

Analysis of future electricity prices

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INTRODUCTION

Research question

- How accurate are the forward prices?
 - What can explain the forward prices?
 - Are they biased towards higher prices than realised?

Two steps

- To hedge price for e.g. DK1 in 2016
 - Forward contract for system price (2016)
 - CfD system price to DK1 (2016)

Data

- Yearly financial contracts (Nasdaq)
 - System price and CfD's (from system price to DK1 and DK2)
 - Price and volume per day from 1.1.2005 to 7.12.2015
- Realised spot prices (Energinet.dk)
 - Same periode as above
 - Note that 2015 only covers until 7.12.2015
- Hydro data (Nord pool)
 - Reservoir content and inflow
 - Weekly value 2005 to 2015

Financial contracts

- Here we focus on yearly contracts
 - Until May 2006: Three years ahead
 - Until February 2013 five years ahead
 - After March 2013: 10 years ahead
- Other products (“cascading”):
 - Quarterly
 - Monthly
 - Weekly
 - Daily



Observation in data set

Product (System price)	Historical observations of trade
ENOYR-2006	2005: 1 year
ENOYR-2007	2005-2006: 2 years
ENOYR-2008	2005-2007: 3 years
ENOYR-2009	2006-2008: 3 years
ENOYR-2010	June 2006-2009: 3.5 years
ENOYR-2011	June 2006-2010: 4.5 years
ENOYR-2012	2007-2011: 5 years
ENOYR-2013	2008-2012: 5 years
ENOYR-2014	2009-2013: 5 years
ENOYR-2015	2010-2014: 5 years

First in 2018 more than 5 years history will be available.
On 2023 10 years history will be available.

Conclusion (preview)

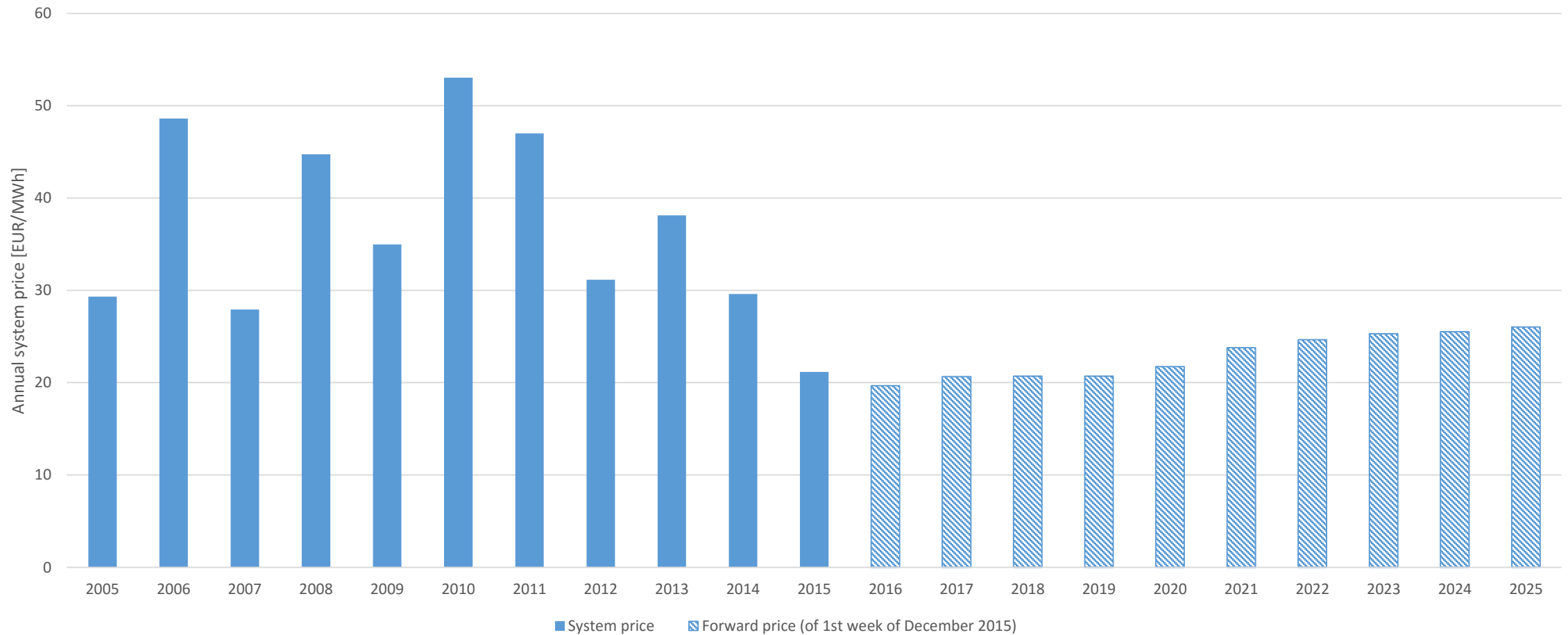
- Forwards for 2016-2025 are nearly equal (in real prices)
- Forwards tend to be above realised prices (20-60% 3 to 5 years before)
- Liquidity is very low for forward – more than 2 years ahead
- Forward price is clearly linked to the daily spot price (or rolling average)
- **Very little information about the expected price, e.g. in 2020 or 2025, can be derived from the forward prices**

SYSTEM PRICE

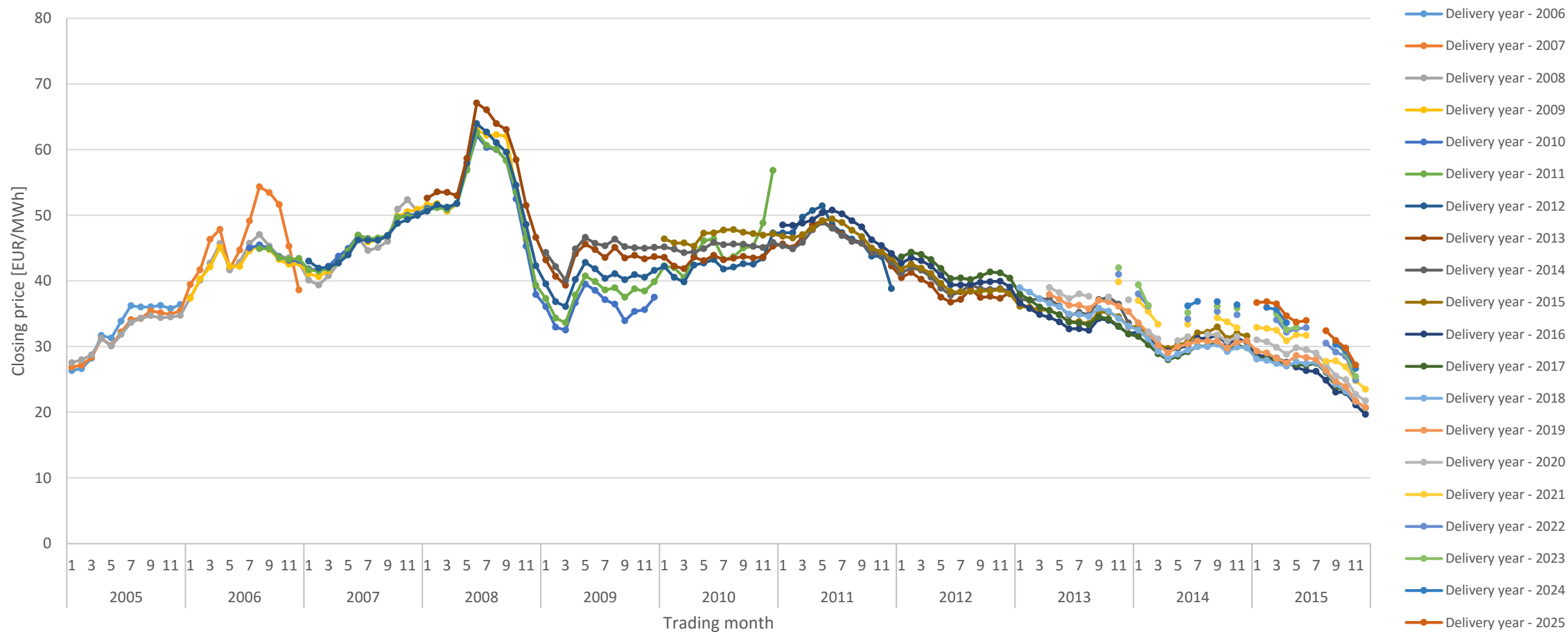
System price

- An artificial price: The spot price for the entire Nord Pool area if there were no congestion
 - Area definition: Nordic area
 - Main function of system price is to act as a reference for the financial contracts

Annual system price and forwards

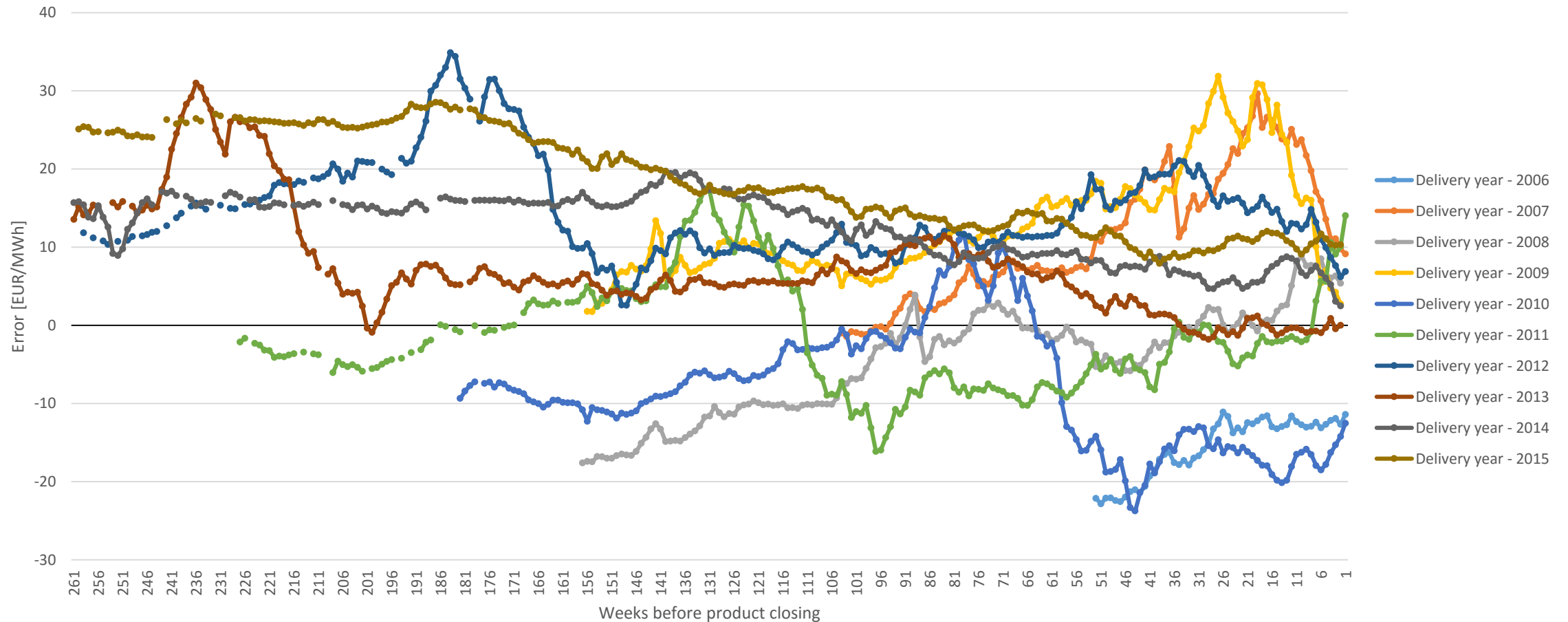


Monthly closing price of the system



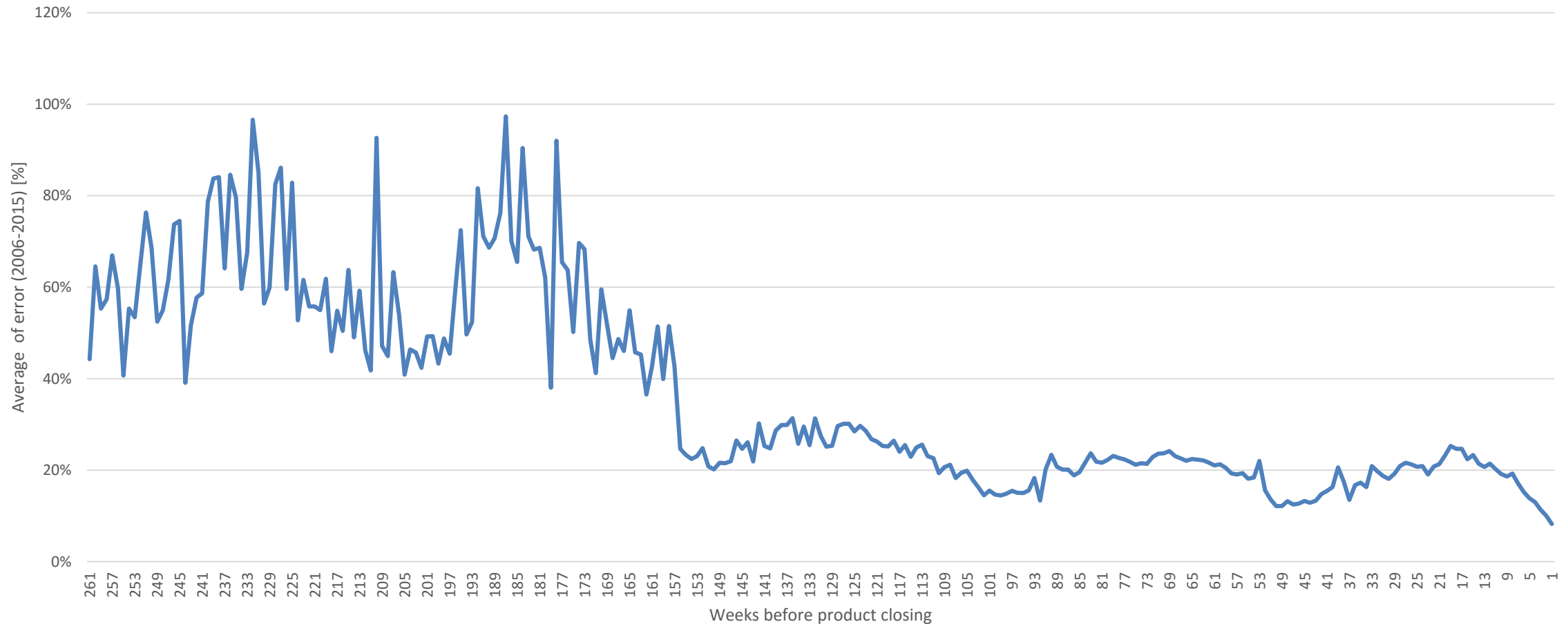
Months with no trade have been excluded.

Weekly error in system price for closed products



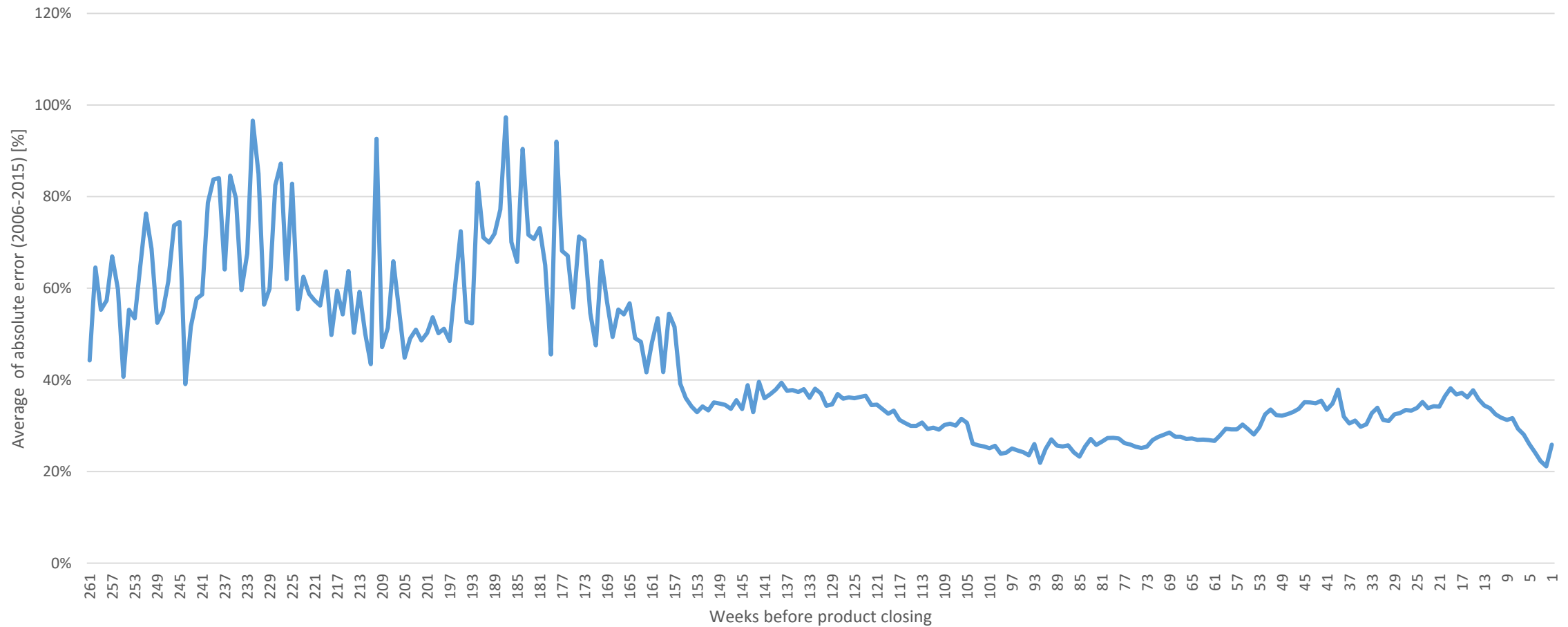
Note that for 2015 only the first 11 months of the realised price have been included (will be updated in January)
Months with no trade have been excluded.

Average of error in system price



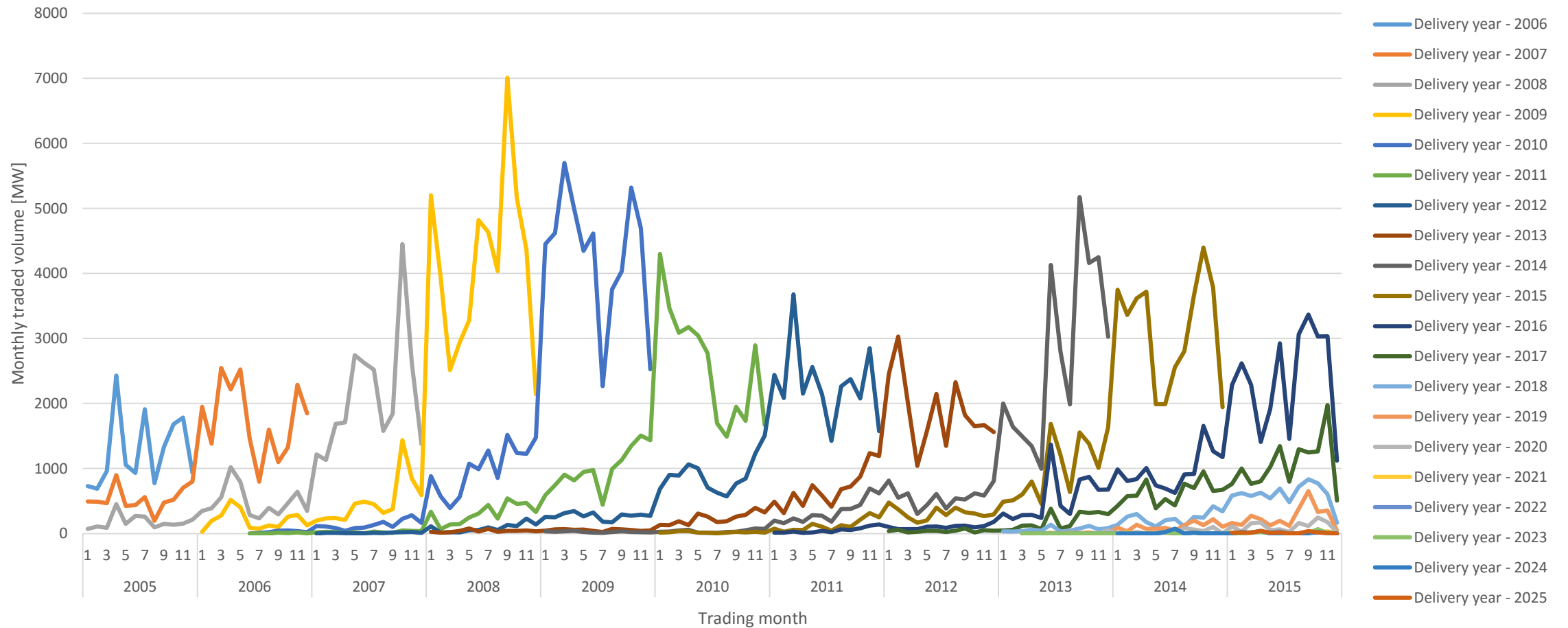
Note: 8 observations with 3 years (156 weeks) before closing. 4 observations with 5 years
Months with no trade have been excluded. Especially relevant for products with 3 and 4 years horizon.

Average of absolute error in system price

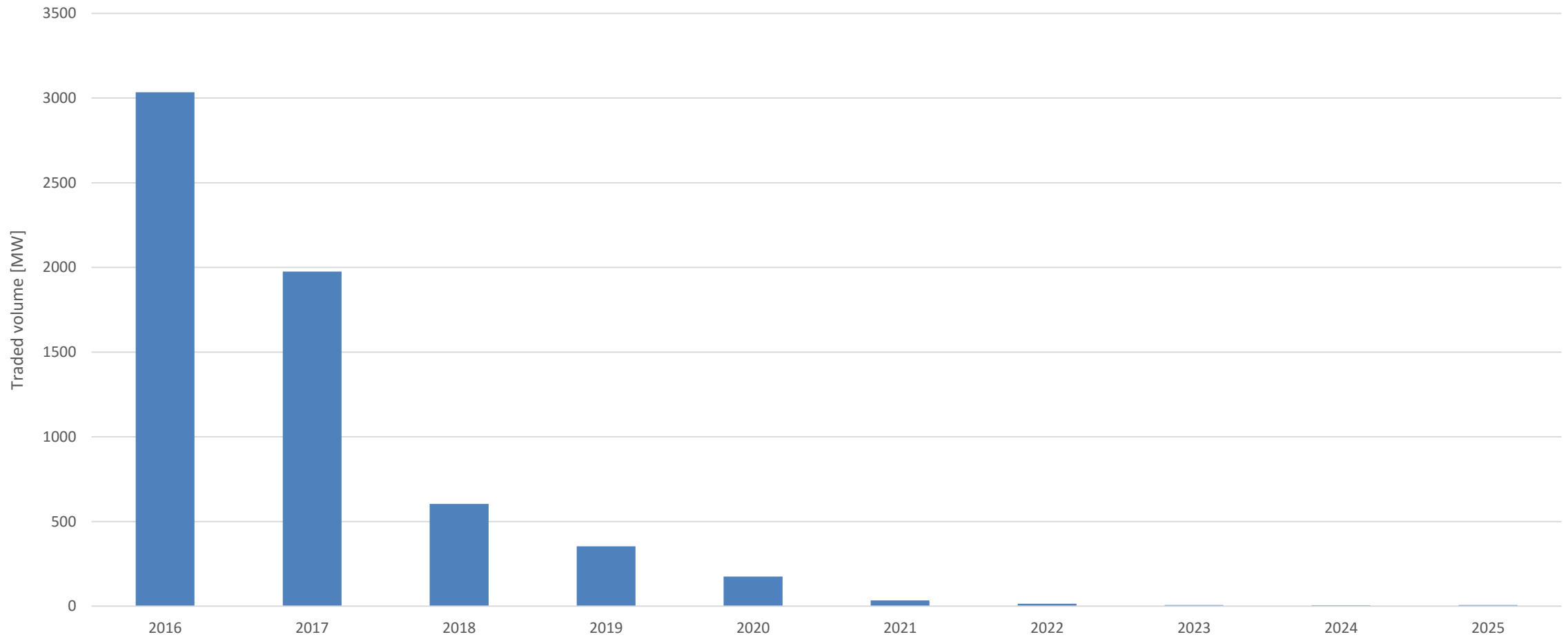


Months with no trade have been excluded.

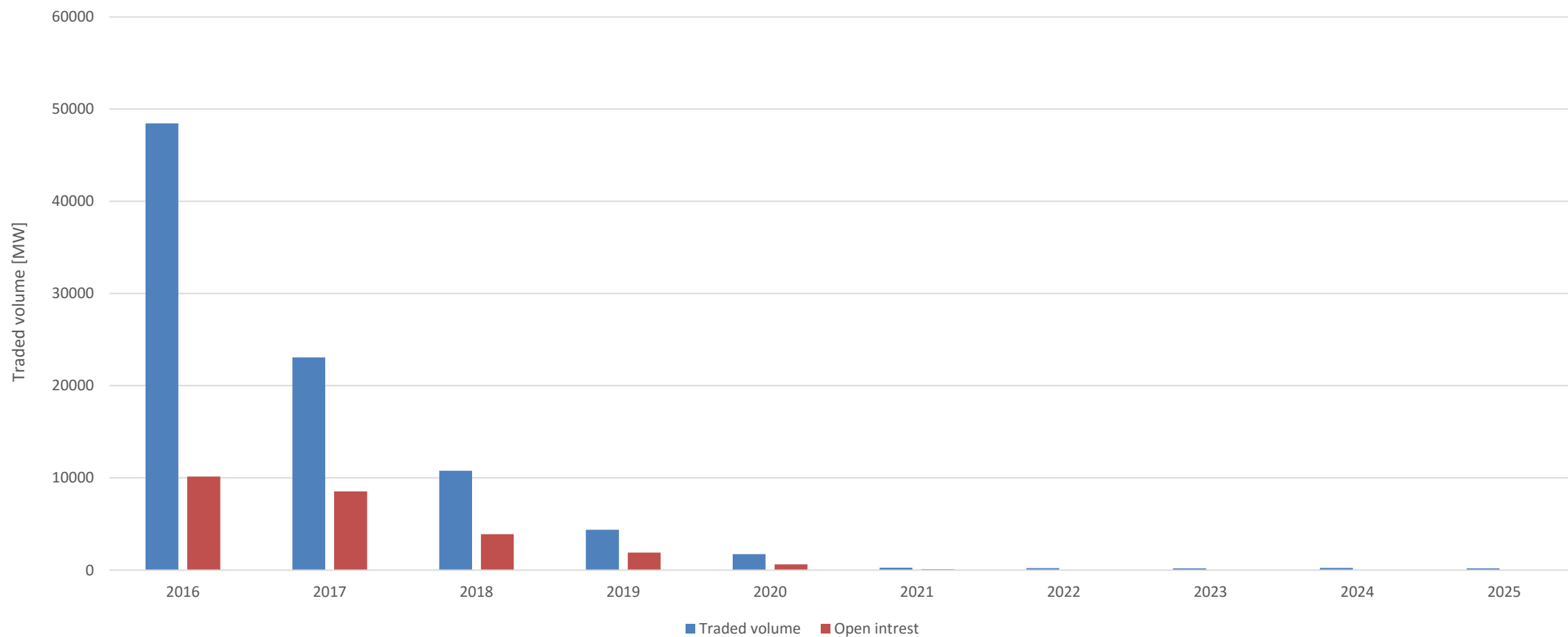
Monthly trade volume of system price



Trade volumes in November 2015



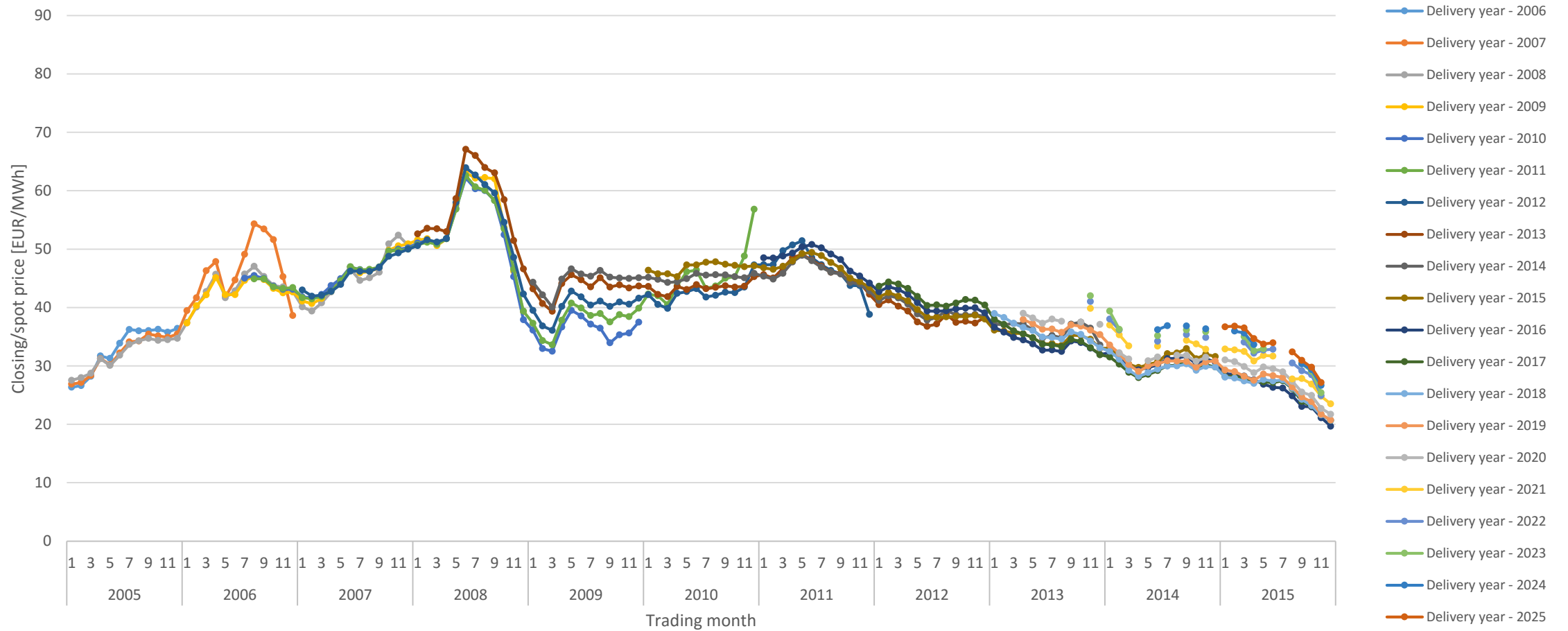
Total traded volumes



To compared with: Average consumption in Nord pool area (2014) = 45,000 MW

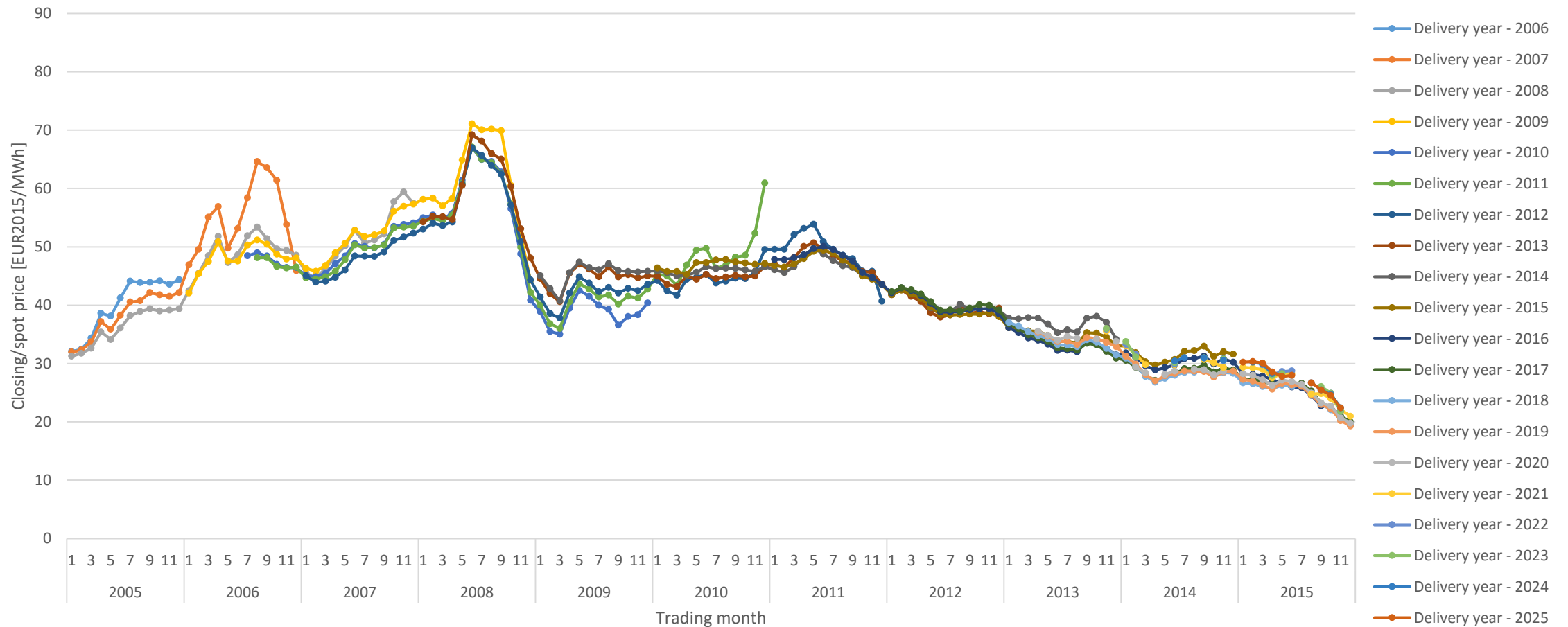
ANALYTICAL...

Forward prices



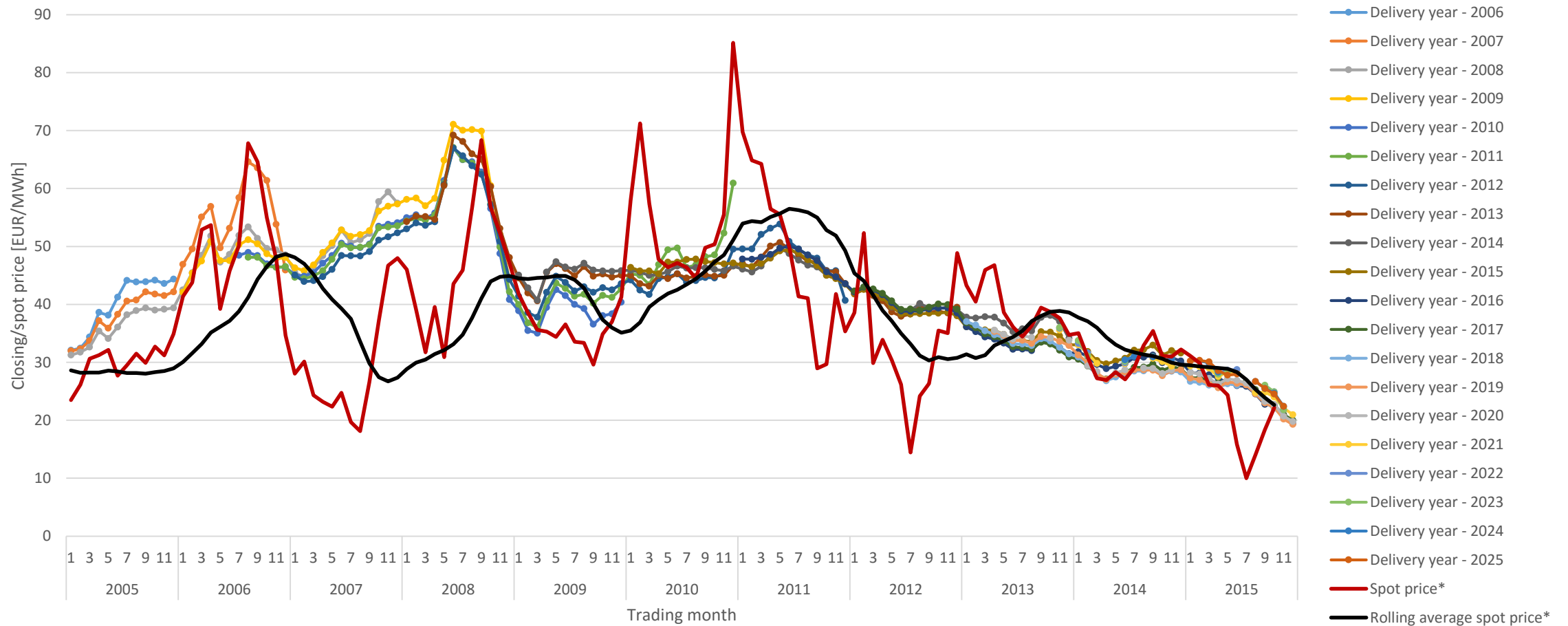
Monthly values

Real (2015) forward prices



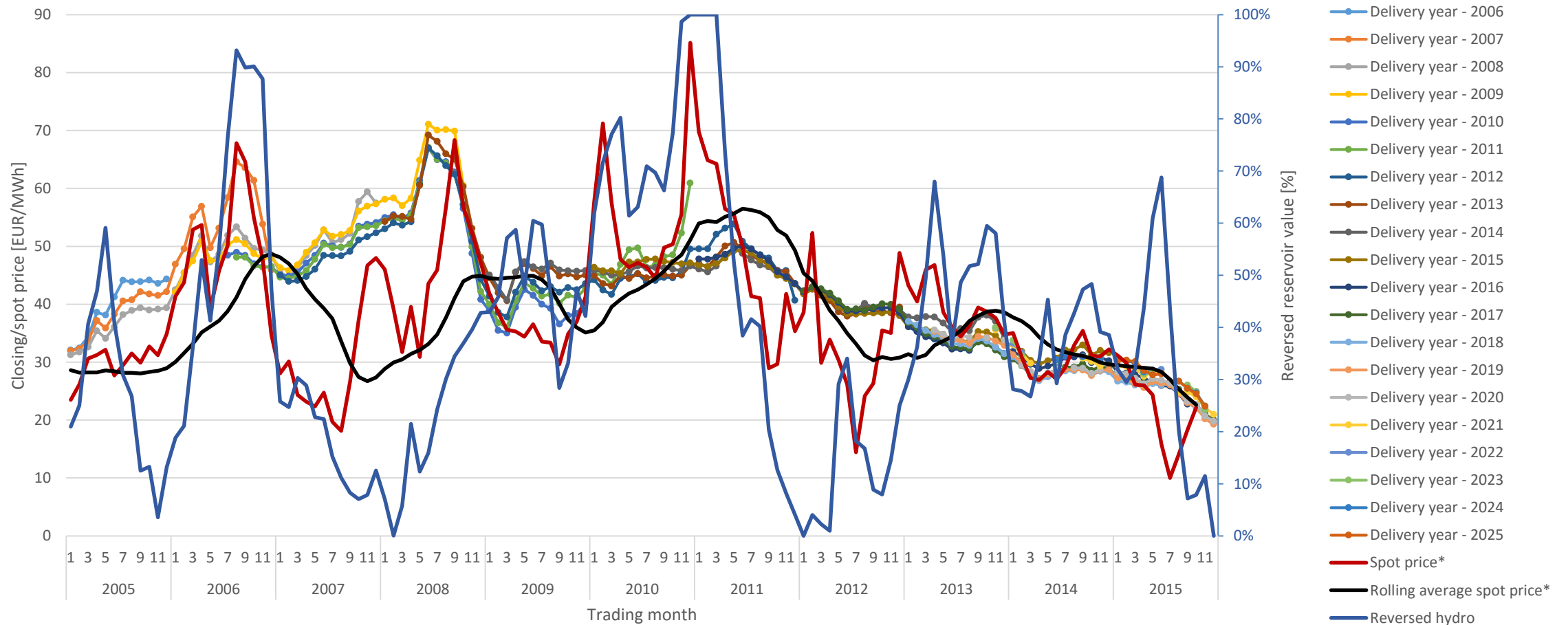
Deflator: Energistyrelsen Samfundsøkonomiske forudsætninger (2014)

Real (2015) forward prices compared to spot price



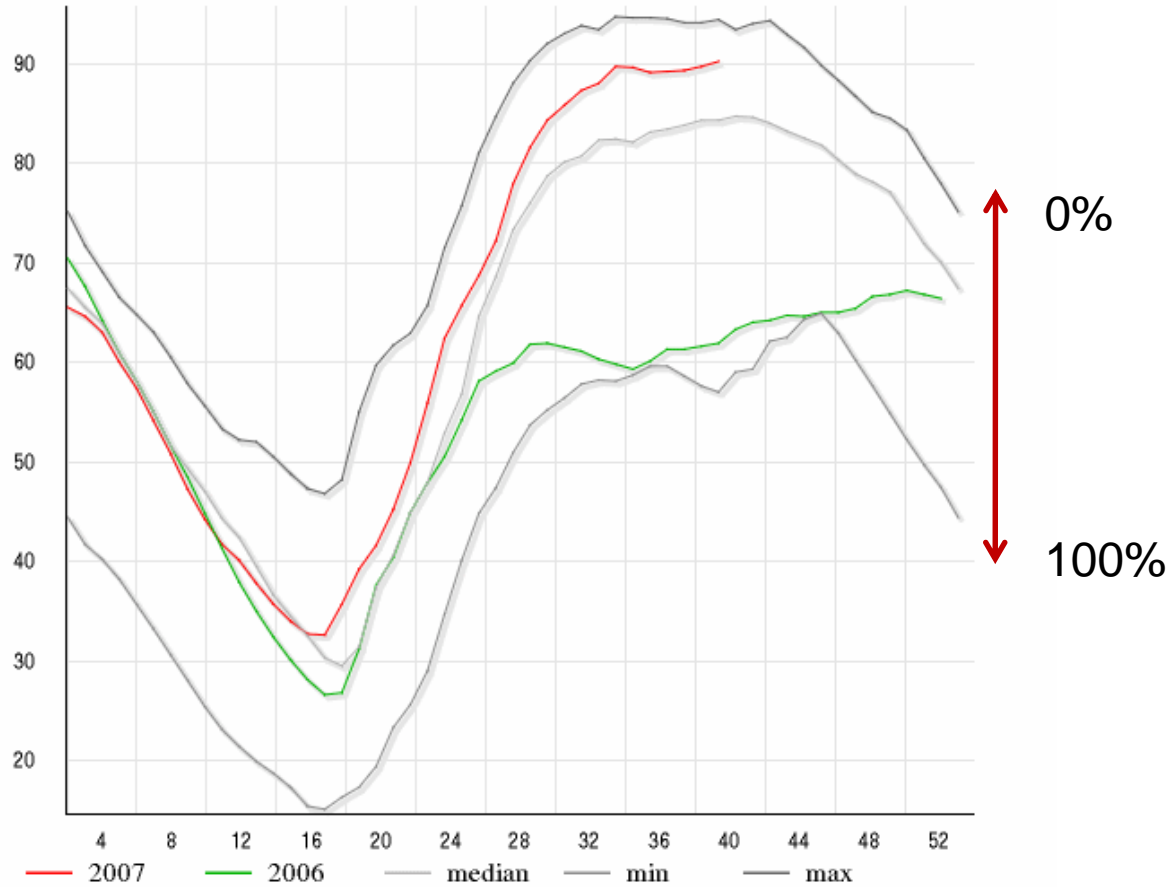
* Spot and rolling average of spot price are nominal prices
Deflator: Energistyrelsen Samfundsøkonomiske forudsætninger (2014)

Real (2015) forward prices compared to spot price and hydro reservoirs



* Spot and rolling average of spot price are nominal prices
 Deflator: Energistyrelsen Samfundsøkonomiske forudsætninger (2014)

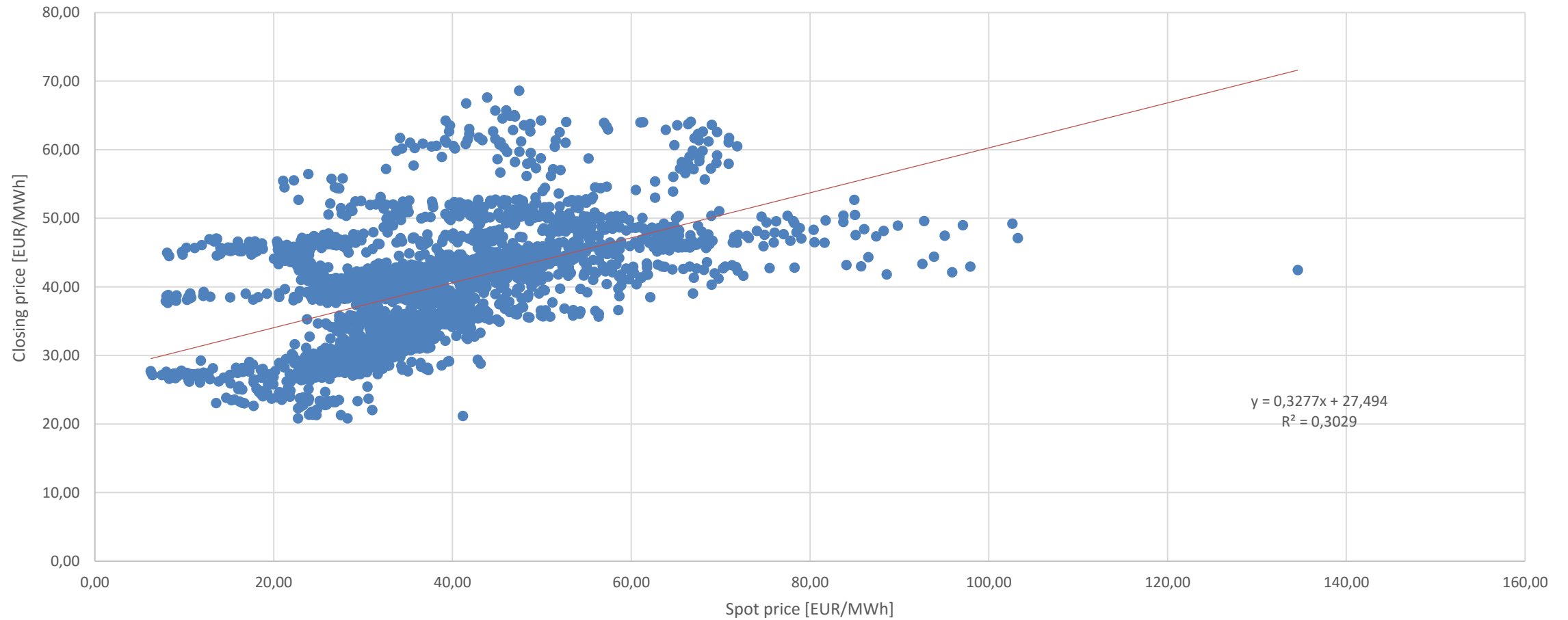
Reversed hydro reservoir



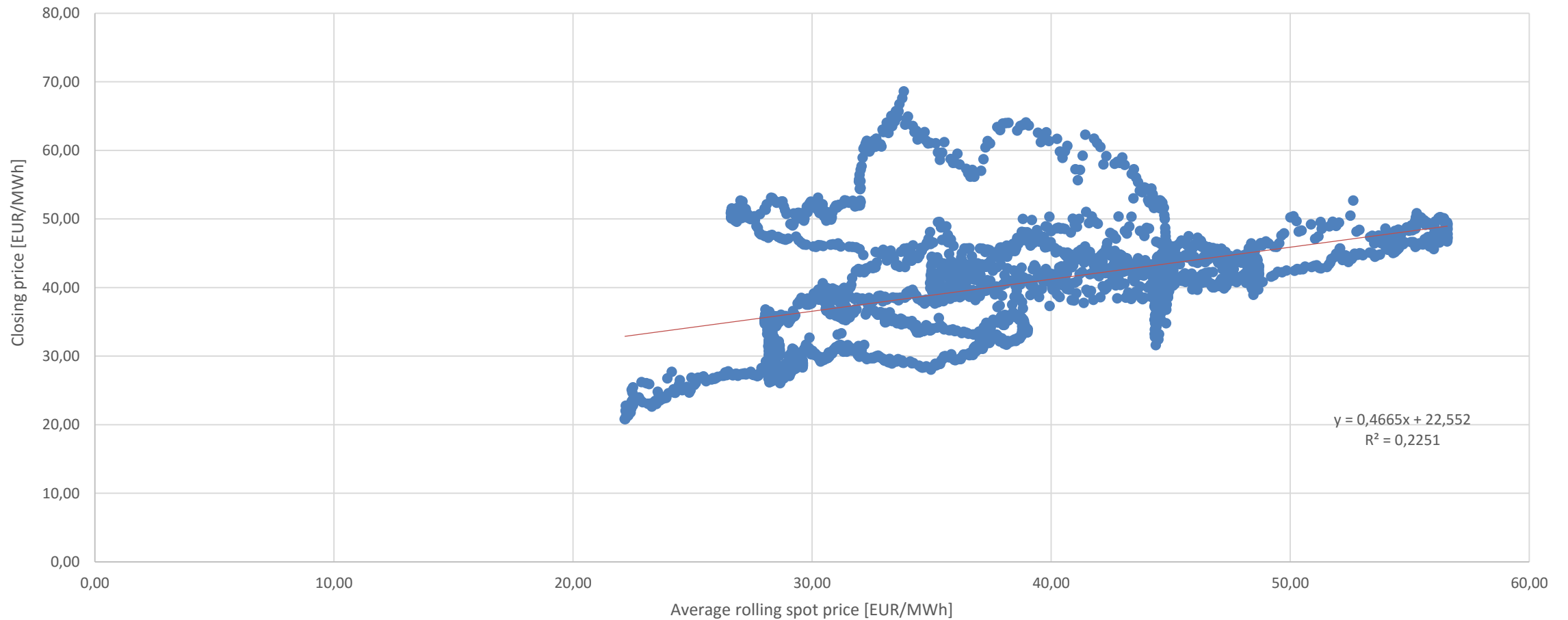
Minimum and maximum values are for the period 1995 - 2015.

Values are for Norway, Sweden and Finland

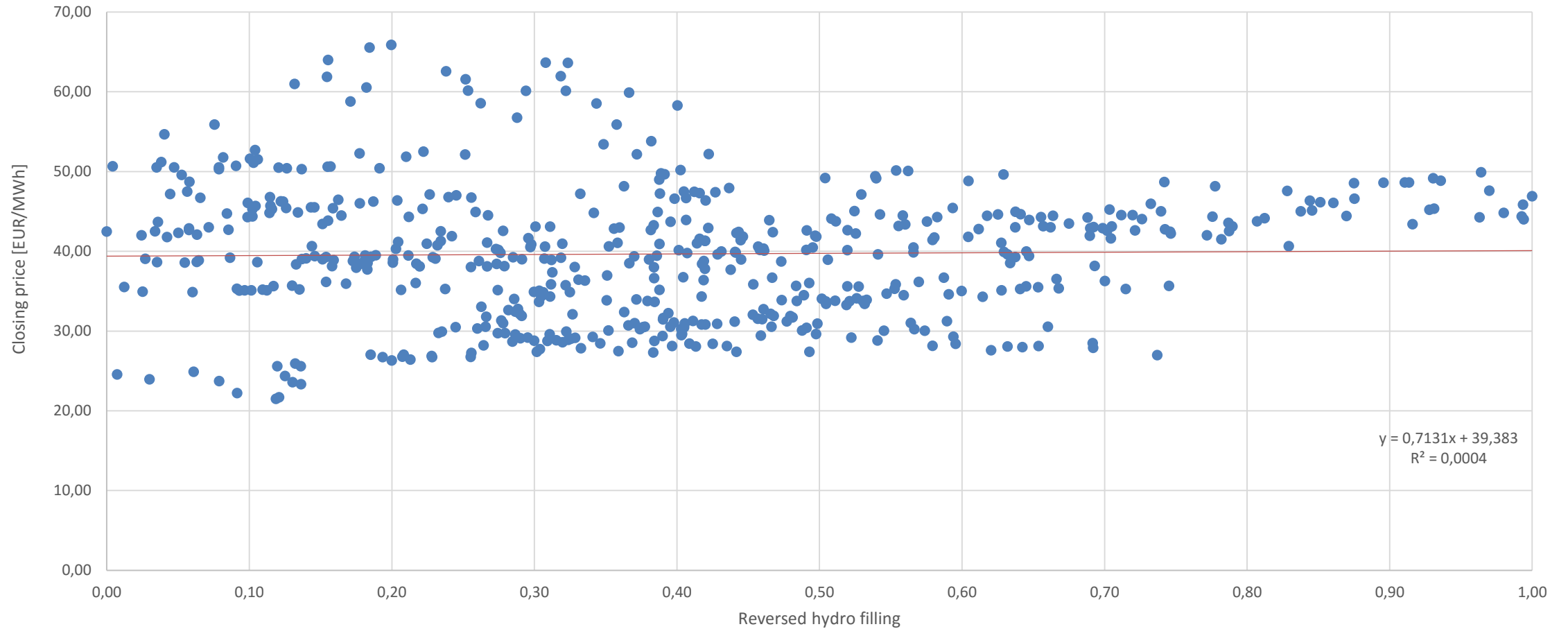
Correlation spot price



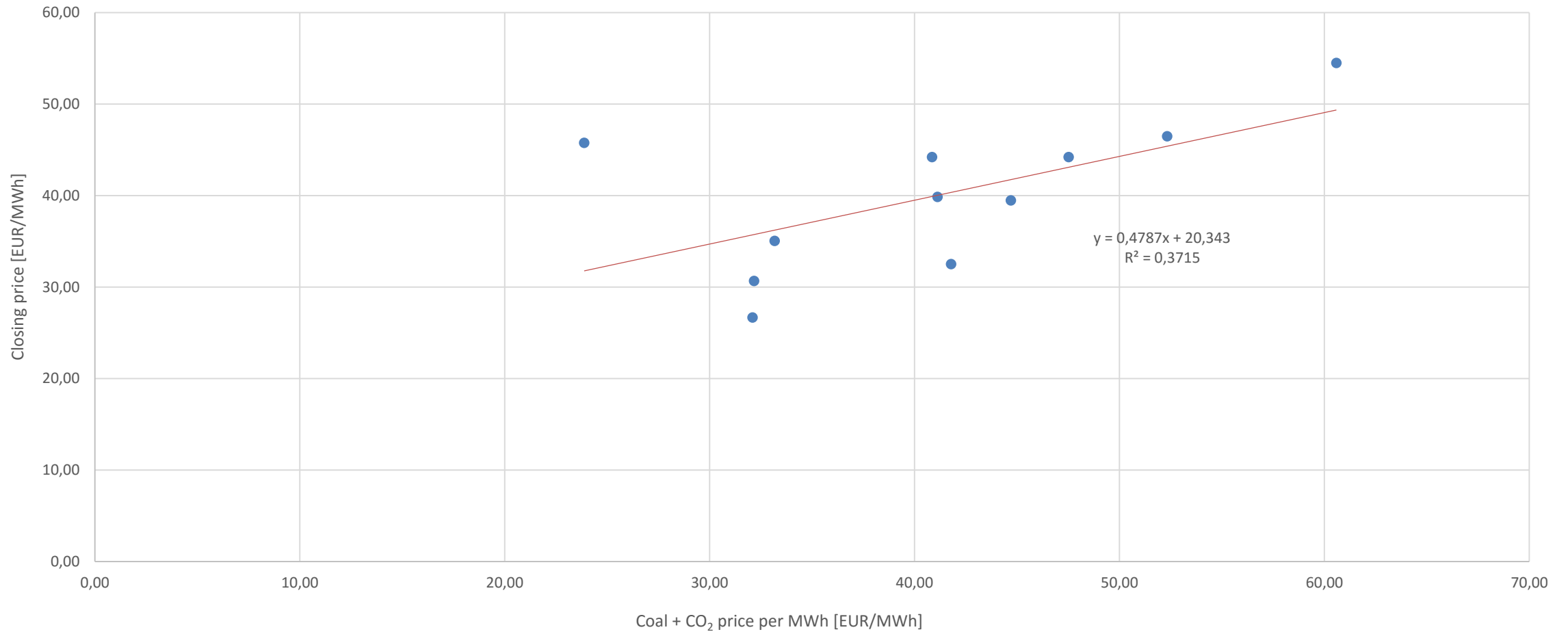
Correlation 12 months rolling average spot price



Correlation reversed hydro fill



Correlation Coal and CO2 price



CONCLUSION

Conclusion

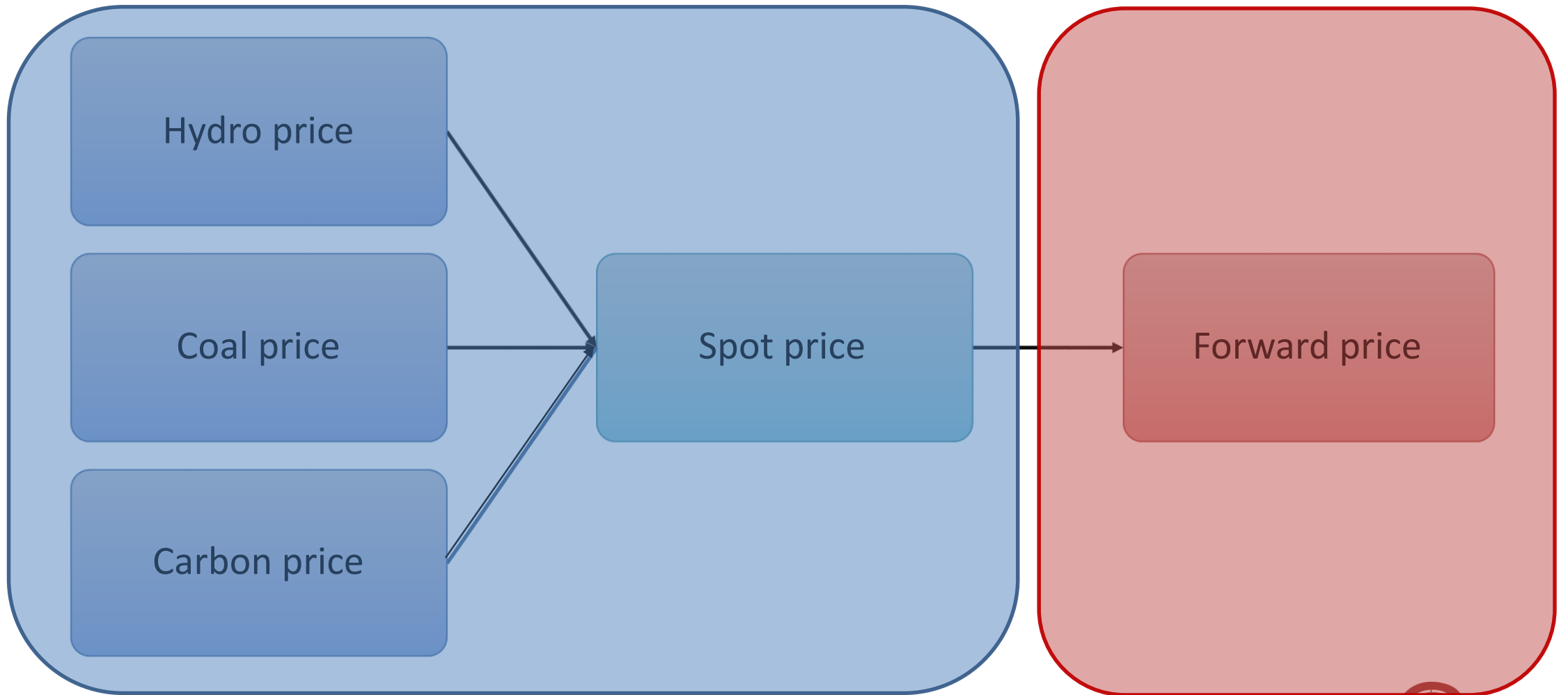
- Forwards for 2016-2025 are nearly equal (in real prices)
- Forwards tend to be above realised prices (20-50% 3 to 5 years before)
 - Insurance premium for consumers
 - Note: Current (Dec. 2015) forward prices are likely to be below realised values (when looking more than 1-2 years ahead)
- Liquidity is very low for forward – more than 2 years ahead
 - Even a minor extra trade is expected to move the price
- Forward price is clearly linked to the daily spot price
- The volumes traded for CfD's are VERY small
 - Many days and months with no trading
- **Very little information about the expected price in e.g. 2020 or 2025 can be derived from the forward prices**



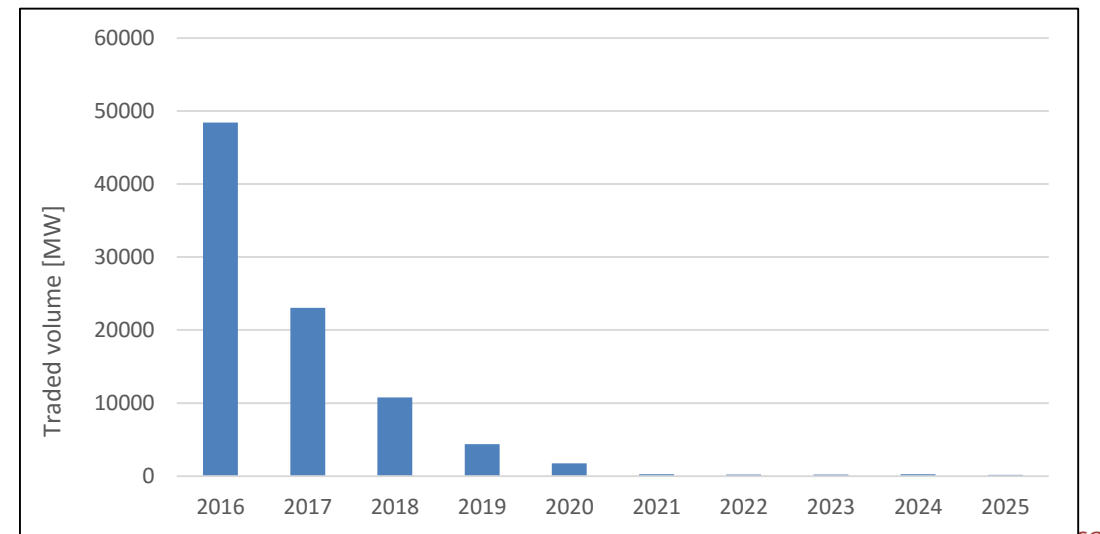
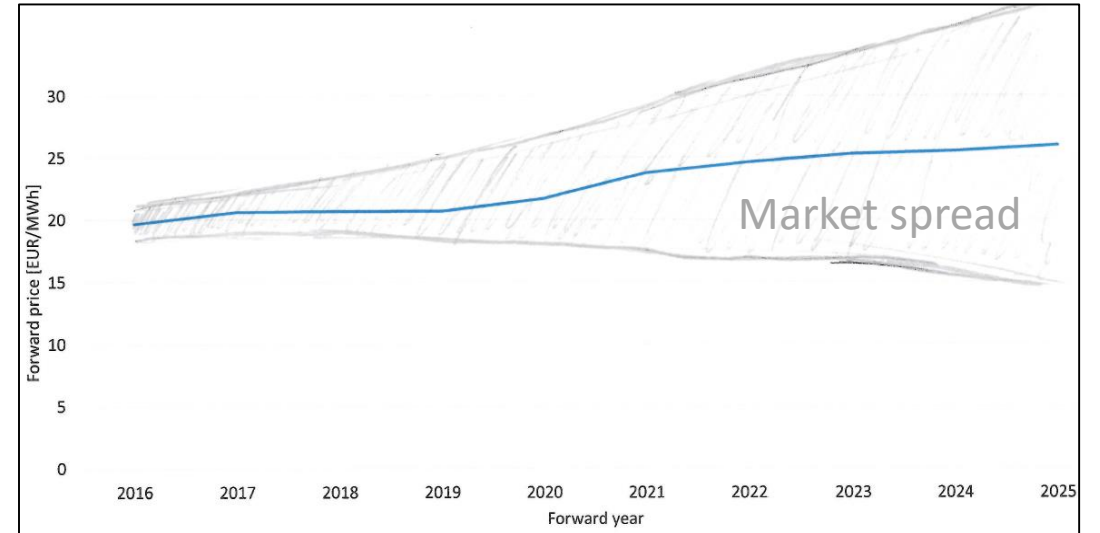
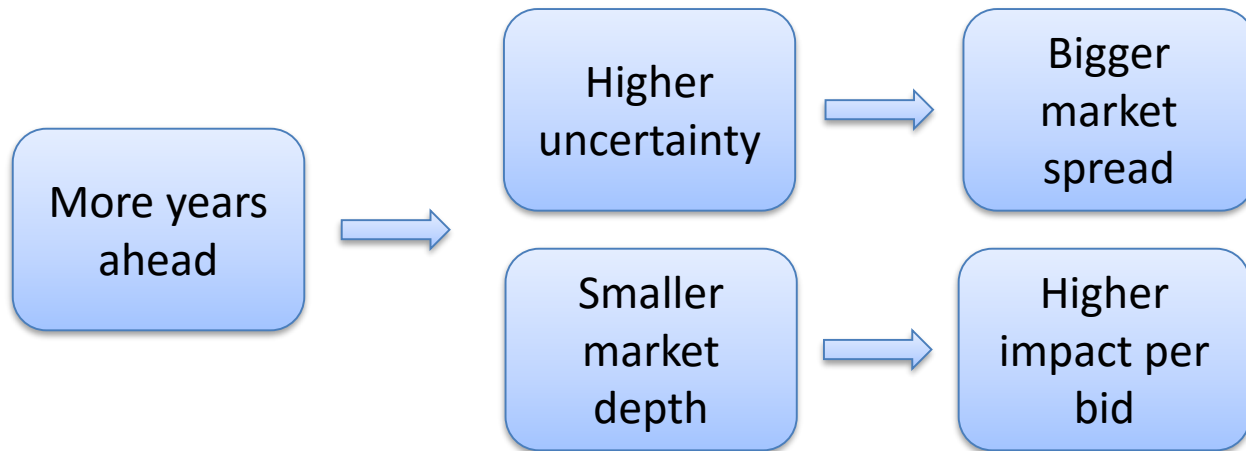
Dependencies

Current

Future



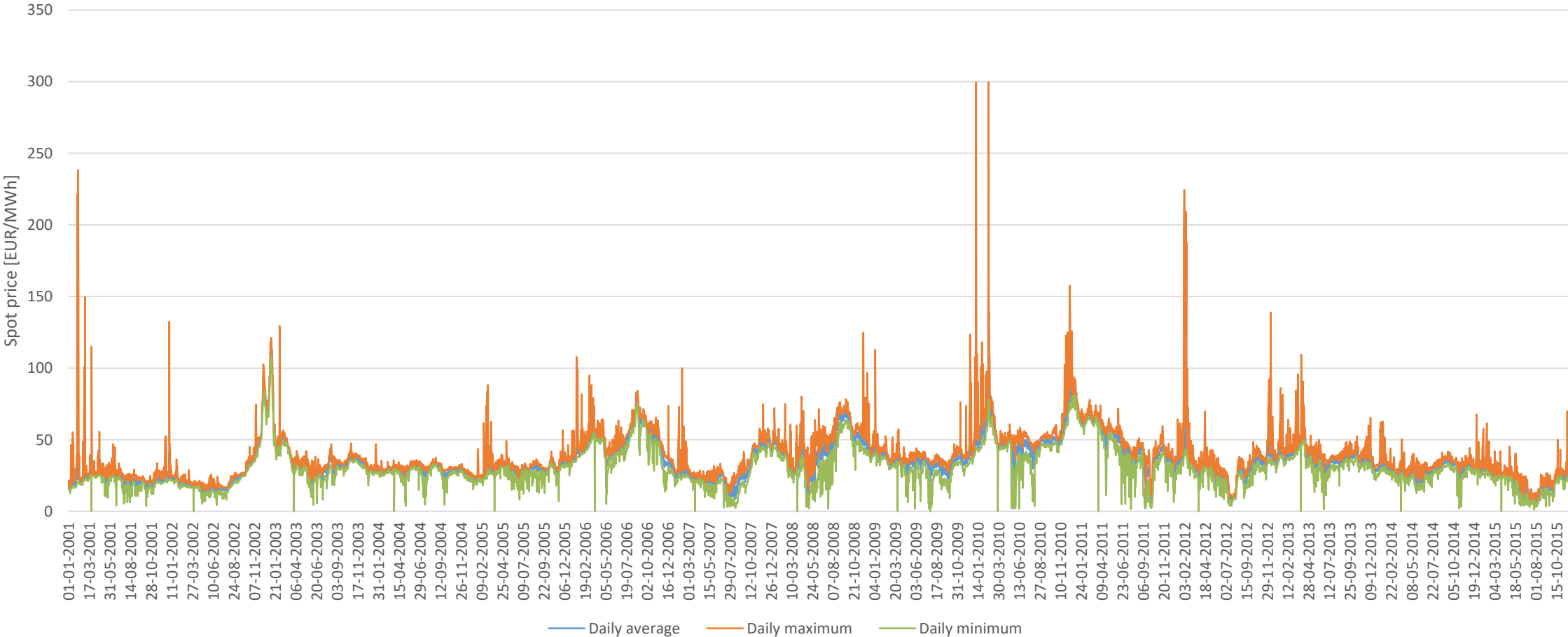
Far future bids



EXTRA

SYSTEM PRICE

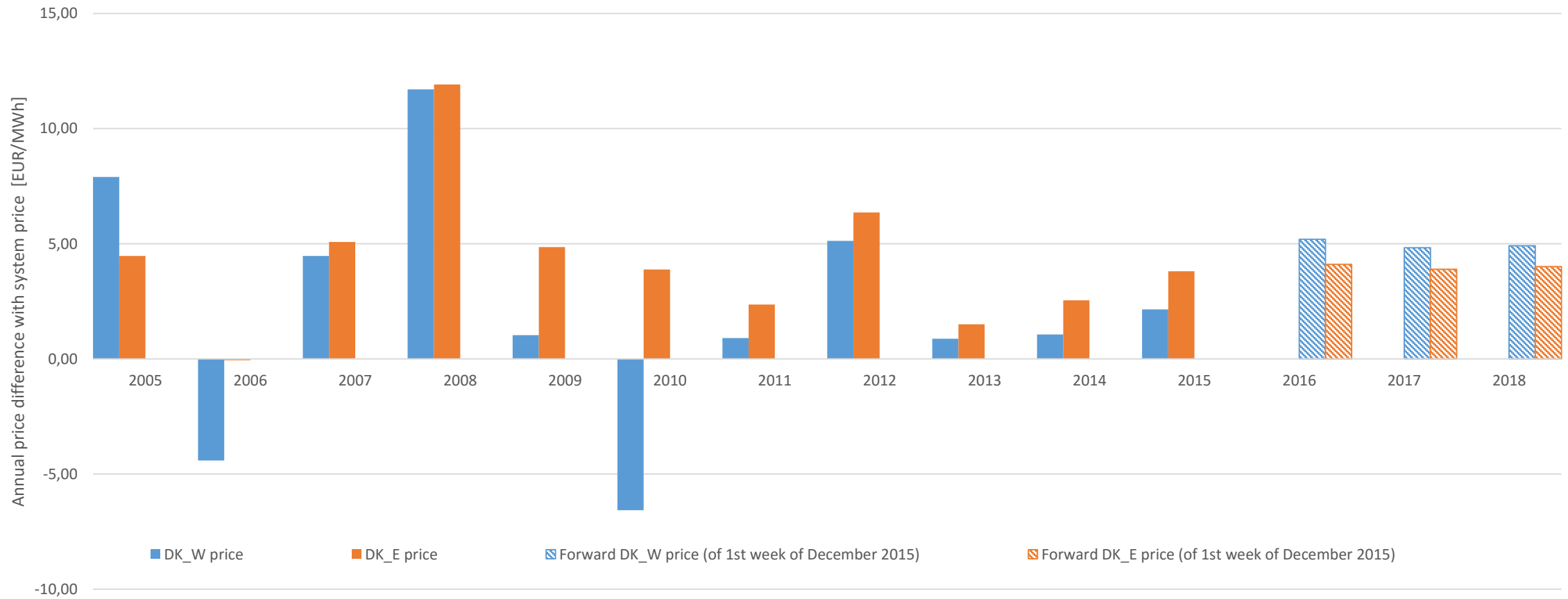
Daily system prices



CFD

PRICE DIFFERENCE: AREA PRICE – SYSTEM PRICE

Annual price difference price and forwards

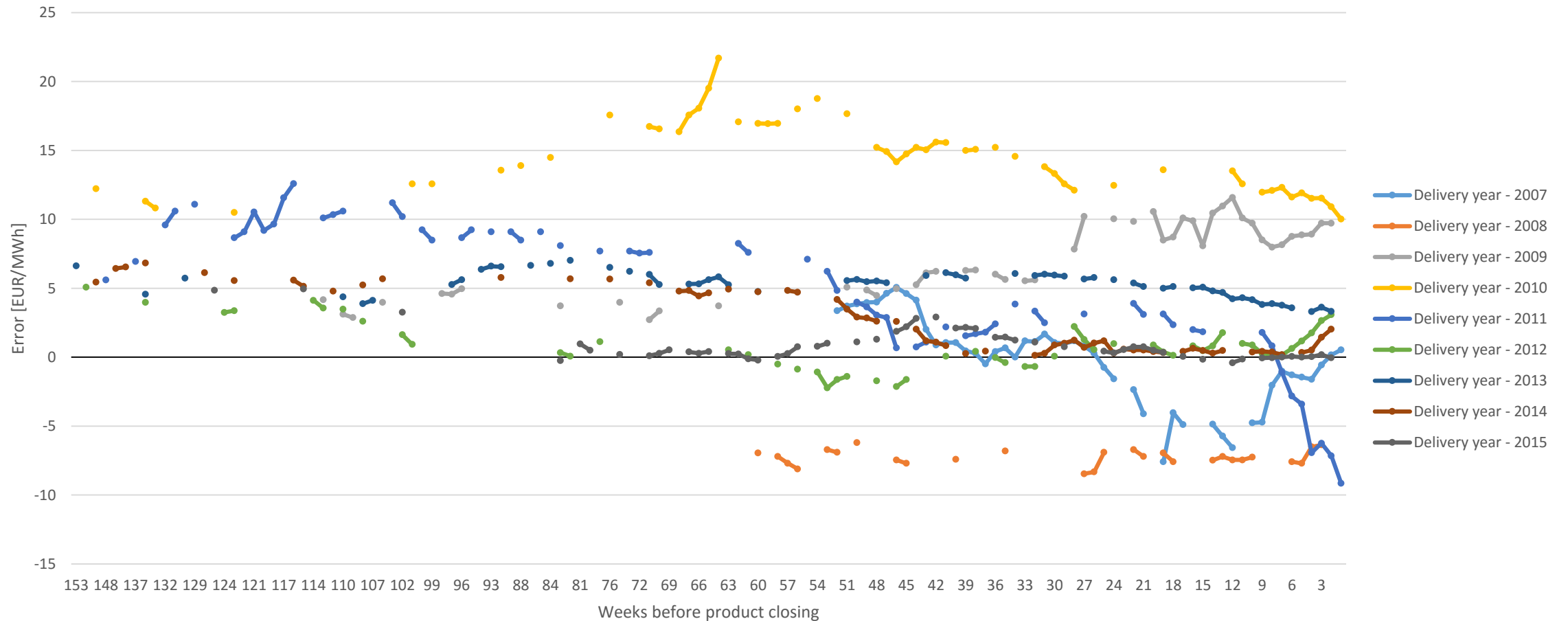


Monthly closing price difference DK_W - SYS



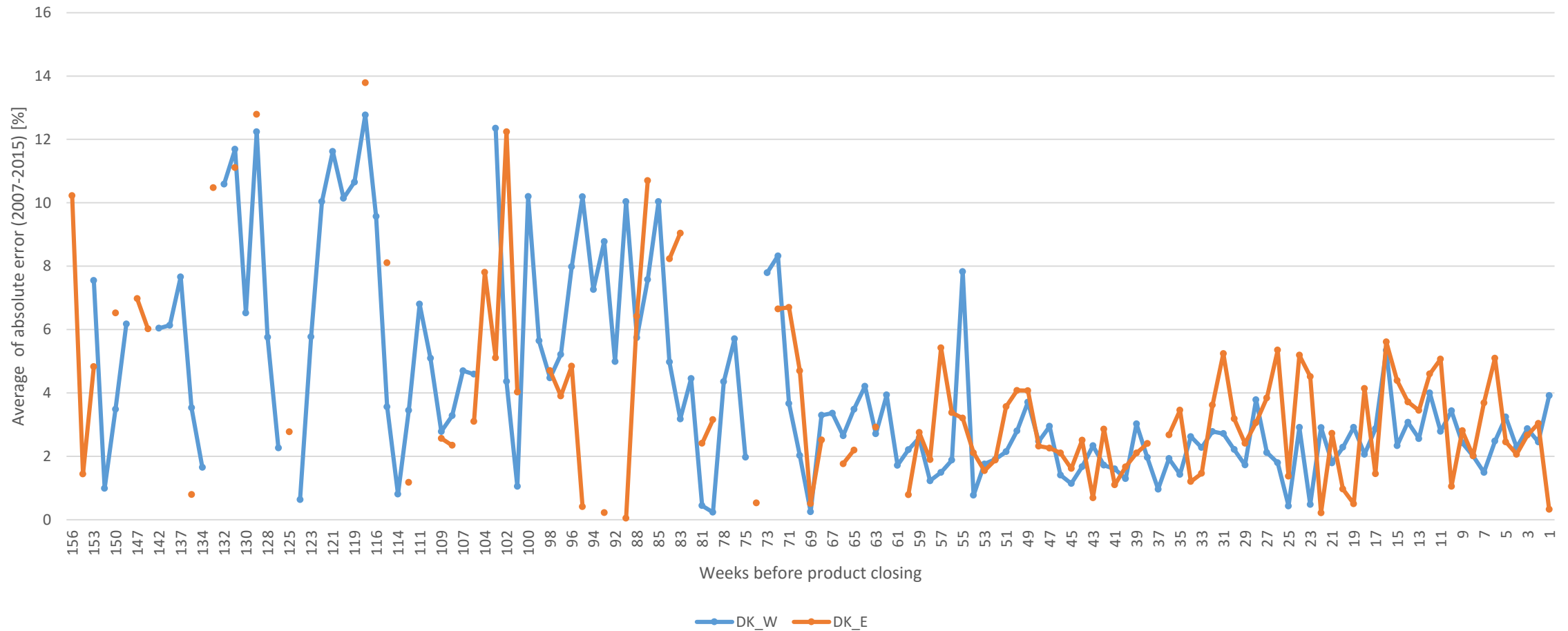
Months with no trade have been excluded.

Weekly error in price difference DK_W - SYS



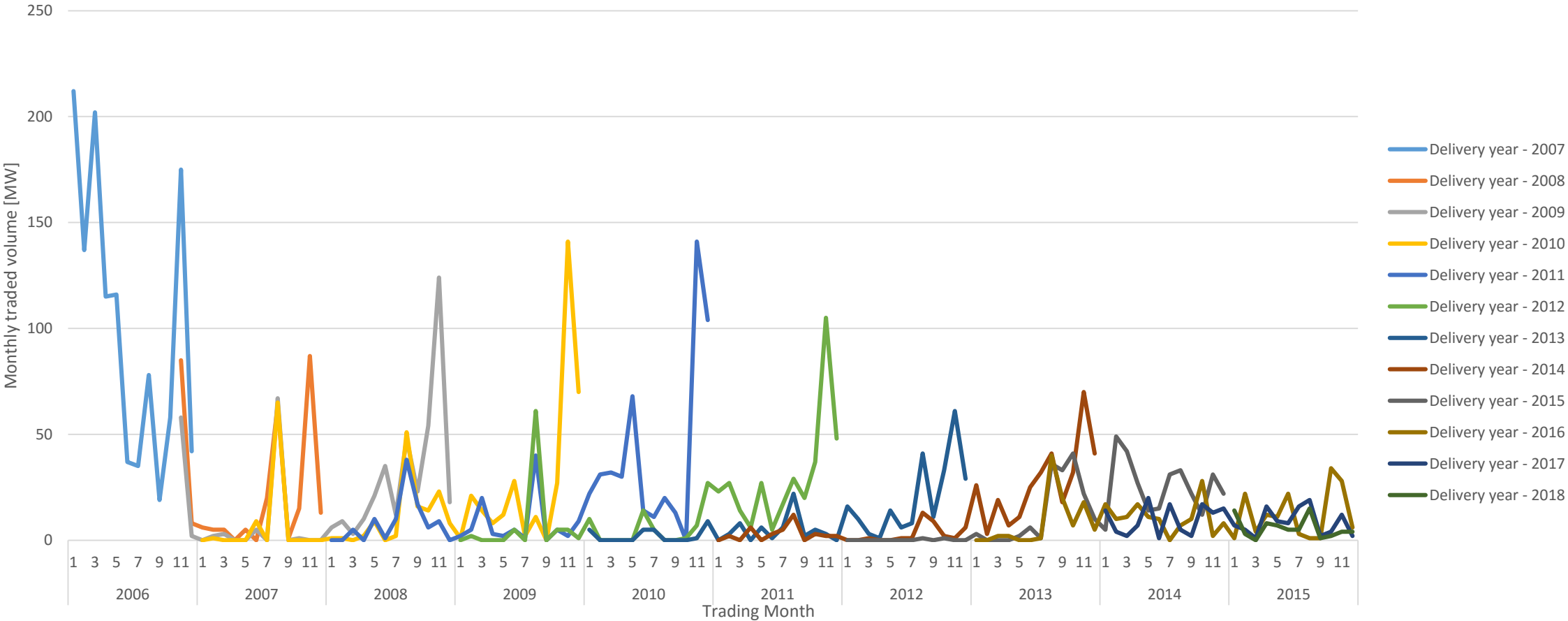
Months with no trade have been excluded.

Average of absolute error in price difference

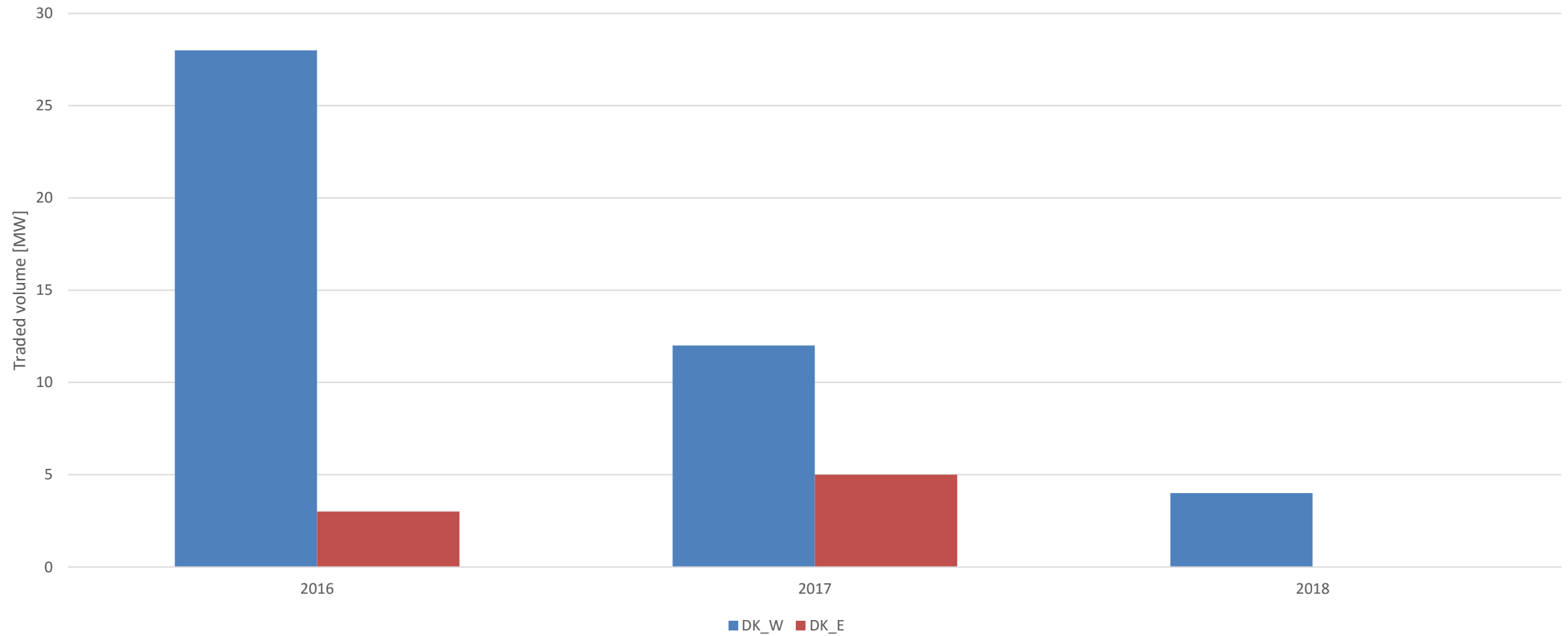


Months with no trade have been excluded.

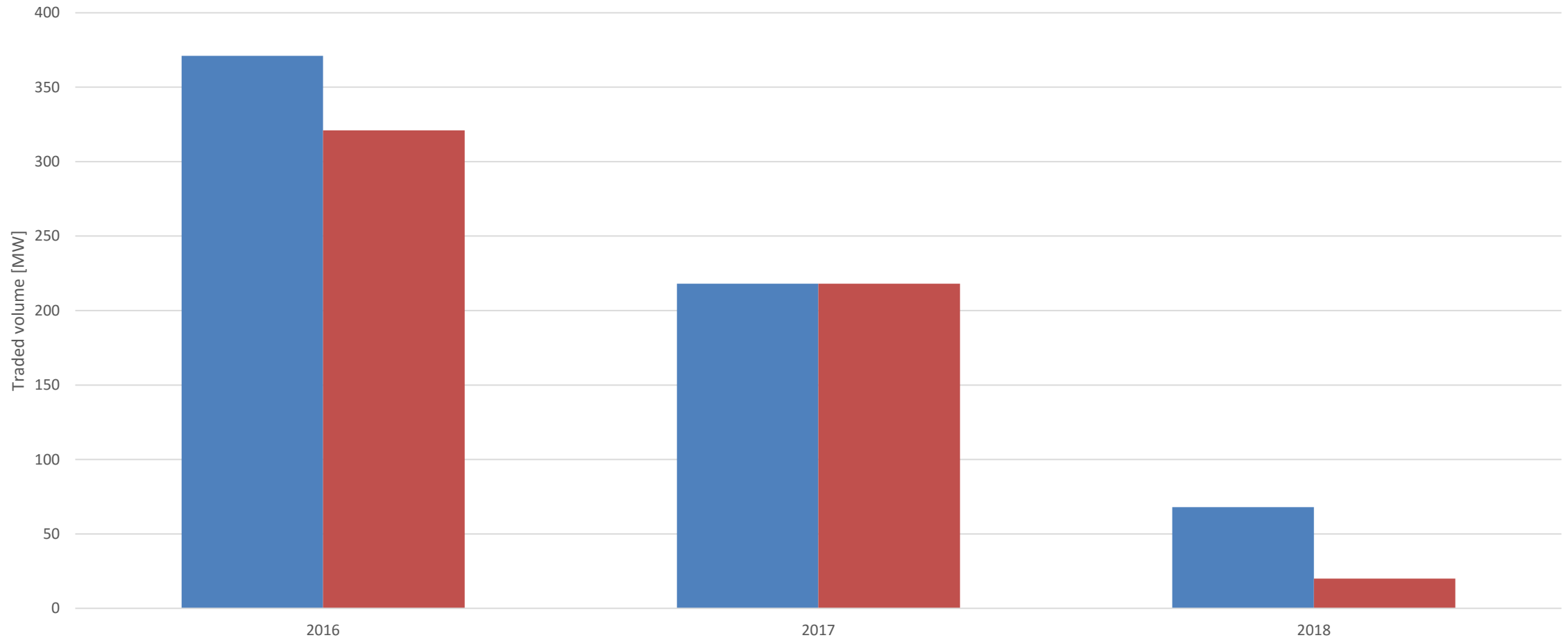
Monthly trade volume of price difference DK_W - SYS



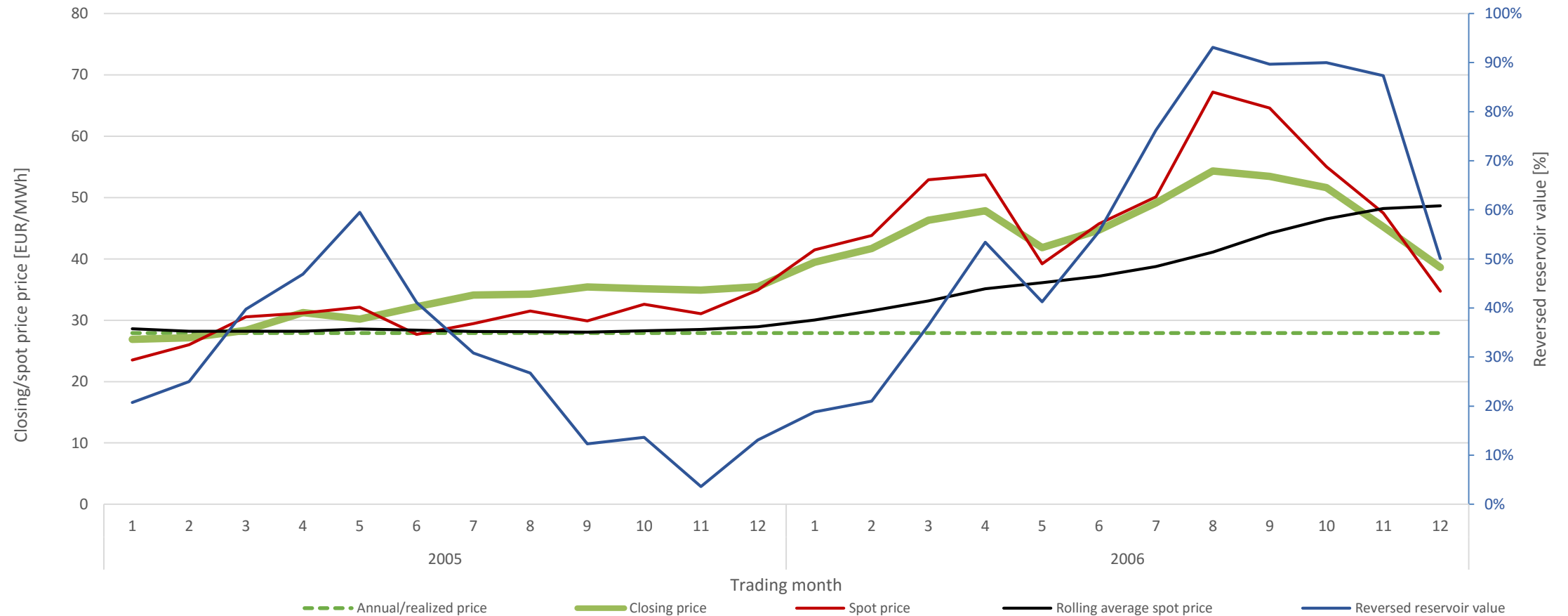
Traded volumes in November 2015



Total traded volumes



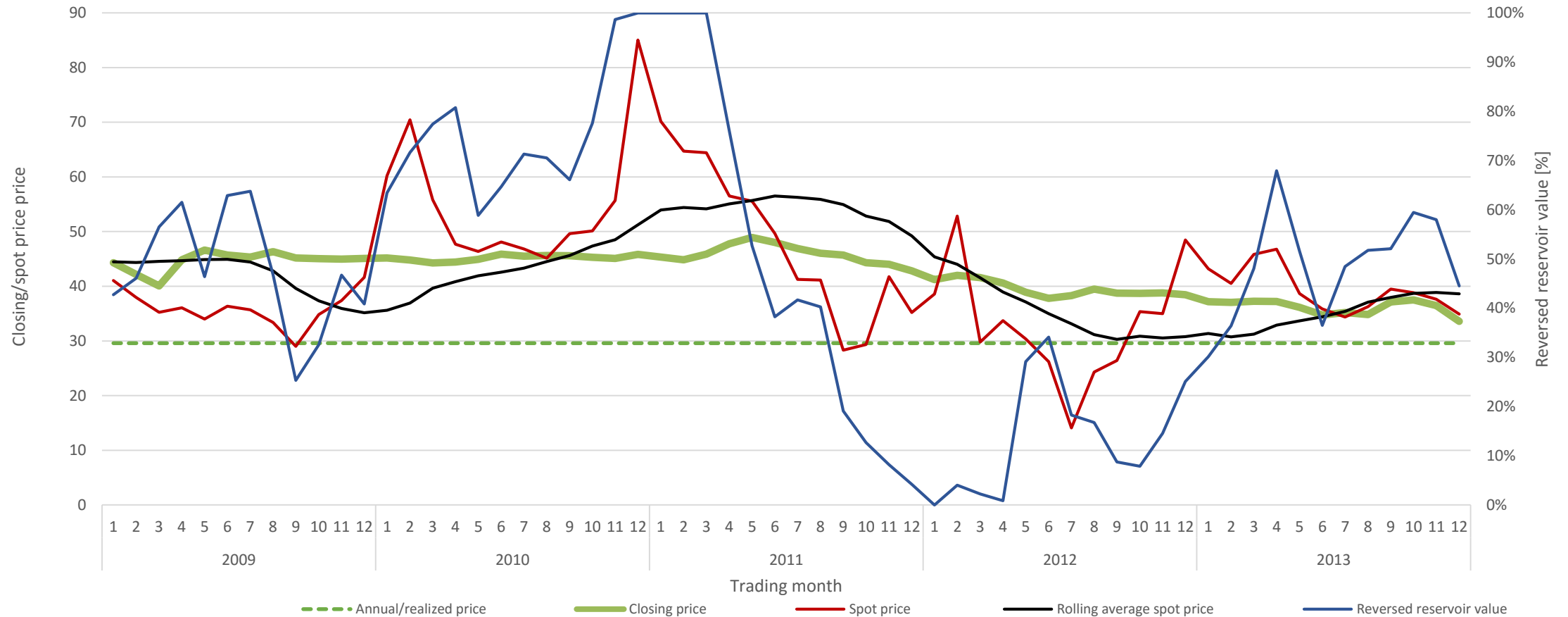
Comparison with spot price and hydro fill 2007



Reversed reservoir value = $1 - (\text{fill} - \text{fill_min}) / (\text{fill_max} - \text{fill_min})$ (min and max computed for each month)



Comparison with spot price and hydro fill 2014



Reversed reservoir value = $1 - (\text{fill} - \text{fill_min}) / (\text{fill_max} - \text{fill_min})$ (min and max computed for each month)

