volumes plunge 13 TWh in 2021, down from 23.8 TWh in 2020.

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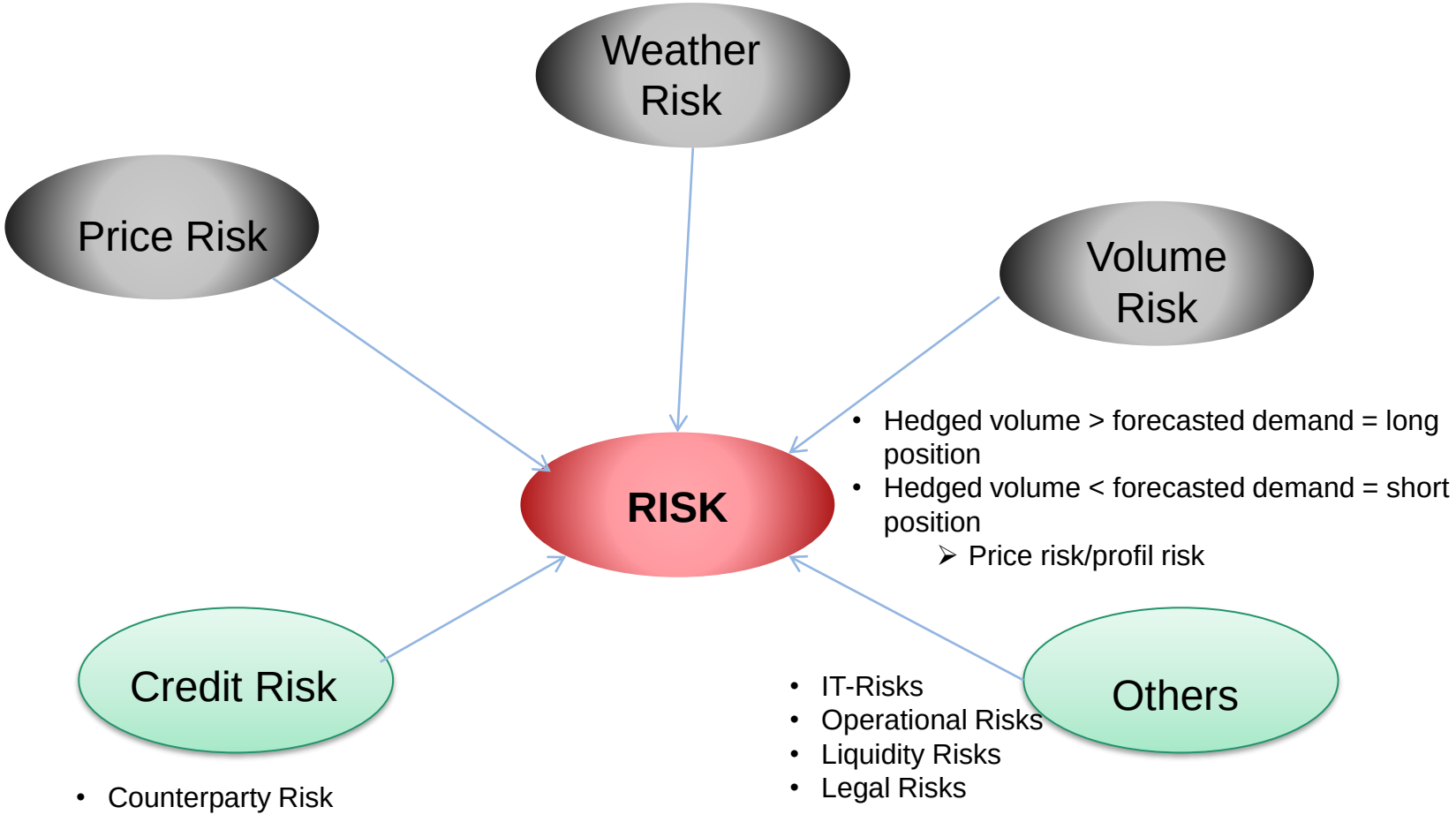
Risk in the power market - Overview



Price Risks – fundamental drivers (short term)

Spot price risk

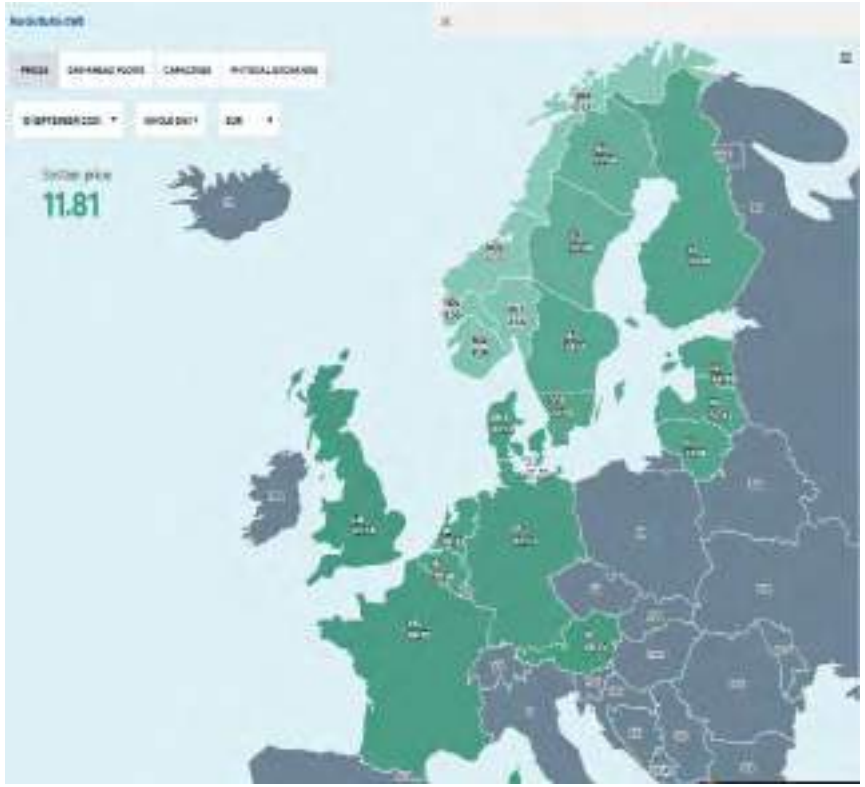
- Hydro balance/Reservoir levels
- Weather/renewables
  (Rain, Wind, Temperature, Sun/Clouds)
- Renewables (especially Wind production) increase intraday spot volatility
- Transmission capacity

Price Risks – fundamental drivers (long term)

Long term price risks (hedging horizon 1-5 years)

- fuel prices (gas, coal and oil) and German Power
- EUA (Carbon)
- Access to nuclear energy (maintenances and failures)
- Expected production and consumption (holidays/workday/weekend)
- Regulation/political decisions
- Macro economics

Power Markets follow trends for Carbon and Fuel Markets



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Exercise

- Thor the salmon farmer has studied the weather and is convinced that the unusual high temperatures indicates a coming period of smaller/fewer fish. Since he feels that the unusual high temperature will influence the price of his salmon **negatively**, he wishes to ensure that he **can sell** parts of his production **at today's price, in a month.**
- Yo sushi restaurant is a big buyer of salmon and do not believe that the weather will have an impact on the size/price of salmon. Therefore, he thinks that the price of salmon **will increase in a month**.
- The two parties agree today on a future price of **€5.00 per kg** for delivery **in a month** and a volume of **500 kg.**

- The price today is € 4.80 per kg.

- A month later the price is € 5.50 per kg.

a) **Who has made a profit/loss on the deal?**
b) **How big is the profit/loss?**

Answer

Since the price **increased**, Yo Sushi made a profit, and the salmon farmer has lost on the deal. But both improved their financial predictability.

Yo Shushi can buy @ EUR 5.00/kg although the market price is about EUR 5.50/kg.

- The farmer could have sold at EUR 5.50/kg, which was the price a month later, but he has committed to selling at €5.00 per kg.
- **Profit/loss (5.50 – 5.00) * 500 = €250**

Derivative – Future

A derivative is a contract between	
2 parties (Buyer/Seller)	Counterpart 1 and Counterpart 2
to buy/sell	C1 = Buyer (long position) C2 = Seller (short position)
a specified Quantity	10 MW
of an specified underlying	System Price
on a specified day in the future (delivery period in power markets)	ENOFUTBLYR-21 (delivery period year 2021)
at a price agreed on today	24 € / MWh
=> FUTURE IS AN OBLIGATION	

Derivative: A contract derived from another price or index (for example Nord Pool's system price).

Financial Contract: A cash settled, non physically delivered contract.

Future: Contract for buying or selling an underlying product (power) that locks in a price for a certain period of time (obligation)

Product Specifications

- The listed power derivatives are settled against a reference price (INDEX) based on the result of the “day-ahead spot market”. The financial market is as such a purely financial market where all contracts are traded and settled irrespective of transmission capacity.

TRADE LOT	1 MW
CURRENCY	EUR
TICK SIZE	0,01EUR/MWh
LOAD	Base Load: 0-24h, Mon-Sun, all days for the current month Peak Load: 8-20h, Mon-Fri incl. holydays, for the current month
CONTRACT BASE/UNDERLYING INDEX	Nordic Power: Nordic System Price (Nordic day ahead spot price) Respectively: PHELIX (DE), N2EX (UK), EPEX (FR), GME (IT)

Reasons for trading power derivatives

1. **HEDGING**
   - Consumption
     - Against increasing prices => long hedge
   - Production
     - Against falling prices => short hedge
   - tailor made products

2. **SPECULATION (PROP TRADING)**
   - Prop traders take risks and creates liquidity

3. **ARBITRAGE (HFT)**
   - Using of price differences

   (Buy the cheaper contract and sell the expensive one at the same time)

What does it mean hedging?

- **WHAT IS HEDGING**

A hedge is used to manage the price volatility of the spot market for both producers and electricity purchasers.

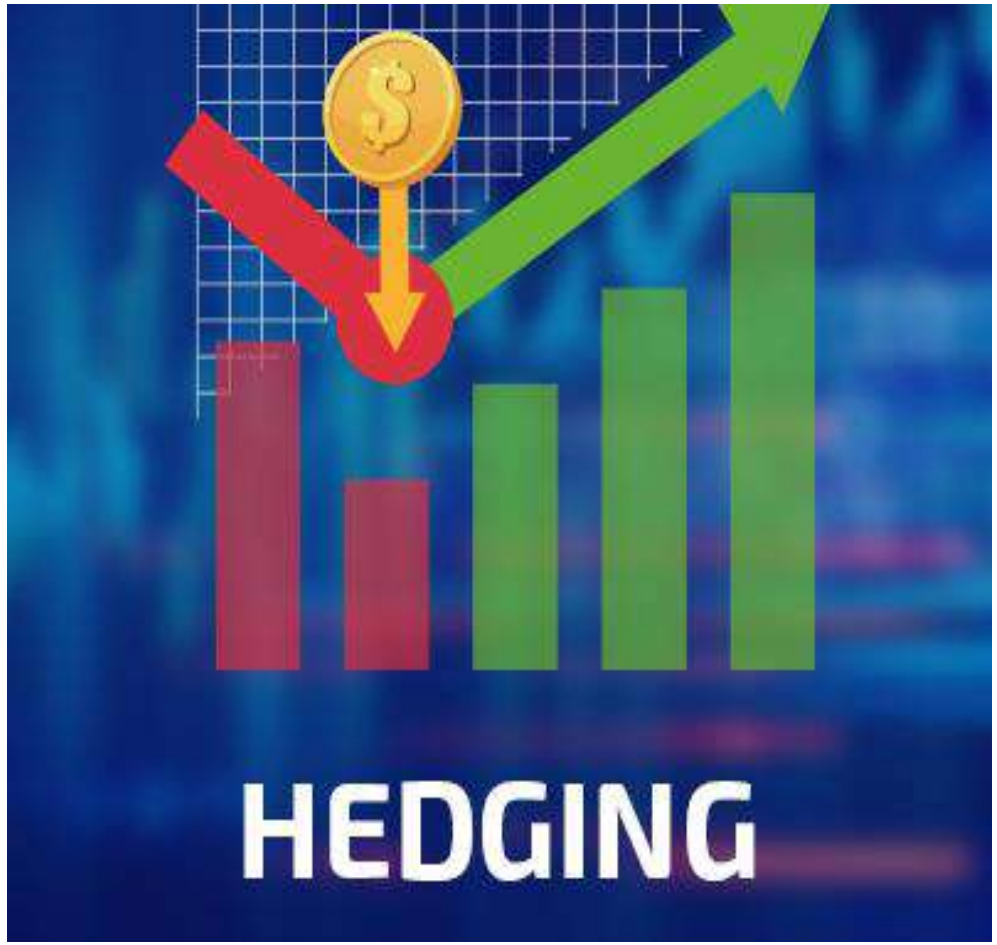
- **HOW AND WHERE HEDGING**

Hedges are either agreed directly between the parties (known as over-the-counter - OTC) or bought as derivatives on the power futures exchange markets.

- **WHY HEDGING**

Is a strategy to reduce risks/volatility of earnings.

As prices fluctuate over time, traders can either close out or hold their futures positions to make money or minimize losses.



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Main types of hedging strategies

- **Not to hedge**

Is in itself a strategy that makes revenues vulnerable to adverse market developments

Reason: avoid having to explain the potential losses that the hedging program may experience

BUT: revenues being fully exposed to market forces outside of own control

- **Hedging with Futures**

Locking in future revenues by fixing sales prices for predictable volumes (reduces exposure to spot prices and provides a high degree of cash flow predictability)

- **Hedging with Options**

Buying insurance by paying a premium to protect against potential price declines/increases

Hedging – real example

Axpo hedges 99% of 2021-22 production at EUR 44.30/MWh

(Montel) Swiss utility Axpo hedged 99% of its baseload power for its fiscal year 2021-22 at an average of EUR 44.30/MWh by 1 May, the company said on Monday.

This represents a rise of one point compared with hedging levels as of 1 December 2019, although the price has come off by EUR 0.20.

At the same time, Axpo increased its hedged baseload position for 2022-23 from 32% to 63%, with the average achieved price dropping to EUR 44.60/MWh from EUR 46/MWh half a year ago.

For 2020-21, Axpo remained hedged at 99% and EUR 40.10/MWh, while all output for 2019-2020 was hedged at an average EUR 37/MWh, unchanged on December's figure.

This compares with an average price of EUR 28.90/MWh fetched for 2018-19.

Swiss front-year baseload last traded at EUR 44.83/MWh, with the Cal 22 at EUR 47.50/MWh and the Cal 23 at EUR 47.16/MWh on the EEX.

The firm, which reported a net loss on Monday, operates nuclear power plants, hydropower and biomass units in Switzerland. Internationally, it is focused on renewables.

Source: Montel News *Date: 8 June 2020*

Volatility increased demand for hedging

Volatile markets increase demand for hedging – Statkraft

(Montel) Insecurity on the energy markets and volatile power prices due the impact of the coronavirus crisis have created new opportunities for traders, said German unit of Norwegian energy company Statkraft on Monday.

"We see many opportunities in the market and a high demand for hedging transactions in view of the current uncertainty," Judith Tranninger, spokeswoman for the company's German operations, told Montel.

Fears of a global recession due to the efforts to curb the coronavirus from spreading, have sent energy markets reeling over the past few weeks.

At times of insecurity, utilities typically try to minimise their exposure to price swings and potential risks of losing money by selling ahead their power output at a fixed price.

Front-year fall

On the power market, for example, the German Cal 21, a European benchmark, has shed 16% since hitting a one-month high of EUR 43.90/MWh on 17 February. The contract last changed hands at EUR 36.85/MWh on the EEX.

Statkraft's rival Uniper, too, felt its hedging strategy was protecting the company against market risks, spokesman Georg Oppermann said, noting it remained confident about the outlook for this year, despite the impact of the virus with lockdowns across Europe.

"A significant share of the generation portfolio [of nuclear and hydropower] is secured for 2020," he said.

Uniper had sold all of its German nuclear and hydropower output for 2020 as of December and around 75% of its Nordic output, according to the latest data.

A carbon analyst agreed, adding power producers, in particular, needed to increase their hedging in the current environment.

Source: Montel News
Date: 6 April 2020

Reasons for and against hedging

Reasons For Hedging	Reasons Against Hedging
➢ Manage production revenues to ensure greater financial stability and stable earnings	➢ Up-Front Payments & Margin Costs (Collateral and Default Fund Contribution)
➢ Reduce budget uncertainty as a result of price volatility by hedging revenues	
➢ Mitigate Price Risks	
➢ Lower Borrowing Costs	
➢ Improved Credit Rating	
➢ Revenue Predictability	

The importance of a Market Maker

“A MEMBER WHO COMMITS TO CONTINUOUSLY QUOTE BUY AND SELL PRICES ON THE EXCHANGE”

The exchange requires that the market maker quotes a maximum ”spread” between buy and sell prices.

A ”spread” is the deviation between a buying and selling price.

Requirement of minimum volumes quoted.

Market Makers benefits for the exchange:

- Generate interest
- Promote and develop market liquidity
- Create a market

Benefits to be a market maker:

- Market maker pays reduced fees
- Market Makers get paid
- Easier possibilities for hedging purposes/speculative trading

What is a LPP (liquidity provider program)?

"A Member who commits to trade a minimum amount of volume (GWh/TWh) per month on a specific product on the exchange"

The exchange **does not** require that the liquidity provider quotes a maximum "spread" between buy and sell prices.

LPP benefits for an exchange:

- Promote and develop market liquidity
- Create a market
- Get more players involved in the market

Benefits to participate to a LPP:

- Liquidity provider pay reduced/no fees
- Easier possibilities for hedging purposes/speculative trading

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- Green products in the power market
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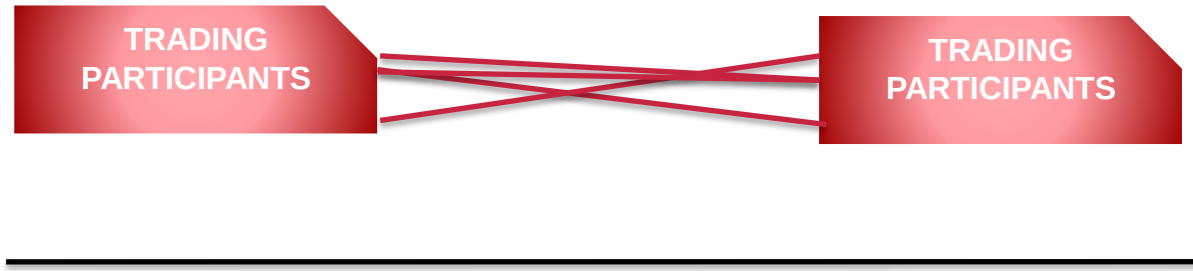
From bilateral to cleared trading



Dimension	Low	Med	High
Market Information	X		
Transaction Cost			X
Matching Efficiency	X		
Counterparty Risk			X
Regulation	X		
Operational Risk			X
Transparency	X		

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Dimension	Low	Med	High
Market Information			X
Transaction Cst	X		
Matching Efficiency			X
Counterparty Risk	X		
Regulation			X
Operational Risk	X		
Transparency			X

Elements in a well-functioning financial market

LIQUIDITY

- Standardized contracts
- Market Making

TRANSPARENCY

- Bid/Offer-Spreads and volumes are visible for all counterparts
- Urgent Market Messages (UMM)
  (i.e. cable outage, power plant outage)

SECURE COUNTERPART (CLEARING)

- Clearing House is a neutral and secure counterpart
  => no counterparty risk
- Clearing house guarantees trading and settlement

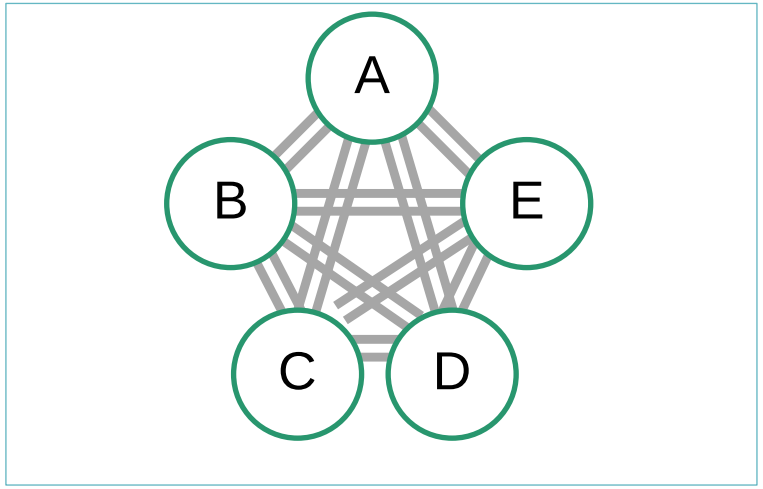
EQUALITY

- Members
- Information (UMM, prices, trades, other external and internal info)

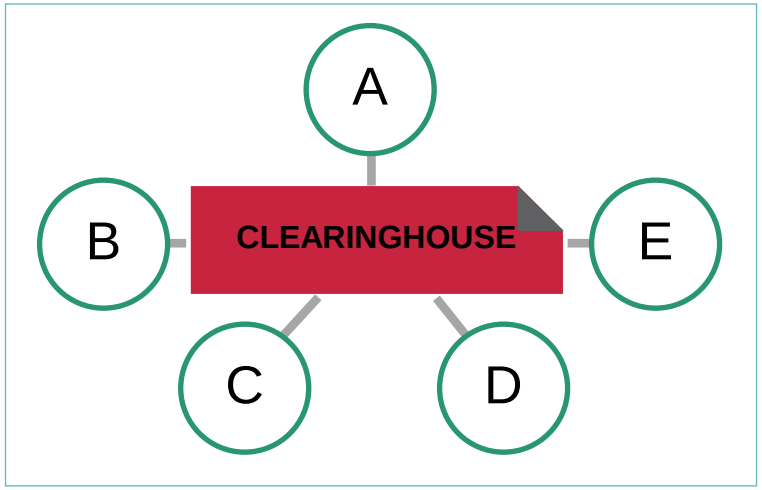
MARKET SURVEILLANCE

- Regulation/compliance
- Supervise and check transactions (Insidertrading)

NON-CLEARED CREDIT RELATIONSHIP



CLEARED CREDIT RELATIONSHIP



Futures– Positions (short/long)

A FUTURE POSITION CAN BE LONG OR SHORT:

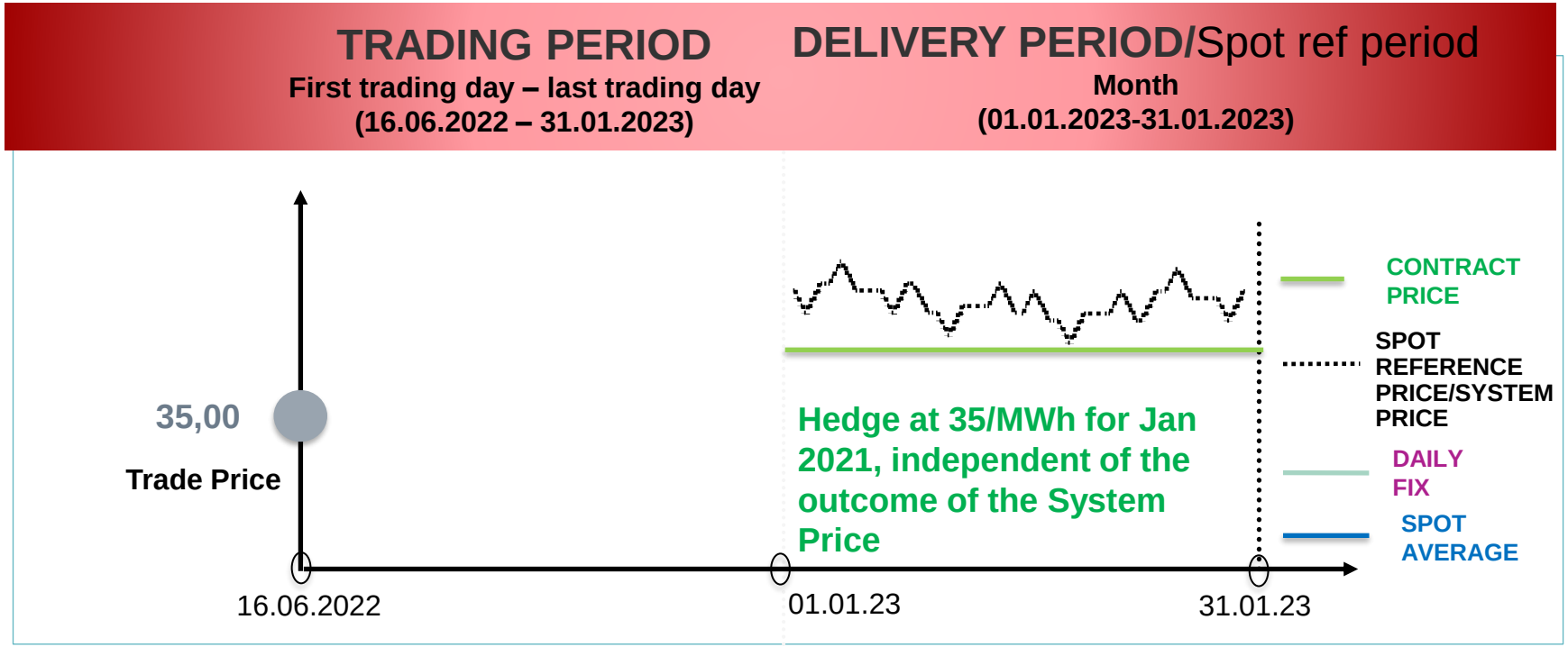
LONG POSITION
Buy a Future contract
(make profits when prices increase)

SHORT POSITION
Sell a Future contract
(expect falling prices)

Close a Position: Eliminate a short or long position in the trading period.

FUTURES
Daily cash settlement (profit/loss)
in trading- **and** delivery period

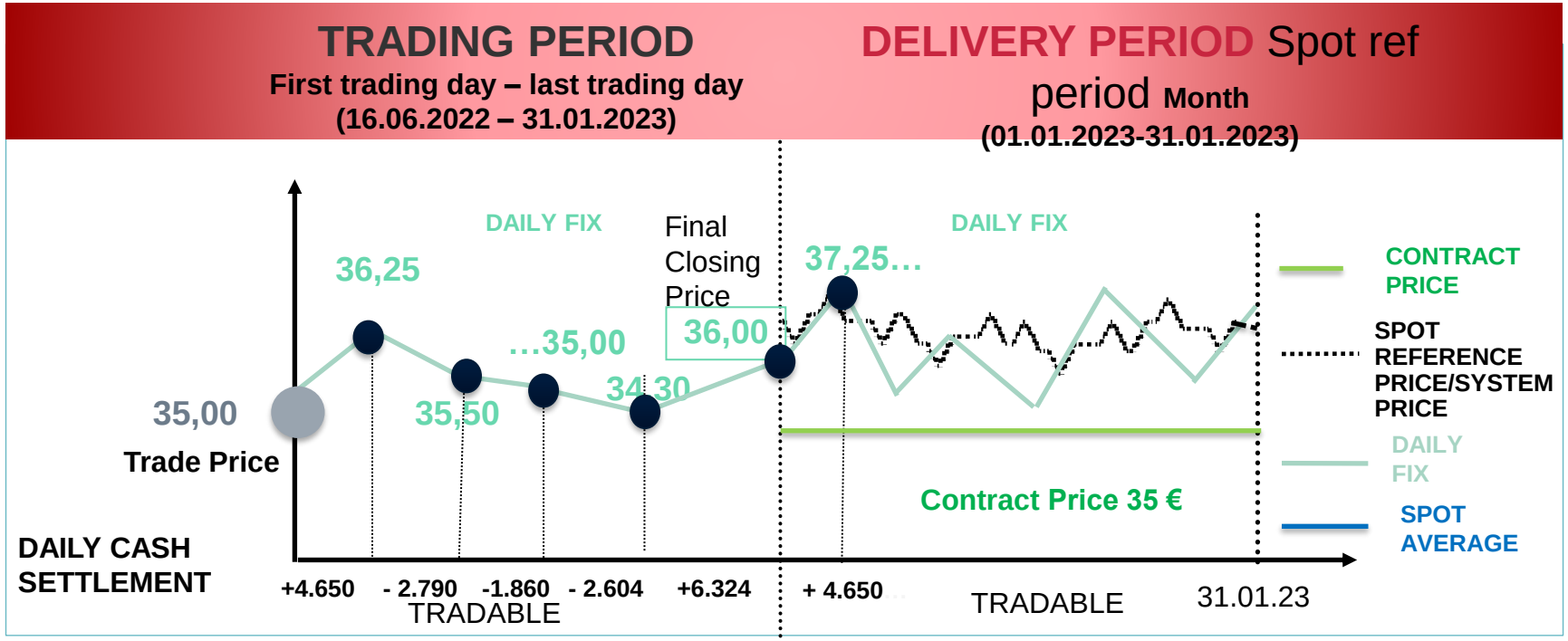
1) Futures – cash flow: Trade Day
+5MW JAN-23 **(744 hours) at 35€/MWh**



- What does the trader pay today straight after he bought 5 MW for Jan-23, before end of day?
- What does the trader pay today at the end of the day if the closing price (daily fix) for Jan-23 contract is 35 EUR /MWh?
- What does the trader pay if he had bought this 5 MW at **Nord Pool** for physical power for one day in January 2023?

  +5MW * 35€/MWh * 744hours = -130.200,00€ will be paid in total for the electricity end of Jan 2023

2) Futures – cash flow: Daily settlement procedure
+5MW JAN-23 **(744 hours) at 35€/MWh**



Cash Settlement in Trading Period (P&L)
(Daily marked-to-market calculation against DAILY FIX)

Contract:	Buy 5MW Month (744 hours)
Contract price:	EUR 35
Settlement T+1:	(36,25-35,00) x 5MW x 744h = € +4.650,00
	=> (daily Fix – previous day Fix) x MW x h

Total Market Settlement in Trading Period
(36,00-35,00) x 5MW x 744h = € + 3.720,00

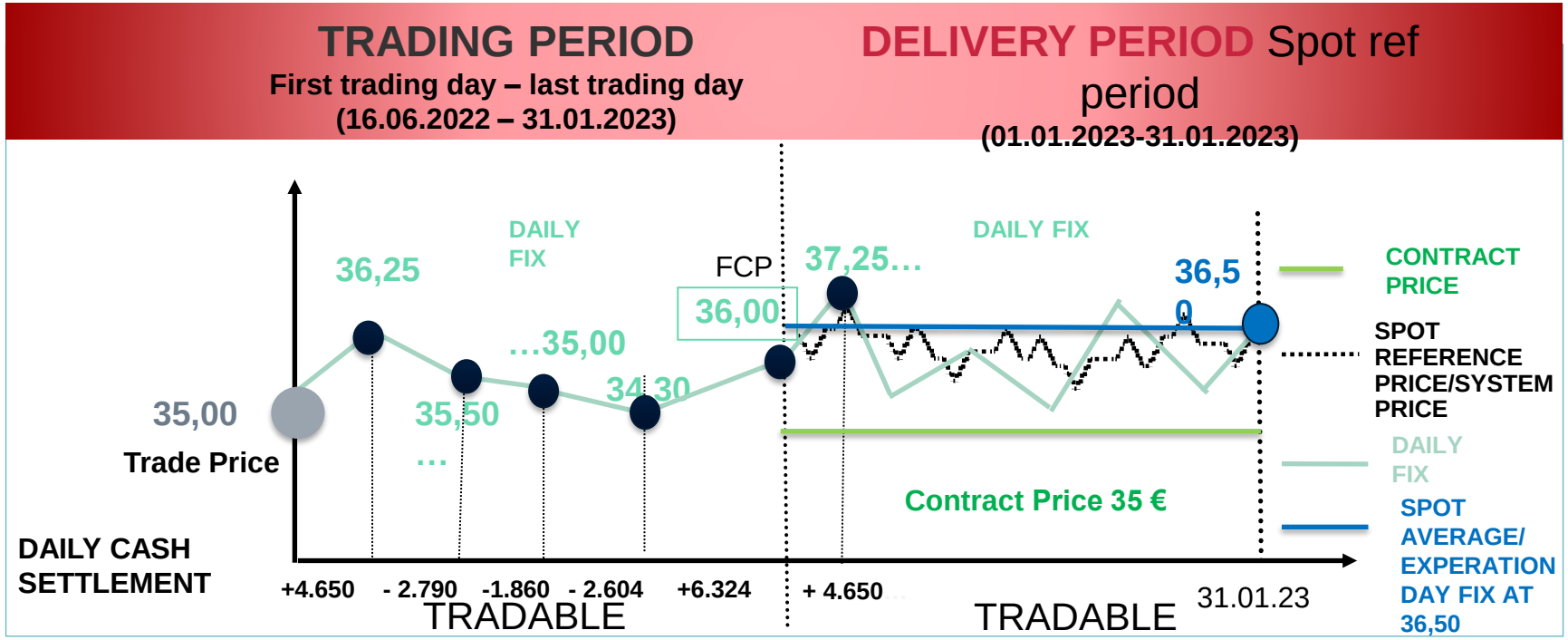
Cash Settlement in Delivery Period/Spot Ref Period (P&L)
(Daily marked-to-market calculation against DAILY FIX)

Cash Settlement on day 1 of delivery period:

(daily fix – previous day FIX) x MW x h
(37,25-36,00) x 5MW x 744h = € +4.650,00

Trading Period: period of time, when the contract is tradable (buy, sell, close a position)
Delivery Period: period of time when the contract is settled against the system price day per day. Trading anyway is still possible.

3) Futures – cash flow: Final settlement
+5MW JAN-23 **(744 hours) at 35€/MWh**



Final Settlement of the Daily FIX on the Expiration Day => the time weighted average of the applicable Spot Reference Fixes (System Price) published in the Spot Reference Period/delivery period by the Spot Exchange (Nord Pool)

Total Market Settlement (P&L) for the trade
(=sum of daily market settlements)
(Exp Day FIX – trade price) x (+/-) MW x h (delivery period)
(**36,50**-**35,00**) * +5 MW x 744h = in total € + 5.580,00

Margining and settlement

First trading day

1. Contract is listed

Trading period: Trade date (T)

1. A trade in the contract is executed
2. End-of-day
   - Daily Fix is determined
   - Initial Margin (IM) is calculated
   - Daily Market Settlement is calculated
   - Trading and clearing fees are calculated

Trading period: T+1

1. Trading and clearing fees are settled
2. Daily Market Settlement T is Settled
3. Collateral for IM is collected
4. End-of-day
   - Daily Fix is determined
   - IM is calculated
   - Daily Market Settlement is calculated

Trading period: T+2 → Expiration day

1. Daily Market Settlement for previous day is settled
2. Collateral for IM is collected
3. End-of-day
   - Daily Fix is determined
   - IM is calculated
   - Daily Market Settlement is calculated

Expiration day (Last trading day)

1. End-of-day
   - Expiration Day Fix is determined
   - *Expiration Day Fix on the Expiration Day (first Bank Day following the Expiration Day if the Expiration Day is a non-Bank Day) by using the time weighted average of the applicable Spot Reference Fixes published in the Spot Reference Period by the issuer of the relevant Contract Base*
   - Daily Market Settlement is calculated

Expiration day+1

1. Daily Market Settlement (final) is settled

Daily Closing Price/Daily FIX

DAILY CLOSING PRICE: This is defined for all products on a daily basis at the end of the day

THE CLOSING PRICE IS DEFINED AS

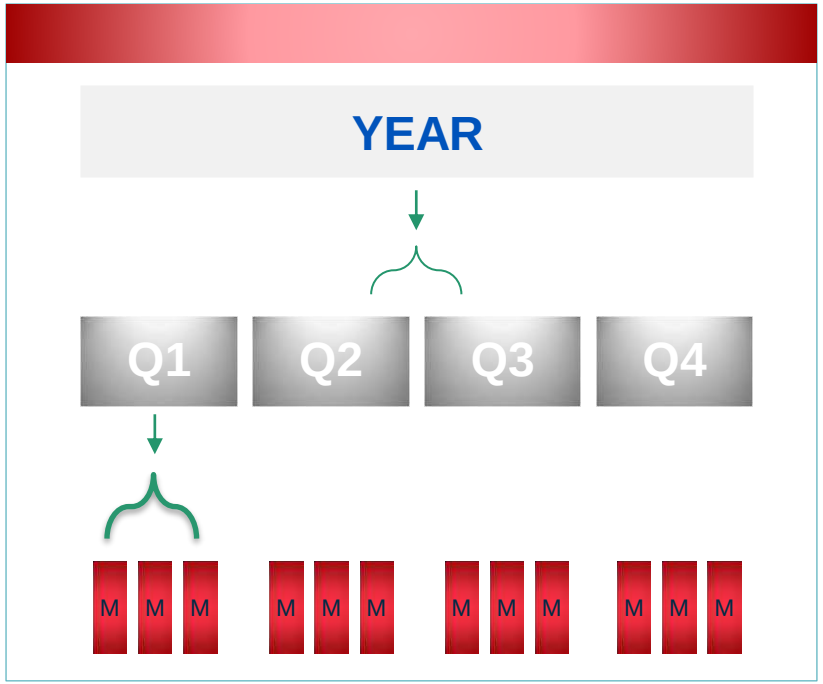
- *The last transaction price registered in the exchange at a specific time selected within the last five minutes of Trading Hours (between 15.55h – 16.00h).*
- if this price falls outside the Spread at the time selected, the Daily Closing Price will be the average of this Spread.

- In the event that no transactions were registered on the exchange the relevant Trading Day, the Daily Closing Price shall be the average of the Spread (”bid-ask spread”) registered at a specific time selected.

- If a contract has not been traded that day and there is no bid-ask-spread, the closing price shall be the Daily Closing Price the previous Trading Day

Cascading of products

- **Year contracts split into quarters.** Expiry (last trading day) is 3 working days before delivery.
- **Quarter contracts split into months.** Expiry (last trading day) is the last working day before delivery.
- **Only the front month goes direct to delivery** <u>but</u> is still tradable in the delivery period
- Month, Week and Day contracts do not cascade



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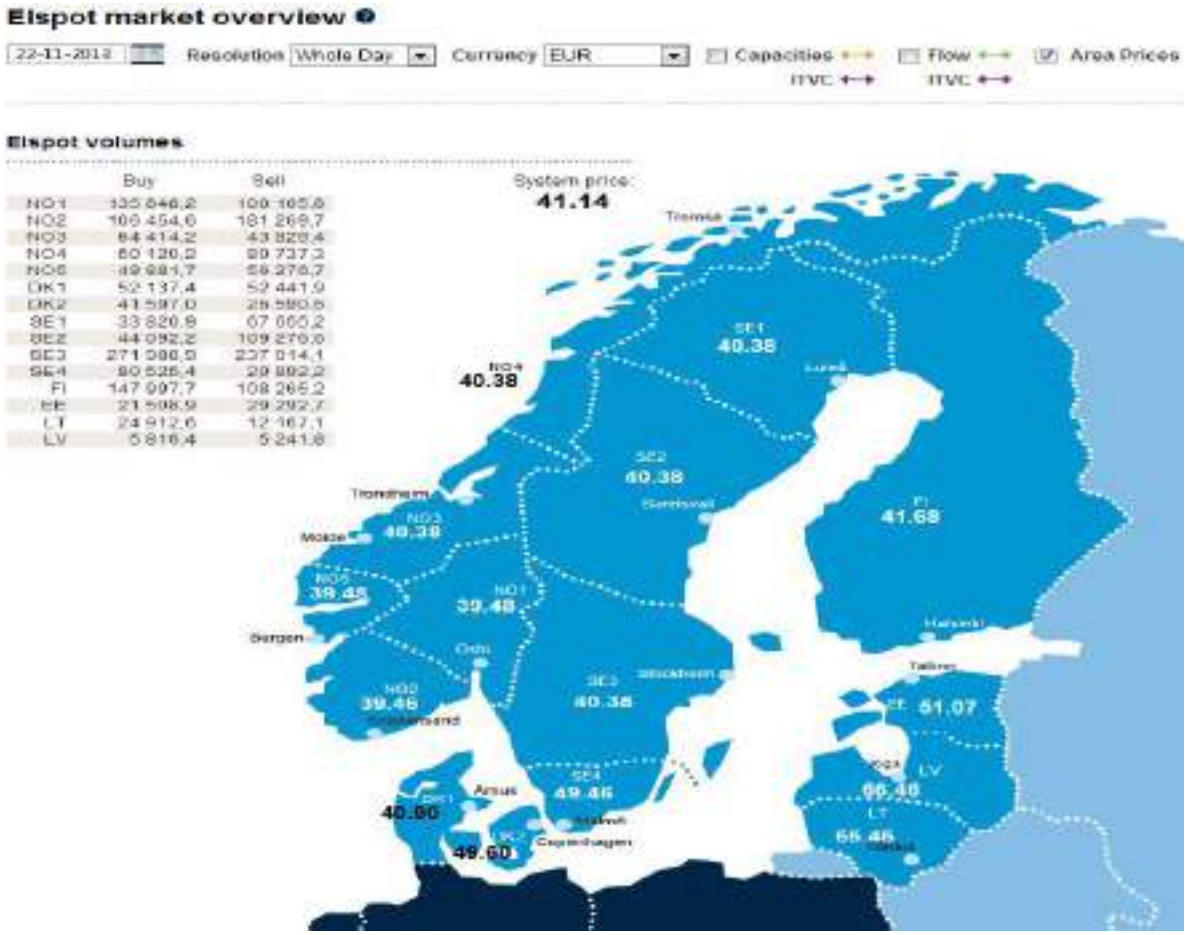
POWER EPAD

EPAD is a contract about the difference between the area price and the system price.

- EPADs are Electricity Price Area Differentials between different price areas
  - Nordic style EPADs are contract difference between a specific area price and the Nordic system price.
    - Stockholm EPAD: SYSTO = Stockholm area price – Nordic System price
  - German style EPADs are contract difference between a specific area price (a neighboring country to Germany) and the Phelix system price.
    - French EPAD: EDEFR = French area price - Phelix system price

EPAD AREAS

In the Nordics there are 15 Epad areas (including the Baltics)



Electricity Price Area Differential (EPAD)

WHY WE HAVE EPADs

Nordic Futures contracts do not fully cover a specific price area risk. Therefore market players can use the EPAD market to hedge against differences between a specific area price and the Nordic system price or between 2 system prices (e.g. SY France minus PHELIX).

EPAD settlement

- Cash settled in delivery period with reference to the difference between an Area Price and the System Price.

Calculation:

=> Area price minus System price (result can be positive, zero or negative)

Example: 49,46 - 41,14 = +8,32€/MWh

EPADs trade at positive prices, when the market expects a specific area price to be higher than the system price. Area price > System Price

EPADs trade at negative prices, when the market expects a specific area price to be lower than the system price. Area price < System Price

EPAD as hedging tool

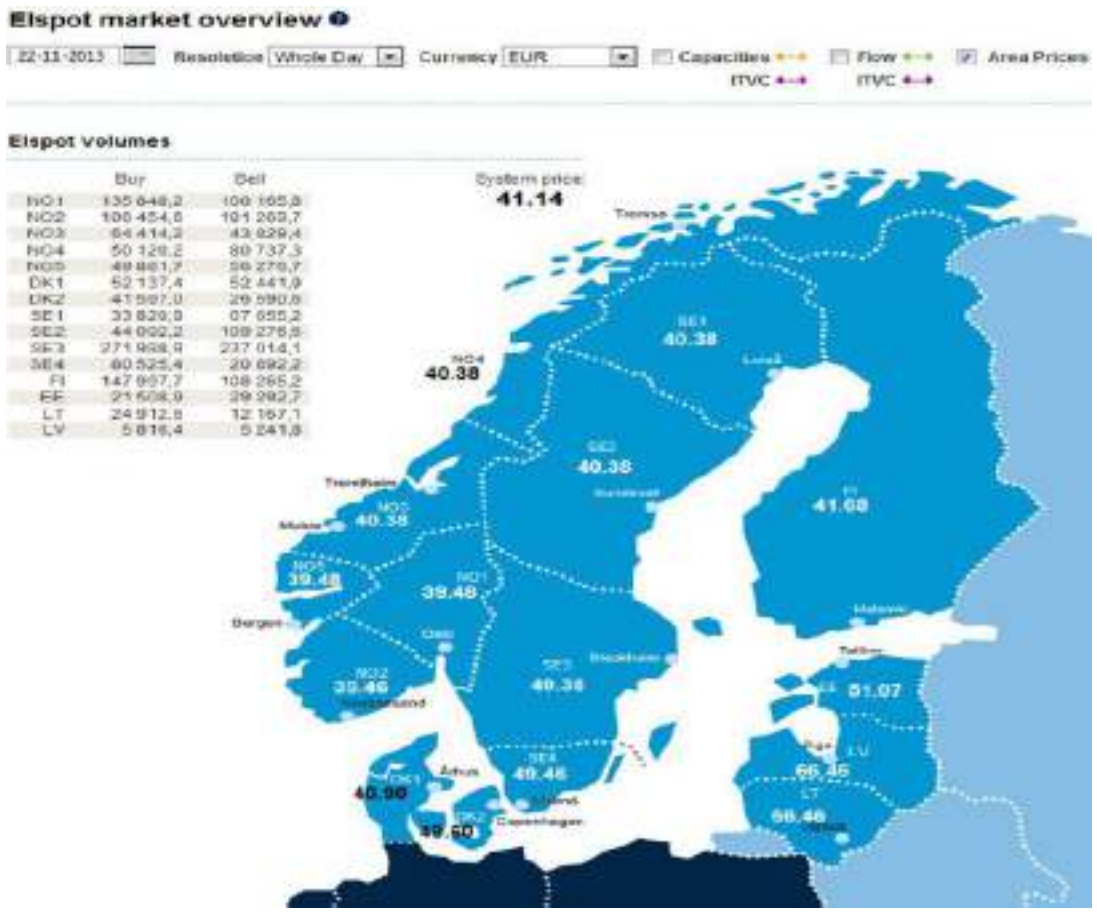
- To create a perfect hedge, a three-step process using EPADs must be followed:

1. Hedge the required volume using future derivative contracts (System price hedge)

2. Hedge, through EPADs, any price difference – for the same delivery period and volume

3. Fullfill physical delivery by trading at Nord Pool in the same spot market area of the hedge

- RESULT: by combining a Future and an EPAD, you have a complete contract settled against that specific area price



AGENDA

- Introduction to the Financial Market
- Financial products and hedging
- Clearing and settlement of financial products
- EPADs (Electricity Price Area Differential)
- Exercise

Exercise - Contract Value

- You buy 10 MW Future for Nordic power for Q3-2022 (2184h).
- The contract price is 32 Eur/MWh.
- What is the value of the contract for the Exchange/Clearing House?

1) If the end of day fixing price is 32 €/MWh

2) What does the trader pay today when he buys this contract on the exchange at 32 €/MWh?

3) Contract value if it was a physical contract at Nord Pool

Thank you for your attention!

nordpoolgroup.com

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nordpoolgroup.com/academy

How to understand mandatory & voluntary markets?

The Physical & Financial Power Markets

16. June 2022

EVERYTHING ENERGY

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World Kinect Energy Services

Solution & Services

Physical Supply

- Bulk Fuel Delivery
- Fuel Tank Solutions
- Natural Gas Supply
- Electricity
- Lubricants & DEF/AdBlue
- Fleet Fuel Cards
- On-Site Fleet Fueling
- Fleet Fuel Card Network For C-Stores
- Fuel Retailers Branded Programs
- Wholesale Fuel

Energy Procurement

- Electricity & Natural Gas Procurement
- Regulatory & Reporting Services
- Generation Asset Optimization
- Energy Tax Optimization
- Water Management

Price Risk Management

- Energy Price Hedging
- Risk Assessment Workshop
- Market Intelligence

Data Management

- Energy Bill Validation
- World Kinect Online & Customer Portals
- FleetConnect
- EMV Dispenser Technology

Sustainability

- Sustainability Strategy
- Carbon Footprint reporting
- Renewable Energy Certificates
- On-Site Solar
- PPA, VPPA
- Biogas
- Carbon Compliance
- EU ETS / UK ETS
- Carbon Offsetting
- SAF

Agenda

30 minutes

- **European Union Emission Trading Scheme EU ETS – (15 min)**
- **Carbon offsets – (7 min)**
- **Guarantees of origin – (7 min)**

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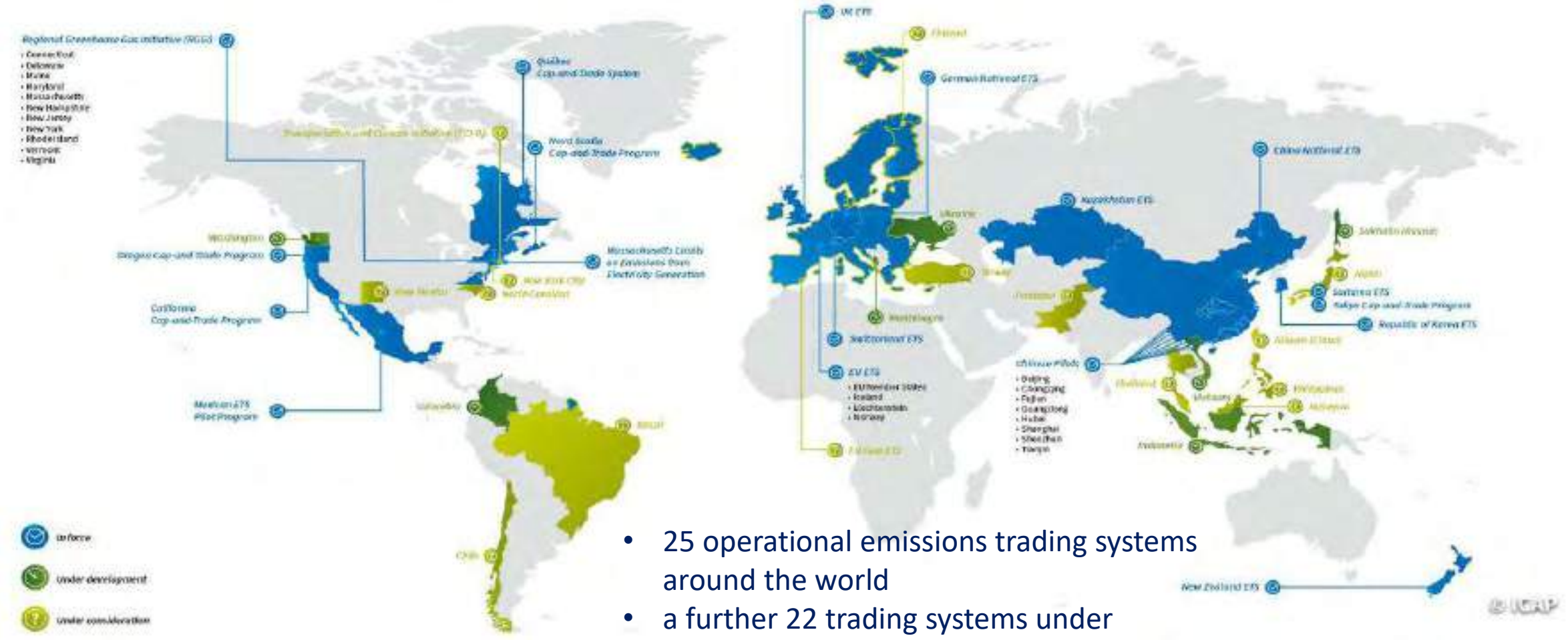
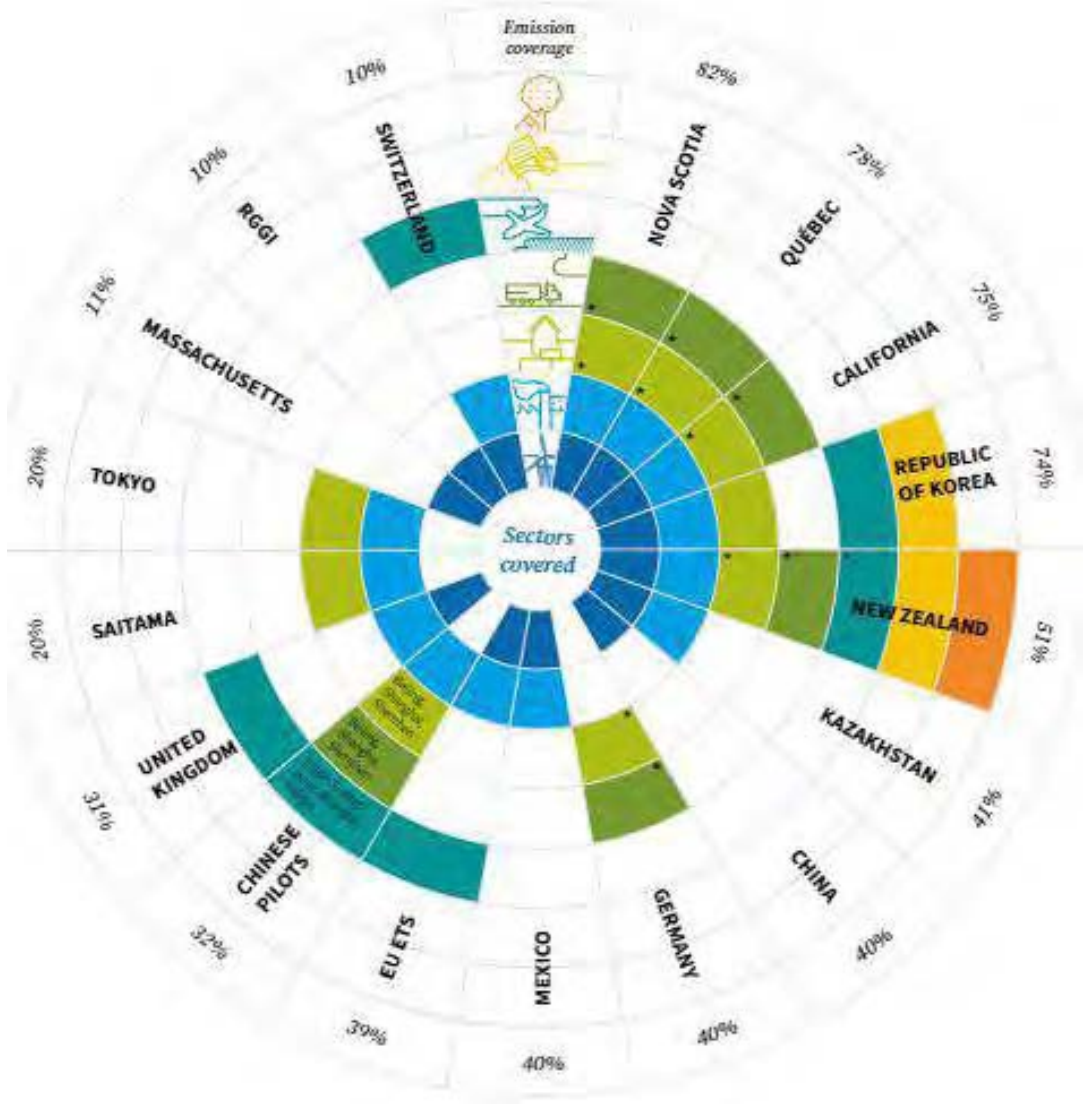
Emissions trading systems play a vital role in realizing the needed decarbonization to reach net zero by mid-century

GLOBAL CARBON MARKETS WORTH OVER €200 BILLION



- 25 operational emissions trading systems around the world
- a further 22 trading systems under development or consideration.

Sector Coverage



More and new sectors are being added to emission trading schemes, increasing industry coverage with compliance obligations!

(17% of global emissions)

What is it?

European Union Emission Trading Scheme (EU ETS)
EU allowance / Emission Unit Allowance (EUAs)

Key facts:

- The cornerstone of the European Union's drive to reduce its emissions
- Around 45% of total EU greenhouse gas emissions are regulated by the EU ETS
- Putting a limit on overall emissions
- Companies can buy and sell emission allowances as needed
- This 'cap-and-trade' approach = the most cost-effective way
- The 28 EU Member States plus Iceland, Liechtenstein and Norway
- 1 EUA = 1 ton of CO_2

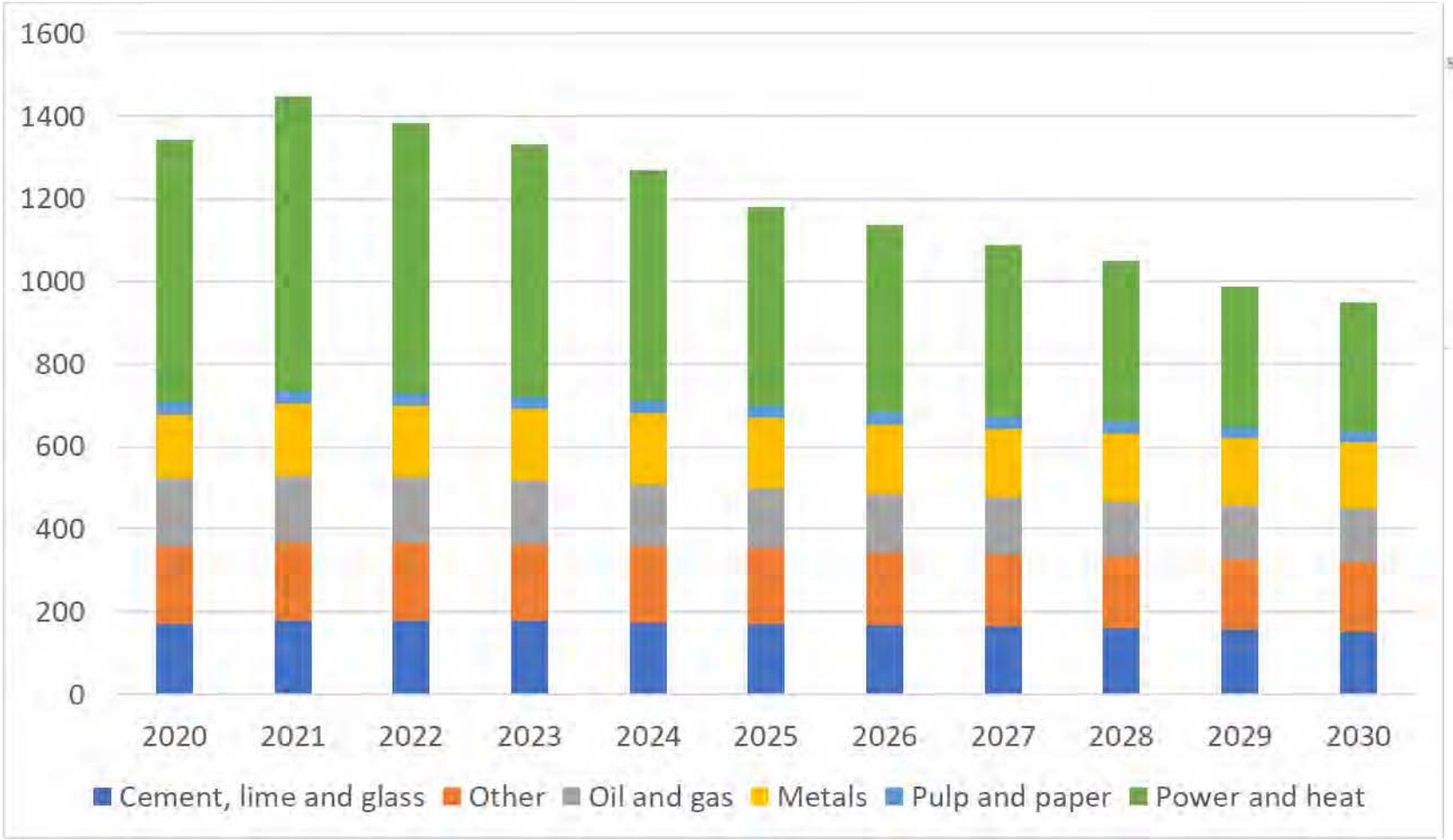
How it works

- ✓ A central authority/governmental body allocates or sells/auctions a limited number of permits that allow a specific quantity of emissions over a set time period.
- ✓ Emitters are required to hold permits in amount equal to their emissions during the time period to demonstrate compliance.
- ✓ Emitters that want to increase their emissions must buy permits from others willing to sell them. In effect, the buyer pays a charge for polluting, while the seller gains a reward for having reduced emissions.

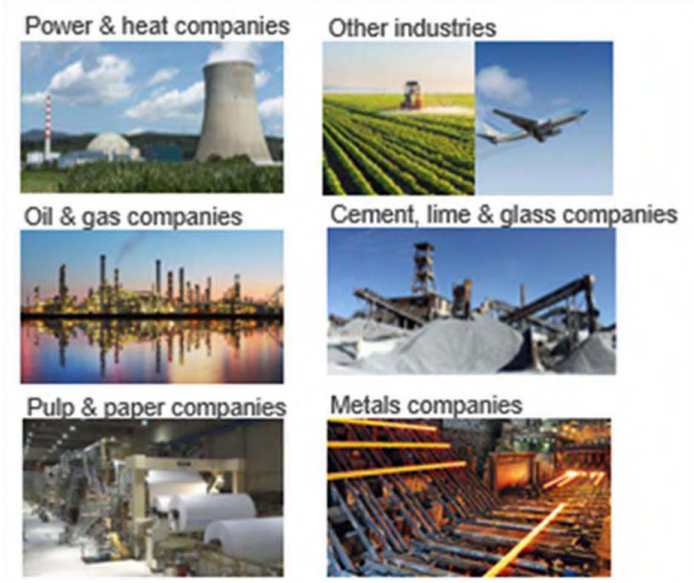
- The European Commission is proposing that by 2030, sectors covered by the revised EU ETS will need to **reduce their greenhouse gas emissions by 61%**, compared to 2005 levels.
- The European Parliament is proposing that by 2030, sectors covered by the revised EU ETS will need to **reduce their greenhouse gas emissions by 63%**, compared to 2005 levels.

Estimate of annual EUA demand from compliance market players

- Covers approximately 11,000 power stations and manufacturing plants
- Aviation activities included



Source: Refinitiv



Maritime Sector included in the EU ETS

European Commission July 14, 2021 EU ETS reform proposal update

Timeline & scope in EU

Ship operators are required to surrender units for:

- 20% of verified emissions reported for 2023
- 45% of verified emissions reported for 2024
- 70% of verified emissions reported for 2025
- 100% of verified emission reported for 2026

Activity scope

- All emissions from voyages within the EU
- 50% of verified emissions of voyages to or from a European port
- All emissions that occur when ships are at berth in EU ports
- The measure will apply to all ships above 5,000 GT

Legal entity

- The ship company / owner is responsible for compliance
- If the ETS administering authority finds that a shipping company has not complied with ETS requirements for two or more consecutive years, its ships could be denied entry to EU ports

Peter Liese (lead EU ETS negotiator), January 14, 2022 EU ETS reform proposal update

Timeline & scope in EU

Ship operators are required to surrender units for:

- 33,3% of verified emissions reported for 2023
- 66,6% of verified emissions reported for 2024
- 100% of verified emissions reported for 2025

The scope could widen from 2026 onwards to ensure alignment with the Paris Agreement targets.

Activity scope

- All emissions from voyages within the EU
- 50% of verified emissions of voyages to or from a European port (2023-2027)
- All emissions that occur when ships are at berth in EU ports
- 100% of non-EU emissions from ships calling at EU ports to be caught if IMO fails to introduce a similar global measure by 2028
- The measure will apply to all ships above 5,000 GT

Legal entity

- ETS responsibility and payment fall on the commercial operator who may not always be the shipping company. ‘Time charterers’ now expressly included in the definition of ‘shipping company’. Operation of the ship’ is now also expressly defined for the purposes of the contractual allocation clause
- If the ETS administering authority finds that a shipping company has not complied with ETS requirements for two or more consecutive years, its ships could be denied entry to EU ports

ENVI, May 16, 2022 EU ETS reform proposal update

Timeline & scope in EU

Ship operators are required to surrender units for:

- 100% of verified emission reported for 2024

Activity scope

- 100% coverage from 2024 (European routes)
- 50% covered from extra-European routes from and to the EU from 2024 to 2026
- 100% covered from and to third countries from 2027
- For countries already having a carbon pricing scheme, the coverage is 50%
- The measure will apply to all ships above 400 GT
- All the relevant GHGs are included (CO2, CH4 or methane, and N2O)

Legal entity

- No change

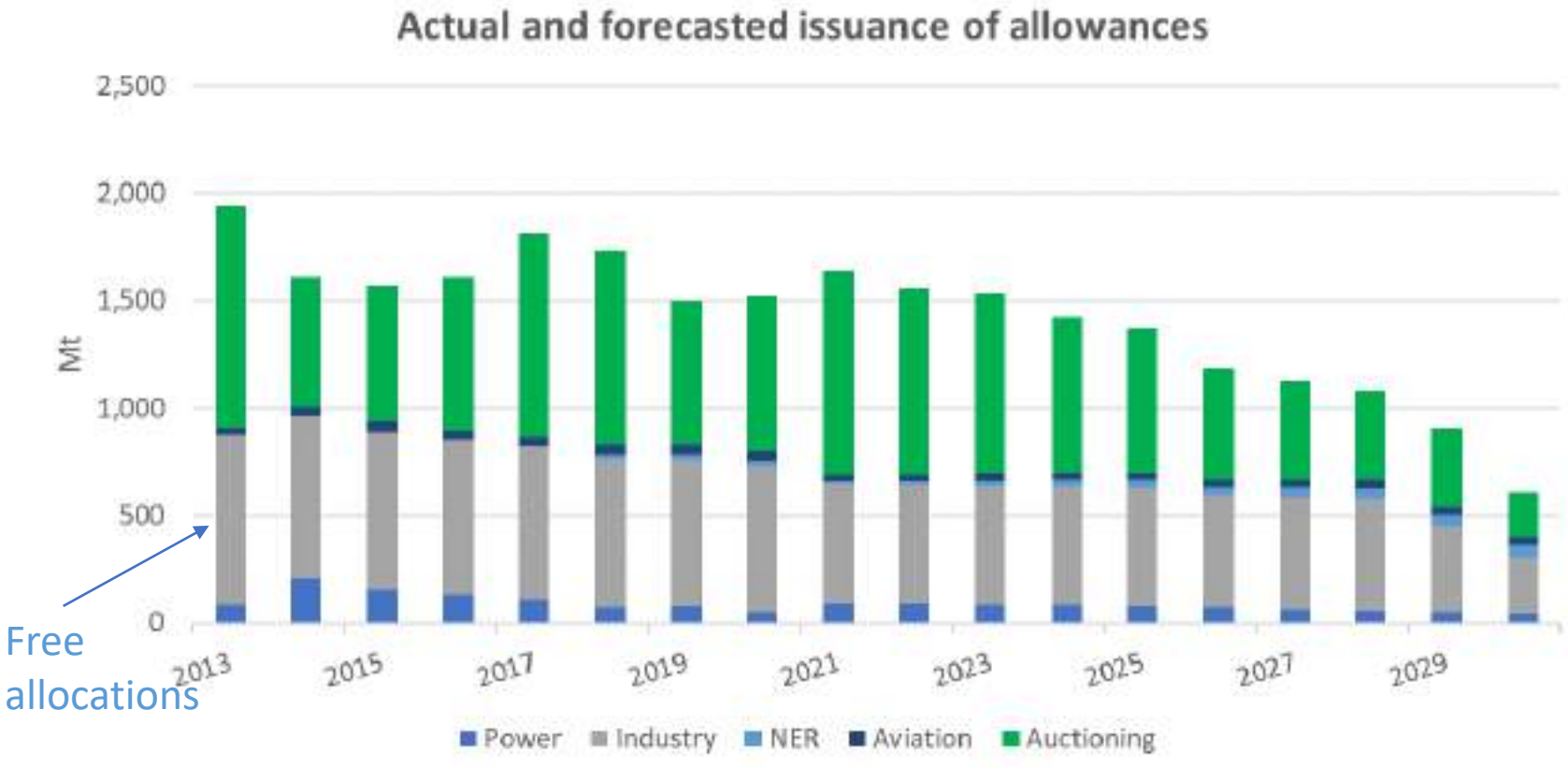
Current market status: € 85/ton

- EUAs are bankable and valid until 2030
- Penalty for each ton of CO2 emitted without surrendering a permit. This penalty is equal to EUR 100/tCO2e. In addition, the allowances will have to be purchased back the following year at market price.

The allocation of free allowances is reduced to the industry

"Free allocations for 2022 will be issued by 28 February 2022 for stationary installations and aircraft operators – well ahead of the 2022 compliance deadline."

EU will phase out free carbon permits over 10 years for all sectors.



Source: Refinitiv

Carbon Border Adjustment Mechanism (CBAM)

CBAM aims to:

- Put a carbon price on imports of a targeted selection of products to avoid and address the risk carbon leakage.
  - I.e.: avoiding carbon intensive industry being moved outside of the EU, and the flooding of EU with carbon-intensive goods
- Reinforce the EU ETS.
- Replace EU ETS measures (free allocation of ETS allowances and in some cases financial measures to compensate for indirect emission costs from increases in electricity prices due to the EU ETS) over time.

CBAM will apply to:

Initially, CBAM will only apply to some goods and sectors at high risk of carbon leakage:

- Iron and steel
- Cement
- Fertiliser
- Aluminium
- Electricity generation

These sectors have benefitted from free allocations under the ETS, but as these will be phased out, which leaves the sectors time to adjust.

CBAM summary:

- The system is based on the purchase of certificates by importers. EU importers buy carbon certificates corresponding to the carbon price which would have been paid if the goods had been produced under EUs carbon pricing rules.
- EU importers register with national authorities where they can buy CBAM certificates based on the weekly average auction price of EU ETS allowances expressed in € / tonne of CO_2 emitted.
- EU importers declare the emissions embedded in its imports and surrenders the corresponding number of certificates each year.

Once a non-EU producer shows that they have paid a price for the carbon used in the production of the imported goods in a third country, the cost may be fully deducted for the EU importer.

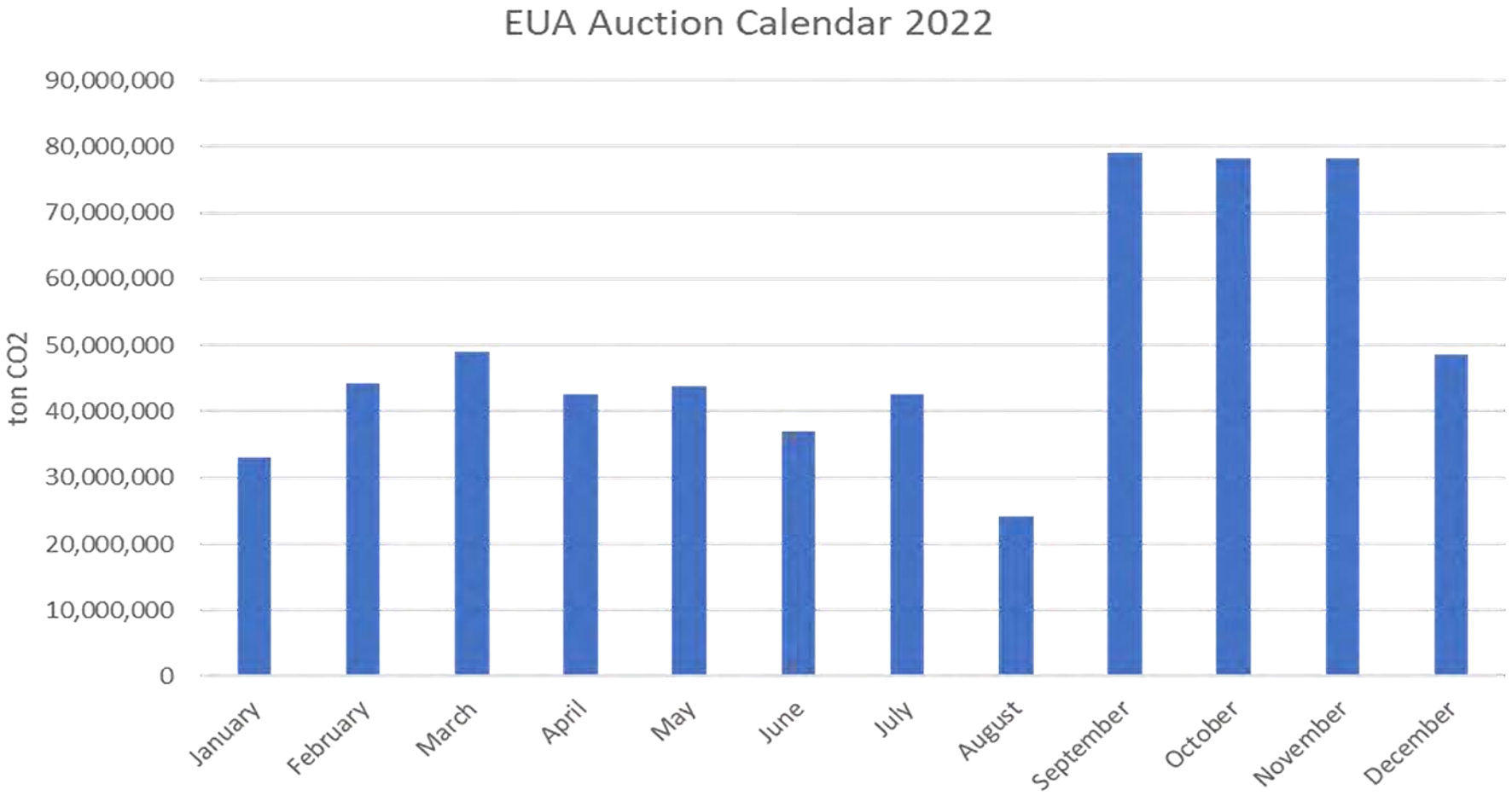
Increased Linear Reduction Factor

EU seeks to tighten carbon market. To do so, the Commission proposed to increase **the Linear Reduction Factor (LRF). The linear reduction factor is reducing the overall cap. The LRF has currently an 2.2% annual rate. ENVI proposal: 4,2% from 2024 and increasing it by 0.1% annually**

Latest proposal:

- 4,4% in 2024
- 4,5% in 2026
- 4,6% in 2029

EU proposal:
one-off cut of 70 mln permits to carbon market cap in 2024 and **50 mln** in 2026



The EU ETS balance is tight!

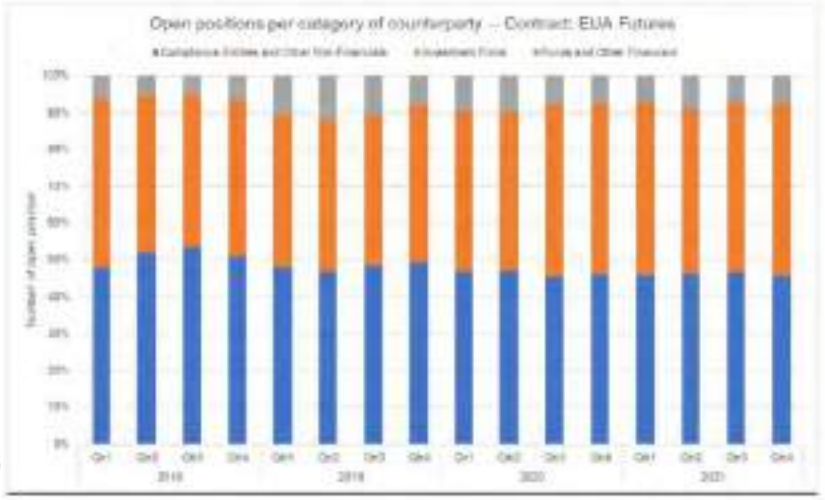
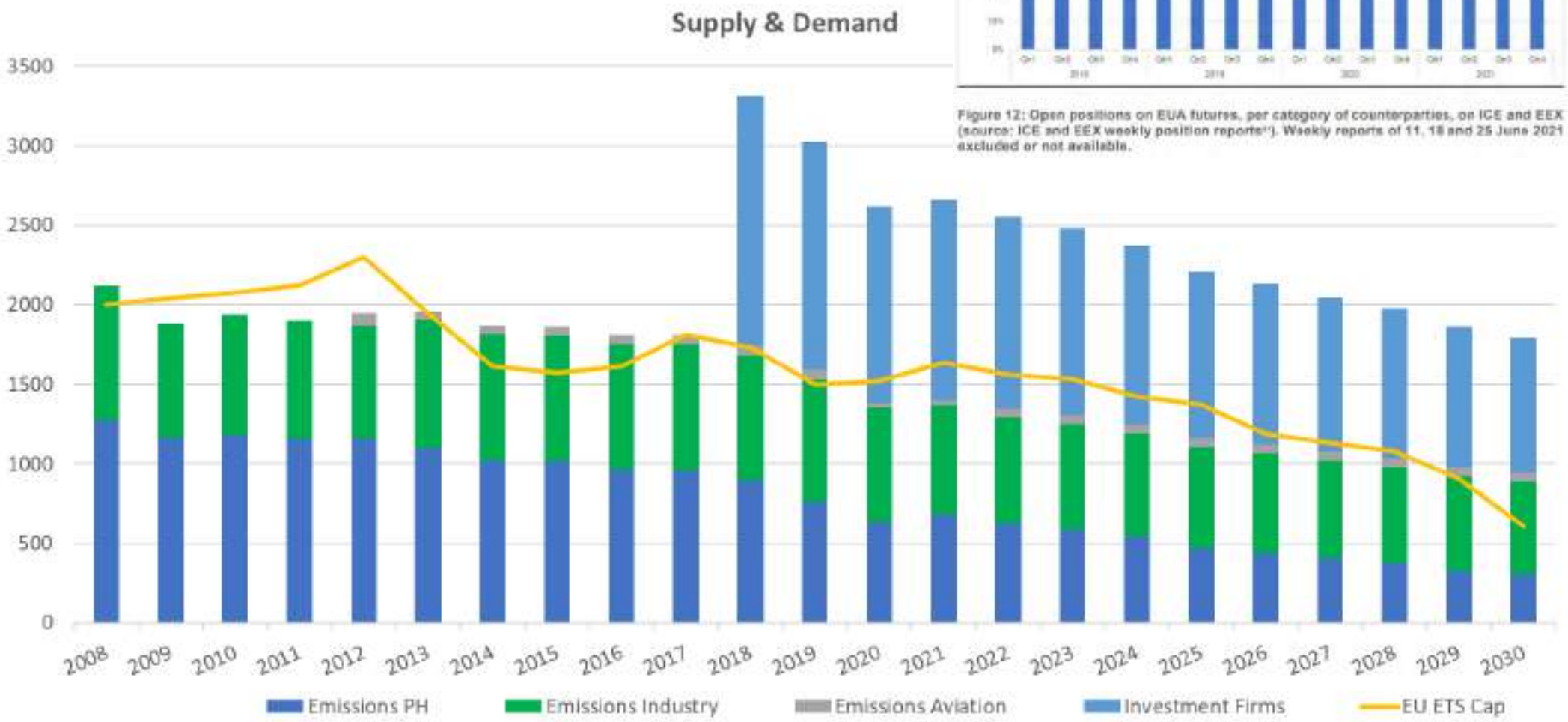


Figure 12: Open positions on EUA futures, per category of counterparties, on ICE and EEX (source: ICE and EEX weekly position reports[11]). Weekly reports of 11, 18 and 25 June 2021 excluded or not available.



Source: Refinitiv & ESMA

Policy Timeline

Fit for 55 package moving forward

May 17th ENVI Committee vote

Major outcomes:

- Increased emissions reduction target 67%
- MSR threshold lowered
- Free allocation phased out by 2030 for CBAM sectors
- Limit market access for speculative investors
- Tighten Article 29a – price control mechanism
- ETS2

June 8th Parliament plenary vote:

Major outcomes:

- Sent back to the ENVI Committee

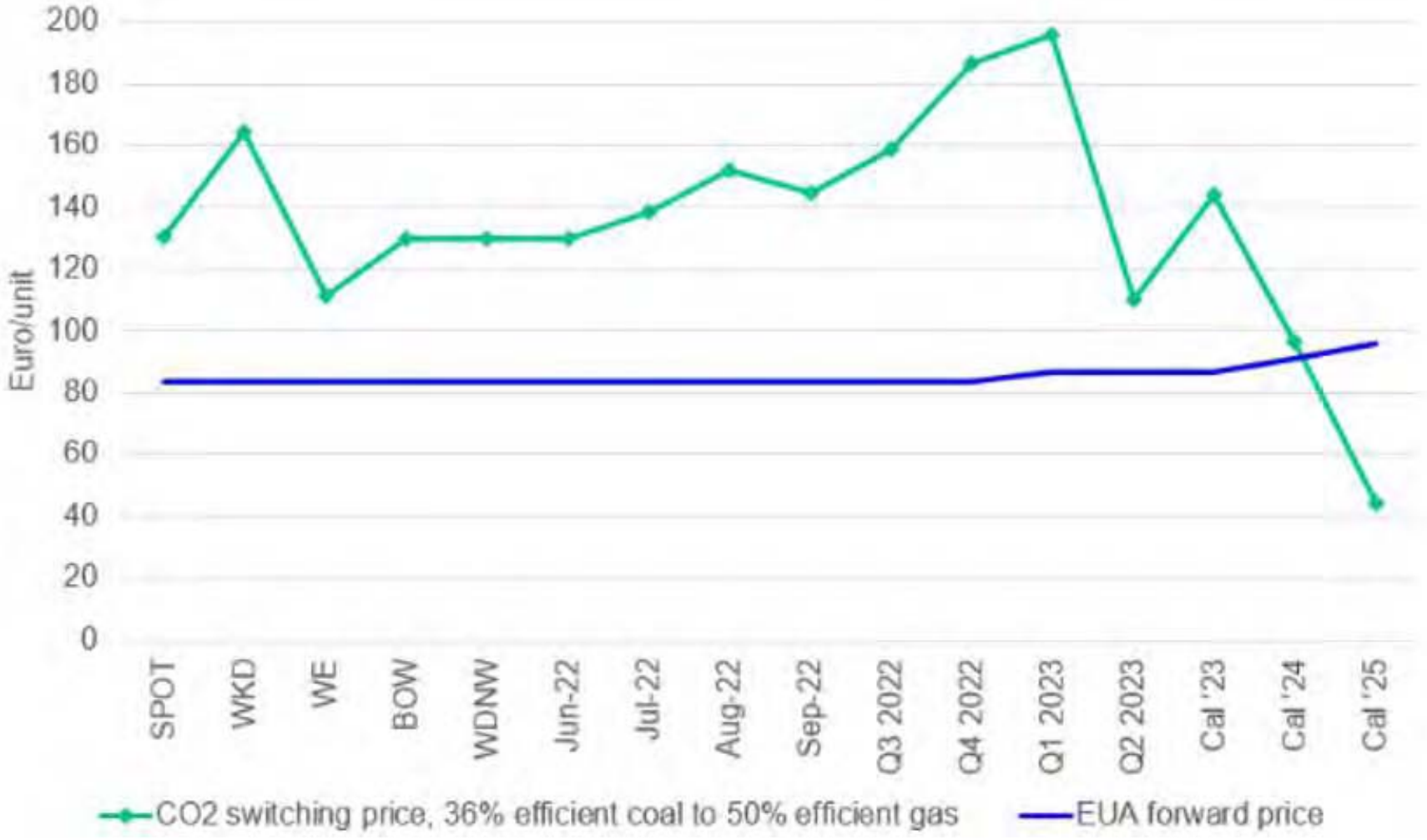
Council finlasing their position (end June)

Trilogue negoatiations H2 2022 (September)

Fit for 55 package turn into law

The gas & coal price is important for the EUA price

- In 2022 and 2023, we expect no or limited fuel switching due to gas market constraints
- Decommissioned coal plants are brought and countries are opening up delay coal phase-out plans.



Source: Refinitiv

Bullish factors

More certain:

- Coal power is more profitable than gas
- German government to introduce price floor at 60 euro per ton
- The EU's securities market regulator ESMA has found no evidence of anti-competitive trading behaviour in the bloc's carbon market
- Delayed allocations of 2021 & 2022 free allowances
- Bullish outlooks attracts mainstream investors and retail
- Increased demand for hedging
- More speculative trading activity
- Unlikelihood of industrials selling off surplus allowances
- Gas storage is drained (political risk with Ukraine and Russia)
- French nuclear provider EDF downgrading 2022 output
- Low hydro reservoir levels in parts of Europe
- Lower cap
- Shipping sector entering the market and hedging volume
- News and developments in the Fit for 55 proposals
- ENVI vote outcome

Uncertain:

- Low wind power in the system
- UK ETS (UKA) linking to the EU ETS

Bearish factors

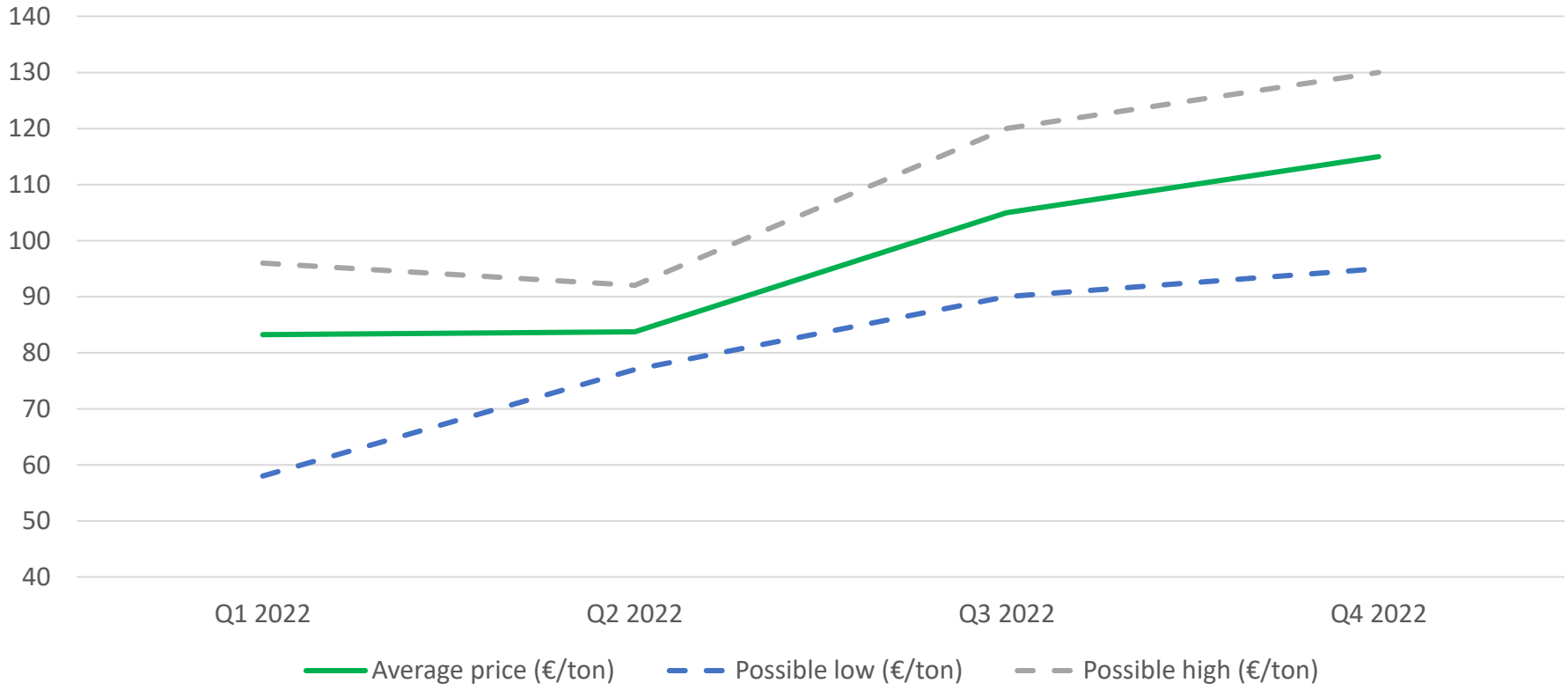
More certain:

- Some industrials lowering production in 2022 due to high energy prices
- Coal to gas switching (old coal facilities are closed down)
- Nord Stream Pipeline
- EU Taxonomy will approve nuclear as a renewable energy source
- 2022 free allocation
- Russian invasion of Ukraine
- ENVI voting to curb speculators
- Possible amendments to Article 29a
- Selling of 200-250 mln EUAs from MSR for the RePowerEU

Uncertain:

- More wind power in the system and lower demand for fossil fuels
- Prospect of the price control mechanism kicking in
- COVID-19 lockdowns

EU ETS Outlook

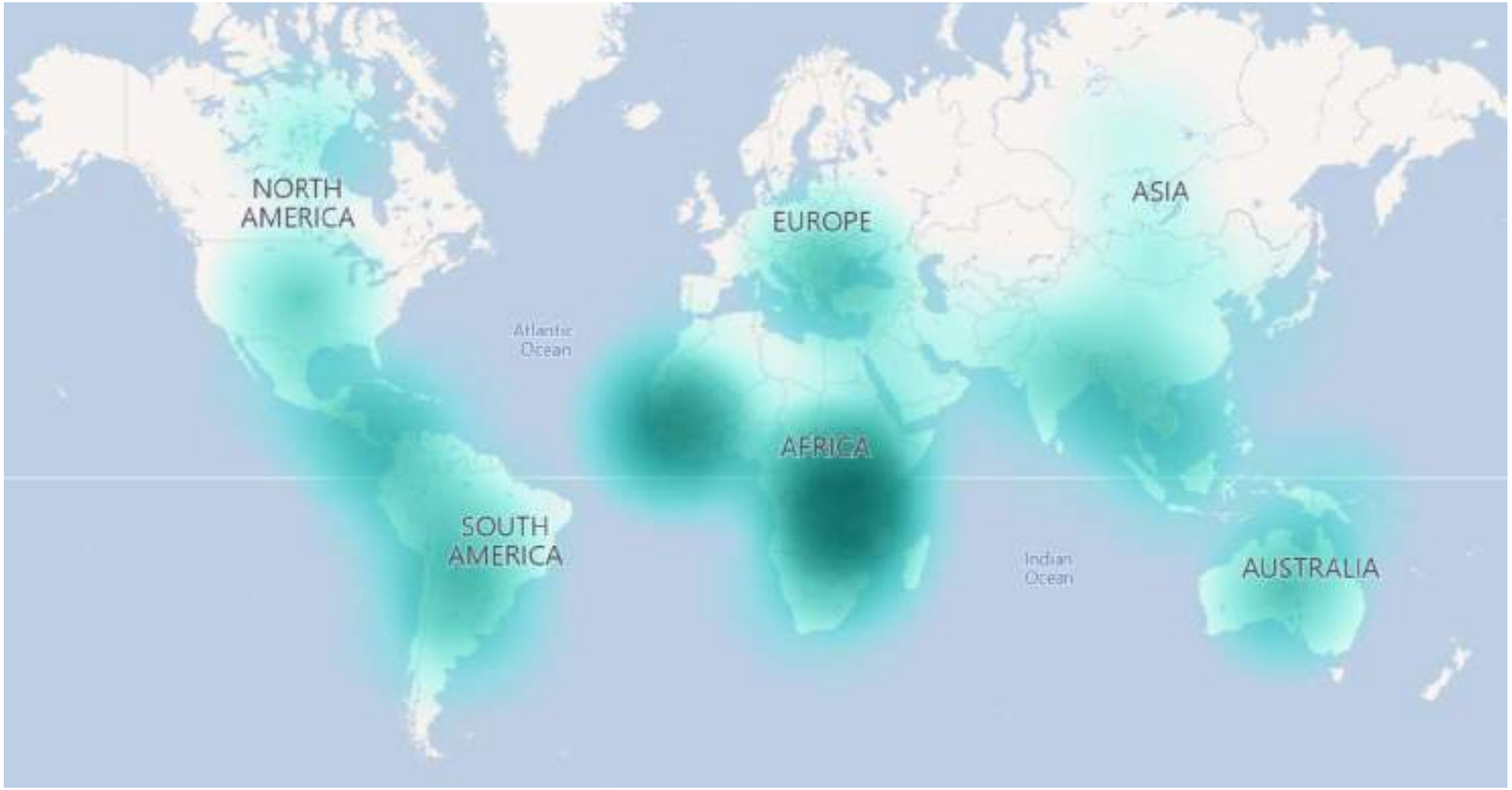


There is a lot of market uncertainty

We believe the upside risk is greater than the downside potential.

Period	Major price influences	Average price (€/ton)	Possible low (€/ton)	Possible high (€/ton)
Q1 2022	EUA Prices traded as low as €55/ton following the Russian invasion of Ukraine	83	58	96
Q2 2022	Prices has traded sideways despite the compliance deadline and Fit for 55 voting	84	77	92
Q3 2022	Announcements on the Fit for 55, lower summer supply and influx of speculators will drive up prices	105	90	120
Q4 2022	Further announcements and possible implementation on the Fit for 55 leading up to 2023 cause rising prices	115	95	130
Average 2022		**101**	**87**	**114**

Voluntary Carbon Projects Location



Types of projects and standards

Carbon offsets are generated from a range of different project types;

- Renewable energy
- Methane capture/avoidance
- Energy efficiency projects
- Forestry
- Other projects

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Everything Energy

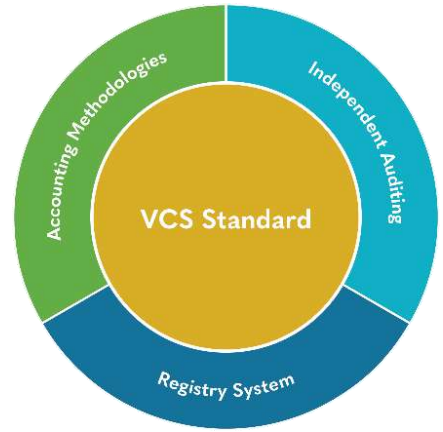
The carbon offset standards

There are multiple standards to carbon offsets. A standard sets additional requrements to a projects and gives a form of qualiity labeling and is impacting the price.

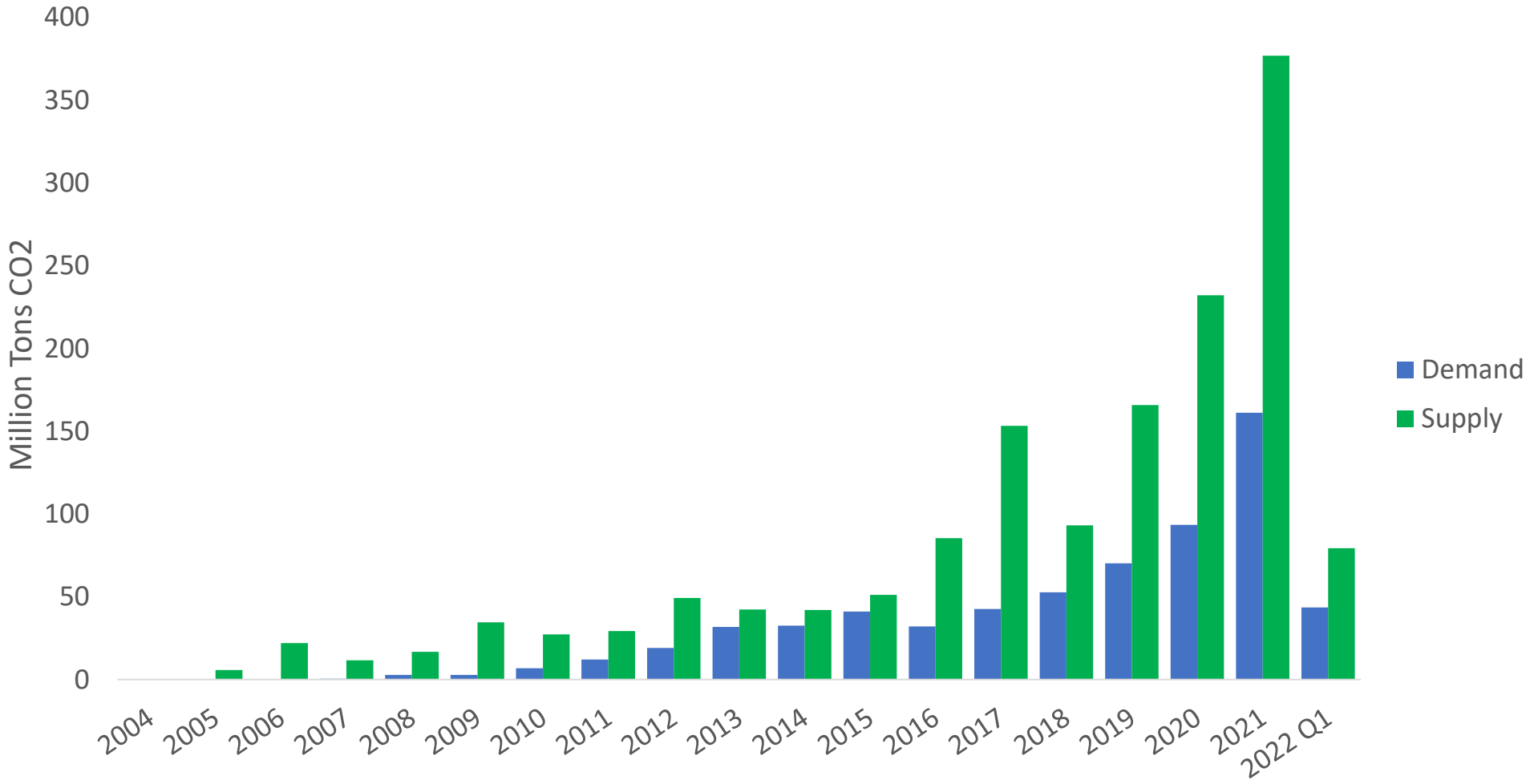
The Gold Standard, is published and administered by the Gold Standard Foundation, a non-profit foundation in Geneva. Was designed with an intent to ensure that carbon credits are real and verifiable and that projects make measurable contributions to sustainable development. Its objective is to add branding, with a quality label, to Carbon Credits. Gold standard is ensuring that projects have the highest levels of environmental integrity and delivered sustainable development benefits to local communities (co benefits).

Environmental co-benefits could include improved air quality, improved soil quality or avoided pollution, improved water quality or access, natural resources protection
Social co-benefits could include education, research, awareness raising, improved health and safety, job or income generation
Economic co-benefits include Improved energy availability or access, support to economic development or stability

Verra is an organization that verifies, that the emission reductions generated by projects are actually occurring. **The VCS Program** ensures the credibility of emission reduction projects. Once projects have been certified against the VCS Program's set of requirements, carbon offsets can be issued. Verra's role is to develop and administer the program.



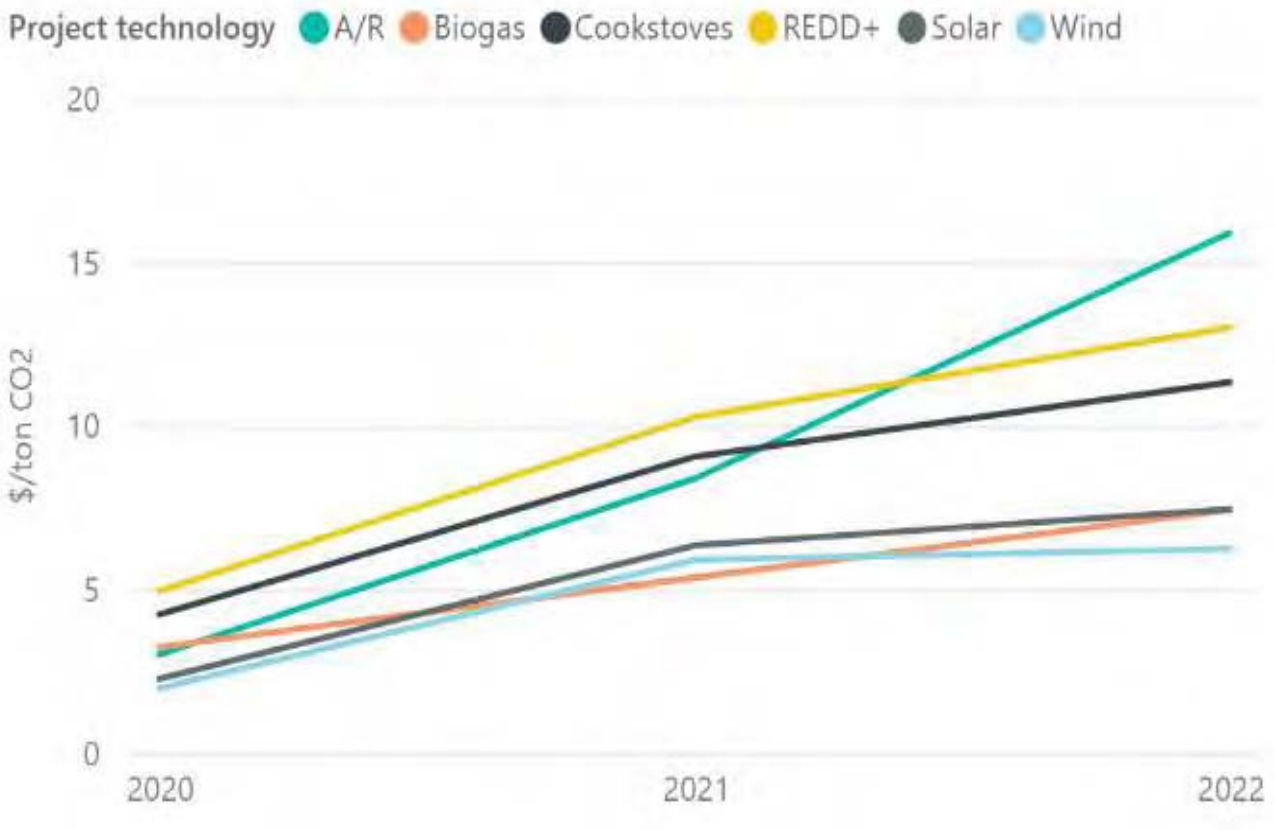
Market Balance by Date



Source: VERRA, Gold Standard, ACR &CAR registries

Voluntary Carbon Price Developments

Average Prices

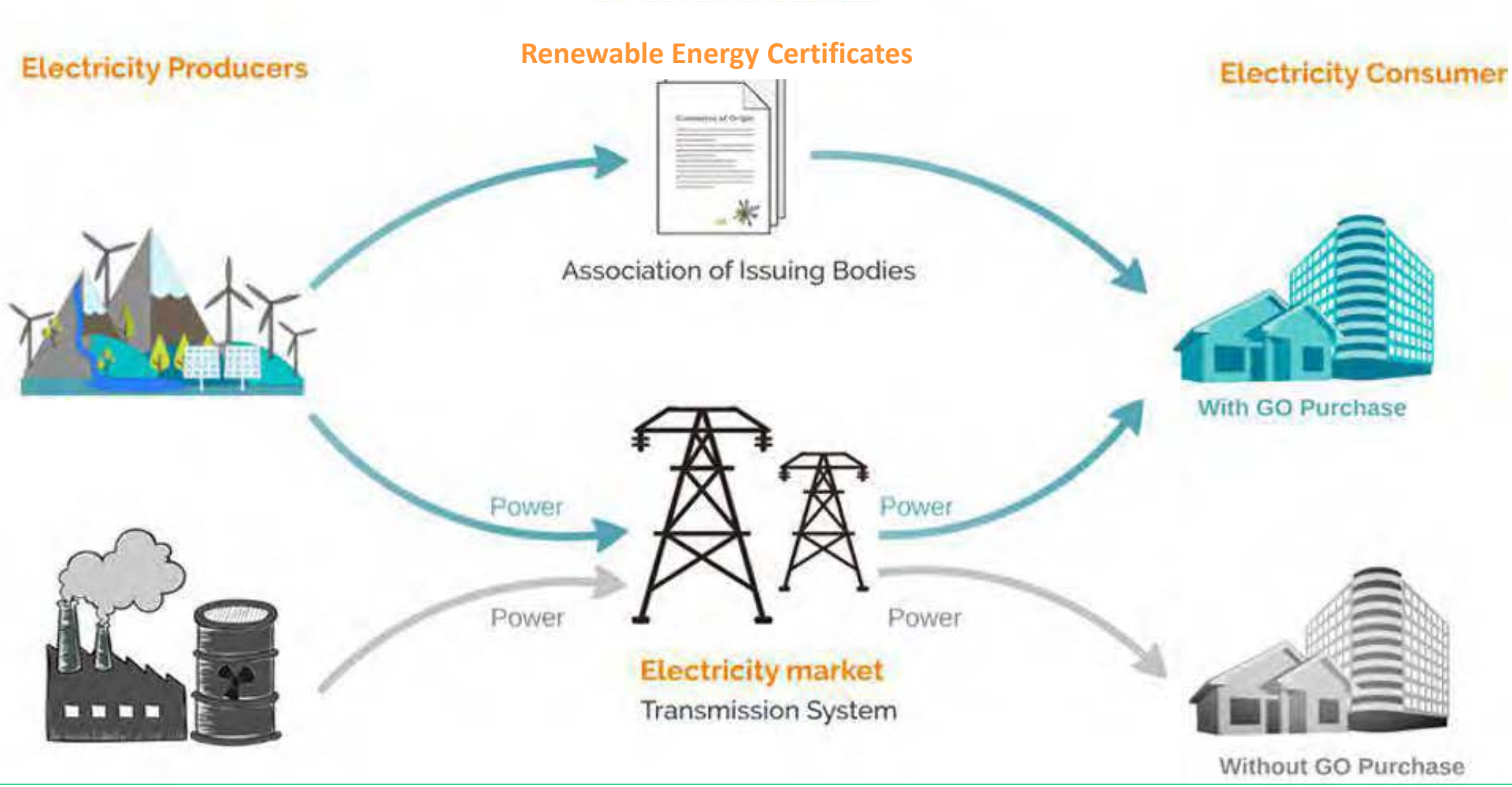


What determines the price of a carbon offset?

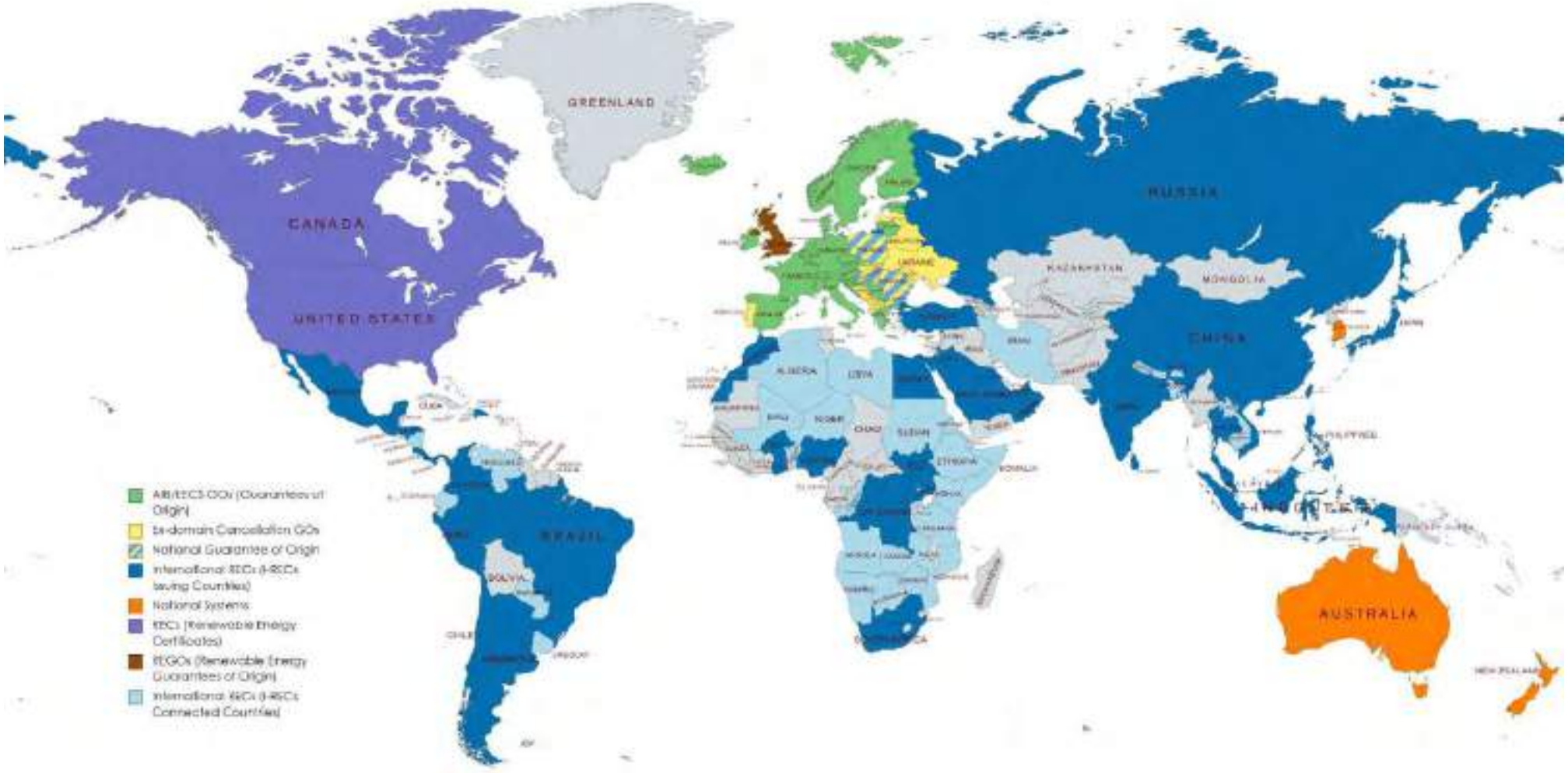
- Technology
- Vintage
- Standard
- Location
- Co-benefits
- Eco-label
- Volume

Carbon Reduction Strategies

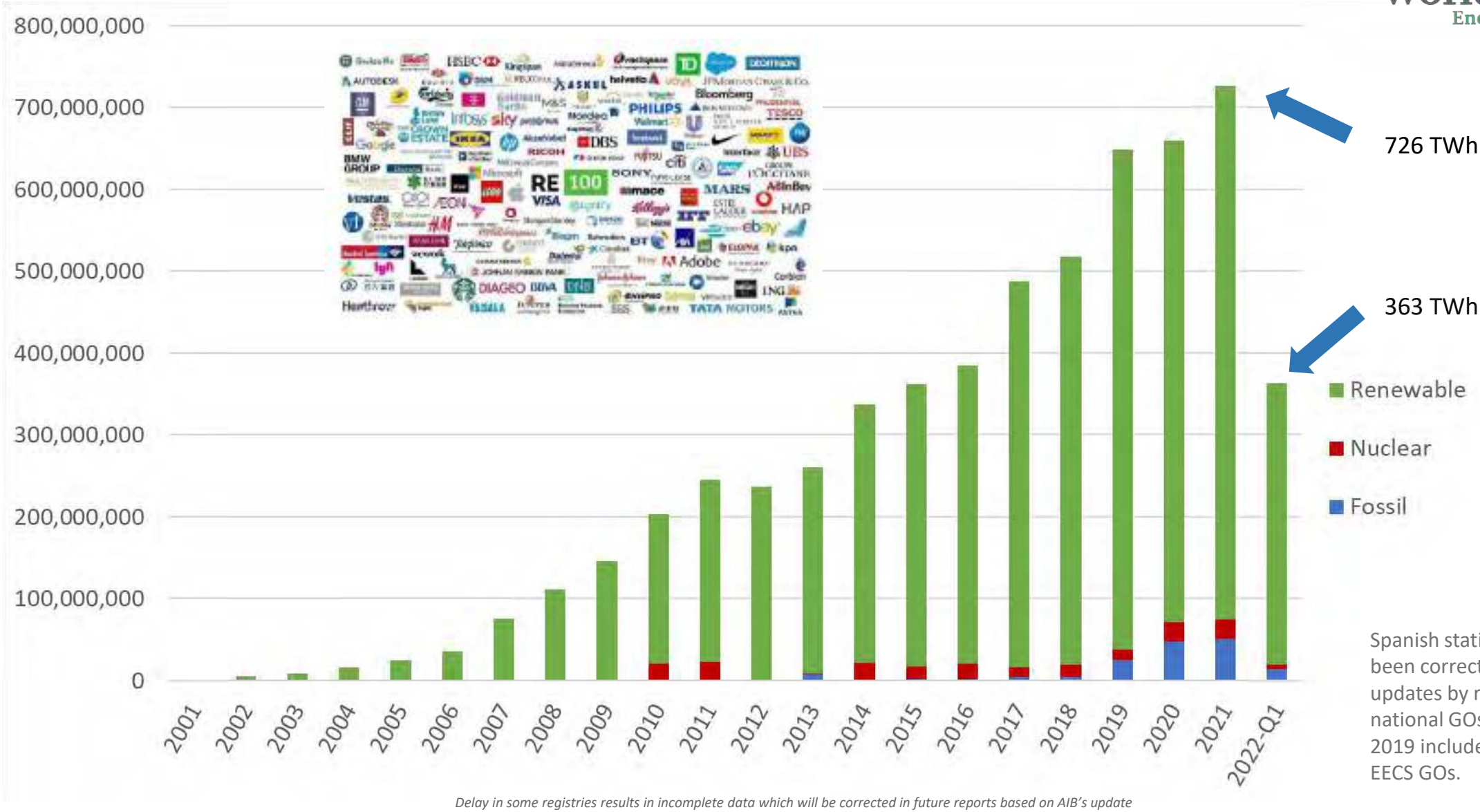
Certificate Systems



Different Renewable Energy Certificates



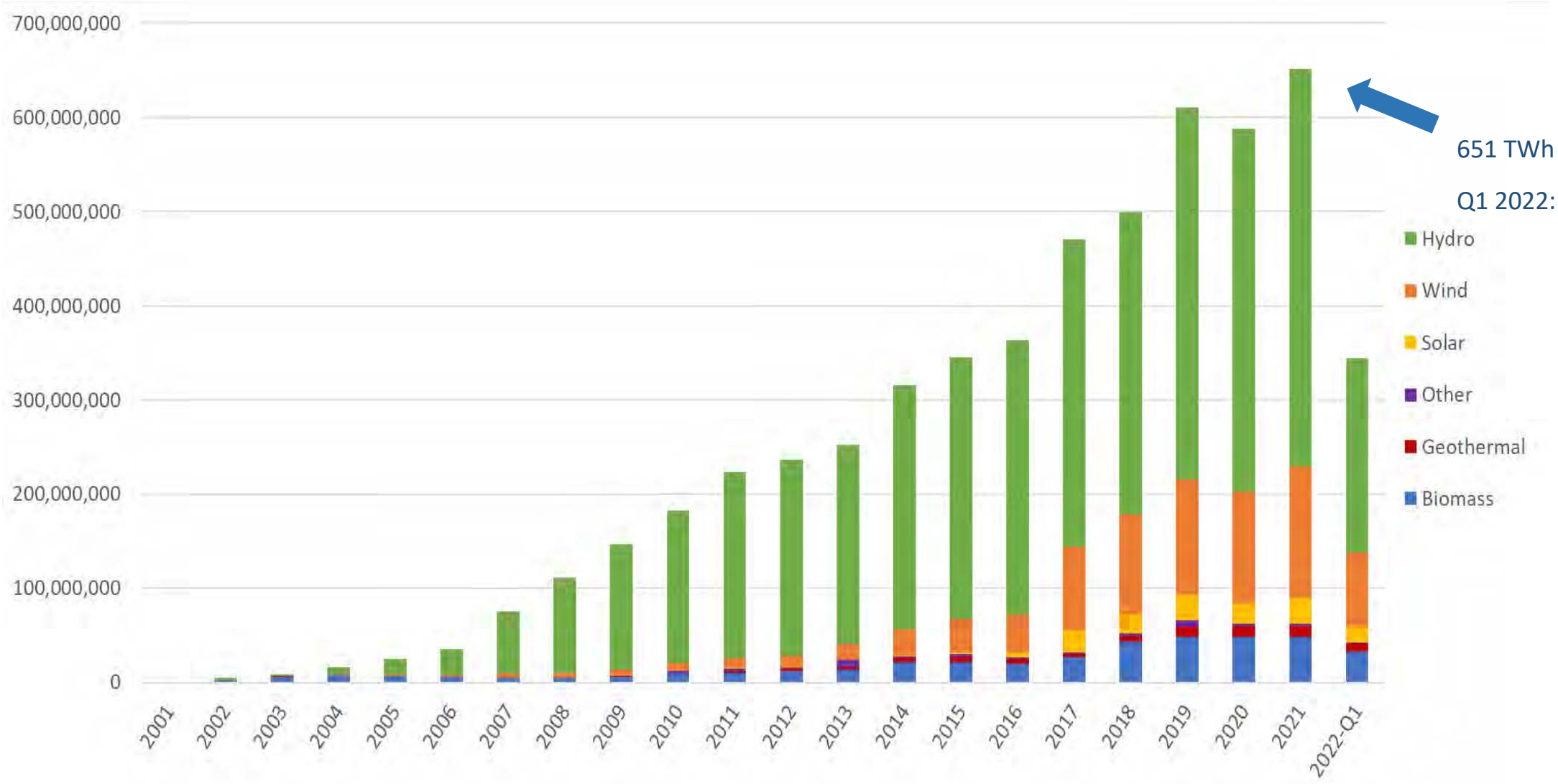
Demand for GOs by technologies in Europe (MWh)



Spanish statistics for year 2020 has been corrected since the previous updates by removing rest of the national GOs from those. The year 2019 includes both National and EECS GOs.

Delay in some registries results in incomplete data which will be corrected in future reports based on AIB's update

Demand for GOs by renewable technologies in Europe (MWh)

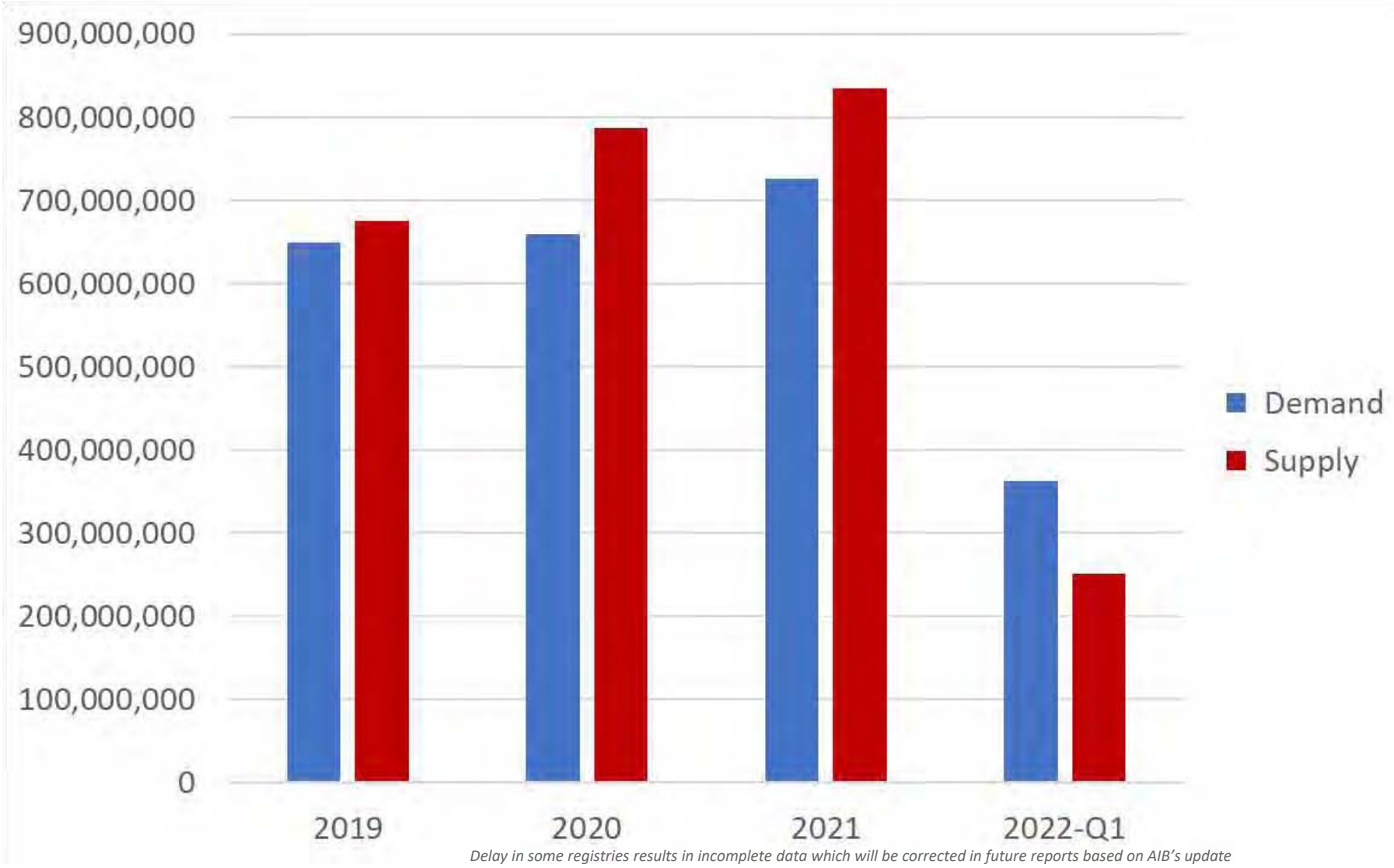


651 TWh

Q1 2022: 344 TWh

Delay in some registries results in incomplete data which will be corrected in future reports based on AIB's update

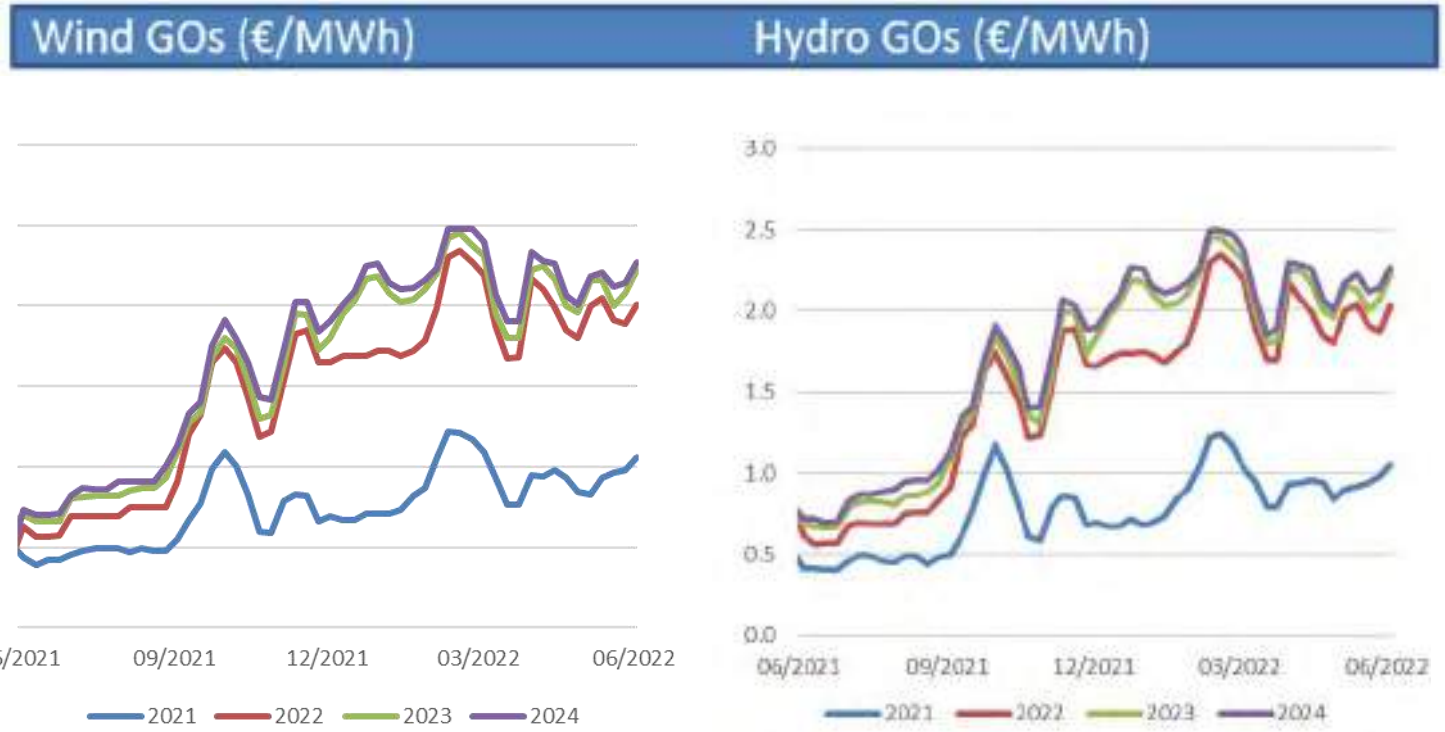
Demand and supply in each year (MWh)



Total supply in 2021 was 835 TWh and total demand was 726 TWh, leaving a gap of 109 TWh. So far in 2022, demand has been 363 TWh and total supply has been 251 TWh.

Delay in some registries results in incomplete data which will be corrected in future reports based on AIB's update

Prices



Prices ranges for the presented countries and vary on a variety of factors such as:

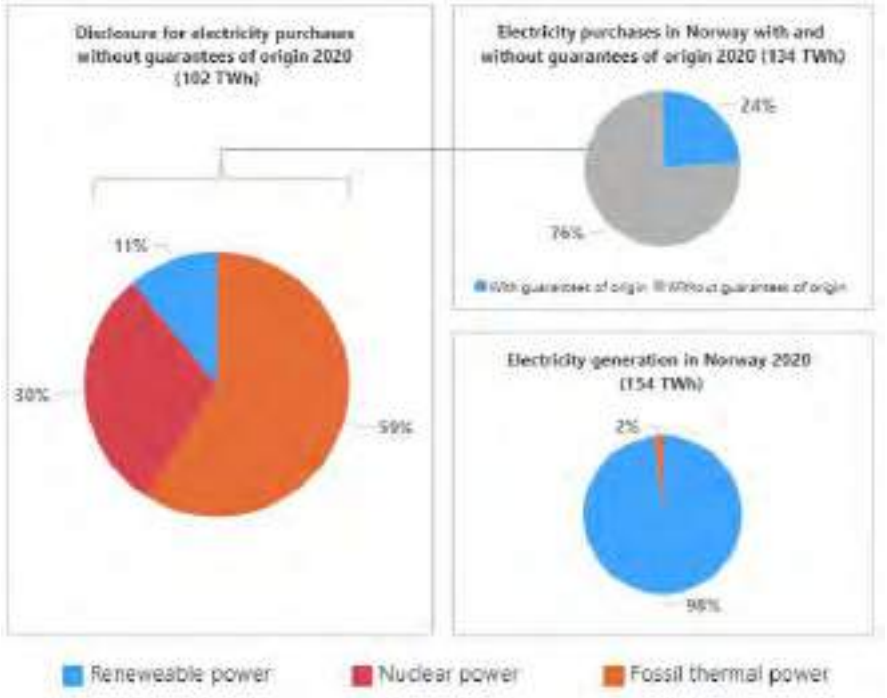
- ✓ Vintage
- ✓ Production period
- ✓ Technology
- ✓ Quantity
- ✓ Market trends, demand & availability
- ✓ Eco-label & additionality features

Policy development to look out for

The Netherlands introduces full disclosure

20 JANUARY 2020

As of the 1st of January 2020, the Netherlands has introduced a full disclosure system for guarantees of origin. Twelve months prior to the implementation it was already possible to voluntarily disclose information on non-renewable energy supply, but this is now compulsory for all suppliers within the Netherlands.



Policy development to look out for

The European Commission "Fit for 55“

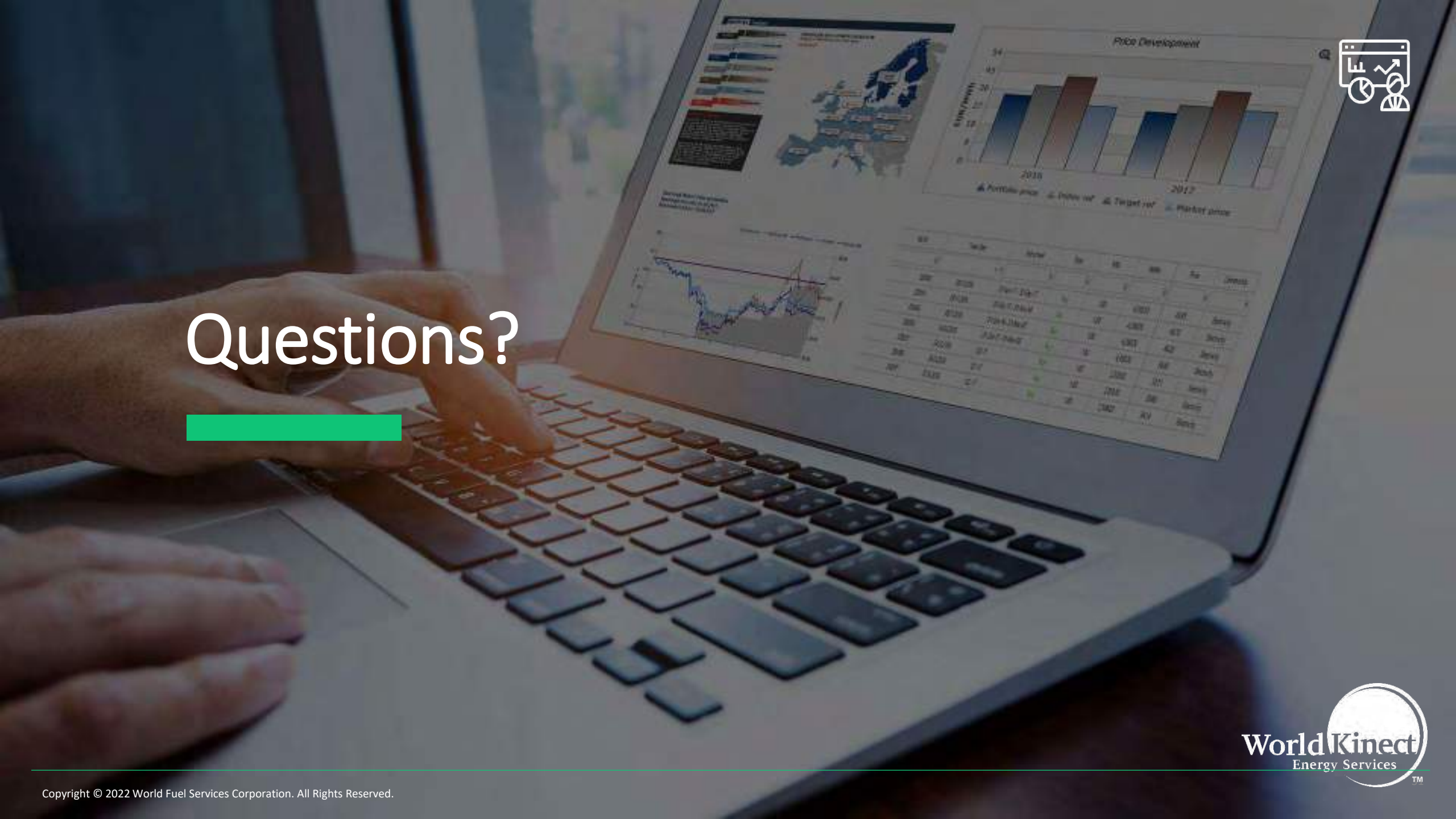
- Increased renewables target of **40%** by 2030 (up from 32%), in addition to the increased energy efficiency target of **36-39%** (up from 32.5%).
- GOs will be a **key tool to help promote PPAs** to reach the increased renewables target.
- **All requests on GOs from renewable producers must be granted by national governments**, including those that receive subsidies.

RePowerEU

- The Commission proposes to increase the headline 2030 target for renewables **from 40% to 45%** under the Fit for 55 package.
- A dedicated EU Solar Strategy to **double solar photovoltaic capacity by 2025** and install 600GW by 2030.

Taxonomy

- The European Parliament voted against including natural gas and nuclear energy on a list of climate-friendly investments.



Questions?

Thank you for joining us!

EVERYTHING ENERGY

World Kinect Energy Services™

Power Purchase Agreements

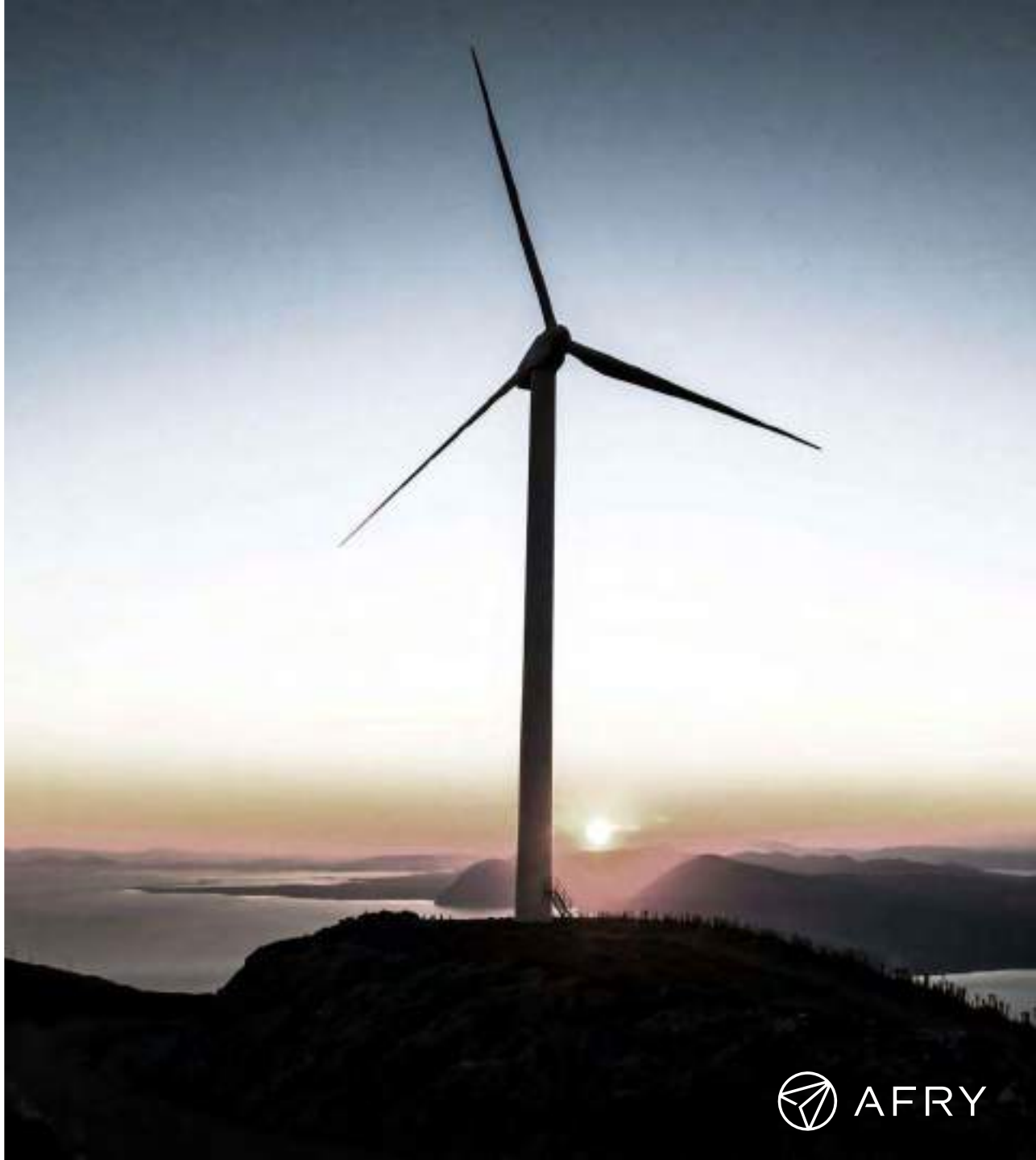
NORDPOOL ACADEMY – 16 JUNE 2022

SERGIU MAZNIC
MANAGER

AFRY MANAGEMENT CONSULTING

Topics for today

- What is a PPA?
- The (changing) role of PPAs
- Key PPA terms
- Q&A



WHAT IS A PPA?

PPA definition

Power Purchase Agreements (PPA) =

– Bilateral agreement

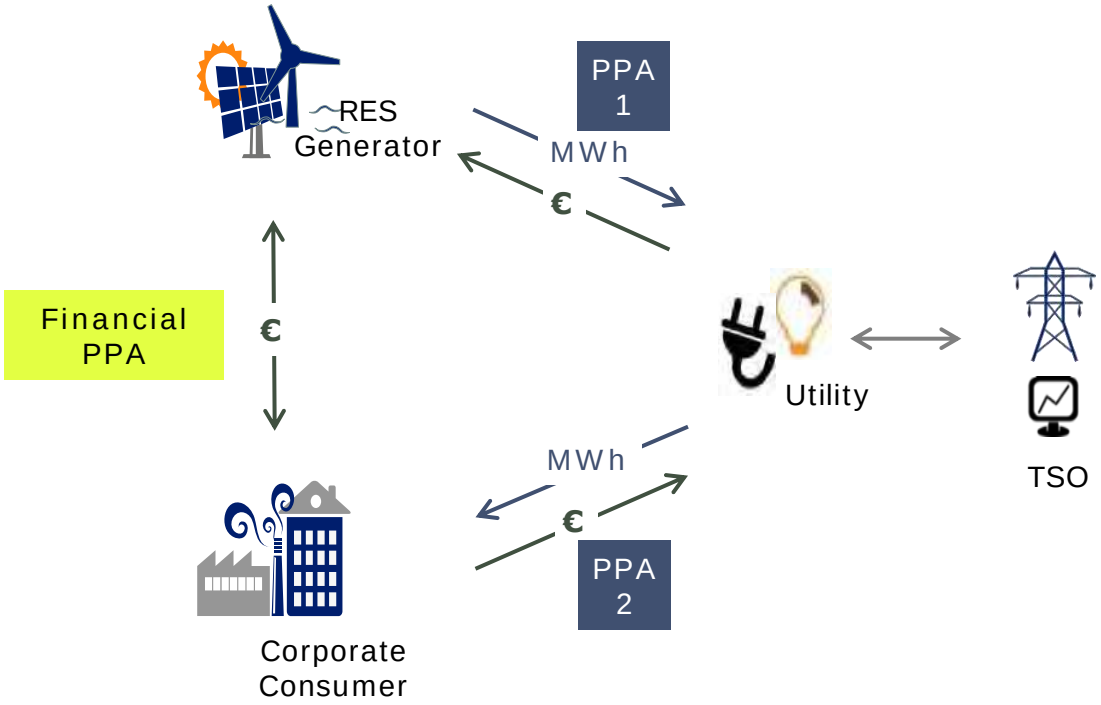
– to transfer ownership of

– a defined amount of power

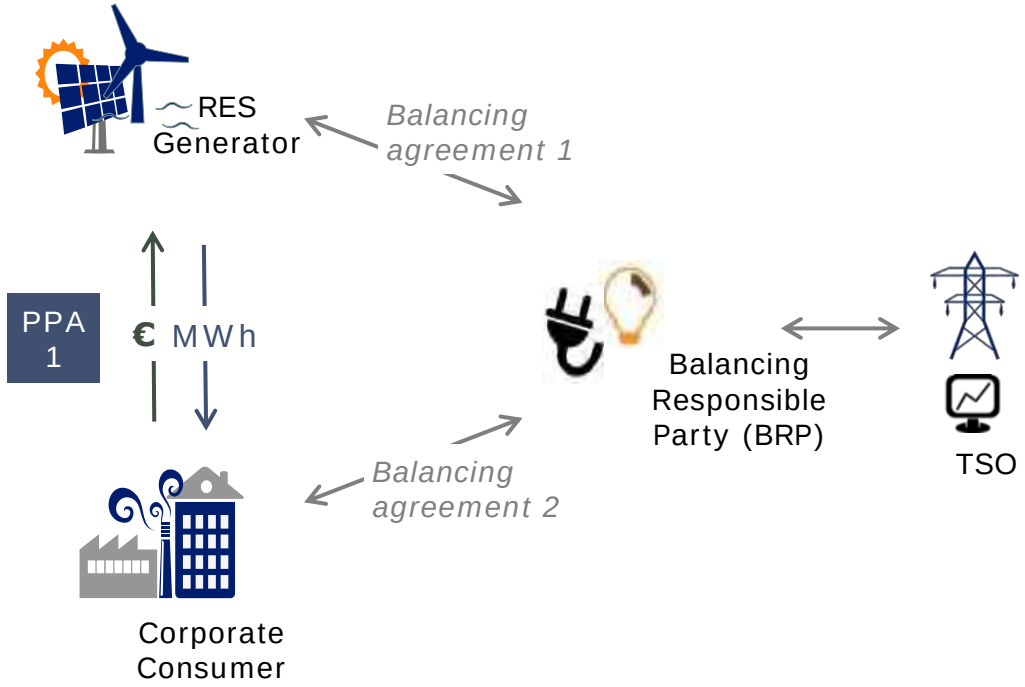
– for a defined sum of money

Can be a simple, bilateral agreement or complex, multi-party arrangements

TRADITIONAL (UTILITY) PPAS



CORPORATE PPAS (SIMPLE)



AFRY

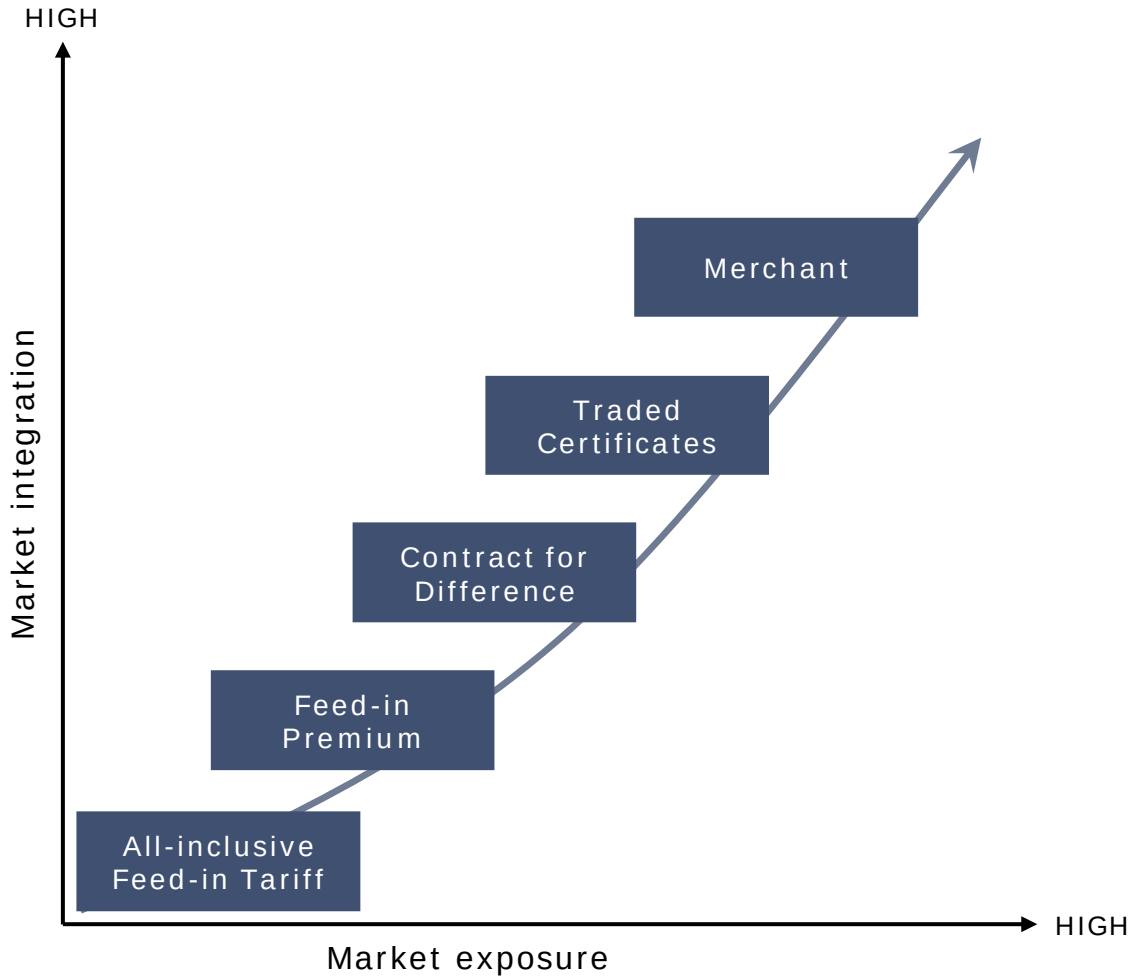
Why use PPAs?

	POWER PRODUCERS	POWER CONSUMERS
 **ROUTE TO MARKET** Producers and consumers without inhouse power trading resources need a PPA to access the market		
 **HEDGING AGAINST PRICE VOLATILITY** PPAs may contain clauses that reduce price volatility (may be necessary e.g. to secure financing)		
 **CORPORATE SOCIAL RESPONSIBILITY** PPAs can be a key tool for companies with ambitious decarbonisation agendas		

AFRY
ÅF PÖYRY

FROM ROUTE-TO-MARKET TO RISK MITIGATION

As subsidy mechanisms change or disappear, PPAs can provide the risk mitigation required to secure financing of new RES projects



Full price risk - PPA provides risk mitigation as well as route to market

Limited price risk - PPA provides route to market

Central buyer at preset price - no PPA required

AFRY

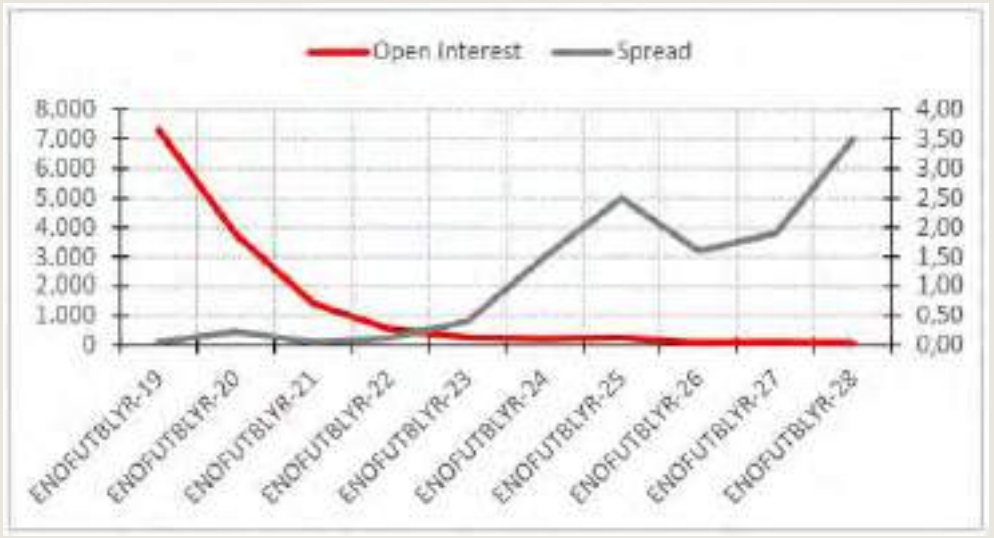
The financial markets are not liquid enough for long-term hedging

LIQUIDITY ON THE NORDIC FORWARD MARKET - NASDAQ

AGGREGATED VOLUMES (3 MONTHS)

Source: Nasdaq OMX Commodities

SPREAD AND OPEN INTEREST

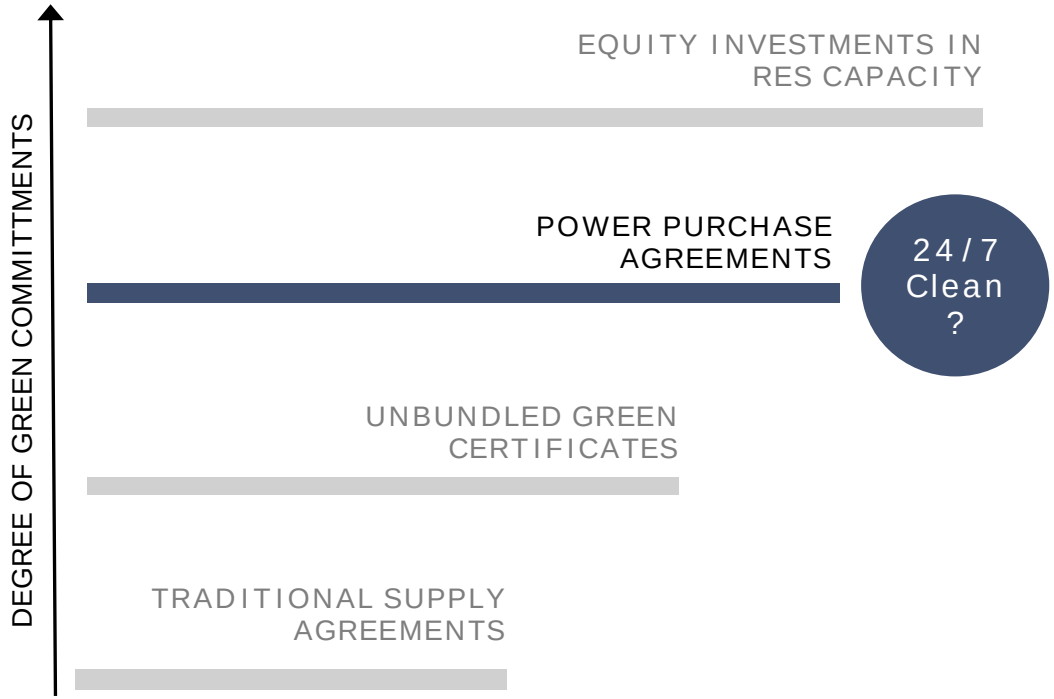


Source: EnergiDanmark, August 2018

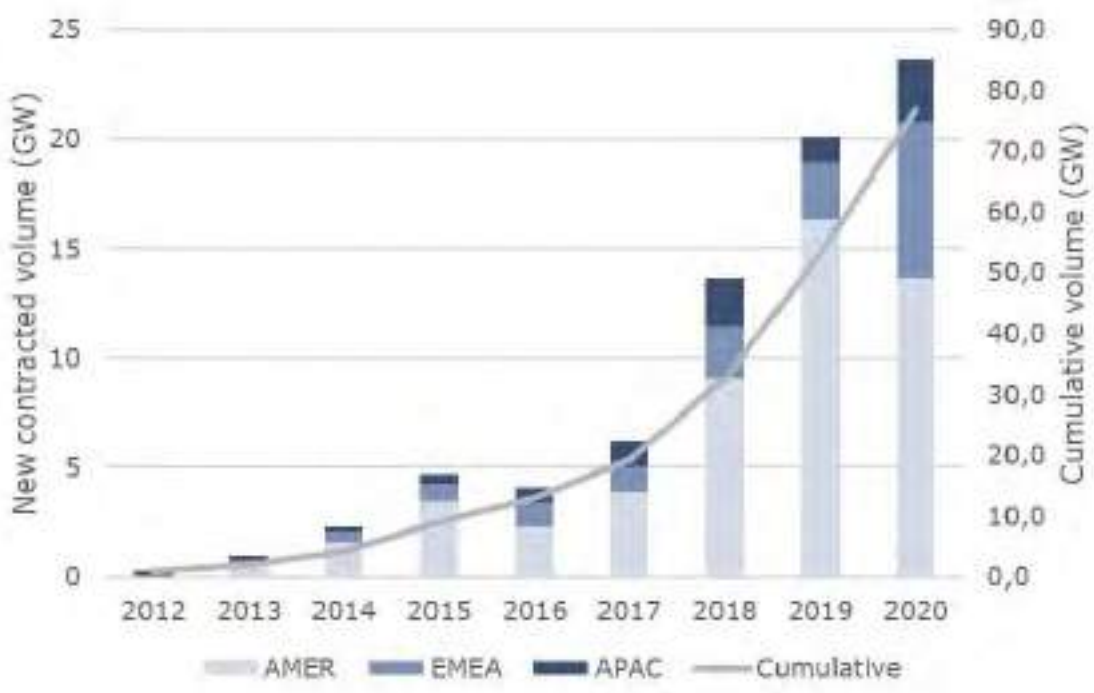
AFRY

Corporate consumers can use PPAs as a tool to reach their decarbonisation targets

GREEN ELECTRICITY PROCUREMENT ROUTES



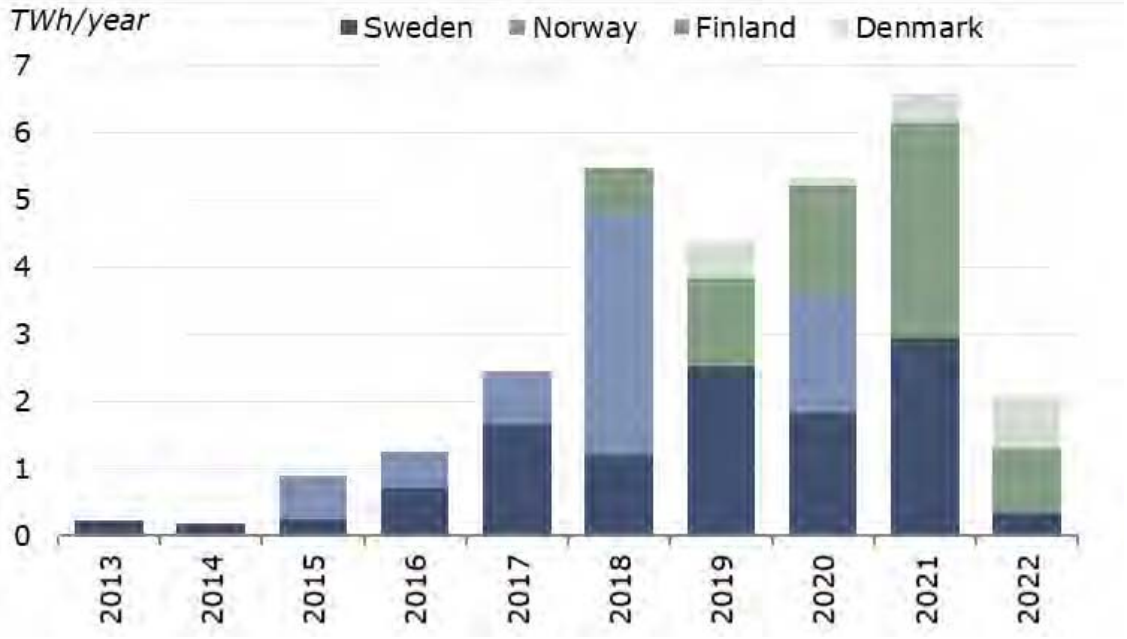
GLOBAL CORPORATE PPA VOLUMES



Source: BNEF, data are through 2020. Onsite PPAs, Australia sleeved, pre-market reform Mexico not included. APAC number is an estimate. Subject to change

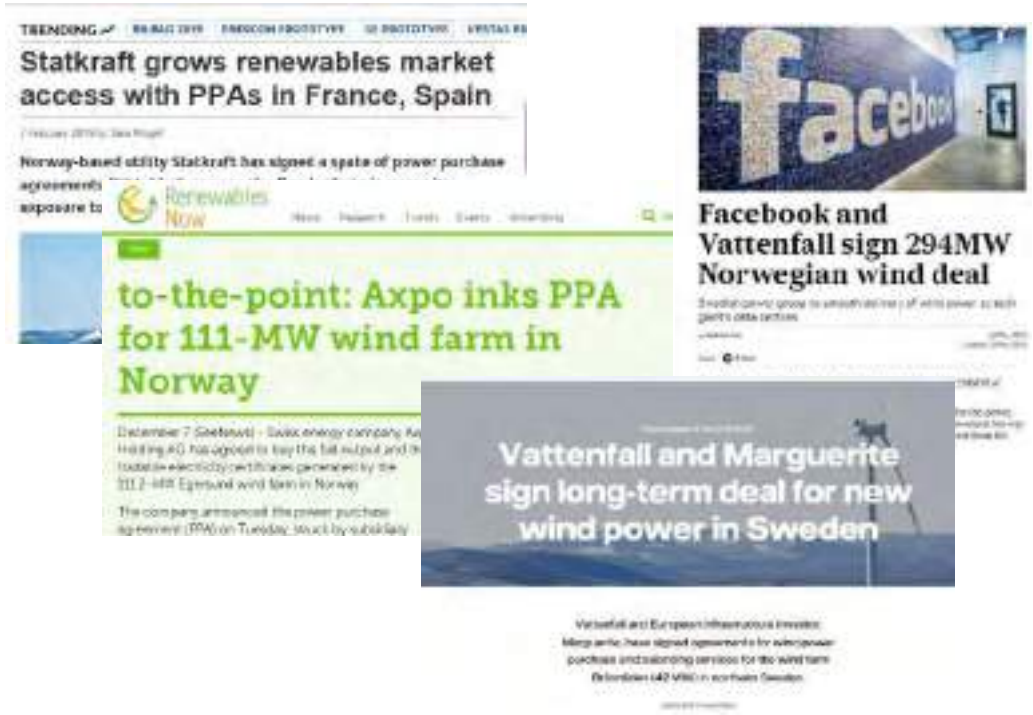
Nordics is the most mature market in Europe for corporate PPAs

CORPORATE PPAS IN THE NORDICS



Source: AFRY Management Consulting

PPAS ARE ALSO PROVIDED BY UTILITIES



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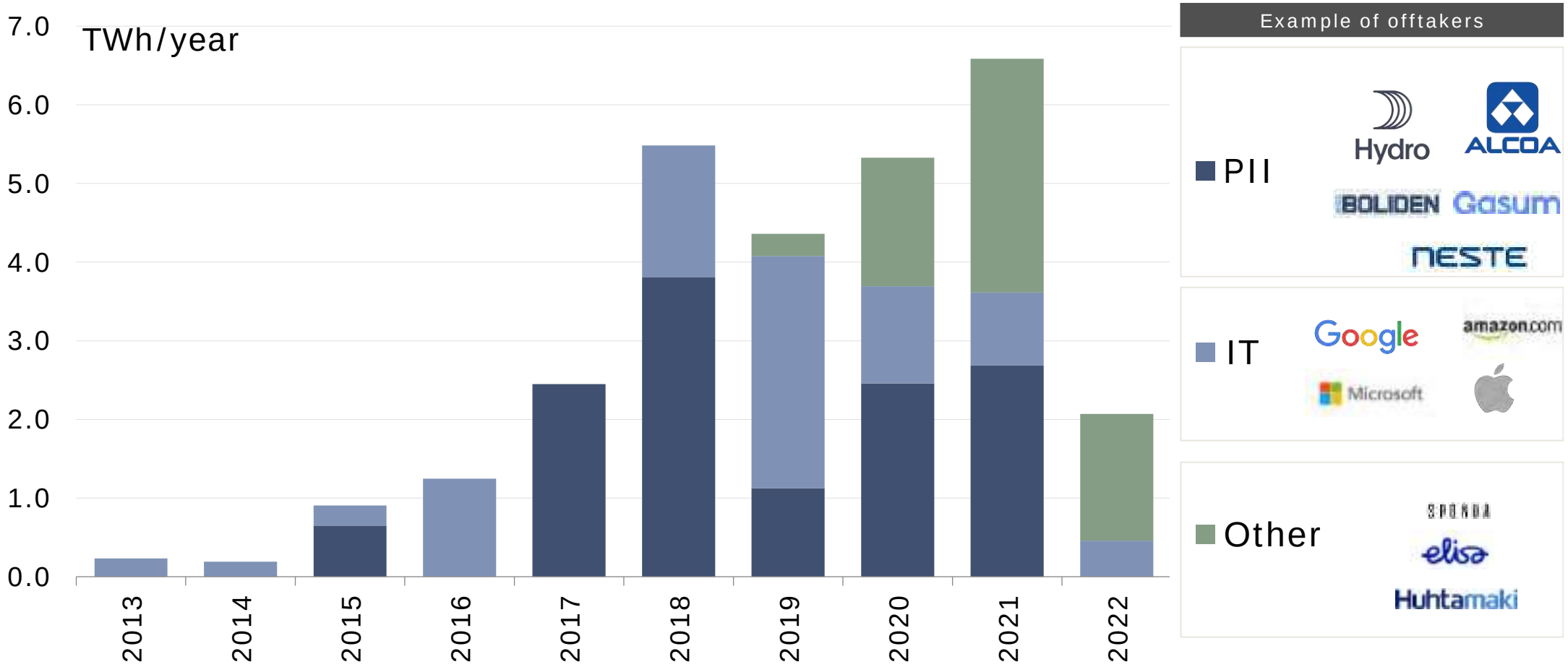
Nordic PPA timeline – IT and aluminium companies led the way



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Setting up a PPA – key terms to negotiate

Key issues to agree in a PPA		Observed terms
Type of PPA	Physical delivery or synthetic PPA?	Typically physical PPAs, but increasing financial PPAs as well
Duration	When does the PPA start, and how long is it? Options to prolong?	Typically long-term (10+) if used for risk mitigation, shorter if route-to-market
Volume and profile	How much electricity should be delivered? When?	Both «as-produced» and baseload contracts observed, some with seasonal profiles

AFRY

Allocation of volume risk affects the price level of the PPA

Price per MWh

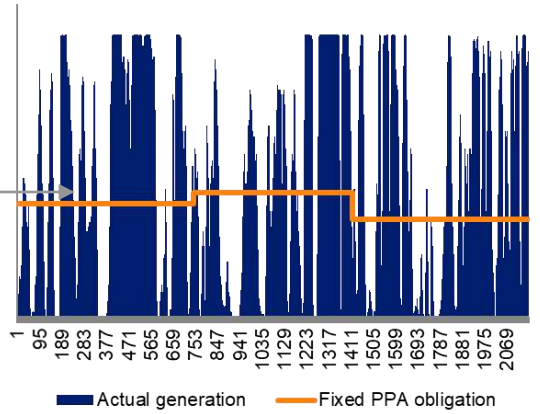
Baseload
- Volume delivery obligation
- Hourly profile obligation

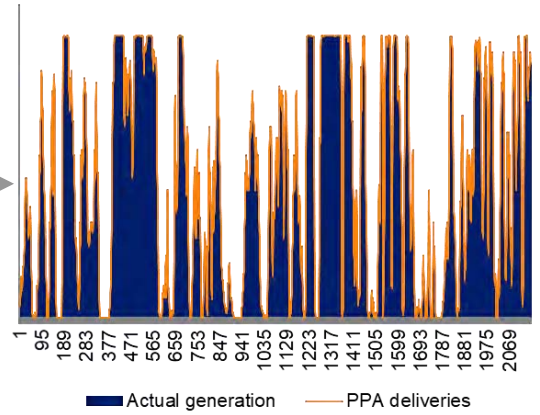
Fixed annual/quarterly volume
- Volume delivery obligation
- No delivery profile obligation

Metered volume (as-produced)
- No volume delivery obligation
- No delivery profile obligation

Volume risk: Offtaker

Volume risk: Generator





AFRY

Setting up a PPA – key terms to negotiate

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Volume and profile	How much electricity should be delivered? When?	Both «as-produced» and baseload contracts observed, some with seasonal profiles
Price level and structure	Is the price fixed or indexed? To what? Floors or collars?	Fixed price deals for subsidy-free projects (required for financing), indexed for route-to-market

AFRY

Setting up a PPA – key terms to negotiate

Key issues to agree in a PPA		Observed terms
Type of PPA	Physical delivery or synthetic PPA?	Typically physical PPAs, but increasing financial PPAs as well
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Price level and structure	Is the price fixed or indexed? To what? Floors or collars?	Fixed price deals for subsidy-free projects (required for financing), indexed for route-to-market
Delivery point	Basis risk? Allocation of grid costs?	Delivery at the export meter
GoOs, green certificates	Are they included, and if so, at what terms?	Agreed on case-by-case basis, in most cases included
Balancing	Who is responsible for balancing services?	Responsibility transferred to offtaker (or the sleeving party in a corp. PPA)

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Other risks to understand and mitigate

Project related risks

- Route-to-market for remaining volumes
- Imbalance costs, curtailments
- Project delays, break downs, etc.

- Development status, likelihood of realisation

Counter-party risk

- Size, credibility, track record
- Creditworthiness

Country risk

- Currency risk
- Political and regulatory stability
- Subsidy schemes

AFRY

1. PPAs come in many shapes and forms
2. PPAs are increasingly important as a hedging tool as we reach the end of subsidised RES
3. The PPA negotiation process is complex and time consuming
4. Make sure that you understand and analyse all the risks




Hot Topic

Jwalith Desu

Jr. Market Manager, Nord Pool AS

Physical and Financial Markets Course

Nord Pool Academy

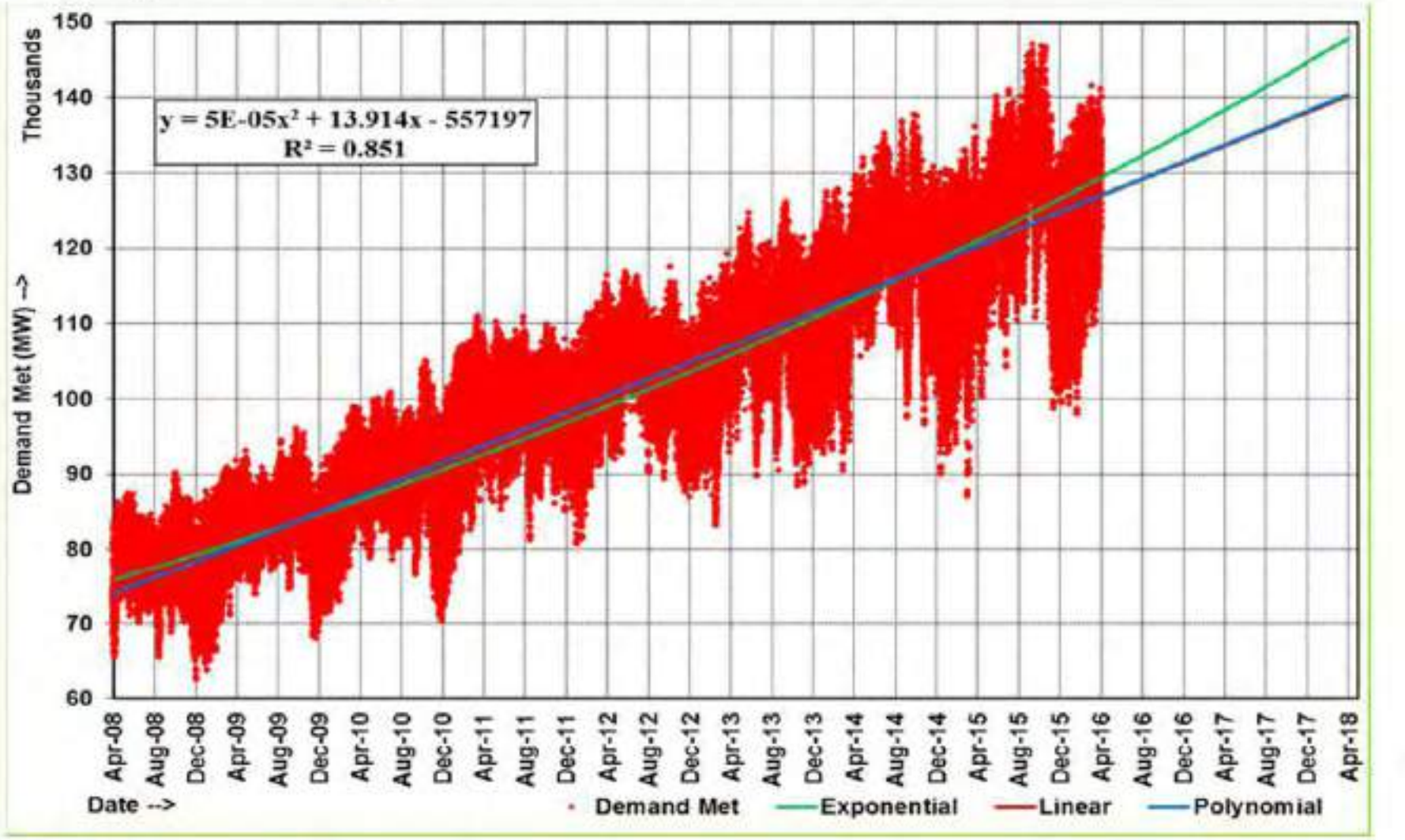
17 June 2022

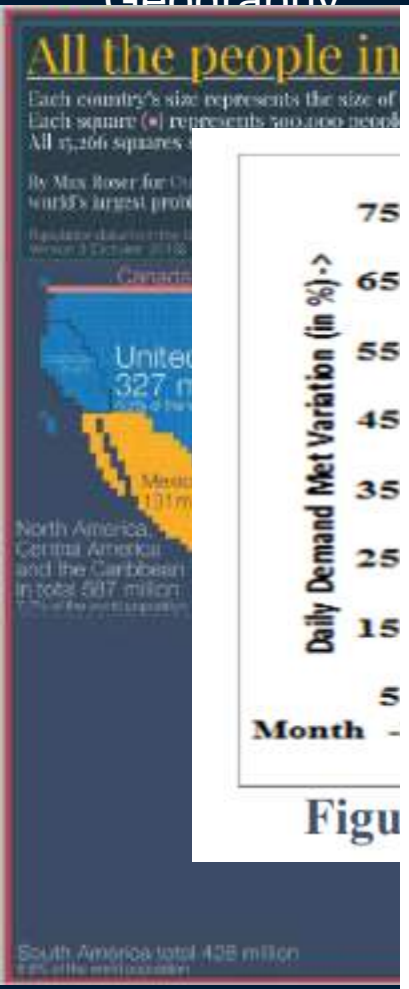
Electricity Market Overview

INDIA

Perspective

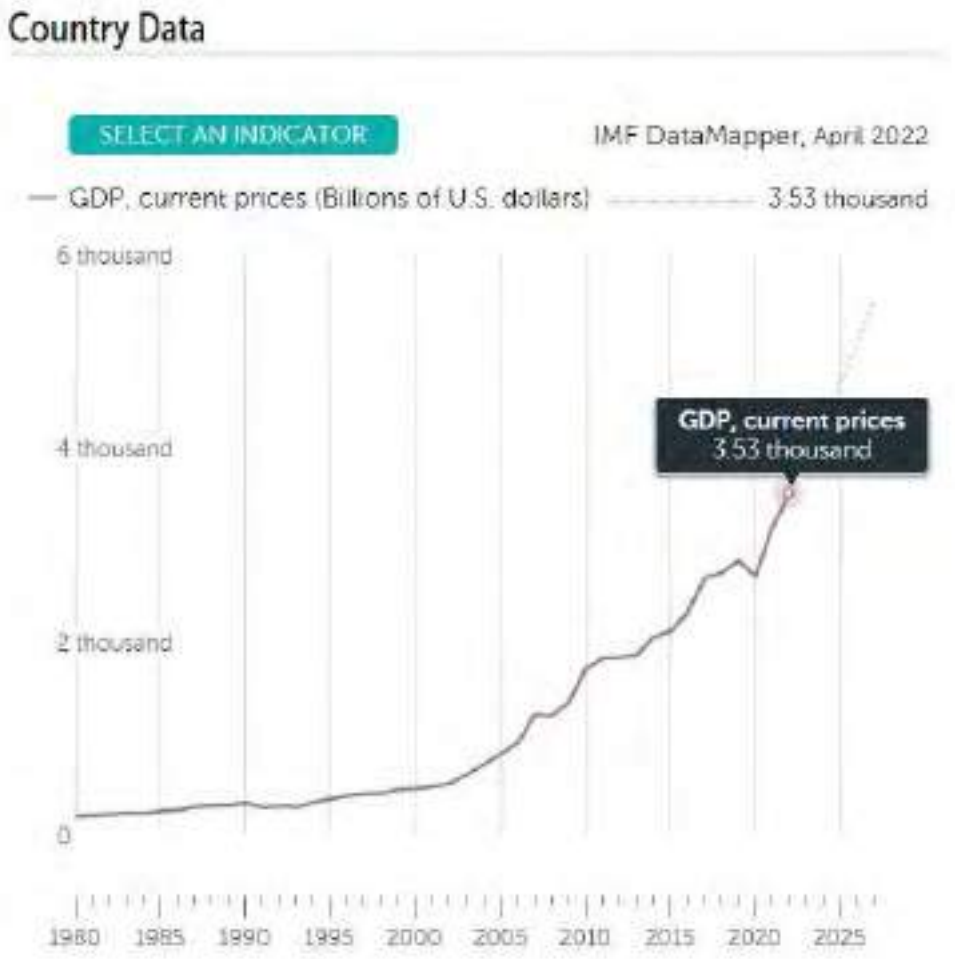
Geography

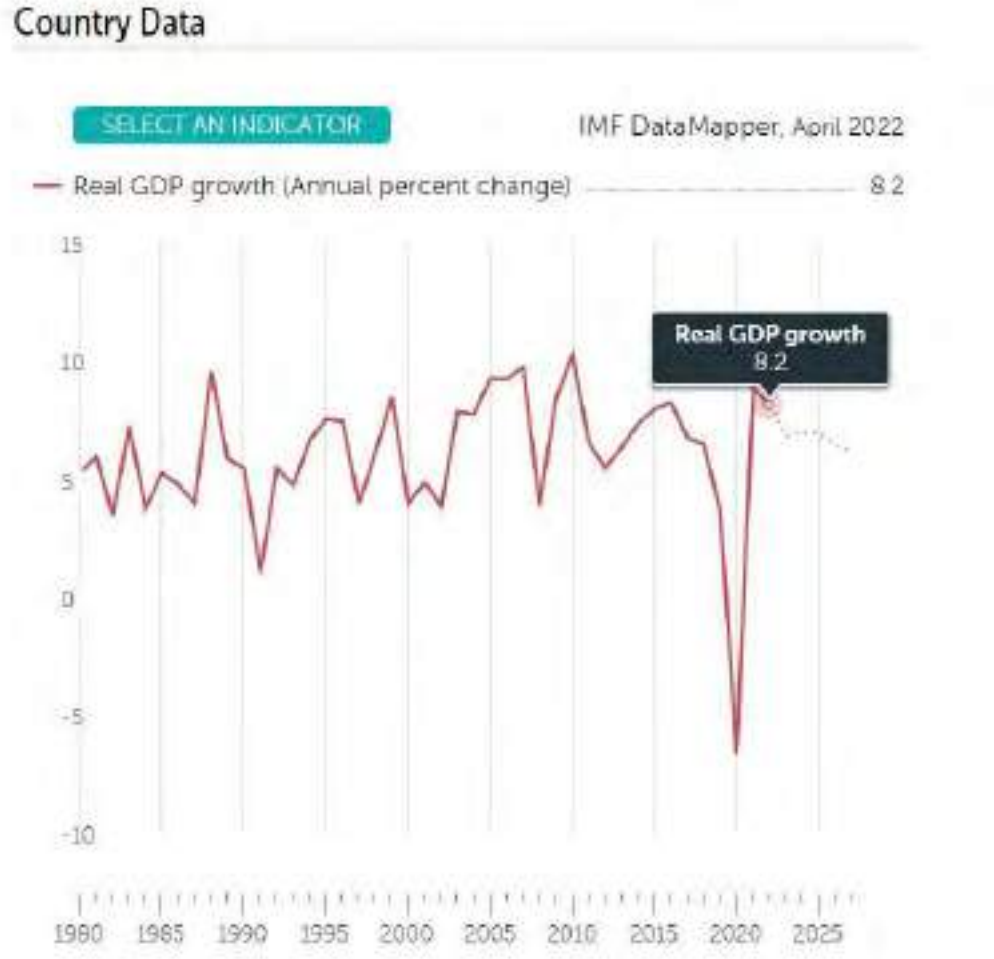




NORD POOL

Some more data....

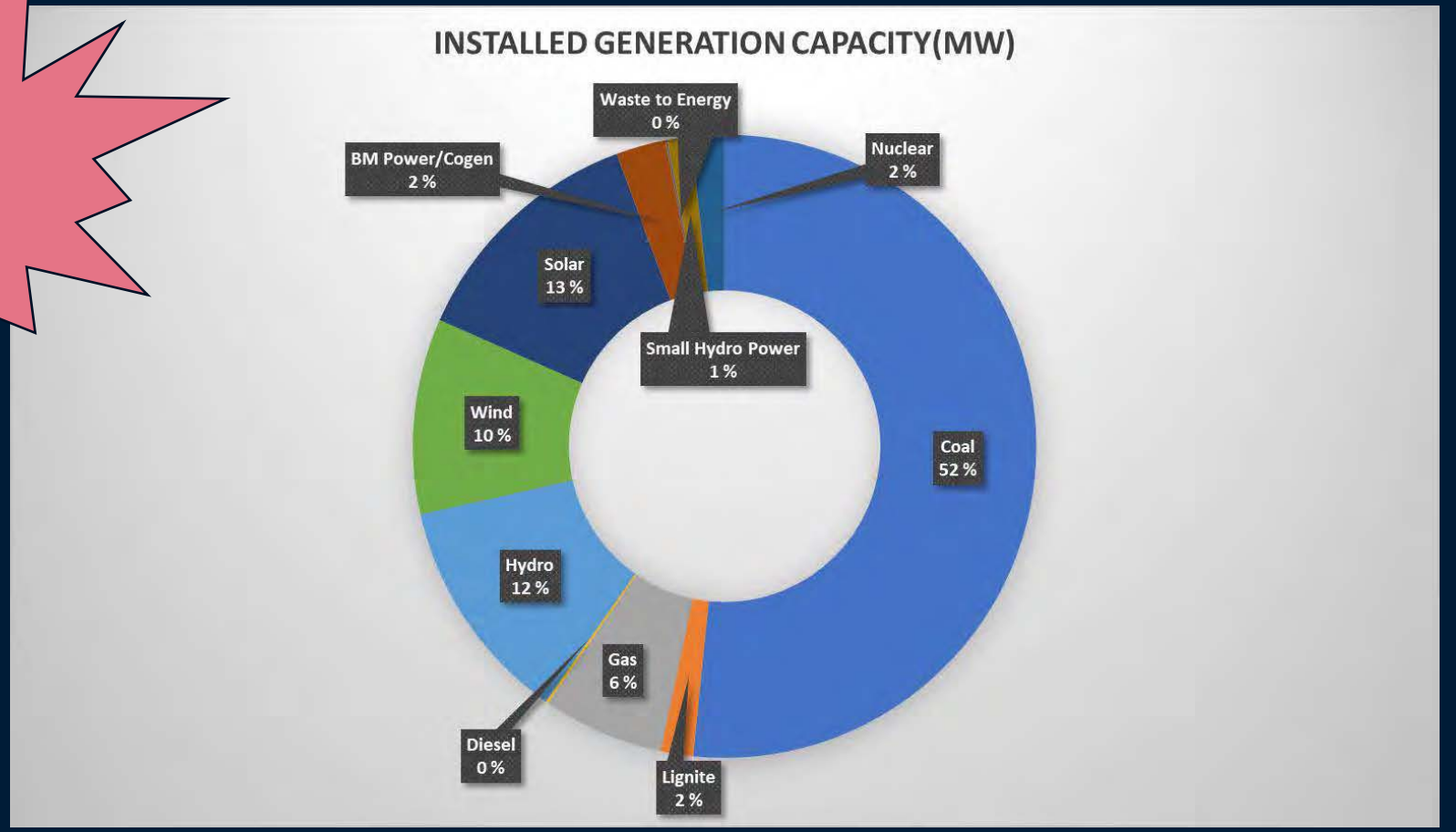




Source:- IMF

How does the Electricity Mix look like?

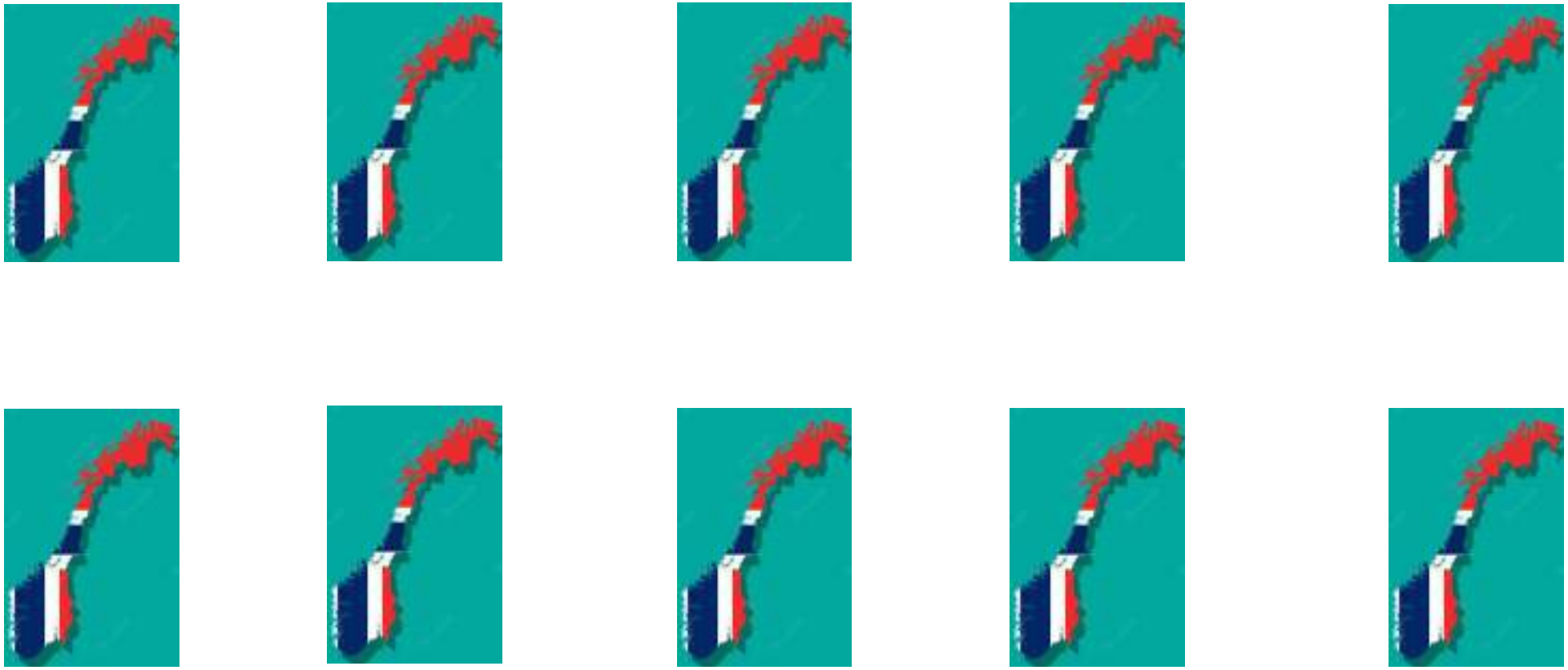
COP 21 Target Achevied



152GW or Ca. 39% Renewable Generation Capacity

Source:- Ministry of Power, Govt. of India

Some Perspective again



9 Sweden’s, 21 Finlands, 24 Denmarks, 3 France, 2 Germany

Source:- IRENA

Traditionally...

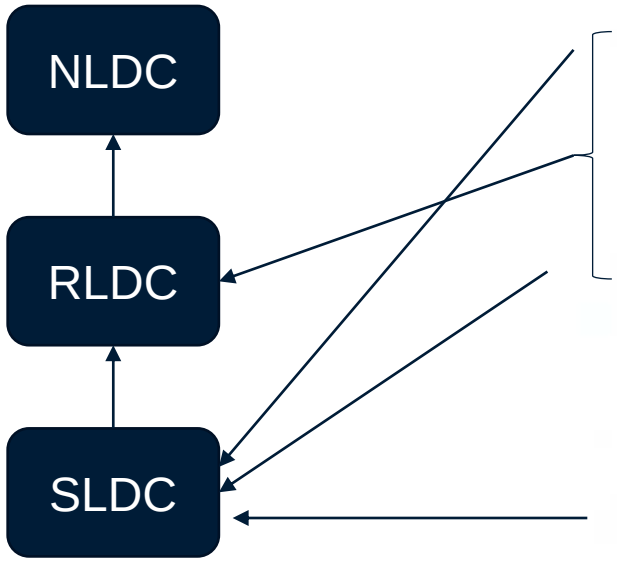
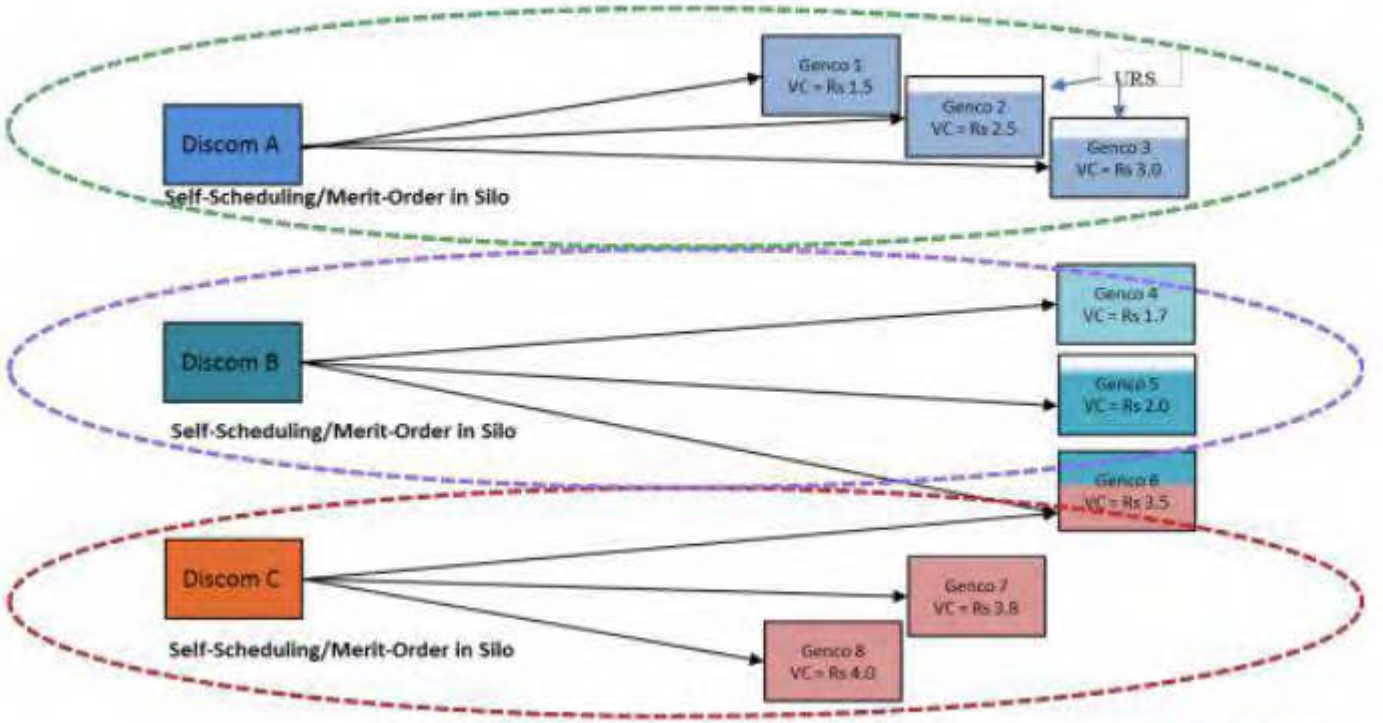


Figure 1



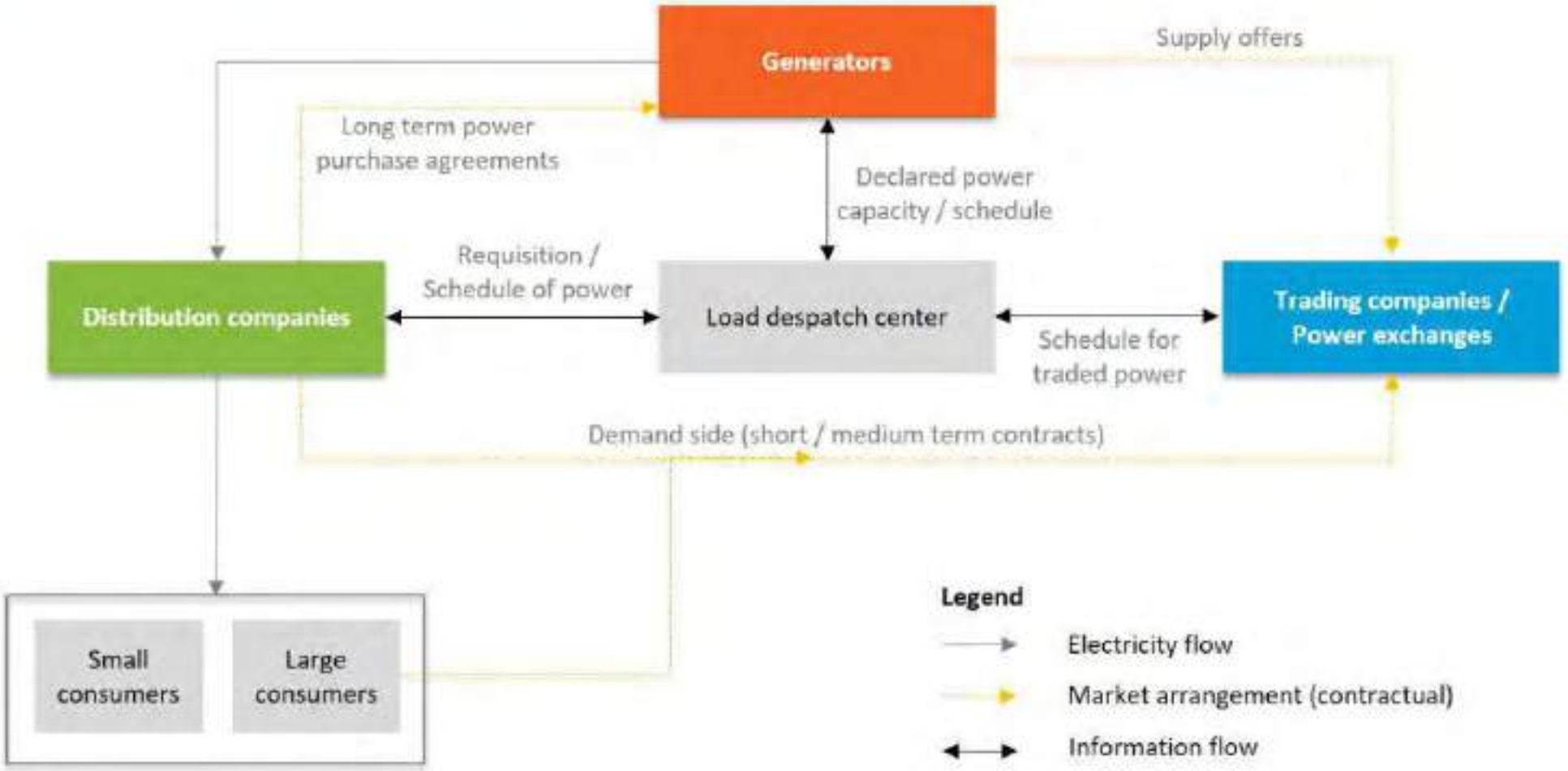
Source: CERC Analysis

CSIS | ENERGY AND NATIONAL SECURITY

NORD POOL

Structure of the Wholesale Market

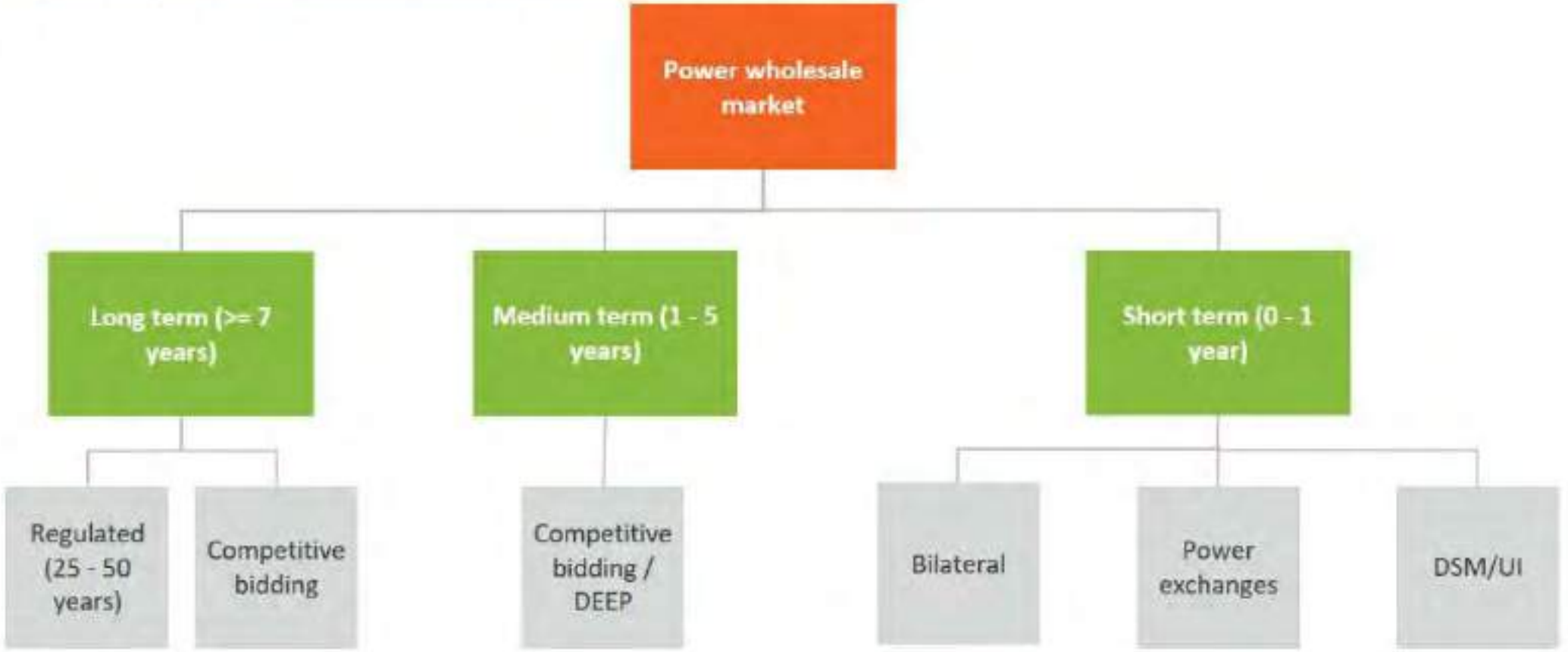
Figure 1: Indian power wholesale market structure



NORD POOL

Types of Contracts

Figure 2: Types of contracts in Indian power wholesale market



Short Term Markets

(Green) Day Ahead Market

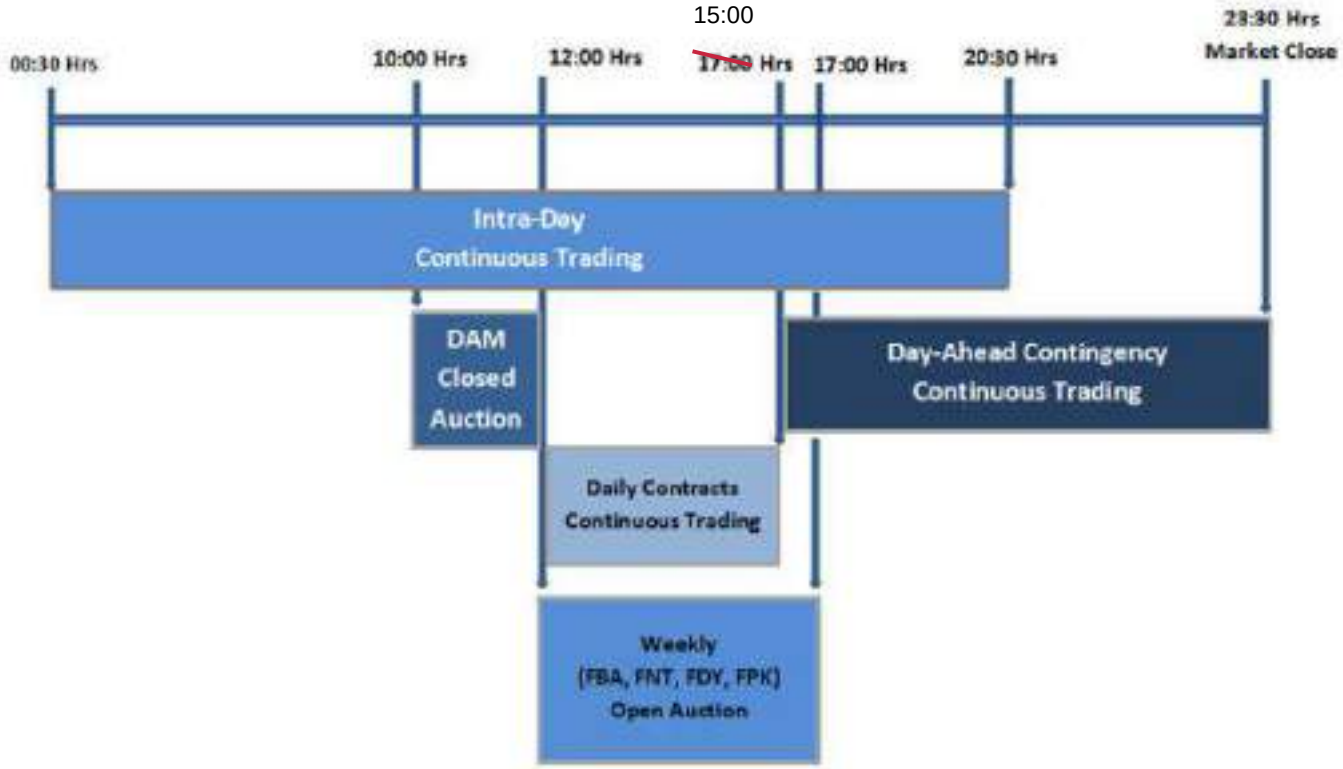
- 15min products
  - Single
  - Blocks

Source:- IEX

Short Term Markets

(Green) Term Ahead Market – Continous Markets

- Hourly contracts (Day Ahead contingency) for delivery next day
- Daily contracts- region specific
- Weekly contracts
- Continous trading/Intraday – 20 hours for the same day delivery

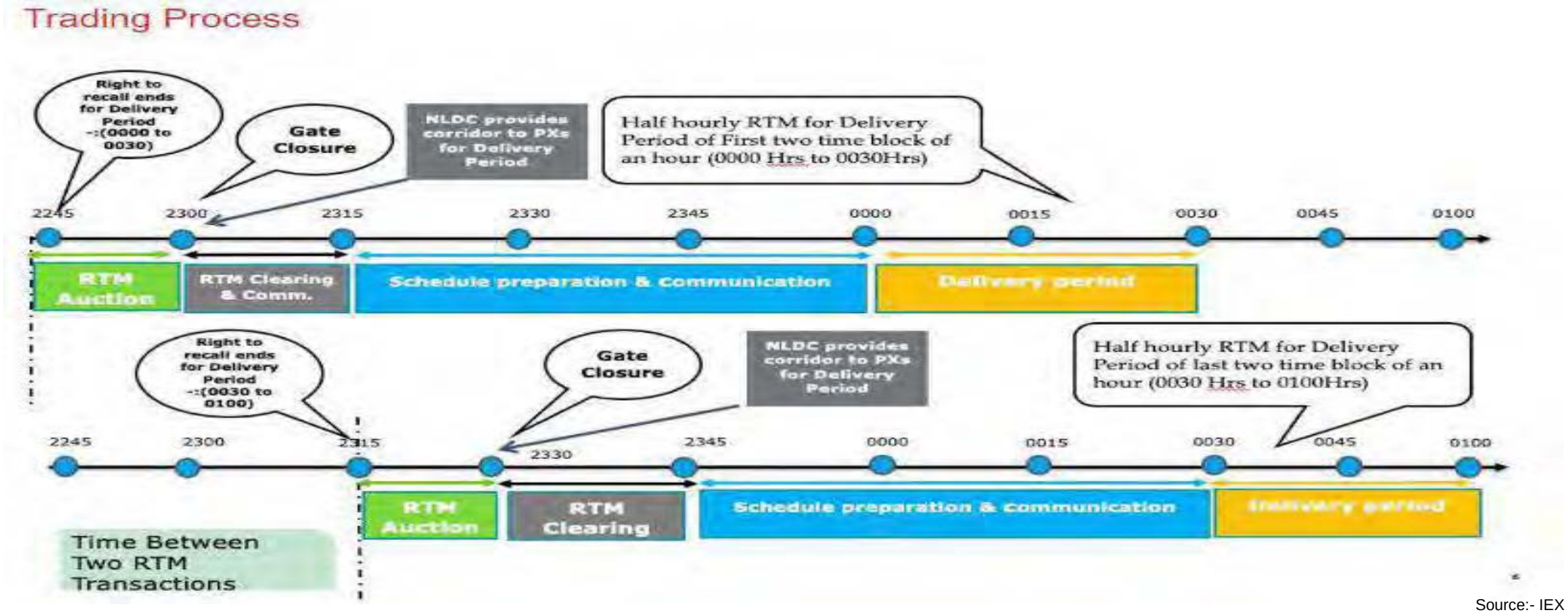


Source:- IEX

Short Term Markets

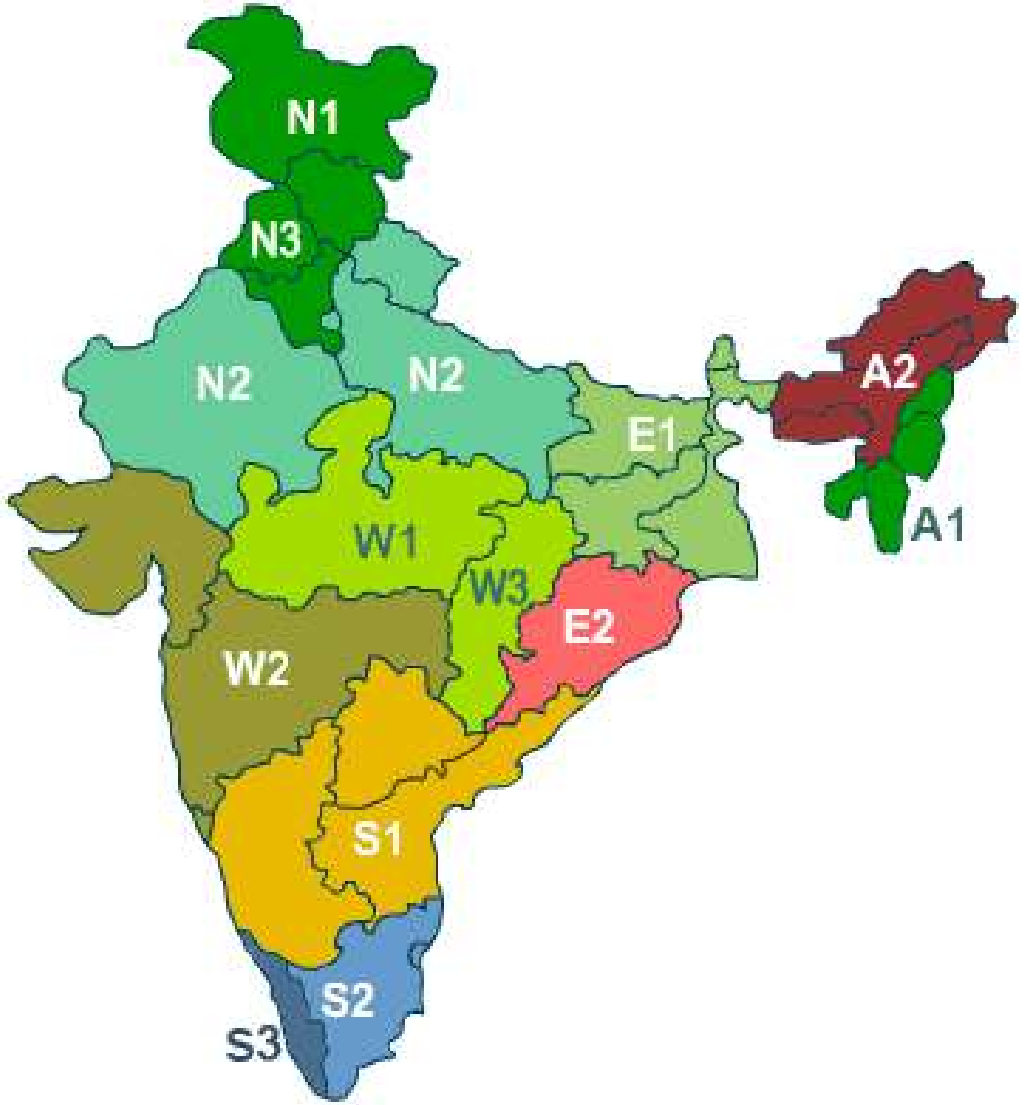
Real time Market

- 48 Auctions conducted every 30 min
- 15min products
  - Single
  - Blocks



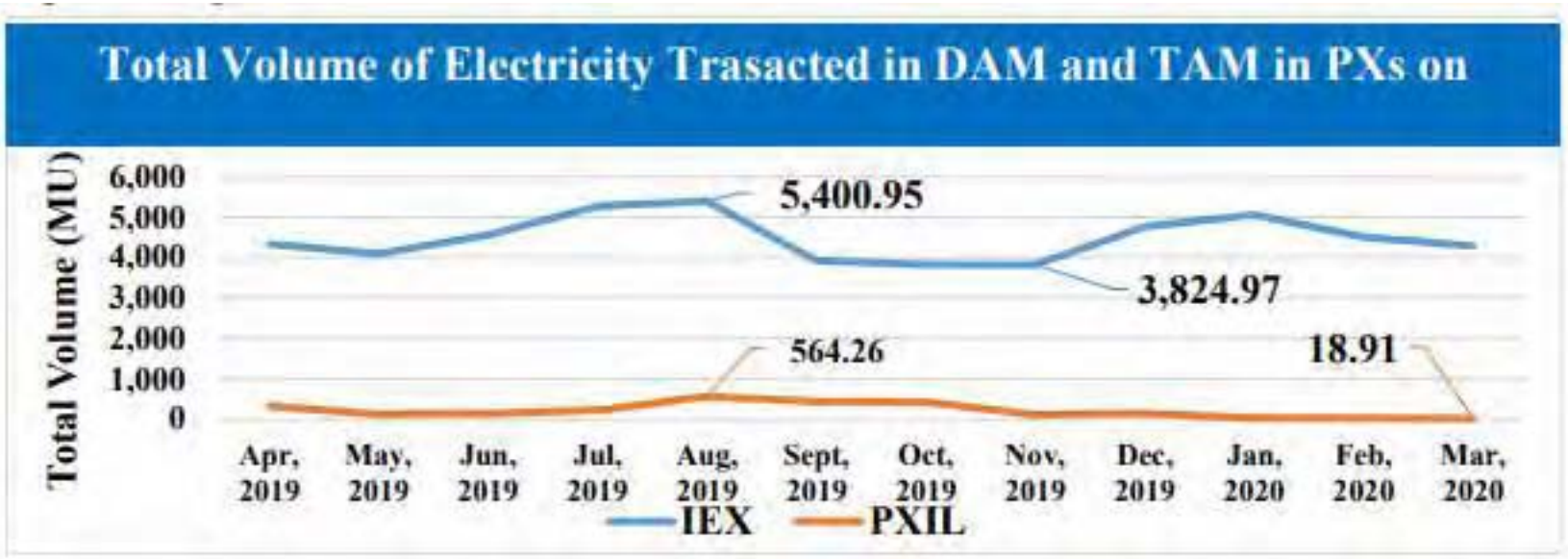
Source:- IEX

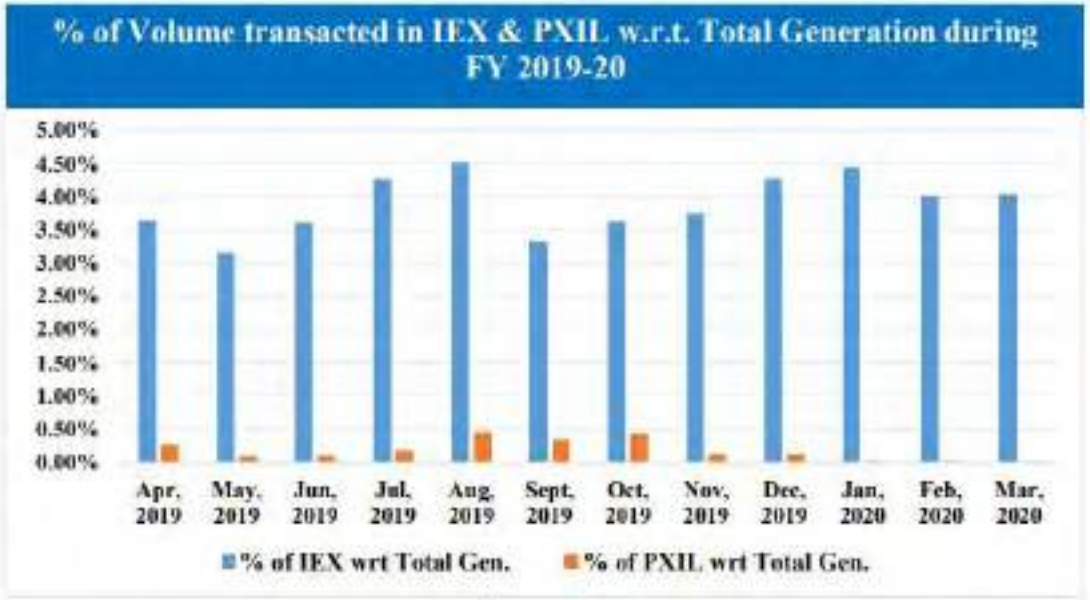
Bidding Zones



Source:- CERC Market Monitoring report

Market Summary





Source:- CERC Market Monitoring report

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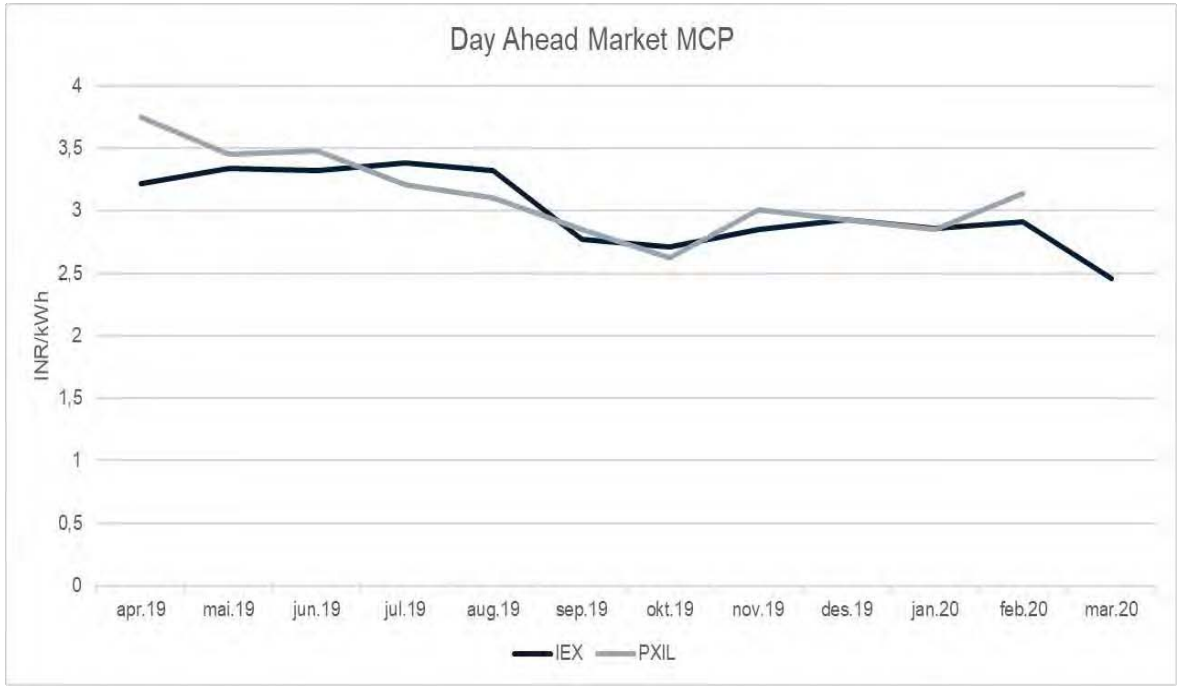
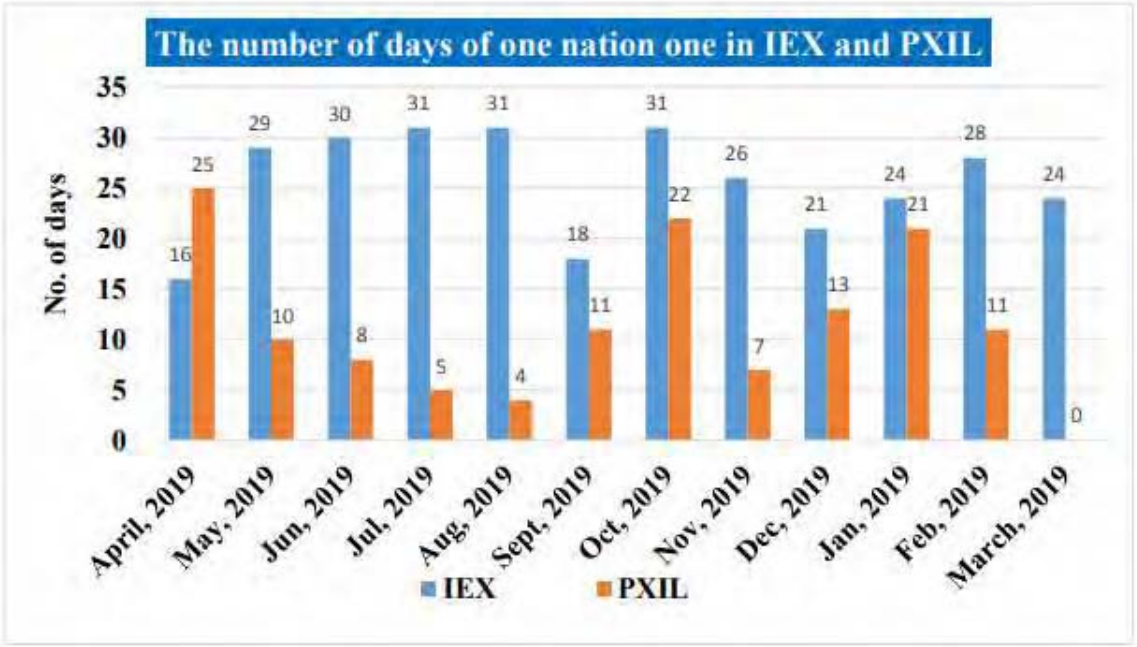




Average clearing price

IEX 3,62 ₹/kWh

PXIL 3,40 ₹/kWh

NORD POOL

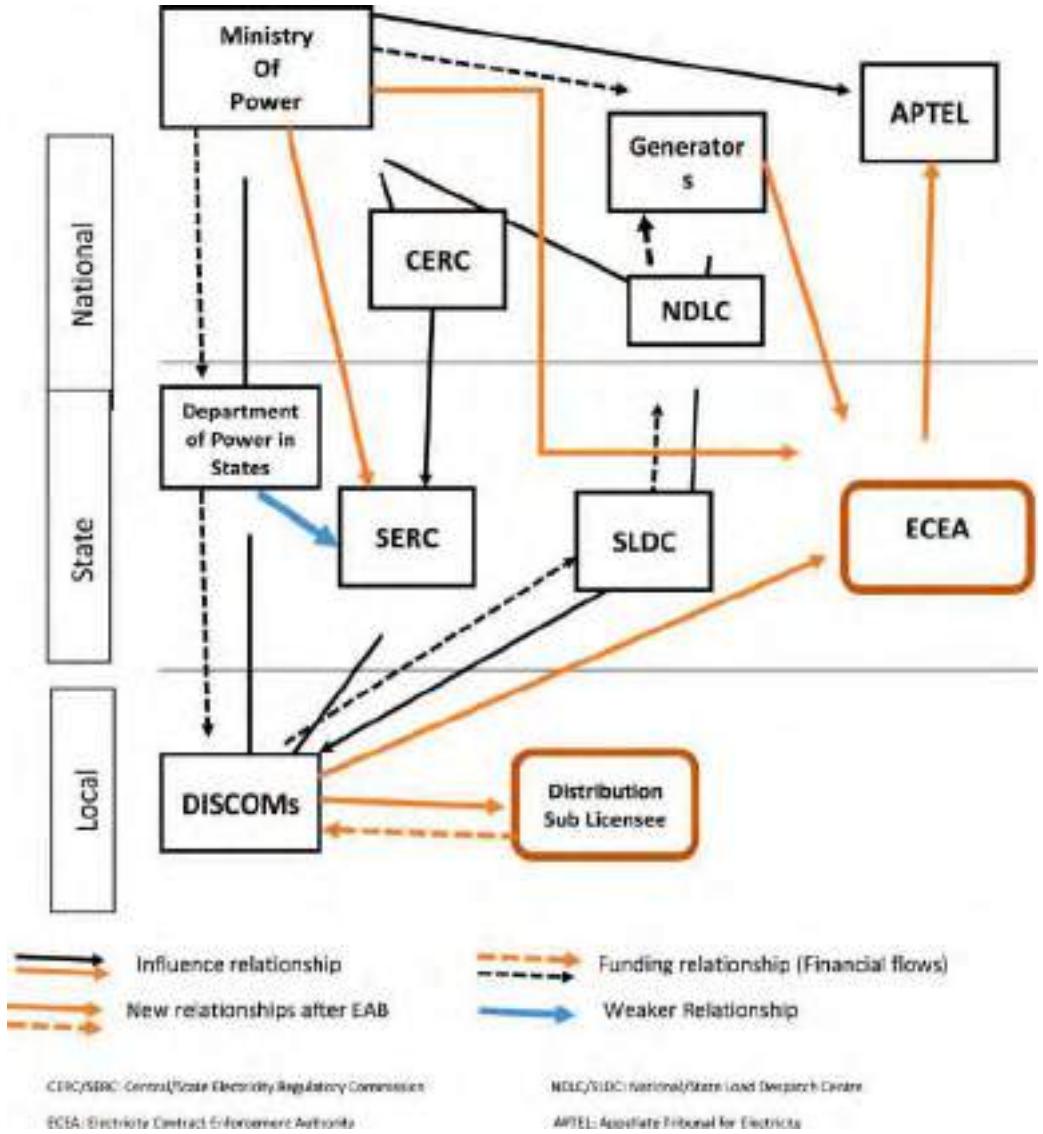
Source:- CERC Market Monitoring report

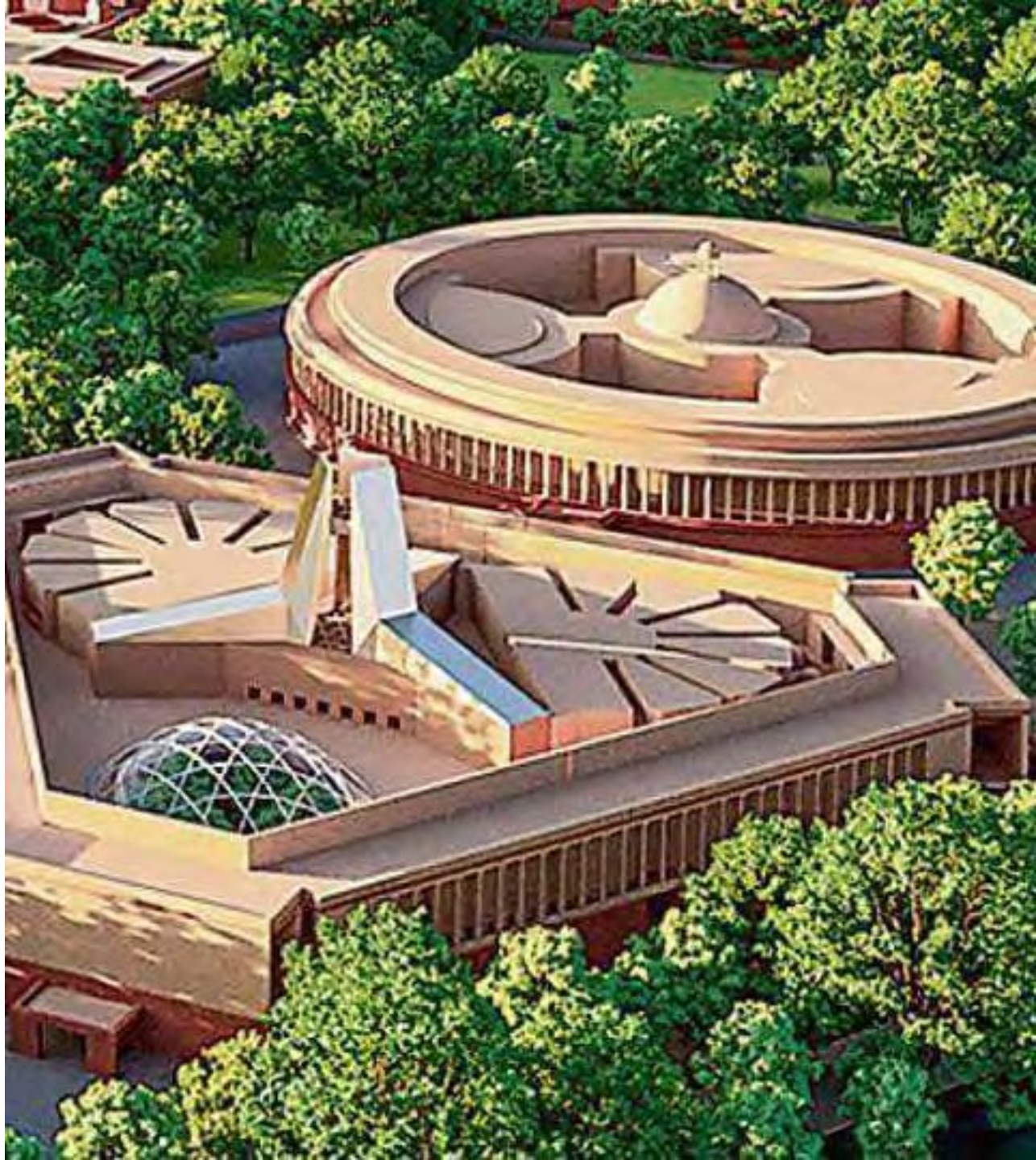
Some New Policy Intiatives

- 277GW of renewable capacity by 2022
- Over 63% share of renewable capacity by 2030

- In October 2021, the Ministry of Power announced a new set of rules aimed at reducing financial stress for stakeholders and safeguarding timely cost recovery in electricity generation.
- In August 2021, the Indian government proposed new rules for the purchase and consumption of green energy. The latest rules are a part of government measures to encourage large-scale energy consumers, including industries, to leverage renewable energy sources for regular operations.
- In July 2021, to encourage rooftop solar (RTS) throughout the country, notably in rural regions, the Ministry of New and Renewable Energy plans to undertake Rooftop Solar Programme Phase II, which aims to install RTS capacity of 4,000 MW in the residential sector by 2022 with a provision of subsidy.
- In July 2021, the Ministry of New and Renewable Energy (MNRE) gave the go ahead to NTPC Renewable Energy Ltd., a 100% subsidiary of NTPC, to build a 4,750 MW renewable energy park at the Rann of Kutch in Khavada, Gujarat. This will be India's largest solar park to be developed by the country's leading power producer.
- In June 2021, Indian Renewable Energy Development Agency Ltd. (IREDA) has invited bids from solar module manufacturers for setting up solar manufacturing units under the central government's Rs. 4,500 crore (US$ 616.76 million) Production Linked Incentive (PLI) scheme.
- As of March 2021, State Bank of India financed Rs. 319.18 billion (US$ 4.28 billion) in renewable energy projects in India, wherein the bank financed 752 renewable energy projects, with a total installed capacity of 13.8 GW.
- In June 2021, the Competition Commission of India (CCI) approved ReNew Power to exchange equity shareholding by its existing shareholders with shares of ReNew Global. Along with this, the CCI also approved a reverse triangular merger of ReNew Global's subsidiary with RMG II.
- In April 2021, the Central Electricity Authority (CEA) and CEEW's Centre for Energy Finance (CEEW-CEF) jointly launched the India Renewables Dashboard that provides detailed operational information on renewable energy (RE) projects in India.
- In April 2021, the Ministry of Power (MoP) released the draft National Electricity Policy (NEP) 2021 and has invited suggestions from all stakeholders such as Central Public Sector Undertakings, Solar Energy Corporation of India, power transmission companies, financial institutions like Reserve Bank of India, Indian Renewable Energy Development Agency, HDFC Bank, ICICI Bank, industrial, solar, and wind associations, and state governments.
- In March 2021, the Union Cabinet approved a Memorandum of Understanding (MoU) in the field of renewable energy cooperation between India and the French Republic.
- In March 2021, Haryana announced a scheme with a 40% subsidy for a 3 KW plant in homes, in accordance with the Ministry of New and Renewable Energy's guidelines, to encourage solar energy in the state. For solar systems of 4-10 KW, a 20% subsidy would be available for installation from specified companies.
- In March 2021, India introduced Gram Ujala, an ambitious programme to include the world's cheapest LED bulbs in rural areas for Rs. 10 (US$ 0.14), advancing its climate change policy and bolstering its self-reliance credentials.
- In the Union Budget 2021-22, Ministry for New and Renewable Energy was allocated Rs. 5,753 crore (US$ 788.45 million) and Rs. 300 crore (US$ 41.12 million) for the 'Green Energy Corridor' scheme.
- Under Union Budget 2021-22, the government has provided an additional capital infusion of Rs. 1,000 crore (US$ 137.04 million) to Solar Energy Corporation of India (SECI) and Rs. 1,500 crore (US$ 205.57 million) to Indian Renewable Energy Development Agency.
- To encourage domestic production, customs duty on solar inverters has been increased from 5% to 20%, and on solar lanterns from 5% to 15%.
- India plans to add 30 GW of renewable energy capacity along a desert on its western border such as Gujarat and Rajasthan.
- The Government of India has announced plans to implement a US$ 238 million National Mission on advanced ultra-supercritical technologies for cleaner coal utilisation.
- Indian Railways is taking increased efforts through sustained energy efficient measures and maximum use of clean fuel to cut down emission level by 33% by 2030.

Policy Field Map





VISION FOR THE INDIAN POWER MARKET: OVERVIEW

The future Indian power sector will be vibrant and diverse

- The Government of India's vision for the 2024 power system is clearly defined in the Five Year Vision of 2019:

  "A sustainable, viable, efficient and competitive power sector catalysing economic and social development"

- The Government's vision is complemented by the Electricity (Amendment) Bill of 2020 focusing on
  - Promotion of renewables,
  - Greater private participation in Distribution,
  - Commitment to introduce retail competition.
- By 2030[1], India plans a power system with 523GW of renewables, growing to over 63% of total capacity
  - in line with the 'Make in India' policy
  - supported by Green Energy Corridors
- Demand will grow +50% by 2030 and customer needs will change driven by strong economic growth, new types of electrical demand (e.g. EVs) and the 'Power for all' programme for universal access
- Renewable power development will cover a range of technologies and scale of installations, including Solar Cities
- The marketplaces and trading formats must match the needs and capabilities of a wide range of new actors and technologies
- Flexibility must come from existing capacity as well as new dedicated capacity, and demand side management using both active and 'passive' participation models

Source:- AFRY(Poyry)

NORD POOL

INDIA ENERGY FORUM

Dimensions

393 GW+
generation capacity

200 GW+
peak demand

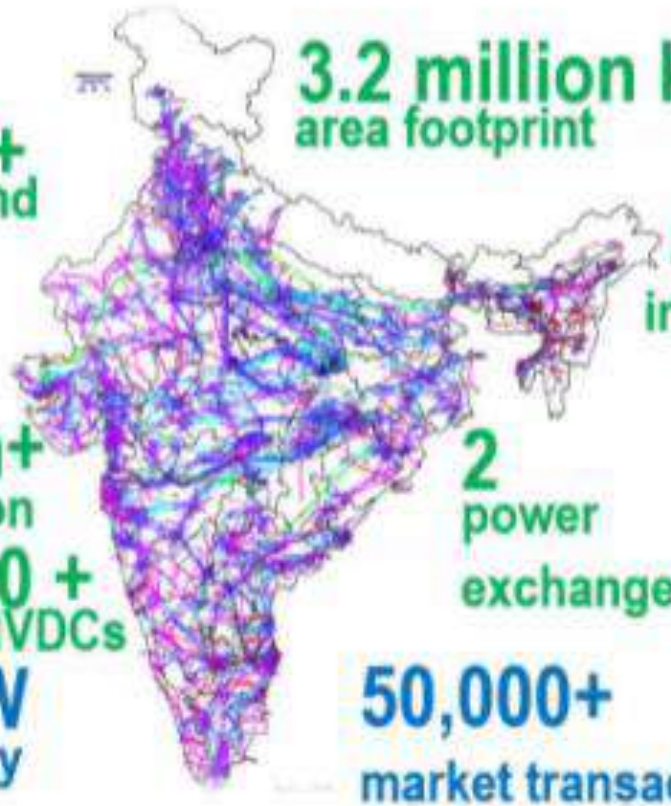
> 4 TWh
daily energy met

425,000 ckm+
EHV transmission

~105 GW
renewables

10 +
HVDCs

~ 100 GW
inter-regional capacity



3.2 million km²
area footprint

1.3 Billion+
people served

4 GW+
international exchanges

120 TWh+
annual market trades

2
power
exchanges

6000+
market participants

50,000+
market transactions

POSOCO

NORD POOL

THANK YOU!

Jwalith Desu

Junior Market Manager

Jwalith.desu@nordpoolgroup.com

https://www.linkedin.com/in/jwalithdesu/

EEX Group and the regulatory framework of energy trading

Anje Stiers
Head of EU Representation Office
22 June 2022

part of eex group

1. About EEX Group

1. About EEX Group

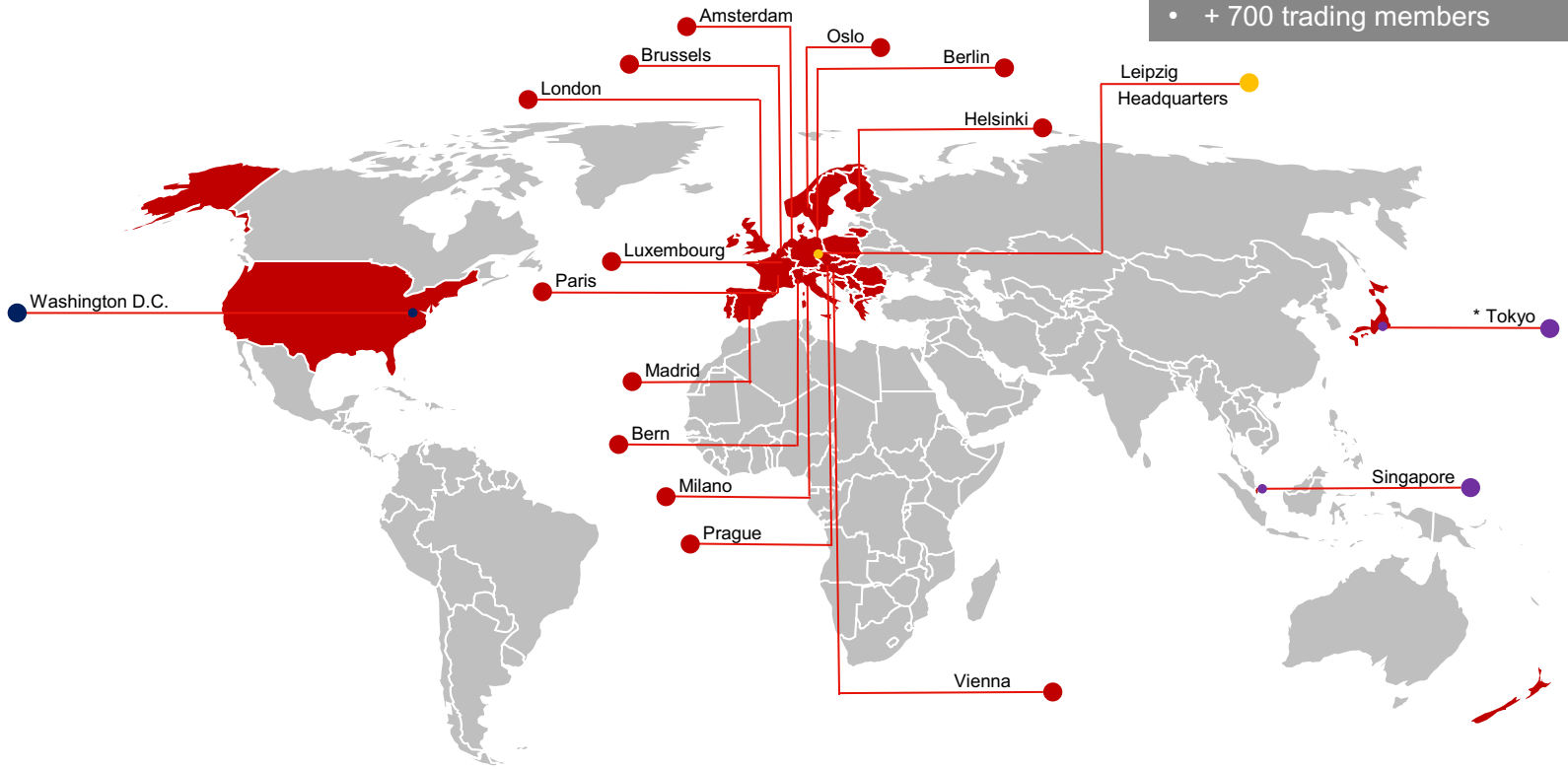
EEX Group is a group of specialised companies providing market platforms for energy and commodity products across the globe. The offering of the group comprises contracts for Energy, Environmentals, Freight, Metals and Agriculturals. The group offers market access and tailor-made solutions to trading participants as well as integrated process handling with its own clearing houses. The companies belonging to the group are specialised for the different markets and provide on-site support for their customers.

EEX Group consists of the trading venues European Energy Exchange (EEX), EEX Asia, EPEX Spot, Power Exchange Central Europe (PXE) and Nodal Exchange as well as the registry provider Grexel Systems and the clearing houses European Commodity Clearing (ECC) and Nodal Clear. EEX Group is based in 17 worldwide locations and is part of Deutsche Börse Group.

1. About EEX Group

EEX Worldwide Coverage: 17 Offices, 5 Time Zones, 3 Continents

- 3 exchanges and 2 clearing houses
- + 700 trading members



* Tokyo Office opening in 2021

Energy Agricultural Environmental Other Base Metals Precious Metals

1. About EEX Group

Shareholders of EEX

The main shareholder is Deutsche Börse AG.

A full list of shareholders is available on the EEX website.

European Energy Exchange AG

75.05%	Deutsche Börse AG
17.03%	Pool of minor shareholders from industrial, energy and financial companies
7.94%	Saxon Shareholders

1. About EEX Group

Business segments EEX Group

	Spot market	Derivative markets (futures)		Derivative markets (options)
	Physical	**Financial**	**Physical**	**Contractual**
Power	Germany, Austria, France, Switzerland, Netherlands, Belgium, GB	Germany, Austria, France, Italy, Spain, Nordic, Switzerland, Belgium, Netherlands, Czech, Hungary, GB, Romania, Slovakia, Poland, Greece, Slovenia, Serbia, Bulgaria, Japan (Tokyo and Kansai)		Germany, France, Italy, Spain
Gas	NCG, GASPOOL, TTF, CEGH, OTE, ETF, PEG, NBP, ZTP, ZEE, PVB, PSV	TTF, CEGH, NCG*	NCG, GASPOOL, TTF, PEG, ZTP, ZEE, NBP, PSV, CEGH, OTE, ETF	TTF
Environmental	EUA, EUAA		EUA, EUAA	EUA
Freight		Dry Bulk Freight		Dry Bulk Freight
Agriculture		Potatoes, Skimmed Milk Powder, Whey Powder, Butter, Liquid Milk		

Both an order book as well as a trade registration functionality are usually offered for spot and derivate market products.

*As of 28/62021

1. About EEX Group

Business segments EEX Group

US markets	Electricity	CAISO*, ERCOT*, ISO-NE*, Mid-C*, MISO*, NYISO*, PJM*, SPP
	Natural Gas	Henry Hub
	Carbon Emissions	RGGI*, WCI*
	RECs	ERCOT*, NEPOOL*, PJM*
	SOx/NOx	23 U.S. states under the Cross-State Air Pollution Rule (CSAPR)
	Trucking Freight	L.A.-Seattle, Seattle-L.A., L.A.-Dallas, Dallas-L.A., Chicago-Atlanta, Atlanta-Philadelphia, Philadelphia-Chicago, East US, South US, West US, National US

Clearing services	HUPX/HUDEX	Hungarian Power Spot and Derivatives
	NorexEco	Nordic Pulp and Paper Futures
	SEEPEX	Serbian Power Spot
	SEMOpx	Irish Power Spot

1. About EEX Group

Market participants

EEX Group connects **588** trading participants from **36** countries:

96 non-European participants:
Bermuda, British Virgin Islands, Canada, Cayman Islands, China, El Salvador, Singapore, South Korea, United States of America

Agenda

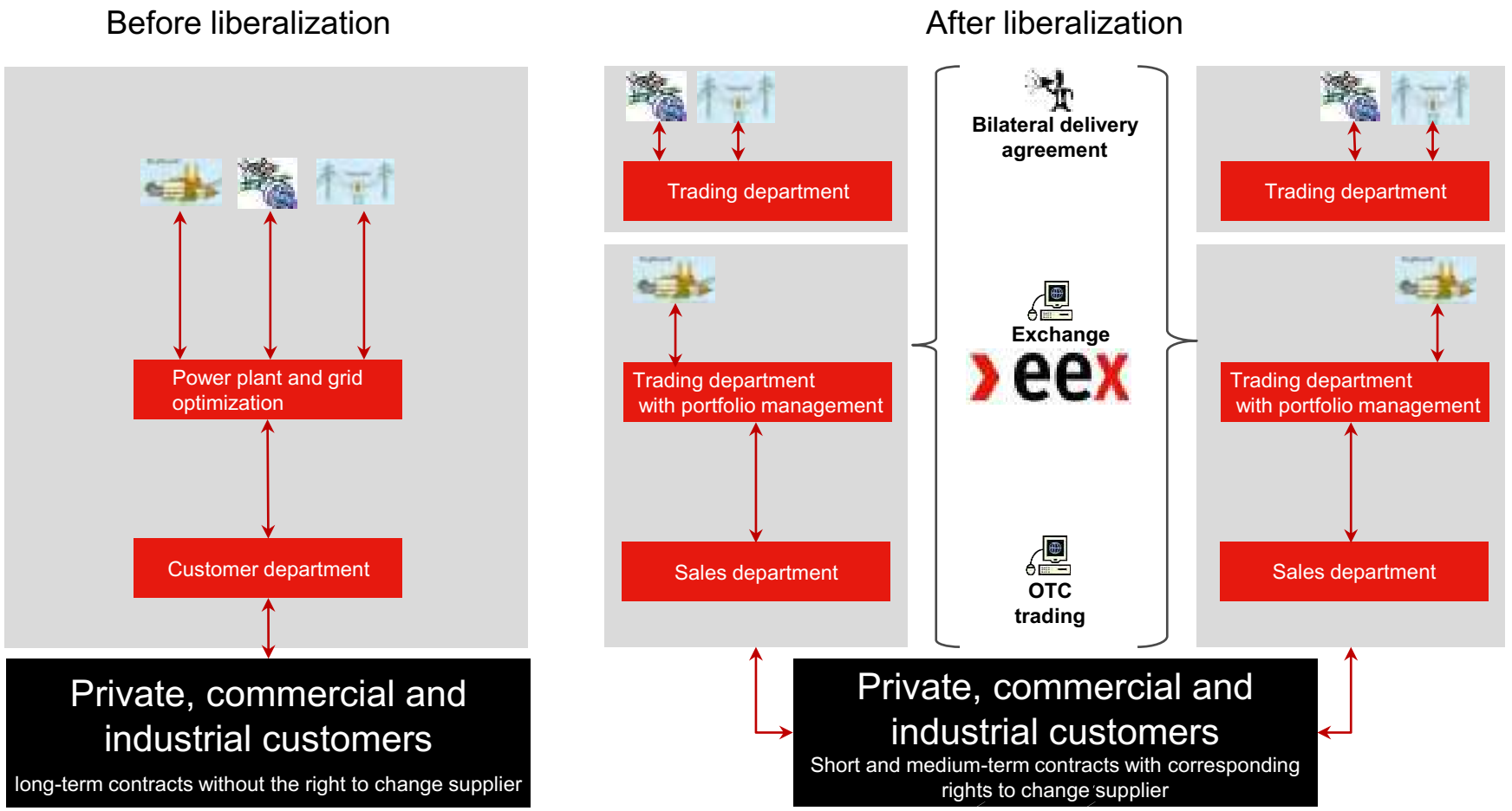
1. About EEX Group

1. Introduction to Energy Trading

3. Regulatory Framework

2. Intro to Energy Trading

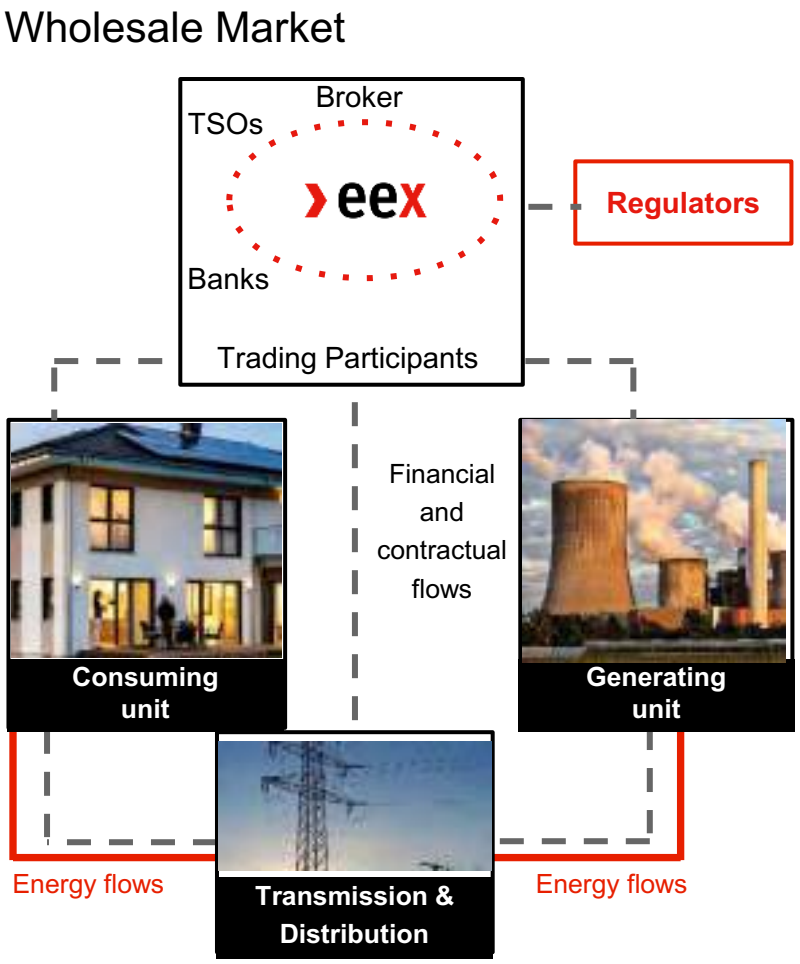
Liberalization of Energy Markets



2. Intro to Energy Trading

Exchange Trading of Energy

- Creating **transparency** through recognised reference prices and the publication of market data
- Access to a large number of trading participants and concentrating liquidity on **one trading platform**
- High degree of **automation** on account of electronic and standardised trading and settlement processes
- **Elimination of the counterparty risk** through clearing and settlement via ECC
- Non-discrimination and **equal treatment of all trading participants** due to anonymity and regulation



2. Intro to Energy Trading

Other Key Trends

Opening up of markets

- Domestic markets are slowly opening up, increasing international participation
- This brings increased liquidity and MPs, leading to more on-exchange trading
- Notably CEE markets are developing and opening up to international participation and exchange trading, as well as diversifying their energy supply

Continuation trend of increased clearing

- There is a long term trend towards more cleared transactions (± 50%)
- This follows maturing of markets, entering of new (types of) MPs
- Large differences between market areas exists

RES investments and hedging

- Increased development of and investment in renewable energy (RES) causes long-term hedging needs
- Subsidy phase out brings new market participants to our derivative markets
- Allowing these markets to grow, the more reliable the price becomes, encouraging more long-term RES projects

Agenda

1. About EEX Group

1. Introduction to Energy Trading

3. Regulatory Framework

3. Regulatory Framework

1. REMIT

1. Intro to Financial Regulation

1. MiFID II / R as Catalyst

1. Other Legislative Acts

1. MiFID II Quick Fix

1. Conclusion

3. Regulatory Framework

EU Energy Policy and Regulatory Framework

European financial legislation

- **MAR/MAD** — Market manipulation, insider trading
- **MiFID II/MiFIR** — Regulating financial market participants, products & operators
- **EMIR** — Clearing thresholds, OTC markets
- **CRD IV/CRR** — Regulatory capital requirements

National and EU authorities

European energy legislation

- **Third & Clean Energy Package** — Unbundling, wholesale market integration, effective retail markets, Network Codes, fundamental data reporting and transparency, clean energy & efficiency targets
- **REMIT** — Market abuse, data and transparency

3.1. REMIT

Historical Background

What triggered REMIT?

- The **global financial crisis** in 2008 dictates a wide reform of the surveillance framework

- **Previous Regulation** considered to be inadequate:
  - Financial regulation not fully adapted to energy market
  - Energy regulation not fully addressing monitoring of energy markets
  - No optimal coordination and fragmented legislation in relation to cross-border cases

Need for …

1. Market Abuse Definitions and Prohibitions

1. Market Monitoring

1. Investigation and Enforcement

3.1. REMIT

At a Glance

Scope	• Trading wholesale energy products: Contracts for gas and electricity / Commodity and transportation /Spot and Derivative.
Transparency	• Obligations for market participants to register and disclose inside information
Integrity	• Explicit prohibitions of abusive practices in wholesale energy markets
Monitoring	• A new, sector-specific, comprehensive and effective monitoring framework for wholesale energy markets
Cooperation	• Close cooperation & coordination between ACER (EU-wide monitoring) and NRAs (national monitoring, investigation and enforcement)

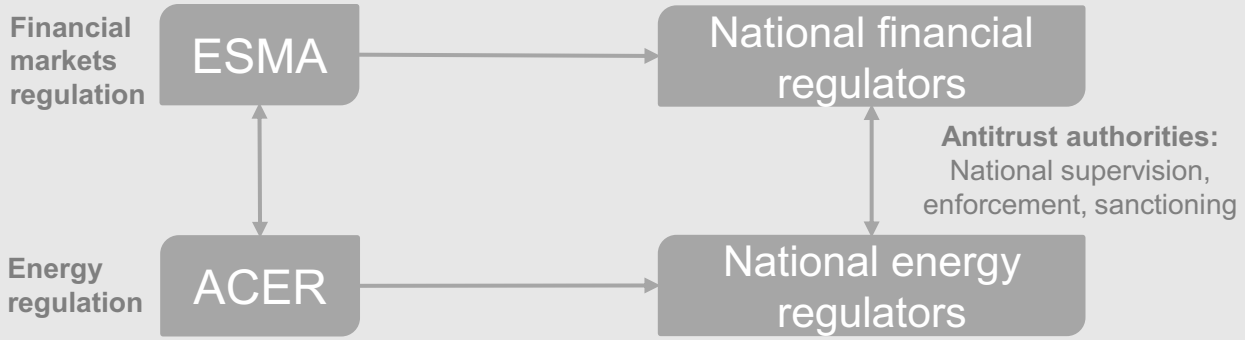
3.2. Intro to Financial Regulation

EU Energy Policy and Regulatory Framework

European financial legislation

- **MAR/MAD** — Market manipulation, insider trading
- **MiFID II/MiFIR** — Regulating financial market participants, products & operators
- **EMIR** — Clearing thresholds, OTC markets
- **CRD IV/CRR** — Regulatory capital requirements
- **BMR** — Benchmarks

National and EU authorities



European energy legislation

- **Third & Clean Energy Package** — Unbundling, wholesale market integration, effective retail markets, Network Codes, fundamental data reporting and transparency, clean energy & efficiency targets
- **REMIT** — Market abuse, data and transparency

3.2. Intro to Financial Regulation

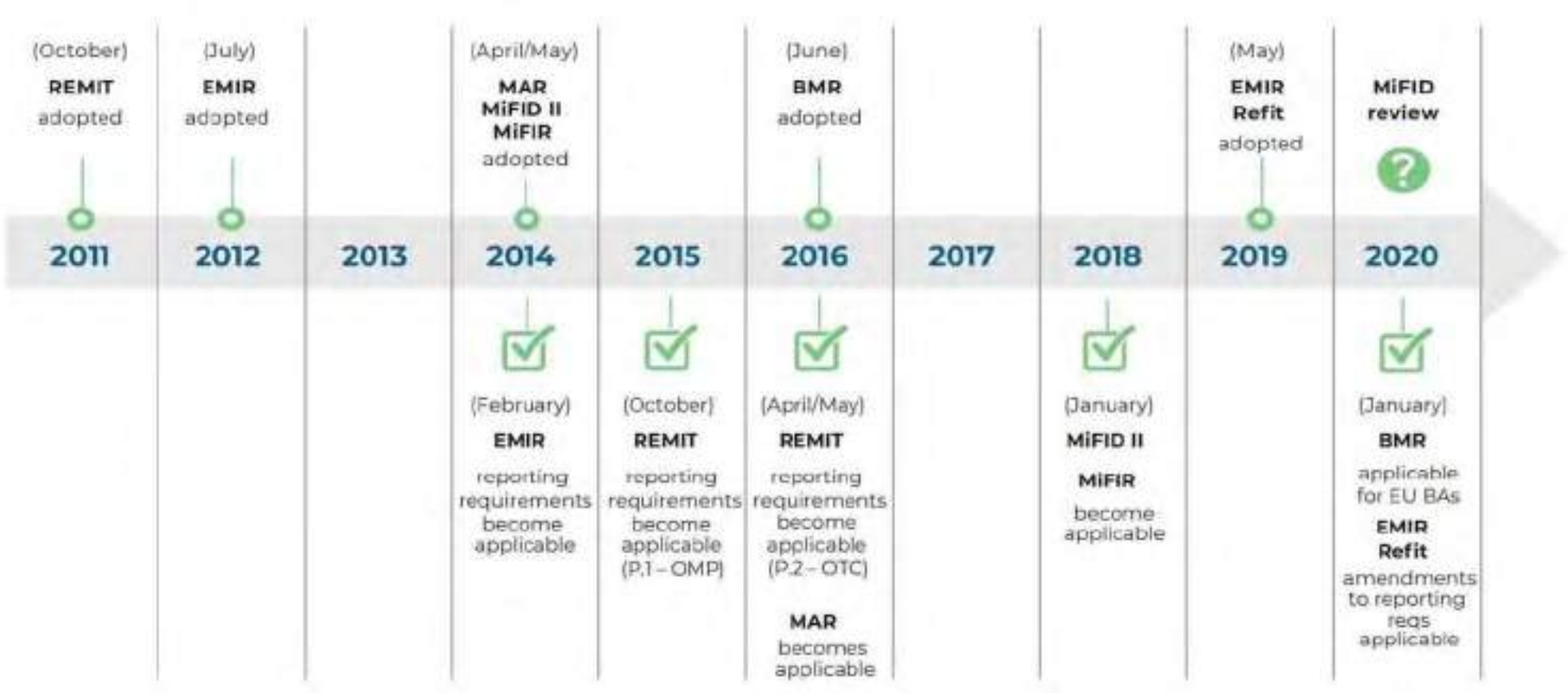
G20 Pittsburgh Commitments: 2009

"… all standardised OTC derivative contracts should be traded on exchanges or electronic trading platforms, where appropriate, and cleared through central counterparties by end-2012 at the latest."

"… improve the regulation, functioning and transparency of financial and commodity markets to address excessive commodity price volatility."

3.2. Intro to Financial Regulation

Chronological development of the regulatory framework



3.3. MiFID II / R as catalyst

The Ancillary Activity Exemption & REMIT Carve-Out

		MiFID I		MiFID II
Ancillary Activity Exemption	Art 2(a)(k)	Main business consists of dealing on own account in commodities and/or commodity derivatives		Deleted
	Art 2(1)(i)	Dealing on own account in financial instruments, or providing investment services in commodity derivatives, provided the activity is ancillary to their main business		Dealing on own account in commodity derivatives or emission allowances and derivatives thereof or providing investment services in such instruments to customers / suppliers, provided the activity is ancillary to their main business
Financial Instrument Definition	Annex I Section C6	Commodity derivatives that **can be physically** settled provided that they are traded on a regulated market and/or an MTF.		Commodity derivatives that can be physically settled provided that they are traded on a regulated market, a MTF, or an OTF, except for wholesale energy products **traded on an OTF** that **must be physically settled.**

Ancillary Activity Exemption is born, incl.
- Liquidity Provision Exemption
- Hedging Exemption
- Intra-Group Transactions Exemption

REMIT Carve-Out is born – gives rise to many OTFs

3.3. MiFID II / R as catalyst

The Ancillary Activity Exemption

Two tests to be passed at group level, on an asset-class basis.

1. **« Market share test »** : Is the size of the trading activity at group level below a certain percentage of EU trading?

2. **« Main business test »**: Is the size of the trading activity at group level below a certain percentage of the size of the main activity undertaken by the group? Two methods:

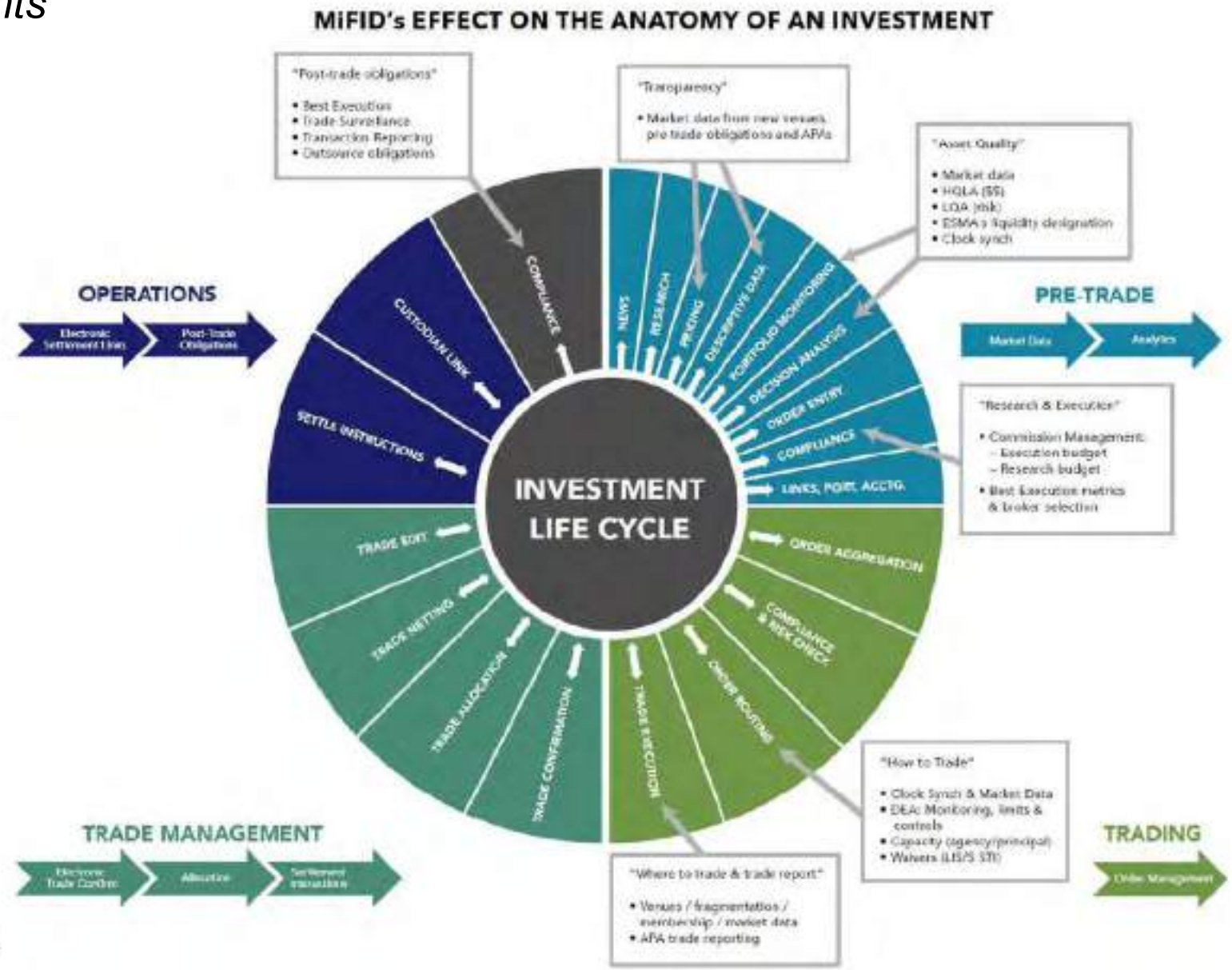
   - Trading Activity Test. If failed, backstop possible.

	Market Share Threshold by Asset Class							
Speculative Ratio	Gas	Power	EUA's	Coal	Oil/oil products	Agricultural commodities	Metals	C10's
< 10%	3%	6%	20%	10%	3%	4%	4%	15%
10-50%	1.5%	3%	10%	5%	1.5%	2%	2%	7.50%
50%	0.6%	1.2%	4%	2%	0.6%	0.8%	0.8	3%

   - Capital Employed Test

3.3. MiFID II / R as catalyst

Other Highlights



3.3. MiFID II / R as catalyst

Other Highlights

(L1) Legal Basis		Obligation	
MiFIR	Art 8 & 9	Pre-Trade Transparency	Trading venue shall **make public current bid and offer prices** and the depth of trading interests at those prices which are advertised through their systems, on a continuous basis during normal trading hours.
	Art. 26	Transaction Reporting	Investment firms should **report "complete and accurate details of transactions i**n financial instruments to the competent authority as quickly as possible, and no later than the close of the following working day". Trading venues should do so for non-investment firms.
MiFID II	Art. 58	Position Reporting	Participants of trading venues must **report to the trading venue on a daily basis a complete breakdown of their positions** in commodity derivatives, emission allowances, and derivatives of emission allowances. Trading venue passes on those reports to NCA, and on a weekly basis, to ESMA.
	Art. 57	Positions Limits	Clear quantitative **thresholds for the maximum size of a net position** in a commodity derivative that persons can hold. Per contract per venue / Two types of limits; spot month & other months / ESMA baseline limit of 25% of deliverable supply and open interest resp. / Allowed to be adjusted by NCA on the basis of 7 factors / Non financial entities are eligible for a hedging exemption.
+ other legislative acts applicable to financial instruments!			

3.4. Other Legislative Acts

Act	Obligation
EMIR (2.1 & 2.2)	Introduces a **clearing obligation** for financial counterparties (FCs) and non financial counterparties (NFCs) exceeding particular clearing thresholds, introduces **reporting requirements** for all OTC and ETD contracts, introduces obligation for FCs and NFCs+ to exchange **initial and variation margin** for transactions in non-cleared OTC derivatives. EMIR 2.1 lowers the reporting burden for NFCs and removes the “breach one clear all” principle related to the clearing obligation.
MAR/MAD	MAR prohibits **insider dealing, the unlawful disclosure of inside information and market manipulation** in financial instruments, including commodity derivatives. This also includes the requirement to publish inside information. The definition is specific to commodity derivatives. Important parallels with REMIT.
CRD IV / CRR	Prudential framework for credit institutions and investment firms. **Commodity dealer exemption**.
BMR	Framework for **administration and governance of benchmarks**, including commodity benchmarks.
CCP R&R	Measures to be taken in extreme but plausible events of financial distress, requiring CCPs to draw up **recovery plans** to be reviewed by the CCP’s supervisory authority. The latter receives **powers to intervene in the operations of CCPs** where their viability is at risk.

3.4. Other Legislative Acts

Overlapping reporting requirements for energy trading

	EMIR	REMIT	MiFID II/MIFIR	MAR
Transactions	✓	✓	✓	-
Orders	-	✓	-*	-
Reference Data	-	-	✓	✓
Positions	✓	-	✓	-
Exposures	✓	-	-	-
Spot	-	✓	-	-
Derivatives	✓**	✓	✓**	✓**
Power & Natural Gas	✓	✓	✓	✓
Other commodities	✓	-	✓	✓

*Only record-keeping and pre-trade transparency required **For regulated markets only

3.5. MiFID II Quick Fix

Scope reduction

- Commodity derivatives deemed significant or critical i.e. with an open interest of at least 300.000 lots on overage over 1 year
- Agriculture contracts that have an underlying that is for human consumption

Exemptions

- Hedging exemption becomes available for financial entities part of a predominantly commercial group
- Introduction of a liquidity provision exemption for financial and non-financial entities

Same contracts

- NCA of the TV where the largest volume of trading takes place, will set a single PL on all trading in that derivative
- ESMA settles any dispute

Position management controls

- RTS to specify position management controls

Ancillary activity exemption

- Meet one of 3 tests to be exempt: capital employed test, trading test or de-minimis threshold of EUR 3bn OTC exposure

3.6. Conclusion

Regulatory Framework for Energy Trading

Market Integrity

- Market abuse prohibitions under MAR.
- Rules for administration and governance of benchmarks under BMR.
- Position limits under MAR
- Market abuse prohibitions under REMIT

Transparency

- Requirement to publish inside information under MAR
- Transaction reporting under REMIT & MiFIR & EMIR
- Pre-and post trade transparency regimes under MiFIR
- Financial instruments reference data reporting under MiFIR & MAR
- Position reporting under MiFID II & EMIR]
- Order reporting under REMIT & order record keeping obligations under MiFIR

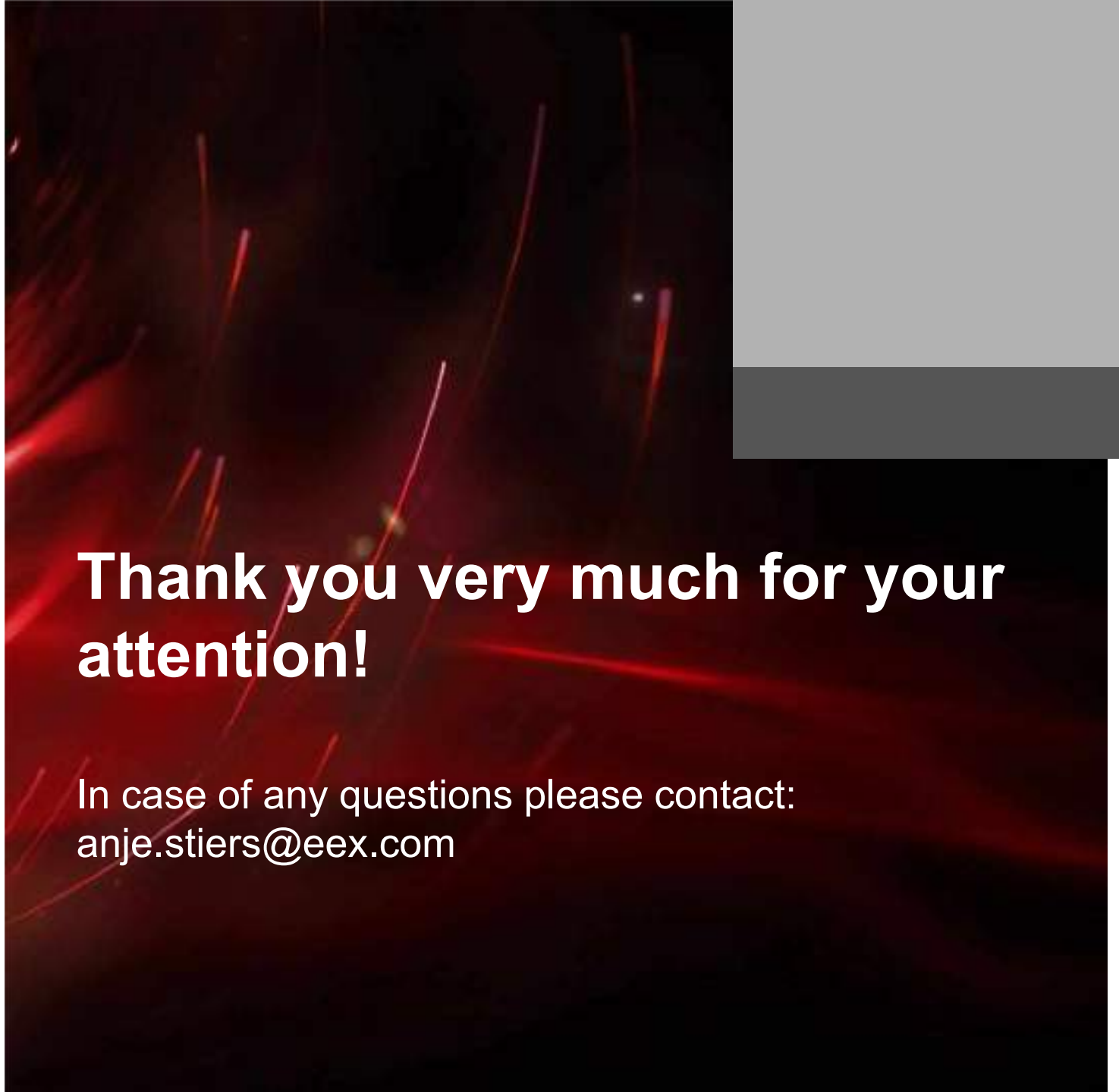
Prudential Requirements

- The prudential requirements under CRR.
- Clearing obligation under EMIR.
- Risk mitigations & CCP requirements under EMIR.

Supervision

- National Financial Regulators
- National Energy Regulators
- ACER
- ESMA
- European Commission

Questions or comments?



Thank you very much for your attention!

In case of any questions please contact:
anje.stiers@eex.com

part of eex group

Sustainable finance: what is it?

- "Shifting the trillions" – *German Federal Sustainable Finance Strategy*
- "Channelling money towards sustainability and the European Green Deal" – *European Council*
- "Capital markets are one of the most powerful tools in the fight against climate change, and one of the most overlooked" - *UNEP Finance Initiative*

Global electricity generation: annual investment increases from about USD 0.5 trillion over the past 5 years to USD 1.6 trillion in 2030. **By 2030, annual investment in renewables is around USD 1.3 trillion.**

European Union: **annual investment increase of €3.5 billion** between 2020-2030, compared to 2010-2020.

This goes well beyond the capacity of public budgets, especially in times of economic recovery.

There is an urgent need to align large-scale (private) investments to the climate goals.

There is a clear need to efficiently allocate capital (and risks) and increase cost-competitiveness of zero-carbon solutions.

An increasing sense of urgency by policy makers and private companies and the promise of a green recovery highlights the critical importance of markets in taking climate change into account.

How EEX Group supports climate neutrality

We develop new and improve existing markets and products to support the energy transition and a sustainable economy.

1 Carbon pricing to guide efficient decarbonisation

- EEX manages the EU ETS emission allowances auction platform.
- EEX runs growing secondary markets for EUAs and EUAAs.

2 Power markets to support RES development

- EEX allows trading closer to real time to facilitate renewable market integration.
- EEX allows trading longer ahead to hedge renewable investments.

3 Registry services for tracking of green power

- We operate registry solutions for Guarantees of Origin in France, providing information to consumers on the source of their energy.
- Grexel operates 15 energy certificate registries.

4 Increasingly sustainable product offering

- EEX further develops biomass offering, providing long term price signals to this growing commodity.
- Epex Spot organises local flexibility markets.
- We work towards new and sustainable market offerings.

3. Volumes & Developments

EEX Power Derivatives

Power Futures

EEX Belgian Futures
EEX-PXE Bulgarian Futures
EEX-PXE Czech Futures
EEX Dutch Futures
EEX GB Power Futures
EEX French Futures
EEX Greek Base Futures
EEX-PXE Hungarian Futures
EEX Italian Future
EEX Nordic Future
EEX Austria Futures
EEX German Futures
EEX German/Austrian Futures
EEX-PXE Polish Future
EEX-PXE Romanian Future
EEX-PXE Serbian Future
EEX-PXE Slovakian Future
EEX-PXE Slovenian Future
EEX Spanish Future
EEX Swiss Future

Power Options

EEX German Options
EEX Italian Base Options
EEX Spanish Base Options

3. Volumes & Developments

EEX Power Derivatives

Commodity	Year 2020	Year 2019	Change
EEX Power Derivatives Market Europe (MWh)	**4,736,334,586**	**3,972,612,379**	**19%**
German Power Futures	3,006,053,525	2,596,674,325	16%
French Power Futures	550,907,818	356,399,216	55%
Italian Power Futures	545,759,553	568,552,607	-4%
Hungarian Power Futures	220,142,027	124,719,329	77%
Spanish Power Futures	189,399,417	150,853,968	26%
Other CSEE Power Futures[1]	57,665,726	61,684,821	-7%
Dutch Power Futures	47,228,932	31,036,412	52%
Austrian Power Futures	12,937,290	15,081,892	-14%
Swiss Power Futures	7,511,076	8,239,310	-9%
Nordic Power Futures	5,589,278	894,706	525%
Belgian Power Futures	5,235,366	2,350,345	123%
Other Power Futures Markets Europe[2]	3,780,493	5,097,724	-26%
GB Power Futures	3,545,992	616,650	475%
Power Options	80,578,093	50,411,074	60%
EEX Power Derivatives Market Japan (MWh)	**587,172**	**n/a**	**n/a**
Nodal Power Derivatives Market US (MWh)	**1,718,837,611**	**1,857,109,762**	**-7%**
EPEX Power Spot Market Europe (MWh)[3]	**621,608,883**	**597,982,246**	**4%**
Total Volume EPEX Day-Ahead	510,439,121	506,323,212	1%
Total Volume EPEX Intraday	111,169,762	91,659,033	21%
EEX Group Global Power Total (MWh)	***7,077,368,252***	***6,427,704,387***	***10%***

4,736 TWh
traded in EEX European Power in 2020

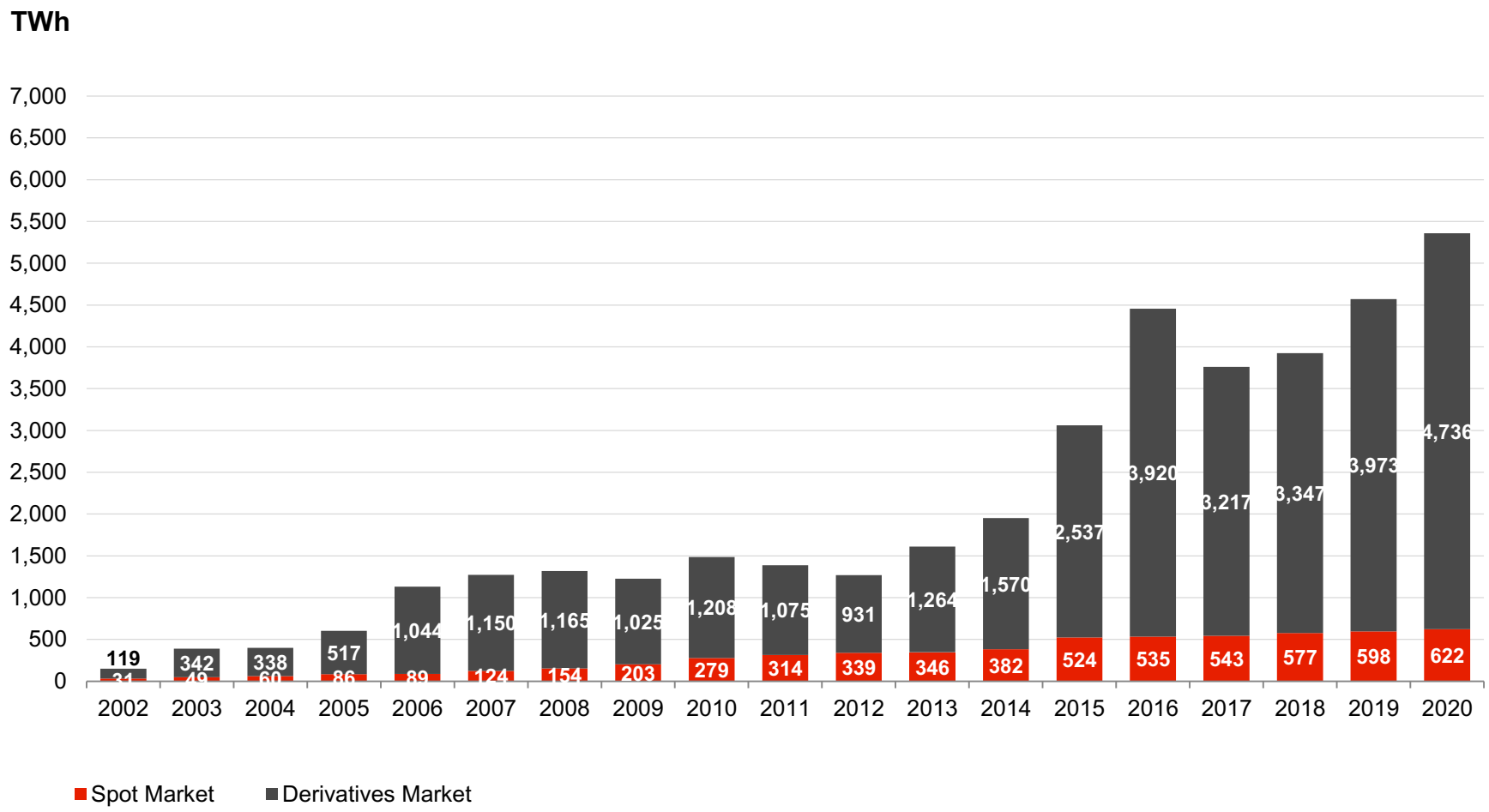
+10%
overall increase in EEX Group Power

587.2 GWh
total trading volume Japanese Power Derivatives since launch in May 2020

1 Includes EEX-PXE Czech, Polish, Slovakian, Slovenian, Serbian, Romanian and Bulgarian Power Futures
2 Other markets includes EEX Greek Power Futures and German/Austrian Power Futures.
3 Includes EPEX SPOT, SEEPEX & PXE power spot volumes.

3. Volumes & Developments

Trading Volume on the Power Spot and Derivatives Market



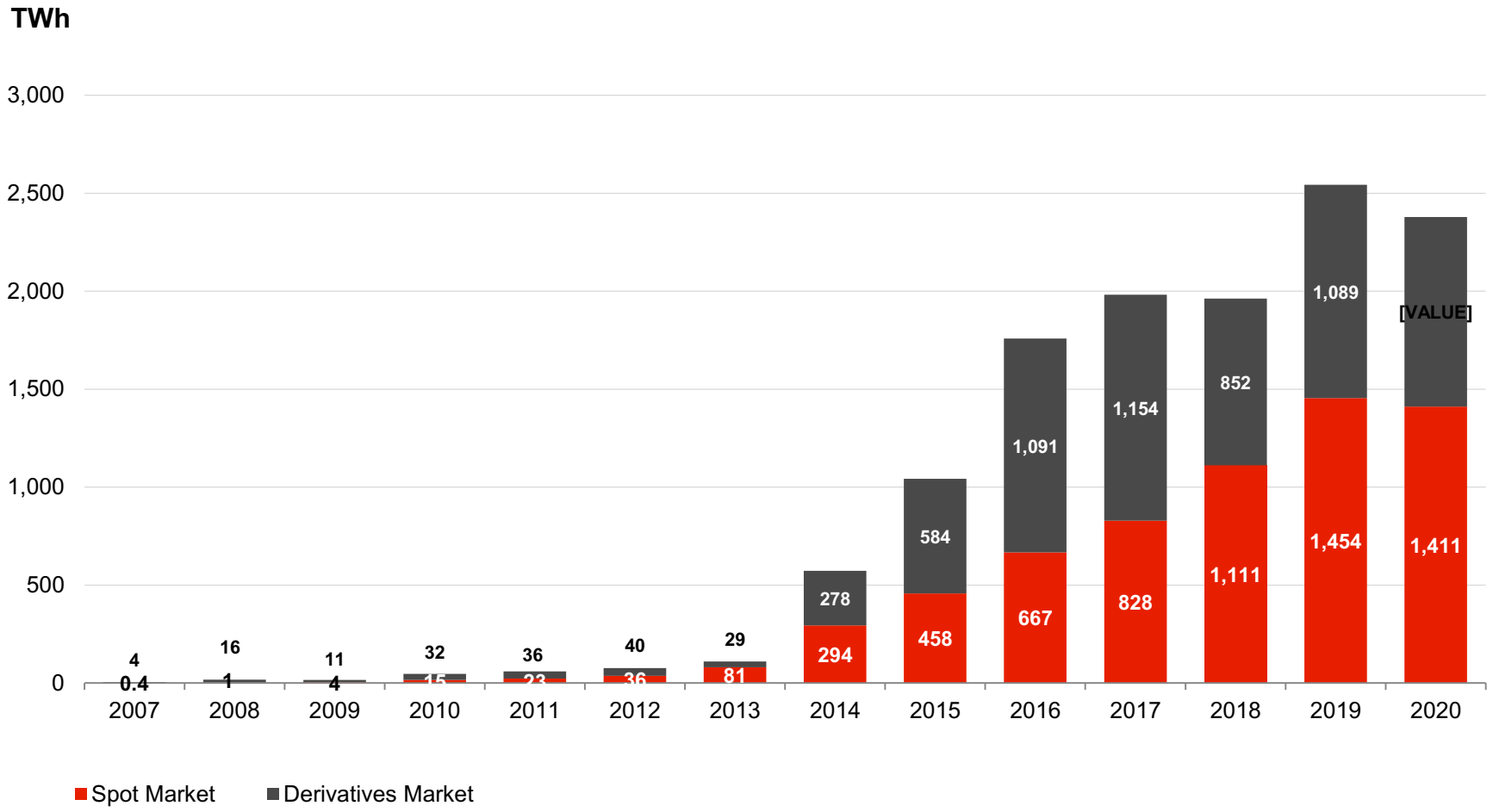
3. Volumes & Developments

Gas Markets

- EEX allows its members to trade natural gas contracts in the Austrian, Belgian, Czech, Danish, Dutch, French, German, Italian, Spanish and UK market areas.
- The natural gas product range covers spot, futures and option contracts for the major European gas hubs as well as trading in location spread strategies between these market areas.
- EEX also offers a Trade Registration service for LNG futures, settled against S&P Platts' JKM® Index, currently the most reliable price estimate for the Asian region.

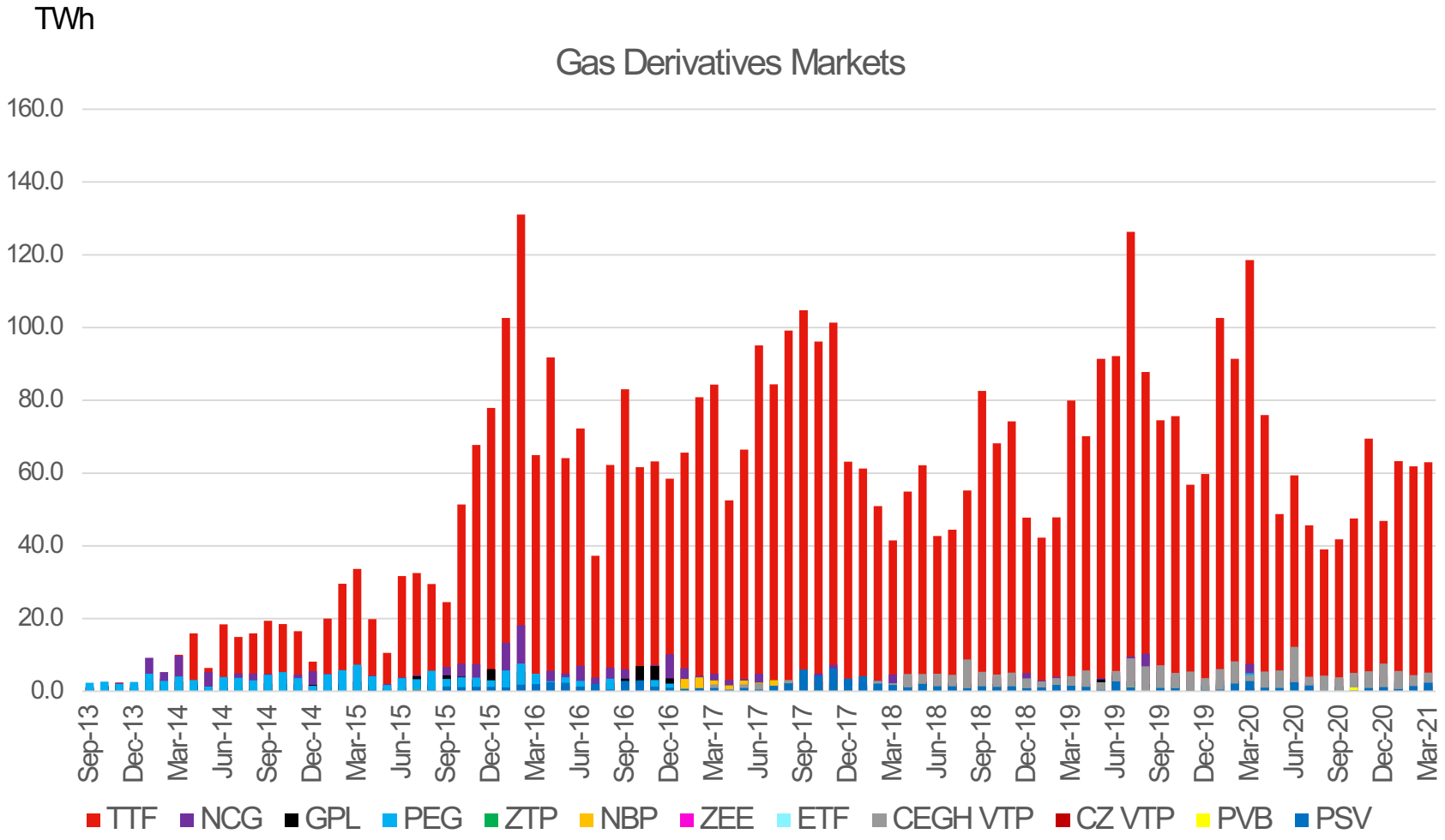
3. Volumes & Developments

Trading Volume European Gas Spot and Derivatives Market



3. Volumes & Developments

Volume on the EEX Gas Derivatives Markets

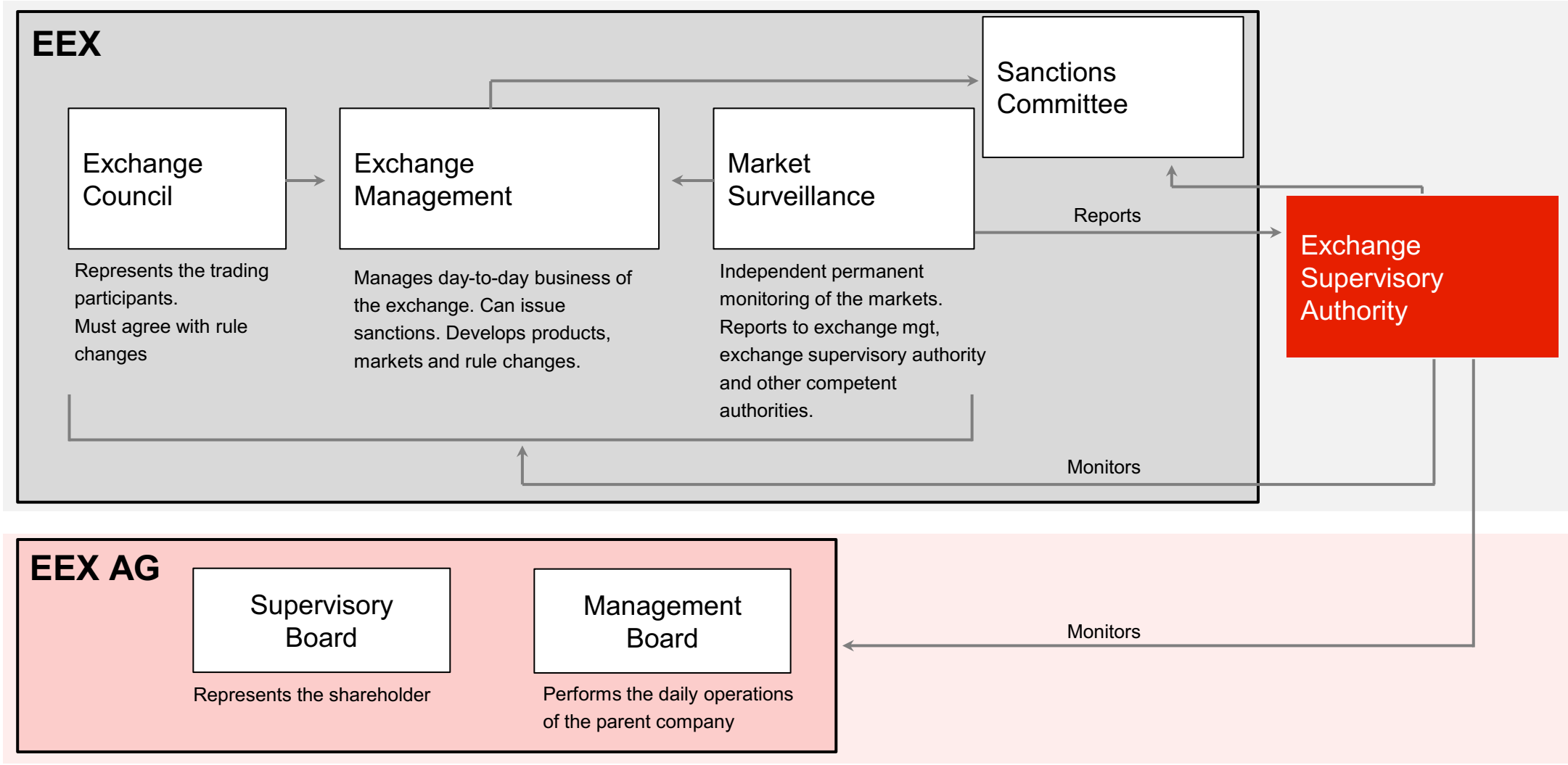


3. Set-up of the Exchange

Exchange bodies and supervision

Public Law

Private Law



3. Set-up of the Exchange

Insight: Market Surveillance

- Is the „prolonged arm“ of the Exchange Supervisory Authority of the Saxon State Ministry for Economic Affairs, Labour and Transport (SMWA) – for supervision of EEX markets on a daily basis.
- Consists of the Head of Market Surveillance and eight member of staff with different professional qualifications.
- Has access to all exchange data.
- Has, according to the German Exchange Act, wide-ranging rights. E.g. request information from market participants.
- Is independent and carries necessary investigation out. The member of staff are subject to a privileged protection against dismissal.
- Does not impose penalties or sanctions but informs the Exchange Supervisory Authority (SMWA), the Exchange Management Board and if necessary the Federal Financial Supervisory Authority (BaFin).

3. Set-up of the Exchange

Admission Rules

Preconditions for admission

In order to become an EEX participant various admission requirements must be met

- The preconditions for admission as a trading participant at EEX are regulated in
  - section 14 et seq. of the EEX Exchange Rules
  - section 19 (4) of the German Exchange Act (BörsG)

- Recognition as a trading participant by the clearing house European Commodity Clearing AG (ECC)
  - A clearing agreement between ECC, trading participant and aclearing bank needs to be signed
  - Trading participants need to pass the KYC process of ECC

- Proof of personal reliability and professional qualifications of the person(s) holding management authority
- Proof of liable equity of at least € 50,000
- Traders need to be reliable and pass a trader exam before getting admitted
- Technical connection to the trading system(s) is required

EMIR and OTC Derivatives

DG FISMA, Unit C2

June 2022

Lessons drawn from the 2008 crisis

The 2008 financial crisis exposed:

- ***weaknesses in the structure of the OTC derivatives** markets that had contributed to the build-up of systemic risk*

- *a potential for contagion arising from the interconnectedness of OTC derivatives market participants and the **limited transparency** of counterparty relationships*

G20 Commitments, Pittsburgh, 2009

***Improving over-the-counter derivatives markets**:*

- *All standardized OTC derivative contracts should be traded on exchanges or electronic trading platforms, where appropriate, and cleared through central counterparties*
- *OTC derivative contracts should be reported to trade repositories*
- *Non-centrally cleared contracts should be subject to higher capital requirements*

 EMIR is the European response to the G20 commitments

Links to EMIR and core delegated regulations

EMIR:

EUR-Lex - 32012R0648 - EN - EUR-Lex (europa.eu)

Clearing thresholds and clearing obligation:

EUR-Lex - 32013R0149 - EN - EUR-Lex (europa.eu)
EUR-Lex - 32015R2205 - EN - EUR-Lex (europa.eu)
EUR-Lex - 32016R1178 - EN - EUR-Lex (europa.eu)
EUR-Lex - 32016R0592 - EN - EUR-Lex (europa.eu)

Margin requirements for non-cleared derivatives:

EUR-Lex - 32016R2251 - EN - EUR-Lex (europa.eu)

But first, what are derivatives?

A derivative is a financial instrument that **derives** its value from the performance of an underlying asset and is used to transfer risk from one party to another. There is a wide range of financial and non-financial instruments that can be used as underlying assets.

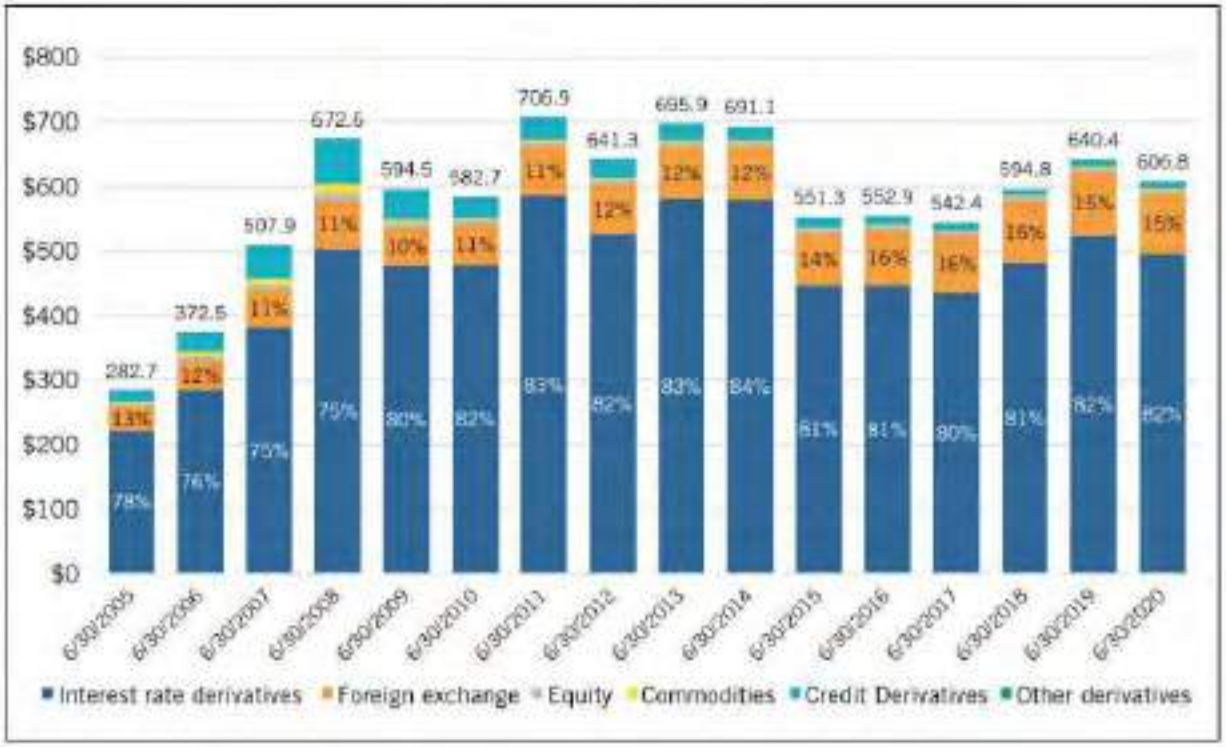
Derivatives can be classified as OTC or exchange-traded derivatives (ETD):

- OTC derivatives are customized contracts that are privately negotiated and booked directly between two counterparties. These derivatives are executed either on trading platforms or bilaterally (by voice or electronically).
- ETDs are standardized contracts that are traded on organized exchanges.

Example of Derivatives Users

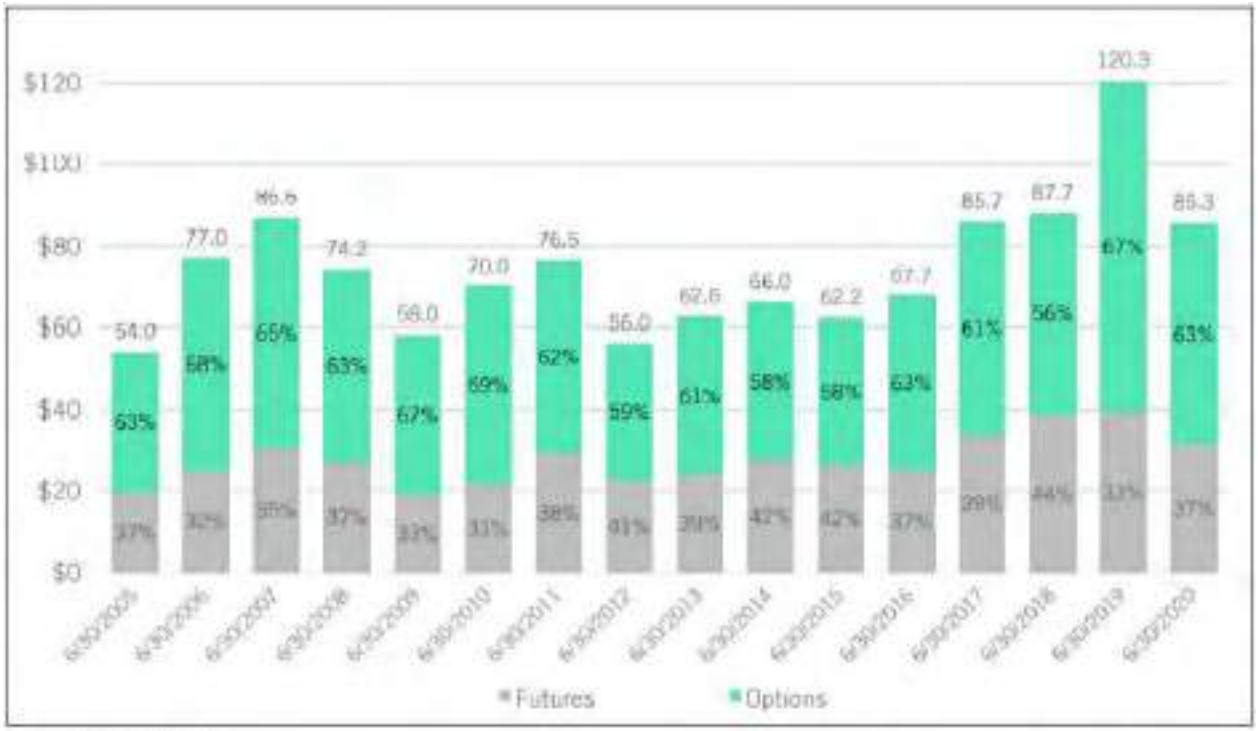
Users	Underlying Risks	Derivative Types
Commodity manufacturers	Commodity price	Commodity derivatives
Multinational companies	Funding cost of foreign debt issuance and investments	Cross-currency swaps/FX forwards
Life insurers	Asset-liability management	Interest rate swaps or swaptions
Corporate treasurers	Funding cost before debt issuance	Forward rate agreements
Construction firms	The cost of raw materials	Commodity derivatives
Exporters	Foreign exchange (FX) fluctuations	Cross-currency swaps/FX forwards
Bank or loan portfolio managers	Credit risk of bond or loan exposures	Credit default swaps
Equity investors	Equity prices	Equity derivatives
Governments	Interest rate risk on new bond issuance	Interest rate swaps

The global OTC derivatives notional was $606.8 trillion at the end of June 2020 (598.4 at the end of December 2021)



Source: BIS OTC Derivatives Statistics

In comparison the Open Interest in ETDs is smaller



Source: BIS ETD Statistics

G20 Commitment to Centrally Clear

Central clearing reduces systemic risk stemming from the OTC derivatives markets by:

- *Breaking interconnectedness between market participants: 'domino effect'.*
- *Ensuring positions are collateralised and mutual guarantee funds are maintained.*
- *Centrally managing defaults.*

Who does EMIR affect?

Applies to all private EU users of derivatives, even when trading with non-EU firms: Financial counterparties, (FCs) including banks, cooperatives, funds, insurers and non-financials counterparties (NFCs)

Lower requirements apply to NFCs that only use derivatives to hedge real economy needs (NFCs-)

Key requirements

1. Reporting to Trade Repositories

1. Central Clearing for OTC derivatives

1. Risk mitigation for non-cleared OTC derivatives

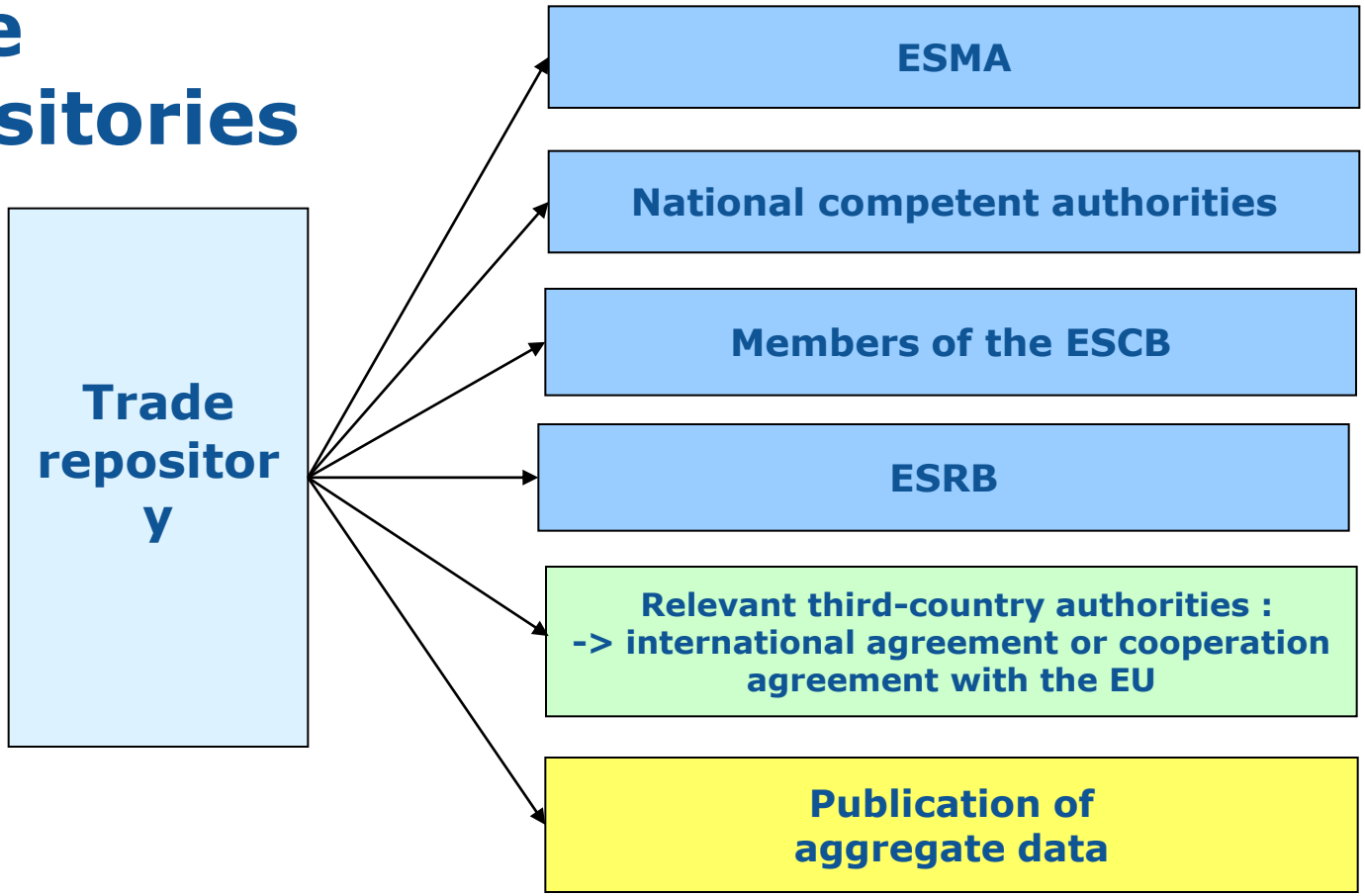
1. Standards for TRs and CCPs (won't develop today)

Key Requirements - Reporting to TRs

- ALL counterparties must report ALL derivative transactions – both exchange traded and OTC – to TRs (or ESMA if no TR is available for a given contract).

- Data in TRs available to regulators – transparency on individual firms and market wide activity.

Access to trade repositories



Key requirements - Central Clearing for OTC derivatives

- ESMA determines which products should be cleared through CCPs: at the moment there is a clearing obligation on certain Interest Rate Derivatives and certain Credit Default Swaps classes

- Financial counterparties and NFC+ must clear those contracts through EU CCPs or recognised third country CCPs

A mandatory clearing obligation applies to contracts between any combination of:

- **Financial Counterparties**
- **NFCs that are above the clearing threshold**

The clearing obligation applies to all OTC derivative contracts once one of the thresholds is reached:

- **Transactions designed to reduce risks to commercial activity or treasury financing activity do not count towards the clearing threshold (hedging)**
- **When calculating its positions, a NFC must include all contracts entered into by other NFCs within its group**

Clearing threshold

- €1bn in gross notional value for OTC credit and equity derivatives (individual thresholds)
- €3bn in gross notional value for interest rate and FX (individual thresholds)
- €3bn in gross notional value for commodities and others (combined threshold)

Hedging definition

An OTC derivative contract is objectively measurable as reducing risks directly relating to the commercial activity or treasury financing activity of the NFC if:

- It covers the risk arising from the normal course of business (includes proxy hedging)
- It covers indirect risks
- It is consistent with the IFRS hedging definition

What is a CCP?

- A CCP stands between the two original counterparties to a contract and guarantees the performance of obligations i.e. removing counterparty risk and reducing systemic risk

Risk management tools of a CCP

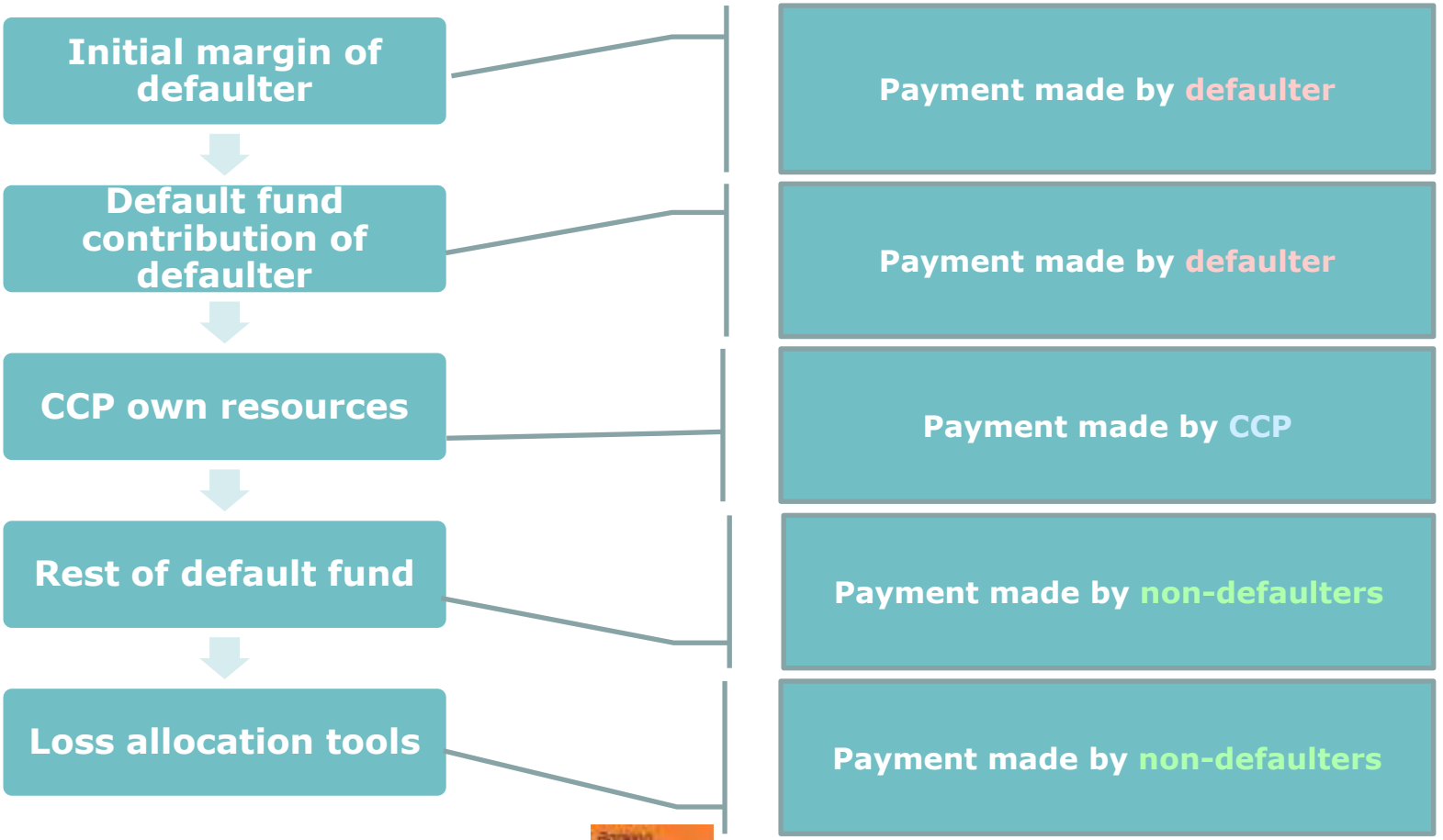
- Initial margin: Collateral collected by the CCP to cover potential future exposure to clearing members providing the margin in the interval between the last margin collection and the liquidation of positions following a default of a clearing member

- Variation margin: Collateral collected or paid out to reflect current exposures resulting from actual changes in market prices

- Haircuts applied to collateral: A discount in the value of the assets collected as collateral that reflects the potential for their value to decline over the interval between their last revaluation and the time by which they can reasonably be assumed to be liquidated

- Default fund contribution: A pool of resources covering losses that exceed the losses to be covered by initial and variation margin, arising from the default of the two largest clearing members

How do CCPs manage a default?



Key requirements - Risk mitigation for non-cleared OTC derivatives

- FC and NFCs must put in place risk management processes to ensure legal certainty and accurate risk capture.

- Further, FCs and NFCs+ must exchange collateral on a bilateral basis for trades that are not centrally cleared.

Risk mitigation techniques

- Timely confirmation
- Dispute resolution
- Reconciliation
- Portfolio compression

Additional requirements for counterparties subject to the clearing obligation

- Initial and variation margin requirements
  - applies to firms subject to mandatory clearing

- Daily valuation requirements
  - Mark-to-model permitted when the market is inactive; or the range of fair value estimates is significant and the probabilities of the various estimates cannot be assessed

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EXPERIENCES FROM NORWAY

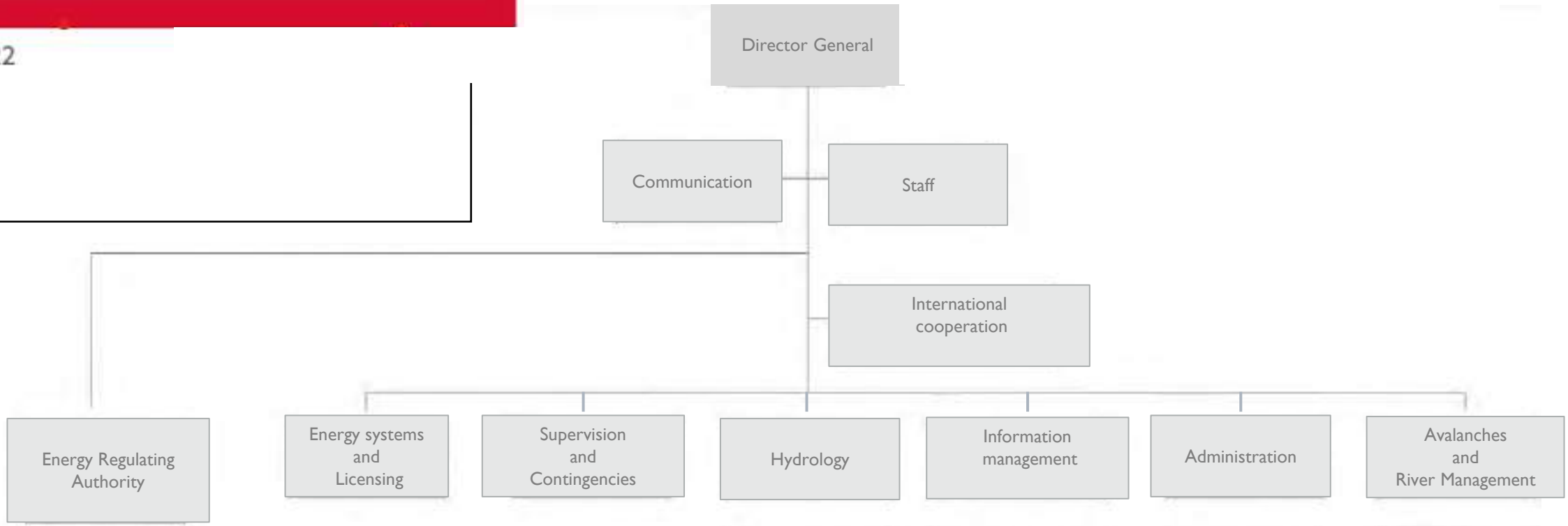
Presentation for the Regional Conferance on Investments and ADR mechanisms in the Energy Sector

Michael Steinfeld
Norwegian Water Resources and Energy Directorate (NVE)

Foto: Simon Oldani/NVE

ORGANISATION

01.01.2022



Energy Regulator

«One-stop shop»

- Hydrological Institute
- Licensing body
- Environmental Supervision

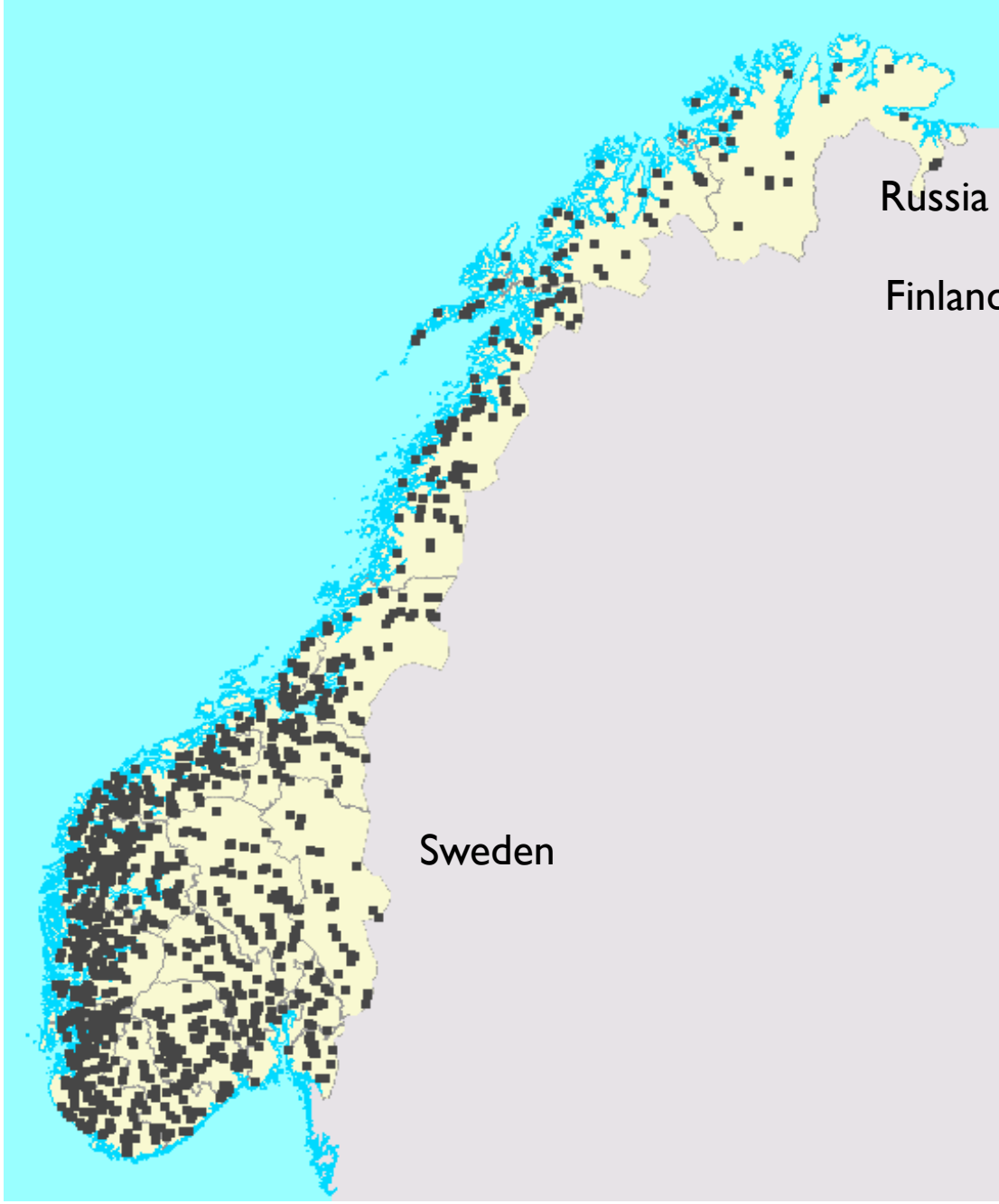
Mitigation - floods & avalanches

Facts about Norway

- Landmass: 385’ square km
- North/south: 1.790 km
- Highest point: 2.469 m.
- Precipitation: 500-3500 mm. yrl.
- Lakes: 440.000
- Shoreline: 103.000 km
- Population 2020: 5.378 mill.

Overview energy system of Norway

- 157 TWh in 2020
- Installed capacity 37.700 MW
- > 2000 HP plants
- 90 % of electricity in Norway is from HP
- 12.000 km HV lines
- HVDC interconnectors to Denmark, Netherlands, Germany and England
- AC to Sweden and Russia



Water – a major natural resource

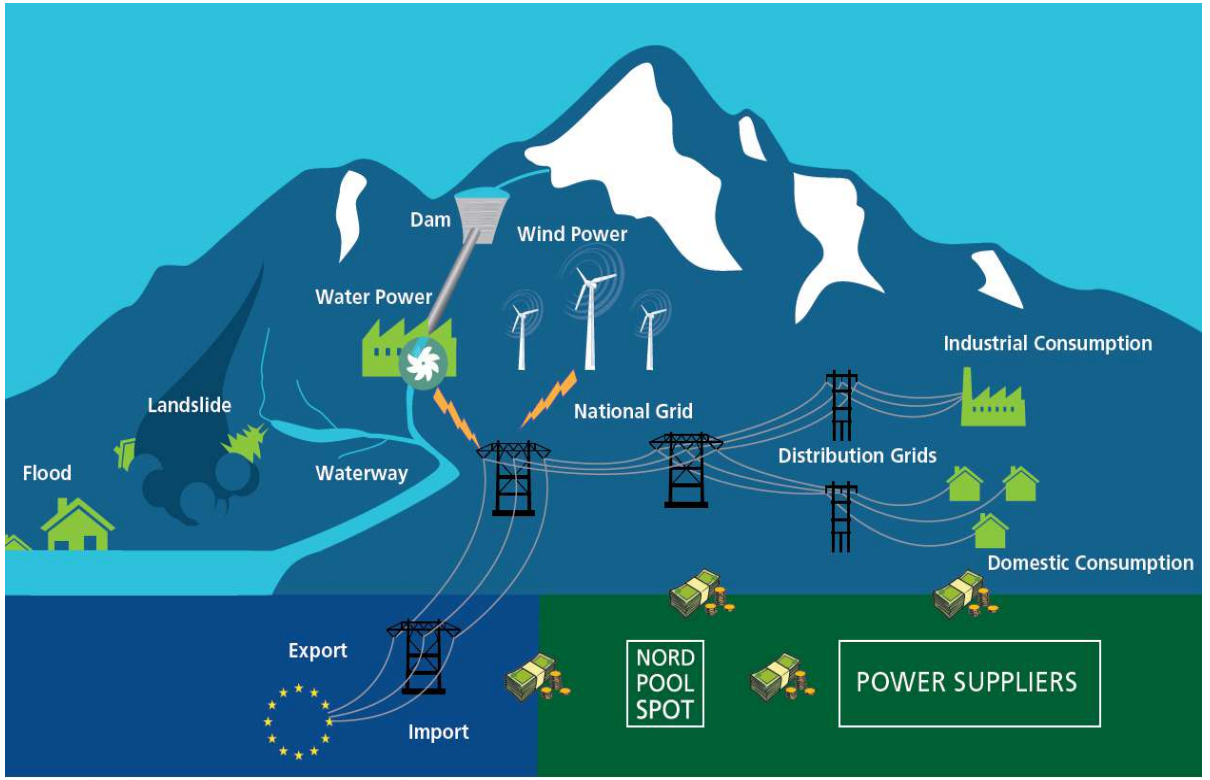


Photo from top left: Rune Engesæter, Sjur Bjerkli, Unn Yilmaz. All NVE

Advantages with hydropower generation*

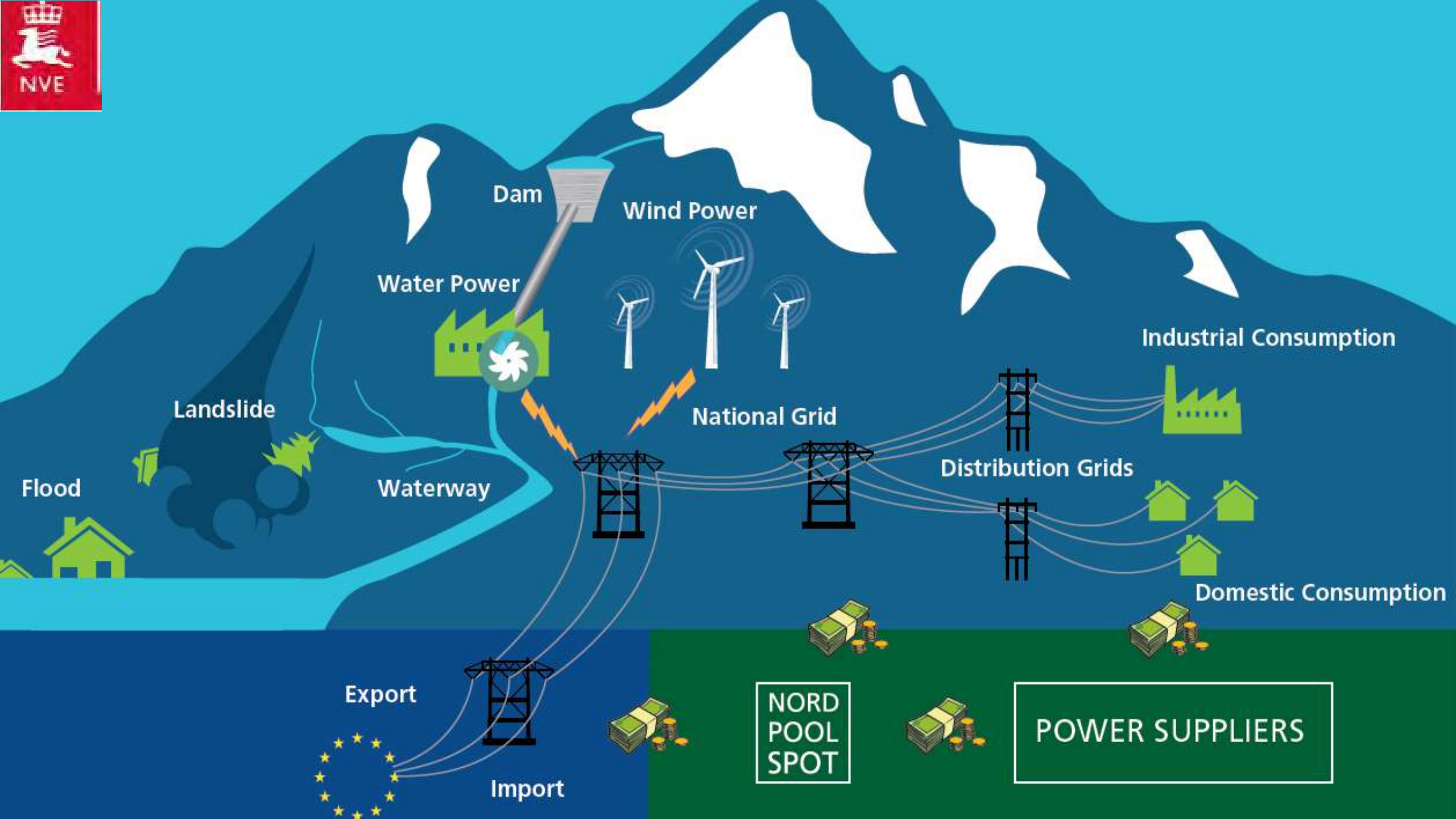
- Renewable resource which is highly flexible (rapid balancing), which provides a higher tolerance of intrancients (wind/PVC) and thermal in the interconnected power system.
- Predictable - according to seasons (NB! Less so when climate change is taken into effect).
- Predictable if used with good water regulation, hydrological and climate models and open sharing of current water values, including levels of reservoirs and catchments
- Most attractive than alternative investments using a 35+ yearly discount rate (IRR).
- If there is water regulation it may provide efficient flood management, especially where nature generate flash floods periodically because of intense percipitation

* Based on the Nordic power market perspective

Disadvantages with hydropower

- Enroachment on land and intervention in local socio-economic-cultural sensitive issues.
- Detrimental effect on environment, local biotope, fish, game, vulnerable species.
- Potential negative impact on farming, husbandery and fishing
- Interference with cultural hertigage sites
- Benefits and development in distant geographic locations for non-local citizens

NB! The disadvantages increases as scale of HP increases


NVE
Dam
Wind Power
Water Power
Landslide
Flood
Waterway
National Grid
Industrial Consumption
Distribution Grids
Domestic Consumption
Export
Import
NORD POOL SPOT
POWER SUPPLIERS

From Union to Independence

1813 Denmark loosing part in Napoleonic war and secedes Norway to Sweden in Jan 1814

1814 Leading men of Norway seize the moment to adopt a new constitution, 17th of May

1884 Parlamentarism emerges (neg.)

1905 Independence negotiated. A new King voted in at ballot box

City life in Kristiania (Oslo)

- Called «capital of the wretched»
- 1/3 of the population were poor, but in public statistics only 10%
- The highest population growth in Europe between 1820-1900
- Death rate for children born out of wedlock was highest in Europe

Rural life and nature

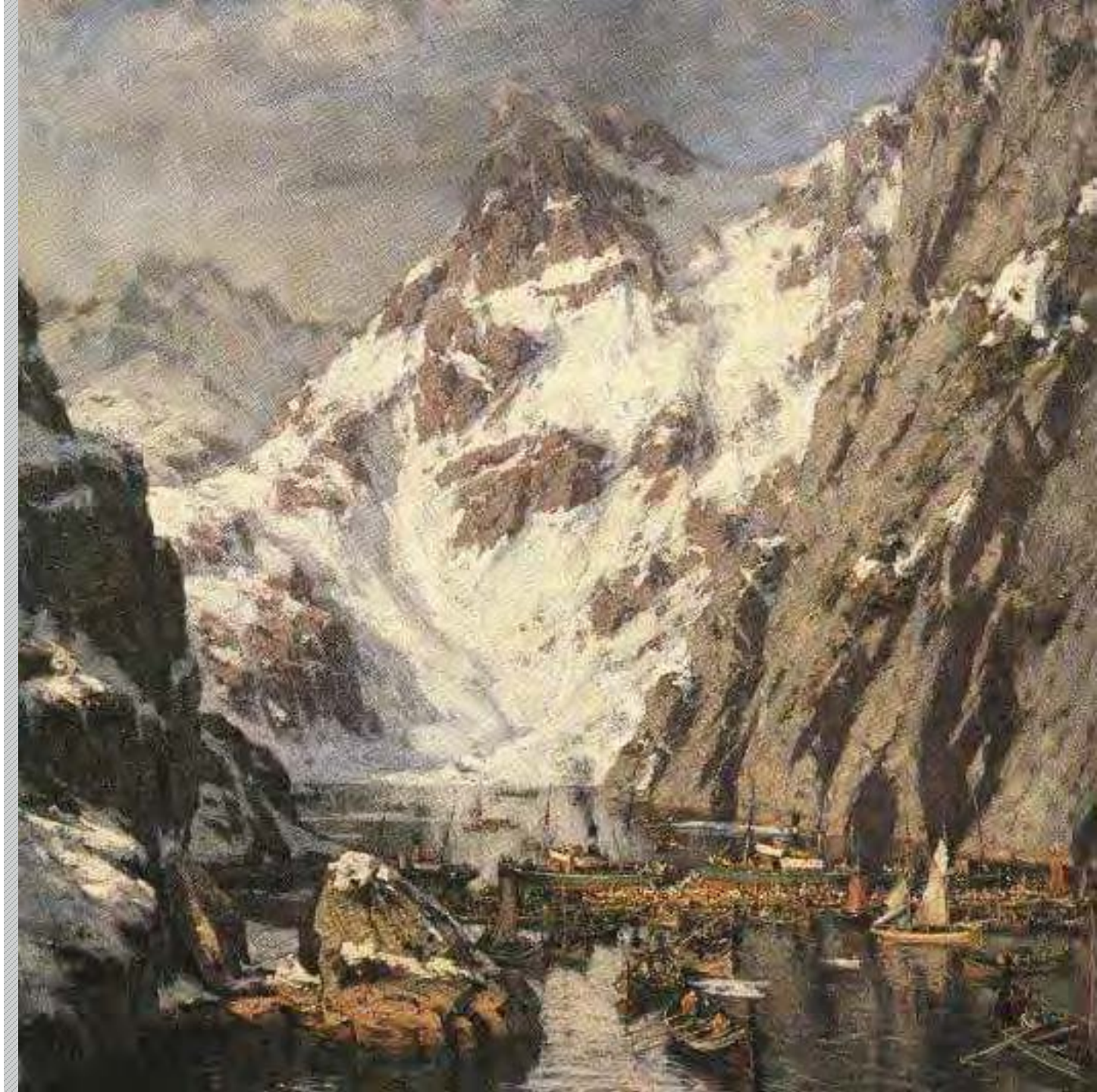
- 70 % of the population lived outside cities in 1900
- Tennant farming, fishing, wood gathering, and husbandry for bartering and subsistance
- Natural resources, but challenging topography + climate
- Increasing scale in industies such as woodworking, mining and steel, fisheries and goods for exports

But also increasing reform, new tech. and organizations

- In 1885 the first tram in Oslo and electricity for industry
- Employers and labour became organized
- International Trade and Investments increased
- Not without conflict

Early example of a conflict

- The Battle of Troldfjord in 1890
- Cod fishery resources important for livelihood
- Investors with steam boats vs. local fishermen rowing
- Resulted in a Fishery Resource Act



Early days of large scale HP

- 1905 - Independence
- How to legislate ownership and rights to water for HPP was centre of political discourse
- "Water speculators" were buying Norwegian "falls rights"
- By 1906 more than ¾ of HP generation built or to be built was owned by foreign interests

Lessons from history

- 1946 largest demonstration in history
- Transmission line through a popular woodland area near Oslo city
- Resulted the East Norway Central Planning Office. Cross sector involvement in planning – common criteria.
- Balancing of considerations - wider society vs. local economy – city vs. periphery – alt. local environment vs. national standards

Hardanger fjord – HV line crossing

- Pearls of tourism
- National pride
- Hart of independence
- Clearly a need for new infrastructure, but how and where?

Events

- Negative to visual sight
- «**Monstertowers**» became a widely used term
- Academia, celeberties, green NGOs and local political representatives against the concession given.

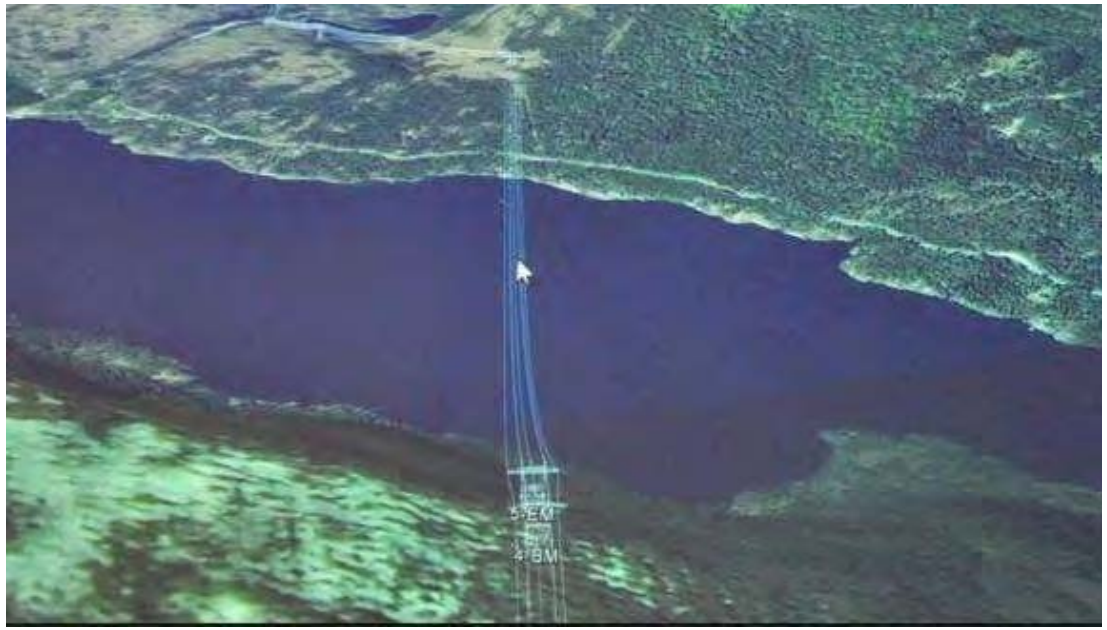

BA
NYHETER
Møtt av hundrevis av demonstranter i Hardanger

High level involvement

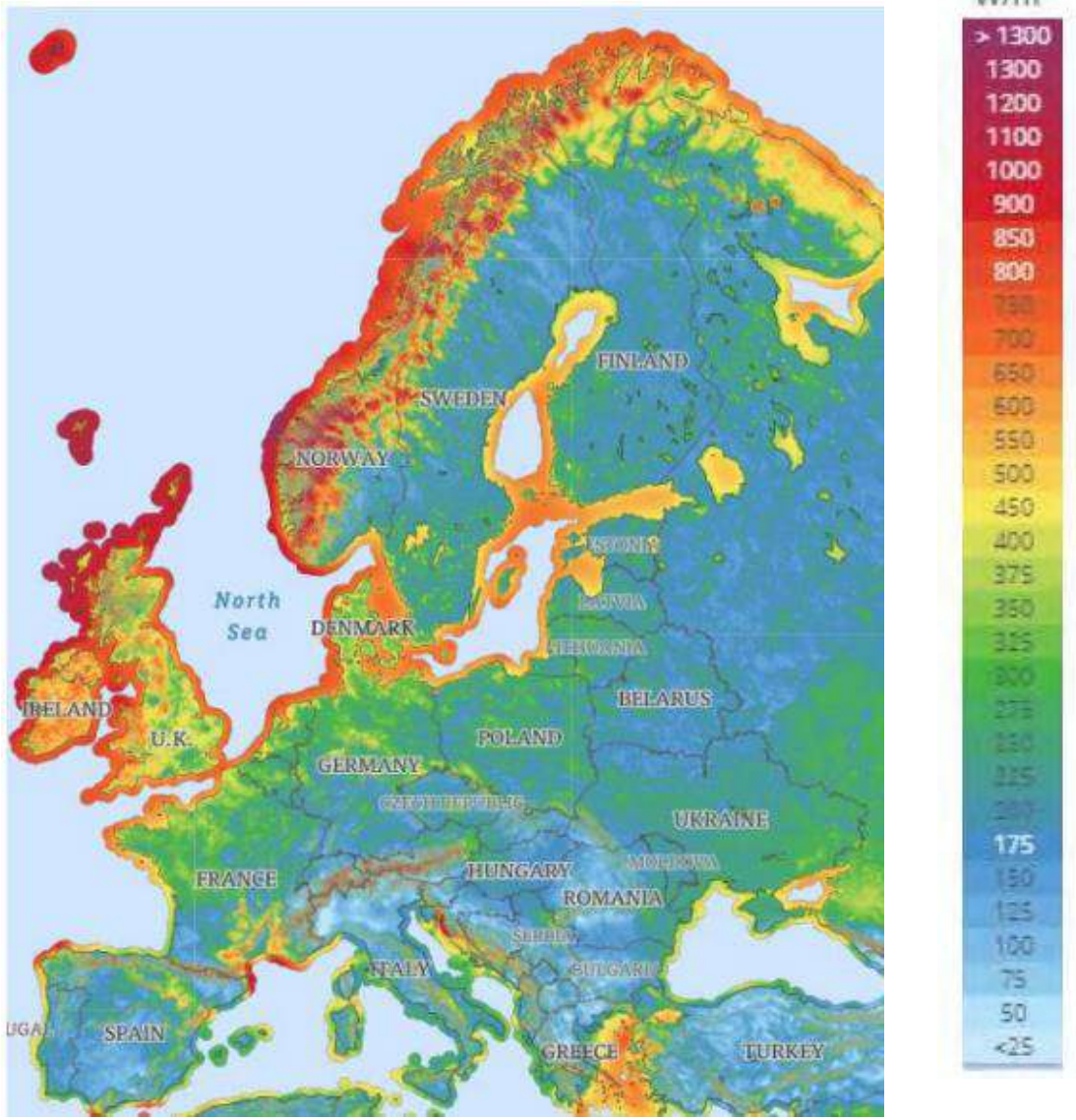
- Instructed Statnett to withhold license to build and operate
- IPR from 4 panels of experts
- Panels concluded that the cost would be 2-3 times higher with cable.
- Cable alternative would have other neg. EAs.

Lessoned learned

- More extensive info. about GDPs locally
- EIA improved to have 3 alternative studies with technical and socio-economic benefits
- More extensive publication of project documentation including GIS visualization, camuflage color masts, message clearer on various local benefits – work, etc.
- Key context and facts centers more on consumers reliability, local business growth, new job opportunities, renewables and climate – not only security of supply

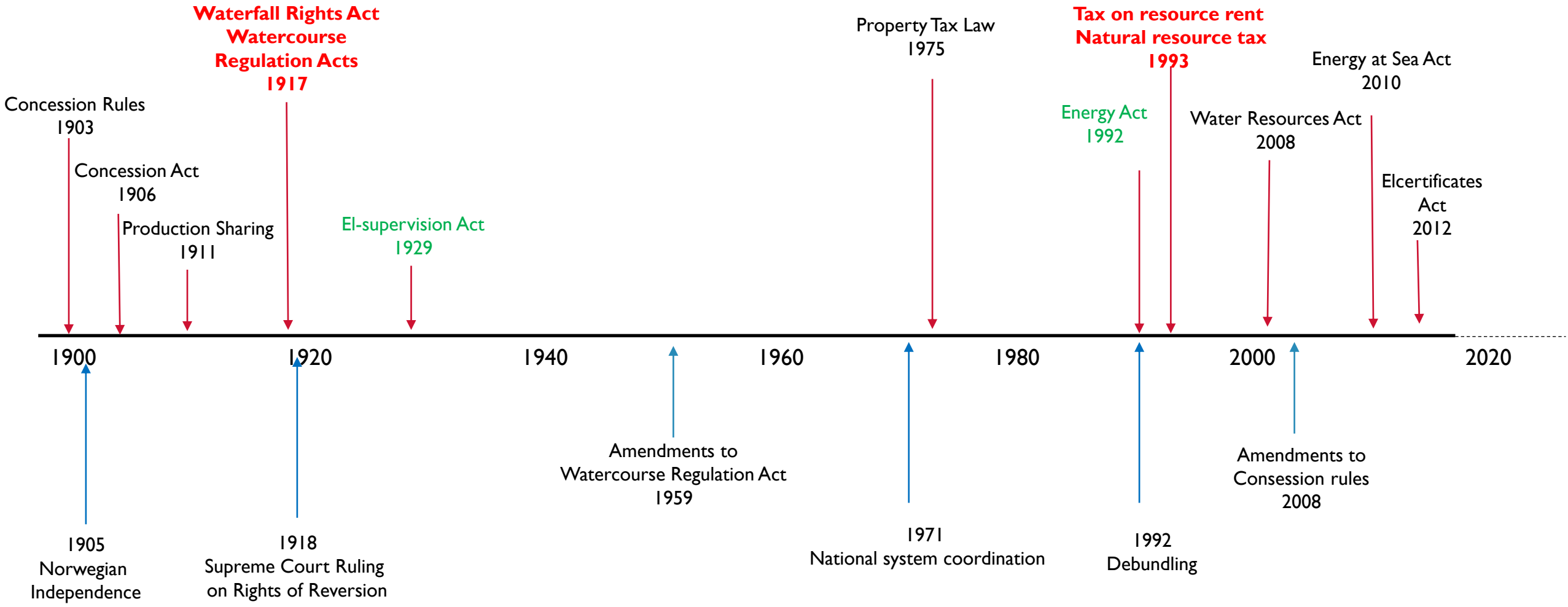


Conflict returns in 2017 – National framework for wind power

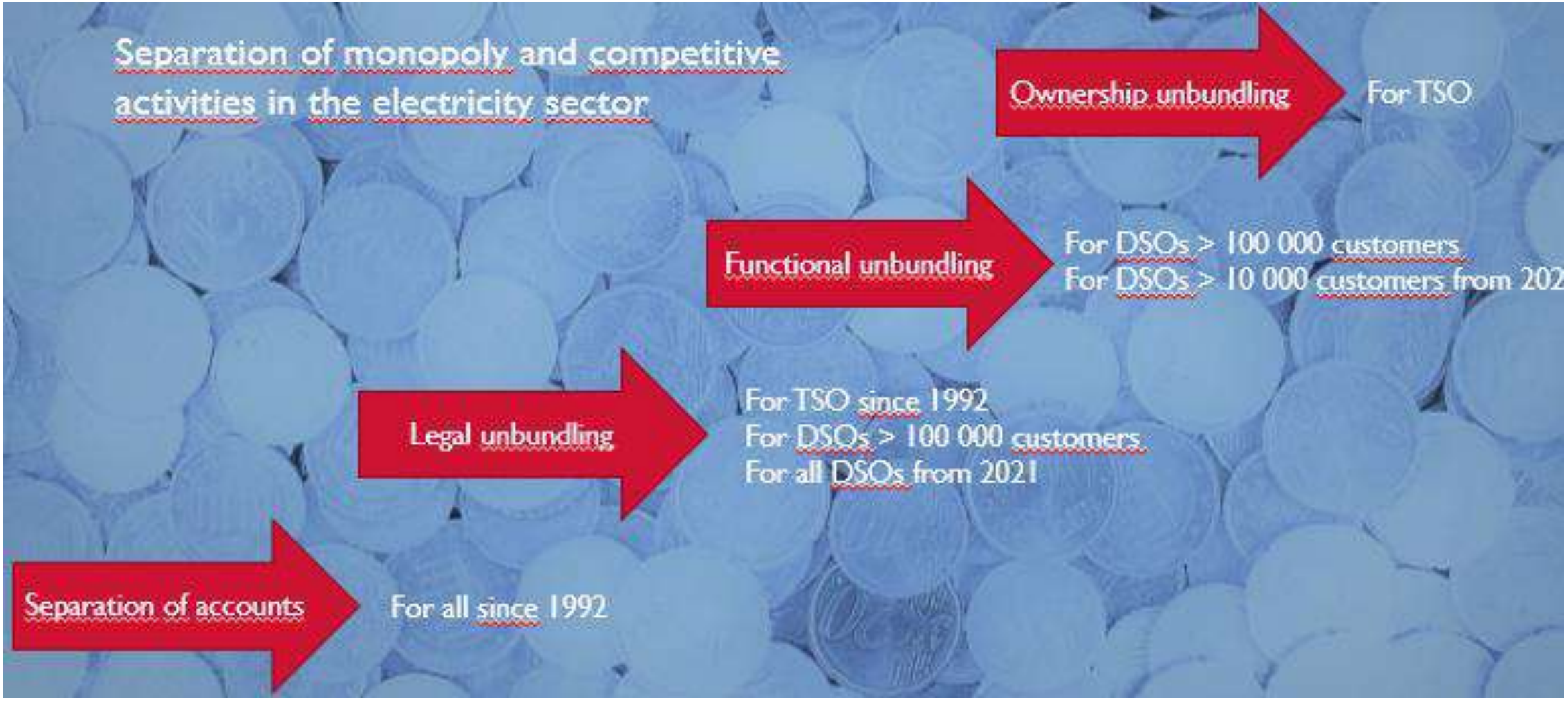


Norwegian statutory developments 1900-2012

«The Panic laws» 1903-1917 → Development and Expansions 1920 - 1980 → Power Market Integration1992 -….



Unbundling stages in Norway 1992-2021



Economic Principles

Investor objectives:

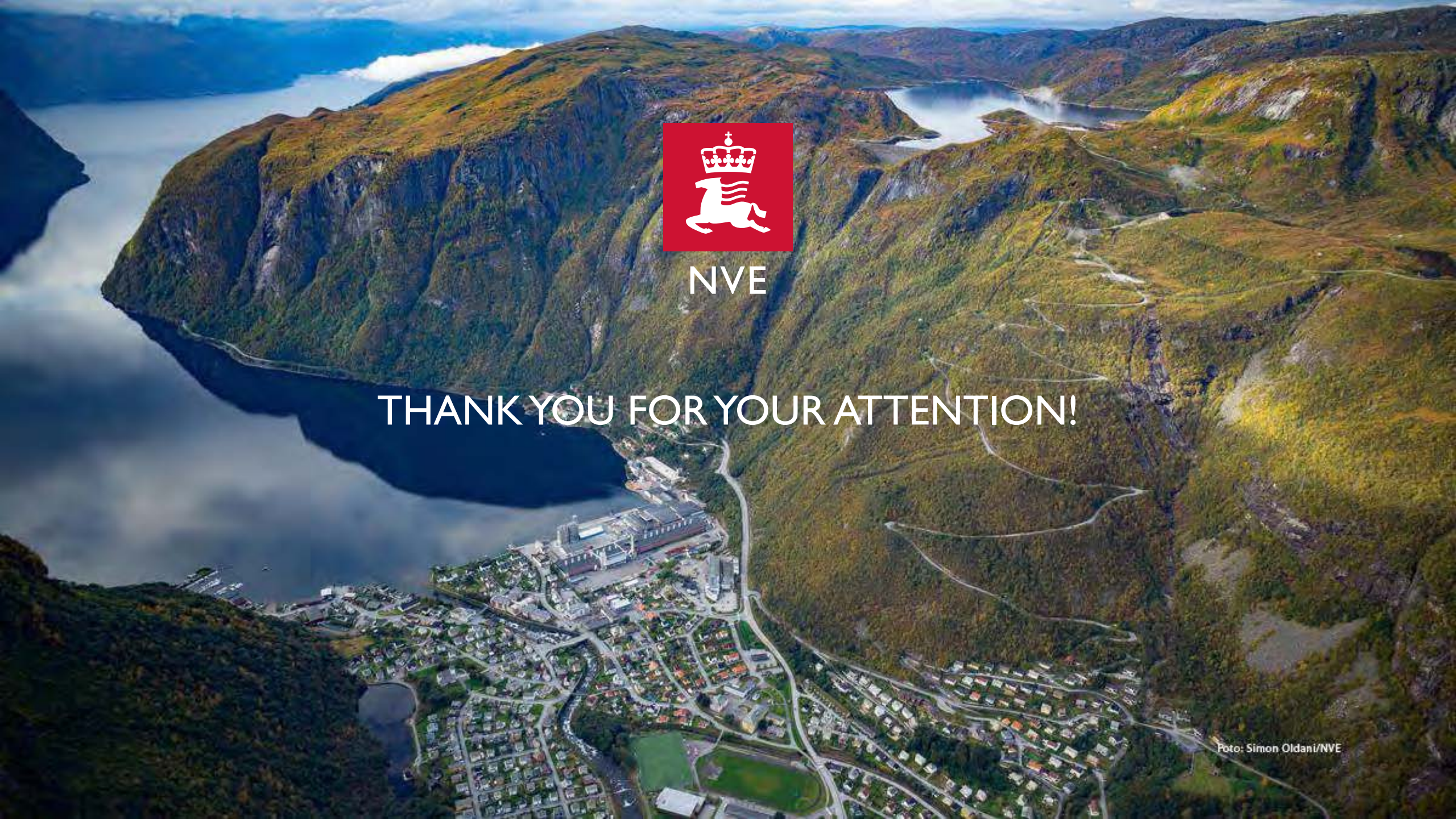
- Return of Investment - IRR
- Responsible corporate governance
- Increase shareholders value
- Increase market share
- Expand business model
- Reduce market and regulatory risk
- Social and environmental responsibility

Socio-economic objectives:

- GDP - work for all, industrial output
- Continously reduce enviromental footprint
- Broad, inclusive consultative procedures
- Learn from changes technology & willing to change frameworks
- Benefits to communities - share of common goods
- Follow-the data, not only the dates

NVE

THANK YOU FOR YOUR ATTENTION!



NVE

The Norwegian Energy Regulatory Authority – RME

WHAT ARE BALANCING MARKETS

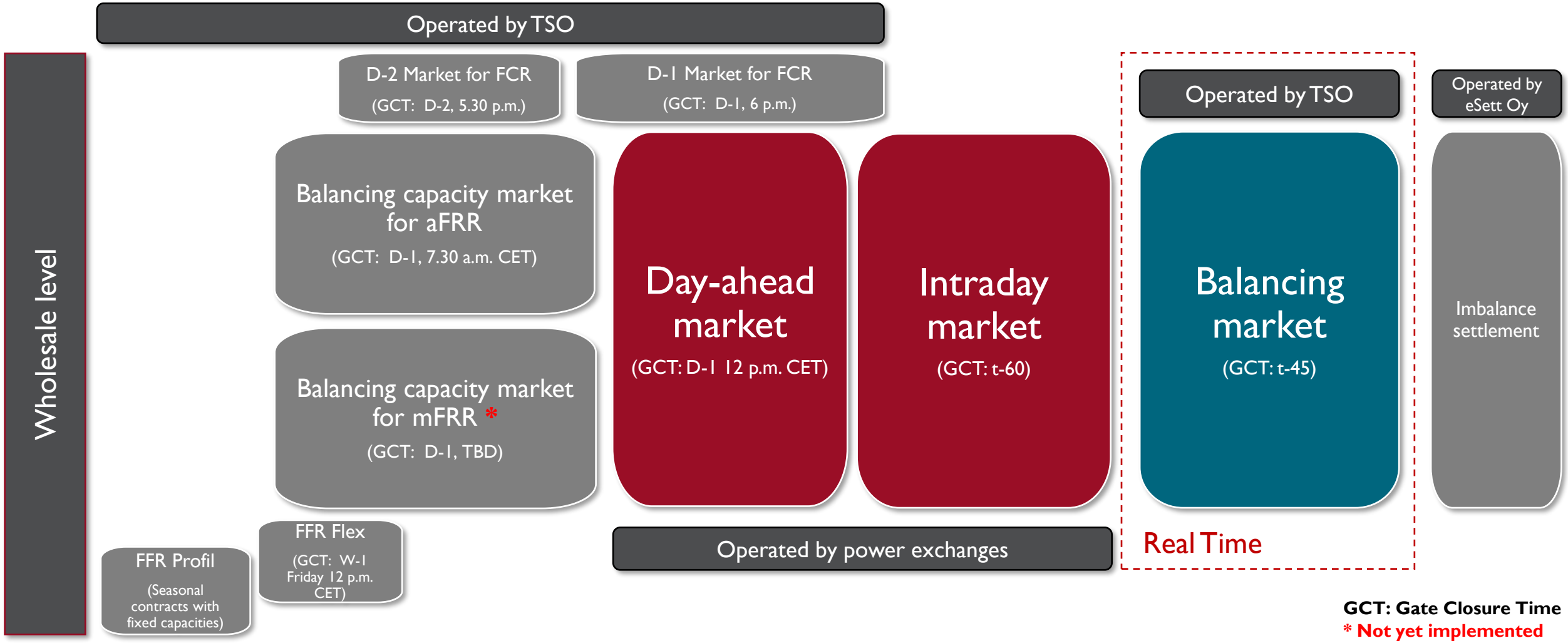
and how do we regulate them?

Alexander Kellerer

Adviser

Section for Markets and System Operation

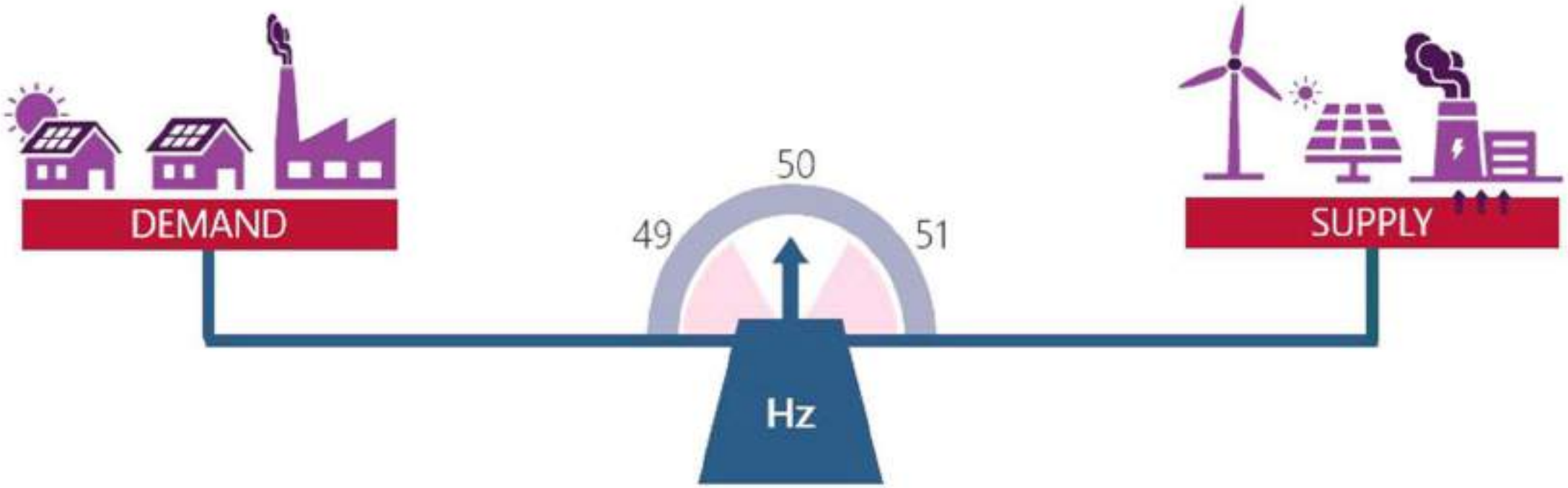
Overview of the market segments in Norway



GCT: Gate Closure Time
*** Not yet implemented**

What is meant by «system frequency»?

Source: Statnett

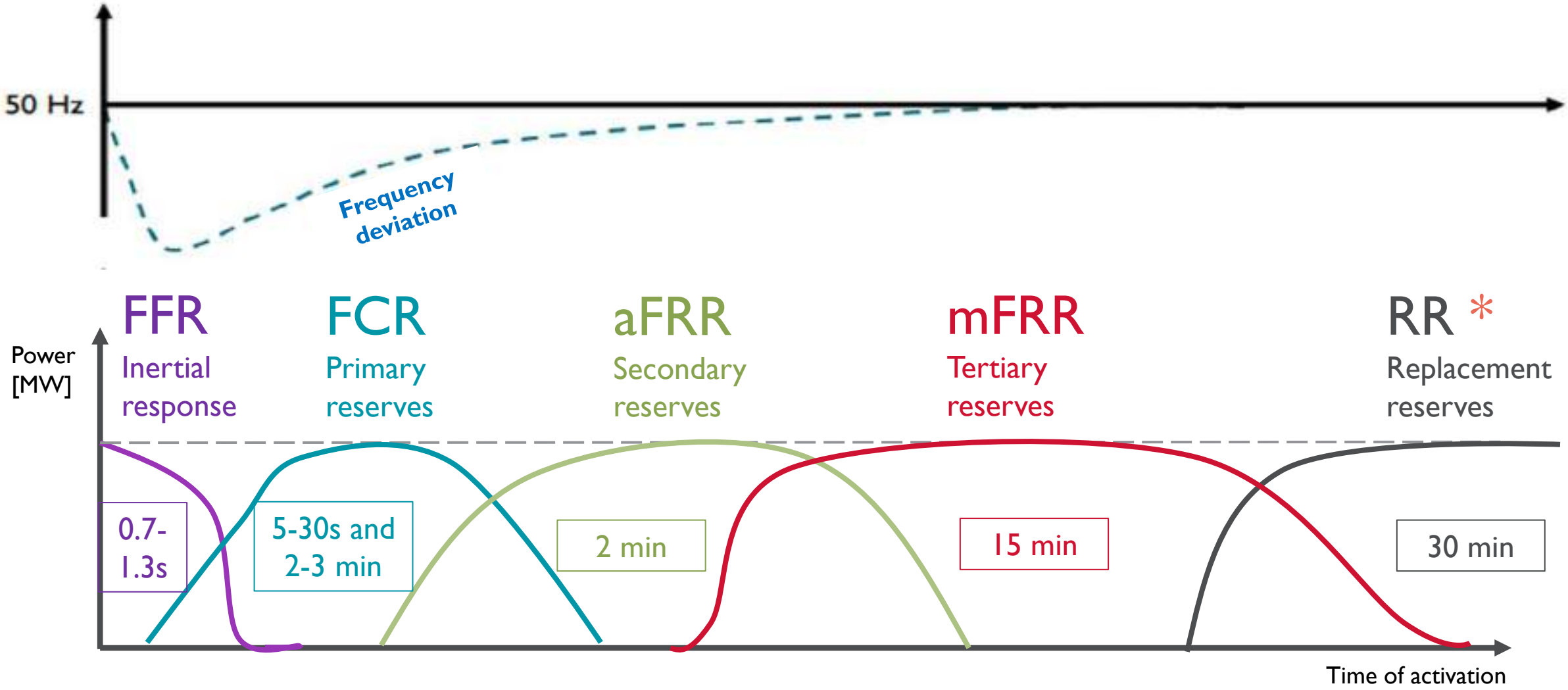


NVE – RME

What are balancing markets?

- A **market platform** where free bids from flexible energy resources are traded and activated
- A **single buyer market** – the TSO is the sole buyer and responsible for rebalancing the power system by activating free bids
- All market participants are obliged to have a neutral final position after closure of the large power exchanges **(«balance reponsibility»).**
- Any **imbalances in the final position are penalised** with an imbalance price that will cover part of the TSO's balancing costs
- The TSO also needs to handle other unexpected events in the system. In Norway, free bids are also used to manage bottlenecks in the network **(«redispatching»)**

Products traded in the balancing markets



* Not used in Norway

Statnett as Transmission System Operator (TSO)

- Statnett SF is a state-owned **enterprise responsible for operating the power system**
- NVE-RME has given Statnett the **licence for «system responsibility»** («systemansvaret»)
- Statnett is a **regulated monopolist** and subject to a **price control** mechanism
- Statnett has established a **strong cooperation with the other Nordic TSOs** and is also a full member of the pan-European association for TSOs **(«ENTSO-E»)**

Source: Expology


Source: Statnett

The Nordic balancing markets

- The Nordic power systems are highly intertwined and forming one **synchronous area with one system frequency**
- The Nordic TSOs established a **Nordic balancing market** in the 90s
- Common **Nordic imbalance settlement function** in place since 2017 (unique in Europe)

*N.B.: DK1 is part of the Nordic balancing market but connected to the continental synchronous area

Source: NordREG

Nordic cooperation of regulators

- There is **no Nordic legislation** and thus approvals are formally made on national level by each individual regulator
- However, the Nordic regulators in many cases **need to coordinate their decisions** as there are many common Nordic projects and common Nordic infrastructure.
- **NordREG is the formal body** for exchanging views and coordinating the regulators' decisions

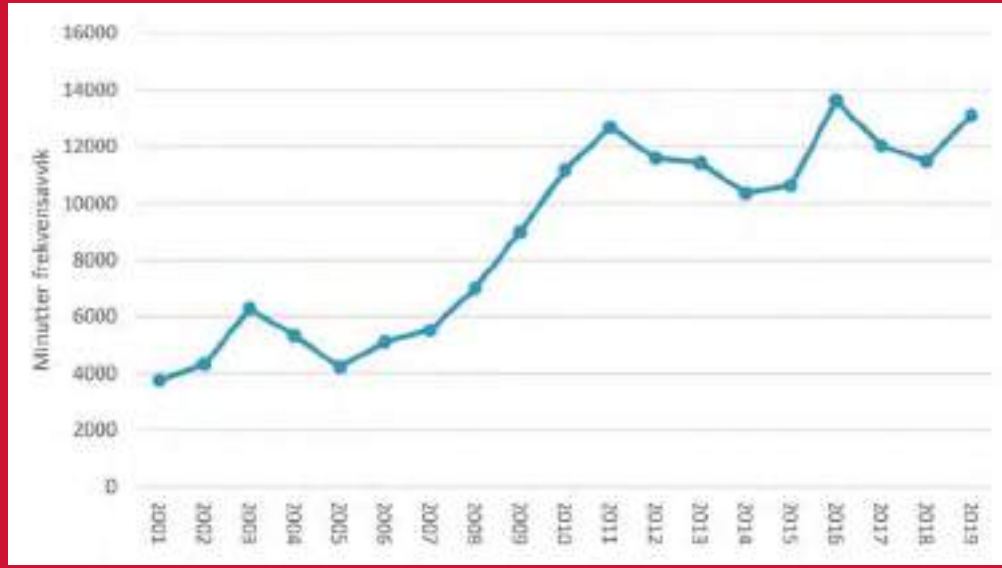
NordREG
Nordic Energy Regulators
POWER THROUGH COOPERATION

A power system in change

System operation is becoming increasingly demanding due to:

- Larger and faster power flow changes on the interconnectors
- Rising share of intermittent renewables
- Areas with few balancing reserves and limited cross zonal capacity
- Increased complexity and lack of automated solutions

Number of minutes (per annum) with frequency deviations outside the standard range



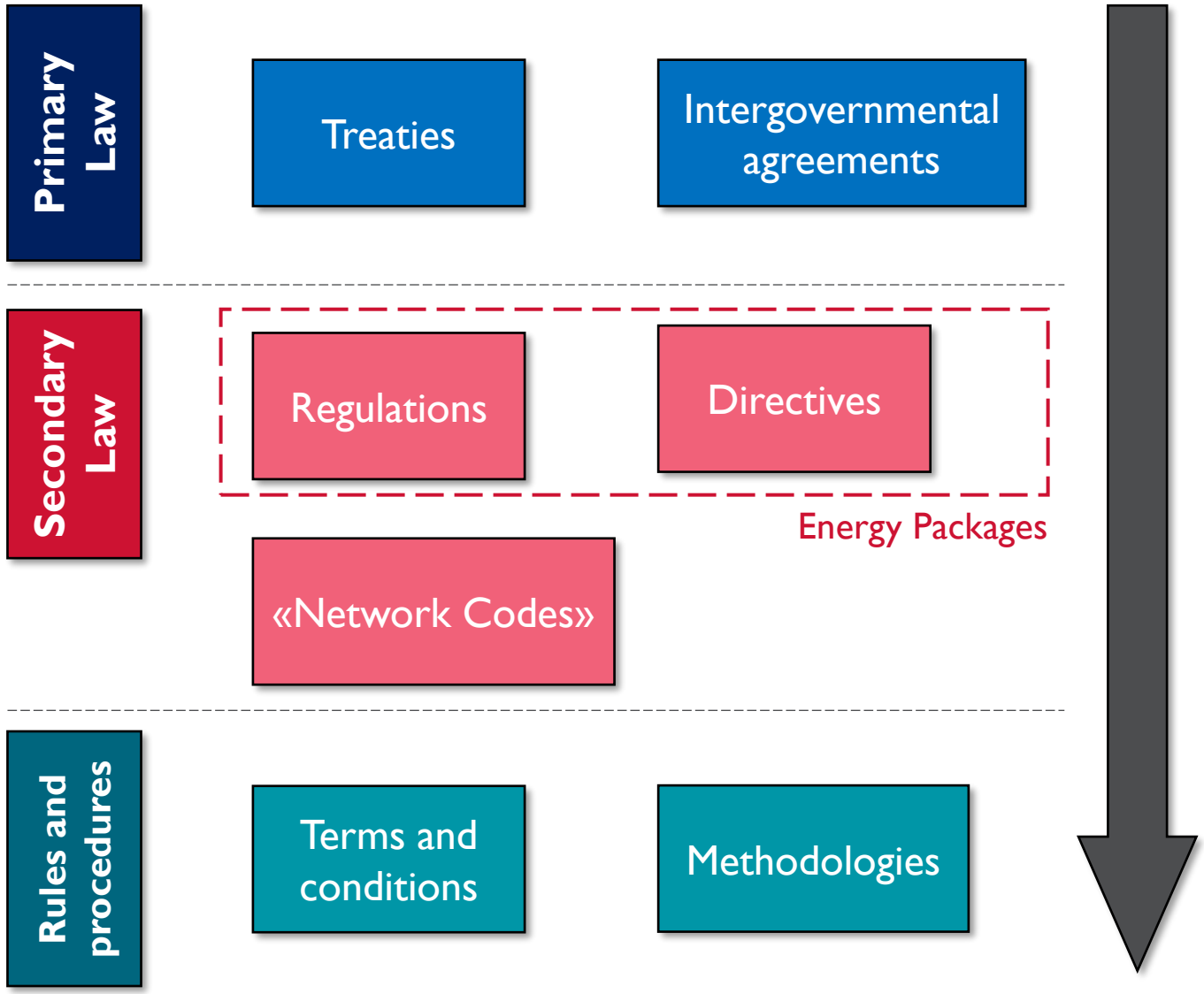
Source: Statnett

The European target model for balancing

- The majority of TSOs in the EU/EEA are legally obliged to connect in the future to the **common European trading platforms for balancing** («MARI» and «PICASSO»)
- These are highly automatised trading platforms that have at their core a **complex algorithm** for finding the optimal solution of all available free bids across Europe
- To be able to connect to the platforms, TSOs and market participants will need to **harmonise and automatise their current market setups**

Source: ENTSO-E

What is the regulator's role on European level?



Regulators are <u>not</u> involved in amending or designing new primary law. Exclusive competence of governments and legislators.

Regulators are involved in amending or designing new secondary law. However, secondary law is formally adopted by the EU institutions.

NVE-RME is also responsible for monitoring compliance with secondary law on national level.

Day-to-day business for regulators. Regulated bodies (e.g. TSOs) submit proposals for new rules and procedures. Regulators approve and monitor compliance with approved rules and procedures.

European cooperation of regulators

- EU/EEA regulation typically requires regulated bodies to **submit proposals for methodologies to ACER and regulators** within given deadlines.
- ACER and national regulators **assess** European proposals **together.**
- **ACER is formally making the decisions in the EU** but needs to have a two-thirds majority of all national regulators in the Board of Regulators.
- ACER and NRAs can approve, reject or send back proposals. Since 2020, they **may also directly amend and rewrite proposals**.

ACER

European Union Agency for the Cooperation of Energy Regulators

Thank you for your attention!

Source: NVE photo stream

NVE – RME

NVE

The Norwegian Energy Regulatory Authority – RME

INTRODUCTION TO THE NORWEGIAN ENERGY REGULATORY AUTHORITY

Catharina Hovind and Laxshitha Arumugadas

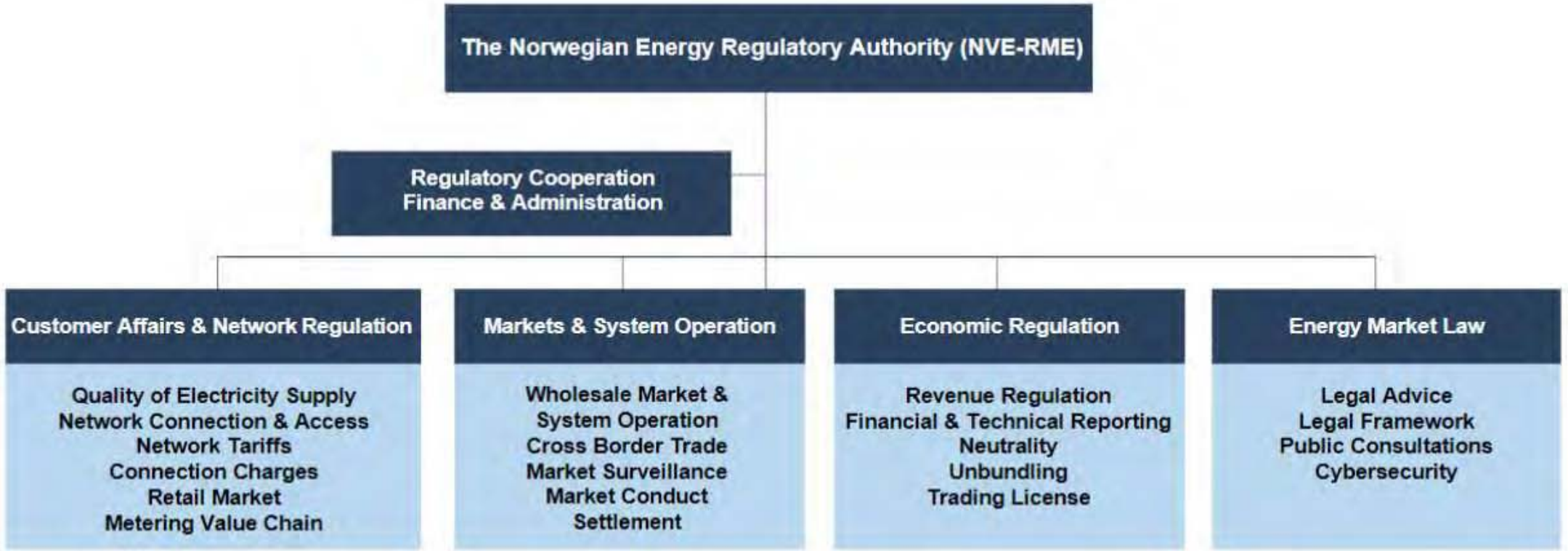
Legal advisors NVE-RME


The Norwegian Regulatory Authority for energy
RME-NVE

The Norwegian Regulatory Authority (NVE-RME)

- Promote socioeconomic development
- The Ministry has designated the regulatory authority (NVE-RME) and the appeal body (Energiklagenemnda)
- The regulatory authority and the appeal body cannot be instructed when carrying out regulatory tasks
- The regulatory authority is a separate entity within NVE
- Separate budget line in the national public budget

NVE – RME


The Norwegian Energy Regulatory Authority (NVE-RME)
Regulatory Cooperation
Finance & Administration
Customer Affairs & Network Regulation
Quality of Electricity Supply
Network Connection & Access
Network Tariffs
Connection Charges
Retail Market
Metering Value Chain
Markets & System Operation
Wholesale Market &
System Operation
Cross Border Trade
Market Surveillance
Market Conduct
Settlement
Economic Regulation
Revenue Regulation
Financial & Technical Reporting
Neutrality
Unbundling
Trading License
Energy Market Law
Legal Advice
Legal Framework
Public Consultations
Cybersecurity

Our tasks and responsibilities

Adopt binding individual decisions

Regulates tariffs

Regulate the system operator

Supervision of the unbundling rules

The balancing market

The markets

Metering, settlement and billing

Digitalization

Regulatory cooperation in the Nordics and in Europe

Regulation of monopolies

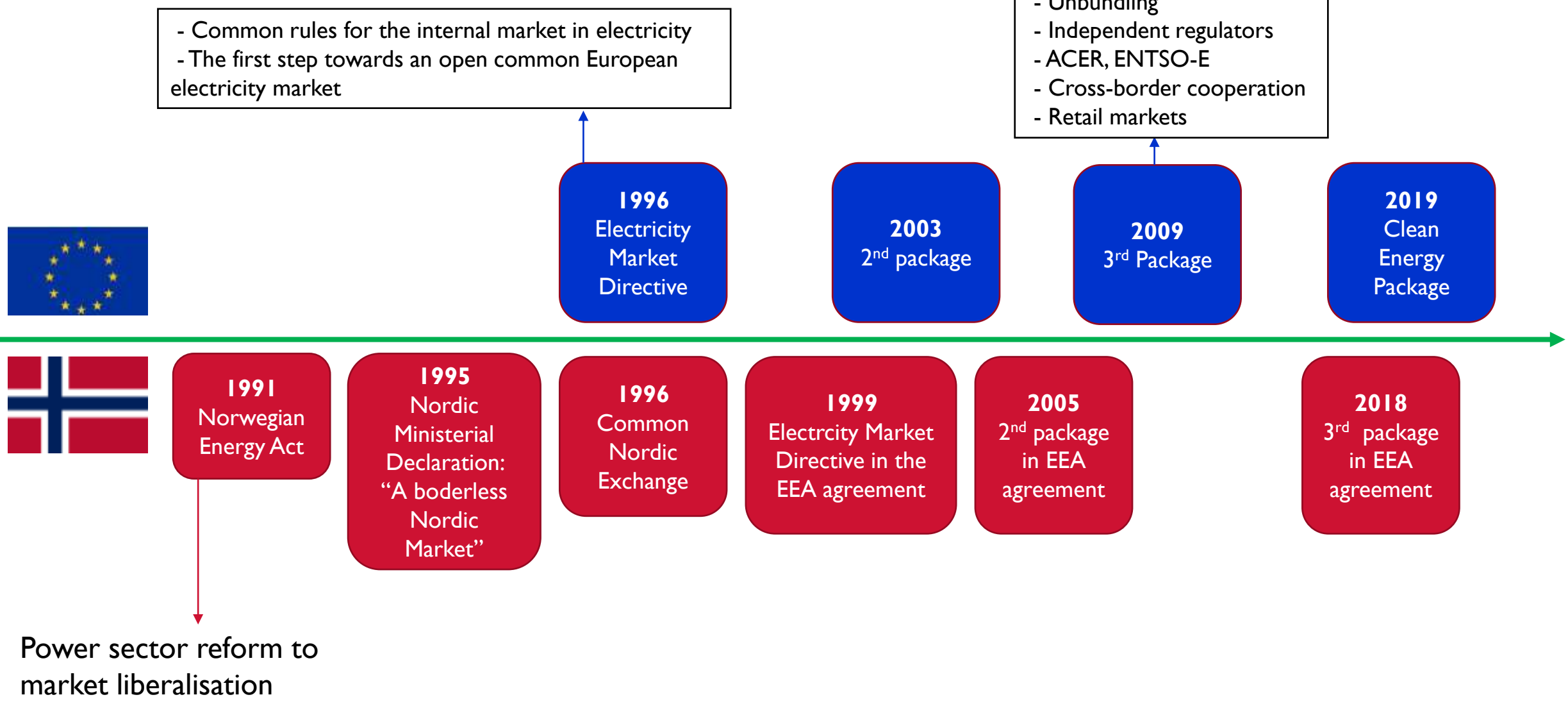
Regulation of competitive activities

Our tasks and responsibilities

- Monitoring and sanctioning
  - May impose administrative fines and sanctions
- Makes expert opinions and recommendations to revise the legal framework and, if requested by the Ministry, prepares draft amendments of secondary legislation

Foto: Simon Oldani/NVE

The Liberalisation of the Norwegian electricity sector

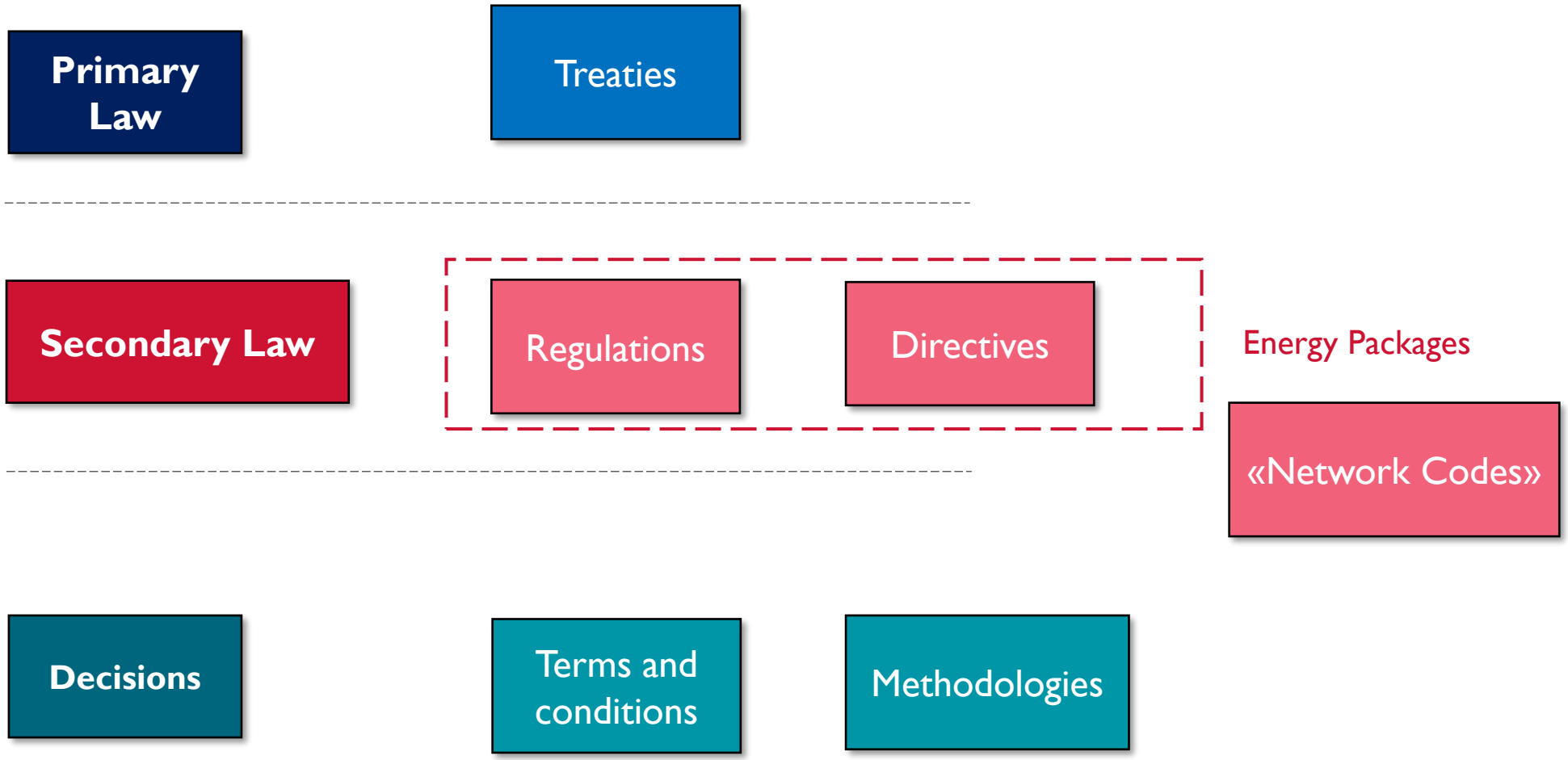


The 3rd Energy Package (2009)

"*aims at improving the functioning of the internal energy market and resolving certain structural problems*"

1. Unbundling
2. Independent regulators
3. Agency for the Cooperation of Energy Regulators (ACER)
4. Cross-border cooperation
5. Open and fair retail markets
6. Third party access improvement

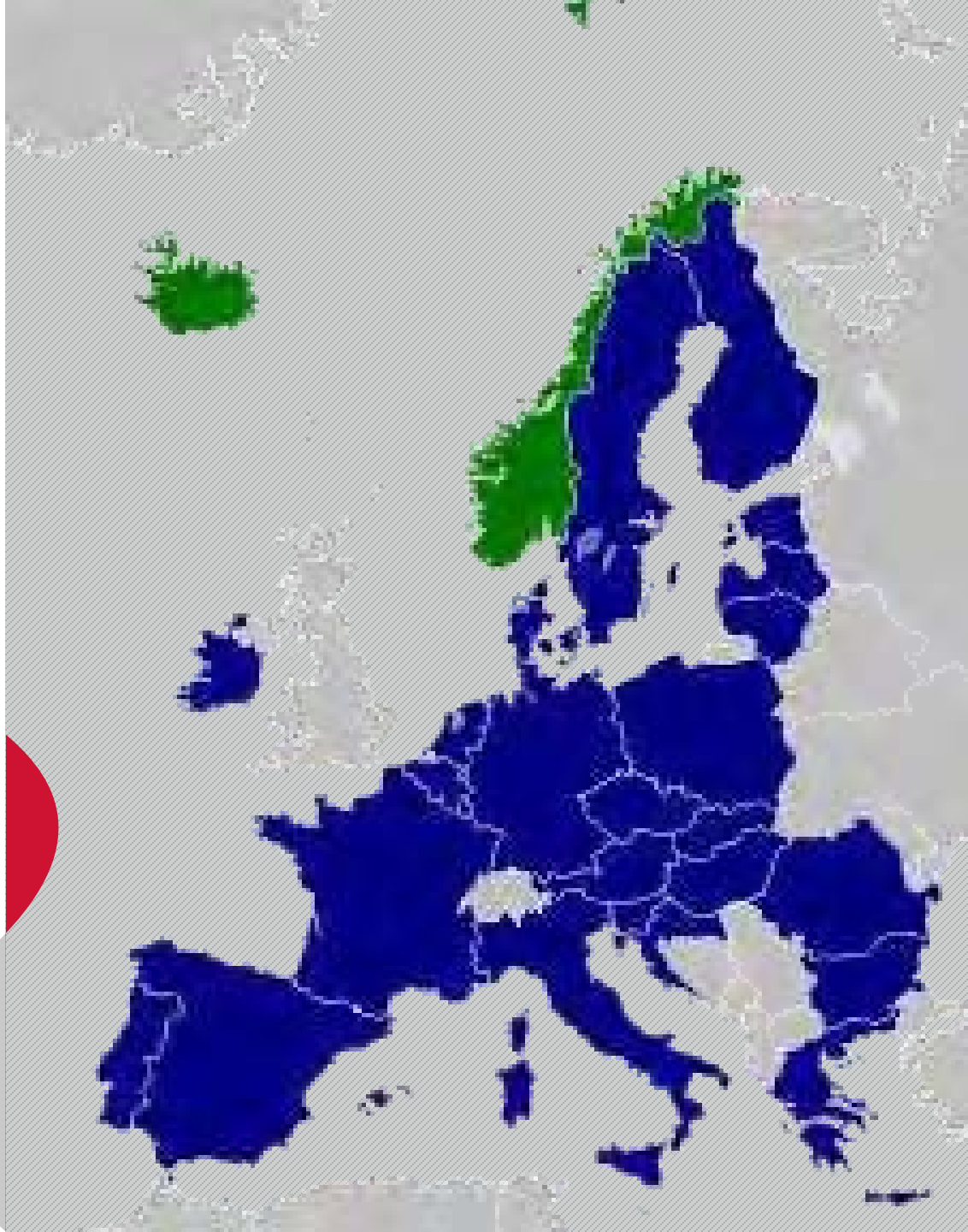
EU Law


Primary Law
Treaties
Secondary Law
Regulations
Directives
Energy Packages
«Network Codes»
Decisions
Terms and conditions
Methodologies

The EEA agreement

The Agreement on the European Economic Area

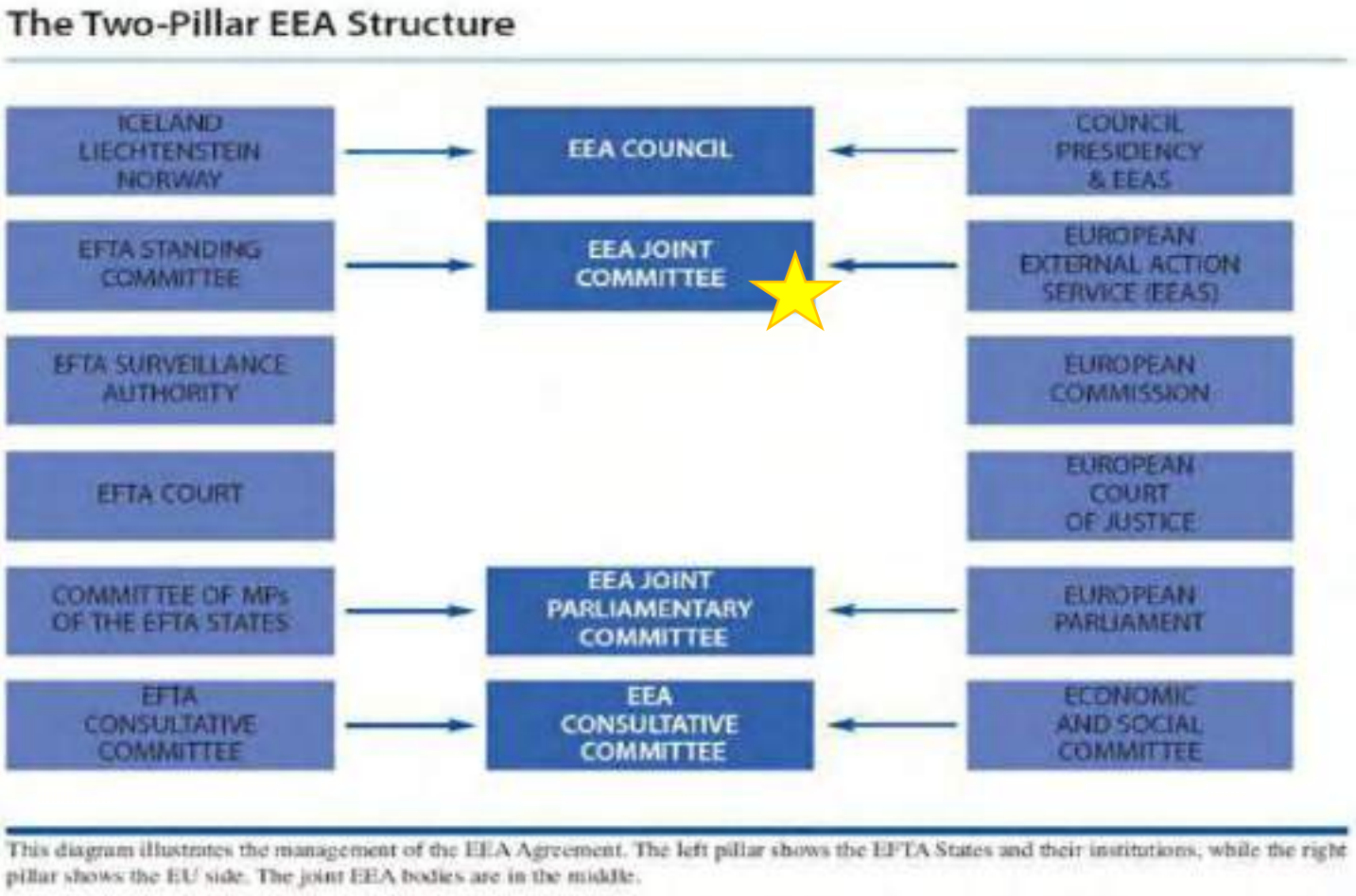
- An agreement between the EU Member States and the EEA EFTA States
- Equal rights and obligations within the internal market for individuals and economic operators in the EEA
- EU legislation regarding four freedoms:
  - Goods
  - Services
  - Persons
  - Capital
- Cooperation



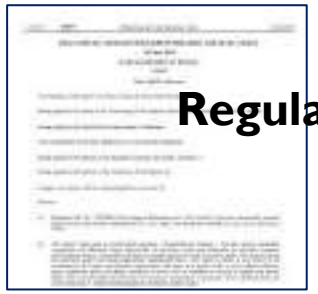
NVE – RME

Norway and EU

- EEA and the EEA agreement
- Two-pillar structure
- Pros and cons

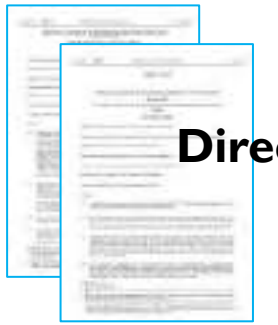


The process from EU legal acts to Norwegian legal acts



Regulations → Taken "As is"

Process in the EEA Joint Committee → Legal acts taken into the EEA agreement → National process → Adoption into national law



Directives → Have to review the legal acts and current national law. Might be need for adjustments, might not be.

Cooperation with our neighbours

NordREG: Forum of Nordic Energy Regulators

- Voluntary cooperation established in 1997.
- All Nordic countries participate

CEER: Council of European Energy Regulators

- Voluntary cooperation established in 2002
- EU27, UK, Norway, Iceland (members)
- Albania, Bosnia & Herzegovina, Georgia, Kosovo, Macedonia, Moldova, Montenegro and Switzerland (observers)

ACER: Agency for the Cooperation of Energy Regulators

- EU-agency established under the 3rd energy market package in 2009
- EU27, Norway, Iceland
- The Norwegian energy regulator participates at all levels
- European Commission and ESA participates as observers

What is ACER and where do we fit in?

- Facilitating cooperation between national regulatory authorities among EU/EEA/EFTA states
- Recommends and provides advice, an important role when it comes to developing the legal framework
- Mediate harmonized implementation of rules and may adopt decisions regarding cross border issues in the event of a disagreement

ACER
European Union Agency for the Cooperation of Energy Regulators

—

ESA | EFTA Surveillance Authority

NVE – RME

Challenges the NRA faces

NVE – RME

Thank you for your attention.

Annexure II

POST-SURVEY OF PARTICIPANTS
FINANCIAL DERIVATIVES AND BATTERY ENERGY STORAGE SYSTEM (BESS) STUDY TOUR
JUNE 13-17, 2022

The United States Energy Association (USEA) is an American non-profit organization participating in the implementation of Energy Partnership Programs, funded by the U.S. Agency for International Development. USEA is conducting a series of surveys to evaluate the effectiveness of this workshop as mandated by the USAID Evaluation Policy.

The purpose of the survey is to determine the amount of information learned and potential areas for follow up training and results.

PERSONAL INFORMATION

1. Name: Mr. Dinesh Prasad Gairola
2. Organization: Uttarakhand Electricity Regulatory Commission, Dehradun
3. Position title: Chairman (I/C)/ Member (Law)
4. Email: secy.uerc@gov.in, member-law.uerc@gov.in

Which presentations or activities were the most relevant to you?

Most relevant : Meeting with European Commission and Meeting with European Energy Exchange (EEX)

Second most relevant: Financial and regulatory aspect of the power market and financial power market: Hedging power prices

Please explain: Subject/topics covered were very practical and meaningful to which we could relate

What is your commissions' role (or future role) in financial derivatives in energy markets?
Our Central Commission is in the process of framing regulations with regard to financial derivates in energy market.

What concerns do you have regarding financial derivatives in energy markets?
The trading of financial derivatives in energy market should be transparent and should provide adequate security to investors in the market.

Are you currently working on regulations involving battery storage? If yes, please describe.
No, Battery Energy Storage System (BESS) is still evolving in the country and it is yet to reach a stage where it would be imperative to make the regulations.

What concerns do you have regarding battery storage?
Battey storage system is going to be a game changer insofar meeting the peak hour demand in the evenings when our country faces shortage of power since during these evening hours solar power is unavailable. Hence, battery energy storage system would be an alternative source of power in future. However, foremost challenge/concern is to have cheaper/competitive rate of power from these battery storage sources.

What materials, ideas or procedures did you learn about that you plan to use or recommend for use in your commission?

1. European Market Infrastructure Regulation (EMIR)

2. European power and financial market regulatory framework

3. Mobility, Logistics and Automotive Technology (MOBI) Battery Innovation Centre

4. Competition to guess tomorrow's Area Price for NO2 (Kristiansand – southern Norway) before CET

5. Green Finance: Voluntary and Mandatory Markets

On what topics would you like more in-depth information?

More in-depth information is required on Battery Energy Storage System, since solar power development is currently undergoing in a big way in our country and BESS would be an alternative source of power during evening hours and also during less sunny days.

In which specific areas do you believe your organization could use further technical assistance/ consulting services?

Development of Green Energy Market and Battery Energy Storage System.

Additional comments: Both Mr. Jake Swanson and Ms. Marjorie Jeal- Piarri were very co-operative and courteous. They were always ready to help us throughout the whole tour. I convey my personal thanks and gratitude to both of them and wish them a great future ahead.

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PERSONAL INFORMATION

1. Name: KHOSE SALE
2. Organization: NAGALAND ERC
3. Position title: Chairman
4. Email: khosesale@yahoo.com

Which presentations or activities were the most relevant to you?

Most relevant: financial & regulatory aspects of power market

Second most relevant: Meeting with NHE

Please explain: Insights of EU energy markets based on efficient & competitive market driven price vis-a-vis Indian energy market largely based on PPA/bi/lateral trading with minimal quantity sourced through exchange.

What is your commissions' role (or future role) in financial derivatives in energy markets?

Provide equal playing field for the Supplier & retail distributors.

What concerns do you have regarding financial derivatives in energy markets?

Monitoring of market manipulation & monopoly.

Are you currently working on regulations involving battery storage? If yes, please describe.

No.

What concerns do you have regarding battery storage? In India comparatively the cost of storage is still very high. Disposal/management of waste is an issue.

What materials, ideas or procedures did you learn about that you plan to use or recommend for use in your commission?

1.

2.

3.

4.

5.

On what topics would you like more in-depth information?

More focus on Regulatory processes & practises.

In which specific areas do you believe your organization could use further technical assistance/ consulting services?

Additional comments:

Meeting breaks into site visit, preferably RE plants - Hydro, Solar, Wind.

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PERSONAL INFORMATION

1. Name: KHARGA BAHADUR KUNWAR (K.B. KUNWAR)
2. Organization: SIKKIM STATE ELECTRICITY REGULATORY COMMISSION
3. Position title: CHAIRPERSON
4. Email: kunwarkb@gmail.com

Which presentations or activities were the most relevant to you?

Most relevant Nordpool - Power Market Course

Second most relevant MOBI- Battery Innovation Centre.

Please explain Found useful for the days to come.

What is your commissions' role (or future role) in financial derivatives in energy markets?

To make the Power Distribution Company financially effective.

What concerns do you have regarding financial derivatives in energy markets?

To introduce system for better financial management.

Are you currently working on regulations involving battery storage? If yes, please describe.

NO, not yet. But will start soon.

What concerns do you have regarding battery storage?

Interested to encourage for electric vehicle

What materials, ideas or procedures did you learn about that you plan to use or recommend for use in your commission?

1. Power Marketing and trading

2. Financial Management

3. Battery Storage System

4. Power Scheduling and Management of transmission System.

5. Overall improvement of Power System Management

On what topics would you like more in-depth information?

Power Marketing and Trading

In which specific areas do you believe your organization could use further technical assistance/ consulting services? Power System Management.

Additional comments:

Such Study tour will be more effective and beneficial if site visits are included along ~~with~~ with the classes.

17/06/2022

(K. B. Kunwar)

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PERSONAL INFORMATION

1. Name: KUMARI SANJAY KRISHNA
2. Organization: ASSAM ELECTRICITY REGULATORY COMMISSION
3. Position title: CHAIRMAN
4. Email: kumarsanjaykr@gmail.com

Which presentations or activities were the most relevant to you?

Most relevant: All especially Nord Pool, NYE

Second most relevant: -

Please explain: least: European Commission

What is your commissions' role (or future role) in financial derivatives in energy markets?

Regulatory function for Generating Transmission & Discom companies, and also tariff fixation

What concerns do you have regarding financial derivatives in energy markets?

At evolving stages

Are you currently working on regulations involving battery storage? If yes, please describe.

NO.

What concerns do you have regarding battery storage?

What materials, ideas or procedures did you learn about that you plan to use or recommend for use in your commission?

1.

2.

3.

4.

5.

On what topics would you like more in-depth information?

Energy Exchanger, Battery storage

In which specific areas do you believe your organization could use further technical assistance/ consulting services?

Additional comments:

A visit to a field site may be to a hydro power project would have been useful to understand issues involved. A visit to Electrolyzer manufacturing plant may be included in future study tours.

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PERSONAL INFORMATION

1. Name: Dr. B.N. SHARMA
2. Organization: Rajasthan ERC.
3. Position title: CHAIRMAN.
4. Email: bnsharma59@yahoo.com

Which presentations or activities were the most relevant to you?

Most relevant TSO, Power Markets. EVs, Storage. NVE

Second most relevant European Commission.

Please explain

What is your commissions' role (or future role) in financial derivatives in energy markets?

Final Approval.

What concerns do you have regarding financial derivatives in energy markets?

Still evolving. Needs transparency.

Are you currently working on regulations involving battery storage? If yes, please describe.

Yes.

What concerns do you have regarding battery storage?

Disposal of it.

What materials, ideas or procedures did you learn about that you plan to use or recommend for use in your commission?

1. Storage, Power Markets

2.

3.

4.

5.

On what topics would you like more in-depth information?

Power Markets

In which specific areas do you believe your organization could use further technical assistance/ consulting services?

Additional comments:

An outstanding visit. Very well planned

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PERSONAL INFORMATION

1. Name: JUS SHABIHUL HASNAIN.
2. Organization: D.E.R.C.
3. Position title: CHAIRPERSON
4. Email: jshabihul.hasnain@gmail.com.

Which presentations or activities were the most relevant to you?

Most relevant: ~~Add~~ NORD POOL PRESENTATION.

Second most relevant: MICHAEL STEINFELD - ~~SPE~~ PRESENTATION

Please explain: CLARITY ON SUBJECT

What is your commissions' role (or future role) in financial derivatives in energy markets?

YES - COMMISSION IS RESPONSIBLE FOR TARIFF.

What concerns do you have regarding financial derivatives in energy markets?

IN INDIA — ENERGY SHOULD BE CHEAP & AFFORABLE

Are you currently working on regulations involving battery storage? If yes, please describe.

NOT REALLY

What concerns do you have regarding battery storage?

HOW DO WE DISCARD THE BATTERIES WITHOUT POLLUTING ENVIRONMENT

What materials, ideas or procedures did you learn about that you plan to use or recommend for use in your commission?

1. WORKING OF DIFFERENT COUNTRIES WITH COMMON Benefits —

2. Underground laying of cables & transformers

3. Energy exchange system and its derivatives are better understood in EU.

4.

5.

On what topics would you like more in-depth information?

How do you use battery with safety & environment after use

In which specific areas do you believe your organization could use further technical assistance/ consulting services?

Additional comments:

17.6.22

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PERSONAL INFORMATION

1. Name: ANIL MUKIM
2. Organization: GERC.
3. Position title: Chairperson.
4. Email: anilmukim@gmail.com

Which presentations or activities were the most relevant to you?

Most relevant Prof Richard Sweedberg on Montel.

Second most relevant Hilde Rosenblad.

Please explain Complexity in Pricing and factors impacting pricing.

What is your commissions' role (or future role) in financial derivatives in energy markets?

Not much as of now.

What concerns do you have regarding financial derivatives in energy markets?

Still Evolving.

Are you currently working on regulations involving battery storage? If yes, please describe.

Yes. Price Discovery & Bid Documents.

What concerns do you have regarding battery storage?

Nascent Stage. Let depends how technology develops & Evolves

What materials, ideas or procedures did you learn about that you plan to use or recommend for use in your commission?

1. Financial & Regulatory aspects of Power Markets.

2. Financial & Physical Markets distinction.

3. Transparency Aspects.

4. Market Survei llance. Issues.

5. Battery Storage - Research & Innovation.

On what topics would you like more in-depth information?

In which specific areas do you believe your organization could use further technical assistance/ consulting services? Transition Challenges in moving towards Renewables.

Additional comments:

Overall a useful program.

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PERSONAL INFORMATION

1. Name: Justice C.V. Nagarjuna Reddy
2. Organization: APERC
3. Position title: Chairperson
4. Email: cvnreb@yahoo.co.in

Which presentations or activities were the most relevant to you?

Most relevant: Regulatory system in EU

Second most relevant: Introduction to financial Markets

Please explain: Insight in to EU Regulatory system made me understand similarities or otherwise with the Indian Regulatory system. Functioning of financial markets gave a fair idea and may help me to understand in regulating the functioning of licencees.

What is your commissions' role (or future role) in financial derivatives in energy markets?

Financial Markets being at an evolving stage, the Commission needs to make appropriate plans for future, ~~by~~ using the exposure ~~I have~~ gained in this ~~by~~ study tour.

What concerns do you have regarding financial derivatives in energy markets?

The aspect of fair and balanced tariff for different categories of Consumers.

Are you currently working on regulations involving battery storage? If yes, please describe.

NO.

What concerns do you have regarding battery storage?

Battery Storage ~~is~~ the most important topic in the context of more and more RE power being injected in to the grid.

What materials, ideas or procedures did you learn about that you plan to use or recommend for use in your commission?

1. The material discussed in general with reference to the speeches ~~to~~ shared ~~understand~~ through IT.

2.

3.

4.

5.

On what topics would you like more in-depth information?

In which specific areas do you believe your organization could use further technical assistance/ consulting services?

Additional comments:

All in all Nordpool and NVE ~~visitb~~ visits
are educative and informative.

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PERSONAL INFORMATION

1. Name: M. CHANDRASEKAR
2. Organization: TAMILNADU ELECTRICITY REGULATORY Commission
3. Position title: CHAIRMAN
4. Email: Chandy.erode@gmail.com

Which presentations or activities were the most relevant to you?

Most relevant: Nord Pool

Second most relevant: NYSE

Please explain: The models ~~that~~ used in Nordpool is Similar to Indian markets. Got lot of insights in Financial derivation.

What is your commissions' role (or future role) in financial derivatives in energy markets?

India need to develop a financial Market in a big way to have more liquid Power Market.

What concerns do you have regarding financial derivatives in energy markets?

Liquidity

Are you currently working on regulations involving battery storage? If yes, please describe.

We are going to ~~work~~ work on it.

What concerns do you have regarding battery storage?

Emerging Technologies, ~~and~~ cost, disposal after use.

What materials, ideas or procedures did you learn about that you plan to use or recommend for use in your commission?

1. Most of the systems is almost similar

to India.

2. MoBi visit has given an insight into Battery ~~Res~~ Research and Development.

3. Nordpool Programs was excellent and ~~very~~ useful.

4. NVE experience was very good. Learnt that it is mainly Hydro generation

5.

On what topics would you like more in-depth information? Battery manufacturing Site may be included

In which specific areas do you believe your organization could use further technical assistance/ consulting services? Battery Technology & testing

Additional comments:

In general the program is useful. Have an insight into Power markets, financial derivitive, the Power System A Nordic countries. Very well organized.

M. Hamidi

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PERSONAL INFORMATION

1. Name: VISWAJEET KHANNA
2. Organization: PSERC (PUNJAB STATE ELECTRICITY REGULATORY COMMISSION)
3. Position title: CHAIRPERSON
4. Email: chairpersonpserechd@gmail.com

Which presentations or activities were the most relevant to you?

Most relevant: NORD POOL PRESENTATIONS

Second most relevant: NYE (New York Regulatory Commission)

Please explain: Derivatives Trading is a new platform emerging in India and exposure to its various facets provides a useful insight! NYE does broadly the same work in regulation that our organisation/regulatory body does

What is your commissions' role (or future role) in financial derivatives in energy markets?

It will have to formulate regulations to accomodate the new platform in power trading.

What concerns do you have regarding financial derivatives in energy markets?

The potential for cartelisation, speculation, insider trading, manipulation of markets and misuse of regulatory loopholes.

Are you currently working on regulations involving battery storage? If yes, please describe.

Yes. The regulatory body at the National level (FOR) is working on its recommendations through a select group.

What concerns do you have regarding battery storage?

Cost effectiveness. Currently the storage capacity is low vis-a-vis costs.

What materials, ideas or procedures did you learn about that you plan to use or recommend for use in your commission?

1. Substantially covered in my Comments above.

2.

3.

4.

5.

On what topics would you like more in-depth information?

On blocking / ensuring control systems to prevent misuse of trading platforms for gaming.

In which specific areas do you believe your organization could use further technical assistance/ consulting services?

In designing trading platform regulations which are comprehensive and tested to be substantially foolproof.

Additional comments:

The programme was useful and provided ideas on regulatory processes and trading platforms operating in developed countries which have established processes. The coordinators, Jake and Marjorie were well organised and helpful. Our thanks to them.

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PERSONAL INFORMATION

1. Name: ***SHISHIR SINHA***
2. Organization: ***BIHAR ELECTRICITY REGULATORY COMMISSION***
3. Position title: ***CHAIRMAN***
4. Email: ***chairmanberc@bihar.gov.in***

Which presentations or activities were the most relevant to you?

Most relevant *Nord Pool Presentation on Battery Storage*.

Second most relevant *Battery Storage*

Please explain *Nord Pool Presentation gave a clear insight into the working of EU Energy exchange.*

What is your commissions' role (or future role) in financial derivatives in energy markets?

As per the Electricity Act, 2003 all financial derivatives have to be vetted and approved by the Electricity Regulatory Commission.

What concerns do you have regarding financial derivatives in energy markets?

Financial derivatives should be free counter party risks, of leverage and complicated web of derivatives contract.

Are you currently working on regulations involving battery storage? If yes, please describe.

At state level, the BERC is committed to formulate the necessary enabling regulatory framework for promotion of BESS and looking forward to approve the model Request for Proposals (RFPs) and Power Purchase Agreement (PPAs) involving RE based generation integrated with BESS.

What concerns do you have regarding battery storage?

High cost of implementation, lack of standardization and outdated regulating policy and market design.

What materials, ideas or procedures did you learn about that you plan to use or recommend for use in your commission?

1. The functioning of energy exchange
2. Grid synchronization
3. Latest battery technology in use throughout the world.
4. Optimisation of renewable source of energy and the phasing out of fossil fuel.
5. Energy interdependence amongst nation.

On what topics would you like more in-depth information?

- Ways to phase out fossil fuel and to achieve net zero carbon emission goal

In which specific areas do you believe your organization could use further technical assistance/ consulting services?

- For achieving net zero carbon emission goal and of optimal use of green hydrogen.

Additional comments: None