TDB
TRADE & DEVELOPMENT BANK

ENABLING A REGIONAL LNG PLATFORM SERVING THE INDIAN OCEAN ISLAND NATIONS

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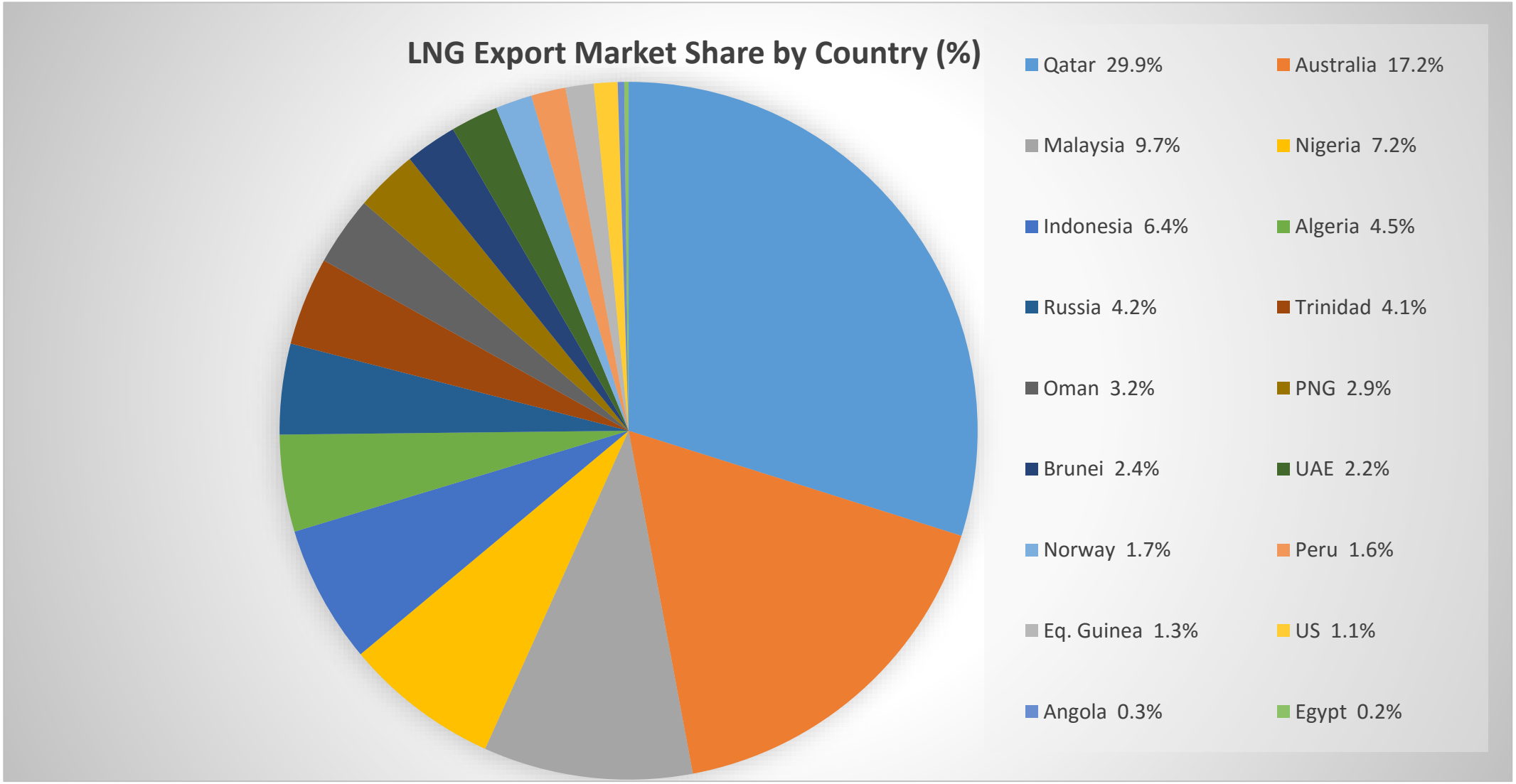
THE GLOBAL LNG PLAY

- The state of the LNG industry according to the 2017 IGU World LNG Report:
  - 258 million tons of global trade in 2016
  - 72 million tons of non long-term trade in 2016
  - $5.52/MMBtu average spot price in Northeast Asia in 2016 ($9.55/MMBtu in February 2017)
  - 340 MTPA global nominal liquefaction capacity in 2017
  - 879 MTPA proposed liquefaction capacity in 2017
  - 114.6 MTPA global liquefaction capacity under construction in 2017
  - 795 MTPA global nominal regasification capacity in 2017
  - 83 MTPA FSRU capacity in 2017
  - 156.9 MTPA proposed FLNG capacity as of January 2017
  - 439 vessels consist LNG fleet in 2017
  - 4.4 MT re-exported LNG volumes in 2016
  - LNG 10% of global gas supply in 2015

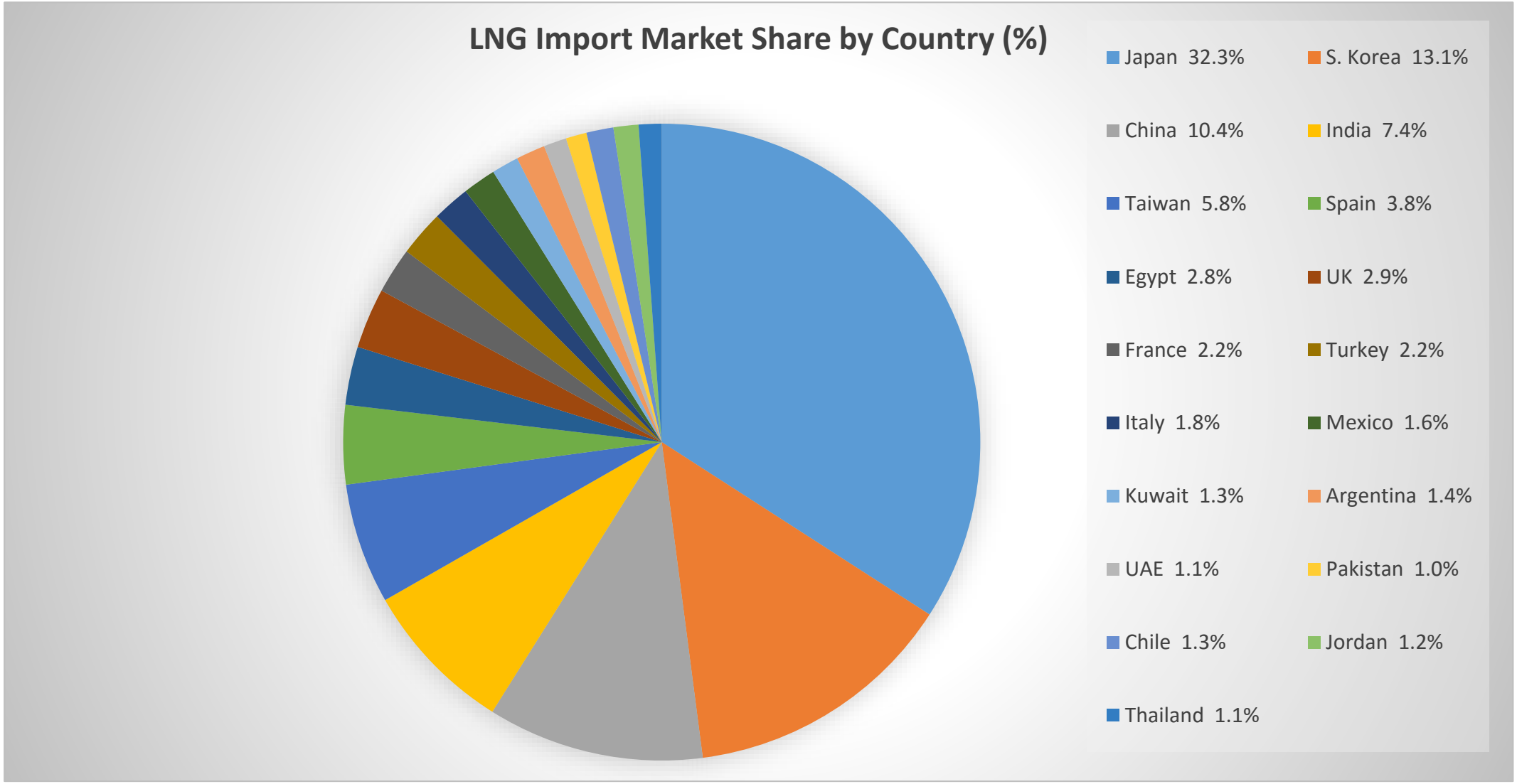
Source : International Gas Union (IGU) 2017 World LNG Report

The Global LNG Play – Continuous increase in resource discovery and export market



Source : International Gas Union (IGU) 2017 World LNG Report

The Global LNG Play – Significant LNG imports are destined to Asia



Source : International Gas Union (IGU) 2017 World LNG Report

The Global LNG Play – Smaller scale technologies accommodating smaller markets

- Growing number of LNG suppliers and advances in small-scale technology are enabling LNG delivery to small island nations
- FSRU new builds and conversions are expanding access for emerging LNG markets
- Developers pushing to locate small pockets of demand and aggregate volumes

The Global LNG Play – Jamaica a new entrant into the LNG market

- Jamaica imported its first LNG cargoes in 2016 through a new LNG regasification infrastructure delivering to the converted 120 MW Bogue power plant. The process involves a series of ship-to-ship transfers from conventional LNG carriers to a floating storage unit stationed offshore, then to a lightering vessel set to deliver smaller volumes to an onshore regasification receiving centre.

The 6,500m³ *Coral Anthelia* chartered to New Fortress Energy will deliver the Bogue power plant from the 140,650m³ floating storage unit (FSU) *Golar Arctic*, moored off Jamaica.

The Golan Freeze was converted from a Moss LNG carrier built in 1976 into a FSU with 125,000 m3 of storage and 4.9 bcm/year regas capacity as well as a side-by-side LNG transfer open loop.

- Malta became an LNG importer in January 2017 by converting an older tanker as a floating storage unit and then sending volumes onshore to a small-scale regasification terminal. Built under a $300 million contract in 2015, the FSU is a conversion of a 125,000-cbm MOSS LNG carrier. The FSU delivers LNG to the onshore regasification plant feeding natural gas to the 200 MW Delimara 4 power plant.

The Global LNG Play – The capital cost for gas to power the lowest among other technologies

Technology	Capital Cost ($/kW)	Operating Cost ($/kWh)
Coal-fired combustion turbine	$500 — $1,000	0.20 — 0.04
Natural gas combustion turbine	$400 — $800	0.04 — 0.10
Coal gasification combined-cycle (IGCC)	$1,000 — $1,500	0.04 — 0.08
Natural gas combined-cycle	$600 — $1,200	0.04 — 0.10
Wind turbine (includes offshore wind)	$1,200 — $5,000	Less than 0.01
Nuclear	$1,200 — $5,000	0.02 — 0.05
Photovoltaic Solar	$4,500 and up	Less than 0.01
Hydroelectric	$1,200 — $5,000	Less than 0.01

Typical capital and operating costs for power plants. Note that these costs do not include subsidies, incentives, or any "social costs" (e.g., air or water emissions)

Source URL: https://www.e-education.psu.edu/eme801/node/530

Estimated levelized cost of electricity (capacity-weighted average) for new generation resources entering service in 2022 (2017 $/MWh)

Plant Type	Capacity Factor (%)	Levelized Capital Cost	Levelized Fixed O&M	Levelized Variable O&M	Levelized Transmission Cost	Total System LCOE
Dispatchable Technologies						
Conventional Combined Cycle	87	13.0	1.5	32.8	1.0	48.3
Advanced Combined Cycle	87	15.5	1.3	30.3	1.12	48.1
Advanced Combustion Turbine	30	22.7	206	51.3	2.9	79.5
Geothermal	91	28.3	13.5	0.0	1.3	43.1
Biomass	83	40.3	15.4	45.0	1.5	102.2
Non-Dispatchable Technologies						
Wind, onshore	43	33.0	12.7	0.0	2.4	48.0
Wind, offshore	45	102.6	20.0	0.0	2.0	124.6
Solar PV	33	48.2	7.5	0.0	3.3	59.1
Hydroelectric	65	56.7	14.0	1.3	1.8	73.9

Source : Levelized Cost and Levelized Avoided Cost of New Generation Resources in the Annual Energy Outlook 2018

World LNG Estimated Landed Prices: August 2018

Federal Energy Regulatory Commission - Market Oversight – www.ferc.gov/oversight

The Global LNG Play – Clean Source of Fuel

- Natural gas is the cleanest form of burning hydrocarbon fuel.
- Natural gas enables compliance with new environmental standards.
- Compared with diesel, natural gas fuel represents the following reductions:
  - 25% reduction in carbon dioxide (CO2),
  - 80% reduction in nitrogen oxide (NOx), and
  - 97% reduction in carbon monoxide (CO) emissions.
- Natural gas-fired generation has the potential to:
  - Reduce carbon monoxide (CO) and emissions of particulates by 90%
  - Emit 80% less nitrogen oxide (NOx) than burning coal
  - Emit virtually no SO2 or Mercury

The Global LNG Play – Gas-to-Power

- Conversion from HFO to LNG for electricity generation:

  - Gas Engines:
    - Higher fuel efficiency
    - Lower initial costs for small schemes (<10 MWe)
    - Better suited for variable load applications
    - More tolerant to high ambient conditions and high elevations
    - Lower fuel pressure requirement
    - Accept low BTU fuels
    - On line in less than 30 sec

  - Gas Turbines:
    - Well suited for Combined Heat and Power (CHP) operations w/large heat to electricity kW ratio
    - Higher exhaust temperature (480 C / 900 F) allowing for combined cycle operations
    - Low weight & minimal space requirement
    - Very simple design
    - Less down time per machine -Replacement at overhaul
    - Ideal for 24/7 operation -Turbines do not like starts & stops
    - Accept high as well as low BTU fuels

- The Role of TBD will include:
  - Advise the member nation on the benefits of the project;
  - Obtain member nation commitments for LNG offtake;
  - Assist in the selection of the Project Developer;
  - Conduct proper due diligence on the project;
  - Ensure the project is properly structured and bankable;
  - Provide a syndicated senior loan facility for the project implementation phase;
  - Reach financial close and secure launch of construction; and
  - Ensure proper operation and maintenance is in place.

The Global LNG Play – A Regional Project Development Company is Key

- The need to in incorporate a Regional Project Development Company to:
  - Assess the LNG market and the demand to be met;
  - Define the sourcing and logistics of LNG delivery;
  - Conduct a feasibility study of the project;
  - Select optimal sites for LNG delivery;
  - Obtain all necessary regulatory approvals, permits and licenses for the project;
  - Conduct an Environmental and Social Impact Study (ESIA) for the project;
  - Prepare the capital budget for the project;
  - Engage and partner with equity providers;
  - Negotiate and secure the LNG supply contracts:
  - Negotiate the project Implementation Agreement with the various governments;
  - Negotiate and engage the necessary contractors;
  - Engage with lenders on the financing plan; and
  - Reach financial close and launch construction.

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