

Evaluation of the 2014 Annual Energy Outlook Early Release:

Implications for U.S. LNG Exports and Natural Gas Prices

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Prepared for:



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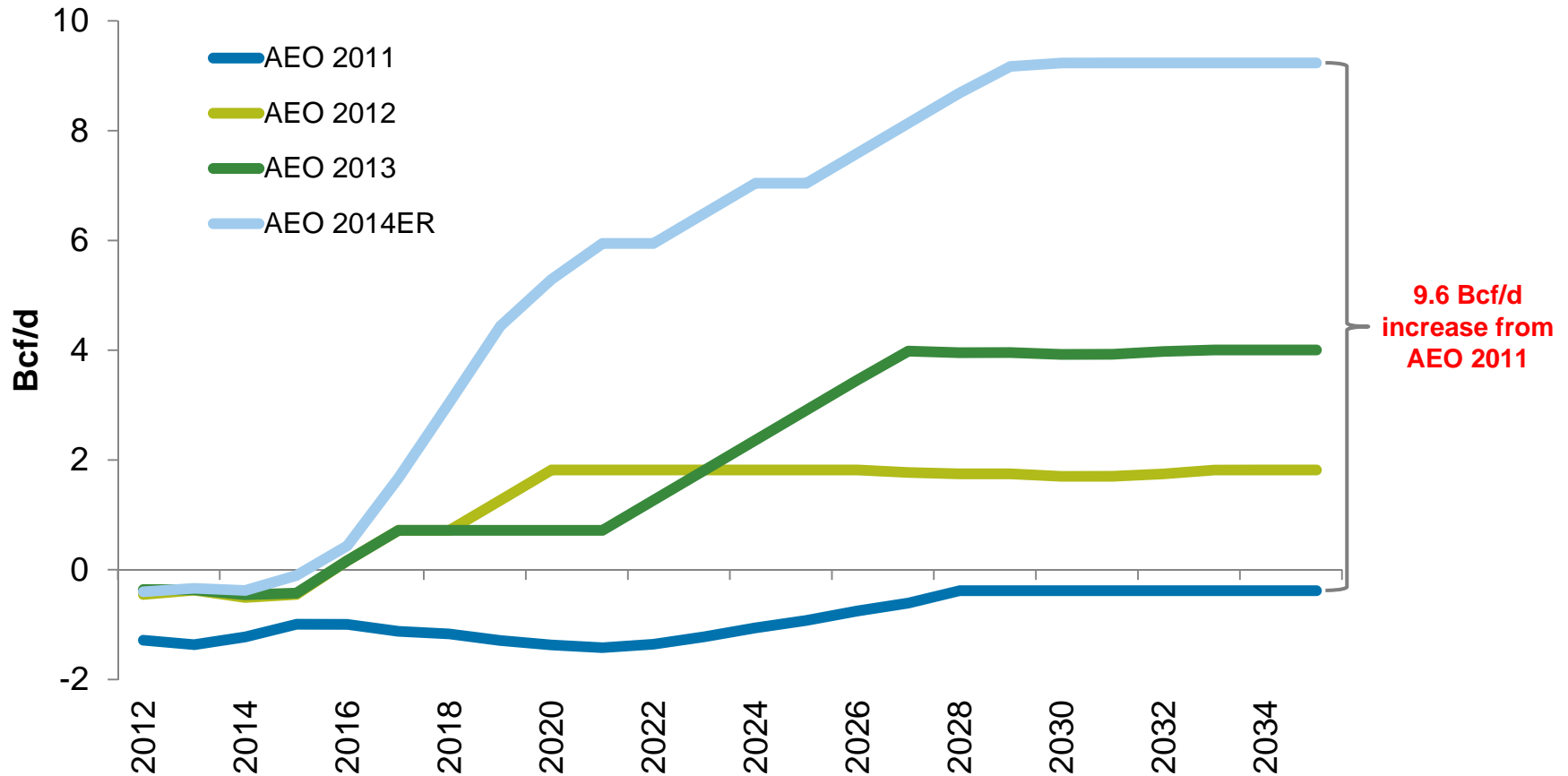
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Executive Summary

- Charles River Associates (CRA) was retained by The Dow Chemical Company to evaluate the Energy Information Administration's (EIA) Annual Energy Outlook 2014 Early Release (AEO 2014ER) as it pertains to U.S. LNG exports and their implication for domestic natural gas prices.
- The AEO 2014ER forecasts LNG net exports to grow to and stabilize at 9.2 Bcf/d or ~10% of total domestic demand after 2030 and that the increase in exports relative to last year's Annual Energy Outlook would have a minimal impact on domestic gas prices.
- The AEO 2014ER's forecasted LNG exports appear conservative relative to the ~14 Bcf/d of financed U.S. projects in the pipeline, which are part of the 19 Bcf/d of U.S. projects at or near existing import terminals.
- It can be inferred from the AEO 2014ER that EIA is forecasting the U.S. to become a marginal global supplier of LNG exports by 2030, which prevents post-2030 growth. This in turn implies that Asian LNG import prices decline from \$16/MMBtu currently to \$12-13/MMBtu by 2030 in order for the U.S. marginal cost of supply to equilibrate with netback prices.
- Analysis of the AEO 2014ER also suggests that U.S. natural gas prices will be based on the domestic supply curve. We do not agree. Once the the U.S. becomes reconnected to the global gas market, economic theory and examples from other global commodity markets show that netback pricing will occur. This means higher prices for U.S. consumers and a return to gas price volatility.
- While the EIA scenario of low international LNG prices is plausible, it is just as likely as a scenario where LNG prices continue to be indexed to oil.
- We suggest that EIA equally weight a low and high-price LNG import price scenario in its final version of the AEO 2014, recognizing the extreme outcomes that could occur in the LNG export market.

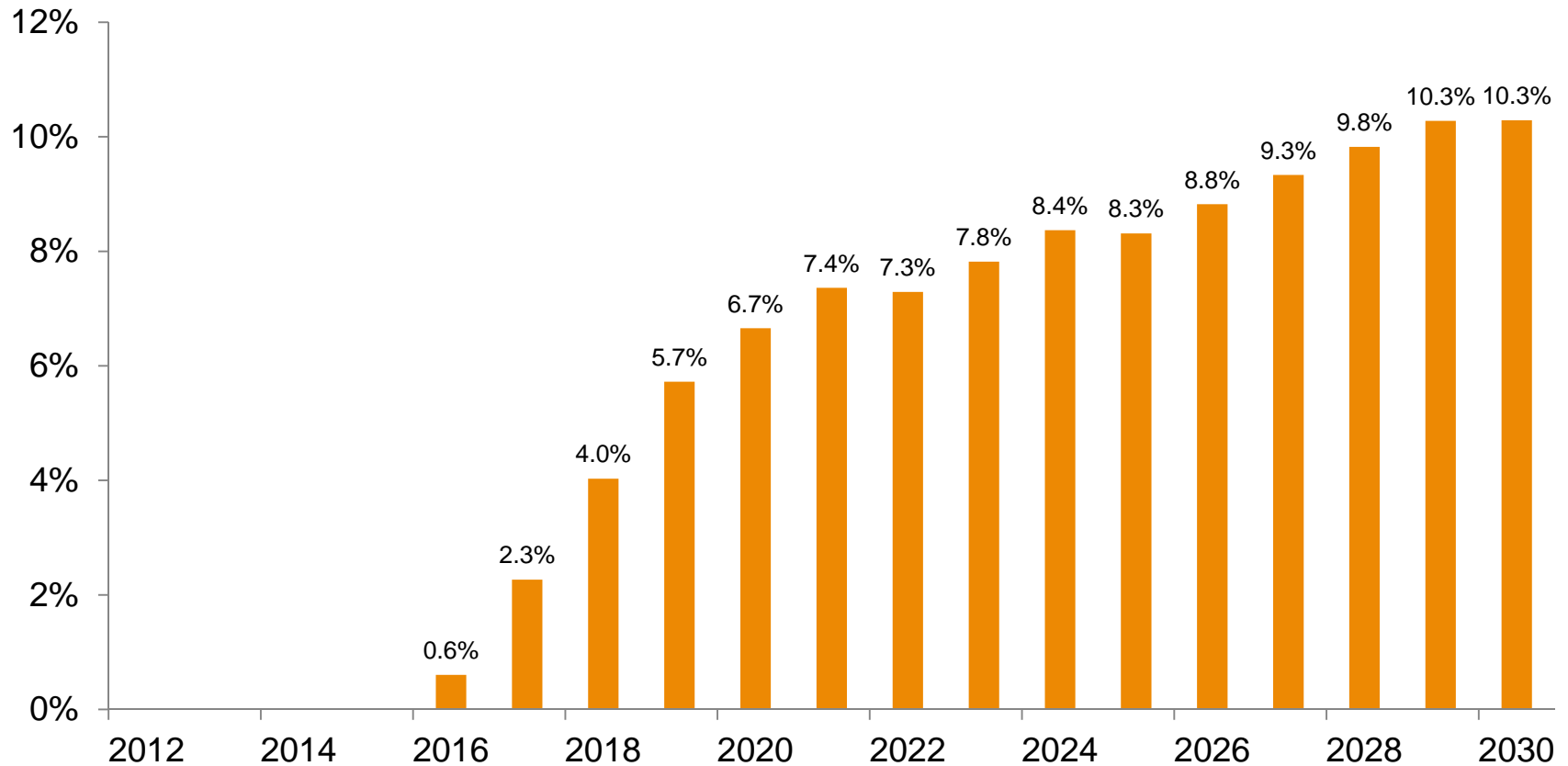
Forecasts for U.S. LNG net exports have shifted considerably in the last four AEO model years – from small scale LNG net imports (AEO 2011) to large scale LNG net exports of 9.2 Bcf/d by 2030 (AEO 2014 ER).

LNG Net Exports by AEO Release



AEO 2014ER forecasts 9.2 Bcf/d of LNG exports by 2030, representing ~10% of total domestic demand (domestic demand + net exports).

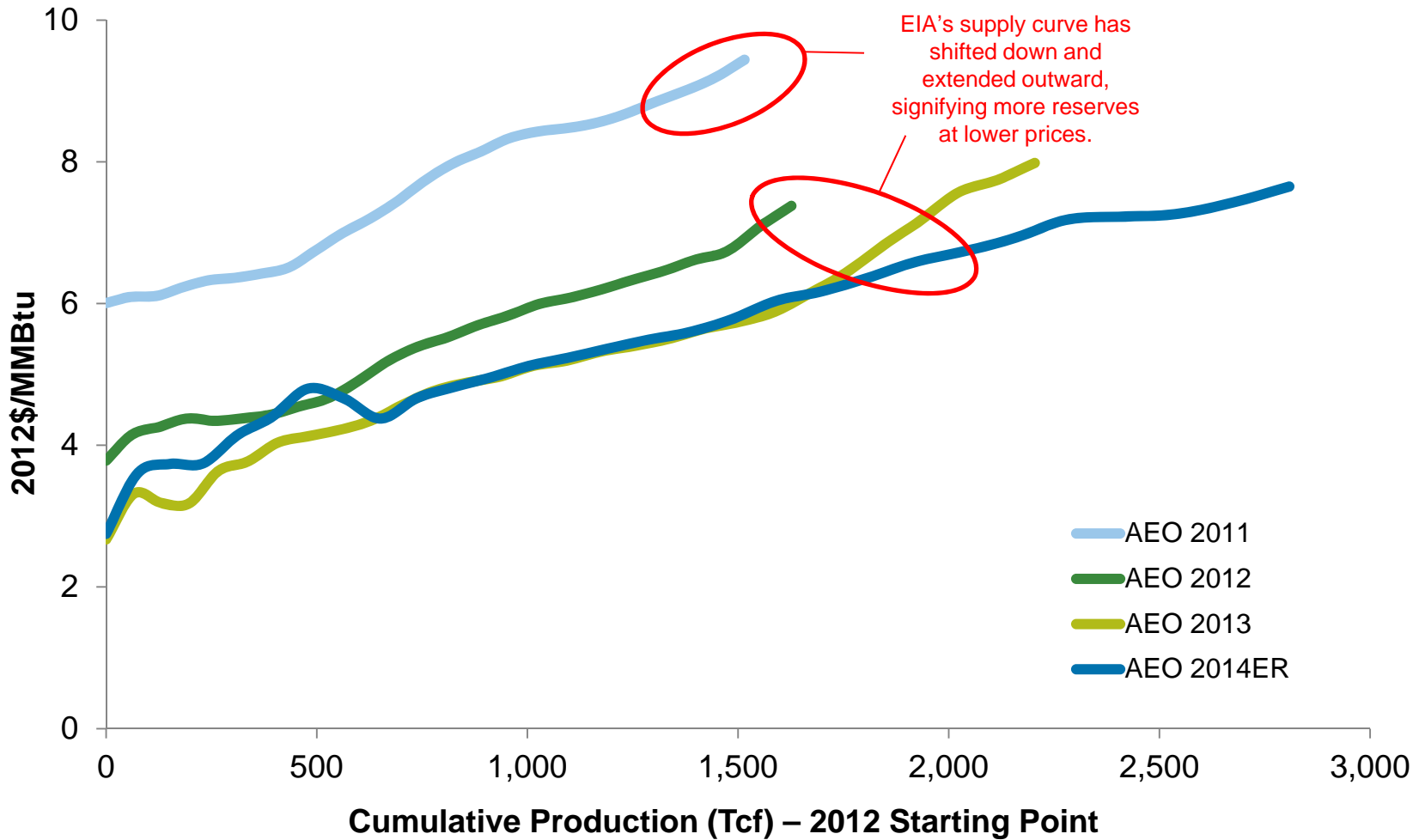
LNG Exports Share of Total Demand¹ – AEO 2014ER



¹ Total demand also is equivalent to U.S. natural gas production

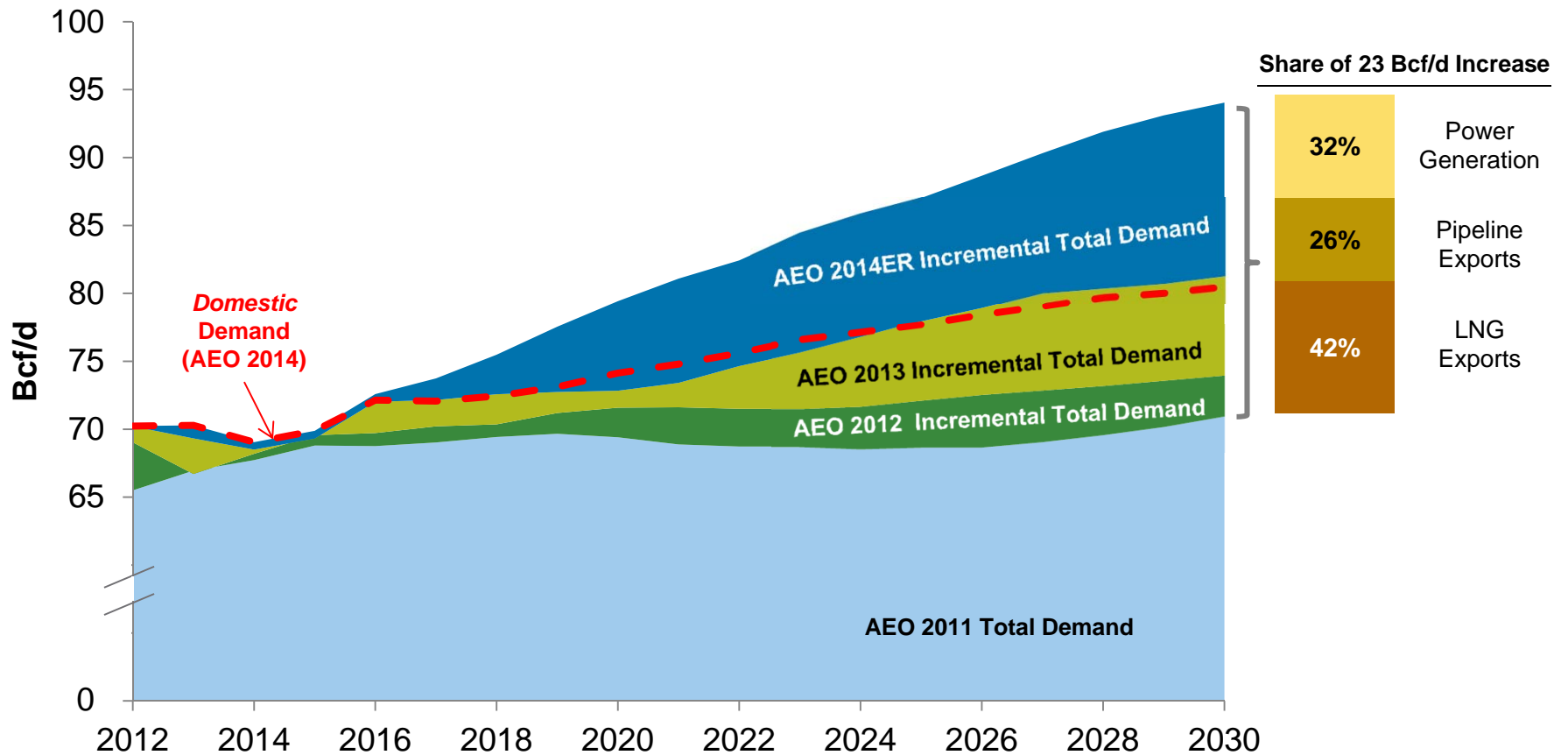
The significant change in EIA's forecasted LNG exports follows a fundamental shift in the supply curve outlook for U.S. natural gas due to shale.

Implied Supply Curve Outlook by AEO Release



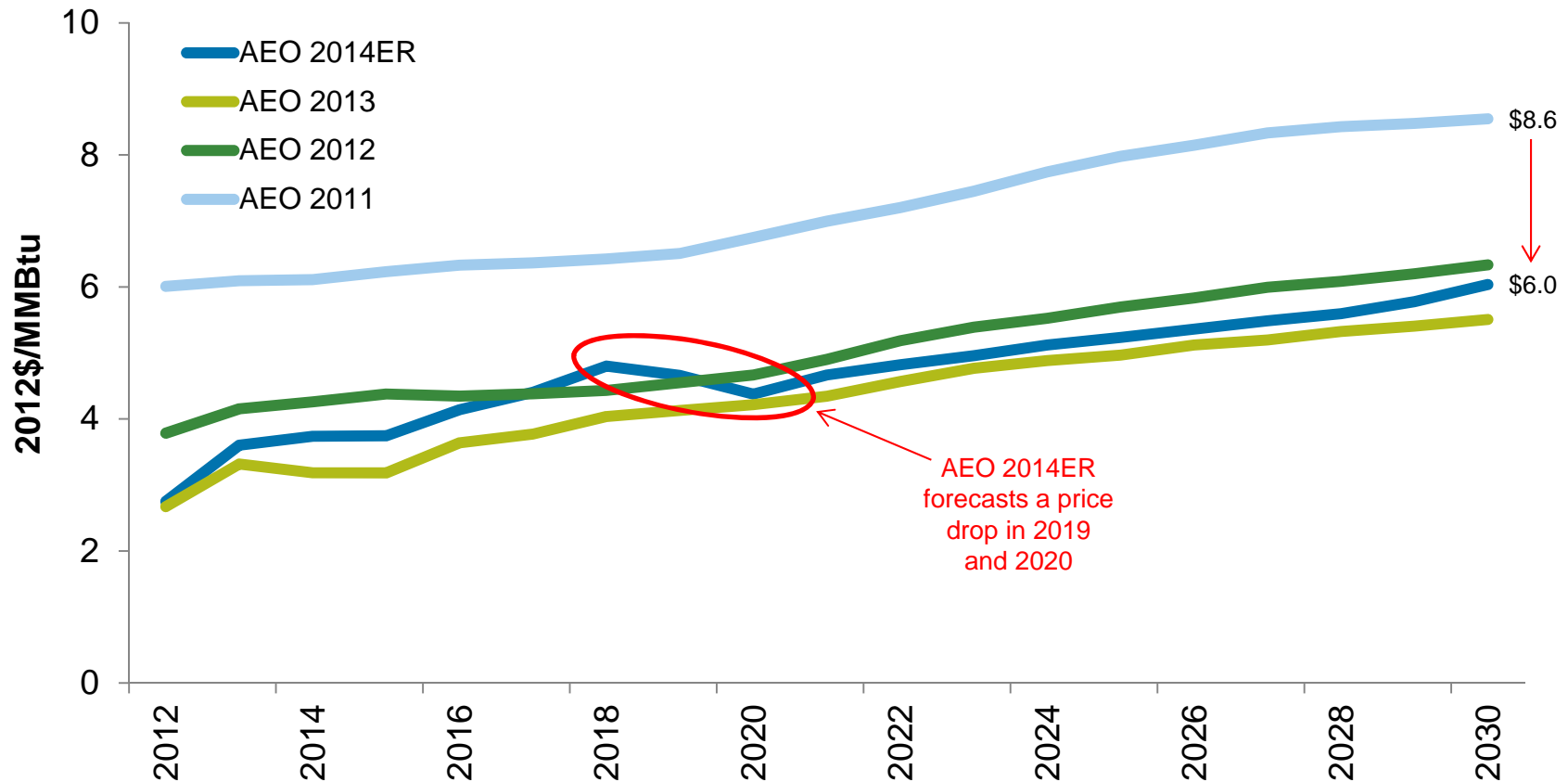
This has led to higher projected total demand for gas in the long-term – an increase of ~23 Bcf/d in 2030 from AEO2011 to AEO2014ER....

Total Demand (Domestic + Net Exports)



...as forecasted gas prices have declined from \$8.6/MMBtu (AEO 2011) to \$6.0/MMBtu (AEO 2014ER) by 2030 in 2012\$.

Forecasted Henry Hub Prices by AEO Release



Could U.S. LNG export potential be even higher than the 9 Bcf/d that EIA forecasts – 19 Bcf/d at or near existing sites or even the 38 Bcf/d total proposed?

Proposed and Actual Projects at or Near Existing U.S. Sites

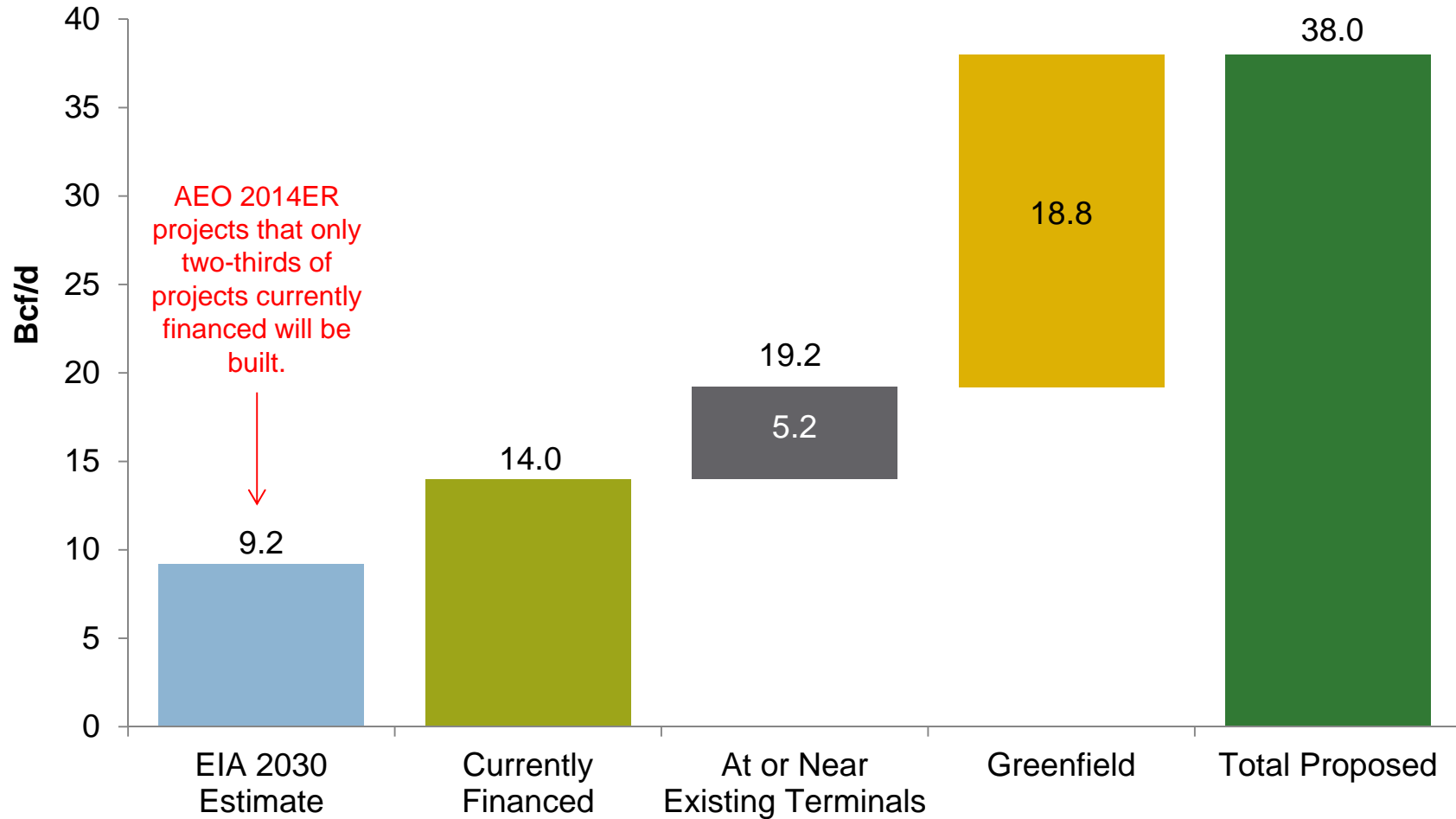
	Project	Status	Non-FTA Approval	Estimated Start-Up	Capacity (Bcf/d)
Financed	Sabine Pass	Under Const.	Yes	2016-2017	2.20
	Freeport LNG	Proposed	Yes	2018	1.80
	Lake Charles	Proposed	Yes	2018	2.00
	Dominion Cove	Proposed	Yes	2018	0.77
	Cameron	Proposed	No	2019	1.70
	Magnolia LNG	Proposed	No	2019	0.54
	Golden Pass	Proposed	No	2019	2.60
	Freeport LNG (exp.)	Proposed	No	2019	1.00
	Sabine Pass (exp.)	Proposed	No	2016-2017	1.38
	Sub-total				
Others	Main Pass	Proposed	No	2020+	3.22
	Gulf LNG	Proposed	No	2020+	1.50
	Southern LNG	Proposed	No	2020+	0.50
Total Projects at or Near Existing U.S. Sites					19.21
Total Projects at Greenfield Sites					18.75
Grand Total					37.96

Comments

- Existing sites, due to their infrastructure, typically are in the best economic position to pursue an LNG export terminal.
- ~19 Bcf/d of additional exports have been proposed at greenfield locations.
- ~17 Bcf/d of LNG export capacity has been proposed in Canada.

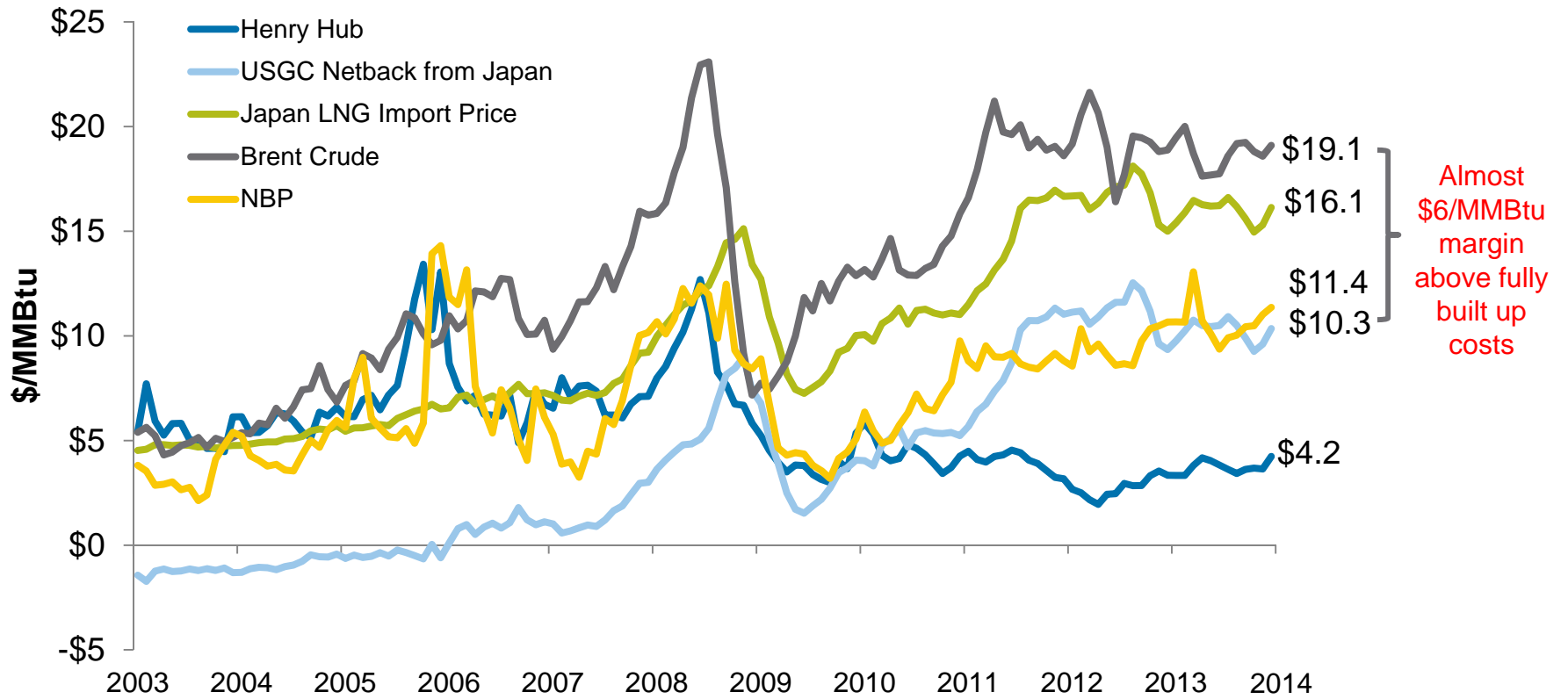
Given the LNG export capacity that has been financed and proposed for 2030, the AEO 2014ER LNG forecast appears conservative.

AEO 2014ER LNG Exports vs. Proposed 2030 Capacity



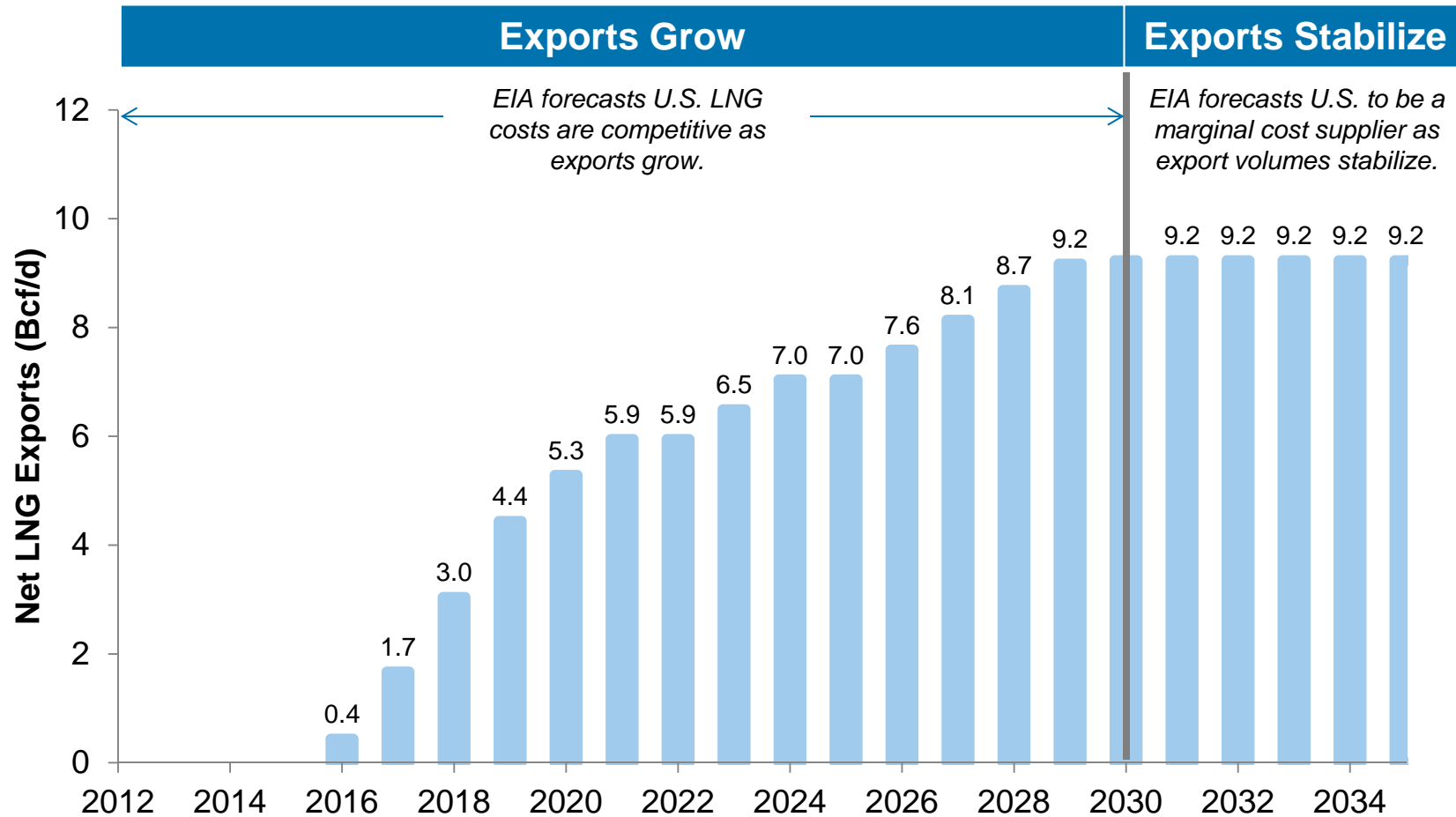
Current netback pricing from Japan to the U.S. Gulf Coast (USGC) suggests plenty of margin to incentivize U.S. LNG investments beyond 9.2 Bcf/d...

Historical Oil & Gas Prices

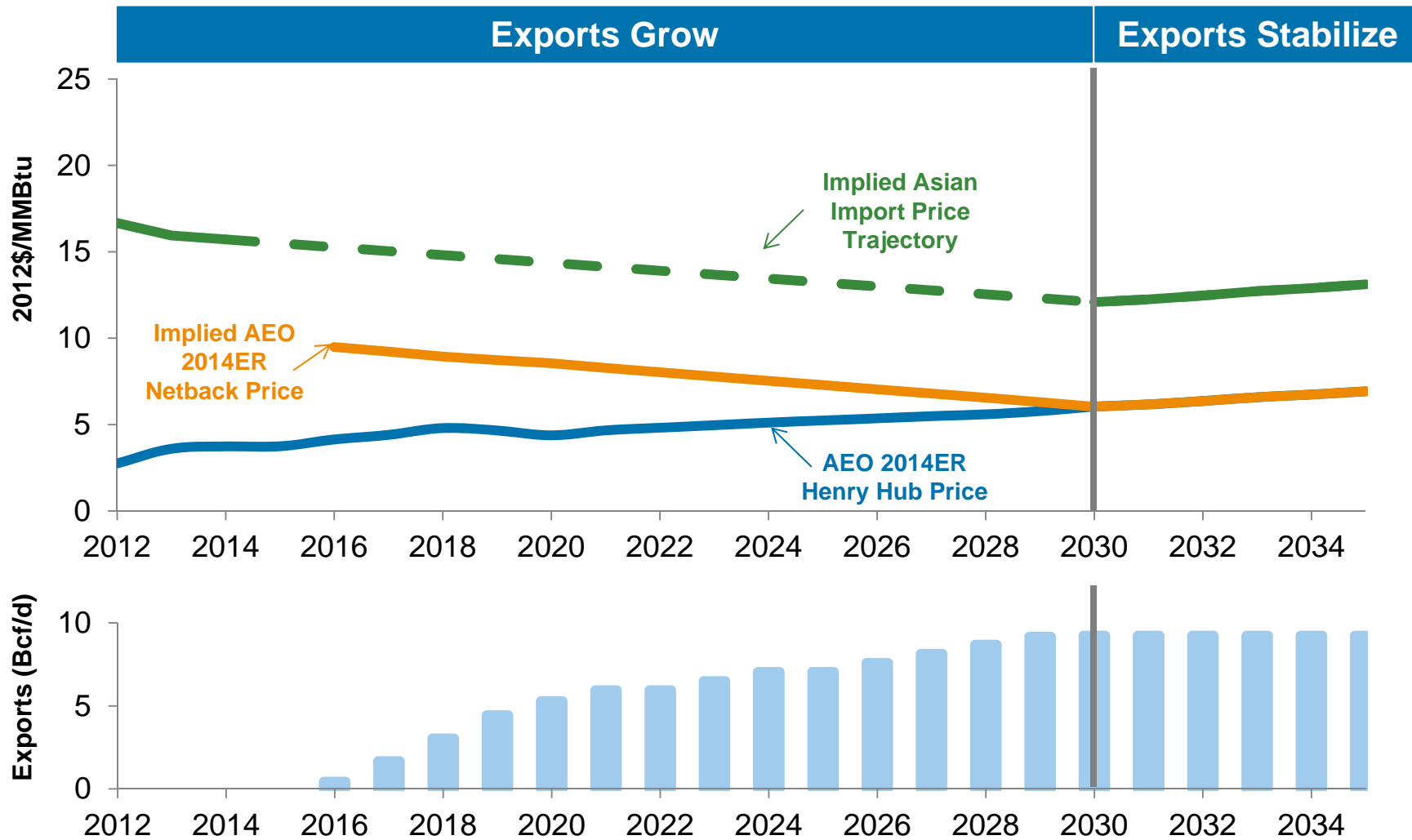


Source: Bloomberg, Thomson Reuters, CRA Analysis

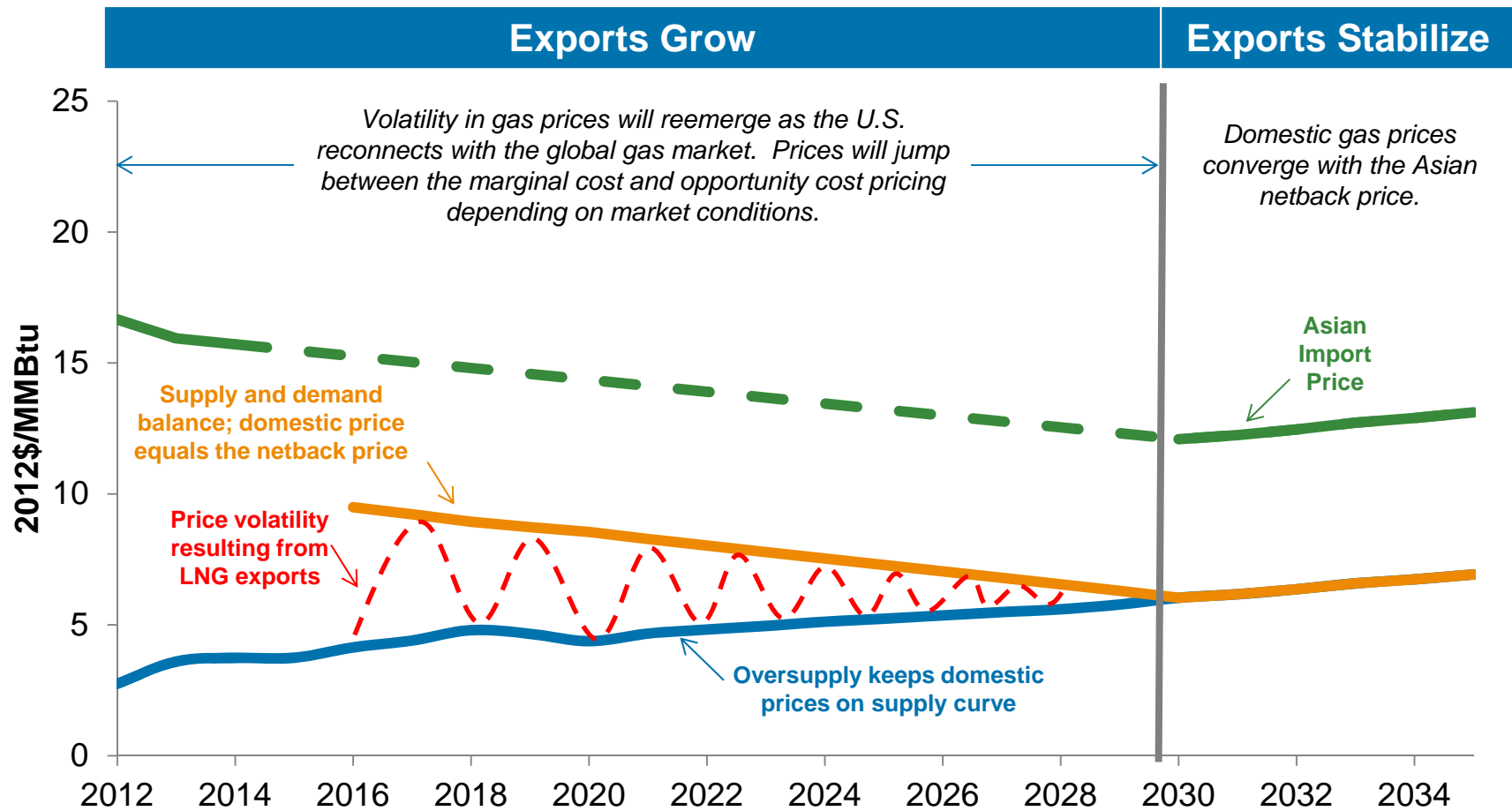
...unless one forecasts that U.S. LNG netback prices eventually equilibrate with international LNG prices, thereby stabilizing the volume of U.S. LNG exports. This is what is implied by the AEO 2014ER.



Based on a netback pricing analysis, EIA appears to be forecasting Asian LNG import prices to decline from \$16/MMBtu currently to ~\$12-13/MMBtu by 2030.



It also can be inferred that the EIA is forecasting domestic prices based on the domestic supply curve and not on netback pricing— *market evidence shows otherwise when supply and demand balance for globally traded commodities!*



A review of drivers for lower international LNG prices indicates that the EIA scenario is plausible, but not a “reference” case scenario.

Summary of Drivers for Lower International LNG Import Prices

Driver	Description	Likelihood	Rationale for Likelihood Ranking
Flat global GDP growth	Soft GDP growth keeps LNG demand growth low for the next decade	Low	Forecasts for global GDP growth remain robust due to developing countries
Global shale gas boom	Shale-rich countries are able to develop resources at costs less than LNG import prices using U.S. learning experience	Low to Medium	The U.S. has advantageous geology, mineral rights, regulations, public acceptance and infrastructure in its favor; most other countries do not have this successful combination.
LNG contracts move away from oil-linkage	Most LNG contracts have a linkage to oil prices; gas establishes its own pricing that spurs lower costs. Or, a two-tier market emerges, where greenfield project baseload is indexed to oil while some is sold in spot market.	Medium	LNG export terminals are multi-billion dollar investments often requiring oil-linkage to support the investment. Marginal new builds will require oil index pricing due to cost risk. Australia and Mozambique are examples
Japan restarts nuclear	Japan prioritizes fuel diversity even in the aftermath of Fukushima	Low to Medium	Current indications are that Japan will be slow to re-start the remaining part of its nuclear fleet.
Germany abandons plans to retire nuclear plants	Germany recognizes a need for nuclear to achieve CO2 reduction goals and to maintain baseload power capabilities	Low	Germany has made a firm decision to abandon nuclear; there are no signs to reverse this decision yet.

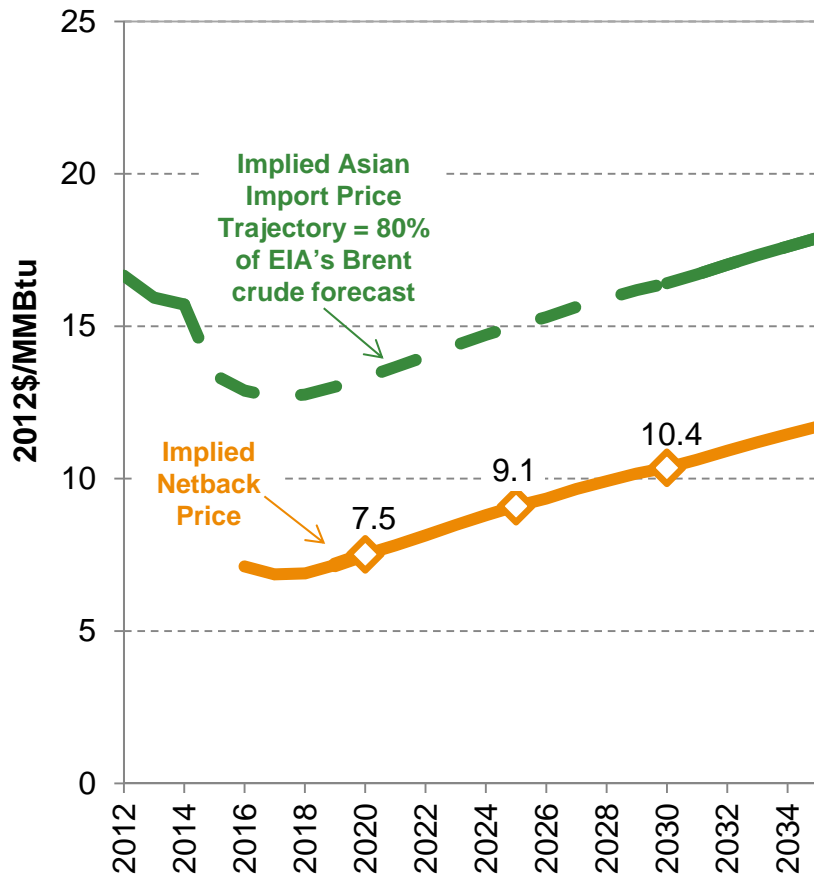
A scenario of LNG import prices remaining close to oil parity is just as plausible and is equally likely as EIA forecasting international LNG import prices to decline.

Summary of Drivers for International LNG Import Prices Remaining High

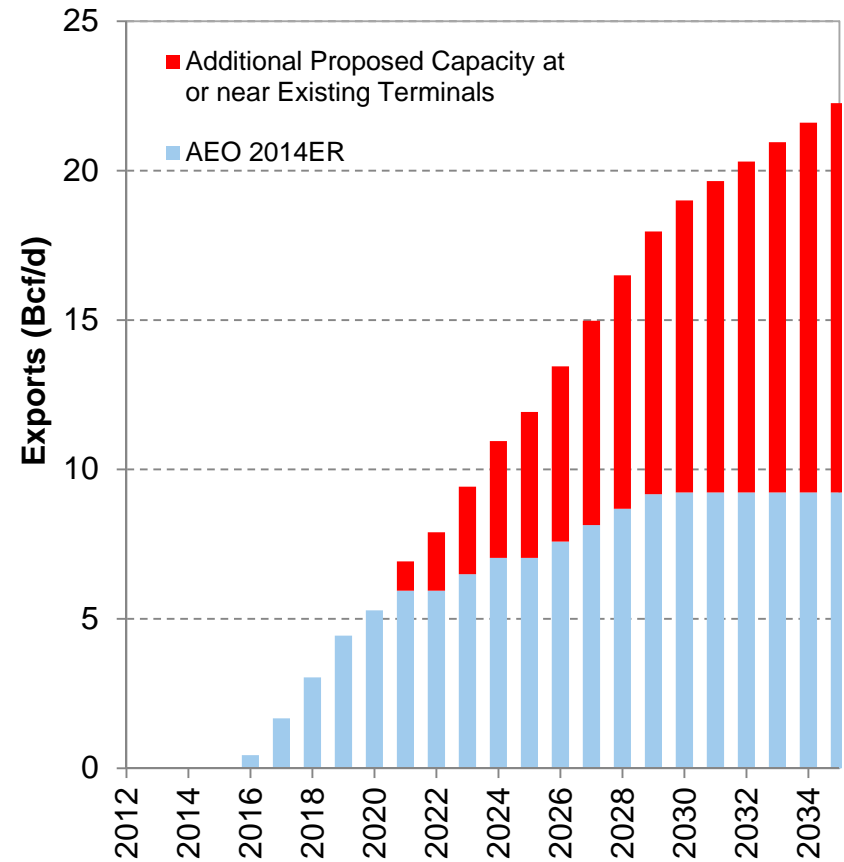
Driver	Rationale
Robust global GDP growth	Forecast by the World Bank and OECD indicate that global growth prospects are moving upwards over the past year as the legacy of the global financial crisis is being overcome.
The cost of developing international shale gas remains high	The geology, mineral rights, regulations, public acceptance and infrastructure may preclude shale-rich countries from becoming major producers of shale gas. High profile exits from Poland and China well costs triple those in the U.S. are indications that international shale gas may be slow to develop.
Europe backtracks on its renewable goals	Rising electricity prices in Europe due to heavy adoption of renewables have decreased the competitiveness of its industry. Easing of renewable goals would increase reliance on gas.
LNG export facilities require oil-linkage to support investment	Given their high costs, many proposed LNG export facilities will require oil-linked pricing to support the investment. Australia is an example of exports requiring oil-linkage. Mozambique is another example with no current infrastructure to support LNG exports.
Continued environmental pressures encourage coal to gas switching	Developed countries continue to emphasize de-carbonization of fuels. For example, the U.S. EPA has a number of proposals that would reduce the size of the U.S. coal fleet significantly over the next decade, switching reliance from coal to gas power most of the electric sector's generating fleet.
Natural gas vehicle market penetration	Fuel cost arbitrage enables significant switching of medium and heavy duty fleet vehicles from gasoline and diesel to natural gas over the next decade. Also, emissions control and pricing drives maritime consumption growth for near port transit because the alternatives are distillates

In such a scenario, the Asian LNG import price would maintain its relationship with international oil prices, which could result in 18+ Bcf/d in U.S. LNG exports and Henry Hub prices reaching \$7.5 – \$10/MMBtu between 2020 and 2030.

Domestic Price Forecast (based on Netback Pricing) under a Higher LNG Export Scenario

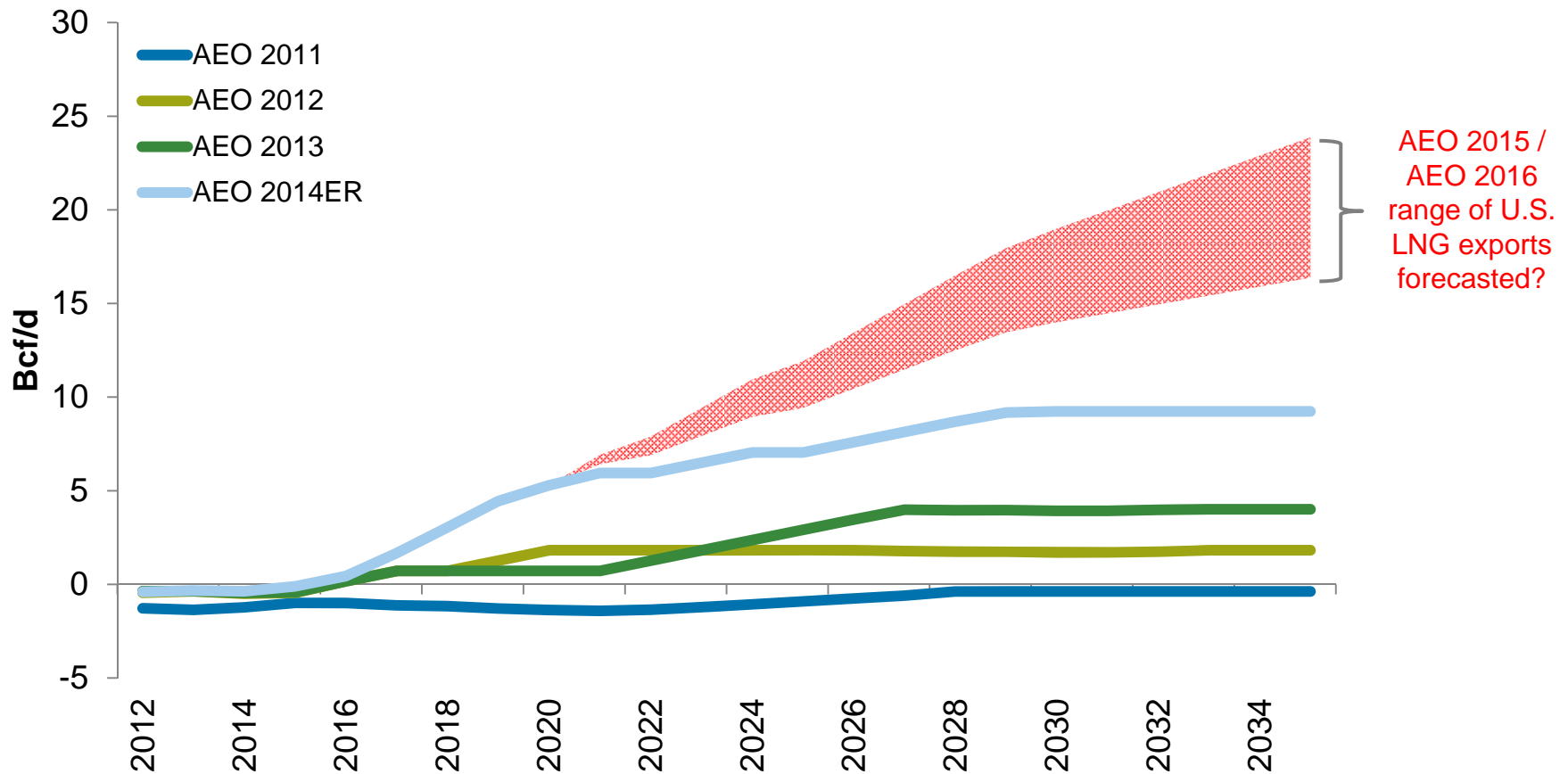


U.S. LNG Export Volumes Reaching Total Proposed Potential at or near Existing Import Terminals



EIA has been catching up with the LNG market over the last three AEO cycles. Should we expect to see 14+ Bcf/d by 2030 in AEO 2015 and/or AEO 2016 as more terminals are approved and more construction begins?

LNG Net Exports by AEO Release



Conclusions

- The AEO 2014ER forecasts U.S. LNG exports to grow to and stabilize at 9.2 Bcf/d by 2030, indicating that international LNG import prices no longer incentivize U.S. LNG exports.
- This implies that the U.S. becomes a marginal supplier into the global LNG market by 2030 and that the Asian netback prices to the USGC converge with domestic gas prices.
- The EIA scenario might occur if increased global gas production, softer LNG demand, or some combination thereof were to transpire.
- While this is a possible scenario, an equally plausible and likely scenario is one where Asian LNG import prices remain closely linked to international oil prices, which would further drive demand for U.S. LNG exports.
- Even the EIA states in the AEO 2014ER Overview that sensitivities are needed:

“Projected exports are sensitive to assumptions regarding conditions in U.S. and global natural gas markets. The full AEO2014 will include cases that illustrate the sensitivity of projected natural gas exports to alternative resource, economic, and price scenarios.” (pg. 2 of 18)
- It is recommended that EIA reconsider its reference scenario to be one that represents the mid-point of possible LNG market outcomes. Additionally, it is suggested that EIA address the plausibility of higher domestic prices due to netback pricing and the price volatility that would result from the U.S. being reconnected to the global LNG market via exports.

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