

LNG and storage strategy - follow-up study -

Final Presentation

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Jalil Jumriany

Energy Markets Global Limited

LNG and storage strategy - follow-up study -

LNG: Main Findings

LNG: Main Findings of the Study

- **How to improve liquidity, flexibility, transparency**
 1. Scenarios
 2. Characteristics of energy trading markets
 3. LNG Industry structure and major players
 4. Case study: liberalisation of pipeline gas
 5. Case study: oil trading markets
 6. Case study: iron ore trading
 7. Results of interviews with LNG industry
 8. Conclusions and recommendations

Three key factors drive trading markets

1. A market crisis or other major driver for change
2. Deliberate government action to create the environment for a market
3. The market then develops by itself

LNG: Drivers for LNG Trading

1. Many sellers or suppliers
2. Many buyers or customers
3. Industry crisis
4. Supportive regulatory and fiscal framework
5. Standard contract
6. Price publication service
7. Storage infrastructure
8. Other infrastructure
9. Diversity of supply
10. Entry of new players

LNG: Indications of Active Trading

- 11. Increased contract flexibility
- 12. Shorter-term and smaller contracts
- 13. Resale and secondary markets
- 14. Capacity trading
- 15. Spot and futures price

LNG: Barriers to Liquidity in LNG

- Concentration of players
- LNG trading suitability
- Rigid contractual terms

LNG: State of LNG Trading Markets

1. Market crisis

- Supply overhang
- New technology

2. Government actions (EU)

- Ship fuelling regulations
- Destination clauses
- Regulated regasification terminals

3. Market actions

- New business models
- Luck

LNG: Recommendations

- What governments can and cannot do
 - Actions which can only be carried out by the market
 - Areas where governments can set the environment within which a market operates
 - Areas where government can take direct action

LNG: Recommendations

1. Essential actions by the market alone
 - Contracts
2. Actions where the EU can set the environment
 - LNG hubs
 - International cooperation
3. Areas where the EU can take direct action
 - Transparency
 - LNG prices
 - Information for new market entrants
 - Terminal pricing
 - Terminal access

LNG: Example - US DOE, US LNG Publication



U.S. DEPARTMENT OF
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OFFICE OF OIL & NATURAL GAS

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Office of Fossil Energy
Office of Oil & Natural Gas
Office of Regulation and International Engagement
Division of Natural Gas Regulation
Phone: 202-586-7991
Email: ngreports@hq.doe.gov

LNG: Example - US DOE, US LNG Publication

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VESSEL-BORNE EXPORTS OF DOMESTICALLY-PRODUCED LIQUEFIED NATURAL GAS (LNG)

Table 2a

Date of Departure	Name of Exporter	Supplier	Docket Number	Docket Term	Country of Destination	Name of Tanker	Departure Terminal	Volume (Mcf of Natural Gas)	Price at Export Point (\$/MMBtu)	Notes
1/12/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	10-111-LNG	Long-Term	Japan	Maethane Lydon Volney	Sabine Pass LNG Terminal	3,111,137	\$ 3.72	
1/20/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	10-111-LNG	Long-Term	Spain	Sestao Knutsen	Sabine Pass LNG Terminal	2,940,374	\$ 3.72	
1/4/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	10-85-LNG	Long-Term	Mexico	Clean Ocean	Sabine Pass LNG Terminal	3,455,279	\$ 7.52	[3]
1/5/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	10-111-LNG	Long-Term	Malta	Gaslog Santiago	Sabine Pass LNG Terminal	867,349	\$ 4.52	[9]
1/5/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	10-85-LNG	Long-Term	Jordan	Gaslog Santiago	Sabine Pass LNG Terminal	2,428,613	\$ 4.52	[9]
1/7/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	10-85-LNG	Long-Term	Mexico	Cool Voyager	Sabine Pass LNG Terminal	3,428,332	\$ 7.52	[3]
1/11/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	10-111-LNG	Long-Term	India	SCF Mire	Sabine Pass LNG Terminal	3,622,568	\$ 4.52	
1/15/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	10-111-LNG	Long-Term	Spain	Rioja Knutsen	Sabine Pass LNG Terminal	3,944,042	\$ 7.01	[3]
1/17/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	10-111-LNG	Long-Term	Japan	Creole Spirit	Sabine Pass LNG Terminal	3,703,484	\$ 7.52	[3]
1/19/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	10-85-LNG	Long-Term	Mexico	Maran Gas Pericles	Sabine Pass LNG Terminal	3,025,173	\$ 4.52	[9]
1/19/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	10-85-LNG	Long-Term	Mexico	Maran Gas Pericles	Sabine Pass LNG Terminal	384,212	\$ 7.52	[9]
1/24/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	10-111-LNG	Long-Term	China	Maran Gas Achilles	Sabine Pass LNG Terminal	3,391,067	\$ 4.52	
1/25/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	10-111-LNG	Long-Term	Portugal	Golar Kelvin	Sabine Pass LNG Terminal	3,442,355	\$ 7.01	[3]
1/26/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	10-85-LNG	Long-Term	Mexico	Stena Crystal Sky	Sabine Pass LNG Terminal	3,706,516	\$ 7.52	[3]
1/28/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	15-171-LNG	Short-Term	Spain	Methane Spirit	Sabine Pass LNG Terminal	3,411,662	\$ 7.00	[10] [3] [4]
1/29/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	10-111-LNG	Long-Term	Japan	Maria Energy	Sabine Pass LNG Terminal	3,718,018	\$ 7.52	[3]
1/31/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	10-85-LNG	Long-Term	Jordan	Galea	Sabine Pass LNG Terminal	2,939,021	\$ 7.52	[3]
2/2/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	10-111-LNG	Long-Term	Portugal	Clean Ocean	Sabine Pass LNG Terminal	1,591,600	\$ 6.90	[13]
2/2/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	10-111-LNG	Long-Term	Spain	Clean Ocean	Sabine Pass LNG Terminal	1,765,061	\$ 6.90	[13]
2/3/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	10-111-LNG	Long-Term	Turkey	La Manchua Knutsen	Sabine Pass LNG Terminal	3,705,488	\$ 6.39	[3]
2/5/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	10-111-LNG	Long-Term	India	Palu LNG	Sabine Pass LNG Terminal	3,399,239	\$ 3.90	
2/6/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	15-171-LNG	Short-Term	Mexico	Cool Voyager	Sabine Pass LNG Terminal	3,427,496	\$ 7.07	[10] [3]
2/11/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	10-111-LNG	Long-Term	Turkey	Oak Spirit	Sabine Pass LNG Terminal	3,696,872	\$ 6.90	[3]
2/12/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	10-111-LNG	Long-Term	China	Maran Gas Amphipolis	Sabine Pass LNG Terminal	3,464,863	\$ 3.90	
2/14/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	10-85-LNG	Long-Term	Mexico	Rioja Knutsen	Sabine Pass LNG Terminal	3,506,218	\$ 6.39	[3]
2/15/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	10-85-LNG	Long-Term	Chile	Gemrata	Sabine Pass LNG Terminal	2,950,188	\$ 6.90	[3]
2/17/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	10-111-LNG	Long-Term	China	Maran Gas Pericles	Sabine Pass LNG Terminal	3,444,825	\$ 3.90	
2/20/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	15-171-LNG	Short-Term	Mexico	Ribera del Duero	Sabine Pass LNG Terminal	3,667,863	\$ 5.33	[10] [3]
2/20/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	15-171-LNG	Short-Term	Kuwait	Golar Penguin	Sabine Pass LNG Terminal	3,378,113	\$ 5.29	[10]
2/23/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	10-85-LNG	Long-Term	Jordan	Madrid Spirit	Sabine Pass LNG Terminal	2,944,820	\$ 3.90	
2/24/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	15-171-LNG	Short-Term	Mexico	Stena Crystal Sky	Sabine Pass LNG Terminal	3,705,511	\$ 5.89	[10] [3]
2/25/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	10-111-LNG	Long-Term	Japan	Stena Clear Sky	Sabine Pass LNG Terminal	3,705,039	\$ 6.90	[3]
2/25/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	10-111-LNG	Long-Term	China	Clean Planet	Sabine Pass LNG Terminal	3,428,365	\$ 6.39	[3]
3/2/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	10-85-LNG	Long-Term	South Korea	Gaslog Gibraltar	Sabine Pass LNG Terminal	3,563,966	\$ 3.02	
3/6/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	15-171-LNG	Short-Term	Mexico	Cool Voyager	Sabine Pass LNG Terminal	3,404,654	\$ 5.10	[10] [3]
3/6/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	10-85-LNG	Long-Term	Jordan	Maran Gas Apollonia	Sabine Pass LNG Terminal	3,358,586	\$ 3.02	
3/12/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	10-85-LNG	Long-Term	Jordan	Golar Kelvin	Sabine Pass LNG Terminal	3,296,471	\$ 5.51	[3]
3/15/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	10-111-LNG	Long-Term	Pakistan	Gaslog Skagen	Sabine Pass LNG Terminal	3,165,927	\$ 3.02	
3/17/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	15-171-LNG	Short-Term	South Korea	Clean Ocean	Sabine Pass LNG Terminal	3,457,554	\$ 4.34	[10] [3]
3/19/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	15-171-LNG	Short-Term	Turkey	Oak Spirit	Sabine Pass LNG Terminal	3,520,905	\$ 4.42	[10]
3/20/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	15-171-LNG	Short-Term	Dominican Republic	GDF Suez Point Fortin	Sabine Pass LNG Terminal	3,533,395	\$ 5.07	[10]
3/22/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	10-111-LNG	Long-Term	Thailand	Methane Alison Victoria	Sabine Pass LNG Terminal	3,112,643	\$ 3.02	
3/24/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	15-171-LNG	Short-Term	Mexico	Creole Spirit	Sabine Pass LNG Terminal	3,707,229	\$ 4.54	[10] [3]
3/28/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	10-85-LNG	Long-Term	Mexico	Rioja Knutsen	Sabine Pass LNG Terminal	3,615,896	\$ 5.51	[3]
3/30/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	10-111-LNG	Long-Term	Kuwait	Valencia Knutsen	Sabine Pass LNG Terminal	3,360,169	\$ 3.02	
3/30/2017	Sabine Pass Liquefaction, LLC	Sabine Pass Liquefaction, LLC	10-85-LNG	Long-Term	Chile	Galea	Sabine Pass LNG Terminal	2,951,103	\$ 6.02	[3]

[5] Spot - a one-time transaction for near-term delivery of a specific quantity of LNG at a specific location. Prior to 2006, spot cargoes could be included in either long-term or short-term authorization types.

[7] Split cargo - a single shipment of LNG where portions of the cargo have different characteristics. For instance, a single cargo can have more than one buyer, supplier, price, unloading port, loading port, or DOE authorization.

[8] Co-mingled cargo - pre-commercial cargo loaded while export facility operations are still undergoing final testing and inspection. Co-mingled cargoes may occur multiple times for the same facility as individual LNG trains enter service.

[9] Liquefaction fees - liquefaction fees have been included in the cargo's price. Export prices for cargoes made pursuant to long-term sales and purchase agreements (SPA's) or contracts do not include liquefaction fees unless indicated.

Countries of destination are current as of publication date. Any updates to countries of destination reported will be published in the next scheduled LNG Monthly.

LNG and storage strategy - follow-up study -

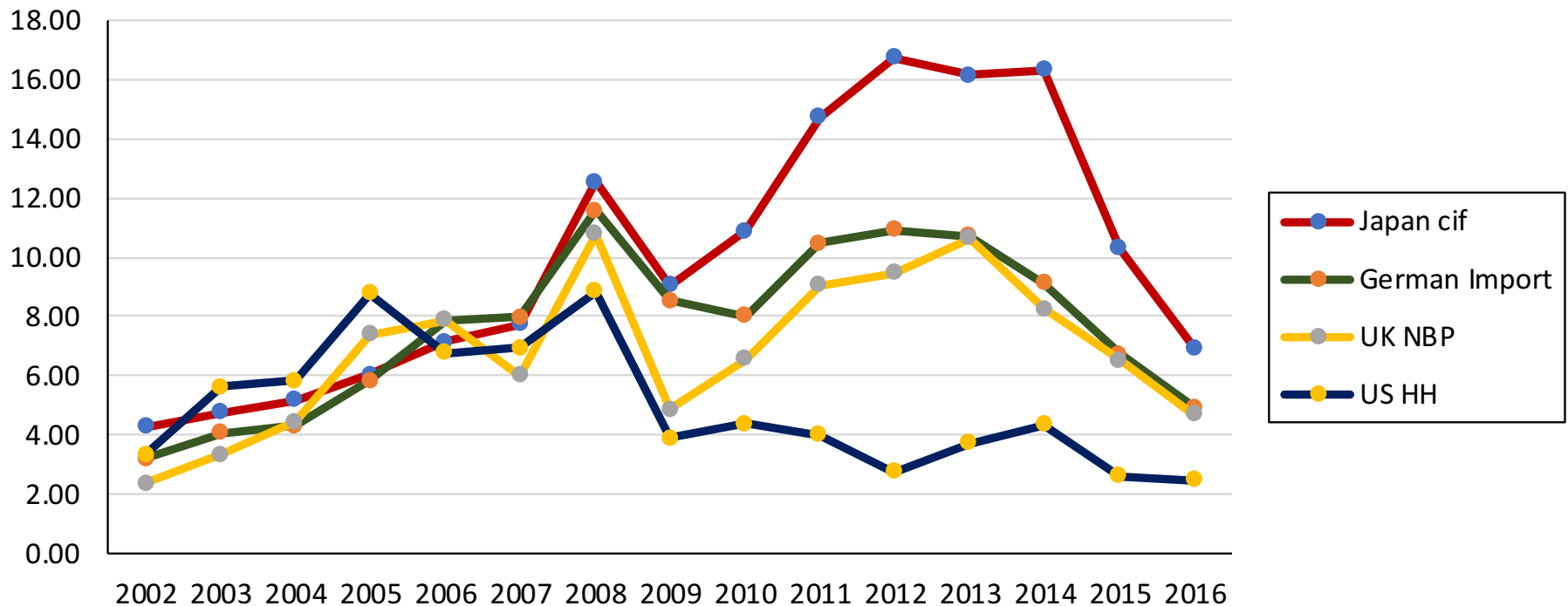
LNG: Future Price and Supply Dynamics

LNG: Future Price and Supply Dynamics

- Henry Hub pricing
 - Marginal supplier sets the market price
 - USA largest supplier and marginal supplier
 - LRMC: HH + liquefaction + transport (+ regasification)
 - SRMC: HH + very minimal transport
- Different benchmarks
 - USA – Henry Hub
 - Europe – HH/NBP/TTF + Russia
 - East Asia – JKM / Singapore hub / Shanghai?

LNG: Gas and LNG Prices

Natural Gas and LNG Prices, \$/MMbtu



Source: Data: BP Annual Statistical Review 2017, Analysis: EMG

Note: UK NBP = National Balancing Point; US HH = Henry Hub

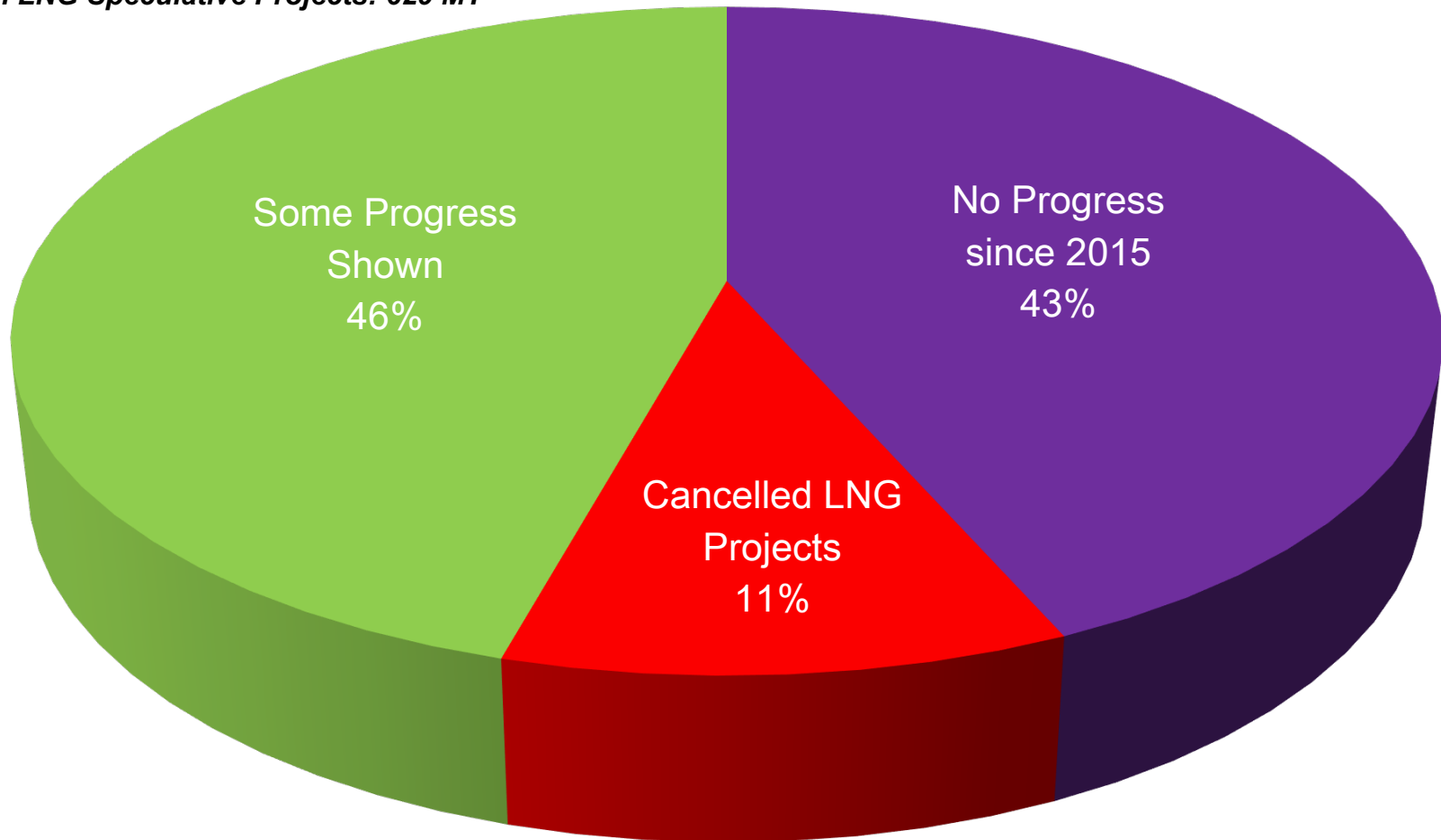
LNG: EEGM Reference Case

Implications for the EEGM Reference Case:

- Volumes available for Europe:
 - 2020: 87 mt (~1300 TWh);
 - 2025: 113 mt (~1700 TWh);
- Prices, Europe LNG:
 - 2020: \$6.50 (~26 €/MWh)
 - 2025: \$7-8 (~28-32 €/MWh)

Speculative LNG Projects Since March - Sep 17

Total LNG Speculative Projects: 629 MT



Some Progress Shown: 287.8 MT

No Progress since 2015: 273.5 MT

Cancelled LNG Projects: 68 MT

LNG: Scenarios

	Low Supply	High Supply
High Demand	<p><u>“Emerging Markets”</u></p> <p>High emerging market demand</p> <p>LNG price up to \$10/mmbtu</p>	<p><u>“Steady As She Goes”</u></p> <p>Existing production as now</p> <p>IEA global demand estimates</p> <p>LNG price around \$7-8</p>
Low Demand	<p><u>“Boom and Bust”</u></p> <p>No new liquefaction built</p> <p>Prices rise in early 2020s</p> <p>new liquefaction capacity built</p> <p>Price falls to around \$3-5/mmbtu</p>	<p><u>“Chinese Shale”</u></p> <p>Large supply overhang</p> <p>A period of turmoil</p> <p>LNG price collapse to \$3-5/mmbtu</p>

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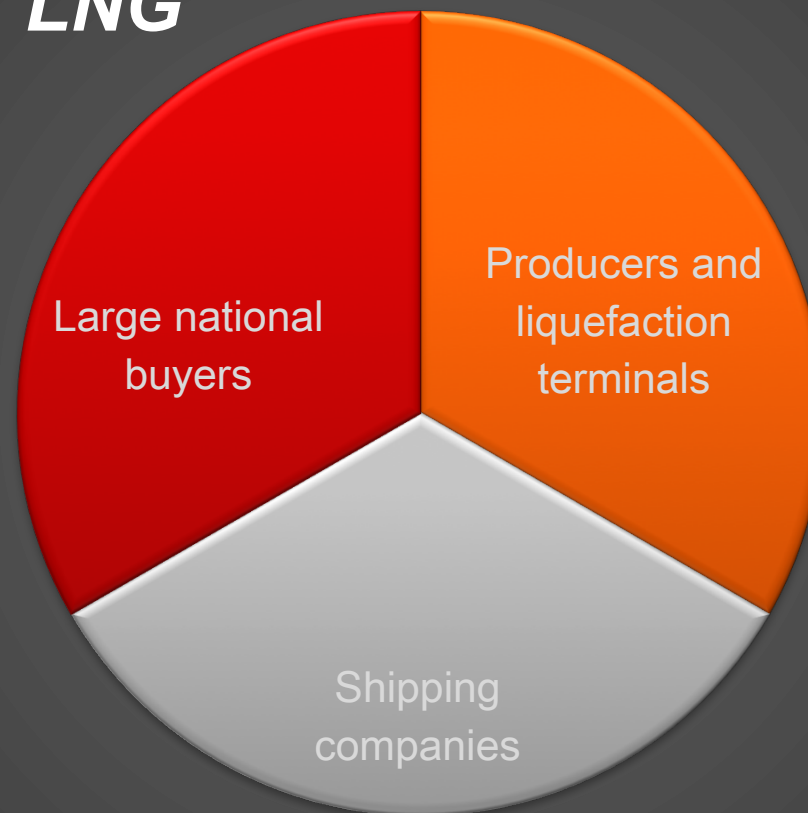
LNG: Instruments for Flexibility in Global LNG

LNG: Instruments for Flexibility in Global LNG Market

- LNG Industry players
 - Traditional
 - New players
- New business models
- Swaps
- Drivers for flexibility

LNG: Industry Players

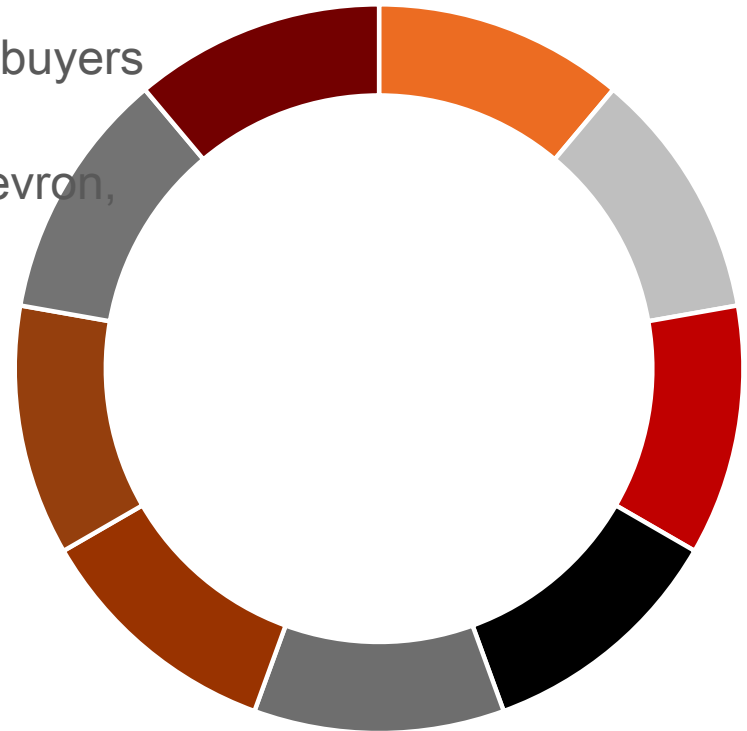
Traditional LNG Business



LNG: New industry players and business models

- Traditional producers - IOCs & NOCs
- Liquefaction terminals - JVs of producers and buyers
- Aggregators / portfolio players - Shell/BG, Chevron, Gazprom etc
- Shipping companies
- New US LNG companies
- Project developers - Höegh, Golar
- Traditional buyers - Japan, SK

LNG Chain



LNG: New Business Models bringing flexibility



New emerging market buyers	<ul style="list-style-type: none">• FSRUs• National buyers with surplus supplies to resell
Contracts	<ul style="list-style-type: none">• Increasing take or pay flexibility• Buyers renegotiating prices• Exporters maintaining existing export contracts + contracting new domestic market imports
Infrastructure	<ul style="list-style-type: none">• Buyers buying stakes in liquefaction plants• Traders investing into infrastructure
Government actions	<ul style="list-style-type: none">• Hubs + Re-exports• Removal of destination clauses + shipping fuels + regulated regas

LNG: Swaps

- A useful tool generally: Location swaps and time swaps
- Not common in LNG
 - Almost all by month or quarter and are seasonal swaps
- Reasons include
 - Scheduling (both time and location swap needed)
 - Vessel differences
 - Terminal specifications
 - Gas quality specifications
 - Limited communications between buyers
 - Contract inflexibility

Thank You

Jumriany@Energymarketsglobal.eu