Quick charging the share prices

Faster EV adaptation can generate EUR 806 billion more equity value

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About this report

This report has been commissioned by Transport & Environment. The study aims to demonstrate the potential value generation for auto manufacturers that quickly transitions to electric vehicle business as opposed to slower strategies.

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Summary and conclusion

A quick EV adoption by six legacy car manufacturers could trigger a EUR 806 billion equity value enhancement versus a slow adoption. On top of inferior operational cash flows, slow movers will probably face higher carbon emission liabilities due to larger ICE car park heritage while quick movers phase-out ICEs. This might raise the value enhancement to above one trillion euros.

- **The car industry is entering into a major transition period from Internal Combustion Engine (ICE) technology to Electric Vehicles (EVs).** Pioneered by the American car manufacturing start-up Tesla, the successful business case for EVs is now being adopted by almost all legacy car makers with different strategies and roadmaps. Among the producers mainly serving the mass market, Volkswagen (VW) and Stellantis are planning to reach at least 50% battery electric vehicle (BEV) sales by 2030. Toyota, despite being a leader in hybrid electrification, has a slower roll-out plan for BEVs and aims to reach 3.5 million sales (approximately 30% of total) by 2030. Luxury car maker Volvo Cars has the quickest EV transition plan, planning to phase-out ICEs to go all-electric by the end of the decade whereas Mercedes-Benz plans to go-all electric by 2030 in markets where conditions allow.
- **The outlook for the business success of EVs looks bright while ICEs can even see negative operating margins after 2030.** Although the production costs and sales prices of EVs are currently at a disadvantage against ICEs, the expected fall in battery costs along with improving economies of scale, will help EVs reach price parity with ICEs. Although the battery prices and production costs are expected to rise in 2022, as a result of the war in Ukraine, the long-term projections of falling EV manufacturing costs are still intact. As evidenced by the development of the operating metrics of Tesla in recent years, EV business operating margins are expected to reach and even surpass that of ICEs in the next 2-3 years. This while margins of ICEs are set to decline as the product with old technology loses bargaining power against the incoming product. Especially after 2027 where most car segments are expected to reach price parity, we estimate diminishing, even negative operating margins for ICE businesses.
- **Quicker EV transition strategies can create c. EUR 806 billion higher value for companies and their shareholders compared to slow scenarios.** Our in-depth case study for VW and valuation models for the remaining 5 companies clearly show that quicker rather than slower EV transition strategies are set to generate higher cash flows, meaning higher equity values for shareholders. On average, the quick case scenarios yielded 316% upside potential compared to current market values of the car makers whereas the slow cases were only 121%. While these results are derived from only the operational cash flow projections, possible carbon liabilities can change the valuations quite drastically. For example, the slow EV transition case without carbon costs for VW yields a target equity value of EUR 194 billion (104% upside potential) but when the EUR 275 billion carbon costs are included, the target value drops to negative EUR 82 billion, implying a complete wipe-out of the equity value.

- **Operational cash flow and equity benefits of a quick shift to EV are further escalated by huge uncertainty about ICE carbon liability.** Adding a carbon liability is a good proxy for differences in discount rate (WACC) between ICE and EV business and the differences in reputation risk (ICE) and opportunities (EV). The carbon liability reflects the uncertainty whether the manufacturer or the customer will bear the costs of increasing regulation and carbon costs of an ICE car. The carbon liability will be relatively larger for slow-movers in the switch to EV, while quick-movers will face a relatively low liability and thus lower uncertainties. Thus, the equity valuation outcomes showing that operational cash flows develop more favourable in a quick shift to EV, are further escalated by a much lower carbon liability and/or uncertainty.
- **The large difference between market values and the valuation results for the companies stem from uncertainties and calculation methodologies.** The main reason why even the slow case results are higher (except for Toyota) than the current market values of carmakers is that the investors (overall market participants) are discounting risks such as the aforementioned carbon liabilities as well as the execution risk in case companies fail to make the transition to the new technology that is electric mobility. This discount is also evident in the trading multiples of automakers where the household appliances sector (with no apparent carbon or any significant environmental risks) on average traded at a 64% premium (12.7x EV/EBITDA) vs. carmakers average (7.8x) in the last 5 years. Considering that a quick transition to EVs (and ICE phase-out) can lift the majority of the uncertainties, the successful EV manufacturers can be valued with even higher multiples. Although the current valuation of Tesla is hard to compare and not completely indicative for other carmakers, the current EV/EBITDA multiple of Tesla is at 46.3x which would have been 3x higher than the average valuation result of our quick case scenario. The second reason behind the high valuation results is the long forecast period that has been used in DCF models, where the methodology tends to result in high terminal values when a growing business (the EV business) forecasted far into the future, in this case 2035. In contrast the DCF methodology cannot completely reflect the value of a declining business (ICEs). Additionally, long forecast periods in DCFs exaggerates the impact of different discount rates (WACC) between companies, as in the case of BMW and Volvo Cars, where BMW with a WACC of 4.8% has much higher valuation potential than Volvo Cars with 7.2% (higher due to larger equity share in its liabilities). All in all, despite its limitations DCF is the only methodology to use when valuing separated businesses (EV and ICE). The main aim of this study is not to make highly accurate market value predictions but to demonstrate the difference in potential and risks in quick and slow EV adoption cases. Table 1 through Table 6 summaries operational estimates and valuation results of the six carmakers in this study.

Table 1 Volkswagen: Summary of model assumptions and results

Operations		2022	2023	2024	2025	2030	2035
Share of EVs	Base	7.5%	11.0%	15.0%	21.0%	50.0%	72.5%
	Slow	7.5%	8.0%	10.0%	12.0%	35.0%	40.0%
	Quick	7.5%	11.0%	15.0%	25.0%	75.0%	100.0%
EV operating margin	Base	-3.7%	2.3%	7.3%	11.3%	13.5%	13.1%
	Slow	4.0%	6.6%	8.5%	9.7%	11.2%	10.8%
	Quick	-8.4%	-2.4%	2.4%	8.0%	13.2%	13.3%
ICE operating margin	Base	9.0%	9.2%	9.3%	8.8%	2.3%	-4.3%
	Slow	8.1%	8.5%	8.9%	8.9%	3.2%	-1.3%
	Quick	9.6%	10.1%	10.5%	10.1%	-1.2%	-37.4%

Valuation		Base	Slow	Quick
WACC		6.5%	6.5%	6.5%
Terminal growth rate		3.0%	3.0%	3.0%
Effective tax rate		30.0%	30.0%	30.0%
Calc. market value (EUR mn)		**246,060**	**193,659**	**334,856**
Potential / Risk to current value		**159%**	**104%**	**253%**

Carbon liability		Base	Slow	Quick
# of ICEs produced (2022-2035)		91,523	117,405	65,282
Calc. carbon liability (EUR mn)		**214,988**	**275,785**	**153,348**
Market value after carbon liability		31,072	-82,125	181,508
Potential / Risk to current value		**-67%**	**-187%**	**91%**

Source: Volkswagen, Profundo estimates

Table 2 Toyota: Summary of model assumptions and results

Operations		2022	2023	2024	2025	2030	2035
Share of EVs	Base	1.0%	2.0%	5.0%	10.0%	29.0%	44.0%
	Slow	1.0%	2.0%	3.0%	5.0%	13.0%	18.0%
	Quick	1.0%	2.0%	10.0%	15.0%	50.0%	75.0%
EV operating margin	Base	-24.9%	-4.8%	4.2%	9.0%	11.7%	10.7%
	Slow	3.4%	8.0%	8.2%	9.8%	12.4%	10.7%
	Quick	-56.1%	-30.6%	-16.6%	6.9%	12.3%	10.4%
ICE operating margin	Base	8.5%	8.7%	8.8%	8.1%	5.6%	2.5%
	Slow	8.5%	8.8%	8.9%	8.4%	6.4%	4.0%
	Quick	9.7%	10.1%	10.1%	9.6%	6.9%	2.1%

Valuation		Base	Slow	Quick
WACC		4.1%	4.1%	4.1%
Terminal growth rate		2.0%	2.0%	2.0%
Effective tax rate		30.0%	30.0%	30.0%
Calc. market value (EUR mn)		**285,102**	**227,709**	**432,671**
Potential / Risk to current value		**12%**	**-11%**	**70%**

Carbon liability		Base	Slow	Quick
# of ICEs produced (2022-2035)		127,966	151,084	101,584
Calc. carbon liability (EUR mn)		**300,593**	**354,895**	**238,621**
Market value after carbon liability		-15,491	-127,186	194,050
Potential / Risk to current value		**-106%**	**-150%**	**-24%**

Source: Toyota, Profundo estimates

Table 3 Stellantis: Summary of model assumptions and results

Operations		2022	2023	2024	2025	2030	2035
Share of EVs	Base	7.5%	11.0%	15.0%	21.0%	57.5%	80.0%
	Slow	7.5%	8.0%	10.0%	12.0%	42.5%	47.5%
	Quick	7.5%	11.0%	15.0%	25.0%	80.0%	100.0%
EV operating margin	Base	0.8%	4.2%	10.7%	12.0%	13.1%	12.4%
	Slow	4.8%	5.9%	9.2%	8.9%	9.9%	10.1%
	Quick	-6.2%	-0.9%	6.1%	11.5%	13.3%	13.3%
ICE operating margin	Base	11.5%	12.8%	12.3%	11.3%	6.6%	-4.1%
	Slow	10.8%	11.8%	11.5%	10.6%	6.2%	-1.0%
	Quick	11.9%	13.0%	12.8%	12.1%	2.4%	-22.4%

Valuation		Base	Slow	Quick
WACC		7.1%	7.1%	7.1%
Terminal growth rate		3.0%	3.0%	3.0%
Effective tax rate		25.0%	25.0%	25.0%
Calc. market value (EUR mn)		**153,288**	**103,836**	**204,041**
Potential / Risk to current value		**267%**	**148%**	**388%**

Carbon liability		Base	Slow	Quick
# of ICEs produced (2022-2035)		59,550	78,608	43,029
Calc. carbon liability (EUR mn)		**139,883**	**184,649**	**101,075**
Market value after carbon liability		13,406	-80,813	102,966
Potential / Risk to current value		**-68%**	**-293%**	**146%**

Source: Stellantis, Profundo estimates

Table 4 Mercedes-Benz: Summary of model assumptions and results

Operations		2022	2023	2024	2025	2030	2035
Share of EVs	Base	7.5%	15.0%	22.5%	32.5%	80.0%	100.0%
	Slow	7.5%	10.0%	12.5%	15.0%	50.0%	55.0%
	Quick	7.5%	15.0%	22.5%	35.0%	100.0%	100.0%
EV operating margin	Base	-14.5%	0.3%	9.2%	13.4%	13.1%	12.1%
	Slow	-3.0%	2.2%	6.3%	7.0%	11.3%	10.3%
	Quick	-14.5%	0.3%	9.2%	14.5%	14.6%	13.4%
ICE operating margin	Base	11.9%	12.7%	13.8%	13.5%	5.4%	-26.2%
	Slow	11.7%	12.4%	13.1%	12.6%	5.6%	-0.2%
	Quick	11.9%	12.7%	13.8%	13.3%	-11.3%	-11.3%

Valuation		Base	Slow	Quick
WACC		4.9%	4.9%	4.9%
Terminal growth rate		2.5%	2.5%	2.5%
Effective tax rate		30.0%	30.0%	30.0%
Calc. market value (EUR mn)		**352,257**	**227,524**	**392,814**
Potential / Risk to current value		**412%**	**231%**	**471%**

Carbon liability		Base	Slow	Quick
# of ICEs produced (2022-2035)		14,176	27,511	12,169
Calc. carbon liability (EUR mn)		**33,299**	**64,624**	**28,585**
Market value after carbon liability		318,958	162,900	364,229
Potential / Risk to current value		**364%**	**137%**	**430%**

Source: Mercedes-Benz, Profundo estimates

Table 5 BMW: Summary of model assumptions and results

Operations		2022	2023	2024	2025	2030	2035
Share of EVs	Base	7.5%	10.0%	15.0%	20.0%	45.0%	57.5%
	Slow	7.5%	8.0%	10.0%	12.0%	35.0%	40.0%
	Quick	7.5%	10.0%	15.0%	25.0%	75.0%	100.0%
EV operating margin	Base	-7.3%	-0.1%	7.8%	11.1%	11.9%	11.5%
	Slow	0.3%	6.4%	9.4%	12.5%	12.7%	8.9%
	Quick	-14.8%	-5.1%	3.2%	11.1%	13.4%	14.1%
ICE operating margin	Base	11.4%	11.1%	11.5%	11.4%	7.1%	0.2%
	Slow	10.0%	9.6%	9.9%	9.3%	3.9%	-2.8%
	Quick	11.4%	11.1%	11.5%	11.6%	2.0%	-33.3%

Valuation		Base	Slow	Quick
WACC		4.8%	4.8%	4.8%
Terminal growth rate		2.5%	2.5%	2.5%
Effective tax rate		30.0%	30.0%	30.0%
Calc. market value (EUR mn)		**195,230**	**126,253**	**292,386**
Potential / Risk to current value		**282%**	**147%**	**472%**

Carbon liability		Base	Slow	Quick
# of ICEs produced (2022-2035)		27,754	32,507	18,450
Calc. carbon liability (EUR mn)		**65,193**	**76,358**	**43,339**
Market value after carbon liability		130,037	49,894	249,048
Potential / Risk to current value		**155%**	**-2%**	**388%**

Source: BMW, Profundo estimates

Table 6 Volvo Cars: Summary of model assumptions and results

Operations		2022	2023	2024	2025	2030	2035
Share of EVs	Base	7.5%	15.0%	30.0%	50.0%	100.0%	100.0%
	Slow	7.5%	10.0%	15.0%	25.0%	60.0%	65.0%
	Quick	7.5%	15.0%	30.0%	50.0%	100.0%	100.0%
EV operating margin	Base	-31.3%	-10.3%	4.0%	9.6%	13.0%	13.3%
	Slow	-1.1%	3.5%	8.3%	11.2%	11.2%	11.2%
	Quick	-44.1%	-20.9%	-4.0%	8.5%	13.3%	14.7%
ICE operating margin	Base	10.0%	11.2%	11.9%	11.3%	-0.7%	-0.7%
	Slow	7.5%	8.1%	8.5%	7.8%	2.0%	-4.0%
	Quick	10.1%	11.3%	12.1%	11.5%	n.m.	n.m.

Valuation		Base	Slow	Quick
WACC		7.2%	7.2%	7.2%
Terminal growth rate		3.0%	3.0%	3.0%
Effective tax rate		24.4%	24.4%	24.4%
Calc. market value (EUR mn)		**67,042**	**42,573**	**70,917**
Potential / Risk to current value		**226%**	**107%**	**245%**

Carbon liability		Base	Slow	Quick
# of ICEs produced (2022-2035)		3,503	9,314	3,028
Calc. carbon liability (EUR mn)		**8,228**	**21,879**	**7,112**
Market value after carbon liability		58,814	20,695	63,805
Potential / Risk to current value		**186%**	**1%**	**210%**

Source: Volvo Cars, Profundo estimates

Abbreviations

BEV	Battery Electric Vehicle
CAPEX	Capital Expenditures
CAPM	Capital Asset Pricing Model
DCF	Discounted Cash Flow
EBIT	Earnings Before Interest and Tax
EV/EBITDA	Enterprise value over Earnings Before Interest, Tax, Depreciation and Amortization
ICE	Internal Combustion Engine
IPO	Initial Public Offering
NOPAT	Net Operating Profit After Tax
OPEX	Operational Expenses
R&D	Research and Development
SG&A	Sales General and Administrative Costs
SOTP	Sum of the Parts
TCO	Total Cost of Ownership
WACC	Weighted Average Cost of Capital

Introduction

While the share price and valuation multiples of Tesla move ahead, the value traditional ICE (internal combustion engine) manufacturers has been depressed in recent years despite a recent recovery. This report will investigate whether a faster shift to Electric Vehicles (EVs) production can unlock a potential value increase for shareholders of six car manufacturers operating in Europe. Throughout this report, we refer to EVs excluding hybrid and plug-in hybrid powertrains. The important question is whether a scenario of a quick strategy shift is generating more cash flow than a slow shift. EU regulation as well as increasing regulation outside Europe will lead to a nearly 100% EV based production for global car manufactures. (i.e. Mercedes-Benz and Volvo by 2030)

This study will investigate some car manufacturers' argumentation that "an accelerated transition is destroying value". In the solution of this question, a crucial aspect is the different costs structures related to ICE car versus EV production and distribution. Both groups will be confronted with their own costs challenges and opportunities. EV might increasingly benefit from declining battery costs and lower power costs, while ICE production (and use of the product) will be hurt by rising costs related to carbon emissions. Since 2020, car manufacturers selling cars in Europe are confronted with paying a EUR 95 fine for every gram of CO^2 that is emitted for an average car in their fleet above the 95 gram/km level. As this 95 gram will be reduced from 2025 and 2030 onwards, the total production costs and costs of ownership of an ICE might rise substantially. Although there are uncertainties how the extra carbon costs are divided between producers and consumers, it affects the total costs of ownership and/or the margin of car manufacturers. While slow moving ICE manufacturers will be left with a high cost base in combination with declining sales, and might end up in the need to close factories, the car manufacturers that shift quickly to EVs might benefit of increasing economies of scale.

Although this study only focusses on the cash flow benefits, the quick movers (QMs) might benefit from more attractive financing costs as investors and banks increasingly focus on low-risk financing of sustainable activities. Finally, investors in shares and bonds of QMs might benefit from a reputation value enhancement on their investments. Investors in slow movers (SMs) is the shift to EV might be confronted with reputation risk.

This study will focus on six car manufacturers, and will first analyse the current profile and strategies of each companies, their upfront investments in new technology. Secondly, an analyses of differences between ICE and EV production cost will form the basis for forecasting in the model to 2035. A third step is to develop a case study on Volkswagen with three scenarios, a base case, a QMs scenario and a SMs scenario. The last step is the conclusion on opportunities and risks for each car manufacturer. This will be based on the current knowledge of the strategies of the six companies.

1

Profiles and strategies

1.1.1 Volkswagen Group

Volkswagen Group is the second largest automaker globally with 8.9 million vehicles delivered in 2021. Among legacy carmakers, VW is one of the leading companies in the transition to EVs, aiming to become 100% zero emission by 2040 in all major markets, and then globally by 2050. As of 2021, the share of battery electric vehicles (BEVs) in VW's total vehicle sales was 5.1% (453K units) while its aim is to approximately double BEV sales volume every second year for a 50% sales share in 2030. To reach these goals, VW plans to invest EUR 52 billion (33% of total investment) in BEV's and electrification between 2022 and 2026. VW sees software and mobility services, such as auto-pilot and car sharing, as a new (additional) revenue stream next to EV and ICE businesses and expect this new segment to push the group operating margins above its historical trend. Between 2022 and 2026, VW plans to invest EUR 30 billion (19% of total investment) in software and digital technologies (on top of electrification investments). VW's important investments outside the group are; the solid-state battery researcher Quantumscape, battery giga factories Northvolt AB and Gotion, and the autonomous driving company Argo (with Ford).

Table 7 VW: Company Metrics

Company	# of Employees (thousands)	Revenues (2020, EUR bn)	Market Capitalization (EUR bn)
Volkswagen	665	223	94.9

Source: Refinitiv Eikon, market data as of 19 April 2022

1.1.2 Toyota Motor Corporation

With 10.5 million vehicles sold in 2021, Toyota is the best-selling automaker in the world through its Toyota and Lexus brands and subsidiaries Daihatsu and Hino Motors. Although Toyota was the pioneer in the electrification of passenger cars with its hybrid Prius model, first launched back in 1997, the company did not introduce any full battery electric models until late 2021. With its recently announced strategy, Toyota as a group aims to launch 30 new BEV model until 2030 and plans to reach 3.5 million BEV sales (approximately 30% of total). The company foresees JPY 4 trillion (~EUR 30 billion) investment towards battery electric vehicles until 2030, while the same amount is earmarked for investments in hybrid and fuel cell drivetrain technologies. Toyota currently does not have any phase-out plans for its ICE business and its management see that it is up to the customer to make the choice and they want to keep all options available. The management also think that pushing for more BEVs without the necessary infrastructure (i.e. charging stations) will be inconvenient for the customers.

Table 8 Toyota: Company Metrics

Company	# of Employees (thousands)	Revenues (2020, EUR bn)	Market Capitalization (EUR bn)
Toyota	366	209	255

Source: Refinitiv Eikon, market data as of 19 April 2022

1.1.3 Stellantis

Stellantis is the resulting company of the January 2021 merger between Groupe PSA (PSA Peugeot Citroën) and Fiat Chrysler Automobiles (FCA), creating the 4th largest global automotive OEM by volume and 3rd largest by revenue[1]. In 2021, the two combined groups sold 6.1 million vehicles worldwide. The company during its March 2022 strategy update, stated its ambition to sell 5 million BEVs (~58%) in 2030 and reach net zero emissions by 2038. Stellantis plans to invest EUR 30 billion over the next 5 years for BEVs and expects full EV business to deliver double digit operating margins by 2026. Stellantis has 3 battery joint venture projects, one each with LG and Samsung for battery production in North America and one with Total and Mercedes-Benz in Europe.

Table 9 Stellantis: Company Metrics

Company	# of Employees (thousands)	Revenues (2021, EUR bn)	Market Capitalization (EUR bn)
Stellantis	407	149	41.8

Source: Refinitiv Eikon, market data as of 19 April 2022

1.1.4 Mercedes-Benz

Operating in the luxury segment, Mercedes-Benz sold 2.4 million vehicles in 2021, 4% (99K units) of which were BEVs. The management believes that the transition from internal combustion engines to electric vehicles is feasible and already underway at Mercedes-Benz. The company is getting ready to go all electric by the end of the decade, where market conditions allow. The share of xEV (plug-in + BEV) in sales is expected to be up to 50% by 2025 and after that year, all newly launched vehicle architectures will be electric-only. In total, investments into battery electric vehicles between 2022 and 2030 will amount to over EUR 40 billion. In the meantime, capital allocation in Mercedes-Benz is shifting from EV-first to EV-only. The company expects investments into combustion engines and plug-in hybrid technologies to drop by 80% between 2019 and 2026. In terms of margins, Mercedes-Benz forecasts operating margins in the BEV era to be similar to those in the ICE era.

Table 10 Mercedes-Benz: Company Metrics

Company	# of Employees (thousands)	Revenues (2021, EUR bn)	Market Capitalization (EUR bn)
Mercedes-Benz	288	134	68.8

Source: Refinitiv Eikon, market data as of 19 April 2022

1.1.5 BMW Group

Comprising of BMW, MINI and Rolls-Royce brands, BMW Group sold 2.5 million vehicles in 2021, where 104K units (4%) were fully electric vehicles. The group projects at least half of global sales will be all-electric vehicles by 2030, with the MINI brand offering exclusively all-electric vehicles from that year on. BMW group aims to be climate neutral in 2050. BMW is forming JVs with Daimler for mobility services and charging solutions (BP as the third shareholder).

Table 11 Company Metrics

Company	# of Employees (thousands)	Revenues (2020, EUR bn)	Market Capitalization (EUR bn)
BMW	121	99	51.0

Source: Refinitiv Eikon, market data as of 19 April 2022

1.1.6 Volvo Cars

The Swedish luxury brand Volvo Cars has recently been IPO'd (October 2021). The company sold 0.7 million cars in 2021, of which 3.7% was BEVs. Volvo aims to reach 50% pure electric share by mid-decade then all fully electric by 2030. Polestar, a 49.5% owned affiliate of Volvo Cars, is a pure electric car company which is expected to be publicly traded during the first half of 2022 with an implied enterprise value of USD 20 billion.[2]

Table 12 Volvo Cars: Company Metrics

Company	# of Employees (thousands)	Revenues (2021, EUR bn)	Market Capitalization (EUR bn)
Volvo Cars	41	27.8	20.6

Source: Refinitiv Eikon, market data as of 19 April 2022

2

ICE versus EV production costs

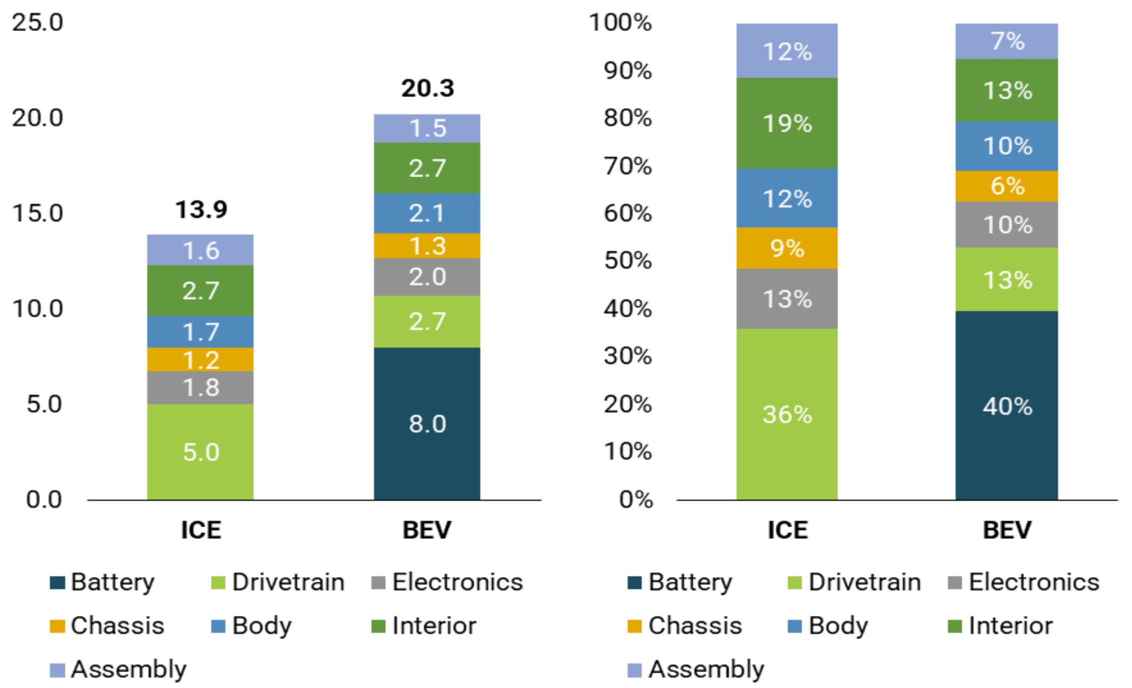
Production costs of EVs are set to decline in the coming years, driven by falling battery prices and development of dedicated EV platforms. However, the recent surge in commodity prices is likely to push production costs up in 2022, delaying the decline in manufacturing costs and ultimately the price parity between EVs and ICEs.

2.1 Production costs comparison

The main difference in production costs of EVs and ICEs stem from the battery and drivetrain costs. In 2020, the battery and drivetrain (including e-motors) of a BEV were estimated to cost about EUR 10,700 vs EUR 5,000[3] for an ICE, both in Compact (C) segment. This difference corresponds to 90% of the total production cost difference between EVs and ICEs.

The battery cost alone constitutes to 40% of the total production cost of an EV and it is the component where the majority of cost reduction is expected over the next several years.

Figure 1 Production cost comparison, C segment EV vs. ICE (2020, EUR thousand)

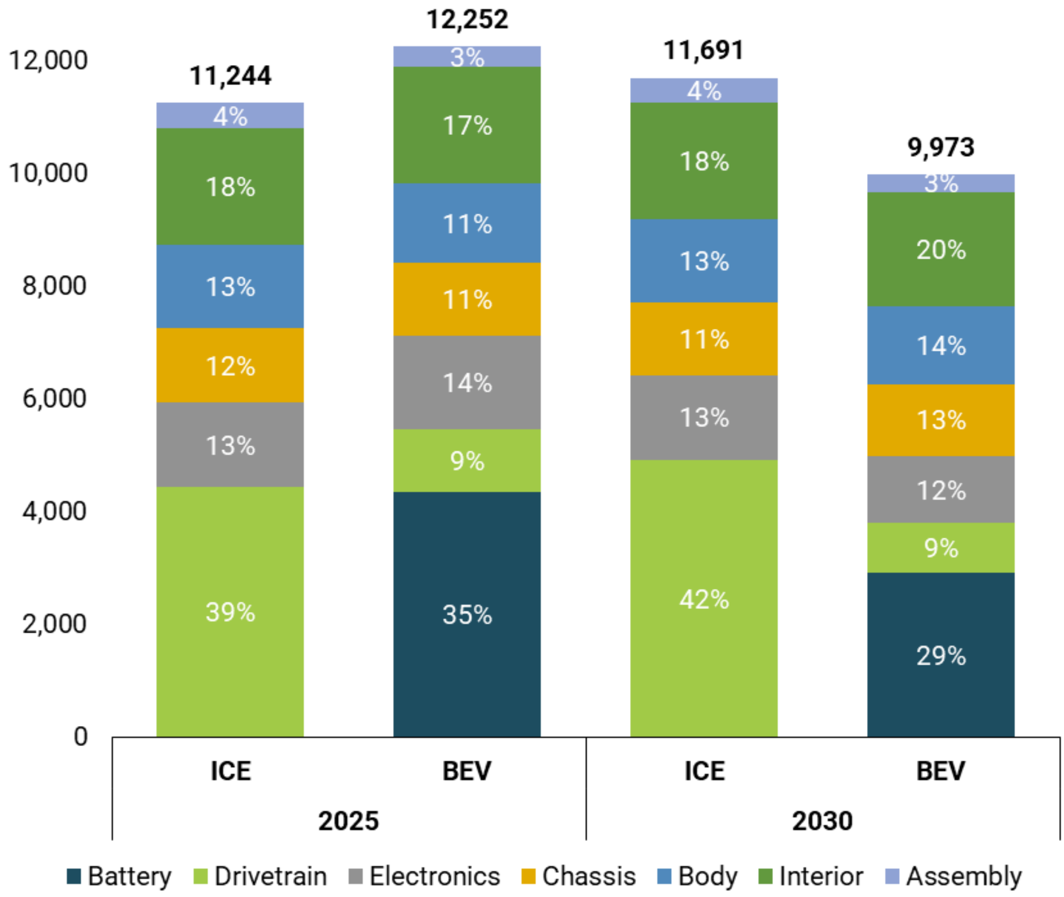


Source: Oliver Wyman[3]

Looking ahead, the production costs of EVs are expected to decline, at least by 50% by 2030, according to the May 2021 study by Bloomberg NEF, commissioned by Transport and Environment[4]. More than three quarters of this decline will be due to falling battery prices, where a ~60% decline is expected from 120 EUR/kWh in 2020 to 50 EUR/kWh in 2030. More power-dense electric motors, cheaper electronics and development of dedicated platforms will be additional drivers of production cost declines.

Figure 2 shows the Bloomberg NEF forecasts, where the manufacturing costs of a BEV is expected to decline below that of ICEs by 2030. The pre-tax sales prices of same segment EVs and ICEs are expected to be at parity by 2026 on average for different segments, which is a derivation of the manufacturing costs.

Figure 2 Production cost projection, C segment EV vs. ICE (2025, 2030, EUR, share in total)



Source: T&E, Bloomberg NEF

2.2 Rising commodity prices delay the decline in production costs

Mostly driven by the war in Ukraine, prices of materials used in battery production, as well as ICEs, have risen significantly. Although the long-term trend of declining battery prices are kept in projections, we now incorporate a 5% y/y increase in production costs in both EVs and ICEs in the valuation models to reflect the current situation. This pushes the expectation of ICE – EV price parity expectations by 1-3 years depending on the car segment.

2.3 Tesla as the reference

As the legacy auto-makers start rolling out BEVs, Tesla is probably the best company to take reference as to how the operating metrics of the new EV businesses change as the production increases. Last 4 years of the company is a good proxy for **1)** the impact of economies of scale on unit costs, **2)** impact of declining unit prices (changing product mix, start of Model 3) and **3)** the operating margin development from -5.2% in 2018 to 10.5% in 2021.

Perhaps the only non-indicative metric is the investment ratio because Tesla is building all factories from scratch while the legacy car makers have the option to convert existing facilities in to EV plants. Table 13 show the development of Tesla's operating metrics.

Table 13 Tesla: Operating figures

TESLA (USD mn)	2018	2019	2020	2021
Total production	**254,530**	**365,232**	**509,737**	**930,442**
Automotive Sales	17,213	19,358	24,604	44,125
Unit price	**68**	**53**	**48**	**47**
y/y		*-22%*	*-9%*	*-2%*
Cost of Auto sales	13,686	15,939	19,696	32,415
Auto Gross profit	3,527	3,419	4,908	11,710
Auto Gross margin	**20.5%**	**17.7%**	**19.9%**	**26.5%**
SG&A	2,835	2,646	3,145	4,463
Restructuring and other	135	149	0	-27
Total OPEX	4,430	4,138	4,636	7083
Unit costs	**71**	**55**	**48**	**42**
y/y		-23%	-13%	-11%
Auto Operating profit	-903	-719	272	4,627
Auto Operating margin	**-5.2%**	**-3.7%**	**1.1%**	**10.5%**
CAPEX	**2,101**	**1,327**	**3,157**	**6,482**
	12.2%	6.9%	12.8%	14.7%
R&D	**1,460**	**1,343**	**1,491**	**2,593**
	8.5%	6.9%	6.1%	5.9%
Total investment ratio	**20.7%**	**13.8%**	**18.9%**	**20.6%**

Source: Tesla[5]

3

Methodology for scenario analysis

This section will explain the methodologies that will be used to estimate the future cash flows of car manufacturers which will form a basis to value the companies with their current trajectory vs alternative faster or slower transition to EV scenarios. The difference between resulting company valuations will demonstrate the value creation potential.

3.1 SOTP and DCF analysis

The equity value of the selected car manufacturers will be calculated with a sum of the parts approach where the ICE, EV and any other separable parts and equity investments of the companies will be valued and summed up to reach an estimated Enterprise Value for the firm. From this, net debt and any minority interest will be deducted and if needed, a holding (SOTP) discount will be applied to account for the holding structure risk. The resulting value will be the estimated or target value of the company's equity.

3.1.1 Valuation methodologies

The car manufacturing businesses of the companies will be split in to two, ICE and EV, and each will be valued via DCF methodology. The remaining business lines, such as customer financing, (connected) services and third party parts (batteries) will be valued either via trading multiples or according to their book values, based on data availability.

3.1.2 DCF methodology

The calculation methodologies for each item of the DCF analysis are shown on Table 14.

Table 14 Calculation methodologies for DCF items

Item	Code	Methodology	Source
Sales Volume	A	Derived from company strategy	Company data, T&E, Bloomberg, Profundo
Sales Price	B	Forecasted using current average unit prices and battery cost and demand outlook (around 2027 price-parity year)	Profundo
Revenues	C	A * B	
Operating Margin	D	See Section 3.1.3	Profundo estimates
Operating Profit	E	C * D	
Tax	F	E * Corporate tax rate	
NOPAT	G	E – F	

Item	Code	Methodology	Source
Depreciation	H	Calculated using historic company practise	Company data, Profundo
CAPEX	I	Calculated using company strategy and announcements and historic ratios	Company data, Profundo
Working Capital Requirement	J	Calculated using historic ratios	Company data, Profundo
Free Cash Flow	K	G + H – I – J	
WACC	L	Calculated for the current market conditions and applied to both ICE and EV businesses	Profundo calculation

Source: Profundo

3.1.3 Operating margin estimation methodology

The estimation of future operating (EBIT) margin for ICE and EV businesses is the key determinant of the valuation study. As evident in the historic variation in margins across automakers, the operating margin is not only a function of production costs, but also dictated by product positioning, target segment and consumer perception. Thus, the operating margin can be seen as the result of a negotiation process between the consumer and the automaker over a long period of time with millions of iterations. We believe that the ramp up period of a disruptive innovation in the market, in this case EVs, create volatility in margins, for example low or even negative figures, but as the product matures, the margins eventually will normalize to historic averages of respective companies.

With this in mind, we see the EV business as the only product line in the long run, in line with the policy direction of almost all major countries. ICE's will be fully eliminated as we reach net-zero emissions targets of countries. Thus, making the EV business the only activity area of the car manufacturers. This suggests that as the EV sales volumes reach the critical mass (depending on the car manufacturer), the EV business margins would most likely normalize at the historic operating margin of the given company. In the respective DCF models, we will use a normalized operating margin for EV businesses in line with the historic (ICE) trend of given company, taking into account the estimated ramp up period in the company strategy to forecast the needed to reach normalized margin levels for EV businesses.

Fixed costs and variable costs, and economies of scale. We use a more quantitative methodology to forecast future margins, taking into account the impact of declining economies of scale and the distinction between fixed costs (overhead) and variable costs (costs that depend on number of cars produced).

The impact of declining economies of scale: In order to calculate the scale impact, a distinction between fixed and variable costs will be done, where available, and will be modelled accordingly. The main reported fixed costs are R&D costs and depreciation costs whereas the remaining cost items, usually around 80% of total costs, are variable and modelled on a per car basis. The sudden fall in vehicle sales during 2020 pandemic lockdowns also serves as a great reference to calculate the future margin impact of declining economies of scale.

In this part of the analysis, the impact of increasing legislation, regulation and costs of carbon emissions by the outgoing ICE businesses is not taken into account. This issue is explained in section 4.

3.2 Estimating value creation potential from faster EV adaptation

After estimating the future cash flows for the current strategic outlooks of the companies, a scenario analysis will be conducted by pulling forward the EV transition plans and faster phase-out of ICEs. Thus, the difference between the valuation of the current strategy vs. the faster transition will demonstrate the value creation potential. To be able to reach credible results, the proposed strategy in the scenario analysis will incorporate time buffers, meaning that any different plan that cannot take effect immediately, will have a later (i.e. 2 years) impact. On the other hand, opting for a slower strategy and delaying plans are relatively easier to do and take effect the following year, as with the slow cases in our study.

3.3 Comparison

The results will be compared both within the two groups, mass market and luxury segment, and also as aggregated group differences will be demonstrated. The comparison will try to point out the value effect of different EV transition strategies of car manufacturers as well as an estimated total value creation opportunity if the sector as a whole can move more quickly towards EVs, possibly through regulatory incentives.

4

CO^2 emissions in valuation models

In addition to the emissions limit scheme currently applied to European automakers' fleets, the emissions from every vehicle could be subject to carbon pricing through ETS in Europe and similar schemes elsewhere in the world. This could impact the enterprise value and the market capitalisation of a car manufacturer with a large ICE business.

4.1 Introduction – Investors will discount uncertainties of ICE future

Investors will take into account that carbon pricing initiatives might have an impact on the price that consumers want to pay for an ICE car, and/or on the demand for ICE cars, and/or the margins of ICE car production. Related question is how much of the burden will be at the car manufacturer, and how much at the customer. Do car manufacturers that change quickly to EV production have a benefit versus the slow-movers?

Total Cost of Ownership (TCO), combined with the production costs of ICEs versus EVs, is a crucial element in the pricing of a car and in the profitability of ICE business. The risk is that the car manufacturer might have to bear the burden due to its diminished bargaining power, thus eroding the value of the business in proportion of the potential Scope 3 emissions produced by the ICEs in the remaining period to 2035 when they phase out ICE production.

4.2 Carbon cost/liability methodology

4.2.1 Calculating with a margin impact versus introduction of a liability

The key question for the car manufacturers valuation model, is whether carbon costs are introduced as a margin impact or as a liability, reducing the enterprise value of the ICE production activity.

The car market in specific jurisdictions is already affected by the issue of carbon (CO^2-equivalent) costs. Carbon cost accounting will affect car manufacturers in two ways:

- Through regulation/legislation in production. The EU already sets targets for CO^2 emissions for the average manufactured fleet per km. This includes fines when the average product portfolio consists of cars emitting more than 95 gram of CO^2 per km. The company could pass this on to the customer or the company could accept a margin decline.
- In case of pricing carbon emissions through fuel sales, the consumer will discount this in its decision process when buying a new car. Other costs can be added to this, like a higher pricing for parking an ICE car in city centres, or a ban on driving into certain areas. These elements will add to the Total Cost of Ownership (TCO) of an ICE car.

Current regulation does not lead to material pressure on margins of ICE's. The EU is most advanced with CO^2 cost regulation for car manufacturers. Target levels on a new sold fleet level are set for 2020-2024 with cars and vans to emit a maximum of respectively 95 and 147 gram CO^2/km. For 2025 these targets are reduced by 15% (2025) for cars and vans. For 2030, a reduction of 37.5% for cars and 31% for vans is required. Penalties are currently EUR 95 per gram/km (for a car with a weight of 1,379.88 kg) of target exceedance for the average fleet produced.[6] Now, the EU commission proposed in its "Fit for 55" package a reduction of 55% for cars and 50% for vans in 2030 and 100% for both categories in 2035.[7] In this regulation, pooling is allowed, which means that car manufacturers can group together and act jointly to meet their emission targets.

The EU system means that for instance a BMW 2 Serie Active Tourer (weight 1,494 kg, so adjusted 99 gram/km) with emissions of approximately 126 gram/km[8] on a NEDC (New European Driving Cycle) basis[9], generates 27 grams of CO^2/km above the EU level. If the whole fleet would consist of this car, BMW would need to pay EUR 2,565 (27 X EUR 95) per car to the EU. Of a net sales price of EUR 30,000, this is 8.6%. In its average 2020 fleet however, BMW says to have achieved a 99 g/km, close to the target of the EU.[10] The actual number according to T&E is 114 gram/km[11]: emissions in 2020 were reported with NEDC; from 2021, equivalent targets are set as emissions are measured using the Worldwide Harmonised Light Vehicle Test Procedure (WLTP), and they lead to higher absolute value of emissions to be used for carbon accounting.[12]

Total cost of ownership approach is the preferred way of embedding CO2 costs into the model. In this BMW example (145 gr/km at WLTP basis), a 15-year lifetime of a vehicle with 15,000 per year would lead to 32.63 metric tons of CO^2. Although currently there is no carbon costs involved, one could calculate with a certain value of these CO^2 emissions.

Like in the Morgan Stanley analysis "EV assets vs. ICE Liability"[13], the costs can be included in the margin or can be added as a liability in the DCF and equity valuation. In the Ford example the scenarios of USD 10 dollar/ton CO^2 and USD 100/ton would lead to USD 50 billion respectively USD 500 billion liability. The study states that it is uncertain how this potential liability will be divided between manufacturer and customer.

The current EU ETS market price is CO^2/ton (EUR 75). As investors are gradually getting accustomed with the EU ETS market, this EUR 75 would be a good assumption as potential cost. If in the BMW 2 example the EUR 75 per ton CO^2 would be used, the total emission costs would be EUR 2,447 over the lifetime of a car (75 x 32.63). In this BMW 2 example, the choice is for two approaches:

- Margin impact: this would be 8.1% (2,447 / 30,000) of the net sales price of the BMW.
- Liability impact: the alternative is to add this EUR 2,447 to the manufacturer's liability in the DCF and equity valuation.

In the USA, the Environmental Protection Agency (EPA) used the same methodology. It stated that a typical passenger vehicle emits about 4.6 metric tons of CO^2 per year. This is based on 22 miles per gallon and 11,500 miles per year.[14] In 15 years, this would mean 69 metric ton CO^2 emission. At EUR 75 per ton CO^2, this adds up to EUR 5,175.

In a competitive environment where car manufacturer A adjust quickly to become a EV manufacturer while car manufacturer B is much slower, B will be confronted with margin pressure when the costs of CO^2 emissions can be difficult passed on to customers. This certainly occurs in an environment where production costs of EV reach parity with ICEs, and EVs will be increasingly subsidized.

To apply the carbon costs (which is affecting the Total Cost of Ownership = TCO) into the valuation model, the preferred methodology is through the addition of a liability. Companies and scenarios that choose for a quick switch to EV production, will face a lower liability than companies and scenarios that choose for a slow switch.

4.2.2 The introduction of a liability

The CO^2-emissions per 'average' car produced sold in Europe have developed as follows in the period 2016-2020. On a global scale, the companies have already moved close to the requirements in the EU (95 gram CO^2/km). These data are NEDC values. Note that WLTP values are higher.

Table 15 Average CO^2 emission per produced cars (Europe)

Average CO^2/km	2016	2017	2018	2019	2020
VW	120.2	121.5	121.9	124.0	112.4
Toyota	105.5	103.1	102.1	99.7	97.0
Stellantis	112.8	114.0	117.0	118.7	102.7
Mass market average	**112.8**	**112.9**	**113.7**	**114.1**	**104.0**
BMW	123.0	121.8	126.4	126.8	114.0
Daimler	125.3	127.0	134.2	137.4	118.6
Volvo Cars	121.2	124.4	132.2	131.9	106.5
Luxury market average	**123.2**	**124.4**	**130.9**	**132.0**	**113.0**

Source: T&E; NEDC values. WLTP values are higher.

As most manufacturers still produce mainly ICEs, these CO^2 outcomes reflect the ICE business. To calculate the potential carbon liability per car manufacturer, most logical is to calculate the remaining number of ICEs to be produced in 2022–2035, multiply this with an CO^2 emission per average car in 2022-2035, multiplied by the total kilometres in the lifetime of a car, and finally multiply this by the carbon price per ton (EUR 75). As the report works with three scenarios per manufacturer, there will be three different emission cost liabilities per manufacturer.

The calculation with a carbon price of EUR 75 per ton can be justified by already existing carbon pricing initiatives around the world[15] and the existing EU ETS price.[16] Based on European Environment Agency (EEA) preliminary data for 2020[17], the average CO^2 emissions of new cars sold in Europe (total for all carmakers) was 107.8 g/km on the NEDC cycle and 130.4 g/km on the WLTP cycle. Excluding pure electric vehicles (BEV), the average WLTP emissions were 139.2 g/km in 2020. Considering that this average is only for Europe, where there are legal targets to match, we can assume that the global figures are higher than this average. However, we opt to use 139 g/km until the end of the calculation period to compensate for any possible reductions in ICE (incl. PHEV) emissions.

For instance, in the base case VW will produce cumulative 92 million ICEs in the period 2022-2035. The assumption is they might emit on average 139 gram per car. In the total lifetime, the average car drives 225,000 km leading to 2,867 million ton CO^2 emissions for all 92 million VW ICEs cars produced in 2022-2035 (cumulative). This leads to a total carbon cost liability of EUR 214,988 million in case of EUR75/ton emission cost.

Table 16 Example VW: Emission liability in Enterprise Value in Base Case

Factor	Input	Formula
Cumulative # ICEs (000)	91,523	A
Emissions/km (gram)	139	B
Total km per car per year	15,000	C
# years	15	D

Factor	Input	Formula
Total km per car lifetime	225,000	E= C x D
2022-2035 ICEs emissions (million ton)	2,867	F = A x E X B
Emission costs/ton (EUR)	75	G
Emission costs ICE fleet 2022-2035 (EUR million)	214,988	H = F x G

Source: Profundo

The introduction of this Carbon Liability leads to a negative Enterprise Value for VW's ICE business. The positive DCF based on realistic production costs excluding the potential liability of emission costs, is completely wiped out. The end result would be a negative EUR 115 billion.

In a scenario analysis of a Quick Case, the number of ICEs will decline strongly in 2022-2035, leading to a strong reduction of the Emission Liability (to EUR 153.3 billion). As a consequence, the ICE including the Emission Liability could lead to a negative Enterprise Value of EUR 30.9 billion. **Including an enhancement of the EV Enterprise Value, the value of Chinese activities and Financial Services, this would lead to a strong increase of the total Enterprise Value versus the Base Case for VW due to a quick adjustment to EV. The outcome would be EUR 209 billion in Enterprise Value. After deduction of Net cash, Hybrid Capital, Pension Liabilities and Minorities, an Equity Value of EUR 182 billion would result. This is above the current Market Capitalization (see Table 21).**

5

Case study Volkswagen

The case study will present Volkswagen's company valuation under three different EV adaptation scenarios while hypothetically splitting the company into 4 businesses: EV business, ICE business, China JVs and Financing business.

5.1 Forecasting, scenario and valuation methodology and assumptions

To be able to demonstrate the different business outlooks of EVs and ICEs, we performed a hypothetical split between the two product lines. Because VW does not report financial figures on EVs and ICEs separately, this split had to rely on company guidance and analyst assumptions, especially on unit revenues, costs and investments. The financial figures of the Chinese JVs are already excluded from Volkswagen's consolidated numbers, thus only the unit sales figures had to be separated from the total. The separation of the finance business (leasing, consumer loans etc.) was done according to the reporting by VW. Following the splitting, 3 different EV adaptation scenarios, Base, Quick and Slow adoption, were formed to forecast the operational outlook and the cash flows until 2035 as the input for the DCF valuation study.

5.1.1 Total vehicle sales and EV adaptation assumptions

The total vehicle sales forecasts are based on publicly available sales targets of OEMs, where the recovery in production and sales expected in 2022 had to be distributed to the next few years as the chip shortage problems are still valid for the whole sector. The level of EV adaptation, in other words the share of pure electric vehicle within the total vehicle sales, forms the basis of the scenarios and the analysis. Please note that the EV adaptation ratios used throughout the study are global shares of EV, not specific to any region unless stated otherwise. For the base case, the most recently communicated strategic targets by VW were used. In its latest five-year planning round presentation[18] covering the strategic outlook for 2022-2026, the company stated that it aims to reach ~50% BEV share in total sales by 2030. Table 17 summarises the sales volume assumptions for the Volkswagen case study.

Table 17 VW: Summary of sales volume and EV adaptation assumptions

Case	('000s)	2022	2023	2024	2025	2030	2035
	EV share	**7.5%**	**11.0%**	**15.0%**	**21.0%**	**50.0%**	**72.5%**
Base	# of EVs	713	1,073	1,500	2,229	5,638	9,070
	# of ICEs	8,788	8,678	8,500	8,384	5,638	3,440
	EV share	**7.5%**	**8.0%**	**10.0%**	**12.0%**	**35.0%**	**40.0%**
Slow	# of EVs	713	780	1,000	1,274	3,947	5,004
	# of ICEs	8,788	8,970	9,000	9,340	7,330	7,506
	EV share	**7.5%**	**11.0%**	**15.0%**	**25.0%**	**75.0%**	**100.0%**
Quick	# of EVs	713	1,073	1,500	2,653	8,457	12,511

Case	('000s)	2022	2023	2024	2025	2030	2035
	# of ICEs	8,788	8,678	8,500	7,960	2,819	0

Source: Volkswagen, Profundo estimates

As reference, Volkswagen sold 231,600 (2.5% share in total) and 452,900 (5.1% share) BEVs in 2020 and 2021, respectively. While the Base Case scenario reflects the company strategy, the quick case represents a much higher level of EV adaptation. In order for the quick case to be more realistic, the EV share in the first 3 years (2022, 2023 and 2024) were kept the same as Volkswagen's strategic plans, as any decision taken to speed-up the adaptation would need 2-3 years to make an impact. Overall, the quick case assumes a 75% EV adaptation by 2030 (vs. 50% base) and full phase-out of ICEs by 2035. The slow case, on the other hand, represents a scenario where Volkswagen decides to slow down the EV roll-out, either due to market conditions, regulatory environment (adopting to only minimum emission reduction requirements) or operationally failing to achieve its strategic targets. The slow case features lower EV shares from 2023 (8% vs. 11% in base case) and the EV adaptation level at the end of the forecast period is 40%. Please note that all numbers exclude sales in China.

5.1.2 Vehicle sales price assumptions

The sales price assumptions for both EVs and ICEs are pre-tax (before VAT) figures and they are used the same in all three cases. The reasoning for using the same sales prices is that the price is mostly dictated by the market for similar vehicles, meaning that it is not very sensitive to the decisions of any particular auto-maker's decisions. For Volkswagen, 2021 EV sales figures were taken as a reference for the average sales price (see Table 18) which was calculated at EUR 45,507 per EV vehicle.

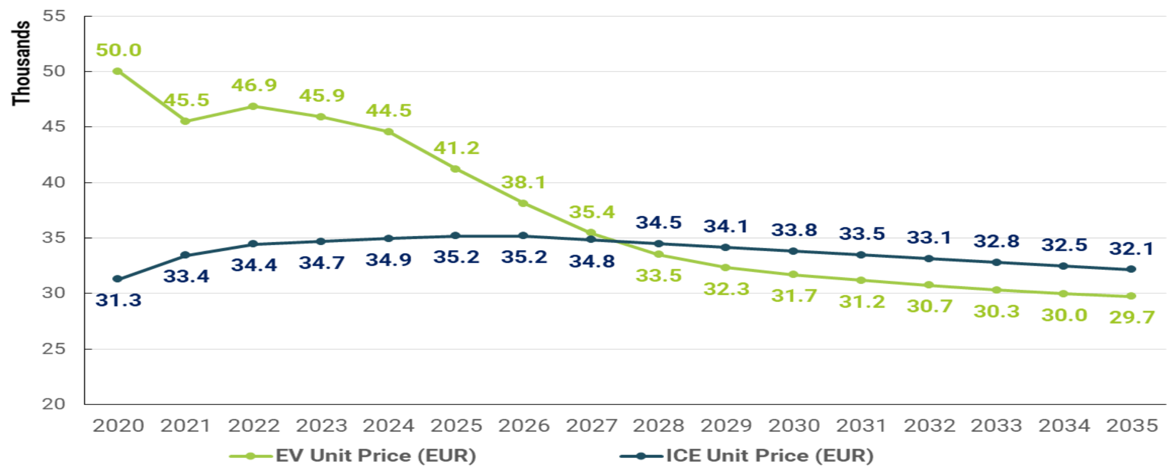
Table 18 VW: Calculation of reference 2021 EV sales price (EUR)

EV Model	Units sold	% of total EVs	Assumed pre-tax price	Contribution
Volkswagen ID.4	119,600	27%	41,600	11,138
Volkswagen ID.3	75,500	17%	34,000	5,747
Audi e-tron (incl. Sportback)	49,200	11%	58,333	6,425
Audi other	32,000	7%	41,600	2,980
ŠKODA Enyaq iV	44,700	10%	41,600	4,163
Seat	13,000	3%	26,667	776
Volkswagen e-up!	41,400	9%	26,667	2,471
Other	30,000	7%	26,667	1,791
Porsche Taycan (incl. Turismo)	41,300	9%	108,333	10,016
Total	**446,700**			**45,507**

Source: Volkswagen[19], Profundo calculations

The outlook for unit EV sales price for Volkswagen is driven by 1) expectations of declining battery costs (see 2.1), 2) increasing economies of scale, 3) increasing consumer demand for EVs, and 4) marketing efforts to gain market share. While all these drivers are towards a declining trend for the sales prices, from a business perspective, the fall in battery costs will be the most dominant force as it will open up the competition in this new product line. We argue, especially after 2027 when similar sized EVs and ICEs reach price parity, that the auto market will move closer to a perfect competition environment. As the most expensive and probably the most important differentiator of a vehicle, the drivetrain, gets very standardized, almost commoditized, auto makers will need to compete more and more on price as the technology continues to mature. As for ICEs, only moderate price increases (around 1% per annum) are expected until 2027, after which ICEs are expected to lose almost all bargaining power against EVs and we expect declining demand, prices and margins for the ICE business.

Figure 3 VW: Unit sales price projections for EV and ICE



Source: Profundo estimates

5.1.3 Investment and operating cost assumptions

The investments in car manufacturers, in this case Volkswagen, consist of two accounting items, CAPEX (investments in fixed assets like buildings, production machinery etc.) and Research and Development (R&D). As per Volkswagen's latest five-year planning round document[18], the company expects to invest ~EUR 52 billion on BEVs and electrification, ~EUR 30 billion on software and digital technologies, and ~EUR 8 billion on hybrid powertrains in the next 5 years (~56% of total R&D plus CAPEX). For the analysis, EUR 72.1 billion was assumed to be for the EV business (all of BEV and 2/3 of software/digital investments) until 2026 vs. EUR 91.1 billion for the ICE business. As an accounting principle, a portion of the development costs can be capitalized (rather than being treated as a cost in the profit and loss statement) and be treated like capex to form a fixed asset, and then be amortized in the P&L.

Table 19 VW: Total investments (R&D + CAPEX) as a % of sales

Case	Business	2020	2021	2022	2023	2024	2025	2030	2035
	EV			57%	43%	37%	29%	12%	12%
Base	ICE			9%	10%	10%	10%	9%	5%
	Total	13.7%	13.8%	14.5%	14.7%	14.5%	14.5%	10.6%	9.8%
	EV			35%	30%	30%	23%	10%	8%
Slow	ICE			11%	11%	11%	11%	10%	10%
	Total	13.7%	13.8%	13.6%	13.1%	13.3%	12.6%	10.2%	9.5%
	EV			69%	54%	47%	39%	14%	11%
Quick	ICE			8%	8%	8%	8%	5%	3%
	Total	13.7%	13.8%	14.3%	14.5%	14.5%	15.9%	11.7%	11.0%

Source: Volkswagen, Profundo estimates

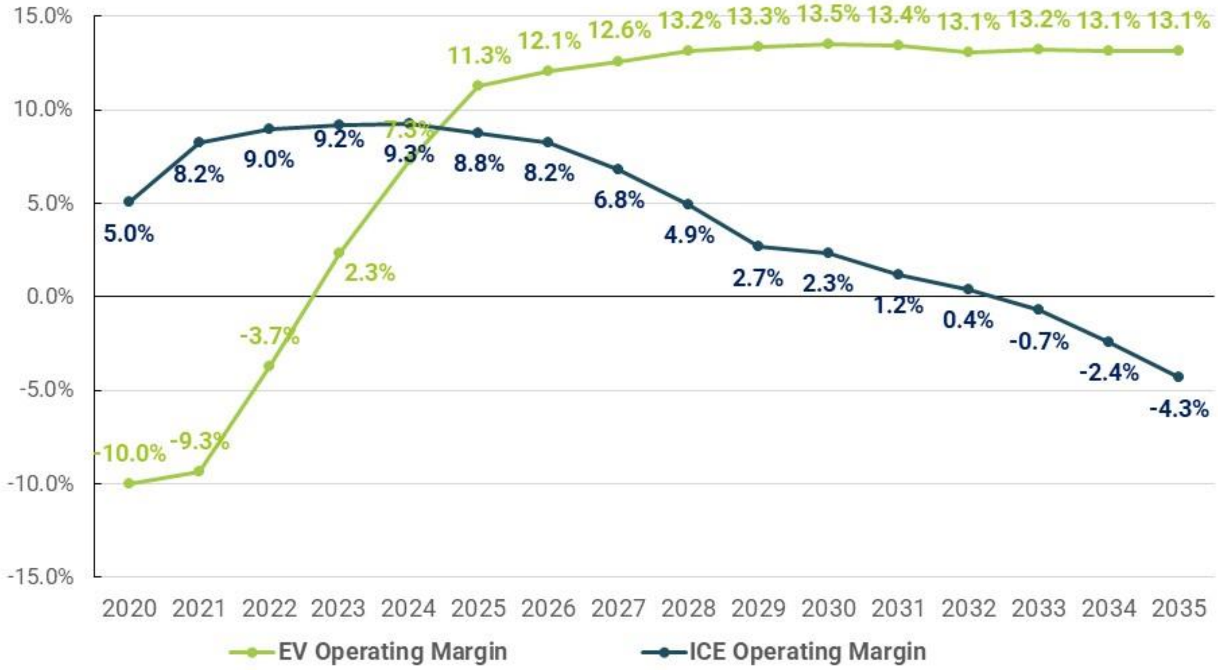
The operating costs of both EV and ICE businesses were analysed and projected with a fixed and variable cost differentiation. Depreciation and amortization expenses along with R&D costs (expensed portion) are two major fixed cost items that are not directly correlated with the amount of car sold and they are calculated using the investment assumptions. Historic depreciation averages and R&D capitalization rates were used for both EV and ICE figures. Other fixed costs were assumed to be EUR 19.7 billion as of 2020, as deducted from the five-year planning document's fixed cost reduction program section[18]. This other fixed cost is assumed to increase by 2% per annum (inflation proxy) and is distributed to EV and ICE businesses proportional to their sales.

The remaining operating costs are assumed to be variable costs that are linked to the amount of production and sales of cars such as cost of materials, selling and marketing expenses etc. For the ICE business, the variable cost per car sold is linked to the historic reference (VW disclosed cost of materials and services as a separate item for 2016 and 2017 but the disclosure is discontinued after 2018) which is around EUR 23,300 per car for 2021. This per car cost is project to increase 5% in 2022 as a reflection of global high material prices, and are expected to grow by 1% per annum until 2035. One exception is 2025 when the EURO 7 standards are expected to come into force, likely to result in a EUR 300 – 500 increase in average car manufacturing costs. The striker emission standards are likely to force the car makers to use more advanced tools and technologies in their cars, push the overall costs up.

The variable costs of EV business are constructed using T&E and BloombergNEF's joint study[4] on the outlook of battery and overall EV manufacturing costs (also discussed in 2.1) and the product mix of VW. Further on the subject, BloombergNEF's more recent survey (plus the impact of the war in Ukraine) on Lithium-Ion Battery prices suggests that the rising raw material and battery component prices are likely to push battery costs up in 2022, for the first time in the industry. While the overall declining trend is expected to be maintained, Bloomberg now expects the long-term price curve to be slightly above its previous forecast. Parallel to these insights, we expect VW's variable costs on EV production to decline by 36% by 2030 on our base case scenario. Although there are small differences in variable cost outlook for EVs in quick and slow cases, they are the result of higher or lower investment and scale factors. We expect the cost of manufacturing to be mainly dictated by the overall market pushing for new technologies.

The volume, sales price and cost assumptions of the base case scenario yields the operating margin outlook shown in Figure 4. In the base scenario for Volkswagen, the EV business margin catches up to ICE in 2024 and keeps rising until 2030 with the help of operating leverage (fast increasing sales vs. relatively stable fixed costs) and declining production (battery) costs. After 2030 we expect margins to stabilize as the competition increases. The ICE margins on the other hand are expected to decline steadily as the demand falls and the operating leverage (scale effect)

Figure 4 VW: Base case operating margin estimates

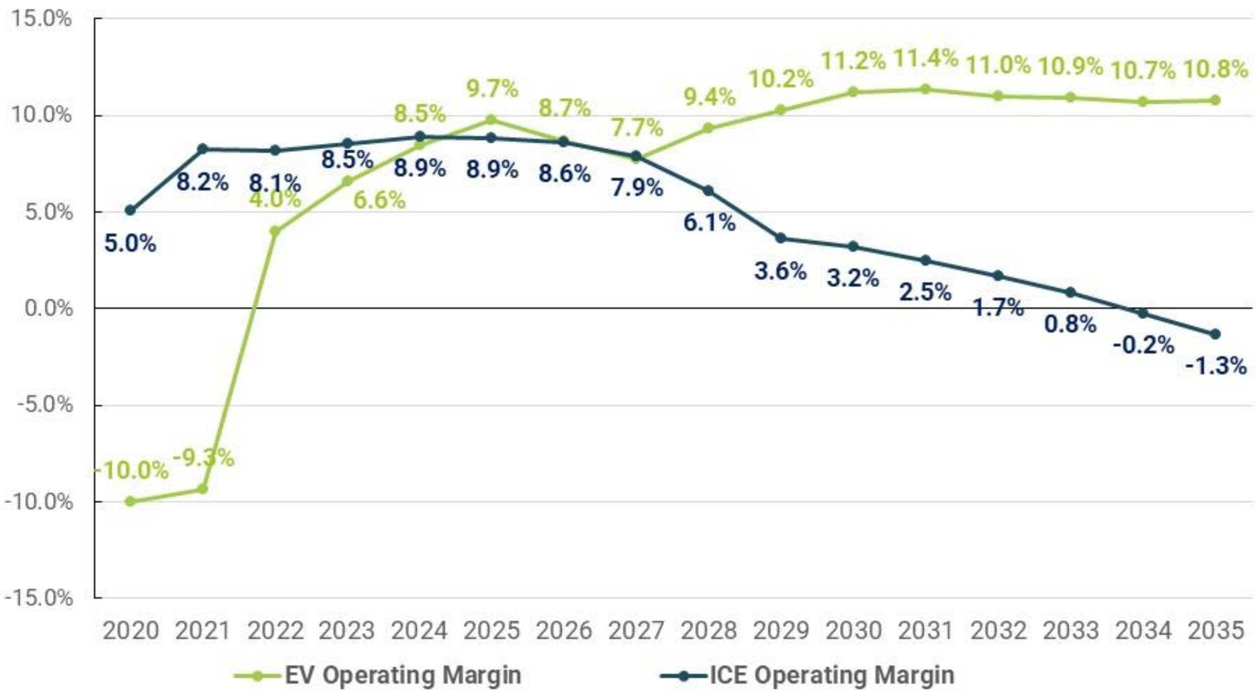


Source: Profundo estimates

starts to work the other way around. Although we expect negative ICE operating margins, this does not mean that ICE business after 2031 will be burning cash. There will still be significant depreciation and amortization charges within the operating expenses which are non-cash items. Thus, the ICE business is projected to still generate an annual free cash flow around EUR 5.3 billion in 2035.

In the slow case, the scale effect is expected to be non-linear as the scenario considers the roll-out of EV production capacity just when Volkswagen needs to comply with emission reduction requirements. The ending operating margin is still expected to be higher for EVs as ICEs are expected to lose bargaining power in the market regardless of how slow or quick VW adopts. The overall company margin and the valuation will therefore be lower in the slow case as the company would be selling less of the high margin product and more of the low margin one.

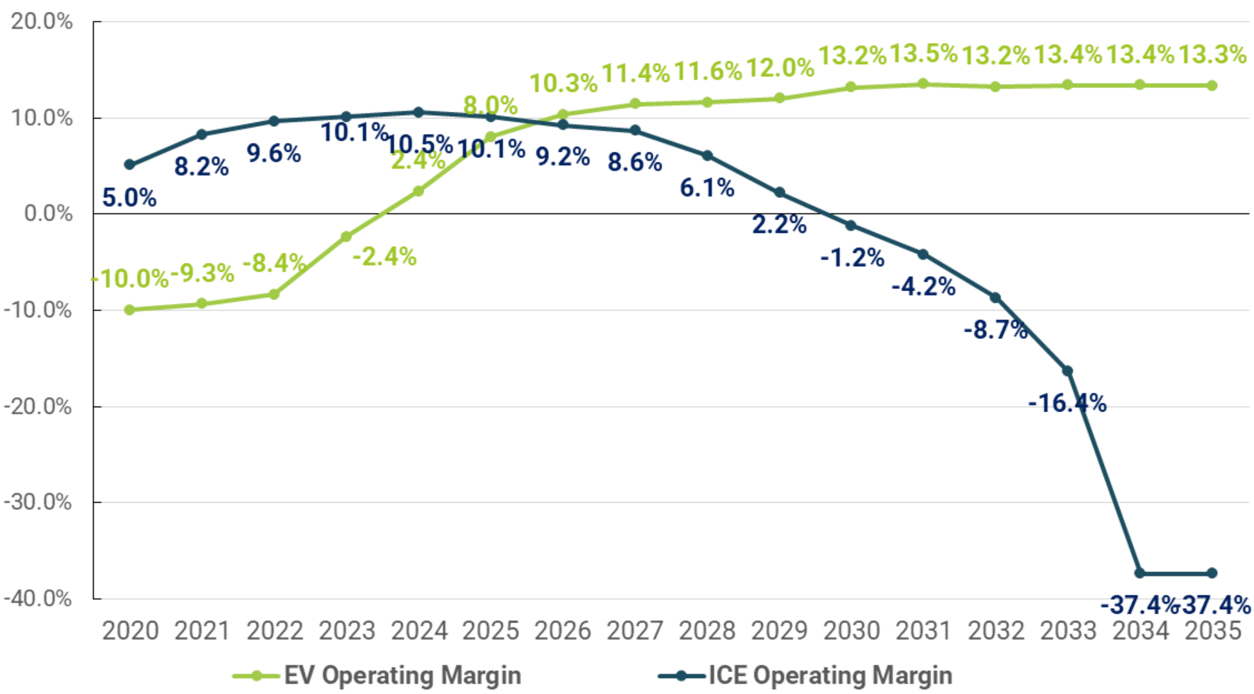
Figure 5 VW: Slow case operating margin estimates



Source: Profundo estimates

The quick case margins follow a similar trend to the base case in EVs, just slower to increase in the first years due to higher R&D costs. The ending few years' ICE margins are mathematically less meaningful as the sales figures approach zero.

Figure 6 VW: Quick case operating margin estimates



Source: Profundo estimates

5.1.4 Other assumptions for valuation

As the case studies provide the cash flows for the valuation analysis (DCF) of the EV and ICE businesses, China JVs and the Finance business are valued using valuation multiples. Since the percentage of ownership and net profit amounts of the Chinese JVs are reported by Volkswagen, we applied 9x Price/earnings (P/E) multiple on the average of 2019 and 2020 earnings to reach a valuation of EUR 24.2 billion. This is a very conservative approach as we look at old earnings data, but we choose to be on the safe side with limited data. As for the Finance business, we applied, as per market convention, 1x Book(equity) value (price-to-book multiple) to the latest reported equity of the finance business to reach a valuation of EUR 36 billion.

To reach the target market capitalization for Volkswagen we also took net financial liabilities of the company (excl. finance business) comprising EUR 27.9 billion net cash, EUR 14.3 billion hybrid capital, EUR 40.2 billion pension liabilities and EUR 1.0 billion minorities.

Finally for the discounted cash flow (DCF) analysis, we used for both EV and ICE businesses a weighted average cost of capital (WACC) of 6.5%, in line with the company's own calculations. Although calculations using the capital asset pricing model (CAPM) yield a lower WACC at 5.2%, we choose to be conservative about the valuation. The effective tax rate and the terminal growth rate for Volkswagen were assumed to be 30% and 3%, respectively.

For the ICE businesses, we did not calculate a terminal value after 2035, the end of our forecast period, with the thinking that any remaining (salvage) value can only offset the phasing-out costs of the business. Also, the carbon costs liability is not added in this phase but will be done in section 5.3.

5.2 Results excluding carbon liability

The results clearly show that the equity value of Volkswagen will be higher if the company makes a quicker roll-out of EVs and earlier phase-out of ICEs. The shareholders of Volkswagen will benefit from higher share prices and reduced uncertainty about their company being future-proof or not. In all three scenarios the EV business makes the higher contribution to the valuation vs the ICE business. It is also important to note that the value of the ICE business is also highest in the quick EV adaptation scenario as Volkswagen would be spending less on investments and be selling less of a low margin product. Accordingly, the quick case yields the highest value for EV, ICE and total business at EUR 334 billion assuming that Volkswagen phases-out the ICE business in 2035.

Table 20 Volkswagen sum of the parts summary

SOTP Summary (EUR mn)	Methodology	Base Case	Slow Case	Quick Case
EV Business	DCF	113,990	79,313	179,957
ICE Business	DCF	99,590	81,866	122,418
Financial Services	1x Equity (book) Value	35,987	35,987	35,987
VW China	9.0x 19-20 avr. Earnings	24,181	24,181	24,181
Enterprise Value		**273,748**	**221,347**	**362,544**
Net Cash (exl. Fin. Services)	as of 3Q21	27,855	27,855	27,855
Hybrid Capital	as of 3Q21	-14,345	-14,345	-14,345
Pension Liabilities	as of 3Q21	-40,209	-40,209	-40,209
Minorities	as of 3Q21	-989	-989	-989
Target Equity Value		**246,060**	**193,659**	**334,856**

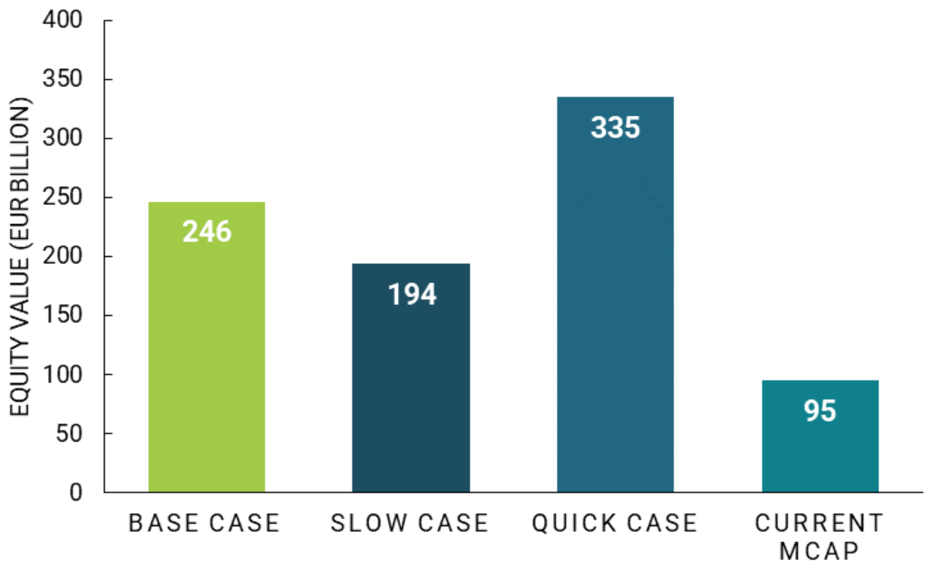
SOTP Summary (EUR mn)	Methodology	Base Case	Slow Case	Quick Case
Current Market cap.	94,876			
Potential / Risk		**159%**	**104%**	**253%**

Source: Volkswagen, Profundo calculations

Figure 7 compares the outcome of the valuation study by the different EV adaptation cases. The base case, representing the current strategic plans of Volkswagen yields a target equity value of EUR 246 billion. Note that the current market valuation of Volkswagen is substantially below all the case results, even the slow case. This is probably the result of the 2015 Diesel scandal when investors both experienced market risk, reputation risk and legal risk being realized. Investors might be using higher risk parameters when valuing the company, especially the outgoing ICE business stemming from uncertainty about carbon costs scope 3. In section 5.3, we present the results including the carbon costs to better demonstrate how much risk can be considered by investors on ICE business.

Thus, even though the current outlook of the company is among the best in terms of transformation to EV, the investors may need to see the management deliver on their promise before lifting the execution risk premium. Another probable reason for the discount on the shares might be the holding structure, that many valuable brands such as Porsche and Lamborghini might be undervalued within the total group while could be worth much more if they were stand-alone companies. The recent news flow regarding a Porsche IPO may unlock that hidden value for Volkswagen shareholders, bringing the valuation closer to our target.

Figure 7 Target market value for Volkswagen vs current valuation



Source: Profundo estimates

The results suggest that a slower transition to EV business is a worst-case scenario for VW shareholders with a target equity value at EUR 194 billion. With the exact opposite of quick EV adoption, VW would be investing more money on an outgoing technology which will lose its ability to compete with EVs probably in the second half of the decade. The company would be selling more of the low margin product, thus would generate less cash flows for its investors.

5.3 Results including carbon costs

Although it was not included in our valuation scenarios above we believe that the carbon costs methodology is a useful way to account for ESG uncertainties, as a proxy. It explains, at least partially, the large discount we see on VW shares compared to our valuation scenarios. The target equity value for the base case falls to EUR 31 billion as we include the carbon cost, implying a 67% downside potential for VW. In the slow case, the resulting target will be negative (-) EUR 82 billion, wiping out the entire value of the company. As discussed in section 4.2, the carbon costs (emissions liability on Table 21) are significantly higher in the slow case (EUR 275 billion) vs the quick case (EUR 153 billion). This is directly proportional to the number of ICEs produced between 2022 and 2035. Thus the slow case yields a higher carbon cost estimate. The inclusion of carbon costs into the equation also increases the difference between slow and quick case outcomes, such that without the carbon costs, the target value difference between slow and quick cases were EUR 141 billion (EUR 335 bn – EUR 194 bn) but including the carbon costs the difference goes up to EUR 264 billion. This suggests that the potential value impact of the EV transition pace can be even more significant with carbon costs included in the thought process.

Table 21 Volkswagen sum of the parts summary with carbon costs

SOTP Summary (EUR mn)	Methodology	Base Case	Slow Case	Quick Case
EV Business	DCF	113,990	79,313	179,957
ICE Business	DCF	99,590	81,866	122,418
Emissions Liability (ICE)		**214,988**	**275,785**	**153,348**
ICE Net Enterprise Value		-115,398	-193,919	-30,930
Financial Services	1x Equity (book) Value	35,987	35,987	35,987
VW China	9.0x 19-20 avr. Earnings	24,181	24,181	24,181
Enterprise Value		**58,760**	**-54,437**	**209,196**
Net Cash (exl. Fin. Services)	as of 3Q21	27,855	27,855	27,855
Hybrid Capital	as of 3Q21	-14,345	-14,345	-14,345
Pension Liabilities	as of 3Q21	-40,209	-40,209	-40,209
Minorities	as of 3Q21	-989	-989	-989
Target Equity Value		**31,072**	**-82,125**	**181,508**
Current Market cap.	94,876			
Potential / Risk		**-67%**	**-187%**	**91%**

Source: Volkswagen, Profundo calculations

6

Results for Toyota, Stellantis, Mercedes-Benz, BMW and Volvo Cars

Following the detailed explanation of the methodology and Volkswagen case, the results of the valuation studies of the remaining five companies are presented in this section. The results in this section do not include our calculations for carbon costs.

6.1 Toyota: The laggard within the mass market in EV adoption

Toyota is the company with the slowest EV adaptation plan announced so far. In the base case scenario, only 29% of total sales are expected to be BEVs by 2030 and 44% at the end of the forecast period (2035). However, Toyota differs from all other car manufacturers in this study with its much lower revenue exposure to Europe, which can enable the company to sell ICEs with better margins for longer. Having the slowest base case also means that the potential value that can be unlocked in the quick case is the largest for Toyota. Table 22**Error! Reference source not found.** summarises the results of the scenario analysis.

Table 22 Toyota sum of the parts summary

SOTP Summary (EUR mn)	Methodology	Base Case	Slow Case	Quick Case
EV Business	DCF	147,251	83,605	259,024
ICE Business	DCF	96,680	102,932	132,476
Financial Services	1x 3Q21 Book Value	27,144	27,144	27,144
Joint Ventures	9.0x 2021E Earnings	33,231	33,231	33,231
Enterprise Value		**304,306**	**246,913**	**451,874**
Net Cash (exl. Fin. Services)	as of 3Q21	-4,596	-4,596	-4,596
Pension Liabilities	as of 3Q21	-7,809	-7,809	-7,809
Minorities	as of 3Q21	-6,798	-6,798	-6,798
Target Equity Value		**285,102**	**227,709**	**432,671**
Current Market cap.	254,790			
Potential / Risk		**12%**	**-11%**	**70%**

Source: Toyota, Profundo calculations, market cap as of 19 April 2022

6.2 Stellantis: The newly merged FCA and PSA offers the highest upside in mass market

The strategy update announced by Stellantis on 1 March 2022 puts the company slightly ahead of VW in terms of EV adaptation plans. Although the margin development is expected to be similar to that of VW, our valuation for Stellantis is lower due to smaller volume and smaller share of premium segment sales. Since merger has happened during 2021, the annual results announced on February 23 are the only source of comparable data. Thus, the modelling assumptions are based on only 2020 and 2021 figures and assumptions carried over from Volkswagen. Note that Stellantis accounts its finance business under unconsolidated investments, thus we valued them under joint ventures.

Table 23 Stellantis sum of the parts summary

SOTP Summary (EUR mn)	Methodology	Base Case	Slow Case	Quick Case
EV Business	DCF	78,018	44,245	126,130
ICE Business	DCF	58,696	43,018	61,337
Joint Ventures	9.0x 2021 Earnings	6,633	6,633	6,633
Enterprise Value		**143,347**	**93,895**	**194,100**
Net Cash (exl. Fin. Services)	as of 4Q21	19,090	19,090	19,090
Pension Liabilities	as of 4Q21	-8,749	-8,749	-8,749
Minorities	as of 4Q21	-400	-400	-400
Target Equity Value		**153,288**	**103,836**	**204,041**
Current Market cap.	41,817			
Potential / Risk		**267%**	**148%**	**388%**

Source: Stellantis, Profundo calculations, market cap as of 19 April 2022

6.3 Mercedes-Benz: Best potential in luxury segment

Mercedes-Benz has one of the most ambitious plans for EV adaptation, stating that it can go all-electric by the end of this decade if market conditions allow. Accordingly, our base case is for a 80% BEV share by 2030 and 100% from 2033 while in the quick case, the sales are expected to be only electric starting from 2030. Despite having relatively smaller volume, Mercedes-Benz's valuation targets are among the highest as the premium sales would generate higher cash flows with similar margins. Finally, majority of Mercedes' China operations are included in the consolidation, thus the only separate valuations were the Mobility (financing) business and recently spun-off Daimler Trucks and Busses (30% stake valued at market price).

Table 24 Mercedes-Benz sum of the parts summary

SOTP Summary (EUR mn)	Methodology	Base Case	Slow Case	Quick Case
EV Business	DCF	232,430	114,023	279,336
ICE Business	DCF	81,691	75,365	75,342
Financial Services	1x 3Q21 Book Value	16,619	16,619	16,619
Daimler Truck (30%)	Market Value	6,098	6,098	6,098
Enterprise Value		**336,838**	**212,105**	**377,396**
Net Cash (exl. Fin. Services)	as of 3Q21	21,005	21,005	21,005
Pension Liabilities	as of 3Q21	-4,300	-4,300	-4,300
Minorities	as of 3Q21	-1,590	-1,590	-1,590

SOTP Summary (EUR mn)	Methodology	Base Case	Slow Case	Quick Case
Target Equity Value		**351,953**	**227,220**	**392,511**
Current Market cap.	68,769			
Potential / Risk		**412%**	**230%**	**471%**

Source: Mercedes-Benz, Profundo calculations, market cap as of 19 April 2022

6.4 BMW: Slowest within luxury segment

Among the luxury brands, BMW has the slowest EV transition outlook. However, similar to Mercedes-Benz, BMW can unlock relatively higher value (compared to mass market peers) thanks to the already high pricing in the luxury segment allowing for higher margins. Chinese operations of BMW is also included in the EV and ICE business and there are no other (yet) significant businesses that should be valued.

Table 25 BMW sum of the parts summary

SOTP Summary (EUR mn)	Methodology	Base Case	Slow Case	Quick Case
EV Business	DCF	101,301	53,043	202,980
ICE Business	DCF	63,781	43,062	59,258
Financial Services	1x 3Q21 Book Value	17,208	17,208	17,208
Enterprise Value		**182,290**	**113,313**	**279,446**
Net Cash (exl. Fin. Services)	as of 3Q21	17,231	17,231	17,231
Pension Liabilities	as of 3Q21	-3,693	-3,693	-3,693
Minorities	as of 3Q21	-714	-714	-714
Target Equity Value		**195,114**	**126,137**	**292,270**
Current Market cap.	51,081			
Potential / Risk		**282%**	**147%**	**472%**

Source: BMW, Profundo calculations, market cap as of 19 April 2022

6.5 Volvo-Cars: Fastest EV adopter

Volvo Cars is the smallest company in the study with around 0.7 million cars currently being sold. However, The EV transition strategy of the company is the best in class where ICEs are phased out in 2030 in the base case and in 2028 in the quick case scenario. The most important upside potential outside this valuation is Polestar. With the expected IPO in 1H22, the potential benefit of going all-electric earlier could start to unlock for Volvo investors.

Table 26 Volvo Cars sum of the parts summary

SOTP Summary (EUR mn)	Methodology	Base Case	Slow Case	Quick Case
EV Business	DCF	42,994	26,709	47,896
ICE Business	DCF	11,099	2,916	10,073
Polestar (49.5%)	USD 20 bn EV	9,000	9,000	9,000
Enterprise Value		**63,094**	**38,625**	**66,969**

SOTP Summary (EUR mn)	Methodology	Base Case	Slow Case	Quick Case
Net Cash (exl. Fin. Services)	as of 4Q21	4,395	4,395	4,395
Pension Liabilities	as of 4Q21	0	0	0
Minorities	as of 4Q21	-447	-447	-447
Target Equity Value		**67,042**	**42,573**	**70,917**
Current Market cap.	20,560			
Potential / Risk		**226%**	**107%**	**245%**

Source: Volvo Cars, Profundo calculations, market cap as of 19 April 2022

7

Trading Multiples Analysis

Following the detailed explanation of the methodology and Volkswagen case, the results of the valuation studies of the remaining five companies are presented in this section. The results in this section do not include our calculations for carbon costs.

To provide a sanity check for the valuation results of the SOTP analysis, a trading multiples study was conducted. Enterprise value over earnings before interest, tax, depreciation and amortization (EV/EBITDA) was chosen as the trading multiple to analyse. This multiple is widely used in valuations of industrial companies as investors focus on cash flows in companies with a high investment (capex) needs, thus high non-cash depreciation and amortization items. The multiples presented in Table 27 refer to 12 month forward EV/EBITDA, where the enterprise value is calculated as the current capitalization plus the net debt of the company. Whereas EBITDA is the estimated figure by analysts to be generated by the company during the next 12 months.

Under current multiples on Table 27, the EV/EBITDA calculated by own estimates (Profundo) and by market analysts (Refinitiv consensus) shows that VW, Mercedes-Benz BMW and Volvo Cars are similarly valued with respect to their expected EBITDA. Toyota has the highest multiple at 11.5x while Stellantis has the lowest at 1.0x. These large differences in Toyota and Stellantis can be explained partially by historic performance (10 yr averages) and the fact that the Japanese Central Bank has accumulated significant equity holdings (c.USD 470 billion) in local companies.

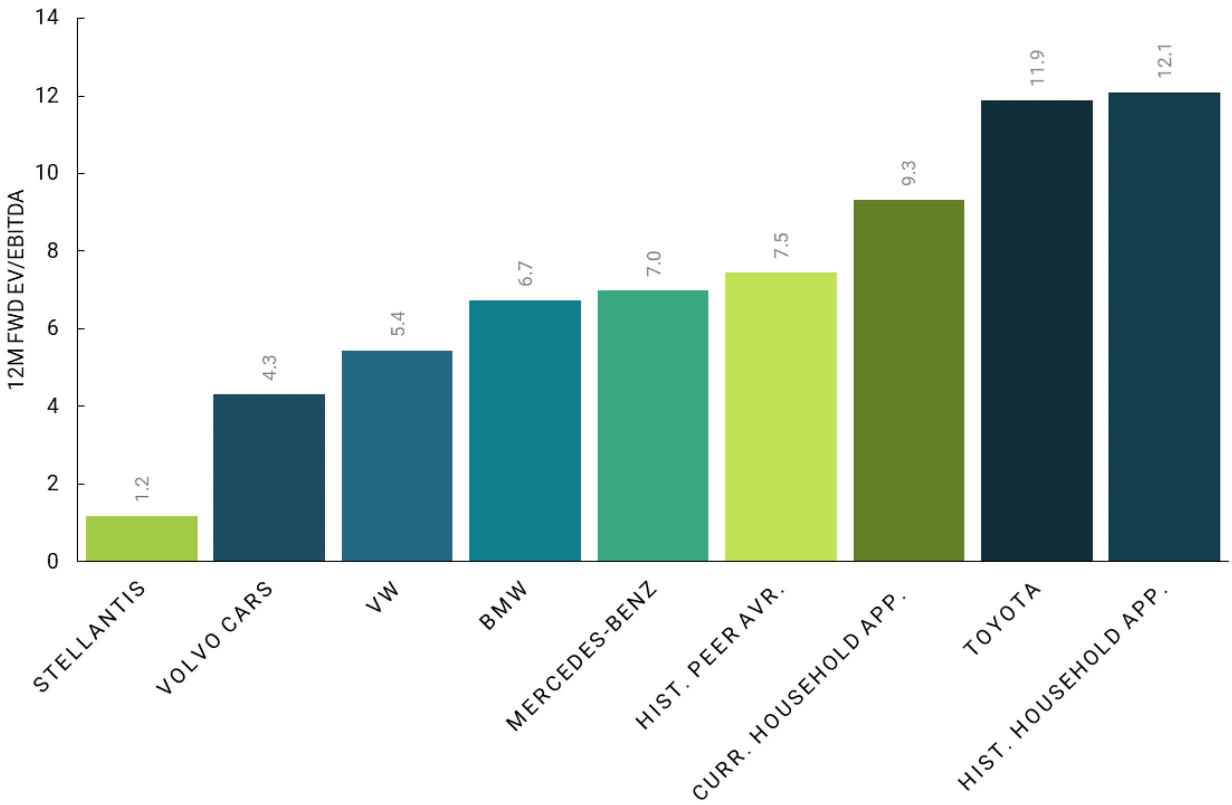
Table 27 Overview of current and implied EV/EBITDA multiples

	VW	Toyota	Stellantis	Mercedes Benz	BMW	Volvo Cars	Peers Average
Current Multiples							
Profundo	5.3	11.5	1.0	6.7	6.5	4.5	5.9
Refinitiv Consensus	5.4	11.9	1.2	7.0	6.7	4.3	6.1
Historic Multiples							
Own 10 yr Historic avr	6.5	10.8	2.0	9.0	6.5	4.5	6.6
Peers 10 yr Historic avr	7.5	7.5	7.5	7.5	7.5	7.5	7.5
Implied Multiples							
Base Case	8.6	12.1	5.5	18.4	13.0	16.4	12.3
Slow Case	7.4	10.3	3.5	13.2	9.7	10.0	9.0
Quick Case	10.5	16.4	7.5	20.1	17.5	17.4	14.9

Source: Refinitiv, Profundo estimates as of 19 April 2022

Implied multiples refer to the EV/EBITDA values as if the companies were valued at the target market cap in our base, slow and quick cases. As discussed before, the results of the valuation study in all cases are much higher compared to the current market values of the carmakers. However, compared to a sector with similar industrial dynamics, the household appliances sector, the current multiples of carmakers imply a discounted valuation. The household appliances sector, on average, traded at 12.1x EV/EBITDA multiple in the last 10 years vs. the carmakers at 7.5x (Figure 8). This difference can be related to possible carbon liabilities that the carmakers may face, whereas household appliances sector is not subject to that kind of uncertainty. In this context, the average implied multiple of our base case scenarios is 12.3x, almost in line with the household sector. Given the value creation opportunity thanks to the technology change, the automotive sector can justify even higher multiples with quicker transition EVs. If the market valuations reach the targets in our quick case scenarios, the average implied multiple would be 14.9x. Although the current valuation of Tesla is hard to compare and not completely indicative for other carmakers, the current EV/EBITDA multiple of Tesla is now at 46.3x.

Figure 8 Carmakers' trading multiple vs. household appliances sector's



Source: Refinitiv

8

Conclusions

Faster adaptation to EVs drives significant potential for shareholder value creation

The valuation and scenario studies (excluding carbon cost uncertainty) clearly show that quicker EV adaptation pays off significantly in terms of company valuations. On average, the quick case scenarios yielded 316% upside potential compared to current market values of the car makers whereas the slow cases were only 121%.

Table 28 Potential / Risk compared to current market value

Potential / Risk (%)	Base Case	Slow Case	Quick Case
VW	159%	104%	253%
Toyota	12%	-11%	70%
Stellantis	267%	148%	388%
Mass market average	**146%**	**81%**	**237%**
Mercedes-Benz	412%	230%	471%
BMW	282%	147%	472%
Volvo Cars	226%	107%	245%
Luxury market average	**307%**	**161%**	**396%**
Total average	**226%**	**121%**	**316%**

Source: Profundo calculations

Also within the peer groups, the laggards in EV adaptation, Toyota in the mass market and BMW in the luxury market, have less upside potential, as their current strategies are falling behind of competition. The main reason behind the results is that quicker EV adaptation **1)** leads to higher sales volume of the high margin product (EV) within the forecast period and **2)** leads to higher terminal value from EV business which can be interpreted as a more future-proof business. As demonstrated in the VW case, we expect ICE margins to steadily decline until they are phased out. As EV adoption increases, ICE market will shrink, lose economies of scale and lose bargaining power especially after 2027 when ICE/EV price parity is reached for most of the car market. On the other hand EV business margins are expected to trend upwards and normalize around 2027, where we expect an increase in competition. Carbon costs and other measures hitting ICEs might increase Total Cost of Ownership of ICEs. This will further increase the differences in share price potential between a quick change to EV and a slow pace.

Table 29 shows the valuation study results, excluding the carbon cost methodology, by company and by case to demonstrate the total impact that can potentially unlock with the right EV adaptation strategy. In total, the quick adaptation potential compared to a slow adaptation scenario is EUR 806 billion higher, or almost 2 times more in terms of target equity values.

Table 29 Valuation study results by company and case (EUR mn)

Target Market Cap	Base Case	Slow Case	Quick Case
VW	246,060	193,659	334,856
Toyota	285,102	227,709	432,671
Stellantis	153,288	103,836	204,041
Mercedes-Benz	351,953	227,220	392,511
BMW	195,114	126,137	292,270
Volvo Cars	67,042	42,573	70,917
Total Target Market Cap	**1,298,560**	**921,136**	**1,727,266**

Source: Profundo calculations; excluding carbon costs

Although the upside potential in some of the results may seem too high, the most probable cause for the depressed valuations in car makers is execution risk. Investors would want to see how well the car makers deliver on their electrification promises and overcome the technological and logistic challenges of ramping up a completely new business. In valuation terms, the investors could be using a higher cost of capital while valuing the business, explaining the difference between our results and the market prices of the companies. Thus, the ones that communicate transparent goals and achieve them, will most likely be rewarded in terms of share prices.

Additionally, the legacy ICE business might be confronted with the impact of a high carbon liability. This liability is potentially material, and the cost will be shared by the manufacturers and the customers with an unknown split.

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