GUINNESS ATKINSON FUNDS

2022 Outlook for Global Energy

The Guinness Atkinson Global Energy Team, January 2022

2021 was a year which saw a tightening oil market and extraordinarily high gas prices. Here, we would like to share our thoughts on 2021 and the outlook for 2022 and beyond.

Highlights

2021 IN REVIEW

The year of 2021 saw a sustained tightening in the balance of the oil market. The Organization of the Petroleum Exporting Countries (OPEC) kept their discipline, maintaining their production quotas at levels which allowed global oil inventories to decline. The recovery in global oil demand has been strong but uneven. The Organisation for Economic Cooperation and Development (OECD) demand has lagged, held back by the aviation sector, but non-OECD demand is now at new highs. Natural gas has become front page news, with a "perfect storm" of supply and demand events driving European and Asian prices to record levels. Rising oil and gas prices created a positive backdrop for oil & gas equities. Energy was the strongest equity sector in the MSCI in 2021.

The dominant themes for global oil and gas markets last year were:

Recovery in oil demand, up by 5.5m b/day (+9%) vs 2020, but still 3m b/day behind 2019. After lockdowns in the first quarter, COVID vaccination programs contributed to mobility improving across the world, especially in the US and Europe. Freight and industrial activity surged, while aviation continued to lag. Oil demand in China rose by around 1.1mb/day and is now 1.5m b/day higher than 2019.

OPEC+, led by Saudi, were focused on micromanaging the oil market as demand improved. Their approach has been a cautious one, returning oil to the market but in volumes that have kept the overall balance tight. The group started the year with quotas 7.8m b/day below "base line", adding 2m b/day of supply back into the market over the first half. In July, the group set out a clear trajectory for their quotas, announcing a monthly supply increase of 0.4m b/day from August 2021 to September 2022. The group has been disciplined, maintaining at least 100% compliance with quotas every month in 2021.

Outside OPEC+, there has been no significant supply response, leaving the direction of the oil price in OPEC's hands. 2021 ended as the lowest year for large non-OPEC project additions since the early 2000s. For US shale oil, production has recovered from the lows of mid-2020, but still sits around 1.2m b/day below the November 2019 peak of 10.4m b/day. Shale oil producers added back drilling rigs in 2021, but at a significantly slower pace than in the 2016 cycle. Instead, equity markets rewarded companies that prioritized free cashflow and dividends over additional drilling.

For natural gas, several factors came together across to globe to drive prices materially higher. Surging power demand as many economies recovered from COVID; cold weather in Europe; drought in Brazil and China curbing hydro output; higher European carbon prices; lower supply from Russia; and a shortage of coal in China combined to create extraordinarily tight markets.

Strength in oil and gas prices (spot and long-dated) led to **good returns for energy equities in 2021**. The sector (MSCI World Energy Index) finished +40.1%, well ahead of the broad market (MSCI World +21.8%) in USD. Best performing were oil and gas producers, enjoying a high degree of operational leverage to rising commodity prices. Midstream and service companies underperformed.

OUTLOOK FOR 2022

- Following a successful year of oil inventory management in 2021, the OPEC+ group will be looking this year to bring additional supply back into the market as the oil demand trajectory allows. Their aim will be to keep global inventories under control, while achieving an oil price which satisfies the fiscal needs of its members.
- **The path for oil demand will vary region by region**, as developed markets plus China continue their strong vaccination roll out, while other emerging countries remain more exposed to COVID. Overall, the IEA forecast demand in 2022 of 99.5m b/day, up by 3.3m b/day versus 2021. This would put global oil demand on par with its previous peak in 2019, and on course to reach a new high in 2023. The IEA's forecasts imply that oil demand in the OECD region will still, on average, be around 3% lower in 2022 than in 2019. By contrast, demand in the non-OECD region in 2022 is expected to be around 3% ahead of 2019.
- **OPEC+ will maintain high compliance with quotas**, remaining alert to any demand or supply issues that might require deviation from the 0.4m b/day monthly increases in production currently planned until September. Iran remains the wildcard, with a possible 1m b/day supply increase if negotiations with the US conclude successfully. If this occurs, OPEC+ will take it in its stride. We believe the oil price desired by OPEC is at around $65-70/bl, though they will welcome a higher outcome if it does not destabilize the global economy.
- We expect **moderate growth from US shale production**, with average production rising 0.5m-0.75m b/day versus 2021. Non-OPEC (ex US shale) will take its share of the OPEC+ quota increases, but beyond that, there will be no major roll-out of large new projects, the cycle having peaked in 2020.
- **For natural gas, relief from very high prices should be forthcoming**. Additional supply will come from Russia and Norway; China is increasing its coal supply, and with normalized weather, hydro and wind generation will pick up again. Prices should settle back around $7-9/mcf, well down on current levels, but a significant step up on 2019/20.

- **Despite the 2021 rally, energy equity valuations remain subdued.** The MSCI World Energy Index now trades on a price to book ratio of 1.6x, versus the S&P500 at 4.9x. The relative P/B of energy vs the S&P500 remains close to a 55-year low.
- Oil and gas companies are demonstrating a **meaningful shift towards capital discipline**, manifested in lower levels of reinvestment, lower levels of debt and a return of free cash to shareholders. Assuming a $65/bl Brent oil price, we forecast a free cashflow yield for our portfolio in 2022 of around 9%.
- **Energy equities offer attractive upside if our oil price, profitability and free cashflow scenarios play out**. We believe energy equities currently discount an oil price of around $55/bl. Adopting $65/bl Brent as a long-term oil price (consistent with the bottom end of OPEC's desired range), we see 30-40% upside across the energy complex.

Review of 2021

The year of 2021 saw a sustained tightening in the balance of the oil market. OPEC kept their discipline, maintaining their production quotas at levels which allowed global oil inventories to decline. The recovery in global oil demand has been strong but uneven. OECD demand has lagged, held back by the aviation sector, but non-OECD demand is now at new highs. Oil prices responded positively, with the Brent spot price up by around 50% over the year. European and Asian natural gas prices reached record levels, driven by surging global power consumption, lower Russian supply, and a shortage of coal. Rising oil and gas prices created a positive backdrop for oil & gas equities. Energy was the strongest equity sector in the MSCI in 2021, having been the weakest in 2020.

Global oil demand in 2021 is estimated to have risen by around 5.5m b/day, the post-COVID economic recovery having gained momentum. After lockdowns in the first quarter, accelerated vaccination programs contributed to mobility improving across the world, especially in the US and Europe. Freight and industrial activity surged. The area of oil demand that continued to lag was aviation. Globally, commercial flights in 2021 remained around 25% lower than in 2019. Even in this sector, however, there were signs of improvement, with commercial flights ending the year down by less than 20% versus 2019.

OPEC, led by Saudi, were focused on micromanaging the oil market as demand improved. Their approach has been a cautious one, returning oil to the market but in volumes that have kept the overall balance tight. Outside OPEC+, there was no significant supply response, leaving the direction of the oil price in OPEC's hands.

OPEC+ started the year with quotas 7.8m b/day below "base line". Saudi reacted to the softness in European demand in the first quarter with the unilateral decision to remove a further 1m b/day from the market, which was later reversed. From March to June, OPEC+ increased their supply by 2m b/day. Then in July, the group set out a clear trajectory for their output, announcing a monthly supply increase of 0.4m b/day from August 2021 to September 2022, adding to 5.8m b/day. At the same time, the quota agreement was extended from

April 2022 to December 2022. "OPEC+ is here to stay", declared the Saudi Energy Minister after the July meeting, adding that the OPEC+ spirit of cooperation would enable supply coordination beyond 2022 if required. The group has been disciplined, maintaining at least 100% compliance with quotas every month in 2021.

Low investment in oil supply outside OPEC in 2021 further compounded an already weakened outlook for oil project investment, increasing the risk that new large-scale oil projects will not be sufficient to satisfy demand. 2021 ended as the lowest year for large project additions since the early 2000s.

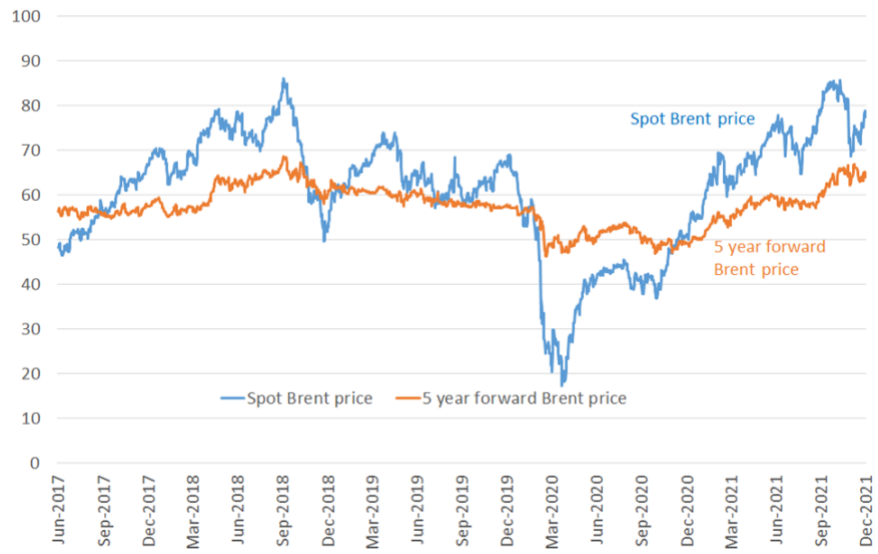
For US shale oil, production has recovered from the lows of May/June 2020, but still sits around 1.2m b/day below the November 2019 peak of 10.4m b/day. Shale oil producers added back drilling rigs, but at a significantly slower pace than in the 2016 cycle. Instead, equity markets rewarded companies that prioritized free cashflow and dividends over the recycling of cashflow into additional drilling.

Overall, non-OPEC supply is expected to have recovered by 0.7m b/day in 2021, having fallen by 2.6m b/day in 2020. Given that demand has rebounded by over 5m b/day, it has fallen to OPEC to control market balance.

Thanks to the events described above, spot oil prices rose strongly in 2021. Brent started the year at $51/bl, moved up to nearly $70/bl in early March, before falling to the low $60s/bl. The price then resumed its upwards trajectory, rising to over $80/bl in October. Uncertainty around the Omicron COVID variant created volatility in the final few weeks of the year, the spot price dropping back into the $60s/bl, before rallying to close 2021 at $77/bl. Brent spot averaged $70/bl in 2021, versus $42/bl in 2020. The five-year forward Brent price opened the year at $49/bl and rose by the end of December to $64/bl, averaging $53/bl over the year.

WTI oil prices in the US followed a similar path, with WTI reaching $77/bl by the end of December. Five-year forward WTI was up from $45/bl to $58/bl.

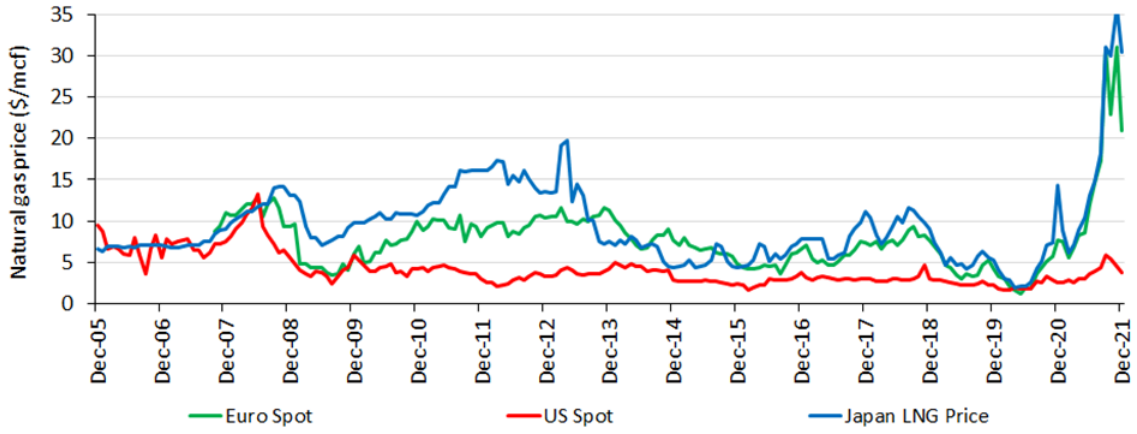
Brent spot vs five year forward oil prices (2017-21)



Source: Bloomberg

For natural gas, several factors came together across to globe to drive prices materially higher. Surging power demand as many economies recovered from COVID; cold weather in Europe; drought in Brazil and China curbing hydro output; higher European carbon prices; lower supply from Russia; and a shortage of coal in China came together to create extraordinarily tight markets. The European gas price (using UK NBP) rose from $7.7/mcf to $21.0/mcf; Japanese LNG prices rose from $7.3/mcf to $31.0/mcf; and the US spot price (Henry Hub) rose from $2.5/mcf to $3.7/mcf. In the US, exports of LNG reached new highs of around 11 Bcf/day, as the arbitrage between US and European/Asian prices was wide enough to incentivize export operations to run at full capacity.

International natural gas prices 2005-21



Source: Bloomberg; Guinness Atkinson Asset Management

Strength in oil and gas prices (spot and long-dated) led to good returns for **energy equities** in 2021. The sector (MSCI World Energy Index) finished +40.1%, well ahead of the broad market (MSCI World +21.8%).

As ever, the performance of the MSCI World Energy Index was only part of the story, with 2021 seeing divergence between the energy equity subsectors:

- **Integrated oil and gas companies** were slightly below average in the sector. US super majors (Exxon and Chevron) were among the best performers, benefitting from the strength in the US economy and buoyancy of the US stock market in general. European integrateds outperformed the broad market but lagged US peers despite reporting free cashflow yields far in excess of the 10-year average. The weakest integrateds were those more exposed to aviation fuel refining, where demand continued to struggle.

- **Exploration and production (E&P)** was the strongest performing sector. E&Ps in most regions benefitted from the tightening of oil and gas markets, in particular those with North American operations. Higher commodity prices resulted in especially good returns for companies with lower growth but greater operational and financial leverage. The stock market was also kind to E&P companies that showed commitment to capital discipline over production growth, with new mechanisms such as variable dividends being well received.

- **Oil refiners** were underperformers, performing well versus the broad market but underperforming E&P and integrateds. While refining margins in the US and Europe have improved since 2020, the

COVID demand overhang remains. A bright spot was biodiesel exposure, with demand helped by governments mandating higher biodiesel consumption. In emerging markets, the strength of oil prices (especially in local currency terms) put pressure on refining margins, particularly in countries with regulated retail fuel pricing.

- **Midstream** was a slight underperformer over the year. With revenues generally linked to pipeline capacity and throughout rather than commodity prices, most midstream companies were relative laggards versus producing companies. Pipeline companies exposed to gas generally performed better than those exposed to oil.

- **Energy services** underperformed, despite the rising oil and gas price environment. The sector remained weighed down by excess capacity issues. Sustained capital discipline from oil and gas producers was also a factor, with lower E&P spending translating into lower service revenues. Large cap diversified service providers were a little more resilient. We also saw a number of service companies, particularly in offshore design and installation, turn to the energy transition (e.g. offshore wind), though replacing oil & gas revenues is proving challenging.

Performance as of 12/31/21

	1 Year	3 Years*	5 Years*	10 Years*	Since inception*
Global Energy Fund	45.98%	1.97%	-3.19%	-2.00%	4.32%
MSCI World Energy Index Net Return	40.09%	2.28%	-1.12%	-0.18%	3.99%

***Periods over 1 year are annualized returns; inception date: June 30, 2004**

Performance data quoted represents past performance; past performance does not guarantee future results. The investment return and principal value of an investment will fluctuate so that an investor's shares, when redeemed, may be worth more or less than their original cost. Current performance of the fund may be lower or higher than the performance quoted. Performance data current to the most recent month end may be obtained by calling 800-915-6566 and/or visiting ***www.gafunds.com.***

Prospectus expense ratio: 1.46% (net) 2.56% (gross)

The Advisor has contractually agreed to reimburse expenses (excluding Acquired Fund Fees and Expenses, interest, taxes, dividends on short positions and extraordinary expenses) in order to limit the Fund's Total Annual Operating Expenses to 1.45% through June 30, 2025. To the extent that the Advisor absorbs expenses to satisfy this cap, it may recoup a portion or all of such amounts absorbed at any time within three fiscal years after the fiscal year in which such amounts were absorbed, subject to the expense cap in place at the time recoupment is sought, which cannot exceed the expense cap at the time of the waiver. The expense limitation agreement may be terminated by the Board of the Fund at any time without penalty upon 60 days' notice.

The **Guinness Atkinson Global Energy Fund** in 2021 produced a total return of 46.0%. This compares to the total return of the MSCI World Energy Index (net return) of 40.1%.

On a stock-by stock-basis in the fund (in USD), our three US shale oil biased E&P companies (Devon Energy Corp +196%; EOG Resources +89%; Pioneer Natural Resources +66%) were strong performers, enjoying a high degree of operational leverage to rising oil prices. US integrateds (Exxon +57%; Chevron +27%) and our US refining holding (Valero +42%) outperformed, benefitting from growing optimism around the US refining environment, plus general buoyancy in the US stock market. Canadian integrateds (Imperial Oil +96%; Canadian Natural Resources +85%; Suncor +55%) were also strong, with high-cost oil sands operations enjoying oil price leverage and growing free cashflow profiles.

Natural gas producers performed well, thanks to strength in the underlying commodity. Gazprom, which controls a significant proportion of gas imports in Europe and China, returned 73%. PetroChina, which owns the majority of China's domestic natural gas reserves, was up by 55%.

Weaker subsectors in the fund included European mid and larger cap integrateds (Galp -3%; Repsol +21%; TotalEnergies +26%), the common theme here being weaker prospects for downstream earnings, especially for refining operations exposed to the aviation sector, as Galp and Repsol's are. In the oil services sector, our main large cap pick, Schlumberger (+40%) underperformed the fund but was a relatively good performer versus peers, whereas smaller cap offshore services company Helix (-26%) struggled.

Outlook for 2022

Following a successful year of oil inventory management in 2021, OPEC+ will be looking this year to bring additional supply back into the market as the oil demand trajectory allows. The aim will be to keep global inventories under control, while achieving an oil price which satisfies the fiscal needs of its members. We believe the oil price desired by OPEC is at around $65-70/bl, though they will accept a higher outcome if it does not destabilize the global economy.

Oil supply

The world's oil supply grew sharply in 2021, as the OPEC+ group reacted to global demand recovery post the worst of COVID dislocations. Supply rose, on average, by around 2.5m b/day, as OPEC and partners raised their quotas. Non-OPEC supply (outside OPEC+ members) grew very modestly, as capital discipline in the US shale oil patch held production back.

OPEC are looking in 2022 to raise their production in line with the expected further recovery in oil demand. There will be moderate growth from US shale production, where average production this year is expected to rise by 0.5-0.75m b/day versus 2021; non-OPEC (ex US shale) will take its share of the OPEC+ quota increases, but beyond that, there will be no major roll-out of large new projects, the cycle having peaked in 2020.

OPEC oil supply

OPEC, led by Saudi, focused last year on micromanaging the oil market as demand improved. Their approach was a cautious one, returning oil to the market but in volumes that kept the overall balance tight. Outside OPEC+, there has been no significant supply response, leaving the direction of the oil price in OPEC's hands.

In July, the OPEC+ group set out a clear trajectory for their supply, announcing a monthly supply increase of 0.4m b/day from August 2021 to September 2022, adding to 5.8m b/day. At the same time, the quota agreement was extended from April 2022 to December 2022. OPEC+'s longer-term production guidance demonstrates how the group plans to proceed in 2022. However, there will be ongoing monthly meetings for ratifying each production increase. Even though OPEC+ has now provided the market with a longer-term guidance, it will continue to micro-manage the market and adjust production according to the market situation. OPEC+ continues to have little interest in pushing the oil market into an oversupply situation.

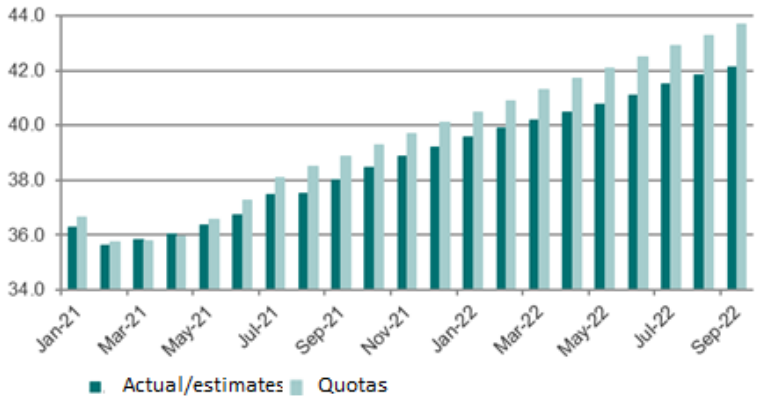
Amid uncertainty around the Omicron COVID variant, OPEC and OPEC+ partners met for scheduled meetings in December 2021 and January 2022. The December meeting resolved to continue increasing OPEC+ production quotas by 0.4m b/day in January 2022, consistent with the monthly quota plan set out in July 2021. OPEC+ included unusual wording in their formal communique, stating that:

"[the Dec 2] meeting shall remain in session pending further developments of the pandemic and continue to monitor the market closely and make immediate adjustments if required"

In other words, the OPEC group are signaling maximum flexibility in 2022 to adjust their production, thereby attempting to put a "soft" floor under oil prices. We also believe that OPEC+'s actions have been designed to appease President Biden. By sticking to the monthly quota increases, the group can be seen to be doing "their bit" to slow the commodity price inflation that is causing political tension in the US.

For wider context, it is worth remembering that OPEC+ has been struggling to keep up with its official production quotas. In January 2022, OPEC+ production is expected to be around 39.6m b/day, which is nearly 1m b/day lower than group quotas. The gap between production and quotas has opened up since May 2021 and can be explained largely by poorer OPEC members such as Nigeria, Algeria and Angola struggling to increase production in the face of underinvestment.

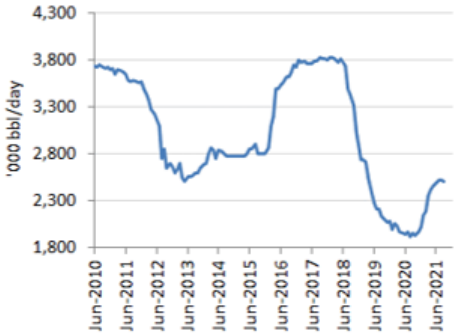
OPEC+ production vs quotas (2021-2022E) m b/day



Source: DNB; IEA; OPEC; Guinness Atkinson Asset Management

As ever, there are "wildcards" within OPEC which need to be watched closely. The situation in Iran, for example, remains unclear. Iran is a member of the OPEC+ group but exempted from quotas as US sanctions are severely restricting Iran's oil production. If a deal is struck to restore the 2015 nuclear deal, there will likely be a delay of roughly two months before the US lifts sanctions, while Iran scales back its nuclear activities, and to allow time for possible US Congressional review.

Iranian oil supply



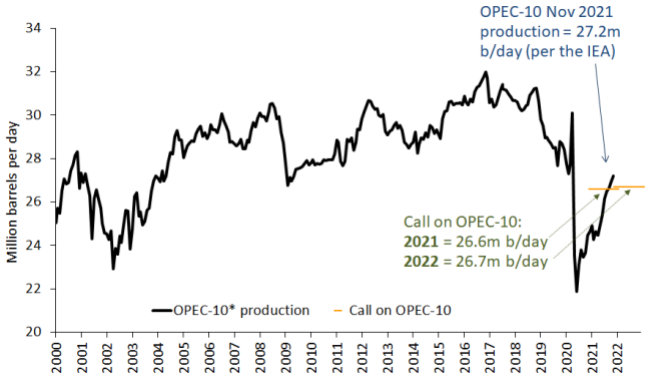
Source: Bloomberg; Guinness Atkinson Asset Management

Iranian crude oil production recovered to 2.5m b/day in 2021, from the 2020 low of 2.0m b/day, as US President Biden has turned a blind eye to increased Iranian oil exports to China. Iran's crude oil production capacity looks to be around 3.6m b/day, implying that a recovery of around 1m b/day in 2022 is possible. Ultimately, if greater Iranian exports do return in 2022, we expect OPEC+ to accommodate the increase, as it would be against the group's interest to do otherwise.

Overall, we believe that Saudi's long-term objective remains to maintain a "good" oil price, as close to their fiscal breakeven of $70/bl as possible, without overstimulating US shale supply. The actions taken in recent months represent further steps on that journey.

Overall, based on IEA forecasts, the "call on OPEC-10" (i.e. the amount of oil that core OPEC members will need to supply in 2021 to keep the market in balance) is around 26.7m b/day for 2022:

OPEC-10 production vs call on OPEC-10 according to the IEA (m b/day)



Source: Bloomberg; IEA; Guinness Atkinson Asset Management

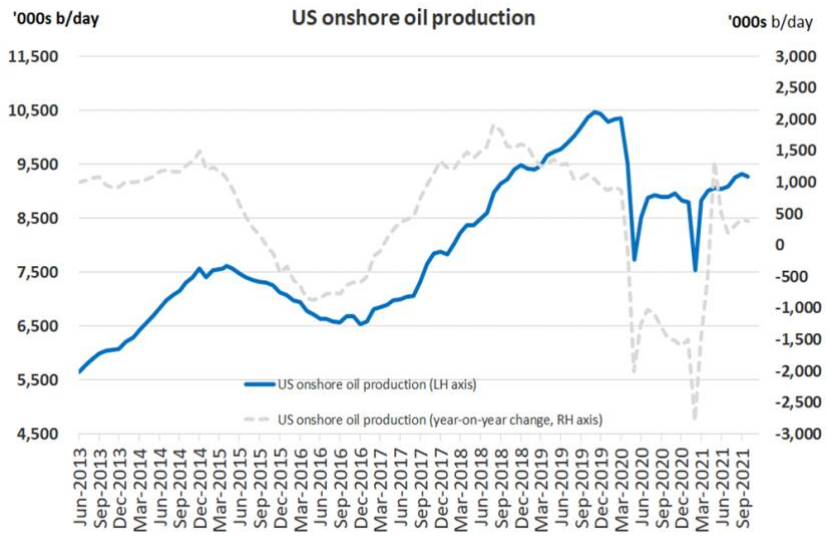
Compared to the IEA's forecasts for 2022, we expect global oil demand to be stronger, and non-OPEC supply to be weaker, than the IEA are forecasting, leading to a higher call on OPEC-10 than shown here. Nevertheless, OPEC will need to proceed cautiously with monthly supply increases of 0.4m b/day, as they may lead to a market surplus in the first half of the year.

US onshore (shale) oil supply

For much of the last decade, growth in the US shale industry had been responsible for keeping global oil markets well supplied, forcing OPEC and other allies to hold some of their production back to achieve a balanced market. The extreme drop in oil prices in 2020 thanks to COVID-led demand issues, however, caused major disruption to the shale oil industry.

Latest EIA data for September (published at the start of January) confirmed that while production has recovered well from the lows of May/June 2020, it still sits around 1.2m b/day below the November 2019 peak of 10.4m b/day.

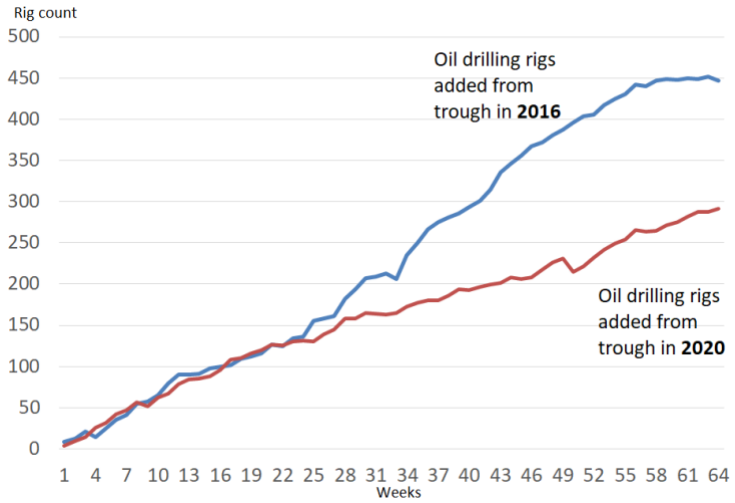
US onshore oil production 2013-2021 (m b/day)



Source: EIA; Bloomberg; Guinness Atkinson Asset Management

What to make of the modest rebound in production despite high WTI prices in 2021? The last rebound in production, post the 2016 trough, was achieved thanks to near limitless funding from equity and debt markets, combined with a producer mentality that favored growth over returns. This time, shale oil producers have been adding back drilling rigs at a lower pace than in the 2016 cycle, with equity markets rewarding companies that are prioritizing free cashflow and dividends over the recycling of cashflow into additional drilling. Moreover, the rigs that have been coming back into the market in 2021 have predominantly been in the hands of private companies, while public E&Ps continue to hold back.

US onshore oil rig count additions: 2016/17 cycle vs 2020/21 cycle



Source: EIA; Bloomberg; Guinness Atkinson Asset Management

One interesting aspect of current shale oil production is the number of completed wells per month, which has been running well ahead of the number of newly drilled wells. Additional well completions are being driven by shale companies depleting their well inventories (i.e. drawing down wells that were previously drilled but uncompleted, or "DUCs"). The total number of DUCs is now at a seven-year low, and the industry will not be able to rely on this additional source of supply as much in 2022 as it did in 2021. That said, we do expect the US shale oil supply to grow in 2022 by around 0.5-0.75m b/day. Growth of this magnitude would be significantly less than the average from 2017-19, with the industry persisting in its focus on free cashflow yields, deleveraging, increasing returns to shareholders and consolidation.

Ultimately, US supply will continue to be watched closely by OPEC. If shale oil growth resumes at a manageable level, and particularly a level that does not exceed (normalized) global oil demand growth, then OPEC will feel they retain control of the market. Growth of around 0.5-0.75m b/day in 2022 would likely fit this model.

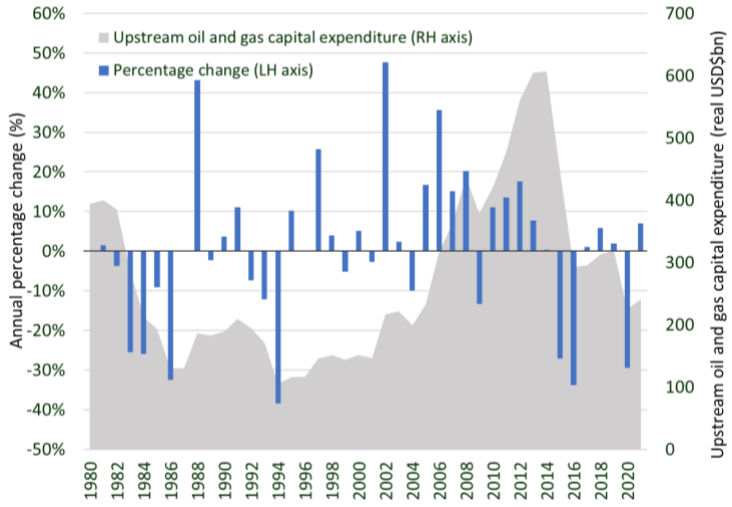
Non-OPEC (ex US onshore) oil supply

Despite representing over half of world oil supply (estimated 50m b/day in 2020), non-OPEC (ex US-onshore) production receives relatively little attention.

Upstream oil and gas capital expenditure fell in 2020 by 28% to US$225bn (the lowest level since 2005) as sharply lower oil prices reduced operating cash flow for oil and gas companies. This was the third reduction of over 25% that the industry has suffered in the prior six years, bringing the 2020 spend to a level that is 60% lower than the 2014 peak of $553bn. In 2021, we saw a modest rebound in spending of around 8%, but much of this was directed to gas projects. Adjusting for oil service cost deflation that we have seen since 2014, we find that "real" upstream capex on oil/liquids projects in 2021 was still likely to be down over 40% versus the peak level seen in the 2011-14 period. This is important because there is a clear long-term correlation

between investment levels and future volume growth, and these reduced levels of investment raise concern over the long-term growth potential of non-OPEC (ex US).

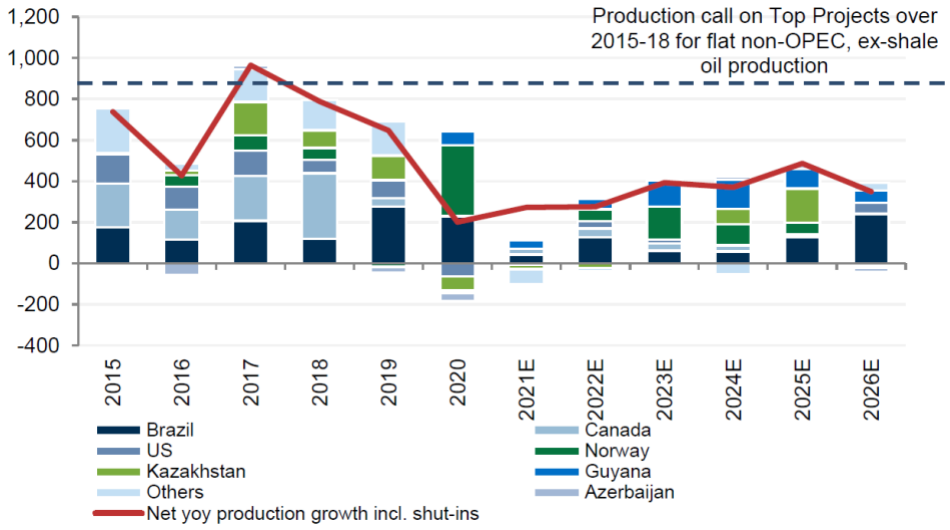
Upstream oil and gas capital expenditure (US$bn)



Source: JP Morgan, IEA, Wood Mackenzie, Guinness Atkinson Asset Management estimates

Since 2015, we have been in a period where companies have been drawn towards the short-term project returns available from investments in the US onshore, at the expense of investing in longer cycle offshore and oil sand projects. 2020 was a final year of large supply additions (the Johan Svedrup development in waters offshore Norway, plus sub-salt field start-ups offshore Brazil), as projects that were sanctioned as long ago as 2014 continued to come into production. As expected, we saw very few large project additions in 2021, and while Brazil supports a slightly better outlook for 2022, additions are expected to be 0.4m b/day below 2020 levels, translating into little if any net growth.

Non-OPEC (ex US onshore and Russia) large new project production additions, 2015-2026E



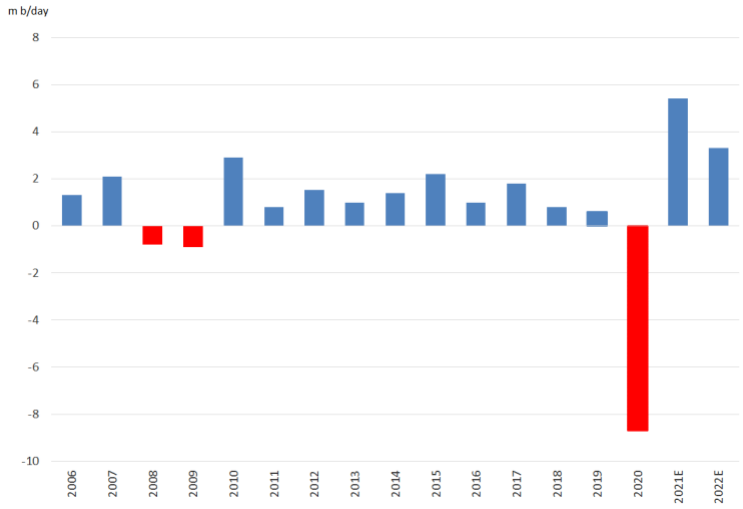
Source: Goldman Sachs; Guinness Atkinson Asset Management

There will, of course, be some planned recovery in supply from non-OPEC members that are part of the OPEC+ alliance, but like OPEC production, we expect this to be "controlled" supply addition in sync with improvements to global oil demand. Longer term, the lack of investment in non-OPEC oil projects (capex being instead curtailed or diverted to gas/renewables projects), creates an environment where non-OPEC supply growth looks increasingly challenged.

Oil demand

According to the IEA, global oil demand for 2021 will end up rising by around 5.5m b/day. This compares to forecast growth at the start of the year of 5.7m b/day. It represents a partial recovery from the collapse in oil demand in 2020, brought about by COVID mitigation measures:

Global oil demand growth (2006-2022E)



Source: IEA; Guinness Atkinson Asset Management

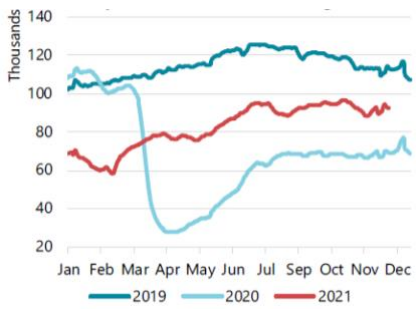
Looking ahead to 2022, the path for oil demand will vary region by region, as developed markets plus China continue their strong vaccination roll out, whilst other emerging countries remain more exposed to COVID.

Road traffic has largely recovered outside Asia, led by Europe and the US. Car use still lags pre-pandemic levels a little, while trucking activity has moved ahead. US trucking miles in Q4 2021 were over 10% higher than Q4 2019, for example.

Oil demand in China has remained strong throughout the pandemic, climbing above 15m b/day for the first time in Q2 2021. Chinese demand growth is likely to moderate in 2022 but still increase by around 4%. Demand in India has also recovered well from the COVID Delta surge in early 2021, with October 2021 data indicating a consumption above October 2019 levels.

Globally, by product, the laggard remains jet fuel demand, averaging around 2.7m b/day lower in 2021 than pre-pandemic levels. We expect a recovery in 2022 of around 1m b/day, but this would still leave jet fuel consumption around 1.7m b/day lower than 2019. The emergence of the Omicron COVID variant adds uncertainty (positive and negative) to demand, particularly in the aviation sector.

Daily number of commercial flights



Source: IEA; Flightradar; Guinness Atkinson Asset Management

Overall, the IEA forecast demand in 2022 of 99.5m b/day, up by 3.3m b/day versus 2021. This would put global oil demand on par with its previous peak in 2019, and on course to reach a new high in 2023.

The IEA's forecasts imply that oil demand in the OECD region will still, on average, be around 3% lower in 2022 than in 2019. By contrast, demand in the non-OECD region in 2022 is expected to be around 3% ahead of 2019.

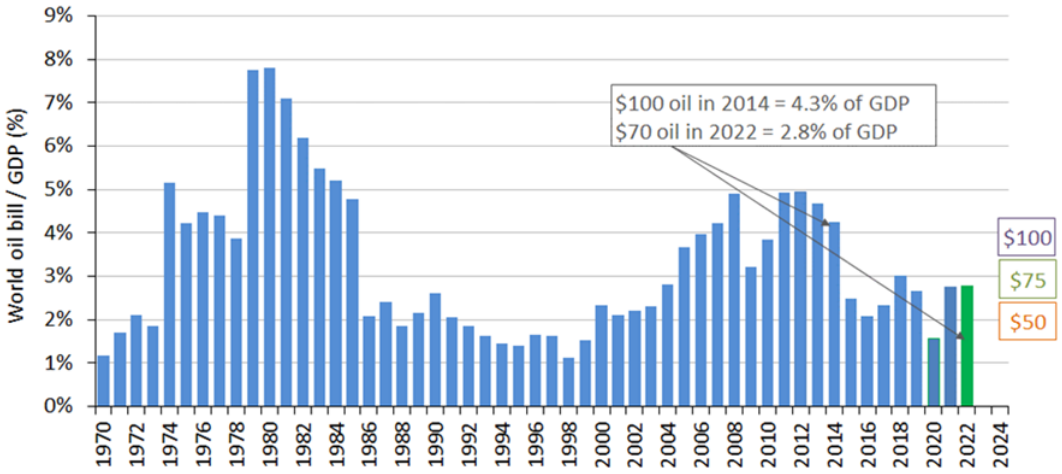
World oil demand 2007-22E

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021E	2022E
OECD demand														IEA	IEA
North America	24.5	23.7	24.1	24.0	23.6	24.2	24.2	24.6	24.9	25.1	25.4	25.5	22.4	24.2	25.0
Europe	15.5	14.7	14.7	14.3	13.8	13.6	13.5	13.8	14.0	14.4	14.3	14.3	12.4	12.9	13.5
Pacific	8.3	8.0	8.2	8.2	8.5	8.3	8.1	8.1	8.1	8.1	8.0	7.9	7.1	7.4	7.6
Total OECD	**48.3**	**46.4**	**47.0**	**46.5**	**45.9**	**46.1**	**45.8**	**46.5**	**47.1**	**47.7**	**47.7**	**47.7**	**42.0**	**44.5**	**46.1**
Change in OECD demand	*-1.8*	*-1.9*	*0.6*	*-0.5*	*-0.6*	*0.2*	*-0.3*	*0.7*	*0.6*	*0.6*	*0.0*	*0.0*	*-5.7*	*2.5*	*1.6*
NON-OECD demand															
FSU	4.2	4.0	4.1	4.4	4.6	4.5	4.6	4.6	4.4	4.7	4.7	4.7	4.5	4.8	4.9
Europe	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.7	0.8	0.8
China	7.7	7.9	8.9	9.3	9.9	10.4	10.8	11.6	12.0	12.5	13.0	13.5	13.9	15.0	15.6
India	3.1	3.2	3.3	3.5	3.7	3.7	3.8	4.2	4.4	4.8	5.0	5.0	4.5	4.7	5.0
Other Asia	6.8	7.1	7.5	7.6	7.6	7.9	8.0	8.3	8.8	8.9	9.0	9.0	8.1	8.5	9.0
Latin America	5.6	5.7	6.1	6.2	6.5	6.6	6.8	6.7	6.5	6.4	6.3	6.3	5.6	6.0	6.1
Middle East	6.7	7.1	7.3	7.5	7.9	8.0	8.4	8.5	8.4	8.3	8.2	8.2	7.7	7.9	8.0
Africa	3.3	3.4	3.5	3.5	3.8	3.8	3.9	4.2	4.2	4.2	4.2	4.2	3.8	4.0	4.1
Total Non-OECD	**38.1**	**39.1**	**41.4**	**42.7**	**44.8**	**45.6**	**47.4**	**48.8**	**49.3**	**50.4**	**51.1**	**51.8**	**48.8**	**51.7**	**53.4**
Change in non-OECD demand	*1.0*	*1.0*	*2.3*	*1.3*	*2.1*	*0.8*	*1.8*	*1.4*	*0.5*	*1.1*	*0.7*	*0.7*	*-3.0*	*2.9*	*1.7*
Total Demand	**86.4**	**85.5**	**88.4**	**89.2**	**90.7**	**91.7**	**93.1**	**95.3**	**96.3**	**98.1**	**98.9**	**99.5**	**90.8**	**96.2**	**99.5**
Change in demand	*-0.8*	*-0.9*	*2.9*	*0.8*	*1.5*	*1.0*	*1.4*	*2.2*	*1.0*	*1.8*	*0.8*	*0.6*	*-8.7*	*5.4*	*3.3*

Source: IEA; Guinness Atkinson Asset Management

Globally, we believe that oil remains a "good value" commodity. Based on Brent oil price of around $70/bl in 2022, we calculate that the world would spend around 2.8% of GDP on oil, below the 30-year average of around 3%. We believe that oil would need to increase to over $100/bl, reflecting 4%+ of world GDP in 2022, if it were to have a noticeable negative impact on the global economy.

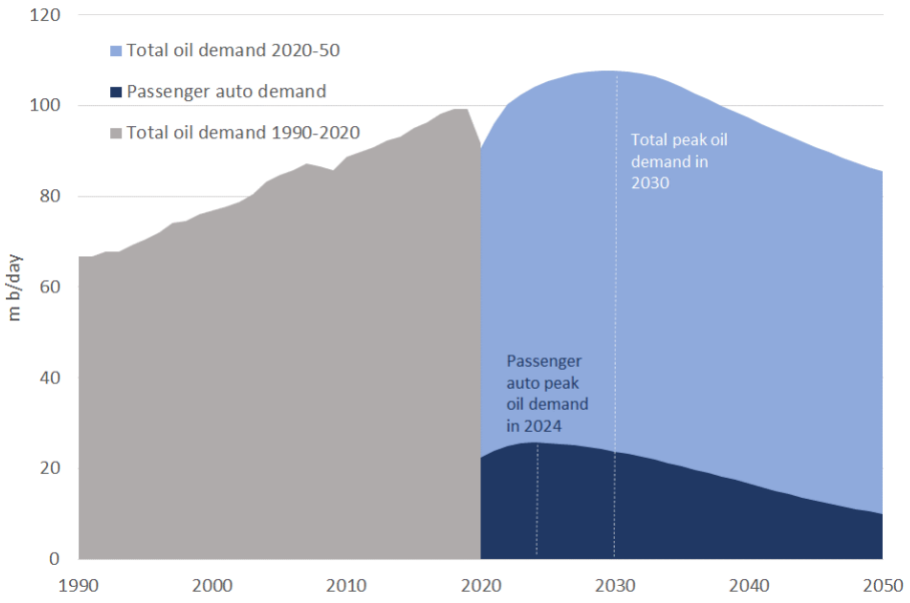
The world oil "bill" as a percentage of GDP



Source: IEA; Bloomberg; Guinness Atkinson Asset Management

Looking longer term, the key issue for global oil demand is the electrification of personal transportation. In 2021, we saw a sharp increase in the take up of electric vehicles (EVs), with global EVs sales rising to around 6% of total auto sales, versus 3% in 2020. We believe that oil product demand (gasoline and diesel) for personal transportation will peak in the mid-2020s, shortly after improvements in battery technology allow EVs to be price competitive with internal combustion engine vehicles. We expect the other areas of global oil demand, such as petrochemicals and aviation, to continue to grow with global GDP, and the net of this activity suggests a peak in global oil demand around 2030, somewhere around 105-110m b/day.

World Oil Demand (1990-2050E)

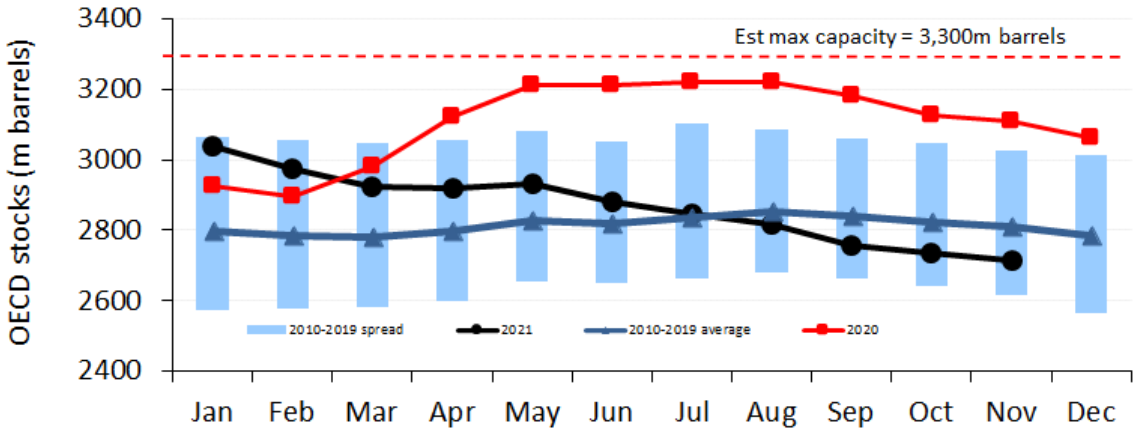


Source: IEA; Guinness Atkinson Asset Management

Oil inventories and conclusions

As ever, the picture of oil supply and demand in 2022 will be dynamic, depending on price, OPEC delivery, corporate behavior and macro-economic factors. Our base case for 2022, making assumptions for the key sensitivities discussed in this report, is that the world oil market will by kept roughly in balance by OPEC, but with a greater prospect of market looseness in 1H 2022, followed by tighter conditions in 2H 2022.

OECD oil and oil product inventories



Source: IEA; Guinness Atkinson Asset Management

Similar to 2021, OPEC+'s task in the months ahead is to be dynamic with supply, reacting to a recovery in oil demand that will continue but also be erratic, as restrictions on movement in different countries and regions come and go. Longer term, once the COVID crisis fades further, there is the question of where oil prices settle back to.

We believe that Saudi's long-term objective remains to maintain a "good" oil price, as close to their fiscal breakeven of $70/bl as possible. The world oil bill at around $70/bl represents 2.8% of 2022 Global GDP, well under the average of the 1970 – 2015 period (3.4%). Faltering non-OPEC (ex-US supply) suggests they are well positioned to keep control of the market, though Saudi will be mindful that excessively high prices may be too much of a good thing, opening the door to a resurgence in US shale supply.

Adopting a slightly more conservative stance, we model an average Brent oil price in 2022 of $65/bl and beyond.

Natural gas markets

US natural gas

The US natural gas market was undersupplied in 2020 with natural gas inventories ending the "injection" season on November 1st, 2021 below the ten-year average, having been above average 12 months earlier. Strong demand, coupled with a muted supply response, pushed the Henry Hub spot gas price higher, averaging $3.71/mcf for the year versus $2.13/mcf in 2020 and $2.53/mcf in 2019.

The key features of the US gas market were:

- Strong demand for LNG exports, as new terminals were completed and a surge in European and Asian gas prices created highly attractive export economics.
- Higher industrial and commercial demand, as the economy recovered, offset by lower power generation demand, driven by less extreme weather conditions.
- A small decline in associated (by-product) gas supply from shale oil production.
- A modest increase in low-cost Marcellus and neighboring Utica fields in the north-east of the country as higher prices incentivized a tick up in drilling activity.

The outlook for natural gas in the US in 2022 is likely to be defined by various factors:

- Further recovery in gas demand, as the US economy continues to normalize. In particular, we expect industrial gas demand in the US to grow well,
- A small rise in LNG exports, reflecting a full year of availability of new US Gulf Coast terminals post their completion in 2021.
- Rising onshore production, as higher associated gas supply combines with increases elsewhere, especially the Marcellus, reacting to higher prices.

US natural gas demand model (2012 – 2022E)

Bcf/day	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021E	2022E
US natural gas demand:											
Residential/commercial	19.2	22.4	23.4	21.4	20.5	20.9	23.4	23.5	21.3	22.2	22.0
Power generation	24.9	22.3	22.3	26.5	27.3	25.3	29.0	30.9	31.7	30.3	31.2
Industrial	19.7	20.3	20.9	20.6	21.1	21.6	23.0	23.0	22.6	23.0	23.6
Pipeline exports (Mexico)	1.8	1.9	1.9	2.7	3.8	4.0	4.6	5.1	5.4	6.1	6.4
LNG exports	-	-	-	0.1	1.0	2.6	3.4	5.7	7.3	10.3	10.9
Pipeline/plant/other	6.1	6.7	6.3	6.5	6.4	6.5	7.1	7.6	7.7	7.8	8.0
Total demand	**71.7**	**73.6**	**74.8**	**77.8**	**80.1**	**80.9**	**90.5**	**95.8**	**96.0**	**99.7**	**102.1**
Demand growth	3.1	1.9	1.2	3.0	2.3	0.8	9.6	5.3	0.2	3.7	2.4

Bcf/day	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021E	2022E
US natural gas supply:											
US (onshore & offshore)	65.7	66.3	70.9	74.2	73.4	73.6	84.0	92.3	92.1	93.0	96.7
Net imports (Canada)	5.4	5.0	4.9	4.9	5.5	5.8	5.4	4.7	4.4	5.3	5.3
LNG imports & other	0.8	0.6	0.5	0.5	0.4	0.3	0.1	0.1	-	-	0.1
Total supply	**71.9**	**71.9**	**76.3**	**79.6**	**79.3**	**79.7**	**89.5**	**97.1**	**96.5**	**98.3**	**102.1**
Supply growth	2.4	-	4.4	3.3	- 0.3	0.4	9.8	7.6	- 0.6	1.8	3.8
(Supply)/demand balance	- 0.2	1.7	- 1.5	- 1.8	0.8	1.2	1.0	- 1.3	- 0.5	1.4	-

Source: EIA; Bloomberg; Goldman Sachs; Guinness Atkinson Asset Management

The US natural gas price since 2010 has fluctuated in a band between around $2 and $4/mcf. The extremes of this range have tended to coincide with warm and cold winters, and any sustained recovery over $3.50/mcf has generally been muted by strength in gas supply. Assuming normal weather, we expect prices to be held, for now, in the $3-4/mcf range.

International natural gas

Natural gas moved in 2021 from being a reasonably obscure commodity to front page news, thanks to a surge in pricing which is contributing to global resource inflation. The European price rose from $7.7/mcf at the start of the year to $21.0/mcf by the end of December, averaging $15.5/mcf (vs $3.5/mcf in 2020 and $4.4/mcf in 2019) while the Asian price (Japanese LNG) increased from $14.3/mcf to $31.0/mcf and averaged $17.9/mcf (vs $4.7/mcf in 2020 and $5.4/mcf in 2019).

While there have been many interconnected factors at play, the story starts with global electricity demand, which has been particularly strong. According to the International Energy Agency (IEA), after falling by around 1% in 2020 due to the COVID slowdown, global electricity demand is set to grow by close to 5% in 2021 and 4% in 2022. For context, global electricity consumption grew by an average of 2.7% per annum between 2010 and 2018.

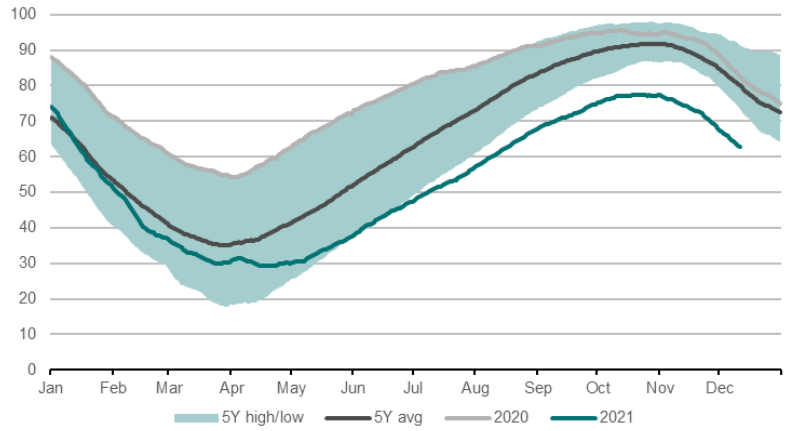
Strong demand has been especially evident in China, where electricity consumption has been driven not only by economic recovery, but also an unusually hot summer which drove demand for air-conditioning. Typically, in China, around 65% of electricity consumption is powered by coal, and a further 17% is powered by hydro. However, the supply of power from both sources in 2021 was restricted. Domestic coal production struggled thanks to regulatory reforms, underinvestment, and safety concerns. Meanwhile, thermal coal imports into China from Australia were reduced to virtually zero for much of 2021, stemming from a political row around the origins of COVID. Australia normally accounts for around 40% of China's thermal coal imports, so the impact was sizeable. Resulting from all of this, demand for natural gas in China was very strong in 2021.

In Europe in recent years, there has often been a surplus of LNG imports, the region acting as the market of last resort for LNG exporters. However, with the global LNG market much tighter than usual last year, Europe saw a reduction in its usual LNG supply. The tightness in the global LNG market can partly be explained by the pull of supply into Asia, but there have been other factors also at play, such as LNG terminal supply outages running at unusually high levels, and higher than expected demand from South America.

Another factor influencing European gas prices has been the competitive dynamic between gas and coal power plants. Historically, high natural gas prices would catalyze a meaningful switch to coal generation, which would be offering better economics. However, with the rise in European carbon prices, up by over 100% since November 2019, coal fired plants (which are more carbon intensive than gas fired plants) have become less competitive relative to gas. With this "relief" valve of coal power being relatively less attractive, the pressure on gas demand has only intensified.

With inventories tightening (relative to seasonal averages) over the final months of 2021, it has set up a concern in the market that there will be insufficient supply over this winter, hence forward prices have remained high.

European natural gas inventories (% of capacity)



Source: DNB; Guinness Atkinson Asset Management

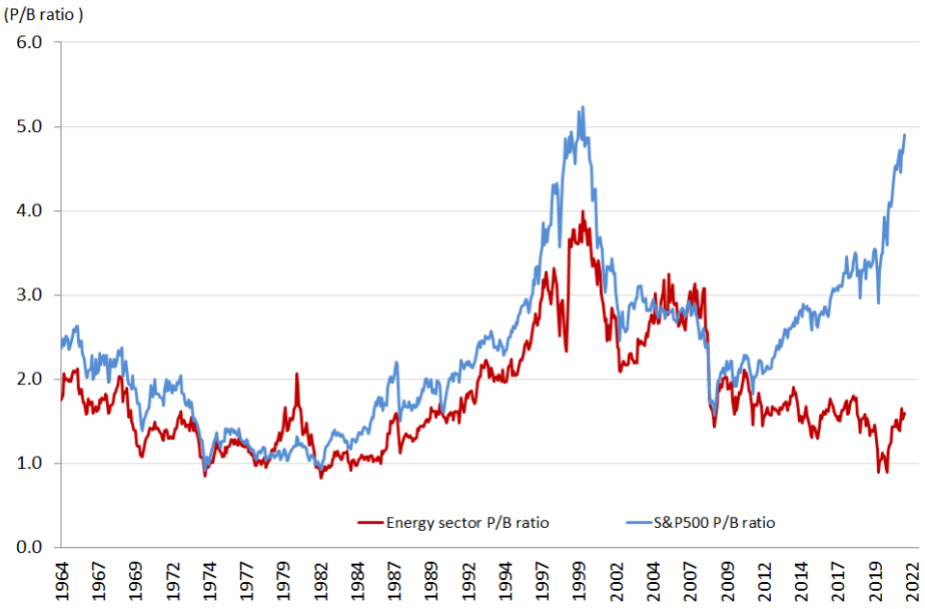
How does this play out? Winter balances look very tight, but some relief will come via lower demand, either from a dampening of activity or switching to other commodities. We have written here around gas-to-coal switching in Europe being challenged, but we do expect to see further gas-to-oil switching, as heating oil supply is maximized. Additional supply will be forthcoming from Russia and Norway; China is increasing its coal supply, and with normalized weather, hydro and wind generation will pick up again. Ultimately, we do not expect these very high prices to be sustained and see the price in the medium term at around $7-9/mcf. Keep in mind that international gas prices averaged around $4-5/mcf in 2019-20, so this would still represent a significant step up and would still incentivize LNG exports from the US.

Energy equities

Rises in oil and natural gas prices, combined with an improved refining environment, resulted in strong returns for energy equities in 2021. The sector (MSCI World Energy Index) finished +40.1% in USD, significantly ahead the broad market (MSCI World +21.8% in USD) and outperforming all other MSCI sectors. However, valuation still appears subdued relative to the recovery in return on capital employed from the sector that we expect.

The rise in energy equities lifted the price-to-book ratio for the energy sector at the end of December 2021 to around 1.6x, versus the S&P 500 trading at 4.9x. On a relative price-to-book (P/B) basis (versus the S&P500), therefore, the valuation of energy equities remains close to a 55-year low, at just over 0.3x.

P/B of energy sector versus S&P 500



Source: Bernstein; Bloomberg; Guinness Atkinson Asset Management

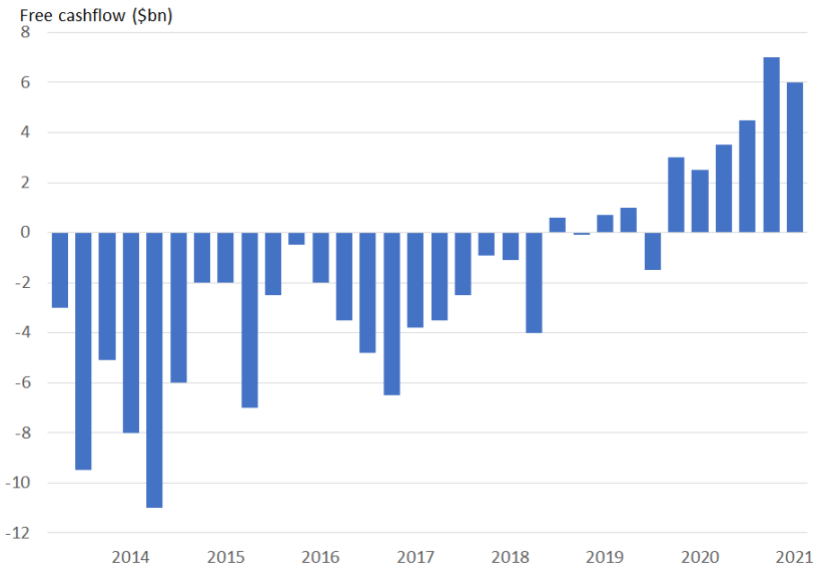
We see the low P/B ratio for the energy sector as driven by its low return on capital employed, and skepticism in the market around a sustained improvement. Historically the two measures are closely correlated, a topic we return to later in this section.

The rise of free cashflow in the sector

After several years of focusing on production growth at the expense of return on capital employed and free cashflow, the oil & gas industry is demonstrating a meaningful shift towards capital discipline. This is being manifested in lower levels of reinvestment, lower levels of debt, and a return of free cash to shareholders.

Considering, firstly, the exploration and production sector, 2021 saw E&P companies collectively generate their highest free cashflow in over a decade. Capital discipline has been key, with nearly all E&P companies sticking to the constrained capital reinvestment rates that they laid out at the start of the year. Generally, we saw companies spending 70-80% of cashflow, which compares to the average reinvestment rate between 2016 and 2019 of 125%. A lack of new debt being available contributed to the slowdown in spending, but it was also driven by the stock market rewarding those E&Ps that embraced capital restraint over those that continued to spend.

US exploration and production sector free cashflow ($bn)



Source: Rystad Energy; Guinness Atkinson Asset Management

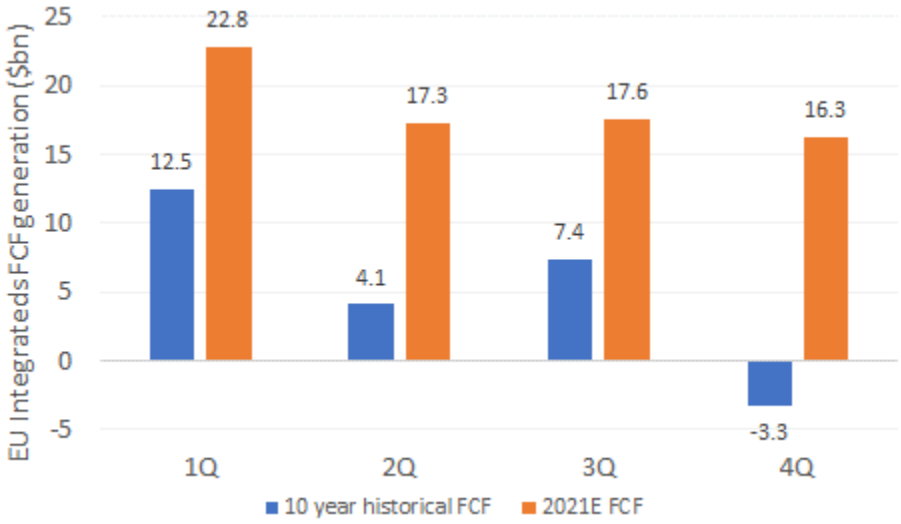
There will be some cost inflation to contend with in 2022, particularly in areas like the Permian Basin in the US, where activity has rebounded the most. Companies have noted increases in the costs of tubulars, fuel, and labor. However, we expect that most of these cost increases will be offset by drilling and completion efficiency improvements, meaning that spending budgets should remain under control.

The route by which free cashflow is being returned to shareholders has varied. The approach which attracted most attention last year was the variable dividend, employed by Devon Energy and Pioneer Natural Resources (both in our portfolio). The variable dividend framework, in which a percentage of excess free cashflow beyond base dividends is returned to shareholders, was received favorably. We see it as providing transparency, and clear through-cycle alignment between producers and shareholders and should tie companies better to being capital disciplined. Other companies, such as EOG Resources, have relied on special dividends as their preferred mechanism for returning cash, though our sense is that there is a preference in the market for a codified rather than discretionary dividend framework.

Looking ahead into 2022, and assuming an average Brent price of $65/bl, we expect that most E&Ps will be looking to grow their production by +/- 5%, which would be consistent with continued capital restraint. Capital expenditure budgets are likely to be higher to achieve that growth, but overall free cashflow should improve versus 2021, as most E&Ps currently have below market oil price hedges that will be rolling off in 2022.

For the large integrated oil and gas companies, positive momentum in all key macro drivers (oil prices, gas prices, chemical margins and, to an extent, refining margins) paved the way in 2021 for higher cash returns. These effects were particularly evident for the European integrated oil & gas companies, where quarterly free cashflow returns are expected to be a multiple of the 10-year average historical free cashflow for the group:

European integrateds FCF generation ($bn)



Source: Goldman Sachs; Guinness Atkinson Asset Management

The higher free cash is being translated, firstly, into buyback programs. BP was the first company to announce the beginning of a buyback program in Q1 2021, with others following suit.

As a group, we estimate that the super-majors covered their dividend by around two times in 2021, versus only around half cover in 2020. Ongoing capital discipline is supporting the lowest "oil breakeven price" (i.e. oil price required to cover capex and dividends) in recent history for the group, sitting at around $45/bl Brent.

Energy transition among the oil & gas large caps

At the COP26 climate conference in November 2021, we saw greater focus on global net zero carbon targets by mid-century and keeping 1.5 degrees warming within reach. The conference put a spotlight on the transition of the oil & gas sector to lower carbon technologies, which we explore here.

The pace of change in the oil and gas industry towards energy transition targets is accelerating. At the end of 2019, just one of the largest 15 oil and gas majors, Repsol, had announced net-zero emissions pledges by 2050. By the end of 2020, the number of companies pledging net zero by 2050 had increased to 10, including all of the European majors and, in the US, Chevron and ConocoPhillips. The main outlier among the European and US majors, then, is Exxon, who are continuing to assess the pledge. The route to net zero for these companies will take many forms, but the key transition activities are likely to be:

- **Significant expansion of low carbon electricity divisions**. This is likely to be a combination of renewable power capacity (solar; onshore & offshore wind) and growing power retail and trading capabilities.

- **Expansion in petrochemicals**. The petrochemicals industry is relevant to the net zero route in that it forms a non-combustion market for hydrocarbons.

- **Scaling up in biofuels**. This will be a combination of renewable natural gas and renewable liquids, with various end markets particularly in power and transportation.

- **Carbon sequestration**. As carbon capture activities ramp up, these should achieve better economies of scale.

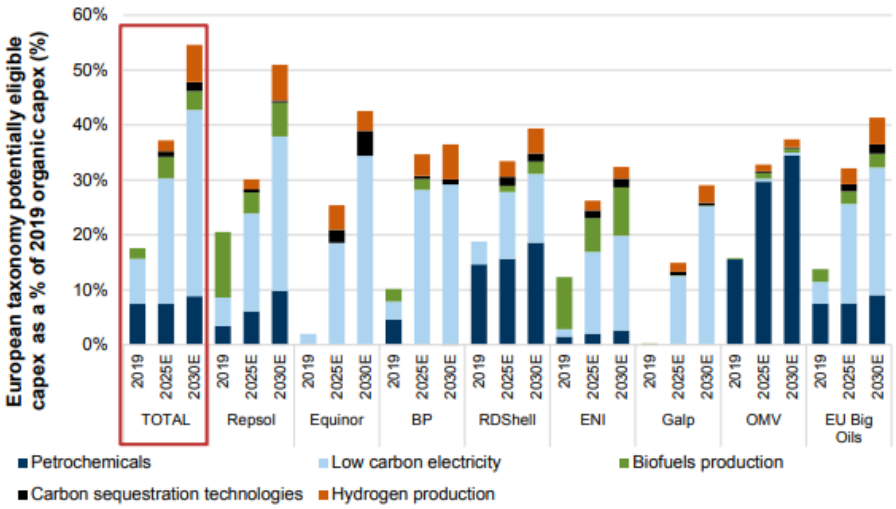
- **Green hydrogen.** Cleaner hydrogen is emerging as a key technology to decarbonize at the higher end of the cost curve, especially in power and gas-intensive industrial processes.

The pace and ambition of large cap oil companies in their pursuit of renewable generation capacity varies considerably.

TotalEnergies started its transition several years ago, and in September 2021 highlighted its commitment to lead the way, becoming a net-zero corporate across all scopes by 2050. On this journey to net-zero, TotalEnergies is aiming to reduce scope 1 & 2 emissions by 40% by 2030, and a reduction of scope 1 ,2 & 3 emissions by 2030 (vs a 2015 baseline). The company is building out a portfolio of low-carbon technologies, including renewables (targeting 35 gigawatts (GW) gross capacity by 2025, 100 GW by 2030), bioenergy (production of 2-3 million tons per annum (mtpa) by 2025), and early positions in hydrogen and CCUS.

When assessing the proportion of capex currently allocated to low carbon or energy transition projects, TotalEnergies currently sits in the middle of the pack at around 15%. However, by 2025, the company is expected to up its "green" spending around 35% of CAPEX, rising further to over 50% in 2050, ahead of its European peers.

European big oils: EU taxonomy "green" capex as a % of total capex

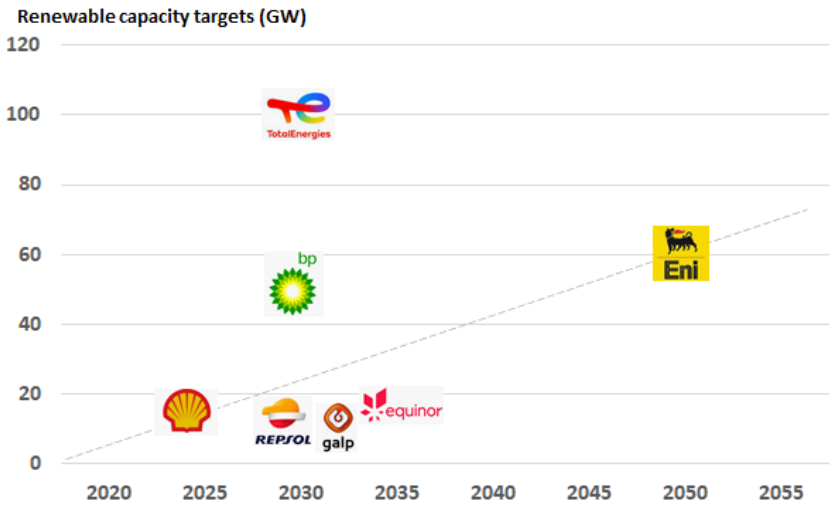


Source: Goldman Sachs; Guinness Atkinson Asset Management

BP plans to increase its annual low-carbon investment by ten times to around $5bn per annum in 2030, representing over 20% of their capital employed over this period. The portfolio of low carbon assets which BP

develops will include renewables, bioenergy, hydrogen and carbon capture and storage (CCS). BP is also looking to expand its electricity trading arm, doubling from 250 TerraWatt hour (TWh) in 2019 to 500 TWh by 2030.

European large-cap oils: renewable energy capacity targets



Source: Morgan Stanley; Guinness Atkinson Asset Management

Royal Dutch Shell is progressing on a different path to BP and Total, with less focus on a renewable power capacity target. Instead, Shell's new energies division (formed in 2016) is looking energetically at various options for low carbon growth, including renewable power (560 TWh by 2030), EV charging (500,000 charge points by 2025) and biofuels. The company is also pursuing carbon capture (25 Mtpa of CCUS capacity by 2035) and is likely to expand more aggressively than peers into petrochemicals. By 2030 then, it is estimated that over 40% of Shell's capex will be allocated to "green" revenue aligned activities, up from around 20% today.

The European majors are significantly more progressed in their development of renewable power generation than the US majors, ExxonMobil and Chevron. Despite being the US's largest integrated oil & gas company, **Exxon** has shown little interest in investing in renewable energy technologies, and currently has no meaningful renewable generation assets. Total cumulative low carbon investment for the company in 2025 is expected to be around $3bn, representing just 3% of CAPEX at that time. Instead, any diversification strategy that the company has is focused on reducing relative intensity of GHG emissions, advancing biofuels, and developing carbon capture and storage (CCS). Notably, Exxon holds interests in around one third of the world's CCS capacity.

Similar to ExxonMobil, **Chevron**, the second US supermajor, has largely not followed the recent moves of its European peers into renewable energy capacity. Chevron did develop solar, wind, and geothermal projects in the 2000s, but sold most of those positions in the mid 2010s. While the company retains a small renewable portfolio consisting of legacy wind and solar projects, Chevron's New Energies business focuses instead on renewable fuels. Renewable fuel volumes are expected to treble by 2025, with the ambition of producing 100k b/day of renewable diesel and sustainable aviation fuel by 2030. The company is also investing in two of

the world's largest carbon dioxide injection projects: the Quest CCS project in the Canadian oil sands and the Gorgon Project in Australia.

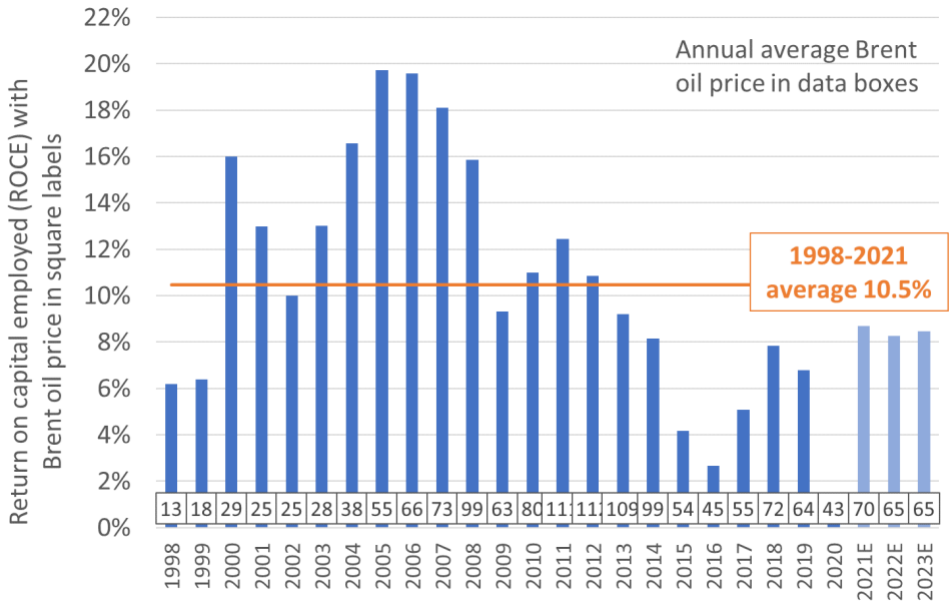
For all the interest around big oils and their potential transition to renewable and other low carbon technologies, we must recognize that it will be a long journey. Even with the scale of Total's plans, for example, we estimate that only around 20-25% of the company's enterprise value in 2030 will be represented by its low-carbon business. Repsol and BP will see around 20% of their EV represented by transition activities, while for Exxon, Chevron and other European large cap oils, the equivalent figure is estimated to be between 5% and 15%.

Valuation of the Guinness Atkinson Energy portfolio

Looking ahead, we make the following observations for the Guinness Atkinson Global Energy portfolio:

- Having dropped to around 1% in 2020, the recovery in oil prices to $70/bl in 2021 likely brings ROCE for the Guinness Atkinson Global Energy portfolio to nearly 9%, above the level seen in 2018 when the Brent oil price averaged $672/bl. Our case base assumption sees the Brent oil price average $65/bl in 2022. In these circumstances, ROCE would rise to just over 8%:

Return on Average Capital Employed (ROCE) for Guinness Atkinson energy portfolio

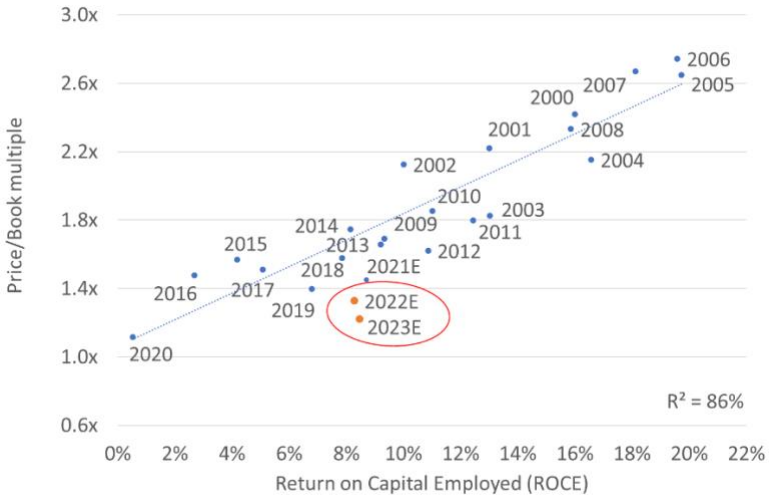


Source: Guinness Atkinson Asset Management

The stock market has historically valued energy companies based on their sustainable levels of profitability (generally a combination of both ROCE and FCF Return) whether it is delivered by self-help improvements or via increases in the long-term oil price.

Current valuation implies that the ROCE of our companies will stay at about 3%. If ROCE stays at 8-10% and the market were to pay for it sustainably, it would imply an increase in the equity valuation of around 30-40%.

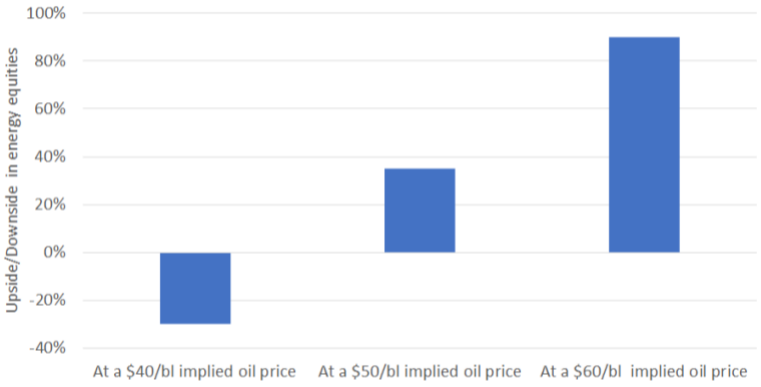
ROCE vs P/B multiple for Guinness Atkinson Energy portfolio



Source: Guinness Atkinson Asset Management

To put this another way, we are often asked what oil price is implied in the portfolio, as a barometer of the expectation priced into the equities. At the end of December, we estimate that the valuation of our portfolio of energy equities reflected a long-term Brent/WTI oil price of around $55/bl combined with a normalization of global refining margins. If the market were to price in a long-term oil price of $60/bl, it would imply 20-25% upside while there would be 45-55% upside at a long-term oil price of $70/bl Brent:

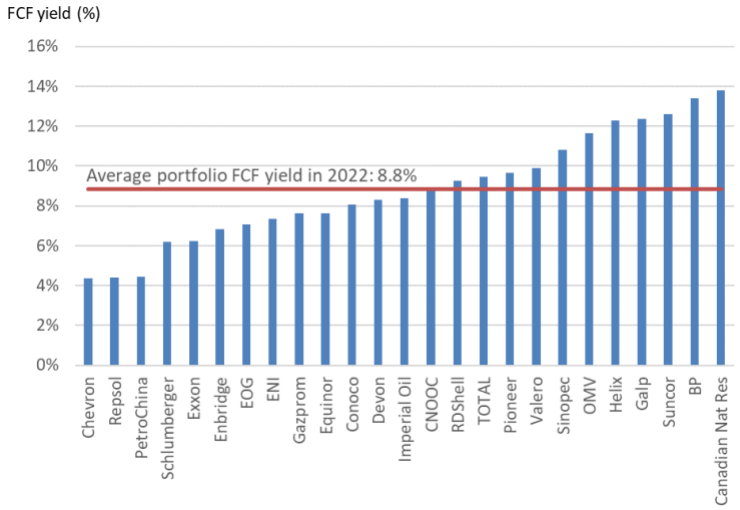
Upside/downside for Guinness Atkinson energy portfolio (1-year view)



Source: Guinness Asset Atkinson Management

We wrote earlier about the emergence of significantly stronger free cashflows in the sector, thanks to better commodity prices and greater capital discipline. Translating these thoughts to our portfolio, we see high free cashflow yields across most subsectors of the portfolio, and particularly for companies with upstream operations:

Guinness Atkinson global energy portfolio: estimated FCF yield in 2022 (%) based on $65/bl Brent



Source: Guinness Atkinson *Asset Management*

In our portfolio, we currently combine the themes of expanding free cash flow for mid to large caps, higher ROCE for the super majors, and North American shale oil & gas growth as key areas of exposure.

Will Riley, Jonathan Waghorn & Tim Guinness
January 2022

Opinions expressed are those of Guinness Atkinson Funds, are subject to change, are not guaranteed and should not be considered investment advice.

The Fund's investment objectives, risks, charges and expenses must be considered carefully before investing. The statutory and summary prospectus contains this and other important information about the investment company, and it may be obtained by calling 800-915-6566 or visiting gafunds.com. Read it carefully before investing.

The Fund's holdings, industry sector weightings and geographic weightings may change at any time due to ongoing portfolio management. References to specific investments and weightings should not be construed as a recommendation by the Fund or Guinness Atkinson Asset Management, Inc. to buy or sell the securities. Current and future portfolio holdings are subject to risk.

Mutual fund investing involves risk and loss of principal is possible. The Fund invests in foreign securities which will involve greater volatility, political, economic and currency risks and differences in accounting methods. The Fund is non-diversified meaning it concentrates its assets in fewer individual holdings than a diversified fund. Therefore, the Fund is more exposed to individual stock volatility than a diversified fund. The Fund also invests in smaller companies, which involve additional risks such as limited liquidity and greater volatility. The Fund's focus on the energy sector to the exclusion of other sectors exposes the Fund to greater market risk and potential monetary losses than if the Fund's assets were diversified among various sectors. The decline in the prices of energy (oil, gas, electricity) or alternative energy supplies would likely have a negative effect on the fund's holdings.

S&P 500 Index is a broad-based unmanaged index of 500 stocks, which is widely recognized as representative of the equity market in general.

MSCI World Energy Index is a free-float weighted equity index based on the energy sector.

MSCI World Index is a capitalization weighted index that monitors the performance of stocks from around the world.

One cannot invest directly in and index.

R-Squared (R^2) is a statistical measure that represents the proportion of the variance for a dependent variable that's explained by an independent variable or variables in a regression model. R-squared explains to what extent the variance of one variable explains the second variable.

Price to Book Ratio (P/B) is used to compare a stock's market value to its book value and is calculated by dividing the current closing price of the stock by the latest quarter's book value per share.

Return on Capital Employed (ROCE) is a return from an investment that is not considered income. The return of capital is when some or all of the money an investor has in an investment is paid back to him or her, thus decreasing the value of the investment.

FCF (Free Cash Flow) yield represents the cash that a company is able to generate after laying out the money required to maintain or expand its asset base. Data presented reflects that of the underlying holdings of the Fund, not of the Fund itself.

OPEC-10 are the 10 largest countries (by production quota) that are within OPEC (Organization of Petroleum Exporting Countries): Algeria, Angola, Iran, Iraq, Kuwait, Libya, Nigeria, Saudia Arabia, United Arab Emirates (UAE), Venezuela.

CAPEX or Capital Expenditure are funds used by a company to acquire or upgrade physical assets such as property, industrial buildings or equipment.

Click here for a complete list of holdings of the Guinness Atkinson Global Energy Fund.

Top 10 holdings as of December 31, 2021: 1. Chevron (4.81%), 2. Imperial Oil (4.58%), 3. Canadian Natural Resources Ltd (4.52%), 4. Conocophillips (4.48%), 5. Exxon Mobil Corp (4.42%), 6. EOG Resources Inc (4.39%), 7. Devon Energy Corp (4.32%), 8. TOTAL SA (4.28%), 9. Equinor ASA (4.23%) and 10. Suncor Energy Inc (4.19%).

Holdings are subject to change.

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