



Climate Scenario Analysis

Volkswagen

Report 2019

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Executive Summary

Volkswagen

This report by 2° Investing Initiative provides an assessment of **Volkswagen**'s automotive production by technology, its future alignment with climate transition pathways and evaluates its performance against other automotive companies globally.

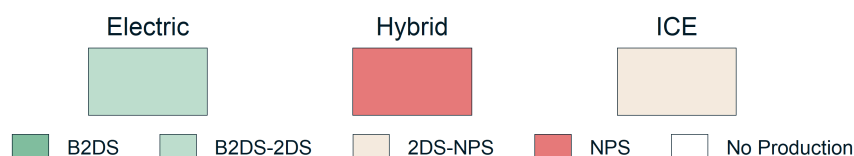
production in 2019

Volkswagen is predicted to build 10,263,834 vehicles with 3.3% coming from low carbon technologies - electric and hybrid. By 2024, it intends to be producing 128,331 additional vehicles (an increase of 1.3%) of which 100% is low carbon.

	Electric	Hybrid	ICE
2019 Production Mix (Vehicles)	149,895	186,481	9,927,457
Planned Additional Production (Vehicles) 2019-2024	660,286	418,172	-950,128

Comparison of production plans with transition scenarios

Volkswagen's planned additional production is compared to the different climate scenarios of the International Energy Agency (IEA) for each technology as described on page 4. The additional production planned by **Volkswagen** aligns it to be between the B2DS and 2DS for Electric vehicle production and to be between the 2DS and RTS for ICE vehicle production.



Changes in production required to align with the B2DS by 2024

In order to align with the Beyond 2° Scenario (B2DS) by 2024, **Volkswagen** would require the following additional changes in production by technology to its current plans by 2024:

	Electric	Hybrid	ICE
2024 Planned Production (Vehicles)	810,182	604,653	8,977,330
Required Changes to Planned Production (Vehicles)	134,609	1,156,266	-1,789,157

Introduction

Key Questions

This climate scenario report addresses five key questions regarding **Volkswagen**'s climate strategy:

1. How does the company's current production mix compare to the automotive market's production mix? (Page 6)
2. How does the company's future vehicle production compare to different climate transition scenarios? (Page 7)
3. How does the company's planned production mix by 2024 compare to the scenario-aligned market? (Page 9)
4. How can the company adjust its production plans to align with the B2DS by 2024? (Page 10)
5. How does the company's climate alignment compare to other automotive companies? (Page 11)

This document solely presents the results of the above analyses. For more information on the methodology, scenarios, underlying data, and limitations, please refer to methodology documentation available at:

www.transitionmonitor.com/company-reports/.

Why is scenario analysis important?

Scenario analysis is highlighted within by the Task Force for Climate-related Financial Disclosures (TCFD) as a recommended tool for understanding the resilience of organization's strategies under different climate related scenarios. It supports both companies and investors in developing action plans as a response to the Paris Agreement.

How does this scenario analysis work?

This scenario analysis is an assessment of the physical assets owned by **Volkswagen** and its plans for future production, based on third party data. The share of responsibility, defined by climate scenarios that outline possible transition pathways, has been allocated to the company according to the regional distribution of its automotive production. Further analyses allow us to understand how **Volkswagen** is currently, and in the future, exposed to climate transition risks and opportunities.

How can it be used?

For **Companies**, this analysis provides a comparison of its performance relative to peers, and an understanding of how climate change responses differ. It also provides an overview of how planned production changes compare to the climate scenarios developed by the International Energy Agency (IEA). It highlights potential areas for action by companies.

For **Investors**, this report may be used to inform their decision making by highlighting the alignment of the trajectories of companies in their portfolio with different climate scenarios and therefore their potential exposure to transition risks. The information provided in this report can support engagement activities with companies and may provide data for reporting requirements.

For **other stakeholders**, such as policy makers or NGOs, this may support the development of guidelines for reporting or research.

What this report doesn't do: this report is not a financial analysis of the company and should not be taken as investment advice.

Data used in this report is based on third party data from Auto Forecast Solutions (effective as of 06/2019) and may vary from what is announced by the company in annual reports; the data in this report reflects an aggregation of the known subsidiaries of **Volkswagen** aggregated under the equity share principle. Details regarding the data sources and processing can be found on page 14. Companies are invited to review the data and provide feedback to assist in improving the underlying data sets by emailing 2dii at transitionmonitor@2degrees-investing.org.

Reading the Report

Report Contents

This report consists of three elements:

1. **Company profile:** information about the current installed production of the company, its technology mix and its global production distribution.
2. **Scenario Analysis:** results of the comparison of the company production plans to different scenarios and the market.
3. **Peer Comparison:** a comparison of the scenario analysis results to peer companies operating in the same market.

Key Concepts

To understand the results presented in this report, some of the key concepts are summarised below. For detailed information about the methodology, scenarios and underlying data, please refer to methodology documentation available at:

www.transitionmonitor.com/company-reports/.

Low carbon technologies: This analysis treats electric and hybrid vehicles as low carbon technologies, and internal combustion engine vehicles (ICE) as a high carbon technology.

Hybrid Vehicles: The hybrid category considers both plug in hybrids and standalone vehicles.

production: Refers to the production of new vehicles based upon a model developed by AFS.

Production mix: The distribution of the automotive production of **Volkswagen** is used as an indicator. This refers to the share of installed production that **Volkswagen** has in each technology.

Market: The market referred to in this report is global and therefore includes all automotive companies globally.

Aligned with a scenario: To be aligned with a scenario implies that the future production of the company matches what is expected based on the roadmaps developed by the IEA.

Scenarios: Three IEA scenarios are included in this report's analysis: these are sourced from the Energy Technology Perspectives 2017 (ETP 2017) and are detailed in Table 1. These have been chosen due to their regional and technological granularity. The B2DS is used as the benchmark scenario. The scenarios consist of technology roadmaps that outline the production changes required for each technology globally. This is aggregated to the company to determine the overall expected change required.

Table 1: Overview of the IEA scenarios used in the analysis.

Scenario Full Name	Abbreviation	Estimated temperature increase by 2100*	Source
Beyond 2° Scenario	B2DS	1.75°C	ETP 2017
2° Scenario	2DS	2°C	ETP 2017
Reference Technology Scenario	RTS	2.7°C	ETP 2017

*The temperature rise estimates for the B2DS, and 2DS are specified by the IEA. The RTS estimate is taken from Climate Action Tracker's 2018 Warming Projections Global Update.

Company Profile

This section outlines the current and future production mix of **Volkswagen**. Figure 1.1 shows the changes in production in each technology between 2019 and 2024. From this, one may be able to extrapolate whether the company's transition risks increase or decrease. Figure 1.2 and 1.3 show the geographical distribution of automotive production and production mix.

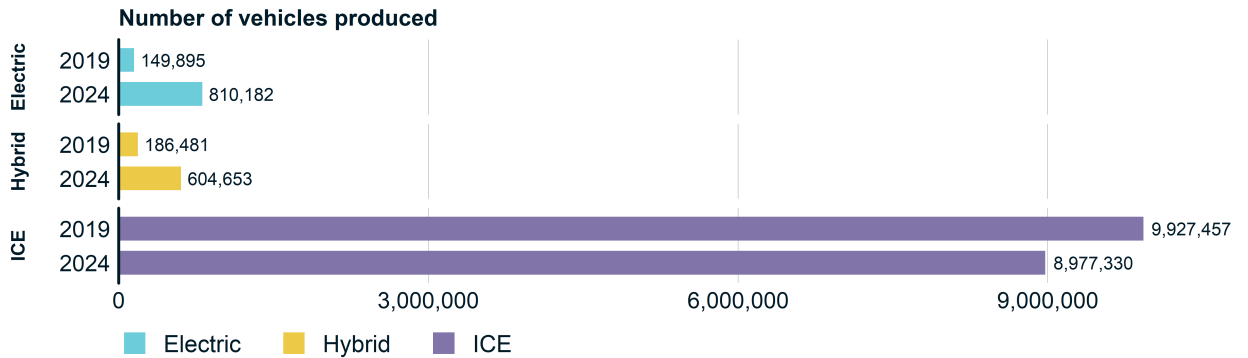


Figure 1.1: Company production mix in 2019 and 2024.

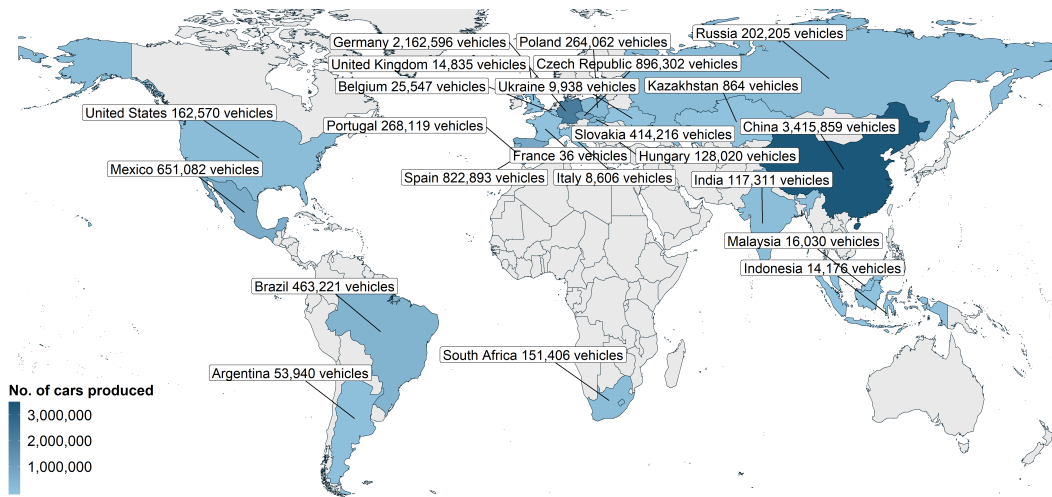


Figure 1.2: Geographical distribution of the company's automotive production in 2019.

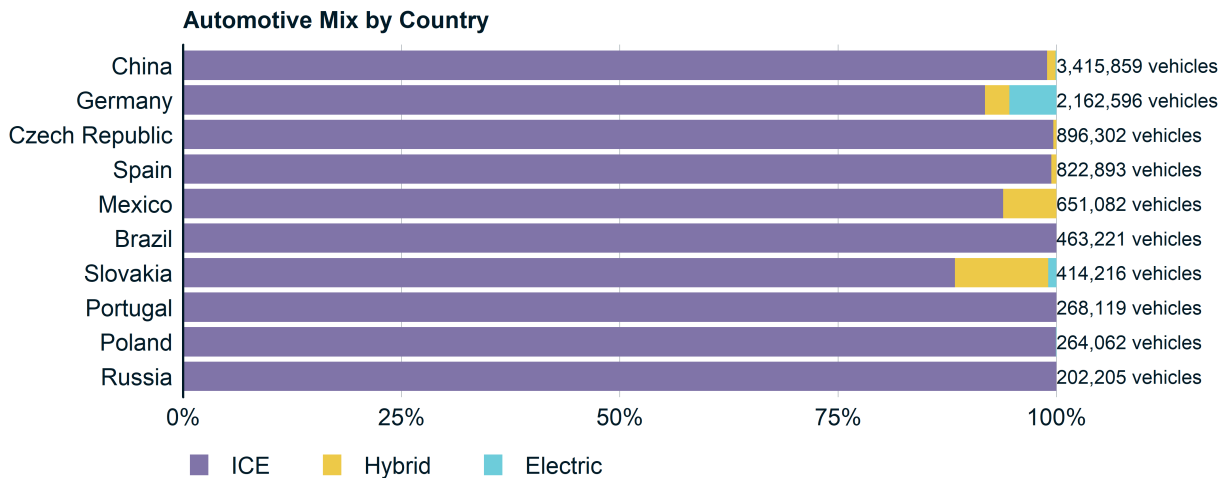


Figure 1.3: Overview of the company's production mix and total production in the largest countries by total production in 2019.

Current Alignment

How does the current production mix of Volkswagen compare to the market?

This section provides an overview of the diversification of **Volkswagen's** production across high and low carbon technologies. In order to meet the goals of the Paris Agreement, the IEA broadly signals that the share of "low carbon technologies" must increase while the share of "high carbon technologies" must decrease.

The company's production mix is presented in terms of the breakdown of its production by technology. The market is representative of all automotive companies in the global automotive market.

Low and high carbon production mix percentage

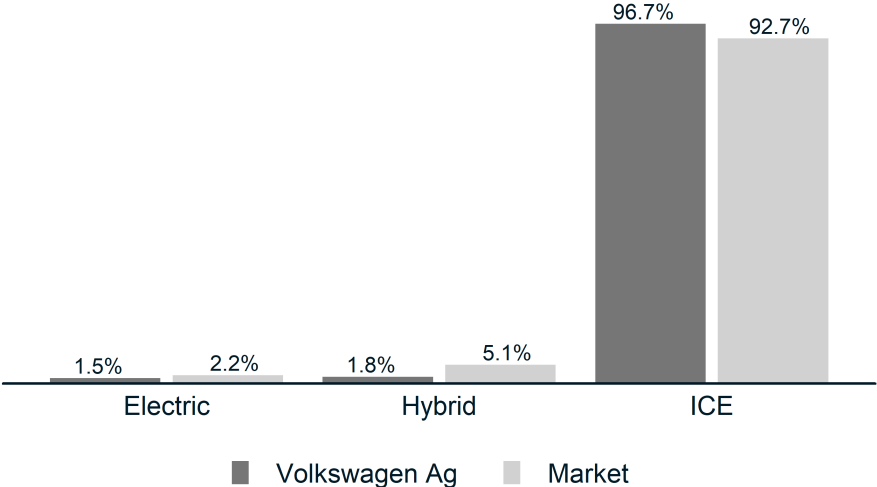


Figure 2.1: Comparison of the company's production mix to the market's production mix in 2019 by technology.

Volkswagen has 3.3% of its automotive production in low carbon technologies compared to 7.3% in the market. Volkswagen has a relatively higher share of ICE production than the market; it has a lower share of Electric and Hybrid than the market.

Trajectory

How do the capital expenditure plans for different technologies compare to the climate scenarios?

Volkswagen's plans to increase or decrease production in different technologies over the next 5 years can be compared to the International Energy Agency (IEA) scenarios. These scenarios present possible transition pathways and the changes in production required if each company in the world were to align its production accordingly.

The expected change in production by technology as per the IEA scenarios has been applied to the automotive production of Volkswagen to calculate the changes required under each scenario. This report benchmarks the company against the Beyond 2° Scenario (B2DS), though the following charts show the Beyond 2 Degree Scenario (B2DS), the 2 Degree Scenario (2DS) and the Reference Technology Scenario (RTS) together.

Alignment with climate scenarios may vary by technology. For each technology, figure 3.1 summarises the different IEA scenarios that Volkswagen's future production plan aligns with. It is important to note that these charts are independent of the current exposure to each technology (that only determines the starting point in terms of production). The initial (2019) weighting of a technology within the company's production mix is not reflected in these charts.

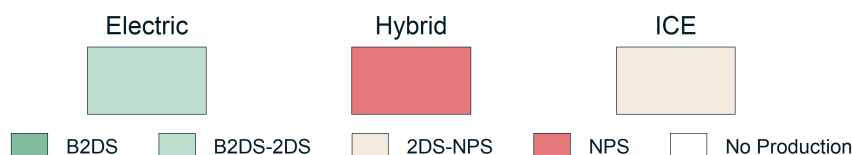
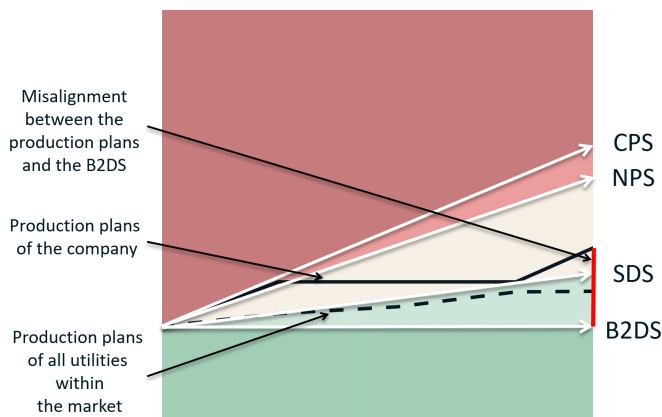


Figure 3.1: Scenario outcome of the change in production plans for each technology by 2024. This summarises the results of the trajectory charts in 2024.

The additional production planned by Volkswagen aligns it to be between the B2DS and 2DS for Electric vehicle production and to be between the 2DS and RTS for ICE vehicle production.

The charts on the following page (figure 3.2) provide additional details on how Volkswagen's production plans for each technology align with three IEA scenarios over the next five years. They also show the market's trajectory for context.

The background colours represent how the trajectory of a technology should progress under the relevant scenario based on the company's current automotive production. The solid and dashed lines represent the production plans of the company and those of the automotive market scaled to the starting point of the company. In the chart to the right, the company's production plans for this technology lie between the SDS and NPS trajectories. The difference in 2024 between the company's production plan and the end point for a specific scenario indicates the change in production that would be required for alignment. The market production can be compared to the company plans as a relative indicator only, as the scenarios are specific to the company. In this case, the company will produce relatively more of this vehicle type than the market.



Trajectory

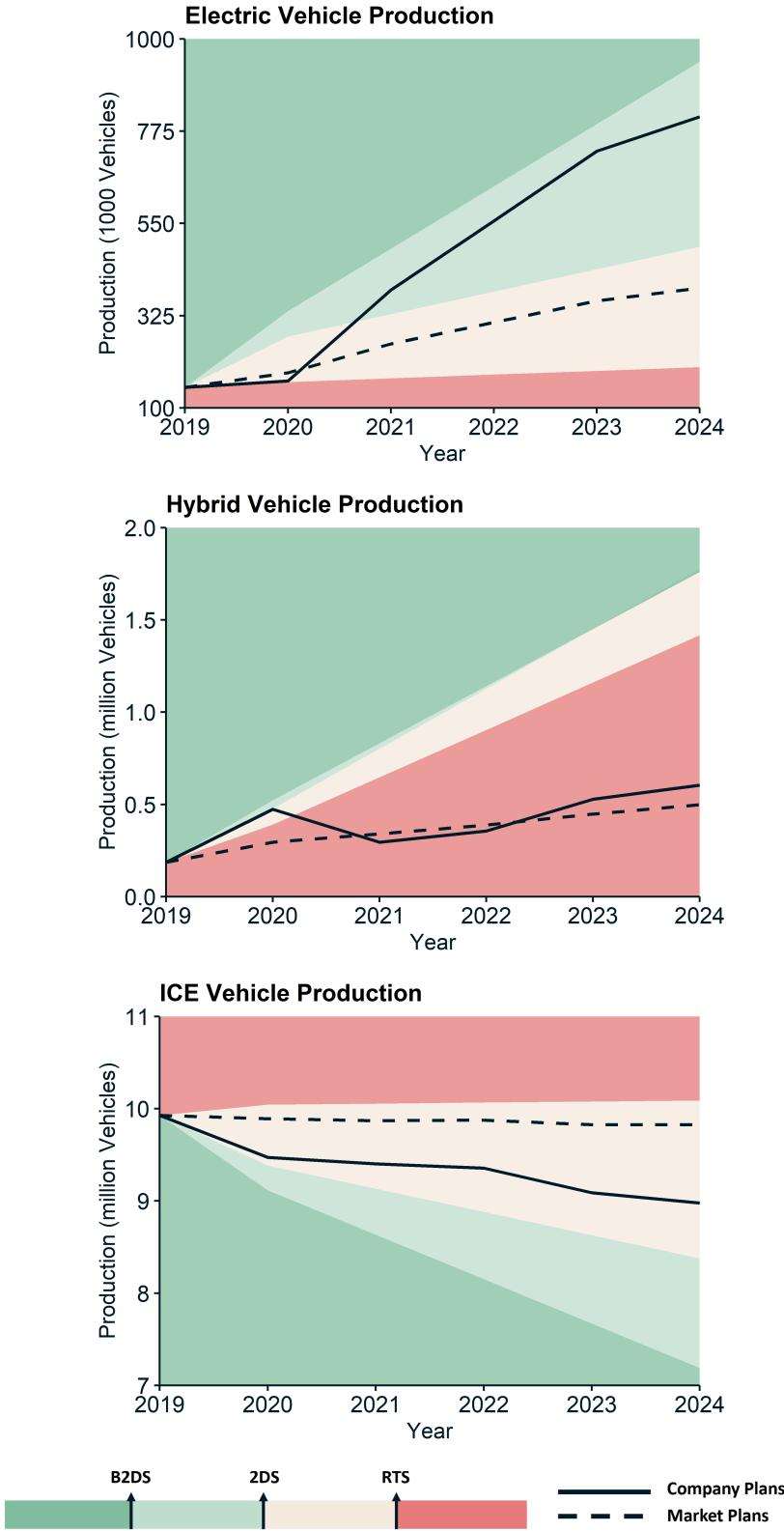


Figure 3.2: illustrates how Volkswagen’s planned production changes in each technology compare to different IEA transition pathways and the market.

Future Alignment

How will the planned production mix of Volkswagen compare to a global market aligned with the B2DS in 2024?

The production mix of **Volkswagen** in 2024 is based on its production mix in 2019 plus planned production changes between 2019 and 2024. The aligned market production mix shows what would be expected if the current global automotive market were to develop over the next five years in accordance with the B2DS.

If the company has a lower amount of low carbon technologies than the theoretical aligned market, it may be exposed to higher transition risks based on the technological trajectories outlined by the IEA.

Figure 4 shows that **Volkswagen** has an production mix in 2024 which has 17.5 percentage points or 56.2% less low carbon production than an aligned market.

Low and high carbon production mix percentage

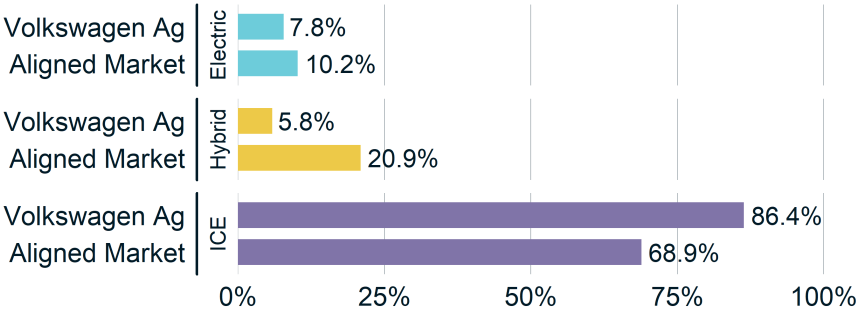


Figure 4.1: Comparison of the company production mix to the market production mix in 2024.

By 2024 Volkswagen has a higher share of ICE production than the market aligned to the B2DS; it has a lower share of Electric and Hybrid production than the market aligned to the B2DS.

Achieving Alignment

What changes in production are required by Volkswagen to align itself with the B2DS?

For **Volkswagen** to align itself with the B2DS by 2024 based on the company's current production, the following production changes by technology are required.

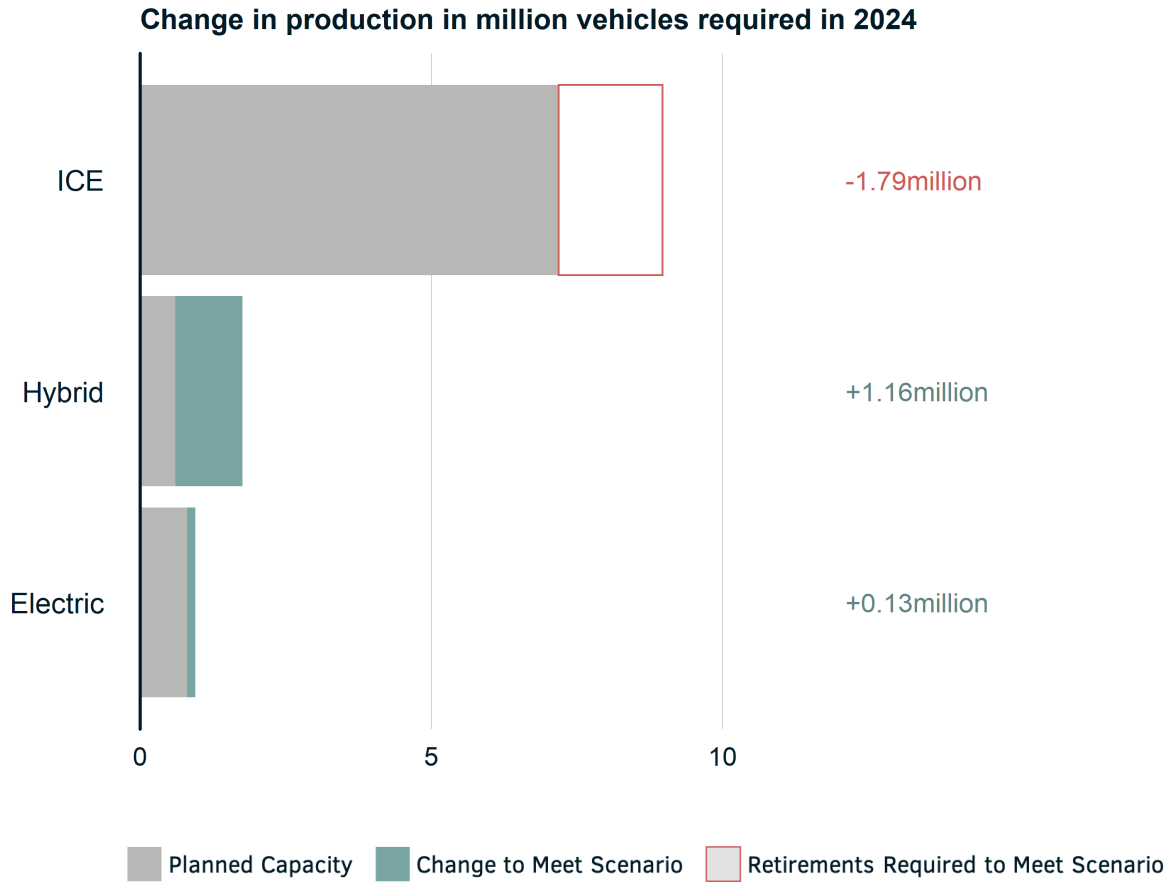


Figure 5: Changes in production required to align with the B2DS.

By 2024, Volkswagen requires additional production of Electric and Hybrid vehicles to be aligned with the B2DS, as well as a reduction in the production of ICE vehicles.

In some cases, the company's production plans may outperform the production required to align with the B2DS. If the company's production plan for low carbon technologies exceeds scenario targets, no changes in production plans are specified. Similarly, no additional production is specified if the company's plans already meet the transition pathways for ICE vehicles.

Comparison Between automotive companies

How does the current production and future planned production of Volkswagen for low carbon technologies compare to other automotive companies in the global market?

In this section, we represent the current and future production mix of **Volkswagen** relative to the other automotive companies in the global market. Figure 6 highlights:

- On the x-axis, the percentage of low carbon technologies in the production mix in 2019.
- On the y-axis, the percentage of low carbon technologies in the production mix in 2024.
- The 2019 total automotive production of each company via the size of the circles. Each circle represents a separate automotive company.

Volkswagen is highlighted in black.

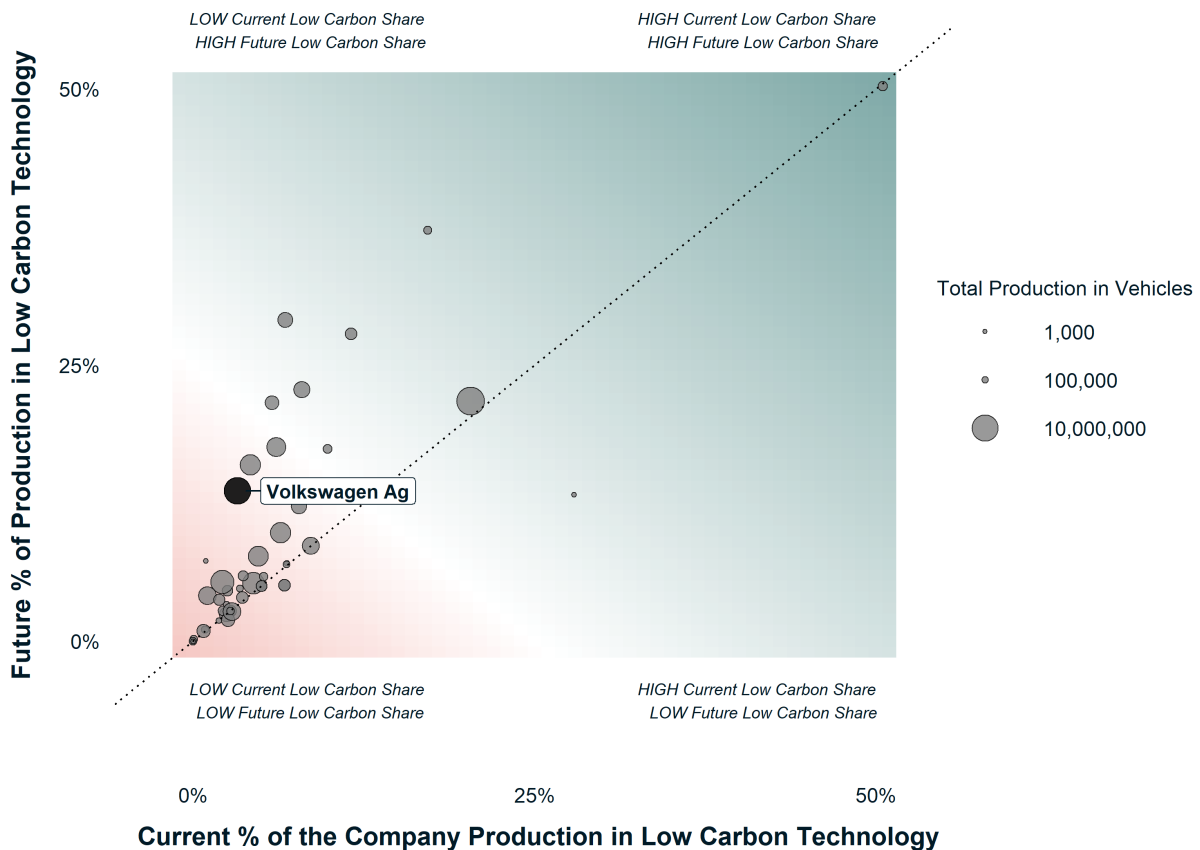


Figure 6: % planned future production in low carbon technologies vs % current production in low carbon technologies.

When the company lies above the diagonal line it indicates that the share of low carbon technology is increasing. The further up the company is, the higher their low carbon share is in the future. The further to the right the company is, the higher is their current share of low carbon production.

Market Share

How does Volkswagen's market share of each automotive technology evolve between 2019 and 2024?

This section shows how **Volkswagen's** market share in low carbon technologies is expected to develop between 2019 and 2024 and what the company's future positioning relative to the market will be.

Figure 8 shows changes in the company's electric and total automotive production market share, defined as the % of total production in each technology over the entire global automotive production.

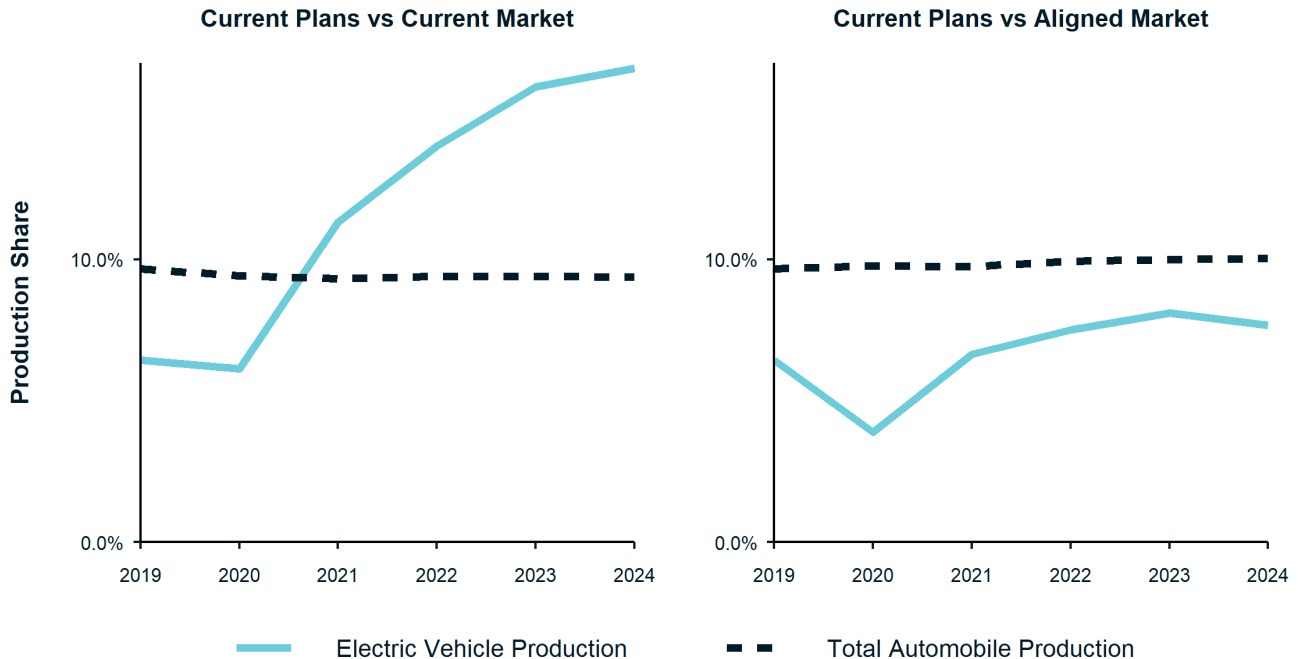


Figure 8: The above charts show how **Volkswagen's** share of the global market develops for electric and total automotive production. The chart on the left provides a comparison to the global market given current plans, and the chart on the right shows how this would develop if the market were aligned with the B2DS.

The total market share of Volkswagen is set to decrease given the actual plans of the market however would increase compared to the market under the B2DS by 2024. Its market share of electric vehicle production is set to increase given the actual plans of the market and the market under the B2DS by 2024.

The market share for each technology represents the company's production as a percentage of the production of all automotive companies (actual and aligned) including current announced plans. If the company's electric vehicle market share is decreasing over the next 5 years, this suggests that **Volkswagen** plans to increase electric vehicle production at a lower rate than the automotive companies market as a whole.

Data Sources

2dii scenario analysis is based on forward-looking automotive data from Auto Forecast Solutions (AFS) paired with company ownership information from Bloomberg.

AFS use a model to predict future production values for plants and therefore countries at a company level. AFS provides granular information on the brand, nameplate, drive train technology, and location of production currently and modelled for the upcoming eight years. This modelling takes into consideration not just what the company states online and publically but also considers geopolitical, consumer behaviour, competition and shareholder values. The modelling generally takes a conservative approach. Backtesting of this model, has shown the model production estimates have a variance of up to 5% of total global production with a 5 year time frame. Nevertheless there may be discrepancies at the brand nameplate level.

The company's current production mix was calculated by aggregating production where the company is listed as owner, weighted by an ownership stake. 5-year production plans were calculated by aggregating production for the years between 2019 and 2024. The result is a forward-looking production mix for **Volkswagen** that serves as starting point and basis for comparison for scenario analysis.

Reasons for variation from company reported production may fall into the following categories:

1. We take asset data and ownership information from two major data providers: AFS and Bloomberg. While the production data at a global level has a low error margin, this may be more for any given company or technology.
2. We allocate production from subsidiaries to parent companies according to the following rules: If a subsidiary company is private/unlisted, 100% of its production is allocated to the parent company holding the controlling stake. If a subsidiary is public/listed, the non-free float portion of its production is allocated to the parent company holding the controlling stake. No automotive production is allocated to parent companies holding non-controlling stakes.

Please review the legal disclaimer for further information about the limitations of the data.