



# PLEXOS

BY ENERGY EXEMPLAR

**Energy Investments and Business  
Opportunities in SE Europe.**

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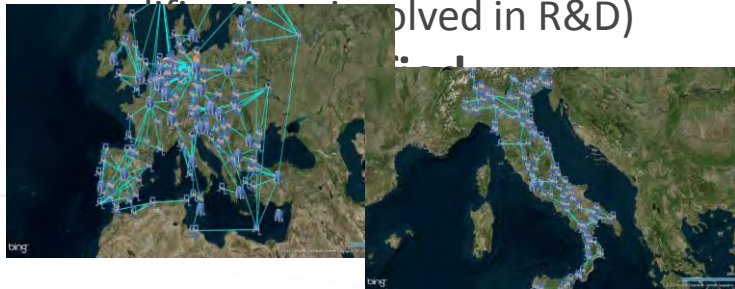
**10<sup>th</sup> SE Europe Energy Dialogue,  
Belgrade - 2017**

# PLEXOS® by Energy Exemplar



## ➤ GLOBAL LEADER in Integrated Energy Systems and Energy Markets Modelling & Optimisation.

- ✓ **5 Regional Offices** in AUSTRALIA, UK, USA WC & EC, and SOUTH AFRICA
- ✓ **Focus on Research and Development** (20 highly skilled staff, many with PhD level plved in R&D)



## ➤ Multiple markets:

- ✓ **Electric**
- ✓ **Gas**
- ✓ **Water** (New product launched Q4-15)



## ➤ Multiple products:

- ✓ Desktop computing
- ✓ **Cluster & HP Computing** (PLEXOS Connect)
- ✓ Enterprise Solution (from PLEXOS 8)
- ✓ Data sets
- ✓ Implementation consulting
- ✓ Custom solutions (OpenPLEXOS)

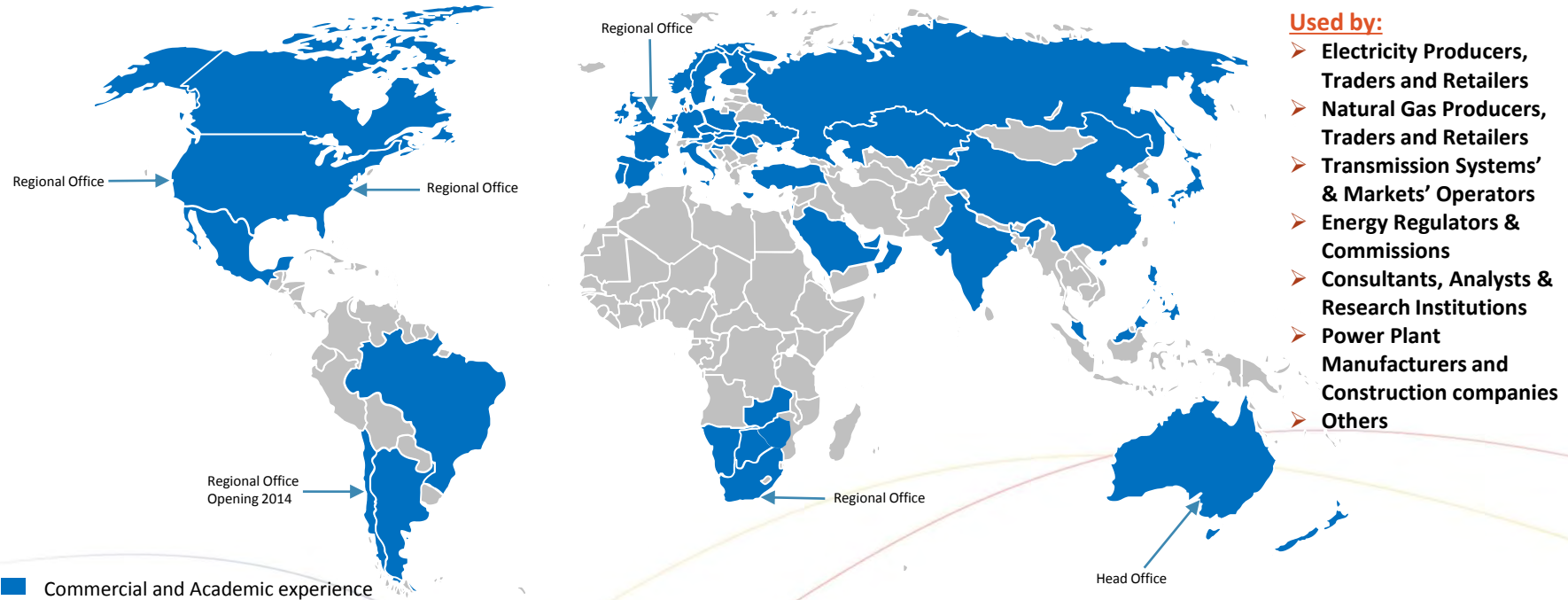
## ➤ Significant size and market share:

- ✓ More than **1,100 installations in 42 Countries**

# About Energy Exemplar



## *Clients' Portfolio in all five continents*



**“The Energy (Power & Gas) Market is constantly changing and today's market differs fundamentally from the market five years ago”**

# **A Short Guide when looking for Energy Investments and Business Opportunities in SE Europe?**

# 1<sup>st</sup> - The Question Overwhelming Global Energy Markets:

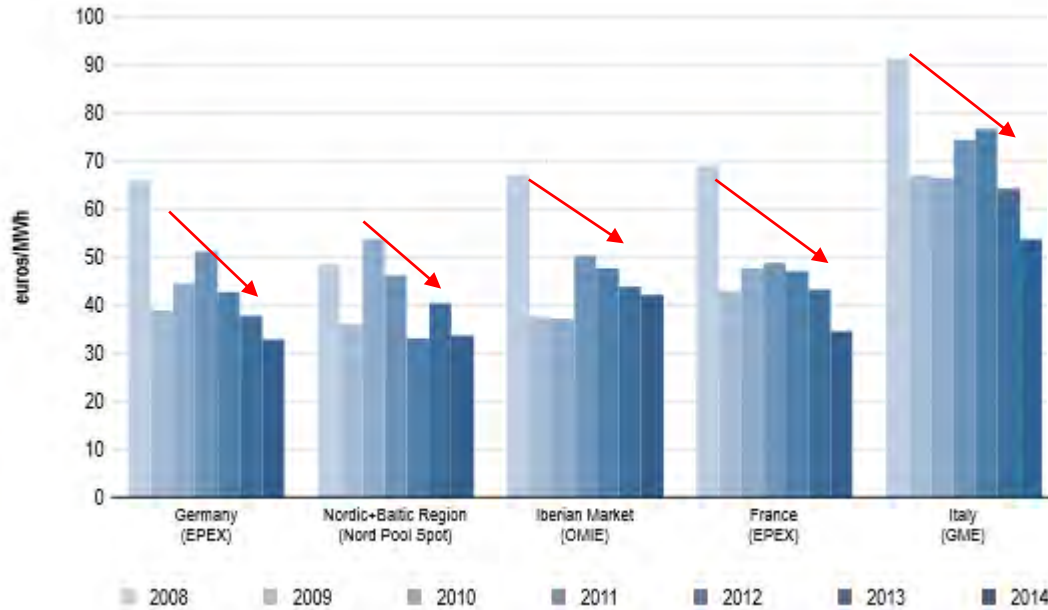
**How can we increase the Renewable Electricity Uptake Potential?**

**The Answer:**

**More Systems' Flexibility & Markets' Flexibility**

# 2<sup>nd</sup> – The Main Characteristic of European Electricity Markets Today - Falling wholesale electricity prices.

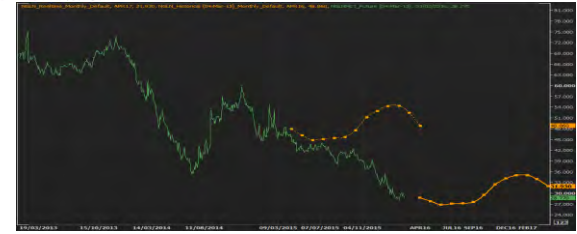
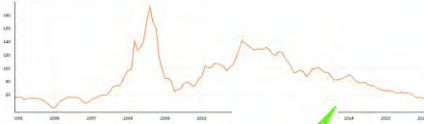
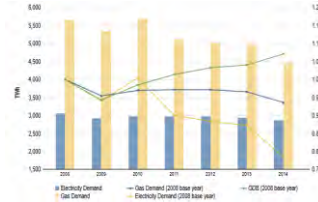
Evolution of European wholesale electricity prices at different European Exchanges



Source: EMOS, Platts, and EU power exchange data

# What is causing falling European wholesale electricity prices?

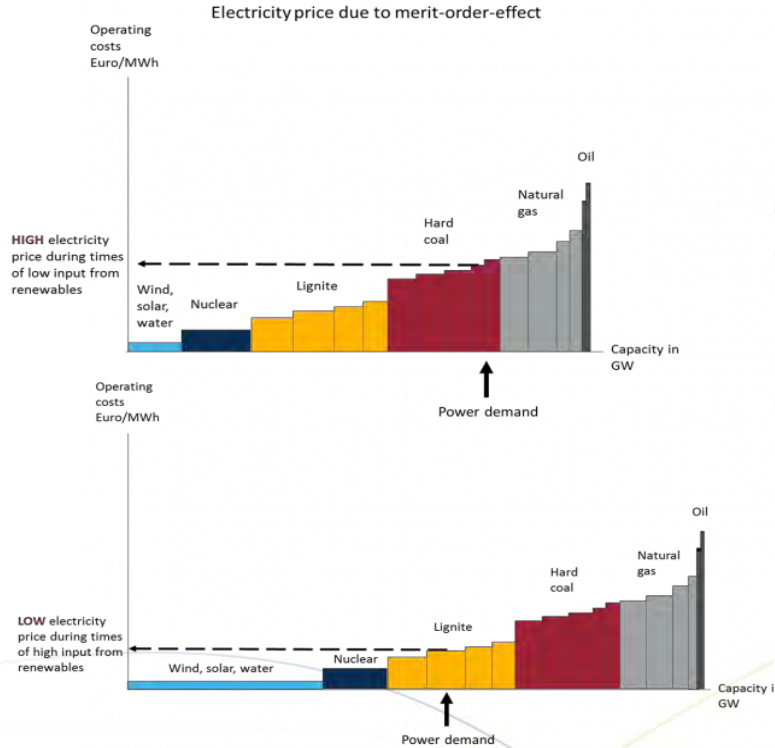
- Declining energy demand? ✓
- Increasing share of renewables? ✓
- Low fuel prices? ✓
- Flow Based Market coupling? ✓
- Low carbon prices? ✓
- New energy efficiency technologies and smart grids? ✓



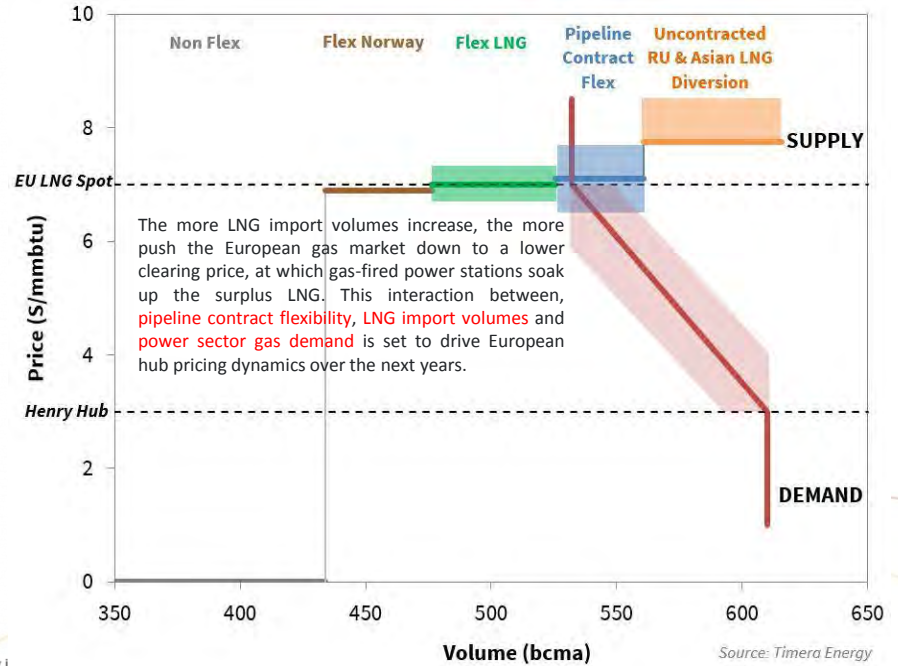
*How can we anticipate fundamental drivers of energy prices in the future for Optimal Investments' & Operational Planning?*

# “2016 Snapshot” of European Power and Gas Markets Supply Stacks

## Power Market Supply stack (2016)



## Gas Market Supply stack (2016)



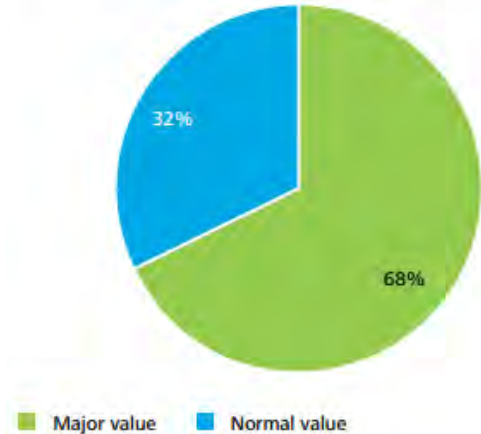




# Asset Risk

- Within the energy sector asset risk is referred to as the **physical risk arising from a asset non-performing**
- Asset risks are spread across the whole asset life cycle
- Risks to consider
  - ✓ Project risk for new Investment (design, timing, building, regulation, tax, environmental)
  - ✓ Forced outages of Plants/Lines (Capacity risk)
  - ✓ Volume uncertainty (Demand risk)
  - ✓ Weather risk (e.g. a warm winter for a gas supplier),
  - ✓ Transmission risk (will gas or renewable power be able to reach the load centres?)

How much value do you think asset risk management can bring for your business in the future?



Source: Deloitte, *Asset Management: A risk-Based Approach - 2015*

# Market Risk

- Is the risk that the **value of an investment will decrease due to moves in market factors**
- What markets might a company be concerned with market risk?
  - ✓ Electricity/Gas Spot or Day ahead market
  - ✓ Futures or Forward market
  - ✓ Reserves/ancillary service or capacity market
  - ✓ Commodity market (coal, gas, oil etc.)
- Risk mitigation
  - ✓ Market risk cannot be eliminated through diversification though it can be mitigated through appropriate hedging
- Questions need to be then asked such as:
  - ✓ How much exposure to the spot price should an new investment and a company as a whole have?
  - ✓ How much should they hedge?
  - ✓ What products should they use to hedge?



# We assist with PLEXOS® in Managing Asset & Market Risk

- How do can we value and optimise a company's portfolio against these risks?
  - ✓ *PLEXOS can assist us better understand both **Asset** and **Market Risks***
- The most important elements to any Investment hedging and optimisation strategy by a company is the accurate **modelling of spot and forward prices** and how they will **evolve over time**
- Spot and forward price forecasts form the basis to many typical risk models such as:
  - ✓ Value at Risk
  - ✓ Credit Value at Risk
  - ✓ Earnings at Risk
  - ✓ Etc.



# What situations are modelled?

➤ The following are questions an modern energy company might ask

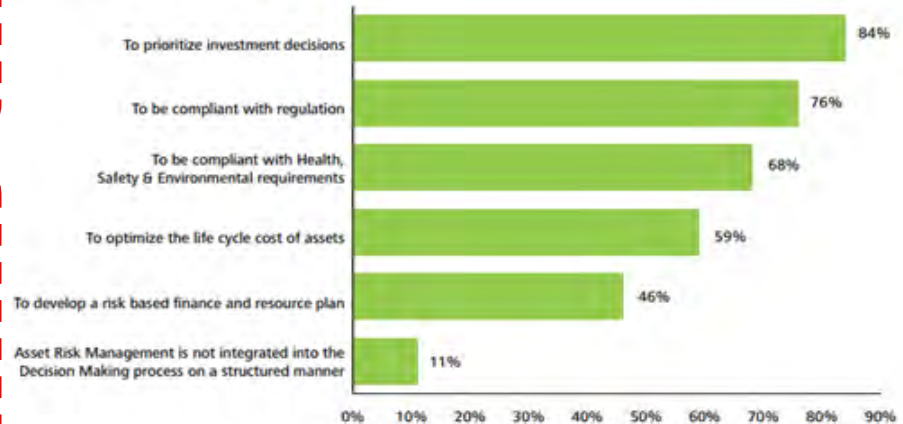
➤ **Long term**

- How can we make the best investment decisions in the future?
- What assets should we retire and when?

➤ **Short/Medium term**

- ✓ How can we ensure that our financial obligations are met?
- ✓ How can we manage the risk of asset failure?
- ✓ How can we optimise our portfolio to generate the maximum revenue?
- ✓ How can we ensure we are compliant with market rules and regulations?

Drivers for the use of asset risk management



Source: Deloitte, Asset Management: A risk-Based Approach - 2015

## New Investments' Decision Making Support

So, any New Investment but also any Operational Planning Process in European Energy Systems today unavoidably falls under the full scope of:

*“Decision Making Process under **Uncertainty, Risk and Constraints** (Physical, Financial, Political, Regulatory, Environmental etc.)”.*

# Historical Analysis becomes less relevant

- Fundamental changes in the European & Global Energy Markets are already affecting Energy Prices, introducing various types of Investments' Risks and Opportunities coming from:
  - ✓ Significant changes in Governmental Energy Policies (Subsidies' Policies Reforms)
  - ✓ **Changes in the established Markets' Design (Integration & Coupling of Markets – Energy Union)**
  - ✓ Drop in Energy Demand Growth due to a weaker Economic Growth & Improved Energy Efficiency.
  - ✓ Falling CO<sub>2</sub> price
  - ✓ Renewables and/or Coal driven Power prices (some Gas Generation Displacement)
- What is currently under consideration?
  - ✓ **Systems Flexibility** and **Market's Flexibility** (New-Shorter Markets' products), with more emphasis towards Balancing/RT Markets
  - ✓ Distributed Generation (Smart Grids) and Demand Side Management
  - ✓ New Energy Storage technologies
  - ✓ Increased Electrification of Rail Networks and of Road Transport Sector (?)
  - ✓ Increased Gasification of Maritime and of Road Transport Sector (?)
  - ✓ New Regulatory Frameworks and Policies
- Understanding **Renewables Potential** and **Profiles** is becoming more critical in forecasting costs and prices on Energy Sector too both for **Optimum Investment Planning on needed Infrastructure**, **Operational Planning Evaluation** and **Energy Portfolios Optimisation.**

# Systems Flexibility (Optionalities) through Energy Transformations & Storage



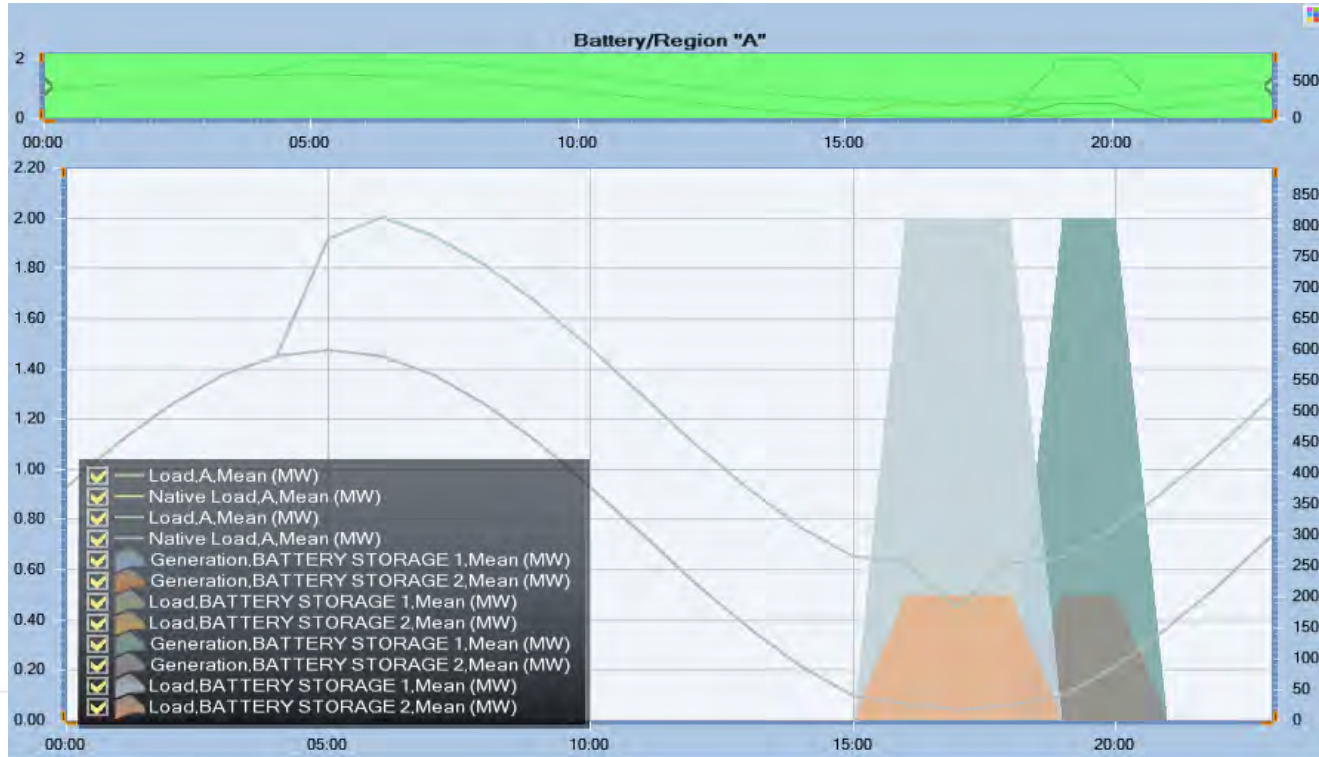
In the New Era of Excess RES and Power Production Intermittency, Major the Role of **Energy Storage** and **Energy Transformation** Options:

- **Small Scale LNG/FSRUs**
- **Electrical Pump Storage (Hydro)**
- **Electric Batteries**
- **CAES**
- **Power to Natural Gas (Compression)**
- **Power to H<sub>2</sub> for Direct use or injection to N. Gas Network**
- **Power to Heat (DH/DC)**
- **Power to Water (Desalination-RO)**
- **Power and Gas to Other Commodities**

**No need to say more on Power/Gas Cross Competition and Substitution Issues with associated Risks & Opportunities...**



**Battery Storage – Keeping CCGTs ON** by Battery Charging when the load rumps down very low and **Discharging** when the load rumps up.



# Slap a Battery on a Gas Turbine and Make an Extra \$1.4 Million!!

“Bloomberg New Energy Finance, 5/5/2017”

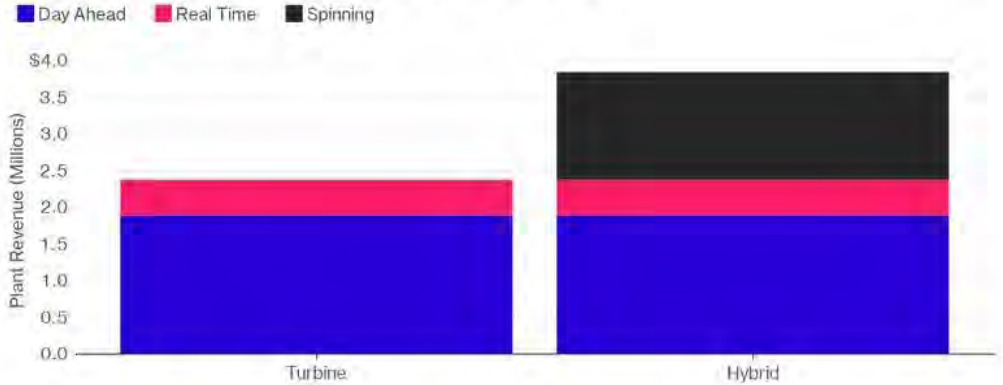


“SoCal Edison paired two GE turbines with battery storage”.

By adding battery storage to a quick-start natural gas turbine, General Electric Co. made a **hybrid power plant** that allows Edison to collect payments for keeping the generator ready to instantly supply electricity when California’s grid needs it, 24 hours a day.

## Turbine Boost

Batteries open a lucrative new market for gas generators

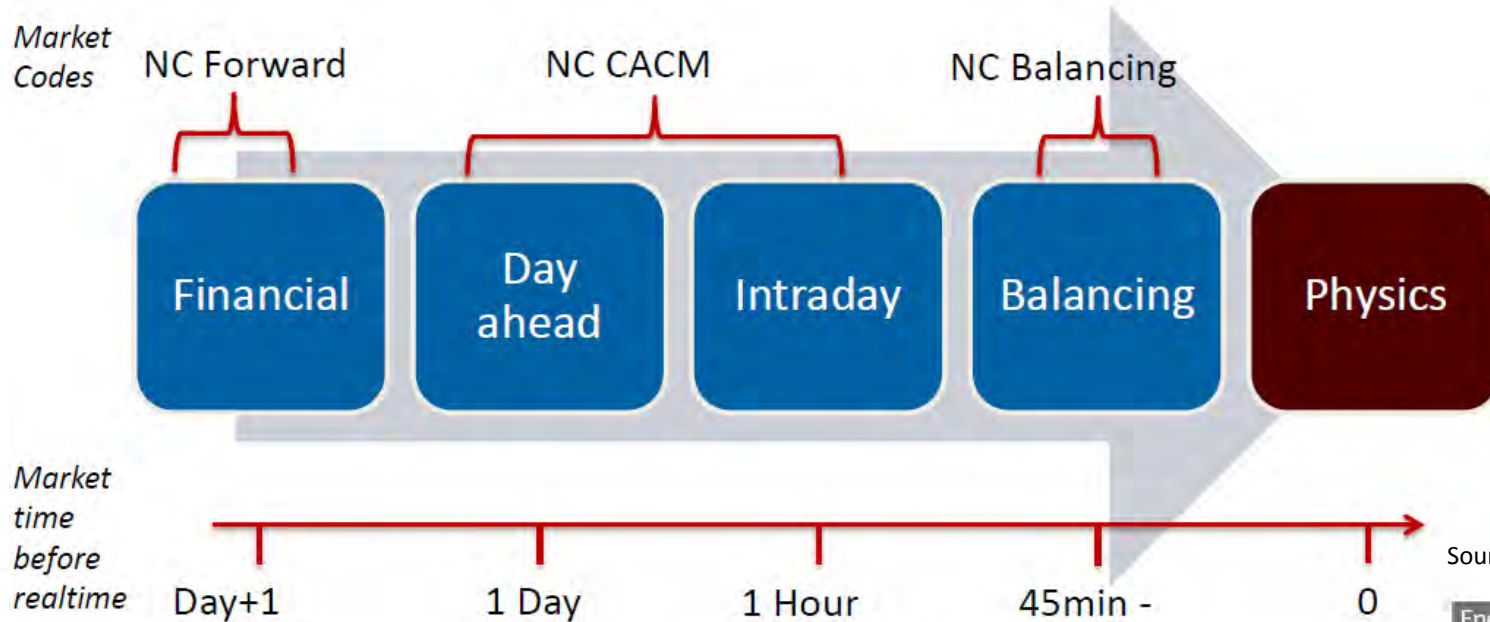


Source: FERC, Bloomberg New Energy Finance

Bloomberg

# Markets Flexibility - European Electricity Wholesale Markets Model

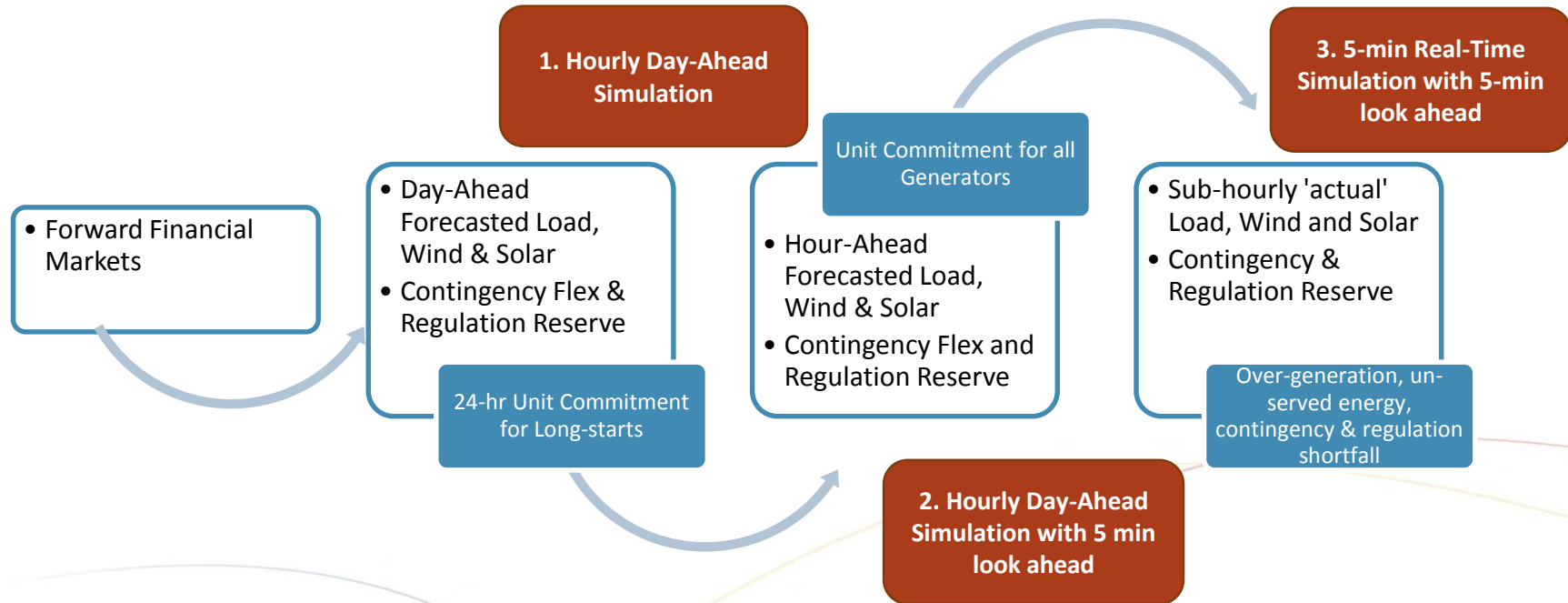
Electricity (wholesale) markets are normally illustrated in order of time of the market before real time



Source:

Energi Danmark

# Markets Flexibility - Our Approach - Multi-stage (Interleaved) Markets' Model



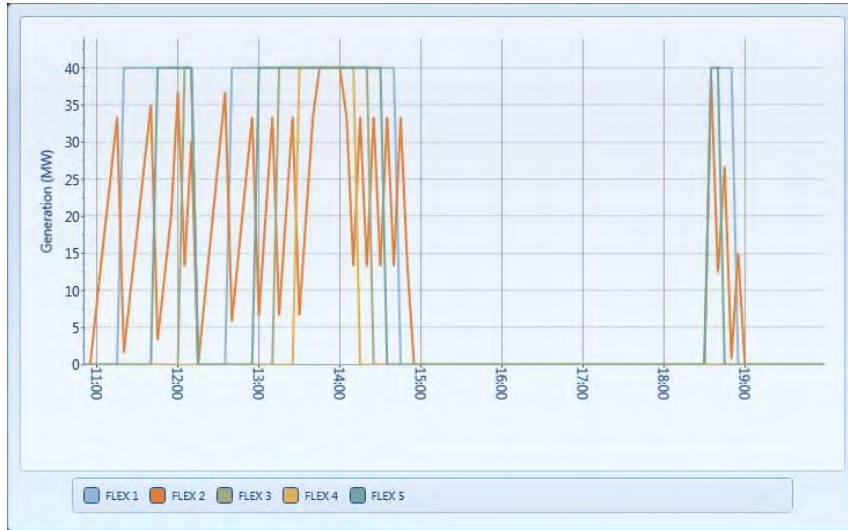
# The Key - Matching Systems & Markets Flexibilities



- Recent studies with PLEXOS<sup>®</sup> in US, Europe and elsewhere have revealed the Importance of **Detailed Integrated Modelling** that can also take also into account the **Flexibility (Dynamic) Characteristics** of the power system that are mostly related to Wind's Intermittency.
- In high wind periods (and/or Low Demand) below are Generation Ramping Up/Down Rates already observed in some European Systems:
  - > **~700MW per 10 minutes – Balancing/Reserves Markets**
  - > **~3,000MW per hour – ID Markets**
  - > **>10,000 MW per day – DA/Capacity Markets**

# Modelling & Pricing Flexibility

## 10 minute Dispatch



## 1 Hour Dispatch



Modelling and optimising at a higher temporal resolution that can best capture **variability in system load** and **renewable generation** and can also best capture the **inflexibilities of the power system** thus, leading to **more realistic estimations in total generation costs and improved ST price forecasting**

# Capturing Flexibility

## SUB-MINUTE RESOLUTION

Reserve Restoration Management is a red hot issue today.

Sub-minute capability, as seen in this 4-second resolution simulation and AGC modelling properties will further enhance the ability to accurately capture frequency restoration services, not to mention those added benefits related with **Demand Response** & **Batteries Storage** Integration in Modern Power Systems.



# Pricing Flexibility

- When requirements for reserves are considered, the **optimal trade-off between energy and reserve provision must be determined.**
- The marginal price for a Reserve in a region is the incremental cost for meeting an additional MW of the requirement for the Reserve in the region.
- If no additional compensation were required to cover the cost of operating at lower efficiency to provide reserves, the required compensation is given by the **Opportunity Cost** of backing off generation to provide balancing reserves.
- In PLEXOS® this compensation will be automatically embodied in the **Energy and Reserves Prices**, which are **co-optimised** and provided by the **Shadow Prices** associated with the related constraints defining the required quantities of energy and reserves.



# Conclusion

In general, any new planned capacity will need not only to have true dynamic characteristics to maintain system frequency levels but also at the same time to support **EU Decarbonisation** and **Renewable Goals**...:

With grids integrating more renewables there is a clear need to account for Uncertainty and Risk in Decision Making for Investment Planning and for Efficient Portfolio Optimisation & Hedging.



**PLEXOS**  
BY ENERGY EXEMPLAR

Thank you for your  
time and the  
opportunity

For More Information, please do not hesitate to contact me:

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