Can the SEA FLNG Approach Monetise Small Australian Stranded Gas Resources?

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Purpose and Disclaimer

+ SEA FLNG projects: a different approach to gas developments
+ S2V Consulting FLNG experience in Malaysia
+ This presentation is our view on the future of FLNG
+ Information from the public domain
+ FLNG is a novel technology
+ Project references are still uncertain
+ Oil and gas market volatility
Remaining Commercial Gas Reserves (2P): 35 tcf

- Sarawak holds >50% of the remaining reserves
  - Average field size: <1.5 tcf
  - 86% of these fields are stranded and/or deepwater

MALAYSIA REMAINING COMMERCIAL GAS RESERVES BY REGION

- PENINSULAR MALAYSIA: 53%
- SARAWAK: 22%
- SABAH: 20%
- Others: 5%

Source: Woodmac Malaysia Country Overview, Feb 2015
Malaysia Gas Monetisation Challenges

- Small reservoir size
- Distance from gas evacuation infrastructure
- Deepwater, off shelf remaining reserves
- Processing complexity (sour gas)

Bintulu MLNG is the only practicable gas evacuation in Sarawak
- All existing 9 trains are at full capacity up to 2023
- 10th train planned but not yet confirmed (not sufficient reserves)
- MLNG gas gathering infrastructure is strongly controlled by one Operator

Limited domgas demand in the Sarawak / Sabah region
- Sabah-Sarawak pipeline to MLNG is only a partial mitigation
Petronas sees FLNG as a solution to monetise marginal gas fields

**SMALL GAS RESERVOIR (<1.5 tcf)** + **STRANDED and /or DEEPWATER** = **MARGINAL GAS FIELD**

Petronas focused on small FLNG to unlock these opportunities

+ 2 FLNGs are currently in execution

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## Malaysia FLNG Solution

<table>
<thead>
<tr>
<th></th>
<th><strong>PFLNG1</strong></th>
<th><strong>PFLNG2</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Location</strong></td>
<td>Kanowit Gas Field, 180km offshore Bintulu, Sarawak</td>
<td>Rotan Gas Field, 240km offshore Kota Kinabalu, Sabah</td>
</tr>
<tr>
<td><strong>Reserves</strong></td>
<td>N/A</td>
<td>950 bcf</td>
</tr>
<tr>
<td><strong>Capacity</strong></td>
<td>1.2 MTPA</td>
<td>1.5 MTPA</td>
</tr>
<tr>
<td><strong>Award</strong></td>
<td>2Q 2012</td>
<td>1Q 2014</td>
</tr>
<tr>
<td><strong>Est. 1st LNG</strong></td>
<td>1Q 2016</td>
<td>1Q 2018</td>
</tr>
<tr>
<td><strong>Hull Size</strong></td>
<td>300m (L) x 60m (W) x 33m (D)</td>
<td>321m (L) x 64m (W) x 31m (D)</td>
</tr>
<tr>
<td><strong>LNG Storage Capacity</strong></td>
<td>177,000 m³</td>
<td>177,000 m³</td>
</tr>
<tr>
<td><strong>FLNG Mooring</strong></td>
<td>External Turret</td>
<td>External Turret</td>
</tr>
<tr>
<td><strong>Loading</strong></td>
<td>Side by Side</td>
<td>Side by Side</td>
</tr>
<tr>
<td><strong>Water Depth</strong></td>
<td>70m-200m</td>
<td>500m-1500m</td>
</tr>
<tr>
<td><strong>Design Life</strong></td>
<td>20 years</td>
<td>20 years</td>
</tr>
<tr>
<td><strong>LQ</strong></td>
<td>100-150 pax</td>
<td>100-150 pax</td>
</tr>
</tbody>
</table>

Source: Petronas Press Releases
A step change in the marginal field development landscape

CONVENTIONAL GAS UPSTREAM DEVELOPMENT PHASES

GATHER

PROCESS

EXPORT TO SHORE

LIQUEFY / DOMGAS

FLNG
An integrated facility merging process, export and liquefaction functionalities into one single asset.

Can the SEA FLNG Approach Monetise Small Australian Stranded Gas Resources?
Field Development Configurations

1. **FLNG + WHRP/Subsea Gathering**
   - Mooring
   - Riser
   - PLET
   - WHRP
   - Marginal field most likely implementation

2. **FLNG + CPP + WHRP Gathering**
   - Mooring
   - Riser
   - Gas/Liquid Pipeline(s)
   - CPP
   - Allows complex processing (i.e., high contaminants)

3. **FLNG + Subsea Processing**
   - Mooring
   - Riser
   - Gas/Liquid Pipeline(s)
   - PLET
   - Short field life (<20 years) minimizes reliability issues

A SIMPLIFIED DEVELOPMENT

NO 3RD PARTY PROCESSING OR EVACUATION

STORE/SELL BOTH GAS AND LIQUIDS

PROCESS FACILITIES ARE CLOSER TO WELLS
- Less dependence on chemicals
- Reduce slugs and liquid hold-up risks
- No need for compression
- Allows implementation of alternative hydrate management technologies (DEH)

REDUCE ENVIRO IMPACT AND DECOMMISSIONING LIABILITIES

Can the SEA FLNG Approach Monetise Small Australian Stranded Gas Resources?
New contracting strategies for gas developments

1. OPERATOR FULLY OWNED
Operator owns and operates the FLNG + gathering infrastructure

2. JV MODEL (PFLNG 1 & 2)
1st JV partner owns and operates the FLNG. Gathering infrastructure is owned and operated by a 2nd JV partner
- 2nd JV partner responsible for exploration and development drilling
- Battery limit at the turret
- 2nd JV partner sells gas at the battery limit
- FLNG operations commoditised & paid via adjusted gas price

3. LEASED MODEL (GOLAR)
Operator leases FLNG (bare vessel + O&M) + owns and operates gathering infrastructure
- Operator responsible for exploration + development drilling
- FLNG operations commoditised
- Similar to FPSO model
Golar Leased FLNG Solution

**WORLD'S FIRST-OF-ITS-TYPE CONVERSION OF A LNG CARRIER**

**FIRST LEASED FLNG**

**KEY BENEFITS**
+ -50% CAPEX vs new built FLNG
+ -30% execution duration vs new built FLNG
+ Leased option minimises upfront investment

Golar has recently awarded on speculation a third vessel (Gandria) to Keppel shipyard for conversion

<table>
<thead>
<tr>
<th></th>
<th>Hilli</th>
<th>Gimi</th>
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</thead>
<tbody>
<tr>
<td>Location</td>
<td>Kribi Project, Cameroon</td>
<td>Fortuna Project, Block R, Equatorial Guinea</td>
</tr>
<tr>
<td>Operator</td>
<td>Perenco</td>
<td>Ophir</td>
</tr>
<tr>
<td>Reserves</td>
<td>500 bcf</td>
<td>2.5 tcf</td>
</tr>
<tr>
<td>Capacity</td>
<td>1.2 MTPA</td>
<td>2.2 MTPA</td>
</tr>
<tr>
<td>Award</td>
<td>3Q 2014</td>
<td>3Q 2016 (est.)</td>
</tr>
<tr>
<td>Est. 1st LNG</td>
<td>2Q 2017</td>
<td>2Q 2019 (est.)</td>
</tr>
<tr>
<td>Vessel</td>
<td>Converted LNG tanker (Keppel shipyard)</td>
<td>Converted LNG Tanker (Keppel shipyard)</td>
</tr>
<tr>
<td>LNG Storage Capacity</td>
<td>125,000 m3</td>
<td>125,000 m3</td>
</tr>
<tr>
<td>Field Life</td>
<td>&lt;10 years</td>
<td>&lt;20 years (est.)</td>
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</table>

Source: Golar / Ophir Press Releases, 2015
## 6 Reasons to choose small FLNG for marginal developments

<table>
<thead>
<tr>
<th></th>
<th>Access remote fields</th>
<th>Deliver cheaper and faster</th>
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<tbody>
<tr>
<td>1</td>
<td>- No pipelines</td>
<td>- Monetise reserves otherwise non-economic</td>
</tr>
<tr>
<td></td>
<td>- No dependency on 3rd party tie-backs, ullage constraints</td>
<td>- Reduce upfront CAPEX and cashflow</td>
</tr>
<tr>
<td></td>
<td>- Floating facility fits deepwater scenarios</td>
<td>- Faster schedule vs grass root facility</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Get enviro approvals more easily</td>
</tr>
<tr>
<td>2</td>
<td>Design one, build many</td>
<td>New contracting strategies</td>
</tr>
<tr>
<td></td>
<td>- Modular, standardised design</td>
<td>- JV-model facilitates small/mid cap operators</td>
</tr>
<tr>
<td></td>
<td>- Build in smaller yards</td>
<td>- Broadens range of involved service providers</td>
</tr>
<tr>
<td></td>
<td>- Economy of scale</td>
<td>- Lease opportunity</td>
</tr>
<tr>
<td></td>
<td>- Avoid Gold Rush</td>
<td>- Commoditise technology</td>
</tr>
<tr>
<td>3</td>
<td>Use over multiple fields</td>
<td>New commercial options</td>
</tr>
<tr>
<td></td>
<td>- Relocate FLNG, produce multiple fields</td>
<td>- No 3rd party tariffs or O&amp;M liabilities</td>
</tr>
<tr>
<td></td>
<td>- Develop spread reserves</td>
<td>- Avoid gas export infrastructure - offload directly to LNG tanker</td>
</tr>
<tr>
<td></td>
<td>- Allow project phasing</td>
<td>- Control gas price and marketing</td>
</tr>
<tr>
<td></td>
<td>- Early production system for large fields</td>
<td></td>
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</tbody>
</table>
Malaysian vs Australian FLNG Concepts: A matter of scale

<table>
<thead>
<tr>
<th></th>
<th>Small Scale FLNG</th>
<th>Large Scale FLNG</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Capacity</strong></td>
<td>&lt;2.0 mtpa</td>
<td>&gt;3.0 mtpa</td>
</tr>
<tr>
<td><strong>Required Gas Reserves</strong></td>
<td>0.5-2.0 tcf</td>
<td>&gt;3.0 tcf</td>
</tr>
<tr>
<td><strong>Field Life</strong></td>
<td>5-10 years</td>
<td>&gt; 20 years</td>
</tr>
<tr>
<td><strong>Storage Capacity</strong></td>
<td>&lt;180,000 m³</td>
<td>&lt;250,000 m³</td>
</tr>
<tr>
<td><strong>Fab. Yard Scale</strong></td>
<td>Small/Medium</td>
<td>Large</td>
</tr>
<tr>
<td><strong>Est. Total Project CAPEX</strong></td>
<td>&lt; US$ 3.0 billion</td>
<td>&gt; US$ 10.0 billion</td>
</tr>
<tr>
<td><strong>Est. Project Duration (FID to 1st LNG)</strong></td>
<td>3.5-4 years</td>
<td>&gt;5 years</td>
</tr>
<tr>
<td><strong>Employment</strong></td>
<td>Marginal fields</td>
<td>Giant fields</td>
</tr>
<tr>
<td><strong>Participants</strong></td>
<td>O&amp;G small/mid cap</td>
<td>O&amp;G large cap only</td>
</tr>
<tr>
<td><strong>Examples</strong></td>
<td>PFLNG, Golar</td>
<td>Prelude</td>
</tr>
</tbody>
</table>

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Malaysian vs Australian FLNG Concepts: Three key differences

1. CHEAPER LIQUEFACTION COST

- **Gold-rush effects**: Liquefaction CAPEX increased more than average upstream cost escalation (UCCI)
- **Australian LNG & FLNG projects** are on the **upper cost band**
- Estimated Small FLNG cost (US$/tpa) is **below recent assets range**, 30% cheaper

2. FASTER EXECUTION SCHEDULE

- **30% shorter execution schedule**
- Smaller size reduces design and fabrication complexity
- Allows use of modular, standard liquefaction equipment
- Transfer of lessons learned
- Uncertainty over commissioning and start-up phases

3. ACCESS MORE FABRICATION YARDS

- **Small FLNG vessels** fit within a **wider range** of fabrication yards
- Opportunity to use yards with **experience in FPSO & LNG tankers** fabrication
- **Risk reduction** due to less complex construction practices, predictable productivity and better established safety performance

Sources: Oxford Institute for Energy Studies, 2014
Look Ahead

FLNG PROJECTS WORLDWIDE

168 mtpa
Total proposed FLNG capacity as of early 2015

8.0 mtpa
FLNGs Under Construction
Africa, Australia, Colombia, Malaysia

FUTURE IS BRIGHTER FOR SMALL SCALE FLNGs:
- More marginal fields than giant fields
- Commoditised technology (FPSO model)
- More operators and service contractors involved
- Possible financing of FLNG as a standalone asset

RECENT OIL PRICE COLLAPSE IS NOT EXPECTED TO CHANGE THIS SCENARIO
- Petronas claims PFLNG can be economic on a 500 bcf field at 60 US$/bbl
- FLNG re-use opportunity: rely on long term economics based on multiple marginal fields
- Need to control current liquefaction cost escalation but CAPEX will reduce with experience and increased number of projects

4 Risks of FLNG projects

1. As-yet unproven concept
   - Novel design
   - No robust cost/schedule basis
   - Risk of budget / schedule escalation
   - Know-how in the hands of few service providers
   - No operating history

2. Smaller means higher safety risk
   - All processing equipment in close proximity
   - Susceptible to escalation
   - Safety risk will increase operations complexity

3. High production downtime
   - Complex commissioning phase
   - Lack of operations experience

4. Global gas market instability
   - LNG demand and price
   - Operators less inclined to novel concepts
   - Ability to establish long term sales contracts due to small reserves and plateau production
Australia has the conditions to implement the small FLNG model

- **Stranded gas**
  - Fields with <2tcf reserves
  - Spread >2tcf fields that could be phased

- **Deepwater fields**
  - Established subsea technical know-how

- **Operators will favor more cautious investments in the future**
  - Many recent projects experienced severe budget overruns

- **LNG and future FLNG operating know-how**

- **LNG sales intelligence**
  - Developed by local operators and partners (WEL, Chevron, Inpex and other Japanese companies)
  - Easier to market smaller LNG quantities

- **First agreements for 3rd party upstream tie-backs are appearing**
  - 3rd party Hess feed stock into Woodside Karratha
  - Woodside Julimar/Brunello field tie-back to Chevron Wheatstone
Conclusions

1. SMALL FLNGs ADD VALUE TO MARGINAL AND STRANDED OFFSHORE GAS RESOURCES OTHERWISE UNECONOMICAL TO DEVELOP

2. AUSTRALIA APPEARS AN IDEAL REGION TO EMPLOY THE SMALL FLNG MODEL

3. NEAR TERM FLNG OPERATIONS WILL DETERMINE FURTHER INVESTMENT CONFIDENCE
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