LNG Bunkering in Australia
How to Scale up & Diversify via Small Scale LNG

Online
29 July 2020
## Agenda

<table>
<thead>
<tr>
<th>Item</th>
<th>Presenter</th>
</tr>
</thead>
</table>
| Introduction                        | Margot Matthews  
CEO  
LNG Marine Fuel Institute          |
| Australian Opportunity – Size of the pie | Jonathan Abrahams  
Head of Maritime Advisory, Regional Representative Australia, New Zealand  
DNV GL                               |
| Scalable options for Australian ports | Fraser Bennie  
Global Director, LNG, Hydrogen & Marine Chart Industries            |
| Q&A                                 | All                                                                       |
Vision
LNG is the primary marine fuel to benefit the nation, grow our industry and reduce our environmental footprint.

Purpose
Galvanize & drive invested stakeholders to enable LNG as a marine fuel.

How
● Collaborate with industry & government
● Knowledge development and sharing
● Inform Industry and government

To join us go to www.lng-mfi.org
IMO has set GHG intensity and absolute emission targets 2030 & 2050

LNG is the cleanest marine fuel currently commercially available

A TWO-PRONGED APPROACH TO DECARBONISING SHIPPING

GROW LNG SHIP FLEET & BUNKERING CAPACITY

RELENTLESSLY DEVELOP ZERO EMISSION FUELS

It's not a case of doing one or the other. We need both.
WAITING IS CLEARLY NOT AN OPTION

- **BUSINESS AS USUAL**
- **WAIT FOR ZERO EMISSION FUEL**
- **COST OF WAITING FOR ZERO EMISSIONS**
- **LNG FUEL + OTHER EFFICIENCY IMPROVEMENTS**
- **IMO TARGET (50% REDUCTION IN GHG EMISSIONS)**

**GHG EMISSIONS**

2008 (BASE YEAR)  2020  2030  2040  2050

(POTENTIAL COMMERCIAL AVAILABILITY OF ZERO EMISSION FUELS)
Jonathan Abrahams

- Head of Maritime Advisory, Regional Representative Australia, New Zealand DNV GL
- Joined DNV GL in Norway 2007
- Head’s Shipping Advisory practice for South East Asia Pacific and India
- Led numerous projects on energy efficiency, alternative fuels, environmental compliance
- Engaged with supply chain, customers, charterers, owners, operators and regulators
How big is the pie?

Demand for LNG as a marine fuel in Australia – a snapshot

Presented by DNV·GL
A global quality assurance and risk management company

12,000 employees
150+ years
100+ countries
100,000+ customers
5% R&D of annual revenue

MARITIME
OIL & GAS
ENERGY
BUSINESS ASSURANCE
DIGITAL SOLUTIONS

Technology & Research
Global Shared Services
Recent LNG supply chain engagements

- **Green Corridor (2016-18)**
  - West Australia Pilbara mining sector
  - Sought to test the feasibility of LNG fuelled bulkers
  - Design a ship
  - Involvement from mining, gas suppliers, regulators, ship designer

- **Indonesia (2018/19)**
  - Techno-commercial studies comparing environmental compliance of LNG versus Scrubber/HFO
  - CAP2020 a driver

- **East Coast Australia LNG Marine Fuel Joint Industry Project - 2020**
  - Quantify marine fuel demand using 2018/19 baseline
  - Account for fleet development, fuel mix, price sensitivity
  - Funded by upstream suppliers from across Australia and SE Asia with contributions from ship owners, operators, regulators and industry associations

- “Accelerate the transition to lower emission marine fuels through the uptake of LNG on the East Coast of Australia”
## West Coast JIP versus East Coast JIP

<table>
<thead>
<tr>
<th>West Coast Australia</th>
<th>East Coast Australia</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 port</td>
<td>23 ports</td>
</tr>
<tr>
<td>Population ca. 1m</td>
<td>Population ca. 20m</td>
</tr>
<tr>
<td>Single segment</td>
<td>Major segments</td>
</tr>
<tr>
<td>Single trade route</td>
<td>container, bulker,</td>
</tr>
<tr>
<td>(Nth Asia to/from</td>
<td>tanker, passenger</td>
</tr>
<tr>
<td>Port Hedland)</td>
<td>Multiple trade</td>
</tr>
<tr>
<td></td>
<td>routes</td>
</tr>
</tbody>
</table>
East Coast Australia JIP Demand Dashboard

- Based on 2018/19 financial year
  - Pre IMO2020
  - Pre COVID
  - Infancy for LNG (162 ships-in-operation worldwide)
- AIS methodology estimate fuel consumed
- Utilised research and analysis from inhouse, IEA, IMO and others
  - Energy demand
  - Alternative duel developments
  - Fleet development
  - Technology uptake
### Gladstone demand baseline

**Vessel arrivals*** 2284

<table>
<thead>
<tr>
<th>Ship Type</th>
<th># arrivals</th>
<th>Average size</th>
<th>Fuel consumed</th>
</tr>
</thead>
<tbody>
<tr>
<td>LNG Tanker</td>
<td>476</td>
<td>102k GT</td>
<td>530k MT</td>
</tr>
<tr>
<td>Bulkers</td>
<td>1,253</td>
<td>54k GT</td>
<td>490k MT</td>
</tr>
<tr>
<td>Bunker tanker</td>
<td>68</td>
<td>2600 GT</td>
<td>-</td>
</tr>
<tr>
<td>Tugs</td>
<td>75</td>
<td>600 GT</td>
<td>-</td>
</tr>
</tbody>
</table>

### Country of origin

<table>
<thead>
<tr>
<th>Country of origin</th>
<th># arrivals</th>
<th>Total fuel consumed</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>414</td>
<td>238k MT</td>
</tr>
<tr>
<td>Japan</td>
<td>234</td>
<td>127k MT</td>
</tr>
<tr>
<td>Korea</td>
<td>103</td>
<td>76k MT</td>
</tr>
<tr>
<td>Taiwan</td>
<td>45</td>
<td>19k MT</td>
</tr>
<tr>
<td>Singapore</td>
<td>30</td>
<td>19k MT</td>
</tr>
</tbody>
</table>

- Vessel arrival defined as movement of a vessel into defined port area
- Fuel consumed defined as estimate of fuel burned on voyage to designated port only

**Total fuel consumed: 1.09m MT**
# Port of Newcastle demand baseline

<table>
<thead>
<tr>
<th>Vessel arrivals*</th>
<th>2250</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ship Type</strong></td>
<td></td>
</tr>
<tr>
<td><strong># arrivals</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Average size</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Fuel consumed</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Bulkers</strong></td>
<td>1,894</td>
</tr>
<tr>
<td><strong>Dry Cargo</strong></td>
<td>169</td>
</tr>
<tr>
<td><strong>Oil / Chemical Tanker</strong></td>
<td>79</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Country of origin</th>
<th># arrivals</th>
<th>Total fuel consumed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>623</td>
<td>327k MT</td>
</tr>
<tr>
<td>China</td>
<td>482</td>
<td>261k MT</td>
</tr>
<tr>
<td>Taiwan</td>
<td>156</td>
<td>70k MT</td>
</tr>
<tr>
<td>Korea</td>
<td>103</td>
<td>62k MT</td>
</tr>
<tr>
<td>Canada</td>
<td>20</td>
<td>20k MT</td>
</tr>
</tbody>
</table>

- Vessel arrival defined as movement of a vessel into defined port area
- Fuel consumed defined as estimate of fuel burned on voyage to designated port only

**Total fuel consumed: 1.05m MT**
## Port of Fremantle demand baseline

<table>
<thead>
<tr>
<th>Vessel arrivals*</th>
<th>1841</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ship Type</td>
<td># arrivals</td>
</tr>
<tr>
<td>Container</td>
<td>817</td>
</tr>
<tr>
<td>Dry Cargo</td>
<td>642</td>
</tr>
<tr>
<td>Oil / Chemical</td>
<td>88</td>
</tr>
<tr>
<td>Passenger</td>
<td>63</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Country of origin</th>
<th># arrivals</th>
<th>Total fuel consumed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Singapore</td>
<td>250</td>
<td>73k MT</td>
</tr>
<tr>
<td>Indonesia</td>
<td>93</td>
<td>16k MT</td>
</tr>
<tr>
<td>South Africa</td>
<td>54</td>
<td>17k MT</td>
</tr>
<tr>
<td>Reunion</td>
<td>63</td>
<td>31k MT</td>
</tr>
<tr>
<td>Malaysia</td>
<td>49</td>
<td>19k MT</td>
</tr>
</tbody>
</table>

- Vessel arrival defined as movement of a vessel into defined port area
- Fuel consumed defined as estimate of fuel burned on voyage to designated port only

**Total fuel consumed: 384k MT**
Gladstone forecast demand

- Scenario baseline assumptions
  - LNG capable fleet in line with Regional growth
  - Australia price the same as Singapore and LNG=LSFO
  - 50% of fuel consumed on voyage to port is replaced
  - Bulkers only

- Scenario 1
  - LNG price is 20% less than LSFO (ref: H1, 2020)

- Scenario 2
  + LNG price in Australia 20% less than Singapore
Gladstone forecast demand
Port of Newcastle forecast demand

- Scenario baseline assumptions
  - LNG capable fleet in line with Regional growth
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- Scenario 1
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- Scenario 2
  - LNG price in Australia 20% less than Singapore
Port of Newcastle forecast demand
Port of Fremantle forecast demand

- Scenario baseline assumptions
  - LNG capable fleet in line with Regional growth
  - Australia price the same as Singapore and LNG=LSFO
  - 50% of fuel consumed on voyage to port is replaced
  - Containers only

- Scenario 1
  - LNG price is 20% less than LSFO (ref: H1, 2020)

- Scenario 2
  + LNG price in Australia 20% less than Singapore
Port of Fremantle forecast demand
Concluding remarks

- Policy/regulations
  - Develop with the industry
  - Government support in the form of infrastructure and/or price subsidy
  - Incentives at Port-level
- Social license to operate
  - Nearby urban populations require convincing of the value of any shipping
  - Shore-side impacts
- Smaller vessels to garner support
  - Tugs, pilot vessels, passenger ferries
- LNG is a transition fuel (30+ years)
  - Synthetic LNG / BIO LNG
Lower Emissions For A Better Future

www.lng-mfi.org
Modular SSLNG Terminals for Australia
Fraser Bennie

- Global Director, LNG, Hydrogen & Marine with Chart Industries
- Worked LNG in the marine sphere since the late 1990’s after several years working for upstream gas compression projects
- Chart Industries specialising in cryogenic systems and technologies.
Chart is specialist in highly engineered solutions for LNG and Hydrogen

- Liquefaction
- Storage
- Distribution
- Vaporization and end-use

With a global reach, Chart has its principal engineering and manufacturing centres across the US, Europe, China & India.
Modular SSLNG Terminals

Chart SSLNG Terminals

- Reduces Cost
- Reduced Real Estate
- Rapid installation time
- Simple project management
- Minimum civil engineering

Expand your Terminal with your business growth
SSLNG Terminals : Repowering Gibraltar

This compact Chart SSLNG Terminal switched Gibraltar from diesel to LNG.
SSLNG Terminals: Repowering Gibraltar

Gibraltar International Airport & RAF Base

Residential Area
Population 33718

80MW Power Plant

Chart’s SSLNG Terminal
5000M3 of LNG

Cruise Terminal
SSLNG Terminals: Repowering Gibraltar

- 5 x 1000m³ of LNG Capacity
- High Performance, Vacuum Insulated, Double Containment, fully Stainless Steel tanks
  - LNG Pumps, Vaporizers and Heat delivery system
  - LIN system
  - Gas regulation station
  - Control system
  - Marine Loading Arm
  - Emergency Release
  - Quick Connect Couplings
  - SSL

50 metres
SSLNG Terminals: Multi-function Klaipeda

Chart's Multi-function SSLNG Terminal. 5000M3 of LNG

Sea Delivery and rebunker lines
SSLNG Terminals: Multi-function Klaipeda

Gas Vaporizers, by Chart

LNG delivery by sea is also the bunker send out line.

Chart’s SSLNG Terminal of 5000M3

Chart Service The Lifecycle Team!

2 LNG Truck Loading bays

(Chart makes LNG trucks)
SSLNG Terminals : Multi-function Klaipeda

Chart’s SSLNG Terminal

Resupplying the SSLNG Terminal

FSRU “Independence”

Lithuanian Sea Museum/ Lietuvos jūrų muziejus

Smiltyne

Distance
7,376.43 m

Lower Emissions For A Better Future

LNG
MARINE FUEL INSTITUTE
Madeira – Virtual Pipeline

520 Nautical Miles (560 km)

LNG delivery from Portugal to Madeira

Then trucked inland to the Chart LNG Satellite Plant

LNG Satellite Plant
Madeira – Virtual Pipeline

Satellite LNG Regasification Plant
600m³ Storage
8 Vaporizer Stacks
55 ISOContainers

with maximum payload 43.5m³
LNG ISOcontainers

ISO Containers fleet = 55
Energy supply up to 450 GWh/year
Business Ideas for Australian Ports
Australian Ports & SSLNG Terminals

Gladstone, Curtis Island

Chart Example:
Montego Bay, Jamaica
7000m³ SSLNG Terminal

Opening up Multi-functional business opportunities
Australian Ports & SSLNG Terminals

Fremantle: Start, invest, diversify and grow your plant as you earn by adding capacity
Australian Ports & SSLNG Terminals

Port Kembla:
- FSRU breakbulk.
- Truck & Regas
- LNG inland

5000m³ of LNG = 120m x 120m of Real Estate
Australian Ports & SSLNG Terminals

Newcastle:
LNG bunker station

Build business by trucking LNG to a Satellite Regas Plant inland
Refueling the ships
Chart’s LNG fuel gas system powers the Australian built Francisco, the world’s fastest and cleanest high speed ferry.
Marine Fueling Systems is standard with Chart

The Australian ferry SeaRoad Mersey uses Chart LNG semi-trailers as fuel tanks

In Norway, several ferries transport 589 passengers and 212 cars with Chart’s LNG fuel system

Several fleets of Yangtze river barges run with our engineered LNG fuel systems
In Conclusion

SSLNG Terminals Bring Business

- Bunkering
- Gas to Power
- Inland trucking
- LNG filling stations
- Satellite regasification plants

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Fraser.Bennie@Chartindustries.com
Thank You
LNG Bunkering in Australia

Q & A
SESSION 1: IMO Update – The Shipping emissions reduction ambition  
Tuesday, August 4 - 3pm AEST, 1pm AWST

SESSION 2: Lifecycle Assessment 101  
Tuesday, August 11 – 3pm AEST, 1pm AWST

SESSION 3: An Alternative Fuels Overview  
Tuesday August 18 – 3pm AEST, 1pm AWST