

The Impact of the Paris Accords on Car Manufacturers

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Readers Note: This memo focuses only on car manufacturers, but the broader project also considers the impact of the Paris Agreement on mining companies as well.

Did firms in “convertible” industries shift resources to decarbonization in the wake of the Paris Accords? The Paris Agreement sought to mobilize global action on the climate crisis by encouraging voluntary national commitments. Most emissions, however, come from actors in the private sector rather than from governments or state-owned actors. Political scientists are predisposed to focus on states, but much of the action involves industry and firms. It is essential that we know how global governance on climate change generally, and the Paris Agreement specifically, affects private firms.

To preview our results, we find little hard evidence that Paris shifted business strategies in the car sector. Instead, the continuing dominance of regional variation is striking, with Japanese car companies diverging significantly from Atlantic-area companies, though there are leaders and laggards in each region with regard to decarbonization.

Of the twelve companies we considered, nine of the companies mostly continued on their pre-Paris trajectories, with little indication of change. Some were already increasing their ambition; others were latecomers or remained laggards. In the other three companies, there is evidence of a change in their trajectory in the years following 2015. Plausibly these were linked to the Paris Agreement, but other factors such as national regulations designed in advance of 2015 may have been more important.

Motivation and Research Design

Achieving global decarbonization requires private firms to make deep changes to their business models. Some highly carbon-dependent industries face ‘existential’ risks from

decarbonization (Colgan et al. 2021) and have strongly resisted change. But others can, with some investment, transform their operations and products to survive in a decarbonized world. Just because an industry is theoretically ‘convertible,’ however, does not mean that individual firms actually will convert, or that they will do so at a pace consistent with minimizing major climate impacts.

In this research project, we look at two sectors—automotive manufacturing and mining—which both have clear options for conversion. Most cars currently rely on fossil fuels to run, but emerging alternatives to internal combustion engines—particularly battery electric vehicles (EV) and plug-in hybrid electric vehicles (PHV)—mean automakers can decouple their business models from oil. Similarly, many mining firms currently rely on fossil fuel extraction but could focus on minerals—copper, lithium, and others—that are key inputs for electrification. In this memo, we focus solely on cars.

We examine the twelve largest firms in the automotive manufacturing sector (measured by total sales in 2020), and compare their behavior before and after the Paris Accords. We focus especially on the period 2014-2021, to compare behavior prior to the Paris Agreement with the changes since. Firms can try to cut emissions in many ways: changing their operations (Scope 1), changing their inputs (Scope 2), or reducing emissions associated with consumption of their products (Scope 3). These are all important, but we focus on vehicle electrification because Scope 3 are the sector’s largest emissions source.

To do so, we draw on four key sources. First, we look at annual reports to shareholders and the sustainability reports that have become increasingly common over the last decade. These contain, in varying levels of detail, descriptions of the steps these companies have taken, the goals they are setting, and how many resources they are devoting to meeting these goals. Second, we reviewed corporate reports to the Carbon Disclosure Project from 2010, 2014, 2018, and 2022 to trace how firms’ electrification plans changed over this period. These reports contain a wide range of updates on company actions with respect to climate

change. Third, we use relevant news coverage to provide additional background and context for statements made in the other sources. Fourth, we use automotive sales data from Marklines to look at actual changes in firm activity. This fourth item also has a key advantage: intent can be hard to measure but investment in producing BEVs or PHEVs is clear.

What evidence would we expect to see if the Paris Agreement did have a material impact on firms' behavior? We assess three primary factors, none of which is dispositive on its own. First and foremost, we should see a change of production behavior the years following 2015, the year the Paris Agreement was signed. Complicating this assessment, however, is the possibility of a lag between corporate decisions made because of the Paris Agreement and the actual change in corporate behavior. Second, we consider the extent of corporate statements referencing the Paris Agreement to explain the change in their behavior, or government policies that occurred because of the Paris Agreement. Companies tend to talk a lot about the Paris Agreement, but unfortunately that alone does not indicate that it is changing their behavior. Third, we consider what other factors might have caused a change in corporate behavior, as potential confounding factors. For instance, VW had a major corporate scandal ("Dieselgate") that peaked in 2017-18, after which they immediately announced a major new EV strategy.

Another complicating factor is that some jurisdictions have implemented restrictions on vehicle emissions. In particular, the European Union's Euro 6 emissions standards, promulgated in 2014 with a target date of 2020, were stricter than comparable regulations elsewhere. Automakers selling in Europe have a strong financial incentive to meet these regulations, since emissions that exceed them can garner non-trivial fines in the billions of dollars (PA Consulting). Many automakers in 2014 announce plans to bring their fleets into compliance with Euro 6, but frame them as driven by environmental standards rather than regulatory mandates.

Results

For the automotive sector, we observe a general trend towards more production of electric and hybrid vehicles. This is consistent with a story in which the Paris Agreement catalyzes ambition, but as discussed above it is not the only factor at play. Figure 1 highlights the change in behavior in the sale of electric vehicles (EV) and plug-in hybrid vehicles (PHV) in the years before and after the 2015 Paris Agreement. Traditional hybrids, which have an electric motor to recover power from braking but ultimately rely on gasoline to generate power, are not included in Figure 1 (but see Figure A-1 in the appendix).

Three firms showed a clear shift in production trends that is plausibly linked to Paris: General Motors, Volkswagen, and Hyundai. All had low sales of electric vehicles prior to 2015 (less than 1%, though GM was still a leader in the US market with the Chevy Volt plug-in hybrid). Then after 2015 their sales volumes sharply increased (to more than 5%). As discussed above, for some firms this may have been a matter of regulatory compliance rather than commitment to the Paris goals. For instance, VW may have been more motivated by the Euro 6 emissions regulations that come into effect in 2020 than Paris per se. GM, on the other hand, does not sell significant volumes to Europe, so its investment into electric vehicles is unlikely to have been motivated by the regulatory tightening there. The case for VW is also complicated by a major corporate scandal (“Dieselgate”) that peaked in 2017-18, after which they immediately announced a major new EV strategy, possibly motivated more by changing the public narrative about VW than the Paris Agreement. Still, we include VW as plausibly connected to Paris, at least compared to the other nine firms we consider.

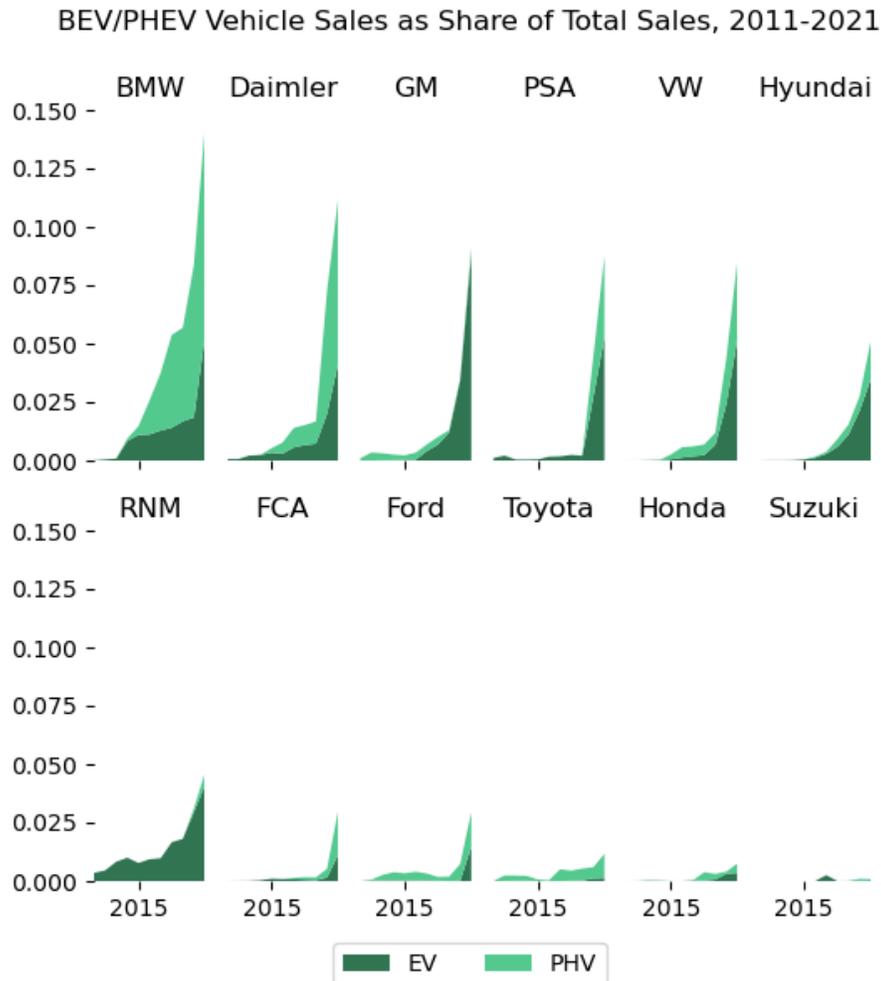


Figure 1: Electric Vehicle Production at Twelve Global Car Companies, 2010-2021.

Note: PSA and FCA merged to form Stellantis in 2021.

For the other nine-firms, there is largely a continuation of pre-Paris trends. Four of them ramp up production of battery electric and plug-in hybrids relatively rapidly in the years after 2015: BMW, Daimler, Peugeot (PSA), and Renault-Nissan (RNM). Two of these firms (Daimler and BMW) are primarily premium producers that were already shifting towards the electric vehicle market prior to the Paris Agreement. Renault-Nissan is the only mass-market firm to have had a meaningful (> 1%) sales share of electric vehicles prior to Paris. Given the fact that their electric vehicle production trends predated Paris, it seems unlikely that the COP21 agreement drove their strategy (though it may have accelerated it). In

Peugeot's case, the firm explicitly denied that their change in behavior was due to the Paris Agreement (see below). While we should consider whether their statement is accurate, there seems little reason to believe that Peugeot was lying in this case.

Two of the nine firms showed relatively weak increases in electric vehicle production: Fiat Chrysler (FCA) and Ford. FCA in particular was only able to meet its 2020 European emissions requirements by paying Tesla to "pool" their emissions for regulatory purposes. Though a latecomer, Ford has now committed to relatively ambitious electrification. While it is possible that these two firms were influenced by Paris, their late entry into the electric market suggests that this choice was probably driven by other factors after 2015.

Finally, three firms have shown very little commitment to full electrification, preferring to continue with existing investments into traditional hybrids: Toyota, Honda, and Suzuki. All three firms had large hybrid businesses prior to Paris, and appear to have been reluctant to change this strategy. It seems unlikely that Paris provoked a major shift at these firms.

Rather than the Paris Agreement itself, other factors seem to have weighed heavily: domestic regulatory regimes, firm-level specialization, and sector-level technological change. Perhaps most striking is the divergence between the Japanese firms – which have focused on hybrid vehicles since well before the Paris Agreement, and continue to do so afterwards, with relatively little investment in electric vehicles – and, on the other hand, the US and European car companies in the Atlantic region, where more investment in electric vehicles exists. Even within these two broad regions, however, there is significant variation. Toyota and Honda have much more investment in hybrid vehicles than Suzuki, for instance; and European companies like BMW and Daimler, have tacked more quickly and strongly towards electric vehicles than have Fiat-Chrysler or Peugeot.

Corporate reports to the Carbon Disclosure Project highlight industry variation. Looking in 2018, most firms make some reference to the Paris Accords. Many of these references are fairly general: saying that their modelling followed procedures set out at Paris, or that their

company recognizes the importance of the climate issue as highlighted by Paris. But in some cases, the references are more specific. For instance, Hyundai and Nissan both mention that they anticipate stricter domestic regulation in the wake of Paris. Hyundai specifically cites the European Union's low carbon strategy for transport and the Korean government's plan to reduce emissions 37% by 2030. Volkswagen claims to be the first automaker to commit to the Paris Agreement.

Yet, not all corporate references to Paris indicate strengthening ambition. In their 2018 submission to the Carbon Disclosure Project, Toyota states "that it is unnecessary to change our current strategy for the ratio of electric vehicles" and adopt what amounts to a "wait and see" approach, saying that their hybrid production lines can be shifted to zero-emissions vehicles if necessary (Toyota CDP filing 2018):

[...] it is possible to change the power-train lineup flexibly and strategically according to changes in demand. Analysis results revealed that we are capable of responding to changes in social demand through our technological advancements in electric motorization.

One firm, Peugeot, goes so far as to explicitly say that Paris did not change their emissions reductions strategies:

[The Paris Agreement] on climate change led PSA to have its CO2 pathway validated by a tier; it did not change the CO2 strategy since PSA has been considering climate change as a key issue for many years.

Unfortunately, despite their claim to consider climate a "key issue for many years", PSA consistently had one of the lowest shares of electrified vehicle sales among the largest manufacturers until 2020.

While this analysis can only be indicative, not dispositive, the overall record of change in the car manufacturing does not suggest that the Paris Agreement had a major effect on the global electric vehicle market.

Appendix: Company Profiles

BEV/PHEV/HV Vehicle Sales as Share of Total Sales, 2011-2021

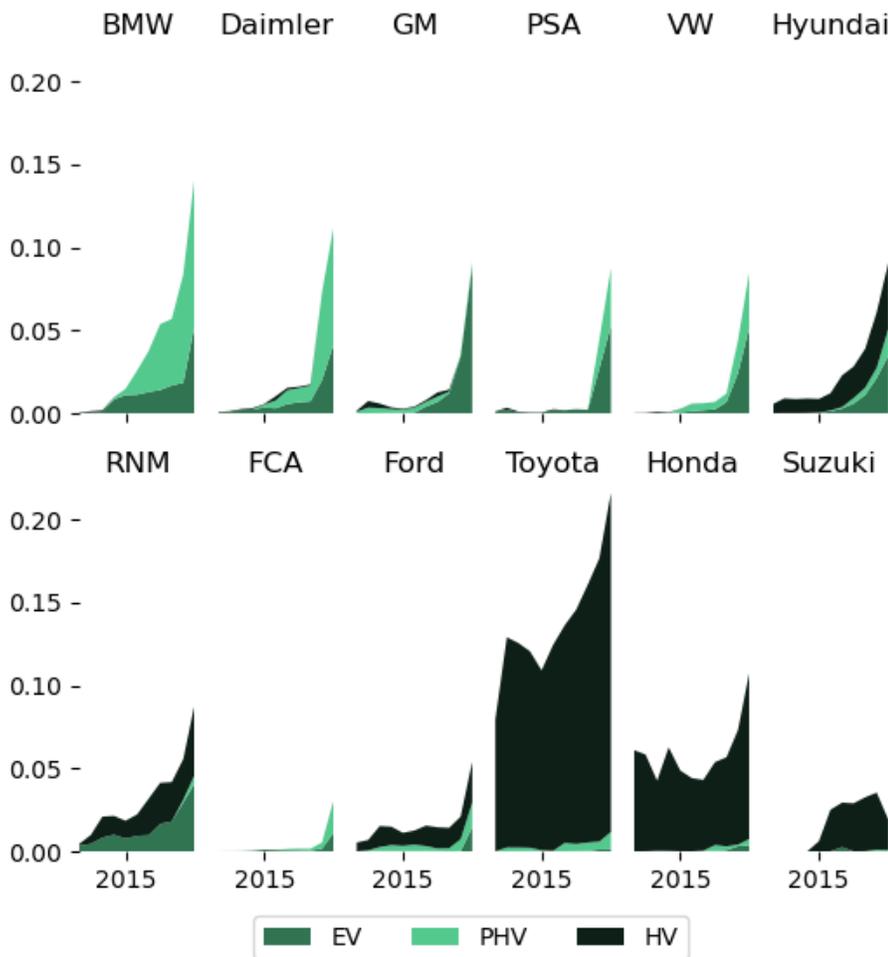


Figure A-1: Low Carbon Vehicle Production at Twelve Global Car Companies, 2010-2021. Firms are ordered by their production of EV and PHV vehicles. PSA and FCA merged to form Stellantis in 2021.

Toyota

Toyota has been a longstanding leader in the production of hybrid vehicles. After declining from 12.7% of sales in 2012 to 10.8% in 2015, the share of hybrids in their sales

has risen steadily to around 20% in 2021. Toyota's fleet emissions in Europe are one of the few to decline between 2016 and 2018. The fact that the pivot point in their hybrid sales comes in the year the Paris Agreement was signed is at least consistent with the idea that this represents an important juncture for Toyota.

But while Toyota can undoubtedly be proud of their hybrid record, they also have a record before and after Paris of being bearish on electrification. Prior to Paris, their sustainability plans clearly indicated that they saw the future of electric vehicles as being confined to smaller, short-distance applications. Fuel cell vehicles are instead strongly emphasized as "ideal eco cars," appropriate for longer-distance travel.

In the immediate aftermath of Paris, Toyota actually reduced a major investment in electric vehicles:

A decade ago when Toyota took a stake in Tesla and the two collaborated to produce a battery-electric version of the RAV4, many Toyota engineers believed Tesla's technology was no threat, two of the sources said. "They concluded back then there wasn't much to learn," one of the sources said. Toyota discontinued the electric RAV4 in 2014 and sold its stake in Tesla in 2017.

This decision could have been driven as much by problems with Tesla as by electric doubts at Toyota. But in 2019 Toyota backed an effort by the Trump administration to stop California from setting its own efficiency standards for vehicles (Reuters). In 2021 it committed to spending \$30 billion on battery electric car development, but emphasized that it remained committed to hybrids for many markets. Toyota decided not to join a pledge by other major carmakers to end fossil fuel vehicle production by 2040. Even in 2022 its plans continued to assume "that demand for electric cars won't grow much for decades".

Toyota's dominance in the hybrid space means it can hardly be called a laggard in reducing transportation emissions. But while it deserves credit for its pioneering investments in hybrids, it took Toyota many years to recognize the need for fully electric

vehicles. In 2021, Toyota sold less than 12,000 battery electric cars (sales of the former “ideal eco cars” or fuel cell vehicles were less than 6,000). Paris may have encouraged Toyota to invest more in hybrids, but it seems unlikely that it directly pushed Toyota to speed up full electrification.

PSA

Peugeot (also known as the PSA Group, formerly PSA Peugeot Citroën until 2016) has one of the weakest electrification records of any major automaker. Through 2019 its production of electrified vehicles of any kind remained tiny relative to both other manufacturers (less than 10,000 units annually in most years) and as a share of its own sales (less than 1% of its sales).

Prior to Paris, PSA’s communications emphasized heterogeneity across markets and the importance of encouraging different driver behaviors rather than changing product offerings:

Worldwide, the group aims at proposing product solutions adapted to local context, taking into account the local energetic situation to develop the most efficient and affordable technologies for alternative energies.

Driver behaviour, car aging, or maintenance can make a difference in consumption compared to the theoretical value. The Group is currently working on a more responsible communication towards customers to give them all the relevant environmental information to guide their buying choice and to make them aware of the impact of their behaviour when driving.

While these statements are fairly anodyne, they also implicitly shift attention away from more transformative changes. If the ‘local energetic situation’ takes priority, then there is less room for a global shift towards electric vehicles. If driver behavior is what really matters, then manufacturer behavior is less key.

In the immediate aftermath of the Paris Accords, PSA's submission to the Carbon Disclosure Project explicitly disclaimed the need to raise its ambition:

PA on climate change led PSA to have its CO2 pathway validated by a tier; it did not change the CO2 strategy since PSA has been considering climate change as a key issue for many years.

Its 2018 strategy did include reasonable targets: a 55% reduction of average emissions in new vehicles sold world wide by 2035 (baseline 2012), the creation of a plug-in hybrid powertrain, and an electric version of all models available for sale by 2025. But these targets follow on minimal production of electric vehicles before and in the immediate aftermath of Paris. Only in 2020 did PSA start increasing production of electric vehicles.

Despite a weak electrification record, PSA has still been able to meet (or nearly meet) regulatory requirements for fleet emissions because of its sales of diesel models. In 2018 their CEO anticipated needing 7 percent of sales in Europe to be low-emissions vehicles in order to avoid fines. In the end their sales of low-emissions vehicles were only 6%, but strong demand for diesel vehicles saved them. This suggests that although PSA met their regulatory requirements, they did so through compliance rather than ambition. It seems very unlikely that Paris drove transformation at PSA.

FCA

Fiat Chrysler Automobiles (or FCA) has a record similar to PSA's. Indeed, their styles and strategies were sufficiently similar that in 2021 they merged to form Stellantis.

Prior to the Paris Agreement, their sustainability strategy was strongly focused on natural gas rather than electric or hybrid models. In 2014 they emphasized that they were the "undisputed leader in this market sector in Europe" and "the only automaker to offer a factory-built natural gas pickup". The same report mentioned research into electric and hybrid models, but emphasized their nascent state and claimed that "[e]lectric vehicles do not yet offer the same level of advantages for the environment and consumers as natural gas

vehicles” and called for more public and private “pilot projects aimed at overcoming these barriers and testing the market potential”. Note that by 2014, more than 150 thousand battery electric vehicles, more than 100 thousand plug-in hybrids, and more than 1.6 million hybrids were already being sold by other firms.

This approach is reflected in almost zero growth in electric vehicles sold by PSA through 2021. By 2019 they had introduced some electric models, but still emphasized the that they “maintain a wide offering of CNG models in Europe.”

Their 2019 goals targeted a 40% cut in mass-market car emissions by 2020 relative to 2006 in Europe. Insofar as this only applies to the European market’s higher regulatory stringency, and does not envision exceeding it in Europe or applying it elsewhere, this appears to be a compliance-focused target. A year before the deadline this goal was marked as “achieved or in line with glide path”, despite the fact that emissions had only been reduced by 17%.

In the end, FCA did manage to meet its goal—but not because of any substantial changes to its fleets. Instead, it took advantage of a provision in the EU regulations that allows firms to pool their fleet emissions with other firms. FCA paid Tesla 2 billion dollar to share emissions. Given that all Tesla’s vehicles are battery electric and therefore produce zero emissions, this pooling was enough to bring FCA into technical compliance. But the idea that FCA was moved by Paris to overhaul its business seems very unlikely.

Renault-Nissan

The alliance between Renault and Nissan has shown steady growth in low emissions vehicles, mostly split between hybrids and battery electric vehicles. In 2014 they sold 72 thousand BEVs, and 82 thousand HVs. These figures have been on an upward trend: by 2021 sales had increased to 250 thousand EVs and 260 thousand HVs. This is an increase of more than 3 percentage points for each type of vehicle. When the Paris Accords passed, CEO Carlos

Ghosn emphasized that its goals would not be achieved without business participation, and that electric vehicles were critical to the transition.

The growth in electric and hybrid sales by the Nissan-Renault alliance since 2015 is consistent with a story in which Paris spurs on additional action. But it is also consistent with the firm's pre-Paris trajectory. Prior to the Paris Accords, both Renault and Nissan had Scope 3 emissions reductions targets in place. In 2015 the alliance was already responsible for half the electric cars sold to date (TechCrunch). Since then, a third-party analysis of firms' progress towards meeting European emissions standards noted that Renault-Nissan remains the "global leader in affordable mass market EVs" (PA Consulting):

The Alliance has made huge investments in electrification, research and development, and its production system in recent years. This has let it increase production volumes in its current plants and prepare new facilities to produce EVs.

In the end, Nissan-Renault appears to be more ambitious about electrification than Toyota, the other early market leader for low emissions vehicles. But it is not clear that the Paris Accords themselves were responsible for a change in strategy, since the investment foundation (especially in battery technology) was already laid before its passage.

VW

Volkswagen's low emissions strategy from before Paris through 2018 was mostly focused on plug-in hybrids, but more recently they have made a strong push into electric vehicles. In 2014 sales of any low emissions vehicle made up substantially less than 1% of sales. By 2021 battery electric vehicles made up more than 5% of sales, and plug-in hybrids more than 3%.

Prior to the Paris Accords, Volkswagen had set a target of reducing absolute emissions from the use of their products by 45% in 2020, compared with 2006 levels. But these plans appear to have been motivated primarily by the need to comply with tightening emissions regulations, especially in Europe. Rather than emphasizing electrification, their plans

focused on the efficiency of their diesel vehicles, calling the diesel XL1 “the world’s most economical and eco-friendly car”. Concerns about falling demand for diesel were driven by its cost-competitiveness with gasoline cars, not electric cars or environmental regulations.

In 2018, however, Volkswagen dramatically changed course. Having been a reluctant investor in electrification before, they now promised to spend a third of their investment budget—\$50 billion—over the five years to 2023 on new technologies, much of which would be spent on an ‘electric offensive.’ CEO Herbert Diess said that he wanted VW to be “the global number one in e-mobility”. It took several years for these investments to bear fruit, but while their 2019 BEV sales were only 0.65 percentage points above 2014 levels, the 2021 BEV sales were 5.22 percentage points higher.

This turnaround is perhaps one of the clearest examples of a firm making a substantial change in strategy in the few years after the Paris Accords. Volkswagen claims it was “the first automaker to commit to the Paris climate agreement back in 2018”. The pivot towards electric vehicles is substantial and is not simply a continuation of the pre-Paris strategy.

However, the timing of VW’s shift in strategy is extremely suspect, because it came at the height of VW’s “Dieselgate” scandal. In 2017, VW pleaded guilty to a nitrogen oxide emissions scandal related to its diesel-powered cars and agreed to pay \$4.3 billion in penalties. In 2018, its ex-CEO Martin Winterkorn was indicted for fraud, and Audi CEO Rupert Stadler was arrested in Germany. It is plausible to interpret VW’s shift to EV’s as primarily a way to shift the narrative about the company in the wake of some very bad press. While the Paris Agreement may have created an opportunity for VW, it is difficult to attribute much causal impact to Paris in the absence of a counterfactual world in which VW did not face a scandal.

BMW

BMW was an early leader in sales of battery electric vehicles, following the launch of the BMW i3 in 2014. When the Paris Agreement was signed in 2015, BMW had the highest proportion of BEV sales in its lineup of any major car manufacturer. In that year its plug-in

hybrid sales also began to increase, eventually growing larger than its BEV sales. By 2021, its combined sales of battery electric and plug-in hybrid vehicles were larger as a share of sales than any other major manufacturer. It has not pursued traditional hybrids.

In the wake of Paris 'MW's vehicle emissions targets did not appear to intensify, though it did expand the number of electric models it intended to produce. BMW met its 2020 European emissions targets, though it had to take advantage of a loophole in the program which allowed firms to not count the 5% of their fleet with the highest emissions (Daimler, Renault-Nissan-Mitsubishi, and the FCA-Tesla-Honda pool also had to use this provision) (Data Force 2021). This meant BMW avoided fines for its fleet emissions. But it was subject to a separate fine from the European Commission of 373 million euros for colluding with Volkswagen and Daimler to limit the use of emissions reduction technology in diesel-powered cars between 2006 and 2014 ([Reuters](#)).

BMW has undoubtedly been a leader in vehicle electrification, and its sales of electric vehicles were already increasing prior to 2020. This suggests its transition to electrification was motivated by more than compliance. But the fact that it only narrowly met its 2020 targets and avoided using technology that would have helped reduce emissions further suggests that it does not see emissions reductions as a goal to be pursued aggressively beyond regulatory requirements. And the fact that its electrification rollout began before Paris and seemed to continue on a similar trajectory after 2015 suggests that its plans were probably not motivated primarily by Paris.

Daimler

Like BMW, Daimler is a German company with a prominent premium brand (Mercedes-Benz). And its electrification curve has followed a similar shape to that of BMW, though at a slower pace of investment and sales. Prior to the Paris Agreement their filings with the CDP included no concrete goals for reducing Scope 3 emissions. In 2015, when the Paris

Agreement was signed, their sales of battery electric and plug-in hybrid vehicles were only half that of 'MW's.

In the first years after the Paris Agreement Daim'er's commitment to electrification increased gradually. By 2018, the firm had adopted a Scope 3 goal to reduce emissions 37% between 2010 and 2021, but this was simply in line with their regulatory requirements. By 2019, they set a goal of reaching zero vehicle emissions by 2039: a somewhat distant target. These increases are consistent with a firm that is trying to comply with regulations, but perhaps not looking to exceed them dramatically.

But by 2021 their BEV and PHEV sales had increased substantially, and electrification had become one of t"e "four cornersto"es" of the f"rm's strategy (PA). Now the goal is to "e "dominantly, if not all electric, by the end of the dec"de". This is five years ahead of the'EU's new goal of ending ICE sales by 2035. This goal is backed by a 40 billion euro investment plan through 2030. That said, the firm has clearly hedged on when they will stop producing ICE vehicles entirel":

"We need to move the debate away from when you build the last combustion engine because it's not relevant," Kallenius said. "The question is how quickly can you scale up to being close to 100% electric and that's what we're focusing on." ([Nikkei](#))

GM

General Motors was one of the first firms to offer an electric car, the EV1. But it controversially ended the program in 2003, giving it a reputation as an enemy of electric transport. But in the years since GM has shown promising signs of re-committing to electrification.

General Motors is one of the few major firms that bypasses the European market entirely. This means that its actions are plausibly independent of regulation there. Over 80% of its sales in 2020 were split between the U.S. and China. Yet despite being focused on markets

with lower regulatory stringency, GM has seen increasing sales of electric vehicles since 2015. At least in terms of timing, it is one of the best candidates for an effect of the Paris Agreement.

Prior to 2015, GM had limited battery electric offerings, focused on plug-in and traditional hybrids. The Chevy Volt was at one point the best-selling electric vehicle in the United States. Yet GM's sales of both PHEVs and HVs peaked in 2012, and actually declined through 2015. Then in the first few years after Paris, GM began shifting resources away from its hybrid models towards battery electric cars. It became clear that GM saw hybrids as a transitional vehicle type and not a long-term prospect:

“The need to carry around a backup generator under the hood is just going away,” Balch [a Chevrolet spokesman] said. “We’re seeing that as...our customers are leaving the Volt to get into the Bolt EV.” ([Greentech Media](#))

In 2018 GM ended production of the Volt in favor of the Bolt BEV. In 2019 it announced plans to have electric models in all its product lines, though without a commitment to full electrification. But despite these tentative goals, and even without European regulatory pressure, GM has increased sales of its BEVs substantially between 2019 and 2021. It now sells more BEVs as a percentage of total sales than any other major automaker.

Ford

Like GM, Ford sells a majority of its output to the American market. But whereas China is GM's second market, Ford also has substantial sales in Europe (more than 20%). This means that Ford is at least somewhat exposed to European regulations.

Prior to 2015, Ford's electric vehicle strategy focused on traditional hybrid vehicles, with a smaller share of plug-in hybrids and no battery electric vehicles. In its 2014 CDP filings it lacked any concrete vehicle emissions targets, mentioning only a general commitment to reduce emissions (and noting that emissions had actually increased in the past year due to

strong truck sales). By 2019 its Scope 1 and 2 emissions reduction targets had strengthened, but it continued to lack concrete vehicle targets. That said, it had also begun investing in electrification, aiming to spend 11 billion dollars by 2024. This spending has continued to rise: in 2021 Ford announced it would invest 22 billion dollars in electrification by 2025, only to up the target further to 30 billion later in the year. And in 2022 it increased planned investments to 50 billion dollars by 2026. In 2020, Ford also signed an agreement with Volkswagen to make use of their modular electric drive platform.

In 2021 the fruits of these efforts had just begun to be visible, with Ford making meaningful sales of battery electric vehicles for the first time. Ford appears to be a latecomer to electrification, but its spending plans suggest a real change in priorities. These come substantially later than the Paris Agreement, calling into question whether they could have been motivated directly by it, but it at least seems clear that recent increases are not simply a continuation of a pre-Paris trend.

Suzuki

Suzuki is an outlier among major automakers. It largely ignores the European, North American, and Chinese markets in favor of other Asian markets, primarily India (53%) and Japan (23%). The firm is primarily known for its smaller vehicles and motorcycles. Though smaller cars tend to have less emissions per passenger than larger vehicles, electrification has not been a priority for Suzuki until very recently.

Prior to 2015 Suzuki sold practically no electric vehicles. From 2015 onwards it developed a hybrid sales line, but had no substantial sales of either plug-in hybrids or battery electric vehicles. Its hybrid sales share rose only minimally between 2016 and 2020, and actually declined in 2021. The only substantial change in its sales through 2021 was expansion of “mild HV” offerings: cars that have a small battery to increase efficiency, but

which cannot run on electric propulsion alone. To all appearances, electrification was not a priority for Suzuki, either before or after the Paris Agreement.

Very recently Suzuki management has made new commitments to electrification, but they are substantially behind other firms' timelines. It is aiming at carbon neutrality by 2050 in Europe and Japan, and by 2070 in India. Its plans to release new BEV models in its markets, but not until 2030. Taken together, it seems clear that Suzuki was not inspired by the Paris Agreement to increase its ambitions for electrification.

Honda

Honda is the second-largest automaker in Japan, behind Toyota. Like its larger peer, Honda has pursued an electric vehicle strategy strongly focused on hybrids, to the near exclusion of plug-in hybrids or battery electric vehicles (though its hybrid sales are lower as a share of total sales than Toyota's by half).

In 2014 Honda's sustainability report adopted the slogan "continuation and evolution". Its record since then has been more focused on continuation than evolution. Between 2011 and 2019 its hybrid sales remained roughly constant at around 5% of total sales, though they grew to 10% in 2021. Since 2015 it has begun to produce some plug-in hybrids and battery electric vehicles, but their sales remained minimal through 2021.

Like Suzuki, Honda now appears to be trying to play catch-up in electrification. In 2022 it announced that over the next decade it would spend around 40 billion dollars on electrification and related software, as well as develop its own solid state battery production line. These investments are accompanied by plans to release 30 new EV models by 2030. Honda envisions exiting from ICE vehicles entirely by 2040. These new efforts are encouraging, but given their timing it seems unlikely that they were motivated primarily by the Paris Agreement as opposed to post-Paris developments.

Hyundai

Hyundai is the largest automaker in the Republic of Korea, and owns a substantial share of Kia, another Korean automaker. Prior to 2015, Hyundai's electrified sales were limited to traditional hybrids, similar to other major Asian automakers but with a smaller share of sales (around 1%). Its 2014 CDP filing discussed reducing emissions first by making ICE vehicles more efficient, then by developing other technologies. After the Paris Agreement, Hyundai's CDP filing explicitly recognizes the change in expectations for future automotive demand:

Following the new climatic deal made in COP21, The IEA has predicted that new energy market worth 12.3 trillion KRW will be generated in the next 15 years

Since then, Hyundai has made a wider range of "bets" than other automakers. After 2015, Hyundai's sales of battery electric, plug-in hybrid, and fuel cell vehicles all began to grow (though fuel cell sales remain minimal), and by 2021 Hyundai was also selling mild hybrids. It currently offers battery electric, plug-in hybrid, mild hybrid, and fuel cell vehicles. BEV and PHEV sales began to grow steadily after 2015, while FCEV sales remain low. Mild hybrids were added to the lineup in 2021, at which point battery electric and plug-in hybrid vehicles accounted for more than 5% of sales combined.

Hyundai appears committed to pursuing multiple technological strategies in parallel. In February of 2023 it reiterated its commitment to hydrogen fuel cell vehicles. This commitment is tied up with Honda's business offerings in areas outside passenger vehicles. But while hydrogen is sometimes seen as a distraction from electrification, in Hyundai's case it appears that the two have been able to coexist so far. And the timeline of the firm's electrification is at least consistent with influence from the Paris Agreement.