

# Natural gas markets

Jan Osicka

## Production + treatment



## Wholesale market



## Retail market



# Wholesale and retail markets

## Oil

- Wholesale market
  - World oil market
  - Producers – traders – consumers (refineries, chemical plants)
  - Price = benchmark + differential
- Retail market
  - Gas stations
  - Gas retailers – car users
  - Price = wholesale price + costs of refining services + taxes and tariffs

## Gas

- Wholesale market
  - Continental and regional gas markets
  - World LNG market
  - Transit (high pressure) network
  - Producers – traders – large consumers (utilities, power plants, factories)
  - Price = price of commodity + transport + storage
- Retail market
  - Distribution (low pressure) network
  - Utilities – small consumers
  - Price = wholesale price + taxes and tariffs

## Setting the price of the commodity

- Regulated: end user prices set by a national authority
- Fuel indexation: pegging the price to competing fuel reflects fuel substitutability (oil, oil product basket, fuel basket)
- Market-based pricing: price set through the market mechanism

# Fuel indexation

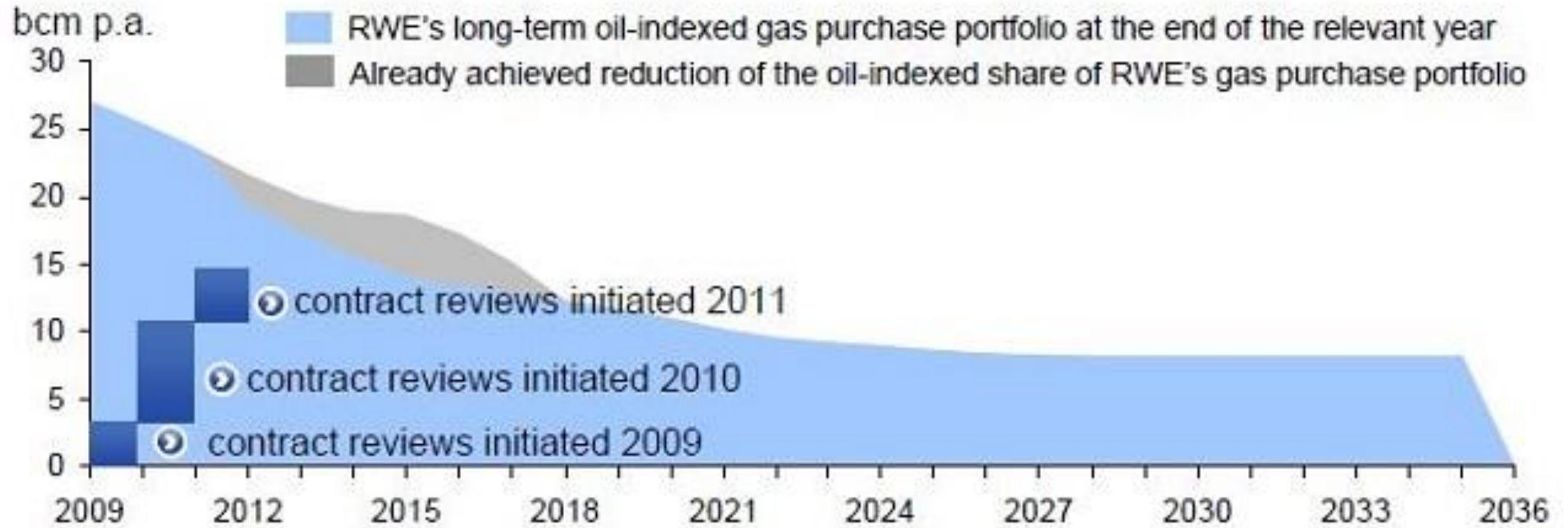
Two parties, direct negotiations, details typically business secret (Russia-China gas deal of 2014)

## Content

- Duration
- Pricing formula
- Additional clauses



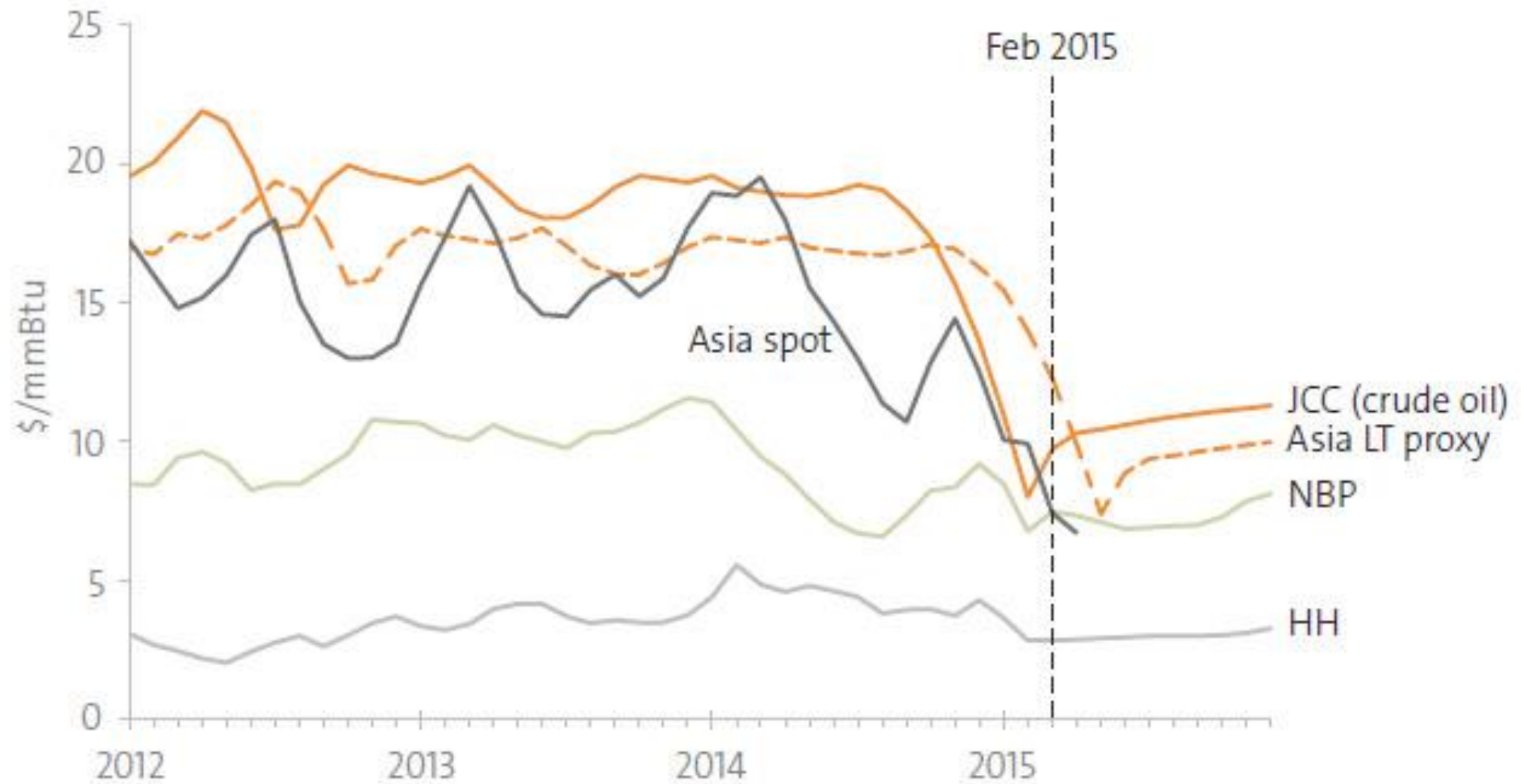
## Duration



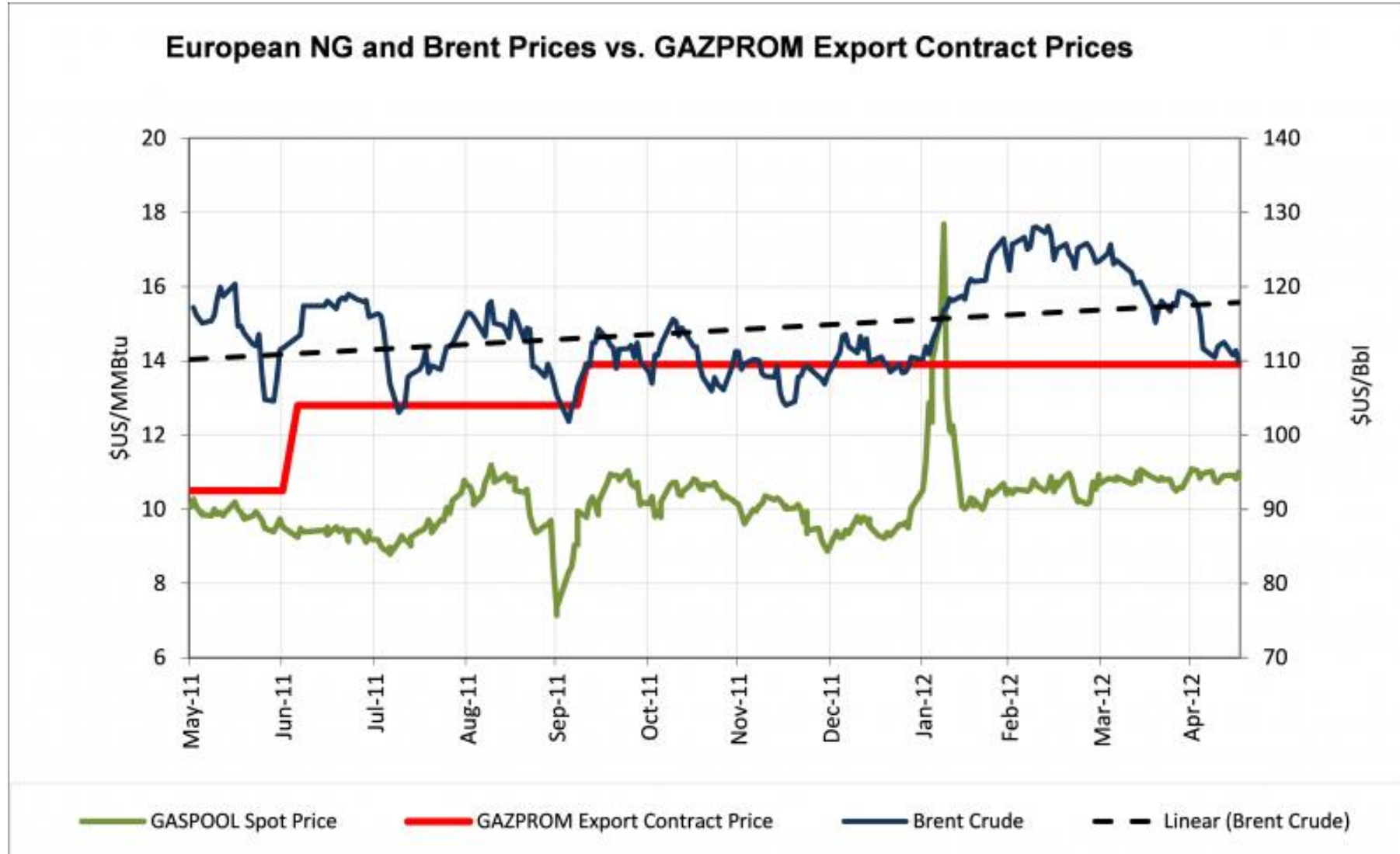
- 15-35 years, recently up to 20 years

- Example: RWE contract portfolio

## Pricing formula



# Pricing formula





## Pricing formula

$$\begin{aligned} P(t) = & P(c) \\ & + 0.60 \times 0.80 \times 0.0078 \times \Delta P(\text{LFO}) \\ & + 0.40 \times 0.90 \times 0.0076 \times \Delta P(\text{HFO}) \end{aligned}$$

...  $P(t)$  = gas price in the target period

...  $P(c)$  = gas price in the current period

...  $\Delta P$  = change in price of the reference fuel during the pre-agreed period

... LFO = light fuel oil

... HFO = heavy fuel oil

... 0.60, 0.40 = market shares of competing fuels

... 0.80, 0.90 = pass through factors

... 0.0078, 0.0076 = FO/gas energy parity

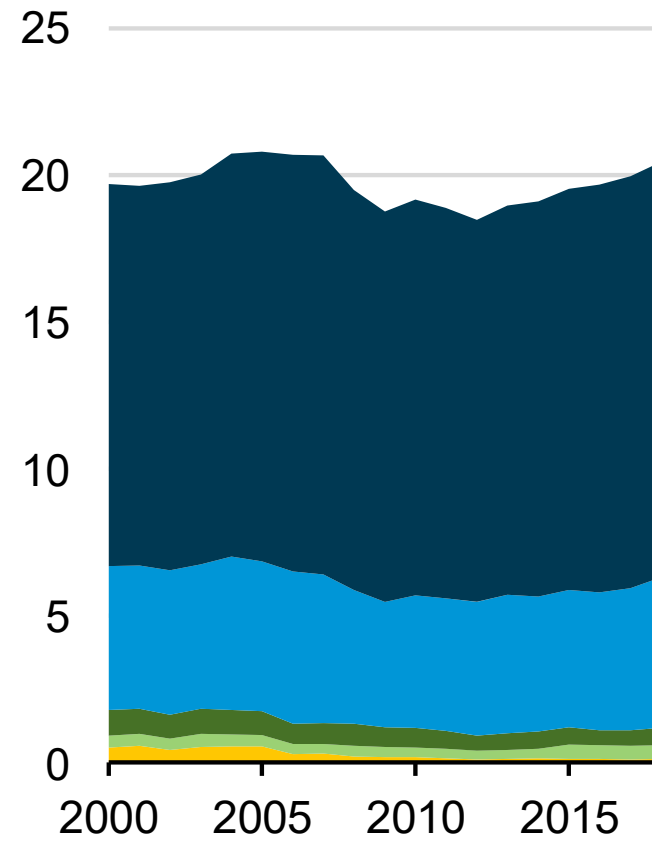
# Pricing formula

## U.S. fossil fuel energy consumption by sector (2000-2018)



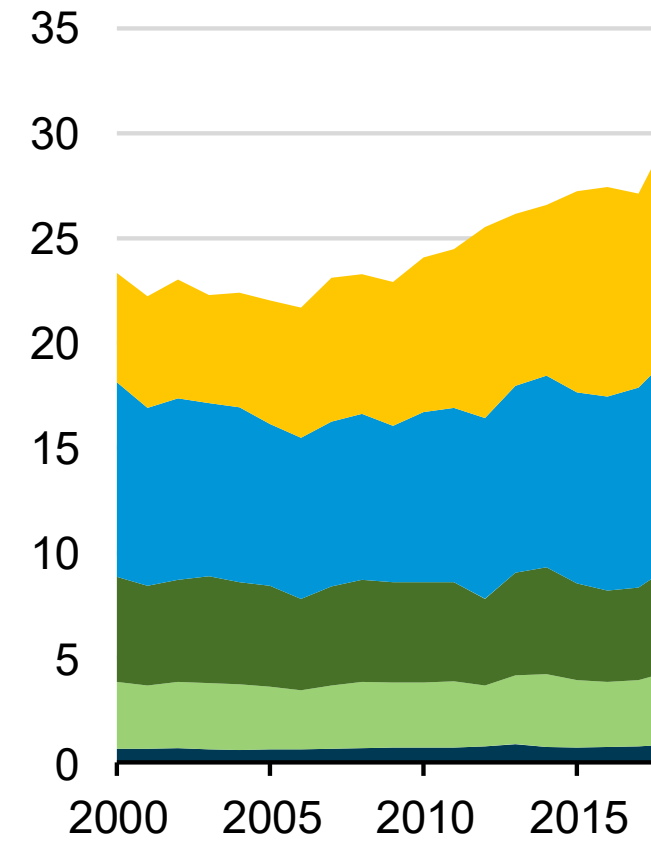
### petroleum

million barrels per day



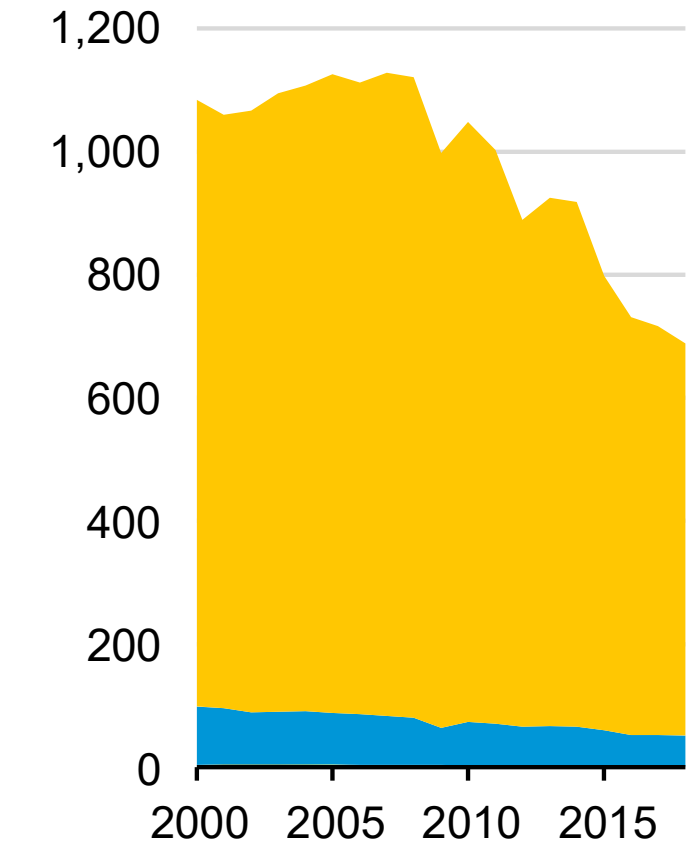
### natural gas

trillion cubic feet



### coal

million short tons



transportation

industrial

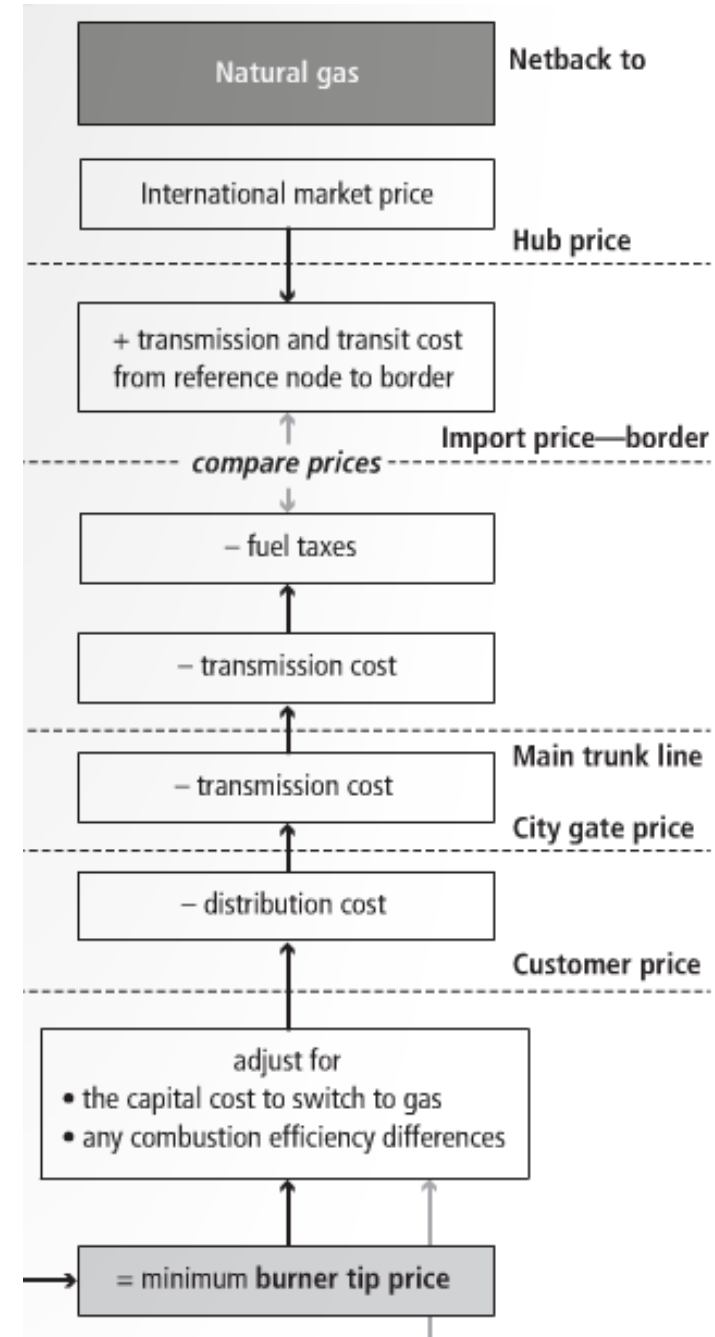
residential

commercial

electric power

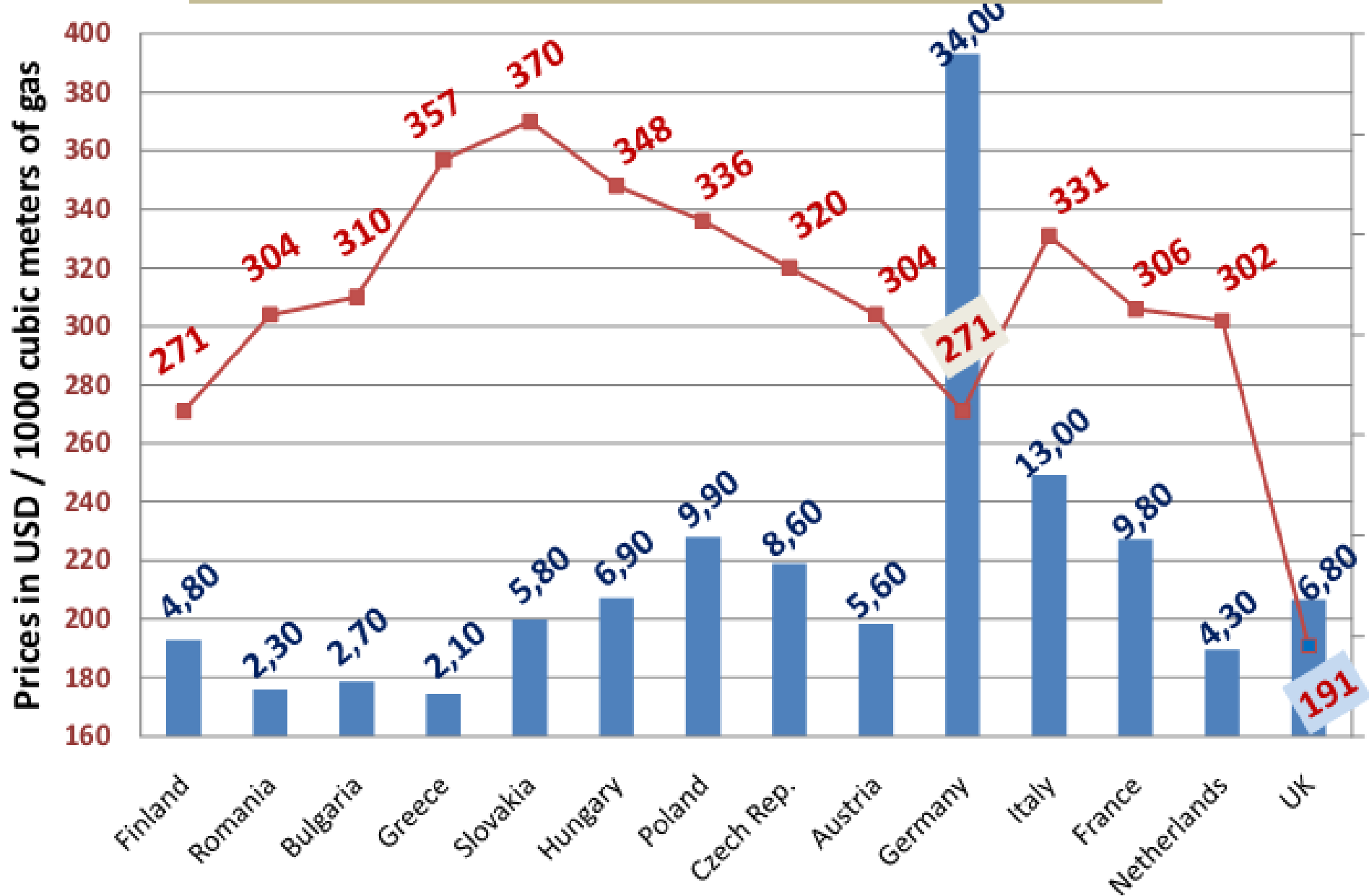
# Pricing formula: Netback pricing

- Netback price = replacement value
- What is the maximum competitive price?
  
- Netback to natural gas
- Netback to other fuels

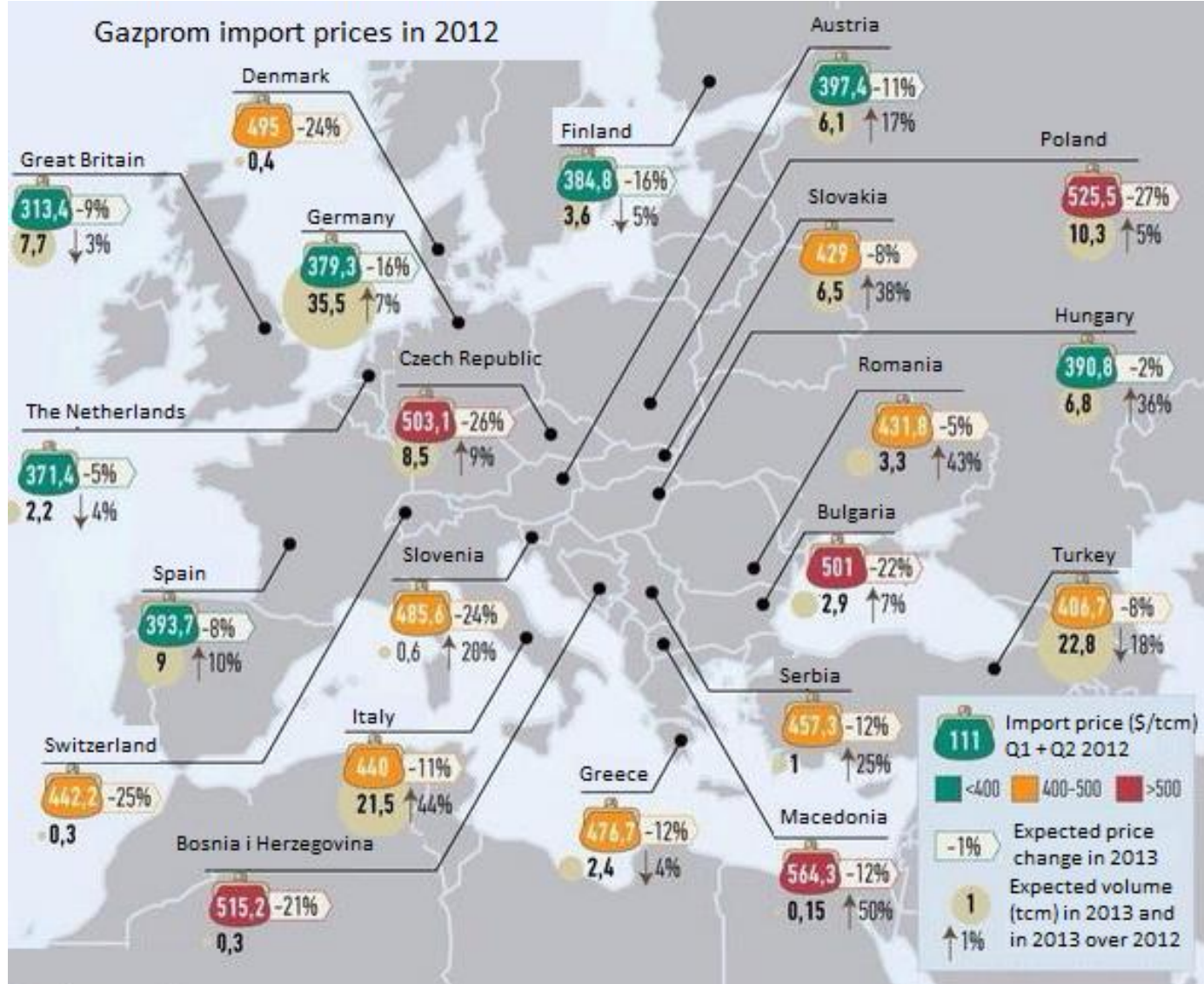


# Gazprom gas prices for EU – 2010

Source: [www.vedomosti.ru](http://www.vedomosti.ru) – 25th February 2011



# Russian import price in 2012



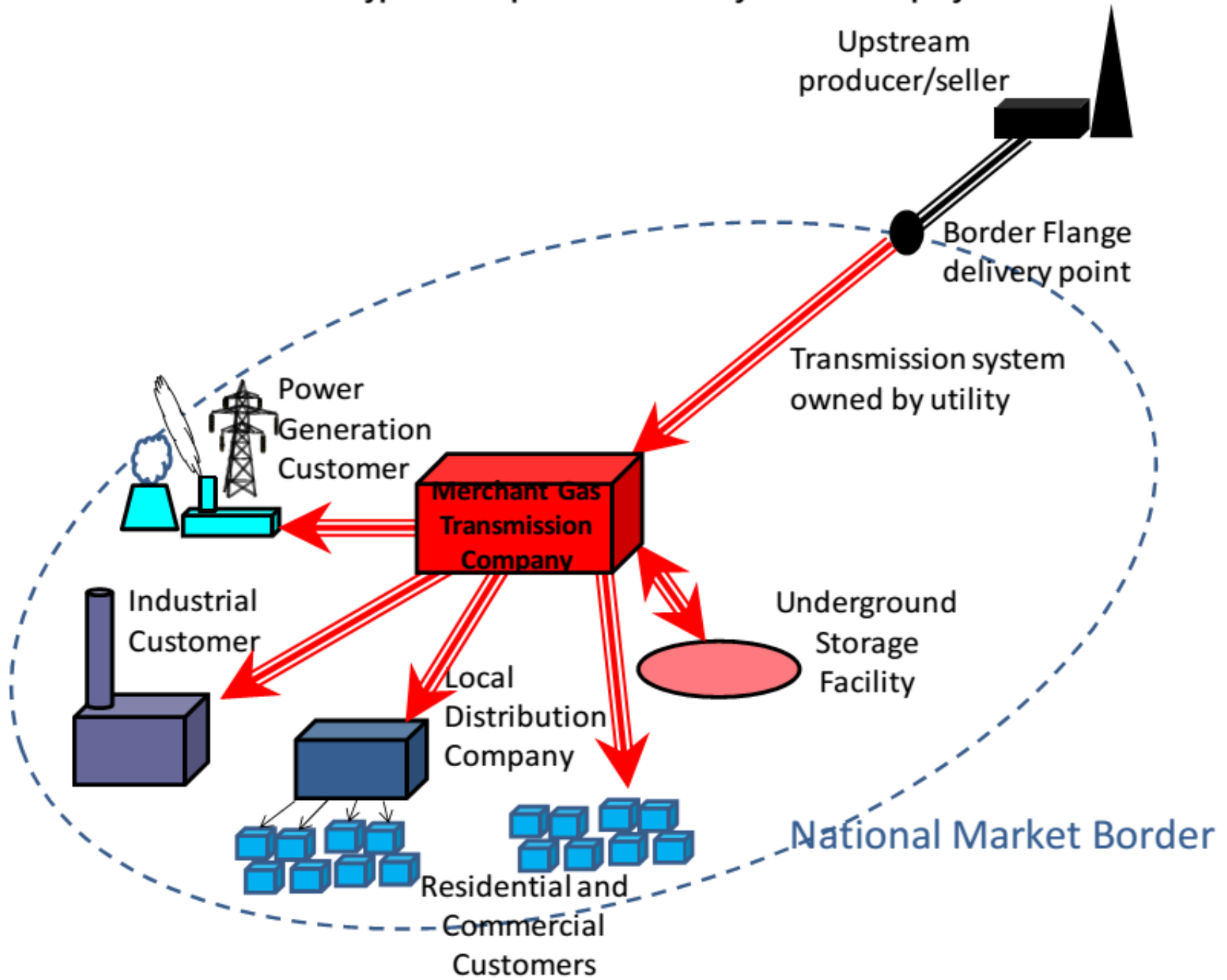


## Additional clauses

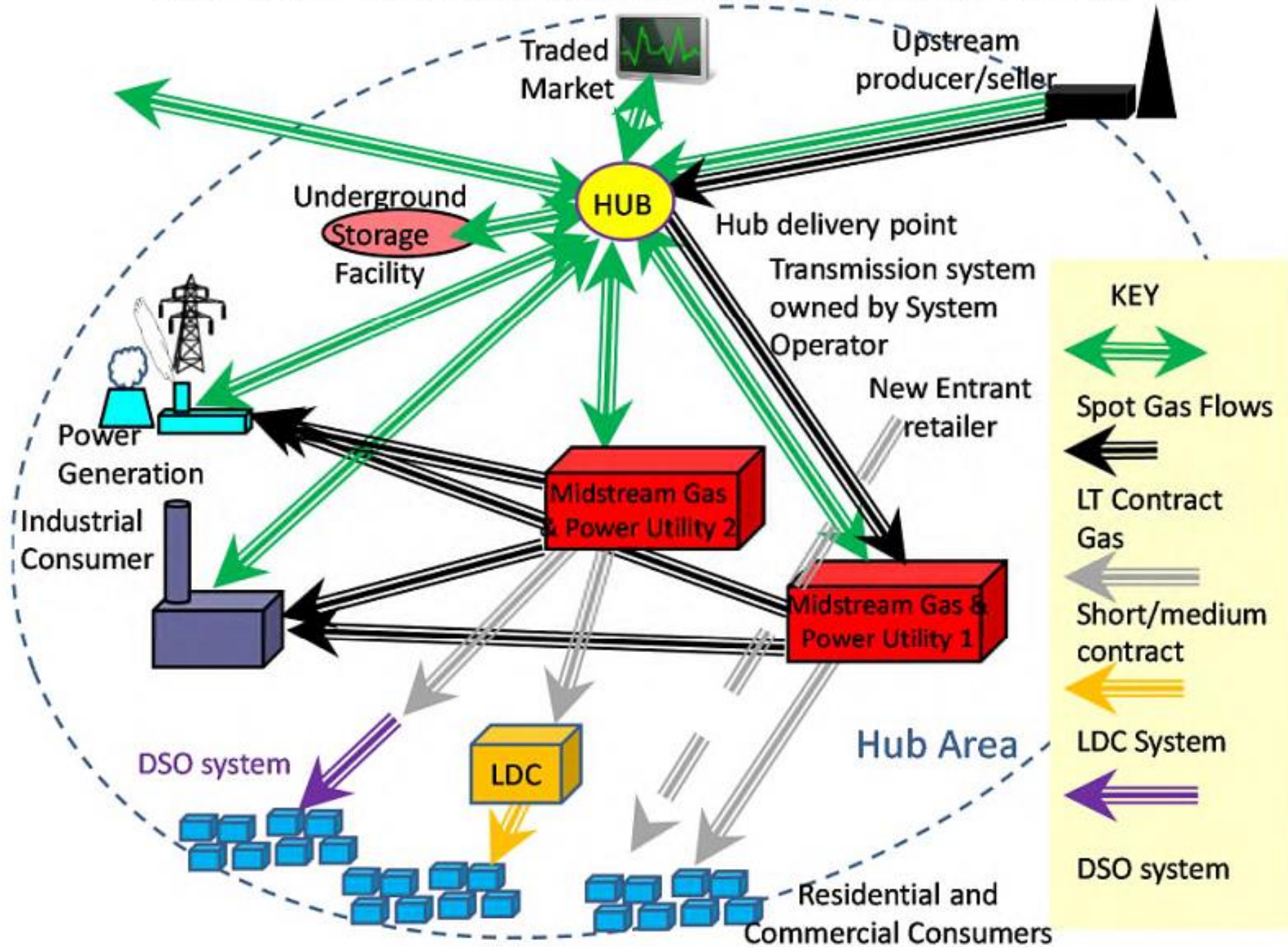
- Flexibility (take-or-pay): (70-) 85-90%
- Destination clause (reexport)
- Delivery point

# Competitive pricing

# Schematic of a Typical European Gas Industry in the Monopoly Era



# Schematic of a Continental European Market with an Established Gas Hub



# Hubs and trading

## Physical hubs

- Transit hub: infrastructure crossroad + OTC trading
- Trading hub: infrastructure crossroad + Exchange
- Transition hub: in between

## Virtual hubs

- Regulated emergence
  - Geographical delimitation (regional or national market)
- 

## OTC (over-the-counter)

- Direct or broker-facilitated trading
- Negotiated units (mostly €/MWh)
- Non-regulated trading (general laws apply)
- Contracts are not guaranteed

Hubs = infrastructure crossroads where trading happens

Exchanges = trading places where gas is (also) traded

---

## Exchange

- Anonymous trading via the exchange system
- Standardized units (€/MWh)
- Trading is regulated
- Contracts are guaranteed by the exchange (exchange acts as “central counterparty”)



## Exchange trading: bids and offers

Price (EUR)	Volume (MWh)	
17.320	1,200	Offer/ask
17.022	450	
16.921	600	
16.853	300	
16.789	100	Last trade
16.562	200	Bid
16.232	500	
16.082	350	
15.902	150	

- Offer/ask = prices offered by sellers

- Bid = prices offered by buyers

Exchange trading: Buying 1,000 MWh at 17.100

Price (EUR)	Volume (MWh)	
17.320	1,200	Offer/ask
17.022	450	
16.921	600	
16.853	300	
16.789	100	Last trade
16.562	200	Bid
16.232	500	
16.082	350	
15.902	150	

Price (EUR)	Volume (MWh)	
17.320	1,200	Offer/ask
17.022	<del>450</del> => 350	
<del>16.921</del>	<del>600</del>	
<del>16.853</del>	<del>300</del>	
16.789	100	Last trade
16.562	200	Bid
16.232	500	
16.082	350	
15.902	150	

Exchange trading: Selling 1,000 MWh at 15.900

Price (EUR)	Volume (MWh)	
17.320	1,200	Offer/ask
17.022	450	
16.921	600	
16.853	300	
16.789	100	Last trade
16.562	200	Bid
16.232	500	
16.082	350	
15.902	150	

Price (EUR)	Volume (MWh)	
17.320	1,200	Offer/ask
17.022	450	
16.921	600	
16.853	300	
16.789	100	Last trade
<del>16.562</del>	<del>200</del>	Bid
<del>16.232</del>	500	
16.082	<del>350</del> => 50	
15.902	150	

2016

European hubs



Sources: worldatlasbook.com; P. Heather

# Hub development

2018	TRADED GAS HUBS CHURN RATES*				
HUB	2008	2011	2016	2017	2018
TTF	3.3	13.9	57.1	54.3	70.9
NBP	14.4	19.8	22.1	23.9	16.9
VTP	CEGH 2.4	CEGH 2.2	5.7	5.3	6.9
NCG	0.4	1.8	4.0	3.4	3.8
GPL		0.8	2.5	2.6	2.8
ZEE+ZTP	5.1	4.1	4.1	2.9	3.1
TRF	FRANCE 0.4	FRANCE 1.0	PEG N 1.7 TRS 0.6	PEG N 1.7 TRS 0.6	1.7
PSV	0.2	0.2	1.2	1.2	1.4
VOB	n/a	n/a	1.1	1.1	0.9
PVB	n/a	n/a	0.1	0.2	0.3

\*Calculated on a **Net Market Churn** basis; not the same methodology in all years.

## Hub maturity criteria

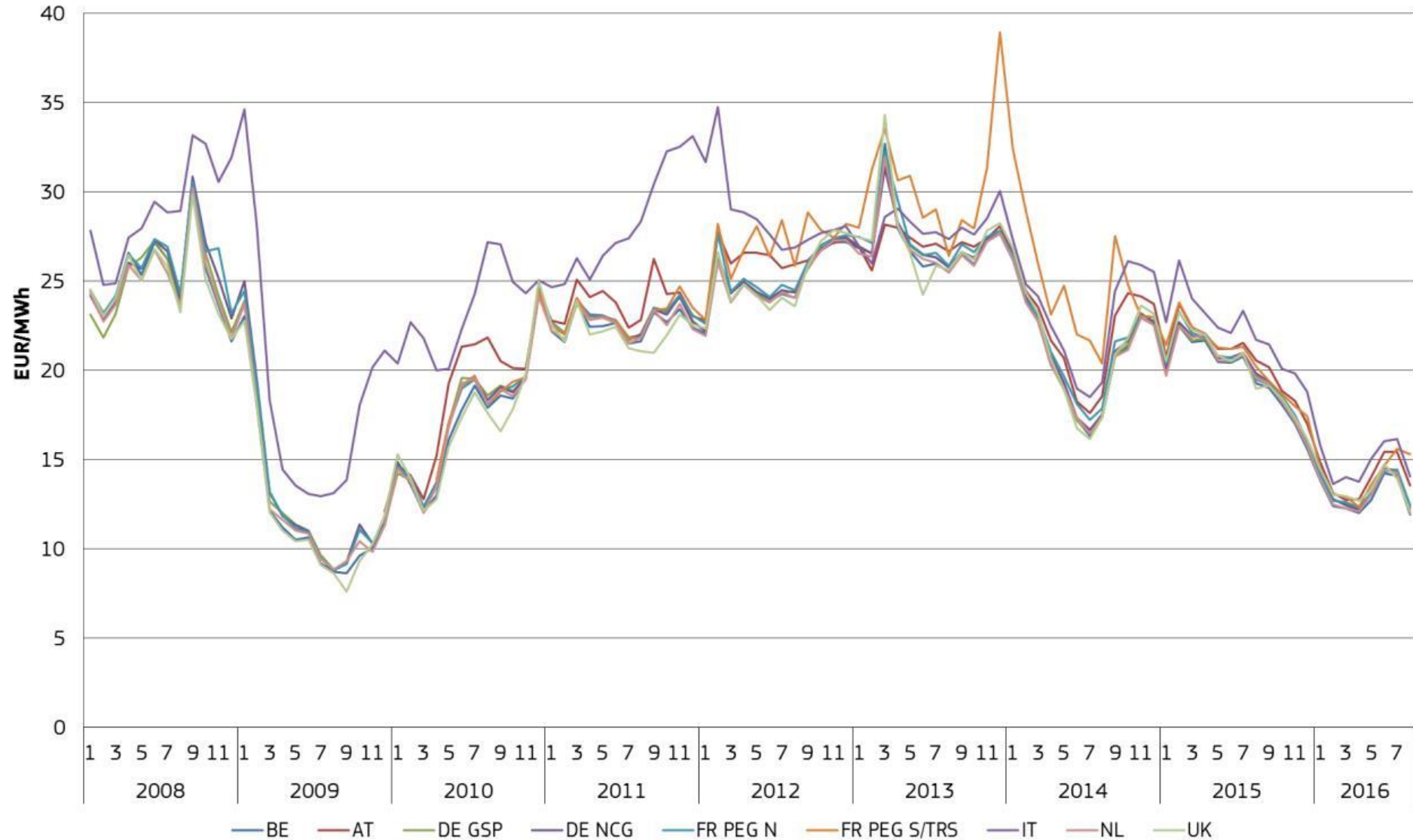
- Market participants (= number of active/registered participants)
- Traded products (e.g. physical trade, balancing, risk management)
- Traded volume (total volume of gas traded at a hub per year)
- Tradability index (= bid/ask spread)
- Churn rate (ratio of the total traded volume and the physical volume of gas going through a hub)



## Gas-to-gas competition: arbitrage



# Gas-to-gas competition: arbitrage



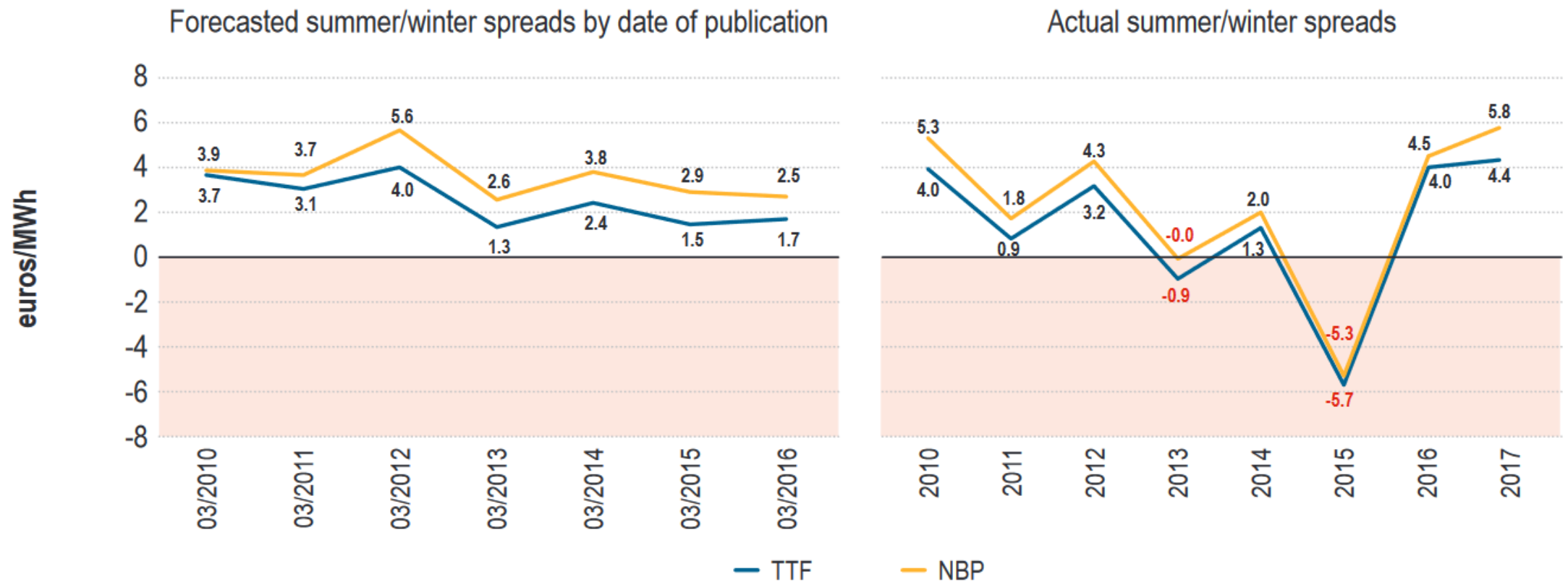
# Competition

## Traders' strategy

- Sourcing gas: hubs x contracts x LNG
- Utilizing arbitrage and risk-management opportunities
- Utilizing storage

# The importance of storage: summer/winter spreads

Figure 11: NBP and TTF forward and actual summer/winter spreads 2010–2018 - euros/MWh



# World gas market and European supply dynamics



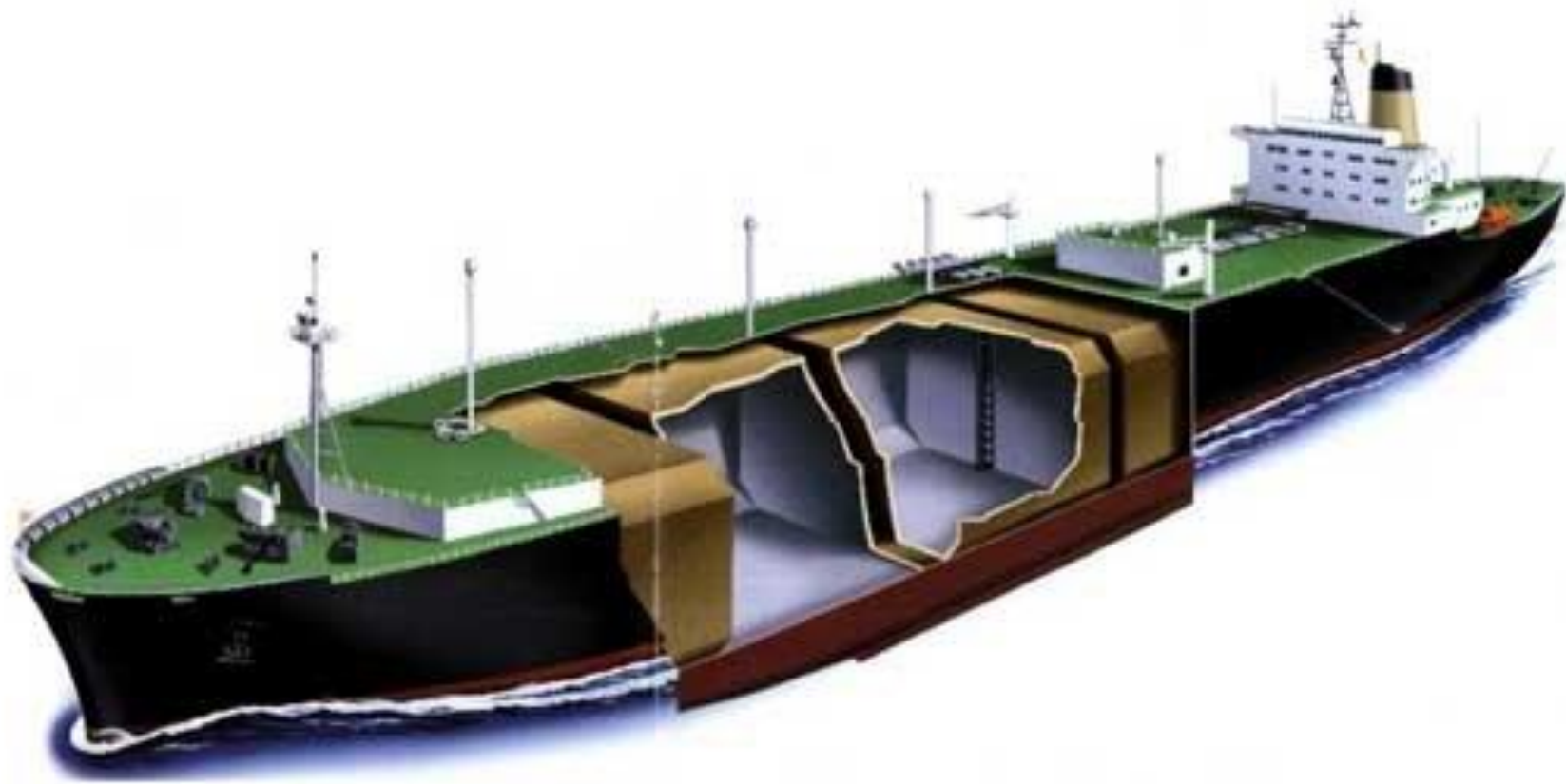
Oil, Gas, Coal 2010

(milion MMBtu)	Oil	Gas	Coal
Reserves	8 021 000	6 657 200	16 441 176
Production	169 456	113 670	150 794
Traded	107 512	34 710	24 520
Seaborne trade	59 096	10 573	13 631

## Oil, Gas, Coal 2010

	Oil	Gas	Coal
Trade/Production (%)	63.4	30.5	16.3
Seaborne trade/Trade (%)	55.0	30.5	55.6
Seaborne trade/Production (%)	34.9	9.3	9.0

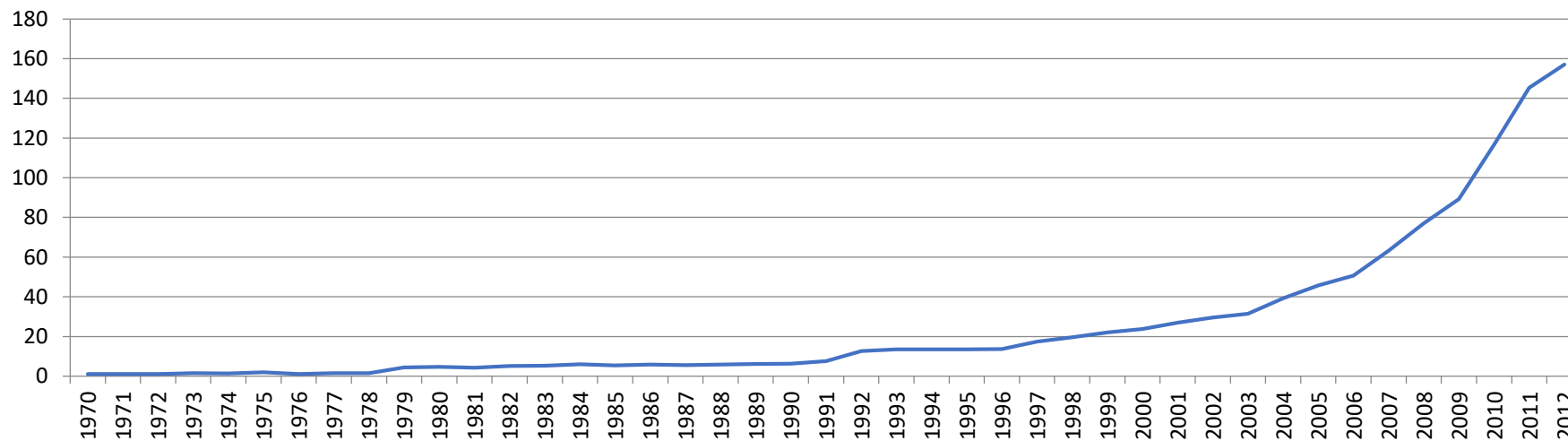
LNG



## Development of LNG trade

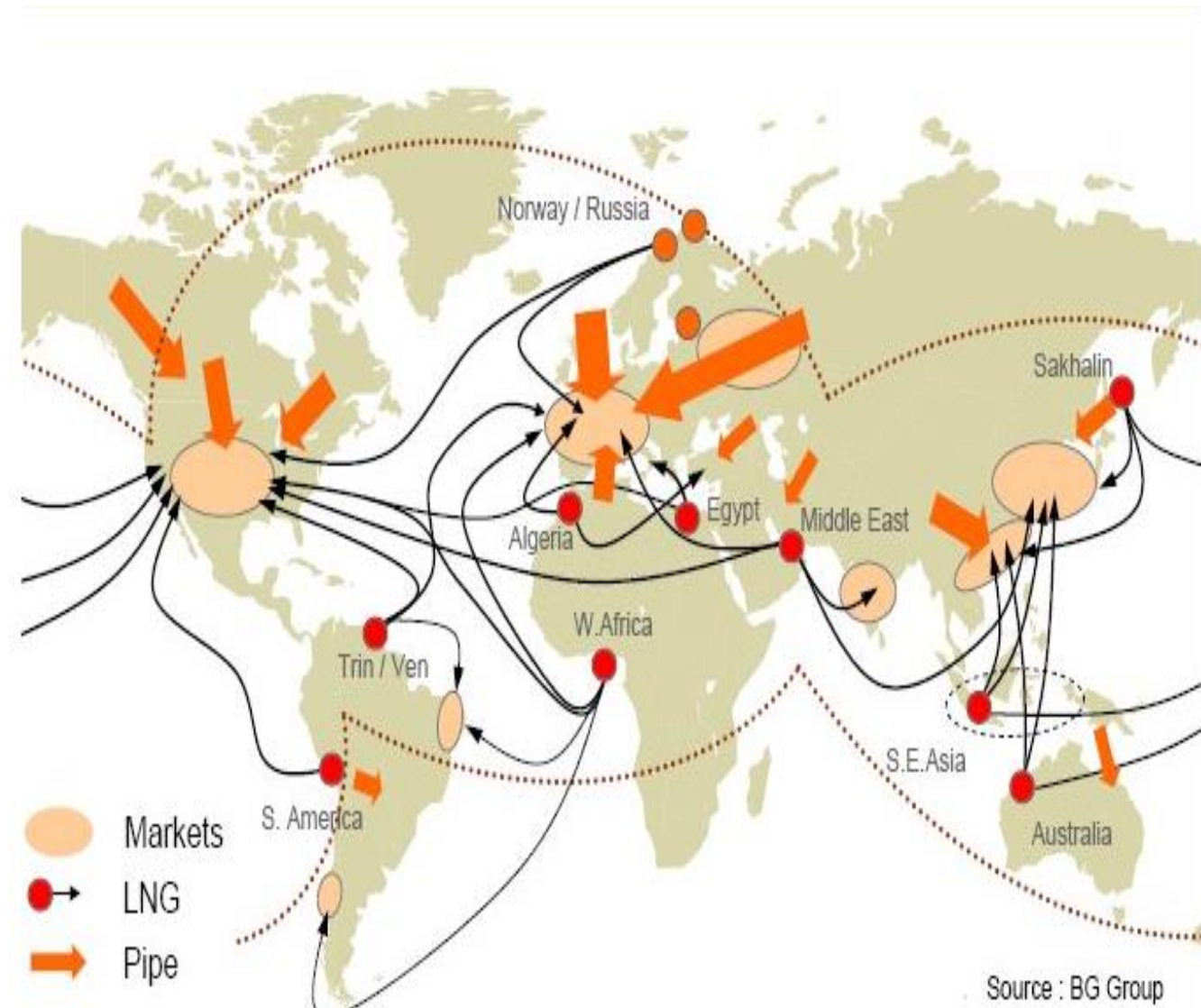
- Before 2000: strictly bilateral LTCs supplying premium markets (Spain, France, Japan, South Korea)
- After 2000: the rise of Qatar
  - 1997: 0.16 bcm of LNG exported
  - 2012: 105.4 bcm of LNG exported

**Qatari NG production (bcm/y)**

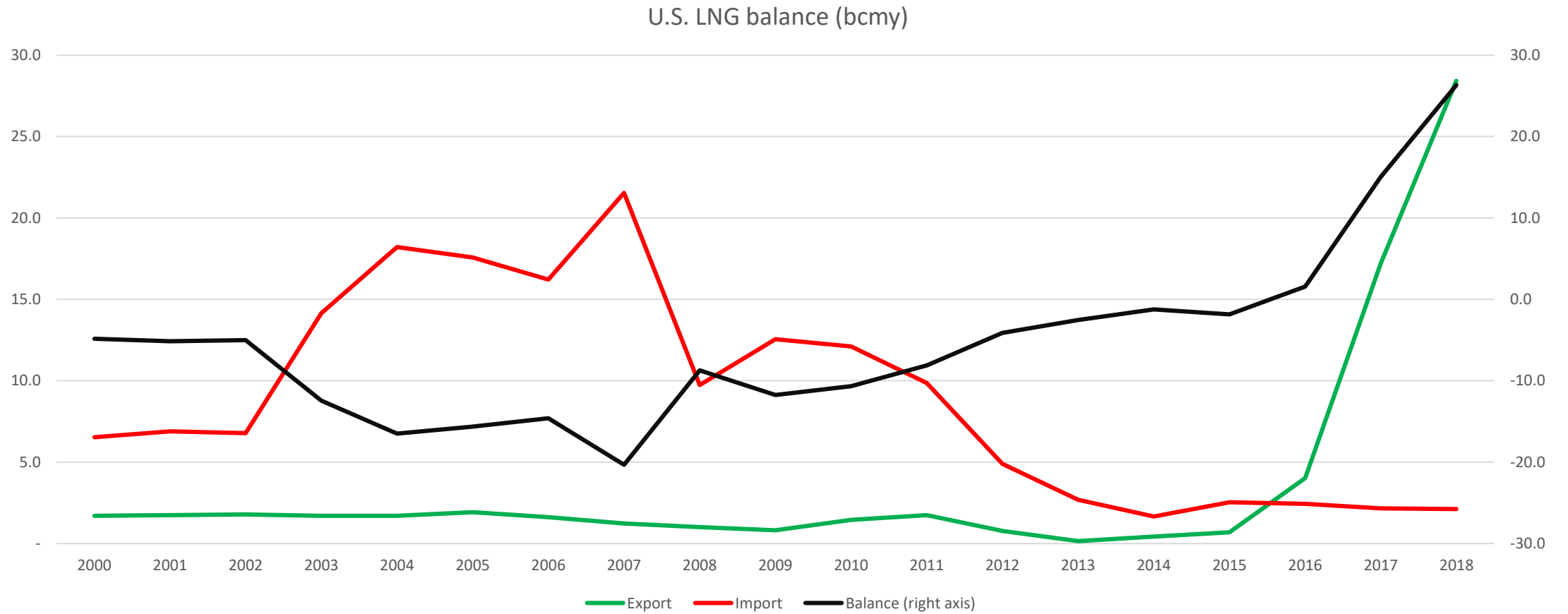


## Global Situation before 2010

- Two main production areas:
  - Atlantic basin
  - Pacific basin
- Three main consumption areas:
  - North American market
  - SE Asia
  - Europe
- Growing share of LNG on the overall traded volume.
- The rise of Qatar (and possibly Australia).



# Changes after 2010

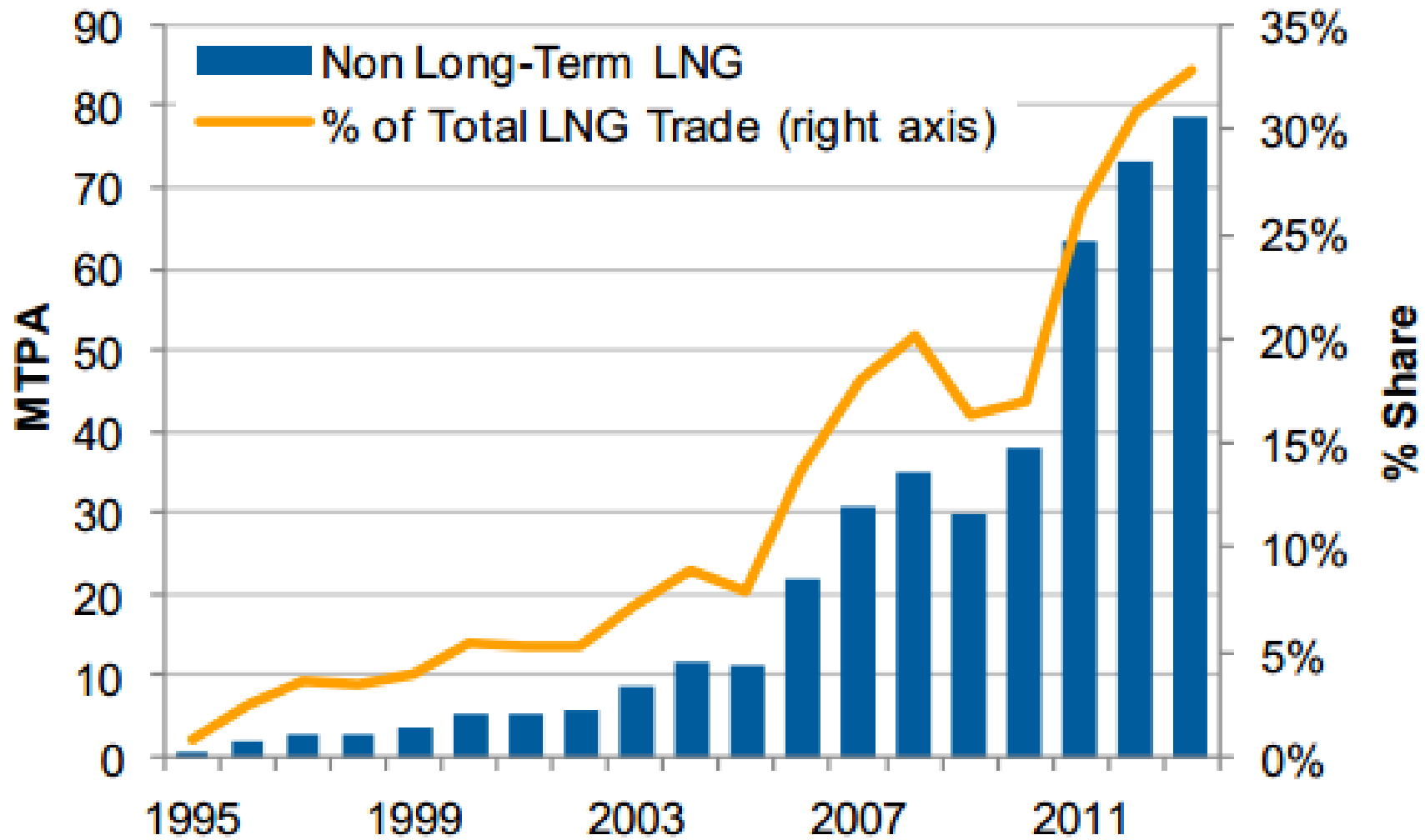




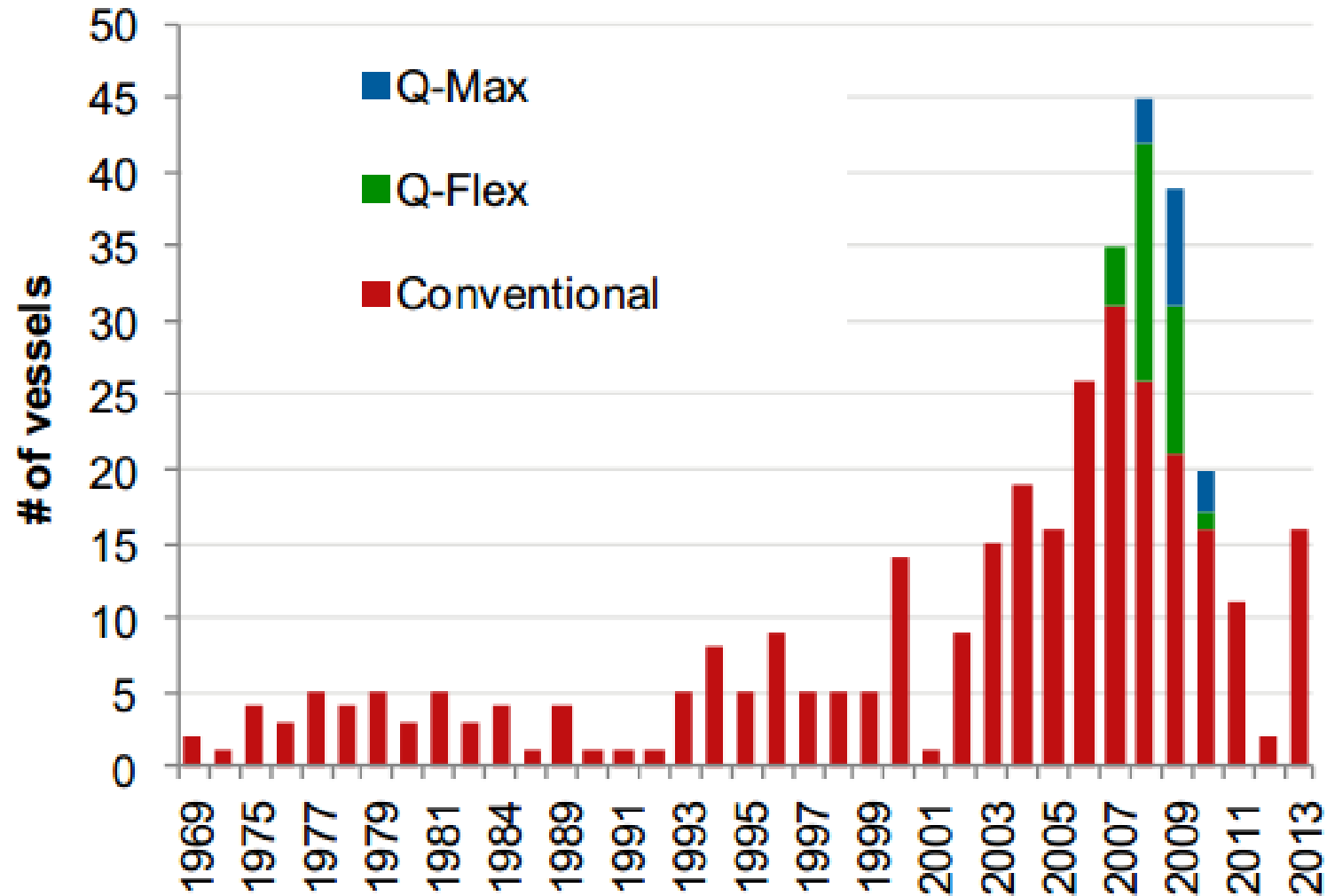
Since 2010

- North America's import market collapses
- Rapid rise of flexible trading
  - More LNG contracts with destination flexibility
  - New exporters and importers
  - Balancing needs in traditional markets
  - The continued disparity between prices in different basins which has made arbitrage an important and lucrative monetization strategy.
  - The large growth in the LNG fleet
  - The decline in competitiveness of LNG relative to coal and shale gas
  - The large increase in demand in Asia and in emerging markets

## Flexible LNG trading

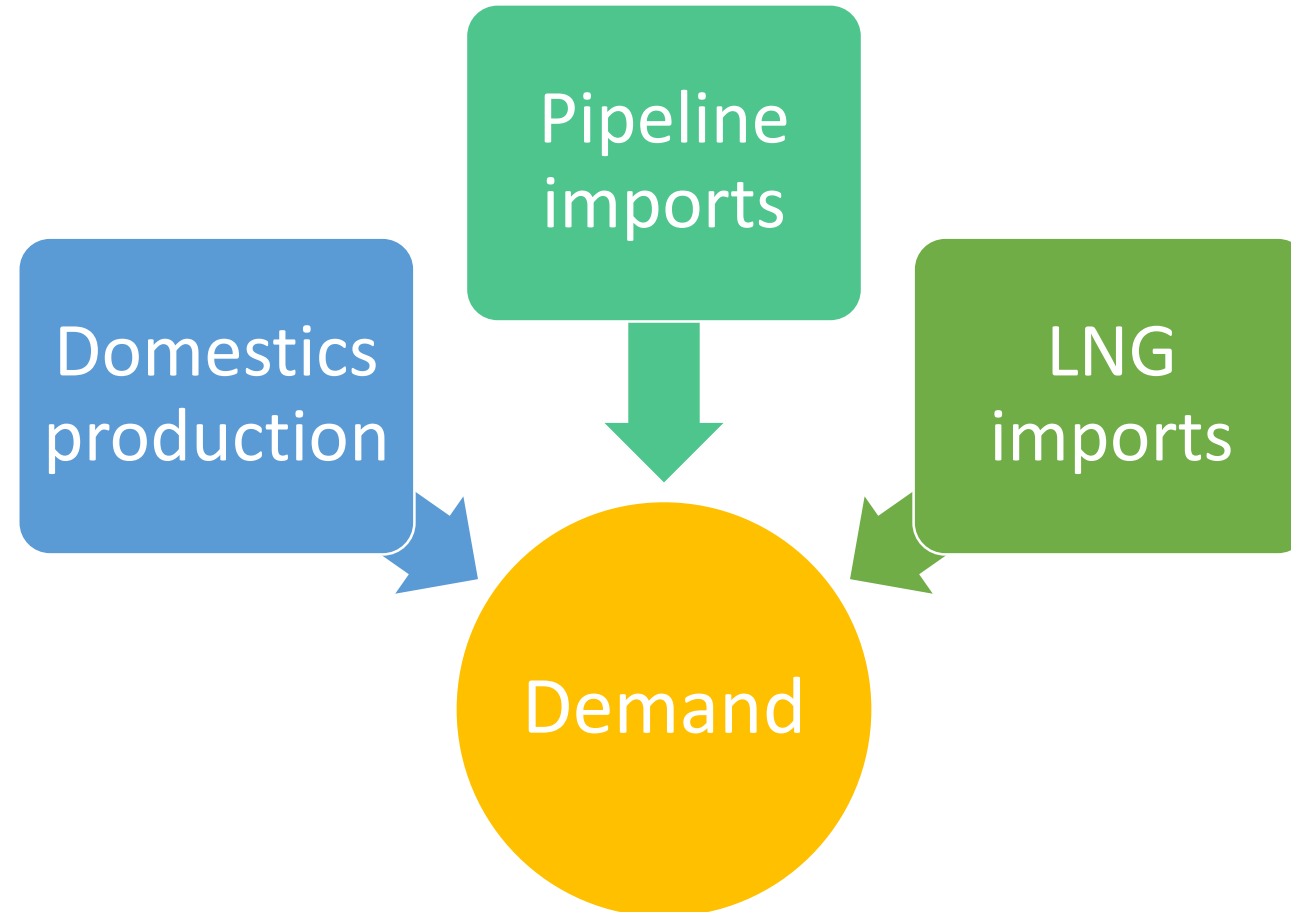


## Global LNG Fleet by Year of Delivery

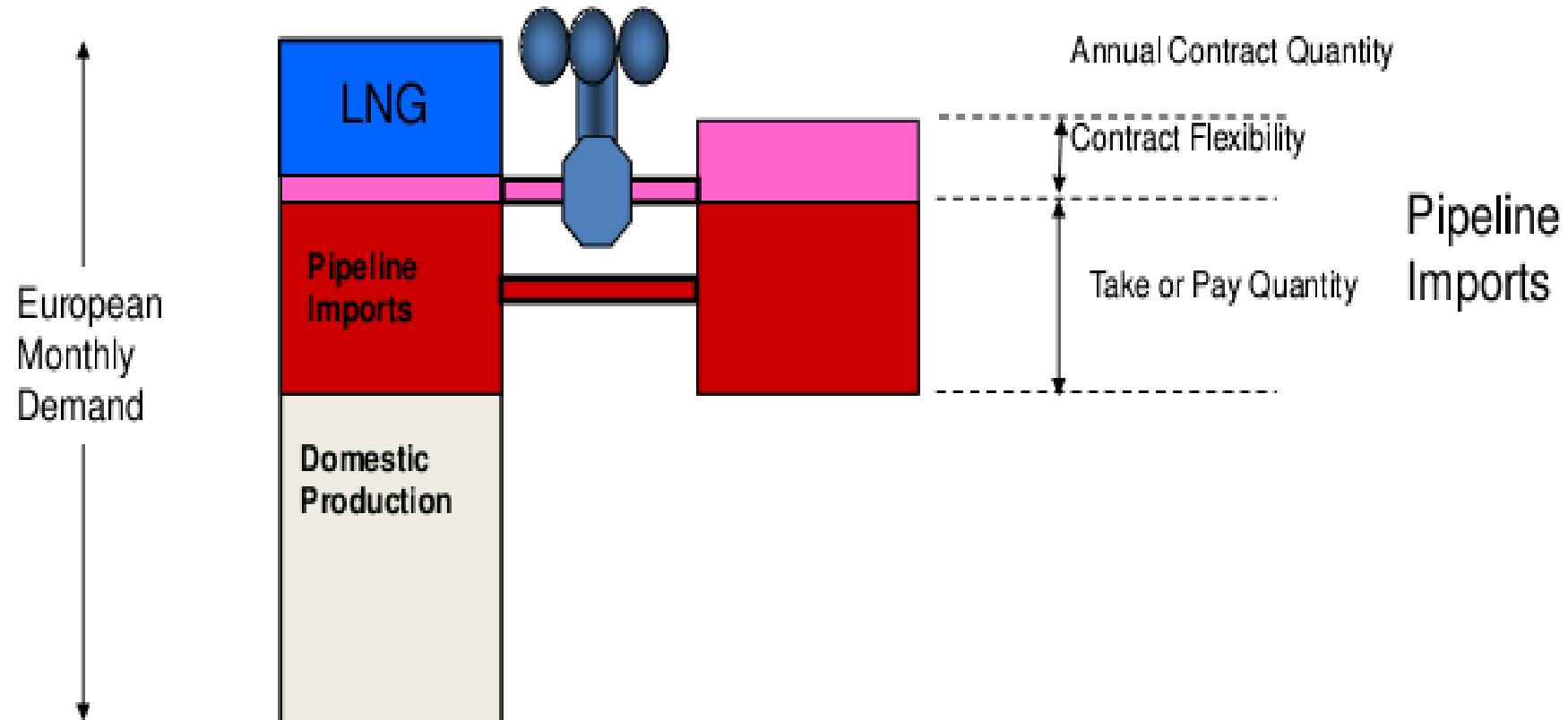


European supply dynamics

## European supply dynamics

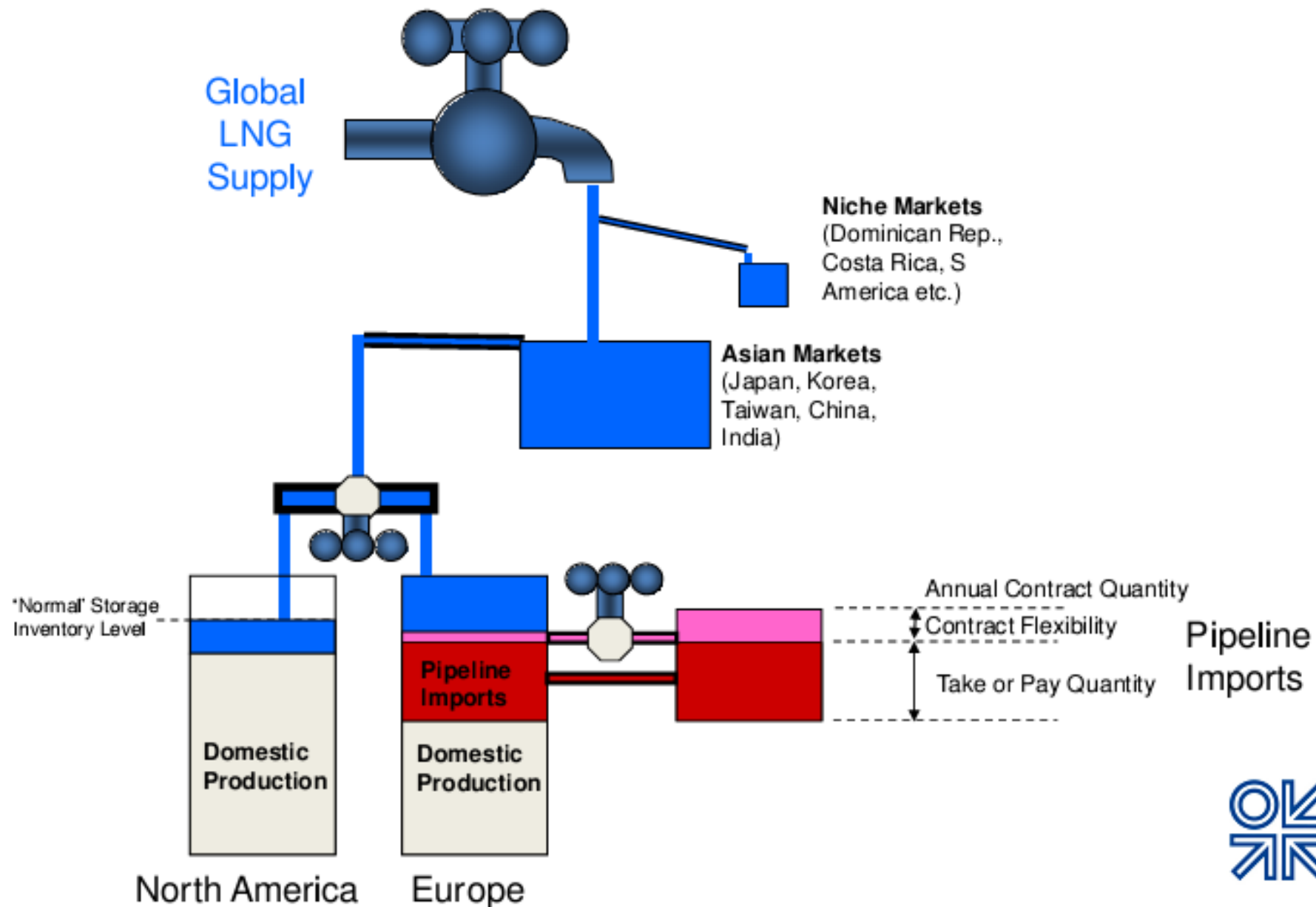


# European Supply Dynamics

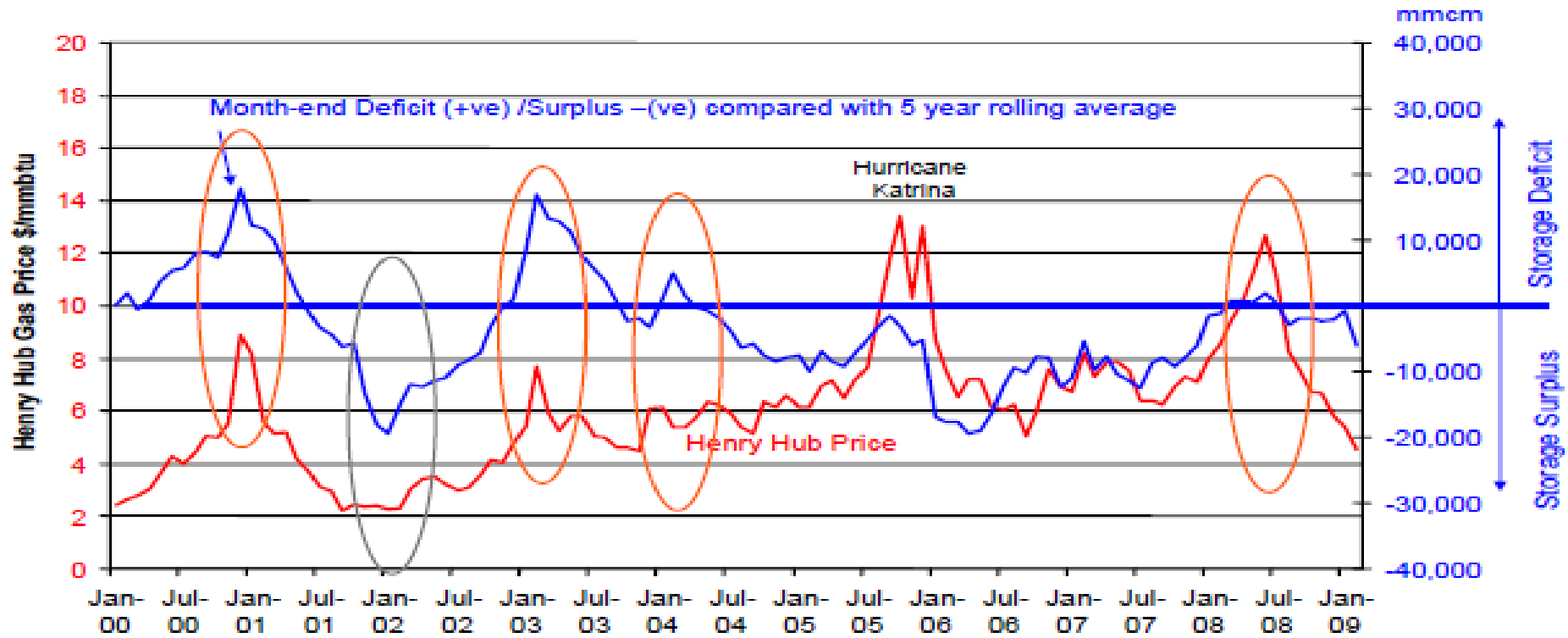




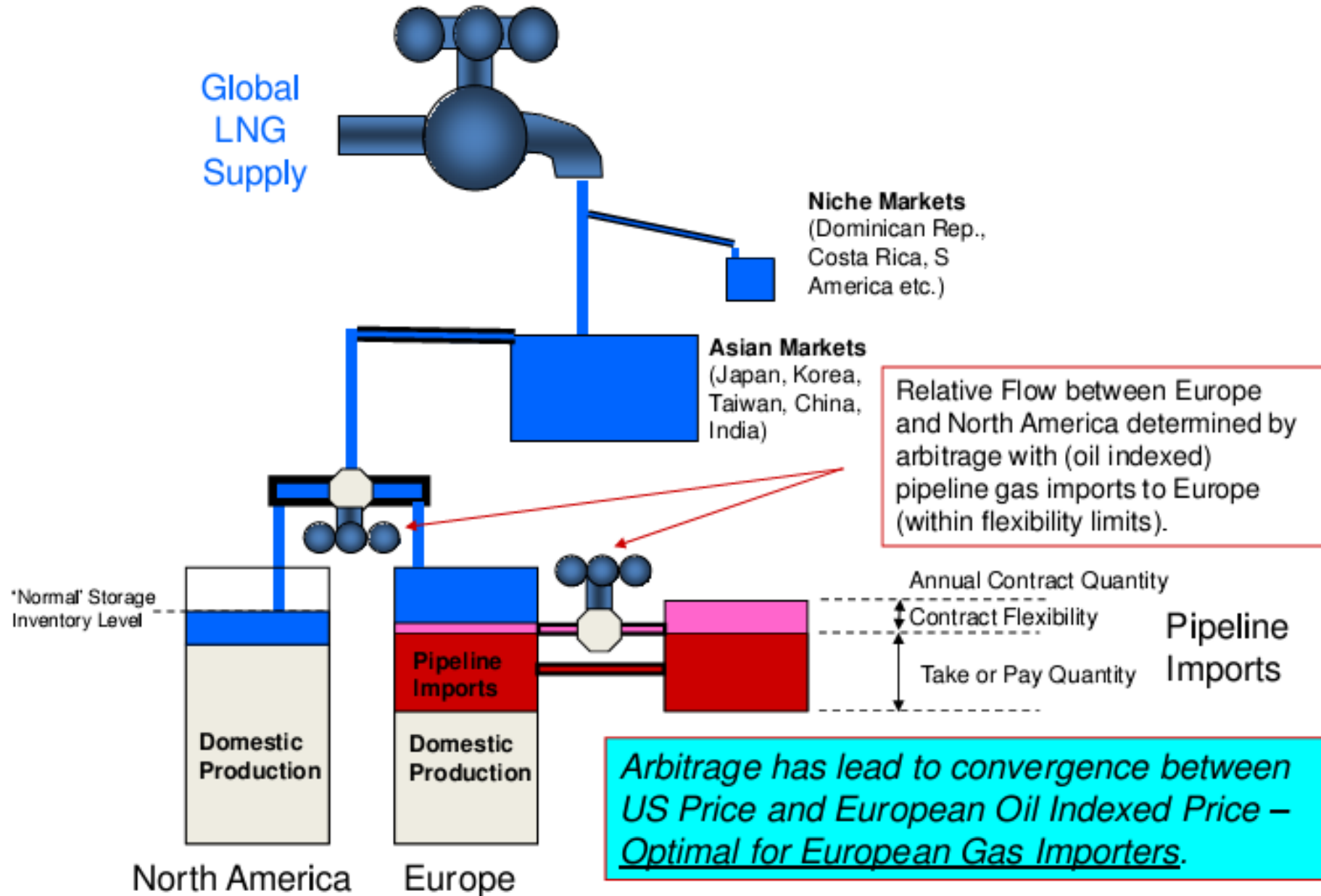
# Global LNG System -1



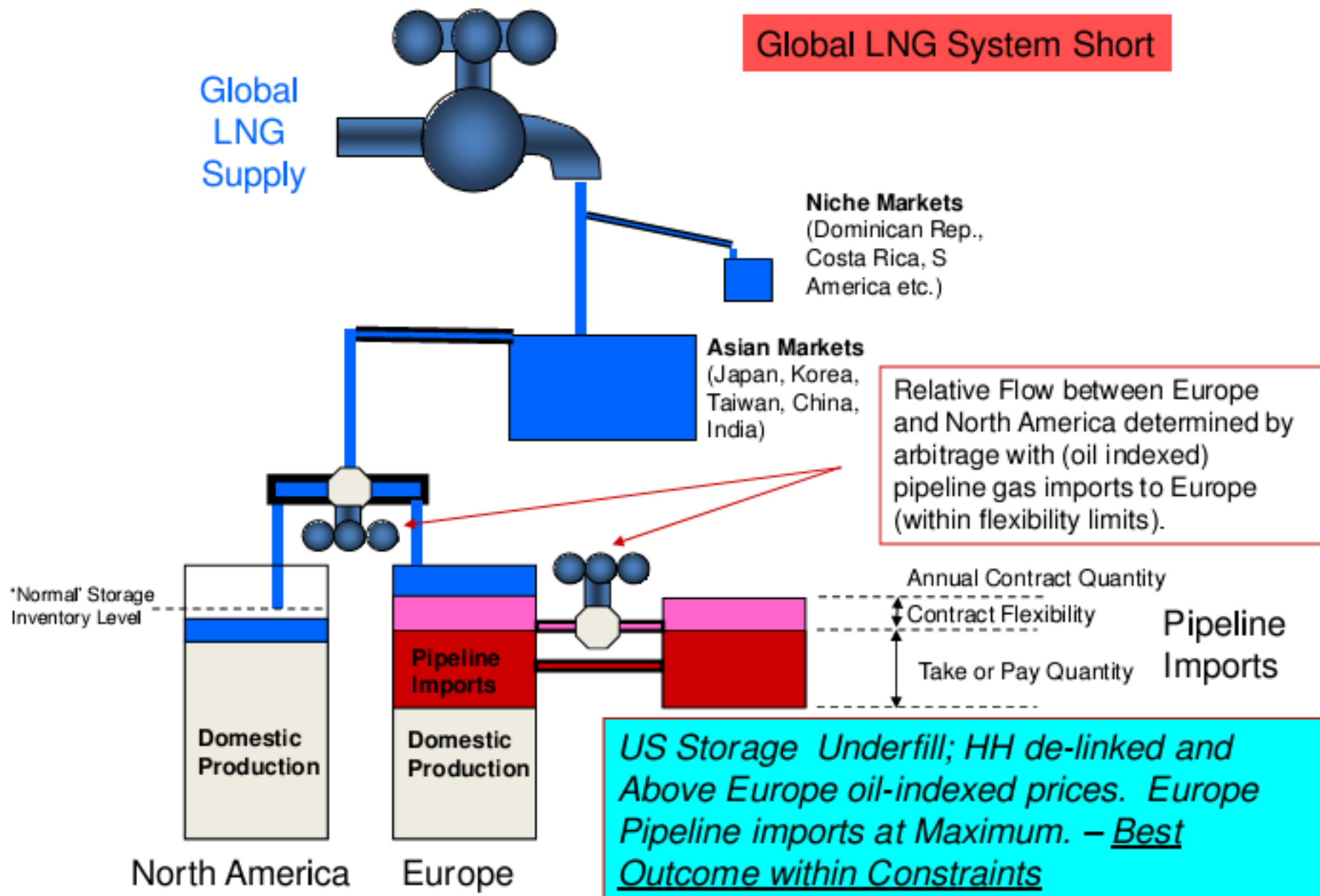
# US storage level as a volatility factor



# Global LNG System - 1

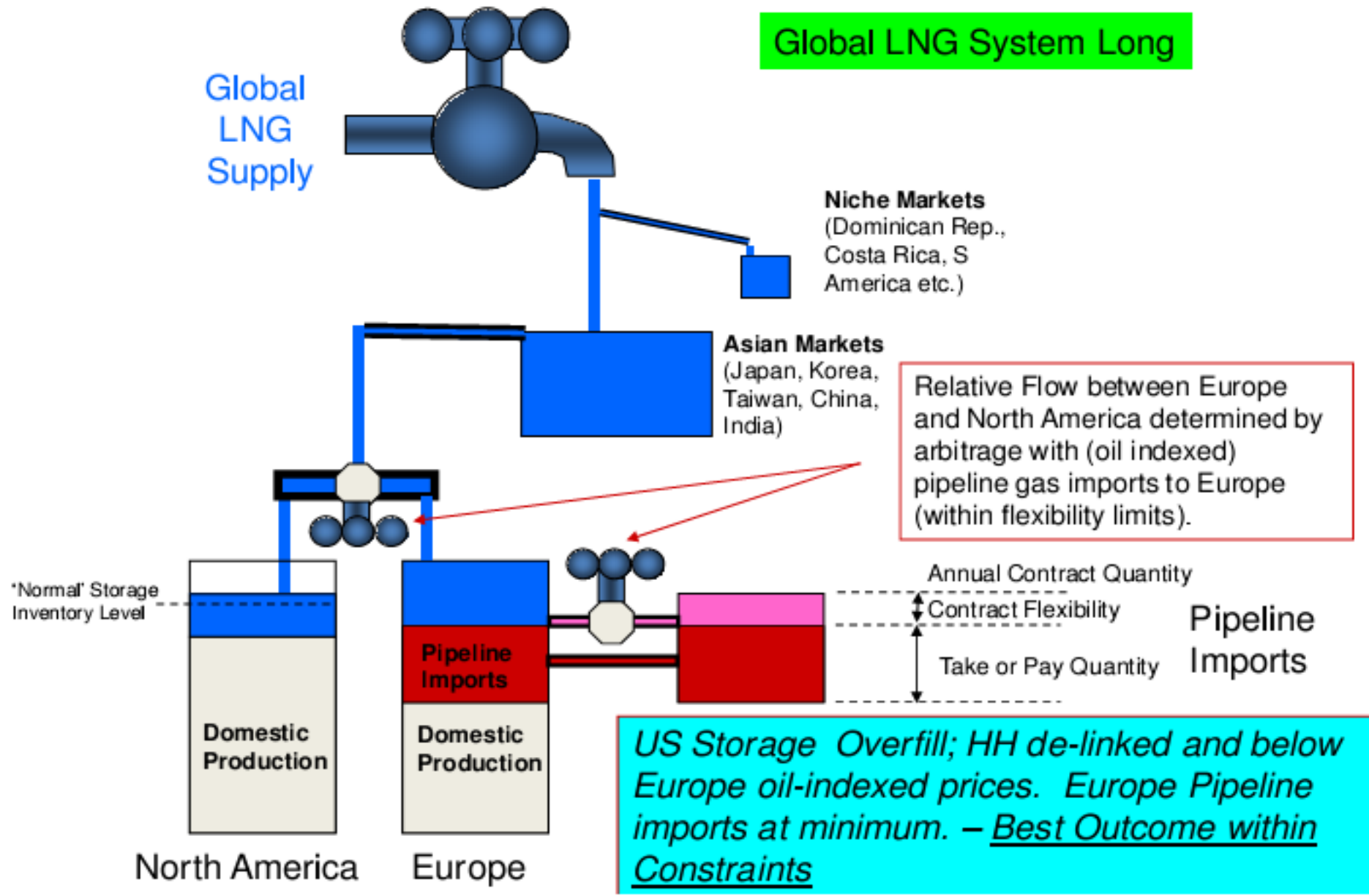


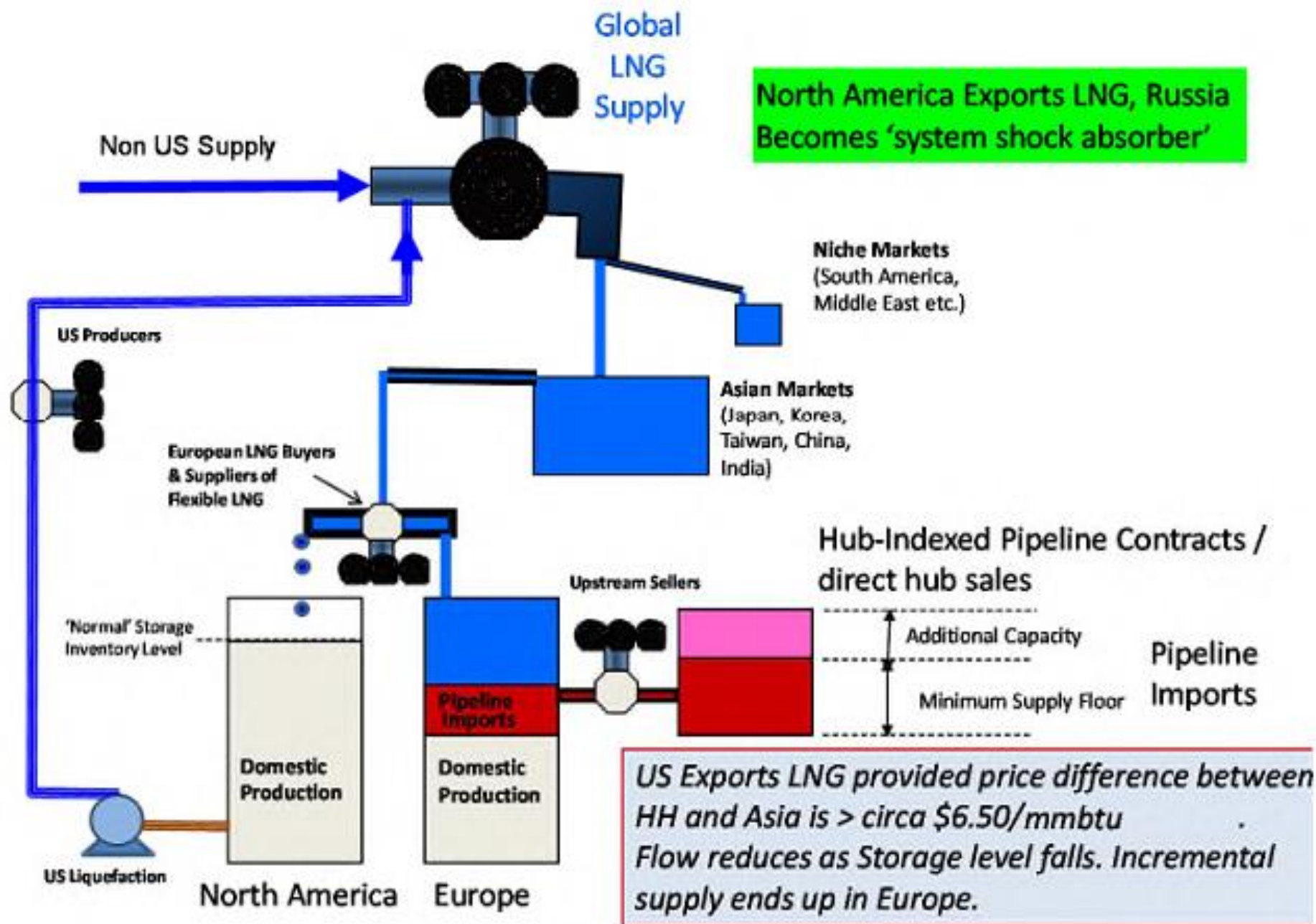
# Global LNG System - 5



# Global LNG System - 4

## Global LNG System Long



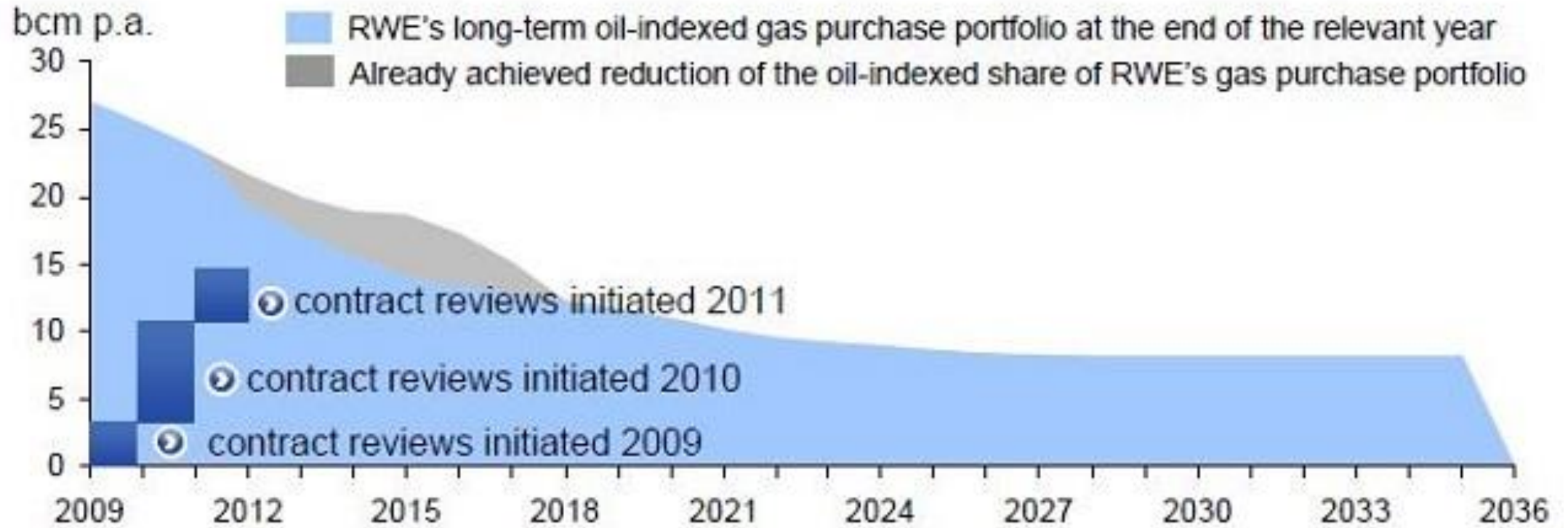




## EU LNG imports



## Contract reviews



Compromising oil and hub indexation: mixed formula (Gazprom – E.ON, RWE 2010)

Price formula:

85% oil indexed + 15% hub indexed

Compromising oil and hub indexation: „Indirect spot pricing“ (Gazprom – ENI, PGNiG, 2013)

