

North American Fundamentals Update

4Q18
Fundamentals Analysis

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Key Insights: Medium term energy markets

Gas

- **Similar 2019 production call as our 3Q view, keeping our view on 2019 HH prices neutral to the forward curve**
 - The low OCT18 EoS inventory of 3,143 bcf, and a cold November have increased the risk of a cold winter and/or infrastructure delays that are the main upside risks to our call
 - Our supply view increased from 1.5 to 2.2 bcf/d higher than our 3Q view over 2020 to 2023
- **We remain bullish versus the forward curve 2020-2021**
 - We expect HH to maintain > \$3 in 2020, and \$2.90 in 2021 as supply growth loosens balances
 - We closely match the forward curve in 2022-2023

NGLs

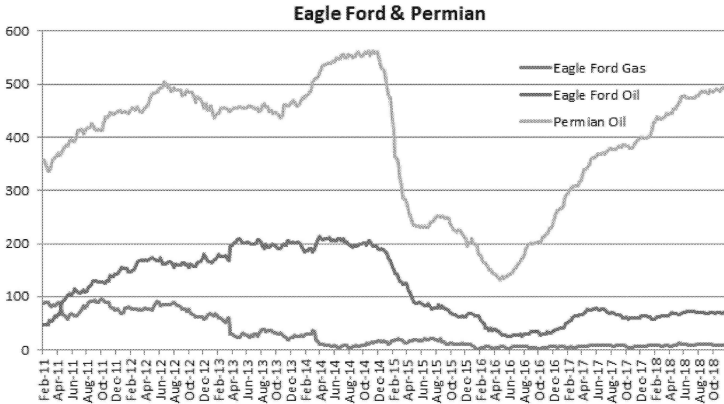
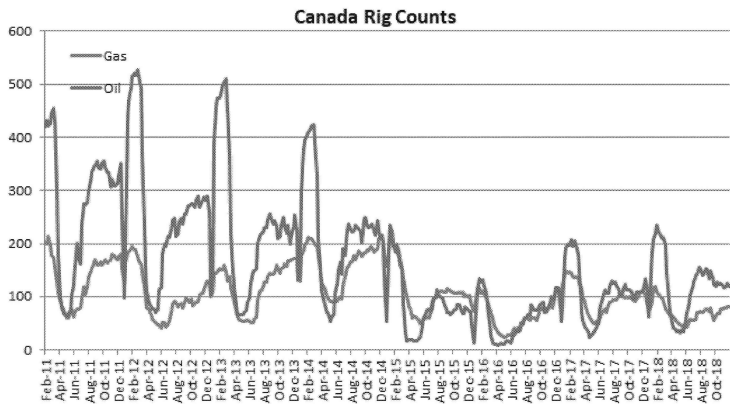
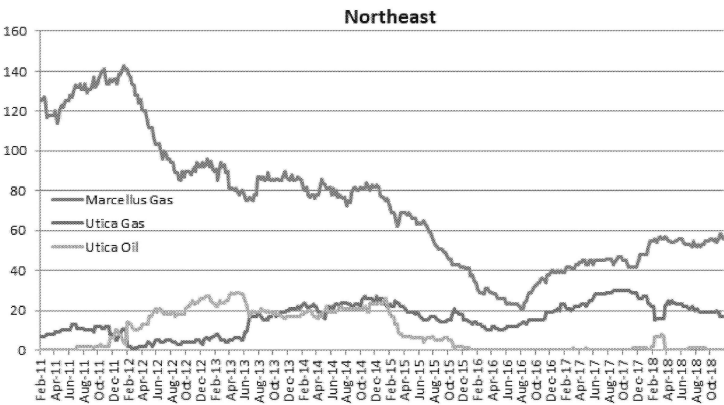
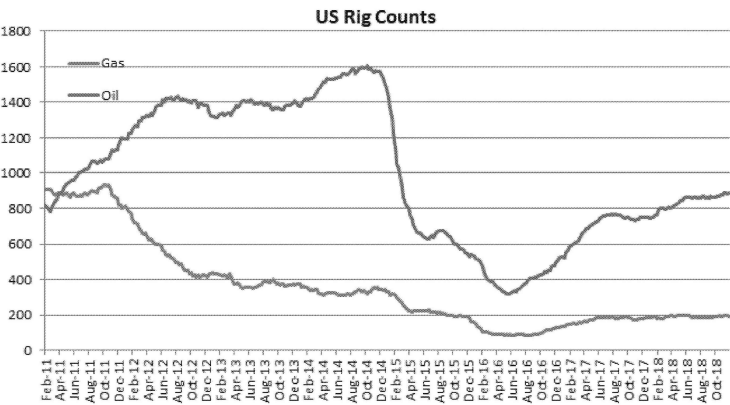
- C2: trending looser 2019 - 2021 as supply grows and LPG compete in the feed slate until another wave of new crackers in 2022+; We continue to monitor progress of multiple proposed ethane export facilities 2020+
- C3: strong petrochemical demand and exports are needed to balance supply growth
 - E/P mix competitiveness and global LPG length will increase propane cracking from 2019 to at least 2021
 - **Exports to grow ~ 540 KBD 2018-2023; more USGC capacity needed by mid-2022**
- C4: Expect looser balances vs C3 as new Canadian export terminals and new NA/global PDH plants can only absorb C3 length and there is more limitation for crackers to take C4 vs C3. Continue to monitor global residential heating and cooking demand to absorb excess C4

Key Risks:

- Infrastructure timing (NE/Mexico/Permian pipe and LNG exports)
- Producer ability to generate free-cash flow
- Upside to supply forecast from associated/Northeast/Haynesville
- Global LNG balances
- Global LPG balances



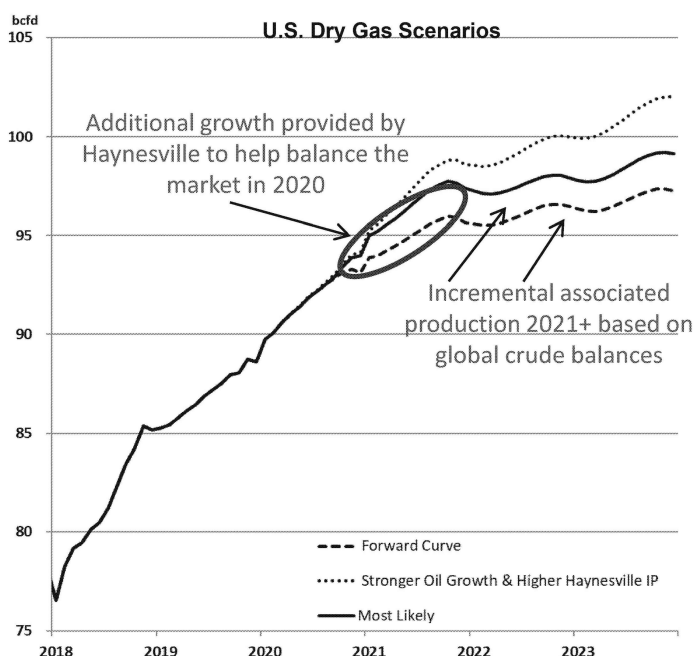
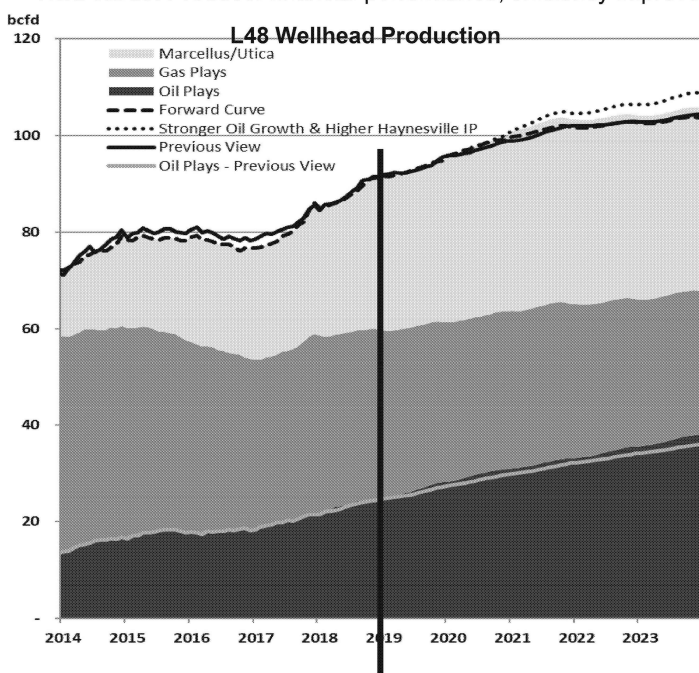
Gas rigs seem to have stabilized; oil rigs slightly up in 4Q





L48 gas production: Annual production growth expected to average 3.4 bcf/d between 2019 and 2023; slightly higher associated production

- **L48 dry gas production is 1.9 bcf/d higher, on average, than our previous view between 2019 and 2023.** Higher associated production as Permian expected to ramp up once takeaway capacity comes online and higher Haynesville. Similar oil production growth to previous view on average between 2021 and 2025 (700 kbd average annual growth). Haynesville needed to help balance the market in 2020/2021. SW Appalachia becomes constrained again in 2022.
- **Watching closely the behavior of IP rates which are showing signs of plateauing**
- **Wild cards:** Producer financial performance, efficiency improvements, pipeline delays, **oil prices; Haynesville surprising to upside**



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Source: Fundamental Analysis, 4Q18

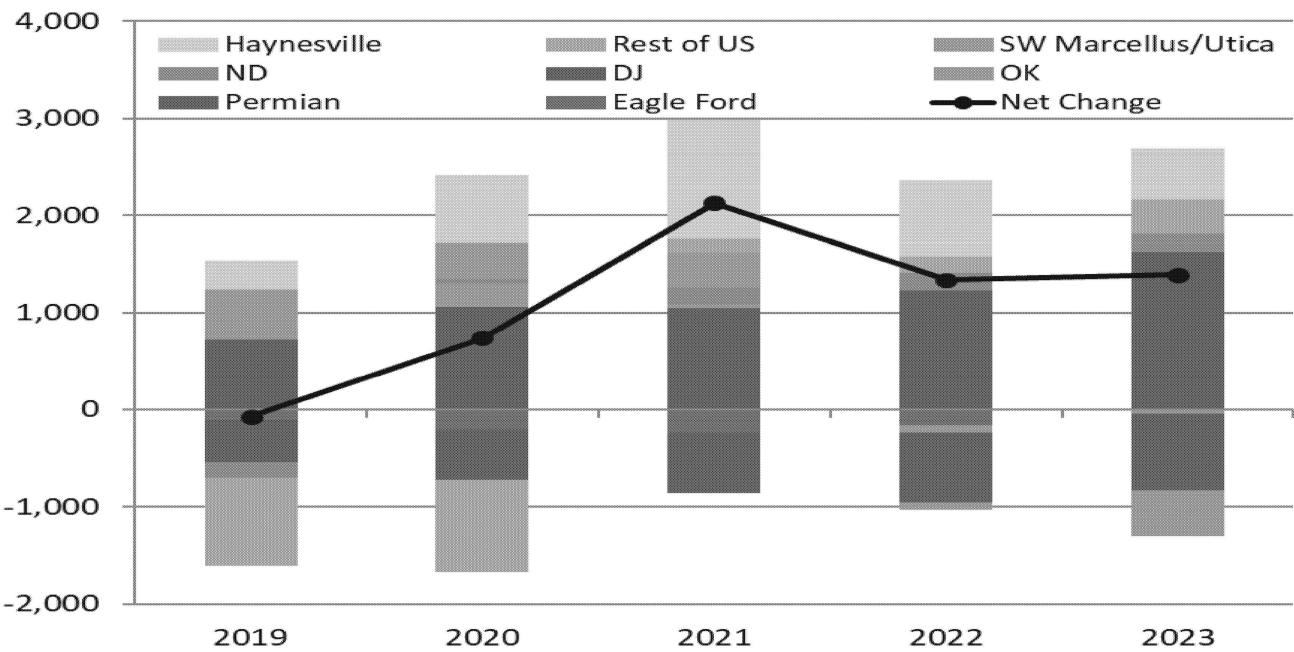
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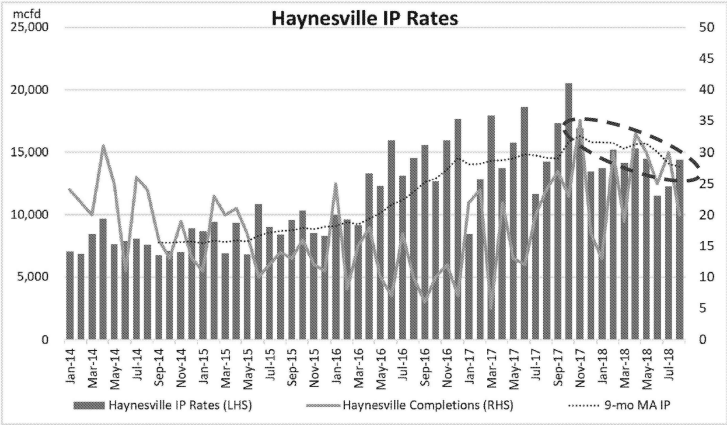
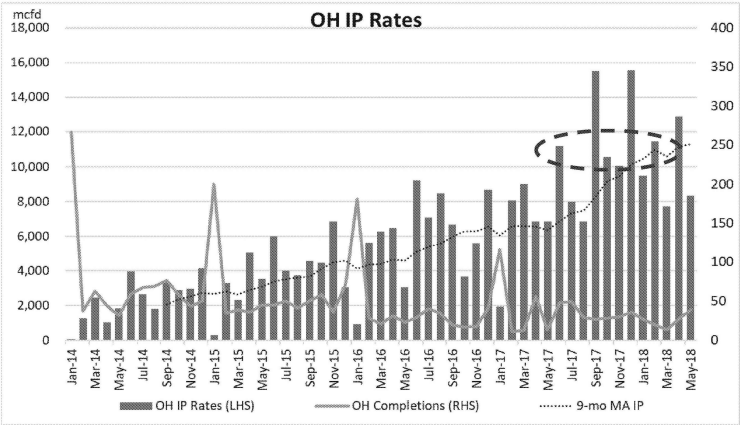
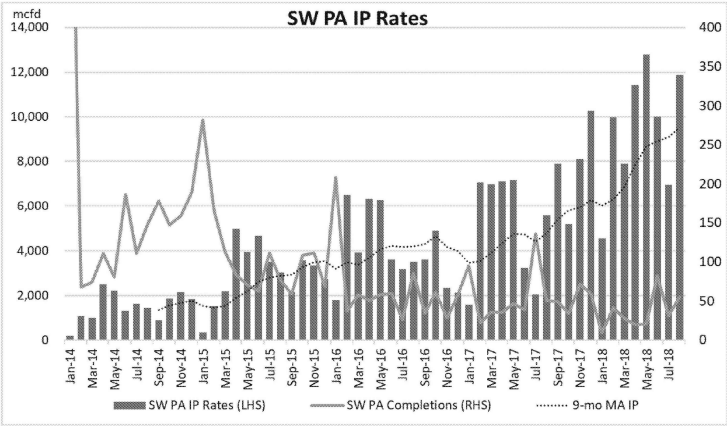
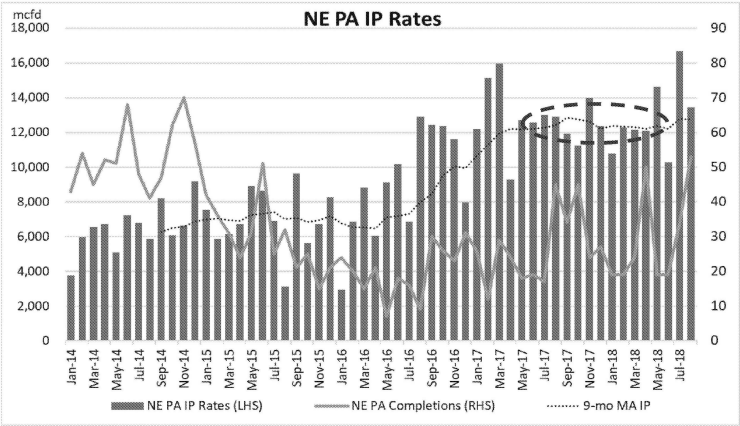


Production has been revised higher post 2020 due to higher Permian completions as the basin debottlenecks; additional oil drilling to begin 2022; Haynesville helps balance the gas market in 2020/2021

- Higher growth in the Permian as the region gets adequate take-away capacity on both the oil and the gas side in 2019 and 2020. Additional gas pipes will be required post 2021 to help support growth. Risks to the downside, particularly for 2019, as weaker pricing and low hedging coverage will reduce the producer appetite for drilling.
- Haynesville remains the marginal play that helps balance the market in 2020 and 2021 as the NE appears to be bottlenecking again in 2021/2022 depending on pipeline cancellations.
- Risks: Weaker oil pricing, IP rate growth stagnation, continued push for free cash flow neutrality, debt maturities



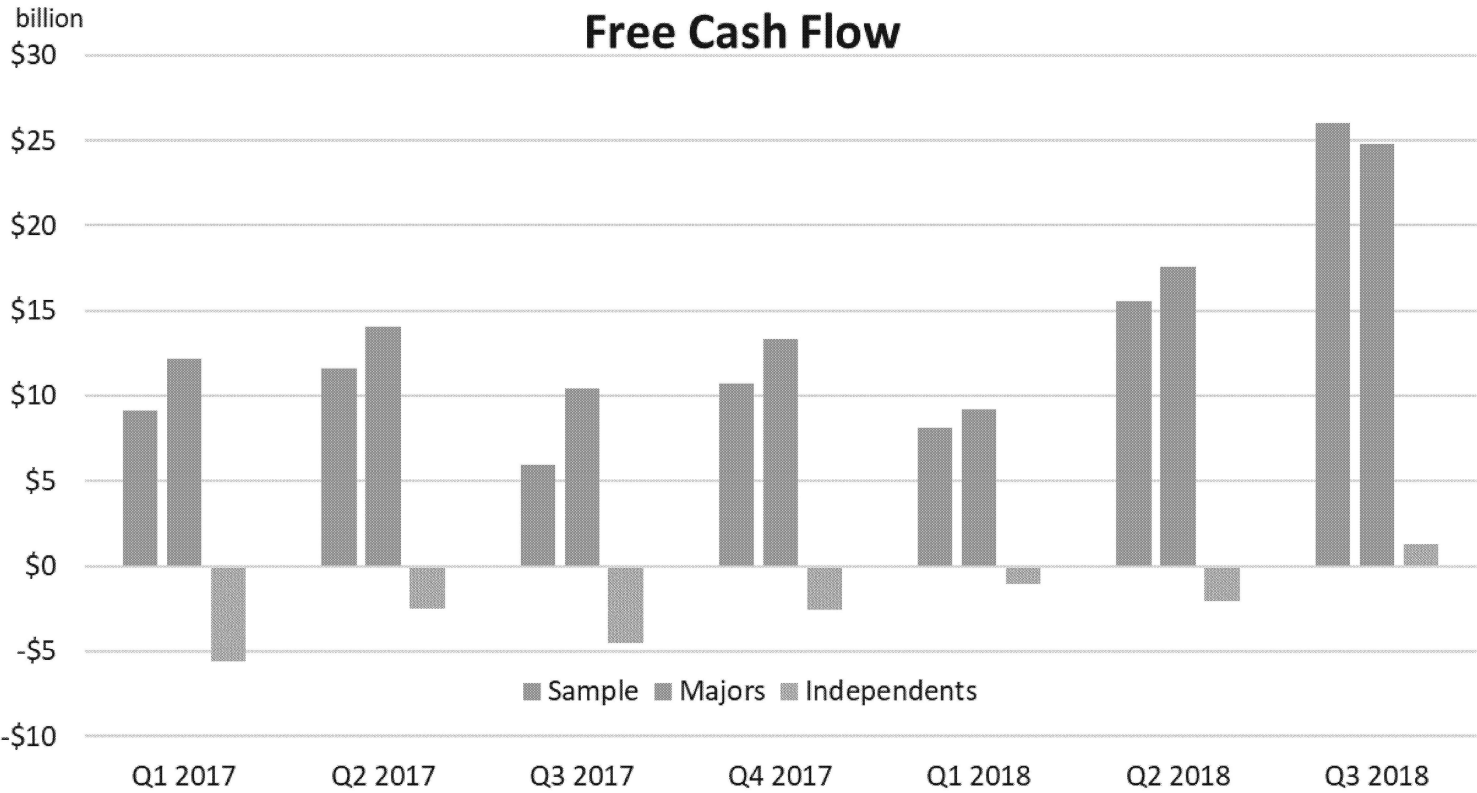
NE PA, OH, and Haynesville IP rate growth showing signs of plateauing



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Source: Fundamental Analysis, 4Q18

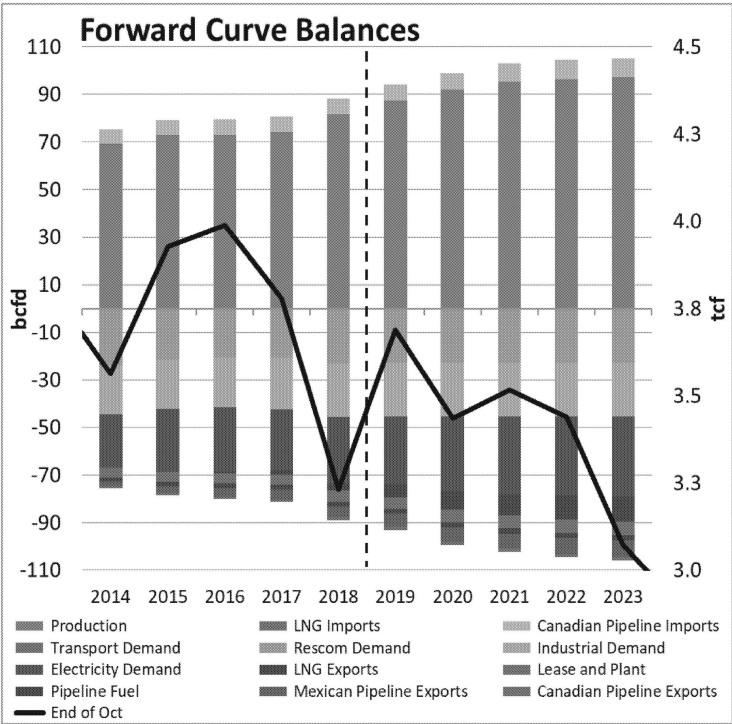
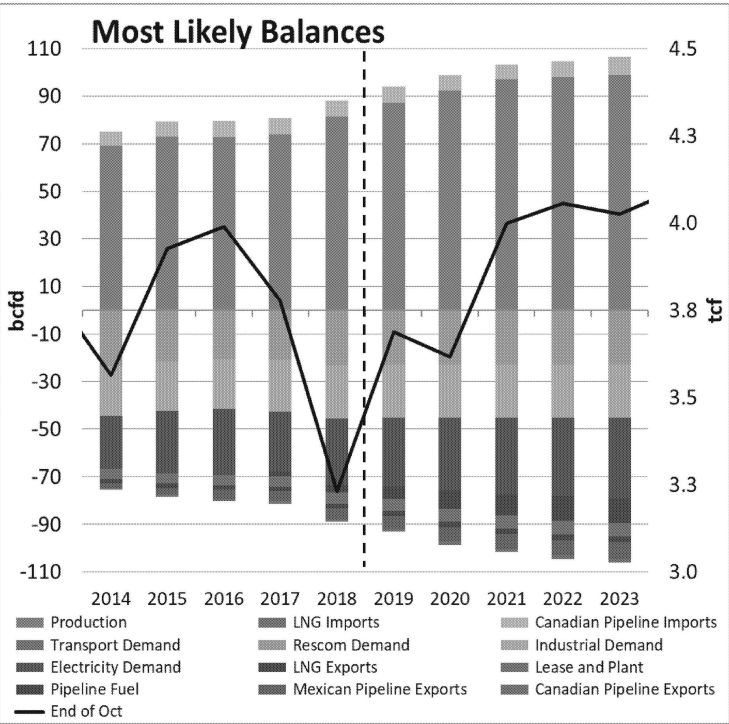
Free cash flow has improved substantially since Q3 2018, in aggregate; still, 50% of our sample remains free cash negative





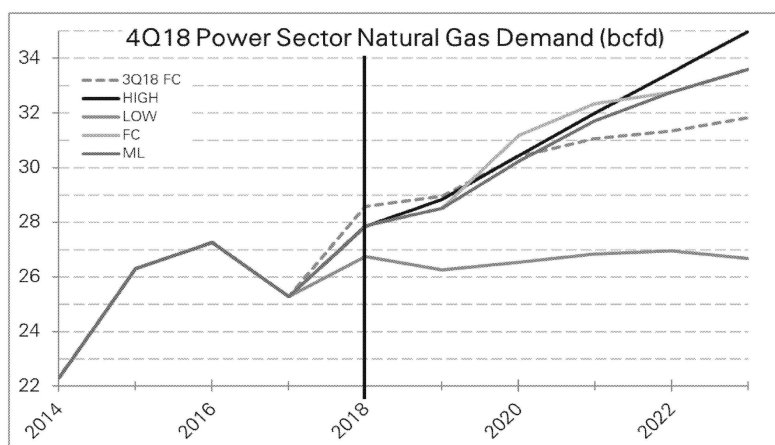
US gas balances: 2019 balanced; slightly more dry gas drilling needed in 2H 2020

- **Forward Curve:** 2019 balanced; post-2019 balances trend tighter as demand growth outpaces supply
- **Mostly Likely:** Increased Haynesville (2020)/associated (2021+) supply; decreased coal to gas displacement
- **Key risks:** Supply upside (NE/associated/Haynesville); **new pipeline timing**; global LNG balances/prices

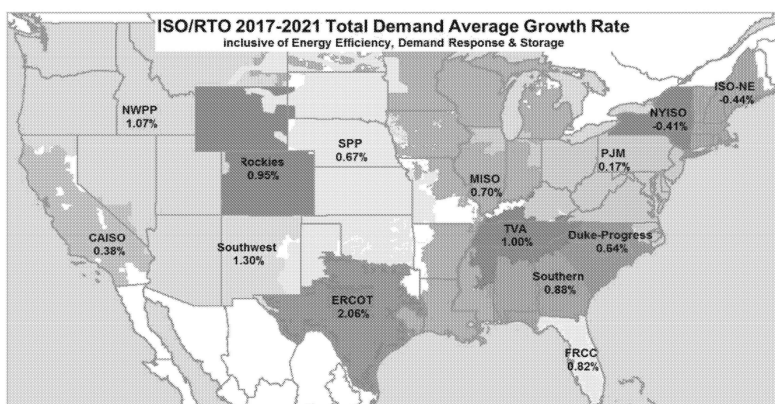




Electricity load growth and generating capacity changes drive power sector natural gas demand



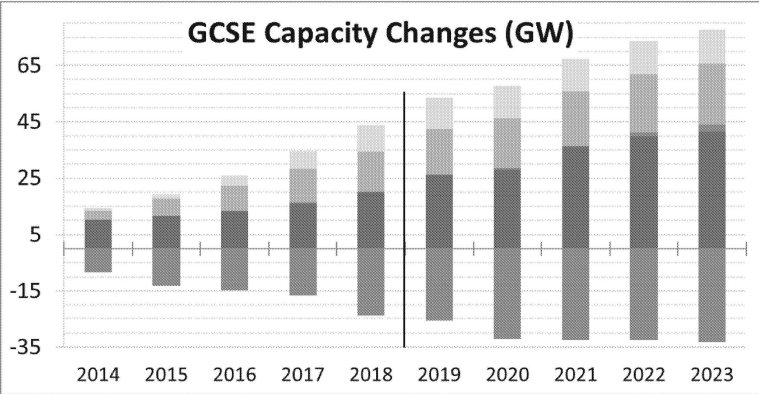
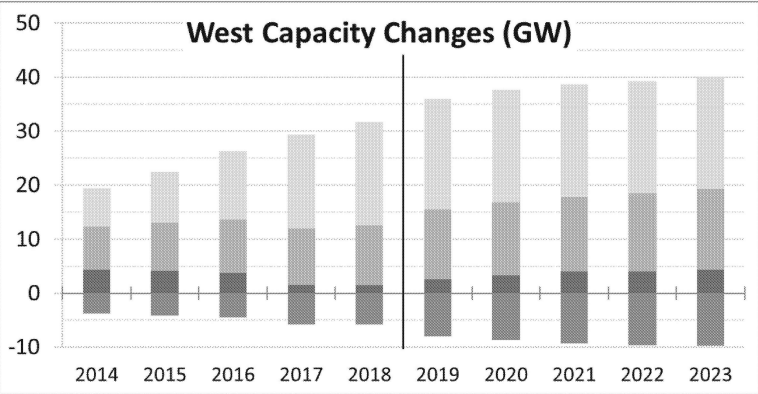
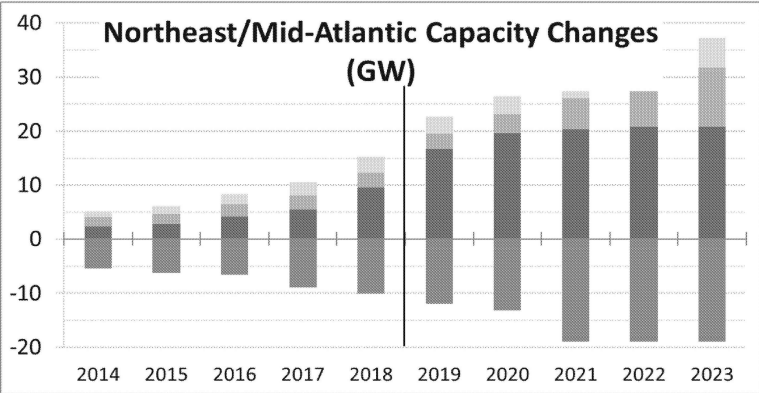
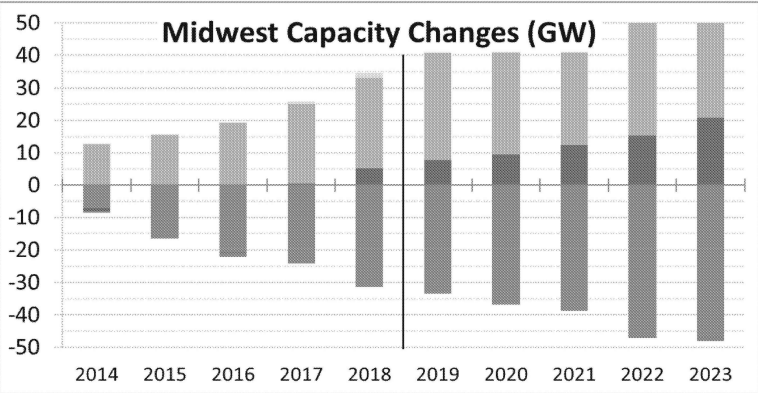
- Average expected electricity demand growth is now below 1% per year from 2018-2022 in virtually the entire country
 - Demand growth is partially muted by embedded assumptions for Demand Response and Energy Efficiency
- Natural gas capacity increases by 51 GW by 2023 from 2018 levels
- Natural gas generation accounts for approximately 39.3% of total electricity output by 2023
 - Coal generation retains a ~25.5% share of total generation despite significant incremental capacity retirements
- State RPSs drive renewables builds; impacts of ACE expected to be minimal as gas economics still more favorable than coal



Redacted - First Amendment



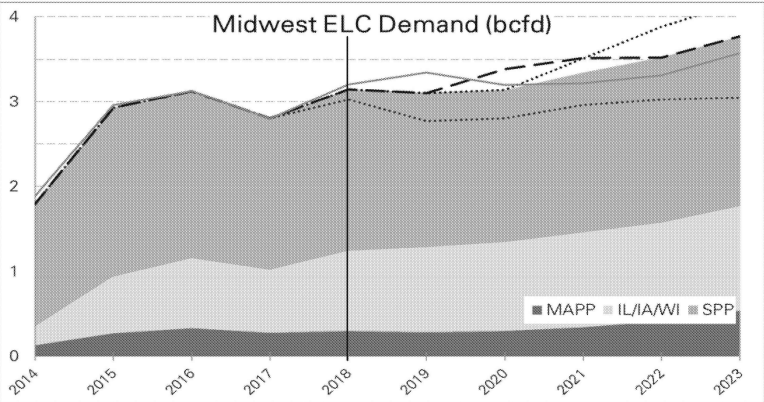
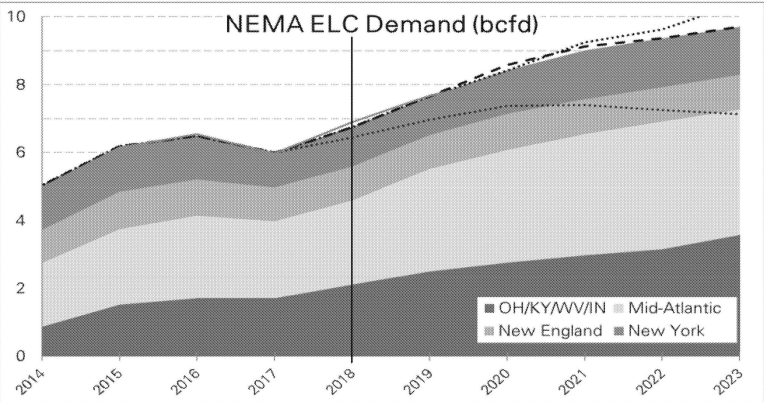
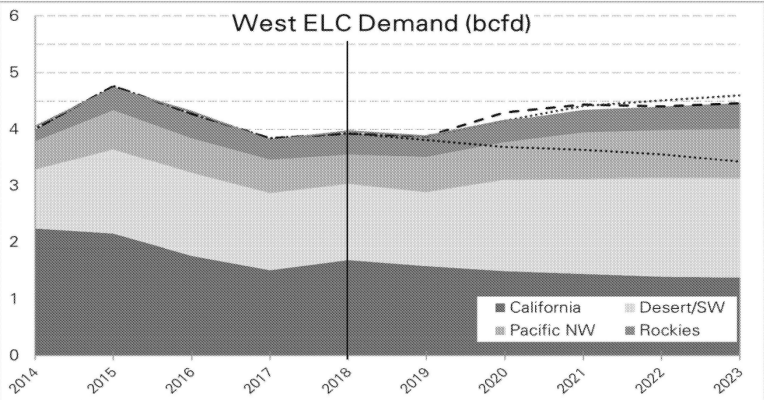
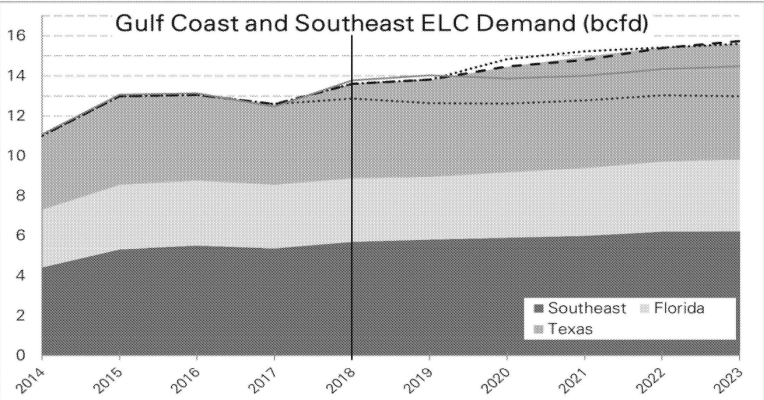
Coal retirements in the Eastern and ERCOT grids; gas dominates new builds; stalled federal subsidies for nuke & coal



Solar Wind Nuclear Gas Coal



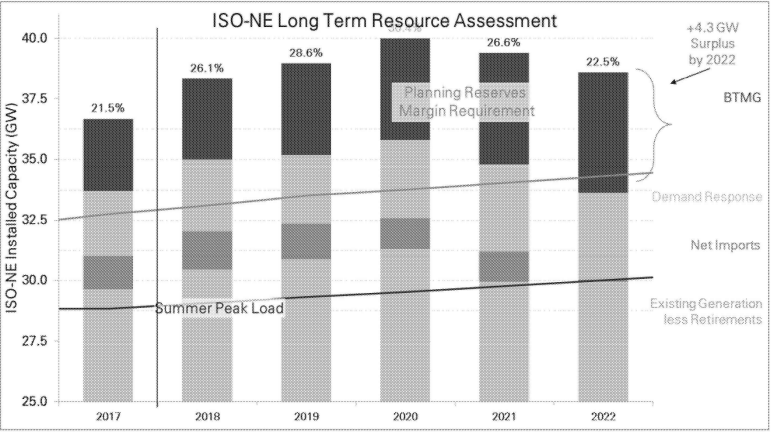
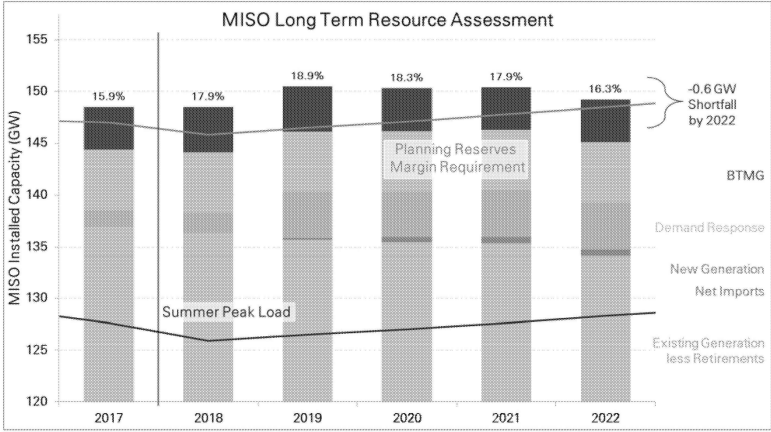
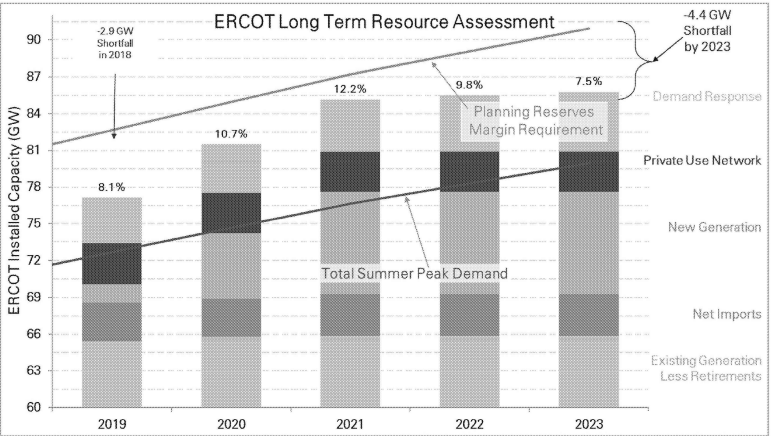
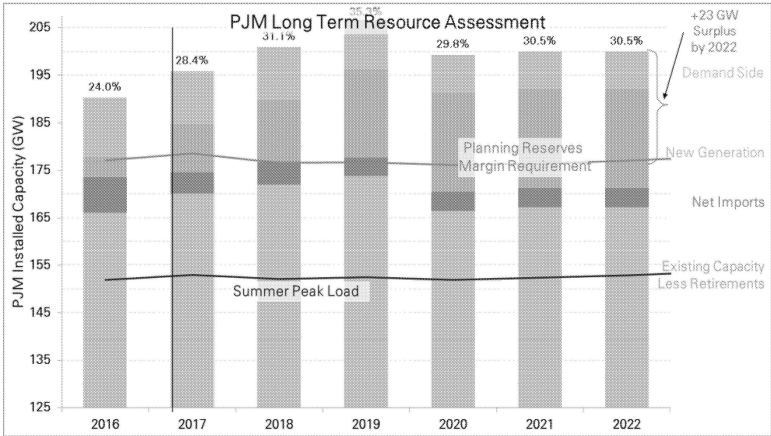
U.S. power sector gas demand: Coal subsidy risk to gas (Low Demand Case) in all regions



--Forward Curve Low Demand High Demand —4Q17 Most Likely

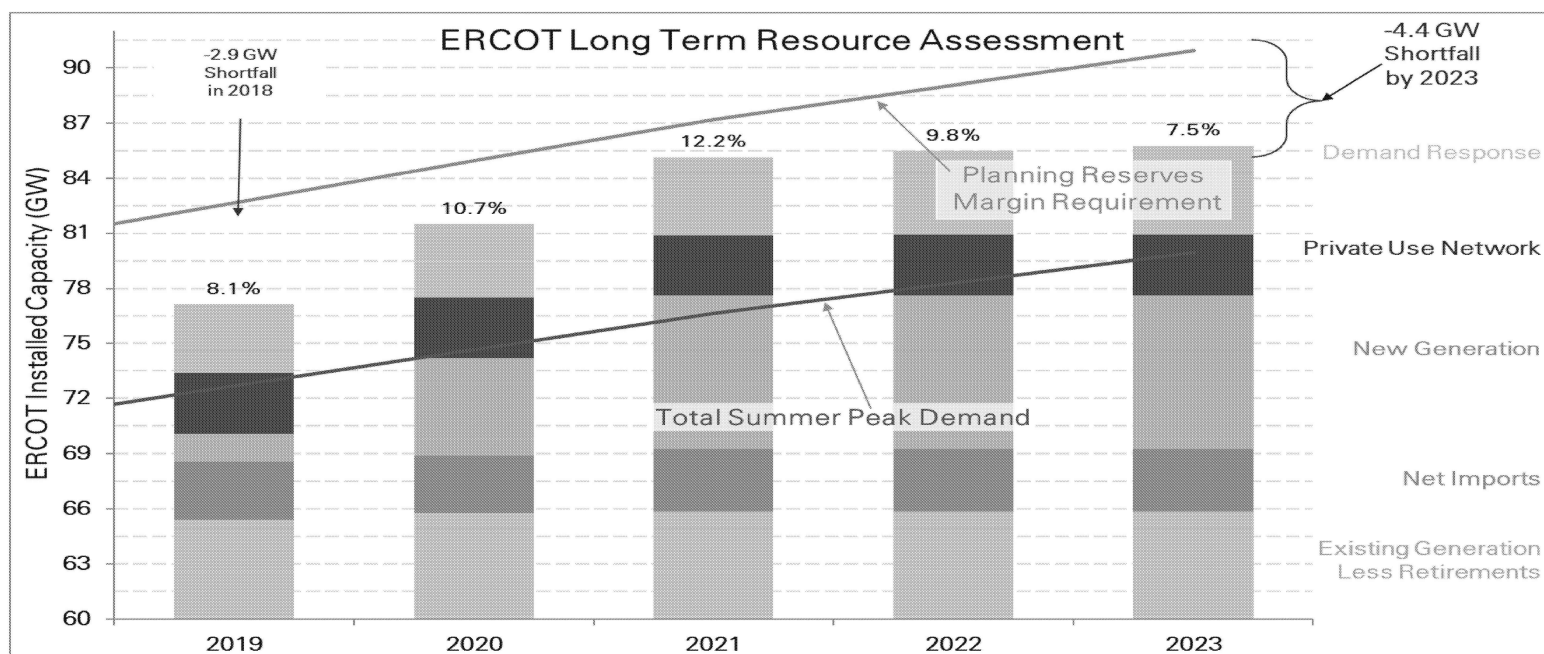


Most markets S/D is loose, save for ERCOT...





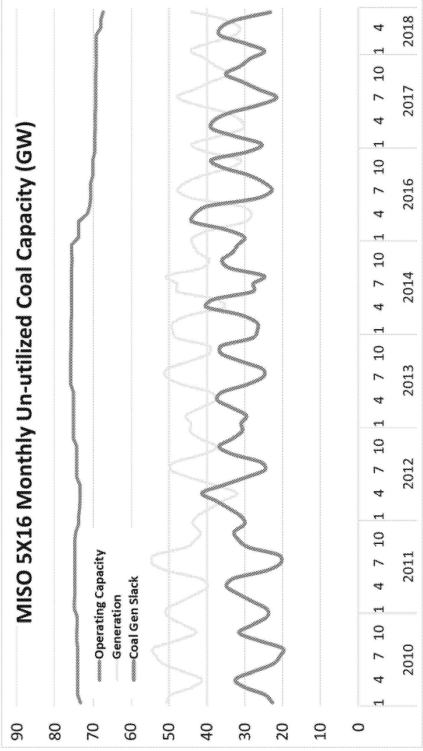
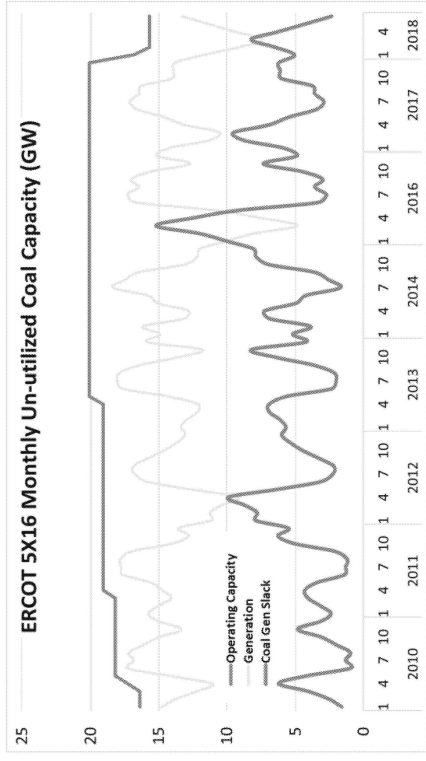
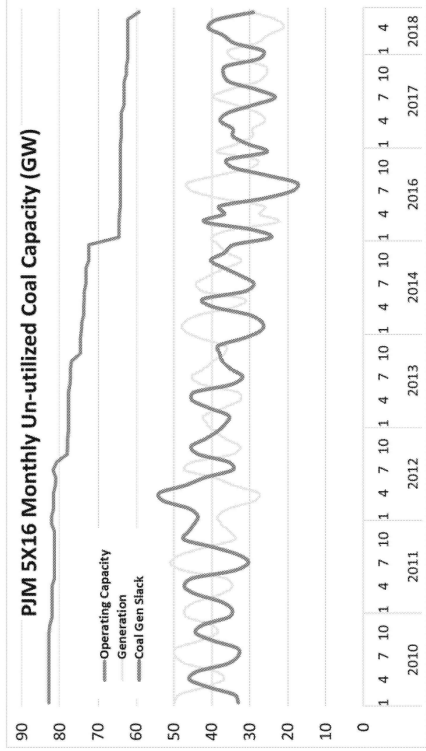
...ERCOT reserves below targets due to methodology as much as fundamentals



- ERCOT's latest forecast materially reduces expected reserve margins to below targets in each of next five years
- Contributing factors to the tightness in 2019 are: increase of 600 MW in peak load from previous forecast, less contracted emergency capacity, and delayed new projects
- Many of these factors are likely over-stated by ERCOT's forecast
- Market response to report was minimal (0.6 MMBtu/MWh in 5X16)



Flexibility for coal to ramp during peak demand coasting downwards

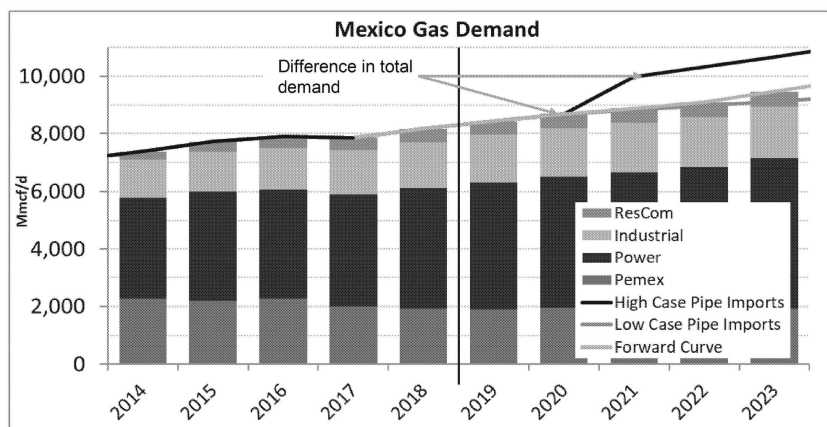
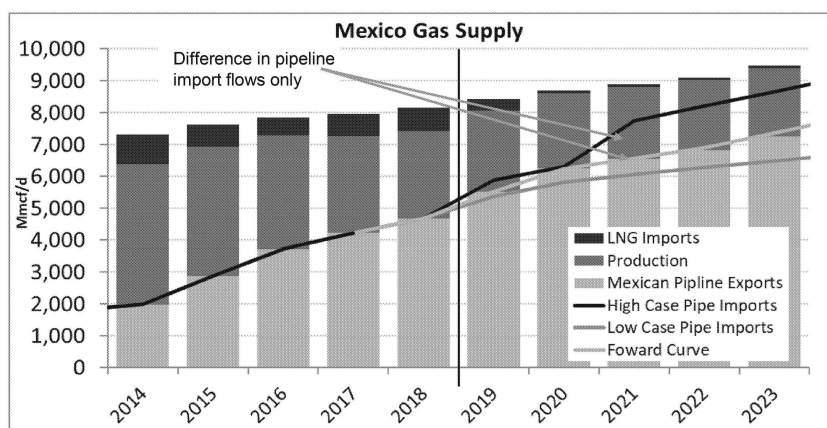


- Bold green line represents the amount of extra coal capacity that was not used
- Only **slightly negative trend**, as coal generation has declined with retiring coal capacity
- Gas price and weather are major drivers in addition to installed coal capacity

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Mexico: Domestic supply view revised lower 2019-2023; offset by ~275 mmcf/d more pipeline imports from 2Q18 view



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Supply

- Mexican production falls continuously up to 2023 and beyond, though total output reductions are smaller each year
- Cumulative production declines from 2019 to 2023 will be ~416 mmcf/d
- LNG needed for gas supply until mid-2019; waiting on new infrastructure within Mexico; cool-down cargos only in 2H19 and beyond (~75 mmcf/d)
- Increased imports average 110 mmcf/d more from 3Q18 view
- Pipeline imports in High and Low cases driven by production and power sector
- **There is now a risk of production declines after new Mexican president announced 3-yr moratorium on upstream lease auctions**

Demand

- Power demand still expected to be the key demand driver, reaching 5.2 Bcf/d by 2023

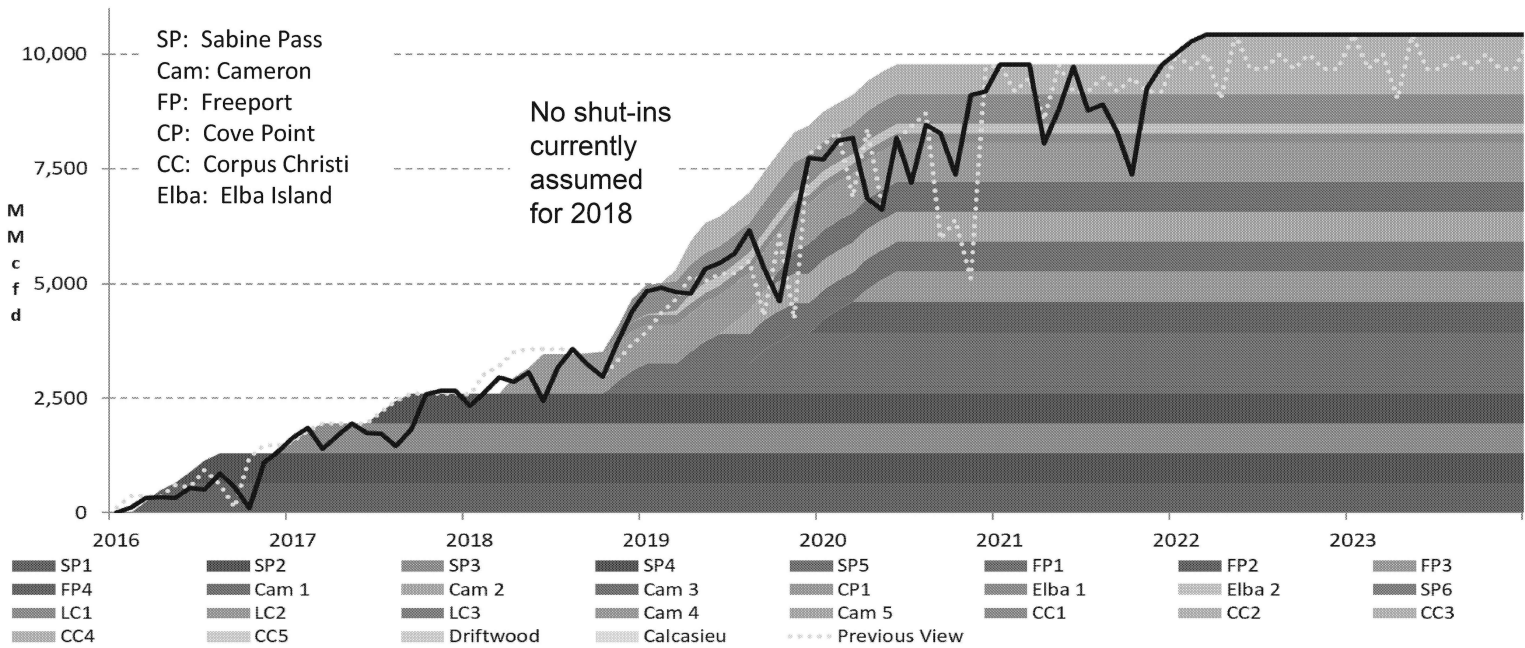
Source: Fundamental Analysis, 4Q18 16

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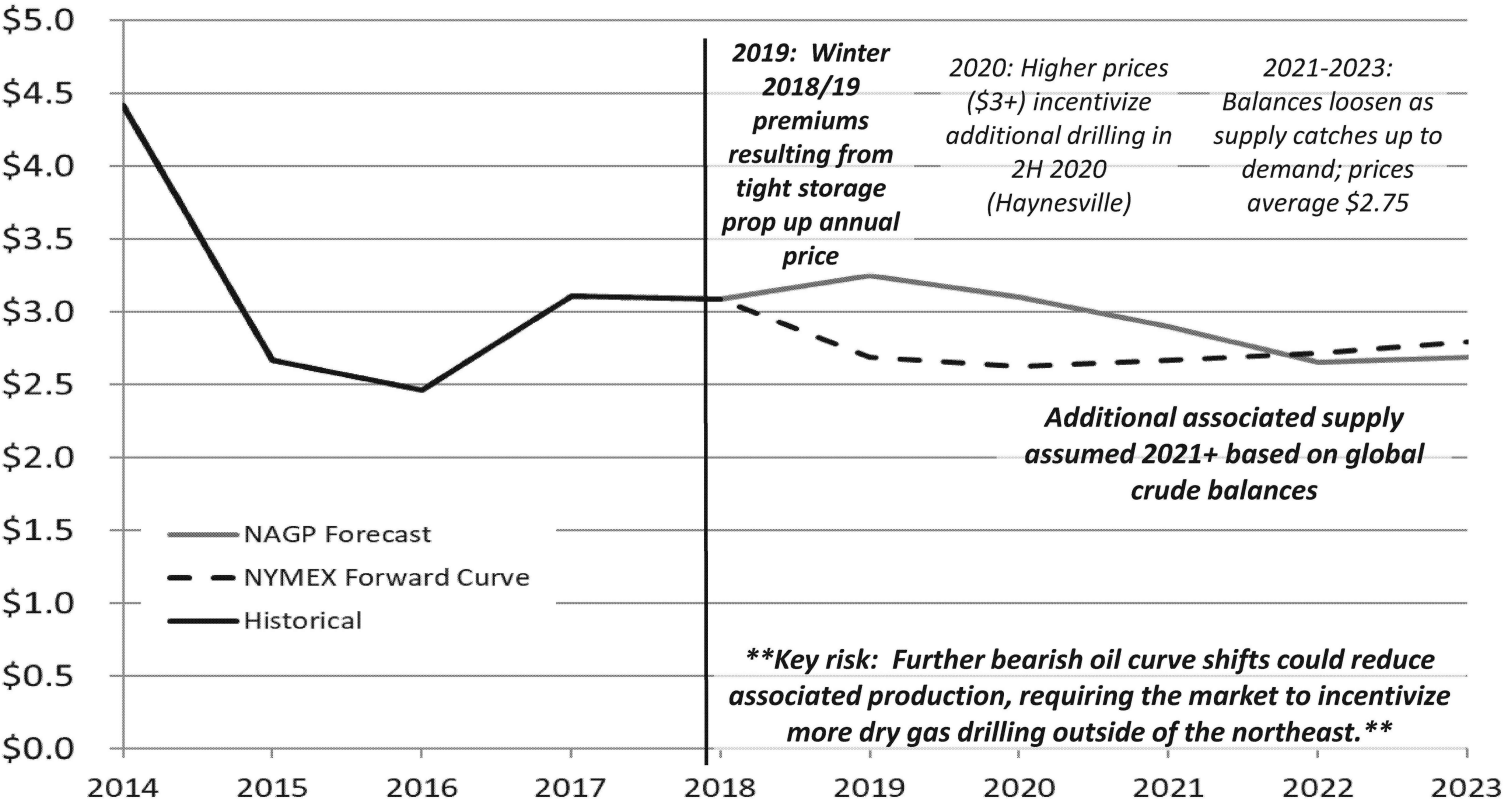
LNG Exports: 4Q18 forecast revised higher again as global balances continue to shift tighter

- Shut-ins now primarily expected to be an issue only in 2019-2020 (no shut-ins from 2022 onward); OCT19 shut-ins driven by forecast of major maintenance
- Multiple facilities in US/CAN looking to make FID by end of 2018 for pre-2025 start
- Key risks: Delays in project completion; **incremental shut-ins/collapse of export arb due to global oversupply** (especially during seasonal demand weakness); Russian export behavior





HH price outlook: Market looks balanced in 2019; trajectory post 2019 will depend on associated production and gas producers response to 2019 price environment

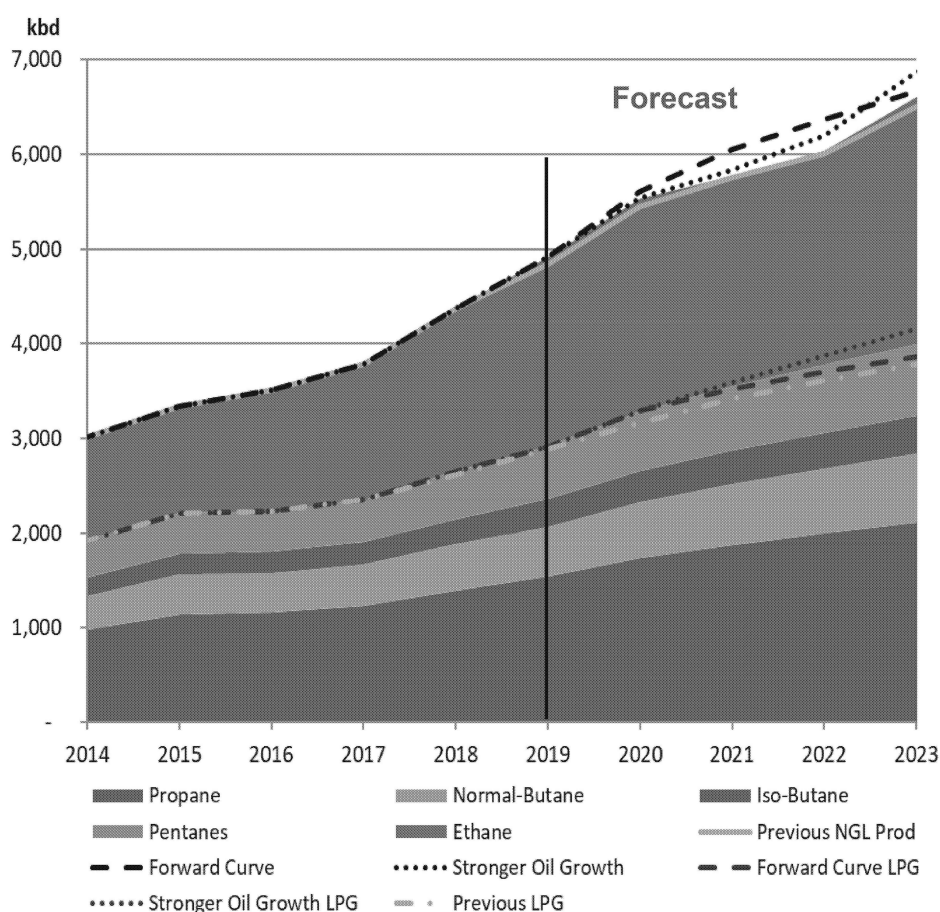




NGLs Outlook: Details



US NGL gas plant production: 6,602 kbd in 2023 – 98 kbd higher than our previous view

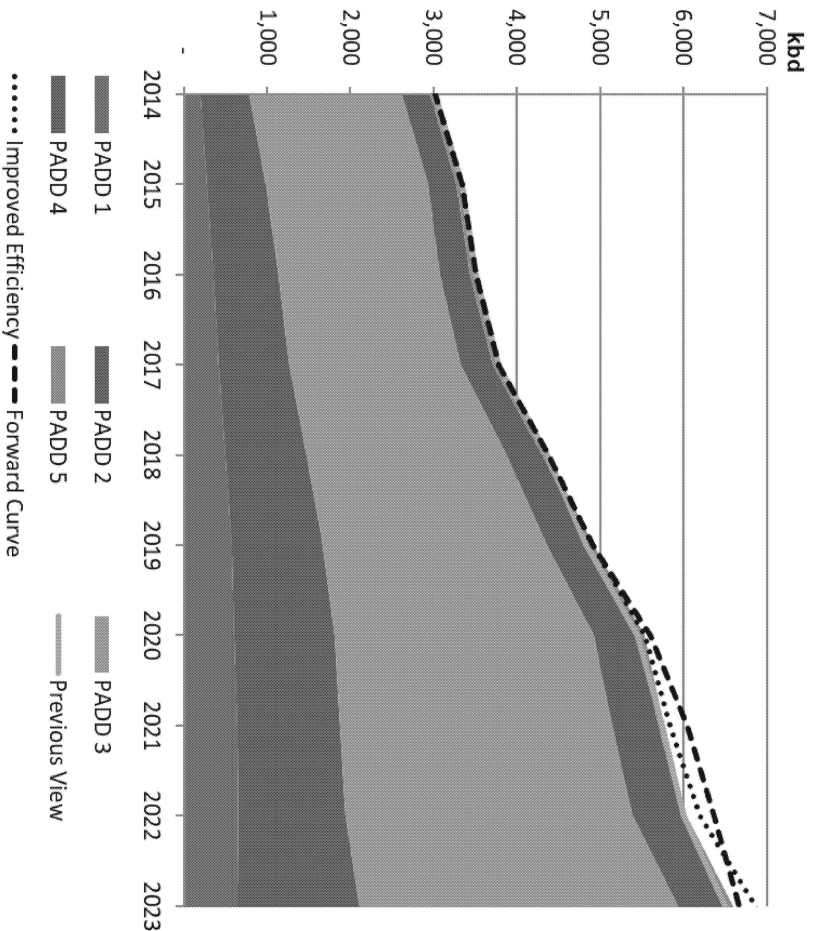


- Production is 98 kbd higher than our previous view by 2023, driven by higher LPG production (+210 kbd), offset by lower ethane production (-98 kbd) due to higher LPG penetration in the cracker fleet
- Total production averages 6,602 kbd in 2023 vs. 6,504 kbd in our Q3 view; the increase is due to higher production in PADD 3 and PADD 2
- The NE, Rockies and the Bakken will continue to see elevated levels of ethane rejection
- Most Likely case assumes NE ethane production remains relatively flat through the end of 2023 due to lack of take-away capacity
- Key risks: **Oil price trajectory**, NE producer drilling preference (dry vs. wet gas), adequate processing and frac capacity (for the NE and ND); Permian regional constraints

Source: Fundamental Analysis, 4Q18 20

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US NGL gas plant production: 6,602 kbd in 2023 – 98 kbd higher than our previous view



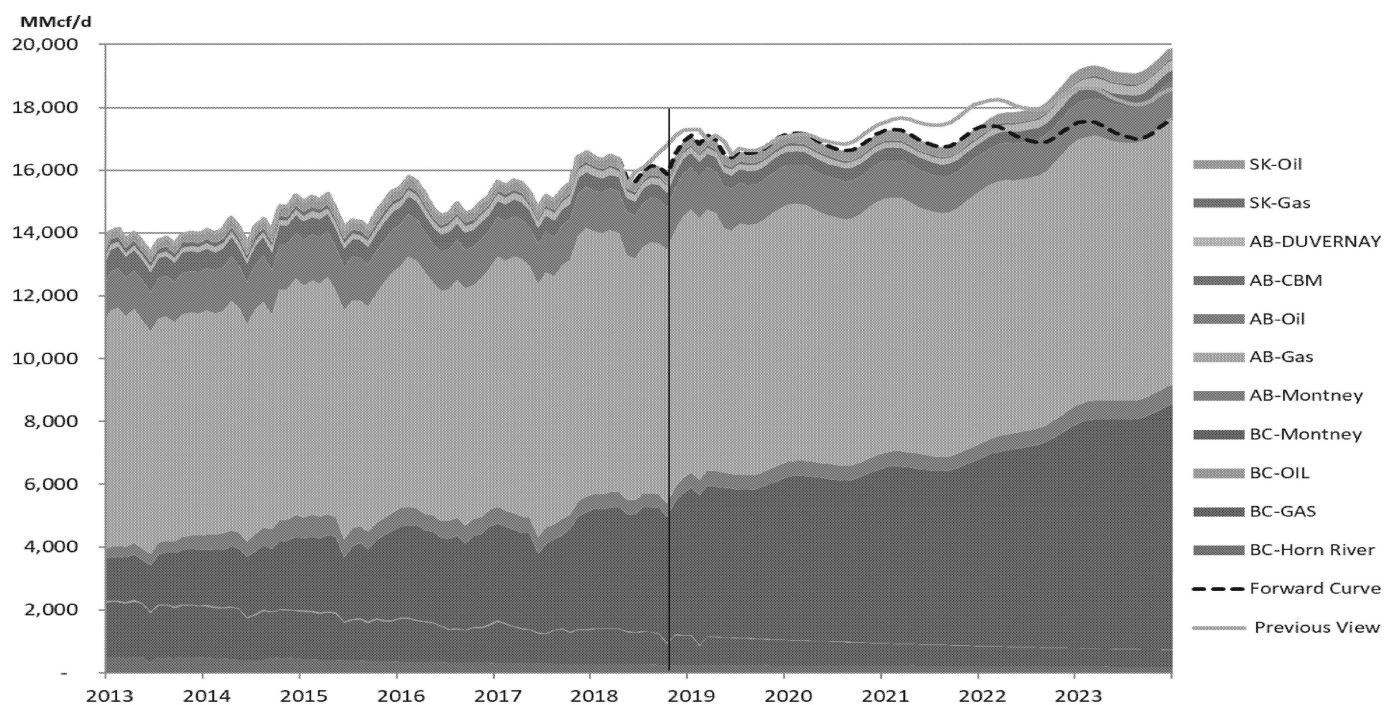
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- PADD 3 production remains the main source of growth, expanding from 2,405 kbd in 2018 to 3,821 kbd in 2023. Growth is 110 kbd higher than previous view due to higher gas production.
- PADD 2 expected to grow by 491 kbd between 2018 and 2023 (+41 kbd than Q3 view). LPG production expected to grow 53 kbd faster than previous view.
- PADD 1 increases in line with Q3 2018 view (+145 kbd vs. 139 kbd of growth previously)
- PADD 4 adds 172 kbd of new production between 2018 and 2023, lower than our 232 kbd growth previously, driven by lower gas production and higher ethane rejection.



Canadian Gas Production: 2.5 bcfd of growth expected between 2019 and 2023

- Lower production in the front due to price weakness and US flow curtailments due to BC pipe explosion. 2021-2022 weakness due to lack of contracting from East Gate to Dawn and NE production competitions. Production to rebound considerably in 2023 as BC LNG expected to come online
- **Wild cards:** Oil prices, TCPL contracting, Marcellus/Utica push into the Midwest, lack of local demand growth outside oil sands, LNG exports



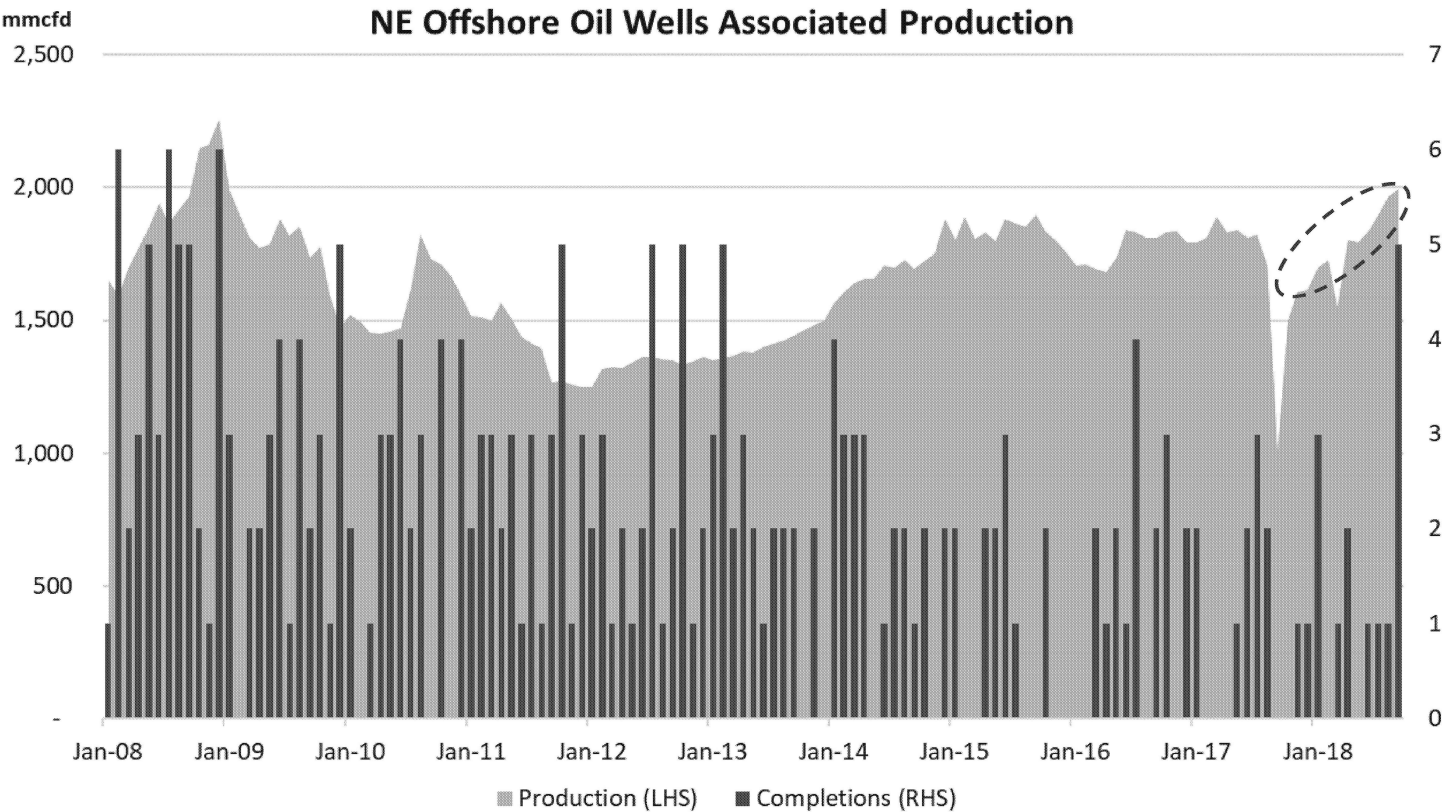
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Source: Fundamental Analysis, 4Q18

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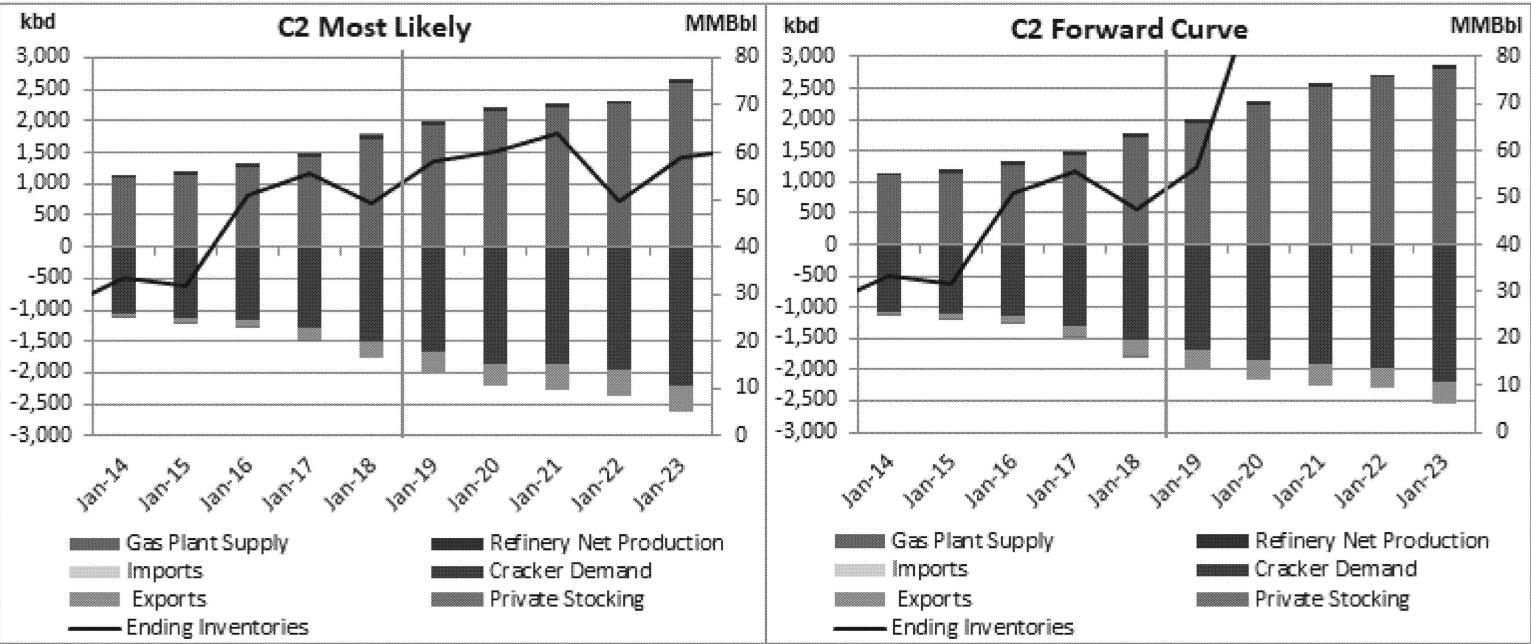
MX gas production beginning to rebound in the NE Offshore Oil area



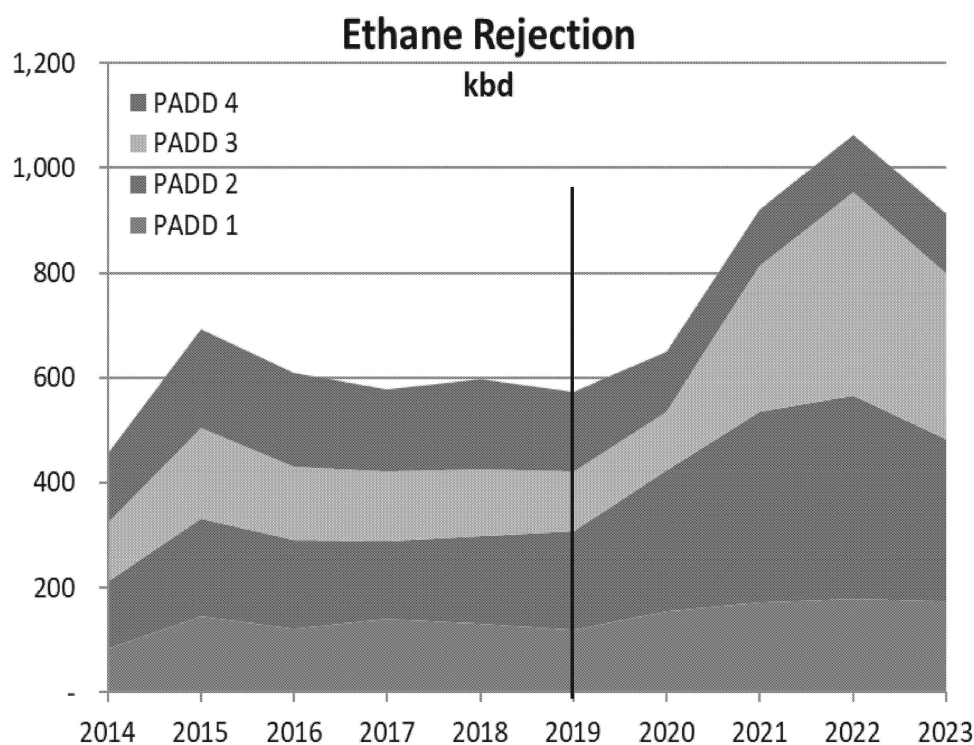


US C2 balances: Despite more demand from crackers and exports, balances trend looser 2020+

- **Forward Curve Case:** Balanced market through 2019; building 2020+ as supply continues to grow
- **Most Likely Case:** Rejection continues to be the primary lever to balance growing supply
- **Risks:** Crude prices; timing of new infrastructure (especially from PADD2/4); ethane competitiveness versus other cracker feeds



US Ethane Rejection: Northeast, Rockies and Bakken remain infrastructure constrained; oil-directed drilling post 2021 will require more rejection

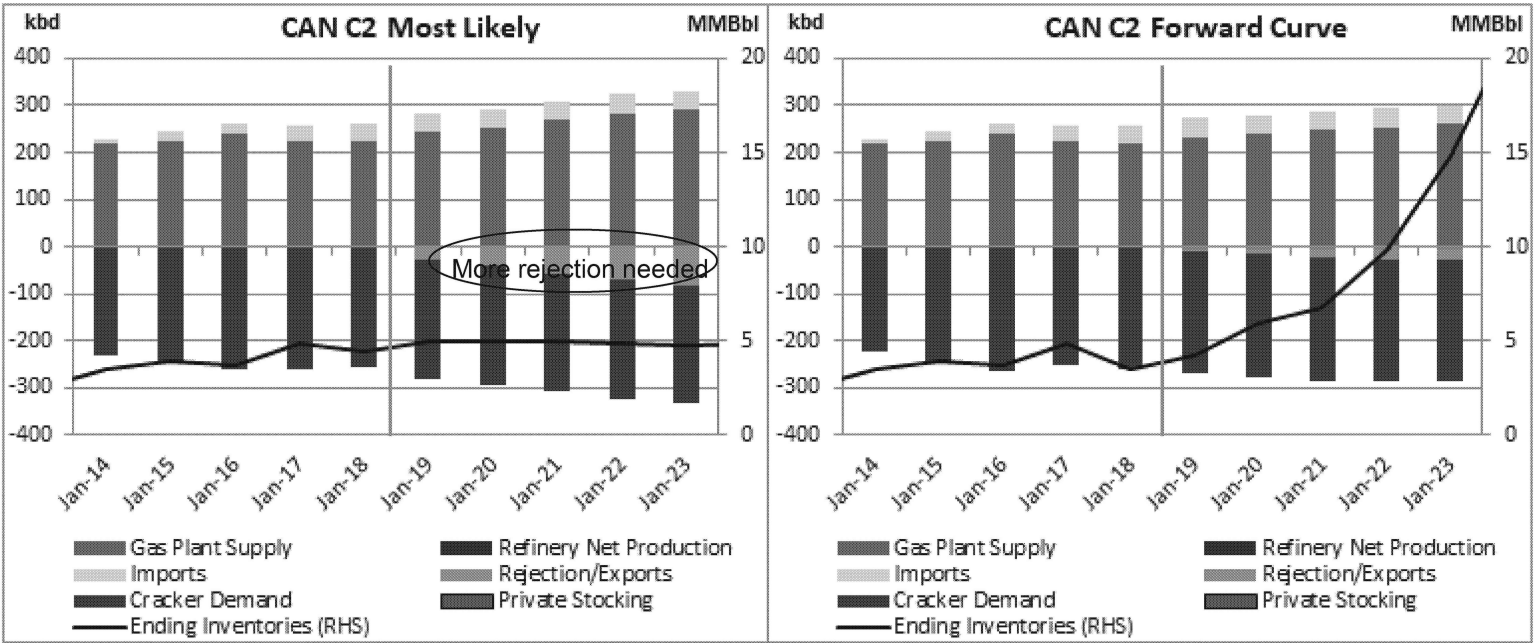


- Higher rejection than previous view due to higher production and further increased competitiveness of LPGs in the cracker feedstock; rejection levels to exceed 1 mmbd in 2022
- PADD 4 and Bakken rejection expected to continue due to inadequate take-away capacity until Elk Creek comes online in late 2019
- Rejection should continue in the Marcellus (PADD 1) and Utica (PADD 2) as these plays remain pipeline constrained
- PADD 3 should see lower rejection levels in 2019 and 2020; however, growth in oil drilling activity will require more rejection post 2019 absent additional cracking demand



WCAN C2 balances: Continued length as producers focus on liquids-rich Montney

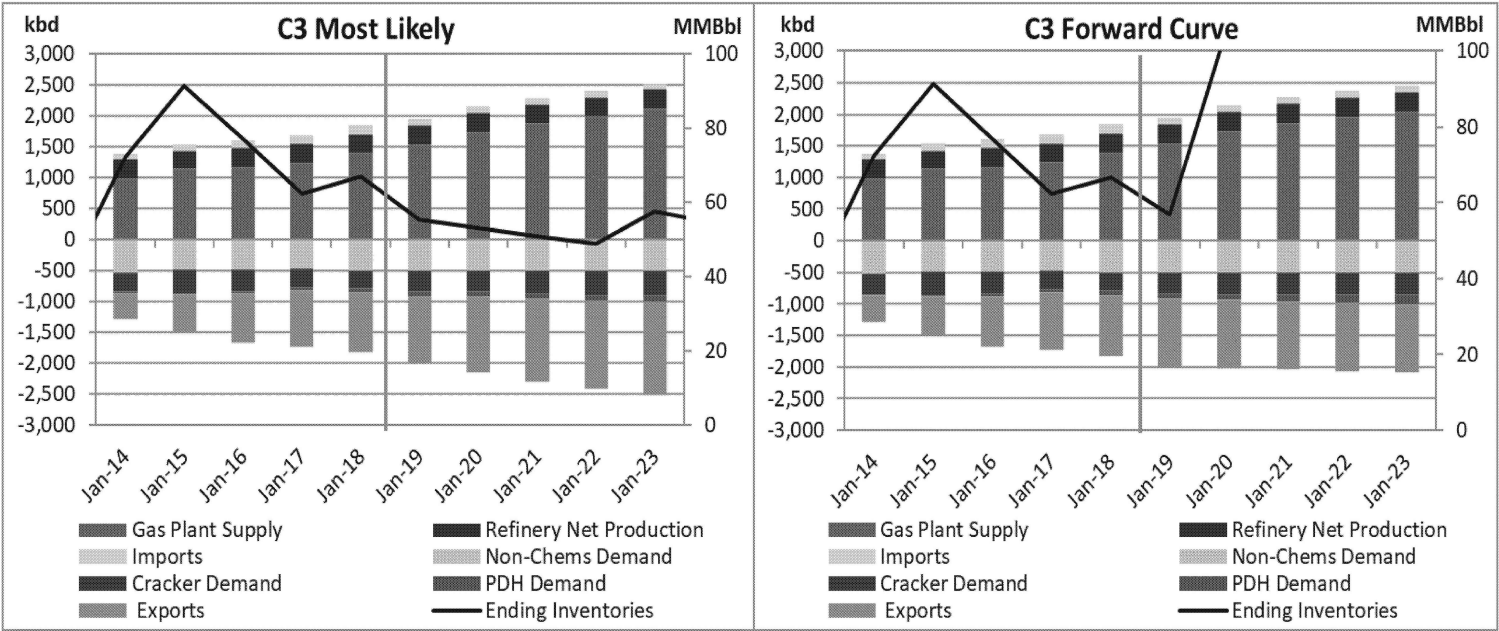
- **Forward Curve Case:** Inventory starts to build 2019+ at the current rejection level
- **Most Likely Case:** More rejection needed to balance as supply continues to grow and demand stays relative stable
- **Risks:** Import price elasticity; revisiting of Joffre cracker expansion by NOVA; further Vantage expansions





US C3 balances: strong petrochemical demand and exports are needed to clear the length

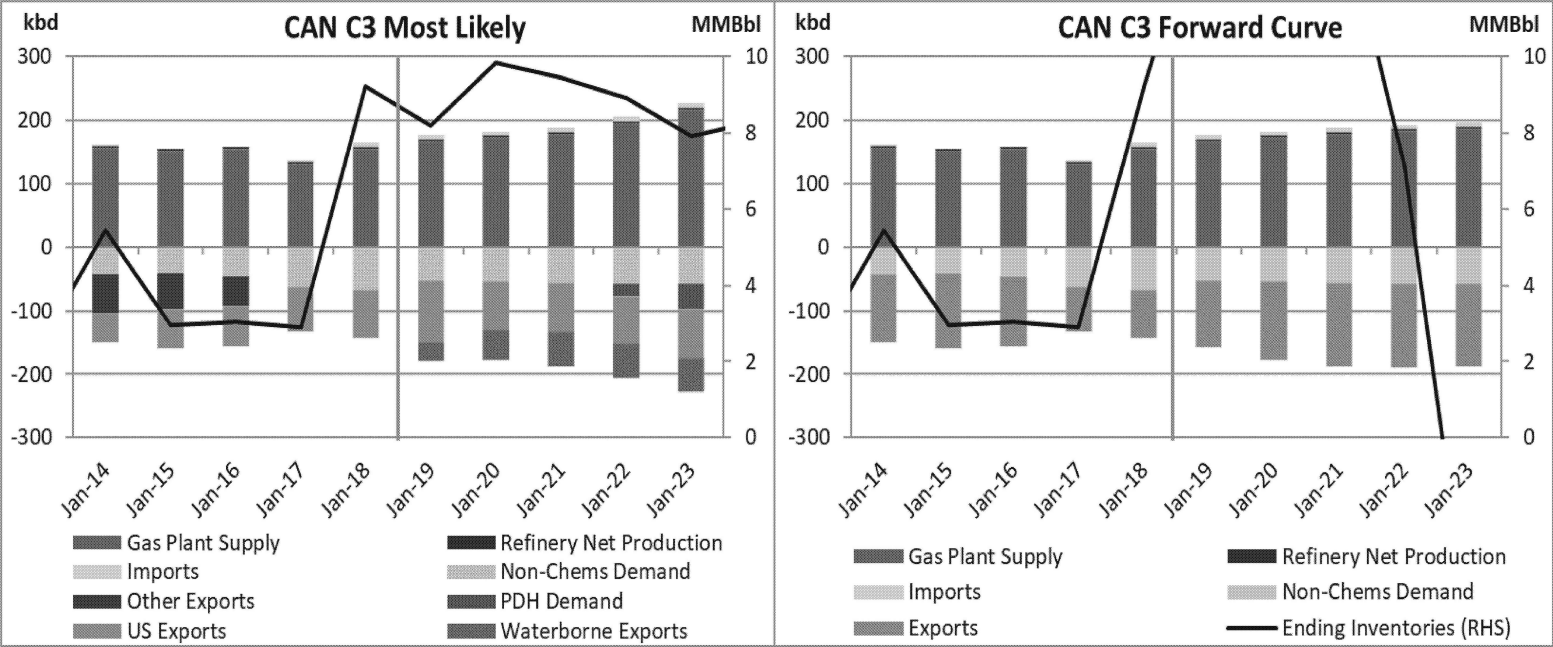
- **Forward Curve Case:** 2018/2019 tightness starts to ease 2020+ as supply catches up to demand
- **Most Likely Case:** More exports (2019+) and more cracker demand to balance continued supply growth
- **Risks:** Crude prices; international demand; cracker feed competitiveness; timing of new export infrastructure





WCAN C3: Region will continue to clear via rail, but will tighten with new export and PDH demand

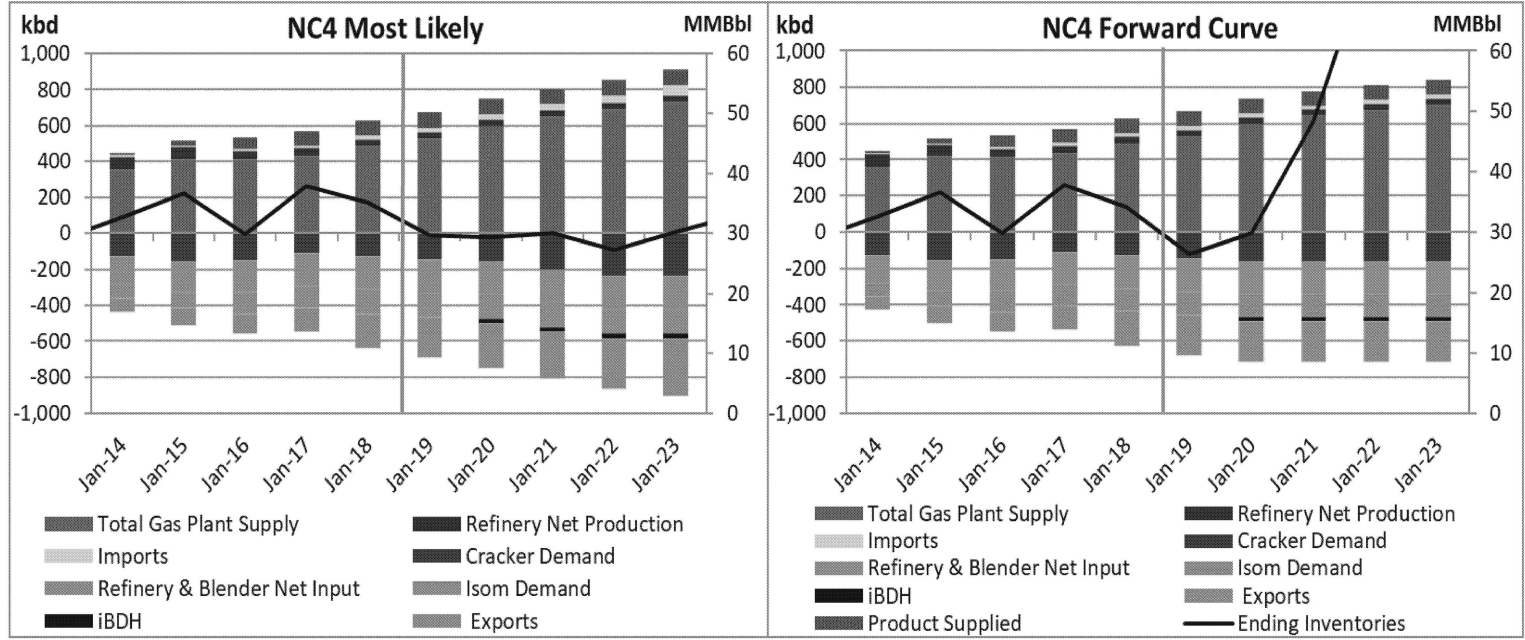
- **Forward Curve Case:** Supply growth will outpace demand; inventory builds 2018-2023 without a US push
- **Most Likely Case:** Exports push to the US falls from 21 KBD in 2019 to below zero by 2023 (**55 KBD waterborne assumed**)
- **Risks:** Crude prices; US ability to take exports; cracker feed competitiveness; PNW exports; new WCAN demand





US NC4 balances: Export push and competition in US cracker feeds still needed to balance the market 2019+

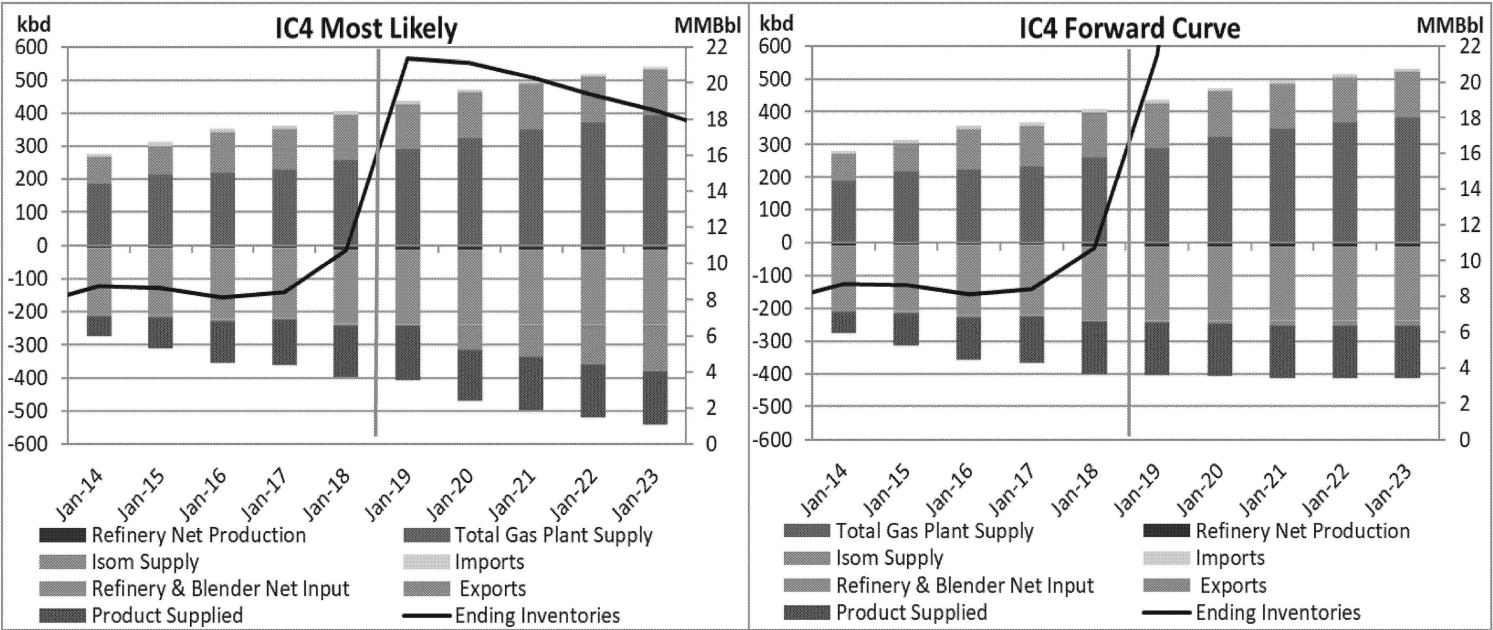
- **Forward Curve Case:** Market transitions longer 2020+ as not enough demand priced into the market
- **Most Likely Case:** Cracker demand (112 kbd) and exports (125 kbd) must increase 2019-2023 to balance
- **Risks:** Crude prices; timing of new infrastructure; competitiveness versus other cracker feeds; international demand growth





US IC4 balances: IC4 will increasingly need to clear via exports to balance; relatively unchanged from previous view

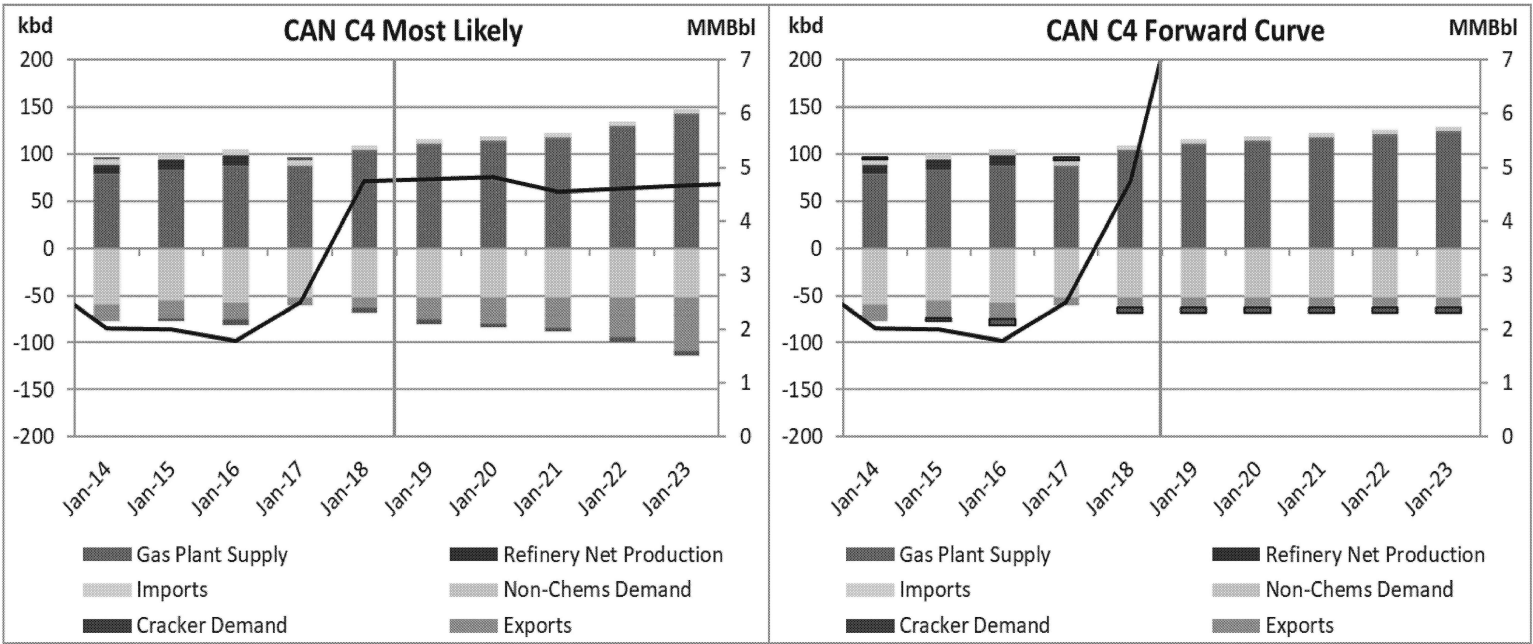
- **Forward Curve Case:** Not enough exports priced into the market; inventories build 2018+
- **Most Likely Case:** Exports must increase 140 kbd by 2023 to keep inventory from increasingly building
- **Risks:** Crude prices; timing of new infrastructure; competitiveness versus other cracker feeds; **international demand growth**





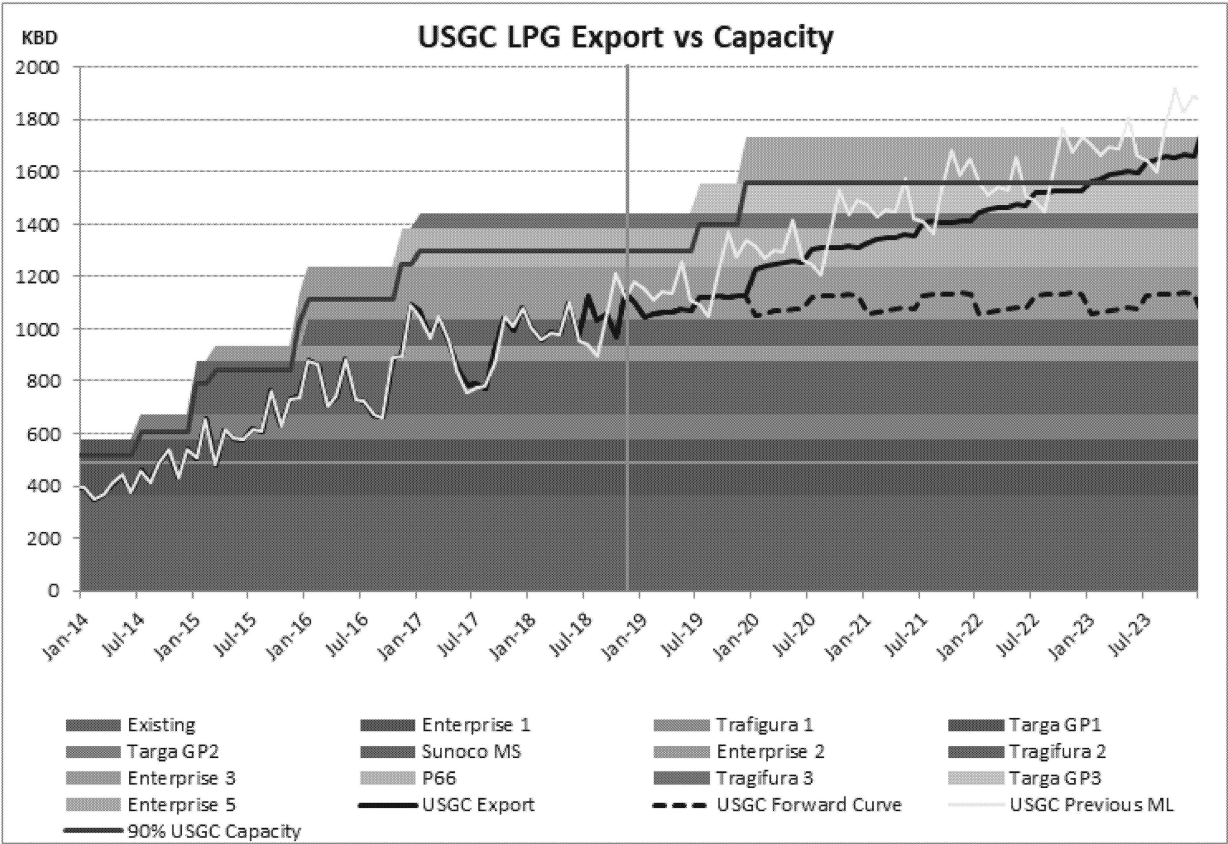
WCAN C4 balances: Continued length with supply growth, more barrels need to be cleared via exports

- **Forward Curve Case:** Supply growth outpaces demand; inventory builds 2018+
- **Most Likely Case:** WCAN must clear 46 KBD extra to the US 2018-2023 to keep inventory flat to 2019 level
- **Risks:** Crude prices; timing of new infrastructure; competitiveness versus other cracker feeds; waterborne exports?





USGC LPG Exports: production growth outpaces export capacity, needs additional capacity starting mid 2022

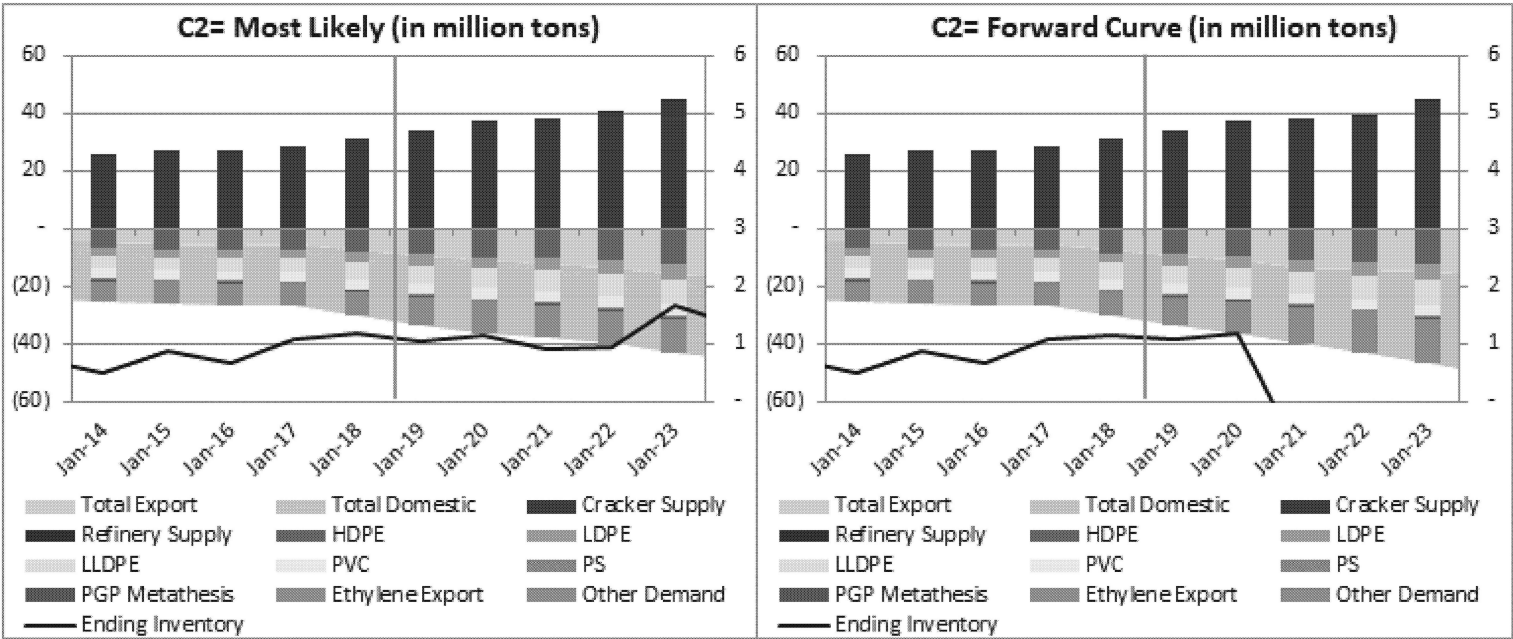


- **Forward Curve Case:** Exports relatively flat 2019+
- **Most Likely Case:** Arbs widen to incent more exports 2019+; new USGC capacity needed by mid 2022
- **Risks:** Crude prices; US export competitiveness in global cracker feed slates; OPEC impact on global LPG supply; **timing of new capacity**



US C2= balances: Export push needs to balance new cracker supply

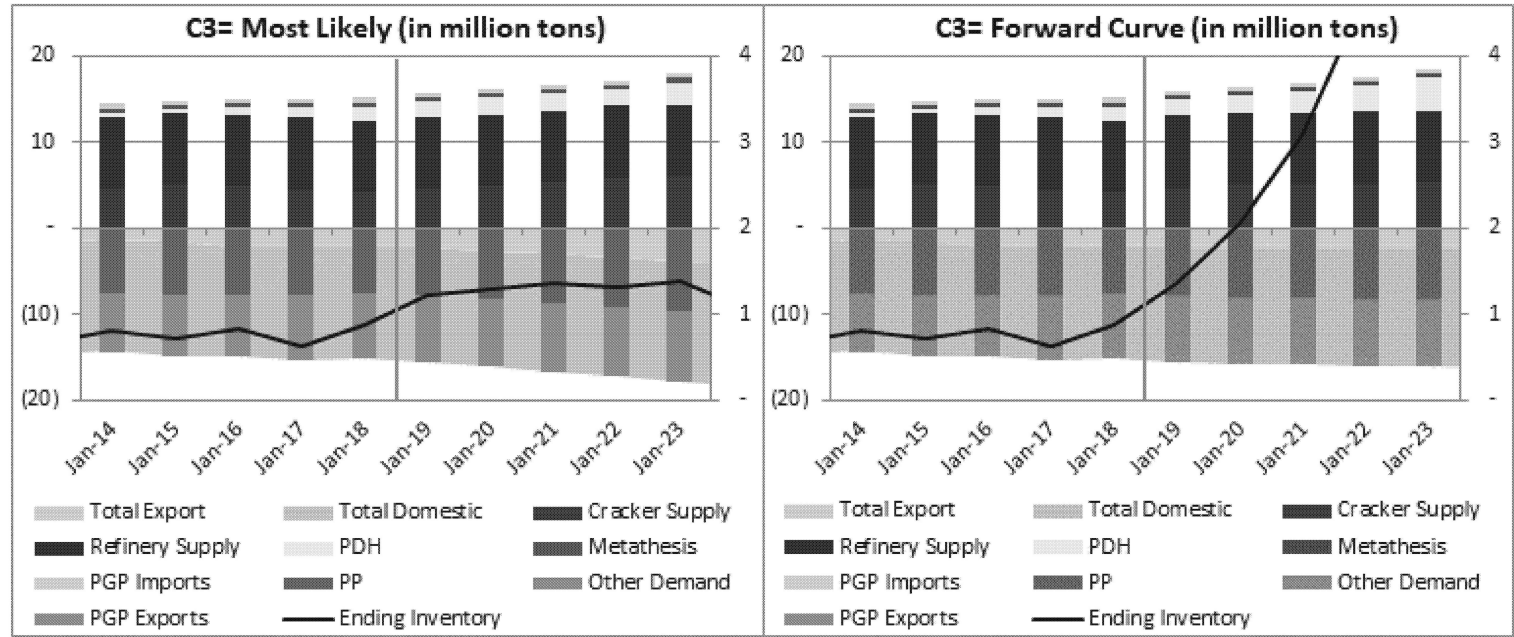
- **Forward Curve Case:** Strong PE demand sustains longer and outpaces cracker capacity growth
- **Most Likely Case:** Catch up in PE capacity (2019-2020), exports (2020) and a shift to cracking LPG (2019+) balances the market longer term
- **Risks:** Cracker completion timing; international demand for derivatives; global GDP; export completion timing





US C3= balances: Market trends looser with increasing PDH utilization and more LPG cracking

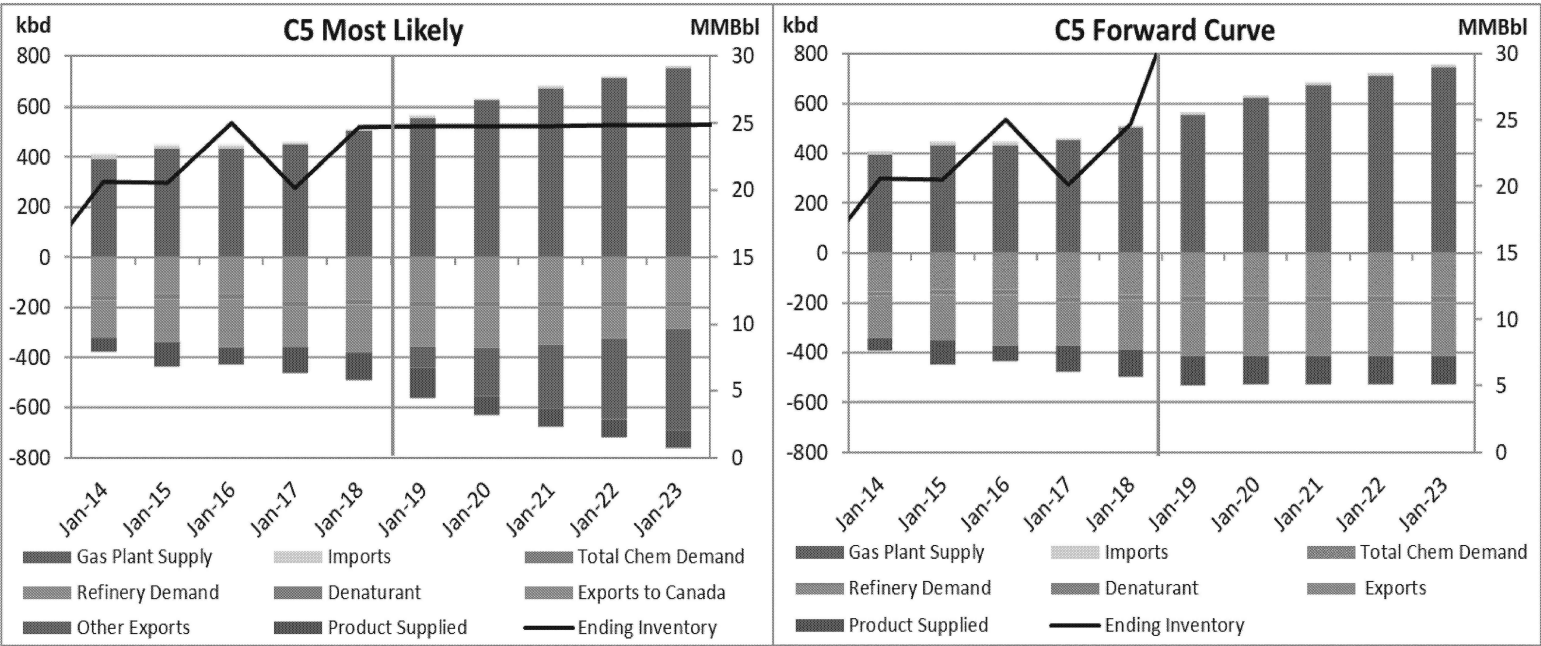
- **Forward Curve Case:** Inventory continues to build through 2023 from PDH ramping and more LPG cracking
- **Most Likely Case:** Increased domestic demand (primarily polypropylene) and exports balance growing supply
- **Risks:** Cracker feedstock competitiveness; more new PDH builds; Global demand on C3= and derivatives





US C5 balances: More barrels must clear in the US refining pool or via the water, as Canadian supply continues to grow

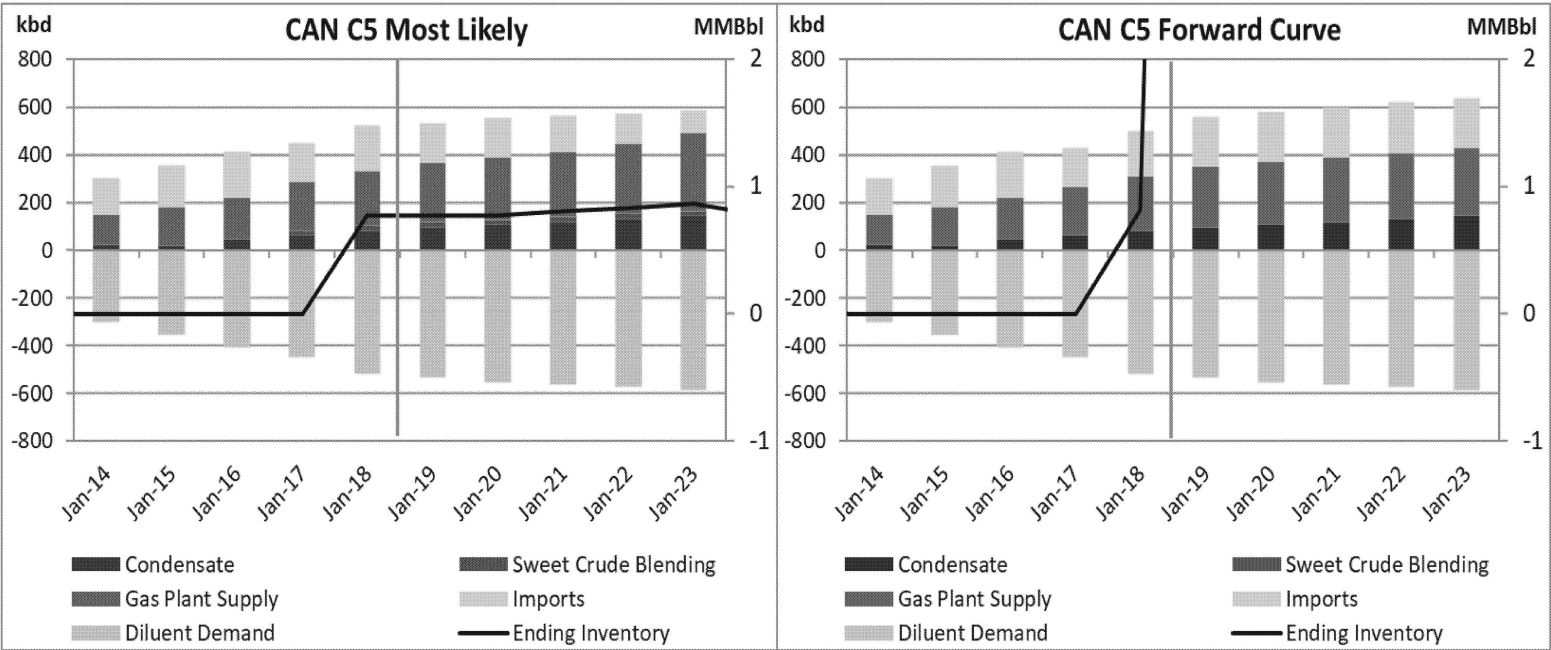
- **Forward Curve Case:** Supply outpaces demand; US must price to turn on blending demand and/or export more 2018+
- **Most Likely Case:** Exports must grow over 298 kbd 2018-2023 to keep inventory flat to 2019 level
- **Risks:** Crude prices; **oil sands growth**; mogas blending economics





WCAN C5 balances: WCAN supply continues to grow, less imports needed to balance market

- **Forward Curve Case:** Inventory starts to build 2018+ if keeps the same level of imports from US
- **Most Likely Case:** Growth in supply will need to be balanced by reduction in imports from US (99 kbd less imports by 2023)
- **Risks:** Crude prices; **oil sands growth**; WCAN condensate supply growth





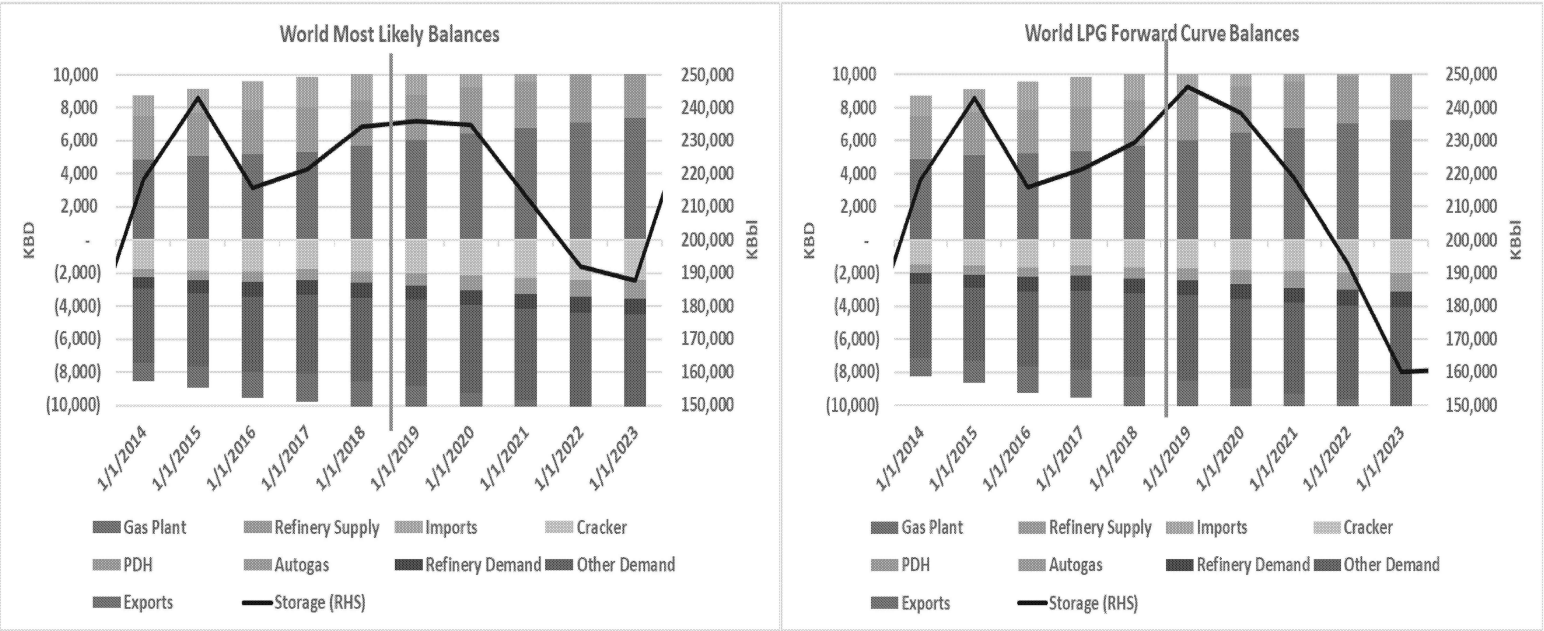
Global LPG: Key messages

- Strong North American Gas Plant supply (~1,200 KBD) and EH demand (~1,500 KBD) will continue to be the primary market drivers 2018-2023
- **The global LPG market looks relatively balanced over the five year period, but our bias remains bearish**
 - Naphtha balances look increasingly long over time, as the global crude slate continues to lighten. This will increase competition for petchem demand and pressure prices
 - US crude production can (and often does) surprise to the upside, bringing more gas plant supply
 - Demand growth is concentrated in a few regions (CHN/IND/SEA), and subject to project completion delays and/or continued economic growth
- Waterborne arbs will need to widen over time from the US to the EH to incentivize more exports, and eventually, more export capacity (2022/2023)
- Demand growth 2018-2023 will be led by China (~580 KBD), IS (~325 KBD) and SEA (~175 KBD)
- Risks: Oil prices; timing of new infrastructure; global economic outlook; tariffs/sanctions; chemicals balances; naphtha balances



Global LPG Balances: Market looks relatively balanced over the next five years as NA supply and EH demand growth continues

- **Forward Curve Case:** Relatively balanced (+/- 70 KBD) through 2021; *short 2022-2023* as EH demand growth continues
- **Most Likely Case:** More NA exports (2019+) and more cracker demand (2021+) to balance continued supply growth
- **Risks:** Global economic outlook (especially Asia); timing of new infrastructure/demand; naphtha balances; crude prices





WH LPG Balances: Growing NA supply must be exported to EH to balance

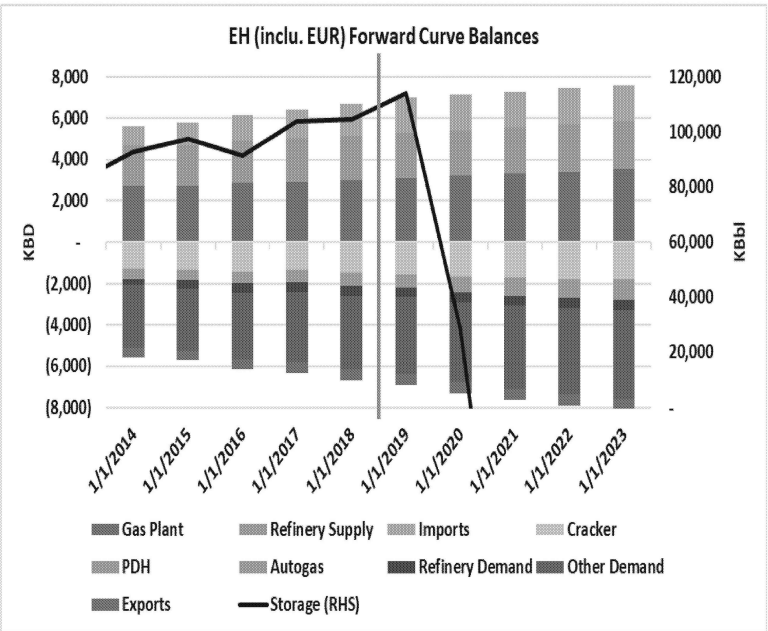
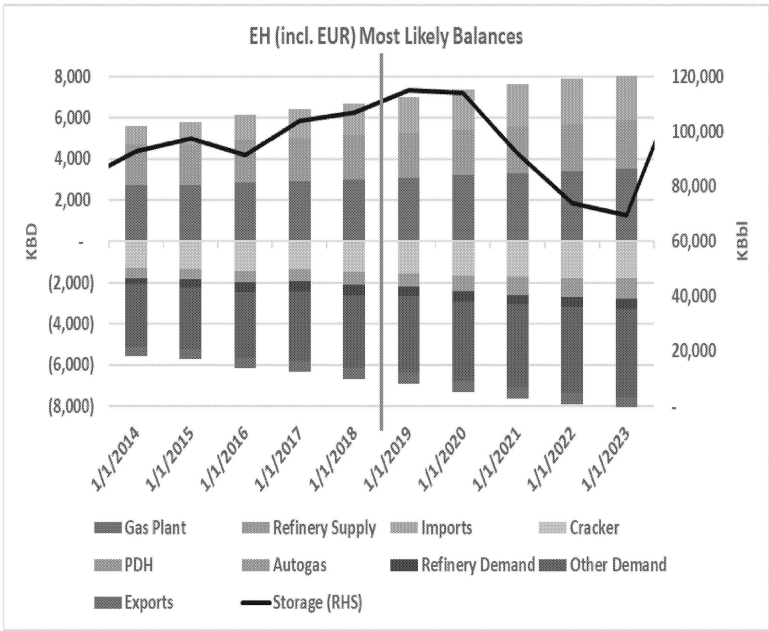
- **Forward Curve Case:** Relatively balanced through 2019; trending much longer 2020+ with growing NA supply
- **Most Likely Case:** Exports and arbs must increase to balance the market 2020+; more US export capacity needed by 2022/2023
- **Risks:** Global economic outlook (especially Asia); timing of new infrastructure/demand; naphtha balances; **crude prices**





EH LPG Balances: Growing Asian demand will increase the call on NA exports

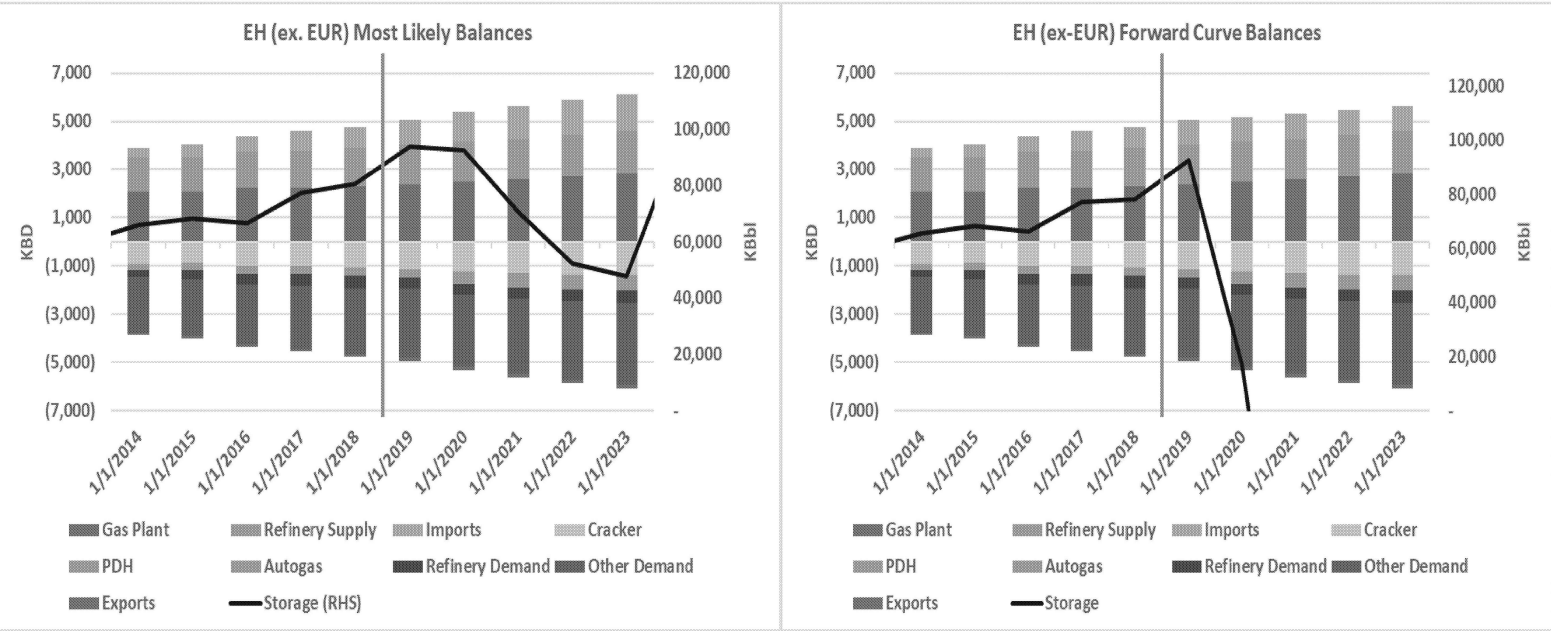
- **Forward Curve Case:** Relatively balanced through 2019; trending much shorter 2020+ with growing Asian demand
- **Most Likely Case:** Growing imports from North America will help balance the market
- **Risks:** Global economic outlook (especially Asia); timing of new infrastructure/demand; **naphtha balances**; crude prices





EH (ex-EUR) LPG Balances: Growing Asian demand will increase the call on global exports

- **Forward Curve Case:** Relatively balanced through 2019; trending much shorter 2020+ with growing CHN/IND demand
- **Most Likely Case:** Growing imports from North America will help balance the market
- **Risks:** Global economic outlook (especially Asia); timing of new infrastructure/demand; **naphtha balances**; crude prices





Lat Am LPG Balances: Call on US/CAN exports will increase 120 KBD from 2018 to 2023

- **Forward Curve Case:** Trending shorter with falling supply in Mexico and modest demand growth (primarily Mexico and Brazil)
- **Most Likely Case:** Growing imports from North America will help balance the market
- **Risks:** Crude prices; economic outlook (especially Venezuela); pace of Mexico supply development

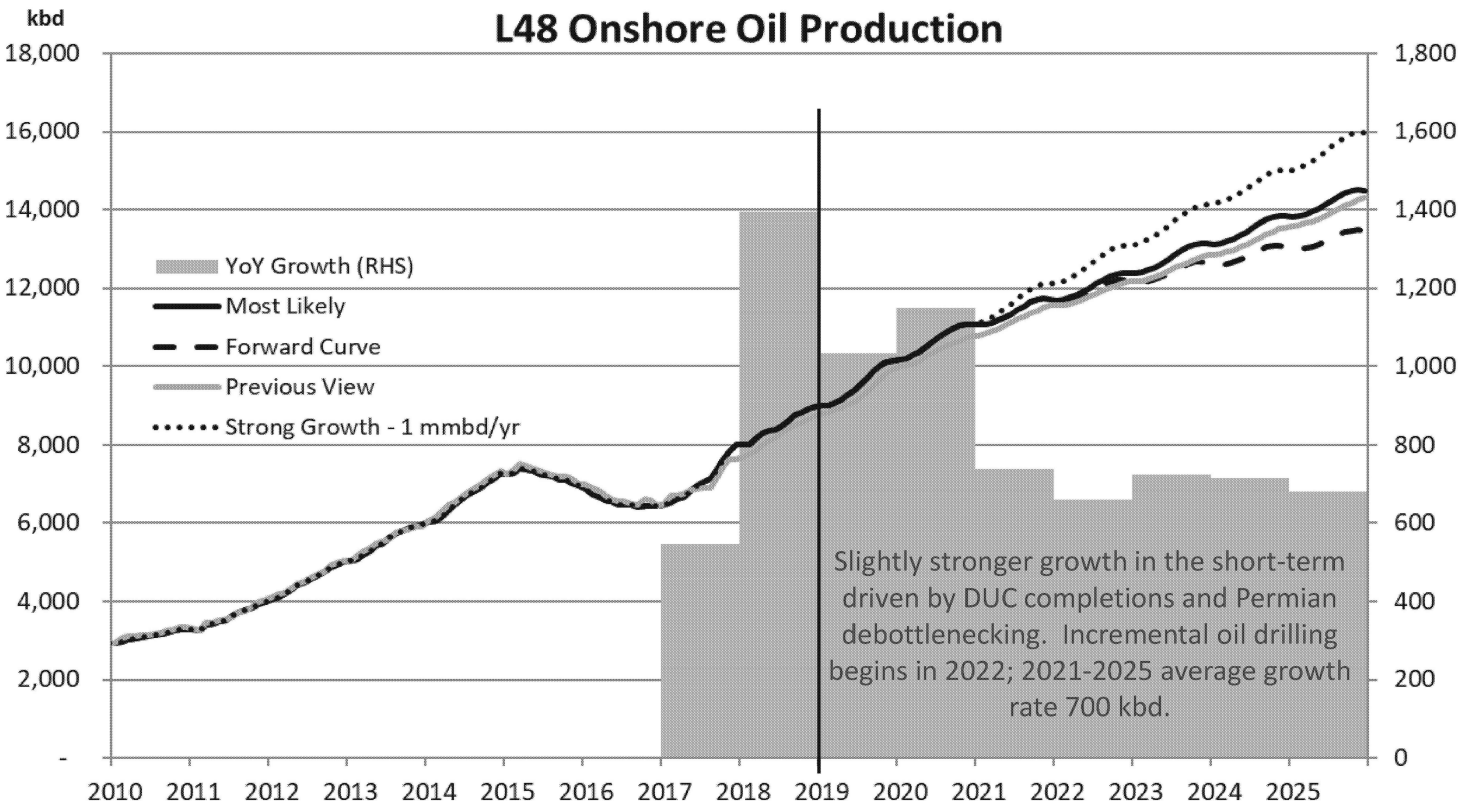


Appendix



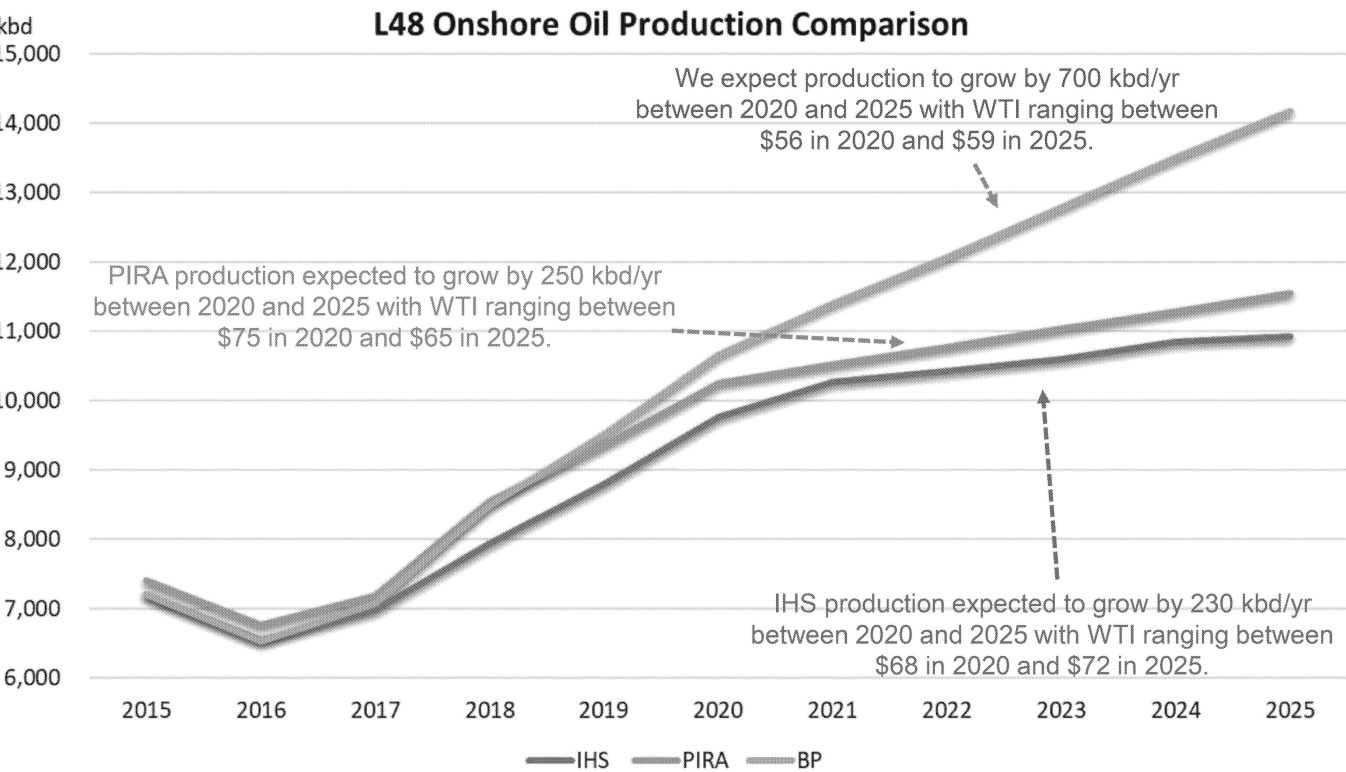


Higher production due to higher prices and stronger pull on US oil



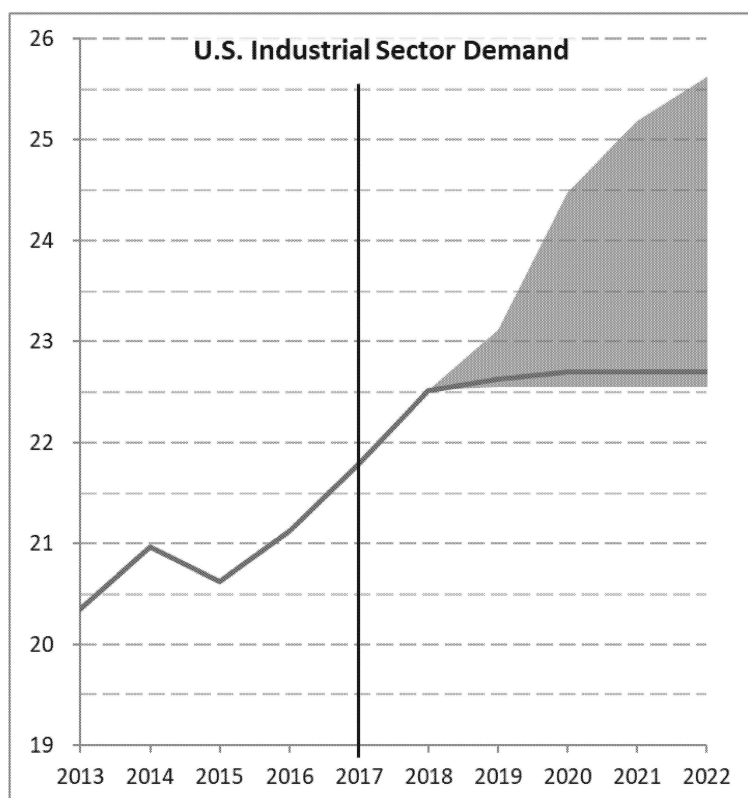


L48 onshore oil production: Third party outlooks call for considerably lower production, despite higher prices



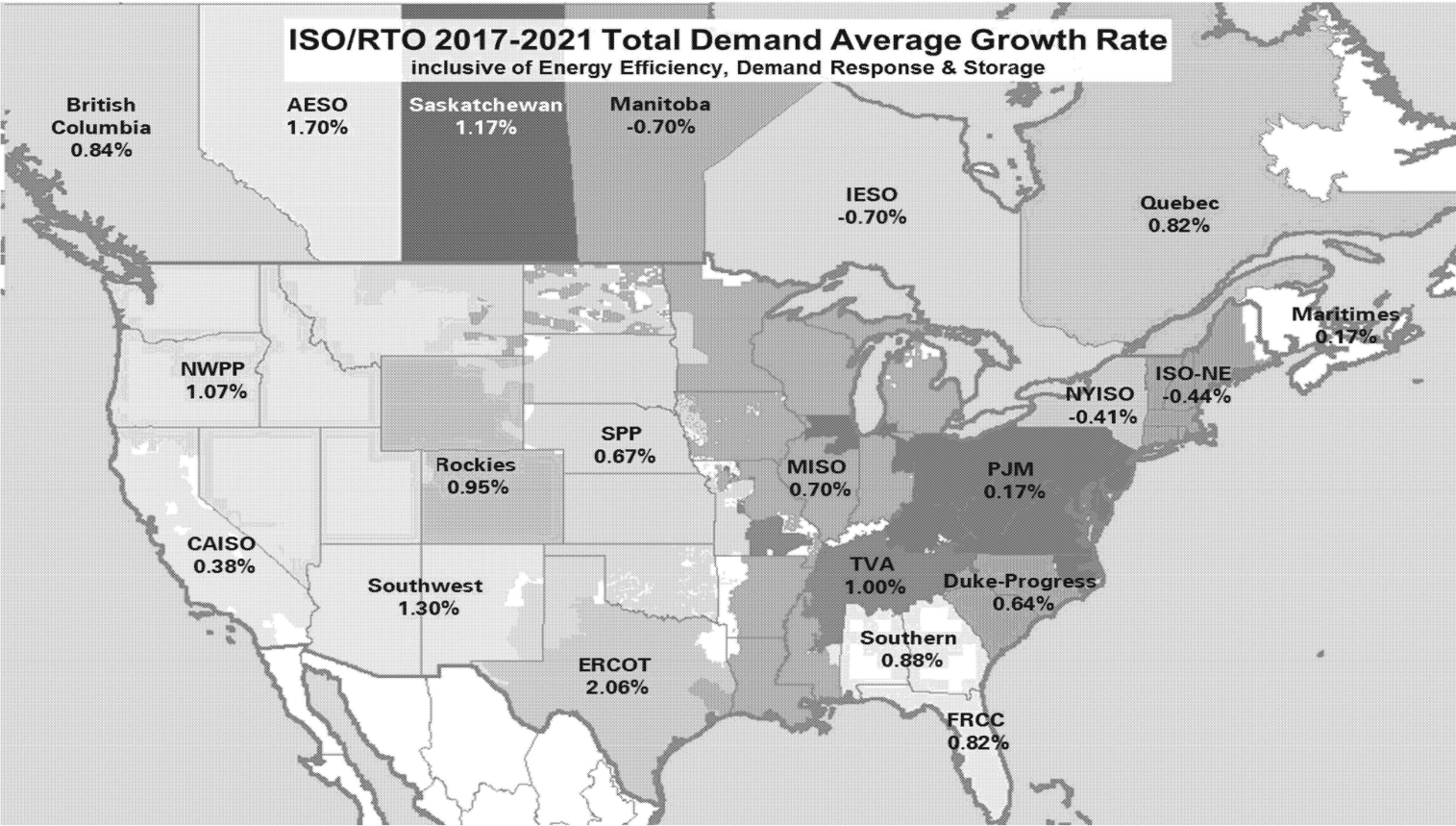


Industrial demand projected to be up by ~0.20 bcfd by 2023
from 2018 levels



- LA and TX account for three-fourths of industrial gas demand growth
 - WA, IA, and CA are the runners up
- Methanol, ethylene, and fertilizer are the leading industries
- The High-Demand Case adds ~2.92 bcfd more in the same states and industries by 2022 by assuming less likely projects proceed
- The Low-Demand Case poses ~0.15 bcfd of risk by 2022, in LA, by assuming only the highest probability projects are completed

ISOs/Balancing Authorities Forecast Small Electricity Demand Growth





Coal retirements in the Eastern and ERCOT grids; gas dominates new generation builds; increasing nuclear risk

