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Towards a Balance Amid Energy Turmoil

Houston Economics Club October Luncheon

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Federal Reserve Bank of Dallas, Houston Branch

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UPSTREAM | MIDSTREAM | DOWNSTREAM | FUEL & TRANSPORT

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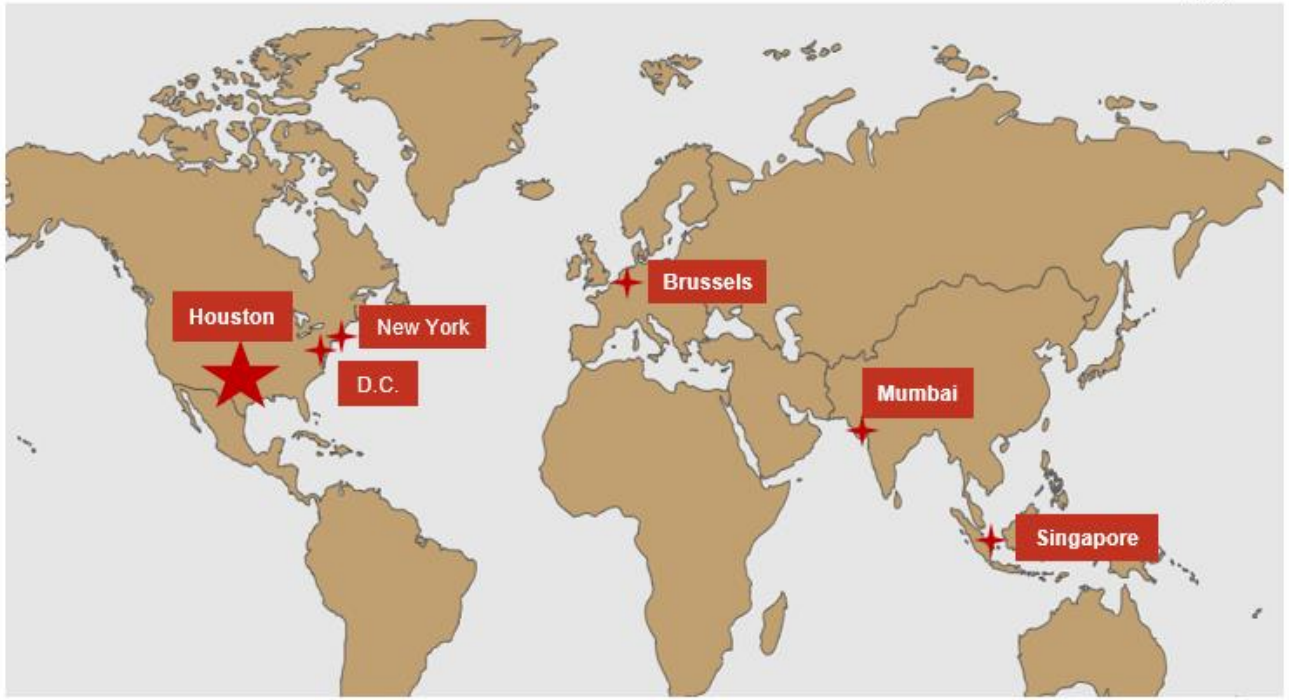
Boots on the Ground to Cover a World of Energy



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  - Integrated analysis across the entire energy value chain, including macro-level analysis (geopolitics, macro-economics, policies and regulations)
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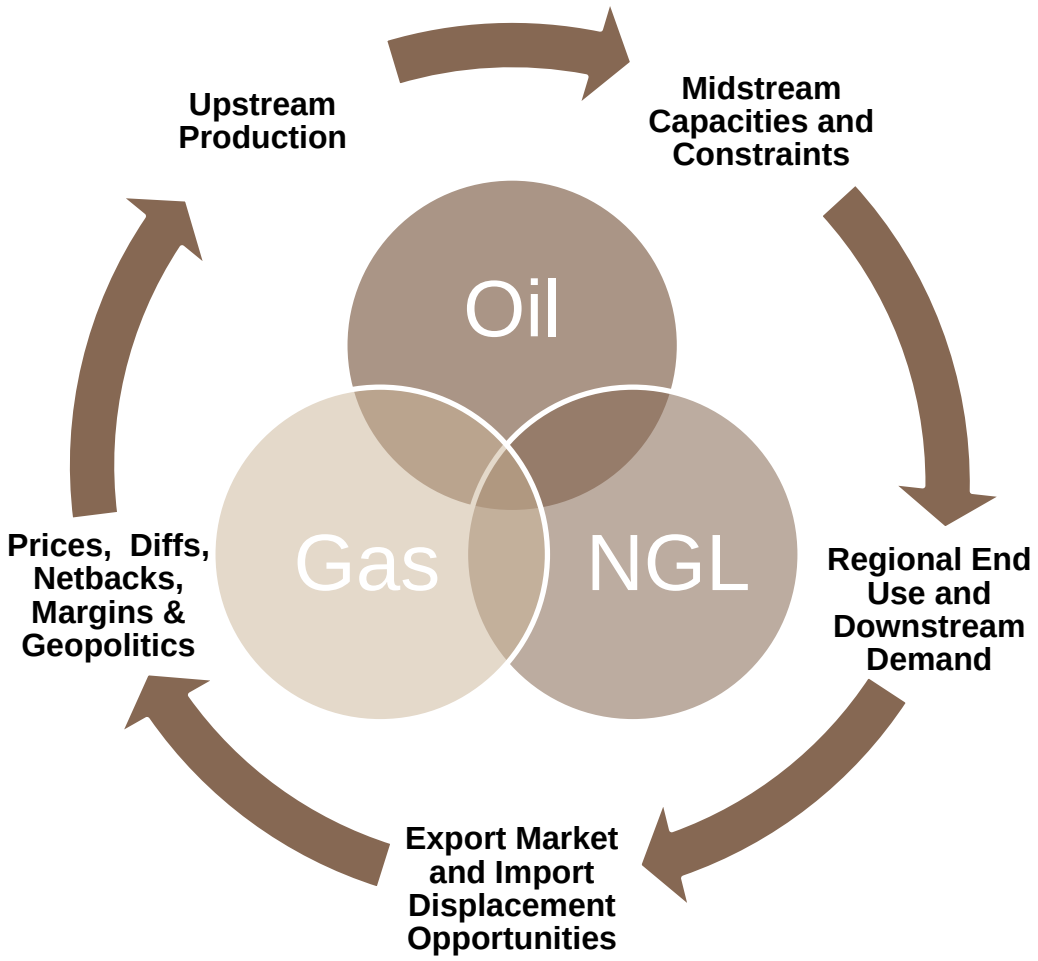

Subscription Services Form Basis for Consulting & Advisory Engagements

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	Global Heavy Crude Outlook	Global LNG	Catalyst Market Outlook	Global Biofuels Outlook
	Global Upstream Projects Analytics	Global NGLs Outlook	Global Syngas Conversion	Global Transport Fuel Outlook
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Clients have access to world of energy insights and experienced professionals in Houston, New York, DC, Brussels, Mumbai, & Singapore

Agenda

Agenda

- Crude Oil Balances
- Produce Local, Sell Global
- Gray Swans
- Key Takeaways

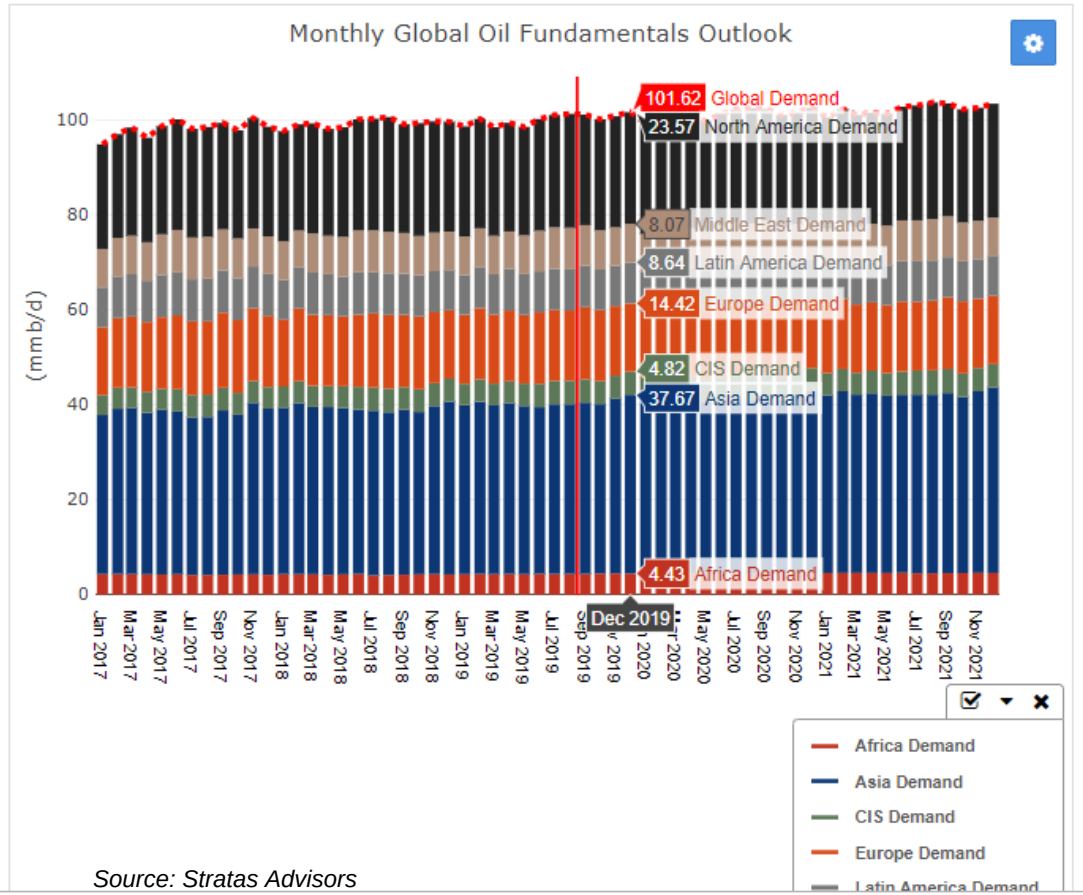
Crude Oil Balance Fundamentals

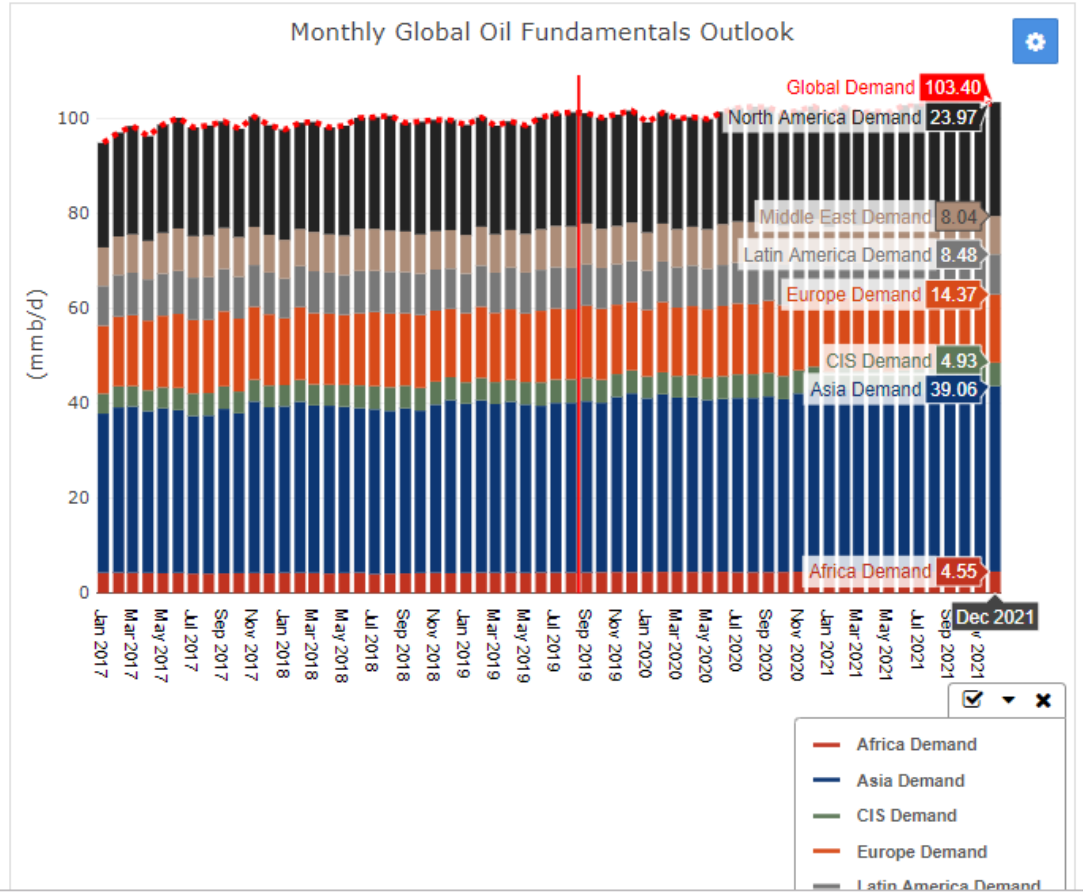
Crude Oil Balance Fundamentals

Key Discussion Points

- Crude Oil Balances
- Supply Growth Will Moderate
- Demand Growth Exists But Mainly NGL
- Inventory to Stay Inline
- OPEC and OPEC+ Has Spare Capacity
- Crude oil price trends

We see Demand Growing ~1 MMbbl/year For Next 2 Years





Source: Stratas Advisors

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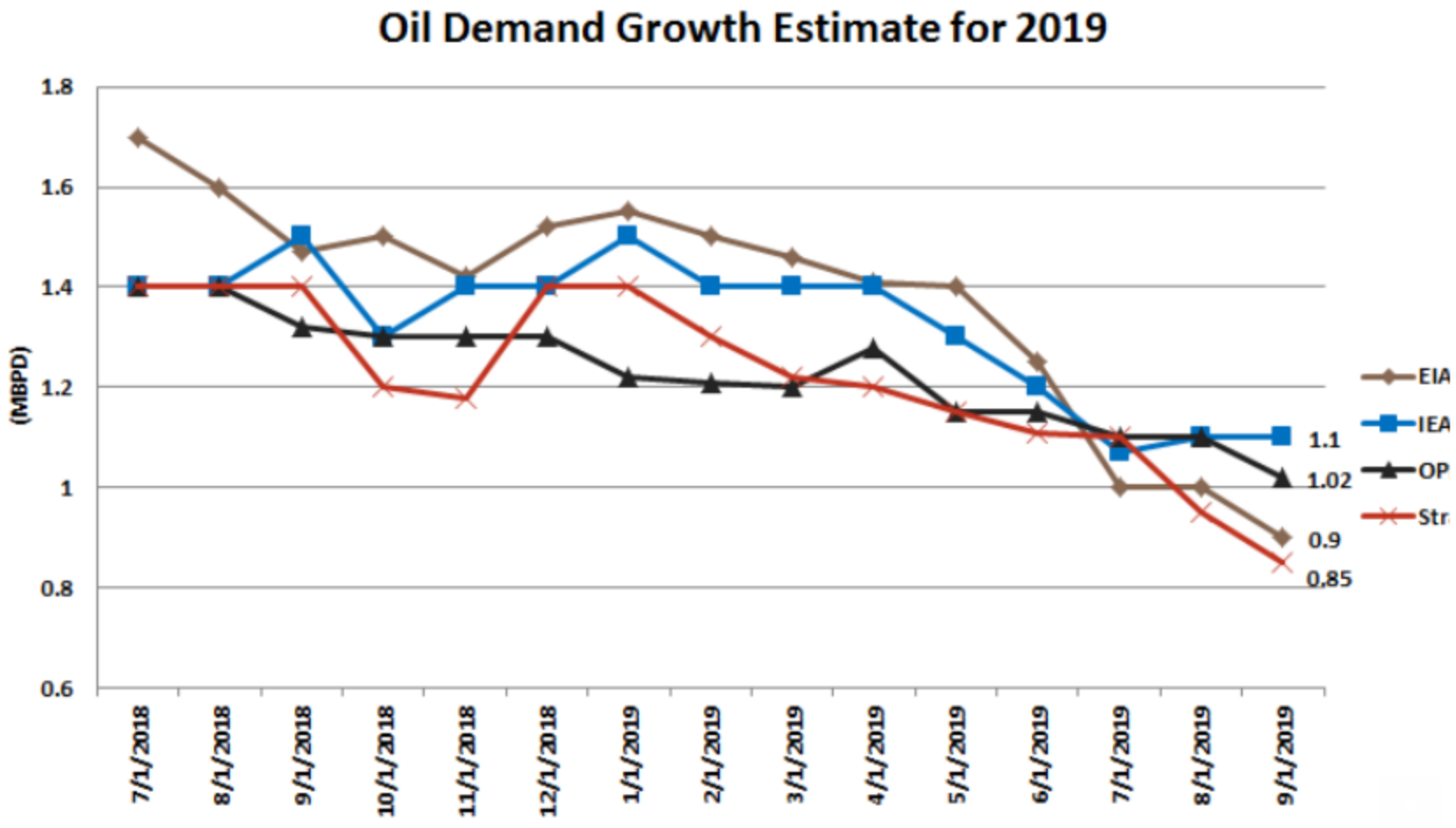
We Generally Are More Conservative Than Other Forecasters

We saw demand dropping below 1 MMbbl/d in late 2019



Source: Stratas Advisors, EIA

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Non-OPEC Production Growth Drives Supply Upward

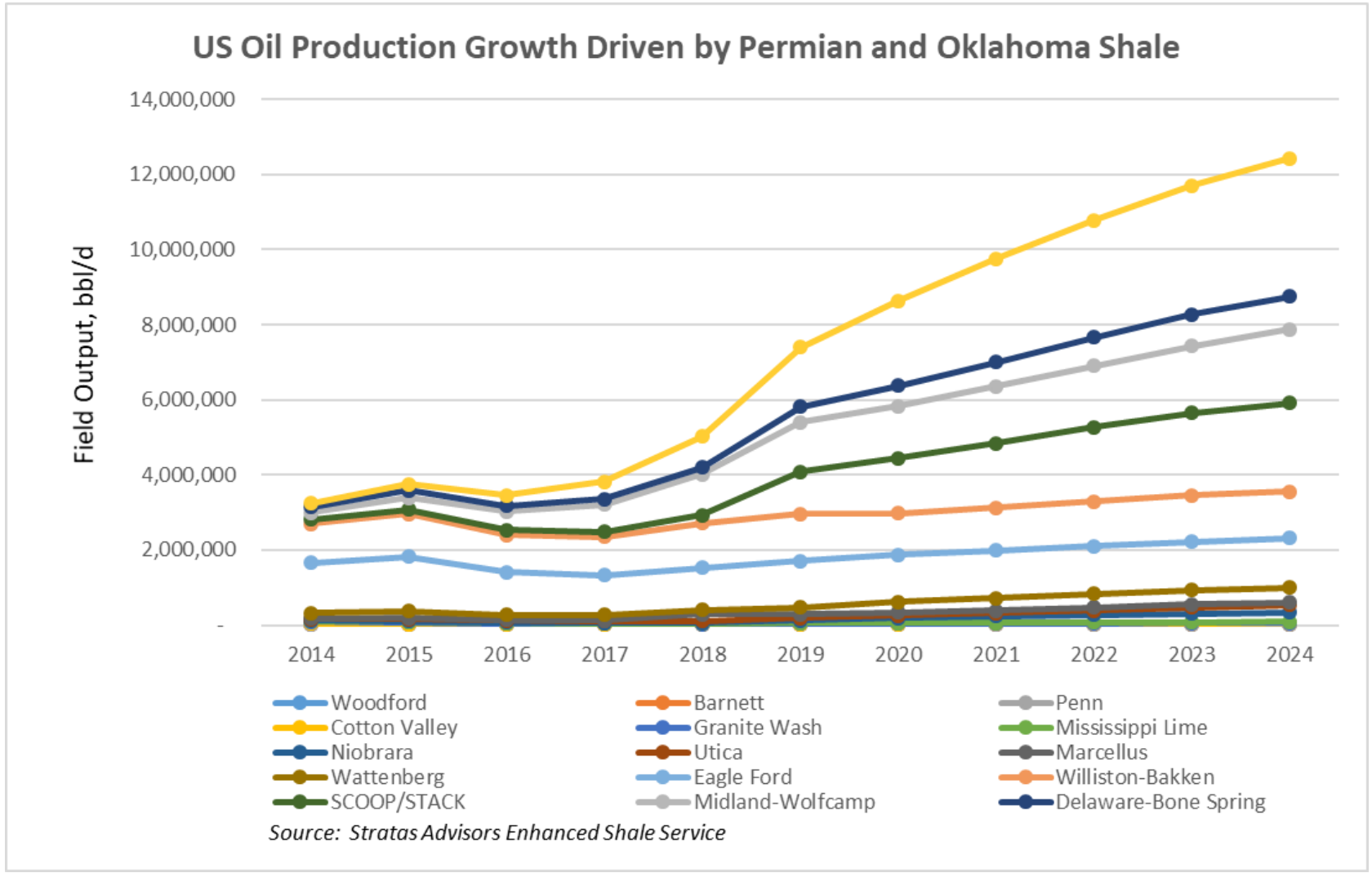
Our 3Q19 forecasts reflect lower OPEC supply, higher non-OPEC supply

UPDATED		Reference Case	Last Quarter Forecast
Brent	2019	$ 63.20	$ 67.78
	2020	$ 58.09	$ 73.39
	2021	$ 56.80	
WTI	2019	$ 56.69	$ 59.70
	2020	$ 53.86	$ 66.35
	2021	$ 52.76	
OPEC Total Supply	2019	35.4	35.8
	2020	35.0	36.2
	2021	35.5	
Non-OPEC Total Supply	2019	62.2	61.9
	2020	63.5	62.9
	2021	64.5	

Source: Stratas Advisors

- Our 3Q19 price deck includes significantly lowered prices for global oil benchmarks
- We gave our Brent 2020 prices saw a 21% haircut while WTI saw an 18% trim
- We now see OPEC production declining more strongly than our prior forecast, with 2020 output below 2019 and recovering to just above that level in 2021
- Non OPEC supply continues expansion and averages in 2021 at 2.3 MMbbl/d higher than 2019

U.S. Crude Production Drives Non-OPEC Growth



- US crude production is on pace to set a new record in 2019
- Majority of the production coming from the Permian
- U.S. crude supply is currently higher than U.S. demand
- This means export demand markets are needed if production is to keep growing

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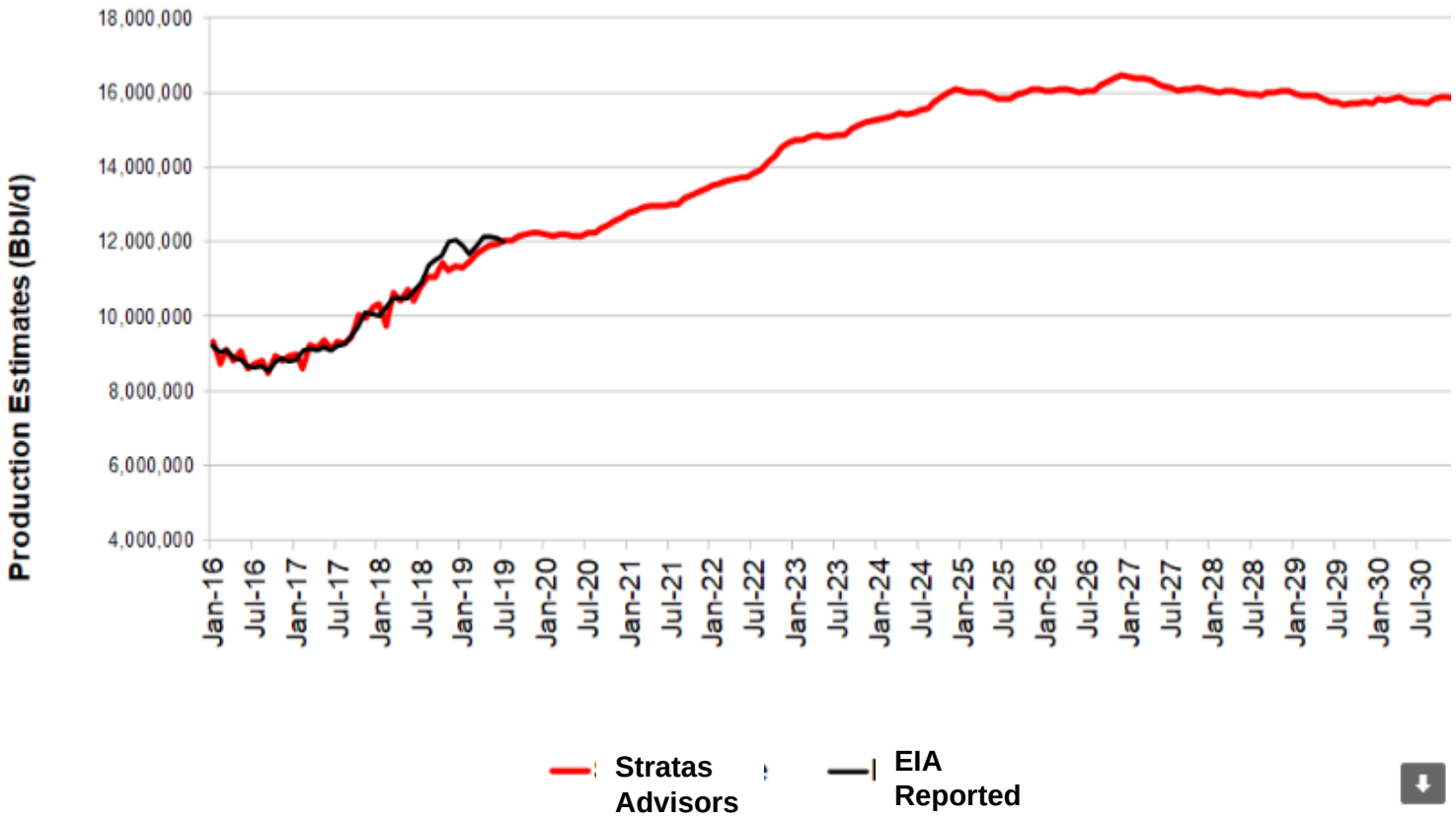
Total US Crude and Field Condensate to Flatten post-2024

Our Shale 3.0 forecasts are based on well-up forecasting and “fullstream” analyses



Source: Stratas Advisors

- We see the current oil era as “Shale 3.0” and we forecast continued growth under Shale 3.0 until the middle/latter 2020s
- We see consolidators and deep-pocketed majors driving disciplined growth in world class liquids fields (Permian, Bakken, others to be determined by economics)
- We see larger producing entities having the cash flows, the deep bench, and the wide integrated portfolio to optimize US unconventional activity in a slower growth petroleum world
- ExxonMobil and Chevron typify the new players. XOM has re-integrated via partnership and investment to drive fullstream cash flows from source to sink (Permian drill bit to expanding Beaumont refinery connected by water to global markets)

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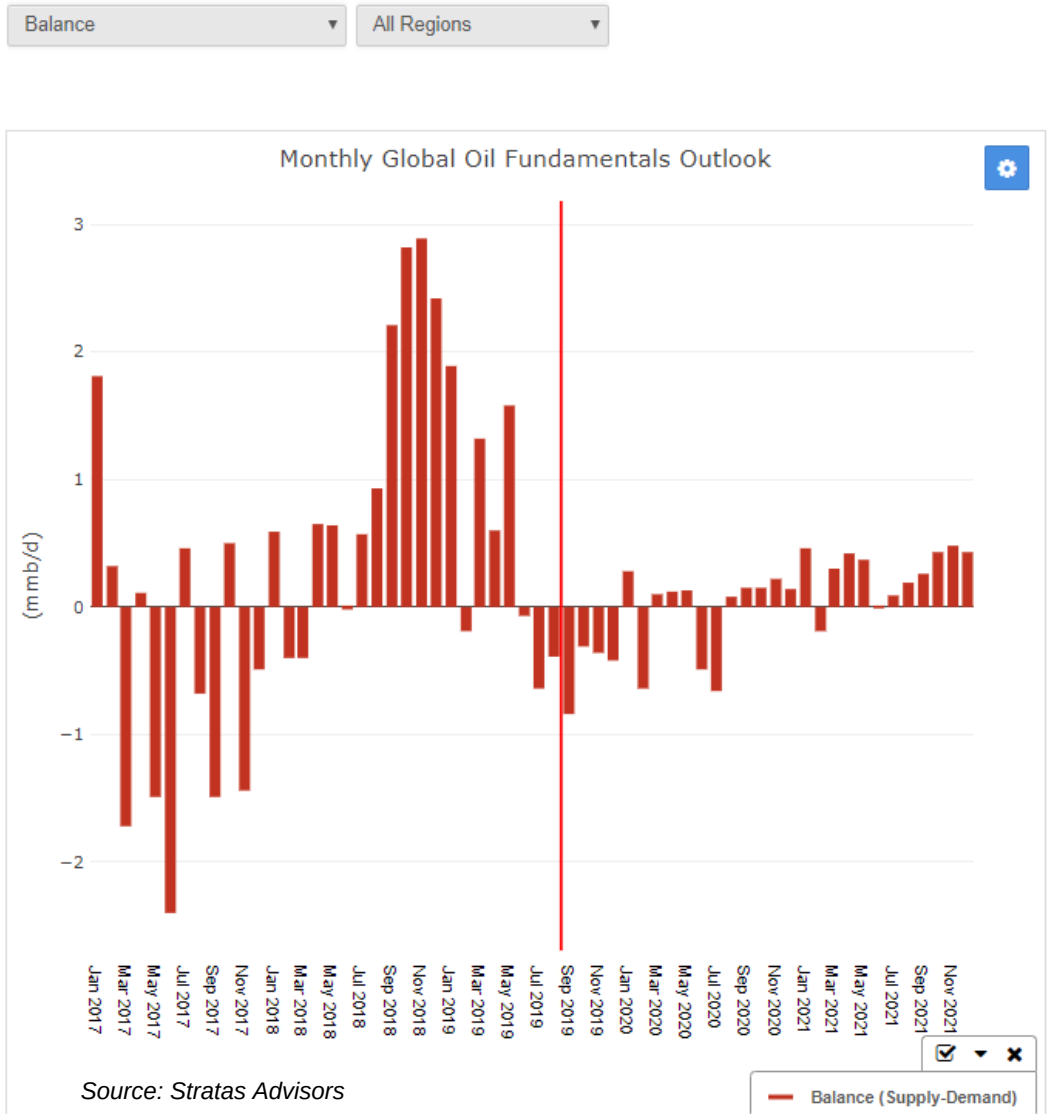
Balance During Next Two Years Looks Best of Recent Periods



Source: Stratas Advisors

- The last two years showed a surplus of 540 Mbbl/d on average
- By the end of the current year, we expect the average 2019 petroleum balance to show a surplus of 180 Mbbl/d
- By 2020, we show the full erosion of that surplus and a slight deficit of 25 Mbbl/d
- After that, we see 2021 recovering some length to a 280 Mbbl/d average surplus
- For the next two years, the average length is 120 Mbbl/d

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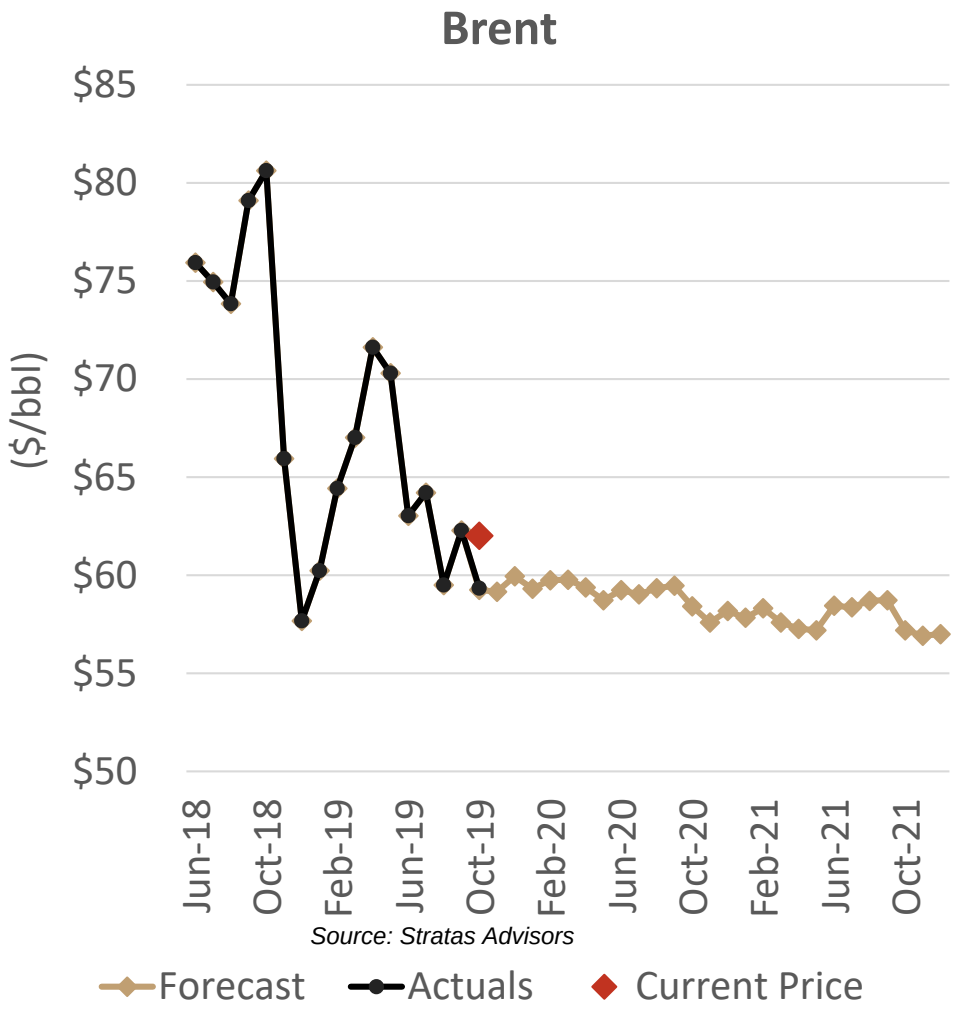
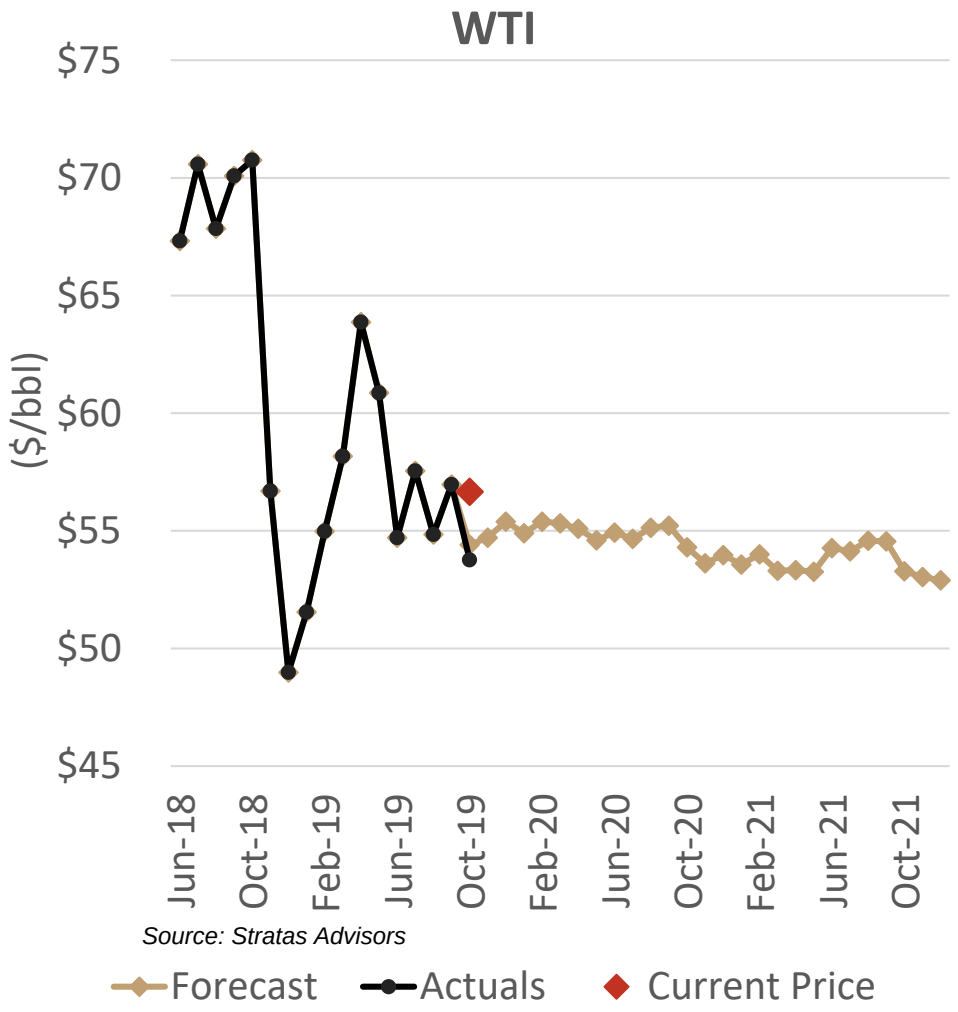
Current Price Outlook vs Actuals

Prices showing negative drift driven by an amply-supplied balance (with limited demand visibility)





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Produce Local, Sell Global

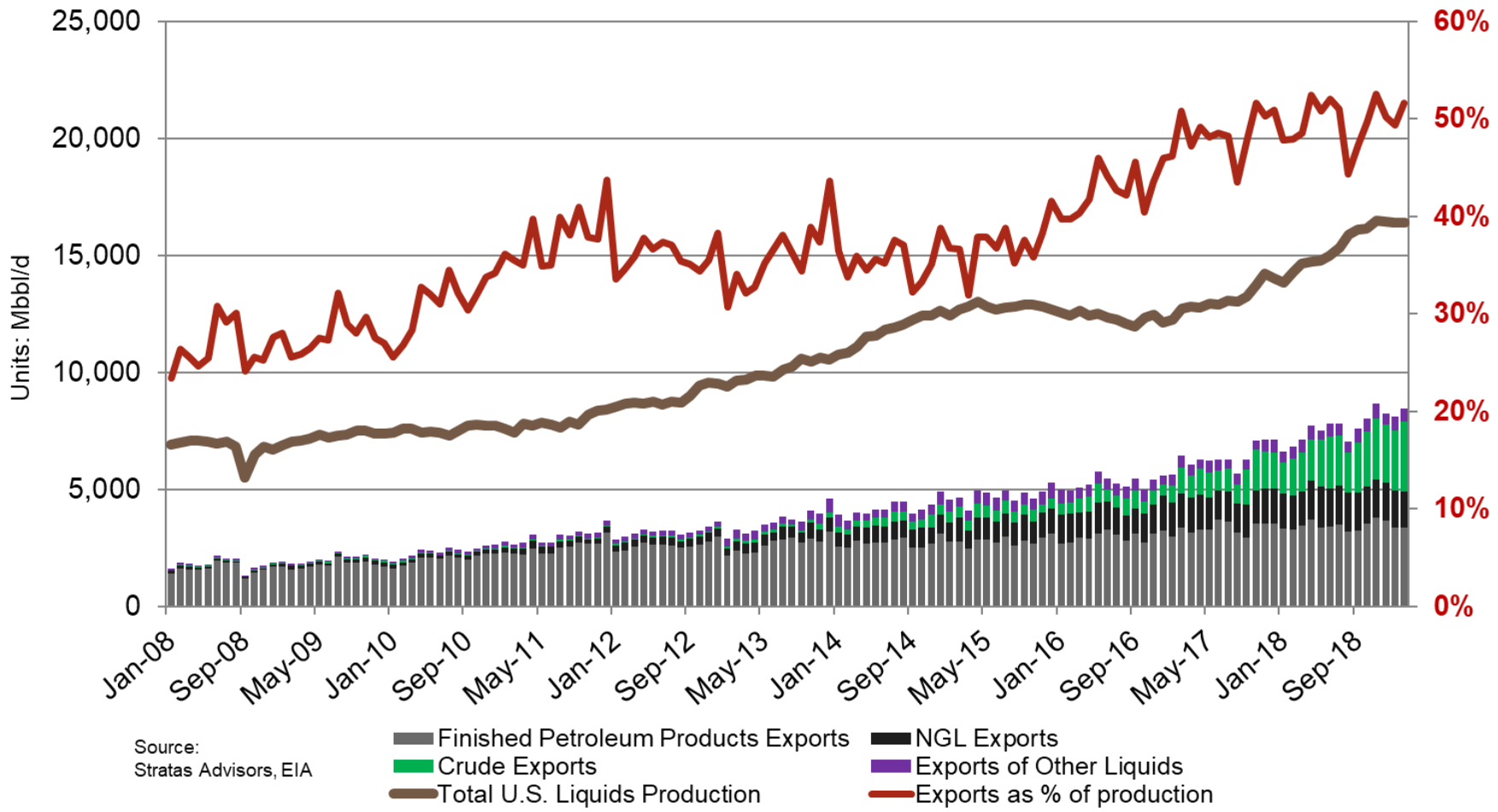
Produce Local, Sell Global

Key Discussion Points

- From Importer to Export Leader
- US Must Export All Hydrocarbon Types
  - Crude
  - Natural Gas
  - Refined Products
  - NGL
- Infrastructure Implications

US ~~Now~~ *Must Remain* Net Exporter of Hydrocarbons

As US has emerged as a net exporter, global markets now more directly affect US petroleum activity



More than 50% of U.S. field production is exported in one form or another in 2018

Source: Stratas Advisors TEXIS Service

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US Becoming a Net Petroleum Liquids Exporter

Crude exports nearing 4 MMbbl/d, NGL+Product exports at 5 MMbbl/d and just 8.1 MMbbl/d of imports

- Crude exports reaching 4 MMbbl/d of high-value light oil while largest import stream is deeply discounted heavy Canadian crude oil largely delivered via secure pipeline to ideally configured complex US refineries

Exports	3,683

- Net product exports reaching 3 MMbbl/d comprising both refined fuels and NGL processing plant output from wet field gas production

Net Imports[9]	-2,795
Imports[9]	2,141
Exports[9]	4,936

- With net crude imports at just 2.17 MMbbl/d and net product exports at 2.795 MMbbl/d, the nation was a net petroleum exporter by 621 Mbbl/d

Total	-621

Table 1. U.S. Petroleum Balance Sheet, Week Ending 10/18/2019

Petroleum Stocks (Million Barrels)	Current Week 10/18/19	Week Ago 10/11/19	Week Ago Difference	Week Ago Percent Change	Year Ago 10/19/18	Year Ago Difference	Year Ago Percent Change
Crude Oil	1,075.5	1,078.2	-2.7	-0.3	1,079.3	-3.8	-0.3
Commercial (Excluding SPR)[1]	433.2	434.9	-1.7	-0.4	422.8	10.4	2.5
Strategic Petroleum Reserve (SPR)[2]	642.4	643.3	-1.0	-0.2	656.5	-14.1	-2.2
Total Motor Gasoline[3]	223.1	226.2	-3.1	-1.4	229.3	-6.2	-2.7
Reformulated	0.0	0.0	0.0	2.2	0.1	0.0	-9.8
Conventional	22.8	22.9	-0.2	-0.7	23.2	-0.4	-1.8
Blending Components	200.3	203.2	-2.9	-1.4	206.1	-5.8	-2.8
Fuel Ethanol	21.4	22.1	-0.7	-3.2	23.9	-2.5	-10.6
Kerosene-Type Jet Fuel	40.5	42.8	-2.3	-5.5	43.9	-3.4	-7.8
Distillate Fuel Oil[3]	120.8	123.5	-2.7	-2.2	130.4	-9.6	-7.4
15 ppm sulfur and Under[3]	105.2	108.1	-2.9	-2.6	114.9	-9.7	-8.4
> 15 ppm to 500 ppm sulfur	4.3	4.3	0.0	0.8	4.8	-0.5	-10.1
> 500 ppm sulfur	11.3	11.2	0.1	0.9	10.7	0.6	5.2
Residual Fuel Oil	28.1	28.6	-0.6	-2.0	29.2	-1.2	-4.0
Propane/Propylene	100.0	100.4	-0.5	-0.5	82.0	18.0	21.9
Other Oils[4]	310.9	308.3	2.6	0.8	293.5	17.4	5.9
Unfinished Oils	97.3	92.8	4.5	4.9	90.0	7.3	8.1
Total Stocks (Including SPR)[2,3]	1,920.1	1,930.2	-10.0	-0.5	1,911.5	8.7	0.5
Total Stocks (Excluding SPR)[3]	1,277.8	1,286.8	-9.0	-0.7	1,255.0	22.8	1.8

Petroleum Supply (Thousand Barrels per Day)	Current Week 10/18/19	Week Ago 10/11/19	Week Ago Difference	Year Ago 10/19/18	Year Ago Difference	Four-Week Averages Week Ending 10/18/19	Four-Week Averages Week Ending 10/19/18	Four-Week Averages Percent Change	Cumulative Daily Average 10/18/19	Cumulative Daily Average 10/19/18	Cumulative Daily Average Percent Change
Crude Oil Supply											
(1) **Domestic Production**[5]	12,600	12,600	0	10,900	1,700	12,550	11,025	13.8	12,190	10,663	14.3
(2) Alaska	485	485	0	473	12	481	485	-0.9	464	476	-2.5
(3) Lower 48	12,100	12,100	0	10,400	1,700	12,050	10,525	14.5	11,714	10,186	15.0
(4) **Net Imports (Including SPR)**	2,174	3,047	-873	5,498	-3,324	2,867	5,599	-48.8	4,020	6,077	-33.8
(5) Imports	5,857	6,295	-438	7,678	-1,821	6,167	7,664	-19.5	6,928	7,932	-12.7
(6) Commercial Crude Oil	5,857	6,295	-438	7,678	-1,821	6,167	7,664	-19.5	6,928	7,932	-12.7
(7) Imports by SPR	0	0	0	0	0	0	0	0.0	0	0	0.0
(8) Imports into SPR by Others	0	0	0	0	0	0	0	0.0	0	0	0.0
(9) Exports	3,683	3,248	435	2,180	1,503	3,300	2,065	59.8	2,908	1,855	56.7
(10) **Stock Change (+/build; -/draw)**	-385	1,145	-1,530	741	-1,126	398	831	--	-49	-23	--
(11) Commercial Stock Change	-242	1,326	-1,568	907	-1,149	486	957	--	-25	2	--
(12) SPR Stock Change	-143	-181	38	-165	22	-88	-126	--	-24	-25	--
(13) **Adjustment**[6]	706	933	-228	611	94	724	561	--	388	181	--
(14) **Crude Oil Input to Refineries**	15,865	15,436	429	16,268	-403	15,744	16,354	-3.7	16,647	16,944	-1.8
Other Supply											
(15) **Production**	6,830	6,777	53	6,590	239	6,821	6,576	3.7	6,897	6,382	8.1
(16) Natural Gas Plant Liquids[7]	4,679	4,679	0	4,411	268	4,707	4,390	7.2	4,674	4,125	13.3
(17) Renewable Fuels/Oxygenate Plant	1,099	1,074	25	1,096	3	1,070	1,099	-2.6	1,113	1,129	-1.4
(18) Fuel Ethanol	996	971	25	1,024	-28	972	1,023	-4.9	1,024	1,046	-2.1
(19) Other[8]	103	103	0	72	31	98	76	28.9	89	83	7.2
(20) Refinery Processing Gain	1,052	1,023	28	1,083	-32	1,043	1,088	-4.1	1,110	1,128	-1.6
(21) **Net Imports**[9]	-2,795	-3,078	283	-3,643	848	-2,916	-3,244	--	-2,818	-2,801	--
(22) Imports[9]	2,141	1,907	234	1,705	436	2,099	2,180	-3.7	2,277	2,237	1.8
(23) Exports[9]	4,936	4,985	-49	5,348	-412	5,015	5,424	-7.5	5,096	5,037	1.2
(24) **Stock Change (+/build; -/draw)**[3,10]	-1,046	-1,553	507	-2,048	1,002	-1,192	-449	--	122	109	--
(25) **Adjustment**[11]	218	218	0	227	-9	216	228	--	214	224	--
Products Supplied											
(26) **Total**[12]	21,164	20,905	259	21,491	-327	21,056	20,362	3.4	20,818	20,641	0.9
(27) Finished Motor Gasoline[13]	9,590	9,354	236	9,324	267	9,385	9,172	2.3	9,376	9,367	0.1
(28) Kerosene-Type Jet Fuel	2,088	1,613	475	1,765	323	1,808	1,709	5.8	1,769	1,742	1.5
(29) Distillate Fuel Oil	4,076	4,366	-289	4,006	70	4,109	4,076	0.8	4,011	4,049	-0.9
(30) Residual Fuel Oil	314	436	-122	170	144	332	352	-5.7	300	325	-7.7
(31) Propane/Propylene	1,277	1,053	224	1,408	-131	1,135	1,102	3.0	1,089	1,130	-3.6
(32) Other Oils[14]	3,818	4,083	-265	4,818	-1,000	4,286	3,952	8.5	4,273	4,028	6.1
Net Imports of Crude and Petroleum Products											
(33) Total	-621	-31	-590	1,855	-2,476	-49	2,355	-102.1	1,202	3,276	-63.3

Source: EIA with annotations by Stratas Advisors

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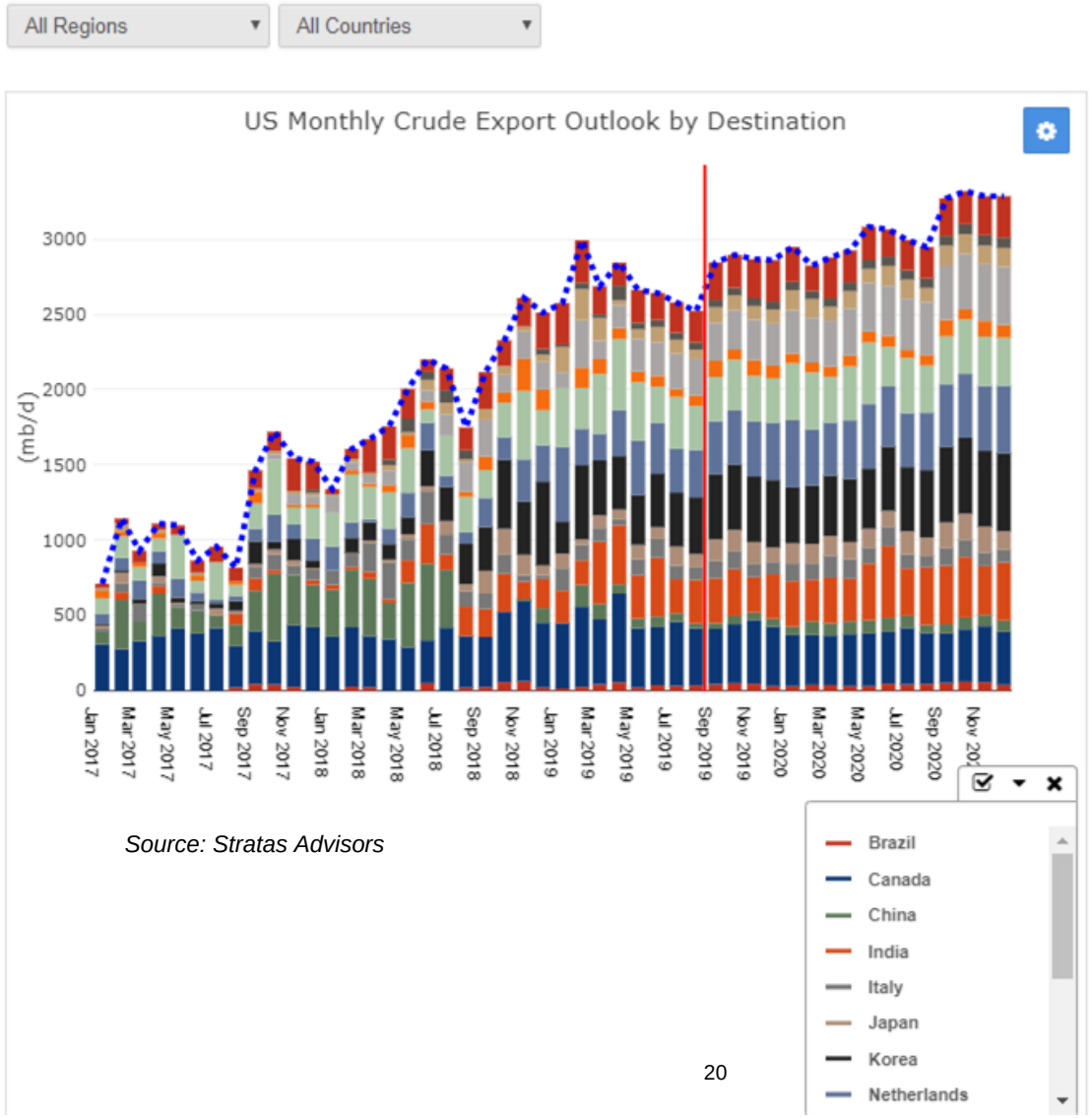
US Crude Export Growth Follows US Oil Production Growth

Producers need more market capacity than offered by the US (and Chinese) refining industry



Source: Stratas Advisors

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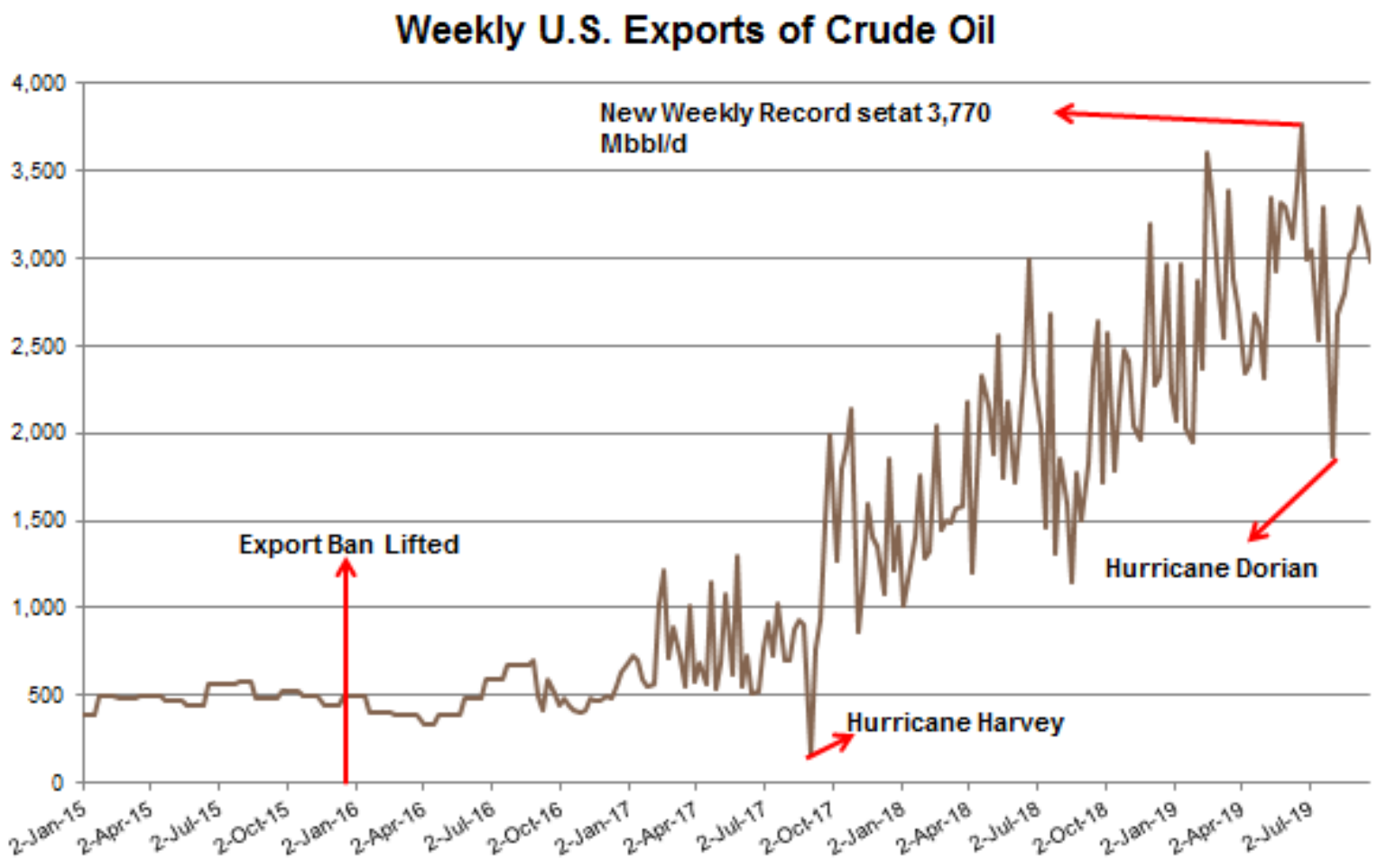
Inbound Crude Increasingly Exported via Gulf Coast Terminals



Source: EIA, Stratas Advisors

- With high utilization at existing refineries already happening, the crude heading to the coast has to likely go offshore
- Texas and other US refiner expansion projects (field skid units, Exxon Beaumont, Limetree Bay) may absorb up to 800 MMbbl/d of incremental production growth but that will be exceeded by light oil production growth
- The Gulf Coast has about 5 MMbbl/d of crude oil export capacity along its shores
- Traffic congestion in Houston Ship Channel and Corpus Christi will limit exports. Combined the two regions have about 62% or 3.1 MMbbl/d of export capacity
- Deepwater exports are needed, but not all those proposed!

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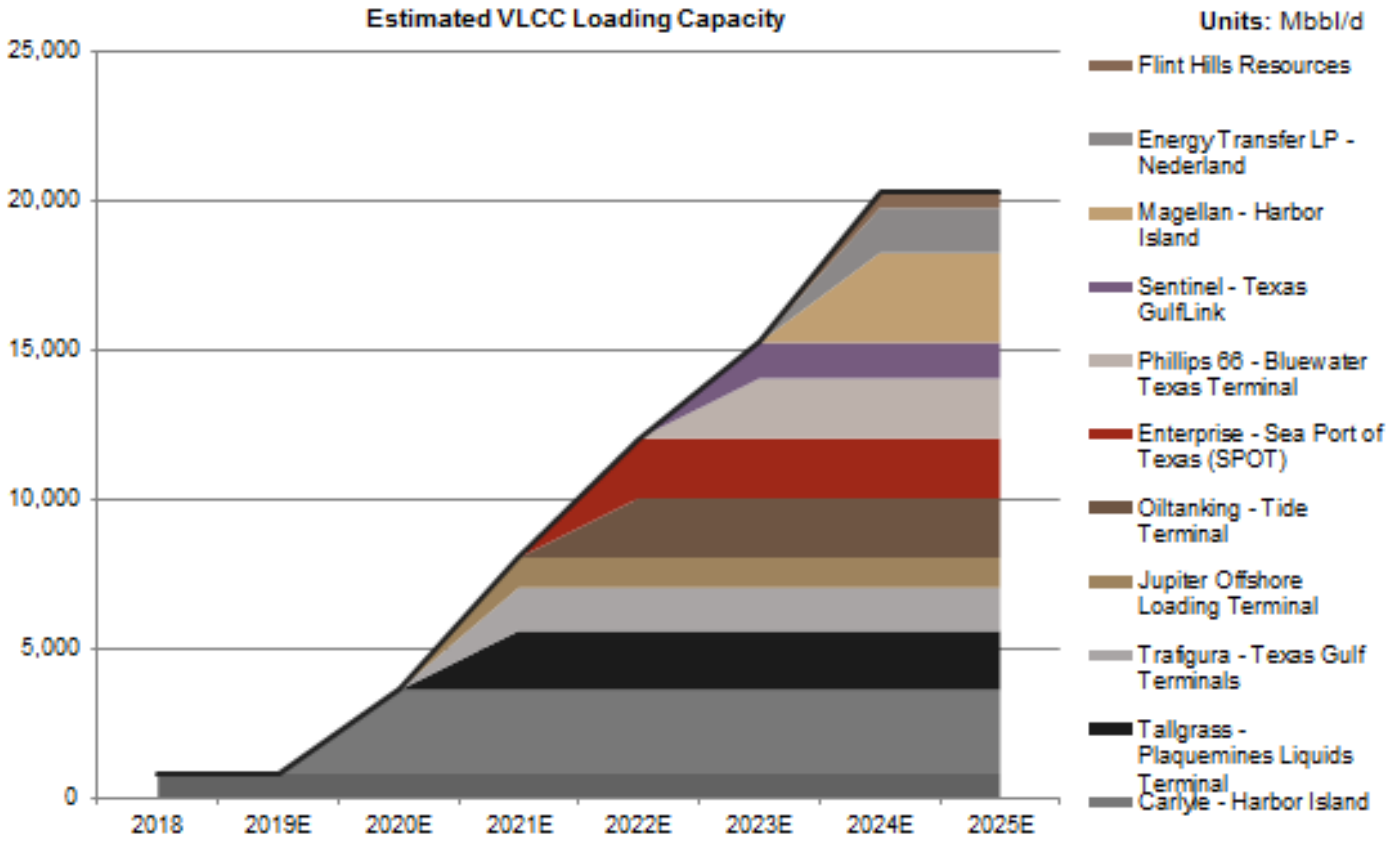
Excessive Plans for VLCC Export Terminals – 11 in Development



Source: Stratas Advisors, company information

- Currently only one terminal, the LOOP, can fully load VLCC exports
- A VLCC can carry up to 2 MMbbl of crude oil in one shipment
- If all projects come online, the Gulf Coast region will have more than 20 MMbbl/d of VLCC loading capacity by 2024
- This will greatly exceed expected exports and even current U.S. crude oil production
- We expect only two to three projects to come online

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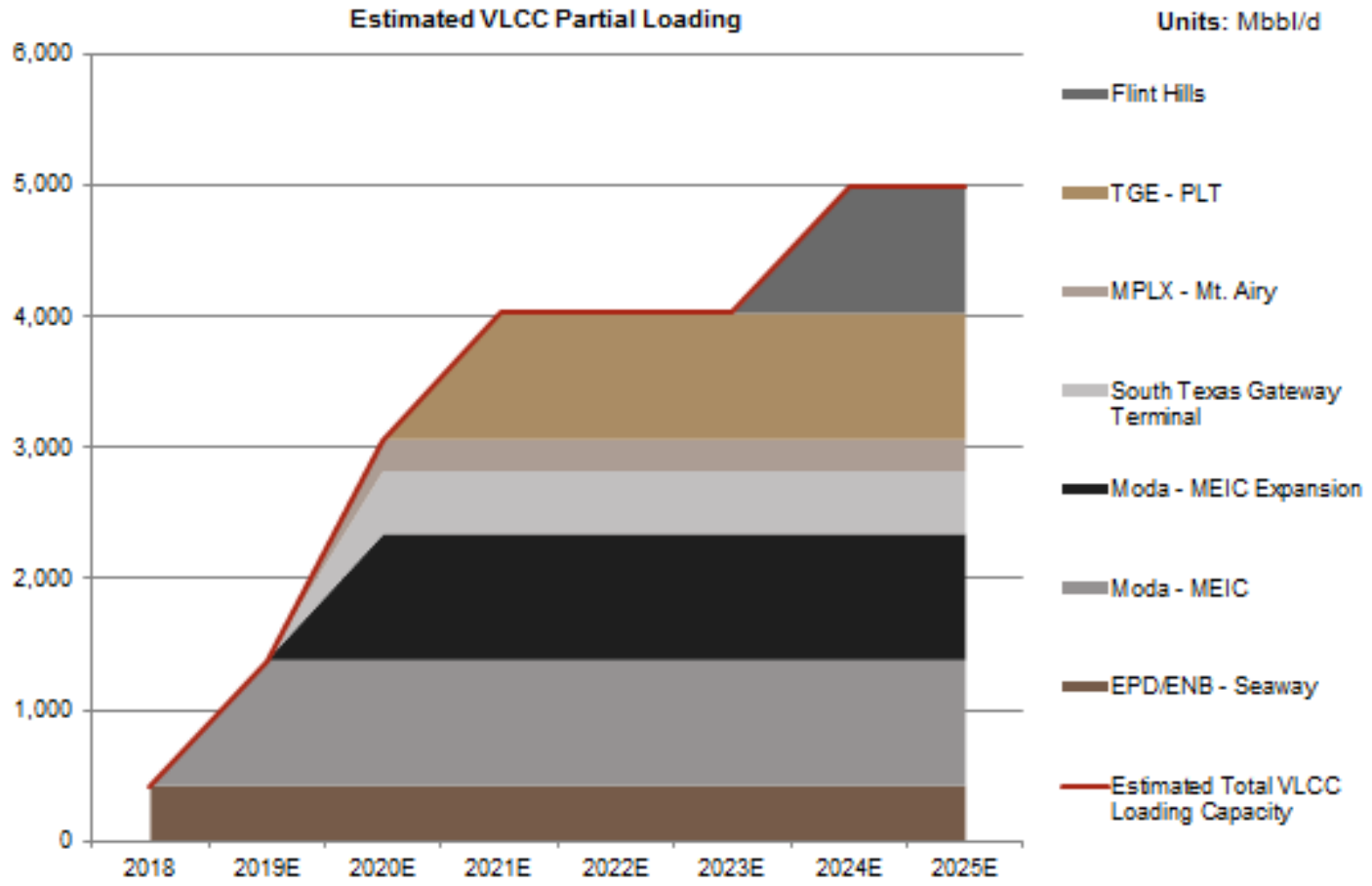
Six Gulf Coast Medium Size Crude Export Terminals



Source: Stratas Advisors, company information

- If all projects are constructed, partial loading terminals would have a 4,980 Mbbl/d loading capacity
- This would still require reverse lightering in transshipment zones
- We believe that the partial loading terminals could be utilized for petroleum product exports due to the possibility of being under-utilized once a cheaper alternative like fully loading VLCC terminals come online.

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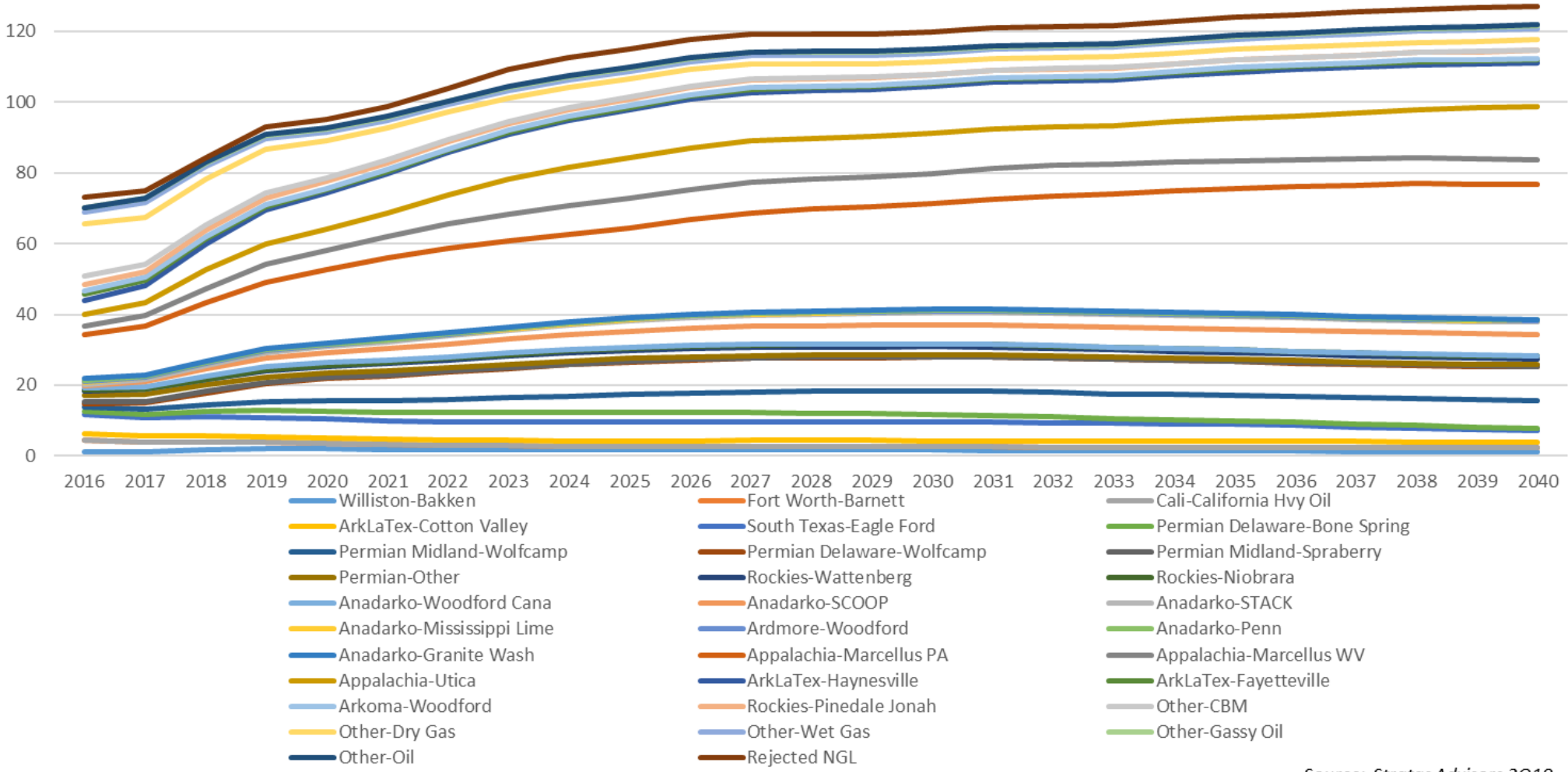
Lower 48 Onshore Residue Gas to Soon Top 100 bcf/d

Incentivized to spend to grow, much of the upstream does despite decaying prices…capital markets changing this



Source: Stratas Advisors 2Q19

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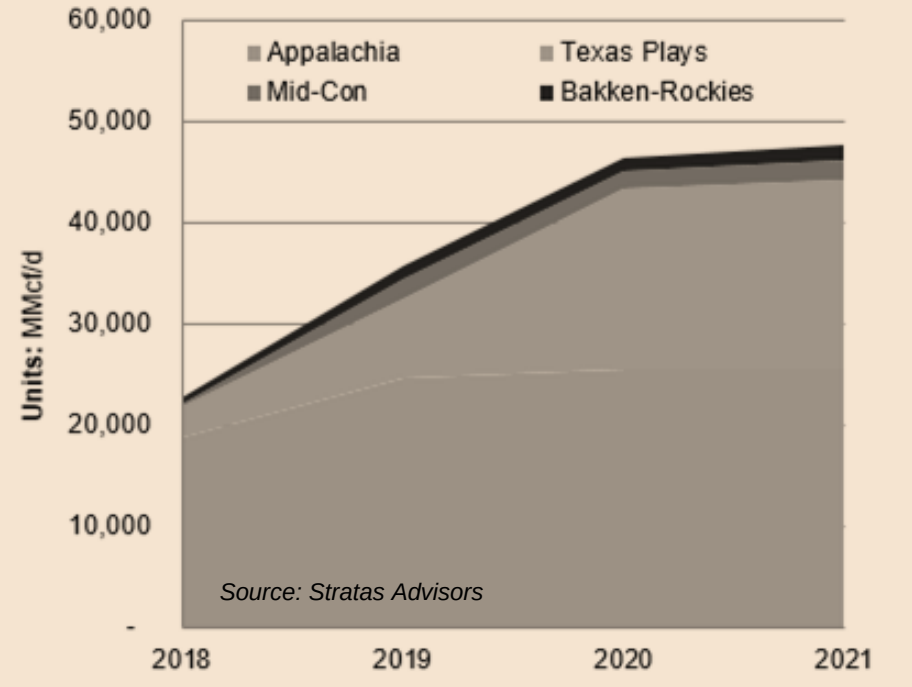
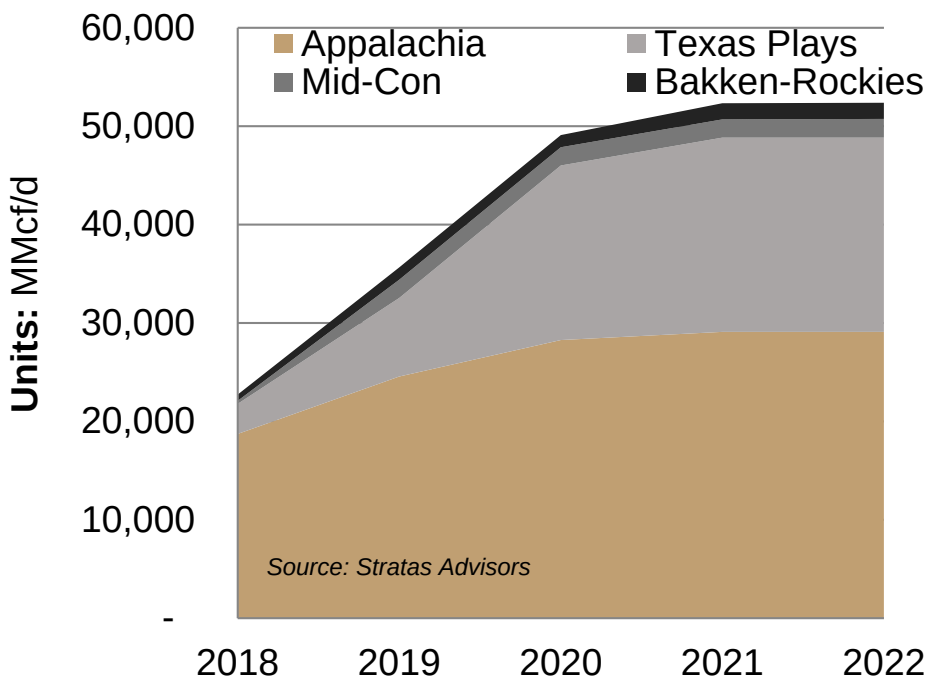
Midstream Drivers: Forecast of US Gas Takeaway Expansions





- Last year, we saw 2020 having 10.8 bcf/d of pipeline expansion followed by 1.4 bcf/d in 2021
- This year, we see a front loading of expansions in 2020 by 13.5 bcf/d then a 2021 increase of 0.8 bcf/d
- We are now initiating 2022 with takeaway from these plays flat with the prior year

Source: Stratas Advisors North American Shale Infrastructure Service

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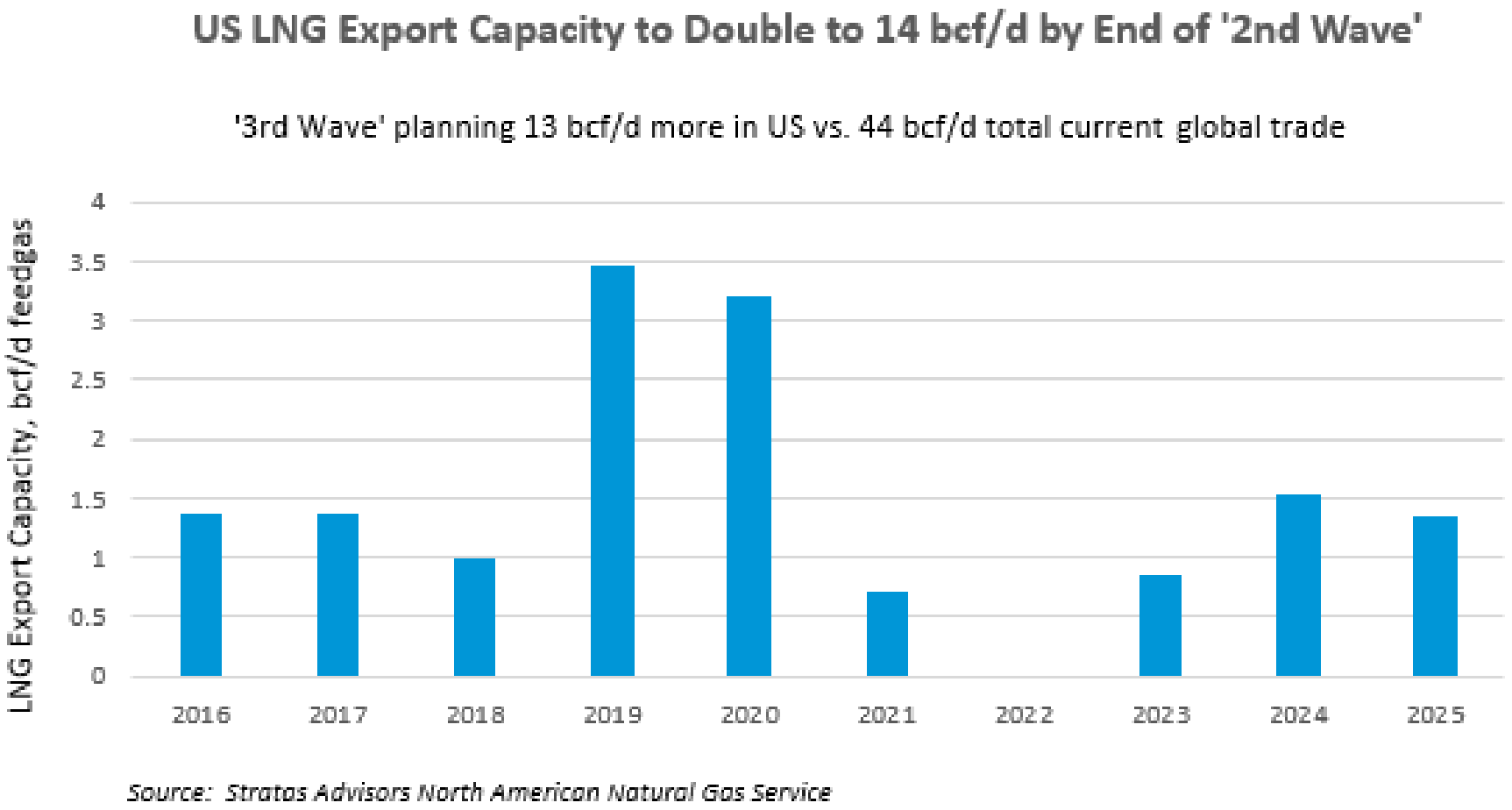
US LNG Supercycle

May be too much of a good thing…. FIDs and groundbreakings are crawling along given slow global uptake



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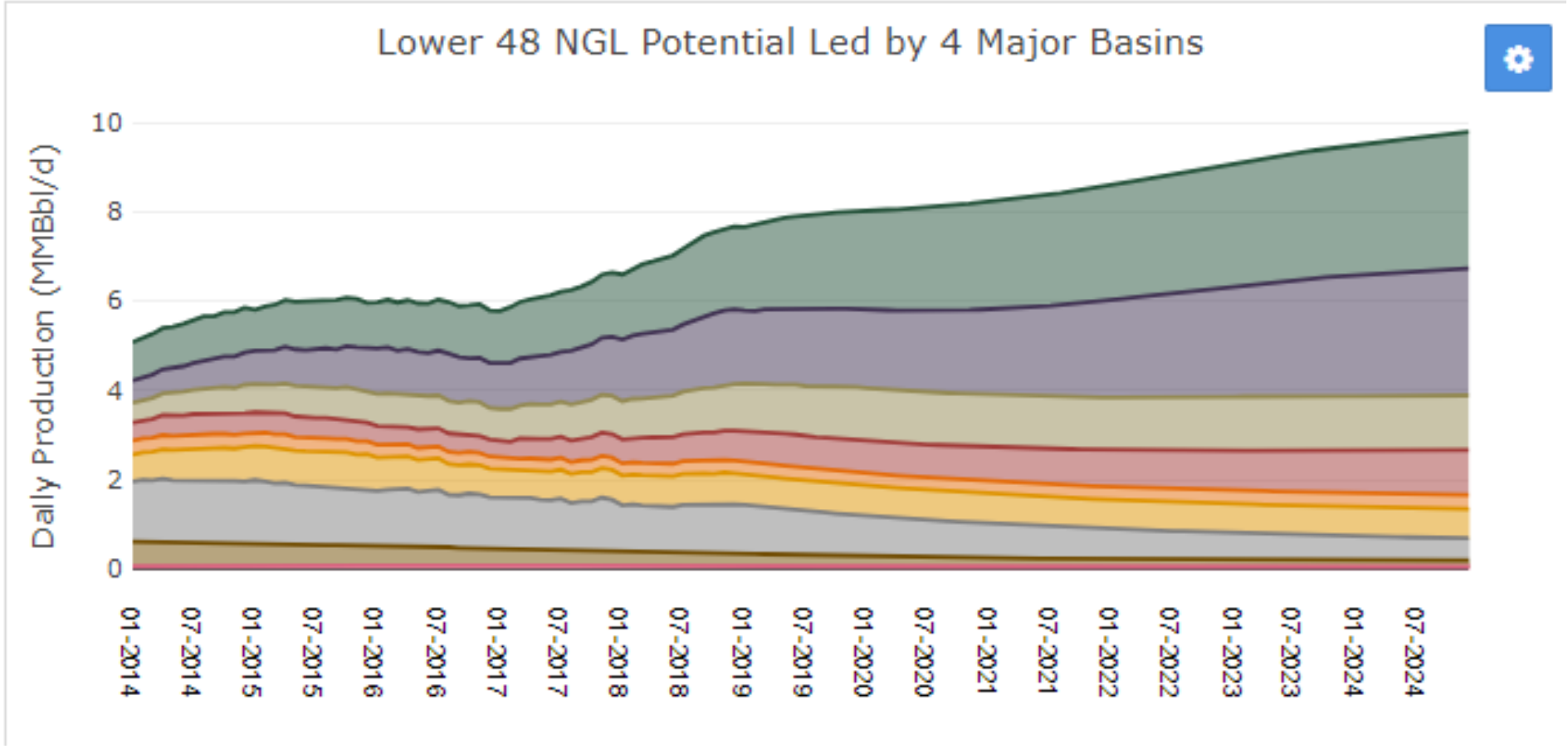
U.S. Field Supply of Potentially Recoverable NGL Still Growing

Key Producing Regions are Texas, Oklahoma, Rockies and Appalachia



Source: Stratas Advisors NGL Service

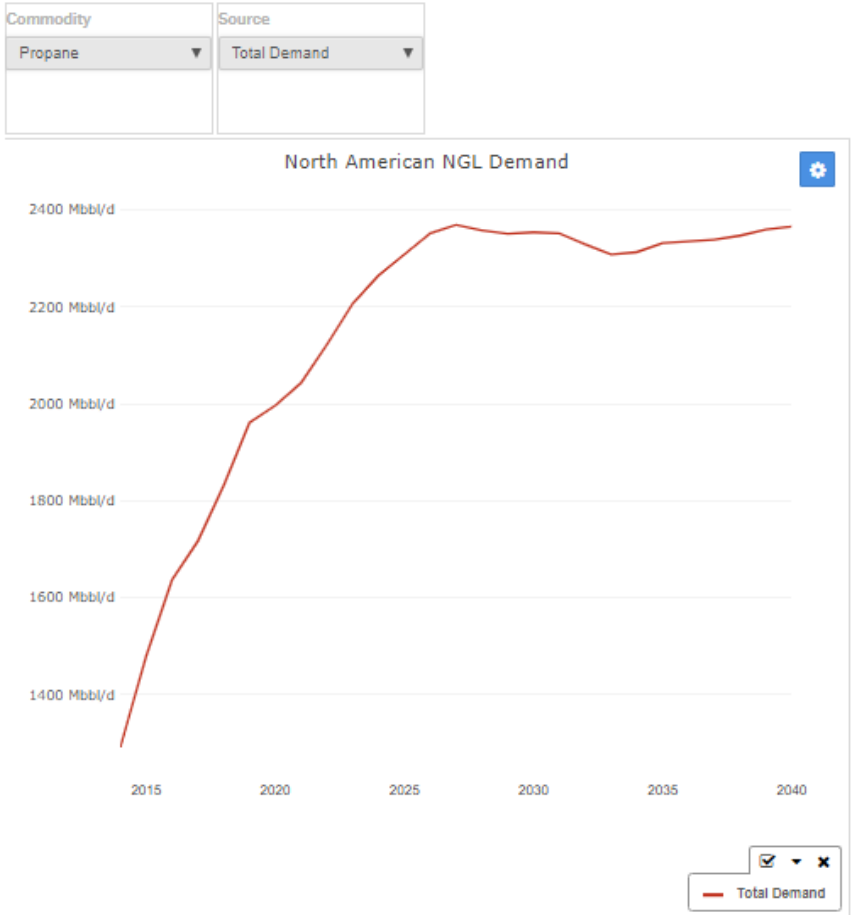
This year we raised our estimates of potential NGL production to nearly 9.8 MMbbl 5 years from now

But we cut our recovered NGL forecasts by 5%.... Meaning, rejection has expanded.

Rejection means too much NGL is being produced to make it to market profitably

Petrochemicals & Exports Drive US Propane Demand Growth

Over this decade, the US emerged as a net exporter of commodities ranging from the lightest gas to the lightest crudes



Source: Stratas Advisors TEXIS Service

Not many industries use significant quantities of U.S. propane

A primary growth driver is petrochemical manufacturing which uses propane as a feedstock in dehydrogenation plants and crackers that produce propylene. We see about 75 Mbbl/d of propane petchem use between 2018 and 2022.

An even larger demand comes from overseas importers. The exportation of US propane is set to grow by 425 Mbbl/d by 2022.

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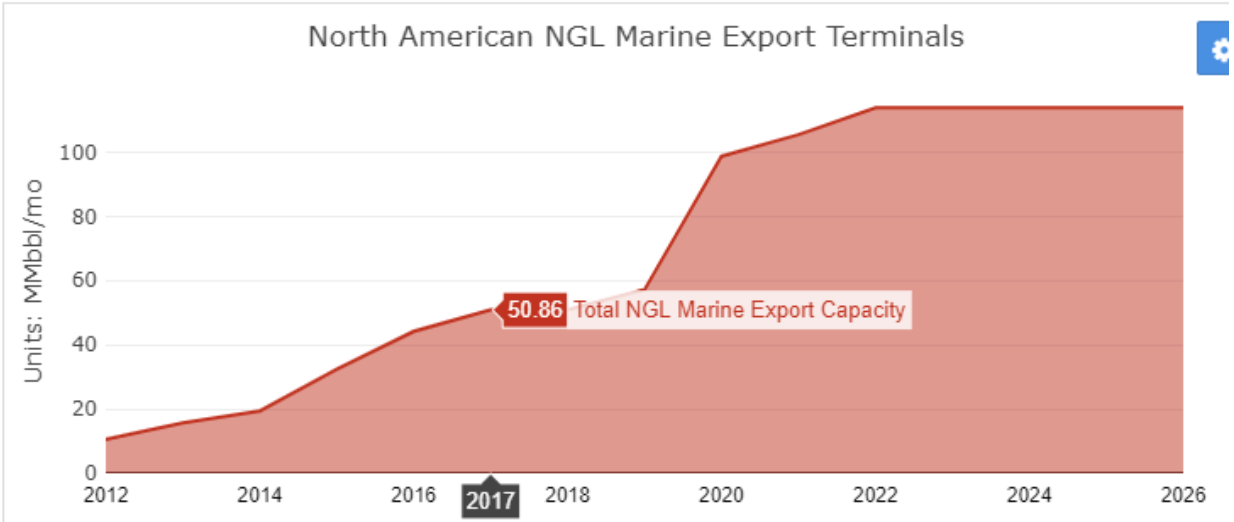
US ~~Now~~ *Must Remain* Net Exporter of NGL

The shale revolution would not have happened without unregulated ability to export excess propane NGL

New and Planned NGL Export Projects

Export Facility Type: Total NGL Export Capacity

Region:



	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Total NGL Marine Export Capacity	10.50	15.65	19.39	32.39	44.17	50.86	50.86	57.30	98.70	105.45	113.78	113.78	113.78	113.78

Source: Stratas Advisors TEXIS Service

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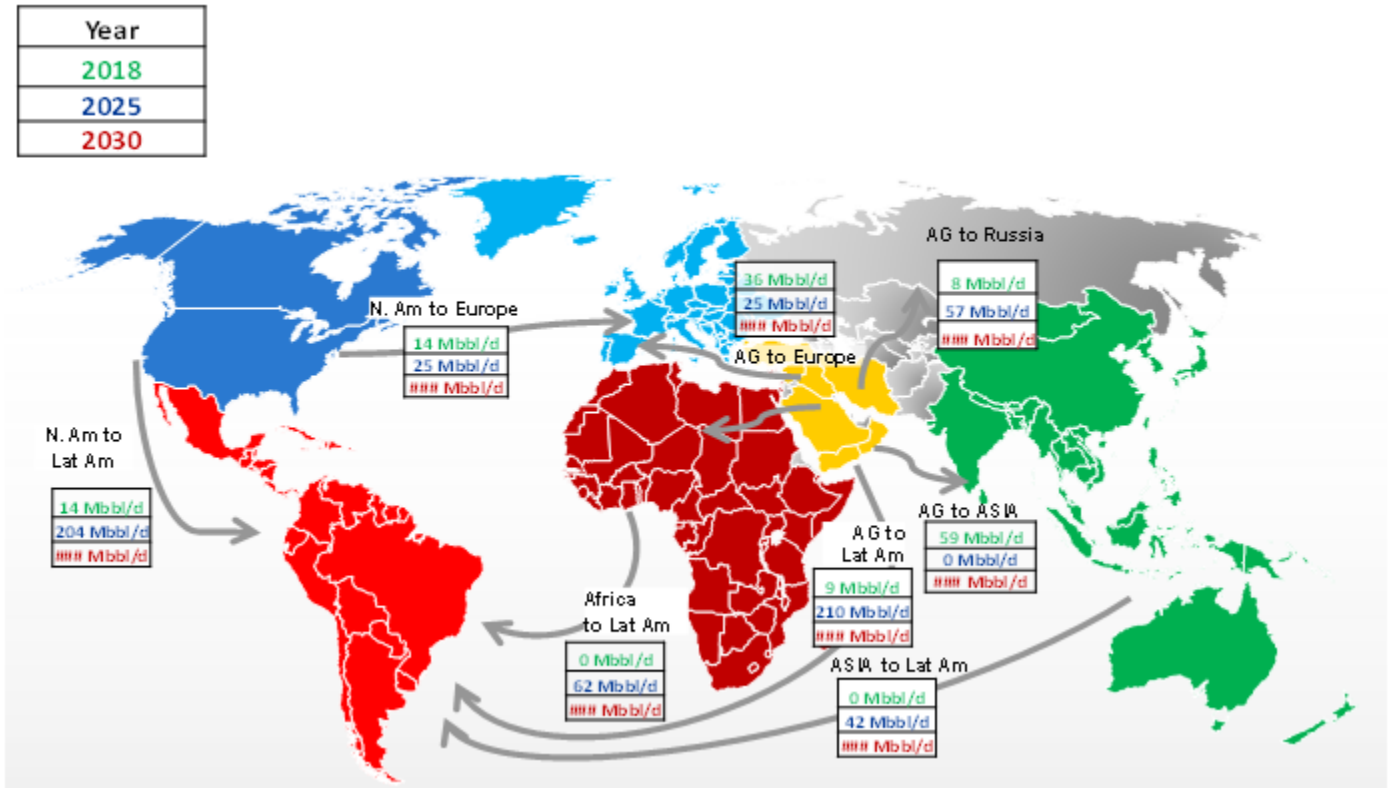
Produce NGL Local, Market Global

Our forecasts of trade flows within the Global NGL Service shows that the key producing nations are not necessarily key exporting nations.

Significant NGL supply growth in certain nations will be met with significant in-border demand growth.

Ethane to remain stranded (rejected) since most difficult to move, unload, and utilize



Source: Stratas Advisors Global NGL Service

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Gray Swans

A Menagerie of Likely Swans

Key Discussion Points

In a grey zone, these risks are not exactly a sure thing, but not exactly unexpected either

- OPEC and Middle East risks
- Trade and global economic risks
- Alternative Threats to the Natural Gas Thesis
- Higher Uncertainty, Lower Investability

OPEC Risk a Toss Up Between Bulls and Bears?

If tanker takings and export plant attacks don't cause long term upside, what will?

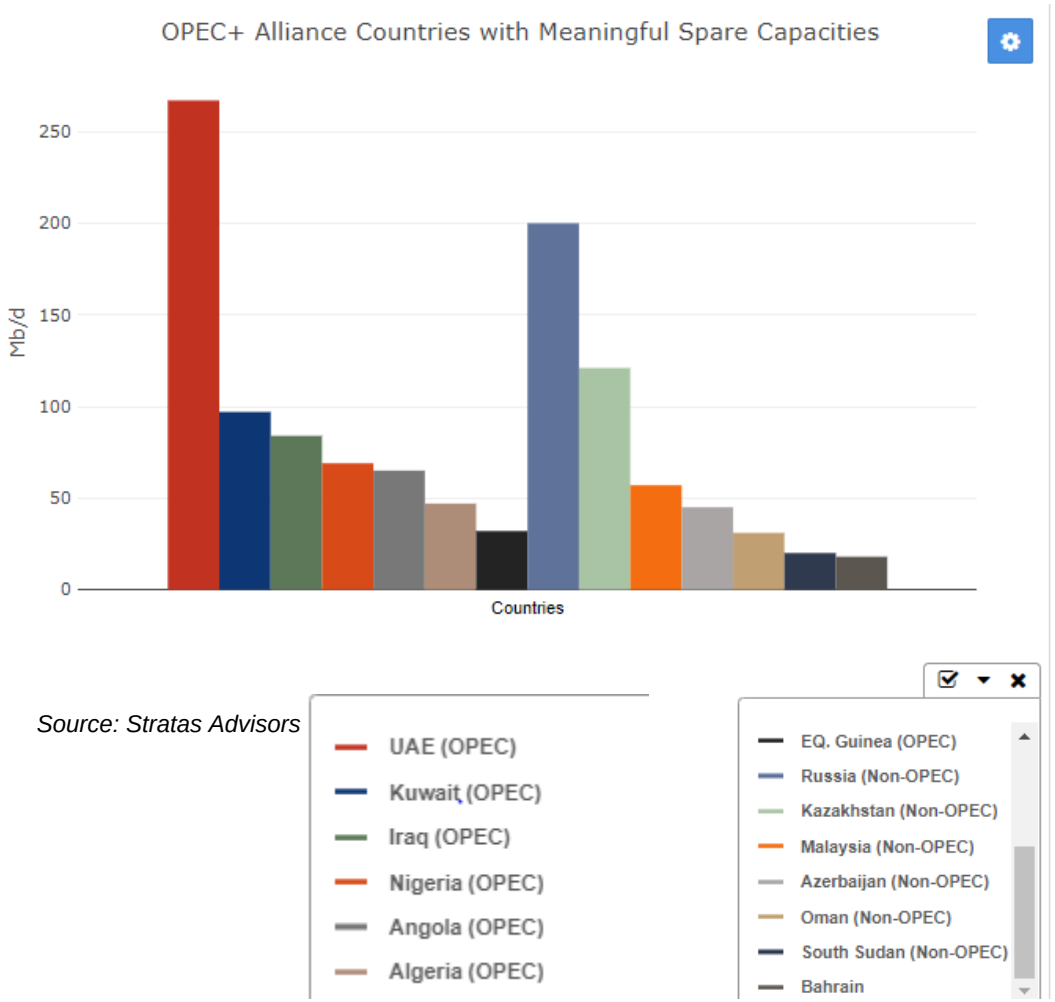
Bullish Risks – Supply oriented

- OPEC over-compliance
  - Likely would be caused by outages
- Disruptions in Strait of Hormuz
- Sanctions against Iran
- Outages possible in Libya, Nigeria, Algeria
- Declines in Venezuela

Bearish Risks – Demand oriented

- OPEC under-compliance
- OPEC follows through with current schedule
- Will Aramco IPO materially add to coffers?
- OPEC Makes only meager adjustments
  - Market could sell the fact after buying the rumors of longer or deeper curtailments

OPEC+ Have Finite Spare Capacity



Source: Stratas Advisors

About 900 Mbbl/d of crude production could be brought online if needed, in the OPEC and Alliance countries according to our analysis

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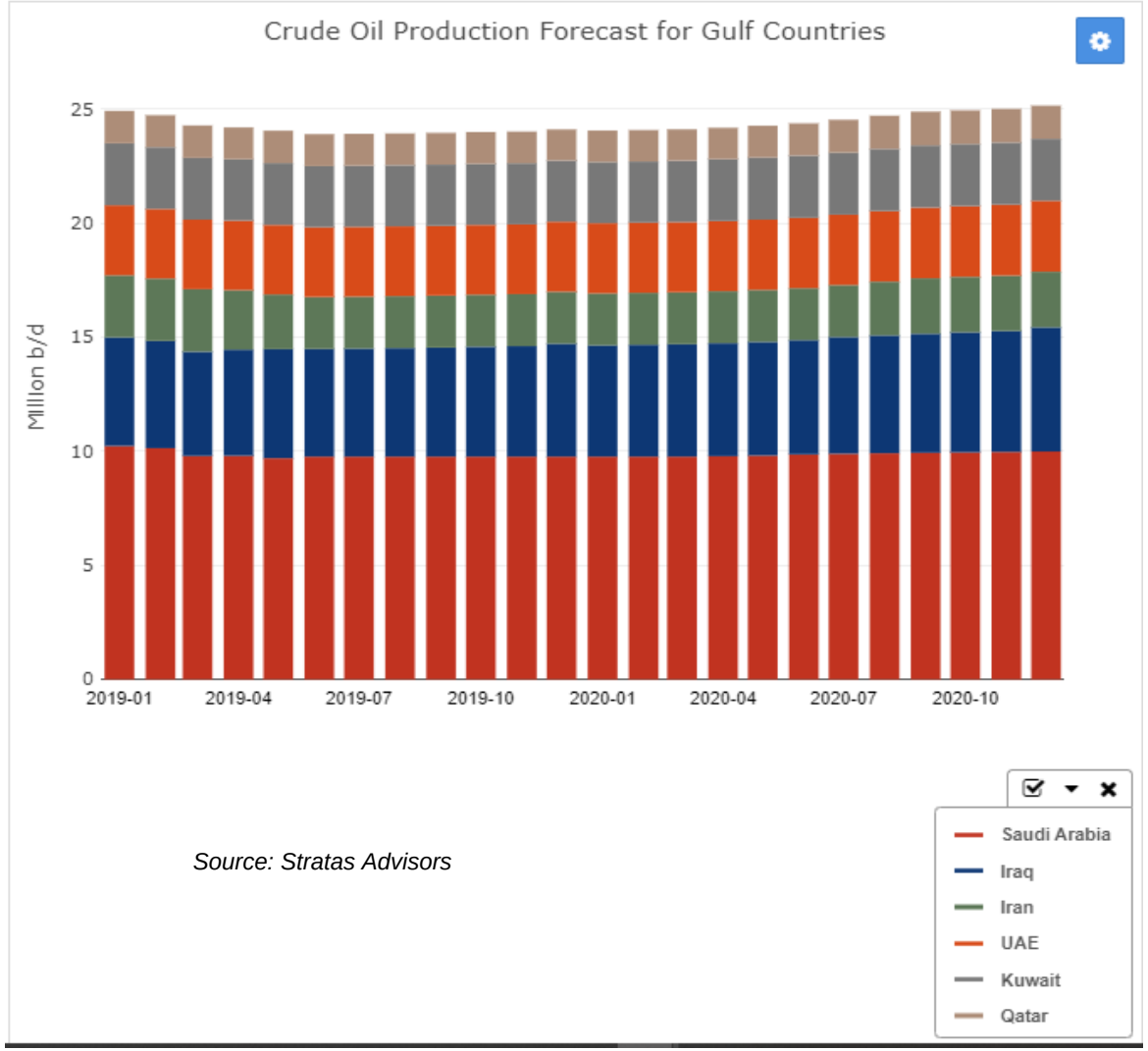
Mid East Crude Output Growth Certainly Possible



Source: Stratas Advisors

Main options to grow Middle East crude production come from Iraq and Saudi Arabia

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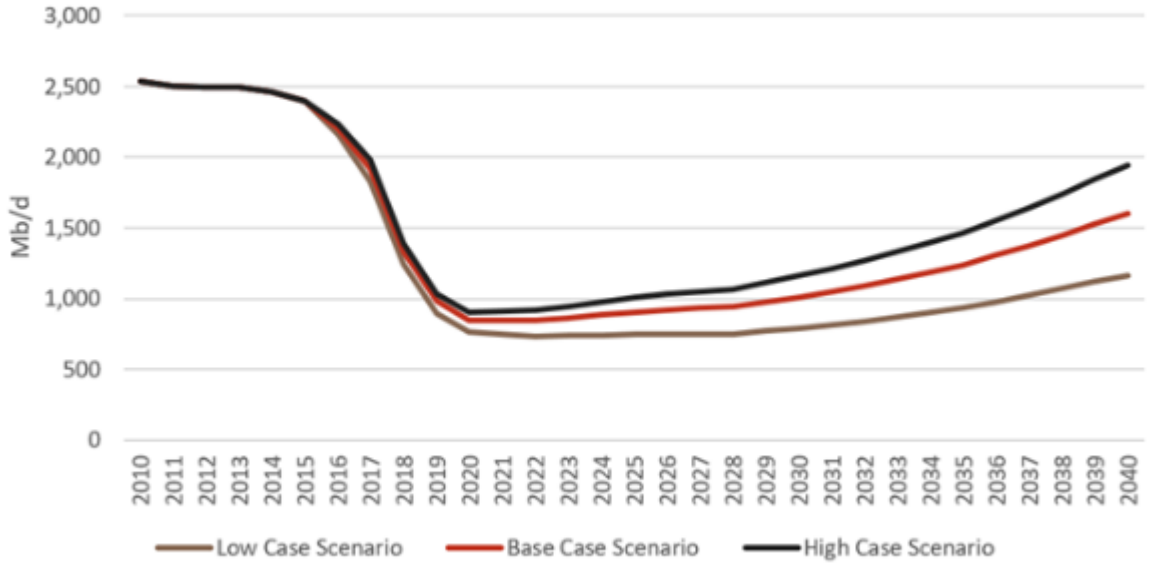
Venezuelan Crude Production

We expect output to be down and out for some time

Figure 4 Venezuela Crude Oil Production Outlook



Source: Stratas Advisors

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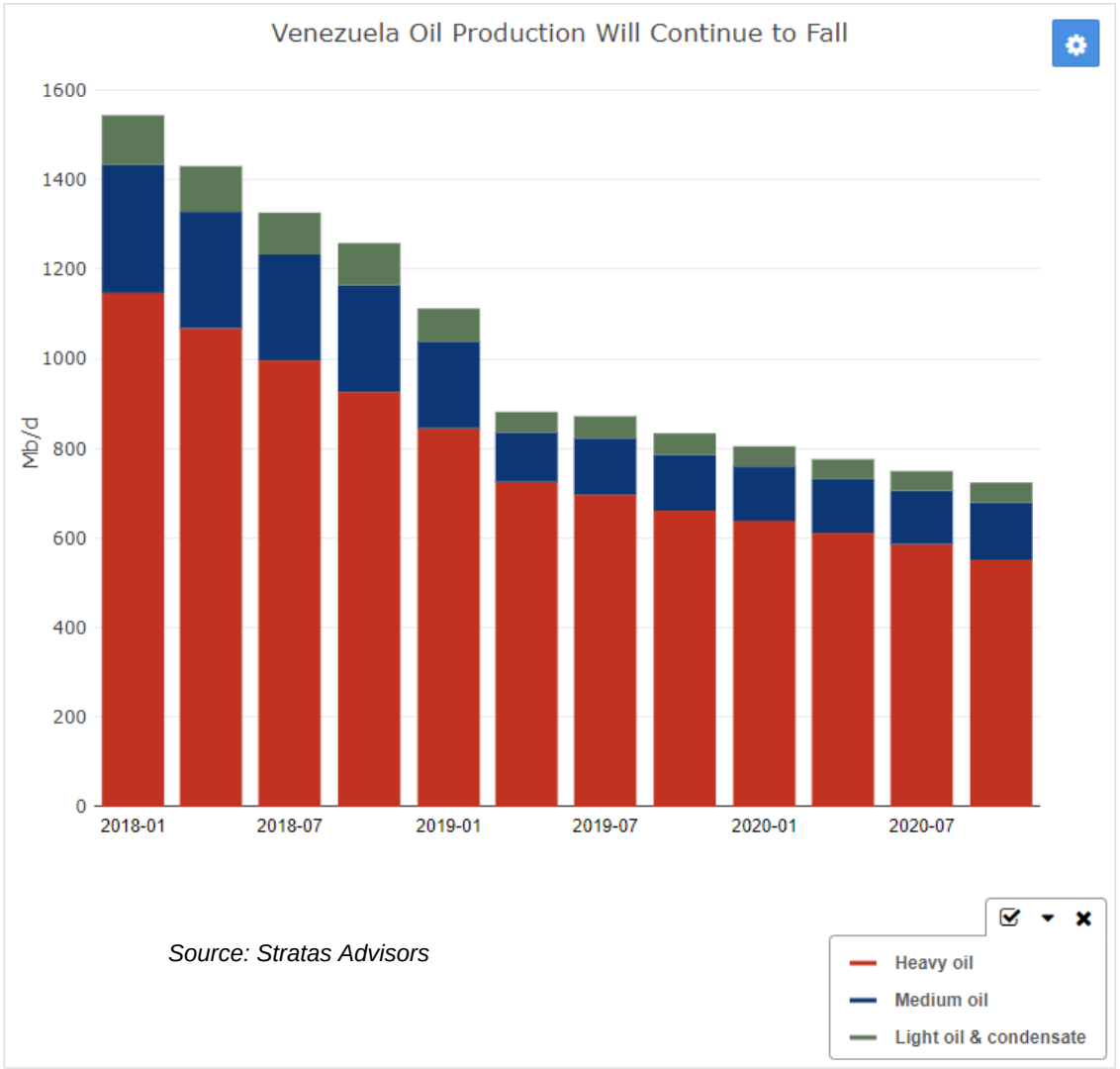
Venezuelan Heavy Oil Was Most Sought and Now Most at Risk



Source: Stratas Advisors

Dispersed workforce and economic ruin means heavy oil output has nowhere but down in the near term

Edit View

Source: Stratas Advisors

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Global Economic Risks Swinging to the Downside?

Persistent fears about demand are muting the impact of everything

Bullish Risks – Supply oriented

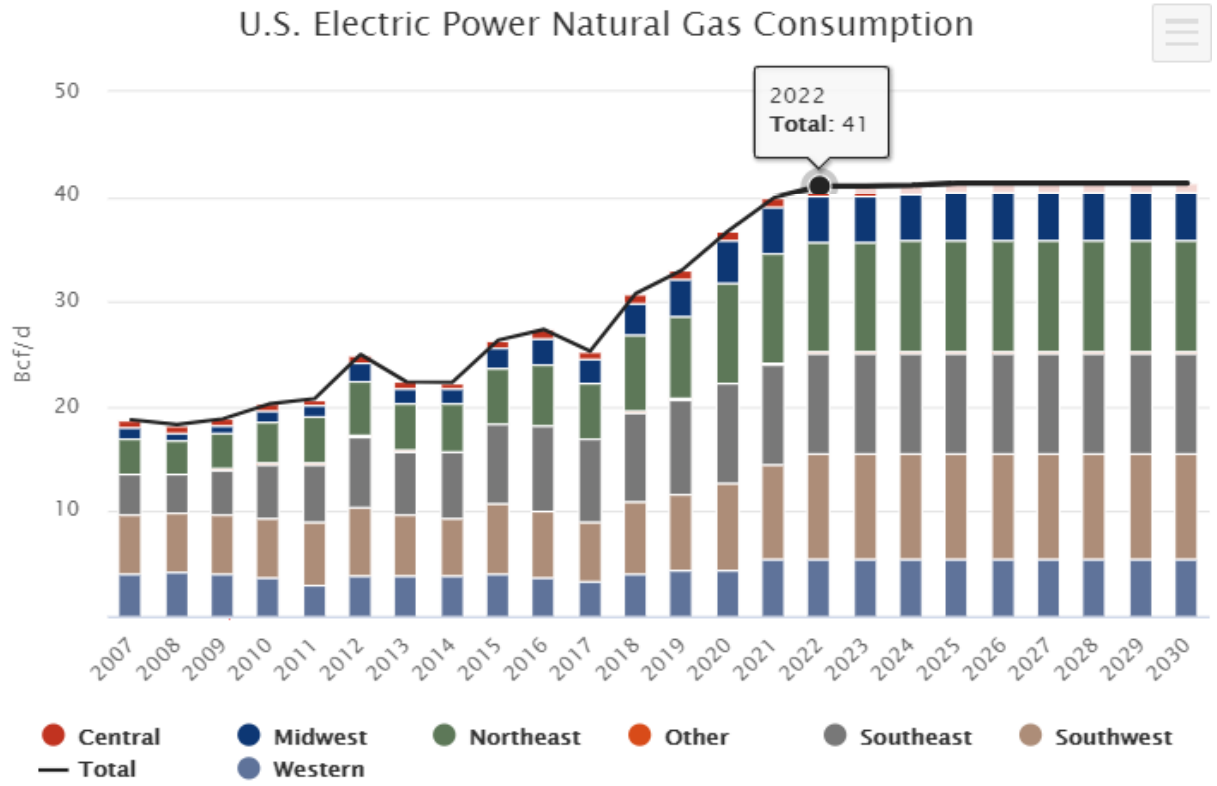
- Strong US consumer demand
- Surprise trade deal between US and China

Bearish Risks – Demand oriented

- Global recession
- US-China trade war drags on
- IMO 2020 costs may be more than expected
- Oversupply of refined products
  - Appearing in Asia
- Oversupply of crude on US production growth
- Hedge funds continue cutting bullish positions

Will Natural Gas Become the New Coal?

New gas fired generators now must compete for share against zero-fuel cost renewables



Source: Stratas Advisors

- The power buildout of gas fired generation is slowing and underperforming our prior forecasts
- The 41.7 bcf/d of new gas projects we anticipated to come online by 2021 is not going to be met

We see just 41 bcf/d in 2022 and 41.5 bcf/d in 2025

Solar and Wind generation taking significant share from all other generation types including “clean” natural gas

Biogas will be another threat to the sustainability of U.S. shale gas

Next threat will be hydrogen electrolyzed from excess renewable power and stored long term as gas in the gas pipeline grid

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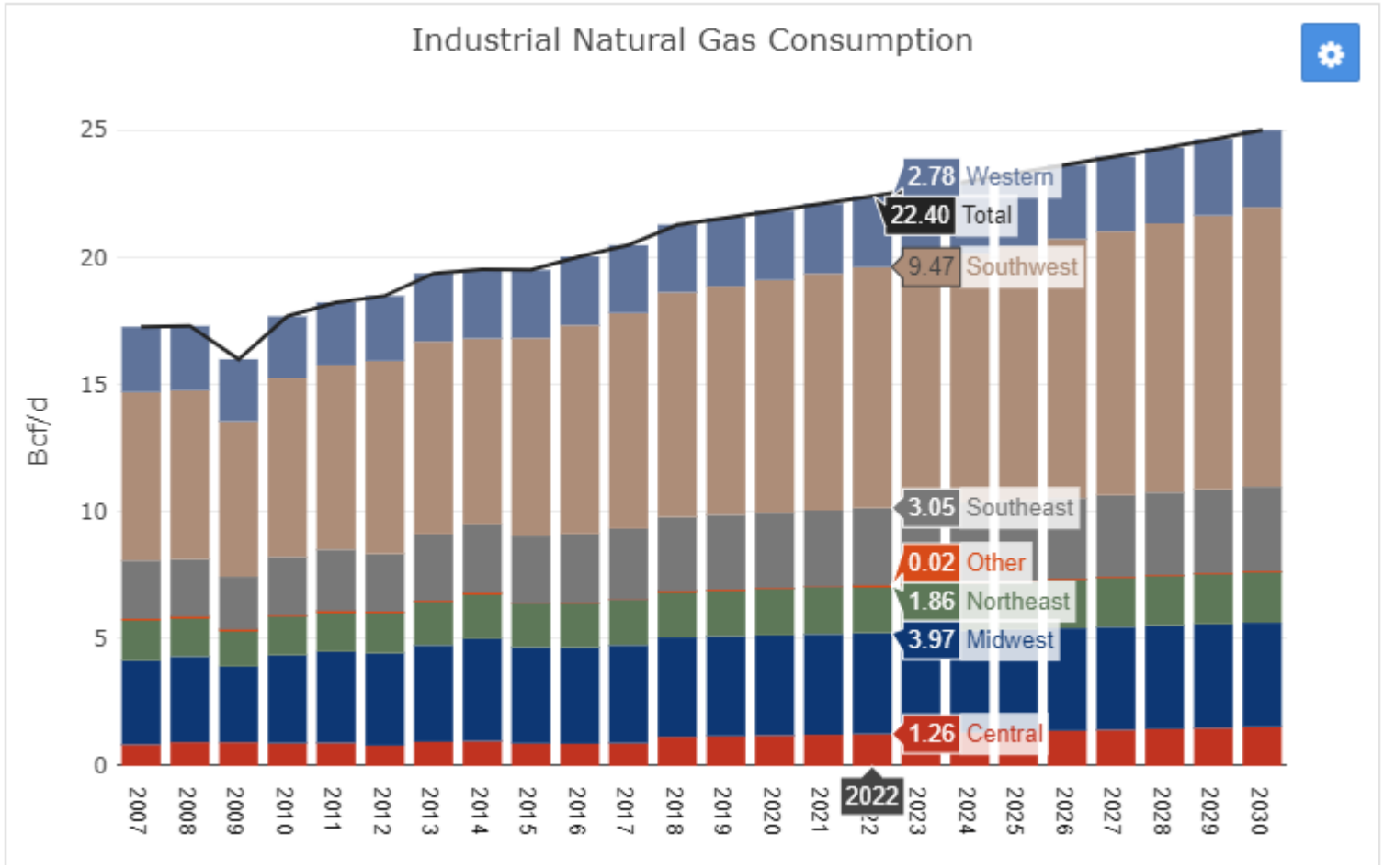
Poor US Gas Demand Impacting US Crude Supply Economics

Worker availability and complexity and overall economic uncertainty slowing industrial demand for gas



Source: Stratas Advisors

- We see slower demand across the world for a variety of internationally traded commodities.
- We see lower demand holding back utilization in existing assets and operations that are gas intensive (industries such as fertilizer, steel, chemicals, and more)
- Furthermore, we have taken down our forecasts for new projects out into the future. We now see just 5.6 bcf/d of new gas consuming projects being completed by 2022. That's down from 7.9 bcf/d.
- We downwardly revised estimates for 2019 gas consumption at existing industrial plants to just 0.3 bcf/d from last year's forecast of 0..35 bcf/d
- We expect the Gulf Coast to host most of the growth. We see this region as advantaged by plentiful gas and ready dock space for exporting in bulk

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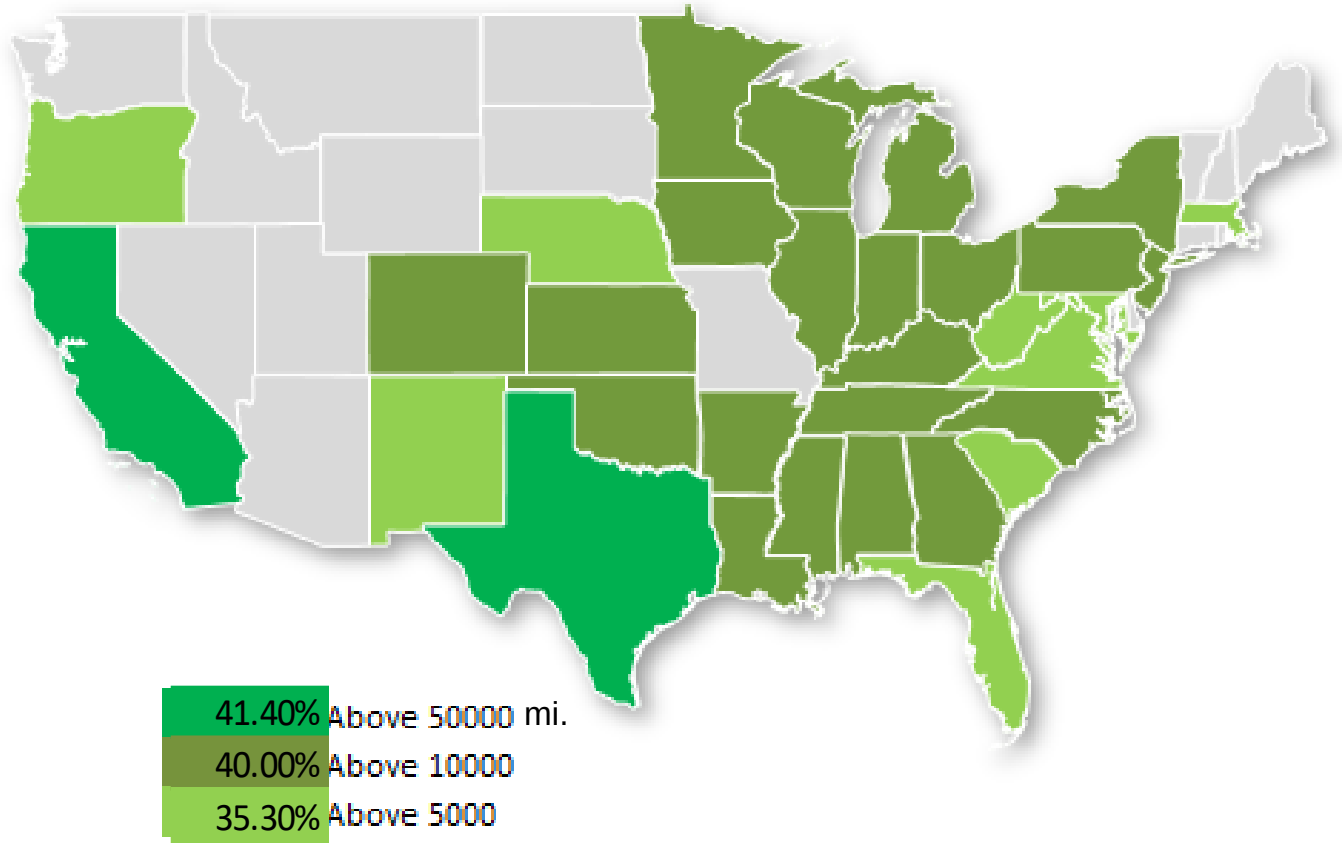
No Country for Old Pipelines

Does industry and society have cash and will to replace aging gas pipelines today?



Source: Stratas Advisors North American Natural Gas Service

- Significant portions of the U.S. gas pipeline transmission and distribution assets went into service before 1970
- More than 70,000 miles highly aged
- In two of the most populous and energy consuming states, 42% of the pipeline network is pre-70's.

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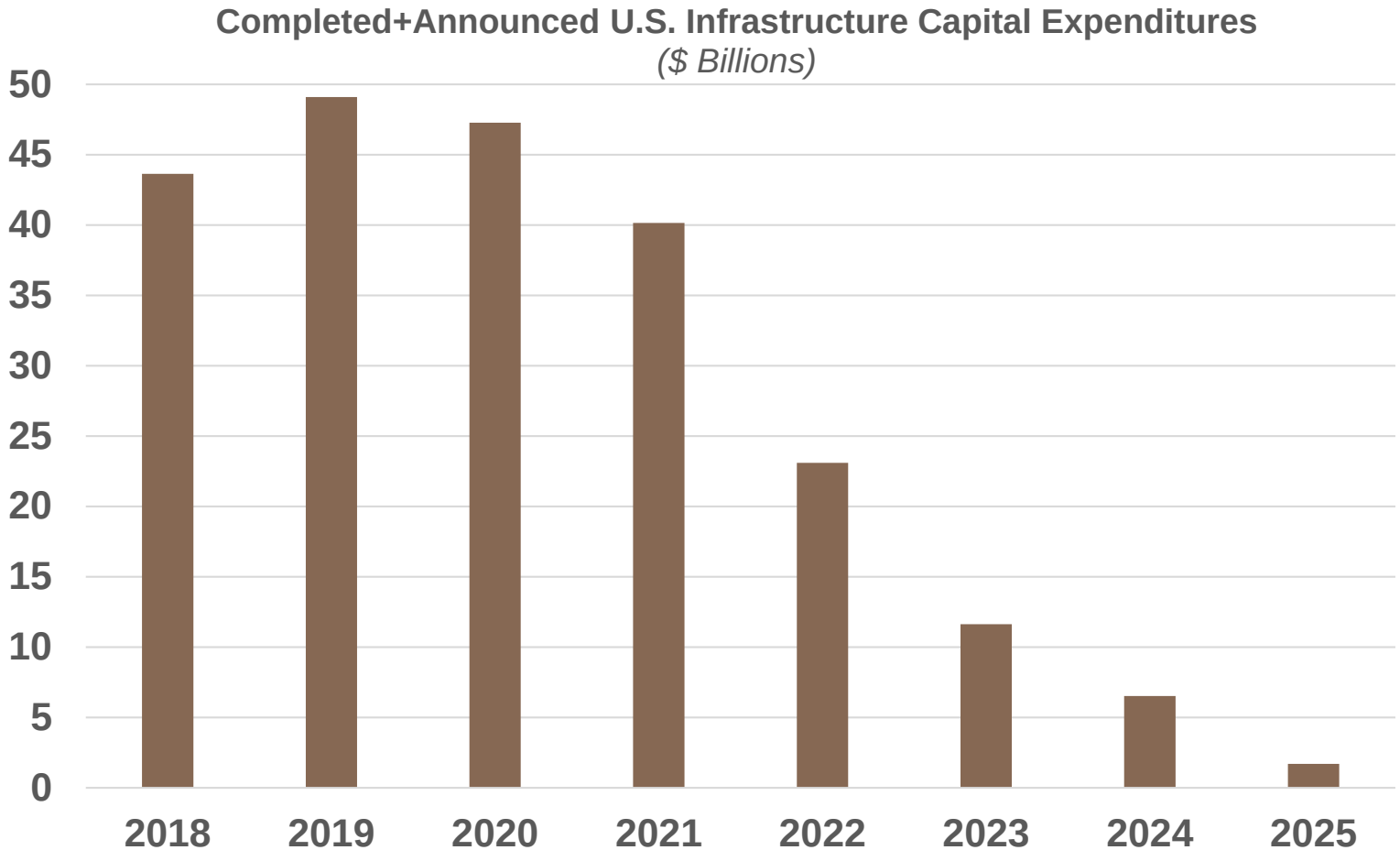
Low Prices and Energy Investment

Energy sector capital investment hindered by poor demand visibility, strong supply competition



Source: Stratas Advisors North American Shale Infrastructure Service

- The "2nd wave" of energy infrastructure may just be a slow ripple
- Field bottlenecks accompanying US shale boom are effectively being alleviated but now demand needs to be uncorked here or globally to keep chain
- 2018's energy builds were delayed by weather into 2019
- We expect 2020 energy investment to be below 2019's peak
- FID's have been slow in coming, and that influences 2022 and forward
- LNG may be glutted until mid-decade
- Too many crude export terminals on the project rolls….will need to combine/cancel

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Key Takeaways

Key Takeaways

- Field petroleum production supply growth will continue under *Shale 3.0* era but at a slower pace
- Petroleum demand growth exists (mainly in NGLs for petchem)
- Monetizing US output to increasingly rely on logistics aimed for export markets
- Low prices & poor visibility/investability to slow logistics investment
- While OPEC has spare capacity, we expect renewals of cuts in future meetings
- Global economic energy demand could weaken
- Biogas and renewable H2 will begin challenging natural gas & the entire US shale oil/gas sector

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