Transportation Research Board
Transporting LNG Marine In The Marine Sector

May 2014
WesPac Midstream LLC

- WesPac founded in 1998 to develop, own, and operate energy infrastructure projects
- Project history in tank farms, pipelines, marine terminals, rail offloading, and airport fuel facilities
- Focus on LNG, NGL, and gas processing infrastructure
- Geographic emphasis is in North America, Central America, and Caribbean

Ownership

- $7 Billion Independent, infrastructure investment firm with deep expertise in energy investing and development
- Portfolio includes Kinder Morgan G.P., Ports America, Southern Star, Advanced Disposal

- Diversified construction company focused on energy, including pipelines, terminals, power plants, process and refining
- Over 5,000 employees, revenue $1.5BB, strong balance sheet and large bonding capabilities

Newark Container Terminal, Jaxport Container Terminal, American Ref-Fuel Plant, Kern River Pipeline, Boron LNG Plant, Sunrise Power Plant
LNG Projects In Development
Conventional Midstream Developer Business Model

Commodity Buyer

Commodity Producer

Developer

- Originates structures
- Coordinates commercial & technical aspects

Infrastructure Provider
Emerging Market Integrator Business Model
Multiple Stakeholders Interests Must Be Addressed to Implement LNG Project

LNG Buyer
- Fuel cost savings must justify conversion cost
- Security of supply
- Fueling infrastructure

LNG Producer
- Netbacks no worse than alternative projects
- Credit worthy customers

Infrastructure Provider
- Adequate returns
- Term agreements to support financing
- Credit quality

Integrator
- Establishes markets
- Originates structures
- Glues pieces together
- Coordinates commercial & technical aspects

Logistics Supplier
- Emerging designs
- Economies of scale
- Ability to integrate into existing supply chain

Marketer
- Sufficient Netbacks after LNG and logistics costs
- Supply & demand linkage
Primary Marine LNG Markets

<table>
<thead>
<tr>
<th>Ship Fuel</th>
<th>Ship Cargo</th>
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</table>
| • Bunkering vessels | • Bulk Transport  
  - Large & small vessel |
| • Shore-side fuel terminals | • ISO Tank Transport  
  - Existing commercial  
  - Dedicated ship |

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Marine Logistics Models

LNG Supply Chain

**LNG SUPPLY**
- Container Ship
- Bulk Carrier
- Bunker Ship

**SEA TRANSPORT**
- Container Ship
- Bulk Carrier
- Bunker Ship

**TRANSPORT**
- Truck

**STORAGE**
- ISO Container or Small Tank

**End Use**
- Regas
# LNG Cargo Ship Choices

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ISO Tank Logistics Chain Example

- Demand requirement of 10 ISOs per day
- ~9,000 MMBtu or 50MW equivalent
- Assumes:
  - 20 day round trip per ISO tank
  - 200 tanks per voyage
  - 1 vessel
- Logistics model requires 3 sets of ISOs
- Total of 600 ISO Tanks
ISO Container Specifications

• Typical Construction
  – Stainless/Nickel steel inner tank
  – Vacuum interstitial space
  – Carbon steel outer tank

• ISO Tank Specs
  – Size – 20 ft. or 40 ft.
  – Volume – 5,000 or 10,000 gallons
  – Hold time - 60 to 110 days

• Uses and Applications
  – Relatively short supply chains
  – Temporary storage
  – Rail and truck transport
Bulk LNG Shipping

• Requires shore side infrastructure
  – Marine import & export terminals
  – Liquefaction
  – Regas

• Existing Global Exports
  – Large scale - 140,000 m³ ships
  – Numerous import & export markets

• Emerging Domestic
  – Small scale - 8,000 to 80,000 ships
  – Potential HI, AK & Caribbean
Supply Chain Creation

Integrate into existing supply chain or establish new?

• Some existing infrastructure may be used for LNG
  – ISO container loading terminals
  – ISO container Cargo Ships
  – Fuel loading terminals

• Other infrastructure must be created
  – Storage and regas facilities
  – Bulk LNG ships
  – LNG loading equipment

• Dependent on end user demand profile & schedule, and current fuel supplier priorities
LNG Marine Logistics Summary

• Emerging marine markets require “Integrators” to piece together multiple stakeholders

• Some aspects of current fuel supply chains can be leveraged to optimize LNG supply chains

• Tailoring supply chains can overcome first mover fears

• ISO tank supply chains can seed emerging markets and provide a bridge to bulk shipping
Thank You