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For sustainable energy.

Present and future in energy evolution
Dr.I.Purica

Promoting sustainable energy for the greatest benefit of all



World Energy Council – Romanian National Committee

Bucuresti, 11.Mar.2013

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Topics for discussion

Energy Trends a new paradigm

Energy Market in a regional context

Integrated corporate action

New Technologies – real options

Conclusions

Energy Trends a new paradigm

The 2007 Integrated Energy Package

Competitiveness "LISBON"

- Internal Market
- Interconnections
- European electricity and gas network
- Research and innovation

FULLY BALANCED INTEGRATED AND MUTUALLY REINFORCED

Sustainable Development "KYOTO"

- Renewable energy
- Energy efficiency
- Nuclear
- Research and innovation
- Emission trading

Security of supply „MOSCOW"

- International Dialogue
- European stock management
- Refining capacity and energy storage
- Diversification

Natural gas & renewables become increasingly important

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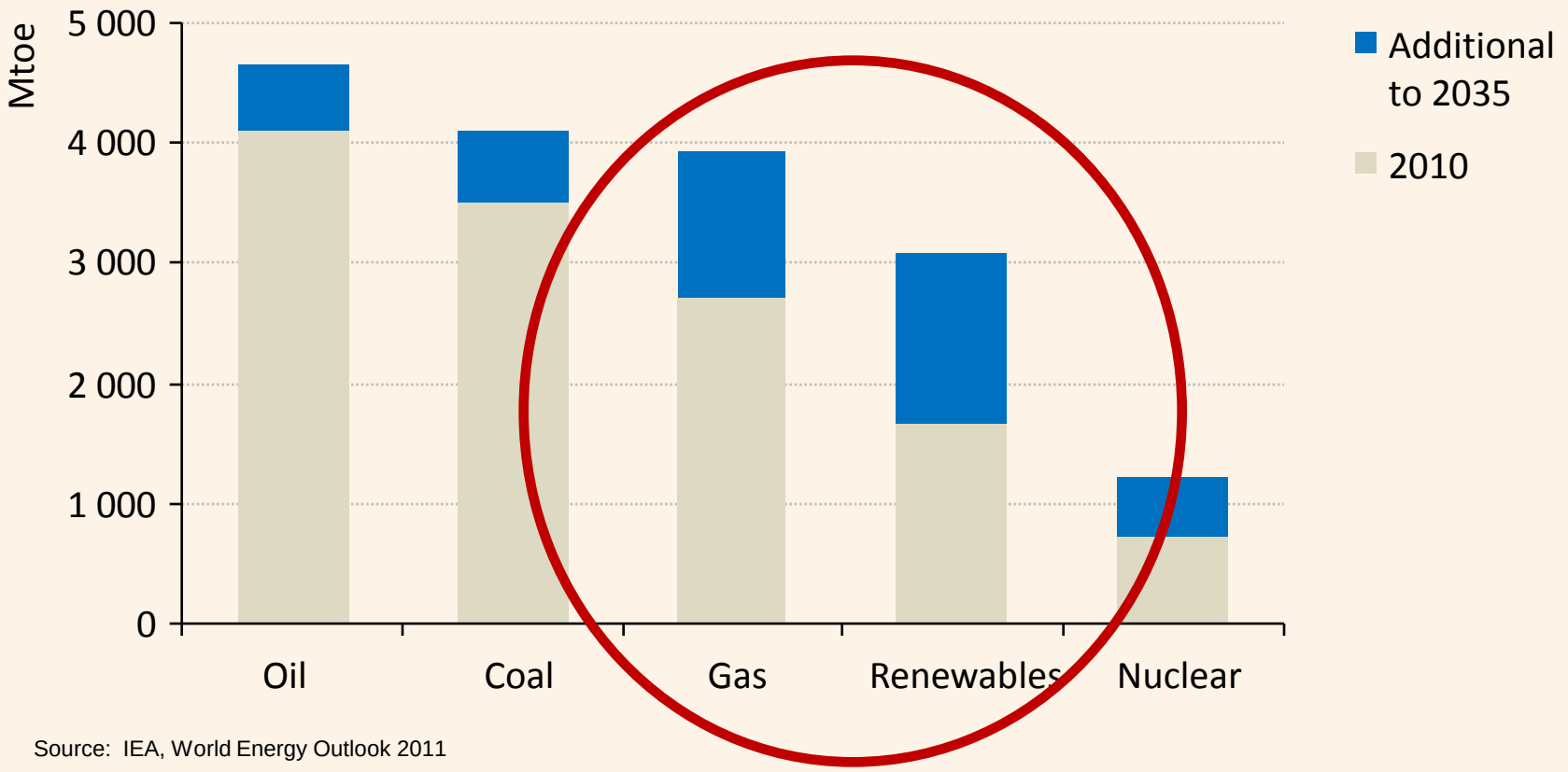
World primary energy demand



Source: IEA, World Energy Outlook 2011

Renewables & natural gas collectively meet almost two-thirds of incremental energy demand in 2010-2035

Natural gas demand by region

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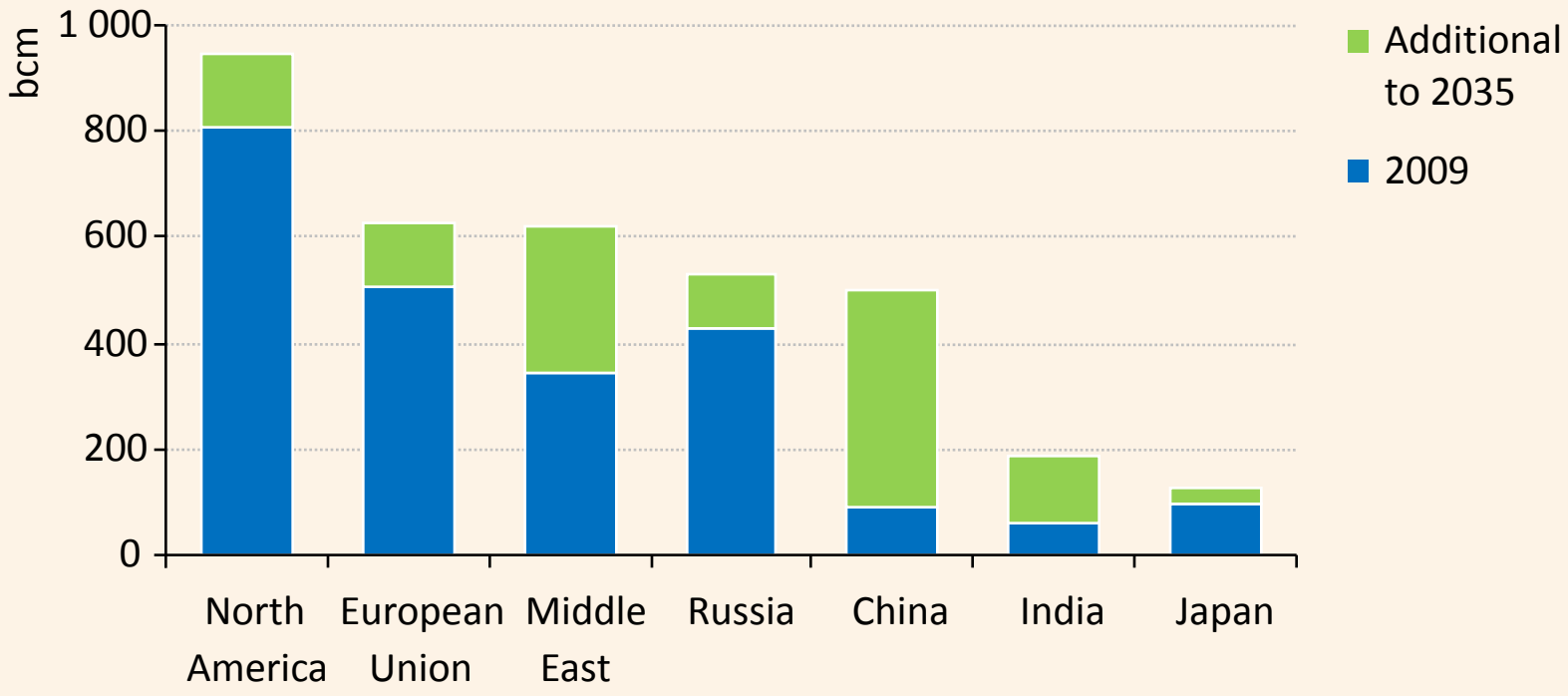
New Policies Scenario, 2009 and 2035



Power generation as main driver of gas demand

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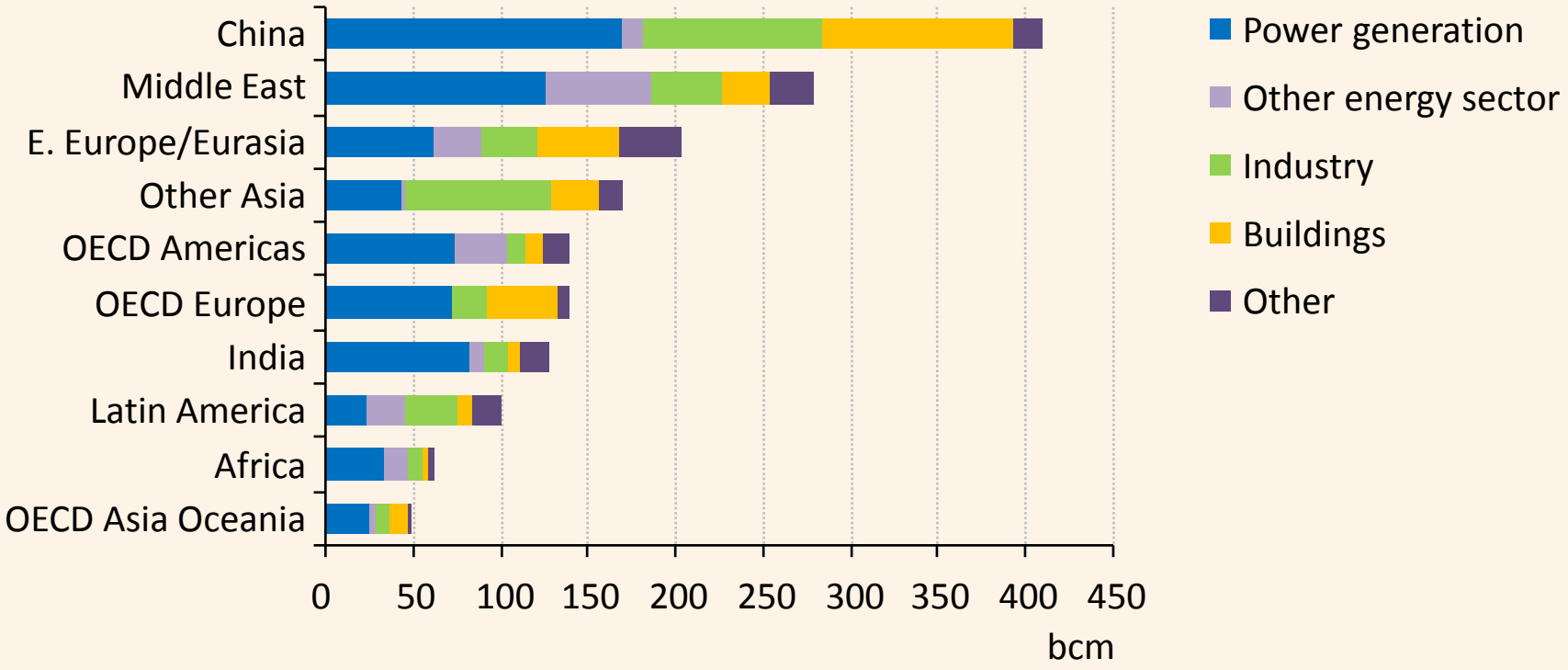
IEA New Policies Scenario, 2009-2035



Gas trading is increasing

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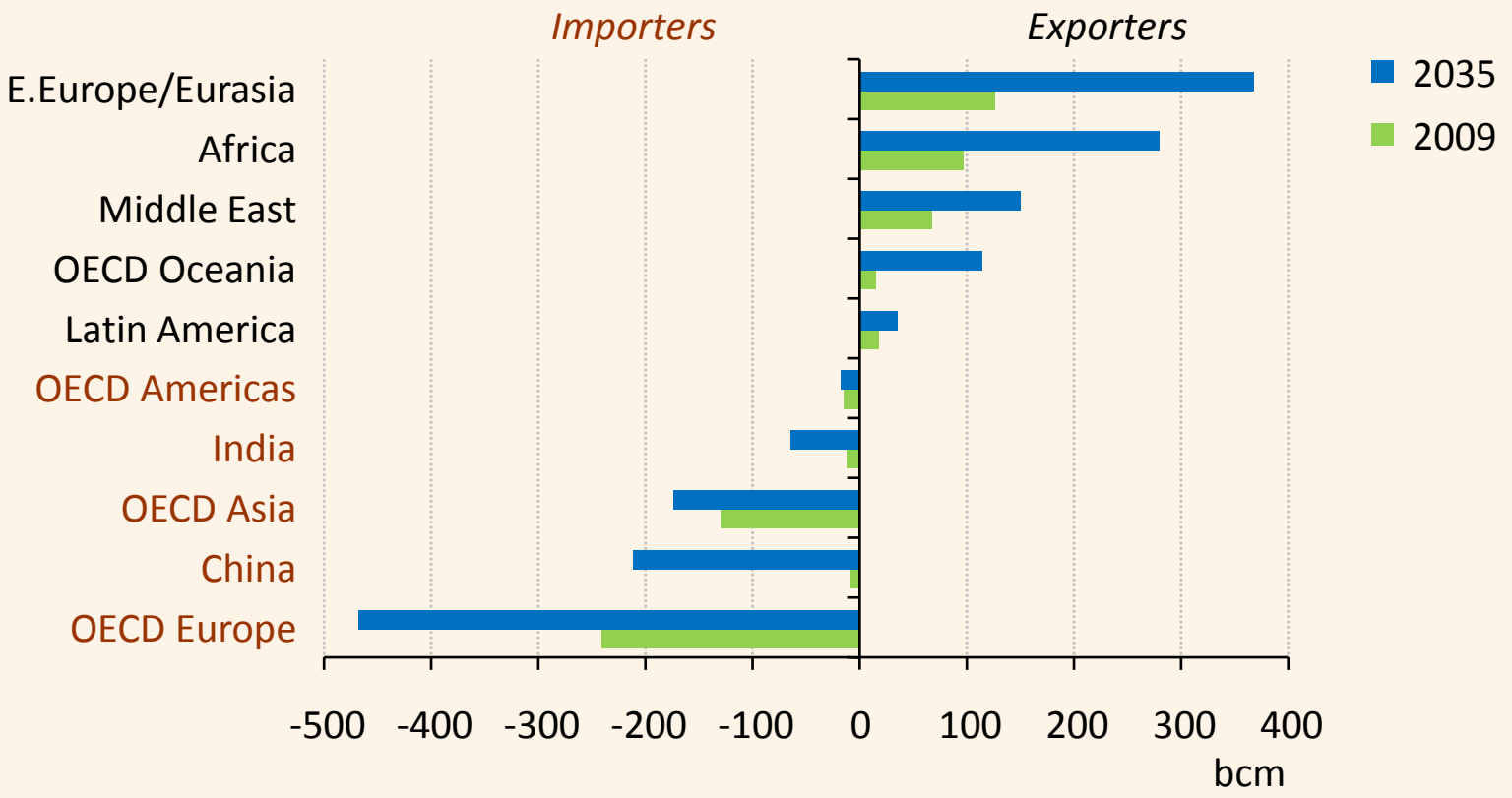
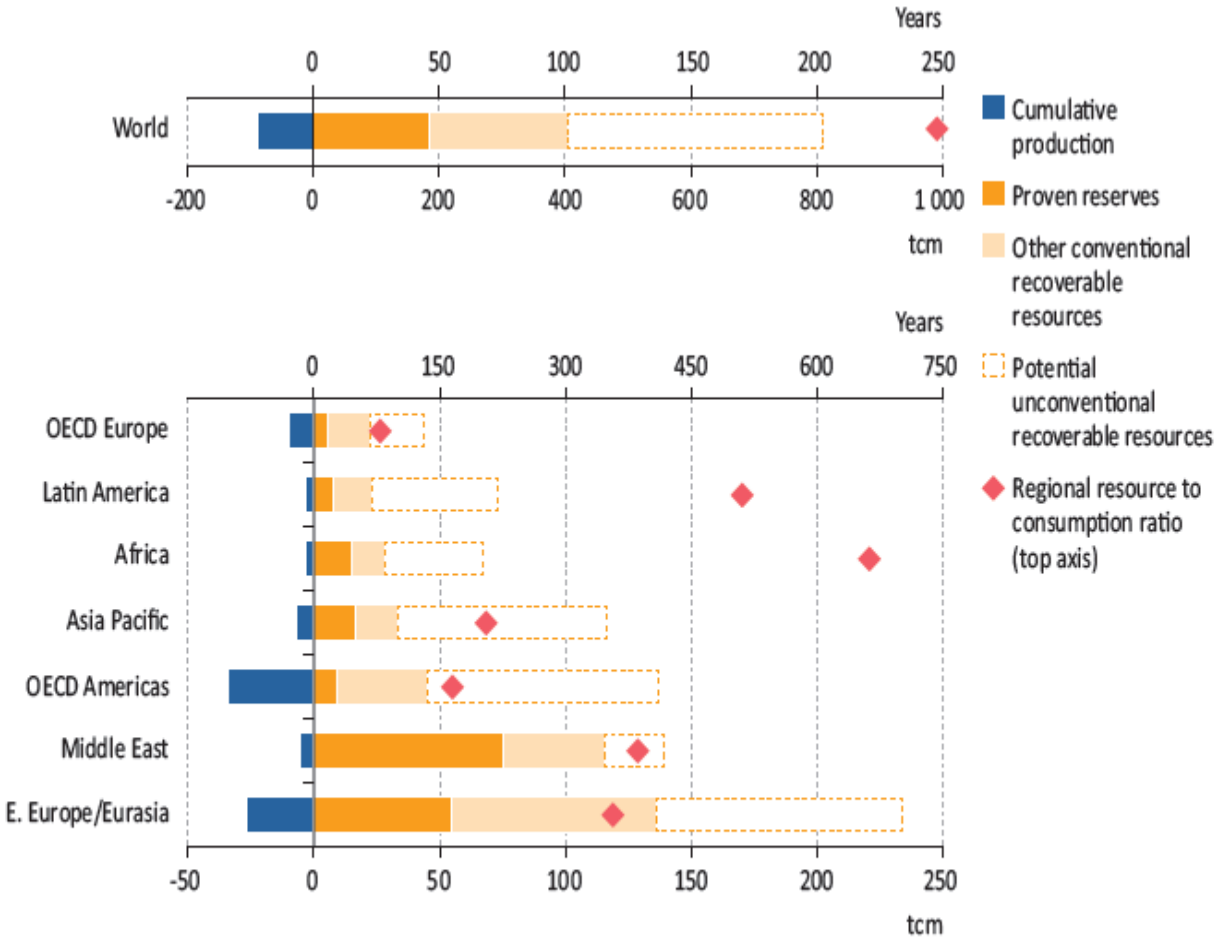
Net gas trade by major region in the IEA New Policies Scenario



World gas resources by production and region



Notes: Cumulative production to date is shown as a negative number, so that the total of the bars to the right indicates remaining recoverable resources. Russian reserves are discussed in detail in Chapter 8.

Sources: Cedigaz (2010); USGS (2000 and 2008); BGR (2010); US DOE/EIA (2011); IEA estimates and analysis.

- Current conventional recoverable resources of gas can last for 120 years at 2010 production levels.
- Along with unconventional resources, gas will last for 250 years.
- Huge potential for Africa and LAC to meet energy demand through gas.

Golden prospects for natural gas?

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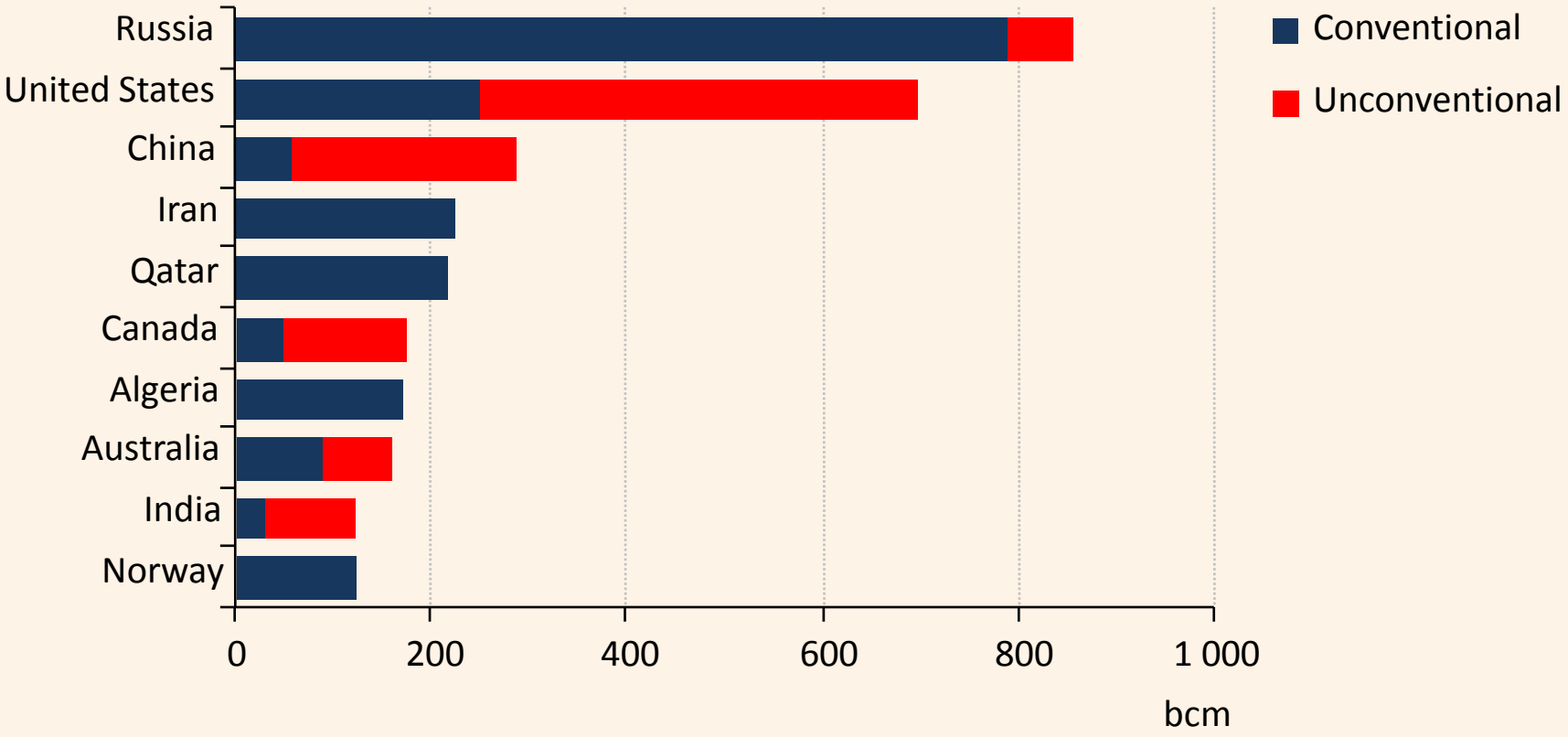
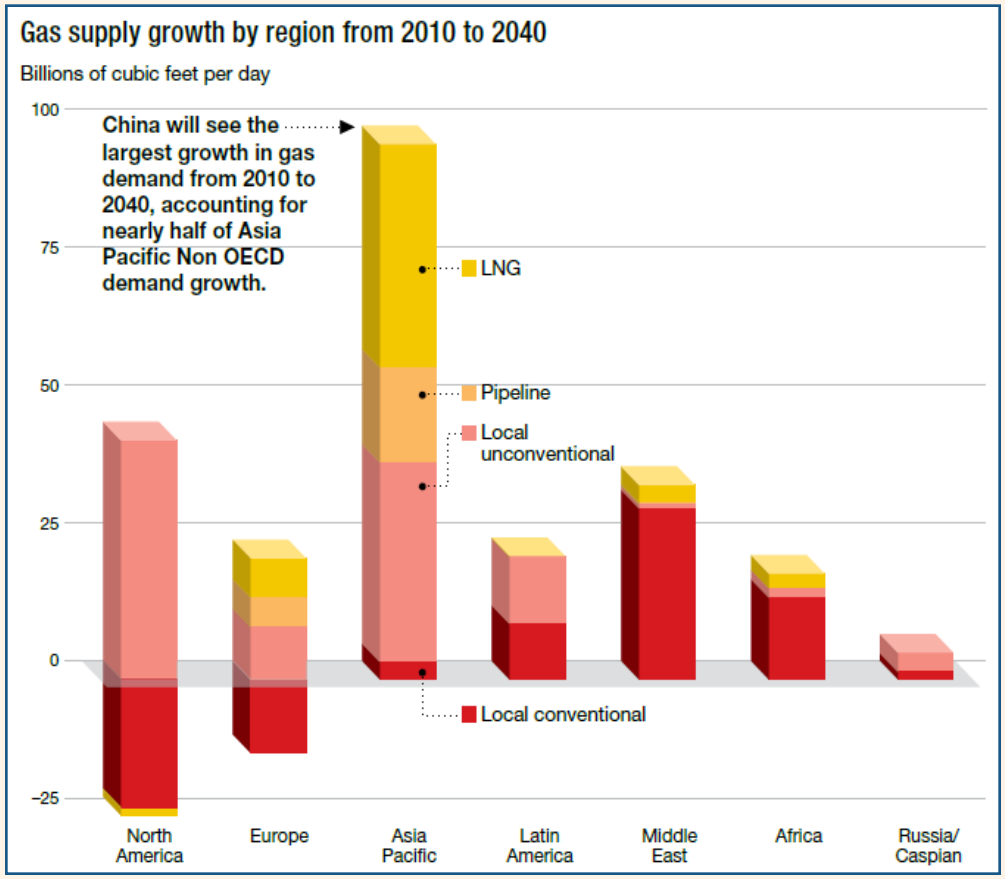
Largest natural gas producers in 2035

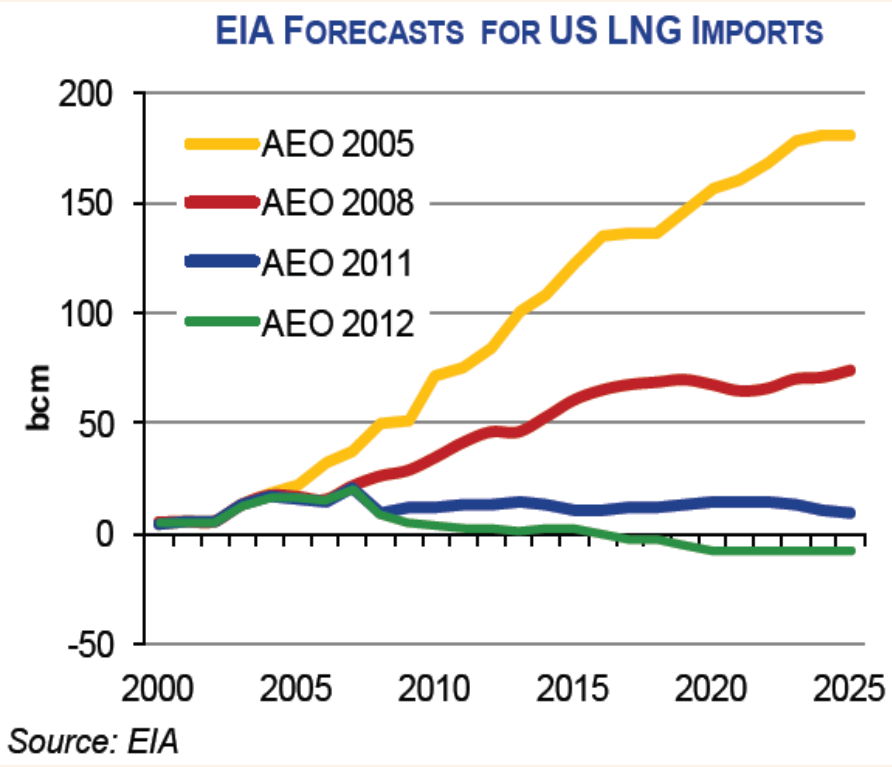


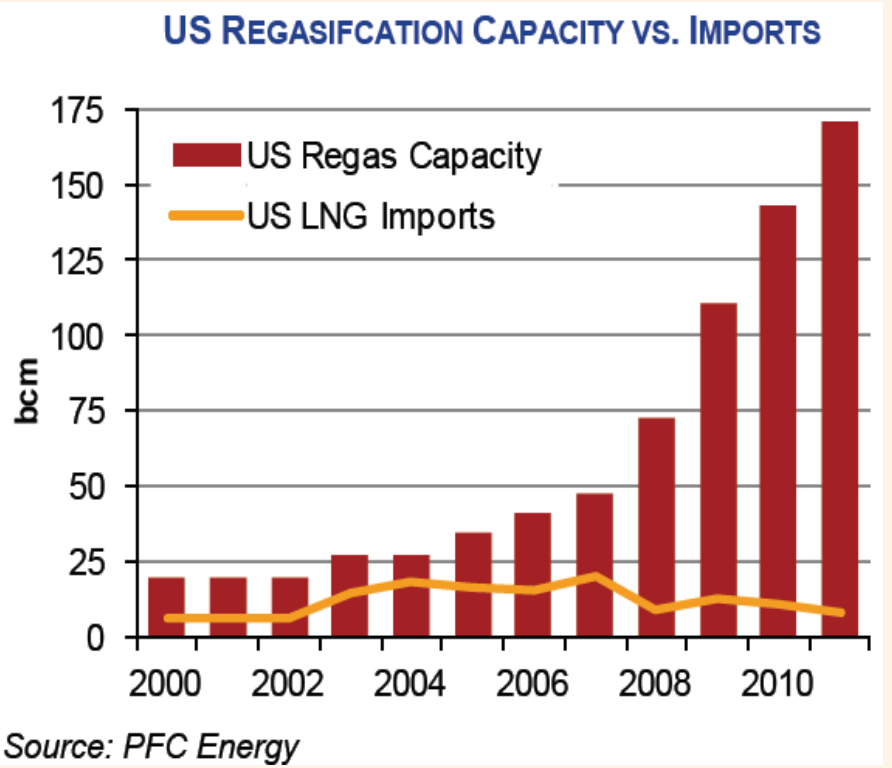
Future gas production



Source: Exxon, Outlook to 2040 (2012)

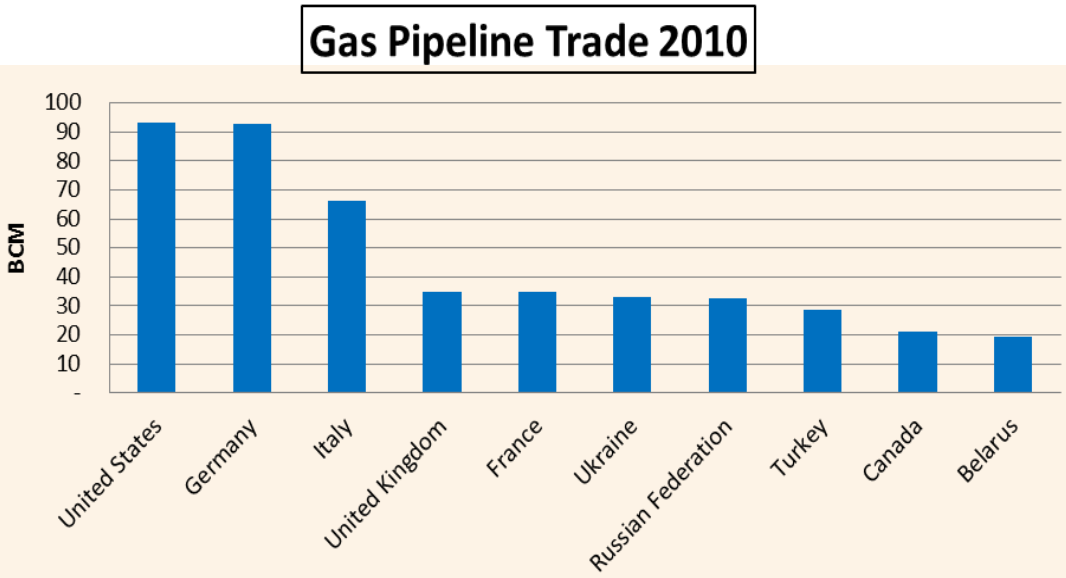
Impact of US shale gas on US LNG imports



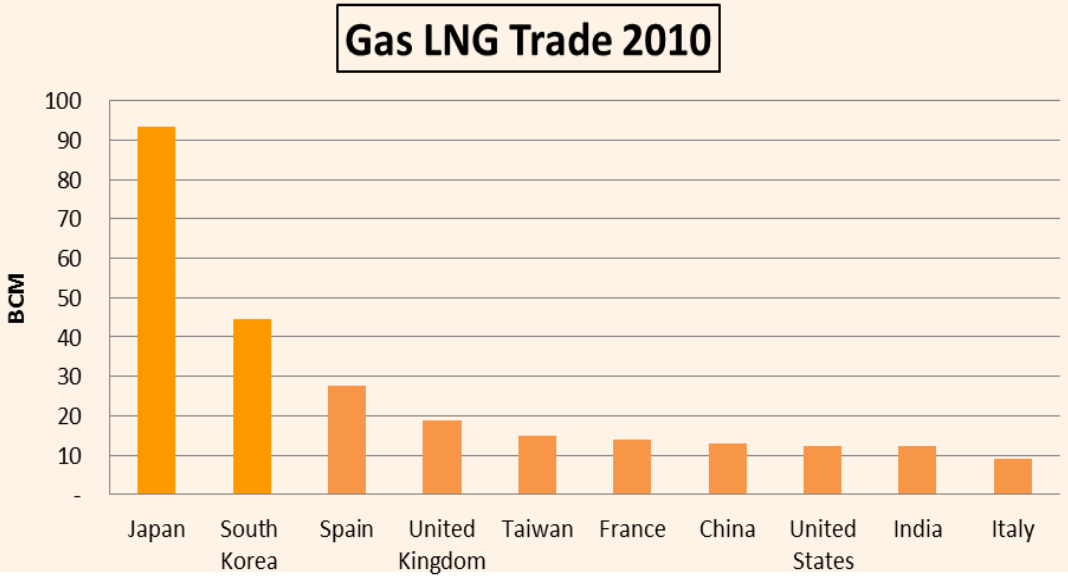


- In 2005, US EIA expected US to import around 70 bcm in 2010.
- US is expected to become a net exporter of gas after Sabine Pass comes online in 2015.
- In 2011, US gas prices were 68% lower than Japan gas prices.
- US LNG exports are not expected to have a major impact on LNG markets.

World gas trade



- US obtains 88% of its pipeline gas imports from Canada
- Germany imports pipeline gas from Russia, Norway & the Netherlands.
- Italy imports 40% of its pipeline gas from Algeria.



- Japan and South Korea's gas needs are met solely by LNG.
- Japan alone accounts for 31% of world LNG trade.
- Asia Pacific accounts for 60% of world LNG trade.

Source: BP Statistical Review of World Energy 2011

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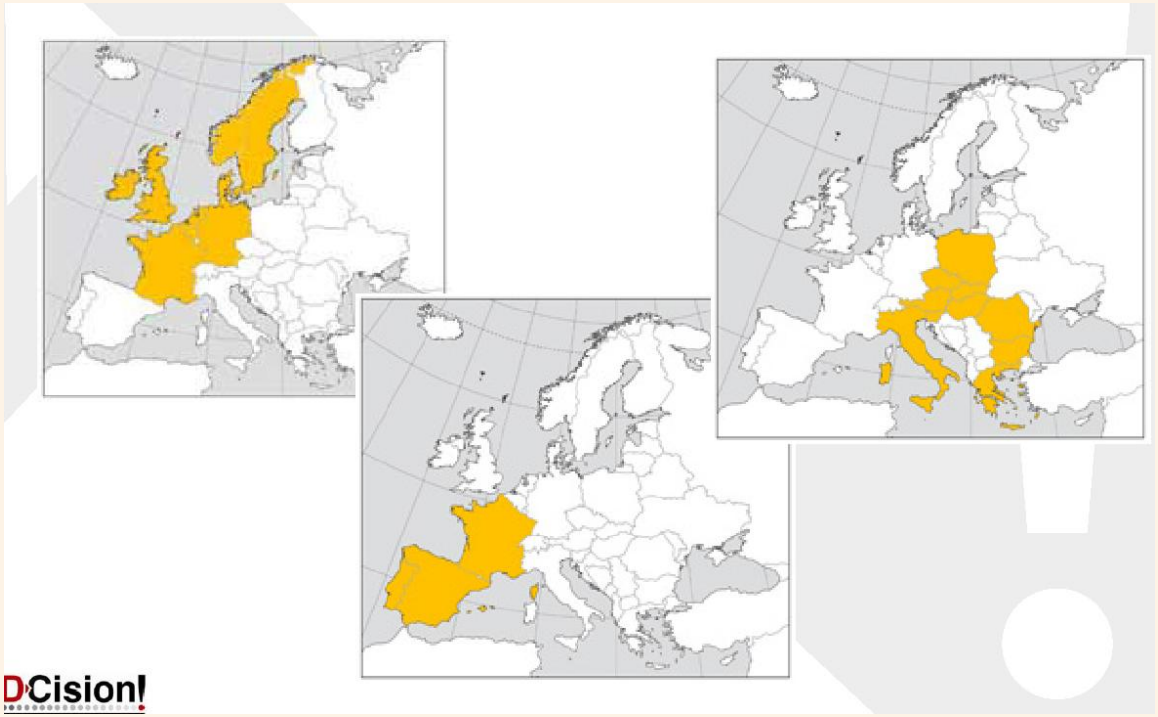
Energy Market in a regional context

Gas Markets in Europe



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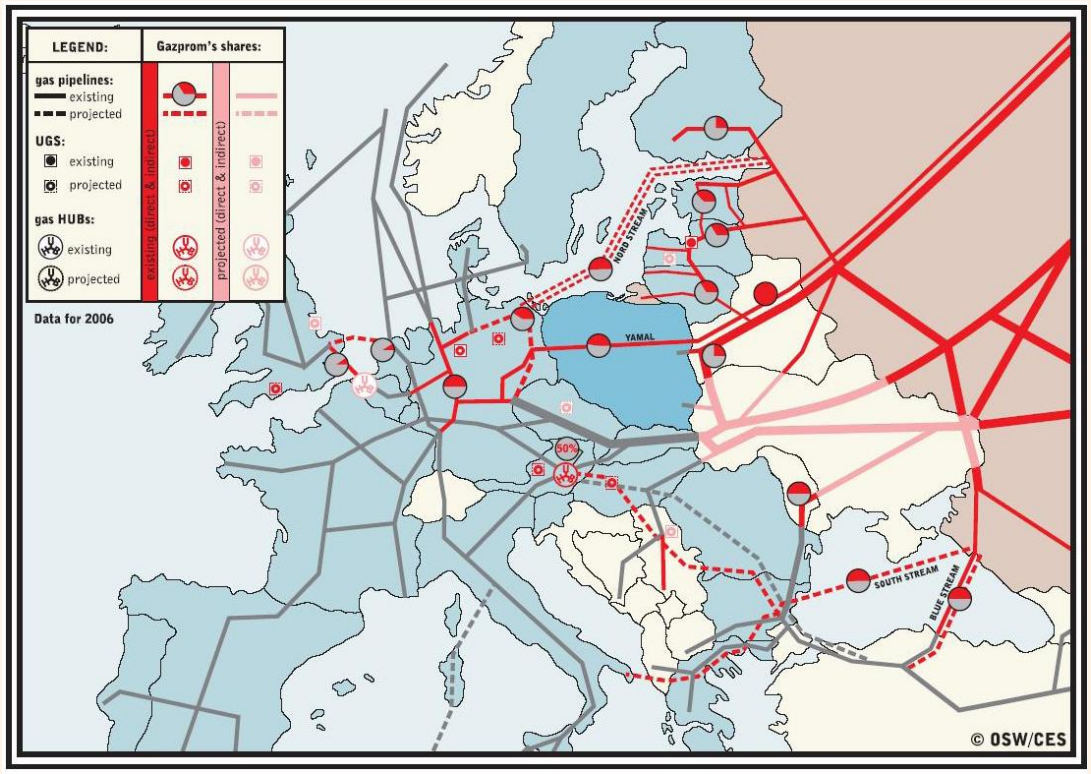
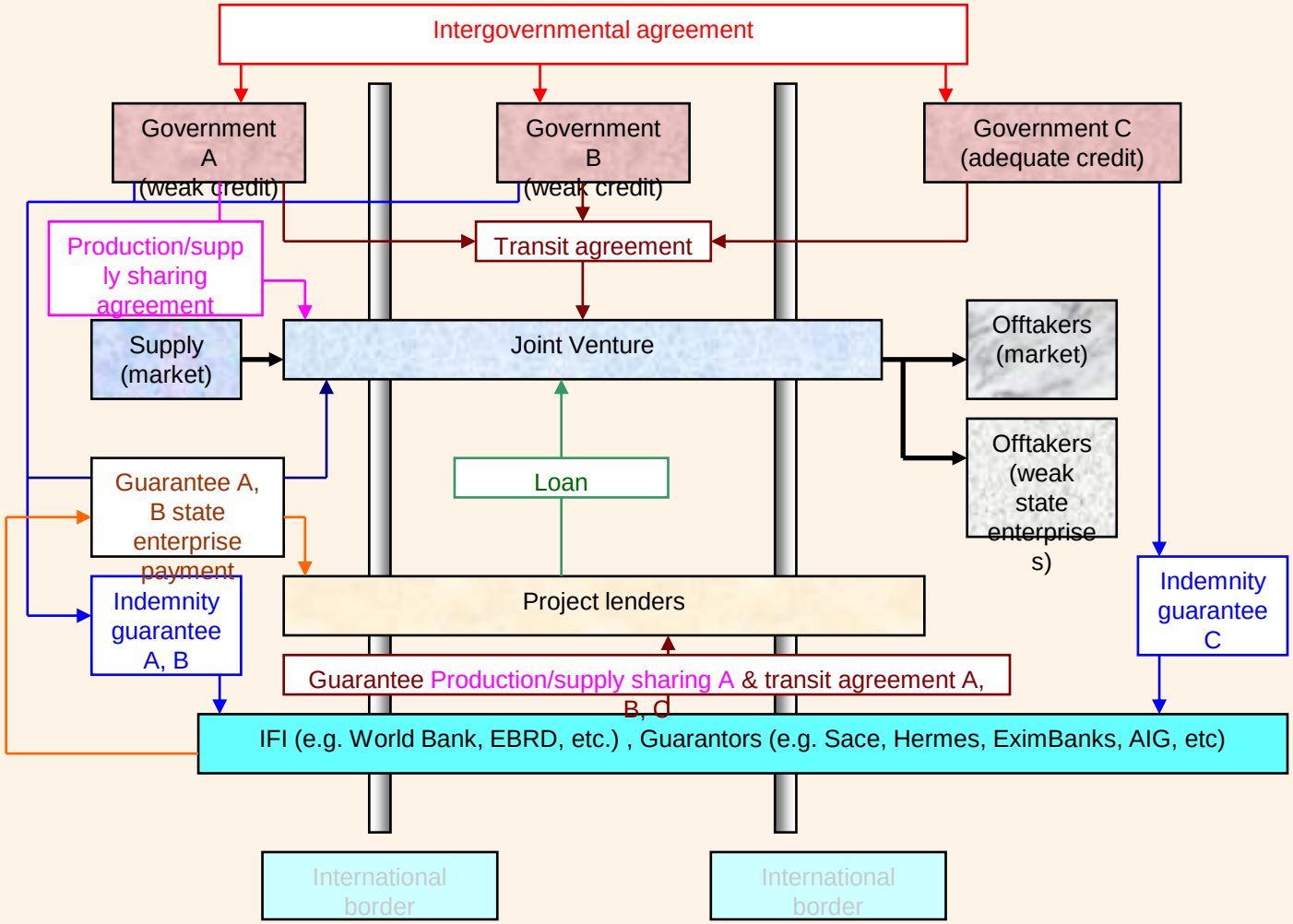
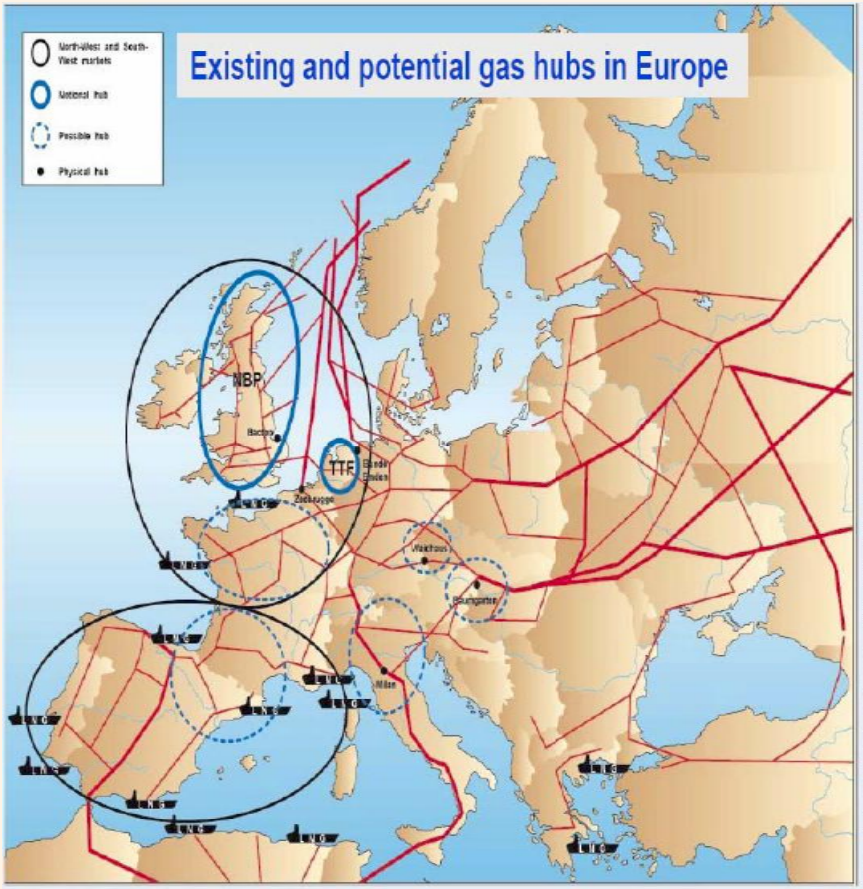
Gas pipelines



Pipeline Project
(possible project / guarantee structure)



How much reserve is enough ?



Hubs:
NBP (UK)
Zeebrügge
BEB_VEP
GASTRA
PEG
PSV

Trading at the flange/Hul
Baumgarten

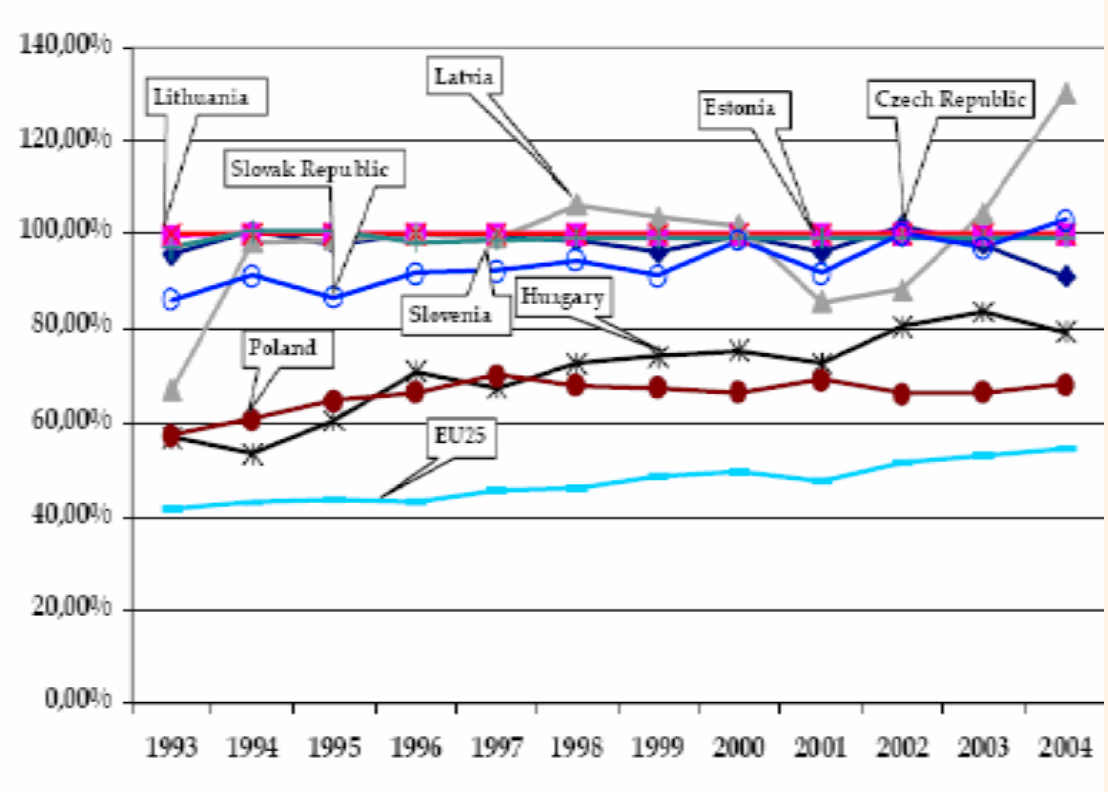
Trading at the flange
Oude Statenzijl
Eynatten
Emden
Ellund
Wallbach
Griess Pass
Tarvisio Blaregnies
Griess Pass
Lampertheim
Oberkappel

LNG gas capacity

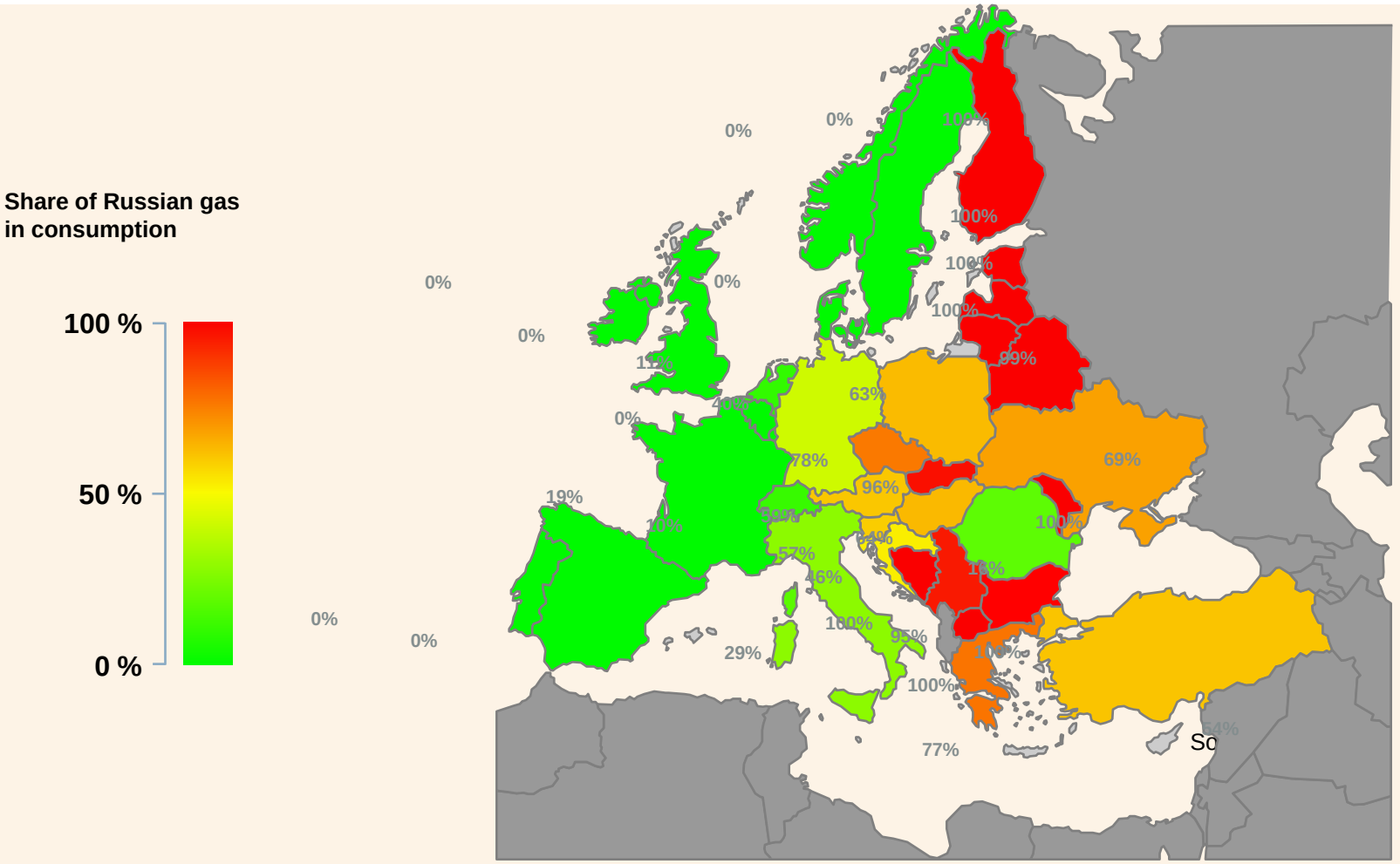
Likely/possible

	2007	2010	2015
Belgium	**6,5**	**9,1**	**9,1**
France	**15,6**	**23,9**	**26,4-59,4**
UK	**9,0**	**44,0**	**49,7-54,7**
NL	**0,0**	**1,0**	**17,0-27,0**
Italy	**3,5**	**16,5**	**23,5-47,5**
Spain	**50,5**	**57,3**	**64,3**
Portugal	**5,5**	**5,5-8,5**	**5,5-8,5**
Greece	**2,6**	**2,6**	**2,6**
Ireland	**0,0**	**0,0**	**2,5**
Croatia	**0,0**	**0,0**	**10,0**
Germany	**0,0**	**5,0**	**10,0**
Total	**93,2**	**159,8-167,8**	**198-299,5**

Vulnerability to gas imports



Dependency on Russian gas imports



Source : CEDIGAZ- Estimate of international gas trade by pipeline in 2009

Natural gas in Europe

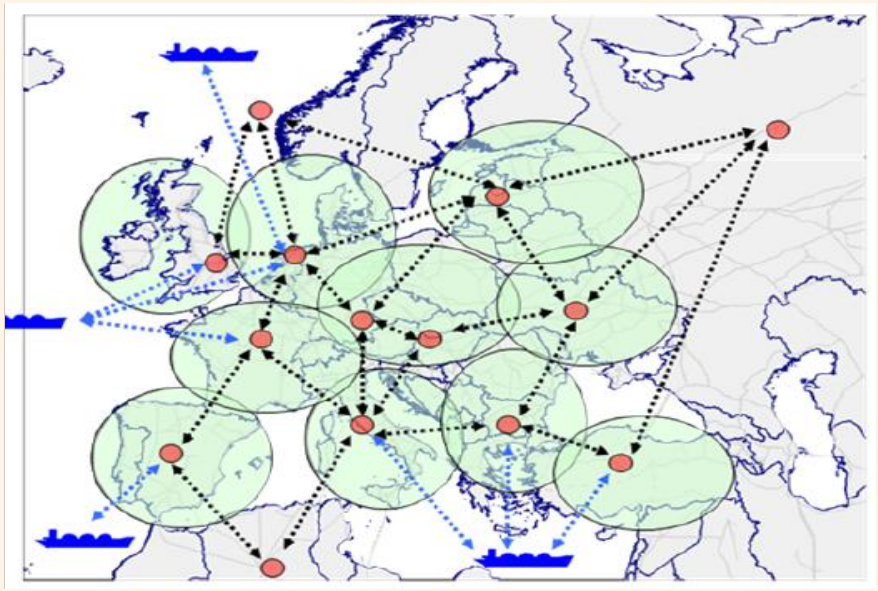
Security of supply

Increasing liquidity on European market places

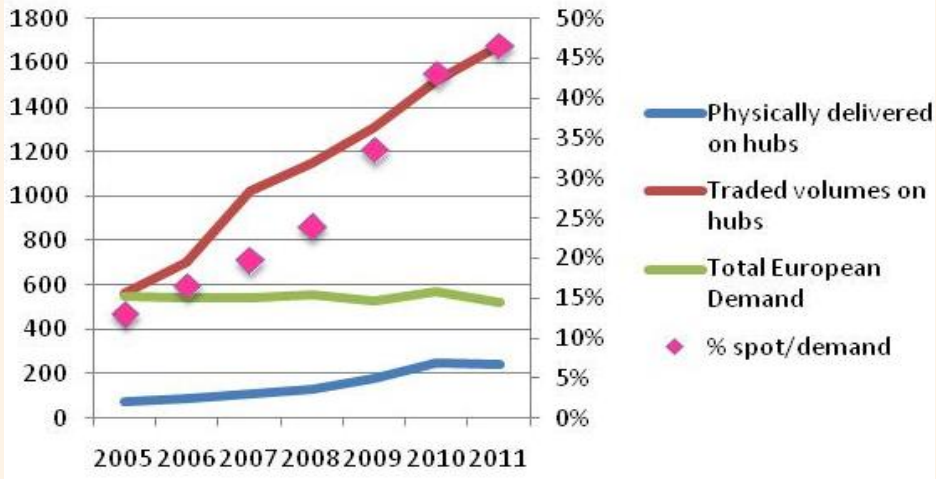
- Spot-linked gas volumes: 42% in 2011, 45% in 2012 (SG)
- Physical volume on hub and virtual market place in 2011: 47% (IEA)*

Sharp acceleration of the process towards a unified market

On-going discussions on the Gas Target Model



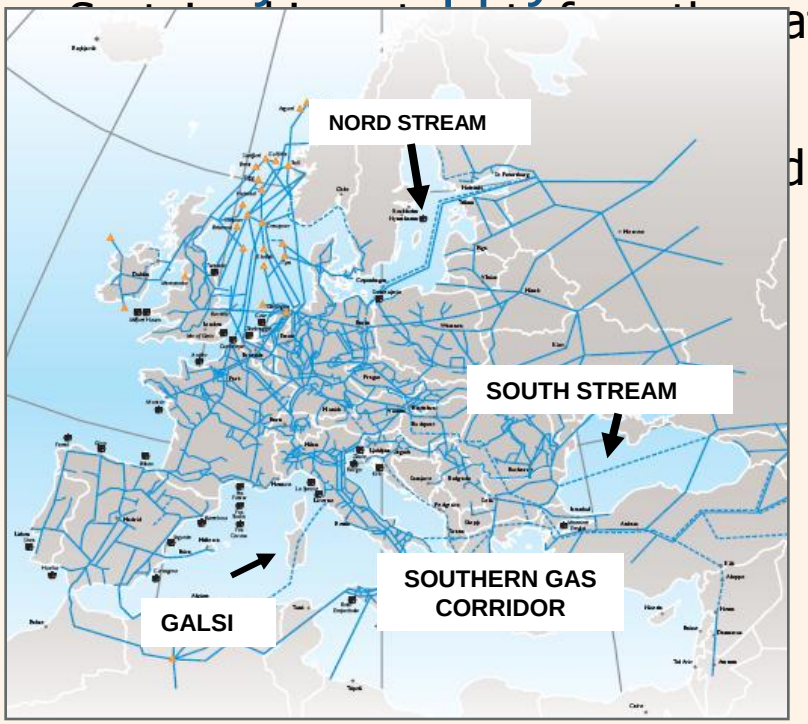
Total traded volumes in Continental Europe market places (in TWh)



Source: IEA

Natural gas in Europe

Security of supply



Source: Eurogas

The Southern Gas Corridor

Nabucco and Nabucco West pipeline

Trans Adriatic Pipeline project

Natural gas: towards a globalised market

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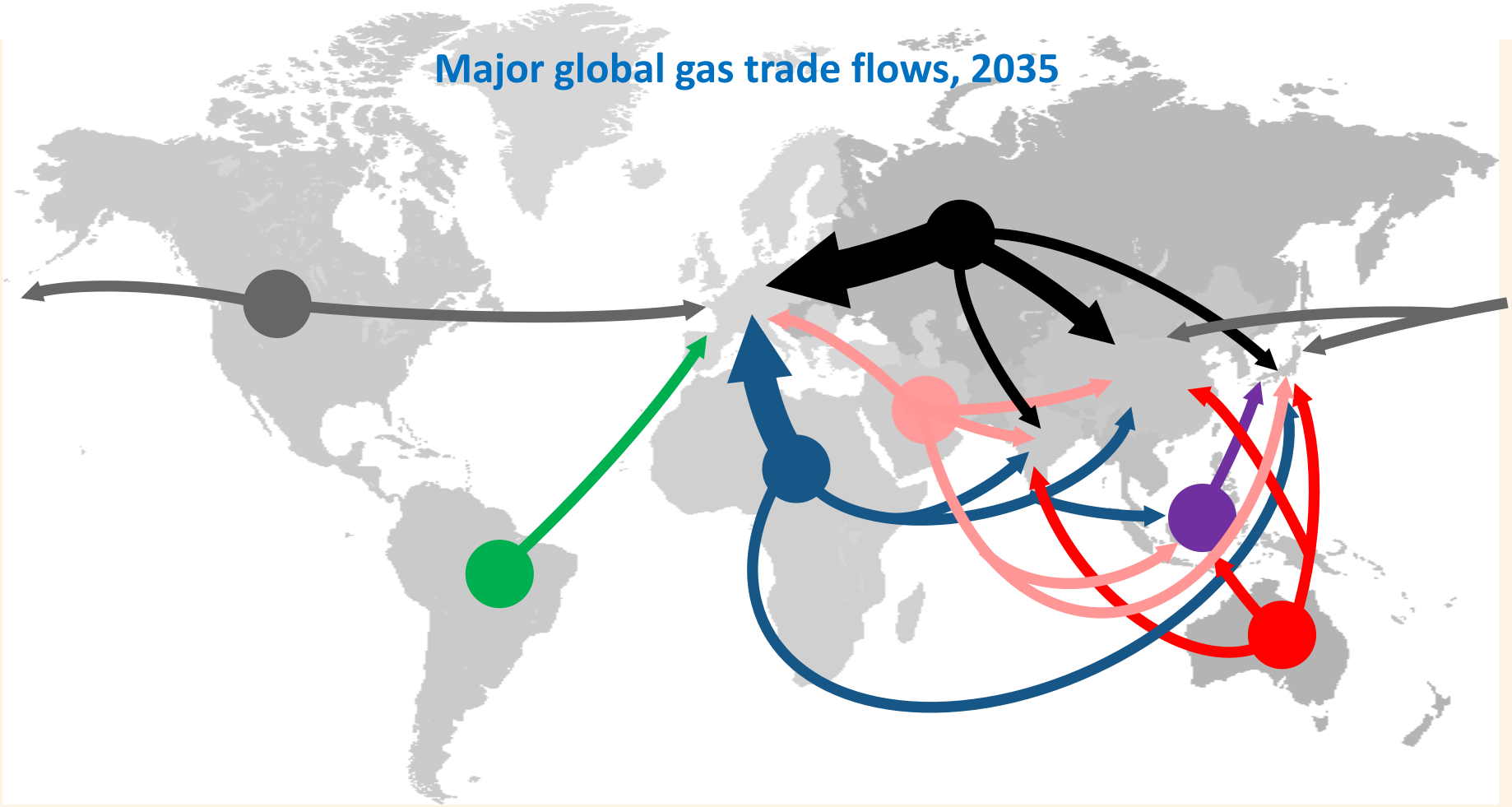
Major global gas trade flows, 2035



Rising supplies of unconventional gas & LNG help to diversify trade flows, putting pressure on conventional gas suppliers & oil-linked pricing mechanisms

Different trends in oil & gas import dependency

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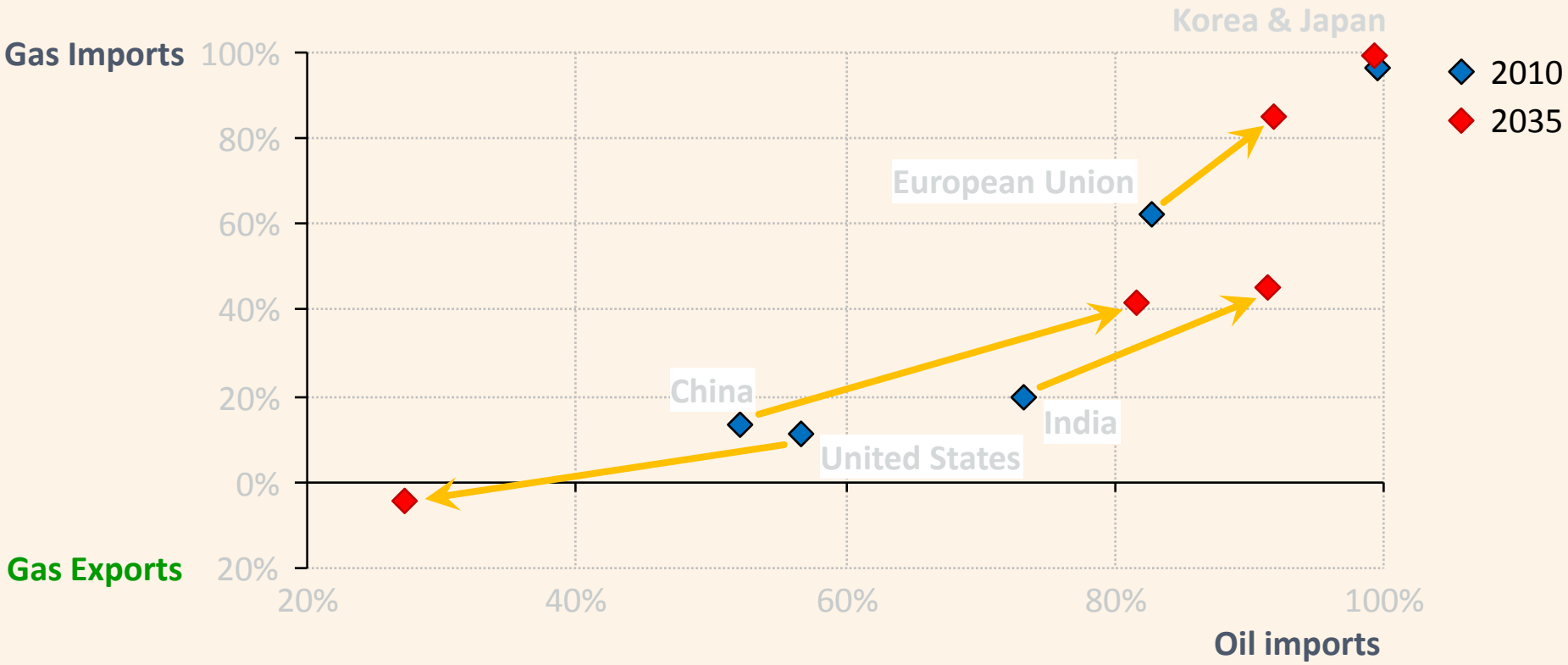
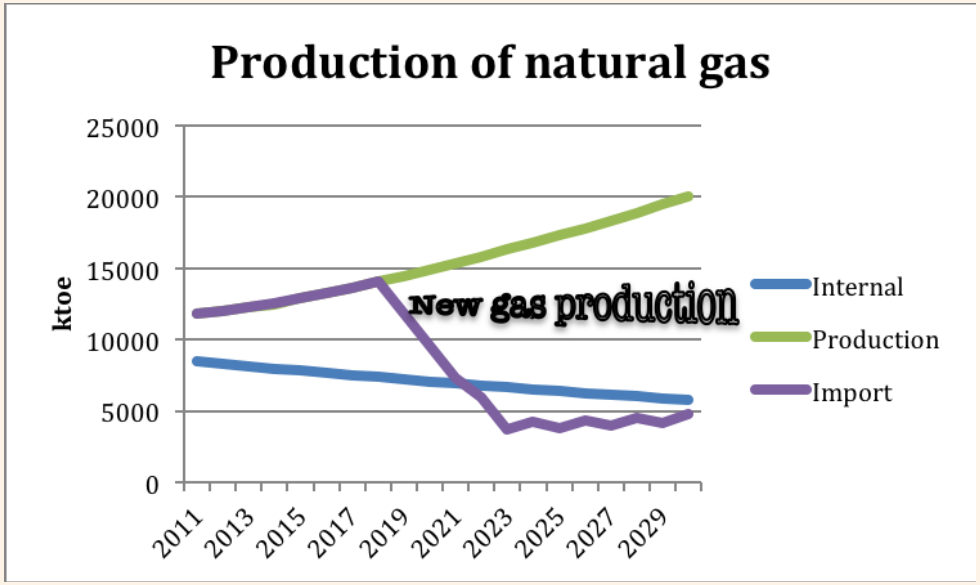
Net oil & gas import dependency in selected countries



While dependence on imported oil & gas rises in many countries, the United States swims against the tide

Non-conventional gas potential in Romania



Integrated corporate action

North and South Parts of Gas Ring

Gas upstream competition & downstream deals

Scope for bilateral deals ?

All eastern gas via Gazprom?...

Southstream, Northstream

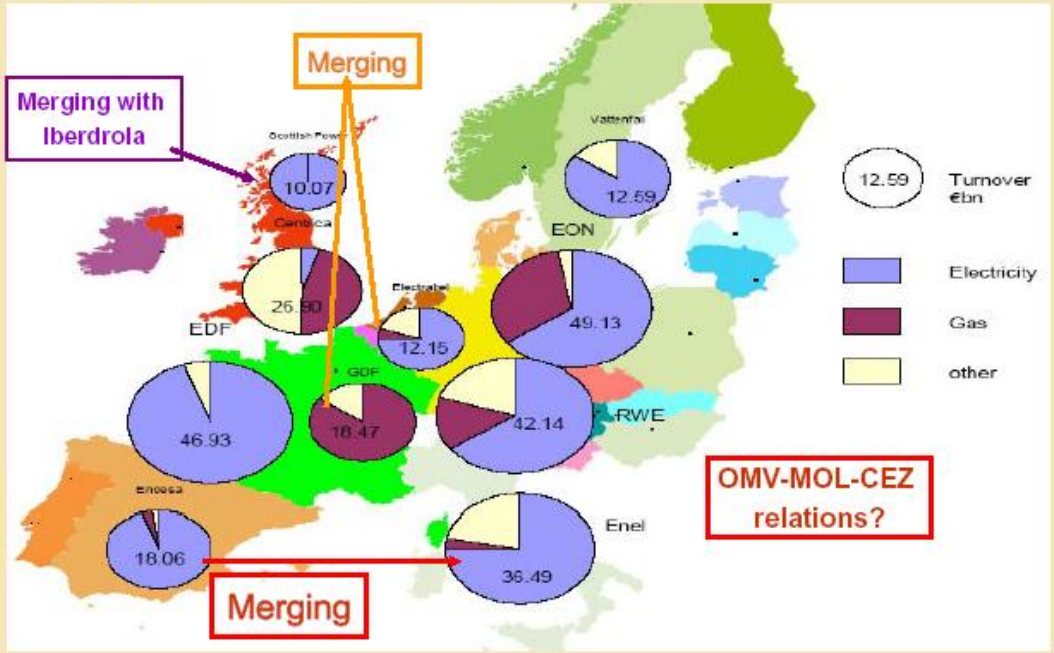
Gazprom-Sonatrach Cooperation ?

Doha, april 2007: gas cartel to come ?

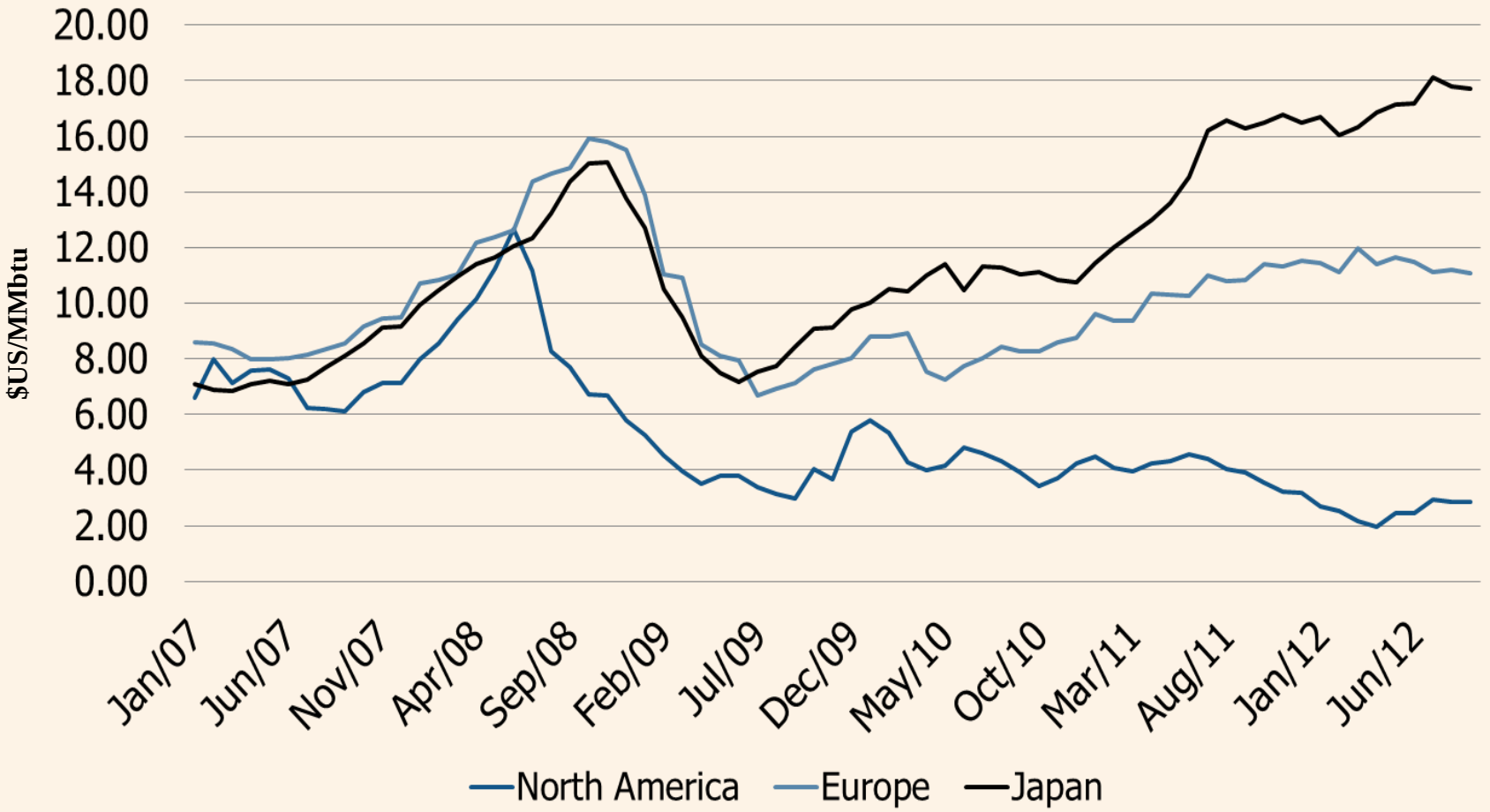
Shtokman

Market-Monopoly paradox

The need for strong EU energy companies facing Gazprom ?



World Natural Gas Prices



Source: World Bank

Gas prices in Europe: spot price vs. indexed price

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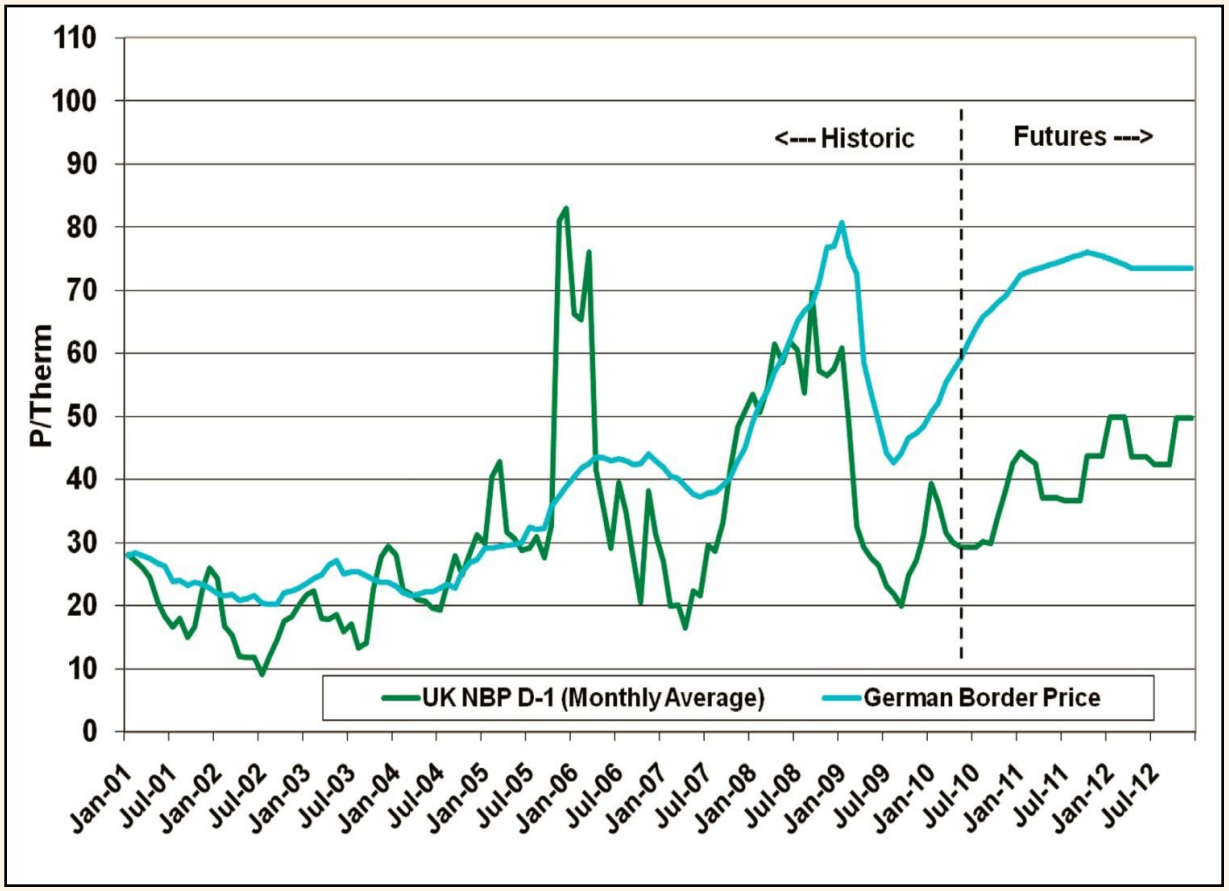

Natural gas in Europe
Competitiveness

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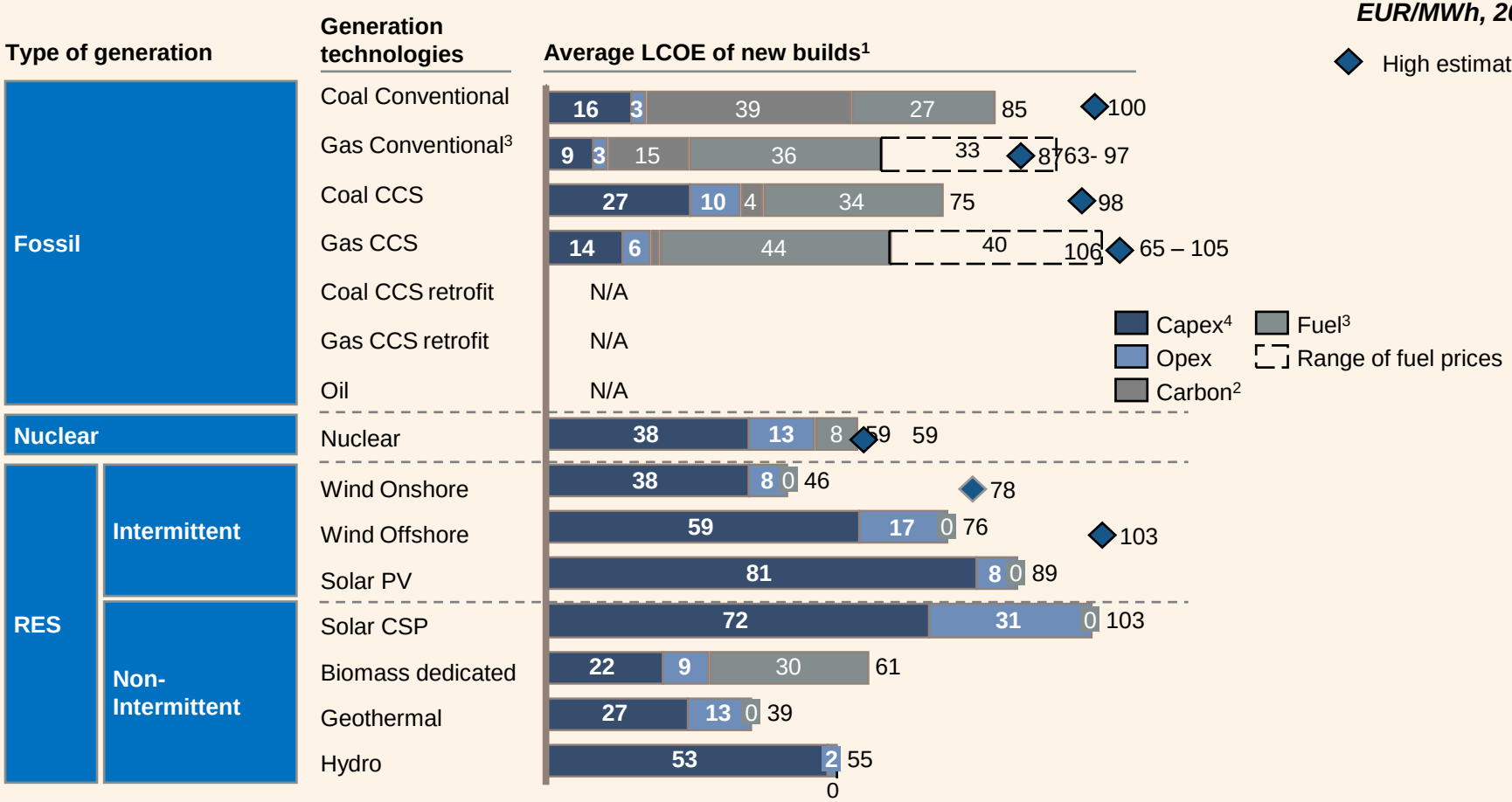
- Gas remains a cost competitive base load generation technology in the long term, but the gas price is a critical driver of overall cost

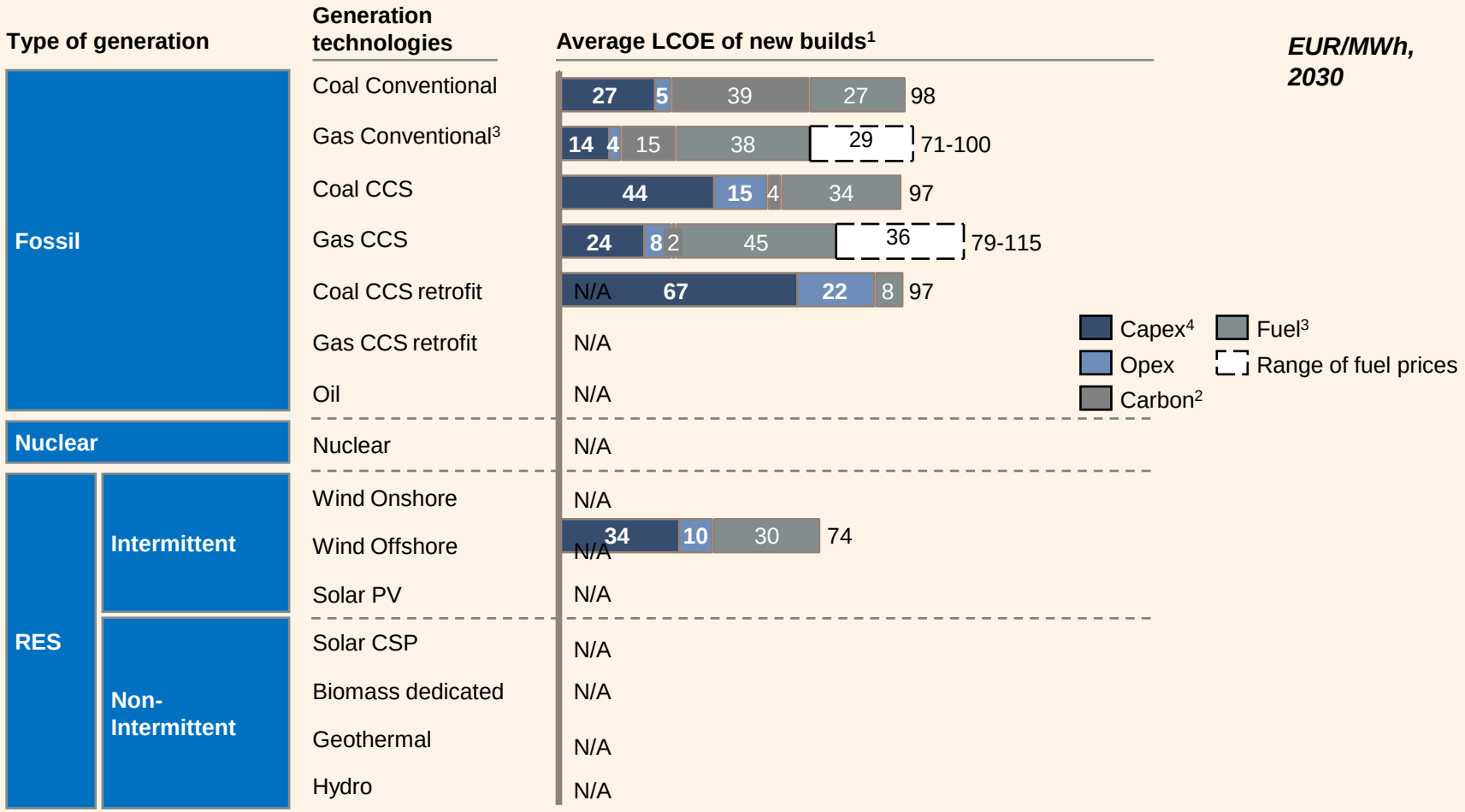


SOURCE: ECF roadmap 2050, Centrica, MoH MaCDonald UK electricity generator costs update

(1) Average of low and high cost estimates. Exchange rate of 1.1 EUR/GBP, (2) Assuming a carbon price of 44 EUR/tonne, (3) Based on IEA price forecasts and a gas price of 7.50 USD/mmbtu (base case shown) and 14.8 USD/mmbtu (high case), assumed load factor of 85%, (4) Assumes 7% discount rate, (5) Including storage cost of 1.11 EUR/MWh and transportation costs of 1.46 EUR/MWh (source: Centrica), (6) High estimate based on Mott MacDonald 'case 8' pg 88 estimates for 2023 Nth of a kind at 7.5% cost of capital (compared to 7% for ECF), carbon prices adjusted to match ECF for the purposes of comparison, and a gas price rising to approx 12 USD/mmbtu by 2030

Natural gas in Europe
Competitiveness

- For mid-merit order load factors (4,500 hours per year) and at low gas price, gas looks most attractive

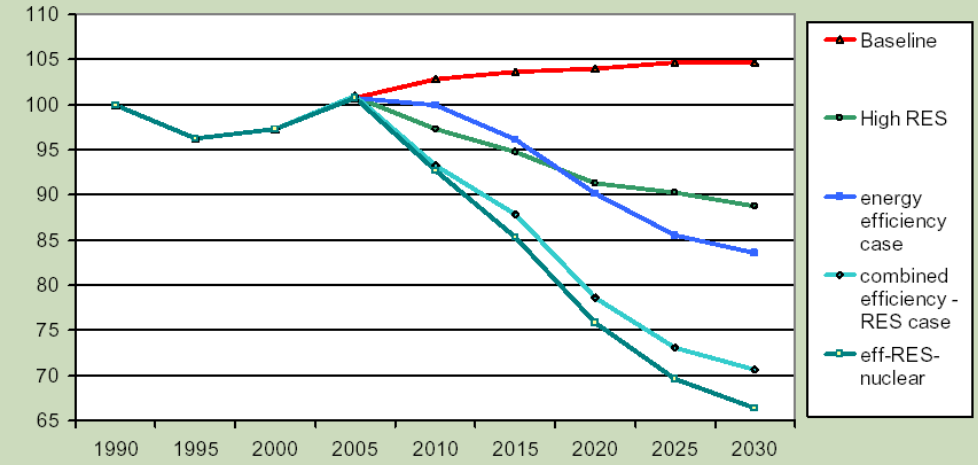


SOURCE: ECF roadmap 2050

(1) Average of low and high cost estimates, (2) Assuming a carbon price of 44 EUR/tonne, (3) Based on IEA price forecasts and a gas price of 7.50 USD/mmbtu (base case) and 14.8 USD/mmbtu (high case)
(4) Capex is assumed to spread in a NPV neutral way, (5) Including storage cost of 1.56 EUR/MWh and transportation costs of 2.44 EUR/MWh (source: Centrica)

New Technologies – real options

How to reduce CO2 without more gas consumption?



Strong photovoltaics supply increases wholesale price volatility … – Prices are reduced during sunny middays in spite of high electricity consumption

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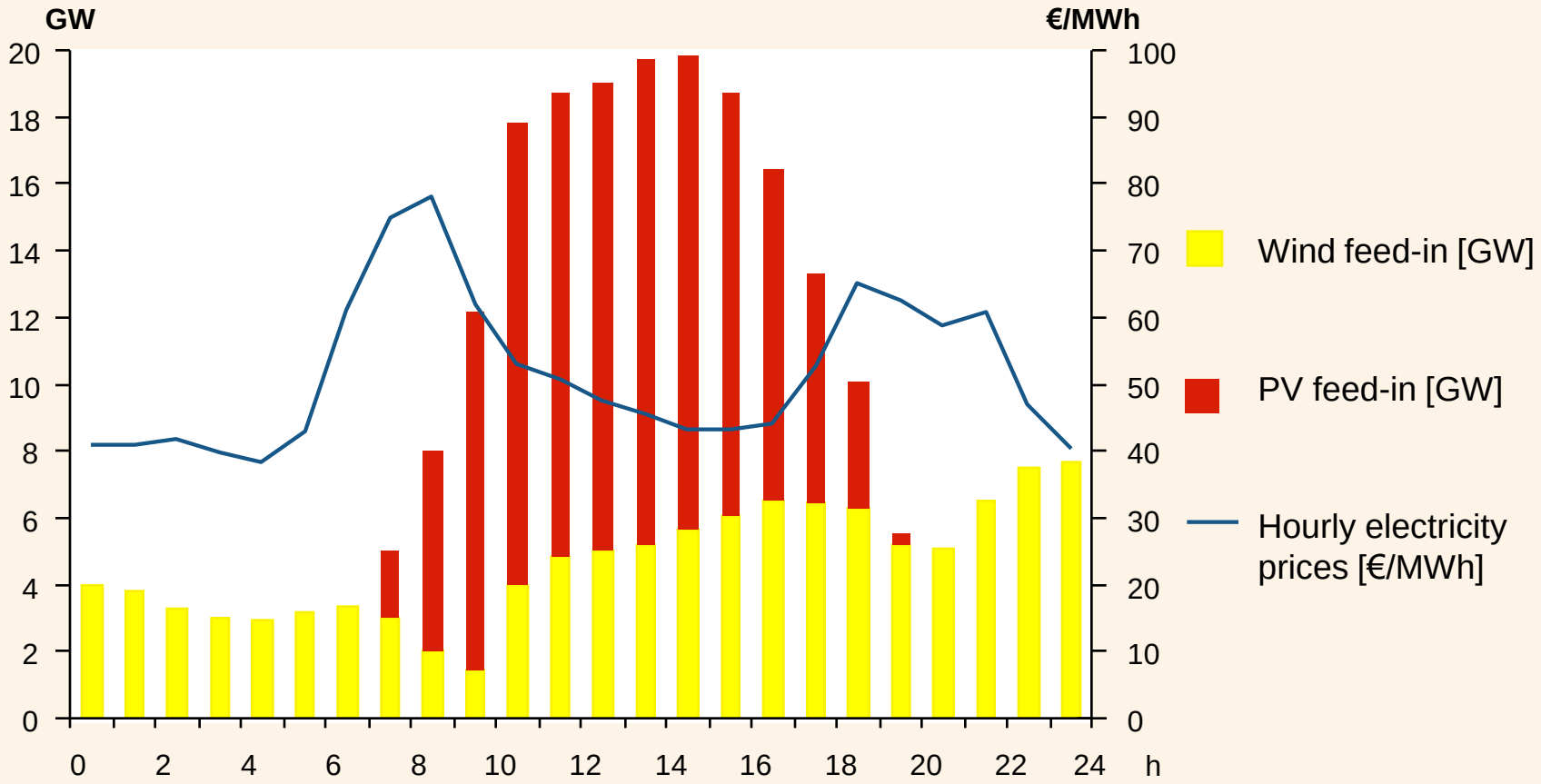
German electricity spot prices plotted against intermittent photovoltaics & wind power supply, 17 April 2012



Nuclear Power in the World

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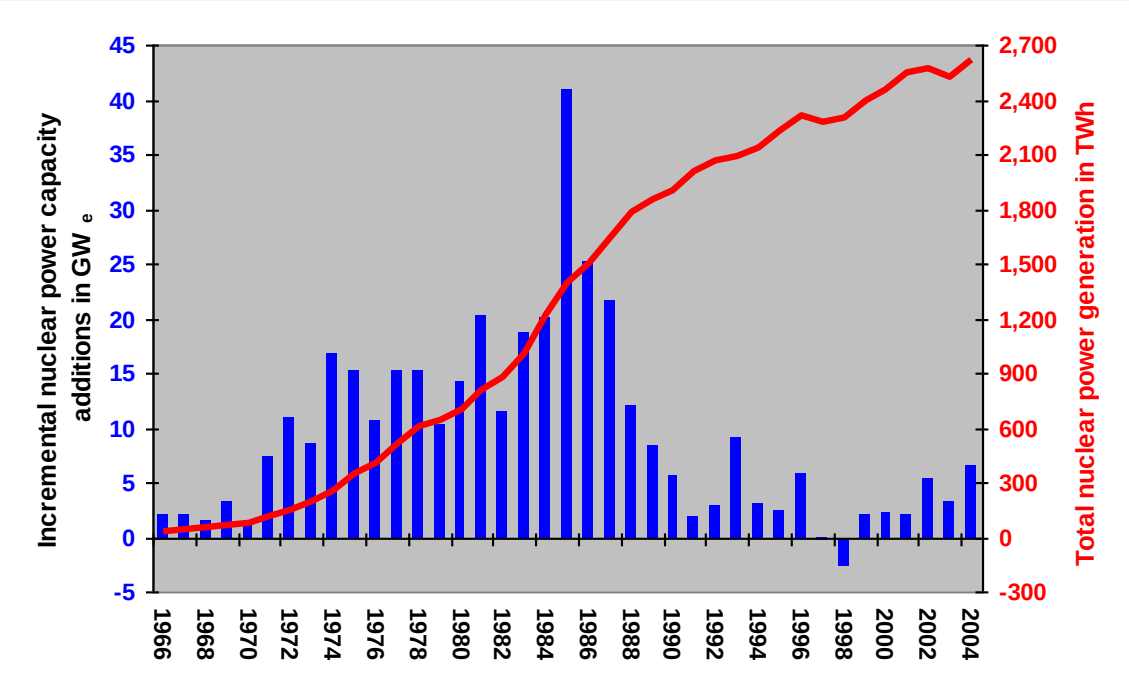
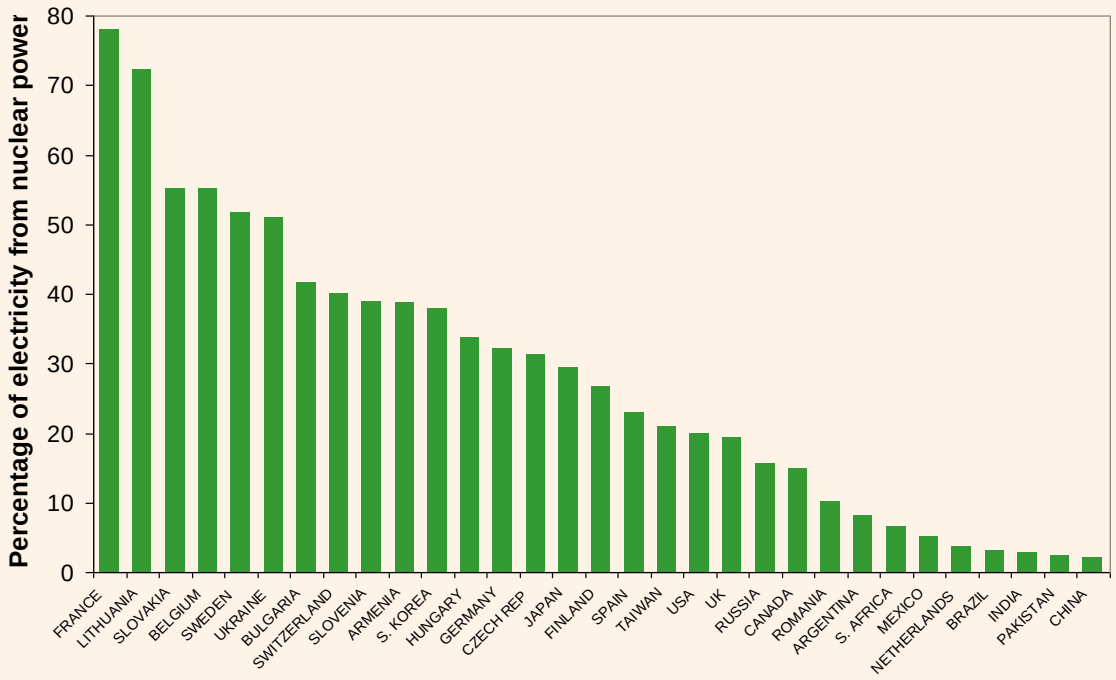
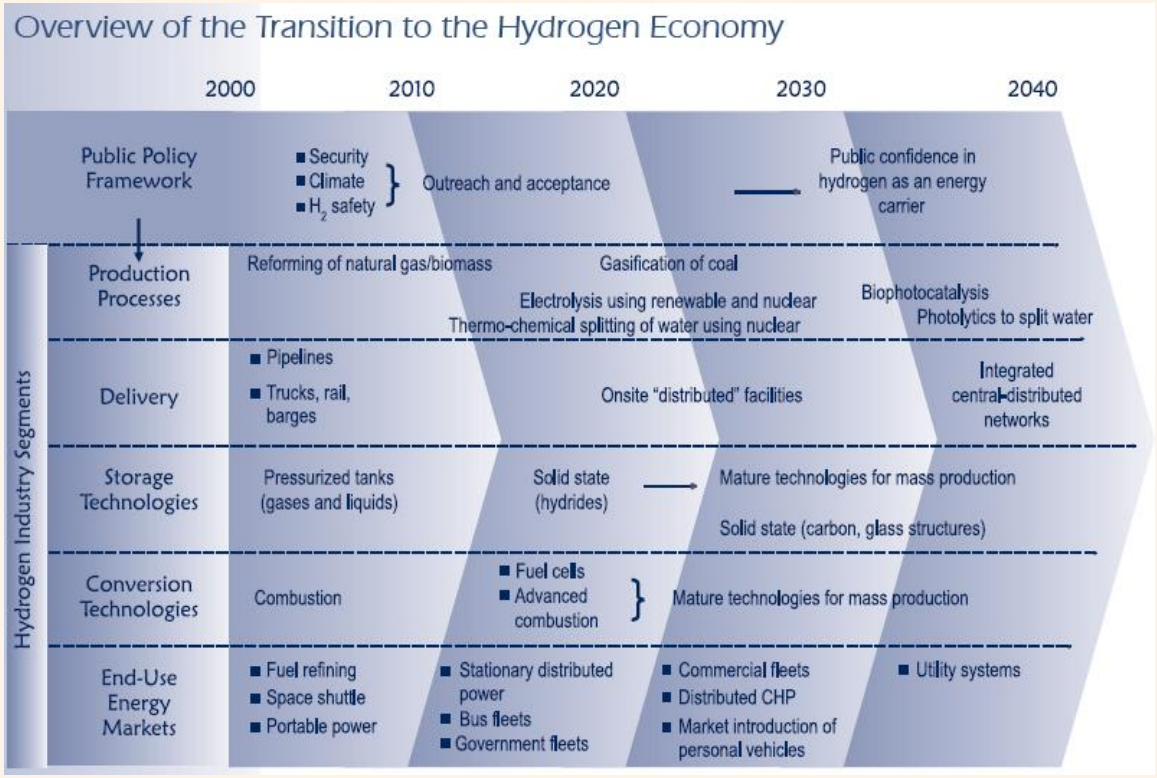


Nuclear power in electricity generation



Should we begin to ‘Think Big’?



Have we got enough time ?

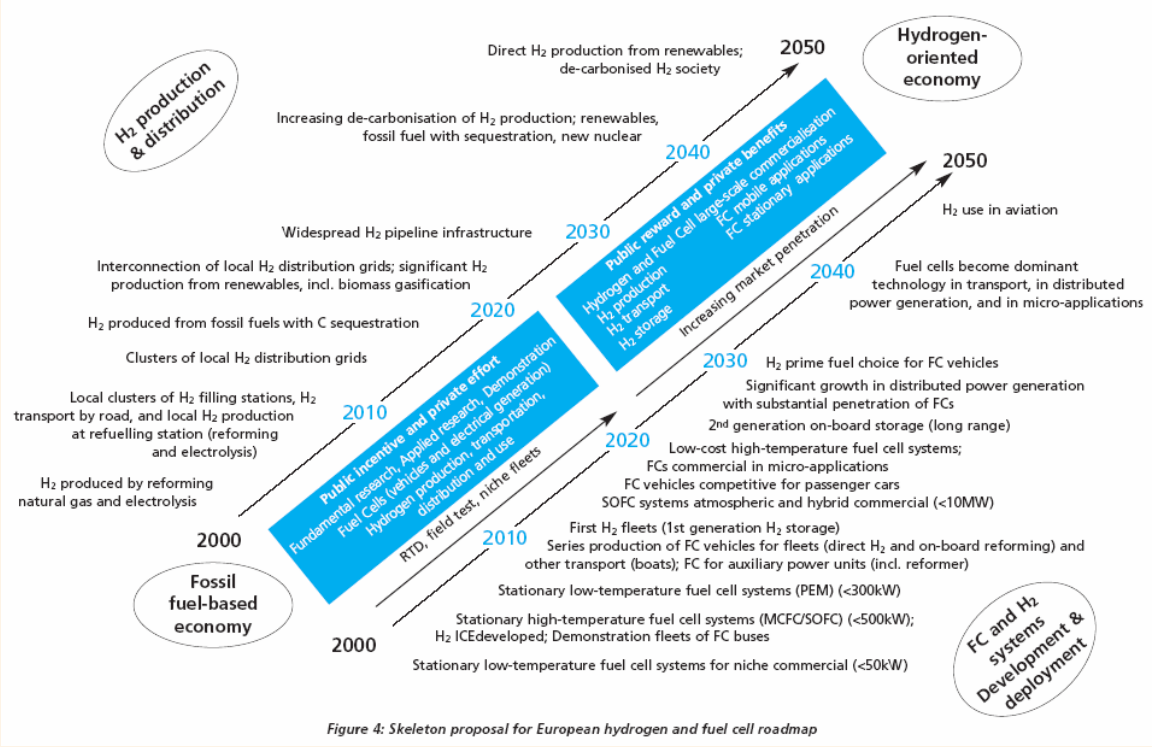


Figure 4: Skeleton proposal for European hydrogen and fuel cell roadmap

Q3 2012 global Levelised cost of electricity ranges for developed markets ($/MWh)

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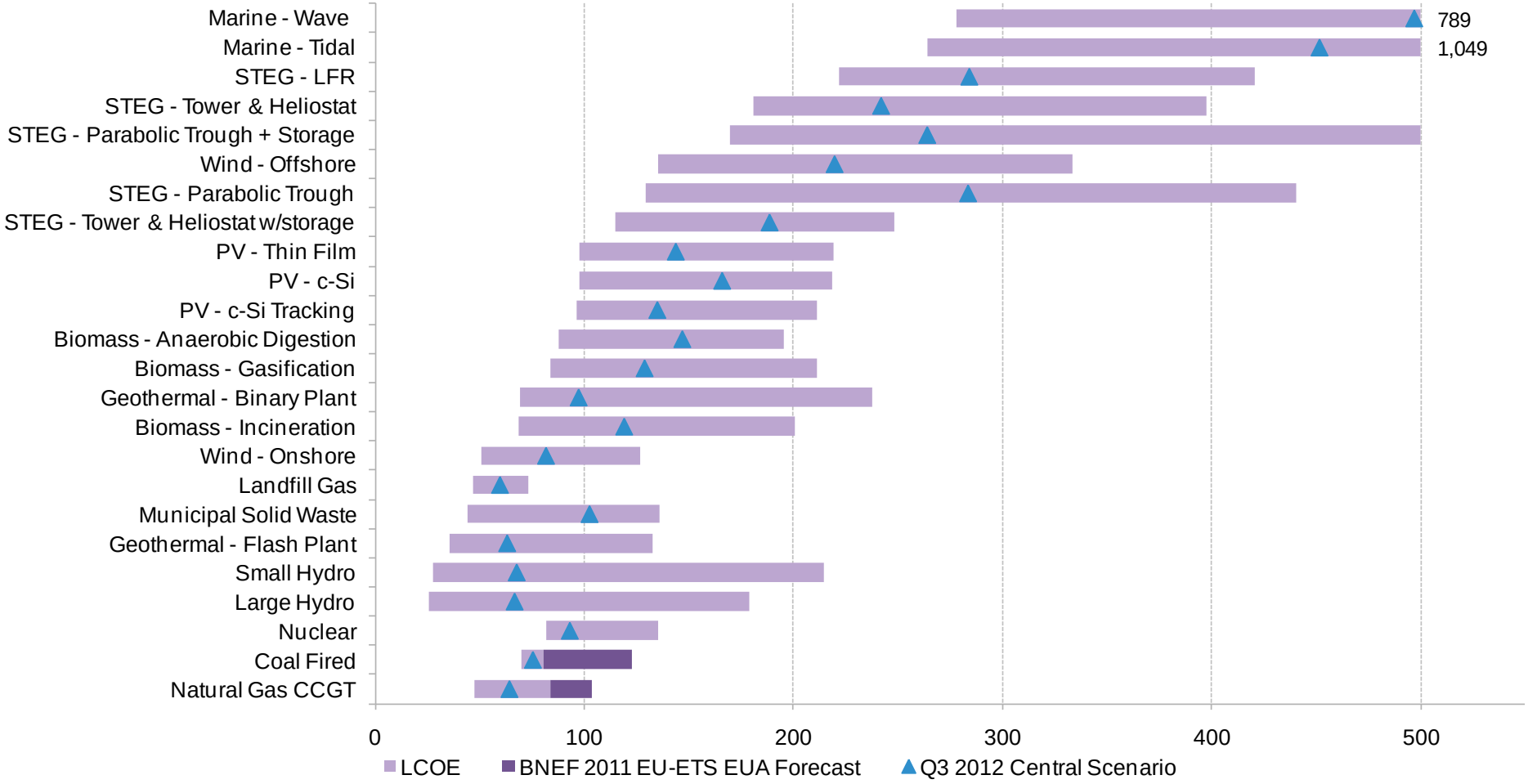

Note: Carbon forecasts from the Bloomberg New Energy Finance European Carbon Model with an average price to 2020 of $30/tCO2. Coal prices from US EIA, average price to 2030 of $3.07/mmBtu. Natural gas prices from EIA & BNEF with central scenario average price to 2030 $8.39/mmBtu. Developed markets defined as countries with well developed markets for renewable energy

Source: Bloomberg New Energy Finance.

Conclusions

Energy strategy should be viewed at continental and even at World level

Environmental measures should include technologies not only markets

North-South view may shed new solutions in the East of the EU

Global corporate strategy needed for energy companies

New energy paradigm is setting in – beware !

The road ahead for energy