DANISH GREEN TRANSITION – AND ONE PERSPECTIVE ON PUBLIC INVOLVEMENT

January 2021

Peter Markussen, Energinet

ENERGINET

THE ENERGY BACKBONE

We operate and develop the transmission grids and gas pipelines in Denmark

ENSURE BALANCE

We have the day-to-day and long-term responsibility for the overall electricity and gas system in Denmark

WORKING FOR THE SOCIETY

We are owned by the Danish Ministry of Climate, Energy and Utilities

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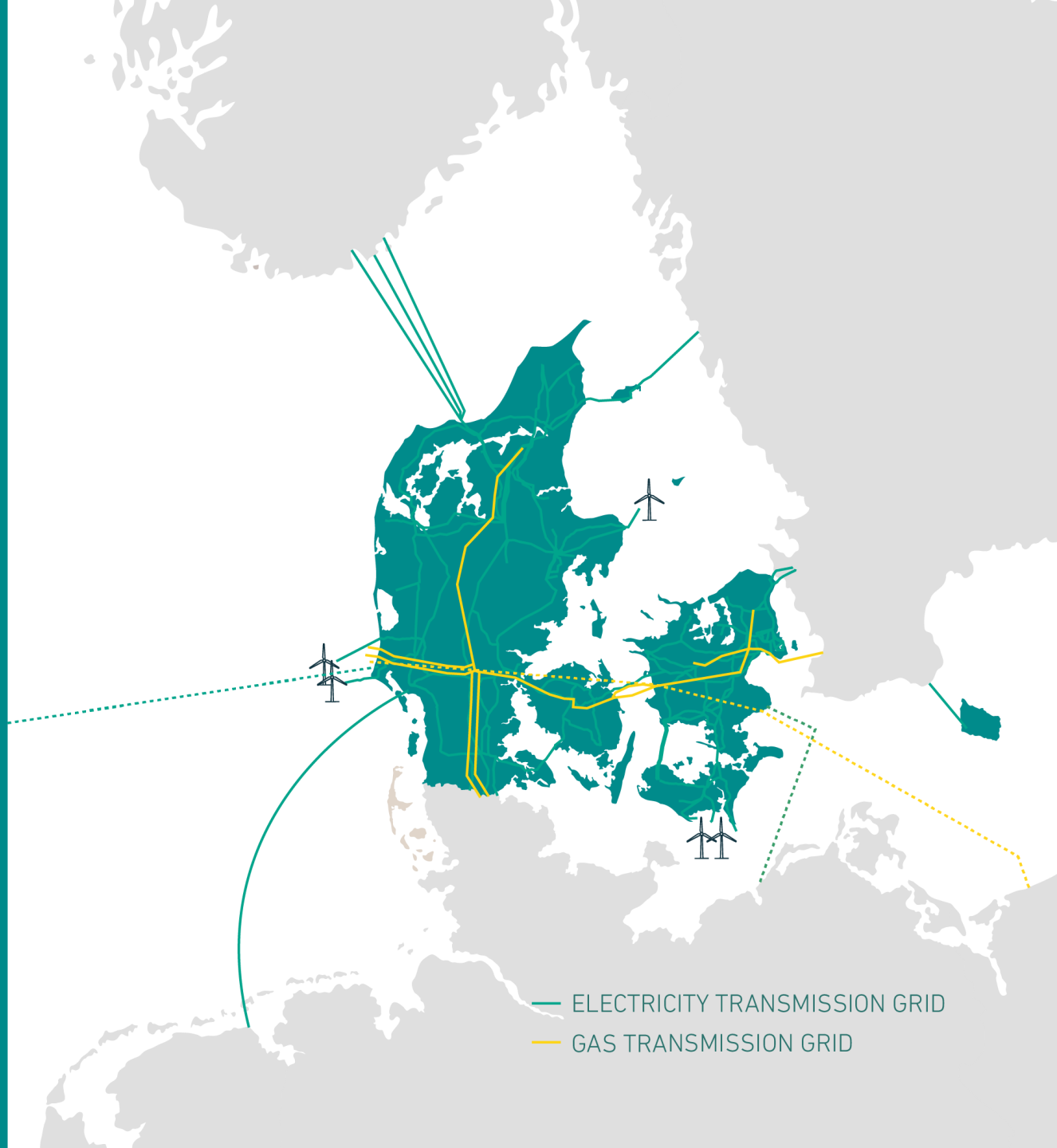
VISION

GREEN ENERGY FOR A BETTER WORLD



FACTS

DENMARK (NORDIC)

Energy consumption (TWh)	200 (1.600)
CO2 emissions (mio tonnes)	35 (160)
Electricity consumption (TWh)	35 (400)
Area (km2)	38.000 (1.210.000)
Population density (km2)	127 (20)

KOREA

Energy consumption (TWh)	3.400
CO2 emissions (mio. tonnes)	600
Electricity consumption (TWh)	500
Area (km2)	100.000
Population density (km2)	500

WHO AM I

Peter Markussen– pmr@energinet.dk

1995-2001

Masters Degree Political Science , University of Aarhus

2001-2005

Regulatory affairs and business development, Danish utility/power generation

2005-2009

Analysis and electricity price forecast, manager, Danish utility/power generation

2009-2012

Strategy and business development, head of department, Danish utility/power generation

2012-2014

Power Plant Engineering, head of department, Danish utility/power generation

2014-2020

Electricity system Flexibility and Ancillary services, head of department, Energinet

2020 -

CEO Associated Activities, Energinet

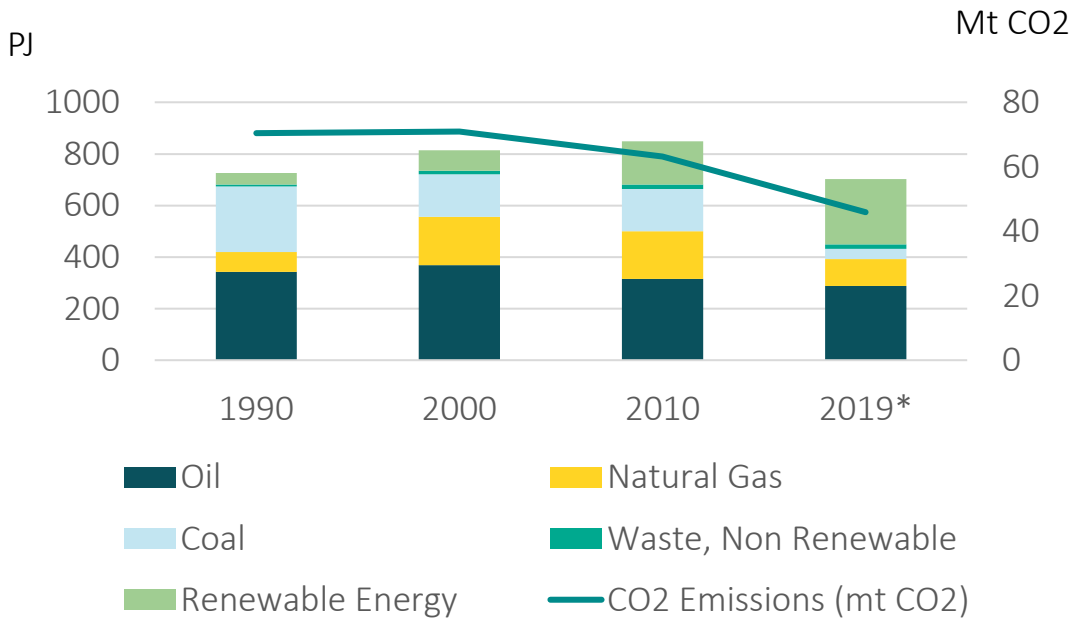
- Green transition of electricity systems
- Grid codes, operations and market development
- Long term planning and renewable energy investments

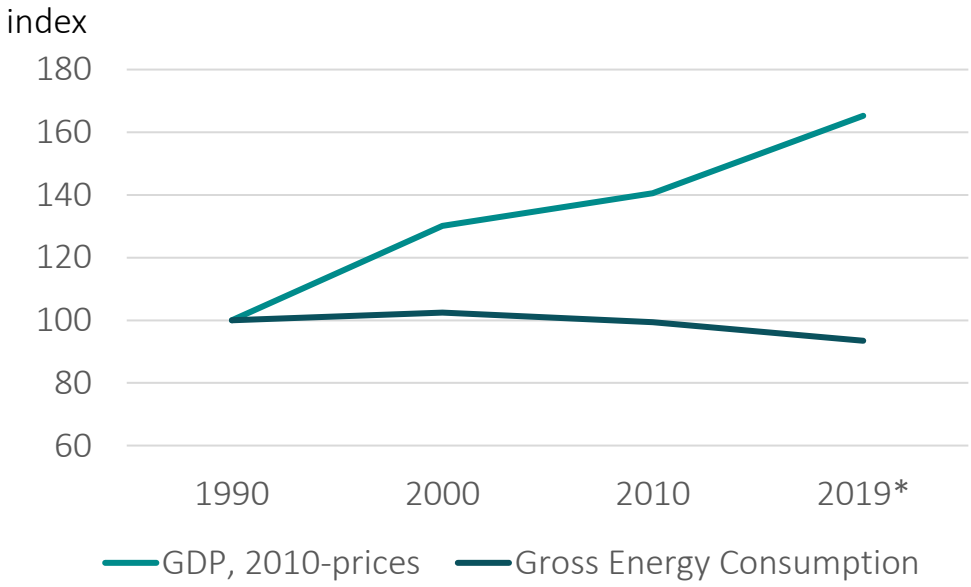
AGENDA

1. The Danish Green transition – the big picture
2. The development of the electricity market
3. Increased need for flexibilty the consumer as part of the green transition

DANISH ENERGY CONSUMPTION AND CO2 EMISSIONS

Energy efficiency and increasing share of renewables have resulted in reduced CO2 emissions and continous economic growth

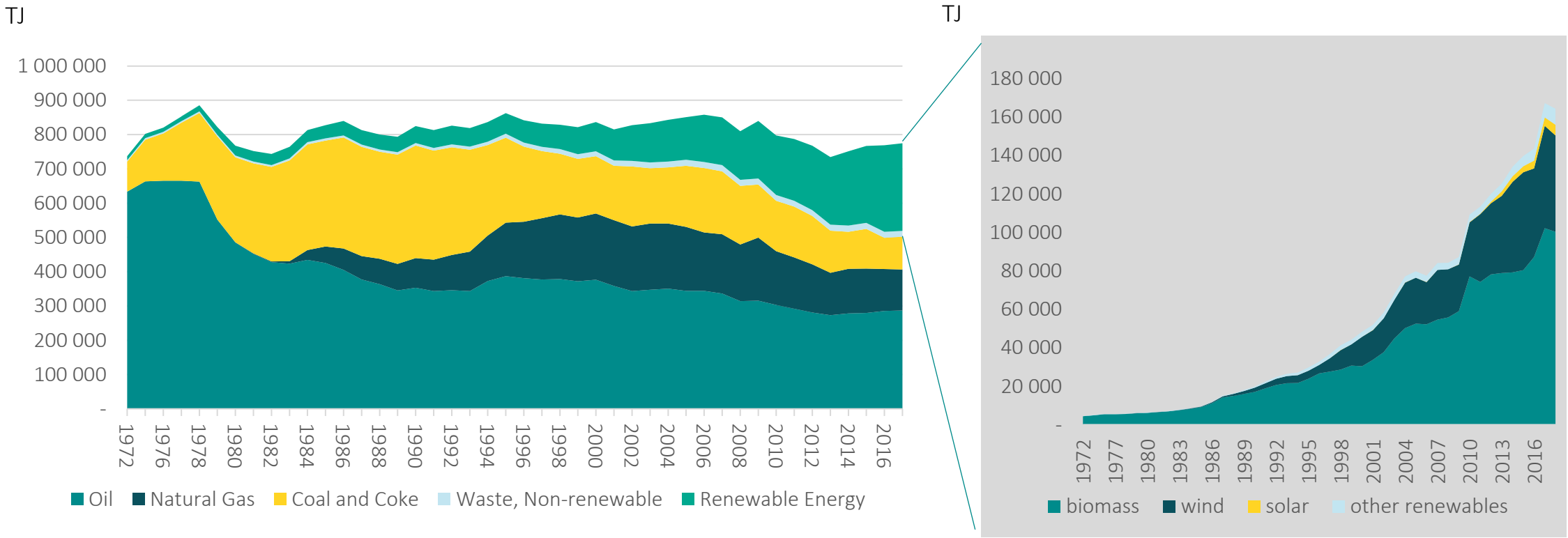




Source: Danish Energy Authority

ENERGY CONSUMPTION 1972-2018, DENMARK

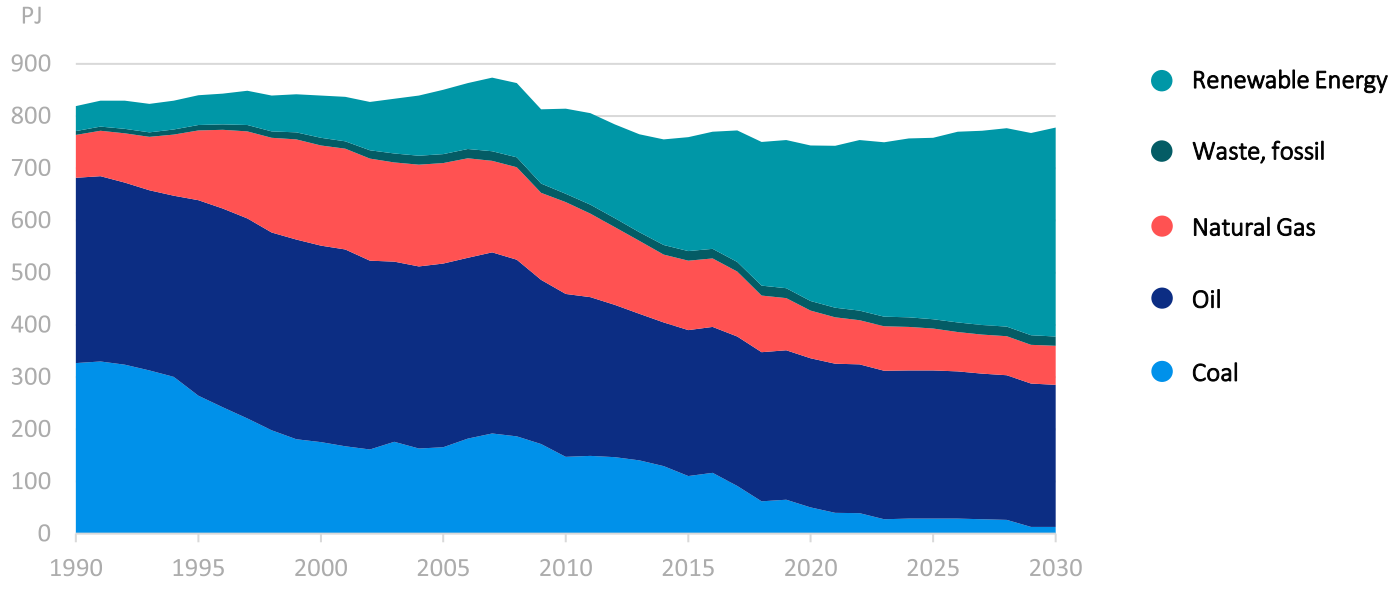
From year 2000 share of renewables increases and coal is phased out



Source: Danish Energy Authority

FUTURE OBJECTIVES

Long history of political agreements to support renewables and reduce CO2 since 1980's



GREEN TRANSITION

STATUS:

63.7% green electricity

34.2% green energy

2030 TARGET:

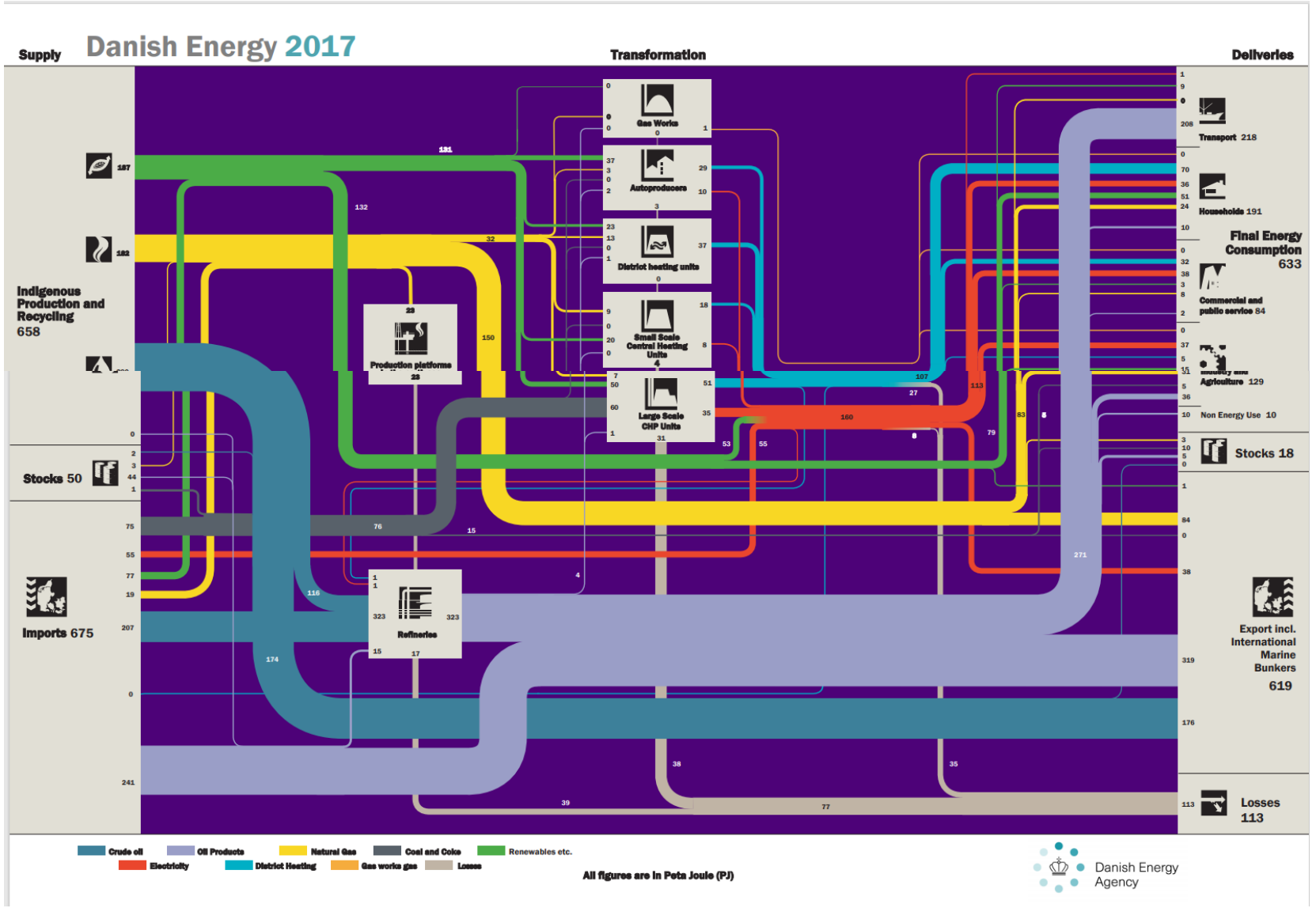
100% green electricity

55% green energy

2050 TARGET:

100% green energy

DANISH TRADITION FOR HOLISTIC ENERGY PLANNING AND POLICY



AGENDA

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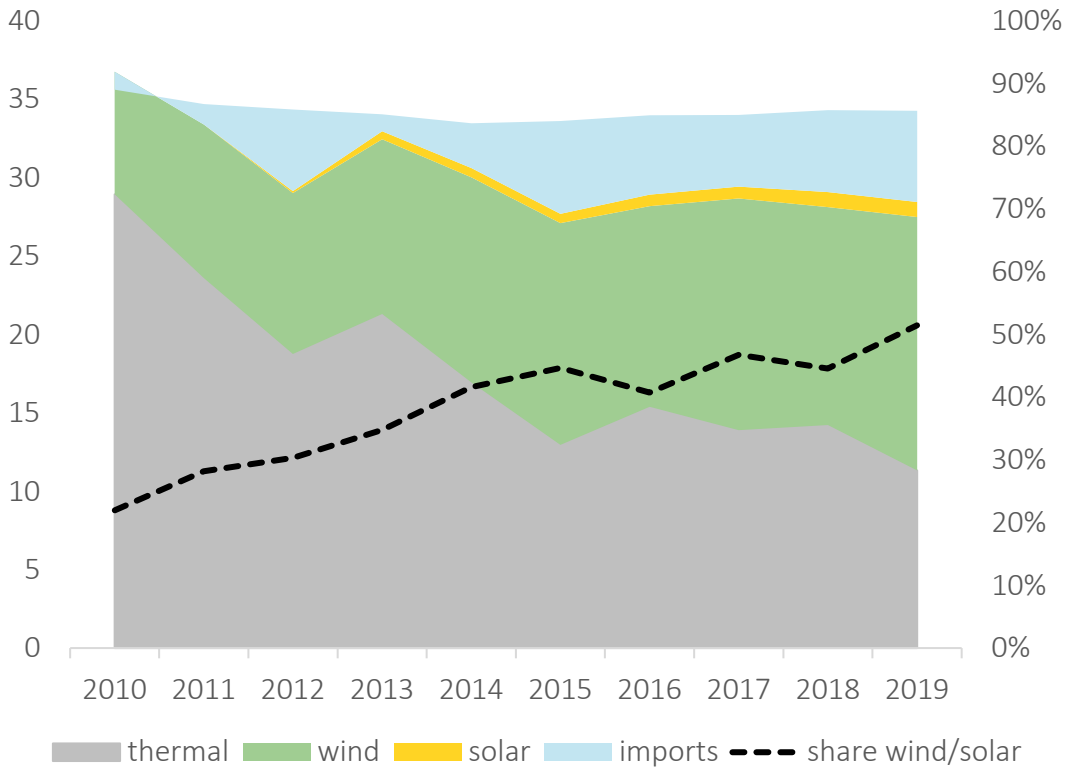
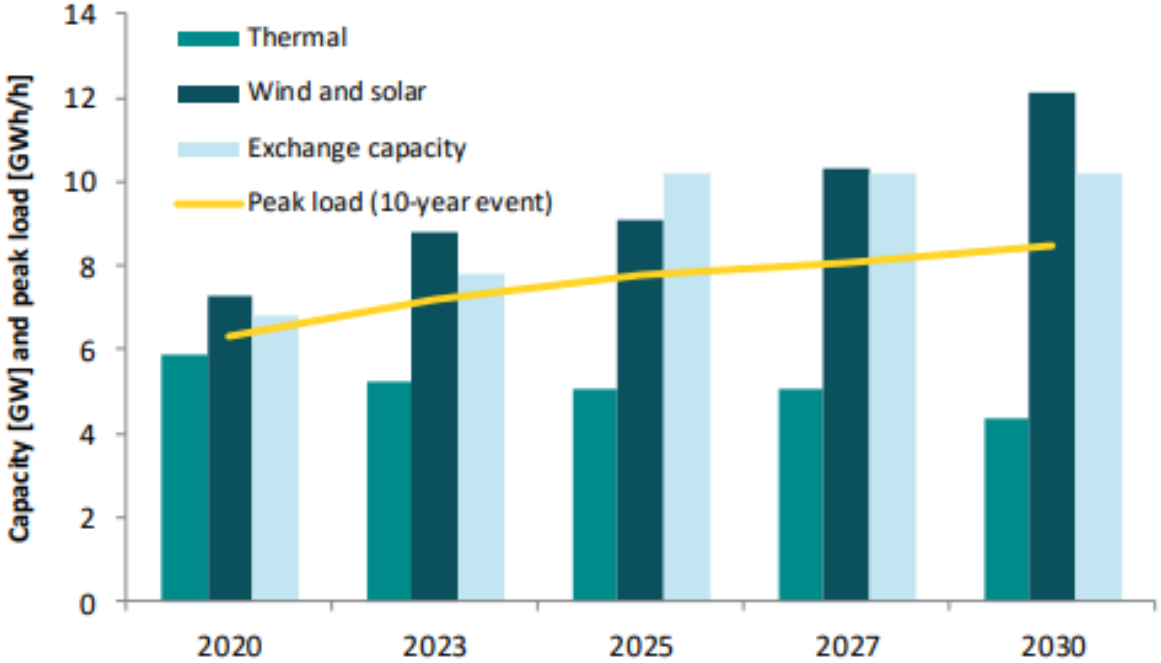
TODAY 50% WIND AND INCREASING

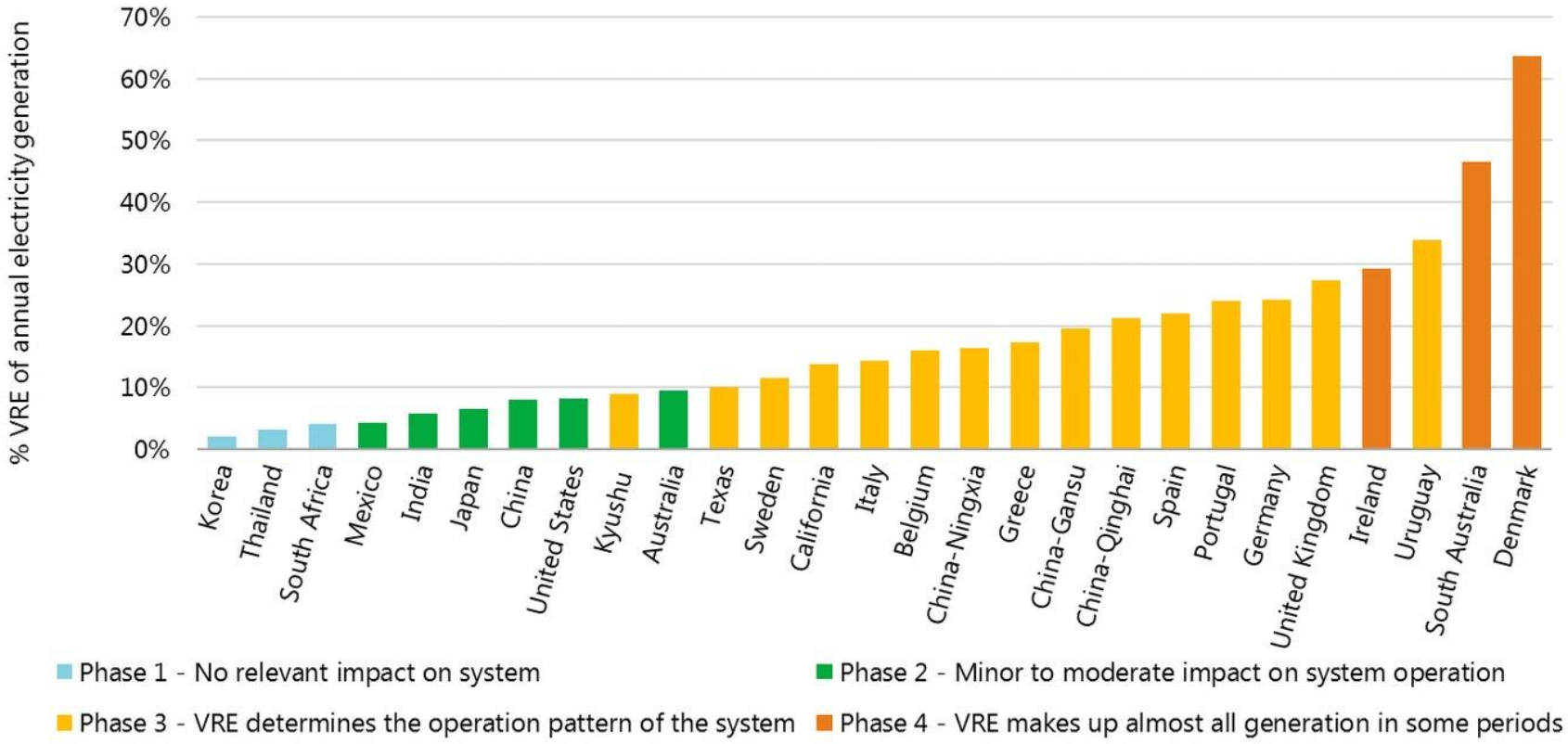
Production mix in Denmark, TWh





DENMARK HAS HIGHEST SHARE OF RENEWABLES

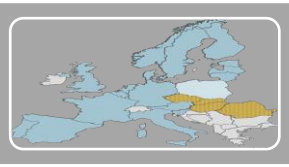
Annual VRE share and corresponding system integration phase in selected countries/regions, 2018



Status of Power System Transformation 2019: Power system flexibility – Analysis – IEA, 2019

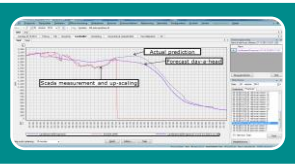
TOOLBOX FOR EFFICIENT INTEGRATION OF RENEWABLES

Strong transmission grids and interconnectors

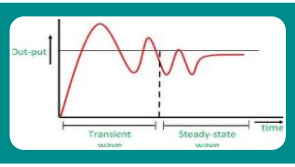


International electricity markets and efficient dispatch

Flexible generation system



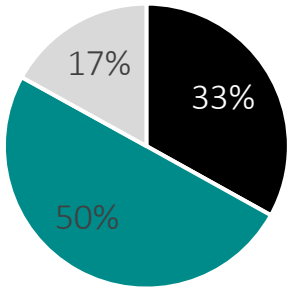
Specialized forecasting and operational planning tools



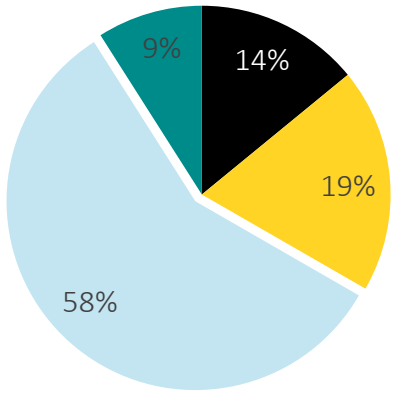
Stability through grid codes and dynamic resources

DENMARK TOO SMALL FOR COMPETITION AND EFFICIENT INTEGRATION WITH REST OF EUROPE

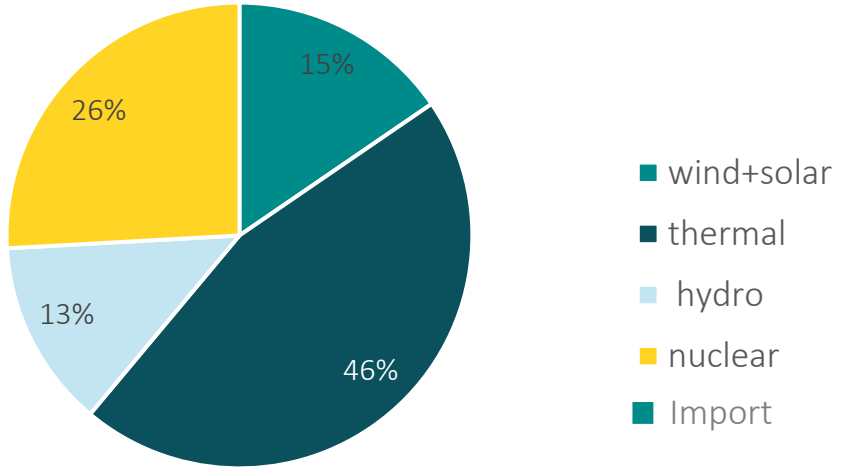
Denmark, 33 TWh



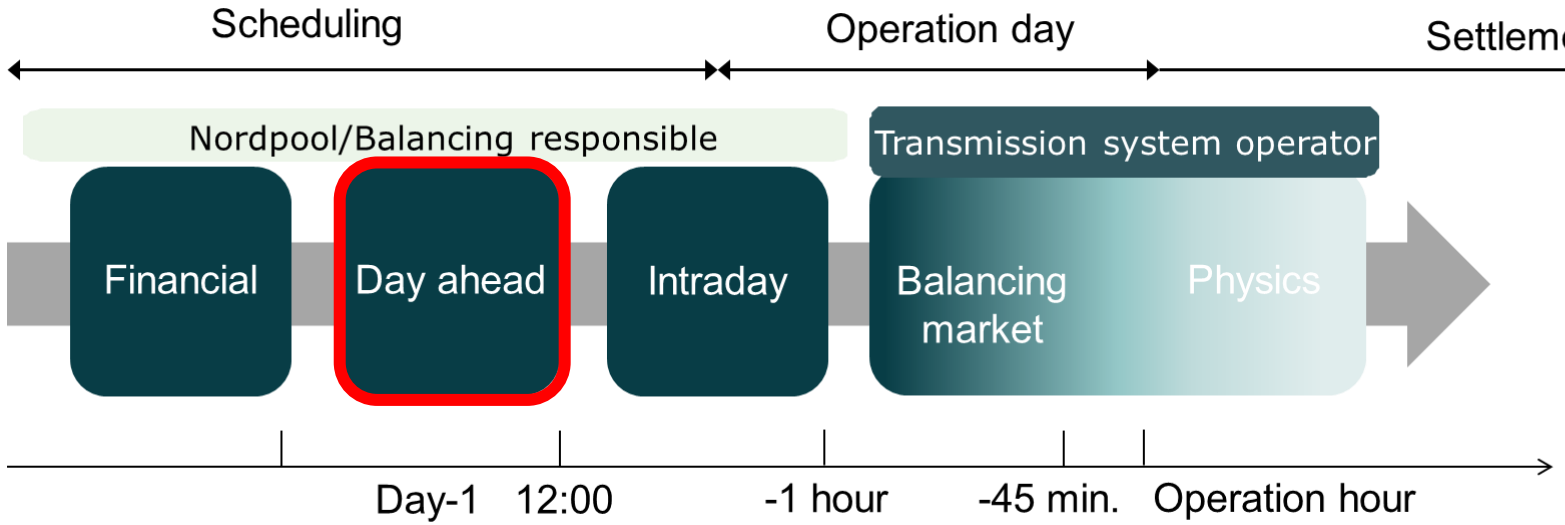
Nordic, 399 TWh



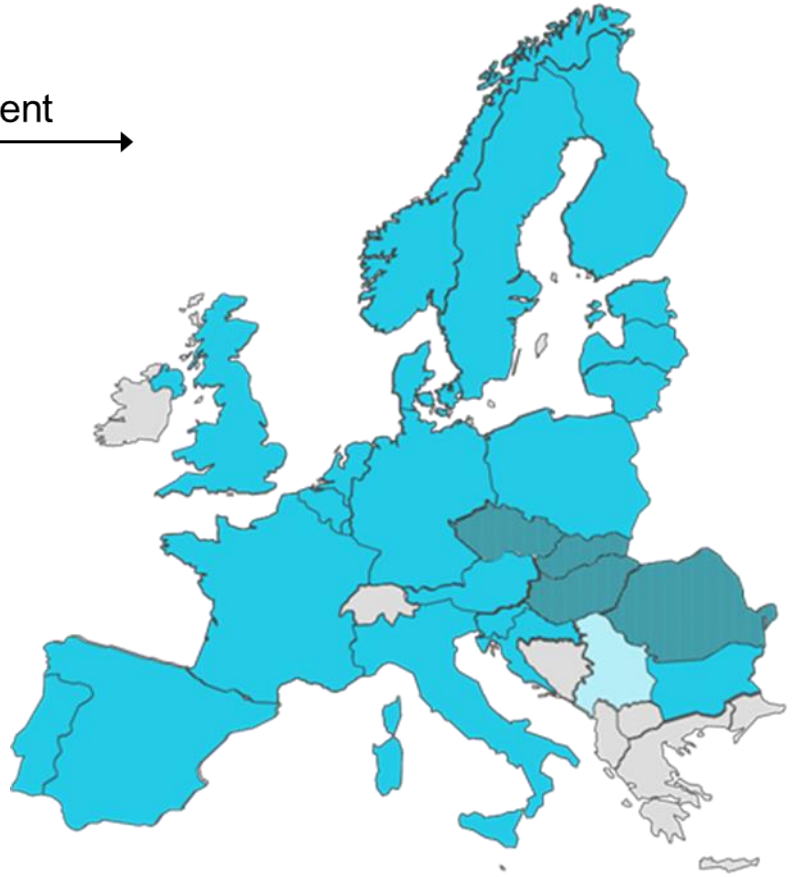
EU-27, 2806 TWh



THE ELECTRICITY MARKETS

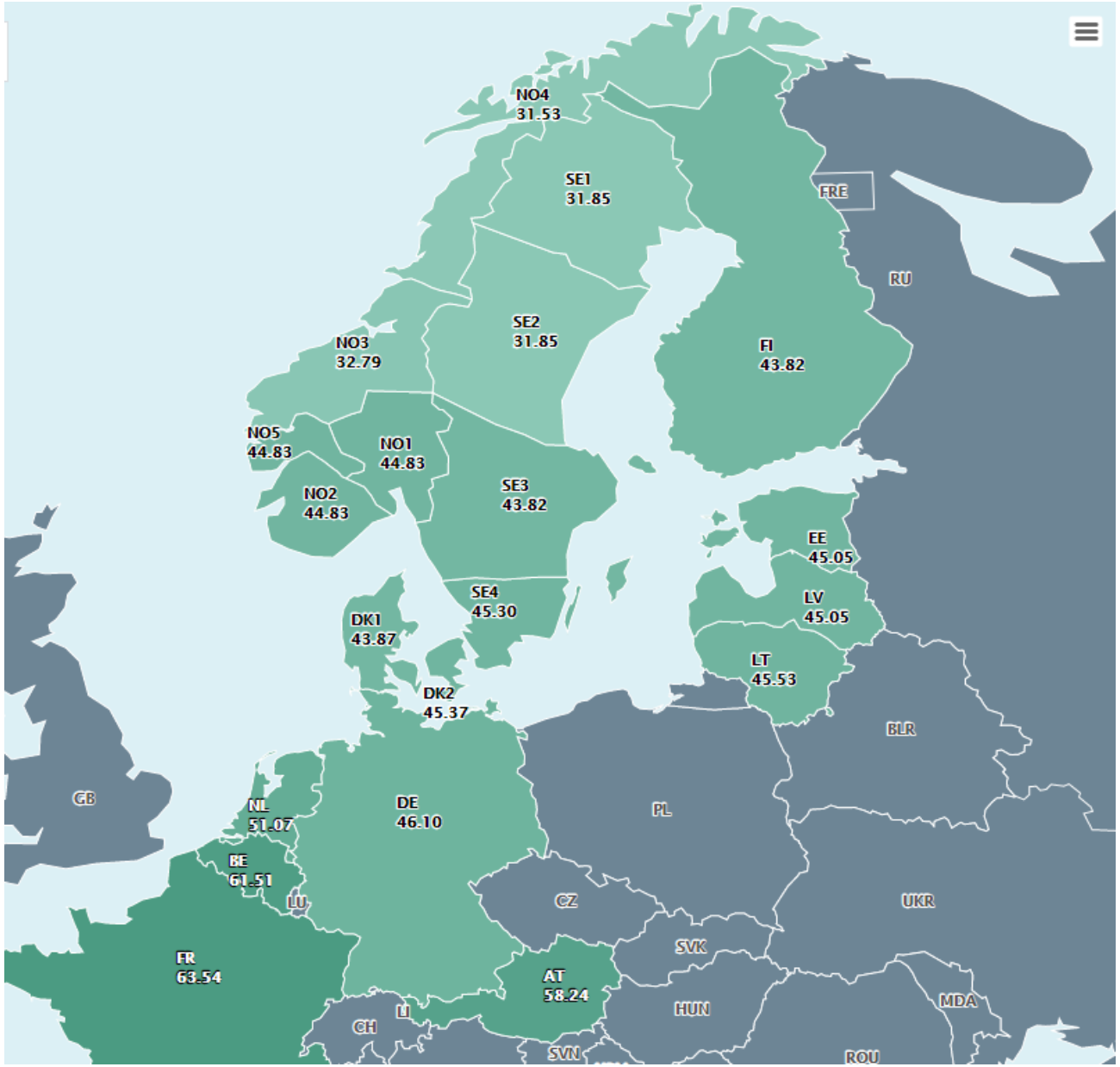


Trade in Nordic area:	500 TWh	4TWh	2TWh

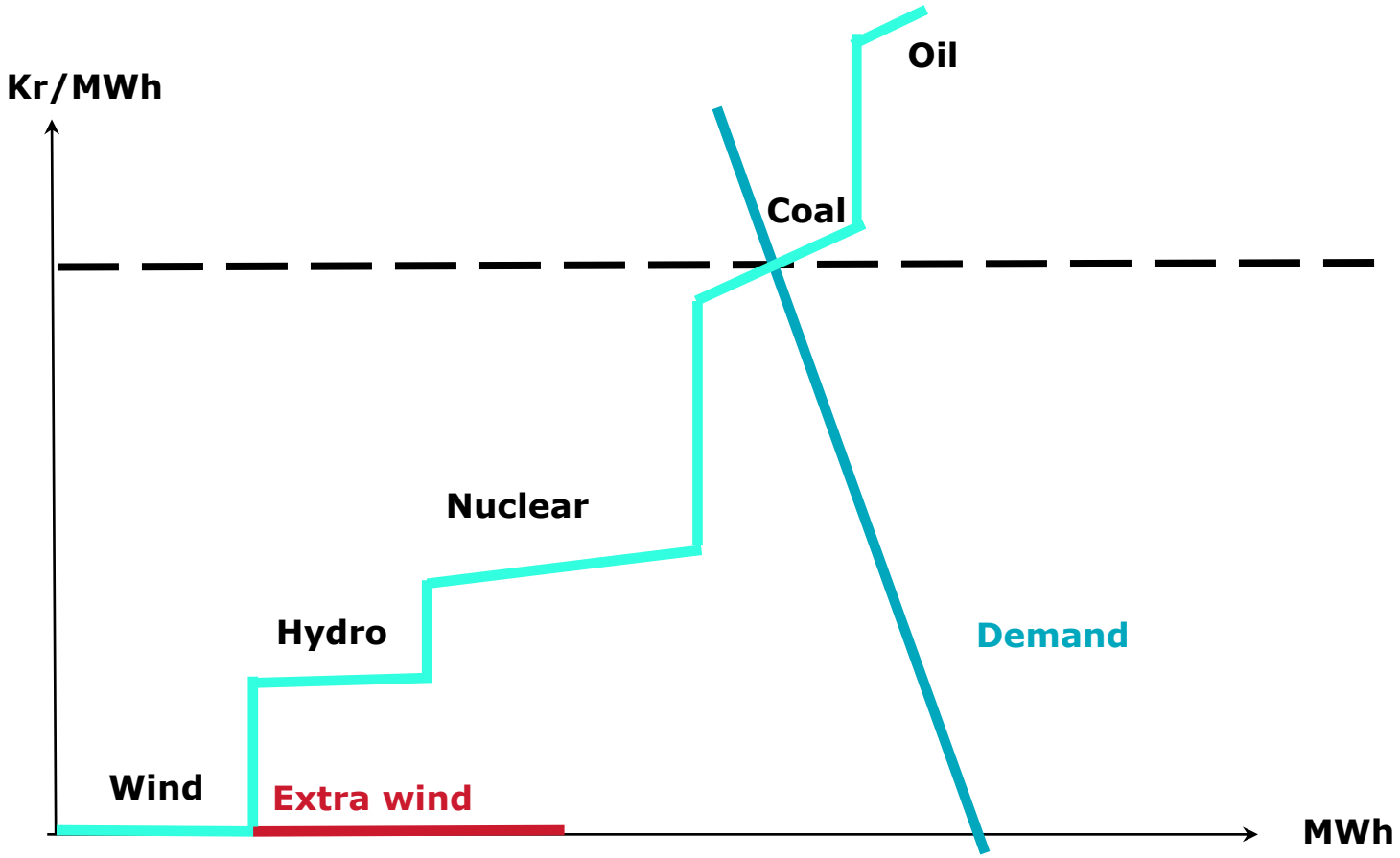


European market coupling

THE POWER PRICES – RIGHT NOW



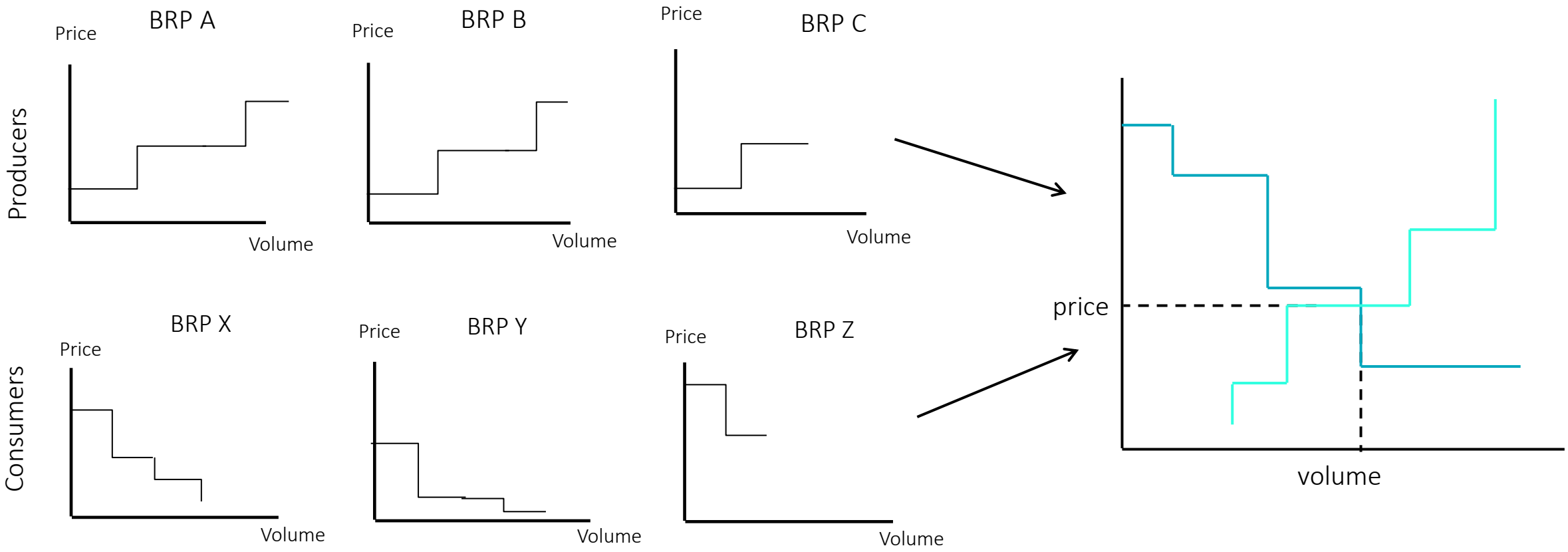
MARGINAL PRICE IN THE ELECTRICITY MARKET



- The most expensive unit activated sets the price and all units receive this price.
- This ensures that the cheapest units produce first and that all bid according to actual cost.
- More wind shifts the supply curve and reduces clearing price.

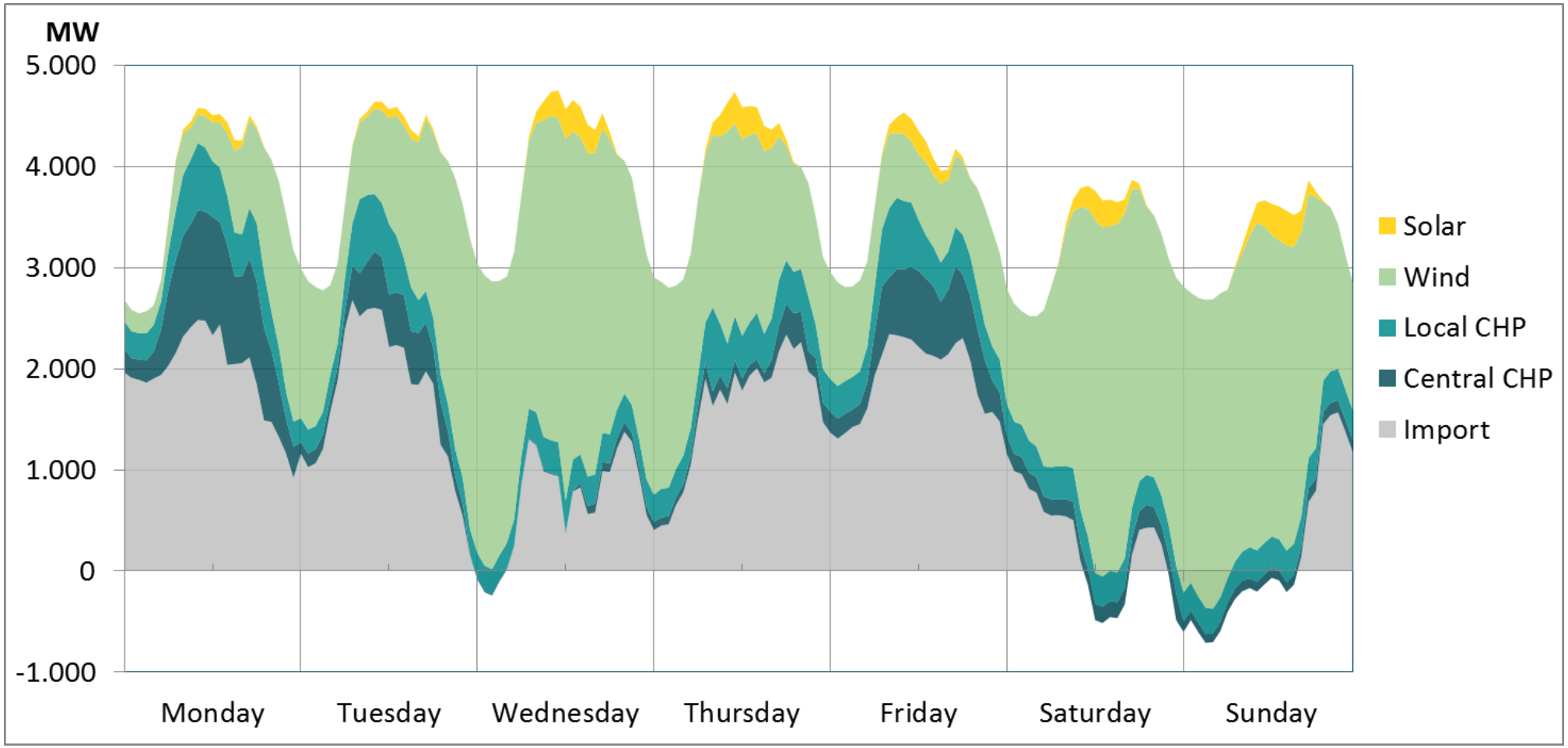
CALCULATION OF HOURLY ELECTRICITY PRICE

The algorithm ensures that the cheapest resources are utilized

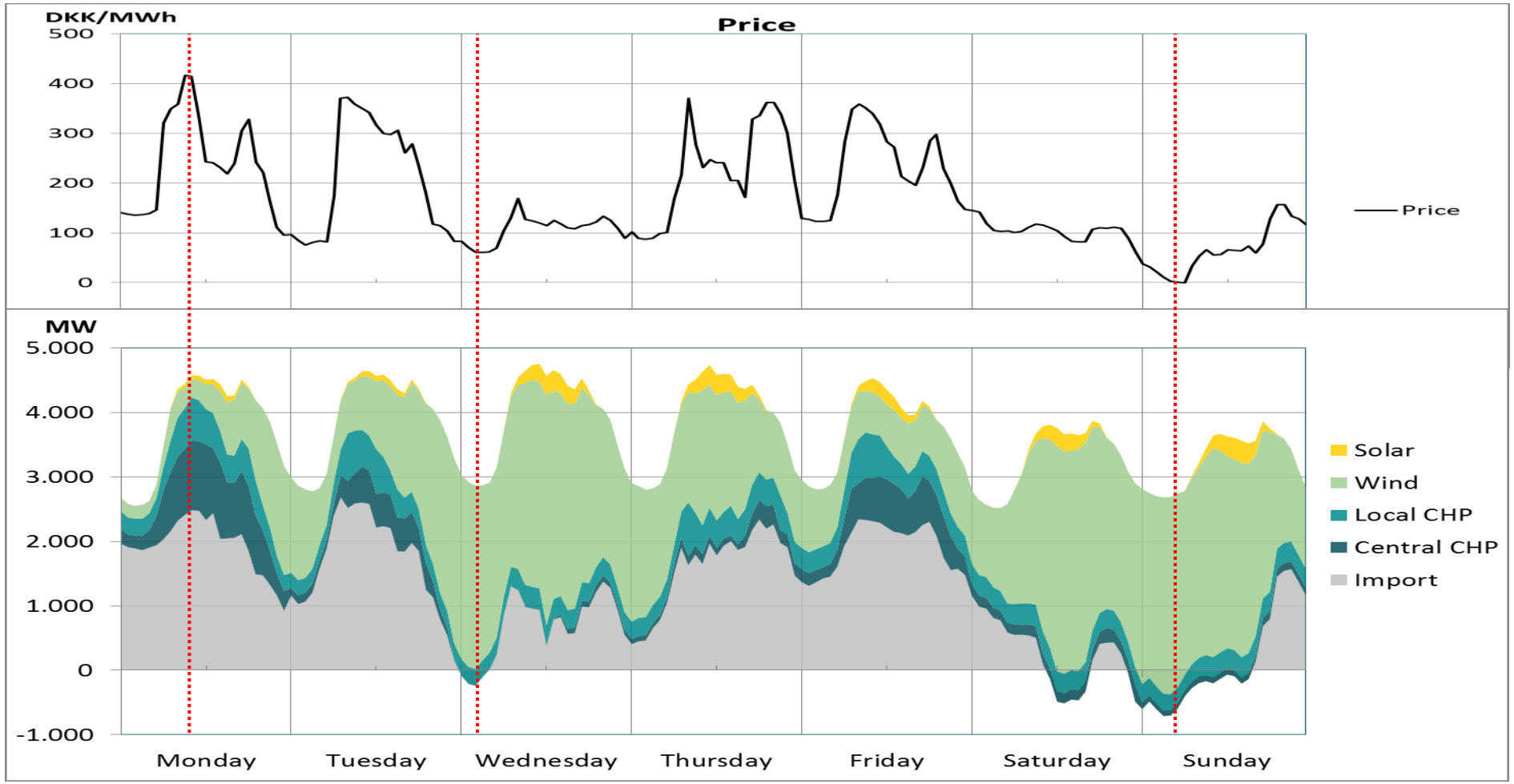


FLEXIBILITY IN THE ELECTRICITY SYSTEM – A WEEK IN THE AUTUMN

- HOURLY DISPATCH



SPOT PRICE, WIND POWER AND MARKET DYNAMICS



Key participants in the current market

DSO

Local monopolies

DSO's are responsible for the distribution grid and for metering demand

TSO

Monopoly

Is responsible real-time operation and own, operate and develop the transmission system.

Consumers

All consumers can choose a supplier and different types of contracts, e.g. with a fixed price for a period, or with a variable price.

It is easy and free of charge to change supplier or type of contract.

Supplier

Commercial companies.

The main interface to the consumers.

All retailers are associated with a balance responsible.

Balance responsible

Commercial companies.

Deliver plans to the TSO for generation, demand and trade.

Generators

Commercial companies. Submit bids for potential generation.

Power exchange

Nord Pool operates day-ahead and intra-day markets.

The day-ahead market results in hourly prices in each price area.

Danish Energy Agency

Retail market

Development of retail market has been slow

By the end of 2020, all consumers will have a smart meter

- No need for estimated bills
  - Before the smart meters, the meter reading was yearly, but payment quarterly
- With remote reading of meter, consumers can now participate in demand response
  - Adjust demand after prices, e.g. with heat pumps, electric heating or electric vehicles.
  - Commercial products exist, e.g. for heat pumps

Key features of the Danish liberalised power sector

UNBUNDLING: Transmission

Unbundling ensures that the transmission grid supports competition to the largest extent possible. Owners of generator capacity must not be able to limit competition by controlling the use of the transmission grid.

SHORT TERM market

Hourly dispatch according to marginal costs. Level playing field for all generation technologies. Demand can also respond to prices.

Existing long-term agreements, e.g. on import/export, have been removed

INTERNATIONAL COMPETITION

Competition ensures efficient dispatch, and least cost delivery of ancillary services.

A fundamental transformation

The transformation will have winners and losers – and may require difficult compromises and transition agreements

- Before: Vertically integrated companies: Generation, distribution, sales
- Now: Unbundled setup with commercial units (generation and sales) and regulated monopolies (TSO and DSOs)

Danish Energy Agency

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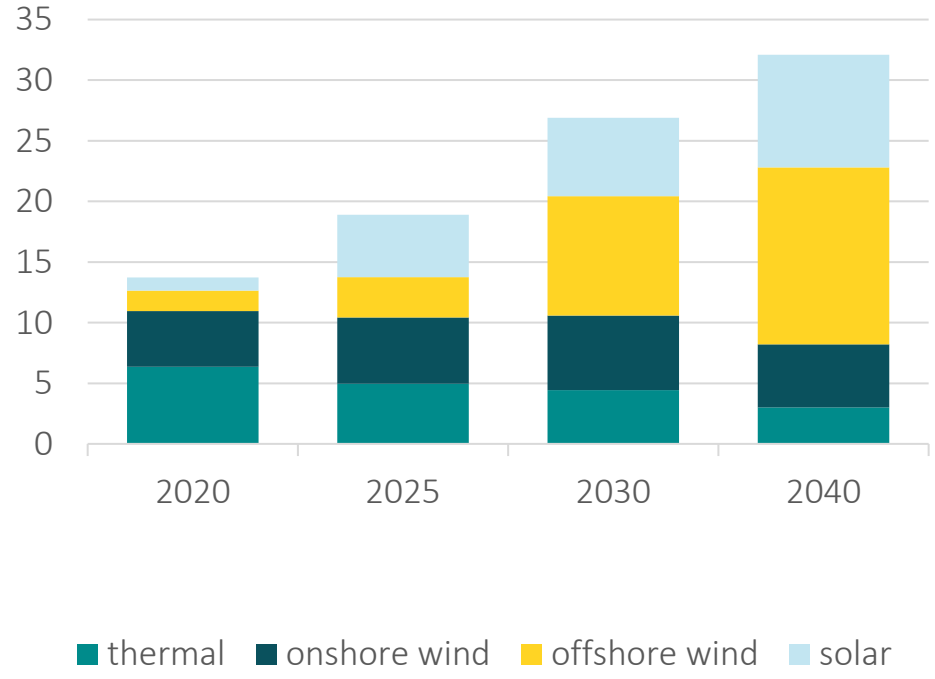
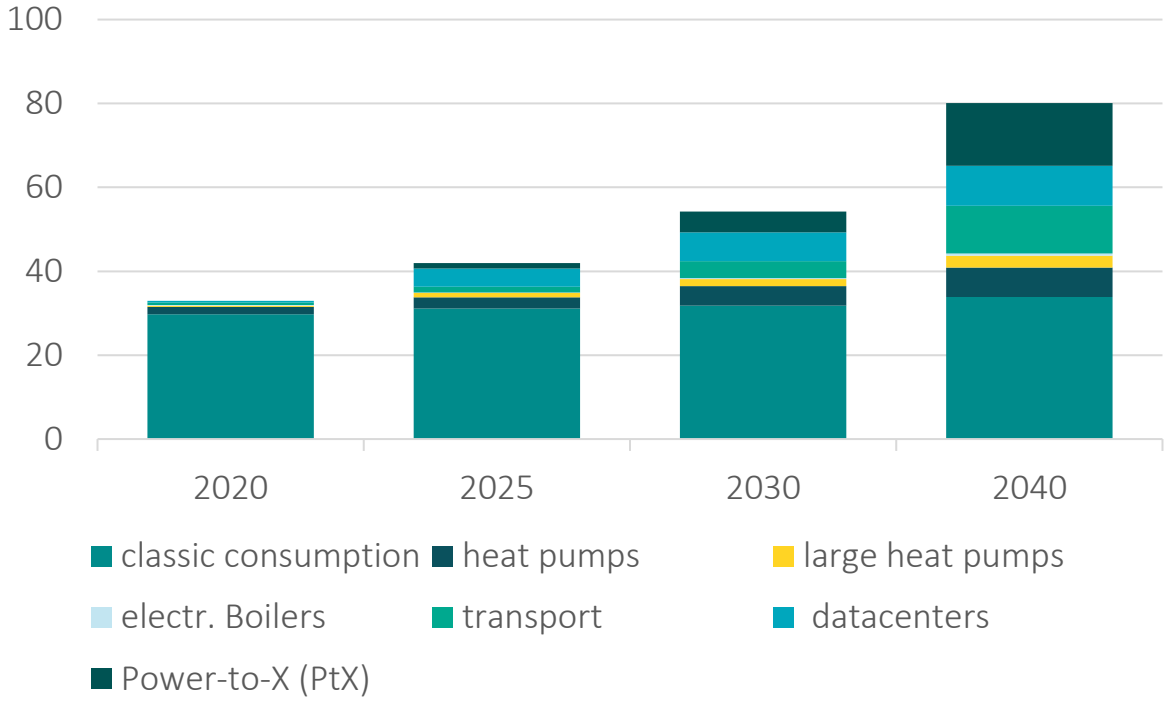
EXPECTED INCREASE IN CONSUMPTION AND VARIABLE RENEWABLES TOWARDS 2030

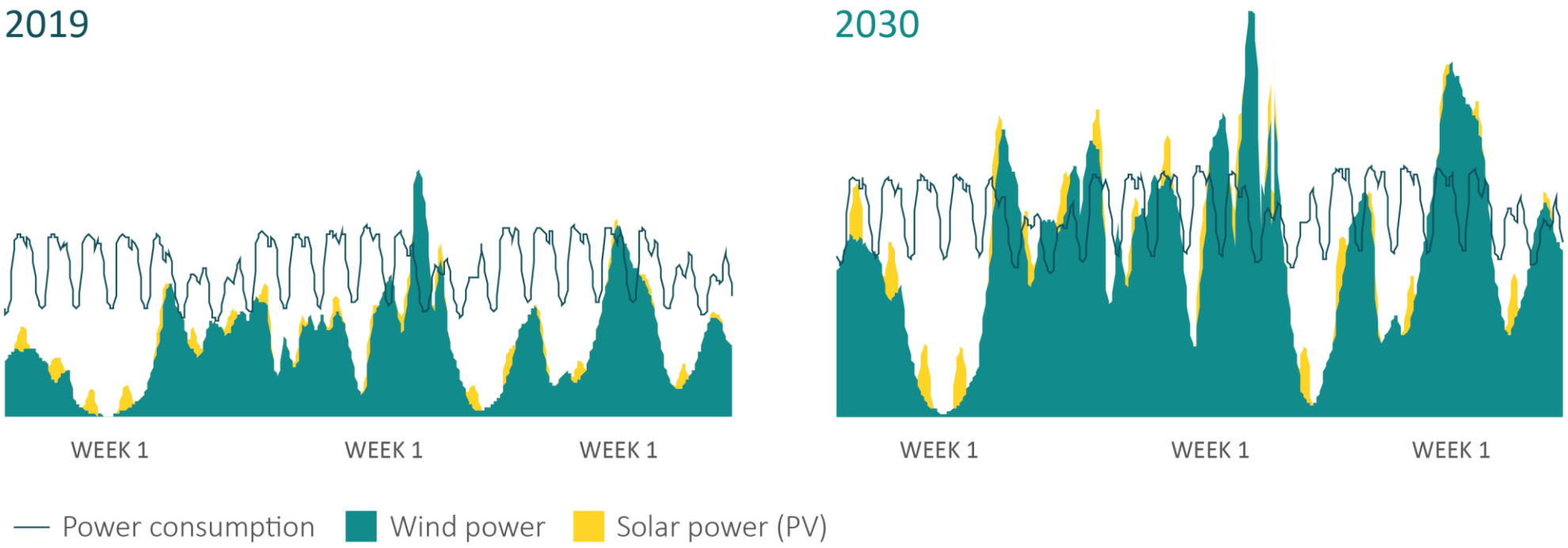
Electricity production capacity, GW



Electricity consumption, TWh

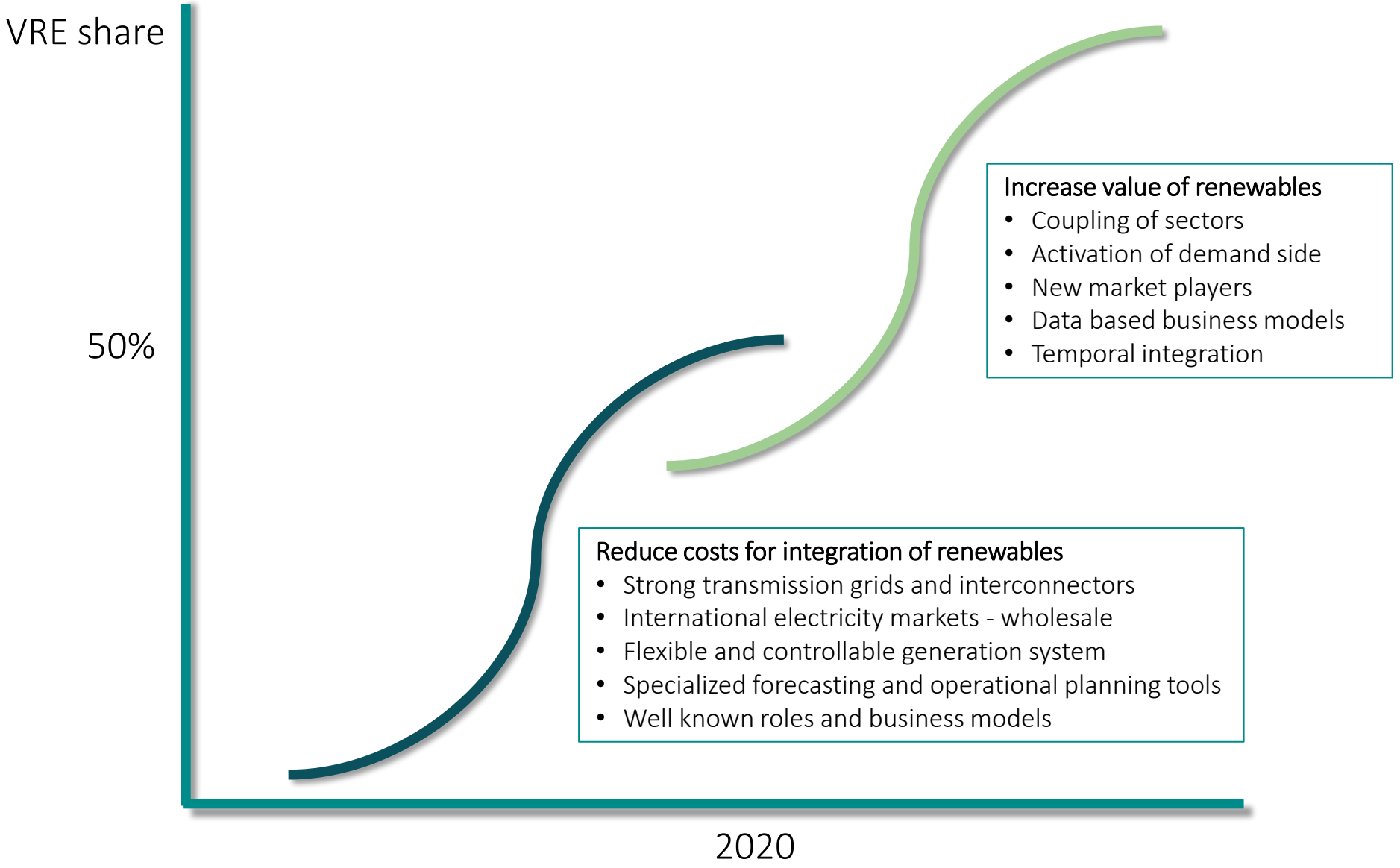


CONSUMPTION AND GENERATION ARE OUT OF STEP



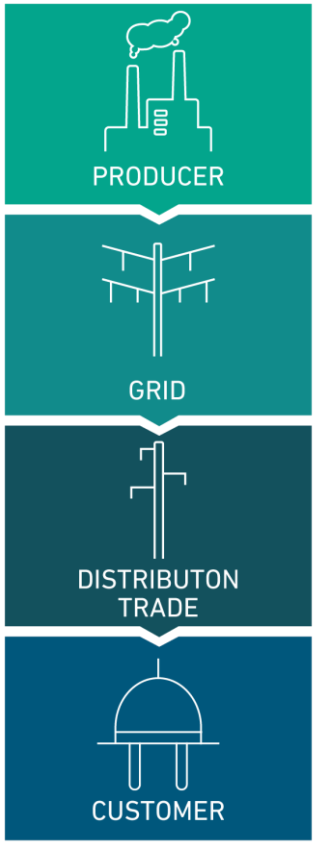
MARKET BASED INTEGRATION OF VRE – FOCUS ON VALUE

After the first 50% VRE new challenges and options arise



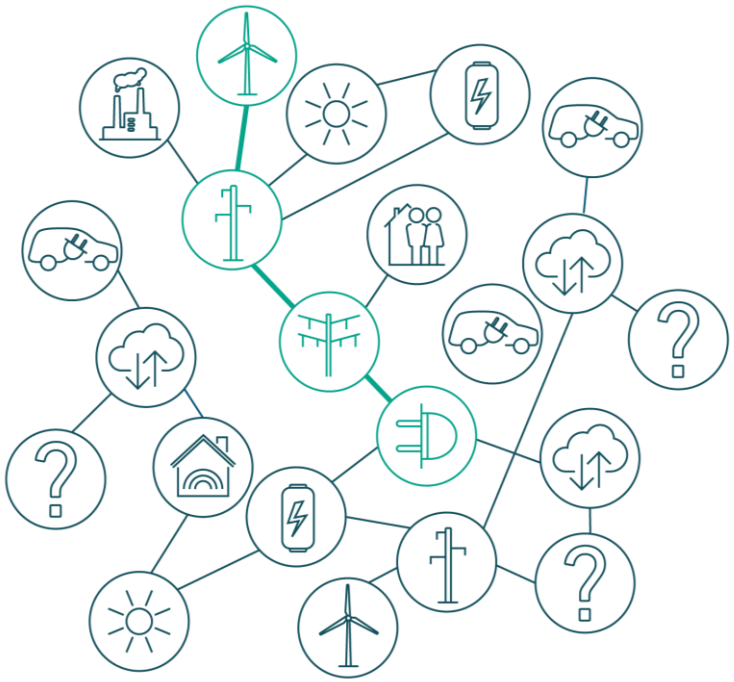
THE ENERGY VALUE CHAIN IS TRANSFORMING

BEFORE



- Green energy ~~has~~ does not have to be subsidized
- Electricity can ~~not~~ be stored
- Electricity and gas consumers are ~~passive and inflexible~~ active and flexible
- All consumers ~~receive~~ do not demand and receive the same product

IN THE FUTURE



And it will require a lot of data and software !

DANISH CONSUMERS OWN THEIR DATA

ENERGINET FACILITATES CONTROLLED AND OPEN ACCESS TO DATA – TO RELEASE THE VALUE OF FLEXIBLE CONSUMPITION IN THE GREEN TRANSISTION

2014

DataHub

Central register and market platform for all metering data

2016

DataHub 2.0

MYDATAACCESS

DataHub 2.0 and data access to 3. parties

2017

ENERGI DATA SERVICE

Open Data Platform

2018

OPEN DOOR LAB

Data and Market Innovation Platform

2019

MYDATAACCESS 2.0

Energy Data Portal 3. Party Access 2.0

2020

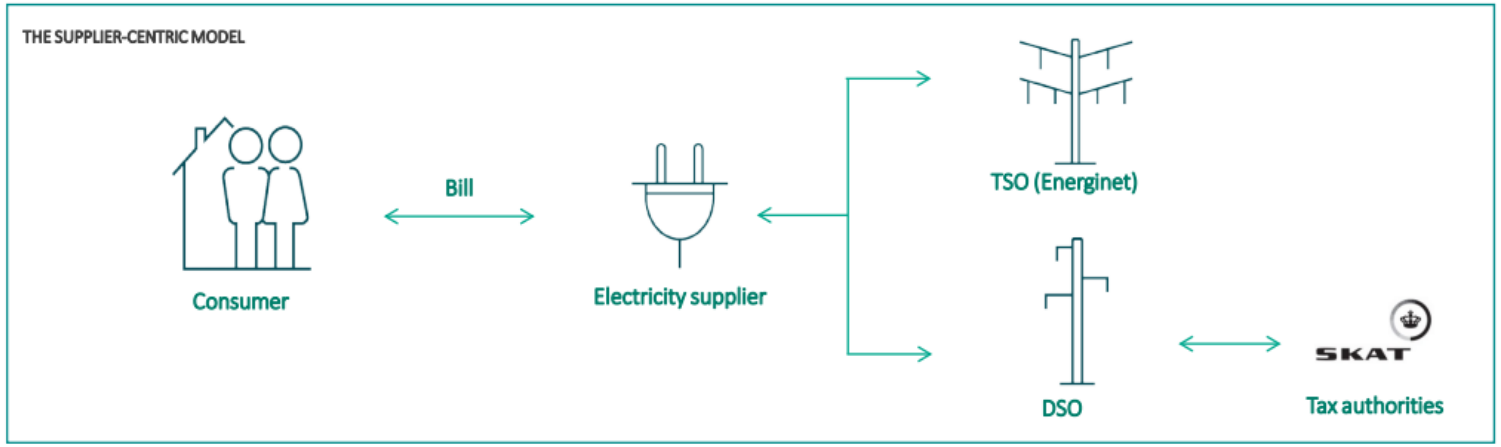
Hourly settlement of all Danish consumers

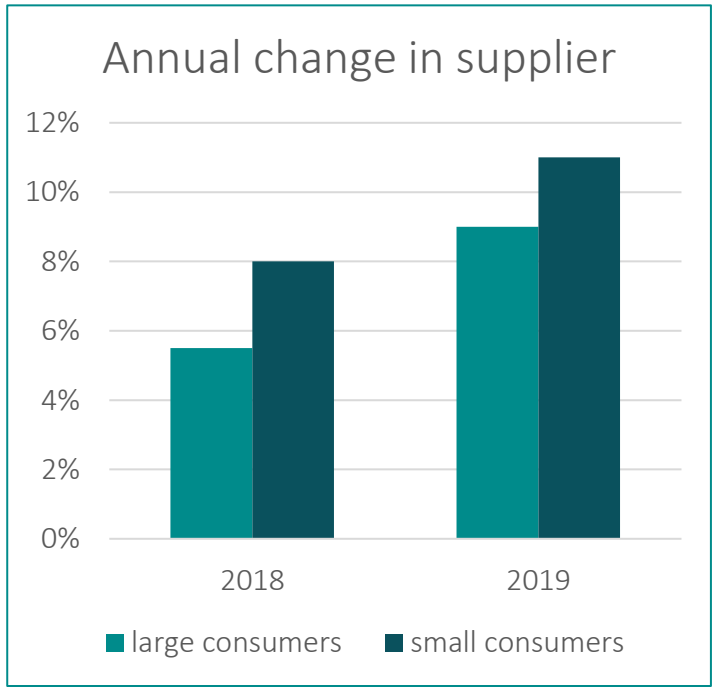
THE RETAIL MARKET AND THE BILLING PROCESS

Datahub and the Supplier centric model together with smart meters supports the possibility for hourly billing

Increase retail market competition through central data communication and standardised market processes

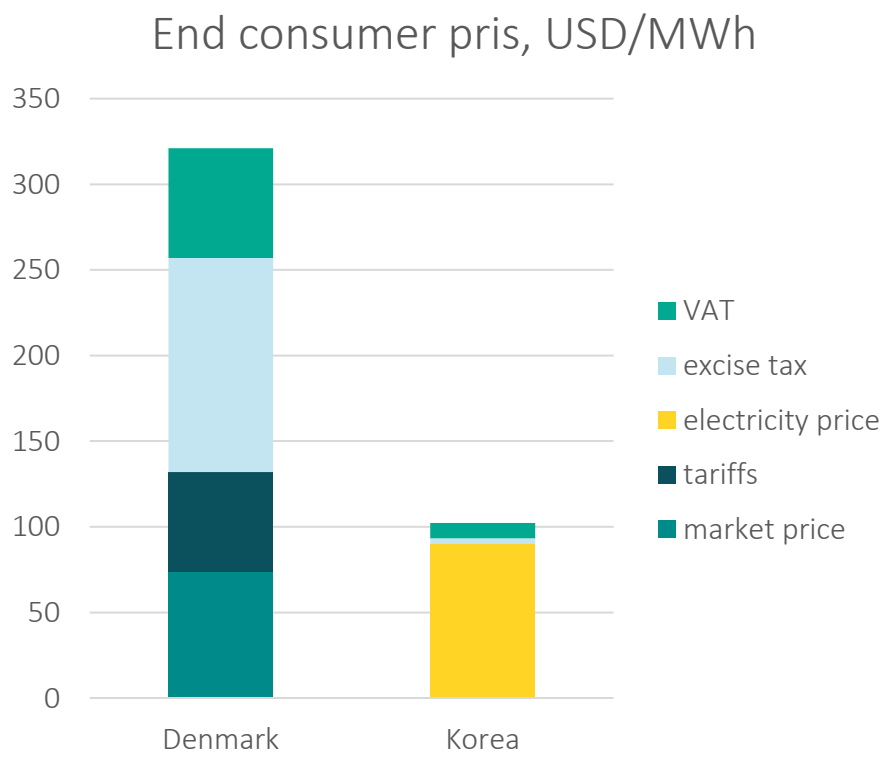
Appr. 50 electricity suppliers in Denmark

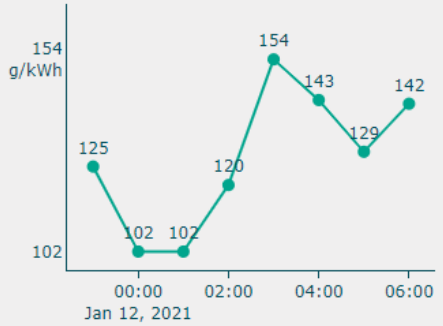




THE RETAIL MARKET

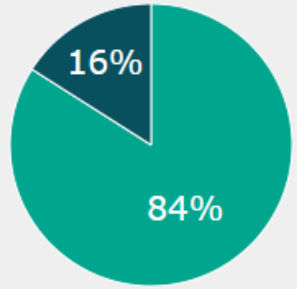
End consumer electricity price influence incentive to be flexible – other incentives than the price is needed





CO_2 EMISSION NEXT 8 HOURS

ENERGI DATA SERVICE



CONSUMPTION COVERAGE LAST HOUR

STIMULATE MARKET INNOVATION AND DEVELOPMENT

Energinet support market players with access to data and close dialogue

SETTING DATA FREE

ENERGI DATA SERVICE

COMMUNICATION

INNOVATION PLATFORM

OPEN DOOR LAB

EXAMPLES OF PROJECTS TO INCREASE FLEXIBILITY

Which projects and external collaborations are actually up and running (not exhaustive)?

True Energy – Aggregator and electricity supplier delivering flexibility from electric vehicles

IBM – IT developer creating systems to handle flexibility from large buildings

Vestas et al – Acting as aggretor wothout BRP in order to minimize transaction costs in the delivery of ancillary services

Coop – Collection of super market to deliver ancillary services from cooling systems

Energi Danmark – A Danish BRP and electricity supplier delivering ancillary services from industrial companies, back-up power systems etc.

TRUE ENERGY

Start-up electricity supplier with focus on consumers with electrical vehicles

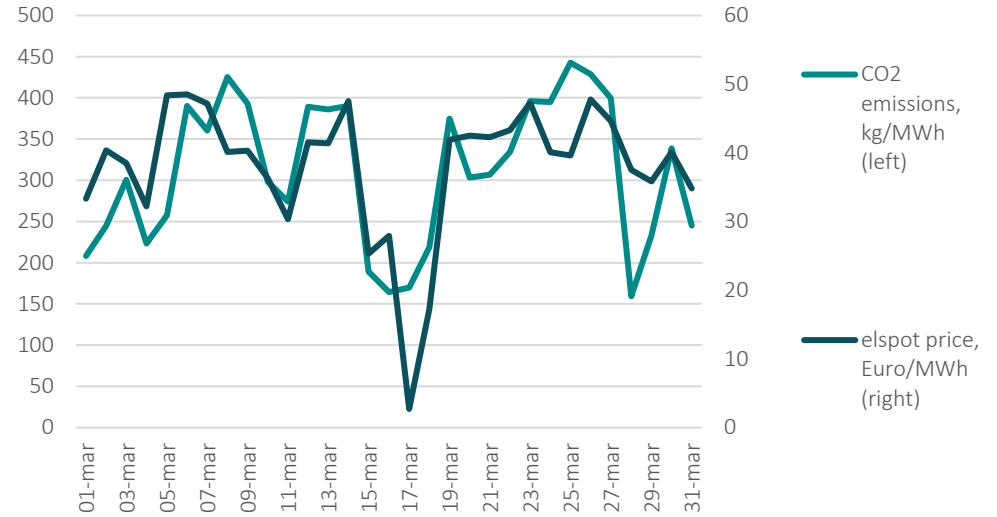
Incentivize flexible consumption based on hourly settlement

- Lower electricity price
- Reduced CO2- emissions
- Offer automatic charging of electrical vehicle
- Aggregating EV's and deliver ancillary services

Energinet support:

- Advice and understanding of market framework
- Use of data and electricity declaration

Electricity price and CO2 emissions, DK-West, March 2019



Potential gain from flexible consumption: 10% reduction in electricity price and CO2 emissions (Energinet estimation)

PARKER PROJECT

Demonstration project with NUVVE, DTU, Frederiksberg Forsyning, Nissan, ENEL, Centrica, Mitsubishi and Insero

Delivering FCR from Nissan Leaf (V2G)

- Symmetrical FCR bids
- Test of business model, new charging technology and software

Energinet support:

- Understanding market framework and settlement
- Control of quality of delivered ancillary service

Knowledge from project has been commercialised in i.e. Germany, Sweden and Holland

B. FCR-N DK2

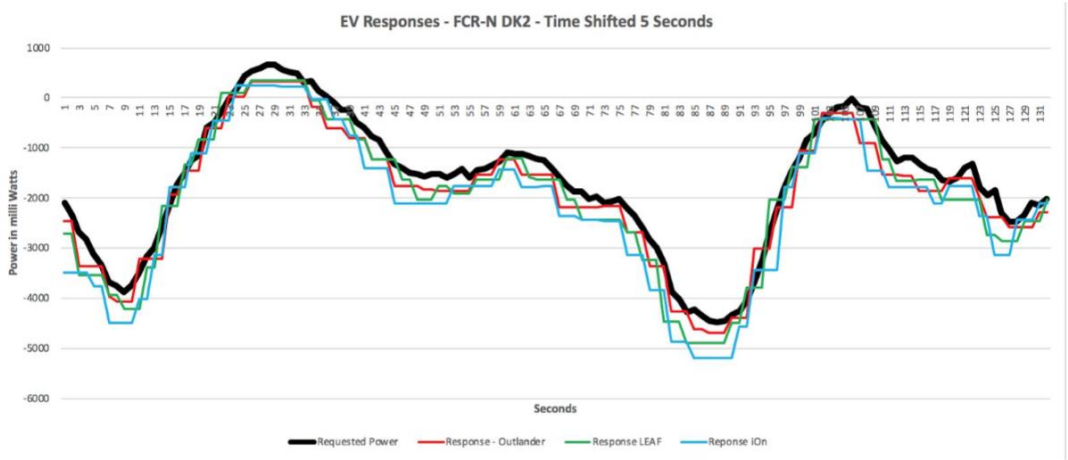


Figure 10 - FCR-N DK2 Test

http://parker-project.com/

TO SUM UP – 100% GREEN ENERGY IN 2050

Increased electricity consumption is solution to decarbonization

As electricity end-consumer you also have important role for green transition

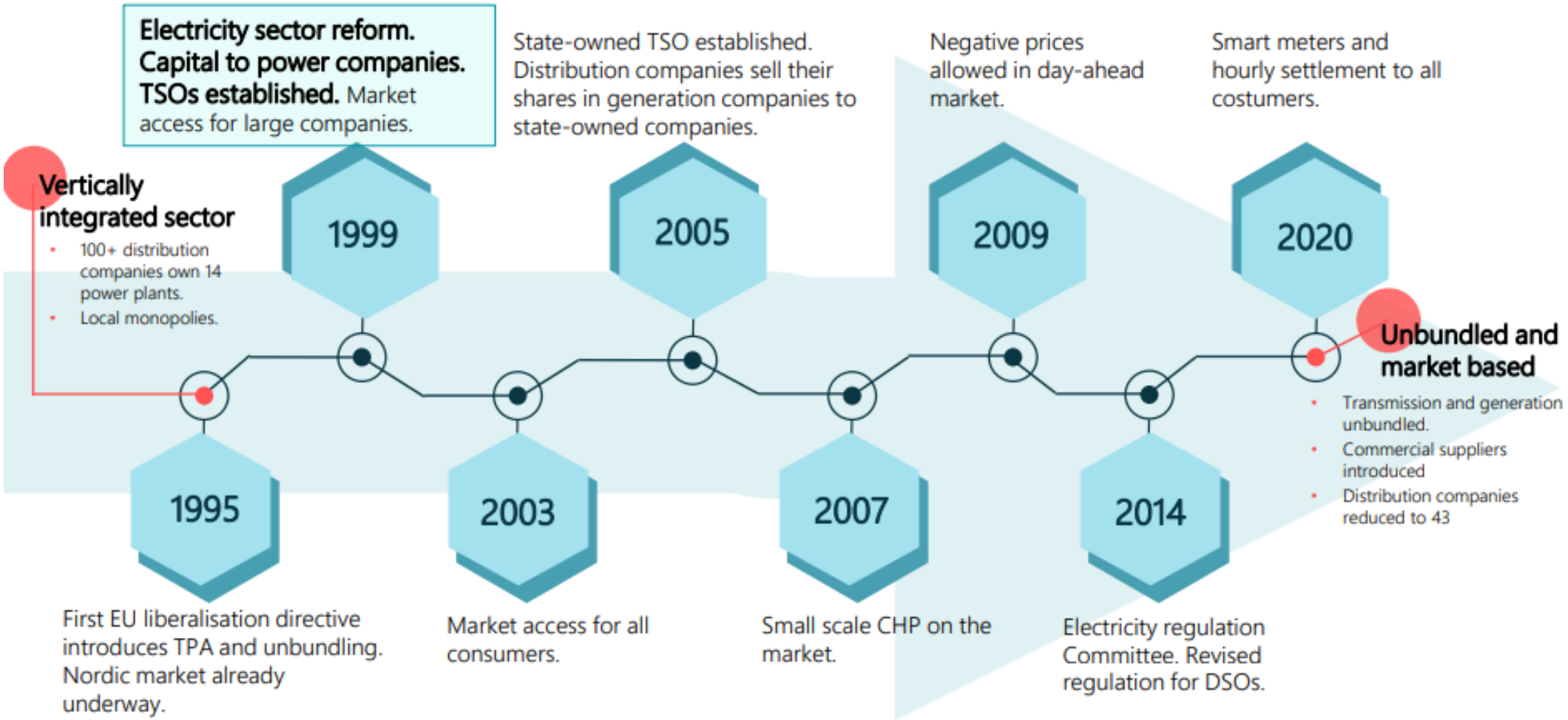
Electricity markets are important for facilitating flexibility – both consumption and production

Holistic energy system approach and long term planning is necesary

Cooperation across sectors, business, consumers and authorities to find common solutions

QUESTIONS

Contact: PMR@energinet.dk


Vertically integrated sector
100+ distribution companies own 14 power plants.
Local monopolies.
1995
First EU liberalisation directive introduces TPA and unbundling. Nordic market already underway.
1999
Electricity sector reform. Capital to power companies. TSOs established. Market access for large companies.
2003
Market access for all consumers.
2005
State-owned TSO established. Distribution companies sell their shares in generation companies to state-owned companies.
2007
Small scale CHP on the market.
2009
Negative prices allowed in day-ahead market.
2014
Electricity regulation Committee. Revised regulation for DSOs.
2020
Smart meters and hourly settlement to all costumers.
Unbundled and market based
Transmission and generation unbundled.
Commercial suppliers introduced
Distribution companies reduced to 43