Superpower in yet another Sphere
(The Energy Renaissance in the U.S.)

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About EPRINC

• Founded 1944
• Not-for-profit organization
• Studies intersection of petroleum economics and public policy
• Provides independent and technical analyses for distribution to the public
• Supports USG projects, e.g. Quadrennial Energy Review, DoD strategic outlook
• EPRINC Embassy Series
• IEEJ-EPRINC Project on “Future of ASIAN LNG
• www.eprinc.org
Before we get started.....................

A few words about energy security, petroleum, and US energy policy,

Or

Why import dependence is not the same as import vulnerability
Dueling Chemistries: Batteries & Barrels

Range Per Pound Of Fuel

Source: Courtesy of Mark Mills, Manhattan Institute
**Dueling Hardware & Technology Asymptotes**

**Energy Output Per $1 Million CapEx**

- Shale well
- Wind turbine
- Solar panel

**Solar & Wind: Cost per kW**

Cost Reduction Normalized to 1980 = 100

Source: Courtesy of Mark Mills, Manhattan Institute
ENERGY CONSUMPTION FORECAST BY FUEL (EIA 2018)
WESTERN INTERIOR SEAWAY

Main U.S. Shale Basins and Plays
Power of Source Rock + Private Property

Source: EIA
Source: EPRINC from EIA data
Monthly U.S. Natural Gas Production - Conventional Vs Shale:
12/01/1987 through 11/30/2017

Billion Cubic Feet Per Day

Shale
Conventional

Analysis based on EIA Data
Total Dry Gas Production Y/Y Growth

Associated gas production (e.g. Bakken, Eagle Ford, Niobrara, and Permian) and major dry gas plays (Marcellus, Haynesville) is driving a significant portion of the Y/Y growth in total dry gas.

Source: Raymond James, EIA
U.S. Oil Production (millions of barrels/day)

Source: EIA
Permian Basin Horizontal Decline Curves (Texas and New Mexico) (b/d)

Source: PetroNerds, DrillingInfo.
Laterals Above Here Represent real productivity gains

Source: Completion Design Changes on Well Productivity, Curtis & Montalbano, EPRINC paper, (November 2017). Note: Well productivity indexed to a base curve, which equals 1.
North American Petroleum Renaissance Needs Pipelines
(Incremental Production Must Be Moved to Coastal Processing Centers)

Source: CAPP
Of these net imports, 2.5 MMBD from Canada
Can LNG Markets Look Like Oil Markets?

.........or at least more like the US Natural Gas Market
U.S. Natural Gas Market is both Prolific and Efficient because........

1. Resource is vast, distributed among many players, subject to constant cost reductions and technology improvements, rapid infrastructure build-out (except in NY), government oversight is largely (but not always) efficient.

1. The separation of pipeline transportation services from gas sales

1. Third-party access to pipelines, storage, and LNG terminals

1. Transparency in the reporting of gas pipeline capacity utilization, tariffs, and prices at market hubs

1. Broad liquidity in the physical and financial markets

Nat Gas consumption increased from 50 bcf/d in 2005 to 73 bcf/d 2017 and LNG exports are rising
US NATURAL GAS EXPORT COULD GROW QUICKLY

trillions cubic feet/year

Source: EIA, Reference Case

Note: \( \approx 4 \text{ tcf/yr (11 bcf/d)} \)
or 82 MMt on the water
By 2030 (maybe)
US LNG Exports Are Growing & Face Challenges

billions of cubic feet/day

9 bcf/d = 67.4 MMt LNG in 2020?

Source: EIA, projects approved and under construction
REGIONAL WORLD NATURAL GAS PRICES

ASIA now (Jan 2018) at $10 MMBTU
Range of Uncertainty remains large, almost 100 million tons in 2030.
LNG Demand Growth Requires Growth Outside JKT

- Key uncertainties in niche markets
  - Credit ratings
  - Seasonality requirements
  - Infrastructure requirement and development
  - Logistics of small scale, and timing

Source: Poten & Partners
How Might Demand Growth Playout to 2030?
There’s Still Room for US Exporters

Note: By 2020, an estimated (cumulative) 3.0 Bcf/d of contracts will expire, and by 2025 10.4 Bcf/d will expire. Most of these expiring contracts are in Asia Pacific markets.

Sources: FTI & ICF, EIA
• Joint Effort IEEJ and EPRINC

• Supported by Governments of Japan and U.S.

• Policy Proposals Presented in Tokyo (Oct 2017) -- Accepted by both Governments

• Discussions on Follow Up Study for 7th Annual LNG Producer Consumer Meeting in Nagoya (October 2018) – Now Underwat
Study overview

- The Institute of Energy Economics Japan (IEEJ) and the Energy Policy Research Foundation, Inc. (EPRINC) undertook an assessment of future LNG demand growth in Asia and strategies to improve the competitiveness of U.S. LNG exports in the region.

- The two organizations have reached out to nearly 100 experts, government officials and market participants through a series of workshops in Washington D.C., Tokyo, and Bangkok since July 2017.

- We also engaged our own research teams and the project received support from Economic Research Institute for ASEAN and East Asia, as well as the U.S. and Japanese governments.
Asia’s LNG market

- Asian LNG market will reach 350 million metric tons in 2030, growing twice from 2015.
  - Historic Asian LNG demand centers, Japan, Taiwan, and Korea are likely to experience modest or declining demand growth.
  - Emerging Asian LNG importers such as China and India will see rising demand for LNG, growing by more than four times from 2015 to 2030.
  - Power sector and industrial sector will be major drivers of the future LNG demand growth in emerging Asian countries.
Policy recommendations

- Developing more transparent and flexible LNG market
  - Remove destination restrictions to stimulate spot markets and price discovery
  - JFTC study’s finding of incompatibility of destination restriction to Japanese Anti-Monopoly Act is important.
  - Creation of Asian hubs is essential to activate spot trading and price discovery.

- Sustaining competitive US LNG export platform:
  - Streamline the regulatory process
  - Provide clarification of U.S. revocation risk on LNG exports.

- Providing financial supports
  - Engage their export credit agencies (ECAs) and multilateral development banks (MDBs), to increase supports for LNG projects.

- Capacity building
  - Provide capacity building program for emerging LNG importing countries in the areas of policy, regulations, technologies, technical standards, operational safety guidelines, environmental regulation, and so on.

- Assisting policy and regulatory developments in Asia
  - Help structure energy mix targets and policy planning so that Asian countries could take full advantage of natural gas.
WORLD LNG REVOLUTION IS UNDERWAY

World Natural Gas Demand is Growing – IFIs are supporting natural gas regas and power infrastructure

World LNG supply potential is growing -- US led shale gas leading the way, but new supplies also coming from Egypt, East Med, Africa

Natural gas demand is expanding driven by energy security and environmental benefits

LNG offers greater market flexibility, lower political risk, & lower cost for longer distance markets than pipelines

US is cooperating with Asian and European Allies to expand natural gas infrastructure and regas Capacity
Some Brief Remarks about Natural Gas and the
LNG Trade is Entering a New Era (and taking on features of the oil market)

Source: Poten & Partners
This is Not Your Grandfather’s LNG Market
Cyprus Opportunity?

- Offer lower cost LNG
  - Qatar de-bottlenecking (clearly) and all US liquefaction projects (maybe)

- Securing import capacity
  - In existing terminals, particularly in liquid NW Europe, to create optionality—directly or with options

- Offer more flexibility
  - FOB contracts through tolling (or semi-tolling) facilities in the US Gulf, which allow buyers to leave capacity unused
  - Highly flexible SPAs

- Offer fixed price contracts
  - Tellurian, other US Gulf

- Integrate from liquefaction to market development
  - FSRU-focused
    - Total, Shell in Cote D’Ivoire, Cheniere in Chile, NextDecade in Ireland

- Integrate from liquefaction to upstream
  - Tellurian

- Let trading houses take niche market risks
  - Gunvor in EG, Pakistan

- Aggregators securing offtake
  - Providing anchor volumes, facilitating project finance (Coral FLNG)

- Offer basket of price indices
  - Tangguh, Mozambique

- Front run the market by trading
  - Tellurian
US Strategy Outline for Promoting LNG Development (Possibly?)

Open, resilient, and integrated global energy markets advance the security and economic interests of the United States, our friends, and allies.

Energy Security:
- Access to reliable, diversified, and affordable energy resources increases regional stability.

Economic Opportunity:
- Provide our energy resources, technologies, and services to other countries.

Opportunity
- Rapid regional energy demand growth.
- Countries weighing supply options.

Risk
- Market/price risk, financial risk, environmental risk, community impact, sovereign risk, regulatory risk, development risk, etc.

Priority Country
- Does engagement strengthen regional stability and security?
- Do compelling economic opportunities exist for U.S. firms?

Government Value Add
- What tools are available to break down barriers to energy development and trade?

Engagement
- Deploy resources (e.g., diplomatic engagement, technical assistance, financial programs, etc.).
The Turkish problem: Part 1
The Turkish problem: Part 2

ENI drill ship turned away by Turkish Navy