ICH Regional Energy Cooperation Workshop

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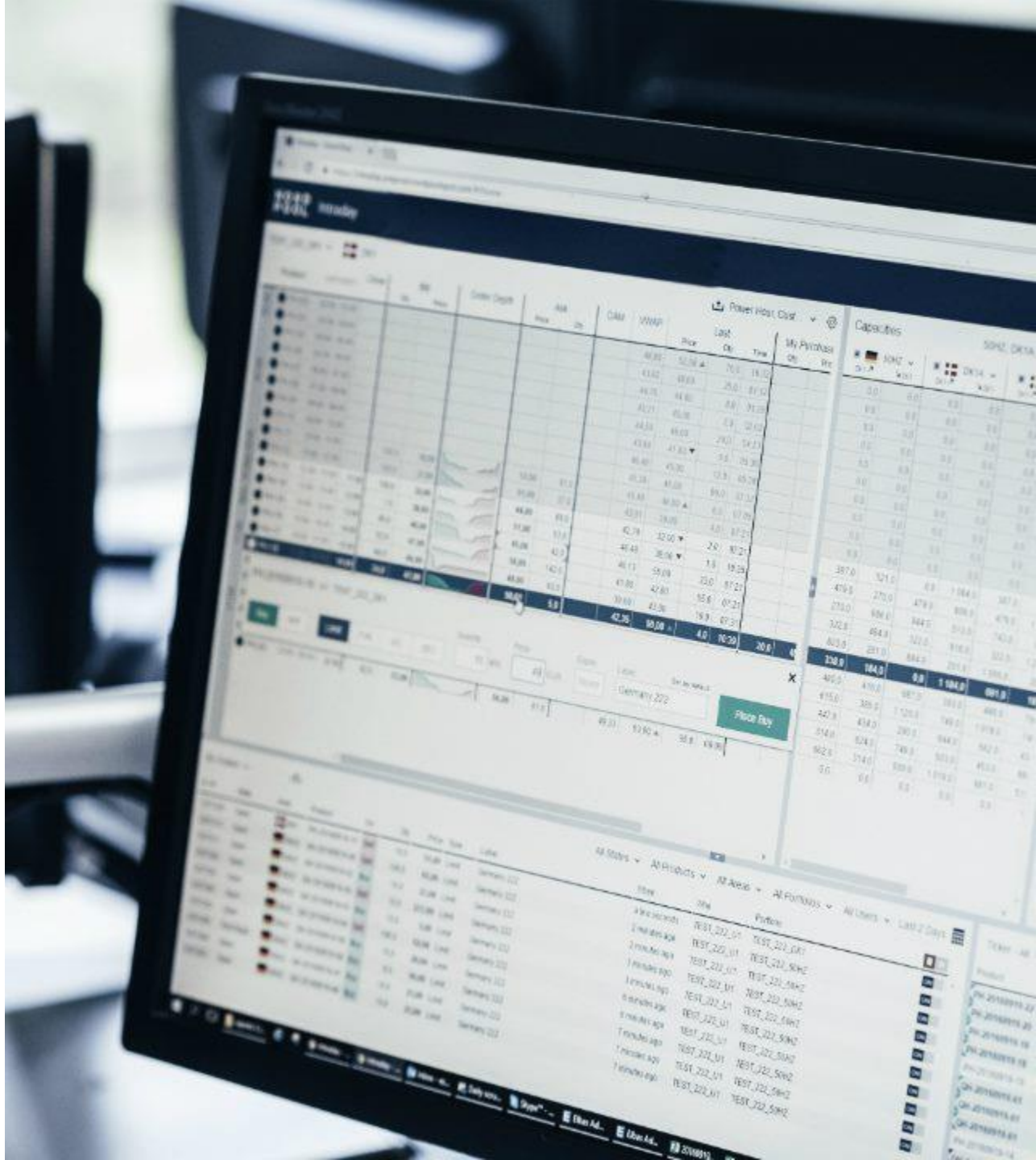
Agenda

1. Introduction to Nord Pool Consulting
2. Energy market foundation
3. Market coupling and optimization of cross border flows
4. Regional market in the Asian context
   - Case examples SAPP and ASEAN
   - Conclusions
5. Q&A session and closing



Nord Pool

NORD POOL

Europe‘s leading power market

Efficient, simple and secure power trading across Europe.

- The world’s first electricity exchange.
- The world’s first multinational electricity exchange.
- A driving force in European market integration through XBID and PCR projects.
- A global thought-leader in the field of physical power trading.

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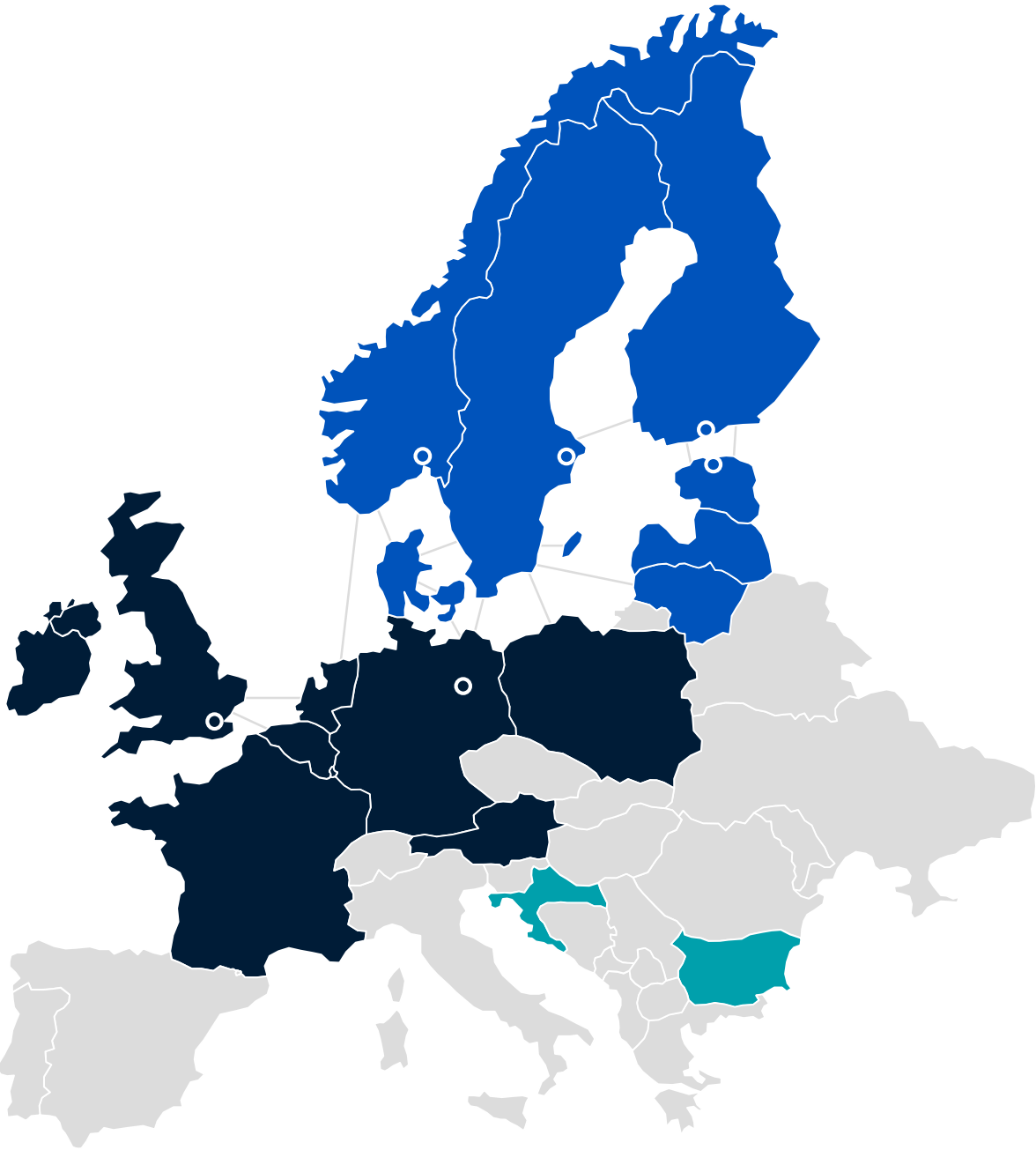
Nord Pool at a glance

- More than 360 customers from 20 countries trade on Nord Pool's markets.
- Nominated Electricity Market Operator (NEMO) in 15 European countries.
- Offices in Oslo, Helsinki, Stockholm, Tallinn, London and Berlin.
- Over 140 employees work at Nord Pool.
- 524 TWh of power was traded in 2018.



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Nord Pool's stakeholders

- Regulated in Norway by Norwegian Water Resources and Energy Directorate (NVE)
- NVE is a directorate under Norwegian Ministry of Petroleum and Energy
- 100 % owned by Nordic and Baltic transmission system operators
- Nominated NEMO in Austria, Belgium Denmark, Estonia, Finland, France, Germany, Great Britain, Ireland, Poland, Latvia, Lithuania, Luxembourg, the Netherlands and Sweden
- A free but regulated market fair for everyone

NORWEGIAN MINISTRY OF PETROLEUM AND ENERGY

EU

NVE

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Statnett SF (Norway) 28.2%

Svenska kraftnät (Sweden) 28.2%

Energinet.dk (Denmark) 18.8%

Fingrid Oyj (Finland) 18.8%

Elering AS (Estonia) 2%

Litgrid AB (Lithuania) 2%

Augstsprieguma tīkls AS (Latvia) 2%

Statnett ENERGINET SVENSKA KRAFTNÄT FINGRID

elering Litgrid AST

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A journey towards a European electricity market

1991
Norwegian power market deregulated

1993
The Norwegian power exchange is established as ‘Statnett Marked’

1996
Norway and Sweden joins, this is the world’s first international power market – called **Nord Pool**

1998
Finland joins Nord Pool

1999
The first international intraday market is established

2000
The Nordic market becomes fully integrated as Denmark joins

2010
UK and Estonia joins Nord Pool

2013
Baltic now completed – Lithuania and Latvia join Nord Pool

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

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

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

2017
NODES is established

2018
XBID go live

Products and Services

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

DAY-AHEAD

Our day-ahead trading platform offers single hourly blocks, block orders, minimum acceptance ratio, linking, flexi orders and exclusive orders.

INTRADAY

Through the European Cross-Border Intraday Market (XBID) 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.

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Nord Pool Consulting

Ambassadors for modern power market across the world

Unique competence in a wide span of topics

Market design
Specialised competence in overall market design and structuring, with emphasis on local needs

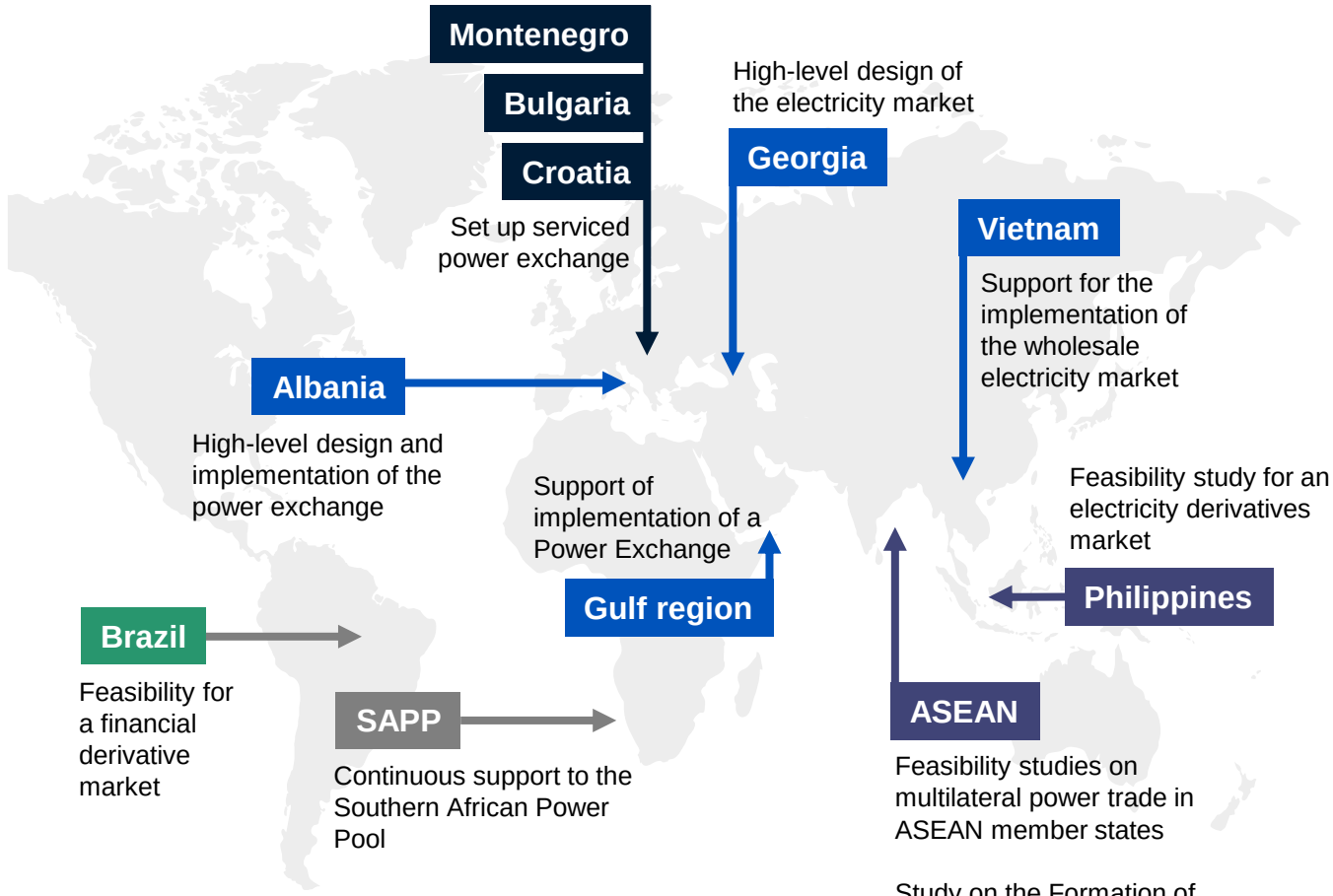
Rulebook development
Development of rule books for all market participants to ensure well-functioning markets

Regulation
Deep insight into regulatory frameworks with continuous lobbying efforts towards regulators and politicians

Market systems
Provision of power exchange backbone systems and MCO services

Competence building
Nord Pool Academy is a vehicle to educate customers and stakeholders on internal and external developments

A selection of projects recently completed



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Energy market foundation

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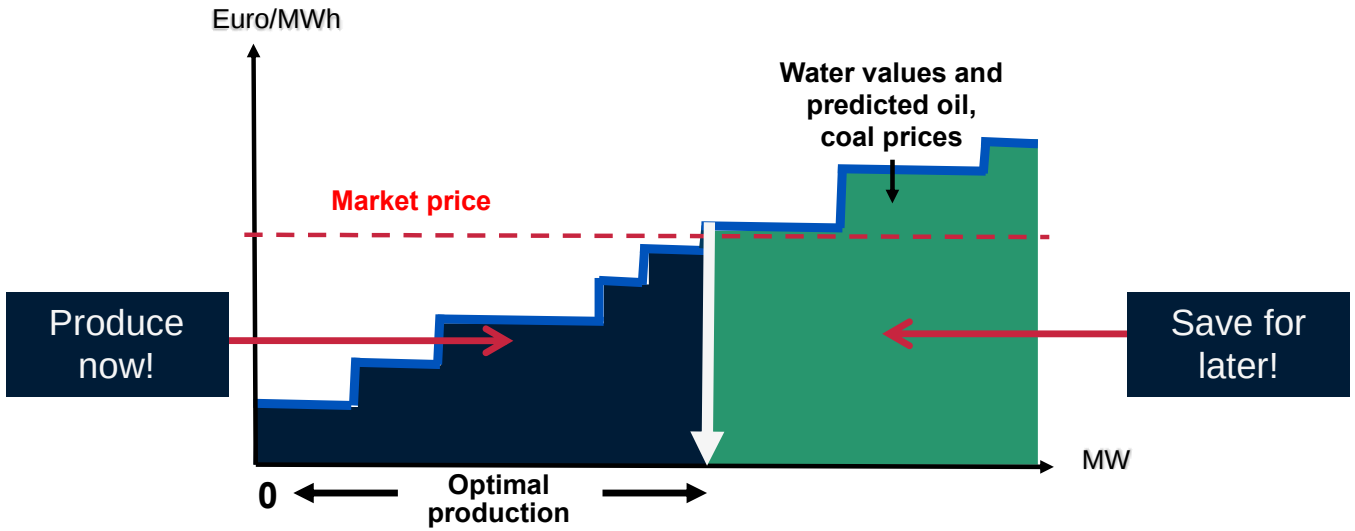
What are we trying to achieve?

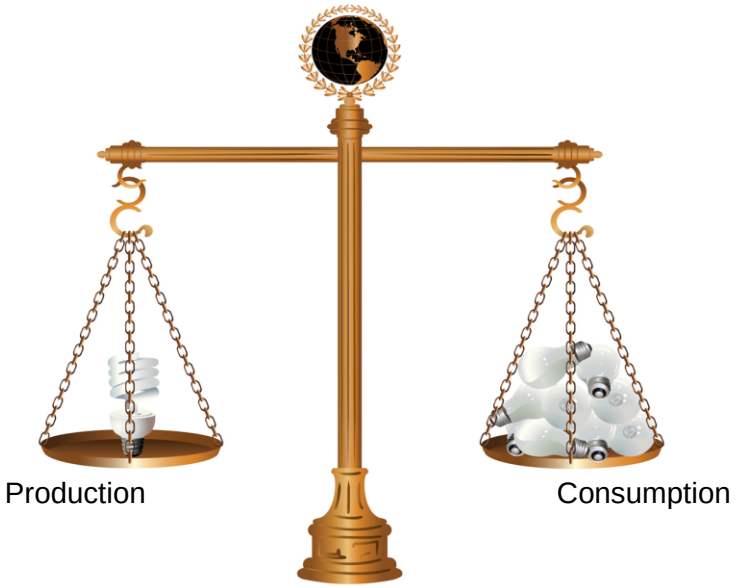
At a high level it is easy...

To Produce or not to Produce



The fuel value is the opportunity cost of producing now compared with producing in the future?

Market Principle



Price

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A typical situation prior to market operation

- Vertical integrated utilities responsible for production, grid and deliveries managed as a monopoly
- No market for short-term electricity trade
- Trade based on trade with bilateral contracts
- Local area responsibility for security of supply
- There is no real competition in the industry in a surplus or a deficit situation
- This situation can create inefficient system operation and result in higher prices for the end consumers

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An example: Norway

Economic inefficiencies and lack of coordination in the Norwegian market

- Starting point in Norway was over-investment and thereby low prices
- Inefficient management where municipalities were responsible for the local power balance (Norway at that point had 4,5 mill people and 435 municipalities)
- Investments and profits for the companies literally disappeared ‘straight into the ocean’
- Excess power was exported to Sweden at a lower price than that paid by Norwegians
- The Ministry of Finance, not the Ministry of Oil and Energy, realising that the industry was based on uneconomic principles and operations, therefore raised the question of efficiency.

The challenge was to develop a model tailored to an industry and a commodity that was produced and consumed at the same time and that thus had special prerequisites and requirements.

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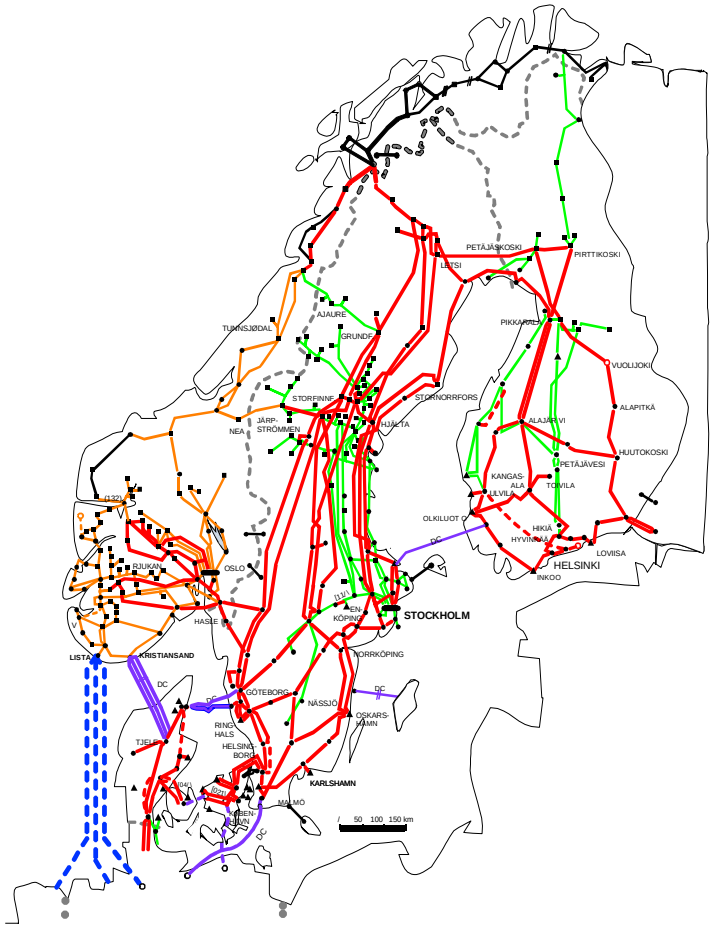
The Nordic Electricity System



Norway:

- Population 5,0 mill
- Peak load: 21 800 MW
- Installed capacity: 31 700 MW
- Annual Consumption: 122 TWh
- Normal production*: 126 TWh
- Variation. 60 TWh
- Hydro production: 97%

Nordic:

- Population > 25 mill
- Peak load: 67 300 MW
- Installed capacity: 98 400 MW
- Annual consumption: 379 TWh
- Production:
  - Hydro: 52%
  - Nuclear: 21%
  - Thermal: 23%
  - Wind: 4%

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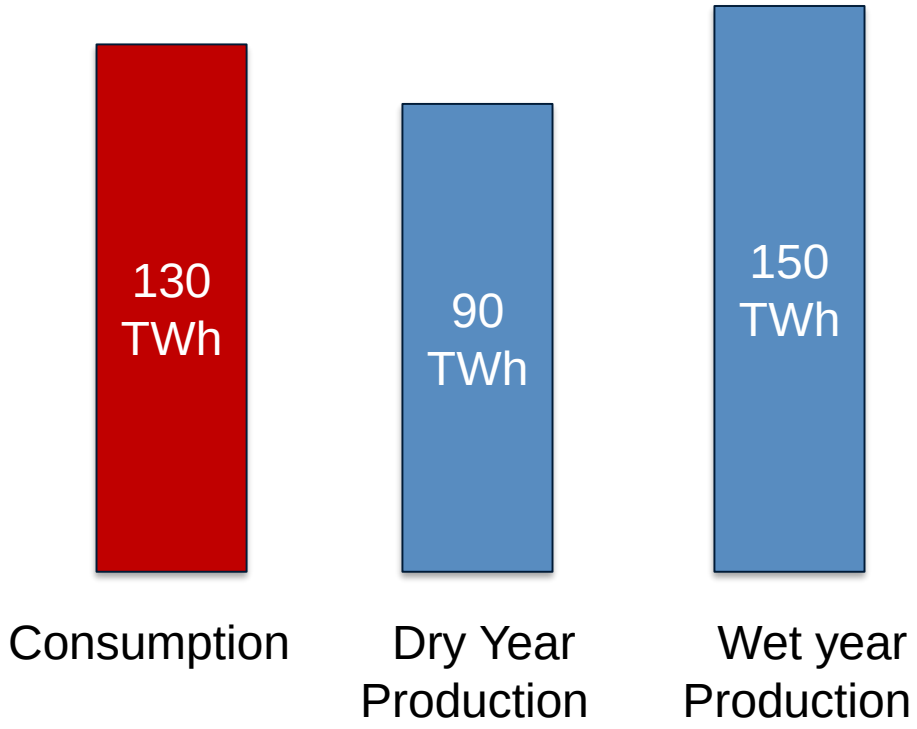
Variation in Production - Norway

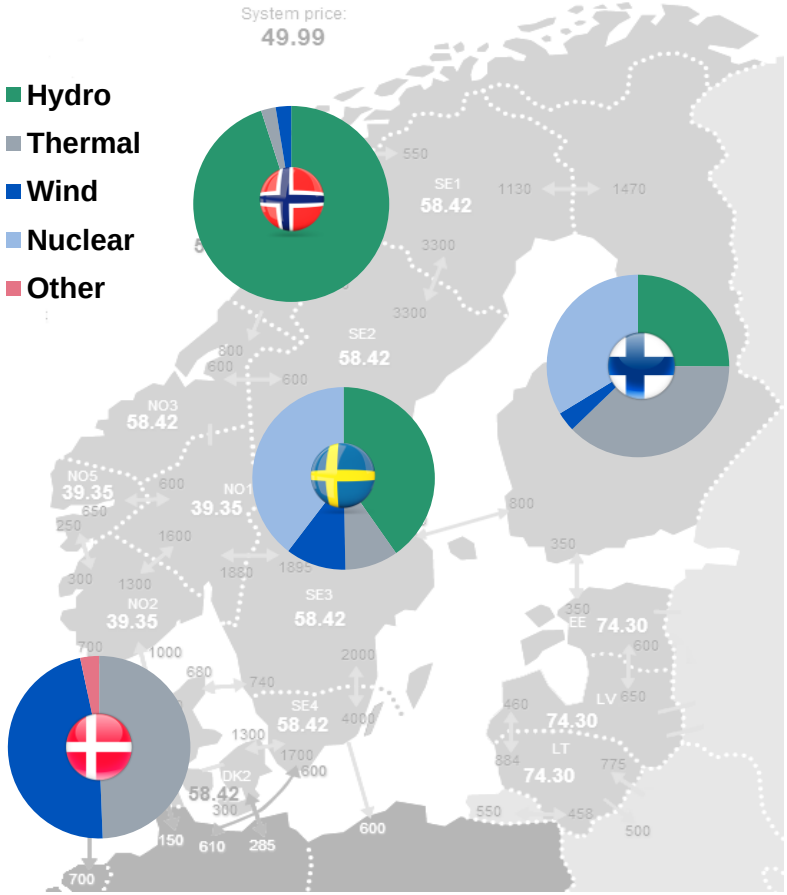
Example for a hydro system :



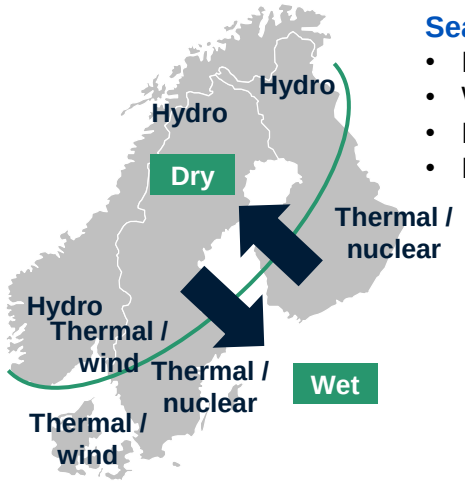
Why cooperate across borders? The Nordic Model

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

Nordic power production capabilities

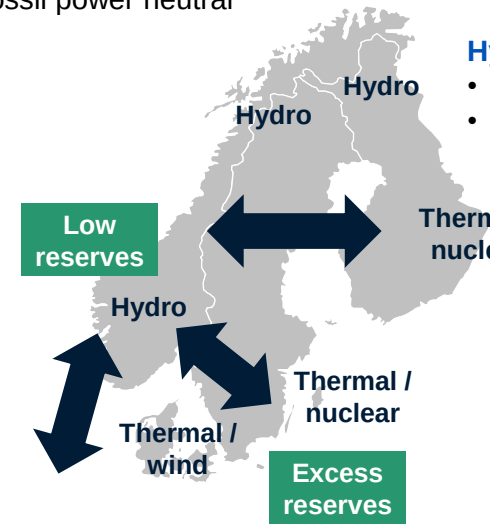


Connecting markets with differing production profiles provides stability to the system



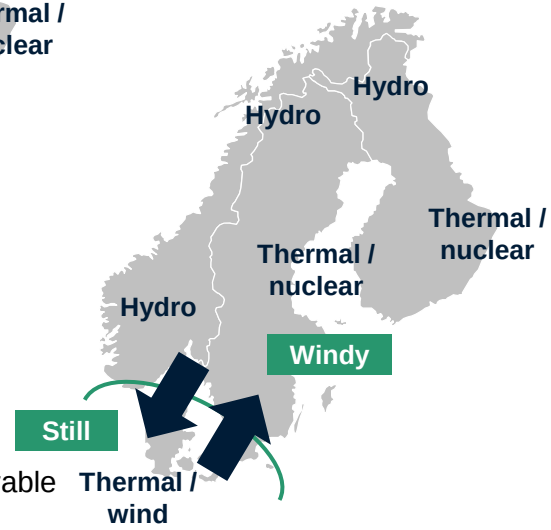
Seasons

- Hydropower highly seasonal
- Wind power highly seasonal
- Nuclear neutral
- Fossil power neutral



Hydrology

- Wet year – more hydro production
- Dry year – less hydro production



Daily weather situation

- Wind power not flexible or storable
- All other sources flexible

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The Electricity Industry System Changes

1. State owned production and main grid management and operation established as two different companies.
2. Main, regional and local grid organized as a monopoly.
3. Electricity production exposed for competition.
4. Reducing number of bilateral contracts step by step.
5. A Power Exchange and a free open electricity market was established.
6. A voluntarily change towards unbundling of the vertical integrated utilities.
7. The market and not the Government (politicians) will have define wholesale power prices and products.

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Market Price Principle

- The market price is based on the market participants willingness to sell or buy electricity and the available transmission capacities available.
- The price formation ensures that the demand for electricity is satisfied at the lowest possible cost to the society.
- The Day-Ahead Market is the main “market tool” to balance production and consumption. Ensuring that the cheapest energy is produced/sold and consumed/bought first.

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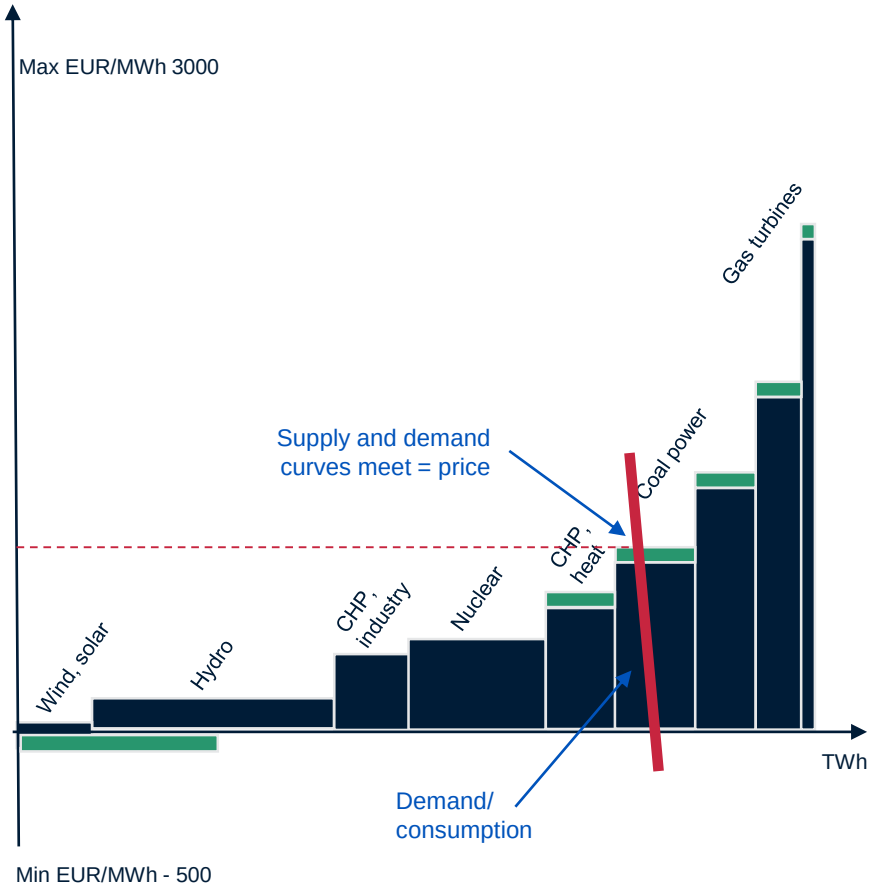
Day-Ahead price formation in theory

- Day-Ahead prices are calculated using an optimization algorithm
- Optimization happens through maximising overall social welfare
- Calculation methodology ensures that, based on the placed sell and buy bids, least-cost generation units are activated first*
- Last activated order sets the price for all production needed to meet demand



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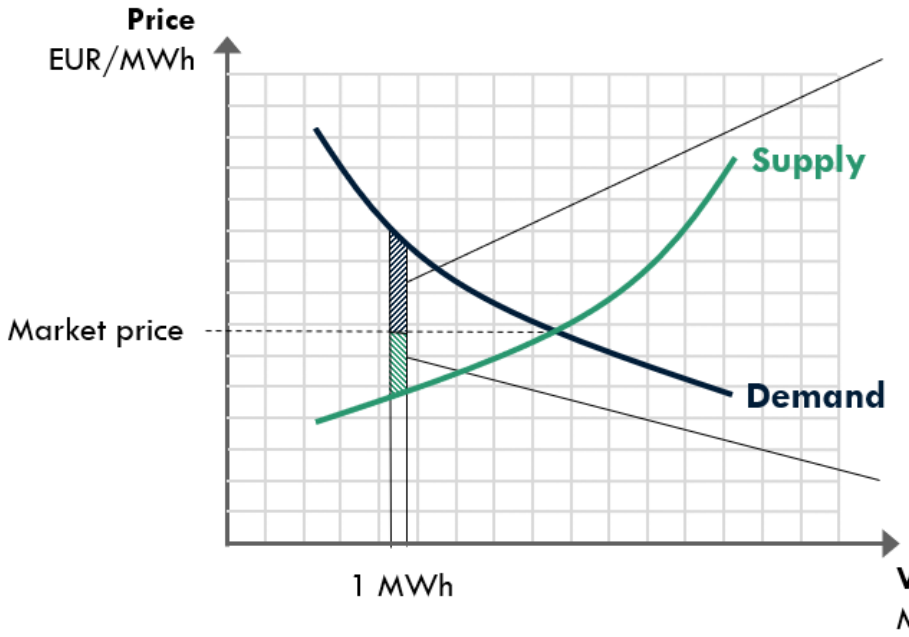
*) The traditional 'merit order' of short-run marginal costs of generation is not fully applicable to intermittent generation as it cannot be dispatched to meet peak demand. Due to zero marginal cost of intermittent generation such as wind and solar, they always become first in the 'merit order': they produce when they produce.

Economic approach

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.



Consumer surplus = difference between the demand offer price and market price

Producer surplus = difference between the supply offer price and market price

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.

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Market Role

- The primary role of a power market is to facilitate power trade and establish a price where supply and demand is in balance taking into account available transmission capacity
- A well functioning and competitive power market produces a balance at a marginal price hour for hour the next delivery day.
- The marginal price represents:
  - The cost of producing one MWh of power from the last generator source needed to be employed in order to balance the system.
  - The price that the consumers are willing to pay for the final MWh required to satisfy demand

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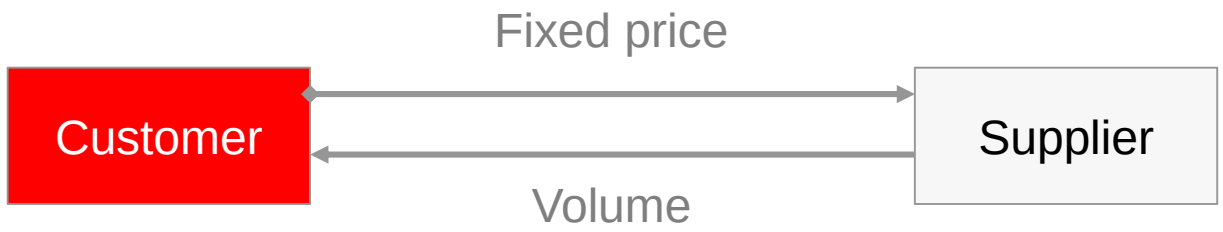
Trading of Power - Traditionally

Traditionally customers have purchased all their power needs from a single supplier that provides all the required services on a fixed price tariff where:

- The customer takes all the risks by complex price tariffs.
- The customer have the advantage in simplicity, but with a disadvantages in cost, market transparency, flexibility and price setting.
- The supplier takes the risk in many relations among other as future prices, inefficient operation and balancing service



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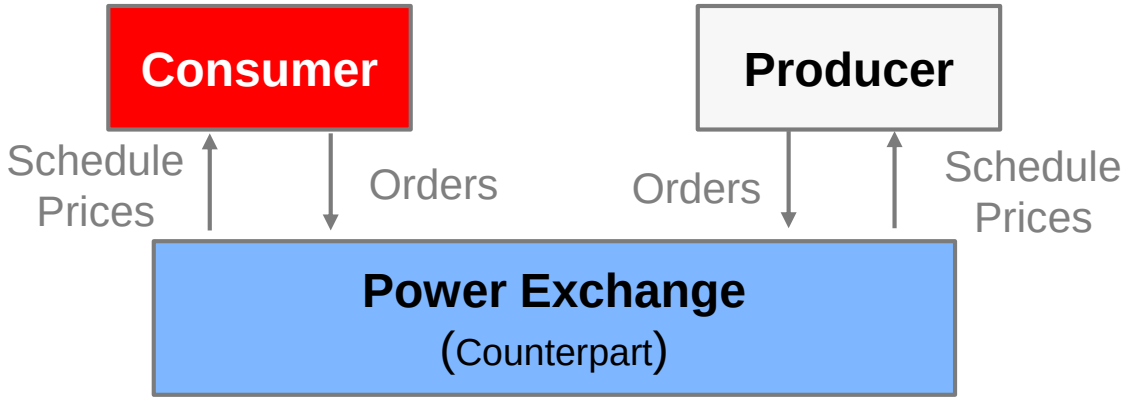
Trading of Power in a Open Market

In a market environment the supplier must:

- Both supplier and consumer predict the load for the next day
- Supplier will among many variables value the different production assets marginal prices,
- Predict market prices (Power Exchange)
- Prepare and submit orders for the short term market
- Report the schedule to the TSO for the country (area)
- Manage the total portfolio on a hourly basis and void the balancing market



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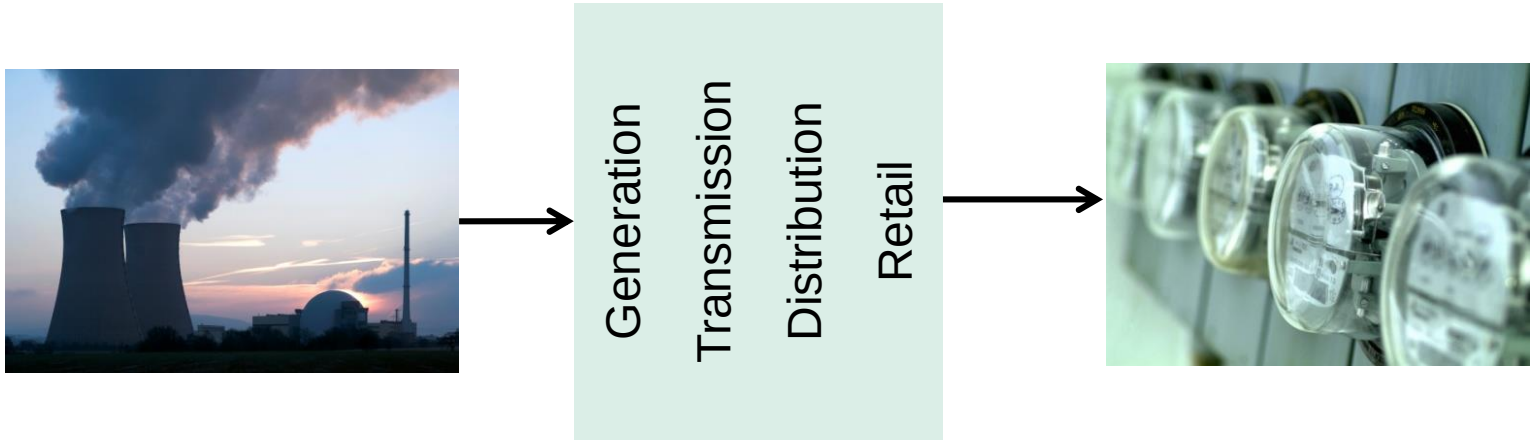
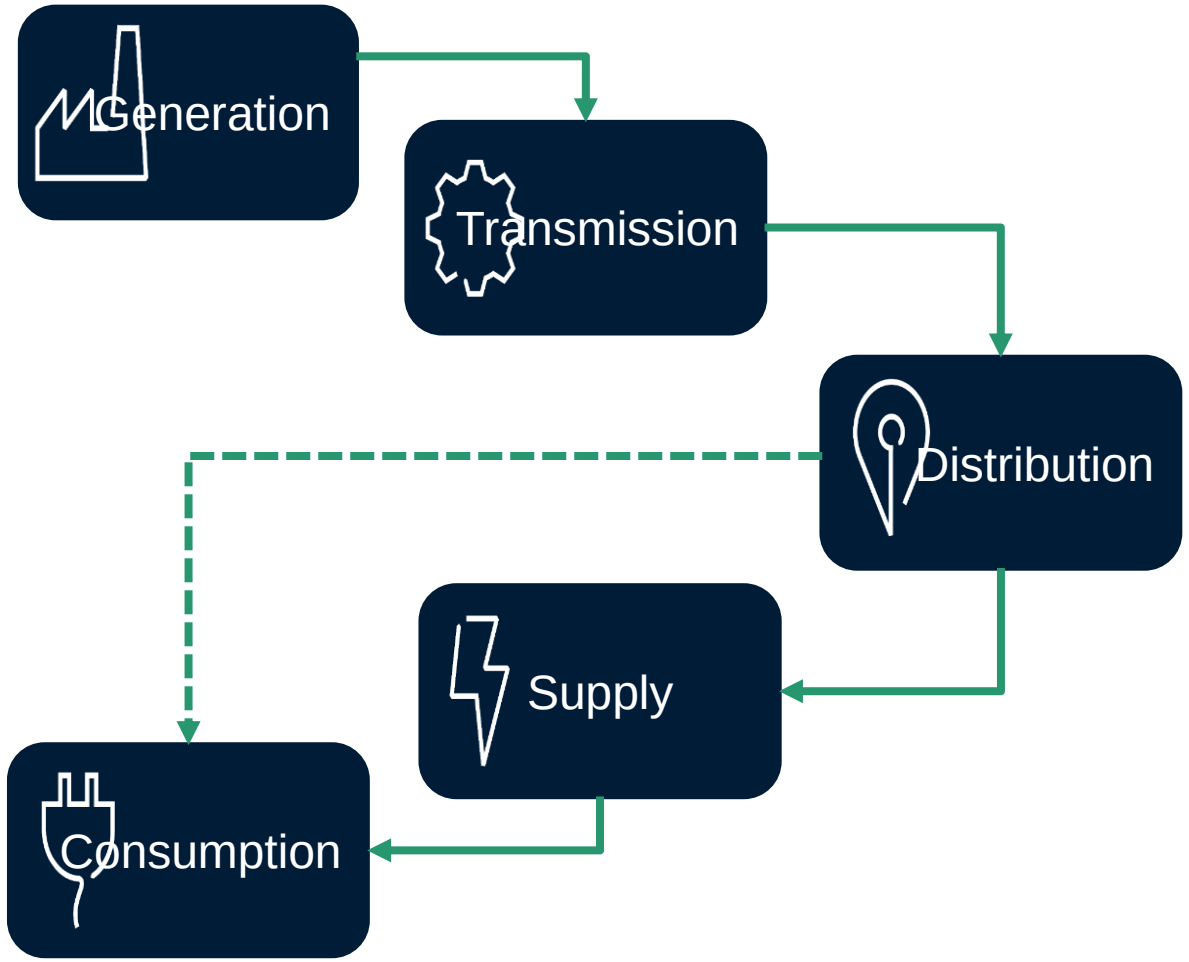
Vertically Integrated Utility

- All functions performed by one company



Dimensions of electricity business



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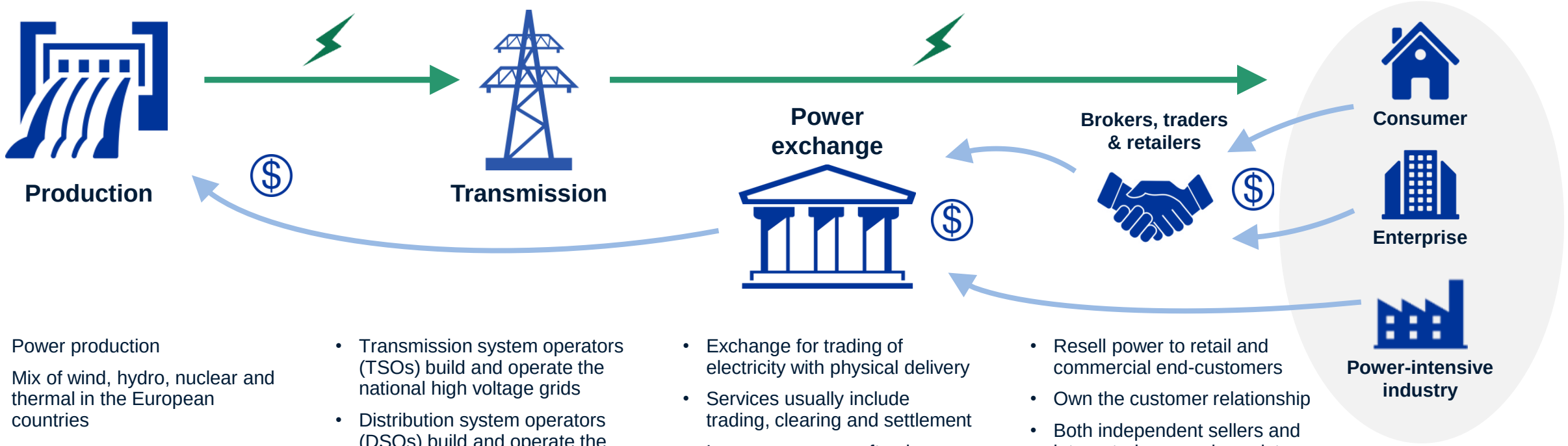
Overview of the electricity value chain

Power exchanges play an important role in the value chain



- Power production
- Mix of wind, hydro, nuclear and thermal in the European countries

- Transmission system operators (TSOs) build and operate the national high voltage grids
- Distribution system operators (DSOs) build and operate the local distribution networks

- Exchange for trading of electricity with physical delivery
- Services usually include trading, clearing and settlement
- Large consumers often buy directly from exchanges

- Resell power to retail and commercial end-customers
- Own the customer relationship
- Both independent sellers and integrated companies exist

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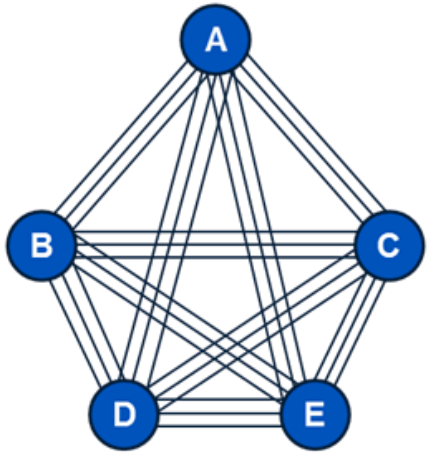
Central Counter Party

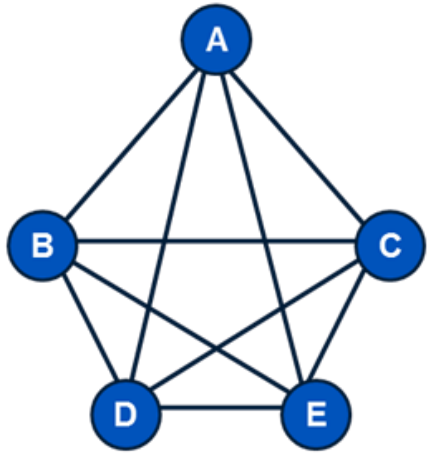
From bilateral trading to Central Counter Party trading

Old world:
Bilateral trading
without netting



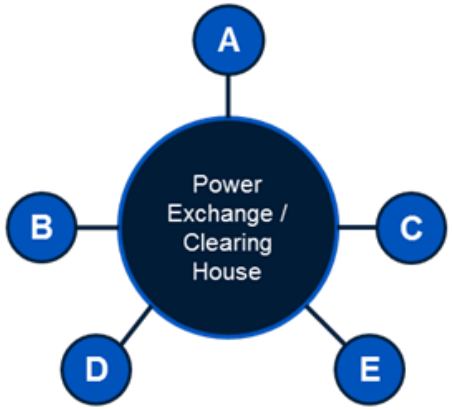
Several counterparties
and transactions

Bilateral trading
with netting



One transaction for
each counterparty

Most trading nowadays:
Trading with several
counterparties



Always only Power Exchange / Clearing House as the only counterparty for all trades!

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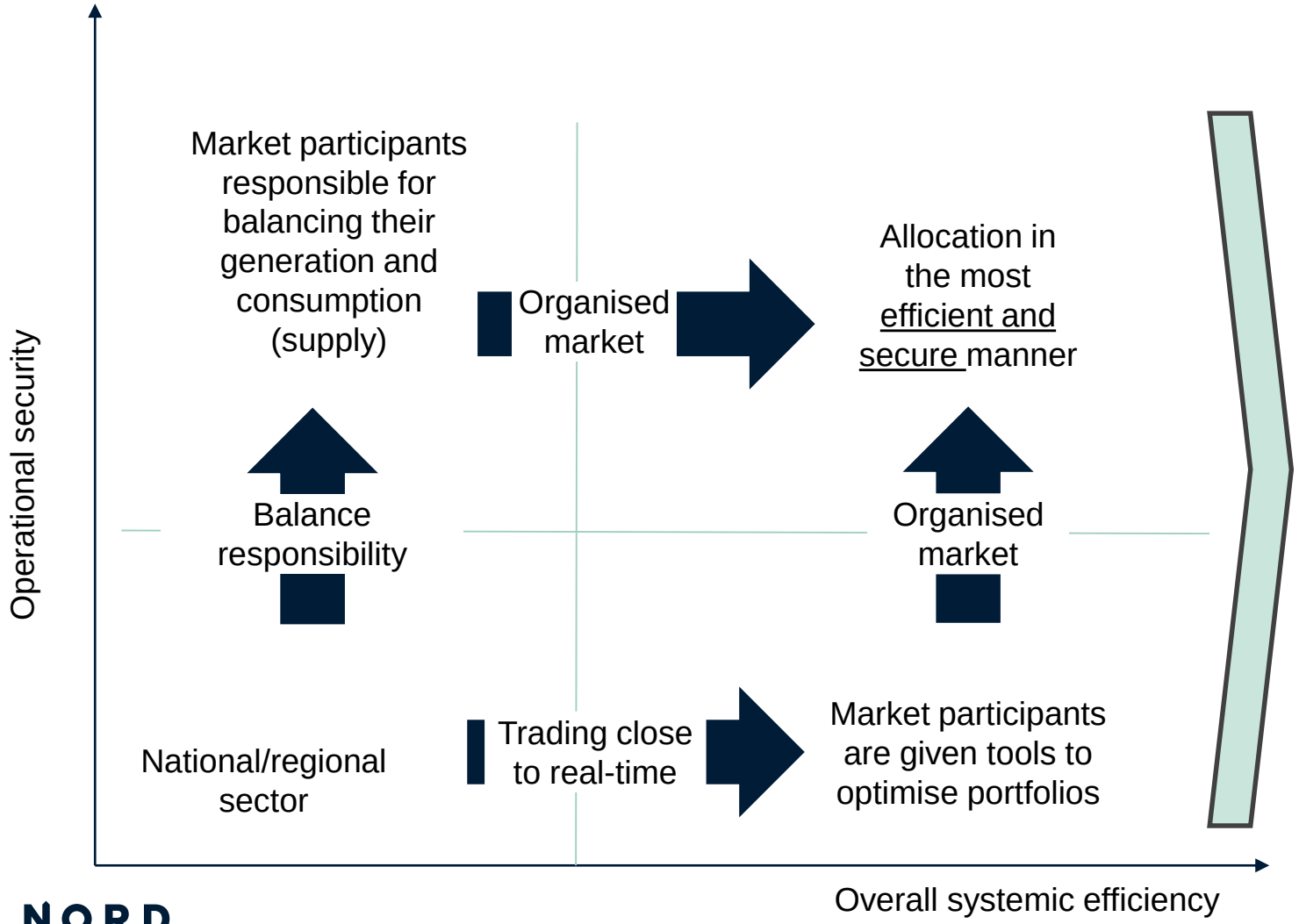
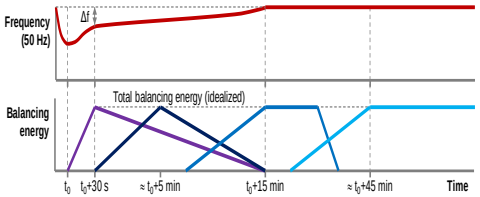
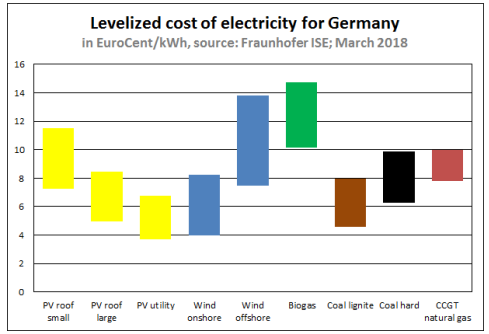
A market reform promotes both security of supply and the sector's long-term efficiency through a holistic approach



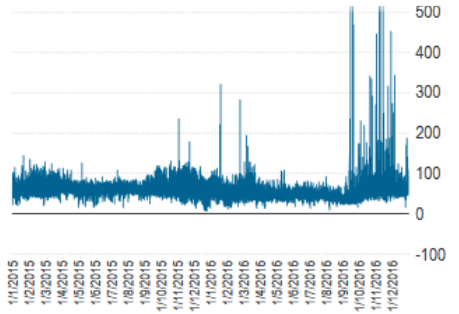
Market-based tools for real-time balancing of residual need



Market prices provide true investment incentives



Energy (import/export) goes where it is valued the most



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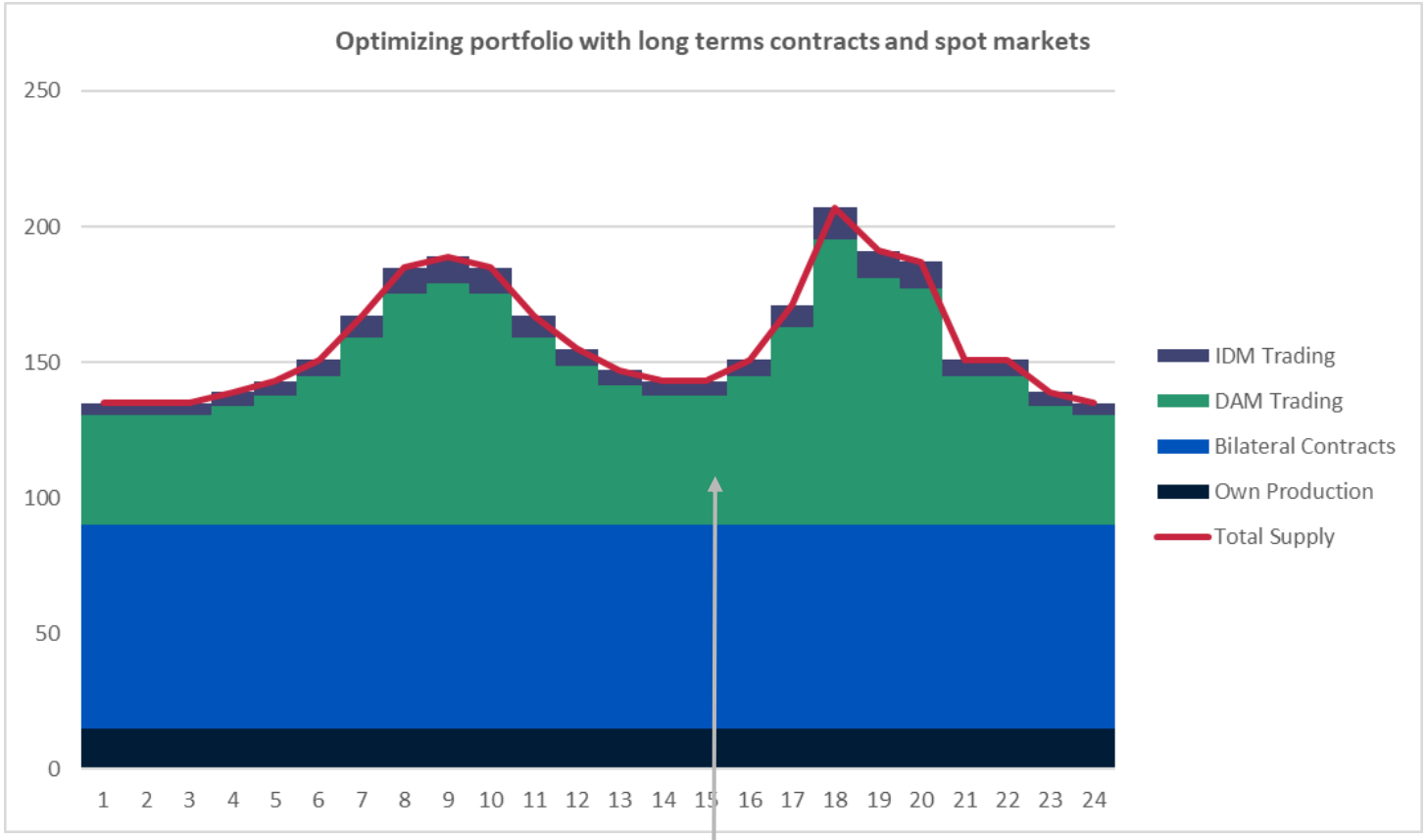
The BRPs are self-balancing the portfolio through the different market segments

- BRPs need to plan how to sell or cover their needs for electricity in the different market segments
- Own production and bilateral long term contracts will provide a **baseline** of their planning
- DAM and IDM allow for **self-balancing** before physical delivery
- The BRPs need to forecast and execute the portfolio balancing activities as their daily routine & responsibility



Selling the difference between long term contracts and estimated total supply to DAM/IDM = **self-balancing**

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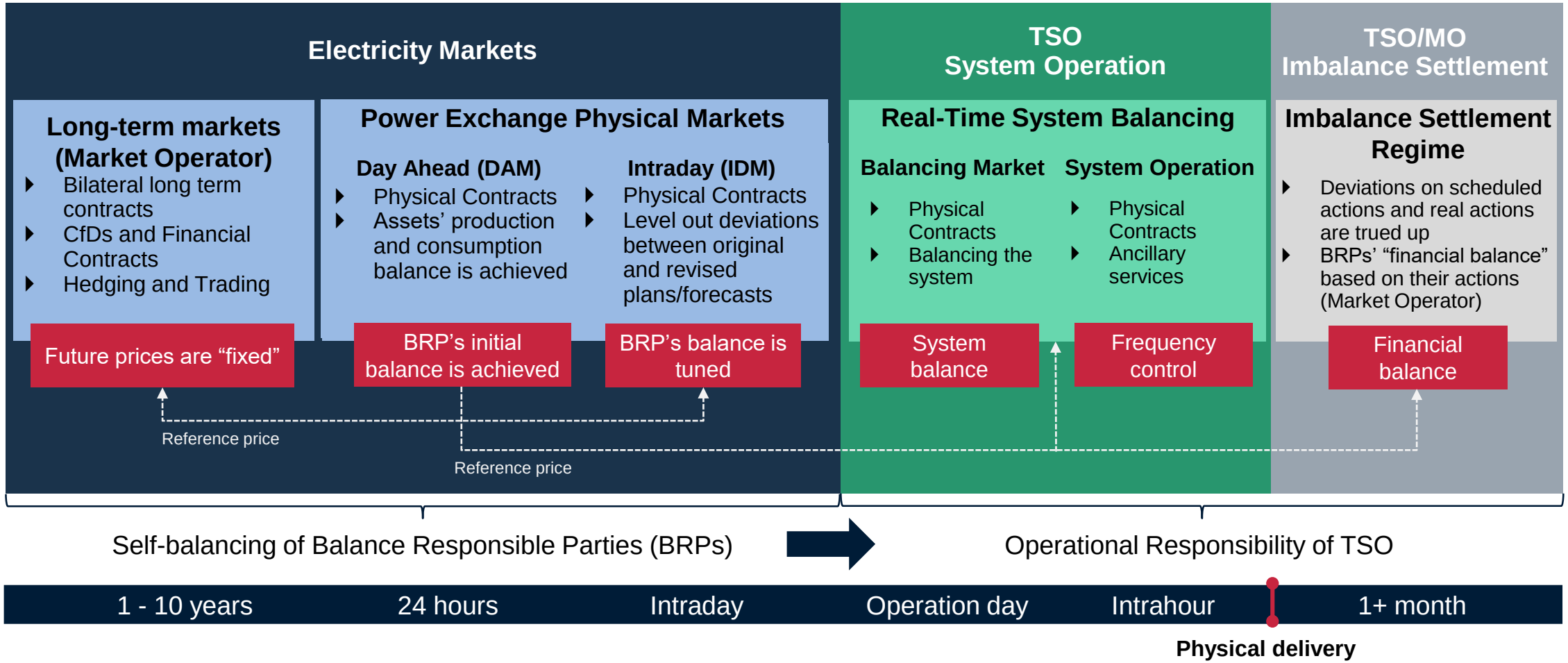
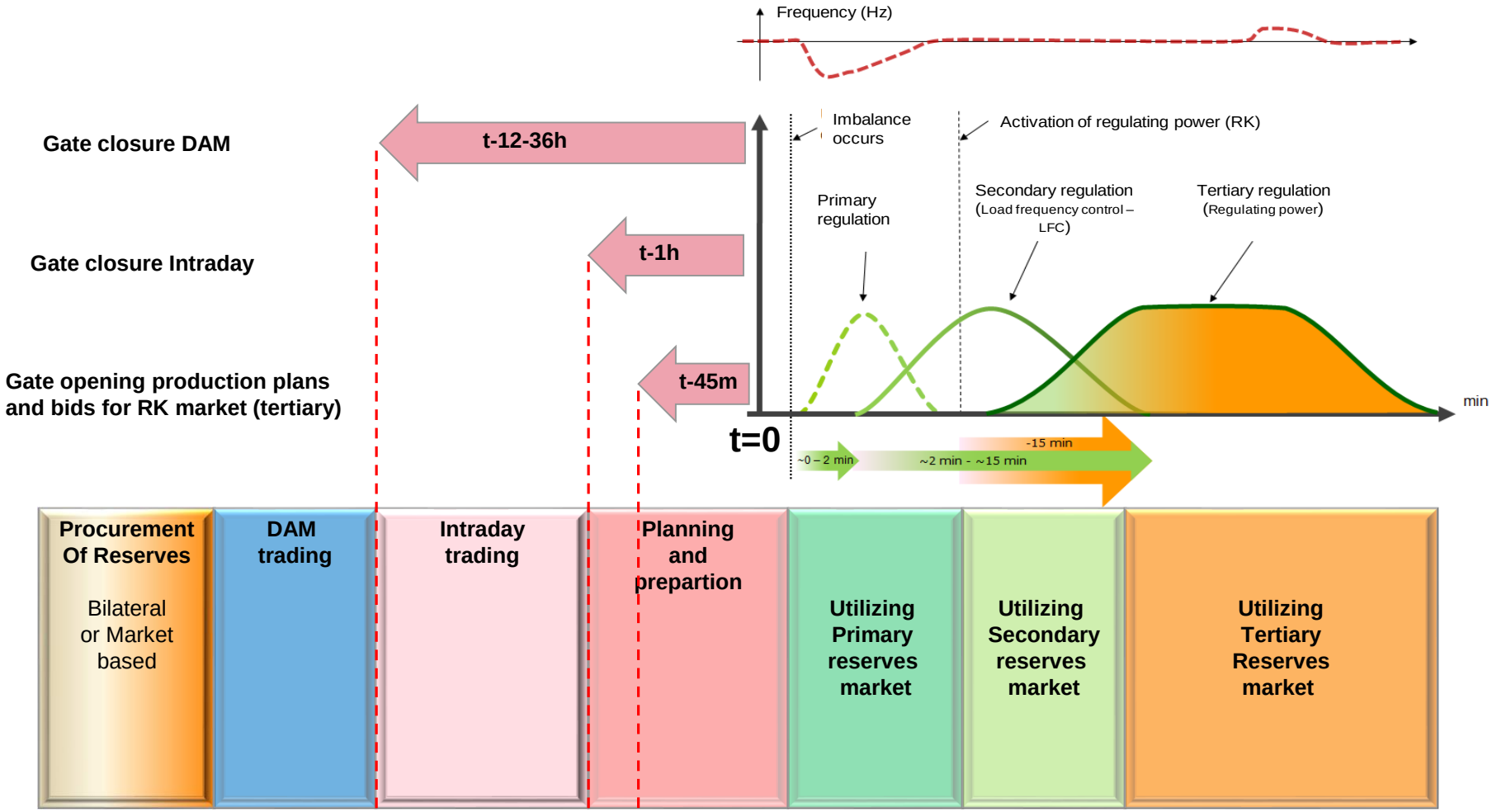
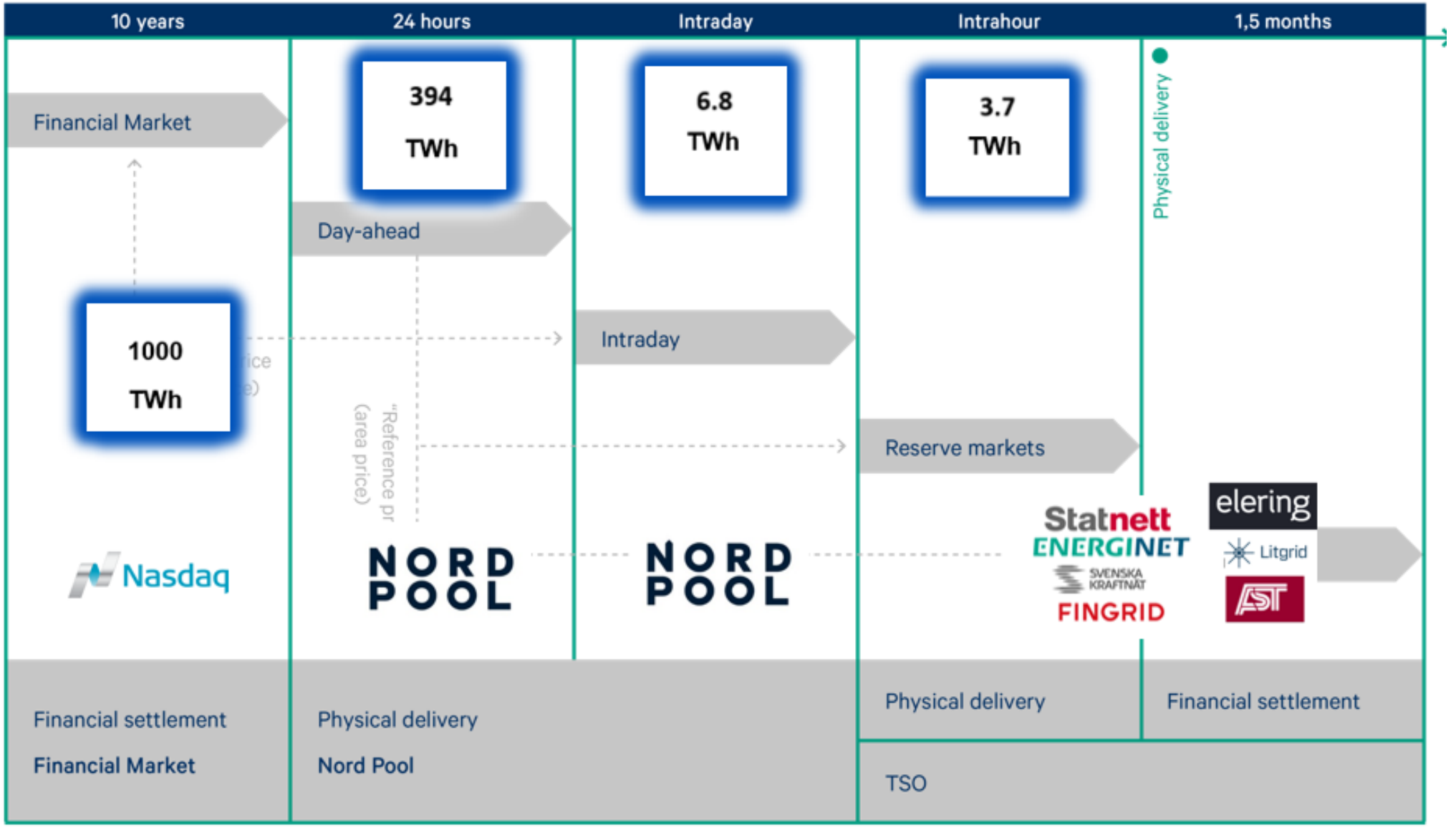
The European target model contains several power market segments for individual purposes



Balancing Overview – all Markets Combined



The proof of success is in the TWh/year 2017



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Primary Market Features

Market Liquidity

- Wholesale Market Participants need a liquid market in order to be able to balance their expected generation/consumption with market contracts to support secure of supply

Portfolio bidding and Self Dispatch

- The participants will manage their own production assets

Implicit auctioning of Available Transmission Capacity between the market areas

- The price calculation and the implicit congestion auction is securing correct power exchange between the market areas

Transparency

- In price determination and power system Information

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Regulator - a key party

A competitive internal energy market cannot exist without independent regulators who ensure the application of the market rules.

- Regulator must be independent from both industry interests and government.
- Regulator must be their own legal entity and have authority over their own budget.
- National governments must supply Regulator with sufficient resources to carry out the operations
- Regulator can issue binding decisions to companies and impose penalties on those that do not comply with the legal obligations
- Electricity generators and energy suppliers are required to provide accurate data to regulators when necessary

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Market coupling and optimization of cross border flows

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Management of Transmission Capacity

The effective management of Transmission Capacities is a critical success factor for the operation of all markets.

In the case that we have several different markets, it is crucial that this is done based on some sound principles

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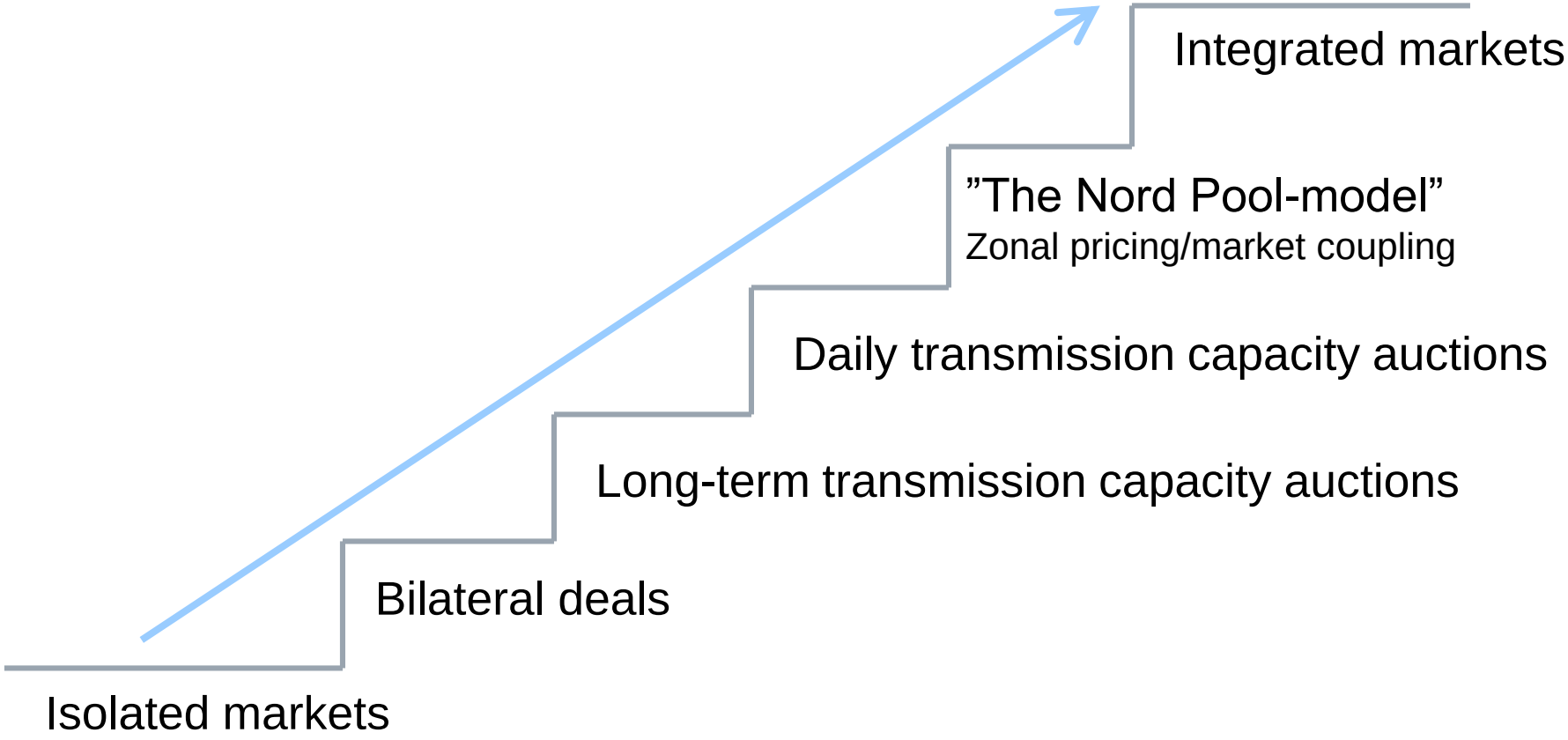
Development of cross zonal and boarder trading arrangements



Transmission management - Explicit

Transmission capacity on an interconnector is **auctioned** to the market **separately** and independently from the marketplaces where electrical energy is auctioned

- Considered as a simple method of handling the capacity
- The capacity is normally auctioned in portions through annual, monthly and daily auctions
- Transmission capacity and electrical energy are traded at two separate auctions, there is a lack of information about the prices of the other commodity.
- Inefficient utilization of interconnectors, i.e. less social welfare, less price convergence and more frequent adverse flows
- SEE CAO is functioning as explicit auction for the interconnection capacities in the region

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Transmission management - Implicit

Day-ahead transmission capacity is used to integrate the spot markets in the different bidding areas in order to maximize the overall social welfare in both (or more) markets

- The flow on an interconnector is found based on market data from the marketplace/s in the connected markets
- Auctioning of transmission capacity is included (implicitly) in the auctions of electrical energy in the market
- The resulting prices per area reflect both the cost of energy in each internal bidding area (price area) and the cost of congestion
- Ensures that electrical energy flows from the surplus areas (low price areas) towards the deficit areas (high price areas) thus also leading to price convergence

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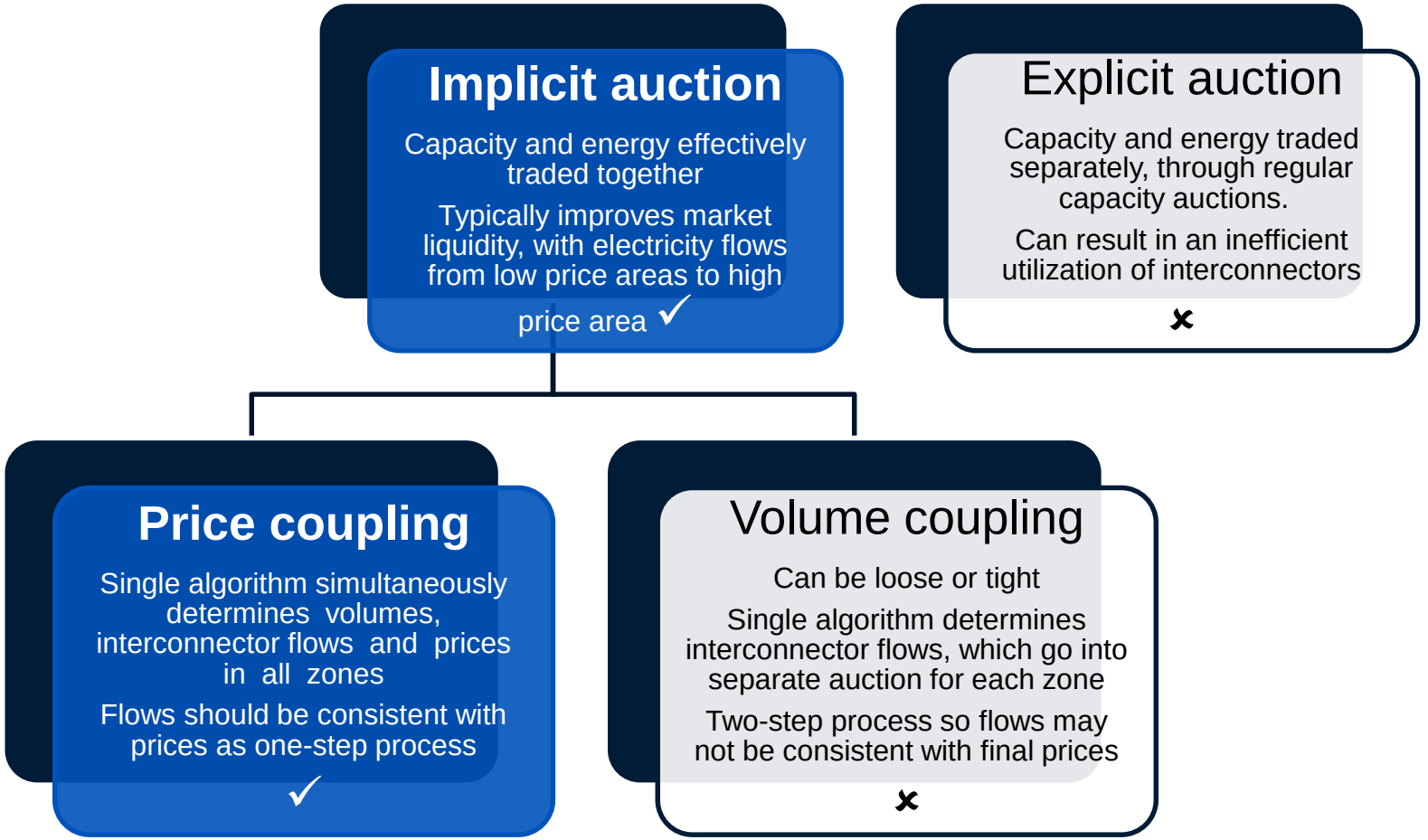
Price Coupling is a key Feature of the European Target Model



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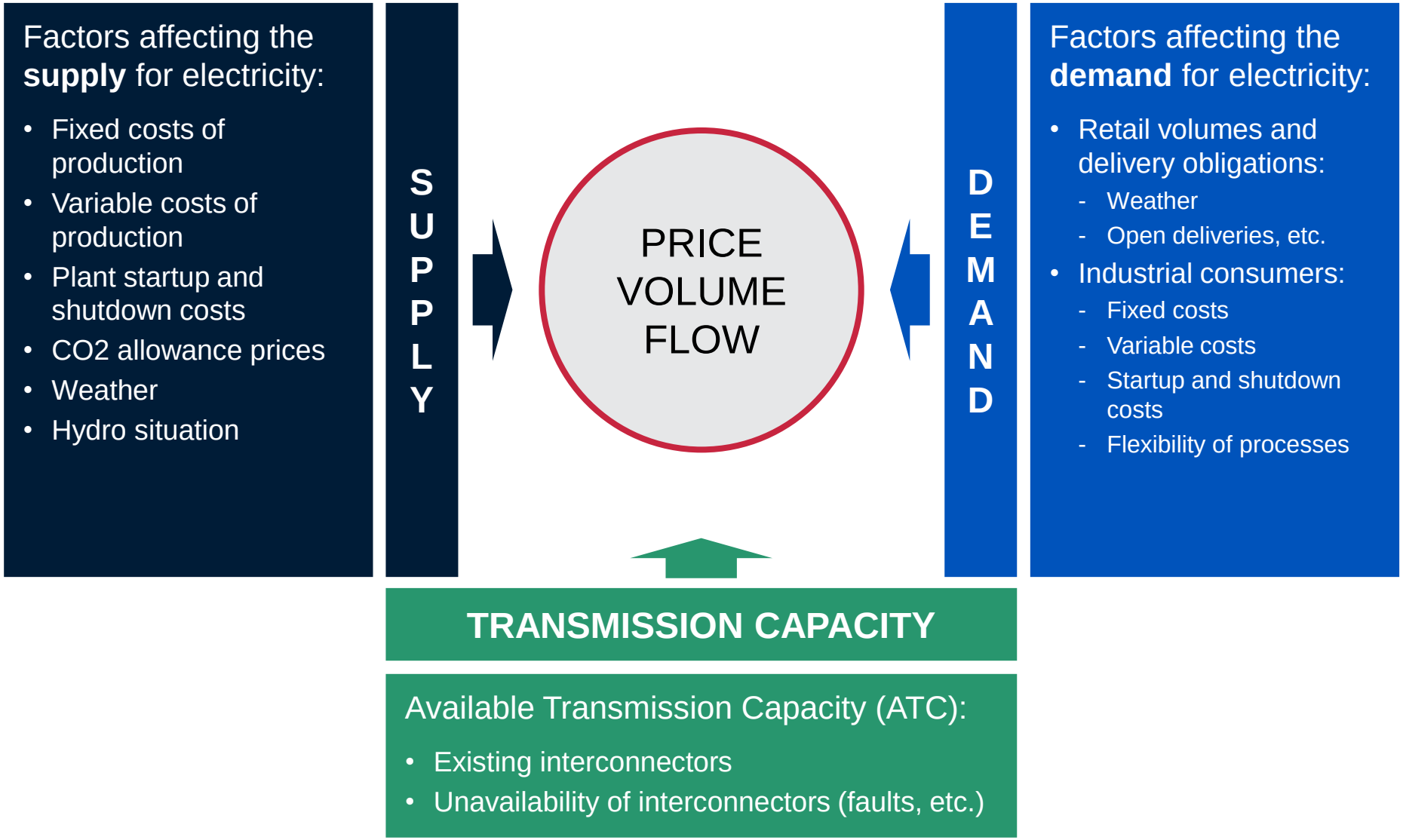
Day Ahead price formation in practice

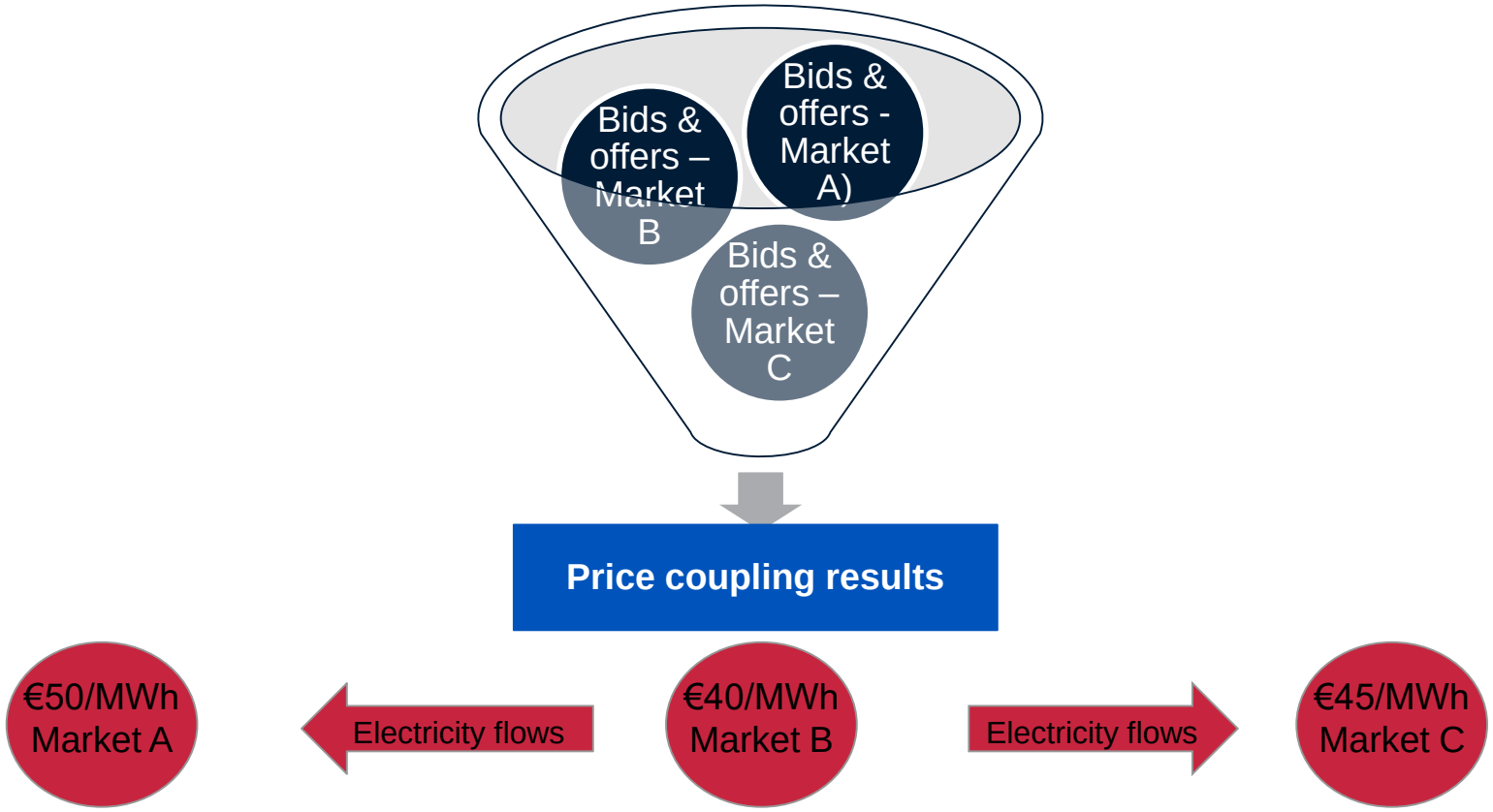


Transmission capacities and implicit auction

Example from Nordics

- Each morning, the TSOs determine the trading capacity between each bidding area:
  - Trading capacities for the next day are published on Nord Pool's website at 10:00 CET
  - All trading capacity between the Nordic and Baltic bidding areas is dedicated to Nord Pool for implicit auction
- Implicit auction, performed through the PCR market coupling, simultaneously determines prices, sell and purchase volumes and flows between bidding areas:
  - All trading capacity is available to all market participants on equal terms
  - There are no explicit capacity auctions on these connections

Day-Ahead Market: Prices and flows determined simultaneously in a one-shot auction



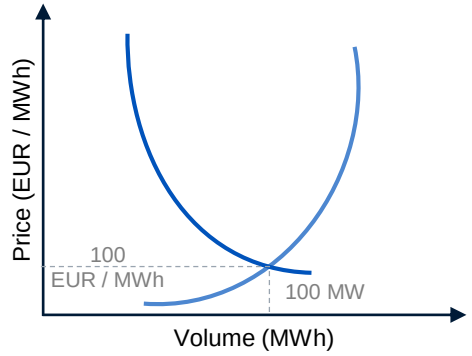
-Source Pöyry Management Consulting

Illustrative example of the price formation across bidding zones

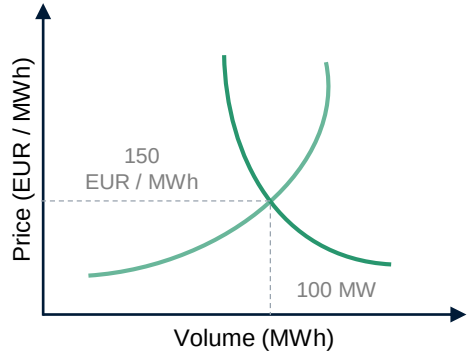
Actual prices are calculated based on supply and demand between regions with capacity constraints

Area prices with no transmission capacity

Norway – surplus area



Sweden – deficit area



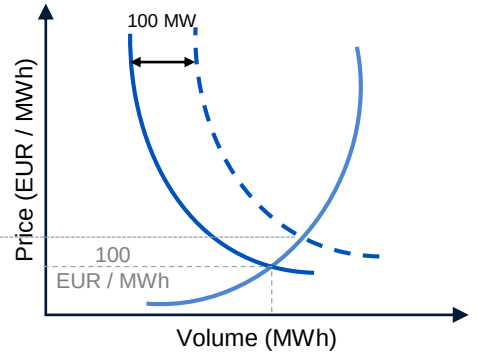
Different prices in the different areas due to asymmetries in supply and demand

Area prices with infinite capacity (system price)

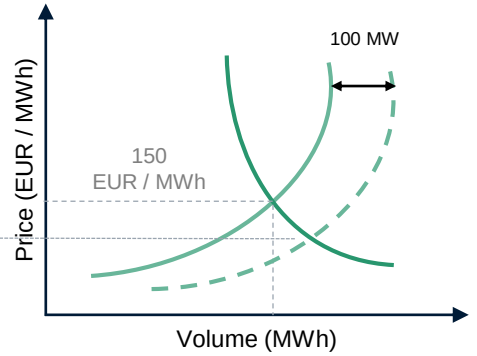
Example

Norway has the possibility to export 100 MW to Sweden

Common price for Norway = 125 EUR / MWh



Common price for Sweden = 125 EUR / MWh



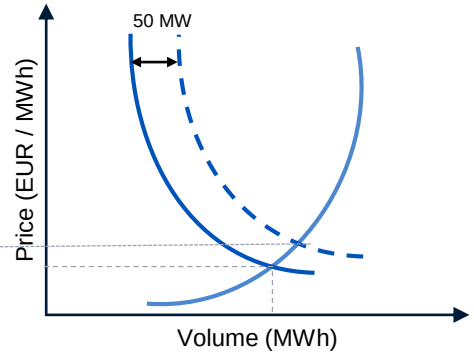
Common price for Norway and Sweden = 125 EUR/MWh
A (theoretical) price is referred to as the "system price"

Area prices with given transmission capacity

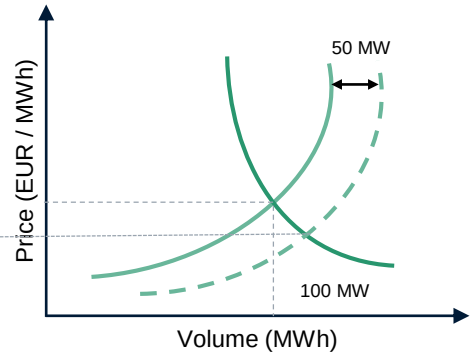
Example

Only **50 MW** available transmission capacity between Norway and Sweden

110 EUR / MWh



140 EUR / MWh

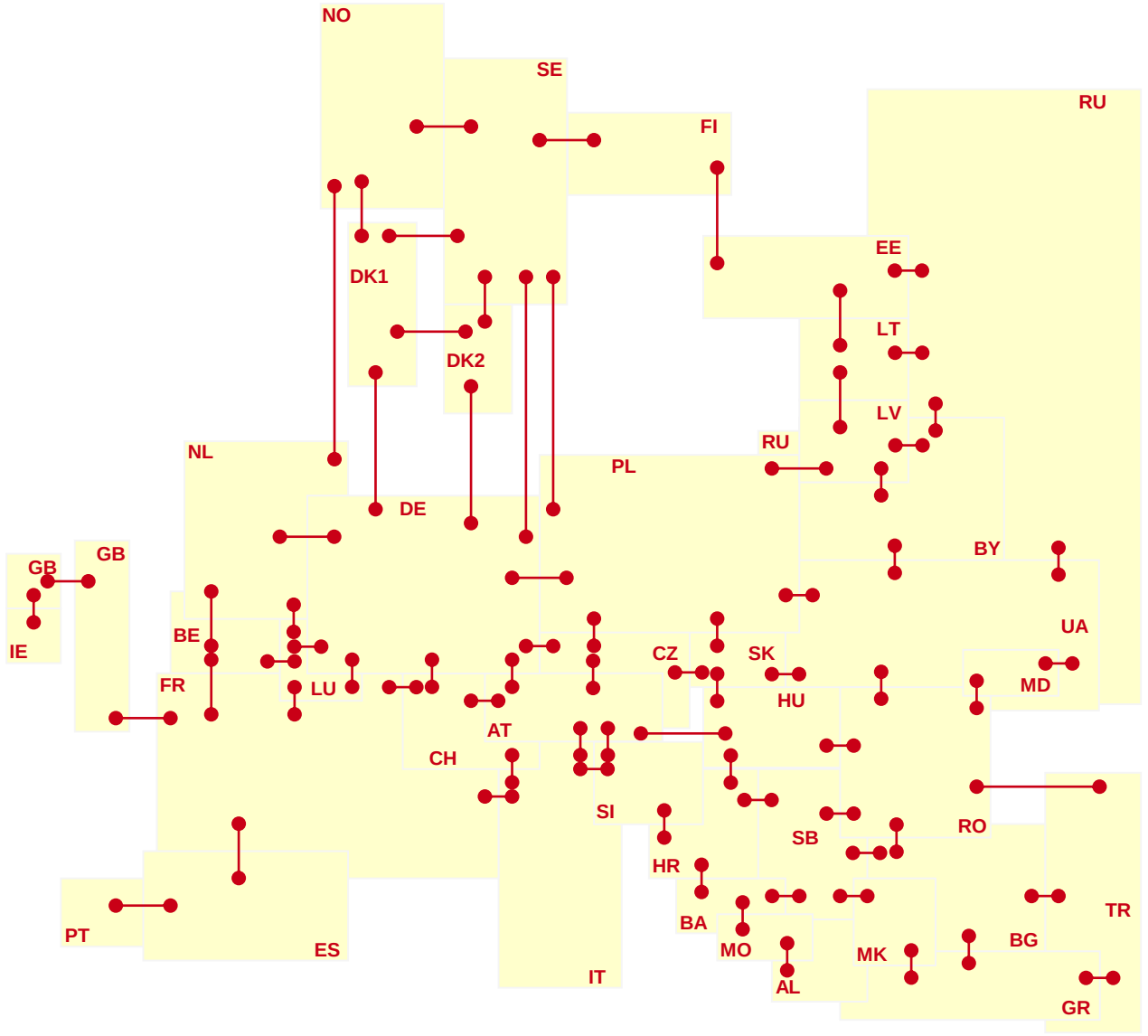


Due to actual limitations in transfer capacities, prices will vary between every bidding area

NORD POOL

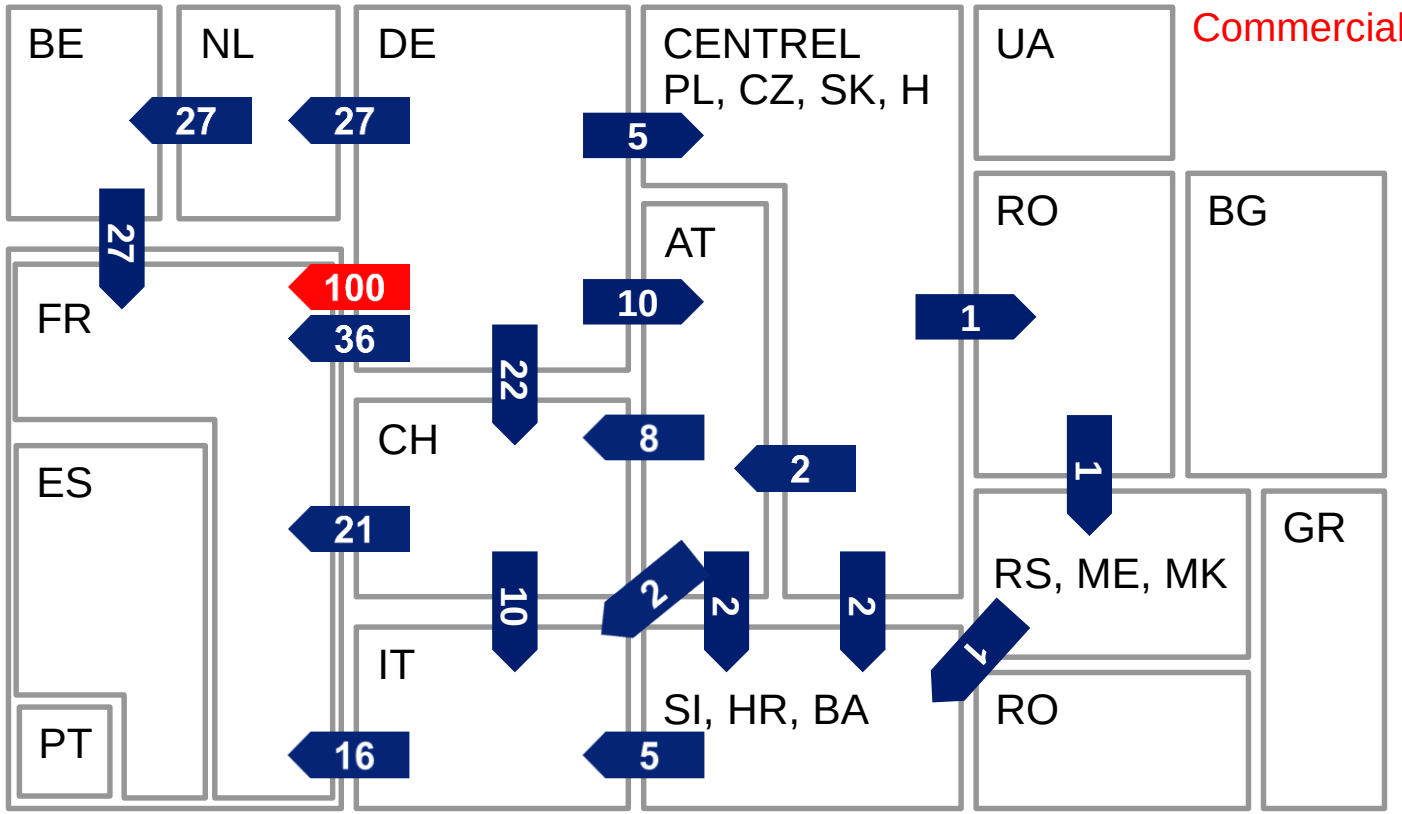
The European Challenge – Pre Target Model

- Europe had many interconnections, where different regimes are used to handle the exchange
  - implicit (Nordic)
  - explicit
  - market coupling
- How can we characterize the handling of interconnections in Europe when we today have to state that explicit handling of interconnections "produce" wrong flows in up to 25% of the operational hours (2008)?



NORD POOL

An Example



Actual physical flow

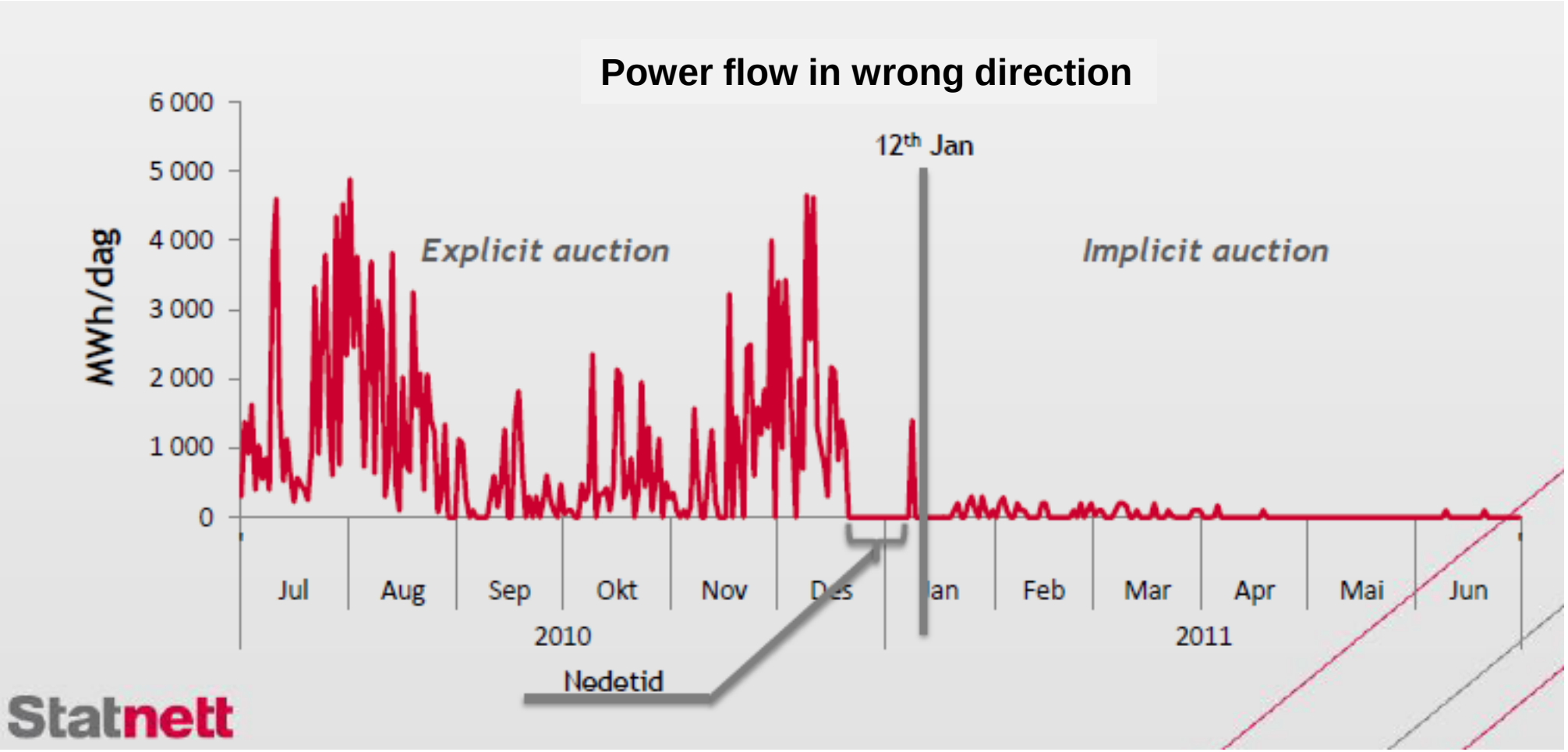
	D-F
D-NL	27
B-NL	-27
B-F	27
D-F	36
CH-F	21
F-I	-16
CH-D	-22

Based on a study from ENTSO-E

NORD POOL

Explicit vs. Implicit Auctions

Result of Market Coupling of Norway with Netherlands January 2011



Market and prices: the way forward in EU

NORD POOL

Day Ahead prices are determined simultaneously across Europe

Current state of play

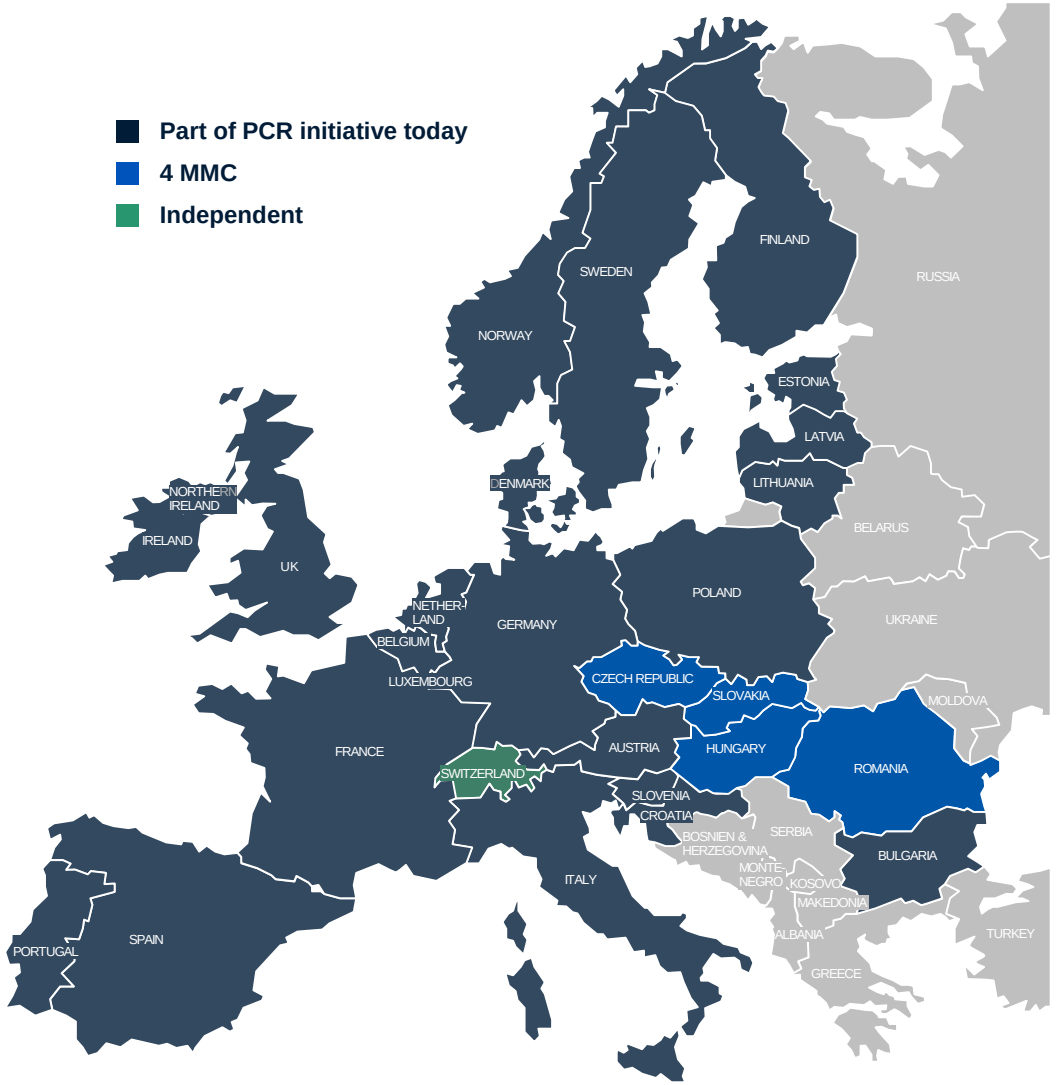
The **EU Internal Energy Market for electricity** covers Day Ahead (DA), Intra-Day (ID), Balancing and Forward Market.

Price Coupling of Regions (PCR)
- The initiative of 7 PXs to develop a single price coupling solution, launched Feb 2014
- EUPHEMIA algorithm

Multi-Regional Coupling (MRC)
- Coupling of regions and efficient management of available transmission capacities between areas and countries
- Implicit capacity allocation

Cross Border Intraday Trading (XBID)
- First wave launched in June 2018, second coming in 2019.

Giving:
- **Less CO2 emissions**
- Better competition
- Saved costs
- **Higher security of supply**



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Some level of harmonisation and coordination to facilitate efficient cross border trade

In the EU, the project Multi-Regional Coupling (MRC) produces harmonisations of needed key topics.

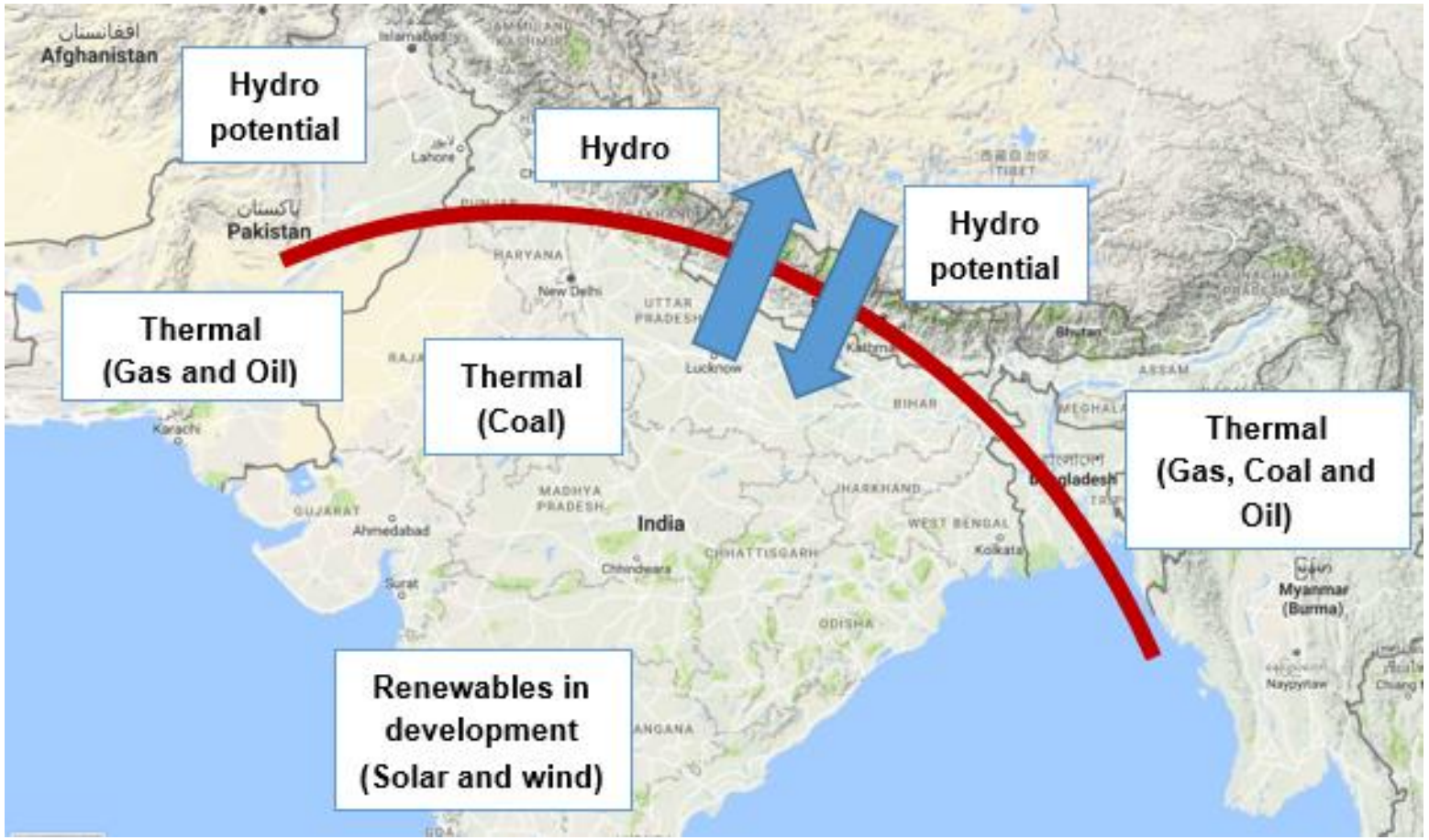
CACM regulation is the EU grid code managing and setting standards for the EU market coupling.

In the SAPP market, the agreed operating guidelines are governing the transmission capacities management.

Regional market in the Asian context

NORD POOL

The value of difference in the region applies here too..



How to establish a regional market in this region?

- Similarities with both the ASEAN/GMS and the Southern African region. Both of these cases could be seen as good examples for further development of regional trade in this region.

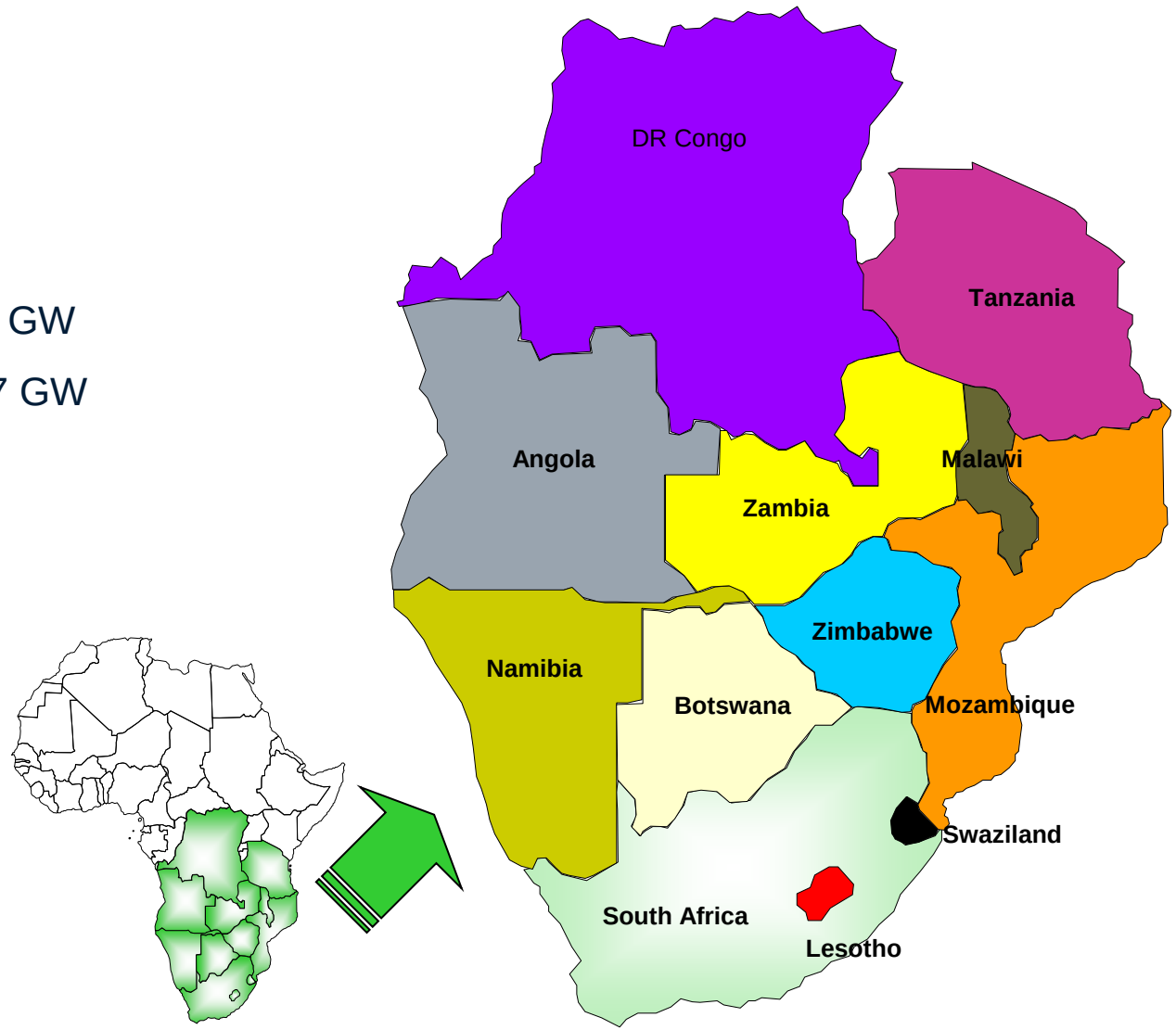
- Although, the local context needs to be applied when making the final market design

Case study: Southern African region - SAPP

NORD POOL

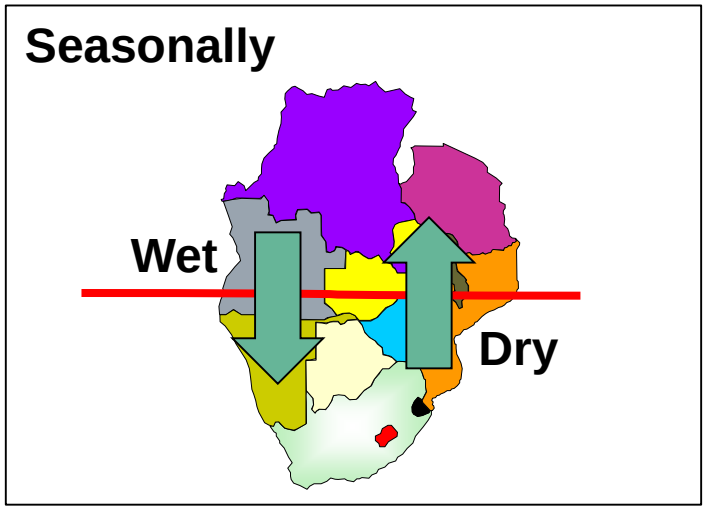
SAPP Market Area

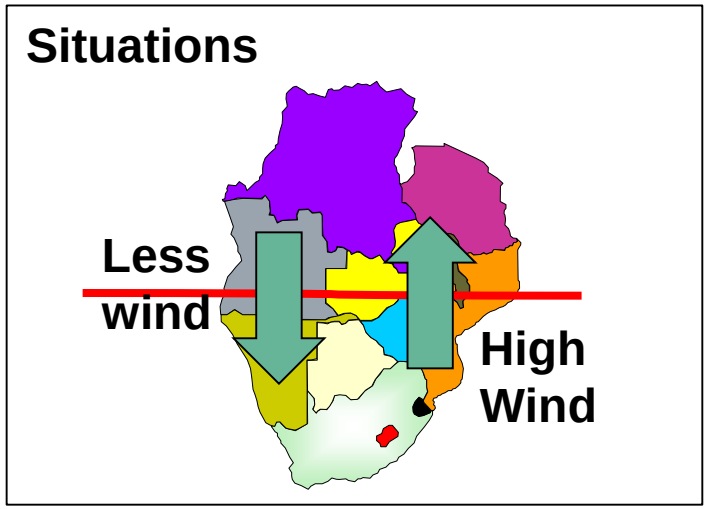
- SAPP was created in 1995
- 12 SADC Member Countries
- 16 SAPP Members
- 280 Million people
- Installed Generation Capacity - 62 GW
- Available Generation Capacity - 47 GW
- Peak Demand - 55 GW
- Consumption - 400TWh

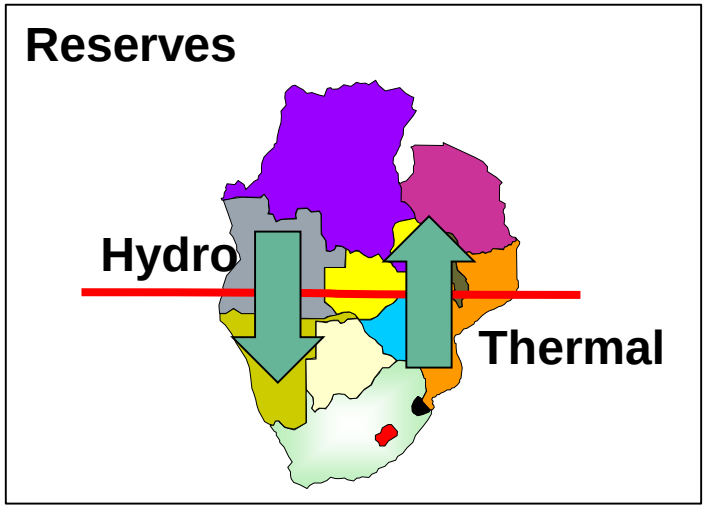


NORD POOL

Utilizing the Value of Differences in a Region







- Complementary production
- Security of supply
- Cost synergies
- Climate challenge

SAPP main objectives

The aim for SAPP was to enable national power capacity merging into regional market in order to further optimize social welfare and increase security of supply.

- Cooperation and coordination of both planning and operation
- Facilitate cross border trading in the region
- Facilitate more efficient management of available production and transmission resources, security of supply
- Increase Access to Electricity in Rural areas
- Facilitate to attract investments in the electricity sector

The slogan for the market integration in SAPP can be summarized as:

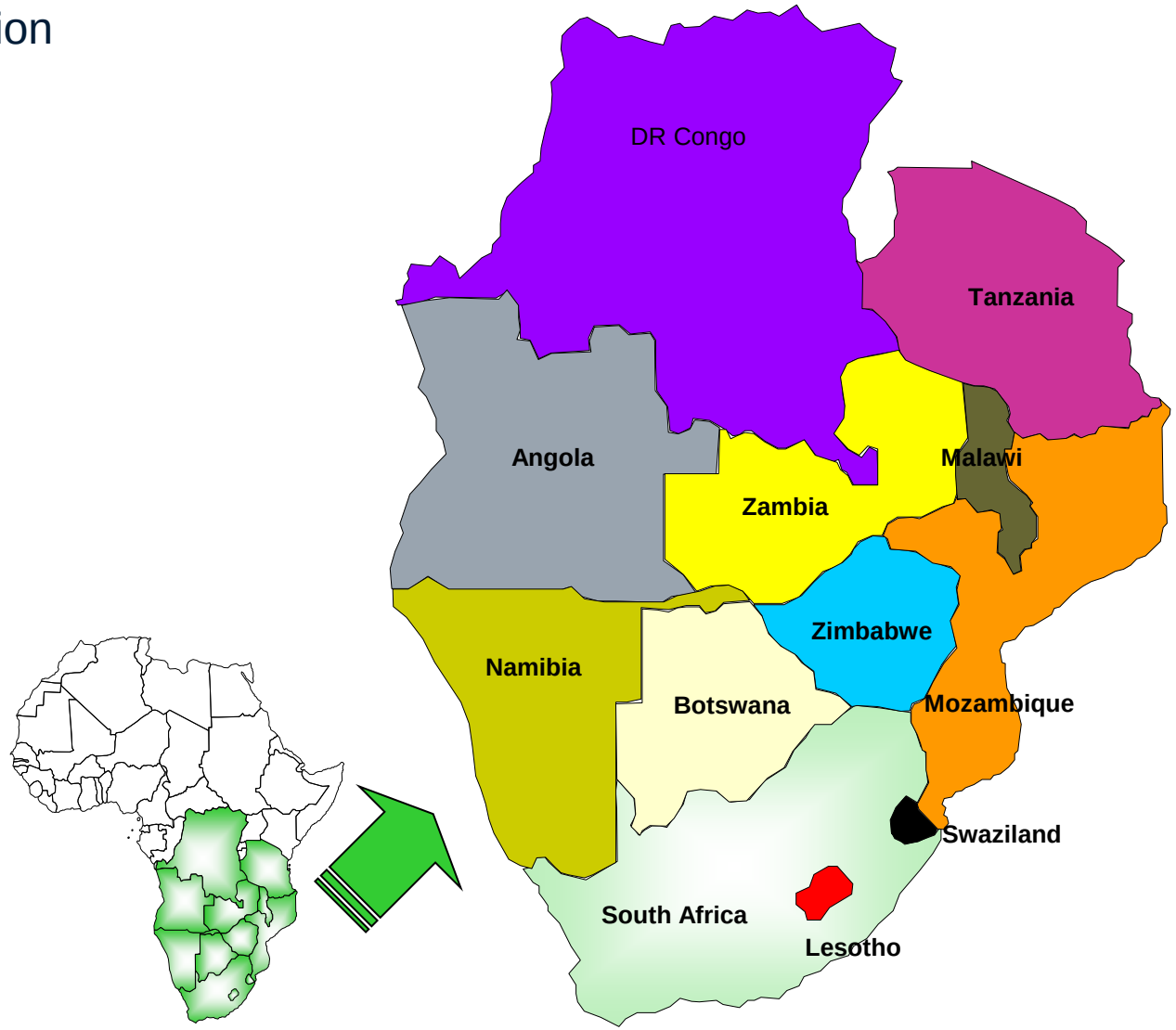
“National control – regional cooperation”

NORD POOL

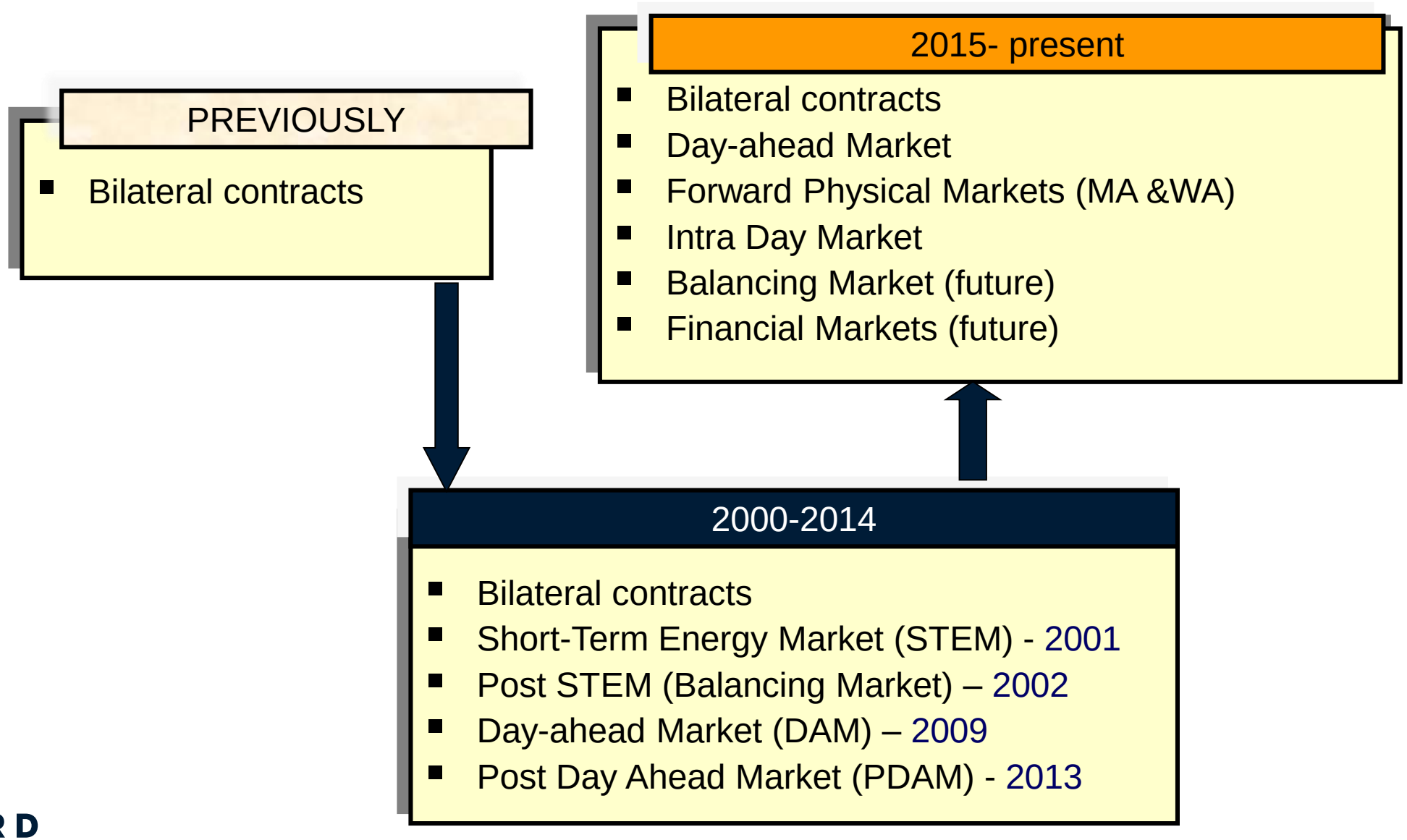
The African power market development

Based on **evolution**, not revolution

- Based on international experience applied for the SADC region
- Stepwise implementation
- Develop new markets when ready



SAPP Market evolution



SAPP Main governing documents

Document	Dated	Main Content
Inter-Governmental MOU	November 1995 Revised in February 2006	Established SAPP on a political level and was signed by the 12 energy ministers
Inter-Utility MOU	November 1995 Revised in April 2007.	Established the Management of SAPP (both the organizational structure SAPP, the meeting structure and the main areas of work) and signed by the utility members
Agreement Between Operating Members	Initial version in 1996; Revised in May 2008	This is essentially the implementation of the Inter-utility MOU outlining the main content of the cooperation of the interconnected members of the pool. Often referred to as ABOM
Operating guidelines and procedures	Initial versions in 1996; Reviewed and approved in 2014.	These guidelines are the details of the ABOM outlining the detailed technical operation and cooperation, for instance **management of transmission capacity, wheeling and losses methodologies** etc.
Market rules (consisting of both Book of Rules as the binding rules and the Market guidelines)	Initial version in 2001 Revised version in February 2017	These are the detailed trading rules for all markets

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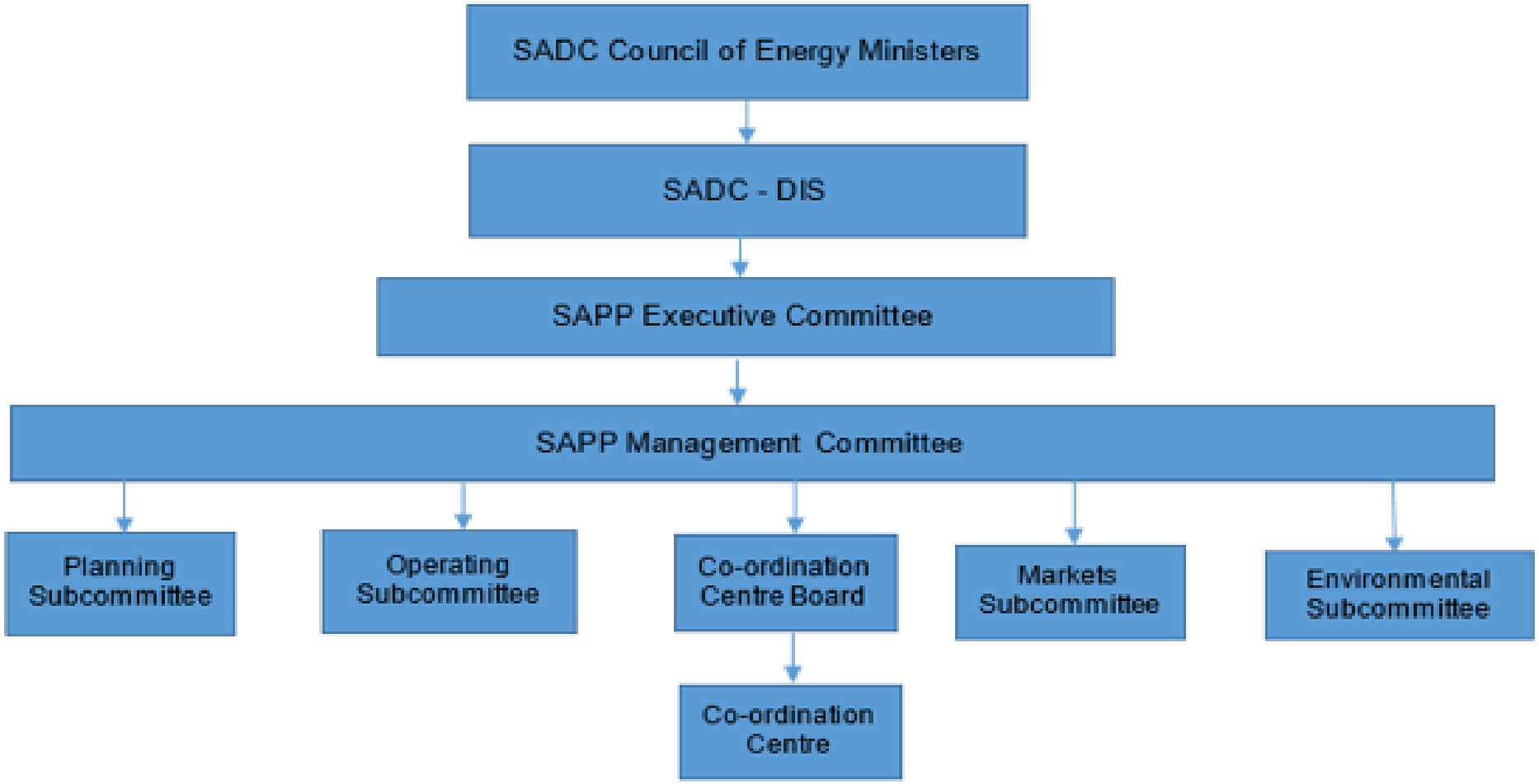
SAPP Organization - Governance structure



NORD POOL

SAPP Market concept

Southern African Power Pool

FPM

Forward Physical Contracts

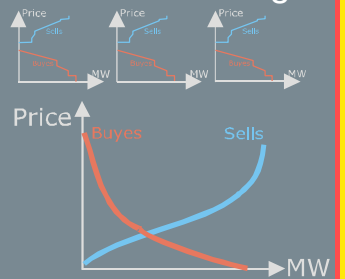
Weekly and monthly
- auction trading -

Forwards
Week – Peak
Week – Standard
Week – Off-Peak

Monthly – Off-Peak
Monthly – Non-Off-Peak

DAM

Physical Contracts
Market equilibrium
one day ahead
- auction trading -



IDM

Physical contracts

Up to hour ahead

Continious Trading

114,25 (50)
114,00 (20)
113,75 (60)
113,50 (45)
113,00 (25)
112,75 (55)
112,50 (40)
112,25 (15)

SAPP Settlement and financial management

Settlement of all physical contracts

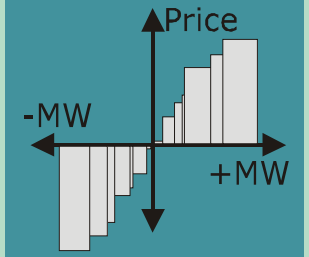
Settlement of wheeling and losses

Market monitoring and reporting

TSOs

Balancing Power Single buyer

National markets



Balancing generation and consumption in realtime

System Operation

Real-Time Operation

Services during the Real-Time-Operation: Controlling frequency and voltage etc.

NORD POOL

Does it really work?

- One could think that based on the installed capacity that the market would be totally dominated by South Africa
- However – the trading is based on ***cross-border capacities***
- The trading pattern has changed over time:
  - Initially (2009-2011) buying in South-Africa from the others
  - Changed with new interconnection – and increased understanding of the market
  - Now flow of base-load capacity in off-peak hours from South-Africa all the way to Zambia (+ Zimbabwe) and Mozambique
  - Trading more expensive (but flexible) hydropower in the opposite direction during standard and peak time
  - The focus on capacity building has improved the trading patterns to follow economic principles
- Ongoing project to couple SAPP and the EAPP

NORD POOL

Does it really work?

How can a market work in an under-supplied region?

- In a shortage situation, the use of the scarce resources should be based on economics
- There are hours/periods of the day where there is little trading – but trading small volumes “on the margin” also help.
- The same objections was made in India – but has proved to be wrong

But the national markets are not deregulated?

- True – but still the region benefits of regional cooperation and integration
- The market model is flexible so that when the underlying national markets opens, they will have access to the larger market from day one.

NORD POOL

Case study: ASEAN multilateral trade

NORD POOL

ASEAN regional trading

- The ASEAN Member States have an aim of establishing multilateral power trading in the region
- As of now, regional power trading consist mostly of uncoordinated bilateral cross-border arrangements
- Multilateral power trading in the ASEAN can bring multiple benefits, such as:
  - more efficient use of the region's energy resources leading to **reduced system costs**
  - **increased energy security**, assist the utilities in the region to balance their excess supply and demand
  - potential to **integrate and manage higher shares of variable renewable energy**

https://www.iea.org/publications/freepublications/publication/WEO2017SpecialReport_SoutheastAsiaEnergyOutlook.pdf

NORD POOL

ASEAN power grid (APG)

- The concept of connecting the power grids all of the various AMS was first established at the Second ASEAN Informal Summit, held in Kuala Lumpur in December 1997.
- ASEAN Power Grid Consultative Committee (APGCC), ASEAN policy on power interconnection and trade
- Heads of ASEAN Power Utilities/Authorities (HAPUA), promote cooperation among its members to strengthen regional energy security through interconnection.
- Interconnection Master Plan studies (AIMS II), identification of feasible interconnection projects

https://www.iea.org/publications/freepublications/publication/WEO2017SpecialReport_SoutheastAsiaEnergyOutlook.pdf

NORD POOL

ASEAN regional trading

ASEAN Power Grid Consultative Committee (APGCC) have agreed to a set of principles that should underpin increased power system integration in the region.

1. Efforts to establish multilateral power trading should be **stepwise and voluntary**.

2. Power trade should focus on **gaps and excesses** and not require the full participation of all domestic generation in a regional power market. In particular, multilateral power trading should not interfere with the operation of national power systems.

3. National regulations should be **complemented by regional co-ordination**. While some regulatory alignment may be necessary to support trade, multilateral power trading should not require complete regulatory harmonisation among the participating countries.

4. Multilateral power trading should be supported by the **expansion of regional (cross border) power system infrastructure**. A master regional infrastructure plan should be developed with multilateral power trading in mind.

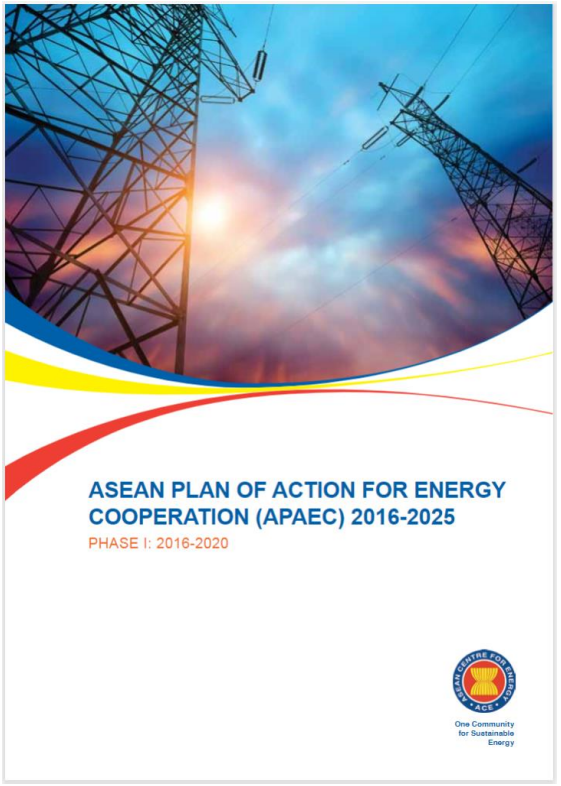
5. True multilateral power trading will require the development of a **regional wheeling price model**.

NORD POOL

ASEAN regional trading

ASEAN PLAN OF ACTION FOR ENERGY COOPERATION (APAEC) 2016-2025, presented during 33rd Ministers on Energy Meeting in Kuala Lumpur, Malaysia, in October 2015

➡ **Initiate multilateral electricity trading**



Resulting studies (led by HAPUA):

ASEAN Power Pool formation (ATSO/AGTP study)
- Finished 2018 – ERIA/Nord Pool Consulting/TEPCO

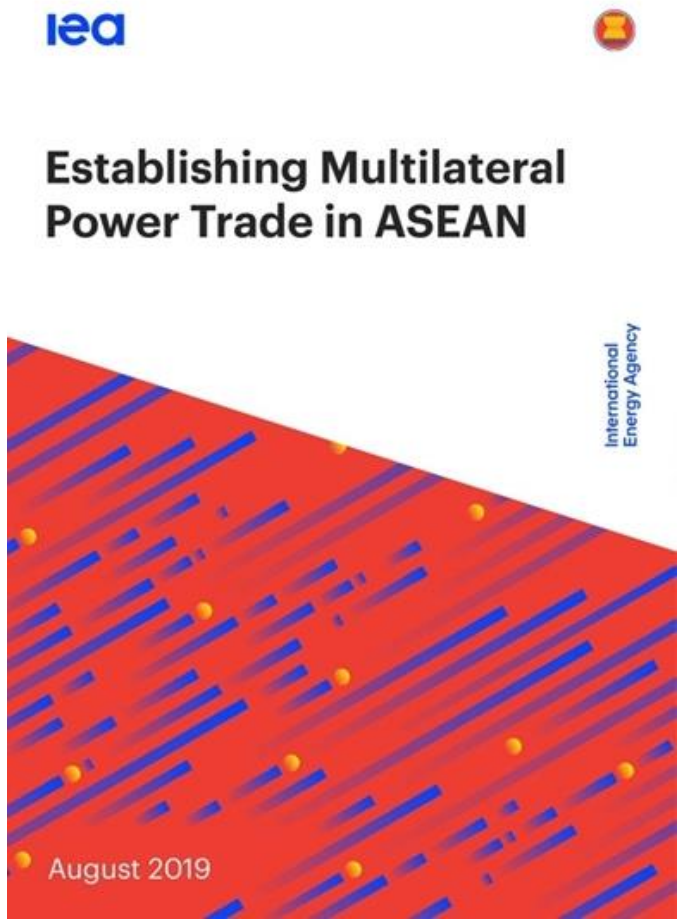
Feasibility Study for ASEAN Multilateral Power Trade
- Finished 2019 – IEA/Nord Pool Consulting

Establishing multilateral power trade in ASEAN

Project: Feasibility Study for ASEAN Multilateral Power Trade (IEA, Nord Pool Consulting, ACE)

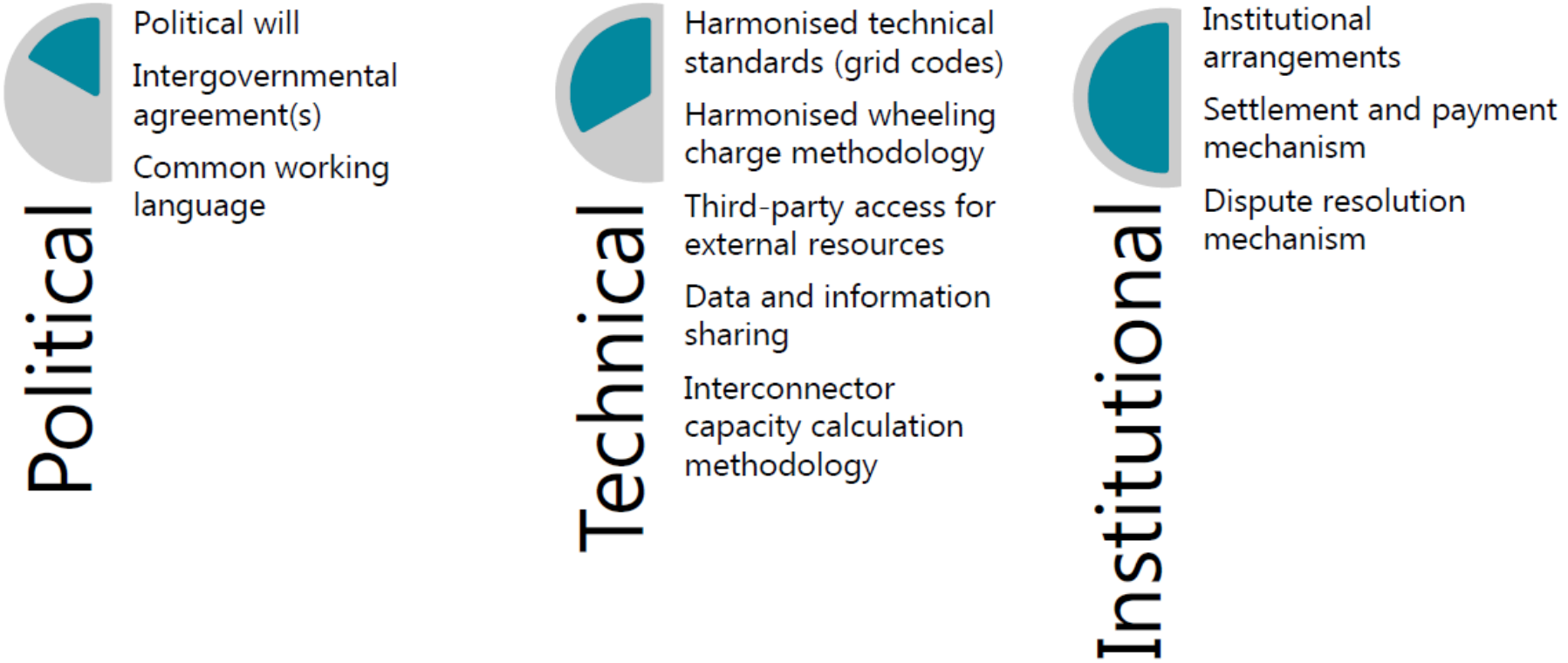
Aim: Concrete recommendations for how to establish multilateral power trading in the ASEAN guided by international best practices and ASEAN's local needs and requirements

- Based on a set of international case studies (North America, Europe, South Asia, southern Africa, Central America and the Persian Gulf region)
- The report identifies a set of minimum political, technical, and institutional requirements, the report also proposes a set of trading arrangements of increasing levels of ambition
- In addition it brings up the implications for ASEAN stakeholders related to implementing multilateral power trading
- Report also presents an overview of ASEAN's energy sector and each counties generation situation.
- **Core principles: voluntary participation, stepwise development, and a respect for national autonomy**



Establishing multilateral power trade in ASEAN

Minimum political, technical, and institutional requirements



NORD POOL

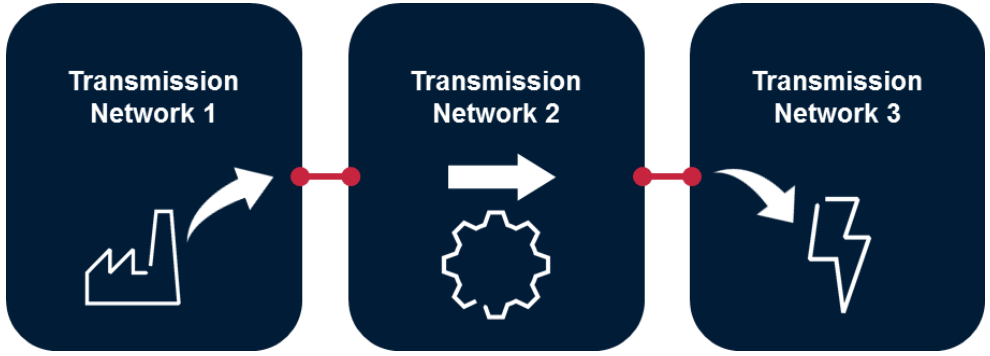
Establishing multilateral power trade in ASEAN

Minimum technical requirements for open access to the APG

To establish efficient multilateral trading, the transmission infrastructure that makes up the APG must be made available for all relevant parties under transparent and non-discriminatory principles.

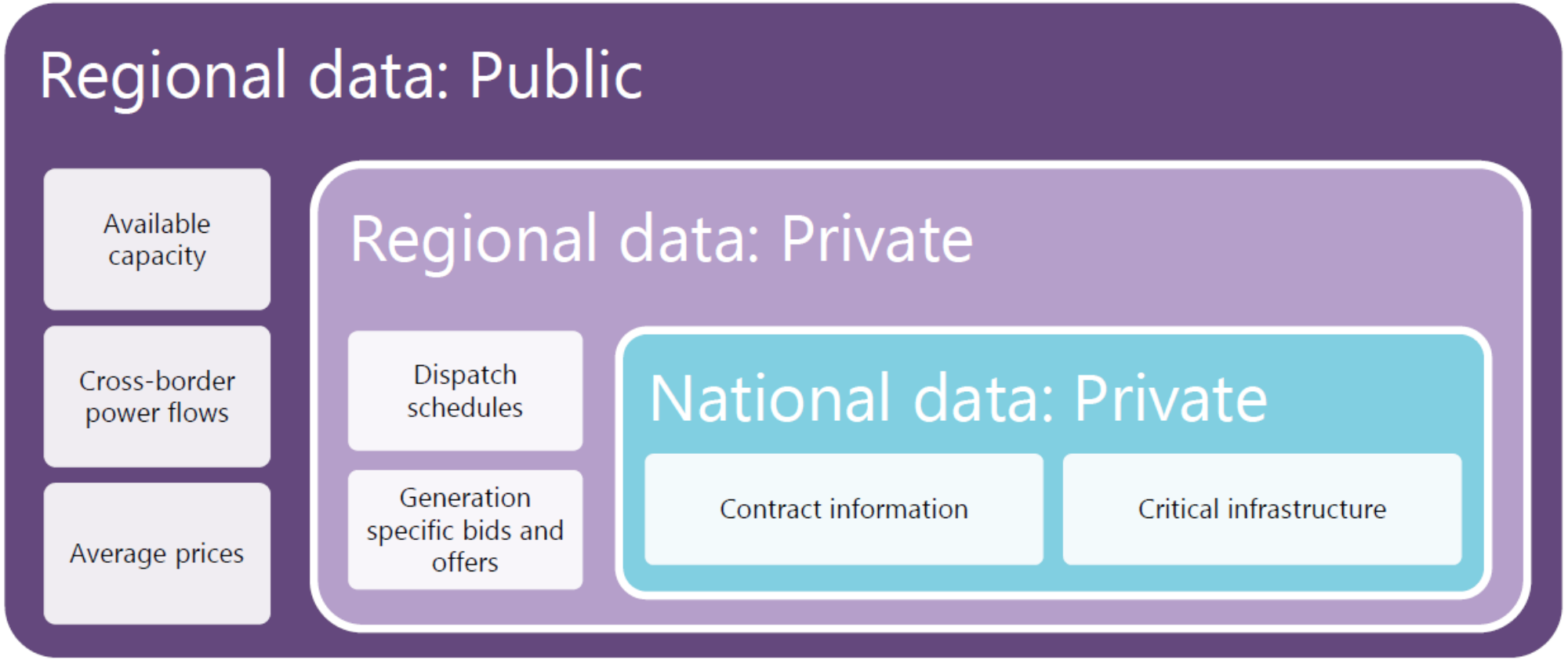
The open access can in this circumstance be divided up into three parts,

- **Third Party Access** (TPA) – allow for transit flows across borders
  - Basic agreement package for establishing cross-border TPA: Transmission licence, Connection and usage agreement
- Methodology to calculate the **Available Transmission Capacity** (ATC)
- **ASEAN Wheeling methodology** – determine the transmission charges for use of the transmission infrastructure.
  - A wheeling arrangement needs to consider both the physical and commercial aspects of transmission of power.



Establishing multilateral power trade in ASEAN

Minimum technical requirements - Data and information sharing: Private versus public



NORD POOL

Establishing multilateral power trade in ASEAN

Institutional requirements and functions requiring the regional cooperation

- Regional co-ordination to achieve multilateral trading in ASEAN naturally requires some level of harmonisation and coordination of different functions that are currently performed by domestic institutions in each AMS
- HAPUA working groups
- Inter-governmental agreements may be needed to establish and/or designate specific authorities to relevant regional institutions
- A regional co-ordinating institution or market operator needs to be established

Stepwise process of establishing multilateral power trade in ASEAN

Proposed trade models for ASEAN and the move towards short-term trading

Nascent model

Secondary model

Primary model

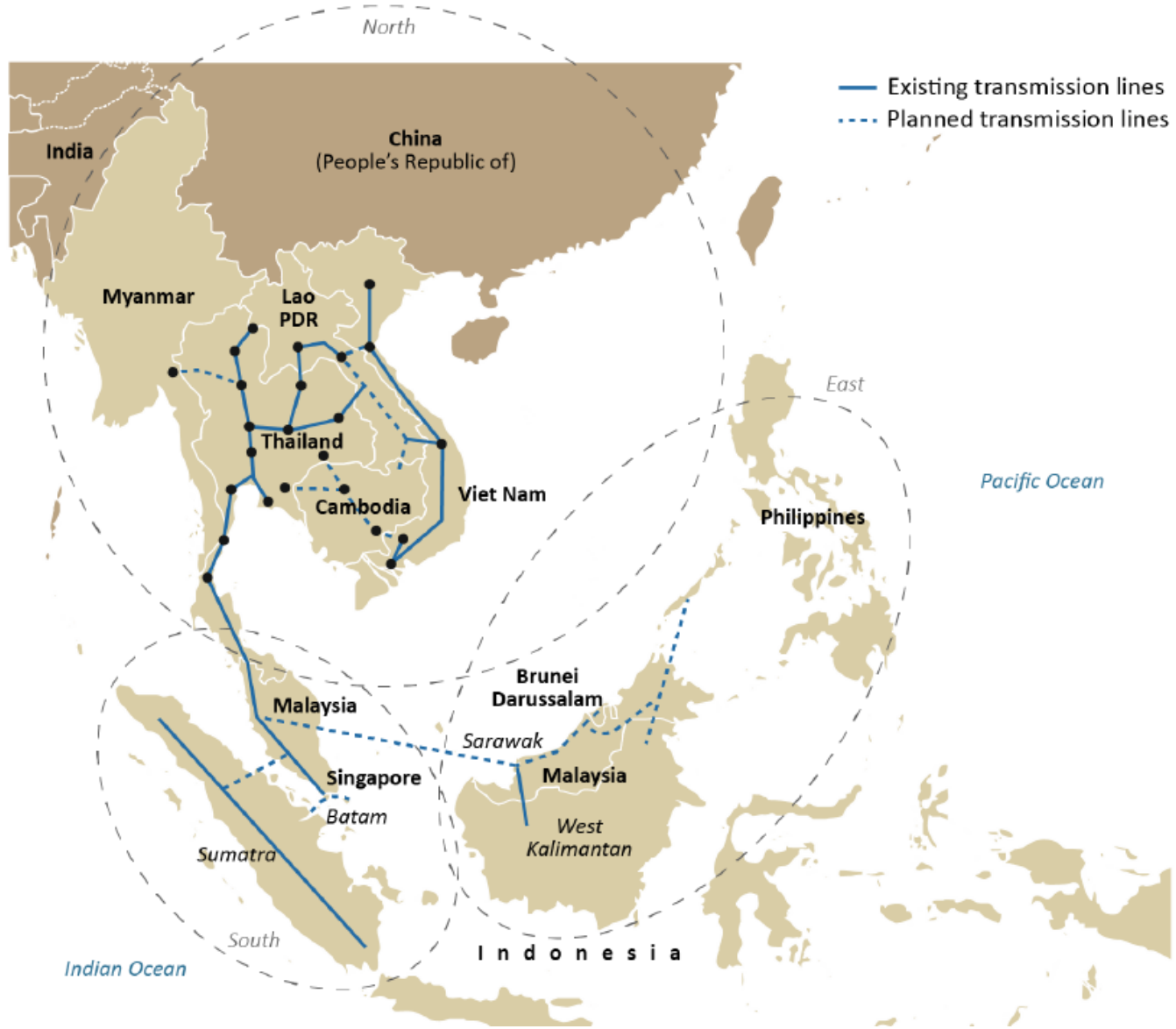
Establishing multilateral power trade in ASEAN

HAPUA has identified three regional priorities for interconnections:

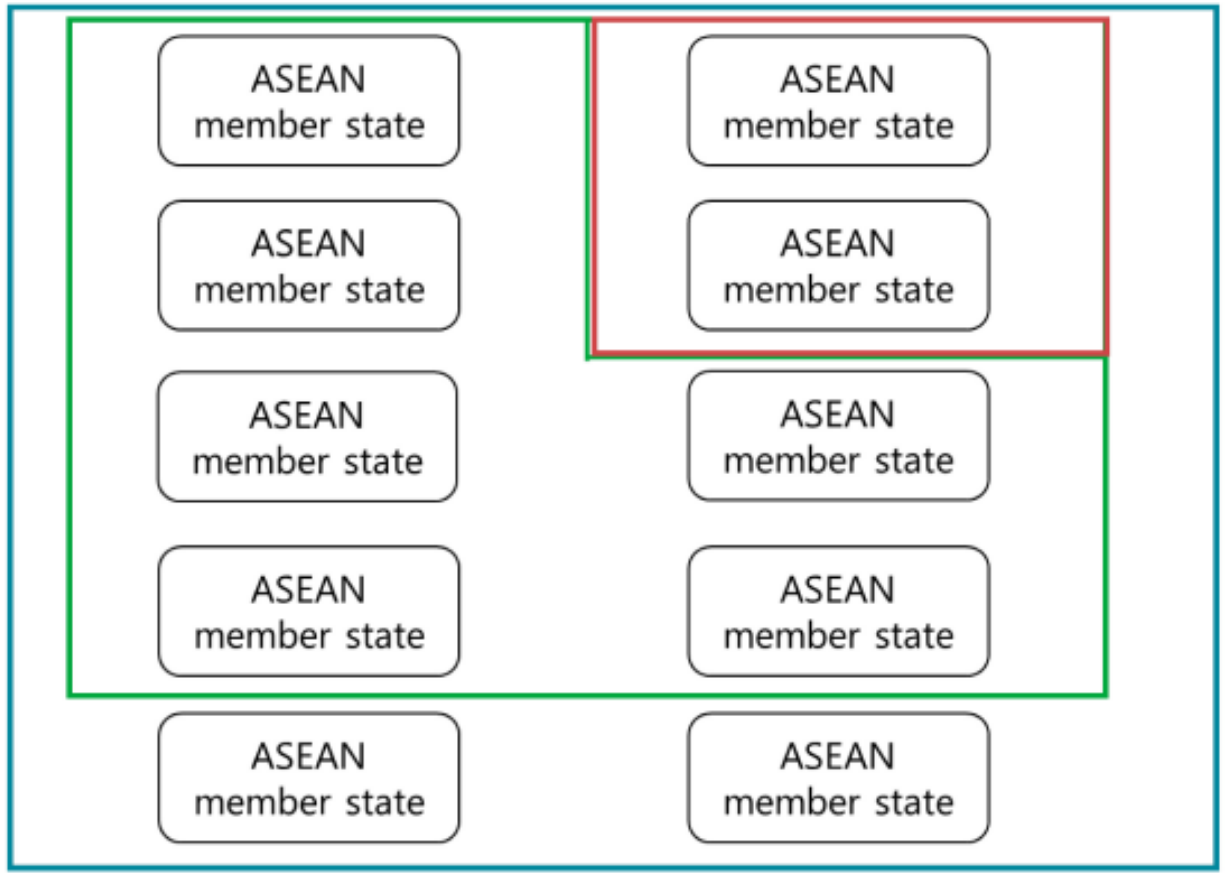
- **The northern region**
  (Cambodia, Lao PDR, Myanmar, Thailand and Vietnam)

- **The southern region**
  (peninsular Malaysia, Singapore and most of Indonesia)

- **The eastern region**
  (Malaysian Borneo, Indonesian Borneo, Brunei Darussalam and Philippines)



Stepwise implementation of trading structures



Model 1: Harmonised bilateral trading

Model 2: Secondary trading model

Model 3: Primary trading model

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Step 1. Harmonised bilateral trade model

- A common framework for entering into and managing cross-border bilateral contracts
- Allow any two interconnected AMS to trade with each other, regardless of whether they share a border
- Wheeling methodologies, ensuring that “transit” countries are compensated
- “Regional co-ordinator” institution, enabler of bilateral trading,
  - Only collect and share information, such as available transmission capacity, willingness among participants to trade and relevant information on signed bilateral contracts. It would not be directly involved in the transactions

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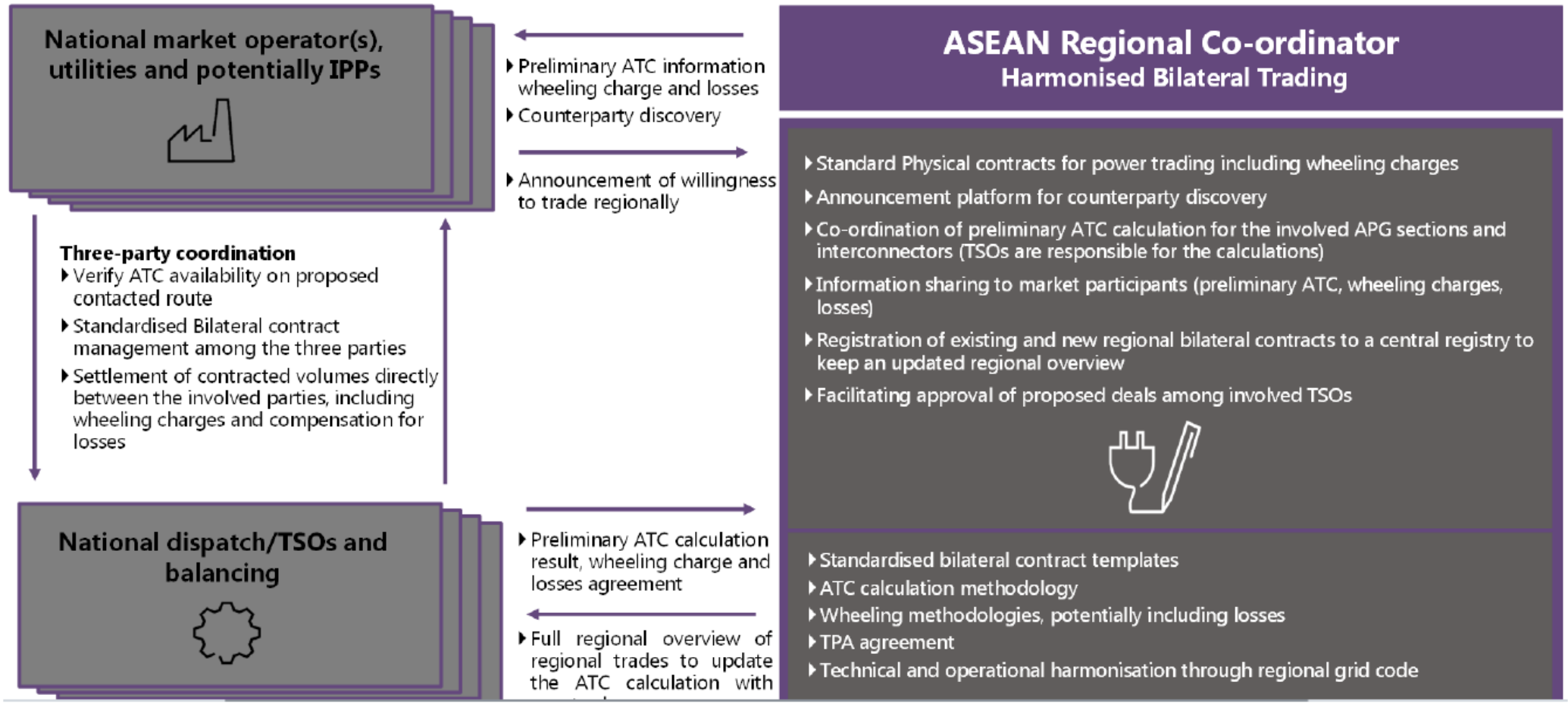
Step 1. Harmonised bilateral trade model



Example harmonised bilateral trade process

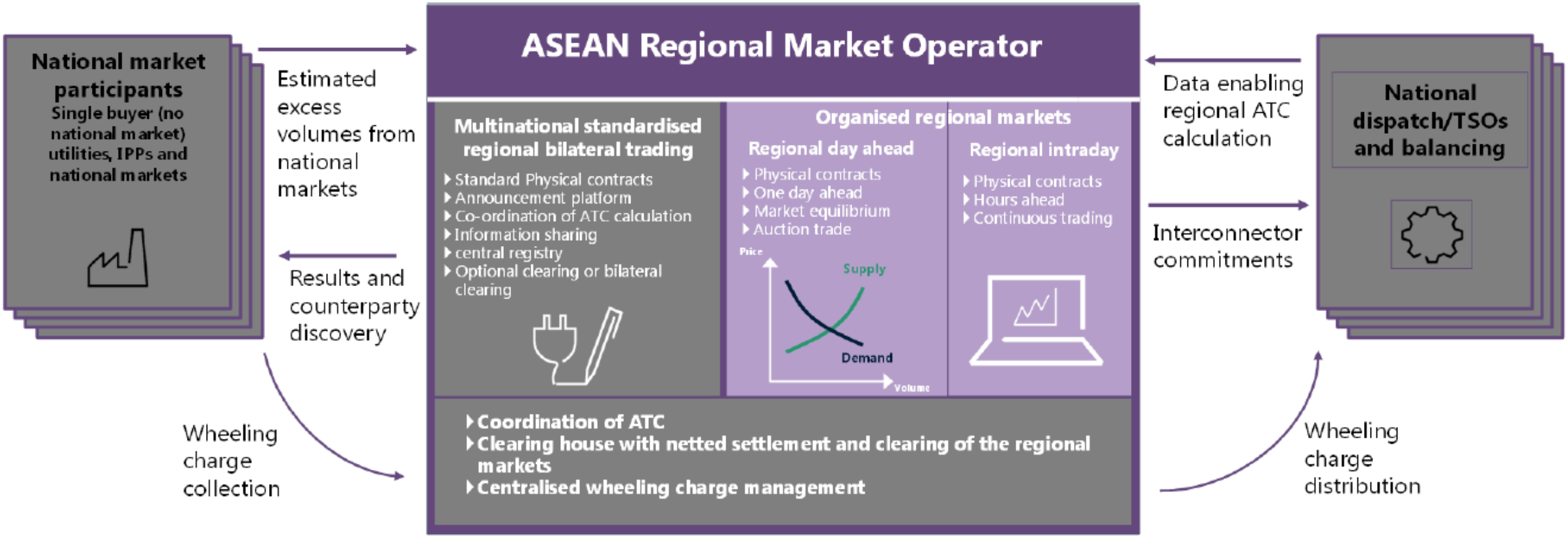
1	TSOs calculate the preliminary ATC; ATCs are aligned at each border based on the agreed-upon methodology
2	TSOs provide the preliminary ATC to the regional co-ordinator
3	Market participants, taking into account the preliminary ATC, announce their willingness to trade regionally by using the announcement platform
4	After counterparty discovery, parties are to verify that the final ATC is available on the proposed contracted route by consulting the involved TSOs directly
5	Standardised bilateral contract management and signing among the relevant parties (buyer, seller and TSO[s])
6	Registration of the accepted trade at the regional co-ordinator
7	Delivery of power between the two parties using wheeling services as relevant
8	Settlement of contracted volumes directly between the involved parties, including wheeling charges and compensation for losses and imbalances as agreed in the standardised contact

NORD POOL

Step 2. ASEAN multilateral regional market

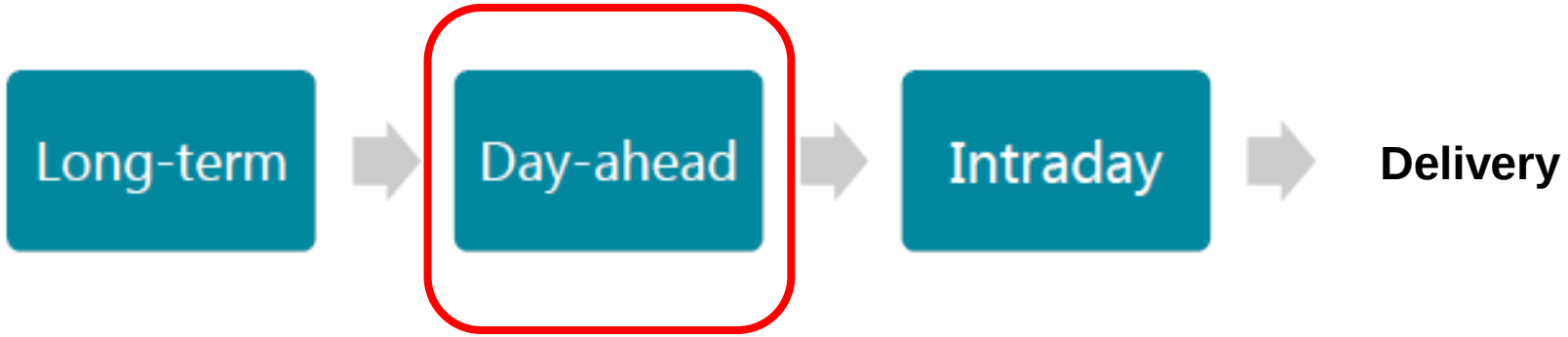
- Domestic markets or power systems would clear first, and the secondary market would be used only if and when doing so adds value to participating AMS
- Enable full multilateral, multidirectional power trading among the AMS
- Same wheeling methodologies as in step 1
- Regional market operator
  - collect information on excess supply and demand, matching of trades
  - central clearing party (CCP), collect and distribute money associated with any cleared trades and wheeling charge calculations

Step 2. ASEAN multilateral regional market (Regional power exchange)



Step 2. ASEAN multilateral regional market (Regional power exchange)

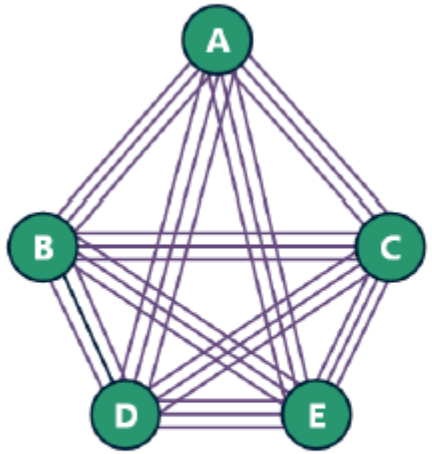
Organised regional markets and the aspect of time



- The day-ahead market is internationally recognised as a cornerstone of power market design
- Auction market, marginal pricing of power
- The day-ahead market typically creates a reference price that can be used in other markets such as forward markets and balancing markets, which are typically developed after a day-ahead market has been established.

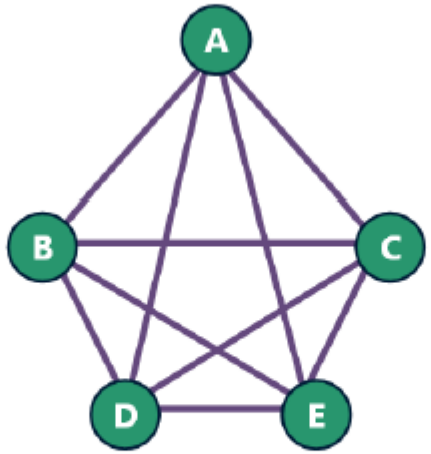
Step 2. ASEAN multilateral regional market (Regional power exchange)

Bilateral trading without netting



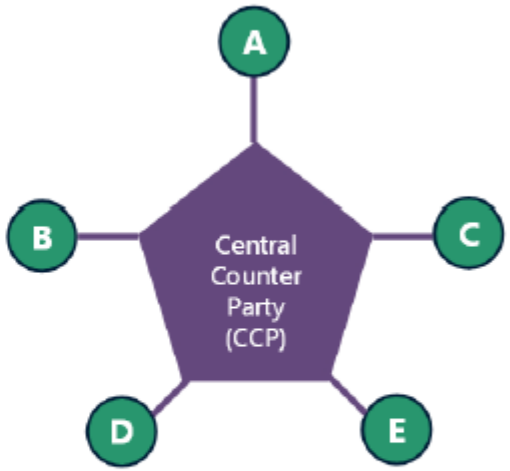
Several counterparties and transactions

Bilateral trading with netting



One transaction for each counterparty

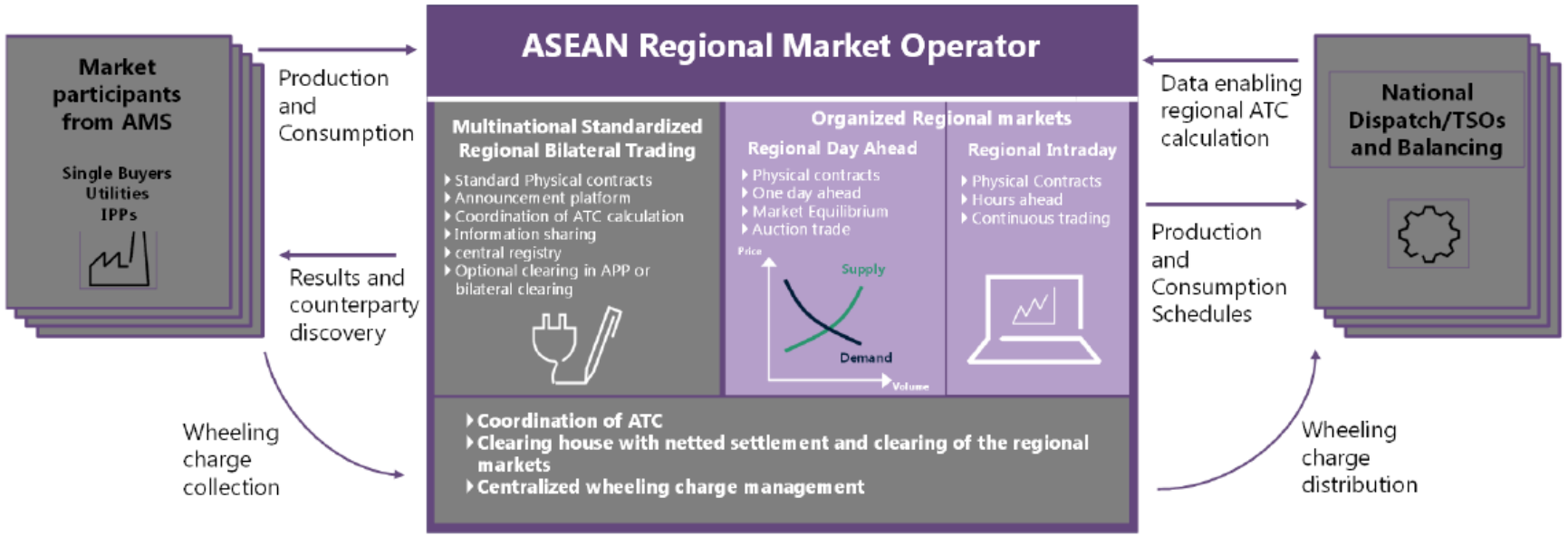
Multilateral trading



Always only one counterparty

Step 3 - ASEAN fully integrated market

- In this model the default mode of trade is in the regional multilateral market
- All national supply and demand is traded through the primary market trading platform hosted by the regional market operator
- Future potential long-term goal



Way forward in ASEAN

JOINT MINISTERIAL STATEMENT OF THE 37th ASEAN MINISTERS ON ENERGY MEETING
4 September 2019, Bangkok, Thailand

Widening multilateral electricity trade in the ASEAN Power Grid

"The Ministers welcomed the Feasibility Study for ASEAN Multilateral Power Trade. The recommendations on the minimum requirements included harmonised grid interconnection codes, harmonised wheeling charge methodology, provisions for third-party access to domestic grids and for data and information sharing, regulation and dispute resolution mechanisms, allocation of responsibilities among new and existing institutions, and capacity development. ***As the next step, the Ministers tasked the SOME and HAPUA to follow up on these recommendations including through the APAEC Phase 2.*** *The follow up actions on the recommendations with proposed timelines should be reported in the next AMEM in 2020."*

Conclusions

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Potential barriers to establish a regional trading and coordination

- Convincing the government/government policy - top down and bottom up
- Communication among the member states, language barriers
- Data requirements, quality and confidentiality issues
- General capacity and knowledge level of regional trading
- Location of the “Regional coordination centre” office and determining the membership fees etc.

Key points to facilitate regional trading

- Keep **national control** of transmission and generation but **enable regional cooperation**
- Start with **trading excess generation** and facilitate emergencies volumes
- Establish **enabling agreements** for the formation of a regional coordination centre
- **Start with a few member countries** and expand geographically when ready.
- Need of an efficient and **clear governance structures**, preferably build on existing India/Nepal organizational structures
- **Stepwise implementation without a mandatory** plan but with an agreed road map for all member states.
- **Capacity building** among decision makers, politicians and throughout the industry is of high importance

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Potential market design options for regional trading

Level of required harmonization effort and complexity of the trading setup:

- **Minimum level:** Multinational Standardized Regional Bilateral Trading
  - Standardized bilateral contract templates
  - Harmonized ATC calculation method
  - Third-party agreement
  - Wheeling methodologies
  - Harmonized regional grid code

- **Medium level:** Multilateral organized regional market
  - Reform package (national legislation, licenses etc.)
  - Clearing house function
  - Implicit capacity (ATC) allocation
  - DAM and IDM introduction
  - Short-term trading (Hourly trading)
  - Trading platforms

- **High level:** Fully integrated multilateral market (EU style)
  - Major market and legislation reform package to allow all the regional supply and consumption to go through the integrated market.

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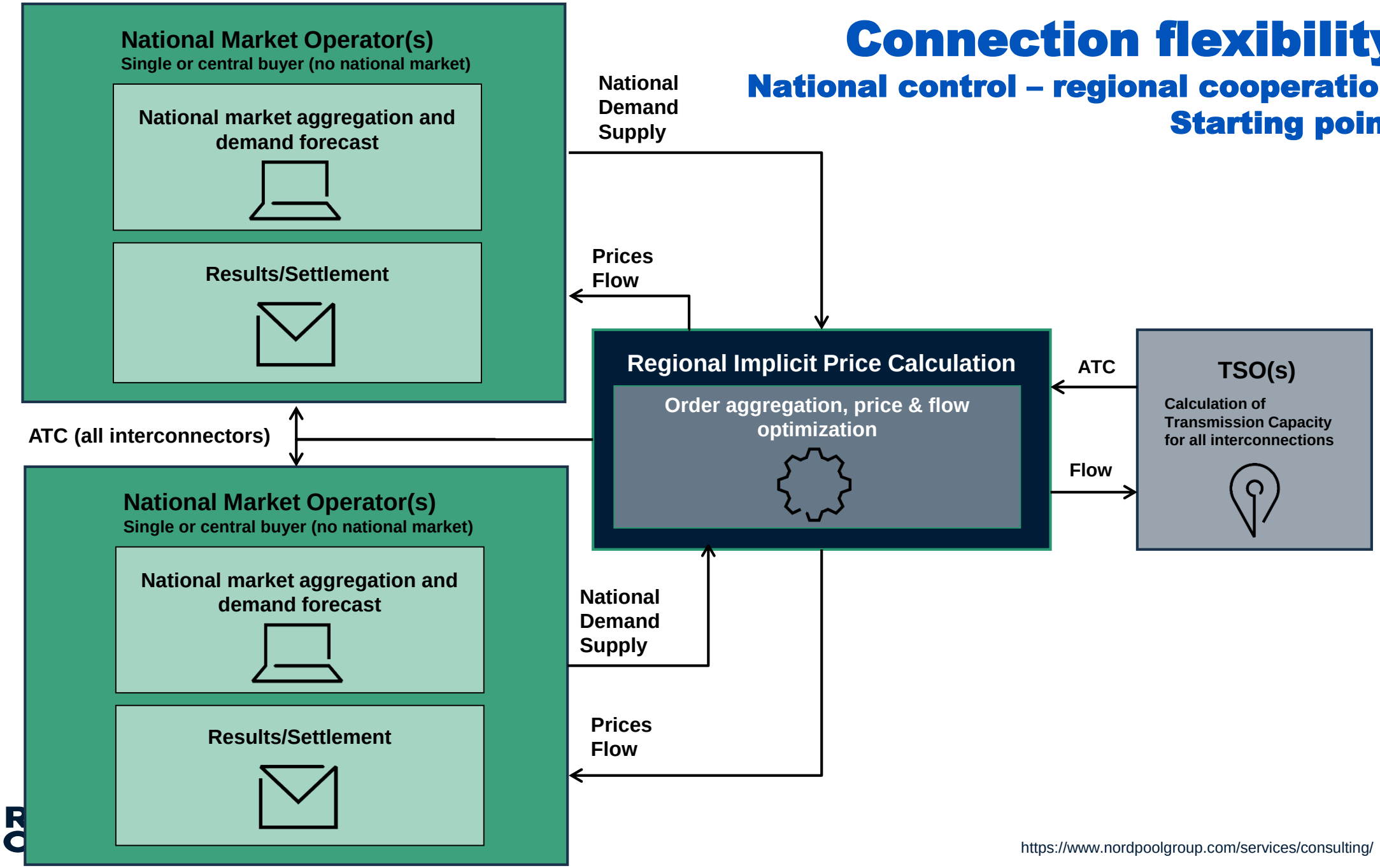
Connection flexibility

National control – regional cooperation

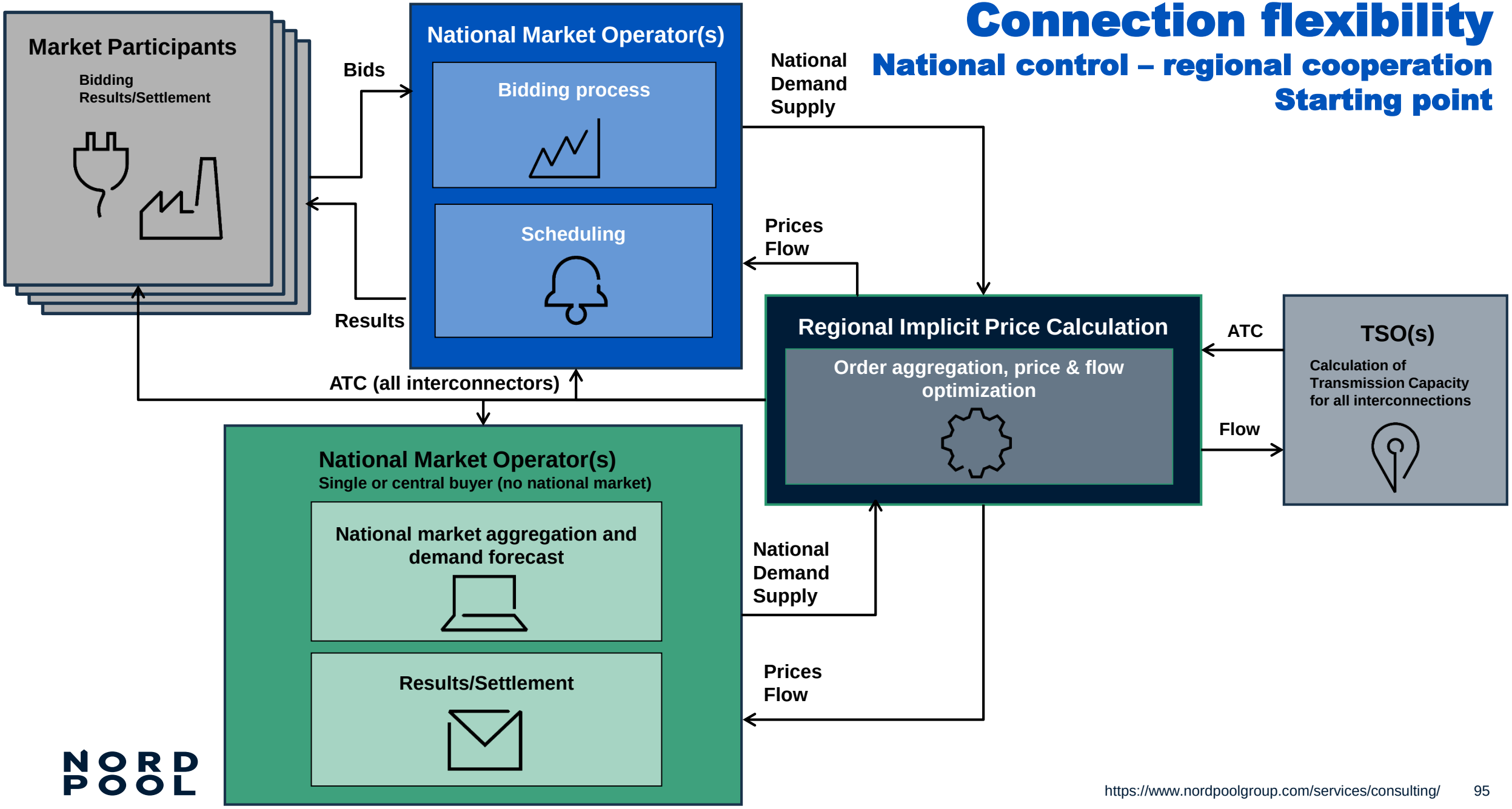
Starting point



Connection flexibility

National control – regional cooperation

Starting point



Conclusions in South Asia

- Utilizing the value of differences in the region
- Utilizing price coupling to determine the interconnector flows is the international best practise and should be seen as the most efficient way for South Asia region to fully utilize the potential of cross border trading
- The Day-Ahead auction market should be the key market place, providing an efficient cross border trading due to the marginal pricing methodology and implicit capacity auctioning
- Reliable and realistic investment signals are created with an interconnected power system
- An important aspect of the regional cooperation is also that it does not require total standardization of all markets in order to achieve efficient cross border capacity trading
- A stepwise approach to integration of the markets should always be considered

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Any questions?

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