

## Oil

## Down but not out

- Brent prices have declined 25% since early June, driven by low trading liquidity and a mounting wall of worries: recession, China's zero-Covid policy and real estate sector, the US SPR release, and Russian production recovering well above expectations. We believe that the case for higher oil prices remains strong, even assuming all these negative shocks play out, with the market remaining in a larger deficit than we expected in recent months.
- Reiterating our bullish view, however, requires addressing the divergence between Brent prices, which averaged \$110/bbl in June-July, and the \$160/bbl Brent-equivalent global retail fuel price. We draw three takeaways from this disconnect. The good: until the recent collapse, retail prices - while not tradable - came in close to our forecasts despite all the current macro uncertainties. The bad: the disconnect between retail and Brent financial prices was much wider than we expected, keeping Brent futures well below our \$130 June-July forecast. The ugly: our retail price forecast, though in line, did not result in enough demand destruction to end the deficit.
- Updating our supply and demand forecasts, we continue to expect that the oil market will remain in unsustainable deficits at current prices. Balancing the oil market therefore still requires oil demand destruction on top of the ongoing economic slowdown, where we are more cautious than consensus. This requires a sharp rebound in retail fuel prices - the binding constraint to balancing the oil market - back to \$150/bbl Brent equivalent prices, equivalent to US retail gasoline and diesel prices reaching \$4.35 and \$5.45/gal by 4Q22.
- The unprecedented discount of Brent prices, even wider than we expected, can be explained by the worsening Russian energy crisis, as it boosts the costs of transforming crude out of the ground (Brent) into retail pump prices around the world through surging EU gas prices, freight rates, USD and global refining utilization. While we assume that the exceptional wedge between retail fuel and Brent futures prices will remain wider than previously expected, we still expect that Brent prices will need to rally well above market forwards, with our 3Q-4Q22 forecasts now \$110-125/bbl vs. \$140-130/bbl previously (with our \$125/bbl 2023 forecast unchanged).

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## Down but not out

### What is the right oil price?

Conceptually, two prices matter for modeling the oil market: (1) the retail price of fuels paid by consumers as it drives demand elasticity and (2) the crude price received by producers as it drives supply elasticity. Up until 2021, retail prices followed a stable relationship to Brent prices, leading us to use Brent prices as a common input for both sides of our fundamental modeling. This is however no longer the case, as we have recently discussed ([here](#) and [here](#)), due to significant distortions to each of the steps required to transform crude oil coming out of the ground into fuels consumed by producers<sup>1</sup>.

Understanding this disconnect is all the more important since our key tradable forecast is for Brent futures while our current framework is based on the view that retail prices are the key balancing mechanism for the oil market given record low inventories and the lack of supply elasticity (beyond our base-case increases in shale and core-OPEC production). This leaves us solving for retail prices in our fundamental modeling, the level at which demand elasticity is achieved, and subsequently deriving our Brent futures price forecast. To help in our discussion, we will express retail fuel prices as a “consumer” facing Brent price, the Brent price we estimate consumers, and the global economy, actually pay for ([see methodology here](#))<sup>2</sup>.

Looking back, our *Brent financial* price forecasts for June and July were \$125 and \$140/bbl - this was our expectation for the average level of the front-month contract on the ICE exchange. Our mapping into retail prices had us expecting a *Brent consumer* price of \$150-160/bbl. Brent futures have instead averaged \$117 and \$105/bbl - below our forecasts - while the *Brent consumer* price has been \$150-170 - slightly above our forecast.

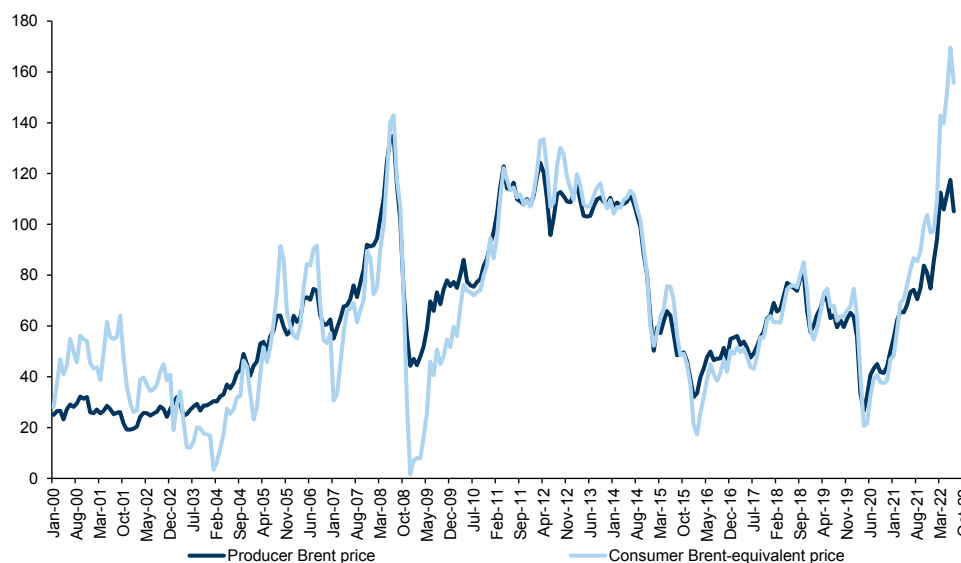
We draw three takeaways from this. **The good:** retail prices - while not tradable - came in close to our forecasts despite all the current macro uncertainties. **The bad:** the disconnect between retail and Brent financial prices was much wider than expected, keeping Brent futures well below our forecast. **The ugly:** our retail price forecast - which proved broadly accurate - did not result in enough demand destruction to end the current, unsustainable deficit.

<sup>1</sup> The calculation of Brent futures from retail prices can be broken down into three stages: (1) the difference between retail (local currency) fuel prices and wholesale (USD) fuel prices - which is driven by marketing margin (inclusive of taxes) and the effect of the USD. (2) The difference between wholesale (USD) fuel prices and physical crude prices - which is driven by refinery utilization levels and refinery input costs (freight, natural gas). (3) The difference between the price of physical oil paid by refiners and Brent financial futures. We identify six moving parts to these three stages: taxes, the broad USD, refinery margins, freight rates, global natural gas prices and the physical basis between physical and financial crude prices (while marketing margins matter as well, they are much harder to isolate and appear stable over time).

<sup>2</sup> The consumer Brent price is the answer to the question: Given global demand weighted retail prices, what Brent price would one have expected based on historical relationships? i.e. we try to map a shadow USD Brent price from local retail prices.

### Exhibit 1: The Brent price paid by consumers has significantly diverged from to the Brent price received by producers (ie. Brent futures)

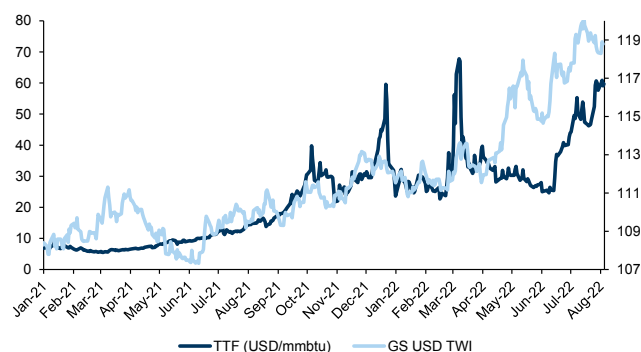
Brent (producer) and implied (consumer) Brent price (USD/bbl)



Source: ICE, CME, GPP, IEA, Haver Analytics, EIA, Goldman Sachs Global Investment Research

### Exhibit 2: The dollar and natural gas prices have both acted as headwinds to our Brent price forecasts

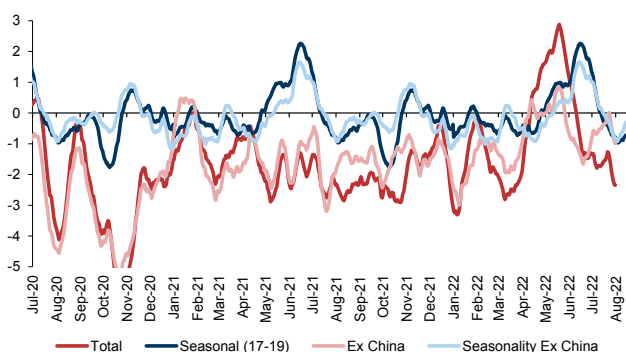
TTF (USD/mmbtu, lhs) versus GS trade-weighted dollar index (rhs)



Source: ICE, Bloomberg, Goldman Sachs Global Investment Research

### Exhibit 3: Stock draws (especially including China) remain at or deeper than seasonal levels since June

Rolling 4-week global observable inventory change vs. 2017-19 seasonal (mb/d, lighter colours are ex-China crude).



Source: Kpler, IEA, JODI, EIA, PJK ARA, PAJ, IE Singapore, Fujairah, Oilchem, Goldman Sachs Global Investment Research

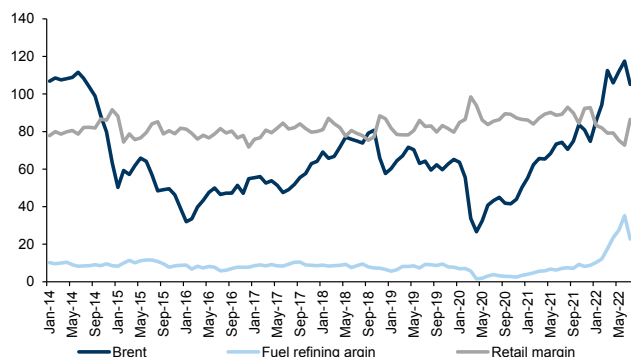
## Russian gas and oil investors are both in short supply

The much wider than expected gap between *Brent physical* prices (i.e. Dated Brent, not ICE Brent futures) and *global retail fuel* prices in Brent-equivalent terms (c.\$45/bbl on average in June-July vs. our c.\$25/bbl assumption) can be linked to the Russian energy and EU gas crises. Three of the five moving parts we identify exceeded our expectations: clean freight, EU natural gas prices and the USD, all due to the ongoing Russian energy sanctions. This was only slightly offset by weaker refining margins in July (which we had expected) and continued efforts by governments to suppress retail

prices through tax reliefs and subsidies.

**Exhibit 4: Much larger input costs - due to the Russia distortion to refining and EU gas markets - are the main drivers to the current wide differential between Brent price and retail prices**

Global demand weighted passenger fuel (gasoline and diesel) refining and retail prices (USD/bbl). Calculated in USD terms to abstract from FX impacts

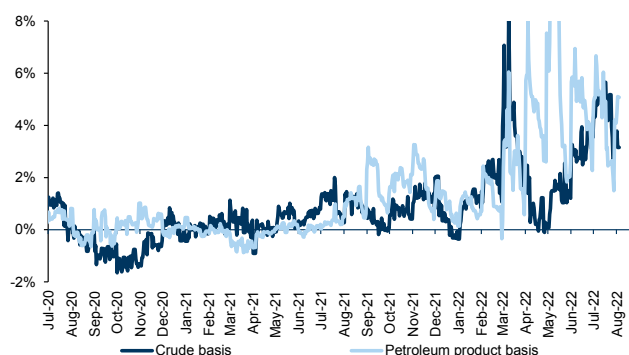


The jump in retail margin in July is typical of retailers more slowly passing on input cost decreases versus increases

Source: Platts, ICE, CME, DME, GPP, EIA, Haver Analytics, Goldman Sachs Global Investment Research

**Exhibit 5: The unprecedented price premium of physical barrels relative to financial barrels is another large distortion in the transmission mechanism of Brent prices into retail fuel prices**

Crude and products physical (cash) basis (demand and geography weighed, %ICE Brent)

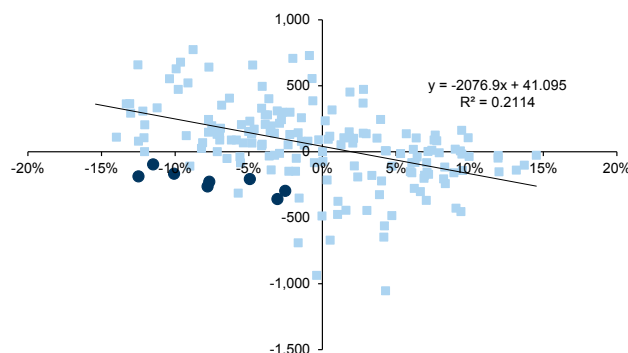


Source: Platts, CME, ICE, DME, IEA, Goldman Sachs Global Investment Research

The disconnect between *retail fuel* prices and *Brent financial* prices (traded on ICE) was even larger, due to a record wide premium of physical over financial barrels. We believe the growing lack of financial participation in the commodity futures market helps explain this record wide premium as well as the recent new collapse in Brent prices as well as the current extreme level of crude backwardation.

**Exhibit 6: The current positioning liquidation is extreme versus recent fundamental changes**

Oil market 12-mo change in managed money net length (y-axis, mb) versus 12-mo change in OECD inventories (in % of days of demand cover, versus 5y average, 1m lagged). Dark blue is 2022.



Source: IEA, COT, CFTC, Reuters

**Exhibit 7: Brent open interest and liquidity continue to fall to new depths**

Prompt ICE Brent open interest (million barrels)



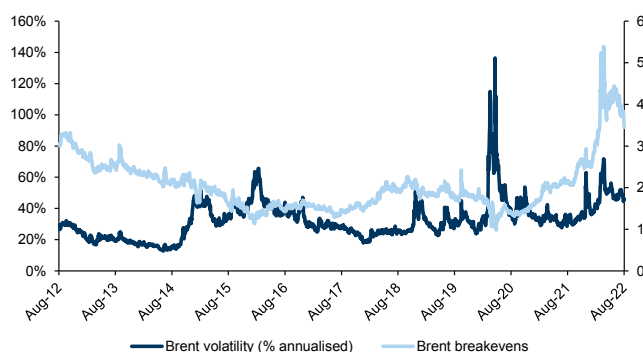
Source: CFTC, ICE, Reuters, Goldman Sachs Global Investment Research

The catalyst for this break was initially fundamental but is now financially self-reinforcing, as we recently discussed. The Covid shock and sanctions on Russia were two unprecedented fundamental disruptions, with initial fears for even greater shocks. This drove price volatility sharply higher, a move quickly exacerbated by extreme inventory levels. Importantly, this volatility forced investors away from commodities,

further supporting volatility. A key driver for this self-reinforcing mechanism is the use of value at risk (VaR), the dollar notional measure of at risk capital in a portfolio. When prices and volatility rise, so does the VaR associated with a given volume of commodities, forcing commodity market risk managers to reduce the size of their trades, leaving shrinking positions in barrel terms even if the size of the physical market hasn't changed. A similar argument holds for banks and dealers, which significantly reduces the ability for producers to hedge, further limiting their ability to invest in future production as reinvestment rates need to be reduced to match higher volatility in oil prices.

#### Exhibit 8: Volatility is elevated, especially in notional terms

Brent 3-m ATM implied volatility (%), lhs versus Brent put implied daily breakevens (USD/bbl, rhs)

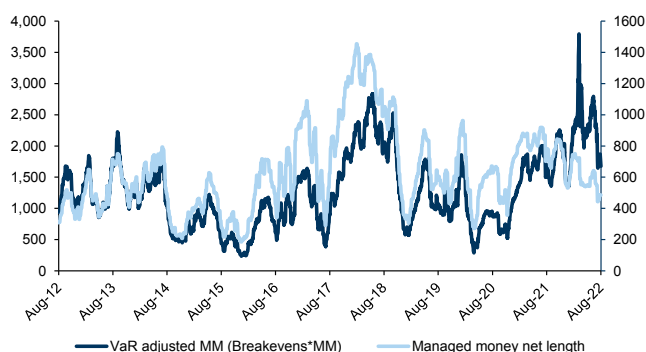


Breakevens calculated as  $[\text{flat price}] \times \sqrt{\text{annualised volatility}/365}$

Source: ICE, Bloomberg, CME, Goldman Sachs Global Investment Research

#### Exhibit 9: This has kept industry risk exposure high in USD terms but very low in barrel terms

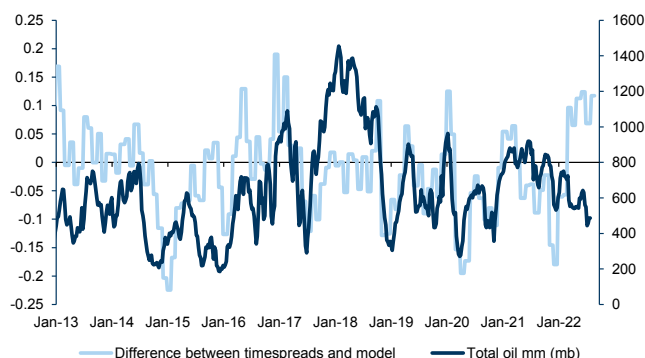
Brent market VaR proxy (Managed money net length\* daily breakeven, \$m, lhs) vs managed money net length (mb, rhs)



Source: ICE, CME, Bloomberg, Reuters, CFTC, Goldman Sachs Global Investment Research

Why does this matter since we have previously argued that commodities are real assets, pricing today's supply and demand imbalances and unable to borrow from future supply? Key is that investors' trading of commodity futures helps translate expected shifts in supply and demand into immediate price signals. In essence, investors' participation helps smooth out fundamental shocks, incentivizing supply and demand elasticities to prevent stock-out outcomes. For example, our modeling shows that oil forward curves are typically most responsive to three-month forward changes in inventories, with the corn vs. onion price volatility chasm the classic example as only the former - much less volatile - is tradable by investors.

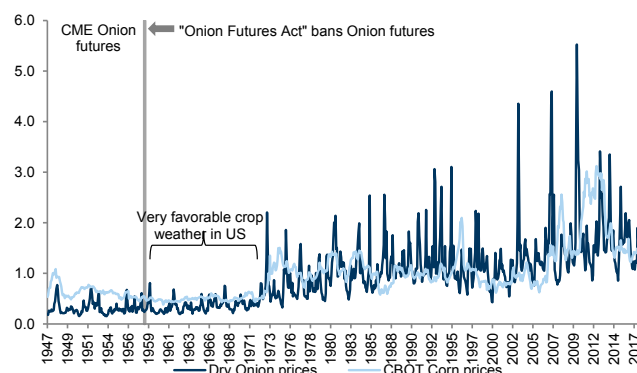
**Exhibit 10: The fall in positioning is rarely associated with markets this tight and may in fact be exacerbating market backwardation**  
 OECD commercial stocks in days of OECD demand coverage vs. 5-yr avg (lhs) vs. 1-mo to 3-yr Brent timespreads (% , rhs, inverted)



Source: IEA, CFTC, CME, ICE, Reuters, Goldman Sachs Global Investment Research

**Exhibit 11: Speculators reduce volatility and improve price discovery**

Units: Index of monthly average US Farm Producer Prices (rebased to 1 as of 1982)



Source: CME, BLS

To be clear, we are not arguing that the formation of physical commodity prices is broken - with retail prices accurately reflecting a very tight physical market in recent months. It is the pass-through to financial commodity futures that is currently distorted due to the conflict in Russia. First, the significant uncertainty that occurred as sanctions were applied on Russia kickstarted the volatility trap that has pushed investors out of commodities, creating a gap between financial crude and physical crude prices and driving the latest price fall. Second, the gas shortage in Europe is the primary cause for the unprecedented value gap between physical crude and retail fuel prices as it causes (1) historically elevated refining margins (on higher natural gas input prices and lost Russian refining capacity), and (2) the strength in the USD (which reduces the need for USD crude rally), (3) the unprecedented strength in gas-to-oil substitution for power generation which will exacerbate the tightness in diesel.

### All oil prices need to be higher given still unresolved deficits

Our *Brent financial* price view therefore comes down to (1) our updated fundamental supply and demand expectations, (2) the level of *retail fuel* prices needed to balance the oil market through demand elasticity (the only buffer left in the face of record low inventories and inelastic supply), (3) the expected gap between these *retail fuel* prices and *Brent physical* prices and finally (4) how the recent investor exodus from commodity futures markets will evolve, driving the wedge between *Brent physical* and *Brent financial* prices.

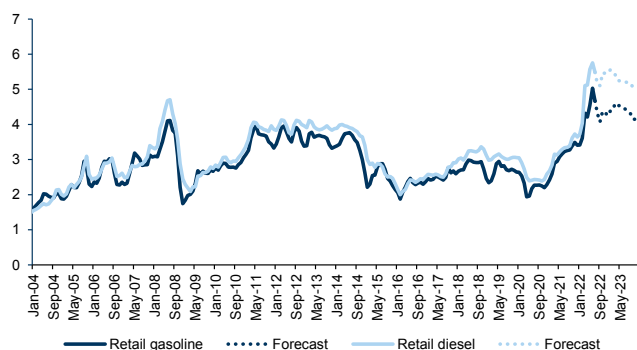
1. Our updated fundamental forecasts point to continued disappointments in supply, with demand instead supported by the still ongoing Covid reopening and gas-to-oil substitution. This will leave markets in open-ended deficits at current spot prices. This is the key to our still bullish view as commodity markets need to balance and inventories can't go to zero.
2. This requires demand destruction on top of the ongoing economic slowdown, requiring high retail fuel prices to end the market deficit. Even cautiously assuming weaker economic growth than our economists, this leaves us forecasting that

consumer Brent prices will need to average \$150/bbl in 4Q22 and in 2023.

3. Updating our EU gas, refining margin and USD assumption, we expect the differential of Brent-equivalent consumer prices to *Brent physical* prices to average \$27/bbl in 4Q22 vs. the exceptionally wide c.\$45/bbl seen in June/July and the \$15/bbl that we had expected previously over 2H22. With refinery runs surprising to the upside this summer - the primary reason for the compression in refinery margins recently - we expect refining margins to average \$10 vs. \$14/10/bbl previously for 2H22/2023. This incorporates higher EU gas prices than we previously expected.
4. Forecasting how the lack of financial participation in Brent futures will evolve is much harder, however, leaving us having to assume that the basis between Brent physical and financial prices narrows modestly from historically wide levels to \$5/bbl through 2023. This leaves us forecasting *Brent financial* prices of \$125/bbl in 4Q22 and 2023 vs. \$130 and \$125 previously.
5. This lack of investor participation is likely to weigh most on near-term prices, leaving us making the largest downgrade to our forecast in 3Q22, now at \$110/bbl vs. \$140/bbl previously. This revision reflects (1) a consumer Brent-price equivalent of \$140/bbl vs. \$160/bbl previously, reflecting higher Russian supply and a faster than expected rate of SPR release (all offset in 4Q22), (2) a \$30/bbl discount of Brent to retail prices vs. \$20/bbl previously, reflecting a stronger dollar and sticky high physical premium (ie. lack of investor participation in the face of still high recession concerns).
6. Based on our modeling, we are further introducing - for the first time - a forecast for US retail gasoline and diesel prices, which we expect to rebound to \$4.35 and \$5.50/gal by 4Q22, with average levels of \$4.40 and \$5.25/gal in 2023. This forecast reflects our expectations for US refining and marketing margins as well as assumes flat state and federal taxes. We forecast that US retail fuel prices will rally into year-end then decline from 2Q23 onward as refining and marketing margins start to normalize.

**Exhibit 12: US retail fuel prices should ease in 2023 with refining margins**

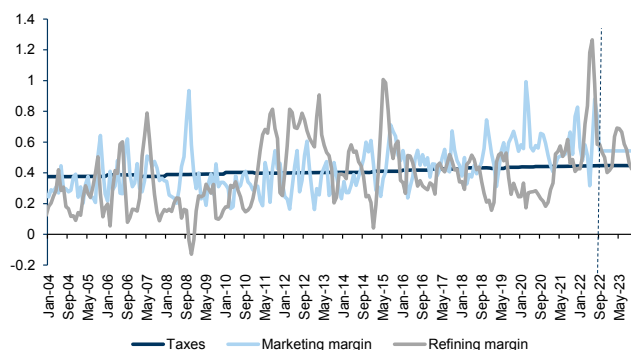
US retail gasoline and diesel price forecasts (USD/gal)



Source: EIA, Goldman Sachs Global Investment Research

**Exhibit 13: Refining margins will nonetheless remain at historically elevated levels**

Breakdown of retail premium to crude prices (USD/gal)



Source: EIA, CME, ICE, Goldman Sachs Global Investment Research

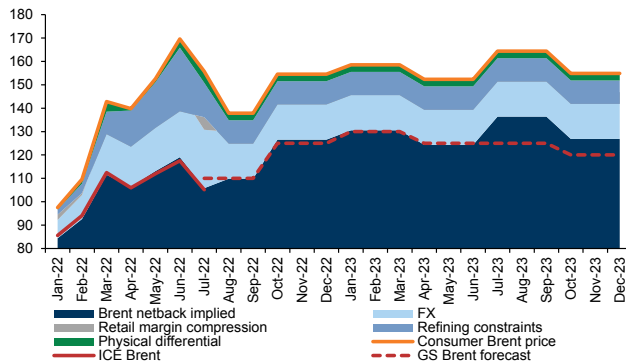
Our reiterated bullish view has three drivers: (1) oil markets remain undersupplied - with



record retail fuel prices unable to stop the market deficit in June and July, and with prices now much lower and helping support demand; (2) higher Brent financial prices are required, even assuming a historical large gap discount to retail fuel prices; (3) oil remains the cheapest source of energy that is logistically substitutable against gas.

#### Exhibit 14: We account for the present distortions in the retail price transformations to produce our Brent price forecast as a netback

Breakdown of Brent price forecast from required consumer Brent-equivalent prices (USD/bbl)



Source: Goldman Sachs Global Investment Research

#### Exhibit 15: While we raise our consumer oil price forecast, bigger distortions cause us to lower our Brent price forecast

USD/bbl, USD/gal for retail prices

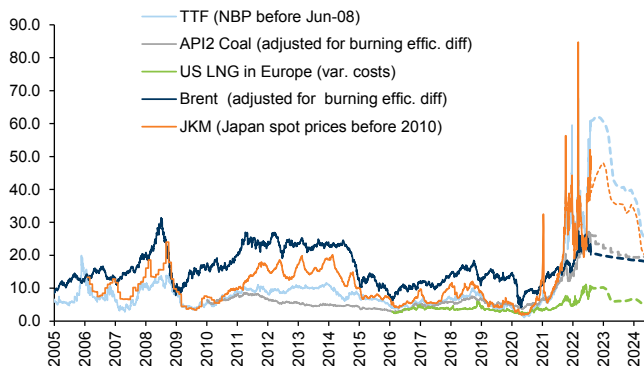
	Brent spot			WTI spot			Brent-WTI			Consumer oil price		US Retail prices		
	Spot	Prior	Fwd	Spot	Prior	Fwd	Spot	Prior	Fwd	Brent-price equivalent	Prior	Gasoline	Diesel	All-grades
2022	112	125	112	108	119	108	3.4	6.0	3.4	154	153	4.60	5.48	
3Q22	110	140	97	105	137	90	5.0	3.0	6.6	144	158	4.35	5.24	
4Q22	125	130	94	120	125	88	5.0	5.0	5.8	155	143	4.32	5.46	
1Q23	130	130	92	125	125	86	5.0	5.0	5.6	159	135	4.46	5.49	
2Q23	125	130	90	120	125	84	5.0	5.0	5.7	152	135	4.53	5.24	
3Q23	125	125	88	120	120	82	5.0	5.0	5.8	164	135	4.38	5.20	
4Q23	120	115	87	115	110	81	5.0	5.0	5.8	155	135	4.13	5.05	
2H22	118	135	95	113	131	89	5.0	4.0	6.2	149	151	4.34	5.35	
2023	125	125	89	120	120	83	5.0	5.0	5.7	158	135	4.38	5.24	
3m	125	130	94	120	125	88	5.0	5.0	5.7	155	143	4.32	5.46	
6m	130	130	92	125	125	86	5.0	5.0	5.6	159	135	4.46	5.49	
12m	125	125	88	120	120	82	5.0	5.0	5.8	164	135	4.38	5.20	

Source: ICE, CME, Goldman Sachs Global Investment Research

In our last update in early June, our preferred short-term implementation of our bullish view was to be long crude timespreads to capture the summer increase in runs that we expected would far exceed the downside risks to demand. With this view having played out, our preferred short-term implementation of our bullish view is now to be long distillate prices outright, to benefit from fall maintenance and express our bullish flat price view as closely as possible to retail prices and to gas-to-oil substitution.

#### Exhibit 16: After converging since late last year, natural gas prices have significantly dislocated to the rest of the power complex

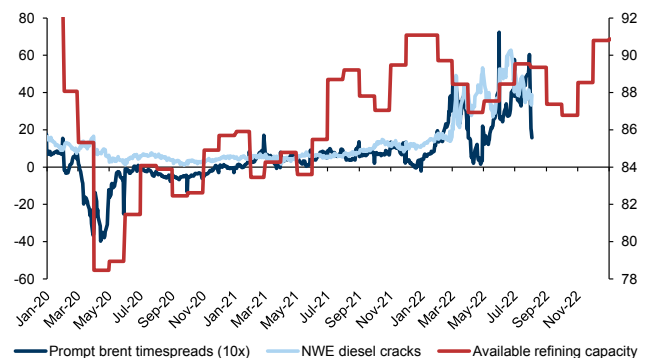
Power generation fuels in natural gas equivalent terms (USD/mmbtu, adjusted for heat rates, efficiency, and carbon costs)



Source: Platts, Bloomberg, ICE, CME, Goldman Sachs Global Investment Research

#### Exhibit 17: Distillate cracks and Brent timespreads are correlated (negatively and positively) to available refining capacity

Prompt NWE diesel cracks (USD/bbl, lhs) and prompt Brent timespreads (10x, USD/bbl, lhs) versus available refining capacity (operational less maintenance, mb/d, rhs)



Source: IIR, IEA, BP, ICE, CME, Platts, Goldman Sachs Global Investment Research

## From fundamental to financial risks

The first set of risks to our view is of course the still elevated level of fundamental uncertainty. We discuss our updated forecasts in nine questions in this report - with the

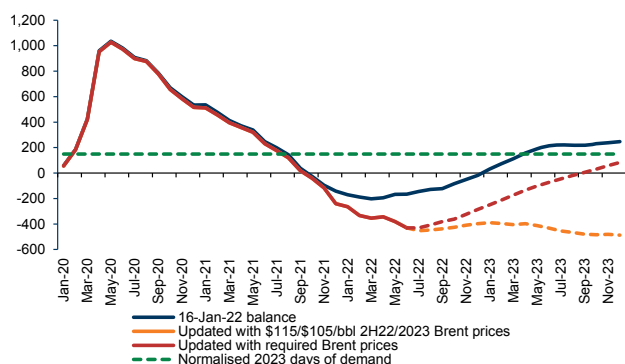


notable changes being: (1) a tighter starting point for the oil market than we had expected in June-July, (2) a large upward revision to Russian production mostly offset by supply downgrades elsewhere, (3) still resilient expected demand growth, especially after the move lower in prices and the growing shortage of European gas.

At our supply forecasts, we estimate that the oil market is currently pricing in global real GDP growth outside of China of 0.8% yoy in 2H22 and 2023 (versus GSe at 2.1%, BBG consensus 2.4%). We believe this is too conservative, 0.35% below the average level of global real GDP growth during the four post-war recessions that proceeded 2008. Assuming instead a still cautious 1.2% and 1.9% yoy global real GDP growth outside of China in 2H22 and 2023, and including the Covid reopening effects (jet fuel, on-road Asia), a modest further recovery in Chinese demand as well as expected higher natural gas-to-oil demand substitution, we forecast global oil demand growth of 1.2 mb/d yoy in 2H22 and of 2.0 mb/d yoy in 2023 (at our update price forecast, with 0.7 and 0.5 mb/d higher demand growth at \$110/bbl Brent prices instead). At our mostly price-inelastic supply forecast, this leaves global inventories drawing at current spot prices, with our bullish price forecast needed to end 2023 at normalized inventories but with OPEC spare capacity at a record low of 1.2 mb/d (1 mb/d lower than 2Q22).

**Exhibit 18: Our updated supply and demand expectations are unable to rebuild the required inventory buffer (without assuming additional price driven-demand destruction)**

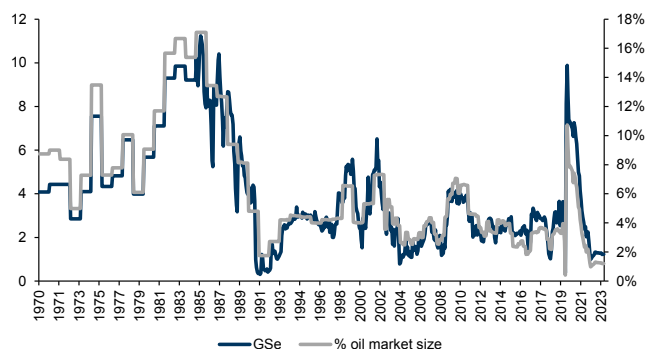
Global stocks vs Dec-19 levels at previous assumed Brent prices before marginal demand destruction and shale growth (mb)



Source: Kpler, Kayros, JODI, IEA, EIA, PAJ, PJK ARA, Oilchem, IE Singapore, Goldman Sachs Global Investment Research

**Exhibit 19: Spare capacity is likely to remain at uncomfortable, historical lows**

Global spare oil production capacity in mb/d (lhs) and % (rhs)



Source: IEA, EIA, Platts, Goldman Sachs Global Investment Research

The second set of risks is on the gap between *Brent physical* prices and *retail fuel* prices. Unexpected refinery issues (due to high runs, sanctions or hurricanes) or higher EU gas prices and a stronger dollar are all risks for further widening of the expected c.\$45/bbl gap between *Brent physical* and *Brent consumer* prices similar to that in recent months. Taking a step back, the Russia shock to energy markets has proved bullish TTF vs. bearish Brent so far this year, depressing *Brent financial* prices relative to retail fuel prices, with oil exports also holding up. As we look to 2023, the ongoing forced EU gas demand rationalization (in large part solved with substitution to oil), the modest further downside to Russian gas exports to Europe but greater downside to Russian oil exports as the EU embargo kicks in all point to a likely reversal in 2023, helping support our bullish *financial Brent* forecast.

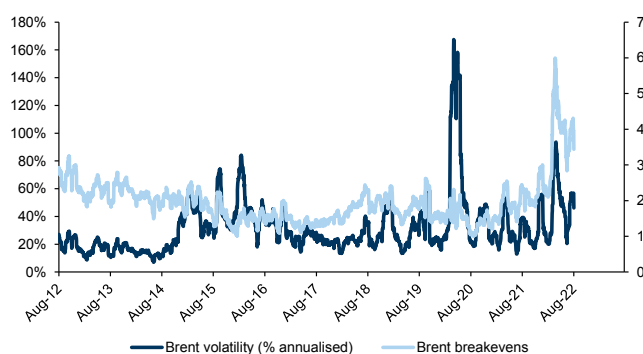
## Solving for a lack of investors

The third risk to our forecast resides in the potential further exodus of investors from the commodity futures market. We see two reasons to expect a short-term improvement and, if insufficient, two structural offsetting repricing mechanisms to this lack of participation.

- Lower price levels and volatility should help ease the current liquidity and volatility trap. Given low levels of inventories, it is hard to argue that oil price volatility should materially decline. Nonetheless, implied and realized volatility levels have started to decline as some of the largest recent oil fundamental uncertainties are clearing up: (1) the recovery in Russian exports and the easing of EU oil sanctions on Russia are reducing the risks for a material loss in supply, (2) Chinese oil demand appears increasingly resilient to Covid waves, while (3) the probability of a bearish surprise by OPEC+ has faded given diminished spare capacity. For a given USD VaR allocation, this should allow for more contracts (i.e. barrels) traded. A similar dynamic should play out at the current lower price levels, as this will further allow for more contracts (i.e. barrels) to be traded. All else constant, these two dynamics should allow for a short-term rebound in liquidity once the late summer doldrums end. Such a dynamic will also likely play out in petroleum products given the sharp decline in cracks. It could be helped further by investors returning to commodities if inflation proves more persistent than expected.

### Exhibit 20: Volatility is elevated, especially in notional terms

Brent put implied volatility (% annualised, lhs) versus Brent put implied daily breakevens (% annualised, rhs)

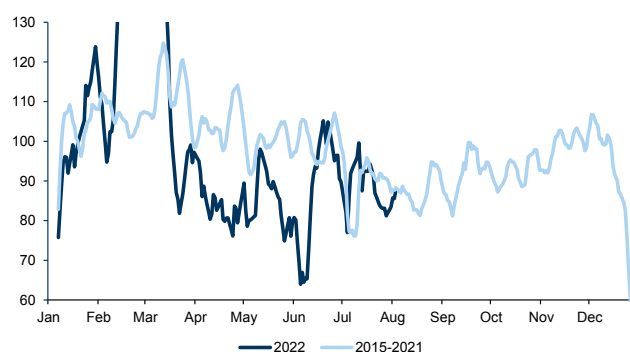


Breakevens calculated as  $[\text{flat price}] \times \sqrt{\text{annualised volatility}/365}$

Source: ICE, Bloomberg, CME

### Exhibit 21: We are still amidst the least liquid time of the year in oil markets (and many others)

Seasonal traded volumes for Brent (Indexed to first 10 days)



Source: Bloomberg, Goldman Sachs Global Investment Research

Should this not play out, the lack of financial participation in commodity futures markets would still get resolved medium-term in two ways in our view:

1. **Sustained backwardation levels.** Investors' participation in commodity futures can be active (trading around changes in fundamentals) or passive through long rolling futures positions. Most striking in the recent collapse in investor participation has been the exodus of passive capital, in part due to ESG constraints/excess volatility and simply very poor commodity returns in the past decade that pushed the asset out of allocation choices. Backwardation is what attracted these passive investors

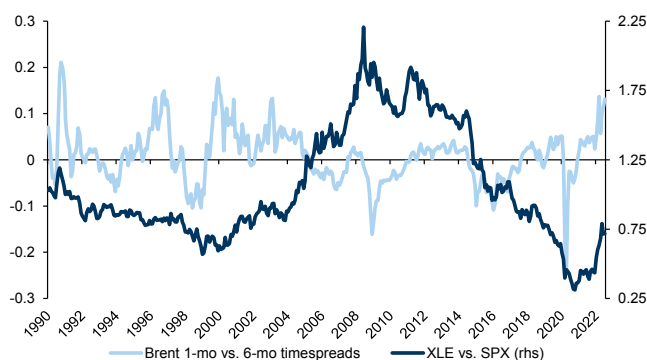
into commodities in the first place, with the current record level of backwardation likely to start drawing them in again, improving liquidity. This dynamic starts with the economic agent that most benefits from trading commodities: a producer looking to hedge to reduce his cash flow volatility and, hence, his cost of capital. This selling flow in deferred commodity futures in turn depresses deferred prices relative to spot clearing prices up to the point where liquidity providers emerge. This is the source of long-run returns in commodities: the convergence yield offered by backwardation to passive investors - with this risk-adjusted level of returns having to compete with other asset classes to attract such investors<sup>3</sup>. The 1-year forward roll-up in Brent futures of 18% on average this year suggests that the investor exodus is increasingly exceeding the decline in producer hedging flows (especially since US private producers continue to be aggressive hedgers and the fastest source of US production growth).

2. **A cross-asset energy rotation.** An even larger price disconnect between Brent financial and physical prices or even greater levels of backwardation could conceptually materialize. The economic agent that would be most impacted by this would oil producers, as they would budget (or hedge) at severely discounted future prices. This would in turn reduce global oil production, exacerbating the premium of physical oil barrels. This would leave these producers realizing very high physical prices on their production but operating at low reinvestment rates, paying out a significant dividend (in a period of likely high inflation). Investors would in turn seek exposure to these high spot prices through an increased allocation to the equity - and dividend streams - of these producers, finally providing the capital base necessary to ramp up capital spending to raise production. This is many ways similar to what occurred in 1999-2003/04, when significant Brent backwardation and cash premia were similar to current levels, setting the stage for the subsequent energy equity rally that solved the energy under-investment of the 2000s. As we have argued previously, it is such an equity rally that is ultimately necessary for the supply cycle to start, as oil cash flows remain too small relative to enterprise values - given the scale of the global equity and debt markets - to fund a significant investment cycle.

Ultimately too slow a return of investors to either commodity futures or energy equities could precipitate a return to the solutions of the 1970s: nationalizations and the emergence of large conglomerates (the only capital structure able to withstand high price volatility), the return of fixed price contracts (given the loss of commodity future liquidity) and government intervention in energy markets and investments. These are the solutions that Europe is already having to start to deploy in natural gas.

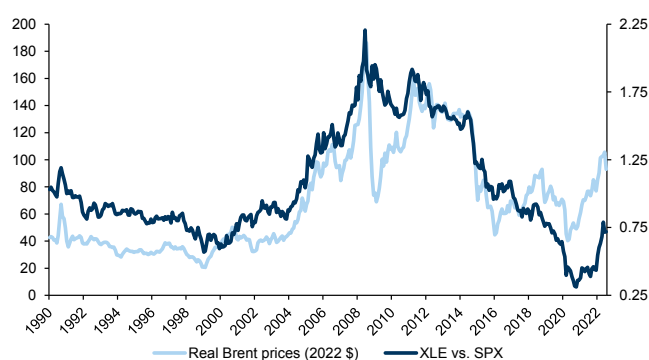
<sup>3</sup> This is the key appeal for passive investors to participate in commodity futures, which are conceptually a zero-sum game that does not directly provide capital to companies but instead needs to generate similar risk-adjusted returns to funding a company - through either debt or equity - with comparable long-run positive roll returns compensating.

**Exhibit 22: It took sustained tight markets in 2000-2003 to trigger the outperformance of energy relative to the broader market**  
Brent backwardation in % (lhs); Ratio of XLE to SPX (total returns, rhs)



Source: FactSet, Compustat, ICE

**Exhibit 23: The supply cycle is triggered by a tight oil market but funded by the equity and debt capital markets**  
Ratio of XLE to SPX; Brent 6-mo forward price adjusted for inflation



Source: FactSet, Compustat, ICE

## Why oil demand is still robust despite higher prices and weakening economic growth

### Everyone is concerned about a recession - is reported oil demand data showing signs of weakness?

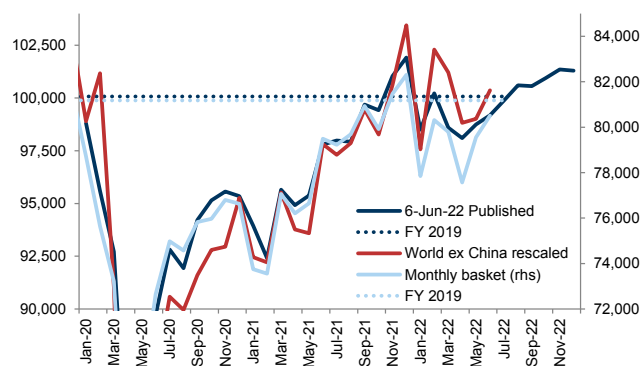
Concerns are warranted - recession risks are rising and retail fuel prices were at levels in June-July equivalent to Brent trading at \$160/bbl. Despite these headwinds, we find that reported oil demand has held up surprisingly well:

- Data for our monthly reported demand sample (covering c.81% of global demand for May and 55% for June) shows demand tracking above our expectations ([Exhibit 24](#)) following downward revisions in April. The demand recovery has been led by jet fuel (+1 mb/d YoY for the sub-sample), with the expected weakness in gasoline demand (-0.5 mb/d, given higher price elasticity) offset by strength in industrial products potentially being pulled into the power stack ([Exhibit 31](#)).
- Looking at the regional breakdown in [Exhibit 26](#) and [Exhibit 27](#), we find that US demand surprised to the upside in 1H22 by c.0.4 mb/d, although recent datapoints suggest this outperformance has ended (more on this below). Other developed countries meanwhile underperformed by 0.25 mb/d in 1H22, although mobility data in Europe has remained been quite robust.
- We find an even more robust story in EM, despite the stronger dollar. China demand has recovered from the 2Q22 lockdowns faster than expected, other BRICs consumption has also realized stronger - now clearly above 2019 levels - with Russian demand notably not suffering from the heavy expected hit to GDP from the war with Ukraine and associated sanctions. Lastly, other emerging markets (for which we only have a c.1/3 sub-sample of monthly data) are also showing signs of resilience, with data for this grouping exceeding 2019 levels since March, and exceeding our expectations in May.

- The prevalence of retail government interventions such as price freezes/controls (such as those in China and India, versus tax holidays in the OECD) continues to shield oil demand more than expected. Additionally, large emerging market economies are positively levered to high commodity prices on average (versus DMs), driven by LatAm, Middle East, and Africa, helping support their demand growth (Exhibit 30), as was the case in 2009 vs. 2016 for example.
- These conclusions are corroborated in implied demand data - measured as the global level of demand calculated from the more complete supply and inventories data, where deep draws in June and July of c.1.3/2.3 mb/d implied demand levels c.1.7 mb/d above our prior June-22 expectations. This also indicates that recent prices haven't been sufficiently high to generate the required builds this market requires to regain the depleted system buffers of stocks and spare capacity.

#### Exhibit 24: The monthly sample of countries with June data implies demand levels slightly above our prior expectation

GS published global demand (kb/d, lhs) versus high-frequency monthly basket (kb/d, rhs)

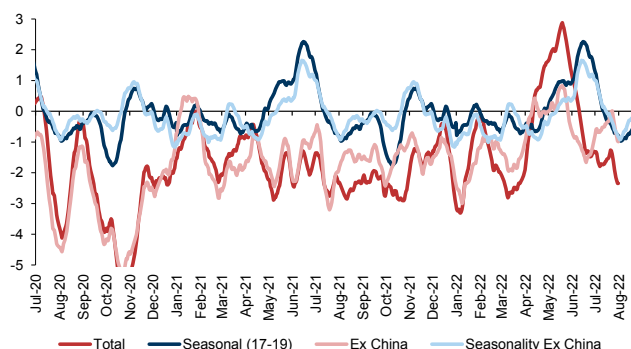


Monthly basket is sample of countries covering c.80% global demand through May, June extrapolated from higher frequency subsample for June covering c.55% global demand

Source: IEA, EIA, JODI, National sources, Goldman Sachs Global Investment Research

#### Exhibit 25: Deep observed draws imply demand is even more robust

Rolling 4-week global observable inventory change vs. 2017-19 seasonal (mb/d, lighter colours are ex-China crude).

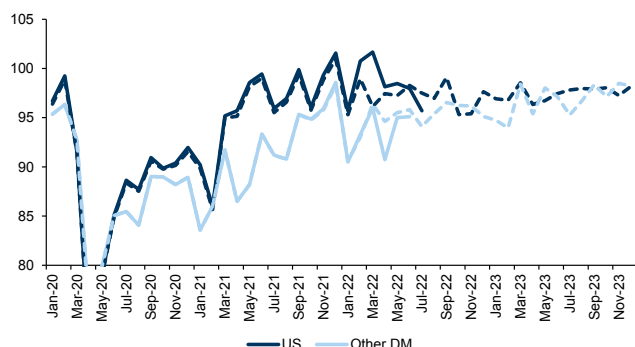


We scale up EM stocks to account for incomplete coverage, recent deep observed EM draws could potentially be overstated if unobserved stocks exhibit different behaviour

Source: Kpler, IEA, JODI, EIA, PJK ARA, PAJ, IE Singapore, Fujairah, Oilchem, Goldman Sachs Global Investment Research

### Exhibit 26: US demand has so far outperformed, though this is expected to invert with the continued recovery in international travel

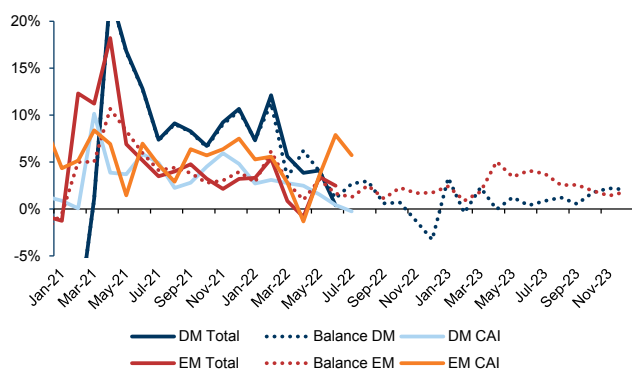
OECD oil demand indexed to 2019 levels (solid line is monthly sample, dashed is GS Jun-22 published S&D balance)



Source: IEA, EIA, JODI, National sources, Goldman Sachs Global Investment Research

### Exhibit 28: Oil demand growth is reconverging back to its historical relationship to economic growth, although some supportive base effects (jet, China, omicron) remain

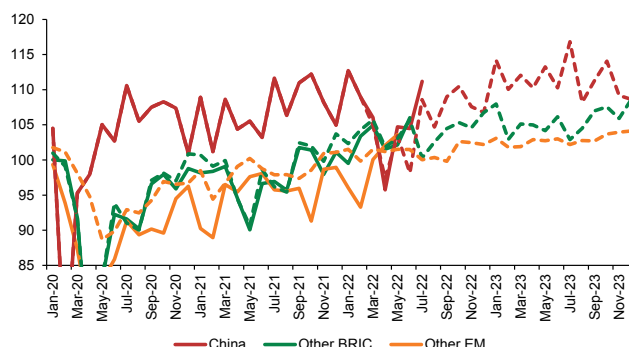
High-frequency demand basket for DM and EM subsamples (and GS balance forecasts) versus GS Current Activity Indicators (CAI, % YoY)



Source: IEA, EIA, JODI, National sources, Goldman Sachs Global Investment Research

### Exhibit 27: EM demand looks in line with our balances at present with most forward growth coming from China

Non-OECD oil demand indexed to 2019 levels (solid line is monthly sample, dashed is GS Jun-22 published S&D balance)

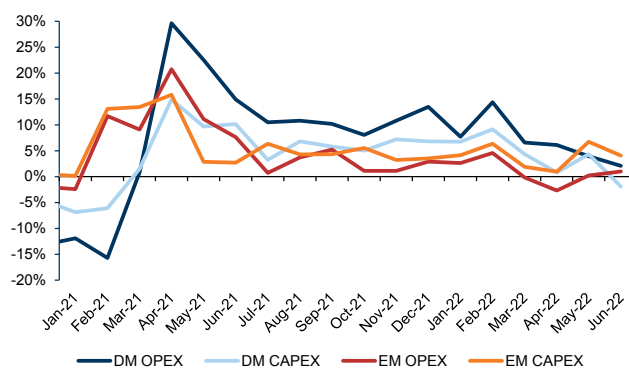


For other EM - the only group where we have a partial sample - our subsample likely understates the demand recovery seen across the group as it is overweight Asia and Middle East versus Africa and Latin America

Source: IEA, EIA, JODI, National sources, Goldman Sachs Global Investment Research

### Exhibit 29: There has been a relative recovery of CAPEX demand in May/June, led by EM, with fuel oil and diesel leading the way, possibly into power

DM and EM high frequency demand samples split by OPEX and CAPEX associated demand

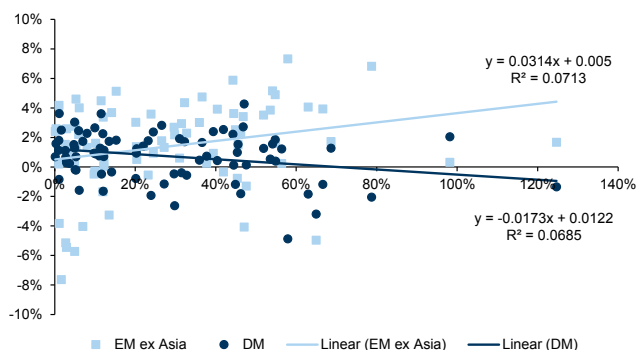


OPEX includes LPG, naphtha, jet fuel, gasoline. CAPEX includes diesel, fuel oil, other products.

Source: IEA, EIA, JODI, National sources, Goldman Sachs Global Investment Research

**Exhibit 30: Demand growth in EMs (ex Asia) exhibits a (weak) positive correlation to oil price levels versus negative for DMs as credit expansion and better terms of trade support their economies**

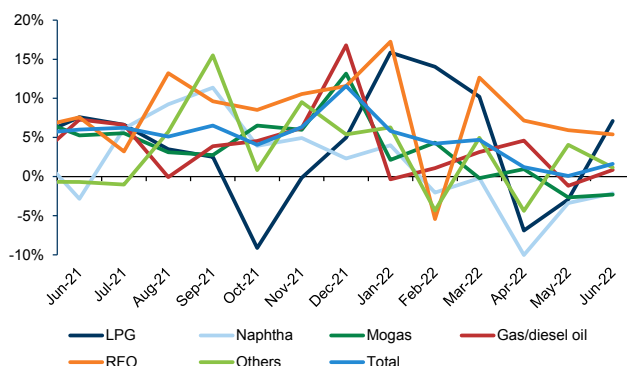
YoY Brent price changes (% , x-axis) vs YoY oil demand changes (% , y-axis) for positive Brent increases only



Source: IEA, ICE, CME, Goldman Sachs Global Investment Research

**Exhibit 31: Fuels most associated with potential heating demand have held up relatively well**

Demand by product within high frequency subsample (% YoY, excluding jet fuel)



Source: IEA, EIA, JODI, National sources, Goldman Sachs Global Investment Research

## How about high-frequency data - is demand taking a hit?

Looking at more contemporaneous mobility data, we observe a sequential weakening in implied passenger car demand (seasonality and bias-adjusted) of almost two percentage points (versus March-June 2022 average). This amounts to 800 kb/d demand destruction given c.40 mb/d road oil demand. While this seems a lot, it is still insufficient to balance the market, and is set to reverse at current prices:

- While such a demand impact seems large, it implies a price elasticity of just c.2-2.5% given (1) the c.30% increase in consumer Brent-equivalent oil prices alongside (2) essentially flat real sequential GDP growth (global ex China).<sup>4</sup> This observed elasticity is lower than the c.3% historical negative oil demand elasticity. As such, we do not find the observed sequential weakness in demand to be inconsistent with our expectations.
- Based on our high-frequency tracking of mobility, flight schedules, vessel movements, and petchem plant throughput, our estimate of demand in July is consistent with c.100 mb/d (versus 99.9 mb/d published 6-Jun-22, [Exhibit 33](#)). However, as already noted, deep observed draws imply demand more than 1 mb/d higher than this at present, which may be accounted for by wide-scale gas-to-oil switching for which we do not have good quality, high-frequency, measurements<sup>5</sup>. This would nonetheless point to insufficient demand destruction through prices.
- The recent c.\$35/bbl combined price fall in crude prices and refining margins is set to unwind this insufficient level of demand destruction. While retail prices have

<sup>4</sup> This assumes negligible price-induced demand destruction in the other c.60% of oil demand (petchems, jet fuel, industry, power, etc) and that the vast bulk of demand destruction occurs for passenger car demand where prices reflect final consumption rather than intermediate/input costs.

<sup>5</sup> The inventory changes could be overstated due to the scaling factors we use predominantly in EM regions to account for poor data coverage. These scaling factors were calibrated for some countries based on official government monthly data as well as from our implied (supply minus demand) imbalances.

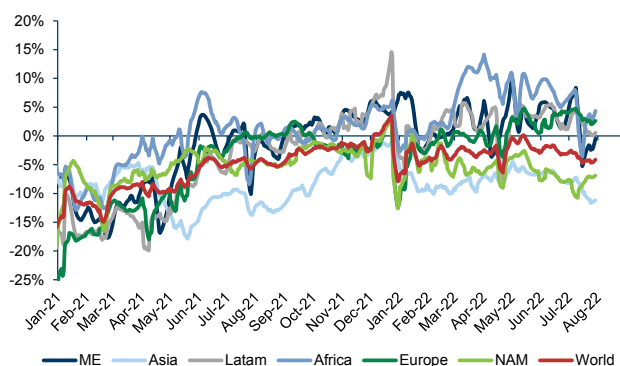


admittedly lagged this significant fall in wholesale prices, as is historically the case<sup>6</sup>, we would also expect marketing margins to soon normalize to their low May-June levels, reflecting increasing government support and subsidies.

- Admittedly, mobility may be overstating demand, as Google's data - unlike the now-terminated Apple mobility data - does not distinguish the mode of transport used by individuals, just the areas they frequent. As such, it would not capture those switching their commute from car to train for example, a more likely mechanism in Europe than in the US.

#### Exhibit 32: Sequential declines in mobility have been consistent with our assumed elasticities given the increase in retail prices

Passenger vehicle demand vs. 2019 levels by region (seasonally adjusted)

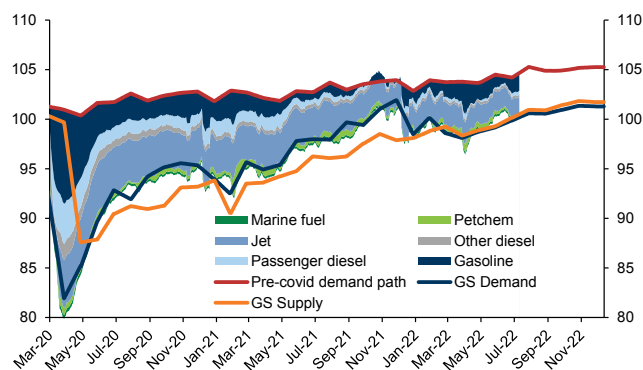


Eid will have sharply reduced mobility in Middle East and Africa in mid-late July. Google LLC "Google COVID-19 Community Mobility Reports". <https://www.google.com/covid19/mobility/> Accessed: 02-Aug-22

Source: Apple, IEA, JODI, Goldman Sachs Global Investment Research, Google COVID-19 Community Mobility Reports

#### Exhibit 33: Mobility data implies demand surprised to upside in June led by China and has stayed near or above 100 mb/d in July

High frequency oil demand (areas measure shortfall from pre-covid trend) vs GS 6-Jun-22 Supply-Demand balances (mb/d)



Google LLC "Google COVID-19 Community Mobility Reports". <https://www.google.com/covid19/mobility/> Accessed: 02-Aug-22

Source: Google COVID-19 Community Mobility Reports, IEA, EIA, JODI, OAG, IIR, Reuters, Goldman Sachs Global Investment Research

### What about US gasoline demand - hasn't it been weak recently?

Recent weekly US oil demand data from the EIA has disappointed versus market and our expectations, especially following YTD outperformance. We believe, however, that this weakness is overstated and set to reverse:

- Our alternative measures of US gasoline demand - based on mobility and ethanol - point to consumption still in the c.9.0-9.1 mb/d range versus the recent EIA four-week average of 8.5 mb/d (Exhibit 34). This could be due to data/technology issues the EIA has faced since late June, as well as overstatement of exports (versus vessel-tracking data), as well as tertiary stock draws (as fuel stations wait for lower crude prices to be reflected in rack prices).<sup>7</sup>
- Such a sequential c.0.2 mb/d (c.2%) fall in gasoline demand since March-June would be in line with the price elasticities of demand that we use given where retail prices

<sup>6</sup> We find that retail prices tend to follow wholesale prices with a more lagged response to the downside than for upside changes.

<sup>7</sup> Product supplied (implied demand) is measured as production + imports - exports + primary and secondary inventory draws. Recent product supply data has diverged from refinery runs. Overstated exports and total inventory builds (due to coverage only of primary and secondary centres) will similarly understate true demand.

have been. Several fuel retailers and refiners (Valero, Shell, PBF, Delek, P66, Murphy) have commented this earnings season that US gasoline demand has remained robust, comforting us in our estimate, and it has already begun rebounding from the recent lows as retail prices have declined.

- Monthly final data over March-May observed upward revisions of 0.1-0.15 mb/d to weekly gasoline demand.

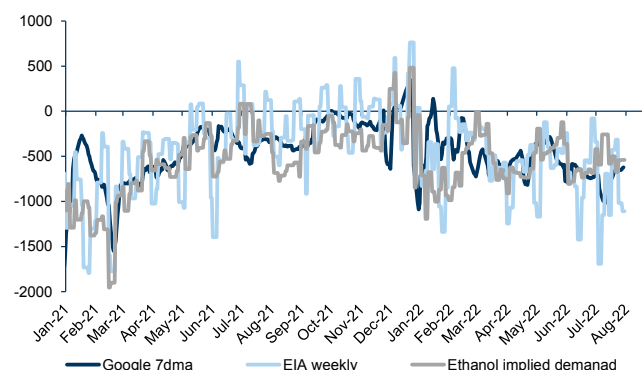
Ethanol and mobility data nonetheless corroborate a sequential weakening in US gasoline demand (versus 2019 seasonals), likely explained by the combination of prices, Covid and a new seasonality - which should all be transient:

- While US gasoline prices are low relative to other DMs due to low excise taxes, they have for the same reason faced the largest percentage changes globally, implying that US gasoline demand elasticity should be relatively large.
- The lack of state-sponsored childcare may also be resulting in a new summer increase in work-from-home that is less evident in the workplace mobility data in the rest of the world ([Exhibit 35](#)). This could therefore be a new, recurring seasonality in US gasoline demand patterns.
- High implied Covid-19 positivity rates in [wastewater data](#) also suggests that the current infection wave may be keeping people at home.
- Lastly, the reopening of international travel, although a large net boost to oil demand, may be subtracting gasoline demand from fewer domestic vacations. We estimate this could be as high as c.50 mb/d during the summer months, an overall negligible figure.

Finally, we find that US distillate demand also looks understated versus our truck/rail/weather-based modeling ([Exhibit 36](#)), most likely due to overstated exports as well as a high 2021 base (where monthly demand realized 150 kb/d lower than weeklies). Further corroborating our view that some EIA data may be distorted recently, the early July fall in jet fuel demand (now normalized) had not lined up well with our daily tracking of flights and TSA checkpoint figures.

### Exhibit 34: US demand has sequentially weakened but not to the extent implied by weekly data

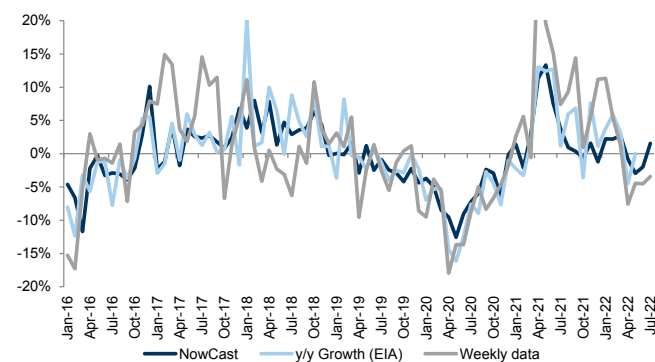
US motor gasoline demand vs 2019 levels implied from different measures (kb/d)



Source: EIA, Google COVID-19 Community Mobility Reports, Goldman Sachs Global Investment Research

### Exhibit 36: Distillate demand data also looks too weak in the weekly data versus our modelling

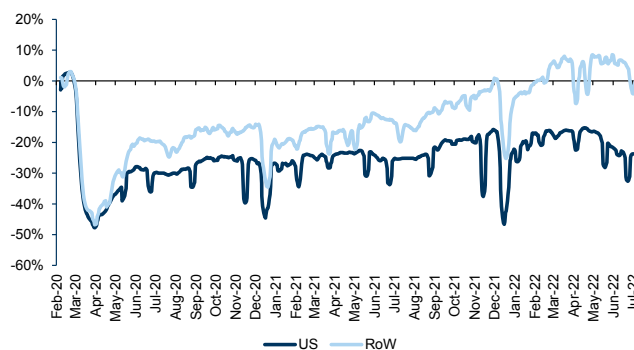
US monthly distillate demand implied from weekly PSW data and from Nowcast with trucking, rail, weather inputs (% YoY)



Source: EIA, Bloomberg, Goldman Sachs Global Investment Research

### Exhibit 35: US workplace mobility has dropped since late Spring, either reflecting a new WFH summer seasonality or the recent Covid wave

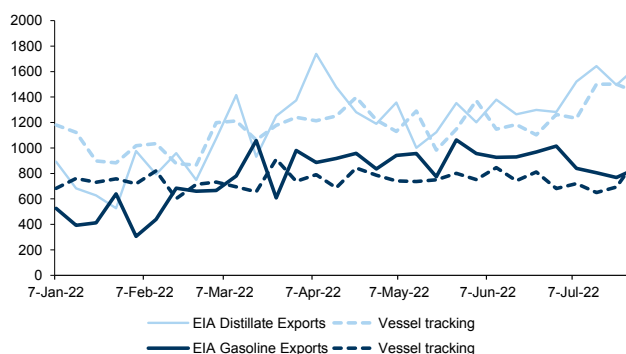
Workplace mobility (bias but not seasonally adjusted) versus early 2020 baseline



Source: Google COVID-19 Community Mobility Reports, IEA, Goldman Sachs Global Investment Research

### Exhibit 37: Exports seem to have been relatively overstated in recent months

EIA weekly reported product exports versus vessel tracking implied estimates (kb/d)



Source: EIA, Kpler, Goldman Sachs Global Investment Research

## Is Chinese demand disappointing due to its zero Covid policy and a weak housing sector?

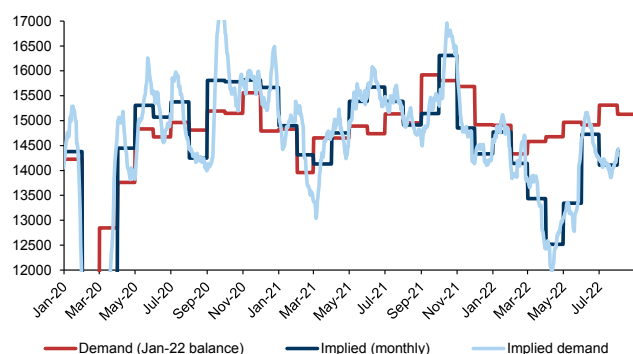
China demand has outperformed our cautious expectations:

- Chinese demand rebounded rapidly from the Spring lockdowns as the central government undertook more surgical Covid responses to prevent the intense lockdowns faced by Shanghai and Beijing. As a result, after Chinese demand fell 2.5 mb/d at its peak during April, demand since June is tracking 0.5 mb/d higher than we had expected in our previous balance update ([Exhibit 38](#)).
- Since June, there has been a small increase in Covid cases and an associated increase in our China Effective Lockdown Index (ELI) but mobility data ([Exhibit 39](#)) implies only a small sequential dip to levels consistent with 2019, with cases once again now back under control.

- Concerns have also been raised over the weakness in the China property sector where the central government has been allowing bankruptcies in order to reduce financial risk, consistent with President Xi's initiative that "Housing is for living in, not for speculation." It should be noted that the direct links from the housing market to oil demand are very small (c.150 kb/d total construction sector oil demand). Therefore, our focus remains on whether the financial risks broaden to something more systemic. Our economists, however, continue to view the issues observed in the banking sector as idiosyncratic versus systematic thus far and remain unconcerned about broader contagion that could be addressed by the central government, if required.

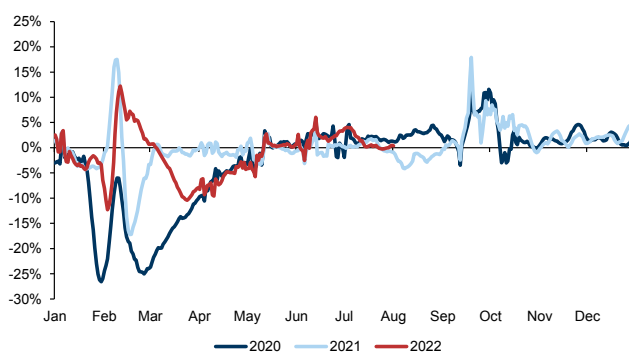
All in all, we expect China's relative success in controlling recent outbreaks to continue into 2H22 and revise our expectations of their demand in 2H22/2023 by +115/-40 kb/d respectively. We continue to view this as a conservative forecast, with only +0.4 mb/d of demand growth expected between 2023 and 3Q22, with 4Q22 demand down -70 kb/d YoY.

**Exhibit 38: Chinese oil demand has rebounded sharply from its lows**  
High-frequency oil demand model (7dma, kb/d)



Source: Kpler, ICIS, SCI, Oilchem, IEA, Goldman Sachs Global Investment Research

**Exhibit 39: Mobility data is broadly consistent with 2019 levels**  
Traffic congestion index in 100 cities in China vs 2019 levels (congestion index is ratio of actual travel time to 'free flow' travel time, higher=more congested, 7dma)



Source: Wind, Goldman Sachs Global Investment Research

## Jet was supposed to be the big source of demand growth this summer - are high ticket prices and cancellations headwinds?

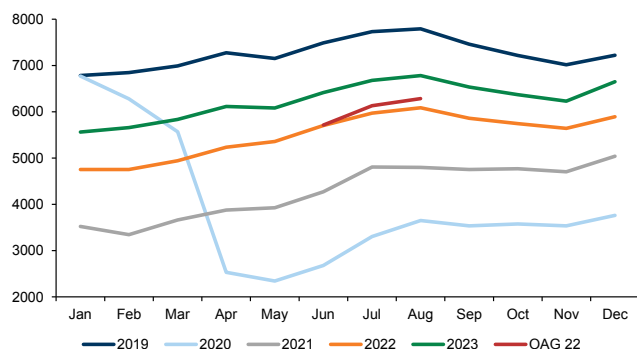
The outlook for jet fuel demand has been improving versus our previous modeling, following modest disappointments in 1H22 amid the China lockdowns. After a modest c.50kb/d beat in June, July and August air travel demand looks likely to beat our expectations by c.0.2 mb/d, finally surpassing 6 mb/d, something we now expect to continue through 2H22. In fact, if air travel stays at the expected August level through year-end, jet demand would already be tracking ahead of our previous expectations for November 2023.

Recent disruptions to flight schedules and associated cancellations are symptomatic of the pent-up demand for travel, and do not represent downside risks to our current expectations. Despite high ticket and jet fuel prices, and with one of the highest price elasticities of demand historically (as a luxury good), international flights for August are

still likely to realize almost 30% below 2019 levels. Therefore, this still represents upside risk to our forecasts, with the potential reopening of c.0.4 mb/d of China's international travel routes an additional positive.

#### Exhibit 40: The summer recovery in flying is so far beating our conservative forecasts to the upside by c.150-200 kb/d

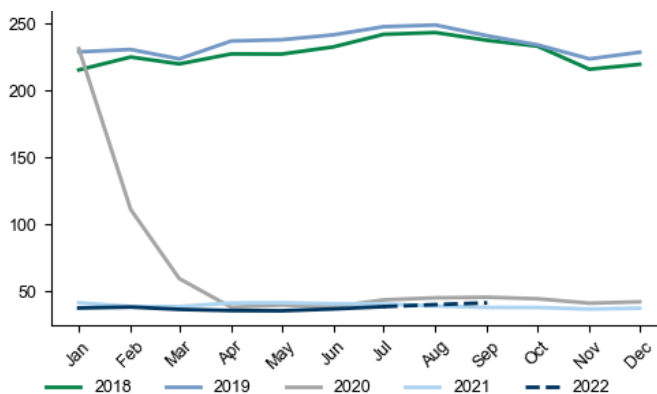
Global jet fuel demand (kb/d), OAG is latest implied by flight schedules versus Jun-22 expectations



Source: OAG, IEA, JODI, Goldman Sachs Global Investment Research

#### Exhibit 41: An international reopening of China air travel could boost jet demand by up to 0.4 mb/d alone

China international flight jet fuel demand (kb/d)



Since aircraft refuel on each side, a two-way reopening would result in double the demand boost seen above.

### Europe is in a recession - shouldn't this push demand lower?

Our economists recently downgraded their outlook for Europe, expecting a recession in 2H22, with 2023 real GDP growth also downgraded to 0.8% YoY, versus 1.65% in early June. To model the hit to oil demand from this GDP impact, we first map the downgrades to various economic sectors based on their gas usage intensity ([Exhibit 43](#)) and then subsequently into oil via the associated oil usage intensity. As a result of this mapping, we scale up the normal c.80% GDP to oil demand beta by 2x and thus lower European oil demand by c.0.25 mb/d based on our economists' new forecast.

However, we model a significant offset from higher gas-to-oil switching due to the gas shortage, with governments now actively encouraging precautionary switching of power feedstocks from natural gas towards petroleum liquids and coal. Given the more significant physical shortages (and higher prices) in the coal market, and the required dedicated burn infrastructure, we expect liquids will likely remain the most attractive substitute in Europe. Indeed, many companies in the current earnings season have announced that they are already achieving significant gas substitution or are planning to imminently (e.g. Repsol, Michelin, Stadtwerke Muenchen, Siltronic, to name a few). While only a small amount of this will be observable on high-quality grid data, the potential scale is very substantial, with a full switching of the 15% voluntary consumer gas demand reduction (4 bcf/d) equivalent to 1 mb/d worth of liquids demand in NW Europe. Although we don't anticipate this will be achieved, its scale could be significant in helping offset weaker local economic activity.<sup>8</sup>

Finally, our tracking of European consumer oil demand via mobility data has proved

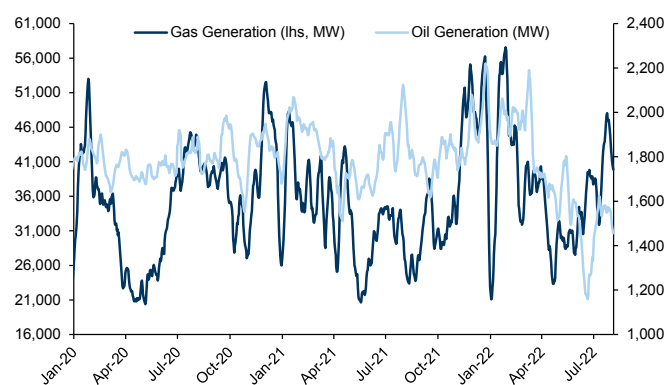
<sup>8</sup> To provide more sense of scale, the global gas market amounts to c.70mboe/d vs 100mboe/d for the global oil market.

remarkably resilient, even in recent months and weeks despite record high retail fuel prices. Indeed, IEA estimates for European motor gasoline demand have been revised to new highs for both 1Q2022 and 2Q2022 despite the war (c.+5% versus Sep-21 OMR estimates). Road diesel estimates have also been revised a few percentage points higher for 1H2022, and data for June across European countries with high-frequency data (c.45% demand) suggests normal seasonal MoM changes in road demand, despite retail prices surging to all-time highs.

Overall, despite the economic concerns, due to robust data and the high potential of G2O switching, we lower our European oil demand estimate by just -0.25/-0.1 mb/d in 2022/23 respectively at our new (lower) price path.

#### Exhibit 42: High frequency, high quality grid data will give a misleading picture of G2O switching

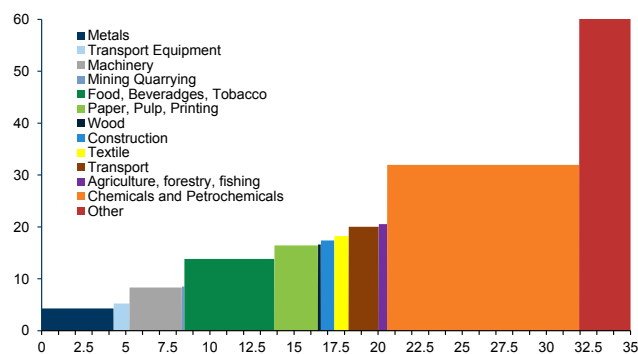
EU power generation by fuel (on grid, disaggregated data, MW)



Source: Bloomberg, Goldman Sachs Global Investment Research

#### Exhibit 43: We expect gas-intensive sectors to face proportionally larger hits to activity

Cumulative gas usage (% total, x-axis) versus cumulative gross value added (% total, y-axis). Average of France, Italy, Germany



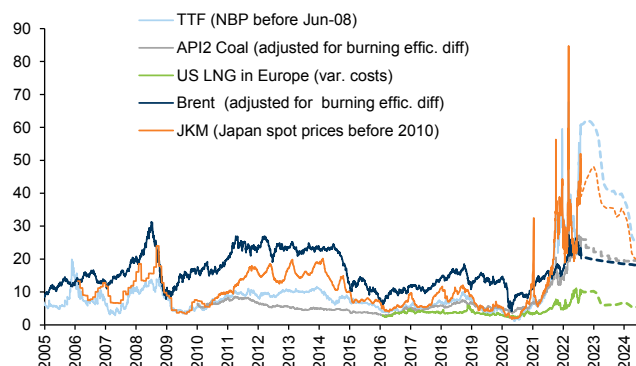
Source: Haver Analytics, Goldman Sachs Global Investment Research

### How big can this gas-to-oil substitution get globally?

We believe the persistent and widening incentive to switch from natural gas to oil-powered generation (G2O switching) remains underestimated since the global energy crisis began in summer 2021. We believe the continued focus on DM grid data to identify this trend is misplaced, so far occurring more often in emerging markets as well as off-grid (in both DM and EM).

We cautiously estimated G2O switching to have peaked above 1 mb/d last winter, and had expected this to average 0.5 mb/d over the rest of 2022. However, following developments in the gas markets, we revise up this expectation by 0.5 mb/d globally in 2H22 (with a heavier burn - 1.3 mb/d - in 4Q22). We nevertheless believe that risks are skewed sharply higher given the fact that global gas prices are currently double that of liquid alternatives.

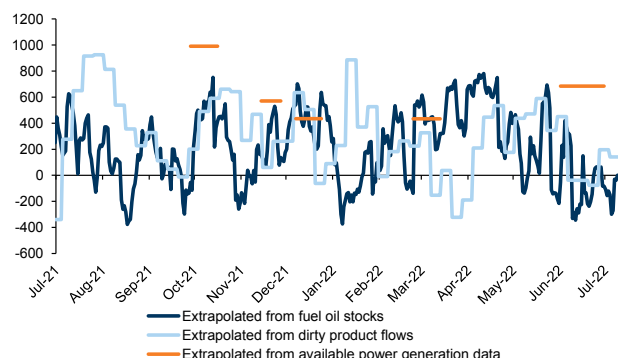
**Exhibit 44: After converging since late last year, natural gas prices have significantly dislocated to the rest of the power complex**  
Power generation fuels in natural gas equivalent terms (USD/mmbtu, adjusted for heat rates, efficiency, and carbon costs)



Source: Platts, Bloomberg, Reuters, ICE, CME, Goldman Sachs Global Investment Research

**Exhibit 45: We estimate G20 switching has increased to nearer 0.7 mb/d at present from c.0.4 mb/d pre-war and over 1mb/d at its winter peak**

Gas-to-oil switching implied from various measures (kb/d)



The stock and flow based measures will be less relevant over time as refiners increase their fuel oil yield, especially at such high utilisation rates

Source: Kpler, National sources, Bloomberg, IEA, JODI, Goldman Sachs Global Investment Research

- Looking at varied power generation, fuel oil flows, and refinery burn data, we conservatively estimate G2O switching (incrementally, versus seasonal norms) may have reached 0.7 mb/d in June 2022, with Egypt, Kuwait, Pakistan, Bangladesh, Korea and Japan all ramping up liquids burn. Specifically, data on refinery oil liquids (inc. refinery gas) power burn suggests a c.30% increase YoY in the OECD (40-50% for liquid derivatives) already by 1Q22. Extrapolating this globally, we estimate that 0.3 mb/d of the current 0.7 mb/d of G2O substitution is coming from refining, although we see risks for significantly higher demand.
- Given almost 6 mb/d of oil is consumed by the oil/refining/petrochemical industry itself, alongside almost 10 mboe/d of natural gas, the capacity to switch could be very significant, given refiners are essentially the physical manifestation of an LP optimisation model. Case in point: Repsol has already cut its gas consumption by 40% this year, unusually replaced by naphtha instead of more conventional heating fuels. This is equivalent to c.20 kb/d of oil demand for a refining company operating less than 1% of global refining capacity (i.e. >2mb/d of additional oil demand could be burnt in refineries alone if fully replicated globally elsewhere).
- This bias for a significant amount of substitution is consistent with our initial deep-dive on gas to oil switching, where we found that significant gas-fired power generation capacity (of which much lies off-grid) is technically capable of functioning on oil (with possibly only modest-to-no capex requirements). With European officials already encouraging switching from gas to alternative fuels, our estimated increase in additional winter oil burn remains conservative to say the least.
- In 4Q21, the residual of our QoQ oil demand estimates that couldn't be explained by seasonality, improved mobility, or jet fuel recovery amounted to 0.7 mb/d. In addition, IEA reported the largest negative miscellaneous-to-balance (MTB<sup>9</sup>) since

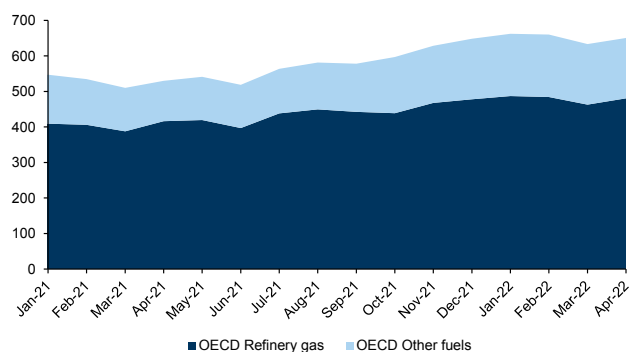
<sup>9</sup> The miscellaneous to balance is a residual term that measures the supply minus demand (surplus) estimates that couldn't be tracked in observable inventory changes.



1987, indicating the unusual premium of demand to supply that quarter. While negative MTB can be associated with over-stated demand, our more complete tracking of global inventories (especially EM) actually showed no such large discrepancy, indicating the demand estimate was in fact broadly correct. The IEA's substantial 0.8 mb/d upward revision of OECD 4Q21 demand over Feb-Mar 2022, of which the vast majority of which was across fuels associated with heating (distillates, fuel oil, LPGs) is also testament to this dynamic.

- Importantly, this should prove a significant support to oil demand in 4Q22, requiring an upgrade to our previous forecasts. In our Jun-22 balances, we had expected just 0.4 mb/d of global oil demand growth 4Q22 vs 4Q21 YoY, with a -0.6 mb/d decline in OECD led by the US and the 1 mb/d of EM YoY growth entirely outside of China. This was despite an expectation that jet fuel will be up 0.9 mb/d YoY. We had therefore just been forecasting -0.3 mb/d (negative!) YoY demand growth excluding jet fuel. Given the G20 incentives this year should be meaningfully larger than last winter, we are now upgrading our 4Q22/1Q23 G20 demand estimates by 0.7/0.5 mb/d respectively. This G20 assumption should be robust to warm winter weather, as a one standard deviation warmer winter in Europe would only resolve 20% of its missing gas needs, such is the current scale of the shortage.

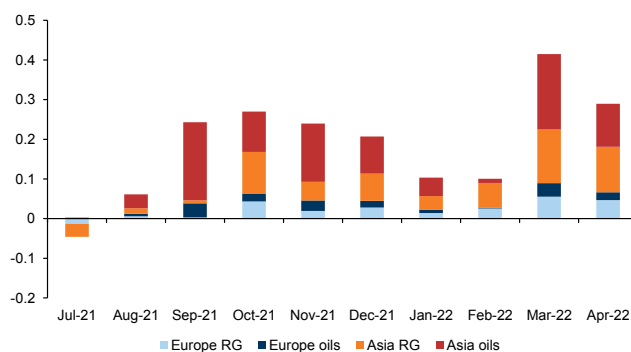
**Exhibit 46: DM refinery liquid burns alone look to be c.0.15 mb/d (30%) higher than a year ago**  
OECD refinery fuel burn (kb/d)



Source: IEA, Goldman Sachs Global Investment Research

**Exhibit 47: Extrapolating Germany refinery oil burn data across Europe and Asia suggests at least 0.3 mb/d of refinery site switching**

Estimated increase in liquids burn at refineries (runs-adjusted) across Europe and Asia (mb/d)



Source: National data, IEA, Goldman Sachs Global Investment Research

**Exhibit 48: The potential capacity to burn oil in place of gas across industries, power, and transport is significantly underappreciated**

Oil (total and by products) and gas use by sector (mboe/d)

	Ref. gas	LPG	Diesel	Fuel oil	Total oil	Natgas
<b>Total demand</b>	<b>2.76</b>	<b>9.16</b>	<b>27.80</b>	<b>5.98</b>	<b>99.60</b>	<b>67.04</b>
<b>Transformation processes</b>	<b>0.22</b>	<b>0.22</b>	<b>0.97</b>	<b>1.53</b>	<b>4.75</b>	<b>27.60</b>
<b>Energy industry own use</b>	<b>2.35</b>	<b>0.33</b>	<b>0.44</b>	<b>0.22</b>	<b>4.44</b>	<b>6.48</b>
<b>Final consumption</b>	<b>0.20</b>	<b>8.61</b>	<b>26.39</b>	<b>4.23</b>	<b>90.41</b>	<b>32.96</b>
<b>Industry</b>	<b>0.17</b>	<b>0.70</b>	<b>2.26</b>	<b>0.74</b>	<b>6.08</b>	<b>12.38</b>
Mining and quarrying	0.00	0.01	0.42	0.04	0.49	0.24
Construction	0.00	0.03	0.67	0.02	0.76	0.16
Manufacturing	0.16	0.53	0.53	0.28	2.74	8.65
Iron and steel	0.00	0.03	0.04	0.03	0.12	1.26
<b>Chemical and petrochemical</b>	<b>0.16</b>	<b>0.33</b>	<b>0.09</b>	<b>0.07</b>	<b>1.29</b>	<b>3.08</b>
Non-ferrous metals	0.00	0.01	0.02	0.02	0.07	0.35
Non-metallic minerals	0.00	0.05	0.14	0.07	0.77	1.29
Transport equipment	0.00	0.01	0.02	0.00	0.04	0.27
Machinery	0.00	0.03	0.05	0.01	0.10	0.65
Food and tobacco	0.00	0.04	0.10	0.03	0.18	0.99
Paper, pulp and printing	0.00	0.01	0.02	0.03	0.08	0.47
Wood and wood products	0.00	0.00	0.03	0.00	0.04	0.06
Textile and leather	0.00	0.01	0.02	0.01	0.04	0.23
Industry not elsewhere specified	0.00	0.13	0.64	0.40	2.09	3.33
<b>Transport</b>	<b>0.00</b>	<b>0.75</b>	<b>20.04</b>	<b>3.31</b>	<b>57.92</b>	<b>2.39</b>
World aviation bunkers	0.00	0.00	0.00	0.00	4.25	0.00
Domestic aviation	0.00	0.00	0.00	0.00	2.85	0.00
<b>Road</b>	<b>0.00</b>	<b>0.73</b>	<b>17.61</b>	<b>0.00</b>	<b>44.91</b>	<b>1.07</b>
Rail	0.00	0.00	0.67	0.00	0.68	0.00
Pipeline transport	0.00	0.00	0.01	0.00	0.01	1.30
<b>World marine bunkers</b>	<b>0.00</b>	<b>0.00</b>	<b>0.98</b>	<b>3.00</b>	<b>3.99</b>	<b>0.15</b>
Domestic navigation	0.00	0.00	0.71	0.30	1.14	0.00
Transport not elsewhere specified	0.00	0.02	0.07	0.00	0.11	0.01
<b>Residential</b>	<b>0.00</b>	<b>4.11</b>	<b>0.89</b>	<b>0.00</b>	<b>5.48</b>	<b>9.77</b>
<b>Commercial and public services</b>	<b>0.00</b>	<b>0.56</b>	<b>0.85</b>	<b>0.06</b>	<b>1.70</b>	<b>4.20</b>
<b>Agriculture/forestry</b>	<b>0.00</b>	<b>0.08</b>	<b>1.91</b>	<b>0.01</b>	<b>2.25</b>	<b>0.21</b>
<b>Fishing</b>	<b>0.00</b>	<b>0.00</b>	<b>0.11</b>	<b>0.01</b>	<b>0.13</b>	<b>0.00</b>
<b>Not elsewhere specified</b>	<b>0.00</b>	<b>0.09</b>	<b>0.22</b>	<b>0.06</b>	<b>0.47</b>	<b>0.07</b>
<b>Non-energy use</b>	<b>0.03</b>	<b>2.31</b>	<b>0.11</b>	<b>0.04</b>	<b>16.38</b>	<b>3.93</b>

Source: IEA, Goldman Sachs Global Investment Research

**What do falling refining margins imply for demand?**

We do not believe that the collapse in refining margins from extraordinary all-time highs to merely extreme levels is reflective of weak demand ([Exhibit 51](#)) but instead of more available capacity this summer - both seasonal, incentivized by record margins, and due to smaller than expected disruptions in China and Russia (see our deep dive [here](#)).

- Swings in oil product demand and refining runs are seasonal, absorbed via swings in inventories with little impact on prices. However, in an environment of depleted stocks, the seasonal increase in planned refinery maintenance from c.2mb/d at the beginning of the year to almost 7 mb/d at the peak of this year's spring turnaround season, was very disruptive. No longer having the ability to seasonally draw down stocks, product prices had to jump to demand-destructive levels to attempt to

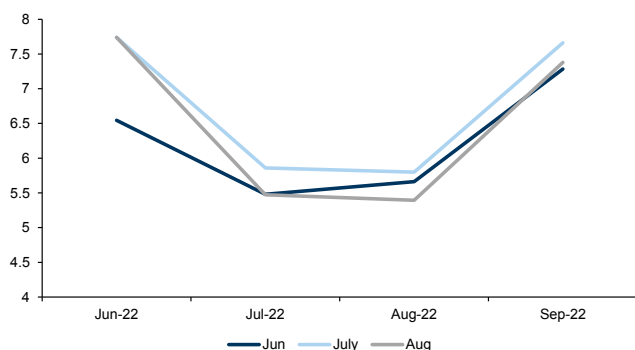
balance end-markets. This was exacerbated by the initial impact of sanctions on Russia, which saw the entire volumetric impact fall on products, where Europe accounts for a larger share of exports. In addition, reduced refinery runs in China due to local lockdowns also curtailed a large volume of clean product exports. This left refining cracks surging to unprecedented levels, with our own modeling of required refining margins and clean product cracks unable to justify the observed peak cracks above \$50/bbl for both distillates and gasoline, suggestive of how constrained the system was. The compression in margins since then can therefore first be viewed as a correction to this dislocation.

- Weak demand would of course also contribute to weaker margins, reducing the level of demand versus available refining capacity, requiring lower utilization and hence margins. However, the scale of demand destruction that we expect of c. 1 mb/d only requires a modest weakening of margins of perhaps \$2-4/bbl at current crude prices, given empirically observed relationships ([Exhibit 52](#)). This reinforces our view that the current much larger weakness in margins is instead driven by supply, with available refining capacity in August exceeding our early-July estimate by 0.5 mb/d currently. Despite this large seasonal enhancement in capacity, refining margins remain strong overall outside of the simplest of European and Asian refiners with high fuel oil and naphtha yields with high natural gas-driven processing costs, comforting us in our view that the level of demand remains robust.

With absolute levels of products stocks still very low, the coming fall maintenance season, combined with what's expected to be a heavy US hurricane season, is likely to require product prices to dislocate once again. This may have to happen seasonally until product inventories rebuild sufficiently, which is unlikely without the higher prices, and associated demand destruction, which we view as a necessary part of the rebalancing process. There are few quick fixes for the product markets. There's no large SPR for products, no OPEC of refining, nor short-cycle solutions such as US shale. Additionally, with peak refining demand on the horizon, there's no incentive to build long-cycle capacity either. While some planned closures are already being delayed, the outlook for refining capacity remains tight as demand continues to grow, aided by additional uplift from novel, large-scale G2O substitution, as well as the ongoing recovery in international travel.

### Exhibit 49: There was a moderate increase in expected refinery runs in July-September vs a month ago

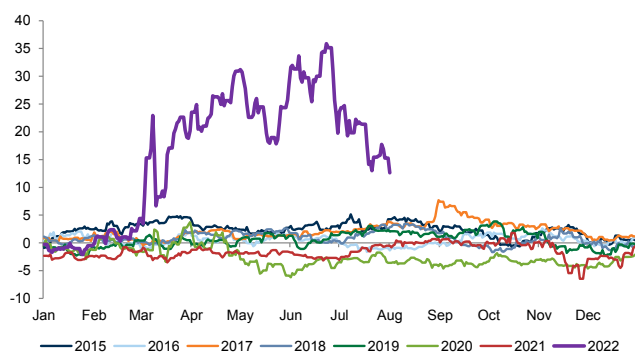
Global total refinery maintenance forecasts by month and forecast vintage (mb/d)



Source: IIR, Goldman Sachs Global Investment Research

### Exhibit 51: Refining margins have merely fallen from extraordinary levels to extreme levels

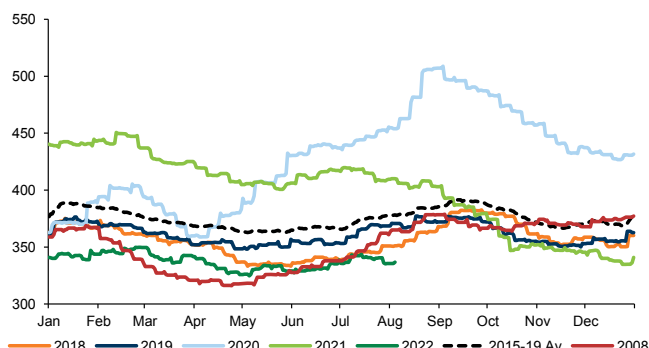
European gross cracking refining margin adjusting for yield, crude slate inclusive of freight, and processing costs (USD/bbl)



Source: ICE, CME, Platts, IEA, Bloomberg, Goldman Sachs Global Investment Research

### Exhibit 50: Current distillate stocks are as tight as 2008 but with much worse prospects later this year given Russia sanctions and G20 switching

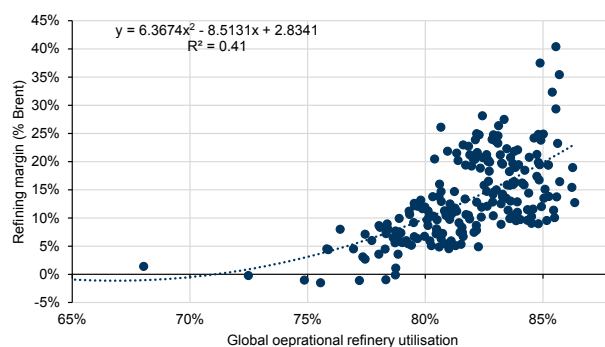
High frequency distillate inventories (mb) - note underlying series are held flat pre-existing their start



Source: EIA, PAJ, PJK ARA, Fujairah, Oilchem, IE Singapore, Goldman Sachs Global Investment Research

### Exhibit 52: Margins have a convex response to utilisation, indicating the recent fall can't be explained by demand

Global refinery utilisation (%), x-axis vs 3m-lagged refining margins (%), y-axis



Source: BP, IEA, JODI, National sources, ICIS, SCI, CME, ICE, Platts, Goldman Sachs Global Investment Research

## So what is our current demand view? How bad can things get?

In our current framework, we forecast non-price related changes to global supply and demand before solving for the required surpluses to rebalance oil inventories by the end of 2023 while OPEC spare capacity continues to shrink further. Given negligible supply elasticity at present, we achieve this through demand destruction, solving for demand elasticity at the consumer retail price levels.

We therefore must distinguish between the exogenous changes that we are making to our demand profile (GDP, China, jet fuel, G2O) from those that occur after our new equilibrium prices are found. We show this in [Exhibit 53](#), where we break down the changes to the level of oil demand made since our Jun-22 forecast, but *before* incorporating higher prices. As discussed above, some exogenous factors lead us to revise our global demand estimate higher by c.700 kb/d over 2022-23: jet fuel, G2O, and

China upward level revisions.

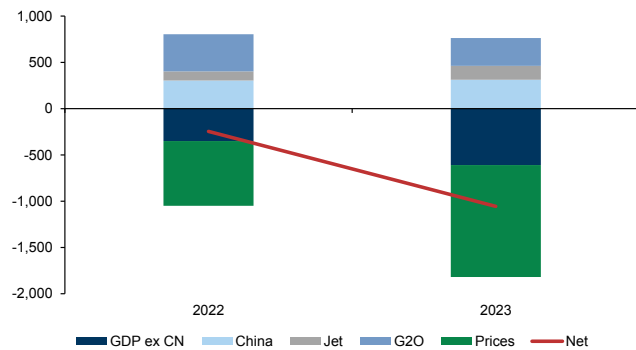
In addition, we incorporate in this balance update c.0.6 mb/d weaker demand based on lower GDP growth assumptions. This hit, assumed greatest for energy (and thus oil) intensive sectors, is consistent with a GDP hit of c.0.5-0.6 p.p, rather than the c. 0.9 p.p. hit implied by historical elasticities. While this downward revision to our GDP assumption is only modestly larger than our economists' changes since early June ([Exhibit 55](#)), our prior demand forecasts were already conservatively based on weaker global GDP assumptions. As a result, we continue to build prudent growth expectations into our demand balances. This is displayed in [Exhibit 54](#) where we show the global ex China GDP growth reflected in our balances after adjusting for other exogenous demand influences discussed above. We currently assume 2H22-23 real GDP 0.3 p.p. below our economists' forecast, which, in turn, is also below consensus.

After adjusting our retail price views to solve for normalized inventories by late 2023, we expect demand growth of +2.6/2.0 mb/d YoY in 2022/23, little changed from our June balance at our prior price forecast. Since, in aggregate, we made only modest changes to global supply figures for 2022/23, and solve the level of demand to achieve the same rebalancing process, we mechanically solve for similar revisions to demand in the end, via modest adjustments to our retail price forecast. This leaves the main change to our price forecast coming from the disconnect between Brent and retail fuel prices, as we discuss above.

Consensus perceived risk from here is that global economic activity will disappoint. Our balances base-cases a c.70% GDP-to-demand income elasticity as well as a c.3% absolute price-to-demand elasticity ([Exhibit 56](#)). Thus, a c.\$20/bbl change in (consumer) Brent prices is required to offset a 1 p.p. deceleration in global growth to maintain the same rebalancing path to normalized inventories.<sup>10</sup> However, it is important that a one percentage point hit to global GDP would be significant, equivalent to almost an entire standard deviation in post-1980s global growth, from an already weak starting point. Case in point, there have only been three instances of global GDP falling below 1% YoY since 1960 (excluding the pandemic) and just one below 0% (GFC). Under such an outcome, our 2023 Brent forecast would still be above current market forwards.

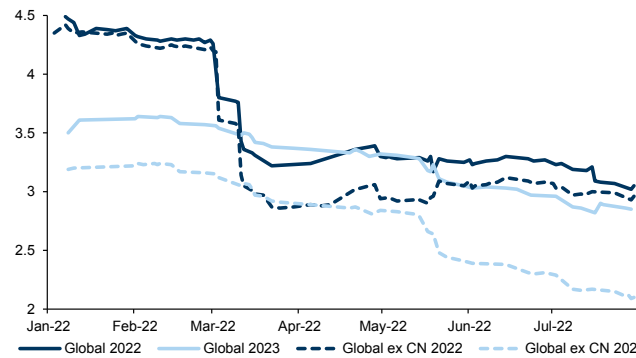
<sup>10</sup> Technically we would need to normalise to a lower inventory level (in barrels) than before, requiring a larger fall in prices than suggested here to create a net tightening impact on the inventory path to the new, lower equilibrium level, although this will be second order.

**Exhibit 53: G20, jet fuel, and China combine to provide a modest offset to the downward GDP revisions we make**  
Breakdown of demand level revisions versus pre-price change 6-June balance (kb/d)



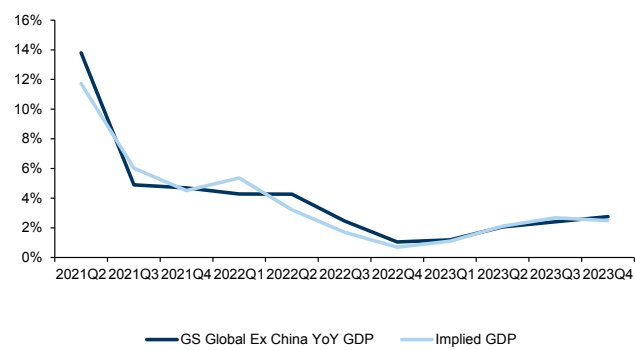
Source: Goldman Sachs Global Investment Research

**Exhibit 55: ... which are themselves below consensus forecasts**  
GS Global and Global ex China real GDP forecasts by vintage (% YoY)



Source: Goldman Sachs Global Investment Research

**Exhibit 54: We conservatively base-case global GDP forecasts modestly below our economists' estimates ...**  
GS Global ex China real GDP forecasts by quarter versus implied from our (pre-price change) global ex china oil demand forecasts (adjusting for jet fuel, base effects, G20)



Source: Goldman Sachs Global Investment Research

**Exhibit 56: It would take a larger hit to GDP and still much higher oil prices to derail oil's demand recovery**  
2023 oil demand growth scenario analysis

		Global ex China real GDP							
		-0.5%	0.0%	0.5%	1.0%	1.5%	2.0%	3.0%	4.0%
Brent prices	85	1750	2000	2250	2750	3000	3500	4250	4750
	95	1250	1750	2000	2250	2750	3000	3750	4500
	105	1000	1250	1750	2000	2250	2750	3500	4250
	115	500	1000	1250	1750	2000	2250	3000	3750
	125	250	500	1000	1250	1750	2000	2750	3500
	135	0	250	500	1000	1250	1750	2500	3000
	145	-500	0	250	500	1000	1250	2000	2750
	155	-750	-500	0	250	500	1000	1750	2500
	165	-1250	-750	-500	0	250	500	1250	2000
	175	-1500	-1000	-750	-500	-250	0	750	1500

The above includes the additional impacts of pandemic reopening (0.2 mb/d), China specific reopening (+0.7), and international jet fuel recovery (+0.75). The individual GDP and price betas are 71% and 3% respectively.

Source: Goldman Sachs Global Investment Research

## Higher Russian supply mostly offset by generalized disappointments

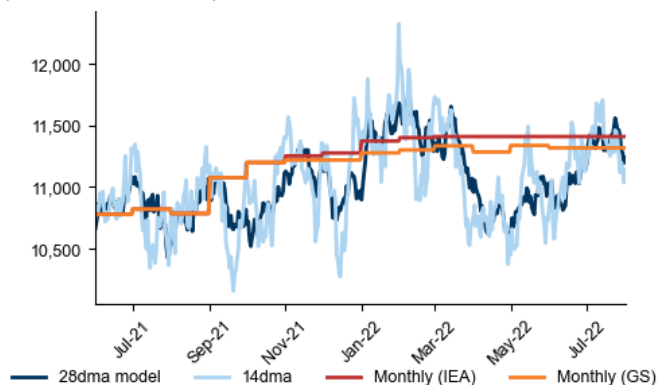
### Were we too aggressive on expecting Russian supply to fall?

Yes. Although we have always been cautious in assuming large political or sanction-driven supply losses, we did not expect Russian production to rebound as it has. Output is currently estimated at c.11.1 mb/d total liquids (c.9.8 mb/d crude alone) versus 11.35 mb/d (10 mb/d) prior to the start of the war in Ukraine and c.10.4 mb/d (9.2 mb/d) at the April lows. The net disruption is therefore only 0.2 mb/d versus March, and 0.35 mb/d versus pre-war expectations ([Exhibit 57](#)).

This rebound reflects the difficulty European countries face in sanctioning Russia's oil sector when already dealing with gas shortages. The original wording of statements surrounding the initial sanctions packages suggested a progressive wind down of European imports over 2H22 that evidently has not occurred. Case in point, the rebound in Russian exports started after the EU wavered on its prior May-15 deadline for tightening sanctions. Such a bias was further illustrated this week, with the [EU easing restrictions on shipping and insurance to third countries](#). These limitations were potentially a binding constraint on smaller prospective importers that lack the large state P&I firms<sup>11</sup> that India and China possess.

#### Exhibit 57: We estimate Russia's production to be c.0.2 mb/d below pre-war levels

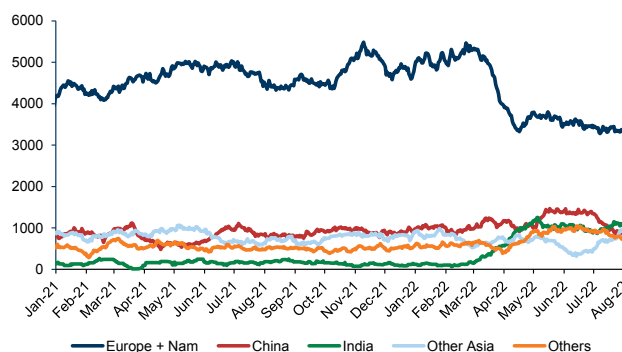
GS high-frequency Russia total liquids production model (kb/d) vs. pre-war GS and IEA expectations



Source: Kpler, IIR, IEA, Goldman Sachs Global Investment Research

#### Exhibit 58: The overall scale of redirection (c.1-1.5 mb/d) has been relatively comfortable thus far, heading mostly India

Russia seaborne oil (crude and product) exports by destination (kb/d)

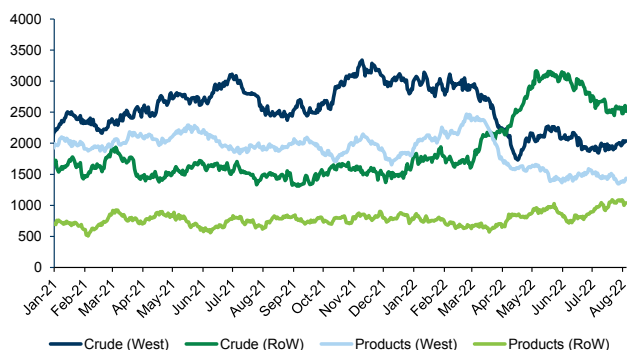


Source: Kpler, Goldman Sachs Global Investment Research

<sup>11</sup> Two types of insurance are needed to transport oil. One is H&M (Hull and Machinery), which covers damage to vessel structures and equipment. This can be self insured. The other is P&I (Protection and Indemnity) which insures shipowners' liability for others. The large potential costs of the latter - for instance a multi-billion dollar fine for a oil spill and the associated clean-up costs - require third party insurance, typically the large EU and UK financial institutions. Given the lack of parallel banking system, it is unclear how Russia offering to insure ships would be an effective solution.

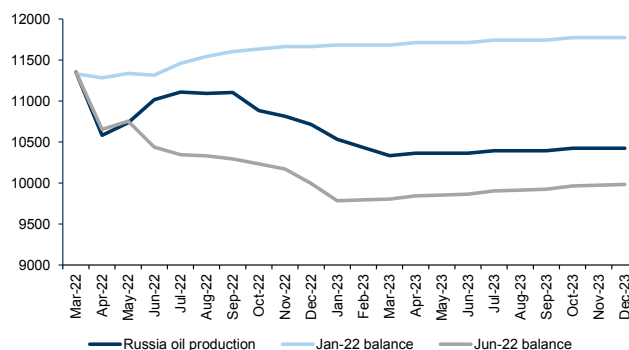


**Exhibit 59: Products have been harder to place to alternative destinations, possibly due to tanker size constraints**  
Russia seaborne exports by destination group and product type (kb/d)



Source: Kpler, Goldman Sachs Global Investment Research

**Exhibit 60: We upgrade our Russian production profile, expecting later declines in 4Q22 as the EU embargo approaches**  
GS Russia total oil production forecasts (kb/d)



Source: IEA, Goldman Sachs Global Investment Research

So far, the c.1-1.5 mb/d of Russian oil exports that have been self-sanctioned by European buyers have successfully found new destinations - almost entirely India thus far, with China and other Asian destinations only modestly ramping as yet ([Exhibit 58](#)). Such a small redirection is uncomplicated for the shipping markets to absorb, creating minimal issues for Russian production. Our original view that c.1.5 mb/d of Russian production would need to shut in by early 2023 (vs 4Q21) was based on the exigent task of having to redirect c.5mb/d of NATO imports to alternatives buyers - which remains only partially achievable in our view.

Importantly, the 2023 EU embargo remains in place - for now - with a repeal unlikely in our view given the difficulty in reaching such a decision and the likely opposition by Eastern EU members (the decision needs to be unanimous). This will still require a large volume of redirection - up to 4 mb/d - of seaborne flows from the West to the East, creating disruptions due to ship constraints, refining slate limitations in Asia as well as competing market share dynamics with core-OPEC at such high levels of displacement in Asia. The rebound in exports and the weakening of EU sanctions lead us, however, to raise our forward Russian production path ([Exhibit 60](#)), with a smaller expected decline in 2023 than previously. We assume 2H22 total liquids output of 10.9 mb/d (+0.7 mb/d vs. our prior forecast) and 2023 at 10.4 mb/d (+ 0.55 mb/d vs. our prior forecast). The higher level of Russian exports has also coincided with stronger than expected Russian economic growth and oil demand, which we are raising by 50 kb/d on average going forward, a modest offset to the higher assumed exports.

### What about the US proposed Russian price cap? Wouldn't that allow for uninterrupted flows?

Conceptually, a price cap - if fully and successfully implemented - would be bearish, as it would keep oil flowing while simultaneously achieving Europe's aims of limiting Russian revenues. Such a scheme benefits from being less blunt than an outright ban in terms of the physical disruption, as well as offering better political incentives via its flexibility. The key risk to this policy, however, is the potential for Russian retaliation, similar to what has occurred on EU gas, which in turn would turn this into an additional bullish shock for

the oil market.

- Even if China and India do not formally participate in such a price cap mechanism, they would likely de facto engage in it by offering to purchase barrels only slightly above the cap. Since we believe that there is only a limited ability to redirect flows into alternative (non-price cap) regions, Russian oil would still need to discount to the marginal buyer: those imposing a price cap. In this scenario, Russia would be able to export oil at pre-war levels (c.7mb/d) at the prices close to the cap.
- However, a key assumption in adopting such a price cap is that Russia will be incentivized to continue sending exports as long as the price cap is above its production costs. This overlooks Russia's ability to influence global prices, however. Consistent with actions taken in the natural gas market, Russia could opt to retaliate, cutting Europe and other NATO buyers off and shutting in production, thereby elevating global prices. What's more, since countries outside of the price cap would no longer be able to compete with discounted barrels, they would end up paying market prices minus any Russian oil discount (currently reportedly closer to \$10-15/bbl). This scenario features the same problems, with the same constraints, and therefore results in the same consequences as the oil import ban. As such, we would still expect to lose c.1 mb/d of Russian supply (versus pre-war levels) due to incomplete redirection to alternative non-NATO buyers.
- On our estimated demand elasticities, this would result in prices trading back towards our updated forecasts of c.\$125/bbl Brent. Assuming a discount of \$20/bbl, Russian revenue is actually higher here, as it exports c.6 mb/d of oil (c.-20%) at more than double the price. As such, we are skeptical that Russia would be economically incentivized to continue to send oil to buyers that try to cap its price. Such retaliation is not only potentially economically rational, but also consistent with acts of reprisal in the natural gas markets, as well as an opinion piece written by the founder of leading Russian producer Lukoil, which called for a voluntary production cut to increase revenue, while extending resource life.
- Assuming a successful implementation of a price cap with no retaliation, we would only expect c.0.6 mb/d of upside to our updated Russian production path. The ongoing war effort will likely have disrupted the highly seasonal drilling season (due to freezing winter temperatures), while the abrupt shut-ins will also have caused permanent damage to productive capacity. This can be seen in Russia's recovery from the c.2mb/d pandemic cuts. Russia had only returned c.75% of these cuts by early 2022 before all major domestic producers commented that all productive wells had been returned. Leveraging our current pricing framework, this would provide c.\$15/bbl of downside to our forecasts, still leaving them above current spot and forward values.
- Beyond the impact on global crude prices, however, the purchase of additionally discounted barrels should not impact the marginal clearing price and hence retail prices that governments are most interested in addressing. For example, if governments instead attempt to windfall tax away the gains accrued to refiners that purchase this discounted crude, returning the surplus to consumers in the form of retail gasoline vouchers/subsidies, this would amount to a demand boost via a

transfer of Russian producer surplus to Western consumers. This would only act to further bid up retail and wholesale oil costs, all else equal.

- Finally, a tariff structure as an exemption to the EU embargo would be much easier to implement in our view, although conceptually equivalent, to a price cap. In its proposed structure, the cap is based on a shipping and financing ban that the Europeans are either in the process of easing or non-binding as Russia/China and India can offer such insurance/financing. Hence, the cap should be structured as a waiver to the still binding embargo. A tariff also ensures the above situation of counter-productive demand construction is avoided unless tax revenues are, once again, channeled back to consumers.

### How much can the rest of OPEC+ help from here?

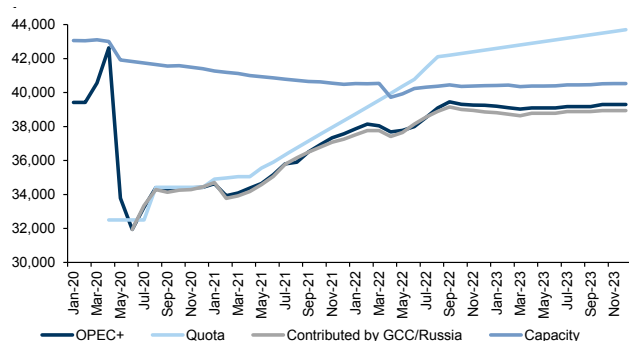
We expect little help from OPEC+, with any meaningful action simply depleting the near record low spare capacity left:

- OPEC announced on August 3 that it would increase its quotas by just 0.1 mb/d per month in September, notably highlighting that “severely limited availability of excess capacity necessitates utilizing it with great caution in response to severe supply disruptions”. In our balances, we had assumed a 0.4 mb/d hike in quotas after August, equivalent to a 0.1 mb/d increase every month through year-end. Given lack of compliance and spare capacity, the effective monthly increase in monthly actual production is likely to amount to just 40 kb/d ([Exhibit 61](#)). We thus view the decision as consistent with our expectations, although the open apprehension on spare capacity provides some incremental concerns.
- We expect OPEC+ (ex Russia) to add a combined 1mb/d by Dec-23 from Aug-22 planned levels. 0.4 mb/d of this should come from a recovery in Libyan/Venezuela/Kazakhstan oil production, with c.0.6 mb/d from those participating in the agreement (ex-Russia/Kazakhstan). However, 0.55 mb/d of this would be provided by core-OPEC (Saudi, UAE mostly), equivalent to their share of three additional hikes of the size implemented over Jun-21 to Jun-22 (+0.43 mb/d group level quota hikes). This leaves the rest of OPEC+ essentially flat, with some small assumed growth (Iraq, Nigeria) offsetting declines elsewhere (Angola, Ecuador). When including the (shallower) Russian declines, we forecast that OPEC+ production will not surpass the levels expected this September ([Exhibit 61](#)).
- The ramp up from core-OPEC will leave Saudi and UAE at record quarterly production levels: 11.25 mb/d and 3.5 mb/d respectively by mid-2023. This, in turn, provides the oil market with spare capacity of just 1 mb/d into this winter, levels only sustained previously briefly following Iraq’s invasion of Kuwait in 1990 ([Exhibit 62](#)). As a result, despite group level production expected to be 3 mb/d below their quotas in August, only 1.2 mb/d of total additional capacity will remain. Given the OPEC rig count remains 30%+ below 2019 levels, we do not expect much additional capacity development, with both Saudi Arabia and UAE commenting that it will take six years or more to add 1mb/d of sustainable additional production.
- In terms of revisions, downward adjustments of -0.18/-0.34 mb/d for Nigeria and Iraq production in 2022/23 respectively are broadly offset by additional use of core-OPEC

spare capacity ([Exhibit 63](#)). We remove a ramp up in Iranian production from our balances, that we had previously included out of an abundance of caution [see also exhibit 59 below with ref to Iran deal in title]. Iraq is the latest large OPEC member to run out of effective capacity. Sea lines feeding Basrah jetty terminals have had to reduce utilization rates due to degradation that risks catastrophic rupture and environmental disaster. Repairs to ease the current production constraints are unlikely to arrive before the end of 2023. The political disruption in Libya has resumed quickly, as expected, although further disruptions provide downside skew for our production profile. Nigerian oil infrastructure, meanwhile, continues to suffer from underinvestment, theft, and vandalism.

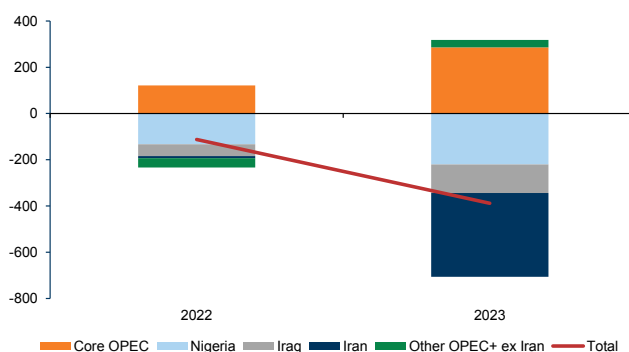
- We note additionally here that the large increase in Saudi exports in July (+0.8 mb/d) doesn't imply a large increase in production beyond their quotas ([Exhibit 64](#)): a small fall in products exports implies some fall in refinery utilization, crude stocks were drawn down, and direct burn may have sequentially fallen from high levels in June when exports and implied production looked surprisingly low (versus quotas).

**Exhibit 61: Group level quotas have now surpassed our estimates of productive capacity given our assumptions on Russian supply**  
OPEC+ production, capacity, quotas (kb/d). Assume zero Russia spare capacity beyond current production expectations.



Source: IEA, EIA, Platts, Goldman Sachs Global Investment Research

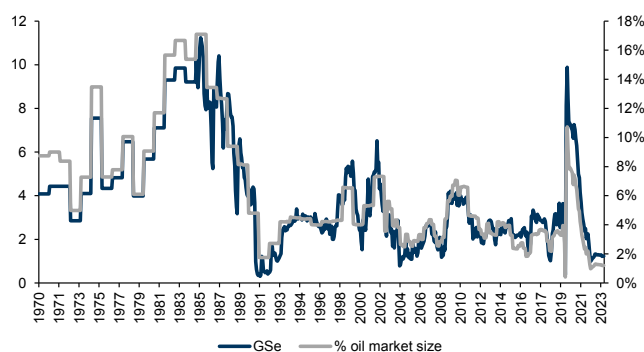
**Exhibit 63: Nigeria and Iraq are the main downward revisions, offset by GCC. We also remove an Iran deal from our balances.**  
Level revisions in OPEC+ (ex Russia) crude production (kb/d)



Source: IEA, OPEC, Goldman Sachs Global Investment Research

**Exhibit 62: Spare capacity is likely to remain at uncomfortable, historical lows**

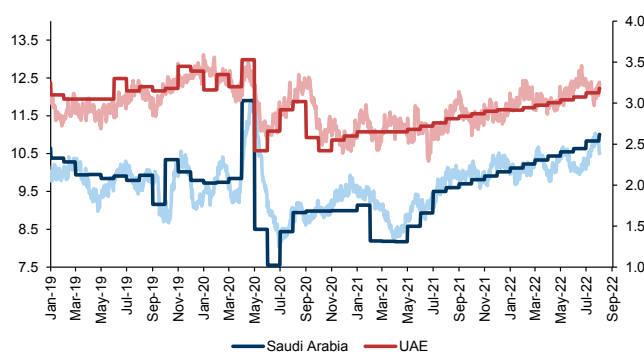
Global spare oil production capacity in mb/d (lhs) and % (rhs)



Source: IEA, EIA, Platts, Goldman Sachs Global Investment Research

**Exhibit 64: The increase in Saudi exports in July looks consistent with their overall quota assuming normal direct burn**

Saudi (lhs) and UAE (rhs) implied crude production (runs + exports + stock changes - direct burn, mb/d)



Source: IEA, Kpler, JODI, IIR, Goldman Sachs Global Investment Research

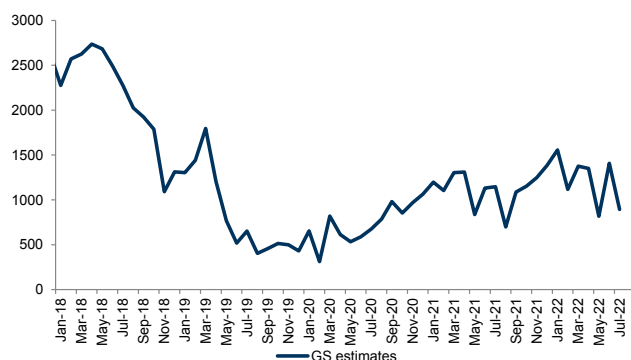
## Do you still expect a return to the JCPOA?

We no longer expect a return to the JCPOA in our balances. We have long been skeptical of a potential return to a deal but have nevertheless tended to conservatively assume a resumption of Iranian exports in our balances out of an abundance of caution, due to our already bullish stance. The widening gap in positions makes this an increasingly unlikely outcome.

- Most importantly, we believe that Iran lacks the incentives to accept the deal reportedly currently on offer from the P5+1, given continued exports (>1 mb/d) at high prices, record high enrichment, and their ultimate medium-term nuclear goals. In addition, the parallel banking systems that operate to shield Iran's oil exports from the reach of US secondary sanctions only grow deeper and more effective over time. An announcement by Iran indicating willingness to entertain nuclear talks is likely to simply draw out further ongoing discussion in our view, before more disruptive counter-measures are potentially taken by the US and its allies.
- Furthermore, the original 2026 expiration date of the JCPOA is drawing near, with some provisions beginning to unwind as early as next year. In fact, the nuclear breakout limit that the original deal was designed around is now functionally irrelevant given Iran's technological progress, likely requiring the redrawing of an agreement that was originally closer to a decade in the making.
- The increasing alignment of Iran and Russia following the start of the war in Ukraine not only reduces the probability of a deal this year or next, but likely for the foreseeable future too. Russia additionally had a key role in the original deal in resolving logistics around the storage of fissile material. Russia's interest in high commodity prices makes their obstruction of a deal more likely in our view. Lastly, revived relations between the US and Saudi Arabia also reduce the likelihood of the Biden Administration seeking to obtain additional barrels from a nation it maintains no formal diplomatic relations with.

### Exhibit 65: Iran has found it harder to place its exports as it competes against Russia's discounted barrels

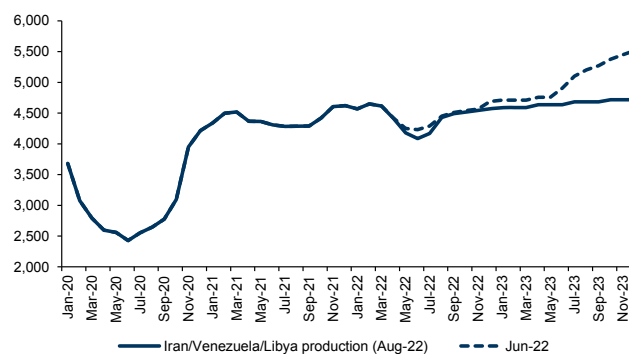
Estimated Iranian crude and condensate exports (kb/d)



Source: Kpler, Goldman Sachs Global Investment Research

### Exhibit 66: We no longer expect an Iranian deal and modestly downgrade the production profiles of Libya and Venezuela

Iran, Libya, Venezuela combined crude production (kb/d) versus previous forecast



Source: IEA, Woodmac, Goldman Sachs Global Investment Research

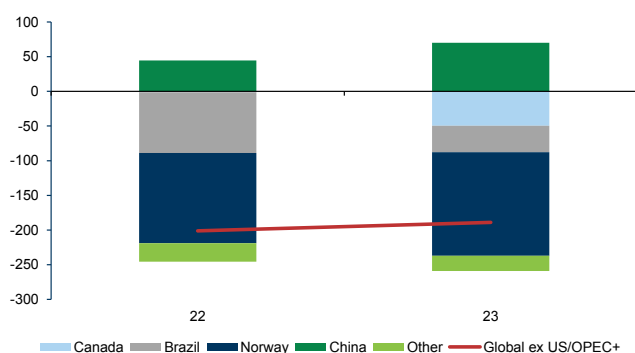
## What is going on outside of OPEC+ and the US?

We have revised down 2022/2023 global supply outside of OPEC+ and the US by c.200 kb/d in both years:

- The downward revisions are mostly due to continued project delays, high underlying declines rates, and exceptional maintenance in Brazil and Norway in particular. Our high-frequency production model for Canada continues to come in line with expectations; nevertheless we modestly reduce growth expectations next year to +40 kb/d given continued discipline advertised by the consolidated upstream industry. Only minor adjustments were required elsewhere (Exhibit 63). China continues to beat expectations as it encourages its SOEs to ramp up legacy fields.
- It has to be highlighted how constant a feature these downward revisions have become for our balance updates. Not once since early 2021 have we upgraded the forward path for this group representing mostly long-cycle production (Exhibit 68). Revisions to 2H21-22 production have aggregated to -750 kb/d since 1Q21, revisions to the 2023 path since September 2021 have already amounted to 300 kb/d so far.
- Nevertheless, we continue to expect this group to grow by 1.4 mb/d from Jun-22 to Dec-23. This is again driven entirely by Brazil (0.4 mb/d; FPSO additions), Norway (0.5 mb/d; maintenance recovery, Sverdrup Phase II), and Canada (0.4 mb/d; seasonal maintenance). Biofuels (-0.5 mb/d) seasonally declines in December versus June, but is offset by Argentina (+70 kb/d), Colombia (+50), Guyana (+120), and Refinery Gains (+150).

### Exhibit 67: Supply outside of short cycle regions continues to get revised lower

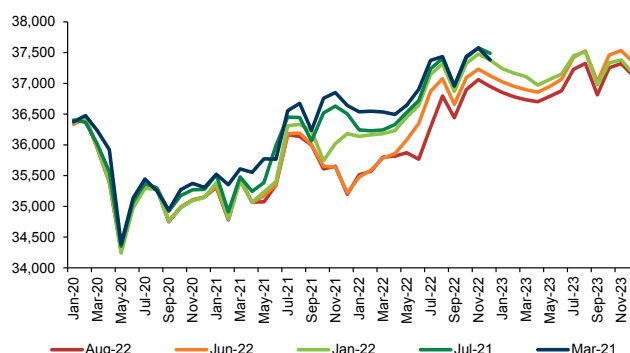
Supply revisions for global ex OPEC+/US (kb/d)



Source: IEA, Woodmac, ANP, Kpler, Goldman Sachs Global Investment Research

### Exhibit 68: Disappointment in the recovery in long cycle production has been ever-present feature of our updates since the pandemic

Global ex OPEC+/US oil production forecasts by GS published balance date (kb/d)



Source: IEA, Woodmac, Kpler, Goldman Sachs Global Investment Research

## You were focused on pressure pumping being the bottleneck to shale growth - is that still the case?

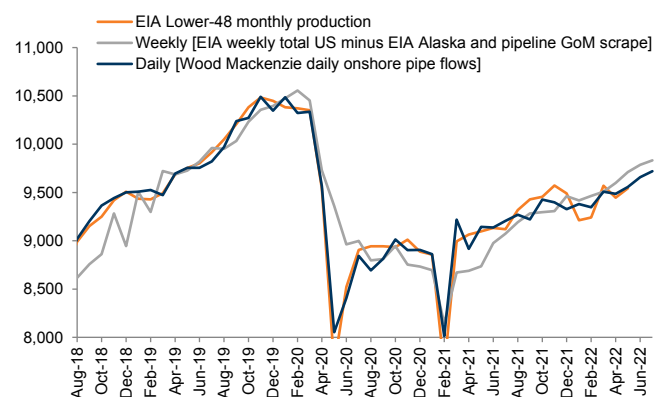
US onshore production disappointed in 2Q, in part due to weather, although high-frequency production tracking suggests the expected 3Q acceleration in shale production is playing out. We estimate July US crude production at 11.9 mb/d, up +0.25 mb/d since Dec-21, and 0.1 mb/d higher than expected, although the growth itself was little changed. Importantly, macro and logistical bottlenecks appear increasingly binding



and are leading us to reduce our 2023 US L48 crude production growth forecast from 0.82 mb/d yoy down to 0.79 mb/d.

#### Exhibit 69: US onshore production is accelerating in 3Q after disappointing in 2Q

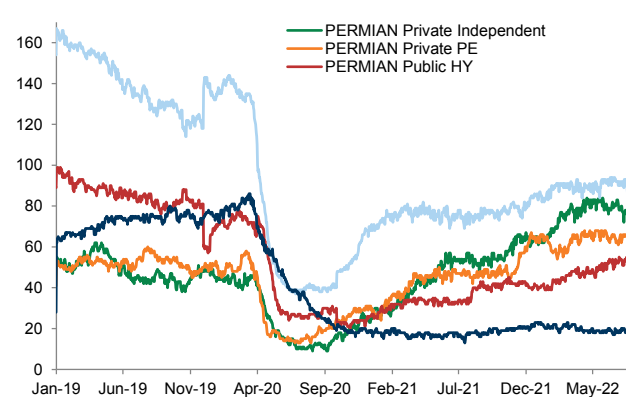
Thousand barrels per day



Source: EIA, Wood Mackenzie

#### Exhibit 70: Private drilling is starting to slow, as cost inflation and capacity constraints start to bite

Permian horizontal oil rig count by producer capital structure



Source: Enverus, Bloomberg, Company data, Goldman Sachs Global Investment Research

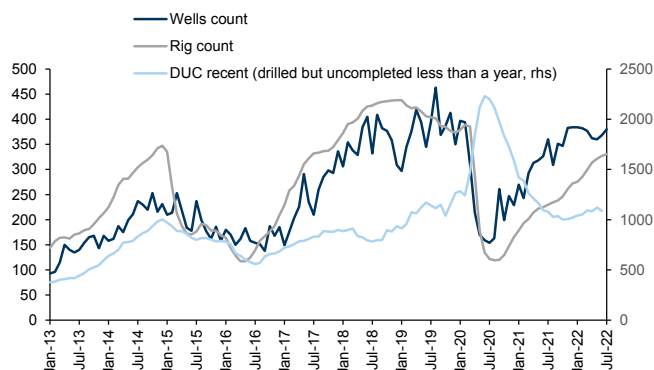
- The increase in shale drilling activity has slowed in recent weeks, with private producers actually reducing their rig deployment. This likely reflects the binding shortage in completion capacity, both pressure pumping and trained frac crews, which we argued previously would be the key bottleneck for shale production growth, limiting the pace of production growth in both 2022 and 2023 even at higher prices.
- Such a constraint on production growth was clear in the 2Q22 earnings comments from oilfield service companies. While oil service pricing power is strong, improving even faster than our analyst expectations, this is unlikely to translate into additional capacity, and we do not expect meaningful new build activity to increase the supply of frac fleets. This is driven by both company commentary to remain disciplined and return capital to investors, and commentary from equipment manufacturers that suggests orders are not commensurate with meaningful fleet additions.
- Specifically, our oil service analysts estimate that, at \$20 mil EBITDA/fleet, a new build fleet carries a breakeven of 2-3 years. The lack of long-term contracting by E&Ps is therefore preventing meaningful capacity expansion – as pressure pumpers will no longer invest without contracts. For now, better profitability at most implies a greater willingness to high grade fleets to e-fleets as natural attrition from fleets occurs in 2022-23, as this further reinforces pricing power as e-fleets remain sold out and are more likely to be contracted for longer terms.
- Net, with no improvement in pressure pumping supply expected in coming quarters, we reiterate our view that the potential growth in shale is capped, with downside risks to our 0.8 mb/d potential growth capacity next year. In fact, producer earnings released this week have confirmed a cautious outlook on production growth, with still clear signs of strong cost inflation and fears of recession. As a result, while we expect the anticipated acceleration in 3Q22 US onshore supply to play out, we are reducing our expected sequential growth rate from 4Q22 to 4Q23. This leaves us now forecasting US onshore production growth of 0.6 in 2022 and 0.79 in 2023. This



is admittedly offset by stronger than previously expected US NGL production growth, with total oil growth now expected at 1.19 and 1.17 mb/d yoy in 2022 and 2023 respectively (vs. 1.13 and 1.08 prior).

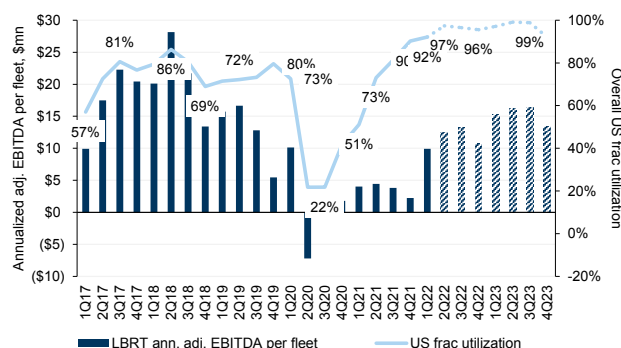
#### Exhibit 71: The increase in drilling is outperforming the increase in well completion given increasingly binding oil service capacity constraints

Permian oil rig and well count



Source: Kayrros, IHS, Goldman Sachs Global Investment Research, Enverus

#### Exhibit 72: Frac utilization is expected to reach and stay at record high levels, with discipline in the service sector limiting capacity addition



Source: EIA, Company data, Goldman Sachs Global Investment Research, Rystad, Primary Vision

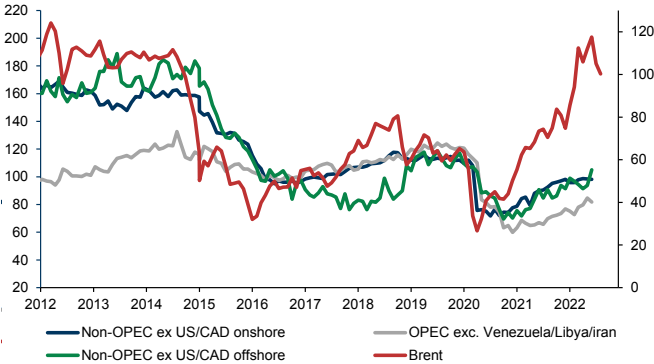
### Big picture, are we seeing signs of a global supply response?

The lackluster global supply response remains concerning.

- Beyond the continued discipline and constraints exhibited by US shale, long-cycle production outside of OPEC+ has been revised down every time we have updated our balances, despite higher realized prices than we were expecting at the time. The medium-term outlook for production growth also remains tepid, with rig counts still 5/15/30% respectively below their 2019 levels for non-OPEC (ex US/CAD) offshore/onshore/OPEC respectively, all 30-40% below their 2014 levels still, despite oil prices at similar levels ([Exhibit 73](#)). Persistently high price volatility and recessionary concerns will continue to depress the desire to add capex.
- Appetite for greenfield production remains almost entirely absent, exacerbating the shortfall in long cycle production that was expected anyway following the end of the era of \$100/bbl sanctioned additions. FIDs were only tracking at 300 kboe/d (expected peak production) in May, less than half of pre-pandemic, post-millennium average for this time of year, and barely above 2020 levels. Historically more than 1.5 mboe/d (peak production) of FIDs would be sanctioned annually over 2000-19 ([Exhibit 74](#)).
- Our equity colleagues' [Top Projects](#) report covers this dynamic in extensive detail. They estimate that shrinking industry reserve life (-50% versus 2014), due to a halt in exploration, will require a significant increase in energy investment to replenish. However, a doubling in the industry's cost of capital to 20% has seen this drop by more than 50% versus the post-2000 average over the 2015-2023E era, with a recovery to sustainably levels still unanticipated in their view.

Exhibit 73: There is still minimal to no sign of long-cycle supply response

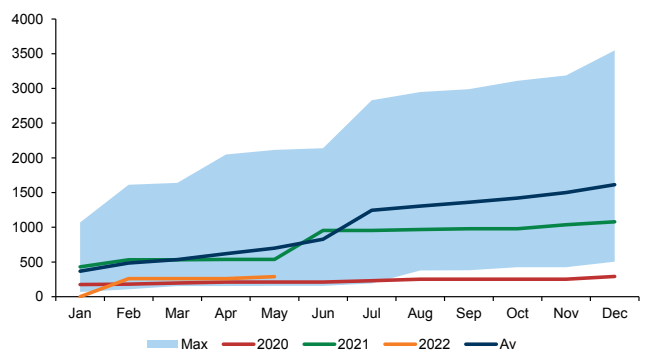
OPEC exc. Venez/Libya/Iran and onshore/offshore Non-OPEC exc. US/CAD rig count (lhs, indexed to 2016) vs. Brent prices (rhs, USD/bbl)



Source: Baker Hughes, ICE, Goldman Sachs Global Oil Investment Research

Exhibit 74: FIDs, discoveries, and CAPEX all remain near cycle lows

FIDs by peak production by year excluding shale (kb/d, average is for 2000-19)



Source: Woodmac, Goldman Sachs Global Investment Research

GS Global Oil Supply-Demand Balance

Exhibit 75: GS Global Oil Supply

	1Q2019	2Q2019	3Q2019	4Q2019	1Q2020	2Q2020	3Q2020	4Q2020	1Q2021	2Q2021	3Q2021	4Q2021	1Q2022	2Q2022	3Q2022	4Q2022	1Q2023	2Q2023	3Q2023	4Q2023	2019	2020	2021E	2022E	2023E	yoy 20E	yoy 21E	yoy 22E	yoy 23E	
Lower 48 crude	9,450	9,747	10,060	10,437	10,343	10,163	8,810	8,520	8,003	8,492	8,098	8,280	8,505	9,341	9,558	8,820	10,058	10,221	10,370	10,579	10,705	9,823	9,194	20,016	8,697	10,484	-729	98	601	789
Gulf of Mexico crude	1,863	1,930	1,830	1,963	1,987	1,663	1,430	1,507	1,818	1,798	1,486	1,714	1,671	1,748	1,757	1,820	1,887	1,857	1,777	1,760	1,887	1,847	1,704	1,749	1,820	-250	57	45	71	
Alaska crude	400	460	427	477	477	407	407	460	457	443	406	445	447	424	407	423	440	447	417	447	465	446	438	425	433	-19	-8	-13	7	
US crude	11,803	12,143	12,317	12,877	12,807	10,680	10,790	10,870	10,767	11,339	11,181	11,664	11,459	11,730	11,962	12,302	12,548	12,684	12,772	12,971	12,285	11,287	11,278	11,871	12,736	-968	-49	633	868	
US NGL	4,663	4,807	4,823	5,000	5,170	4,957	5,343	5,227	4,840	4,547	5,523	5,737	5,810	5,870	5,957	6,037	6,033	6,131	6,167	6,253	4,823	5,174	5,389	5,668	6,146	351	215	479	278	
Lower 48 ether	90	97	97	84	86	101	104	100	123	133	137	173	167	160	167	160	163	166	162	167	92	98	142	178	162	7	43	37	13	
US ethanol	1,013	1,047	1,017	1,040	1,027	707	927	977	900	990	963	1,063	1,023	1,007	1,017	1,033	1,032	1,015	1,025	1,042	1,029	909	979	1,020	1,028	-120	70	41	8	
Total US	17,510	18,083	18,254	19,000	18,992	16,444	17,164	17,174	16,630	17,179	17,504	18,638	18,299	18,147	18,206	18,900	19,990	20,157	20,462	20,462	18,229	17,468	17,748	18,837	20,102	-761	279	1,160	1,168	
Canada	5,462	5,549	5,590	5,800	5,800	4,983	5,015	5,064	5,388	5,594	5,794	5,732	5,841	5,792	5,866	5,901	5,911	5,779	5,925	5,925	5,609	5,351	5,602	5,740	5,779	-259	252	138	39	
Mexico	1,915	1,913	1,939	1,944	1,979	1,918	1,908	1,899	1,930	1,961	1,951	1,951	1,951	1,951	1,951	1,951	1,951	1,951	1,951	1,951	1,951	1,951	1,951	1,951	1,951	-2	80	3	3	
Total North America	24,877	25,546	25,744	26,700	26,672	23,346	24,086	24,476	24,224	25,288	25,348	26,376	25,991	26,351	26,907	27,458	27,790	27,632	27,340	28,379	25,767	24,745	25,304	26,891	27,898	-1,822	659	1,387	1,298	
Argentina	636	644	659	650	644	585	599	604	622	633	644	673	691	704	718	730	742	748	754	776	647	609	643	711	758	-38	34	68	47	
Brazil	2,737	2,737	3,009	3,170	3,148	3,014	3,132	2,880	2,948	3,035	3,104	2,930	3,083	2,998	3,097	3,220	3,161	3,163	3,207	3,276	2,895	3,043	3,004	3,100	3,205	-148	-39	96	105	
Colombia	889	890	884	889	880	783	749	784	752	721	749	751	751	746	746	754	769	774	791	803	893	788	744	762	784	-105	-46	9	32	
Guyana	0	0	0	0	0	5	73	63	94	122	102	110	105	123	205	305	345	345	345	345	1	70	110	245	345	69	40	135	100	
Other Latin Am	356	350	360	363	354	317	328	324	319	320	324	318	312	319	311	315	311	316	307	330	320	316	313	317	313	-27	-10	-4	-2	
Non-OPEC LatAm	4,555	4,630	4,913	5,077	5,079	4,749	4,869	4,666	4,763	4,811	4,931	4,776	4,860	4,979	5,183	5,368	5,348	5,335	5,335	5,419	4,794	4,441	4,820	5,245	5,405	-47	-20	392	282	
Norway	1,778	1,773	1,694	1,964	2,047	1,997	2,022	2,136	1,919	2,054	2,043	1,968	1,740	1,644	2,028	2,169	2,018	1,995	2,051	1,742	2,007	2,037	1,848	2,049	268	-30	-192	203	3	
UK	1,213	1,157	1,089	1,143	1,158	1,136	965	1,042	1,028	789	880	876	900	892	786	863	806	887	742	886	1,151	1,078	883	862	858	-73	190	-26	-5	
Other Europe	615	596	577	560	608	565	501	592	581	559	570	566	566	568	564	582	590	565	573	585	587	592	569	570	578	4	-22	1	8	
Total Europe	3,607	3,525	3,321	3,667	3,825	3,702	3,623	3,646	3,748	3,344	3,598	3,446	3,443	3,289	3,988	3,472	3,645	3,471	3,272	3,533	3,477	3,677	3,495	3,278	3,485	189	-152	-217	207	
Azerbaijan	800	743	762	756	762	691	659	684	697	693	714	713	695	673	677	681	708	698	691	668	765	699	704	682	691	-66	-5	-22	10	
Kazakhstan	2,202	1,830	1,837	1,999	2,031	1,838	1,892	1,787	1,845	1,844	1,794	1,894	1,983	1,756	1,812	1,970	2,005	1,956	1,839	2,014	1,842	1,837	1,847	1,880	1,818	-105	10	34	98	
Russia	11,668	11,501	11,573	11,590	11,641	10,358	10,079	10,367	10,523	10,802	10,893	11,242	11,375	10,778	11,102	10,804	10,344	10,364	10,394	10,424	11,583	10,611	10,805	11,015	11,404	-972	-254	100	-411	
Other FSU	351	353	353	359	359	355	354	352	351	350	350	347	342	341	341	341	341	341	341	341	351	351	351	351	351	2	-5	-39	-11	
Total FSU	14,829	14,428	14,654	14,791	14,793	13,543	13,243	13,191	13,415	13,689	13,682	14,286	14,396	13,893	13,764	13,447	13,318	13,322	13,456	14,443	13,892	13,745	13,887	13,373	13,411	-543	-253	122	-454	
China	3,522	3,548	3,915	3,899	3,990	3,981	3,981	3,950	4,056	4,090	4,081	4,013	4,230	4,243	4,236	4,254	4,258	4,286	4,256	4,288	3,921	3,971	4,000	4,241	4,272	50	89	181	31	
India	628	698	791	785	770	740	747	742	739	724	727	721	716	711	718	716	716	705	709	803	750	729	715	708	714	-63	-22	-13	-7	
Indonesia	791	780	762	756	754	737	715	728	705	678	678	670	663	656	651	643	635	630	629	622	724	683	653	638	639	-51	-30	-15	-3	
Malaysia	708	690	603	679	675	653	583	597	608	574	530	554	573	572	574	587	595	585	564	581	670	604	567	577	574	-66	-38	-10	-3	
Australia	391	439	487	514	455	463	450	450	445	391	445	456	416	426	424	424	421	419	416	414	458	455	444	423	418	-3	-11	-21	-5	
Vietnam	241	244	225	219	215	206	193	201	195	194	192	189	189	185	189	188	187	173	166	170	232	204	192	188	174	-29	-11	-4	-14	
Non-OPEC Asia	7,728	7,769	7,822	7,892	7,887	7,444	7,444	7,527	7,749	7,749	7,749	7,496	7,496	7,496	7,496	7,496	7,496	7,496	7,496	7,496	7,790	7,512	7,429	7,482	7,486	-188	-82	63	-27	
Oman	978	978	978	978	1,005	954	918	951	951	951	951	951	951	951	951	951	951	951	951	951	978	978	978	978	978	-22	-22	101	40	
Qatar	1,742	1,719	1,718	1,718	1,717	1,717	1,717	1,717	1,717	1,717	1,717	1,717	1,717	1,717	1,717	1,717	1,717	1,717	1,717	1,717	1,717	1,717	1,717	1,717	1,717	-46	51	23	24	
Other Middle East	291	310	315	319	302	287	270	282	279	280	288	288	286	287	293	294	290	314	317	306	309	285	284	290	307	-24	-1	6	17	
Non-OPEC Middle East	3,011	3,087	3,012	3,017	3,069	3,018	2,963	3,011	3,058	3,044	3,096	3,123	3,151	3,203	3,238	3,208	3,201	3,208	3,201	3,208	3,012	3,013	3,008	3,013	3,008	-1	71	159	80	
Egypt	641	637	630	622	616	609	592	570	569	560	560	560	560	560	560	560	560	560	560	560	641	637	630	622	616	-7	-29	-7	-29	
Chad	186	208	219	211	196	203	200	183	173	169	158	165	160	146	159	154	150	146	146	149	205	196	186	165	148	-10	-30	-11	-7	
Other Africa	650	659	631	623	626	614	601	600	570	567	575	569	545	542	550	559	567	536	542	548	650	644	629	604	591	-21	-23	-26	2	
Non-OPEC Africa	1,477	1,505	1,481	1,486	1,439	1,426	1,383	1,313	1,312	1,336	1,298	1,301	1,272	1,283	1,273	1,270	1,286	1,282	1,215	1,212	1,487	1,399	1,312	1,267	1,234	-97	-79	-44	-33	
Processing gains	2,337	2,351	2,390	2,344	2,255	1,975	2,095	2,127	2,139	2,150	2,226	2,270	2,250	2,250	2,250	2,250	2,250	2,250	2,250	2,250	2,337	2,351	2,390	2,344	2,255	-62	77	114	81	
Refineries exc. US ethanol	1,288	1,552	2,246	2,140	1,246	1,246	1,246	1,246	1,246	1,246	1,246	1,246	1,246	1,246	1,246	1,246	1,246	1,246	1,246	1,246	1,246	1,246	1,246	1,246						

Exhibit 76: GS Global Oil Demand

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	1Q2019	2Q2019	3Q2019	4Q2019	1Q2020	2Q2020	3Q2020	4Q2020	1Q2021	2Q2021	3Q2021	4Q2021	1Q2022	2Q2022	3Q2022	4Q2022	1Q2023	2Q2023	3Q2023	4Q2023	2019	2020E	2021E	2022E	2023E	2019	2020E	2021E	2022E	2023E	
USA	20,628	20,624	20,591	20,805	19,855	19,217	19,037	18,855	18,569	18,569	20,351	20,351	20,350	20,350	20,259	19,918	19,957	20,391	20,277	20,781	18,549	19,912	20,151	20,151	20,151	20,151	1,634	259	5		
Canada	2,290	2,406	2,705	2,824	2,514	2,099	2,312	2,294	2,263	2,240	2,500	2,406	2,406	2,339	2,402	2,487	2,455	2,311	2,319	2,510	2,484	2,506	2,305	2,352	2,413	2,406	-201	47	61	-7	
Mexico	1,899	2,059	1,985	1,890	1,850	1,390	1,498	1,580	1,616	1,540	1,594	1,712	1,746	1,949	1,888	1,883	1,974	2,046	2,009	1,953	1,958	1,981	1,641	1,865	1,985	-377	59	224	130		
North America	24,817	25,089	25,681	25,394	24,048	19,715	22,417	22,739	22,448	24,647	24,448	24,678	24,470	24,635	24,674	24,296	24,242	24,343	24,910	24,714	25,246	22,235	23,905	24,428	24,552	-3,910	1,670	624	124		
Brazil	2,989	3,027	3,143	3,191	2,837	2,528	2,581	3,126	2,966	2,964	3,206	3,115	3,021	3,061	3,158	3,228	3,075	3,107	3,226	3,249	3,078	2,886	3,063	3,106	3,164	-182	177	43	58		
Chile	363	363	351	370	369	286	283	376	340	329	380	371	419	331	353	349	364	363	360	371	362	324	365	362	365	-38	31	7	3		
Latin ex. Mexico, Brazil, Chile	3,186	3,245	3,241	3,185	3,286	2,946	2,998	3,032	3,067	3,250	3,209	3,119	3,198	3,244	3,195	3,124	3,129	3,175	3,180	3,134	3,214	3,065	3,161	3,178	3,155	-149	96	17	24		
Latin ex. Mexico	6,538	6,635	6,736	6,706	6,592	6,740	6,232	6,634	6,273	6,544	6,794	6,605	6,639	6,636	6,707	6,791	6,568	6,645	6,766	6,754	6,654	6,275	6,679	6,646	6,683	-379	305	67	37		
OECD Europe	14,092	14,260	14,743	14,149	13,341	11,019	12,878	12,508	11,916	12,642	13,853	13,907	13,101	13,404	14,163	13,642	13,609	13,925	14,294	13,896	14,311	12,436	13,080	13,532	13,931	-1,875	644	452	399		
Non-OECD Europe	750	786	798	792	798	631	686	717	708	731	701	676	697	794	807	843	715	745	757	758	782	708	704	762	744	73	-4	78	-38		
Total Europe	14,842	15,046	15,541	14,941	14,139	11,649	13,564	13,225	12,628	13,373	14,555	14,583	13,798	14,198	14,970	14,485	14,324	14,671	15,051	14,654	15,093	13,144	13,784	14,314	14,675	-1,948	639	531	381		
Japan	4,130	3,481	3,518	3,834	3,752	2,928	3,065	3,534	3,732	3,084	3,186	3,609	3,720	3,022	3,272	3,548	3,847	3,198	3,249	3,588	3,741	3,327	3,418	3,378	3,470	-414	91	-40	92		
South Korea	2,636	2,488	2,590	2,691	2,535	2,445	2,364	2,403	2,551	2,503	2,594	2,699	2,738	2,448	2,572	2,540	2,708	2,556	2,653	2,707	2,599	2,437	2,587	2,603	2,678	-162	150	16	75		
Australia & New Zealand	1,360	1,350	1,349	1,391	1,325	1,040	1,121	1,211	1,191	1,238	1,117	1,194	1,229	1,338	1,239	1,274	1,269	1,303	1,291	1,343	1,363	1,174	1,185	1,265	1,302	-168	11	81	36		
Israel	235	235	242	223	224	186	204	202	216	220	218	225	218	225	218	225	218	225	241	218	234	204	214	230	229	-29	10	10	-1		
OECD Asia Pacific	8,381	7,854	7,898	8,129	7,867	6,609	6,793	7,351	6,776	7,842	7,117	7,780	7,912	7,102	7,380	7,894	8,145	7,285	7,433	7,885	7,966	7,143	7,494	7,477	7,689	-783	351	73	293		
China	13,740	13,588	13,881	14,578	12,247	14,349	14,929	15,082	14,419	14,898	15,179	15,499	15,044	14,942	15,115	15,439	15,208	15,673	15,463	15,724	13,947	14,151	14,949	14,983	15,517	205	797	34	535		
India	5,158	5,008	4,975	5,040	4,961	3,959	4,205	5,052	5,141	4,499	4,456	4,586	5,227	5,194	5,105	5,444	5,585	5,566	5,187	5,572	4,983	4,919	4,771	5,236	5,502	-464	252	465	265		
Other non-OECD Asia	9,167	9,057	8,799	8,985	9,045	8,196	8,526	8,854	8,858	8,912	8,788	9,208	9,140	9,123	9,010	9,456	9,429	9,303	9,520	9,002	8,655	8,941	9,148	9,430	-347	286	207	282			
Total Asia	28,065	27,703	27,386	28,603	26,252	26,403	27,661	29,987	29,419	29,168	28,422	29,694	29,411	28,889	29,289	30,338	30,362	30,668	29,863	30,816	27,931	27,326	28,661	29,367	30,469	-606	1,335	798	1,083		
FSU	4,080	4,436	4,902	4,851	4,414	4,073	4,477	4,500	4,541	4,531	4,847	4,981	4,864	4,906	4,919	4,892	4,682	4,766	5,006	5,002	4,722	4,417	4,725	4,905	4,861	-305	380	180	-43		
Total Middle East	8,824	8,970	8,668	8,210	7,956	7,476	7,768	7,779	7,584	7,999	8,156	8,652	8,16	8,663	8,468	8,387	8,405	8,474	8,763	8,538	8,241	7,745	7,948	8,341	8,545	-486	203	434	164		
Total Africa	4,311	4,291	4,142	4,260	4,437	3,939	3,918	4,220	4,338	4,382	4,291	4,437	4,668	4,561	4,382	4,478	4,605	4,573	4,424	4,568	4,291	4,128	4,340	4,486	4,540	-122	211	146	54		
OECD demand	47,633	47,266	48,474	48,462	45,625	37,899	42,331	42,995	42,380	44,680	45,796	46,736	46,903	45,473	46,491	48,040	46,360	45,915	46,998	46,838	47,854	42,138	44,743	45,799	46,528	-5,716	2,605	1,056	728		
Non-OECD demand	91,825	91,758	92,240	93,582	90,891	48,091	50,669	52,360	61,622	61,975	62,743	54,063	54,118	54,088	54,130	55,270	54,943	55,509	55,328	56,065	52,218	50,275	52,601	54,205	55,459	-1,943	2,326	1,604	1,254		
World Demand	99,458	99,024	100,714	101,094	95,706	85,660	92,991	95,355	94,002	96,635	96,539	100,799	100,021	99,562	100,621	101,211	101,303	101,424	102,326	102,894	100,072	92,413	97,344	100,004	101,987	-7,659	4,931	2,661	1,982		

Google LLC “Google COVID-19 Community Mobility Reports”; <https://www.google.com/covid19/mobility/> Accessed: 8/2/2022

Source: IEA, JODI, ICIS, SCI, EIA, Google COVID-19 Community Mobility Reports, Apple, DAG, Goldman Sachs Global Investment Research

Exhibit 77: GS Imbalance and stocks breakdown

kb/d

	1Q2019	2Q2019	3Q2019	4Q2019	1Q2020	2Q2020	3Q2020	4Q2020	1Q2021	2Q2021	3Q2021	4Q2021	1Q2022	2Q2022	3Q2022	4Q2022	1Q2023	2Q2023	3Q2023	4Q2023		2019	2020E	2021E	2022E	2023E
Imbalance	441	1,012	-456	480	4,610	6,111	-2,132	-2,834	-1,368	-1,813	-2,325	-2,807	-1,303	-833	536	1,218	1,046	1,168	837	861	369	1,439	-2,078	254	963	
Global stock change vs. Dec-19 (mb)																										
EM Crude exc. China/Iran (producers)	334	-35	-1	-56	608	-274	-231	-206	143	-221	169	-274	283	-77	-243	50	50	50	50	50						
EM Crude exc. China/Iran (consumers)	-38	47	-45	129	316	606	-52	-331	-564	-255	-201	-261	168	-20	493	133	339	194	269	63						
EM Crude exc. China/Iran	297	12	-46	73	924	332	-283	-537	-421	-476	-31	-534	451	-97	250	183	389	244	319	0						
EM Products exc. China/Iran	-83	-120	-197	-198	472	786	-674	-227	-173	-182	41	150	48	-59	134	20	103	45	75	-8						
EM exc. China/Iran	214	-108	-242	-125	1,395	1,118	-1,157	-764	-248	-658	10	-385	499	-156	383	203	492	289	394	105						
China crude					1,158	718	853	-673	773	-256	159	-222	153	119	-360	101	-54	283	-25	-149						
China products					564	214	407	-357	194	-318	-199	-308	310	-346	-30	64	50	50	-63	114						
China Total					17	278	-44	157	1,723	931	1,260	-1,030	967	-574	-40	-530	463	-227	-390	165	-4	333	-118	-35		
Crude Floating Storage (ex-Iran)	-23	161	-60	91	263	1,469	-485	-378	-15	-210	192	-202	123	-147	-29	23	116	50	84	-9						
Crude in Transit	-254	-375	-464	1,098	-87	-607	-652	1,275	-681	151	-501	1,303	-486	-207	-248	761	-486	-207	-248	761						
Products Floating Storage (ex-Iran)	-120	58	238	-80	290	364	-272	-336	93	-148	5	-233	164	56	140	8	39	17	28	-3						
Products in Transit	339	-526	69	232	-56	-526	-71	373	434	-381	-92	44	0	355	16	172	0	355	16	172						
Iran (onshore & floating)	-424	768	-266	55	31	-145	-125	-100	111	-31	85	-38	-43	2	0	0	0	0	0	0						
Other EM/Floating	-481	85	-483	1,396	440	496	-1,905	834	-337	-620	-311	873	-242	58	-119	963	-332	215	-118	921						
EM total	-249	256	-769	1,428	3,557	2,545	-1,802	-960	383	-1,852	-341	-41	720	-325	-126	1,331	157	837	158	991						
OECD commercial	65	659	102	-357	900	2,086	-395	-1,543	-1,365	-490	-1,308	-1,163	-354	824	779	70	689	254	478	-140						
OECD government	58	-89	-47	-99	22	266	-111	-108	50	-245	-118	-314	-466	-1,018	-917	-183	200	17	200	9						
Miscellaneous vs. Balance (Imbalance less obs)	578	58	165	131	714	176	174	-435	774	-557	1,289	1,201	315	560	1,218	1,046	1,168	837	861							
OECD commercial seasonal	204	364	307	-521	204	364	307	-521	204	364	307	-521	204	364	307	-521	204	364	307	-521						
5 yr. OECD commercial season of demand	61.1	62.5	61.9	61.4	61.9	63.1	62.3	61.8	61.9	63.1	62.3	61.8	61.9	63.1	62.3	61.8	61.9	63.1	61.9	62.3	61.8					
OECD stock changes vs. Dec-19					831	285	142	22	-62	-141	-248	-279	204	133	-126	-82	-38	6	-7							
Global stock change vs. Dec-19					385	221	18	922	777	241	18	-382	-270	177	177	177	177	177	177	177						
OECD commercial values (EoM, mb)					2,894	2,979	3,215	3,179	3,303	2,915	2,872	2,752	2,645	2,615	2,690	2,761	2,768	2,832	2,856	2,900	2,887					
Jet demand level (kbb/d)	6,874	7,305	7,661	7,150	6,205	6,216	3,495	3,623	3,508	4,024	4,786	2,847	6,815	6,815	6,815	6,183	5,926	5,805	6,293	6,724	6,367					

# Disclosure Appendix

## Reg AC

We, Damien Courvalin and Callum Bruce, hereby certify that all of the views expressed in this report accurately reflect our personal views, which have not been influenced by considerations of the firm's business or client relationships.

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