

# Top Projects 2021

A tale of shrinking reserves and rising profits

This 18<sup>th</sup> edition of our annual review of top assets in global oil and gas production shows an acceleration in the **oil & gas industry's transformation**, with tightening financing conditions for new hydrocarbon developments bringing an end to non-OPEC growth, a steepening of the cost curve and much needed improvements in corporate returns. We highlight five key themes of change: 1) **Shrinking reserves**: oil reserve life shrinks to c.25 years, a 50% reduction from 2014, as the industry stops exploring for new resources; 2) **Steepening cost curve**: the Top Projects cost curve becomes smaller and steeper, with a greater differentiation in returns; 3) **End of non-OPEC growth**: we estimate that 2019 saw peak non-OPEC production and non-OPEC ex-shale & Russia starts a phase of structural decline of 0.5 mn blsd, putting pressure on short-cycle production to return to growth, with 1 mn blsd of US shale growth in 2022E; 4) **Consolidation**: we expect OPEC+ to increase market share, with a call on OPEC+ as large as 9.8 mn bl/d over 2021-25E, depleting OPEC+ spare capacity by 2025E unless material incremental capacity expansions are implemented, while the rest of the industry consolidates to focus on cost-cutting; and 5) **Higher returns**: higher hurdle rates are lifting returns on new oil projects to >20% (2x the 2013-14 average), we estimate, on the back of improved capital and cost discipline.

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## PM summary: Shrinking reserves, end of non-OPEC growth and capital efficiency dominate this year's Top Projects analysis

This 18th edition of our annual review of the industry's largest oil & gas assets shows an industry in deep structural change. Strong investor focus on de-carbonization is tightening financing conditions across the industry, driving higher hurdle rates and risk premia for long-term hydrocarbon developments as well as higher barriers to entry, especially for larger, more complex developments. The consequence is an acceleration of the themes of **under-investment, consolidation, capital efficiency and portfolio upgrading** that we first laid out in the 2019-20 Top Projects reports. This year we analyze five key themes of change across the industry: 1) Shrinking reserves; 2) Steepening cost curve; 3) End of non-OPEC growth; 4) Consolidation; and 5) Higher returns. We also refresh our company-by-company analysis of oil & gas projects portfolios, which underpin future cash flow, investments and corporate returns.

### **Shrinking reserves: As focus shifts from volumes to returns, oil resource life halves since 2014**

With CO<sub>2</sub> emissions on a persistent upward trajectory globally over the past few years, investors are taking a leading role in driving the climate change debate, pushing corporate management of oil & gas producers toward incorporating climate change actions in their business plans and strategy. The number of climate-related shareholder proposals has almost doubled since 2011 and the percentage of shareholders voting in favor tripled over the same time period, according to ProxyInsight. This is reflected in a structural shift in the industry's scale of investments (**capex commitments in new long-cycle oil projects have fallen by >60%** over the past six years vs. the six prior to that) and its mix (more focus on gas and brownfield developments and less on long-cycle greenfield oil developments). According to our analysis, **the resource life of Top Projects** (recoverable resources/production) **falls to c.25 years in 2021E from >50 years in 2014**, a halving since the end of the 2004-14 'super-cycle'. Yet the economics are much healthier even under lower Brent and gas price assumptions, with >80% of the undeveloped resources profitable at a Brent price <US\$60/bl vs. only 18% in 2014 on our estimates. In our view, this is symptomatic of the new 'Age of Restraint', with the market placing low value on undeveloped resources due to a high risk premium and with the value accruing to the companies that can self-finance the development and manage their risk through a large diversified portfolio with benefits of scale.

### **Steepening cost curve: The Top Projects oil cost curve is shrinking and steepening for the fourth consecutive year**

Following a decade of resource expansion that ended in 2017, this year's Top Projects edition shows a dramatic shrinking and steepening of the cost curve. This is driven by the **industry's move away from oil exploration and a fourth year of downward revisions in our shale oil estimates**. Cumulative peak production falls c.5 mn bpd vs. last year's cost curve, and we estimate cost support at c.US\$48/bl for the average, US\$53/bl for the marginal quartile and US\$65/bl for the marginal

decile. As the industry focuses its shrinking capital (and carbon) allocation to fewer projects with higher returns, we continue to see portfolio upgrading and re-engineering of projects towards simpler, more standardized, cheaper developments. A number of project **FIDs have been delayed since 2014, translating into 2.6/9.5 mboe/d of lost LNG/oil production in 2025E**, on our estimates.

### **The end of non-OPEC growth: We estimate that 2019 saw peak non-OPEC production**

Our Top Projects bottom-up analysis shows that we have entered a structural phase of no non-OPEC growth driven both by a **thinner pipeline of mega-project deliveries and a slowing pace of US shale growth**. Mega-projects delivery substantially slows from this year, seven years after peak oil prices, as it did in 1987 (seven years after the 1980 oil price peak), as the industry exhausts the development pipeline to which it committed in the 'supercycle' years. We estimate that **the long-cycle developments will only add an average of 300 kbpd pa over the next five years compared with 700 kbpd pa over the past five years**. The downcycle has also accelerated the transformation of shale into a more concentrated (through consolidation), cash generative (through better logistics, infrastructure, data usage, efficiency, contiguous acreage and scale) and lower growth industry (fewer players targeting growth, while mature basins plateau or decline). We still expect a major cyclical recovery in activity over the next two years, with a new high growth level (expected in 2022) of 1 mn blsd. This will lead, on our estimates, to a significant call on OPEC. **Based on the GS demand base, we estimate a call on OPEC as large as 9.8 mn bls/d by 2025E that would exhaust all of OPEC spare capacity**. Assuming demand growth in line with the IEA's Stated Policies Scenario for 2025, the call on OPEC would be 7.8 mn b/d over 2021-25E, but a much smaller 1.9 mn bls/d in their more aspirational Sustainable Development Scenario.

### **Consolidation rises, with US shale the last bastion of fragmentation**

Rising oil prices and a market perception of long-term supply shortages enabled 50 different operators to receive financing to take mega-project Final Investment Decisions (FIDs) in 2003-13, including National Oil Companies (NOCs) operating outside of their home basins for the first time, independent E&Ps, utilities and other conglomerates. In 2014, the industry structure started to rationalize into a more concentrated one on the back of falling oil prices. Seven companies (the 'Seven Sisters') emerged as structural winners, continuing to sanction projects consistently through 2014-19, and we believe that tighter financial conditions for new hydrocarbon developments will keep the barriers to entry high even though profitability has once again become very attractive. **The Herfindhal index of market consolidation on FIDs increased from 10%-20% in 2010-14 to 40%-60% in 2018-20**, by our calculations, consistent with levels that could be considered an oligopoly. US shale remains the last bastion of fragmentation, with >600 players and a Herfindhal index of <4% on our calculation. This however is also showing signs of change, as we expect Big Oils to drive 33% of US shale liquids volume growth over the next five years vs. 22% in the previous five years.

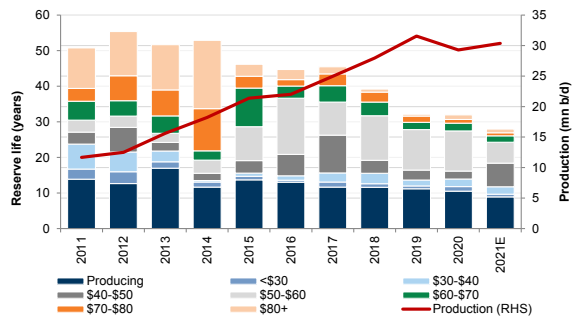
**Higher returns: From 8%-12% IRR in the 2006-16 Age of Expansion to 15%-20% in the Age of Restraint**

The improvement in market structure is leading to a material uptick in profitability of new projects. Project IRR troughed in 2006-16 at 8%-12% on the back of excessive competition. This level of project IRR led Big Oils' overall ROACE (including overhead costs) to fall to single digits. We estimate that **the FIDs (mainly by Big Oils) taken from 2017 to 2021E will instead yield a profitability more consistent with what the industry saw in the 1990s: 15%-20% average project IRR,** which should be consistent with ROACE recovering to low-mid teens by 2025.

# Top Projects in 18 charts

**Exhibit 1: Concerns over stranded assets have pushed the oil industry to halve its resource life since 2014...**

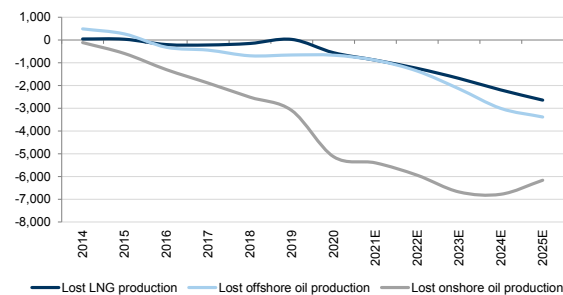
Top Projects reserve life, by year of report and breakeven



Source: Goldman Sachs Global Investment Research

**Exhibit 4: ...as postponements of investment decisions lead to c.9.5 mn bpd of lost oil production by 2025E**

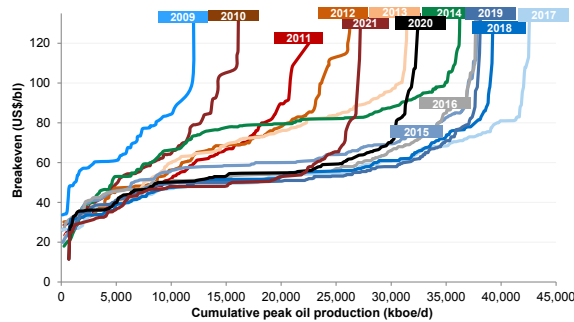
Top Projects lost LNG, offshore and onshore oil production from long-cycle developments in mn boe/d; Top Projects 2021 vs Top Projects 2014 expectations



Source: Goldman Sachs Global Investment Research

**Exhibit 2: ...leading to a dramatic shrinking and steepening of the oil cost curve**

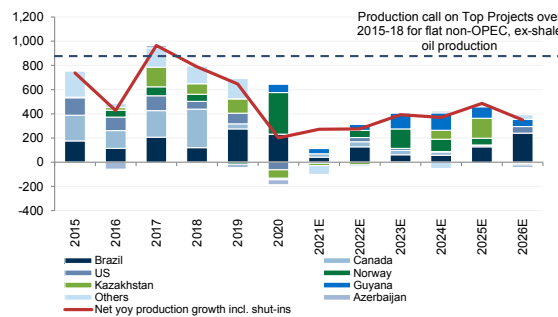
Top Projects oil cost curve for pre-plateau projects through the years



Source: Goldman Sachs Global Investment Research

**Exhibit 5: Non-OPEC stops growing as the pipeline of giant developments committed in the 2008-13 bull market dries up...**

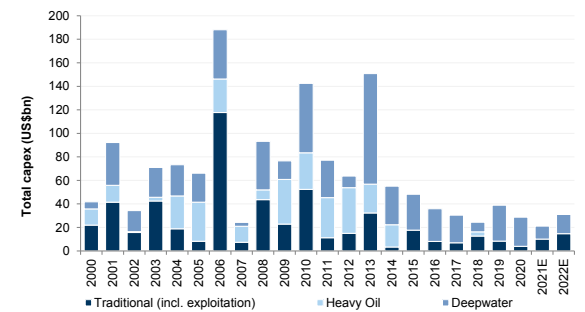
YoY oil production growth (kboe/d) from non-OPEC and ex-Russia, ex-shale, shown excluding and including impact of production shut-ins



Source: Goldman Sachs Global Investment Research

**Exhibit 3: Capital commitment to new oil projects has reached a new trough...**

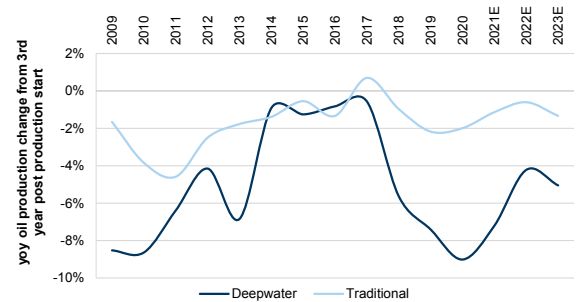
Top Projects capex sanctioned in oil by year of sanction, split by winzone



Source: Goldman Sachs Global Investment Research

**Exhibit 6: ...with further downside risk if the acceleration in decline rates we saw in 2018-20 continues**

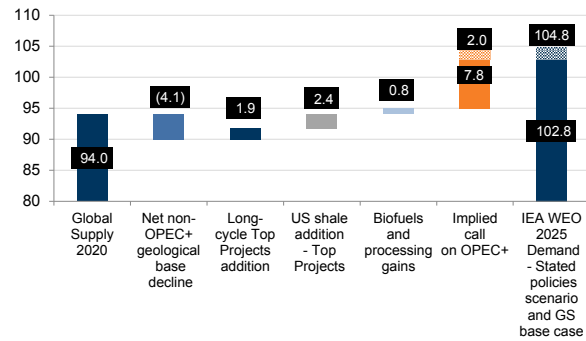
YoY oil production change from 3rd year post production start of Top Projects fields



Source: Goldman Sachs Global Investment Research

**Exhibit 7: Depending on the path of oil demand to 2025E, the call on OPEC could be as big as c.9.8 mnbls pd (2020-25E) under our base case demand scenario...**

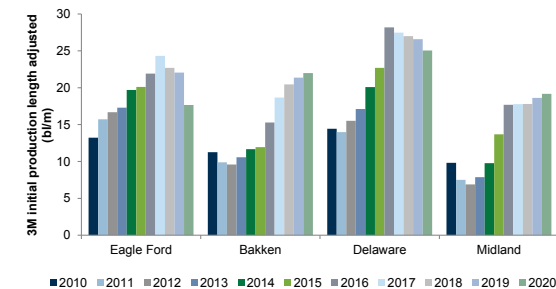
Key drivers of supply growth from 2020 to 2025E



Source: IEA WEO 2020, Goldman Sachs Global Investment Research

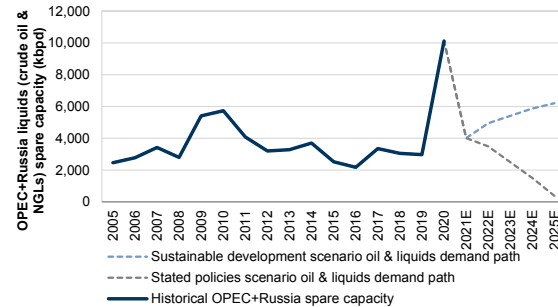
**Exhibit 10: ...as productivity improvements stall or even revert...**

3-month initial production length adjusted (bl/m)



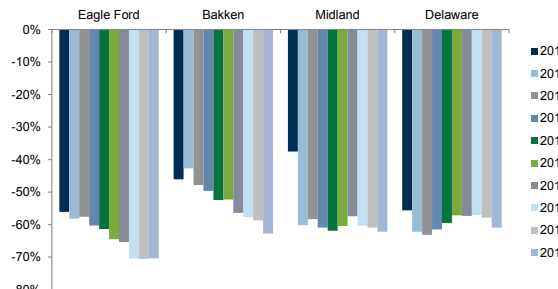
Source: IHS, Goldman Sachs Global Investment Research

**Exhibit 8: ..depleting OPEC+ spare capacity by 2025E, unless material incremental capacity expansions are implemented**  
OPEC+Russia liquids (crude and NGLs) spare capacity under different demand scenarios



Source: IEA WEO 2020, Goldman Sachs Global Investment Research

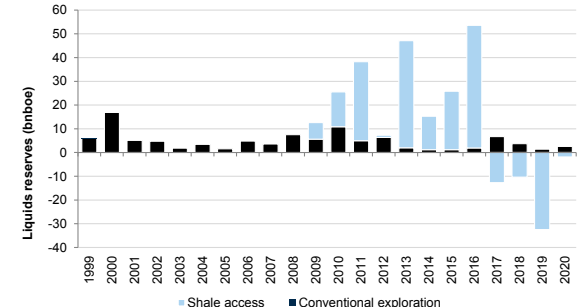
**Exhibit 11: ...and decline rates accelerate in all key basins**  
Decline in % seen between month 3 and month 12 of production



Source: IHS, Goldman Sachs Global Investment Research

**Exhibit 9: US shale has seen consistent negative revisions to its resource base since 2017...**

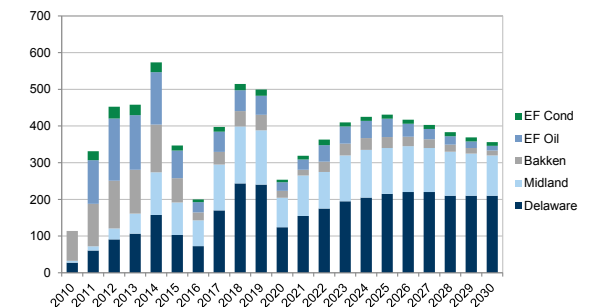
Total liquids reserves discovered/accessed by year, based on Top Projects



Source: Company data, Goldman Sachs Global Investment Research

**Exhibit 12: We forecast a cyclical recovery in US shale activity, mostly focused on the Permian basin...**

Horizontal rig count of the Big 4 basins

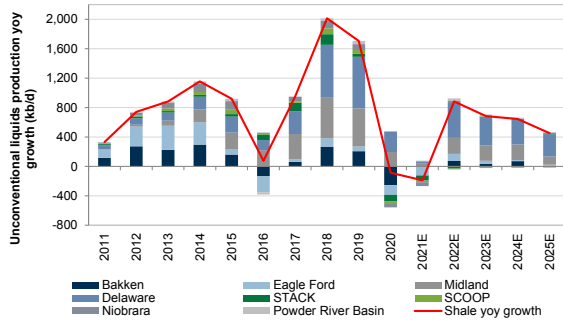


Source: Goldman Sachs Global Investment Research



**Exhibit 13: ...leading to a recovery in shale growth, peaking in 2022E close to 1 mn blsd...**

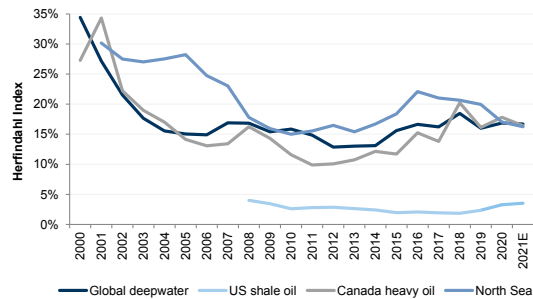
Unconventional liquids production change yoy (kbpd)



Source: Goldman Sachs Global Investment Research

**Exhibit 16: US shale oil is the last major basin with inefficient, fragmented ownership, but consolidation is notably increasing**

Herfindahl index for key oil producing winzones over time (%)



Source: Goldman Sachs Global Investment Research

**Exhibit 14: ...thanks to a temporary reduction in the amount of high decline new wells in the production base**

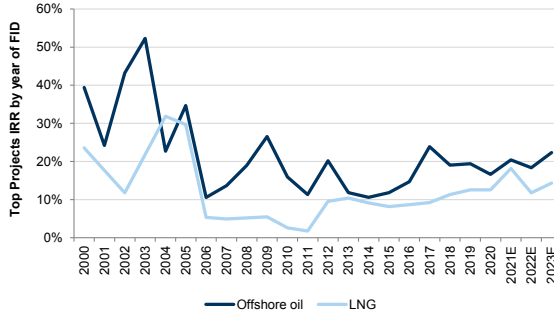
Volume (mn b/d) required yoy to keep production flat with prior year



Source: Goldman Sachs Global Investment Research

**Exhibit 17: Profitability has returned to mid-2000 levels, with offshore oil projects profitability >20%**

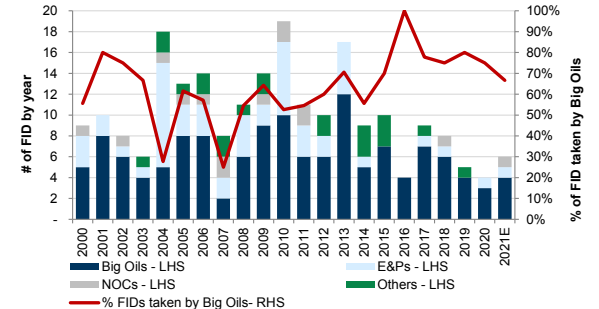
Top Projects IRR by year of FID split by winzone



Source: Goldman Sachs Global Investment Research

**Exhibit 15: The global oil industry is consolidating, with >60% of FIDs in the hands of Big Oils**

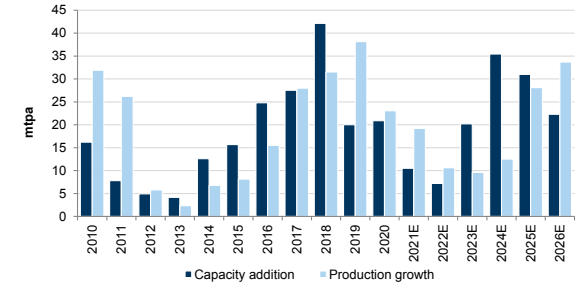
FIDs by year, excludes NOC FIDs in their home basin



Source: Company data, Goldman Sachs Global Investment Research

**Exhibit 18: The LNG market has a tightening window in 2021-24E, before new supply comes in 2025-26E**

Annual increase in LNG production and capacity in mtpa



Source: Goldman Sachs Global Investment Research



# Top Projects 2021 in numbers



We estimate that 2019 saw peak non-OPEC production, with the gap in long-cycle Top Projects developments leading non-OPEC ex-shale and ex-Russia to **shrink by c.0.5 mn bl/d** each year over 2020-24E compared to **growth of c.0.1 mn bl/d** in the previous five years...



...putting pressure on short-cycle production to return to growth, with **c. 1 mn bl/d** of US shale growth in 2022E...



...and a significant call on OPEC+, which could be as large as **9.8 mn bl/d** over 2021-25E (under GS demand base model, 7.8 mn b/d under IEA's Stated Policies Scenario), implying depletion of **OPEC+ spare capacity by 2025E** unless material incremental capacity expansions are implemented.



As industry focus shifts from volumes to returns, the sector's resource life has **halved**, reduced by **>20** years since 2014...



...resulting in **a dramatic shrinking and steepening** of the oil cost curve, with cumulative peak oil production falling by **c. 5 mn b/d** in 2021E vs. last year's cost curve.



Investor engagement in climate change continues to accelerate, with the number of climate change-related shareholder resolutions almost **doubling** since 2011 and the % of shareholders voting in favor of these **tripling**, reaching c. **33%** in 2020...



...resulting in structural underinvestment in the sector since 2014, with capex commitments in new long-cycle oil projects having fallen **>60%** to c. **\$34** bn pa over the past six years vs. **\$95bn** pa in the previous six years...



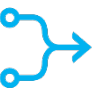
...and with project investment delays (final investment decisions) since 2014 translating into **9.5** mn b/d of lost oil production by 2025E on our estimates (and **2.6** mn boe/d of lost LNG production).



Tightening financial conditions have led to consolidation in most markets, with Big Oils accounting for **82%** of mega-project investment decisions over the past five years vs. **56%** in the previous 10 years...



...supporting strong improvement in profitability, with the average project IRR for Top Projects sanctioned from 2017 to 2021E more consistent with the level the industry saw in the 1990s: **15-25%**, almost **double** that seen over 2006-16 of **8-12%**.



Consolidation is also more evident in the highly fragmented US shale market, with Big Oils starting to show signs of leadership, driving c. **33%** of US shale liquids volume growth over the next five years on our estimates.



Renewed capital discipline in LNG is creating a more attractive global gas market with LNG production growth averaging **13** mtpa pa over in 2021-24E vs. **27** mtpa over the last five years

Source: IEA, ProxyInsights, Goldman Sachs Global Investment Research

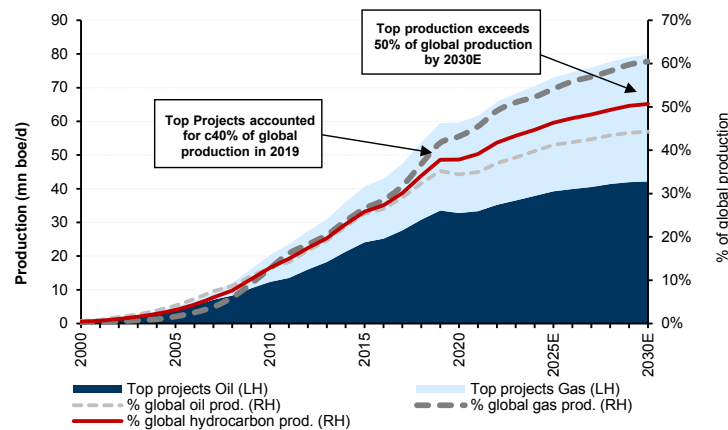


## Methodology: Top Projects 2021 captures c.45% of industry capex and c.50% of production

This is the 18<sup>th</sup> annual iteration of our Top Projects report. In these reports we independently model the industry’s largest new oil & gas developments. We draw conclusions on how the industry cost curve is changing, forecasting cash flow, capex and production, and assess delivery for the industry as a whole and on a company-by-company basis. This proprietary analysis informs our macro views as well as company recommendations and forecasts.

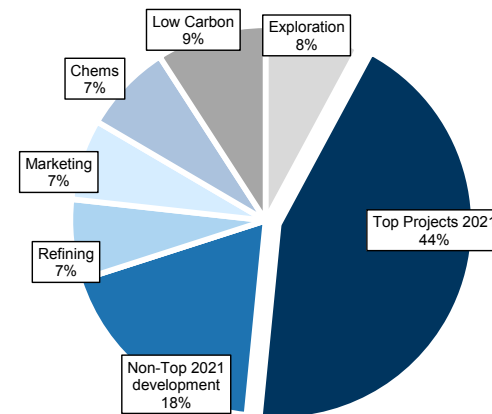
The Top Projects database has evolved from 50 field models in 2003 to 462 models in 2021, encompassing oil & gas fields both in traditional development areas (offshore and onshore) and unconventional (shale, heavy oil, GTL). We include all new fields with at least 300 mnboe of recoverable resources. Combined, we forecast these projects will account for >50% of global supply within the time frame of the next 10 years. This year, we add a small number of new projects, including Block 58 Suriname, Block SK410 in Malaysia, Block 114 in Vietnam and Balder X in Norway.

**Exhibit 20: Top Projects to exceed 50% of global oil & gas production in the next 10 years**



Source: BP statistical review 2020, Goldman Sachs Global Investment Research

**Exhibit 21: Top Projects 2021 capex represents >40% of Big Oils’ total capex (2021-23E)**



Source: Company data, Goldman Sachs Global Investment Research

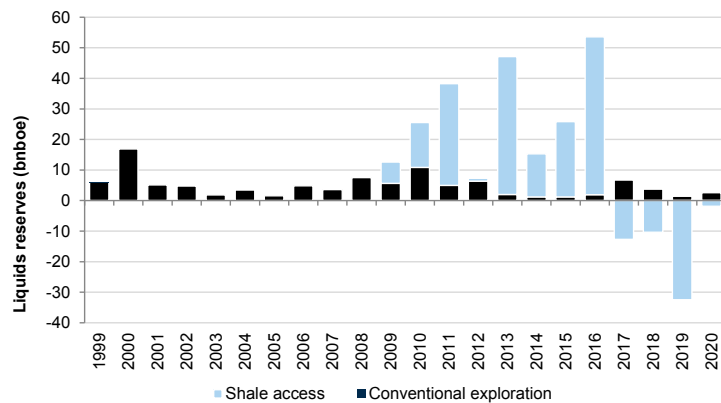
# Stranded assets in action: The resource expansion is over with assets stranded underground by investment constraints

The period of 2004-16 saw two oil & gas revolutions fuelled by cheap financing, leading to industry fragmentation and a compounded 10% cost inflation over that period. The first oil & gas revolution (2004-13) was driven by National Oil Companies that deployed their rising free cash flow into rapid international expansion with a combination of exploration and M&A activities. At the same time, market perception of long-term supply shortages incentivized independent oil & gas players to step up their ambitions, becoming operators of major developments across the globe. The second oil & gas revolution (2009-16) was led by US exploration & production companies, unlocking 100+ bn bls of US shale oil resources.

**We see that these revolutions are now over**, as low exploration success and the fourth consecutive year of shrinking shale resources seal the end of a decade of resource expansion and the resurfacing of the debate around stranded assets. We believe that **oil assets are now stranded under the ground by lack of investment as well as investment constraints - well before demand strands them**, as the **market is turning away from resource expansion in the wake of the low carbon transition**, with financial conditions tightening across the industry. This makes the nature of the under-investment in oil structural in nature, and is evident through the substantially reduced oil capex sanctioned since the previous downcycle, as shown in [Exhibit 23](#).

**Exhibit 22: The last four consecutive years of negative resource revisions seal the end of the great resource expansion of 2009-16...**

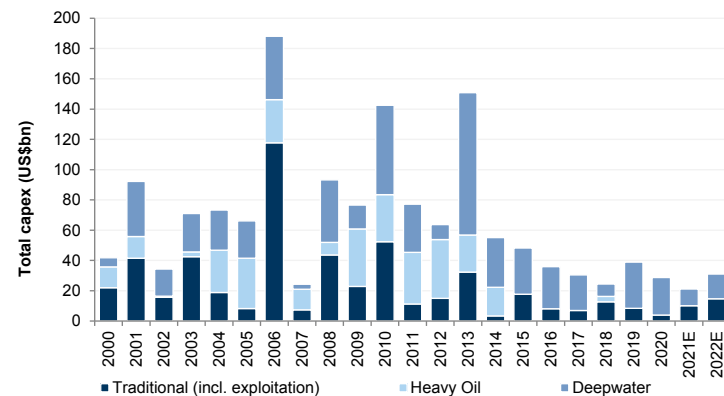
Total liquids reserves discovered/accessed by year, based on Top Projects



Source: Company data, Goldman Sachs Global Investment Research

**Exhibit 23: ...on the back of ongoing oil under-investment in the sector since the 2014 downcycle**

Top Projects capex sanctioned in oil by year, split by winzone



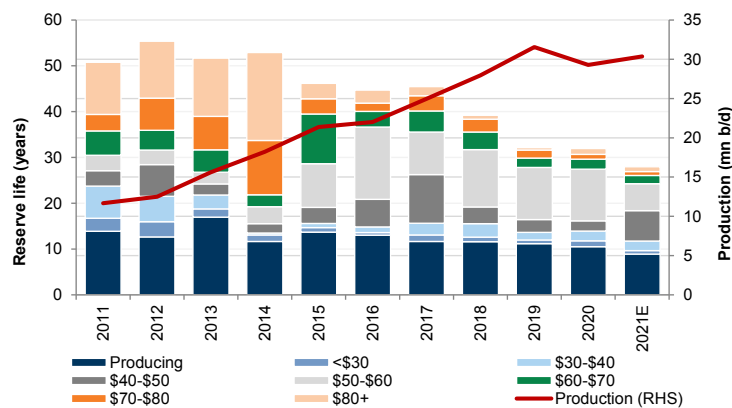
Source: Goldman Sachs Global Investment Research

# Oil resource life has halved since 2014

Under-investment in oil, an increasing focus on returns, de-leveraging, free cash flow, operational efficiency and ongoing capital discipline are taking a toll on oil resource life. According to our analysis, the resource life of Top Projects (recoverable resources/production) halves to c.25 years in 2021E from >50 years in 2014. Yet the economics are much healthier even under lower Brent and gas price assumptions, with >80% of the undeveloped resources profitable at a Brent price <US\$60/bl vs. only 18% in 2014 on our estimates (Exhibit 24). In our view, this is symptomatic of this new 'Age of Restraint', with the market placing low value on undeveloped resources due to a high risk premium and with the value accruing to the companies that can self-finance the development and manage their risk through a large diversified portfolio with benefits of scale. The largest reduction in resource life has been experienced by NOCs and E&Ps, while Big Oils have shown a more consistent pattern over the past decade.

**Exhibit 24: Top Projects oil reserve life has fallen 20 years since 2014...**

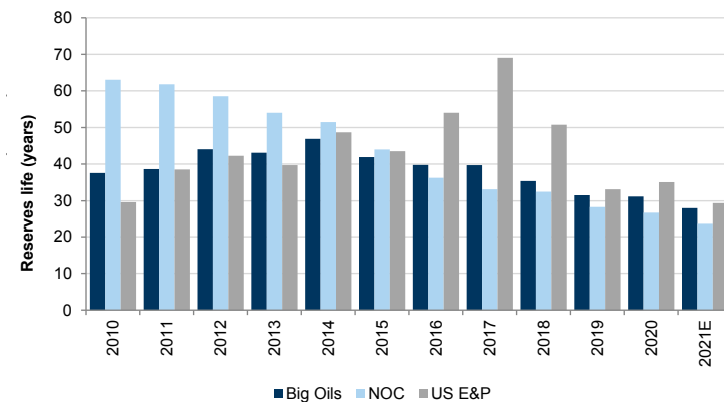
Top Projects reserve life, by year of report and breakeven



Source: Goldman Sachs Global Investment Research

**Exhibit 25: ...driven primarily NOCs and US E&Ps**

Top Projects oil reserve life for Big Oils, NOC and US E&P

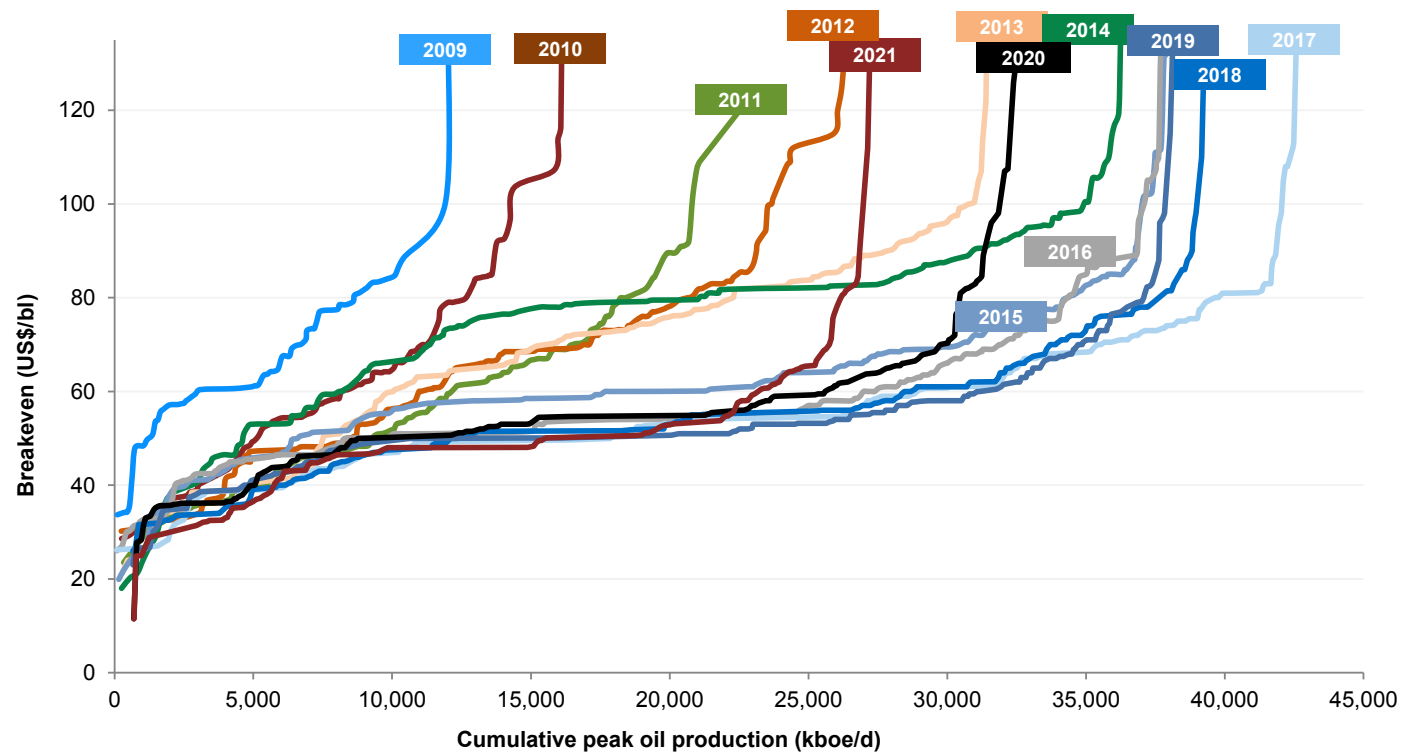


Source: Goldman Sachs Global Investment Research

# The cost curve is shrinking for the fourth consecutive year as we move past the revolutionary phase of resource addition

Following a decade of resource expansion, in this year's edition we model a third consecutive year of resource contraction, driven by limited exploration success, and a fourth year of downward revisions in our shale oil estimates. Cumulative peak production falls c.5 mn bpd in 2021E vs. last year's cost curve, and we estimate cost support at c. US\$48/bl for the average, US\$53/bl for the marginal quartile and US\$65/bl for the marginal decile.

**Exhibit 26: The oil cost curve is shrinking for the fourth consecutive year**  
 Top Projects cost curve of pre-plateau projects through the years

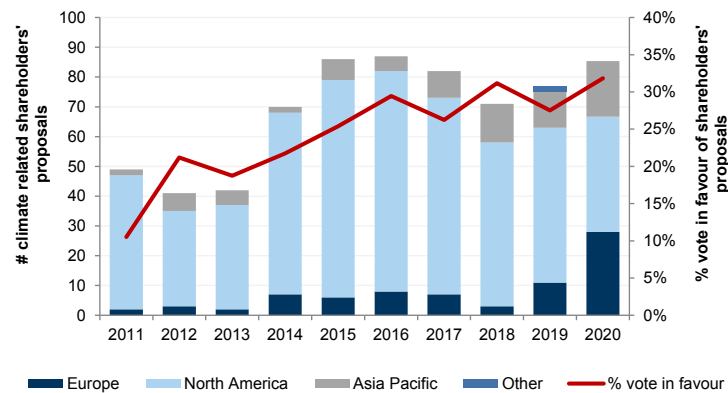


Source: Goldman Sachs Global Investment Research

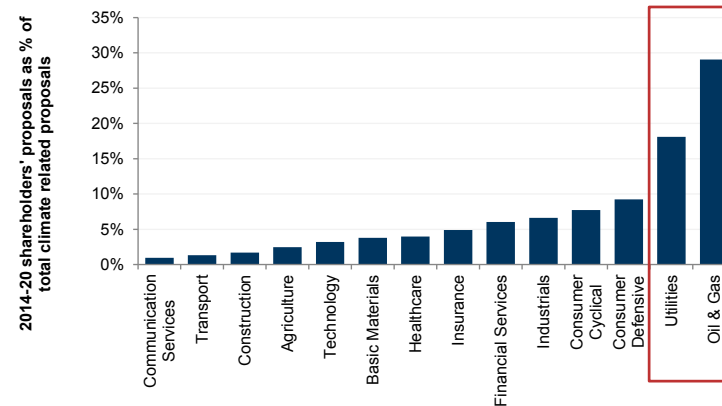
# Under-investment: Climate change is shaping the future of the energy sector, with investors taking an increasingly active role

With CO<sub>2</sub> emissions on a persistently upwards trajectory globally over the past few years, investors are taking a leading role in driving the climate change debate, pushing corporate management of oil & gas producers towards incorporating climate change actions in their business plans and strategy. The number of climate-related shareholder proposals has almost doubled since 2011 and the percentage of shareholders voting in favor has tripled over the same time period. This investor pressure, however, is not evenly distributed across sectors and data indicates a clear bias towards energy producers vs. energy consumers, which in turn is tightening financial conditions for hydrocarbon developments. Data from ProxyInsight shows that c. 50% of climate-related proposals in the past five years have targeted energy producers (oil & gas, utilities) while only 30% targeted the sectors that account for most of the final energy consumption. In particular, transport, agriculture, basic materials and construction accounted for only c.10% of total climate change shareholder proposals, while the focus on utility and oil & gas companies has been the highest and substantially increased over the past few years.

**Exhibit 27: Shareholders are pushing energy companies to embrace the energy transition...**  
Number of climate-related shareholder proposals vs. % vote in favor



**Exhibit 28: ...with the climate-related shareholder proposals having a very targeted focus on the energy industry**  
% of climate-related shareholder proposals split by industry, 2014-20



\* Shareholder resolutions (environmental, energy & social) of companies whose data are included in the ProxyInsight database

Source: ProxyInsight, Goldman Sachs Global Investment Research

Source: ProxyInsight, Goldman Sachs Global Investment Research

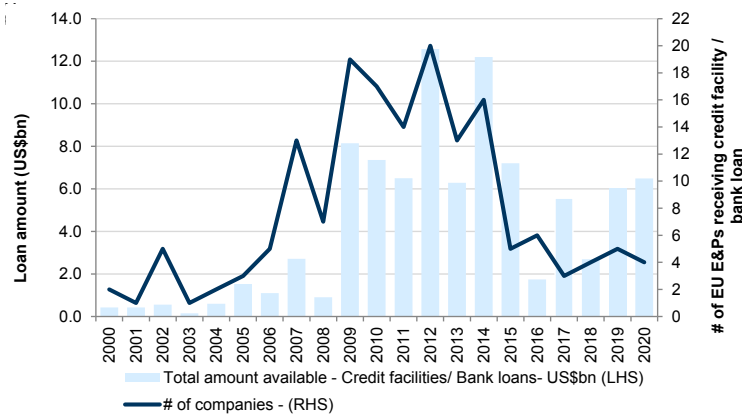


# Tightening financial conditions for all hydrocarbon developments lead us to believe that under-investment is structural in nature

Capital availability has changed materially over the last 10 years, with credit facilities available to international E&Ps and NOCs substantially curtailed following financial institutions reducing their exposure to oil and gas projects with a long lead time. This is evident in both reserve-based lending to E&Ps (2019 and 2020's higher issuance primarily attributable to a few, well capitalized E&Ps such as Lundin) but also in the deceleration of high yield credit issuance of US E&Ps over 2018-19 before a moderate increase in 2020 that still remains well below the issuance of the previous macro commodity downturns. With shrinking funding availability owing to the financial market re-directing financing towards low carbon projects, most companies have stopped developing giant oil & gas projects since 2014. This has allowed only a few to regain industry leadership as concurrently consolidation has unlocked better fiscal terms, cheaper access to undeveloped resources, a more reliable global oil services supply chain and ultimately higher returns.

**Exhibit 29: EU E&Ps relying on credit facilities saw their funding availability shrink materially...**

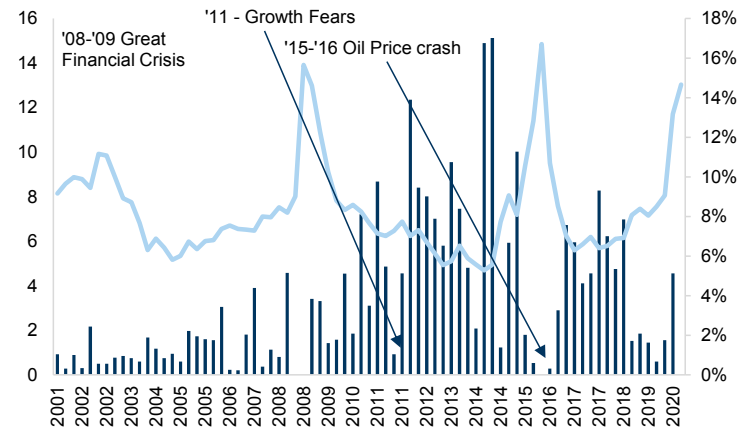
EU E&Ps total amount raised through credit facilities/bank loans, US\$ bn



Source: Bloomberg, Goldman Sachs Global Investment Research

**Exhibit 30: ...and so did US E&Ps in the HY credit market, with issuance increasing in 2020 given the challenging macro conditions yet remaining below the historical average level**

Credit issuance per quarter by HY US E&Ps (LHS US\$ bn) and yield in % (RHS)



Source: Bloomberg, Dealogic, Goldman Sachs Global Investment Research

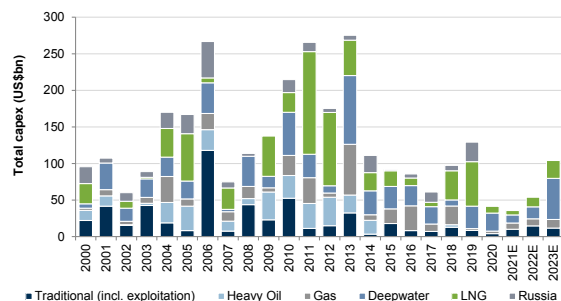
## Final investment decisions (FIDs) for projects have reached historical troughs

Projects sanctions were very low in 2015-17, as falling oil prices pushed NOCs to retrench to their domestic basins and international E&Ps to focus on balance sheet management at a time when Big Oils were busy re-engineering projects for simpler, cheaper solutions while renegotiating tax and regulatory terms with the host countries. In less than three years, the industry moved from 50+ companies taking FIDs globally to <10 companies that continued to sanction projects as operators. Industry consolidation, simpler design and better tax terms have restored profitability with the industry being ready to restart, particularly in LNG and Deepwater, as shown by the peak in FIDs in 2019. The recent (2020) commodity downturn, however, has put an end to the FID re-ignition that started in 2019, with 2020 marking a trough year for project FIDs as shown in [Exhibit 31](#). We expect the pace of FIDs to only moderate increase in 2022 and reach a level closer to normalized in 2023.

[Exhibit 33](#) shows delivered capex sanctioned vs. our initial expectations since 2007. Project FIDs were particularly disappointing in years of sharp oil price corrections (e.g. 2008 and 2014) or extreme cost inflation (e.g. 2007 and 2012). The major years of disappointment were 2007-08, when constraints emerged across most parts of the oil services supply chain, leading to project awards at 37%/65% of our 2007/08 expectations. In contrast, 2015-20 saw a more predictable development, with the pace of sanctions broadly in line with our expectations (c. 100% in 2020).

**Exhibit 31: We expect projects sanctions to remain at historical low levels in 2021 (similar to the abrupt trough in 2020) before returning to normalized levels in 2023...**

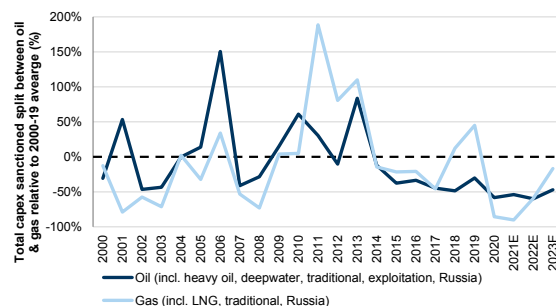
Top Projects capex sanctioned by year, split by winzone



Source: Goldman Sachs Global Investment Research

**Exhibit 32: ...supported by the gradual recovery in gas FIDs, with total oil capex by date of sanction remaining c. 50% below the 2000-19 average**

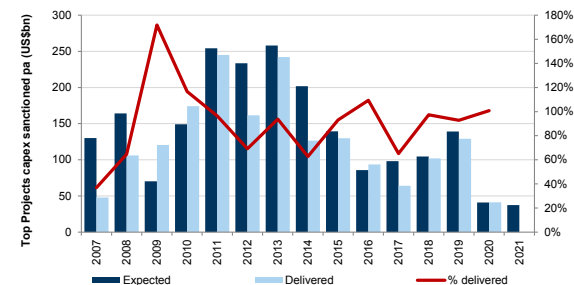
Capex sanctioned (by date of sanction) split between oil & gas relative to the 2000-19 average (%)



Source: Goldman Sachs Global Investment Research

**Exhibit 33: Top Projects capex sanctioned has generally been in line with our expectations since 2015, including our expectation for trough in FIDs in 2020**

Expectations for capex sanctioned by year vs. our estimates (2007-19) and revision of 2020 and 2021E capex (Top Projects 2021 vs. Top Projects 2020)



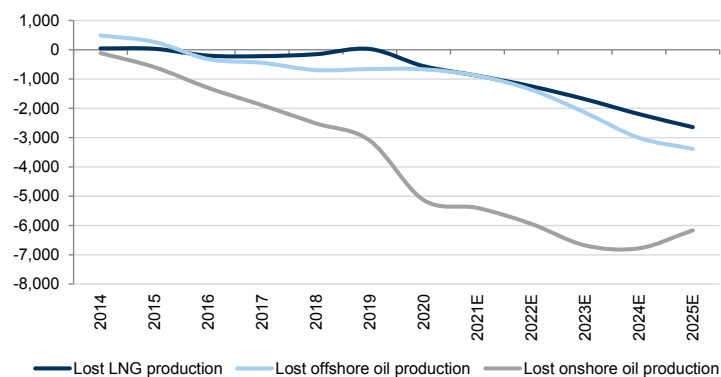
Source: Goldman Sachs Global Investment Research

## FID delays and under-investment bring the end of non-OPEC growth

In [Exhibit 34](#) we show lost oil production in the future owing to FID delays since the beginning of the previous oil price downturn by looking at our current Top Projects oil and LNG production estimates versus our initial expectations in 2014. With falling oil prices since the previous downturn and NOCs/international E&Ps retreating to their domestic basins to focus on balance sheet management, a number of project FIDs have been delayed, translating into 2.6/9.5 mboe/d of lost LNG/oil production in 2024-25, on our estimates. This was exacerbated by the macro commodity downturn in 2020, which came at a time when we had previously expected a catch-up in project FIDs pipeline from the industry and which as such is likely to prolong project sanctions delays for at least another two years on our estimates. This is likely to contribute to a tight market for both oil and LNG in the 2020s, in our view. [Exhibit 35](#) shows that the pace of ramp-up of long-cycle mega project oil production is likely to slow from c.0.8-1.0 mn bl/d in 2017-2019 to 0.1-0.5 mn bl/d from 2021E (including the impact of the return of the shut-ins), implying a fall in non-OPEC ex-US supply in the 2020s after decline rates and excluding the impact of production curtailments.

**Exhibit 34: FID postponements are likely to induce lost oil/LNG production of c.9/2.6 mn boe/d in 2024-25E...**

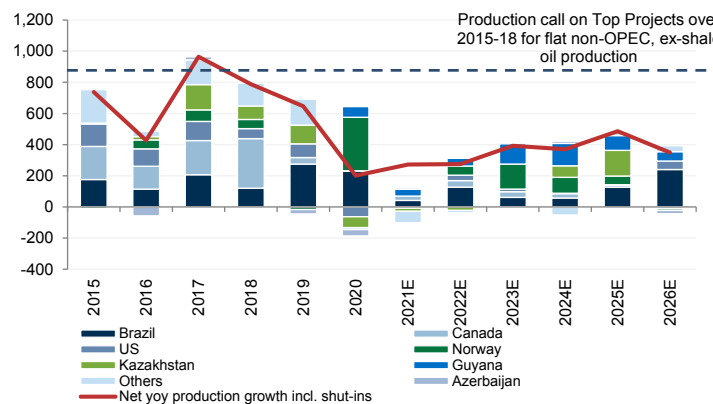
Top Projects lost LNG, offshore and onshore oil production from long-cycle developments in mn boe/d; Top Projects 2021 vs. Top Projects 2014 expectations



Source: Goldman Sachs Global Investment Research

**Exhibit 35: ...leading to the end of non-OPEC (ex-US shale) growth**

YoY oil production growth (kboe/d) from non-OPEC and ex-Russia, excluding shale projects (excluding impact of shut-ins) and net production growth including production shut-ins impact

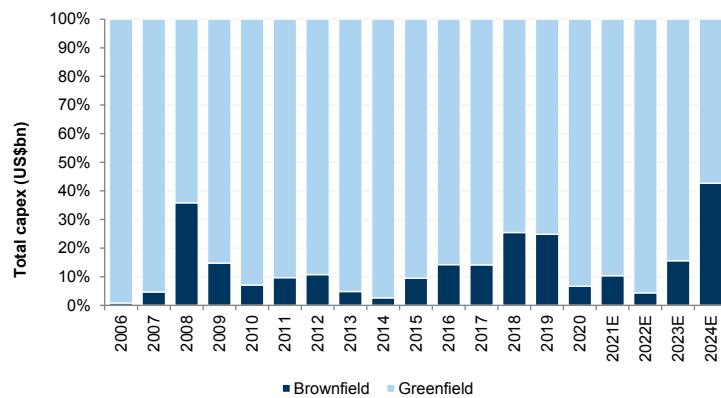


Source: Goldman Sachs Global Investment Research

# Capital efficiency: Brownfield developments gain momentum as the industry targets ‘short-cycle’ offshore resources

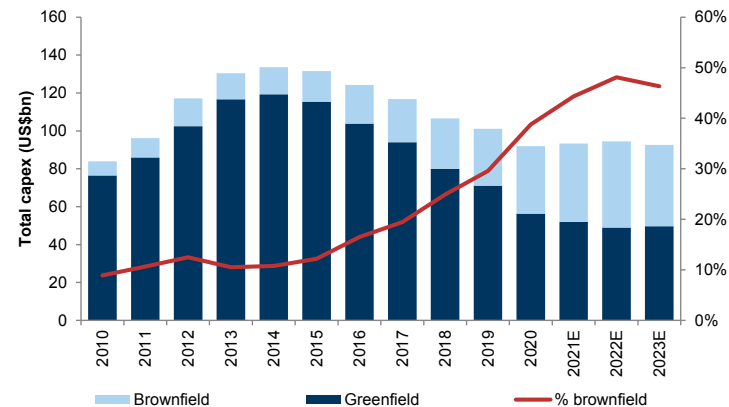
The shale revolution has unlocked billions of barrels of hydrocarbons with a short time to market, drastically changing the industry’s dynamics and resulting in a rapid fall in oil prices. In this new hydrocarbon world, Big Oils shifted their focus to cost discipline and production uptime, re-thinking the way they develop oil and gas projects. Brownfield developments enabled Big Oils to unlock ‘short-cycle’ hydrocarbon resources in their core expertise area, offshore. Our Top Projects analysis shows that brownfield investments continue to take market share vs. greenfield investments, reaching c.50% of total capex by 2022E, on our estimates.

**Exhibit 36: We expect the proportion of brownfield FID capex to increase over the coming years with an increasing number of tie-backs being sanctioned in oil**  
 FID capex by year of sanction for oil developments (excludes shale)



Source: Goldman Sachs Global Investment Research

**Exhibit 37: We expect the share of brownfield capex in total capex spent on oil projects to rise to c.50% by 2022E**  
 Brownfield and greenfield total oil capex, excl. unconventional (US\$ bn)



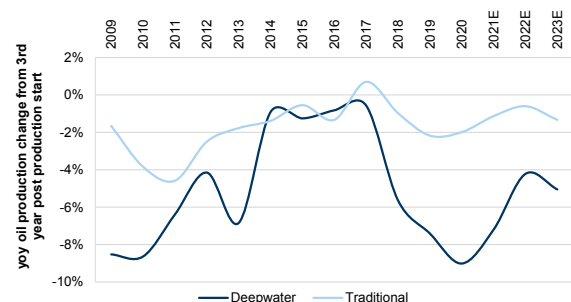
Source: Goldman Sachs Global Investment Research

## Brownfield developments help unlock incremental value for existing infrastructure

Over the past years with the rise of brownfield developments, producers have found ways to unlock incremental value from existing infrastructure through greater access in additional reserves in the absence of the need for substantial incremental capex. Effectively, as greenfield investments get rationed, brownfield investments get more profitable as incremental value is extracted from existing fields and infrastructures, resulting in longer field lives and lower overall field declines in traditional oil and deepwater developments. This is shown in [Exhibit 38](#), with yoy change in oil production for fields post the third year of production on the order of -4% and -9% for traditional and deepwater, respectively, with the strict capital discipline in 2020 having its own impact on accelerated declines. We note that the total capex per flowing barrel sanctioned has now reached the trough level of early 2000s, as shown in [Exhibit 39](#). Nonetheless, we see this improving over time to c.-1% and -2%, respectively, for traditional and brownfield, by 2023 on our estimates as brownfield developments become the preferred choice for a number of assets.

**Exhibit 38: Producers are extracting more value from existing fields, utilizing existing infrastructure through brownfield developments albeit ongoing capital discipline and cost reduction are evident in the accelerated declines in 2020...**

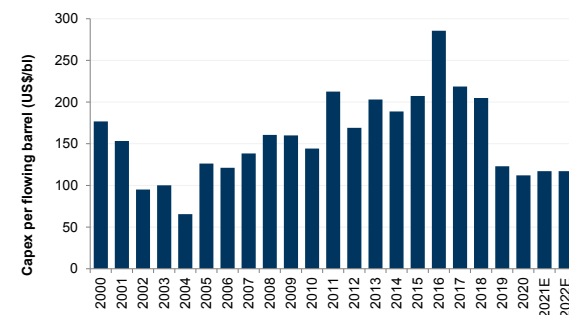
YoY oil production change from 3rd year post production start of Top Projects fields



Source: Goldman Sachs Global Investment Research

**Exhibit 39: ...with the capex per flowing barrel sanctioned having reached the trough levels of the early 2000s...**

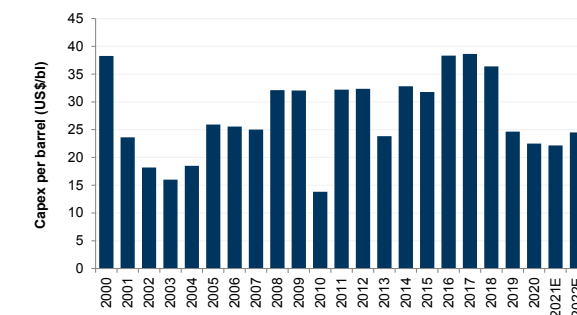
Capex per flowing barrel per year of project FID (US\$/bl)



Source: Goldman Sachs Global Investment Research

**Exhibit 40: ...and the capex per barrel of reserves sanctioned having fallen by c.40% from peak**

Capex per barrel reserves sanctioned per year of FID (US\$/bl)



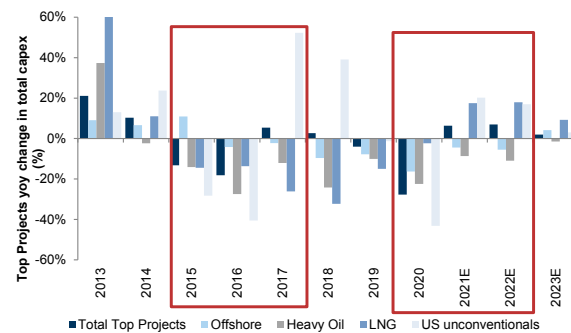
Source: Goldman Sachs Global Investment Research

# Capital expenditure flexibility and cost repositioning

Similar to previous macro commodity downturns, the current challenging macro environment is re-enforcing capital discipline across the industry, with FID postponements and capital expenditure reductions. We expect 2021 to be another year of very low capex levels for the industry. Our Top Projects analysis suggests that aggregate capex in 2020 has fallen by c.30% as all major components of spend moved lower. This compares to a reduction of c.13%/18% in 2015/2016, respectively, during the previous commodity downcycle, and a more abrupt change as the industry reacted quicker to rebase capex levels lower. In 2021 we anticipate the overall level of Top Projects capex to increase by c.6% yoy, yet to remain well below the historical and normalized levels (-23% vs 2019); looking into 2022 we see LNG and US shale as the two areas of possible capex increases. For LNG this is primarily owing to already committed capex that is largely spent and ramping up on LNG projects sanctioned over the past 2-3 years, many of which faced delays during the 2020 downturn. For US shale, while we do expect activity to increase, we do not expect the same magnitude of capital expenditure and activity that we saw during the recovery post the previous macro commodity downcycle. Overall, we note that the industry responded much quicker with more abrupt capex cuts announced in this downturn compared to previous downturns, and we expect this downcycle to bring a new age of capital discipline and rebasing of industry costs lower, likely to set a new lower capex base that is here to stay for years to come.

**Exhibit 41: We saw a c.30% reduction in Top Projects capex in 2020, a more abrupt and quick response to the current macro commodity downturn compared to previous downcycles...**

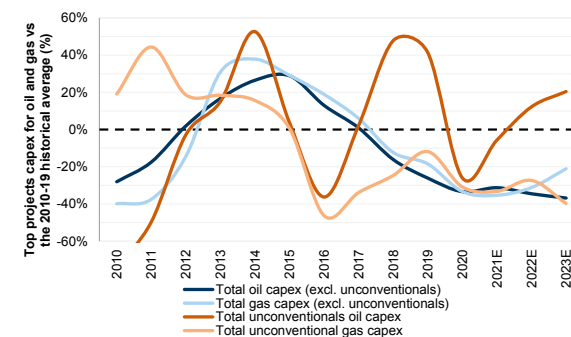
Top Projects yoy change in total capex (%)



Source: Goldman Sachs Global Investment Research

**Exhibit 42: ...and we expect that this new age of capital discipline that started in 2020 to persist for years to come...**

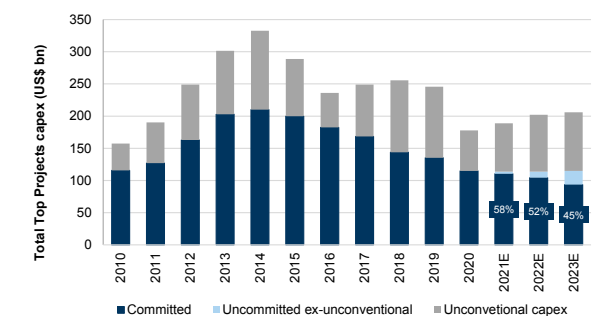
Total Top Projects capex for oil & gas compared to the 2010-19 historical average (%)



Source: Goldman Sachs Global Investment Research

**Exhibit 43: ...with a structurally lower capex base**

Total Top Projects split between committed and uncommitted capex (US\$ bn)



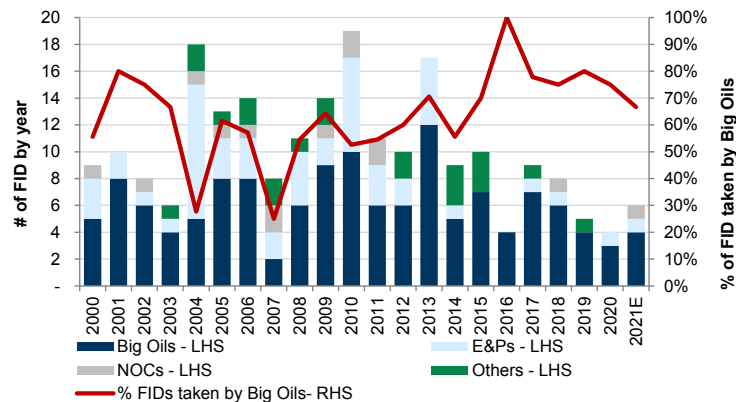
Source: Goldman Sachs Global Investment Research

## The Era of Consolidation: The structure of the industry improves as it consolidates

Rising oil prices and a market perception of long-term supply shortages enabled 50 different operators to receive financing to take mega-project Final Investment Decisions (FIDs) in 2003-13, including NOCs operating outside of their home basins for the first time, independent E&Ps, utilities and other conglomerates. The consequences were significant supply chain issues, rising tax rates and a 10% compounded cost inflation over the decade. In 2014, the industry structure started to rationalize into a more concentrated one on the back of falling oil prices. Seven companies (the ‘Seven Sisters’) emerged as structural winners, continuing to sanction projects consistently through 2014-20, and we believe that tighter financial conditions for new hydrocarbon developments will keep the barriers to entry high, even though profitability has once again become very attractive. Exhibit 45 shows that the Herfindahl Index of market consolidation on FIDs increased from 10%-20% in 2010-14 to 40-60% in 2018-20, by our calculation, consistent with levels that could be considered an oligopoly. The Herfindahl Index is a measure of market concentration (calculated by squaring the market share of each of the companies in the industry and then summing the resulting numbers).

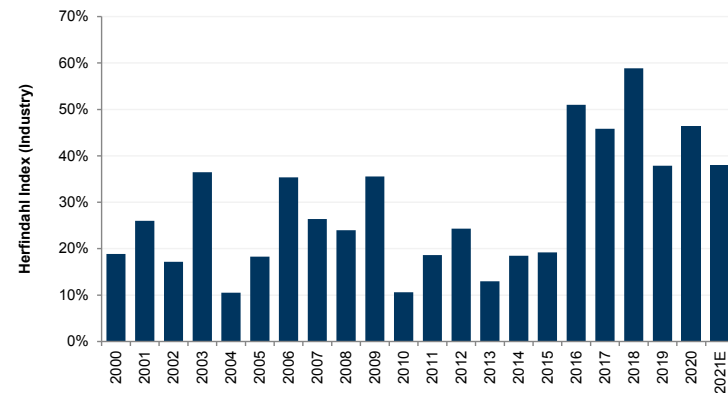
**Exhibit 44: The industry continues to consolidate, with >60%+ of FIDs in the hands of Big Oils...**

FIDs by year; excludes NOC FIDs in their home basin



Source: Company data, Goldman Sachs Global Investment Research

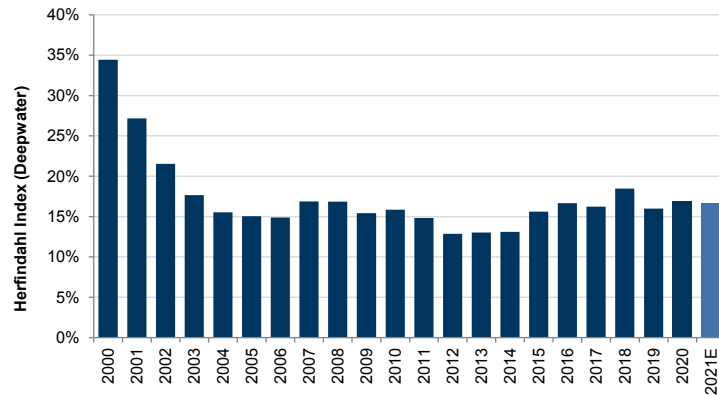
**Exhibit 45: ...with the most consolidated market structure in 20 years**  
Herfindahl Index, Top Projects capex by operator at time of FID, ex-Russia



Source: Company data, Goldman Sachs Global Investment Research

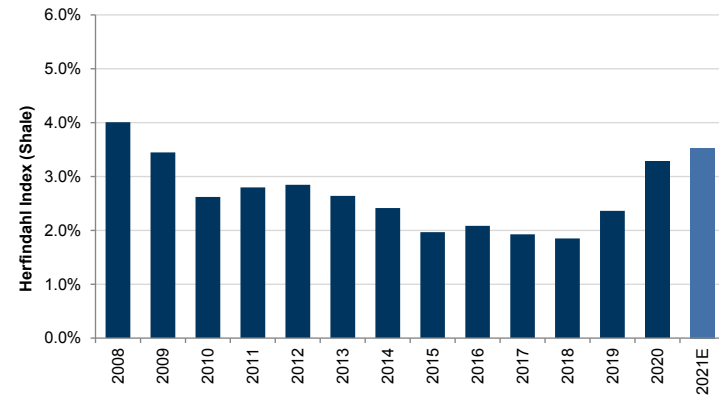
# Consolidation has started to transform the sector even in shale, the most fragmented market

**Exhibit 46: Deepwater has always been a consolidated sector dominated by Big Oils...**  
 Herfindahl Index, Top Projects capex by year for Deepwater



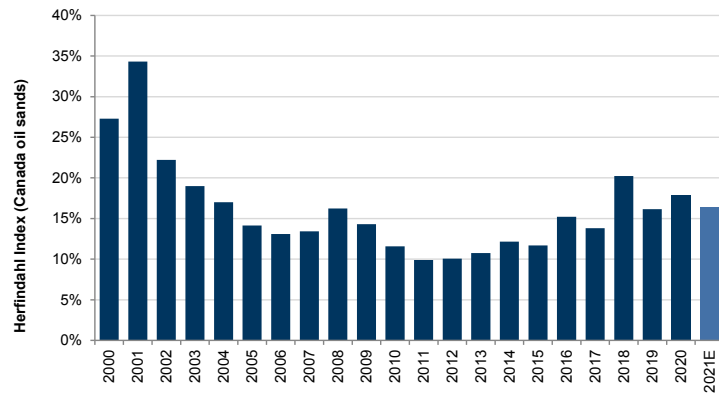
Source: Company data, Goldman Sachs Global Investment Research

**Exhibit 47: ...while consolidation in US shale has started following large acquisition announcements**  
 Herfindahl Index, Top Projects capex by year for US shale oil



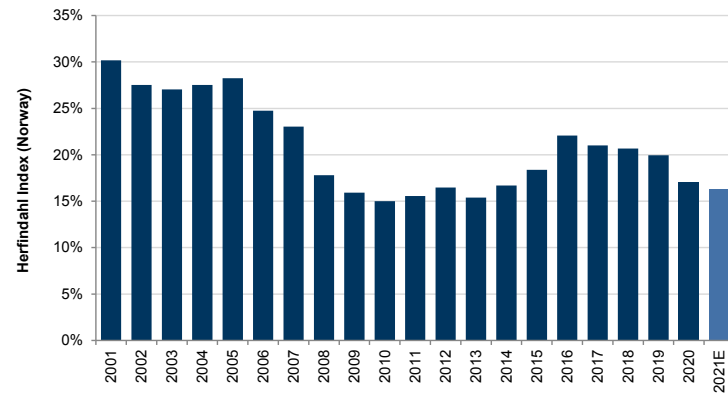
Source: Company data, Goldman Sachs Global Investment Research

**Exhibit 48: Consolidation looks to have also peaked in the Canadian oil sands...**  
 Herfindahl Index, Top Projects capex by year for Canada oil sands



Source: Company data, Goldman Sachs Global Investment Research

**Exhibit 49: ...and in Norway**  
 Herfindahl Index, Top Projects capex by year for Norway



Source: Company data, Goldman Sachs Global Investment Research



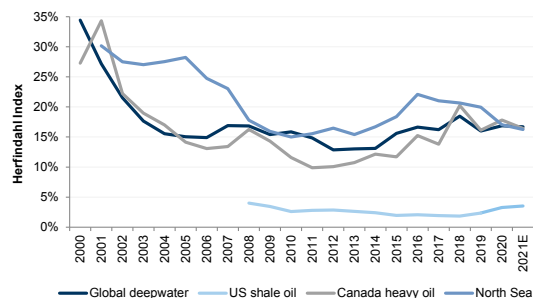
# Shale: The last key oil producing market at the onset of consolidation

Consolidation has already been well underway across most key winzones and regions, but notably in 2020 we saw the beginning of a major consolidation phase in US shale, the key large producing geographical area where consolidation had not been previously evident. The four charts above present the Herfindahl Index across different regions and winzones with consolidation already having reached the high levels of the early 2000s in 2019-2020 in global Deepwater and looks to have peaked in Norway and in the Canadian oil sands. US shale remains the one key producing region characterized by excessive fragmentation (Herfindahl index <4%). As we highlighted in our report *Top Projects: The Era of Consolidation*, announced transactions in the past year led to a doubling in US shale oil's HH index of market concentration on 2021E vs 2019, and in our view could herald the start of a long journey to market and returns repair in this last bastion of fragmentation.

Whilst shale retains option value for cyclical upturns and could use this downcycle to improve, it is the only development area that has not seen a cost improvement in the last three years and needs to catch up. Consolidation will be a key driver of cost restructuring, in our view. We believe the lower commodity price environment in onshore US (WTI) during 2020 has served as a catalyst for a new consolidation phase that is necessary to bring a fragmented industry into a more rational and sustainable state. In our view, it is this fragmentation and largely scattered, non-contiguous shale acreage that had been preventing the industry under the current market structure from moving into its next phase of growth moderation, free cash flow generation and deflation through efficient logistics management, infrastructure layout, Big Data and advanced analytics.

**Exhibit 50: US shale oil is the last major basin with inefficient, fragmented ownership with consolidation notably increasing in 2020-21...**

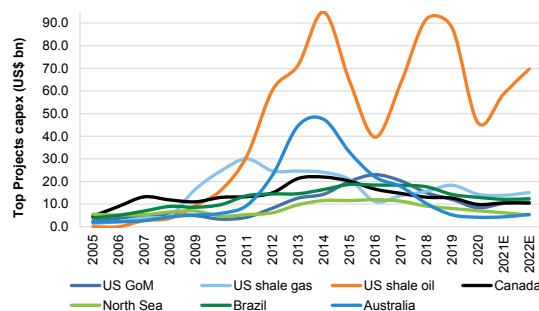
Herfindahl index for key oil producing winzones over time (%)



Source: Goldman Sachs Global Investment Research

**Exhibit 51: ...which could rationalize the excessive investment that had historically fostered boom-bust cycles...**

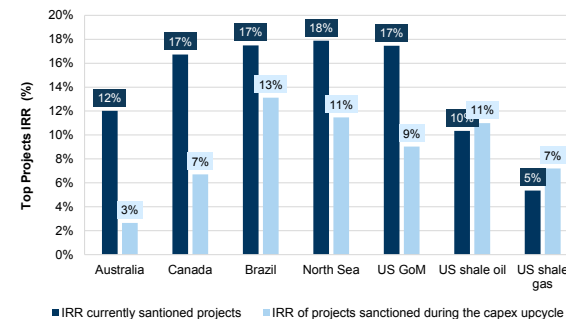
Top Projects total capex spent by year for key producing regions (US\$ bn)



Source: Goldman Sachs Global Investment Research

**Exhibit 52: ...and sub-cost of capital returns, while the rest of the sector starts to benefit from renewed capital discipline**

Top Projects IRR by year of sanction; currently sanctioned projects vs. the years of the previous capex upcycle for each winzone



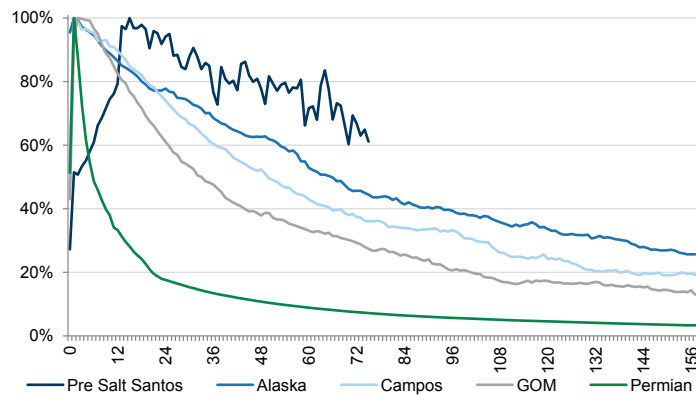
Source: Goldman Sachs Global Investment Research

## Shale: Smaller but perhaps better; continues to set the price for front end of the curve

The geology of shale, with high initial well productivity and rapid decline rates (70% declines in year 1 are not uncommon, as shown in [Exhibit 53](#)), provides different growth and decline rate characteristics vs. conventional reservoirs. Growth can be very rapid in the early years of a basin, but as the production base becomes larger, so do decline rates, especially following a couple of years of very intensive developments when a large part of the production base is made up of high-decline wells in their first 1-2 years of life. Effectively, as shale rapidly increases its global market share, higher activity will be needed to maintain flat production - the shale treadmill is accelerating. In contrast, offshore wells have meaningfully lower decline rates (as well as greater initial rates of production). The pre-salt Santos basin in Brazil displays the most attractive production profile, in our view, with a slow decline; by year 6, production has fallen by only 40% from peak versus >90% for wells in the Permian. The shale deceleration observed in 2020 is a result of lower activity and steep declines, and we expect the latter to make incremental growth harder to achieve in 2021, with moderate yoy growth from 2022. We show our shale growth expectations in [Exhibit 54](#).

**Exhibit 53: Shale has a very steep rate of decline compared to offshore...**

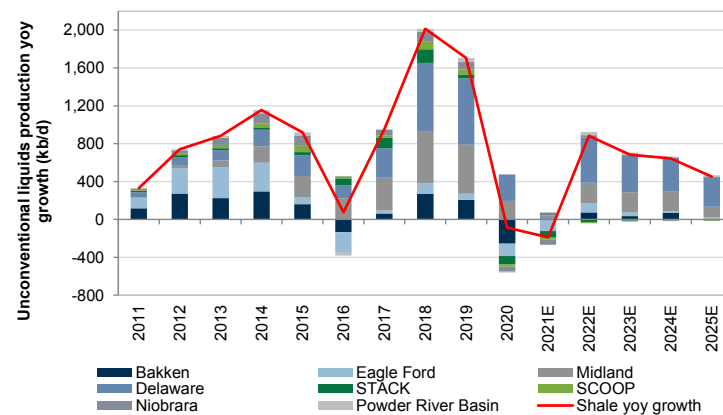
Decline rates seen in 5 basins with peak production rebased to 100%, by month of well life



Source: ANP, Alaska DoE, BOEM, Goldman Sachs Global Investment Research

**Exhibit 54: ...resulting in deep declines in 2020-21E and the return to moderate growth from 2022E onwards**

Unconventional liquids production change yoy (kbp/d)



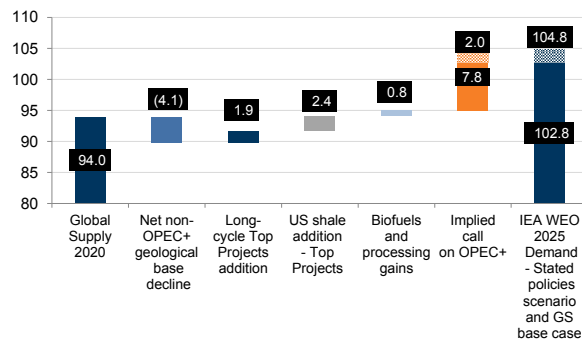
Source: Goldman Sachs Global Investment Research

# OPEC: As in the 1990s, we see OPEC structurally gaining market share in coming years

Looking out to 2025, we believe there will be a material slowdown in non-OPEC growth driven both by a thinner pipeline of mega-project deliveries and a slowing pace of US shale growth (on the back of a higher decline from a larger production base), as discussed in the previous sections. This will lead, on our estimates, to a significant call on OPEC. We believe that the current market structure resembles the one in the 1990s for oil, when c.7 years after the peak in oil prices of 1980s, OPEC had emerged as a key market share winner. We expect a similar trend in the 2020s, c.7 years after the oil price peak in 2013-14. Assuming demand growth consistent with IEA's Stated Policies Scenario (102.8 mn bpd in 2025, WEO 2020), the call on OPEC could be as large as 7.8 mn b/d over 2020-25E, we estimate. Using instead our GS base case scenario, we estimate that the **call on OPEC can be as large as 9.8 mn b/d by 2025E**. This would concentrate the call on the Persian Gulf members, also allowing room for a potential return of currently disrupted volumes in Venezuela and Iran. Should demand on the other hand follow the Sustainable Development Scenario as laid out by the IEA and in line with a <2 degrees Celsius scenario of global warming, the call on OPEC could be 1.9 mn b/d over 2020-25E. For our base case, we believe that the **call on OPEC could therefore vary between these three demand scenarios** (GS, IEA State Policies and Sustainable Development scenarios), **from 1.9 to 9.8 mn bpd for 2020-25E**. In [Exhibit 56](#) we show how the OPEC + Russia spare capacity could go from >9 mn bpd in 2020 to close to zero by 2025E. This analysis assumes a flat inventory path going forward.

**Exhibit 55: Depending on the path of oil demand to 2025E, the call on OPEC could be as big as c.8 mnbls pd (2020-25E) under the IEA's Stated Policies Scenario...**

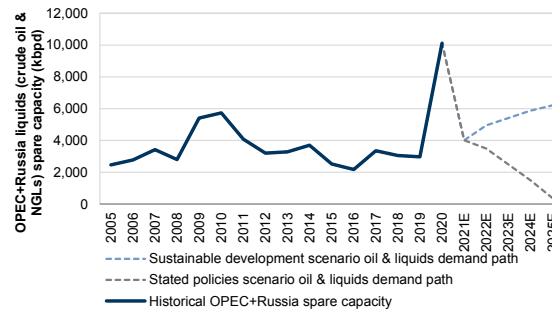
Key drivers of supply growth from 2020 to 2025E



Source: IEA WEO, Goldman Sachs Global Investment Research

**Exhibit 56: ...while OPEC + Russia spare capacity could go from >9 mnblpd in 2020 to close to zero depending on the demand path**

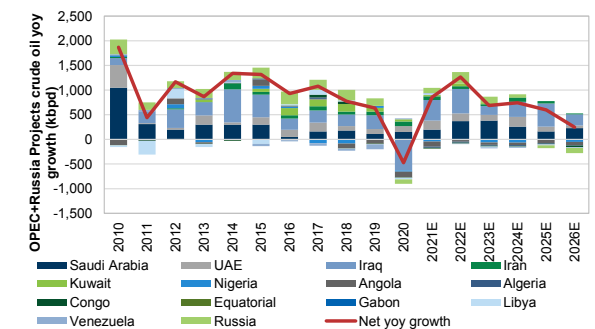
OPEC + Russia liquids (crude and NGLs) spare capacity under different demand scenarios



Source: IEA WEO 2020, Goldman Sachs Global Investment Research

**Exhibit 57: OPEC oil capacity growth investments are also decelerating**

Top Projects yoy oil production growth for OPEC + Russia



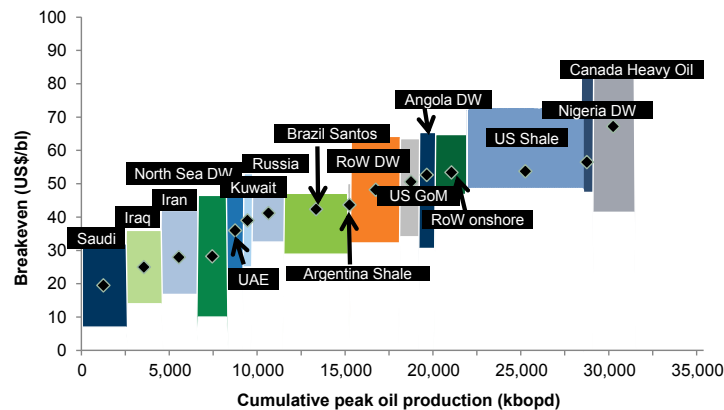
Source: IEA, Goldman Sachs Global Investment Research

# While OPEC remains the low-cost E&P producer, it has lost its cash breakeven leadership

OPEC has historically been the traditional low-cost producer, with new projects in Saudi Arabia, Iraq and Iran breaking even at prices as low as <\$20/bl on an E&P basis. [Exhibit 58](#) shows that the GCC countries have the lowest breakevens in the industry. Nonetheless, while on an E&P basis OPEC’s breakevens are the lowest in the industry, the countries’ budget breakevens are now among the highest in the industry, reversing the competitive advantage of 2010-14. As seen in [Exhibit 59](#), OPEC on aggregate requires c. \$80/bl to balance its budget in 2020, US\$30-40/bl higher than the integrated international Big oils (calculated on the basis of the oil price required to cover capex and dividend commitments, as opposed to balancing national budgets for OPEC countries). In this respect, OPEC’s relative position has deteriorated over the past few years: in 2010-14, OPEC had both the lowest E&P and the lowest cash breakevens in the industry, with a US\$10-40/bl advantage vs. the listed players in the industry.

**Exhibit 58: OPEC Gulf members occupy the lower end of the global oil cost curve...**

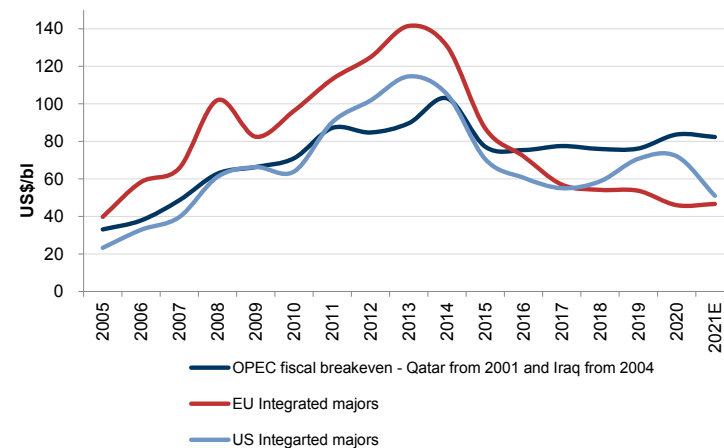
Oil breakeven price for pre-plateau and pre-sanctioned projects (US\$/bl) vs. cumulative peak oil production (kblpd)



Source: Goldman Sachs Global Investment Research

**Exhibit 59: OPEC has lost its advantage at the fiscal breakeven point**

OPEC fiscal breakeven vs. Brent and Big Oils corporate breakevens through time



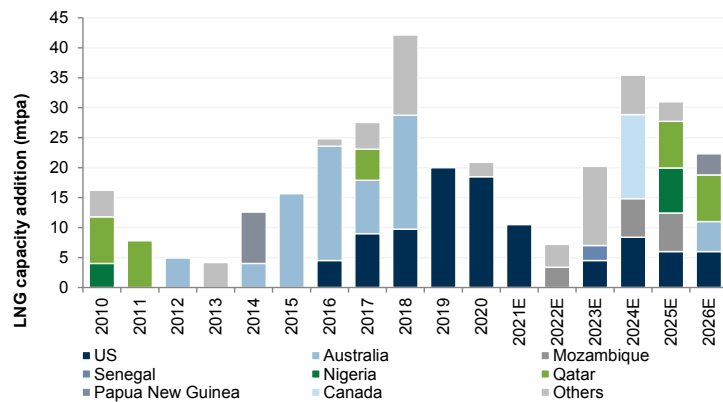
Source: IMF, EIA, Company data, Goldman Sachs Global Investment Research

# Global gas rebalancing: The LNG market looks more constructive in 2021-24E thanks to FID postponements

Our analysis suggests that the lack of LNG investments in 2014-17 and the persistent delays in project sanctions will lead to a more constructive LNG market environment in the early 2020s (2021-24E) with LNG production growth slowing materially, from over c.40 Mtpa in 2019 to c.10-20 Mtpa in 2021-24E, leaving a potential LNG supply gap before the next wave of LNG projects comes onstream in 2025E. Delayed project sanctions in 2020-21E and the observed normalization of Henry Hub are also creating a better LNG market post 2024E, with a bigger role for Qatar and the majors and a smaller role for US LNG exports.

**Exhibit 60: 2020 was the last year of material capacity additions as we reached the final phase of projects sanctioned in 2011-14 coming onstream; 2021-23E should be years of notable deceleration in capacity additions...**

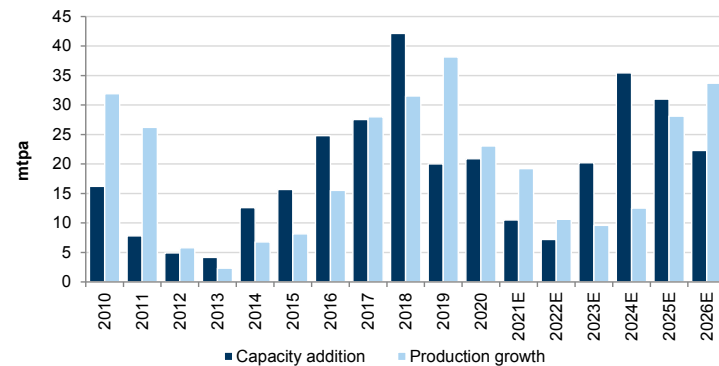
LNG volume additions in mtpa by development status



Source: Goldman Sachs Global Investment Research

**Exhibit 61: ...with slowing production growth in 2021-24E**

Annual increase in LNG production/capacity in mtpa



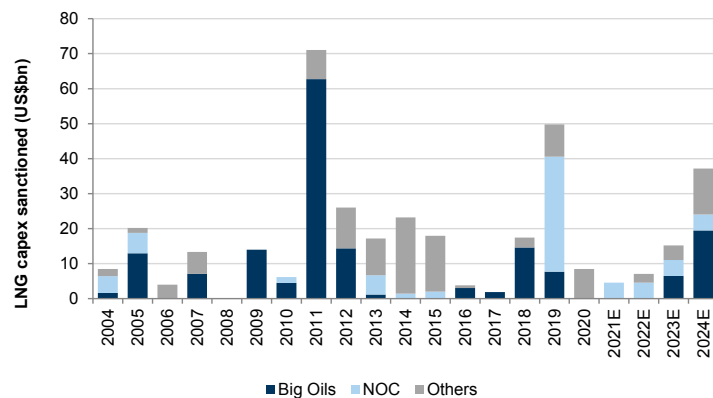
Source: Goldman Sachs Global Investment Research

## LNG project FIDs come to a pause in 2020-23E while costs are down to 2010 levels

Following successful Qatari LNG mega-projects, 2010-15 saw a boom in LNG sanctioning. Australian players sanctioned c.65 mtpa of LNG capacity in 2009-14, while the US saw c.67 mtpa sanctioned (2012-15). After a number of delays and cost overruns, these mega-projects have now been delivered and are ramping up, translating into strong capacity additions and production growth through 2020.

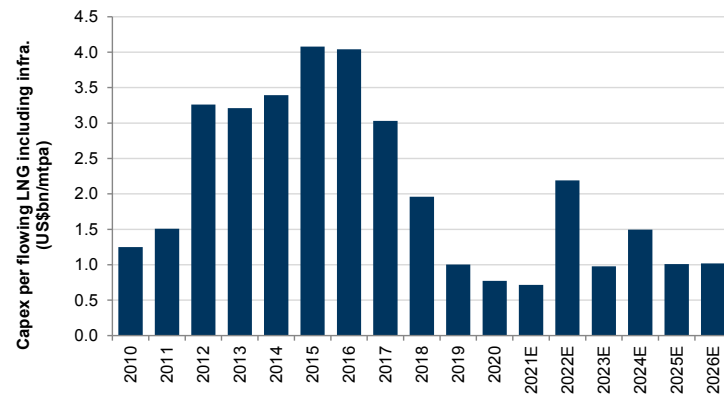
Exhibit 63 shows the total capex per flowing LNG output (US\$ bn per mtpa), leveraging our Top Projects database. We expect the coming wave of LNG projects to deliver output at a very competitive cost (c.US\$1 bn per mtpa), down materially from the peak in 2015-16 (c.US\$4-5 bn per mtpa) when project operators were hit by an overheated supply chain and cost overruns owing to delays.

**Exhibit 62: 2021-23E is likely to see a material reduction in LNG capex sanctioned as more project FIDs get delayed in the current macro commodity environment...**  
LNG capex sanctioned (US\$ bn)



Source: Goldman Sachs Global Investment Research

**Exhibit 63: ...with the new wave of LNG projects coming at a very competitive cost relative to history**  
Top Projects capex per flowing LNG output, US\$ bn per mtpa

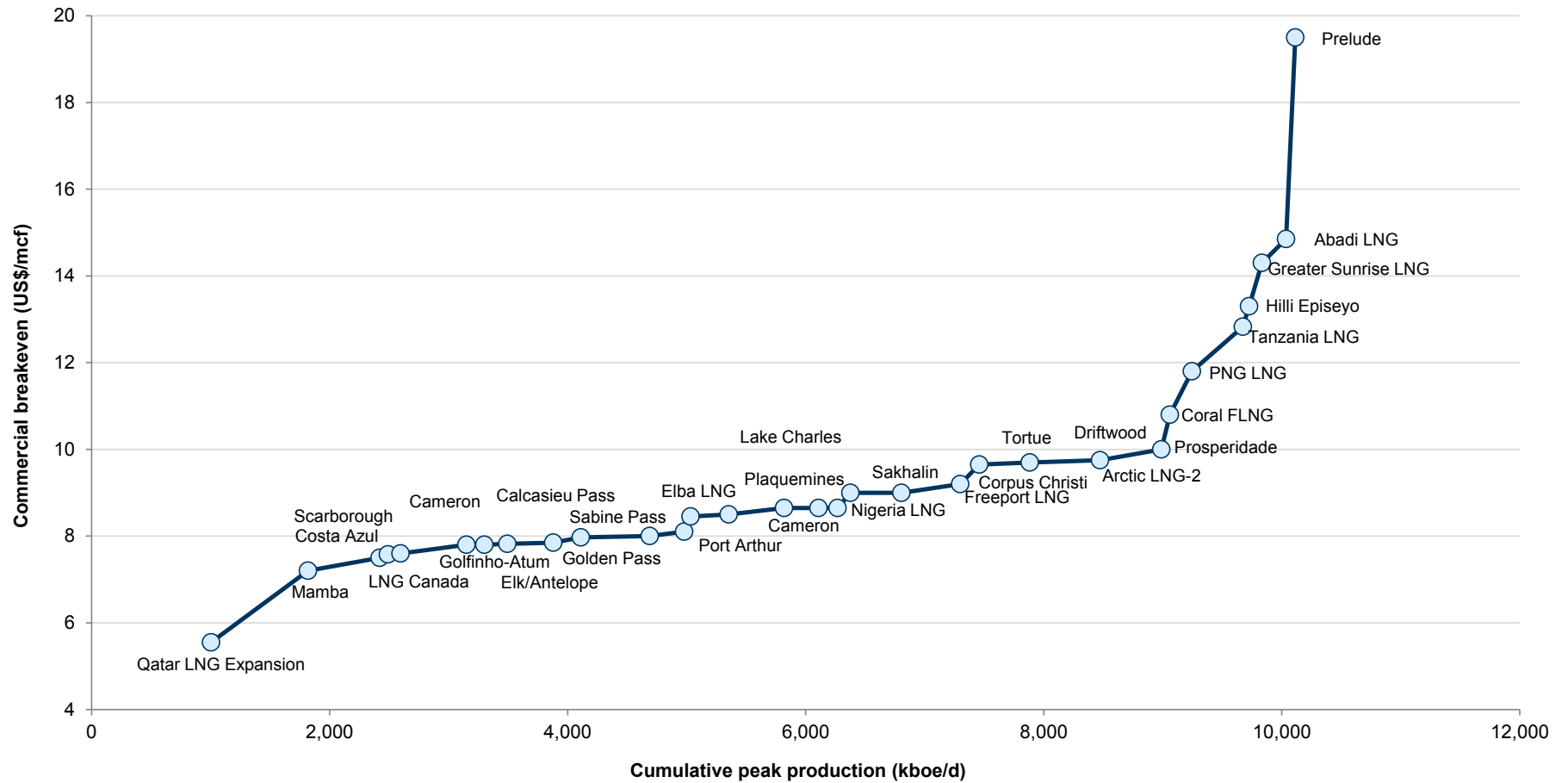


Source: Goldman Sachs Global Investment Research

# The LNG cost curve shows long-term cost support at US\$8-9/mcf Asian gas price

**Exhibit 64: The LNG cost curve shows that most pre-FID projects meet their hurdle rates at US\$8-9/mcf**

Top Projects 2021 LNG cost curve (pre-plateau), excluding "stranded" assets



Source: Goldman Sachs Global Investment Research

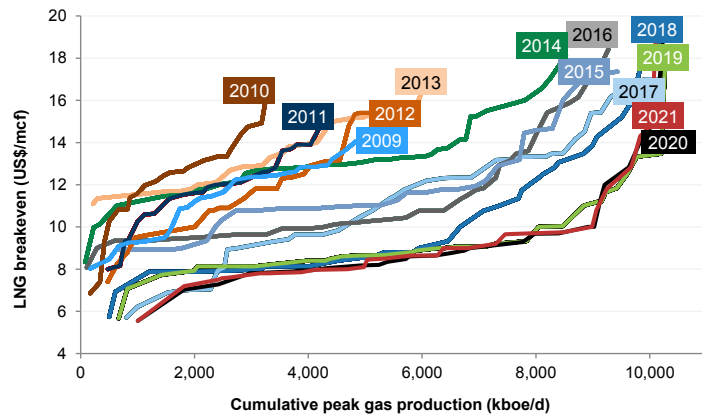
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# The LNG cost curve has moved lower since the 2014 peak

While the substantial increase in project FIDs in 2010-14 had a detrimental impact on the cost dynamics for the industry, we note that the current LNG cost curve is the flattest we have seen in a decade. Our LNG cost curve currently shows support at US\$8-9/mcf delivered Asian gas prices, the gas price required for those projects to meet their hurdle rates vs. a US\$12-14/mcf Asian gas price in 2014, when the previous commodity price downcycle started. We highlight the improvement in resilience and cost positioning of LNG projects over the past five years. Across regions, Qatar, Canada, Mozambique and the US seem to occupy the lower end of the cost curve, yet the whole curve has moved notably lower across all regions.

**Exhibit 65: The LNG cost curve has shown notable repositioning since the previous downcycle and is currently the flattest we have seen in the past decade...**

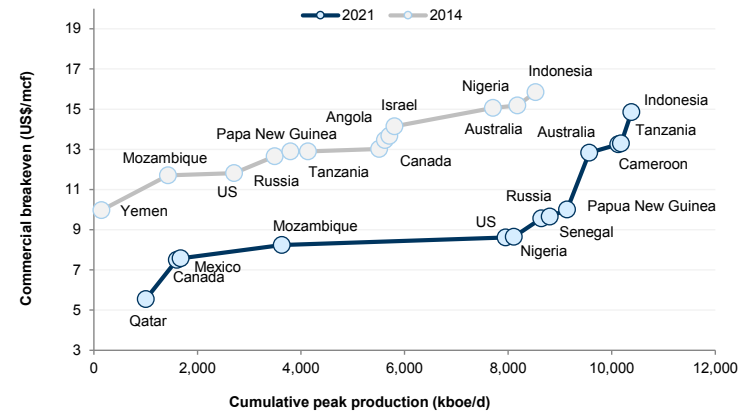
Top Projects 2021 LNG cost curve (pre-plateau), excluding "stranded" assets



Source: Goldman Sachs Global Investment Research

**Exhibit 66: ...with Qatar, Canada and the US among others contributing to the notable cost rebasing**

LNG cost curve by region in Top Projects 2021 vs. 2014



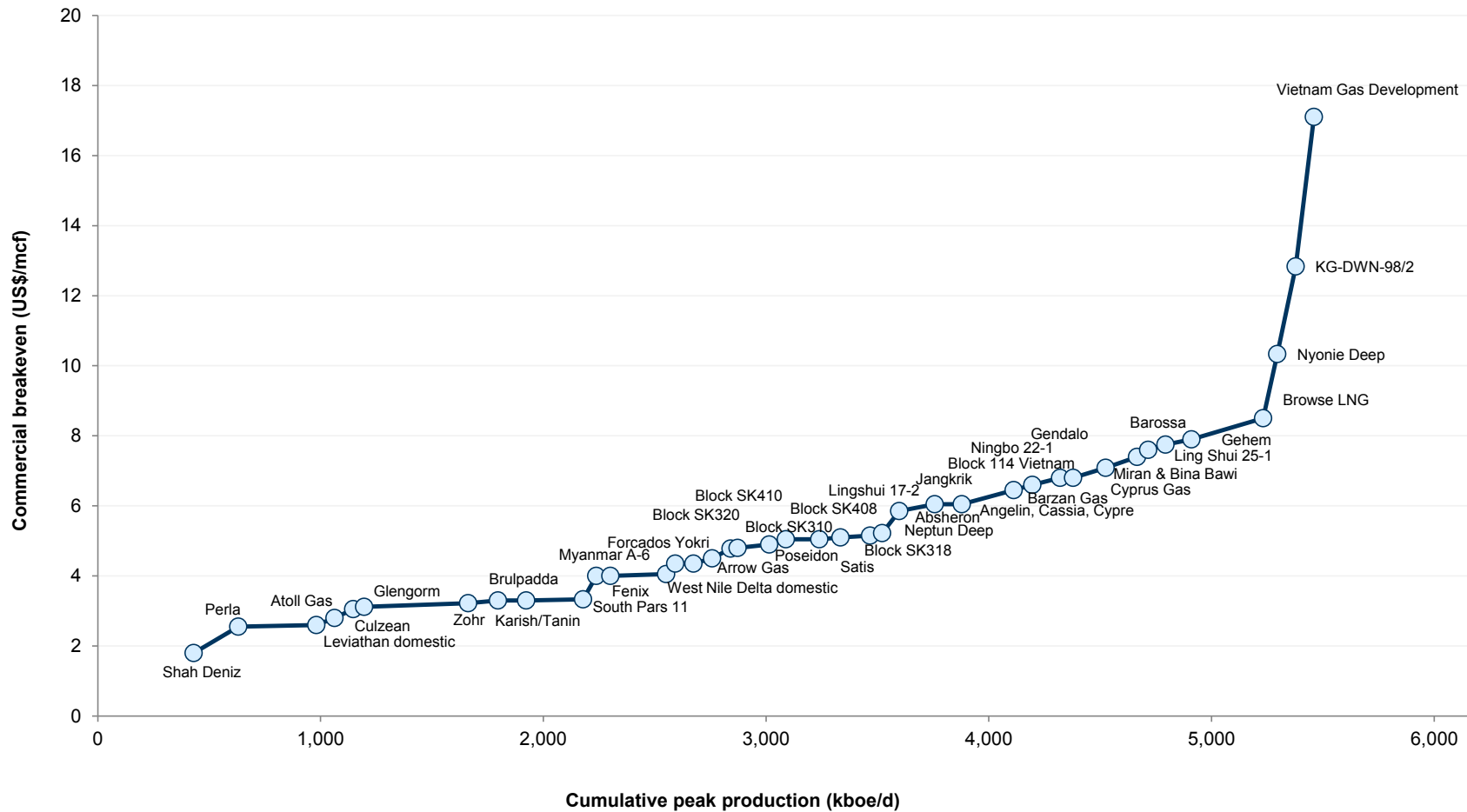
Source: Goldman Sachs Global Investment Research



# Gas cost curve - steep cost curve reflecting regional dynamics

## Exhibit 67: Gas cost curve

Top Projects 2021 gas cost curve (pre-plateau), excluding shale



Source: Goldman Sachs Global Investment Research

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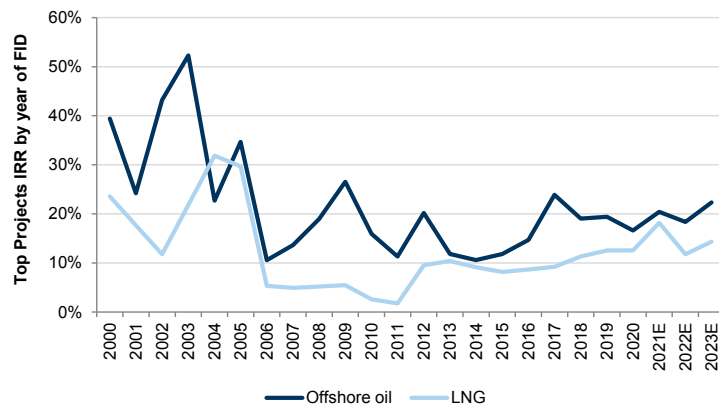
# Long-term returns: from 8%-12% IRR in the 2006-16 Age of Expansion to 15%-25% in the Age of Restraint (since 2017)

The improvement in market structure, together with tighter financing conditions and improved negotiating positions with host governments, are leading to a material uptick in the profitability of new projects. As Exhibit 68 shows, Project IRR troughed in 2006-16 at 8%-12% on the back of excessive competition. This level of project IRR led Big Oils' overall ROACE (including overhead costs) to fall to single digits. We estimate that the FIDs taken (mainly by Big Oils) from 2017 to 2021E will instead yield a profitability more consistent with what the industry saw in the 1990s: 15%-25% average project IRR, which should be consistent with ROACE recovering to low-mid teens by 2025.

Exhibit 68 shows that Deepwater is enjoying the strongest recovery in profitability, with up to c.20-25% IRR for recent project sanctions, while LNG is recovering to a 10%-15% IRR from a trough of mid-single-digit in 2007-11. Both these types of projects are currently dominated by Big Oils as consolidation in the sector continues.

**Exhibit 68: Profitability has returned to mid-2000 levels, with offshore oil projects' profitability >20%...**

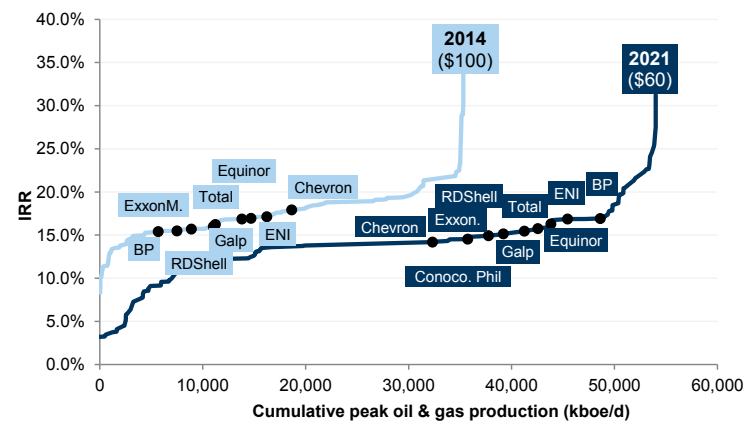
Top Projects IRR by year of FID split by winzone



Source: Goldman Sachs Global Investment Research

**Exhibit 69: ...led by Big Oils that have repositioned themselves on the cost curve and have project portfolios that are more profitable today on a long-term price of \$60/bl than they were in 2014 at \$100/bl**

Top Projects oil & gas IRR curve (%)

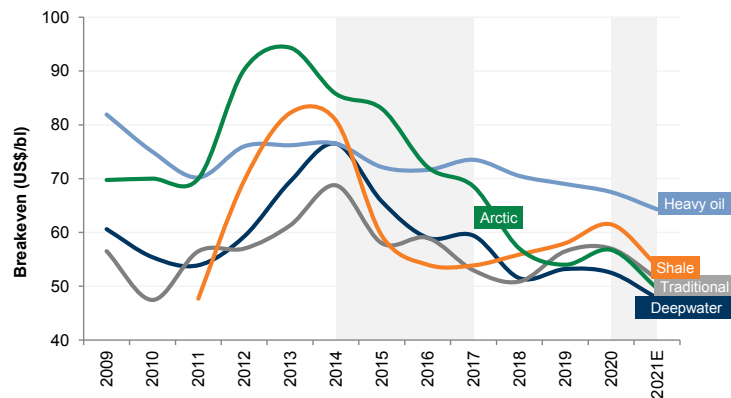


Source: Goldman Sachs Global Investment Research

# This downturn has found the industry in a better cost and FCF position

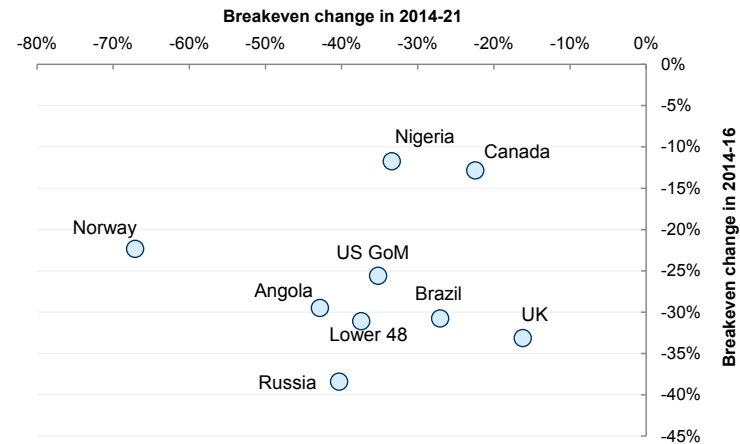
Standardization, simplification and a focus on higher corporate returns in the face of capital discipline across most regions have resulted in a material reduction in project breakevens since the last oil price upcycle (2010-14). Deepwater and Arctic projects sanctioned currently have breakeven oil prices of c. \$48/50/bl on aggregate, a c.40% reduction from the peak in 2014. We believe the current macro downturn finds the industry in a much healthier state than it was in 2014, when excessive fragmentation and capital resulted in significant supply chain issues, rising tax rates and c.10% compounded cost inflation over the decade that had a detrimental impact on the industry’s profitability. This should support a more resilient navigation of the current downturn, and while project sanctions are at historical troughs, the new, fewer projects to be sanctioned in future years are likely to be of much higher profitability.

**Exhibit 70: Project breakevens today are c.30%-50% below the peak levels of 2014 as the current macro downturn finds the industry in a very different place...**  
Oil breakeven price for different winzones through time (US\$/bl)



Source: Goldman Sachs Global Investment Research

**Exhibit 71: ...with a reduction of breakevens observed across all key winzones and regions**  
Breakeven change across regions for 2014-16 and 2016-21E



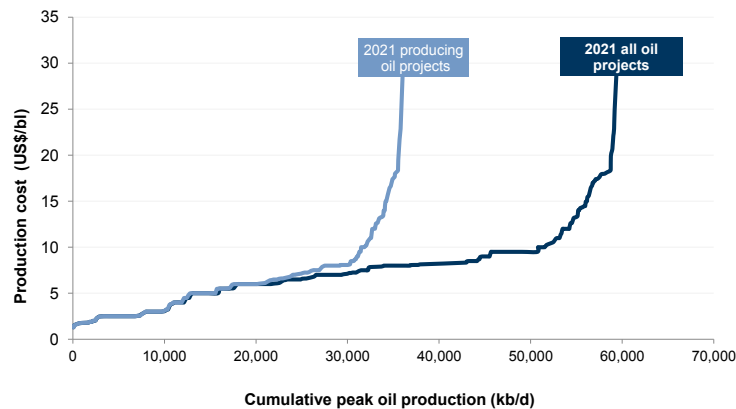
Source: Goldman Sachs Global Investment Research

# The high end of the cash production cost curve is occupied by Canada and shale, two key regions susceptible to shut-ins

To assess the potential impact of the current commodity downturn on currently producing oil fields, we have created a cash production cost curve (as opposed to the full-cycle breakeven cost curve presented in the previous section). The resulting curve is shown in [Exhibit 72](#), with over 90% of the oil fields modelled in our Top Projects database producing below a cost of US\$15/bl and over 80% producing below US\$10/bl. The lowest end of the cash production cost curve per barrel is currently occupied by regions such as Saudi, Iraq, Iran and Russia while the middle range is primarily formed of global deepwater regions. The higher end of the curve is dominated by shale (US and Argentina) and Canadian heavy oil production, the regions that are more susceptible to shut-in risks in the near term.

**Exhibit 72: Over 80% of the currently producing fields in our Top Projects database have a production cash cost <US\$10/bl...**

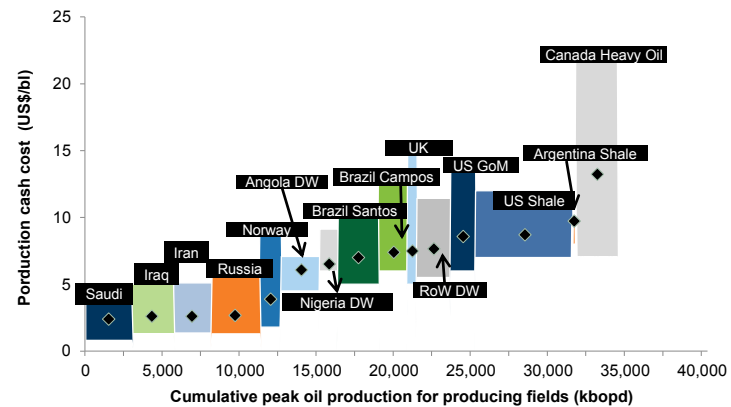
Top Projects 2021 production cost for producing and all oil projects (US\$/bl)



Source: Goldman Sachs Global Investment Research

**Exhibit 73: ...with shale (US, Argentina) and Canadian heavy oil occupying the higher cost end of the curve**

Top Projects 2021 production cash cost of producing oil fields by region (US\$/bl)

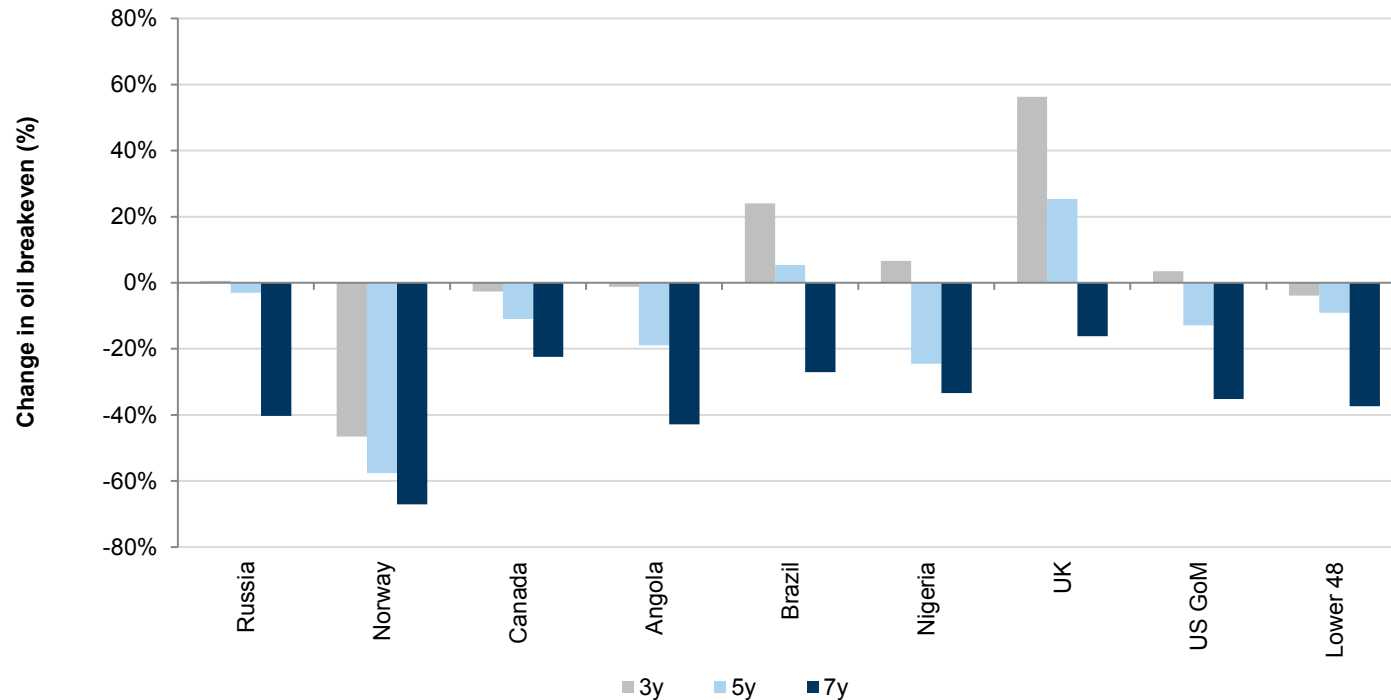


Source: Goldman Sachs Global Investment Research

## Offshore and Russia improved profitability the most since 2014

On average, oil breakeven has fallen by 20%-60% over the past seven years on a combination of cost deflation and a simplification and standardization of projects, especially in 2014-16. The pace of improvement has slowed over the past two years, with Nigeria, UK and Brazil seeing an increase in breakevens as the terms of those developments become more challenging. For the latter, this was primarily due to the number of delays in FPSO start-ups in the pre-salt and less favorable tax terms. The most notable reduction in breakevens since the previous downturn has come from Norway, offshore Russia and the US.

**Exhibit 74: Offshore project breakevens have improved 20%-60% over the past seven years**  
Change in oil breakeven on a 3y/5y/7y basis



Source: Goldman Sachs Global Investment Research

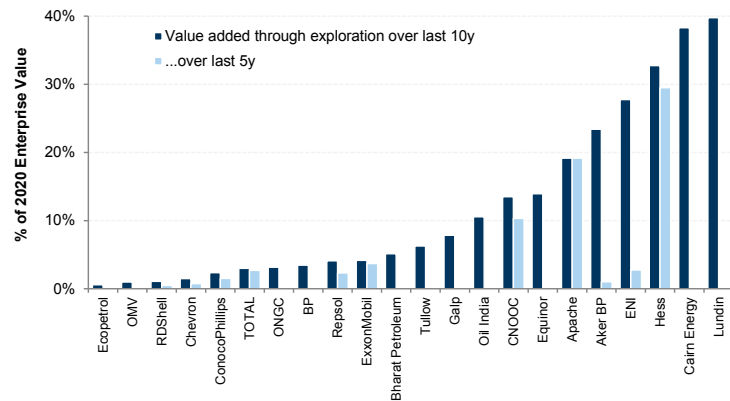
# Successful access to new resources remains in the hand of a few; ENI keeps its leading position in exploration among Big Oils

Over the past decade, we have seen relatively disappointing value creation through exploration, although we have seen an improvement more recently in the ability of Big Oils to create value through the drill bit. Notably, ENI has been able to successfully translate exploration activities into valuable giant oil and gas discoveries. Over the last five years, ENI made a number of giant discoveries, including Zohr in Egypt; Mamba-Coral, Agulha in Mozambique; Mexico Area 1 in Mexico; and several oil discoveries in Block 15-06 in Angola. Exxon, TOTAL, RDSshell and BP are also showing some improvements, although not close to the material levels of ENI’s value creation, with the first two in particular showing successful exploration results in Guyana and Suriname, respectively. Hess, Apache and Galp also rank well thanks to discoveries in Guyana (Liza), Suriname and Brazil/Mozambique, respectively.

We assess the industry’s ability to create value through exploration by calculating the current NAV of the reserves accessed by each company over the past 10 years, and we only show in the exhibits below the top companies. Exhibit 75 shows the value of these exploration successes as a percentage of the company’s 2020 EV. For only five companies has the exploration success and shale access over the past 10 years created more than 20% of the 2020 company value (EV) when NPV is measured from FID.

**Exhibit 75: Of the Big Oils, ENI is leading the industry in exploration success...**

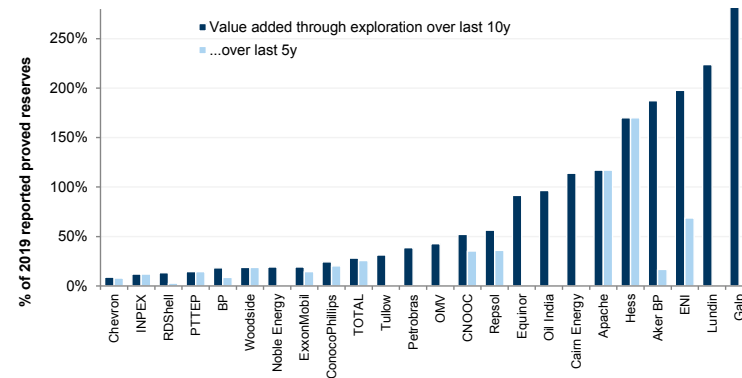
Value added through exploration and shale access at the time of field FID, as a % of 2020 EV



Source: Company data, Goldman Sachs Global Investment Research

**Exhibit 76: ...with some signs of improvement from the rest of Big Oils**

Discovered oil and gas resources as a % of 2019 reported proved reserves



Source: Company data, Goldman Sachs Global Investment Research

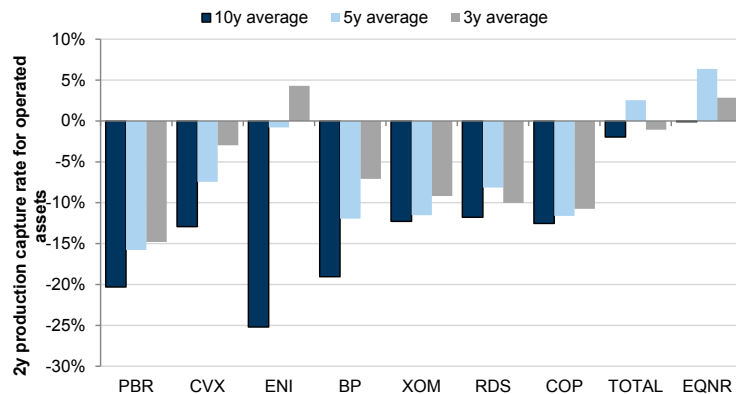
# Delivery: ENI, BP show the strongest delivery improvement in the industry; Equinor and TOTAL maintain strong track records

The oil and gas industry had a poor record of project delivery in the ten years from 2004-14, but is showing strong signs of improvements over the past five years. We believe that a fair assessment of operator effectiveness should consider both the delivery of sanctioned projects and the ability to get projects sanctioned. Although poor project delivery tends to be well flagged, the negative impact of failing to sanction projects also has a material negative effect on NAV. As a result, we look at capture rates for both two (operational delivery) and five years (ability to move projects from discovery to production).

We have assessed how effective Global Big Oils have been in bringing production online over the past two and five years. To do this, we have looked back to each of the previous iterations of our Top Projects report. We have taken the volumes that we forecast the fields operated by each company would produce in two years and five years from the date of publication and compared it with the production that we currently expect from those fields (Top Projects 2021), thereby giving an idea of the capture rate for each company. We note that these data points are based on our estimates and do not necessarily reflect companies' guidance at the time of writing and that companies with a large proportion of assets already in production tend to be favored by this analysis. The overall improvement we have seen in delivery over the past few editions of the report partially reflects the fact that we are still judging these companies against our estimates rather than versus actual delivery.

**Exhibit 77: Equinor and TOTAL have shown the strongest delivery over the past decade...**

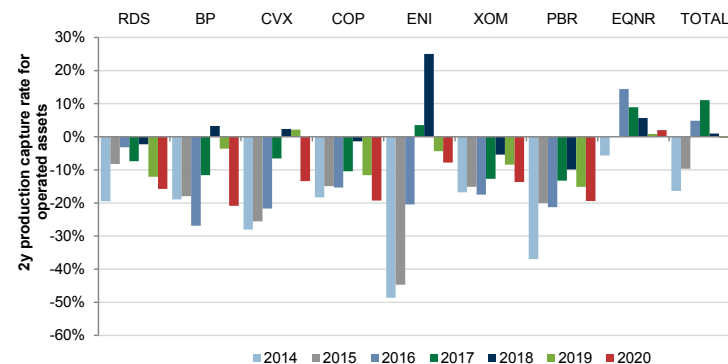
% production miss vs. GSe for operated assets (2y forward), 10y vs. 5y vs. 3y average



Source: Company data, Goldman Sachs Global Investment Research

**Exhibit 78: ...while all companies across Big Oils have delivered below expectations in 2020, given the challenging macro environment and operational disruptions**

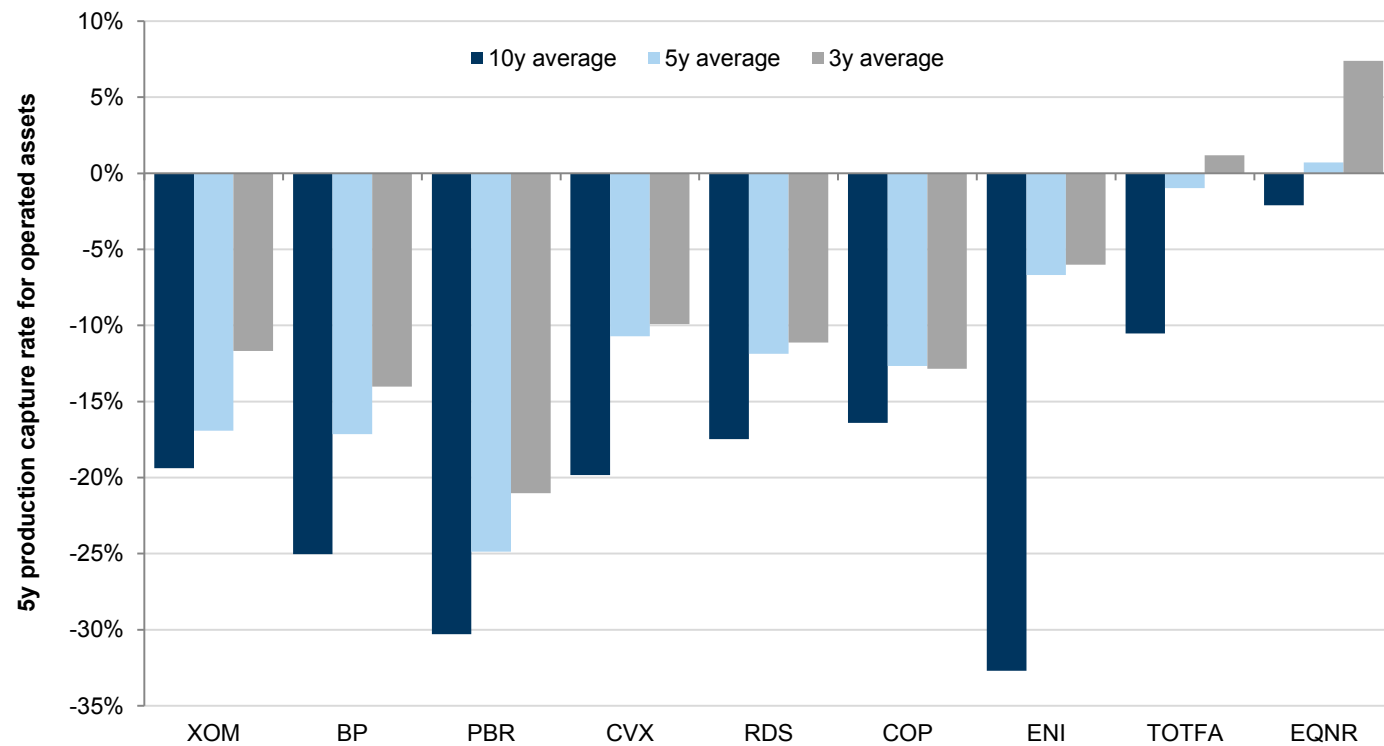
% production miss vs. GSe for operated assets (2y forward), over the past 5y



Source: Company data, Goldman Sachs Global Investment Research

Averaging the results across previous versions of this report, ENI is one of the companies that has improved delivery the most, reflecting an improvement in speed to market of upstream assets (e.g. Zohr in Egypt). TOTAL and Equinor maintain the best track record of physically delivering projects among global Big Oils, with the latter heavily benefiting from the faster ramp-up at Johan Sverdrup, but also increasingly supported by investments in brownfield developments with short time-to-market. Chevron and BP have also joined the group of companies that over the past three years show a notable improvement in delivery.

**Exhibit 79: ENI has improved production delivery the most, from a c.33% miss vs. our initial expectations (10y average) to a c.6% miss over the past 3y**  
 % production miss vs. GSe for operated assets (5y forward), 10y vs. 5y vs. 3y average



Source: Company data, Goldman Sachs Global Investment Research

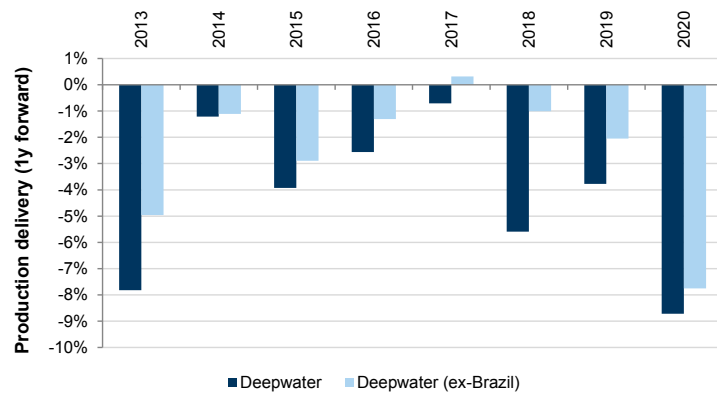


# Oil production delivery in 2020 was materially lower than anticipated across most winzones

Deepwater production delivery (on a one-year forward basis) in 2020 was materially lower than we anticipated, driven primarily by delays in major projects as well as operational disruptions in a challenging macro environment. Traditional and heavy oil production were also below our expectations on a one-year basis, with the former being primarily driven by underperformance in some key North Sea fields such as Clair Ridge and Schiehallion.

**Exhibit 80: Deepwater production delivery in 2020 was much lower than we anticipated, primarily driven by ongoing delays and operational challenges in a difficult macro environment...**

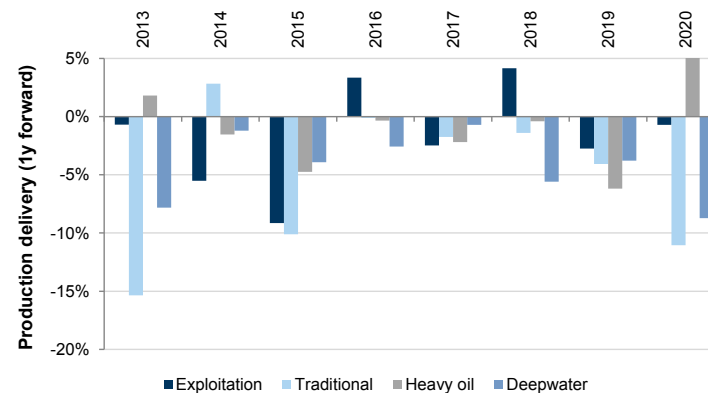
Production delivery (1-year forward basis) as a % for Deepwater projects



Source: Company data, Goldman Sachs Global Investment Research

**Exhibit 81: ...while traditional oil production in 2020 was also below our expectations**

Production delivery (1-year forward basis) as a % for exploitation, traditional and heavy oil projects



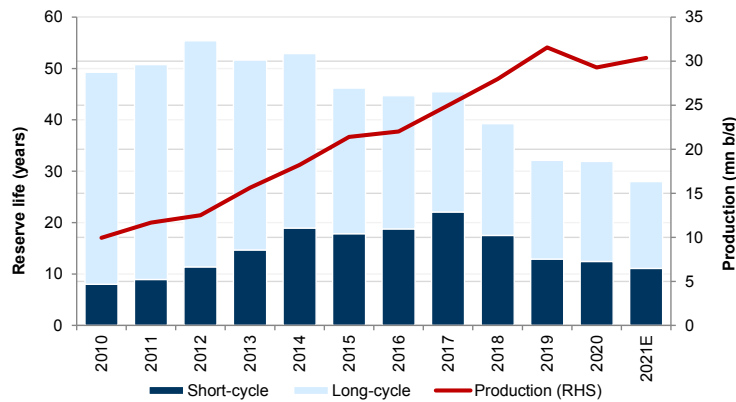
Source: Company data, Goldman Sachs Global Investment Research

# The shift towards short cycle lowers the visibility on resource life

While short-cycle projects made up only 16%/37% of the Top Projects resource life/capex in 2010, they make up 40%/60%, respectively, of the total today. In our view, this structural shift implies less visibility in the forward curve. Also, as shale sets the curve, in our view long-cycle developments are likely to be re-engineered to move below shale on the cost curve, creating more dynamism.

**Exhibit 82: Short-cycle projects now account for 40% of total reserve life...**

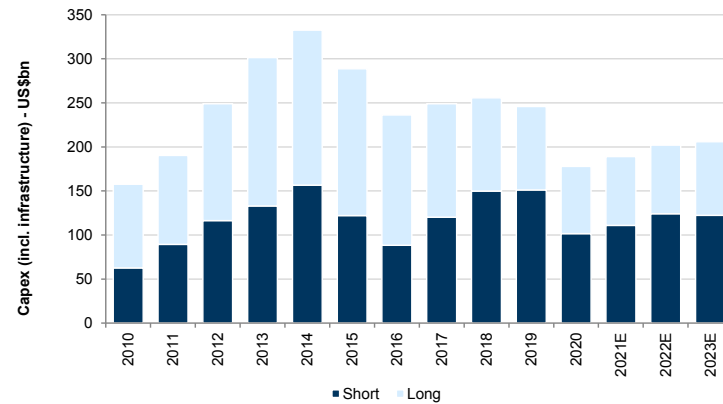
Top Projects reserve life split by short/long cycle



Source: Goldman Sachs Global Investment Research

**Exhibit 83: ...yet they will account for over c.60% of capex in 2022-23E**

Top Projects capex (including infrastructure) split by short/long cycle

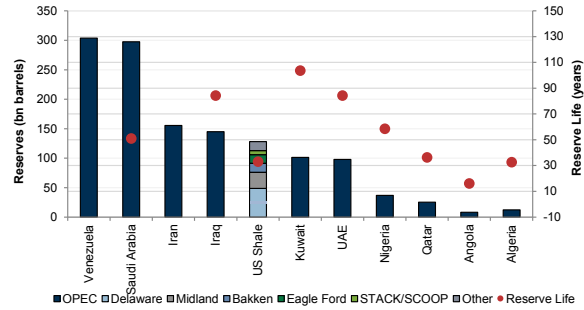


Source: Goldman Sachs Global Investment Research

# US shale deep dive: The short-cycle business model continues to evolve

**Exhibit 84: The US Shale resource is vast – comparable to large Persian Gulf OPEC members – but its resource life is materially lower...**

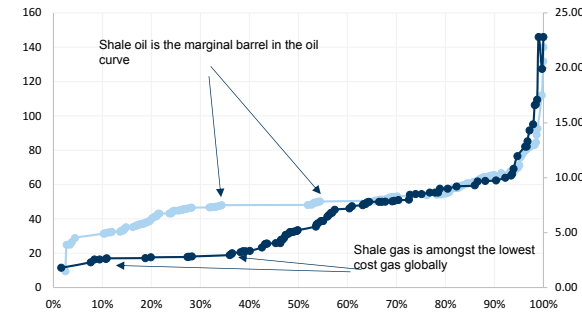
Reserves and reserve life of US shale vs. key OPEC countries



Source: BP Statistical review, Goldman Sachs Global Investment Research

**Exhibit 85: ...but broadly it is the marginal barrel in the global market, while shale gas remains among the lowest cost gas globally...**

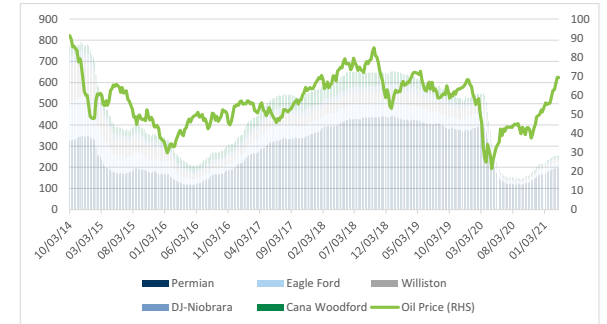
% of cost curve that breaks even at a given oil price (dark line LHS US\$/b) and gas price (light line RHS US\$/mcf)



Source: Goldman Sachs Global Investment Research

**Exhibit 86: ...explaining why as oil prices fell so did US rig activity**

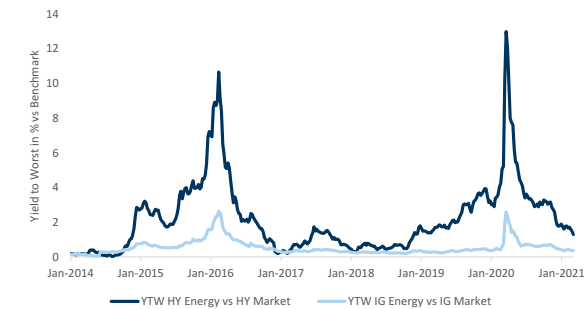
Horizontal rig count vs. oil price (US\$/b)



Source: Baker Hughes, Reuters, Goldman Sachs Global Investment Research

**Exhibit 87: Financing costs are very clearly distinguishing the “haves” - IG issuers - from the “have nots” - HY issuers...**

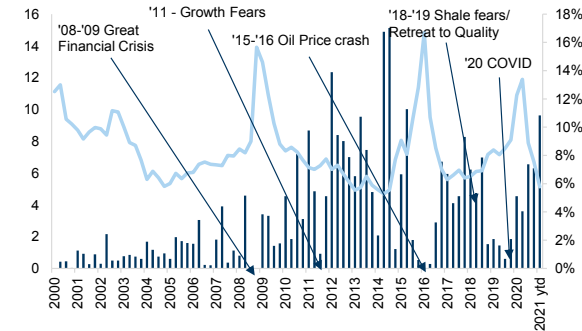
% above IG/HY market average for US IG/HY energy in yield to worst



Source: Bloomberg, Goldman Sachs Global Investment Research

**Exhibit 88: ...while credit issuance for the ‘have nots’ (High Yield issuers) decelerated between 2018-19, issuance has started to recover in the later part of 2020 and into 2021**

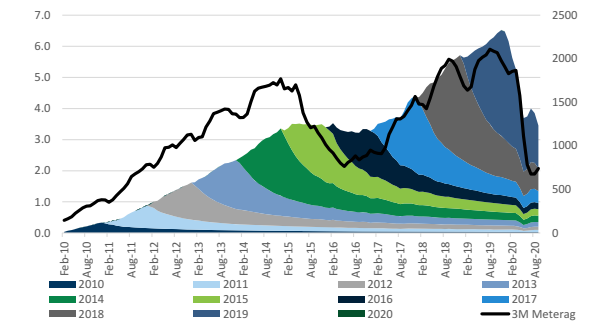
HY E&P bond issuance (LHS bars) and HY Energy YTW (RHS line) by quarter since 2001



Source: Bloomberg, Dealogic, Goldman Sachs Global Investment Research

**Exhibit 89: Shale production is a function of activity: Production from the big 4 basins shows strong correlation with the rolling 3-month average meterage...**

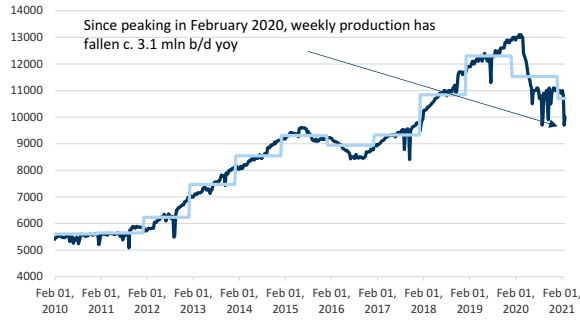
Big 4 basin oil production (million b/d) by year of first oil and 3M rolling horizontal km being put onto production on RHS



Source: IHS, Goldman Sachs Global Investment Research

**Exhibit 90: ...while the Coronavirus pandemic and other macro factors led to weekly production falling by c.3.1 mln b/d from its peak in February 2020...**

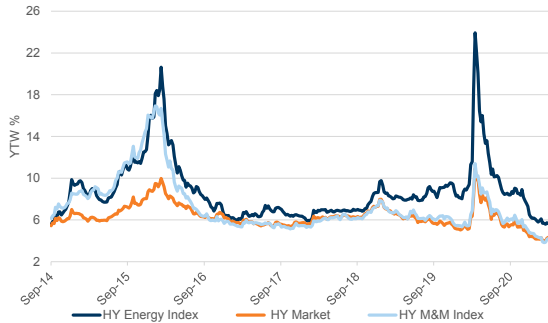
Weekly total US crude oil production in dark and annual average in light blue



Source: EIA, Goldman Sachs Global Investment Research

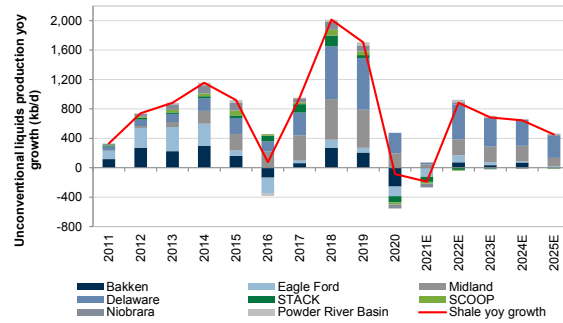
**Exhibit 93: ...as High Yield energy companies are faced with increasingly tighter financing conditions...**

Yield to Worst of HY Energy, Metals and Mining and the US corporate index



Source: Bloomberg, Goldman Sachs Global Investment Research

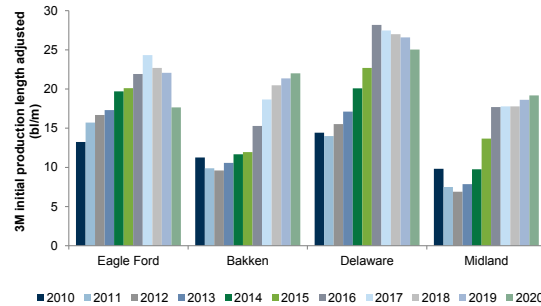
**Exhibit 91: ...while we estimate 2021 will see a c.200 kb/d yoy decline, followed by a recovery in growth in 2022 and moderating thereafter, mostly propelled by the Permian Unconventional liquids - oil + NGL - production yoy growth (kbpd)**



Source: Goldman Sachs Global Investment Research

**Exhibit 94: ...and productivity improvements stall and even fall across some basins...**

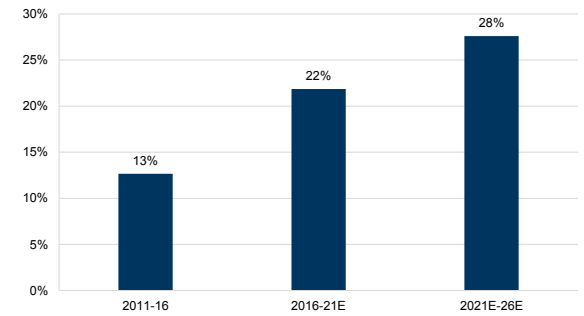
Production in bl/m over 3 months of production



Source: IHS, Goldman Sachs Global Investment Research

**Exhibit 92: We expect Big Oils to move into harvest mode in the Permian, more than doubling their share of growth vs. history in the shale patch...**

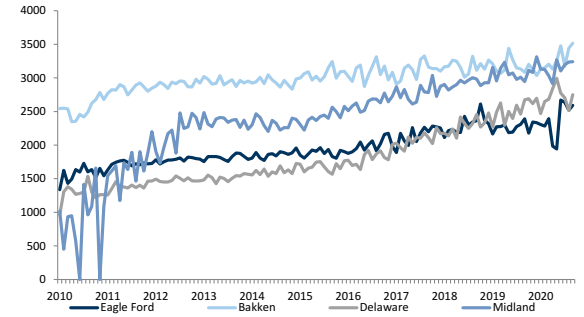
% of US unconventional liquid growth from Big Oils



Source: Goldman Sachs Global Investment Research

**Exhibit 95: ...despite horizontal wells getting longer over time**

Lateral distance of horizontal wells (m)

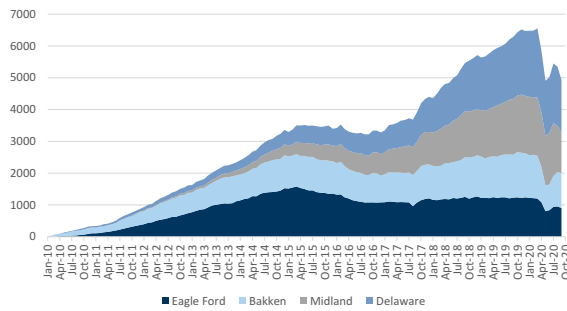


Source: IHS, Goldman Sachs Global Investment Research

# The declines of the shale treadmill continue...

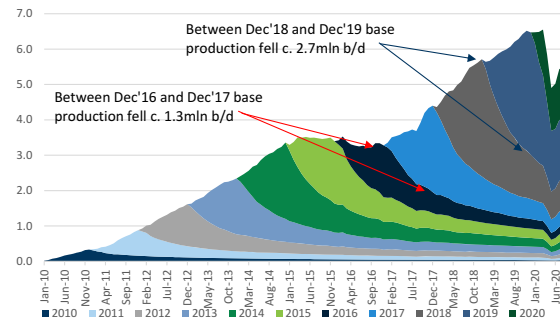
All shale wells undergo exponential decline after first oil. As US shale production has grown, the barrels required to offset this base decline has also increased – a phenomenon we refer to as the shale treadmill. While data seems to support the fact that shale production declines after first oil, we believe this phenomenon is further compounded by initial production rates (IP’s) getting higher but the decline rates accelerating. The fall in shale activity in 2020 has reduced the number of wells in the high decline phase, providing a temporary respite from decline rates forecast in 2021-22, providing further a stronger opportunity for the industry to deliver incremental growth in 2022 and 2023, before underlying declines go back above 2.5 mn blsd pa from 2024, on our estimates.

**Exhibit 96: The 2014-16 crash saw true declines in the EF/Bakken being masked by increased activity in the Permian; in 2020 there was no such growth basin**  
Production in kb/d of the big 4 basins from allocated wells



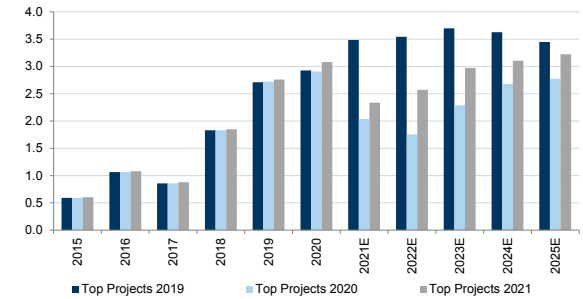
Source: IHS, Goldman Sachs Global Investment Research

**Exhibit 97: Between 2017 and 2019, we saw the rate of exit-exit base decline accelerate from 1.3 to 2.7mn b/d...**  
Oil only allocated well production by year of first production showing base declines of the big 4 Basins



Source: IHS, Goldman Sachs Global Investment Research

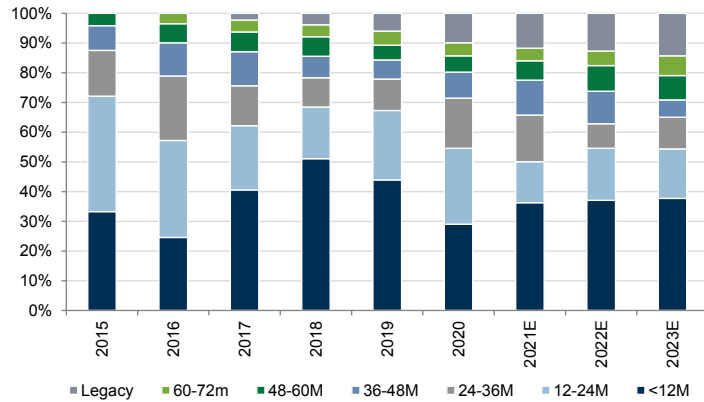
**Exhibit 98: ...which when annualized sees yoy decline rates materially increasing since 2017, albeit we expect the rate of base decline to decelerate in the short to medium term**  
Volume (mln b/d) required yoy to keep production flat with prior year



Source: Goldman Sachs Global Investment Research

**Exhibit 99: At present c.66% of shale production comes from wells that are <3y in age (i.e. in hyper decline) vs. 77% in 2019**

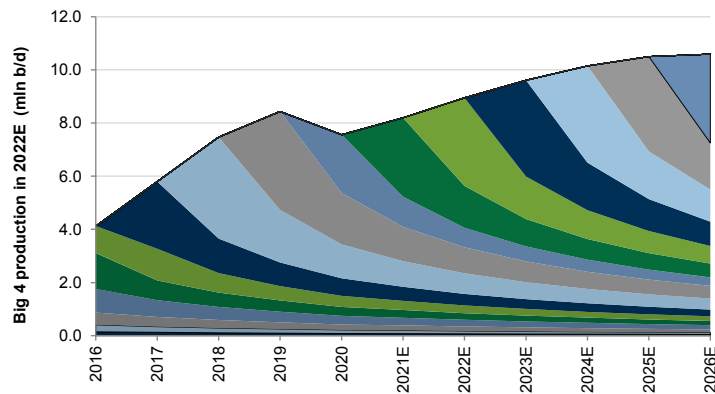
% of shale production volume, split by well vintage in the Big Four



Source: Goldman Sachs Global Investment Research

**Exhibit 101: We estimate that in 2022E, new well capacity of 3.32 mln b/d will be added – c.77% of which will go towards offsetting base declines**

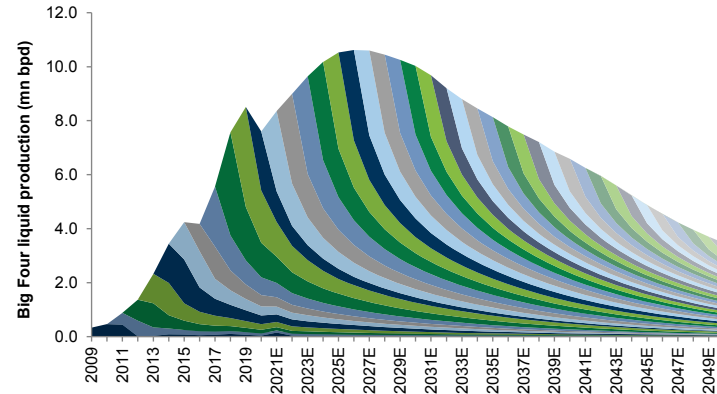
Big Four production in 2016-26E



Source: Goldman Sachs Global Investment Research

**Exhibit 100: The 2020 reduction in activity could likely enable a resumption of strong growth in 2022E, albeit from a lower base**

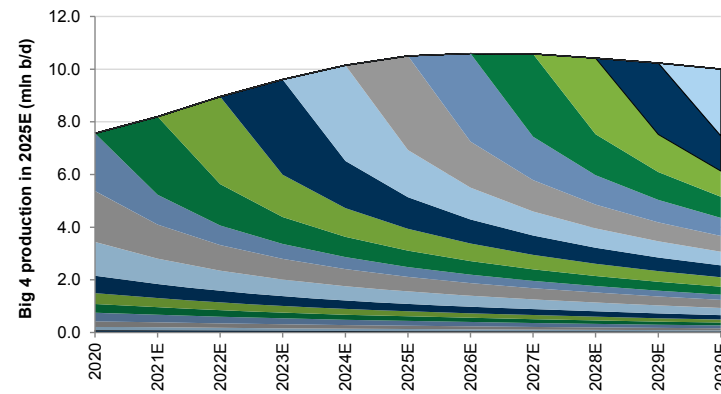
Big Four unconventional liquids production in mln b/d (ex impact of shut ins)



Source: Goldman Sachs Global Investment Research

**Exhibit 102: In 2025E, we estimate 3.57 mln b/d of new well capacity, with c.90% going toward offsetting base declines**

Big Four production in 2020-30E



Source: Goldman Sachs Global Investment Research

## ...and lower activity, which we see recovering from 2021E

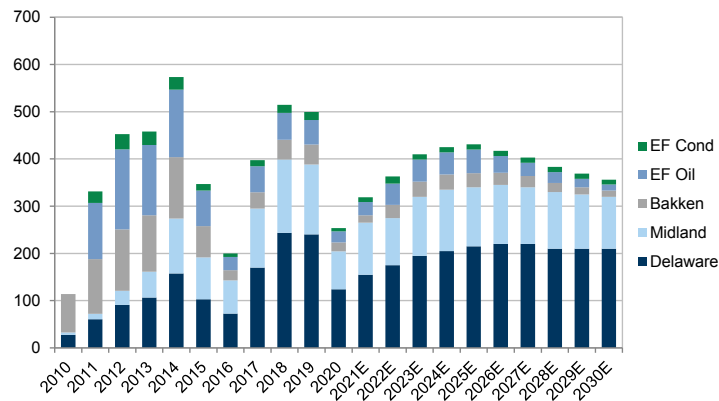
The shale complex needs consistently high levels of activity to maintain production. While a deepwater offshore well can recover 50mln bl's+ per well, it could take 100 shale wells to do the same. Consequently, vast numbers of wells are required annually to maintain flat production across the shale basins.

While the US horizontal rig count plummeted during 2020, we have seen some signs of gradual improvement in activity levels recently: we have observed a trough in rig count across the major basins in the early weeks of 2H20, with the rig count gradually recovering from this trough throughout the end of 2020 and into 2021.

We therefore expect to see a recovery in activity levels in 2021 (albeit from a low base in 2020), with steady growth through to 2025.

**Exhibit 103: We see rig activity recovering from the trough in 3Q20, with a gradual rebuild through to the end of 2021, before normalizing somewhat from 2022 onwards...**

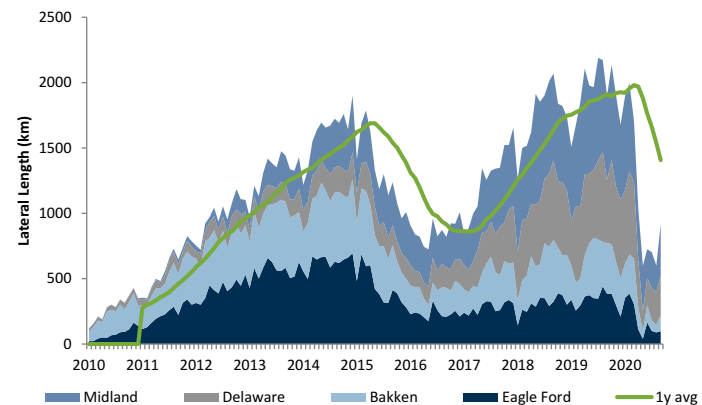
Horizontal rig count of the big 4 basins



Source: Goldman Sachs Global Investment Research

**Exhibit 104: ...while lateral length of drilled wells dropped off sharply in the 2020, we have seen a gradual recovery in the data in the later months of 2020**

Lateral length of horizontal wells starting production per month by basin (and rolling 3M average)



Source: Baker Hughes, IHS, Goldman Sachs Global Investment Research

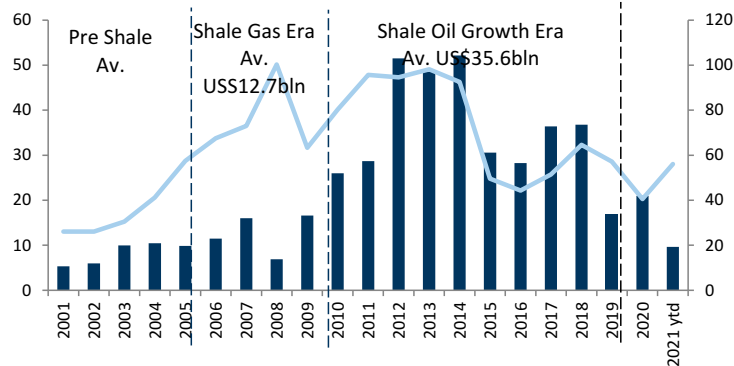
## Credit has dried up in the shale patch for some...

The shale complex saw extraordinary growth funded by HY issuance between 2010 and 2018, when on average over US\$35.6bn was issued annually. But since 3Q 2018, the market has been subdued in terms of issuance. While the market recovered slightly in 2020, the majority of issuance was in the higher quality (higher rating) names within the HY category. We believe that it was also, broadly, to refinance existing facilities rather than true new issuance in the traditional sense.

Over the last decade, there have been a few periods in which the market for HY E&P new unsecured issuance has closed for a few months – with the height of the Coronavirus pandemic in early 2020 one such period. These periods of HY market closure typically coincided with periods of macro concerns (e.g. the 2008-09 financial crisis and 2014-16 oil price crash). In 2018-19, while not a complete closure of the market, we observed materially lower issuances for a number of months, which we believe was based more on structural concerns over the business model of the smaller shale companies in the Age of Decarbonization. We believe that the following shut down in 2020 due to the Coronavirus pandemic further compounded these structural concerns on the shale business model. This lack of credit is, we think, going to result in lower shale activity amongst the smaller, independent companies at a time when the base decline rates are high vs. historical levels and when productivity gains have moderated. This is the difference vs. the 2016 ‘window’, when we believe the majority of credit issued was used to fund the Permian growth.

**Exhibit 105: The Shale Oil Era saw unprecedented corporate bond issuance enabling rapid growth; tighter financing conditions will result in a smaller, better shale complex, in our view**

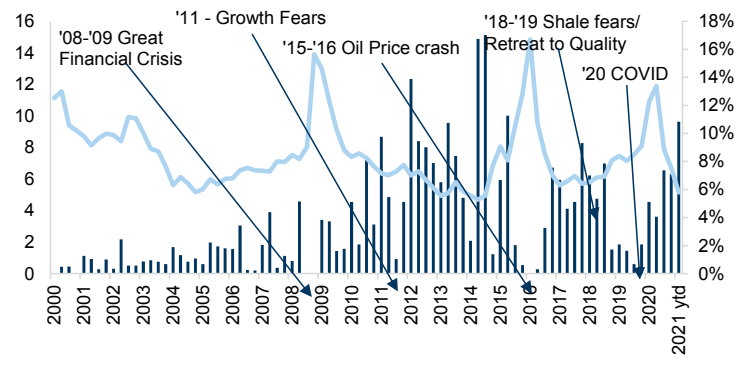
HY Energy bond issuance by year since 2001 (2021 ytd. issuance), including all Energy subsectors in US\$bn (LHS) and average WTI oil price (RHS - US\$/bl)



Source: Dealogic, Bloomberg, Goldman Sachs Global Investment Research

**Exhibit 106: Over the past 12 years, reductions in HY issuance by E&Ps have related to macro concerns – except in 2019, which in our view reflects more structural concerns**

HY E&P USD bond issuance (LHS bars) and HY Energy YTW (RHS line) by quarter since 2000



Source: Dealogic, Bloomberg, Goldman Sachs Global Investment Research



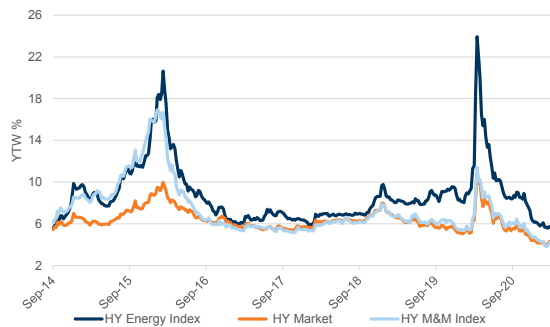
## ...resulting in differentiation between finance 'haves' (IG issuers) and 'have nots' (HY issuers)

Contrary to the high yield market, the credit issuance market for investment grade names is virtually always open, with the energy index rarely deviating more than 3% versus the benchmark historically despite prevailing macro uncertainties. This stands in stark contrast to the high yield market where energy has diverged double digit % versus the benchmark twice in recent history.

In the coming years, we expect a continuation of the divergence observed in quality terms and, as a result, access to capital between the shale 'haves' (e.g. Oil majors with lower cost of capital requirements and the ability to extract value across their integrated value chains, as well as large cap oil companies with concentrated acreage, regional specializations and continued access to capital) and the 'have nots' (e.g. private equity-backed companies, smaller publicly traded E&Ps and highly geared E&Ps). As we discuss in our report *Top Projects: The Era of Consolidation*, we believe that this increasing dichotomy between the "Haves" and "Have nots" will likely facilitate consolidation in the shale plays, resulting in a gradual slowdown in overall shale production growth in the longer term. We do however, see potential for an improvement in overall shale profitability driven by better development plans and scale benefits resulting from consolidation.

**Exhibit 107: HY Energy credit underperformed the market in 2019 before the Coronavirus shock...**

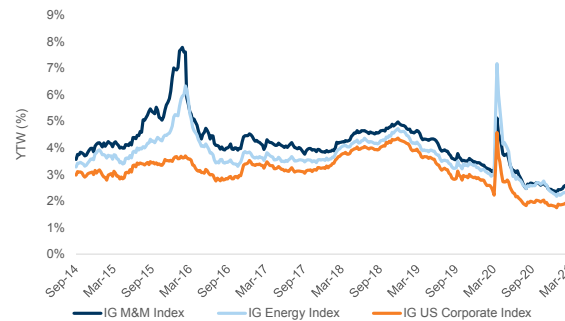
Yield to Worst of HY Energy, Metals and Mining and the US corporate index



Source: Bloomberg, Goldman Sachs Global Investment Research

**Exhibit 108: ...while IG energy has tracked far closer to the market...**

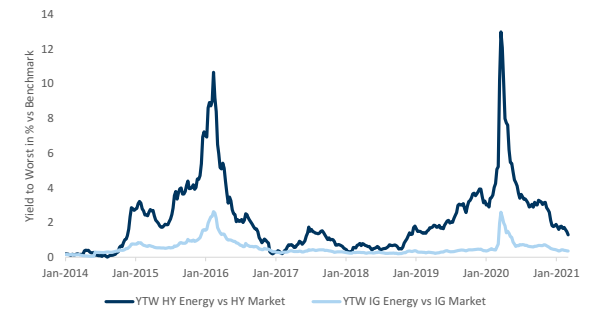
Yield to Worst of IG Energy, Metals and Mining and the US corporate index



Source: Bloomberg, Goldman Sachs Global Investment Research

**Exhibit 109: ...which shows the 'haves' and 'have nots' (lower is better)**

% YTW difference of IG/HY Energy vs. the IG/HY universe over time



Source: Bloomberg, Goldman Sachs Global Investment Research

# Shale reserves continue to fall

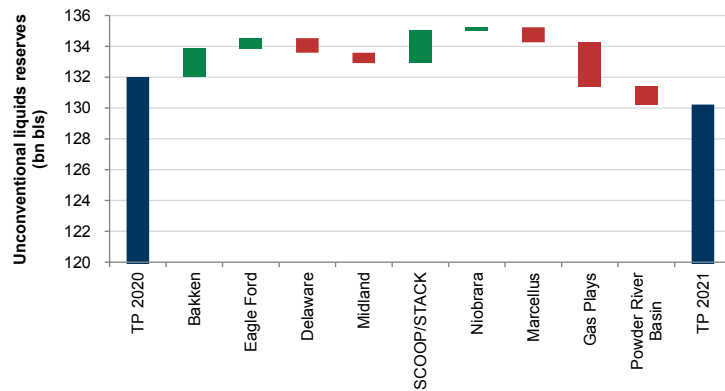
Similar to the trend identified in our previous Top Projects reports, the shale liquid resource base shrunk again yoy in 2020, marginally on our estimates, after previously registering an unbroken run of increases during the shale growth era from 2010-19. While the reduction in liquid resource base was slight and not broad-based across basins, we have reduced our aggregate shale gas volume forecast more materially, with gross resources falling from c.150 bln boe last year to around 140 bln boe this year, on our estimates.

In the Gas plays, we see the greatest reductions in resource in the Utica, Powder River Basin and the Fayetteville plays, with some growth in resource in the Haynesville and SCOOP/STACK plays.

Elsewhere in the liquid plays, we see the greatest reductions in volumes in the Delaware, Marcellus and Powder River Basins, with some material resource additions across the SCOOP & STACK plays.

**Exhibit 110: We expect across-the-board declines in liquid volumes for the third year...**

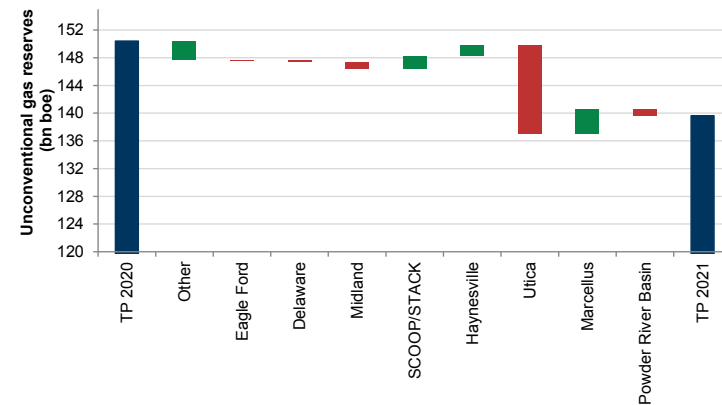
Liquids shale reserves in bn barrels; Top Projects 2021 vs. 2020



Source: Goldman Sachs Global Investment Research

**Exhibit 111: ...while we expect a more material reduction in resources in the gas basins, driven largely by reductions in the Utica basin**

Shale gas reserves in bn boe; Top Projects 2021 vs. 2020

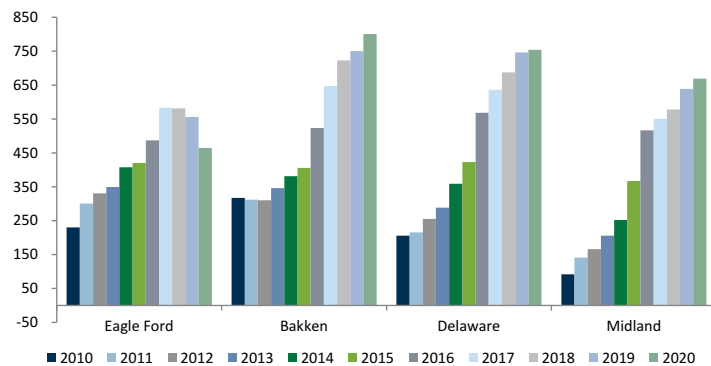


Source: Goldman Sachs Global Investment Research

# Productivity is no longer improving...

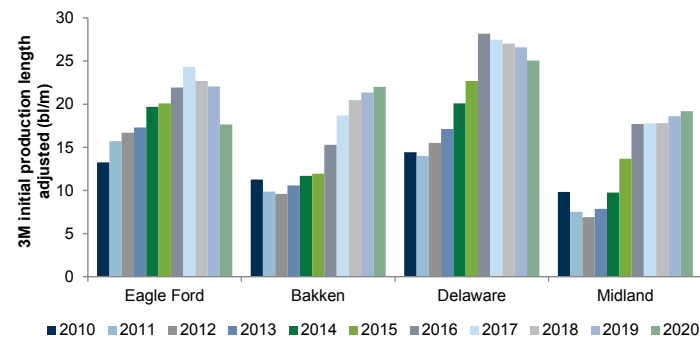
Since the start of the shale boom, year after year initial individual well production has increased. In the Eagle Ford, arguably the most mature shale basin, 3M cumulative production has more than doubled since 2010, while in the Midland basin, 3M cumulative production is up more than 6 times. Despite this impressive growth rate in absolute terms, it is important to note that when we look at lateral length-adjusted production (a measure accounting for increasing well lengths, and providing an indication of productivity per meter of reservoir contact), we see a clear flattening in the growth of productivity since 2017. In the case of the Eagle Ford, productivity has actually declined in both 2018 and 2019 and most significantly in 2020. We think this likely shows depletion of some of the most productive zones which technological gains cannot counteract. Somewhat surprisingly, the Delaware has also seen productivity improvements very slightly reverse since 2016, which we think is likely due to the increased volume of drilling and tighter well spacing in 2017-20 vs. 2016. The main exception to this trend remains the Bakken, where we have seen improvements in productivity in every year following 2016. We believe this is as a result of operators transitioning to using advanced artificial lift technology around 2016-17 to maximize initial production rates, while the Bakken also has more fixed spacing requirements. Our analysis indicating the lack of improvement in lateral length-adjusted productivity suggests that the resource base being drilled is not meaningfully improving anymore (as it was during the initial exploration phases of the Permian boom in 2013-16). It also suggests that current technology is improving the situation in an evolutionary rather than revolutionary way, and further meaningful productivity improvements would require new technological breakthroughs.

**Exhibit 112: Wells have seen 2-6x increases in output since 2010...**  
Average 3-month production in barrels/day for the Big 4 basins by year of well start-up



Source: IHS, Goldman Sachs Global Investment Research

**Exhibit 113: ...but adjusting for lateral length, 3M initial production has not grown as rapidly since 2017 and in some cases reversed**  
Production in bl/m over 3 months of production



Source: IHS, Goldman Sachs Global Investment Research

## ...despite wells getting longer and completions becoming more intense

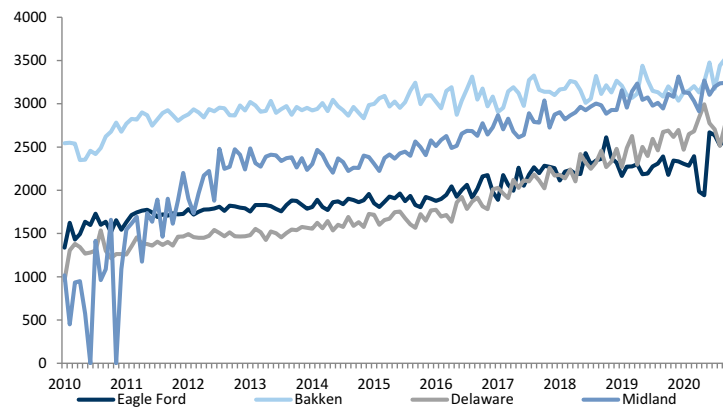
The shale patch has seen a material increase in the lateral length of wells across all basins, but this has been particularly pronounced in the Midland basin (growing from <1,000 m in 2010 to over 3,000 m in 2020). Conceptually, this increasing length means each well has more contact with the oil-bearing shale reservoir and logically should result in more productive wells.

In contrast to the Texan basins (Midland, Eagle Ford and Delaware), the Bakken in North Dakota (a state with limited prior oil and gas exposure) saw a more grid-like series of pads mandated in rows around 6 km apart – accounting for the nearly constant 3 km lateral well length as well as relatively fixed but wide spacing. In Texas, however, the acreage packages are relatively smaller and split up due to the nearly 100 years of hydrocarbon activity in the Permian, and it took some time historically for many companies to create contiguous acreage packages to drill long lateral length wells, as evidenced by the initial lag in well length in the Delaware and particularly in the Midland.

At the same time as wells were getting longer, proppant loading (i.e. the amount of sand per meter of reservoir exposure) increased significantly – up to 7x vs wells drilled in 2010. But since early 2018, the rate of proppant increases appears to have slowed (except for the Delaware), likely as operators reach peak-economic proppant loading.

**Exhibit 114: The horizontal wells continue to get longer...**

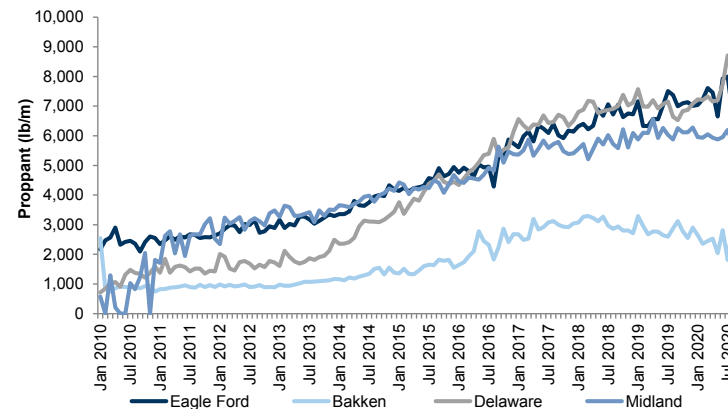
Lateral distance of horizontal wells (m)



Source: IHS, Goldman Sachs Global Investment Research

**Exhibit 115: ...as proppant volumes increased up to 7x, but started to plateau from early 2018 (apart from in the Delaware)**

Proppant loading per m

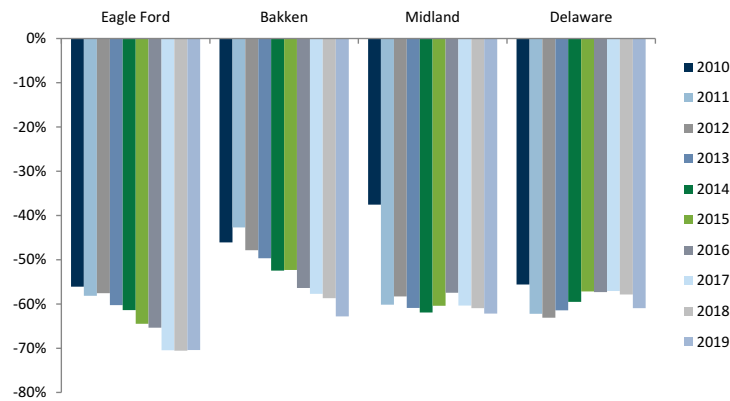


Source: IHS, Goldman Sachs Global Investment Research

## Well decline rates continue to accelerate

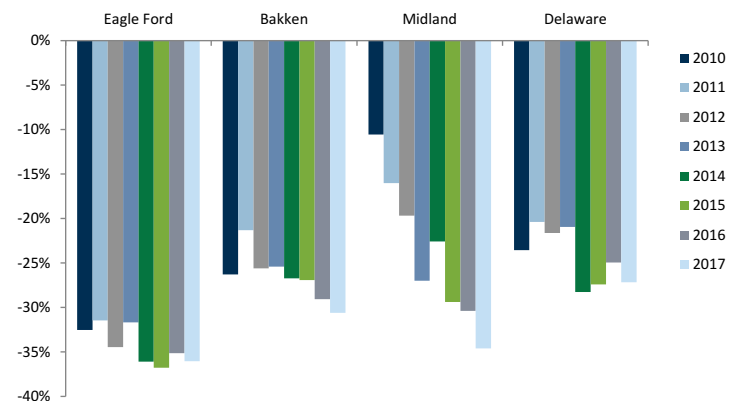
While declines are growing in aggregate, decline rates are also accelerating in individual wells. Although the industry is able to increase initial production rates (mostly driven by increased proppant loading and longer lateral lengths), we have seen accelerated rates of decline between months 3 and 12 in all basins since 2015 – evidence that the treadmill has accelerated. This raises some questions on whether wells are seeing the same estimated ultimate recovery (EUR) because of a faster recovery through advanced completions, or whether the intense completion enables a greater EUR in the first couple of years and then a normalized (or even reduced) rate thereafter. This debate has been ongoing for some time, and is something we study in greater detail in the [Road to Shale Tail](#) report. If all of this increased intensity results in a similar EUR, but with accelerated recovery, it could suggest the shale patch is meaningfully more mature than we anticipate.

**Exhibit 116: All 4 basins have seen accelerated initial decline rates vs. 2015...**  
Decline in % seen between month 3 and month 12 of production



Source: IHS, Goldman Sachs Global Investment Research

**Exhibit 117: ...and many are seeing accelerated declines in year three, especially in the Permian and Bakken**  
Decline in % between month 24 and month 36 of production

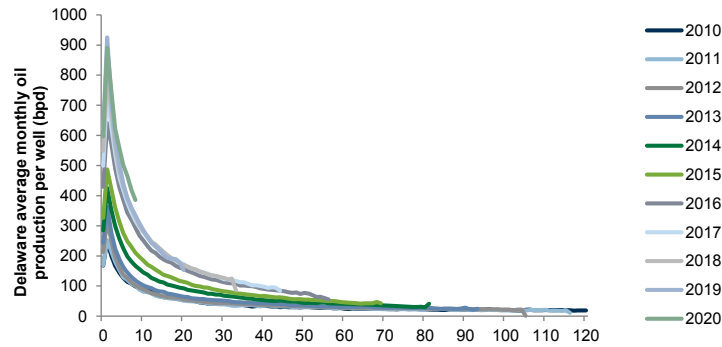


Source: IHS, Goldman Sachs Global Investment Research

# The Delaware saw accelerated decline rates in 2019

**Exhibit 118: Delaware wells have seen increased peak production rates...**

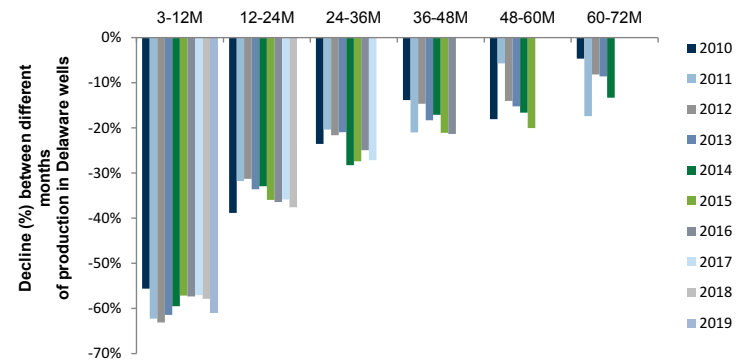
Delaware average oil production (bpd) by month per well



Source: IHS, Goldman Sachs Global Investment Research

**Exhibit 119: ...but saw a greatly accelerated decline in rates in 2019, partly down to reducing spacing too much**

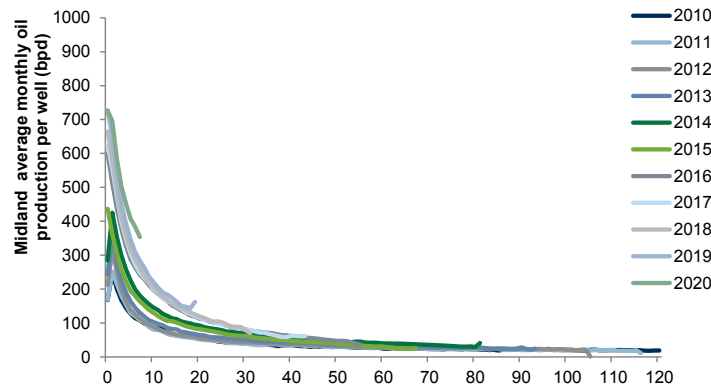
Decline in % between different months of production in Delaware wells



Source: IHS, Goldman Sachs Global Investment Research

**Exhibit 120: While Midland wells have seen 10% increases in IP yoy, but little differentiation in mid life wells since 2016...**

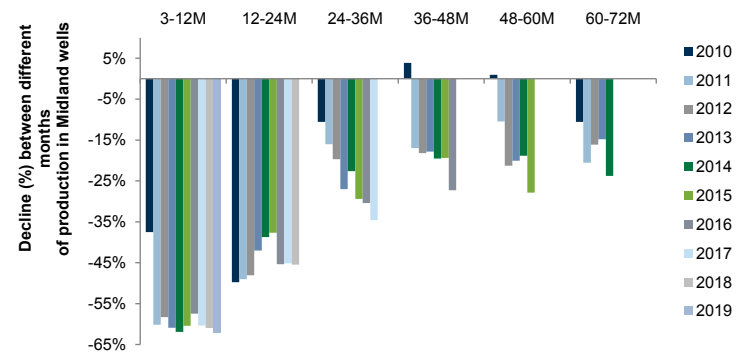
Midland Production in b/d per well by month since first oil



Source: IHS, Goldman Sachs Global Investment Research

**Exhibit 121: ...the Midland has seen a rapid acceleration of mid/late life declines**

Decline in % between different months of production in Midland wells



Source: IHS, Goldman Sachs Global Investment Research

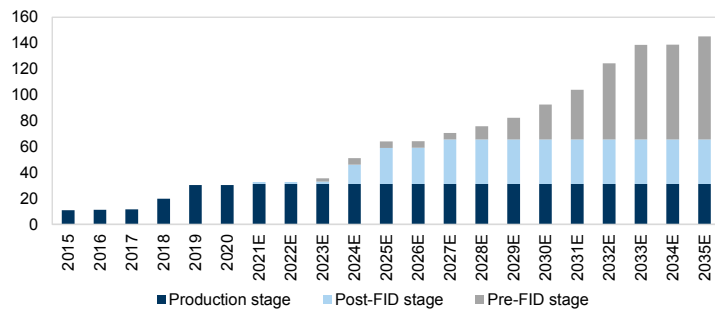
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## Russia’s market share in global gas market is expanding...

Russia continues its expansion on global gas markets, gaining share in the Chinese pipeline gas market and global LNG market whilst maintaining its market share in Europe above 30% (c.33% as of 2020) despite the European gas demand drop in 2020. Russian gas producers were able to navigate smoothly through the period of lower gas prices on the back of a very low cost base, which allowed them to stay profitable even in the distressed gas market environment. Thus, we estimate the operating breakeven for Gazprom’s pipeline gas supplies to Europe and Novatek’s LNG supplies at c.US\$2.5-3/mcf (including transportation and taxes), which is one of the lowest operating breakevens globally. Expansion on the LNG market is mainly related to the ongoing ramp-up of LNG production by Novatek. The three 5.5 mtpa trains of the company’s first LNG plant – LNG – have been ramped-up in a record short time (c.1 year) and are now producing c.10% above nameplate capacity. In addition, in 2019 Novatek launched a medium-scale LNG plant in Vysotsk and plans the launch of the second medium scale plant (Obskiy LNG), which is currently in pre-FID stage. Novatek’s second large scale LNG project – c.20 mtpa Arctic LNG-2 – is planned to be launched in 2023-2024. With the launch and ramp-up of Arctic LNG-2, we expect Russian LNG production to reach >60 mtpa by 2025E. We also note that Gazprom and Rosneft are considering several LNG projects (e.g. Ust-Luga LNG, Sakhalin projects, Vostok Oil), however, the timelines of potential launch and ramp-up of these projects remain uncertain. Gazprom’s expansion on the Chinese pipeline gas market started in December 2019 with launch of gas supplies via Power of Siberia pipeline. The company plans to gradually ramp up gas supplies to contracted volume of 38 bcm/year by 2025. We estimate that by 2025 Gazprom will account for c.10% of China’s gas demand. Gazprom is also considering other potential routes for pipeline gas deliveries to China (from Yamal peninsula/West Siberia and Far East), but we think the realization of these projects is unlikely to begin in the foreseeable future.

**Exhibit 122: We expect Russian LNG production to keep growing in the mid term**

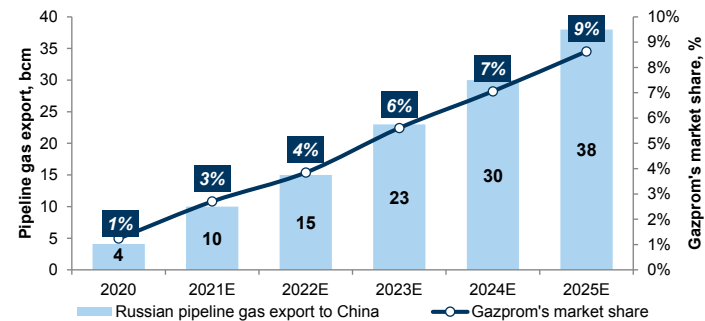
Russian LNG production capacity, mtpa



Source: Company data, Goldman Sachs Global Investment Research

**Exhibit 123: We expect Gazprom to account for c.10% of China’s gas demand by 2025**

Gazprom’s pipeline gas supply to China and market share

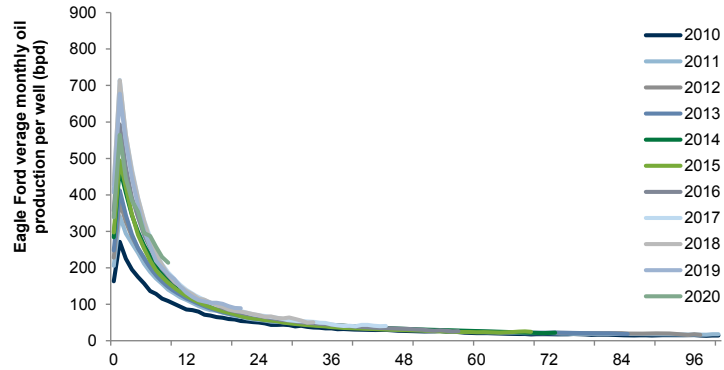


Source: Company data, Goldman Sachs Global Investment Research

# ...while the Bakken and Eagle Ford continue to see higher IP rates and faster declines

**Exhibit 124: Initial Production rates have moderately increased in the Eagle Ford, but production converges rapidly...**

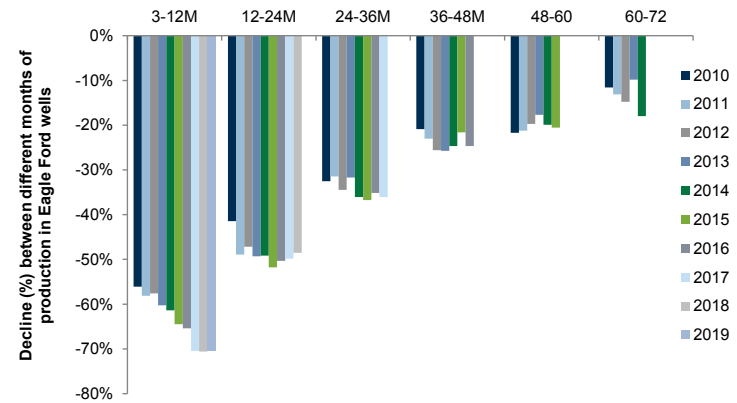
Eagle Ford average oil production (bpd) by month per well



Source: IHS, Goldman Sachs Global Investment Research

**Exhibit 125: ...due to accelerated rates of declines across wells of all ages**

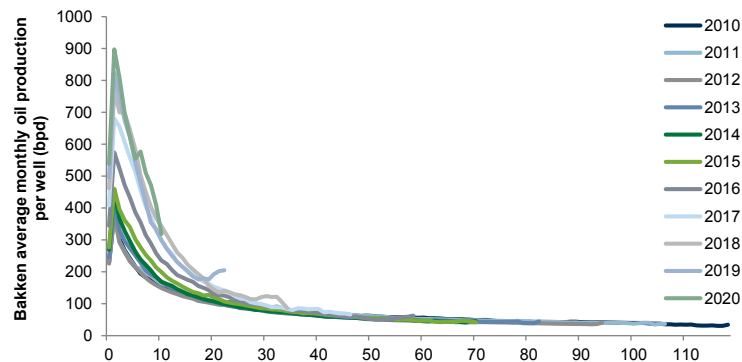
Decline in % between different months of production in Eagle Ford wells



Source: IHS, Goldman Sachs Global Investment Research

**Exhibit 126: The Bakken continues to see significant improvements in early months...**

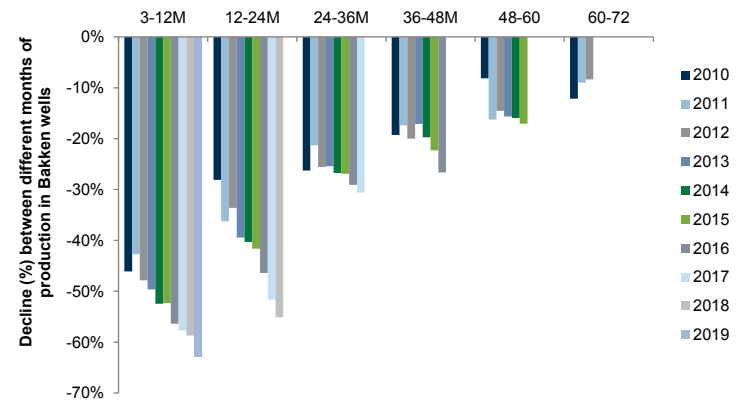
Bakken average oil production (bpd) by month per well



Source: IHS, Goldman Sachs Global Investment Research

**Exhibit 127: ...albeit at the cost of increased mid life decline rates**

Decline in % between different months of production in Bakken wells



Source: IHS, Goldman Sachs Global Investment Research



## US differentials

**Brent-WTI.** We estimate Brent-WTI differentials averaging ~\$3/bbl in 2021/2022 and \$4/bbl in 2023+ versus current levels near \$3.50/bbl. While crude inventories in the US have built significantly in February/March 2021 following refining outages on the US Gulf Coast and Mid-Continent as a result of severe winter weather, we expect a normalization as the macro recovers. US crude inventories (ex-SPR) have built by 36 mn barrels since February 12, 2021 before the winter weather impacts and as of March 5 stood at 498 mn barrels versus the five-year average of 461 mn barrels. As refining runs recover and demand continues to increase as the vaccine roll out progresses, we expect crude inventories to draw, driving a slight tightening of spreads back towards \$3/bbl. In our view, discipline by US shale producers, which remains a key focus area for investors, as well as the steep drop off in 2020 activity/production, will prevent Brent-WTI spreads from widening significantly back towards levels seen in 2018/2019 where differentials averaged ~\$7/bbl. On a normalized basis, we expect the differential to be based off transportation economics, which remain under pressure given significant pipeline capacity and lower oil production in the US versus recent history.

**Brent-Bakken.** Crude differentials in the Bakken compressed over the last year as production in the basin has fallen significantly due to COVID-19 impacts. Brent-Bakken has averaged ~\$4/bbl ytd versus 1Q2020 levels of ~\$9/bbl and we forecast spreads of \$5/\$6 per barrel in 2021/2022 as production begins to recover. Our long-term forecast is \$7/bbl, which assumes pipeline economics to clear the Bakken. The key focus item, in our view, as it relates to the Bakken is the future of the Dakota Access Pipeline (~570 kbpd current capacity with potential to ramp to 745 kbpd in 2H2021), which we currently still embed in our balances. As discussed [here](#), a DC Appeals Court judgment from late January stated that an Environmental Impact Statement (EIS) must be conducted but the US Army Corp of Engineers to decide if the pipeline can remain in service while the EIS is being conducted. Litigation on the pipeline is ongoing, with the next update on whether the pipeline can continue to flow expected on April 9. To the extent DAPL is shut for an extended period, we would see upside risk to our Brent-Bakken differential forecasts.

**WTI-Midland.** We expect Midland to continue to trade at a premium to WTI-Cushing and have a WTI-Midland forecast of \$(0.25)/\$(0.50) in 2021/2022 and \$(1.50)/bbl in 2023+. We believe the Permian basin will remain overbuilt pipe over the extent of our modeling through 2025. As incremental pipeline capacity comes into service through 2021/2022, we forecast a widening of the differential into the out years. We expect EPD's Midland to Echo 3 to reach its full 450 kbpd capacity by 1Q2021 and Wink to Webster (1.05 mn bpd) to reach full in service by 4Q2021 though the Midland to Webster portion of the pipeline has been in operation since January 2021. As the Permian production path has been reset lower following COVID, we believe the Permian basin will have over 800 kbpd of excess pipeline takeaway capacity versus our production estimates.

**Brent-WCS.** We currently see a path for Brent-WCS to trade to \$16.25/\$16.50 per barrel in 2021/2022 and \$16/bbl in 2023+

versus quarter to date levels of ~\$15.50/bbl. We expect a recovery in 2021 production will drive spreads wider in the near term as companies normalize following 2020 COVID impacts as well as the removal of Alberta government curtailments in December 2020. That said, focus remains on two key pipelines, Enbridge's Line 3 Replacement and the TransMountain Expansion, to drive our forecast to \$16/bbl on a long-term basis, which includes WTI-WCS spreads of \$12/bbl and Brent-WTI of \$4/bbl. We expect Line 3 to reach its full 370 kbpd capacity in 1Q2022 and see TMX reaching its full 590 kbpd capacity in 2Q2023. Following the revocation of the permit for the Keystone XL pipeline, we have removed it from our estimates. We now see Western Canada overbuilt starting in 2023 with the addition of TMX.

Exhibit 128: Crude oil and crude differentials in North America

	Crude Oil & Crude Differentials							
	Brent Spot Crude Oil (\$/bbl)	WTI Spot Crude Oil (\$/bbl)	Brent-WTI (\$/bbl)	Brent-Bakken (\$/bbl)	WTI-Midland (\$/bbl)	LLS-Maya	Brent-WCS (\$/bbl)	WTI-WCS (\$/bbl)
1Q19A	\$63.13	\$54.87	\$8.26	\$8.02	\$1.17	\$3.46	\$18.65	\$10.39
2Q19A	\$68.53	\$59.89	\$8.64	\$9.69	\$2.18	\$5.17	\$21.14	\$12.50
3Q19A	\$61.88	\$56.40	\$5.48	\$6.23	\$0.33	\$4.07	\$18.00	\$12.52
4Q19A	\$62.61	\$56.85	\$5.75	\$6.77	(\$0.92)	\$7.64	\$24.67	\$18.92
2019A	\$64.04	\$57.01	\$7.03	\$7.68	\$0.69	\$5.09	\$20.61	\$13.58
1Q20A	\$51.05	\$45.98	\$5.07	\$8.41	(\$0.05)	\$6.94	\$22.67	\$17.60
2Q20A	\$31.14	\$27.65	\$3.49	\$6.67	(\$0.42)	\$5.87	\$11.79	\$8.31
3Q20A	\$42.70	\$40.89	\$1.81	\$3.03	(\$0.15)	\$3.31	\$11.55	\$9.74
4Q20A	\$44.47	\$42.50	\$1.97	\$3.91	(\$0.42)	\$3.52	\$13.19	\$11.22
2020A	\$42.34	\$39.25	\$3.08	\$5.50	(\$0.26)	\$4.91	\$14.80	\$11.72
1Q21E	\$60.44	\$57.50	\$2.94	\$4.94	\$0.00	\$5.00	\$17.00	\$14.06
2Q21E	\$75.00	\$72.50	\$2.50	\$4.50	\$0.00	\$5.00	\$12.50	\$10.00
3Q21E	\$80.00	\$77.00	\$3.00	\$6.00	(\$0.50)	\$5.00	\$18.00	\$15.00
4Q21E	\$75.00	\$72.00	\$3.00	\$6.00	(\$0.50)	\$5.00	\$17.50	\$14.50
2021E	\$72.61	\$69.75	\$2.86	\$5.36	(\$0.25)	\$5.00	\$16.25	\$13.39
2022E	\$75.00	\$72.00	\$3.00	\$6.00	(\$0.50)	\$7.00	\$16.50	\$13.50
2023E	\$60.00	\$56.00	\$4.00	\$7.00	(\$1.50)	\$7.94	\$16.00	\$12.00

Source: Bloomberg, Goldman Sachs Global Investment Research

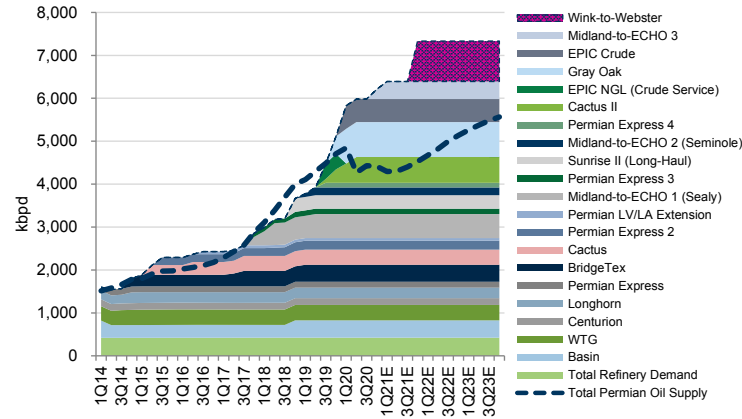
Exhibit 129: Map summarizing key regional oil price and differential assumptions



Source: Goldman Sachs Global Investment Research

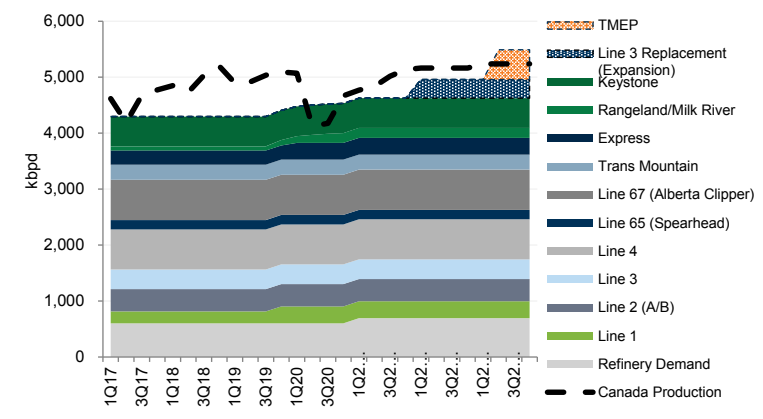
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**Exhibit 130: The Permian is shifting from pipeline undersupply to pipeline oversupply**  
Permian takeaway capacity model (kbpd)



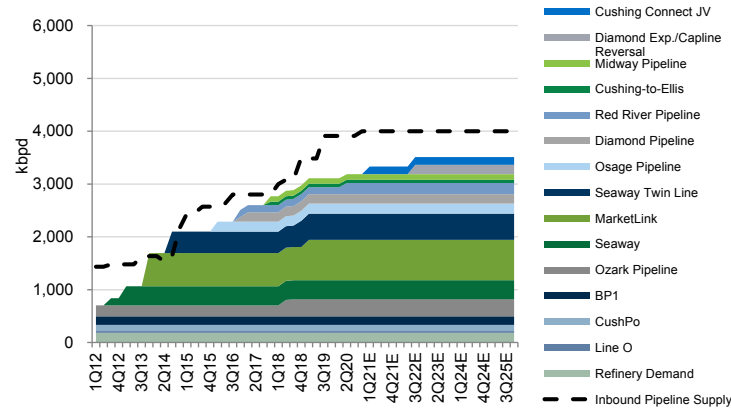
Source: Goldman Sachs Global Investment Research

**Exhibit 131: The Alberta cuts do not sustainably solve the takeaway imbalances in our view**  
Western Canadian pipeline takeaway capacity (kbpd)



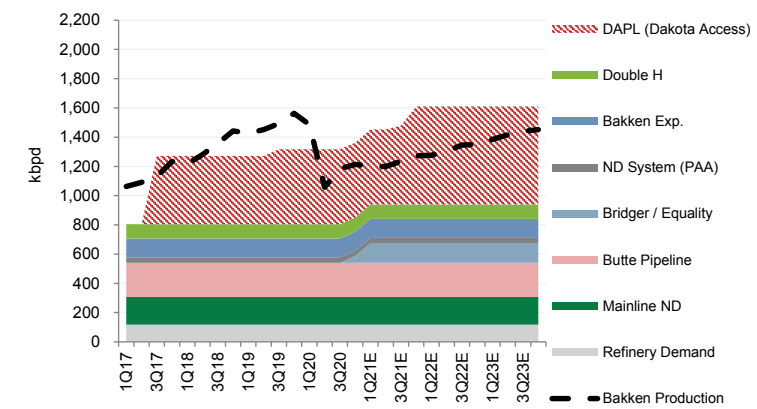
Source: Goldman Sachs Global Investment Research

**Exhibit 132: Cushing inbound pipeline supply continues to surpass takeaway capacity**  
Pipeline takeaway capacity in Cushing (kblp)



Source: Company data, Goldman Sachs Global Investment Research

**Exhibit 133: Bakken basin is likely to clear via rail near term and eventually via pipeline**  
Bakken takeaway capacity model (mn bpd)



Source: Goldman Sachs Global Investment Research

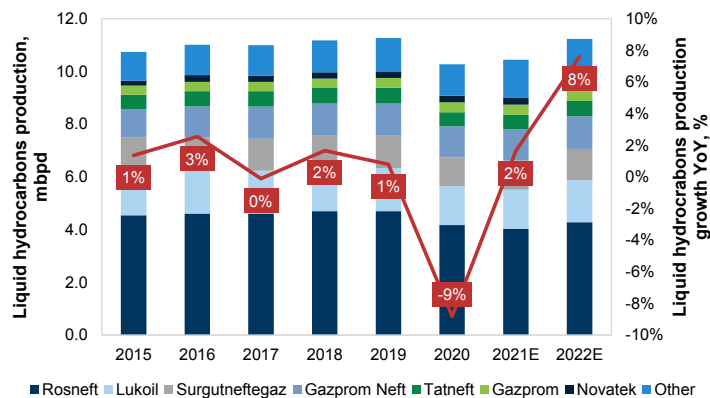
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## Russian oil production growth remains limited by OPEC+ cuts

As we expect global oil demand to continue recovering in 2021, we believe that the Russian oils' output of liquid hydrocarbons will also recover in 2021/22 (vs. 2020) as certain OPEC+ restrictions ease. However, we believe that Russian liquid hydrocarbons production will remain below 2019 levels in 2021/22 despite some output increase. This is mainly driven by two factors. First, Russia remains committed to OPEC+ production cuts and the amount of production growth remains subject to quotas as far as OPEC+ limitations remain in place. Second, since 2017, Russian oils' combined upstream capex has been gradually declining in ruble terms. While part of this capex decrease has been related to production cuts measures, we note that several greenfield project ramp ups were postponed during this period, as production growth is limited by the OPEC/Russia agreement. We believe this has resulted in lower potential Russian production capacity in the near term. Hence, while we continue to believe that Russia remains able to return to pre-cut production levels in a relatively short time (six months), we believe it will require more time and potentially investment from Russian oils to further increase production.

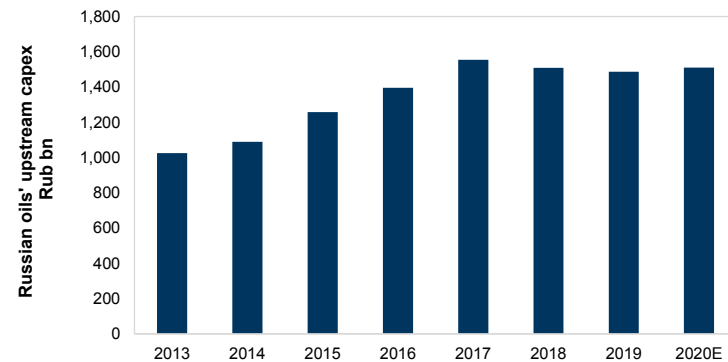
**Exhibit 134: We expect Russian liquid hydrocarbons production to remain below 2019 levels in 2021/22**

Russian liquid hydrocarbons production by company (mbpd) and YoY production growth (%)



**Exhibit 135: Russian oils' upstream capex has gradually declined since 2017**

Russian oils' combined upstream capex, Rub bn



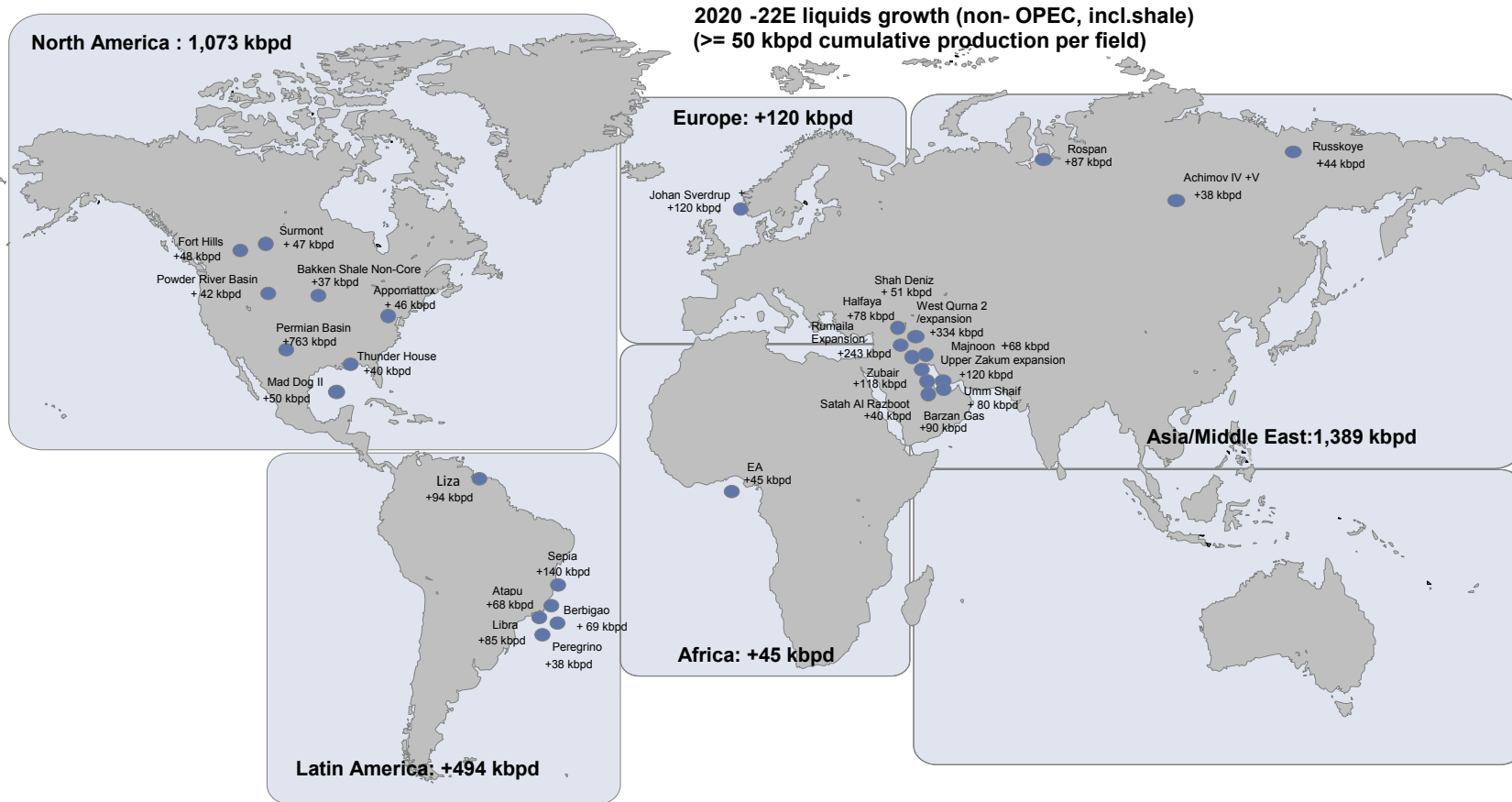
Source: CDU TEK, Company data, Goldman Sachs Global Investment Research

Source: Company data, Goldman Sachs Global Investment Research

# Growth map: Key projects that drive oil growth to 2022E

## Exhibit 136: 2020-22E key non-OPEC growth projects

Non-OPEC (including shale) projects that contribute at least 35 kbpd of liquids production growth by 2021 on our estimates



Source: Goldman Sachs Global Investment Research

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## Project FIDs: Muted for 2021E before cautious re-ignition in 2022E

### Exhibit 137: A very thin pipeline of FIDs in 2021E before moderate recovery in 2022E

Projects/phases expected to be sanctioned in 2021/22E

FID date	Field	Phase	Country	Winzone	Reserves (mnboe)		US\$m Capex	kboe/d Peak oil	Phase start
					Oil	Gas			
<b>2021</b>									
	Qatar LNG Expansion	Train 1	Qatar	LNG	679	2,031	6,050	0	2025
	Ling Shui 25-1		China	Gas	0	404	2,947	50	2024
	BM-S-8	FPSO 1	Brazil	Deepwater	1,276	0	4,222	200	2025
	Jubarte Cachalote	Jubarte Cachalote-Sul Pq. Baleias	Brazil	Deepwater	278	0	2,199	90	2025
	Barossa		Australia	Gas	47	471	5,530	91	2025
	Uganda, blocks 1, 2 & 3		Uganda	Traditional	1,380	0	6,450	230	2025
	Sakakemang		Indonesia	Unconventional Gas	0	268	1,825	64	2024
	Wahoo		Brazil	Deepwater	137	0	1,534	50	2025
	Whale		US	Deepwater	317	146	3,125	113	2025
	Zama		Mexico	Traditional	655	0	3,650	145	2025
<b>2022</b>									
	Liza	Liza3+Liza Deep	Guyana	Deepwater	971	0	6,150	209	2026
	Pikka	Pikka	US	Traditional	468	0	2,795	100	2026
	Girassol	Satellites	Angola	Deepwater	69	0	448	30	2024
	Laggan Tormore	Glendronach	UK	Gas	0	109	1,700	55	2026
	Atoll Gas	Atoll Gas Phase 2	Egypt	Gas	34	286	1,600	25	2024
	Block SK408	Jerun	Malaysia	Gas	34	281	1,720	95	2025
	Marine XII	Nene Marine 3	Congo	Traditional	51	0	547	15	2025
	Qatar LNG Expansion	Train 2	Qatar	LNG	679	1,970	6,050	0	2026
	Buzios	Buzios 6	Brazil	Deepwater	760	95	6,066	180	2025
	Angelin, Cassia, Cypre	Cypre	Trinidad	Gas	5	168	860	55	2026
	NOAKA	Kraffa Askja Area	Norway	Traditional	142	71	4,750	70	2027
	Wisting Central		Norway	Traditional	452	0	6,550	100	2027
	Scarborough LNG		Australia	LNG	0	1,292	6,925	0	2026
	Block SK318		Malaysia	Gas	0	377	1,830	95	2026
	Farfan		Brazil	Deepwater	315	47	3,715	104	2026
	Block SK410		Malaysia	Gas	41	346	2,000	10	2025

Source: Company data, Goldman Sachs Global Investment Research

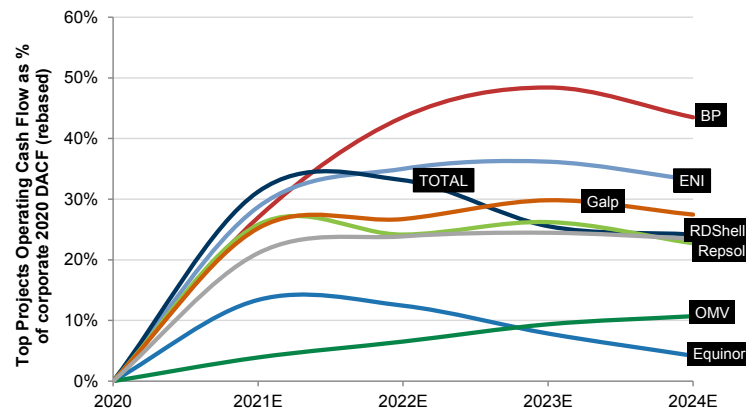
# Company analysis: Top Projects drive cash flow growth, production and capex

## Europe: BP stands out among super majors with superior cash flow growth

In our view, Top Projects will drive a material cash flow uplift for a number of global upstream companies from 2021, as industry dynamics start to normalize. In Europe, BP clearly stands out this year among the super-majors and sees the largest operating cash flow uplift from Top Projects through 2023, on our estimates. We expect a record number of project start-ups, including Mad Dog II, Atlantis Phase 3, Thunder Horse expansion in the US GoM, Angelin, Cassia and Cypre in Trinidad, to support BP's strong OCF growth.

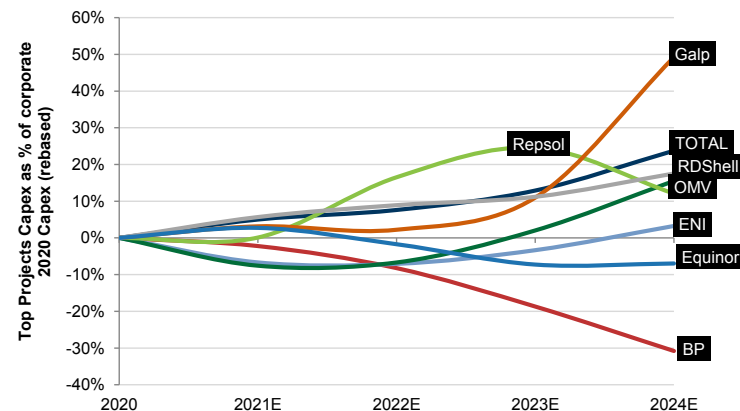
Owing to the challenging macro environment in 2020, which reinforced capital discipline across the industry, we expect capex to remain broadly flat in 2021 for Big Oils before starting to normalize in 2022. We believe BP and Equinor will see the biggest drop in projects capex relative to corporate capex as large projects come onstream and rapidly ramp up towards peak capacity. As per Top Projects, spending remains elevated for Galp, rapidly growing towards the end of the decade owing to large investments required for giant LNG projects in Mozambique.

**Exhibit 138: With major projects ramping up, including an increasing focus on brownfield, we expect BP should see a material cash flow uplift near term...**  
 Top Projects 2021 OCF as % of 2020 corporate DACF (rebased)



Source: Company data, Goldman Sachs Global Investment Research

**Exhibit 139: ...while BP also offers the strongest combination of rising OCF and falling capex commitments, in our view**  
 Top Projects 2021 capex as % of 2020 corporate capex (rebased)



Source: Company data, Goldman Sachs Global Investment Research



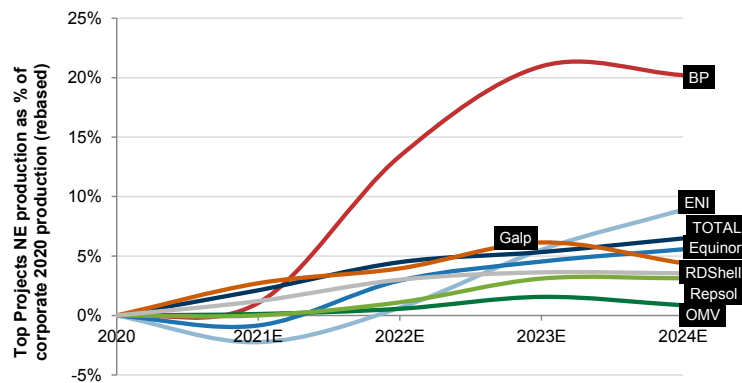
**Europe: GALP maintains its leadership on resource life; BP on the cusp of delivering one of the industry’s strongest pipelines of projects**

Although we prefer cash flow as a metric to assess a company’s potential Top Projects performance, we note that production remains an important metric to the market and thus look at the likely net entitlement production growth from each company. BP stands out among the European companies, in our view displaying among the most attractive production growth profiles vs. peers owing to a record number of projects currently coming onstream and/or in the process of ramping up.

We have also assessed the materiality of each company’s leverage to oil & gas prices and its net entitlement Top Projects reserve life vs. overall 2019 production to determine the longevity of each company’s asset base. We have split oil & gas reserves into three categories: producing (projects currently onstream), high-return (non-producing oil projects with breakeven <US\$60/b) and others (low return new projects, including stranded projects). In this context, Galp stands out as having the highest reserve life in the sector, with TOTAL and BP best placed among the European super-majors.

**Exhibit 140: BP stands out in terms of production growth expected from Top Projects, with a record number of project start-ups and ramp-ups to 2023...**

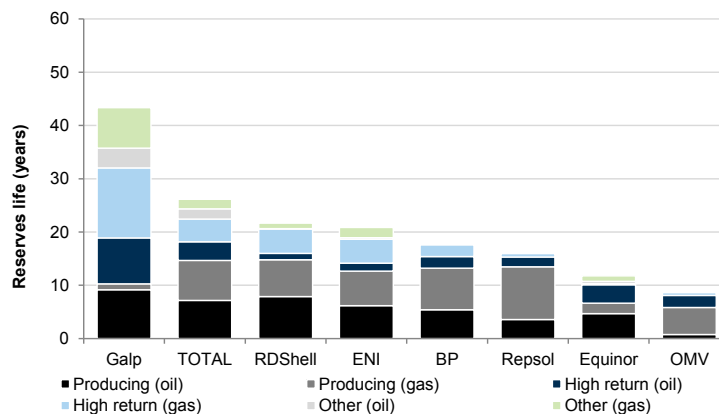
Top Projects 2021 net entitlement production as % of corporate 2020 production (rebased)



Source: Company data, Goldman Sachs Global Investment Research

**Exhibit 141: ...while Galp and TOTAL score best out of the European Big Oils on reserve life**

Based on remaining net entitlement volumes vs. 2020 production; high return oil projects breakeven <\$60/b; P/I >1.0 for gas



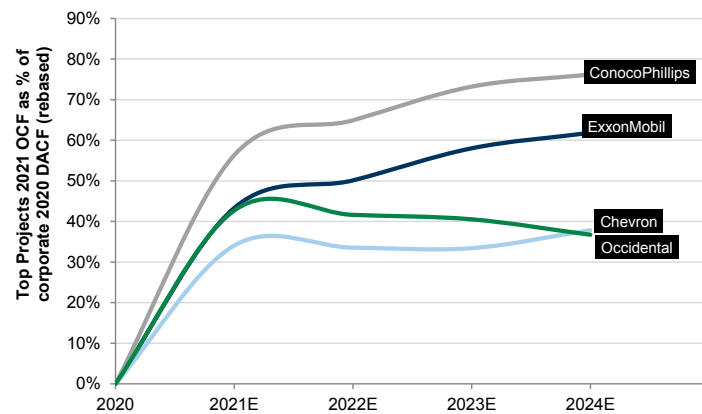
Source: Company data, Goldman Sachs Global Investment Research

### US diversified: Exxon Mobil taking leading position among US Big Oils

Exxon Mobil and ConocoPhillips display an attractive growth profile for the next few years as offshore projects start/ramp up, particularly Guyana for Exxon, further supported by growth in the profitable Permian basin for both. Exxon Mobil looks to be taking the leadership position among US Big Oils in terms of Top Projects net cash flow growth, largely owing to Guyana. For ConocoPhillips, the cash flow generation from high production growth profile is partly offset by a higher relative capex profile over the coming years compared to the rest of US Big Oils. As projects are likely to progressively come onstream, we expect Chevron to continue reducing its capex by the end of the decade relative to 2020 levels.

**Exhibit 142: ExxonMobil and Conoco lead the US Big Oils pack as their large pipelines of projects ramp up towards peak capacity...**

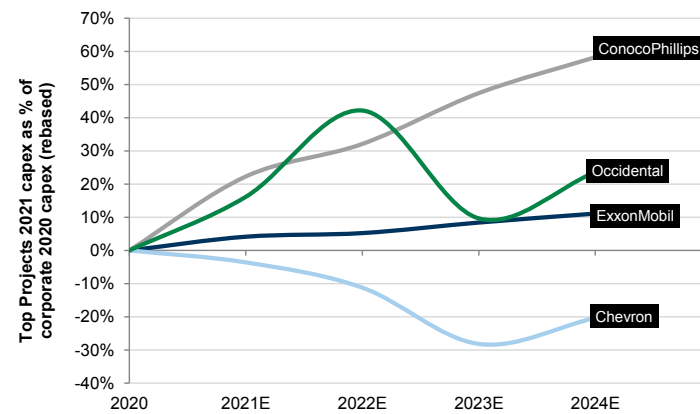
Top Projects 2021 OCF as % of corporate 2020 DACF (rebased)



Source: Company data, Goldman Sachs Global Investment Research

**Exhibit 143: ...yet ConocoPhillips is also the company with the highest capital expenditure commitments in the coming years**

Top Projects 2021 capex as % of 2020 corporate capex (rebased)



Source: Company data, Goldman Sachs Global Investment Research

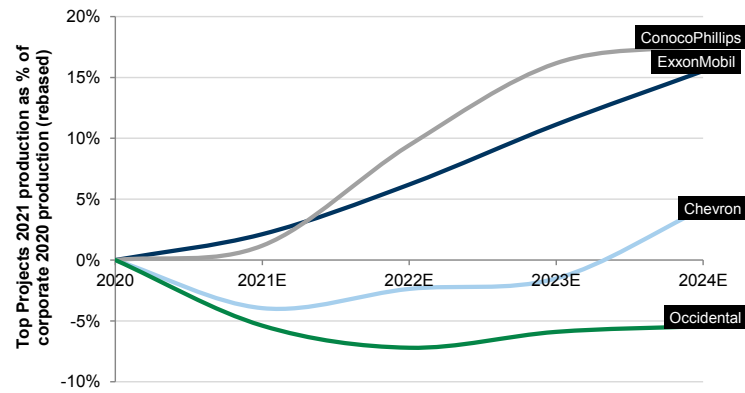
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**US diversified: Large US unconventional resources offer high resource life**

Exposure to the Permian is driving a high resource life for the US super-majors. We believe Devon’s and ConocoPhillip’s high resource life is supported by their exposure to prolific US unconventional resources (i.e. Permian), while Exxon Mobil’s is supported by both the Permian and its Guyana assets.

**Exhibit 144: ConocoPhillips and ExxonMobil lead US Big Oils in terms of Top Projects production growth in the coming years**

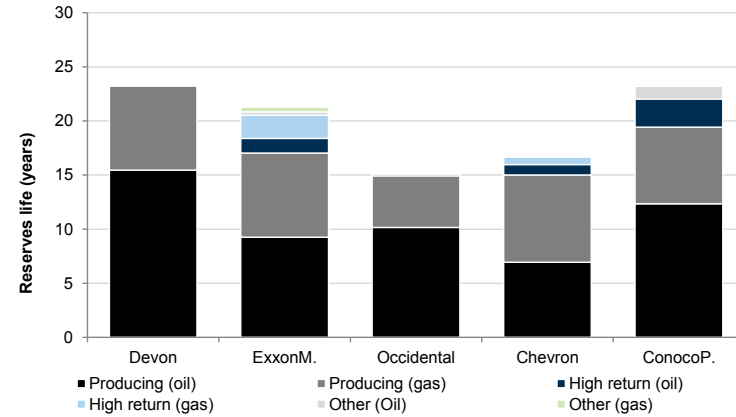
Top Projects 2021 net entitlement production as % of corporate 2020 production (rebased)



Source: Company data, Goldman Sachs Global Investment Research

**Exhibit 145: Devon and COP (following the acquisition of Concho) have the highest reserve life driven by their exposure to giant unconventional resources in the US**

Based on remaining net entitlement volumes vs. 2020 production; high return oil projects breakeven <\$60/b; high return gas projects have P/I >1.0x



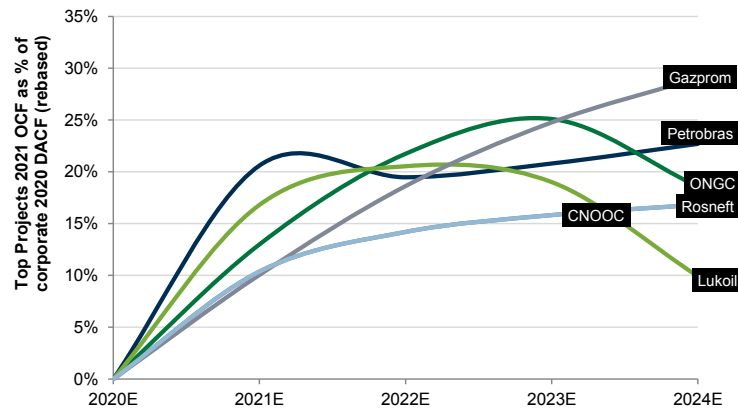
Source: Company data, Goldman Sachs Global Investment Research

**RoW: Petrobras and Gazprom see the biggest cash flow uplift**

Petrobras and Gazprom see the largest cash flow uplift from Top Projects among the large-cap producers outside of Europe and the US. Petrobras continues to benefit from the ongoing ramp-up of giant projects in the Santos basin, with a large number of FPSOs coming onstream or ramping up in the near term. There is a relatively wide range of capex outlooks for EM oils, with the Russian Oils Top Projects capex constantly falling through 2023 on our estimates.

**Exhibit 146: Petrobras and Gazprom have the most attractive cash flow growth near term (2020-24E)...**

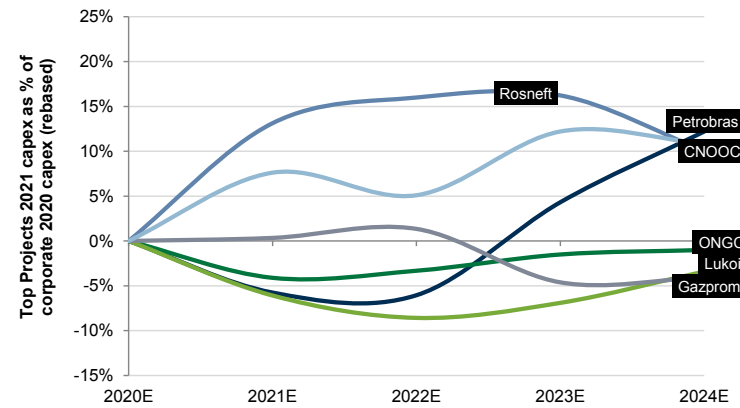
Top Projects 2021 OCF as % of 2020 corporate DACF



Source: Company data, Goldman Sachs Global Investment Research

**Exhibit 147: ...while the Russian Oils appear to have the lowest capex commitments in the near term (excl. Rosneft)**

Top Projects 2021 capex as % of 2020 corporate capex (rebased)



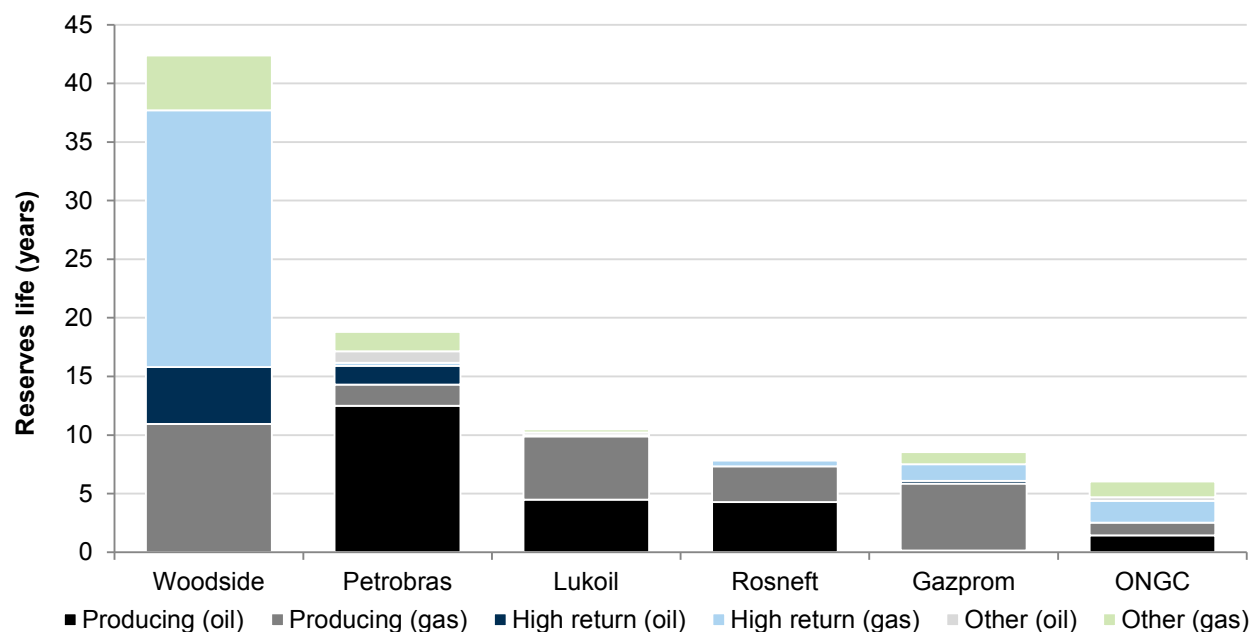
Source: Company data, Goldman Sachs Global Investment Research

**RoW: Petrobras has one of the longest Top Projects reserve life; Russian exposure is high return**

There is a significant divergence in the materiality of Top Projects exposure among the global players. Woodside and Petrobras are by far the most exposed to Top Projects and have a Top Projects reserve life of >20 years. Petrobras' long reserves life is a result of its exceptional exploration success offshore Brazil, with a leadership position in what we view as the most profitable non-OPEC basin with scale: the pre-salt Santos basin. For Woodside, while its resource access screens well in Top Projects, we believe the company's ability to optimize exposure to the various projects, drive down costs and execute well in development will be key. Part of the management of the lower return profile is the company is aiming to introduce a lower cost of capital through sell down of the infrastructure to a pension fund or infrastructure investor under a toll payment. Other EM players have less exposure, partly as a result of high levels of legacy asset production not included in the Top Projects analysis (e.g. Gazprom) and partly as a result of a relatively small absolute exposure to the Top Projects dataset (e.g. ONGC). It is worth noting that the vast majority of reserves for the Russian oils are high return.

**Exhibit 148: Adjusted for field profitability, Petrobras stands out as having the longest high quality Top Projects reserves life**

Based on remaining net entitlement volumes vs. 2020 production; high return oil projects breakeven <\$60/bl; high return gas projects have P/I > 1.0x



Source: Company data, Goldman Sachs Global Investment Research

## Competitive Positioning: Superior legacy assets, higher return growth opportunity, lower risk

We look at six factors that we put into percentiles to allow us to rank each company on competitive position:

- *Production growth*: Estimated production growth over the coming four years (2020-23E), which takes into account decline rates, growth from the Top Project fields, PSC effects and other changes to the portfolio.
- *Cash flow growth from new start-ups*: Cash flow growth from Top Projects over the coming five years.
- *Quality of the portfolio of growth projects*: We estimate the NPV (as a % of GCI) and PI (Profit to Investment ratio) of each company's Top Projects portfolio of new legacy projects.
- *Opportunity set*: We add the NPV from exploration success over the past six years plus the NPV in shale oil as a percentage of current GCI. This sums up exposure to the two most important new business opportunities in the industry, in our view.
- *Risk*: We measure each company's country and technical risk using objective metrics from our Top Projects report.

Exhibit 149 shows the ranking of the global oil & gas companies on our six metrics using the new Top Projects data, with the overall percentile calculated as the average of each metric's percentile. We take companies in the top quartile in the list as the "winners" in this analysis, although this draws an arbitrary line in a continuous data series. We include in this analysis only companies that display in our Top Projects database at least two projects in a "ramp-up" stage (this includes pre-sanction and under-development projects, alongside unconventional oil and gas fields).

Overall, our analysis suggests the US companies are well placed, dominating entries in the first quartile, including Hess, EOG Resources, Conoco Phillips, Devon Energy, Continental Resources and Pioneer. European Offshore E&Ps Lundin and Aker BP emerge as the two main non-US leaders from our analysis, screening particularly well on the quality of their growth projects. From the European majors, first-quartile BP screen best, with ENI, Equinor and GALP and TOTAL also screening well, in the second quartile of our analysis. Top Projects does not model in detail the differentiated economics of each company's acreage within each shale basin.

We also compare competitive positioning with the Top Projects edition published in March 2019 to assess 2-year change. We look at profitability and risk of the companies' Top Projects portfolios as well as at a variety of valuation metrics and share price performance since January 2020 to see whether this change has been fully reflected in valuation. Here, the dominance of the US Shale E&Ps begins to fade, with fewer entries making it into the first quartile. Companies such as Lundin, Equinor, Gazprom and TOTAL continue to screen well, owing largely to the improving quality of their portfolio over the period, driven by improvements in NPV (as a % of CGI) as well as Profit to Investment ratios.

## Exhibit 149: Competitive positioning: E&amp;Ps screen strongly, including Hess and EOG Resources in the US, and Lundin, Aker BP and BP in Europe

Top Projects 2021	5-yr pa Top 2021 cash flow growth as % of 2021 corporate cash flow	2020-23E production CAGR	NPV of 10 years of exploration success and shale access as a % of 2021E GCI	PI of Top 2021 fields not yet at plateau	NPV of Top 2021 fields not yet at plateau as % 2021E GCI	Top 2021 technical + political risk	Overall percentile
Hess	25%	5%	30%	1.69x	69%	1.34	83%
EOG Resources	16%	9%	4%	1.00x	34%	0.54	80%
Devon Energy	24%	16%	4%	0.90x	27%	0.54	78%
Pioneer	34%	14%	-2%	1.33x	75%	0.55	77%
ConocoPhillips	16%	9%	3%	1.08x	16%	0.74	74%
Continental Resources	14%	2%	4%	1.18x	22%	0.55	73%
Aker BP	NA	0%	NA	1.81x	NA	0.39	71%
Lundin	NA	0%	NA	1.71x	NA	0.35	70%
CNOOC	5%	5%	3%	1.73x	11%	1.51	65%
Woodside	13%	4%	1%	1.16x	11%	1.17	63%
Petrobras	5%	4%	5%	1.20x	39%	1.65	62%
YPF	5%	0%	NA	1.48x	NA	0.73	61%
Cenovus	59%	14%	0%	1.30x	1%	0.92	60%
Novatek	32%	3%	0%	1.26x	32%	1.43	60%
BP	7%	1%	2%	1.32x	11%	1.31	59%
ENI	5%	2%	6%	1.46x	9%	1.53	58%
Southwestern Energy	16%	6%	0%	0.89x	14%	0.65	58%
Marathon	11%	-3%	2%	1.13x	19%	0.60	58%
ExxonMobil	13%	0%	3%	1.26x	10%	1.49	57%
Cabot Oil & Gas	14%	2%	0%	0.76x	57%	0.65	54%
Galp	6%	0%	6%	1.24x	26%	1.80	53%
Chevron	9%	2%	2%	1.06x	9%	1.45	51%
PTTEP	1%	5%	0%	1.37x	9%	0.96	50%
Equinor	1%	0%	5%	1.18x	9%	1.06	50%
Chesapeake	NA	2%	NA	0.52x	NA	0.52	49%
OMV	3%	2%	1%	1.21x	2%	0.75	49%
Occidental	7%	-2%	1%	1.02x	12%	0.82	49%
Range Resources	14%	0%	0%	0.67x	29%	0.65	48%
TOTAL	6%	0%	1%	1.33x	6%	1.59	48%
Rosneft	3%	3%	0%	1.61x	6%	1.23	46%
Kosmos Energy	9%	4%	0%	1.06x	5%	1.15	46%
Suncor	11%	4%	0%	1.18x	1%	1.20	46%
INPEX	NA	1%	NA	1.43x	NA	1.66	46%
Gazprom Neft	4%	4%	0%	1.47x	4%	1.40	44%
Oil India	5%	1%	4%	1.15x	4%	2.04	44%
Gazprom	8%	1%	0%	1.26x	2%	1.06	44%
ONGC	3%	1%	1%	1.12x	7%	1.19	44%
Ovintiv	11%	0%	0%	0.83x	8%	0.55	43%
Canadian Natural Resources	13%	2%	0%	0.91x	1%	1.30	43%
Petrochina	0%	3%	0%	1.18x	0%	0.88	40%
Diamondback Energy Inc.	13%	2%	0%	1.08x	17%	0.55	40%
Murphy	4%	2%	0%	0.98x	8%	1.00	39%
RDSHELL	5%	-1%	1%	1.17x	8%	1.60	38%
Sinopec Group	1%	3%	0%	1.27x	1%	1.15	38%
Tullow	NA	0%	NA	1.10x	NA	1.12	38%
Genel	NA	0%	NA	1.47x	NA	2.26	35%
Repsol	4%	0%	1%	0.89x	5%	1.25	34%
Ecopetrol	0%	3%	0%	1.02x	2%	1.55	33%
Oil Search	4%	-1%	0%	1.41x	7%	1.60	31%
EQT	-5%	3%	0%	0.74x	1%	0.63	30%
Lukoil	2%	3%	0%	NA	0%	1.28	29%
BHP Billiton	1%	0%	0%	1.22x	1%	1.90	28%
Origin Energy	7%	0%	0%	1.00x	0%	1.38	25%
Santos	5%	-2%	0%	1.06x	1%	1.42	23%
Apache	4%	-4%	7%	0.56x	-1%	2.49	22%
SASOL	1%	1%	0%	0.89x	1%	1.25	21%
Cairn Energy	NA	0%	NA	NA	NA	1.58	18%
Reliance	1%	0%	0%	0.78x	0%	2.08	9%

Source: Company data, Goldman Sachs Global Investment Research

**Exhibit 150: EU E&Ps, as well as certain IOCs, have improved most over the past two years in our competitive positioning analysis, driven by productivity and efficiency gains**

Changes in the portfolio of growth projects since Top Projects 2019 publication in March 2019. Note: Valuation percentile is calculated based on the average of GS estimates for EV/DACF (2021, 2022 & 2023), P/E (2022 & 2023), FCF yield (2020-23), CROCI (2020 & 2023) and a number of other relevant metrics.

Change vs. Top 2019, published March 2019	PI % change	NPV as % GCI change	10 yr Exploration + shale success as % of GCI change	Risk factor % change	Overall percentile	US\$ Share price performance since Jan 2020	Valuation percentile *
Equinor	10%	-9%	5%	-8%	82%	-4.7%	42%
Canadian Natural Resources	-10%	-14%	0%	-9%	77%	-8.7%	73%
Gazprom	-5%	1%	0%	-13%	71%	-28.2%	86%
Diamondback Energy Inc.	-25%	12%	0%	0%	69%	-18.9%	70%
PTTEP	4%	5%	0%	-9%	69%	-8.0%	56%
TOTAL	-4%	-5%	0%	1%	67%	-19.2%	33%
Petrochina	1%	-2%	0%	0%	65%	-25.2%	30%
Sinopec Group	-8%	-2%	0%	-10%	65%	-12.6%	35%
BHP Billiton	-4%	-3%	0%	3%	64%	15.5%	24%
Apache	-3%	0%	4%	367%	61%	-26.3%	57%
Lundin	-2%	NA	0%	-4%	61%	-12.6%	NA
Novatek	-10%	15%	-2%	1%	61%	-5.8%	23%
SASOL	-4%	-1%	0%	2%	60%	-28.6%	43%
Tullow	-17%	NA	0%	-5%	59%	-16.4%	NA
Suncor	1%	-8%	0%	-6%	59%	-34.3%	78%
Ovintiv	-33%	-18%	0%	-8%	59%	5%	67%
CNOOC	-1%	-6%	0%	-1%	59%	-36%	89%
Lukoil	-4%	-6%	0%	2%	57%	-18%	57%
OMV	-4%	-3%	0%	-1%	57%	-15%	38%
Reliance	5%	0%	0%	9%	56%	38%	4%
Origin Energy	-22%	-15%	0%	-1%	56%	-43%	42%
ENI	-2%	-7%	-6%	-5%	55%	-27%	52%
Oil India	-10%	-2%	-4%	2%	54%	-22%	49%
Occidental	-5%	2%	-3%	24%	51%	-33%	40%
Aker BP	6%	NA	0%	-12%	51%	-14%	NA
Repsol	-12%	-4%	-3%	-8%	51%	-24%	57%
Gazprom Neft	-10%	-10%	0%	3%	50%	-25%	54%
ONGC	-2%	-4%	-1%	0%	49%	-14%	67%
Santos	19%	-8%	0%	-3%	49%	-12%	17%
Rosneft	-10%	-6%	0%	0%	48%	4%	65%
ConocoPhillips	-14%	-8%	-4%	-10%	46%	-20%	66%
Ecopetrol	-11%	-12%	0%	5%	45%	-33%	64%
Oil Search	-1%	-12%	0%	-2%	45%	-40%	18%
BP	-4%	-5%	-2%	5%	44%	-35%	56%
Chesapeake	-33%	NA	0%	-9%	44%	NA	NA
Woodside	-13%	-17%	0%	-3%	44%	-29%	35%
RDSShell	-8%	-9%	-1%	1%	43%	-33%	51%
INPEX	-11%	NA	NA	-3%	43%	-30%	NA
Kosmos Energy	-12%	-33%	0%	-3%	42%	-46%	61%
Genel	-2%	NA	NA	1%	42%	-5%	NA
Cenovus	4%	-51%	0%	-10%	38%	-23%	88%
YPF	-11%	NA	0%	3%	35%	-62%	76%
Devon Energy	-19%	-55%	-8%	-15%	34%	-14%	71%
ExxonMobil	-7%	-10%	-2%	8%	33%	-20%	25%
Marathon	-13%	-30%	-9%	5%	33%	-20%	51%
Southwestern Energy	-41%	-29%	0%	4%	32%	90%	47%
Galp	-10%	-17%	-12%	1%	30%	-32%	33%
Petrobras	-21%	-11%	-9%	0%	30%	-47%	86%
Murphy	-22%	-33%	-3%	-8%	30%	-35%	61%
Chevron	-12%	-19%	-3%	1%	29%	-15%	29%
EQT	-28%	-268%	0%	3%	29%	69%	36%
Continental Resources	-14%	-40%	-9%	5%	28%	-25%	50%
Hess	0%	4%	-9%	12%	28%	3%	31%
EOG Resources	-11%	-21%	-10%	2%	23%	-19%	57%
Cabot Oil & Gas	-41%	-121%	0%	4%	20%	3%	19%
Range Resources	-48%	-91%	0%	4%	19%	114%	44%
Cairn Energy	-8%	NA	0%	18%	17%	-10%	NA
Pioneer	-2%	-30%	-15%	5%	11%	5%	42%

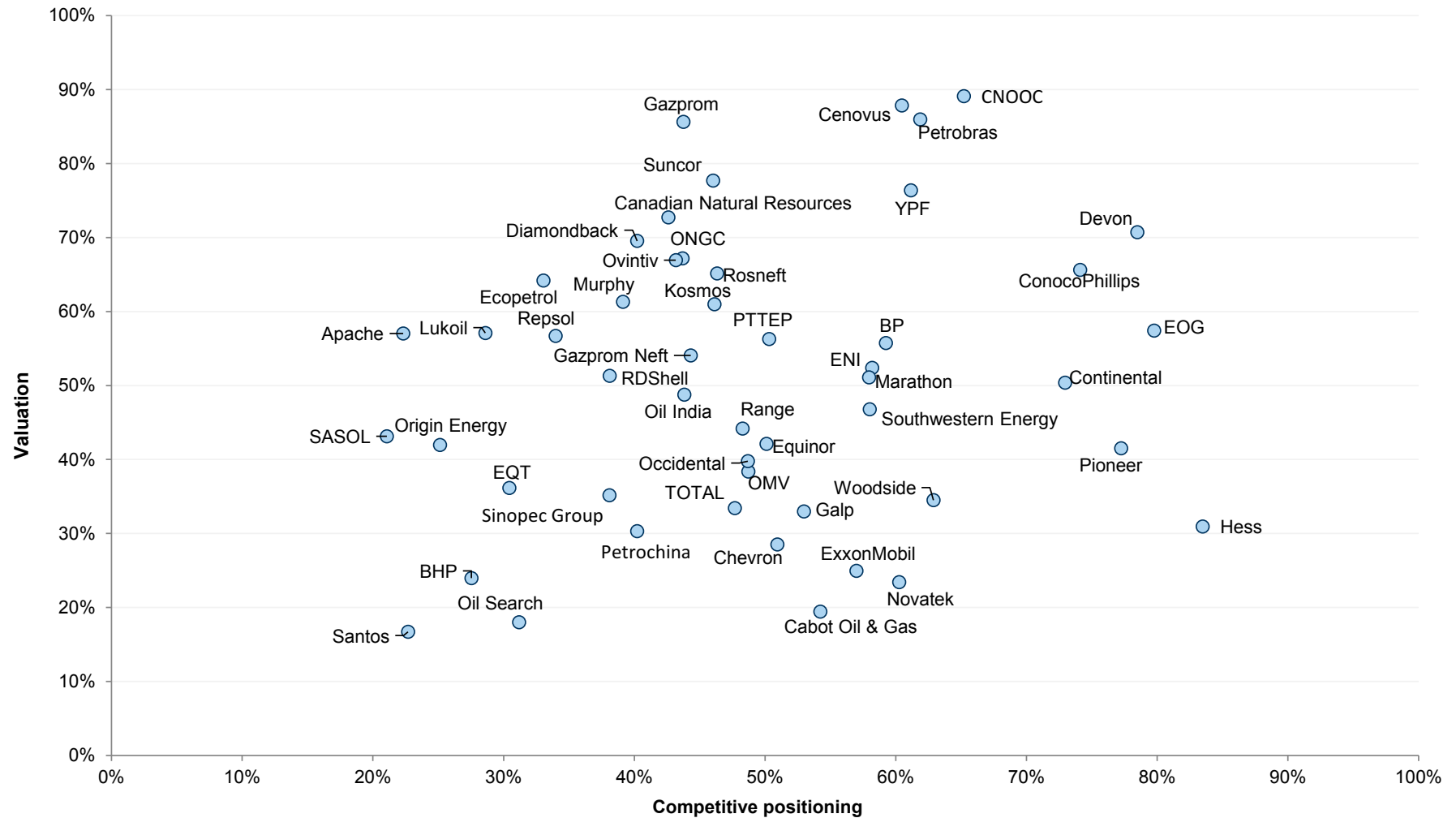
\* P/E, EV, FCF Yield & other relevant metrics based on pricing as at 22/03/2021

Source: Company data, Goldman Sachs Global Investment Research



**Exhibit 151: E&Ps screen well on the combination of competitive positioning and valuation percentile**

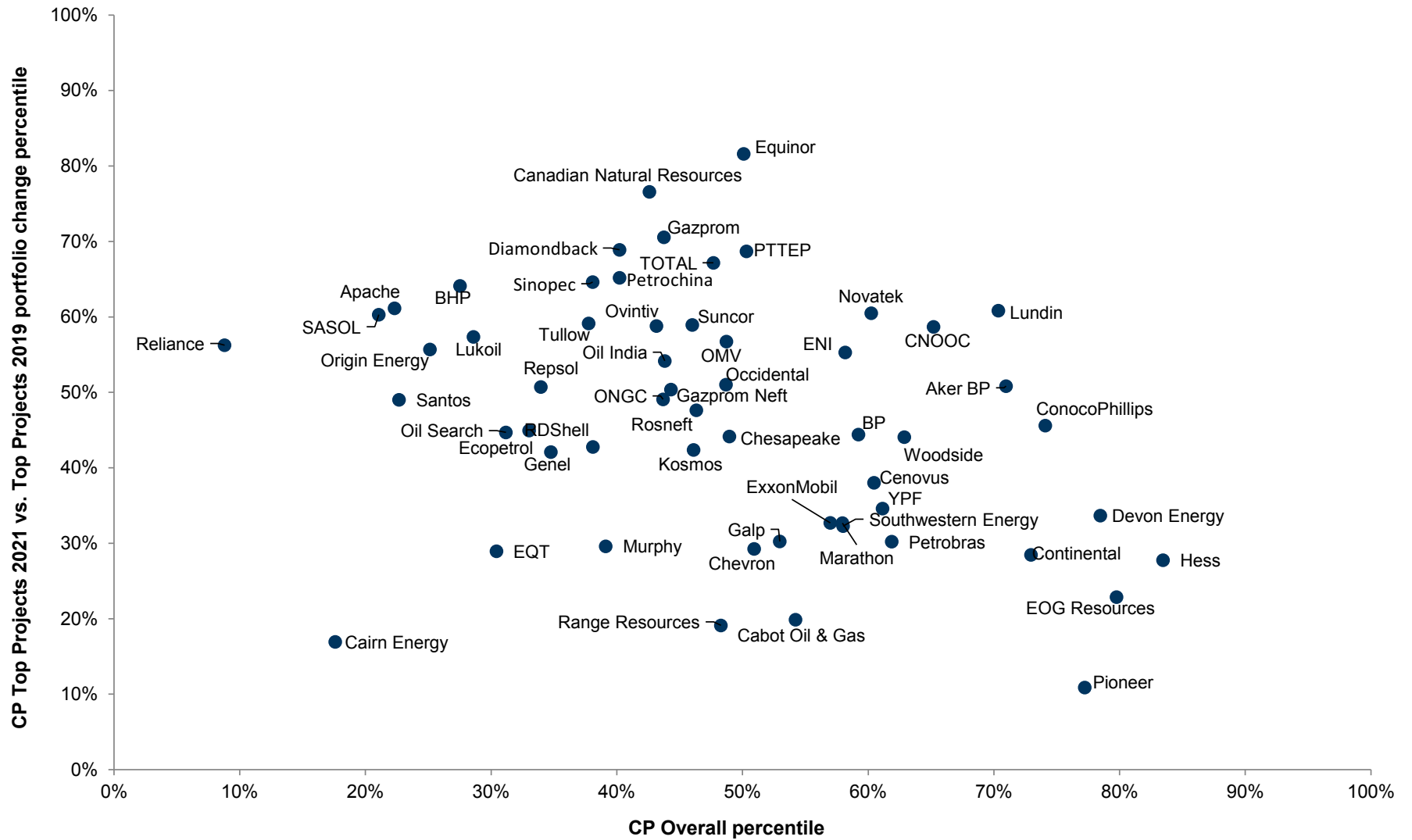
Competitive positioning (x-axis) and valuation percentile (y-axis), Top Projects 2021



Source: Company data, Goldman Sachs Global Investment Research

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**Exhibit 152: E&Ps including AkerBP, Hess and Lundin screen best on current CP and 2y change**  
 CP overall percentile (x-axis) and percentile change in Top Projects 2021 vs. Top Projects 2019 (y-axis)



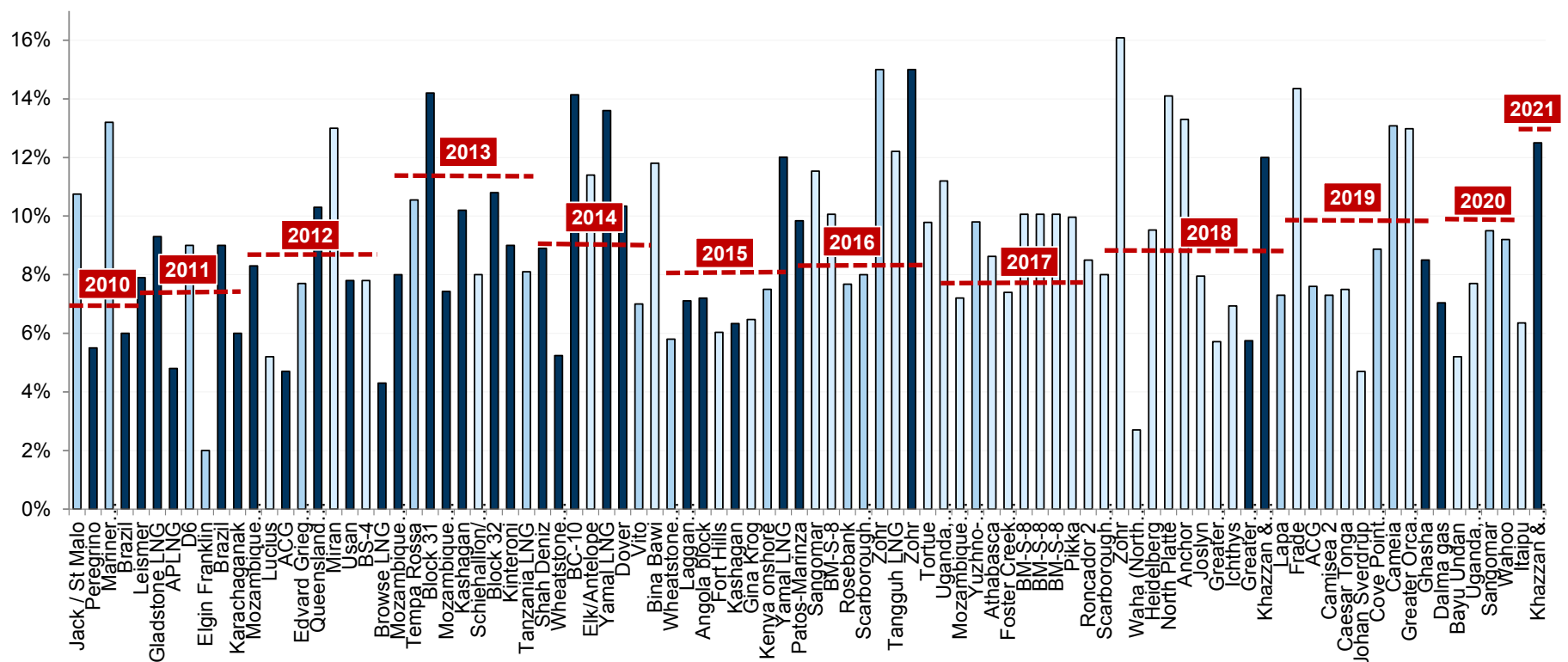
Source: Company data, Goldman Sachs Global Investment Research

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## Recent deals show IOCs are dominating the M&A market for assets again

We believe the size and scale of assets analyzed in Top Projects are advantaged relative to the industry-wide opportunity set. Strategic assets remain scarce and attract premiums as a result, as shown by the lower discount rates that the deals around Top Projects achieve. In an environment in which gaining access to low cost reserves is critical, we have seen implied discount rates for strategic assets remain around 8%-10% on average through 2015-21. We continue to think that asset transactions remain attractive as the NOCs largely left the market in 2016, allowing for more favorable negotiating positions for IOC buyers since then.

**Exhibit 153: NOCs dominated the M&A assets market until 2015, the beginning of the previous oil price downturn; since then IOCs have been more active in the M&A market**  
 Implied discount rates of recent asset deals through time based on Top Projects. Dark blue: NOCs, Light blue: Other companies including Big Oils



Source: Company data, Goldman Sachs Global Investment Research

## M&A: Companies with value and access to strategic assets

We highlight below the companies that have a high level of exposure to world-class material assets, accounting for a high percentage of their EV, and considering each country's hurdle rate assuming an 8% cost of capital. We note these estimates from Top Projects are unrisks and do not include any value for non-Top Projects assets. This is not a screen for potential M&A targets, as it includes companies with state ownership and blocking shareholders, but it shows pockets of value across the industry that may attract interest from buyers keen to increase their exposure to the industry's next generation of legacy assets.

### Exhibit 154: A number of companies have a significant portion of their portfolios in areas which typically see higher discount rates

Strategic assets at commercial and 8% WACC

Company	2021 EV (\$mn) *	NPV of Top Projects 2021 assets at commercial WACC (\$mn)	NPV of Top Projects 2021 assets at 8% WACC (\$mn)	NPV of Top Projects 2021 assets at commercial WACC (\$mn) vs. EV	NPV of Top Projects 2021 assets at 8% WACC (\$mn) vs. EV	Breakeven in \$/bbl **
Cheniere Energy	28,457	26,065	36,892	92%	130%	NA
Cenovus	23,913	19,620	28,271	82%	118%	50.55
Petrobras	117,057	95,145	125,043	81%	107%	51.43
ENI	60,870	40,429	65,749	66%	108%	35.53
Canadian Natural Resources	44,503	26,915	36,740	60%	83%	67.49
CNOOC	44,392	25,252	45,458	57%	102%	37.00
Pioneer	37,107	20,941	30,098	56%	81%	50.58
Marathon	11,533	6,345	8,335	55%	72%	56.51
Gazprom Neft	31,893	17,167	25,830	54%	81%	47.99
Oil Search	8,239	4,342	7,016	53%	85%	47.17
PDCE Energy	4,337	2,223	2,900	51%	67%	54.00
EOG Resources	38,387	19,553	26,714	51%	70%	50.04
PTTEP	14,516	7,176	11,139	49%	77%	27.00
Hess	26,907	13,223	25,589	49%	95%	39.27
BP	126,811	60,807	89,424	48%	71%	51.34
Equinor	78,108	36,796	47,985	47%	61%	30.51
Southwestern Energy	5,714	2,649	3,751	46%	66%	NA
Murphy	5,087	2,253	2,988	44%	59%	52.35
Lukoil	57,107	24,933	38,257	44%	67%	63.10

\* EV based on pricing data as at 22/03/2021

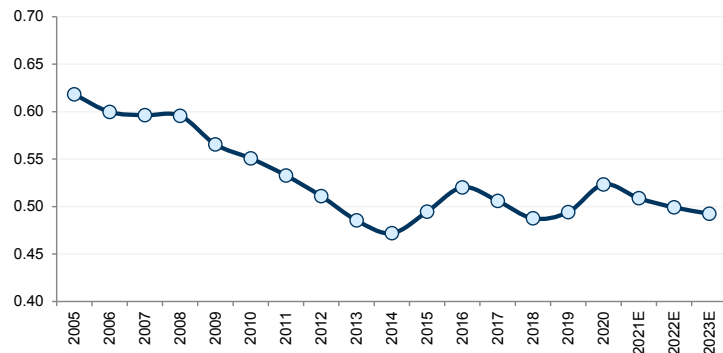
\*\* Oily Projects not yet at plateau only

Source: Goldman Sachs Global Investment Research

# Technical and country risk rise in 2020-21E as shale capex portion contracts, while project delivery gets delayed

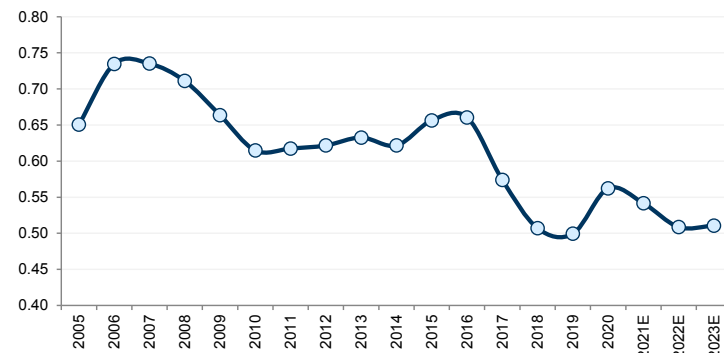
The vast resource base provided by shale replaces the need for some of the higher cost, more technically complex developments in the industry. In the previous editions of this report, both political and technical risk had been on a downwards trajectory as shale, at a rate of growth well above 1mnb/d, could effectively substitute the need for c.10 giant fields each year. These giant fields would take 4-5 years to develop, and so effectively shale substitutes the need for 40-50 giant fields under development at any point in time. However, in 2020, with the macro commodity downturn and the impact we observed on US shale production and capex, US shale shrinks as a proportion of total industry capex, resulting in an overall higher risk profile. This is consistent with the previous macro commodity downturn where the risk profile showed a moderated increase before returning to its downward trajectory path. The exhibits below show that the combination of low country risk in the US and the short-cycle manufacturing nature of shale mean that we have seen both country risk and technical risk reducing over the past 10 years (with the brief exception of 2015-16, when shale investments were temporarily curtailed) yet rising in 2020-21E as the proportion of shale in total capex substantially decreases. In addition, expected growth in capex in some riskier or new jurisdictions such as Angola, Mozambique and Guyana also contributes moderately to the overall rise in risk. We assess the risk of each Top Projects field with reference to two risk types – technical (i.e. those related to the complexity of extracting hydrocarbons from the ground) and political (the risk of doing business in a particular location).

**Exhibit 155: Country risk has reduced over time, driven largely by increased US production, with moderate reversals during times of challenging macro commodity environments...**  
 Capex-weighted country risk for Top Projects developments, 2005-23E



Source: Goldman Sachs Global Investment Research

**Exhibit 156: ...as has technical risk, with more shale investments, less in the technical frontiers of the industry (i.e. Arctic, ultra-deepwater) and more in brownfield projects**  
 Capex-weighted technical risk for Top Projects developments, 2005-23E



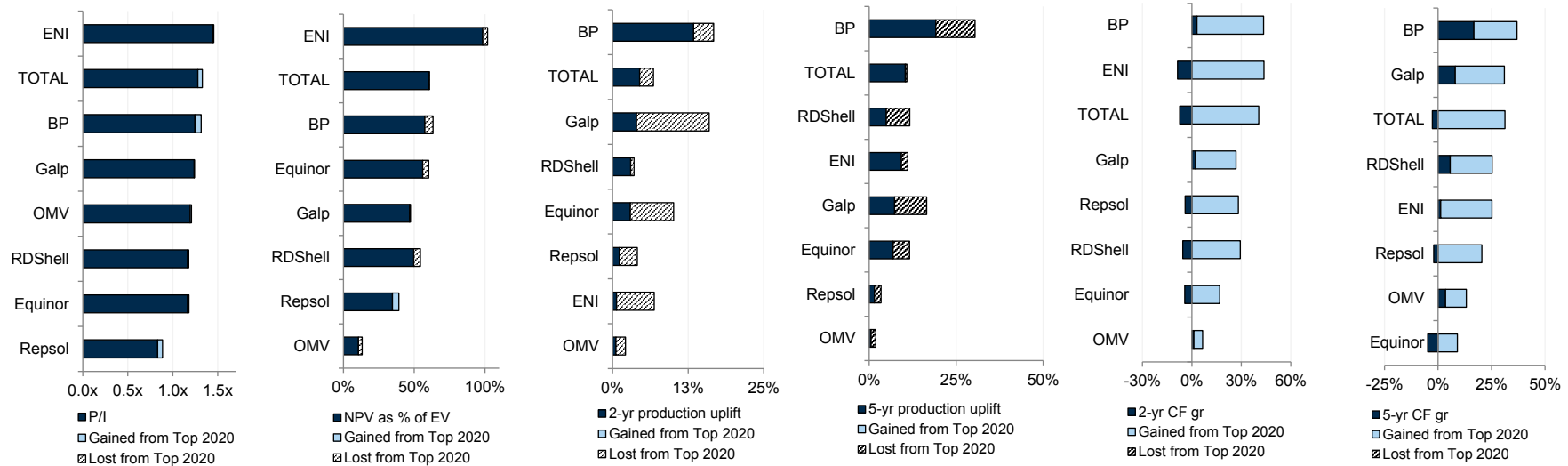
Source: Goldman Sachs Global Investment Research

## European Integrateds: ENI and BP screen well and have improved the most

Exhibit 157 compares the European majors' exposure to Top Projects on a number of key metrics (profitability, cash flow and working interest production growth) and tracks how these metrics have changed vs. last year's report. The profitability and materiality of most companies' portfolios have remained broadly flat relative to last year. Among European integrateds, BP is the company that has on average the highest performance on a number of metrics relative to last year, sitting in the first quartile for cash flow growth in the next two/five years along with ENI, TOTAL and Galp. Production growth (next two/five years) has reduced across the board as non-committed capex was delayed in 2020 (FID delays) and committed capex reduced, with BP nonetheless leading the group as the company enters what we consider a sweet spot of growth driven by the delivery of its strongest pipeline of projects in a decade. ENI screens as benefiting from a material profitability uplift, supported by the ongoing ramp-up of project Zohr and a falling capex profile. We note additions across companies on 2-year and 5-year cash flow, partly driven by our expectations of normalized oil prices as early as 2021 (vs more conservative assumptions in last year's Top Projects) and using a long-term oil price assumption at US\$60/bl.

**Exhibit 157: ENI, BP, TOTAL and Galp screen well across the board, supported by a number of new start-ups and ramp-ups**

Key Top Projects 2021 metrics and improvement/deterioration vs. Top Projects 2020



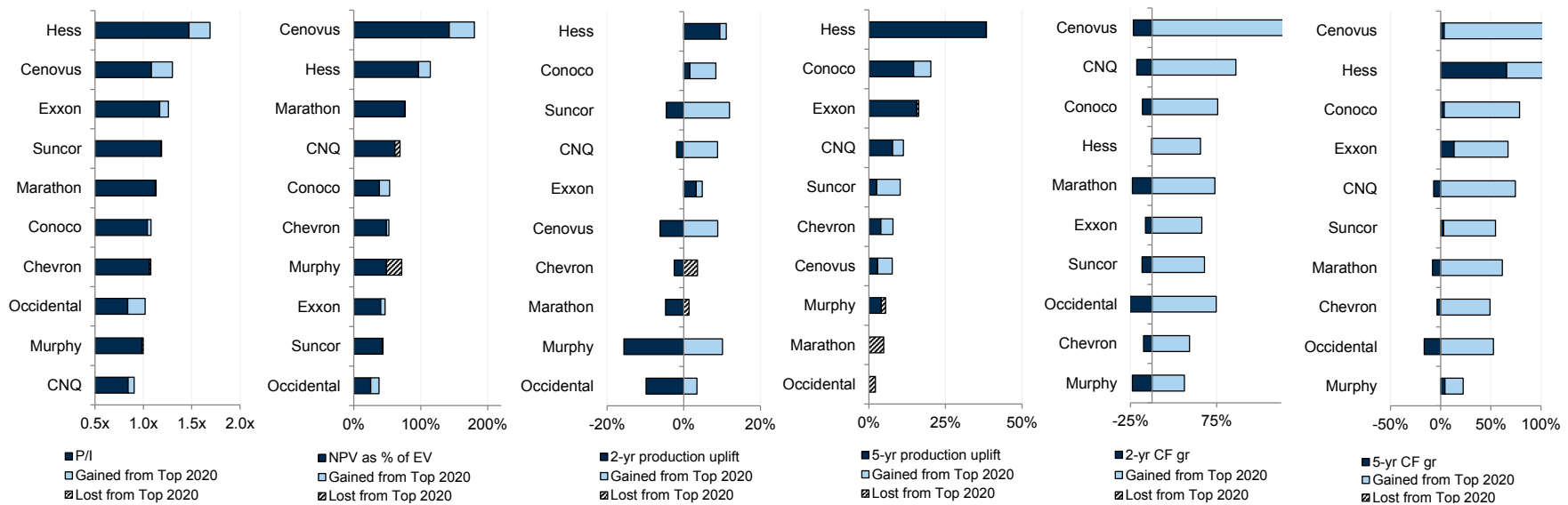
Source: Company data, Goldman Sachs Global Investment Research

# North America large cap oils: Hess and Exxon screen attractively

Exhibit 158 compares the North American large cap oils' exposure to Top Projects on a number of key metrics (profitability, cash flow and working interest production growth) and tracks how these metrics have changed vs. last year's report. Hess consistently leads on the growth metrics as it benefits from the giant Liza field, which has materially grown in size over the past year on the back of additional oil discoveries. Exxon Mobil has joined the list of companies with leading metrics on both production and profitability, mostly owing to its assets in Guyana. Suncor and Cenovus screen well in terms of profitability and cash flow, respectively. We note additions across companies on 2-year and 5-year cash flow, partly driven by our expectations of normalized oil prices as early as 2021 (vs more conservative assumptions in last year's Top Projects) and using a long-term oil price assumption at US\$60/bl.

**Exhibit 158: Hess, Exxon Mobil, Cenovus screen best among the North America large-cap names in the context of Top Projects**

Key Top Projects 2021 metrics and improvement/deterioration vs. Top Projects 2020



Source: Company data, Goldman Sachs Global Investment Research

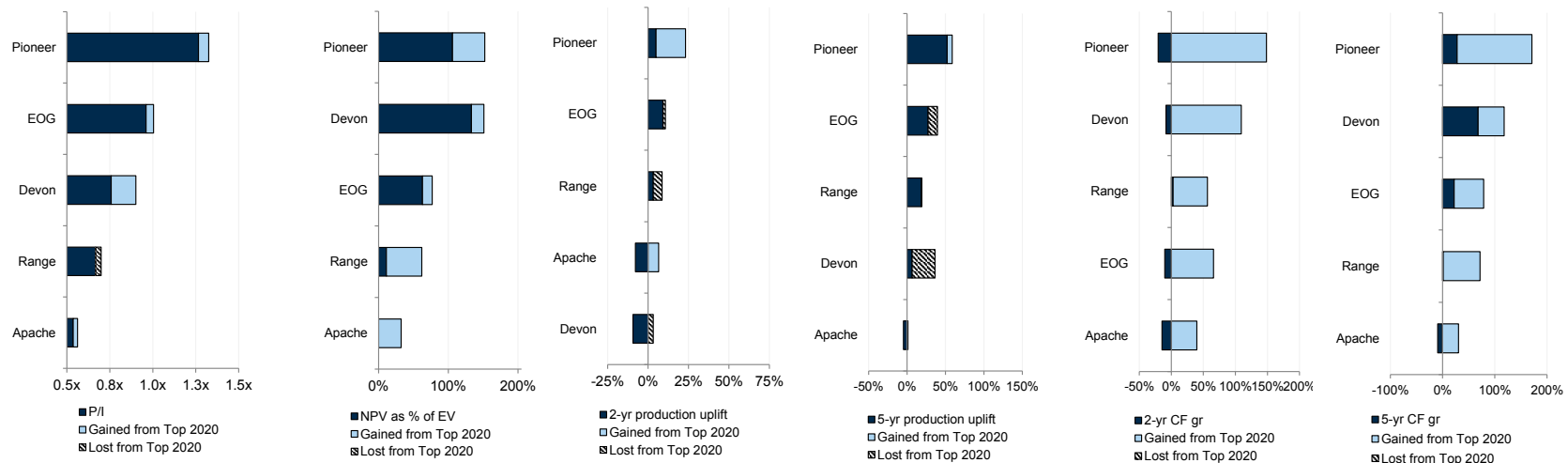
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# US E&Ps: Pioneer leads the US E&Ps pack

Exhibit 159 compares the US E&Ps' exposure to Top Projects on a number of key metrics (profitability, cash flow and working interest production growth) and tracks how these metrics have changed vs. last year's report. Pioneer dominates the table across all metrics. EOG and Devon also screen well across most metrics.

## Exhibit 159: Pioneer dominates the table across most metrics

Key Top Projects 2021 metrics and improvement/deterioration vs. Top Projects 2020



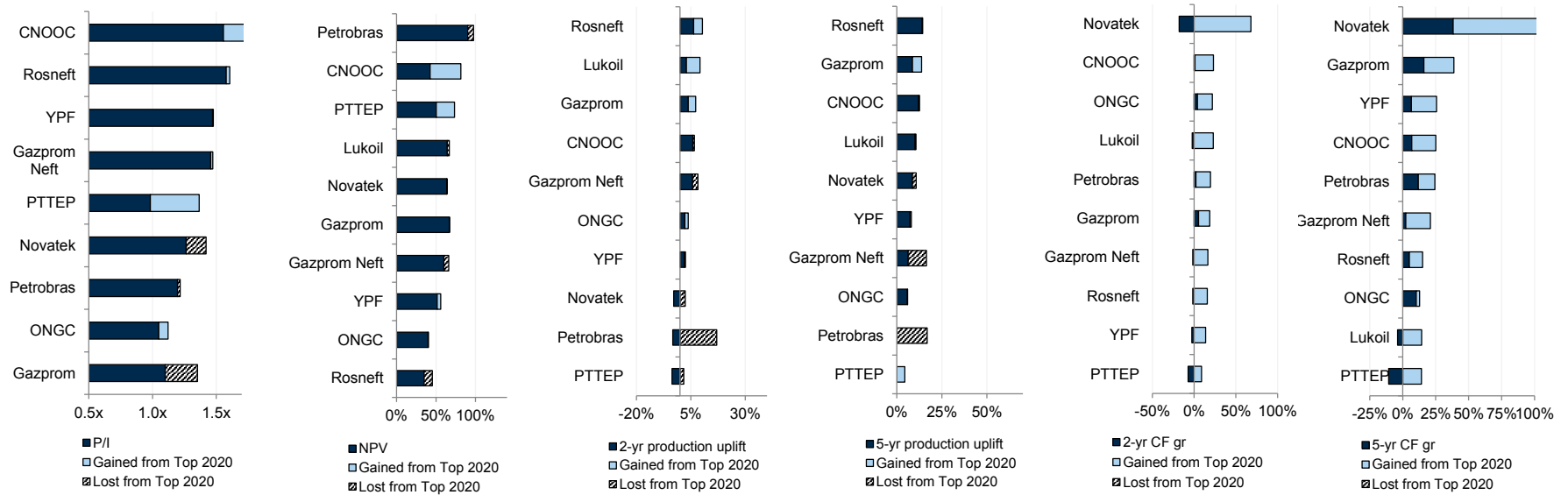
Source: Company data, Goldman Sachs Global Investment Research



## EM Integrations: Petrobras, CNOOC, Novatek, Rosneft and Gazprom screen attractively

Exhibit 160 compares the EM integrated oils' exposure to Top Projects on a number of key metrics (profitability, cash flow and working interest production growth) and tracks how these metrics have changed vs. last year's report. Petrobras screens well given its large exposure to the Santos basin, currently in a growth phase, with an important number of FPSOs coming onstream/ramping up towards peak production (e.g. Lula, Iara, Buzios) offsetting deterioration in its mature Campos basin assets. Russian oils screen consistently well, with Novatek and Gazprom screening as cash flow growth leaders over the next five years on our forecasts. CNOOC screens well in terms of production uplift, profitability and cash flow generation in the coming years. Rosneft screens best in terms of 2- and 5-year production uplift.

**Exhibit 160: Petrobras, CNOOC and Russia Oils screen well across the board**  
Key Top Projects 2021 metrics and improvement/deterioration vs. Top Projects 2020



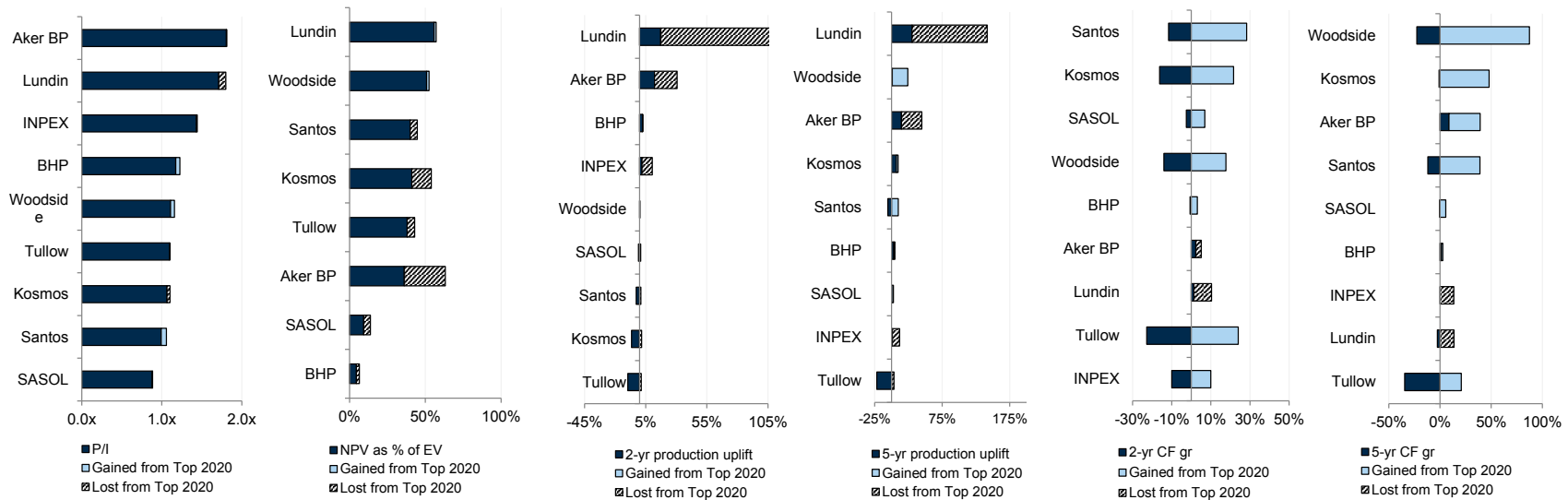
Source: Company data, Goldman Sachs Global Investment Research

## RoW E&Ps: Lundin and Aker BP rank highly on most metrics

The exhibit below compares the RoW E&Ps' exposure to Top Projects on a number of key metrics (profitability, cash flow and working interest production growth) and tracks how these metrics have changed vs. last year's report. This is a very diverse group of companies, with exposure to different basins. Among those, Aker BP and Lundin screen most favorably on profitability, cash flow and production uplift owing to the ramp-up of major projects such as Johan Sverdrup. Tullow appears a relative laggard, particularly on production and cash flow metrics.

### Exhibit 161: Aker BP and Lundin stand out with solid production and cash flow growth

Key Top Projects 2021 metrics and improvement/deterioration vs. Top Projects 2020



Source: Company data, Goldman Sachs Global Investment Research

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## Top Projects oil cost curve details: Field by field

**Exhibit 162: Top Projects 2021 oil cost curve details**

Project name	Breakeven (US\$/bbl)	Peak production (kboe/d)	Country/Region	Project name	Breakeven (US\$/bbl)	Peak production (kboe/d)	Country/Region
Johan Sverdrup	10.00	698	Norway	Permian Horizontal Midland	50.60	3,204	US
Balder X	24.90	70	Norway	Ballymore	50.65	100	US
Johan Castberg	25.00	200	Norway	Mad Dog II	50.75	120	US
Satah Al Razboot	26.50	110	UAE	Lucapa	51.20	100	Angola
Sepia	28.85	171	Brazil	Owowo	51.20	145	Nigeria
Liza	31.40	1,689	Guyana	Powder river basin	51.80	255	US
Sapinhoa South	31.60	80	Brazil	Waha (North Gialo & NC-98)	52.50	180	Libya
NOAKA	32.10	170	Norway	Bay du Nord	52.75	130	Canada
Zama	32.20	145	Mexico	Gila	52.80	100	US
Imilorskoye	32.50	80	Russia	Clair South	52.80	60	UK
Block 58 Suriname	32.55	480	Suriname	Willow	53.10	130	US
Block 31 satellites	30.60	70	Angola	Bakken Shale Core	53.80	1,725	US
Wisting Central	33.10	100	Norway	Lewis	54.75	160	Canada
Loma Campana	34.50	64	Argentina	Meadow Creek	54.80	120	Canada
Buckskin	34.10	37	US	Marine XII	58.50	50	Congo
Whale	35.15	80	US	La Amarga Chica	55.20	37	Argentina
BM-S-8	35.25	400	Brazil	Itaipu	55.50	100	Brazil
Novoportovskoye	36.00	172	Russia	Kaskida	57.60	150	US
Shpilman	36.15	60	Russia	Chissonga	58.00	140	Angola
Messoyakha	36.54	120	Russia	Pike	58.00	105	Canada
Srednebotuobinskoye	37.00	102	Russia	Trion	58.10	130	Mexico
Block 32 satellites	37.10	80	Angola	Sangomar	58.80	84	Senegal
Block 18 satellites	37.20	80	Angola	Tempa Rossa	59.20	48	Italy
Block 31 West satellites	37.50	50	Angola	Bosi	59.50	110	Nigeria
Mexico Area 1	37.85	90	Mexico	Dover	60.55	250	Canada
Orenburgskoye	38.00	63	Russia	Kirby	60.70	93	Canada
Russkoye	38.50	130	Russia	Greater Orca Lontra Development	60.75	150	Angola
Lodochnoye	38.70	42	Russia	Hebron	61.50	150	Canada
Itapu	40.35	135	Brazil	Shaikan	56.00	71	Iraq
Berbigao	41.20	128	Brazil	Block 23 Angola	61.80	80	Angola
Narrows Lake	41.45	125	Canada	Rosebank	62.00	90	UK
Vito	43.00	95	US	Telephone Lake	62.90	84	Canada
Yaregskoye	43.01	74	Russia	Appomattox	63.50	100	US
Libra	43.20	593	Brazil	MTPS	64.20	150	Congo
Yurubcheno-Tahomskoye	43.20	100	Russia	Grouse	64.25	40	Canada
Achimov IV + V	44.20	87	Russia	MEG Energy Surmont	64.30	111	Canada
Great Divide	44.50	35	Canada	Kenya onshore	64.75	160	Kenya
Shenandoah	44.75	50	US	Kurdamir	64.80	90	Iraq
Atapu	44.80	237	Brazil	Thornbury, Clyden and Saleski	65.10	40	Canada
Suzunskoye & Tagulskoye	45.00	118	Russia	Cameia	65.40	154	Angola
Sururu	45.25	80	Brazil	Cana Woodford - SCOOP	65.55	363	US
North Platte	45.40	75	US	Peregrino South	66.60	45	Brazil
Wahoo	45.60	50	Brazil	Frontier	68.80	275	Canada
BM-C-33	45.75	120	Brazil	Ugnu	69.00	60	US
Anchor	46.00	75	US	Pecan	70.00	126	Ghana
Kuyumba	46.50	213	Russia	Ogo	71.20	70	Nigeria
Alta Gohtha	46.50	60	Norway	Gregoire	75.60	60	Canada
Buzios	46.70	1,046	Brazil	Al Ghubar	76.50	50	Oman
Pikka	46.75	110	US	Joslyn	82.50	100	Canada
Aspen	46.90	150	Canada	Northern Lights	79.50	100	Canada
Sierras, Cruz de Lorena, Coiron	43.50	51	Argentina	Schiehallion Redevelopment	75.80	87	UK
BM-S-54	47.10	70	Brazil	Clair Ridge	90.50	80	UK
OPL 245	47.60	180	Nigeria	Grand Rapids	81.50	50	Canada
Bonga SW Aparo	48.00	150	Nigeria	Nsiko	82.00	100	Nigeria
Permian Horizontal Delaware	48.10	5,037	US	Jupiter	83.00	270	Brazil
Uganda, blocks 1, 2 & 3	48.30	230	Uganda	Carmon Creek	84.55	80	Canada
Trebs and Titov	49.00	80	Russia	Stampede	81.00	34	US
Farfan	49.50	90	Brazil	Leismer and Corner	85.70	50	Canada
Argentina Shale Area 1	47.00	91	Argentina	Horizon	86.00	250	Canada
Sea Lion	50.00	139	Falkland Islands	Prirazlom	131.84	84	Russia
Chonsk	50.10	75	Russia	MacKay River (Thickwood)	140.00	15	Canada

Source: Goldman Sachs Global Investment Research



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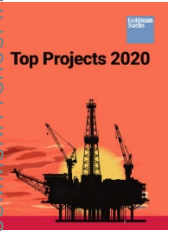
Sept 1, 2020

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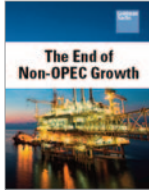
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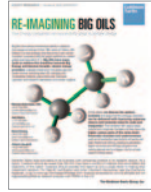
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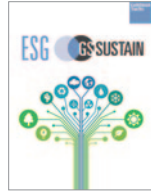
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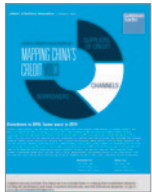
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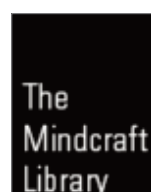
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