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Shale Gas and U.S. National Security

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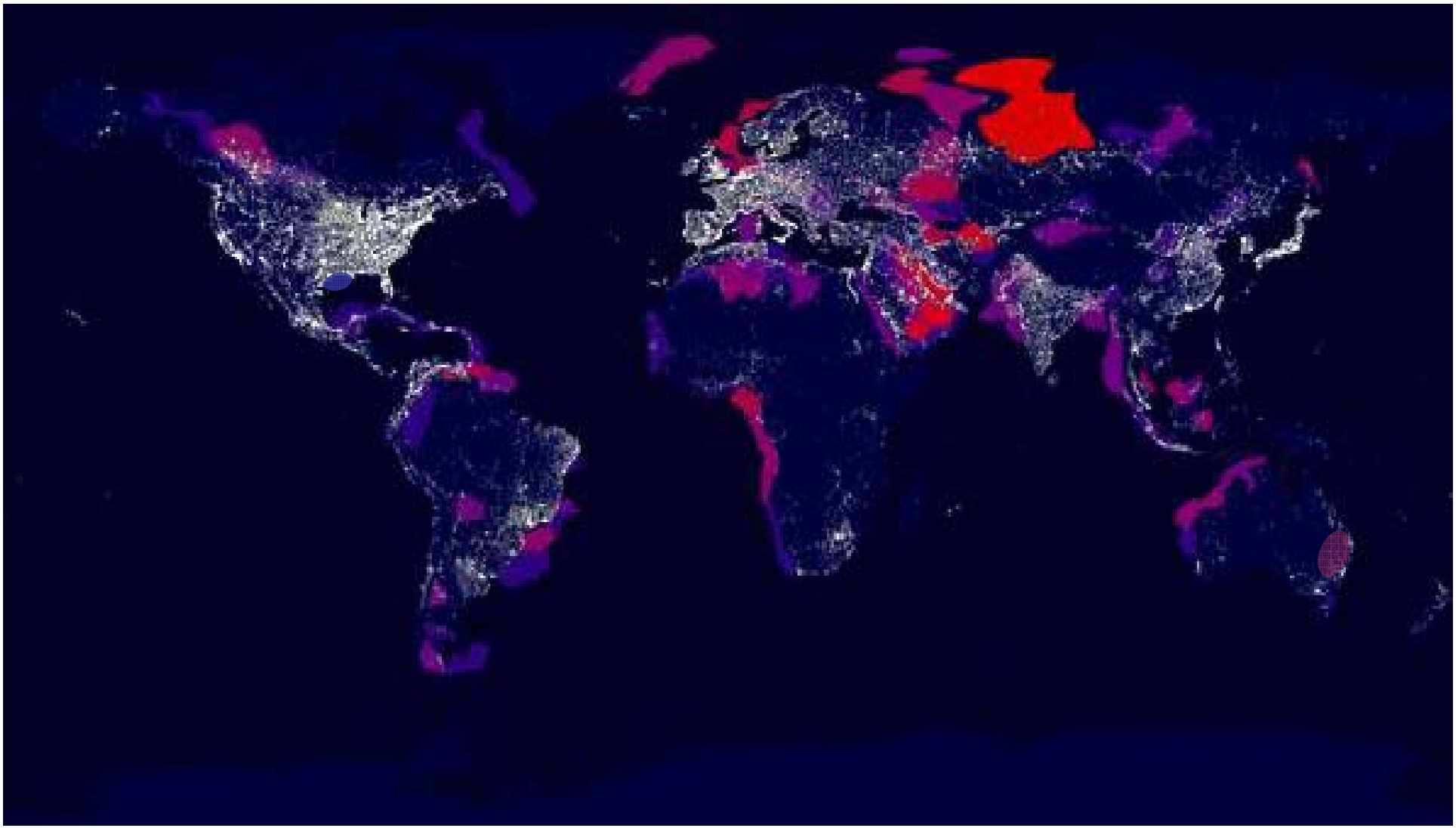
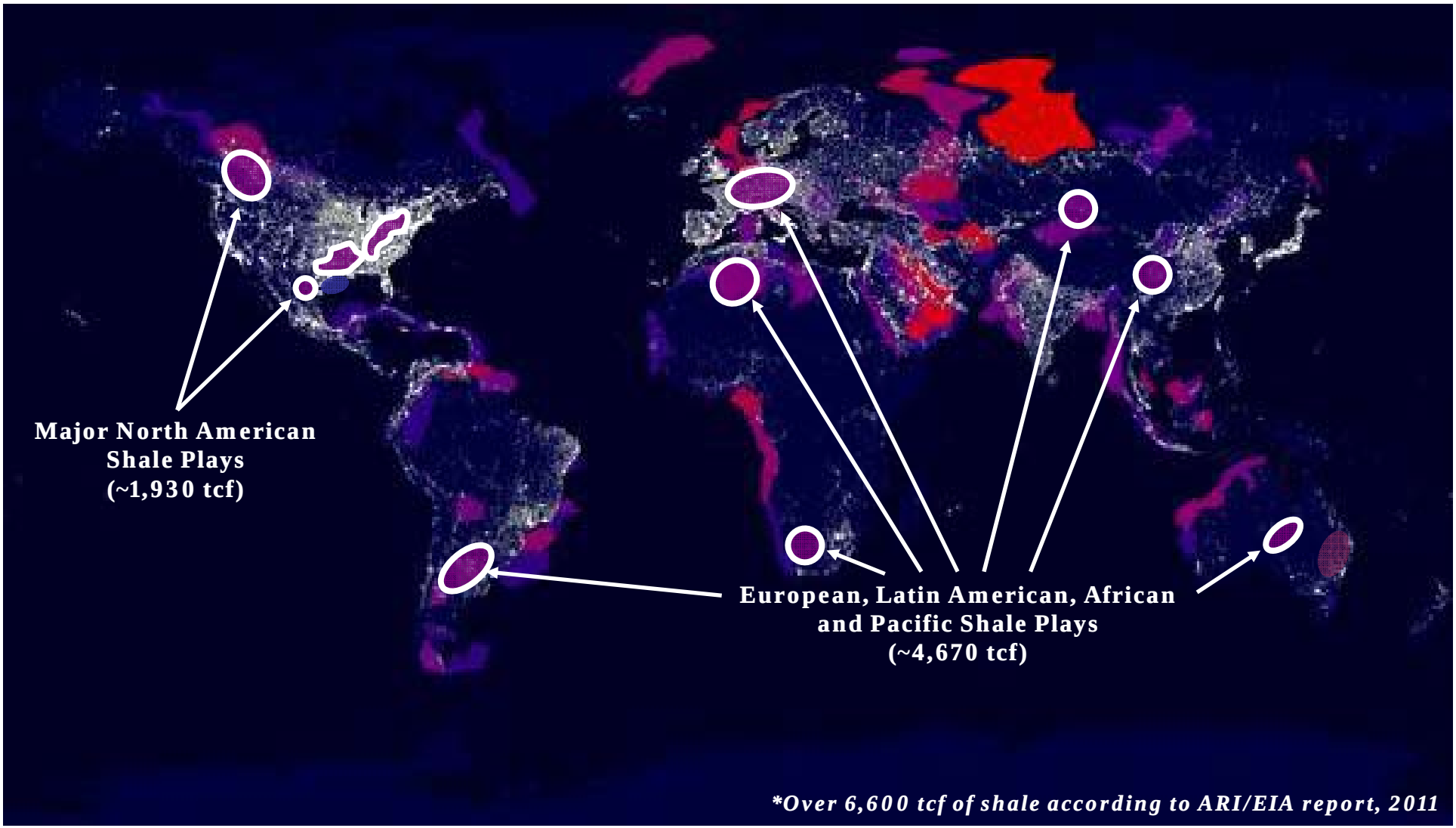
What does the “shale revolution” mean?

The "50,000 Foot" Natural Gas View in 2000: LNG is coming to North America



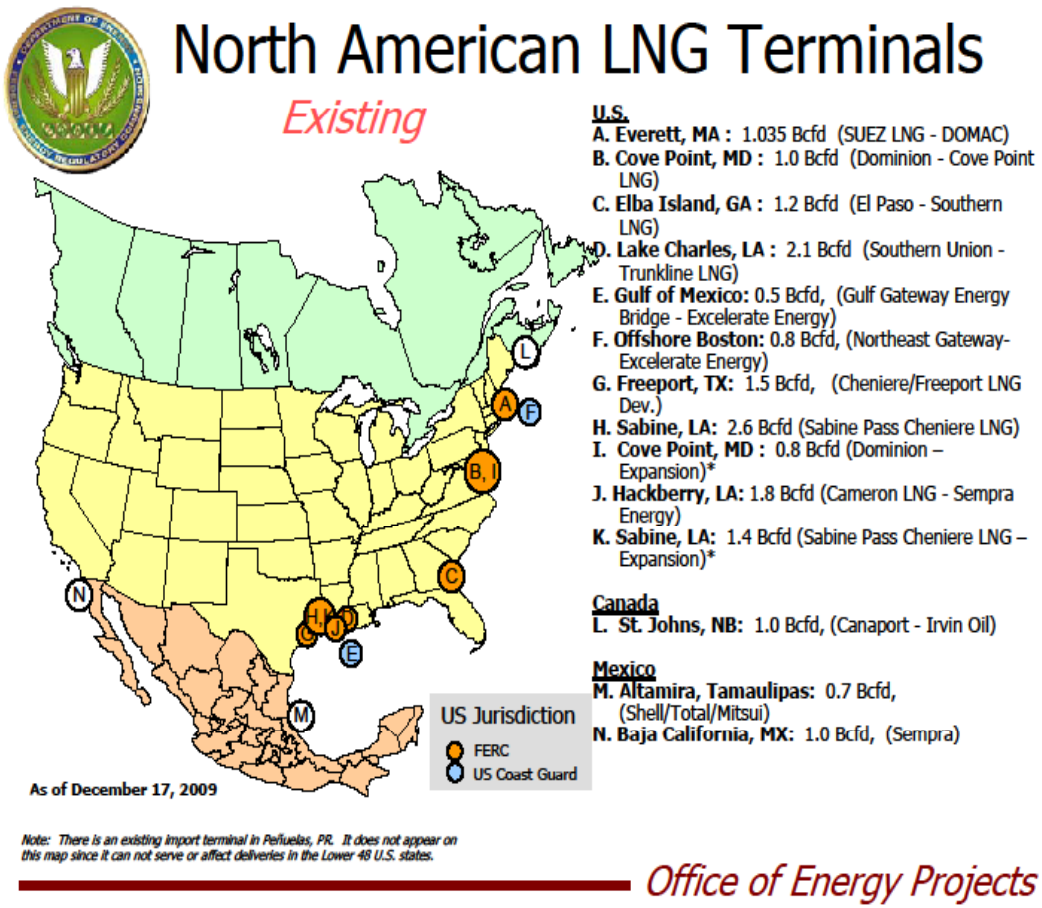
The "50,000 Foot" Natural Gas View in 2011: Over 6,600 tcf of technically recoverable shale*



**Over 6,600 tcf of shale according to ARI/EIA report, 2011*

A Paradigm Shift

- The view of natural gas has changed dramatically in only 10 years
  - Most predictions were for a dramatic increase in LNG imports to North America and Europe.
  - Today, growth opportunities for LNG developers are seen in primarily in Asia.
- Many investments were made to expand LNG potential to North America in particular
  - At one point, 47 terminals were in the permitting phase.
  - Since 2000, 2 terminals were re-commissioned and expanded (Cove Point and Elba); 9 others were constructed.
  - In 2000, import capacity was just over 2 bcfd; It now stands at just over 17.4 bcfd.
  - By 2012, it could reach 20 bcfd.
- A similar story in Europe
  - In 2000, capacity was just over 7 bcfd; It is now over 14.5 bcfd.
  - By 2012, it could exceed 17 bcfd.
- Shale gas developments have since turned expectations upside-down



Executive Summary

Geopolitical Repercussions of Expanded U.S. Shale Gas Production

- Growth in U.S. shale gas output has turned expectations upside down in less than a decade. In fact, rapid growth in shale gas production…
  - Virtually eliminates U.S. LNG imports for at least two decades
  - Combats the long-term potential monopoly power of a "gas-OPEC" or a single producer such as Russia to exercise dominance over large natural gas consumers in Europe or elsewhere
  - Substantially reduces Russia's market share in Europe from 27 percent in 2009 to 13 percent by 2040, reducing the chances that Moscow can use energy as a tool for political gain
  - Reduces the future share of world gas supply from Russia, Iran, and Venezuela; without shale discoveries, these nations would have accounted for about 33 percent of global gas supply in 2040, but with shale, this is reduced to 24 percent.

Geopolitical Repercussions of Expanded U.S. Shale Gas Production (cont.)

- … growth in shale gas production…
  - Reduces the opportunity for Venezuela to become a major LNG exporter and thereby lowers longer-term dependence in the Western Hemisphere and in Europe on Venezuelan LNG
  - Reduces competition for LNG supplies from the Middle East, thereby moderating prices and spurring greater use of natural gas, an outcome with significant implications for environmental objectives as well
  - Reduces U.S. and Chinese dependence on Middle East natural gas supplies, lowering the incentives for geopolitical and commercial competition between the two largest consuming countries and providing both countries with new opportunities to diversify their energy supply
  - Limits Iran's ability to tap energy diplomacy as a means to strengthen its regional power or to buttress its nuclear aspirations

But, nothing is certain…

- A stable regulatory environment that fosters responsible development of domestic resources is critical to achieving the potential benefits presented by shale.
- In general, multiple issues face shale development: some are global, some are not.
  - **Resource Access** – mineral rights ownership; acreage acquisition; resource assessments; environmental opposition; etc.
  - **Market Structure** – transportation regulatory structure (unbundled access vs. incumbent monopolies); bilateral take-or-pay obligations or marketable rights; existence of gathering and takeaway capacity and hurdles to development; competing resources (RPS, coal, nuclear, etc.); pricing paradigms; etc.
  - **Water** – volume and availability for production; water rights and resource management regulation; flowback options (recycle and/or treatment and disposal) and native infrastructure; concerns about watershed protection during drilling operations (casing failures and fracture migration); etc.
  - **Other issues** – earthquakes related to injection of produced and treated water; long term environmental effects of methane (and other gases) escape; concerns about potential chemical and/or radiation contamination from produced water; ecological concerns related to land use and reclamation; etc.

Study Results

Three Scenarios were considered…

Reference Case

The Reference Case posits a scenario in which all known global shale gas resources can be developed, given prevailing commercial technologies and open tendering practices. This scenario includes all global shale resources that are currently identified in Europe and Asia and thereby present a full picture of the current expectations for changing geopolitical and market implications of development of shale gas resources.

Scenario 2

Under this scenario, shale developments in North America are limited to the Barnett, Woodford, and Fayetteville shale plays. Furthermore, under this scenario, no shale gas outside of North America is open for development. This scenario is a counter-factual aimed to demonstrate what the world would look like if shale gas developments did not progress to the levels currently under way.

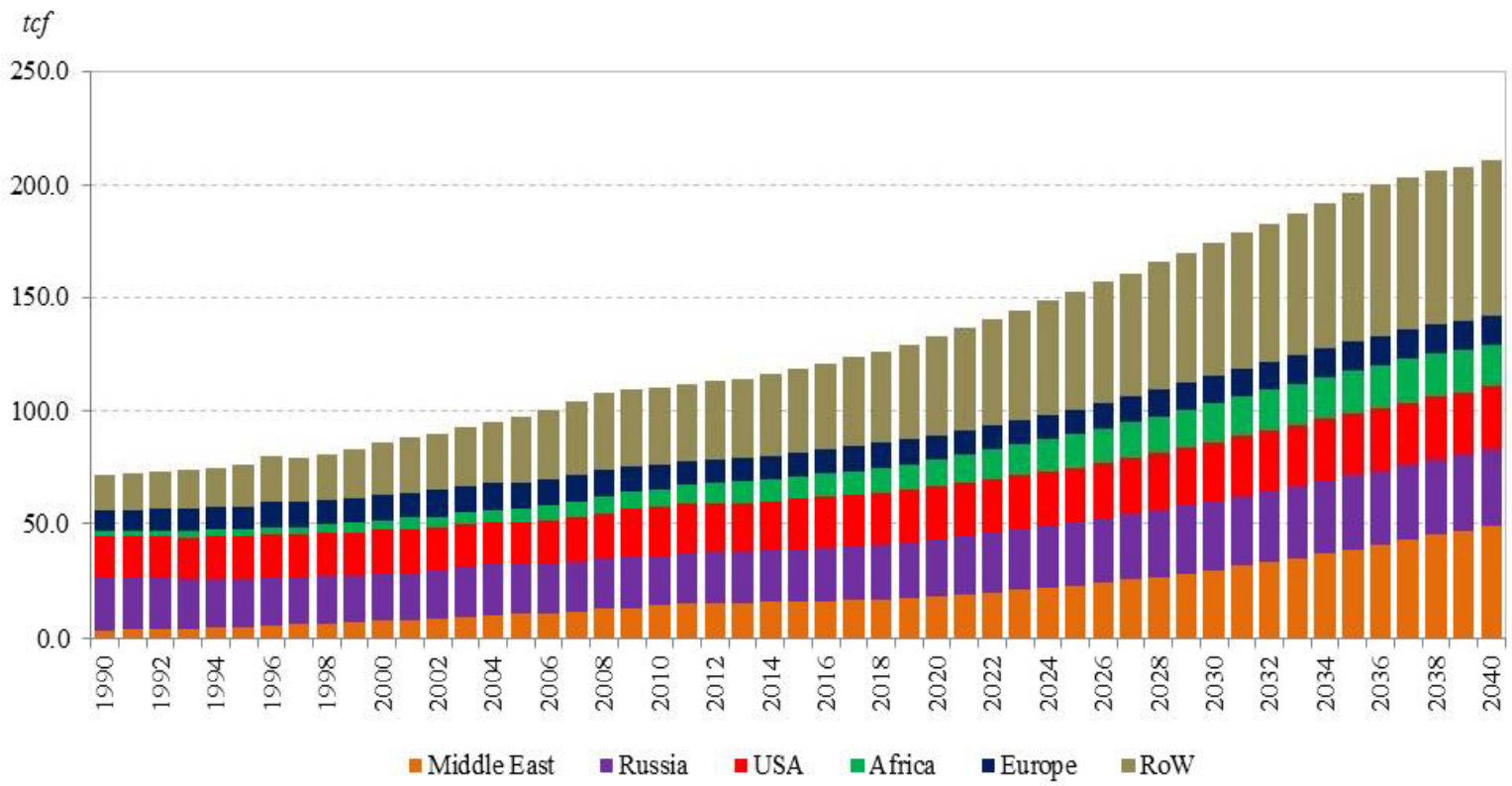
Scenario 3

In this scenario, specific U.S. shale plays located north of Virginia are blocked from development by environmental and/or other political, fiscal, or regulatory factors. Commercial investment in all other U.S., Canadian, and other global shale gas is permitted in the scenario. While it is possible that environmental obstacles may, at some point, also impact development of resources in other countries, this scenario focuses solely on the consequences of limiting U.S. Middle Atlantic resource development to highlight the U.S. energy security implications of such policy choices.

In what follows, we focus our comments on comparisons of the Reference Case and Scenario 2.

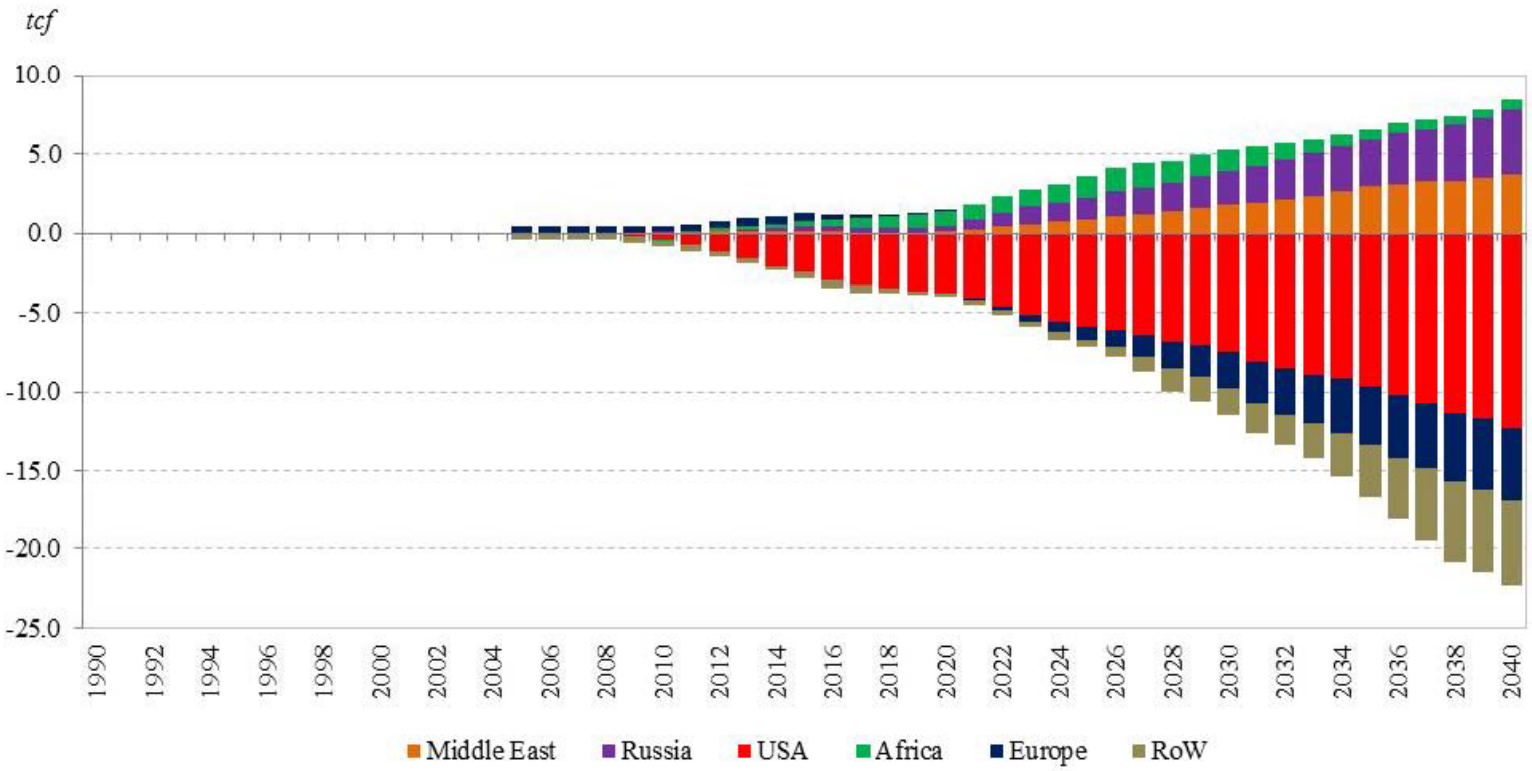
Global Supply by Super Region, 1990-2040

- **Reference Case**: Middle East production grows to meet demand growth in both the Middle East and Russia. By 2040, the Middle East accounts for 20% of global supply.



Global Supply by Super Region, 1990-2040 (cont.)

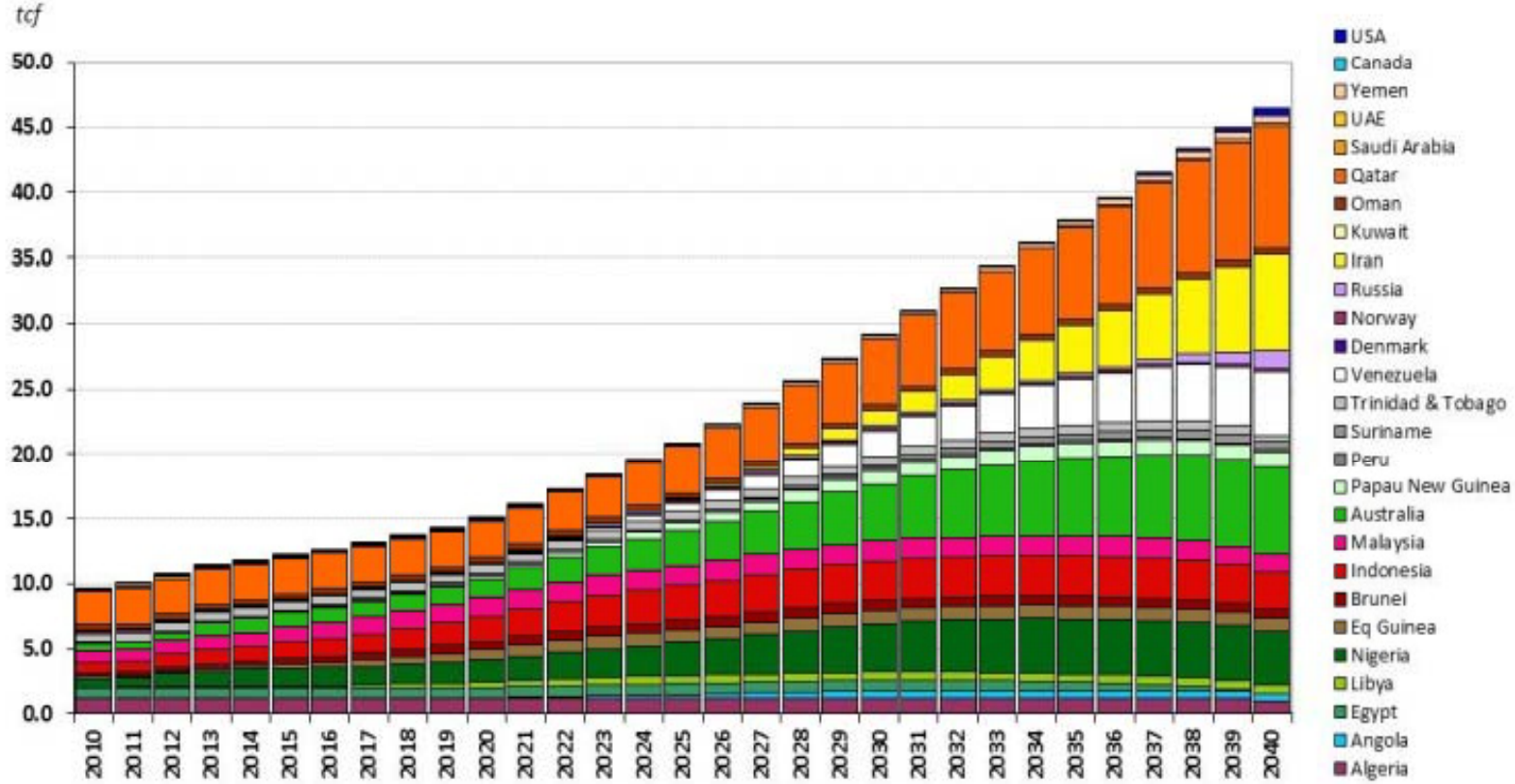
- **Scenario 2 delta to Reference Case**: Scenario 2 sees global dependence on the Middle East grow to 27% by 2040.



LNG Exports by Country

- **Reference Case**: Substantial long term growth from the Middle East, Australia, Nigeria and Venezuela. Qatar and Australia are the largest LNG exporters through 2035, and, collectively, account for about 40% of global *LNG* exports.

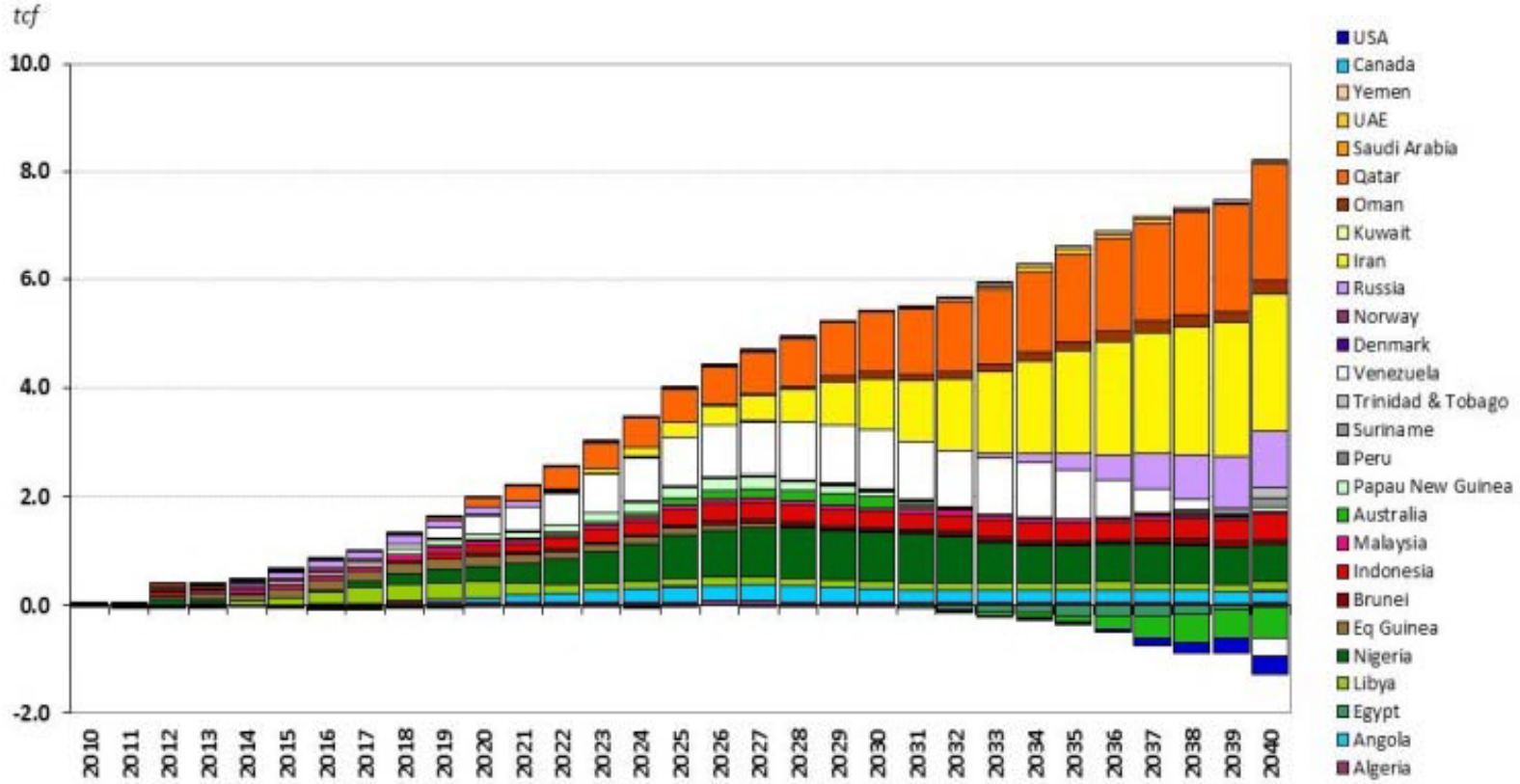
Reference Case



LNG Exports by Country (cont.)

- **Scenario 2**: Growth in Qatar, Nigeria, Venezuela and Iran are all much higher. The lack of shale in the U.S. favors LNG suppliers in or near the Atlantic basin.

Scenario 2 delta to Reference Case

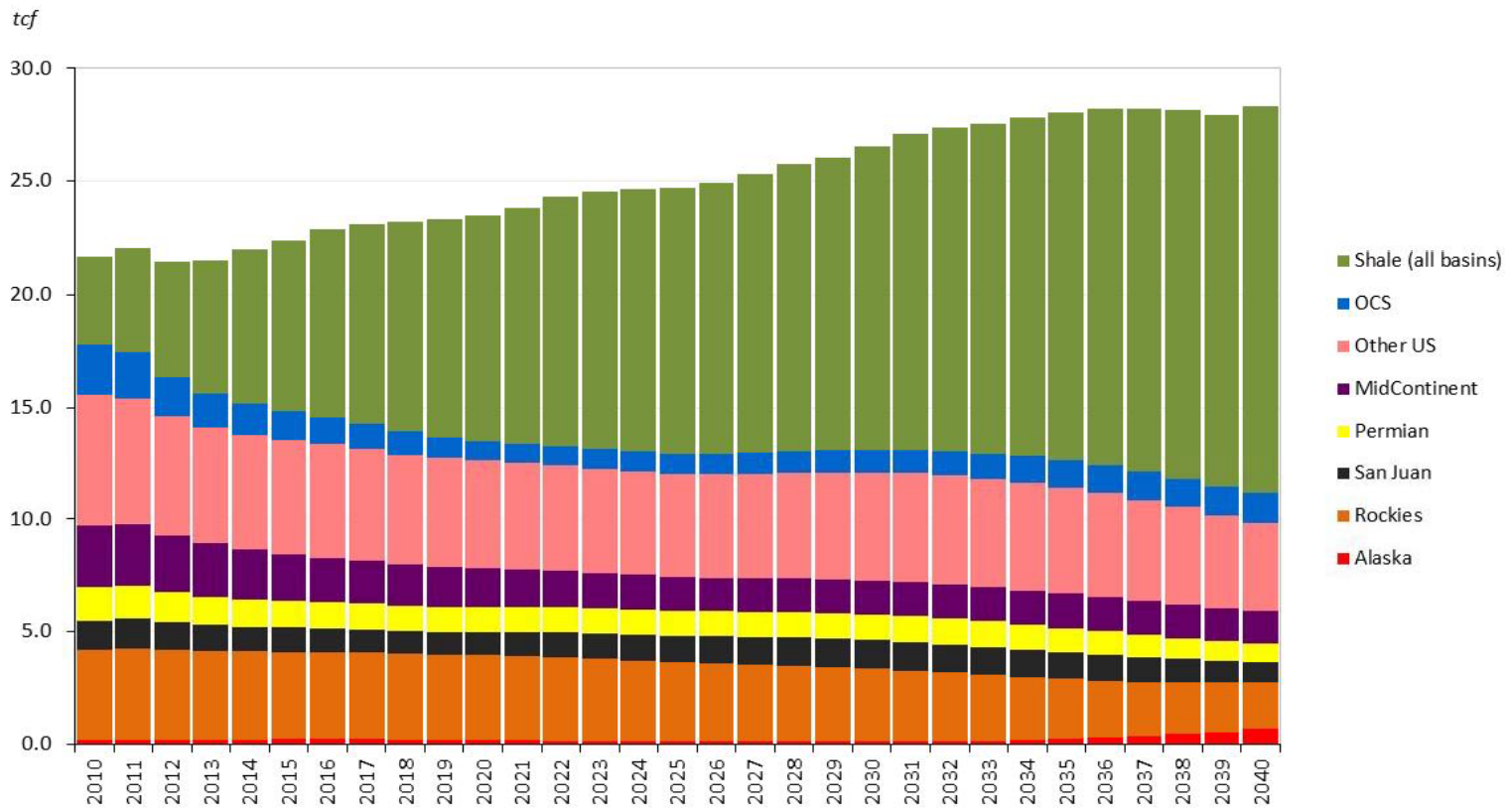


U.S.

Composition of U.S. Production

- U.S. shale gas production exceeds 50% of total production by 2030.
- Canadian shale gas production grows to 1/3 of total output by the mid-2030's (not pictured).

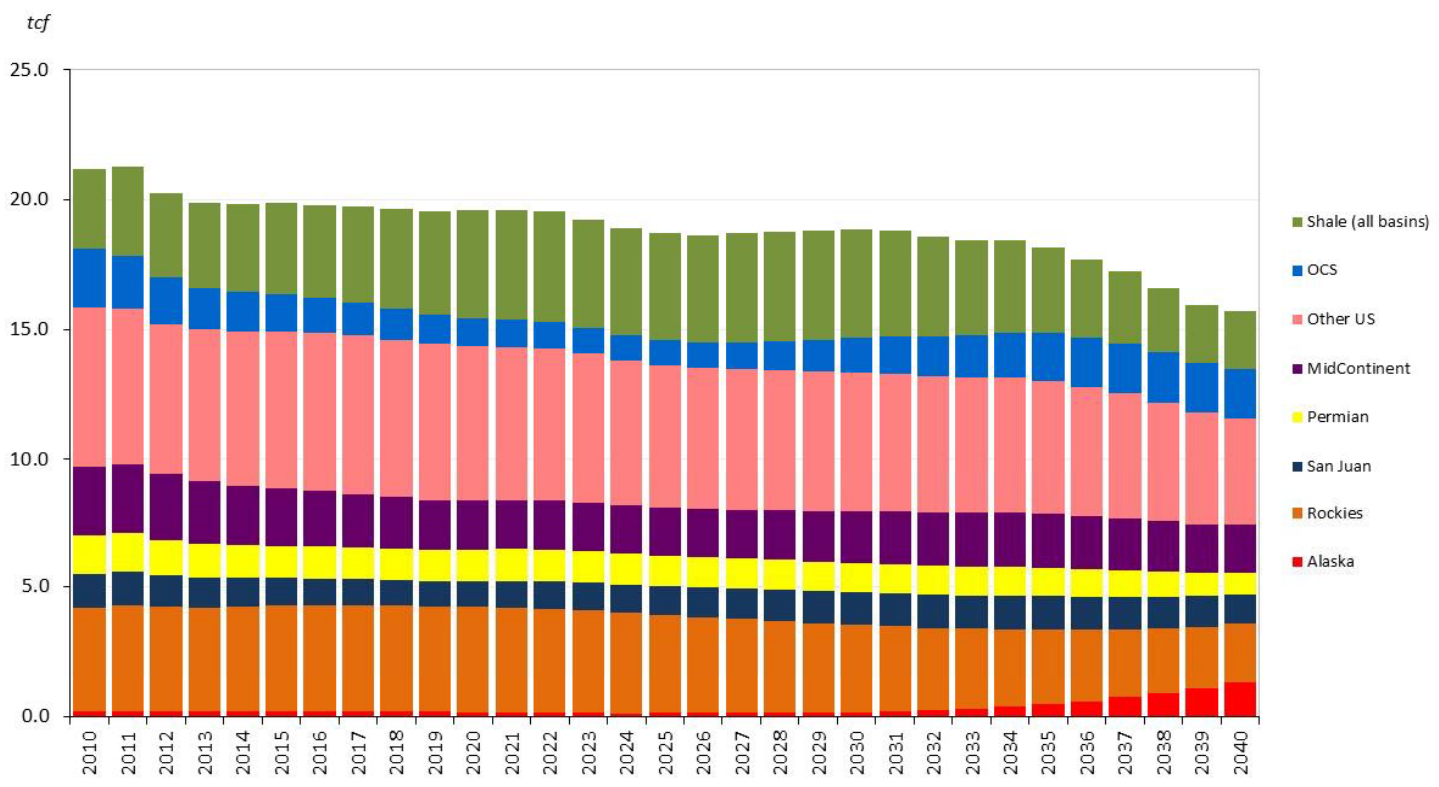
Reference Case



Composition of U.S. Production (cont.)

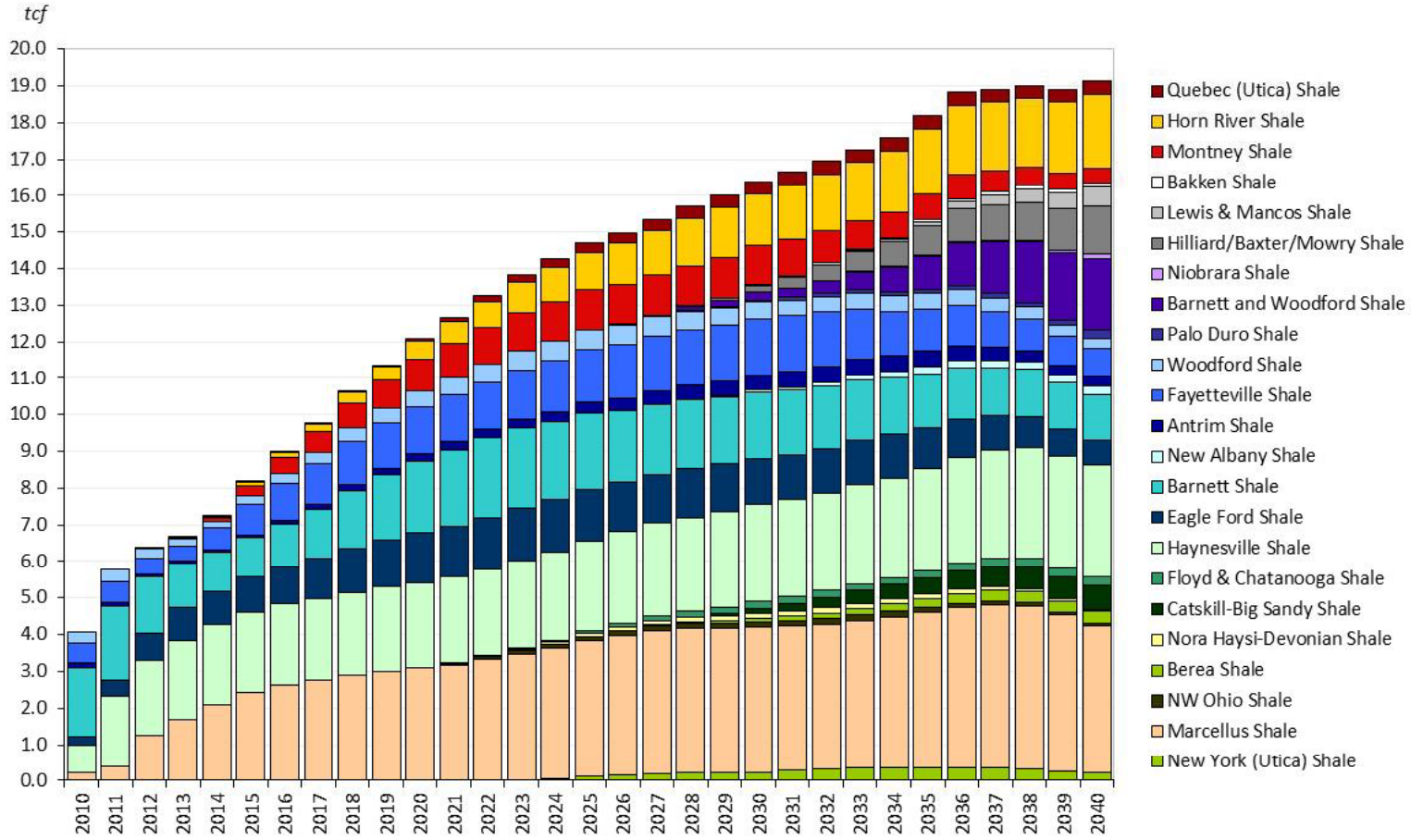
- The lack of shale production leaves domestic supply severely diminished as long term declines in other basins dominate the overall trend.

Scenario 2



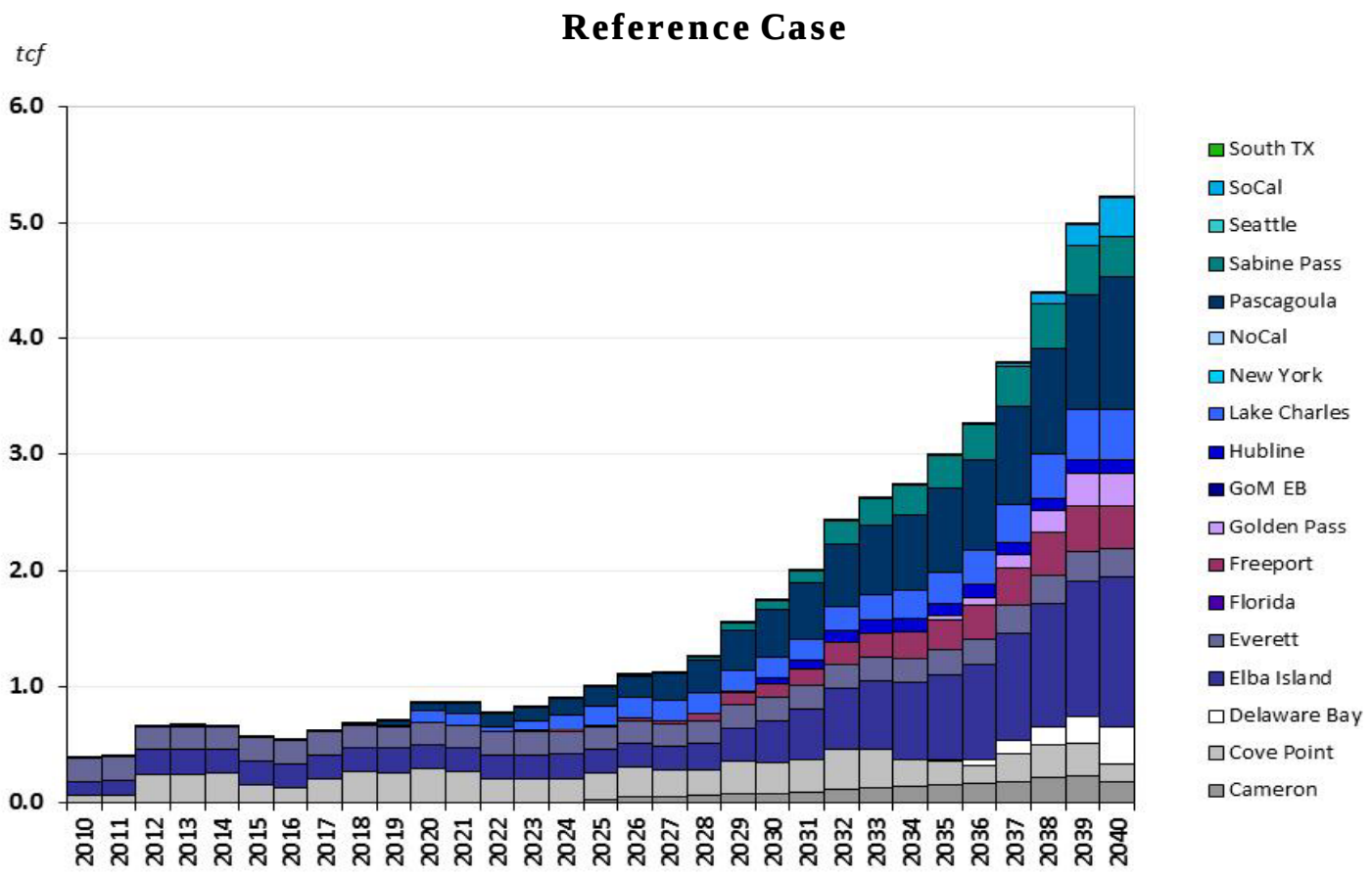
North American Shale Production

Reference Case



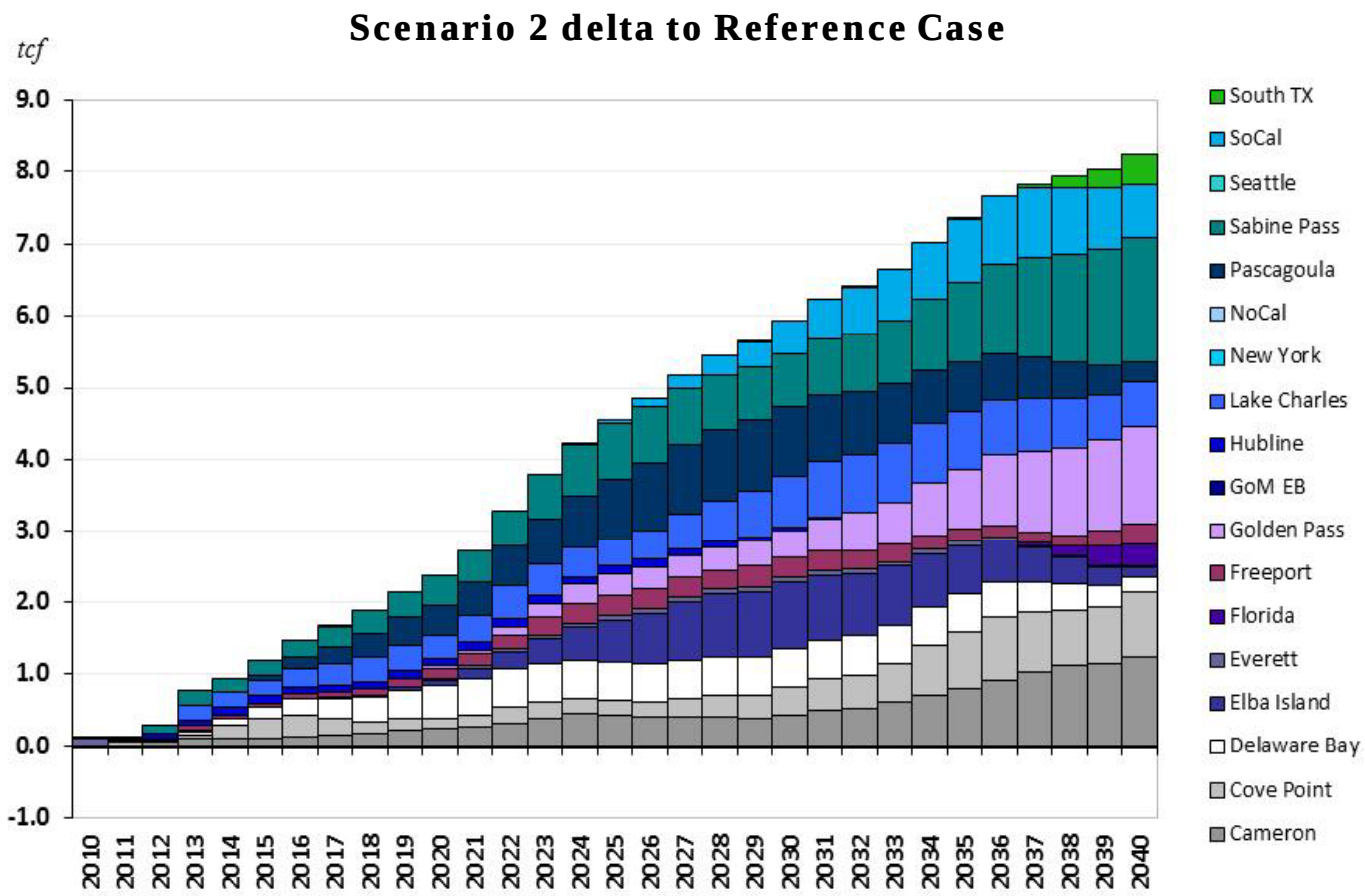
U.S. LNG Imports

- Very low re-gas terminal capacity utilization to 2030.
- LNG imports eventually rise as declines in conventional basins accelerate.



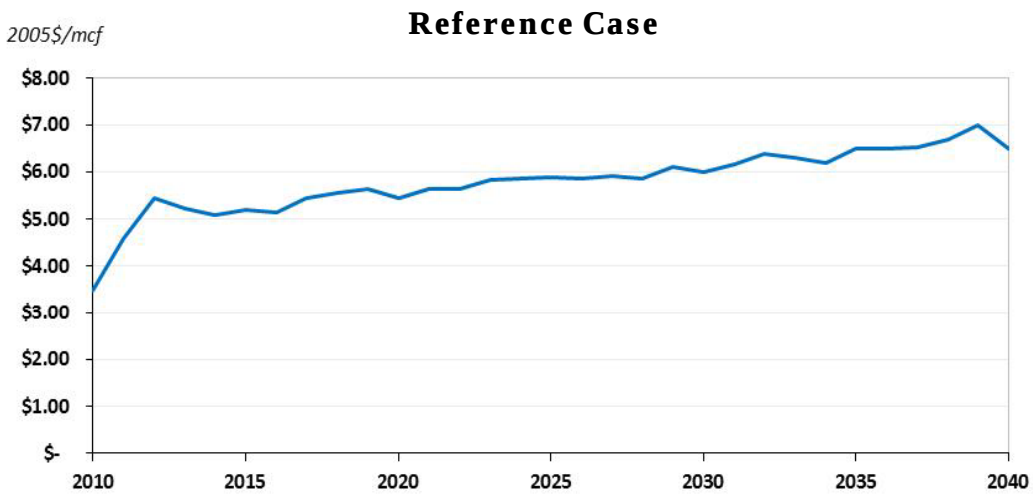
U.S. LNG Imports (cont.)

- Absent shale resources, U.S. LNG imports rise substantially.

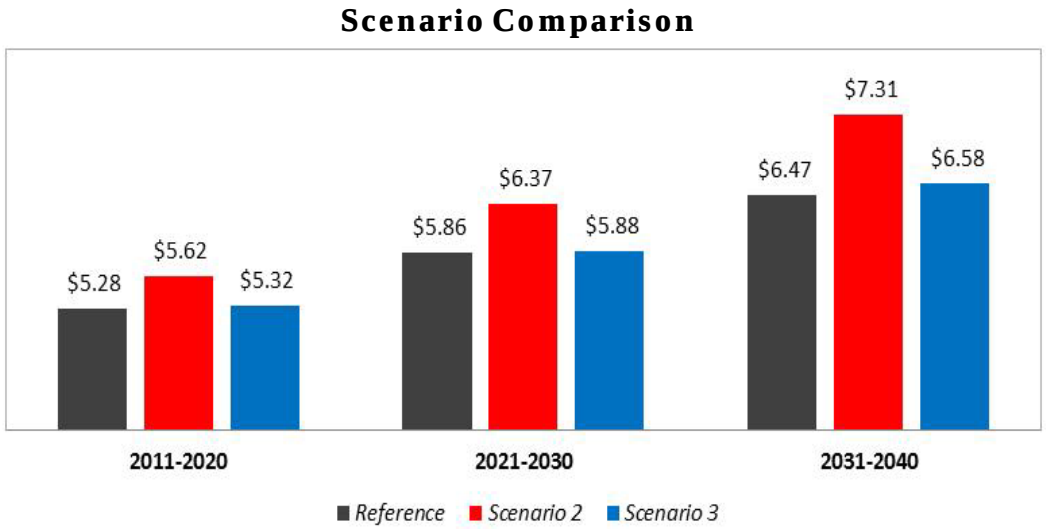


Henry Hub Price

- Prices tend to rise over time as lower cost supplies are depleted. But, abundant shale gas resources render the domestic supply curve to be relatively flat.



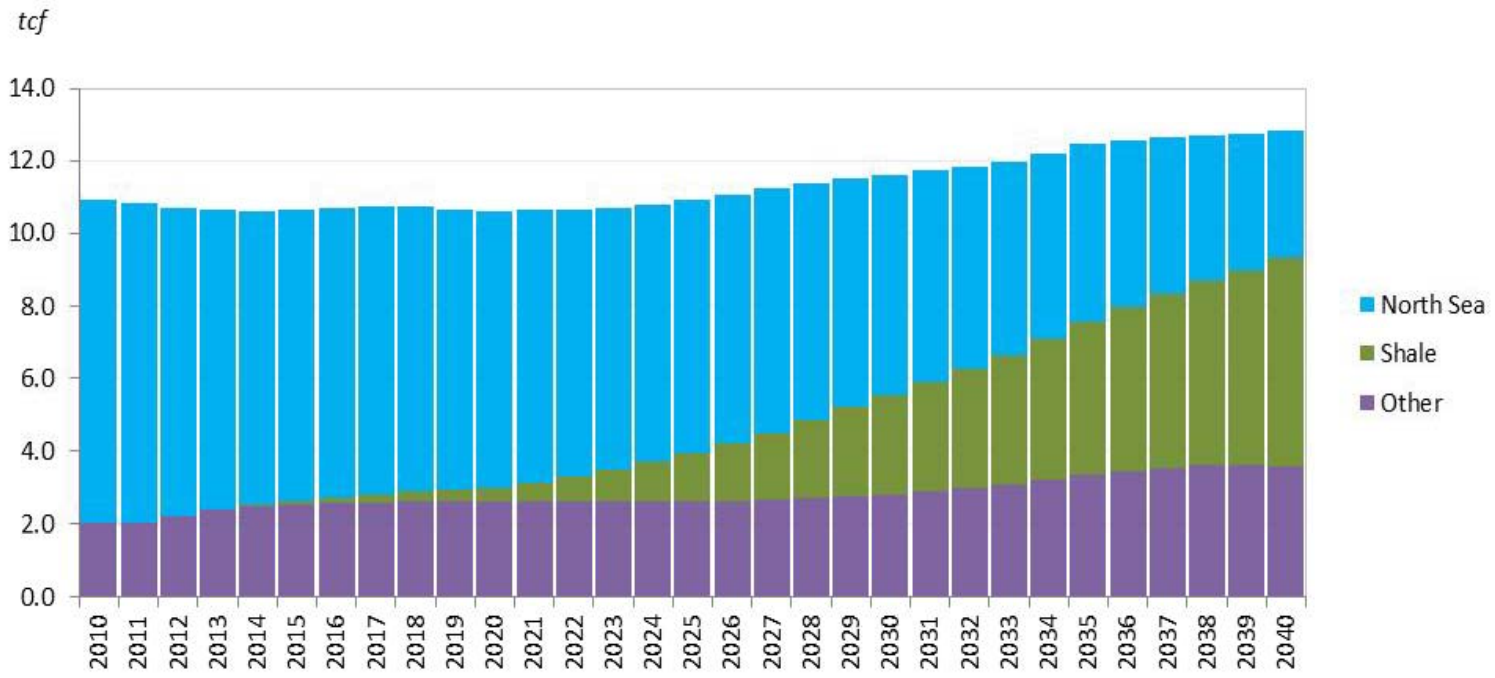
- In Scenario 2, where domestic supply is effectively less elastic, we see the price at Henry Hub rise much more quickly.



Rest of World

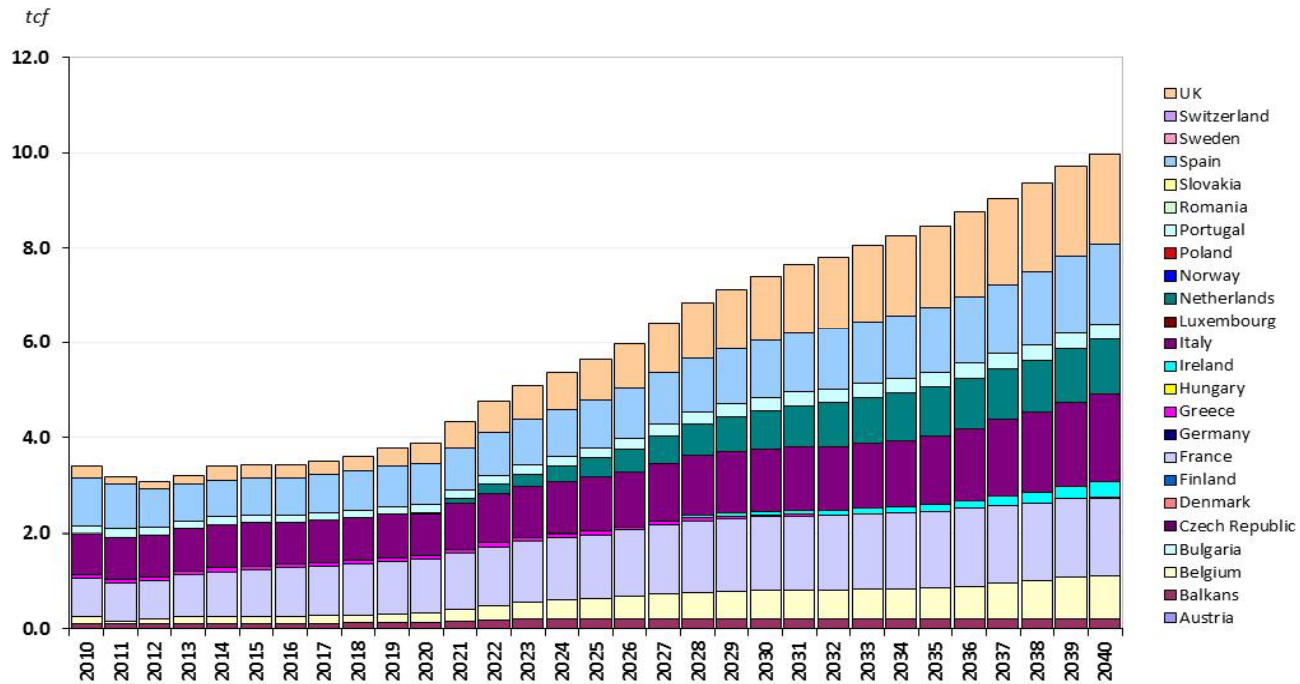
Impact of Shale Production outside North America

- European shale production grows to about 35% of total production by 2040. China shale production is a smaller portion, accounting for about 8% of total production by 2040 (not pictured). While this is not as strong as North America, it does offset the need for increased imports from Russia, North Africa, and LNG. In fact, the impact of shale growth in Europe is tilted toward offsetting Russian imports, but it also lowers North Sea production at the margin, as well as other sources of imports.



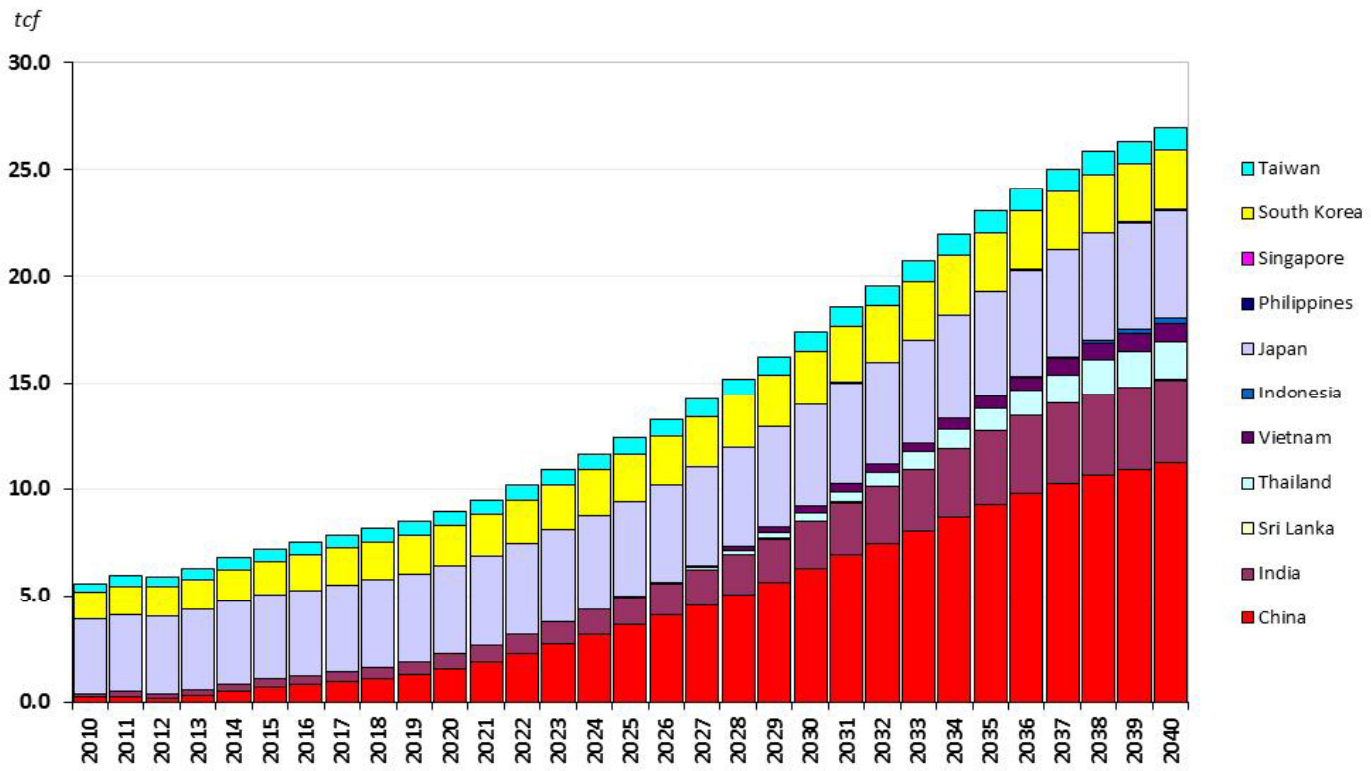
LNG Imports to Europe

- Growth in LNG is an important source of diversification to Europe. Indigenous shale gas opportunities abate this to some extent. However, shale production does not grow as strongly as in North America, so LNG imports in Europe rise. Note that strong growth in North America, by displacement, influences the rise in LNG to Europe.



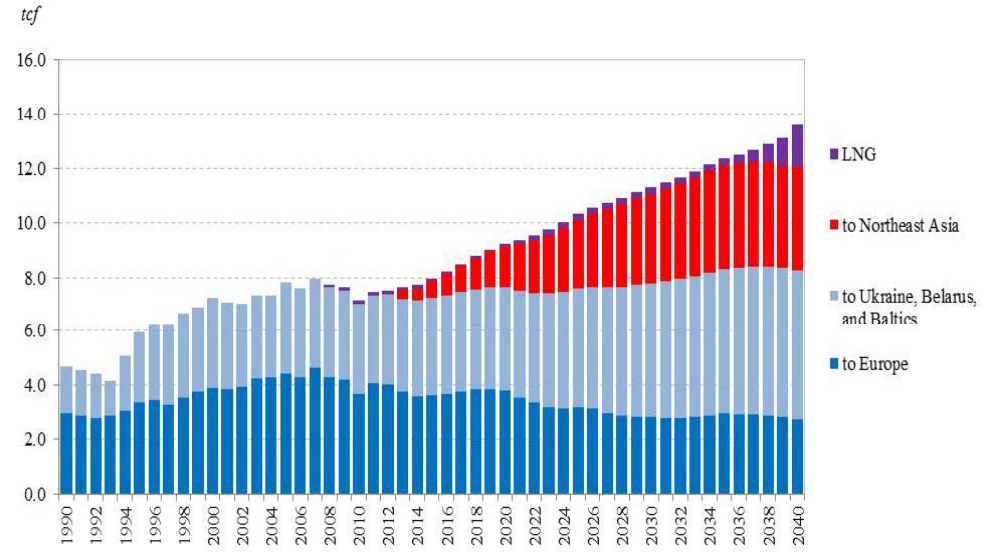
LNG Imports to Asia

- Strong demand growth creates a much needed sink for LNG supplies.
  - China leads in LNG import growth despite growth in both pipeline imports and supplies from domestic unconventional sources.

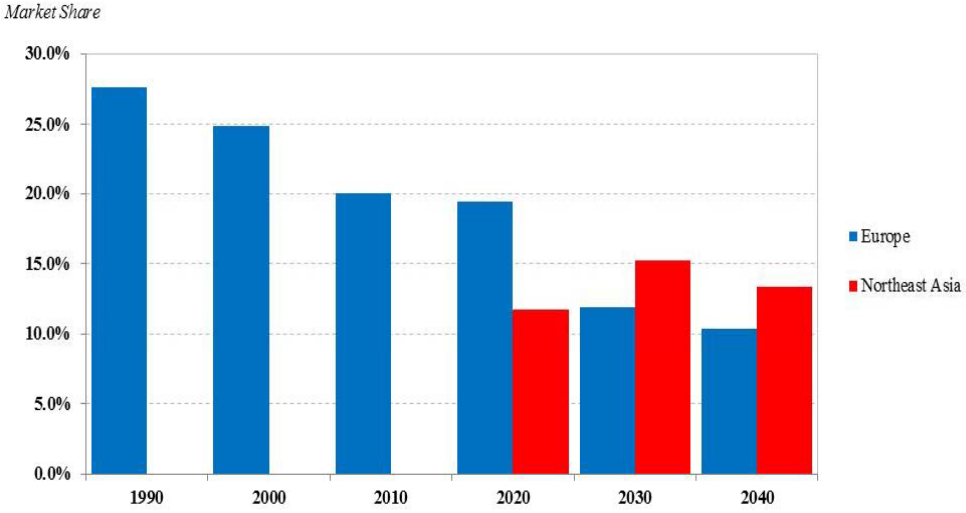


Russian Exports

- **Reference Case**: Russian opportunities to Europe are diminishing as a result of shale production growth and Europe's increased pull on LNG.

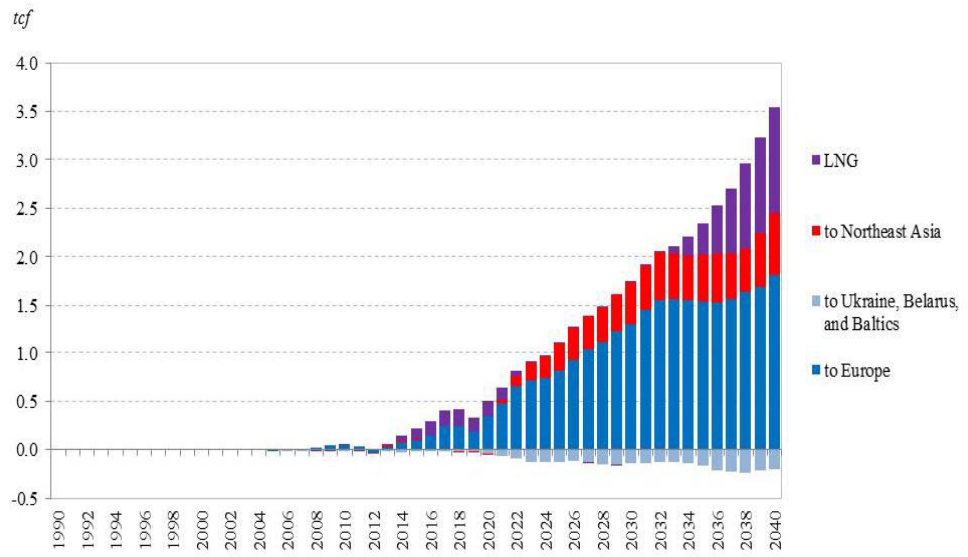


- **Reference Case**: The market share of Russia in non-FSU Europe falls to just over 10% by 2040, while it rises and stabilizes at just under 15% in Northeast Asia.

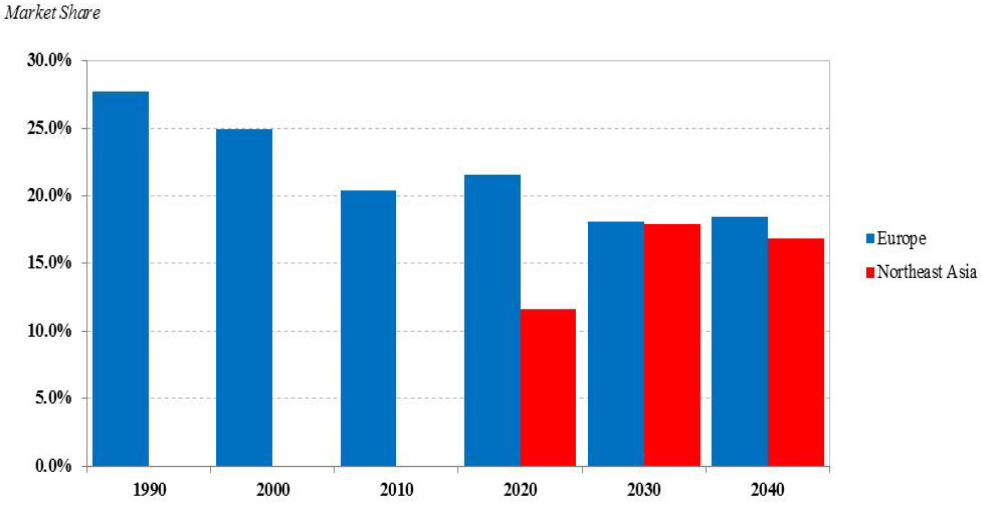


Russian Exports (cont.)

- **Scenario 2**: Absent shale, Russian exports are substantially higher, with a significant impact on flows to Europe.

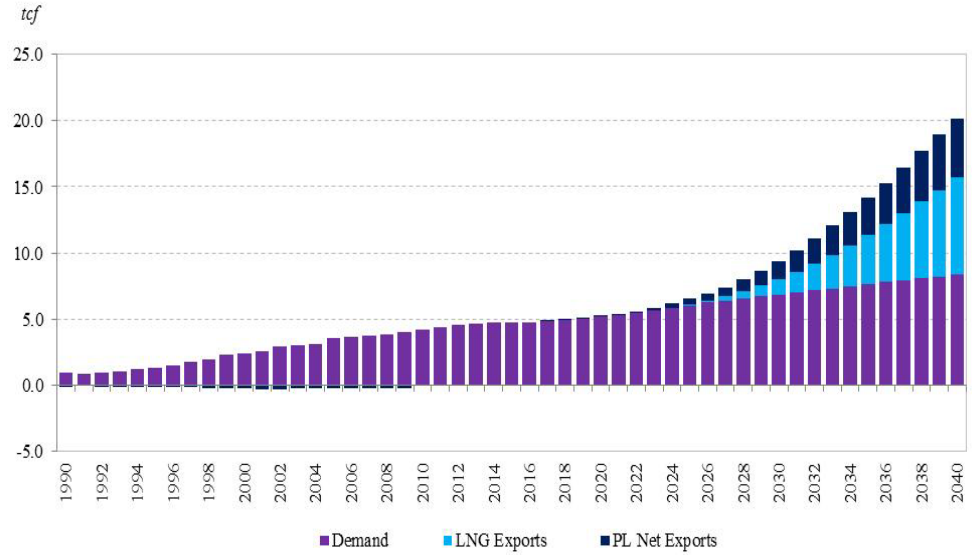


- **Scenario 2** : The market share of Russia in non-FSU Europe stabilizes at about 18% by 2040, and around 17% in Northeast Asia. Note that Russian market share in both regions is higher.

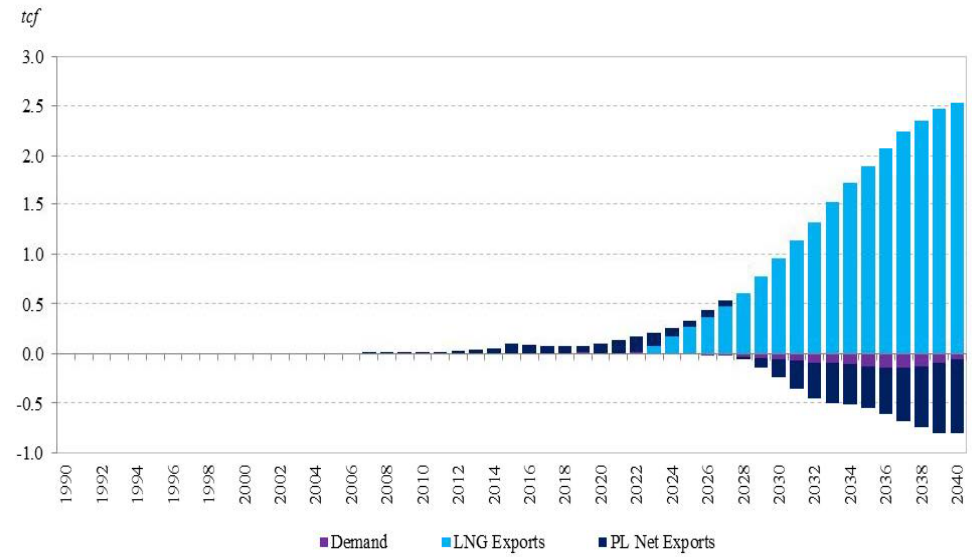


Iranian Supply Disposition

- **Reference Case**: Most Iranian production is consumed domestically, but longer term , LNG exports begin to require a substantial portion of Iranian production.



- **Scenario 2 delta to Reference Case**: LNG exports from Iran are significantly higher. This results from the greater global pull on Iranian resources in the absence of shale gas.



Questions?