



Workshop: Natural Gas Price Formation

C-5 Long-Term-Gas-Supply-Contracts-Europe Conference

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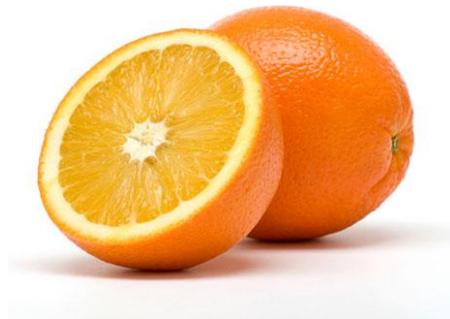
Agenda

- ▶ **Introduction price formation**
- ▶ **Types of price formation – global overview**
- ▶ **Current state price formation European markets**
- ▶ **How it all started in Europe – ‘Groningen’ indifference principle and net-back mechanism**
- ▶ **Price revision:**
 - Escalation supplement moves the price
 - Change in price formation
 - Change of price formation
 - How do I determine hub is price setter?
- ▶ **Value chain broken:**
 - achievable price hub price at point of first sale
 - midstreamer obsolete?
- ▶ **Hub indexation in long-term contracts:**
 - Can it properly reflect value?
 - Will it increase price volatility?
- ▶ **Price disparities – hedging techniques**
- ▶ **A Eurasian ‘Henry Hub’ – how could it look?**

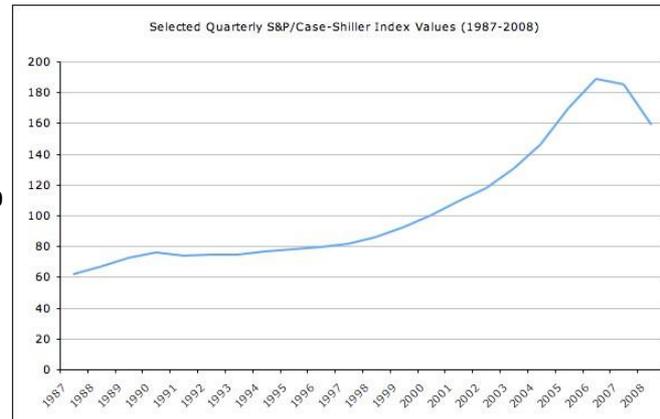
Introduction price formation: index price of one commodity with price of another commodity?

- ▶ Would you consider indexing the price of long-term coffee supply with the traded price of frozen orange juice?
- ▶ If you did, would that be price formation?

Long-Term Coffee Price



Frozen Orange Price Index



Types of price formation – global overview

IGU naming convention: OPE, GOG, BIM

Oil Price Escalation (OPE)

The price is linked, usually through a base price and an escalation clause, to competing fuels, typically crude oil, gas oil and/or fuel oil. In some cases coal prices can be used as can electricity prices.

Gas-on-Gas Competition (GOG)

The price is determined by the interplay of supply and demand – gas-on-gas competition – and is traded over a variety of different periods (daily, monthly, annually or other periods). Trading takes place at physical hubs (e.g. Henry Hub) or notional hubs (e.g. NBP in the UK). There are likely to be developed futures markets (NYMEX or ICE). Not all gas is bought and sold on a short term fixed price basis and there will be longer term contracts but these will use gas price indices to determine the monthly price, for example, rather than competing fuel indices. Also included in this category is spot LNG, any pricing which is linked to hub or spot prices and also bilateral agreements in markets where there are multiple buyers and sellers.

Bilateral Monopoly (BIM)

The price is determined by bilateral discussions and agreements between a large seller and a large buyer, with the price being fixed for a period of time – typically one year. There may be a written contract in place but often the arrangement is at the Government or state-owned company level. Typically there would be a single dominant buyer or seller on at least one side of the transaction, to distinguish this category from GOG, where there would be multiple buyers and sellers trading bilaterally.

Types of price formation – global overview

IGU naming convention: NET, Regulation...(various)

Netback from Final Product (NET)	The price received by the gas supplier is a function of the price received by the buyer for the final product the buyer produces. This may occur where the gas is used as a feedstock in chemical plants, such as ammonia or methanol, and is the major variable cost in producing the product.
Regulation: Cost of Service (RCS)	The price is determined, or approved, formally by a regulatory authority, or possibly a Ministry, but the level is set to cover the "cost of service", including the recovery of investment and a reasonable rate of return.
Regulation: Social and Political (RSP)	The price is set, on an irregular basis, probably by a Ministry, on a political/social basis, in response to the need to cover increasing costs, or possibly as a revenue raising exercise – a hybrid between RCS and RBC.
Regulation: Below Cost (RBC)	The price is knowingly set below the average cost of producing and transporting the gas often as a form of state subsidy to the population.
No Price (NP)	The gas produced is either provided free to the population and industry, possibly as a feedstock for chemical and fertilizer plants, or in refinery processes and enhanced oil recovery. The gas produced maybe associated with oil and/or liquids and treated as a by-product.
Not Known (NK)	No data or evidence.

Types of price formation – global overview

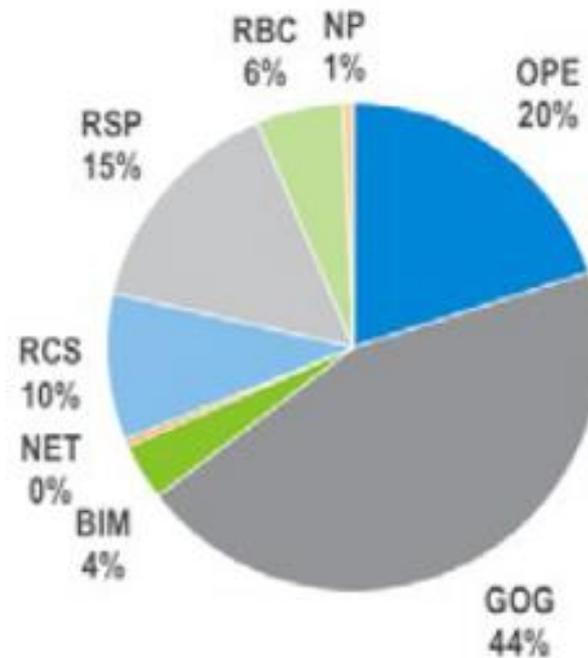
Total world consumption 2016: ~ 3,624 bcm

Price formation in % shares:

GOG (44%, 1,614 bcm) largest: predominantly U.S., Europe, FSU

OPE (20%, 725 bcm): predominantly Asia Pacific, Asia, Europe

Figure 3.8 World Price Formation 2016 – Total Consumption



Source: IGU Wholesale Gas Price Survey 2017 Edition

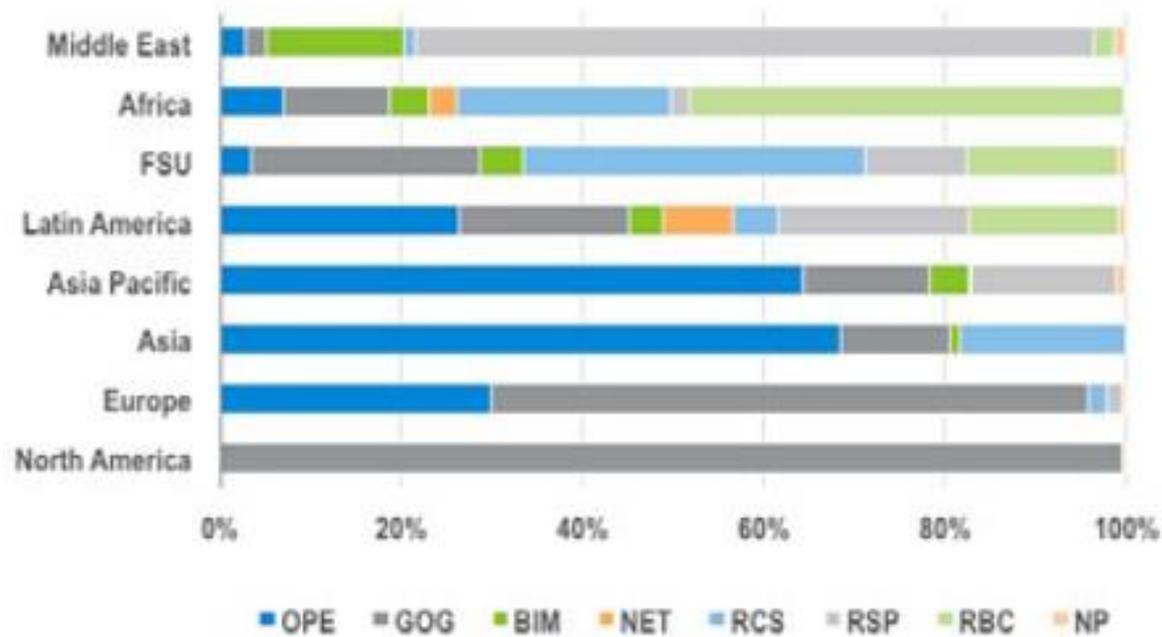
Types of price formation – global overview

Total world consumption 2016: ~ 3,624 bcm

Price formation by regions:

GOG: U.S. 963 bcm; Europe 344 bcm; FSU 155 bcm

Figure 1.1 Regional Price Formation 2016 – Total Consumption



Types of price formation – global overview

The rise of GOG: up from 31% in 2005 to 44.5% in 2016

Types GOG: Trading / Bilateral / Spot LNG

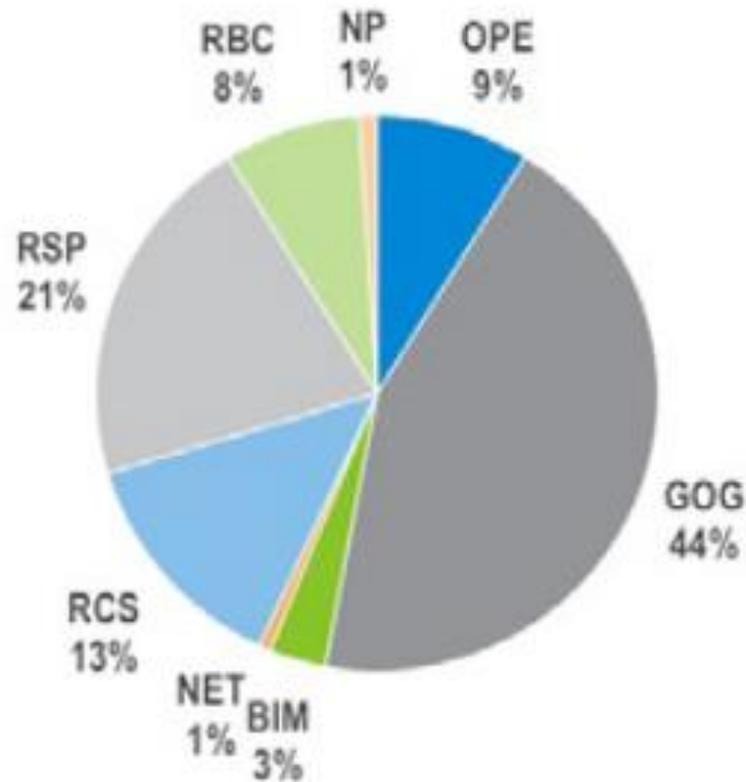
Figure 3.16 Changes in GOG 2005 to 2016



Types of price formation – global overview

Domestic production ~72% (2,620 bcm) of total world consumption

Figure 3.1 World Price Formation 2016 – Domestic Production

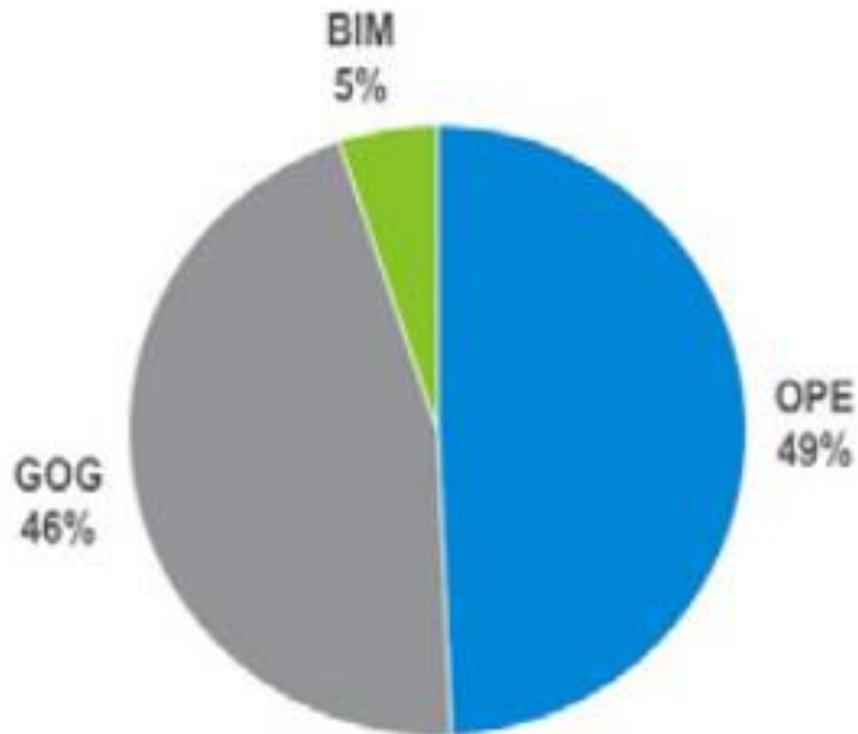


Source: IGU Wholesale Gas Price Survey 2017 Edition

Types of price formation – global overview

Total imports: ~28% total world consumption (~1,000 bcm)

Figure 3.7 World Price Formation 2016 – Total Imports



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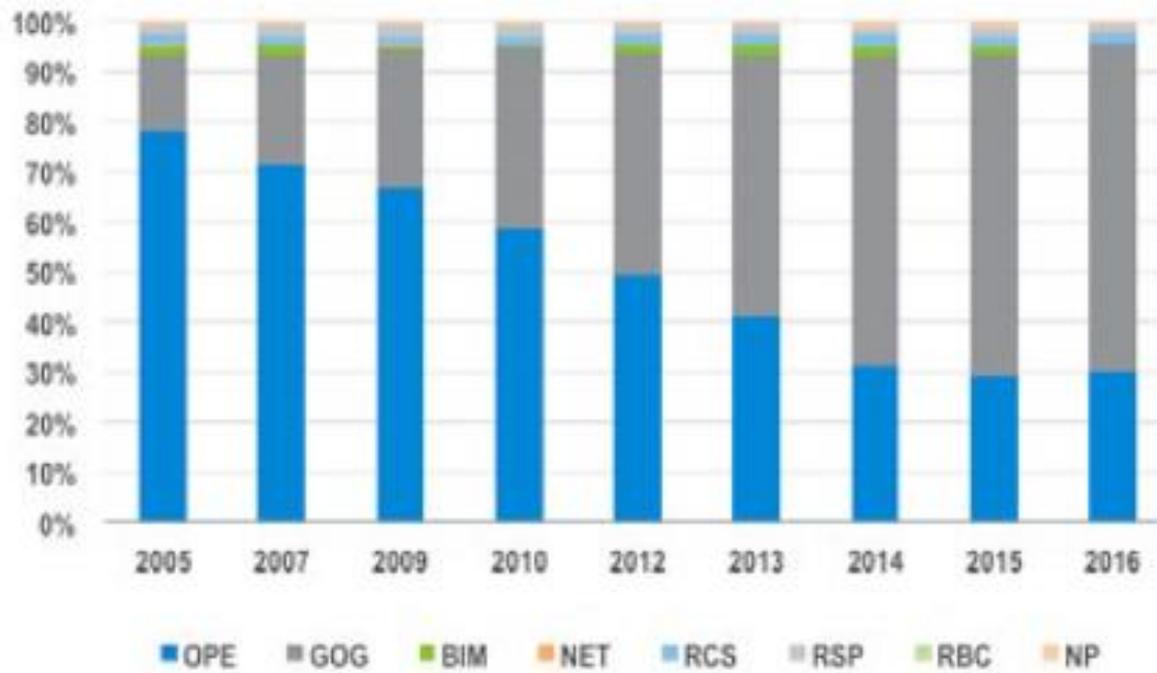
Current state price formation European markets

Most significant changes; variances by region

GOG up from 15% in 2005 to 66% in 2016

OPE down from 78% in 2005 to 30% in 2016

Figure 5.4 Europe Price Formation 2005 to 2016



Source: IGU Wholesale Gas Price Survey 2017 Edition

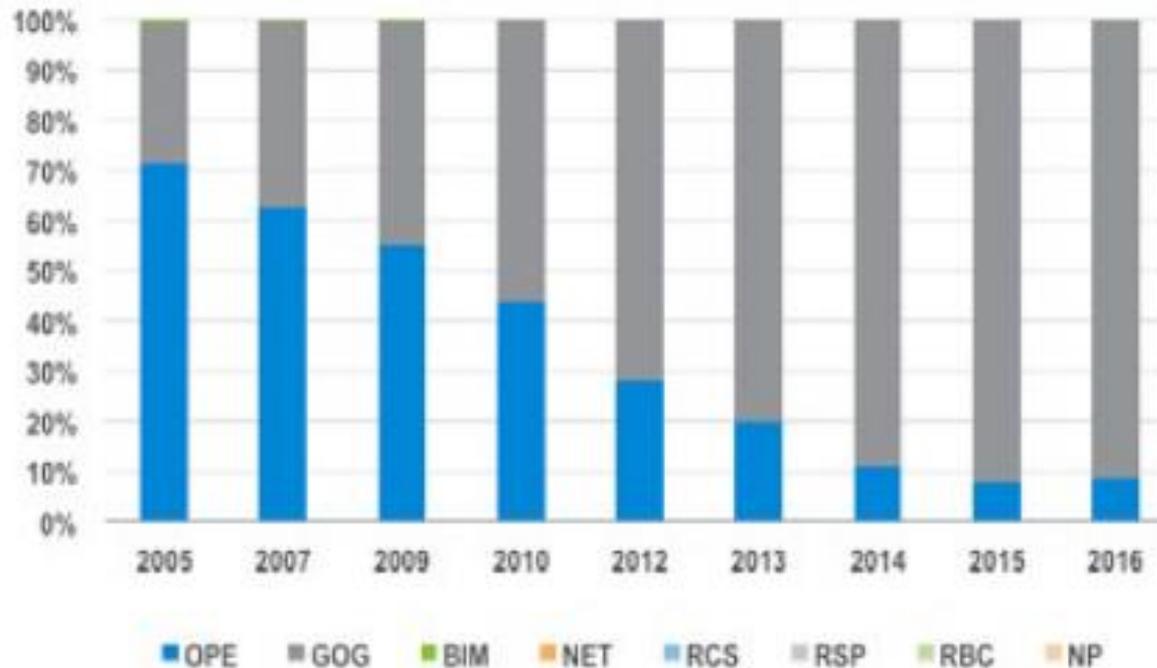
Current state price formation European markets

Northwest Europe: OPE essentially vanished

GOG: up from 28% in 2005 to 91% in 2016

OPE: down from 72% in 2005 to 9% in 2016

Figure 5.5 Northwest Europe Price Formation 2005 to 2016



Source: IGU Wholesale Gas Price Survey 2017 Edition

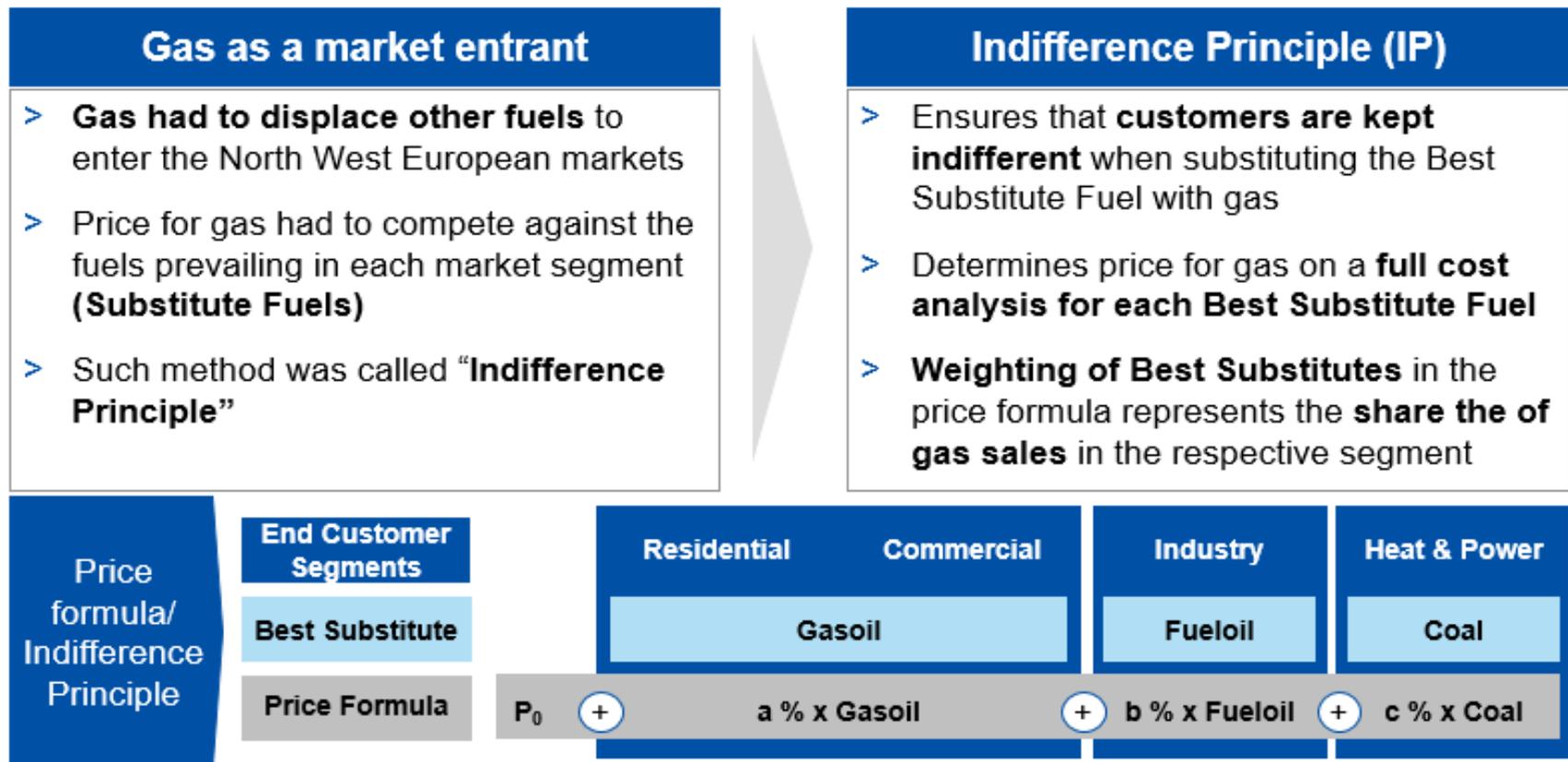
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How it all started – ‘Groningen’ indifference principle and net-back mechanism

Gas new market entrant: ~1% share primary energy in 1960

Displacement competition vs. competing fuels via price



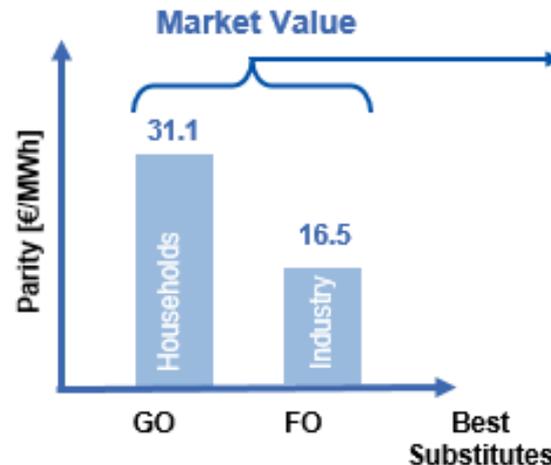
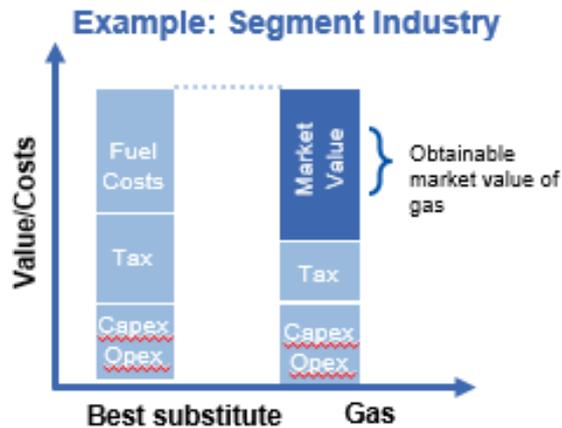
How it all started – ‘Groningen’ indifference principle and net-back mechanism

Indifference principle provided a transparent mathematical mechanism to increase/decrease CP ($P_{0+/-}$)

End users are set indifferent to alternative fuels

For each end customer segment a Best Substitute fuel is defined

Different weightings of Best Substitutes reflect their market share in the respective end customer segment



Schematic

Weighted market value of gas:
 $50\% \times 31.1 + 50\% \times 16.5 = 23.8$

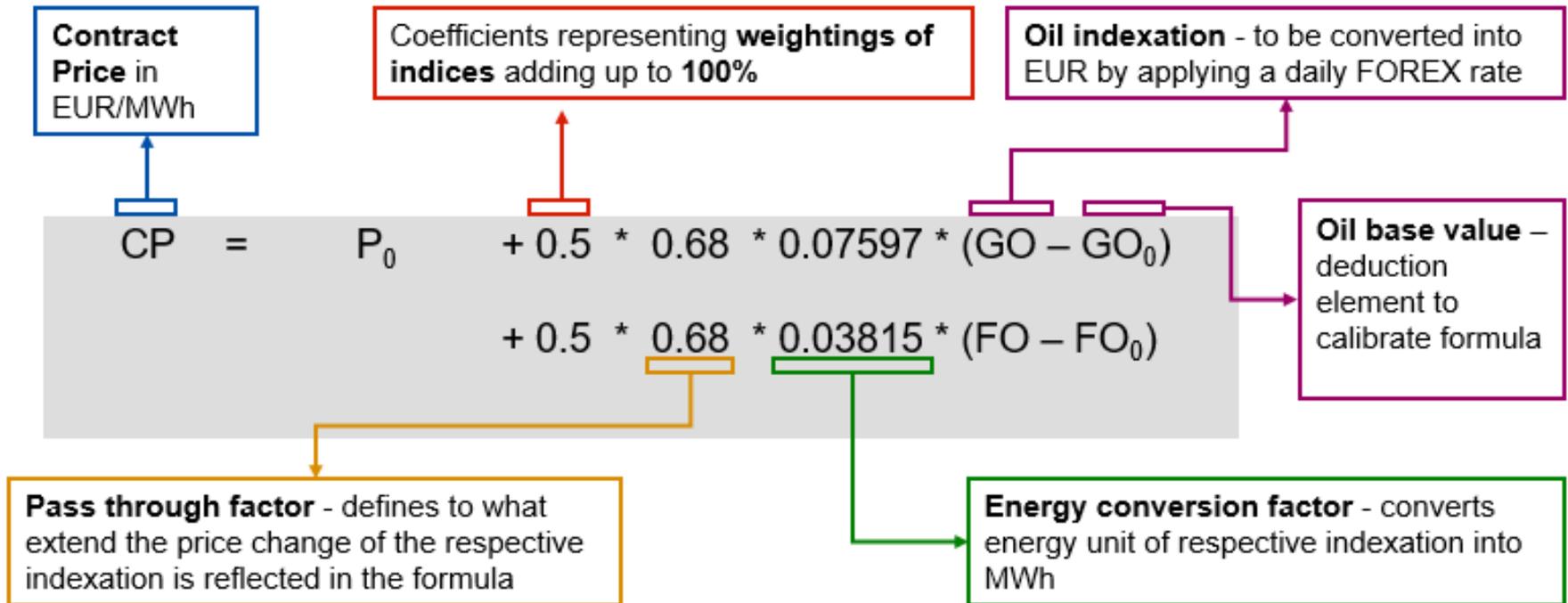
Weighted market value shall equal P_0

Contract Price (CP)

$$CP = P_0 + 50\% \times (GO - GO_0) + 50\% \times (FO - FO_0)$$

How it all started – ‘Groningen’ indifference principle and net-back mechanism

Exemplary: classical formula & function of elements



How it all started – ‘Groningen’ indifference principle and net-back mechanism

Closed grid systems - no third party access – no competition
No traded markets – best substitute fuel / burner tip net back pricing



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Price Revision: Typical clause in LTCs

“If circumstances, beyond the control of the Parties, change significantly compared to the underlying assumptions in the prevailing price provisions, each Party is entitled to an adjustment of the price provisions reflecting such changes. The price provisions shall in any case allow the gas to be economically marketed based on sound marketing operation.

Either party shall be entitled to request review of the price provisions for the first time with effect of dd/mm/yyyy and thereafter every three years.

Each party shall provide the necessary information to substantiate its claim.

Following a request for a price review the Parties shall meet to examine whether an adjustment of the price provisions is justified. Failing an agreement within 120 days either Party may refer the matter to arbitration in line with the provisions on arbitration of the Contract.

As long as no agreement has been reached or no arbitration award has been rendered all rights and obligations under the agreement – including the price provisions – shall remain unchanged.”³⁸

Price Revision:

Escalation supplement moves the contract price (CP)

Is this a price revision?

(Additive) formula with an “invented” gas base price P_o of 2 €cts/kWh.

100% “weight” for HFO, pass through factor 1.

“Start price” for HFO (i.e. HFO_0) 142.22 €/to.

$$CP = P_o + 1.0 * 0.0076 * (HFO - HFO_0)$$

$$CP = 2 \text{ €cts/kWh} + 1.0 * 0.0076 * (HFO - 142.22)$$

If, in a relevant new reference period, HFO were 180, then:

$$CP = 2 + 1.0 * 0.0076 * (180 - 142.22)$$

$$CP = 2 + 1.0 * 0.0076 * (37.78)$$

$$CP = 2 + 0.2871 = \underline{2.2871 \text{ €cts/kWh}}$$

*)The “factor” 1.0 is of course mathematically not necessary, I put it in as a “reminder” that we chose a weight of 100% and no pass through factor.

Price Revision:

Changes in price formation – environmental regulations cause

Increased use of GO: => weight of escalators changes

Is this a price revision?

Before ,significant change‘

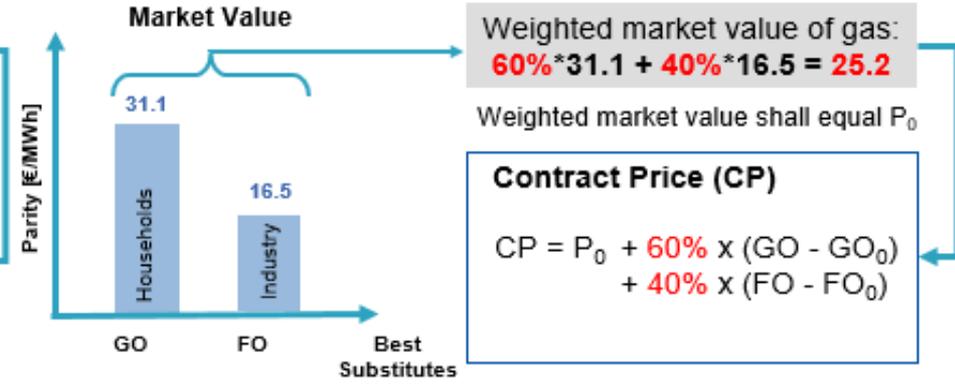
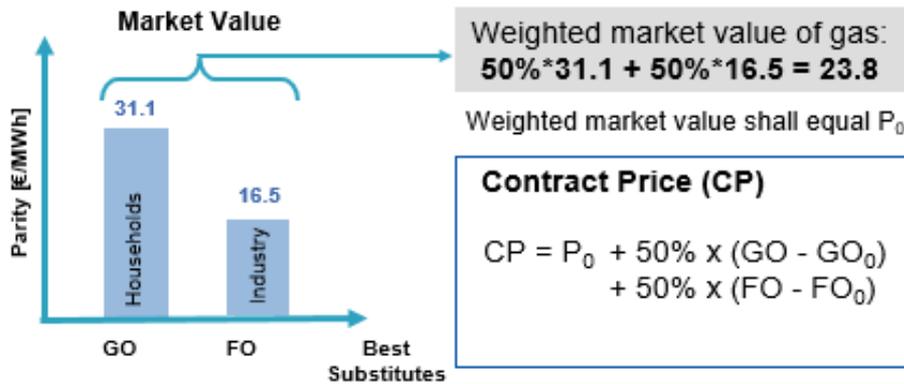
After ,significant change‘

For each end customer segment a Best Substitute fuel is defined

Different weightings of Best Substitutes reflect their market share in the respective end customer segment

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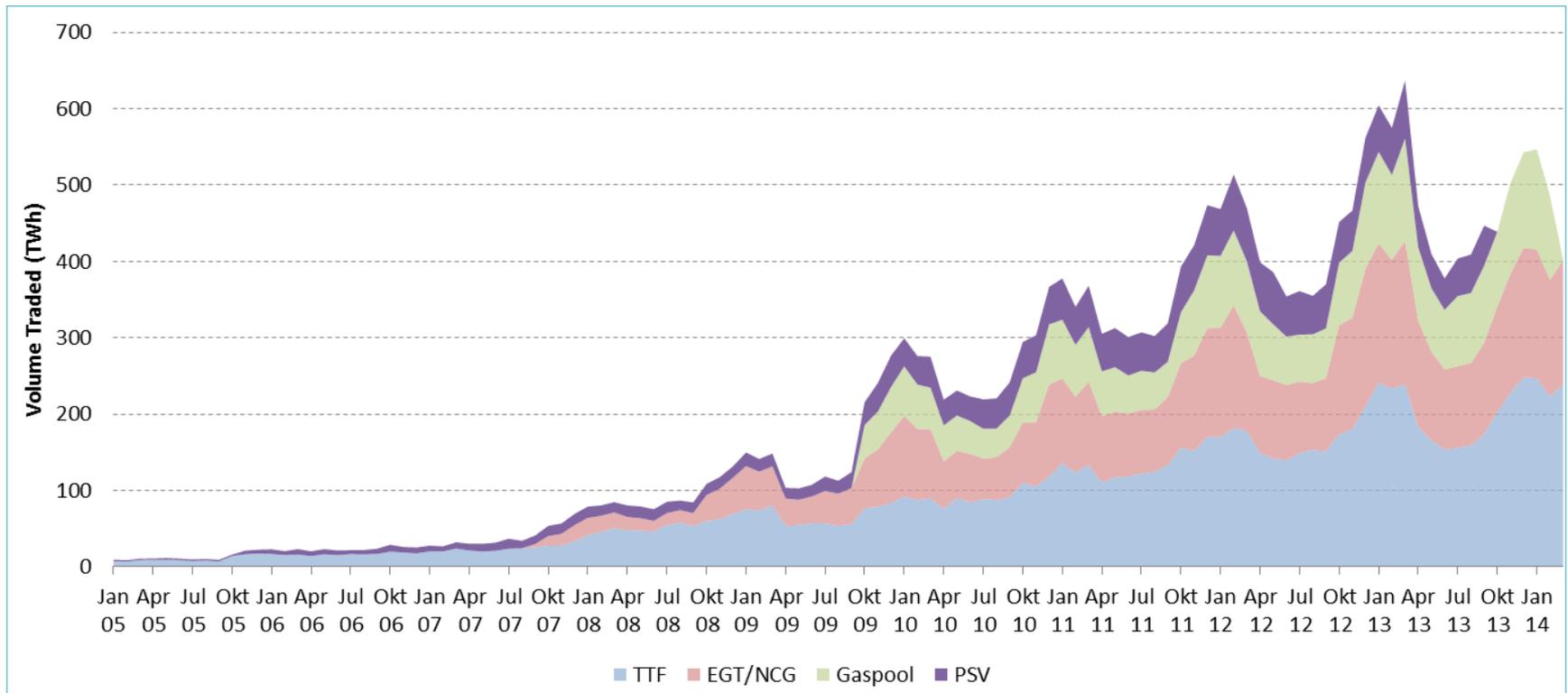


Price Revision:

Changes of price formation – hubs assume price setting role

Monthly trade volumes from ~300 TWh 2010 to ~600 TWh 2014

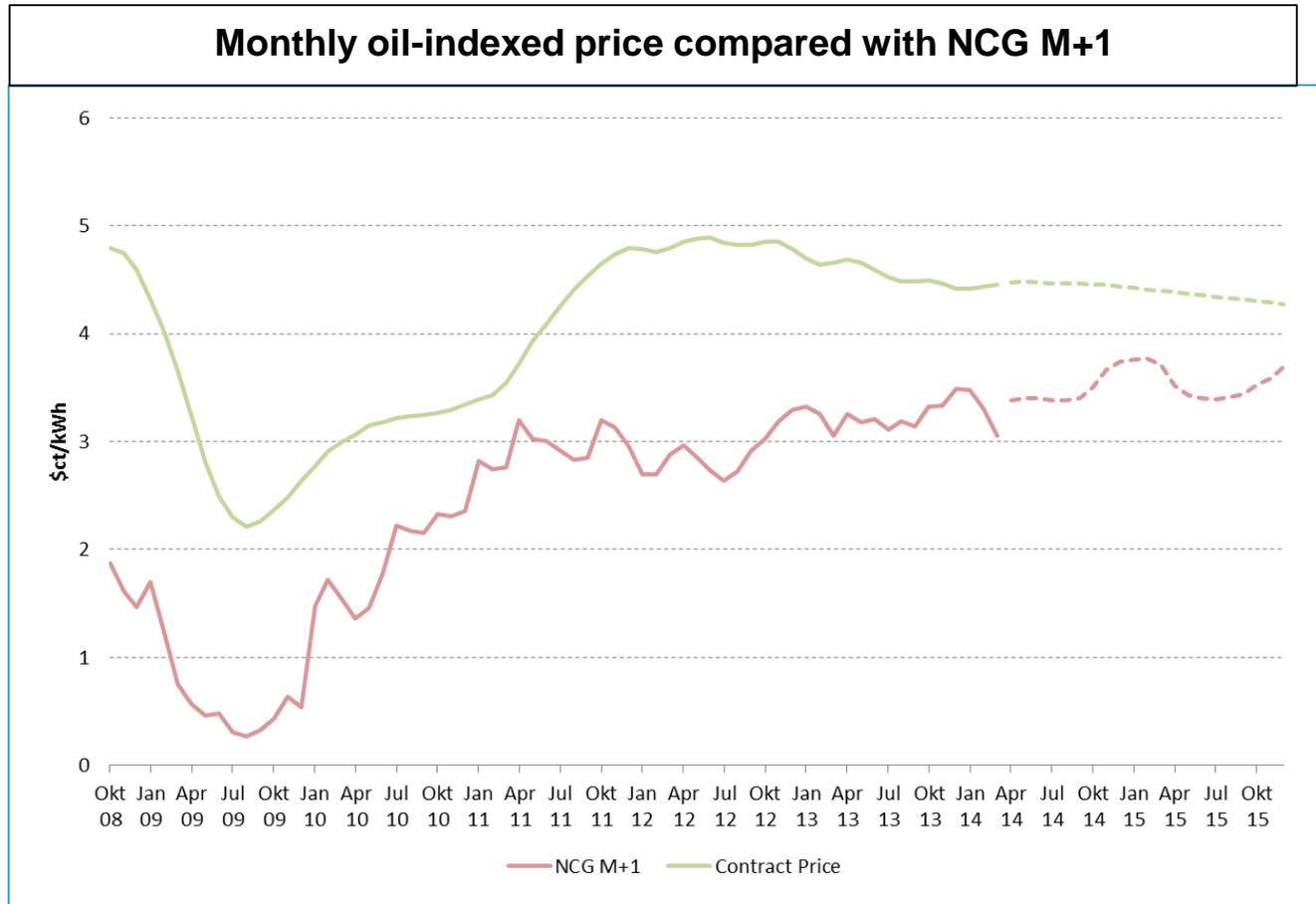
Reliance of market participants on hub's price setting role



Price Revision:

Changes of price formation – hubs take over price setting role

Oil & gas permanently decoupled - Gas-to-oil spreads significant



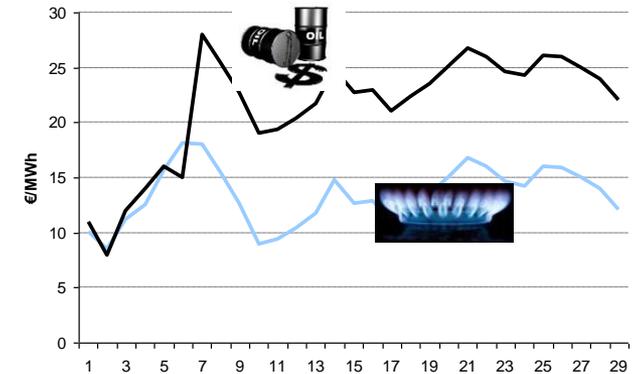
Price Revision:

Changes of price formation

“Gas-to-Oil Spread” created massive losses

Producer’s Windfall Profit = Importer’s Loss

Example “medium” LTC volume	100 TWh
Price Oil Indexed	~35 €/MWh
Price NCG	~25 €/MWh
Gas-to-Oil Spread	10 €/MWh
Producer Cost to Market	~10 €/MWh



Producer:

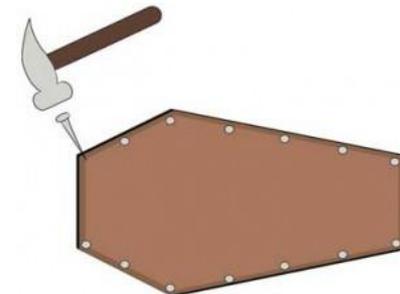
Netback profit + Windfall profit

1.5 + 1 billion €/a



Importer: Nail in the coffin

- 1 billion €/a



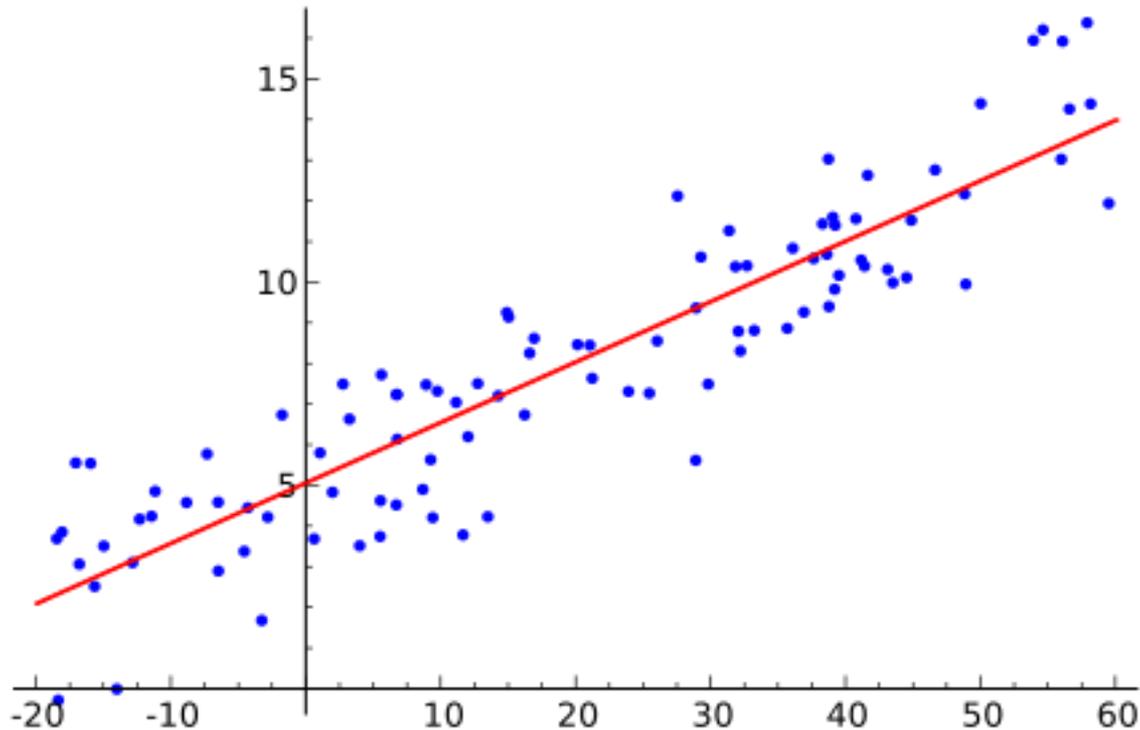
Price Revision:

Changes of price formation

How do I determine (prove) that hub is price setter?

Regression analysis between prices achieved vs. hub prices

Prevailing is still safest 'hard evidence'. Why?

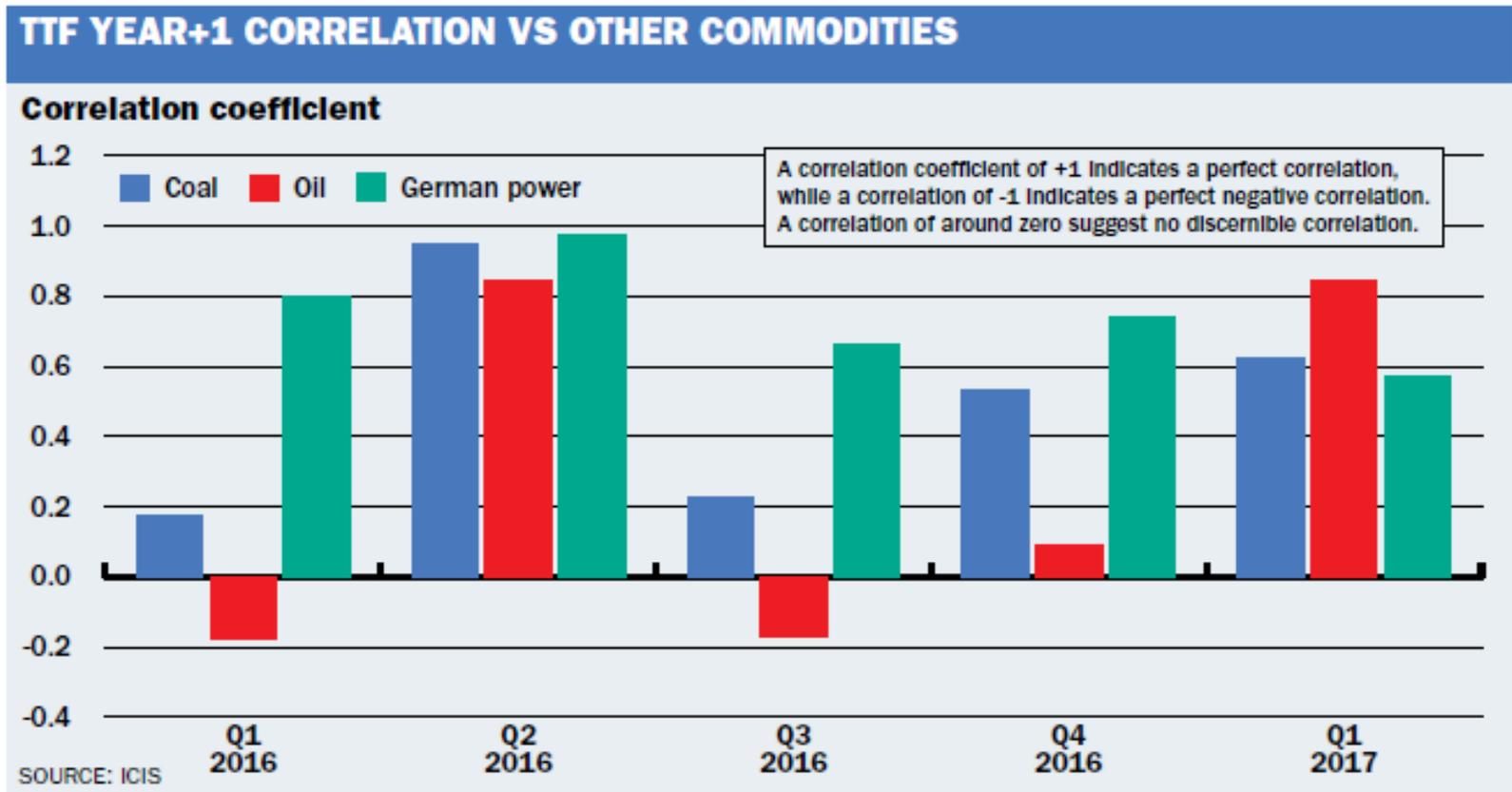


Price Revision:

How do I determine (prove) that hub is price setter?

Why regression analysis?

Correlations swing significantly depending on market circumstances



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Value chain broken – achievable price is hub price at point of first sale

- Indifference principle matching alternate fuels at end-user **abandoned**
- Net-back calculation from burner tip/margin sharing **no longer possible**
- Achievable price for importer: **wholesale traded market price**

Today's Structural Disconnect: End user value can no longer be claimed



Value chain broken: Midstreamer obsolete?

- Producer can 'go it alone' – but at a cost: 'make or buy'?
- Midstreamer disposal 'service' against cost reimbursement & service fee

- > Cash Flow Commitment (Take-or-Pay)
- > Aggregation Risk End Users
- > Volume Disposal Risk Traded Markets
- > Multiple Counterparty Credit Risk
- > Indexation Risk
- > Transaction Cost
- > Force Majeure Supply Interruption
- > Massive deployment of Working Capital



Do I take:
Risk or
"easy"
Cash?

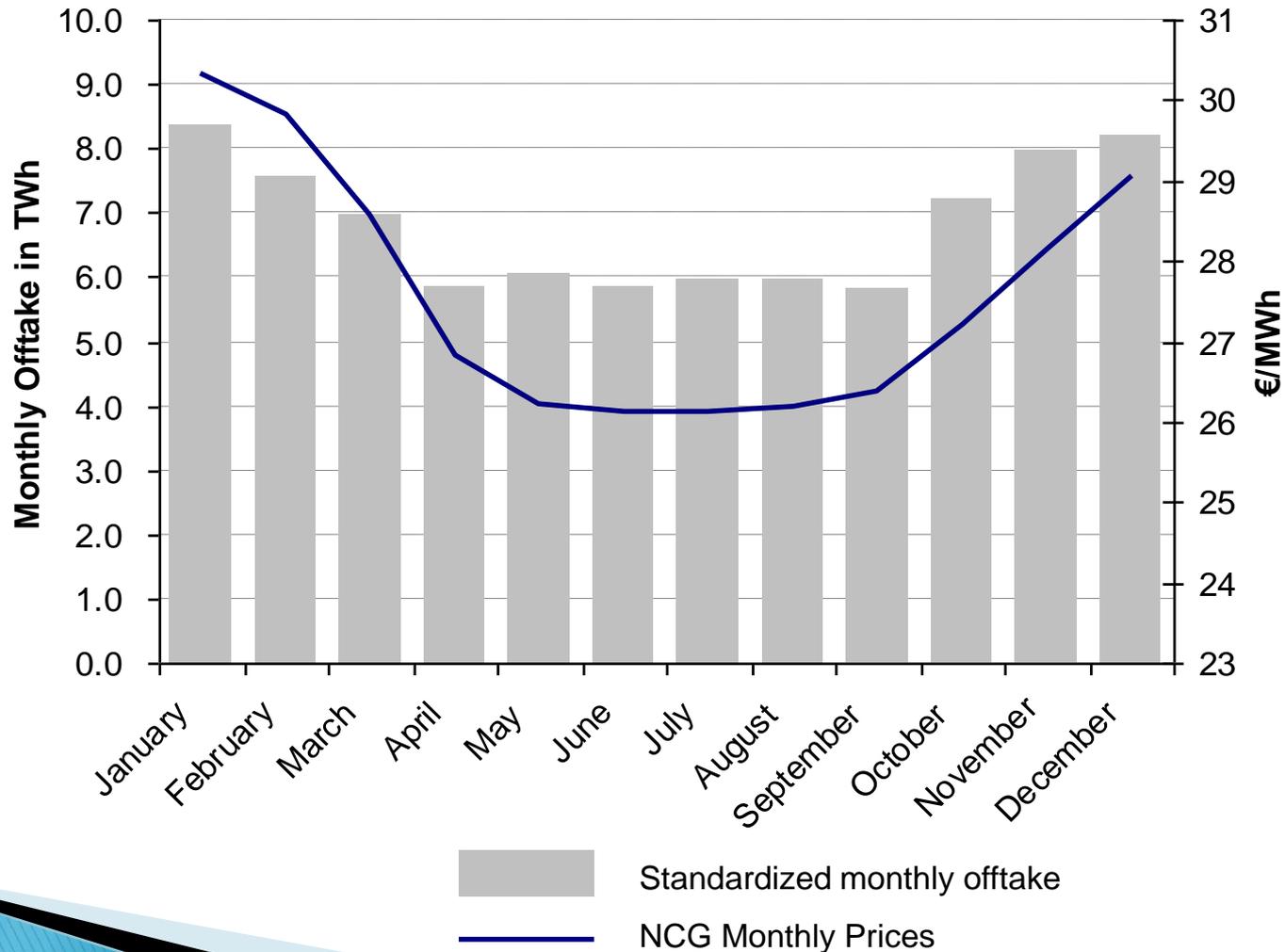


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Hub indexation in long-term contracts – can it properly reflect value?

Month-ahead pricing captures seasonal swing value



Hub indexation in long-term contracts – can it properly reflect value?

Daily flex required to be priced at “day-ahead” index
 ‘Day-ahead’ captures value of daily variations

TRADED RANGES FOR KEY GAS CONTRACT FOR THE PERIOD: 31 MAY 2017 TO 14 JUN 2017

€/MWh

Markets	Day-ahead	
	Low	High
NBP	10.446	18.254
Zeebrugge	14.009	15.340
ZTP	14.250	15.200
TTF	14.600	15.550
GASPOOL	14.950	15.750
NCG	2.525	15.900
PEG Nord	14.225	15.600
TRS	14.450	15.500
VTP	16.300	17.250

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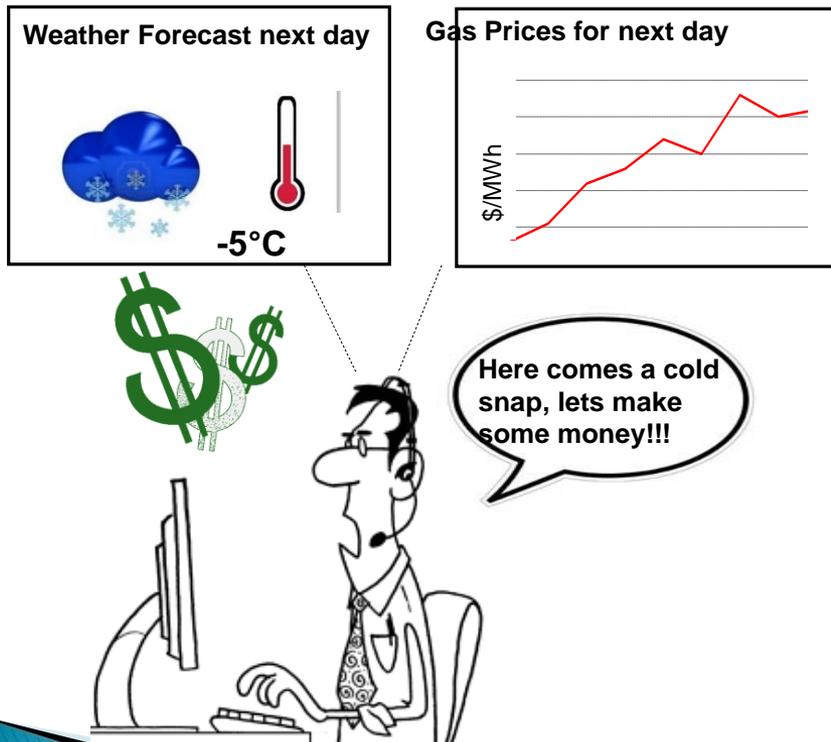
EGM 24.11 | 15 June 2017 | www.icis.com/energy

Source: ICIA Heren EGM 24.11

Hub indexation in long-term contracts – can it properly reflect value?

Daily flex is required to manage daily fluctuations

Alleged ‘enormous value’ in LTCs unfounded, importer cannot wait
for a ‘cold snap’ – producer participates in ‘ups and downs’



Hub indexation in long-term contracts – Will it increase volatility?

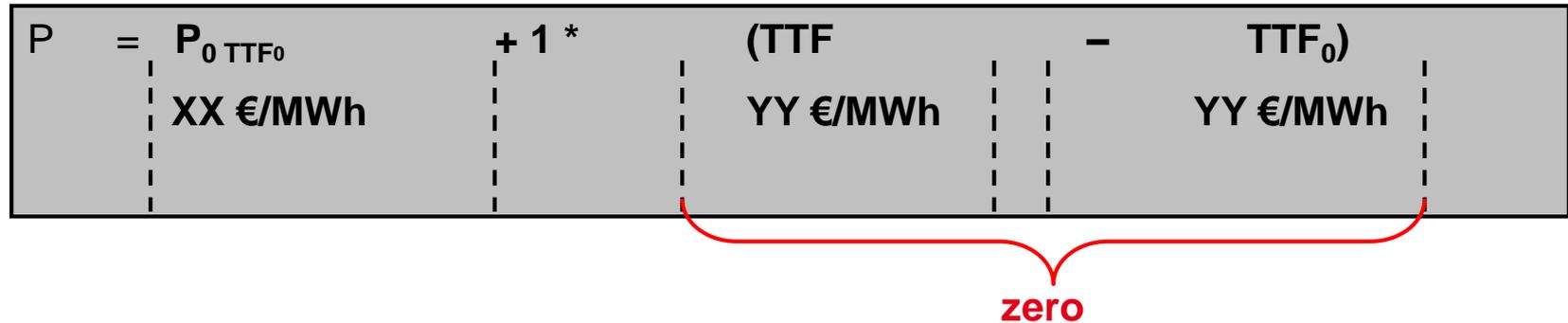
Example month-ahead (M+1) – determined over ~20 days

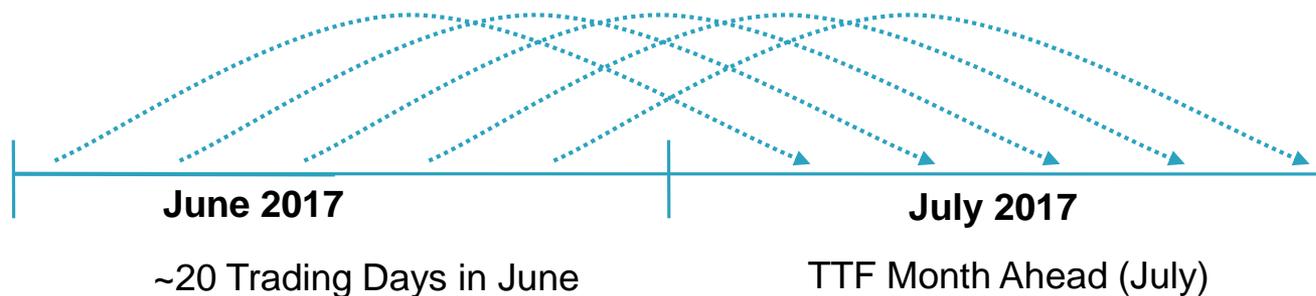
Note: this is NOT ‘spot-pricing’

$$P = P_{0 \text{ TTF}_0} + 1^* \left(\text{TTF} - \text{TTF}_0 \right)$$

XX €/MWh
YY €/MWh
YY €/MWh

zero





This can also be done e.g. year-ahead over ~200 trading days

Hub indexation in long-term contracts – Will it increase volatility?

Example M+1 by direct reference to index

CP_m = TTF M+1 [Heren TTF Monthly Index]

where:

“CP_m” shall mean the Contract Price for the Delivery Month“

“TTF M+1 [Heren TTF Monthly Index]”

shall mean:

“the Heren Monthly TTF Index as published in European Spot Gas Markets (ESGM) by ICIS Heren Energy in the section Heren Monthly Indices TTF expressed in Euro per MWh. The index is derived from actual transactions for flat gas flowing at a given rate for the month ahead. The index is the volume weighted average of the transaction prices for month ahead transactions and is established on the last trading day of the calendar month prior to delivery.”

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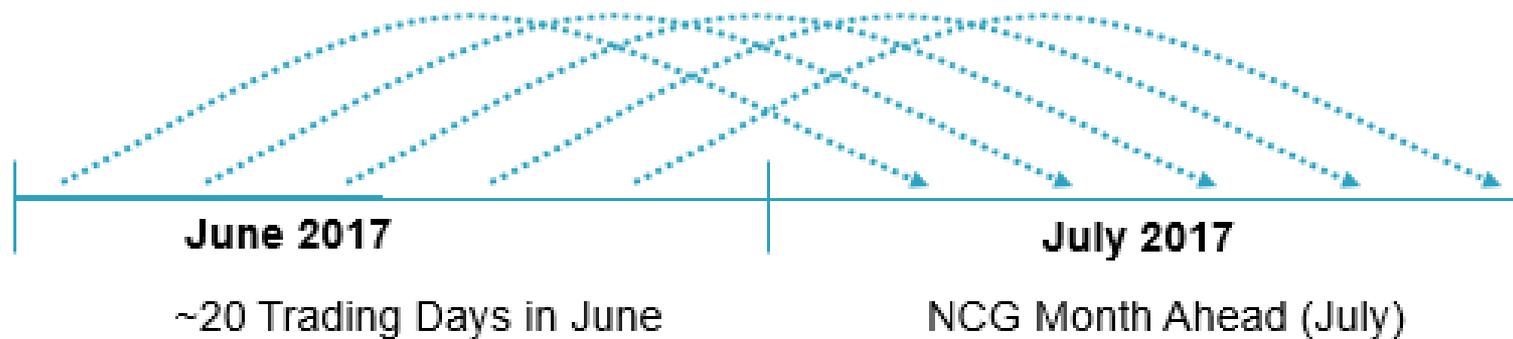
Price disparities – example hedging techniques

You buy at M+1 and sell at M+1? Do nothing!

You buy at M+1 but cannot be sure at what you sell?

Hedge by selling each trading day 1/20th of next month's volume

Buy back from the market commensurate your sales price.



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A Eurasian 'Henry Hub' – how could it look?

Different stages of development, but strong price correlation

Promising developments in Ukraine, Turkey lagging behind



Source: Heather/Petrovich, OIES May 2017

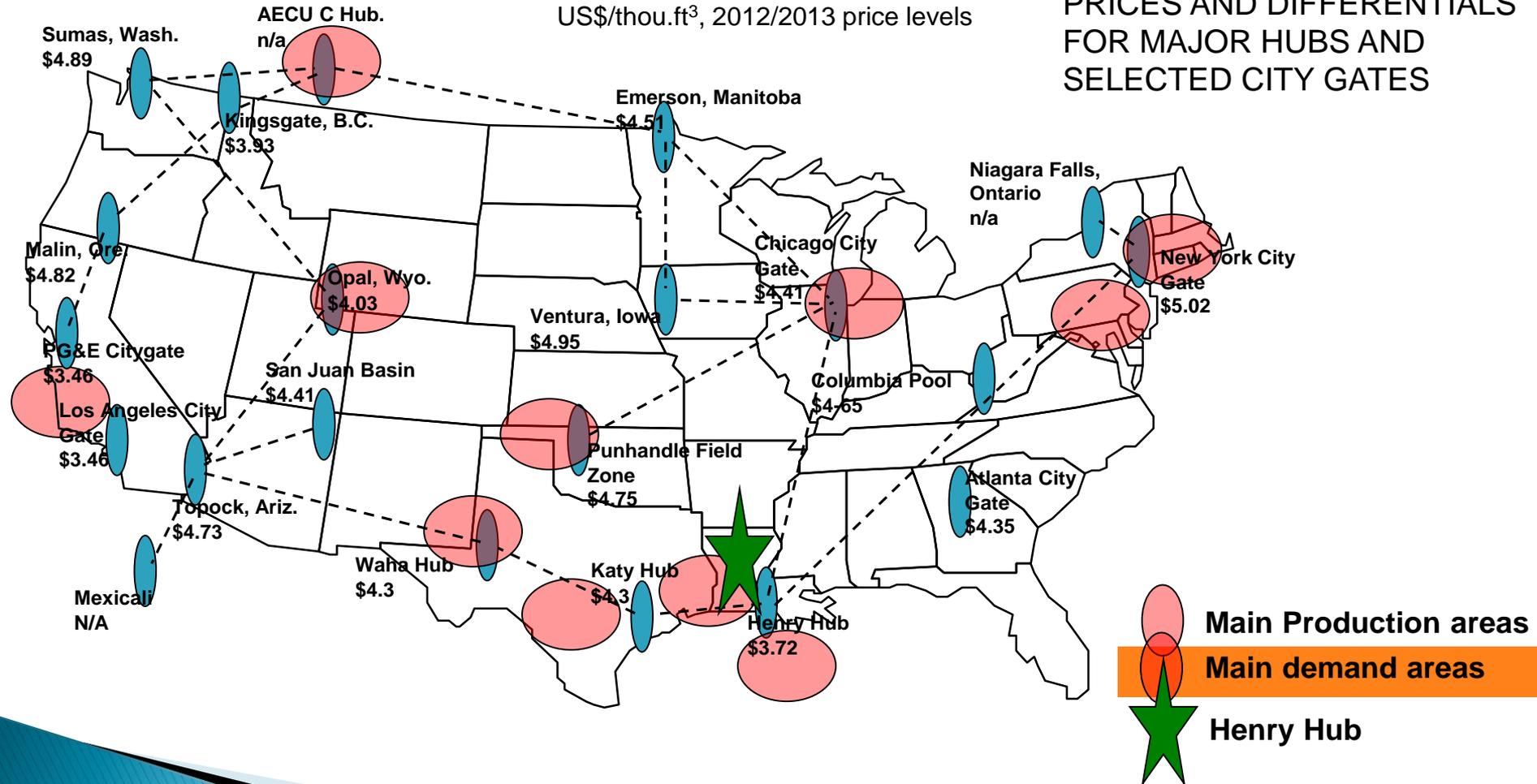
A Eurasian 'Henry Hub' – how could it look?

Also the U.S. Henry Hub does not have uniform pricing

Location basis differentials will prevail (and are quite normal)

US\$/thou.ft³, 2012/2013 price levels

PRICES AND DIFFERENTIALS FOR MAJOR HUBS AND SELECTED CITY GATES



Source: <http://www.eia.gov/naturalgas/monthly/>

For further reading...

THE CASE FOR GAS POST COP21

Natural gas is the „low hanging fruit“ for material and immediate reduction of greenhouse gases

by

Wolfgang Peters (www.gasvaluechain.com)

Thank you for your attention



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