Stranded assets

How worried should the global oil majors be about stranded assets?

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This note aims to address, objectively, the topic of stranded asset risk at the Major oil companies by seeking to answer several questions:

- **Will oil and gas demand decline before the current reserves base of the Majors is extracted?**

  Answer: No. A growing global population and rising prosperity connotes higher energy demand. Renewable penetration is growing, but not fast enough to satisfy demand growth, let alone eat into the market share of fossil fuels. Short-term trends are even less encouraging: 2021 saw the greatest increase in global power consumption on record, even adjusting for the COVID base effect. US gasoline demand hit all-time highs in 2021 and now total product demand (including jet fuel and petrochemicals) is doing the same. The Majors' current reserves will be developed well within the useful lifetime of oil and gas.

- **Does continued oil and gas development run counter to net zero emissions targets?**

  Answer: It's quicker to get to net zero without any further oil and gas, but assuming demand will decline linearly directly contradicts real-world trends. Even the most aggressive (and, sadly, unrealistic) decarbonisation pathways require further oil and gas field development over the coming decades because oil and gas fields, unavoidably, decline, without investment. Carbon reduction trajectories need to reflect current realities. Market share will accrue to the lowest-cost players, and – assuming carbon emissions become globally priced – to the players with the clearest decarbonisation plans. The European Majors screen well on this basis.

- **How much of a big deal are electric vehicles (EVs) with respect to oil demand?**

  Answer: Not as much as you might think, for three reasons. First, the ICE[1] fleet is still growing, even with rising EV penetration, second, vehicle retirals are very slow, especially in low-income economies, and, third, light-vehicle transport (the area most obviously being disrupted by electrification), only accounts for ~25% of global oil consumption. The long-term picture is fairly clear, oil demand for use in transport will peak, but the medium-term effect is barely perceptible.

- **How easy is it to retire fuel sources from the global energy system?**

  Answer: Really hard! More coal is consumed in the world today than when the entire global economy and industrial complex was fuelled by coal. New and cheaper sources of energy tend to lead to even more energy consumption, rather than increased efficiency.

- **But what if we assume a step change in the pace of the transition anyway, are decommissioning costs adequately accounted for in the Enterprise Value of the Majors?**

  Answer: Future decommissioning costs are well known, audited, and reflected on balance sheets using punitively low discount rates. As long as we include them as a call on the capital structure in our valuation approach, they are well accounted for.

[1] Internal Combustion Engine

- **If we assume only the known reserves of the Majors are produced, are the shares cheap?**

  Answer: The results are mixed. On this basis, BP and Shell look cheap, Exxon and Chevron are expensive, Total is somewhere in between. This is only one valuation approach, but it gives some indication of where there is an 'asset-backed' margin of safety.

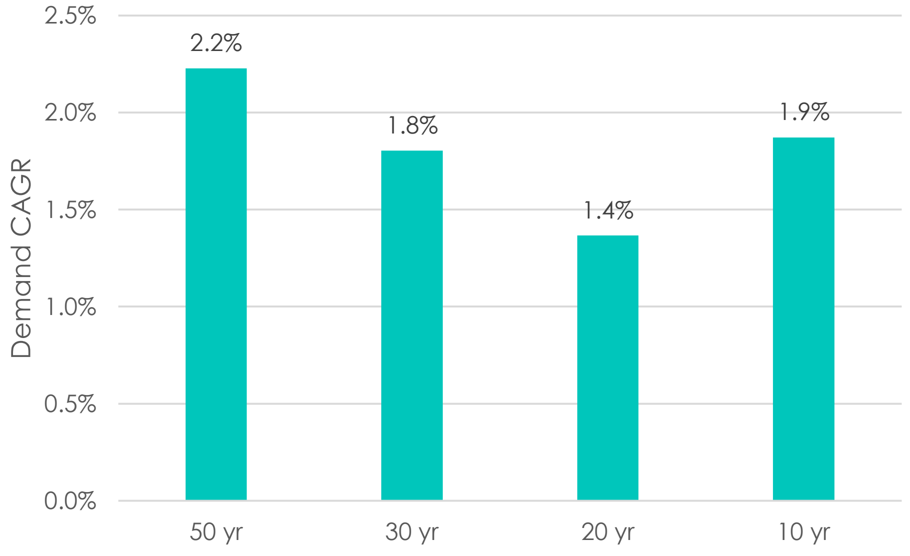
This is not a note that argues renewable power is small and irrelevant, and that it is taking on an insurmountable foe in the established fossil fuel industry. Renewable power is clearly going to be an unstoppable growth machine during our lifetimes. This is a note that aims to take a transparent look at real-world consumption trends, to judge whether we can reasonably expect the Major oils to continue developing their existing asset base and how we should think about attributing value to their other activities.

Growth drivers of global energy demand

First, some background charts, outlining the state of the global energy system.

Growth in global primary energy demand remains fairly consistent over the long-term, driven by population growth and rising wealth per capita. Some damping effect is visible from major global crises, such as the GFC[2], or COVID-19, but the over-arching trend is for 1.5-2.0% per annum growth in the long-term.

Long-term CAGR[3], global energy demand



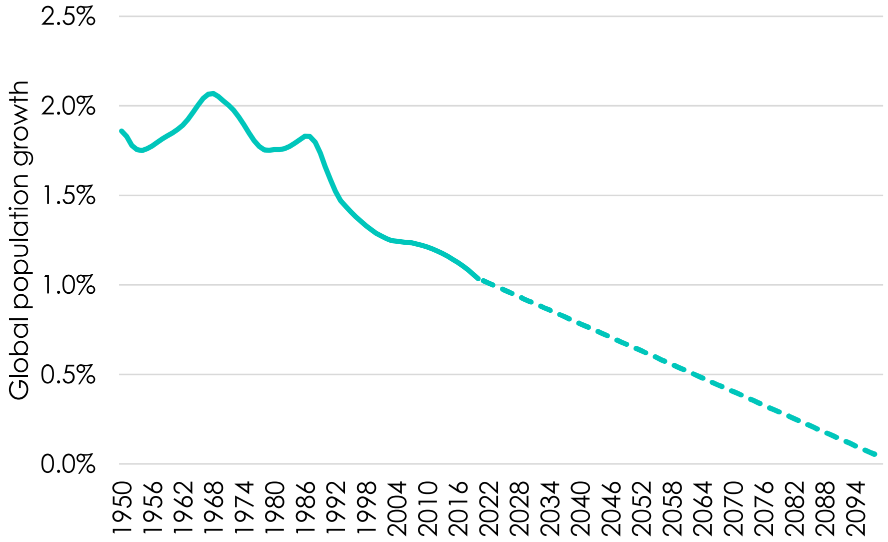
Source: BP, Statistical Review of World Energy 2021, 70th Edition.

Global population growth peaked in the 1960s in proportional terms, at ~2%, and has since declined to ~1% per annum. The UN Population Division forecast this growth to slow to roughly zero by the year 2100, but this still entails adding roughly the population of the UK to the planet each year out to 2050, on average.

Whilst the influence of population growth on energy demand growth is falling, over our investible time horizon it remains a relevant input.

[2] GFC: Global Financial Crisis
[3] CAGR: Compound Annual Growth Rate

YoY population growth, actual and UN forecast



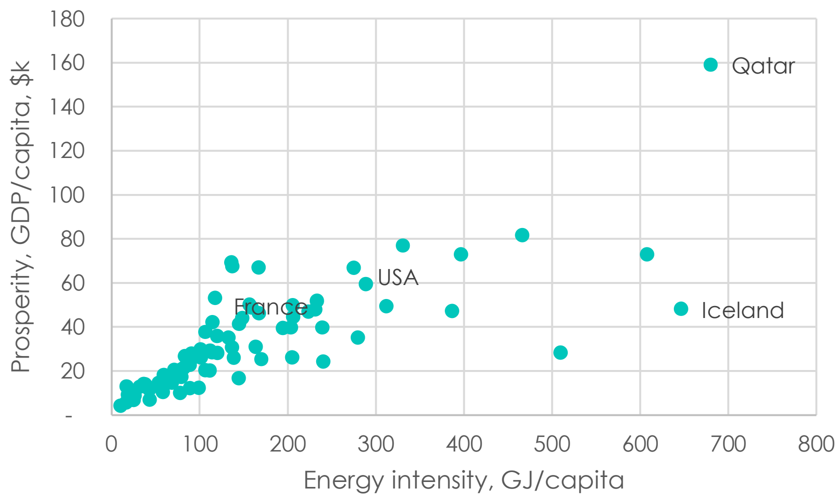
Source: Our World in Data https://ourworldindata.org/world-population-growth.

The effect of rising wealth also remains apparent and we are nowhere near the point where we can argue that a sufficient portion of the world's population is adequately served with energy.

If we break the countries of the world down according to the relationship between energy intensity and prosperity (measured as GDP/capita), a few oddities jump out. Some are obvious, e.g. wealthy Middle Eastern petro-states use a lot of energy for air conditioning. Others are more surprising, e.g. France has half the energy intensity of the US, but prosperity differs by only roughly 25%.

It makes no sense to argue that French energy intensity will trend towards the US over time, since the difference is down to lifestyle choices and population distribution and culture. Most wealthy countries are, therefore, at something like a steady-state of energy consumption. The hope is that their energy consumption will decline over time, due to rising efficiency (better cars, better-connected grid, more efficient industry), although, as we will see in a later section, the current trends are pointing to growth, not decline, in developed world energy demand.

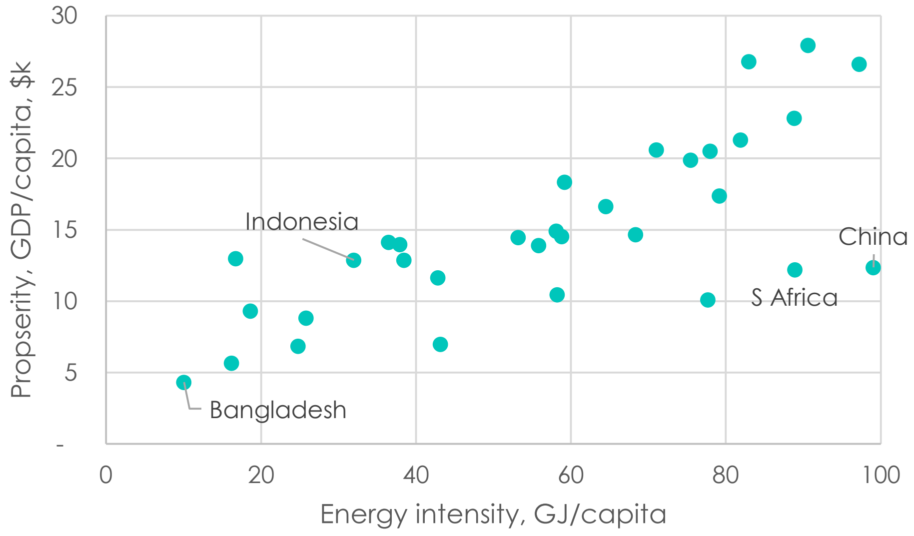
Energy intensity vs. prosperity - global



Source: Our World in Data https://ourworldindata.org/world-population-growth.

The main needle-mover for global energy demand stems from countries at the lower end of the income distribution becoming more energy intensive as prosperity rises. There is no strong reason to expect this dynamic to change: It seems reasonable to assume that as countries such as Indonesia or Bangladesh progress through the middle-income transition, they will use more energy, and start to look more like France, for example.

Energy intensity vs prosperity – bottom quartile



Source: BP, Statistical Review of World Energy 2021, 70th Edition, Our World in Data https://ourworldindata.org/world-population-growth.

We could draw a line somewhere and say that 100GJ[4] of energy per capita per annum (roughly the level consumed by Lithuania or Hungary, for example) is a basic human right. 58% of the world's population currently lies below this level of consumption.

If all of these people had access to 100GJ per annum of energy, global energy demand would be 40% higher, and that is before further population growth is taken into account. Rising efficiency in richer countries will not offset this demand growth.

Short-term energy demand trends are positive in all regions, and this is no longer a COVID base effect. There is an energy demand boom underway, which we will look at in a later section, but first, a reminder of the make-up of the global energy system.

Mix of the global energy system

The global energy mix remains dominated by fossil fuels. It's not always useful to mix analysis of oil demand with fuels used for power generation which are fungible with one another, but in terms of the global energy system, oil is the largest market in terms of units of energy, followed by coal, then gas.

Global coal demand has flatlined since 2013 but it is worth noting that 2021 saw a resumption of growth in coal demand due to energy price volatility, particularly gas, leading to a record level of coal consumption.

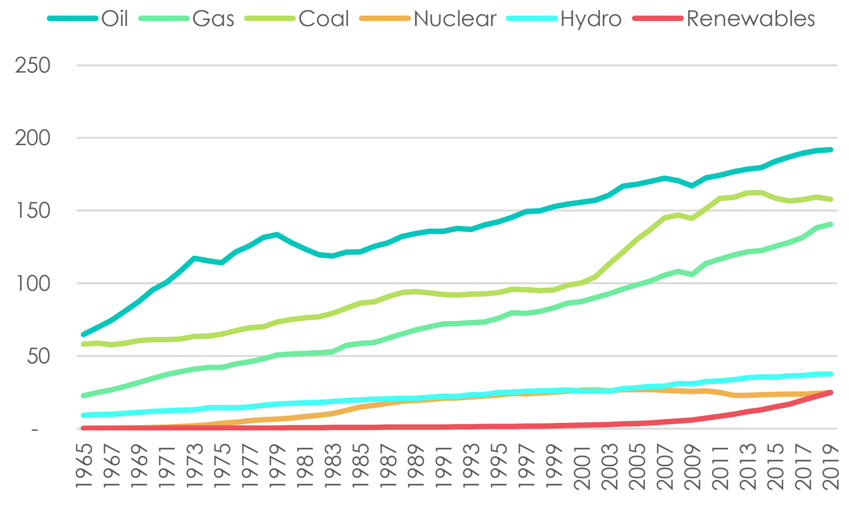
More coal is consumed today than when the entire global economy was dependent on coal! This is an important reminder that no energy source has successfully been backed out of the global system, ever.

[4] GJ: Gigajoule

Linked to this is the point that cheaper, more abundant energy (e.g. renewable power moving down the cost curve) leads to more energy demand, not more efficiency.

All examples of widespread energy cost deflation have led to step-changes in demand. This is known as Jevon's Paradox, first outlined in 1865 when an English economist, William Jevons, observed that improved technology in the coal value chain led to more consumption, not less.

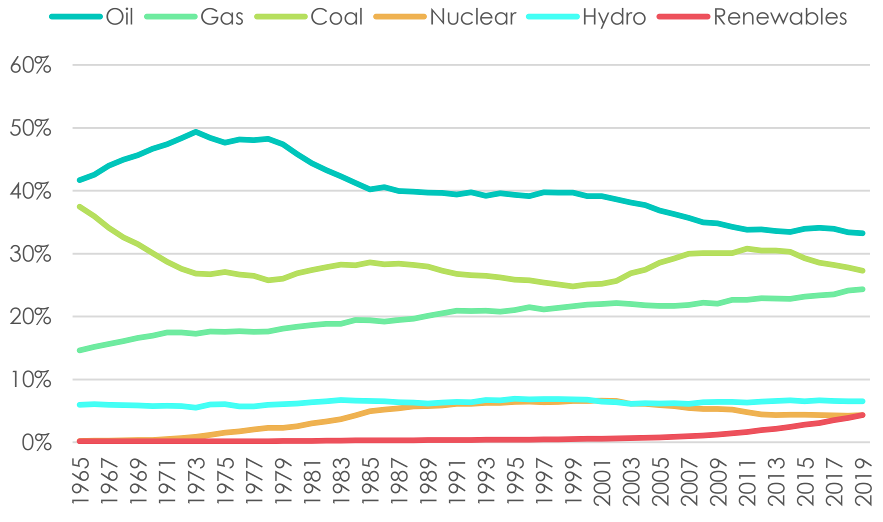
Primary energy demand, including transport fuels, global, exajoules[5]



Source: BP, Statistical Review of World Energy 2021, 70th Edition.

Noticeable changes in the energy mix happen slowly, but once they get going, they tend to be very powerful. The two notable trends of the past decade being coal-to-gas switching, and rising renewable penetration. But as we have just discussed, demand for all major sources of energy, with the exception of nuclear, are growing in absolute terms.

Primary energy demand mix, including transport fuels, global



Source: BP, Statistical Review of World Energy 2021, 70th Edition.

[5] The **exajoule** (EJ) is equal to one quintillion (10^{18}) joules.

The energy transition is well underway and the direction of travel is clear. However, current efforts to electrify the energy system and realign it to renewables are not sufficient.

Global wind and solar installations have to treble from today's levels, immediately, and rise from that level, if we are to install capacity quickly enough to achieve Net Zero carbon emissions in 2050.

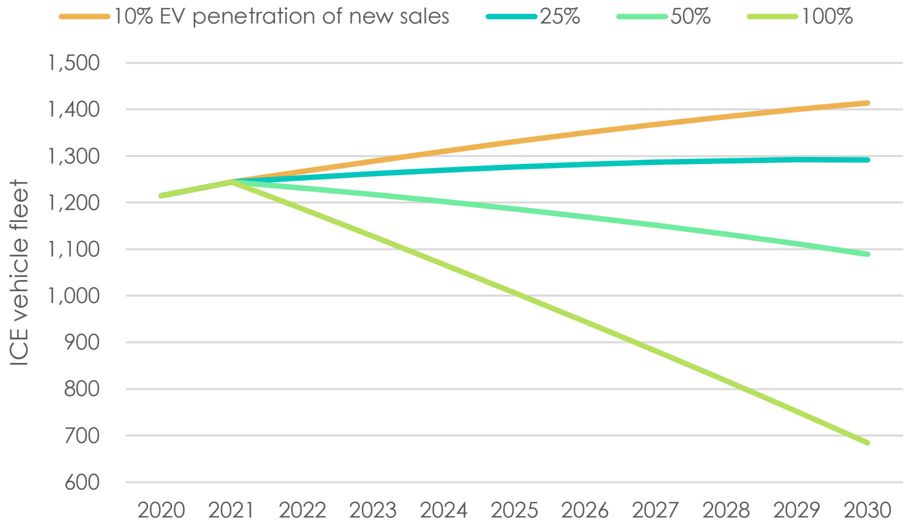
This is not to say that Net Zero ambitions are not worthwhile, or that there is no chance of achieving them (although, slower roll-out today puts even more pressure on action in 2030-2050). But, the energy system is currently solving for satisfying demand, rather than minimising carbon emissions, and until there is a global carbon price in place, it is hard to see that changing. This backdrop is positive for natural gas demand, which is cleaner than coal on a life-cycle emissions basis, and is becoming increasingly globalised, as the LNG[6] market grows.

For oil demand substitution, clearly EV penetration is the relevant issue, and it is undeniable that it has surprised to the upside in recent years, making up ~8% of new car sales in 2021[7].

There are **three reasons** why this is less of an issue for medium-term oil demand trends than may be imagined.

The first is that the car fleet is itself growing, so the ICE fleet can still grow, even with rising EV penetration, as shown in the below chart. Put another way, EVs are penetrating car sales, but car sales are still penetrating the global population. Note that the global car fleet is projected to double by 2050[8].

ICE vehicle fleet size under different EV penetration rates, mn



Source: Bloomberg, M&G Investments, January 2022

Second, and relatedly, the car fleet turns over only very slowly, due to a reluctance to retire assets. Even if we assume 100% of light vehicles sold from 2022 were EVs, the global car fleet would still be 50% fossil-fuel-consuming ICE in 2030. The consensus is for 30% EV penetration of new sales by 2030[9] (which may well be exceeded).

These points tie into the economic disparity highlighted earlier. A UN report from 2020 noted the average age of a car sold in, for example, Zimbabwe, was 13.3 years. Under the current set-up, old used cars from rich

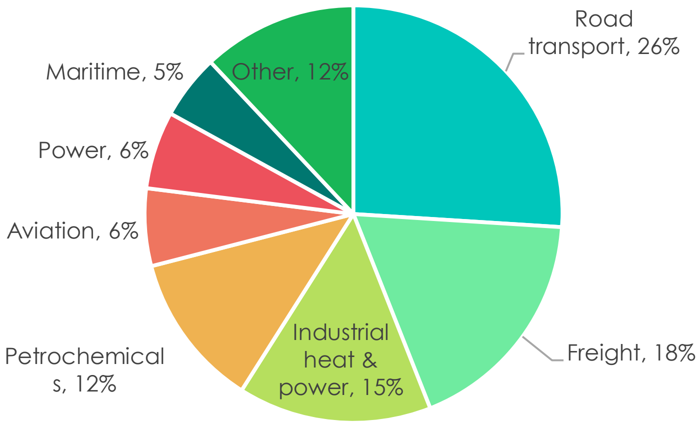
[6] Liquid Natural Gas
[7, 8] Source: Bloomberg, January 2022

[9] Source: Bloomberg, January 2022

countries find their way to lower-income countries where they have a second life. Over time, and as EVs become cheaper, this dynamic will likely change, but it is not a threat to oil demand in the next few years, or even this decade.

The **third** related point is that light-duty vehicles account for ~25% of global oil consumption[10]. Light vehicles are the easiest segment to disrupt, with cheap EVs, but even there absolute progress is slow.

Global oil demand by end use



Source: International Energy Agency (IEA), January 2022.

Other areas of oil demand - heavy duty transport, marine, and aviation – rely on other decarbonisation solutions such as hydrogen or sustainable aviation fuel, which are even earlier stage than EVs. Petrochemical is likely to be the stickiest area of demand, since putting oil into paint or plastic does not release carbon into the atmosphere (beyond the process emissions). These areas of demand will also be disrupted, probably by increased recycling or biological inputs, but the effect will take many years.

The conclusion is that the plateau and eventual decline in global oil demand will be a prolonged phenomenon.

An extreme approach

Based on the above dynamics, it seems reasonable to assume global oil demand will continue to grow this decade, and gas most likely beyond. But we are exploring stranded assets so let's take a more extreme approach.

Let's assume that oil and gas demand immediately starts following a 1.5-2.0°C temperature pathway. For this we can use the demand trajectories from *The Production Gap* report, which is compiled jointly by 40 academics, sponsored by the UN and the International Institute for Sustainable Development, among others.

The trajectories imply a fall in oil demand of roughly 20% by 2040 for a 2.0°C temperature rise by 2100, and by 60% for a 1.5°C temperature rise. The latter is equivalent to a 4.4% compound decline rate in oil demand.

The range of outcomes for gas are more complex due to its potential to replace coal in power generation, but equivalent figures in the report are a 10% decline in demand by 2040 for a 2.0°C temperature rise, and a 50%

[10] Source: International Energy Agency (IEA), January, 2022

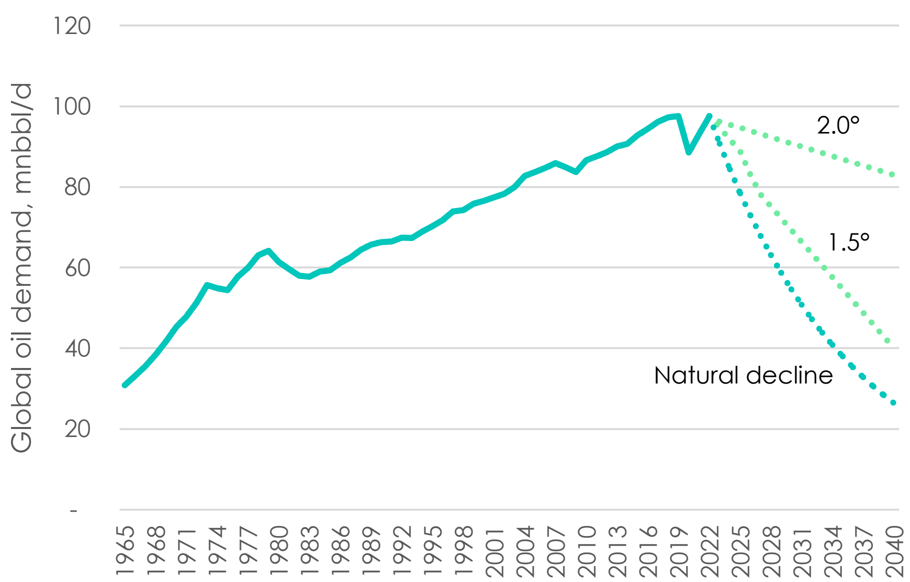
decline for a 1.5°C rise. Note that the report doesn't extrapolate beyond 2040, but the ~20-year trajectories give us a good basis to work from.

We can't go any further in this thought process without considering a defining feature of oil and gas production: the underlying geological decline of production. Without investment in new wells, platforms, pressure maintenance, water, gas and CO_2 injection, production from oil and gas fields naturally declines, at a rate of 5-10% per annum, depending on the field. The industry accepted global average is 7-8% per annum, and I have used 7% to make the below charts.

The point is that with no further investment in oil and gas fields, production will decline at roughly double the pace of demand decline in the next decade, under a 1.5°C scenario.

The conclusion from this is that we need significant continued investment and development of oil and gas fields, even to track a 1.5°C temperature pathway.

Global oil demand under different temperature pathways

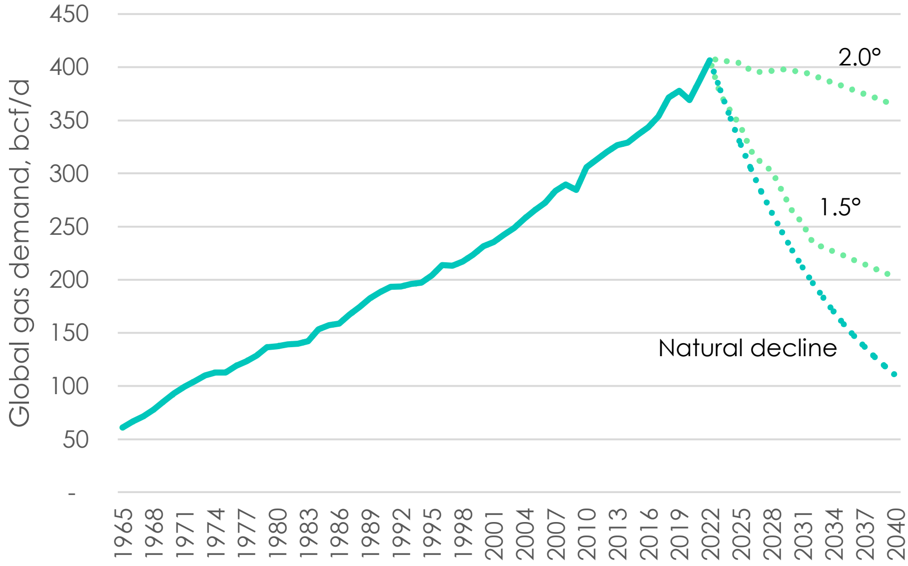


Source: M&G Investments, BP, Statistical Review of World Energy 2021, 70th Edition, UN-sponsored Production Gap report, January 2022.
*mnbbl/d = million barrels per day

Gas looks slightly different, depending on how you assume it features in the global energy mix as a coal substitute.

Not all participants in the global energy value chain are trying to solve for minimising emissions currently, but those who are generally view gas as a coal substitute, meaning gas demand is a beneficiary of the energy transition, not a victim. Nonetheless, *The Production Gap* report produces the below range of outcomes for global gas demand, which are also 'missed' or undercut by a zero investment approach to gas developments.

Global gas demand under different temperature pathways



Source: M&G Investments, BP, Statistical Review of World Energy 2021, 70th Edition, UN-sponsored Production Gap report, January 2022.
*bcf/d = billion cubic feet per day

What to make of the 'no further investment' argument

There is some debate among climate commentators about whether adequate production to satisfy 1.5°C oil and gas demand can come from *existing* oil and gas fields, e.g. just drilling a few more wells and sweating the assets, or if we also need brand-new greenfield developments to supplement.

As an example, the IEA's[11] 2021 Net Zero 2050 scenario, which received a huge amount of press attention, included the conclusion that '*no new investment in oil and gas fields is required under a NZ2050 scenario*.'

It's important to note that what the IEA presented is one possible net zero pathway, that solves for zero emissions, not for real-word energy demand trends. The report concludes that the current level of oil and gas industry spending, at $350 billion per annum (crisis levels), is broadly consistent with a 1.5°C trajectory. This roughly stacks up: current spending is aligned with a global production decline of 4% per annum, while in the IEA's linear net zero scenario, global oil demand will decline 4.4% per annum.

The problem with this is that global oil demand is not declining by 4% this year and has never declined by 4% in a year outside of global economic crisis such as the GFC or the first covid wave.

The IEA also notes that under its scenario, income per capita in producer economies falls by 75%, from $1,800 to $450, noting that this 'could have knock-on societal effects'. No consideration is given to whether countries such as Saudi Arabia or Russia would be prepared to let this happen to their economies.

Further, an oil price of $35/bbl is used out to 2030, declining to $25/bbl by 2050. But this pre-supposes that oil demand and investment fall in an orderly way, in lockstep. Much more likely in the short-term is that demand will surprise to the upside, and prices will send a signal that more production is required. If the industry doesn't respond to higher price signals, because of a higher cost of capital imposed by capital markets in developed countries, the effects will be further price escalation until either new supply comes on, or demand is curtailed through industrial slow-down or outright global economic crisis. **It is a glaring philosophical error to assume that declining oil demand connotes declining oil prices.**

[11] International Energy Agency

Nowhere is this tension more apparent than in the capital allocation decisions of the European major oil companies.

The next couple of charts, again, use the oil and gas demand pathways from *The Production Gap* report, and overlay the expected production of oil and gas from the global majors.

The conclusions may be surprising:

- **BP is exiting oil and gas production (through disposals and under-investment) so rapidly that it is already operating inside of a 1.5°C demand pathway for both oil and gas.**

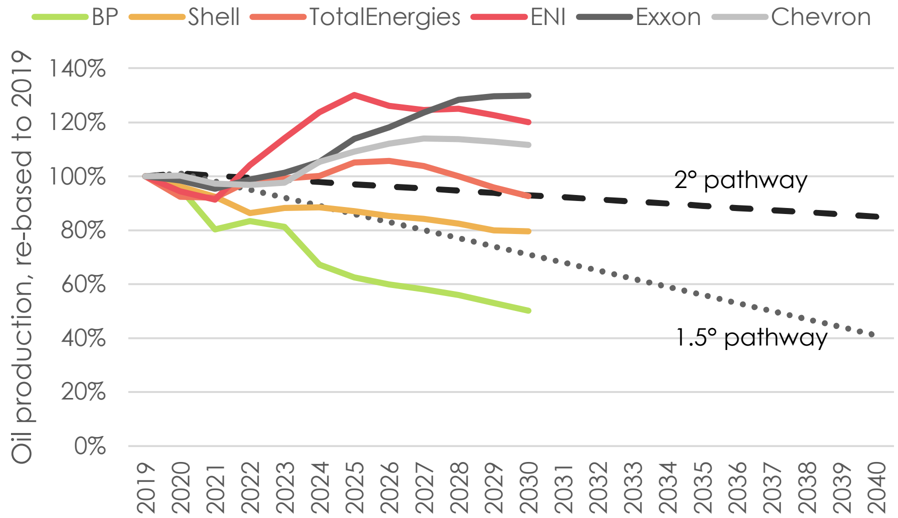
- Shell is tracking 1.5°C for oil and is closer to 2.0°C on gas, which in its strategy it attributes to the wide range of possible outcomes for gas demand (not unreasonable in my opinion).

- Total is close to 2.0°C for oil and is growing gas production, so screens as a laggard.

- Exxon and Chevron, as might be expected, screen poorly, having not had an ESG focus at all until relatively recently.

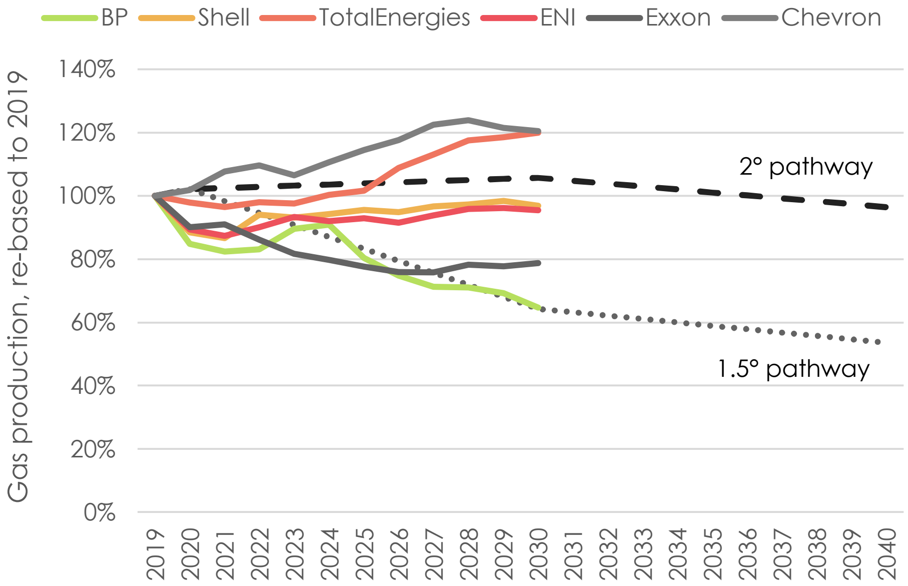
There are legitimate questions about whether the falling participation of highly-regulated, predominantly-well-managed advanced economy energy companies in the development of oil and gas reserves is a good thing for the world, or for their own value-creation, but we are where we are.

Majors' production outlook, oil



Source: M&G Investments, January 2022

Majors' production outlook, gas



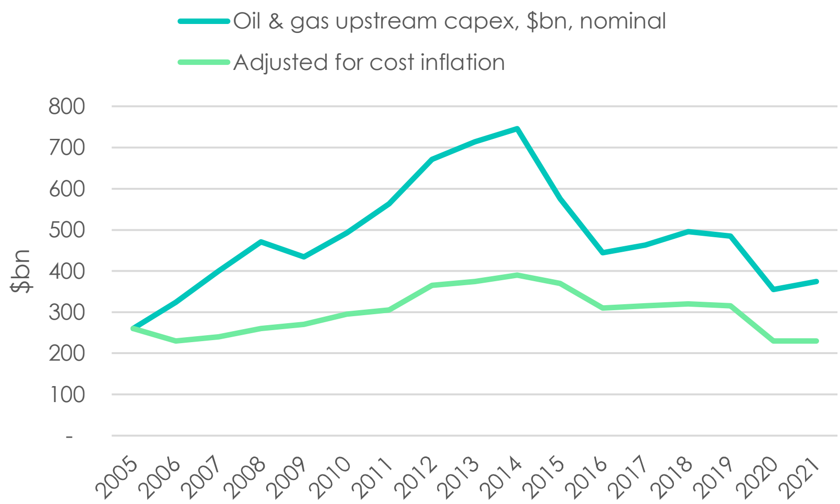
Source: M&G Investments, January 2022

Oil and gas capex is currently aligned with net zero…

As mentioned earlier, the IEA Net Zero scenario views the current level of spending on upstream oil and gas development of $350 billion as broadly 'right'. This is roughly half the level of investment seen in 2014, but global oil and gas demand is 15% higher, and still growing!

If we adjust for cost inflation specific to the oil and gas value chain, we can observe the current level of spending is roughly equivalent to that seen in 2006-2007, which was also the last period of prolonged cyclical tightness in oil markets.

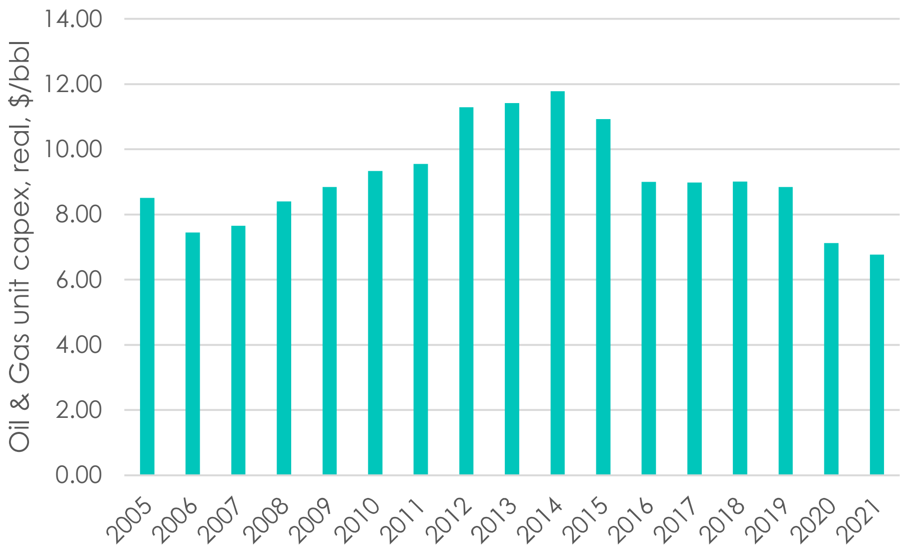
Global upstream oil and gas capex, nominal and real terms



Source: Morgan Stanley Research, January 2022

On a unit of production basis, we are investing at record low levels. On top of this, and perhaps as would be expected, exploration spend across the industry has fallen by roughly two-thirds since 2014, meaning the hopper of new fields is not being replenished.

Capex/barrel of global production



Source: Morgan Stanley Research, January 2022

Taken all together, within our investable time horizon, the world should probably be more worried about satisfying future fossil fuel demand than the known assets becoming stranded.

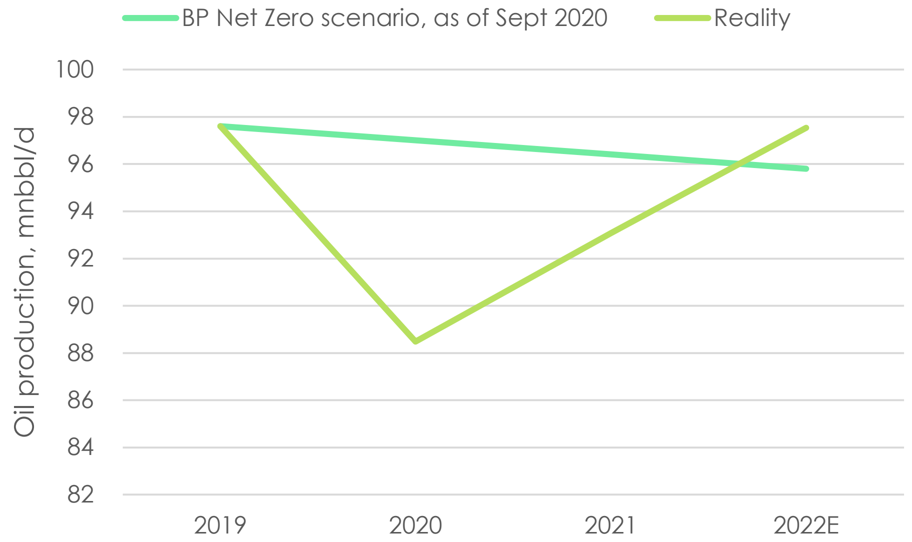
…but demand is not!

Attributing the aggressive ESG-pivot of the likes of BP and Shell wholly to capital markets pressure is not entirely correct. They also each re-aligned their businesses during the COVID-19 pandemic in a way that has turned out to be flat wrong, at least in the short term.

In September 2020, BP outlined a scenario for oil demand which effectively implied 2019 was the peak, and that home-working and reduced global mobility would mean we would never return to pre-COVID activity levels.

While understandable at the time (100% of participants viewed the presentation from home), such a scenario has been disproved in less than 18 months, since global oil demand is set to hit an all-time high in the coming months and will very likely keep growing from there.

Global oil demand out-turn vs. BP's view from the depths of COVID crisis



Source: M&G Investments, BP Annual Company Report, January 2022

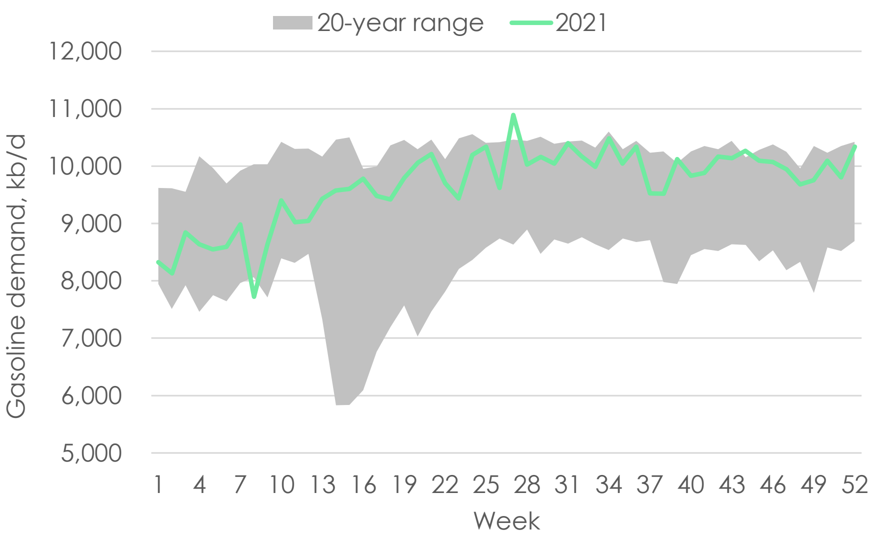
Shell, in its own way, also subscribed to this view that the global energy system was fundamentally altered, cutting its dividend by two thirds in April 2020 and sending a clear message that it prized balance sheet strength above all else in the uncertain period to come.

The point of highlighting this is not to claim that the companies were obviously wrong or should have come to a different conclusion, but it serves to highlight the mindset with which they have embarked on the current cycle.

Now let's look at the energy demand trends since the depths of the COVID-19 crisis in 2020.

US gasoline demand set several weekly highs in 2021.

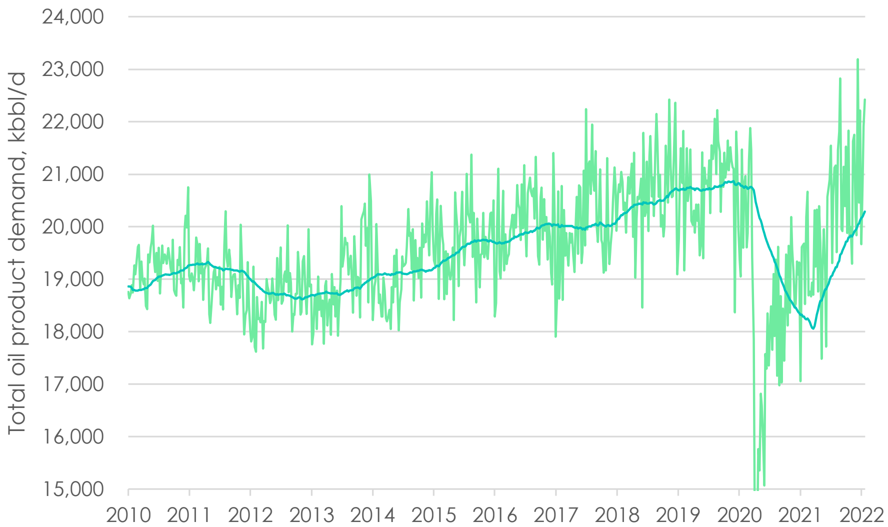
US gasoline demand, weekly



Source: US Energy Information Administration (EIA), January 2022.

Total US oil product demand is rising in a way that no commentator predicted, helped by a combination of high personal mobility, recovering aviation demand, significant movement of goods (trucking) and growing petrochemical demand.

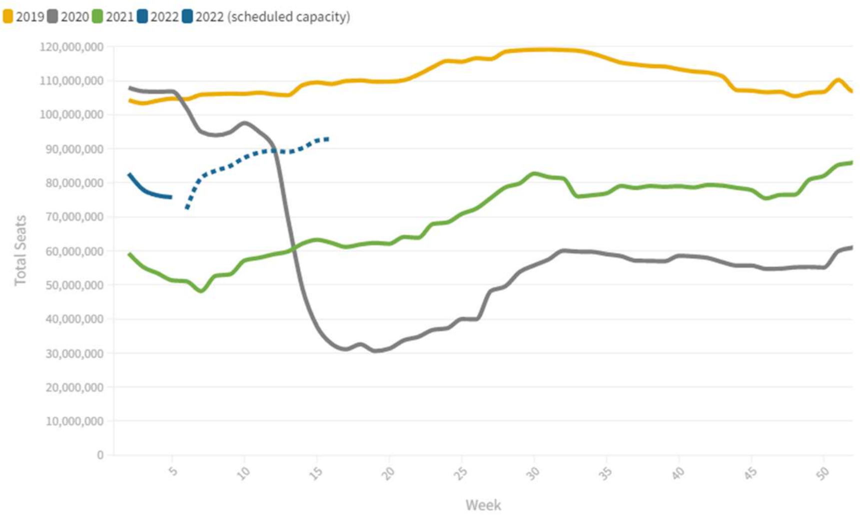
US total oil products demand, weekly & rolling average



Source: US Energy Information Administration (EIA), January 2022.

The recovery in global aviation demand was temporarily delayed by the Omicron wave, but has since resumed its normalisation and seems likely to return to pre-pandemic levels at some point this year.

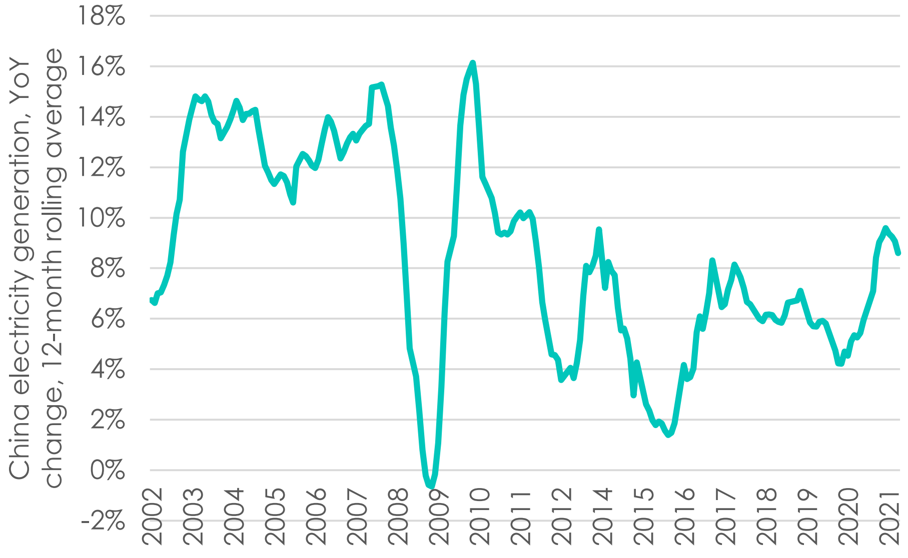
Global airline seats



Source: OAG, https://www.oag.com/coronavirus-airline-schedules-data, 24 January 2022

More relevant for gas, China saw a sharp snap-back in power demand in 2021. Having not been as deeply affected as the rest of the world by COVID-19 in 2020, the growth in 2021 was not driven by a base effect, it was genuine demand growth.

Chinese electricity generation, YoY change, 12-month rolling



Source: Bloomberg, January 2022

2021 saw the highest absolute increase in global electricity demand ever, at 1,500TWh.

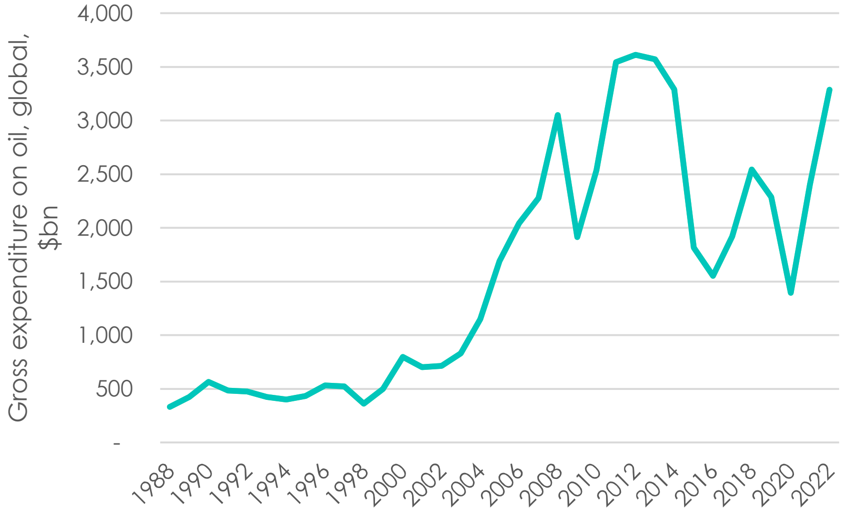
Even adjusting for the 2020 covid base effect, global electricity demand grew by a record level, reaching an all-time high, with roughly half of the growth attributed to China. Around 60% of this demand growth was satisfied by coal, demand for which reached an all-time high. There were many exceptional factors behind this, Latin American drought affecting hydro output, a cold Northern Hemisphere winter, low wind output in Europe, but it is nonetheless a notable trend in a decarbonising world.

This, again, highlights that the landscape we are operating in is one where the world should be more worried about satisfying global energy demand than stranded asset risk.

If the oil and gas industry continues to ignore price signals that are incentivising investment in new supply, the next phase is for prices to rise until demand is destroyed. We have already seen this dynamic in the gas market in Europe over the past few months, when urea fertiliser synthesis was rendered uneconomic by high gas prices.

Through a combination of higher oil prices and rising demand, the world’s total bill for oil consumption is nearing all-time highs. Due to varying local prices, the calculation is hard to carry out for the gas market, but we know enough to say that the world’s gas bill is already at an all-time high.

Total expenditure on oil, $bn (nominal terms)



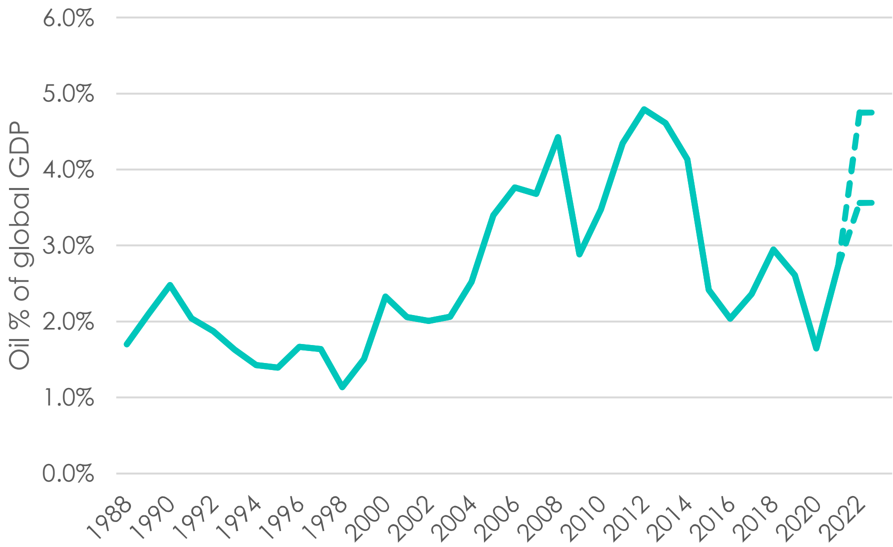
Source: BP, Statistical Review of World Energy 2021, 70th Edition, Bloomberg, January 2022.

As a proportion of GDP, the picture is not quite so bad, but using an oil price range of $80-120/bbl, as shown in the below chart, we can see that we are likely to be at, or around, the level seen before the GFC and the subsequent pre-shale price cycle of 2010-2014.

There are many moving parts to this analysis, but at some point it seems likely that governments and society will have to resolve the paradox of increasing fossil fuel demand while discouraging development capex. At the moment the only release valve is sharply-rising commodity prices.

It seems likely that a global carbon tax is needed to steer capital and behaviour in the right way, but the level of geopolitical cohesion required to get to that point seems a long way off. It is worth noting, too, that it's easier to bring in a carbon tax during periods of low commodity prices, to dampen the effect on the consumer. The current price cycle makes it harder to implement such measures.

Oil expenditure as a % of GDP (range of $80-120/bbl oil price used for 2022)



Source: BP, Statistical Review of World Energy 2021, 70th Edition, Bloomberg, Our World in Data, January 2022.

How should we think about stranded asset risk for the Majors?

The previous sections imply oil and gas demand will continue for decades, and that further development capex is needed to unlock oil and gas reserves. It follows that we should support the best-governed, highest-quality companies to participate in this development. Short-term demand trends suggest there is more risk that supply is exhausted in the short-term, than demand.

Nonetheless, stranded asset risk remains a key debate for the Majors (BP, Shell, Total, Exxon, Chevron). In order to assess the financial risk, we can split the stranded asset question down into parts:

1. Do we think there is a reasonable likelihood that the known reserves of the company will be produced? If not, what does this mean for decommissioning costs provided for on the balance sheet?

2. What are the other known parts of the Majors' businesses worth?…and, therefore, what value is the market placing on the ongoing ability of the Majors to discover and develop oil and gas fields?

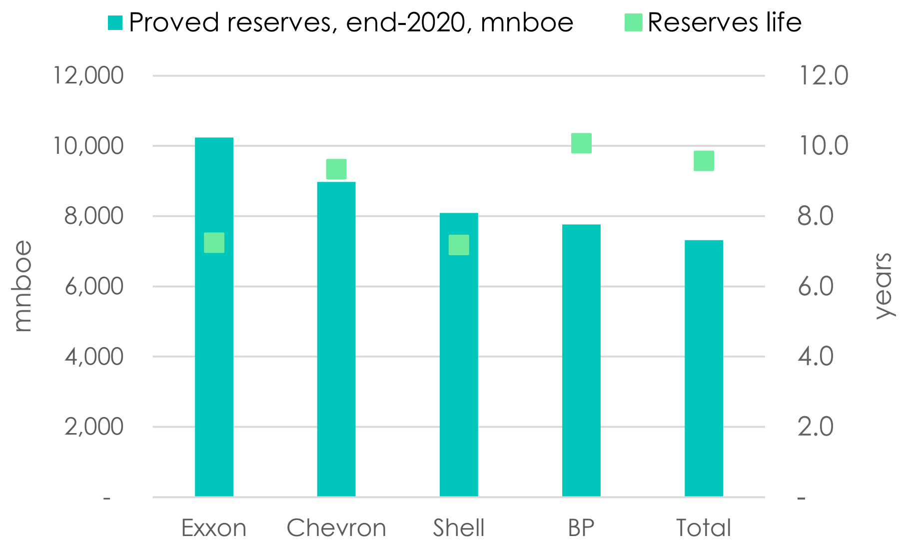
Proved reserves & reserves lives

Reserves disclosure is audited and adheres to strict definitions. 'Proved' reserves are conservatively defined as those with a 90% probability of being produced, where infrastructure is in place, and in some cases (such as large-scale gas developments) an offtake agreement is in place with a customer.

Industry players would caution against using proved reserves in economic analysis as they are too low. Fields will always produce more than the 'proven' reserves as reservoir understanding improves during development. Most corporate transactions are executed on a 'proven plus probable' basis, or 2P, representing the reserves with a 50% probability of being produced (or the middle of the bell curve of probabilities). The industry's value-add is to de-risk probable reserves such that they become proven reserves.

We can see on a reported basis, the Majors proven reserves are each in the range of 7-10bnboe[12], as of end-2020. Implying a 'reserves life' relative to current production of 7-10 years, with BP the highest and Shell the lowest.

Majors proved reserves & reserves lives



Source: Exxon, Chevron, Shell, BP, and Total annual company reports.

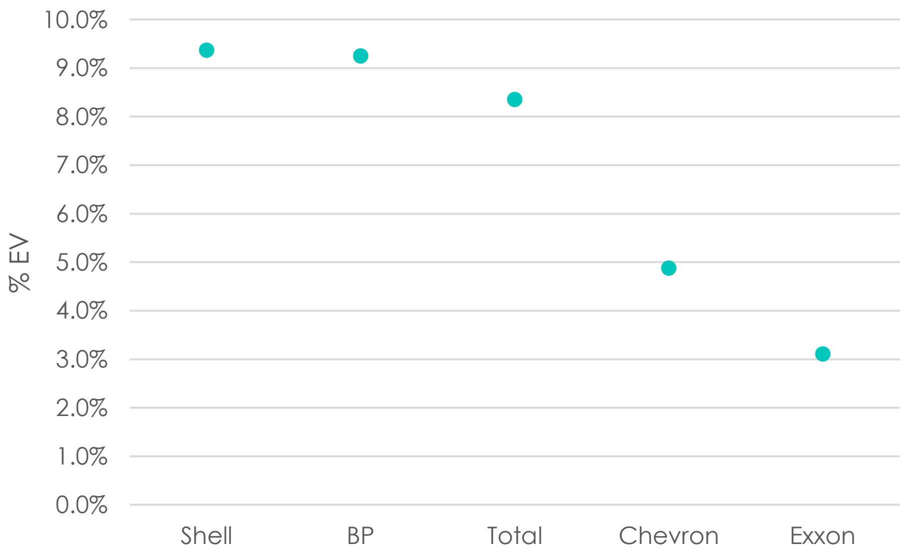
[12] Bnboe = Billion barrels of equivalent oil

There is some economic sensitivity here, as reserves have to be economically producible to be booked, but the variance with oil and gas prices is not very significant. Proven reserves by definition have some existing infrastructure in place and are, therefore, carrying a high degree of sunk cost. This means they often break even economically with a single-digit oil price.

The first conclusion is therefore that the proven reserves of the Majors are set to be produced this decade, when oil and gas demand will still be alive and well (growing even for the first part of this decade). It follows that the stranded asset risk attached to these reserves is close to zero.

If we were worried about the producibility of the Majors proven reserves, it would also be valid to question the sanctity of the decommissioning provisions on the Majors balance sheets, which are material figures, representing 3-10% of Enterprise Value.

Decommissioning provision as a % of Enterprise Value



Source: Exxon, Chevron, Shell, BP, and Total annual company reports, Bloomberg, January 2022.

Decommissioning provisions are compiled at the project level and audited. They are based on today's costs, with an escalation rate applied, and a discount rate based on long-term bond yields. Having spoken to some experts on the topic, considerable time goes into forecasting the cost and timing of spend, since this is a regulatory requirement in most countries, and where it is not, the Majors apply their own functional standards.

The three European Majors disclose the discount rate used in the provision, while the US companies make no comment. BP and Total also disclose the escalation rate assumed, and Shell confirmed to us that its assumption is aligned with peers without saying it was exactly the same.

Discount rate and escalation assumptions

	Discount rate	Escalation	Downstream included
BP	2.50%	1.50%	No
Total	3.00%	1.50%	No
Shell	1.75%	?	Yes
Exxon	?	?	No
Chevron	?	?	No

Source: Exxon, Chevron, Shell, BP, and Total annual company reports.

The point of this is to highlight that the decommissioning provision is a future obligation on the balance sheet which is effectively discounted at 1% for BP and 1.5% for Total! As long as we include it in our fair value calculations, it is captured and shouldn't be considered an unquantified future risk.

What if decommissioning costs are pulled forward in time?

BP notes that moving the decommissioning spend around in time by one or two years makes no meaningful difference to the value of the provision. This is all very well, but what if decommissioning is pulled forward by a decade, because oil and gas consumption becomes more heavily regulated?

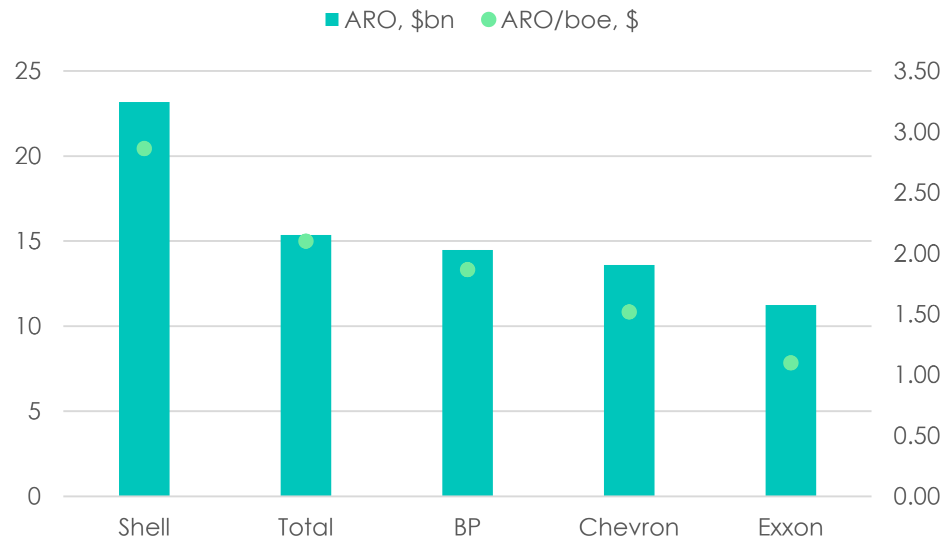
Taking BP as an example, we can estimate this sensitivity by building a cash flow profile which matches their provision and moving it around in time. **Pulling the bulk of the spend forward by ten years is not particularly material.** BP's provision would increase by ~17%, or $2.5 billion. This is unhelpful but as we will see later it does not counteract the underlying value case for the shares.

The reason for this low sensitivity is the low starting discount rate. Note that the entire $2.5 billion effect of a decade-earlier decommissioning programme would be offset if the long-term bond yield assumption were to be increased by only 70 basis points, an accounting assumption which may well be set to rise in the coming years.

The bottom line is that decommissioning costs are well considered by the industry, receive auditor scrutiny, are based on real-world costs, and are punitively discounted at a low rate.

Put another way, future decommissioning costs are only ~$2/bbl of proved reserves, versus today's oil price of over $80/bbl. This is not to say they are not material in absolute terms. Decommissioning activity is set to become a significant sub-industry of the oilfield services value chain. But, the financial risk to the Majors of upstream decommissioning provision changes appears limited.

Decommissioning provision, absolute and per boe of proved reserves



Source: Exxon, Chevron, Shell, BP, and Total annual company reports, January 2022.

One area that stands out is the treatment of downstream, which is not provisioned for in the same way as upstream, on the basis that global refined fuel demand is generally expected to continue to grow and that refineries, therefore, have indefinite lives.

In its 2020 accounts, Shell was the first company to recognise that certain downstream assets had shorter useful lives than the accounts reflected, leading both to asset impairments and increased decommissioning provisions as they acknowledged they would have to 'de-construct' the refineries and remediate the site. This was an interesting step, and led to an increased decommissioning provision of $1.7 billion, or 8%. It is the reason that Shell screens relatively highly versus peers on the above chart.

We should expect the other Majors to take steps along these lines, although note BP has a much smaller, more focused, refining footprint than Shell, mainly in the US. There is also the prospect of re-engineering refineries to produce renewable fuels, such as diesel from waste fats, which is a significant area of investment for the likes of Total.

Does the world have enough oil to satisfy demand?

So if we are happy to pay for proven reserves, and we can account for the decommissioning cost adequately through the balance sheet provision, how should we think about the rest of the Majors upstream portfolios – i.e. the 'probable' or 'possible' reserves and the ongoing ability of the companies to explore and develop assets in the longer term.

From what has been discussed, it seems logical to assume that the reserves which already have existing infrastructure will be developed as they are cost-advantaged and quick to get to market. Beyond this, each Major has a development portfolio of 'probable' assets, most of which require significant new infrastructure investment if the reserves are to be developed.

Is it sensible to assume these will be produced and should we attach value to them?

We saw earlier that under a 1.5°C temperature pathway, global oil demand will decline by about 28mnbbl/d by 2030, and, that with no further investment, global oil production will decline by 43mnbbl/d. The gap of 15mnbbl/d must be filled under any scenario. But, as discussed earlier, the required crude oil will likely be much higher as we are nowhere near a 1.5°C pathway, and the world's actions today determine the glidepath of where oil demand will be in the coming decades.

Note that under a 2.0°C temperature pathway, global oil demand will have declined 7mnbbl/d by 2030, but the zero investment case is still a fall of 43mnbbl/d, meaning 36mnbbl/d of additional future production is required.

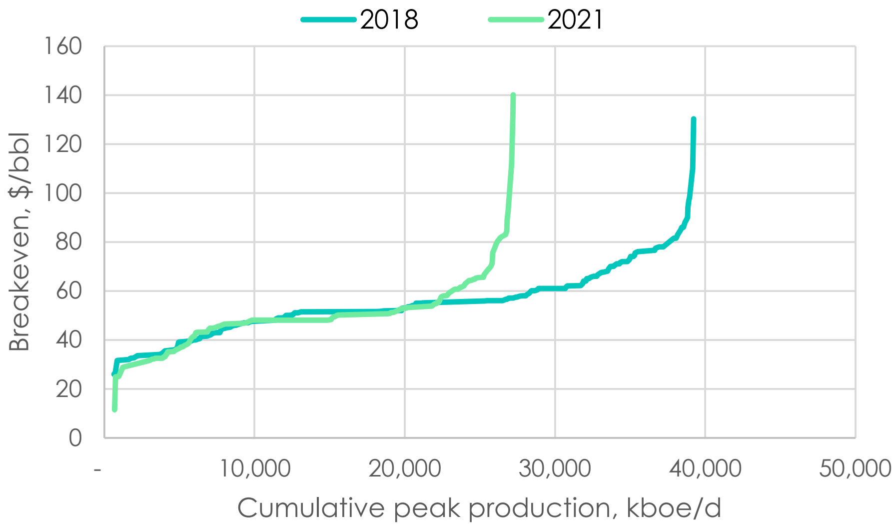
Does the world have identifiable projects which can produce this volume within a decade?

The answer is 'yes' in the case of 1.5°C. There are around 27mnbbl/d of identified future projects, the vast majority of which break even below $70/bbl oil.

Note the shift in the cost curve between 2018 and 2021 in the chart below. This resource has not disappeared, but the projects have been cancelled or delayed, so they are no longer talked about in a way that is clear enough to make it into the referenced project database.

The conclusion is that the world requires ~50% of the identified projects in the lowest case for oil demand by 2030 and 130% in the highest case. Given that we are not tracking a 1.5°C pathway and that the world is unlikely to make the necessary adjustments within the next few years to fit this trajectory, it is highly likely that more oil production will be required beyond what has already been discovered.

Cost curve for new oil projects, 2021 vs. 2018



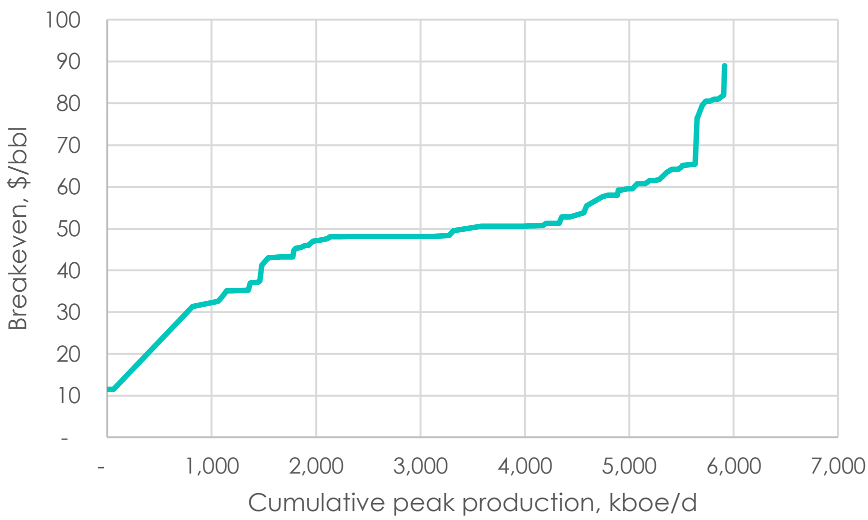
Source: Goldman Sachs Global Investment Research, Top Projects 2021 report, May 2021.

If we take the most extreme scenario implied by 1.5°C, which is that the top 50% of the cost curve is 'stranded', we can roughly conclude that every asset with a breakeven below $50/bbl will be developed and is 'advantaged'.

Within the 'advantaged' project data-set, the Majors are well positioned, making up 3mnbbl/d of the future project slate of the industry's 15mnbbl/d which is economic below $50/bbl. Put another way, the Majors make up 21% of the world's commercial resources, vs. their ~8.5% of their contribution to current global oil and gas production.

There are all kinds of complications with this analysis – are small, regional producers adequately captured, how are opaque, poorly-monitored projects in Saudi reflected, etc – but as a broad-brush indicator, the global Majors appears well positioned on the cost curve. Logically, this makes sense given their scale, existing infrastructure and project management expertise.

Cost curve for new oil projects – global Majors

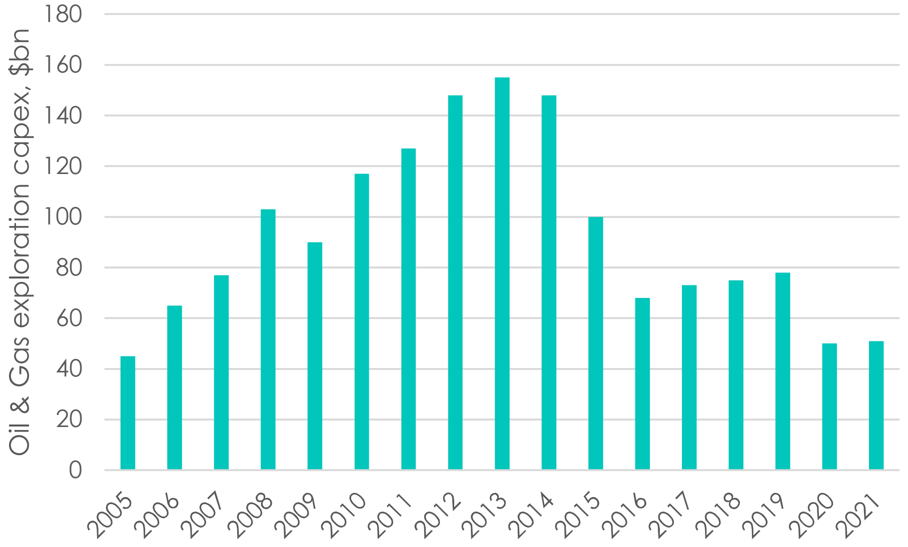


Source: Goldman Sachs Global Investment Research, Top Projects 2021 report, May 2021.

Bear in mind that there is no real effect on the decommissioning provision from this stranded asset approach, since these developments require largely new infrastructure, and we have shown the financial sensitivity of movements in the decommissioning provision in time to be limited.

At this point it is worth noting that the industry is not exploring at levels that will lead to sufficient discoveries to plug any remaining demand-supply gaps, either beyond 2030, or in the shorter term if demand surprises to the upside.

Global oil and gas exploration capex, $bn



Source: Morgan Stanley Research, January 2022

What are the Majors pricing, at current levels?

It follows that we should be bullish on the Majors if we can show they are cheap relative to the valuation of their proven reserves, plus any reserves that can easily be developed through existing infrastructure. We should ignore unproven future developments (although the data suggests it is highly likely they will be developed). Finally, the world should be more worried about peak supply than peak demand.

One approach is to take the company's own disclosed NPV10[13] of its proven reserves, reported annually, adjust for our own commodity price assumptions, apply multiples to the non-upstream businesses, and fully-load the balance sheet with decommissioning and other provisions.

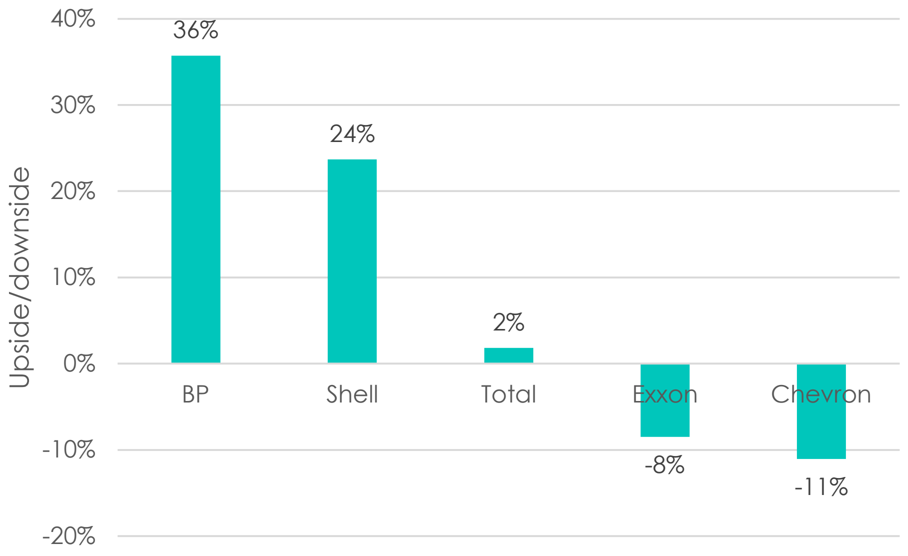
If this approach reveals upside at a conservative oil price assumption (say, $65/bbl), then we have reasonable margin of safety in holding the shares.

<u>Observations on this basis:</u>

- BP offers relative value
- Total is the least attractive of the European Majors
- The US Majors are over-valued assuming $65/bbl flat

[13] NPV10 = Net present value using a 10% forward discount rate.

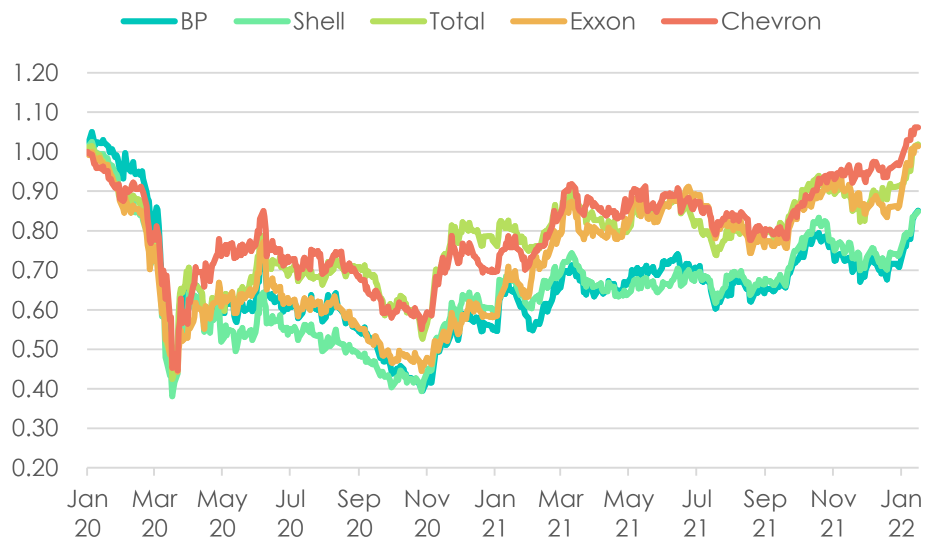
Upside/downside to current equity valuation vs. FASB* valuation of upstream reserves



Source: M&G Investments, January 2022. *FASB = Financial Accounting Standards Board.

The dispersion in upside makes sense, given that the US Majors, along with Total, have recovered to pre-pandemic levels of share price (Chevron, in fact, is at an all-time high), whereas BP and Shell are still lagging.

Re-based share price performance through COVID-19 pandemic

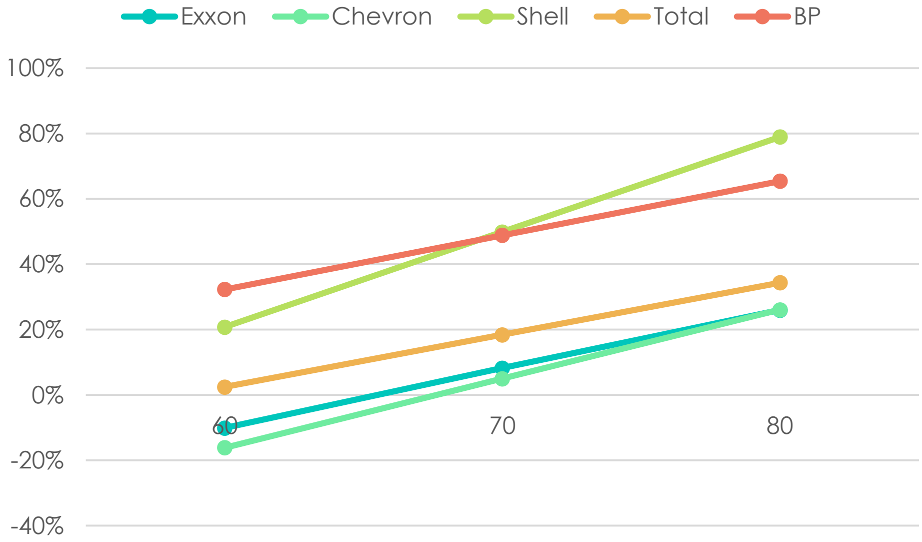


Source: M&G Investments, Bloomberg, January 2022. Rebased to January 2020.

Shell offers the highest torque to higher commodity prices (based on their own historical FASB reserves accounting data). Note that this is simply using the historical correlation of the accounting value of the reserves versus oil and gas prices, there is no genuine P&L sensitivity being run here. The conclusion would seem to make broad sense, though, given Shell's integrated gas portfolio which makes it the largest LNG trader in the world (LNG prices most often being benchmarked to oil prices rather than gas).

On this basis, the US Majors are broadly discounting $70/bbl in perpetuity, and to see value in the shares one needs to believe in $80/bbl being sustained.

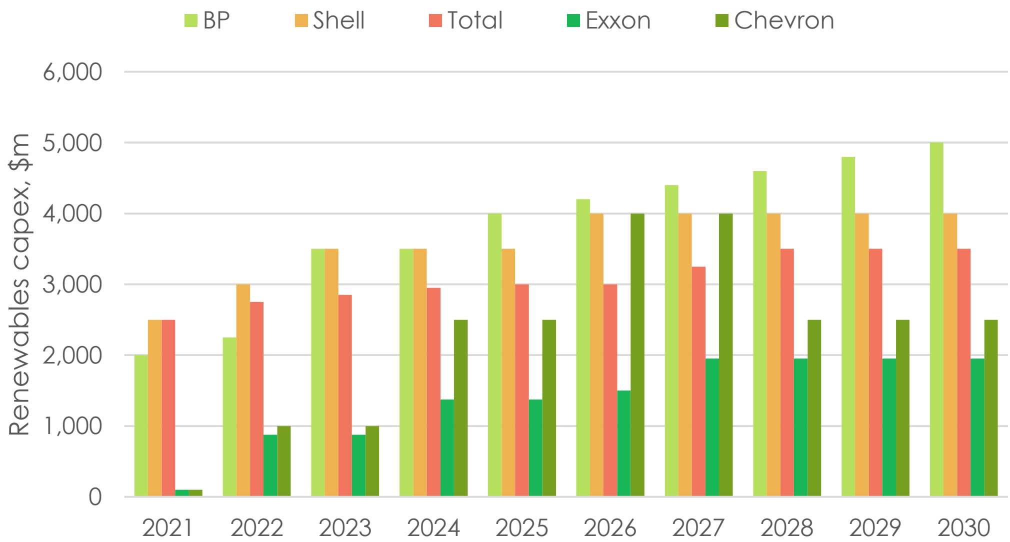
Upside/downside to share price at different oil price assumptions



Source: M&G Investments, January 2022

Peer multiples would suggest the Majors' renewable divisions should be fairly highly-valued in this type of sum-of-the-parts approach, but it is important to recognise the absolute earnings contribution is currently very low, and will only reach 15-20% by 2030 in most cases. This is despite renewable energy investment currently accounting for 10-20% of capex, and rising.

Majors' renewables capex, $bn

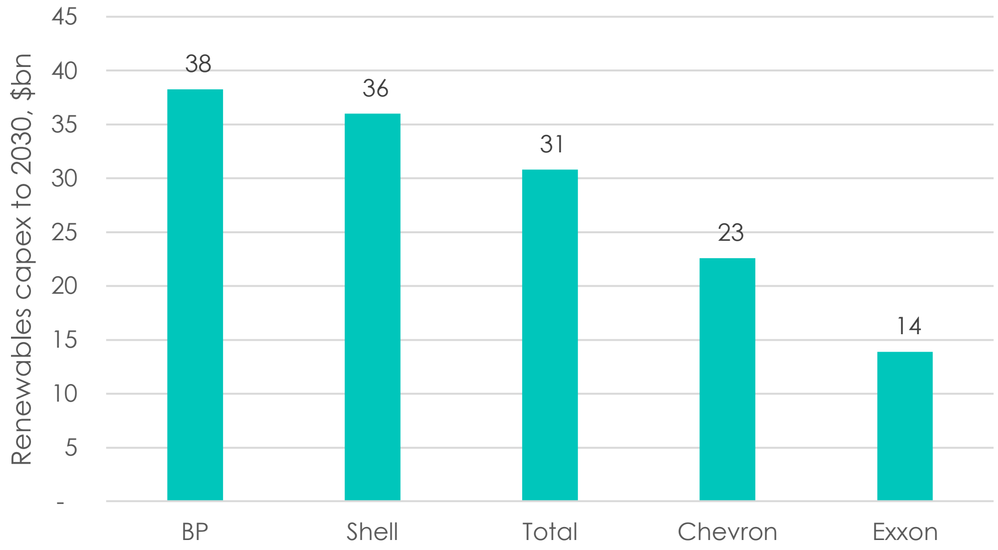


Source: Exxon, Chevron, Shell, BP, and Total annual company reports.

The more aggressive energy transition strategies of the European Majors are often viewed as simply stemming from the fact that the companies have 'no choice' or are 'greenwashing'. But spreading their investments across new energy technologies is the most sensible risk management approach to prepare for a highly unpredictable energy mix in a decade's time.

We should want them to expand in renewables in areas where they have a natural synergy, e.g. offshore wind linked virtually to an EV-charging network installed at their existing petrol stations. On this basis, BP has the clearest and most advanced strategy.

Cumulative renewables capex to 2030, $bn



Source: Exxon, Chevron, Shell, BP, and Total annual company reports.

In summary

We have learned that fossil fuel demand will far outlast the reserves base of the Majors, that EV penetration cannot outweigh near-term demand trends, that energy cost deflation drives more demand, not less, and that even if the world were to revert immediately to a Paris-aligned trajectory, responsible stewards of oil and gas assets will be required for decades to come.

In the period where the Majors are reconfiguring their businesses to become more diversified energy suppliers, they CAN offer value, in fact they are a crucial element of a transition which meets the world's growing energy needs.

Disclaimer

Past performance is not a guide to future performance.

The value of investments will fluctuate, which will cause fund prices to fall as well as rise and investors may not get back the original amount invested.

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