Flame conference – Expert session Bergermeer
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What is the fair value of Bergermeer SBU?

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Bergermeer SBU 2015

Storage name: Bergermeer SBU 2015

Storage physical location: bergerweg, alkmaar

Location coordinates found.

Gas market *: TTF

Volume restrictions

Start date	Max (MWh)
2015-04-01	1000

Default rates (daily)

Inventory level	Firm injection rate	Firm withdrawal rate
0	10.248	7.268
1000	7.737	13.896

+ Add row

Linear interpolation: (•) Yes ( ) No

Storage costs

Valid from	Injection cost - fixed, firm	Withdrawal cost - fixed, firm
2015-04-01	0.161 EUR / MWh	0.131 EUR / MWh

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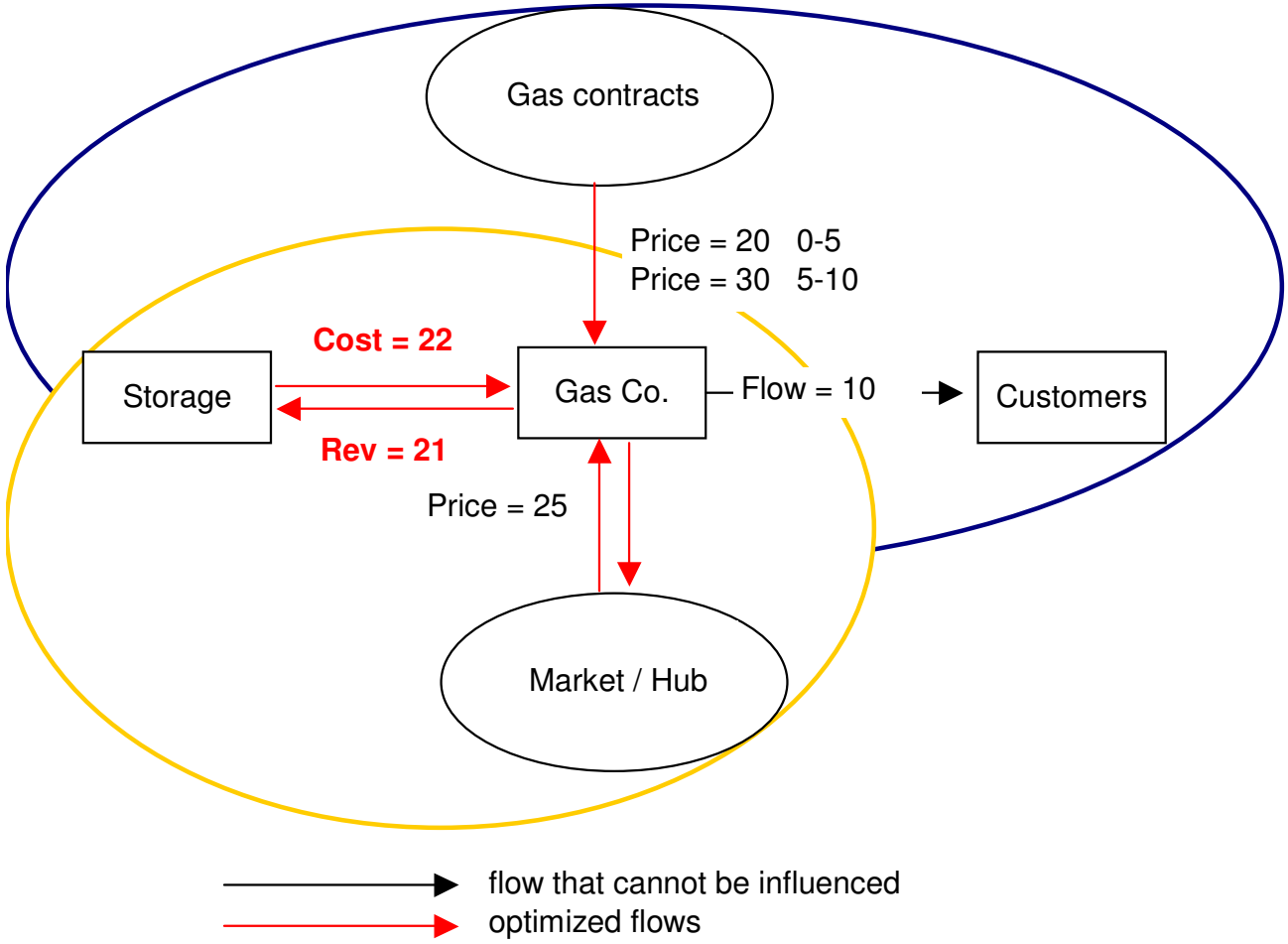
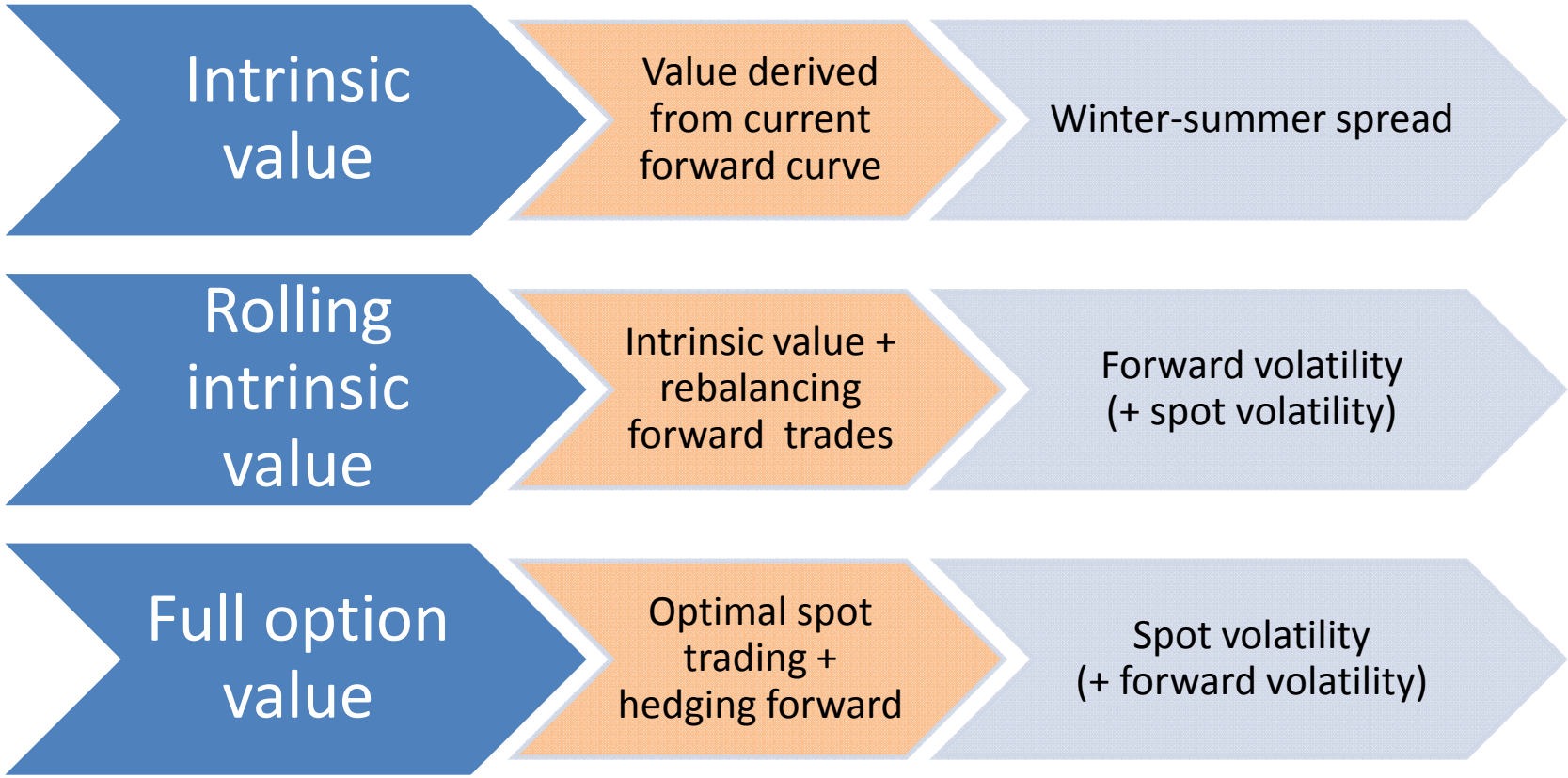
What determines the storage value?

- Winter-summer spread in the forward market
- Forward price volatility (winter-summer variation)
- Spot price volatility
- Added value for your own portfolio (balancing)
- Other factors:
  - Financing costs
  - Market liquidity / trading costs
  - Reliability of the storage service (interruptions)

Valuing storage against market or portfolio?



Valuation and trading approaches



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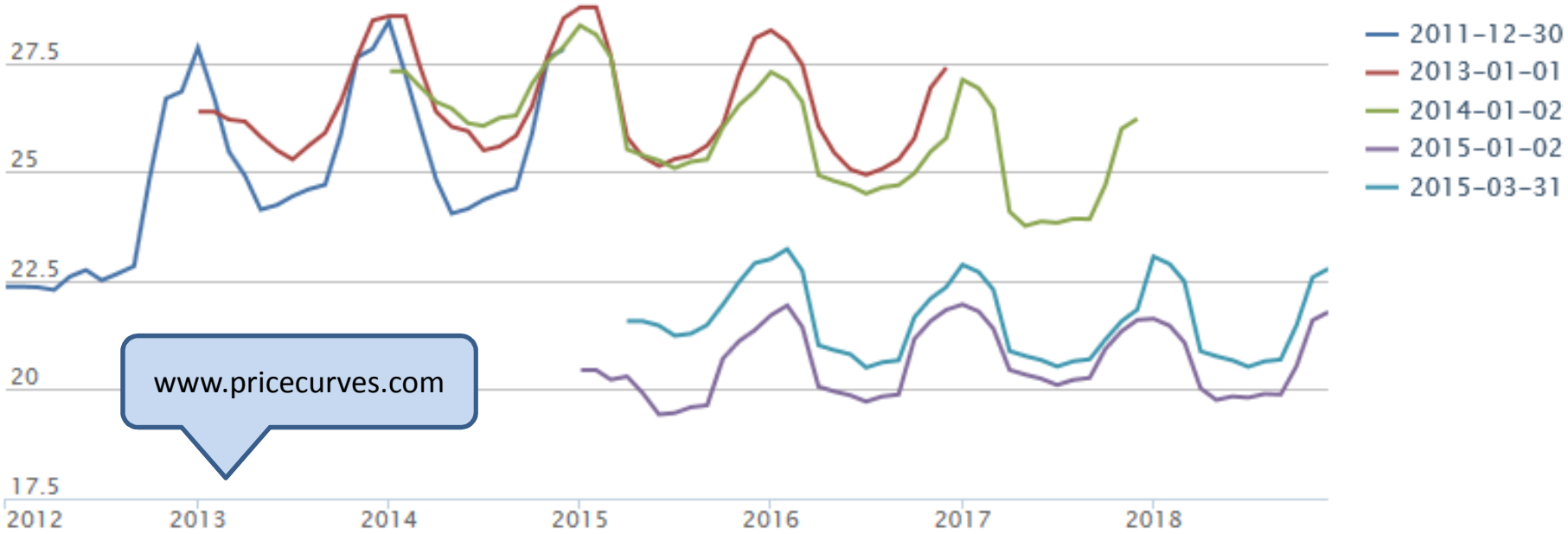
Spot and Forward price volatility TTF



KYOS assessment 31 March 2015

- Available on bergermeer.kyos.com

Intrinsic

	Daily (EUR)	Monthly (EUR)	Tradable (EUR)
Value	991.64	991.64	801.91

Total value based on Monte Carlo price simulations

Strategy	Spot (EUR)	Spot & Hedge (EUR)	Rolling intrinsic (EUR)
Hedge product	No	Months (delta)	Tradable (as defined in the market settings of the commodity)
Avg	2 809	2 809	1 771

- TTF Winter-summer spread = 1.18 EUR/MWh
- Multiplier:
  - Monthly Intrinsic: 0.84
  - Rolling intrinsic: 1.50
  - Spot + delta hedging: 2.38

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Important questions

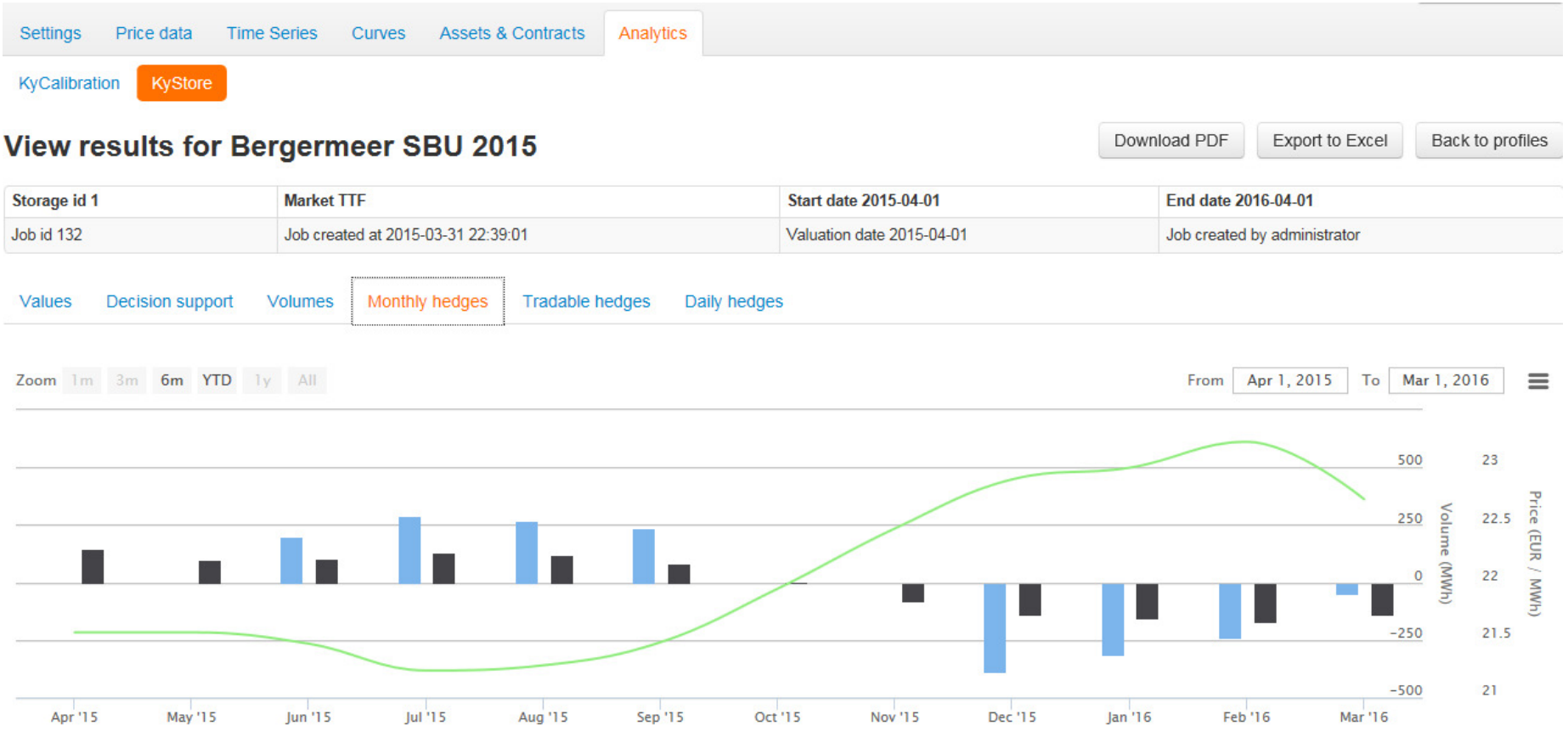
1. Do storage valuation models provide accurate valuations?
2. And: how should I realize this value?

BACKTESTING IS NEEDED

- In pricing / valuation:
  could I have realized the estimated value in the past?
- Applied to gas storage valuation:
  Estimate the value on 1 April
  Then every day follow the trading advice of the storage model which is recalculating every day, based on actual prices

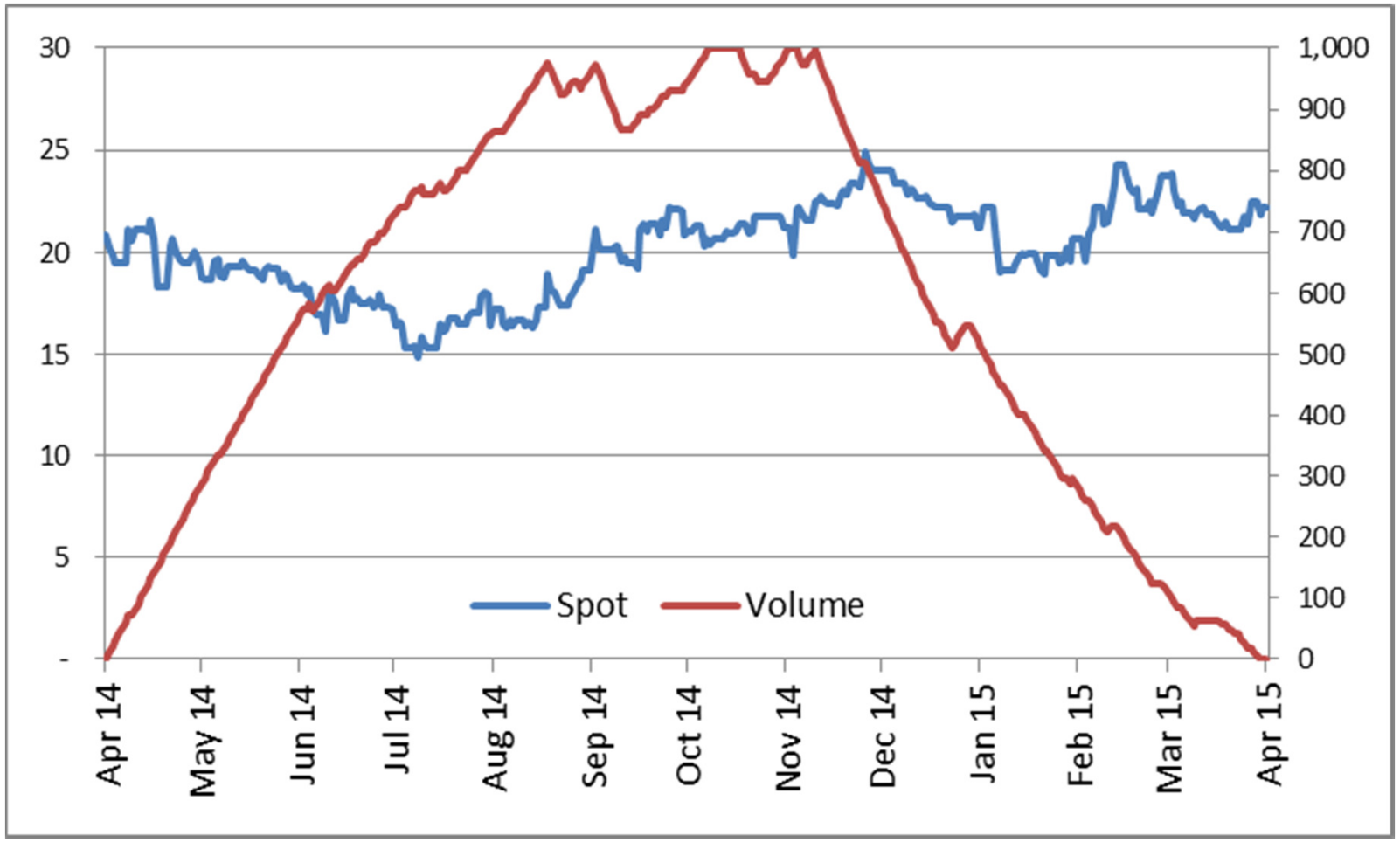
How does it work?

Step 1: initial (delta) hedge



How does it work? Step 2

Step 2: every day optimization of spot trades



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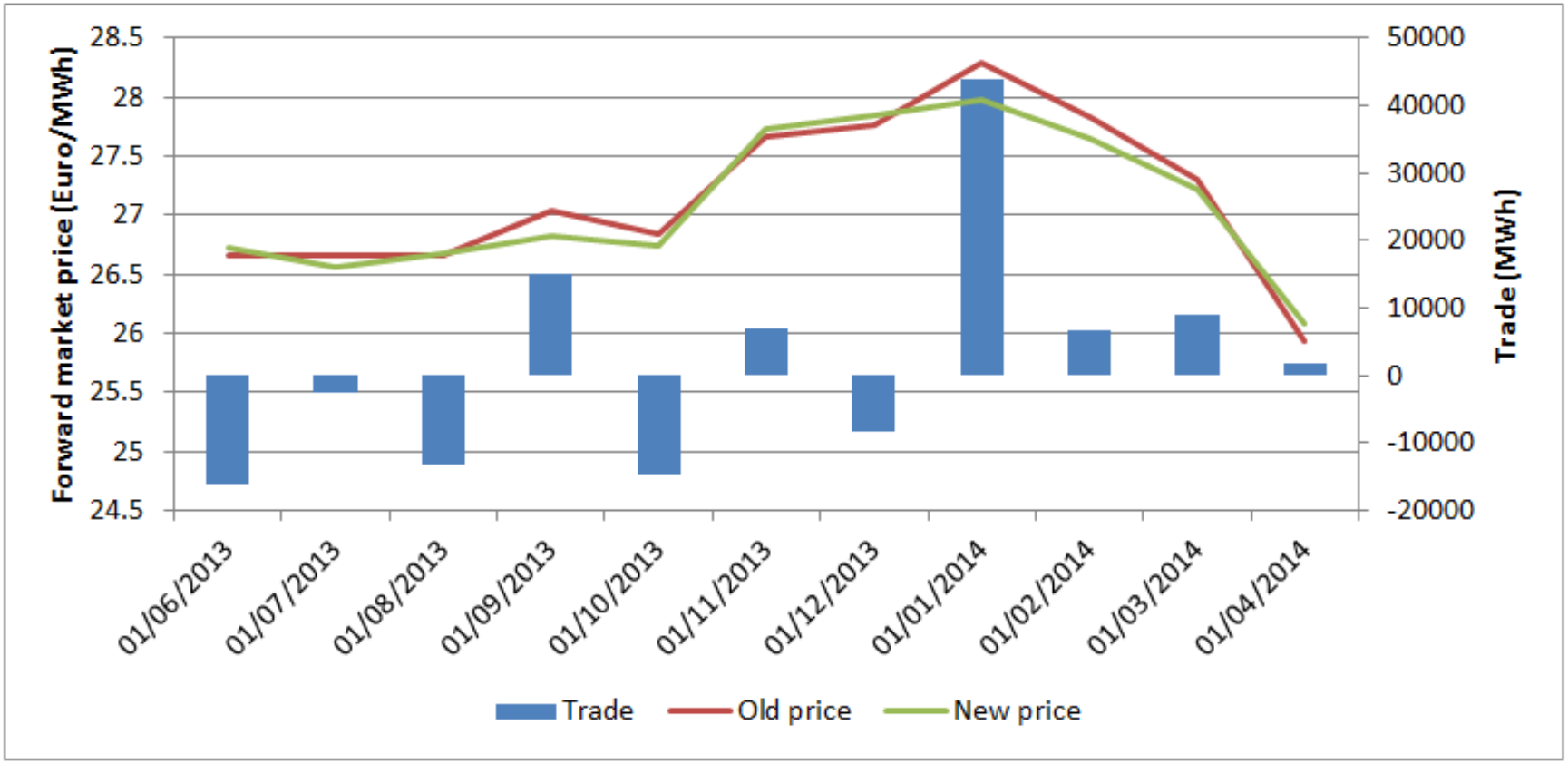
Step 3: adjusting hedge over time



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Bergermeer SBU backtest results

	2012	2013	2014	Avg
Intrinsic value	3,257	1,110	2,794	2,387
Estimated value	4,028	1,678	3,988	3,231
Realized value	3,157	2,810	4,177	3,381
Spot volatility	23%	25%	48%	32%

	2012	2013	2014	Avg
Intrinsic value	0.89	0.92	0.91	0.90
Estimated value	1.10	1.39	1.29	1.26
Realized value	0.86	2.32	1.36	1.51
Winter-Summer spread	3.67	1.21	3.08	2.65

Value = spot trading + delta hedge (rebalanced monthly)
Volatility levels were known beforehand

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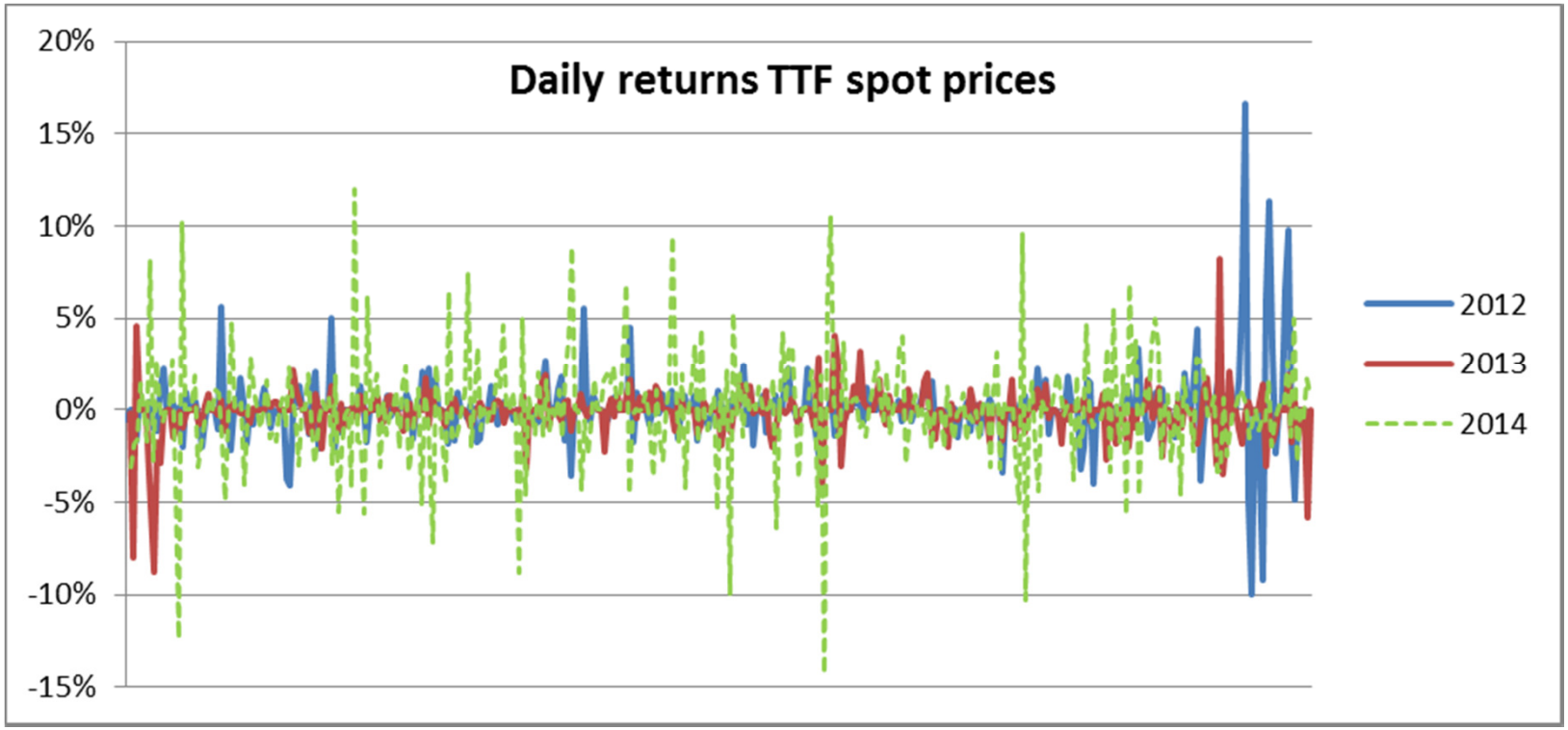
Storage trading results: uncertainy

Various KYOS backtests show that trading results are quite uncertain, despite spot optimization and delta hedging.

On average, estimated value is realized (e.g. in 17 years of NBP history), though last few years were relatively difficult.



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Delta hedge versus Intrinsic hedge

- Optimal hedge = delta hedge
- Provides best stabilization of value
- Roughly speaking:
  - Delta hedge = expected volume (or value) in the spot trading strategy

Comparison: intrinsic hedge does not take into account uncertainty and flexibility to adjust positions over time

Introduction KYOS

Background

- Strong focus on energy & commodity markets: trading, valuation, risk management
- Core competence: combine quantitative methods with practical solutions
- Experienced and dedicated expert team based in Haarlem, the Netherlands

Activities

- Modelling and software

  Apply quantitative financial methods to energy markets

- Consulting

  Advise on energy trading, valuation and risk management

- Training

  Combine theory with real life examples

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KYOS software

Power Markets

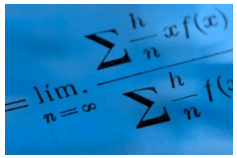
- KyPlant - power plant optimization and valuation
- KyDispatch - short-term dispatch optimizer

Gas Markets

- KyStore - gas storage valuation
- KySwing - gas (swing) contract valuation

Risk Management / Price modeling

- KyCurve - create hourly price forward curves
- KySim - Monte Carlo price simulations
- KYOS PRM - Portfolio & Risk Management System
- AtRisk - Cf@R, E@R, V@R



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Companies with KYOS software

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