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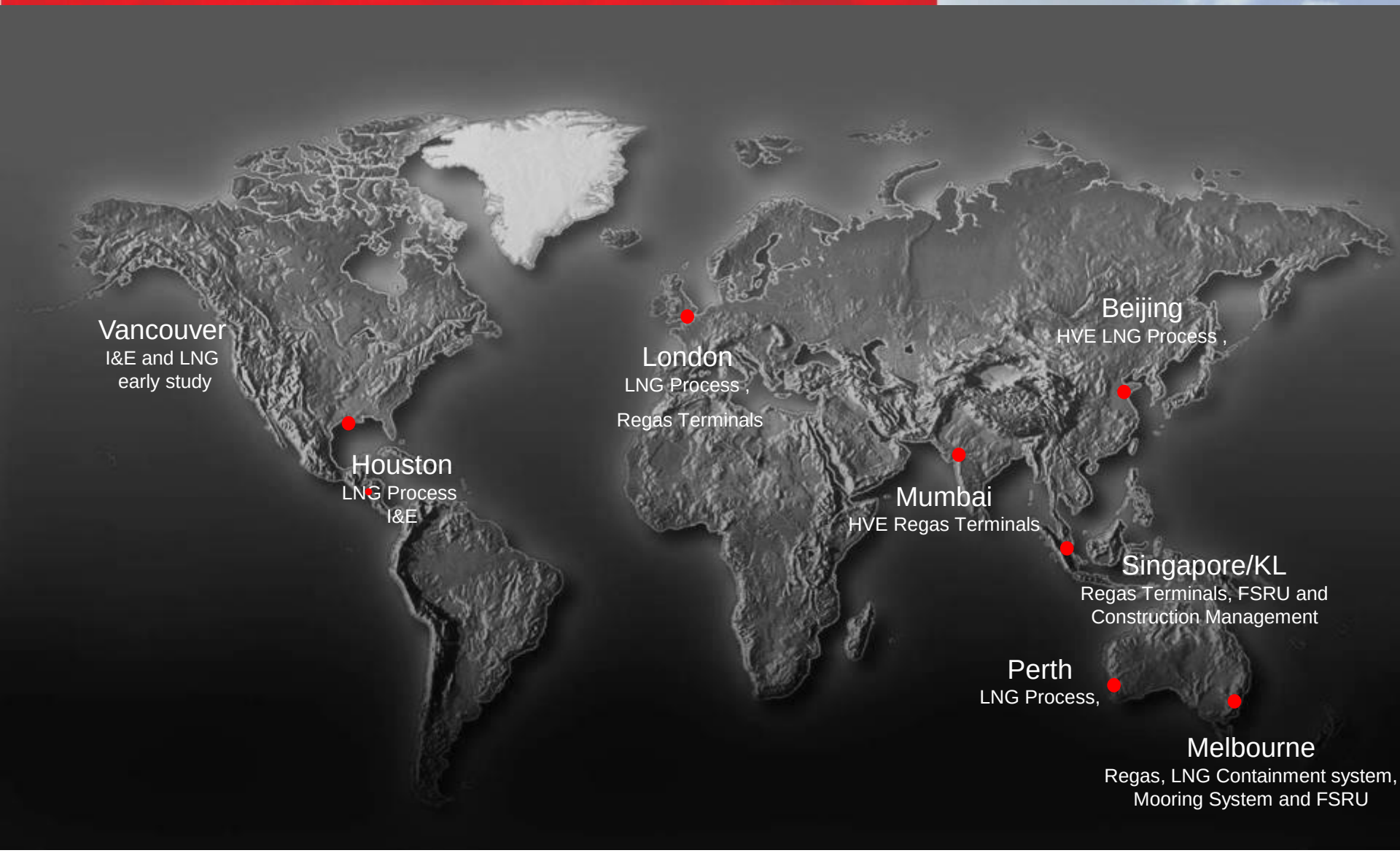
LNG to Power – The Industry Savior/Driver?

Intergas Summit – Nice Nov 28th/29th

Ing. Paul Sullivan Senior Vice President - Global LNG and FLNG

EcoNomics

The WP Global LNG Team



The big opportunity

- You will have had some interesting figures by now…….

- You will understand that we have a classic opportunity to expand the LNG business globally due to the overhang of supply and the need to create new markets……

- The main areas of untapped business are power opportunities in locations/countries with no gas distribution infrastructure, hence conversion of gas to power is the prime means of energy distribution……

Substitution of other liquid fuels

- Most underserviced markets depend on a diesel or other oil based products for power generation, due to their commoditisation and ease of import and handling.
- From a macro-economic point of view this is very debilitating for developing countries and isolated island markets.
- The current spot market figures speak for themselves;
  - Propane $33 per mmbtu
  - Diesel $24-$30 per mmbtu
  - Contracted LNG $6-$8 per mmbtu
  - Spot LNG circa $5 per mmbtu

Costs of storage and handling

- Clearly the advantages for Diesel and other oil products is the familiarity with their storage and handling.
- Most countries and regions have history and experience in their use and understand the economics.
- LNG because of its considerably more expensive storage and handling can create barriers to its use.
- These challenges are being addressed by the LNG industry due to the oversupply situation which is likely to persist over the medium term of between 6 and 8 years.

Economics

- The capital and operational cost of a regasification terminal has to be borne by the customers/users and has to be built into the fuel tariff.
- The advantage enjoyed by LNG over Diesel is considerable, certainly in the $10 per mmbtu range
- This leads to a straight calculation on recovery volume economics, so for a 1 mmtpa market this will be around $1.30 per mmbtu

In support of the theme

- **India's imports of liquefied natural gas rose 34.6 percent in August as compared to the same month a year ago, according to the data from oil ministry's Petroleum Planning and Analysis Cell (PPAC).**

- India imported 1 million tonne of LNG in August compared with 0.7 million tonne in the same month last year, PPAC said.

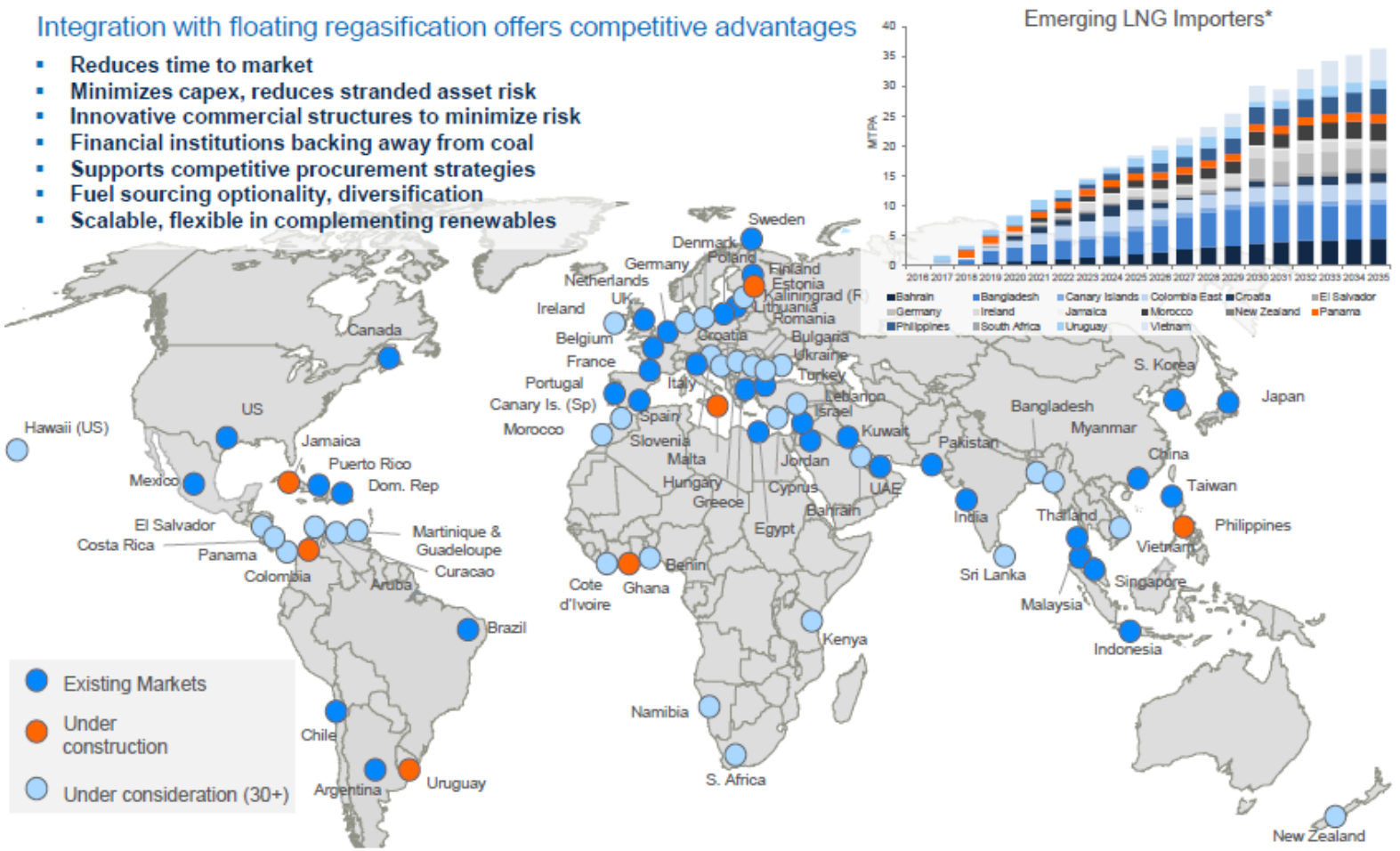
- This is a country with existing gas infrastructure (30 mtpa of Regas capability existing) and they are not going to miss the opportunity.

The scale of prospects

Many Emerging LNG Markets Targeting Integrated LNG to Power

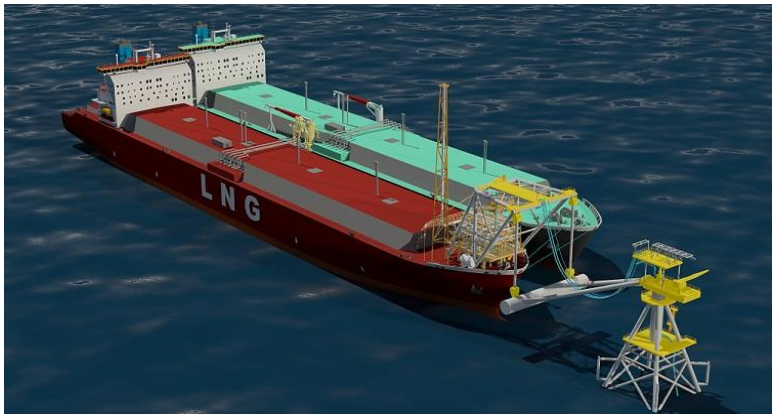
Integration with floating regasification offers competitive advantages

- **Reduces time to market**
- **Minimizes capex, reduces stranded asset risk**
- **Innovative commercial structures to minimize risk**
- **Financial institutions backing away from coal**
- **Supports competitive procurement strategies**
- **Fuel sourcing optionality, diversification**
- **Scalable, flexible in complementing renewables**



Sources: Wood Mackenzie Q2 LNG Tool , Cheniere Research;
**Represents Wood Mackenzie's view of select emerging LNG importers, map represents a wider collection of potential LNG importers*

Offshore berthing



Soft Yoke

External Turret

Internal Disconnectable Buoy

Jetty berthing

Single Berth

Dual Berth

Dual Berth with Regas

Example for WorleyParsons' Module(Conversion)

- Delivery Schedule of 18 months based on standard module design on DDP terms (any shipyard in Singapore)

Activity		Duration (Months) 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
Receive Letter of Award		◆
Procurement of Long Lead Items	Pumps	Lead time 14 months
	Cryogenic Valves	Lead time 12 months
	Exchangers	Lead time 10 months
Detailed Engineering		
Procurement of bulks		
Start Construction		◆
Main Equipment ROS		◆
Module Fabrication		
Mechanical Completion		◆
Pre-commissioning, Testing and Transport		
Delivered to site (Singapore)		◆

Indicative Lease Costs

LNG Terminal Solution	FSRU										FSU+ onshore	
Mooring Type	Soft Yoke		External Turret		Internal Turret		Single berth		Dual Berth		Single Berth	
Throughput (mtpa)	5				5		5		5		5	
Storage (m3)	175,000-265,000		175,000-265,000		175,000-265,000		175,000-265,000		175,000-265,000		175,000-265,000	
OPEX (Million USD / year)	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
Fixed Costs												
FSRU / FSU leasing costs (2)	58		58		58		46		46		37	
Crew wages (1)	4.5		4.5		4.5		4.5		4.5		3.0	
Crew transport (3)	1.0		1.0		1.0		0.2		0.2		0.2	
P&I	0.7		0.7		0.7		0.7		0.7		0.7	
Hull Maintenance	1.5		1.5		1.5		1.5		1.5		1.5	
Variable Costs												
Fuel Gas	15	25	15	25	15	25	15	25	15	25	15	25
Tug assistance	8	10	8	10	8	10	8	10	8	10	8	10
Overall OPEX (Million USD /year)	**89**	**101**	**89**	**101**	**89**	**101**	**76**	**88**	**76**	**88**	**65**	**77**
Notes												
1. Includes food and personnel insurance.												
2. Range of FSRU/FSU leasing costs : 125,000USD-160,000USD per day												
3. Assumed by helicopter for the softyoke and turrets mooring and by boats for the jetty mooring.												

FSRU to Power

- The key consideration for effective deployment of FSRUs is their cost and ultimately their cost per KWhr.
- The range of cost for purchase could be anywhere between $100 million to $260 million, between an old lady conversion to new build.
- The berthing facilities will be in addition to this.

FSRU Leasing

- A typical leasing arrangement could be between $65 million to $100 million per year for a 4MTPA unit, plus berthing facilities.
- This would give a Regasification cost of under 0.05 cents per KWhr on a baseload power play.
- Most LNG to Power projects though are not 4,000 MW.
- The figures for a 1,000 MW baseload plant would be in the order of 0.15 cents per KWhr
- Getting down to the 350 MW range baseload would move the regas cost up to a significant 1 cent per KWhr.

Integrated LNG/Power

- Taking the LNG to power argument further, several developers are looking at integrated power barges
- They have the advantage of being fully self contained and capable of quick deployment in regions with severe power shortages or high tariffs
- They also have the facility to remain economic in the smaller size range

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Conclusion and some salutary thoughts

London – Thursday September 22nd 2016

EcoNomics

Closing Thoughts

- **A staggering 30+ terminals are under active consideration/early development.**
- **If only half are finally developed, the new markets will account for 25 – 45 MTPA of new business.**
- **There is spare capacity of over 350 MTPA in existing Regas plants worldwide.**
- **$7 to $8 per mmbtu LNG delivered can be accommodated in most wholesale electricity tariffs.**

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