Kepler Cheuvreux TRANSITION RESEARCH

360 Report

Climate change scenarios

Risks and opportunities

30 July 2018

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Transition risks in the automotive sector

CLIMATE X CELLENCE

THE CO FIRM

What's it all about?

Since the FSB's Task Force on Climate-related Financial Disclosures (TCFD) published its recommendations in 2017, scenario analysis has been a leading tool to assess the risks and opportunities to companies from measures taken to mitigate climate change. This study analyses the degree to which the valuation of automotive companies could differ between two climate change scenarios and a market 'consensus' baseline, with a specific focus on European companies, i.e. BMW, Daimler, and Volkswagen. This report also analyses how company valuations can vary due to two different strategic decisions they could take to adapt to the low-carbon transition. We provide insights for equity analysis and company engagement, with regional and technological sensitivities.

Authors

Luke Sussams
Kepler Cheuvreux
lsussams@keplercheuvreux.com
+44 207 621 5186

Jana Mintenig
Dr. Nicole Röttmer
Dr. Jean-Christian Brunke
The CO-Firm
climateXcellence@co-firm.com

Energy Transition Risk Project
Project details at the end of the report and under www.et-risk.eu

Please refer to the last page of this report for "Important disclosures"

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360 in 1 minute

Climate change scenario analysis of passenger vehicles

This report is the third in a series of six as part of the Energy Transition (ET) Risk project. It investigates the potential financial impact of climate change scenarios on companies in the automotive sector, focusing on BMW, Daimler, and Volkswagen's (VW) future passenger vehicle sales.

Macro climate change scenarios and company trajectories

We use The CO-Firm's climateXcellence model to assess two climate change scenarios and, overlaid onto them, two pathways illustrating different ways a company might adapt to the changing passenger vehicle market.

- Macro climate change scenarios: From the International Energy Agency's 2017 Energy Technology Perspectives: 1) the **Limited Climate Transition** scenario (LCT) (a c. 2.7° C temperature increase by 2100); and 2) the **Ambitious Climate Transition** scenario (ACT) (c. 2°C).
- Company adaptation pathways: 1) **"MARKET"** expects companies to grow relative to their current and forecast (to 2023E) regional market share by technology, and enables growth in new markets according to current and forecast (to 2023E) global market share by technology; and 2) **"MARKET REVENUE"** acknowledges that financially strong companies (higher sales revenues) could capture a larger share of profitable growth in the future.

Based on these scenario inputs, the model produces earnings, cash flows, depreciation, etc. results at the company level to 2050.

Key findings: Tools for engagement and further research

Kepler Cheuvreux (KECH) analyses how to integrate the earnings outputs from the scenario modelling in to equity valuations by altering the company's growth profile in DCF models. While our findings suggest that the companies could profit under the LCT/ACT scenarios, we caution that this should not be seen as an investment recommendation or forecast. Instead, our analysis illustrates, through one of many sets of plausible climate change scenarios, that there will be winners and losers in the low-carbon transition. KECH and The CO-Firm's conclusions provide insights into how climate change scenario analysis could tie into traditional company- and sector-level equity analysis. They should benefit both equity analysts in the integration of this issue into their investment assessments and asset managers in their engagements with companies.

This analysis was produced independently from Kepler's Autos team and does not reflect their views or ratings on any of the companies mentioned.

Contents

The Energy Transition (ET) Risk project 4
Executive summary: results in six charts 5
Executive summary: the results in context 6
Objectives and reader's guide 8
How to interpret and integrate the results 9
Scope of the study 12
The analyst view: the automotive sector in transition 14
Regulatory risks and financial impact 14
The scenarios: climate change and adaptive capacity 19
Building blocks: The global climate change scenarios 19
Building blocks: the market adaptation pathways 22
Key results: sector and company earnings 25
Sector findings 25
Key results: BMW 25
Key results: Daimler 28
Key results: Volkswagen (VW) 31
Embedding the results within valuations 34
Identifying potentially mispriced assets 35
Valuation results: winners and losers 36
A reflection of one future and one valuation 39
Company risk profiles: the other side of the coin 42
Assessing companies' adaptive capacity 46
Appendix: climateXcellence model 49
Research ratings and important disclosure 54
Legal and disclosure information 56

The Energy Transition (ET) Risk project

The ET Risk consortium, funded by the European Commission, is developing the key analytical building blocks needed for energy transition risk assessment and is bringing them to market:

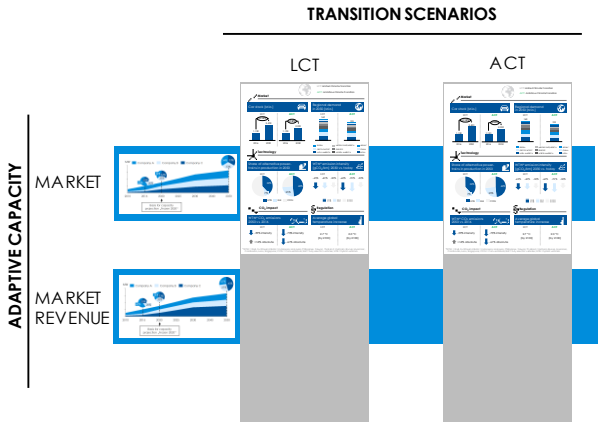
1. **Climate change scenarios:** The consortium has developed and made public two climate change scenarios, the first (LCT) representing a limited transition extending current and planned policies and technological trends, i.e. IEA ETP RTS, and the second (ACT) representing an ambitious scenario that expands on the data from the IEA ETP 2DS.
2. **Company data:** Oxford Smith School and 2° Investing Initiative have jointly consolidated and analysed asset level information across six energy-relevant sectors (power, automotive, steel, cement, aircraft, shipping), including an assessment of committed emissions and the ability to potentially "unlock" such emissions (e.g. reducing load factors).
3. **Valuation and risk models:**
    a. climateXcellence model: The CO-Firm's scenario risk model covers physical assets and products and determines asset-, company-, country-, and sector-level climate transition risks and opportunities under a variety of climate change scenarios. Effects on margins, EBITDA, and capital expenditure are illustrated under different adaptive capacity assumptions.
    b. Valuation models: Kepler Cheuvreux. The above impact on climate- and energy-related changes to company margins, cash flows, and capex can be used to feed discounted cash flow and other valuation models for financial analysts.
    c. Credit risk rating models: S&P Global. The results of the project will be used by S&P Global to determine if there is a material impact on a company's creditworthiness.
    d. Assumptions on required sector-level technology portfolio changes are aligned with the Sustainable Energy Investment (SEI) Metrics project (link), which developed a technology exposure-based climate performance framework and associated investment products that measure the financial portfolio alignment.

Acknowledgements
For sharing his insights and providing feedback in the writing of this report, we wish to thank Mark Fulton. Mark is an advisor to the Carbon Tracker Initiative and the 2° Investing Initiative; a Senior Fellow at CERES; and Special Advisor to the Climate Bond Initiative.

See seimetrics.org for more information on the "sister" project on companies' technological exposure

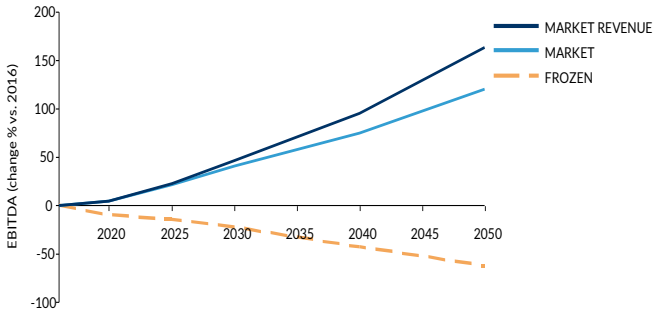
Executive summary: results in six charts

Chart 1: Two climate change scenarios overlaid with two adaptive capacity pathways



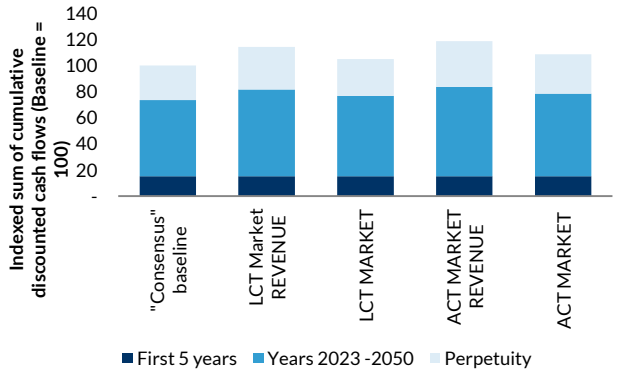
Source: The CO-Firm

Chart 2: Auto company earnings from passenger vehicles in each scenario, e.g. Daimler sees strong EBITDA growth to 2050



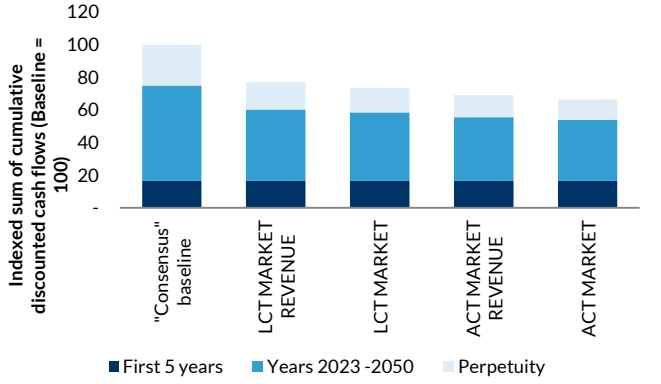
Source: The CO-Firm

Chart 3: Daimler is valued higher in the climate change scenarios than a market 'consensus' baseline[1]



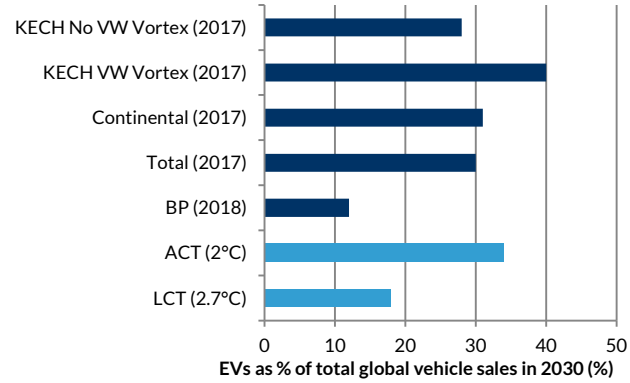
Source: Kepler Cheuvreux

Chart 4: BMW's valuation could fall in climate change scenarios compared to a consensus baseline



Source: Kepler Cheuvreux

Chart 5: The scale and type of future EV sales varies widely depending on the source and scenario



Source: Kepler Cheuvreux and The CO-Firm

Chart 6: Investors should question the valuation impact of climate change scenarios on auto companies

Engagement questions for investors

What are the biggest risks to Daimler's e-mobility strategy in the short term?

What are BMW's plans for diversifying into emerging markets and larger, premium EV models?

What is VW's strategy if the e-mobility transition is led by plug-in PHEVs?

Source: Kepler Cheuvreux and The CO-Firm

[1] Valuation estimates calculated in this report apply the cash flows from CO-Firm's modelling of the passenger vehicle segment to the valuation of the company/group on the whole, although each company derives some revenues outside of passenger vehicles.

Executive summary: the results in context

The e-mobility transition is underway

In 2017, global sales of EVs (EVs), i.e. BEVs (BEVs) and plug-in PHEVs (PHEVs), topped three million, driven largely by beneficial government policies in key regions and persistent cost reductions. This puts the technology in line with the growth rates required to limit global warming to 2°C by 2100, according to the International Energy Agency (IEA).

E-mobility is set to be a growth story in the medium- to long-term

The passenger vehicle segment must be overhauled if it is to remain aligned with the Paris Agreement and limit global warming to 2°C. Regulatory and technological factors are progressing to try to deliver this outcome, which should see the e-mobility sector become a key growth market for carmakers in the future.

The passenger vehicle segment must be overhauled if it is to remain aligned with the Paris Agreement

However, the preceding transitionary phase is fraught with risk. Financially strong companies are backing a costly strategy of double spending – on internal combustion and EVs. This includes our three featured companies; BMW, Daimler and VW. Those without the requisite financial clout must adopt an alternative strategy.

Ours is a story of emerging markets and plug-in hybrid vehicles (PHEVs)

This study analyses the impact of two climate change scenarios on automotive company earnings and valuations – LCT (+2.7°C by 2100) and the ACT scenario (+2°C by 2100).

Simply put, these scenarios see strong growth of PHEV sales, with only modest growth in BEV sales pre-2035 in ACT and pre-2050 in the LCT scenario. Vehicle sales growth is concentrated in the emerging markets while the developed economies mainly see a substitution of EVs for conventional drivetrains.

The CO-Firm is able to estimate the financial (revenues, cash flows, earnings) impact of future vehicle sales on companies split by vehicle technology, size, geographic market and companies' propensity to capture this growth. Company EBITDA grows to 2050 for each of these companies in the climate change scenarios, albeit to differing degrees. Note, cash flows and earnings stated for the selected companies relate to the passenger vehicles segment only but are communicated in this report as if they represent 100% of the companies' earnings sources.

Company EBITDA grows to 2050 for each of these companies, albeit to differing degrees

Searching for mispriced assets

To answer the question, '*What could the valuation of a company be under different climate change scenarios*?', Kepler Cheuvreux (KECH) takes The CO-Firm's company cash flows and runs them through a DCF model, under its equity analysts discount and terminal growth rate assumptions, to produce a company valuation.

KECH then compares the valuations of each company in the climate change scenarios with that of a market 'consensus' baseline, based on Bloomberg data. The difference gives an illustration of the current potential mispricing of a stock if different low-carbon pathways transpire. Our analysis suggests Daimler's valuation

could be higher in a 2°C/2.7°C scenario than in the baseline, while BMW and VW could be overvalued at present, if either of those futures were to transpire.

One future leads to one valuation

One future leads to one valuation

Our valuation conclusions are entirely dependent on the modelling of the future passenger vehicle market. For example, KECH's equity analysts published a scenario in March 2017 ('VW Vortex Scenario') in which BEV sales were equal to PHEV sales in 2030 – quite the opposite of the PHEV-led LCT/ACT scenarios applied in this study. This means that EV sales in the VW Vortex Scenario resemble the IEA's 'Below 2°C Scenario' (B2DS) for the timeframe considered.

VW's e-mobility strategy prioritises BEVs over PHEVs. Consequently, the company's financial prospects look far stronger in the VW Vortex Scenario (a market based approach, not a climate change scenario) than the PHEV-led LCT/ACT. This goes some way towards explaining the divergence between the somewhat disappointing prospects for VW in this study and KECH's view that VW is a 'game-changer' with realistic chances of being the leader in e-mobility.

Adaptive capacity can determine whether a company is future-proof

Adaptive capacity becomes all the more critical for companies exposed to transitioning sectors

Adaptive capacity is the result of dynamic capabilities (e.g. opportunity recognition, partnering, etc.), that allow existing resources (e.g. financial strength, intellectual property, etc.) to be put to good future use, by means of a strategy. This forms an implicit part of an equity analyst's everyday evaluation of a stock.

Adaptive capacity becomes all the more critical for companies exposed to transitioning sectors, such as the automotive sector, because it can determine the degree to which they are able to foresee, align, and adapt to market shifts. This report acknowledges the importance of adaptive capacity by running two pathways within each climate change scenario ('MARKET' and 'MARKET REVENUE'), which vary one aspect of a company's resource base, i.e. its financial strength. Of course, in reality, adaptive capacity is comprised of many more factors.

We also include a "standstill" pathway ('FROZEN') in which companies' expected product portfolios are frozen from 2023. This demonstrates the potential cost to companies of inaction in a sector that is undergoing a low-carbon transition.

Scenarios are critical to manage uncertainty

In the face of a host of unknown low-carbon transition factors (e.g. vehicle emission regulations, air pollution limits, vehicle city bans, falling EV costs, improving battery densities, etc.), scenario analysis emerges as a vital tool to:

- Illustrate a range of potentially extreme market outcomes.
- Identify key drivers of change within each scenario.
- Understand how a company might be able to adapt to the changing market, given its current and potential future resources.

As evidenced by the differences between the company valuations in KECH's VW Vortex Scenario and LCT/ACT, the stakes on the low-carbon transition are high. Scenario analysis helps to enhance the management of uncertainty and inform any decisions taken.

Objectives and reader's guide

This report aims to illustrate how climate change scenario analysis can be integrated into mainstream company earnings and valuation analysis, through the example of the automotive sector.

This is the third in a series of six reports. The first report, *Investor primer to transition risk analysis*, discussed the methodological and conceptual underpinnings of such an endeavour. The second *report* focused on the potential impact of climate change scenarios on the valuations of specific companies within the utilities sector (EDF, Enel, Engie). This report tests the previously developed financial risk analysis methods on the automotive sector with a focus on BMW, Daimler, and VW. Upcoming reports apply the same approach to the steel and cement sectors. The last report will bring together the results and lessons from the previous reports.

The primary audience of this report is financial analysts who wish to understand the materiality of transition risks on company performance and valuation, and the more technical aspects involved in scenario analysis. We also hope to inform investors on which automotive companies could be the winners and losers in the transition to e-mobility as a means to inform their engagements with companies.

The CO-Firm lays out methodologies to determine financial risk based on climate change scenarios. Kepler Cheuvreux then investigates how to integrate these results within traditional equity valuation models. The results should not be considered investment recommendations, financial forecasts or a judgement of their veracity, but rather the result of a number of plausible assumptions around the low-carbon transition. They constitute an outside-in analysis for providing guidance on company engagement.

Our findings illustrate a scenario analysis, not investment advice. None of the comments or data included in this report should be seen as informing or relating to Kepler Cheuvreux's equity analysts' ratings or views on any company mentioned in this report

The report builds on the following previous reports:

- The Transition Risk-o-Meter: Reference scenarios for financial analysis (2°C Investing Initiative, The CO-Firm, June 2017, link).
- Technical supplement: The use of scenario analysis in disclosure of climate-related risks and opportunities, TCFD (June 2017, link).
- Changing colors: Adaptive capacity of companies in the context of the transition to a low carbon economy (2dii, The CO-Firm, Allianz, Allianz Global Investors, August 2017, link).
- Climate scenario compass: Investor primer to transition risk analysis (Kepler Cheuvreux, The CO-Firm, January 2018, link).
- Climate scenario compass: Transition risks for electric utilities (The CO-Firm, Kepler Cheuvreux, January 2018, link).
- Climate scenario compass: Transition risks for the steel sector (The CO-Firm, Kepler Cheuvreux, forthcoming).
- Climate scenario analysis: Cement's financial performance under 2°C and 2.7°C - A how-to guide for the sector, and three companies across six countries (The CO-Firm, forthcoming).

- Climate scenario scenarios: Transition risks: How to move ahead. (The CO-Firm, Kepler Cheuvreux, forthcoming).

How to interpret and integrate the results

This section outlines how our target audiences can interpret and use the results of our analysis.

What are our research themes?

With regards specifically to the passenger vehicle segment of the automotive sector, this report comments on the:

- **Materiality of business risks and opportunities under long-term climate change scenarios** by looking at the relative development of company EBITDA.
- **Speed of manifestation of transition risks and opportunities,** revealed by changes in company and sectoral financial performance over time.
- **Drivers of change** supporting the low-carbon transition.
- **Company readiness and capacity to transition;** factors which are central to determining the future winners and losers.

What could we learn about company-level analysis?

What could we learn about company-level analysis?

This research aims at supporting the reader in understanding:

- What the **key determinants** of company growth and profitability in climate change scenarios are.
- **Which mechanisms (volumes, prices, costs, etc.)** can impact company performance in each scenario**.**
- Whether, and how, the structural set-up of companies today provides a perspective on its **future performance potential** in a transitioning market.

What relevance does adaptive capacity have in climate change scenarios?

We test different assumptions of a company's adaptive capacity to learn about its importance when sectors are transitioning. We consider the following:

- The **scenario readiness** of the resource base: How is a company positioned for a changing market scenario, e.g. its potential to participate in relative growth, in specific technologies/ geographic markets?
- **Winner propensity**: How is the company positioned relative to others, regarding their types of physical or intellectual assets and their geographic market presence?
- The **cost of inaction:** What are the financial implications for a company that stands still in a changing market?

How does our approach to climate change scenario analysis relate to current equity analysis?

Similarities:

- Both are financial assessments.
- Both are data-driven.
- Both reflect specific company strengths and weaknesses (current asset base).
- Both reflect the current corporate strategy (to 2023).
- Both incorporate industry and competitive dynamics, though with different timelines.

Differences:

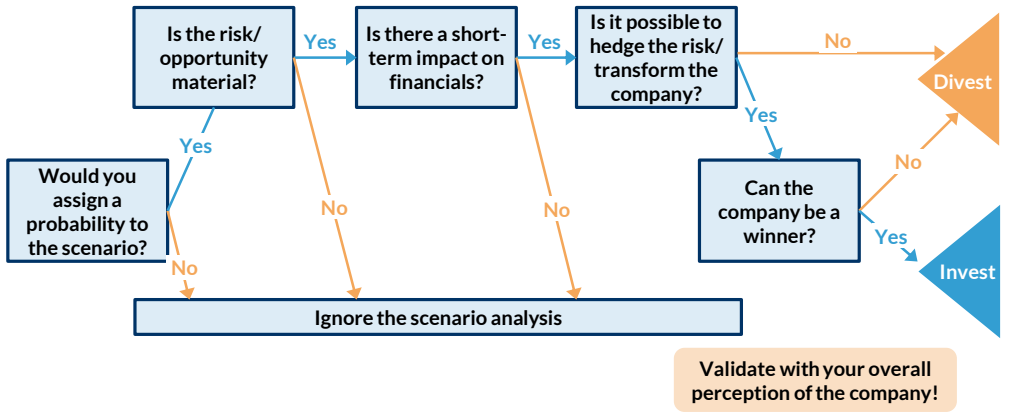
- The scenario analysis timeline extends to 2050, beyond the currently available consensus data (to 2023).
- The climate change scenarios are designed to ensure limiting global emissions to keep within a pre-determined level of average temperature increase to 2100. Almost all company forecasts and expectations will not be from this climatic angle, although some assumptions might take climate change into consideration.
- The fundamental driver of the assessment is the physical asset park/ product portfolio of the company, not its past financial performance.
- The analysis is more forward-looking than near-term outlooks which tend to leverage historical data and performance more.
- Focus is on general propensity to change the asset park, not on specific point-in-time strategic decisions as soon as these are announced.
- The company is only considered in terms of its most risk-prone or opportunity-laden business segments.

As an equity analyst, ask yourself the following:

- To what degree do you **believe the scenario**? Do you assign a probability to it?
- Do you consider **climate risk/opportunity to be material** for your sector(s) and company(ies)?
- Does the risk/ opportunity **materialise soon enough** for you to integrate it into your investment case? Or does managing the risks and capturing the opportunities already require preparation on the side of company(ies) that impacts their financial performance within your time horizon?

The following chart introduces a sample decision-tree that an equity analyst might be guided by when first interpreting the results of a climate change scenario analysis (Chart 7).

Chart 7: How an analyst can interpret their climate change scenario analysis



Source: The CO-Firm

As an asset manager, ask yourself the following:

- Do you want to **foster the low-carbon transition** by investing strategically into it? For example, by supporting companies that drive the transition.
- Confronted by transition risk(s), **can the company credibly transform?** If so, do you need to engage with the company to either transition within its current business segments or more fundamentally shift to other business segments?
- In the case that the company can transform, do you agree with its belief that it will **be a winner in the market?**
- If the company cannot align with the transition, can the risk be **ignored or hedged** outside the business segment/ sector concerned?
- Do you need to **divest** your holdings from the company due to unacceptable financial risks from the low-carbon transition?

As a portfolio manager, ask yourself the following:

- What are the **risk and opportunity drivers** of the underlying scenario?
- How might transition risks impact the sectors' relative **risk-return** profiles?
- How large is the **gap** between traditional valuation and longer-term scenario dynamics and what are **main drivers**?
- After performing a scenario analysis **transparency** should have increased and you could ask whether you have identified **structural characteristics of companies for their resilience**?
- To what extent can stock-picking impact the **average sector risk**?

As a risk manager, ask yourself the following:

- What are **drivers and early warning indicators** for transition risks in a 2°C scenario in TCFD relevant sectors?
- Do I want to assign the scenario a **probability weighting**? If so, which?
- Can I identify a **structural nature of the opportunities and risks** that exist for companies?

- Would a change in the **materiality of risk factors** or new risk factors imply changes to general risk management?

Scope of the study

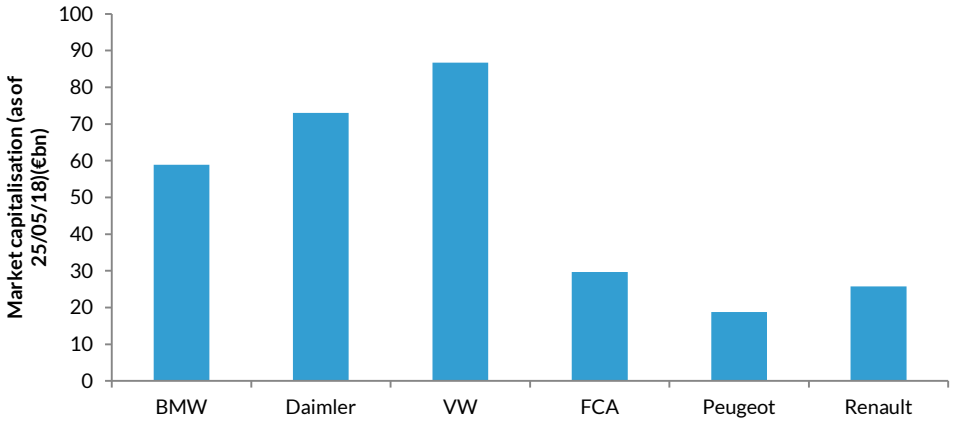
This report focuses on the possible impact of the low-carbon transition on the automotive sector, which is one of the focus sectors in the TCFD's reporting recommendations due to its high level of risk exposure. BMW, Daimler, and VW are analysed to give an indication of which factors could determine the winners and losers in the transition to e-mobility.

Financial resource base

The market capitalisation of BMW, Daimler, and VW is greater than that of their peers

Although the three organisations featured in this analysis are deemed to be in the same peer group, they of course possess different financial structures (just one component of the current resource base), which can distort the accuracy of comparisons made between the companies. Chart 8 shows that the market capitalisation of BMW, Daimler, and VW is greater than that of their peers (according to Bloomberg), who are used as a point of comparison in this report.

Chart 8: BMW, Daimler and VW have greater financial strength than their European 'peers'



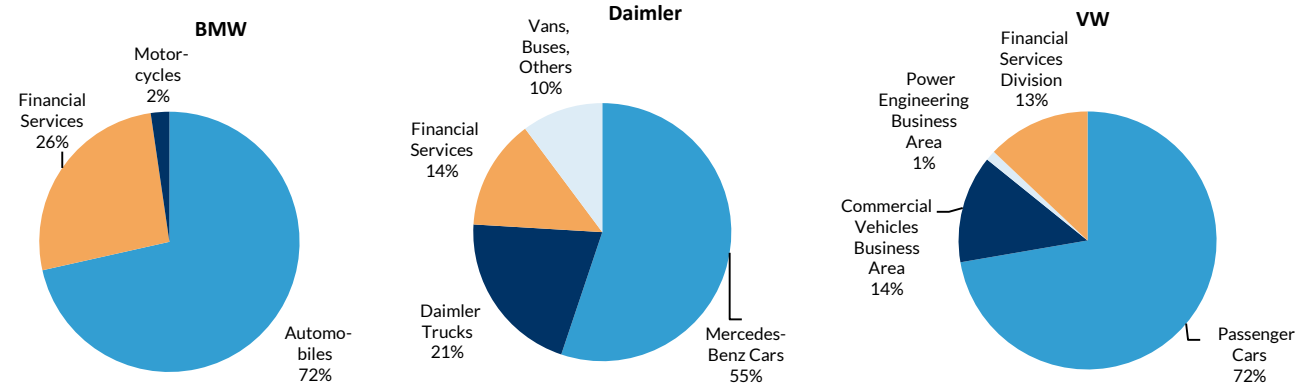
Source: Bloomberg

The market capitalisation of BMW, Daimler, and VW in Chart 8 gives an insight into the relative financial strength of each of these companies in the MARKET REVENUE adaptive capacity pathway, which assumes that companies with greater sales revenues relative to peers are able to gain market share in a transitioning sector.

Revenue base in focus

This report compares company cash flows in climate change scenarios with that of a consensus baseline for the passenger vehicle segment only. Chart 9 demonstrates that BMW, Daimler, and VW each generate revenues from segments other than passenger vehicles. For example, Daimler has a significant trucks, vans, and buses segment.

Chart 9: A greater percentage (72%) of VW's revenue was from the sale of passenger vehicles than Daimler (55%) and BMW (72% from automobiles generally) in 2017



Source: Bloomberg

However, while our three companies do not source 100% of their revenues from the passenger vehicles segment, it makes up the majority of the total (2017). Consequently, the earnings and valuation results from our analysis are communicated as though they represent the company/group on the whole, although it is based on the modelling of the passenger vehicle segment only. Similarly, when we reference other financial metrics in this report (e.g. capex, R&D spend, etc.), we do not pro-rata them down to reflect companies' other revenue generating segments.

While the three companies do not source 100% of their revenues from the passenger vehicles segment, it makes up the majority of their total revenues

The analyst view: the automotive sector in transition

The transition to e-mobility in the global automotive sector is underway. According to the International Energy Agency (IEA), EVs (EVs), i.e. BEVs (BEVs) and plug-in PHEVs (PHEVs), are one of only four low-carbon technologies currently aligned with limiting global warming to 2°C by 2100[2].

The sale of EVs to date has been impressive (three million globally), although this is minor compared to the volumes that will likely be required to remain in line with the Paris Agreement (<2°C). This transition poses a portfolio of risks to automobile manufacturers who face significant value destruction if incorrect or untimely strategic decisions are implemented. The scope for financial outperformance is equally large for those companies able to align with the transition to e-mobility at the right time.

The fall in cost of EVs has been dramatic and a key reason for growing sales. However, the growth of e-mobility is still largely being driven by national and regional policies that support the shift from ICEs to EVs. This section delves into some of the regulations posing existential risks to diesel and petrol-fuelled vehicles, their producers, and investors. Furthermore, we analyse the relative exposure and resilience of BMW, Daimler, and VW to this regulatory risk.

Regulatory risks and financial impact

Governments have the automotive sector in the cross-hairs because its emissions levels of air pollutants and global warming driving greenhouse gases (GHGs) are worsening in a number of key markets. In particular:

Governments have the automotive sector in the cross-hairs because its levels of air pollutants and global warming driving greenhouse gases (GHGs) are worsening

- The transport sector overtook the power sector as the most carbon dioxide (CO2)-intense industry in the US in 2016; almost two-thirds of these emissions were from petrol motors.
- Average CO2 emissions from new cars in Europe rose in 2017 for the first time in ten years due to increasing consumer demand for fuel-intensive sports utility vehicles (SUVs).
- The Chinese vehicle fleet is expected to grow by almost 200% (2015-40) to 500m, according to the IEA New Policies Scenario 2017. The Indian passenger vehicle fleet follows a similarly strong growth path. This will add to road transport emissions significantly.

Governments are responding to these trends by implementing and proposing more stringent fuel economy and emissions regulations, e.g. CO2, nitrous oxides (NOx) and particulate matter (PM), which will see car manufacturers incur compliance costs or be forced to invest in new product strategies.

[2] Note, e-mobility will only lead to lower CO2-emissions if the power grid supplying the electricity to power them has a low CO2-intensity.

The European war on diesel: A supply and demand squeeze

In 2017, sales of diesel cars and SUVs in Europe fell by nearly 8%

Consumer demand for diesels has fallen. In 2017, sales of diesel cars and SUVs in Europe fell by nearly 8% to its lowest market share in eight years. One reason for this stark drop-off in demand is public concern over the VW "Dieselgate" scandal. In turn, this has led to an increase in political will to challenge the diesel sector. Consumers are now concerned about the impact of city driving bans and pollution charges on the resale value of diesel vehicles. At present, the European cities of Paris (2024), Rome (2024), Athens (2025), and Madrid (2025) have announced plans to apply restrictions on diesel vehicles in city centres.

This list is set to expand, however, as the German Federal Administrative Court in Leipzig recently ruled that German cities could legally ban more polluting diesel cars from areas most affected by air pollution. Subsequently, Hamburg has banned older diesel vehicles from selected urban areas starting from 31 May 2018, and a judge in Aachen ruled that the city must ban older diesels by January 2019. It is believed that Stuttgart, Dusseldorf, and Munich will announce similar bans if carmakers fail to progress in meeting EU standards.

"Diesel cars are finished. I think in several years they will completely disappear. This is the technology of the past".

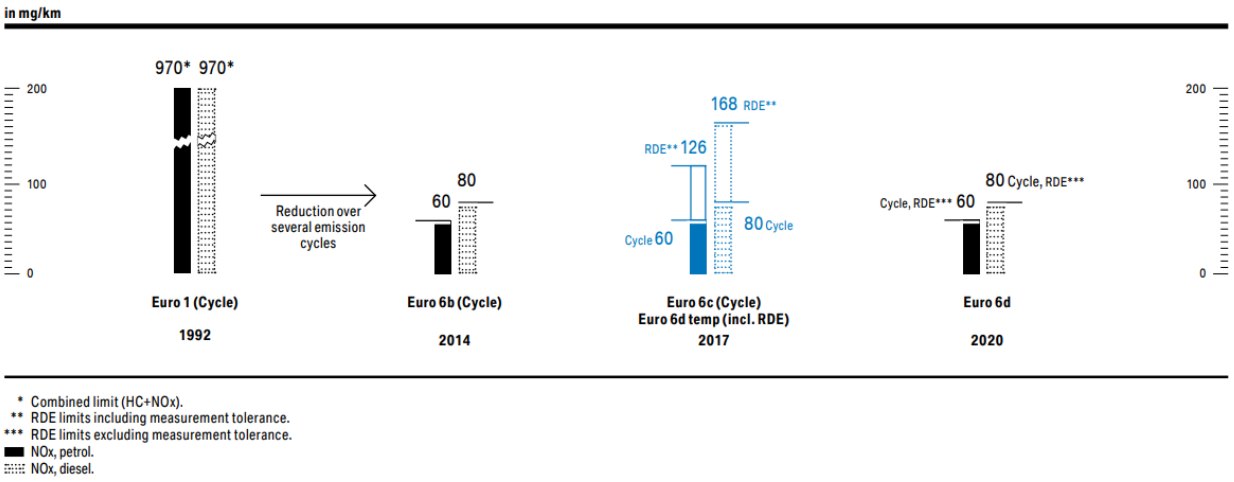
Elżbieta Bieńkowska, European Commissioner, Internal Market, Industry, Entrepreneurship and SMEs (27 May 2018)

This takes us on to the profit margin squeeze on diesel sales being felt by vehicle producers. As illegal levels of air pollution persist in cities across France, Germany, the UK etc., and litigation cases threaten national governments with hefty fines, the EU will continue to mandate increasingly stringent vehicle emissions standards.

Carmakers' profit margins on diesel vehicles are being squeezed

For example, the Euro 6d standard aims to reduce NOx, PM, and carbon monoxide. While it does not tangibly reduce the emissions threshold for passenger vehicles compared to previous standards, it mandates an improved laboratory testing (World harmonised Light vehicle Test Procedure (WLTP)) process and a new testing methodology (Real Driving Emissions (RDE)) that are tantamount to a far more strict emissions limit (Chart 10). For many car manufacturers (e.g. Toyota, Subaru, Volvo, Fiat-Chrysler), the additional costs required to meet the Euro 6d regulations, coming into force in 2021, have rendered diesel vehicles unprofitable, and they will halt their sales over the coming years.

Chart 10: The change of test cycle methodology could be costly for producers that continue to sell diesel vehicles in the future



Source: BMW

For those seeking to continue diesel vehicle production, the compliance investments required to meet Euro 6d standards could be costly. For example, it is estimated that only 2.7m of the 15m diesel vehicles on Germany's roads are fitted with Euro 6 technology. Hardware retrofits to get Euro 5 diesels up to the required standards can be anywhere from EUR1,500 to EUR7,000 per vehicle.

The European experience with diesel-powered vehicles gives an insight into the policy and technology trends that could emerge in other developed and developing nations

The European experience with diesel-powered vehicles gives an insight into the policy and technology trends that could emerge in other developed and developing nations.

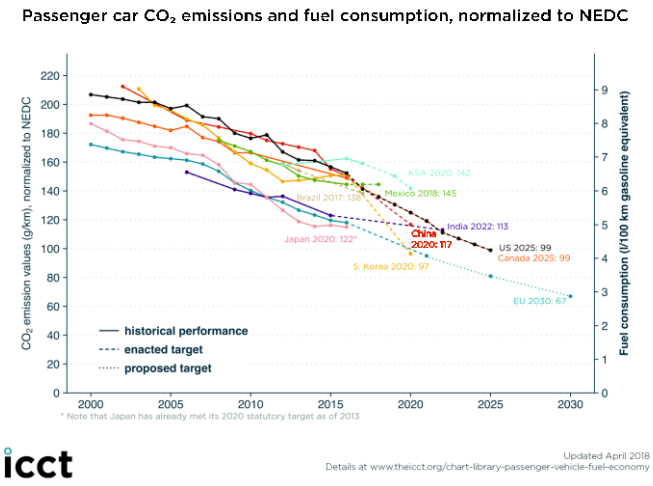
Petrol-powered ICEs are most exposed to CO2 regulations

Greenhouse gases (GHGs) drive global warming; CO2 is the most abundant GHG in the atmosphere. Consequently, CO2 is the first port of call when governments aim to mitigate GHGs. Petrol-driven internal combustion engine (ICEs) vehicles are the most CO2-intense form of passenger vehicle and so are highly exposed to such regulations.

Europe currently mandates the most stringent vehicle CO2 regulations globally

A number of countries have implemented passenger vehicle CO2 emissions and fuel consumption targets (Chart 11). Europe mandates the most stringent regulations globally, while it is noteworthy that India and the US also have targets in place. China is the one major automobile market that does not have a vehicle CO2-emissions target in place. However, China has implemented a fuel economy (miles per gallon) target, which translates into an equivalent trend direction for CO2 emissions.

Chart 11: Passenger vehicle CO2 emissions and fuel consumption standards[3]



Source: ICCT

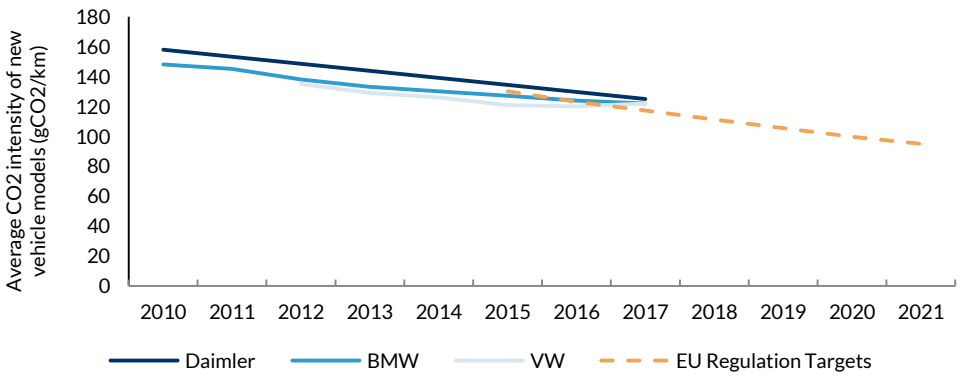
These CO2 policies require automobile manufacturers to determine compliance strategies in each region, which can either mean investing in efficiency improvement technologies for petrol ICEs, investing in EV powertrains or incurring costs to comply with similar standards for diesel vehicles (as explained above), which are less CO2-intense than petrol ICEs.

Carmakers must continue to produce increasingly efficient vehicles to ensure future compliance

The challenge to comply with EU CO2 regulations

Chart 12 shows the average CO2-intensity of the new vehicle fleets from Daimler, BMW and VW in the EU28. Although numerous recent cases of emissions fraud have called the validity of carmakers' emissions compliance into question, Chart 12 shows that officially these companies are aligned with EU regulations to date. However, it also shows the degree to which they must continue to produce increasingly efficient vehicles to ensure future compliance.

Chart 12: Average CO2-intensity of new vehicle fleet of our selected companies in the EU28 relative to regulated targets[4]



Source: Kepler Cheuvreux

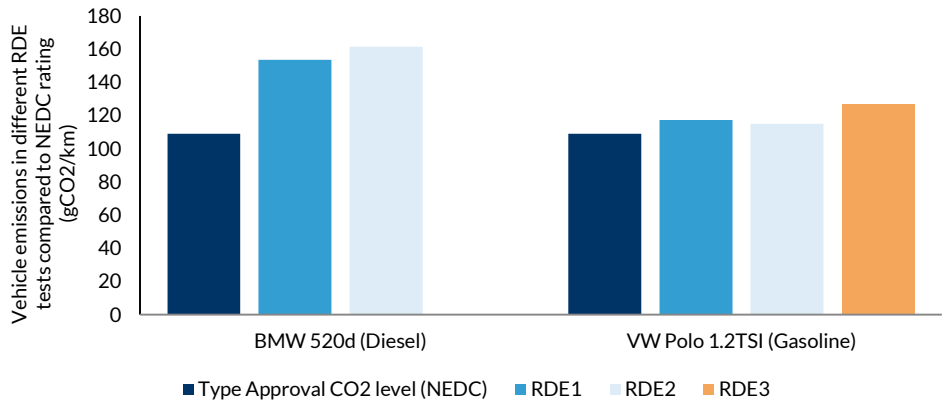
[3] Normalised to NEDC
[4] Chart assumes linear interpolation between given data points for Daimler and EU regulation targets.

European vehicles must adhere with this increasingly stringent CO2-intensity vehicle limit via the new laboratory test procedure (WLTP – Worldwide harmonised Light vehicles Test Procedure). Similar to the testing of diesel vehicles, this testing procedure leads to more realistic, but higher, fuel economy and CO2 emissions values, via higher average and maximum speed requirements, more dynamic handling, etc.

The new testing procedure leads to more realistic, but higher, fuel economy and CO2 emissions

To illustrate the degree to which observed vehicle CO2 emissions might increase under the WLTP/RDE testing compared to the old NEDC tests, we cite a study that tests a BMW 520d 2.0 (diesel) and a VW Polo 1.2TSI (petrol) – two vehicles with the same approved CO2 emissions rating (109gCO2/km) under the NEDC method. The study conducts a number of RDE tests on each vehicle and finds that the average CO2 intensity of the BMW and VW under real-world driving conditions is 45% and 10% higher than the official NEDC rating (Chart 13).

Chart 13: Comparing vehicle CO2 emissions under WLTP/RDE and the previous NEDC method



Source: Emisia, 2017

This is just one study and the results would be different for every trip under real-world conditions. However, the trend whereby the WLTP/RDE tests are likely to increase observed vehicle CO2 emissions is undeniable, and the extent to which it is currently underestimated could be drastic. This would have knock-on effects for costs incurred by car manufacturers.

For those that do not comply, the penalties are costly

BMW, Daimler, and VW all note in their annual filings how challenging the 2021 CO2-intensity target (95gCO2/km) will be to meet, especially through RDE testing. For those that do not comply, the penalties are costly. From 2012, the manufacturer had to pay EUR5 for the first gram per kilometre (g/km) of exceedance for each car registered, rising to EUR95 for each gram after the third gram of exceedance. From 2019, the EU mandates a flat penalty of EUR95 from the first g/km of exceedance.

The scenarios: climate change and adaptive capacity

Building blocks: The global climate change scenarios

The building blocks of the analysis are two climate change scenarios and two adaptation pathways

The building blocks of the analysis are two climate change scenarios, which include two company adaptation pathways. The two climate change scenarios are:

- The Limited Climate Transition (LCT), which corresponds to the International Energy Agency's (IEA) Reference Technology Perspective (RTS), a scenario consistent with +2.7°C by 2100.

The Ambitious Climate Transition (ACT), which corresponds to the IEA Energy Technology Perspectives' 2°C scenario (2DS).

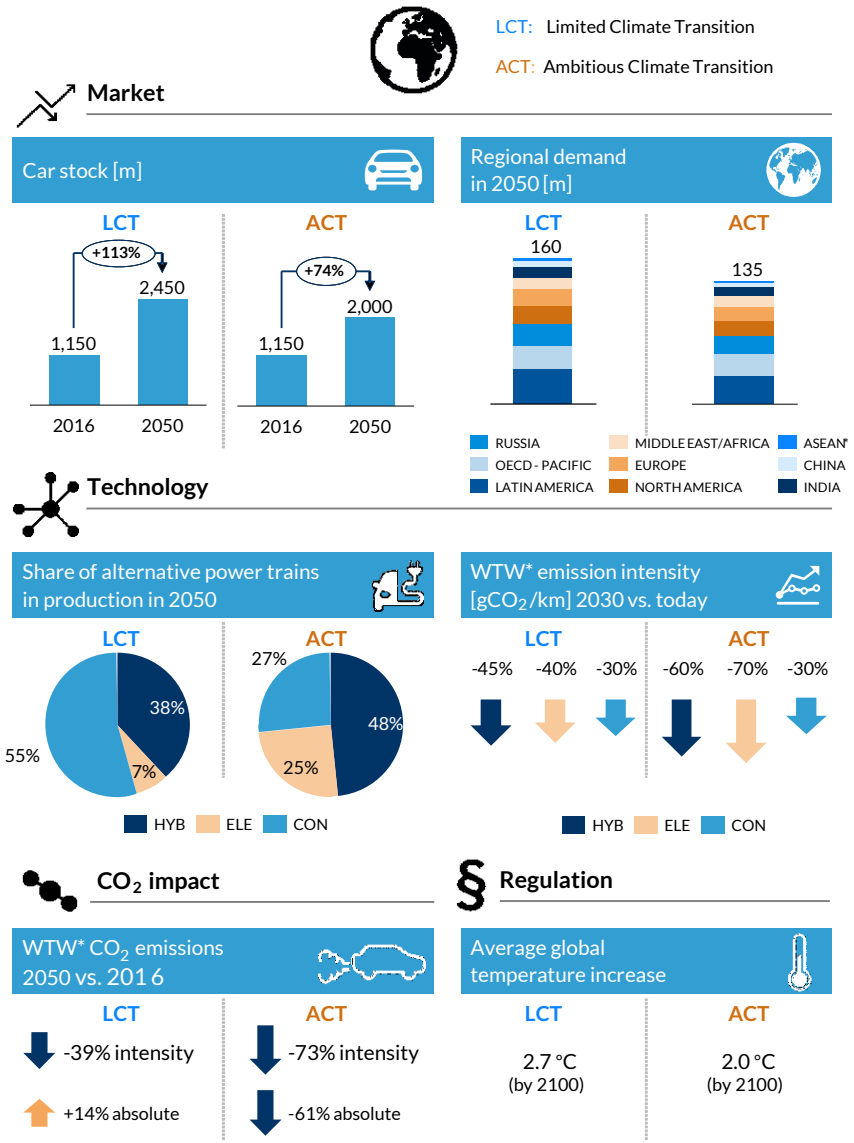
At present, the pledges that national governments have made to limit global warming, known as Nationally Determined Contributions (NDCs), are estimated to deliver an average global temperature rise of 2.7°C by 2100, based on pre-industrial levels. As such, the LCT scenario should be perceived as a form of 'business as usual' outcome.

In the 2015 Paris Agreement, all 197 parties to the UN Framework Convention on Climate Change (UNFCCC) pledged to limit global warming to 2°C by 2100, with ambitions to keep temperature rise to 'well below' 2°C. The ACT, with its 2°C global warming ambition, falls short therefore of what governments have committed to transition their economies towards. In order to comply with the terms of the Paris Agreement, a more ambitious transition plan than ACT needs to be implemented.

Key market drivers and trends

Our two scenarios comprise a narrative on regulatory, technology, and market-related changes that are consistent with the underlying IEA scenarios. This underlying narrative ("what needs to happen to get us there") forms the foundation for the company-level scenario analysis. The following key trends (Chart 14) exert a strong influence over the financial impacts of each climate change scenario on the companies

Chart 14: Key characteristics of the low-carbon transition in the passenger vehicles segment under the two climate change scenarios



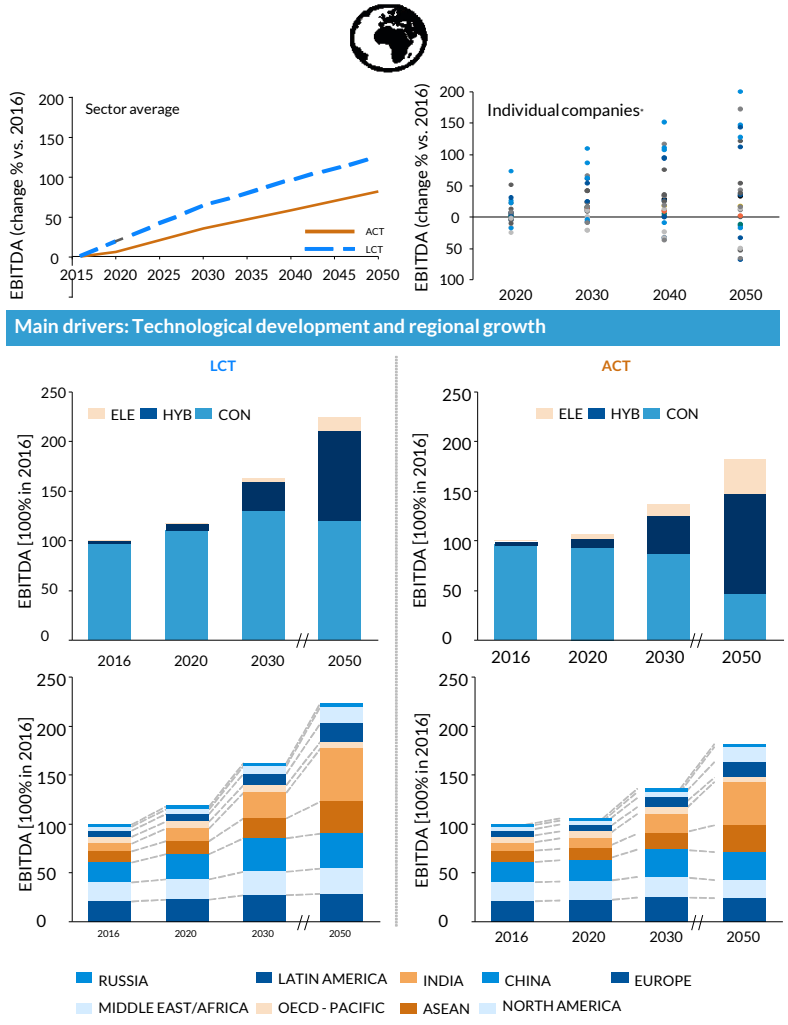
- Overall growth of the passenger vehicle fleet across both scenarios is driven mainly by the developing markets, in particular India and China (Chart 14, top-right).
- The global passenger vehicle fleet is set to grow by 113% by 2050 in LCT (vs. 2016 levels) and by 74% in ACT, a difference of 400m vehicles between the two (Chart 14, top-left).
- Lower vehicle ownership in ACT arises from increased public transport utilisation, as well as emerging trends such as car sharing and ride pooling. Passenger activity (measured in passenger km) is 25% lower in ACT than LCT. This shift in transport demand is fostered by trends such compact cities.
- The ACT scenario sees a larger market share for EVs than LCT (Chart 14, middle-left). Delivering on more ambitious climate targets will require strong growth of low- and zero-carbon vehicles, as well as electricity powered by renewables and biofuels.
- In ACT and LCT, plug-in hybrid vehicles (PHEV) are imperative to the transition from petrol and diesel ICEs to full BEVs (BEVs). Therefore, PHEVs dominate both scenarios, but particularly in LCT.
- In terms of regulation, the removal of fossil fuel subsidies combined with the application of CO2 and differentiated vehicle taxation help achieve climate targets. On the demand side, road pricing is assumed to offset any rebound effect of efficiency improvements.
- Finally, we assume that the emergence of new market players does not occur on a significant scale.

CON = Conventionals, ELE = Full Battery EVs, HYB = Plug-in hybrid vehicles

Source: The CO-Firm

Determinants of company EBITDA performance

Chart 15: Regional and technological diversity drive company earnings performance



*Startups/small companies are excluded from the sample when they show extreme EBITDA changes because they start close to 0 EBITDA in 2016.

CON = Conventionals, ELE = Fully electric vehicles, HYB = Hybrid vehicles

Source: The CO-Firm

Sector earnings grow in LCT and ACT, driven by the developing world (Chart 15, top-left). As expected, ACT exhibits lower EBITDA growth than in the LCT scenario due to lower vehicle demand. Despite the general, positive trend, companies within the sector show significant divergence in growth (Chart 15, top-right).

The main differentiators between winners and losers are regional and technological exposure, and diversity, relative to the peer group:

- PHEVs are the dominant low-carbon vehicle option (38% of sector earnings) in LCT, while BEVs make modest inroads (7%) in the market by 2050 (Chart 15, middle-left).[5] In ACT, the relative market share of these technologies is more even; 48%:25% PHEVs to BEVs in 2050 (Chart 15, middle-right).
- EBITDA also varies in relation to car size. The model accounts for small, medium-large, and premium vehicles, where the profit margin increases with size, across all powertrains.
- PHEVs and BEVs initially have profit margins close to zero due to the large research and development (R&D) investments required in emerging technologies. According to industry experts, however, when economies of scale take hold, EV profit margins will increase and converge with those of ICEs. Differences between vehicle size remain.
- Additional R&D investments are required for efficiency improvements of ICEs. The financial stress caused by double spending can be best accomplished by financially strong companies (accounted for in the adaptive capacity pathway, MARKET REVENUE).
- These profitability drivers are all subject to regional and temporal variations in the model (Chart 15, bottom row).
- Each company's product portfolio, split by car size, is critical to understand company profit margins and earnings. Our data is sourced from WardsAuto and varies according to three size categories: small, medium to large, and luxury cars.

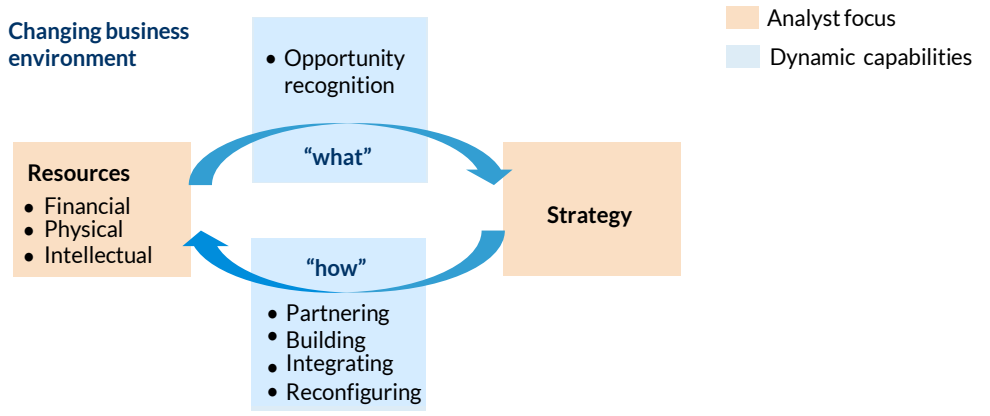
[5] In our scenarios, fuel cell vehicles do not take off.

Building blocks: the market adaptation pathways

Alongside companies' technological and regional portfolios, the financial performance of companies in the future is also likely to be determined by the "strategic approaches" they take to counter changes in their markets, i.e. adaptive capacity.

Adaptive capacity is the degree to which a company is able to "integrate, build, and reconfigure internal and external competencies to address rapidly changing environments". It is the result of dynamic capabilities (partnering, integrating, building, etc.), which allow existing resources (assets, financial pockets, intellectual property) to be put to good use, by means of a strategy (Chart 16).

Chart 16: Explicit (orange) and implicit (blue) factors in an equity analyst's assessment of a company's adaptive capacity



Source: The CO-Firm

The resources of the company, its strategies and dynamic capabilities determine whether it is future-proof

In this study, we run two pathways to test the potential impact of adaptive capacity on company financial performance and valuation.

The "MARKET" pathway

We differentiate between three growth options for a company:

- Rising product demand in existing markets.
- Expansion into new markets.
- A broader product range.

If the market grows, the individual companies are also likely to grow, but the rates could differ

The propensity to grow depends therefore on existing and planned physical resources (regional diversification), intellectual resources (market knowledge, technological expertise) and financial resources (financial means for expansion).

Generally, growth in a market is split between local players (who benefit from market knowledge and customer loyalty) and global players (who benefit from brand recognition and enhanced economies of scale). The degree of market openness varies by country/region and can be driven by regulation[6], as well as customer

[6] At this stage, our modelling does not include China's decision to open up its market.

preference for design and security. Here, we assume that a region's import/export ratio serves as an indicator to determine the market's openness and thus the benefit of being already present in a market; the degree of openness is assumed to be constant over time. Hence, all companies can participate in the growth in existing as well as new markets, but the share varies depending on specific market conditions. The basis for existence/non-existence in a market is determined in 2023 through WardsAuto.

Offering a greater product assortment mainly refers to the extension of the product range with a focus on EVs, which (as seen below) is expressed through increasing market share for EVs. This option is dependent on a company's investment decisions planned until 2023 as determined by WardsAuto.

If a company does not have a strategy to expand the hybrid fleet until 2023, for example, it can still capture some of the overall market growth, but their market share will not increase significantly compared to peers with a hybrid strategy. We consider 2023 to be a reasonable year to fix investment decisions because we see a significant share of vehicle demand for PHEVs in 2030 (in the ACT), to fulfil this demand the respective production cycle needs to be triggered 7-8 years prior, thus in 2022-23. If investment decisions have not been placed by then we consider that knowhow and technology development are hard to catch up.

The "MARKET REVENUE" pathway

This pathway assumes that financially stronger companies (higher sales revenue) have greater potential to capture a larger share of growth

The general dynamics are the same as the MARKET pathway, with the additional assumption that financially stronger companies (higher sales revenues) have greater potential to capture a larger share of growth (Chart 17).

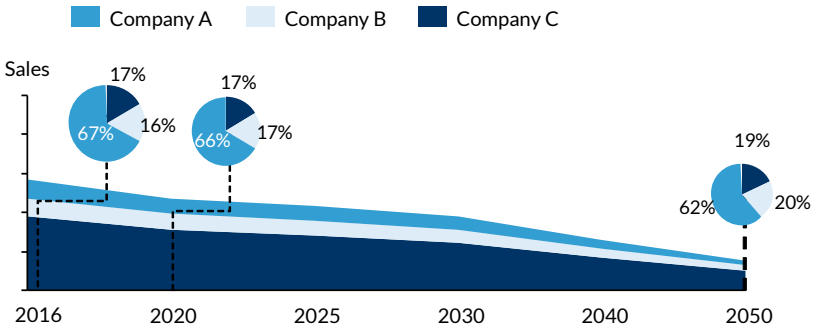
It enables companies with a strong financial position to push more strongly into regional/ technology markets that have good growth prospects and thereby increase their market share. The underlying rationale is that companies in a strong financial position are able to follow a strategy of 'double spending', involving both large R&D expenses for new electrified technologies as well as efficiency improvements of ICEs, and are in a better position to buy their way into markets. Potential first-mover advantages (as forecast by WardsAuto until 2023) are still accounted for.

Finally, FROZEN illustrates the opportunity cost of inaction, i.e. of not seeing the required change or not being able to act upon it. It assumes that a company does not adjust to the changing environment from 2023 onwards. This means that a company only produces the existing technology in the existing regions. FROZEN illustrates the financial extent and speed of the transition that is required for the individual company. Also, it illustrates the speed and strength of the market change, along with the timing of the impact and its extent. This is not a proxy for the cost of transitioning, but, in comparison to the MARKET or MARKET REVENUE pathways, for the cost of inaction.

Chart 17: Three variations of a company's adaptation strategies in the ACT scenario (company and market shares are illustrative)

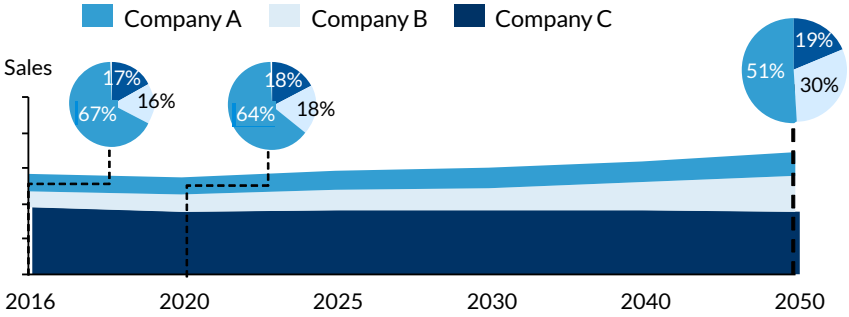
MARKET

Overall market development is fully in line with developments outlined in the climate change scenario. Company growth stems from demand growth in existing markets, expansion into new markets, as well as enlargement of the product range, i.e. EV portfolios. Investment decisions until 2023 (WardsAuto) are crucial for further growth, and technological expertise and regional diversity are the main drivers of success.



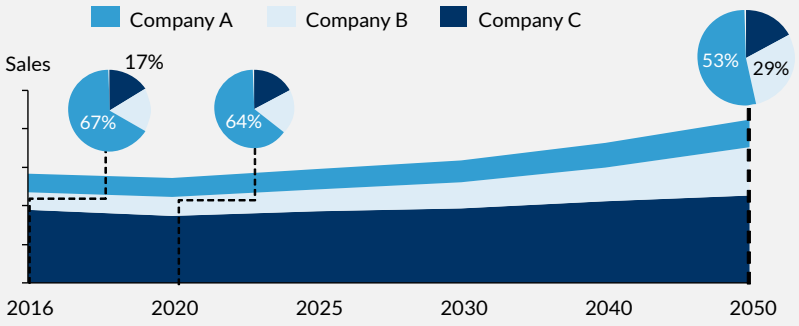
MARKET REVENUE

Market revenues build on the market pathways but also assume that financially solid companies can enter regional/technological markets more aggressively. A company's position compared to the average revenue across all companies determines the annual mark-up growth (twice the average corresponds to a 2% mark-up). This function ensures that the company with the strongest revenue is able to gain a larger share of new investment in EVs compared to companies with average and below-average revenue strength.



FROZEN

The hypothetical cost of inaction after 2023: Each company's expected 2023 product portfolio is frozen until 2050. This assumption is not in line with the scenario; this pathway illustrates the extent of change likely to be seen in this scenario after 2023.



Source: The CO-Firm

Key results: sector and company earnings

Sector findings

- All companies show EBITDA growth to 2050 in both of our climate change scenarios.
- Earnings growth is stronger for each company in the MARKET REVENUE adaptive capacity pathway, reflecting their financial strength to gain market share. The gain in this pathway is most dramatic for VW which is consistent with its superior current EBITDA of EUR40.5bn, compared to Daimler (EUR27.1bn) and BMW (EUR18.4bn) (FY2017), according to KECH analysts.
- Daimler displays the strongest earnings growth of the three, followed by BMW and VW respectively.

The earnings charts presented in this chapter focus just on the ACT scenario and the MARKET REVENUE pathway so not to overburden the reader with information. A full breakdown of the results from all scenario combinations can be found in the accompanying online tool, which you can access at www.et-risk.eu or climateXcellence@co-firm.com.

Key results: BMW

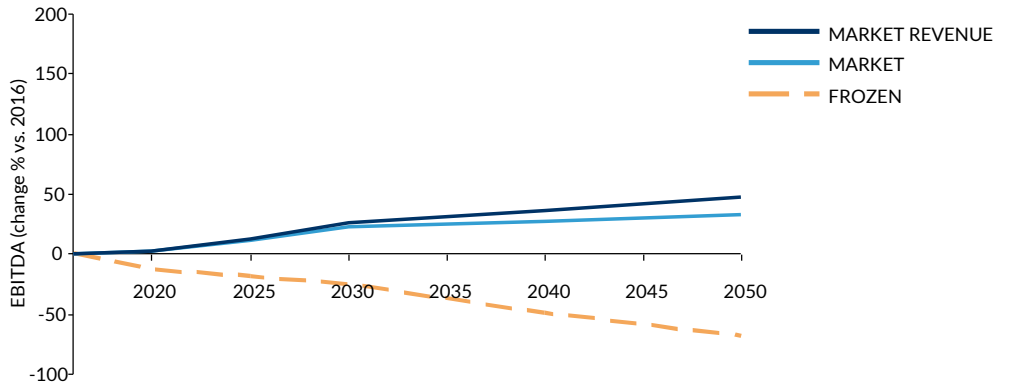
- **Highlight 1:** BMW shows steady EBITDA growth in both adaptive capacity pathways due to its strong position in the European and North American markets (Chart 18).
- **Highlight 2:** BMW's expansion plans in electric powertrains are smaller than the industry average, meaning BMW's earnings in ACT are lower than LCT, the slower transition scenario.
- **Highlight 3:** BMW's portfolio focuses on small and medium sized EVs, which has a dampening effect on earnings growth.

Sustainability report 2017 (link)

Analyst guidance: The results and charts below exclusively highlight findings from a climate risk and opportunity scenario analysis. As such, they neither contain nor provide any assessment of probabilities. They illustrate relative changes in financial parameters over time. Results are subject to the scope (sales of new cars only), the applied operationalised scenarios, corporate adaptation (technology portfolio development: FROZEN, MARKET, MARKET REVENUE, in the current markets and technologies), and the modelling limitations. Companies' portfolio data and new investments until 2023 are based on WardsAuto Production database from 2016 with selected updates based on 2017 data due to dynamics in the industry. Any significant, interim changes in corporate strategies are likely to have an impact on these results. They do not constitute a financial forecast nor investment advice. See Appendix for more information.

Generally, BMW exhibits modest earnings growth in our climate change scenarios until 2050 compared to its 2016 level. This is the case for the two adaptive capacity pathways, MARKET and MARKET REVENUE (Chart 18).

Chart 18: Due to its exposure to both EV technologies, BEVs and PHEVs, BMW is able to modestly increase its EBITDA to 2050 (ACT scenario)



Source: The CO-Firm

BMW shows steady EBITDA growth in both adaptive capacity pathways, particularly to 2030, due to its strong position in the European and North American markets

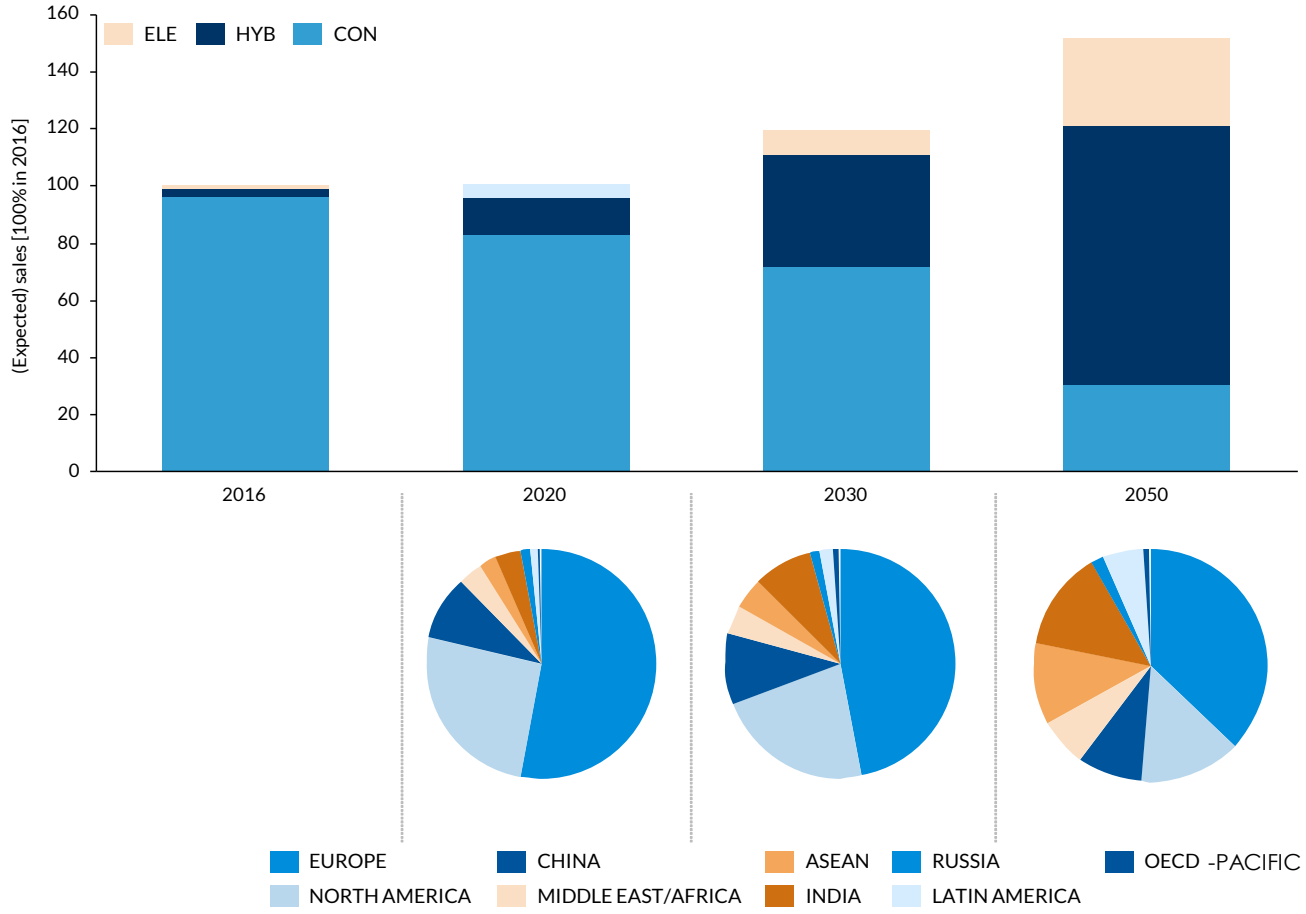
For the MARKET pathway, BMW's earnings growth is below average market growth. Due to its financial strength, BMW performs slightly better on the MARKET REVENUE pathway.

Reasons for BMW's modest earnings growth are outlined below (based on the MARKET REVENUE pathway, general reasoning for MARKET is the same):

- Although, BMW is well positioned in the premium segment in Europe (especially Germany) and North America (NA), both markets depict less growth in vehicle sales compared to the global market. However, these regions see the fastest growth in EVs worldwide, particularly in the near term. As such, Europe and NA would remain BMW's largest sales markets (Chart 19).
- BMW is focusing on both types of EVs, BEVs as well as PHEVs. However, WardsAuto analysts assume that BMW's expansion plans in EVs are less extensive than the industry average. Therefore, BMW's market share gains in the EV market could also be lower than average.
- At present, profit margins are highest for larger, premium ICE vehicles. In contrast, current profit margins for EVs are virtually zero, particularly for smaller vehicle types. BMW's current EV portfolio focuses on small and medium-sized vehicles. Consequently, the more rapid and widespread the transition to e-mobility, the greater the earnings gap that will be created for BMW compared to its conventional powertrain sales. This effect will mostly be seen in the short- and medium-term.
- On the upside, BMW would outperform overall market growth in ASEAN, India, Latin America, OECD-Pacific and Russia.

The more rapid and widespread the transition to e-mobility, the greater the earnings gap that will be created for BMW

Chart 19: Globally, BMW's future sales growth would mainly come from PHEVs



Source: The CO-Firm

Engagement questions:

- What are BMW's plans for diversifying into emerging markets and larger, premium EV models?
- What risks has BMW identified to its EV expansion strategy?
- How do these earnings results compare to BMW's expectations for its EV strategy?

Questions to ask BMW

Key results: Daimler

DAIMLER

2017 Sustainability report (link)

- **Highlight 1:** Daimler's earnings would reflect strong growth in our climate change scenarios (Chart 20), as a result of stronger than average expansion plans for EVs.
- **Highlight 2:** By 2050, Daimler's diversified technology portfolio is likely to gain significant market share in India, the Middle East/Africa and the ASEAN region (Chart 21).
- **Highlight 3:** The company's continued focus on medium-sized and premium EV models in its portfolio will maintain Daimler's profit margins.

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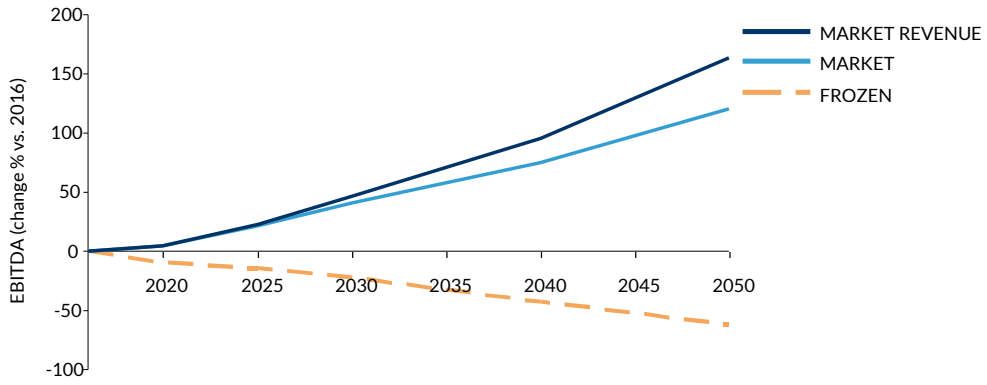
Generally, Daimler shows strong earnings growth to 2050 (note the different scale of chart compared to other companies). This is the case for both the MARKET and MARKET REVENUE pathways.

Chart 20: Daimler's financial strength and expertise in both types of EVs enables it to profit from its transformation under a 2°C scenario (ACT scenario)



Source: The CO-Firm

Daimler to post strong earnings growth in our climate change scenarios, particularly post-2035

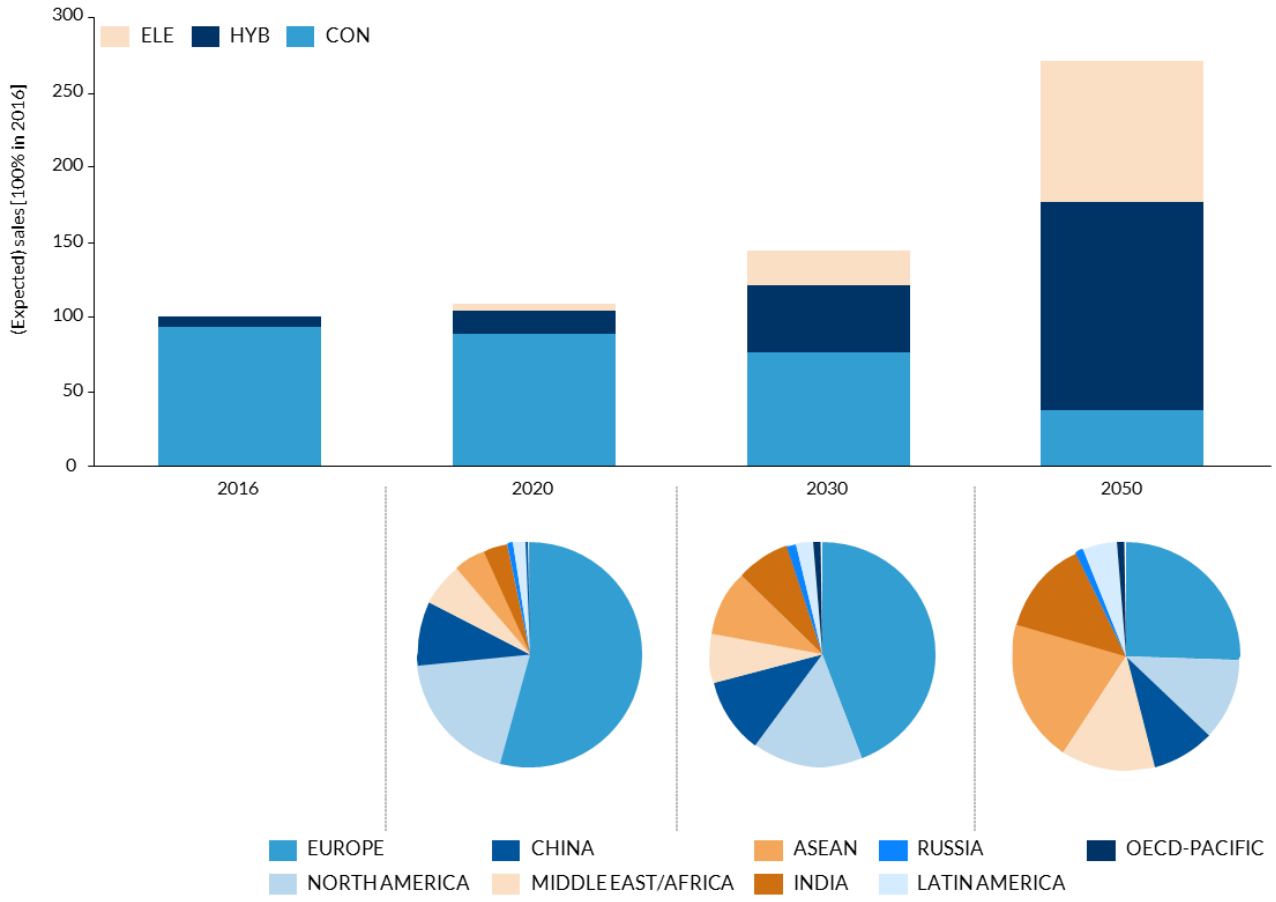
For the MARKET pathway, Daimler's performance would be ahead of the overall market, reflecting its stronger than average expansion plans for EVs, according to WardsAuto analysts. Given Daimler's financial strength, its growth potential is even higher for the MARKET REVENUE pathway.

In particular, Daimler is expected to post strong earnings growth because:

- It plans to continue with its focus on the high-margin, medium-sized and luxury vehicle segment in EVs, as well as conventional powertrains.
- Daimler's future portfolio appears to exhibit growth in both types of EVs, with PHEVs taking a slightly higher share (Chart 21). According to WardsAuto analysts, Daimler would benefit from strong growth in demand for PHEVs, in addition to its significant capacity expansion plans. Comparing Daimler's sales to EBITDA growth, PHEVs contribute more than BEVs, as the number of premium cars being sold as PHEVs is higher compared to BEV premium cars.
- Daimler has the potential to outperform average market growth in every region. In 2050, Daimler's sales are likely to be more regionally diverse than either BMW or VW.
- Daimler is currently well positioned in the premium segment in Europe (especially Germany) and North America (NA). Both markets depict less growth in demand compared to overall market growth. Nevertheless, these markets present an opportunity for EV growth, in which Daimler is likely to take significant share.
- Daimler is likely to gain significant market share in developing regions, partly because it is already present in these regions and partly thanks to its large global market share in EVs. In 2050, ASEAN countries will represent the second-largest sales market for Daimler, after Europe. The weight of the Middle East/Africa and Indian markets in Daimler's sales is expected to match that of the North American market.

Daimler outperforms average market growth in every region

Chart 21: Daimler's sales growth comes from BEV and PHEV sales and developing countries (ACT/MARKET REVENUE scenario)



Source: The CO-Firm

Engagement questions:

- What are the biggest risks to Daimler's strategy for the transition to e-mobility in the short- to medium-term?
- What risks has Daimler identified in its EV expansion strategy?
- How does Daimler see its comparative advantage relative to other vehicle manufacturers materialising in terms of technologies and regional market access?

Questions to ask Daimler

Key results: Volkswagen (VW)

- **Highlight 1:** VW's earnings show negligible growth to 2030 in the MARKET adaptation pathway, before plateauing to 2050.
- **Highlight 2:** Of the three companies analysed, VW exhibits the highest percentage increase in EBITDA in the MARKET REVENUE pathway, compared to the MARKET path, illustrating the company's financial strength versus competitors.
- **Highlight 3:** In the long run, VW is likely to focus on BEVs as its main EV technology form, which will see the highest growth in India.

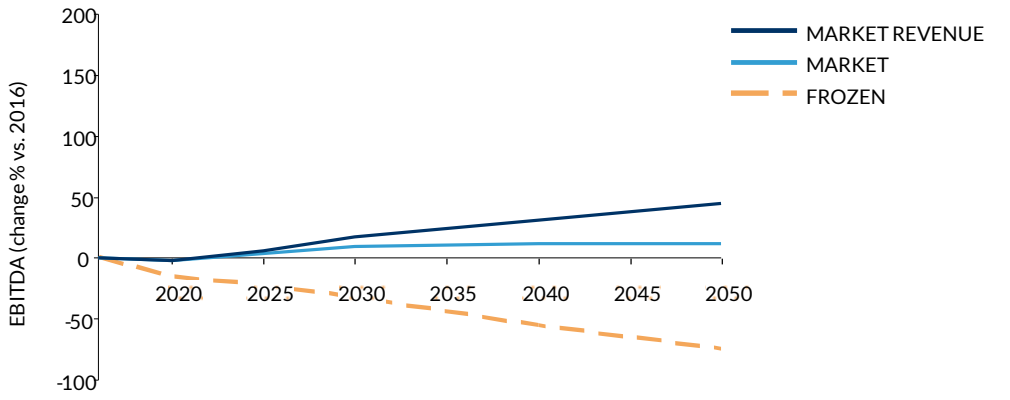
Volkswagen

Sustainability report 2017 (link)

Analyst guidance: The results and charts below exclusively highlight findings from a climate risk and opportunity scenario analysis. As such, they neither contain nor provide any assessment of probabilities. They illustrate relative changes in financial parameters over time. Results are subject to the scope (sales of new vehicles only), the applied operationalised scenarios, corporate adaptation (technology portfolio development: FROZEN, MARKET, MARKET REVENUE, in the current markets and technologies), and modelling limitations. Companies' portfolio data and new investments until 2023 are based on WardsAuto Production database from 2016, with selected updates based on 2017 data due to dynamics in the industry. Any significant interim changes in corporate strategies are likely to have an impact on these results. They do not constitute a financial forecast or investment advice. See Appendix for more information.

Under both adaptive capacity pathways, VW's earnings would fall to 2020 (Chart 22). This dip is caused by a significant drop in conventional powertrain sales in absolute terms, caused by an overall decline in demand in China and Europe. Electric vehicle sales are not expected to make up for this deficit until post-2030 due to the significant size of VW's conventional powertrain production. Thereafter, growth in EVs is expected to take off. Due to VW's financial strength, growth would be significantly higher for the MARKET REVENUE pathway.

Chart 22: VW profits in the MARKET REVENUE scenario, based on BEV sales and growth in India (ACT scenario)



Source: CO-Firm

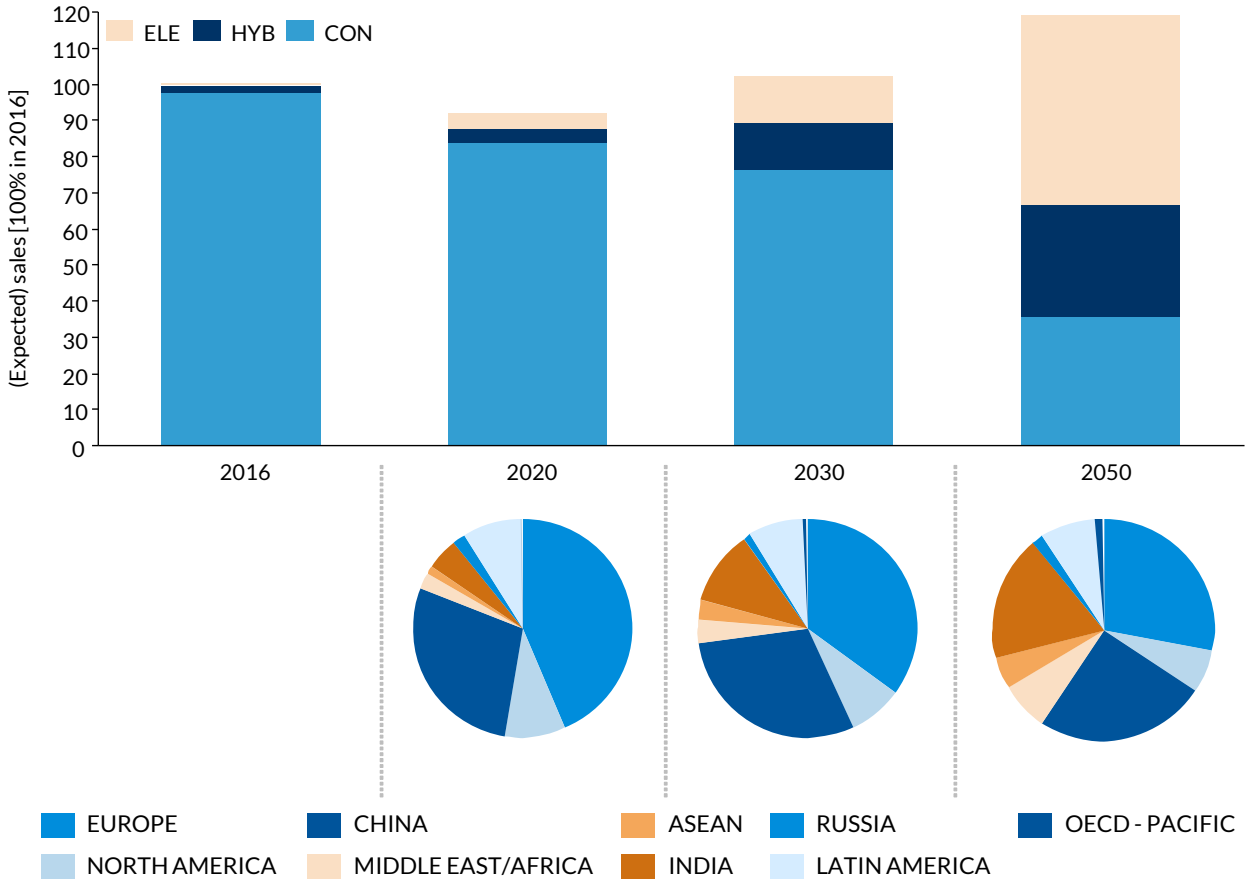
VW's earnings to grow below market average, although, post-2030 would be profitable in the MARKET REVENUE scenario

VW's earnings are expected to grow below market average, particularly for the MARKET pathway, due to the following:

- Whereas VW has a dominant market position for conventional vehicles, this is currently not the case for EVs, especially PHEVs. Therefore, market dominance is not guaranteed in a transition to e-mobility.
- WardsAuto analysts assume stronger than average expansion plans for EVs, with a clear focus on BEVs. In 2050, VW's market share in BEV sales would match its current market share in conventionals, making it possible for VW to maintain its current strong market position. However, the company's market share in PHEV sales is expected to be half the size of its share in BEVs. LCT and ACT are both PHEV-led climate change scenarios, for which VW's earnings could suffer (see Chart 23).
- VW's EBITDA is growing below vehicles sales levels as a result of its focus on zero- to low-margin BEVs in the short-term. Its share of high-margin, medium-sized and premium vehicles is even smaller than in the PHEVs and conventional segments.
- Regionally, the EU and China would continue to be VW's largest markets, followed by India as the third largest market in 2050 for the MARKET REVENUE pathway. Based on sales data, VW would outperform the average market growth in ASEAN, India, OECD-Pacific, Middle East/Africa, and North America in the MARKET pathway.

VW's EBITDA is growing below vehicle sales levels as a result of its focus on zero- to low-margin BEVs

Chart 23: VW's future sales growth would mainly come from BEVs



Source: The CO-Firm

Engagement questions:

- What is VW's strategy in the event that the transition to e-mobility is led by PHEVs in the near term?
- What risks does VW see for its BEV-led EV growth strategy?
- How does VW intend to exploit its broader-than-market-average regional diversity in the future?

Questions to ask VW

Embedding the results within valuations

Analysts and investors are concerned about mispriced assets and subsequent value destruction. Climate change scenarios, such as the LCT and ACT, represent one lens through which potentially mispriced assets can be identified because:

1. **The low-carbon transition is typically considered a long-term issue by mainstream equity analysis, and is subsequently overlooked.**
2. **These scenarios often present sector, country and macro level futures, which are materially different from the consensus view, hereby challenging conventional assumptions.**

Climate change scenarios represent one lens through which potentially mispriced assets can be identified

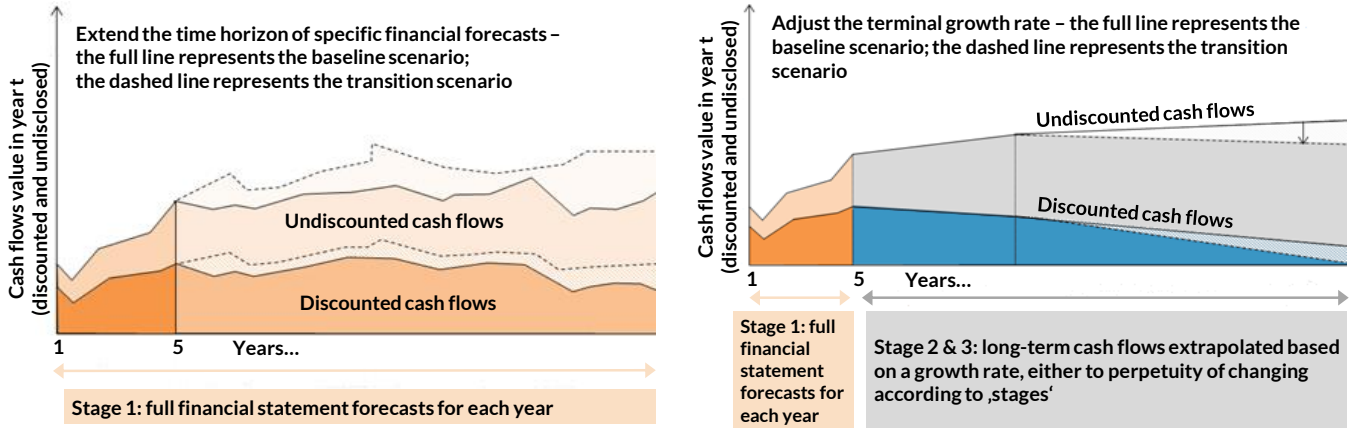
In this section, Kepler Cheuvreux investigates whether the results of transition risk modelling, such as that carried out by our partner The CO-Firm, can be used in bottom-up stock valuation, and if so, how?

Integrating transition risk into valuation modelling

The integration of climate change scenarios into financial modelling can be done via the **growth potential** and/or **risk profile** of specific stocks.

1. The energy transition is likely to affect the **long-term growth potential** of any given company, sector or country. In the context of scenario analysis, analysts can integrate this consideration by extending the time period over which **specific cash flows** are modelled YOY, i.e. extending stage one and testing for different scenarios, Chart 24. Alternatively, an analyst could change either the **growth** rate used in stage two of a stock valuation or the perpetuity rate used in stage three.

Chart 24: Either extending specific cash flows or adjusting stage two or the growth rate to perpetuity



Source: Kepler Cheuvreux

2. Low-carbon transition pathways, as captured by these scenarios, can also affect the **risk profile** of a company. It is worth noting that the notion of risk in finance refers to the variability from an expected outcome, either positive or negative, even if in practice investors are more concerned about downside risks. This is captured in the **discount rate**, which can be adjusted to reflect an analyst's perception of risk to the stock's future cash flows.

The CO-Firm model provides extended cash flows to 2050, and is therefore more amenable to the first option (growth). Our results apply this methodology for integrating climate change scenarios into equity valuations, prior to highlighting what could potentially be done on the risk side of the story, if preferred by an analyst.

The CO-Firm model provides extended cash flows to 2050, and is therefore more amenable to altering the company growth profile

Identifying potentially mispriced assets

Investors are increasingly asking the question: **What could the valuation of a company be under a climate change scenario?** This question hints at the potential gap between current company valuations and what they could be under a climate change scenario, hereby providing information on the potential mispricing of a stock. This is the approach taken in this study, focusing on a climate scenario with a global mean temperature increase of 2°C in 2100.

The "consensus" baseline valuation

We compare the company valuation estimates from our climate change scenarios with a market "consensus" baseline. This baseline is comprised of:

- Bloomberg consensus data from 2018-23E on company EBITDA, depreciation, and capex from the passenger vehicle segment.
- From 2024-50E, the baseline assumes that company cash flows from passenger vehicles will grow in line with the terminal growth rate of each company applied by KECH's own equity analysts.
- We model the company cash flows to perpetuity (post-2050E) by applying the terminal growth rate and discount rate used by KECH analysts to the company's average annual cash flows between 2040E and 2050E.

Any difference between the consensus baseline valuation and that of the LCT scenario provides insight into the current potential mispricing of the stock due to the short-term nature of valuation models.

Any difference between the baseline valuation and the one included in our scenarios provides insight into a potential mispricing of the stock

Any difference between the consensus baseline valuation and that of the ACT scenario highlights the current potential mispricing of a stock compared to a world which limits global warming to 2°C above pre-industrial limits.

Key considerations for auto company valuation

Company valuation is a dynamic process that changes over time, particularly in the automotive sector. In view of the fact that visibility in the auto sector is typically no more than one year, most of the time investors are most concerned about the short-term outlook for financial metrics when pricing stocks in the sector. At present, in view of macro turmoil, the importance of short-term cash flows on the overall company valuation is relatively higher than in previous years. Certainly, the weighting of short-term factors on company valuations in the automotive sector is higher than in other sectors such as utilities.

It is important to note that the transition to e-mobility is just one factor that affects the valuation of an automotive company, and the results of this analysis should be considered in that context. However, the low-carbon transition could change not only the automotive industry's growth rate forecasts, but also a company's positioning in a specific market, or its ability to adapt and maintain higher than

industry-average returns. In this context, could climate change scenarios be used to derive a growth profile for each company which is more specific to the risks and opportunities brought to the table by the low-carbon transition?

Altering the growth profile of our stocks

Our approach to valuation modelling for the three automotive companies selected in this study consists of:

- The same company EBITDA, depreciation and capex data for passenger vehicles from Bloomberg for 2018-23E that is used in the consensus baseline. This reflects our assumption that the consensus adequately reflects financially-relevant shorter-term transition risks.
- Extending the modelling of specific cash flows from 2024-2050E by using The CO-Firm's product and region-specific climateXcellence model (see Appendix), added up to the company level. This reflects our view that consensus data does not adequately evaluate and price in transition risks post-2023.
- Calculating the company's cash flows to perpetuity, as in the baseline scenario, by applying the discount rate and terminal growth rate used by KECH's equity analysts to the average company cash flows from 2040E to 2050E.

As a result, the bulk of the discrepancy between company valuations in the climate change scenarios and the consensus baseline is attributable to the difference in company cash flows in 2024-50E.

Valuation results: winners and losers

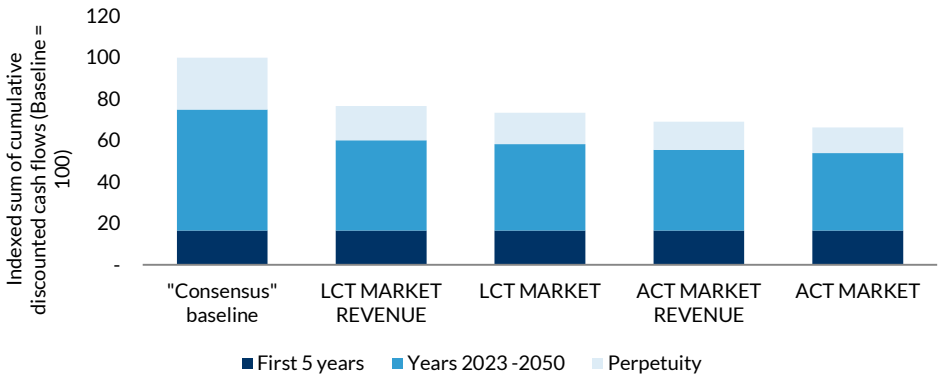
Under the assumptions made in our methods highlighted above, we find that:

- BMW and VW could be overvalued in the consensus baseline, compared to the climate change scenarios, while Daimler could be undervalued if the passenger vehicle segment were to follow the path of either the LCT or ACT scenarios.
- BMW and VW are more highly valued in the LCT scenario versus ACT, while the opposite is true for Daimler.
- All three companies are more highly valued for the MARKET REVENUE adaptive capacity pathway than MARKET.

Results in focus

Our analysis suggests that BMW would be the most overvalued of the three companies in the consensus baseline, compared to its market valuation in the climate change scenarios. Chart 25 suggests that BMW's valuation could fall from the ongoing transition to limit global warming to 2.7°C (LCT), while it would fall further from additional efforts to meet a 2°C climate target (ACT).

Chart 25: BMW is the most overvalued of our companies in the consensus baseline, compared to its valuation in both of the climate change scenarios



Source: Kepler Cheuvreux; "Consensus baseline" represents current five-year cash flow estimates per Bloomberg valuation Excel tools and our analysts' discount and terminal growth rates. It is therefore not the consensus of all analysts' current forecasts. Other dat a based on The CO-Firm climateXcellence model

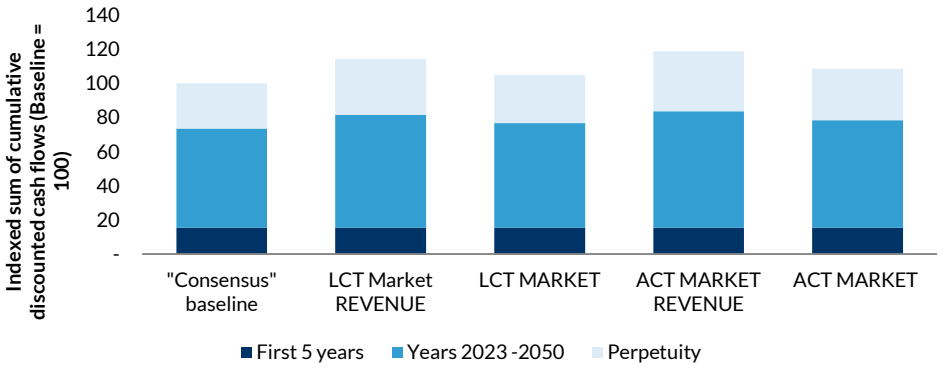
BMW's valuation would not benefit from the climate change scenarios

BMW's cumulative discounted cash flows are higher in an LCT scenario versus ACT due to greater global demand for passenger vehicles. Additionally, the larger market share maintained by conventional powertrains in an LCT scenario versus ACT favours BMW, which has a strong market position in premium ICEs.

Within each climate change scenario, the MARKET REVENUE pathway yields slightly higher discounted cash flows compared to the MARKET path because BMW's financial strength would result in slightly higher growth in new markets, regionally as well as technologically.

Daimler is the only company of the three which appears to be undervalued in the consensus baseline, compared to its projected discounted cash flows under different climate change scenarios. Chart 26 suggests that Daimler's earnings could show marginally stronger growth under the ACT scenario than LCT. It is clear that Daimler is in a position to use its financial strength to bolster future earnings (MARKET REVENUE).

Chart 26: Daimler is potentially undervalued at present under the lens of the LCT and ACT climate change scenarios



Source: Kepler Cheuvreux; "Consensus baseline" represents current five-year cash flow estimates per Bloomberg valuation Excel tools and our analysts' discount and terminal growth rates. It is therefore not the consensus of all analysts' current forecasts. Other data based on The CO-Firm climateXcellence model

Daimler is the only company which appears to be undervalued in the baseline scenario

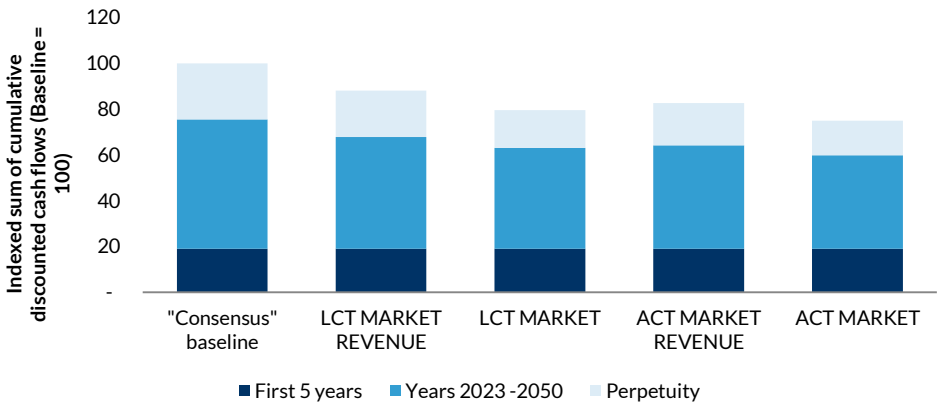
Daimler has a perfect storm of the characteristics required to profit in climate change scenarios such as LCT and ACT:

- Strong market position in electrified powertrains, especially PHEVs.
- Ambitious future EV expansion plans.
- Strong regional diversification.
- A focus on larger profit margin EV vehicle types, e.g. medium-sized and premium models.

VW could be marginally overvalued in the consensus baseline

Chart 27 suggests that VW could be marginally overvalued in the consensus baseline, compared to its projected cash flows under different climate change scenarios. Our results for VW follow the same trends as for BMW – discounted cash flows are higher in the LCT scenario versus ACT, and in MARKET REVENUE versus REVENUE, with the difference being very pronounced in the case of the latter, reflecting VW's financial strength.

Chart 27: VW could be marginally overvalued in the baseline, compared to climate change scenarios



Source: Kepler Cheuvreux; "Consensus baseline" represents current five-year cash flow estimates per Bloomberg valuation, Excel tools, and our analysts' discount and terminal growth rates. It is therefore not the consensus of all analysts' current forecasts. Other dat a based on The CO-Firm climateXcellence model

VW's valuation falls due to:

- An earnings hit to 2020, as conventional powertrain vehicle sales fall due to an overall reduction in vehicle demand in the ACT scenario, which cannot be compensated for by increased sales of EVs. VW would not recover and surpass 2016 sales levels until 2030. In the LCT scenario, VW's sales would grow at the same rate as the market for ICEs but at only half the rate for PHEVs.
- VW's focus on small BEVs would not become a profitable strategy until close to mid-century. Up to this point, it would fall behind competitors which are better placed to capitalise on the growth of PHEVs.
- VW has the greatest exposure to the Chinese market, which helps to bolster the company's valuation during other strategic turbulence.

A reflection of one future and one valuation

We temper the results presented above with the fact that they represent only one pathway for the passenger vehicle segment to be consistent with each pre-determined temperature target, without any probability attached. In fact, there are numerous ratios of ICEs/EVs in the passenger vehicle fleet, which could deliver each global warming outcome. The technological and regional structure of the scenario chosen for analysis has significant implications for the resulting company valuations.

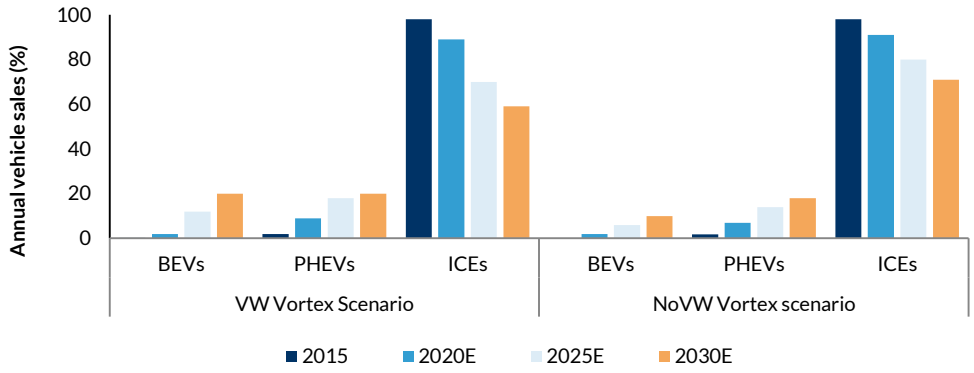
How might the EV market grow, according to KECH's equity analysts?

The LCT and ACT scenarios have been generated by The CO-Firm and derived from the IEA's 2017 Energy Technology Perspectives report. This climactic approach results in different outcomes for the passenger vehicle market to the market based approach in scenarios produced by KECH equity analysts (Michael Raab CFA, December 2017).

KECH tested two different pathways (Chart 28):

- **"VW Vortex" scenario**: A pathway in which VW exerts its influence on the automobile industry and acts as a trailblazer for the widespread industrialisation of e-mobility. Annual global sales of ICEs would peak in 2020, falling to 59% of the market by 2030. Meanwhile, BEVs would grow to 20% of global sales, as would PHEV sales. According to Raab in December 2017, the probability of this scenario materialising has risen since these scenarios were first run in March 2017.
- **"No VW Vortex" scenario**: Annual sales of ICEs would still lose market share to 2030, but would remain more robust than the previous scenario at 71%. EVs (BEVs + PHEVs) would capture 28% of annual sales in 2030 in this scenario, compared to 40% in the "VW Vortex" scenario.

Chart 28: Modelling the possible impact of VW's financial strength on future EV growth

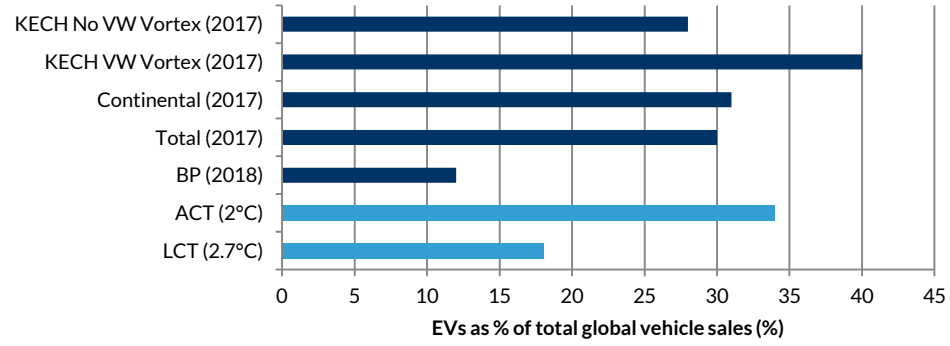


Source: Kepler Cheuvreux, 2017

In KECH's VW Vortex scenario, the annual market share of BEV and PHEV sales by 2030 would be the same…

Both KECH's VW Vortex and No VW Vortex scenarios foresee bullish growth in EVs to 2030, relative to companies from related industries (Chart 29). Both Continental (autos and parts) and Total SA (oil and gas major) have projected EV sales reaching a market share of approximately 30% by 2030. BP's (oil and gas major) central "Evolving Transition" is more bearish on the prospects for EVs.

Chart 29: Contextualising KECH's EV sales scenarios in industry projections in 2030



Source: Kepler Cheuvreux, 2017; BP Energy Outlook, 2018; Continental Investor Presentation, 2017; Total, 2017; The CO-Firm scenarios

… this is largely at odds with the ACT and LCT scenarios, in which the tipping point from PHEVs to BEVs occurs much later

The devil is in the details for company valuations

It is important to note that in KECH's VW Vortex scenario, the market share of annual BEV and PHEV sales by 2030 is the same. This comes as a result of accelerated improvements in the cost, performance, and supplementary infrastructure for BEVs in this scenario.

In the LCT scenario used in this study, overall EV sales are at the lower end of market estimates. The more ambitious target for limiting global warming in ACT results in higher EV sales than in LCT, mainly from PHEVs. The discrepancies in the number and, in particular, the type of EVs sold in the ACT/LCT and KECH scenarios lead to very different conclusions on company valuations.

For example, in this scenario analysis, VW's valuation is lower in the LCT and ACT scenarios than in the consensus baseline. Contrastingly, KECH's equity analysts perceive VW to be one of the best-positioned companies for the shift to e-mobility.

VW's earnings and valuations will fare better in KECH's scenarios than the LCT and ACT scenario

"VW is once again proving to be a game-changer in the industry with its ambition to become the leader in e-mobility by 2025; we think its chances are realistic. In our view, the uniqueness of its set-up, combined with cost reductions will allow it to cope with the financial challenges of developing new technologies, while simultaneously paying its fines for the diesel scandal." (Michael Raab, Kepler Cheuvreux, 2017)

Given VW's prioritisation of BEV technologies over PHEVs – by 2030 it plans to offer 50 BEV models compared to 30 PHEV - it is clear that VW's earnings and valuation prospects will be stronger in KECH's scenarios than the LCT and ACT scenarios, which see negligible BEV market penetration to 2050.

Further limitations

We highlight two additional limitations of the integration of climate change scenarios into company valuations:

- **Scope and calibration:** Scenario results only cover passenger vehicle activities and exclude other vehicle types, e.g. buses, medium-duty vehicles, and non-automobile sources of revenue. According to Bloomberg, non-passenger vehicles accounted for 27.7% and 46.8% of VW and Daimler's revenues in 2017. BMW's financial reporting is less granular, but shows that non-automobile services accounted for 28.5% of revenues in 2017. Therefore, there is a clear limitation in conducting an assessment of a company/group's overall valuation based on future cash flows from a 50-75% portion of that company. It is more appropriate to say that this approach *gives an indication* of the possible valuation impacts on the company from the transition to e-mobility in the passenger vehicle sector.
- **Perpetuity assumption:** This analysis assumes that these companies will neither cease operations, nor be delisted or bought. This is directly rooted in the way DCF models are built, but it is highly unlikely. Indeed, the average age of an S&P company was 90 years in the 1930s, 61 years in 1958, and down to 18 years in 2012 (link) – mostly due to changes in size and M&A activity. By understanding the percentage of discounted cash flows arising from different time periods, analysts can understand the impact of different events on the total company valuation.

Company risk profiles: the other side of the coin

Our approach for embedding transition risks into valuations has been to alter the company's growth profile. As highlighted earlier, another approach would be to alter the company's risk profile. A company is considered to have high financial risk if the likelihood that investors could receive a return that is different from what was expected is high. In this context, a company which is more exposed to, or less prepared for, transition risks would have riskier/less certain future cash flows than a company with opposite qualities.

A company is considered to have high financial risk if the likelihood that investors could receive a return that is different from what was expected is high

This is usually captured through the discount rate. One way to calculate the discount rate (also known as the cost of capital) is through the capital asset pricing model (CAPM) (Chart 30).

Chart 30: The capital asset pricing model (CAPM) formula to determine the discount rate

$$E(R_i) = R_f + \beta_i[E(R_m) - R_f]$$

$\boldsymbol{E(R_i)}$ **= cost of equity**
R_f = risk–free rate
$\boldsymbol{\beta_i}$ **= beta of asset i; a measure of systematic risk**
$E(R_m)$ = return of equity
$\mathbf{[E(R_m) - R_f]}$ **= equity market risk premium, a measure of the excess return of the market portfolio over the risk-free rate**

$E(R_i)$ feeds into the "weighted average cost of capital", used as the **discount rate** in DCF models

Source: Kepler Cheuvreux

There are two sides to the CAPM equation: the equity risk premium and the beta. Deciding which variable is most appropriate to adjust depends on the story that one wants to tell, i.e. whether we want to investigate the historical sensitivity of companies' stock prices to transition-related shocks, or how this sensitivity is changing as their strategy and exposure evolves. This is beyond the requirements of this study, but provides insight into the variables and methodology that go into calculating the appropriate discount rate for each stock.

Sensitivity analysis

The valuation methodology in this study applies the terminal growth rate (TGR) – typically in line with the overall sector growth rate - and discount rate (DR) used by KECH's equity analysts. In the case of the three companies selected for this analysis, these rates are the same: 2% TGR and 5.9% DR, highlighted in gray in the tables below.

In Tables 1-3, we conduct a sensitivity analysis of different TGRs and DRs to illustrate the degree to which changing these input assumptions, and the risk profile of the stock, can affect its overall valuation. Our analysis shows that varying the DR

and TGR by 1% above or below KECH's equity analyst's assumption for each stock can affect the valuation of our selected automobile companies by approximately ±25-35%.

Table 1: BMW difference between the baseline and ACT/MARKET REVENUE (orange text indicates scenarios in which BMW's valuation is lower than the consensus baseline)

		Terminal growth rate				
		1.0%	1.5%	2.0%	2.5%	3.0%
Discount rate	4.90%	-13%	-19%	-25%	-31%	-37%
	5.40%	-13%	-18%	-24%	-30%	-35%
	5.90%	-13%	-18%	-23%	-28%	-34%
	6.40%	-13%	-17%	-22%	-27%	-32%
	6.90%	-12%	-17%	-22%	-24%	-31%

Source: Kepler Cheuvreux

Table 2: Daimler difference between the baseline and ACT/MARKET REVENUE (blue text indicates scenarios in which Daimler's valuation exceeds the consensus baseline)

		Terminal growth rate				
		1.0%	1.5%	2.0%	2.5%	3.0%
Discount rate	4.90%	38%	30%	21%	13%	4%
	5.40%	35%	28%	20%	12%	4%
	5.90%	33%	26%	19%	11%	4%
	6.40%	31%	24%	18%	11%	4%
	6.90%	29%	23%	16%	10%	4%

Source: Kepler Cheuvreux

Table 3: VW difference between the baseline and ACT/MARKET REVENUE (orange text indicates scenarios in which VW's valuation is below the consensus baseline)

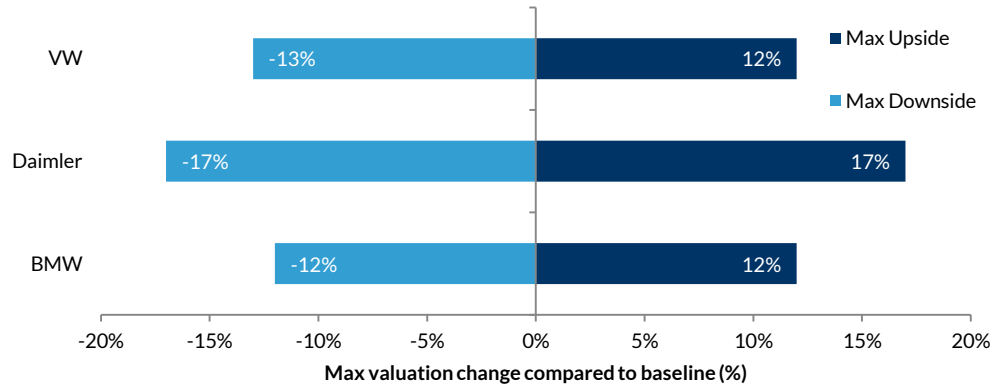
		Terminal growth rate				
		1.0%	1.5%	2.0%	2.5%	3.0%
Discount rate	4.90%	-1%	-7%	-13%	-20%	-26%
	5.40%	-1%	-7%	-13%	-19%	-25%
	5.90%	-2%	-7%	-13%	-18%	-24%
	6.40%	-2%	-7%	-12%	-17%	-23%
	6.90%	-3%	-7%	-12%	-17%	-22%

Source: Kepler Cheuvreux

Valuation model inputs reflect the beliefs of the analyst. Conducting sensitivity analyses, such as Tables 1-3, is a useful exercise to understand how resilient or volatile a company valuation estimate is to alterations in these inputs. Chart 31 shows how the valuation of each stock can change relative to the baseline if one changes our equity analyst's DR and TGR. Chart 31 shows that Daimler's valuation is the most sensitive to changes in valuation assumptions. Daimler's value in an ACT/MARKET REVENUE scenario can either exceed that of the consensus baseline by a further 17%, depending on the analysts' input assumptions, or converge on this baseline by 17%. This swing would be in the region of 12% for BMW and VW.

Conducting sensitivity analyses is a useful exercise to understand how resilient or volatile a company valuation estimate is to model inputs

Chart 31: Varying our analysts' DR (5.9%) and/or TGR (2%) results in upward and downward valuation swings for all three companies in our climate change scenarios



Source: Kepler Cheuvreux

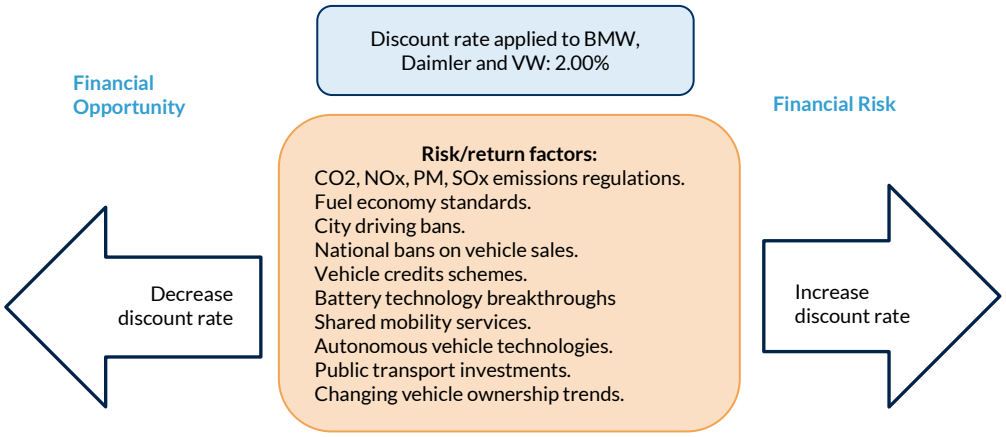
Why change the discount rate?

One might want to amend either the DR or TGR of a company if it holds a different view from that of the equity analyst. The TGR typically reflects the expected growth rate for the industry in question, or sometimes it simply represents future economic growth. The discount rate reflects the rate at which future cash flows are discounted. It is used to internalise risk in the valuation calculation; the greater the perceived risk to future company cash flows, the higher the discount rate, and vice versa.

The more risk there is perceived to be to future company cash flows, the higher the discount rate

Throughout this report, we have highlighted a number of different regulatory and technological factors which could impact the earnings and valuations of auto companies in the event of a low-carbon transition. If one's view differs from that of our analyst, a different discount rate could be applied to the stock valuation to reflect whether that difference would give rise to upside (opportunity) or downside (risk) impacts on the company in question. The diagram below (Chart 32) illustrates how a discount rate could be changed to reflect an analyst's views on regulatory and technological criteria.

Chart 32: A discount rate should reflect an analyst's perception of risk-return from key criteria in the sector



Source: Kepler Cheuvreux

Assessing companies' adaptive capacity

Adaptive capacity is the result of dynamic capabilities (partnering, integrating, building, etc.), which allow existing resources (e.g. assets, financial pockets, intellectual property, etc.) to be put to good use, by means of a strategy (Chart 16). These dynamic capabilities comprise, for example, the ability to perceive external market changes, engage in alliances, reconfigure internal resources for future use, etc.

Adaptive capacity is the result of dynamic capabilities, which allow existing resources (e.g. assets, financial pockets, intellectual property, etc.) to be put to good use, by means of a strategy

These need to be closely analysed when assessing whether an individual company is "future-proof", especially in transitioning sectors. In this comprehensive scenario analysis across the global passenger vehicle segment, The CO-Firm assumes that all companies have the same dynamic capabilities at their disposal. Therefore, their adaptive capacity is differentiated by their current resources, i.e. physical, intellectual and financial assets, and their fit within future market requirements under the scenario. This assumption creates a data-driven, reproducible basis for comparing companies.

Traditionally, adaptive capacity forms part of an analyst's judgement in an implicit fashion, for example, when judging the credibility of strategic announcements or financial forecasts ("can the company really do it?"), and/or under the label "management quality".

By comparison, explicit consideration is given by the analyst to the company's current resource base (EBITDA, current model mix, etc.), the implementation of strategies in the transformation process (R&D expenditures), and strategic targets (model strategy).

An example of bottom-up adaptive capacity assessment

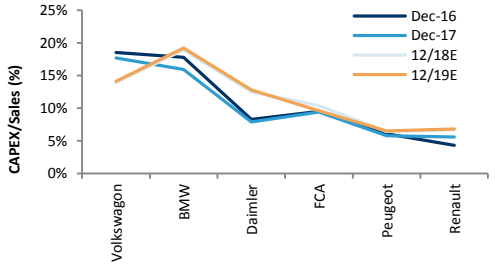
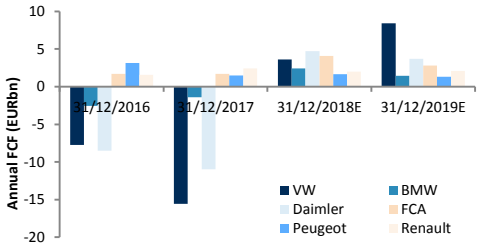
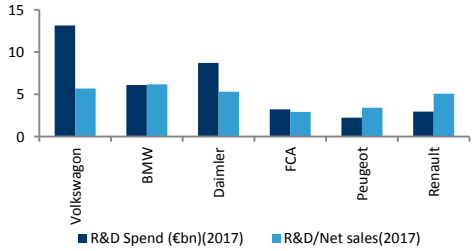
In Table 4, we show a sample assessment of a company's adaptive capacity to transition risks and opportunities. This is not exhaustive; for example the "partnering", "integrating", and "reconfiguring" adaptive capacity criteria are not addressed. Furthermore, The CO-Firm and Kepler Cheuvreux focus solely on the passenger vehicle segment. Thus, the potential to offset weaker growth or losses through other business units is not analysed.

However, this assessment maps: 1) Kepler Cheuvreux's bottom-up assessment framework and criteria; with 2) The CO-Firm's conceptual framework for adaptive capacity of resources, strategies and dynamic capabilities.

Our multi-criteria adaptive capacity assessment confirms that Daimler, BMW and VW are financially stronger and more flexible financially than their European peers. This has allowed them to adopt double-spending strategies, i.e. investing in both EV expansion plans and efficiency improvements for their ICE fleets. VW is following the most aggressive EV strategy. The assessment finds climate change expertise to be lacking at the board level across the companies, while explicit target setting for CO2 and pollutants is also sparse.[7]

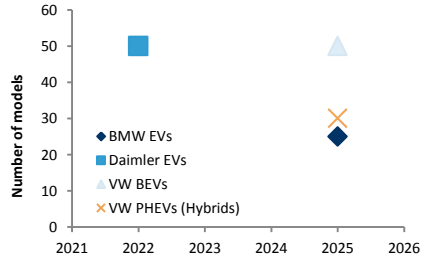
[7] We note that the companies featured in Table 4 also derive revenue from products outside the passenger vehicles segment - according to Bloomberg, non-passenger vehicles accounted for 27.7% and 46.8% of VW and Daimler's revenues in 2017, and non-automotive products for 28.5% of BMW's revenues in the same year. Therefore, comments and comparisons on financial metrics such as capex and R&D spend should be taken as illustrative of a company's future automotive spending behaviour, as these resources could be committed to non-passenger vehicle business segments.

Table 4: An illustrative (not exhaustive) multi-criteria adaptive capacity assessment of BMW, Daimler and VW versus their European peers (as determined by Bloomberg)

Conceptual embedding	Criteria	Metric	Data analysis	Estimated impact on adaptive capacity	Description
	P&L				
Resources	Capital allocation, investments	Capex	 Source : Kepler Cheuvreux	BMW: Positive Daimler: Neutral VW: Positive	VW and BMW are implementing an aggressive capital expenditure strategy to gain market share, much like the MARKET REVENUE adaptive capacity pathway applied in this report. To date, Daimler's capex-to-sales ratio is in line with other European peers. KECH's analysts expect Daimler to increase this ratio to end-2019E, following more in the footsteps of VW and BMW.
Resources, Strategy	Revenues, earnings and cash flows	Free cash flow	 Source : Kepler Cheuvreux	BMW: Neutral Daimler: Neutral VW: Positive	In spite of their double-spending strategies, KECH expects BMW, Daimler and VW to be cash flow positive by end-2018E, leaving these companies with some capital flexibility. However, we anticipate the biggest swing for VW, which is expected to be rewarded for its bold spending approach.
	Intangible assets				
Resources (Building)	Technological expertise and innovation	R&D spend	 Source : Bloomberg	BMW: Positive Daimler: Positive VW: Positive	R&D spending by BMW, Daimler and VW exceeds that of their peers, both in absolute terms and relative to net sales. This confirms that these companies are following a strategy of "double-spending" in this transitionary period. Building capacity in conventional and alternative powertrains should prepare these companies for a range of potential market shifts.
	Disclosure of metrics and targets				
Resources	Vehicle emissions	CO2 emissions of fleet	Only BMW has a target in place for CO2 emissions reduction from its vehicle fleet (50% reduction from 1995 levels)	BMW: Positive Daimler: Neutral VW: Neutral	To a degree, vehicle fleet emissions are governed by regional regulations, so company targets are somewhat pre-determined.

Source: Kepler Cheuvreux

An illustrative (not exhaustive) multi-criteria adaptive capacity assessment of BMW, Daimler and VW versus their European peers (as determined by Bloomberg) - continued

Conceptual embedding	Criteria	Metric	Data analysis	Estimated impact on adaptive capacity	Description
	Governance				
Resources (Expertise), **Opportunity Recognition** (Quality, Oversight)	Expertise, quality and oversight	Climate change expertise	N/A	BMW: Negative Daimler: Negative VW: Negative	No discernible climate change expertise on the board of directors of any of the three companies.
	Tangible assets				
Strategy	Capacity	Production of EV models	 Source : Kepler Cheuvreux	BMW: Neutral Daimler: Positive VW: Positive	BMW (25), Daimler (50) and VW (80) all look set to offer consumers a wide range of EV models (both BEVs and PHEVs) by 2025E. VW is seeking a BEV-led strategy, while Daimler and BMW have yet to disclose the technological breakdown of their EV product lines.
	Strategy				
Strategy, resources	Alignment with structural trends	EV targets	• BMW: No details on EV CAPEX spend; 25 EV models by 2025E; extend EV range to 700km; 400 charging stations by 2020E. • Daimler: EUR10bn EV capex spend "in the years ahead"; battery and EV production in China from 2020E. • VW: 80 EV products to 2025E; EUR20bn EV capex spend to 2030E; battery density and EV range targets to 2025E.	BMW: Neutral Daimler: Neutral VW: Positive	All companies are seeking to align with the transition to e-mobility. Based on publicly made announcements, VW is driving the transition.
Opportunity Recognition	Risk management	Scenario analysis	• Scenario analysis is conducted at BMW, Daimler and VW. • BMW and Daimler conduct macroeconomic scenarios. • BMW and VW conduct different drivetrain scenarios to understand price, margin and material demand risk.	BMW: Positive Daimler: Neutral VW: Positive	BMW and VW have more detailed discussions of scenario analysis as a risk management tool in their 2017 annual report. BMW states that its risk and opportunities analysis only looks at the next two years. This could be typical across the sector. Two-year analysis is unlikely to be long enough to pick up the majority of transition risks highlighted in this report.

For reference, company market cap as of 25 May 2018: BMW (BMW GR) EUR58.9bn, Daimler (DAI GR) EUR73.0bn, VW (VOW GR) EUR86.7bn, FCA (FCAU US) EUR29.9bn, Peugeot (UG FP) EUR18.9bn, and Renault (RNO FP) EUR27.1bn.

We note that the companies featured in Table 4 also derive revenue from products outside the passenger vehicles segment - according to Bloomberg, non-passenger vehicles accounted for 27.7% and 46.8% of VW and Daimler's revenues in 2017, and non-automotive products for 28.5% of BMW's revenues in this year. Therefore, comments and comparisons on financial metrics such as capex and R&D spend should be taken as illustrative of a company's future automotive spending behaviour, as these resources could be committed to non-passenger vehicle parts of the business.

Source: Kepler Cheuvreux

Appendix: climateXcellence model

This section builds on:

- Validation by a broad range of financial and ESG analysts, academics, and practitioners over the last five years.
- Model co-development and extensions with Allianz Global Investors, Allianz Climate Solutions, WWF Germany, and the Investment Leaders Group hosted by the University of Cambridge.

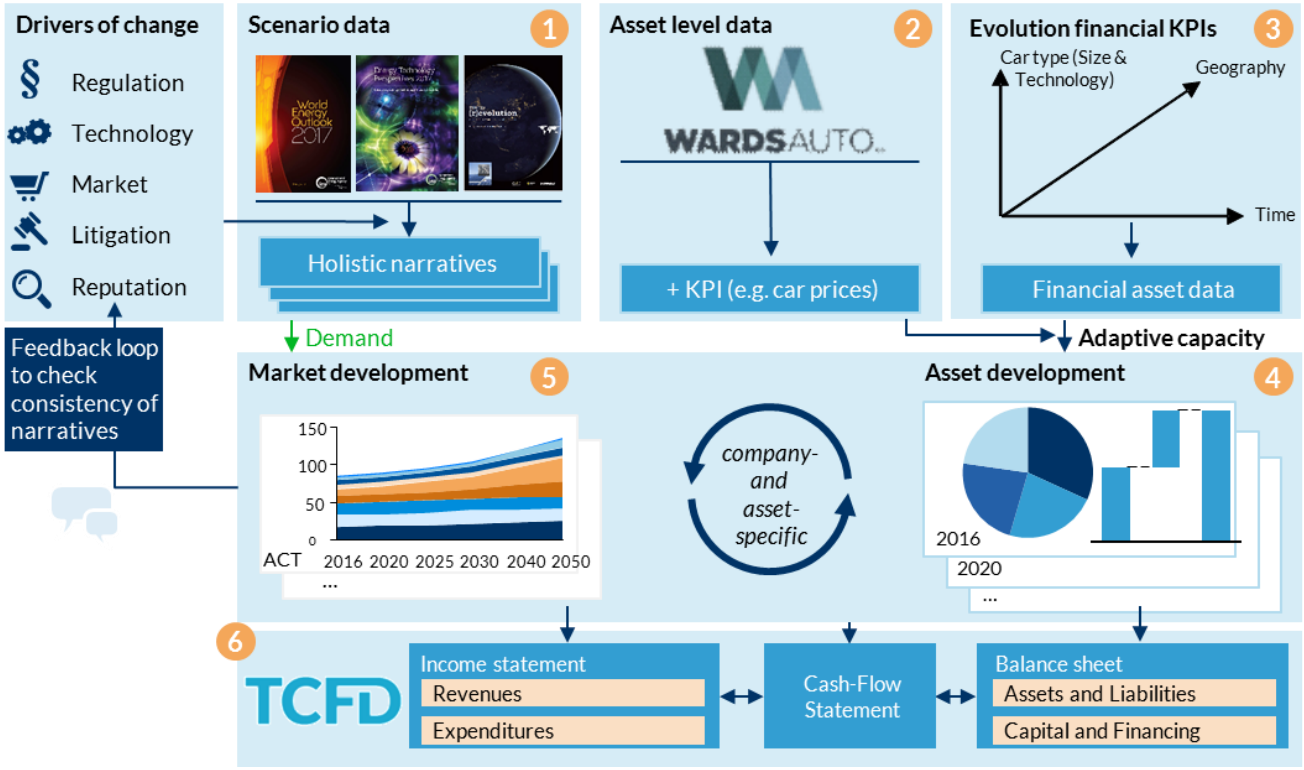
Research is published in the following documents:

- Feeling the heat, CISL, and CO-Firm (2016, *link*).
- "Transition scenarios: the transition risk-o-meter. Reference scenarios for financial analysis" (2dii, The CO-Firm, June 2017, *link*).
- "Adaptive capacity: changing colors. Adaptive capacity of companies in the context of the transition to a low carbon economy" (2dii, The CO-Firm, Allianz, Allianz Global Investors, August 2017, *link*).
- "Investor primer to scenario analysis" published by Kepler Cheuvreux and The CO-Firm (*link*).
- "Transition risks for electric utilities sector" (The CO-Firm and Kepler Cheuvreux, *link*).
- Climate scenario compass: Transition risks for the steel sector (The CO-Firm, Kepler Cheuvreux, **forthcoming**).
- Climate scenario analysis: Cement's financial performance under 2°C and 2.7°C - A how-to guide for the sector, and three companies across six countries (The CO-Firm, **forthcoming**).
- Climate scenario scenarios: Transition risks: How to move ahead. (The CO-Firm, Kepler Cheuvreux, **forthcoming**).
- "The way into an economy below 2 degrees (analysis paths - assessments - economic implications): Using the example of key economic sectors for Germany: automobile production and selected plastic goods."

This section illustrates the practical application of the investor primer to scenario analysis published by Kepler Cheuvreux and The CO-Firm (*link*), with a focus on the automotive industry, and provides a higher-level discussion of the concepts and analysis described below.

Overview of the climateXcellence model

Chart 33: Overview of the method applied, how to derive the business impact of transition scenarios in the power sector



Source: The CO-Firm.

The automotive sector's financial modelling with respect to climate scenario analysis can be divided into six central steps (Chart 16, subsequent numbering is consistent with the chart, for more general information on each of the following steps, please refer to the "Transition Risk Compass", *link*).

The automotive sector's financial modelling only analyses impacts from new car sales. Other common revenue streams (e.g. after sales or insurance) are excluded from the analysis, as they are less relevant with respect to climate change and transition impacts. The modelling is carried out as follows:

1. **Derive the key risk drivers so as to translate a scenario into a narrative.** First, develop a holistic transition narrative by extending scenario data with consistent transition drivers. For automotive, we took the following steps to achieve a consistent scenario:
    a. Translating information on the development of car stock over time from IEA ETP 2017 into company-relevant information production. The main driver in the automotive sector is the change in powertrains from conventional to PHEVs or BEVs.
    b. Production is determined through the delta of stock and the replacement of old cars, assuming an average lifespan of cars, which differs by technology types depending on each type's maturity (for ICEs it is 15 years).

c. Due to the close correlation between production and sales, both are assumed be the same for simplicity's sake.

2. **Translate the global scenario into regionalised information.** The automotive sector can be considered a global market; nevertheless regional differences prevail due to difference with regards to demand and consumer preferences (security, design, brand loyalty) as well as preconditions in a regional market, such as grid reliability. Therefore, global developments are broken down on a regional level.

   a. Breaking down region-specific technology pathways (hybrid, BEVs etc.) based on IEA ETP data.

   b. Analysing, extrapolating, and breaking down data is based on the development of activity levels (measured in passenger kilometres) on a regional level, as well as efficiency improvements for the different technology types.

   c. Nine regions are considered relevant based on their different market structure: Latin America, Russia, the Middle East/Africa, Europe, ASEAN (Association of Southeast Asian Nations: Indonesia, Malaysia, Philippines, Taiwan, Thailand, and Vietnam), India, China, OECD-Pacific (Australia, New Zealand Japan and Korea), and North America (Canada, Mexico, and the US).

   d. A country/region's degree of openness is determined by its export-import ratio. The more open to trade the countries are within a region, the easier it is for companies to gain access to it.

3. **Build a technology database with financial information on individual technologies.** Since climate transition impacts technologies differently (even within the same sector), building a financially meaningful technology database is central to the modelling. For automotive sector modelling, we build a separate technology model based on WardsAuto's production database from 2016, with selected updates based on 2017 data due to dynamics in the industry. The database contains information such as type of powertrain (petrol, diesel, hybrid or full electric vehicle), car size, ownership structure, location, etc. We have complemented the available data (technology-specific) with the following information:

   a. Expansion of production lines over time. including the possibility of entering new markets.

   b. Development of car prices and profit margins that vary across regions, time, technology and size. As an example, margins for alternative powertrains are currently small and are set to converge to the levels of conventionals in the future, with the main drivers being the cost regression of battery prices and economies of scale.

   c. Capex over time by scenario and region.

4. **Conduct a techno-economic assessment of risk mitigation measures ("adaptive capacity").** Financial modelling of climate risk must consider companies' ability to anticipate transition risks and develop mitigation strategies. With respect to the automotive sector, analysing risk mitigation has to take into account a variety of aspects such as:

   a. The scenario applied (e.g. ACT, LCT).

b. The current production portfolio of a company, e.g. technology type and location, as well as the expansion plans in alternative powertrains.

c. A company's financial strength.

5. **Forecast companies' portfolio development with and without adaptive capacities under different scenarios.** The development of companies' portfolios is basically a function of demand growth (point 1), regional changes (point 2), the company's current technologies and future plans (point 3) and its adaptive capacity (point 4). For the automotive sector, we modelled three individual technology development pathways: FROZEN, MARKET, and MARKET REVENUE (see the section "*Building blocks: the market adaptation pathways"* for a detailed description of adaptive scenarios).

   We model entry into new markets in which automotive companies are not operating as the main driver of a company's overall performance in a certain technology, independent of regional performance. The expansion plans predicted by WardsAuto are considered trend indicators, as the predictions in absolute terms are below the levels needed in ACT.

6. **Determine financial impact on companies.** The relative position of all technologies (and companies - point 5) is analysed across different scenarios (points 1 and 2). For the automotive sector, potential revenue and profit streams from new car sales are modelled over time, including an approximation of capex.

Note: For an overview of how to develop scenario analysis and integrate this into company valuations and investment decision-making, please see the transition risk compass published by Kepler Cheuvreux and The CO-Firm (*link*).

Limitations of the method applied

Although the underlying method has been developed over years and reviewed by a range of stakeholders, it does have limitations, which need to be taken into account and tested for when incorporating results into financial modelling.

- **Scenarios are not associated with likelihoods.** The underlying scenarios are operationalised IEA scenarios (see the investor primer for the scenario analysis report). While it is fair to say that the scenarios try to anticipate drivers such as falling battery prices, they do not estimate the likelihood of these drivers. The strength of a scenario is the plausibility and consistency of the parameters outlined over time.
- **The companies currently present in the automotive market will remain the important players.** The transformation of the automotive sector will not be restricted to changes in powertrains only, even though this can be considered the most important transformation for climate change. Trends, such as autonomous cars, are not considered in the underlying analysis. New players, originally from other sectors such as tech giants are, therefore, not considered.
- **Companies' asset development assumptions.** The current strength and expansion plans that have been outlined so far by companies are a main determinant of future growth. Due to the current dynamics of the automotive sector, taking data from 2016 can lead to developments that look different compared to modelling based on up-to-date data, even though selected updates based on the year 2017 have been made.

- **Scenario analysis and alignment assessments.** It is important to understand that the ACT/MARKET REVENUE (2°C) scenario tests for the financial impact of the various scenarios that are compatible with such a trajectory. However it does not assume that the companies are "aligned" in terms of their current portfolios, as understood under the science-based target approach (and more specifically the sector decarbonisation approach) or SEI Metrics' 2°C portfolio test (misalignment of activities is based on future production by technology, and the technology portfolio requirements illustrated in the IEA's scenarios).

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Europe

Amsterdam
+31 20 573 06 66
Brussels
+32 11 491460
Frankfurt
+49 69 756 960
Geneva
+41 22 361 5151
London
+44 20 7621 5100
Madrid
+34 9 14 36 51 00
Milan
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Oslo
+47 23 13 9080
Paris
+33 1 53 65 35 00
Stockholm
+46 8 723 51 00
Vienna
+43 1 537 124 147
Zurich
+41 43 333 66 66

America & Asia

Boston
+1 617 295 0100
New York
+1 212 710 7600

Research team

Luke Sussams
Co-author
lsussams@keplercheuvreux.com
+44 207 621 51986

Luke Sussams is a Sustainability Research Analyst focusing on climate change and environmental risk. Previously, Luke worked for over 5 years as an analyst on fossil fuel risk and the energy transition, helping grow the Carbon Tracker Initiative into a world leading think-tank. Luke graduated with distinction from the Environmental Technology MSc at Imperial College London and holds the CFA IMC.

Jana Mintenig
Co-author
jana.mintenig@co-firm.com
+49 40 2281-6551

Jana specialises in modelling climate-related financial risks and opportunities for numerous industries. Furthermore, she has been part of the consultative group of the Science Based Targets Initiative for renewing the transport sector curves. Jana holds a master's degree in economics from the University of Hamburg, with a specialisation in climate economics.

Nicole Röttmer
Co-author
nicole.roettmer@co-firm.com
+49 40 2281-6551

Nicole is the founder of The CO-Firm. She created the climateXcellence toolset and manages the co-operation with investors, banks and the real economy on climate risk assessments. Prior to this, she worked for McKInsey, building the energy efficiency service line and supporting financial clients in optimizing risk management models and processes. She holds a PhD in strategic management from the university of Leiden and a diploma in economics.

Jean-Christian Brunke
Co-author
jean-christian.brunke@co-firm.com
+49 40 2281-6551

Jean-Christian leads the The CO-Firm's scenario development and financial impact assessment across a broad of sectors. He holds a PhD in energy engineering from the University of Stuttgart, and two master degrees in business and energy engineering from the universities of Karlsruhe (KIT) and Linköping (LiU).