

17th INTERNATIONAL CONFERENCE & EXHIBITION ON LIQUEFIED NATURAL GAS (LNG 17)



Opportunities and Challenges of Using LNG as Fuel in Small- to Medium-Size Power Generation

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International Organizers



Host Association

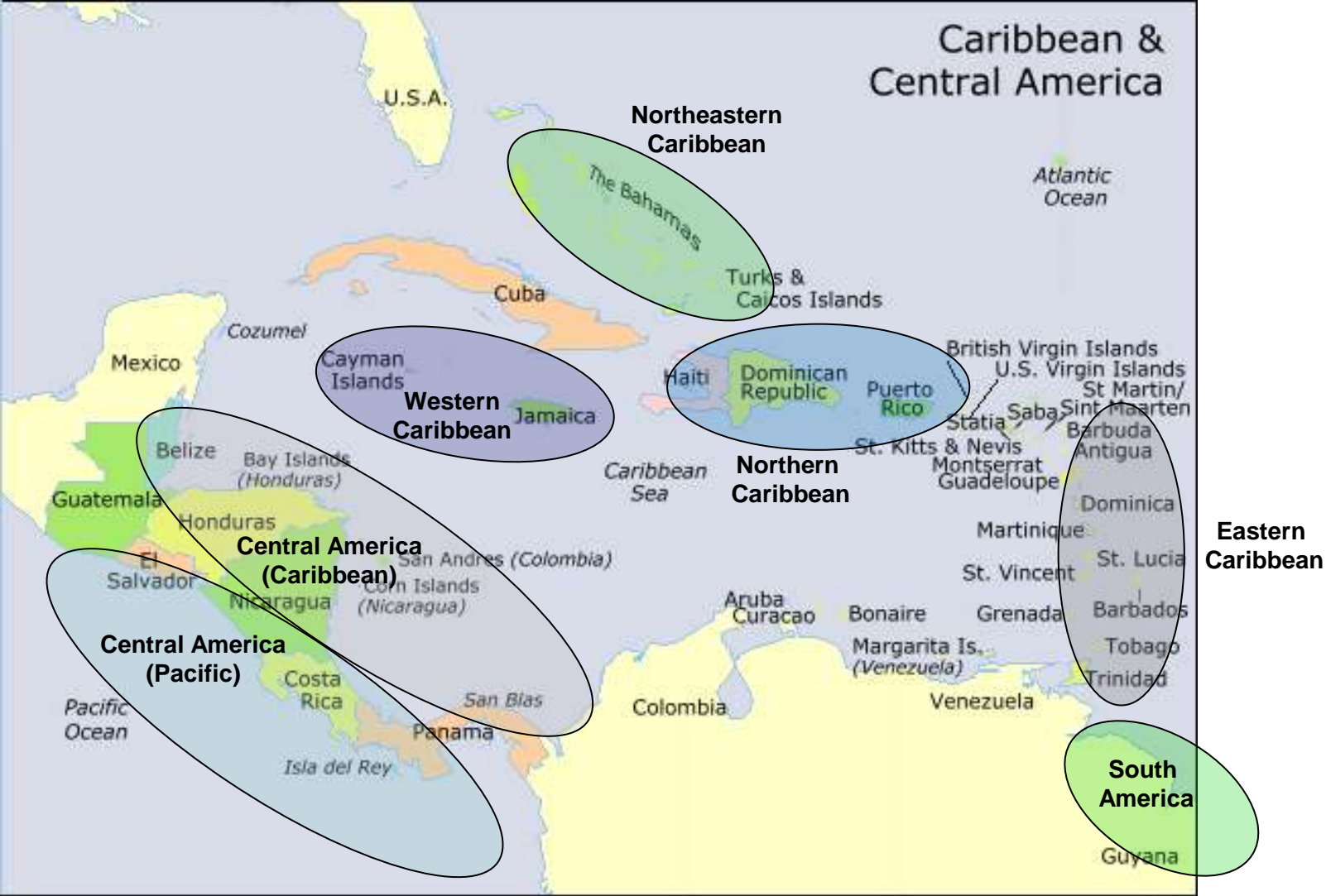


LNG Can Be an Attractive Alternative Fuel for Small-Scale Oil-Fired Power Generation

- In many power markets, heavy fuel oil and diesel are used as primary fuel sources for small-scale power generation
- High fuel costs lead to high power cost, and have a negative impact on local economies
- LNG is a potential alternative fuel – but need to solve challenges of:
 - Logistics
 - Supply source
 - Commercial structure

Case Study

Central America & Caribbean Region



Power Generation Facilities Tend to Be Relatively Small

Area	Fuel Oil Fired Power Generation Clusters							Total	Power Generation Capacity (MW)	Potential LNG Volume (MTPA)
	45 - 100 MW	100 - 200 MW	200 - 300 MW	300 - 400 MW	400 - 500 MW	500 - 1000 MW	> 1000 MW			
E. Caribbean	3	1	0	1	1	0	0	6	1,135	1.5
N. Caribbean	2	2	3	2	0	3	1	13	5,952	8.7
NE. Caribbean	1	1	0	0	1	0	0	3	644	0.9
W. Caribbean	0	2	0	0	0	0	0	2	261	0.4
CA (Caribbean)	0	1	1	1	0	0	0	3	840	1.1
CA (Pacific)	0	1	1	2	1	0	0	5	1,603	2.2
	6	8	5	6	3	3	1	32	10,435	14.7



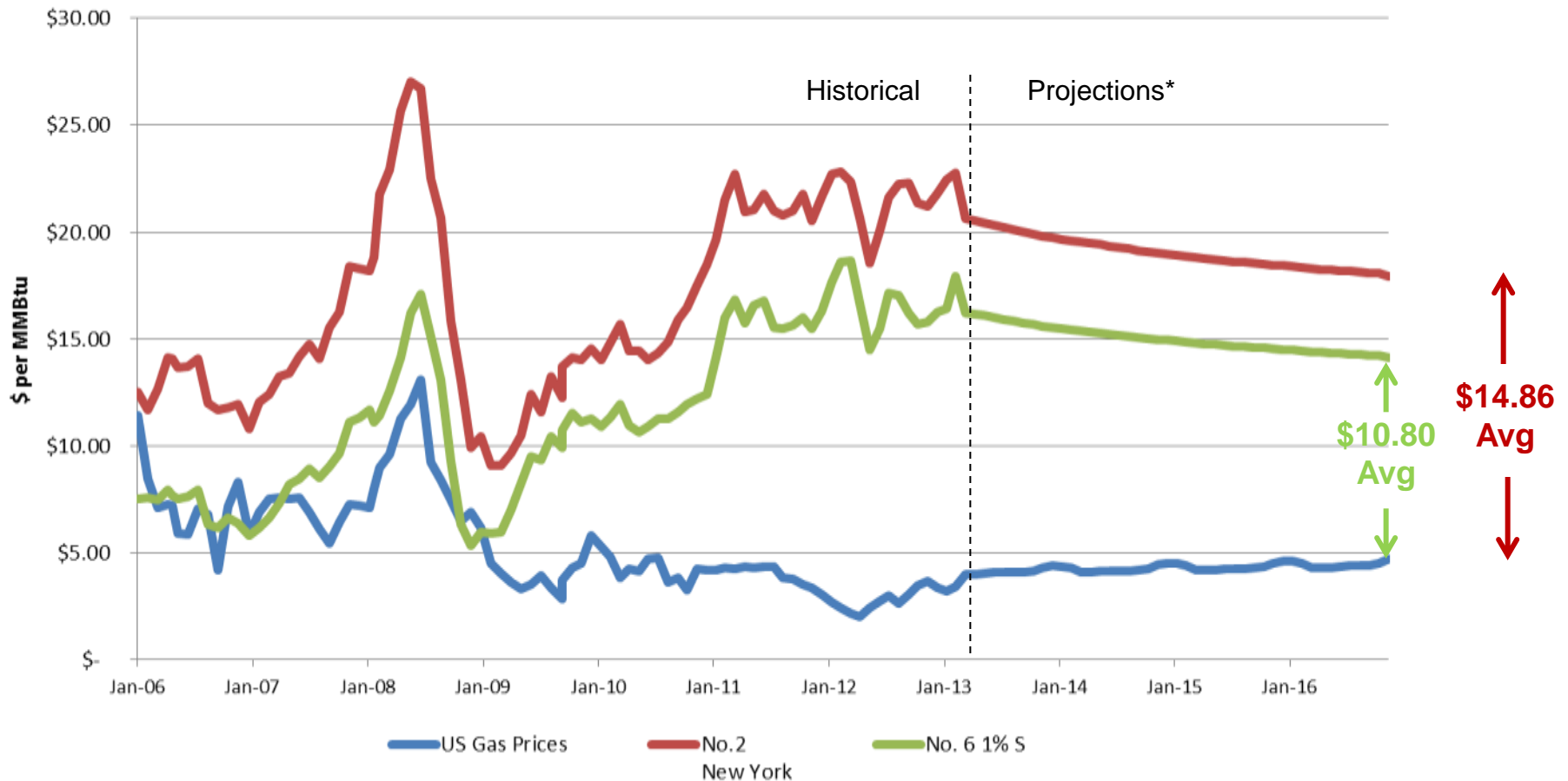
~ 80% of Facilities
 ~ 50% of Installed Capacity

Switching to LNG Delivers Several Key Benefits

- Reduced environmental impact
 - Lower carbon footprint and emissions
 - Reduced opacity
- Lower operating costs
 - Reduced maintenance expenses
 - Potential for higher generation efficiencies
 - Potentially cheaper fuel than HFO or Diesel
- Fuel supply diversity
 - Mitigates risk of potential refinery strategy changes
 - New source of fuel to replace/complement fuel oil
 - Platform for additional natural gas uses

Price Spread Between Gas Price & Fuel-Oil Offers Significant Switching Incentives

Gas Prices vs. Diesel and Heavy Fuel Oil



* Projections based on 3/19/2013 NYMEX forward curve for Henry Hub and Brent

Challenges with “Standard Scale” LNG Logistics Have Hindered Progress

- Shipping logistics
 - Deep water access
 - Tug support & other port services
- Terminal siting & costs
 - Land requirements & availability
 - High Working Capital
 - ~ 125 days of inventory per cargo for 150 MW plant
 - High up-front CAPEX
 - High terminal unit cost can absorb much of the spread
 - 150 MW Plant: LNG requirement ~24,000 MMBtu per Day
 - LNG Terminal CAPEX: \$250 MM (Simple) to \$500 MM (Complex)
 - Terminal Unit Cost Estimate: \$4.30/MMBtu to \$8.20/MMBtu



Small/Mid-Scale LNG Solutions Address Logistical Challenges

- Small-scale ships or barges
 - Reduce fuel inventory working capital
 - May be able to use existing port facilities
- Small Terminals (onshore or floating)
 - Lower CAPEX
 - Smaller footprint
 - Lower Unit Cost

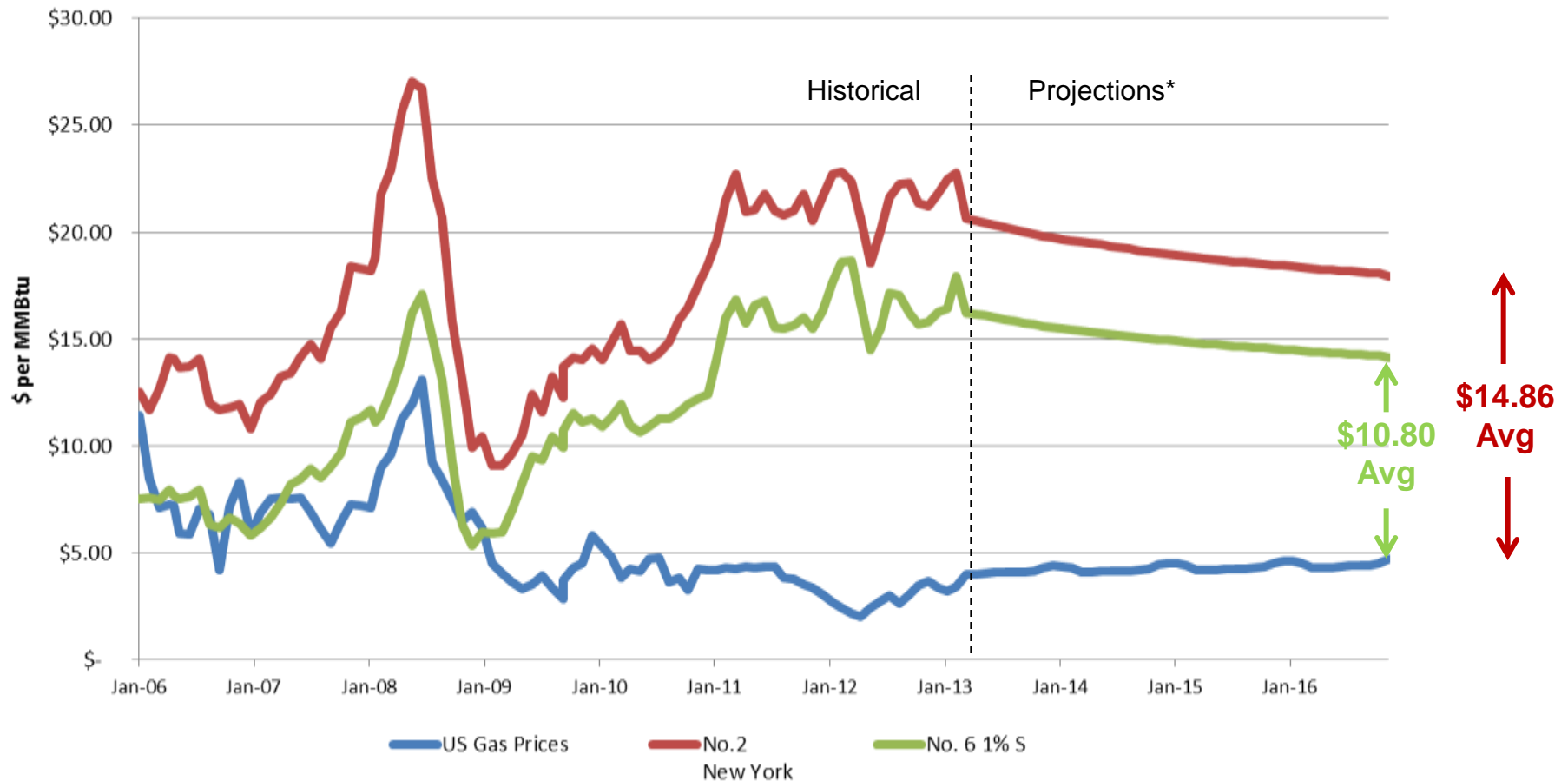


But, Finding Near-term LNG Supplies Continues to Be Challenging

- Access to “global” LNG market is limited
 - Opportunities generally too small for “traditional” suppliers
 - Liquefaction plants reluctant to accommodate small ships
 - Competing with traditional Asian and European markets
- New regional small/mid-scale LNG plants are being developed and are targeting regional rather than global markets
- Potential for “Hub & Spoke” terminals to unload full-sized cargoes and redistribute via smaller ship/barge(s)

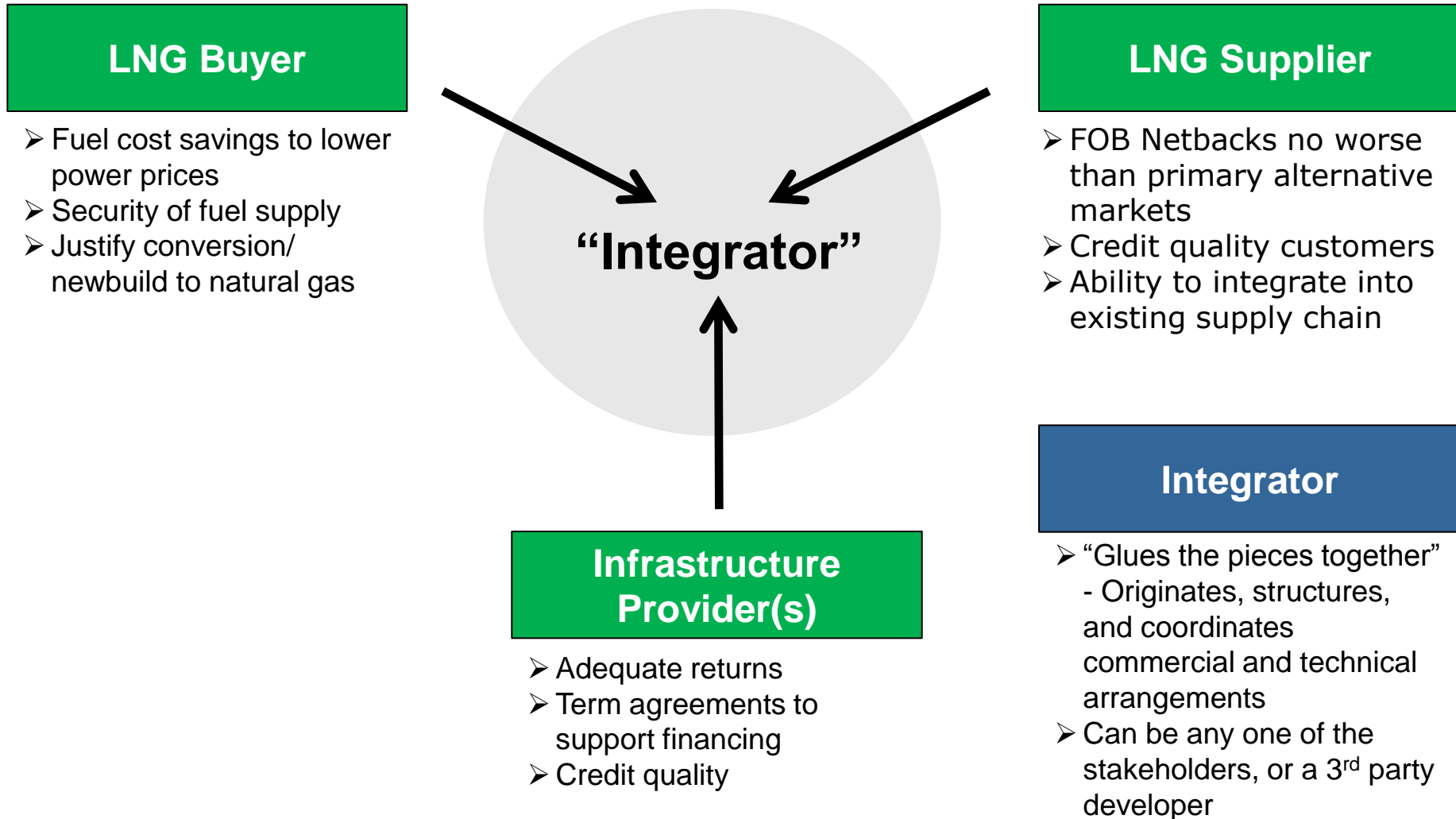
Question Remains How to “Allocate” Potential Fuel Savings Amongst Stakeholder

Gas Prices vs. Diesel and Heavy Fuel Oil



* Projections based on 3/19/2013 NYMEX forward curve for Henry Hub and Brent

Interests of Multiple Stakeholders Must Be Addressed to Implement Small-Scale Project



Case Study

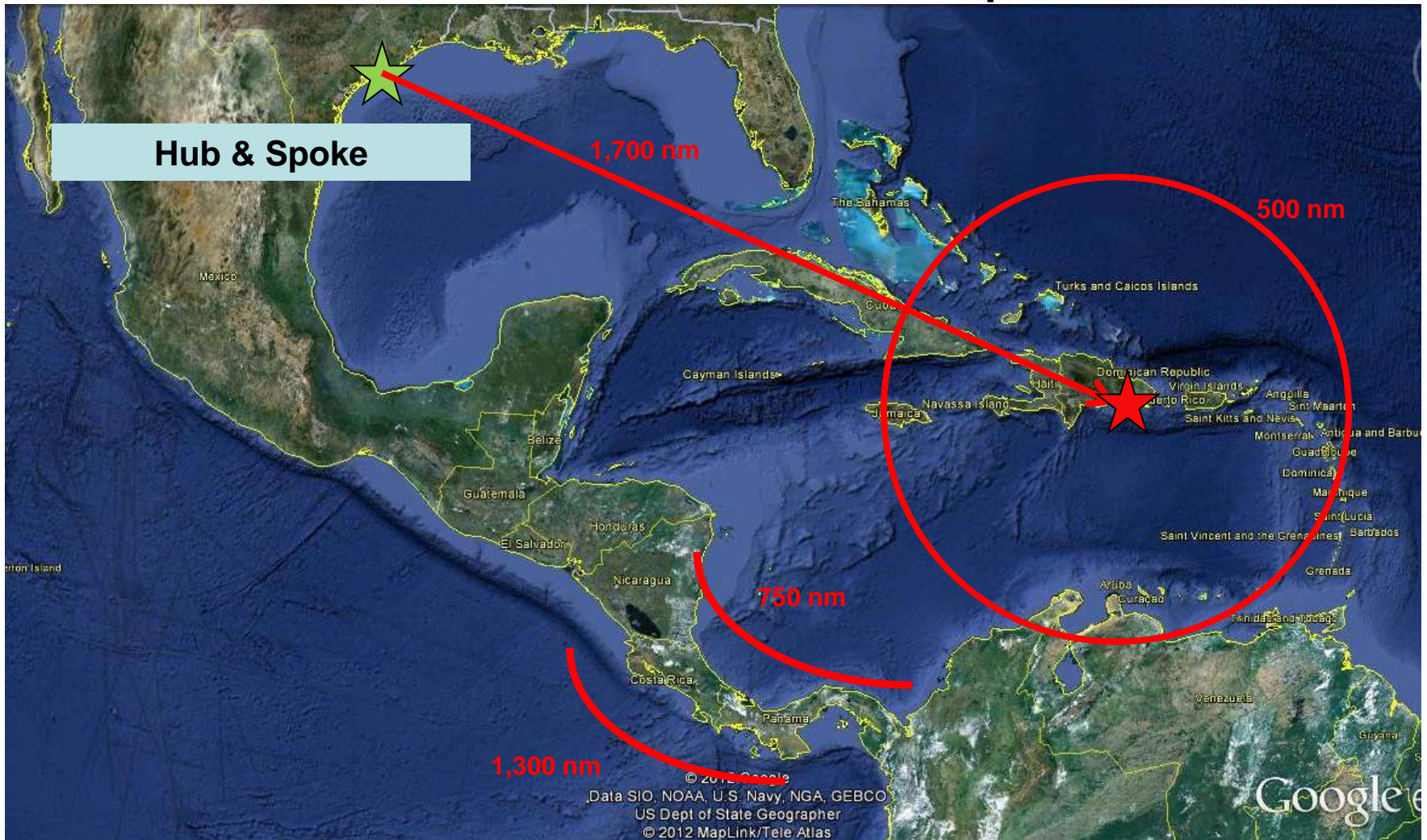
Direct Distribution vs. Hub & Spoke Model



★ Hypothetical U.S. Small/Mid-Scale LNG Export Project

Case Study

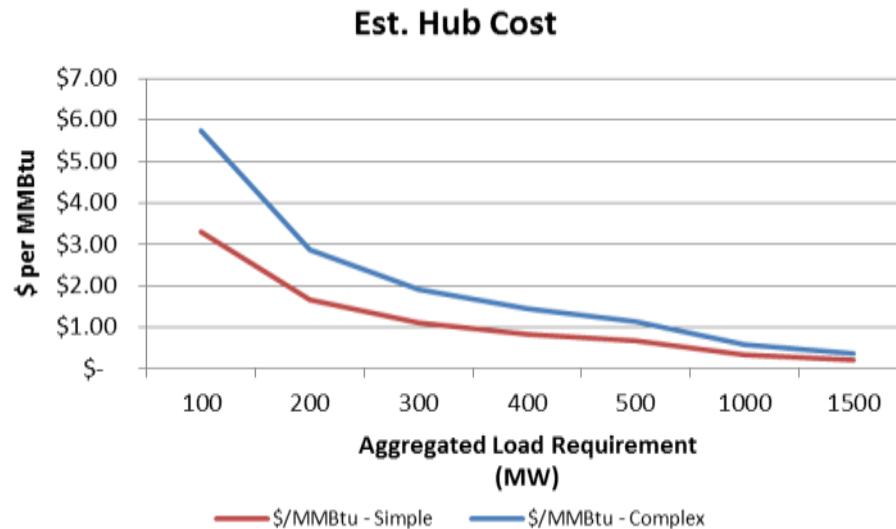
Direct Distribution vs. Hub & Spoke Model



★ Hypothetical U.S. Small/Mid-Scale LNG Export Project

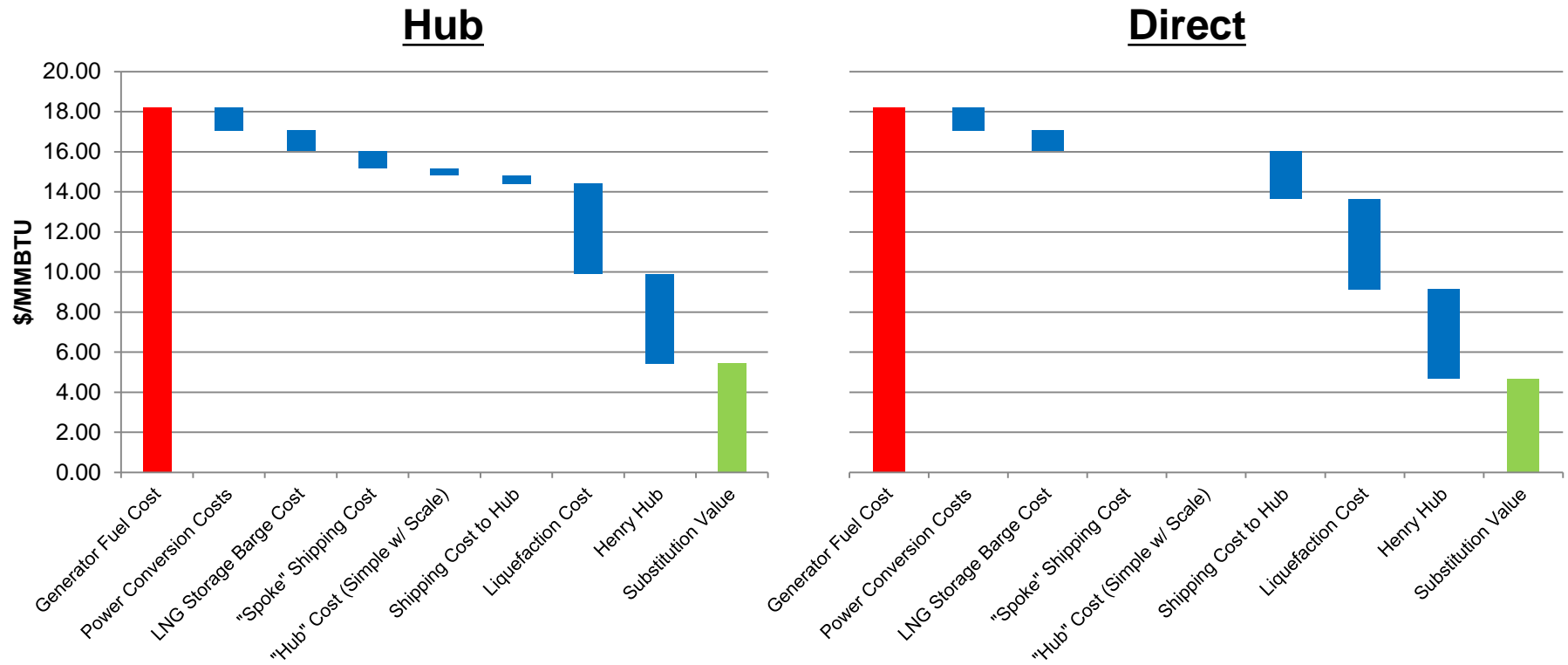
★ Hypothetical Regional Transshipment Terminal

One of the Challenges for the Hub & Spoke Model is Achieving Sufficient Scale



- High development & timing risk
 - Potential significant equity risk – “build it and they will come”
 - Development risk and timing – “line up the dominoes”

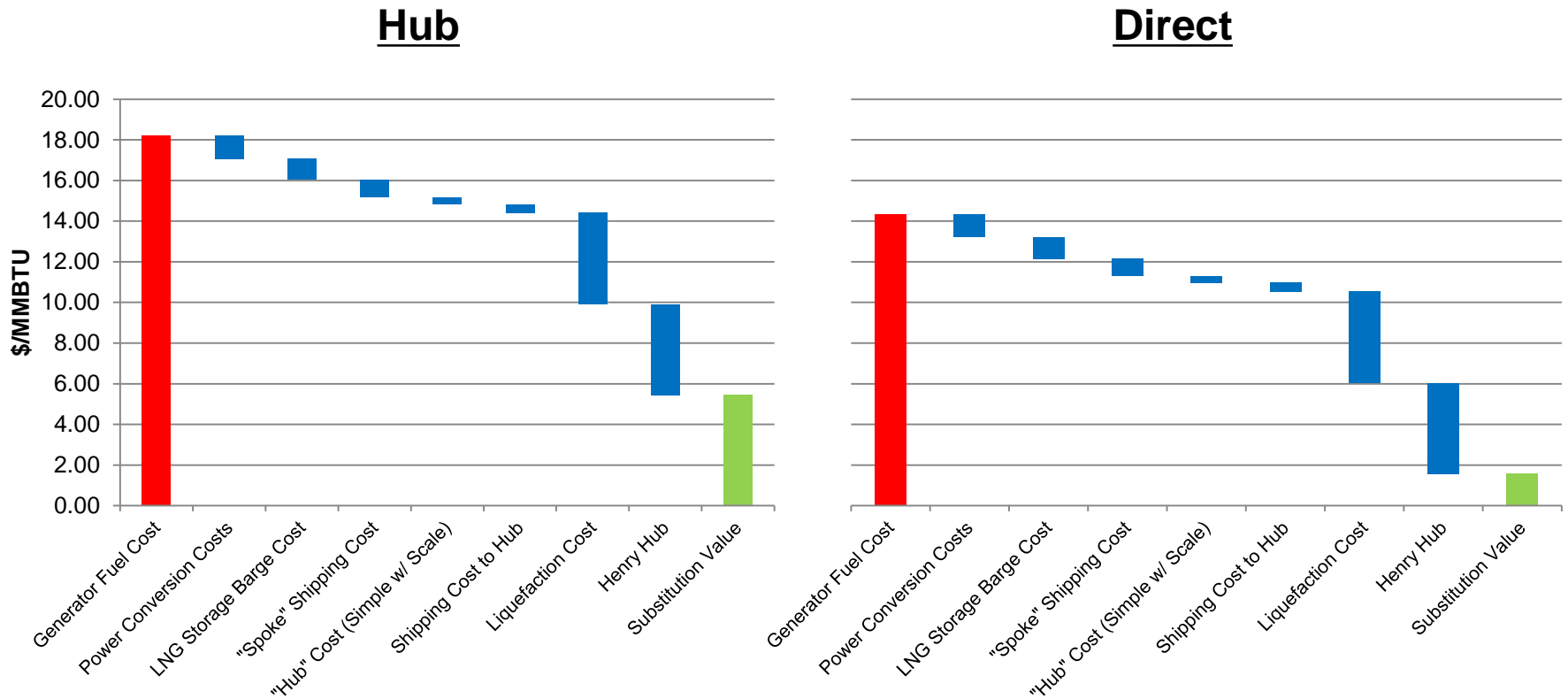
Hub vs. Direct Deliveries Examples: Streamlined Logistical Costs



~ 15% Substitution Value Improvement

300 MW Diesel Plant
500 nm from Hub; 2,000 nm from Liquefaction Plant
Hub "at Scale" (1,000 MW)

Although Streamlining Logistics is Important, Real Value Driver is Cost of Fuel



300 MW Plant

500 nm from Hub; 2,000 nm from Liquefaction Plant

Hub "at Scale" (1,000 MW)

Key Takeaways

- LNG can become the “fuel of choice” for many small power generators currently burning HFO and Diesel
- But need to solve several issues
 - Logistics: Small/Mid-scale LNG shipping and terminal solutions are readily available and can be economic
 - Supply Sources: Small-scale liquefaction and “hub” projects under development to serve smaller fuel-oil substitution markets
 - Commercial Structure: Interest of multiple stakeholders need to be aligned and substitution value shared → Need for Integrator

Thank you!

 GALWAY GROUP_{LP}

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