

# Introduction

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- ▶ **The concepts capacity, power and energy are explained in appendix 1**
  - **Further, using the Nordic area and Western Denmark as cases, appendix 2 illustrates how the TSOs trade balancing energy and balancing capacity with market players**
    - **In order to maintain the security of supply.**
- ▶ **Appendix 3 contains a list of the terms and acronyms used in this presentation**
- ▶ **This PowerPoint presentation is animated**
  - **It's strongly recommended to run the animation when viewing the presentation.**
- ▶ **On most computers, you can start the animation by pressing F5.**
  - **Now the presentation moves one step forward, when you press Page Down. It moves one step backward, when you press Page Up.**



# The Single European Electricity Market

For The Single European Electricity Market, this document has two messages:

1) The TSOs must establish separate markets for balancing energy and balancing capacity

For the security of supply, with separation of the TSOs' markets for energy and capacity, the green producers become part of the solution

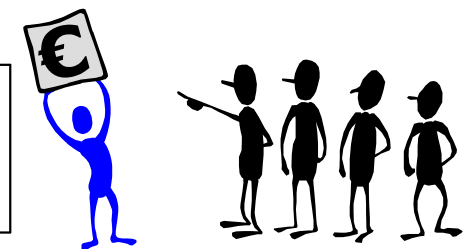
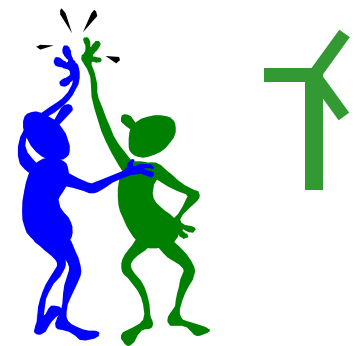
Instead of being part of the problem

Please refer to slide no. 21.

2) For capacity, the TSOs must establish short-term capacity markets

Thus providing a continuous updated price signal for capacity.

In contrast: the electricity supply business will slide back to planning economy, if the TSOs buy capacity on medium-term or long-term contracts.



# Separation of the TSOs' markets for capacity and energy

▶ Referring to slide no. 10: the TSOs can ensure maximum competition at their market for balancing energy by separating their markets for energy and capacity.

▶ **Efficient competition at the TSOs' market for balancing energy is vital for the competition at the retail market.**

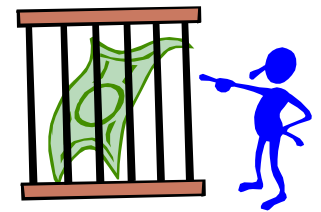
▶ Because the prices for imbalances are derived from the TSOs' prices for balancing energy.

▶ A new retailer (with few customers) will have relatively high imbalances

➤ Buying the right amount of energy for every hour is difficult, when you have few customers

- As predicting a small customer portfolio's consumption is relatively more difficult than predicting a big portfolio's consumption.

➤ Thereby, **at the retail market, high prices for imbalances create an high entrance barrier.**



▶ However, the TSOs can keep the imbalance prices in check by separating their markets for energy and capacity.

# Players at the TSOs' capacity and energy markets

- ▶ In order to promote innovation and competition, it's very important the players are normal, commercial players
  - Retailers, producers, traders, portfolio managers.
- ▶ Every balance responsible player must be allowed to offer services at the TSOs' capacity and energy markets.
- ▶ As for the so-called **"smart grid" technologies:**
  - **The investment in these technologies must be made solely by commercial players,** who see a business opportunity
    - An opportunity to use the technologies to offer more services at the TSOs' markets for capacity and energy.
  - The investments must not be made by the monopolies (ie, not by TSOs or distribution system operators).
- ▶ We ensure the grid users will not end up paying for non-viable investments by ensuring smart grid investments are made by commercial players on fully commercial terms
  - The TSOs' job is solely to provide the price signal.



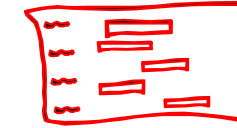


**Portfolio manager:  
retailer or other  
commercial player.  
Aggregate small players'  
service offers**

**balancing  
capacity:  
offers**



**balancing  
energy: bids  
and offers**

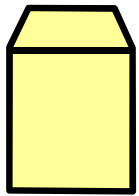


**TSO. Buying  
balancing capacity.  
Buying and selling  
balancing energy**

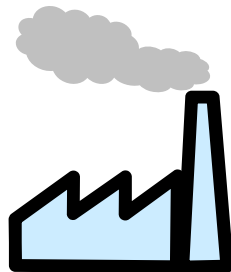
**Commercial  
agreements**



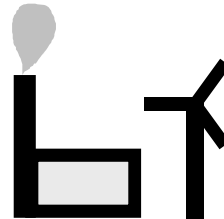
**House-  
holds**



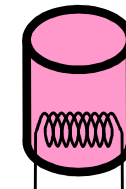
**Offices**



**Factories**



**Small power  
producers**



**District  
heating  
companies**

**Consumers  
and producers  
of electrical  
energy, who  
have the ability  
to change  
production/  
consumption**

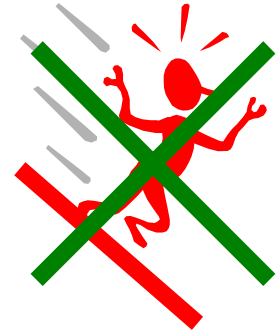
# Capacity markets in EU – 1

- ▶ The electricity supply system gets more and more capacity from subsidized producers (eg, wind turbines and solar cells).
- ▶ This drives down the market price of electrical energy as:
  - Many of the subsidized producers receive feed-in tariffs. Hence they'll produce without regard to the market price.
  - For these producers: after their subsidy period has expired, they'll still produce even if the market price is close to zero
    - As their marginal production costs are close to zero.
- ▶ **Will this process drive non-subsidized producers out of business?** (such as gas or coal fired power stations).
- ▶ In order to maintain the security of supply, the TSOs need capacity
  - Due to the process described above: **in order to ensure sufficient capacity, will the TSOs have to buy capacity from otherwise non-subsidized producers on long-term or medium-term contracts?**



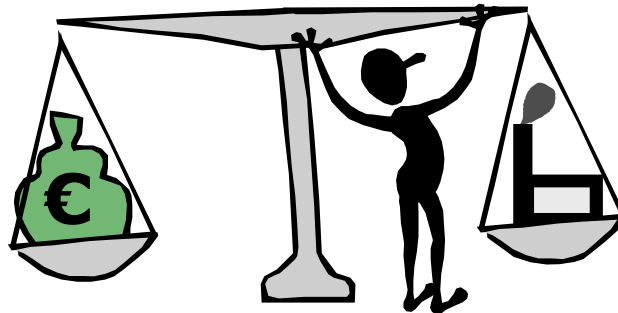
# Capacity markets in EU – 2

- ▶ **Suppose the TSOs increased the purchase of capacity on medium-term or long-term contracts:**
  - **Now no investor would build a new power station, unless it was subsidized.**
- ▶ **Therefore, this would send us down the slippery slope**
  - **Where no new power stations would be built, unless they were subsidized**
    - **Subsidized due to environmental or security of supply issues.**
- ▶ **Hence, a vital element of market economy would be lost for the electricity supply business**
  - **In a market economy, one of the purposes of the price signal is to alert potential investors of scarcity of the commodity.**
  - **With this element removed, the electricity supply business would slide back to planning economy.**
- ▶ **The following slides will demonstrate how this can be avoided.**



# The right type of capacity markets – 1

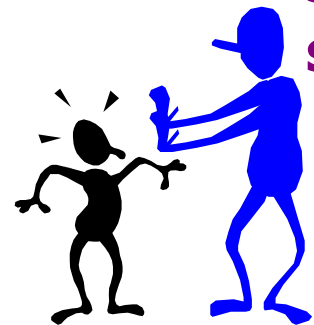
- ▶ The TSOs can buy capacity on short-term contracts
  - Buying capacity day-ahead, week-ahead and/or month-ahead.
- ▶ Thereby, the TSOs do not pay for investments in power stations
  - Instead, by means of their short-term capacity markets' prices, the **TSOs provide the market and potential investors with a price signal.**
  - This price signal will prompt investors to provide new capacity when it's needed.
- ▶ Hence, **all we need is a short-term market for capacity providing a continuous updated price signal.**





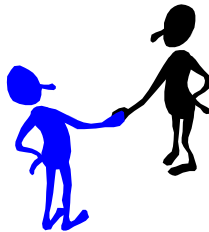
# The right type of capacity markets – 2

- ▶ In order to create trust among potential investors, it's **imperative the framework for the TSOs' markets for energy and capacity is regarded as stable and fair.**
- ▶ Building trust and reliable prices at a market is a very time-consuming process.
- ▶ Hence, this work should start immediately
  - And plans for medium-term or long-term capacity markets should be abandoned.
- ▶ Otherwise, it will be unnecessarily expensive to meet EU's goals for renewable energy.
- ▶ Suppose the TSOs carry on buying capacity on medium-term or long-term contracts (perhaps even increasing this activity)
  - In this case, for balancing capacity, the TSOs have signalled they do not believe it's possible to create fair short-term markets with reliable prices
    - This would be a costly surrender.
    - And it would block the establishment of viable short-term capacity markets.



# Features of a well-designed short-term capacity market

- ▶ **As for the minimum amount of capacity players can offer at the TSOs' capacity market:**
  - **The allowed minimum must be very small**
    - **As experience illustrates: this attracts capacity, which otherwise would not have been put to the market.**
- ▶ **Players must be allowed to offer only up balancing capacity or only down balancing capacity (ie, asymmetric offers must be allowed)**
  - **This makes it possible for unconventional players to offer capacity. For example:**
  - **Smelteries and other types of industry (who can offer up regulation by temporary reducing consumption).**
  - **District heating (who can offer down regulation by starting to produce hot water by means of electricity).**
  - **Owners of a UPS (who can offer up balancing).**
- ▶ **Note: precisely because it's a short-term market, all these players (and many more) have the option of offering services at the TSOs' markets (ie, enhancement of competition).**



# Multinational markets needed!

## For energy and capacity

▶ So far, the TSOs' markets for balancing energy and balancing capacity have largely been national affairs.

▶ If EU's goals for renewables are to be met with reasonable costs, we need to improve this

➤ Enhance the competition by establishing a Single European Market for these services.

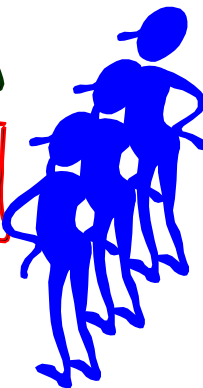
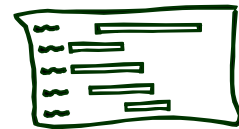
➤ Probably, due to grid bottleneck issues, the Single Market will work this way:

➤ For each bidding zone, the local TSO is the sole counterpart for the players

• ie, the players cannot themselves offer these services across the borders.

➤ However, the TSOs establish an EU-wide pricelist for the services – and trade with the "best" counterparts

• To the extent grid bottlenecks do not prevent this.



# The common electricity market



What is actually *common*?

We have many markets. Some of them are:

## Capacity markets

All operated by the TSOs

**Tertiary reserves**  
Activated manually

**Secondary reserves**  
Automatically, pretty  
fast reacting units

**Primary reserves**  
Automatically, very  
fast reacting units

## Energy markets

### Day-ahead trading

Trading electrical  
energy for tomorrow

Exchange plus  
bilateral trading

### Intra-day trading

Trading electrical  
energy for today

Exchange plus  
bilateral trading

### Balancing energy

Operated  
by the TSOs

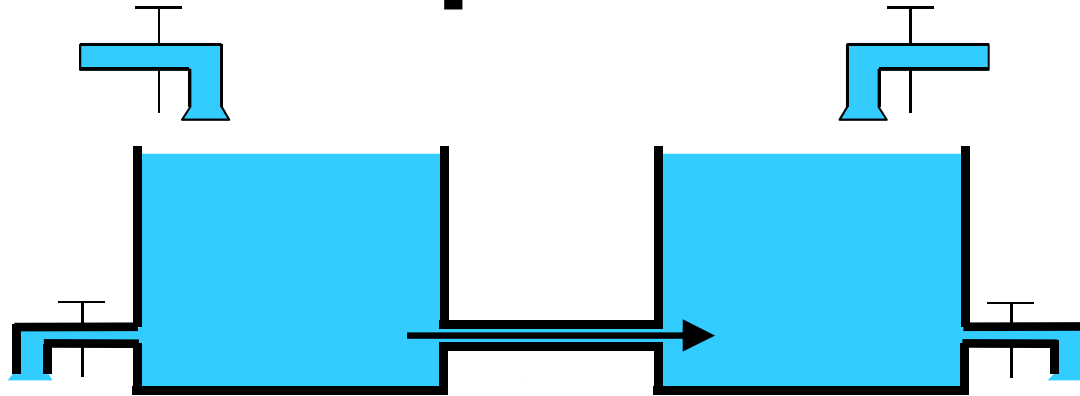
**Currently  
mainly  
national  
markets**

**First made common**

# **Appendix 1**

## **concepts and units**

# Concepts and units



Concept

Explanation

Unit

Water analogy

**Power**

**Flow: How much energy per second?**

**W  
(Watt)**

**Flow: How much water is being fed in, taken out or is flowing by per second?**

**Energy**

**The amount (for example, during an hour)**

**Wh  
(Watt-hour)**

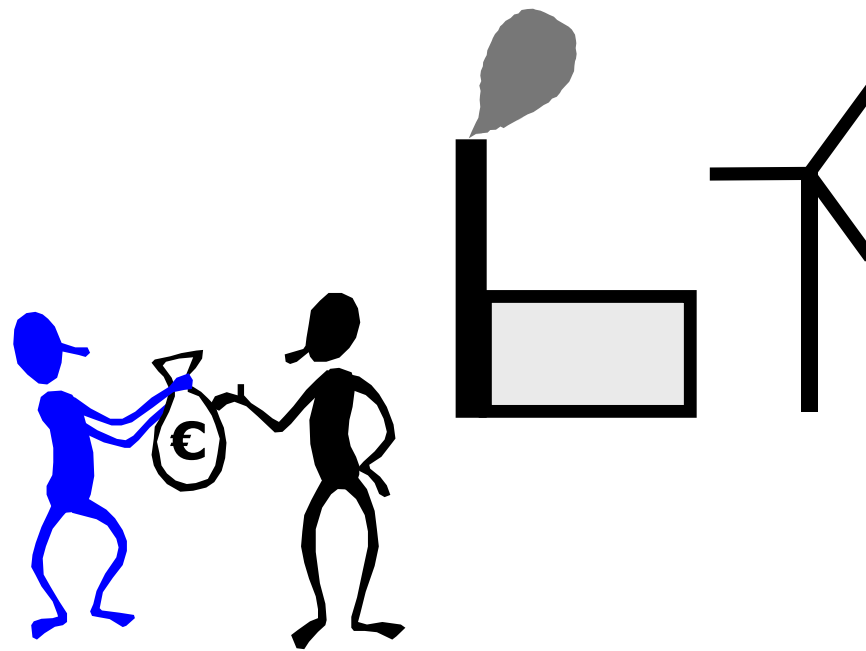
**During an hour: how much water was fed in, taken out or flowing by?**

**Capacity**

**The ability to change a flow**

**W  
(Watt)**

**The ability to change a flow**



# Appendix 2

## The TSOs' markets for balancing energy and balancing capacity

### The Nordic area and Western Denmark as cases

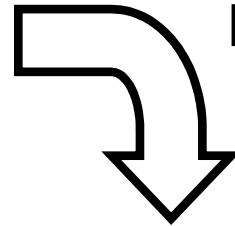
# The Nordic TSOs' market for balancing energy

Example for an hour where the production is too big

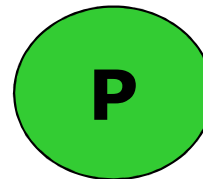
Result for TSO: a  
production decrease  
of 200 MWh



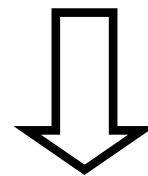
Sell 200 MWh to producer.  
Producer's purchase bid  
price: 40 EUR/MWh



Producer: buy at  
40 EUR/MWh and sell  
at 44 EUR/MWh

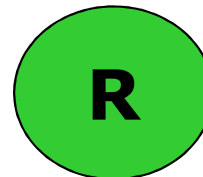


Producer's initial plan:  
produce 200 MWh  
Producer's marginal  
costs are 41 EUR/MWh



The producer has sold 200  
MWh to the retailer. Price:  
44 EUR/MWh

Retailer





# Offers and bids at the Nordic TSOs' market for balancing energy – 1

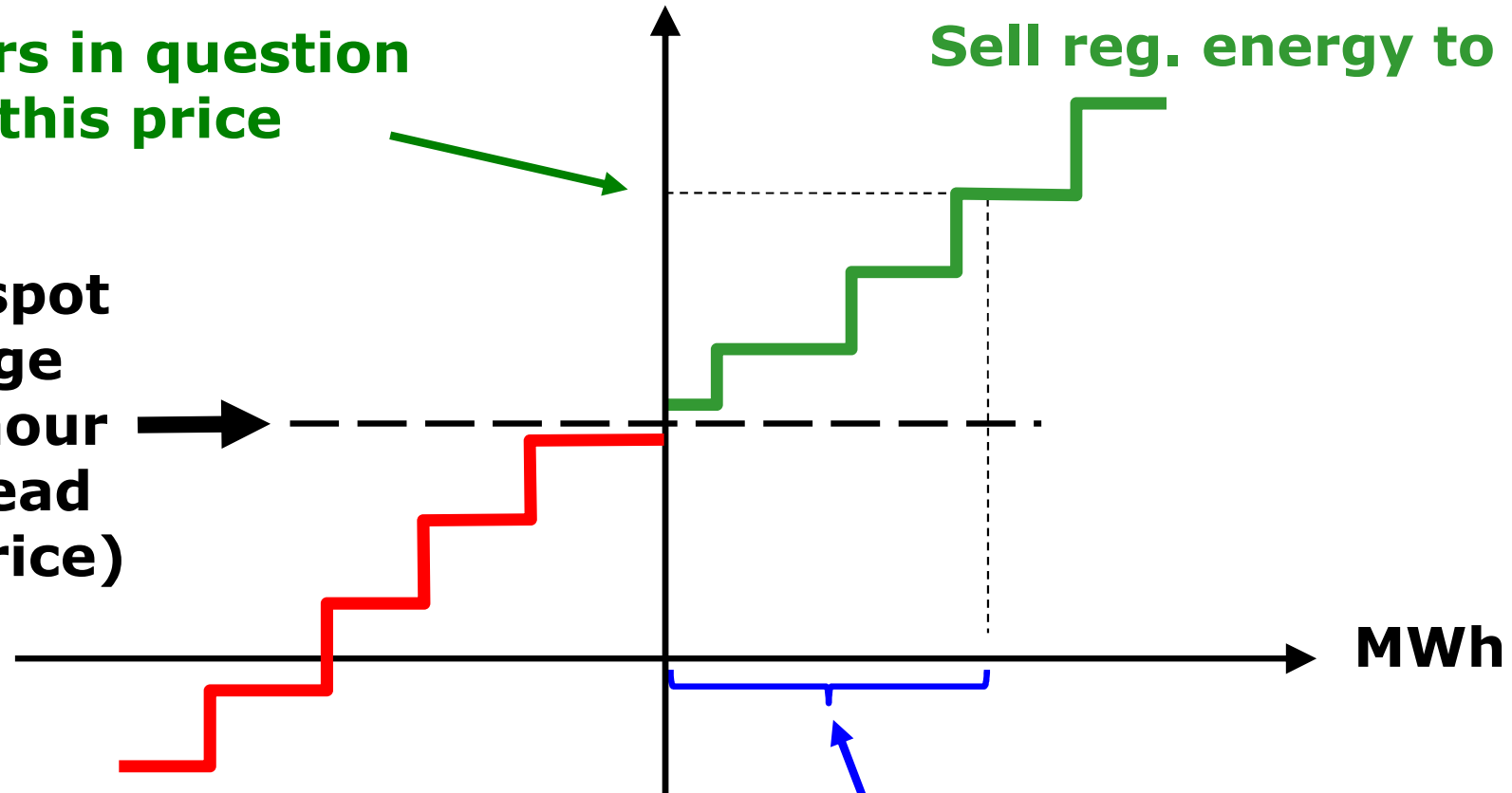
Example for one Hour of Operation

EUR/MWh

Sell reg. energy to TSOs

All sellers in question get this price

Price at spot exchange for this hour (day-ahead market price)



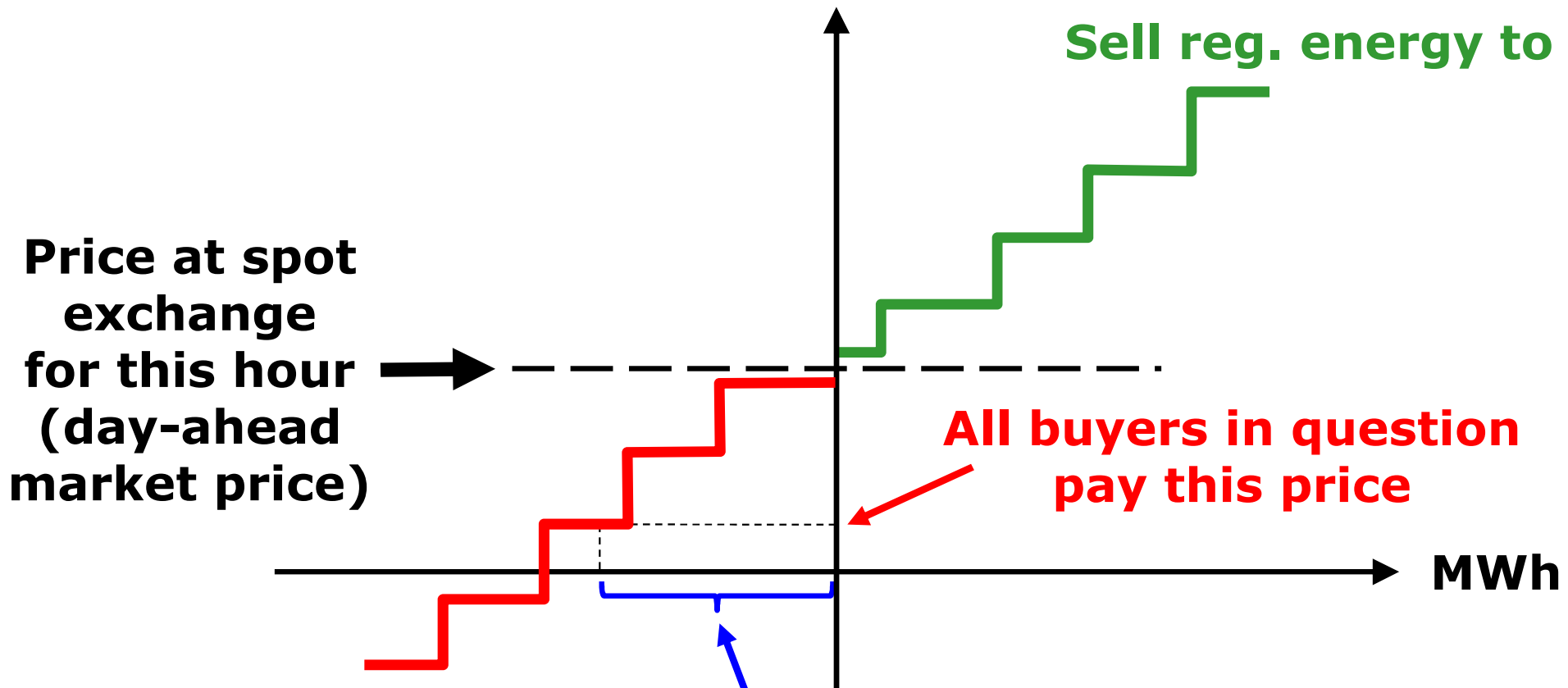
Buy reg. energy from TSOs

Example 1: during this hour, the TSOs had to buy this amount of balancing energy

# Offers and bids at the Nordic TSOs' market for balancing energy – 2

Example for one Hour of Operation

EUR/MWh



Example 2: during this hour, the TSOs had to sell this amount of balancing energy

# Balancing energy – 1

- ▶ **The players at the Nordic TSOs' market for balancing energy are paid the marginal price**
  - ***The last player's price sets the price for everyone.***

## Balancing energy – 2

**Assume you are a player with both wind turbines and gas fired power plants in your portfolio.**

**For the next Hour of Operation: assume your gas fired power plants have spare capacity.**

**Probably, your forecast for the wind turbine production will fail somewhat.**

**Should you keep the spare capacity as your own reserve?**

**This will enable you to adjust the production at the gas fired power plants. Thus fluctuations in your wind turbine production can be levelled out.**

**Thereby your total production will be according to plan.**

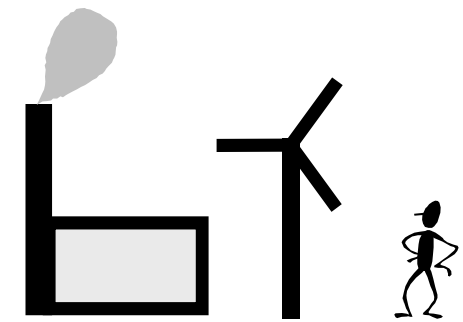
**Hence you'll avoid settling an imbalance with the TSO.**

**Alternatively, you can use the spare capacity to send balancing energy bids to the TSO.**

**Due to the marginal pricing of balancing energy: the most profitable option is to use all your spare capacity to submit bids to the TSO's market for balancing energy.**

**Thereby, the marginal pricing automatically draws in the maximum volume of bids to the TSOs' market for balancing energy.**

**This is expedient for the security of supply.**



# The Nordic market for balancing energy

At the latest 45 minutes before the start of the Hour of Operation, players can send the local TSO the prices, at which they are willing to buy and sell balancing energy.

Due to the separation of the TSOs' markets for balancing energy and balancing capacity, the TSOs ensure maximum participation at the market for balancing energy:

Players who could not offer capacity at the TSOs' day-ahead markets for capacity, can offer to trade balancing energy



For example: the owner of a wind farm, who knows the wind turbines will produce during the next Hour of Operation, can offer down regulating

The owner will buy back energy at negative prices.

Thereby, for the security of supply, by separating the TSOs' markets for energy and capacity – and by having a late deadline for submitting bids to the TSOs' energy market – **the wind turbines become part of the solution** (instead of being part of the problem)

With increasing amounts of intermittent energy sources, **the TSOs' markets for energy and capacity must be designed, so the green producers become part of the solution.**

# Western Denmark (DK1) – 1

- ▶ Consumption about 20 TWh/year.
- ▶ Min. load about 1,200 MW. Max. load about 3,700 MW.
- ▶ *Wind turbines more than 4,200 MW (!).*
- ▶ In 2017, energy produced by wind turbines constituted more than 50% of the total Danish electricity production
  - This is the world's highest wind penetration.
  - In Western Denmark it was 57%.
- ▶ Still, with the world's highest wind penetration, the DK1 security of supply was maintained solely by means of short-term capacity markets before the establishment of an electrical connection between Western and Eastern Denmark.

# Western Denmark (DK1) – 2

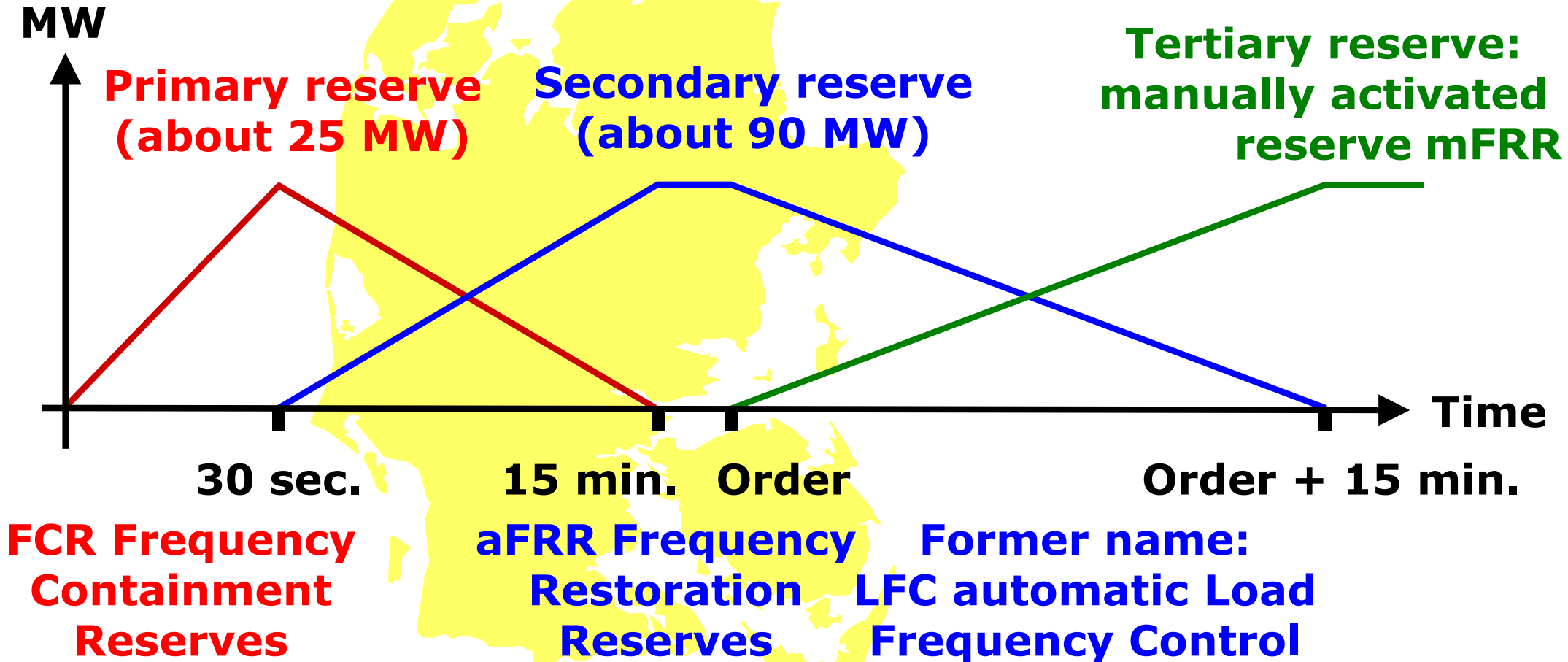
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- ▶ **DK1 became a case of how the TSO's purchase of capacity on a medium-term contract can play havoc with a short-term capacity market**
    - **This happened after the establishment of an electrical connection between Western and Eastern Denmark.**
  - ▶ **The DK1 experience with short-term capacity markets illustrate two points:**
    - **The short-term market's price signal can attract lots of new capacity.**
    - **TSO purchase of capacity on a medium-term contract can ruin a well-established short-term capacity market.**

# Reserves bought by the TSO Western Denmark as a case

**Day-ahead purchase**

**Month-ahead purchase**

**Day-ahead purchase (in principle)**



**Tertiary reserve: manually activated reserve mFRR**

**FCR Frequency Containment Reserves**

**aFRR Frequency Restoration Reserves**

**Former name: LFC automatic Load Frequency Control**



# Western Denmark – 3

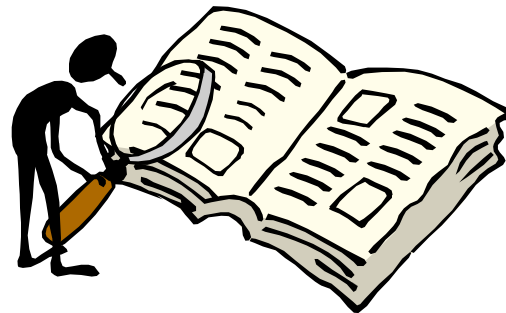
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- ▶ **The primary reserve is bought day-ahead. The capacity is autonomous**
    - **“Self activating” when needed.**
  - ▶ **The supplier of the service must be able to maintain the regulation up to 15 minutes.**
  - ▶ **The secondary reserves are bought month-ahead. The capacity is activated automatically via an electronic signal from the TSO’s control room.**

# Western Denmark – 4

- ▶ The tertiary reserves were previously solely bought day-ahead
  - Now, 300 MW have been bought via a medium-term contract.
  - The day-ahead purchase is currently about 200 MW.
- ▶ The tertiary reserves are activated manually.
- ▶ Note: even if a player has not sold balancing capacity day-ahead, the player can send bids and offers to the TSO's market for balancing energy
  - The player's capacity will be activated manually, if the TSO wants to trade with the player.
  - Hence, a player's capacity becomes part of the tertiary reserves, if the player sends bids to the TSO's market for balancing energy shortly before the start of the next Hour of Operation
    - At the latest 45 minutes before the start of the Hour of Operation.
    - Due to the late enrolment, the player is not paid for putting the capacity at the TSOs' disposal. There's only settlement for energy (if the player's capacity is activated).
- ▶ For balancing energy from the manually activated units, there is a common Nordic market.
- ▶ All the information on the slides no. 16 – 21 refers to balancing energy delivered from manually activated units.

# Appendix 3

## Terminology and acronyms



# Terminology and acronyms – 1

## As used in this presentation

- ▶ ***Balancing capacity*** Capacity the TSOs buy in order to ensure the security of supply.

The TSOs' purchase of capacity ensures, the TSOs will always have balancing energy available.

By changing the energy production/consumption of the capacity bought by the TSOs, the TSOs can ensure a balance between total production and total consumption.

- ▶ ***Balancing energy*** Energy which the TSOs buy or sell in order to maintain the security of supply (ie, maintain a balance between the total consumption and the total production). The TSOs' counterparties are commercial market players.

- ▶ ***Balance responsible player*** A player who is responsible for settling imbalances with the TSO.

For a retailer, an imbalance occurs if the customers' hourly consumption does not fit the retailer's hourly purchase.

For a producer, an imbalance occurs if the producer's production does not fit the producer's sale.

A balance responsible player may also be portfolio manager, who settles imbalances on behalf of other market players.

# Terminology and acronyms – 2

## As used in this presentation

- ▶ ***Bidding zone*** A geographical area, within which the players can trade electrical energy day-ahead without considering grid bottlenecks.
- ▶ ***Day of Operation*** The day where the electrical energy is produced and consumed.
- ▶ ***DK1*** Western Denmark.
- ▶ ***Down regulating*** A player buying electrical energy from the TSO. It's either a producer reducing the production or a consumer increasing the consumption.
- ▶ ***EU*** European Union.

# Terminology and acronyms – 3

## As used in this presentation

- ▶ ***Hour of Operation*** The hour where the electrical energy is produced and consumed.
- ▶ ***Long-term purchase of capacity*** Purchase where the capacity bought by the TSO must be put at the TSO's disposal for more than five years.

**It's implied the capacity is bought shortly before entering the period where the TSO has disposal of the capacity.**

- ▶ ***Medium-term purchase of capacity*** Purchase where the capacity bought by the TSO must be put at the TSO's disposal for more than one month and up to five years.

**It's implied the capacity is bought shortly before entering the period where the TSO has disposal of the capacity.**

- ▶ ***Nordic and Nordic area*** refer to the countries Denmark, Finland, Norway and Sweden.

# Terminology and acronyms – 4

## As used in this presentation

- ▶ ***Short-term purchase of capacity*** Purchase where the capacity bought by the TSO must be put at the TSO's disposal for maximum one month.

It's implied the capacity is bought shortly before entering the period where the TSO has disposal of the capacity.

In practice, this is capacity bought day-ahead, week-ahead or month-ahead.

- ▶ ***UPS*** Uninterruptible Power Supply. An electrical apparatus that provides emergency power when the main power fails.

For example, a hospital normally have an UPS.

- ▶ ***TSO*** Transmission System Operator. An organisation owning and operating the transmission grid in a given area, and responsible for this area's security of supply.

- ▶ ***Up regulating*** A player selling electrical energy to the TSO.

It's either a producer increasing the production or a consumer reducing the consumption.

# **Thank you for your attention!**

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