Note: The following is a redacted version of the original report published October 27, 2021 [77 pgs].

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Goldman Sachs | Research

Carbonomics

GS SUSTAIN

Taking the Temperature of European Corporates: An Implied Temperature Rise (ITR) toolkit

In this report we leverage our *Carbonomics Net Zero Paths* to **gauge the implied temperature rise (ITR) of corporate de-carbonization strategies** through the lenses of >110 corporates in the 15 most carbon intensive sectors of the European market. In collaboration with GS SUSTAIN, we test different ITR tools in order to determine a methodology that takes into account each corporate's growth outlook, technological readiness and positioning on the de-carbonization cost curve. We find that **an interpolation of each company's carbon intensity path to 2030** compared with our three Carbonomics Net Zero Paths (1.5°C, <2°C and 2°C) offers the benefit of focusing on tangible de-carbonization targets to 2030 without the uncertain assumptions post-2030. We translate each company's 2030 target into an emission intensity path and compare it with sector-specific Carbonomics Net Zero Paths for interpolation, on absolute intensity where possible, and including scope 3 emissions for some key sectors (integrated oil & gas, autos).

We make five main observations from our analysis: 1) **78% of the corporates have 2030 targets aligned with the Paris Agreement** based on our GS Net Zero pathways; 2) **the aggregate ITR (based on 2030 targets) is 1.75°C if weighted by emissions,** but only 1.53°C if weighted by market cap, as emissions are skewed towards low P/E multiple sectors; 3) the market is starting to price in de-carbonization ambitions, with a **60% correlation between sector P/E and the average 2030 ITR;** 4) **Materials, Heavy Transport and Energy are the most challenged sectors** on the cost curve and in our ITR analysis, but also have the most ambitious 2030 targets vs. historical de-carbonization trends; 5) **50% higher ambition:** this universe in aggregate targets 2.7% annual reduction in carbon intensity to 2030 compared with 1.9% annual trend reduction over the past 4 years.

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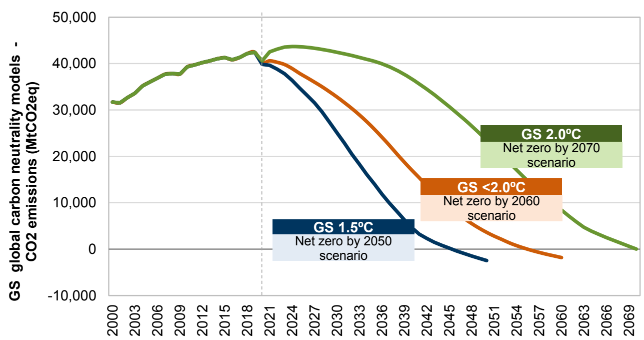

Source: Emission Database for Global Atmospheric Research (EDGAR) release version 5.0, FAO, Goldman Sachs Global Investment Research

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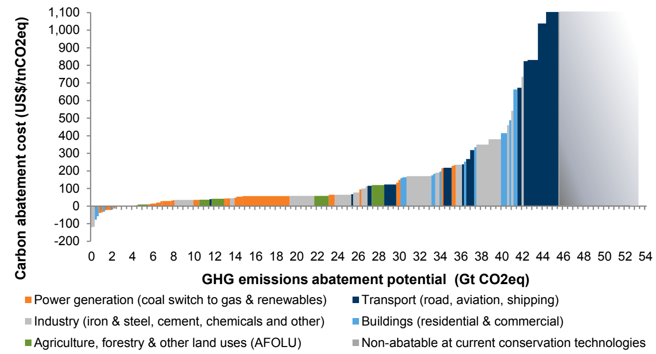

Source: Goldman Sachs Global Investment Research

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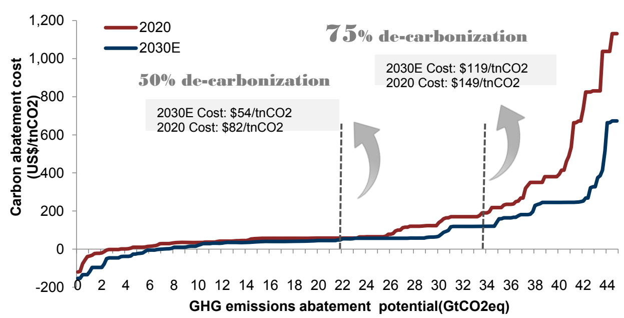

Source: Goldman Sachs Global Investment Research

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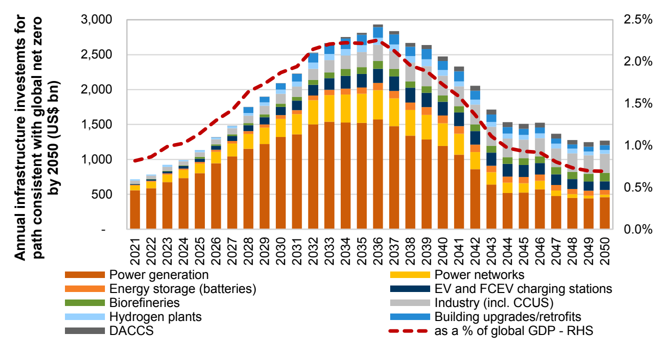

Source: Goldman Sachs Global Investment Research

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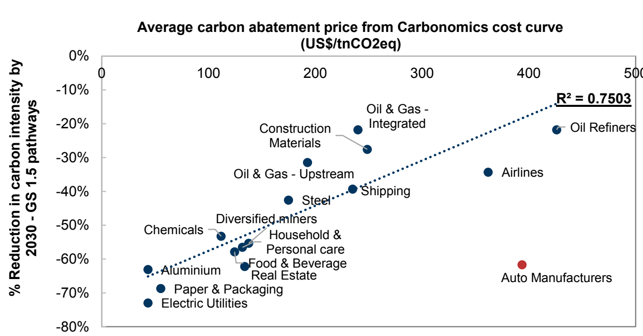

Source: Company data, Goldman Sachs Global Investment Research

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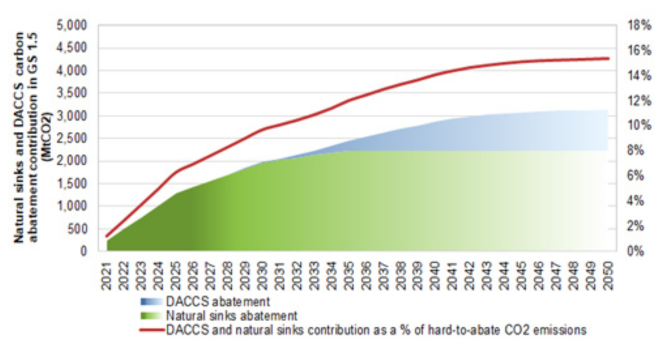

Source: Goldman Sachs Global Investment Research

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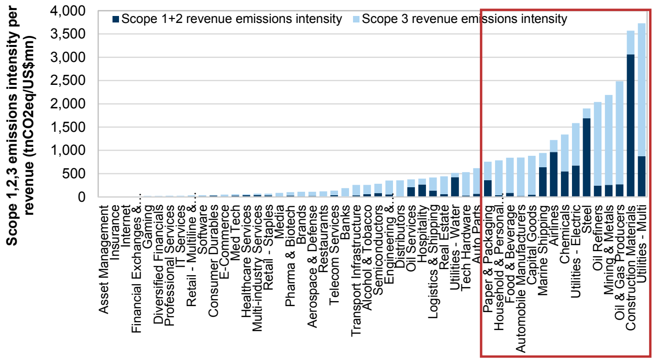

Source: Thomson Reuters, Bloomberg, MSCI, Company data, Goldman Sachs Global Investment Research

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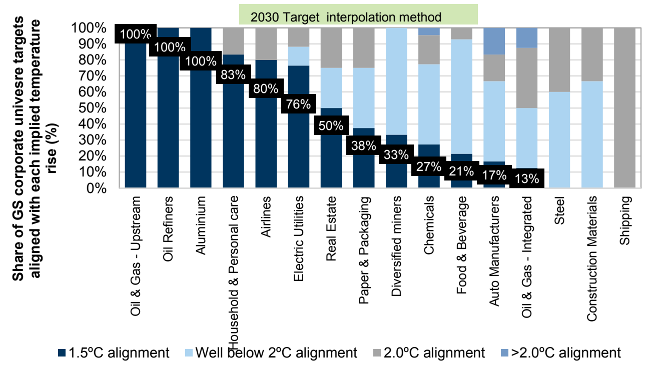

Source: Company data, Goldman Sachs Global Investment Research

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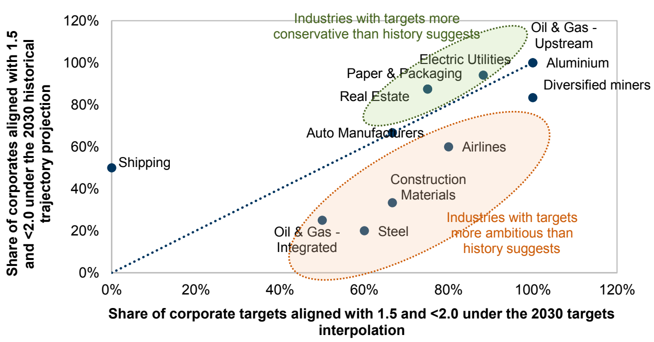

Source: Company data, Goldman Sachs Global Investment Research

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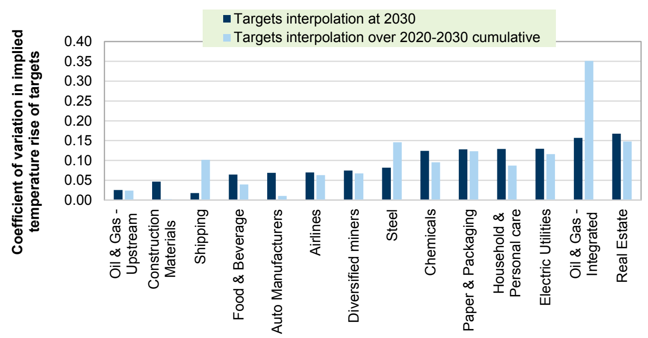

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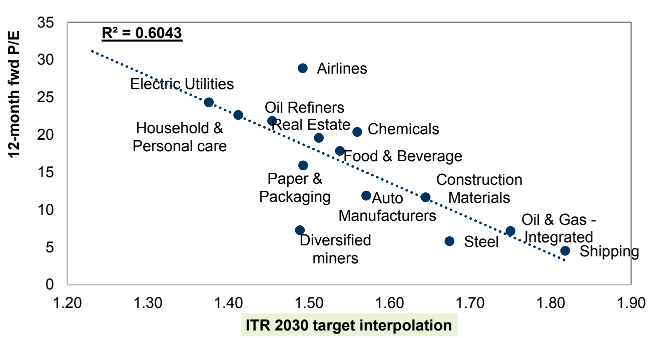

Source: Company data, Bloomberg, Goldman Sachs Global Investment Research

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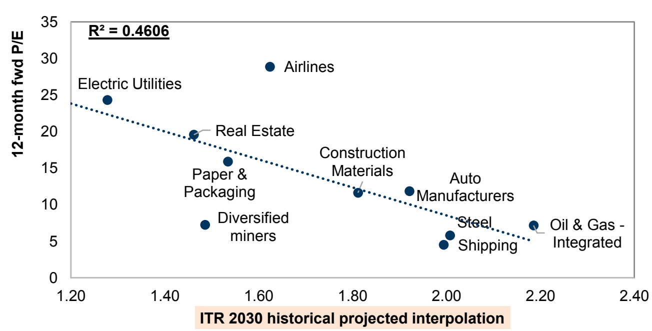


Source: Company data, Bloomberg, Goldman Sachs Global Investment Research

PM Summary: Taking the temperature of European Corporates

In this report we leverage our *Carbonomics Net Zero Paths* to gauge the implied temperature rise (ITR) of corporate de-carbonization strategies through the lenses of >110 corporates in the 15 most carbon intensive sectors of the European market. In collaboration with GS Sustain we test different ITR tools in order to find a methodology that takes into account each corporate's growth outlook, technological readiness and positioning on the de-carbonization cost curve. We believe that there are advantages and disadvantages in each of the methodologies that we have tested and that some of the more interesting conclusions actually come from comparing the different results.

We make five main observations from the results: 1) 78% of the corporates have 2030 targets aligned with the Paris Agreement based on our GS net zero pathways; 2) the aggregate ITR is 1.75°C (2030 targets) if weighted by emissions, but only 1.53°C if weighted by market cap, as emissions are skewed towards low P/E multiple sectors; 3) the market seems to have started to price in de-carbonization ambition, with a 60% correlation between sector P/E and 2030 ITR; 4) Materials, Heavy Transport and Energy are the most challenging sectors on the cost curve and ITR analysis, but also show the most ambitious 2030 targets vs. historical de-carbonization trends; 5) Higher ambition: this universe in aggregate targets c.3% annual reduction in carbon intensity to 2030 compared with c.2% trend reduction over the past four years.

The GS Net Zero paths inform our analysis, with industry-by-industry analysis of three different scenarios (GS 1.5°, GS <2.0°, GS 2.0°)

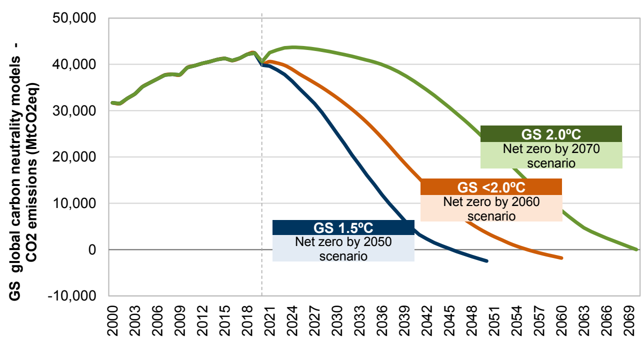
We have built three global sectoral paths to Net Zero carbon with global models of de-carbonization by sector and technology leveraging our Carbonomics cost curve. The first scenario is very aspirational and consistent with a 1.5°C global temperature rise (GS 1.5°); the second one is consistent with a rise well below 2.0°C (GS <2.0°; the 'Paris Agreement scenario'), and the third scenario consistent with 2.0°C (GS 2.0°); we utilize these GS net zero carbon models as benchmarks for our ITR analysis, the focus of this report. The GS 1.5° scenario reaches global net zero carbon by 2050, which would be consistent with limiting global warming to 1.5°C, with limited temperature overshoot. For this scenario, we assume a carbon budget for remaining net cumulative CO_2 emissions from all sources from 2020 to be c.500 $GtCO_2$, in line with the IPCC AR6 WGI Summary for Policymakers[1], and consistent with a 50% probability of limiting warming to 1.5°C by 2100. The GS <2.0° scenario would be consistent with the Paris Agreement's aim to keep global warming well below 2°C and achieve global net zero around 2060. For the purpose of this analysis, we define the cumulative remaining carbon budget for our GS <2.0° model to be 750 $GtCO_2$, consistent with around 1.65°C global warming with 50% probability. The GS 2.0° is a less aspirational scenario that aims for global

[1] IPCC, 2021: Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [MassonDelmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press. In Press

carbon neutrality by 2070 and leads to a 50% probability of 2.0°C global warming to 2100, and has a cumulative carbon budget from 2020 of 1,350 $GtCO_2$, in line with the carbon budgets outlined in the IPCC AR6 WGI Summary for Policymakers. The pace of de-carbonization in each sector and sub-sector for each of these scenarios is driven by our assessment of the positioning of each Low Carbon abatement opportunity on the de-carbonization cost curve and by its technological readiness.

Exhibit 13: We have constructed three global carbon neutrality scenarios: one consistent with 1.5°C of global warming, one consistent with well below 2.0° and one less aspirational consistent with 2.0°...

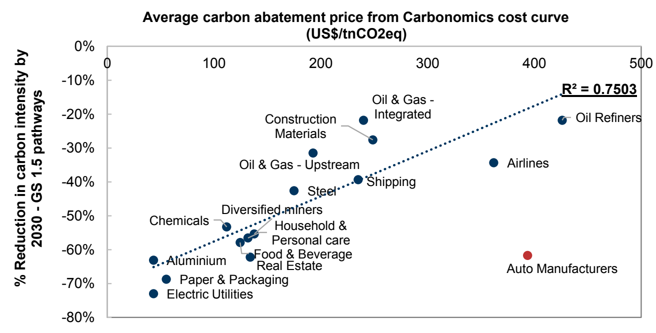
GS global net zero models, CO2 emissions (incl. AFOLU)



Source: Emission Database for Global Atmospheric Research (EDGAR) release version 5.0, FAO, Goldman Sachs Global Investment Research

Exhibit 14: ...which were done on a sectoral basis, resulting in industry-by-industry carbon intensity reduction paths. The pace of de-carbonization of each industry for each of these scenarios is driven by our assessment of the positioning of each Low Carbon abatement opportunity on the de-carbonization cost curve and by its technological readiness

% reduction in carbon intensity under GS 1.5 industry pathways vs. average carbon abatement price from Carbonomics cost curve



Source: Goldman Sachs Global Investment Research

Implied Temperature Rise (ITR) of corporate de-carbonization targets: A deep-dive into the different methodologies

Our Implied Temperature Rise (ITR) analysis leverages interpolation to compare companies' emissions trajectories with our GS Net Zero scenario industry benchmarks up to 2030. We have decided not to take a view on companies' de-carbonization paths beyond 2030 given: (a) the challenges with forecasting company performance beyond 10 years with any degree of accuracy; (b) the high likelihood of technological innovation that could alter the long-term de-carbonization trajectories and company targets; and (c) the lack of consistency on timeframe and methodology of long-term company net zero targets. Limiting ourselves to corporate de-carbonization trajectories to 2030 provides, in our view, more comparable and reliable results. However, this limitation rules out using a TCRE multiplier to translate the carbon intensity paths into an implied temperature rise score, hence the decision to apply interpolation instead. Specifically, the transient climate response to cumulative carbon emissions (TCRE) multiplier represents the global mean surface temperature rise due to a given quantity of cumulative anthropogenic CO_2 emissions in the atmosphere and can be leveraged to convert the cumulative emissions overshoot of a company or portfolio versus a climate scenario benchmark into a degree warming outcome. This underlying assumption is the rest of the world will over/undershoot a climate pathway by the same amount as the company. The TCRE multiplier can be an elegant and straightforward tool to use for ITR analysis. However, it requires the emissions of a company and the emissions in the benchmark scenario to both reach net zero in order to calculate the complete cumulative emission over/(under) shoot for which the TCRE is applied to. This implies that the results would be largely influenced by the emissions trajectory post-2030. We have instead preferred to limit ourselves to a scenario to 2030 using interpolation with our three GS Net Zero scenarios to estimate ITR scores.

In total, we provide four ITR outputs for each company, grouped as follows: **(1)** Historical Trajectory: a historical trajectory pathway (assuming the future emission reductions follow the path of the reductions achieved by the company over the past four years - less if the historical record is limited), and **(2)** Stated Company Targets: the stated target pathway to 2030 (the path to the company's 2030 targets converted into carbon intensity for consistency with our GS benchmark). For each, we calculate the interpolation vs. the benchmark paths both on (i) cumulative emissions intensity throughout the decade (i.e. 2020-2030 cumulative) and (ii) just on the 2030 target datapoint. Exhibit 15 shows the results of these four ITR calculation methods across the key sector that we have analyzed in this report.

Exhibit 15: Summary of the implied temperature rise (ITR) analysis for the 15 key emitting industries in the European market and for the GS selection of corporates in these

Implied temperature rise under the four methodologies for each sector both: (a) absolute CO2 emissions weighted and (b) market-capitalization weighted for each of the 15 key emitting industries in Europe and for the GS selected universe

ITR results - Absolute CO2 emissions weighting	Historical		Targets	
	2030	2020-2030 cumulative	2030	2020-2030 cumulative
Airlines	1.75	1.74	1.53	1.53
Aluminium	1.40	1.31	1.35	1.31
Auto Manufacturers	1.42	1.38	1.58	1.42
Chemicals	2.07	2.03	1.67	1.69
Construction Materials	1.73	1.56	1.65	1.49
Diversified miners	1.57	1.50	1.58	1.53
Electric Utilities	1.34	1.37	1.50	1.47
Food & Beverage	1.59	1.63	1.56	1.53
Household & Personal care	1.44	1.46	1.51	1.55
Oil & Gas - Integrated	2.12	2.06	1.84	2.35
Oil & Gas - Upstream	1.20	1.23	1.25	1.26
Oil Refiners	-	-	1.45	1.45
Paper & Packaging	1.69	1.63	1.56	1.49
Real Estate	1.47	1.50	1.79	1.70
Shipping	1.77	1.78	1.83	1.90
Steel	2.16	2.35	1.77	1.95
GS Corporate universe selection	1.92	1.88	1.75	2.06

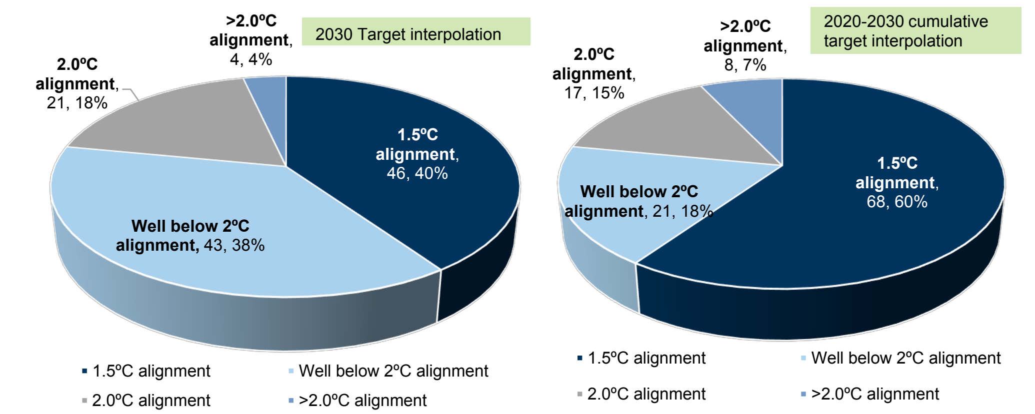
ITR results - Market capitalization weighting	Historical		Targets	
	2030	2020-2030 cumulative	2030	2020-2030 cumulative
Airlines	1.61	1.58	1.51	1.49
Aluminium	1.40	1.31	1.35	1.31
Auto Manufacturers	1.27	1.24	1.44	1.27
Chemicals	1.88	1.87	1.59	1.62
Construction Materials	1.88	1.68	1.62	1.49
Diversified miners	1.56	1.49	1.56	1.51
Electric Utilities	1.26	1.28	1.36	1.33
Food & Beverage	1.57	1.58	1.54	1.52
Household & Personal care	1.22	1.29	1.28	1.36
Oil & Gas - Integrated	2.14	1.83	1.81	2.24
Oil & Gas - Upstream	1.20	1.22	1.23	1.25
Oil Refiners	-	-	1.45	1.45
Paper & Packaging	1.62	1.55	1.51	1.45
Real Estate	1.41	1.43	1.62	1.56
Shipping	1.91	1.93	1.82	1.95
Steel	2.12	2.28	1.75	1.90
GS Corporate universe selection	1.58	1.54	1.53	1.58

Source: Company data, Goldman Sachs Global Investment Research

Our ITR analysis indicated that c.78% of corporates in the 15 most emitting industries in the European market are Paris-aligned

Exhibit 16 shows the share of the European corporates examined in our analysis that have an implied temperature rise score (under the two GS ITR methodologies driven by the companies' 2030 stated targets) that are aligned with: (a) 1.5°C scenario or below, (b) well below 2°C, (c) 2.0°C, and (d) above 2°C. On aggregate, European corporates in the 15 key emitting industries included in this report have set ambitious targets, with c.78% of them having set targets that are Paris-aligned ('well within 2°C of global warming' and in line with our GS net zero pathway - GS <2.0°) under both methodologies. Interestingly, the percentage of targets that are aligned with the more aspirational 1.5°C scenario or below is larger when calculated on cumulative carbon intensity rather than purely on the 2030 targets. This is because European corporates have a head start vs. our global paths by generally starting with much lower carbon intensities than the rest of the world and sometimes target a lower % reduction than the global path would suggest. This strong starting point (and lack of ambition) is currently especially evident in sectors such as autos, real estate and for some utilities.

Exhibit 16: Share of European corporates included in our analysis whose de-carbonization target-implied temperature rise result (under the two target-based methodologies) falls within each category (1.5°C, <2.0°C, 2.0°C and >2.0°C)



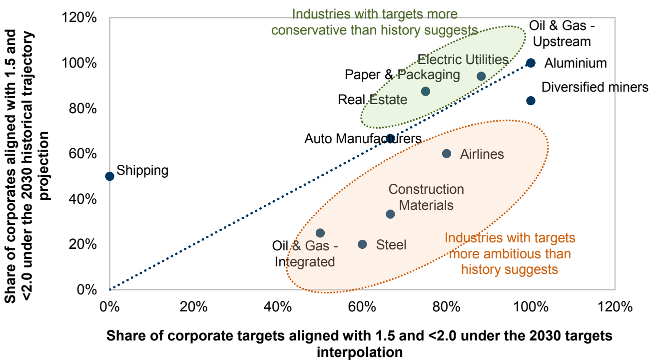
Source: Company data, Goldman Sachs Global Investment Research

Ambition vs. historical delivery: Comparing the ITR implied by corporate targets vs. their historical trajectory identifies sectors where the targets imply a breakthrough in carbon intensity vs. recent history

Exhibit 17 compares the implied temperature rise results based on corporates' targets vs. projecting the corporates' historical carbon intensity trajectories. This analysis provides useful insights with regard to the sectors that have set either more ambitious or more conservative targets than their historical emission reduction delivery. Overall, our results indicate that the tougher to abate sectors such as airlines, steel, construction materials and integrated oil & gas appear to be substantially accelerating their low carbon transition compared to a more muted historical delivery. Their historical record is not as strong as other industries given the limited availability of large-scale, mature de-carbonization technologies for these industries. On the contrary, industries such as real estate, electric utilities and paper & packaging have on aggregate de-carbonization targets that appear more conservative than their historical trajectory would suggest is achievable, either because these industries in Europe have already achieved most of the low hanging fruit or because they have not yet updated their de-carbonization targets to better reflect their more ambitious de-carbonization strategies announced (as is the case for most of the auto manufacturers). We have also examined the degree of variation between the implied temperature rise results across the companies in each of the key industries considered. Overall, as shown in Exhibit 18, across sectors the coefficient of variation appears to be less than 0.5, indicating strong consistency in targets across industries. Notable examples of higher dispersion of results include real estate, integrated oil & gas producers and electric utilities.

Exhibit 17: Comparison of the implied temperature rise between the corporates' current de-carbonization targets and their historical trajectory provides useful insights with regard to which industries have set more ambitious de-carbonization targets for this decade (vs. their historical track record)...

Share of GS corporate universe selection's targets and historical trajectories aligned with each implied temperature rise (%)

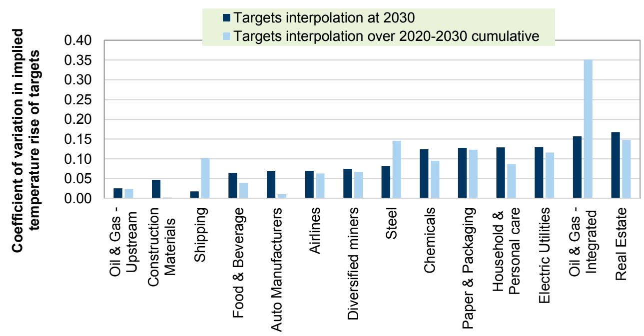


* In this exhibit we include only the industries for which a historical projectory analysis was performed. This excludes therefore the 'Index' carbon intensity heterogeneous industries

Source: Company data, Goldman Sachs Global Investment Research

Exhibit 18: ...while the coefficient of variation can provide a useful insight to the consistency of de-carbonization targets across industries

Coefficient of variation in implied temperature rise results for corporate targets in each industry



* In this exhibit we include only the industries for which a historical projectory analysis was performed. This excludes therefore the 'Index' carbon intensity heterogeneous industries

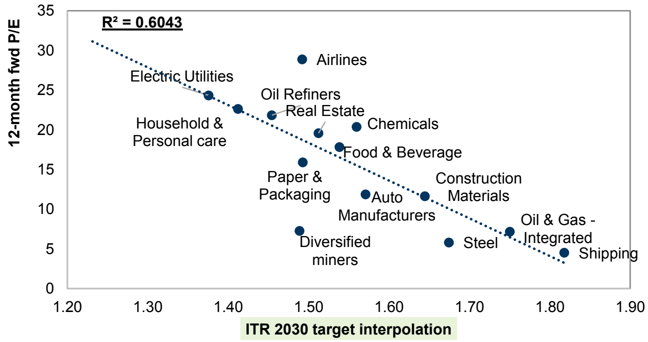
Source: Company data, Goldman Sachs Global Investment Research

The market is paying for ambitious de-carbonization strategies: we find a 60% correlation between the 12-month forward P/E and ITR score.

We examine the correlation between the implied temperature rise (ITR) results of each corporate industries and the 12-month forward P/E multiple. Our results indicate that there is a correlation between the average 12-month forward P/E multiple and the average 2030 de-carbonization target ITR for each industry (as shown in Exhibit 19), with the 2030 target interpolation method giving a higher correlation compared to the 2020-30 cumulative target interpolation method. This would suggest that the market is rewarding ambitious de-carbonization strategies and appears more concerned with the final 2030 target than with the trajectory that gets the corporates to that target (lower correlation with 2020-30 cumulative target implied temperature rise). We have performed the same analysis to examine the correlation between the implied temperature rise (ITR) of each corporate industry's projected historical de-carbonization trajectory (average ITR result by industry) to the 12-month forward P/E multiple (average for each industry). The correlation however, as shown in Exhibit 20, appears to be weaker than the correlation with actual 2030 corporate targets, which would suggest that the market is more focused on targets than historical track records.

Exhibit 19: We find a c. 60% correlation between the ITR score of corporates' 2030 stated targets and the 12-month forward P/E multiple...

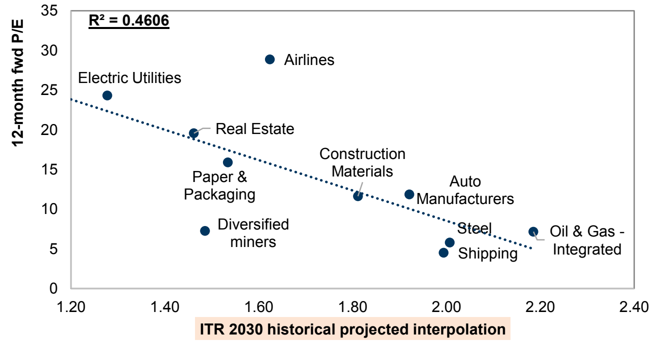
Average ITR 2030 target results vs. 12-month forward P/E by industry



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

Exhibit 20: ...which is stronger than the correlation between that same P/E with the projected historical trajectory ITR score, implying the market is more focused on targets than historical track records

Average ITR 2030 projected historical trajectory result vs. 12-month forward P/E by industry



* In this exhibit we include only the industries for which a historical projectory analysis was performed. This excludes therefore the 'Index' carbon intensity heterogeneous industries

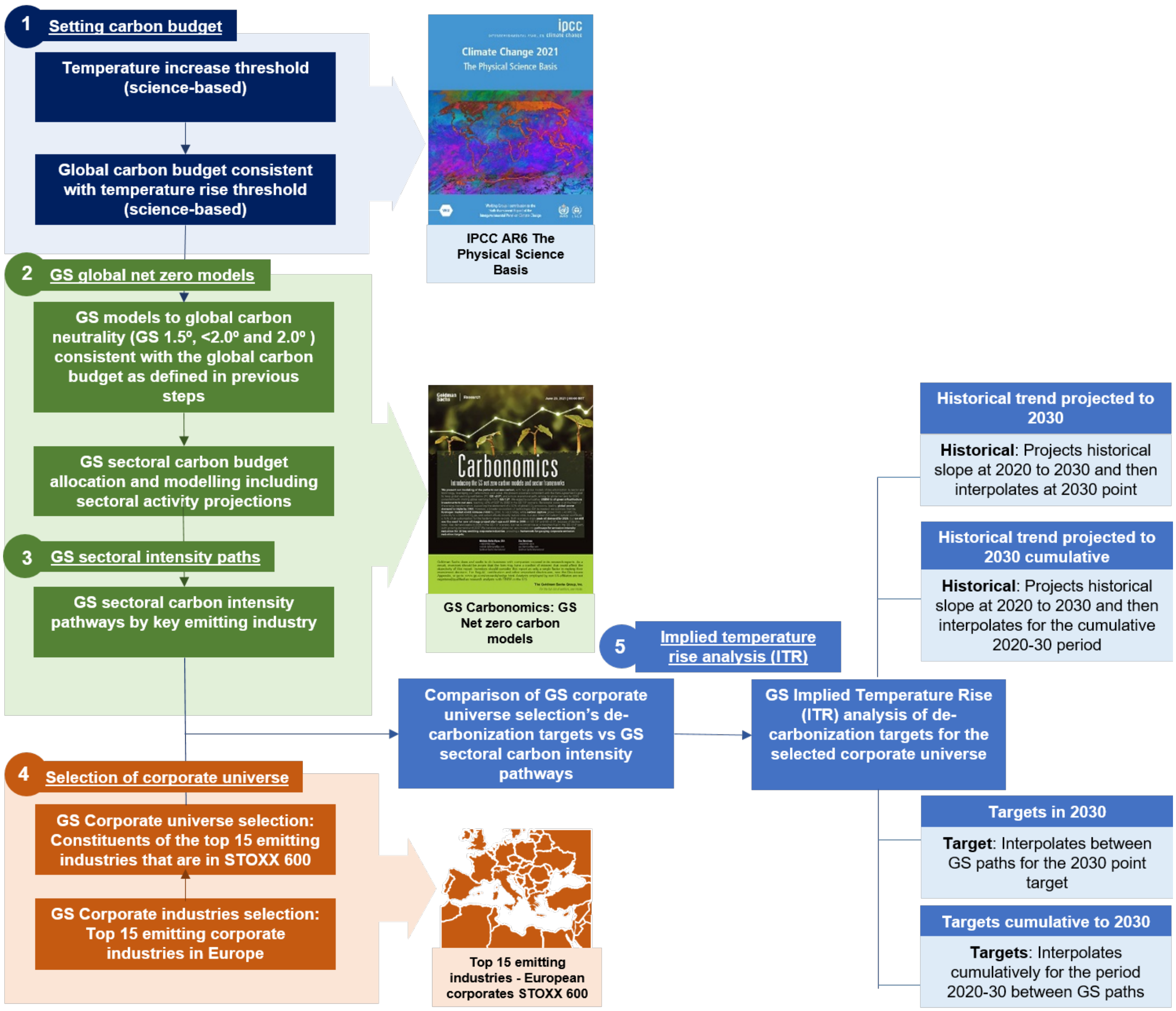
Source: Company data, Bloomberg, Goldman Sachs Global Investment Research

This report was done in collaboration with GS SUSTAIN.

GS Implied Temperature Rise (ITR) analysis explained in 5 key steps

In this report we leverage our *Carbonomics Net Zero Paths* to gauge the implied temperature rise (ITR) of corporate de-carbonization strategies through the lenses of >110 corporates in the 15 most carbon intensive sectors of the European market. To do so, we utilize our sectoral GS net zero carbon models (GS 1.5°, GS <2.0°, GS 2.0°) and present our implied temperature alignment analysis and results for a corporate universe selection comprising the 15 most carbon intensive industries in the European market (STOXX 600). In **Exhibit 21** we provide an overview of the main features and steps of our approach and the rest of the report goes through these steps in further detail, summarizing our findings as well as outlining methodology, assumptions and limitations.

Exhibit 21: A method overview for GS Implied Temperature Rise analysis of de-carbonization targets for corporates

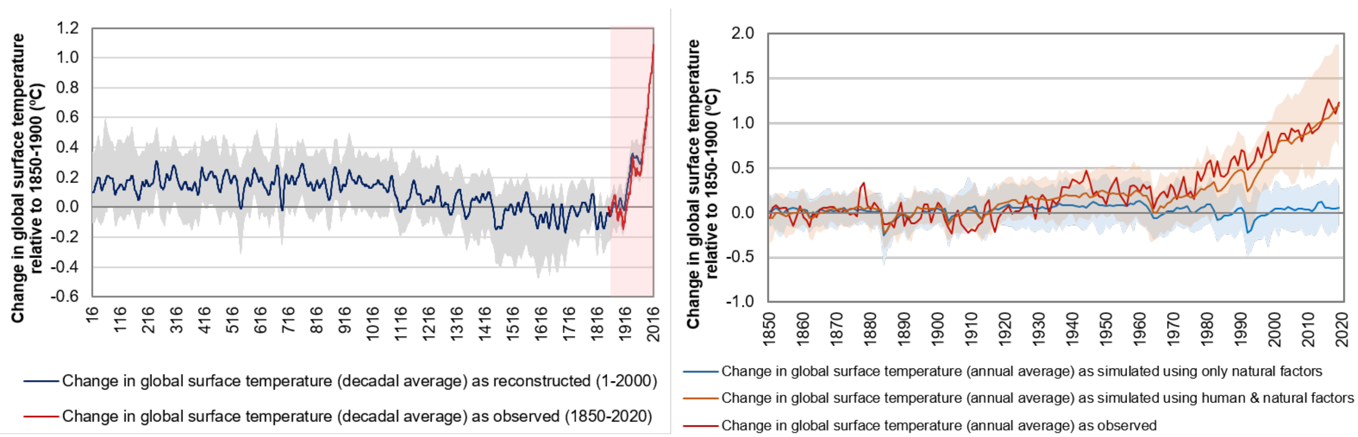


Source: Goldman Sachs Global Investment Research

1) Setting the carbon budget: We utilize the IPCC's physical science basis estimates and analysis

The Intergovernmental Panel of Climate Change has recently published *'AR6 Climate Change 2021: The Physical Science Basis report'* [2] addressing the latest physical understanding of the climate system and providing the latest status on the current state of climate change. Despite the increasing focus and engagement of governments, corporates and investors on this topic, global GHG emissions have been on a persistent upward trajectory over the past decade while, at the same time according to the IPCC's AR6 Summary for Policymakers, each of the last four decades has been successively warmer than any decade that preceded it since 1850. As shown in Exhibit 22, the global surface temperature has already risen 1.09°C in the 2011-20 period above the pre-industrial level (1850-1900), whilst the **likely range of total human-caused global surface temperature increase from 1850–1900 to 2010–2019 is 0.8°C to 1.3°C**, with a best estimate of 1.07°C according to the report. Subsequently, the effects of climate change have already started to be more profound and evident, with the report stating with high confidence that hot extremes (including heatwaves) have become more frequent and more intense across most land regions since the 1950s, while cold extremes (including cold waves) have become less frequent and less severe, with high confidence that human-induced climate change is the main driver of these changes.

Exhibit 22: The global surface temperature is rising at a rate that is unprecedented in the last 2000 years according to the latest IPCC report
(a) Changes in global surface temperature reconstructed from paleoclimate archives and from direct observations, (b) Changes in global surface temperature over the past 170 years relative to 1850-1900 compared to simulations of the temperature response to both human and natural drivers (orange) and only natural drivers (light blue)



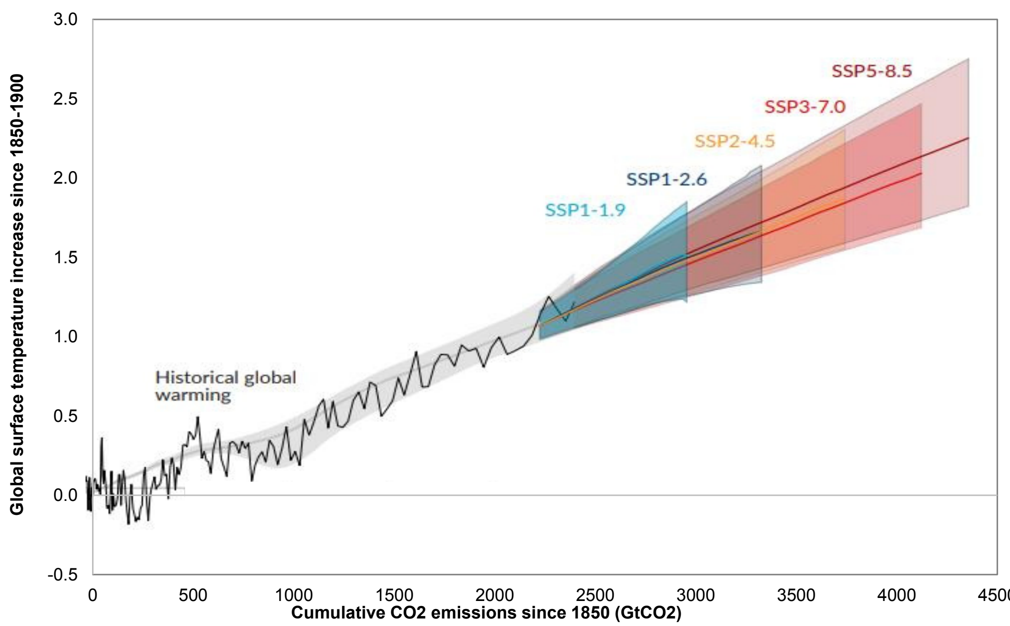
Source: CEDA Data Catalogue Page for this dataset: http://catalogue.ceda.ac.uk/uuid/76cad0b4f6f141ada1c44a4ce9e7d4bd, IPCC, 2021: Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S. L. Connors, C. Pean, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T. K. Maycock, T. Waterfield, O. Yelekci, R. Yu and B. Zhou (eds.)]. Cambridge University Press. In Press.

[2] IPCC, 2021: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press. In Press

Cumulative carbon dioxide (CO_2) emissions over time is considered to be the principal driver of long-term global warming, and the concept of a **cumulative carbon budget** has entered the forefront of climate change implied temperature rise discussions over recent years. The IPCC AR6 report re-affirms with high confidence that there exists a **near-linear relationship between the cumulative anthropogenic CO_2 emissions and the global warming** that these may cause. According to the report, each 1000 $GtCO_2$ of cumulative CO_2 emissions is assessed to likely cause a 0.27°C to 0.63°C increase in global surface temperature with a best estimate of 0.45°C. This quantity is often referred to as the transient climate response to cumulative CO_2 emissions (**TCRE**). **This relationship implies that reaching net zero anthropogenic CO_2 emissions is a requirement to stabilize human-induced global temperature increase at any level, but that limiting global temperature rises to a specific level would imply limiting cumulative CO_2 emissions within a certain confined carbon budget.**

Exhibit 23: The near linear relationship between the cumulative CO2 emissions and global warming for five illustrative scenarios (by IPCC) until 2050

Global surface temperature increase since 1850-1900 (°C) as a function of cumulative CO2 emissions (GtCO2)



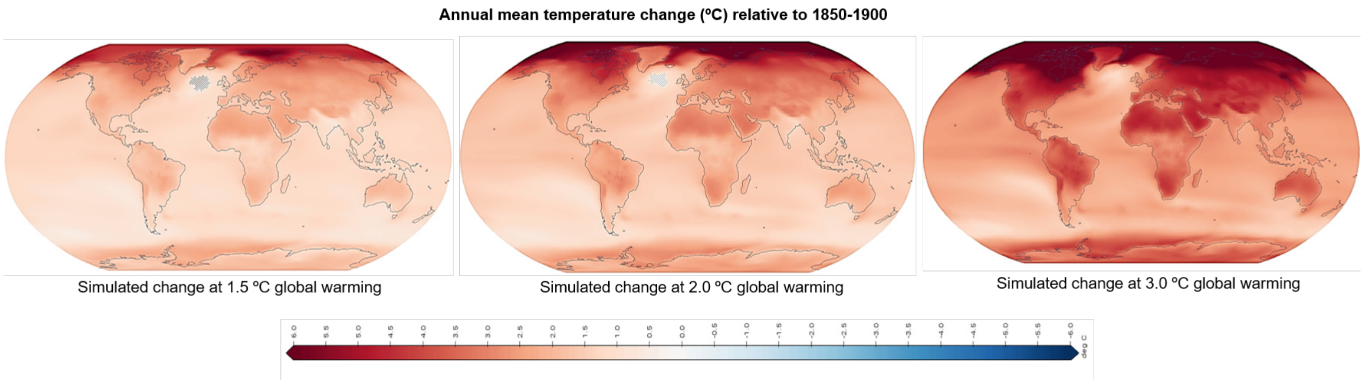
Global warming between 1850-1900 and 2010-19	Historical cumulative CO2 emissions from 1850-2019 (GtCO2)
1.07 ºC [0.8-1.3 likely range]	2390 (±240, likely range)

Approximate global warming relative to 1850-1900 until temperature limit	Approximate global warming relative to 2010-2019 until temperature limit	**Estimated remaining carbon budgets from the beginning of 2020 (GtCO2)**				
Likelihood of limiting global warming to temperature limit		***17%***	***33%***	***50%***	***67%***	***83%***
1.5 ºC	0.43	900	650	500	400	300
1.7 ºC	0.63	1450	1050	850	700	550
2.0 ºC	0.93	2300	1700	1350	1150	900

Source: CEDA Data Catalogue Page for this dataset: http://catalogue.ceda.ac.uk/uuid/cfe938e70f8f4e98b0622296743f7913, IPCC, 2021: Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S. L. Connors, C. Pean, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T. K. Maycock, T. Waterfield, O. Yelekci, R. Yu and B. Zhou (eds.)]. Cambridge University Press. In Press.

Exhibit 24: With every increment of global warming, changes get larger in regional mean temperature, precipitation and soil moisture. Across warming levels, land areas warm more than oceans, and the Arctic and Antarctica warm more than the tropics.

Globe schematics for annual mean temperature change relative to 1850-1900

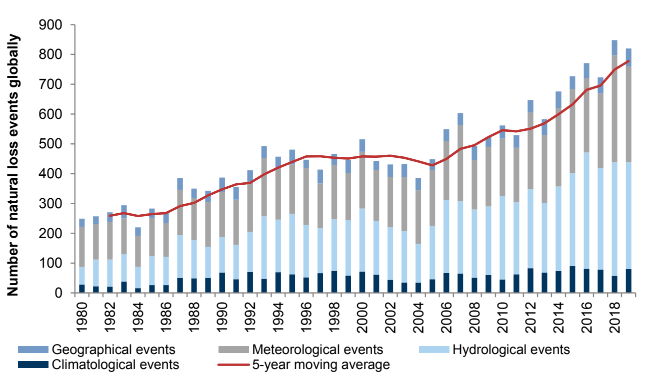


Source: Iturbide, M., Fernández, J., Gutiérrez, J.M., Bedia, J., Cimadevilla, E., Díez-Sierra, J., Manzanas, R., Casanueva, A., Baño-Medina, J., Milovac, J., Herrera, S., Cofiño, A.S., San Martín, D., García-Díez, M., Hauser, M., Huard, D., Yelekci, Ö. (2021) Repository supporting the implementation of FAIR principles in the IPCC-WG1 Atlas. Zenodo, DOI: 10.5281/zenodo.3691645. Available from: https://github.com/IPCC-WG1/Atlas, Gutiérrez, J.M., R.G. Jones, G.T. Narisma, L.M. Alves, M. Amjad, I.V. Gorodetskaya, M. Grose, N.A.B. Klutse, S. Krakovska, J. Li, D. Martínez-Castro, L.O. Mearns, S.H. Mernild, T. Ngo-Duc, B. van den Hurk, and J.-H. Yoon, 2021: Atlas. In Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L.Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K.Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press. In Press. Interactive Atlas available from http://interactive-atlas.ipcc.ch/

As mentioned previously, the impacts of climate change are already starting to accelerate and become more evident. T**he frequency of climate-related events and natural catastrophes has increased notably over the past decade** with data from Munich Re NatCaService showing an overall upward trend in the number of natural catastrophe events (Exhibit 25). 2020 has marked another year of increase, with 980 natural catastrophe events, up from 860 in 2019, resulting in approximately US$210 bn in overall losses according to this data set. This has started to become a notable cost for major economies, such as the United States, which accounted for c.US$95 bn of these losses in 2019 and which, as shown in Exhibit 26, has seen a major rise in the frequency of billion-dollar natural disasters. According to NOAA National Centers for Environmental Information (NCEI), the disaster costs for the first nine months of 2021 ($104.8 bn) are already surpassing the disaster costs for all of 2020.

Exhibit 25: The number of natural catastrophe-related loss events globally has increased materially over recent years...

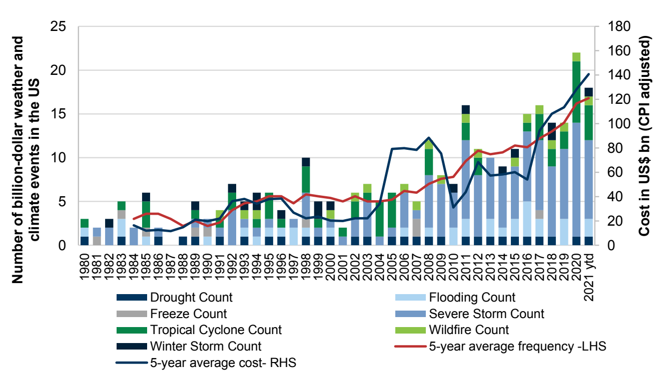
Number of natural loss events globally



Source: Munich Re- NatCatSERVICE (2019), Goldman Sachs Global Investment Research

Exhibit 26: ...and has started to translate into notable costs for major economies such as the US

United States billion-dollar weather and climate disasters (no of events - LHS, cost in US$bn - RHS)



Source: NOAA National Centers for Environmental Information (NCEI) U.S. Billion-Dollar Weather and Climate Disasters (2021). https://www.ncdc.noaa.gov/billions/, DOI: 10.25921/stkw-7w73

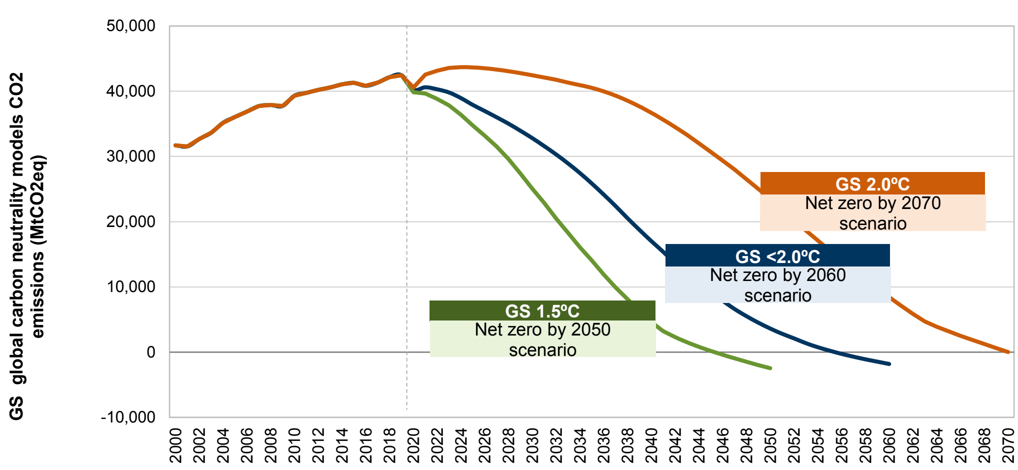
2) The global GS Net Zero paths: A sectoral approach consistent with limiting global warming to 1.5°C, well below 2.0°C and 2.0°C

We have built three global paths to Net Zero carbon: one aspirational scenario consistent with a 1.5°C global temperature rise, one consistent with a rise well below 2.0°C (the 'Paris Agreement scenario') and one consistent with 2.0°C

In our report *Carbonomics: Introducing the GS net zero carbon models and sector frameworks*, we introduced our global paths to Net Zero carbon, with global models of de-carbonization by sector and technology, leveraging our Carbonomics cost curve.

- **GS 1.5°:** We introduced our emissions path for **global net zero carbon by 2050,** which would be **consistent with limiting global warming to 1.5°C**, with limited temperature overshoot. For this scenario, we assumed a carbon budget for remaining net cumulative CO_2 emissions from all sources from 2020 to be c.**500** $GtCO_2$, in line with the IPCC AR6 WGI Summary for Policymakers, and consistent with a 50% probability of limiting warming to 1.5°C by 2100.
- **GS <2.0°:** We also introduced a more achievable global net zero model which is **consistent with the Paris Agreement's aim to keep global warming well below 2°C and achieving global net zero around 2060**. For the purpose of this analysis, we define the carbon budget for our GS <2.0° model to be one with cumulative remaining carbon budget of **750** $GtCO_2$, **consistent with around 1.65°C global warming** with 50% probability.
- **GS 2.0°:** We also introduced a **less aspirational scenario** that aims for global carbon neutrality by 2070 and leads to a 50% probability of **2.0°C global warming to 2100**, and with a cumulative carbon budget from 2020 of **1,350** $GtCO_2$, in line with the carbon budgets outlined in the IPCC AR6 WGI Summary for Policymakers.

Exhibit 27: We have constructed three global carbon neutrality scenarios: one consistent with 1.5°C of global warming, one consistent with well below 2.0° and one less aspirational consistent with 2.0°
GS net zero global models, CO2 emissions (incl. AFOLU)



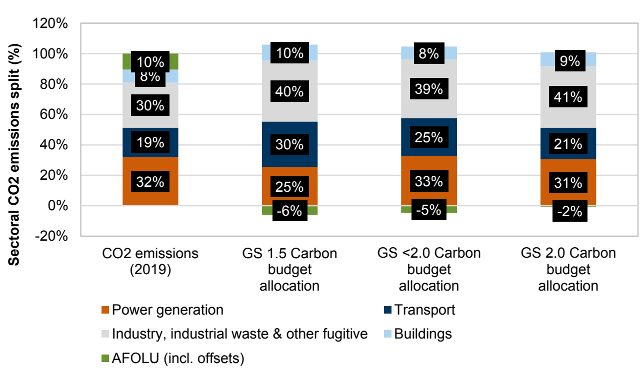
Source: Emission Database for Global Atmospheric Research (EDGAR) release version 5.0, FAO, Goldman Sachs Global Investment Research

We adopt a sectoral approach in forming our global net zero carbon models, leveraging our Carbonomics de-carbonization cost curve for our sectoral carbon budget allocations

Our paths to net zero addresses all the key emitting sectors: **power generation, transport** (light and heavy-duty road transport, aviation, shipping, rail), **industry** (including industrial combustion, industrial processes, fuel extraction, other fugitive and waste), **buildings** (residential and commercial) and **agriculture, forestry and other land uses (AFOLU)**. For our global zero carbon scenarios we adopt a **sectoral approach**, **leveraging our Carbonomics de-carbonization cost curve,** and **allocating the available carbon budget across different emitting industries on the basis of current cost and technological readiness.**

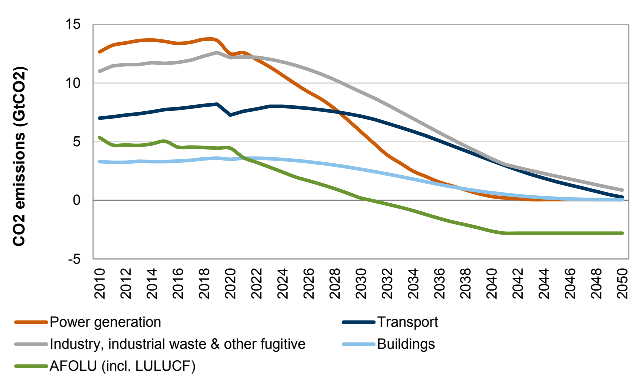
Overall we expect all the key technologies addressed in our de-carbonization cost curve to play a role in facilitating the path to net zero, each in their respective sector. **The speed of de-carbonization in each sector is largely dependent on the current carbon abatement cost and state of readiness of the available clean technologies presented in our Carbonomics cost curve**. As such, in our modes for global net zero, different sectors de-carbonize at different speeds and have a different carbon budget allocation depending on their relative cost positioning and readiness on our de-carbonization cost curve. We note that our Carbonomics cost curve of de-carbonization **is not static, and is expected to evolve over time as the costs of existing technologies continue to change and as technological innovation leads to the addition of further de-carbonization technologies across sectors.** As such, **our GS global net zero models are also dynamic, and are expected to evolve over time** as technological innovation and focus on de-carbonization continues.

Exhibit 28: We adopt a sectoral carbon budget allocation approach which is largely dependent on the technological readiness and carbon abatement cost of clean de-carbonization technologies in each sector, as addressed by our Carbonomics cost curve...
Sectoral CO2 emissions split (%)



Source: Emission Database for Global Atmospheric Research (EDGAR) release version 5.0, FAO, Goldman Sachs Global Investment Research

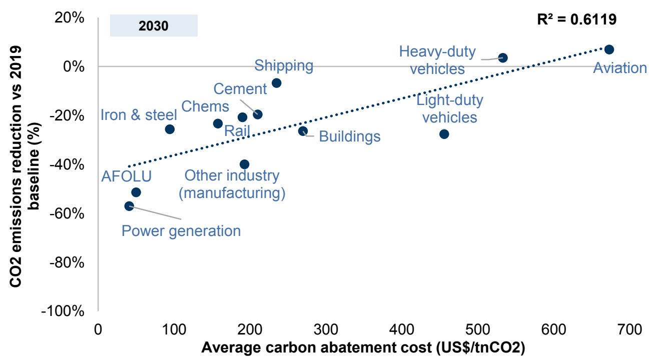
Exhibit 29: ...and we model the emissions across all key emitting sectors
Global CO2 emissions by major emitting sector (GtCO2), including AFOLU for our GS 1.5°C scenario



Source: Emission Database for Global Atmospheric Research (EDGAR) release version 5.0, FAO, Goldman Sachs Global Investment Research

Exhibit 30: The pace of de-carbonization in each sector and sub-sector is correlated to the average carbon abatement price of the available clean technologies in that sector...

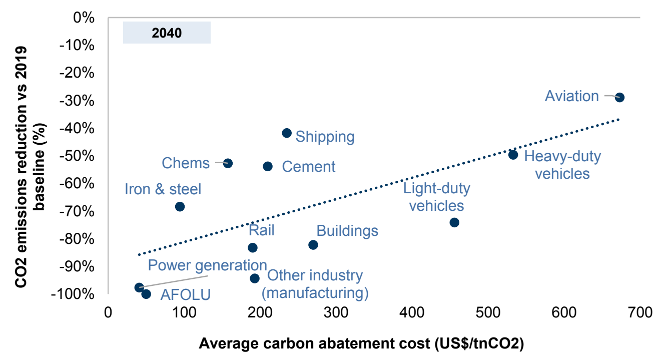
CO_2 emissions reduction vs. 2019 by sub-sector vs. average carbon abatement cost for our GS 1.5°C scenario



Source: Goldman Sachs Global Investment Research

Exhibit 31: ...as shown in these exhibits for both 2030 and 2040

CO_2 emissions reduction vs. 2019 by sub-sector vs. average carbon abatement cost for our GS 1.5°C scenario



Source: Goldman Sachs Global Investment Research

Exhibit 32: The overall carbon budget and sectoral carbon budget allocations differ between our three global carbon neutrality scenarios

Sectoral approach emissions analysis	Further sectoral emissions analysis breakdown	GS 1.5º model – Carbon budget allocation (GtCO2, % of total budget)			GS <<2.0º path – Carbon budget allocation (GtCO2, % of total budget)			GS 2.0º path – Carbon budget allocation (GtCO2, % of total budget)			CO2 emissions 2019	
Power Generation	Power Generation	129	25%	25%	246	33%	33%	412	32%	32%	32%	32%
Transportation	Aviation	22	4%	30%	34	4%	25%	54	4%	21%	2%	19%
	Shipping	18	4%		21	3%		32	2%		2%	
	Rail	2	<1%		2	<1%		4	<1%		<1%	
	Light-duty road transport	59	12%		64	8%		93	7%		9%	
	Heavy-duty road transport	51	10%		66	9%		98	7%		6%	
Buildings	Residential buildings	37	7%	10%	45	6%	8%	85	6%	9%	5%	8%
	Commercial buildings	16	3%		19	3%		37	3%		3%	
Industry (combustion & process), fugitive & waste	Iron & Steel	43	8%	40%	56	7%	39%	81	6%	41%	6%	30%
	Cement	46	9%		56	8%		76	6%		6%	
	Aluminium*	8	1%		10	1%		17	1%		1%	
	Chemicals & petrochemicals, incl. ammonia, methanol, HVCs	31	6%		47	6%		72	5%		3%	
	Pulp, paper & packaging	3	1%		4	1%		5	1%		1%	
	Food & tobacco processing	10	2%		13	2%		15	2%		2%	
	Other industry incl. fuel extraction/ processing and waste	63	12%		103	14%		282	21%		11%	
AFOLU (Agriculture, forestry, other land use)	Agriculture and land use change	44	9%	-6%	61	8%	-5%	119	8%	-2%	10%	10%
	Natural sinks, DACCS	-74	-14%		-95	-13%		-131	-10%		nr	
	Total cumulative budget	508	100%		750	100%		1,350	100%		100%	

* Direct emissions

Source: Goldman Sachs Global Investment Research

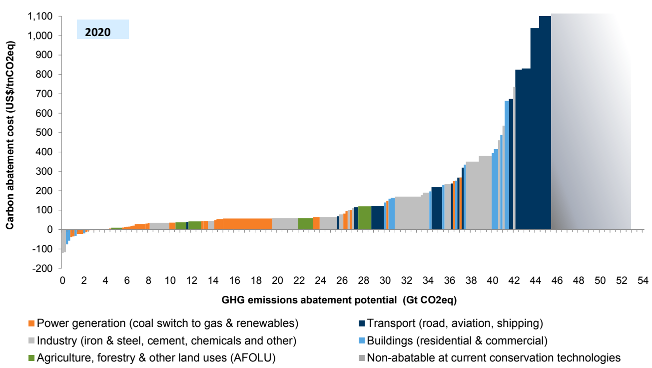
We expect the Carbonomics cost curve to transform this decade, driven by cost deflation, mostly in energy storage (batteries and clean hydrogen)

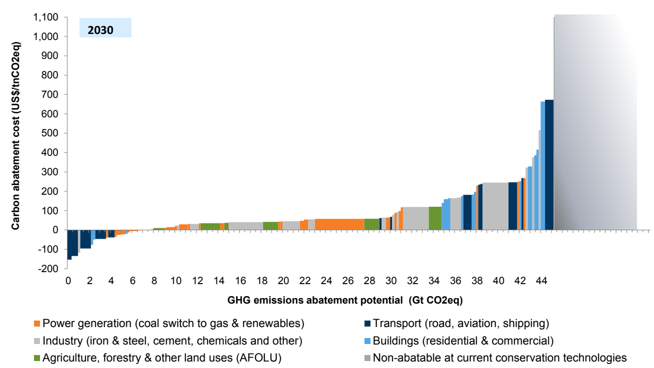
The additional carbon budget flexibility offered by the <2°C path (compared to the more aspirational 1.5°C scenario) effectively provides an extra decade to achieve global net zero. This would provide more time for three key technologies driving the de-carbonization of transport and industry (batteries, clean hydrogen and carbon capture) to move lower on the Carbonomics cost curve before being rolled out on a giant scale worldwide. **We estimate that the upper half of the cost curve could fall by 22%/30%, respectively by 2025/2030, driven by technological innovation and the benefits of scale**, mostly in energy storage and carbon capture technologies.

In the GS 1.5° path, power generation needs to de-carbonize by 57% by the end of this decade, we estimate, implying retirement of coal power plants by 2035 (two decades before the end of their useful life) and of gas power plants by 2045 (one decade before). This potentially disruptive and abrupt change in the power generation sector is a result of the tight carbon budget and the immaturity of de-carbonization technologies in transport and industry to be deployed at giant scale this decade. However, under the less strict GS <2.0° path, the de-carbonization technologies in transport and industry have more time to evolve (we estimate 83% lower carbon abatement costs for the de-carbonization of transport by 2030 compared to today) and need a smaller relative allocation of the carbon budget (25% to transport compared to 30% in the GS 1.5° path). This allows power generation to de-carbonize at a more reasonable pace (-28% de-carbonization by 2030), avoiding the mass retirement of young power generation assets, with a more gradual transition and a greater role for natural gas.

Exhibit 33: We estimate that the upper half of the cost curve can fall by c.30% by 2030, driven by technological innovation and the benefits of scale, mostly in energy storage and carbon capture technologies

2020/30E conservation carbon abatement cost curve for anthropogenic GHG emissions, based on current technologies





Source: Goldman Sachs Global Investment Research

We expect US$56 tn pa of infrastructure investments to global Net Zero carbon, reaching >2% of GDP by 2033E in the 1.5° scenario

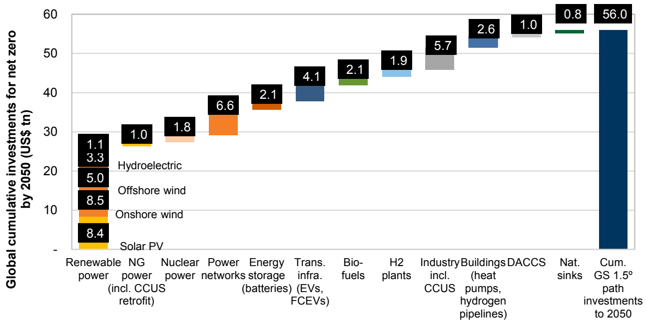
In aggregate, we estimate a total investment opportunity in clean tech infrastructure <u>of US$56 tn by 2050 in the GS 1.5° path</u>. This figure focuses solely on **incremental infrastructure investments** and does not include maintenance and other end-use capex. Overall, the average annual investments in de-carbonization that we estimate over 2021-50 are c.US$1.9 tn, with the peak in the 2036 (US$2.9 tn) representing 2.3% of global GDP (vs. US$1.6 tn pa with a peak of US$2.5 tn in 2041 in the GS <2.0° scenario). We estimate that **c.50% of de-carbonization is reliant on access to clean power generation**, including electrification of transport and various industrial processes, electricity used for heating and more. Overall, we expect **total demand for power generation** in a global net zero scenario by 2050 to **increase three-fold (vs. that of 2019) and surpass 70,000 TWh as the de-carbonization process unfolds.** Based on our GS 1.5° model, power generation almost entirely de-carbonizes **by 2040** (2055 under the GS <2.0° scenario).

The de-carbonization of transport, buildings and industry will require a complex ecosystem of low carbon technologies, including energy storage (both batteries and clean hydrogen) and carbon capture alongside the supply of clean power. For light duty vehicles (LDVs) transport (primarily constituting passenger vehicles, commercial vehicles and short/medium-haul trucks), we consider **electrification the key de-carbonization technology.** For **long-haul heavy trucks**, we **consider clean hydrogen a competitive option,** owing to its faster refueling time, lower weight and high energy content. Sustainable aviation fuels (SAFs), synthetic fuels and improved aircraft efficiency are in our view all key parts of the solution to lower carbon aviation, while LNG and ammonia drive the de-carbonization of shipping, and hydrogen addresses rail.

Fuel switch and efficiency govern emissions reduction in buildings, while clean hydrogen, CCUS, efficiency, circular economy and electrification set the scene for a new industrial technology revolution. We estimate that clean hydrogen can contribute to c.20% of global de-carbonization with its **addressable market growing 7-fold from c.75 Mt in 2019 to c.520 Mtpa on the path to global net zero by 2050.** We have incorporated carbon capture technologies in our GS 1.5° path for carbon neutrality by 2050, **with CCUS across sectors contributing to annual CO_2 abatement of c.7.2 $GtCO_2$ by 2050. Electrification and clean energy are likely to have an impact on total demand for natural resources and, in particular, base metals** such as aluminium, copper, lithium and nickel, driven by renewables (solar panel, wind turbines manufacturing), power network infrastructure, charging infrastructure, electric vehicles and battery manufacturing. We attempt to quantify the potential impact that the path to net zero will have on the demand for each of these metals. We estimate that annual **green copper demand in a global net zero path by 2050 will rise by c.10 Mtpa, a c.40% increase from global copper demand in 2019.** Similarly, **the global average incremental annual green aluminum demand is estimated to be around 25Mtpa to 2050, c.40% of total global aluminium demand in 2019.**

Exhibit 34: We expect US$56 tn of infrastructure investments to global Net Zero carbon under GS 1.5° scenario...

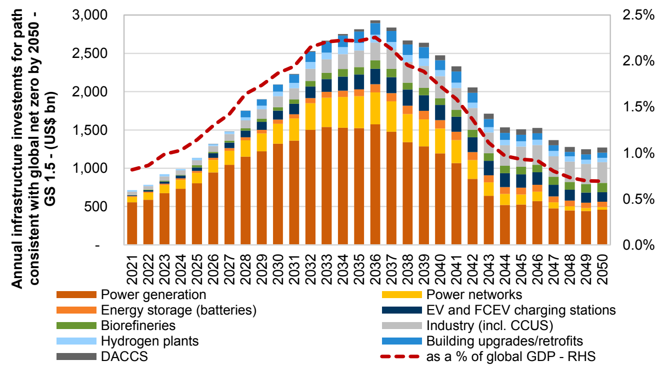
Cumulative infrastructure investment opportunity for our GS 1.5° global net zero by 2050 model (US$ tn)



Source: Goldman Sachs Global Investment Research

Exhibit 35: ...representing c.2.3% of global GDP at peak in mid 2030s

Annual infrastructure investments for GS 1.5° path to net zero by 2050 (US$ tn)

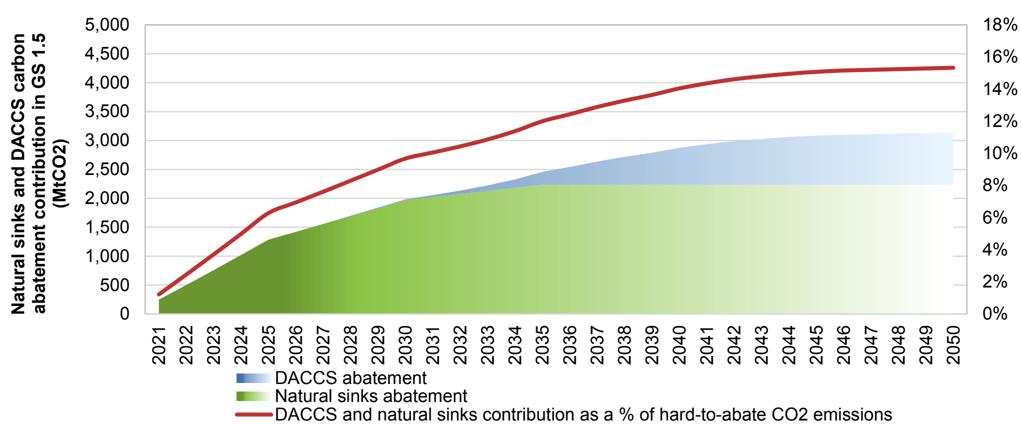


Source: Goldman Sachs Global Investment Research

The importance of carbon offsets: We incorporate carbon offsets in all of our GS global carbon neutrality models as these offsets could help the abatement of an estimated c. 15% of the harder-to-abate sector emissions

We do consider carbon offsets (natural sinks and DACCS) as a critical tool for net zero to be plausible and do incorporate natural sinks into our global net zero models (GS 1.5, GS <2.0 and GS 2.0). This is particularly the case for the path to global net zero for harder-to-abate sectors in the absence of further technological innovation. We estimate that natural sinks and DACCS' contribution to the de-carbonization of harder-to-abate sector emissions (defined as the CO_2 emissions with a carbon abatement cost above US$100/tn$CO_2$ in our cost curve) is around 15% by 2050 as shown in the exhibit below. Voluntary offsets remain one of the only global carbon markets today offering useful tool for global collaboration of the de-carbonization challenge.

Exhibit 36: Natural sinks and DACCS are an important component to our global net zero path, contributing to c. 15% abatement of hard-to-abate CO2 emissions (defined as those with a carbon abatement cost above US$100/tnCO2 in our Carbonomics cost curve)



Source: Goldman Sachs Global Investment Research

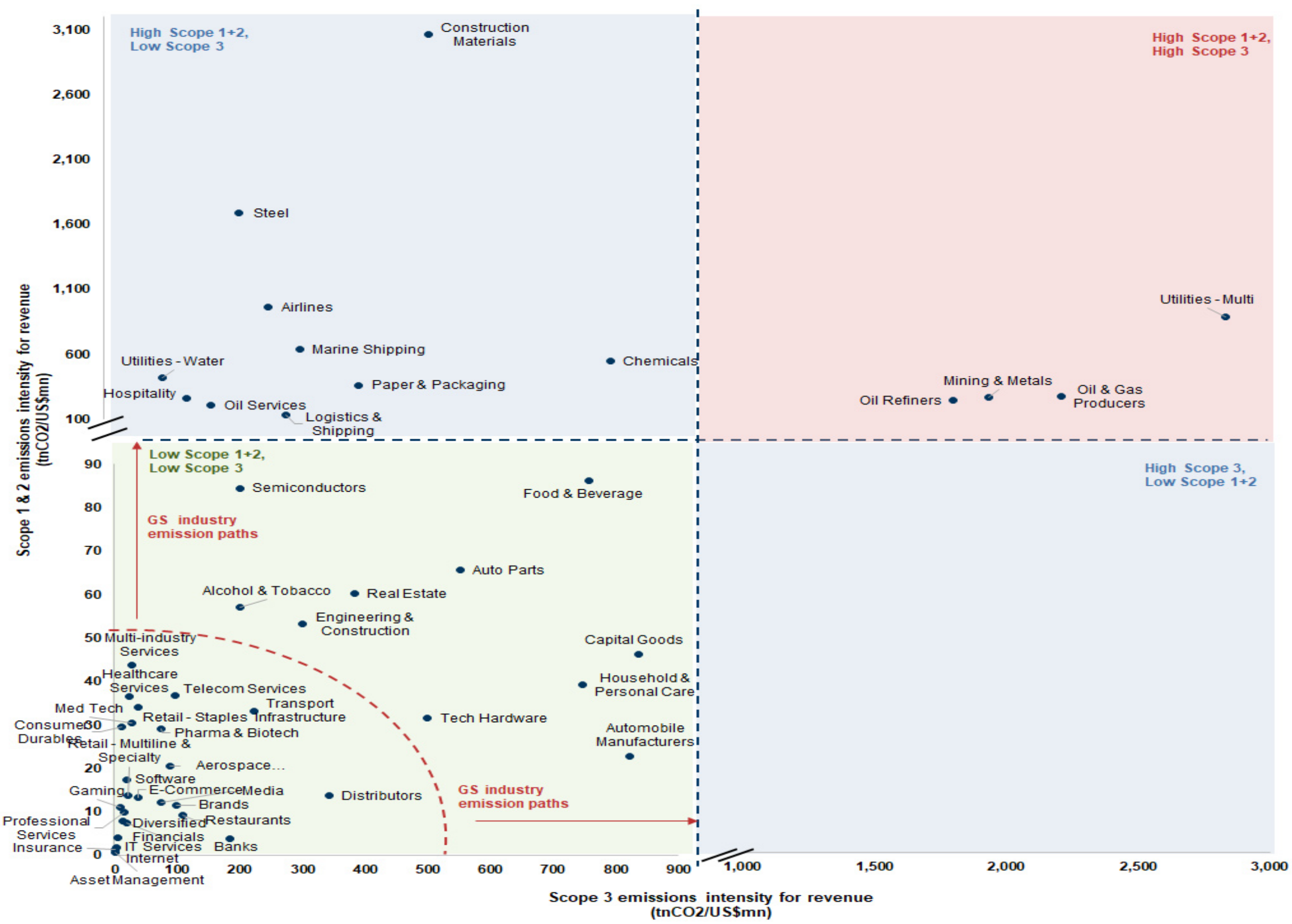
3) The GS sectoral carbon intensity paths

We have translated our global net zero models into pathways for emission intensity reduction for the key emitting corporate industries in all three of our global net zero scenarios (GS 1.5°, GS <2.0°, GS 2.0°)

We have applied our GS 1.5° net zero by 2050, GS <2.0° net zero by 2060 and GS 2.0° net zero by 2070 scenarios to **construct corporate emission reduction paths by industry for the most carbon intensive industries globally on Scope 1 and 2 but also on Scope 3 for sectors where Scope 3 emissions are material.** This provides a tool to screen corporates against the aspirational/less aspirational net zero by 2050/2060/2070 paths, and to assess their current emissions intensity reduction targets. We primarily formulate these corporate paths for a **carbon intensity measure rather than on absolute emissions** (to adjust for market share movements). We have mapped 30 industries with high relative Scope 1 & 2 revenue emissions intensity and/or high Scope 3 revenue emissions intensity.

Exhibit 37: We construct emission reduction pathways for 30 corporate industries with high Scope 1 &2 and/or high Scope 3 emissions intensity per revenue

Scope 1 & 2 emissions intensity for revenue (y-axis) vs. Scope 3 emissions intensity for revenue (x-axis) for corporates listed in Europe



Source: Bloomberg, MSCI, Thomson Reuters Eikon, Company data, Goldman Sachs Global Investment Research

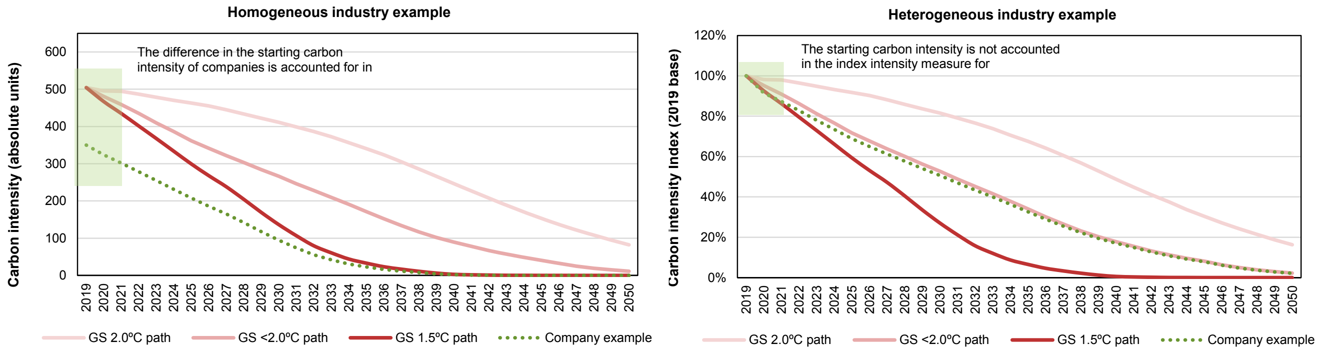
For the purpose of constructing our GS industry emission reduction pathways, we primarily focus on industries with high relative Scope 1 & 2 revenue emissions intensity and/or high Scope 3 revenue emissions intensity. This is shown in the diagram above, Exhibit 37, the dashed red line separating the areas of emission intensity materiality and immateriality. The corporate industries addressed in our emission reduction paths are the ones found on the right of the dashed red line (inside the 'materiality' space). Corporate industries found on the left of the red dashed materiality line are considered to be industries with immaterial emissions intensity both on Scope 1 & 2 and Scope 3 on a comparative basis and as such are excluded from the industry emission pathways analysis that follows. On the contrary, industries placed in the top right box (high scope 1,2,3 intensity) are considered the most critical industries from a de-carbonization perspective and as such are analysed in detail in our industry paths both on scope 1&2 and on scope 3. We note that the accuracy of the data presented in the exhibit below with regard to the relative emission intensity by scope for each industry is largely reliant on the current emission disclosure quality of each industry.

For the purpose of constructing our GS industry emission reduction pathways, we primarily focus on industries with **high relative Scope 1 & 2 revenue emissions intensity and/or high Scope 3 revenue emissions intensity.** We have mapped c.30 industries with high relative Scope 1 & 2 revenue emissions intensity and/or high Scope 3 revenue emissions intensity. We more broadly classify the major corporate industries into two buckets:

- **Homogeneous industries with a defined unit of production:** Defined as corporate industries whose emissions are homogeneous, and are largely relying on a single activity metric. Examples include the electric utilities sector, where a carbon intensity measure can be derived by dividing the total emissions with the activity metric such as gCO_2/kWh with the power generation (kWh) being the key activity metric, autos sector (gCO_2/km), airlines (gCO_2/pkm), pure single metal producers and construction materials ($tnCO_2$/tn metal or cement), real estate (gCO_2/meter square of floor area) and more.
- **Heterogeneous sectors:** There are sectors where a carbon intensity measure cannot be derived from a single activity metric. Examples include household products, food & beverage, diversified chemicals and more. **For these sectors, instead of an absolute carbon intensity measure we have constructed an index for emissions reduction based on the current emissions split and emissions sourcing of key corporates in each sector**. The key limitation of this method however is the fact that it does not take into consideration the difference in the starting point intensity and therefore does not account for the historical de-carbonization performance of corporates, as explained in Exhibit 38 below.

The GS carbon intensity paths constructed incorporate the role of carbon offsets such as natural sinks. We consider carbon offsets a critical tool for net zero to be plausible and do incorporate natural sinks into our global net zero models (GS 1.5, GS <2.0 and GS 2.0), yet to attribute them amongst sectors poses an additional challenge when it comes to constructing corporate industry carbon intensity pathways. We assume that the allocation of carbon offsets annually is done proportional to the contribution of the emissions of each industry to the total global emissions in that year in this exercise.

Exhibit 38: Schematic diagram demonstrating the difference between homogeneous industries (with a specific well defined activity metric for absolute carbon intensity) and heterogeneous industries (where a carbon intensity index is used, based in 2019)



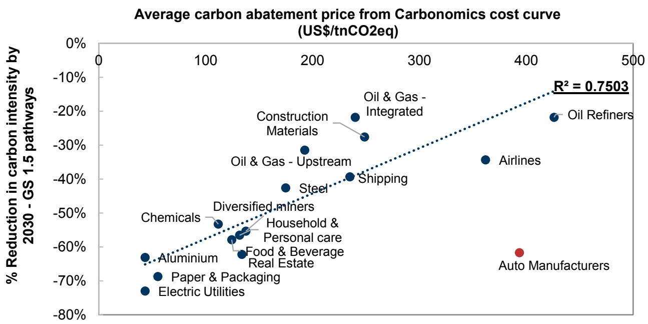
Source: Goldman Sachs Global Investment Research

Our GS carbon intensity pathways by industry imply a % reduction required to 2030 that is highly correlated with the average carbon abatement price cost of our Carbonomics cost curve

The pace of de-carbonization of each industry varies in the corporate industry carbon intensity paths (similar to how the pace of de-carbonization of each key emitting sector in our GS models does - Exhibit 30). The GS corporate sectoral carbon intensity reduction paths follow more broadly the current positioning of the available de-carbonization technologies in each sector on the Carbonomics cost curve. This implies that for industries where the clean alternative technologies that enable de-carbonization are found low on the cost curve due to the current commercial scale, economic status and availability will have a larger % reduction in their carbon intensity path compared to other industries where technologies are largely uneconomic or undeveloped (pilot scale). In the two exhibits that follow we show how the % reduction in GS carbon intensity required by each industry (under the two scenarios GS 1.5° and GS <2.0°) is correlated with the current average carbon abatement price of the relevant technologies from our Carbonomics cost curve. Overall there is an >70% correlation for both scenarios, with the sole exception to this trend being autos scope 3 carbon intensity where despite the high current carbon abatement price our paths require a high carbon intensity reduction. This is driven by (a) the availability of subsidies which make these technologies (such as EVs) more economic than our cost curve suggests, and (b) the strong cost reduction we expect in these technologies (primarily EV battery cost) over this decade (as shown in the 2030 vs. 2020 cost curve in Exhibit 33).

Exhibit 39: There is a strong correlation between the % reduction in carbon intensity required for each industry under our GS sectoral intensity pathways...

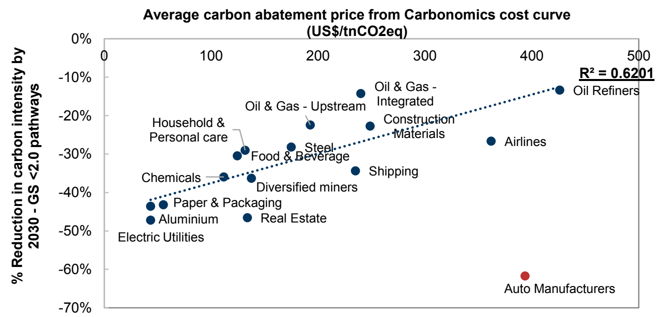
% reduction in carbon intensity in GS 1.5° sectoral pathways vs. average carbon abatement price from our Carbonomics cost curve for each industry



Source: Goldman Sachs Global Investment Research

Exhibit 40: ...and the current average carbon abatement cost of the available de-carbonization technologies in each industry from our Carbonomics cost curve

% reduction in carbon intensity in GS <2.0° sectoral pathways vs. average carbon abatement price from our Carbonomics cost curve for each industry



Source: Goldman Sachs Global Investment Research

Exhibit 41: Table summarizing our corporate carbon intensity pathways by industry for a global net zero by 2050 scenario (GS 1.5°)

Sector	Industry	Carbon intensity measure	Activity indicator	Scopes coverage	Carbon intensity - base year	GS 1.5° sectoral carbon neutrality pathways: % Reduction in carbon intensity vs 2019 base					
					2019	2025	2030	2035	2040	2045	2050
Energy	Oil & Gas Integrated producers	gCO2/MJ	energy sold	Scope 1,2,3	70.2	-9%	-22%	-45%	-80%	-99%	-100%
	Oil refiners	gCO2/MJ	energy sold	Scope 1,2,3	83.0	-9%	-23%	-47%	-78%	-99%	-100%
	Gas producers	gCO2/MJ	energy sold	Scope 1,2,3	63.2	-9%	-19%	-42%	-83%	-99%	-100%
	Electric Utilities	kgCO2/MWh	energy produced	Scope 1,2	504.3	-41%	-73%	-93%	-99%	-100%	-100%
Transportation	Airlines	gCO2/pkm	fleet	Scope 1,2	93.8	-17%	-34%	-58%	-81%	-99%	-100%
	Aerospace & defence	gCO2/pkm	aircrafts sold	Scope 1,2,3	67.6	-17%	-34%	-57%	-81%	-99%	-100%
	Automotive manufacturers - LDV	gCO2/km	vehicles sold	Scope 1,2,3	165.2	-28%	-62%	-91%	-100%	-100%	-100%
	Automotive manufacturers - HDV	gCO2/km	vehicles sold	Scope 1,2,3	631.3	-9%	-30%	-77%	-100%	-100%	-100%
	Maritime Shipping	gCO2/tkm	fleet	Scope 1,2	6.9	-20%	-40%	-59%	-81%	-99%	-100%
	Logistics & Shipping	Index		Scope 1,2,3		-17%	-38%	-64%	-85%	-99%	-100%
Basic materials	Copper	tnCO2/tn	tonnes refined	Scope 1,2	4.0	-32%	-60%	-79%	-89%	-97%	-100%
	Steel	tnCO2/tn	tonnes produced	Scope 1,2	1.81	-21%	-43%	-65%	-86%	-100%	-100%
	Cement (Construction materials)	tnCO2/tn	tonnes produced	Scope 1,2	0.62	-14%	-28%	-49%	-74%	-99%	-100%
	Aluminium (all)	tnCO2/tn	tonnes produced	Scope 1,2	10.1	-31%	-63%	-82%	-90%	-99%	-100%
	Aluminium primary	tnCO2/tn	tonnes produced	Scope 1,2	14.8	-31%	-62%	-80%	-89%	-99%	-100%
	Iron ore	tnCO2/tn	tonnes produced	Scope 1,2	0.0105	-19%	-50%	-77%	-97%	-100%	-100%
	Iron ore	tnCO2/tn	tonnes produced	Scope 1,2,3	1.21	-21%	-43%	-65%	-87%	-100%	-100%
	Coal mining	tnCO2/tn	tonnes produced	Scope 1,2	0.061	-19%	-40%	-57%	-75%	-92%	-100%
	Nickel	tnCO2/tn	tonnes produced	Scope 1,2	12.48	-27%	-53%	-71%	-84%	-95%	-100%
	Diversified metals & mining	Index		Scope 1,2		-26%	-54%	-73%	-86%	-97%	-100%
	Diversified metals & mining	Index		Scope 3		-18%	-39%	-62%	-83%	-99%	-100%
	Paper & packaging	tnCO2/tn	tonnes produced	Scope 1,2	0.69	-36%	-69%	-91%	-99%	-100%	-100%
Chemicals	Chemicals- ammonia	tnCO2/tn	tonnes produced	Scope 1	2.3	-10%	-26%	-52%	-79%	-99%	-100%
	Chemicals- methanol	tnCO2/tn	tonnes produced	Scope 1	2.1	-12%	-28%	-49%	-77%	-99%	-100%
	Chemicals- HVCs	tnCO2/tn	tonnes produced	Scope 1	0.98	-22%	-40%	-59%	-81%	-99%	-100%
	Diversified chemicals	Index		Scope 1,2		-29%	-53%	-73%	-88%	-99%	-100%
	Diversified chemicals	Index		Scope 3		-14%	-33%	-50%	-71%	-92%	-100%
Other	Real estate	tnCO2/m2	square meter	Scope 1,2	0.039	-35%	-62%	-85%	-97%	-100%	-100%
	Real estate	tnCO2/m2	square meter	Scope 1	0.015	-19%	-45%	-72%	-93%	-100%	-100%
	Semiconductors	Index		Scope 1,2		-33%	-65%	-88%	-99%	-100%	-100%
	Hospitality	Index		Scope 1,2		-34%	-64%	-87%	-97%	-100%	-100%
	Household & Personal Care	Index		Scope 1,2		-25%	-57%	-82%	-98%	-100%	-100%
	Household & Personal Care	Index		Scope 3		-19%	-42%	-67%	-89%	-100%	-100%
	Food & beverage	Index		Scope 1,2		-26%	-58%	-83%	-98%	-100%	-100%
	Food & beverage	Index		Scope 3		-9%	-19%	-33%	-48%	-58%	-63%
	Food retail	Index		Scope 1,2		-29%	-61%	-85%	-98%	-100%	-100%
	Food retail	Index		Scope 3		-9%	-21%	-36%	-53%	-63%	-68%
	Tobacco	Index		Scope 1,2		-28%	-59%	-84%	-98%	-100%	-100%
	Tobacco	Index		Scope 3		-12%	-24%	-40%	-57%	-69%	-73%
	Capital goods	Index		Scope 1,2		-27%	-55%	-79%	-95%	-100%	-100%
	Capital goods	Index		Scope 3		-18%	-38%	-61%	-83%	-99%	-100%

Source: Goldman Sachs Global Investment Research

Exhibit 42: Table summarizing our corporate carbon intensity pathways by industry for a global net zero by 2060/2070 scenarios (GS <2.0° and GS 2.0°)

Sector	Industry	Carbon intensity measure	Activity indicator	Scopes coverage	Carbon intensity - base year	GS <2.0 degrees sectoral carbon neutrality pathways: % Reduction in carbon intensity vs 2019 base						
					2019	2025	2030	2035	2040	2045	2050	2060
Energy	Oil & Gas Integrated producers	gCO2/MJ	energy sold	Scope 1,2,3	70.2	-7%	-14%	-26%	-43%	-64%	-85%	-100%
	Oil refiners	gCO2/MJ	energy sold	Scope 1,2,3	83.0	-6%	-14%	-28%	-48%	-70%	-89%	-100%
	Gas producers	gCO2/MJ	energy sold	Scope 1,2,3	63.2	-6%	-13%	-21%	-35%	-54%	-78%	-100%
	Electric Utilities	kgCO2/MWh	energy produced	Scope 1,2	504.3	-28%	-47%	-66%	-82%	-92%	-98%	-100%
Transportation	Airlines	gCO2/pkm	fleet	Scope 1,2	93.8	-13%	-27%	-42%	-59%	-73%	-86%	-100%
	Aerospace & defence	gCO2/pkm	aircrafts sold	Scope 1,2,3	67.6	-13%	-27%	-42%	-59%	-73%	-86%	-100%
	Automotive manufacturers - LDV	gCO2/km	vehicles sold	Scope 1,2,3	165.2	-28%	-56%	-84%	-95%	-99%	-100%	-100%
	Automotive manufacturers - HDV	gCO2/km	vehicles sold	Scope 1,2,3	631.3	-8%	-18%	-36%	-69%	-96%	-99%	-100%
	Maritime Shipping	gCO2/tkm	fleet	Scope 1,2	6.9	-17%	-34%	-51%	-66%	-84%	-94%	-100%
	Logistics & Shipping	Index		Scope 1,2,3		-16%	-31%	-47%	-65%	-79%	-90%	-100%
Basic materials	Copper	tnCO2/tn	tonnes refined	Scope 1,2	4.0	-21%	-39%	-58%	-74%	-85%	-94%	-100%
	Steel	tnCO2/tn	tonnes produced	Scope 1,2	1.81	-13%	-28%	-47%	-65%	-79%	-92%	-100%
	Cement (Construction materials)	tnCO2/tn	tonnes produced	Scope 1,2	0.62	-13%	-23%	-33%	-50%	-67%	-86%	-100%
	Aluminium (all)	tnCO2/tn	tonnes produced	Scope 1,2	10.1	-24%	-44%	-62%	-76%	-85%	-92%	-100%
	Aluminium primary	tnCO2/tn	tonnes produced	Scope 1,2	14.8	-24%	-43%	-60%	-75%	-83%	-91%	-100%
	Iron ore	tnCO2/tn	tonnes produced	Scope 1,2	0.0105	-9%	-21%	-45%	-66%	-83%	-94%	-100%
	Iron ore	tnCO2/tn	tonnes produced	Scope 1,2,3	1.21	-13%	-28%	-47%	-65%	-79%	-92%	-100%
	Coal mining	tnCO2/tn	tonnes produced	Scope 1,2	0.061	-11%	-28%	-45%	-61%	-76%	-88%	-100%
	Nickel	tnCO2/tn	tonnes produced	Scope 1,2	12.48	-18%	-35%	-54%	-70%	-82%	-92%	-100%
	Diversified metals & mining	Index		Scope 1,2		-18%	-35%	-54%	-70%	-82%	-91%	-100%
	Diversified metals & mining	Index		Scope 3		-12%	-26%	-43%	-60%	-75%	-89%	-100%
	Paper & packaging	tnCO2/tn	tonnes produced	Scope 1,2	0.7	-24%	-43%	-64%	-81%	-92%	-98%	-100%
Chemicals	Chemicals- ammonia	tnCO2/tn	tonnes produced	Scope 1	2.3	-6%	-14%	-28%	-48%	-64%	-81%	-100%
	Chemicals- methanol	tnCO2/tn	tonnes produced	Scope 1	2.1	-10%	-20%	-34%	-50%	-68%	-86%	-100%
	Chemicals- HVCs	tnCO2/tn	tonnes produced	Scope 1	0.98	-15%	-28%	-42%	-55%	-70%	-85%	-100%
	Diversified chemicals	Index		Scope 1,2		-20%	-36%	-51%	-66%	-79%	-90%	-100%
	Diversified chemicals	Index		Scope 3		-8%	-24%	-42%	-58%	-74%	-87%	-100%
Other	Real estate	tnCO2/m2	square meter	Scope 1,2	0.039	-28%	-47%	-64%	-80%	-92%	-98%	-100%
	Real estate	tnCO2/m2	square meter	Scope 1	0.015	-17%	-36%	-58%	-79%	-94%	-99%	-100%
	Semiconductors	Index		Scope 1,2		-21%	-38%	-59%	-77%	-89%	-96%	-100%
	Hospitality	Index		Scope 1,2		-25%	-44%	-63%	-81%	-92%	-98%	-100%
	Household & Personal Care	Index		Scope 1,2		-15%	-29%	-51%	-71%	-86%	-95%	-100%
	Household & Personal Care	Index		Scope 3		-16%	-33%	-52%	-71%	-87%	-95%	-100%
	Food & beverage	Index		Scope 1,2		-16%	-30%	-53%	-72%	-86%	-95%	-100%
	Food & beverage	Index		Scope 3		-7%	-14%	-26%	-39%	-51%	-60%	-71%
	Food retail	Index		Scope 1,2		-18%	-34%	-55%	-74%	-87%	-96%	-100%
	Food retail	Index		Scope 3		-6%	-14%	-26%	-39%	-52%	-63%	-75%
	Tobacco	Index		Scope 1,2		-17%	-32%	-54%	-73%	-87%	-95%	-100%
	Tobacco	Index		Scope 3		-10%	-19%	-31%	-44%	-56%	-67%	-79%
	Capital goods	Index		Scope 1,2		-18%	-33%	-53%	-71%	-86%	-96%	-100%
	Capital goods	Index		Scope 3		-12%	-26%	-42%	-60%	-75%	-89%	-100%

Sector	Industry	Carbon intensity measure	Activity indicator	Scopes coverage	Carbon intensity - base year	GS 2.0 degrees sectoral carbon neutrality pathways: % Reduction in carbon intensity vs 2019 base							
					2019	2025	2030	2035	2040	2045	2050	2060	2070
Energy	Oil & Gas Integrated producers	gCO2/MJ	energy sold	Scope 1,2,3	70.2	-5%	-9%	-15%	-23%	-35%	-48%	-80%	-100%
	Oil refiners	gCO2/MJ	energy sold	Scope 1,2,3	83.0	-4%	-8%	-14%	-22%	-35%	-51%	-83%	-100%
	Gas producers	gCO2/MJ	energy sold	Scope 1,2,3	63.2	-5%	-10%	-16%	-23%	-33%	-43%	-75%	-100%
	Electric Utilities	kgCO2/MWh	energy produced	Scope 1,2	504.3	-8%	-18%	-33%	-51%	-70%	-84%	-98%	-100%
Transportation	Airlines	gCO2/pkm	fleet	Scope 1,2	93.8	-7%	-15%	-21%	-30%	-44%	-59%	-84%	-100%
	Aerospace & defence	gCO2/pkm	aircrafts sold	Scope 1,2,3	67.6	-7%	-15%	-21%	-30%	-44%	-59%	-100%	-100%
	Automotive manufacturers - LDV	gCO2/km	vehicles sold	Scope 1,2,3	165.2	-23%	-45%	-58%	-70%	-84%	-94%	-100%	-100%
	Automotive manufacturers - HDV	gCO2/km	vehicles sold	Scope 1,2,3	631.3	-2%	-9%	-18%	-33%	-54%	-75%	-96%	-100%
	Maritime Shipping	gCO2/tkm	fleet	Scope 1,2	6.9	-12%	-24%	-37%	-46%	-58%	-74%	-91%	-100%
	Logistics & Shipping	Index		Scope 1,2,3		-7%	-15%	-24%	-34%	-49%	-65%	-88%	-100%
Basic materials	Copper	tnCO2/tn	tonnes refined	Scope 1,2	4.0	-7%	-17%	-32%	-49%	-67%	-81%	-98%	-100%
	Steel	tnCO2/tn	tonnes produced	Scope 1,2	1.81	-4%	-9%	-19%	-35%	-53%	-68%	-91%	-100%
	Cement (Construction materials)	tnCO2/tn	tonnes produced	Scope 1,2	0.62	-7%	-12%	-18%	-24%	-40%	-55%	-84%	-100%
	Aluminium (all)	tnCO2/tn	tonnes produced	Scope 1,2	10.1	-8%	-19%	-33%	-50%	-66%	-76%	-88%	-100%
	Aluminium primary	tnCO2/tn	tonnes produced	Scope 1,2	14.8	-9%	-19%	-32%	-48%	-63%	-73%	-85%	-100%
	Iron ore	tnCO2/tn	tonnes produced	Scope 1,2	0.0105	-4%	-9%	-17%	-31%	-45%	-57%	-80%	-100%
	Iron ore	tnCO2/tn	tonnes produced	Scope 1,2,3	1.21	-4%	-9%	-19%	-35%	-53%	-68%	-91%	-100%
	Coal mining	tnCO2/tn	tonnes produced	Scope 1,2	0.061	-6%	-16%	-31%	-46%	-63%	-78%	-97%	-100%
	Nickel	tnCO2/tn	tonnes produced	Scope 1,2	12.48	-7%	-17%	-32%	-48%	-66%	-80%	-97%	-100%
	Diversified metals & mining	Index		Scope 1,2		-7%	-17%	-30%	-46%	-63%	-76%	-92%	-100%
	Diversified metals & mining	Index		Scope 3		-4%	-9%	-18%	-32%	-49%	-62%	-85%	-100%
	Paper & packaging	tnCO2/tn	tonnes produced	Scope 1,2	0.7	-7%	-18%	-34%	-54%	-72%	-85%	-98%	-100%
Chemicals	Chemicals- ammonia	tnCO2/tn	tonnes produced	Scope 1	2.3	-4%	-9%	-15%	-25%	-38%	-48%	-70%	-100%
	Chemicals- methanol	tnCO2/tn	tonnes produced	Scope 1	2.1	-3%	-9%	-16%	-25%	-39%	-53%	-82%	-100%
	Chemicals- HVCs	tnCO2/tn	tonnes produced	Scope 1	0.98	-6%	-17%	-27%	-37%	-47%	-56%	-79%	-100%
	Diversified chemicals	Index		Scope 1,2		-7%	-18%	-29%	-43%	-56%	-67%	-87%	-100%
	Diversified chemicals	Index		Scope 3		-6%	-15%	-30%	-43%	-60%	-76%	-96%	-100%
Other	Real estate	tnCO2/m2	square meter	Scope 1,2	0.039	-18%	-31%	-42%	-55%	-67%	-79%	-97%	-100%
	Real estate	tnCO2/m2	square meter	Scope 1	0.015	-8%	-15%	-24%	-35%	-52%	-70%	-94%	-100%
	Semiconductors	Index		Scope 1,2		-7%	-15%	-27%	-44%	-61%	-74%	-92%	-100%
	Hospitality	Index		Scope 1,2		-8%	-17%	-30%	-46%	-64%	-80%	-97%	-100%
	Household & Personal Care	Index		Scope 1,2		-5%	-12%	-22%	-37%	-53%	-65%	-85%	-100%
	Household & Personal Care	Index		Scope 3		-7%	-15%	-25%	-35%	-51%	-67%	-90%	-100%
	Food & beverage	Index		Scope 1,2		-5%	-12%	-23%	-38%	-54%	-66%	-86%	-100%
	Food & beverage	Index		Scope 3		-4%	-9%	-17%	-27%	-38%	-48%	-66%	-81%
	Food retail	Index		Scope 1,2		-6%	-13%	-24%	-40%	-57%	-69%	-88%	-100%
	Food retail	Index		Scope 3		-4%	-9%	-17%	-28%	-38%	-48%	-66%	-84%
	Tobacco	Index		Scope 1,2		-6%	-13%	-24%	-39%	-55%	-68%	-87%	-100%
	Tobacco	Index		Scope 3		-6%	-13%	-22%	-33%	-43%	-53%	-70%	-86%
	Capital goods	Index		Scope 1,2		-6%	-14%	-25%	-41%	-57%	-71%	-90%	-100%
	Capital goods	Index		Scope 3		-4%	-10%	-19%	-33%	-49%	-63%	-86%	-100%

Source: Goldman Sachs Global Investment Research

Limitations to our corporate industry carbon intensity paths

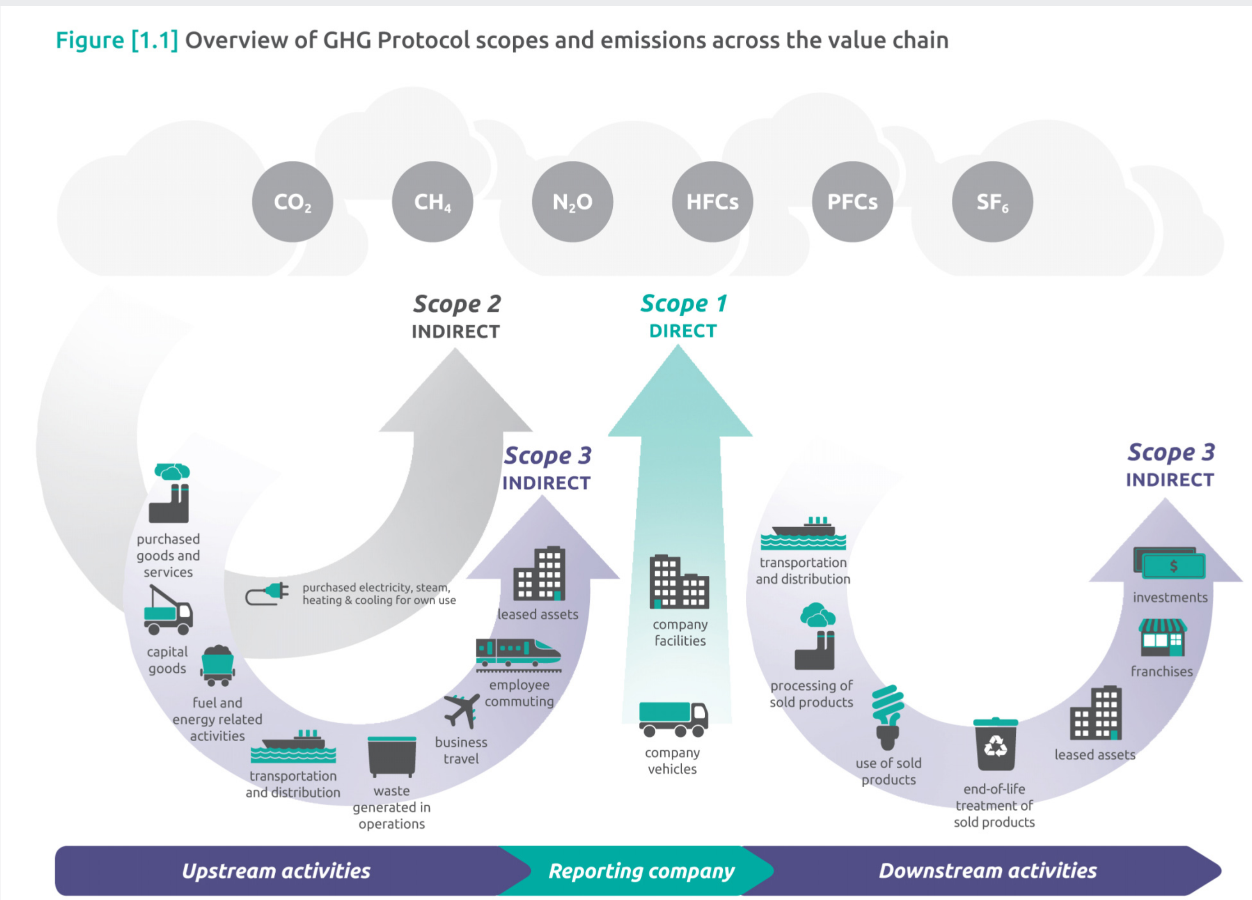
- **Regional differences:** The carbon intensity paths for corporate industries were constructed on the basis of our global net zero models, which do not differentiate between regions. Whilst that provides a fair representation of the speed of de-carbonization across sectors on a global basis on average, we note that different regions' de-carbonization process will likely move at different speeds based on the current economic and policy framework in place. Similarly, corporates listed in different regions and with operations across different regions globally may end up de-carbonizing at a pace that differs from the one suggested by our corporate carbon intensity charts. For instance, in our view most corporates in Europe will likely have a carbon intensity that is already well below the global average and therefore may need to move their de-carbonization process at a different pace to converge with the global average carbon intensity path.
- **Allocation of carbon offsets:** The carbon intensity paths constructed above incorporate the role of carbon offsets such as natural sinks. We do consider carbon offsets as a critical tool for net zero to be plausible and do incorporate natural sinks into our global net zero models (GS 1.5, GS <2.0 and GS 2.0), yet to attribute them amongst sectors poses an additional challenge when it comes to constructing corporate industry carbon intensity pathways. We assume that the allocation of carbon offsets annually is done proportional to the contribution of the emissions of each industry to the total global emissions in that year. Carbon offsets in the form of natural sinks and DACCS are critical for the path to global net zero, especially for harder-to-abate sectors in the absence of further technological innovation. We estimate that natural sinks and DACCS' contribution to the de-carbonization of harder-to-abate sector emissions (defined as the CO_2 emissions with a carbon abatement cost above US$100/tn$CO_2$ in our cost curve) is around 15% by 2050 as shown in Exhibit 36.
- **Heterogeneous sectors:** As we mentioned previously, these are sectors where a carbon intensity measure cannot be derived from a single activity metric. Examples include household products, food & beverage and capital goods. For these sectors, instead of an absolute carbon intensity measure, we have constructed an index for emissions reduction based on the current emissions split and emissions sourcing of key corporates (benchmarks) in each sector. The key issue with this approach is of course that it cannot be readily applied to all corporates within each industry and most importantly it excludes the difference in the starting carbon intensity between companies. Indeed, more heterogeneous sectors also have a wider variety of corporates in each, a prominent example being capital goods with different companies exposed to different end markets and with different emissions composition.

Defining different GHG emission scopes

The Greenhouse Gas (GHG) Protocol, developed by World Resources Institute (WRI) and World Business Council on Sustainable Development (WBCSD), sets the global standard for how to measure, manage and report greenhouse gas emissions. GHG emissions are categorized by companies under three main buckets:

- **Scope 1** (direct emissions) occurs from the companies' owned or controlled by the operating entity, including for example flaring, venting and fugitive emissions from oil & gas production facilities.
- **Scope 2** (indirect emissions) refers to indirect GHG emissions that are a consequence of the activities of the reporting entity, but occur at sources owned or controlled by another entity's emissions. For scope 2 in particular this includes primarily emissions from the consumption of purchased electricity, heat or steam.
- **Scope 3** (indirect emissions) refers to all other indirect emissions such as the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting entity, electricity-related activities not covered in Scope 2, outsourced activities, waste disposal and more.

Exhibit 43: Defining the three scopes in the GHG Protocol: Scope 1, direct emissions; Scope 2, indirect emissions; and Scope 3, other indirect emissions in the value chain



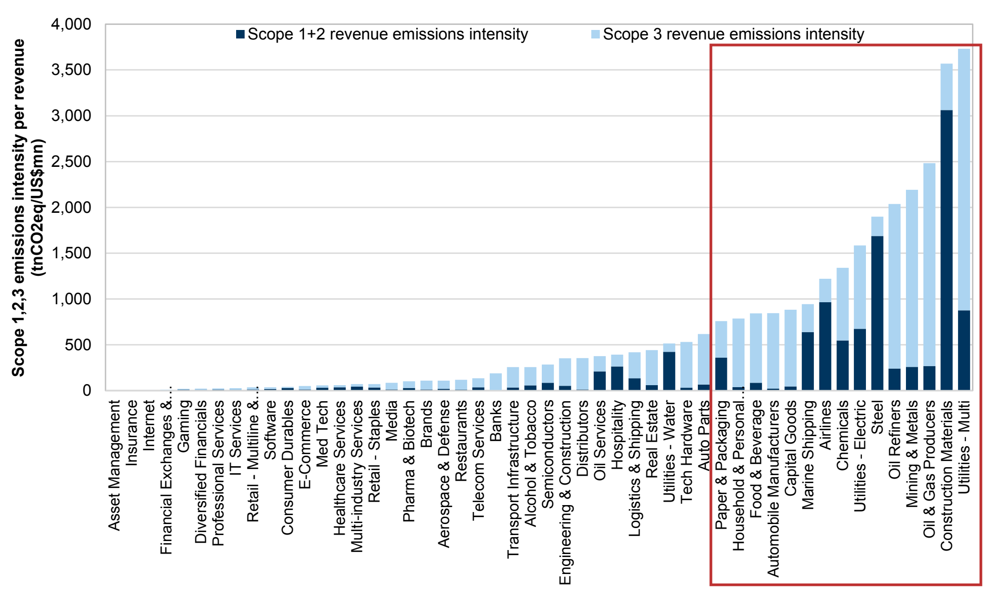
Source: World Resources Institute

4) Corporate universe selection: >100 European corporates across 15 most carbon intensive industries

Universe selection: An implied temperature rise analysis of the de-carbonization targets for the 15 most carbon intensive industries in the European market focusing on the corporate constituents of these industries in STOXX 600 (>100 corporates in total)
As mentioned previously, we have applied our GS 1.5° net zero by 2050, GS <2.0° net zero by 2060 and GS 2.0° net zero by 2070 scenarios to **construct corporate emission reduction paths by industry** for the highest emitting industries on Scope 1 and 2 but also on Scope 3 for sectors where Scope 3 emissions are material. **That provides a tool to screen corporates against the aspirational net zero paths and assess the suitability of their current emissions intensity reduction targets. For the purpose of this analysis, which aims to address the temperature rise implied by corporate de-carbonization targets, we primarily focus on the 15 most highly emitting European industries (in terms of intensity, as shown in Exhibit 44 with the red box) and, within each of these industries, we focus on the European corporate constituents in STOXX 600.**

Exhibit 37 shows the average revenue carbon intensity (tnCO_2eq/$mn revenue) by industry for corporates listed in Western Europe based on the current corporate emissions disclosure. The highest emitting sectors are shown to be primarily fossil fuel producing and directly consuming industries such as multi-utilities, construction materials, oil & gas producers, metals & mining, oil refiners, steel producers, airlines, shipping and chemicals.

Exhibit 44: As part of this report we lay out the de-carbonization path by industry and examine the European corporates' targets, primarily focusing on the most highly emitting industries
Scope 1,2,3 emissions intensity per unit of revenue (tnCO2eq/US$ mn revenue for 2019) for European corporates



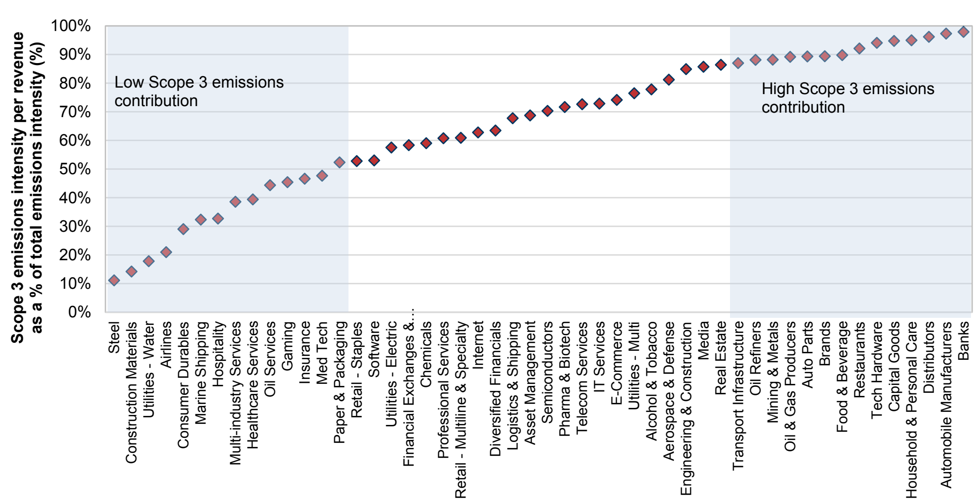
Source: Thomson Reuters, Bloomberg, MSCI, Company data, Goldman Sachs Global Investment Research

Timeframe of consideration: We primarily focus on the European corporates' de-carbonization targets in the 2020-2030 timeframe and historical trends

For the purpose of this analysis, we primarily focus on the **de-carbonization targets of European corporates in STOXX 600** that are **set for the 2020-2030 timeframe**. Whilst we appreciate that the physical climate basis for climate change, carbon budgets and ultimate temperature alignment is based on longer timeframes, typically to the point of carbon neutrality (net zero), for the purpose of this analysis we focus on the key targets set for this decade as (a) there are challenges associated with forecasting company performance beyond 10 years; (b) the high likelihood that technological innovation could alter the long-term de-carbonization targets and trajectory; and (c) the lack of consistency on timeframe and methodology of long-term net zero targets. We have therefore consistently looked at the de-carbonization targets set for the 2020-30 period across all industries and corporates considered in our analysis, and including, where available, any intermediary targets in this timeframe. Whilst we acknowledge that the de-carbonization path of corporates this decade is unlikely to be linear, for the purpose of consistency and simplicity we have **assumed a linear path between any de-carbonization targets set in the timeframe of consideration** (2020-30). In cases where a corporate has not set an explicit 2030 de-carbonization target but does have intermediate targets in the prescribed timeframe, we assume a linear continuation of that trend (linear extrapolation from intermediate targets). Across all sectors we prefer to look at intensity as opposed to absolute emissions to account for market share movements. Historical carbon intensity disclosures are shown on the basis of each corporate's reporting fiscal year. We mostly focus on scope 1 & 2 carbon intensity for the purpose of this analysis with the exception of specific sectors where scope 3 is dominating the total emissions and where there was sufficient and consistent corporate disclosure to enable this analysis. These sectors include oil & gas integrated producers, oil refiners and automotive manufacturers.

Exhibit 45: The importance of scope 3 emissions varies widely depending on the industry considered. We address scope 3 emissions primarily for sectors where scope 3 contribution dominates and where corporate disclosure is sufficient and consistent for the analysis to be performed

Scope 3 emissions intensity per unit of revenue contribution (%, 2019, corporates listed in Europe)



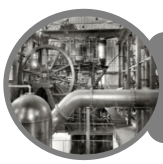
Source: Bloomberg, MSCI, Company data, Thomson Reuters Eikon, Goldman Sachs Global Investment Research

In Exhibit 46 we summarize the corporate universe considered in this analysis. As highlighted earlier, we primarily focus on the 15 most highly emitting industries in the European market (STOXX 600). We note that we excluded companies where sufficient disclosure of emissions and/or de-carbonization targets was not available or comparable to the rest of the sector peers. We also note that throughout this analysis we focus on **publicly announced corporate targets and corporate emissions disclosure** (published on or before the 20th October 2021). As companies update their de-carbonization targets we highlight that parts of this analysis will need to also be updated to reflect subsequent changes. Finally, we note that for the real estate industry specifically we primarily focus on the companies with a market capitalization exceeding US$10 bn (given the very large and broad group of real estate companies included in STOXX 600 and the variety of real estate portfolios and emissions disclosure these have).

Exhibit 46: Summary of corporate universe selection for the implied temperature rise of de-carbonization targets analysis

Sector		Corporate industry	Corporate Universe (European corporates - STOXX 600)	Ticker	Emissions scope coverage	Carbon intensity	Activity metric
 Power Generation	1	Utilities - Electric	Enel SpA	ENEI.MI	Scope 1	gCO2eq/kWh	Power generation
			Uniper SE	UN01.DE			
			Electricite de France SA	EDF.PA			
			Fortum Oyj	FORTUM.HE			
			Endesa SA	ELE.MC			
			Iberdrola SA	IBE.MC			
			EDP Energias de Portugal SA	EDP.LS			
			SSE PLC	SSE.L			
			Orsted A/S	ORSTED.CO			
			Verbund AG	VERB.VI			
			Acciona SA	ANA.MC			
			EDP Renovaveis SA	EDPR.LS			
			Scatec ASA	SCATC.OL			
		Utilities - Multi	RWE	RWEG.DE	Scope 1	gCO2eq/kWh	Power generation
			Engie	ENGIE.PA			
			Naturgy Energy Group	NTGY.MC			
			A2A SpA	A2.MI			
 Energy producers	2	Oil & Gas Integrated Producers	Royal Dutch Shell PLC	RDSa.AS	Scope 1,2,3	gCO2eq/MJ	Energy sold
			BP PLC	BP.L			
			TotalEnergies	TTEF.PA			
			ENI	ENI.MI			
			Repsol	REP.MC			
			Equinor	EQNR.OL			
			OMV	OMVV.VI			
			Galp	GALP.LS			
	3	Oil & Gas Upstream producers	Aker BP ASA	AKERBP.OL	Scope 1,2	gCO2/boe	Energy produced
			Lundin Energy	LUNE.ST			
	4	Oil Refiners	Neste Oyj	NESTE.HE	Scope 3	gCO2eq/MJ	Energy sold
 Transportation	5	Airlines	Deutsche Lufthansa AG	LHAG.DE	Scope 1	gCO2/pkm	Fleet passenger-km
			IAG	ICAG.L			
			Easyjet	EZJ.L			
			Ryanair	RYA.I			
			Wizz Air Holdings	WIZZ.L			
	6	Marine Shipping	AP Moeller - Maersk	MAERSKb.CO	Scope 1	gCO2/tkm	Fleet tonne-km
			Hapag Lloyd AG	HLAG.DE			
	7	Automobile Manufacturers	Volkswagen	VOWG_p.DE	Scope 3	gCO2/km	LDVs vehicle sales km (* in EU where global not available)
			Stellantis NV	STLA.MI			
			Daimler AG	DAIGn.DE			
			Bayerische Motoren Werke	BMWG.DE			
			Renault	RENA.PA			
			Ferrari NV	RACE.MI			
 Real Estate	8	Real Estate	Vonovia	VNAn.DE	Scope 1,2	kgCO2eq/sqm	Square meters in portfolio
			Deutsche Wohnen SE	DWNG.DE			
			Unibail-Rodamco-Westfield SE	URW.AS			
			LEG Immobilien SE	LEGn.DE			
			Aroundtown SA	AT1.DE			
			Gecina	GFCP.PA			
			SEGRO PLC	SGRO.L			
			Fastighets AB Balder	BALDb.ST			

Source: Thomson Reuters, Company data, Goldman Sachs Global Investment Research

Sector	Corporate industry	Corporate Universe (European corporates - STOXX 600)	Ticker	Emissions scope coverage	Carbon intensity	Activity metric
Industrial 	9 Steel	ArcelorMittal	MT.AS	Scope 1,2	tnCO2eq/tn steel	Tonnes steel produced
		EVRAZ plc	EVRE.L			
		SSAB	SSABa.ST			
		Thyssenkrupp AG	TKAG.DE			
		voestalpine	VOES.VI			
	10 Construction Materials	Holcim Ltd	HOLN.S	Scope 1	tnCO2/tn cementious material	Tonnes cement/ cementious material produced
		HeidelbergCement	HEIG.DE			
		CRH	CRH.I			
	11 Mining & Metals	Glencore PLC	GLEN.L	Scope 1,2	tnCO2eq/tnCueq	Tonnes of copper equivalent
		BHP Group Ltd	BHPB.L			
		Rio Tinto Ltd	RIO.L			
		Anglo American PLC	AAL.L			
		Antofagasta PLC	ANTO.L			
		Boliden	BOL.ST			
	Aluminium	Norsk Hydro	NHY.OL	Scope 1,2	tnCO2eq/tn Al	Tonnes of Al produced
	12 Paper & Packaging	UPM-Kymmene Oyj	UPM.HE	Scope 1,2	tnCO2/tn paper, cardboard product	Tonnes of paper, cardboard sellable product
		Mondi Group	MNDI.L			
		Stora Enso Oyj	STERV.HE			
		Smurfit Kappa Group PLC	SKG.I			
		DS Smith	SMDS.L			
		Huhtamaki Oyj	HUH1V.HE			
		BillerudKorsnas AB (publ)	BILL.ST			
		Svenska Cellulosa SCA	SCAb.ST			
	13 Chemicals	Linde PLC	LINI.DE	Scope 1,2	Volumes-based Carbon intensity **Index**	Index
		Air Liquide	AIRP.PA			
		BASF SE	BASFn.DE			
		Yara International	YAR.OL			
		Solvay	SOLB.BR			
		Evonik Industries	EVKn.DE			
		Covestro	1COV.DE			
		Arkema SA	AKE.PA			
		Lanxess AG	LXSG.DE			
		Clariant	CLN.S			
		Johnson Matthey	JMAT.L			
		Novozymes	NZYMb.CO			
		Symrise	SY1G.DE			
		Akzo Nobel	AKZO.AS			
		Sika	SIKA.S			
		Croda International	CRDA.L			
		Corbion NV	CORB.AS			
		Givaudan	GIVN.S			
		Victrex PLC	VCTX.L			
		Umicore	UMI.BR			
		Hexpol	HPOLb.ST			
		Koninklijke DSM	DSMN.AS			
Consumer products 	14 Household & Personal Care	Essity AB	ESSITYb.ST	Scope 1,2	Volumes-based Carbon intensity **Index**	Index
		Unilever PLC	ULVR.L			
		Henkel	HNKG_p.DE			
		Reckitt	RKT.L			
		Beiersdorf	BEIG.DE			
		L'Oreal	OREP.PA			
	15 Food & Beverage	Nestle	NESN.S	Scope 1,2	Volumes-based Carbon intensity **Index**	Index
		Associated British Foods	ABF.L			
		Tate & Lyle	TATE.L			
		Danone	DANO.PA			
		Kerry Group	KYGa.I			
		Coca Cola HBC AG	CCH.L			
		Glanbia PLC	GL9.I			
		Mowi ASA	MOWI.OL			
		Orkla ASA	ORK.OL			
		Bakkafrost	BAKKA.OL			
		Britvic PLC	BVIC.L			
		SalMar ASA	SALM.OL			
		Lindt & Spruengli	LISN.S			
		Barry Callebaut	BARN.S			

Source: Thomson Reuters, Company data, Goldman Sachs Global Investment Research

5) Implied Temperature Rise (ITR) of corporate de-carbonization targets: A deep-dive into the different methodologies

Our Implied Temperature Rise (ITR) analysis leverages interpolation to compare companies' emissions trajectories with our GS net zero scenario industry benchmarks up to 2030. We do not take a view beyond 2030 given: (a) the challenges with accurately forecasting company performance over the longer term and uncertainties around execution of company stated long-term net zero targets; (b) the high likelihood of technological innovation that could alter the long-term de-carbonization trajectory and targets of corporates and which cannot be forecasted; and (c) the lack of consistency on timeframe and methodology of company targets. We primarily focus on the corporate targets to 2030. In total, we provide four outputs for each company under two approaches — a historical trajectory pathway and a stated company targets pathway — for each of which we then calculate ITR through interpolating 2030 performance and cumulative 2020-2030 performance of the company relative to our three industry climate scenario benchmarks (GS 1.5°C, GS <2.0°C, and GS 2.0°C). **In this section we outline the full methodology covering the 4 outputs -**

- **Methodology I:** uses **Historical Trajectory** (Step 1, Point 1) with **interpolation of 2030 performance** (Step 2, Point 1).
- **Methodology II**: uses **Historical Trajectory** (Step 1, Point 1) with **interpolation of cumulative 2020-2030 performance** (Step 2, Point 2).
- **Methodology III:** uses **Stated Company Targets** (Step 1, Point 2) with **interpolation of 2030 performance** (Step 2, Point 1).
- **Methodology IV:** uses **Stated Company Targets** (Step 1, Point 2) with **interpolation of cumulative 2020-2030 performance** (Step 2, Point 2).

Step 1: Project company emissions out to 2030

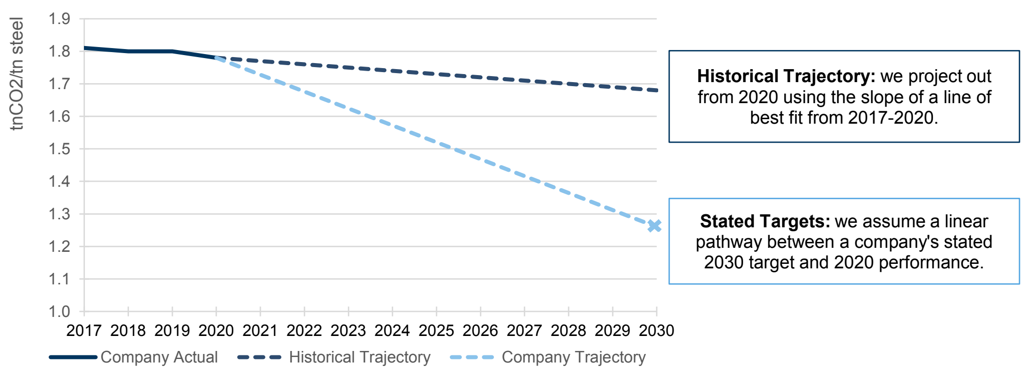
We have collected each company's historical performance (from 2016 to 2020, disclosures permitting) and standardized outputs to ensure they are in the same units as prescribed by our GS net zero pathways. For example, integrated oil and gas companies must be in the intensity unit gCO_2eq/MJ and include Scopes 1-3. Beyond 2020, we have taken two approaches to project emissions performance using (1) historical trajectory and (2) stated company targets.

1. ***Historical Trajectory:*** We calculate the slope of a line of best fit for historical company performance between 2017-2020 (using the maximum number of data points available) and apply this slope out to 2030. For Airlines only, we did not include 2020 in the historical slope calculation given the extraordinary impact of Covid on the industry globally, and instead used the years 2016-2019 to generate the slope and forecast out from a base year of 2019 (however we do include the company reported intensity in 2020). Where a company's emissions have increased over the historical period, we assume their 2020 performance (2019 for Airlines) holds constant to 2030.

- Limitations: Past performance is not necessarily indicative of future performance - companies that have already shown material decarbonization in the past may find incremental improvements more difficult, while those without meaningful progress shown historically may have plans to accelerate their transition. Factors such as the availability of lower carbon alternative solutions across sectors may also lead to significant differences in the decarbonization history of companies.

2. ***Stated Company Targets:*** We have standardized company stated targets, and assumed a linear reduction for performance between 2020 and 2030. For Airlines only, we use 2019 as the baseline year to determine the linear reduction required due to the extraordinary impact of Covid on the industry globally. For companies with interim targets between 2020 and 2030, we assume linearity between targets.
    - Limitations: Company performance will not likely follow a linear pathway towards a stated target, which would impact the cumulative assessment in Step 2 where a company's pathway to 2030 is factored into the assessment. This method also assumes that a company will meet stated targets, which is not always the case.

Exhibit 47: We use two methods to forecast out company emissions intensity or performance out to 2030
Example of company emissions forecast for a steel company



Source: Goldman Sachs Global Investment Research

Step 2: Compare projected company performance with the GS pathways benchmarks

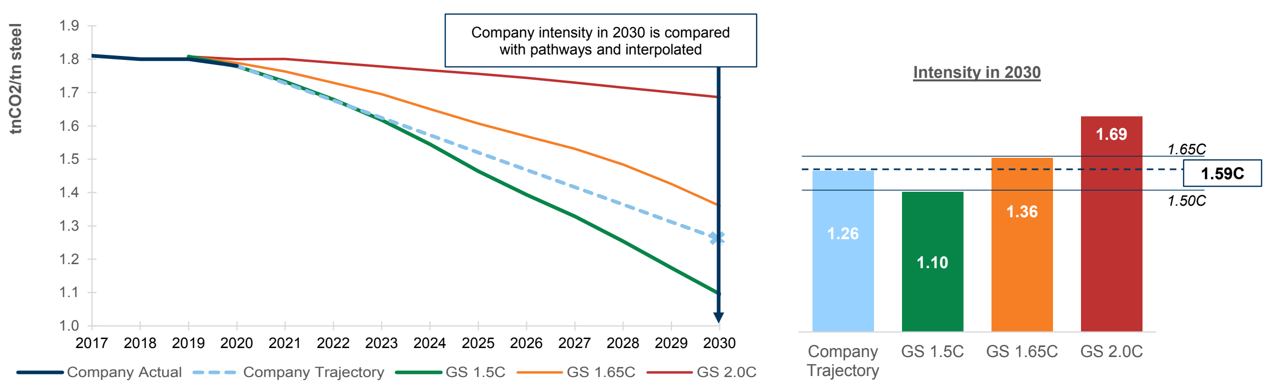
For each industry, we use three benchmark climate pathways to inform our interpolation analysis that are consistent with our 1.5°C, <2.0°C and 2.0°C warming outcomes. Each company's performance is plotted against these three respective industry pathways with an interpolation assessment made on: 1) 2030 performance and 2) cumulative 2020-2030 performance.

1. ***Interpolation on 2030 performance*** (Exhibit 48): We take the company's emissions performance in 2030 and compare it against the 2030 emissions performance under the 1.5°C, <2.0°C and 2°C pathways. Using a sensitivity analysis between each of the three industry pathways, we can understand which band a company's 2030 performance falls within and apply the relevant temperature sensitivity to the difference between the pathways performance and the company's performance.
    - Limitations: This method is a point in time assessment and does not factor in

the pathway to 2030. A company may be aligned with a certain degree warming outcome in 2030, however may grossly over/undershoot the pathway on a cumulative basis up to 2030. As global warming is a function of cumulative emissions, this may lead to misalignment with climate goals. The method may also overly reward companies that have set very ambitious targets relative to their current performance level.

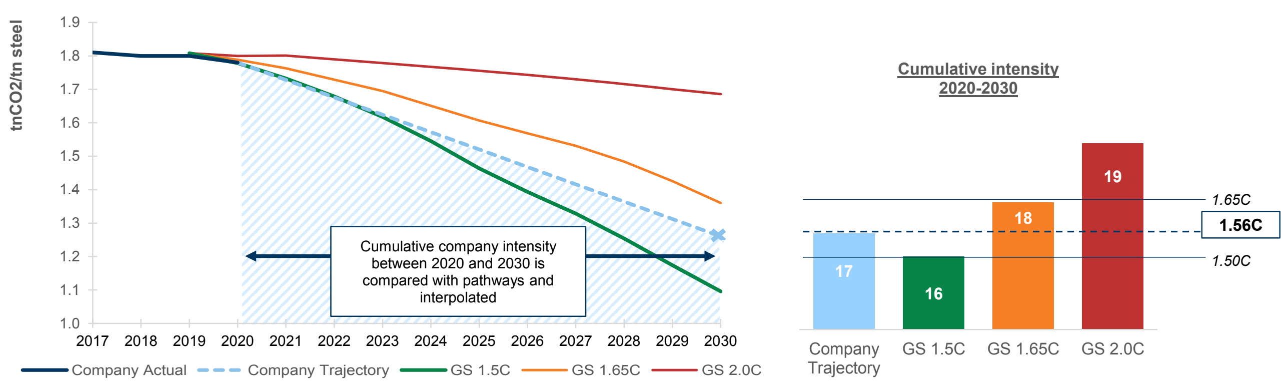
2. ***Interpolation on cumulative 2020-2030 performance*** (Exhibit 49): We take the company's cumulative 2020-2030 emissions performance and compare it against the cumulative 2020-2030 industry emissions performance under the 1.5°C, <2.0°C and below 2.0°C pathways. Using a sensitivity analysis between each of the three industry pathways, we can understand which band a company's cumulative 2020-2030 performance falls within and apply the relevant temperature sensitivity to the difference between the pathways performance and the company's performance.
    - □ Limitations: This method assumes that company and industry volumes remain constant as we do not convert intensities and indexed performance into absolute emissions, resulting in the impact of each year's intensity or indexed performance being equally weighted over the 2020-2030 period.

Exhibit 48: Example of 2030 intensity interpolation methodology using a hypothetical steel company



Source: Goldman Sachs Global Investment Research

Exhibit 49: Example of 2020-2030 cumulative intensity interpolation methodology using a hypothetical steel company



Source: Goldman Sachs Global Investment Research

Broader assumptions and limitations of our model

- **Company and sector volumes remain constant:** Our pathways are developed on an intensity or index basis, where we do not incorporate volumes to convert to absolute emissions. This inherently means that our methodology assumes that volumes remain constant for the company and the sector.
- **No view beyond 2030:** Challenges with forecasting company emissions and uncertainties around execution of longer-term corporate decarbonization targets result in us limiting our analysis to an assessment up until 2030. We also view that ultimately the near-term targets are the ones that influence and drive the corporate's current strategy and strategic decisions and therefore we primarily focus on the targets set in this decade (2020-30). We do not take a view on the alignment of companies beyond 2030 and our implied temperature methodology was developed such as to enable the determination of a potential implied temperature rise despite the fact that it does not extend to 2050. TCRE methodologies are much harder to apply with a timeframe limited to 2030 (please see Appendix section for further details around TCRE methodology).

Limitations of using the TCRE Multiplier for our implied temperature rise analysis

What is the TCRE Multiplier? The transient climate response to cumulative carbon emissions (TCRE) multiplier represents the global mean surface temperature rise due to a given quantity of cumulative anthropogenic CO_2 emissions in the atmosphere and can be leveraged to convert the cumulative emissions overshoot of a company or portfolio versus a climate scenario benchmark into a degree warming outcome. This underlying assumption is the rest of the world will over/undershoot a climate pathway by the same amount as the company. Notably, the multiplier can only be applied to CO_2 (or equivalent long-lived gasses), with short-lived gasses such as methane required to be assessed separately.

How is a company's ITR calculated using TCRE? Using the TCRE multiplier, the implied temperature rise (ITR) of a company can be calculated as follows: *ITR = Current Temperature + (remaining global Carbon Budget x cumulative emissions overshoot ratio x TCRE)*

The current temperature estimate per the Intergovernmental Panel on Climate Change (IPCC) is approximately 1.2°C with a remaining global carbon budget of ~500GtCO_2e for a 1.5°C global warming with 50% probability. The TCRE multiplier has a best estimate of 0.45°C according to the latest report by the IPCC.

What limitation prevented usages in the GS ITR model? The TCRE multiplier requires the emissions of a company and the emissions in benchmark scenario both reach zero in order to calculate the complete cumulative emission over/(under) shoot to which the TCRE is applied. **Given the challenges around longer-term forecasting and execution uncertainties of corporate long-term net zero targets, we chose to limit our assessment of company to stop at 2030, meaning that for most companies the emissions forecasts would not have yet reached zero. Therefore, the TCRE multiplier was unable to be used in our methodology.**

6) Taking the temperature of European corporates: Key observations from the results of the GS ITR methodology

In this section of the report we **summarize the key findings from our implied temperature rise (ITR) analysis** which is based on the comparison of our GS net zero sectoral pathways (GS 1.5°, GS <2.0° and GS 2.0°) with the de-carbonization targets of corporates in each of the 15 highest emitting industries in the European market (STOXX 600) under our different temperature alignment methodologies described in the previous section. We present the results, our assumptions and approach by industry in the sectoral deep-dive section that follows.

The table that follows (Exhibit 50) presents the implied temperature rise under the four methodologies described above both: (a) absolute CO_2 emissions weighted (based on the same emissions scope coverage of each corporate and industry as prescribed earlier - Exhibit 46) and (b) market-capitalization weighted for each of the 15 key emitting industries in Europe and for the GS selected universe of 110+ corporates. Based on the historical projection data, sectors such as steel, oil & gas, chemicals, construction materials and shipping screen less attractively compared to sectors such as electric utilities, household & personal care and real estate where the low-carbon transition has already gained momentum and accelerated over the past few years. Nonetheless, **across sectors European corporates in the 15 key carbon intensive industries of STOXX 600 have on aggregate ambitious de-carbonization targets to 2030 that align with an implied temperature rise of 2°C of global warming or lower** (absolute emissions weighting)**,** according to our analysis and methodology.

Exhibit 50: Summary of implied temperature rise analysis at the industry level for the 15 key emitting industries in the European market and for the GS universe selection of corporates

Implied temperature rise under the four methodologies for each sector both (a) absolute CO2 emissions weighted and (b) market-capitalization weighted for each of the 15 key emitting industries in Europe and for the GS selected universe

ITR results - Absolute CO2 emissions weighting	Historical		Targets	
	2030	2020-2030 cumulative	2030	2020-2030 cumulative
Airlines	1.75	1.74	1.53	1.53
Aluminium	1.40	1.31	1.35	1.31
Auto Manufacturers	1.42	1.38	1.58	1.42
Chemicals	2.07	2.03	1.67	1.69
Construction Materials	1.73	1.56	1.65	1.49
Diversified miners	1.57	1.50	1.58	1.53
Electric Utilities	1.34	1.37	1.50	1.47
Food & Beverage	1.59	1.63	1.56	1.53
Household & Personal care	1.44	1.46	1.51	1.55
Oil & Gas - Integrated	2.12	2.06	1.84	2.35
Oil & Gas - Upstream	1.20	1.23	1.25	1.26
Oil Refiners	-	-	1.45	1.45
Paper & Packaging	1.69	1.63	1.56	1.49
Real Estate	1.47	1.50	1.79	1.70
Shipping	1.77	1.78	1.83	1.90
Steel	2.16	2.35	1.77	1.95
GS Corporate universe selection	1.92	1.88	1.75	2.06

ITR results - Market capitalization weighting	Historical		Targets	
	2030	2020-2030 cumulative	2030	2020-2030 cumulative
Airlines	1.61	1.58	1.51	1.49
Aluminium	1.40	1.31	1.35	1.31
Auto Manufacturers	1.27	1.24	1.44	1.27
Chemicals	1.88	1.87	1.59	1.62
Construction Materials	1.88	1.68	1.62	1.49
Diversified miners	1.56	1.49	1.56	1.51
Electric Utilities	1.26	1.28	1.36	1.33
Food & Beverage	1.57	1.58	1.54	1.52
Household & Personal care	1.22	1.29	1.28	1.36
Oil & Gas - Integrated	2.14	1.83	1.81	2.24
Oil & Gas - Upstream	1.20	1.22	1.23	1.25
Oil Refiners	-	-	1.45	1.45
Paper & Packaging	1.62	1.55	1.51	1.45
Real Estate	1.41	1.43	1.62	1.56
Shipping	1.91	1.93	1.82	1.95
Steel	2.12	2.28	1.75	1.90
GS Corporate universe selection	1.58	1.54	1.53	1.58

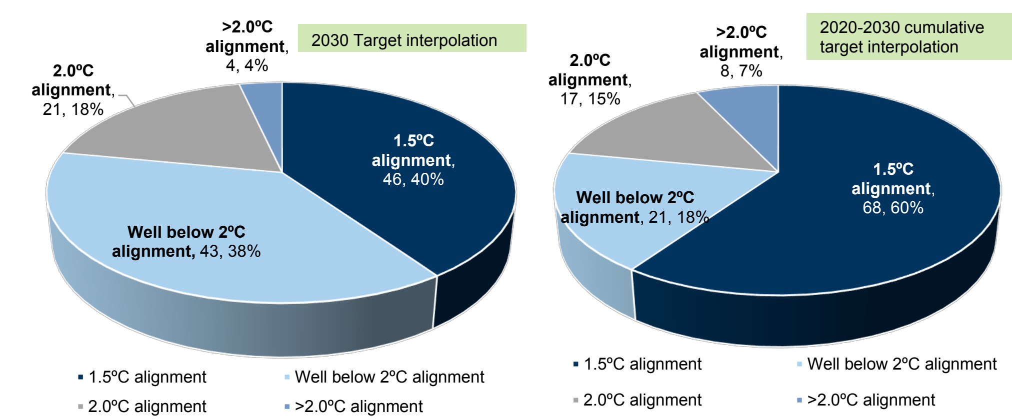
Source: Company data, Goldman Sachs Global Investment Research

Our ITR results indicate that c. 78% of corporates in the 15 most emitting industries in the European market have set targets that are aligned with 1.5°C and well below 2°C paths...

In the charts that follow we summarize the results of the implied temperature rise analysis under the company stated targets and their historical projected trajectory under the two interpolation methodologies (one that interpolates at the 2030 target point between our GS carbon neutrality models and one that interpolates based on the cumulative path from 2020-30 compared to our GS carbon neutrality models).

Exhibit 51 shows the share of the European corporates examined in this analysis (15 most emitting industries in European market, STOXX 600 constituents in these industries) that have an implied temperature rise result (under the company stated target framework of the GS ITR methodologies) that would be potentially aligned with: **(a) 1.5°C, (b) well below 2°C (for the purpose of this analysis this is defined as 1.65°C to be precise), (c) 2.0°C and (d) above 2°C. On aggregate European corporates in the 15 key emitting industries included in this report have set ambitious targets with c.78% of corporates having set targets that are aligned with well below 2°C of global warming under both methodologies.** Given the generally lower carbon intensity target point of most European corporates vs the global GS paths across many sectors, the cumulative 2020-30 targets interpolation methodology finds a greater proportion of the corporate de-carbonization targets being aligned with 1.5°C (60% vs. 40% under the 2030 target methodology).

Exhibit 51: Share of European corporates included in this analysis whose de-carbonization target-implied temperature rise result (under the two GS methodologies) falls within each category (1.5°C, <2.0°C, 2.0°C and >2.0°C)



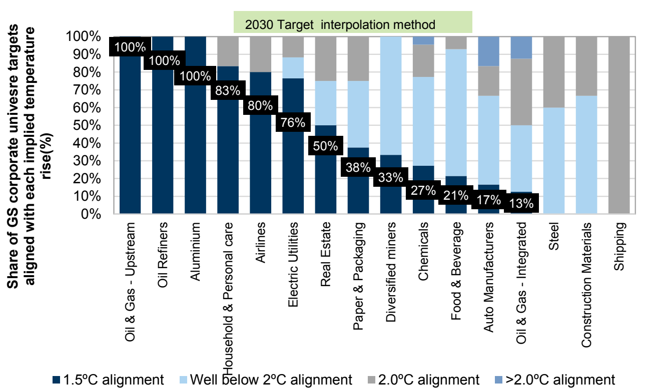
Source: Company data, Goldman Sachs Global Investment Research

...with European electric utilities, aluminium, household & personal care, real estate having the greatest proportion of corporates with targets aligned with 1.5°C and well below 2°C

We also present the results for the implied temperature rise of corporate de-carbonization targets by industry, as shown in Exhibit 52 and Exhibit 53. Sectors that screen less attractively in the two exhibits below, with a higher portion of corporates that are not aligned with 1.5 or well below 2 degrees, typically **include the heavier industrial and transport industries such as shipping, steel and oil & gas**

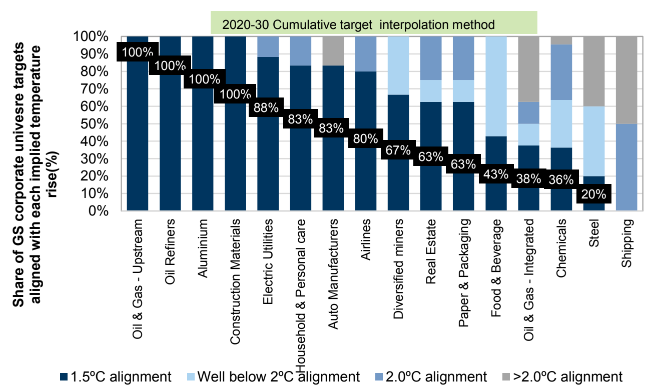
(integrated) given the more global nature of these corporates' operations and the need for further technological innovation and economies of scale that are needed to unlock new technologies and therefore greater potential technological abatement achievable this decade. These sectors typically also occupy the more costly part of our Carbonomics cost curve (Exhibit 33). On the contrary, sectors such as **Electric Utilities, aluminium (where the majority of emissions come from electricity use), and household & personal care** screen very well with > 80% of corporates in these industries having targets with an implied temperature rise that is aligned with 1.5°C under both methodologies as de-carbonization commercial and economic technologies are already available at scale**.**

Exhibit 52: European household & personal care, aluminium, airlines, utilities and real estate have some of the most ambitious de-carbonization targets, with >50% of the corporate targets to 2030 in these industries aligned with 1.5°C.
Share of corporates in each of the key emitting industries covered in this analysis with targets that have an ITR result that aligns with each category (%)



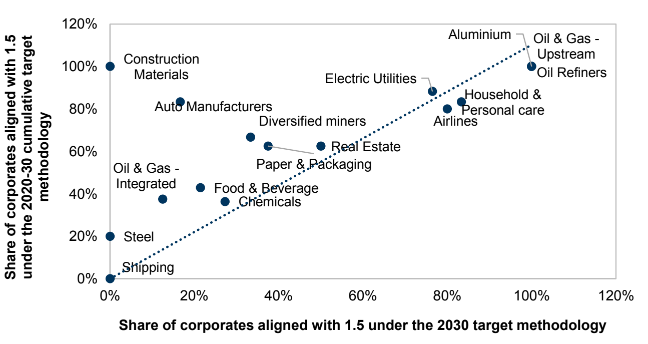
Source: Company data, Goldman Sachs Global Investment Research

Exhibit 53: ...under both ITR methodologies (interpolation at 2030 target and cumulatively in the period 2020-30)
Share of corporates in each of the key emitting industries covered in this analysis with targets that have an ITR result that aligns with each category (%)



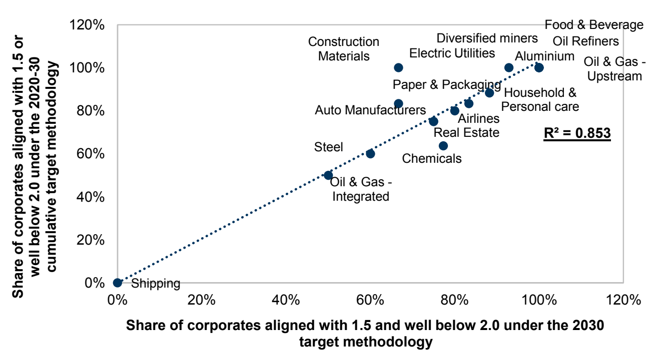
Source: Company data, Goldman Sachs Global Investment Research

Exhibit 54: More corporates across the selected universe are aligned with 1.5 degrees under the 2020-30 cumulative target methodology (vs. the 2030 target point methodology) given the lower starting carbon intensity of European corporates vs. global intensity paths...
Share of corporate targets aligned with 1.5 degrees under the 2020-30 target cumulative methodology vs. the 2030 target methodology



Source: Company data, Goldman Sachs Global Investment Research

Exhibit 55: ...yet the two methodologies give, more broadly, very consistent results for the share of corporates' de-carbonization targets with an implied temperature rise well below 2.0 degrees
Share of corporate targets aligned with 1.5 and <2.0 degrees under the 2020-30 target cumulative methodology vs. the 2030 target methodology



Source: Company data, Goldman Sachs Global Investment Research

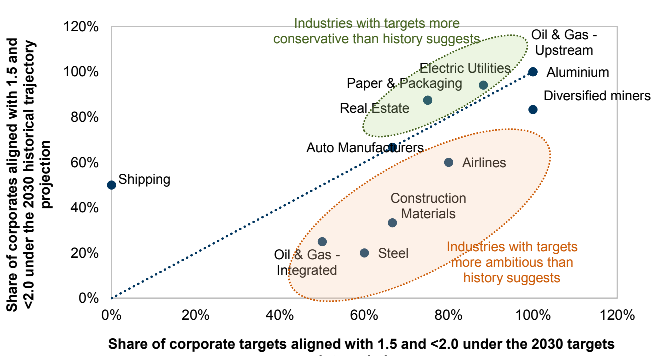
Comparing the ITR implied by corporate stated targets vs. their historical trajectory projected forward, we identify sectors that have set more or less ambitious compared to what is implied by their historical carbon intensity track record

The exhibits that follow (Exhibit 56 and Exhibit 57) focus on comparing the implied temperature rise results across our four methodologies: stated corporate targets vs. the implied temperature rise results coming from projecting the corporates' historical carbon intensity trajectories. Whilst we acknowledge that the historical trajectory of the corporates' carbon intensity is unlikely to continue in this coming decade given the focus on ESG and acceleration of sustainability initiatives across all sectors, and therefore unlikely to be reflective of the final implied temperature rise of these companies, this analysis provides useful insights with regard to the sectors that have set either more ambitious or more conservative targets than their historical emissions intensity pathway would imply.

Overall, our results indicate that the corporate de-carbonization targets in industries such as airlines, steel, construction materials and oil & gas (integrated) appear to be more ambitious than the historical trajectory suggests for a large portion of corporates, implying that these industries really are accelerating their low carbon transition compared to their historical record. Their historical record is not as strong as other industries given the limited availability of large-scale, economic de-carbonization technologies for these industries. On the contrary, industries such as real estate, electric utilities and paper & packaging have on aggregate de-carbonization targets that appear more conservative than their historical trajectory would suggest, either because these industries in Europe already had a strong historical de-carbonization record (at least for the emissions scope coverage in this analysis, such as real estate and electric utilities) or because they need to update their de-carbonization targets to better reflect their more ambitious de-carbonization strategy announced (as is the case for some auto manufacturers).

Exhibit 56: Comparison of the implied temperature rise between the corporates' current de-carbonization targets and their historical trajectory provides useful insights with regard to which industries have set more ambitious de-carbonization targets for this decade (vs. historical track record)...

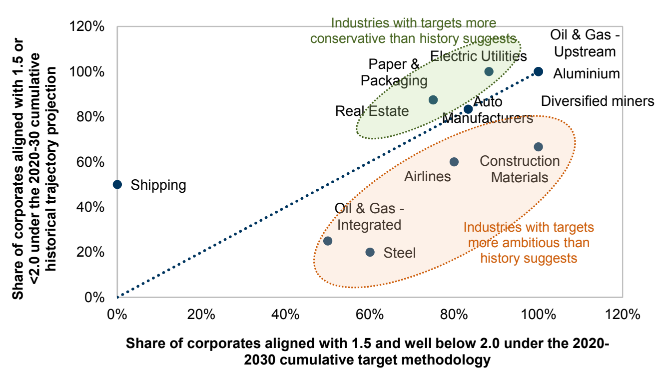
Share of GS corporate universe selection's targets and historical trajectories aligned with each implied temperature rise (%)



Source: Company data, Goldman Sachs Global Investment Research

Exhibit 57: ...or more conservative de-carbonization targets, either due to an already strong de-carbonization historical record or due to out-dated targets

Share of GS corporate universe selection's targets and historical trajectories aligned with each implied temperature rise (%)

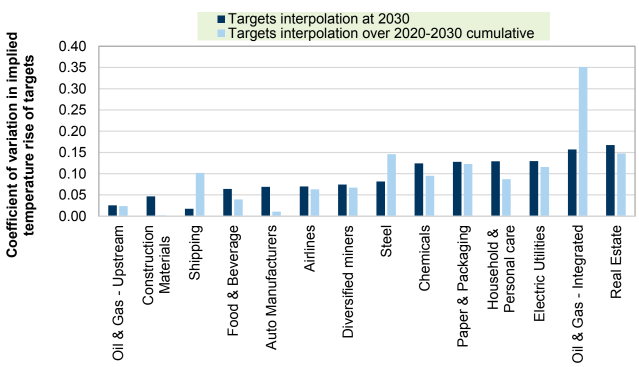


Source: Company data, Goldman Sachs Global Investment Research

The coefficient of variation can provide useful insight to the dispersion of de-carbonization targets across industries

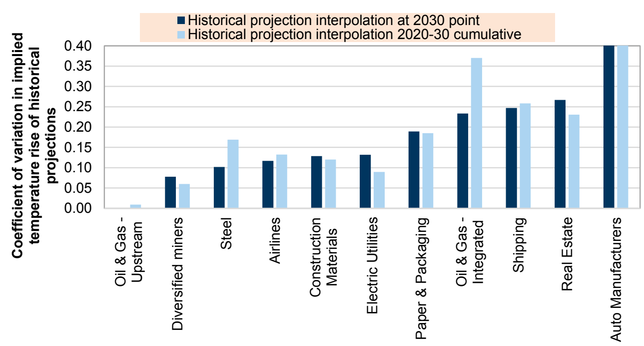
We have also examined the degree of variation between the implied temperature rise results across the key industries considered. The coefficient of variation (defined as the standard deviation of the implied temperature rise results divided by the mean in each industry) is a measure that can provide useful insights to the variation and the dispersion of the corporates' de-carbonization targets in each industry. Overall, as shown in Exhibit 58, across sectors the coefficient of variation appears to be less than 0.5, indicating a broadly consistent set of targets across industries. Notable examples of higher dispersion of results include real estate (where different corporates have different real estate asset portfolios, with a clear differentiation between residential and commercial-focus corporates), integrated oil & gas producers (where the starting carbon intensity is largely dependent on their final energy sales mix - differs by company between oil, gas, bioenergy, power and more) and electric utilities.

Exhibit 58: The coefficient of variation can provide useful insight to the consistency of de-carbonization targets across industries...
Coefficient of variation in implied temperature rise results for corporate targets in each industry



Source: Company data, Goldman Sachs Global Investment Research

Exhibit 59: ...with the dispersion of de-carbonization targets across corporates in each industry being smaller than the dispersion observed in their historical trajectory projections
Coefficient of variation in implied temperature rise results for corporate historical projections



* Auto manufacturers coefficient of variation largely skewed by a single corporate

Source: Company data, Goldman Sachs Global Investment Research

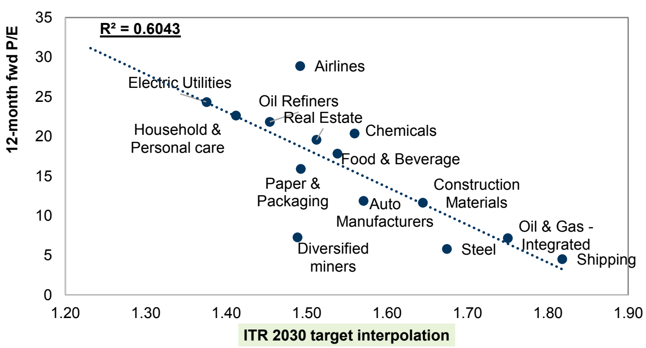
The implied temperature rise associated with corporates' de-carbonization targets in each industry appears to be correlated with the current 12-month forward P/E multiple

In this part of the report we examine the correlation between the implied temperature rise (ITR) results of each corporate industry (average ITR result by industry) **and the 12-month forward P/E multiple** (average for each industry). Our results indicate that there appears to be a correlation between the average 12-month forward P/E multiple and the average 2030 de-carbonization target ITR for each industry (as shown in Exhibit 60 and Exhibit 61), with the 2030 target interpolation method giving a higher correlation compared to the 2020-30 cumulative corporate stated target interpolation method. This would suggest that the market multiple is more highly correlated with the final 2030 target implied temperature rise, and less so with the trajectory that gets the corporate to that target (lower correlation with 2020-30 cumulative target implied temperature rise).

We have performed the same analysis to examine the correlation between the implied temperature rise (ITR) of each corporate industry's projected historical de-carbonization trajectory (average ITR result by industry) to the 12-month forward P/E multiple (average for each industry). The correlation however appears to be weaker than the correlation with actual 2030 corporate targets, indicating that the market is forward looking on that aspect.

Exhibit 60: There appears to be a correlation between the implied temperature rise of corporates' 2030 targets and the 12-month forward P/E multiple...

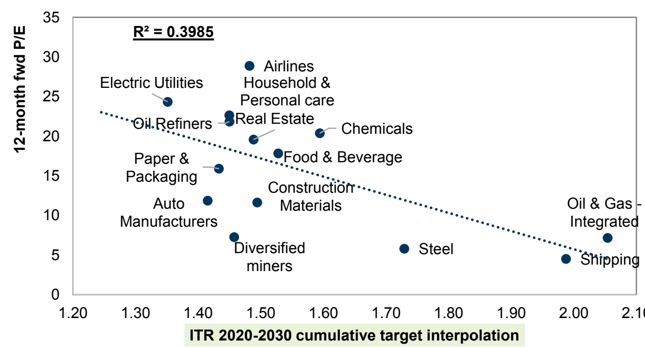
Average ITR 2030 target result vs average 12-month forward P/E by industry



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

Exhibit 61: ...yet a lower correlation between 12-month forward P/E and the trajectory to get to the 2030 target (2020-30 cumulative target ITR result)

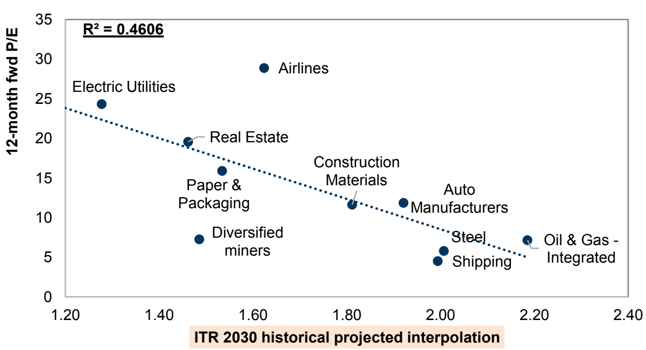
Average ITR 2020-2030 cumulative target result vs. average 12-month forward P/E by industry



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

Exhibit 62: There also appears to be a relationship between the 12-month forward P/E and the implied historical carbon intensity trajectory ITR result...

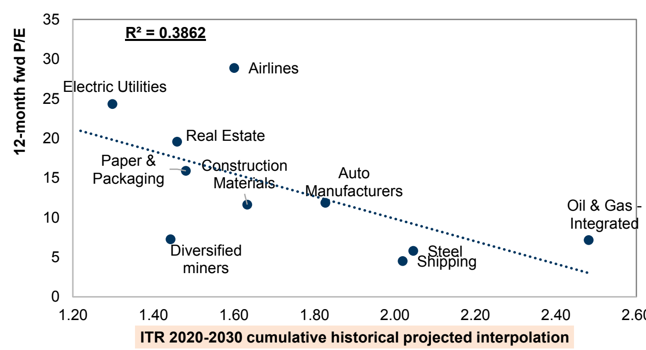
Average ITR 2030 projected historical trajectory result vs average 12-month forward P/E by industry



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

Exhibit 63: ...yet a comparatively lower correlation compared to the actual 2030 corporate targets

Average ITR 2020-30 cumulative projected historical trajectory result vs. average 12-month forward P/E by industry



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

Exhibit 64: Summary of the GS implied temperature rise analysis results for the 15 key European emitting industries and their constituent corporates' de-carbonization targets and historical paths (for the selected GS corporate universe outlined earlier in this report and in the 2020-2030 timeframe)

			Historical: Projects historical slope at 2020 to 2030 and then interpolates between GS scenarios		Targets: Follows company targets pathway to 2030 and then interpolates between GS scenarios	
Ticker	Name	Sector	2030	2020-2030 cumulative	2030	2020-2030 cumulative
ENEI.MI	Enel SpA	Electric Utilities	1.20	1.24	1.38	1.34
UN01.DE	Uniper SE	Electric Utilities	1.62	1.60	1.76	1.70
EDF.PA	Electricite de France SA	Electric Utilities	1.20	1.21	1.28	1.24
FORTUM.HE	Fortum Oyj	Electric Utilities	1.70	1.49	1.40	1.39
ELE.MC	Endesa SA	Electric Utilities	1.20	1.22	1.41	1.33
IBE.MC	Iberdrola SA	Electric Utilities	1.20	1.24	1.31	1.27
EDP.LS	EDP Energias de Portugal SA	Electric Utilities	1.20	1.23	1.22	1.28
SSE.L	SSE PLC	Electric Utilities	1.60	1.45	1.47	1.40
ORSTED.CO	Orsted A/S	Electric Utilities	1.20	1.21	1.20	1.22
VERB.VI	Verbund AG	Electric Utilities	1.20	1.20	1.22	1.21
ANA.MC	Acciona SA	Electric Utilities	1.20	1.20	1.20	1.20
EDPR.LS	EDP Renovaveis SA	Electric Utilities	1.20	1.20	1.20	1.20
SCATC.OL	Scatec ASA	Electric Utilities	1.20	1.20	1.20	1.20
RWEG.DE	RWE	Multi Utilities	1.20	1.38	1.72	1.72
ENGIE.PA	Engie	Multi Utilities	1.20	1.32	1.53	1.42
A2.MI	A2A SpA	Multi Utilities	1.20	1.33	1.60	1.48
NTGY.MC	Naturgy Energy Group	Multi Utilities	1.20	1.34	1.30	1.37
		Mean	1.28	1.30	1.38	1.35
RDSA.AS	Royal Dutch Shell PLC	Oil & Gas - Integrated	2.04	2.64	1.95	2.76
BP.L	BP PLC	Oil & Gas - Integrated	2.99	>4.0	2.36	3.59
TTEF.PA	TotalEnergies	Oil & Gas - Integrated	1.46	1.47	1.55	1.49
ENI.MI	ENI	Oil & Gas - Integrated	2.42	2.28	1.56	1.50
REP.MC	Repsol	Oil & Gas - Integrated	1.98	2.42	1.53	1.72
EQNR.OL	Equinor	Oil & Gas - Integrated	2.37	2.20	1.50	1.49
OMVV.VI	OMV	Oil & Gas - Integrated	1.50	1.49	1.83	1.61
GALP.LS	Galp	Oil & Gas - Integrated	2.72	3.36	1.73	2.28
		Mean	2.19	2.26	1.75	2.05
AKERBP.OL	Aker BP ASA	Oil & Gas - Upstream	1.20	1.23	1.26	1.27
LUNE.ST	Lundin Energy	Oil & Gas - Upstream	1.20	1.21	1.20	1.22
		Mean	1.20	1.22	1.23	1.25
NESTE.HE	Neste Oyj	Oil Refiners			1.45	1.45
LHAG.DE	Deutsche Lufthansa AG	Airlines	1.89	1.92	1.42	1.47
ICAG.L	IAG	Airlines	1.81	1.78	1.69	1.66
EZJ.L	Easyjet	Airlines	1.49	1.45	1.44	1.43
RYA.I	Ryanair	Airlines	1.51	1.45	1.49	1.45
WIZZ.L	Wizz Air Holdings	Airlines	1.42	1.40	1.41	1.40
		Mean	1.62	1.60	1.49	1.48
MAERSKb.CO	AP Moeller - Maersk	Shipping	1.50	1.50	1.85	1.79
HLAG.DE	Hapag Lloyd	Shipping	2.49	2.54	1.79	2.19
		Mean	1.99	2.02	1.82	1.99

Source: Company data, Goldman Sachs Global Investment Research

Ticker	Name	Sector	Historical: Projects historical slope at 2020 to 2030 and then interpolates between GS scenarios — 2030	Historical — 2020-2030 cumulative	Targets: Follows company targets pathway to 2030 and then interpolates between GS scenarios — 2030	Targets — 2020-2030 cumulative
VOWG_P.DE	Volkswagen	Auto Manufacturers	1.36	1.37	1.61	1.42
STLA.MI	Stellantis NV	Auto Manufacturers	1.61	1.42	1.70	1.43
DAIGN.DE	Daimler AG	Auto Manufacturers	1.42	1.39	1.64	1.43
BMWG.DE	Bayerische Motoren Werke	Auto Manufacturers	1.25	1.34	1.50	1.41
RENA.PA	Renault	Auto Manufacturers	1.88	1.44	1.40	1.39
RACE.MI	Ferrari NV	Auto Manufacturers	>4.0	>4.0	-	-
		Mean	1.92	1.83	1.57	1.42
VNAn.DE	Vonovia	Real Estate	1.20	1.30	2.00	1.85
DWNG.DE	Deutsche Wohnen SE	Real Estate	1.42	1.43	1.62	1.48
URW.AS	Unibail-Rodamco-Westfield SE	Real Estate	1.20	1.21	1.28	1.27
LEGn.DE	LEG Immobilien SE	Real Estate	2.44	2.32	1.73	1.80
AT1.DE	Aroundtown SA	Real Estate	1.55	1.40	1.44	1.37
BALDb.ST	Fastighets AB Balder	Real Estate	1.20	1.22	1.27	1.26
SGRO.L	SEGRO PLC	Real Estate	1.42	1.48	1.56	1.58
GFCP.PA	Gecina	Real Estate	1.27	1.32	1.20	1.30
		Mean	1.46	1.46	1.51	1.49
MT.AS	ArcelorMittal	Steel	2.24	2.53	1.81	2.06
EVRE.L	EVRAZ plc	Steel	2.09	2.26	1.87	2.01
TKAG.DE	Thyssenkrupp AG	Steel	1.99	1.95	1.59	1.56
VOES.VI	voestalpine	Steel	2.08	2.01	1.58	1.54
SSABa.ST	SSAB AB	Steel	1.63	1.49	1.52	1.47
		Mean	2.01	2.05	1.67	1.73
HOLN.S	Holcim Ltd	Construction Materials	1.70	1.49	1.62	1.49
HEIG.DE	HeidelbergCement	Construction Materials	1.60	1.49	1.75	1.50
CRH.I	CRH	Construction Materials	2.14	1.91	1.57	1.49
		Mean	1.81	1.63	1.64	1.49
GLEN.L	Glencore PLC	Diversified miners	1.47	1.48	1.65	1.61
AAL.L	Anglo American PLC	Diversified miners	1.61	1.62	1.59	1.60
ANTO.L	Antofagasta PLC	Diversified miners	1.37	1.43	1.33	1.42
BOL.ST	Boliden	Diversified miners	1.35	1.32	1.39	1.33
BHPB.L	BHP Group Ltd	Diversified miners	1.52	1.47	1.55	1.50
RIO.L	Rio Tinto Ltd	Diversified miners	1.67	1.47	1.56	1.44
		Mean	1.50	1.46	1.51	1.48
NHY.OL	Norsk Hydro	Aluminium	1.40	1.31	1.35	1.31
UPM.HE	UPM-Kymmene Oyj	Paper & Packaging	2.22	2.11	1.50	1.51
MNDI.L	Mondi	Paper & Packaging	1.65	1.63	1.80	1.73
STERV.HE	Stora Enso Oyj	Paper & Packaging	1.48	1.37	1.54	1.39
SKG.I	Smurfit Kappa Group PLC	Paper & Packaging	1.39	1.36	1.52	1.40
SMDS.L	DS Smith	Paper & Packaging	1.39	1.32	1.38	1.32
HUH1V.HE	Huhtamaki Oyj	Paper & Packaging	1.61	1.59	1.72	1.66
BILL.ST	BillerudKorsnas AB	Paper & Packaging	1.26	1.23	1.23	1.22
SCAb.ST	Svenska Cellulosa SCA	Paper & Packaging	1.28	1.24	1.25	1.24
		Mean	1.53	1.48	1.49	1.43

Source: Company data, Goldman Sachs Global Investment Research

			Targets Follows company targets pathway to 2030 and then interpolates between GS scenarios	
Ticker	Name	Sector	2030	2020-2030 cumulative
LINI.DE	Linde PLC	Chemicals	1.68	1.69
AIRP.PA	Air Liquide	Chemicals	1.68	1.70
BASFn.DE	BASF SE	Chemicals	1.63	1.73
YAR.OL	Yara International	Chemicals	1.62	1.65
SOLB.BR	Solvay	Chemicals	1.75	1.68
EVKn.DE	Evonik Industries	Chemicals	1.63	1.67
1COV.DE	Covestro	Chemicals	2.06	2.02
AKE.PA	Arkema SA	Chemicals	1.61	1.58
LXSG.DE	Lanxess AG	Chemicals	1.52	1.61
CLN.S	Clariant	Chemicals	1.54	1.59
JMAT.L	Johnson Matthey	Chemicals	1.57	1.66
NZYMb.CO	Novozymes	Chemicals	1.58	1.47
SY1G.DE	Symrise	Chemicals	1.20	1.40
AKZO.AS	Akzo Nobel	Chemicals	1.45	1.49
SIKA.S	Sika	Chemicals	1.53	1.48
CRDA.L	Croda International	Chemicals	1.51	1.55
CORB.AS	Corbion NV	Chemicals	1.89	1.84
GIVN.S	Givaudan	Chemicals	1.39	1.43
VCTX.L	Victrex PLC	Chemicals	1.20	1.38
UMI.BR	Umicore	Chemicals	1.46	1.49
HPOLb.ST	Hexpol	Chemicals	1.30	1.38
DSMN.AS	Koninklijke DSM	Chemicals	1.54	1.59
		Mean	1.56	1.59
ESSITYb.ST	Essity AB	Household & Personal care	1.73	1.70
ULVR.L	Unilever PLC	Household & Personal care	1.20	1.37
HNKG_p.DE	Henkel	Household & Personal care	1.46	1.44
RKT.L	Reckitt	Household & Personal care	1.40	1.43
BEIG.DE	Beiersdorf	Household & Personal care	1.48	1.46
OREP.PA	L'Oreal	Household & Personal care	1.20	1.29
		Mean	1.41	1.45
NESN.S	Nestle	Food & Beverage	1.51	1.50
ABF.L	Associated British Foods	Food & Beverage	1.60	1.55
TATE.L	Tate & Lyle	Food & Beverage	1.59	1.54
DANO.PA	Danone	Food & Beverage	1.64	1.61
KYGa.I	Kerry Group	Food & Beverage	1.50	1.48
CCH.L	Coca Cola HBC AG	Food & Beverage	1.52	1.49
GL9.I	Glanbia PLC	Food & Beverage	1.59	1.59
MOWI.OL	Mowi ASA	Food & Beverage	1.50	1.49
ORK.OL	Orkla ASA	Food & Beverage	1.47	1.45
BAKKA.OL	Bakkafrost	Food & Beverage	1.57	1.61
BVIC.L	Britvic PLC	Food & Beverage	1.38	1.47
SALM.OL	SalMar ASA	Food & Beverage	1.55	1.52
LISN.S	Lindt & Spruengli	Food & Beverage	1.76	1.64
BARN.S	Barry Callebaut	Food & Beverage	1.35	1.44
		Mean	1.54	1.53

* We note that for industries where the analysis was performed on the basis of a carbon intensity index (with 2019 base year, 'heterogeneous' industries) we did not provide a historical ITR result (given the limited history of just one year - 2019-2020)

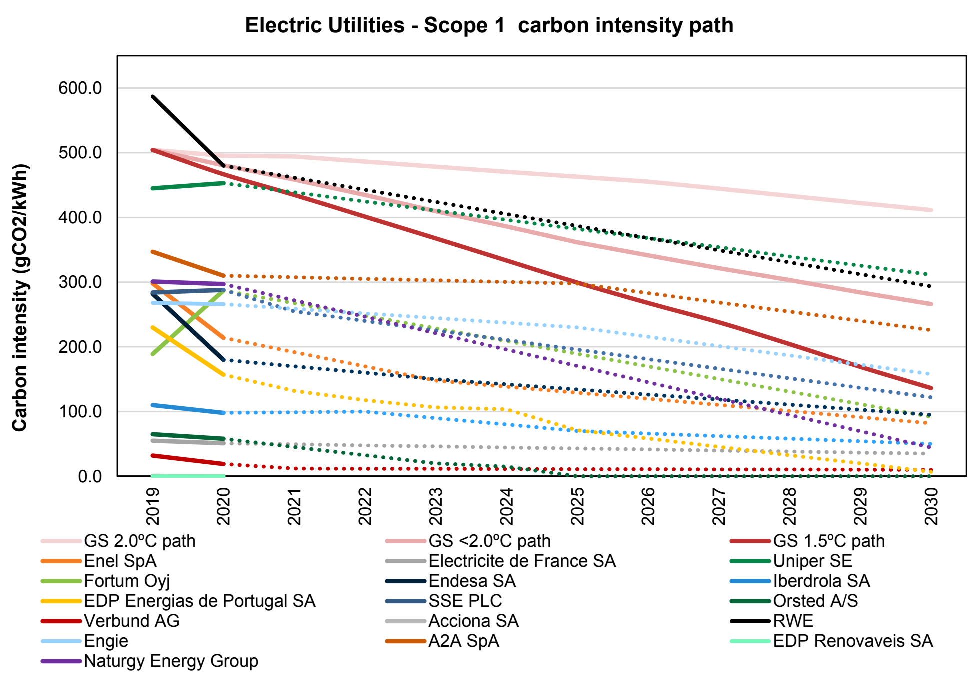
Source: Company data, Goldman Sachs Global Investment Research

Industry deep-dives: A closer look at the 15 highest emitting industries of the European market

1) Electric Utilities

Electric utilities is a sector classified as 'homogeneous' which, as mentioned earlier in the report, is defined as one which is largely relying on a single activity metric, that being the power generated by the industry. As part of our bottoms up sectoral global carbon neutrality models (GS 1.5°, GS <2.0° and GS 2.0°) we have modeled both the global power generation and its mix (TWh by technology), enabling us therefore to devise the global emissions from the power generation industry and subsequently the global average carbon intensity measure in gCO_2/kWh over time for each of the three temperature alignment models. This refers to direct Scope 1 emissions corporate carbon intensity measure associated with the entities' power generation. We note that for utilities classified as multi-utilities, the presented results and analysis and associated carbon intensity are based solely on the power generation business to be comparable with the rest of the electric utilities universe.

Exhibit 65: Electric utilities sector Scope 1 carbon intensity under our global carbon neutrality models (GS 1.5°, GS <2.0° and GS 2.0°) vs. European corporates' de-carbonization targets pathways
Scope 1 carbon intensity gCO2/kWh



Source: Company data, Goldman Sachs Global Investment Research

The results of our analysis, presented in Exhibit 65 and Exhibit 66, show how both the current carbon intensity positioning and de-carbonization pathways based on the companies' targets compare to our global carbon intensity scenarios and the implied temperature rise associated with these targets. Our results lead us to conclude that the European electric utilities sector is one of the leading sectors in de-carbonization globally, **with European utilities, for the vast majority, having an already well below global average carbon intensity and ambitious de-carbonization targets that are in aggregate screening below 1.5°C (with all companies having a target ITR of below 2.0°C).**

Exhibit 66: Summary of implied temperature rise analysis of European electric utilities' de-carbonization targets and historical trajectories

			Historical: Projects historical slope at 2020 to 2030 and then interpolates between GS scenarios		Targets: Follows company targets pathway to 2030 and then interpolates between GS scenarios	
Ticker	Name	Sector	2030	2020-2030 cumulative	2030	2020-2030 cumulative
ENEI.MI	Enel SpA	Electric Utilities	1.20	1.24	1.38	1.34
UN01.DE	Uniper SE	Electric Utilities	1.62	1.60	1.76	1.70
EDF.PA	Electricite de France SA	Electric Utilities	1.20	1.21	1.28	1.24
FORTUM.HE	Fortum Oyj	Electric Utilities	1.70	1.49	1.40	1.39
ELE.MC	Endesa SA	Electric Utilities	1.20	1.22	1.41	1.33
IBE.MC	Iberdrola SA	Electric Utilities	1.20	1.24	1.31	1.27
EDP.LS	EDP Energias de Portugal SA	Electric Utilities	1.20	1.23	1.22	1.28
SSE.L	SSE PLC	Electric Utilities	1.60	1.45	1.47	1.40
ORSTED.CO	Orsted A/S	Electric Utilities	1.20	1.21	1.20	1.22
VERB.VI	Verbund AG	Electric Utilities	1.20	1.20	1.22	1.21
ANA.MC	Acciona SA	Electric Utilities	1.20	1.20	1.20	1.20
EDPR.LS	EDP Renovaveis SA	Electric Utilities	1.20	1.20	1.20	1.20
SCATC.OL	Scatec ASA	Electric Utilities	1.20	1.20	1.20	1.20
RWEG.DE	RWE	Multi Utilities	1.20	1.38	1.72	1.72
ENGIE.PA	Engie	Multi Utilities	1.20	1.32	1.53	1.42
A2.MI	A2A SpA	Multi Utilities	1.20	1.33	1.60	1.48
NTGY.MC	Naturgy Energy Group	Multi Utilities	1.20	1.34	1.30	1.37
		Mean	1.28	1.30	1.38	1.35

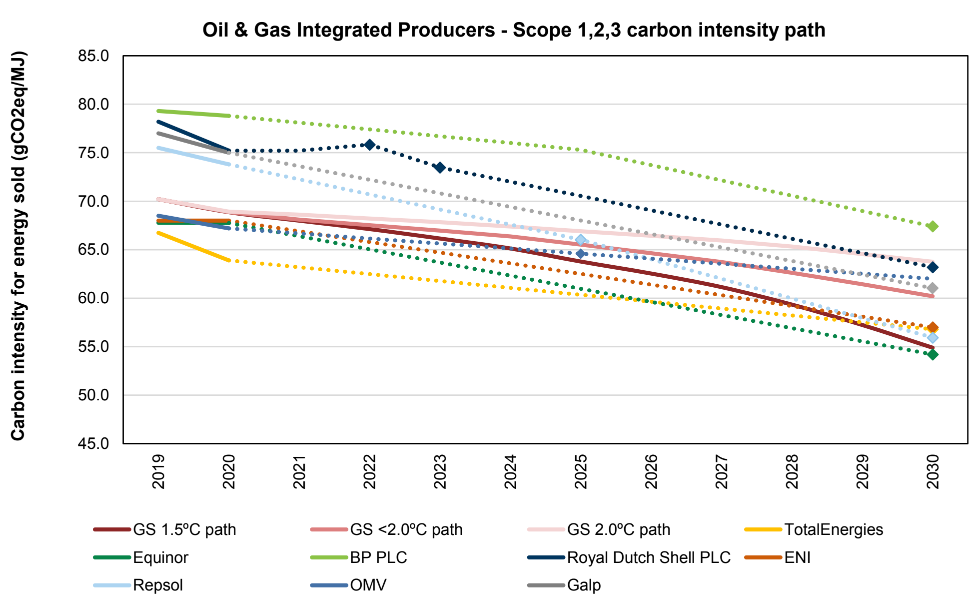
Source: Company data, Goldman Sachs Global Investment Research

2) Oil & Gas Integrated Producers

Whilst the oil & gas industry is in theory considered a homogeneous one, with the key activity metric being the amount of energy that is sold in Joules (the universal unit for energy), the wide range of activities and energy products that the integrated oil & gas companies sell makes the carbon intensity evolution analysis more complex than the pure industry example of electric utilities described above. We have constructed carbon intensity pathways for the oil & gas industry encompassing all of Scope 1,2 and 3 given the significance of scope 3 emissions for the sector (as shown in Exhibit 45). We have assumed in constructing our GS sectoral intensity paths that the companies maintain their current market share in their respective oil & gas end markets yet the mix of their energy product offering evolves with the de-carbonization of these markets (such as transport, industry, buildings for oil, power generation, industry and buildings for natural gas). In other words, whilst these companies maintain their current market share when it comes to energy sales, the form of energy sold evolves with the de-carbonization of each respective end market, away from fossil fuels in most cases and towards power, bioenergy, clean hydrogen and more.

Since for the purpose of this analysis we take into consideration Scope 3 emissions associated with final energy product sales (which is responsible for the majority of this sector's emissions and carbon intensity), we note that this could be described as a relatively harsh approach for this industry in comparison to others. This is particularly true for companies with high oil products sales exposure as it could result in a higher starting carbon intensity (carbon intensity reflects the difference in energy product sales mix between corporates with energy sales including all of oil products, natural gas, bioenergy, hydrogen, power).

Exhibit 67: Integrated oil & gas sector Scope 1,2,3 carbon intensity under our global carbon neutrality models (GS 1.5°, GS <2.0° and GS 2.0°) vs. European corporates' de-carbonization targets-based pathways
Carbon intensity for energy sold (gCO2eq/MJ)



Source: Company data, Goldman Sachs Global Investment Research

Exhibit 68: Summary of implied temperature rise analysis of European integrated oil & gas producers' de-carbonization targets and historical trajectories

Ticker	Name	Sector	Historical: Projects historical slope at 2020 to 2030 and then interpolates between GS scenarios		Targets: Follows company targets pathway to 2030 and then interpolates between GS scenarios	
			2030	2020-2030 cumulative	2030	2020-2030 cumulative
RDSA.AS	Royal Dutch Shell PLC	Oil & Gas - Integrated	2.04	2.64	1.95	2.76
BP.L	BP PLC	Oil & Gas - Integrated	2.99	>4.0	2.36	3.59
TTEF.PA	TotalEnergies	Oil & Gas - Integrated	1.46	1.47	1.55	1.49
ENI.MI	ENI	Oil & Gas - Integrated	2.42	2.28	1.56	1.50
REP.MC	Repsol	Oil & Gas - Integrated	1.98	2.42	1.53	1.72
EQNR.OL	Equinor	Oil & Gas - Integrated	2.37	2.20	1.50	1.49
OMVV.VI	OMV	Oil & Gas - Integrated	1.50	1.49	1.83	1.61
GALP.LS	Galp	Oil & Gas - Integrated	2.72	3.36	1.73	2.28
		Mean	2.19	2.26	1.75	2.05

Source: Company data, Goldman Sachs Global Investment Research

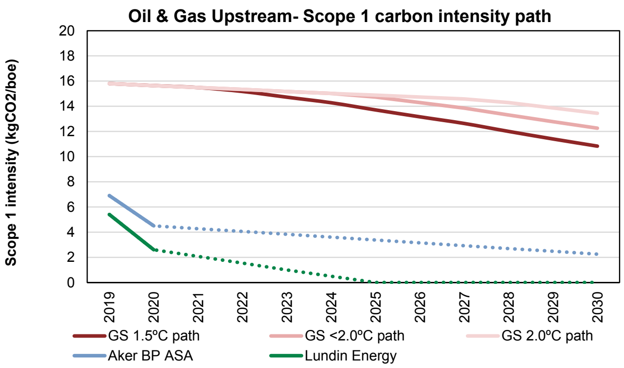
The results of our analysis are presented in Exhibit 67 and Exhibit 68, showing how the current carbon intensity positioning and de-carbonization pathways based on the companies' targets compare to our global carbon intensity scenarios as well as the implied temperature rise associated with these targets. Our results lead us to conclude that the Europe-listed integrated oil & gas producers currently are positioned in aggregate around the global average carbon intensity given the global nature of the operations of these companies. Even for the companies that currently screen as less attractive from their current carbon intensity positioning however, the vast majority of companies have set de-carbonization targets by 2030 that are aligned with 2.0° global warming or less (>80% under the 2030 target point interpolation).

3) Oil & Gas Upstream producers and oil downstream refiners

Oil & gas upstream producers is another homogeneous sector with a clearly defined intensity activity metric, that being the net equity oil & gas production. As part of our bottoms up sectoral global carbon neutrality models (GS 1.5°, GS <2.0° and GS 2.0°) we have modeled both the global oil & gas demand and the path for the global oil & gas production emissions, enabling us to devise the global average carbon intensity measure in kgCO_2/boe for each of our three models. This refers to direct Scope 1 net equity emissions carbon intensity. We note that this is very different from the approach taken for integrated oil & gas producers, where Scope 3 emissions were included in the analysis. For upstream oil & gas companies the only key activity is considered to be oil & gas production and therefore only Scope 1 emissions associated with that activity were considered. As such, it could be argued that this is a favorable approach for this industry (in comparison to integrated oil & gas producers) and direct comparison of the ITR results between these two industries is not recommended (not comparable in our view).

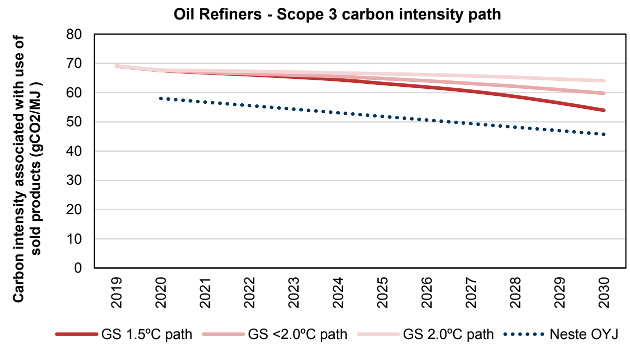
For oil refiners, only one company is in the STOXX 600 and provides sufficient intensity disclosure to be considered in this analysis (Neste). The activity metric for this sub-sector is the carbon intensity of the energy associated with use of sold products (includes scope 3). Neste screens well compared to the global oil refiners intensity given the bio-energy focus of the company.

Exhibit 69: European upstream oil & gas producers are global leaders in low carbon oil & gas production, with a carbon intensity per barrel produced that is less than half the global average...
Scope 1 carbon intensity (kgCO2/boe)



Source: Company data, Goldman Sachs Global Investment Research

Exhibit 70: ...whilst in oil downstream, Neste also appears aligned with the 1.5 degrees path
Carbon intensity associated with use of sold products (gCO2/MJ)



Source: Company data, Goldman Sachs Global Investment Research

Exhibit 71: Summary of implied temperature rise analysis of European upstream oil & gas producers and downstream oil refiners' de-carbonization targets and historical trajectories

			Historical: Projects historical slope at 2020 to 2030 and then interpolates between GS scenarios		Targets: Follows company targets pathway to 2030 and then interpolates between GS scenarios	
Ticker	Name	Sector	2030	2020-2030 cumulative	2030	2020-2030 cumulative
AKERBP.OL	Aker BP ASA	Oil & Gas - Upstream	1.20	1.23	1.26	1.27
LUNE.ST	Lundin Energy	Oil & Gas - Upstream	1.20	1.21	1.20	1.22
		Mean	1.20	1.22	1.23	1.25
NESTE.HE	Neste Oyj	Oil Refiners			1.45	1.45

Source: Company data, Goldman Sachs Global Investment Research

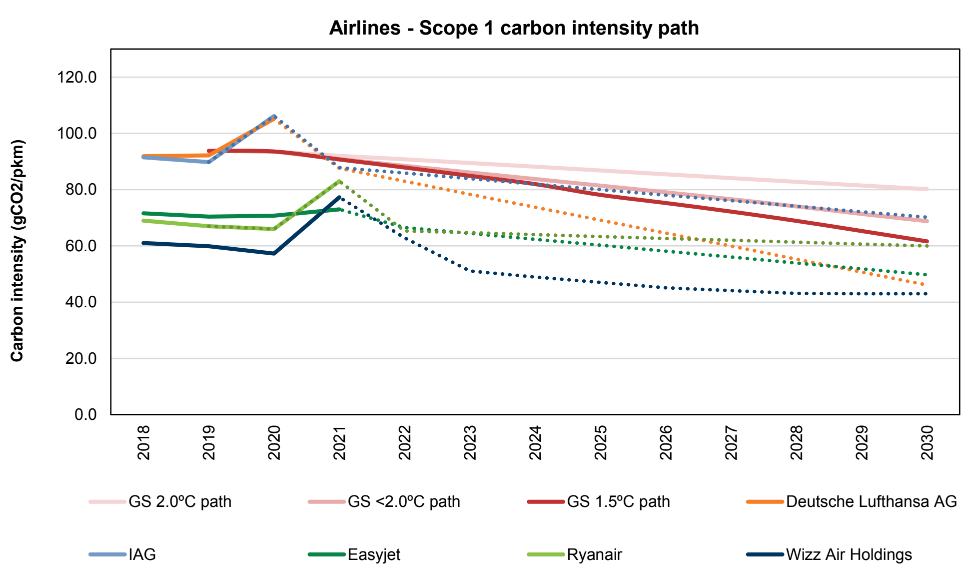
4) Airlines

As part of our bottoms up sectoral global carbon neutrality models (GS 1.5°, GS <2.0° and GS 2.0°) we have modeled both the global aviation industry's activity (passenger kilometers for passenger aviation, tkm for freight) as well as its technological (fuel) mix, enabling us therefore to devise the global emissions from the aviation industry and subsequently the global average carbon intensity measure in gCO_2/pkm over time for each of the three temperature alignment models. This refers to direct Scope 1 emissions carbon intensity associated with each entity's aircraft fleet. We note that the industry was one of the most impacted by the Covid-19 pandemic and as such we do not consider the 2020 intensities of the companies as representative of their fleet given the notably lower passenger load factors (as shown in Exhibit 72); therefore we have excluded that year from the historical trajectory implied temperature rise analysis of these companies.

Aviation sits at the top of our Carbonomics cost curve, and is one of the toughest sectors to de-carbonize. Sustainable aviation fuels (SAFs), synthetic fuels and improved aircraft efficiency are in our view all key parts of the solution. In the near term, we view that the new generation of aircraft and fleet renewal are likely to achieve the lowest-cost aviation emissions abatement. New generation aircraft, which can burn c.15%-20% less fuel than their predecessors, currently have limited penetration across the global fleet, yet as fuel costs typically account for >25% of airline opex, simplistically assuming a unilateral switch to new gen aircraft could boost airline margins, all else equal. In our GS carbon neutrality models we incorporate all of aircraft efficiency improvements, SAFs, carbon offsets and even synthetic fuels longer-term as potential de-carbonization levers.

Exhibit 72: European airlines have set ambitious de-carbonization targets as they step up their efforts in de-carbonization

Airlines' Scope 1 carbon intensity (gCO2/pkm)



Source: Company data, Goldman Sachs Global Investment Research

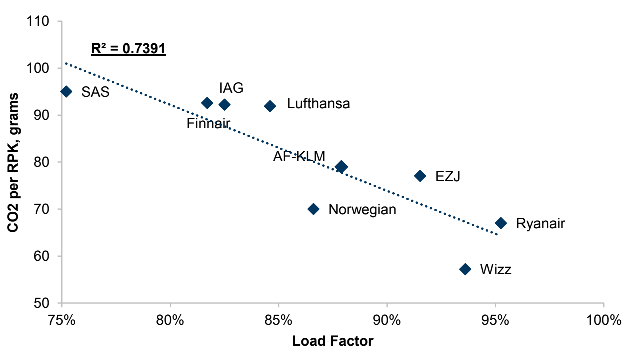
Exhibit 73: Summary of implied temperature rise analysis of European airlines de-carbonization targets and historical trajectories

			Historical: Projects historical slope at 2020 to 2030 and then interpolates between GS scenarios		Targets: Follows company targets pathway to 2030 and then interpolates between GS scenarios	
Ticker	Name	Sector	2030	2020-2030 cumulative	2030	2020-2030 cumulative
LHAG.DE	Deutsche Lufthansa AG	Airlines	1.89	1.92	1.42	1.47
ICAG.L	IAG	Airlines	1.81	1.78	1.69	1.66
EZJ.L	Easyjet	Airlines	1.49	1.45	1.44	1.43
RYA.I	Ryanair	Airlines	1.51	1.45	1.49	1.45
WIZZ.L	Wizz Air Holdings	Airlines	1.42	1.40	1.41	1.40
		Mean	1.62	1.60	1.49	1.48

Source: Company data, Goldman Sachs Global Investment Research

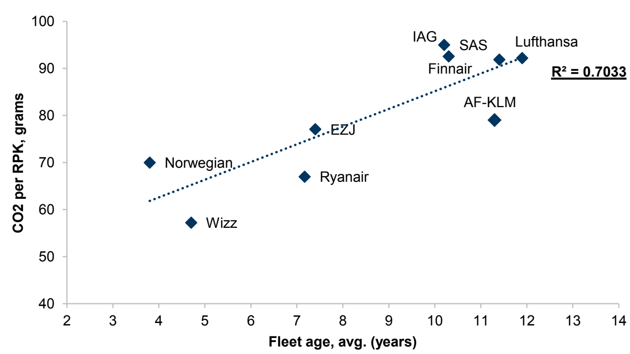
The efficiency levels of all major EU carriers have been improving in recent years as fleet renewal and increasing load factors have reduced CO_2 emissions/RPK. This appears set to continue under ongoing environmental commitments. Looking at current carbon intensity, some airlines appear better positioned than others - primarily Ryanair, Wizz and Easyjet as these stand out as the most efficient in terms of CO_2 emissions/passenger km of the major EU carriers, reflecting young fleets and high load factors, as shown in Exhibit 74 and Exhibit 75. Overall, our implied temperature analysis results (Exhibit 73) indicate that all European airlines' de-carbonization targets are aligned with well below 2°C implied temperature rise, positioning them very well compared to global peers. As mentioned earlier in this report, for corporates which do not have an explicit 2030 carbon intensity reduction target but do have intermediary targets in the timeframe of consideration (2020-30), we assume a linear extrapolation of the trend to that intermediary target forward to 2030. This is the case for Easyjet in this industry for example (which has a near-term target pre-2025 but not a 2030 - we simply linearly extrapolate that trend forward to 2030).

Exhibit 74: There appears to be a strong relationship between carbon intensity and passenger load factors...
Load factor % vs. gCO2/RPK, 2019



Source: Company data, Goldman Sachs Global Investment Research

Exhibit 75: ...as well as fleet age as this in turn correlates with fuel efficiency
Fleet age vs. gCO2/RPK, 2019



Source: Company data, Goldman Sachs Global Investment Research

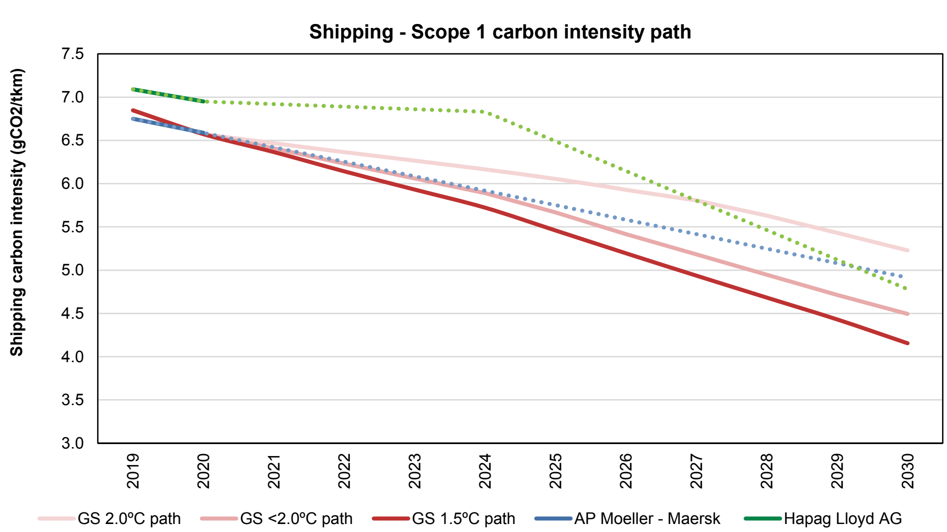
5) Shipping

Marine shipping is responsible for c.0.9 $GtCO_2eq$ (2019), accounting for a similar share of the global CO_2 emissions as aviation. As part of our bottoms up sectoral global carbon neutrality models (GS 1.5°, GS <2.0° and GS 2.0°) we have modeled both the global shipping industry's activity (tonne-kilometers) as well as its technological (fuel) mix, enabling us therefore to devise the global emissions from the shipping industry and subsequently the global average carbon intensity measure in gCO_2/tkm over time for each of the three temperature alignment models. This refers to direct Scope 1 emissions carbon intensity associated with each entity's fleet.

Shipping is another sector with hard-to-abate emissions given a lack of widespread adoption of the available low-carbon de-carbonization technologies at scale and the relatively long operating life of vessels. Similar to aviation, we expect gradual emissions reduction this decade, accelerating thereafter, as alternative fuels become more widely adopted. Amongst these is liquefied natural gas (LNG), which whilst not a zero-emitting fuel, can play a key role as a transition fuel for the shipping sector. Longer term, we expected advanced biofuels, and clean ammonia, methanol and hydrogen to play a larger role as the ultimate de-carbonization technologies for the sector.

The two companies considered in this analysis both have de-carbonization targets that broadly align with 2.0°C of implied temperature rise despite the sector being one of the most challenging to de-carbonize in the near term given the lack of large-scale, commercial net zero alternatives at present.

Exhibit 76: Shipping is one of the toughest industries to de-carbonize in the near term given the lack of large-scale, economic net zero de-carbonization alternatives
Marine shipping scope 1 carbon intensity (gCO2/tonne-km)



Source: Company data, Goldman Sachs Global Investment Research

Exhibit 77: Summary of implied temperature rise results of European maritime shipping companies' de-carbonization targets and historical trajectories

			Historical: Projects historical slope at 2020 to 2030 and then interpolates between GS scenarios		Targets: Follows company targets pathway to 2030 and then interpolates between GS scenarios	
Ticker	Name	Sector	2030	2020-2030 cumulative	2030	2020-2030 cumulative
MAERSKb.CO	AP Moeller - Maersk	Shipping	1.50	1.50	1.85	1.79
HLAG.DE	Hapag Lloyd	Shipping	2.49	2.54	1.79	2.19
		Mean	1.99	2.02	1.82	1.99

Source: Company data, Goldman Sachs Global Investment Research

6) Auto manufacturers

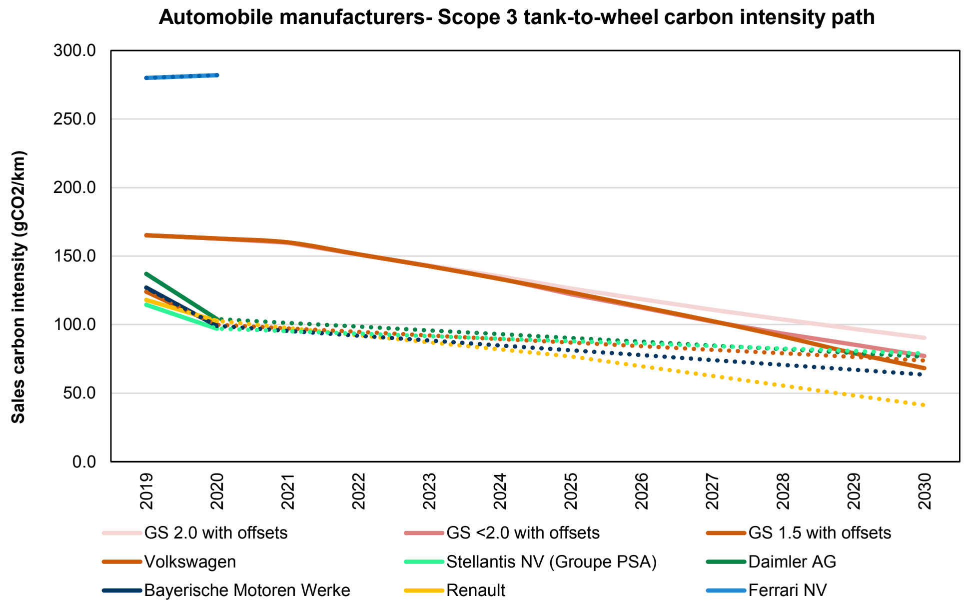
We believe road transport is at the start of its most significant technological change in a century, with electrification, autonomous driving and clean hydrogen at the core of the de-carbonization challenge. For light duty vehicles (LDVs) transport (primarily constituting passenger vehicles, commercial vehicles and short/medium-haul trucks), we consider electrification the key de-carbonization technology. For long-haul heavy trucks, we consider clean hydrogen a competitive option owing to its faster refueling time, lower weight and high energy content.

As part of our bottoms up sectoral global carbon neutrality models (GS 1.5°, GS <2.0° and GS 2.0°) we have modeled both the global LDVs industry's sales as well as its technological mix, enabling us therefore to devise the overall mix of the global LDVs fleet over time and the associated global emissions from the industry. **For this sector we primarily focus on Scope 3 use-phase emissions of auto sales given this contributes to the majority of the industry's emissions (as shown in Exhibit 45).** We therefore look at the average carbon intensity in units of gCO_2/km for the entities' sales.

We note that **our GS carbon intensity paths for this sector include all types of LDVs** (which includes passenger vehicles, vans, commercial vehicles and light-duty trucks) **and are therefore reflecting the global LDVs sales' carbon intensity. However, due to lack of consistent corporate disclosure for the global LDV sales carbon intensity of these companies, the corporate carbon intensity paths shown in Exhibit 78 below only refer to passenger vehicle EU sales' (not global) carbon intensity for all companies,** therefore making auto manufacturers' carbon intensity pathways not directly comparable with the GS net zero ones. Nonetheless, as European passenger vehicles sales form a notable part of their business we decided to run the analysis, bearing in mind that the **overall implied temperature rise result will not be representative of the companies' global operations.**

Exhibit 78: The use-phase carbon intensity of European auto manufacturers' passenger vehicle sales in Europe screens attractively compared to the global average but an update of targets to reflect the companies' latest strategies may be required

Auto manufacturers Scope 3 use-phase emissions intensity (gCO2/km) for EU passenger vehicles sales vs. our GS LDVs global paths



* Use-phase carbon intensity for the European passenger vehicle sales of auto manufacturers (not total LDVs and not global). ** For Stellantis NV we use the Groupe PSA intensity (historical) and targets given the recently formed company.

Source: Company data, Goldman Sachs Global Investment Research

The results of our implied temperature analysis (Exhibit 78 and Exhibit 79) show that all European auto manufacturers' (with the exception of Ferrari) tank-to-wheel intensity currently is well below the global average. This is in line with our expectations given we only consider the intensity of passenger car sales in Europe, a region that is one of the leaders in road transport de-carbonization. Moreover, the targets of the companies appear to be conservative, both relative to our GS global LDVs fleet de-carbonization pathways but also compared to the historical trajectory of carbon intensity for some of the companies. We believe this is mostly the result of outdated **targets which do not fully reflect the latest strategy announced by the companies** - notable examples include Daimler where the latest target announced from 2019 does not yet consider the recent strategic shift to EVs (July 2021) with a 50% EV global sales share by 2025 and to be all-electric by 2030 (where market conditions allow). Similarly, Ferrari has re-iterated its ambition to increase the share of hybrid vehicles in its sales mix in the coming years yet no explicit target on use-phase intensity was provided.

Exhibit 79: Summary of implied temperature rise results of European auto manufacturers' de-carbonization targets and historical trajectories

Ticker	Name	Sector	Historical: Projects historical slope at 2020 to 2030 and then interpolates between GS scenarios — 2030	Historical — 2020-2030 cumulative	Targets: Follows company targets pathway to 2030 and then interpolates between GS scenarios — 2030	Targets — 2020-2030 cumulative
VOWG_P.DE	Volkswagen	Auto Manufacturers	1.36	1.37	1.61	1.42
STLA.MI	Stellantis NV	Auto Manufacturers	1.61	1.42	1.70	1.43
DAIGN.DE	Daimler AG	Auto Manufacturers	1.42	1.39	1.64	1.43
BMWG.DE	Bayerische Motoren Werke	Auto Manufacturers	1.25	1.34	1.50	1.41
RENA.PA	Renault	Auto Manufacturers	1.88	1.44	1.40	1.39
RACE.MI	Ferrari NV	Auto Manufacturers	>4.0	>4.0	-	-
		Mean	1.92	1.83	1.57	1.42

Source: Company data, Goldman Sachs Global Investment Research

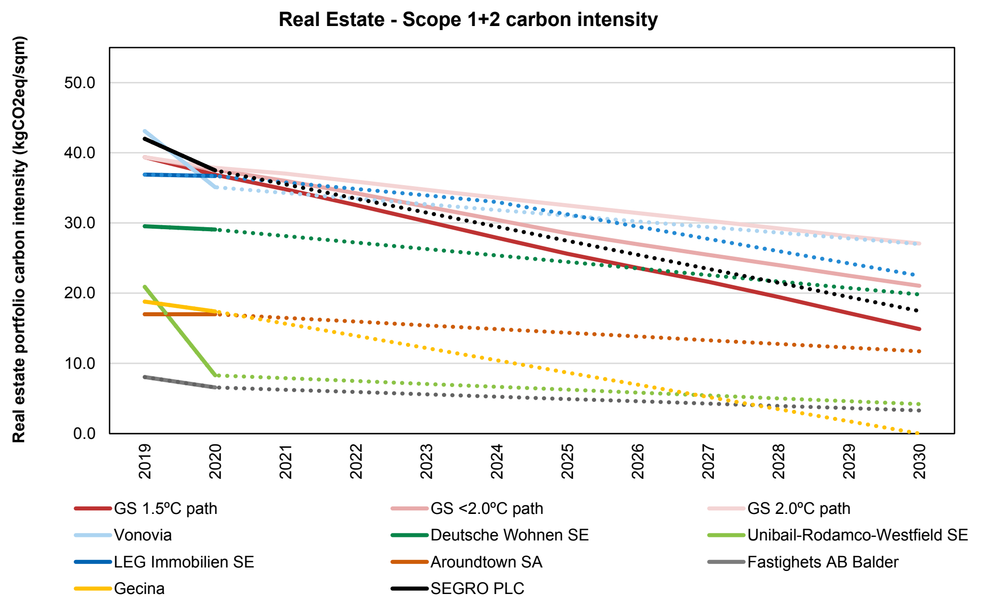
7) Real Estate

Direct carbon emissions from buildings, both residential and commercial, in 2019 accounted for c.8-9% of total global CO_2 emissions, primarily attributed to the use of fossil fuels for space and water heating (natural gas and oil predominantly). As part of our bottoms up sectoral global carbon neutrality models (GS 1.5°, GS <2.0° and GS 2.0°) we have modeled the global emissions from buildings, including both direct and indirect (through the power generation mix), and subsequently the global average carbon intensity of the industry in $kgCO_2eq/sqm$ over time for each of the three temperature alignment models. **This refers to Scope 1 and 2 emissions carbon intensity associated with each corporate's portfolio** (primarily energy-related). Whilst for other sectors we tried to include all corporates of that industry in STOXX 600 (provided there was sufficient and consistent intensity and targets disclosure to enable our analysis), for real estate we have restricted the corporate universe considered in this analysis to only corporates with >US$10 bn market capitalization (the largest corporates in the sector) due to the very wide range of real estate stocks/REITs listed in STOXX 600.

We note that the European real estate corporates included in our analysis have a broad range of portfolios (some more residential and others more commercial focused) and a broad range of geographical exposures, which may help explain the difference in the starting carbon intensity between them (in general we prefer to look at location-based Scope 2 unless the carbon intensity and targets disclosed by the companies were explicitly based on market-based Scope 2 emissions). More broadly, the European real estate companies' targets included in our analysis screen well in terms of implied temperature rise, as shown in Exhibit 80 and Exhibit 81, with all of them being consistent with 2.0°C of global warming or less.

Exhibit 80: European real estate companies screen well compared to our GS global carbon neutrality paths, with all corporates having set targets that are broadly aligned with 2 degrees implied temperature rise or less

Real estate scope 1+2 carbon intensity (kgCO2eq/sqm)



* For Vonovia we present and do our analysis on the basis of the carbon intensity of the company's German portfolio for which they have set explicit de-carbonization targets (and which represents the majority of the company's portfolio) ** For SEGRO intensity based on operational influence portfolio. ***For Aroundtown the intensity shown is the net intensity (given our own pathways include carbon offsets). ****Gecina's intensity includes also partially scope 3 to account for the tenants' energy emissions (as disclosed by company).

Source: Company data, Goldman Sachs Global Investment Research

Exhibit 81: Summary of implied temperature rise results for European real estate companies' de-carbonization targets and historical trajectories

			Historical: Projects historical slope at 2020 to 2030 and then interpolates between GS scenarios		Targets: Follows company targets pathway to 2030 and then interpolates between GS scenarios	
Ticker	Name	Sector	2030	2020-2030 cumulative	2030	2020-2030 cumulative
VNAn.DE	Vonovia	Real Estate	1.20	1.30	2.00	1.85
DWNG.DE	Deutsche Wohnen SE	Real Estate	1.42	1.43	1.62	1.48
URW.AS	Unibail-Rodamco-Westfield SE	Real Estate	1.20	1.21	1.28	1.27
LEGn.DE	LEG Immobilien SE	Real Estate	2.44	2.32	1.73	1.80
AT1.DE	Aroundtown SA	Real Estate	1.55	1.40	1.44	1.37
BALDb.ST	Fastighets AB Balder	Real Estate	1.20	1.22	1.27	1.26
SGRO.L	SEGRO PLC	Real Estate	1.42	1.48	1.56	1.58
GFCP.PA	Gecina	Real Estate	1.27	1.32	1.20	1.30
		Mean	1.46	1.46	1.51	1.49

Source: Company data, Goldman Sachs Global Investment Research

8) Steel

The iron & steel industry accounts for c.2.6 $GtCO_2$ of total emissions (2019), the single highest emitter among industrial sub-sectors. However, a combination of fuel switches, circular economy and innovative process routes can aid the low-carbon transition path for these ferrous alloys. As part of our bottoms up sectoral global carbon neutrality models (GS 1.5°, GS <2.0° and GS 2.0°) we have modeled both the global steel industry's activity (tonnes production) as well as its global emissions and have subsequently derived the global average carbon intensity measure in $tnCO_2$/tn steel over time for each of the three temperature alignment models. This refers to Scope 1 and 2 emissions carbon intensity associated with each entity's steel production. It is worth noting that we have tailored our GS carbon intensity pathways to reflect the corporates' production mix (2019) of primary vs. scrap steel, assuming that this mix remains constant over time. This is why, as shown in Exhibit 83, each steel company is compared to its own tailored steel carbon intensity reduction pathways. We acknowledge that there exists some uncertainty around the starting steel carbon intensity, particularly for primary steel given the lack of data availability from all global steel producers - for the purpose of our intensity paths and this analysis we assume a starting primary steel carbon intensity which is broadly in line with Worldsteel's and IEA's estimated current primary steel carbon intensity.

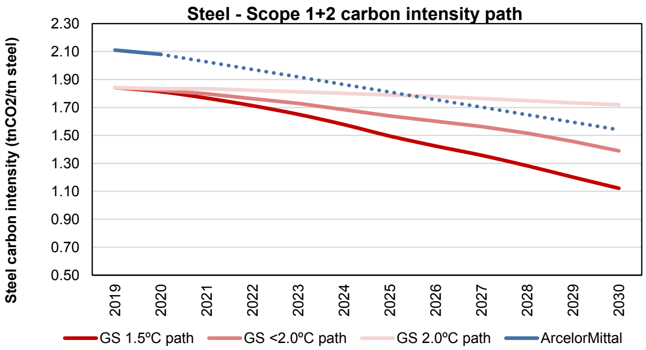
Overall, our results indicate that whilst the historical carbon intensity trajectory of these steel companies would imply a temperature rise above 2° (historical columns in Exhibit 82), the corporates have set ambitious targets which in fact position them on aggregate in line with an implied temperature rise well below 2°, implying a notable acceleration of de-carbonization initiatives and increasing focus and engagement from corporates in this sector. SSAB, Voestalpine and Thyssenkrupp all screen very well in this analysis.

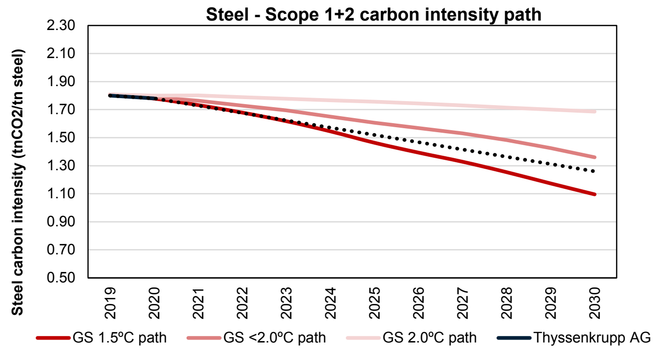
Exhibit 82: Summary of implied temperature rise analysis results for European steel companies' de-carbonization targets and historical trajectories

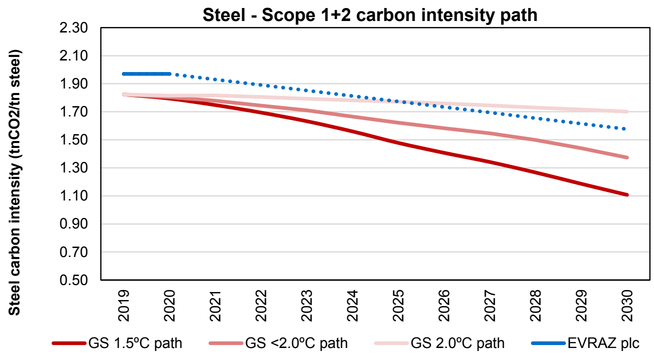
			Historical: Projects historical slope at 2020 to 2030 and then interpolates between GS scenarios		Targets: Follows company targets pathway to 2030 and then interpolates between GS scenarios	
Ticker	Name	Sector	2030	2020-2030 cumulative	2030	2020-2030 cumulative
MT.AS	ArcelorMittal	Steel	2.24	2.53	1.81	2.06
EVRE.L	EVRAZ plc	Steel	2.09	2.26	1.87	2.01
TKAG.DE	Thyssenkrupp AG	Steel	1.99	1.95	1.59	1.56
VOES.VI	voestalpine	Steel	2.08	2.01	1.58	1.54
SSABa.ST	SSAB AB	Steel	1.63	1.49	1.52	1.47
		Mean	2.01	2.05	1.67	1.73

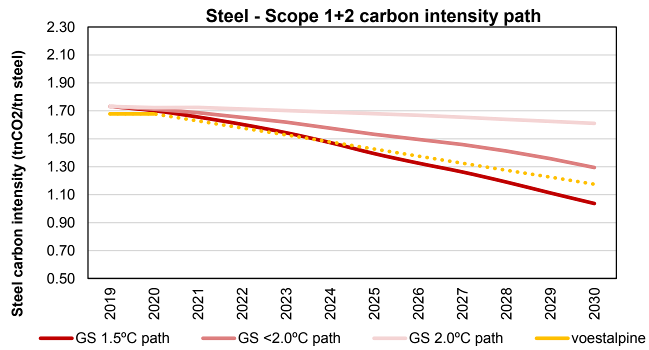
Source: Company data, Goldman Sachs Global Investment Research

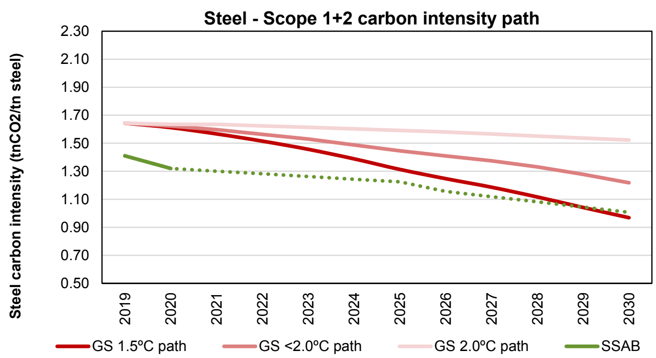
Exhibit 83: Depending on the European steel companies' primary vs. scrap steel production mix (2019), the pathway against which they are compared is adjusted to reflect that production mix over time
Steel carbon intensity (tnCO2/tn steel)











Source: Company data, Goldman Sachs Global Investment Research

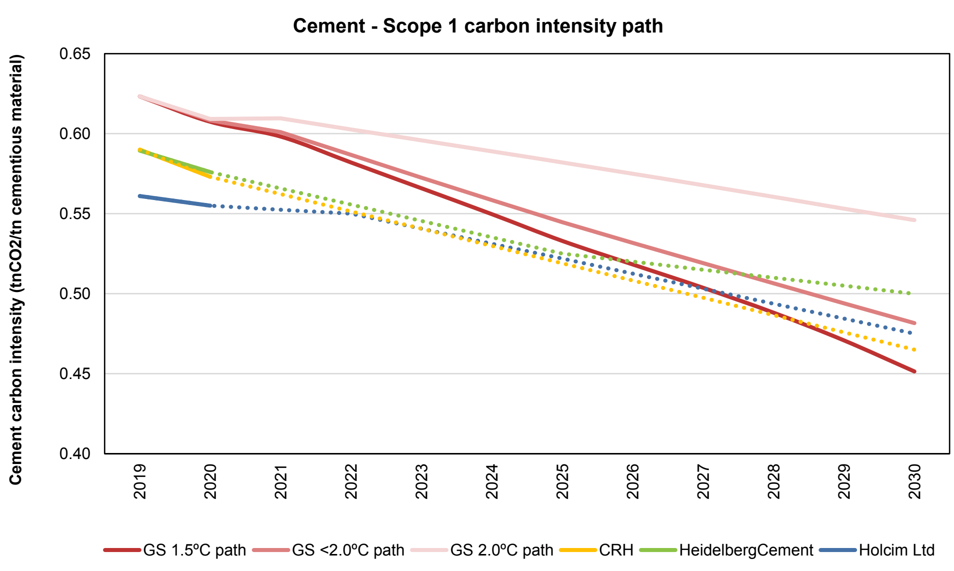
9) Construction materials

Construction materials, and in particular the production of cementious products, is the second most highly emitting industrial sub-sector with a tonne of cement today having an average carbon intensity of around 0.6 $tnCO_2$/tonne, largely attributed to the emissions associated with the raw materials and processes involved. Energy emissions account for <40% of the total direct emissions of the cement industry, in contrast to other key emitting heavy industries such as steel and chemicals (where energy emissions account for >80% of total direct emissions), making its de-carbonization harder to achieve through basic fuel switching. Cement is the binding agent for concrete, one of the key inputs to the construction industry which is itself one of the highest emitting global industries on a Scope 1 basis.

As part of our bottoms up sectoral global carbon neutrality models (GS 1.5°, GS <2.0° and GS 2.0°) we have modeled the global emissions from the cement industry as well as the industry's activity (production) and subsequently we were able to devise the global average carbon intensity of the industry in $tnCO_2$/tn cementious material produced over time for each of the three temperature alignment models. This refers to Scope 1 emissions carbon intensity associated with each corporate's cementious products. In general, European cement producers' current carbon intensity positions them below the global average and they, in their vast majority, have set very ambitious targets that have, according to our analysis, an implied temperature rise well below 2°C and close to 1.5°C.

Exhibit 84: European cement producers have on aggregate set targets with an implied temperature rise that is well within 2 degrees

Scope 1 carbon intensity for cementious material (tnCO2/tn cementious material)



Source: Company data, Goldman Sachs Global Investment Research

Exhibit 85: Summary of implied temperature rise results for European cement companies' de-carbonization targets and historical trajectories

Ticker	Name	Sector	Historical: Projects historical slope at 2020 to 2030 and then interpolates between GS scenarios		Targets: Follows company targets pathway to 2030 and then interpolates between GS scenarios	
			2030	2020-2030 cumulative	2030	2020-2030 cumulative
HOLN.S	Holcim Ltd	Construction Materials	1.70	1.49	1.62	1.49
HEIG.DE	HeidelbergCement	Construction Materials	1.60	1.49	1.75	1.50
CRH.I	CRH	Construction Materials	2.14	1.91	1.57	1.49
		Mean	1.81	1.63	1.64	1.49

Source: Company data, Goldman Sachs Global Investment Research

10) Aluminium

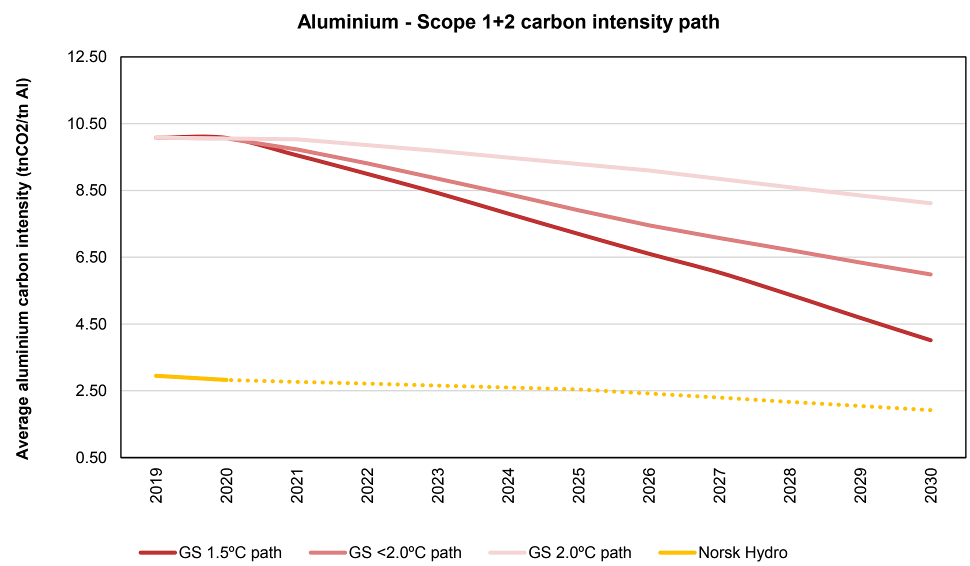
Aluminium is a key input required to produce decarbonizing technologies including potential EVs and solar power, yet its own production is very carbon intensive, leading to what our commodities analysts refer to as the 'aluminium paradox'. As part of our bottoms up sectoral global carbon neutrality models (GS 1.5°, GS <2.0° and GS 2.0°) we have modeled the global emissions from the aluminium industry, both direct and indirect (power-related emissions), enabling us to model the global average carbon intensity in tnCO_2/tn aluminium produced over time for each of the three temperature alignment models. This refers to Scope 1 and 2 emissions carbon intensity associated with each corporate's aluminium production. There is only one pure aluminium producer in STOXX 600, Norsk Hydro, and the results of our analysis are therefore presented below for the company. Both Norsk Hydro's current carbon intensity positioning and de-carbonization target screen impressively well compared to the global average, largely attributed to the cleaner power mix the company utilizes for its aluminium activities. The result is not surprising given the strong sustainability focus of the company over the years, as highlighted in our metals and mining analysts' recent report *The race for Green Aluminium*.

Exhibit 86: Summary of implied temperature rise results for European aluminium companies' de-carbonization targets and historical trajectories

Ticker	Name	Sector	Historical: Projects historical slope at 2020 to 2030 and then interpolates between GS scenarios		Targets: Follows company targets pathway to 2030 and then interpolates between GS scenarios	
			2030	2020-2030 cumulative	2030	2020-2030 cumulative
NHY.OL	Norsk Hydro	Aluminium	1.40	1.31	1.35	1.31

Source: Company data, Goldman Sachs Global Investment Research

Exhibit 87: Norsk Hydro, the sole aluminium pure-player in our analysis, screens exceptionally well compared to the global average, largely driven by the company's low carbon power mix
Aluminium carbon intensity (tnCO2/tn aluminium)



Source: Company data, Goldman Sachs Global Investment Research

11) Diversified metals & mining

Whilst diversified miners is considered a 'homogeneous' sector, which as mentioned earlier in the report is defined as one which is largely relying on a single activity metric, that being the tonnes of copper equivalent produced by a company (tnCUeq), this measure is not a simple activity metric to use given it incorporates not only the volumes of metals produced by the entity but also the commodity pricing. Therefore, in order to perform this analysis we had to make a number of assumptions to ensure the comparability of a company's carbon intensity reduction target and our own GS global net zero paths. We have constructed company-tailored carbon intensity paths. In devising those we have assumed the same metal pricing as the corporate under consideration in 2019 (the latest normalized year) such that the denominator (tnCueq) only varies with volumes and not pricing. We have also assumed, for the purpose of simplicity, that the metal production mix of the companies remains constant over time such that the carbon intensity pathway is driven by the emissions reduction pathway of each metal the company produces weighted by its share in the production mix, which we assume remains constant over time. We focus on scope 1 and 2 carbon intensity for the purpose of this analysis and our company-tailored pathways account for the company's production mix and normalized pricing assumed in each company's 2019 disclosed carbon intensity index.

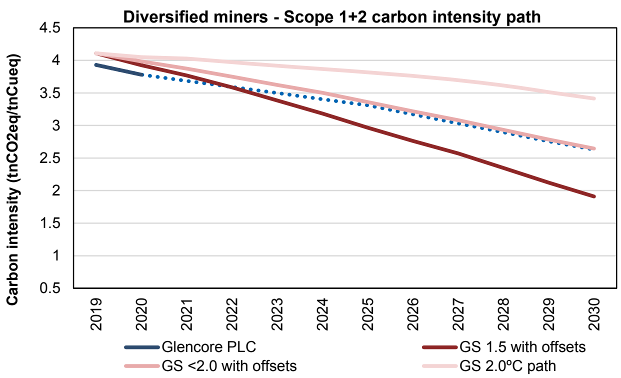
The results of our analysis are presented in Exhibit 89, and as shown include company-tailored set of GS temperature alignment pathways against which each individual corporate is compared. Overall, our results indicate that **diversified miners in STOXX 600 have on aggregate emission intensity reduction targets whose implied temperature alignment is well below 2°C global warming according to our analysis and methodology and in line with the ambitions laid out in the Paris Agreement.** As mentioned earlier, this analysis only accounts for diversified miners' scope 1 and 2 emissions and therefore **does not take into account scope 3 emissions**. Whilst we acknowledge Scope 3 emissions are important for this industry, the very wide and diverse range of activities from which these emissions are derived and the lack of full and thorough breakdown disclosure across all corporates make this analysis challenging.

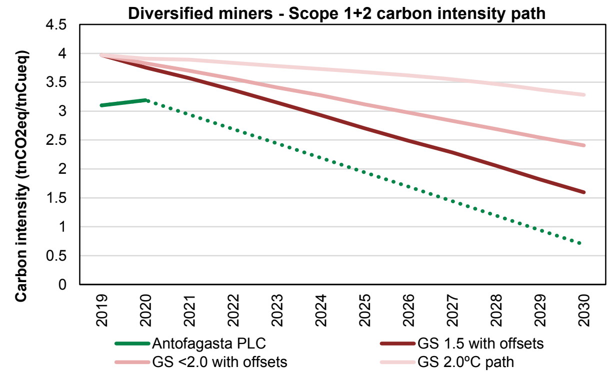
Exhibit 88: Summary of our analysis results for the implied temperature rise of European diversified metals and mining companies' de-carbonization targets and historical trajectories

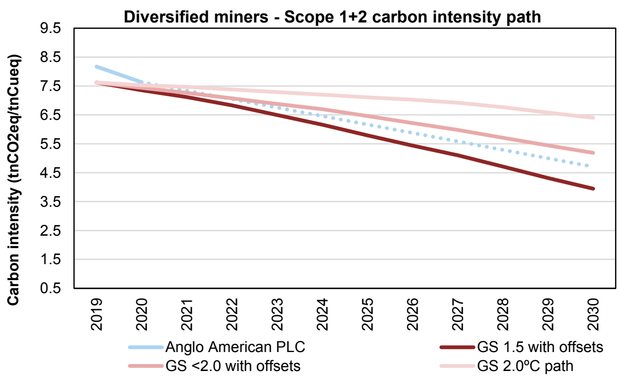
			Historical: Projects historical slope at 2020 to 2030 and then interpolates between GS scenarios		Targets: Follows company targets pathway to 2030 and then interpolates between GS scenarios	
Ticker	Name	Sector	2030	2020-2030 cumulative	2030	2020-2030 cumulative
GLEN.L	Glencore PLC	Diversified miners	1.47	1.48	1.65	1.61
AAL.L	Anglo American PLC	Diversified miners	1.61	1.62	1.59	1.60
ANTO.L	Antofagasta PLC	Diversified miners	1.37	1.43	1.33	1.42
BOL.ST	Boliden	Diversified miners	1.35	1.32	1.39	1.33
BHPB.L	BHP Group Ltd	Diversified miners	1.52	1.47	1.55	1.50
RIO.L	Rio Tinto Ltd	Diversified miners	1.67	1.47	1.56	1.44
		Mean	1.50	1.46	1.51	1.48

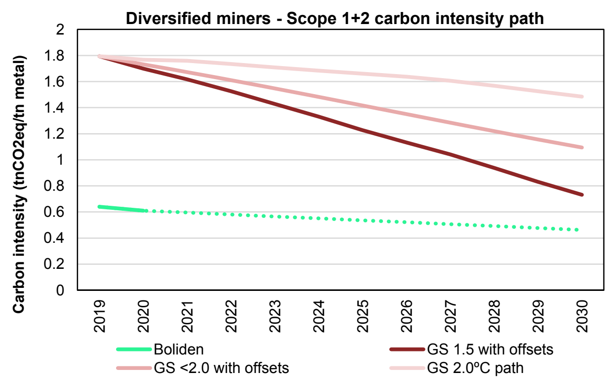
Source: Company data, Goldman Sachs Global Investment Research

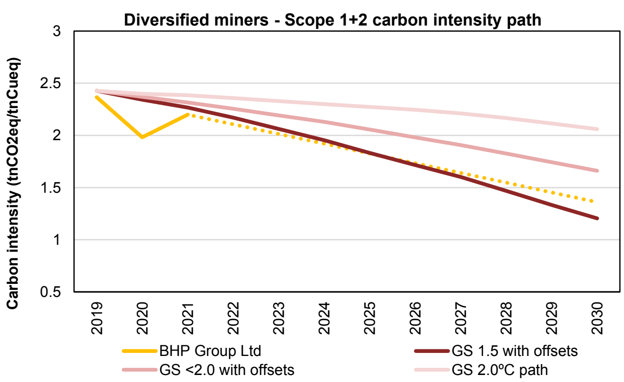
Exhibit 89: We have constructed company-tailored carbon intensity de-carbonization paths for each diversified metals and mining corporate to reflect their specific metals production mix which we assume remains constant over time for the purpose of this analysis
Scope 1 and 2 carbon intensity for diversified miners (tnCO2eq/tnCueq)

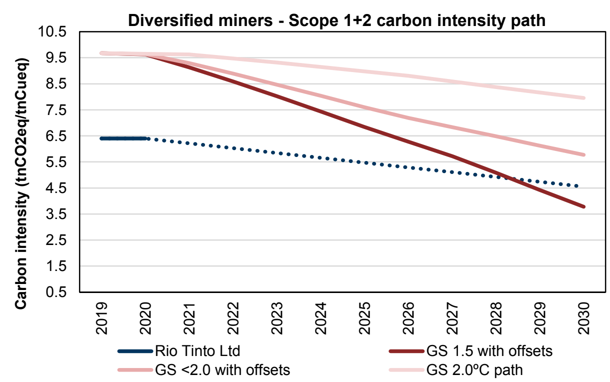












* Boliden discloses carbon intensity per tonne of metal (as opposed to per tonne Cueq) and therefore our GS paths for that company are constructed to be consistent with that.

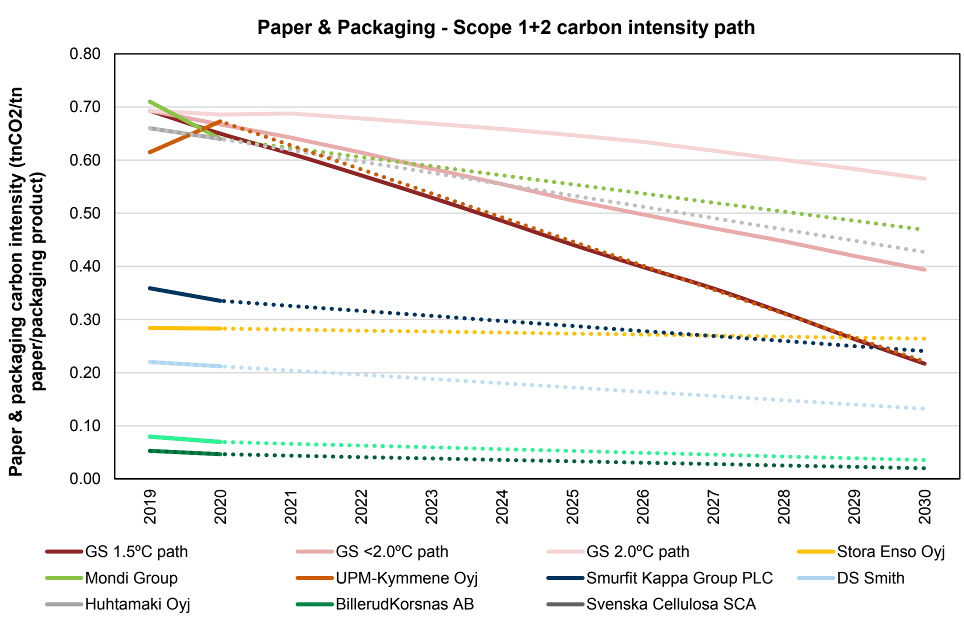
Source: Company data, Goldman Sachs Global Investment Research

12) Paper & packaging

Global paper and paperboard output increased by over 25% between 2000 and 2019 yet the sector has improved over time in terms of both emissions and energy intensity, with energy only rising moderately (about 6% according to the IEA) in that same time period, indicating a decoupling of energy use from production. As part of our bottoms up sectoral global carbon neutrality models (GS 1.5°, GS <2.0° and GS 2.0°) we have modeled the global emissions from the paper and packaging industry, and we view that the increasing use of bioenergy, alternative fuels, ongoing efficiency improvements, offsets and circular economy all play a part in reducing emissions from this industry.

For the purpose of this analysis we focus on Scope 1 and 2 emissions carbon intensity associated with each corporate's paper/packaging products. Scope 2 is a key contributor to emissions for this industry and therefore it is not surprising that the geographical exposure and the energy mix used in the production of these products are key determinants for their carbon intensity. Note that we only include corporates of this sector in STOXX 600 which disclose this carbon intensity over time and have set de-carbonization targets in the timeframe of consideration (to 2030). Our results indicate that on aggregate the European paper & packaging industry has set targets that are in line with an implied temperature rise of 1.5°C, with the corporates broadly split into three categories: (a) bulk paper and packaging producers, (b) more specialized paper and packaging producers, and (c) biogenic paper products producers (such as Svenska Cellulosa - SCA). This differentiation in final paper & packaging products mix could help partially explain the difference in the starting carbon intensity of different corporates as well as the difference in energy mix of each specific company.

Exhibit 90: The European paper & packaging industry screens well in terms of the implied temperature rise of the corporates' de-carbonization targets, with all of them aligning with 2 degrees or below.
Paper & packaging scope 1 and 2 carbon intensity (tnCO2/tn of paper/packaging product)



Source: Company data, Goldman Sachs Global Investment Research

Exhibit 91: Summary of our results for the implied temperature rise of European paper & packaging companies' de-carbonization targets and historical trajectories

			Historical: Projects historical slope at 2020 to 2030 and then interpolates between GS scenarios		Targets: Follows company targets pathway to 2030 and then interpolates between GS scenarios	
Ticker	Name	Sector	2030	2020-2030 cumulative	2030	2020-2030 cumulative
UPM.HE	UPM-Kymmene Oyj	Paper & Packaging	2.22	2.11	1.50	1.51
MNDI.L	Mondi	Paper & Packaging	1.65	1.63	1.80	1.73
STERV.HE	Stora Enso Oyj	Paper & Packaging	1.48	1.37	1.54	1.39
SKG.I	Smurfit Kappa Group PLC	Paper & Packaging	1.39	1.36	1.52	1.40
SMDS.L	DS Smith	Paper & Packaging	1.39	1.32	1.38	1.32
HUH1V.HE	Huhtamaki Oyj	Paper & Packaging	1.61	1.59	1.72	1.66
BILL.ST	BillerudKorsnas AB	Paper & Packaging	1.26	1.23	1.23	1.22
SCAb.ST	Svenska Cellulosa SCA	Paper & Packaging	1.28	1.24	1.25	1.24
		Mean	1.53	1.48	1.49	1.43

Source: Company data, Goldman Sachs Global Investment Research

13) Chemicals

Chemicals is a broad industry including a very large variety of companies involved in the production of commodity petrochemicals, specialty chemicals and products including plastics, fertilisers, pharmaceuticals, explosives, paints, solvents and more. The resulting carbon intensity therefore varies greatly depending on the final product. Whilst looking at the carbon intensity per unit of product produced would had been the preferred carbon intensity metric, lack of such disclosure by corporates in the industry makes the use of an absolute carbon intensity metric difficult. A such, for the purpose of this analysis we consider chemicals as a 'heterogeneous' sector, one that does not have a clearly defined activity metric to be used in a carbon intensity metric. As outlined in the earlier sections of this report, fo**r these sectors, instead of an absolute carbon intensity measure, we have constructed an index for emissions intensity reduction with 2019 being the index's base year** (the latest normalized year). The index is based on **volumes-based Scope 1 and 2 intensity reduction** (reduction in Scope 1 and 2 emissions per tonne of product produced).

There are two key limitations of this approach: (a) Using an index that is rebased to be equal to 1.0 in the base year (2019) implies that the **emissions intensity reduction pathways do not account for the difference in the starting carbon intensity of each corporate** and therefore **do not take into consideration the difference in the historical de-carbonization trajectory of each corporate.** That can be in some case unfair to companies which already started their de-carbonization drive years ago and have already achieved carbon intensity reductions per unit product produced - a clear example in the selected chemicals corporate universe being Covestro. (b) A lot of the companies in the chemicals STOXX 600 corporate universe **have not explicitly set Scope 1 and 2 carbon intensity reduction targets per unit product (volumes-based intensity),** and many also do not have historical carbon intensity per unit product disclosure. **Nonetheless, the vast majority of these companies have set absolute Scope 1 and 2 emission reduction targets**. In these instances, we have used these absolute Scope 1 and 2 emissions reduction targets and **have made an assumption regarding the product volume growth of these corporates (typically between 2-5%**

CAGR to 2030) to convert the absolute emission reduction targets into implied carbon intensity reduction targets per unit product produced.

Exhibit 92: Summary of our results for the implied temperature rise of European chemical companies' de-carbonization targets (index-based sector)

			Targets: Follows company targets pathway to 2030 and then interpolates between GS scenarios	
Ticker	Name	Sector	2030	2020-2030 cumulative
LINI.DE	Linde PLC	Chemicals	1.68	1.69
AIRP.PA	Air Liquide	Chemicals	1.68	1.70
BASFn.DE	BASF SE	Chemicals	1.63	1.73
YAR.OL	Yara International	Chemicals	1.62	1.65
SOLB.BR	Solvay	Chemicals	1.75	1.68
EVKn.DE	Evonik Industries	Chemicals	1.63	1.67
1COV.DE	Covestro	Chemicals	2.06	2.02
AKE.PA	Arkema SA	Chemicals	1.61	1.58
LXSG.DE	Lanxess AG	Chemicals	1.52	1.61
CLN.S	Clariant	Chemicals	1.54	1.59
JMAT.L	Johnson Matthey	Chemicals	1.57	1.66
NZYMb.CO	Novozymes	Chemicals	1.58	1.47
SY1G.DE	Symrise	Chemicals	1.20	1.40
AKZO.AS	Akzo Nobel	Chemicals	1.45	1.49
SIKA.S	Sika	Chemicals	1.53	1.48
CRDA.L	Croda International	Chemicals	1.51	1.55
CORB.AS	Corbion NV	Chemicals	1.89	1.84
GIVN.S	Givaudan	Chemicals	1.39	1.43
VCTX.L	Victrex PLC	Chemicals	1.20	1.38
UMI.BR	Umicore	Chemicals	1.46	1.49
HPOLb.ST	Hexpol	Chemicals	1.30	1.38
DSMN.AS	Koninklijke DSM	Chemicals	1.54	1.59
		Mean	1.56	1.59

Source: Company data, Goldman Sachs Global Investment Research

14) Household & Personal care

Household and personal care is another 'heterogeneous' sector where a carbon intensity measure cannot be derived from a single activity metric across this universe of companies. Our approach is similar to that described for the chemicals sector (see sub-section above), and therefore for household & personal care companies we have **created a Scope 1 and 2 volumes based carbon intensity index (Scope 1 and 2 emissions per ton product produced) which is rebased to 2019** (setting 2019 index value to be equal to 1.0). Whilst we acknowledge that household and personal care is an industry where Scope 3 emissions are a key contributor to the total emissions and carbon footprint of these corporates (as shown in Exhibit 45), the lack of consistent disclosure across companies in the sector and the lack of consistent targets set on these scope 3 emissions led us to exclude them for the purpose of this analysis and rather focus on the Scope 1 and 2 emissions.

Similar to chemicals, there are **three key limitations** of this approach: (a) Using an index that is rebased to be equal to 1.0 in the base year (2019) implies that the **emissions intensity reduction pathways do not account for the difference in the starting carbon intensity of each corporate** and therefore **do not take into consideration the difference in the historical de-carbonization trajectory of each corporate.** That can be in some case unfair to companies which already started their de-carbonization drive years ago and have already achieved carbon intensity reductions per unit product produced. (b) A number of the companies in the household & personal care STOXX 600 corporate universe **have not explicitly set Scope 1 and 2 carbon intensity reduction targets per unit product (volumes-based intensity),** and many also do not have historical carbon intensity per unit product disclosure. **Nonetheless, the vast majority of these companies have set absolute Scope 1 and 2 emission reduction targets**. In these instances, we have used these absolute Scope 1 and 2 emissions reduction targets and **have made an assumption regarding the product volume growth of these corporates (typically between 2-5% CAGR to 2030)** to convert the absolute emission reduction targets into implied carbon intensity reduction targets per unit product produced. (c) Our analysis does not take into consideration Scope 3 emissions, which for this particular industry are key contributors to the total carbon footprint of these corporates. The reason we do not attempt this analysis including Scope 3 emissions is primarily due to the very wide and diverse range of activities from which these Scope 3 emissions are derived from (making the analysis hard to perform, especially in the absence of consistent and thorough Scope 3 emissions breakdown disclosure amongst all corporates).

In general our results for this industry indicate that the **corporates considered in this analysis for the household and personal care industry have on aggregate very ambitious and strong de-carbonization targets with the vast majority of these corporates' targets to 2030 having an implied temperature rise that is consistent with the aspiration 1.5°C pathway**, as shown in Exhibit 93.

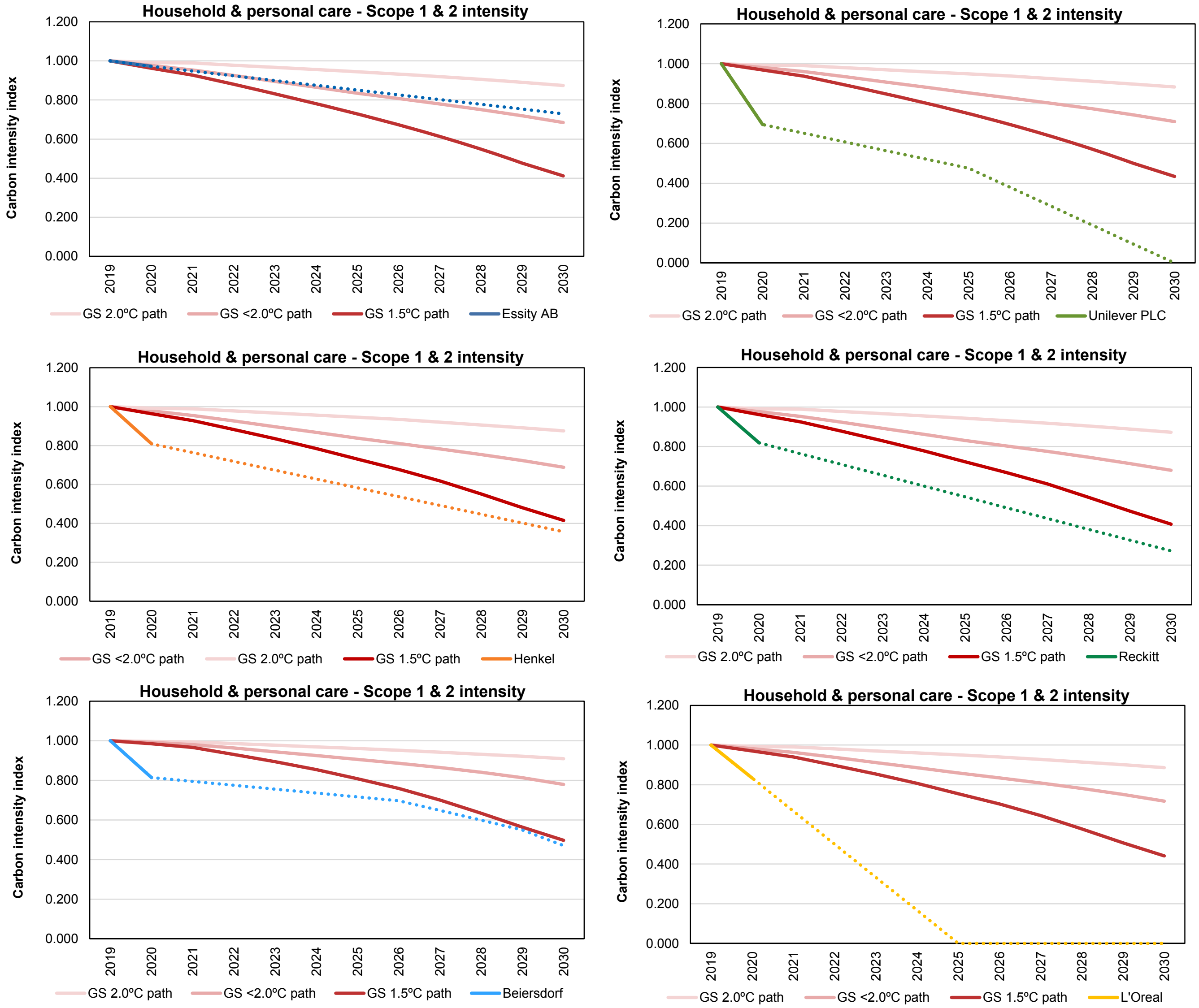
Exhibit 93: Summary of our results for the implied temperature rise of European household & products companies' de-carbonization targets (index-based sector)

			Targets: Follows company targets pathway to 2030 and then interpolates between GS scenarios	
Ticker	Name	Sector	2030	2020-2030 cumulative
ESSITYb.ST	Essity AB	Household & Personal care	1.73	1.70
ULVR.L	Unilever PLC	Household & Personal care	1.20	1.37
HNKG_p.DE	Henkel	Household & Personal care	1.46	1.44
RKT.L	Reckitt	Household & Personal care	1.40	1.43
BEIG.DE	Beiersdorf	Household & Personal care	1.48	1.46
OREP.PA	L'Oreal	Household & Personal care	1.20	1.29
		Mean	1.41	1.45

Source: Company data, Goldman Sachs Global Investment Research

Exhibit 94: We have constructed company-tailored carbon intensity de-carbonization paths for each household & personal care corporate to reflect their specific Scope 1 vs Scope 2 emissions mix for the purpose of this analysis. Our carbon intensity paths are based on Scope 1 and 2 emissions per unit product and are shown as an index with 2019 being the base year

Scope 1 and 2 carbon intensity index (volumes-based with 2019 the base year)



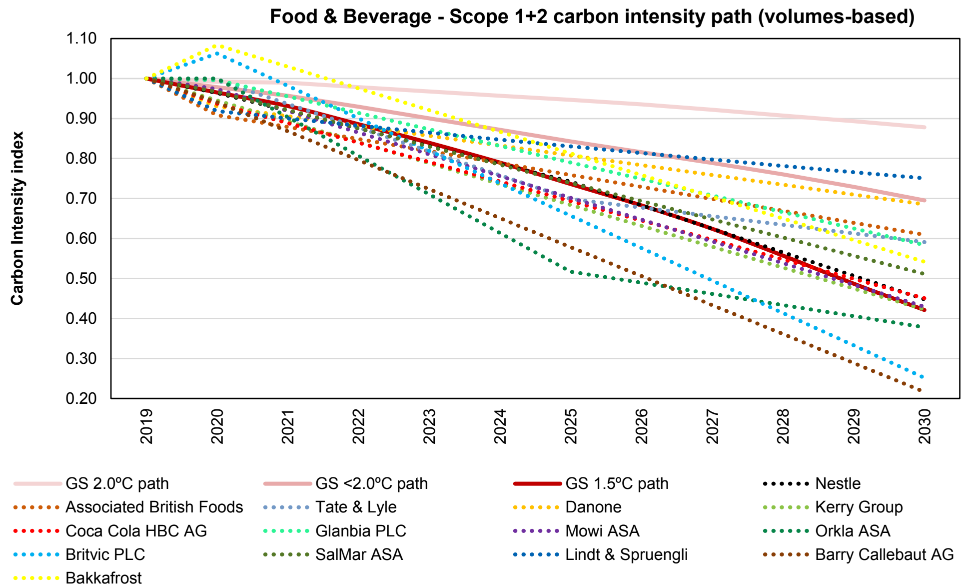
Source: Company data, Goldman Sachs Global Investment Research

14) Food & Beverage

The food & beverage industry, similar to household & personal care, is another 'heterogeneous' sector where a carbon intensity measure cannot be derived from a single activity metric across this universe of companies. Our approach is similar to that described for the chemicals and household & products industries (see sub-sections above), and therefore for food & beverage companies we have **created a Scope 1 and 2 volumes based carbon intensity index (Scope 1 and 2 emissions per ton product produced) which is rebased to 2019** (setting 2019 index value to be equal to 1.0). Whilst we acknowledge that food & beverage is an industry where Scope 3 emissions are a key contributor to the total emissions and carbon footprint of these corporates (as shown in Exhibit 45), the lack of consistent disclosure across companies in the sector, the lack of consistent targets set on these scope 3 emissions and the strong contribution of non-CO_2 emissions (such as methane for agriculture) led us to exclude Scope 3 emissions for the purpose of this analysis and rather focus on the Scope 1 and 2 emissions of these companies.

As mentioned previously, there are **three key limitations** of this carbon intensity index approach: (a) Using an index that is rebased to be equal to 1.0 in the base year (2019) implies that the **emissions intensity reduction pathways do not account for the difference in the starting carbon intensity of each corporate** and therefore **do not take into consideration the difference in the historical de-carbonization trajectory of each corporate.** That can be in some cases unfair to companies which already started their de-carbonization drive years ago and have already achieved carbon intensity reductions per unit product produced. (b) A number of the companies in the food & beverage STOXX 600 corporate universe **have not explicitly set Scope 1 and 2 carbon intensity reduction targets per unit product (volumes-based intensity),** and many also do not have historical carbon intensity per unit product disclosure. **Nonetheless, the vast majority of these companies have set absolute Scope 1 and 2 emission reduction targets**. In these instances, we have used these absolute Scope 1 and 2 emissions reduction targets and **have made an assumption regarding the product volume growth of these corporates (typically between 2-5% CAGR to 2030) to convert the absolute emission reduction targets into implied carbon intensity reduction targets per unit product produced.** (c) Does not take into consideration scope 3 emissions which for this particular industry are key contributors to the total carbon footprint of these corporates. The reason we do not attempt this analysis including Scope 3 emissions is primarily due to the very wide and diverse range of activities from which these Scope 3 emissions are derived from (making the analysis hard to perform, especially in the absence of consistent and thorough Scope 3 emissions breakdown disclosure amongst all corporates).

Exhibit 95: The food & beverage industry screens well in terms of corporate de-carbonization targets, most aligned with well below 2 degrees implied temperature rise based on our analysis and methodology
Food & Beverage corporate universe scope 1 and 2 carbon intensity paths (volumes-based), index with 2019 as the base year



Source: Company data, Goldman Sachs Global Investment Research

Exhibit 96: Summary of our results for the implied temperature rise of European food and beverage companies' de-carbonization targets (index-based sector)

			Targets Follows company targets pathway to 2030 and then interpolates between GS scenarios	
Ticker	Name	Sector	2030	2020-2030 cumulative
NESN.S	Nestle	Food & Beverage	1.51	1.50
ABF.L	Associated British Foods	Food & Beverage	1.60	1.55
TATE.L	Tate & Lyle	Food & Beverage	1.59	1.54
DANO.PA	Danone	Food & Beverage	1.64	1.61
KYGa.I	Kerry Group	Food & Beverage	1.50	1.48
CCH.L	Coca Cola HBC AG	Food & Beverage	1.52	1.49
GL9.I	Glanbia PLC	Food & Beverage	1.59	1.59
MOWI.OL	Mowi ASA	Food & Beverage	1.50	1.49
ORK.OL	Orkla ASA	Food & Beverage	1.47	1.45
BAKKA.OL	Bakkafrost	Food & Beverage	1.57	1.61
BVIC.L	Britvic PLC	Food & Beverage	1.38	1.47
SALM.OL	SalMar ASA	Food & Beverage	1.55	1.52
LISN.S	Lindt & Spruengli	Food & Beverage	1.76	1.64
BARN.S	Barry Callebaut	Food & Beverage	1.35	1.44
		Mean	1.54	1.53

Source: Company data, Goldman Sachs Global Investment Research

** Pricing throughout this report is as of closing of October 22, 2021.*

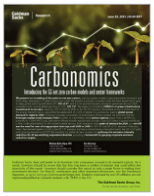
Appendix

Related Research

Carbonomics: Five themes of progress for COP26

24 September 2021

COP26, scheduled to be held in the UK between Oct 31 and Nov 12, is a historical opportunity to accelerate the de-carbonization pledges laid out by COP21 (the Paris agreement) in 2015. The negotiations are likely to focus on climate change-related topics, including ambitious emission reduction targets by country to keep 1.5 degrees of global warming within reach, a framework for global carbon markets including the implementation of Article 6 (Article 6 of the Paris Climate Agreement is designed to enable voluntary international co-operation on climate action.



Introducing the GS net zero carbon models and sector frameworks

23 June 2021

We present our modeling of the paths to net zero carbon, with two global models of de-carbonization by sector and technology, leveraging our Carbonomics cost curve. We present a scenario consistent with the Paris Agreement's goal to keep global warming well below 2°C (GS <2.0°), and a more aspirational path, aiming for global net zero by 2050, consistent with limiting global warming to 1.5°C (GS 1.5°).

Carbonomics: China net zero: The clean tech revolution

Jan 20, 2021

China's pledge to achieve net zero carbon by 2060 represents two-thirds of the c.48% of global emissions from countries that have pledged net zero, and could transform China's economy, starting with the 14th Five-Year Plan. We model the country's potential path to net zero by sector and technology, laying out US$16 tn of clean tech infrastructure investments by 2060 that could create 40 mn net new jobs and drive economic growth.

Carbonomics: Innovation, Deflation and Affordable De-carbonization

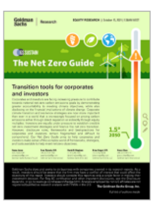
Oct 13, 2020

Net zero is becoming more affordable as technological and financial innovation, supported by policy, are flattening the de-carbonization cost curve. We update our 2019 Carbonomics cost curve to reflect innovation across c.100 different technologies to de-carbonize power, mobility, buildings, agriculture and industry.

Carbonomics: The Rise of Clean Hydrogen

July 8, 2020

Clean hydrogen is gaining strong political and business momentum, emerging as a major component in governments' net zero plans such as the European Green Deal. This is why we believe that the hydrogen value chain deserves serious focus after three false starts in the past 50 years. In this report we analyze the clean hydrogen company ecosystem, the cost competitiveness of green and blue hydrogen in key applications and its key role in Carbonomics: the green engine of economic recovery.



The Net Zero Guide: Transition tools for corporates and investors

October 15 2021

Net zero commitments from corporates and investors have rapidly increased in recent years, with two-thirds of the largest 167 global emitting corporates (responsible for over 80% of global industrial emissions) (CA100+) and over US$88tn in assets having committed to net zero. Despite significant pressure to develop a net zero transition strategy continuing to mount, particularly in the lead up to the 26th UN Climate Change Conference (COP26) this year, existing frameworks are nascent and still evolving.

Green Capex: Making infrastructure happen

11 October 2021

We believe Green Capex will be the dominant driver of global infrastructure over the next decade, with $6 trillion of investment needed annually to decarbonize the world, address water needs and shore up transportation and other critical systems.

Stock Implications:

Investing in Green Capex: Themes and stocks to own (Oct 11, 2021)

Explore our dedicated theme pages: Carbonomics > Green Capex >

Disclosure Appendix

Reg AC

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Growth is based on a stock's forward-looking sales growth, EBITDA growth and EPS growth (for financial stocks, only EPS and sales growth), with a higher percentile indicating a higher growth company. **Financial Returns** is based on a stock's forward-looking ROE, ROCE and CROCI (for financial stocks, only ROE), with a higher percentile indicating a company with higher financial returns. **Multiple** is based on a stock's forward-looking P/E, P/B, price/dividend (P/D), EV/EBITDA, EV/FCF and EV/Debt Adjusted Cash Flow (DACF) (for financial stocks, only P/E, P/B and P/D), with a higher percentile indicating a stock trading at a higher multiple. The **Integrated** percentile is calculated as the average of the Growth percentile, Financial Returns percentile and (100% - Multiple percentile).

Financial Returns and Multiple use the Goldman Sachs analyst forecasts at the fiscal year-end at least three quarters in the future. Growth uses inputs for the fiscal year at least seven quarters in the future compared with the year at least three quarters in the future (on a per-share basis for all metrics).

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	Rating Distribution			Investment Banking Relationships		
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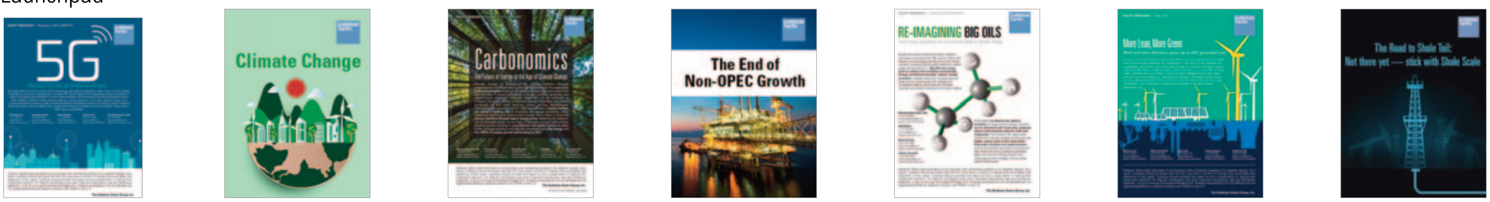

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