No room for passengers

Are auto manufacturers reducing emissions quickly enough?

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Linking emissions-related metrics to earnings

- We launch our new 'Super-League Table' which ranks companies based on a number of emissions-related metrics which in aggregate could have a material impact on company performance
- Leaders are: Nissan, Toyota, and Renault
- Laggards are: Tata Motors (owner of Jaguar Land Rover), Hyundai, and General Motors

Overview

In this report, we launch our new Super-League Table (SLT) for the global automobile original equipment manufacturers (OEMs).

We rank those companies that responded to CDP's Climate Change questionnaire, which account for 83%[1] of the global auto market by sales volume, based on a number of different emissions-related metrics. When taken in aggregate, we believe these metrics could have a material impact on a company's earnings in a global auto market where emissions regulation is tightening and there are significant penalties for non-compliance.

We highlight those companies that are best positioned to benefit from this regulatory change and those that will struggle without adapting their existing business models.

Scope of report: emissions

Our SLT focuses on three key areas:

- **Fleet emissions:** these account for 75% of total emissions for the auto industry[2].
- **Advanced Vehicles:** Battery Electric Vehicles (BEVs), Plug-in Hybrid Electric Vehicles (PHEVs) and Fuel Cell Vehicles (FCVs) which will increasingly contribute to lowering total emissions.
- **Manufacturing emissions:** these account for 20% of total emissions, split roughly as 17% supplier emissions and 3% auto OEMs own manufacturing emissions (mostly assembly).

Scope of report: geographies

Our study spans the three largest auto markets globally, which together account for 75% of global auto demand.

- **The EU (22% share):** a leader in emissions regulations, it has by far the lowest fleet-wide emissions (on a per unit basis). Vehicle sales in the EU have been declining over the last decade or so.
- **The US (25% share):** by far the highest fleet-wide emissions (on a per unit basis). US consumers demand more super-sized powerful cars. Fleet emissions rules and penalties have been in place since the 1980s, though there has been a culture of non-compliance, with penalties seen as an ongoing business cost that is passed on to consumers. This is set to change under the new EPA regulations that kick in from a penalty perspective in 2016.
- **China (28% share):** is the largest auto market globally, having tripled in size from 2008-2013. It could be an explosive market for Advanced Vehicles if it becomes more stringent in its megacity Low Emission Zones (LEZs). The Chinese government has very aggressive targets for total sales of BEVs and PHEVs of 5 million units by 2020 – achieving this would imply sales of approximately 2 million per annum by 2020, we estimate, which roughly equates to total annual car sales in the UK (or India).

1 Derived from Bloomberg data but adjusted by assigning total sales made by Chinese joint ventures (JVs) to their respective non-Chinese OEM partner (see fleet emissions summary).
2 Averaged over the auto OEMs that responded to the CDP Climate Change Questionnaire

Leaders and laggards

14 of the top 16 auto OEMs globally (excluding China) responded to CDP's 2014 questionnaire, and together represent 83% of the global auto market and US$844 billion in market cap. The non-responders were Suzuki (10th, 3.4% share) and Kia (11th, 3.2% share). The highlights of our analysis are as follows (see condensed SLT below):

- All four of the Japanese OEMs (Nissan, Toyota, Mazda and Honda) were ranked in the top half of the table; three of them were in the top four.
- Nissan was ranked first. It scored consistently high across all metrics, except for EU fleet emissions, where it received an E-grade (it only has small sales exposure here so its EU weighting in the SLT is minimal). It scored an A-grade for Advanced Vehicles – it has the leading model in our view, the Nissan Leaf (a BEV).
- Toyota was ranked second. It was the only OEM to score an A-grade for both Overall Fleet Emissions and Advanced Vehicles, demonstrating its clear leadership in these areas. It has been a pioneer of hybrid technology and was recently the first OEM to launch an FCV with a view to mass manufacturing. It missed the top spot in the SLT as it does not disclose supplier emissions to CDP and consequently we could not calculate certain manufacturing emissions metrics (it received a D-grade for Manufacturing Emissions).
- Renault was ranked third. It was the clear leader for Overall Fleet Emissions; however, it is the only OEM with no US exposure and almost no Chinese exposure (only 1%). Thus, its A-grade for EU Fleet Emissions carried 99% weight in determining Overall Fleet Emissions Rank.

Condensed summary of our new Super-League Table (SLT) for the auto OEMs

SLT Rank	Company	Country	Overall SLT Score	Global market share (2013) (i)	Overall Fleet Emissions Grade	Advanced Vehicle Grade	Manufacturing Emissions Grade (including suppliers)	Manufacturing Emissions Target Grade (ii)	CDP Performance Band (iii)
1	Nissan	Japan	4.1	5.9%	B	A	B	A	A
2	Toyota	Japan	3.6	10.6%	A	A	D	E	A
3	Renault	France	3.6	4.0%	A	C	D	E	A
4	Mazda	Japan	3.3	1.4%	A	E	C	A	B
5	Daimler	Germany	3.3	2.4%	B	D	A	C	A
6	Volkswagen	Germany	3.2	14.8%	C	C	A	E	A
7	Honda	Japan	3.1	5.7%	B	B	D	E	A-
8	BMW	Germany	3.1	3.1%	D	C	A	E	A
9	PSA Peugeot Citroen	France	2.9	3.2%	C	D	B	A	A-
10	Ford	USA	2.9	7.0%	D	B	E	C	D
11	FCA	Italy	2.3	4.9%	E	B	B	B	A
12	General Motors	USA	2.2	12.3%	E	A	E	D	A
13	Hyundai	South Korea	2.0	5.6%	D	D	C	E	B
14	Tata Motors	India	2.0	1.7%	C	n/a	E	E	n/a
			Total	**82.8%**					
% of total industry emissions (iv)					75%		20%	3%	
Weighting in determining overall SLT Sector Score (and SLT Rank)					50%	25%	15%	5%	5%

Notes:
(i) Derived from Bloomberg data but adjusted by assigning the total sales from each Chinese JV to the respective non-Chinese OEM (see Fleet emissions summary chapter).
(ii) Assessment of auto OEM's own manufacturing emissions target. This is a Scope 1 and 2 target and excludes suppliers emissions.
(iii) This is the annual CDP climate performance band applied across all 1,749 companies that respond to CDP. It uses a consistent approach for all sectors, and in the past has focused more on Scope 1+2 emission.
(iv)Total emissions averaged over the OEMs in our study: does not sum to 100% as the table does not take account of a small amount of Scope 3 emissions such as business travel - these account for 5% of overall emissions

- The German OEMs were all placed in the top-mid range table. Daimler was fifth, VW, the world's largest auto OEM, is ranked sixth and BMW eigth.
- Daimler (owners of Mercedes and Smart cars) scored a B-grade for Overall Fleet Emissions due to an impressive track record of fleet emissions reductions in Europe. We estimate that if this progress is maintained its fleet will be one of the most efficient in the EU by 2021. Smart cars will increasingly contribute.
- We note that the rankings in a large portion of the table are very tight. There was a narrow range for the Overall SLT Score between fourth and tenth places. For instance, if French OEM, PSA Peugeot Citroen which ranked ninth had received a B-grade rather than a D-grade for Advanced Vehicles, it would have been propelled up to fourth place. This suggests that there is everything to fight for amongst the OEMs. Technological advancements could see a dramatic change in the rankings in future iterations of our SLT.
- The US OEMs were both ranked towards the bottom of the SLT, which is not surprising given their market-leading positions in (and sales exposure to) the US market. US consumers tend to demand more super-sized cars (which have notably higher emissions). GM was third from bottom – it was graded E for Overall Fleet Emissions but was saved from bottom rank by its A-grade for Advanced Vehicles. Ford was ranked tenth (or fifth from bottom).
- Tata Motors is the bottom-ranked OEM. This is partly due to an incomplete response to CDP's questionnaire but also due to its high-emitting Jaguar Land Rover brands coupled with the fact that it is the only OEM in our analysis that is yet to release an Advanced Vehicle.
- FCA was the worst performer from a fleet emissions perspective, which is perhaps not quite so surprising given that its US-based Chrysler division has a high-emitting vehicle range, coupled with the fact that FCA has consistently made one of the lowest investments in R&D over a number of years. That said, FCA shows some promise with a B-grade achieved for Advanced Vehicles.
- Hyundai was the most consistent poor performer, with D-grades for its fleet emissions in each of the EU, US and China, and also for its Advanced Vehicle Grade. It was hardly surprising that Hyundai ranked second from bottom.
- The Japanese OEMs may have performed even better had our analysis extended to the Japanese market (which like the EU is a relatively low-emission market); a lack of credible data prevented this. That said, they each have more than 50% sales exposure (before our normalization) to the geographies covered in this report.

Penalties

- General Motors and FCA are the only two OEMs that are at notable risk of a penalty in both the EU and US; these penalties could potentially equate to a combined US$1.7 billion (33% of EBIT[3]) and US$574 million (15% of EBIT) respectively.
- In addition, we estimate that Ford is at risk of a penalty in the US of US$889 million (or 16% of EBIT).
- BMW, Volkswagen, Daimler, Hyundai, and Nissan are all also at risk of a penalty in either the EU or US.
- The potential penalties facing OEMs at risk of missing their targets are CDP estimates. They do not take into account any credits available to OEMs to assist the transition of their fleets to meet regulatory targets. The penalties are for illustrative purposes only.
- We note that CAFE fleet emissions penalties have been levied in the US since the 1980s and it is not uncommon to see OEMs pay fines into the tens of millions of US dollars. We note that recently in 2011, Daimler paid a fine of US$16 million and Tata Motors paid a fine of US$14 million. The highest fine paid so far has been US$90 million by Daimler-Chrysler (as it was then) in 2006.

See the Fleet emissions summary chapter for more detail on the potential penalties.

3 EBIT – Earning Before Interest & Tax

Linking our findings to investment choices

We recognize that investment decisions are based on a multitude of different factors and that some of these factors can be misaligned with emissions reductions.

Our SLT rankings are not intended as definitive winners and losers for investment purposes, more as a proxy for business-readiness in an industry where there is significant regulatory tightening across all major vehicle markets.

We would flag that companies towards the bottom of our SLT are possibly higher risk investments than those towards the top. However, we appreciate an investment such as Tata Motors, a leader in the fast growing SUV segment of the vehicle market, could well be able to pass penalties on to consumers of its premium vehicles without a major impact on earnings. On this basis, investors might view Tata Motors as a high(er) risk but potentially high reward investment.

A summary of key areas, associated metrics and relative weighting in the Super-League Table

Area in Super-League table	Link to company earnings	Metrics	Weighting
Fleet emissions	Significant financial penalties for non-compliance.	(i) EU fleet emissions (gCO_2/km) (ii) US fleet emissions (mpg) (iii) China fleet emissions (L/100km)	50%
Advanced Vehicles	Potentially explosive market growth opportunity, in particular in China. Early movers will benefit. Laggards may miss out.	(i) Technical grade (ii) Sales momentum/first mover grade (iii) other considerations i.e. technology collaborations, domestic market strength	25%
Manufacturing emissions	Efficient manufacturing can enhance financial performance. Manufacturing emissions (intensity) reduction is a proxy for increased manufacturing efficiency	(i) Manufacturing emissions intensity (ii) Reduction in intensity 2011-13 (iii) Supply chain engagement (by % spend) (iv) Emissions reduction target analysis	20%
CDP climate performance band	A good annual CDP score is a proxy for a generally well run company. Well run companies are better placed to succeed in a changing marketplace.	(i) CDP 2014 climate change performance band	5%

Source: CDP

Methodology

We score each OEM based on a number of different metrics which are first ranked and then graded A to E, with A being best and E the worst.

The metrics can be categorised into three key areas:

1) Fleet emissions: we analyze fleet emissions for each OEM across three major auto markets: the EU, the US and China. We use historic emissions data to assess whether each OEM is on track or off track to meet the regulatory emissions targets in each of these markets; and if off track, the potential financial impact.

2) Advanced Vehicles (AVs): we perform a detailed review of most available models of BEVs and PHEVs globally. We also consider a number of other factors including each OEM's exposure to FCVs, the commitment of their domestic markets towards charging station build-out and consumer subsidies, and sales momentum of BEVs, PHEVs and FCVs per OEM.

3) Manufacturing emissions: we assess each OEM across four key metrics related to manufacturing emissions. The first relates solely to each OEM's own manufacturing emissions (known as Scope 1 and Scope 2 emissions), the second relates solely to their suppliers' emissions (known as Scope 3 – supplier emissions), and the remaining two relate to manufacturing emissions as a whole.

Each of the above focus areas has a separate chapter within this report, and the precise methodology for how we rank and grade each metric is described in the relevant chapter.

In addition to the three key areas, we also include CDP's climate performance band for 2014 in the SLT. It scores the 1,749 companies that respond to CDP's main questionnaire based on their climate change readiness. A high score can infer a well-run business with a forward-looking management team, not just focused on the short term.

The table on the previous page summaries the key areas of the SLT and the weightings we have assigned to each area, according to our sense of their potential impact on company performance.

In determining the Overall SLT Score and therefore the SLT Rank, we assign a number (1 to 5) to each of the grades for the key areas above (and the CDP climate performance band), with A=5 down to E=1. We then apply the weightings in the table above to each numbered grade and aggregate them to arrive at the Overall SLT Score and Overall SLT Rank.

Note that the Overall Fleet Emissions Grade is an exception to the above procedure. Rather than applying the weighting to the numbered grade, we instead apply the weighting to the Overall Fleet Emissions Score. As fleet emissions carry so much weight (50%) in the SLT, we believe using the Overall Fleet Emissions Score (rather than the grade) gives a more accurate result.

For further study

Interesting areas for further investigation include:

- The cost per OEM of complying with the fleet emissions targets in each region and whether they would need to increase their R&D spend to meet these targets.
- An extension of our study to include light commercial vehicles, as well as trucks (and heavier vehicles) where relevant.
- Different profiles for forecasting reductions in fleet emissions rather than assuming a constant percentage reduction across the forecast periods for all OEMs. Such profiles might include a period of steady emissions reductions followed by a period of faster reductions as new technologies are implemented. One could also look to vary the emissions reduction profile for each OEM and link it to forecast/ targeted R&D spend and the release of new technologies, model renewal cycles or changes to average fleet mass.
- Adding a consumer review score for the main BEVs and PHEVs on the market as another component in determining the Advanced Vehicle Grade.
- Further work on the component suppliers and each OEM's exposure to other components used to optimize existing combustion engine technology, for example, super-chargers, fly-wheels etc.
- An extension of the fleet emissions study to other regions including Japan, India, and Latin America, and the level of potential penalties for non-compliance, if applicable.
- Incorporate a 'lobbying' grade into the SLT to assess which companies are most involved in shaping the future.
- Expand the study to include other pollutants arising from vehicles, such as nitrogen oxides, fine particulate matter, volatile organic compounds, carbon monoxide, and sulphur dioxide, amongst others.

Fleet emissions summary

- Most major car markets are tightening regulation on fleet emissions, with significant penalties for non-compliance
- The smart OEMs are investing significant R&D budget in optimizing the internal combustion engine, hybrid and advanced vehicles technologies
- Renault, Mazda and Toyota are fleet emissions leaders, in our view

Overview

This chapter summarizes the results of detailed analysis on fleet emissions (75% of total auto industry emissions) from the following three chapters:

- EU Fleet Emissions
- US Fleet Emissions
- China Fleet Emissions

In each of these chapters, we assess whether each OEM is on track to meet their respective fleet emissions targets in each region, along with an estimation of the potential financial penalty if the OEM is off track.

We award each OEM a Fleet Emissions Grade in each region, which we aggregate on a weighted basis in this chapter to give an overall Fleet Emissions Score, from which we determine the Overall Fleet Emissions Grade.

Leaders and laggards for overall fleet emissions

- Renault is the clear leader for overall fleet emissions; however, it is the only OEM with no US exposure and almost no Chinese exposure (only 1%). Thus, its A-grade for EU Fleet Emissions carried 99% weight in determining Overall Fleet Emissions Rank.
- Mazda is ranked second. It scored consistently well across all three markets (2 A-grades and a B-grade).
- Toyota was ranked third. It has been a pioneer of the hybrid segment of the market. It commands more than a 70% share of the hybrid segments in each market. It only missed top spot due to its surprising E-grade in China (although we believe it is on track to meet the 2015 China target, it is just the other OEMs are forecast to beat the target by a higher amount).
- Daimler was ranked fifth. It has been a leader in the EU in reducing fleet emissions over the last decade (c. 30% reduction).
- General Motors and FCA were the bottom two performers. They both received E-grades in the EU and US and a D-grade in China. We believe FCA's fleet emissions are being pushed up by US-based Chrysler's high-emitting vehicle range.

Beat or Miss targets?

- **The EU:** we find that four OEMs (out of 14 with EU exposure) are at risk of missing their EU 2021 target. These are General Motors, FCA, Nissan and Hyundai. Collectively, they account for just 19% of the EU market.
- There is a low risk of any OEM missing its EU 2015 target.
- **The US:** we find that six OEMs (out of 10 with US exposure), collectively accounting for almost 60% of the US market, are at risk of missing their 2016 target in the absence of any credits. We believe these credits will not always be so generously available beyond 2016.
- We do not consider the US 2025 target in our US Fleet Emissions Grade due to its distance in the future; moreover, a Republican election victory could impact the EPA's regulation of emissions.
- **China:** the non-Chinese OEMs in our study sell cars in China either through a JV with a Chinese partner or through import into China. In aggregate the total sales from these JVs plus the imports account for 67% of the Chinese market[5]. The JVs account for the vast majority of these sales (62% of the Chinese market in total).
- All of the JVs between the OEMs and a Chinese partner are on track to meet their 2015 China target. In total, 12 of the OEMs in our study have one or more JV in China which sold vehicles in 2013[4].
- All 14 of the OEMs in our study import vehicles directly into China, although these imports account for just 5% of the Chinese market[5] . We find that General Motors, Nissan, Hyundai, FCA and Renault are at risk of missing their 2015 China target (for imports).
- Of the OEMs which we believe are at risk of missing their target, FCA and Renault are only two where the miss is material in the context of their total sales in China[6].

4 The Chinese government approved the formation of a JV between Renault and Dongfeng in December 2013, for which there is no sales data for that year.
5 Based on 2013 data .
6 Renault has no JV sales in China in 2013. For FCA, its imported sales are approximately twice the size of its JV sales.

A summary of Fleet Emissions Grades in each of the EU, US and China ranked by Overall Fleet Emission Score and Grade

OEM	Country	% sales exposure to EU, US and China	EU Fleet Emissions Grade	% normalized exposure to the EU(i)	US Fleet Emissions Grade	% normalized exposure the to US (i)	China Fleet Emissions Grade	% normalized exposure China(i)	Overall Fleet Emissions Score	Overall Fleet Emissions Grade
Renault	France	73%	A	99%		0%	E	1%	4.9	A
Mazda	Japan	65%	B	24%	A	48%	A	28%	4.8	A
Toyota	Japan	54%	A	16%	A	61%	E	23%	4.1	A
Nissan	Japan	74%	E	15%	A	44%	B	41%	4.0	B
Daimler	Germany	84%	A	55%	D	27%	C	19%	3.8	B
Honda	Japan	66%	D	6%	B	63%	C	31%	3.6	B
Tata Motors (ii)	India	33%	B	49%	D	22%	B	29%	3.6	C
Volkswagen	Germany	86%	C	47%	D	9%	B	44%	3.4	C
PSA Peugeot Citroen	France	91%	B	71%		0%	E	29%	3.1	C
Ford	USA	89%	D	23%	C	61%	A	17%	3.1	D
BMW	Germany	97%	C	42%	D	37%	A	21%	3.0	D
Hyundai	South Korea	60%	D	19%	D	33%	D	47%	2.0	D
General Motors	USA	85%	E	15%	E	41%	D	44%	1.4	E
FCA	Italy	80%	E	28%	E	67%	D	6%	1.1	E

Notes:
(i) Geographical exposure normalized by each OEMs aggregate exposure to the EU, US and China.
(ii) Tata Motors non-Indian brands Jaguar and Land Rover have more than 75% sales exposure to the EU, US and China.

Source: Bloomberg, CDP estimates

Summary of potential penalties in the EU and US

OEM	US 2016		EU 2021		Combined	
	Total penalty (US$]	% EBIT (i)	Total penalty (US$]	% EBIT (i)	Total penalty (US$]	% EBIT (i)
General Motors	1,053	21%	650	13%	1,703	33%
Ford	889	16%			889	16%
FCA	293	7%	281	7%	574	15%
BMW	412	4%			412	4%
Volkswagen	529	3%			529	3%
Daimler	246	2%			246	2%
Hyundai			82	1%	82	1%
Nissan			164	3%	164	3%

(i) 2013 company results

Source: CDP estimates

Penalties

The table above shows that General Motors and FCA are the only two OEMs that are at notable risk of a penalty in both the EU and US; these penalties combined could potentially equate to US$1.7 billion (33% of EBIT) and US$574 million (15% of EBIT) respectively.

In addition, we estimate that Ford is at risk of a penalty in the US of US$889 million (or 16% of EBIT).

BMW, Volkswagen, Daimler, Hyundai, and Nissan are all also at risk of a penalty in either the EU or US.

Targets by region: US the most disappointing

The table at the top of p14 outlines the similarities and differences between the EU, US and Chinese emissions schemes. For completeness, we include the Japanese scheme in the summary.

The four schemes all use different but equivalent units for their respective fleet emissions targets. To enable a fair direct comparison, we have first converted them to gCO_2/km (in line with the EU scheme) and then converted them to a 'real world' equivalent. A conversion to real world equivalent takes account of the fact that the different test methods - NEDC, CAFE and JC08 - are laboratory-based tests and thus it is difficult to perfectly replicate real world driving conditions. Moreover, the different test methods vary in proximity to real world driving conditions.

From our research, it appears that the US CAFE test method is the furthest from 'real world' conditions, requiring at least 25% uplift for conversion. The EU NEDC method requires an uplift of 15-20%. Japan's JC08 test method is the closest to real world, requiring just a 10% uplift. We apply these conversion factors to arrive at real world versions of the targets. These compare as follows:

- **Comparing 2015 targets on a 'real world' adjusted basis:** on an equivalent, real world basis, Japan and the EU have the lowest near-term targets of 152 and 156 gCO_2/km respectively.
- The US and China have the highest targets of 176 and 194 gCO_2/km respectively, although we note the US target is for a year later than the rest (2016 instead of 2015).
- **Comparing 2020+ targets on a 'real world' adjusted basis:** the EU sets a 2021 target, and China and Japan set a 2020 target. On an equivalent, real world basis, the EU's is lowest at 114 gCO_2/km. China's is highest at 140 gCO_2/km. The US sets a real world 2025 target of 111 gCO_2/km – a similar level to the EU's 2021 target.

Comparing current (2013) fleets:

The US fleet had by far the highest emissions in 2013 on a per unit basis at 206 gCO_2/km (straight average across OEMs in 2013), compared to 129 gCO_2/km for the EU on the same basis. For China, the fleet emissions are 181 gCO_2/km, averaged over the JVs of the OEMs in this study (which we estimate account for around 70% of the Chinese market).

In order for the US to beat its 2016 fleet-wide emissions target, emissions need to fall by more than 10%. This compares to the EU and China which on a fleet-wise basis have both beaten their respective targets a couple of years early.

Methodology

We outline the detailed methodology for our assessment of whether each OEM is on track to meet its fleet emissions targets in the EU, US and China. If the targets are missed, the potential penalties for each region are outlined.

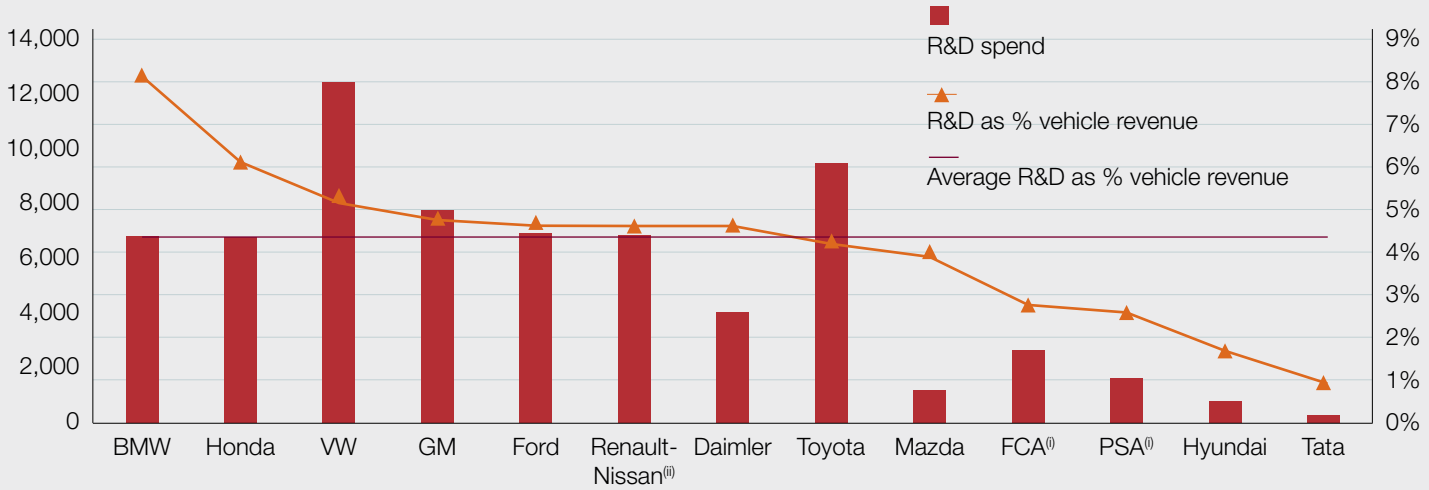
We outline in this section how the Fleet Emissions Grade for each of the EU, US and China are combined to determine an Overall Fleet Emissions Score (and then Grade).

First, each Fleet Emissions Grade is assigned a number (1 to 5), where A=5 down to E=1. We then apply a normalization factor to each of the numbered Fleet Emissions Grades according to each OEM's normalized exposure to the EU, US and Chinese market (see table at the start of this chapter). This determines the Overall Fleet Emissions Score from which the Overall Fleet Emissions Grade is awarded, with A-grades going to the highest scores down to E-grades for the lowest.

For consistency of comparison across the group of OEMs, we use raw data (for 2013) from Bloomberg to arrive at our percentage exposure by geography assumptions for each OEM, rather than company data (i.e. annual reports). We find that sales data reported by OEMs in their annual reports is inconsistent on a number of levels, including the classification of geographies, inclusion of associates and JVs, and inclusion of used as well as new vehicles.

All OEMs except Renault and Tata Motors have sales exposure to China in 2013 through one or more JVs. All OEMs (in our study) import vehicles produced outside China for sale within the country, although the aggregate imports are under 10% of aggregate sales by the JVs. We assign 100% of the vehicles sold by the JVs to the relevant (non-Chinese) OEM for the purposes of this analysis, as we believe that this best reflects the footprint of their Chinese sales.

Total R&D spend by OEM (US$ million) (LHS) and R&D as % vehicle revenue (RHS) in 2013



Notes:
(i) For FCA and PSA we have assigned a proportionate amount of R&D spend to their component divisons. If total R&D spend purely relates to vehicles, then for R&D as % of vehicle revenue, for FCA equals 2.8%, and 3.5% for PSA
(ii) We have combined the R&D spend of Renault and Nissan as they have a technology sharing agreement.

Source: company data, CDP

R&D as a percentage of vehicle revenue

As a sense check against the fleet emissions reduction assumptions used in our forecasts, we have considered R&D expenditure for each OEM (see the chart above) for 2013.

BMW spends the most on R&D in relative terms at 8% of vehicle revenue, Honda is second (5.8%) and Volkswagen third (5.2%). Volkswagen spends the most on an absolute basis at US$12,323 million. FCA, PSA, Hyundai and Tata Motors all spend notably below average on R&D in both absolute and relative terms. Seven of the thirteen OEMs considered in this chart[7] each spend more on R&D than these bottom four combined.

Limitations

Due to the subjective nature of our analysis there are limitations on our ability to forecast fleet emissions accurately. Our view of whether a company is on track to meet its targets in the EU, US and China is based on forecast fleet emissions from 2013 up to the target year. Forecasting is subjective in nature and the results are inherently uncertain. We believe we have been fair in our forecasts; however, they are limited by the information available to us and are based solely on historic emissions and do not take into account, for example, planned increases in R&D spend, model renewal cycles or changes to average fleet mass. Our degree of confidence is highest in the EU, where we had fleet emissions data for each OEM for the last 12 years. For the US, we have the last three years of data on sales-weighted emissions. The Chinese Ministry of Industry and Information Technology has only made available sales-weighted fleet emissions data for 2013 and H2 2012, thus we are unable to assess previous trends in fleet emissions data in China. Instead, we check the data for 2013 against a 2013 hurdle that the Chinese government sets for each OEM to assess whether they are on track to meet their respective 2015 targets.

The potential penalties facing OEMs at risk of missing their targets are CDP estimates. They do not take into account any credits available to OEMs to assist the transition of their fleets to meet regulatory targets. The penalties are for illustrative purposes only.

We do not believe that these penalties, which would be levied annually for non-compliance, will materialize in full as soon as 2016 for the US or 2021 for EU; however, we note that the credits will not be available at their current levels in perpetuity, thus our penalty estimates highlight the amount that each OEM could potentially be liable to once the credits are removed and if they fail to bring their fleet emissions down at the required rate.

7 We have combined the R&D spend of Renault and Nissan as they have a technology sharing agreement.

Summary of fleet emissions regulations across the EU, US, China and Japan

Region	% global market	Test Method (i)	Structure	Targeted Fleet (ii)	Target Year	Fleet Target	Fleet target gCO_2/km Equivalent	Real world equivalent $g/CO_2/km$	Penalties
EU	22%	EU NEDC	Weight-based fleet average	PVs LCVs	2015 2021 2017 2021	130 gCO_2/km 95 gCO_2/km 175 gCO_2/km 147 gCO_2/km	130 95 175 147	156 114 210 176	On a per vehicle basis: €5 for the first g/km, €15 for the second g/km, €25 for the third g/km, €95 for each subsequent g/km. From 2019, the cost will be €95 from the first gram onwards.
U.S.	25%	U.S. CAFE	Footprint based-fleet average	PVs LCVs	2016 2025 2016 2025	39.5 MPG 62.2MPG 29.8MPG 54.4MPG	141 89 186 127	176 111 233 159	Section 205 of the CAA authorizes the assessment of penalties of up to $37,500 per vehicle for a violation. The NHTSA penalty is $5.50 for each tenth of a mpg that a manufacturer's average fuel economy falls short of the standard multiplied by the OEM's entire US sales.
China	28%	EU NEDC	Weight-class based per vehicle and fleet average	PVs/SUVs	2015 2020	6.9 L/100km 5 L/100km	162 117	194 140	Naming and shaming, potential ban on expansion plans and producing new models.
Japan	8%	JC 08	Weight-based fleet average	PVs LCVs	2015 2020 2015	16.8 km/L 20.3 km/L 15.2km/L	138 115 153	152 127 168	No clear penalty structure. Penalties are referred to as 'minimal'.

Notes
(i) EU NEDC - European Union New European Driving Cycle; U.S. CAFE - US Corporate Average Fuel Economy
(ii) PVs - passenger vehicles; LCVs - light commercial vehicles; SUVs - sports utility vehicles

Source: ICCT, EPA, Bloomberg, CDP estimates

EU regulation

- Four OEMs, General Motors, FCA, Nissan and Hyundai, are at risk of missing their 2021 targets
- All OEMs are on track to meet their 2015 targets
- Renault ranks top in our EU Fleet Emissions analysis, with Toyota a close second, and General Motors ranks bottom

Overview

All 14 OEMs in our study have some exposure to the European auto market, and together represent an EU market share of 94%. In this chapter, we assess whether they are on track to meet the EU fleet emissions targets for both 2015 and 2021. The EU sales-weighted fleet-wide targets are:

- **2015: 130 gCO_2/km**
- **2021: 95 gCO_2/km**

These targets are adjusted to give a specific target for each OEM according to fleet average mass in running order[8].

The 2015 target implies a total reduction of EU fleet-wide emissions of 13% over the six year period from 2009. In fact, nearly all OEMs have already met their 2015 targets.

The 2021 target is significantly more difficult to achieve. It requires a total reduction of emissions of 27% over the six year period from 2015. However, as most OEMs met their 2015 targets by 2013, they effectively have eight years to reduce emissions to the required 2021 levels.

That said, the EU-wide fleet has reduced its emissions by 19% over the eight year period to 2013, so meeting the 2021 targets will not necessarily be straightforward.

Highlights:

- Volkswagen, Renault and PSA Peugeot Citroen, the top three OEMs by market share in the EU (with a share of 51%), are on track to meet both 2015 and 2021 targets.
- All OEMs are on track to meet their 2015 targets.
- General Motors, ranked number four in the EU by market share, is at risk of missing its target for 2021. We estimate this could lead to a penalty of US$650 million (or 13% of EBIT).
- FCA, Nissan and Hyundai are also at risk of missing their respective 2021 targets. We estimate the potential penalties later in this chapter.
- Renault is ranked number one. It has a fleet of small, efficient vehicles and has been reducing emissions at an average of 5.7% per annum over the last three years.
- Toyota is ranked second for EU Fleet Emissions. It has been selling hybrids in the EU for over a decade, with sales more than doubling to 110,000 over the two years to 2013, accounting for nearly 25% of Toyota's EU sales.
- General Motors, Nissan and FCA are the bottom three for EU Fleet Emissions. Our EU forecasts for FCA do not include sales of Chrysler. FCA's fleet emissions could be inflated by increasing EU sales of Chrysler's high-emitting vehicle range, although we note that this would also increase the sales-weighted target (due to Chrysler's heavier vehicle range). We have data for sales of Jeep, one of Chrysler's brands, in Germany: it had the highest 2013 emissions of any car of 211 gCO_2/km, ahead of both Land Rover and Porsche.

Methodology

Our EU Fleet Emissions Grade is determined as follows:

- We rank the OEMs based on the percentage that their projected fleet emissions are over/under their respective EU targets for 2015 and 2021.
- The EU fleet emissions grade is based on the weighted combined rank of the 2015 rank and the 2021 rank.
- We weight the 2015 target at 25% as we see it as less important, as the OEMs are all on track to meet the 2015 target.
- We weight the 2021 rank as 75%, since a number of OEMs are off track to meet this target and thus we consider the 2021 rank to be more significant.
- We use targets that are specific to each OEM. They are sourced from ICCT data, or calculated from the EU fleet wide target (of 130gCO_2/km for 2015 and 95g CO_2/km for 2021) by scaling it according to the fleet average mass in running order for each OEM.

8 Mass in running order is the total mass of a vehicle with standard equipment, all necessary operating consumables (e.g. motor oil and coolant), with fuel tanks filled to at least 90% of their capacity, and including the mass of the driver (at 75kg) but not loaded cargo.

EU Fleet Emissions: Rank and Grade

OEM	% EU market share	2015 EU Fleet Emissions Rank	2021 EU Fleet Emissions Rank	Weighted Combined Rank	EU Fleet Emissions Grade
Renault	14%	3	1	1.5	A
Toyota	4%	1	2	1.8	A
Daimler	5%	6	3	3.8	A
PSA Peugeot Citroen	10%	2	5	4.3	B
Mazda	1%	7	4	4.8	B
Tata Motors	1%	4	6	5.5	B
BMW	6%	9	7	7.5	C
Volkswagen	27%	8	8	8.0	C
Ford	7%	5	10	8.8	D
Honda	1%	11	9	9.5	D
Hyundai	3%	13	11	11.5	D
FCA	5%	10	13	12.3	E
Nissan	3%	14	12	12.5	E
General Motors	7%	12	14	13.5	E
	94%				
	Weighting:	25%	75%		

- We do not take into account super credits available to OEMs. Super credits are available for the production of low emitting cars (below 50g CO_2/km). They can be offset against fleet emissions, and are intended to assist OEMs in reaching their fleet emissions targets in the transitional years of the regulation. For 2020-22, there is a cap on super credits of 7.5 gCO_2/km for the entire three year period.

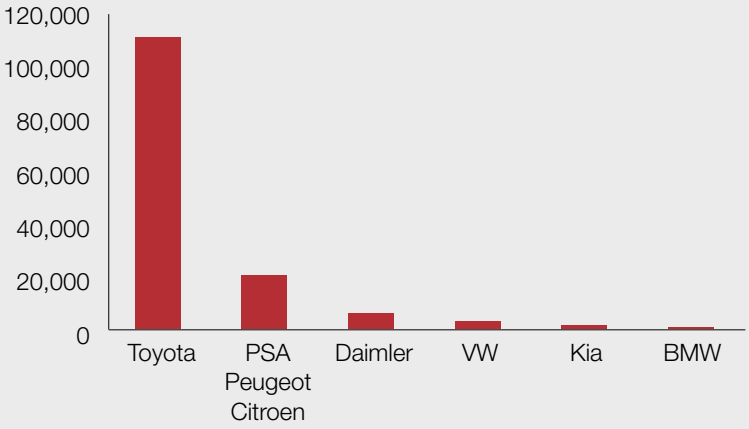
In order to assess whether each OEM is on track to meet its fleet emissions targets for 2015 and 2021, we forecast their fleet emissions-reductions over the period 2014-21 by adopting a constant percentage reduction in annual emissions over the forecast period (2014-21), determined by the greater of:

- **(i) A line of best fit** through each OEM's percentage reduction in annual emissions since 2002 (i.e. 12 years of trend data, sourced from the ICCT), with the percentage reduction in annual emissions adopted in our analysis equal to the intercept of the line of best fit with the latest year (2013) (see chart on the next page) – we would adopt -4.4% as the emission reduction rate in this case.
- **(ii) 3-year CAGR for fleet emissions:** to recognize that percentage reductions are generally increasing over time, we adopt the average percentage emissions reduction over the last three years if it is higher than the percentage reduction given in (i) above. In fact, this only occurred for four out of eleven OEMs.
- **Daimler** is one of the four OEMs for which the 3-year CAGR calculated in (ii) is greater than the percentage reduction calculated in (i). However, as the percentage reduction calculated in (i) for Daimler is already the highest of the group at -6.2%, we adopt this instead of the -6.7% 3-year CAGR.
- **For Tata Motors and Mazda** we only had two years of historic fleet emissions data (and therefore one percentage emission reduction data point for each), however, they both have niche derogation targets[9], which specify a target that is based on 25% of their respective sales-weighted fleet emissions in 2007. Assuming a constant reduction in emissions per year, we can back out an implied growth rate over the period. We adopt the implied CAGR for the last three years.
- **For Honda,** we only had two years of historic fleet emissions data (and therefore one percentage emission reduction data point) thus we adopted the industry average reduction rate for Honda. This is not unreasonable as Honda spends an above average amount on R&D (as a percentage of vehicle revenue).

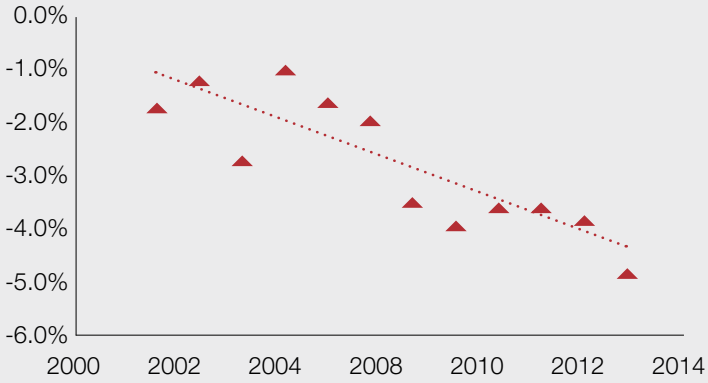
We believe that our percentage reductions in annual emissions assumptions are generous but fair. We note that significant R&D is being invested across the industry, which has led to the development of a fledgling hybrid market in the EU over the last few years. Hybrid sales doubled to 145,000 units in 2013 (see chart above left), equating to just 1.4% of total EU car sales. Most OEMs now have hybrid technology available and we expect this to be a driver of fleet emission-reductions in

9 Niche derogation target for OEMs which sell low volumes in a niche segment of the market.

EU: Hybrid sales in 2013 (units sold)



EU fleet average % reduction emissions reduction (with line of best fit)



the coming years along with further enhancements and modifications to traditional combustion engine vehicles.

2015 and 2021 targets: beat or miss?

Penalties

For each OEM that is off track to meet its target, we estimate the potential financial penalty based on the percentage by which they miss the target.

We forecast sales over the period of 2014-21 by assuming a 1% decline from 2013 sales volumes to estimate the potential penalty for those OEMs that fail to meet the 2021 target.

2015 target: all OEMs are on track

As indicated in the table below, all OEMs are on track to meet their EU 2015 targets.

Toyota and PSA Peugeot Citroen are 'top-ranked'. They beat their targets by 19% and 18% respectively.

EU fleet emissions: assessment of whether OEM is on track (B) or off track (M) to meet the EU 2015 target

OEM	% EU market share	2013 actual gCO_2/km	% change in fleet emissions pa (forecast)	2015 Projected gCO_2/km	2015 target gCO_2/km	Beat or Miss target?	%(under)/ over target	2015 Rank
Toyota	4%	115	-5.0%	104	128	Beat	-19%	1
PSA Peugeot Citroen	10%	116	-4.4%	106	129	Beat	-18%	2
Renault	14%	116	-5.7%	104	122	Beat	-15%	3
Tata Motors	1%	173	-5.2%	156	178	Beat	-13%	4
Ford	7%	123	-4.0%	113	129	Beat	-12%	5
Daimler	5%	139	-6.2%	122	139	Beat	-12%	6
Mazda	1%	128	-5.5%	114	129	Beat	-12%	7
Volkswagen	27%	128	-4.7%	116	131	Beat	-12%	8
BMW	6%	136	-4.8%	123	139	Beat	-11%	9
FCA	5%	120	-2.8%	113	124	Beat	-9%	10
Honda	1%	130	-4.5%	119	130	Beat	-8%	11
General Motors	7%	132	-2.8%	125	133	Beat	-6%	12
Hyundai	3%	129	-3.5%	120	128	Beat	-6%	13
Nissan	3%	135	-3.8%	125	130	Beat	-4%	14
	94%							

Notes:
(i) Niche derogation target

Source: ICCT, CDP estimates

2021 target: four OEMs at risk

Four OEMs are at risk of missing their 2021 targets. General Motors and FCA are the most at risk. We forecast that they will miss their targets by 8% and 6% respectively (not including super-credits). This could lead to penalties of US$650 million and US$281 million respectively, equating to 13% of EBIT for General Motors and 7% for FCA.

We estimate that Hyundai and Nissan will miss by 4% each, giving penalties of US$82 million (1% of EBIT) and US$164 million (3% of EBIT) respectively.

In the table at the bottom of this page, the third column from the left shows the percentage decrease in emissions per annum required for each of the OEMs to meet their targets. General Motors and FCA are the most challenged to meet their targets, as they would need to increase their percentage emissions reductions per annum by 100 bps and 70 bps respectively relative to our percentage emissions reduction forecasts.

EU fleet emissions: assessment of whether OEM is on track (B) or off track (M) to meet the EU 2021 target

OEM	% EU market share	2013 actual gCO_2/km	% change in fleet emissions per year (projected)	2021 Projected gCO_2/km	2021 target gCO_2/km	Beat or Miss target?	%(under)/ over target	2021 Rank
Renault	14%	116	-5.7%	73	90	Beat	-19%	1
Toyota	4%	115	-5.0%	76	93	Beat	-18%	2
Daimler	5%	139	-6.2%	83	101	Beat	-18%	3
Mazda	1%	128	-5.5%	81	95	Beat	-14%	4
PSA Peugeot Citroen	10%	116	-4.4%	81	94	Beat	-13%	5
Tata Motors	1%	173	-5.2%	113	130	Beat	-13%	6
BMW	6%	136	-4.8%	92	101	Beat	-9%	7
Volkswagen	27%	128	-4.7%	87	95	Beat	-9%	8
Honda	1%	130	-4.5%	91	95	Beat	-5%	9
Ford	7%	123	-4.0%	89	93	Beat	-5%	10
Hyundai	3%	129	-3.5%	97	93	Miss	4%	11
Nissan	3%	135	-3.8%	99	95	Miss	4%	12
FCA	5%	120	-2.8%	96	90	Miss	6%	13
General Motors	7%	132	-2.8%	105	97	Miss	8%	14
	94%							

Source: ICCT, CDP estimates

EU penalties: estimated for the 5 OEMs in our study that are off track to meet their 2021 targets

OEM	% change in fleet emissions per year (projected)	% change in fleet emissions per year required to meet target	Additional % reduction per year in emissions required to meet target	% miss 2021 target	Total penalty per unit	Forecast 2021 Volume sales (i)	Total penalty (EURm)	Total penalty (USDm)	% EBIT (ii)	% Revenue (ii)
General Motors	-2.8%	-3.8%	-1.0%	8%	680	743,332	565	650	13%	0.4%
Hyundai	-3.5%	-4.0%	-0.5%	4%	110	374,340	71	82	1%	0.1%
FCA	-2.8%	-3.5%	-0.7%	6%	395	514,402	244	281	7%	0.2%
Nissan	-3.8%	-4.3%	-0.5%	4%	300	374,418	142	164	3%	0.2%

Notes:
(i) Sales are forecast by assuming a decline of 1% pa from 2013
(ii) 2013 company results

Source: ICCT, CDP estimates

US regulation

- Three of the top four OEMs by market share, GM, Ford and FCA, are all at risk of missing their US 2016 targets
- We believe that the four Japanese OEMs, Toyota, Nissan, Mazda and Honda, are the only ones on track to meet their US 2016 targets
- Mazda ranks top in our US Fleet Emissions analysis, with Toyota a close second, and FCA ranks bottom

Overview

10 of the 14 OEMs in our study are exposed to the US auto market, and together represent 88% market share. In this chapter we assess whether they are on track to meet the US fleet emission targets for 2016. The US sales-weighted fleet-wide target for passenger cars in 2016 is:

- **On an unadjusted (CAFE) basis:** 39.5 mpg which equates to 225 gCO_2/mile (or 141 gCO_2/km)
- **On a real world basis:** 49.4 mpg which equates to 281 gCO_2/mile (176 gCO_2/km)

The real world version of this target is adjusted to give a specific target for each OEM (according to tire tread width, in sq ft).

We do not address the US 2025 target in this report for two main reasons. Firstly, a ten year period is inherently very difficult to forecast, particularly when only three years of historic data are available (for the EU 12 years were available). Secondly, we believe that if the Republicans win the US election there is a risk that the EPA regulations on fleet emissions will be weakened.

The US 2016 target implies a total reduction of US fleet-wide emissions of 17% over the four year period from 2012 (we do not have data from earlier years). This seems fairly challenging given that the US fleet-wide average emissions reduction rate has been just 2-3% per annum for the last two years (2012-14); adopting preliminary fleet estimates for 2014 (from the EPA), the US fleet would need to reduce emissions by, on average, 6% per year to meet the 2016 target.

Highlights:

- General Motors, Ford and FCA, three of the top four OEMs by market share in the US (with a combined share of 44%), are all at risk of missing their 2016 targets.
- We note that both General Motors and FCA were also flagged as at risk of missing the EU 2021 target.
- Other OEMs at risk of missing their US targets are German OEMs Volkwagen, BMW and Daimler, with a combined US market share of 11%.
- All four Japanese OEMs - Toyota, Nissan, Mazda and Honda - are on track to meet their 2016 targets. These are the only OEMs that are on track.
- Toyota is ranked second for US Fleet Emissions as it is for EU Fleet Emissions. As with the EU, Toyota is the dominant market leader in the hybrid segment of the US market with a 70% market share.
- FCA is the worst performer in the US, receiving an E-grade for US Fleet Emissions. We note that FCA's R&D spend in recent years (averaging 2.7% of vehicle + component[10] revenue over the last three years) is significantly below the industry average of 4.5% (over the same period), which does not bode well for reducing fleet emissions through technological advancements.

10 FCA has an auto component manufacturing division; we apportion equally the R&D incurred across this division and the vehicles division.

US Fleet Emissions Grade

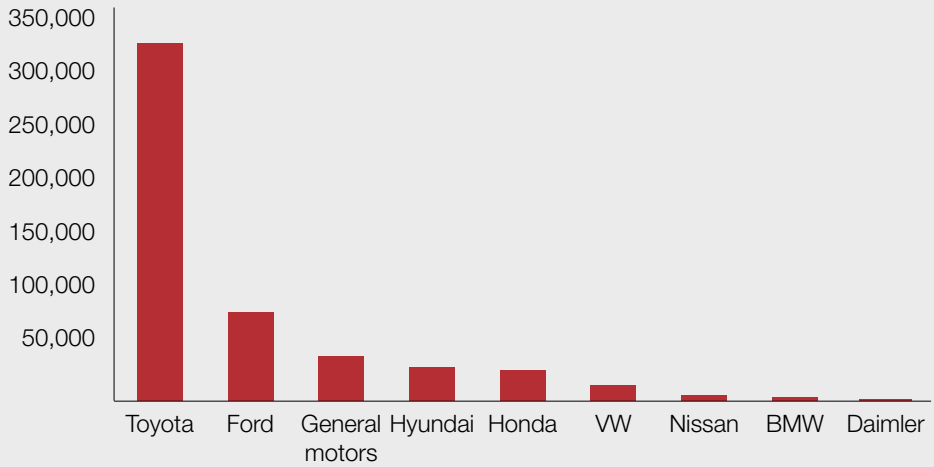
We awarded the four Japanese OEMs three A-grades (Mazda, Toyota and Nissan) and a B-grade (Honda) for their US Fleet Emissions. Ford was ranked fifth; however, we could not award it a B-grade as it is off track to meet its target. Based on our forecasts, the German OEMs are at notably higher risk of missing their targets than Ford, so we awarded them all a D-grade.

US Fleet Emissions Rank and Grade

OEM	% US market share	Beat or Miss 2016 target	%over/ (under) target	2016 US Fleet Emissions Rank	US Fleet Emissions Grade
Mazda	2%	Beat	-7%	1	A
Toyota	14%	Beat	-5%	2	A
Nissan	8%	Beat	-5%	3	A
Honda	10%	Beat	-1%	4	B
Ford	15%	Miss	4%	5	C
Daimler	2%	Miss	11%	6	D
BMW	4%	Miss	11%	7	D
Volkswagen	4%	Miss	11%	8	D
General Motors	18%	Miss	15%	9	E
FCA	11%	Miss	19%	10	E
	88%				

Source: EPA, CDP estimates

US: Hybrid sales in 2013 (units sold)



Methodology

Our US Fleet Emissions Grade is determined as follows:

- We rank the OEMs based on the percentage that our forecast fleet emissions for each OEM are over/under their respective US 2016 targets.
- The US Fleet Emissions Grade is based directly on this rank. We assign no weight to the US 2025 target as explained earlier in this chapter.
- We use targets that are specific to each OEM. They are sourced from EPA data
- We do not take into account any of the credits aimed at assisting OEMs over a transitional period.
- We appreciate that including the credits could change the outcome of our analysis for 2016. However, we also note that these credits are only intended as support during a transitional period and not as a way to plug a perpetual shortfall in emissions reductions. Thus, we believe that proper forward-thinking analysis should consider a scenario without the benefit of these credits.

In order to assess whether each OEM is on track to meet its fleet emissions targets for 2016, we forecast their fleet emissions-reductions over the period 2014-21. We only have two years' historic fleet emissions data (2012 and 2013) and preliminary data for 2014 for each OEM and therefore just two years of percentage emissions reduction data. Thus, our forecasts are inherently unreliable and recognizing this we are as generous as possible to the OEMs by adopting a constant percentage reduction in annual emissions (different for each OEM) over the forecast period (2014-21), determined as follows:

- (i) Calculating the average of the two annual emissions reduction rates (2013 and 2014), determined from the three years of emissions data;
- (ii) If the rate is less than 4%, then take the greater of the 2013 and 2014 reduction rates;
- (iii) Otherwise, adopt the average of the two annual emissions reduction rates.

There were three instances where the average reduction rate was greater than 4% (Mazda, Nissan and Ford). We note that adopting this methodology in the EU section, where we had 12 years of historic emissions data, would have given a higher (more beneficial) emissions-reduction rate in seven out of eleven instances when compared to the rate adopted for the purposes of our EU analysis. Under these circumstances, we are comfortable that our assumptions are reasonable and, if anything, on the generous side.

For ease of comparison within this report, we convert the EPA's fleet emission data and targets by OEM from gCO_2/mile to gCO_2/km. Furthermore, we recognize the OEMs' individual (footprint-weighted) targets that we have adopted from the EPA's Final Rule MY2012-16, are 'unadjusted' targets, thus need to be adjusted to equate to 'real world' figures (see discussion in fleet emissions summary chapter). We increase the unadjusted targets by 25% to arrive at an estimated real world target for each OEM.

US 2016 target: beat or miss?

Penalties

For each OEM that is off track to meet its target, we estimate the potential financial penalty based on the percentage by which they miss the target.

We calculate a penalty under 3 scenarios:

- **Scenario 1:** The NHTSA CAFE penalty of US$5.50 per vehicle sold in the US. This penalty scheme has been in existence since the 1980s but is replaced by a new EPA penalty under the CAA.
- **Scenario 2:** The EPA penalty under the CAA is up to US$37,500 per offending vehicle. We adopt this maximum in one of our scenarios, although note in practice this is extremely unlikely to happen.
- **Scenario 3:** We assume just US$1,000 per offending vehicles is levied by the EPA.

We use the EPA's own volume sales forecasts for each OEM in 2016 to estimate the penalties under scenario 1.

The number of 'offending' vehicles needed to estimate the penalties under scenarios 2 and 3 is notably more subjective and tricky to estimate. To estimate the number of offending vehicles, we have performed an in-depth modelling exercise, using data from the EPA for all new models registered for sale in the US for 2015, and from this analysis we have determined the percentage of new registrations (by model) in 2015 that would not achieve the EPA hurdle (intermediate target) in 2015 for each OEM. We adopt this percentage in determining the number of 'offending' vehicles.

The results of this analysis are surprising: only 20% of the nearly 1,300 passenger models registered for 2015 would meet the 2015 hurdle.

2015 hurdles assumptions by passenger car type

Passenger car type	2015 EPA hurdle (converted to gCO_2/km)
Small car	169
Midsize car	189
Large car	216
Station wagon	220
Small SUV (2WD)	210
Standard SUV (2WD)	225

Source: EPA, CDP estimates

US fleet emissions: assessment of whether OEM is on track (B) or off track (M) to meet the US 2016 target

OEM	% US market share	2014 preliminary gCO_2/km (i)	% change in fleet emissions per year (projected)	2016 Projected gCO_2/km	2016 EPA target gCO_2/km	Beat or Miss target?	%over/ (under) target	2016 Rank	US Fleet Emissions Grade
Mazda	2%	174	-4.2%	160	173	Beat	-7%	1	A
Toyota	14%	177	-3.7%	164	173	Beat	-5%	2	A
Nissan	8%	186	-4.9%	168	177	Beat	-5%	3	A
Honda	10%	183	-3.0%	172	173	Beat	-1%	4	B
Ford	15%	198	-3.1%	186	179	Miss	4%	5	C
Daimler	2%	225	-4.4%	206	186	Miss	11%	6	D
BMW	4%	209	-2.8%	198	178	Miss	11%	7	D
Volkswagen	4%	206	-4.1%	189	170	Miss	11%	8	D
General Motors	18%	218	-2.5%	207	180	Miss	15%	9	E
FCA	11%	231	-3.5%	216	181	Miss	19%	10	E
	88%								

Source: EPA, CDP estimates
Notes: (i) EPA estimates

Most OEMs are off track

The table on the bottom of the previous page summarizes our assessment of whether each OEM is on track to meet the US 2016 target. Six OEMs are at risk of missing their 2016 targets. General Motors and FCA are the most at risk. These two were also most at risk in our EU fleet emissions analysis. We forecast that they will miss their targets by 15% and 19% respectively (not including credits), and question whether credits will be enough to plug this gap in any case. We estimate penalties in the range of US$272 million to US$1.0 billion for General Motors (or 5-21% of EBIT), and for FCA US$88 million to US$293 million (or 2-7% of EBIT). The maximum penalties in scenario 2 are for illustrative purposes only.

The third column from the left in the table below shows the percentage decrease in emissions per annum required for each of the OEMs to meet their targets.

US penalties: estimated for the 6 OEMs in our study that are off track to meet their 2016 targets

OEM	Scenario 1		Scenario 2		Scenario 3	
	2016 penalty (USDm)	% EBIT	2016 penalty (USDm)	% EBIT	2016 penalty (USDm)	% EBIT
General Motors	272	5.3%	39,488	770%	1,053	21%
Ford	71	1.3%	33,347	613%	889	16%
FCA	88	2.2%	11,003	279%	293	7%
BMW	69	0.6%	15,466	146%	412	4%
Volkswagen	90	0.6%	19,844	128%	529	3%
Daimler	41	0.3%	9,228	64%	246	2%

Source: EPA, CDP estimates

Additional % emissions reduction per year required to meet 2016 targets

OEM	% change in fleet emissions per year (projected)	% change in fleet emissions per year required to meet target	Additional % reduction per year in emissions to meet target
FCA	-3.5%	-11.5%	-8.0%
General Motors	-2.5%	-9.1%	-6.6%
Volkswagen	-4.1%	-9.1%	-5.0%
BMW	-2.8%	-7.8%	-4.9%
Daimler	-4.4%	-9.1%	-4.7%
Ford	-3.1%	-5.0%	-2.0%

Source: EPA, CDP estimates

China regulation

- All nineteen JVs (belonging to OEMs in our study) are on track to meet their 2015 target, in our view
- For imported vehicles (i.e. non-JV sales), five OEMs are at risk of missing their 2015 target; any potential penalty would be the most material[11] for FCA and Renault
- BMW and Mazda ranks top two in our China Fleet Emissions analysis, and Toyota rank bottom

Overview

All of the 14 OEMs in our study are exposed to the Chinese auto market, and together represent a market share of 67%[12]. They mainly sell cars in China through a JV with a Chinese partner (62% share of Chinese market [11]) but also through direct imports into China (5% share).

In this chapter, we assess whether each OEM is on track to meet its fleet emissions target for 2015, under China's Corporate Average Fuel Consumption (CAFC) regulations. The CAFC regulations use the EU regulations as a template but with different hurdles and penalties. The sales-weighted fleet-wide target for passenger cars in 2015 is: 6.9 L/100km, which equates to 162 gCO_2/km.

The target is measured under NEDC (see Fleet Emissions Summary chapter). It is adjusted to give a specific target for each OEM according to fleet average curb weight[13].

China also has a 2020 target of 5 L/100km, measured under NEDC, which equates to 117 gCO_2/km. We do not consider the 2020 target in this study as we do not have sufficient data to forecast sales-weighted fleet emissions over the period to 2020.

Highlights:

- All of the JVs between the OEMs and a Chinese partner are on track to meet their 2015 target. In total, 12 of the OEMs in our study have one or more JVs in China which made sales during the period under consideration[14].
- All 14 of the OEMs in our study import vehicles directly into China, although these imports account for just 5% of the Chinese market[15]. We find that General Motors, Nissan, Hyundai, FCA and Renault are at risk of missing their 2015 target for these direct imports.
- FCA and Renault are the only two OEMs where the penalties, which include a ban on all models that fail to meet the target, are material in the context of their overall Chinese vehicle sales (see Imports: beat or miss section below).

11 Relative to total sales (imported sales plus JV sales) in China.
12 Assuming 100% of JV sales are assigned to the non-Chinese OEM partner.
13 Curb weight is the total weight of a vehicle with standard equipment, all necessary operating consumables (e.g. motor oil and coolant), a full tank of fuel, while not loaded with either passengers or cargo.
14 The Chinese government approved the formation of a JV between Renault and Dongfeng in December 2013, for which there is no sales data for that year.
15 Based on 2013 data.

China: Fleet Emissions Rank and Grade

OEM	Market share in China (%)	Import weighting (%)	JV weighting (%)	Import Rank	JV Rank	China Rank	China Grade
BMW	2%	47%	53%	3	1	1.9	A
Mazda	1%	4%	96%	2	2	2.0	A
Ford	4%	4%	96%	4	3	3	A
Volkswagen	18%	4%	96%	7	5	5	B
Tata Motors	1%	100%	0%	6		6	B
Nissan	6%	2%	98%	13	6	6	B
Honda	4%	0%	100%	9	7	7.0	C
Daimler	1%	44%	56%	1	12	7.1	C
Hyundai	6%	4%	96%	12	8	8.2	D
FCA	1%	68%	32%	11	4	8.8	D
General Motors	16%	1%	99%	14	9	10.1	D
PSA Peugeot Citroen	3%	1%	99%	8	10	9.0	E
Renault	0%	100%	0%	10		10.0	E
Toyota	5%	9%	91%	5	11	10.5	E
Non-Chinese total (i)	**67%**						

Notes:
(i) Including full sales for JV (which is typically owned 50:50 by a Non-Chinese OEM and a Chinese OEM).

Source: Chinese Ministry of Information and Technology, CDP

China Fleet Emissions Grade

The table above shows the Fleet Emissions Grade for each OEM. Surprisingly, Toyota was ranked bottom and received an E-grade, in complete contrast to its A-grades for both EU and US fleet emissions. We note that Toyota is on track to meet its target for its JVs and imports, however, its grade was low as all other JVs were also on track to beat their targets (and by a larger margin than Toyota). We also note that Toyota's hybrid sales in China are significantly lower as a percentage of its total China sales (c. 4%) than in the EU (c. 20%) and the US (c. 16%).

General Motors and FCA both received a D-grade, their highest of the three regions covered. BMW was top and achieved an A-grade. Mazda and Ford also achieved an A-grade.

Methodology

Our China Fleet Emissions Grade is determined as follows:

- We rank the OEMs based on the percentage that their actual 2013 sales-weighted[16] fleet emissions are over/under their respective China 2013 hurdles, which are set by the CAFC regulations to assess whether an OEM is on track to meet its 2015 target, we assess JVs and imports separately and therefore determine a separate rank for each of these.
- We are unable to forecast future emissions for the OEMs in China as we have insufficient historic data: the Chinese Ministry of Industry and Information Technology has only published fleet emissions data for 2013 and H2 2012[17].
- The China Fleet Emissions Grade is based on the weighted combined rank of the JV Rank and the Import Rank. We weight the JV Rank and the Import Rank according to each OEM's exposure[16] to each of these methods of sales in China (see table on China Fleet Emissions Rank and Grade for the weightings used for each OEM).
- We are able to assess whether each OEM is on track to meet its 2015 target from the 2013 published data because the CAFC regulations provides formal hurdles, which are used to assess whether each OEM is on or off track. These hurdles are set at 106% of each OEM's 2015 target.
- We use hurdles that are specific to each OEM. They are sourced from the Chinese Ministry of Industry and Information Technology data.
- We do not take into account credits available to OEMs .
- As mentioned above, the OEMs in our study sell cars in China either through a JV with a Chinese partner or through import. The JVs account for the vast majority of these sales (62% of the Chinese market in total). 12 of the 14 OEMs have JVs in China which made sales during the period under consideration[18]; seven have two JVs and five have one JV. The Chinese government assesses each JV individually under the regulations; thus, an OEM with two JVs could receive a penalty on one JV but not on the other.
- However, for the purpose of determining the China Fleet Emissions Rank (and therefore Grade), where an OEM has two JVs, we sales-weight the fleet emissions of each JV.

China 2015 target: beat or miss?

Penalties

For each OEM that fails to meet its 2015 target, there are the following penalties:

- Publicly name and shame;
- A ban on the production of new models that do not meet the target (determined by a weight-based formula);
- Any proposed investment projects of plant expansion or new plants will not be approved.

With the information available to us, we are unable to estimate the impact of the above penalties on the EBIT of the OEMs in our study (as we have done for the EU and US markets).

16 For the JVs, the Chinese government only publishes production data, thus we use production data as a proxy for sales. For imports, the Chinese government publishes data on volume of cars imported, thus we use this as a proxy for sales.
17 The CAFC regulations were issued by the Chinese State Council in June 2012.
18 The Chinese government approved the formation of a JV between Renault and Dongfeng in December 2013, for which there is no sales data for that year.

China fleet emissions for JVs: assessment of whether OEM is on track (Beat) or off track (Miss) to meet the 2015 target

OEM	No of JVs	% share of JV vehicle production in 2013 (i)	Average curb weight (kg)	2015 Target	CAFC 2013 hurdle	Reported sales-weighted emissions 2013	Beat or Miss target?	%(under)/ over CAFC 2013 hurdle	JV Rank
BMW	1	2%	1,675	8.6	9.1	7.3	Beat	-20%	1
Mazda	1	1%	1,243	7.1	7.6	6.6	Beat	-13%	2
Ford	1	6%	1,413	7.7	8.2	7.2	Beat	-12%	3
FCA	1	0%	1,458	7.8	8.3	7.4	Beat	-11%	4
Volkswagen	2	27%	1,383	7.6	8.0	7.1	Beat	-11%	5
Nissan	2	9%	1,250	7.1	7.6	6.8	Beat	-10%	6
Honda	2	7%	1,412	7.7	8.2	7.6	Beat	-6.7%	7
Hyundai	1	9%	1,305	7.2	7.6	7.2	Beat	-5.4%	8
General Motors (ii)	2	25%	1,305	6.0	6.3	6.1	Beat	-5.1%	9
PSA Peugeot Citroen	2	5%	1,356	7.5	7.9	7.6	Beat	-4.6%	10
Toyota (iii)	2	8%	1,462	7.9	8.3	8.1	Beat	-3.2%	11
Daimler	2	1%	1,784	9.0	9.6	9.4	Beat	-1.4%	12

Notes:
(i) for JVs involving the OEMs in our study.
(ii) in reporting to MIIT, General Motors splits one of its two JV (the SGM one) in to three separate JVs according to factory location.
(iii) in reporting to MIIT, Toyota splits one of its two JVs (the FAW one) into two separate JVs according to factory location.

Source: Ministry of Industry and Information Technology of China, CDP

JVs: beat or miss?

The table above summarizes how we determined the JV rank. Although for OEMs with two JVs the table combines the sales-weighted fleet emissions for each JV[15] (in order to determine the JV rank), we believe that each separate JV is on track to meet its target.

China fleet emissions for imports: assessment of whether OEM is on track (Beat) or off track (Miss) to meet the 2015 target

OEMs	% share of imports for 2013 (i)	Average curb weight (kg)	2015 Target	2013 hurdle	2013 Reported sales-weighted emissions	Beat or Miss target?	%(under)/ over CAFC 2013 hurdle	Import Rank
Daimler	12%	1,782	9.1	9.7	8.5	Beat	-12%	1
Mazda	1%	1,539	8.3	8.8	7.8	Beat	-11%	2
BMW	22%	1,763	9.0	9.5	8.5	Beat	-11%	3
Ford	3%	1,954	9.8	10.3	9.3	Beat	-10%	4
Toyota	10%	1,790	9.0	9.6	8.7	Beat	-9%	5
Tata Motors	11%	2,066	10.1	10.7	9.7	Beat	-9%	6
Volkswagen	14%	1,862	9.3	9.9	9.5	Beat	-4%	7
PSA Peugeot Citroen	1%	1,396	7.7	8.1	8.0	Beat	-2%	8
Honda	0%	1,682	8.7	9.2	9.2	Beat	0%	9
Renault	4%	1,591	8.4	8.9	9.1	Miss	2%	10
FCA	12%	1,745	8.9	9.5	9.8	Miss	3%	11
Hyundai	6%	1,581	8.6	9.1	9.7	Miss	7%	12
Nissan	2%	1,871	9.4	9.9	10.6	Miss	7%	13
General Motors	4%	1,955	9.5	10.1	10.8	Miss	7%	14

Note:
(i) for imported vehicles of OEMs in our study.

Source: Chinese Ministry of Industry and Information Technology, CDP

Imports: beat or miss?

The table above summarizes our assessment of whether each OEM is on track to meet the China 2015 target for imported vehicles. As explained above, we have assessed each OEM's fleet emissions for 2013 against the CAFC 2013 hurdle. This hurdle is set at 6% above the 2015 target.

Hyundai, General Motors and Nissan all missed the 2013 hurdle (which is 6% above the 2015 target) by 7% and are therefore each off track to meet the 2015 target – they are 13% below it at the end of 2013. We note that based on the emission reduction rates we have seen in the EU (average 4.5% per annum) and the US (average 3.5% per annum), a 13% reduction in two years (roughly 6.5% per annum) seems a big challenge.

FCA missed the 2013 hurdle by 3% and Renault missed by 2%, so both are also off track to meet the 2015 target - they are 9% and 8% below it at the end of 2013.

FCA and Renault are the only two OEMs where the penalties, which include a ban on all models that fail to meet the target, are material in the context of their overall Chinese vehicle sales. This is because Renault only imported cars in 2013 and FCA's imports constitute a much higher portion of its overall sales in China than the other OEMs who we believe are at risk of missing their 2015 targets.

All other OEMs are on track to meet the 2015 target in respect of vehicles imported into China.

Advanced Vehicles

- The most important factors for AV market growth are vehicle cost, fuel savings, charge range[19] and infrastructure roll-out
- The Chinese AV market could reach sales of nearly 2 million vehicles per annum by 2020, if aggressive government targets are met
- Nissan, Toyota and General Motors occupy the top three ranks for Advanced Vehicle score and each receive an A-grade

Overview

Advanced Vehicles (AVs) such as BEVs (Battery Electric Vehicles), PHEVs (Plug-in Hybrid Electric Vehicles) and FCVs (Fuel Cell Vehicles) are potentially game-changing technologies for the auto industry for a number of reasons:

- From a strategic government-level perspective, AVs mitigate the risks associated with oil dependency[20].
- Consumers have been suffering at the pump in recent years due to high and volatile oil prices. AVs mitigate the risk of this volatility. We acknowledge that the oil price has dropped very sharply over the last six months; however, we note that this has had a limited impact on EU pump prices due to high taxation, thus the economics have not been significantly impacted and still work[21].
- From an emissions perspective, BEVs have zero tail-pipe emissions, however, their total emissions depend on power generation sources. Irrespective of sources, due to the higher energy efficiency of BEVs compared to internal combustion engine vehicles, their overall emissions footprint is notably lower. Even in the US, whose electricity mix is c50% coal, the total lifecycle emissions of a BEV are still nearly 40% lower than an equivalent gasoline vehicle[22].

In this chapter, we assess the AV landscape and perform a detailed review of the various BEV, PHEV and FCV product offerings[23] of the OEMs in our study. There are three parts to our review:

- **Technical:** we assess most models of BEVs and PHEVs available globally on a number of key metrics: cost, mpg-equivalent, charge range and charge time.
- **Vehicle sales:** we consider each OEM's sales of BEVs and PHEVs in the EU, US, Japan and China.
- **Other factors:** we consider technology collaborations between groups of OEMs; current charging infrastructure and roll-out plans in key markets globally, and also consumer subsidies available in those markets.

19 Charge range is important for Battery Electric Vehicles. For Fuel Cell Vehicles that run on hydrogen, range is generally much longer and therefore is not such an issue.
20 Electric vehicles run on electricity, which is mostly generated without oil as a source of the energy; fuel cell vehicles run on fuels such as hydrogen.
21 Notwithstanding that the economics for AVs work even with a lower oil price, consumers are also choosing advanced vehicles for their environmentally-friendly image, which is likely to be a growing trend in major markets
22 US Department of Energy
23 We do not consider traditional hybrid vehicles in this Advanced Vehicle chapter. They are implicitly considered in our fleet emissions forecasts in the Fleet Emissions chapters; we consider them a necessary part of achieving these reductions.

Highlights:

- The 'top-ranked' and 'bottom-ranked' OEM overall for AVs is Toyota. General Motors ranks number two and Nissan three. The bottom ranked OEM is Mazda. It receives the only E-grade as it is bottom-ranked for both vehicle sales and technical review.
- Tata Motors' Jaguar Land Rover currently has no electric vehicles. We are therefore unable to consider it in our analysis for the Advanced Vehicle Grade. We acknowledge that it has the Jaguar XJe, a PHEV, in its development pipeline; however, since it is a research vehicle, we are unable to consider it in our technical review.
- The top-ranked vehicles in our technical review are FCA's Fiat 500e (a BEV) and the Honda Accord PiH (a PHEV).
- In terms of cumulative vehicles sold in the EU (to Oct 2014), US (to the end of 2014) and Japan and China (to the end of 2013), Nissan ranks first, General Motors second and Toyota third.
- We took two collaborations for the development of FCVs into account in arriving at the overall Advanced Vehicle Rank. These are: (1) General Motors and Honda; and (2) Nissan, Ford, Renault and Daimler.
- We found that China and Japan were the two most favourable markets for charging infrastructure development. We took this into account when ranking the Japanese companies (as a domestic market advantage).
- We believe that China could be a game-changer for AVs and therefore include a special feature on China at the end of this chapter. BEVs, PHEVs and FCVs were identified as one of seven strategic emerging industries in the 12th Five Year Plan (2011-15) and the government proposed investment of RMB 100 billion (US$16 billion) within the decade to support the R&D for this industry (see the China in focus section at the end of this chapter).

Advanced Vehicles: scorecard summary

	Technical Rank			Sales rank	Other considerations (adjustment)	Overall weighted-rank	Overall Advanced Vehicle grade
OEM	BEV	PHEV	Combined				
Toyota	2	2	2	3	-0.75	1.8	A
General Motors	3	5	3	2	-0.25	2.3	A
Nissan	7		7	1	-0.75	3.3	A
Ford	12	3	5	4	-0.25	4.3	B
Honda	5	1	1	10	-0.75	4.8	B
FCA	1		1	9		5.0	B
BMW	8	4	7	5	-0.25	5.8	C
Renault	9		9	6	-0.50	7.0	C
Volkswagen	4	6	4	11	-0.25	7.3	C
Daimler	10		10	8	-0.50	8.5	D
PSA Peugeot Citroen	11		11	7	-0.25	8.8	D
Hyundai	6		6	12		9.0	D
Mazda	13		13	13	-0.50	12.5	E
	Weighting:		50%	50%			

Source: CDP

Advanced Vehicle Grade Summary

The table on p30 summarizes the rankings for the metrics which make up our Advanced Vehicle Grade. We weight the Technical Rank and Sales Rank equally at 50% each and then adjust the weighted combined Sales and Technical Ranks (see Other Considerations section) according to the relative attractiveness of each OEM's domestic market and to the extent of any technology collaborations.

We calculate the Combined Technical Rank by adopting the lower of: (i) the BEV Rank; and (ii) the PHEV rank doubled, minus one (this adjustment allows for the fact that only six OEMs have a PHEV on the market, and these OEMs have an unfair advantage unless this adjustment is made).

Weightings for the metrics used in determining the Technical Rank

Factor	Weighting for BEV	Weighting for PHEV
Retail price (USD)	30%	30%
Fuel economy (mpg-e)	30%	30%
Combined electric range (miles)	25%	20%
PHEV total driving range (miles) (1)		5%
Charge time (hours)	15%	15%

Notes:
(1) For PHEVs the range was split according to the electric range and the overall range of the PHEV (which includes the petrol tank).

Source: CDP

Technical review

In this section we present the findings of our technical review of BEVs and PHEVs. We find that all OEMs in our study, except Tata Motors, currently have at least one model of BEV on the market. Only six of the OEMs have a PHEV currently available for sale.

Methodology

We calculate our Technical Rank by weight, combining the rankings of most available models of BEVs and PHEVs (separately) outside China on each of four metrics: cost, mpg-equivalent, charge range and charge time. We believe these are the most important metrics for consumers relating to their choice of BEVs and PHEVs.

According to a survey by EY, "Gauging the interest for plug-in hybrids and electric vehicles in select markets"[24], fuel savings is the most important factor driving purchases of BEVs or PHEVs. We use mpg-e as a proxy for fuel saving. The EY survey also highlights battery driving range, access to charging stations (see Other Considerations section) and vehicle price as factors that made consumers most hesitant to purchase PHEVs or BEVs. We weight the four metrics as shown in the previous page.

24 Consumers in EU, US, Japan and China were surveyed.

BEVs: summary of rankings for each of the metrics used to determine the BEV Technical Rank

OEM	No of distinct models offered	First version of model available	Retail Price rank	Combined mpg-e rank	Combined range rank	Charge time rank	Weighted Metrics Rank	BEV Technical Rank
FCA	1	2012	8	5	8	4	6.5	1
Toyota	2	2012	3	2	22	4	7.6	2
General Motors	1	2013	5	3	12	18	8.1	3
Volkswagen	1	2014	11	5	11	4	8.15	4
Honda	1	2012	13	4	12	4	8.7	5
Hyundai	1	2014	12	11	6	4	9	6
Nissan	1	2010	9	7	10	12	9.1	7
BMW	2	2011	16	1	14	4	9.2	8
Renault	1	2012	2	14	17	1	9.2	9
Daimler	2	2010	4	10	16	14	10.3	10
PSA Peugeot Citroen	1	2012	6	8	17	18	11.15	11
Ford	1	2012	15	11	15	3	12	12
Mazda	1	2012	10	19	3	18	12.15	13

Source: CDP

PHEVs: summary of rankings for each of the metrics used to determine the PHEV Technical Rank

OEM	No of distinct models offered	First version of model available	Retail Price Rank	Combined mpg-e Rank	Combined range rank	PHEV total driving range Rank	Charge time Rank	Weighted Metrics Rank	Technical rank
Honda	1	2013	1	2	2	1	1	1.5	1
Toyota	2	2012	2	1	1	3	2	1.6	2
Ford	1	2013	3	4	4	2	4	3.6	3
BMW	2	2014	5	3	3	12	9	5.0	4
General Motors	2	2010	4	5	5	7	9	5.4	5
Volkswagen	3	2014	8	8	8	3	5	7.3	6

Source: CDP

Summary of findings: BEVs

For BEVs we reviewed 22 different models in total for each of the four metrics. 16 of these models belonged to the OEMs in our study, and six to OEMs outside our review, the most notable of which is the Tesla model S.

BMW, Daimler and Toyota each have two distinct models of BEV. For each OEM we use the highest ranking of its two models in calculating the BEV Technical Rank.

Key highlights are as follows:

- FCA's Fiat 500e achieves the top Technical Rank, performing consistently well across all metrics.
- The Mazda EV receives the lowest Technical Rank, despite having the best combined range of any OEM in our study; it ranks near the bottom for the other three metrics.
- The cheapest model in the table is the Renault Twizy, at US$10,712, second of all models analyzed[25]. The Renault Twizy also has the shortest charge time at 3.5 hours (1st of 22 models).
- The most expensive BEV model of the OEMs in our study[26] is the BMW i3 BEV, with a price of US$41,350; however, it has the best fuel economy with a combined mpg-e of 124 (1st of 22 models) and also ranks highly for its minimum charge time of four hours.
- Mazda, PSA Peugeot Citroen and General Motors have the longest charge time at seven hours.
- The best for combined range of the OEMs in our study is the Mazda EV with a range of 125 miles; however, the Tesla Model S is the clear overall leader with 265 miles.

Summary of findings: PHEVs

For PHEVs we reviewed 12 different models in total for each of the four metrics. 10 of these models belonged to the OEMs in our study. The other two models were the Fisker Karma and Maclaren Automotive P1.

VW has three distinct models of PHEVs on the market – all Porsche models. General Motors and BMW both have two distinct models of PHEVs.

Key highlights are as follows:

- The Honda Accord PiH and Toyota Prius PiH rank first and second for overall Technical Rank. They both score consistently highly across all metrics.
- VW ranks the lowest of the OEMs in our study. All three of its models rank low. Its lowest ranked model is the Porsche 918 Spyder.
- The Honda Accord PiH is best for price, PHEV total driving range and charge time, and comes second for combined mpg-e rank and combined electric range rank.
- The Toyota Prius PiH has the best combined mpg-e and combined electric range, and achieves second place for retail price and charge time. It comes third for PHEV total driving range.
- The most expensive PHEV model of the OEMs in our study is the BMW i8 at US$135,700 (although this model is not included for ranking purposes above).

25 Mahindra & Mahindra's Reva Electric was the cheapest of the 22 models reviewed.
26 The most expensive model on the market is the Tesla Model S, at US$69,900.

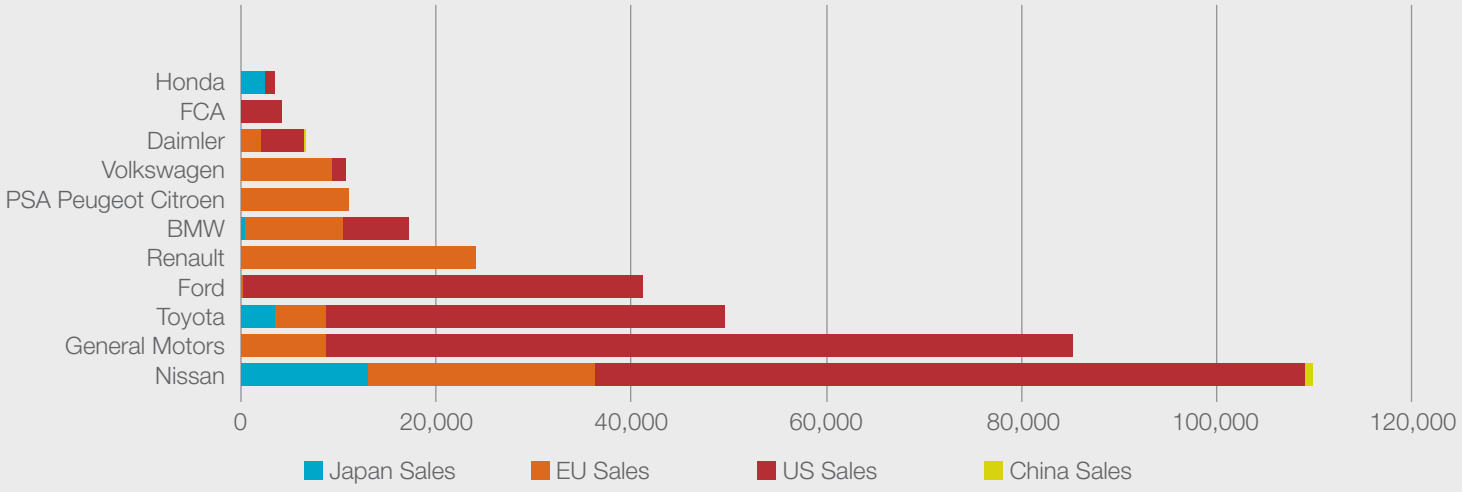
Sales review

We gathered data on BEV and PHEV sales in four key AV markets: the EU, the US, Japan and China. We assessed each OEM on cumulative sales in each of these markets. For the EU, we have data up to the end of October 2014 and for the US we have data up to the end of 2014. 2013 for Japan but the end of 2014 for China.

Key highlights are as follows:

- The Nissan Leaf (a BEV) is by far the best-selling vehicle with over 100,000 units sold in the markets under consideration.
- General Motors ranks second for sales with contributions from its BEV and two PHEVs. The most notable contribution is from the Chevrolet Volt which is the best-selling PHEV, with over 70,000 units sold in the markets under consideration.
- Hyundai and Mazda have sold zero units according to our dataset. Honda and FCA are the next lowest ranking OEMs based on BEV and PHEV sales.
- We believe that FCA's Fiat 500e, which is top placed for BEV Technical Rank could achieve higher sales; however, we understand that it is only currently being sold in the US market, in particular in California due to the availability of tax credits which make it more attractive economically.

Cumulative BEV and PHEV sales in key markets



- Nissan and Daimler are the only OEMs in our study that have made notable sales in China, although the combined sales for both OEMs is still under 1,000 units.
- There is a good opportunity for BMW to penetrate the Chinese AV market: its JV with China's Brilliance Automotive has developed a BEV for sale in China, the Zinoro EV.

Other considerations

In determining the overall Advanced Vehicle Grade we adjust the weighted combined Sales and Technical Ranks according to: (i) the relative attractiveness of each OEM's domestic market; and (ii) the extent of any technology collaborations.

(i) Domestic market advantage

In this section, we assess the relative attractiveness of a number of key BEV/PHEV markets. The table at the bottom of the previous page summarizes electric charging infrastructure roll-out and investment plans and also consumer subsidies for BEVs and PHEVs in the UK, Germany, France, the US, Japan and China. In our view, China is the most attractive market for BEVs and PHEVs from an infrastructure perspective. Japan is second and the UK, France and Germany are joint third. Due to lack of visibility over future plans, the US comes last.

We adjust the combined Technical and Sales Ranks by the following amounts to factor in any domestic market advantage enjoyed by the OEMs in our study: Japan = -0.5 points; France and Germany = -0.25 points; US = 0 points. We note that none of the OEMs in our study is based in China or the UK.

(ii) Technology collaborations

We adjust the combined technical and sales ranks by -0.25 points per collaboration that each OEM is involved in. We note the following collaborations

- **Fuel cell collaboration:** Nissan, Ford, Renault and Daimler. The plan is to create common technology for fuel cell stacks and fuel cell systems but sell models under their own brands.
- **Fuel cell collaboration:** General Motors and Honda. Commitment to expanding hydrogen fuel cell technology for use within their vehicles.
- **Nippon Charge Service:** created by Toyota, Nissan and Honda to promote installation of highly convenient infrastructure network for electric powered vehicles (PHEVS, BEVs) – we note that Mitsubishi, which is not included in our study, is also part of the service.

Summary of electric charging infrastructure roll-out plans and subsidies in key markets

	UK	Germany	France	US	China	Japan
Electric charging points (BEVs and PHEVs)						
Current	5,500	2,850	2,100	31,232	8,103	5,009
2015		5,200			402,000	
2020	122,000	150,000	97,000			2,005,000
Monetary investment						
Rollout of planned investment	2015-2020	n/a	2015-2020	n/a	2015-2020	2015-2020
Investment (US$million)	101	n/a	60	n/a	16,000*	149
Consumer subsidies						
Consumer Subsidies	Yes	No	Yes	Yes	Yes	Yes
Maximum subsidy (US$ per vehicle)	5,000		5,000-7,000	5400	4,200-7,200	6,300
Tax Breaks	Yes	Yes	Yes	No	Yes	Yes

Source:Bloomberg, IEA, OLEV, EY, CDP

In focus: AVs in China

China is currently a small but fast-growing AV market with BEV and PHEV combined annual sales of approximately 75,000 cars in 2014. We believe the market could potentially explode in the coming years. We highlight some reasons why:

AVs is a strategic emerging industry

- In 2010, 'new energy' vehicles (China's term for BEV, PHEV and FCV) were identified as one of seven strategic emerging industries in the 12th Five Year Plan (2011-2015)[27].
- The government will invest RMB 100 billion (US$16 billion) within the decade to support the research and development of this industry.

Ambitious sales target of AVs

- In 2012, the State Council set the cumulative sales targets (for BEVs and PHEVs) of 500,000 by 2015 and 5 million by 2020[28].
- Although it now seems unlikely that China will meet the target for 2015, the China Association of Automobile Manufacturers (CAAM) predicts that it will be achieved just a year late.

Generous subsidies and tax breaks for purchases of AVs

- The national government and some municipal governments offer generous subsidies. For example, the national subsidies in 2015 offer a maximum of RMB 54,000 (US$ 8,616) for BEV, RMB 31,500 (US$ 5,026) for PHEV and RMB 180,000 (US$ 28,720) for FCV; Guangzhou and Shenzhen municipal governments offer the same amount of subsides as the national level.
- For the national level and the majority of cities we cover, there is an increase in subsidies for BEV as the electric range increases. These changes incentivize technology advancement for BEV.
- For the proposed national subsidies (2016-2020), there is a gradual decrease for BEV and PHEV, i.e. subsidies in 2017 are 10% less than in 2016, subsidies in 2019 are 10% less than in 2017. This is in line with the central government's plan of the industrialization and commercialization of BEVs and PHEVs in the near future.
- However, there is no decrease in subsidies for FCVs during 2016-2020, showing a clear sign of the government's support in the development of FCVs. We note that FCVs are further from commercialization than BEVs and PHEVs and so we believe require this additional support.
- Since imported AVs are not eligible for these subsidies, foreign OEMs who collaborate with Chinese OEMs and set up domestic manufacturing facilities are better positioned to take advantage.
- Since the subsidies announced so far cover the period through to 2020, OEMs that can launch qualifying AV models within this period have an early-mover advantage to gain market share.
- In 2014, the central government announced that the vehicle purchase tax for AVs will not apply from 1 September 2014 to the end of 2017. This tax break is applicable to domestically-produced and imported BEVs, PHEVs and FCVs that meet certain technical requirements[29].

27 Notice of Accelerating the Fostering and Development of Strategic Emerging Industries, State Council
28 Energy-Saving and New-Energy Automobile Industry Development Plan (2012-2020), State Council
29 Notice of purchase tax exemption of new energy vehicles, State Administration of Taxation

Preferential policies for AVs to receive license plates

- Several big cities in China have set quotas for license plates, with a specific portion earmarked for AVs in order to curb air pollution.
- Under these quotas licenses are allocated by lottery, auction or a mix of both methods, and can be very difficult or costly to secure; the preferential policies for AVs ensure that there is a much higher chance of securing a plate at a much lower cost than for conventional vehicles.
- For example, in 2014 in Beijing, 2.3 million applicants applied for conventional vehicle license plates in the lottery and around 5% of applicants succeeded to secure the 130,000 quotas for conventional vehicles, whereas only around one-third of the 20,000 quotas for AVs was used. In 2014 in Shanghai, the average price of a conventional vehicle license plate at auction was RMB 74,000 (US$ 11,900), compared to free plates for AVs.

Highlights of OEMs' AVs in China

BMW

- BMW and its Chinese partner Brilliance launched their first vehicle Zinoro 1E (a BEV) in 2013. This model is only available through a leasing arrangement as the JV aims to introduce the premium AV concept to the market and build the brand before rolling out the sales plan.
- The JV also launched a Chinese-market only 530Le PHEV in January 2015. It is the first PHEV premium business sedan offered in the market and it is equipped with BMW's leading electrical technology which is used in many other BMW models.
- Besides developing AVs locally through its JV, BMW has also started to import the electric i3 sedan and i8 PHEV since the end of 2014.

Daimler

- Daimler formed a JV in 2010 with BYD, dedicated to electric vehicles, and in 2014 launched its first vehicle, the Denza (a BEV). This complements BYD's less expensive AVs. This model uses Daimler's technology but is made in China. In 2014, the JV made a further investment of RMB 2.5 billion (US$401 million) to manufacture 40,000 Denzas for the Chinese market.

Hyundai

- Hyundai and its Chinese partner BAIC launched their first BEV in China in 2014.

Nissan

- In September 2014, Nissan, together with its Chinese partner Dongfeng, launched the joint-venture's first vehicle, the Venucia E30 (a BEV) in China.
- The Venucia E30 is based on Nissan's best-selling electric model, the Leaf, but developed locally by the JV. The JV expects to reach annual sales of 50,000 by 2018.

Volkswagen

- Volkswagen currently sells the BEV model e-up! under the VW brand and the PHEV Panamera S E-Hybrid under the Porsche brand.
- Volkswagen plans to import three more AV models the e-Golf (a BEV), and the Golf GTE and the Audi A3 e-tron (both PHEVs) in 2015 and develop two AV models locally with its two Chinese partners, FAW and SAIC.
- Volkswagen also recently announced that it plans to sell more than 20 AV models in China by 2018, ranging from PHEVs to BEVs, from small cars to large-sized SUVs, many of which will be produced locally.

Manufacturing emissions

- The top three places for Total Manufacturing Emissions were occupied by the three German OEMs, BMW, Volkswagen and Daimler
- Mazda, PSA Peugeot Citroen and Nissan received an A-grade for progress towards their own manufacturing targets
- Ford, Toyota and Tata Motors scored low on Total Manufacturing Emissions due to incomplete responses to CDP's Climate Change Questionnaire. This may have cost Toyota the top spot in the Super League Table

Overview

Manufacturing emissions account for 20% of total emissions, on average, for the auto OEMs in this study. This is split between supplier emissions which account for roughly 17% of the total and auto OEMs' own manufacturing emissions (mostly assembly) which account for roughly 3%.

In this chapter, we assess each OEM based on four metrics, which we believe best reflect the key areas relating to manufacturing emissions. Three of the metrics relate to total manufacturing emissions (including suppliers) and one relates purely to the OEM's own manufacturing emissions (Scope 1 and 2 emissions).

Supplier engagement:

- We assess each OEM based on the percentage of suppliers it is actively engaged with on emissions reductions (through the CDP Supply Chain Program).

Manufacturing emissions intensity in 2013:

- Normalized by: (i) volume; (ii) revenue. This metric identifies those OEMs that have lowest sales-adjusted emissions. We use intensity rather than absolute emissions as we believe it is unfair to penalize an OEM that is growing faster than another.

Reduction in manufacturing emissions intensity over 2011-13:

- Normalized by: (i) volume; (ii) revenue. This metric identifies the OEMs that have reduced their manufacturing emissions intensity by the most over the last few years.

Progress towards OEMs' own manufacturing emissions targets:

- This assesses whether each OEM is on track to meet its own emissions reduction target(s). We consider both absolute and intensity targets.
- The above four metrics are all ways of assessing manufacturing efficiency. We believe that efficient manufacturing can enhance financial performance by improving margins.

Highlights

- The three German OEMs, BMW, Volkswagen and Daimler all rank in the top three for Total Manufacturing Emissions (including suppliers) (metrics 1 to 3 above), achieving A-grades.
- The two US OEMs, General Motors and Ford, and the Indian OEM Tata Motors rank in the bottom three for Total Manufacturing Emissions (including suppliers), achieving E-grades. For Ford and Tata Motors, this was partly due to their submission of incomplete responses to CDP's Climate Change questionnaire.
- Toyota scores poorly on Manufacturing Emissions due to its incomplete response to CDP's Climate Change questionnaire on supplier emissions. This cost Toyota top spot in the SLT.
- Mazda, Nissan and Peugeot all receive A-grades for the progress towards their own manufacturing emissions targets.
- Honda, Hyundai, Renault, Tata Motors, Toyota and Volkswagen each receive an E-grade for this metric as none has set a meaningful target.

Summary of metrics used to determine the Total Manufacturing Emissions Grade

	Supply Chain Rank	Emissions intensity in 2013	Reduction in intensity 2011-13	Combined rank	Total Manufacturing Emissions Grade
BMW	1	8	2	3.7	A
Volkswagen	1	8	3	3.8	A
Daimler	1	5.5	7	4.5	A
PSA Peugeot Citroen	5	1.5	9	5.2	B
FCA	11	3	2	5.2	B
Nissan	8	4.5	9	7.0	B
Mazda	12	6	5	7.5	C
Hyundai	13	1.5	8	7.5	C
Renault	7	7	9	7.7	D
Honda	6	10.5	7	7.8	D
Toyota	1	12	12	8.3	D
General Motors	10	10.5	7	9.2	E
Ford	9	12	12	11.0	E
Tata Motors	14	12	12	12.7	E

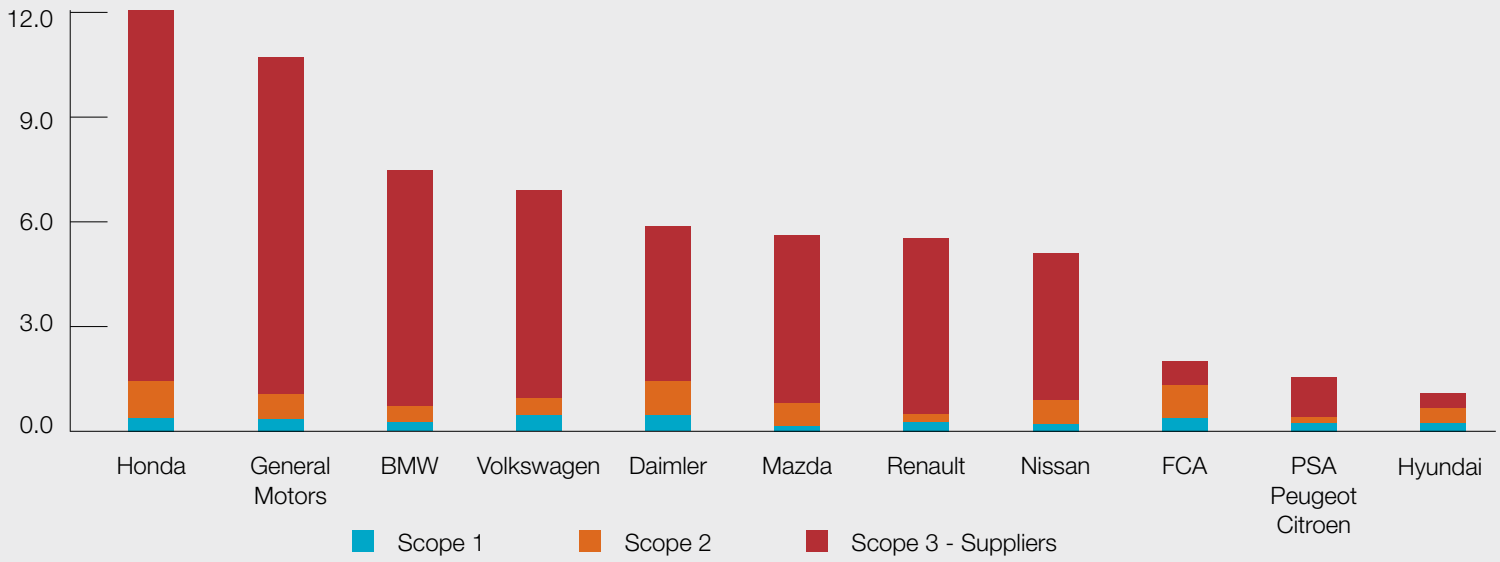
Source: CDP

Total Manufacturing Emissions

The Total Manufacturing Emissions Grade is based on the average rank over metrics 1) to 3). Toyota, Ford and Tata Motors came joint last for metrics 2) and 3) as they did not provide information in their CDP Climate Change questionnaire response on supplier emissions and we were therefore unable to calculate these metrics.

- BMW, Daimler, Volkswagen and Toyota come joint top on metric 1): supplier engagement. They each engage with all of their suppliers on manufacturing emissions.
- PSA Peugeot Citroen and Hyundai share the top rank for metric 2): manufacturing emission intensity. PSA Peugeot Citroen benefits from the fact that a majority of its manufacturing base is France where the electricity generation mix is 80% nuclear (which has zero emissions).
- FCA is top ranked for metric 3): manufacturing emissions intensity reduction over 2011-2013. It made by far the greatest reduction in manufacturing emissions intensity over 2011-13, achieving reductions of 18% by revenue and 4% by volume. Other than those OEMs with an incomplete CDP response, Nissan ranks lowest on this metric with an increase in manufacturing emissions intensity over 2011-13 of 15% by revenue but a slight decrease of 0.8% by volume.

Manufacturing emissions intensity by category in 2013 (normalized by volume) (mT CO_2/unit)



Manufacturing emissions intensity in 2013 (normalized by: (i) volume; (ii) revenue)

	By volume	Rank	By revenue	Rank	Combined Rank
PSA Peugeot Citroen	1.6	2	45	1	2
Hyundai	1.1	1	49	2	2
Nissan	5.1	4	187	5	5
FCA	2.0	3	55	3	3
Renault	5.5	5	265	9	7
Mazda	5.6	6	193	6	6
Daimler	5.9	7	88	4	6
BMW	7.5	9	249	7	8
Volkswagen	6.9	8	250	8	8
Honda	12.1	11	374	10	11
General Motors	10.7	10	545	11	11
Toyota		12		12	12
Ford		12		12	12
Tata Motors		12		12	12

Source: CDP

Rankings for supplier engagement metric

	No. of suppliers OEM engages with	% spend represented by these suppliers	Rank	Grade
BMW	12,000	100	1	A
Daimler	15,000	100	1	A
Toyota	3,905	100	1	A
Volkswagen	21,917	100	1	A
Honda	1,556	79	6	B
Nissan	1,084	74	8	B
PSA Peugeot Citroen	894	92.3	5	B
Renault	1,544	74.5	7	B
Ford	145	50	9	C
General Motors	169	40	10	C
FCA	126	23	11	D
Mazda	23	16.81	12	D
Hyundai	38	1	13	E
Tata Motors	409		14	E

Source: CDP

Reduction in manufacturing emissions intensity over 2011-13 (normalized by: (i) volume; (ii) revenue)

	By volume	Rank	By revenue	Rank	Combined Rank
FCA	-4.0%	2	-18.1%	1	2
BMW	-6.3%	1	1.0%	3	2
Volkswagen	-2.1%	3	-0.6%	2	3
Mazda	-0.9%	5	1.8%	4	5
Daimler	0.0%	7	3.4%	7	7
Honda	-1.5%	4	5.8%	10	7
General Motors	0.1%	8	2.7%	6	7
Hyundai	3.2%	11	2.4%	5	8
Nissan	-0.8%	6	15.3%	11	9
PSA Peugeot Citroen	2.0%	10	3.8%	8	9
Renault	1.2%	9	4.1%	9	9
Toyota		12		12	12
Ford		12		12	12
Tata Motors		12		12	12

Source: CDP

Progress towards OEMs' own manufacturing emissions targets

Scope 1 and 2 emissions are under OEMs' direct control. Those that are better at reducing their emissions will tend to benefit from increased profitability due to efficiency improvements and hence increasing margins. Therefore the final metric used to assess the manufacturing emissions performance of OEMs is based on progress against any scope 1 and 2 absolute/intensity emissions reduction targets which the companies have set.

The overall grade is summarized in the table below. In order to achieve a high overall grade for this section, a company needs to have set emissions reduction targets and made progress against them. The overall grade takes account of both absolute and intensity targets. Where an OEM's grade differed between its absolute and intensity targets, the higher grade was used.

Mazda, Nissan, and PSA Peugeot Citroen rank first overall and receive A-grades. Seven OEMs, all of whom (except BMW) failed to set targets, receive an E-grade.

To calculate the Absolute and Intensity target grades we took an OEM's target, from which the implied annual emissions reduction rate was determined, and compared it with any reduction that had occurred from the base year. This allowed us to determine, based on the OEMs' current trajectory, whether or not it would achieve its target.

Progress towards OEMs' own manufacturing emissions targets summary

	Set Scope 1+2 emissions reduction target	Absolute target grade	Intensity target grade	Overall target grade
Mazda	Y	A		A
Nissan	Y		A	A
PSA Peugeot Citroen	Y	A	B	A
FCA	Y	C	B	B
Daimler	Y	C	D	C
Ford	Y		C	C
General Motors	Y		D	D
BMW	Y	D		E
Honda		E	E	E
Hyundai		E	E	E
Renault		E	E	E
Tata Motors		E	E	E
Toyota		E	E	E
Volkswagen		E	E	E

Source: CDP

Summary of assessment of intensity targets

	Intensity	Target period (years)	Implied % emissions reduction pa over entire target period	% reduction pa achieved since base year for target	Years remaining for target	Implied emission % reduction pa for remainder of target period	Intensity target grade
PSA Peugeot Citroen	Y	23	-2.7%	-2.2%	5	-4.1%	B
Toyota							E
Renault							E
Nissan	Y	11	-2.8%	-5.1%	3	3.5%	A
Mazda							E
Hyundai							E
Daimler	Y	8	-2.8%	6.9%	2	-26.8%	D
Ford	Y	20	-1.8%	1.7%	17	-2.4%	C
BMW							E
FCA	Y	10	-4.0%	-2.0%	7	-5.1%	B
Honda							E
Volkswagen							E
General Motors	Y	10	-2.2%	4.6%	7	-5.0%	D
Tata Motors							E

Source: CDP

Summary of assessment of absolute targets

	Absolute	Target period (years)	Implied % emissions reduction pa over entire target period	% reduction pa achieved since base year for target	Years remaining for target	Implied emission % reduction pa for remainder of target period	Absolute target grade
PSA Peugeot Citroen	Y	23	-0.8%	-0.9%	5	-0.2%	A
Toyota							E
Renault							E
Nissan							E
Mazda	Y	30	-1.1%	-1.7%	7	1.0%	A
Hyundai							E
Daimler	Y	26	-0.9%	0.4%	7	-4.1%	C
Ford							E
BMW	Y	30	-1.2%	2.4%	7	-12.1%	D
FCA	Y	5	-8.3%	-1.2%	1	-32%	C
Honda							E
Volkswagen							E
General Motors							E
Tata Motors							E

Source: CDP

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www.productionstudios.co.uk

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