Value of Midstream Flexibility

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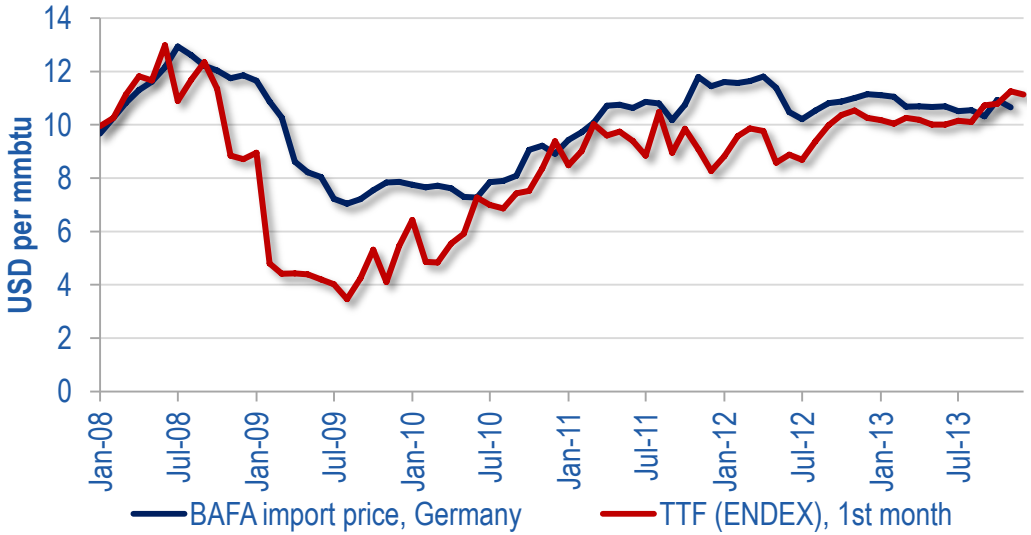
Hub Prices are Derivatives of the Contract Prices

Integration of Contract Prices and Hub prices



Sources: BMWi, Bloomberg

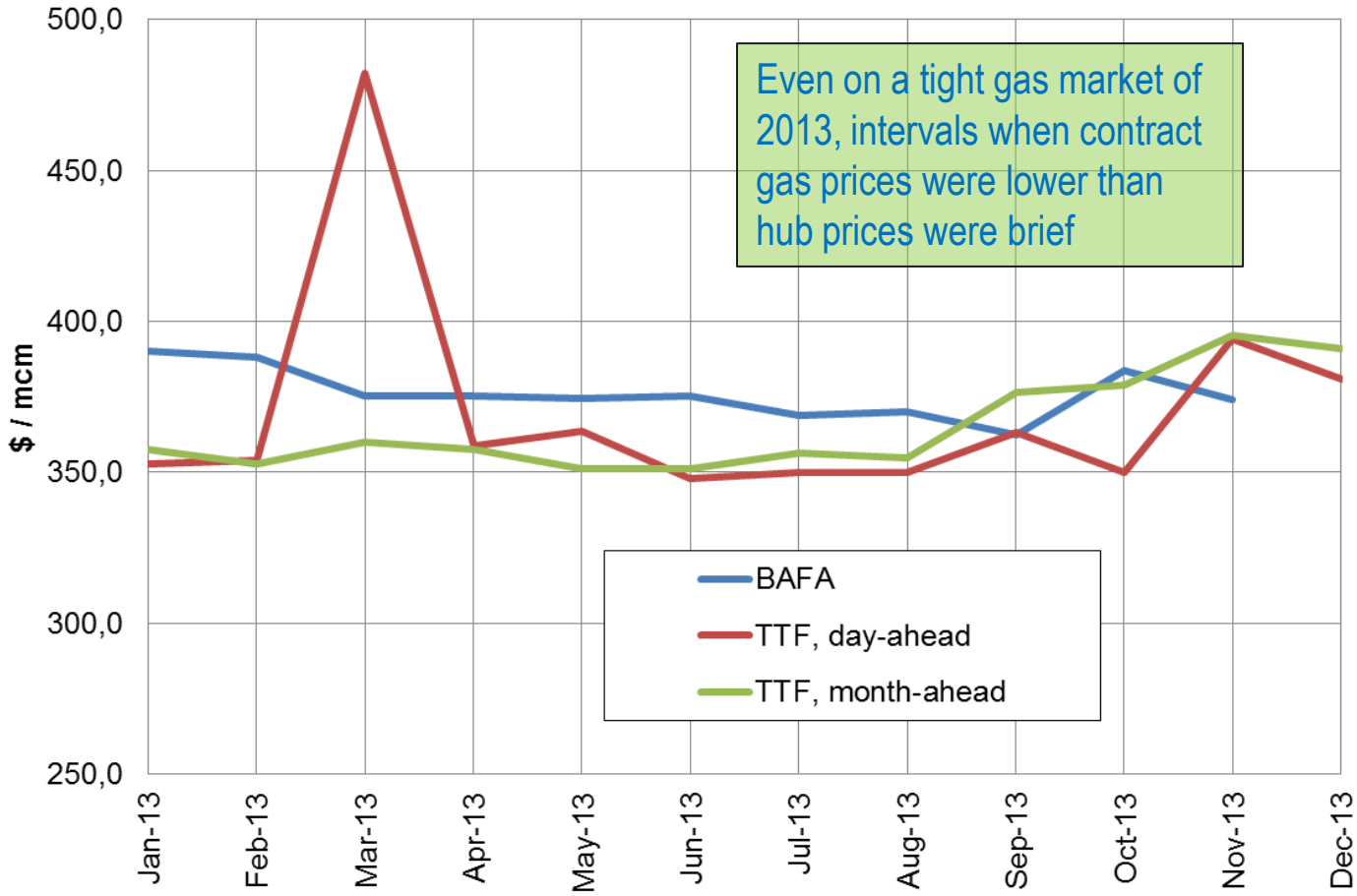
- In 2013 75% of gas exported to Europe was oil-indexed
- Gas hub prices are not independent from oil-indexed contract prices. The correlation coefficient between hub prices and oil prices moving average equals 0.85
- ACER November 2013 Market Monitoring Report states that "Oil prices is still the main determinant of wholesale gas prices in Europe…"(p.180).

Gas Hub and Oil-indexed Prices – Still Bound Together

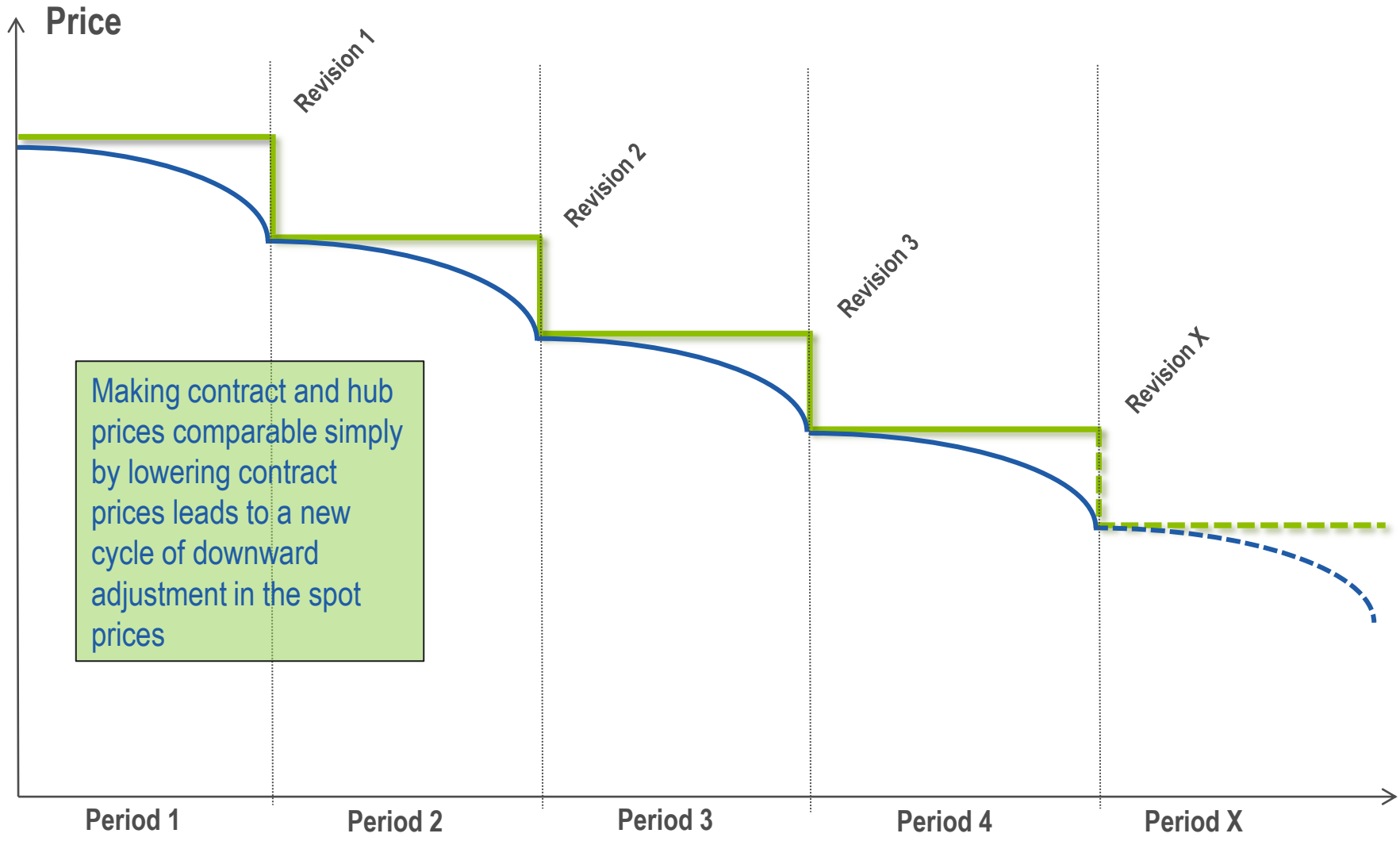
The correlation coefficient prove dependence

Correlation coefficient (r) from January 2010 to December 2013 versus:	NBP	TTF
Brent 1st month futures	0.69	0.69
Brent 1st month futures - 3 months moving average	0.79	0.80
Brent 1st month futures - 6 months moving average	0.84	0.86
Brent 1st month futures - 9 months moving average	0.83	0.85

Contract Gas is More Valuable Product than Hub Gas



Intrinsic Premium for Security Supply and Flexibility reproduces Contract/Hub Price Mismatch

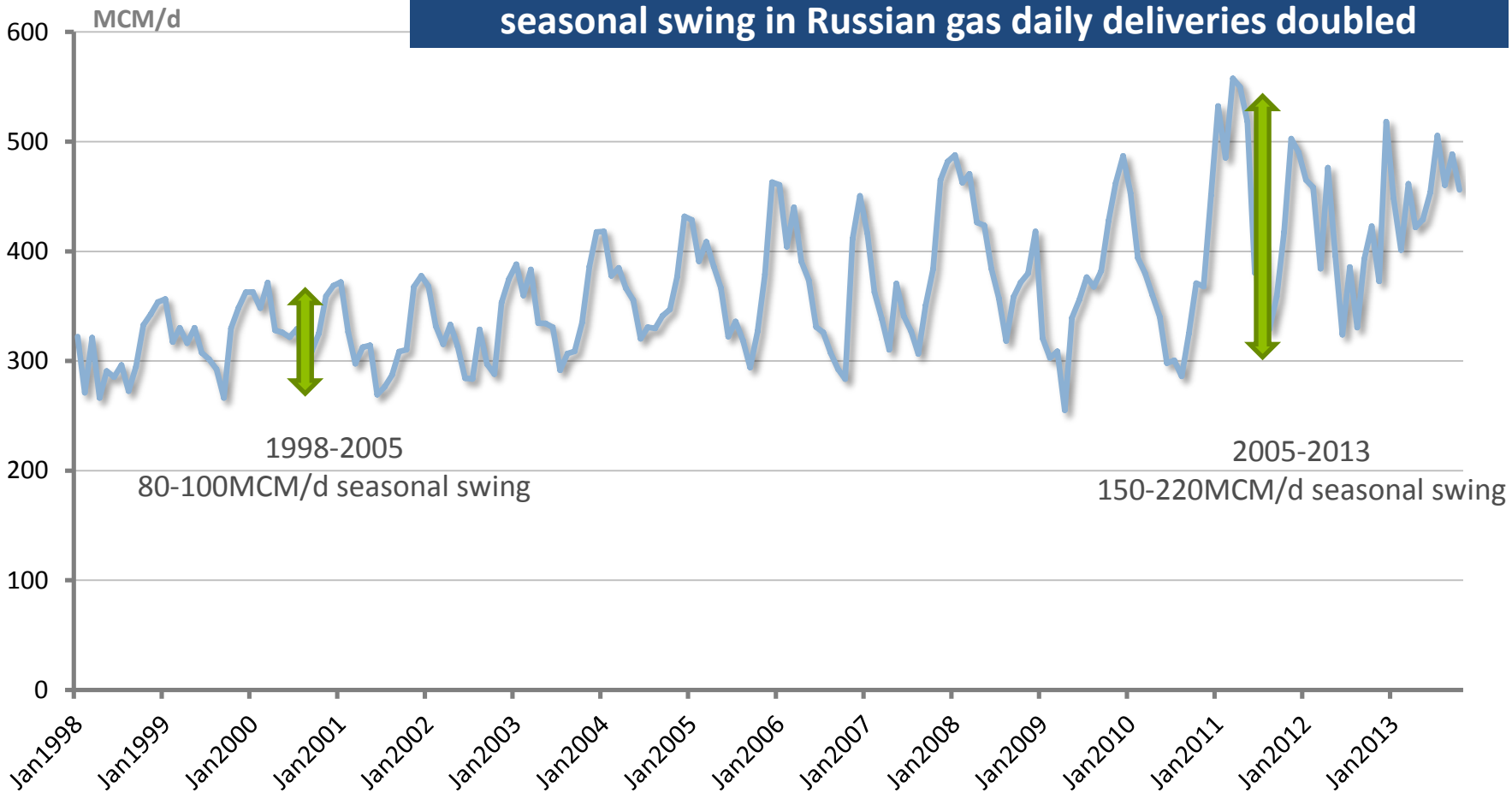


Premium for Security of Supply and Flexibility

- We do not consider hubs to be a suitable competitive benchmark for long-term gas contracts due to a range of important economic differences between the contractual terms of long-term take-or-pay contracts and those of contracts for gas traded at hubs.
- There is a premium for security of supply embedded in the LTCs. Security of supply provided by the LTCs has value. It is hard to estimate the value as it is most clearly demonstrated at times of gas shortages (for example the fire at Rough storage in Great Britain raised NBP prices).
- Another significant difference is that gas purchased from traded market hubs is almost always completely inflexible, in that the buyer is required to take exactly the same volume of gas in each hour of the delivery period, whereas gas purchased under long-term take-or-pay contracts almost always includes a significant degree of flexibility.
- Value of flexibility is comprised of the two components. Firstly, flexibility allows the buyers to match demand and supply and consequently saves them the burden of storage of gas. Secondly, flexibility enhances arbitrage opportunities. Flexible contracts allow the buyer to purchase excess gas at long-term prices to trade when spot markets are high and vice versa.

Removal of Midstream Flexibility Threatens Energy Security

Gazprom is the major provider of supply flexibility to Europe as seasonal swing in Russian gas daily deliveries doubled



Source: International Energy Agency database

Price of Flexibility: Enhanced Arbitrage Opportunities

Contract with flexibility

Assumptions

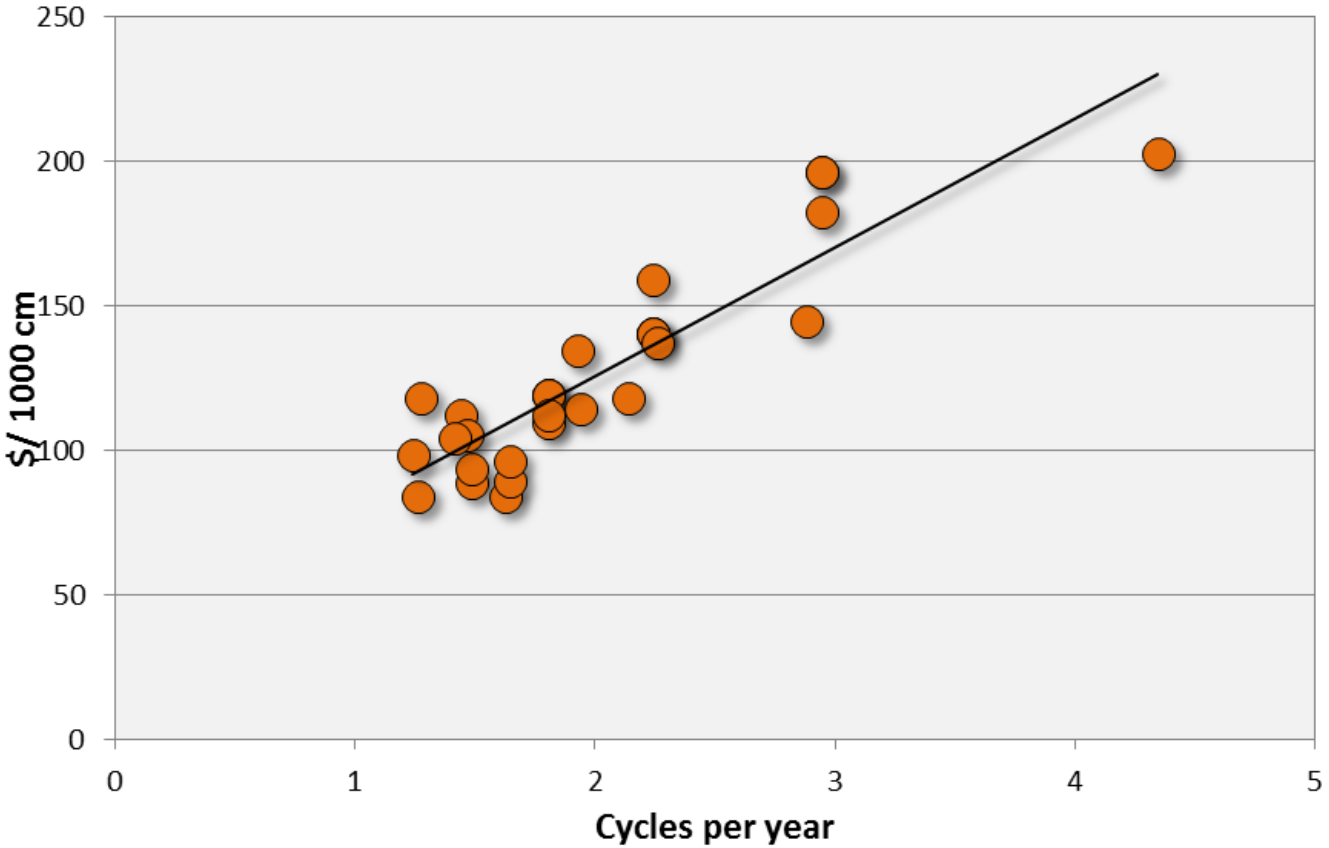
Arbitrage opportunities between BAFA and TTF for the period 1 July 2010 – 30 November 2012 under the following assumptions: gas in the required quantities is available on the hubs; the additional cost of delivering gas to the final place of consumption is not included

Additional profits from arbitrage enhancement (USD/mcm)

% of flexibility	15%	20%	25%
Average profit	7.99	10.66	13.39
Maximal profit	15.16	19.05	22.78

We can also assume that the amount of the fine that Gazprom must pay if it fails to meet its clients' obligations is a suitable proxy for the supply security and delivery flexibility premium embedded in the long-term contract price

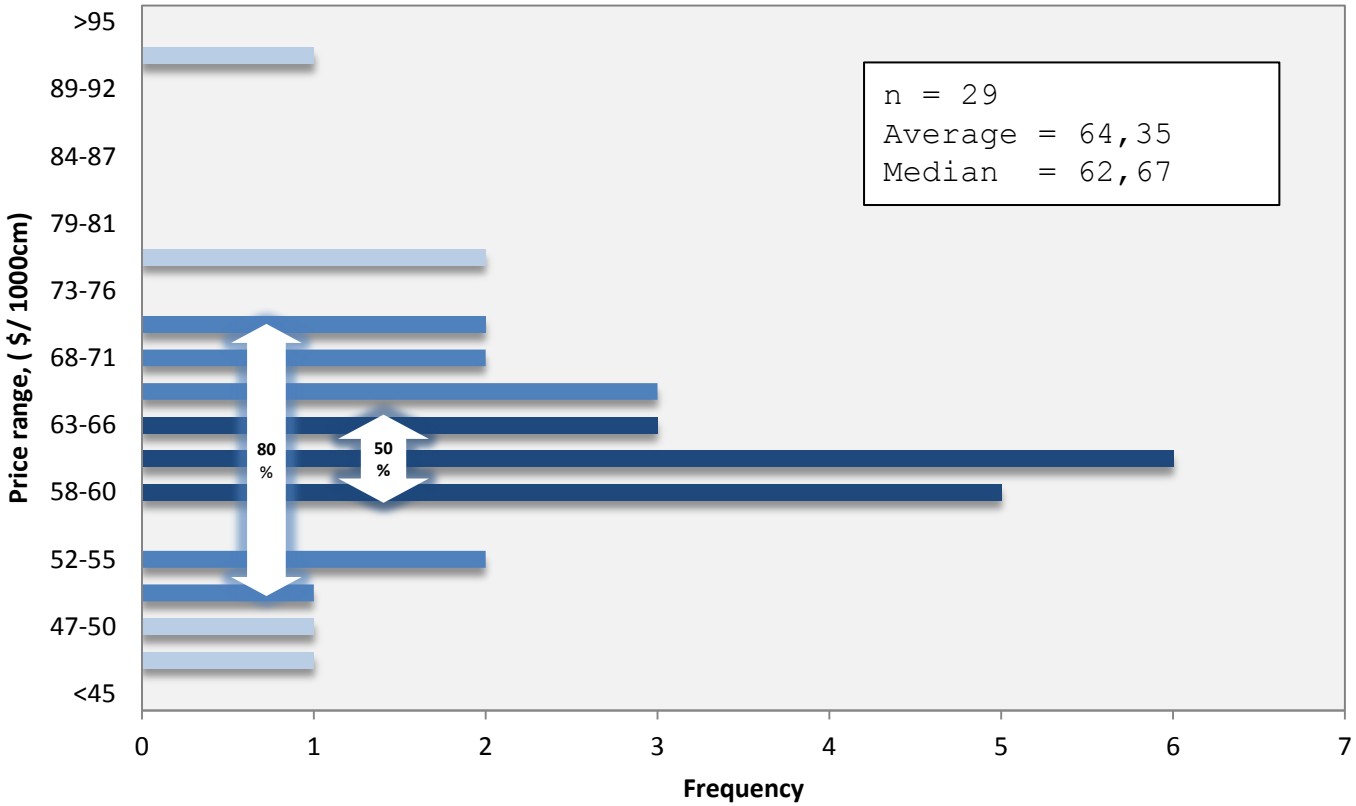
Price of Seasonal Flexibility – Costs of Seasonal Storage (1)



Gazprom Export estimate based on 29 natural gas underground storage tariffs for 2012

Price of Seasonal Flexibility – Costs of Seasonal Storage (2)

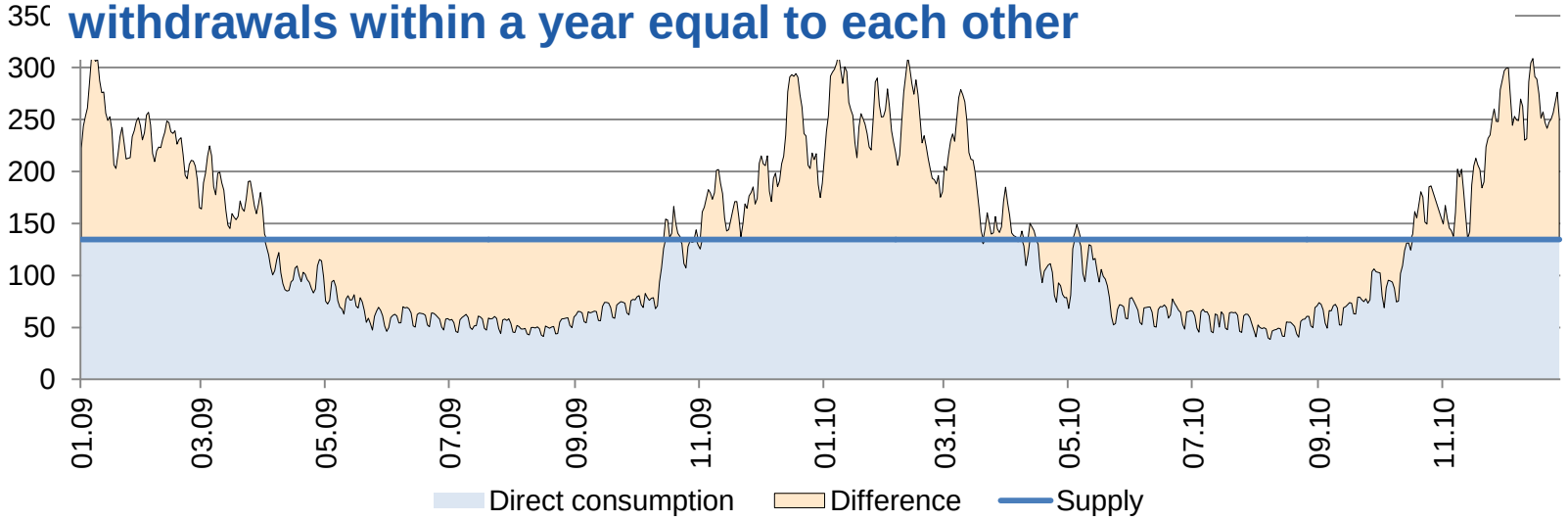
Cost of one full cycle of seasonal storage



In case all the delivered gas goes through UGS cost of European storage is $64/mcm on average.

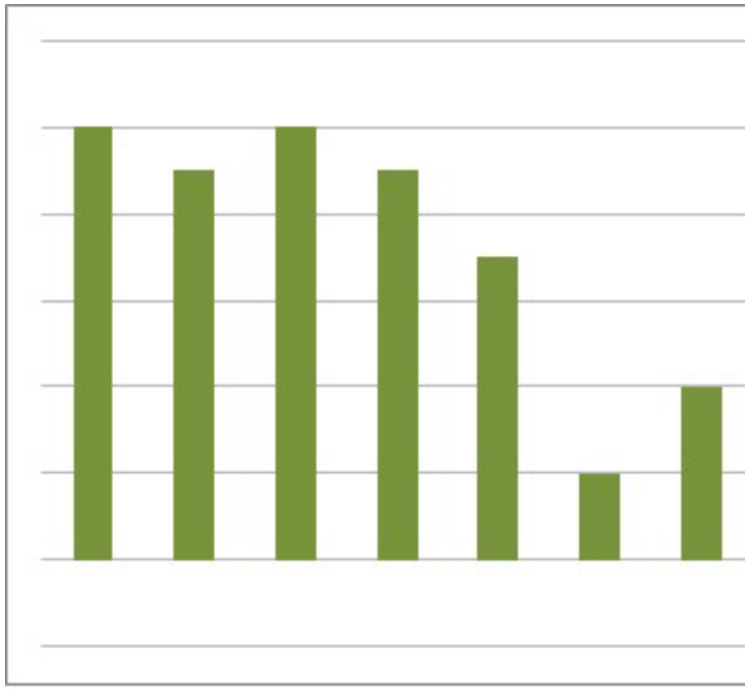
Price of Seasonal Flexibility – Costs of Seasonal Storage (3)

Optimal storage utilization model assumes that injections and withdrawals within a year equal to each other



Countries surveyed for 2004-2012	Storage requirements ranking	Upper limit, %	Lower limit, %	Upper limit, $/1000 cm	Lower limit, $/1000 cm
France	I	51	25	33	16
Netherlands	II	34	16	22	10
Germany	II	31	15	**21**	10
Italy	II	30	14	19	9
UK	III	20	10	13	6
Spain	III	19	11	12	7
Average	**-**	**31**	**15**	**21**	**10**

Short-term Midstream Flexibility



Typical consumption profile within a week

Source: Gasunie

In the absence of short-term flexibility (daily, hourly) provided by the supply contracts buyer has to acquire **flexible transport capacity offered by the system operator**.

From the buyer's point of view the price of transportation will be higher per unit of gas due to the lower capacity utilization ratio. The price for the 100% used capacity is the lowest one.

Flexible hours per year	Cost of SR flexibility, $/mcm
8,760	11.0
7,000	13.7
4,000	24.0

Explanation of the Contract-Hub Price Gap: Contracted Gas Offers Enhanced Delivery Flexibility

Cost of Seasonal Midstream Flexibility	Average cost of full-cycle gas storage *(assumes that over the year the volume of gas pumped into underground storage equals to the volume of withdrawals)*	US$21.45/mcm
Cost of Short-term Midstream Flexibility (1)	Additional transportation capacity payments for flexible capacity *(7,000 hours of flexibility)*	US$13.7/mcm
Cost of Short-term Upstream Flexibility (2)	Average price for a 10% daily production swing in UK – 0.5 p/therm *(Deloitte)*	USD$ 4.0/mcm

Alternative Flexibility Evaluation Method based on Seasonal Spreads

Traditional flexibility evaluation method based on seasonal spreads (see formula below) does not reflect its full value. There are no adequate commercial incentives for seasonal storage build up. Regulators has to interfere by requesting to keep storages full enough to meet coldest gas day from 20 to 50 years

$$P = \frac{Seasonal\ \mathrm{Pr}iceSpread \cdot SeasonalVolumeDifferential}{TotalVolumesConsumed}$$

Countries	Stock Requirements
Netherlands	for -15C (1:50 winter)
Italy	1:20 and importers need to keep 10% non EU imports as security stocks
Germany	No standard criteria
France	coldest year 1:50 and 1:50 peak day demand
Belgium	for -11C (1:50 winter)

Source: Deloitte

Alternative Flexibility Evaluation Method based on Swing Option Estimation

LT contract basic elements

- Daily flexibility (DCQ)
- Annual flexibility (ACQ)
- Carry forward (CF)
- Make up (MU)

Approaches developed by the academics and the industry experts under assumption of effective natural gas market

Authors	Elements of flexibility	Evaluation methods	Statistical process of price dynamic (gas & oil))
Holden, Løland, Lindqvist (2011)	DCQ, ACQ, CF, penalties; restriction: N*maxDCQ <= ACQ	Least squares Monte-Carlo	Spread modeling: one-factor auto regression first order process
Edoli et al. (2011)	DQ, AQ, MU, UDMU, penalties	Scenarios tree	Brownian motion
Bardou, Bouthemy (2008)	DQ, AQ, penalties	Optimal vector quantification	Spot price: Brownian motion

Thank you for your attention

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