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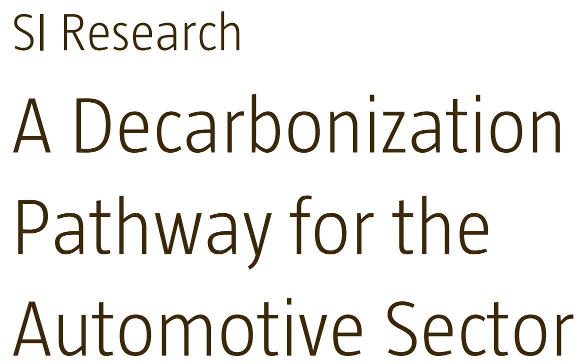

SI Research

A Decarbonization Pathway for the Automotive Sector

Sustainable Investing Expertise by ROBECOSAM

White Paper
For professional investors
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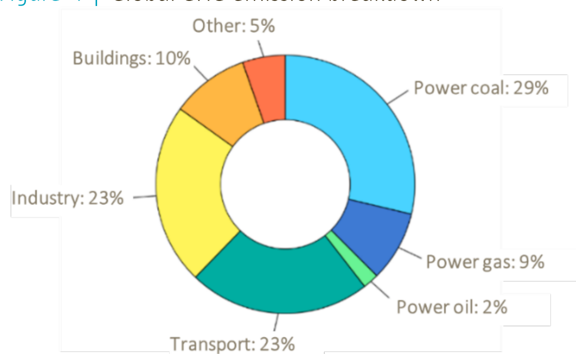
Introduction

Given their outsized share of emissions, passenger vehicles are a critical target for decarbonizing transportation. Decarbonization models are critical tools for helping investors identify sector leaders and laggards in the march to net zero. Building models requires making assumptions across multiple variables that will play out in the future.

The UN Intergovernmental Panel for Climate Change (IPCC) estimates that limiting global warming to around 1.5°C, requires the global economy's greenhouse gas (GHG) emissions to peak by 2025 and decrease by 43% by 2030. As illustrated in Figure 1, with 23% of global GHG emissions, transportation is one of the most polluting economic sectors. Moreover, across all transport segments (which include shipping, aviation, road freight as well as other modes), passenger vehicles are, by far, the worst carbon offenders, contributing to more than half of transportation's GHG emissions[1]. As a result, effectively tackling the climate crisis will mean focused measures to decarbonize the passenger vehicle market.

Figure 1 | Global GHG emission breakdown

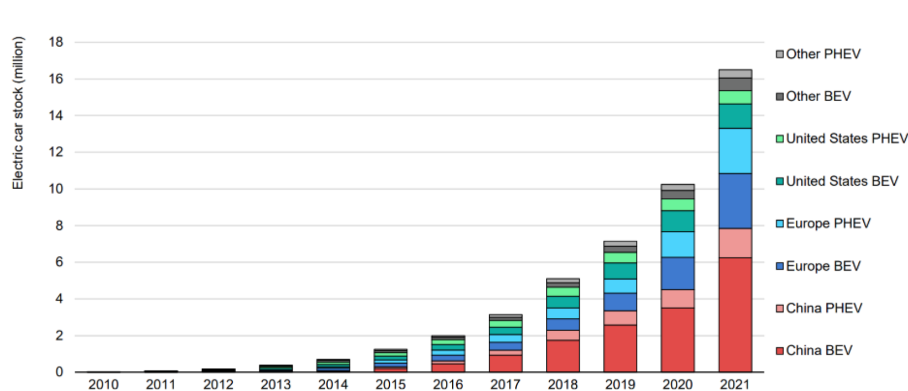


Source: IEA 2021

Recognizing the outsized contribution of passenger vehicles to overall emissions, governments around the world are introducing stricter CO2 emissions on all new car sales. The most sweeping comes from the EU, where member states recently agreed to a 100% emission reduction target by 2035 for all new cars and vans sold. The new rules should bolster production of battery electric vehicles (BEVs) while further hampering internal combustion engines (ICE) supplies[2].

Accelerating regulations and generous purchase incentives combined with increasing consumer preference for climate-neutral products are having the desired effect. In 2021, BEV sales more than doubled, reaching 4.5m units globally, primarily driven by China and the EU (See Figure 2). More importantly, legacy car manufacturers are shifting production from ICEs to BEVs and dedicating more than USD 400bn in capital expenditure (capex) over the next five years to finance the transition[3].

Figure 2 | Global stock of low-emission electric vehicles is rising rapidly



Note: Global electric car stock includes battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs). Figures refer to vehicles classified as passenger light-duty.

"Other" includes Australia, Brazil, Canada, Chile, India, Japan, Korea, Malaysia, Mexico, New Zealand, South Africa and Thailand. "Europe" includes the EU27, Norway, Iceland, Switzerland, and the UK.

Source: IEA 2021, Global Electric Vehicle Outlook 2022

[1] IEA 2021. www.iea.org/data-and-statistics/charts/global-energy-related-co2-emissions-by-sector

[2] Measures are not an outright ban on new internal combustion engine (ICE) sales, as negotiators agreed to draft a proposal to outline how cars that run on CO2-neutral fuels could be sold after 2035.

[3] Hummel et al., UBS, Consumer Survey: EV soaring; ICE melting away, 4th April 2022

Overview – the need for sector decarbonization models

The Automotive Sector Decarbonization Pathway (SDP) is part of a series of proprietary decarbonization pathway models Robeco has developed to inform investors of the risks and challenges faced by companies and sectors across the global economy as they decarbonize their operations and products. SDPs measure the preparedness and comparative position of each sector's constituent companies based on carbon emission reduction targets, capex investments towards low-to-zero-emissions technologies, potential regulatory penalties and other sector-specific criteria. Results help investors more clearly identify sector leaders and laggards based on their overall preparedness for managing the future costs and risks the net-zero transition will inevitably bring.

For each sector, we start by identifying appropriate sector metrics and an emission pathway that allow us to compare and score the decarbonization performance of individual companies against a science-based sector benchmark. Second, we model the costs required to decarbonize and compare these costs with companies' reported investment plans. Finally, we assess potential regulatory fines imposed for failure to hit emission reduction targets.

Model assumptions – what's in scope

For the automotive SDP, we focus on end-use phase emissions (Scope 3) from fuel consumption. Though Scope 3 are indirect emissions (not directly associated with vehicle manufacturing), they represent by far the largest share of emissions across a vehicle's full life cycle. In contrast, Scope 1 emissions from company-owned or controlled plants and Scope 2 emissions generated from the purchase of electricity represent a small share of automaker's overall emissions.

We also assume BEVs will be the low-to-zero emission vehicle of choice among consumers. BEVs have a number of comparative advantages over alternative powertrain technologies including technological maturity, lower cost, and scalability. Our model focuses exclusively on the production of BEVs as the automotive industry's dominant decarbonization strategy and therefore excludes fuel cell electric vehicles (FCEVs) as well as plug-in hybrid electric vehicles (PHEVs)[4]. Our approach is consistent with a wide body of research that indicates FCEVs will only have a limited impact on decarbonization due to lower energy efficiency compared to BEVs in the passenger car market[5]. As for PHEVs, we consider them to be an interim technology that does not appreciably reduce Scope 3 emissions in real-world driving conditions.

Finally, the SDP model developed for the car sector only includes the BEV supply side and excludes demand side considerations. In other words, we assume that demand for BEVs will be sufficient to meet the supply required for decarbonization. Furthermore, the SDP model also excludes factors beyond the control of automakers such as potential battery shortages and the roll-out of charging infrastructure powered with renewable energy.

[5] Source: BNEF, IEA, See Robeco report "Hydrogen: between Hype and hope." 2021. Available on the Robeco website.

The SDP model's components

The SDP model includes three components: a decarbonization score that rates a company's current and future emission reductions pathways against sector peers and an objective sector benchmark; an assessment of a company's credibility and capacity for hitting its own as well as benchmark emission targets; an analysis of the financial impact of stricter regulatory regimes over time.

Decarbonization pathways – defining targets

The Transition Pathway Initiative Global Climate Transition Centre (TPI)[6] has developed several science-based decarbonization pathways for the automotive industry with each based on different temperature scenarios for 2050. We use the most ambitious of these scenarios – the High Efficiency Pathway [7] – to develop customized carbon-reduction pathways for individual automotive companies – the Convergence Pathway.

The Convergence Pathway is calculated by SI research analysts using carbon emission intensity data for each OEM and shows the decarbonization trajectory each should follow in order to eventually align with the High Efficiency Pathway (the sector benchmark) that limits global temperatures to 2°C by 2050.

The Commitment Pathway is the decarbonization trajectory of an individual automaker based on the self-reported emission reduction commitments. They are calculated using interim BEV targets for 2025/2026 or 2030 and longer-term BEV targets (2040-2050).

Figure 3 illustrates all three pathways described above for an illustrative OEM. In order to assess a company's decarbonization performance, we compare its actual emission reduction targets (the OEM Commitment Pathway) with the automotive sector's decarbonization benchmark (the TPI 2°C High Efficiency pathway) that indicates the reduction in emission intensity required of the automotive sector over time through 2050.

The units of decarbonization

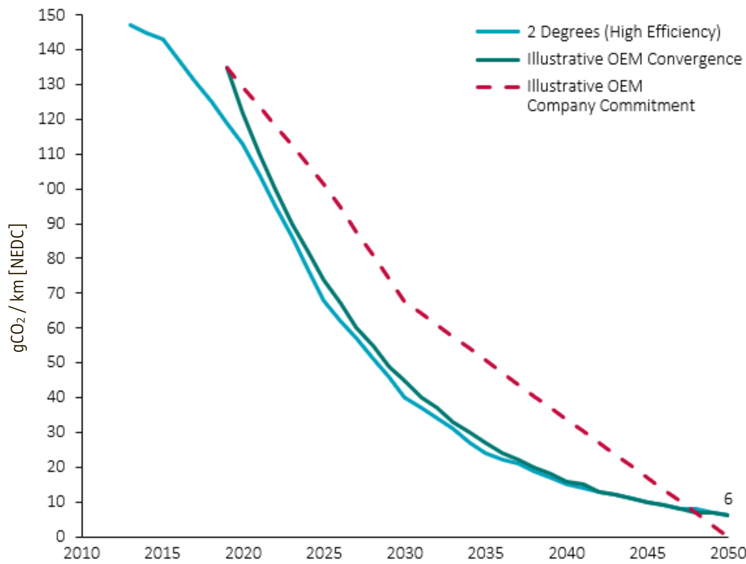
An automakers' decarbonization performance is assessed by tracking the OEMs' end use-phase emission intensity in terms of grams of CO2 emitted per kilometer driven [gCO2/km].

This metric considers the average intensity of all cars sold in a given financial year. Given only end use-phase emissions are considered, BEVs report a carbon intensity of zero gCO2/km.

Using intensities instead of absolute end-use-phase emissions allows us to better compare OEMs with different production capacities.

[6] The TPI Global Climate Transition Centre is an independent source of research and data on corporate progress towards the transition to a low-carbon economy.
[7] The TPI High-Efficiency Pathway on which our Convergence Pathway is modelled assumes a rapid technological shift towards low emission vehicles (e.g., BEVs). Moreover, it is not based on changes in consumer behaviour (e.g., driving less) and therefore places the most responsibility on OEMs for transitioning towards low-emitting vehicles and meeting decarbonization targets.

Figure 3 | Measuring Up – Comparing automaker commitments with required targets



The figure shows the decarbonization trajectories relevant to our analysis. It tracks the average new vehicle emission commitments (measured in grams of CO2 per kilometer driven) of an individual automaker through 2050 (Illustrative OEM Company Commitment) and the path of emission reductions required of the company's vehicles based on science-based calculations (illustrative OEM Convergence).

For comparison, we also include the High-Efficiency pathway, the emissions reduction required to remain below 2°C by 2050. The High Efficiency scenario assumes a rapid adoption of BEVs in society such that average emissions for a new vehicle according to the New European Driving Cycle (NEDC) will fall to 6 grams of CO2 emitted per kilometer (6g CO2/km) by 2050.

Source: Robeco internal model

Measuring performance – Automotive Sector Decarbonization Scores

The results of the benchmarking exercise described above are used to calculate a decarbonization performance score for each automotive OEM. Results help to indicate which companies are the leaders and which are still lagging in terms of decarbonization strategies.

Moreover, when it comes to decarbonization, timing matters. Therefore, when calculating decarbonization scores we assign different weights based on the timing of a company's commitments and actions along its decarbonization pathway (see Table 1).

Table 1: Weights based on commitment timing

Points of reference	Weight
Current intensity	25%
Short-term intensity	20%
Mid-term intensity	45%
Long-term intensity	10%

Source: Robeco internal model

Companies that are aligned with the 2°C High Efficiency Pathway with respect to current performance and are ambitious enough in the short-, mid-, and long-term based on disclosed targets will receive a positive score.

Table 2 summarizes the sector decarbonization scores for selected automotive OEMs and ranks them according to alignment to the TPI's High Efficiency benchmark. Only BEV manufacturers are able to achieve the highest score (10) due to zero tailpipe emissions.

Table 2: Decarbonization scores for selected

OEM	Decarbonization Score
Company 1	1
Company 2	2.6
Company 3	4.1
Company 4	6.4
Company 5	10

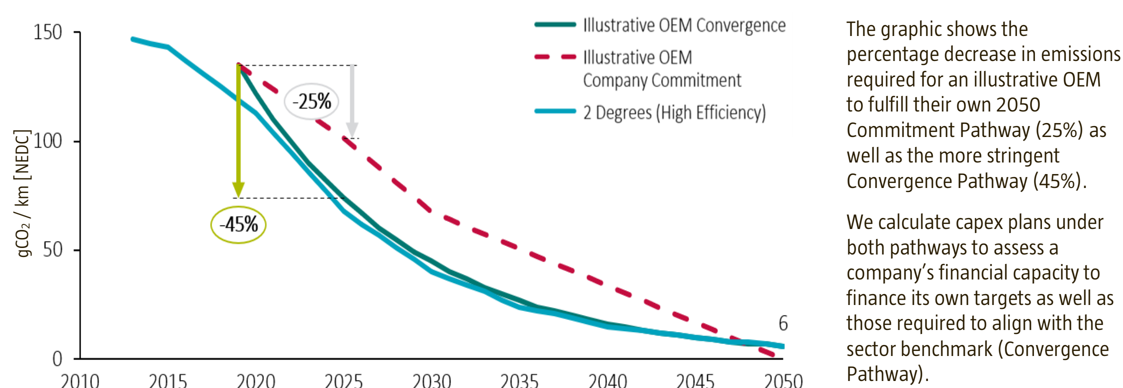
Source: Robeco internal model, (10=highest)

Finally, scores are designed to be comparable across sectors and are calculated based on backward- and forward-looking emission data. In other words, a score of 10 assigned to a steel or automotive company means that these companies are fully aligned with their sector decarbonization pathways. It does not mean that they have the same carbon intensity.

Measuring OEM credibility and capacity – estimated costs vs. planned outlays

Announcements are positive, but true commitment is measured in a company's capex in emission-reducing technologies, namely BEV plants and production platforms. So, in addition to modelling decarbonization pathways, we also assess the capex required to finance those pathways. We calculate the required level of BEV technology financing needed to achieve the company's disclosed decarbonization pathway (the Commitment Pathway) as well as the more ambitious financing required for the company to decarbonize in line with its Convergence Pathway. Comparing the two BEV capex levels with the companies' stated investment plans (announced commitment vs required convergence) reveals individual companies' capex shortfalls (or surpluses) and their capacity for actually achieving emission targets and maintaining their reported decarbonization trajectories (see Figure 4).

Figure 4 | Are companies prepared to finance the drop?



The graphic shows the percentage decrease in emissions required for an illustrative OEM to fulfill their own 2050 Commitment Pathway (25%) as well as the more stringent Convergence Pathway (45%).

We calculate capex plans under both pathways to assess a company's financial capacity to finance its own targets as well as those required to align with the sector benchmark (Convergence Pathway).

Source: Robeco internal model

We have based our calculations on information provided by the companies (as well as estimates in case of insufficient disclosure) in order to assess the total capex outlays necessary to build the required BEV and battery plants, factoring in new and re-tooled manufacturing plants.

Table 3 summarizes our preliminary findings through 2025. A positive number indicates a capex surplus whilst a negative number (in parenthesis) indicates a shortfall. Though it might appear that some automakers are overspending, a capex surplus more likely indicates that they are building out capacity by investing before 2025 in order to reach the medium-term global BEV target.

Based on our SDP calculations and the automakers assessed so far, we conclude that the majority of companies have surplus funding to reach the Commitment Pathway, but the more ambitious Convergence Pathway is underfunded.

Table 3: Measuring OEM capex costs (2022-2025)

OEM	Estimated global capex surplus based on self-reported commitments EUR bn	Estimated capex surplus based on required decarbonization targets EUR bn
	Commitment Pathway	Convergence Pathway
Company 1	0.8	(0.8)
Company 2	1	(5.1)
Company 3	(0.5)	(1.7)
Company 4	5.0	(16.4)
Company 5	7.3	(9.5)

Source: Robeco internal model

A capex surplus increases the credibility of (and decreases the risks to) individual OEMs decarbonization plans; a shortfall reduces credibility and increases risks. Note: Estimates are rounded. Moreover, OEMs mentioned in Table 2 and 3 are not necessarily identical.

Regulations and fines

Automakers must follow carbon emission targets on new car sales which are becoming more stringent with time. Currently, the EU is already one of the strictest jurisdictions globally, imposing emission fines of EUR 95 per excess gram of CO_2 per km. Tighter emission standards not only mean higher capex but also create the potential for higher fines when companies fail to reach targets. In a final step, we estimate potential fines for missing mandated CO_2 targets on new car sales in the EU (See Table 4).

Table 4: Forecasted EU regulatory fines

OEM	Potential EU fines
Company 1	155
Company 2	54
Company 3	0
Company 4	419
Company 5	0

Estimates from 2022-2030. Companies listed in Tables 3 and 4 are the same.

Source: Robeco internal model

Though it may appear contradictory for Company 3 (which is underfunding even its own decarbonization targets by EUR 0.5bn) to not receive fines, it can be explained by the fact that fines are assessed only for the EU region.

Many automakers expect to ramp up BEV production specifically in the EU and as a result avoid EU fines. However, for those less capitalized, more investments in the EU means less is available for funding BEV production in other regions, resulting in a net-negative BEV capex globally. Should international regulatory pressure step up, automakers will be forced to accelerate decarbonization targets, substantially increasing associated capex spending. This could cause significant future cash outflows that should be closely considered by investors.

Outlook and conclusion

A model is only as good as its assumptions. Here we outline structural shifts in policy and financing that are likely to impact our own. We conclude with observations on the current and future state of decarbonization in the automotive sector and how investors can integrate these results into investment analysis.

Robeco's proprietary SDP model attempts to assess OEM decarbonization trajectories based on interim BEV targets, the credibility of those trajectories using capex commitments and the potential for regulatory fines as governments raise emission standards in the run up to 2050.

First, we conclude that most of the automakers assessed in our sample fail to align with 2°C targets. Second, based on OEMs analyzed thus far, the majority of automakers seem to be well funded to reach their own self-reported Commitment pathways but not the required Convergence pathway. However, with the increasing likelihood of regulatory tightening and potential changes to the Convergence benchmark [8], we expect upgrades to their capex plans over time to avoid fines and reputational risks.

The results of the SDP model will be useful for several stakeholders. It allows sustainable investment research analysts to track automotive companies' carbon performance against peers. It also provides fixed-income analysts an additional perspective on company costs, cash generation potential, and creditworthiness. The BEV transition will trigger significant capex. The SDP model provides insights into the adequate capex commitments necessary to succeed in the transition. Additionally, the SDP model estimates potential regulatory fines in the EU. Those inputs can be used to refine cash flow forecasts, which drive the creditworthiness of an automaker.

For equity analysis, the SDP model can be used for valuation purposes. Legacy automakers still generate healthy cash flows from the ICE business which can be deployed to fund their decarbonization targets and net-zero transition. Moreover, many legacy manufacturers have built extensive production platforms, networks of technical expertise and solid supplier and customer relationships — valuable assets that will facilitate a smoother transition.

Nevertheless, most automakers are trading at depressed equity valuation multiples because the market ascribes a low chance of success. Hence, the SDP model serves as a tool to identify automakers which seem to be committing enough capex for the transition and could ultimately benefit from a multiple re-rating. Finally for active ownership, the model provides tangible and quantitative input for climate strategy engagement, helping to prioritize companies with whom to engage.

[8] The SDP model can be adapted to capture more stringent sector-benchmark standards per annum based on revisions to climate change models or OEM behavior.

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The Fund has not been registered with the Superintendencia del Mercado de Valores (SMV) and is being placed by means of a private offer. SMV has not reviewed the information provided to the investor. This document is only for the exclusive use of institutional investors in Peru and is not for public distribution.

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Additional Information for investors with residence or seat in Spain
Robeco Institutional Asset Management B.V., Sucursal en España with identification number W0032687F and having its registered office in Madrid at Calle Serrano 47-14º, is registered with the Spanish Commercial Registry in Madrid, in volume 19.957, page 190, section 8, sheet M-351927 and with the National Securities Market Commission (CNMV) in the Official Register of branches of European investment services companies, under number 24. The investment funds or SICAV mentioned in this document are regulated by the corresponding authorities of their country of origin and are registered in the Special Registry of the CNMV of Foreign Collective Investment Institutions marketed in Spain.

Additional Information for investors with residence or seat in South Africa
Robeco Institutional Asset Management B.V. is registered and regulated by the Financial Sector Conduct Authority in South Africa.

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The Fund(s) are domiciled in Luxembourg. This document is exclusively distributed in Switzerland to qualified investors as defined in the Swiss Collective Investment Schemes Act (CISA). This material is distributed by Robeco Switzerland Ltd, postal address: Josefstrasse 218, 8005 Zurich. ACOLIN Fund Services AG, postal address: Affolternstrasse 56, 8050 Zürich, acts as the Swiss representative of the Fund(s). UBS Switzerland AG, Bahnhofstrasse 45, 8001 Zurich, postal address: Europastrasse 2, P.O. Box, CH-8152 Opfikon, acts as the Swiss paying agent. The prospectus, the Key Investor Information Documents (KIIDs), the articles of association, the annual and semi-annual reports of the Fund(s), as well as the list of the purchases and sales which the Fund(s) has undertaken during the financial year, may be obtained, on simple request and free of charge, at the office of the Swiss representative ACOLIN Fund Services AG. The prospectuses are also available via the website.

Additional Information relating to RobecoSAM-branded funds/services
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Some Funds referred to in this marketing material have been registered with the UAE Securities and Commodities Authority (the Authority). Details of all Registered Funds can be found on the Authority's website. The Authority assumes no liability for the accuracy of the information set out in this material/document, nor for the failure of any persons engaged in the investment Fund in performing their duties and responsibilities.

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Additional Information for investors with residence or seat in Uruguay
The sale of the Fund qualifies as a private placement pursuant to section 2 of Uruguayan law 18,627. The Fund must not be offered or sold to the public in Uruguay, except under circumstances which do not constitute a public offering or distribution under Uruguayan laws and regulations. The Fund is not and will not be registered with the Financial Services Superintendency of the Central Bank of Uruguay. The Fund corresponds to investment funds that are not investment funds regulated by Uruguayan law 16,774 dated September 27, 1996, as amended.

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