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The North American Gas Market: Going Global

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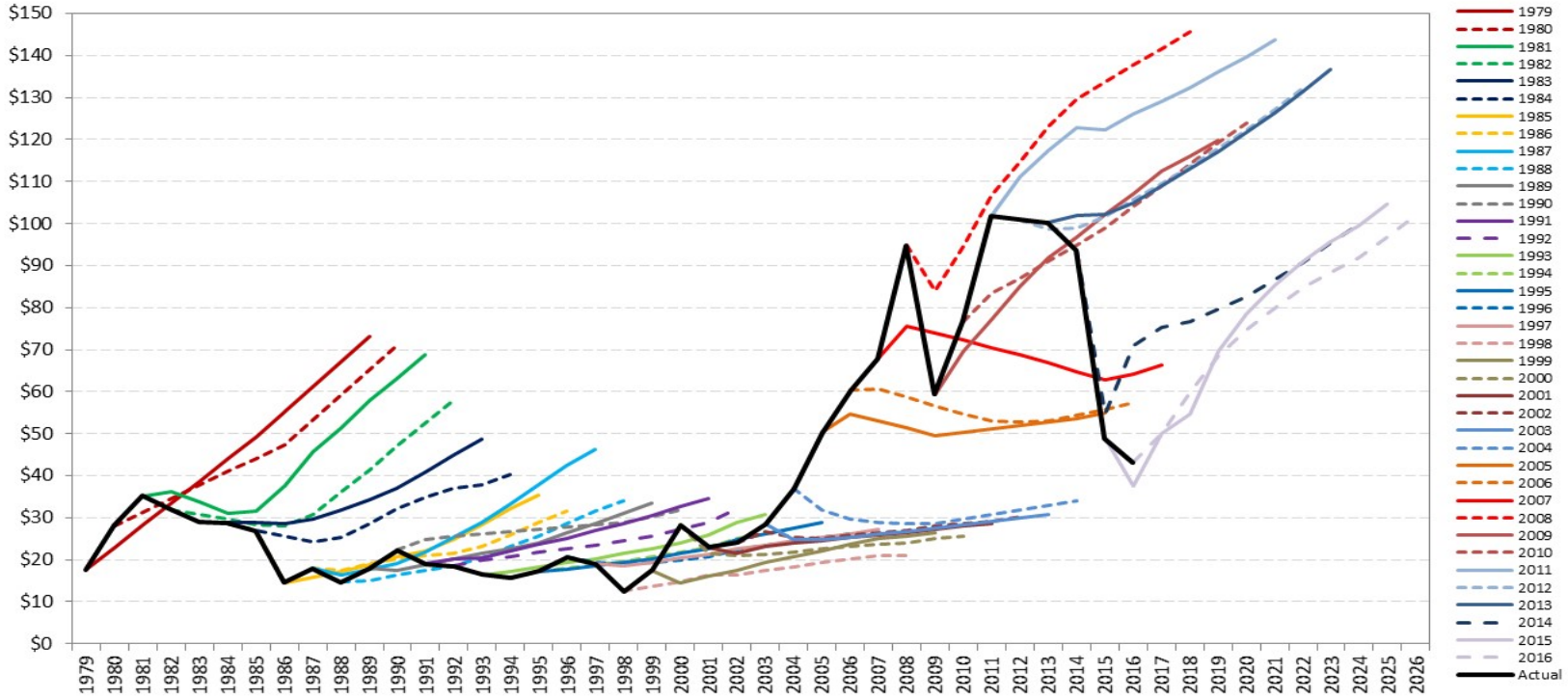
Disclaimer: Forecasting 101 – Precision is Folly!

- Long term price projections are rarely accurate, and appear adaptive and myopic.
- "The best cure for high (low) prices is high (low) prices"

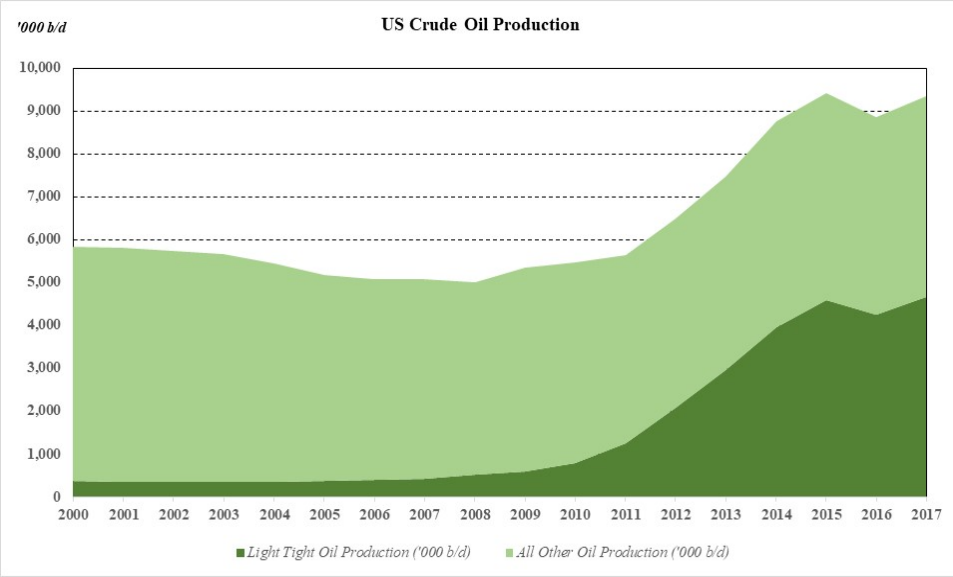


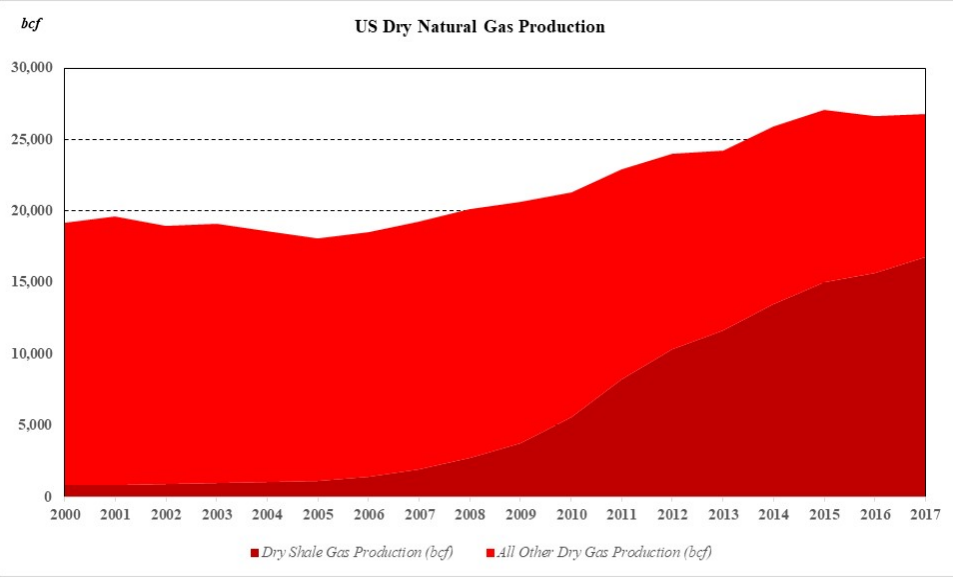
Source: Data from US EIA

- **Critical point:** Markets react along many margins. This is what we must understand!

Shale has driven an increase in US oil and gas production…

- The last 10 years has born witness to a dramatic shift in US oil and gas production and stimulated a very different view of the future.
  - Light tight oil production is now about 50% of domestic output and is Texas-centric, coming from the Permian (40%), Eagle Ford (23%), Bakken (23%), Others (14%).
  - Shale gas production now accounts for about 63% of all domestic dry gas production, and is heavily concentrated in the Mid-Atlantic and Gulf Coast regions, coming from Marcellus/Utica (49%), Barnett/Haynesville/Eagle Ford/Permian (35%), Others (16%).

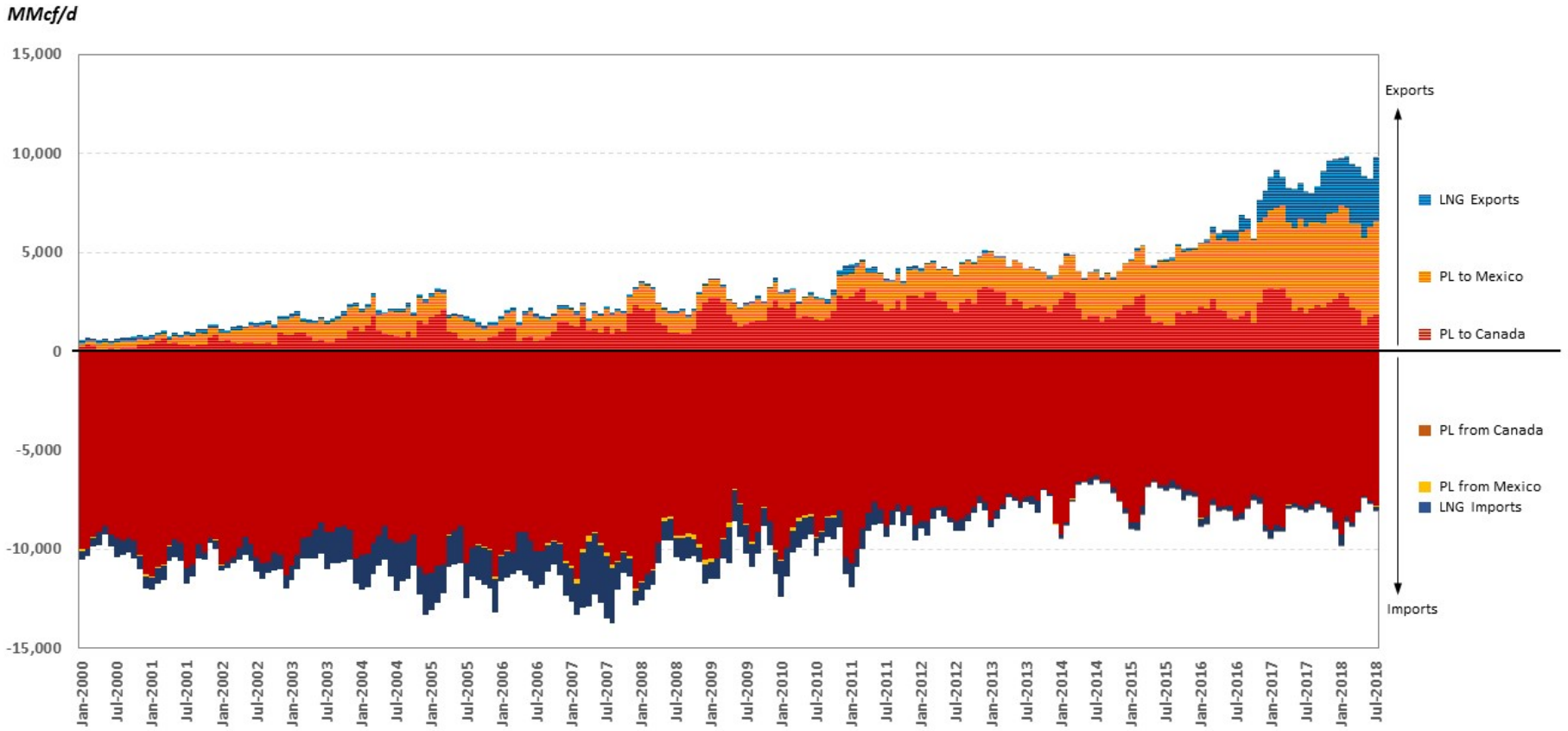




Source: Data from US EIA

… triggering an increase in US gas exports…

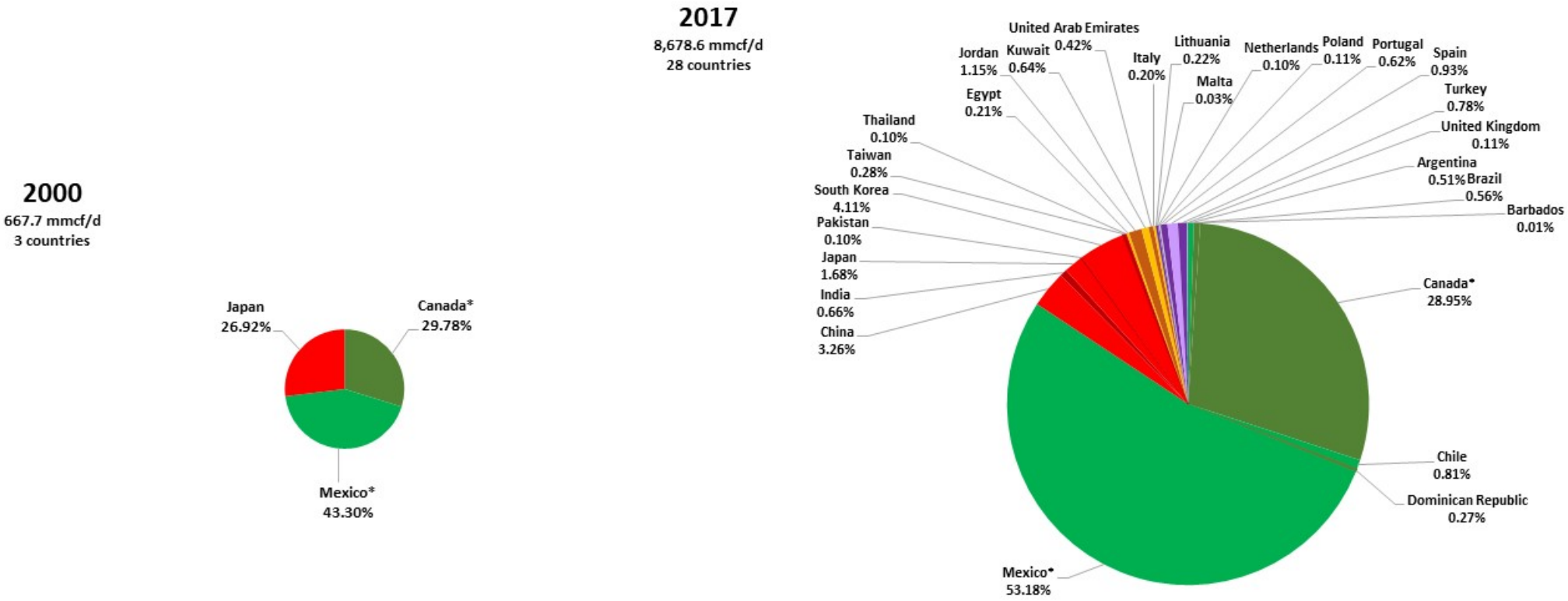
- US LNG exports and natural gas pipeline exports to Mexico have expanded dramatically since 2000, so much so that the US became a *net* exporter in 2018.



Source: Data from US EIA

… with expanding geographic reach…

- US natural gas exports – pipeline and LNG – grew by more than 8,000 mmcf/d from 2000 to 2017, with the vast majority of the growth occurring since 2014, now reaching 28 different countries.

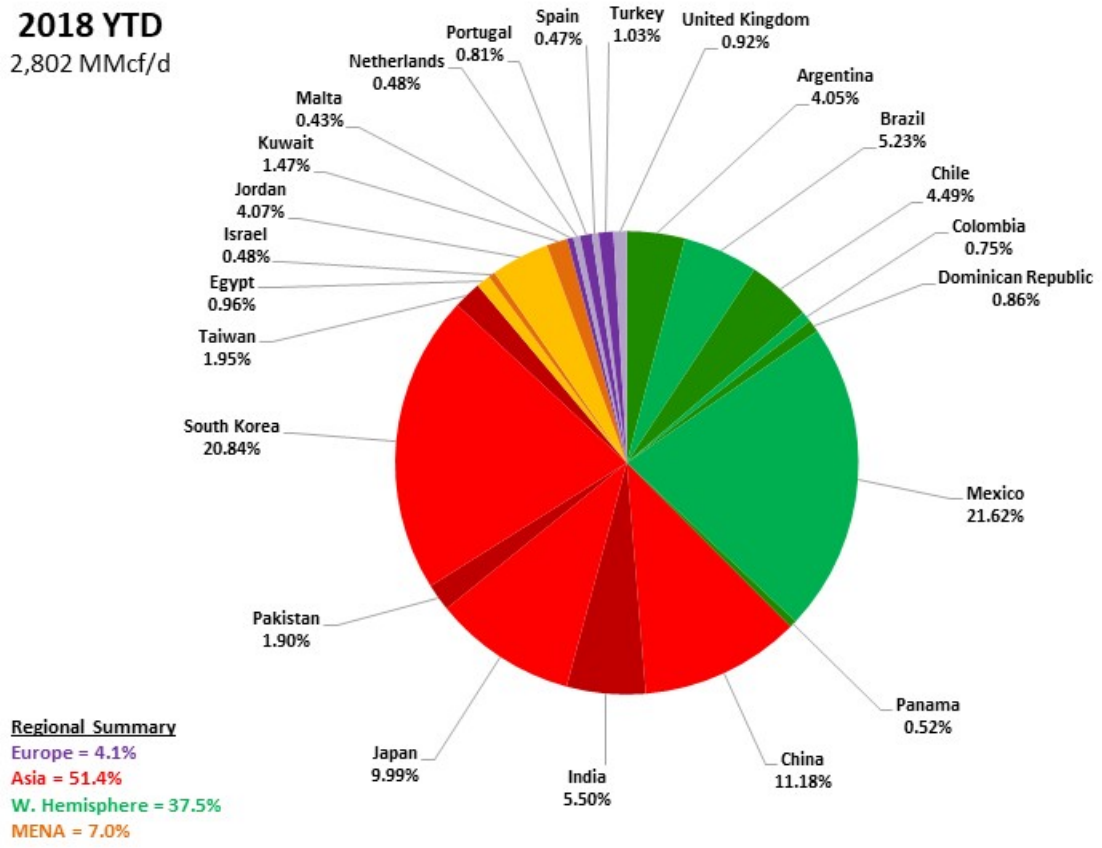


* - includes pipeline exports

Source: Data from US EIA

… with LNG exports at the center of developments…

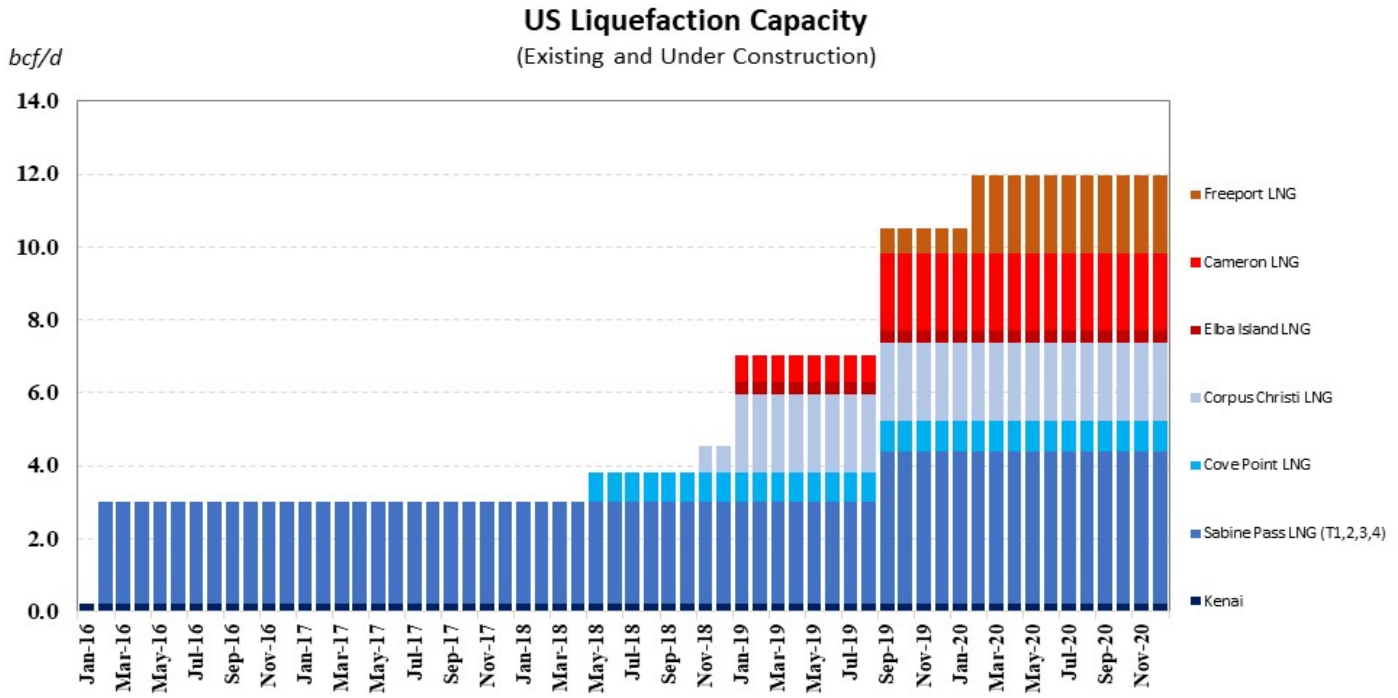
- US LNG exports have averaged over 2,800 mmcf/d in 2018, and reached over 3,100 mmcf/d in July, which represents a 35x increase in 3 years.



Source: Data from US DOE

… and poised to grow even more…

- There exists 3.8 bcf/d of LNG export capacity between Sabine Pass, Cove Point and Kenai.
- There is another 8.1 bcf/d of capacity under construction, setting the stage for a potential surge of exports, the vast majority of which will come from the US Gulf Coast.
- Notably, there is another 6.8 bcf/d approved and 23.6 bcf/d with applications pending.



Source: Data from US FERC and US EIA; Start dates for new capacity are speculative.

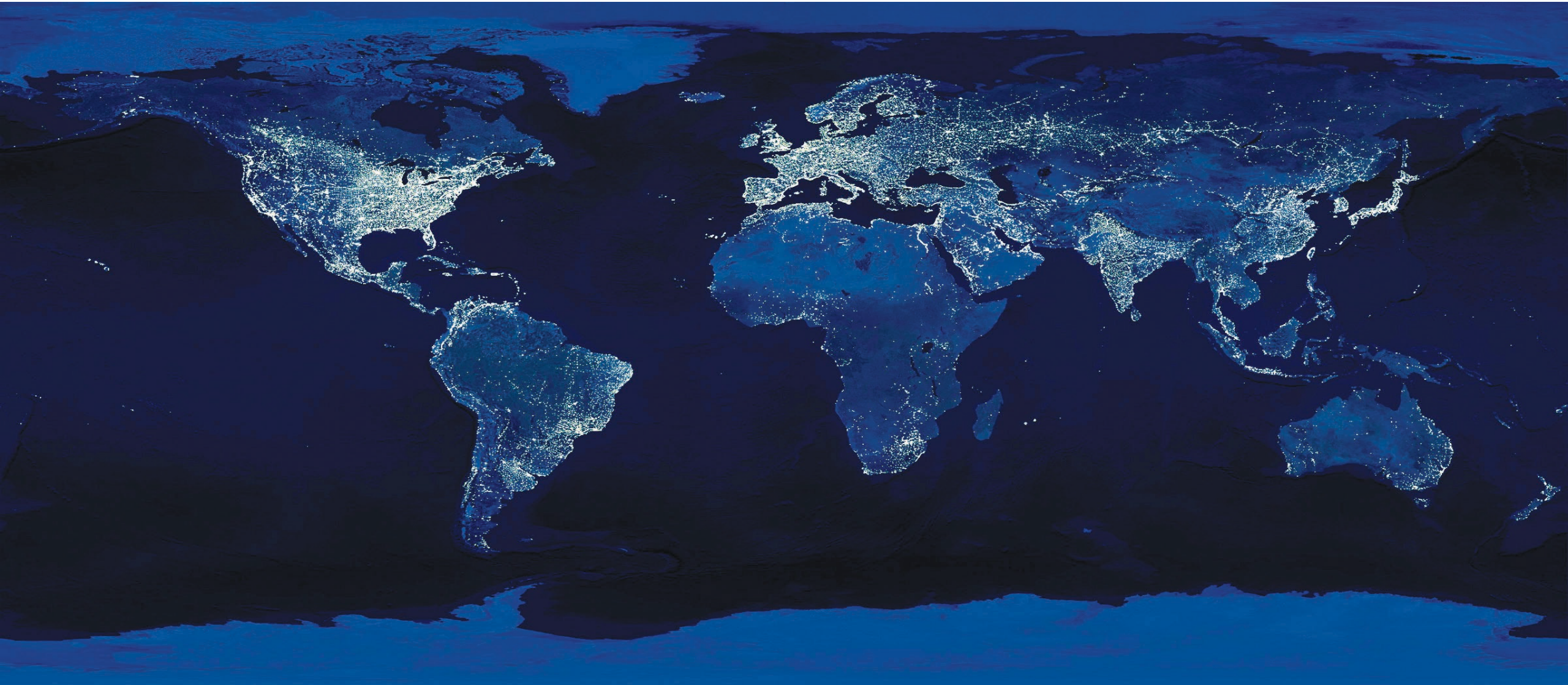
- Of course, capacity does not guarantee volume. But, the reality being forged in the Permian Basin has huge implications. Oil-directed activity is bringing large associated gas volumes, and could open new opportunities. Infrastructure constraints exist, but they are being alleviated.

… with long term market altering implications.

- Physical connectedness with the global market will have implications for market liquidity, pricing and investment paradigms.
- Long-term contracts will remain important because they are "bankable", especially when debt-financing is considered.
- However, take-or-pay clauses will be eroded by the "real option" value associated with capacity rights that are tradable.
- Hence, the chicken-and-egg paradigm…
  - Real option value is greater initially, but as parties begin to capture this value it erodes because trading frequency increases.
  - However, an increase in trading frequency drives greater price discovery, which establishes more market transparency and liquidity.
  - This, in turn, alters the risk associated with market entry, or new investment, because a liquid market mitigates uptake and offtake risk.
  - Liquidity also provides elements of energy security to both producers and consumers because access is not easily compromised.

Source: Ongoing Baker Institute CES research

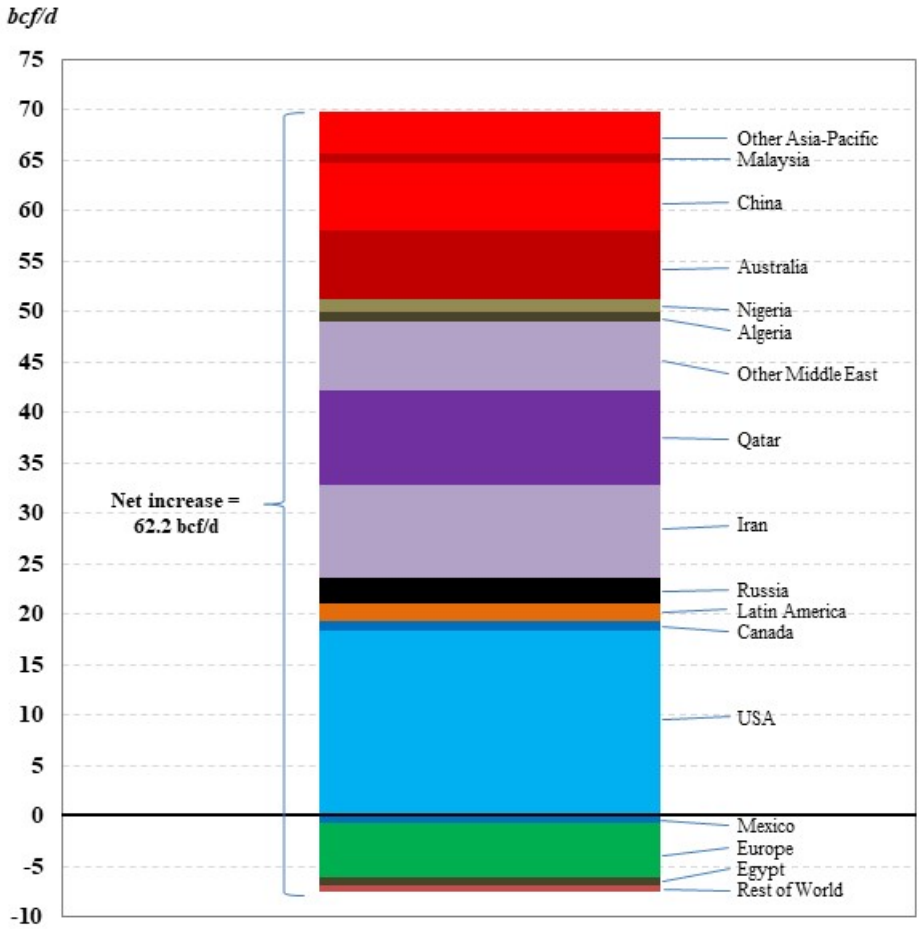
Where does this all fit? The evolving energy picture



Globally, the US is already having a major impact on supply…

- Production growth in the US represents almost one-third of the net increase in global production since 2008.
- Regionally, both the Middle East and Asia also witnessed large increases in output, with significant local use.
- European production declined, as did output in Mexico and Egypt. While the reasons vary, the implications for each region are significant for trade and geopolitics.
- US shale reveals the rapid impact that technological innovation can have when legacy and scalability – through legal and infrastructure support – are present.

Global Supply Changes, 2008-2017



Source: BP

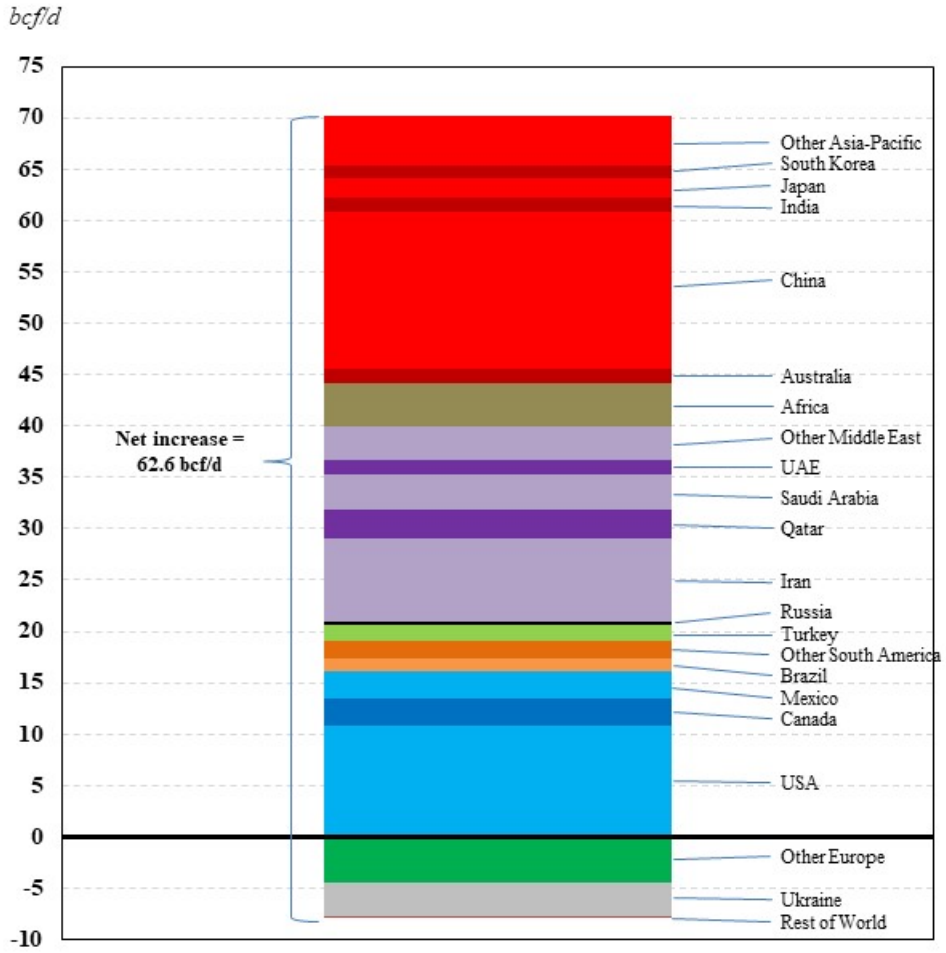
… which is much needed to meet new demands.

- Demand declined Europe and Ukraine, while it grew virtually everywhere else, especially in Asia.
- In fact, Asian demand growth accounted for 42% of the increase in global demand, with China at the forefront.
- Demand growth in the Middle East was also robust, largely absorbing increases in regional production.
- Demand growth in North America has been met by US production growth.

Key point

➢ The two largest single actors on the evolution of supply and demand are the US and China, respectively. This is expected to continue, with US exports playing a key balancing role.

Global Demand Changes, 2008-2017



Source: BP

An important comment on "energy transitions"

- The most impactful yet oft understated "transitions" affecting energy markets in the last 15 years have been the shale revolution in the US and economic growth in Asia.
- Economic activity and population drive demand. As such, developing nations (not developed nations) will dictate the future of energy.
- Technology, scale and legacy are each important factors.
  - Technology signals how fuels will ultimately compete. This can work in multiple, sometimes competing, directions by raising the efficiency of use of existing fuels *and* by introducing new competitive energy sources. Importantly, capital is a vehicle for technology deployment!
  - Scale matters because energy systems are large and must accommodate expanding access.
  - Legacy of infrastructure and energy delivery systems is the footprint for change.
- Scale and legacy affect the diffusion of new technology.
- Economics matter. The cost-benefit must be favorable for sustainable diffusion of new technology.
- Finally, policy and geopolitics shape, and are shaped, by all of the above.

A parting question: does history repeat itself?

- The early 1980s was a period of robust promise for renewable energy and distributed generation. Why?
  - High oil prices and energy security.
  - Natural gas supply concerns.
- What happened?
  - Fuel costs fell and efficiency increased.
  - Fixed costs of adoption matter.
  - Coal expanded.
- How is the present different?
  - Renewables costs are lower and coal is encumbered, each aided by policy.
  - Energy *and* environmental security.
  - Natural gas supply is robust.
- Are recent developments lasting?

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