Accessible version
BofA GLOBAL RESEARCH

BofA SECURITIES

Global Energy Weekly

Petchem doom doesn't mean NGL gloom

07 December 2023

Commodities
Global

Global Commodity Research
BofA Europe (Madrid)

Warren Russell, CFA
Commodity Strategist
BofAS
+1 646 855 5211

Rachel Wiser
Commodity Strategist
BofAS
+1 646 743 4069

Francisco Blanch
Commodity & Deriv Strategist
BofA Europe (Madrid)
+34 91 514 3070

Michael Widmer
Commodity Strategist
MLI (UK)
+44 20 7996 0694

NGL supply to slow in 2024 and prices may find support...

The US NGL market experienced a volatile year in 2023, marked by periods of soft demand, soaring supplies, weak pricing, and fractionation and processing issues. Domestic NGL supply growth should average ~450k b/d YoY in 2023, before slowing down to 230k b/d in 2024 as activity adjusts to lower prices. Downstream, we see fractionation capacity growth of about 255k b/d YoY but no notable export capacity growth next year. Stagnant export capacity and rising output may weigh on spreads between US and NWE and Asian NGL prices, especially if supply exceeds expectations.

...even though petchem margins will likely remain weak...

The petrochemical sector, which consumes more than 40% of NGL supply, struggled this year under the weight soft demand and rising capacity, with Asian PE and PP margins trending near zero and margins in Europe and the US steadily compressing. Plastics demand growth slowed since mid-2022 as consumer spending shifted from goods to services, while production capacity grew at a rapid pace. Historically PE and PP demand growth have tracked GDP, but PE and PP capacity growth averaged >5% YoY during 2020-23. In 2024, PE capacity growth should slow meaningfully to roughly 2%, while PP capacity growth stays elevated near 6% YoY, possibly extending rebalancing efforts.

...if feedstock demand accelerates on a goods turnaround

US propane and ethane face short term price pressure from warm weather, which hurts res/com demand and from Panama Canal constraints, which are a headwind to exports (see Hot takes on winter heating season). These dynamics may keep pressure on prices into 2024. However, manufacturing activity and related plastic usage, could boost NGL demand growth as supply growth slows. Cracker and PDH capacity, which has been a constraint previously, is now ample and ready respond to a turnaround in goods demand. China's PDH run rates are low around 60% and could quickly absorb another 200-300k b/d of propane supply next year if goods restocking or a demand turnaround occurs (see Rates, recession, and restocking are the keys to energy and China stops destocking).

Acronyms see Exhibit 35 page 14

Recycling projects insufficient to lift MT recycling rates

Global plastics demand has grown at a pace of 3.5% during 2010-19, reaching an estimated 460mn mt. While 2019 annual plastic waste totaled 353mn mt, according to the OECD, short lived plastic waste, which includes plastic packaging, hit 238mn mt in 2020, according to the UNEP. This segment of plastic waste is targeted by much of the world's recycling capacity, which managed to turn about 33mn mt into second-use plastic. Mechanical recycling capacity is estimated to be ~40mn mt and chemical recycling capacity, which is growing rapidly, is set to rise from just 1mn mt today to 5mn mt by 2026. This pace of growth is unlikely to keep up with proposed country-level recycling targets or corporate level recycled content goals, in our view. More policy action and incentives are needed to shift plastic recycling rates in a meaningful way.

Exhibit 1: BofA Commodity Research Themes and Outlook
Key takeaways

	View	Recent reports
Macro outlook	▪ Our economists see world GDP rising 3% in 2023 and expanding by 2.8% in 2024.	
WTI and Brent crude oil	▪ We project Brent and WTI to average $90/bbl and $86/bbl, respectively, in 2024. ▪ The global oil balance should stay tight in 2024, as OPEC+ withholds more supply from the market to counteract slowing demand growth ▪ We forecast global demand growth of 2.1mn b/d YoY in 2023 and 1.1mn b/d in 2024. ▪ Non-OPEC supply should grow roughly 2.2mn b/d YoY in 2023 and 1.24mn b/d in 2024. ▪ We project total US crude and NGL supply to rise 1.4mn b/d in 2023 and 590k b/d in 2024. ▪ OPEC crude oil supplies are set to fall 460k b/d in 2023 and 310k b/d in 2024 as OPEC+ actively manages balances	• The grind of the oil bulls 26 September 2023 • Money breaks oil's back 08 May 2023 • OPEC+'s whatever it takes moment 05 April 2023 • Global Energy Paper: Medium-term oil outlook 26 February 2023 • $80 is the new $60 for oil 16 September 2022 • Oil demand has a supply problem 27 May 2022
Atlantic Basin oil products	▪ Refined product markets face risks from OPEC+ cuts, a looming recession, and the pace of global refining capacity growth. ▪ We forecast RBOB-Brent to average $13/bbl in 2024, and we see ULSD-Brent cracks averaging $26/bbl over the same period. ▪ OPEC+ cuts, rising complex refining capacity, lower gasoline and diesel cracks create upside for 3.5% fuel oil cracks, which we see averaging -$12/bbl in 2024.	• Waiting for Dangot(e) 31 October 2023 • Diesel weasels out of a cyclical downturn 29 August 2023 • In the fuel oil market, high sulfur is king 31 July 2023
US natural gas	▪ US gas supply and demand growth should hit 1.6Bcf/d and 2.6Bcf/d YoY in 2024, pushing stocks to 3.95Tcf by October. ▪ We forecast US Henry Hub natural gas prices will average $3/mmbtu in 2024	• US nat gas rollercoaster nears the bottom 17 February 2023
LNG	▪ LNG supply growth is manageable from historical view at 10MMT in 24 and 16MMT in 25, leaving demand to dictate future price path ▪ JKM and TTF should average $15/MMBtu and €50/MWh in 2024, but they could easily hit $25/mmbtu or €100/MWh on cold weather	• Liquid gas can float and fly. So can oil 17 October 2023 • LNG is now a buyer's market 17 April 2023
Thermal coal	▪ Seaborne coal prices pulled back on softer balances. Yet, China has come back in earnest, more than doubling thermal coal imports ▪ We are constructive in 2024 on strong Asian demand and declining Russian supply	• China coal floors global gas 05 September 2023 • King coal loses its crown 31 March 2023

Source: BofA Global Research estimates

BofA GLOBAL RESEARCH

Exhibit 2: BofA Global Research Commodity Price Forecasts
(period averages)

	units	1Q23F	2Q23F	3Q23F	4Q23F	2023F	1Q24F	2Q24F	3Q24F	4Q24F	2024F
WTI Crude Oil	($/bbl)	76	74	82	82	78	86	88	86	84	86
Brent Crude Oil	($/bbl)	82	78	86	86	83	90	92	90	88	90
US NY Harbor ULSD (HO) Cracks to Brent Crude Oil	($/bbl)	41	25	40	37	36	30	25	25	25	26
US RBOB Cracks to Brent Crude Oil	($/bbl)	23	31	29	7	22	11	21	14	7	13
NWE Low Sulphur Gasoil Cracks to Brent Crude Oil	($/bbl)	31	17	32	29	27	23	20	20	19	21
NWE Eurobob Cracks to Brent Crude Oil	($/bbl)	15	22	27	7	18	5	14	10	3	8
NWE 1% Residual Cracks to Brent Crude Oil	($/bbl)	-13	-8	-3	-7	-8	-6	-5	-5	-5	-5
NWE 0.5% Residual Cracks to Brent Crude Oil	($/bbl)	2	2	4	3	3	2	2	2	2	2
NWE 3.5% Residual Cracks to Brent Crude Oil	($/bbl)	-23	-11	-4	-14	-13	-13	-12	-12	-12	-12
US Natural Gas	($/MMBtu)	2.74	2.32	2.66	3.15	2.72	2.90	2.50	3.00	3.60	3.00
Thermal coal, Newcastle FOB	($/t)	253	160	147	145	176	148	148	151	153	150
Aluminium	$/t	2,401	2,260	2,160	2,250	2,268	2,250	2,500	2,750	2,750	2,563
Copper	$/t	8,941	8,461	8,367	8,000	8,442	8,000	8,500	8,750	9,250	8,625
Lead	$/t	2,137	2,118	2,171	2,200	2,156	2,000	2,000	2,000	2,000	2,000
Nickel	$/t	25,973	22,277	20,392	18,500	21,786	18,500	18,500	19,000	19,000	18,750
Zinc	$/t	3,132	2,527	2,435	2,500	2,648	2,500	2,500	2,250	2,250	2,375
Gold	$/oz	1892	1977	1927	1900	1924	1950	1950	2000	2000	1975
Silver	$/oz	22.6	24.2	23.6	22.5	23.2	22.5	23	23.5	24	23.3
Platinum	$/oz	995	1,027	932	950	976	1,000	1,000	1,100	1,100	1050
Palladium	$/oz	1,568	1,445	1,254	1,250	1,379	900	800	700	600	750

Source: BofA Global Research estimates

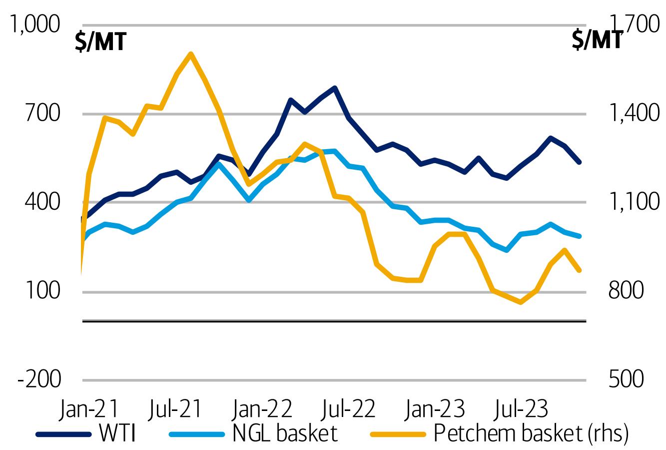
BofA GLOBAL RESEARCH

Petchem doom doesn't mean NGL gloom

NGL prices have suffered this year on soft demand, high supply

The US NGL market has been under pressure this year as soaring supply met weak domestic demand from the petrochemical sector and residential and commercial users. NGLs have underperformed crude oil in recent months, while petrochemicals have ground lower since mid-2021 (Exhibit 3). Amongst the NGLs, ethane has performed most poorly this quarter due in large part to the collapse in natural gas prices, which heavily influences ethane values (Exhibit 4). Propane has performed better, rising 2% on the quarter following a 10-cent rally over the past two weeks. Meanwhile, butane has rallied 19% over the same period, a move that may be attributable to an uptick in petrochemical sector butane demand along the USGC and seasonal gasoline blending.

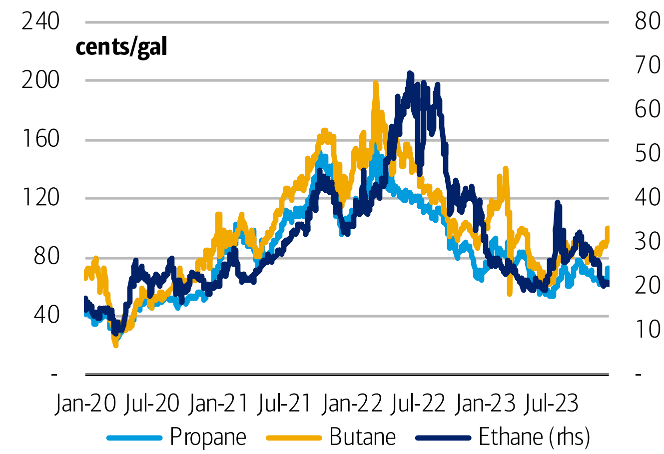
Exhibit 3: Crude oil, NGL, and petrochemical prices
NGLs have underperformed crude oil in recent months, while petrochemicals have ground lower since mid-2021



Source: Bloomberg, BofA Global Research

BofA GLOBAL RESEARCH

Exhibit 4: US NGL prices
Amongst the NGLs, ethane has performed poorly, butane has performed well, and propane has been flattish this quarter



Source: Bloomberg

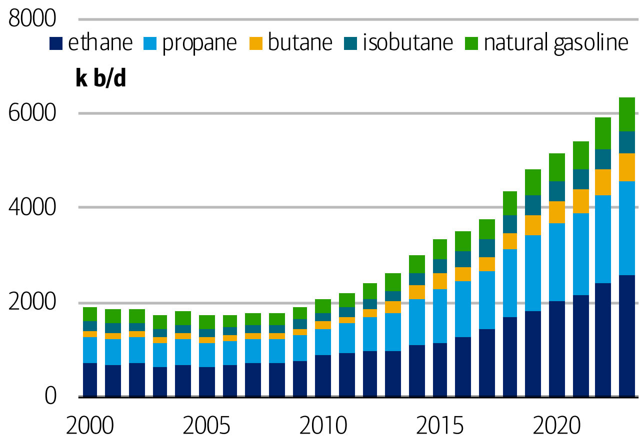
BofA GLOBAL RESEARCH

In the US, production is set to grow ~450k b/d YoY ytd due to shale...

The US shale patch has helped grow domestic NGL supply more than 4mn b/d since 2010, with ethane and propane supply rising 1.54mn b/d and 1.28mn b/d during 2010-22 (Exhibit 5). In 2023, production growth has remained robust with NGL field production on track to grow roughly 440k b/d, with nearly half of incremental volumes (195k b/d) coming from ethane (Exhibit 6). Propane is also expected to contribute nearly 125k b/d to NGL supply growth this year, while natural gasoline, butane, and isobutane make up the remainder.

Exhibit 5: Annual average NGL production

The US NGL supply grew more than 4mn b/d since 2010, with ethane and propane supply rising 1.54mn b/d and 1.28mn b/d during 2010-22

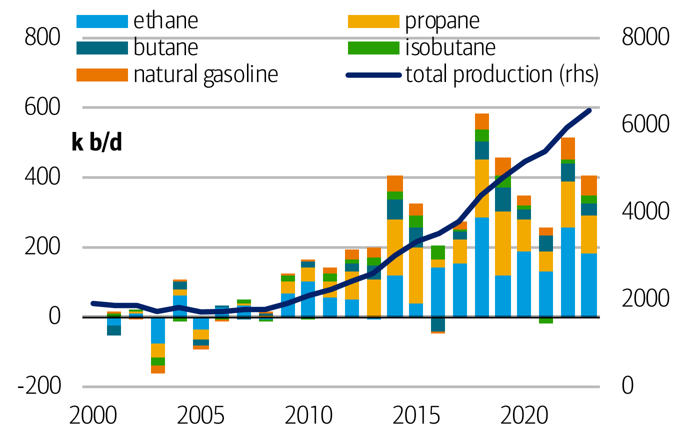


Source: EIA

BofA GLOBAL RESEARCH

Exhibit 6: Year on year production change (2023 ytd)

In 2023, NGL field production on track to grow more than 400k b/d, with nearly half of incremental volumes coming from ethane



Source: EIA

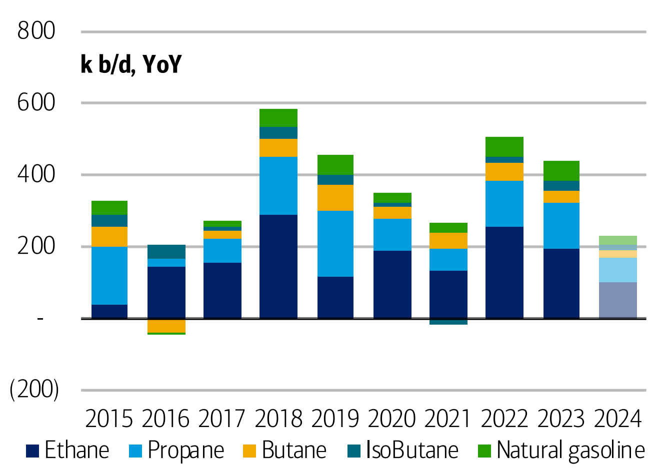
BofA GLOBAL RESEARCH

…and supply growth should slow in 2024 but remain healthy…

A slower pace of upstream activity heading into 2024 and relatively steep shale decline rates should help curb US NGL production growth next year. In fact, we estimate production across all streams will rise just 230k b/d YoY, led by ethane (90k b/d) and propane (60k b/d) (Exhibit 7). Gas processing capacity additions should help support rising NGL supply, with more than 1Bcf/d of new capacity coming online in the Permian during 1Q, and more than 2Bcf/d of new capacity expected online across the entire year (Exhibit 8)

Exhibit 7: US NGL supply growth

We estimate production across all streams will rise just 230k b/d YoY in 2024, led by ethane (90k b/d) and propane (60k b/d)

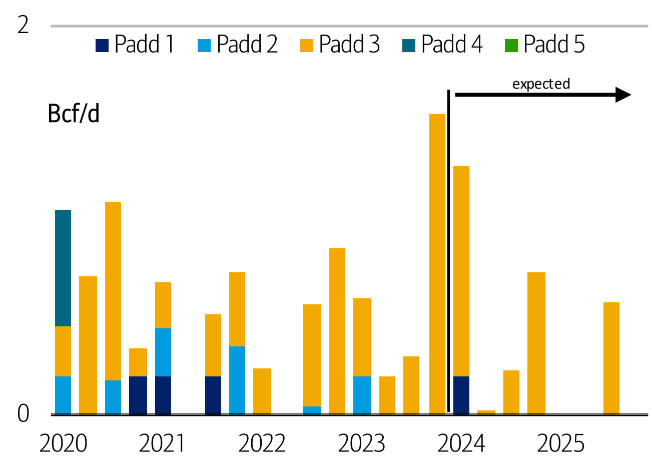


Source: EIA, BofA Global Research estimates

BofA GLOBAL RESEARCH

Exhibit 8: US gas processing additions by quarter

Gas processing capacity additions should help support rising NGL supply, with more than 1Bcf/d of new capacity coming online in the Permian in 1Q



Note: future based on projects currently under construction

Source: Platts

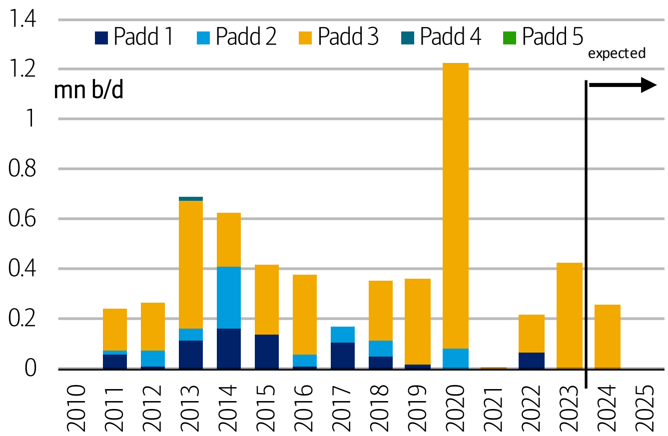
BofA GLOBAL RESEARCH

…matching fractionation growth but exceeding export capacity growth

Downstream of the gas processing, more pipeline (see [Permian NGL pipe oversupply & several asset acquisitions]), fractionation, and export capacity are on the way, but many big projects start in 2025 or later. In 2024, 255k b/d of fractionation capacity is expected to start up along the USGC, which means y-grade volume growth should line up relatively well with incremental fractionation capacity, but fractionation could still become a constraint next year if another weather event occurs like the summer USGC heat of 2023 (Exhibit 9). Meanwhile, export capacity has just stepped up 35k b/d due to an expansion at Targa's Galena Park terminal, but more substantive capacity growth is expected in 2025, when Enterprise adds 120k b/d of ethane export capacity at its Neches River NGL terminal and ETP adds 250k b/d of capacity at its Nederland terminal (Exhibit 10). In the interim, NGL exports capacity utilization will continue to rise and could contribute to wider spreads between US NGL prices and comparable international benchmarks.

Exhibit 9: US fractionation additions by year

Fractionation capacity is set to rise 255k b/d next year...



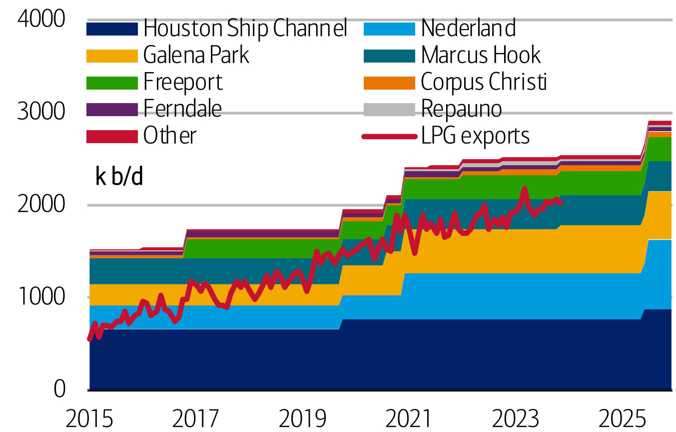
Note: future based on projects proposed, planned, or under construction

Source: Platts

BofA GLOBAL RESEARCH

Exhibit 10: US LPG exports and capacity

...while a meaningful change in export capacity isn't expected until 2025



Source: IHS Markit

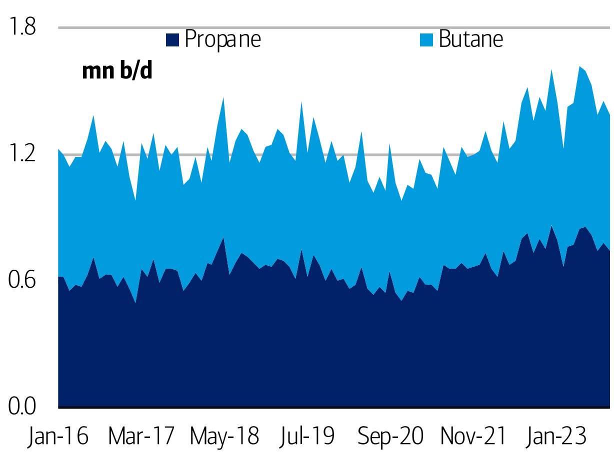
BofA GLOBAL RESEARCH

Meanwhile, Middle East LPG exports ebbed as OPEC+ cuts offset Iran

Middle East propane and butane exports rose steadily from late 2020 through mid-2023, topping out at an estimated 1.6mn b/d in May before slumping to 1.4mn b/d in October (Exhibit 11). Since 2021, a majority of Middle East propane and butane export growth has come from Iran, while Saudi Arabia, the UAE, and Kuwait made up most of the remainder (Exhibit 12). Middle East LPG exports peaked in June before new OPEC+ cuts kicked in, helping to ease export volumes from the region.

Exhibit 11: Middle East LPG exports

Middle East LPG exports topped out at an estimated 1.6mn b/d in May before slumping to an estimated 1.38mn b/d in October

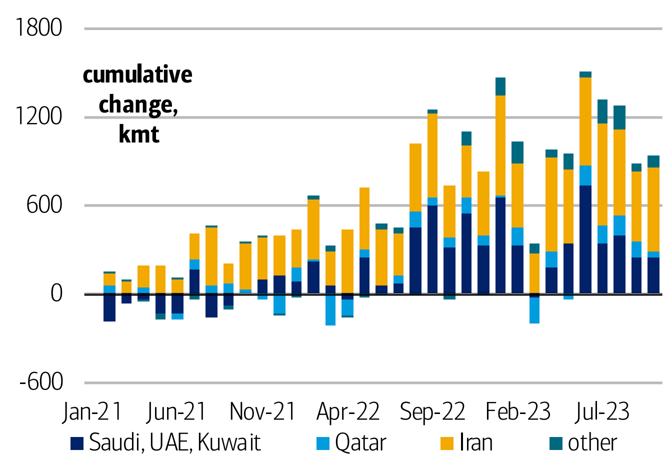


Source: Platts S&P Global

BofA GLOBAL RESEARCH

Exhibit 12: Middle East LPG export growth

Middle East LPG exports peaked in June before new OPEC+ cuts kicked in, helping to ease export volumes from the region



Source: Platts S&P Global

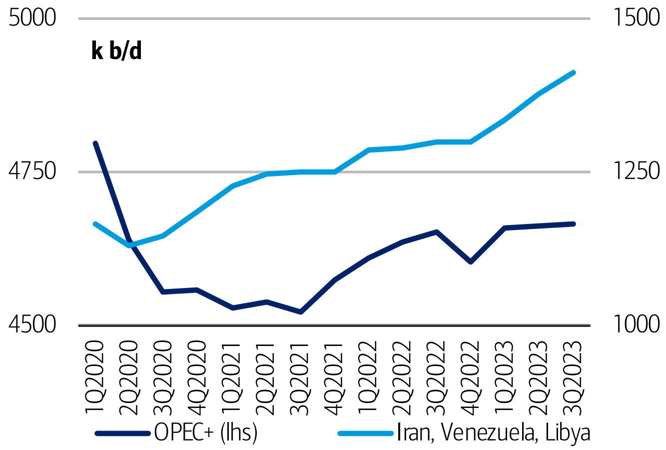
BofA GLOBAL RESEARCH

Deeper supply cuts, geopolitics may push ME LPG exports lower in 2024

OPEC+ NGL supply has climbed an estimated 110k b/d since bottoming out in 3Q20, reaching 4.66mn b/d in 3Q23. Over the same period, NGL volumes from Iran, Venezuela, and Libya have grown nearly 270k b/d (Exhibit 13), largely due to rising Iranian output. Deeper OPEC+ cuts should at least keep a cap on NGL supplies from the group, if not bring volumes lower in 1Q24 (Exhibit 14). Supplies from Iran also faces some downside risk in our view as tensions rise in the Middle East. In an effort to curb Iran's regional influence, the US may attempt to rein in Iran's main source of revenue, petroleum exports, which could have a knock-on impact on LPG availability.

Exhibit 13: OPEC+ and other OPEC NGL production estimates

OPEC+ NGL supply climbed about 110k b/d since 3Q20, reaching 4.66mn b/d in 3Q23, while volumes from Iran, Venezuela, and Libya grew 270k b/d

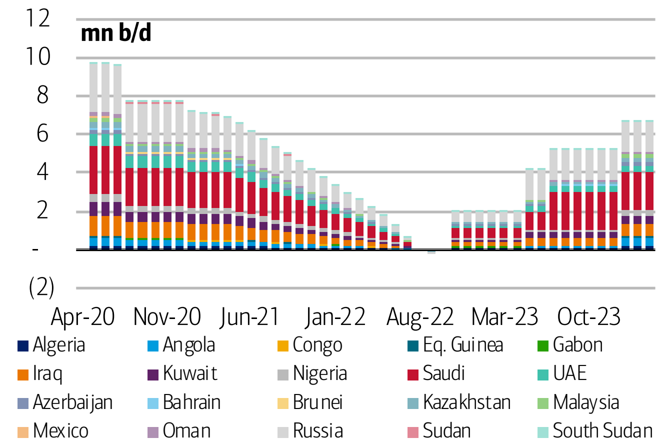


Source: IEA

BofA GLOBAL RESEARCH

Exhibit 14: OPEC+ mandatory and voluntary production cuts

Deeper OPEC+ cuts should at least keep a cap on NGL supplies from the group, if not bring volumes lower in 1Q24



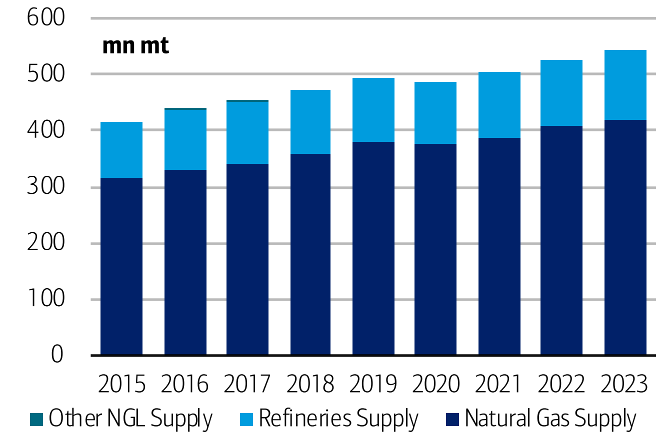
Source: OPEC, BofA Global Research estimates

BofA GLOBAL RESEARCH

Much of NGL demand growth comes from the chemical sector…

Global NGL supply has climbed roughly 30% since 2015 and is expected to approach 540mn mt this year, driven primarily by supply from the natural gas stream (Exhibit 15). Demand growth has been comparable, rising 31% over the same period. The petrochemical sector, which is the largest consumer of NGLs, is expected to climb 35% from 2015-23, while the second largest source of demand, residential and commercial users, grows just 22% (Exhibit 16). Soaring US ethane supply, which has limited use cases outside petchems, has been the primary driver behind chemical sector NGL demand growth over the past decade.

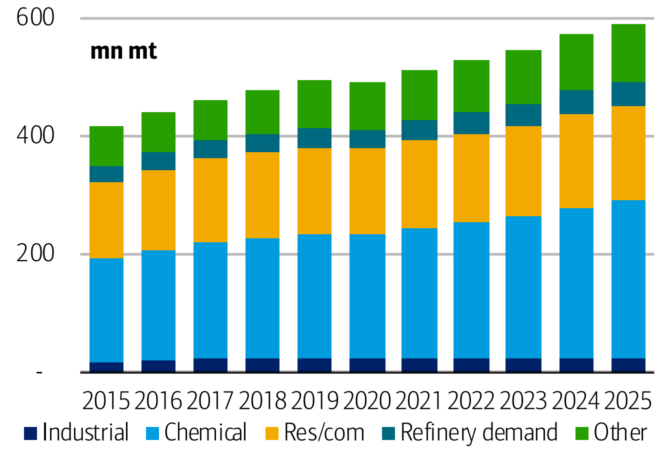
Exhibit 15: Global NGL/LPG supply by source
Global NGL supply climbed roughly 30% since 2015 and should approach 540mn mt this year, driven primarily by supply from natural gas stream



Source: S&P Global

BofA GLOBAL RESEARCH

Exhibit 16: Global NGL/LPG demand by source
Demand growth is expected to be comparable, rising 31% over the same period, led by the petrochemical sector



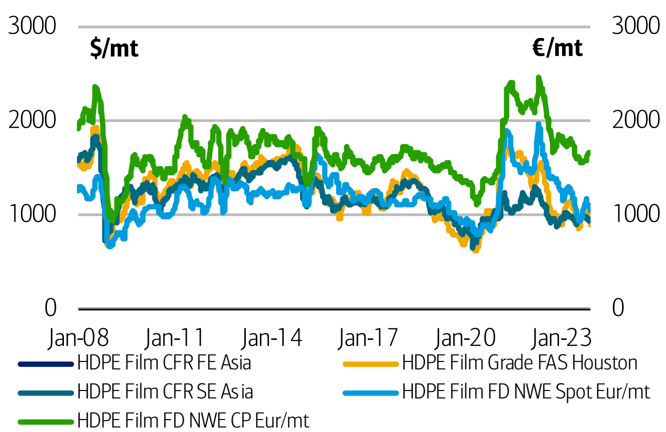
Source: S&P Global

BofA GLOBAL RESEARCH

...where plastics prices and margins deflated since mid-2022

Plastics prices usually take their cue from oil feedstocks, but expansions or contractions in petchem margins play a role too. The petrochemical sector suffered a severe supply shock during the pandemic when soaring goods demand coincided with a debilitating storm that temporarily knocked out significant production capacity along the USGC and global logistical constraints. This sent plastics prices and petchem margins soaring (Exhibit 17 and Exhibit 18). However, demand growth has slowed, disruptions have abated, and plastics prices have come back to earth. Since peaking, most HDPE prices are down 30-40% from the highs, while polypropylene prices have come down even more. Plastics prices are now near the low end of the range witnessed during the 2010-19 period.

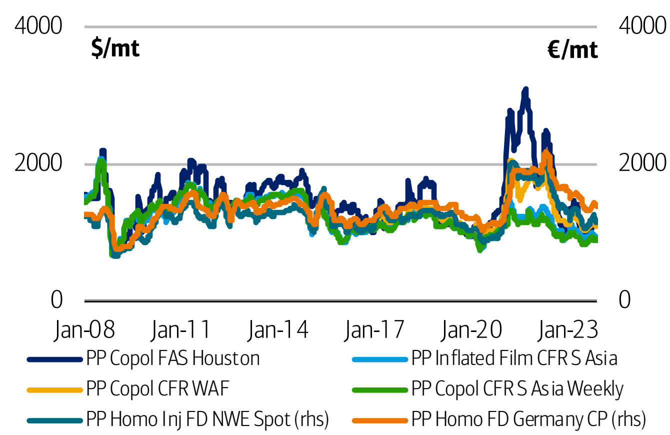
Exhibit 17: HDPE prices by region and type
Weather disruptions, logistical bottlenecks, and strong demand pushed plastic prices to multi-year highs in 2021-22...



Source: Platts

BofA GLOBAL RESEARCH

Exhibit 18: Polypropylene prices by region and type
...but these factors have eased in recent quarters and prices have returned to more normal levels



Source: Platts

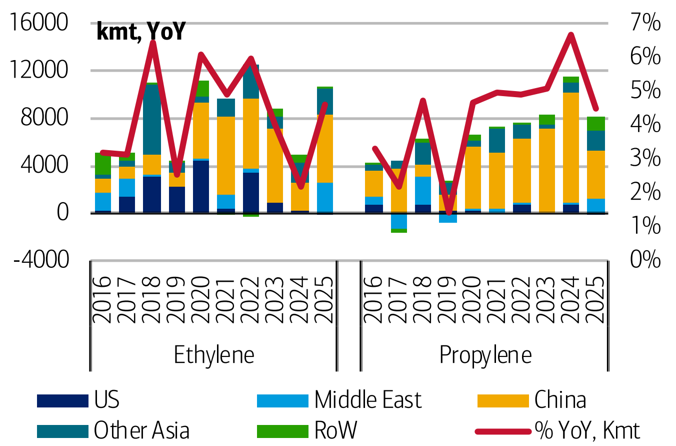
BofA GLOBAL RESEARCH

Soaring capacity to produce polyethylene and polypropylene...

The petrochemical sector has experienced a significant increase in capacity over the past five years and while growth is expected to slow for ethylene and PE, propylene and PP capacity growth is set to remain firm next year (Exhibit 19 and Exhibit 20). Furthermore, the magnitude of capacity growth, coupled with sluggish demand, should mean that margins remain soft for several years until demand catches up with capacity growth or sufficient capacity rationalization occurs. Plastics demand growth more or less keeps pace with GDP, which our economists expect will slow to 2.8% YoY in 2024 before rising back to just 3% in 2025. Meanwhile, capacity, which has grown at a pace of more than 5% during 2020-23 has outstripped GDP and this trend should continue for polypropylene and propylene in 2024.

Exhibit 19: Global ethylene and propylene capacity expansions

The petrochemical sector has witnessed significant increase in capacity over the past five years...

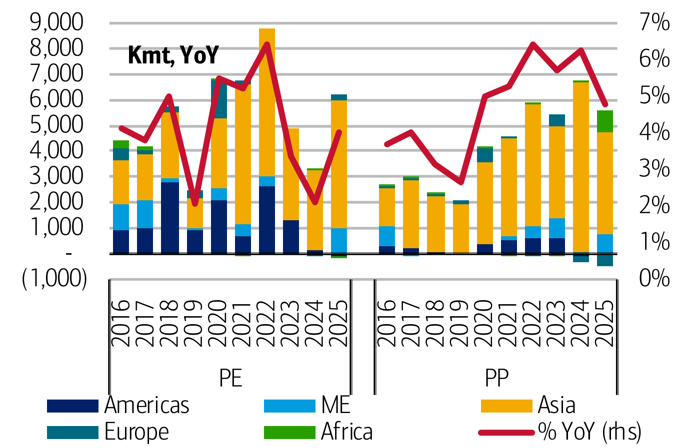


Source: Platts

BofA GLOBAL RESEARCH

Exhibit 20: Global PE and PP capacity expansions

...and while growth is expected to slow for ethylene and PE, propylene and PP capacity growth is set to remain firm next year



Source: Platts

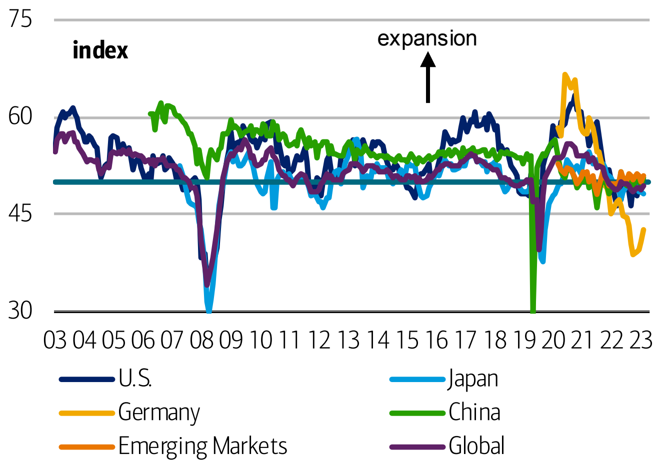
BofA GLOBAL RESEARCH

...has collided with slower goods demand and inventory destocking

Part of the imbalance in the petrochemical sector stems from the boom and subsequent bust in goods demand during the pandemic. The global economy is still struggling to return to growth in the manufacturing sector (Exhibit 21), while the service sector has reached stall speed. Viewed another way, demand for goods remains sluggish while the main source of support for the economy, the service sector, has stopped providing lift to aggregate economic activity. These dynamics are consistent with new manufacturing sector export orders, which remain in contraction across most countries and regions (Exhibit 22). A reversal of export order contraction should provide a reliable indicator for a turnaround in actual or perceived goods demand.

Exhibit 21: Global manufacturing PMIs

The global economy is still struggling to return to growth in the manufacturing sector

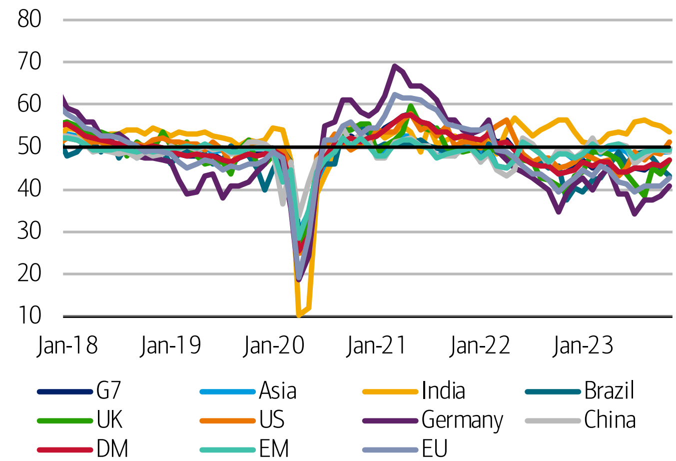


Source: Bloomberg

BofA GLOBAL RESEARCH

Exhibit 22: New export orders (manufacturing PMI)

These dynamics are consistent with new manufacturing sector export orders, which remain in contraction across most countries and regions



Source: Bloomberg

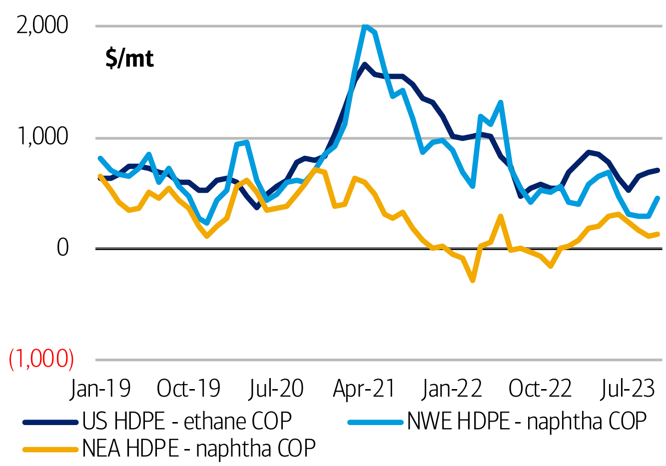
BofA GLOBAL RESEARCH

Petrochemical margins may take several years to recover…

Margins in the petrochemical sector vary widely by region and are driven by new capacity growth, among other factors. Asia, where a majority of new PE and PP capacity is entering the market, has seen the worst margins for both PE and PP streams, while the US and Europe have held up better (Exhibit 23 and Exhibit 24). Even so, margins continue to normalize across regions and should remain quite soft until either the market digests the capacity imbalance, or another disruption event occurs, taking significant supply out of the market.

Exhibit 23: Regional HPDE implied margins

Asia, where a majority of new PE and PP capacity is entering the market, has seen the worst margins for both plastics streams, while the US and Europe have held up better

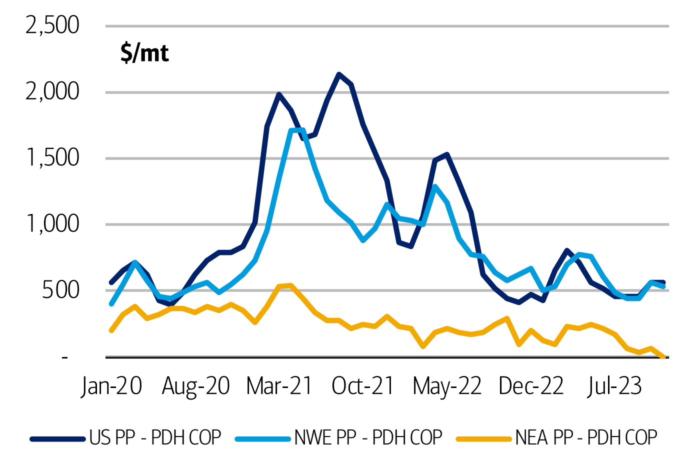


Source: Platts

BofA GLOBAL RESEARCH

Exhibit 24: Regional PP implied margins

Even so, margins continue to normalize across regions and should remain quite soft until either the market digests the capacity imbalance, or another disruption event occurs



Source: Platts

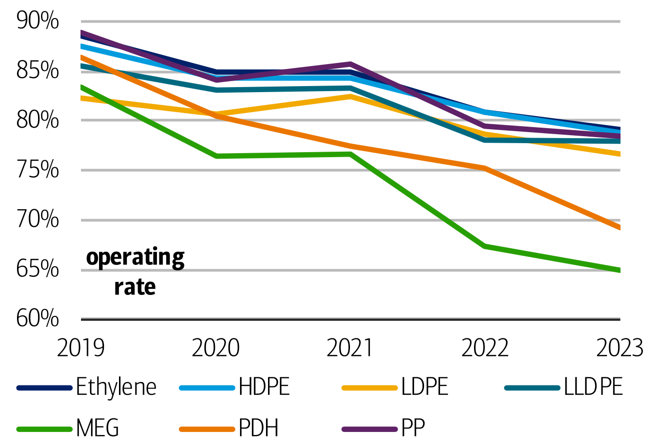
BofA GLOBAL RESEARCH

…but a rebound manufacturing may support NGLs prices in 2024

Global petrochemical sector utilization rates have been trending lower since 2019. We expect rates to stabilize across ethylene and polyethylene in 2024 as capacity growth slows, while propylene and polypropylene operating rates are likely to continue to move lower due to an onslaught of new capacity starts (Exhibit 25). Excess capacity should continue to weigh on petchem margins but that doesn't necessarily spell doom and gloom for NGLs. Afterall, NGL demand can continue to increase even if petrochemical sector margins are soft. Furthermore, inventory ratios across several areas of the supply chain are finally showing signs of rolling over (Exhibit 26), which suggests an unsustainable situation where demand is outstripping the rate of inventory replenishment. Thus, at some point, manufacturing activity, and plastics demand, will likely need to increase just to stop inventory-to-sales ratios from declining further. We think this could happen in 2024. However persistent higher rates have increased the costs of holding inventory, so these relationships may base out at a lower level in the future.

Exhibit 25: Global petrochemical sector utilization rates

We expect rates to stabilize across ethylene and polyethylene in 2024 as capacity growth slows, while propylene and polypropylene operating rates are likely to continue to move lower due to onslaught of new capacity starts

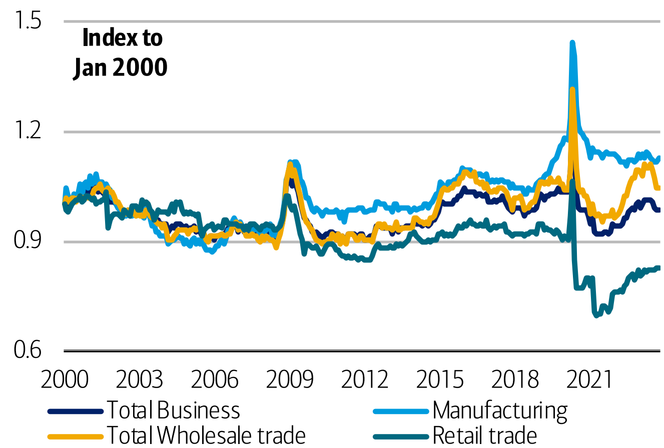


Source: Platts

BofA GLOBAL RESEARCH

Exhibit 26: US inventory/sales ratios (indexed to January 2000)

Inventories across several areas of the supply chain are finally showing signs of rolling over, which could trigger more orders and plastic demand over the coming quarters to slow inventory declines or to restock



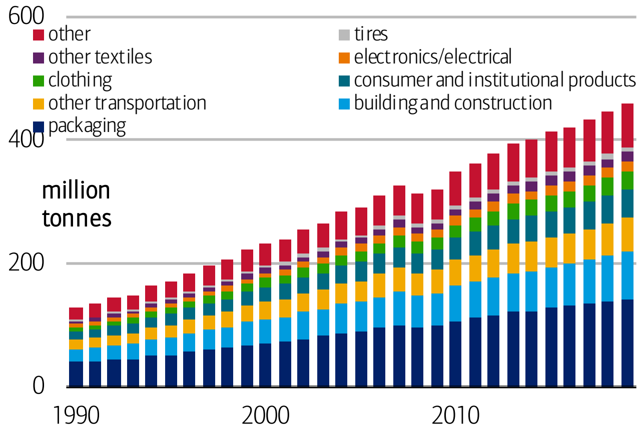
Source: Platts

BofA GLOBAL RESEARCH

Longer term, plastics waste poses a challenge to the sector…

Global plastics demand has risen relentlessly, save for the GFC (Exhibit 27), clocking an annual growth rate of roughly 3.5% YoY during 200-19 timeframe. During the pandemic, global economic activity collapsed, but demand for plastic remained mostly resilient thanks to a surge in goods demand, which led to PE demand growth of more than 2% YoY and roughly flat PP demand in 2020. Positive momentum in consumption has continued in 2021-23, albeit at a slower pace as consumers shifted spending from goods towards services, with PE and PP demand rising at an estimated annual average rate of 2.2% and 3.1% respectively during 2021-23. Packaging and building and construction account for roughly 50% of total plastics usage (Exhibit 28), which explains why consumption held up so well during the pandemic even as overall economic activity soured.

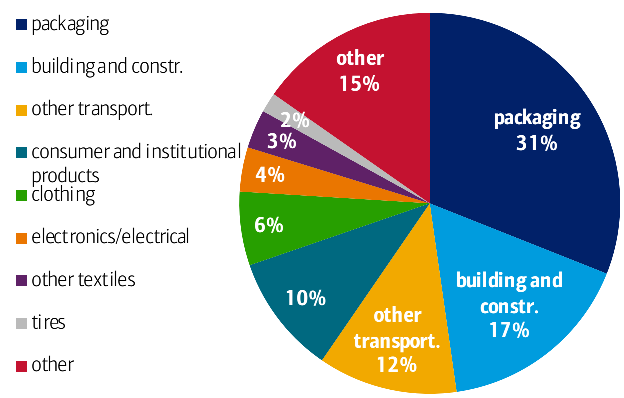
Exhibit 27: Historical plastic use by application
Global plastics demand has risen relentlessly, save for the GFC, clocking an annual growth rate of roughly 3.5% YoY during 200-19 timeframe



Source: OECD

BofA GLOBAL RESEARCH

Exhibit 28: Plastic use by application, 2019
Packaging and building and construction account for roughly 50% of plastics usage, which helps explain resilient plastic demand during the pandemic



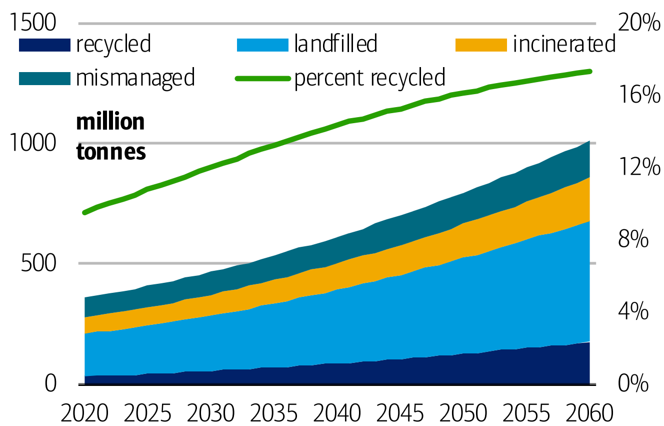
Source: OECD

BofA GLOBAL RESEARCH

…but recycling rates are stubbornly low, constrained by capacity, logistics

Demand for plastics is likely to grow for the foreseeable future as incomes per capita rise in developing economies, and by 2060, plastic waste could more than double, according to the OECD (Exhibit 29). Recycling rates are very low today at roughly 10%, constrained by a whole host of factors like limited recycling capacity and insufficient collection infrastructure and incentives. Targeting short-lived plastics, which includes packaging, would likely help remove some of the most visible signs of plastic waste's Impact on the ecosystem (Exhibit 30). The UNEP estimates that the world used 254mn mt of short-lived plastic in 2020 and generated 238mn mt of waste. While 46mn mt of plastic was sorted for recycling, just 33mn mt made it through to secondary plastic usage. Building out more collection and sorting, as well as recycling capacity, is critical to boosting these figures in the future.

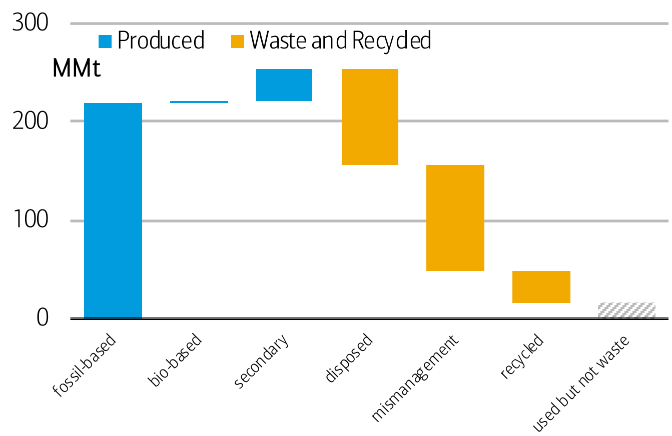
Exhibit 29: Projected plastic waste by end of use (OECD estimate)
Global plastic waste could more than double by 2060 according to the OECD



Source: OECD

BofA GLOBAL RESEARCH

Exhibit 30: Short lived plastics flow, 2020
Just 14% of short-lived plastic waste was recycled in 2020



Source: UN Environment Programme

BofA GLOBAL RESEARCH

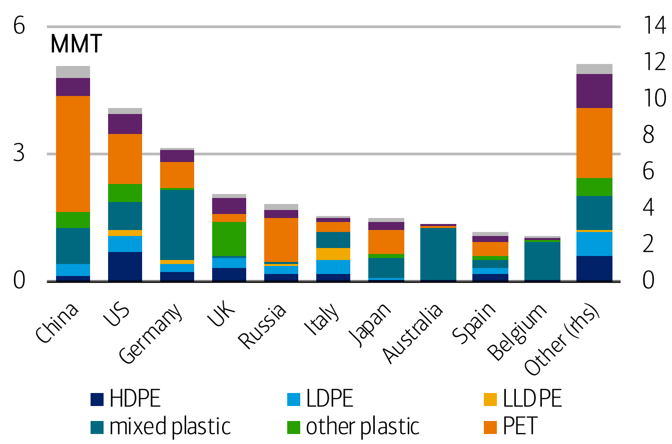
Investments in new recycling capacity are still a drop in the bucket

Plastics can be recycled in several different ways, primarily through mechanical recycling or chemical recycling. Mechanical recycling, which typically entails melting and repurposing waste plastic without meaningfully changing its chemical structure, is the most popular form of recycling and caters to PET and PE products like plastic bottles. Most mechanical recycling capacity is in China, the US, and Europe, according to BNEF

(Exhibit 31). Global mechanical recycling capacity estimates vary by source but are believed to be somewhere around 40mn mt. Chemical recycling, which can take plastic and de-polymerize it or break it down into petrochemical cracker feedstocks, is another way of recycling that is more technically challenging but could help the sector overcome sorting hurdles that prevent more plastics recycling today and allow for the recycling of some of the more chemically complex plastic waste. Chemical recycling capacity is set to grow rapidly, albeit from a very low base of less than 2mn mt in 2023 to about 5mn mt in 2026, according to known project plans (Exhibit 32). For perspective, global plastics demand grew 59mn mt from 2014 to 2019, a growth rate of nearly 12mn mt annually. More plastic recycling project announcements seem likely in the coming quarters, but sanctioning of new projects is likely to require firm offtake agreements, which may be less forthcoming if economic activity slows substantially in 2024.

Exhibit 31: Global mechanical recycling capacity

Mechanical recycling capacity is concentrated in China, the US, and Europe and is estimated to be around 40mn mt globally

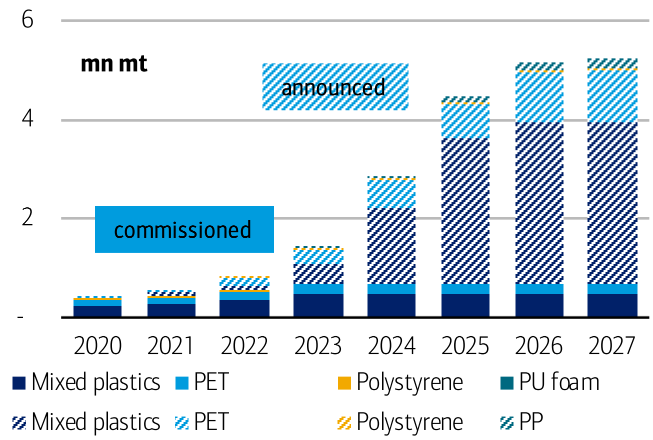


Source: BNEF

BofA GLOBAL RESEARCH

Exhibit 32: Global chemical recycling capacity

Chemical recycling capacity is set to rise by about 4mn mt by 2026, while plastics demand has grown by nearly 12mn mt annually during 2014-19



Source: BNEF

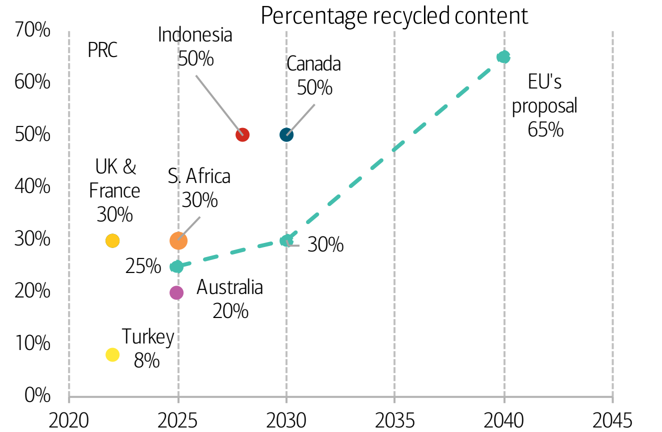
BofA GLOBAL RESEARCH

Ultimately, policy or better economics are necessary to plastic reduce waste

In its business-as-usual scenario, the UNEP suggests short-lived plastic waste could rise from 238mn mt in 2020 to 408mn mt in 2040, with recycling activity (mt) rising just 58% over that period. Meanwhile, waste mismanagement, which is responsible for short-lived plastics polluting our oceans, is expected to more than double, from 107mn mt in 2020 to 227mn mt in 2040. To avoid this outcome, more policy and better recycling economics are needed to drive increased investment in recycling capacity and collection and sorting infrastructure. Several ambitious plans include a proposal by Canada to mandate plastic packaging contain at least 50% recycled content by 2030. Meanwhile, the EU has proposed plastic packaging recycling targets that reach 65% by 2040 (Exhibit 33). Policies help drive demand for recycled plastic, but signals are also needed for suppliers too (Exhibit 34). Spreads between recycled plastic and virgin plastic must be sufficient to attract investment, but recent weakness in recycled plastic premiums and an absence of meaningful policy measures in countries like the US are likely to hinder capacity development. Higher interest rates are likely to only add to headwinds for capacity build-out.

Exhibit 33: Post-consumer recycled content (PCR) mandates for plastic packaging in select G-20 markets

Several countries have proposed aggressive PCR targets but more follow through is needed to steer the industry in the right direction

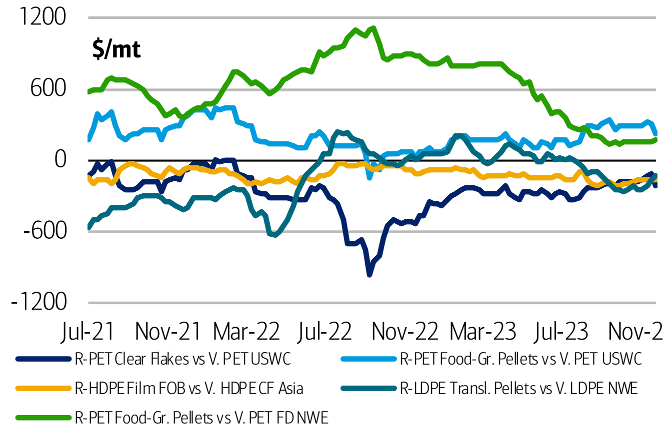


Source: BNEF

BofA GLOBAL RESEARCH

Exhibit 34: Spreads between recycled and virgin plastic

Wider spreads between recycled and virgin plastic prices could also help encourage the plastic recycling capacity buildout



Source: Platts

BofA GLOBAL RESEARCH

Exhibit 35: Acronym list

Acronyms	
NGL	Natural gas liquids
LPG	Liquified petroleum gas
PE	Polyethylene
PP	Polypropylene
HDPE	High density polyethylene
LDPE	Low density polyethylene
LLDPE	Linear low density polyethylene
PET	Polyethylene terephthalate
R-PET	Recycled Polyethylene terephthalate
R-HDPE	Recycled high density polyethylene
OECD	Organisation for Economic Co-operation and Development
WTI	West Texas Intermediate
Petchem	Petrochemical
K b/d	Thousand barrels per day
Mn mt	Million metric tonnes
Bcf/d	Billion cubic feet per day
UNEP	UN Environment Programme
PU	Polyurethane

Source: BofA Global Research

BofA GLOBAL RESEARCH

Disclosures

Important Disclosures

BofA Global Research personnel (including the analyst(s) responsible for this report) receive compensation based upon, among other factors, the overall profitability of Bank of America Corporation, including profits derived from investment banking. The analyst(s) responsible for this report may also receive compensation based upon, among other factors, the overall profitability of the Bank's sales and trading businesses relating to the class of securities or financial instruments for which such analyst is responsible.
BofA Securities fixed income analysts regularly interact with sales and trading desk personnel in connection with their research, including to ascertain pricing and liquidity in the fixed income markets.

Other Important Disclosures

Prices are indicative and for information purposes only. Except as otherwise stated in the report, for any recommendation in relation to an equity security, the price referenced is the publicly traded price of the security as of close of business on the day prior to the date of the report or, if the report is published during intraday trading, the price referenced is indicative of the traded price as of the date and time of the report and in relation to a debt security (including equity preferred and CDS), prices are indicative as of the date and time of the report and are from various sources including BofA Securities trading desks.
The date and time of completion of the production of any recommendation in this report shall be the date and time of dissemination of this report as recorded in the report timestamp.

Recipients who are not institutional investors or market professionals should seek the advice of their independent financial advisor before considering information in this report in connection with any investment decision, or for a necessary explanation of its contents.
Officers of BofAS or one or more of its affiliates (other than research analysts) may have a financial interest in securities of the issuer(s) or in related investments.
Refer to BofA Global Research policies relating to conflicts of interest.
"BofA Securities" includes BofA Securities, Inc. ("BofAS") and its affiliates. Investors should contact their BofA Securities representative or Merrill Global Wealth Management financial advisor if they have questions concerning this report or concerning the appropriateness of any investment idea described herein for such investor. "BofA Securities" is a global brand for BofA Global Research.
Information relating to Non-US affiliates of BofA Securities and Distribution of Affiliate Research Reports:
BofAS and/or Merrill Lynch, Pierce, Fenner & Smith Incorporated ("MLPF&S") may in the future distribute, information of the following non-US affiliates in the US (short name: legal name, regulator): Merrill Lynch (South Africa): Merrill Lynch South Africa (Pty) Ltd., regulated by The Financial Service Board; MLI (UK): Merrill Lynch International, regulated by the Financial Conduct Authority (FCA) and the Prudential Regulation Authority (PRA); BofASE (France): BofA Securities Europe SA is authorized by the Autorité de Contrôle Prudentiel et de Résolution (ACPR) and regulated by the ACPR and the Autorité des Marchés Financiers (AMF). BofA Securities Europe SA ("BofASE") with registered address at 51, rue La Boétie, 75008 Paris is registered under no 842 602 690 RCS Paris. In accordance with the provisions of French Code Monétaire et Financier (Monetary and Financial Code), BofASE is an établissement de crédit et d'investissement (credit and investment institution) that is authorised and supervised by the European Central Bank and the Autorité de Contrôle Prudentiel et de Résolution (ACPR) and regulated by the ACPR and the Autorité des Marchés Financiers. BofASE's share capital can be found at www.bofaml.com/BofASEdisclaimer; BofA Europe (Milan): Bank of America Europe Designated Activity Company, Milan Branch, regulated by the Bank of Italy, the European Central Bank (ECB) and the Central Bank of Ireland (CBI); BofA Europe (Frankfurt): Bank of America Europe Designated Activity Company, Frankfurt Branch regulated by BaFin, the ECB and the CBI; BofA Europe (Madrid): Bank of America Europe Designated Activity Company, Sucursal en España, regulated by the Bank of Spain, the ECB and the CBI; Merrill Lynch (Australia): Merrill Lynch Equities (Australia) Limited, regulated by the Australian Securities and Investments Commission; Merrill Lynch (Hong Kong): Merrill Lynch (Asia Pacific) Limited, regulated by the Hong Kong Securities and Futures Commission (HKSFC); Merrill Lynch (Singapore): Merrill Lynch (Singapore) Pte Ltd, regulated by the Monetary Authority of Singapore (MAS); Merrill Lynch (Canada): Merrill Lynch Canada Inc, regulated by the Canadian Investment Regulatory Organization; Merrill Lynch (Mexico): Merrill Lynch Mexico, SA de CV, Casa de Bolsa, regulated by the Comisión Nacional Bancaria y de Valores; Merrill Lynch (Argentina): Merrill Lynch Argentina SA, regulated by Comisión Nacional de Valores; BofAS Japan: BofA Securities Japan Co., Ltd., regulated by the Financial Services Agency; Merrill Lynch (Seoul): Merrill Lynch International, LLC Seoul Branch, regulated by the Financial Supervisory Service; Merrill Lynch (Taiwan): Merrill Lynch Securities (Taiwan) Ltd., regulated by the Securities and Futures Bureau; BofAS India: BofA Securities India Limited, regulated by the Securities and Exchange Board of India (SEBI); Merrill Lynch (Israel): Merrill Lynch Israel Limited, regulated by Israel Securities Authority; Merrill Lynch (DIFC): Merrill Lynch International (DIFC Branch), regulated by the Dubai Financial Services Authority (DFSA); Merrill Lynch (Brazil): Merrill Lynch S.A. Corretora de Títulos e Valores Mobiliários, regulated by Comissão de Valores Mobiliários; Merrill Lynch KSA Company: Merrill Lynch Kingdom of Saudi Arabia Company, regulated by the Capital Market Authority.
This information: has been approved for publication and is distributed in the United Kingdom (UK) to professional clients and eligible counterparties (as each is defined in the rules of the FCA and the PRA) by MLI (UK), which is authorized by the PRA and regulated by the FCA and the PRA - details about the extent of our regulation by the FCA and PRA are available from us on request; has been approved for publication and is distributed in the European Economic Area (EEA) by BofASE (France), which is authorized by the ACPR and regulated by the ACPR and the AMF; has been considered and distributed in Japan by BofAS Japan, a registered securities dealer under the Financial Instruments and Exchange Act in Japan, or its permitted affiliates; is issued and distributed in Hong Kong by Merrill Lynch (Hong Kong) which is regulated by HKSFC; is issued and distributed in Taiwan by Merrill Lynch (Taiwan); is issued and distributed in India by BofAS India; and is issued and distributed in Singapore to institutional investors and/or accredited investors (each as defined under the Financial Advisers Regulations) by Merrill Lynch (Singapore) (Company Registration No 198602883D). Merrill Lynch (Singapore) is regulated by MAS. Merrill Lynch Equities (Australia) Limited (ABN 65 006 276 795), AFS License 235132 (MLEA) distributes this information in Australia only to 'Wholesale' clients as defined by s.761G of the Corporations Act 2001. With the exception of Bank of America N.A., Australia Branch, neither MLEA nor any of its affiliates involved in preparing this information is an Authorised Deposit-Taking Institution under the Banking Act 1959 nor regulated by the Australian Prudential Regulation Authority. No approval is required for publication or distribution of this information in Brazil and its local distribution is by Merrill Lynch (Brazil) in accordance with applicable regulations. Merrill Lynch (DIFC) is authorized and regulated by the DFSA. Information prepared and issued by Merrill Lynch (DIFC) is done so in accordance with the requirements of the DFSA conduct of business rules. BofA Europe (Frankfurt) distributes this information in Germany and is regulated by BaFin, the ECB and the CBI. BofA Securities entities, including BofA Europe and BofASE (France), may outsource/delegate the marketing and/or provision of certain research services or aspects of research services to other branches or members of the BofA Securities group. You may be contacted by a different BofA Securities entity acting for and on behalf of your service provider where permitted by applicable law. This does not change your service provider. Please refer to the Electronic Communications Disclaimers for further information.
This information has been prepared and issued by BofAS and/or one or more of its non-US affiliates. The author(s) of this information may not be licensed to carry on regulated activities in your jurisdiction and, if not licensed, do not hold themselves out as being able to do so. BofAS and/or MLPF&S is the distributor of this information in the US and accepts full responsibility for information distributed to BofAS and/or MLPF&S clients in the US by its non-US affiliates. Any US person receiving this information and wishing to effect any transaction in any security discussed herein should do so through BofAS and/or MLPF&S and not such foreign affiliates. Hong Kong recipients of this information should contact Merrill Lynch (Asia Pacific) Limited in respect of any matters relating to dealing in securities or provision of specific advice on securities or any other matters arising from, or in connection with, this information. Singapore recipients of this information should contact Merrill Lynch (Singapore) Pte Ltd in respect of any matters arising from, or in connection with, this information. For clients that are not accredited investors, expert investors or institutional investors Merrill Lynch (Singapore) Pte Ltd accepts full responsibility for the contents of this information distributed to such clients in Singapore.
General Investment Related Disclosures:
Taiwan Readers: Neither the information nor any opinion expressed herein constitutes an offer or a solicitation of an offer to transact in any securities or other financial instrument. No part of this report may be used or reproduced or quoted in any manner whatsoever in Taiwan by the press or any other person without the express written consent of BofA Securities.
This document provides general information only, and has been prepared for, and is intended for general distribution to, BofA Securities clients. Neither the information nor any opinion expressed constitutes an offer or an invitation to make an offer, to buy or sell any securities or other financial instrument or any derivative related to such securities or instruments (e.g., options, futures, warrants, and contracts for differences). This document is not intended to provide personal investment advice and it does not take into account the specific investment objectives,

financial situation and the particular needs of, and is not directed to, any specific person(s). This document and its content do not constitute, and should not be considered to constitute, investment advice for purposes of ERISA, the US tax code, the Investment Advisers Act or otherwise. Investors should seek financial advice regarding the appropriateness of investing in financial instruments and implementing investment strategies discussed or recommended in this document and should understand that statements regarding future prospects may not be realized. Any decision to purchase or subscribe for securities in any offering must be based solely on existing public information on such security or the information in the prospectus or other offering document issued in connection with such offering, and not on this document.

Securities and other financial instruments referred to herein, or recommended, offered or sold by BofA Securities, are not insured by the Federal Deposit Insurance Corporation and are not deposits or other obligations of any insured depository institution (including, Bank of America, N.A.). Investments in general and, derivatives, in particular, involve numerous risks, including, among others, market risk, counterparty default risk and liquidity risk. No security, financial instrument or derivative is suitable for all investors. Digital assets are extremely speculative, volatile and are largely unregulated. In some cases, securities and other financial instruments may be difficult to value or sell and reliable information about the value or risks related to the security or financial instrument may be difficult to obtain. Investors should note that income from such securities and other financial instruments, if any, may fluctuate and that price or value of such securities and instruments may rise or fall and, in some cases, investors may lose their entire principal investment. Past performance is not necessarily a guide to future performance. Levels and basis for taxation may change.

Futures and options are not appropriate for all investors. Such financial instruments may expire worthless. Before investing in futures or options, clients must receive the appropriate risk disclosure documents. Investment strategies explained in this report may not be appropriate at all times. Costs of such strategies do not include commission or margin expenses.

BofA Securities is aware that the implementation of the ideas expressed in this report may depend upon an investor's ability to "short" securities or other financial instruments and that such action may be limited by regulations prohibiting or restricting "shortselling" in many jurisdictions. Investors are urged to seek advice regarding the applicability of such regulations prior to executing any short idea contained in this report.

Foreign currency rates of exchange may adversely affect the value, price or income of any security or financial instrument mentioned in this report. Investors in such securities and instruments effectively assume currency risk.

BofAS or one of its affiliates is a regular issuer of traded financial instruments linked to securities that may have been recommended in this report. BofAS or one of its affiliates may, at any time, hold a trading position (long or short) in the securities and financial instruments discussed in this report.

BofA Securities, through business units other than BofA Global Research, may have issued and may in the future issue trading ideas or recommendations that are inconsistent with, and reach different conclusions from, the information presented herein. Such ideas or recommendations may reflect different time frames, assumptions, views and analytical methods of the persons who prepared them, and BofA Securities is under no obligation to ensure that such other trading ideas or recommendations are brought to the attention of any recipient of this information.

In the event that the recipient received this information pursuant to a contract between the recipient and BofAS for the provision of research services for a separate fee, and in connection therewith BofAS may be deemed to be acting as an investment adviser, such status relates, if at all, solely to the person with whom BofAS has contracted directly and does not extend beyond the delivery of this report (unless otherwise agreed specifically in writing by BofAS). If such recipient uses the services of BofAS in connection with the sale or purchase of a security referred to herein, BofAS may act as principal for its own account or as agent for another person. BofAS is and continues to act solely as a broker-dealer in connection with the execution of any transactions, including transactions in any securities referred to herein.

Copyright and General Information:

Materials prepared by BofA Global Research personnel are based on public information. Facts and views presented in this material have not been reviewed by, and may not reflect information known to, professionals in other business areas of BofA Securities, including investment banking personnel. BofA Securities has established information barriers between BofA Global Research and certain business groups. As a result, BofA Securities does not disclose certain client relationships with, or compensation received from, such issuers. To the extent this material discusses any legal proceeding or issues, it has not been prepared as nor is it intended to express any legal conclusion, opinion or advice. Investors should consult their own legal advisers as to issues of law relating to the subject matter of this material. BofA Global Research personnel's knowledge of legal proceedings in which any BofA Securities entity and/or its directors, officers and employees may be plaintiffs, defendants, co-defendants or co-plaintiffs with or involving issuers mentioned in this material is based on public information. Facts and views presented in this material that relate to any such proceedings have not been reviewed by, discussed with, and may not reflect information known to, professionals in other business areas of BofA Securities in connection with the legal proceedings or matters relevant to such proceedings.

This information has been prepared independently of any issuer of securities mentioned herein and not in connection with any proposed offering of securities or as agent of any issuer of any securities. None of BofAS any of its affiliates or their research analysts has any authority whatsoever to make any representation or warranty on behalf of the issuer(s). BofA Global Research policy prohibits research personnel from disclosing a recommendation, investment rating, or investment thesis for review by an issuer prior to the publication of a research report containing such rating, recommendation or investment thesis.

Any information relating to the tax status of financial instruments discussed herein is not intended to provide tax advice or to be used by anyone to provide tax advice. Investors are urged to seek tax advice based on their particular circumstances from an independent tax professional.

The information herein (other than disclosure information relating to BofA Securities and its affiliates) was obtained from various sources and we do not guarantee its accuracy. This information may contain links to third-party websites. BofA Securities is not responsible for the content of any third-party website or any linked content contained in a third-party website. Content contained on such third-party websites is not part of this information and is not incorporated by reference. The inclusion of a link does not imply any endorsement by or any affiliation with BofA Securities. Access to any third-party website is at your own risk, and you should always review the terms and privacy policies at third-party websites before submitting any personal information to them. BofA Securities is not responsible for such terms and privacy policies and expressly disclaims any liability for them.

All opinions, projections and estimates constitute the judgment of the author as of the date of publication and are subject to change without notice. Prices also are subject to change without notice. BofA Securities is under no obligation to update this information and BofA Securities ability to publish information on the subject issuer(s) in the future is subject to applicable quiet periods. You should therefore assume that BofA Securities will not update any fact, circumstance or opinion contained herein.

Certain outstanding reports or investment opinions relating to securities, financial instruments and/or issuers may no longer be current. Always refer to the most recent research report relating to an issuer prior to making an investment decision.

In some cases, an issuer may be classified as Restricted or may be Under Review or Extended Review. In each case, investors should consider any investment opinion relating to such issuer (or its security and/or financial instruments) to be suspended or withdrawn and should not rely on the analyses and investment opinion(s) pertaining to such issuer (or its securities and/or financial instruments) nor should the analyses or opinion(s) be considered a solicitation of any kind. Sales persons and financial advisors affiliated with BofAS or any of its affiliates may not solicit purchases of securities or financial instruments that are Restricted or Under Review and may only solicit securities under Extended Review in accordance with firm policies.

Neither BofA Securities nor any officer or employee of BofA Securities accepts any liability whatsoever for any direct, indirect or consequential damages or losses arising from any use of this information.