



Evolution of the Regional Gas Pricing mechanisms:

Current Situation and Possible Paths to the Future

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Introduction

- **Price mechanisms must balance the needs and interests of suppliers and users**
- .. it is also should properly reflect the current gas market conditions
- There is a **big difference** across countries and regions **in the process by which gas prices are established.**
- The method of gas pricing has a **significant effect** on the level of prices and therefore on the **welfare of each gas end user.**

The regional gas prices in 2010:

- United States (Henry Hub)- \$4/MBtu
- Great Britain (National Balancing Point) - \$5/MBtu
- Japan and Continental Europe - \$7-8/MBtu

Introduction II

The study of reasons behind the **gas price formation and tendencies in the gas pricing mechanisms** is important **both for buyers and sellers** to managing risks associated with changing the gas price levels in each region gas market.

Research questions:

1. What are the **main differences** between the basic gas pricing mechanisms?
2. Which gas pricing mechanisms are **prevalent in the major regional gas markets**: North American, European, Asian-Pacific?
3. How do differences in pricing mechanisms influence the **level of gas price**?
4. How will regional gas prices **change in the future**?

Research question: I

What are the main difference between basic gas pricing mechanisms?

I. What is the main difference between basic gas pricing mechanisms?

Theoretical aspect of gas pricing

$$P = MC \times (1 + RR)$$

- Where:
- P -price of gas
- MC -*Marginal Cost* of gas production, gas treatment and transportation
- RR -is the surplus value called **Resource Rent** which comprises two parts, namely Ricardian and Hotelling rents: $RR = RicR + HtgR$

Theoretical aspect of gas pricing:

Ricardian Rent (RicR): $RR = RicR + HtgR$

- **Ricardian (differential)rent (RicR):** the cost differences given by the quality of the production site and by its location relative to market. E.g. difference between:
 - *Cost of oil production:* in the North Sea - \$15/bbl and from onshore reservoirs in the Gulf: less than \$5/bbl (2007): $RicR = 15 - 5 = \$10/bbl$
 - *Cost of gas transportation*¹: to the NW European market btw. the Groningen field (~100 km): \$4,94/1000 m³ compared to Russian gas (5000 km): \$247/1000 m³.
 $RicR = \$242/1000m^3$

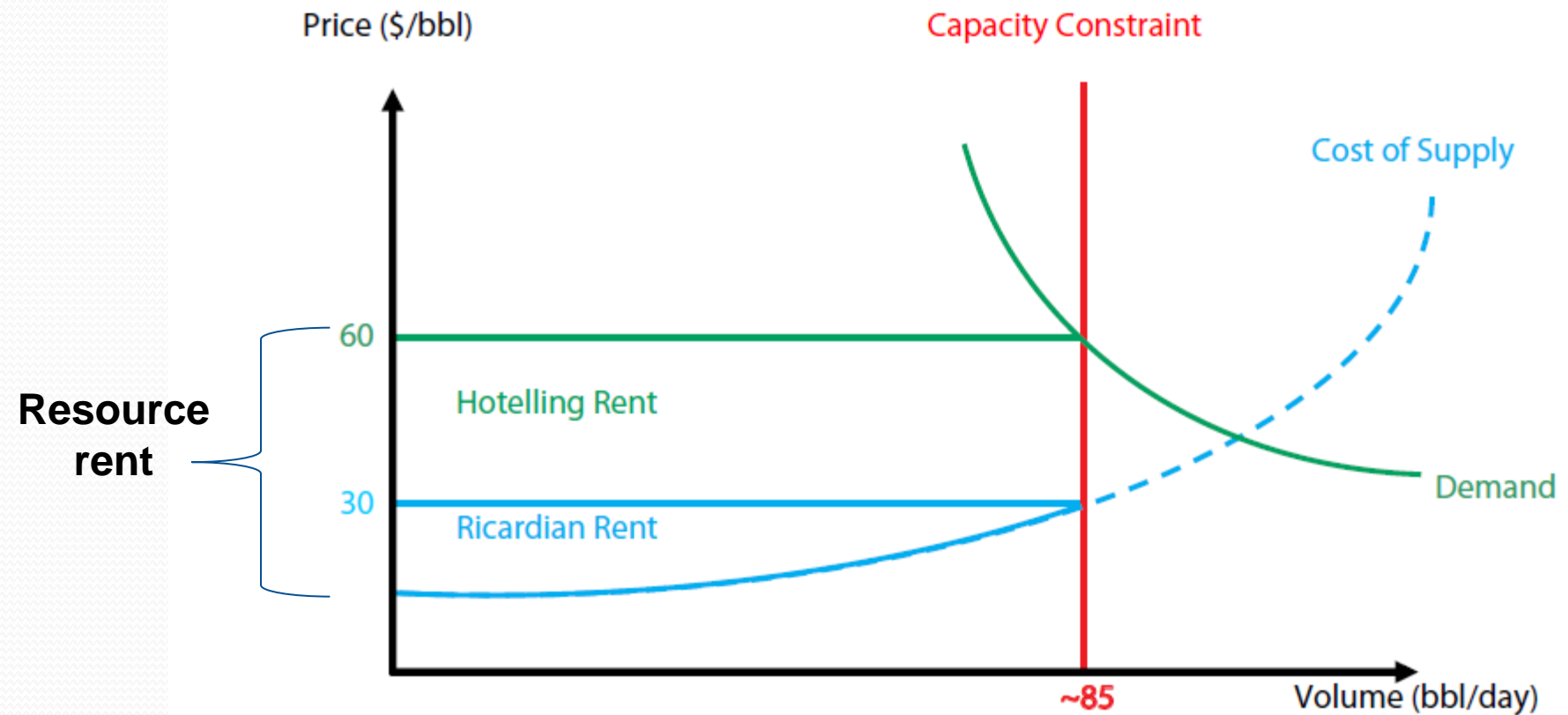
¹For the trunk pipeline of external diameter of 1220 mm and maximum rated pressure of 9.8 KPa. The maximum capacity of pipeline : 31.7 bcm of gas per annum.

Theoretical aspect of gas pricing:

Hotelling Rent (HtgR): $RR = RicR + HtgR$

- The **Hotelling (scarcity) rent (HtgR)** is the amount of money which a resource owner gets for the depletion of a finite resource or conversely, which the consumer is **prepared to pay** (out of his consumer surplus) **beyond the marginal costs** of gas production and transportation.
- This rent is determined by competition between consumers for a **limited supply**.
- Hotelling approach to energy pricing considers the **replacement value** of recourses.

Theoretical aspect of gas pricing: Resource Rent (RR)



Source: Energy Charter Secretariat

**How does Resource Rent
correspond with gas pricing
mechanisms?**

Basic principles of gas pricing

1. **Cost-plus (net-forward) pricing** (bottom-up approach to pricing)
2. **Competing fuel pricing principle** (top down approach)

...varied by the size of Resource rent (Ricardian, Hotelling) included in the price.

1. Cost –plus (cost of service or net-forward) pricing

Bottom up approach to gas pricing:

$$P_{cp} = C_p + C_{st} + C_{tr} + C_{tx} + \pi \quad (2)$$

Where:

P_{cp} - Price of gas at the border;

C_p - Cost of gas production;

C_{st} - Cost of storing gas to meeting the customer's seasonal or daily demand fluctuations;

C_{tr} - Cost of gas transmission;

C_{tx} - Any gas taxes in the country of origin;

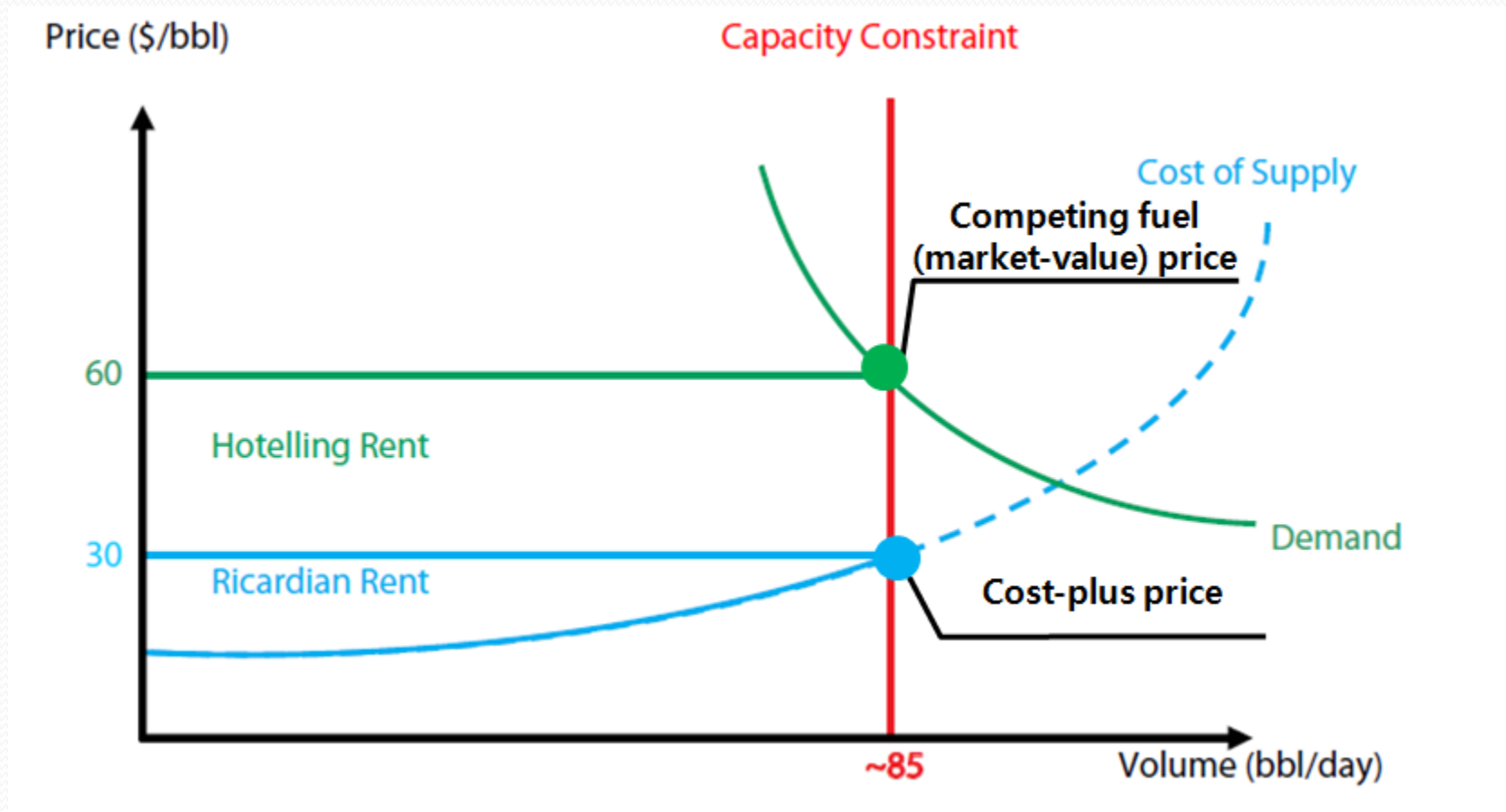
π - Predetermined profit margin (or hurdle rate)

- ✓ Applied in the markets where the production (supply) capacity is **exceeding** the level of gas demand.
- ✓ The price includes **Ricardian** rent but not Hotelling rent.

2. Competing fuel pricing principle

- Price is linked to the price of crude oil (or, rarely, coal) or oil derivatives.
- Price indicator is usually the price of oil in international or domestic exchange
- The ratio of gas to oil prices on an energy parity basis is specified in the gas pricing formula
- Price includes **Ricardian** and **Hotelling** rents (full resource rent)

Basic gas pricing methodologies and rents of resources production



Answer to research question I:

- What is the main difference between major wholesale gas pricing mechanisms?
 - The different portion of the Resource rent included to the final wholesale gas price.
- How is it reflects the level of gas price and hence gas supply and demand?
 - If the Hotelling rent is **not included** to the price, price is lower, gas demand is higher while there is no intention for rising supply
 - If the Hotelling rent is **included**, the price is higher and demand is weaker while supply has intention to grow.

Research question II:

What is the prevailing pricing mechanisms in the major interregional gas markets: North American, European, Asian-Pacific?

There is still no global market of natural gas

Seaborne share of natural resources trade from its total trade volume:

- natural gas (7%)
 - coal (15%)
- crude oil (48%)



Still gas trading is **limited geographically** and concentrated within three major regions: Europe, Asia-Pacific and North America.

North American market

Most liberalized and competitive regional gas market

- In the US, a highly-competitive market has evolved along the whole value chain.
- Gas prices are set freely under the **gas-to-gas competition**

Physical types of gas-to gas competition:

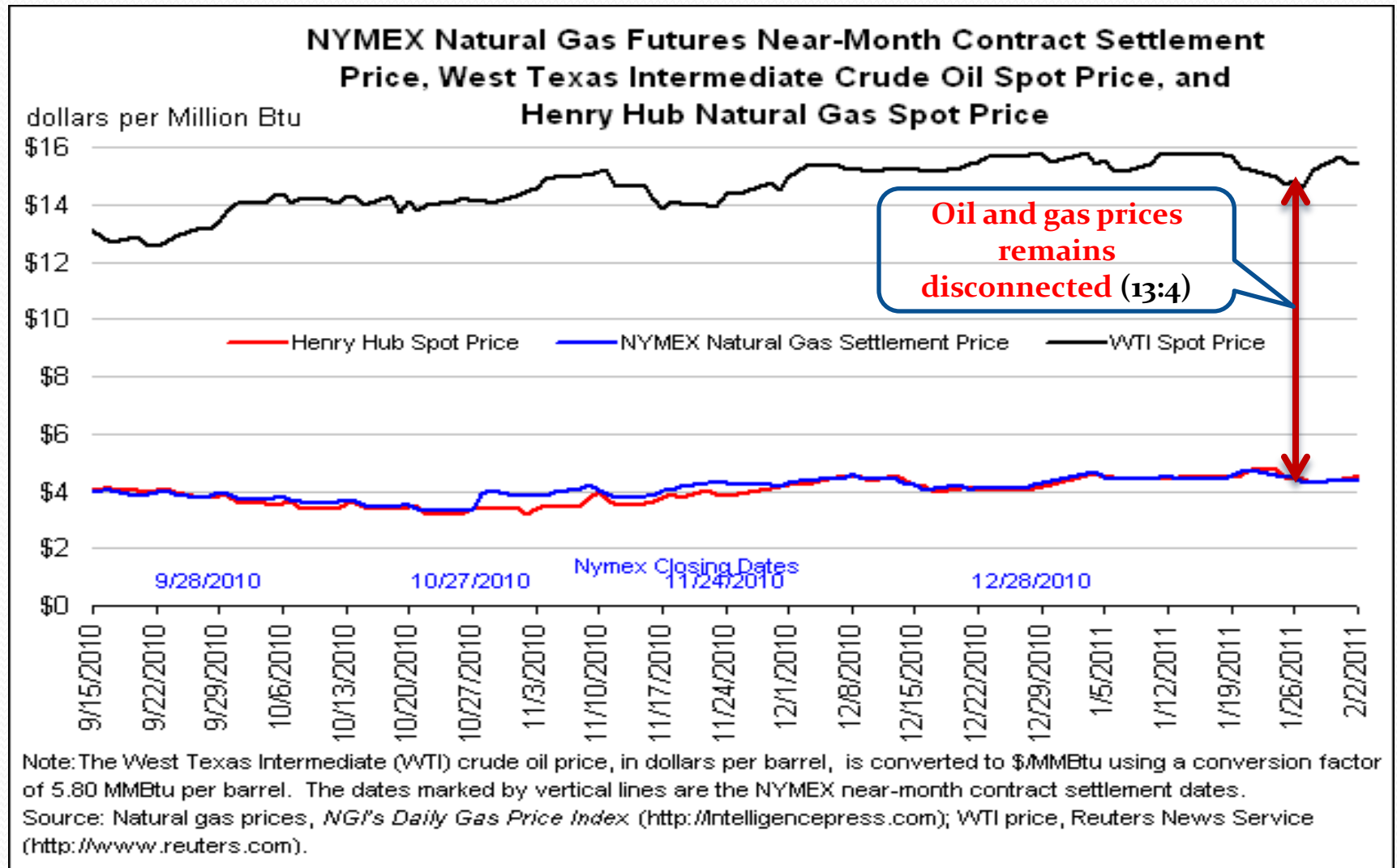
- **LNG-to-LNG** competition – Two or more LNG producing companies supply gas to the same regional market.
- **Pipeline-to-pipeline** competition - Two or more high-pressure transmission pipeline companies transport gas to the same regional market.
- **LNG-to-pipeline competition** – Coexistence of both LNG and pipeline independent gas suppliers in the same regional market.

North American market

Most liberalized and competitive regional gas market

- In the markets with gas-to-gas competition, the trading of gas organized on coast terminals (physical points: **gas hubs**) or at a **virtual point**.
- In North America there are **38** different hubs (29 in US and 9 in Canada).
- The long-term contracts often contain references to some type of **spot gas price** indicator.
- Most contracts use the **Henry Hub Spot** price of natural gas as a benchmark.

North American gas market



North American gas market:

The reasons behind the oil & gas price disconnection:

1. Continuing abundance of **shale gas supply**
2. **Liberal structure** of the gas industry:
 1. considerable number of gas market places (gas hubs)
 2. high number of independent gas suppliers



The price settled by the **gas-to-gas** competition is approaching the **marginal cost** of gas supply and not including the **Hotelling rent** (which remains to the buyer surplus).

Shale gas supply: not all costs are included to the price

- The process of shale gas production demands the use of **many chemicals**, some of them are **carcinogenic** and lead to the significant soil pollution.
- It is estimated that the entire process of shale gas mining and use **triples GHG emissions (!)** relative to the gas combustion alone.
- Exploitation the shale gas resources is taking place **without adequate environmental protection**, partly because this is a relatively new energy source.¹

All these facts should be reflected in the gas price sooner or later..

¹ N. Lior. *Sustainable energy development (May 2011) with some game-changers*. The Energy journal, 2011, 1-16.

Gas-to-gas pricing principle

The number of markets with **gas-to-gas** competition is growing :

- United Kingdom,
- Australia
- Increasingly in continental Europe : **1/4** by volume of traded gas (around **250 bcm**)
- World: approximately **1/3** (**1 tcm**) the total gas trade¹

¹ World Energy Outlook. Are we entering the Golden Age of the Natural gas? Special report. International Energy Agency (IEA), 2011

European gas market

- **Competing fuel pricing principle**
- long-term take-or-pay contracts, with **price** mainly linked to **heavy and light fuel oil**.
- Gas prices normally recalculated with a **3 to 9** month lag to oil price changes.
- The ratio of gas to oil prices is determined in the gas pricing formula (which is in most cases a subject to commercial secret); ratio is often **below 1:1** on an energy basis.
- **Price review** clauses (typically 3-year reviews)

European gas market

- In 2011 it is estimated that $\frac{3}{4}$ of gas consumed in continental Europe is bought wholesale under the long-term contracts with **oil-price** indexation
- **Oil-price** indexation continues to be used for the new gas contracts, where spot gas purchases are physically unavailable (e.g. in Eastern and central Europe)
- The gas pricing in Europe vary significantly from country to country (region to region) (see the graphs)

U. K. gas market

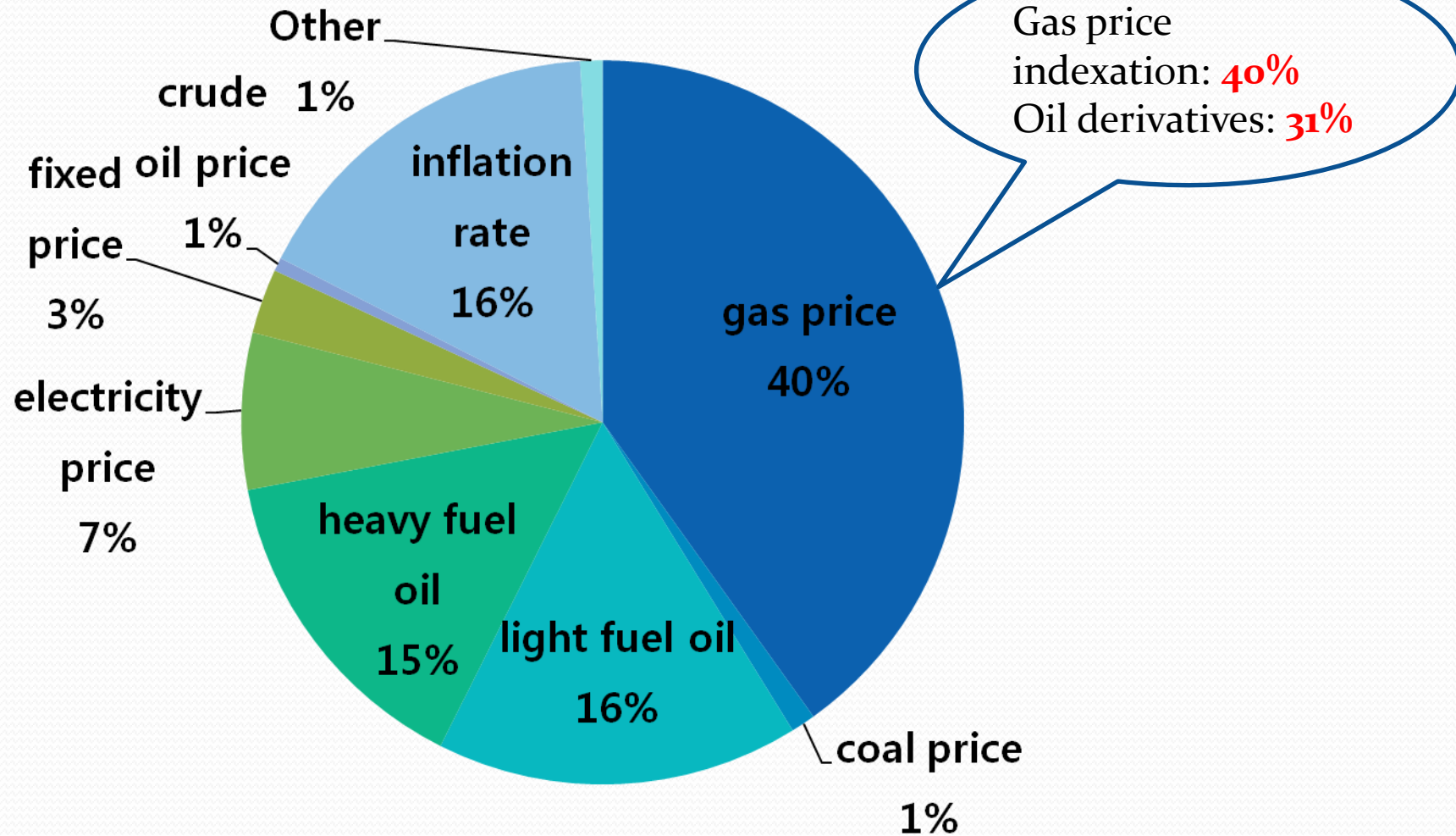


Fig. 4. The gas price indexation in the U.K. contracts (2004)

Western European gas market: oil derivatives dominate the price indexation

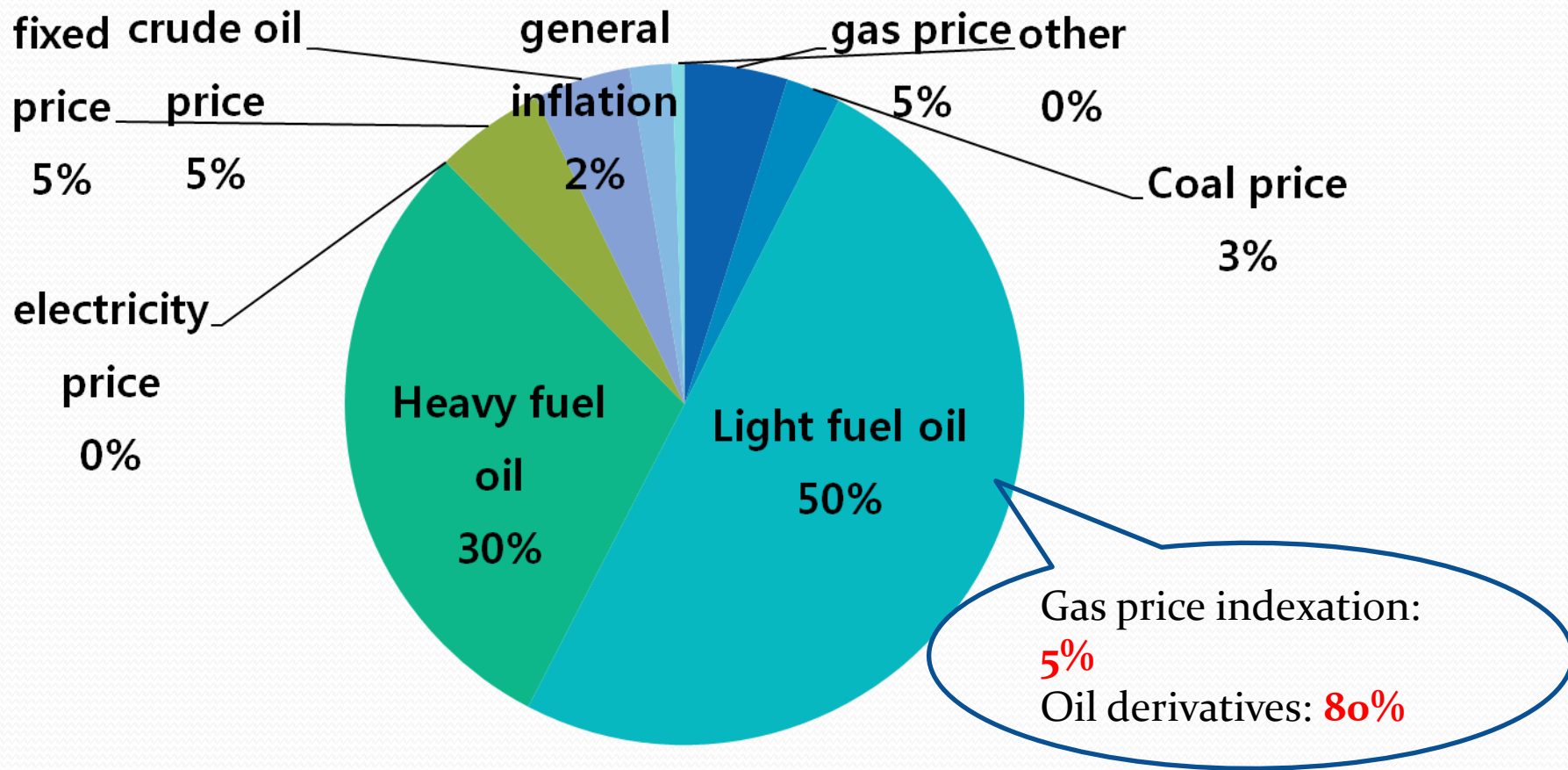


Fig. 5. The gas price indexation in the Western European contracts (2004)

Eastern European gas market:

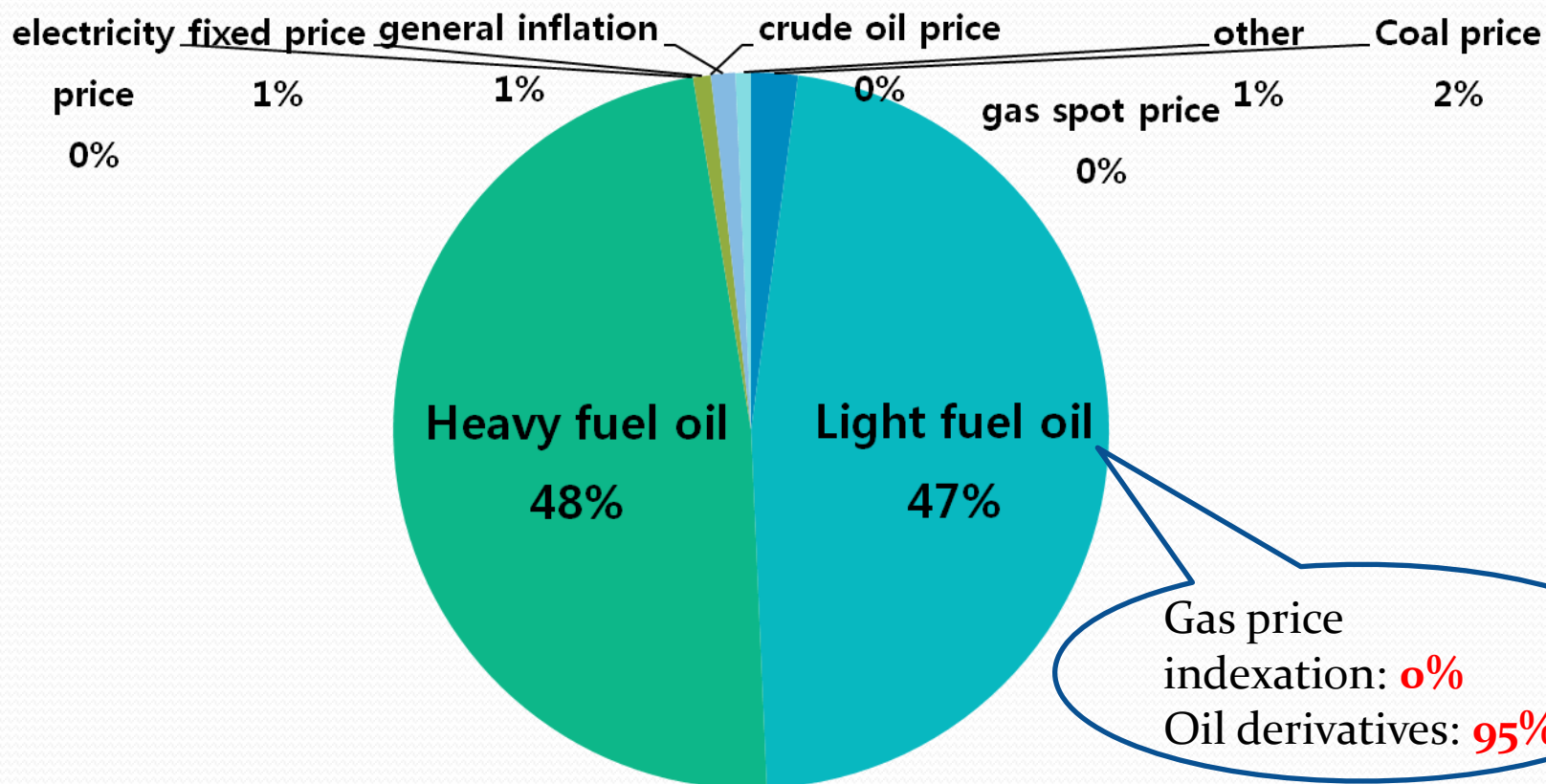


Fig. 6. The gas price indexation in the Eastern European contracts (2004)

Source. For Fig . 4-6: DG Competition Report on Energy Sector Inquiry, 2007, p. 104.

European Commission, Brussels, 2007.

European gas market places (hubs)

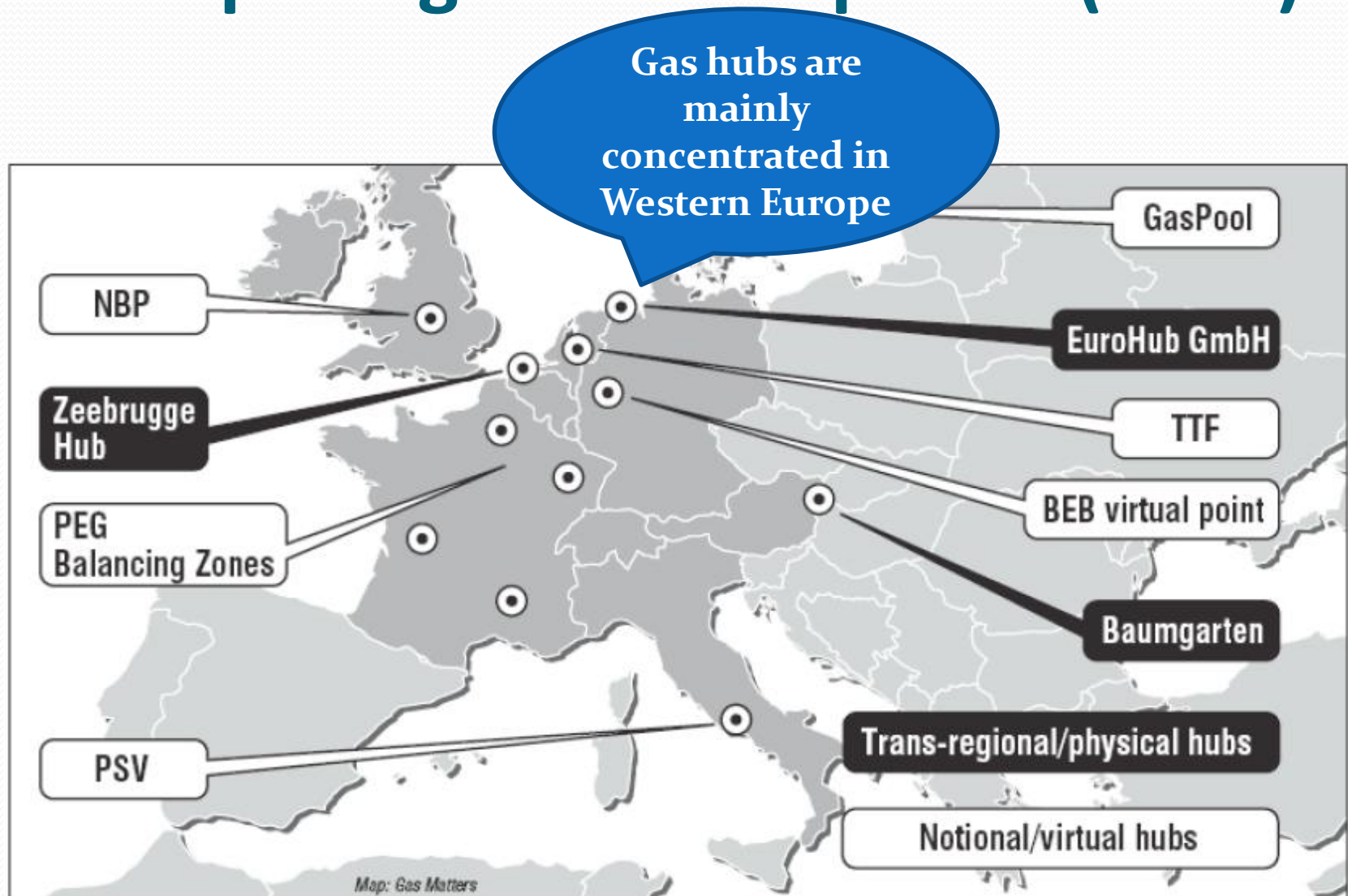
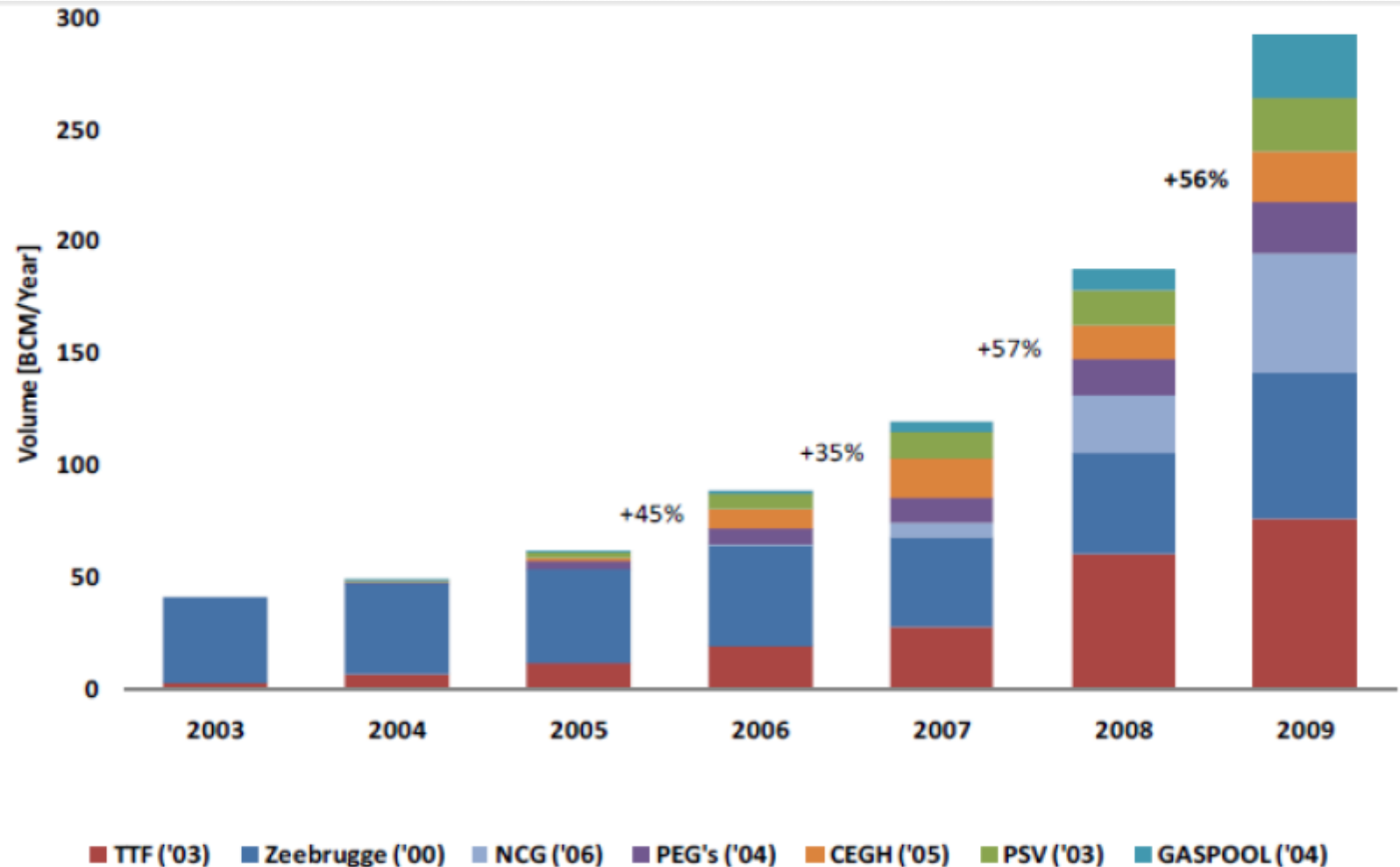


Fig. 8. European Gas Market Hubs

Volume of gas trading in the European gas hubs



Source: IEA, *Medium Term Oil and Gas Markets 2010*, Paris: IEA WEO 2010, p.207.

Comparison of the spot gas and oil-indexed gas prices.

Spot prices lower
for 25-15% than
oil - inked

	TTF average	NWE GCI	TTF/GCI %
January 2011	22.24	25.84	86
December 2010	24.15	26.13	92
November 2010	19.50	25.98	75
October 2010	18.56	25.54	73
September 2010	18.95	25.07	76
August 2010	18.12	24.21	75
July 2010	19.52	23.55	83
June 2010	19.28	22.62	85
May 2010	16.78	21.80	77
April 2010	13.53	21.56	63
March 2010	11.99	21.00	57
February 2010	13.72	20.74	66
January 2010	14.48	20.02	72
Average 2010	17.38	23.19	75

Table 1. European spot gas prices as percentage of oil-indexed gas prices in Euro/MWh

Note: the Table shows TTF day-ahead prices compared with the Platts North West Europe Gas Contract indicator (NWE GCI) which indicates a typical price for long term oil-indexed supplies.

European gas market: Conclusion

- Due to the lack of considerable development of free gas trading in Europe the **competing fuel pricing** principle is applied to the gas pricing.
- The gas prices in Europe **are including the full Recourse Rent**.



- Gas prices in Continental Europe are considerably **higher** than the market prices of gas based on gas-to-gas competition in UK and US.

Asian-Pacific gas Market

- Unlike the European or US market, **no Asian spot gas** price reference exist yet.
- Asian gas market is still dominated by LNG trading under the long-term (25 years) **oil-linked** take or pay contracts.
- The oil price index is the monthly Japan Customs-cleared Crude oil price (**JCC price**) or Indonesian Crude oil price (**ICP**)

Asia-Pacific gas Market

- **JCC** also often referred as "Japanese Crude Cocktail" is the average cost, insurance and freight value of all of customs-cleared crude and raw oils imported in Japan in a specific period. JCC index are published with a monthly frequency by the Petroleum Association of Japan. Applied in Japanese, Korean, Taiwanese, recently Chinese and Indian LNG contracts.
- **ICP** is determined by Pertamina (Indonesia), based on average spot price of a basket of five internationally traded crudes:
 - Minas (Indonesia)
 - Tapis (Malaysia)
 - Gippsland (Australia)
 - Dubai (UAE)
 - Oman

Price formula in the Asian gas contracts

By the mid-80s the price formula in most Japanese, Korean, Taiwanese contracts were:

$$P(\text{LNG}) = 0.1485 * P(\text{Crude Oil}) + 0.6 \quad (3)$$

Where:

$P(\text{LNG})$ - price of LNG in \$/MBtu

$P(\text{Crude Oil})$ - price of crude oil in \$/Bbl,

and 0.1485 and 0.6 are constants¹

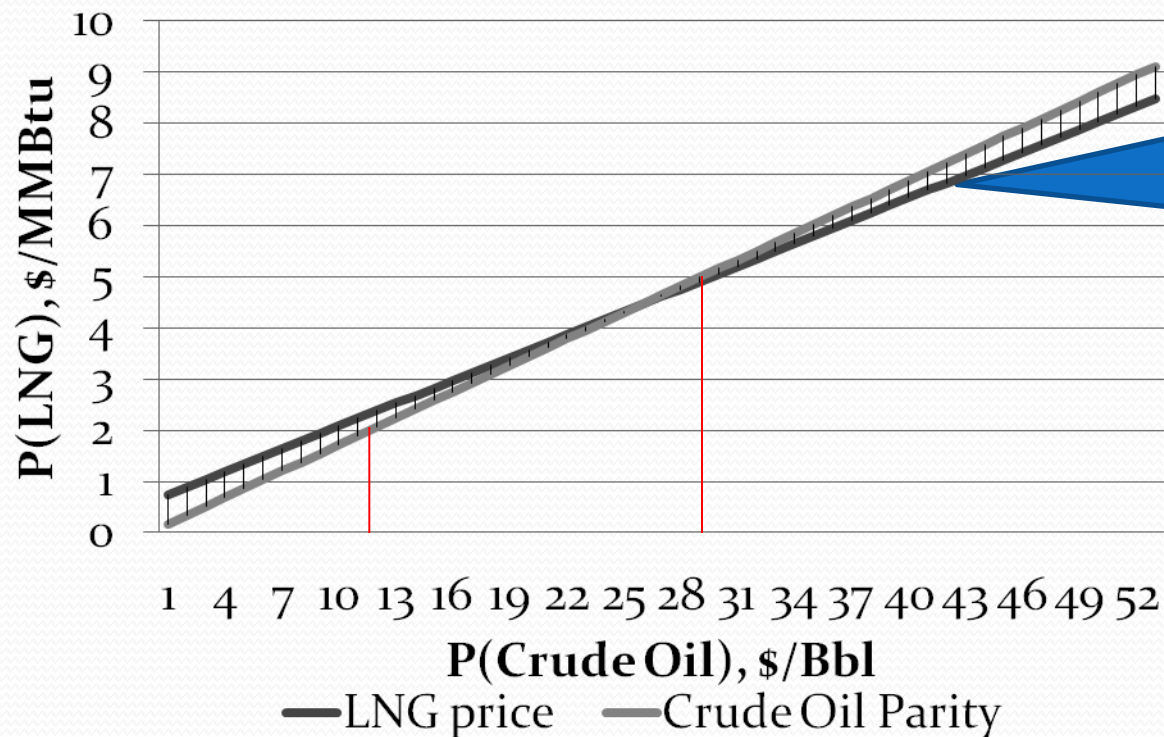
If the LNG price in Asia was priced on a **crude oil parity basis**, i.e. a Btu of LNG was the same price as a Btu of crude oil, the price formula would be:

$$P(\text{LNG}) = (1/5.8) * P(\text{Crude Oil}) = 0.172 * P(\text{Crude Oil}) \quad (4)$$

Since the average barrel of crude oil has an energy content of around 5.8 MBtu. In this case the multiplier $A = 0.172$ and $B = 0$.

¹Stern J. et. al, Natural Gas in Asia, 2008, Oxford University, page 405.

Price formula in the Asian gas contracts: straight relationship



At oil prices higher than \$29/Bbl gas is trading with discount to the crude price

In the late 1980s **\$20/Bbl** was seen as the long-run average price of crude oil. Prices above **\$29/Bbl** and below **\$11/Bbl** were seen as exceptional circumstances.

Fig. 11. Basic Japanese LNG price Formula

Note : LNG Price: $P(\text{LNG}) = 0.1485 * P(\text{Crude Oil}) + 0.6$

Crude Oil Parity: $0.172 * P(\text{Crude Oil})$

Price formula in the Asian gas contracts: S-curve formula

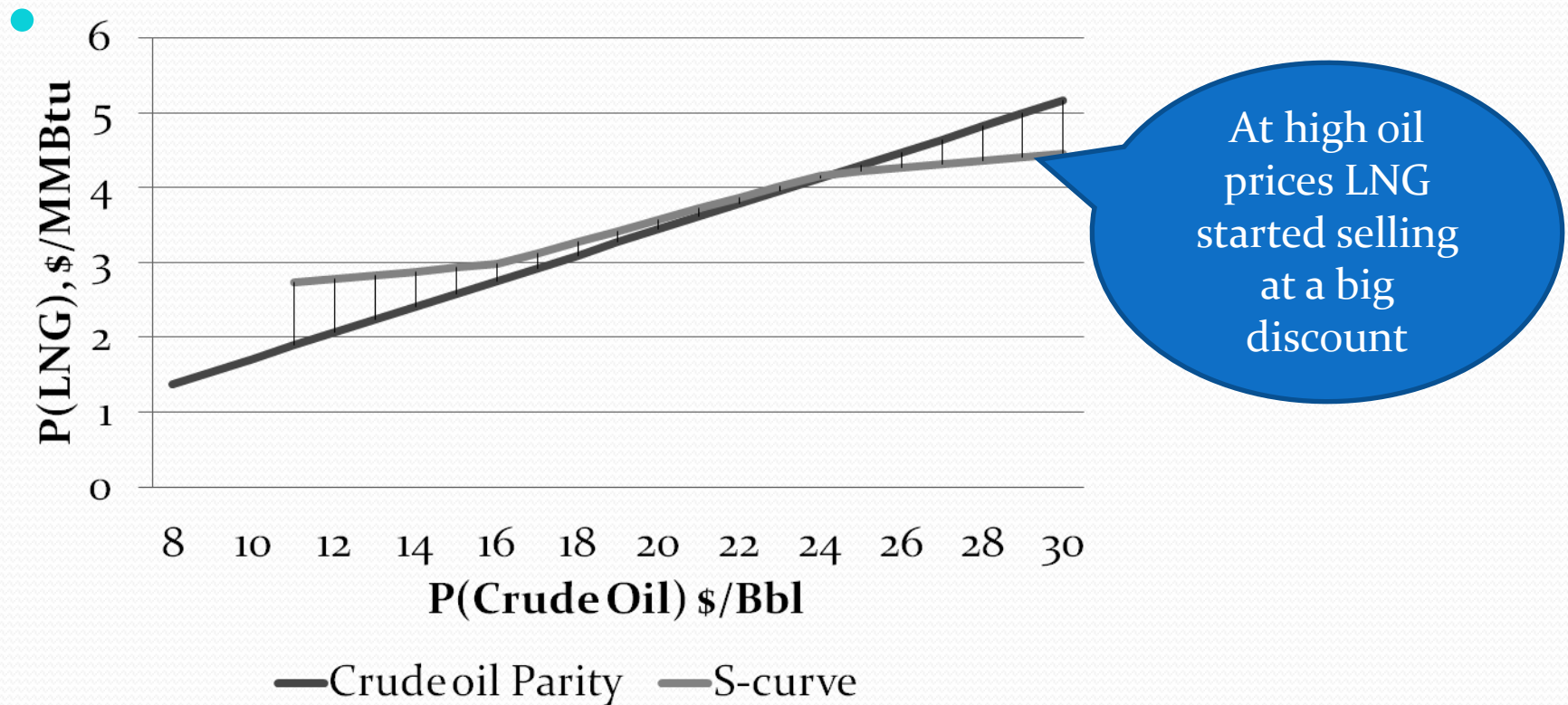


Fig. 12. 'S'-curve Price Formula

Asia-Pacific Gas Market

- In Asia-Pacific Market the main pricing principle is **competing fuel principle**
- Gas price is linked to the crude oil price.
- Oil-linkage determines that gas price in Asia includes the resource rent (profit) that is almost **fully taken by gas producers/suppliers**.
- Almost, because the ratio of gas to oil prices nowadays is below 1:1 on an energy parity basis.

Level of gas price by region:

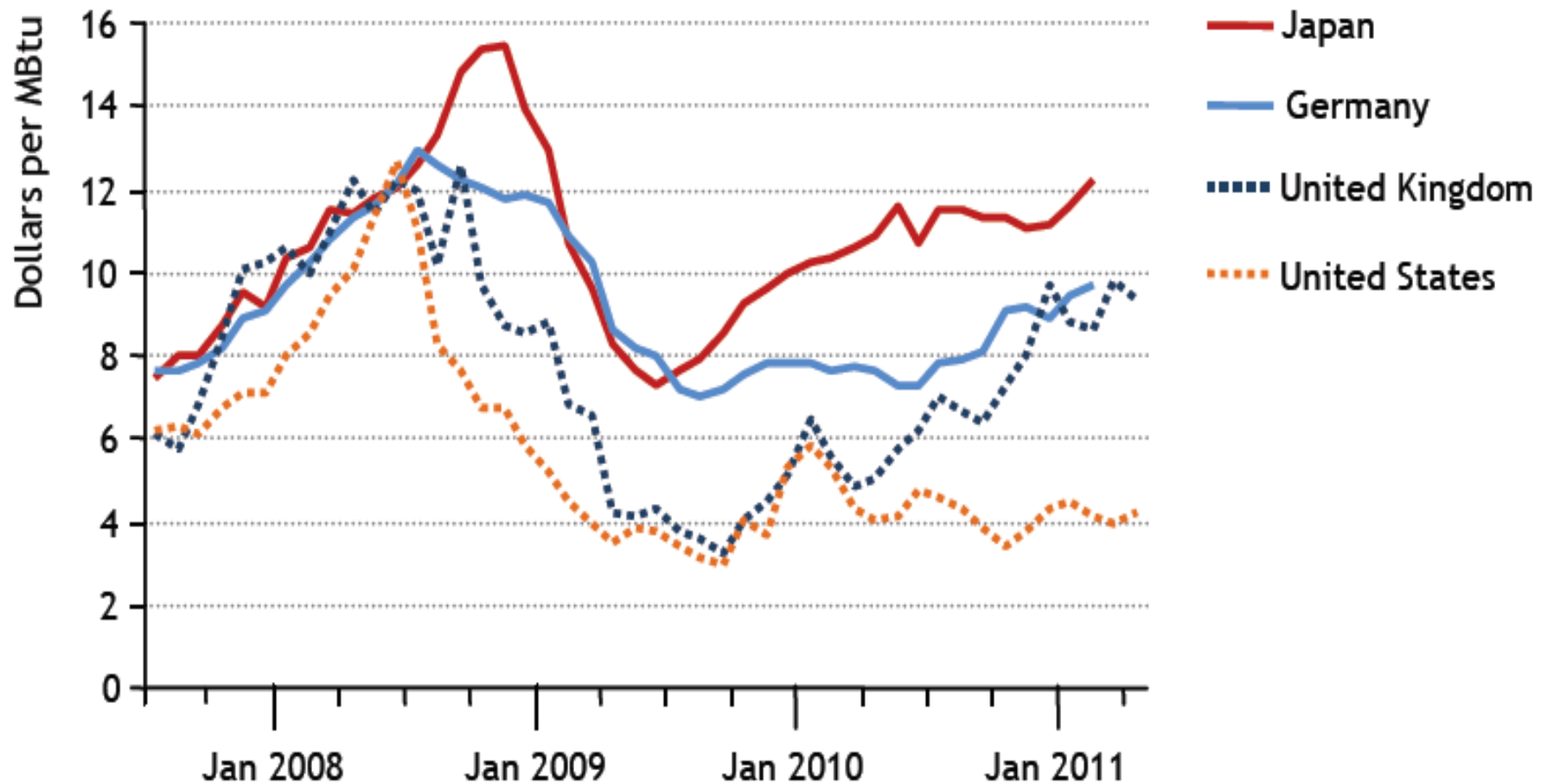


Fig. 13. Natural gas prices in the major markets, July 2007 to April 2011,
Source: WEO. IEA 2011.

Recent attempts of the GECF to settle the oil price parity

- GECF collectively control around **two-thirds** of the world's proven gas reserves.
- At a meeting in Algeria in April 2010 the GECF agreed **to strive for gas price parity with oil**.
- Algeria had proposed a coordinated **cutbacks** in gas production
- Coordinated cutbacks would, however, be difficult to achieve, particularly in the near term, not least because of **volume commitments in long-term contracts**
- The disappearing of the long term contracts from the gas trading will result in a **higher possibility** for exporters **to cut back** gas production without threatening their contract obligations and therefore significantly influence the gas price even in the “free” markets.

Answer to the Question III: Main Regional Pricing Methodologies

Region	Pricing principle	Rent included	Avg. Price level (2010), \$/MBtu
North America	Gas-to-gas	Ricardian	4
Continental Europe	Gas-to-oil	Ricardian+Hotelling (whole recourse rent)	7
- U.K.	Gas-to-gas	Ricardian	5
Asia-Pacific	Gas-to oil	Ricardian+Hotelling (whole recourse rent)	8

Conclusion I: How will regional gas prices change in the future?

- Pricing mechanisms in Europe and in Asia are likely to become more reflective of gas market conditions.
- The expansion of inter-regional trade is likely to be based on **combination of oil linked and spot gas pricing**.
- HOW rapidly and to WHAT extent the role of **spot gas pricing grows** will hinge to some degree on **how long** the overcapacity in global gas supply persists, how it develops regionally and how long **spot gas prices** remain below the price of oil-indexed gas in long-term contracts.

Conclusion II: How the regional gas prices will change in the future?

- The low level of gas prices in North America (as a result of the bump in shale gas production), put pressure on the gas importers in other regions and forced them to renegotiate the contract gas prices for spot basis. However, the future of shale gas production could be questioned later due to significant environmental pollution.
- Therefore, the contractual price decoupling **would not** necessarily mean **weaker gas prices** in the longer term: as the gas glut gradually dissipates, gas prices are likely to come under renewed upward pressure relative to oil prices.

Policy recommendations:

For European gas importers:

- Try to negotiate (or renegotiate) a **spot gas price** reference in gas contracts. **Spot gas price** reflects the real gas supply and demand conditions. The spot gas price doesn't include the resource rent to the price under the high oil prices and therefore the spot gas prices are lower than those for oil.
- Buyers should **be careful** trying to renegotiate the long-term take-or-pay contracts for the more short-terms without ToP obligations, because the gas suppliers are very **reluctant to change** such conditions due to **traditional mechanism** of their investment secure. When supplier makes the multibillion Euros investment into supply infrastructure the returns of investments are usually ensured by the long-term, take-or-pay obligations.

Policy recommendations:

For the North American gas consumers:

- To put **adequate environmental protection** during the shale gas production and to include environmental cost to the shale gas price.

For the Asian gas importers

- To explore the possibilities for establishing the free gas market places (gas hubs) to ensure the competition in the gas supply and therefore to switch the gas pricing mechanisms from the oil- to gas- linkage in the new gas contracts. First gas hub in Singapore (?).

Thank you for your
attention

Grazie

Buon Natale!

