



CURRENT STATE AND PROPECTS OF LNG IN THE UNECE REGION

Group of Experts on Gas

14th April 2014 - Geneva

Structure of the study

- Executive Summary
- Chapter 1: LNG Market
- Chapter 2: LNG Value Chain and Technology
- Chapter 3: Regulation
- Chapter 4: Interoperability

Participants

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Next steps

- Feedback
- Final Wording

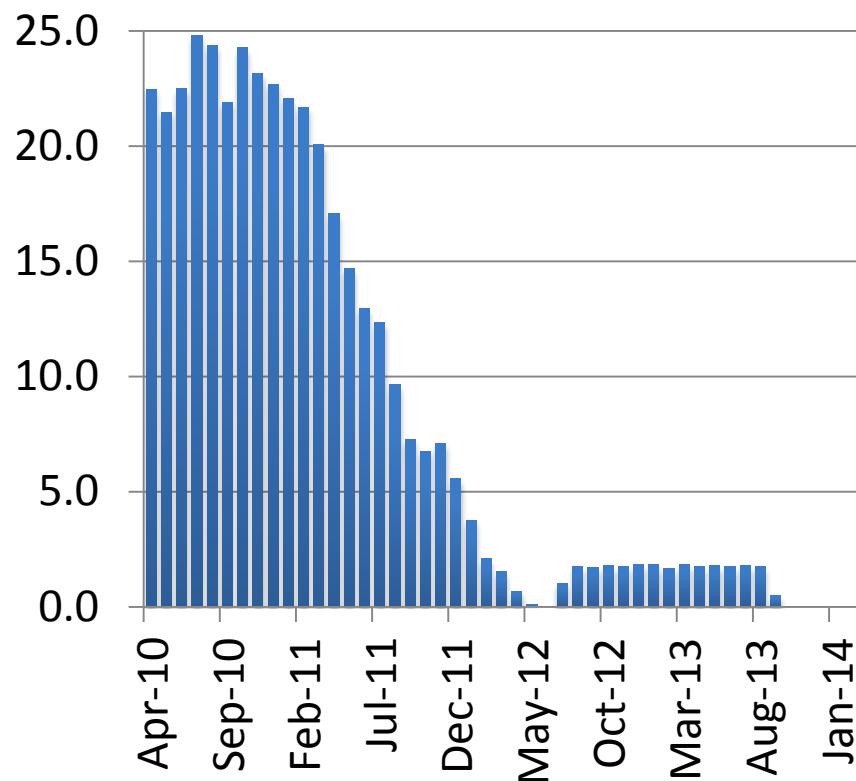
Chapter 1: LNG Markets

- Definitions
- Key market drivers
- Structure and Pricing
- Directions and outlook
- Discussion

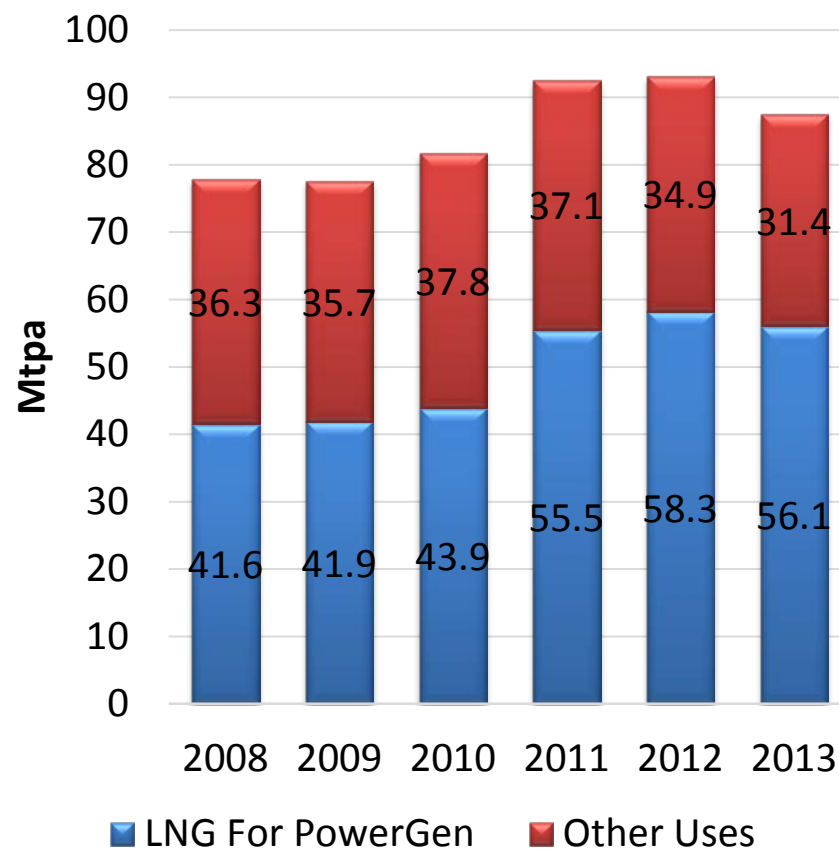


Chapter 1: LNG Markets

Japan Nuclear Power Generation (TWh/month)

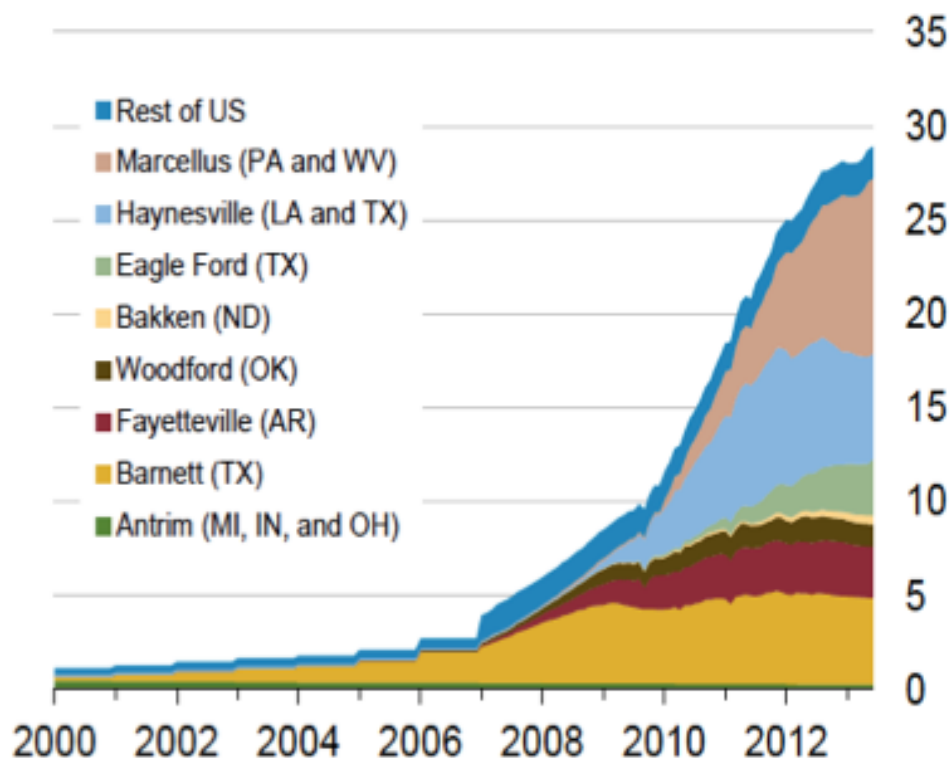


Japan LNG Imports



Chapter 1: LNG Markets

dry shale gas production
billion cubic feet per day

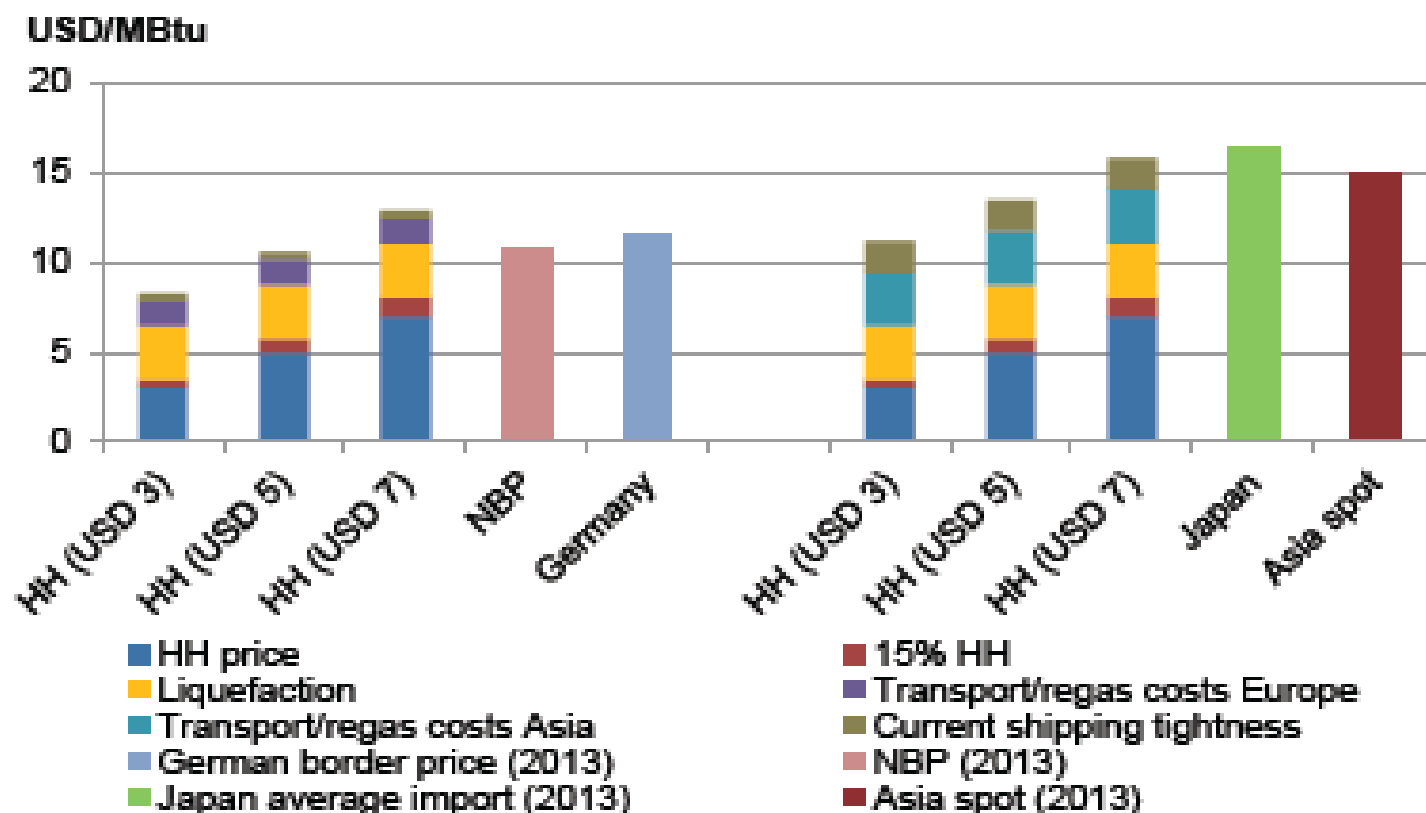


US DOE Approved LNG Exports

Terminal	Approximate Quantity, mtpa
Sabine Pass, TX	16.5
Freeport, TX	13.5
Lake Charles, LA	15.0
Cove Point, MD	5.8
Cameron, LA	12.8
Jordan Cove, OR	6.0
TOTAL	69.5

Chapter 1: LNG Markets

Comparison of US LNG Delivered Costs

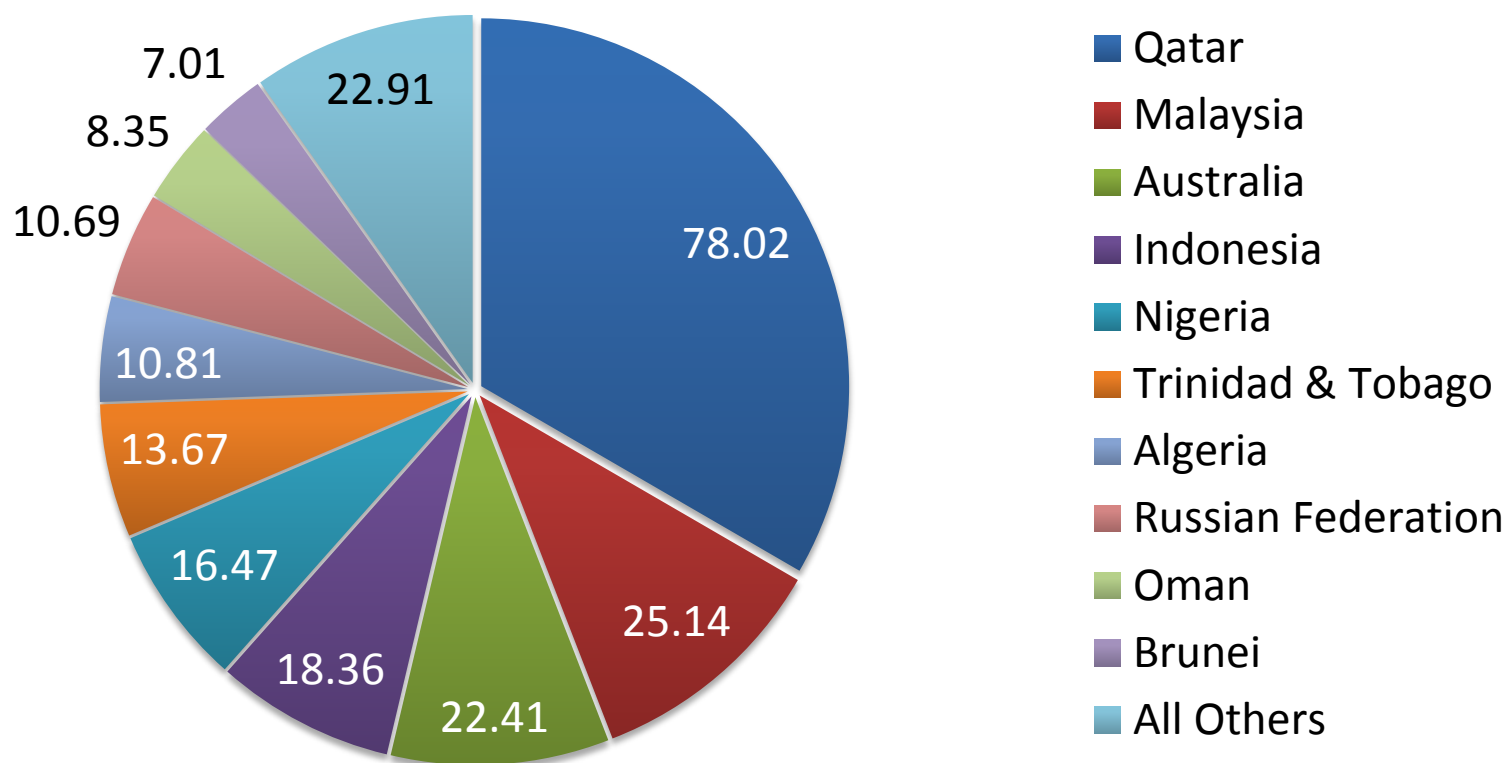


Chapter 1: LNG Markets

- Factors pointing to greater North American LNG Exports
 - Durable price differential
 - Domestic markets evolving slowly
- Factors pointing to less North American LNG Exports
 - Global gas & shale development
 - Environmental/other restrictions
 - Export licensing issues.

Chapter 1: LNG Markets

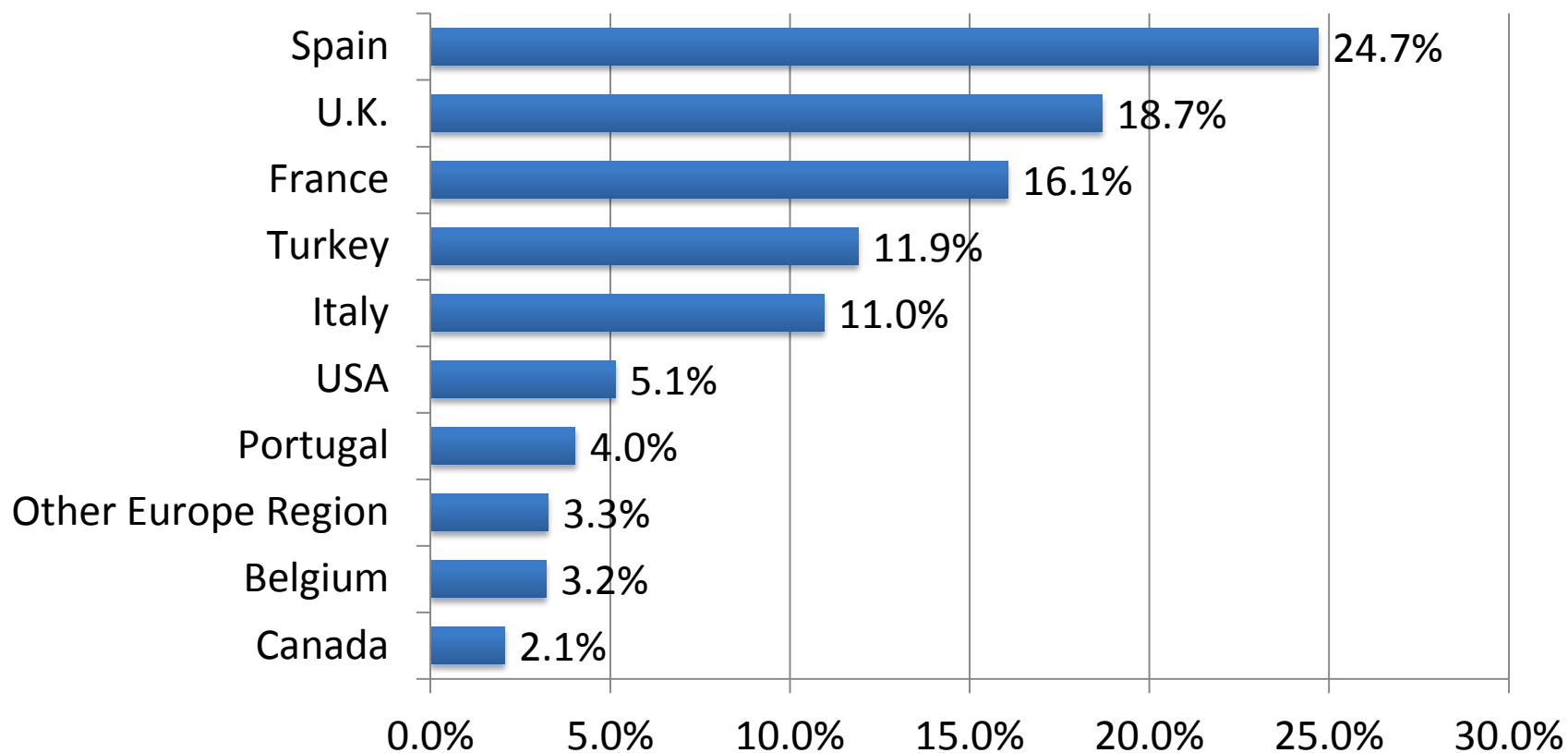
Global LNG Supply in 2013, Highlighting Top 10 Countries (BCM)



Chapter 1: LNG Markets

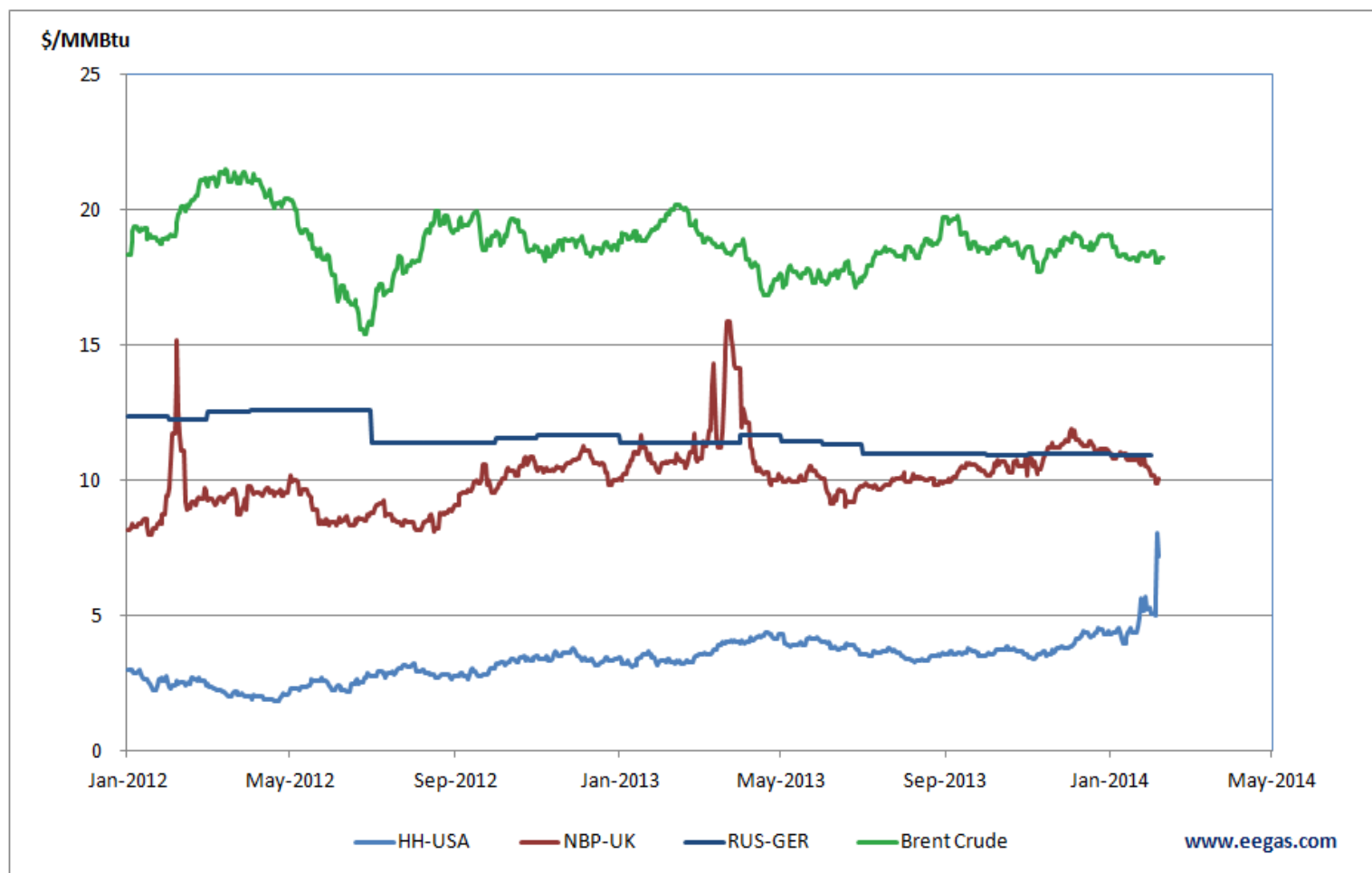


Distribution of LNG Imports in the UNECE Region, 2013



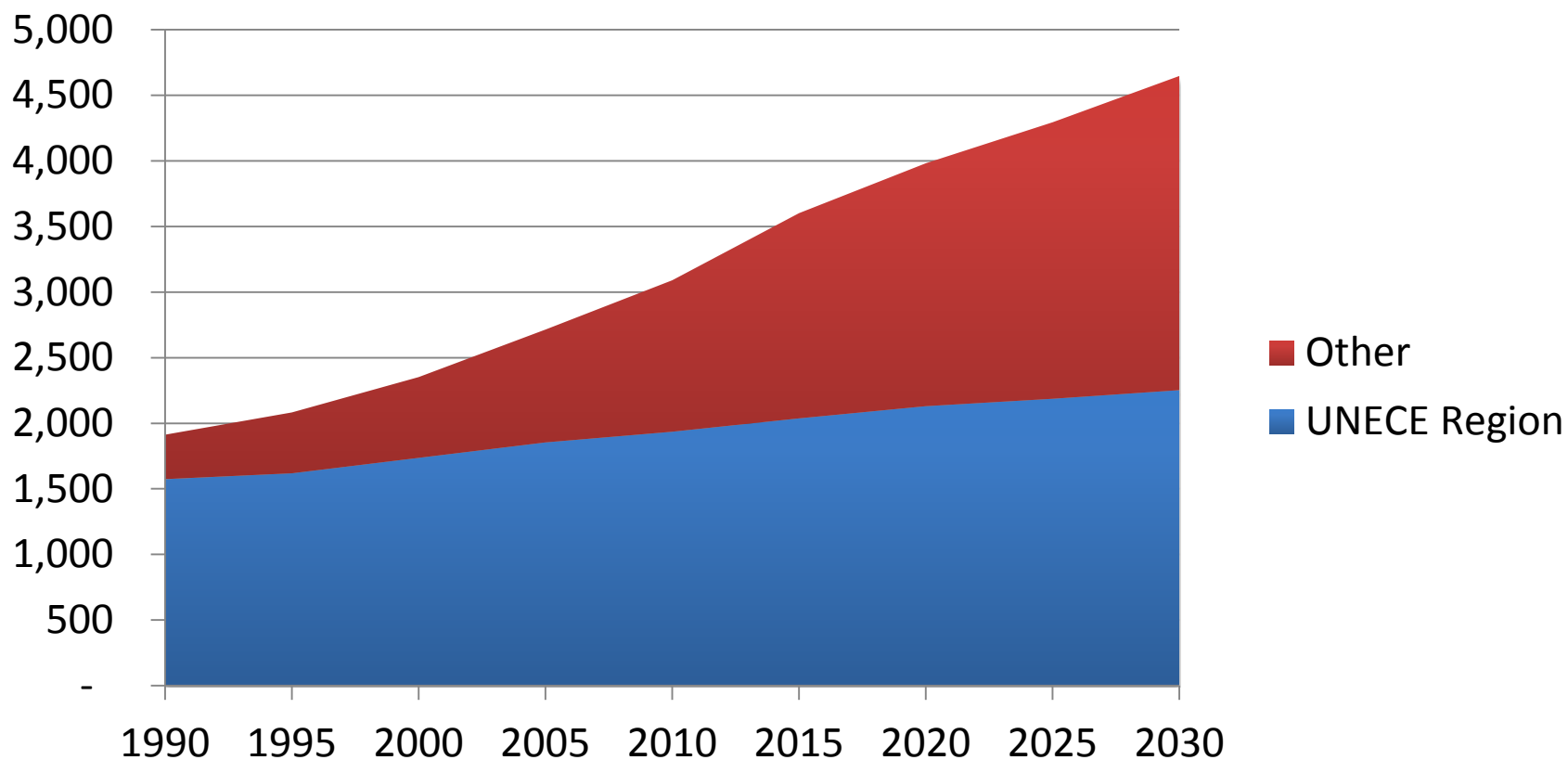
Chapter 1: LNG Markets

Comparison of Spot Gas Prices in Key LNG Markets



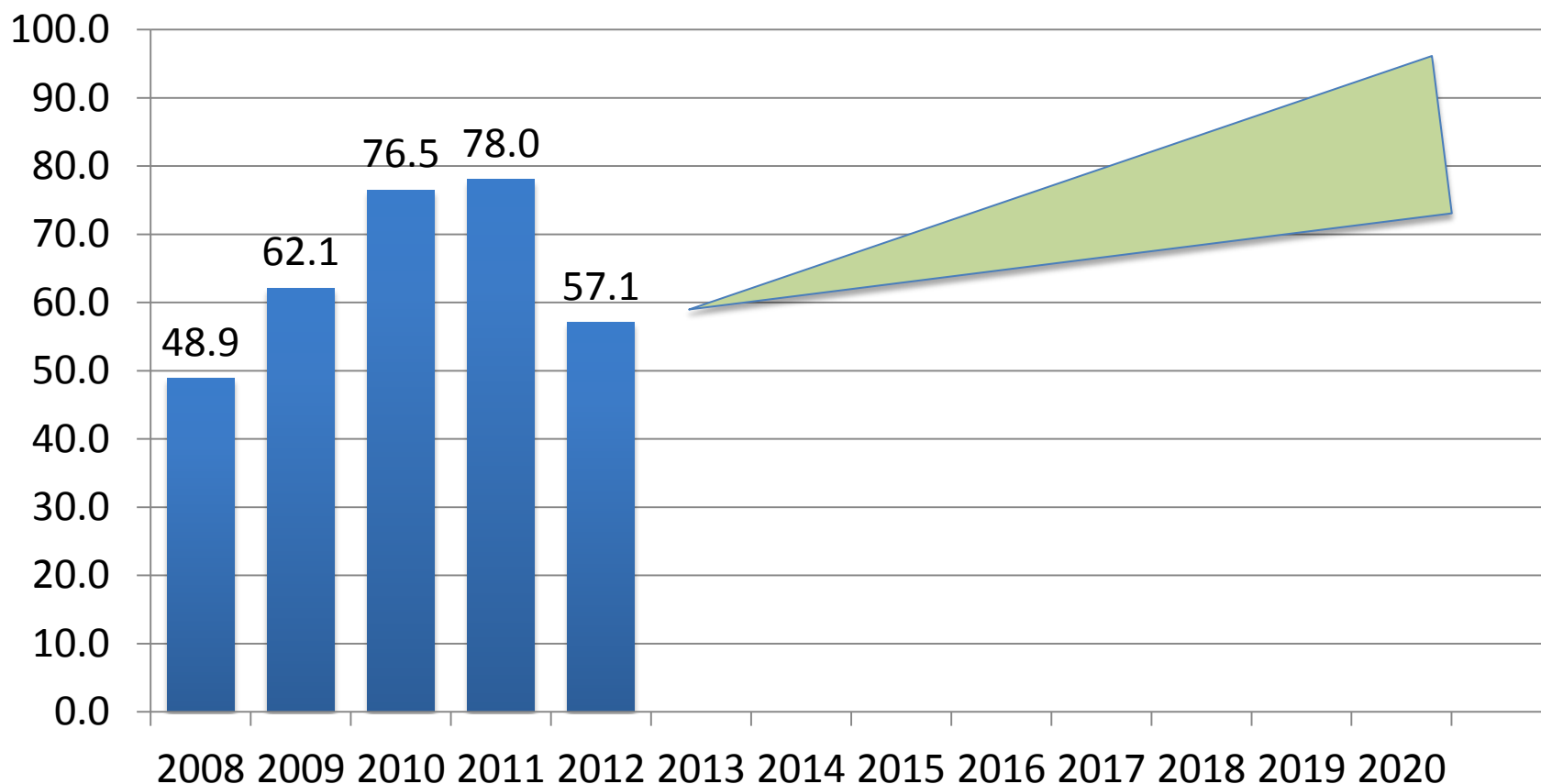
Chapter 1: LNG Markets

Global Gas Markets, BCM



Chapter 1: LNG Markets

LNG Importation into the UNECE Region, mtpa



Chapter 1: LNG Markets

- LNG is increasing faster than pipeline trade.
- Global markets remain price-segmented.
- The UNECE region is raising its LNG market involvement.
- US, Canada and Australia will be major new suppliers in the next decade.

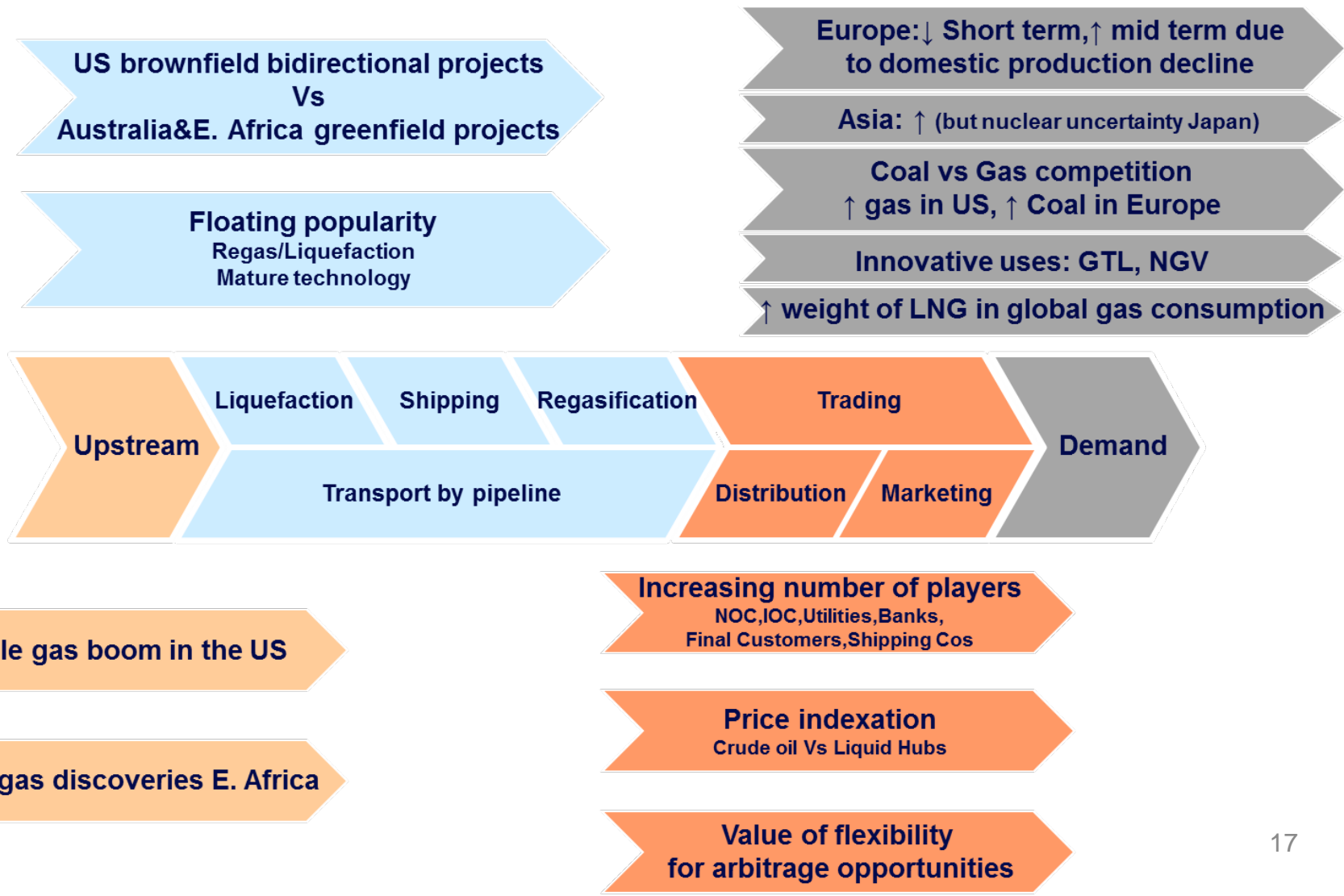
Chapter 2: LNG value chain

Chapter 2 Outline & Scope

- History of LNG
- Segments in the LNG value chain
- Upstream / Reserves
- Technology
 - Liquefaction
 - Regasification
 - Shipping
- Floating LNG
- End user markets
 - Power generation; Industrial process; Feedstock; Residential
 - NGV
 - Satellite & Peak Shaving Plants
- Economics (CAPEX; Business Models; Risk Analysis)

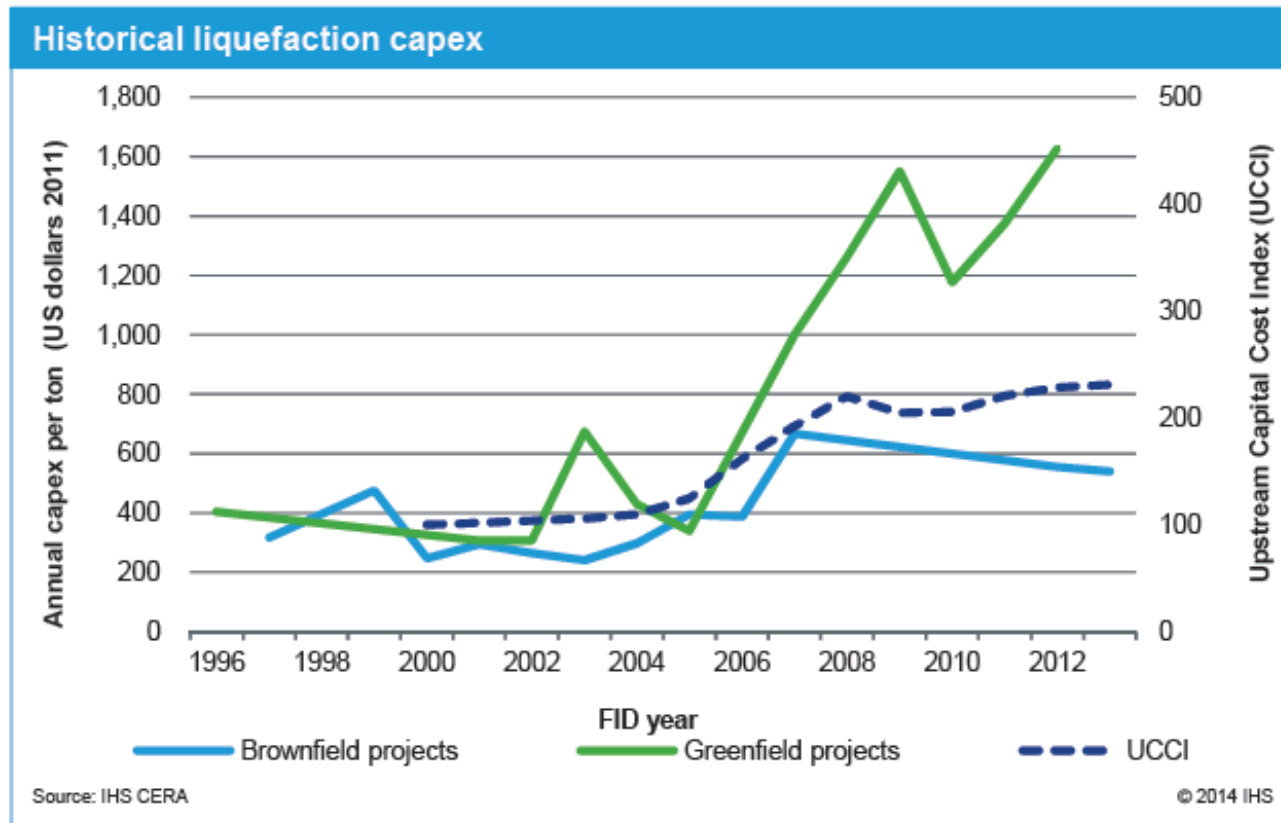
Chapter 2: LNG value chain

LNG Value Chain. Trends



Chapter 2: LNG value chain

Liquefaction CAPEX



- Increasing differential between Greenfield and Brownfield projects
- CAPEX growing much faster than inflation

Chapter 2: LNG value chain

Project Economics



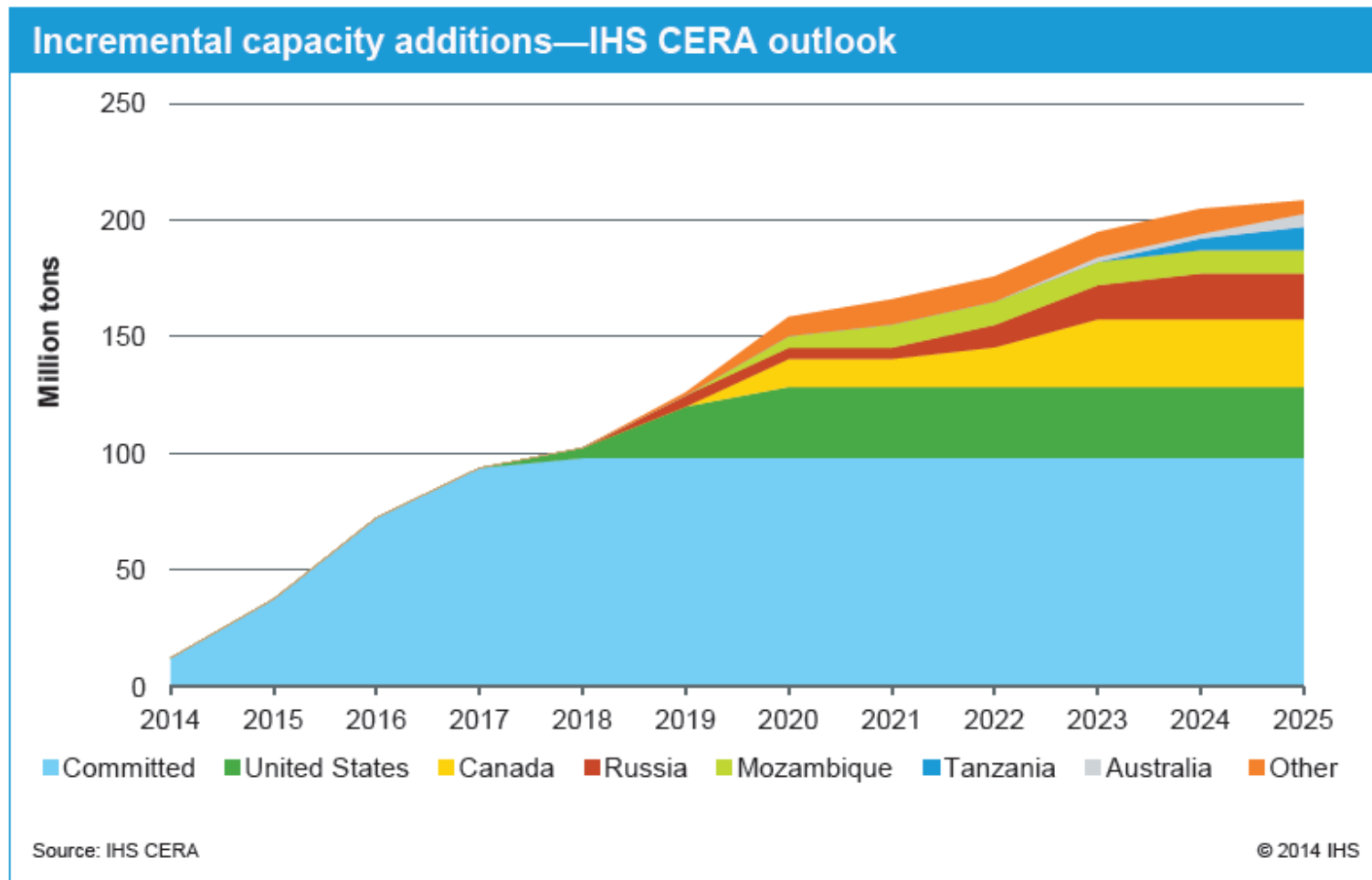
	Exploration & Discovery	Development & Extraction	Transport & Storage	Liquefaction	Shipping	Storage & Regasification
% of Capital Costs	15-20 %			30-45 %	10-30%	15-25%

Source: Office of Fossil Energy, U.S. DoE

- Liquefaction requires the highest investment in the LNG chain
- Currently there is an excess of regasification and shipping capacities
- Massive additional liquefaction capacity proposed
- Only a limited number of the projects will advance

Chapter 2: LNG value chain

LNG Market expected growth



Chapter 2: LNG value chain

Offshore is booming



- **Floating regasification facilities in operation:**
 - 9 countries in less than 10 years
 - USA,
 - UK
 - Argentina (2)
 - Brazil (2-3)
 - Chile
 - Kuwait
 - UAE (Dubai)
 - Italy
 - Israel,
- **3 Floating Liquefaction facilities under construction:**
 - Prelude (Australia), the first to take FID in 2011
 - Petronas FLNG (Malaysia)
 - Pacific Rubiales (Colombia), expecting to start production in 2015
- Many more under development or being studied

Chapter 2: LNG value chain

Floating vs Conventional

	<i>Floating</i>	<i>Conventional</i>
Costs	Lower CAPEX, Higher OPEX	Higher CAPEX, Lower OPEX
Project Lead Time	Faster, possible in less than 1 year	More difficult permitting process
Infrastructure	Considerably less required	
Reserves & Market required	Small - Medium scale projects	Larger size to be economically developed
Loading / Unloading	Could be affected by adverse environmental conditions	14-24h (typically around 10,000 m3/h)
Flexibility	The infrastructure can be moved to a different location	
Financing	Unproven technology adds more risk	
Security	Offshore location and/or compact size make facility easier to protect	Harder to protect, particularly onshore pipelines
Storage	Limited storage	High capital cost associated
Environment	Minimizes fixed infrastructure and environmental impacts	Larger footprints

Chapter 2: LNG value chain

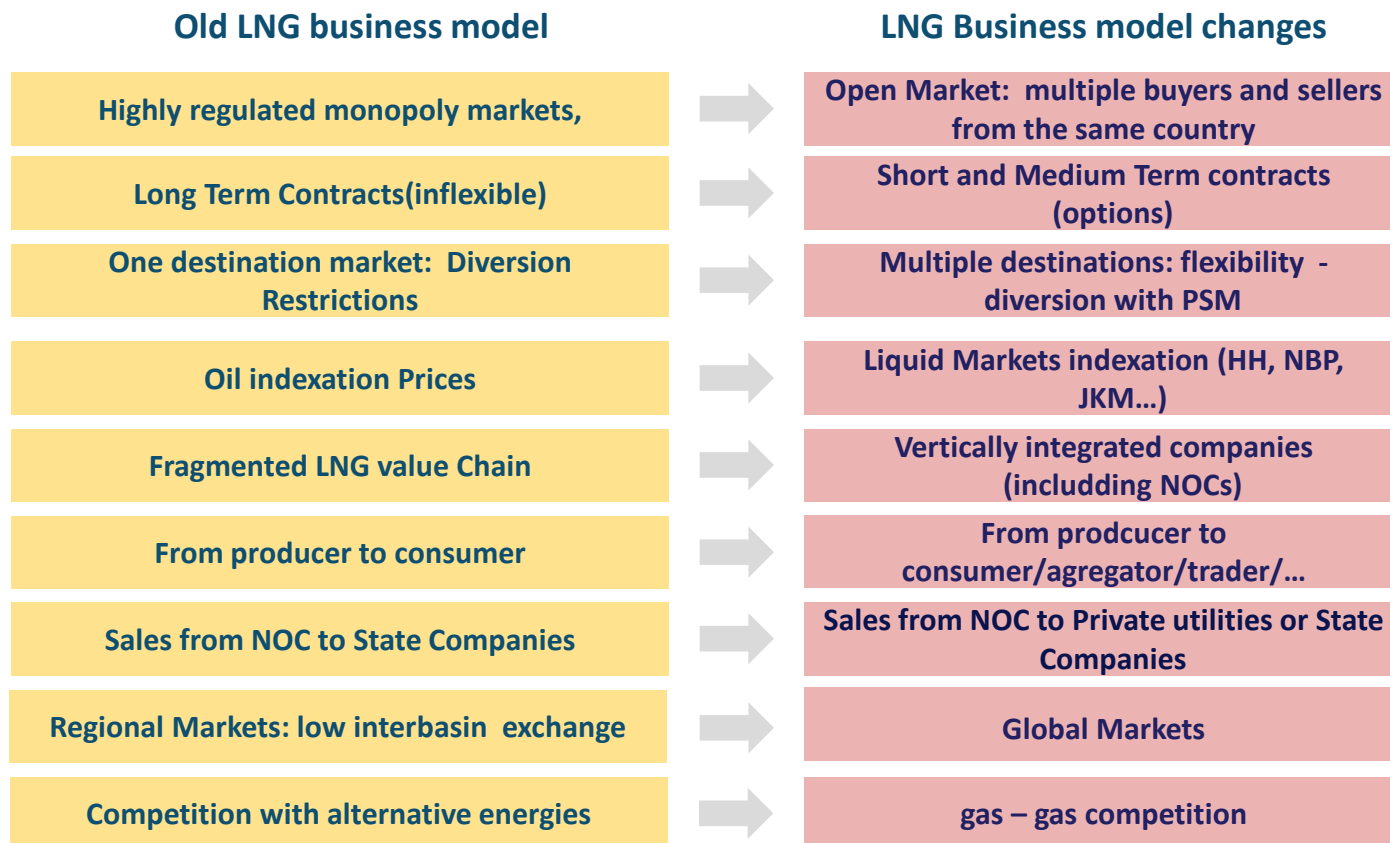
Current trends in the LNG Value Chain



- **Reserves/Development**
 - Increasing costs x4 vs 2000
 - US Shale gas, new areas: Mozambique/Tanzania...
- **Liquefaction:**
 - Increasing costs: x4 vs 2000
 - Floating regasification
- **Shipping**
 - New generation of ships=> minimum boil off losses and reduced fuel consumption.
- **Regasification**
 - Increasing costs
 - Spare capacity in Europe
- **Markets**
 - Three different dynamics: USA, Europe and Asia
 - New Opportunities: LNG for ships, trucks, cars. Small scale LNG

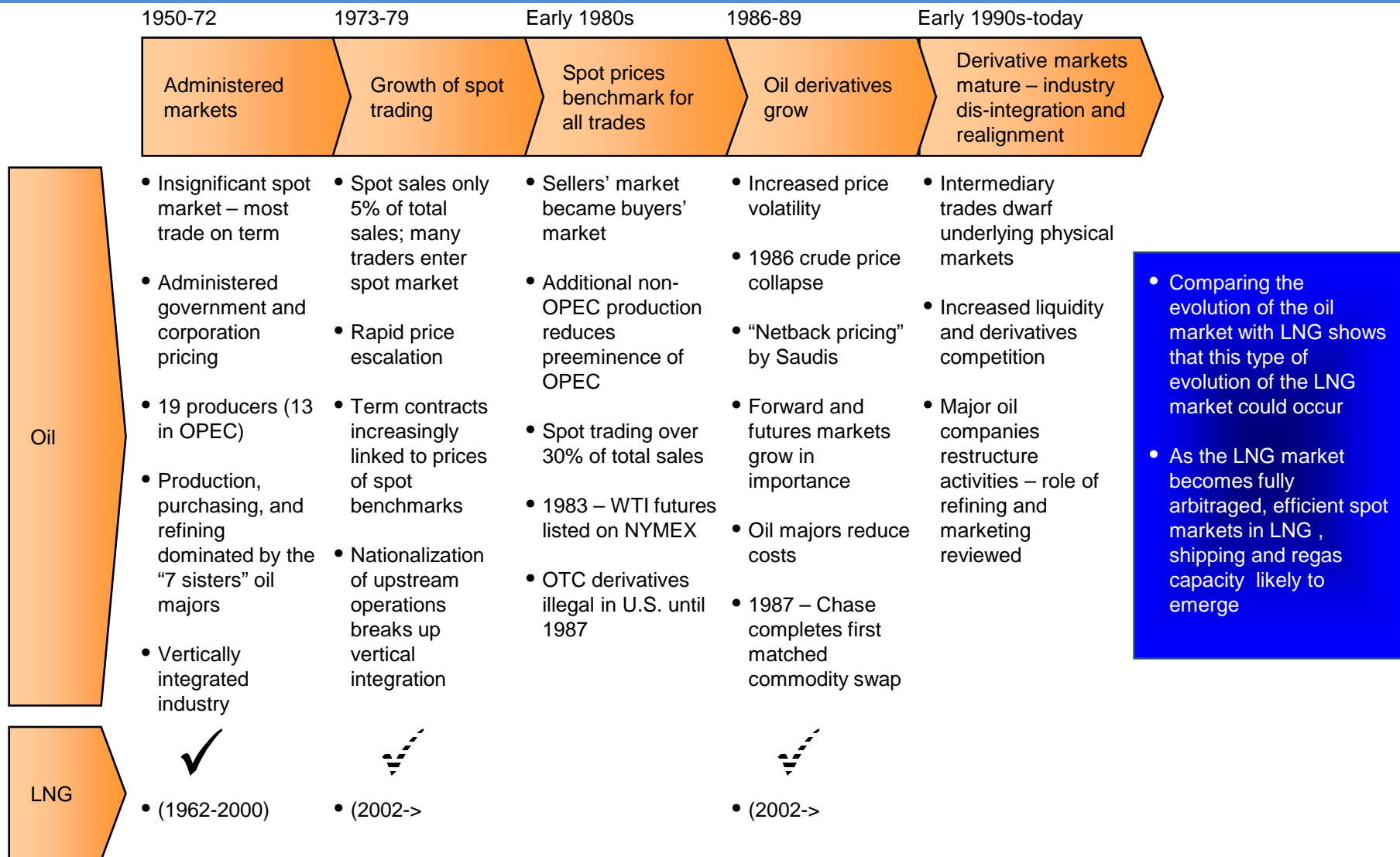
Chapter 2: LNG value chain

Current trends in the LNG Value Chain



Chapter 2: LNG value chain

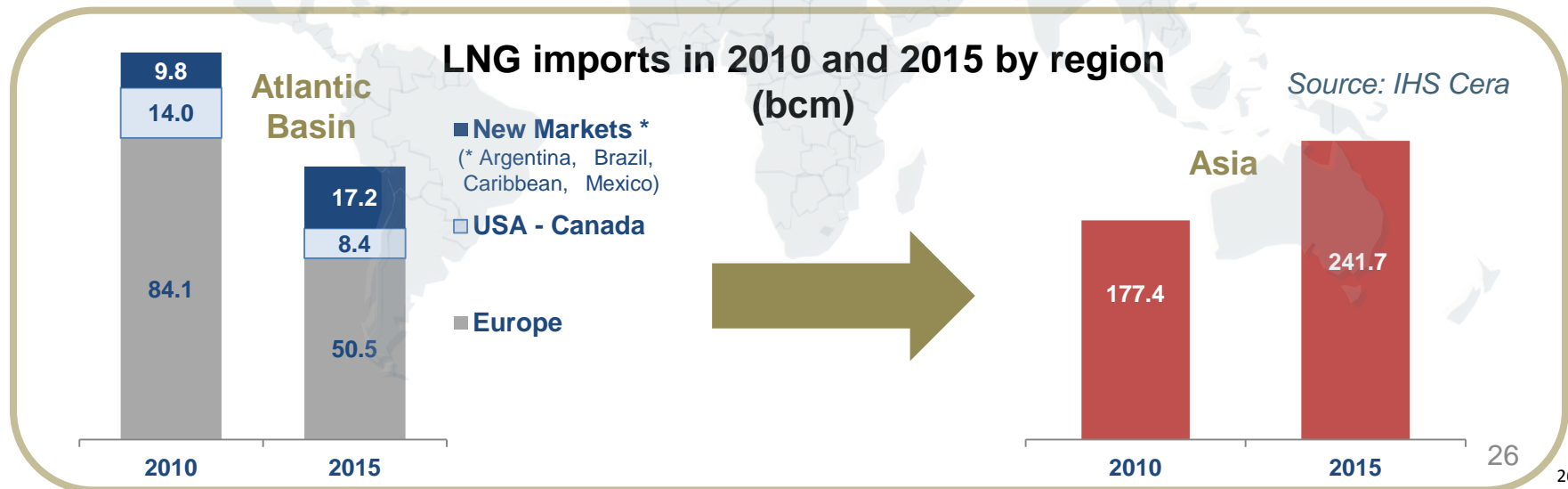
Comparing LNG - oil markets evolution



Chapter 2: LNG value chain

Global LNG Demand

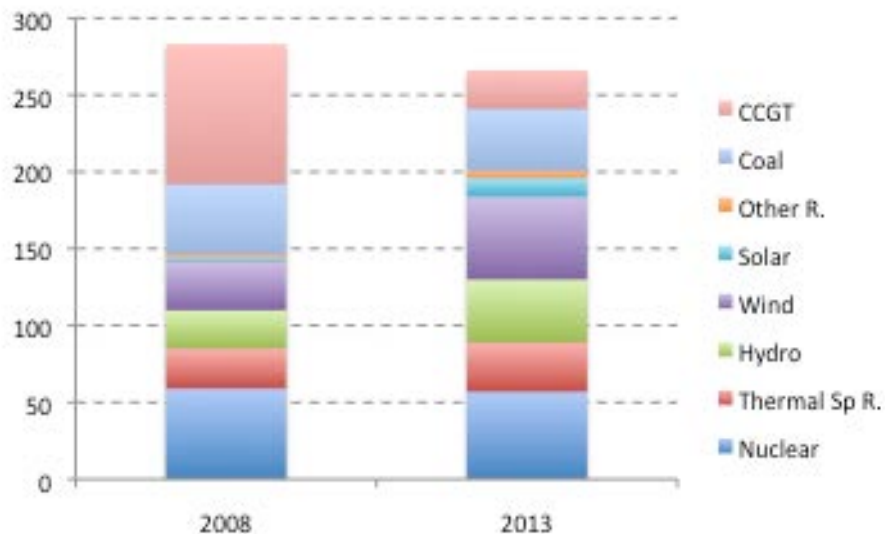
- Global LNG demand is growing dramatically. The main drivers are:
 - ✓ After Fukushima, some countries have implanted non-nuclear policies. Different alternatives to meet the energy demand were considered and LNG was presented as the most competitive and safest option.
 - ✓ New importers have emerged in Asia and Latin America, suppliers have diverted their volumes from the traditional Atlantic Market to the Pacific, affecting prices for the new Atlantic consumers.



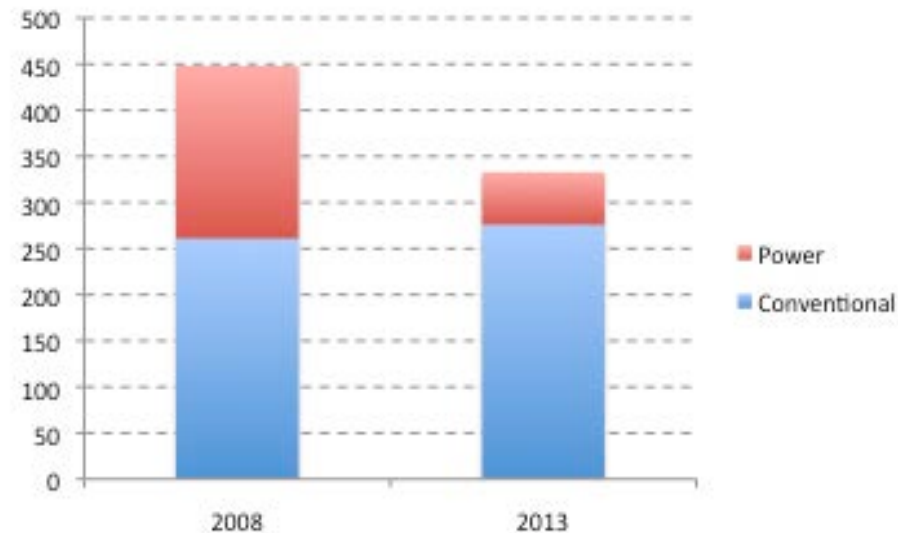
Chapter 2: LNG value chain

NG vs Renewables: the Spanish case

Power Generation by Source (TWh)

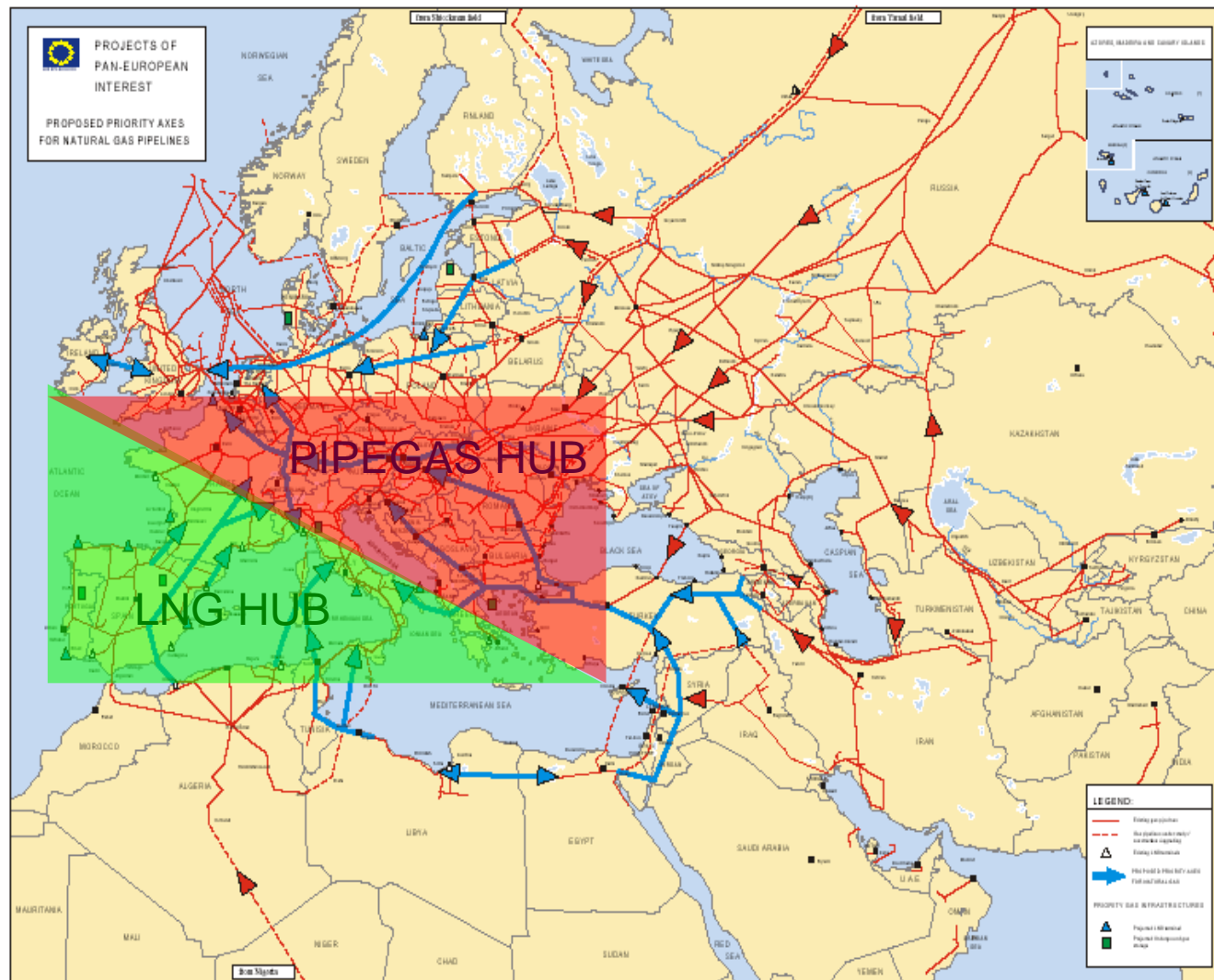


Gas Consumption (TWh)



Chapter 2: LNG value chain

LNG Hubs



Chapter 3: Regulation

Chapter 3: Detailed review of LNG regulation at a European level, in the USA, and in Japan, 3 areas where different regulatory models have been adopted.

Range of approaches to LNG access regulation

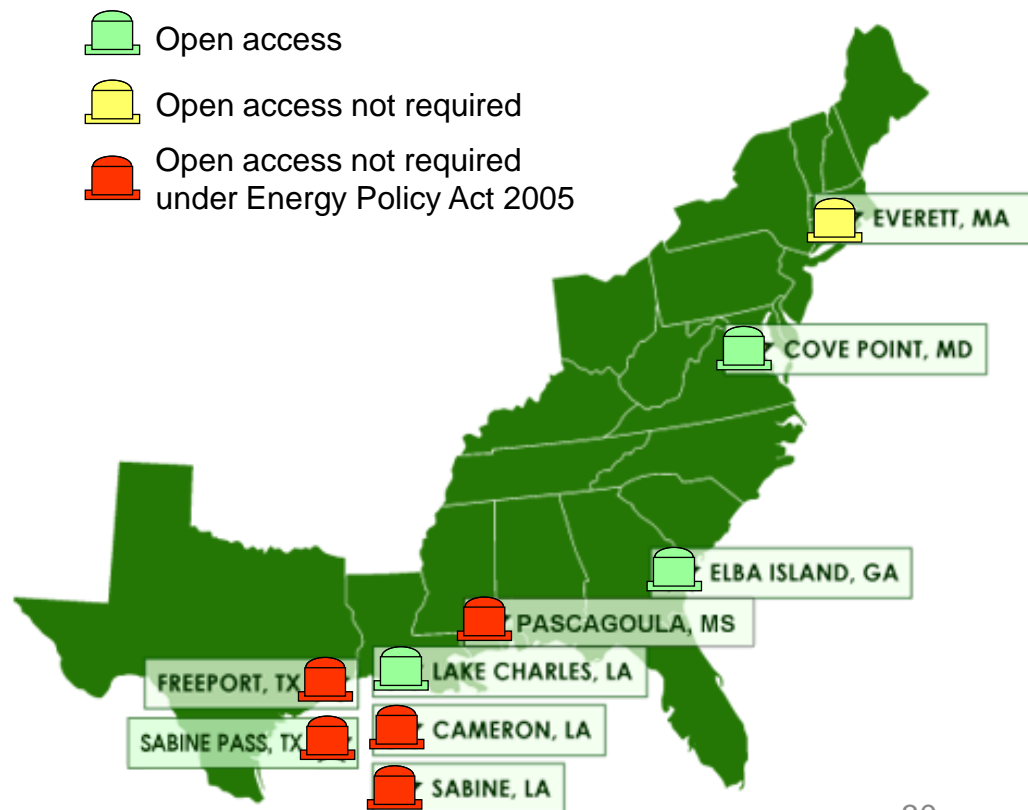


- Regulated and non-regulated regimes are not good or bad per se.
- These models are in constant evolution, as a result of the recurrent interaction between the industry and regulators.

Chapter 3: Regulation

Regulatory evolution and trends - US

- US: decision to remove access regulation from new terminals adopted in 2002 (Hackberry) and 2005 (EPAct).
- Two regimes coexist.

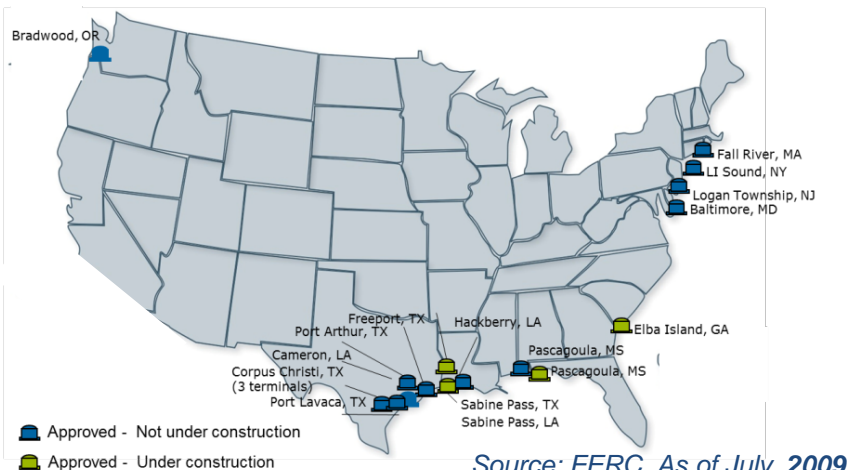


Chapter 3: Regulation

Regulatory evolution and trends - US

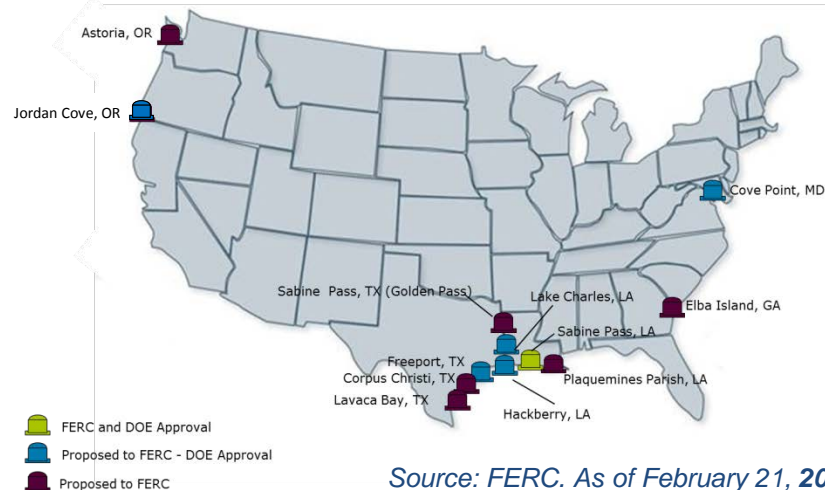
- The access model is not driving the regulatory debate nowadays, after the shale gas revolution. Several terminals plan to export LNG, the debate have shited to export authorisation permits for non-free trade agreement countries.

LNG import terminals (proposed/potential)



Source: FERC. As of July, 2009

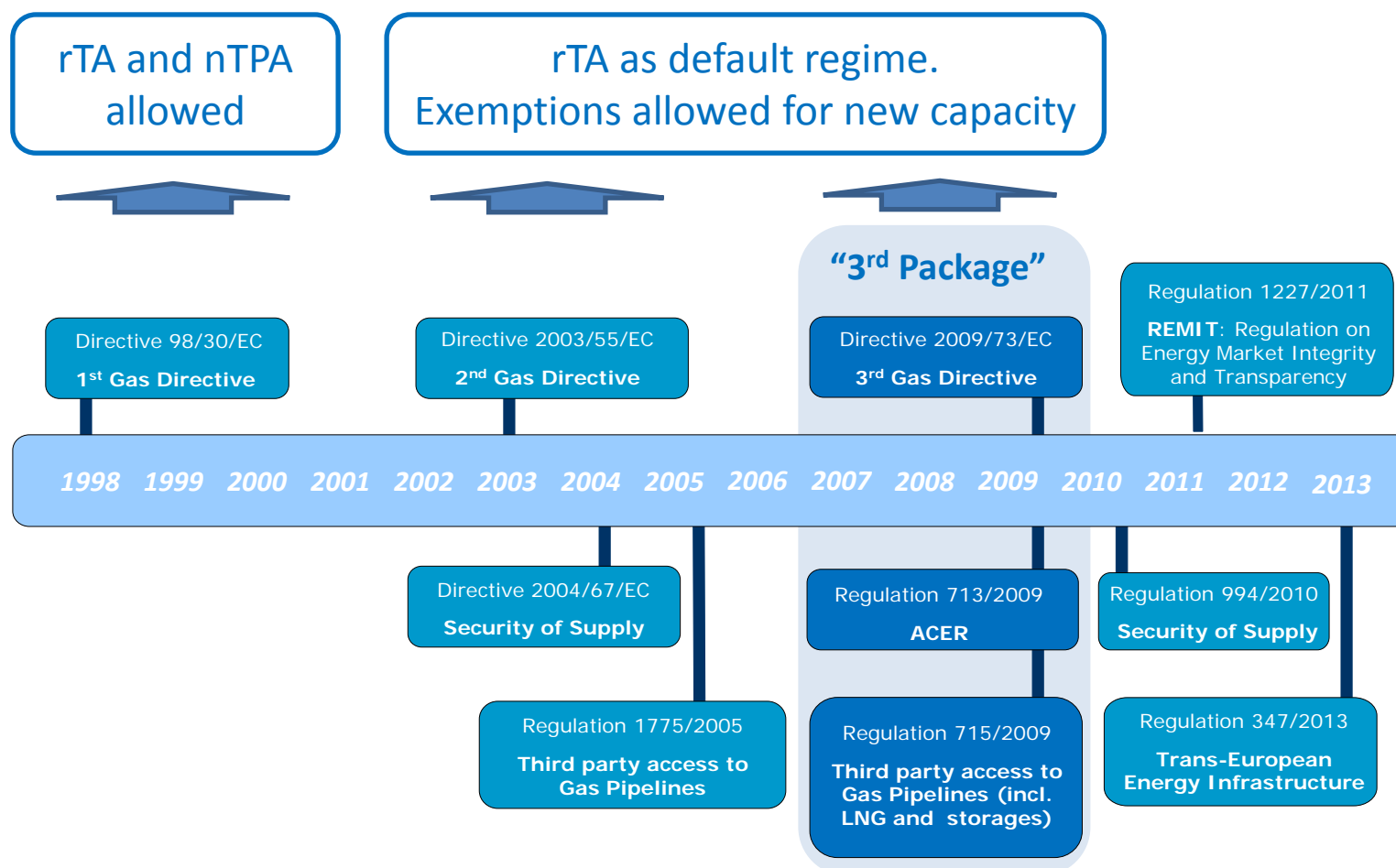
LNG export terminals (proposed/potential/authorised)



Source: FERC. As of February 21, 2014

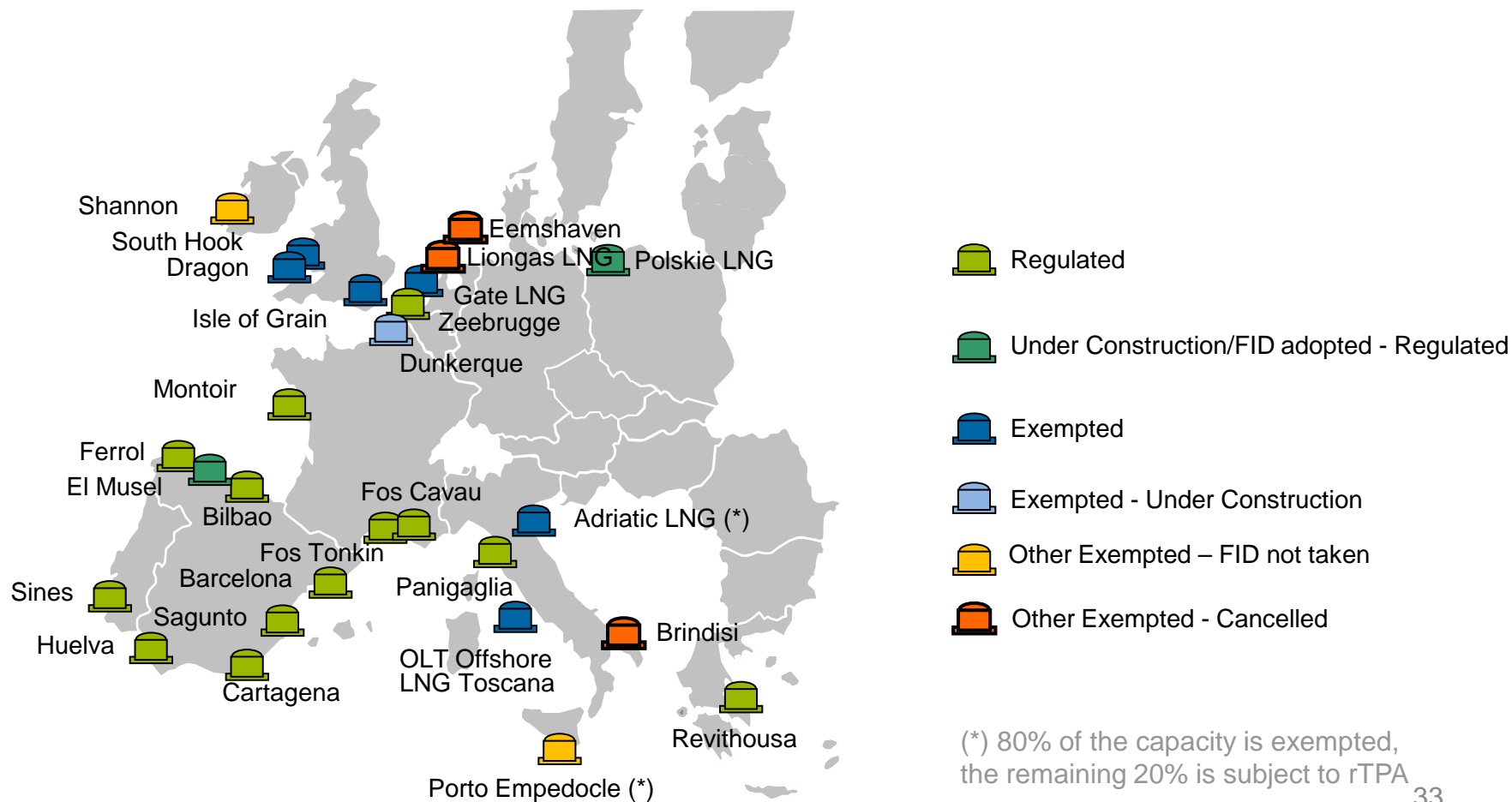
Chapter 3: Regulation

Regulatory evolution and trends - EU



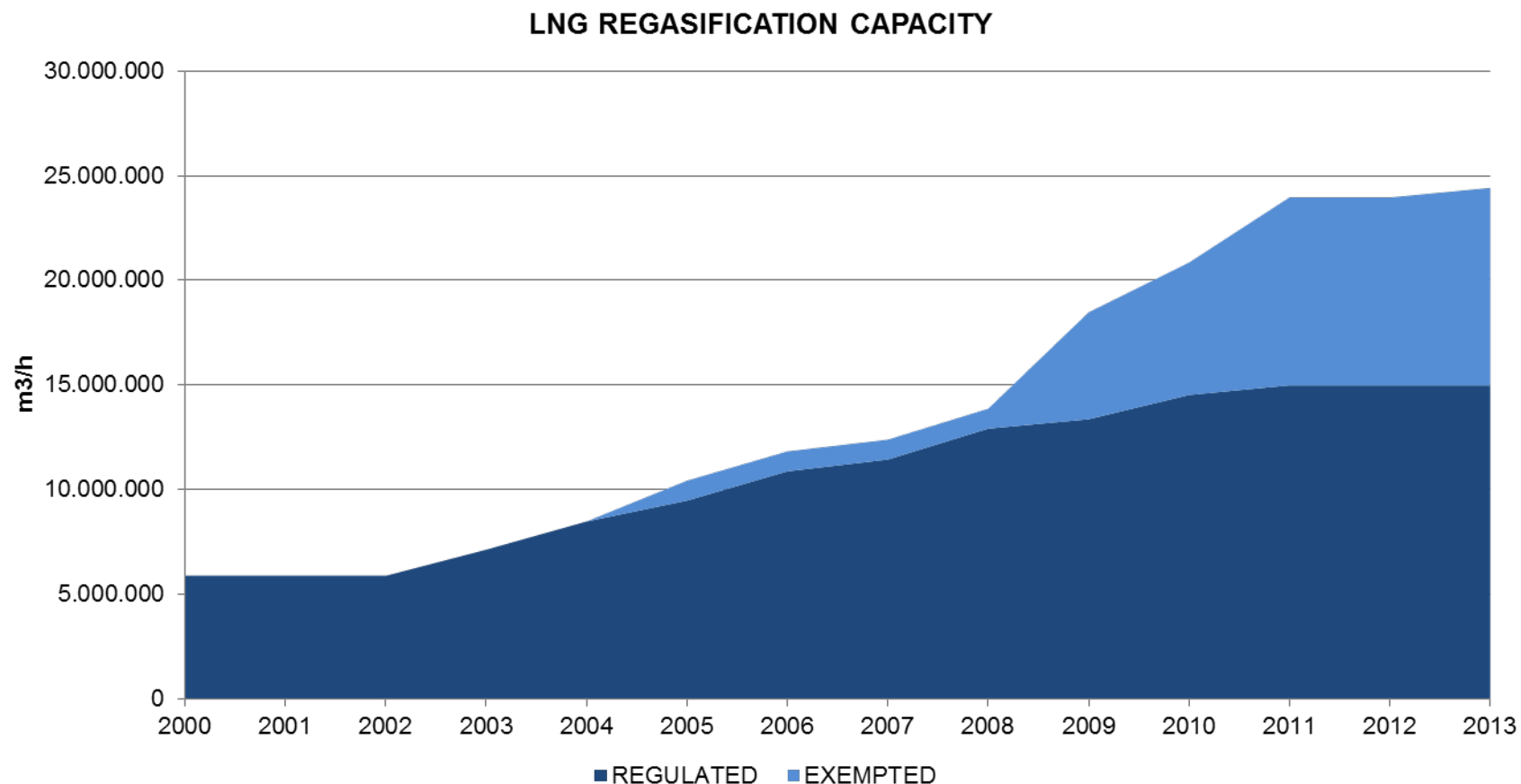
Chapter 3: Regulation

Regulatory evolution and trends - EU



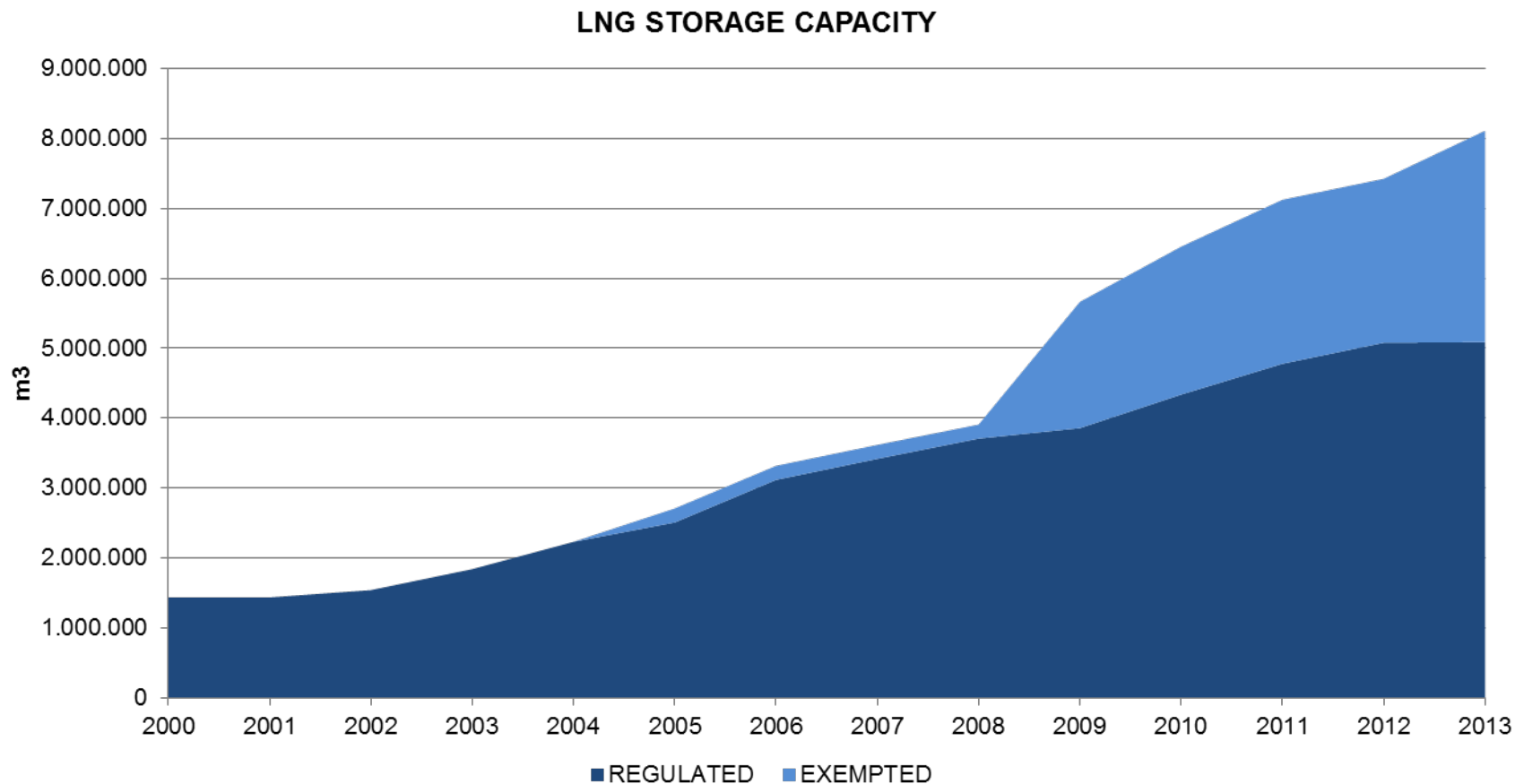
Chapter 3: Regulation

Evolution of LNG regas capacity in Europe



Chapter 3: Regulation








Evolution of LNG storage capacity in Europe



Chapter 3: Regulation

Integrated & unbundled (ownership) operators

- In practice regulated LNG terminals (and some exempted terminals as well) are operated by regulated TSOs subject to ownership unbundling, except in France and in some Spanish terminals

COMPANY	Transmission	LNG	UGS	Distribution
	✓	✓	✓	
	✓	✓	✓	
	✓	✓		
	✓	✓		
	✓	✓		✓
	✓	✓	✓	
	✓	✓	✓	✓

Chapter 3: Regulation

Unbundling situation in Europe

		EXEMPTED	REGULATED
Ownership unbundling	Pure infrastructure operators	 	   <div>Under construction</div>   
	Present at least in supply & regas	    	     

Chapter 3: Regulation

Basic and additional / ancillary services

- All LNG terminals offer the basic services of unloading, storage and regas. Additional services vary per country of terminal and are offered under different regimes

																			
	Zeebrugge (Fluxys)	Fos Cavaou (Fosmax LNG)	Fos Tonkin (Elengy)	Montoir de Bretagne (Elengy)	Revithousa (Desfa)	Adriatic LNG (Adriatic LNG)	Panigaglia (GNL Italia)	Toscana Offshore (OLT Toscana Offshore)	Sines (REN)	Barcelona (Enagás)	Cartagena (Enagás)	Huelva (Enagás)	Bilbao (BBG)	Mugardos (Reganosa)	Sagunto (Saggas)	Rotterdam (Gate LNG)	Milford Haven (Dragon LNG)	Isle of Grain (Grain LNG)	Milford Haven (South Hook)
Basic services																			
Unloading																			
Storage																			
Regasification																			
Additional services																			
Additional storage																			
Additional regasification																			
Redelivery services																			
Tank to ship loading																			
Tanker cooling down																			
Tanker gassing up																			
Ship to ship loading																			
Truck loading																			
Complementary services																			
Ship approval																			
Quality adjustments																			
Odourisation																			
Nitrogen servicing																			
Trading specific services																			
Regasification capacity trading																			
LNG inventory exchange																			
Storage capacity trading																			
Unloading slot trading																			

Chapter 3: Regulation

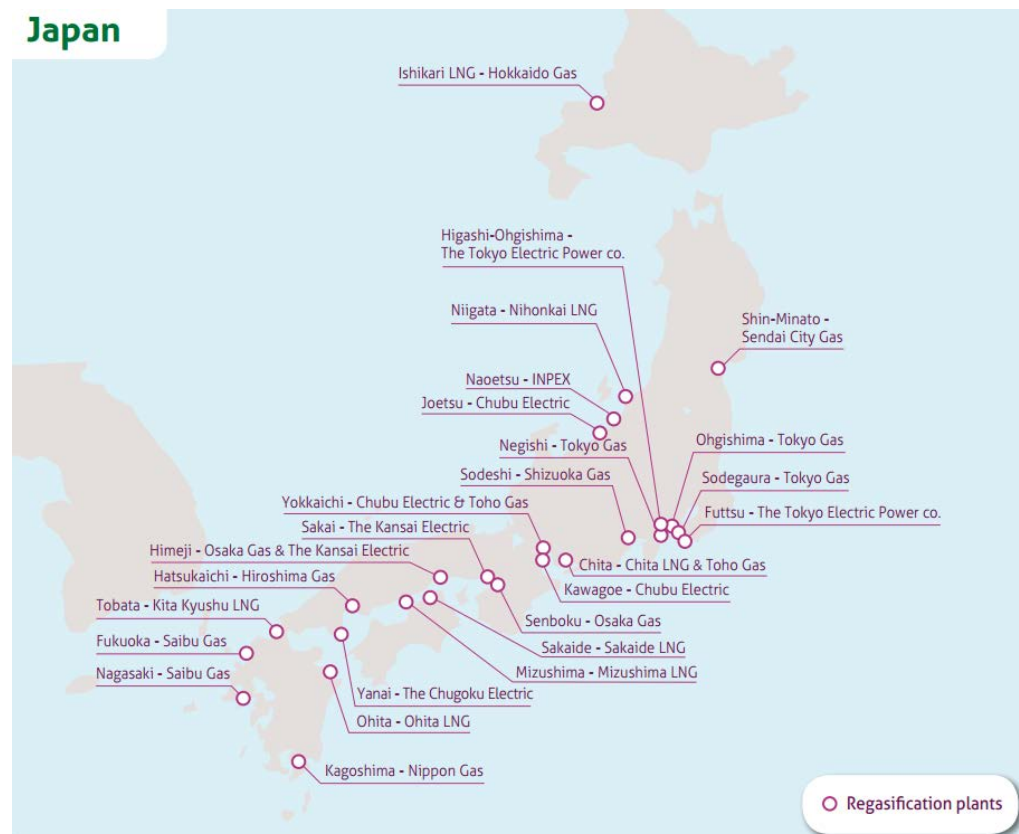
- The coexistence of regimes poses some questions.
- Regulatory developments are focused on implementation of the 3rd Package, CMPs and transparency.
- Tendency to make use of Open Seasons for new capacity, and sometimes to reallocate existing capacity.

Chapter 3: Regulation

Regulatory evolution and trends - Japan

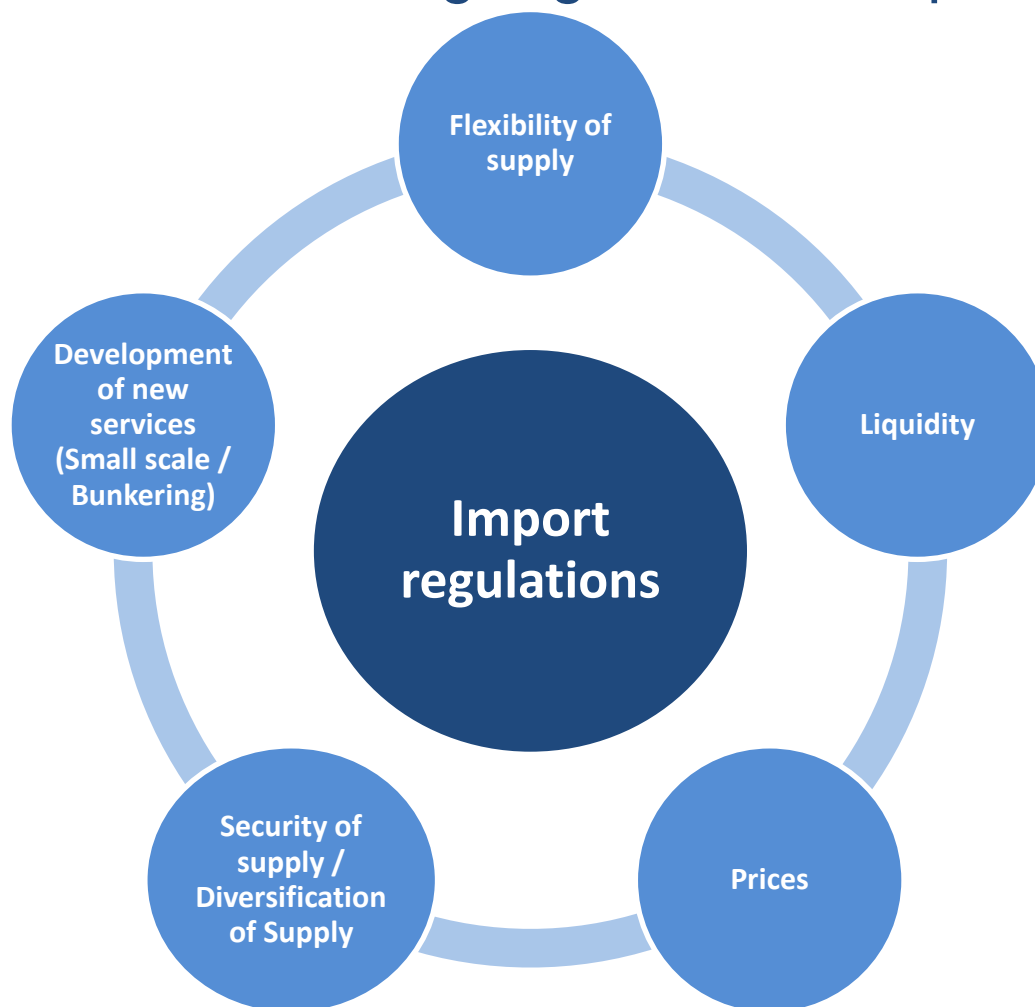
- TPA not implemented in Asia, but debated in some countries.
- Operators in Japan are obliged to create manuals for negotiations about the use of LNG terminals. Not used in practice.
- In late 2013 a public debate has been opened about whether to have clearer rules about TPA to LNG terminals, as part of a series of policy discussions aimed at further deregulating the country's natural gas market.

Japan



Chapter 3: Regulation

- Strategic issues affecting regulation in importing countries



Chapter 4: Interoperability

- Critical aspect: ship to terminal interface compatibility
- Enormous range of coastal and port environments
- Differences in local operational procedures from port to port
- Increasing ship shore compatibility

Chapter 4: Interoperability

Limitation of vessels size

Belgium	Zeebrugge	135,000 m ³
Spain	Barcelona	140,000 m ³
	Sagunto	266,000 m ³
	Cartagena	266,000 m ³
	Huelva	140,000 m ³
	Mugardos	145,000 m ³
	Bilbao	266,000 m ³
France	Fos Tonkin	75,000 m ³
	Montoir de Bretagne	266,000 m ³
	Fos Cavaou	220,000 m ³

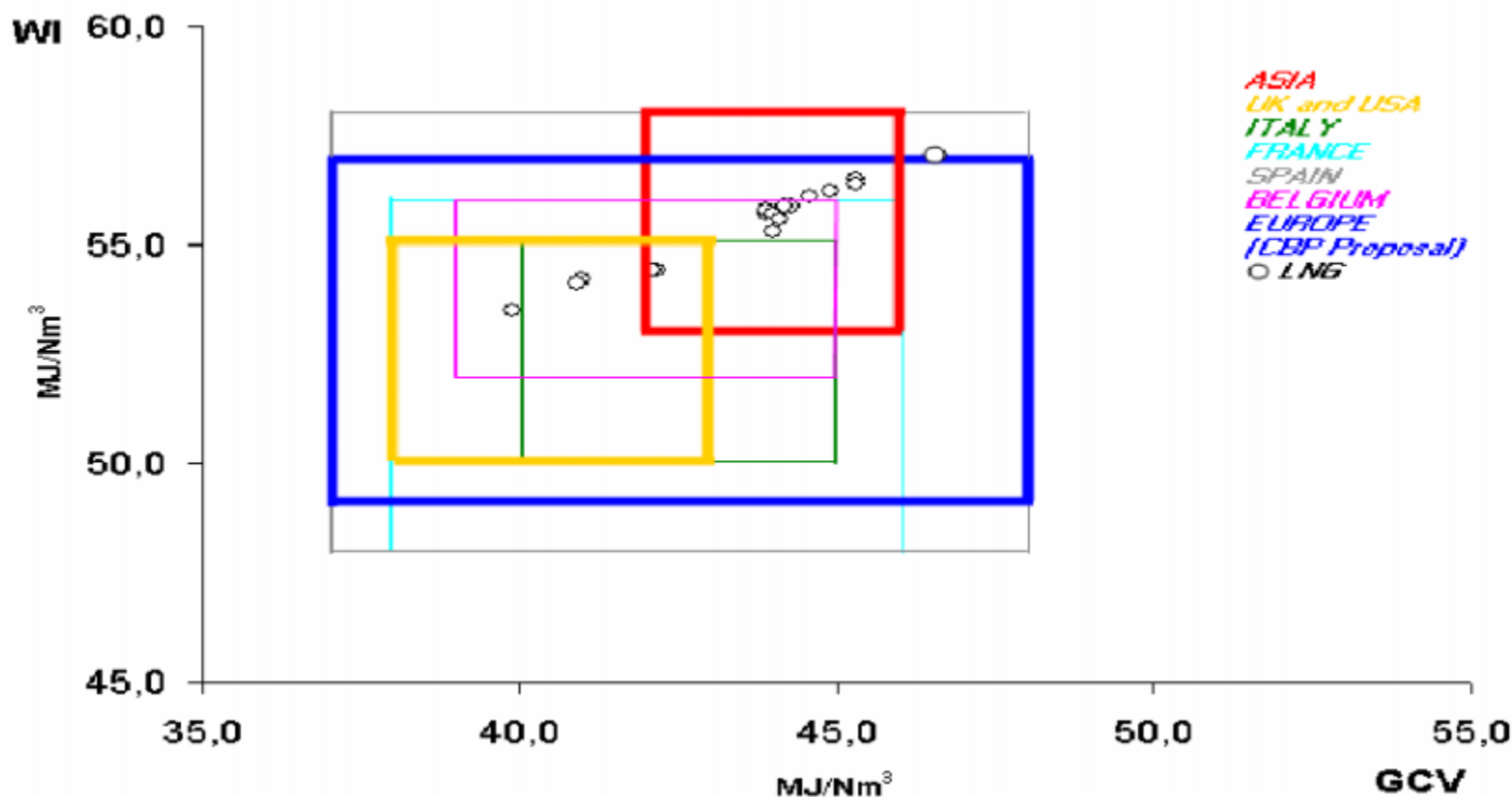
Italy	Panigaglia	70,000 m ³
	Porto Levante	152,000 m ³
Portugal	Sines	215,000 m ³
UK	Isle of Grain	205,000 m ³
	South Hook LNG	266,000 m ³
	Dragon LNG	217,000 m ³
Greece	Revithoussa	135,000 m ³

Chapter 4: Interoperability

- Gas quality harmonization is an important effort
- Global harmonization or at least regional harmonization
- Accurate analysis and measurement of LNG quality is very important

Chapter 4: Interoperability

Wobbe Index



Chapter 4: Interoperability

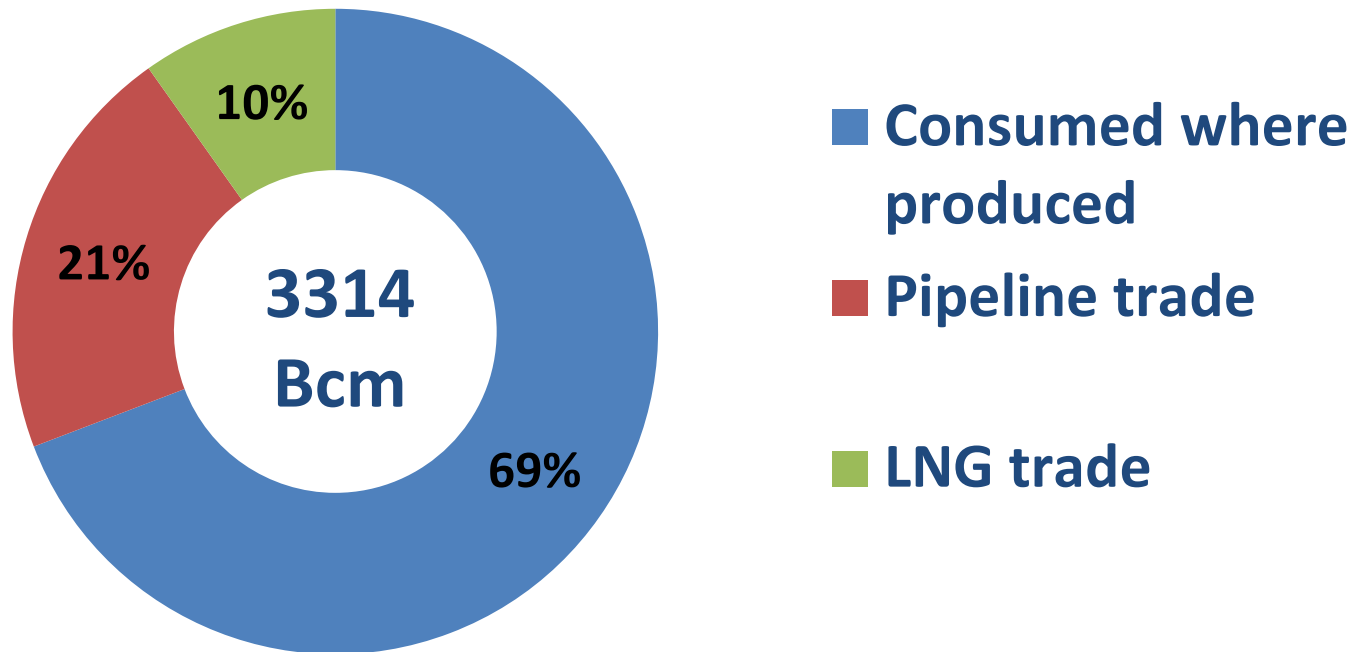
- LNG industry: excellent safety record
- Increasing spot-trading cargoes and off-loading projects (FSRU, FSU, etc...)
- Encourage dialogue between: LNG producers and receivers, LNG shippers, etc...
- New bi-directional capability, regasification+liquefaction in the same plant

Chapter 4: Interoperability

- Summing up, the chapter Interoperability and safety identifies the current issues, trends, requirements and challenges to allow the LNG industry to grow in safety and interoperability worldwide

Some Conclusions

World Gas Consumption in 2012



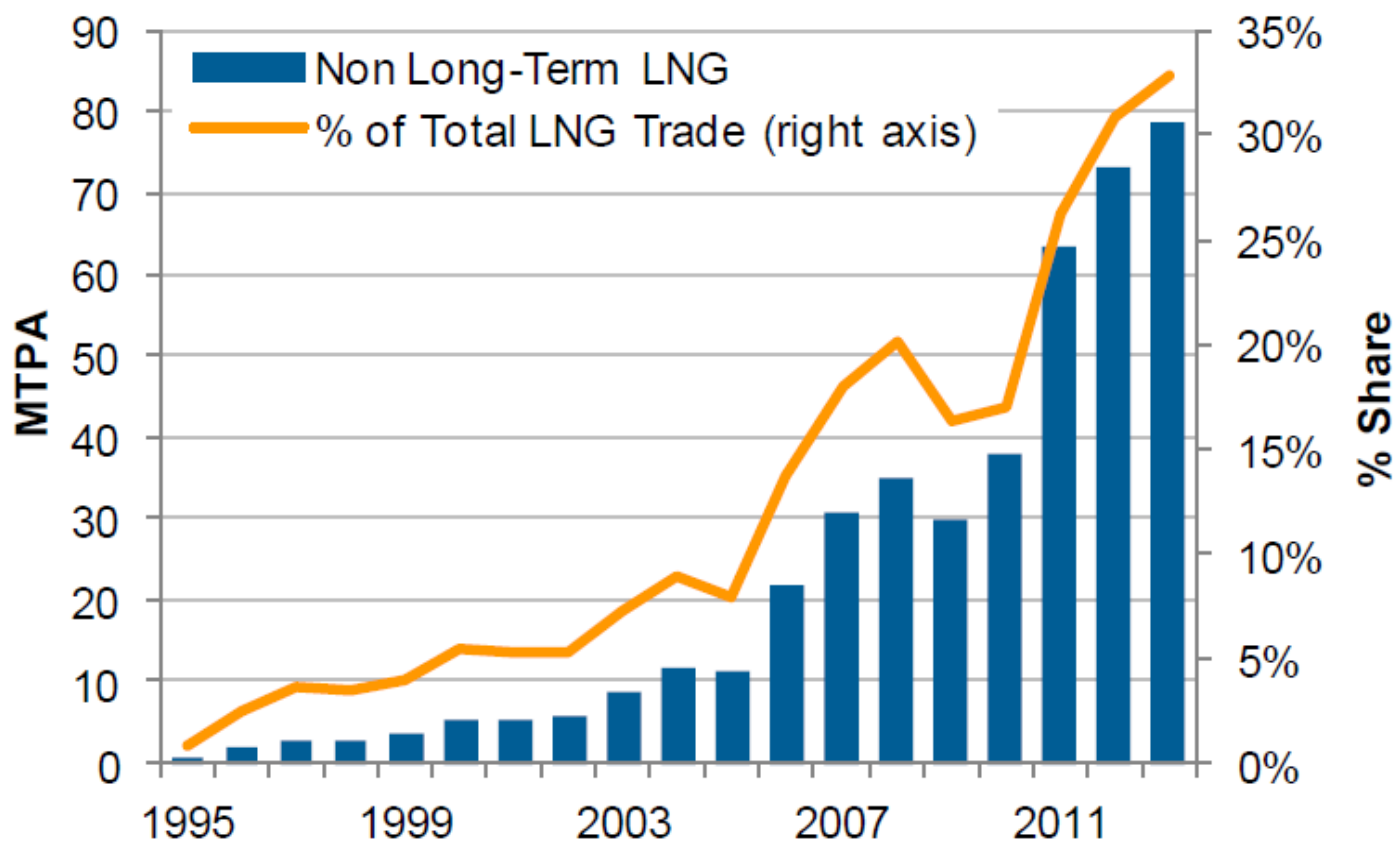
Some Conclusions

LNG advantages specifically fitting emerging energy market needs:

- **Balancing fuel for power generation**
- **New end-user oriented developments (Small Scale LNG)**
- **Spot and short term agreements**
- **Global business**

Some Conclusions

Steep rise of non long-term contracts



Some Conclusions

LNG is a global business



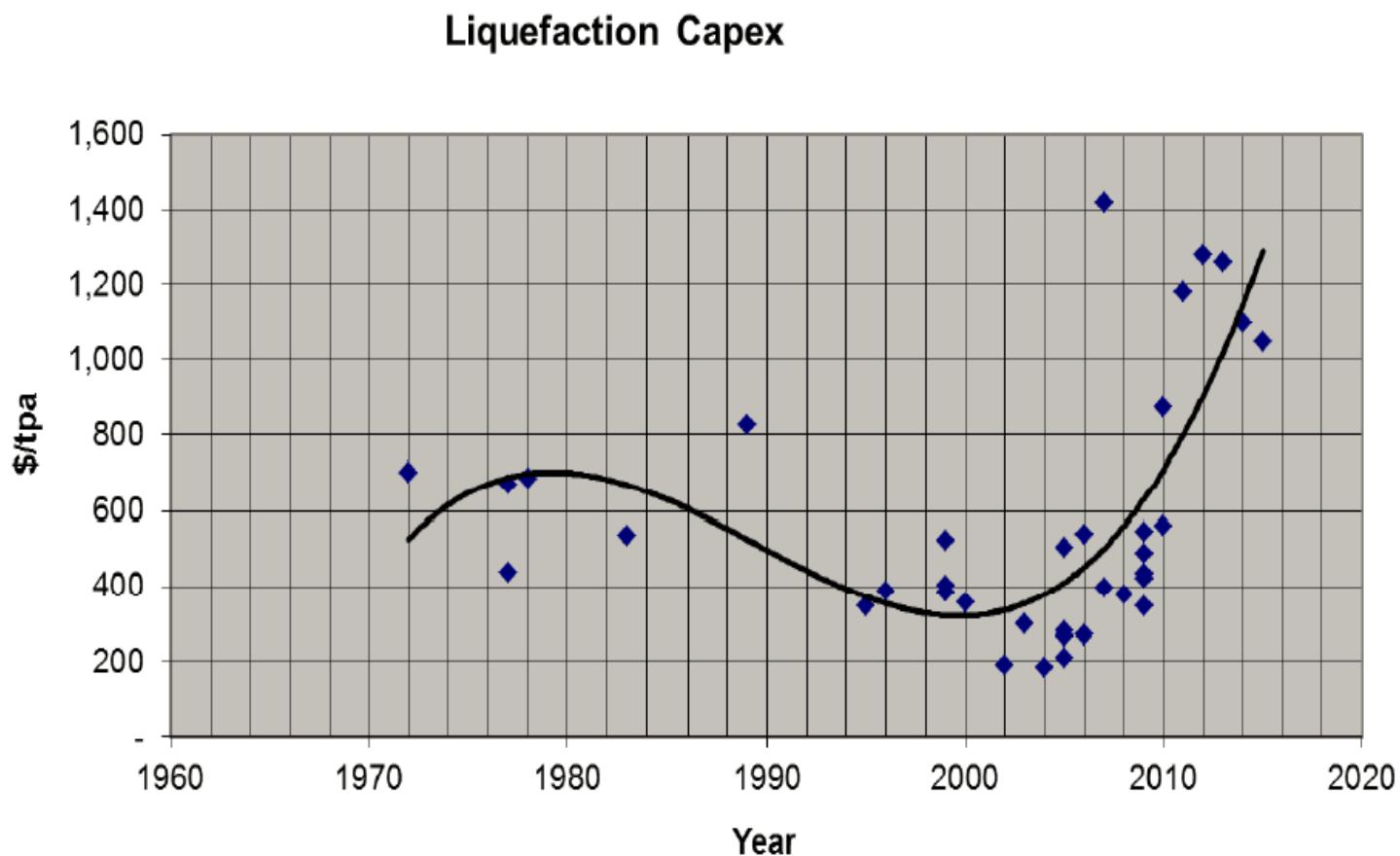
Some Conclusions

LNG industry priority challenges:

- **Containing cost escalation**
- **Remaining competitive in power generation**
- **Attracting financial resources**

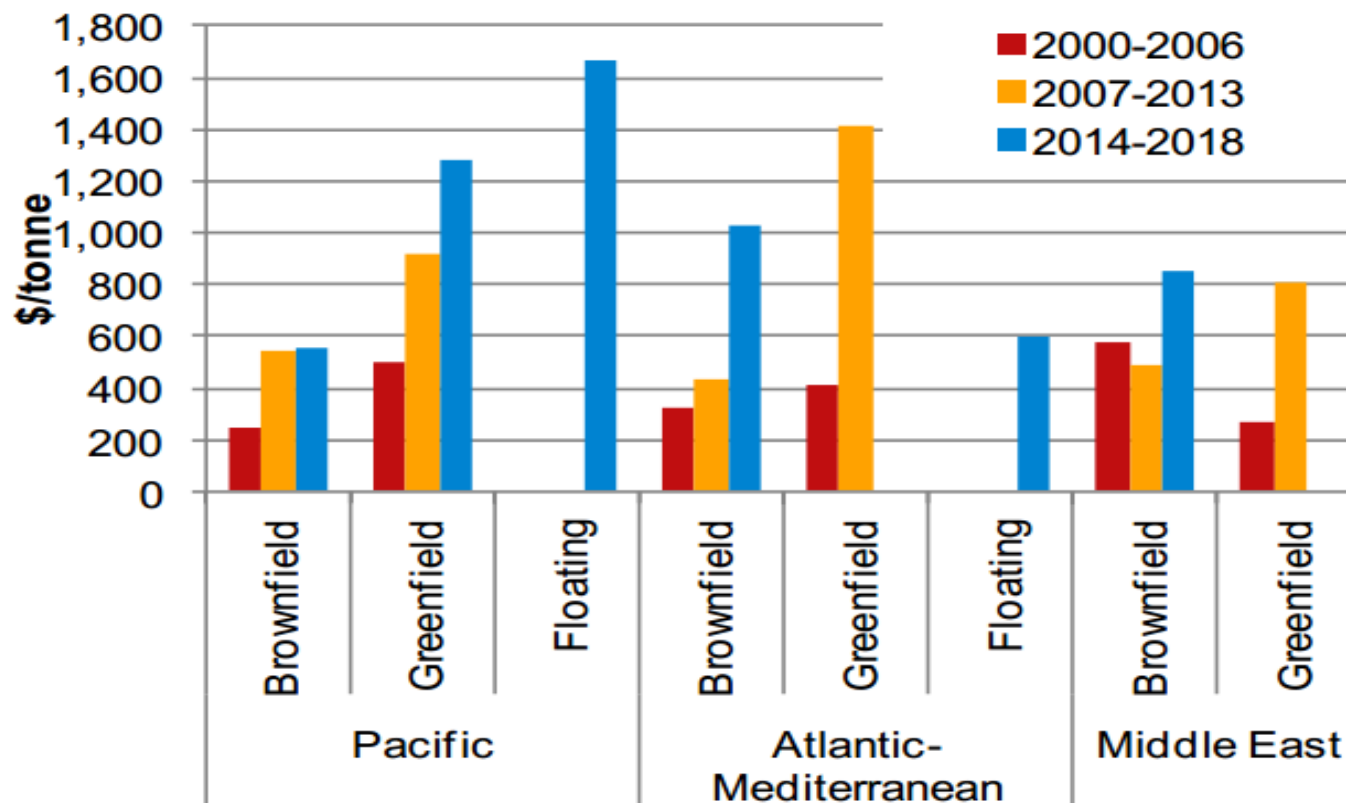
Some Conclusions

The LNG plant cost challenge



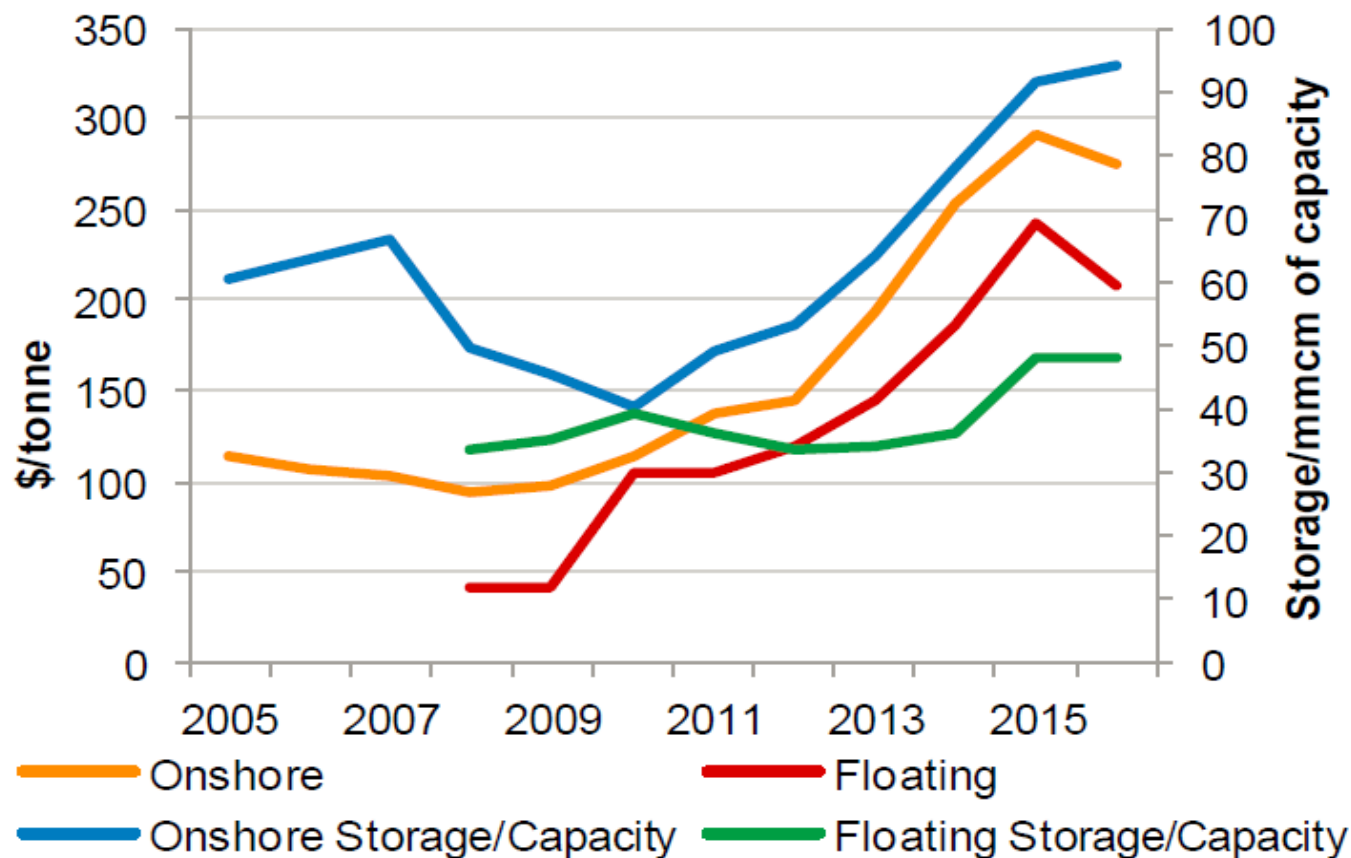
Some Conclusions

Different CAPEX will impact on project competitiveness



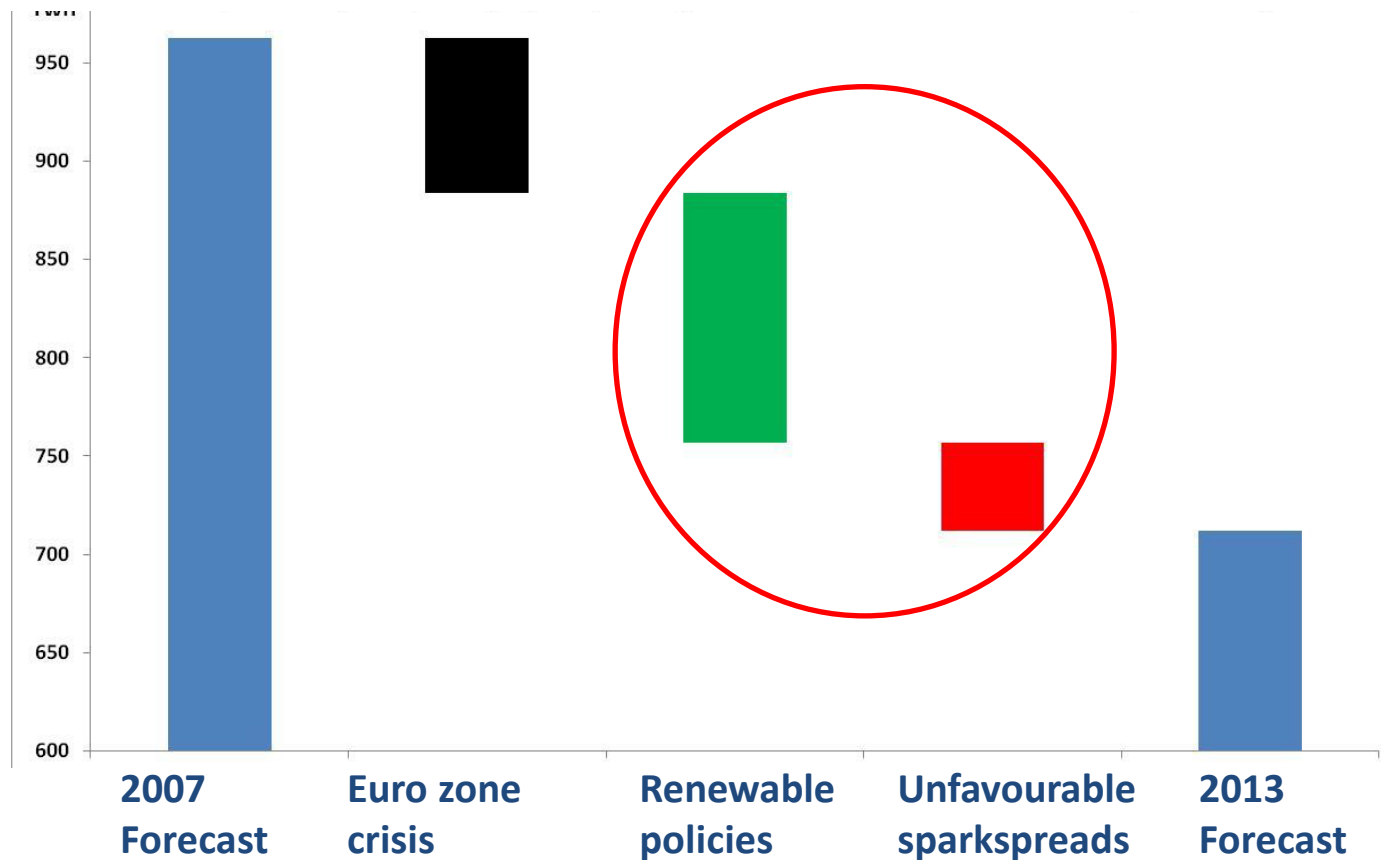
Some Conclusions

Regas: the most economic step of the LNG chain



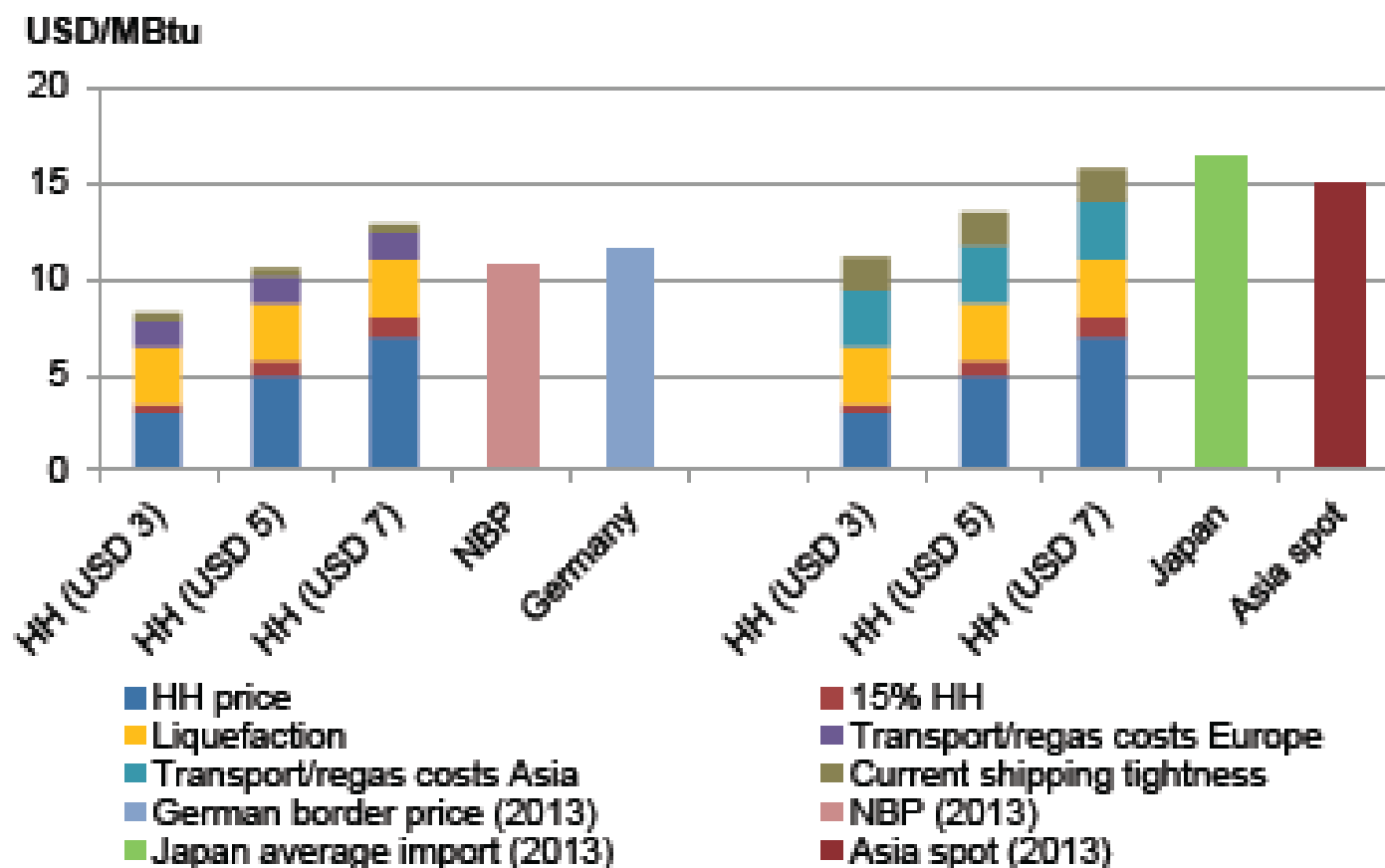
Some Conclusions

Gas competitiveness under threat in Europe



Some Conclusions

Regional gas prices and LNG competitiveness





**Thank you for your
attention...and remember
“LNG Makes Gas Global”**

14th April 2014 - Geneva