Energy Trading

ULG – March 2018
ENERGY TRADING

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March 23rd 2018
AGENDA

• Introduction of EDF Luminus
• European Energy Market
• Price Drivers
• Portfolio Management
• Remit
• Specific cases
EDF Luminus

Shareholders

- 31.4%
- EDF Belgium
- Other Shareholders

68.6%

Vision

"to become the first energy partner, bringing progress and comfort to all our customers through our 5 star service, our innovative and sustainable solutions, the global expertise of EDF (...)."
Energy production

- **67 MW** hydro power installed
- **>17%** of our production capacity from renewable Belgian energy sources
- **587 mio MW** wind energy

- **>600 mio €** In the next years, Luminus will invest over €600 million in renewable energy in Belgium

**FOSSIL OR NUCLEAR ENERGY**
- Thermal power stations
- Cogeneration
- 10% participation in Tihange 2 & 3 and Doel 3 & 4

**RENEWABLE ENERGY**
- Wind farm
- Hydroelectric power station
AGENDA

Introduction of EDF Luminus

European Energy Market

Price Drivers

Portfolio Management

Remit

Specific cases
Power markets: where to trade?

Current state of implementation:
- MRC
- 4MMC
- Independent

* SEEPEX – Only EUPHEMIA to be used
Gas markets: where to trade?
Capacity mix Europe

Installed capacity - Main European countries

Installed Capacity

Germany
France
UK
The Netherlands
Belgium

- Nuclear - Lignite - Hard Coal - Gas - Oil - Hydro
- Wind - Solar - Biomass - Other Ren - Pump/Storage - Others
European power markets – installed capacity (2018)


- Germany
- France
- UK
- The Netherlands
- Belgium

Source: https://transparency.entsoe.eu
FIGURE 1: THE EUROPEAN POWER MIX BY INSTALLED CAPACITY 2000-2014

FIGURE 7: GLOBAL ASSET FINANCE ON NEW INVESTMENTS BY SECTOR

The role of interconnections

German effects
- Gas and Coal pulling Germany to the cheap (exporter side)
- Wind and sun: growing effect, up to negative prices
- Stop of German Nukes

French effects
- Temperature sensitive (on power) in southern area
- Spiky merit order with cheap base

Benelux
- New CCGT’s and Coal PP in The Netherlands

UK
- UK price as $f(gas,coal)$

Decoupling of Prices
- Only when capacities are saturated
Market description – Type of gas

Gas network is divided in 2 types of gas networks

- H-Cal: high calorific value (MWh/m³ delivered) – the orange network
- L-Cal: low calorific value (MWh/m³ delivered) – the blue network

- H-Cal sourcing is coming from all around the world (LNG, North sea, baltic countries and Russia)

- L-Cal sourcing is only coming from the Groningen gas field in the Netherlands

Production of Groningen gas field will decrease due to earthquakes risks

Energy Trading – Frederik Demaret
AGENDA

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Specific cases
Power Price Drivers

Fuel markets:
- CO₂ prices
- Gas prices
- Crude prices
- Coal prices

Supply:
- Revisions
- Technical outages
- Cross border exchange balance
- School holidays
- Bank holidays
- Time of day

Demand:
- Power generation from renewables
- Plant availability

Power price influences:
- Power demand

Weather impacts:
- Precipitation/Snow melt
- Reservoir/Run-off river hydro plants
- Wind
- Wind generators
- Solar radiation
- PV & Solar thermal
- Cloud cover
- Lighting
- Temperature
- Climatisation, electric heating

Long-term influences:
- Regulatory decisions
- Capacity changes (plant/grid new builds & shutdowns)
- Macroeconomic developments/economic activity
Drivers of natural gas prices

Fuel markets
- CO₂ prices
- Coal prices
- Oil prices

Supply
- Climate, weather (temperature)
- Economic activity (industrial production)
  - Households, commercial buildings
  - Industry
  - Power generation
  - Holidays
  - Working days per week

Natural gas hub market price

Demand
- Domestic production (flow)
- Long-term contracts (flow, price)

Long-term influences
- Regulatory decisions, market design
- Production and reserves (e.g. unconventional gas)
- Capacities (transmission, interconnectors, storage)
- Macroeconomic developments
- Political framework

Source: RWE
AGENDA

Introduction of EDF Luminus
European Energy Market
Price Drivers

Portfolio Management
  Portfolio Concept & Definitions
  Hedging
  Short Term Market
  Imbalance Market

Remit
Specific cases
TRADING TERMINOLOGY

PHYSICAL/FINANCIAL POSITION

Customer

Trader

Physical

Financial

Physical

Financial

Net position: Physical + financial

<table>
<thead>
<tr>
<th>Market</th>
<th>Long</th>
<th>Short</th>
</tr>
</thead>
<tbody>
<tr>
<td>UP</td>
<td>👍</td>
<td>👎</td>
</tr>
<tr>
<td>DOWN</td>
<td>👎</td>
<td>👍</td>
</tr>
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</table>
Optimisation versus Trading

Asset Optimiser
Manages a portfolio of assets (power plants, contracts, retail portfolio,…) 
Objective is to control physical and financial risks and maximising margins  
= hedging

Trader
• Creates a position 
• Objective is to make money from this position when market conditions change  
= speculation

Both actors sell and buy in the wholesale markets to achieve their objectives, thus creating a liquid market
Hedging =
• Hedging aims at reducing the riskiness of a portfolio; match an existing exposure with an opposite exposure

Speculation =
• taking risky positions in a market with the intention of exploiting market price movements
MARK TO MARKET

Mark to market

- Value of the position according to the current market prices.
- MtM of the portfolio assumes that the portfolio could be liquidated instantly, to realise the value, without moving the market.
- Process of reconciling asset values or obligations with a set of market prices

Example of MTM:
buy 5 MW for March 2016 & April 2016 @ 41,9 EUR/MWh

<table>
<thead>
<tr>
<th>Date</th>
<th>Volume (MWh)</th>
<th>Market value (EUR)</th>
<th>Contract value (EUR)</th>
<th>MTM (EUR)</th>
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<td>186.664</td>
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<td>40.89</td>
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MARKET PLACES

Execution venues

OTC market

Global vision Screen managed by brokers (GFI, Spectron, Icap, etc.).
Intermediaries between market counterparties

Clearing house
(Organized market place)

ICE Endex, EPEX, Belpex, etc.
(Own platform or via broker)

Secondary market
(OTC alternative)

In direct line with market counterparties
OTC markets and power exchanges

- Continuous Market
- Bilateral contact between counterparties
- Deal not public for the Market
- Credit Line and Authorization to trade different from counterparty

- Ex: EBL, EDF Trading, EON, RWE, Danske Commodities...

Power Exchange

- Auction or continuous market
- Anonymity of the traders
- Deal public for the Market
- Credit line with the platform

- Ex: Belpex (Belgium), EPEXSpot (France & Germany), APX (The Netherlands)
OTC MARKET GV8
SPOT & FORWARD POWER MARKET

- EDFL active on **Belgian and French markets** (Baseload and Peak products)
- **Spot** market ➔ Day ahead (DA) and intraday (ID)
- **Forward** market ➔ Beyond DA & ID
- **Bid** ➔ Buyers side (price at which you are prepared to buy)
- **Ask (or offer)** ➔ Sellers side (price at which you are prepared to sell)
- Both markets ➔ traded in €/MW

### Belgium Baseload vs. France Baseload

<table>
<thead>
<tr>
<th></th>
<th>Belgium Baseload</th>
<th>France Baseload</th>
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<tbody>
<tr>
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<td>Bid</td>
</tr>
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<td>25</td>
<td>37.50</td>
</tr>
<tr>
<td>Thu 21/05/15</td>
<td>25</td>
<td>37.50</td>
</tr>
<tr>
<td>Fri 22/05/15</td>
<td>25</td>
<td>32.50</td>
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<tr>
<td>Sat 23/05/15</td>
<td>25</td>
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<td>2018</td>
<td>5</td>
<td>43.75</td>
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<tr>
<td>2019</td>
<td>5</td>
<td>40.30</td>
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OTC MARKET GV8
SPOT & FORWARD GAS MARKET

- EDFL active on Belgian, French & Dutch markets (Baseload products)
- **Spot & Forward** market ➔ same definition as POWER
- Bid & Ask (or offer) ➔ same definition as POWER
- In Belgium ➔ Traded in Pence/therms (1MWh = 34,1214 therm)
- In France and the Netherlands ➔ Traded in €/MWh
TYPE OF PRODUCTS

Commodities

- Power
- Gas
- CO2
- Oil
- Coal
- ...

Products

- Futures
  Organized exchange, standardized contract
- Forward
  OTC market & secondary market, not standardized
- Spot
  OTC market & secondary market
- Financial swap
  OTC market & secondary market
- Time and location spreads
  OTC market & secondary market
- Spark spread
  OTC market & secondary market
- Options (call put)
  OTC market & secondary market
- Capacities booking
  TSO or secondary market

Buy or sell a specific type of asset at a specific time
For a given price
physically OR financially

TSO: Transmission System Operator
Timeline of activities of an asset optimiser

From 3 years to 1 month ahead of implementation date [D]
- Forecast of the medium-term supply/demand balance
- Scheduling of power plant maintenance
- Sale/purchase operations on the forward markets

1 Month ahead of implementation date [D]
- Refine the supply/demand balance to more accurate weather forecasts and availability of power plants
- Sale/purchase operations on the forward markets

Day Ahead [D-1]
- Create operating schedule for the power plants
- Balancing supply and demand on the Day-Ahead market (DAM)
- Send nominations to TSO

Intraday & Balancing Market [D]
- Respond to latest unanticipated changes in the portfolio
- Send re-nominations to TSO
- Sale/purchase operations on the intraday and balancing markets
THE SPOT MARKET REFLECTS THE PHYSICAL BALANCE OF THE MARKET

- The Belpex Day-Ahead Market (DAM) provides hourly products to sell and purchase electricity to be delivered for each hour of the next day on the Belgian grid
- Retailers and generators can buy and sell on Belpex before handing in a balanced portfolio to the grid operator Elia
BUT SPOT PRICES CAN BE VERY VOLATILE
FORWARD MARKETS PROVIDE A HEDGE AGAINST SPOT VOLATILITY

- Forward markets allow two parties to enter into a contract for future delivery of power at a price agreed upon today
- Forward prices are today’s expectations of future spot prices (thus making it a derivative instrument)
- Traded over-the-counter (OTC) or via a futures exchange (Endex)
- Allows retailers and generators to protect themselves from the volatility of the spot markets by entering into hedging contracts
Forward and spot prices
Forward and spot prices

ICE ENDEX Belgian forward

€/MWh

31/12/2015 20/01/2016 08/02/2016 15/03/2016 05/04/2016 02/05/2016 16/05/2016 02/06/2016 01/07/2016 08/07/2016 15/07/2016 22/07/2016 29/07/2016 05/08/2016 12/08/2016 19/08/2016 26/08/2016 02/09/2016 09/09/2016 16/09/2016 23/09/2016 30/09/2016 07/10/2016 14/10/2016 21/10/2016 28/10/2016 04/11/2016 01/12/2016 08/12/2016 15/12/2016 22/12/2016 29/12/2016 05/01/2017 12/01/2017 19/01/2017 26/01/2017 02/02/2017 09/02/2017 16/02/2017 23/02/2017 01/03/2017 08/03/2017 15/03/2017 22/03/2017 29/03/2017 05/04/2017 02/05/2017 09/05/2017 16/05/2017 23/05/2017 30/05/2017 06/06/2017 13/06/2017 20/06/2017 27/06/2017 04/07/2017 11/07/2017 18/07/2017 25/07/2017 01/08/2017 08/08/2017 15/08/2017 22/08/2017 29/08/2017 05/09/2017 12/09/2017 19/09/2017 26/09/2017 03/10/2017 10/10/2017 17/10/2017 24/10/2017 01/11/2017 08/11/2017 15/11/2017 22/11/2017 29/11/2017 06/12/2017 13/12/2017 20/12/2017 27/12/2017 03/01/2018 10/01/2018 17/01/2018 24/01/2018 31/01/2018 07/02/2018 14/02/2018 21/02/2018 28/02/2018

Cal 2019  Cal 2020  Cal 2021
Forward and spot prices

CWE Market - Power Forward Y+1

ICE Endex BE  ICE Endex NL  EEX DE  EEX FR
Forward and spot prices

Gas Fwd Market Y+1

0 €/MWh
5 €/MWh
10 €/MWh
15 €/MWh
20 €/MWh
25 €/MWh
30 €/MWh

02/01/2013
28/01/2013
18/02/2013
27/02/2013
04/03/2013
20/03/2013
11/07/2013
28/11/2013
21/03/2014
04/04/2014
19/05/2014
04/09/2014
29/10/2014
23/11/2014
17/04/2015
11/06/2015
05/08/2015
29/09/2015
19/11/2015
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04/02/2016
19/03/2016
10/04/2016
04/07/2016
23/09/2016
26/10/2016
08/12/2016
22/02/2017
08/04/2017
25/05/2017
21/06/2017
15/08/2017
10/09/2017
08/10/2018

ICIS Heren NBP
ICE Endex TTF
ICIS Heren ZB
Powernext PEG
FORWARD AND SPOT PRICES (GAS)
YEAR AHEAD GAS PRICE EVOLUTION (FROM 2011 TILL TODAY)

Gas prices have been falling sharply

- Following bearish coal
- Following bearish oil (supply glut)
- Less power generation demand
- Less energy intensive industries
- Less domestic demand
- Slowing Asian growth
- Fukushima crisis over
- Global growing LNG capacities
- Since mid 2016, slow economical regain
Types of customers in a portfolio

B2C
- High value customers with standard load profiles (SLP), strong seasonal and temperature sensitivity (value strongly decreased)
- Increased churn varies from active clients or due to “group buying”
- Pricing (fix prices or market index)

B2B
- From <1GWh to manufactury or hospital or multisited supermarkets
- Varying profiles
- Higher risk on volume from year to year
- Varying customer awareness and purchasing strategies (fixed prices, click-options, autoproducers…)
- Most often locked in sales for 1 to 3 years

Industrial (large B2B)
- High volumes and low margin
- Varying profile and high risk on volume
- Add-hoc pricing

Autoproducer
- Utility can be on the buying or the selling side or both (spark spread)
- Multi-sites and industrials or specific profiles: railway companies, incinerators
- Optimizes portfolio vs wholesale market
Forward Market vs Spot Market

**Spot market** is also known as "cash market" where the commodities are sell on the current price or the spot rate and deliver immediately whereas in case of **forward market**, market dealing with commodities for future delivery at prices agreed upon today (date of making the contract).

Hedging vs Trading

**Hedging** is the practice of taking a position in one market to offset and balance against the risk adopted by assuming a position in a contrary or opposing market. **Trading** is the fact to buy or sell a product on the market.

Stochastic vs Deterministic view

A **deterministic model** is one in which every set of variable states is uniquely determined by parameters in the model and by sets of previous states of these variables. Therefore, deterministic models perform the same way for a given set of initial conditions. Conversely, in a **stochastic** model, randomness is present, and variable states are not described by unique values, but rather by probability distributions.
Portfolio Management: Definition/Concept

**Trader**: A trader is a person or entity who buys and sells financial instruments such as stocks, bonds, commodities, and derivatives, in the capacity of agent, hedger, arbitrageur, or speculator.

**Asset Optimiser**: Asset managers/optimisers are responsible for portfolios. They are supposed to ensure the financial profitability of the assets and are not supposed to speculate.

**Broker**: A broker is an individual or party (brokerage firm) that arranges transactions between a buyer and a seller, and gets a commission when the deal is executed.

**Market Maker**: A market maker is a company, or an individual, that quotes both a buy and a sell price in a financial instrument or commodity, hoping to make a profit on the bid-offer spread, or turn.
Portfolio Management: Definition/Concept

- **Retailer**: A retailer purchases goods or products in large quantities from producers or through a wholesale, and then sells smaller quantities to the consumer for a profit.

- **Producer**: A producer is a company that owns and operated production assets.

- **Integrated Company**: An integrated company is a company that is composed by a producing division and retail division.

Retailers are mostly making high profit in long market, Producers in short market. An Integrated Company should realize confortable profit in all market conditions.
AGENDA

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European Energy Market
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Portfolio Management
  Portfolio Concept & Definitions
  Hedging
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Remit
Specific cases
What is a hedge?

Hedging aims at reducing the riskiness of a portfolio; match an existing exposure with an opposite exposure.

- Earnings depend on fluctuating commodity prices.
- Hedging = act (buy/sell commodities) to reduce the variability of earnings.
- Hedging does not impact expected earnings (except for transaction costs).
- Energy portfolio is complex, and hedging involves buying/selling different commodities (including FX).
What is the right time/price to hedge?

- A hedge is a transaction on the forward market: agree now to buy/sell in the future at agreed fixed price
- Prices can be very volatile -> timing is crucial

![Cal 15 Belgian Baseload](Image)

Player A contracted on 21 Aug 13 for delivery in 2015 and will pay 40,6 €/MWh

Player B contracted on 18 Sep 14 for delivery in 2015 and will pay 52,3 €/MWh

28% PRICE DIFFERENCE FOR THE SAME PRODUCT
Key elements for hedging

- Liquidity is key for hedging
- Bid-Ask cost
- Lot size → slippage risk
- Types of products → forces to proxy hedges or tailor made products (costly)
- Hedge through portfolio → indexes, origination
- But still: Many areas of basis risk: power indexation, time spreads, Hub/ZIG,…
**TRADING TERMINOLOGY**

**HEDGING EXAMPLE**

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<tr>
<td>SHORT HEDGE</td>
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<td>-1000</td>
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<tr>
<td>PORTFOLIO</td>
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<td>59 000</td>
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<td>55 000</td>
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<tr>
<td>SHORT HEDGE</td>
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<td>PORTFOLIO</td>
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DIFFERENT EXPOSURES ➔ DIFFERENT STRATEGIES

Each exposure being different, hedging strategy will be different
**FIXED EXPOSURES**

- **Endex click**
- **Endex/Belpex Mix**
- **Fix Price**
- **Floating to Fix**

Directly hedged as exposure arises to lock margin

- **Gas**
- **Power**

- **Gas**
- **Power?**

- **Gas**
- **Power?**
FLOATING EXPOSURES

- Lagging products
- Day ahead products

For lagging products: Every day we have to buy the volume fixed that day due to the different laggings.

Example B2C 303
Floating sales are structural and arise from:
- B2C: Products like Essential/Optimal
- SME

Floating B2C formula is \(1/3(12-12-12)+1/3(12-0-12)*1/3(3-0-3)\)
- Meaning price for delivery during Q1 2016 is the average of:
  - 12-12-12: Average of closing prices of product Cal16 during year 2014
  - 12-0-12: Average of closing prices of product Cal16 during year 2015
  - 3-0-3: Average of closing prices of product Q1-2016 during Q4-2015

To hedge this exposure, we have to buy every day the volume that was fixed that day
- Example:
  - In Q2-16, we have to deliver 600GWh to our variable customers
  - In 2014, markets will be open 250 days ➔ Every day of 2014, we have to buy \(1/3*600\text{GWh}/250 = 0,80\text{GWh of Q2-16}\)
  - In 2015, markets will be open 250 days ➔ Every day of 2015, we have to buy \(1/3*600\text{GWh}/250 = 0,80\text{GWh of Q2-16}\)
  - In Q1-16, markets will be open 66 days ➔ Every day of Q1-16, we have to buy \(1/3*600\text{GWh}/66 = 3,03\text{GWh of Q2-16}\)
Types of Hedging Strategies

- **No hedging**
  - Naked strategy/"Do nothing": After taking a position, no activities with respect to hedging are pursued

- **Static hedging**
  - Covered strategy with perfect hedge: Trading the underlying asset to completely hedge away the risk
  - Covered strategy with proxy hedge: Trading an asset that is highly correlated to the underlying to hedge away the risk as well as possible
  - Stop-loss strategy: Closing position when a given threshold is exceeded

- **Dynamic hedging**
  - Delta hedging strategy: Dynamically rebalancing a portfolio to make it delta-neutral, i.e., a change in the underlying asset price has no impact on overall portfolio value

Source: Endesa

Energy Trading – Frederik Demaret
Fundamentals of Delta Hedging

Using the forward market to increase value of power plant by taking positions varying with the delta of the option.
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  Portfolio Concept & Definitions
  Hedging
  Short Term Market
  Imbalance Market

Rermit
Specific cases
Day Ahead power price formation

- Merit order principles for bid & ask curves
- Algorithm to calculate match price (on full CWE region and beyond)
- Includes block (conditional) bids & offers
- Settles the price at 1 pm:
  - If bid price > settlement price, power purchased @ settlement price
  - If offer price < settlement price, power sold @ settlement price

Energy Trading – Frederik Demaret
HOW IS THE POWER PRICE FIXED?

- Inelastic demand
- Offer subject to
  - Supply mix
  - Fuel prices
  - Regulatory
- Merit order
- Role of Import/Export

Market price

DEMAND

OFFER

€/MWh

MW

NUCLEAR

COAL

CHP

DIESEL / TURBOJETS

OCGT@ 25%

OCGT@ 37%

CCGT@ 49%

CCGT@ 53%

CCGT@ 57%

GREEN

STRATEGIC RESERVE

$\begin{align*}
\text{Demand} & \quad \text{Offer} \\
\text{Market price} & \quad \text{€/MWh} \\
\text{MW} & \quad \text{MW}
\end{align*}$
HOW ARE POWER PRICES IMPACTED?

Offer/demand logic to 4 common examples

1. Lot of wind tomorrow!
2. Nuclear outage
3. Fuel prices are falling
4. Belgian economic growth is reviewed lower
LOT OF WIND TOMORROW!

- Free wind pushes the merit order to the right, sending some expensive units out of the money!
NUKE IS OUT AGAIN!

- Nuclear shrinks, marginal unit is more expensive

NEW Market price

MARKET price

€/MWh

DEMAND

GREEN

NUCLEAR

COAL

CHP

OCGT@ 37%

OCGT@ 25%

OCGT@ 49%

OCGT@ 53%

CCGT@ 57%

CCGT@ 53%

CCGT@ 49%

CCGT@ 37%

DIESEL / TURBOJETS

STRATEGIC RESERVE

MW
The cost of marginal units is reduced.

**FUEL PRICES ARE DOWN**

- **NEW Market price**

- **GREEN**

- **NUKE**

- **COAL**

- **CHP**

- **DEMAND**

- **MW**

- **$/MWh**

- **OCT GT@ 37%**

- **CCGT@ 53%**

- **CCGT@ 49%**

- **OCGT@ 37%**

- **OCGT@ 25%**

- **Diesel / Turbojets**

- **Strategic Reserve**
SLOWING ECONOMIC GROWTH

- Less demand means we will just use cheaper supply!

NEW Market price

Market price

DEMAND

€/MWh

NUKE

GREEN

COAL

CHP

CCGT@ 57%

CCGT@ 53%

CCGT@ 49%

OCGT@ 37%

OCGT@ 25%

CCGT@ 49% DIESEL / TURBOJETS

STRATEGIC RESERVE
CWE (Nov 9th 2010) > NWE (Feb 4th 2014)

- Two separate Market Couplings (CWE & Nordic) linked by a volume coupling (ITVC organised by EMCC)
- Sequential calculation approach
- No common algorithm applied

- Full coupling with GB
- One single price coupling based on a single calculation
- One single common algorithm to allow for a sound and robust price formation
NWE (Feb 4th 2014) \(\rightarrow\) NWE/SWE (May 13th 2014)

- SWE joined on May 13th 2014
- New Name: MRC (Multi Regional Coupling)
- Feb 24th 2015: + Italy borders
- 4M Market (separated market with the same algorithm principle) -> CZ + SL + HU + RO
Flow Based Market Coupling (2018)

- The flow-based model has been advocated as the target model for highly meshed grids (like the Central West Europe grid).

- Market coupling allocates capacity by optimising the total economic surplus of the different coupled spot markets’ order books, while ensuring that the physical limits of the grid are respected. The consequence of this is price harmonisation in the CWE region when sufficient capacity is available. By using a more detailed grid description, the flow-based method increase this price convergence while ensuring a same security of supply as today.
Definition (Clean) Spark-Spread/Dark-spread

The **spark spread** is the theoretical gross margin of a *gas-fired* power plant from selling a unit of electricity, having bought the fuel required to produce this unit of electricity.

The **dark spread** is the theoretical gross margin of a *coal-fired* power plant from selling a unit of electricity, having bought the fuel required to produce this unit of electricity.

In countries that are covered by the European Union Emissions Trading Scheme, generators have to consider also the cost of carbon dioxide emission allowances.

**Clean spark spread** represents the net revenue a gas-fired power plant makes from selling power, having bought gas and the required number of carbon allowances.

**Clean dark spread** represents the net revenue a coal-fired power plant makes from selling power, having bought gas and the required number of carbon allowances.
Definition of Spark-Spread

- Optimisation of coordinable units based on Clean Spark-Spread:

\[
Spark - Spread = Pelec - \frac{1}{\text{efficiency}}(P_{gaz} + k \ CO2)
\]
Cross Border Trading

Physical capacity
- Total Transfer Capacity
- Available Transfer Capacity
- Net Transfer Capacity

Applied on fluxes

Allocation
- Explicit
- Implicit

Congestion Management

Harmonisation in Europe?

Scheduling
AGENDA

Introduction of EDF Luminus
European Energy Market
Price Drivers
Portfolio Management
  Portfolio Concept & Definitions
  Hedging
  Short Term Market
  Imbalance Market

Remit
Specific cases
Electricity **cannot be stored** in large quantities. Generation must always be equal to consumption, at any time of the day of the year. This **physical reality** is called the ‘generation/consumption balance’.
How does the TSO manage to balance the country?

- **primary reserve**
- **secondary reserve**
- **tertiary reserve 8h (R3 Standard)**
- **tertiary reserve 2h (R3 Flex)**
- **uncontracted reserve (‘free bids’)**
- **reserve contracts with neighbouring system operators**
BRP Responsability = individual

Energy Trading – Frederik Demaret
Imbalance Invoice

Imbalance Volume
(Production-Consumption)

Imbalance Prices
f(country position)
Balancing – Main principles?

1/4h Balancing obligation for each BRP

- Balancing = difference between production and consumption of the whole portfolio (metering)

TSO takes care of the position of the country

- Short position of BRP purchased at imbalance price -
- Long position of BRP sold at imbalance price +

Imbalance price is equal to marginal price activated by TSO

- High incentive for BRP to be balanced
- Many opportunities for BRP

Imbalance price + and – are equal most of the time

- Differences (extra incentive) only if big imbalances
Some examples
Delta between DAH prices and imbalance prices

Sunday 16 June 2013

- Imbalance Prices (€/MWh)
- BELPEX Day Ahead Prices (€/MWh)
Delta between DAH prices and imbalance prices

Sunday 9th March

- Belpex (€/MWh)
- Imbalance (€/MWh)
Demand side management
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Introduction of EDF Luminus
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Remit
Specific cases
Market Regulation

- Prohibition of market manipulation and trading on the basis of ‘insider information’
- Market monitoring by ACER
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Introduction of EDF Luminus European Energy Market Price Drivers Portfolio Management Remit Specific cases

Winter 2017-2018

Sales Trading Platform & Decentralized Production
AGENDA

Introduction of EDF Luminus
European Energy Market
Price Drivers
Portfolio Management
Remit
Specific cases

Winter 2016-2017

Sales Trading Platform & Decentralized Production
LE MARCHÉ DE L’ÉNERGIE HIER

CENTRALIZED POWER

Transmission Network

Distribution Network

house

factory

commercial building
LE MARCHÉ DE L’ÉNERGIE HIER ET DEMAIN

CENTRALIZED POWER

TRANSMISSION NETWORK

DISTRIBUTION NETWORK

CLEAN, LOCAL POWER

- solar PV power plant
- storage
- wind power plant
- power quality device
- local CHP plant
- flow control

- house
- factory
- commercial building

- house with domestic CHP
- storage
- power quality device
UN IMPACT PROFOND POUR NOTRE PORTEFEUILLE

BESOIN EN ÉNERGIE NON COUVERT

MANQUE DE CAPACITÉ POUR ÉQUILIBRER NOTRE PORTEFEUILLE
LA SOLUTION?

Une collaboration “gagnant-gagnant” entre des producteurs locaux et EDF Luminus

- EDF Luminus offre les services nécessaires au producteur local afin de réduire au maximum sa facture d’énergie et d’optimiser son unité de production
- Le producteur local vend son énergie et sa flexibilité à EDF Luminus
- Possible grâce à notre Sales Trading Platform
EDF LUMINUS
SALES TRADING
PLATFORM:

EDF LUMINUS SALES TRADING PLATFORM:
LA SOLUTION IDÉALE POUR DES PRODUCTEURS LOCAUX

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full integrated system via Web application system with a 24h/7d access</td>
<td>The customer will maximize &amp; optimize the value of his asset position thanks to <strong>Flexibility</strong> option</td>
</tr>
<tr>
<td>The customer will be in the <strong>driver seat</strong> for all his energy related services: from the <strong>nomination</strong> till the imbalance position</td>
<td>The customer will automatically have the correct information for <strong>invoicing</strong> purposes</td>
</tr>
<tr>
<td><strong>Trading</strong> desk: the customer will manage his <strong>price</strong> position with accurate and added value information</td>
<td>As full integrated solution, the dataflow will increase the <strong>operational excellence</strong> position</td>
</tr>
</tbody>
</table>
ELECTRICITY PRODUCTS OVERVIEW

Risk Averse

CUSTOMER CHOICE

Risk Taking

LAGGING FORMULA

Services of Clicks on phone OTC, OTC via STP or Endex quote (manual or automated)

ENDEX FORMULA

NO NOMINATION

BELPEX FORMULA

Nomination

Services:
- Financial Swaps (*)
- DAH Conditional Bids
- Intraday ReNomination
- ID Conditional Bids
But in a changing Market context…
We create innovative products for flexibility from decentralised production and our customers

Providing a “window to the market” for our customers allowing them to capture value in the energy and flexibility markets

Sales Trading Platform: web based tool to communicate with our customers
ENERGY OPTIMIZATION ACTS ON THE SHORTEST PERIOD
LUMINUS FLEXIBILITY PROVIDES A COMPLETE OPTIMIZATION SOLUTION

LUMINUS FLEXIBILITY

Pricing Interactivity Program

Active Load Management Program

Energy Optimization

Day Ahead

Intraday

Day (T-Time)

Nomination & Conditional Bid

Remote Activation of capacity

Pricing Interactivity Program

Active Load Management Program

Market Price

Company Load

Company Load

Baseline Load

Load Reduction
You manage your energy load daily, you know what’s your capacity (to consume or to inject)

You make your nomination directly into our Customer Zone the day before or review it intraday

You manage your asset in order to fit to your new profile
ACTIVE LOAD MANAGEMENT PROGRAM
PRINCIPLE

1. You notice your availability to be activated in case of need
2. The signal is sent to your Lumibox installed on your site
3. The action is automated and you are directly informed that an activation is realized.
A REAL TIME ACTIVATION AS FOR THE DEMAND OR SUPPLY SIDE
FLEXIBILITY CHARACTERISTICS

- Call up time: period needed before activation
- Activation time
- Minimum & Maximum duration of activation
- Direction (up/Down)
- Power
- Availability
- Rebound effect?
- Frequency of activation
THANKS TO EDF LUMINUS OPTIMIZE YOUR REVENUE ON EACH MARKET!

- **Cost Volume**
- **Reward €/MWh**
- **Reactivity**

**Forward Market**

**Spot Market**

**Intraday Market**

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Click & Declick Optimalisation via Energy Management solutions
THANK YOU FOR YOUR ATTENTION!