

The value of flexibility on the CWE power market

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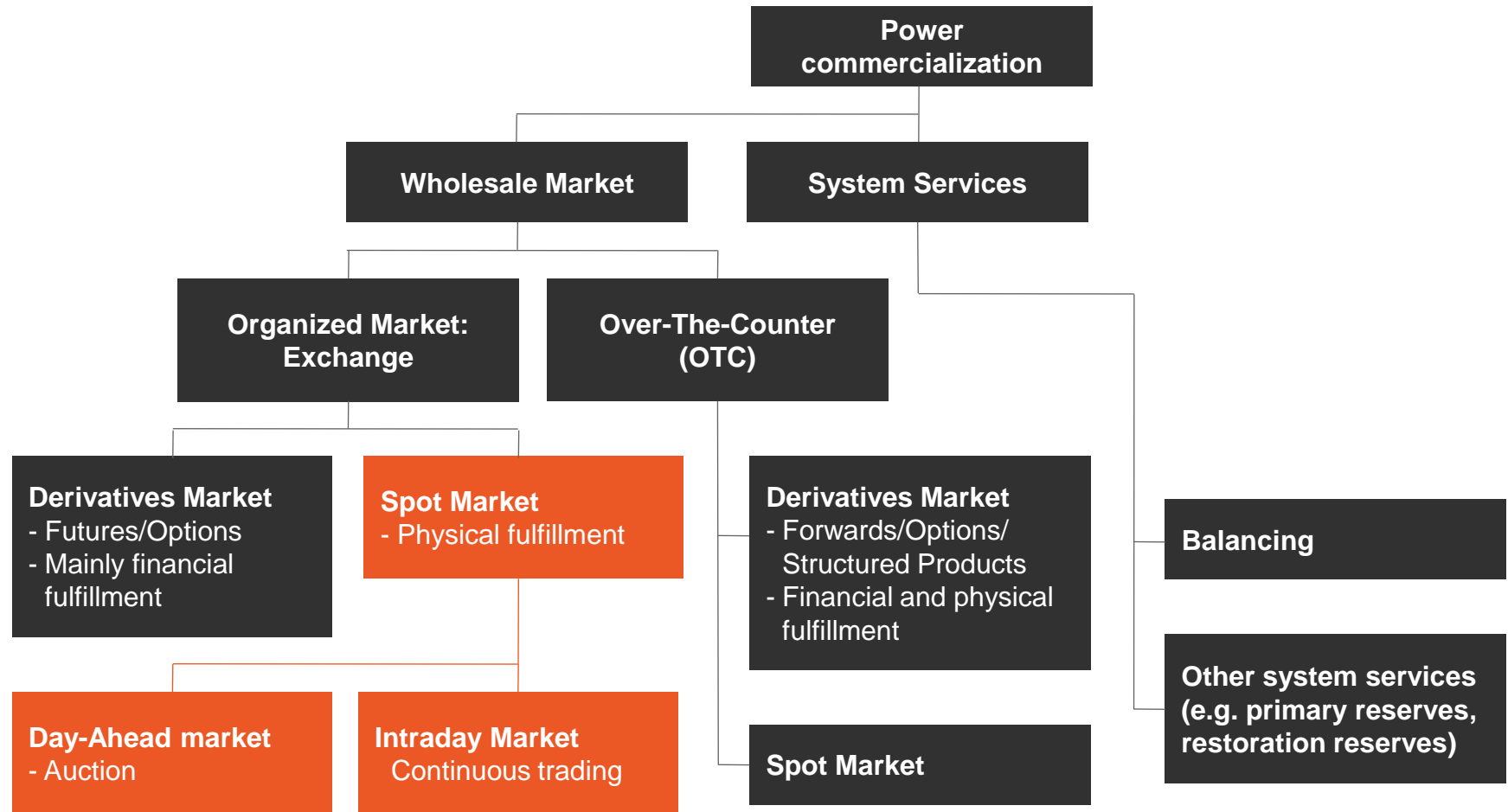


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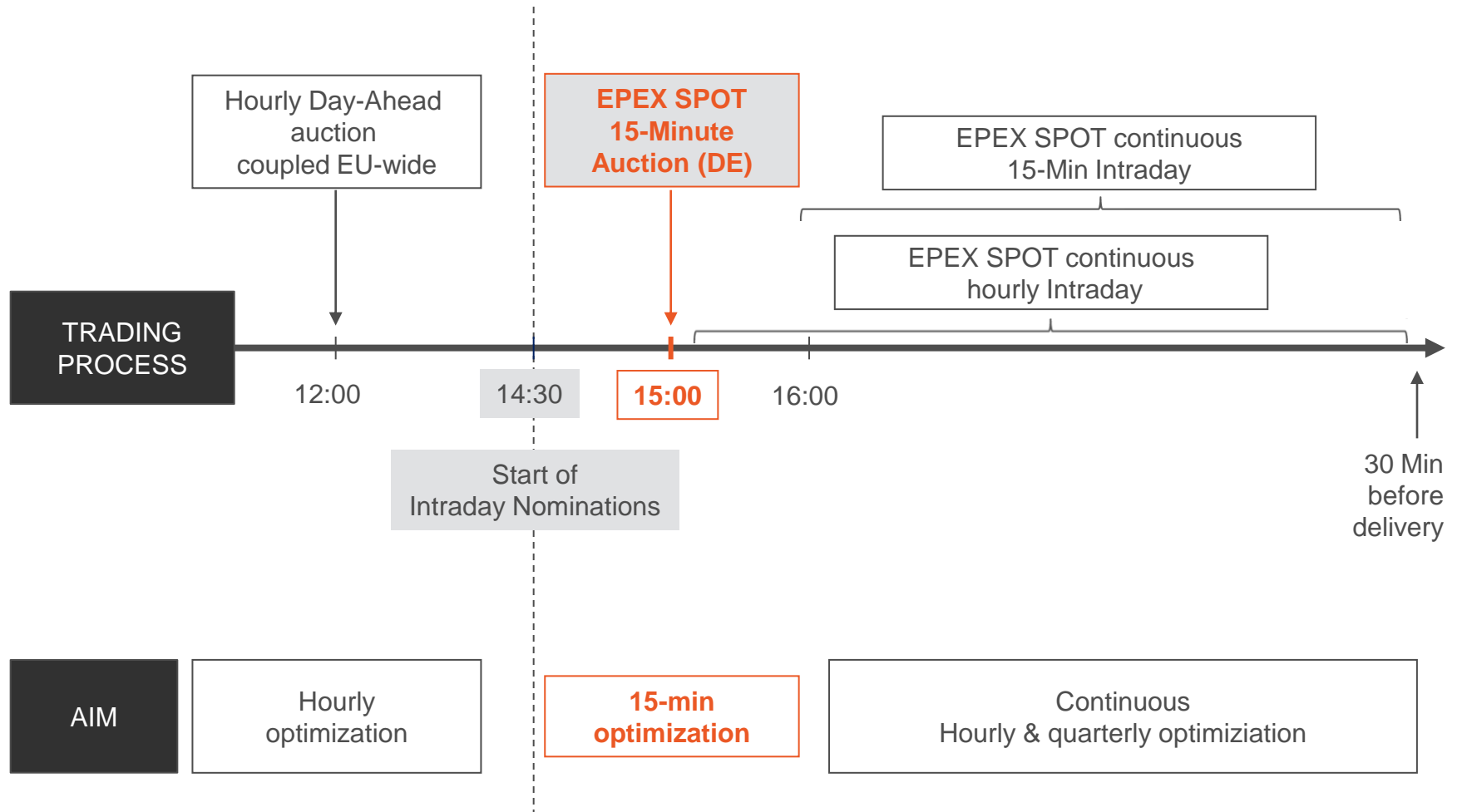
Agenda

1. The CWE Wholesale power market
2. What is the value of flexibility?
3. Flexibility from a market design perspective

Ways of trading power on European Wholesale markets



The wholesale energy trading process



The CWE Wholesale power market

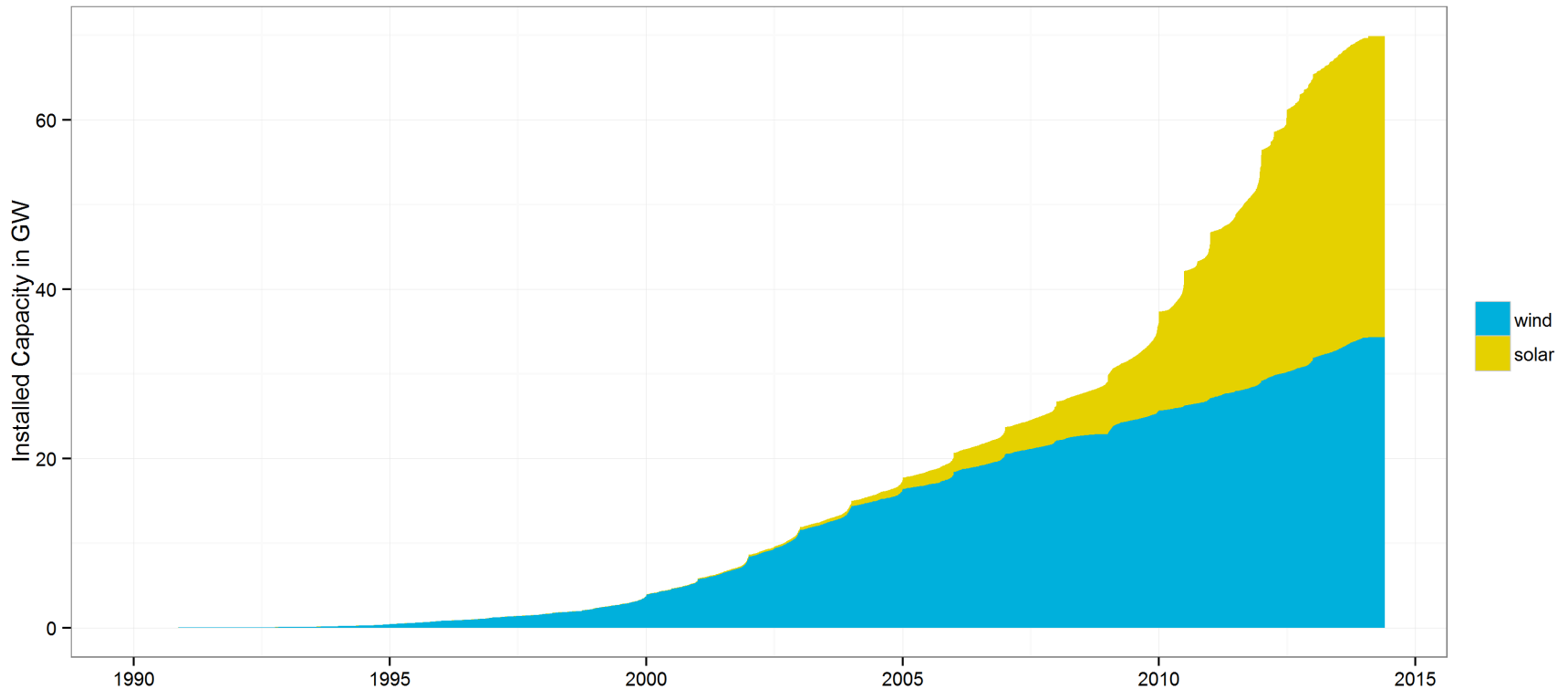
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RES development has boosted need to balance on the Intraday market

Solar and Wind Installed Capacity in Germany



Source: Statkraft

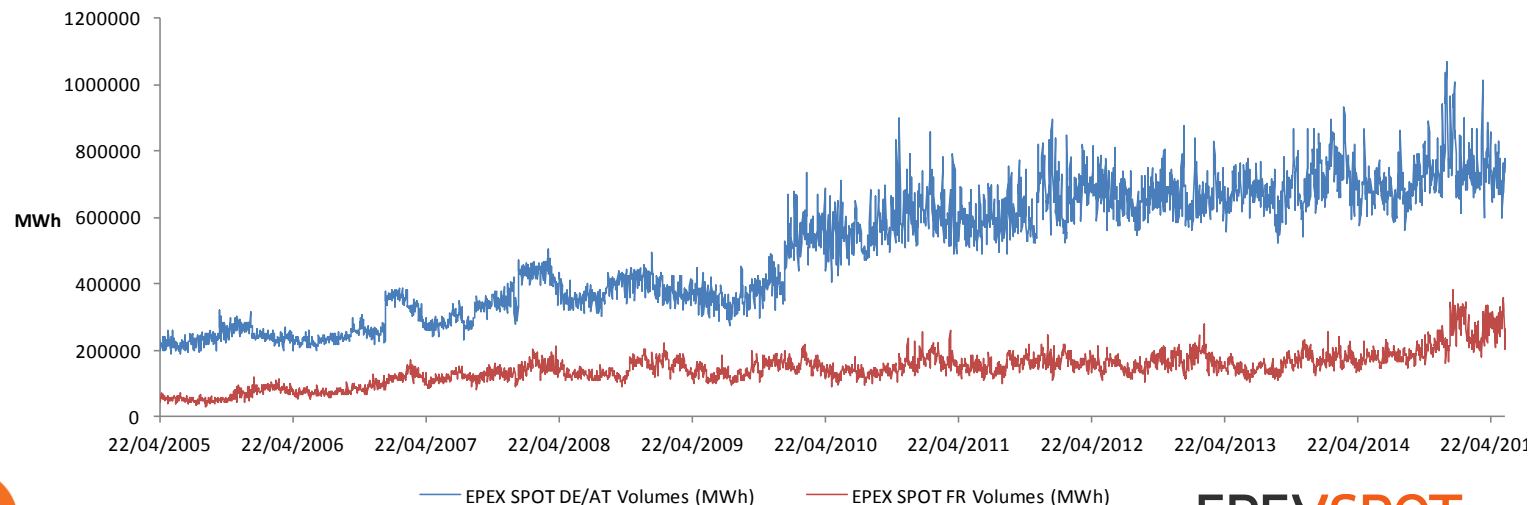
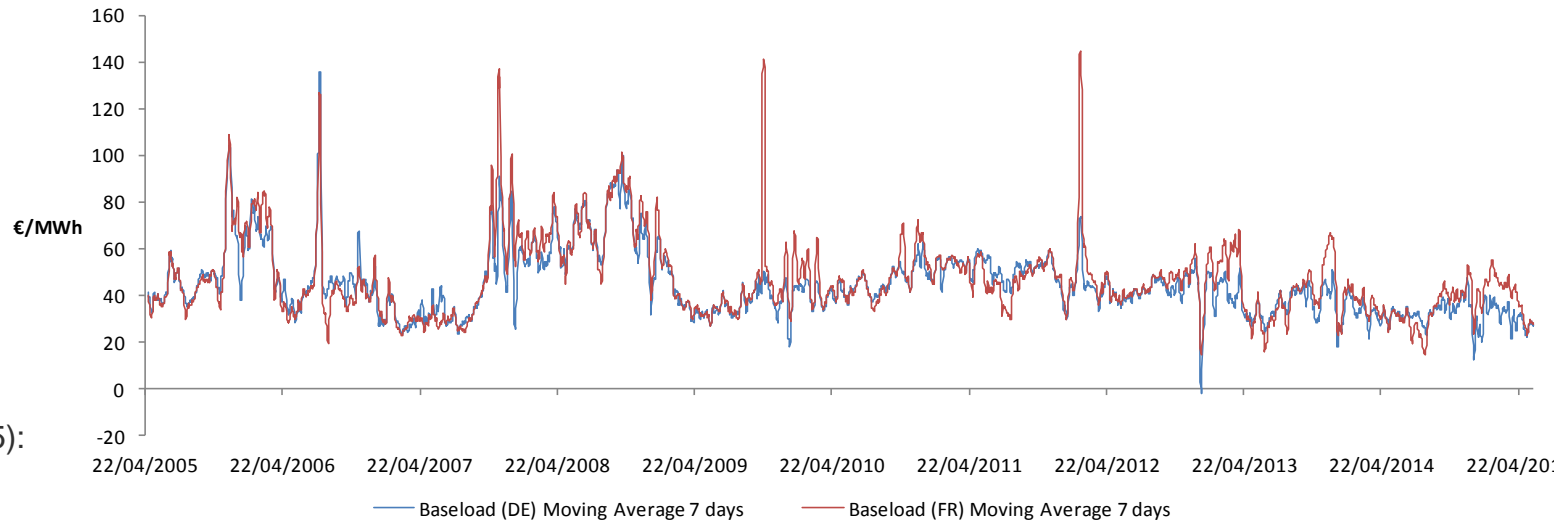
Wholesale power prices at record lows on the Day-ahead market

On the 01/06:

- Oil (WTI):
59 \$/Baril
- Gas (TTF):
20 €/MWh
- Coal (ATW):
58 \$/ton
- CO2 (EUA, Dec 15):
7.3 €/ton

• Power price:
DAM Baseload DE:
31.44 €/MWh

DE (Cal 2016):
31.5 €/MWh



Source: EPEX SPOT

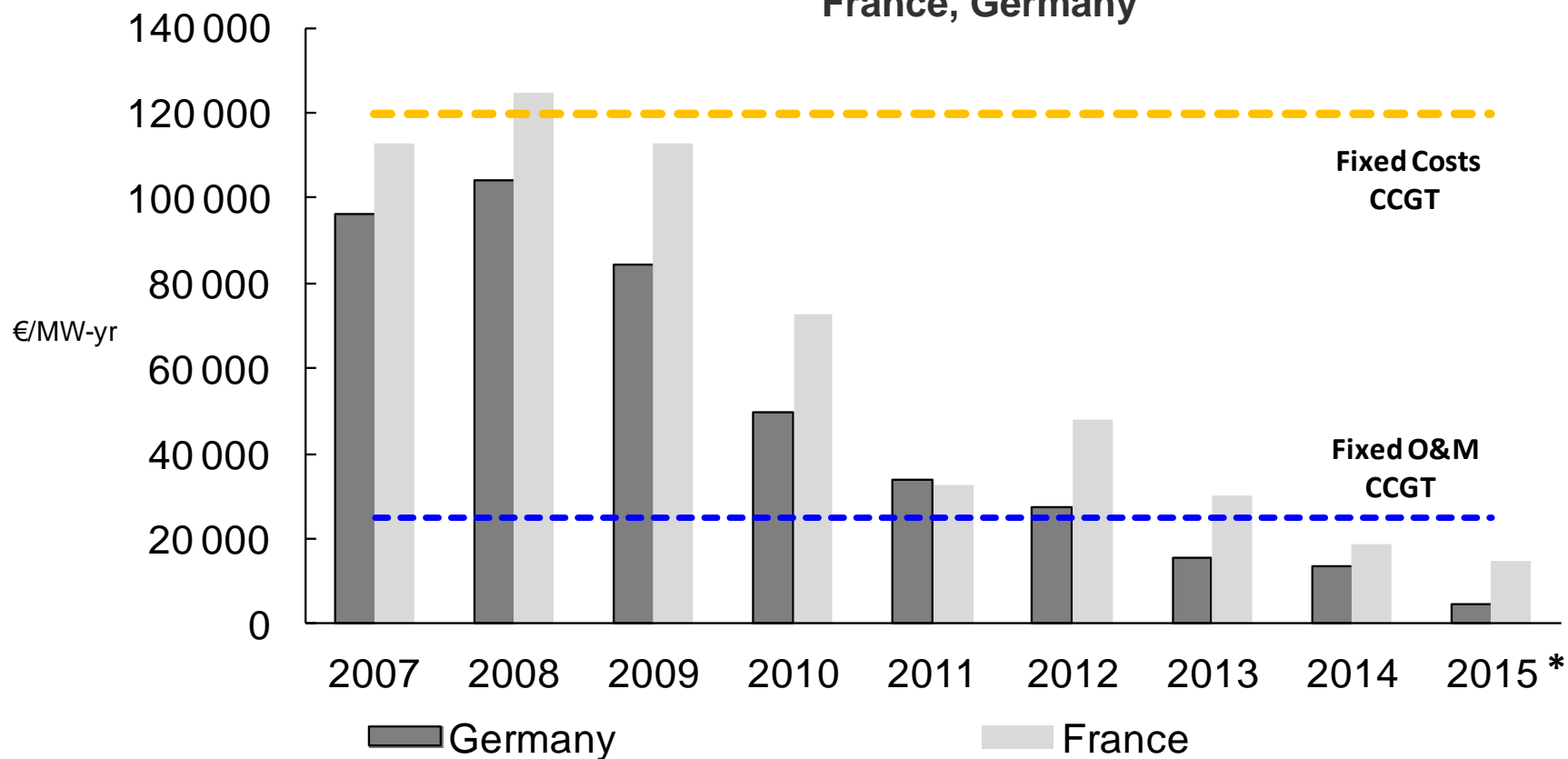
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What are the theoretical revenues for the perfect CCGT offered on the day-ahead?

Net revenues for a 55% efficient CCGT at the Day-ahead prices in France, Germany



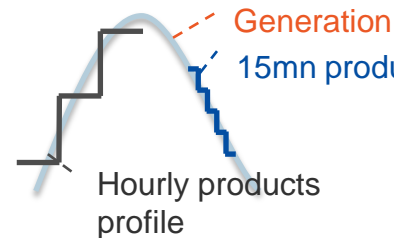
--- Fixed costs CCGT (€/MW/yr)

--- CCGT Fixed O&M (€/MW/yr)

Balancing needs exacerbated by forecast errors

- **Generation ramps** handled with quarters
- **Forecast deviations** : Wind/solar forecasts can vary significantly from Day-ahead forecast to last Intraday Forecast

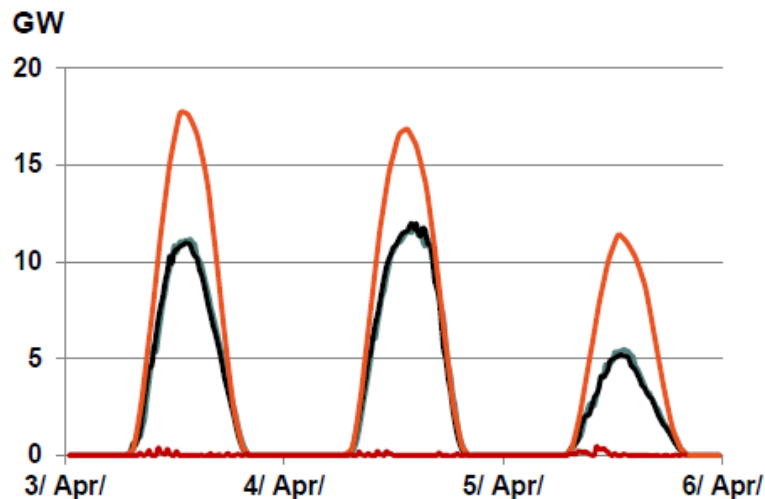
Generation Ramps



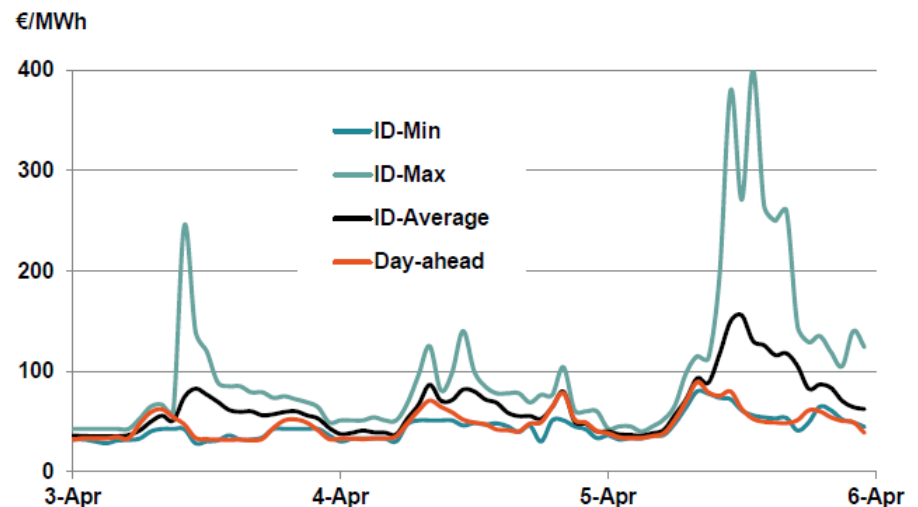
Forecast Deviations



Day-ahead PV forecast inaccuracy and Intraday price impact



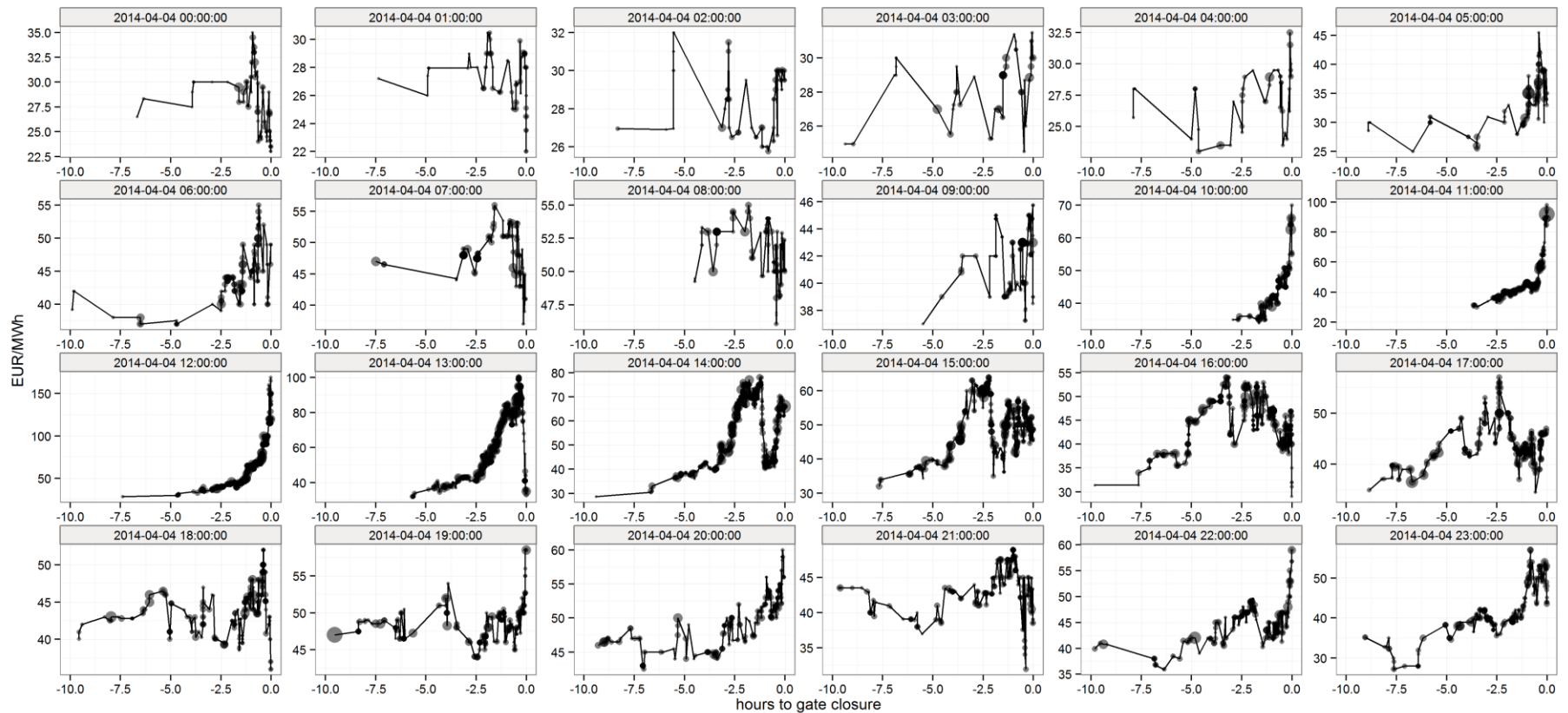
- Day-ahead PV forecast
- Last intraday PV forecast
- PV extrapolation



Source: 50 Hertz, EPEX SPOT

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Some Intraday Price Developments...



Source: EPEX SPOT

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What is flexibility? Is there a value for flexibility on the Intraday?

System
level

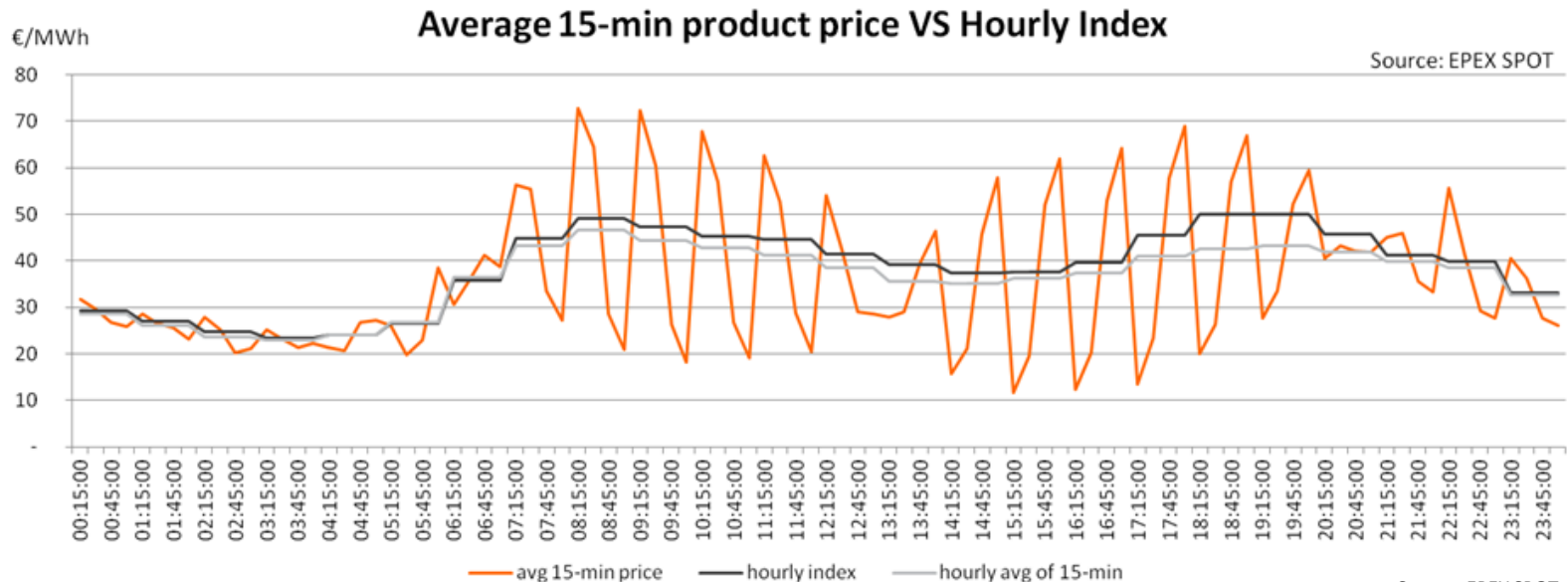


« Ability of the system to accomodate increasing levels of uncertainty while maintaining satisfactory levels of performance »

Ressource
level



« Ability of a ressource to start-up quickly and adjust load output to changing market conditions »



Source: EPEX SPOT

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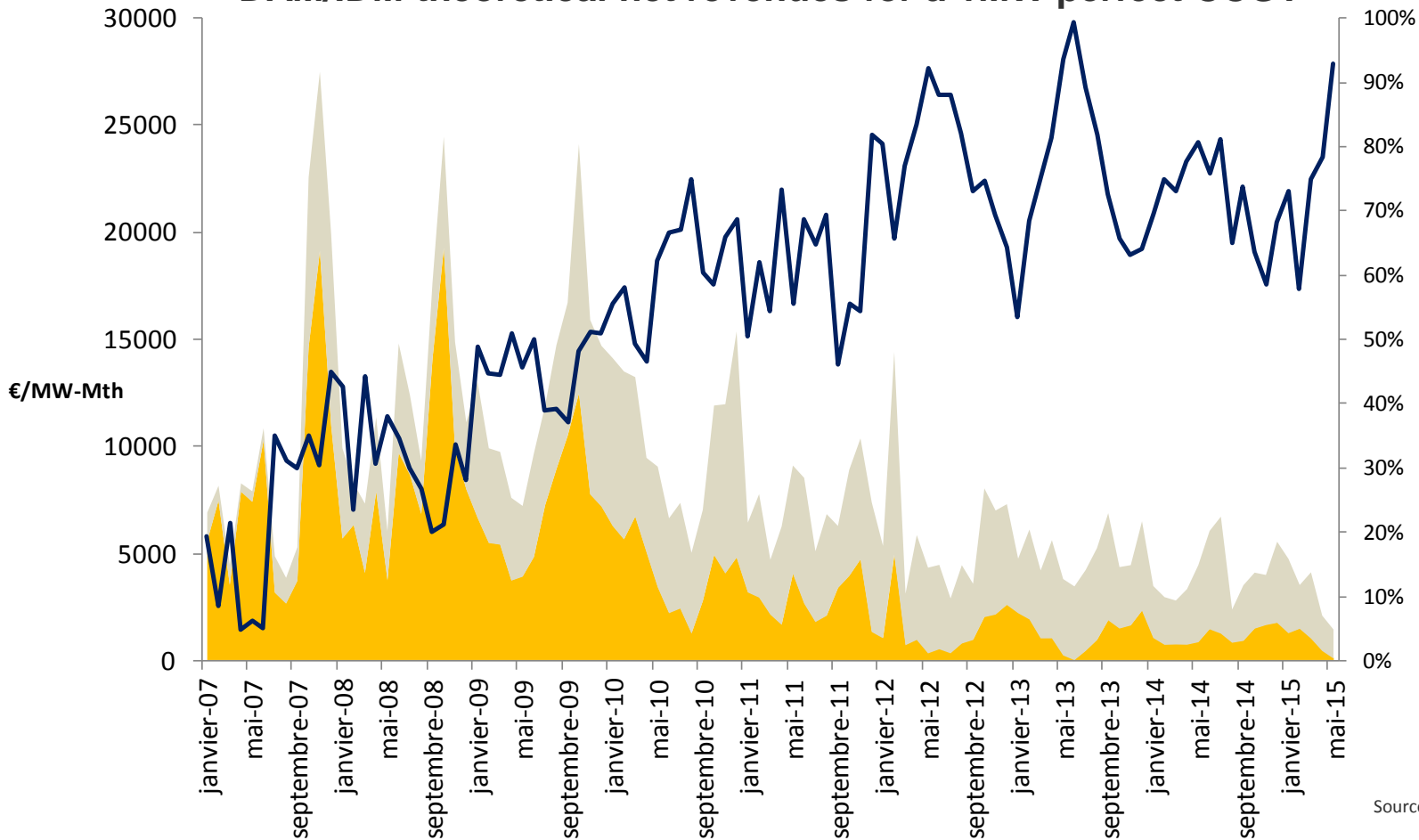


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What is the value of flexibility?

The share of revenues from hourly Intraday compared to day-ahead

DAM/IDM theoretical net revenues for a 1MW perfect CCGT



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Revenues DAM

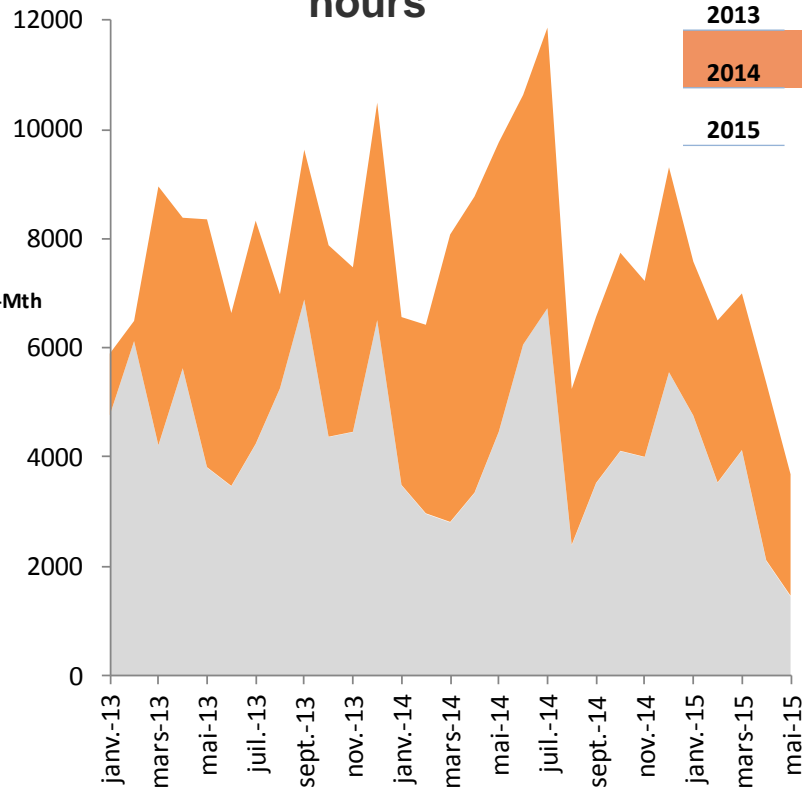
Additional revenues from IDM

Ratio Day-ahead / Intraday

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A flexible plant can increase revenues significantly on the quarterly market

IDM theoretical net revenues for a 1MW CCGT with quarters/ hours



€/MW-yr	Continuous Hr (High)	Continuous Qr (High)	Continuous Qr (WAP)	Continuous Qr (Low)
2013	59 729,39	95 501,44	33 407,95	6 191,27
2014	49 436,61	98 187,12	30 737,11	5 203,61
2015	17 833,67	33 682,18	8 162,30	1 212,21

- On/Off decisions of the plant at the quarterly level
- Flexible plants benefit from higher price volatility at quarterly level
- Revenues almost double with quarters
- Perfect flexibility at quarterly level very challenging...

Source: EPEX SPOT, EEX

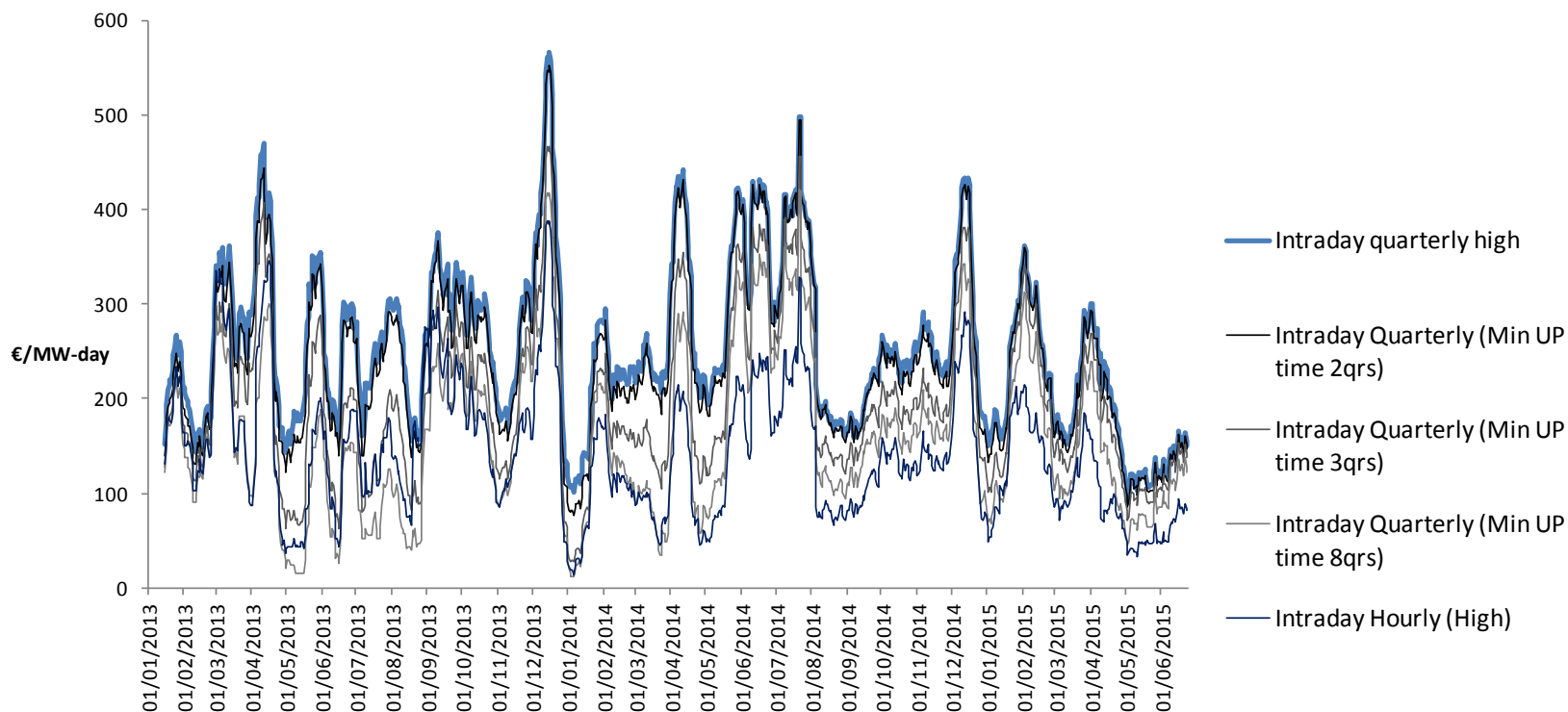
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A unflexible plant would not see benefits in trading quarterly contracts

€/MW-Yr	Intraday quarterly (High)	Intraday quarterly (Min up time 2hrs)	Intraday quarterly (Min up time 3hrs)	Intraday quarterly (Min up time 8hrs)	Intraday hourly (High)
2013	95 501	89 553	70 757	54 242	59 729
2014	98 187,	94 328	77 506,	64 046	49 436
2015	33 682,	32 517	29 318,	24 295	17 833



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Source: EPEX SPOT, EEX

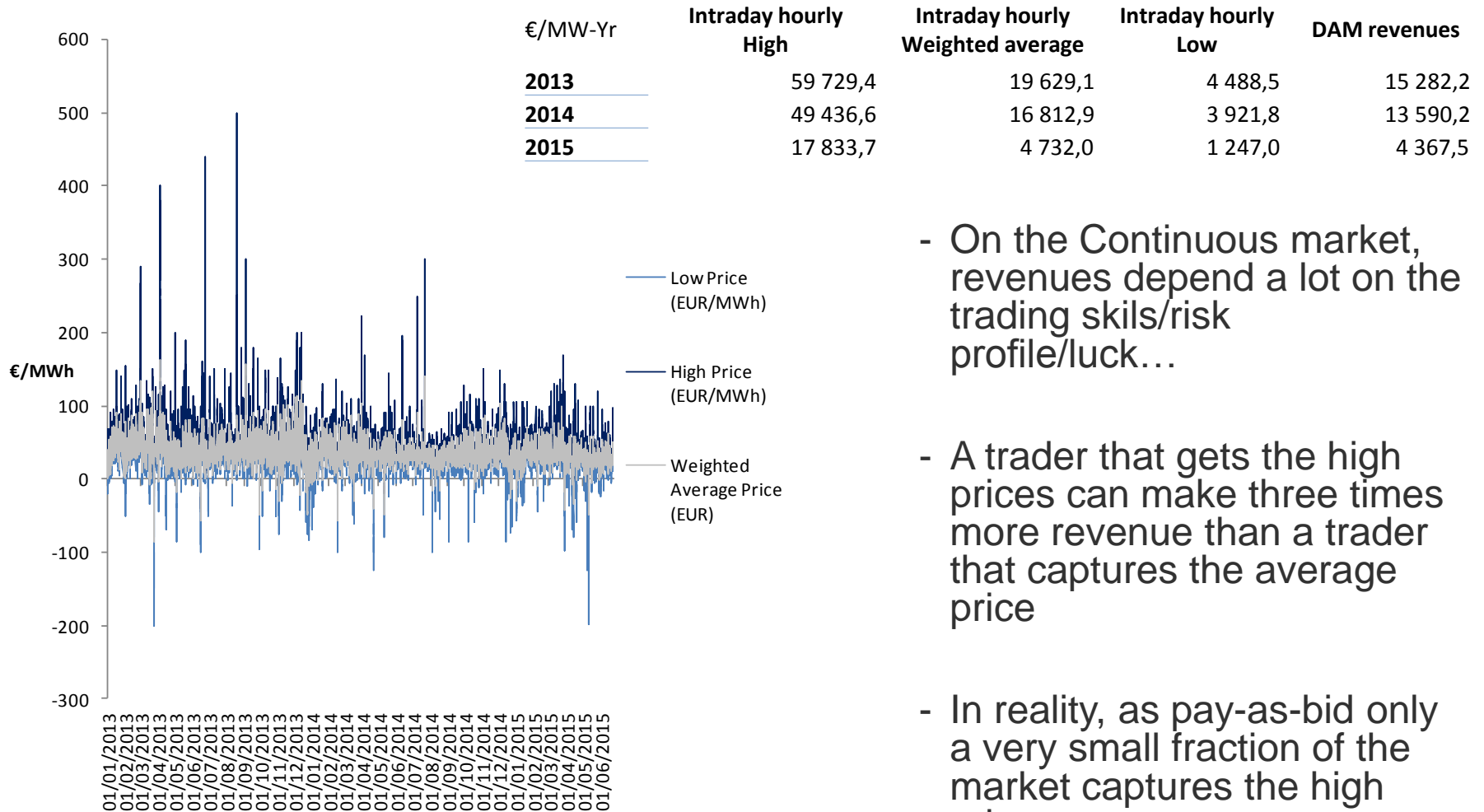
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Recap in terms of Intraday profitability

€/MW-yr	2013	2014	2015*
Intraday hourly price High	59 729,39	49 436,61	17 833,67
Intraday hourly price Weighted average	19 629,12	16 812,89	4 732,02
Intraday hourly price Low	4 488,55	3 921,81	1 246,99
Intraday quarterly (High)	95 501,44	98 187,12	33 682,18
Intraday quarterly (High) (Min up time 2qrs)	89 553,26	94 328,33	32 517,37
Intraday quarterly (High) (Min up time 3qrs)	70 757,88	77 506,94	29 318,18
Intraday quarterly (High) (Min up time 8qrs)	54 242,89	64 046,44	24 295,34
Day-ahead market	15 282,19	13 590,19	4 367,46

Source: EPEX SPOT, EEX

Revenue volatility during the trading session can be high on the continuous Intraday



- On the Continuous market, revenues depend a lot on the trading skills/risk profile/luck...
- A trader that gets the high prices can make three times more revenue than a trader that captures the average price
- In reality, as pay-as-bid only a very small fraction of the market captures the high price

Flexibility from a market design perspective

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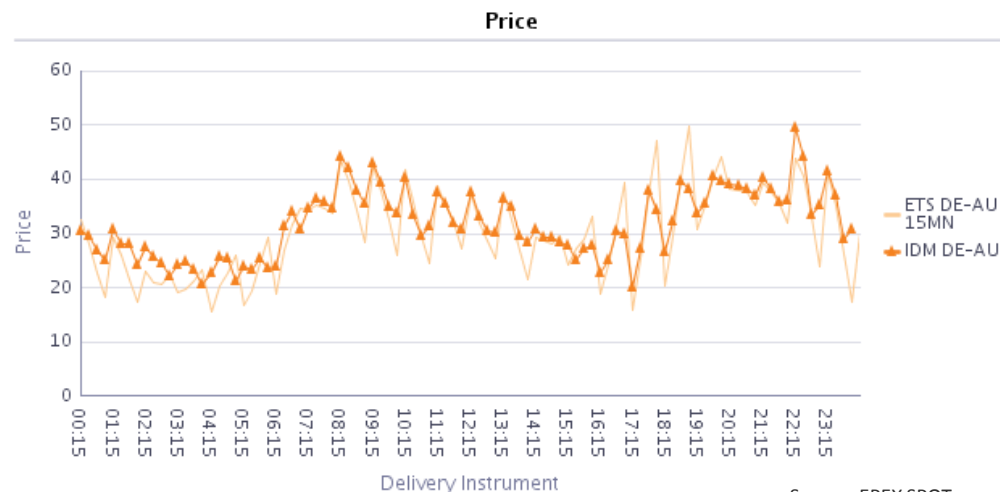
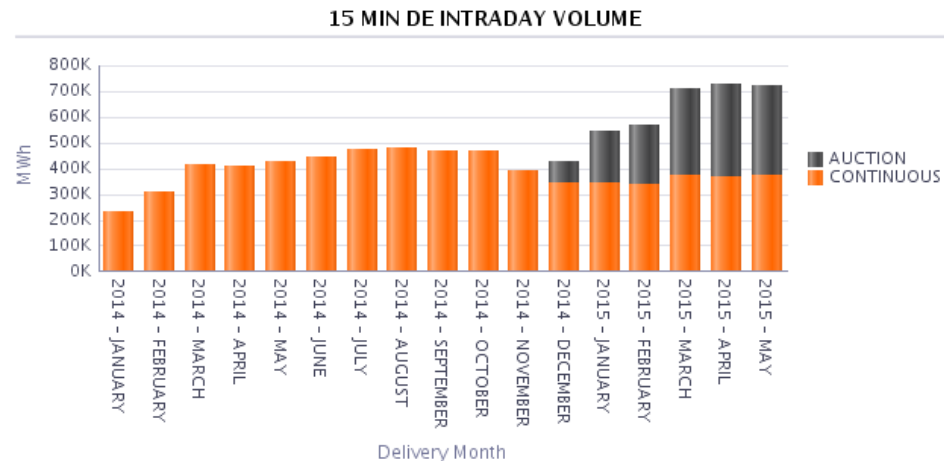
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Flexibility from the PX perspective

- **The Power exchange can help reveal/value embedded system flexibility**
 - If the market needs more flexibility it should signal this need...
 - A question of short-term price signal & liquidity
- **A short-term price signal** to reward flexibility
- **A question of liquidity:** Concentrating liquidity during times of varying market conditions can help ALL market players!
- **The power exchange can facilitate trading/Valuing of flexibility**
 - Decreased lead-time
 - 15mn products satisfy a need that was not covered by 1hr contracts
 - Local DE Auction for 15-minute contracts at 15h to concentrate liquidity
- **What can be done to enhance flexible capacity further?**
 - New products: Intraday Auctions & Options

Intraday auctions as a complement to continuous trading for a flexible target model

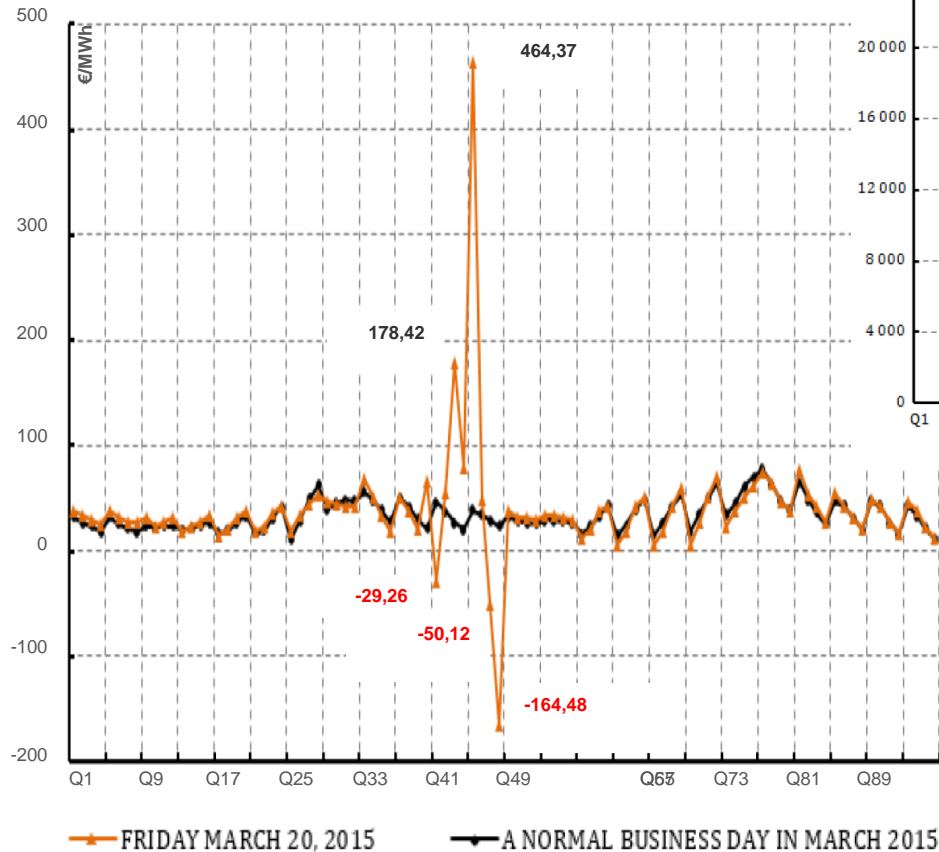
- **Some pros/cons of Intraday auctions Vs Continuous**
 - Liquidity (15mn auction \approx 10-15GWh/day)
 - Uniform pricing Vs Pay As Bid
 - Continuous Vs Discrete
 - Transmission capacity pricing
 - Problem complexity (15/30/60mn+Block products, Smart blocks, multi-part bids)
 - Level-playing field : no arms race
 - Reliability
- **Regulations have an important role to play**
 - **Flexible regulatory framework**
 - **Target model** needs to be flexible to accommodate the evolution in market conditions



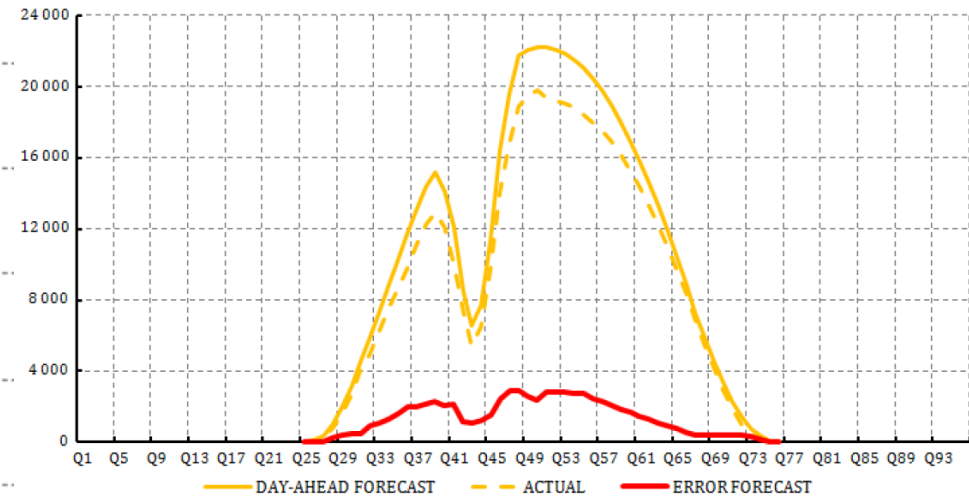
Source: EPEX SPOT

European power exchange as a component of security of supply during the solar eclipse

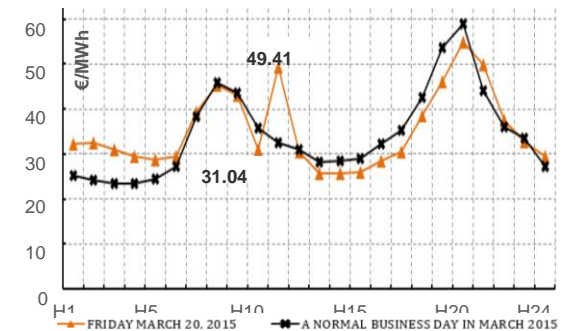
INTRADAY PRICES



SOLAR FORECAST



DAY-AHEAD PRICES



Source: EPEX SPOT, TSOs

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FIVE
YEARS

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