



Stranded Engines

How EVs can save car manufacturers' value

June 2022

Summary¹

Driven by climate regulations and technological innovation, the automotive sector is swapping the combustion engine for emissions-free electric vehicles (EVs). Despite the resistance of the industry and the reluctance of some policymakers to move faster, investors have supported the development of new EV businesses like Tesla, which is now worth more than the 10 top legacy carmakers combined. Faced with low market valuations, established companies like Volkswagen (VW) and Ford now plan to plough dozens of billions to accelerate their EV strategies in an attempt to catch up. The question isn't, anymore, 'if' one should electrify the entire fleet, but 'by when'. European decision-makers are pondering this very question, as part of the EU Cars CO₂ review.

In the industry narrative a fast transition is associated with financial strains, job losses, and potential bankruptcies. The framing of the discussion is, yet again, an obsolete 'environment vs. economics'. T&E has decided to unpack this narrative and to look exclusively at the financial and business case of the 'slow vs. fast' phase out of combustion engines (ICE).

To do this, T&E commissioned a financial analysis from Profundo, an external research outlet, and used the best available data from S&P, Bloomberg and MSCI. Profundo has analysed financial data of six car manufacturers: three mass market car companies (VW, Stellantis and Toyota) and three premium carmakers (Volvo Cars, Mercedes-Benz and BMW). Based on companies' financial figures, strategic plans and market trends, an in-depth analysis was done for VW as representative of the market average, then a similar methodology was applied to others to understand the relationship between the speed of ICE phase-out and companies' market value was performed in three scenarios: *Base* (current EV plans), *Slow* (only half of EV plans realised) and *Quick* (faster switch to EVs in 2025-2030).

This work has set aside all environmental, climate and health issues to focus exclusively on the financial and business aspects of the transition.

The findings can be summarised as follows:

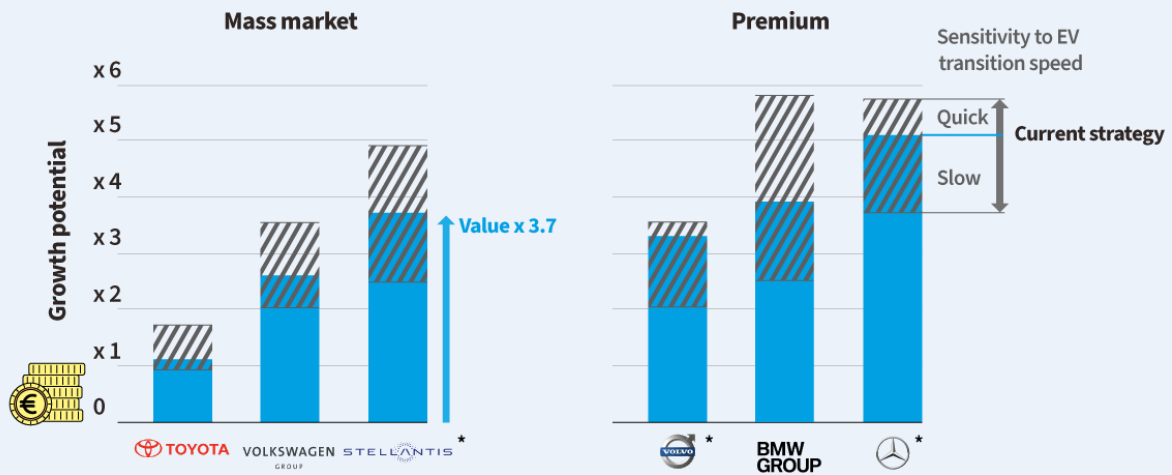
- Profundo, using standard Sum Of The Parts (SOTP) analysis and Discounted Cash-Flows (DCF),

¹ **DISCLAIMER:** this report is a result of a financial analysis modelling possible future scenarios under certain assumptions. Under no circumstances should this be considered as investment or financial advice. If you are seeking to invest - please use professional legal, financial or other advice from a certified body.

shows that a quick EV transition by the six legacy car manufacturers could bring a **EUR 800 billion equity value enhancement compared to a slow switch to EVs**. Quicker rather than slower EV transition strategies in the 2020s are projected to generate higher margins, triggering higher equity value for shareholders as well as better access to capital.

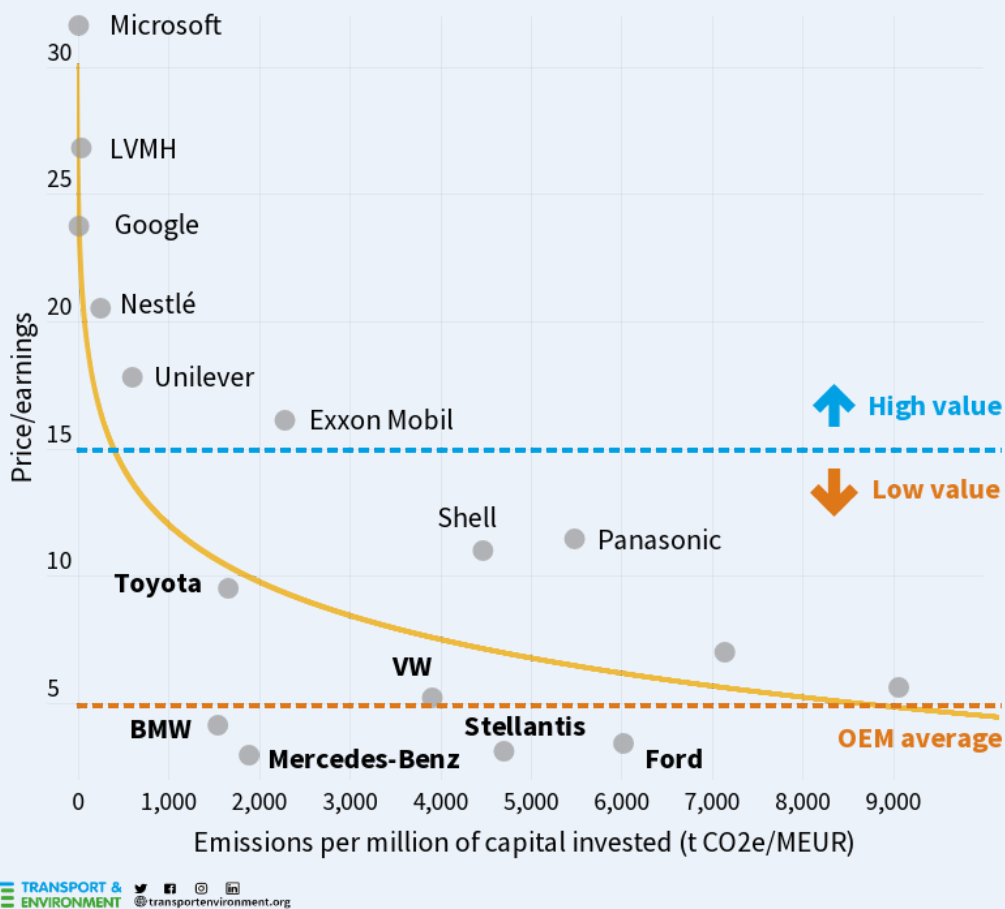
- On average, the *Quick* transition scenario (i.e. faster ramp up in 2025-30 than current plans) shows a 316% growth potential compared to current market values, with mass-market carmakers multiplying their market value threefold and premium carmakers reaching a fivefold increase.
- In the *Base* case (based on carmakers' EV commitments), carmakers with plans to phase-out combustion engines by 2030 in mature markets have the highest potential: Stellantis' market value could grow by 270% and Mercedes-Benz' by 410%. However, these EV commitments remain voluntary so it remains a question whether carmakers will achieve the projected financial gains. The value growth potential is lower for laggards such as Toyota. Volvo Cars having a lower growth potential in this analysis could be explained by the fact that the company is already reaping the benefits of an aggressive ICE phase out policy, and is currently valued twice compared to the others.
- The *Slow* EV transition, contrary to the beliefs held by some policy-makers, results in the lowest market capitalisation growth of companies, or even decreases in Toyota's case. **This scenario is a likely possibility**. In fact, many carmakers including VW and Mercedes, have announced they are currently sold out on EVs. This not only shows that consumer demand is stronger than expected, but that carmakers planned to produce minimum EV supply as required by regulations instead of maximising the EV transition benefits.

A faster EV transition brings higher valuations



* Carmakers with 100% BEV targets in 2030 at EU level

- Best available market data suggests that electric cars will have superior profit margins in coming years, while diesel and petrol cars are expected to suffer as their market share and pricing power shrink. The analysis finds that **EV business operating margins are expected to reach and surpass those of conventional cars in the next 3-5 years.**
- Towards the late 2020s, ICE operating margins are estimated to decrease and even become negative (on balance sheets) as ICE sales prices fall due to competition from cheaper battery electric vehicles (BEV) or due to phase-out in various markets, and because of decrease in economies of scale.
- Car companies are generally valued very poorly by financial markets. If one looks at the top 10 world producers, their Price Earnings ratios (P/E) are among the lowest in the market, with an average of 5x. Oil and cement companies appear to be more popular. When looking for reasons to explain such poor evaluations T&E has plotted OEM's evaluations against their carbon intensity, expressed as total emissions per one million of capital invested. Despite the emissions figures used being the official ones, which an upcoming study by T&E will show are substantially underestimated (by 20% to 68%), the observed relation is quite startling. The fitting explains nearly 80% of the negative relation (higher carbon per million, lower evaluations). Market action suggests that investors reward emission reduction per unit of capital exponentially. Our fitted curve seems to indicate that above 1,000 CO₂e tonnes emitted per million of equity, companies enter a 'carbon trap' where they are relegated to low evaluation.



The ‘carbon trap’ curve seems to indicate that the only way OEMs have to increase their value is to cut emissions aggressively and quickly, changing their product mix, since 98% of their emissions are indirect (the use of sold goods) and mostly unrelated to the industrial process.

CONCLUSIONS

- Contrary to the common narrative that ‘slow is better and more humane’, **it is the faster ramp up of EV supply up to 2030 that will help car companies** to preserve sound financials and protect employment in the sector. This financial analysis indicates that a fast transition is the only chance to keep companies ‘whole’ and allow a socially acceptable conversion to a new product: a case of allowing a painful cure now, to avoid the loss of entire limbs tomorrow.
- The harsh reality described could easily surpass the modelling as slow movers will potentially face higher carbon emission liabilities due to larger ICE fleets, as cities, entire regions and countries restrict or block the access of combustion engines, and as carbon taxes are introduced.
- The analysis, and recent media announcements by Ford and Renault, suggests that, with

diverging valuations (and multiples) between the EV and ICE business, the temptation to spin off the EV business units will get increasingly hard to resist. This 'shortcut' to higher valuations would create a number of 'bad companies', left adrift with their stranded ICE assets, with potentially catastrophic social consequences in Europe in the medium term.

- Regulation - such as Car CO₂ standards - should ensure carmakers at least meet their EV commitments, which remain voluntary and often not backed by industrial plans to achieve those. If not, OEMs risk both losing market share and miss out on potential value increase. If carmakers go slow on EVs, they will be trapped in a downward spiral and lose investors' confidence.

RECOMMENDATIONS

- The analysis suggests that the only chance to keep most legacy OEMs 'whole', and to protect employment in the sector, seem to lie with policies that encourage a fast transition. In Europe, these are the EU clean car rules, of Car CO₂ standards, for 2025 and 2030. The current standards will require little progress until 2030. And the long waiting times for EVs in Europe today suggest that carmakers will not go beyond these weak rules, so likely will follow the Slow transition. But as the Profundo study shows, 2030 will be too late to make the switch. The risk is that American and Asian carmakers will have captured large parts of the EV market by then (and many investors with it). This analysis shows that a faster transition is not only in the interests of the climate and consumers, it is also at the heart of industrial success and financial viability of European automakers.
- Producing electric cars early - i.e. accelerating in 2025-2030 - has many advantages beyond the financials. First, it is an opportunity for new players to establish themselves in the global market, best exemplified by Tesla that grew their market share from 0.1% five years ago to 1.8% in 2022. Second, going early allows traditional carmakers to secure their market share in the growing market: VW is not only reaping economy of scale gains thanks to its modular car platform dedicated to BEV but is also licensing it to other OEMs to manufacture electric cars. Accelerating now also allows one to gain advantage in securing supply chains and raw materials, as well as building consumer trust early on.
- Higher car CO₂ targets in 2025-2030 are also needed to ensure EU carmakers stay ahead of the competition. Chinese carmakers were nearly absent on the European market in 2018, but reached 2.8% of the BEV market in 2020². Despite the fact that European customers were largely unfamiliar with Chinese brands and had preconceived ideas related to quality and safety. It is a sign of a supply gap in the market, as EU OEMs are slow to ramp up the supply to match the demand for EVs.

² <https://www.transportenvironment.org/discover/electric-car-boom-at-risk/>

- The financial case for rapid electrification in the 2020s is clear for the auto industry. But this will require large resources to upgrade production lines, invest in new equipment and supply chains, secure raw materials and reskill the workforce. It requires effort from the entire value chain of companies, from battery makers to charging businesses; as well as for governments, regulators and trade unions to all work together. A clear signal to ramp up this transformation is missing in Europe today.

Without the right policy signals, there is a serious risk that a slow transition to EVs will backfire and produce a number of ‘bad companies’. Left adrift, in the world of semi-stranded financial assets that trade at a fraction of their book price and operate mostly in developing countries with lower environmental safeguards, these companies are unlikely to have a great future.

SUPPORTING BRIEF - Methodology and underlying hypothesis explained

1. Introduction

Despite 2021 being marked by the semiconductor crisis, electric car (EV) sales skyrocketed all around the world. EV sales more than doubled and reached 6.6 million units³, or 9% of the global car market. Europe and China were the two most dynamic markets in 2021. Thanks to the EU car CO₂ standards, the EV sales share has multiplied by six since 2019 in the European Union⁴ reaching 20% with 2.3 million units. Chinese EV sales nearly tripled in 2021 to reach 3.3 million units (15% of sales⁵), and the number of electric cars sold in 2021 in China alone exceeded the number that was sold in the rest of the world in 2020.

These impressive sales are mostly the result of new regulation implemented in major regions. These regulations will be tightened in the coming years as most regions are planning additional regulatory packages to meet their climate goals. For instance, in Europe, the European Commission's proposition to only allow zero emission (electric or hydrogen) car sales from 2035 is coupled with the increased CO₂ emissions cut from new cars by 55% in 2030, implying that at least half of all sales would be full electric. BloombergNEF also shows that a cost-effective pathway to reach 100% electric sales in 2035 would require that zero emission vehicles (ZEV) reach 67% of 2030 sales, and some in the Parliament and Council still might raise the 2030 target higher as the final law is being agreed. Consequently, major carmakers (OEMs) are now adapting their strategies to meet the different regional targets, e.g. many have announced 100% EV sales in Europe by 2030.

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<https://www.iea.org/commentaries/electric-cars-fend-off-supply-challenges-to-more-than-double-global-sale>

4

<https://www.transportenvironment.org/discover/battery-electric-cars-climb-to-9-of-sales-driven-by-eu-targets>

⁵ <https://www.bnef.com/news/1006185>

In view of the changing regulatory climate, many in the automotive industry are also accelerating electrification to improve the sustainability of their stocks and the proposition to their investors. For instance, the EU taxonomy, or the new disclosure requirements for major fund managers as to the environmental performance of their stocks, will only allow zero emission vehicles (battery electric or hydrogen) to be classified as green after 2025. Some carmakers are already accelerating their shift toward zero emission vehicles ahead of the minimum regulatory requirements in order to satisfy investors and anticipate the change in the way the financial markets are valuing electric vs combustion cars.

All this leads to major electrification plans. For instance, Volkswagen Group (VW) plans to invest €52 billion in battery electric vehicles (BEVs) and electrification between 2022 and 2026, while premium carmakers such as Volvo Cars or Mercedes-Benz plan to switch to 100% fully electric sales in 2030⁶.

Recent views from financial markets⁷ suggest that due to the accelerating shift to electric cars, the financial value of internal combustion engine vehicle (ICE) businesses could be close to zero, or even negative, causing value loss for their shareholders. At the same time, the value of EV businesses perceived by investors has been rising significantly over the last few years, resulting in high share prices for those companies active in the EV market. For instance, Tesla's market capitalisation exceeded \$1 trillion in October 2021⁸ and is now larger than the combined value of ten of its biggest rivals⁹. Newcomers with recent or upcoming initial public offerings are also reaching high valuation: Polestar will go public via a special purpose acquisition company at \$20 billion¹⁰, and Lucid Motors is currently valued at \$36 billion¹¹ after its IPO in July 2021.

Transport & Environment aims to assess what impact an accelerated EV adoption among car manufacturers would have on their market value and overall financial viability. To do this, T&E commissioned Profundo, an independent not-for-profit company specialised in equity analysis, to perform the study accompanying this briefing. Profundo integrated the market outlook and the latest strategies of six large carmakers with significant sales in Europe - BMW, Mercedes-Benz, Stellantis, Toyota, VW, Volvo Cars - to carry out a detailed fundamental analysis, or broadly evaluating the value of a company based on its financial statements, strategic initiatives, competitors and markets trends.

⁶ Volvo targets 100% BEV sales globally while Mercedes-Benz only targets 100% BEV where market conditions allow it.

⁷ MORGAN STANLEY & CO. LLC. (2021). *EV Asset vs ICE Liability: GM to \$80, Ford to UW*

⁸

<https://www.reuters.com/business/autos-transportation/tesla-market-cap-eclipses-that-top-5-rival-carmakers-combined-2021-10-26/>

⁹ From market capitalisation accessed the 12/04/2022 from

<https://companiesmarketcap.com/automakers/largest-automakers-by-market-cap/>, Tesla has a market value larger than the combined value of Toyota, VW, Mercedes-Benz, Ford, General Motors, BMW, Stellantis, Honda, Hyundai and Kia.

¹⁰

<https://www.reuters.com/business/autos-transportation/ev-maker-polestar-go-public-20-billion-valuation-via-spac-sources-2021-09-26/>

¹¹ <https://companiesmarketcap.com/lucid-motors/marketcap> accessed the 12/04/2022

Carmakers' ICE and EV businesses were valued separately using a Discounted Cash Flow (DCF) analysis while the valuation of each whole company was calculated using a Sum of the Parts (SOTP) methodology. The methodology applied by Profundo is described in Section 2 of this briefing and key findings are detailed in Section 3.

2. Methodology

This study focuses on six car manufacturers: three mass market car companies (VW, Stellantis and Toyota) and three premium carmakers (Volvo, Mercedes-Benz and BMW). Three steps were followed in this fundamental analysis. First, Profundo analysed the current profile and **strategies of each company**, their upfront investments in new technology, and gathered detailed financial figures from each company's financial reporting and strategic plans publicly available. Second, Profundo **modelled the cash flows of each company** by separating the EV and ICE entities in two distinct businesses. The Discounted Cash Flow methodology enables the breakdown of all costs and revenues to assess the operating margins, the profits and the overall free cash flow of each business. Third and finally, the **Sum Of The Parts valuation methodology** is used to reach each company's target equity value, i.e. the theoretical market value that companies could reach today based on their strategic plans. The analysis was done for three scenarios: slow, base and quick EV transition. The base case accounts for carmakers current strategies. Each of the scenarios shows the potential equity value compared to the current market valuation.

Figure 1 below shows a simplified outline of the methodology while the main hypotheses are described in the following sections. More information about the methodology and data used can be found in the report¹² published alongside this briefing.

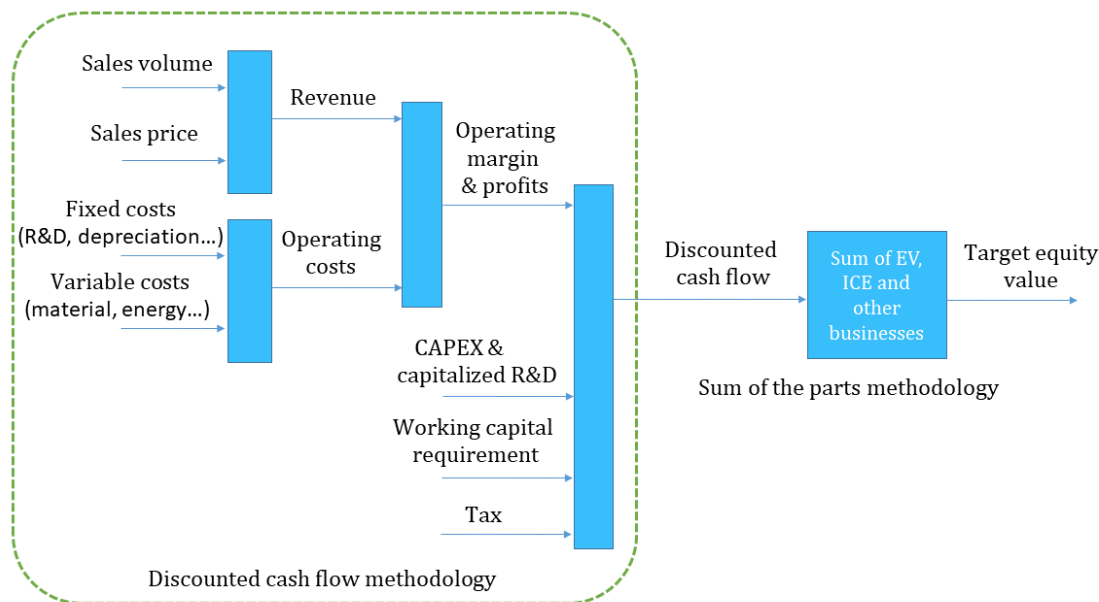


Figure 1 - Simplified outline of the DCF and SOTP methodology

¹²

<https://www.transportenvironment.org/discover/stranded-engines-how-evs-can-save-car-manufacturers-value/>

2.1. Carmakers' strategies

Profundo assessed the profiles and strategies of the six carmakers listed in Table 1 below. The expected sales of battery electric vehicles are derived from carmakers announcements¹³.

Table 1 - Carmakers profiles

	Carmakers	2030 BEV sales share¹⁴	Market capitalization (EUR billion)¹⁵
Mass market OEMs	Volkswagen	50%	95
	Stellantis	58%	42
	Toyota	29%	255
Premium OEMs	Volvo Cars	100%	21
	Mercedes-Benz	80%	69
	BMW	45%	51

Among mass market OEMs, VW is implementing the most ambitious industrial strategy¹⁶ with the third of its total investment in electrification by 2026. Stellantis has recently announced an ambitious strategic shift toward zero emission vehicles, including a 100% BEV target for cars in Europe if conducive public policies are applied. On the other hand, Toyota is slow at ramping up its ZEV production and is still relying on a widespread use of hybrid technologies.

Regarding premium carmakers studied by Profundo, Volvo Cars is the most ambitious with a comprehensive strategy including a full shift to battery electric cars. Mercedes-Benz also shifted its strategy towards fully electric vehicles in 2021, but it still conditions the 100% electrification to the readiness of local markets. BMW appears the least ambitious premium carmaker chosen in this study as the German carmaker still does not target more than half of its global sales to be fully electric in 2030.

¹³ Based either on announcements for the global BEV sales or for each major region with an additional modelling based on the share of each region in carmaker's global sales

¹⁴ Estimate of the global BEV sales share. Profundo modelling based on company data, sales data from Bloomberg and T&E analysis of carmakers production plans

<https://www.transportenvironment.org/discover/commitments-but-no-plans-how-european-policymakers-can-make-or-break-the-transition-to-zero-emission-cars/>

¹⁵ Market Capitalization and Revenue from Refinitiv Eikon, market data as of 19 April 2022

¹⁶ T&E found that Volkswagen and Volvo Cars have the most credible strategies among all carmakers plans announced in the first half of 2021.

<https://www.transportenvironment.org/discover/volvo-and-vw-the-only-european-carmakers-on-track-to-electrify-on-time-study/>

2.2. Cash flow modelling

2.2.1. Production costs

Profundo investigated literature and reports forecasting production cost trends, and analysed the development of the last three years in costs of ICE producers versus 100% EV manufacturers, such as Tesla. The rising expense of improving the combustion engine to meet future emission regulations, such as Euro 7¹⁷, is expected to increase the cost of producing ICEs in the future since more advanced emission control systems will be needed. Most carmakers are also expected to increase the share of hybrids in their ICE sales to reach ever stricter emission standards, which are more expensive to manufacture than conventional petrol or diesel cars.

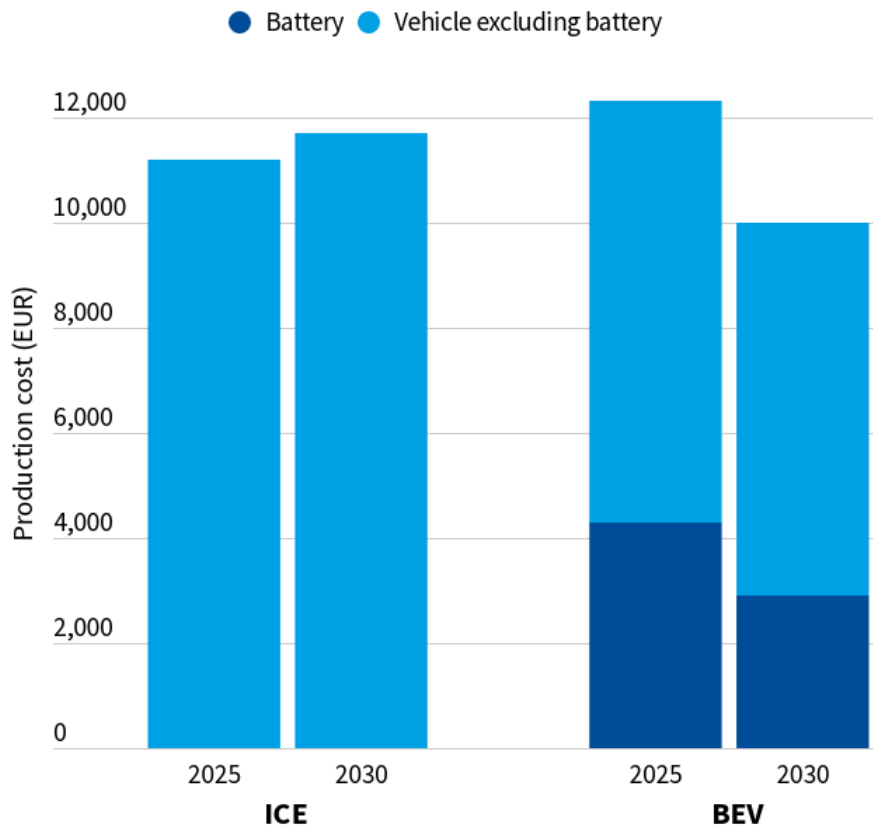
Regarding BEVs, around 40% of today's production cost is allocated to the battery. Despite an expected increase of battery price in the short term¹⁸, battery costs are expected to start decreasing again from 2023 as prices stabilise and raw material production capacity keeps increasing. In the long run, BloombergNEF expects that the direct manufacturing costs of BEVs drop by at least 50%¹⁹ by the early 2030s. The majority of that decrease is due to the battery, while new fully electric vehicle platforms or more power-dense electric motors are also expected to decrease production costs. Estimates of production costs from BloombergNEF are shown in Figure 2 below. To perform their analysis, Profundo developed production cost trends based on the BloombergNEF analysis and applied them to all carmakers based on their historical production costs. For instance, Profundo expects that VW's variable costs in BEV production would decrease by 40% by 2035 compared to 2020.

¹⁷ The additional Euro 7 compliance cost would be about 100-500 € per car, depending on the stringency of the Euro 7 standard.

<https://www.transportenvironment.org/discover/the-seven-dirty-air-pollution-tricks-of-the-auto-industry/>

¹⁸ BloombergNEF 2021 Lithium-Ion Battery Price Survey shows that rising raw material prices are expected to lead to \$3/kWh increase in the average battery pack price in 2022. This would delay the point at which battery pack prices cross the \$100/kWh mark by two years.

¹⁹ <https://www.transportenvironment.org/discover/hitting-the-ev-inflection-point/>



Direct manufacturing costs for ICEs and BEVs (dedicated platform), C segment vehicles

Source: BloombergNEF. (2021). *Hitting the EV inflexion point*

Figure 2 - Production cost projection (segment C) from BloombergNEF

In addition, to account for the Covid supply chain disruptions and the war in Ukraine, Profundo added a 5% increase to the 2022 production costs²⁰. While BEV costs are affected by battery material prices, ICE costs are affected by materials such as palladium used in exhaust aftertreatment systems, or by the focus on more premium vehicles that cost more to produce.

2.2.2. Sales prices

Sales prices are induced by many factors, for instance by carmaker strategic plans, complex interactions between offer and demand, carmaker's sales mix (share of different car sizes in the OEM mix) or carmakers' bargaining power depending on their market positioning. Profundo derived market trends of sales prices for ICE and BEV and applied them to carmakers' historical average prices. The example of VW sales prices is shown in Figure 3. Regarding BEV, sales prices are expected to be mainly driven by:

- expectations of declining battery costs
- increasing economies of scale
- increasing number of models in carmakers' lineup with cheaper mass market models
- marketing efforts by all carmakers to gain share

²⁰ <https://europe.autonews.com/suppliers/automakers-face-soaring-metal-costs-russian-supplies-risk>

Profundo estimates that the BEV market will progressively move closer to a perfect competition environment. As BEVs become more common with more standardised components and a wide model choice from most carmakers, OEMs will need to compete on price to set themselves apart from competitors. As battery electric cars get cheaper and approach the price tag of conventional cars, they are expected to gain in popularity with a higher demand. This means less and less people are expected to buy ICEs that would struggle to compete against the decreasing costs of BEVs. Consumers are also expected to become more uncertain of ICE usability as phase-out in large cities or countries are planned. Therefore, after a price increase period due to the offer of slightly cleaner powertrains, ICE prices are expected to decrease as demand falls.

In the case study of VW, Profundo found that the average price parity between powertrains could be reached in 2028 in line with results from BloombergNEF²¹. While the relative change in sales prices is assumed to be similar for all carmakers, the starting points are different for each carmaker as they sell different types of cars in different regions. These differences lead to differences in the year they are expected to reach sales price parity. In the short term, Profundo assumes carmakers currently have a high pricing power. In the context of the semiconductor crisis and supply chain disruptions due to the Ukraine war, car production doesn't meet the demand and carmakers have the opportunity to set higher sales prices²². Due to higher commodity prices and the prioritisation of premium vehicles with available parts, Profundo expects that carmakers' average sales prices will increase by 3% in 2022.

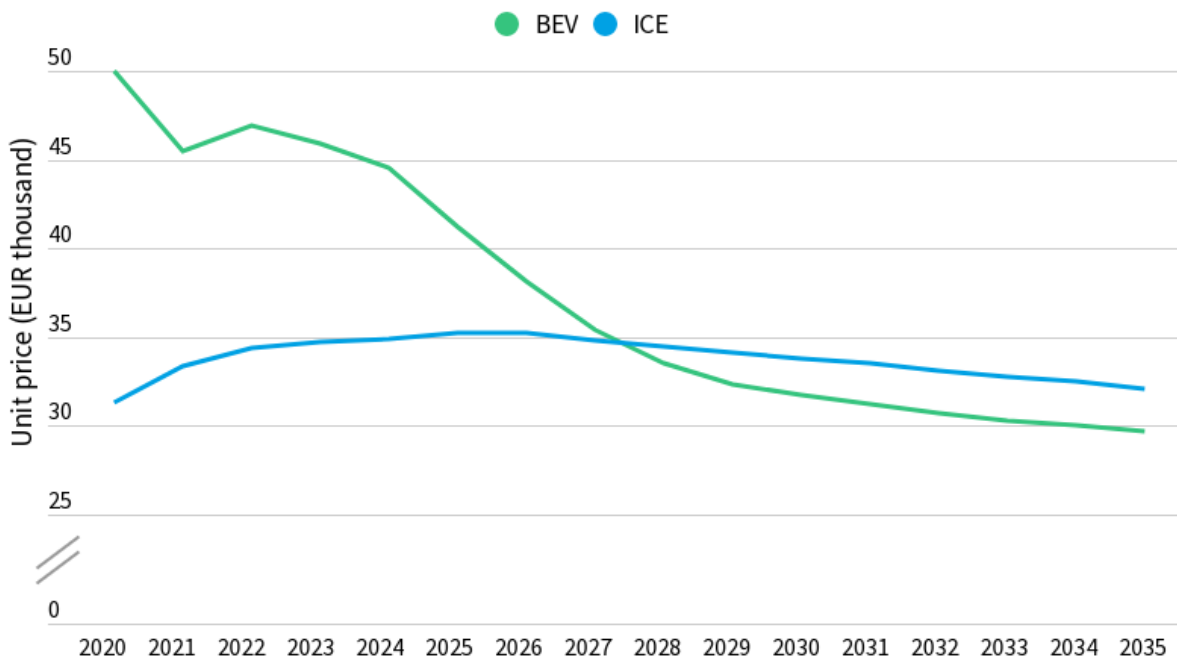
²¹ BloombergNEF expected that, on average, battery electric vehicles would reach the same price as equivalent petrol models between 2025 and 2027.

<https://www.transportenvironment.org/discover/hitting-the-ev-inflection-point/>

According to BloombergNEF's 2021 Lithium-Ion Battery Price Survey, this result could be delayed as battery and BEV sales prices are now expected to rise in 2022.

²² For instance, Mercedes-Benz expects strong demand to allow it to offset rising raw material and transport costs with higher prices.

<https://www.reuters.com/business/autos-transportation/mercedes-sees-rise-earnings-q1-confirms-2022-guidance-2022-04-27/>



Source: Profundo projection of Volkswagen Group ICE and BEV sales price

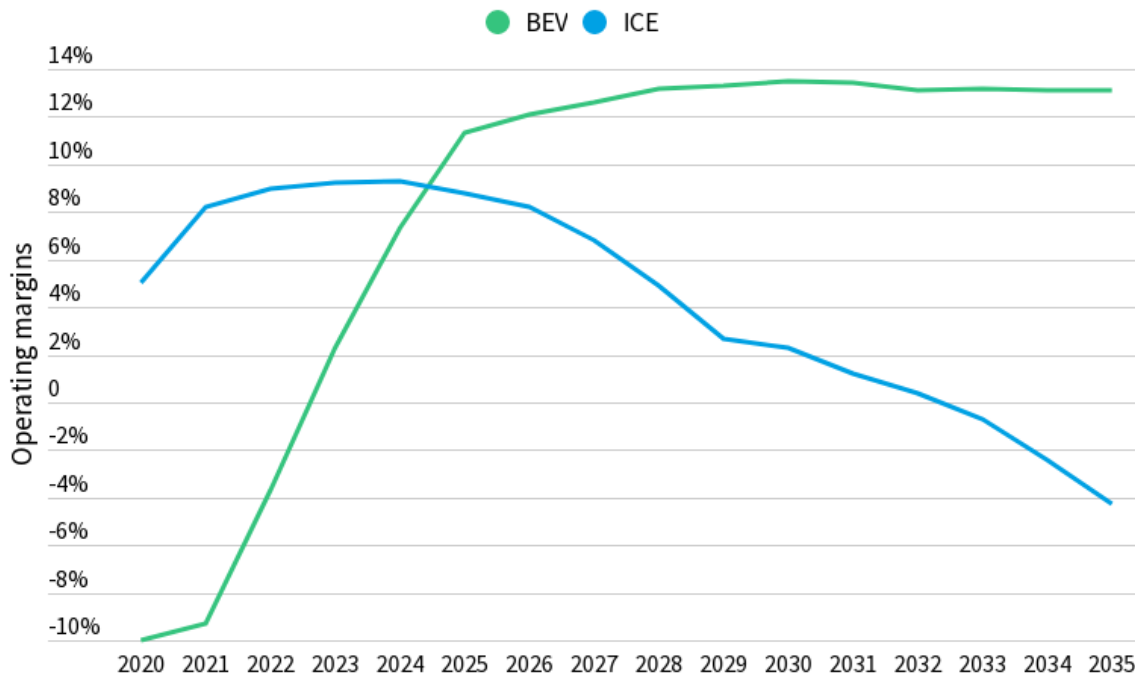
Figure 3 - Unit sales price projections for VW's EVs and ICEs

2.2.3. Discounted cash flow

Profundo applied a detailed cash flow model to derive carmakers operating margins, profits and free cash flows. First, revenues were calculated based on the price assumptions described in Section 2.2.2 and volumes based on carmaker BEV sales mix strategies. Then, operational costs were calculated based on the split between fixed and variable costs. The main fixed costs used in the model are R&D costs²³ and depreciation costs. Then, variable costs include material and battery prices as described in Section 2.2.1 and the cost of the energy required to run plants and machineries. This methodology enabled Profundo to forecast future operating margins taking into account the impact of economies of scale (declining economy of scale for ICEs and increasing for EVs).

In the VW example, Profundo expects the following evolution of ICE and BEV business operating margins:

²³ R&D costs are mostly based on OEMs' own financial reporting.



Source: Profundo projection of Volkswagen Group ICE and BEV operating margins. For other carmakers, trends and values would be different based on their strategies, historical values, sales mix and markets.

Figure 4 - Operating margins projections for VW’s EV and ICE businesses

The EV business operating margins are projected to catch up with the ICE business in 2025. VW recently announced²⁴ that BEV profitability is expected to reach parity with ICE ahead of their initial schedule (2024-2025). This shows that Profundo's result is still on the conservative side.

If the spike in raw materials prices lasts longer, the results might be delayed by a year or two but will not change the fundamental conclusions of this analysis. Commodity price increases are not expected to have a major impact on the operating margin parity as both ICE (palladium and platinum) and BEV (nickel, lithium) are affected. Moreover, carmakers are known to use some market instruments²⁵ (forward contracts, swaps, hedges and price protection) to shield against volatile raw material prices.

The quick increase of the operating margin between 2022 and 2024 is mostly explained by economy of scale. Production volumes are quickly increasing while sales prices are still high due to the still relatively low competition. At the beginnings of a completely new product line such as BEV, fixed costs are assumed to be in the range of 40-45% of total operating costs. As the volume rapidly increases - doubling in every two years in VW’s example - the amount of cars that carmakers produce with the same fixed costs increase, thus the operating margin increases. Competition is expected to increase after 2030 and

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<https://www.bloomberg.com/news/articles/2022-03-15/vw-is-already-sold-out-of-some-electric-models-for-the-year>

²⁵

<https://europe.autonews.com/automakers/vw-first-quarter-profits-rise-ukraine-war-could-still-hurt-business>

carmakers would not be able to keep increasing their margins as quickly in a more competitive market. Profundo does not expect a decrease of BEV operating margins before 2035, but it is possible that carmakers would need to start decreasing their margins after 2035 as BEV will become a mature market with very high competition where ICEs will be phased-out.

Regarding the ICE business, the decrease in demand and a progressive fall in economies of scale lead to a decrease of the operating margin. This would ultimately lead to negative operating margins of the ICE business. Nevertheless, negative margins do not mean that the ICE business is losing cash in real life. In the operating margins calculation, some non-cash items are included for accounting reasons but are not representative of actual cash expenses. For instance, depreciation and amortisation costs are accounted for years after the actual cash investment. Negative operating margins are mainly an accounting consequence resulting from past investments: previous expenses to build ICE production capacity are still amortised each year. This means that the amortisation of these investments is still accounted for, while revenues are falling (as ICE sales are expected to decrease in the future). This leads to negative operating margins in accounting terms but to a positive cash flow as some sales revenues would still be occurring.

From BEV and ICE operating margins, Profundo then calculated the profits of each carmakers' ICE and BEV business, capital expenditure (CAPEX), capitalised R&D, working capital requirements²⁶, taxes, etc. in order to estimate the free cash flow for each year between 2022 and 2035. Then, Profundo finds the present value of expected future cash flows using a discount rate (the weighted average cost of capital). This value is representative of what each business is currently worth based on the expectation of its future performance.

2.2.4. Sum of the parts

The Sum of the Parts methodology is used to derive the equity value of each company, or what the whole company is currently worth based on Profundo's calculations. The DCF of ICE and BEV businesses are summed with other parts of the company (e.g. financial services and joint ventures) to derive the enterprise value. The equity value is then derived by adjusting the company's net debt and net cash.

2.3. Scenarios

Profundo conducted a scenario analysis to estimate the impact of faster and slower transition to fully electric vehicles on companies' capitalisation, or equity value. 3 scenarios are considered:

- **Base case:** This scenario is aligned with carmakers current BEV strategy based on their public announcements. It corresponds to a situation where carmakers back their EV commitments with appropriate industrial strategies, including investments in battery gigafactories and securing raw materials, to reach those BEV commitments on time.
- **Quick case:** In this scenario, carmakers are expected to commit to a faster transition toward battery electric cars. While the ramp-up in 2022-24 remains unchanged (given the realities of adapting production strategies), a much faster ramp-up is modelled in 2025-2030 (reaching 75%

²⁶ Working capital requirement is the capital a company uses in its trading operations, calculated as trade receivables plus inventories, net of its trade payables.

BEV sales in 2030 for VW in the case study) and 100% by 2035²⁷. This is aligned with the fast growing demand for electric cars, the exponential growth in EV market once price parity is reached and is in line with the EU Green Deal ambition.

- **Slow case:** In this scenario, carmakers would fail to meet their own EV commitments and only reach the minimum BEV share required by current regulations in large markets. Either due to market conditions or own failure, this scenario reflects the situation where carmakers did not plan in advance the operational risks they could face during this transition, for instance by failing to secure raw materials or move to mass production of electric cars in a timely manner. Profundo applied a reduction in BEV sales from each OEM's base case. For instance, in VW's case study, the BEV share is limited to 12% in 2025 (compared to 21% in the base case) and 35% in 2030 (50% in the base case).

BEV sales in the quick and slow cases are based on Profundo's analysis of risks and opportunities inherent to each company's strategies. The comparison of the current strategy valuation (Base case) and the faster transition (Quick case) aims to demonstrate the value creation potential. As regards the Quick case, Profundo assumed that any shift in a company strategy cannot take effect immediately and included a 2-year delay to start implementing a more ambitious strategy. On the other hand, a slow strategy can be easily implemented from 2023. Moreover, Profundo included changes of CAPEX and costs (for instance R&D costs) to model each scenario with more trends relevant to the EV strategy. For instance, the quick case would imply a short term increase of CAPEX and R&D costs for the BEV business in order to cover the acceleration.

3. Results for 6 carmakers

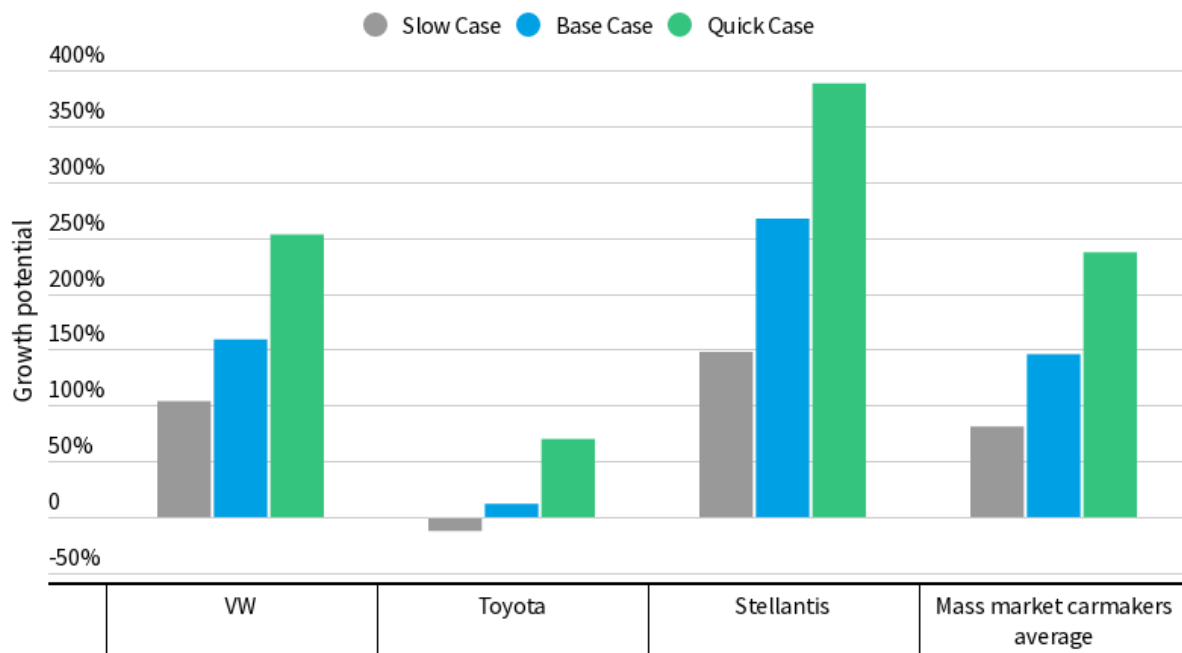
The key finding of Profundo analysis is that quicker EV transition strategies have the potential to generate higher cash flows for carmakers and bring higher equity values for shareholders. In addition, T&E shows that the faster transition of early movers would also enable them to secure or increase their market shares.

3.1 Faster BEV transition brings higher market value

Profundo estimated the target equity, or market value, of all six carmakers based on their current EV sales and investments strategies, and defined an analysis with slower or faster EV transitions. Carmakers have different starting points based on their historical production costs and sales prices, but the year-on-year relative changes in costs and prices are assumed to be the same for all carmakers. As carmakers have different business sizes and current market valuations, Profundo's results are presented as a "potential", defined as the percentage increase compared to the current market valuation. This growth potential shows the increase in equity value that could be achieved today based on the modelling of future cash

²⁷ The fast scenario is defined as an increase in BEV sales compared to carmakers' current strategies. In Toyota's case, a 100% global BEV share would more than double its expected BEV sales share and it cannot be realistically met as early as 2035. Therefore, Profundo assumed Toyota could reach 75% ZEV in 2035 in the quick case.

flows²⁸. The comparison of the potential between each scenario shows the clear benefits that can be brought by a faster BEV roll-out for companies' capitalisation.



Target equity value derived from the net present value of ICE and BEV businesses of each company using Discounted Cash Flow (DCF) and Sum Of The Parts (SOTP) methodologies

The growth potential is based on the percentage increase of estimated equity value compared to the market value as of 19/04/2022

Source: Profundo analysis of carmakers' valuation based on carmakers current strategies (base case) and slow/quick transition toward battery electric cars.

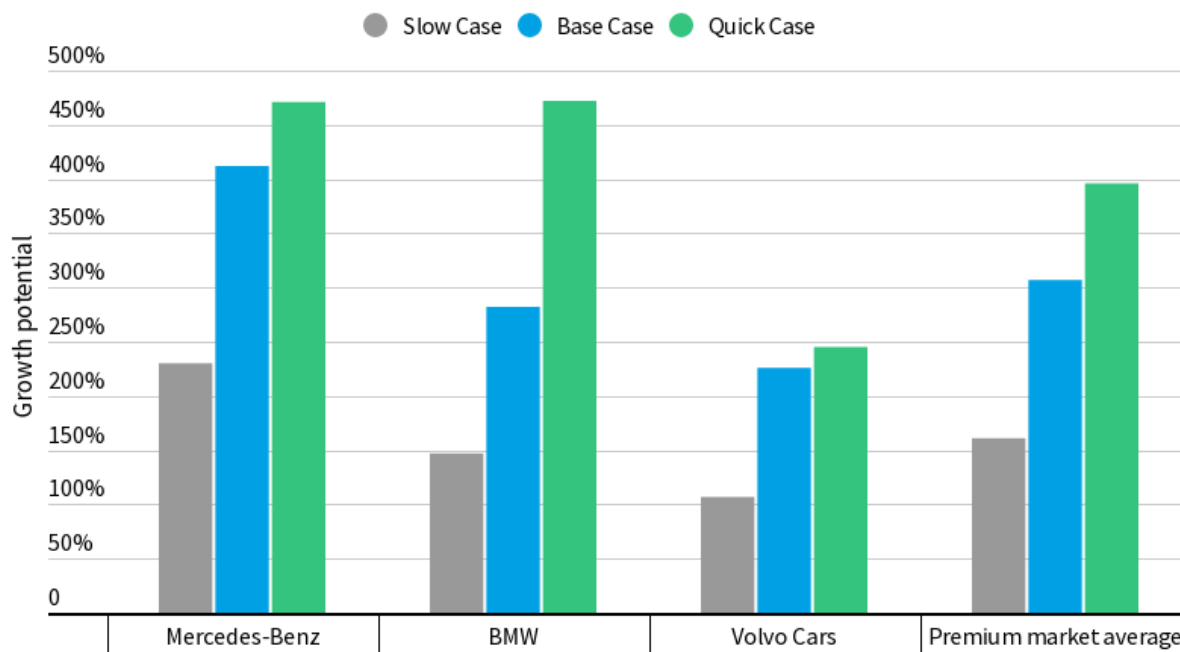
Figure 5 - Potential for equity value compared to current market value

Among mass market carmakers, both VW's and Stellantis' current strategy to accelerate EVs, or Base Case, have the potential to lead to significantly higher market valuation (159% and 267% increase respectively), whereas Toyota's potential is lowest, with a potential target value only 12% higher than its current market value. If carmakers ramp up EV production and sales faster to reach a phase-out of combustion engines by 2035 (Quick case), they can improve the potential of their equity value further. VW's equity value could be multiplied by three and a half compared to its current value, and Stellantis could even multiply it by five. In the case of Toyota, opting for a quicker EV transition would increase the valuation by 70%.

On average over the three mass market carmakers, the quick transition toward fully electric cars would lead to a 237% increase of the equity value compared to the market. Conversely, if carmakers settle for a slow EV transition (e.g. still selling 40% ICE in 2035 in VW case), their growth potential would be limited to

²⁸ The cash flows are modelled for the ICE and BEV businesses for each year between 2022 and 2035, after which a terminal value is used. Future cash flows are discounted based on the weighted average cost of capital (WACC).

81% compared to 146% in the Base case. In Toyota’s case, as the company already has a base strategy with relatively low EV ambition, going slower could even lead to a 11% loss in value compared to its current high market capitalisation. In the scenario where ICEs are sold for longer, the market capitalisation of companies will decrease compared to the Base case, potentially making it harder to attract investors or raise capital on the financial markets.



Target equity value derived from the net present value of ICE and BEV businesses of each company using Discounted Cash Flow (DCF) and Sum Of The Parts (SOTP) methodologies

The growth potential is based on the percentage increase of estimated equity value compared to the market value as of 19/04/2022

Source: Profundo analysis of carmakers' valuation based on carmakers current strategies (base case) and slow/quick transition toward battery electric cars.

Figure 6 - Potential for equity value compared to current market value

As for the premium carmakers, the Mercedes-Benz EV strategy has the largest potential as its equity value could be more than five times its current market value in the Base case scenario. With a less ambitious EV strategy, BMW appears to have a lower potential than Mercedes-Benz with a 282% increase potential compared to its current market value. Even though Volvo Cars has recently been listed in the stock market, Profundo found that its market value has the potential to be multiplied by more than three. Volvo Cars' relatively high market capitalisation already shows that the market is already valuing ambitious EV strategies as Volvo committed to become electric only manufacturer by 2030.

In the base case, the premium group value would be multiplied by four compared to the current market, but it could be multiplied by five with a quicker EV transition. Having a relatively unambitious base case and a low discount rate, BMW would be the carmaker that could benefit the most from a strategic shift as its faster transition toward fully electric cars would increase its equity value up to 472%. Both

Mercedes-Benz and Volvo cars already have existing ambitious strategies and an additional acceleration of the BEV ramp-up would bring a 471% increase for Mercedes-Benz and 245% for Volvo. On the other hand, if premium carmakers adopt a slower EV transition, their target equity value growth would be limited to 161% compared to 307% in the Base case.

Overall, the results for all carmakers clearly show that the quicker EV transition pays off significantly in terms of company market values. For all 6 carmakers, the Quick Case leads to a 316% increase of the equity value on average compared to current market values, highest of all three scenarios. The slower EV transition, contrary to the beliefs held by some policy-makers, results in the lowest market capitalisation growth of companies or even decreases in Toyota's case.

In absolute terms for six OEMs, Profundo calculates that the quick EV transition potential is EUR 806 billion higher compared to the slow case, or nearly two times more in terms of equity value. Toyota has the least ambitious EV transition strategies and the lowest corresponding market capitalisation growth compared to peers. For all carmakers, the acceleration of the emobility transition will bring significant potential for shareholder value creation, while the slower EV transition is the worst case scenario.

3.2 Carmakers are poorly valued by financial markets

With large potential even in the slow case, Profundo theoretical results highlight that carmakers tend to be undervalued by the financial markets. This can be partly explained by the discount rates used to weight future cash flow in the DCF methodology and how the market actually accounts for risks from high carbon emissions.

In Profundo models, the weighted average cost of capital (WACC) serves as the discount rate for calculating the value of each business. It reflects the level of debt and equity value of their overall company²⁹. Toyota and BMW have the lowest WACC which means that the cash they will earn in the future is worth more than, for example Volvo Cars which has a higher WACC (Volvo has lower debt and higher equity). Based on relatively low discount rate³⁰ and long term forecasts (up to 2035), this method leads to results higher than the current market value. In practice, current equity values on the stock market are the result of many trends including wider macroeconomic factors or various considerations based on reputation³¹ and execution risk assessments³², as well as the impact of carbon emission regulation. This means that investors apply different discount rates compared to this theoretical study or include additional liabilities to weight OEM values based on carbon emissions. The latter might be quite significant, Profundo's analysis shows and could have a material impact on the value of a carmaker.

²⁹ Financing a company with debt lowers the overall cost of capital because debt is cheaper than equity. Bank expects 1-2% return from the debt it provides but investors in the equity expect a much higher return as they take much more risk.

³⁰ WACC in the range 4-7% depending on carmakers

³¹ For instance, VW market share fell after the dieselgate scandal.

³² Investors and financial analysts would want to see how well carmakers deliver on their electrification promises before rising their valuation estimates.

This discount is also evident when looking at trading multiples of carmakers. For instance, the household appliances sector (with relatively lower carbon emissions or major environmental risks) traded at a 64% higher³³ than carmakers average in the last 5 years. Looking at the top 10 world carmakers, their Price Earnings ratios (P/E)³⁴ are also among the lowest in the market. With a P/E average of 5x, carmakers are less popular than oil and cement companies. To study the impact of carbon emissions, T&E looked at OEM's valuations against their carbon intensity, expressed as total emissions per one million of capital invested. The relation between valuation and carbon intensity is quite startling: the higher carbon intensity is, the lower the market valuation. This fitting explains nearly 80% of the negative relation and suggests that investors reward emission reduction per unit of capital exponentially. Our fitted curve seems to indicate that above 1,000 CO₂e tonnes emitted per million of equity, companies enter a 'carbon trap' where they are relegated to low valuation.

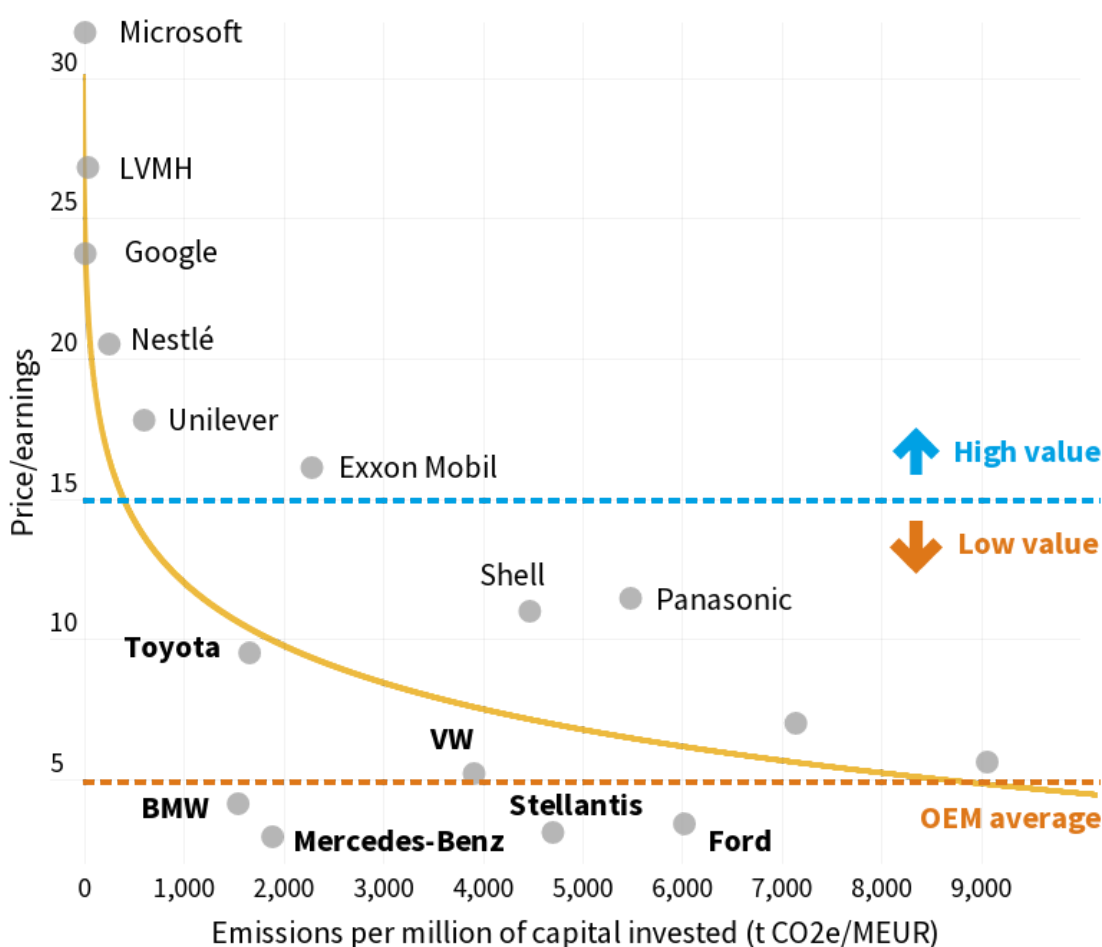


Figure 7 - Correlation between price-to-earnings ratio and emissions per million invested

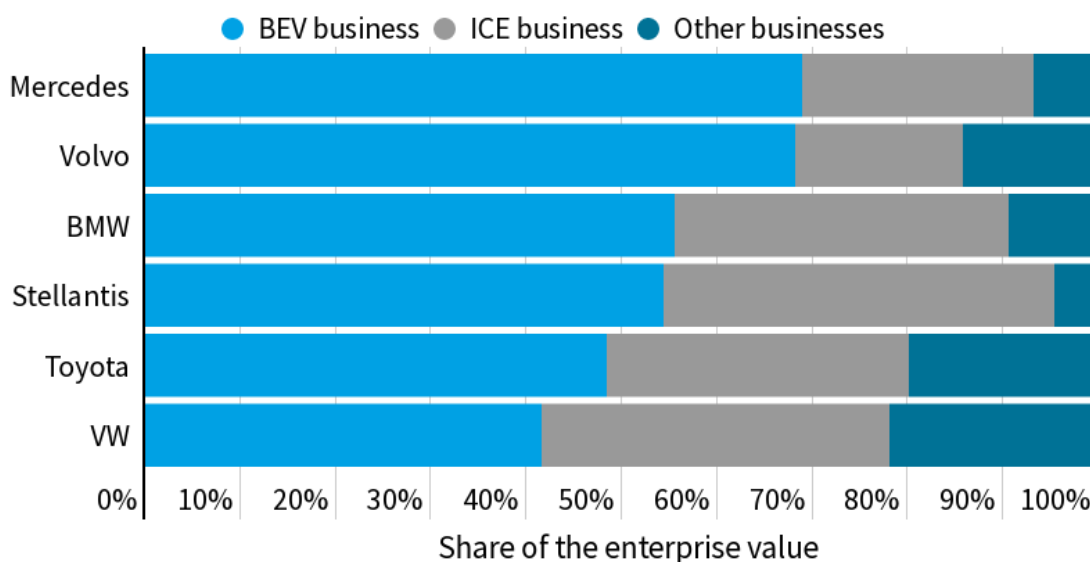
³³ In terms of EV/EBITDA ratio -enterprise value (EV) to the earnings before interest, taxes, depreciation, and amortisation (EBITDA)- household appliances are traded with a 12.7 EV/EBITDA ratio compared to 7.8 for carmakers according to Profundo. The lower the EV/EBITDA, the cheaper the valuation for a company.

³⁴ The price/earnings ratio is the stock price divided by the company's earnings per share. This ratio shows how much investors will pay per share for \$1 of earnings. P/E comparison helps investors to assess if a given company is over- or undervalued.

The 'carbon trap' curve seems to indicate that the only way OEMs have to increase their value is to cut emissions aggressively by quickly changing their product mix, since 98% of their emissions are indirect (the use of sold goods) and mostly unrelated to the industrial process.

3.3 The ICE business is a liability

Profundo showed that the free cash flow of the BEV business is expected to be higher than the ICE business in the coming years. BEV operating margins are expected to exceed ICE ones in the next 3-5 years and BEV volumes are increasing, so ICE businesses are expected to be burdened by the sales of low margin vehicles in decreasing quantity. As shown in Figure 8 below, the present value of the BEV business is higher than the ICE business for most companies based on Profundo's discounted cash flow calculations. On average, the BEV business amounts to 56% of carmakers' enterprise value whereas the ICE business is only 31% of their value.



BEV and ICE value from their Discounted Cash Flow (DCF) and Sum Of The Parts (SOTP) methodology used to derive the aggregated enterprise value

Other businesses includes financial services, joint ventures and stake in other businesses

Source: Profundo analysis of carmakers' enterprise value based on carmakers' current strategies

Figure 8 - BEV business share of carmakers' enterprise value

With additional regulations expected to be enforced in the future, for example the phase-out of ICEs in cities, countries or regions, the demand for ICEs is expected to decrease. Carmakers are expected to decrease their ICE sales price as they lose their bargaining power compared to cheaper BEVs that will benefit from large economies of scale and decreased battery costs. A carmaker that does not ramp up its BEV production in time is expected to end up selling ICEs at loss, so the ICE business is expected to become a burden for carmaker financials.

Moreover, Profundo explains that the legacy ICE business might be confronted with the impact of a high carbon liability. The pricing of carbon emissions in the EU ETS or the expected disclosure of scope 3 emissions might lead to additional costs for CO₂ emitted. It is uncertain how this cost will be split between carmakers and consumers. Any increase of the total cost of ownership of consumers due to higher petrol costs would further decrease the bargaining power of ICEs and generate additional pressures on the ICE business operational margins. Therefore, it would be difficult for carmakers to let carbon costs be entirely passed to consumers and this would need to be included as a liability in the valuation model. This liability could be directly proportional to the number of ICEs produced between 2022 and 2035, so the fast EV transition would decrease this liability and balance it with a higher value of the BEV business. This suggests that the additional market value in a quick EV transition could be even more significant if carbon costs are included in the calculations.

3.4 Additional benefits of a faster EV transition

3.4.1. Market share

The EV transition is the largest change that has ever occurred in the automotive market. This transition is expected to redefine the global state of the competition between carmakers.

This is an opportunity for new players to establish themselves in the global market. The best example is Tesla, which was founded in 2003 and became one of the leading companies in the BEV business. According to LMC Automotive market data acquired by T&E, Tesla sold around 92,000 cars globally five years ago. This number is expected to be multiplied by 14 and reach nearly 1.3 million in 2022. In terms of market share, Tesla's share of the global passenger car market is projected to increase from 0.1% five years ago to 1.8% in 2022 according to the LMC Automotive forecast.

Going electric faster is also a good way for traditional carmakers to secure their market share in a fast-changing environment and a growing worldwide competition. Focusing on the new BEV market opportunity, Chinese carmakers plan to capture foreign markets, including Europe. For instance, registration data shows that Chinese carmakers were nearly absent on the European market in 2018, but reached 2.8% of the BEV market in 2020³⁵. Consequently, if major European carmakers want to stay competitive and not to lose market share, they should commit to a faster transition toward BEVs by ramping up their investments and line-up in their domestic market.

To stay in the game, carmakers will need to accelerate their BEV roll-out in order to face competition and adapt to market changes. Those who choose to delay their transition are at risk of losing market share as electric vehicle demand rises at the expense of ICEs in saturated markets such as Europe or the US. In terms of production, carmakers who reach economies of scale first - therefore reducing costs to themselves and for customers - will reap the benefits. A good example to do so is switching to production platforms dedicated to BEVs. These dedicated platforms allow optimising components for the specific requirements of BEV and could accelerate the manufacturing speed of these vehicles. The early

³⁵ <https://www.transportenvironment.org/discover/electric-car-boom-at-risk/>

implementation of these platforms (such as the Volkswagen Group MEB platform used as early as 2020) will avoid the manufacturing of a high number of BEVs suboptimally (i.e. with lower margins) when regulatory requirements will drive BEV sales upward.

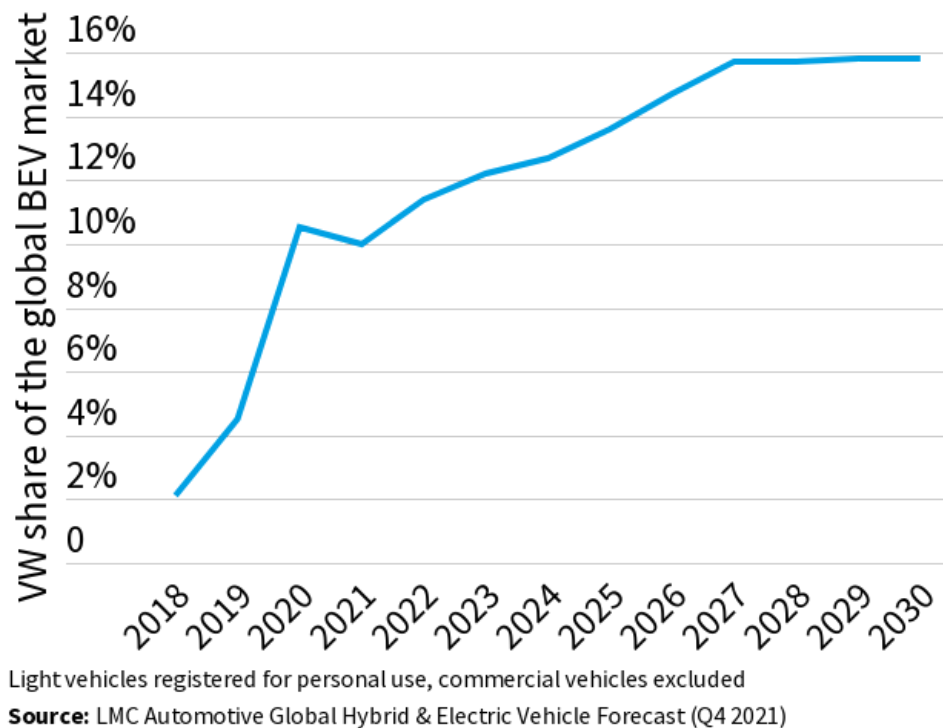


Figure 9 - VW share of the global BEV market

In the case of the Volkswagen Group, which was one of the first major EU carmakers to implement an ambitious electrification strategy, the benefits in terms of the market share of battery electric cars are already seen. The roll-out of the ID.3 produced on the MEB platform enabled the group to achieve a 10.5% share of the global BEV market in 2020, expected to increase to 13.6% in 2025 and 15.8% in 2030 according to LMC Automotive (shown in figure 9 below). VW is not only reaping economy of scale gains thanks to its MEB platform, but is also licensing it to other OEMs like Ford to manufacture electric cars. Licensing the platform not only generates revenue, but also increases the number of BEVs on the market that could be based on the VW chassis. This increases the chances that the chassis becomes standard and puts early movers like VW in a strong position for the BEV after-market (maintenance, spare-parts, services etc)³⁶.

Finally, early movers will also be able to improve their resilience as they will start to vertically integrate their supply chains and to secure raw materials and batteries supply early. This can be seen in the case of Tesla, which is directly signing contracts to supply nickel and lithium for its batteries - which also allows the carmaker to have a say over mining conditions - at the time when the supply of the key metals is tight and prices rising.

³⁶ <https://www.ft.com/content/a2b8cf3a-1e14-11e9-b126-46fc3ad87c65>

3.4.2. Technology readiness

Starting on a technology early also gives more time to try it out and improve it before it is required in the market in large volumes (e.g. when regulations require carmakers to sell EVs). This learning by doing is important especially given that manufacturing electric cars is very different from combustion engines and the skills/technology required is shifting fast.

Carmakers with early BEV offers are the most likely to adapt to this transition as they gain experience in this new business, overcome obstacles early and iteratively optimise their production costs. For instance, Audi's head of electrification explained that the development of the first e-tron (produced since 2019) enabled the brand to have insight to optimise the electric system and bring the cost down³⁷. Their first 2019 model had single phase charging (instead of more common three-phase), which meant the charging process was slow and inefficient, this was later rectified.

Bringing models to the market without previous practice and learning, just when the regulation requires them, poses risks. For example, Ford launched its Kuga PHEV model in 2020 to meet the EU car CO₂ goals, but the model faced battery overheating issues and had to be recalled en masse. This undermined Ford's key compliance strategy in Europe and meant the company had to enter the pooling arrangement (and pay) Volvo Cars instead. OEMs ramping up EVs late, just ahead of the market needs, therefore risk facing unexpected operational problems with no feedback loop from previous experiences or time to deal with them.

Switching to EVs earlier also allows a slow build-up of consumer trust in the new technology and gives a timeframe to secure initial consumer acceptance before the vehicles need to be sold en masse. In terms of marketing and sales strategies, early movers will have more time to experiment and design specific strategies to support consumers in their transition toward mobility. On the other hand, a lack of training of sales staff could lead to inadequate information and advice provided to consumers, and could be responsible for lost sales opportunities.

4. Conclusions

The analysis by Profundo shows that a quick EV transition by six legacy car manufacturers - VW, Stellantis, Toyota, BMW, Mercedes-Benz and Volvo Cars - could bring a EUR 800 billion equity value enhancement compared to a slow switch to EVs. This means that quicker rather than slower EV transition strategies in the 2020s (2025-2030) are set to generate higher cash flows, meaning higher equity values for shareholders as well as better to access capital or attract new investors. Contrary to the claims of some in the auto industry (and some trade unions), it is the faster ramp up of electric car supply up to 2030 that will help European companies stay globally competitive with sound financials.

On average, the *Quick case* scenarios modelled by Profundo show the 316% growth potential compared

³⁷ <https://edition.cnn.com/interactive/2019/08/business/electric-cars-audi-volkswagen-tesla/>

to current market values of the car makers analysed. The value growth potential is lower for the laggard carmakers such as Toyota who will be late to capitalise on the EV momentum. This means carmakers that are slow to ramp up EV production are likely to face inferior operational cash flows. In addition, Profundo expects slow movers to potentially face higher carbon emission liabilities due to larger ICE car park heritage as cities, countries and regions phase out the technology.

Electric cars are expected to have superior profit margins in the next few years, while diesel and petrol cars are expected to take a hit as their market share and price advantage both shrink. With falling battery costs and growing economies of scale, EV business operating margins are expected to reach and even surpass those of conventional cars in the next 3-5 years. At the same time, especially towards the late 2020s, ICE operating margins are estimated to decrease and eventually become negative.

The business case for a fast transition to EVs is now self-evident that the real question is not really if, or when, but how. The sum of the parts (SOTP) analysis can in fact be taken to the extreme of actually splitting the business unit and creating spin-offs to reap the benefits of the superior valuation EV makers get. This seems to be the case of Renault and Ford, for example. There are many reasons to believe this might be a risky gamble for employment and the future of the company left to manage the declining ICE business. In the case of Ford, for example, it is difficult to imagine what investor would want to keep owning 'ICE-Ford' if 'e-Ford' was created. On the other hand, the force of massively diverging valuations does push in the direction of such simplistic decisions.

The role of policy

Car production and emissions is a highly regulated market and policy plays a defining role. One could argue that a slow transition to EV, to some extent caused by the lobbying of the industry and the reluctance of policymakers to adopt the right measures, will backfire and produce a number of 'bad companies'. Left adrift, in the world of semi-stranded financial assets that trade at a fraction of their book price and operate mostly in developing countries with lower environmental safeguards, these companies are unlikely to have a great future.

It seems to be one of those cases where, in the name of social safeguards, massively negative social consequences are determined. Contrary to the common narrative that 'slow is better and more humane', the financial analysis indicates that a fast transition is the only chance to keep companies 'whole' and allow a socially acceptable conversion to a new product: a case of allowing a painful cure now, to avoid the loss of entire limbs tomorrow.

The key policy defining the pace at which carmakers will electrify in Europe are the car CO₂ standards, but a clear signal to ramp up this transformation is missing in Europe today. The current car CO₂ targets for 2025-2029 - which govern the supply of EVs and therefore speed of the transition - will require little progress until 2030. But as the Profundo study shows, 2030 is too late to reap the financial benefits of the switch. The risk is that American or Asian carmakers will have captured large parts of the EV market by then (and many investors with it). Faster transition is not only in the interests of the climate and consumers, it is also at the heart of industrial success and financial viability of European automakers. The

EU decision-makers must set an ambitious EV trajectory from 2025 onwards, including a higher 2025 and an additional 2027 target in the Cars CO₂ review, to ensure the entire ecosystem is moving on time and in the same direction.

Financial markets, and Tesla is clearly an example, will not wait for policymakers. Inaction by policymakers paints a scenario in which, frustrated by low multiples and dwindling margins, a number of large players might be tempted to think that the 'spin-off' option is the only viable one. The next step would be the creation of 'bad companies' and the socialisation of the losses to absorb unemployment in the sector.

Further information

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