Note: The following is a redacted version of the original report. See inside for details.

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Carbonomics

The green engine of economic recovery

Clean tech has a major role to play in the upcoming economic recovery. Leveraging our ***Carbonomics*** cost curve, we estimate that clean tech has the potential to drive **US$1-2 tn pa of green infrastructure investments** and create 15-20 mn jobs worldwide, through public-private collaboration (e.g., "The Green Deal"). **Renewable power will become the largest area of spending in the energy industry in 2021**, on our estimates, surpassing upstream oil & gas for the first time in history, driven by bifurcating cost of capital (up to 20% for long-term oil projects, down to 3-5% for renewables). **Rising capital markets engagement** in climate change is driving this seismic shift in capital allocation, charging an **implied carbon price of US$40-80/ton** for new hydrocarbon developments, on our estimates.

Concerns around affordability and manufacturing cost competitiveness may, however, delay the development of carbon markets (today's average global carbon price is only US$3/ton), similar to the aftermath of previous recessions. We believe this would lead to a **two-speed de-carbonisation process**, with fiscal and monetary stimulus accelerating clean tech investments already at scale (e.g., renewables), while nascent sequestration technologies with carbon pricing as the main revenue line may struggle. **Voluntary credit markets** could fill in some of the policy gaps, particularly in nature-based solutions, but ultimately we believe carbon pricing is necessary to foster broad clean tech innovation and achieve cost-efficient net zero carbon.

A different take on the Stranded Assets debate: We believe structural under-investment in hydrocarbons creates both attractive supply dynamics, as oil & gas resources get stranded by higher cost of capital, as well as a profitable path for Big Oils as they accelerate their transition towards Big Energy.

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This is a redacted report

The following is a redacted version of the Goldman Sachs Research report "Carbonomics: The green engine of economic recovery" that was originally published on June 16, 2020 (37pgs). All company references in this note are for illustrative purposes only and should not be interpreted as investment recommendations.

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PM Summary: A two-speed de-carbonisation process - opportunities and challenges

The rise of clean tech infrastructure: US$1-2 tn pa opportunity through public-private collaboration

Clean tech has a major role to play in the upcoming economic recovery. Leveraging our *Carbonomics* cost curve, we estimate that clean tech can drive US$1-2 tn pa of green infrastructure investments and create 15-20 mn jobs worldwide, mostly through public-private collaboration, low financing costs and a supportive regulatory framework. **Renewable power will become the largest area of spending in the energy industry in 2021**, on our estimates, surpassing upstream oil & gas for the first time in history. These investments encompass mostly renewables, biofuels and the infrastructure investments necessary to support a new era of electrification (both in grids and charging networks, and — more marginally — a growing focus on natural sinks, hydrogen and carbon capture, utilisation and storage. In aggregate, we see a total investment opportunity of up to US$16 tn by 2030 in a scenario that would be consistent with the global ambition to contain global warming within 2°C. Outside of the energy industry, we also identify attractive investment opportunities in industry, agriculture and buildings that sit low on our de-carbonisation cost curve.

Green infrastructure is more capital and jobs intensive than traditional energy - an attractive regulatory framework and low cost of capital are essential

Green infrastructure is 1.5-3.0x more capital- and job-intensive than traditional energy developments per unit of energy produced, on our estimates. This is why it requires a stable, attractive regulatory framework and a low cost of capital, making it a strong example of pro-growth pro-environment public-private collaboration. We estimate that an acceleration of the energy transition towards the goals laid out in the Paris Agreement could lead to net job creation in the next decade (to 2030) of 15-20 mn jobs in the global energy industry. This estimate covers the net job creation from: (1) the shift of power generation towards renewables and (2) the electrification of transport in a pathway consistent with containing global warming below 2°C. We primarily focus on direct job creation in this analysis and do not include the additional multiplier effect of indirect and induced job creation. We do not include in these numbers the material opportunities for job creation that would come from the upgrade of buildings, nature-based solutions and the de-carbonisation of industry.

Two-speed de-carbonisation is a risk as green infrastructure accelerates, but carbon pricing and clean tech innovation may slow

We identify the risk of a two-speed de-carbonisation process emerging, as fiscal and monetary stimulus accelerate the investment in clean tech already at scale (solar, wind, biofuels), but the development of carbon markets and nascent de-carbonisation technologies (CCUS, clean hydrogen) may be pushed back. This may ultimately delay the technological breakthroughs necessary to flatten the de-carbonisation cost curve and achieve cost-efficient net zero carbon (our Carbonomics cost curve shows that c.50% of global CO_2 emissions need a carbon price >US$100/ton to be de-carbonised at current technologies). In particular, affordability and increased concerns on manufacturing cost competitiveness may delay the development of carbon markets (only 16% of total global emissions are currently taxed and the average global carbon price is US$3 per ton, a long way from the price required to foster broad clean tech innovation), delaying R&D and pilot projects that could lead to technological breakthroughs for the high end of the de-carbonisation cost curve. A two-speed de-carbonisation process may therefore accelerate de-carbonisation in the short term, but ultimately delay the long-term path towards net zero.

Past recessions: The 2008-09 recession delayed the development of carbon pricing and the R&D of high cost de-carbonisation technologies, but did not derail scalable, low-cost de-carbonisation initiatives

The 2008-09 financial crisis led to a collapse in European carbon prices, and it took five years for the carbon market to recover thanks to supply allowance reforms that were introduced as part of Phase III in 2013. Since the outbreak of COVID-19, weaker demand, higher renewable build, lower fuel switching costs and the scope for excess allowances given to industry to be sold onto the market have all contributed to a notable fall in carbon prices. A tightening of the market over the medium term is likely to require further regulatory reform. Having noted that, the current fall in carbon prices is of a lesser scale than the previous financial downturn, owing partly to the current EU credit supply mechanism that acts as a protection to a similar collapse as in previous crisis. In addition to slowing the development of carbon markets, the previous global financial crisis materially affected the pace of employment of low-carbon technologies, with investments across all renewables types on aggregate falling yoy in 2009 for the first time since their acceleration in the early 2000s. We note, however, that low-cost technologies such as renewable power were significantly less affected and returned to growth in 2010, while higher-cost technologies with less regulatory support such as biofuels and carbon capture never recovered, raising the risk of a two-speed de-carbonisation re-emerging in the aftermath of COVID-19.

Capital markets are driving the transformation of the energy industry

With global GHG emissions on a persisting upwards trajectory until 2019, as we outlined in our *Carbonomics* report, investors have emerged with a leading role in driving the climate change debate, pushing corporate managements towards incorporating climate change into their business plans and strategies. The number of climate-related shareholder proposals has almost doubled since 2011 and the percentage of investors voting in favour has tripled over the same time period. 2020 has been so far, despite the outbreak of COVID-19, another year of record shareholder engagement on climate change with the year-to-date climate-related shareholder resolutions exceeding last year's on an annualized basis, with the most notable increase coming from Europe. Similarly, the percentage vote in favour has increased yoy, exceeding 30%. This investor pressure, however, is not uniformly distributed across sectors and shows a bias towards energy producers vs. energy consumers, with data showing 50% of proposals targeting energy producers (oil & gas, utilities, coal) while only 30% of the proposals target the sectors that account for most of the final energy consumption.

Hydrocarbon assets stranded by rising cost of capital, not demand

As investors continue to shift capital allocation away from hydrocarbon investments, we are seeing a significant divergence in the cost of capital of oil & gas investments (with hurdle rates of 10-20%) and renewable projects (3-5% for the regulated investments in Europe). We estimate that this divergence in the cost of capital for high carbon vs. low-carbon investments implies a carbon price of US$40-80/ton, well above most carbon pricing schemes. As we outline in our oil & gas yearly study, *Top Projects 2020*, this is structurally constraining the oil & gas industry's ability to invest (Capex commitments in new long-cycle oil projects have fallen by >60% over the past five years vs. the previous five), taking a toll on oil resource life. This shifts, in our view, the stranded asset debate from a demand problem to a cost of capital problem and could lead to an energy transition through higher oil & gas prices. According to our analysis, the resource life of Top Projects (recoverable resources/production) falls to 30 years in 2020 from c.50 years in 2014, a c.20-year reduction since 2014.

The Big Oils transition towards Big Energy is accelerating

European Big Oils have reinforced their climate change commitments since the beginning of the year, following a path that we laid out in *Re-imagining Big Oils*, which is consistent with the Paris Agreement ambitions of containing global warming well within 2°C. We estimate that **the share of low-carbon energy** (mainly renewables, but also biofuels, natural sinks and carbon capture) **as a percentage of total capex has increased from 2-5% in 2018-19 to c.10-15% for the group on average in 2020-21E**. If we were also to include natural gas as a low-carbon fuel (it has half the carbon intensity of coal or oil) Big Oils would be **already spending c.50% of their capex on the low-carbon transition,** another indication that shareholder climate change engagement is yielding results.

Carbonomics in numbers

Clean tech has a major role to play in the upcoming economic recovery and can drive **US$1-2 tn** pa of green infrastructure investments…

…and has the potential to create **15-20 mn** jobs worldwide, mostly through public-private collaboration…

…as we estimate green infrastructure is **1.5-3.0x** more capital- and labour-intensive than traditional energy developments.

Renewable power will become the largest area of spending in the energy industry in 2021 for the first time in history, on our estimates, reaching **25%** of total energy supply capex…

…supported by bifurcating cost of capital, up to **20%** for long-term oil projects, down to **3-5%** for renewables.

Capital markets are driving the transformation of the energy industry, with climate-related shareholder resolutions having almost **doubled** since 2011...

…and the percentage vote in favour having **tripled**, reaching a record **33%** ytd...

…driving a seismic shift in capital allocation, charging an implied carbon price of **US$40-80/tn of CO2** for new hydrocarbon developments.

Oil & gas companies face the largest shareholder pressure, as **30%** of all proposals across the market target them...

…with increased divestment in the coal industry, with **>1,000** institutions in thermal coal, leading to a **45%** EV/EBITDA de-rating since 2011.

Stranded assets and under-investment: Upstream oil & gas spend is down **>60%** from the peak in 2014, and oil reserve life has fallen by 20 years.

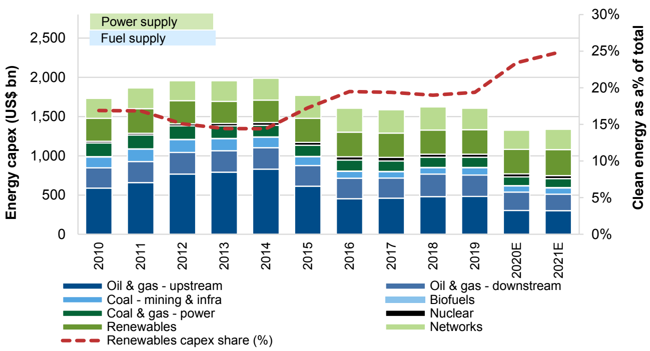
We estimate **7.9 mn bl** of future oil supply will be lost by 2025 due to investment delays...

…leading to the end of non-OPEC growth in 2021E, eight years after the end of the oil price super-cycle, similar to 1988.

The Big Oils transition toward Big Energy is accelerating, with **14%** of their 2021 budgets dedicated to renewables vs. **4%** in 2019.

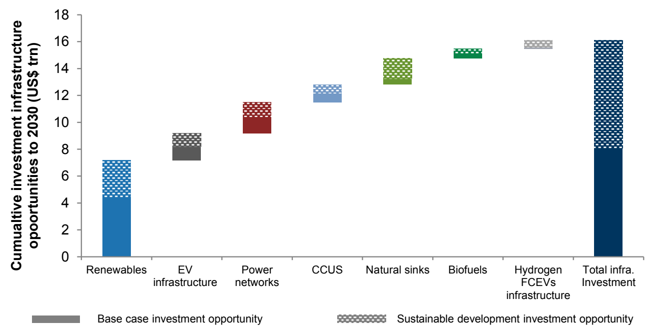
Carbonomics: Thesis in 12 charts

Exhibit 1: A new era for green infrastructure is coming, with renewables overtaking upstream oil & gas investment by 2021E...
Energy supply capex (US$bn), and clean energy as a % of total (%)



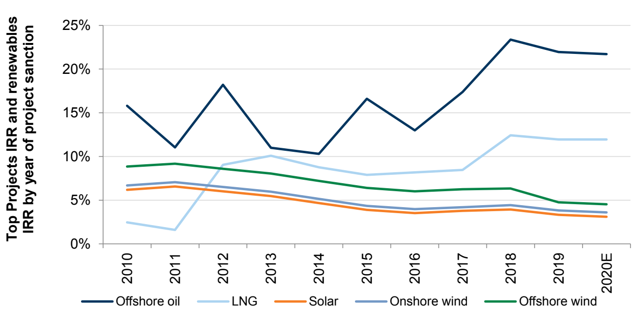
Source: IEA WEI, Goldman Sachs Global Investment Research

Exhibit 2: ...as part of a US$1-2 tn pa investment opportunity in the de-carbonisation of the energy industry...
Cumulative investment in clean energy transition to 2030 (US$tn)



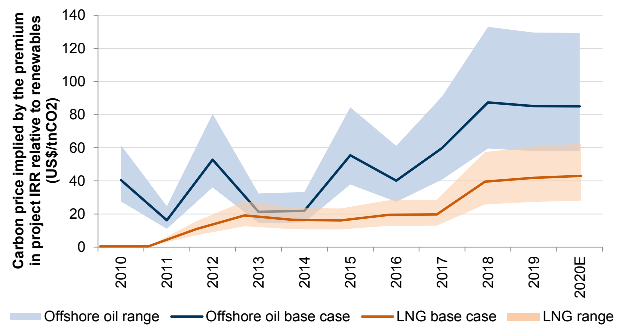
Source: IEA, Goldman Sachs Global Investment Research

Exhibit 3: ...supported by public-private collaboration and diverging cost of capital
Top Projects IRR for oil & gas and renewable projects IRR by year of project sanction



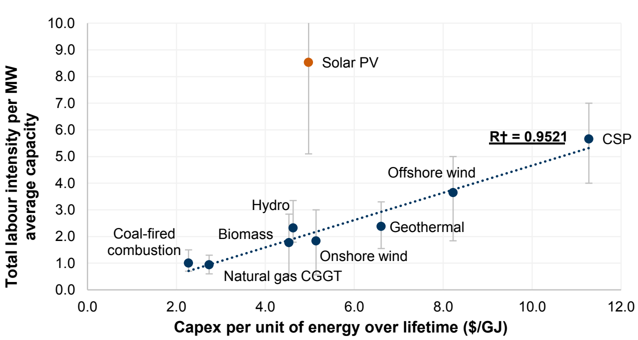
Source: Goldman Sachs Global Investment Research

Exhibit 4: The IRR premium of long-life hydrocarbon developments implies a carbon price of US$40-80/ton
Carbon price implied by the IRR premium for hydrocarbon projects compared to renewables (US$/t CO2)



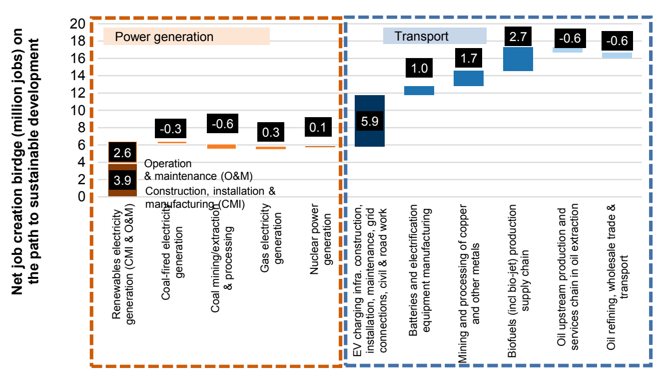
Source: Goldman Sachs Global Investment Research

Exhibit 5: Clean energy technologies are more capital- and job-intensive and benefit the most from low cost of capital and attractive regulation...
Capex per unit of energy over asset life vs. labour intensity per MW average capacity



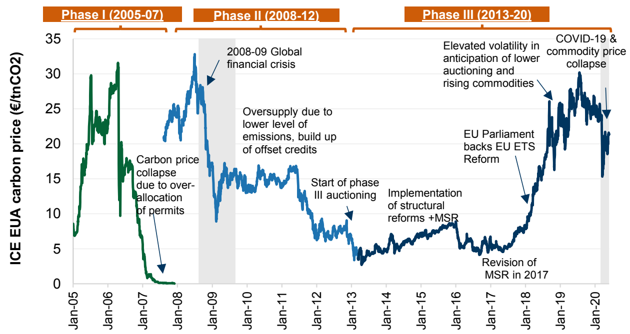
Source: Wet et al. - IRENA, UNEP-ILO-IOE-ITUC, Goldman Sachs Global Investment Research

Exhibit 6: ...while potentially supporting the creation of 15-20 mn jobs by 2030
Net job creation bridge (mn jobs) for a sustainable path across the energy supply chain



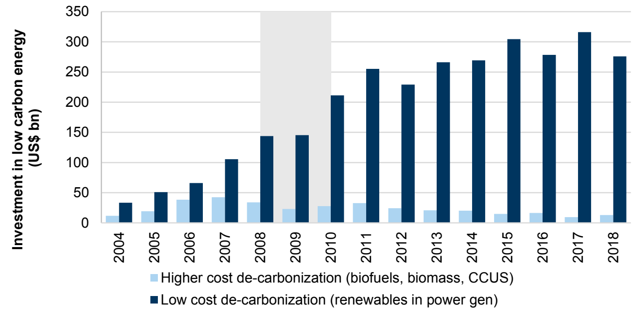
Source: IEA, IRENA, EuropeOn, UNEP-ILO-IOE-ITUC, Goldman Sachs Global Investment Research

Exhibit 7: Past recessions: It took five years for the EU carbon scheme to recover after the 2008-09 recession...
ICE EUA carbon price (EUR/tn CO2)



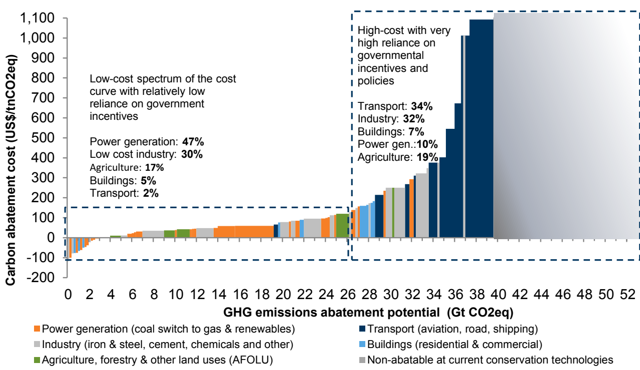
Source: ICE, Thomson Reuters Datastream, Goldman Sachs Global Investment Research

Exhibit 8: ...severely reducing investment and technological innovation in high-cost de-carbonisation technologies...
Total global investment in low carbon energy (US$bn)



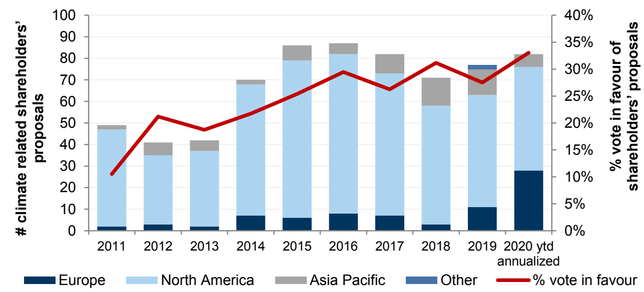
Source: FS-UNEP Collaboration Centre, IRENA, IEA, Goldman Sachs Global Investment Research

Exhibit 9: ...which is key to flattening the de-carbonisation cost curve
Conservation carbon abatement cost curve for anthropogenic GHG emissions



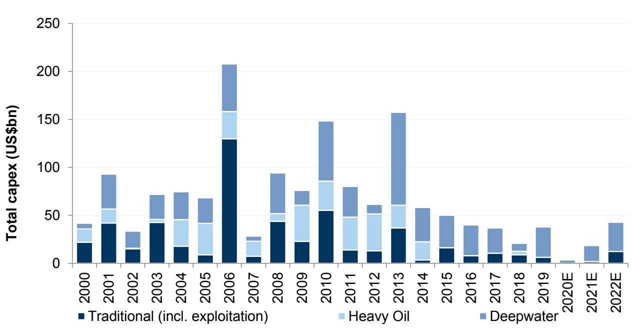
Source: Goldman Sachs Global Investment Research

Exhibit 10: Investor engagement in climate change keeps rising, fostering increased green investments...
Number of climate-related shareholders' proposals vs. % vote in favour



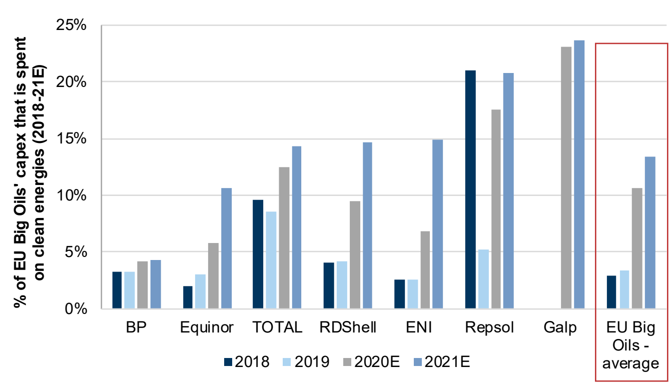
Source: ProxyInsight, Goldman Sachs Global Investment Research

Exhibit 11: ...while investments in new oil fields have reached a new low in 2020
Top Projects capex sanctioned in oil by year, split by winzone



Source: Goldman Sachs Global Investment Research

Exhibit 12: The Big Oils transition towards Big Energy is accelerating
Share of renewables as a % of total capex for EU Big Oils



Source: Company data, Goldman Sachs Global Investment Research

Carbonomics and Investment: A US$1-2 tn pa opportunity

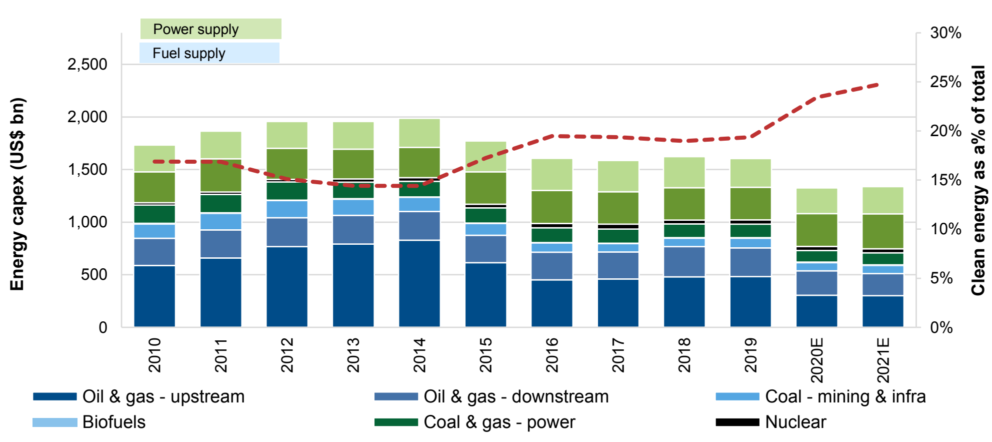
In this report, we aim to address the potential impact of the COVID-19 outbreak on the pace of the global de-carbonisation efforts and the role that clean technologies can play in the upcoming economic recovery. We look through the lenses of both our Carbonomics cost curve to identify areas of opportunity as well as previous economic downturns to identify the key risks to investments and carbon pricing.

For the first time in history, we expect capex in renewable power supply to overtake upstream oil & gas in 2021

Historically, times of macroeconomic downturns have been associated with a deceleration of global de-carbonisation efforts, as affordability has taken precedence over sustainability. We believe this time will be different, especially for technologies that are now mature enough to be deployed at scale and can benefit from a falling cost of capital and an attractive regulatory framework, unlocking one of the largest infrastructure investment opportunities in history on our estimates. As we highlight in our ***Carbonomics*** report, the cost curve of de-carbonisation is steep and is likely to require substantial technological innovation. The low-cost end of the curve is primarily associated with power generation and building efficiency, which together have the triple advantage of generating local jobs, benefiting from low cost of capital and successful public-private partnerships along with limited cost to the national budgets. Whilst the growth in investment in clean energies moderated during previous economic downturns, the much more abrupt fall in investments in other parts of the energy system (particularly upstream oil & gas) resulted in the **overall share of clean energies** (renewables including bioenergy) **in the total energy supply capex increasing from 15% in 2014 to c.25% by 2021E** on our estimates, making **capex in renewable power supply larger than capex in upstream oil & gas for the first time in history by 2021E.**

Exhibit 13: Renewable energy will reach c.25% of global energy supply investments by 2021 on our estimates, surpassing upstream oil & gas for the first time in history

Energy supply capex split by fuel and power supply sources (US$bn - LHS), and clean energy (renewables, biofuels) as a % of total (% - RHS)



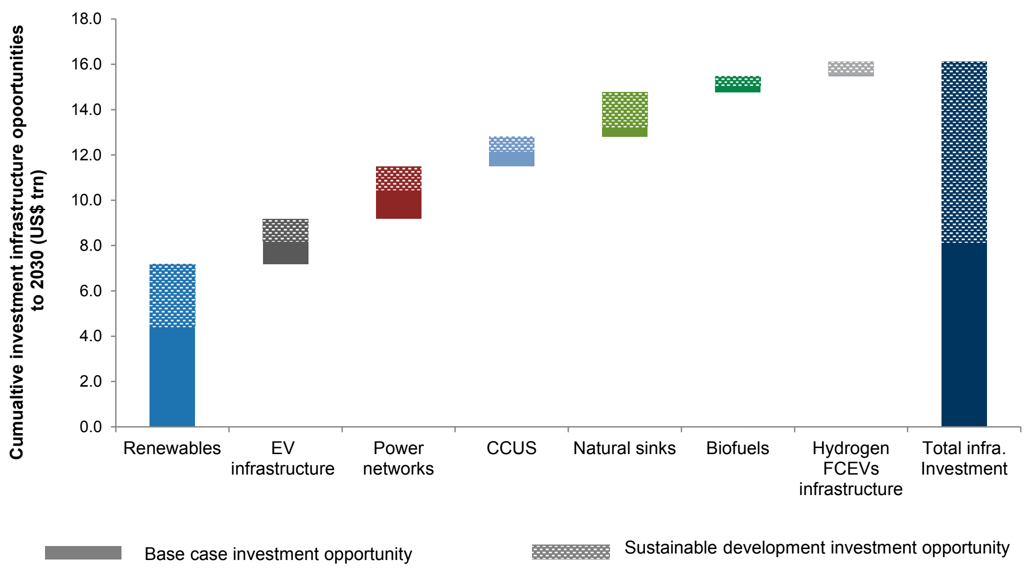
Source: IEA WEI (historicals), Goldman Sachs Global Investment Research

Investing in the time of climate change: A US$8-16 tn investment opportunity in clean energy infrastructure by 2030

Exhibit 14 shows a wide range of investments associated with what we believe are the key technologies required to de-carbonise the energy value chain. These include an increasing uptake of renewables and biofuels, an increasing focus on infrastructure investments that will enable a new era of electrification, and a greater focus on natural sinks, clean hydrogen and carbon sequestration (carbon-dioxide capture and storage, CCS). In aggregate, **we see a total investment opportunity of up to US$16 tn** by 2030 in a scenario that would be consistent with the global ambition to contain global warming within 2°C. This is estimated on the basis of the accelerated capacity uptake of renewables that would be required to set an energy mix consistent with a global warming path of 2°C, the electric vehicle and power networks infrastructure required to facilitate an increasingly electrified transport system, and carbon sequestration likely to be required (including increased uptake of carbon capture and storage, natural sinks and biofuels).

Exhibit 14: We estimate there exists a c.US$8-16 tn investment opportunity for the de-carbonisation of the energy industry by 2030

Cumulative investment in clean energy transition to 2030 (US$tn)

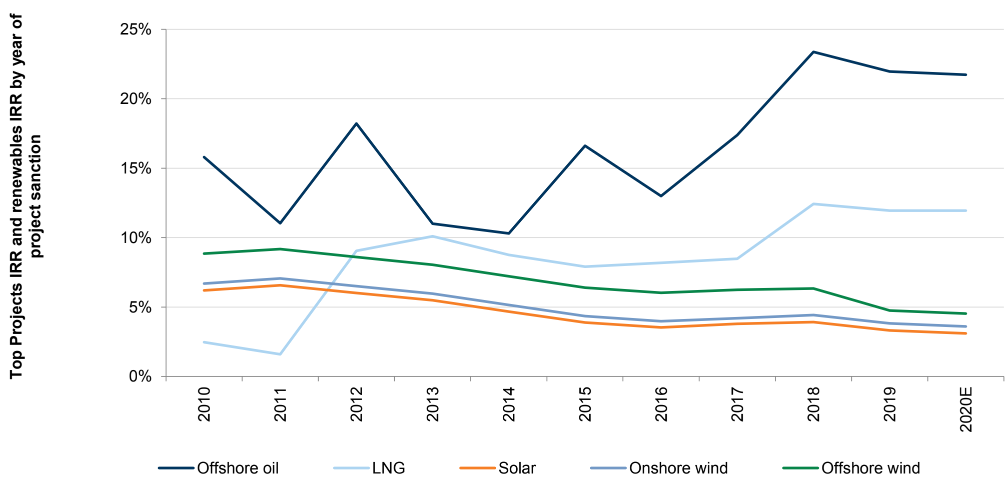


Source: IEA, Goldman Sachs Global Investment Research

The cost of capital of clean energy technologies continues to diverge from hydrocarbon developments, implying a carbon price of US$40-80/ton, on our estimates

The US$16 tn investment opportunity laid out above could be fully funded, in our view, by private capital, provided there is a constructive regulatory framework globally. The cost of capital for new clean energy projects continues on a downward trajectory, improving the affordability and competitiveness of clean energy. On the contrary, financial conditions keep tightening for long-term hydrocarbon developments, creating higher barriers to entry, lower activity, and ultimately lower oil & gas supply in our view.

Exhibit 15: The cost of capital for clean energy continues on a downward trend, whilst financing conditions are tightening for the new hydrocarbon developments
Top Projects IRR for oil & gas and renewable projects IRR by year of project sanction



Source: Goldman Sachs Global Investment Research

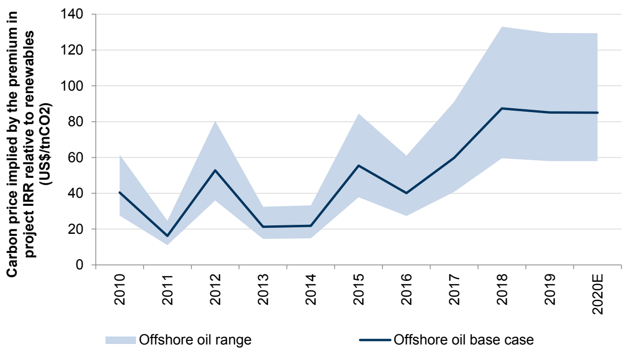
The bifurcation in the cost of capital for high-carbon vs. low-carbon energy can be translated into an implied carbon price of US$40-80/ton

In the charts below, we present the carbon price implied by the IRR premium of long-life offshore oil (deepwater) and LNG projects compared to renewables. We calculate the implied carbon price by leveraging our Top Projects database of the most important oil & gas projects in the world. We estimate the projects "well to wheel" carbon intensity (scope 1+2+3) and charge each project the cost of carbon in full (we assume the producer takes the full economic hit from carbon pricing, without passing any of the cost to the consumer through higher oil & gas prices). We calculate the IRR sensitivity by oil & gas field to different level of CO_2 prices and work out the carbon price that would bring the IRR of the project in line with the IRR of low-carbon projects (renewables) that were developed in the same year. We estimate that the IRR sensitivity of oil and LNG projects is 14-32 bps for each US$1/ton of carbon pricing, with an average of 21 bps. We make two critical assumptions in this analysis: (1) We assume that the carbon cost associated with the use of the oil & gas produced (scope 3) is fully paid by the producers and not by the final consumer of those hydrocarbons; and (2) we consider the different risk profile of renewables vs. hydrocarbon developments given renewables' implicit incentive provided by the governments, and its value is included in the implied carbon price.

Our results indicate that the long-cycle offshore oil and LNG projects' IRR premium relative to renewables implies a carbon price in the range of US$60-130/tn CO_2 (US$80/ton on average) and US$30-60/tn CO_2 (US$40/ton on average) for offshore oil & LNG respectively. The capital markets are therefore implying a materially higher cost of carbon than the global average carbon price of c. US$3/tn CO_2.

Exhibit 16: The current IRR project premium for offshore oil developments compared to renewables implies a carbon price range of US$60-130/tn CO2...

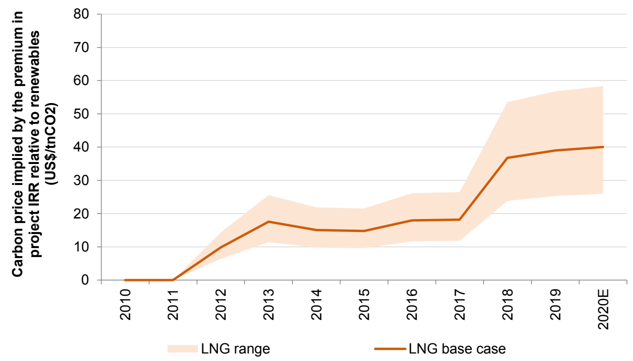
Carbon price implied by the IRR premium for offshore oil projects compared to renewables (US$/t CO2)



Source: Goldman Sachs Global Investment Research

Exhibit 17: ...and a range of US$30-60/tn CO2 for LNG projects

Carbon price implied by the IRR premium for LNG projects compared to renewables (US$/t CO2)



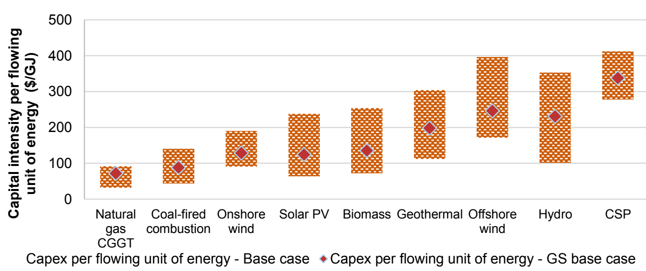
Source: Goldman Sachs Global Investment Research

Carbonomics and job creation: Higher capital intensity and lower cost of capital can create jobs in a financially efficient way through public-private partnerships

Economic policy following a recession is often driven by the desire to increase employment within the constraints of limited financial resources. We believe that green infrastructure could play a major role in this economic recovery, as it tends to be more capital- and job-intensive than traditional energy developments, but also benefits from a much lower cost of capital under the right regulatory framework, making it a strong example of a successful pro-growth pro-environment public-private partnership. In the exhibits that follow, we present the capital intensity (capex) per unit of output energy for each type of power generation and transport technologies. We present the results both in units of capex per flowing unit of energy (US$/GJ of peak energy capacity) and per unit of energy over the life of the asset (US$/GJ). This shows **higher capital intensity per unit of energy as we move to cleaner alternatives for power gen and transport**. This however does not necessarily translate into higher costs for the consumer, thanks to the availability of very cheap financing (under an attractive and stable long-term regulatory framework) and lower opex, compared to traditional hydrocarbon developments.

Exhibit 18: All renewable clean technologies in power generation have higher capital intensity compared to traditional fossil fuel sources based on per flowing unit of energy...

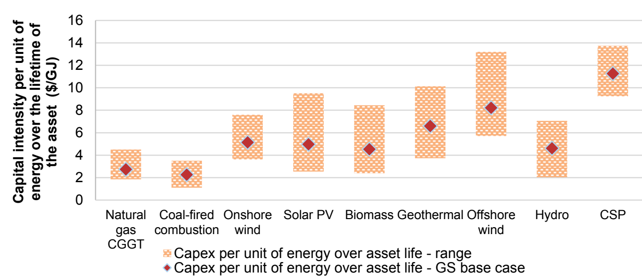
Capex per flowing unit of energy (US$/GJ)



Source: IRENA, EIA, Goldman Sachs Global Investment Research

Exhibit 19: ...and over the lifetime of the asset

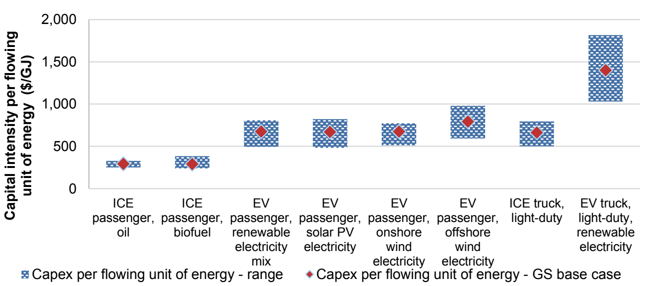
Capex per unit of energy over the life of the asset (US$/GJ) for each technology



Source: IRENA, EIA, Goldman Sachs Global Investment Research

Exhibit 20: Similarly, in transport, clean technology alternatives have a higher capital intensity than their equivalent traditional fossil-fuel technologies per unit of flowing output energy...

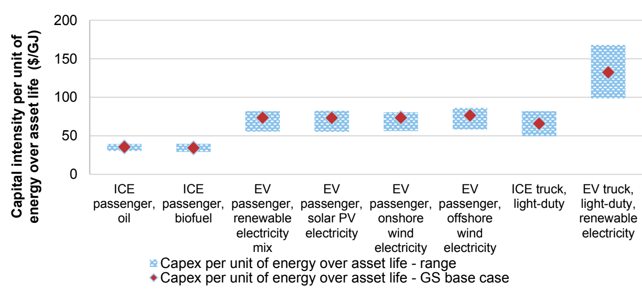
Capex per flowing unit of energy (US$/GJ)



Source: EIA, Goldman Sachs Global Investment Research

Exhibit 21: ...and per unit of energy over the lifetime of the technology

Capex per unit of energy over the life of the asset (US$/GJ) for each technology



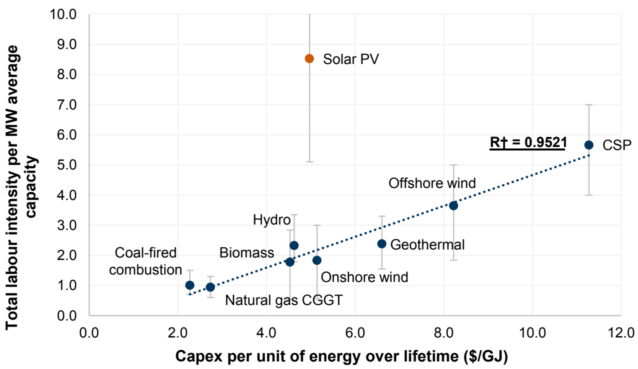
Source: EIA, Goldman Sachs Global Investment Research

Higher capital intensity comes with greater (and local) job creation per unit of energy

Across both power generation and transport, clean technologies have a notably higher capital intensity than hydrocarbons, based on both per unit of flowing output energy and per unit of energy over the asset/technology lifetime. With greater capital intensity comes the greater need for low cost of capital and revenue visibility. Furthermore, the low-carbon economy's higher capital intensity is likely to foster employment creation, as indicated by the strong correlation between the capital intensity per unit of energy and its labour intensity (jobs per unit of average capacity over asset life) presented in the exhibits below. Solar PV is, according to the International Labour Organization (ILO) and the International Renewable Energy Agency (IRENA), the most labour-intensive clean technology in power generation (including construction, manufacturing, installation, operating & maintenance), albeit there exists a wide range of labour intensity factors depending on utility scale vs. rooftop PV.

Exhibit 22: The capital intensity of clean technologies in power generation shows a >90% correlation with labour intensity in the industry...

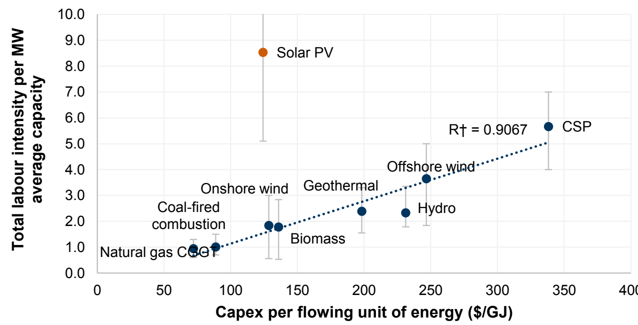
Capex per unit of energy over asset life vs. total labour intensity per MW average capacity



Source: Wet et al. as illustrated by IRENA, UNEP - ILO - IOE - ITUC, Goldman Sachs Global Investment Research

Exhibit 23: ...with solar PV the technology that deviates from the trend, with notably higher labour intensity, particularly in rooftop vs. large-scale utility

Capex per flowing unit of energy vs. total labour intensity per MW average capacity



Source: Wet et al. as illustrated by IRENA, UNEP - ILO - IOE - ITUC, Goldman Sachs Global Investment Research

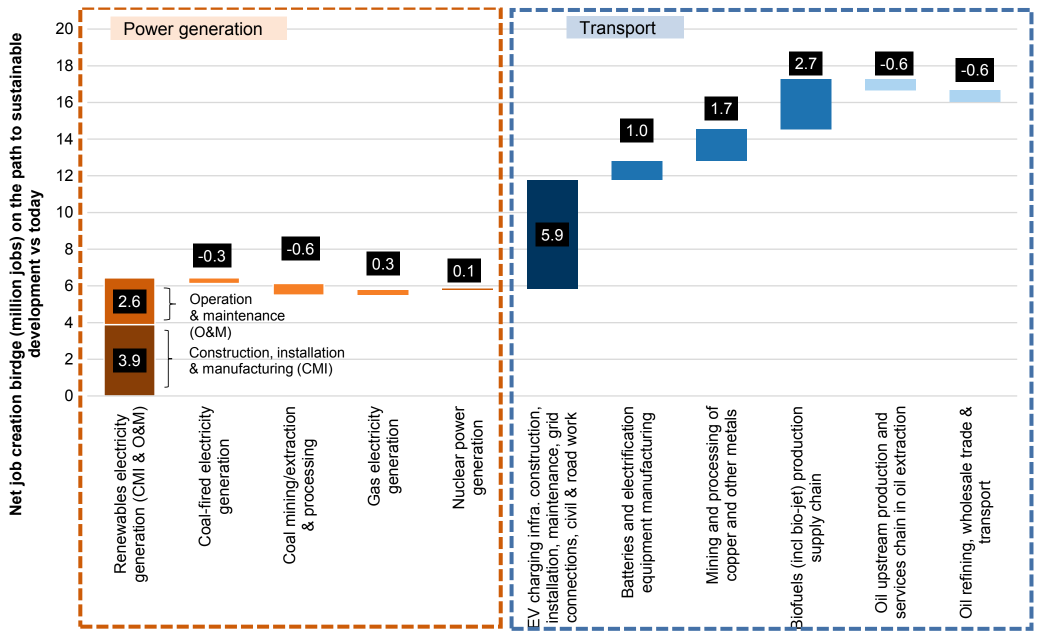
Clean Energy could create 15-20 mn net new jobs globally by 2030

We estimate that an acceleration of the energy transition towards the goals laid out in the Paris Agreement could lead to net job creation in the next decade (to 2030) of 15-20 mn jobs globally. We primarily focus on the low carbon transition within the energy ecosystem, and we separate the analysis into two parts: (1) the shift of power generation to cleaner alternatives in a pathway consistent with containing global warming below 2°C (in line with IEA's Sustainable Development Scenario), assessing the net job creation opportunities compared to current levels; and (2) the potential de-carbonisation of transport. In both parts of the analysis, we primarily focus on the direct impact of employment across the supply chain, accounting for direct job impacts but do not account for indirect and induced employment effects.

Overall, we show that **a path consistent with the sustainable development pathway can contribute to net employment creation of 15-20 mn jobs in the coming decade** when compared to current levels. The majority of the employment creation we see in a sustainable energy system stems from the renewables space and is dominated by construction and manufacturing and from the infrastructure required for the electrification of transport.

Exhibit 24: A path in line with the Sustainable Development Scenario has the potential to lead to a net creation of 15-20 mn jobs globally by 2030

Net job creation bridge (mn jobs) for a sustainable path across the energy supply chain



Source: IEA, IRENA, UNEP - ILO - IOE - ITUC, EuropeOn, Goldman Sachs Global Investment Research

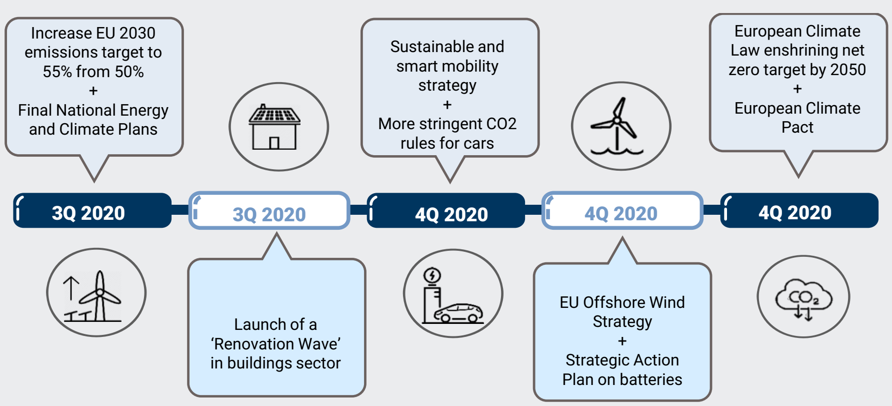
The European Green Deal

The European Commission outlined its roadmap for the "European Green Deal" earlier this year, committing to publish a plan encompassing specific policies and investment requirements to reach "net zero carbon emissions" by 2050. The plan, which we estimate could amount to €7 tn, is likely to fundamentally reshape the entire economy, changing the way we generate electricity, heat our homes, travel, and even our spending habits.

We estimate that Utilities' (or Utilities-like) investments could account for nearly half of the Green Deal, whilst the rest would encompass subsidies to support the electrification in the rest of the economy. The Green Deal goals imply that by 2030 carbon-free power generation could reach c.65% of the EU mix vs. c.40% today. By 2050, the share of renewables could reach up to 90% we estimate, with the rest met by batteries, hydrogen and CCS. The electrification of other parts of the economy (mobility, heating) would require significant investments in power grids, while potentially increasing power demand by 50-60%. Currently, power generation accounts for about one-quarter of the EU's greenhouse gas emissions. To reach net zero, more industries would have to be tackled. This is why the EU plans to focus on mobility and heating (jointly one-third of EU emissions) as electrification could almost fully eliminate emissions. A wider application of carbon taxes could influence consumer spending in various fields such as food (red meat) and travel (airplanes).

The Green Deal seems to be at the centre of the European recovery in a post-COVID world; many EU countries have said they may lean on climate policies to support economic growth and boost employment, and the EC proposal for the EU recovery package has defined the Green Deal as one of its strategic pillars. A recent report published by IRENA suggests that each €1 spent on renewables could translate into €1-€10 of GDP growth; the same report showed that, during 2017, the renewable industry created 1.5 mn jobs globally. Even though the "new normal" might imply a slower rate of adoption owing to the weaker power demand outlook and potentially less support for last mile/subsidised (i.e., expensive for consumers) measures, we see a limited threat of a slowdown in core climate infrastructure spending, owing to recently renewed political support, attractive economics, and the negligible impact that these policies would likely have on energy bills.

Exhibit 25: EU Green Deal roadmap for 2020



Source: Goldman Sachs Global Investment Research

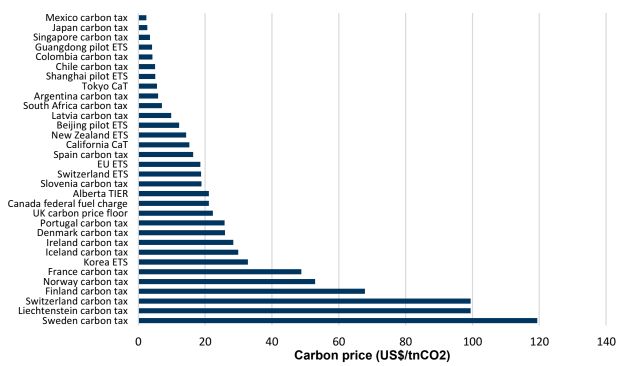
Carbonomics and past recessions

Previous economic downturns have put de-carbonisation investments under pressure, driven by falling carbon prices

Previous recessions have shown carbon pricing to be cyclical, with concerns of affordability and manufacturing cost competitiveness becoming particularly strong in the aftermath of a recession. We believe that carbon pricing will be a critical part of any effort to move to net zero emissions, while incentivising technological innovation and wider adoption and progress of de-carbonisation. At present, 61 carbon pricing initiatives are underway, covering 46 national and 32 regional jurisdictions worldwide. These initiatives had gained significant momentum over the past several years, yet the current pace of implementation is currently at risk given the COVID-19 outbreak and the harsh economic dynamics that have resulted.

Exhibit 26: The carbon prices associated with global national and sub-national carbon price initiatives (carbon taxes & ETS) show a wide regional variability...

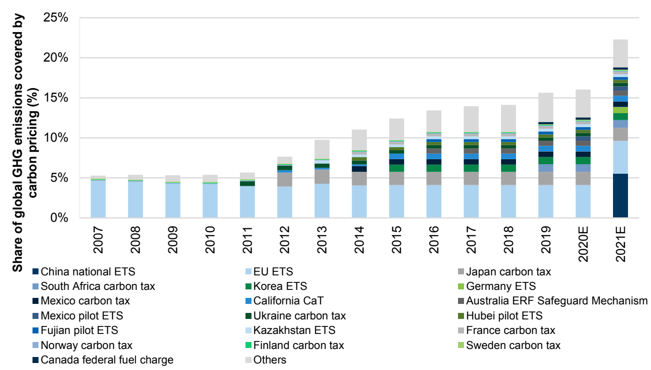
Carbon prices through taxes and ETS (April 2020)



Source: World Bank Group

Exhibit 27: ...and the current macroeconomic downturn poses a risk to new carbon price initiatives, including the addition of China, which is now expected in 2021

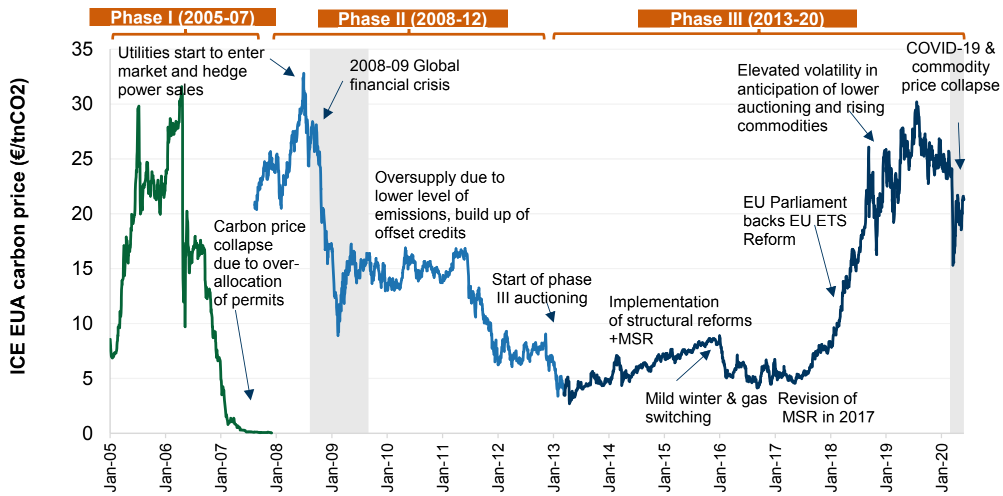
Carbon pricing ETS initiatives' share of global GHG emissions covered (%)



Source: World Bank Group, Goldman Sachs Global Investment Research

Looking at previous financial crisis (2008-09), European **carbon prices collapsed**, a direct result of **deteriorating demand and non-adjusted supply** (supply allowance reforms were introduced later). Since 2017, we have seen a material impact on CO_2 prices on the back of the EU introducing enhancements to the scheme that pushed down the total surplus in circulation to a level where prices needed to move up to balance the system overall. Nonetheless, similar to the previous financial crisis, since the outbreak of COVID-19, weaker demand, higher renewable build, lower fuel switching costs and the scope for excess allowances given to industry to be sold on to the market have contributed to a notable fall in carbon prices, with a tightening of the market over the medium term likely to require further regulatory reform. Having noted that, the current fall in carbon prices is of a lesser scale than the previous financial downturn, owing partly to the current EU credit supply mechanism that acts as a protection to a similar collapse, but also the increased customer awareness and the rising importance of the voluntary carbon credit market which remains active.

Exhibit 28: Past financial crises and regulatory market reforms have caused dramatic changes to the carbon price
ICE EUA carbon price (EUR/tn CO2)

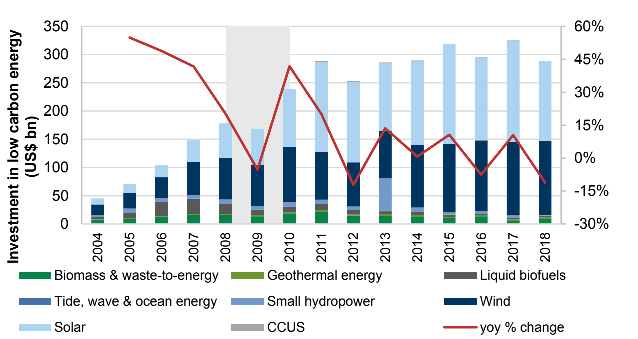


Source: Thomosn Reuters Datastream, ICE, Goldman Sachs Global Investment Research

Higher-cost de-carbonisation technologies suffered materially in previous downturns

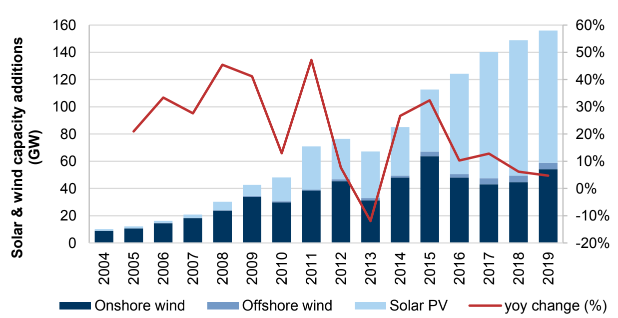
In addition to slowing the development of carbon markets, the previous global financial crisis (2008-09) materially affected the pace of employment of low-carbon technologies, with investments across all renewables types on aggregate falling yoy for the first time since their initial acceleration in the early 2000s. We note, however, that low-cost technologies such as renewable power were significantly less affected and returned to growth, compared to other higher-cost technologies such as biofuels and carbon capture, which did not recover for many years, as shown in Exhibit 29. We believe this pattern may repeat itself with the emergence of a two-speed de-carbonisation process that presents a material risk to technological innovation on the higher-cost end of the de-carbonisation cost curve.

Exhibit 29: Investments in low-carbon energy technologies were muted during the previous economic downturn, with the overall investments falling by c.5%, yet rebouncing very strongly...
Total global investment in low-carbon energy and yoy change (%, RHS)



Source: FS-UNEP Collaboration Centre, Goldman Sachs Global Investment Research

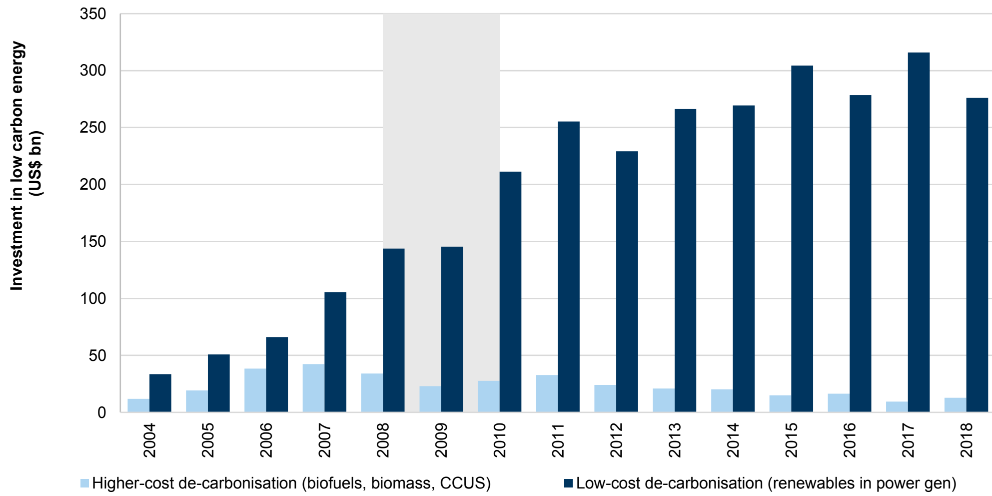
Exhibit 30: ...with solar & wind capacity additions still evident in 2008-10, despite the deceleration in growth
Solar, onshore & offshore wind installed capacity additions (GW, LHS) and yoy change (%, RHS)



Source: IRENA, Goldman Sachs Global Investment Research

Exhibit 31: The biggest impact of the financial downturn was experienced by higher-cost technologies such as biofuels and CCUS, as opposed to the lower-cost renewables

Total global investment in low-carbon energy (US$bn)



Source: FS-UNEP Collaboration Centre, IEA, Goldman Sachs Global Investment Research

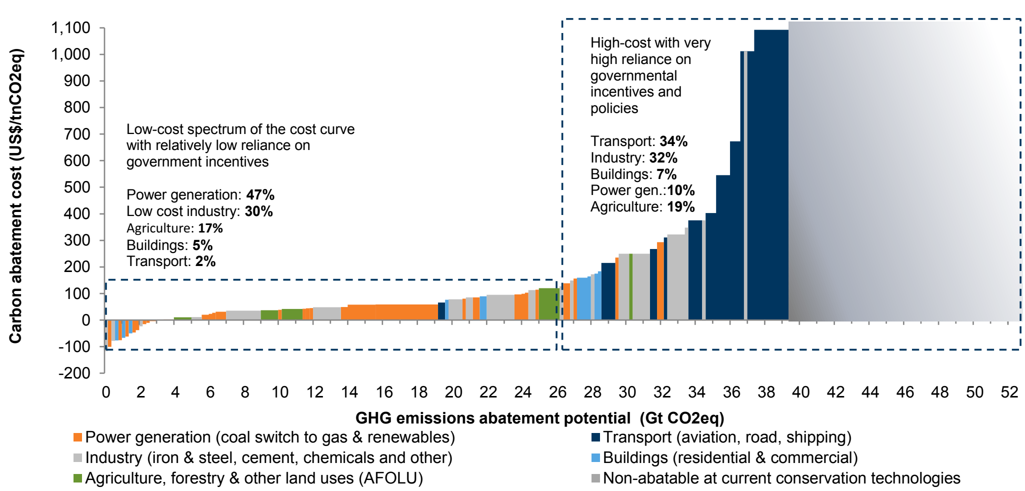
Carbonomics and net zero: The importance of technological innovation

In our deep-dive de-carbonisation report, *Carbonomics: The future of energy in the Age of Climate Change*, we presented the carbon abatement cost curve for de-carbonisation. Exhibit 32 shows the conservation cost curve of the de-carbonisation for global GHG emissions, relative to the current global anthropogenic GHG emissions, in which we include de-carbonisation technologies that reduce gross carbon emissions and are currently available at commercial large scale, and presents the findings of this analysis at current costs. We include almost 100 different applications of GHG conservation technologies across all key sectors globally: Power generation, industry, transport, buildings and agriculture.

As shown, despite the wealth of relatively low-cost de-carbonisation opportunities, **the abatement cost curve is steep as we move beyond 50% de-carbonisation.** We believe that **the recovery that is likely to follow the COVID-19 crisis** should to result in the **acceleration of low-cost opportunities for de-carbonisation** (box on left in the exhibit below), which are primarily focused on the shift of power generation from more carbon-intense fuels (coal) to the cleaner renewables and natural gas and increased penetration of LNG in shipping. In fact, such areas of investment could act as a further catalyst for increased employment, as we highlight in the sections that follow — a key focus of the governments in the coming months. However, as the governments turn their focus to fiscal budgets, the re-start of the economy and increased employment, additional **incentives that focus on the higher-cost emerging de-carbonisation technologies are likely to become more scarce,** resulting in a deceleration of the development, scale-up and broader adoption of higher-cost technologies, whose deployment is likely to be delayed. Amongst these are the electrification of transport, particularly rural long-haul road, biofuels, industrial de-carbonisation and hydrogen.

Exhibit 32: The de-carbonisation cost curve is steep, and we believe the current crisis is likely to accelerate efforts in lower-cost investment opportunities, but also is likely decelerate incentives for the higher-cost technologies

Conservation carbon abatement cost curve for anthropogenic GHG emissions



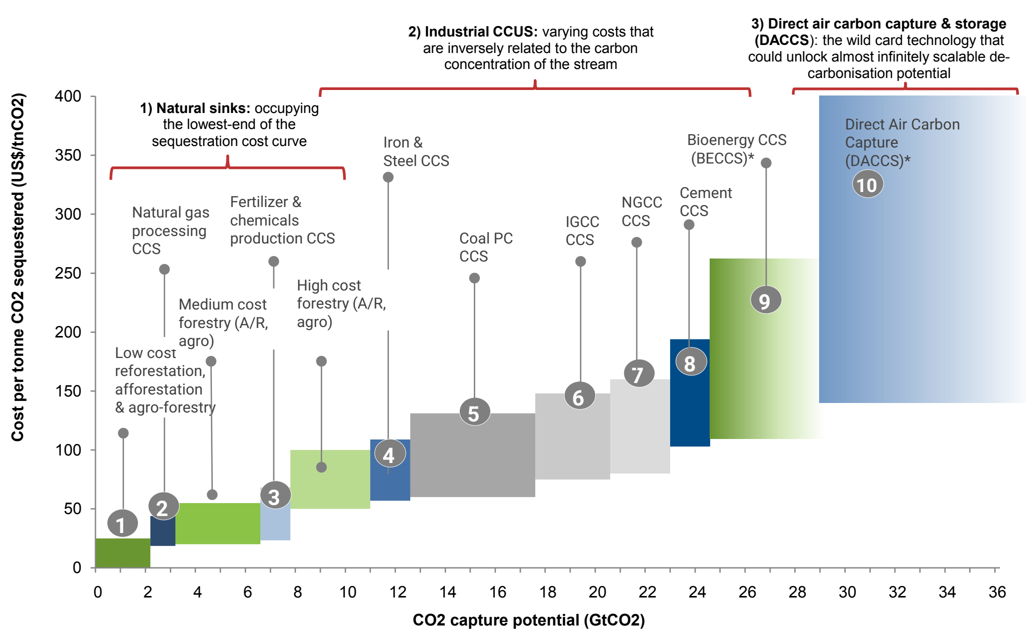
Source: Goldman Sachs Global Investment Research

This shows the risk of a two-speed de-carbonisation: The accelerated uptake of lower-cost de-carbonisation initiatives such as renewables implies a potentially quicker abatement of the first 50% of emissions (power generation), yet the delay of investment on higher-cost opportunities implies further delay in unlocking the full net zero de-carbonisation potential which is reliant on higher-cost de-carbonisation technologies.

In addition to conservation technologies, sequestration is another critical piece of the puzzle. We note that even if all current available technologies were put to action, c.25% of global GHG emissions would remain non-abatable under current technologies (primarily in seasonal heating, industrial processes, aviation transport and agriculture). This further highlights the importance of sequestration. As part of our analysis, we have constructed a carbon abatement cost curve for sequestration (Exhibit 33), although we see a greater range of uncertainty in these technologies, given their under-invested state and the largely pilot nature of the CCUS plants. Carbon sequestration efforts can be broadly classified into three main categories: **(1) Natural sinks,** encompassing natural carbon reservoirs that can remove carbon dioxide. Efforts include reforestation, afforestation and agro-forestry practices. **(2) Carbon capture, utilisation and storage technologies (CCUS)** covering the whole spectrum of carbon-capture technologies applicable to concentrated CO_2 stream coming out of industrial plants, carbon utilisation and storage. **(3) Direct air carbon capture (DACCS)**, the pilot carbon-capture technology that could recoup CO_2 from the air, unlocking almost infinite de-carbonisation potential, irrespective of the CO_2 source.

Exhibit 33: We believe the COVID-19 outbreak is likely to decelerate the development and wider adoption of higher-cost de-carbonisation technologies such as carbon capture and storage

Carbon sequestration cost curve (US$/tn CO2 eq) and the GHG emissions abatement potential (GtCO2 eq)



*Indicates technologies still in early (pilot) stage of development

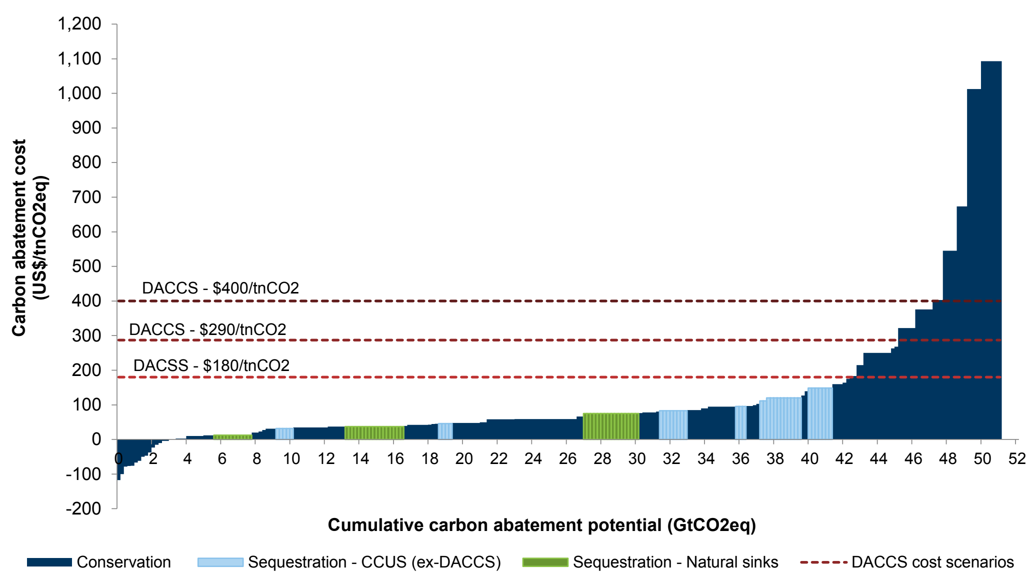
Source: IPCC, Global CCS Institute, Goldman Sachs Global Investment Research

We expect, that similar to conservation technologies, the recovery from COVID-19 is likely to accelerate the de-carbonisation efforts of the low-cost sequestration routes — primarily natural sinks — whilst decelerating the pace of investments, incentives and focus on more costly technologies that have not yet experienced the cost benefits of wider adoption and economies of scale, such as DACCS.

In the exhibit below, we present the merged cost curve of de-carbonisation that incorporates both conservation (Exhibit 32) and sequestration (Exhibit 33) initiatives. We exclude from the merged cost curve the technology of DACC as in theory this technology could unlock almost infinite de-carbonisation potential, ultimately determining the carbon price required to reach net zero. Instead, we present three cost scenarios for DACC below using straight cut-off lines.

Exhibit 34: The merged cost of de-carbonisation (including all conservation and sequestration approaches), indicates that c.50% of emissions can be abated at a price <US$60/bl, comprising mostly of low-cost clean alternatives in power generation and natural sinks

Total conservaton and sequestration abatement cost curve of de-carbonisation for anthropogenic GHG emissions, based on current technologies and associated costs



Source: Goldman Sachs Global Investment Research

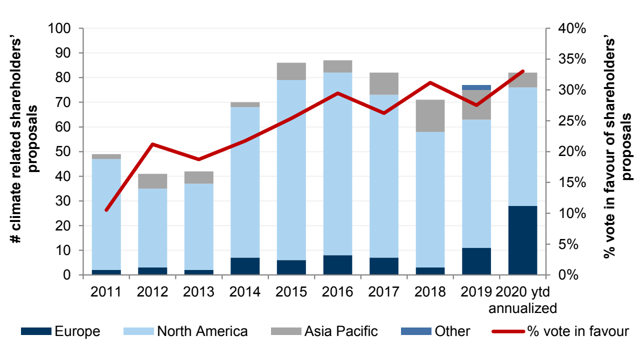
Carbonomics and capital markets: The rise of green shareholder proposals

This section is based on data contributed by the GS SUSTAIN team: Sharmini Chetwode, Ph.D.; Evan Tylenda, CFA; and Derek R. Bingham.

The capital markets focus on de-carbonisation had intensified pre-COVID-19 outbreak, and has maintained strong momentum so far in 2020

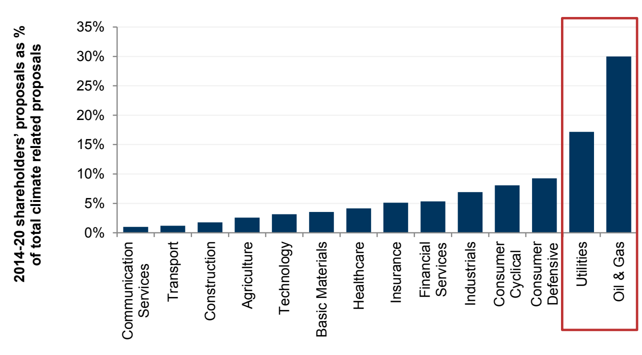
With global GHG emissions on a persisting upwards trajectory over the past few years, investors have emerged with a leading role in driving the climate change debate, pushing corporate managements towards incorporating climate change into their business plans and strategies. The number of climate-related shareholder proposals (as shown by data from ProxyInsight) has almost doubled since 2011 and the percentage of investors voting in favour has tripled over the same time period. The year 2020 has been, so far, despite the outbreak of COVID-19, another year of strong shareholder engagement on climate change, with the year-to-date climate-related shareholder resolutions exceeding last year's on an annualised basis, with the most notable increase coming from Europe. Similarly, the percentage vote in favour has increased yoy, exceeding 30%. This investor pressure, however, is not uniformly distributed across sectors and shows a clear bias towards energy producers vs. energy consumers, with data since 2014 showing 50% of proposals targeting energy producers (oil & gas, utilities, coal) while only 30% of the proposals target the sectors that account for most of the final energy consumption. The ytd 2020 data show even higher engagement, with almost 40% of all climate change-related shareholder resolutions targeting oil & gas companies in all regions: Europe (Equinor, Shell, TOTAL), the USA (Chevron, Cheniere Energy) and Asia-Pacific (Santos and Woodside Petroleum). Oil & gas show the highest engagement by far, with Financial Services (JP Morgan Chase, Danske Bank, the Toronto Dominion Bank), Consumer cyclical and defensives (Restaurant Brands International, Yum! Brands, Amazon.com, Bloomin' Brands, TJX Companies, Walmart, Dollar Tree), Utilities (Fortum, PNM Resources) and Basic Material (Rio Tinto) in aggregate accounting for a similar share as oil & gas alone.

Exhibit 35: The number of climate-related shareholder resolutions and % vote in favour continues to gain momentum so far in 2020...
Number of climate-related shareholders' proposals vs. % vote in favour



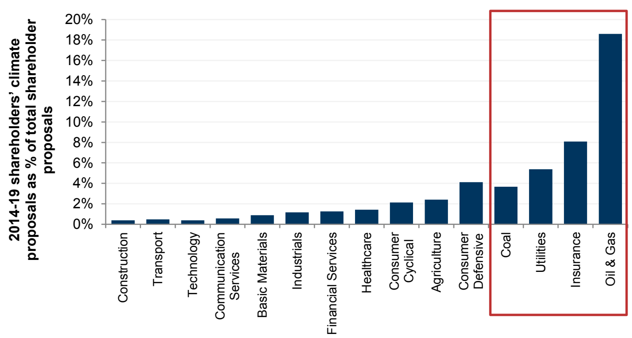
Source: ProxyInsight, Goldman Sachs Global Investment Research

Exhibit 36: ...with a targeted focus on energy producers (oil & gas, utilities)...
% of climate-related shareholder proposals, split by industry, 2014-20



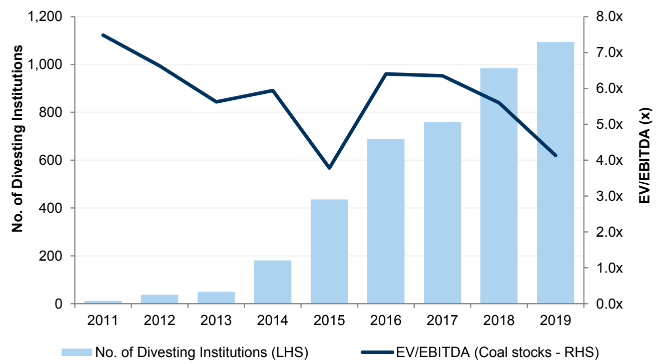
Source: ProxyInsight, Goldman Sachs Global Investment Research

Exhibit 37: ...and with the oil & gas industry also having the largest proportion of climate-related proposals relative to total shareholder proposals...
% of shareholder proposals that are climate-related, split by industry, 2014-19



Source: ProxyInsight, Goldman Sachs Global Investment Research

Exhibit 38: ...and with increased divestment in the coal industry
Number of divesting institutions (LHS) vs. coal stocks EV/EBITDA (RHS)



Source: FactSet, DivestInvest, Thomson Reuters Datastream

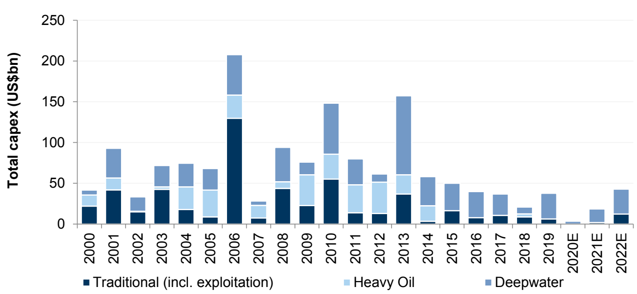
Carbonomics and the end of non-OPEC growth

Stranded assets and under-investment: As the focus shifts from volumes to returns, oil resource life has shrunk 20 years since 2014

With global emissions on an upwards trajectory over the past few years, investors are emerging with a leading role in driving the climate change debate, pushing corporate management of oil & gas producers towards incorporating climate change into their business plans and strategies. As we outlined in our oil & gas industry deep-dive, *Top Projects*, this is reflected in a structural shift in the oil & gas industry's scale of investments (Capex commitments in new long-cycle oil projects have fallen by >60% over the past five years vs. the previous five) and in its mix (more focus on gas and brownfield developments and less on long-cycle greenfield oil developments). 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) will fall to 30 years in 2020 from c.50 years in 2014, a c.20-year reduction, while economics are much healthier even under lower Brent and gas price assumptions, with an estimated 79% of the undeveloped resources profitable at a Brent price <US$60/bl vs. only 18% in 2014.

Exhibit 39: Capital markets pressure on de-carbonisation is driving structural under-investment in the oil sector...

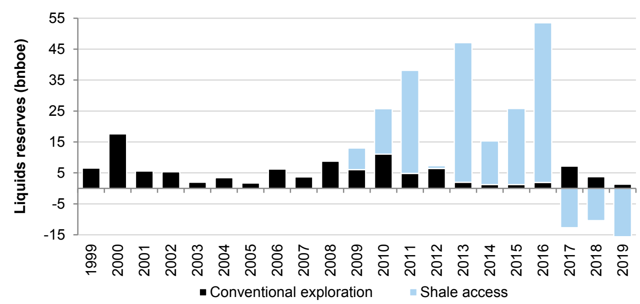
Top Projects capex sanctioned in oil by year, split by winzone



Source: Goldman Sachs Global Investment Research

Exhibit 40: ...depleting oil reserves as the focus shifts from long-term volumes to near-term value...

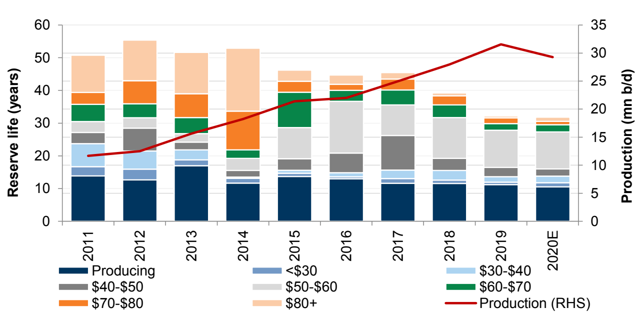
Total liquids reserves discovered by year, based on Top Projects



Source: Goldman Sachs Global Investment Research

Exhibit 41: ...consuming 20 years of oil resource life since 2014...

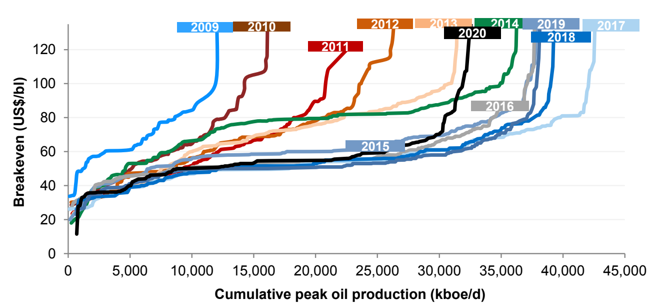
Top Projects reserve life, by year of report and breakeven



Source: Goldman Sachs Global Investment Research

Exhibit 42: ...while the oil cost curve has shrunk for the third consecutive year and is steepening

Top Projects cost curve of pre-plateau projects through the years

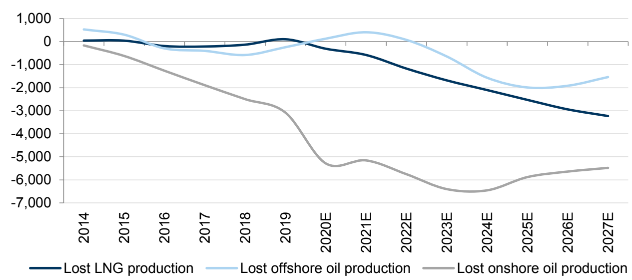


Source: Goldman Sachs Global Investment Research

Investment decisions are at a historical trough, taking 7.9/2.5 mboe/d of oil/LNG out of 2025E supply

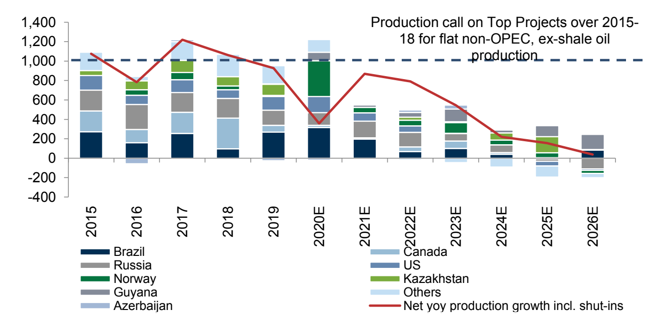
With falling oil prices since the previous downturn, and NOCs/international E&Ps retreating to their domestic basins to focus on balance sheet management, a number of project FIDs have been delayed, translating into 2.5/7.9 mboe/d of lost LNG/oil production in 2025, on our estimates. This is exacerbated by the current macro commodity downturn, which comes at a time when we had previously expected a catch-up in the project FIDs pipeline from the industry and which as such could likely prolong expected project sanctions delays for at least another two years on our estimates. This is likely to create a **tight market for both oil and LNG in the 2020s, in our view**. We expect the pace of ramp-up of long-cycle mega projects' oil production to slow from >1.0 mn bl/d in 2019 to 0.3-0.7 mn bl/d from 2021, implying an end to non-OPEC growth in the 2020s. This is likely to result in oil & gas market tightness from 2021, which is in line with higher and not lower commodity prices in the "Age of Climate Change". In our view, this should be consistent with a **gradual reduction in consumption** of the fuels longer term and could gradually encourage the transition of consumer behaviour, in line with what is required for net zero longer term, **yet in the near term creates a more profitable structure for the oil & gas industry, through consolidation, higher barriers to entry and higher hurdle rates for incremental oil & gas investments.**

Exhibit 43: Delayed investment decisions on long-cycle developments take c.8 mn blpd out of 2025E oil supply...
Top Projects lost LNG, offshore and onshore oil production from long-cycle developments; Top Projects 2020 vs. 2014 expectations



Source: Goldman Sachs Global Investment Research

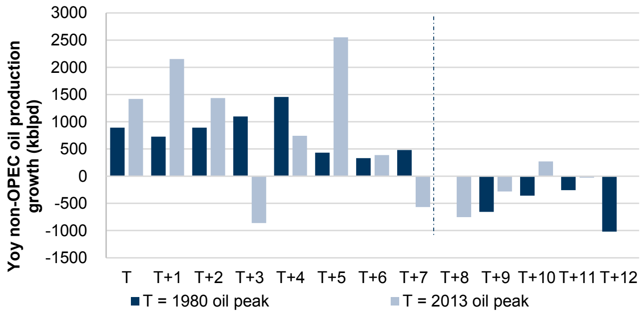
Exhibit 44: ...leading to the end of non-OPEC growth...
YoY oil production growth (kboe/d) from non-OPEC, excluding shale projects (excluding impact of shut-ins) and net production growth including production shut-ins impact



Source: Goldman Sachs Global Investment Research

Exhibit 45: ...which we expect from 2021, eight years from the oil price peak in 2013, similar to 1988...

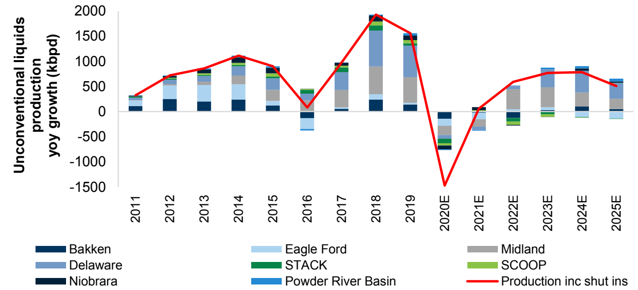
Yoy non-OPEC growth in oil production (kbpd, excl. shut-ins)



Source: BP Statistical Review, Goldman Sachs Global Investment Research

Exhibit 46: ...even as we expect US shale to return to material growth post 2021

US unconventional liquids yoy production growth (kbpd)



Source: Goldman Sachs Global Investment Research

The transition of the European Big Oils into Big Energy is accelerating

Big Oils have shown a significant ability to adapt to technological change in their 100+ years of history. We believe it is now strategic that they drive a low-carbon transition consistent with the global ambition to contain global warming within 2°C. We believe Big Oils have many tools to achieve this transition towards Big Energy and become broader, cleaner energy providers: A deeper presence in the global gas and power chains, including retail, EV charging and renewables; biofuels; petrochemicals; improved upstream and industrial operations; and carbon capture. In our deep-dive analysis, *Re-Imagining Big Oils*, we discussed the options available and argued that the strategic objective can be delivered with improving corporate returns and renewed value for scale and integration. We continue to believe this transition will require deep cultural and corporate changes and may leave the higher-carbon parts of the value chain — such as oil production (particularly oil sands and older fields) and refining — financially stranded and under-invested, as outlined in the previous sections of this report, likely leading to higher oil prices and refining margins in the coming decade.

Overall, we see European Big Oils **already spending c.50% of their capex on the low-carbon transition and path to Big Energy,** when accounting for all low-carbon activities: gas, power & retail, petrochemicals, biofuels, renewables, natural sinks and carbon capture. Moreover, with the current macro commodity downturn resulting in a strong capital discipline response from the group (cutting capex by c.20% on aggregate on our estimates), whilst the absolute amount spent on low-carbon energy remains intact, **the share of low carbon energy as a percentage of total capex has increased from 2-5% in 2018-19 to c.10-15% for the group on average in 2020-21E**, on our estimates.

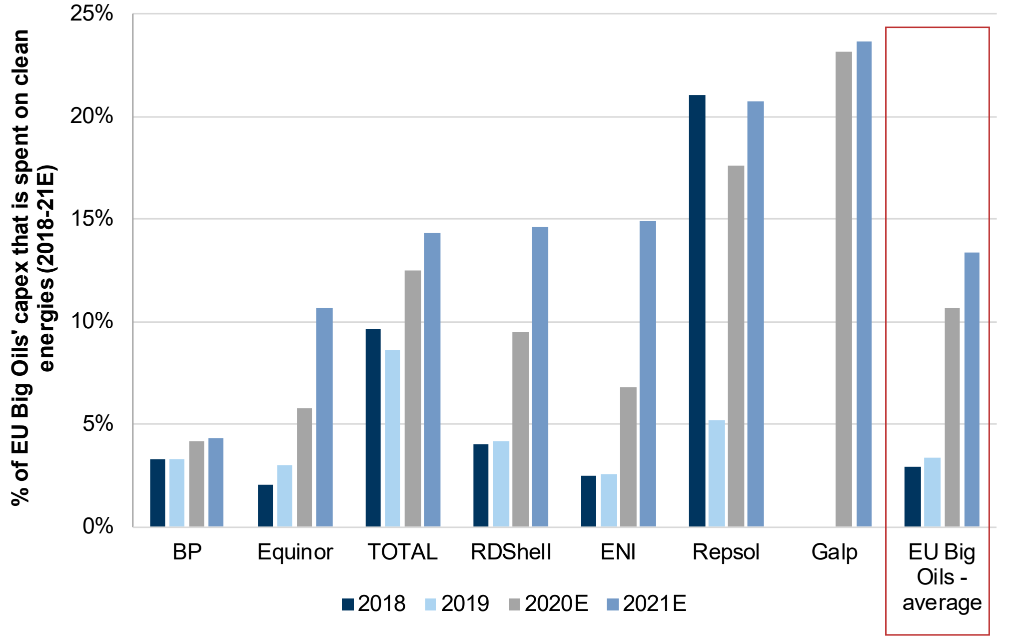
Exhibit 47: Big Oils are already spending c.50% of their capex on low-carbon activities, including gas, power & retail, petrochemicals, biofuels, renewables and sequestration. The percentage of capex spent on renewables and clean energies alone has increased to c.10-15% in 2020-21E for the group on average

	Renewables capacity (GW)	Annual low-carbon energy Gse capex % of total capex				Low-carbon transition capital expenditure		
	GW	%	%	%	%			%
	Company renewables capacity guidance	Annual clean energies investments as % of 2018 GSe capex	Annual clean energies investments as % of 2019 GSe capex	Annual clean energies investments as % of 2020 GSe capex	Annual clean energies investments as % of 2021 GSe capex	Company capex guidance on low-carbon & clean energies	GSe capex expected on low-carbon transition (incl. gas, power, retail, petchems, biofuels, clean energies)	Company total capex on low-carbon transition as % of GSe 2019-21E capex
RDShell	1.0-5.0GW operational capacity by 2025	4.0%	4.2%	9.5%	14.6%	US$1-2 bn to 2020, US$2-3 bn pa for 2021-25	US$10-14 bn pa 2019-20, US$13-17 bn pa 2021-25	52%
TOTAL	Over 25GW of installed renewables capacity by 2025	9.6%	8.6%	12.5%	14.3%	US$1-2 bn pa to 2020	US$7 bn pa to 2021	49%
BP	Solar expected to reach 6GW & 2.2GW gross wind capacity, 10GW by 2023	3.3%	3.3%	4.1%	4.3%	US$0.5 bn pa	US$7 pa to 2021	46%
Equinor	4-6GW by 2026 and 12-16GW by 2035	2.0%	3.0%	5.7%	10.6%	US$0.5-1 bn pa 2020-21, US$2-3 bn for 2022-23	US$4.5 bn pa to 2021	45%
ENI	Installed capacity expected to grow to over 55GW by 2050, 3GW by 2023, 5GW by 2025, 15GW by 2030	2.5%	2.6%	6.8%	14.9%	c.€4 bn for 2020-23 of which €2.3 bn on renewables	.€4-5 bn pa to 2021	52%
Repsol	7.5GW electricity from gas and renewables in 2025, 4.5GW from new energies	21.0%	5.2%	17.6%	20.7%	€2.5 bn (2018-20)	€2.0 bn pa to 2021	51%
OMV	OMV & Verbund PV to build PV plant in Austria	0.0%	0.0%	5.8%	3.7%	€500 mn to 2025	€1.0 bn pa to 2021	40%
Galp	3.3GW capacity from 2023,10GW of total installed capacity by 2030	0.0%	0.0%	23.1%	23.6%	5% capex by 2020, 10-15% capex in renewables new business 2020+	€0.4 bn to 2021	48%
	Median	**2.9%**	**3.4%**	**10.7%**	**13.4%**		**Median**	**48%**

Source: Company data, Goldman Sachs Global Investment Research

Exhibit 48: EU Big Oils are spending c.10-15% of their total capex on low-carbon energy, as capex in the traditional oil & gas business falls by c.20% for the group in 2020-21E and low-carbon initiatives remain intact

Share of renewables as a % of total capex for EU Big Oils



Source: Company data, Goldman Sachs Global Investment Research

Exhibit 49: EU Big Oils' de-carbonisation ambitions have accelerated so far this year, with all large-cap European integrated majors having set net zero ambitions

European Integrated Oil & Gas companies net zero targets			
Company	**Latest targets introduced**	**Details of targets introduced in 2019-2020** (ytd)	**Net zero target**
Repsol	2019	• Repsol was the first company in the oil & gas industry to aim to become a net zero company by 2050. • To achieve this objective, Repsol has set goals for the reduction of its carbon intensity indicator from a 2016 baseline: 10% by 2025, 20% by 2030, 40% by 2040, and net zero CO2 emissions by 2050. • Key pillars outlined to contribute to the low carbon transformation of the company include but are not limited to: natural gas expansion, energy efficiency (3 Mt CO2 reduction for 2018-25), power (renewable installed capacity to reach 7.5 GW by 2025), technological developments (such as CCUS), EV charging, natural sinks.	By 2050
BP	2020	• Net zero across BP's operations on an absolute basis by 2050 or sooner. • Net zero on carbon in BP's oil and gas production on an absolute basis by 2050 or sooner. • 50% cut in the carbon intensity of products BP sells by 2050 or sooner. • Install methane measurement at all BP's major oil and gas processing sites by 2023 and reduce methane intensity of operations by 50%. • Increase the proportion of investment into non-oil and gas businesses over time.	By 2050 or sooner
RDShell	2020	• Become a net-zero emissions energy business by 2050 or sooner (covering scope 1, 2, 3 emissions). • An ambition to be net zero on all the emissions from the manufacture of all RDShell products (scope 1 + 2) by 2050 at the latest. • Accelerating its Net Carbon Footprint ambition, now aiming to reduce the Net Carbon Footprint of the energy products Shell sells to its customers by around 65% by 2050, and by around 30% by 2035. • A pivot towards serving businesses and sectors that by 2050 are also net-zero emissions.	By 2050 or sooner
TOTAL	2020	• Net Zero across Total's worldwide operations by 2050 or sooner (scope 1+2) • Net Zero across all its production and energy products used by its customers in Europe2 by 2050 or sooner (scope 1+2+3). • 60% or more reduction in the average carbon intensity of energy products used worldwide by Total customers by 2050 (less than 27.5 gCO2/MJ) - with intermediate steps of 15% by 2030 and 35% by 2040 (scope 1 + 2 + 3). • Re-affirmation of strategy in action since 2015, with Total having reduced its scope 3 average carbon intensity by 6% since 2015 and setting its target for its scope 3 average carbon intensity to reduced to less than 27.5 GCO2/MJ by 2050.	By 2050 or sooner
ENI	2019, enhanced 2020	• Net zero emissions in the upstream by 2030 (Scope 1 & 2). • Net zero carbon footprint for ENI group businesses' scope 1 & 2 emissions by 2040. • 80% reduction in absolute net GHG lifecycle emissions (Scope 1, 2, 3) by 2050, 30% reduction by 2035. • 55% reduction in net carbon intensity by 2050. • The company is leveraging on a number of pillars including sequestration with forest and CCS, renewables (installed capacity expected to grow to over 55GW by 2050, 3GW by 2023 and 5GW by 2025), expansion of customer base in gas & power, increased bio-refining and recycling in refining and chemicals.	By 2030 for upstream By 2040 (scope 1,2) -80% by 2050 (Scope 1,2,3)
Equinor	2020	• Equinor announced early in 2020 its ambitions to reduce the absolute GHG emissions from its operated offshore fields and onshore plants in Norway by 40% by 2030, 70% by 2040 and to near zero by 2050. • 40% reduction in absolute GHG emissions in Norway by 2030. • <8 kg per boe CO2 intensity by 2025. • The company aims to increase its equity generation renewables capacity to 4-6 GW by 2026 and 12-16 GW by 2035.	Near zero by 2050 for operation in Norway

Source: Company data, Goldman Sachs Global Investment Research

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Reg AC

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