Regional Electricity Market Building

Integration of electricity markets

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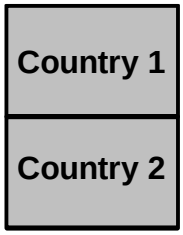
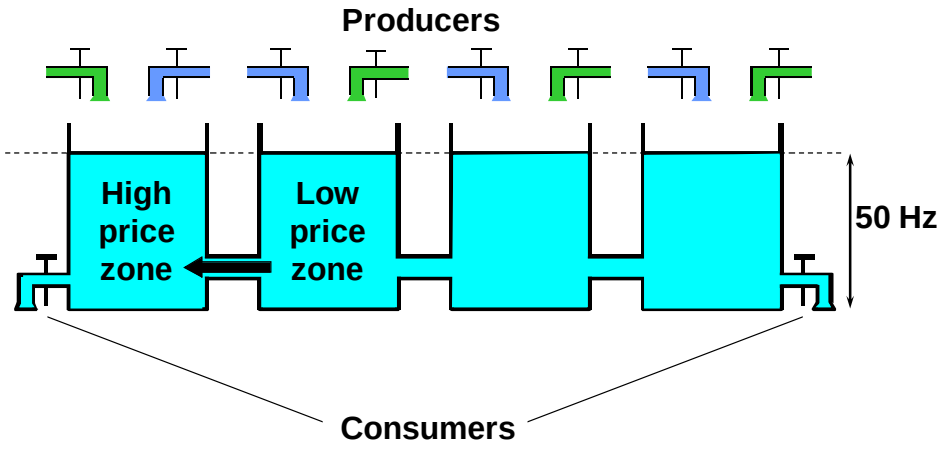
Integration of electricity markets – 1

A simple case with only 2 countries

- For obvious reasons: the interconnectors linking the two countries' electricity grids are the infrastructure, which must provide the integration of the countries' electricity markets.
- After the interconnectors have been built, the issue is this:
  - How to manage the cross-border energy flows between the two countries.
  - This is also called congestion management, as the interconnectors are often congested.
- This presentation will focus on the management of cross-border energy flows.



How to couple electricity markets together



Good congestion management systems will ensure energy flow towards the high price zone!

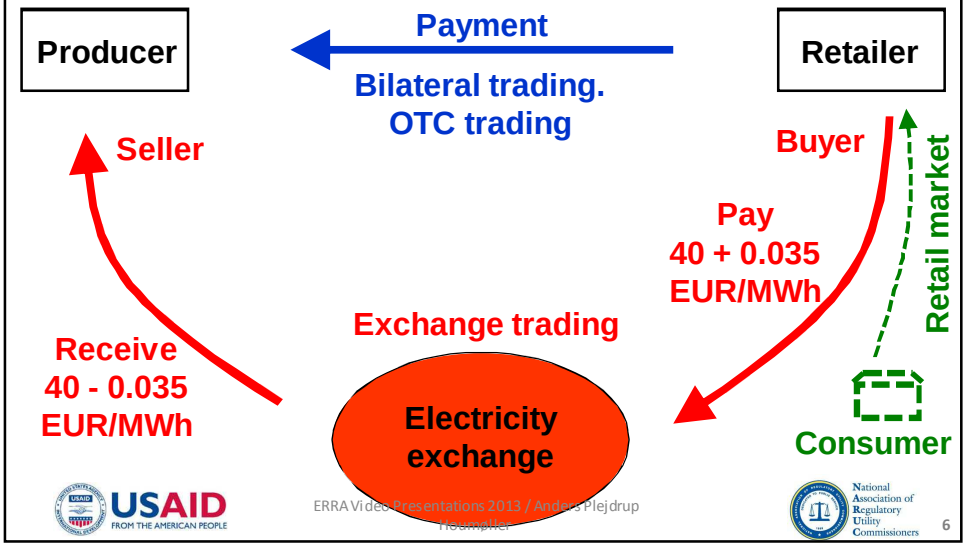
Two introductory remarks

First remark: Transmission System Operator (TSO)

- For simplicity: in this presentation, we'll assume each of the participating countries has a Transmission System Operator (TSO).
- For each country, the local TSO has two tasks:
  - The TSO owns and operates the country's transmission grid
    - As part of this task, the TSO operates the country's grid connections to neighbouring countries.
  - The TSO is responsible for the country's security of supply
    - Hence, the TSO is responsible for there always being electricity in the consumers' plugs.
- *A case: in the European Union, each Member State must have a TSO.*

Second remark: If you have an exchange – two ways of trading electrical energy at the whole-sale market

Example for one hour: assume the exchange price is 40 EUR/MWh.
In the example, the exchange's trading fee is 0.035 EUR/MWh



Integration of electricity markets – 2

First step: in each of the two countries, there is an incumbent. The two incumbents trade with each other (bilateral, cross-border trade).

Country 1 TSO_1

Country 2 TSO_2

Second step – more competition in both countries: more market players in both countries.

Now there are many market players, who want cross-border capacity. How to grant the capacity?

The two TSOs run an explicit auction system, where the market players can buy cross-border grid capacity. After having bought cross-border capacity, the market players can trade across the border.

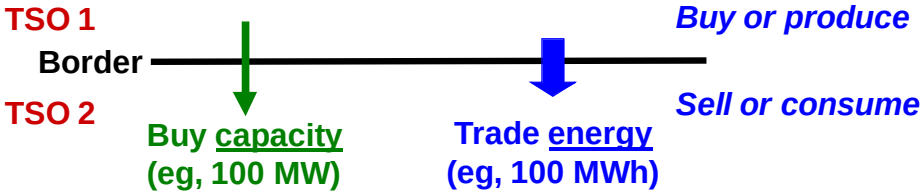
Third step: an electricity exchange in both countries. You establish market coupling or market splitting. This means the exchanges' prices govern the cross-border energy flow.

Explicit auctions

The TSOs can run a co-ordinated explicit auction system

- First: at the explicit auction, the market player buys <u>capacity</u> in the direction, which he believes is the right direction.
- Second: after having bought capacity in a given direction at the border, the market player can trade <u>energy</u> in this direction.

Market player: "*I believe direction south is the right one*"

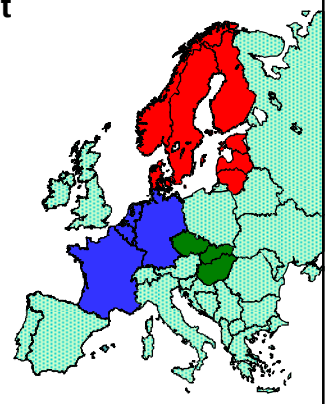


Cross-border electricity trading

- With explicit auctions, the commercial players' cross-border trading determines the cross-border energy flows.
- As an alternative, if the participating countries all have electricity exchanges:
  - The cross-border energy flows can be governed by the prices of the electricity exchanges
    - Ensuring the flows are always towards the high-price areas.
- However, before discussing market coupling/splitting, we'll have a look at how electricity exchanges work
  - We'll discuss those electricity exchanges, which are called *spot exchanges*.

Spot exchanges

- This presentation will describe the spot exchanges, as they work in the Czech Republic, Hungary, Slovakia, CWE and the Baltic-Nordic area
  - CWE (Central Western Europe): Belgium, France, Germany, Luxembourg and the Netherlands.
  - Baltic-Nordic area: Denmark, Estonia, Finland, Latvia, Lithuania, Norway and Sweden.



Trading electrical energy with an exchange

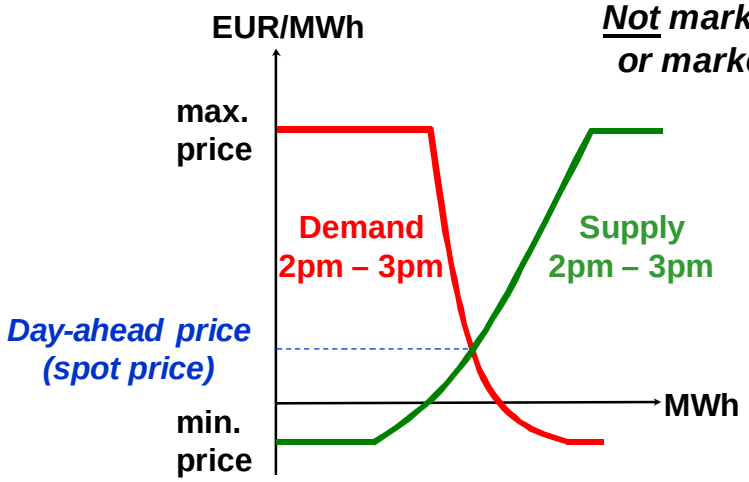
How does an electricity exchange work?

In this presentation, we'll discuss the so-called *spot exchanges*

A spot exchange – 1

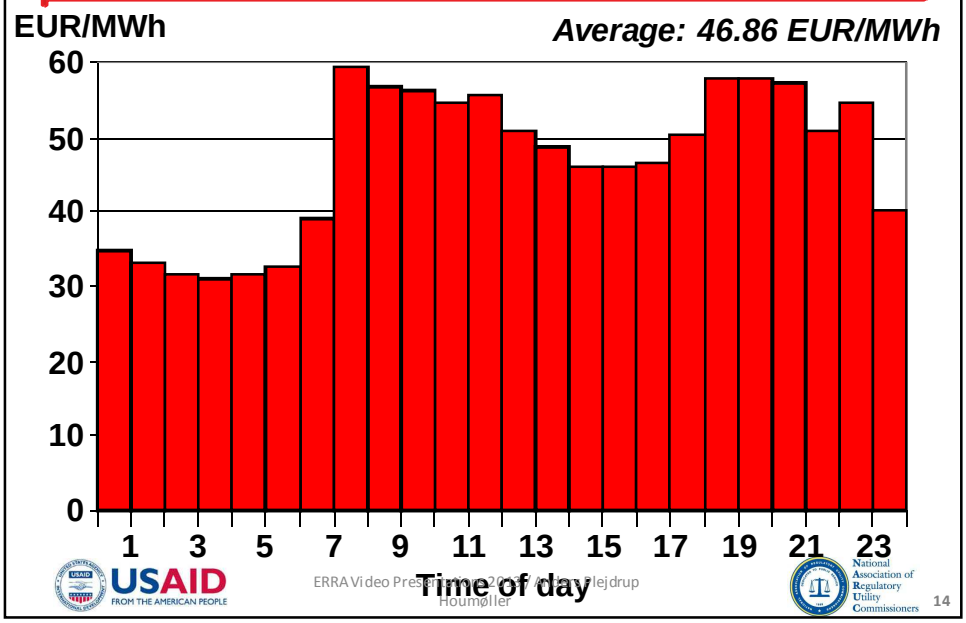
- A ***spot exchange*** **is an exchange, where electrical energy is traded day-ahead (ie, you trade electrical energy for tomorrow).**
- **Bids and offers must be sent to the spot exchange at the latest 12 o'clock the day before the day of operation**
  - **Gate closure time is 12 o'clock.**
  - **The bids and offers are sent via the internet.**
- **At 12 o'clock the computation starts: by matching the bids and the offers for every hour of the following day, a spot price for each hour the following day is calculated.**
- **Normally, the prices for the following day are published around 1 p.m. (i.e., it's day-ahead prices).**
- **Note: in USA, the term *spot market* does not mean the exchange day-ahead market.**

Calculation of the spot exchange's day-ahead price (the so-called *spot price*)



Everybody trading at the exchange will trade at this price!

Germany: spot prices for Wednesday 17 July 2013



The consumers' electricity price

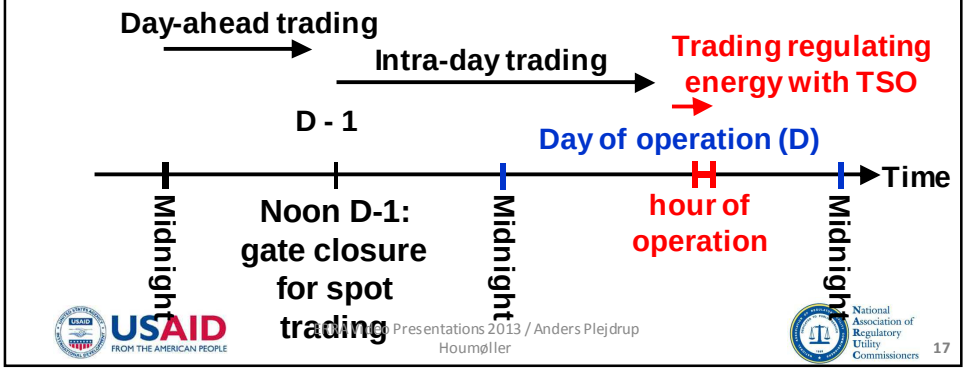
- As for the prices at the previous slide:
- Note that these are the prices paid to the producers!
  - In other words: it's the whole-sale prices (commodity only price).
- In addition to the whole-sale price, the typical consumer must pay:
  - Retailer's margin.
  - Grid fees (fees to both the distribution grid and the transmission grid).
  - Taxes.

A spot exchange – summary

- A *spot exchange* is an exchange, where you trade electrical energy for tomorrow.
- The exchange's prices are calculated by using the exchange's demand and supply curves
  - The exchange's prices are called *spot prices*.
- It's a whole-sale market. The players are producers, retailers (and big consumers).

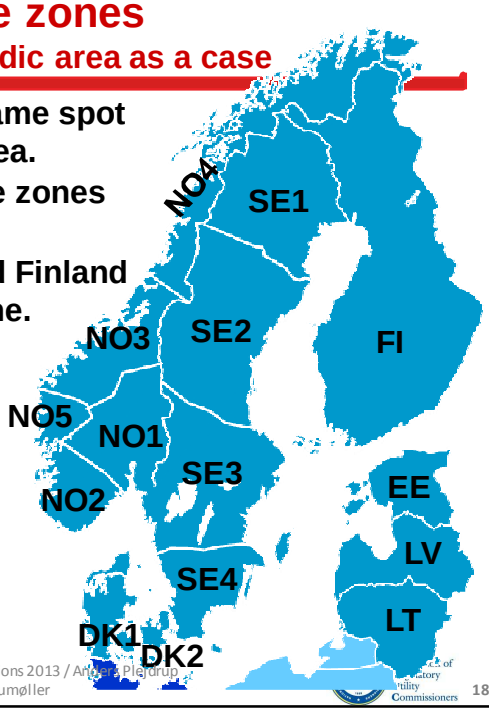
Time line for trading electrical energy

Day of operation:
The day where the electrical energy is produced and consumed.
Hour of operation:
The hour where the electrical energy is produced and consumed.
Long-term contracts (physical and financial):
week-ahead, month-ahead, year-ahead, multi year-ahead.



Price zones
The Baltic-Nordic area as a case

Normally, there are not the same spot prices in the Baltic-Nordic area.
Normally, there are high-price zones and low-price zones.
Lithuania, Latvia, Estonia and Finland each constitute one price zone.
Denmark is divided into two price zones.
Sweden is divided into four price zones.
Norway can be split into a number of price zones
- **Currently, Norway is split into five price zones.**



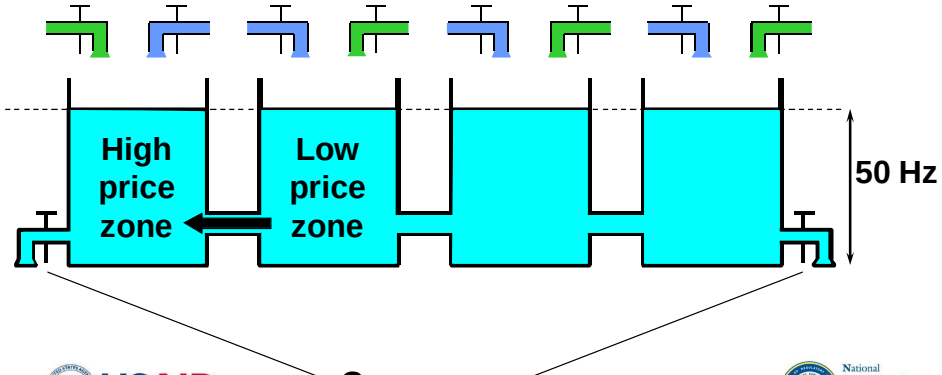
Price zone – definition

- A price zone is a geographical area, within which the market players can trade electrical energy day-ahead without considering grid bottlenecks.
- As a consequence: for a given hour of operation and a given price zone, a spot exchange will calculate <u>one</u> spot price for the whole zone
  - Hence the name *price zone*.

Price zones – illustration

At this picture, you have 4 price zones

Note: <u>inside</u> each zone, the commercial players can trade freely with each other without considering grid bottlenecks



Day-ahead congestion management. Market coupling and market splitting

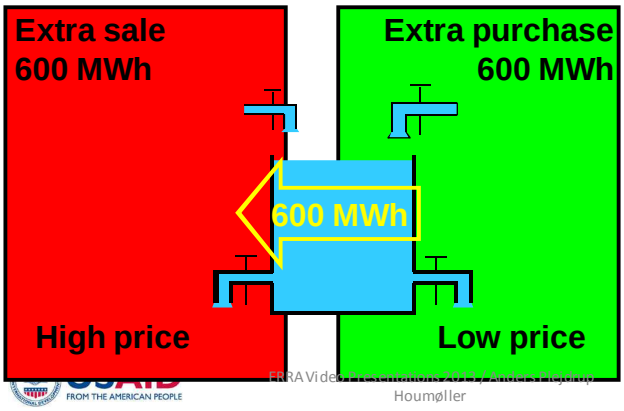
- We will now discuss day-ahead congestion management
  - How to produce the plans for tomorrow's cross-border energy flows.
- Note: the day-ahead plans may be modified by
  - The commercial players doing intra-day cross-border trading.
  - The TSOs trading regulating energy shortly before or during the hour of operation.

Terminology: Market splitting and market coupling

- Market splitting: When one spot exchange creates the day-ahead plans for the cross-border energy flows in its own area
  - Example: the Baltic-Nordic area where its done by Nord Pool Spot.
- Market coupling: When two spot exchanges create the day-ahead plans for the cross-border energy flow at a border where two exchanges meet
  - Example: the coupling between Central Western Europe and the Baltic-Nordic area (EMCC coupling).
- Implicit auction is the common term for market splitting and market coupling.

Market Splitting: the concept

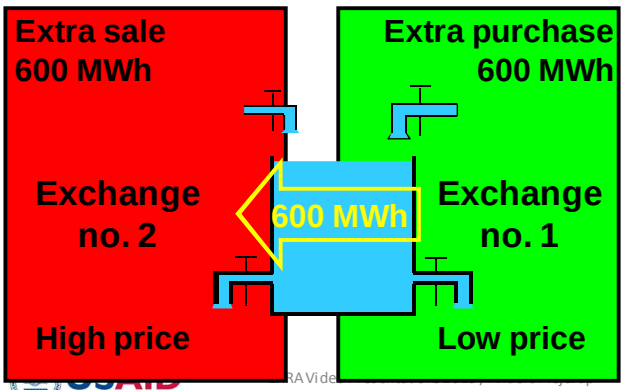
- The spot exchange has a purchase surplus in the low-price zone and a sale surplus in the high-price zone.
- This deliberate imbalance in the exchange's trading ensures an energy flow from the low-price zone to the high-price zone.



Example for one hour of operation: a capacity of 600 MW betw. two zones with different prices.

Market Coupling: the concept

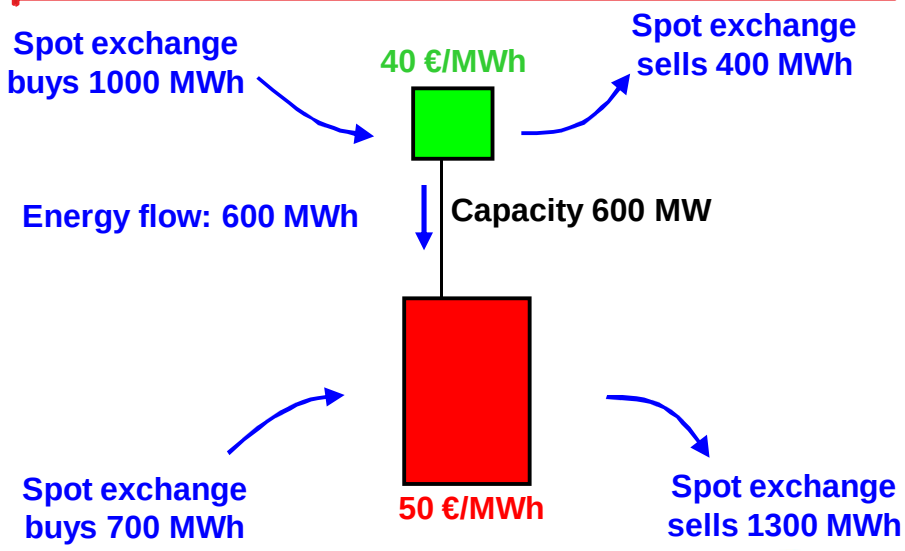
- The market coupler buys in the low-price zone and sells in the high-price zone.
- This cross-border trading done by the market coupler ensures an energy flow from the low-price zone to the high-price zone.



Example for one hour of operation: a capacity of 600 MW betw. two zones with different prices.

Implicit auction

Market coupling/splitting. Example for one hour of operation



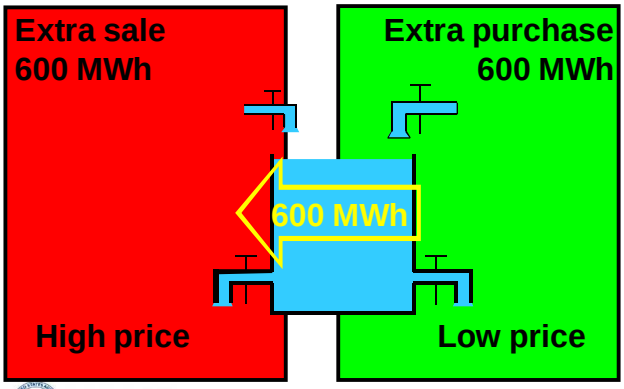
Simplified terminology

- During the rest of this presentation, *market coupling* will be used as a short-term for *market coupling/splitting*.

Where can you use market coupling?

As day-ahead congestion management system

- Necessary condition: on both sides of the border, the spot exchange(s) must have good liquidity.
- Without good liquidity, the prices at the exchange(s) may not truly reflect the value of electrical energy.



Example for one hour of operation: a capacity of 600 MW betw. two zones with different prices.

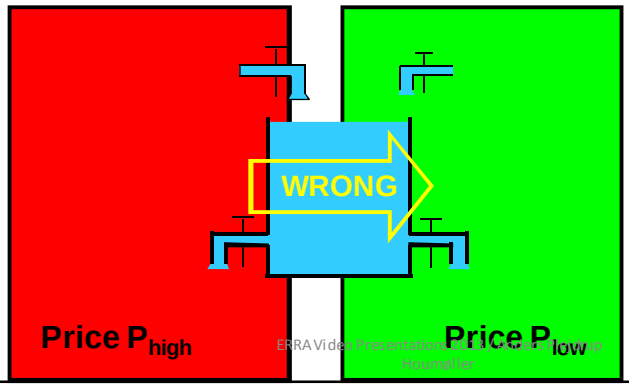
What are the advantages?

When you use market coupling

- This system is neutral and fair for all players in the market.
- When the market coupling is operated the right way:
  - All trading capacity on every bottleneck will be utilised during every hour of operation with economic optimal energy flows.
  - The grid is a resource for society. If the grid is underutilised, society will have a loss.
- A disadvantage: when you introduce market coupling, the spot exchanges become monopolies
  - For each price zone, you can only have one spot exchange
    - Because: for each price zone there must be one, unique price per hour.

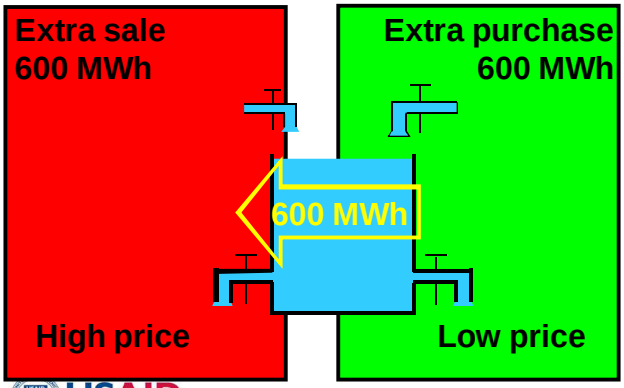
When the energy is flowing in the wrong direction

- With wrong flow: inefficient, expensive producers in the high-price zone are up and running
  - Supplying to both their own country and the neighbouring country.
- At the same time, efficient producers in the low-price country are not producing (standing idle)
  - This is bad for both countries.



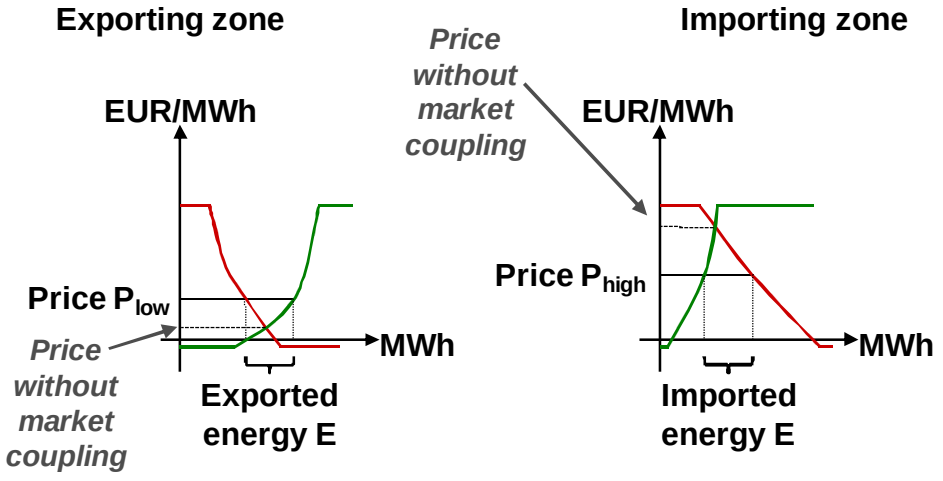
Congestion revenue/rent

- In the low-price zone, 600 MWh is bought at the price P_{low}. In the high-price-zone, the 600 MWh is sold at the price P_{high}.
- The arbitrage revenue (the so-called congestion revenue) is ($P_{high} - P_{low}$) * 600 MWh.
- The arbitrage revenue is given to the capacity owners (normally TSOs).

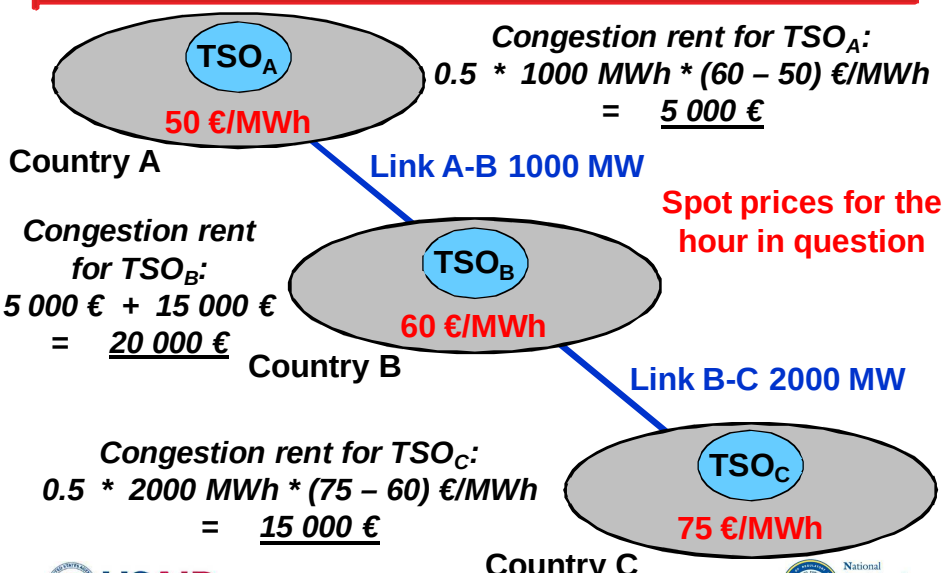


Example for one hour of operation: a capacity of 600 MW betw. two zones with different prices.

Spot price calculation when you have market coupling. For one hour. Only two price zones



Multiple-country market coupling
An example for one hour



Why market coupling? – 1

Question: for the electricity grid – why have market coupling as day-ahead congestion management?

Actually, this is a step backwards to planned economy, as the day-ahead cross-border trading is placed in the hands of monopolies.

At the outset, allowing the players to do all the cross-border trading themselves is the solution conforming to market economy.

Answer: one of the necessary preconditions for a well functioning market is this

Both buyers and sellers must have full overview of the market

For the electricity supply business – where the grid is a monopoly transport system – it turns out, this precondition cannot be met for cross-border trading.

Practical experience shows the electrical energy flows in the wrong direction very often, if the day-ahead congestion management is bilateral cross-border trading.

Why market coupling? – 2

- **The border Germany-Western Denmark as an example:**
  - **Previously, all the capacity was sold at annual, monthly and daily explicit auctions by the Danish TSO and the German TSO.**
  - ***During about 25% of the hours the energy flowed in the wrong direction (towards the low price zone) !***
- **For this border, the Danish TSO Energinet.dk made an estimate of Germany's and Denmark's socio-economic losses, when the trading capacity was not used as it should**
  - **ie, either the energy flowed in the right direction, but there was unused capacity; or the energy flowed in the wrong direction.**
- **Here you have the numbers. Please note – this is for one link only:**
  - **2004 EUR 16.6 mill.**
  - **2005 EUR 30.3 mill.**
  - **Five first months of 2006: EUR 10.1 mill.**

Thank you for your attention!

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