

EXHAUSTED:

Toyota Is Losing the Electrification Race as Automakers Charge Ahead



TABLE OF CONTENTS

Key points	1
Introduction	1
Electric Vehicles Could Rapidly Reduce Road Transportation Emissions	1
Fuel Economy and CO ₂ Emission Standards Are Effectively Accelerating EV Markets ..	2
Toyota’s Lobbying Aims to Weaken Vehicle CO ₂ Emission Standards and Slow Down EV Adoption	2
Toyota Has Lobbied Hard Against a Transition to All-Electric Vehicles.....	2
Toyota Risks Being Stranded by Electric Vehicle Disruption	3
Toyota Falls Far Behind Its Peers in Electrification Plans, Faces Market Share Crisis	4
Global Momentum for Electric Vehicle Targets.....	6
Conclusion.....	7
Appendix I: Types of Electric Vehicle Models	8
Appendix II: Table 2 Ranking Methodology	8
Endnotes.....	9

Thank you to researchers **Irem Kok** and **Michiel Vriens** for contributing to this briefing paper.

Irem is a senior research consultant with experience in energy and transportation. She is currently contracting to European Climate Foundation. She was previously a researcher for Oxford University’s Sustainable Finance Programme and the RethinkX’s future of transport project. She holds a PhD and MSc in Geography and the Environment from the University of Oxford.

Michiel is a research analyst for the European Climate Foundation, specialising in energy finance and electromobility. Prior to that, he worked as an energy analyst for the Institute of Energy Economics and Financial Analysis (IEEFA), analysing the burgeoning renewable energy market in Vietnam. He holds a Masters of Arts from the Johns Hopkins School of Advanced International Studies (SAIS) with a concentration in clean energy policy.

KEY POINTS

- **Rapid electrification will dramatically cut transportation-related emissions.** Road vehicles are responsible for three-quarters of transportation emissions. All-electric vehicles have the highest potential for reducing emissions, while hybrids and hydrogen vehicles offer limited benefits over fossil fuel cars. Toyota bets on the future of hybrids and hydrogen cars, but its key models — Toyota Mirai and Prius — do not significantly reduce emissions when compared to conventional cars.
- **Top leaders of Toyota are dragging their feet in the EV race.** Toyota lobbied heavily against a rapid transition to EVs, deliberately slowing down global electrification efforts. Toyota's executives repeatedly criticized ambitious plans and undermined a speedy transition to electric cars. Investors question Toyota's position against electric vehicles.
- **Toyota risks being stranded in the electric car race.** Toyota's approach to electrification has been slow, and the company remains focused on hybrid and hydrogen cars. Toyota faces a market share crisis as all-electric cars are the key to mitigating against harmful emissions.
- **As millions of new vehicle sales will be all-electric over the next decade, Toyota falls behind its competitors.** Despite being one of the largest automakers globally, Toyota's electric vehicle sales are eclipsed by its competitors. Globally, Tesla and Volkswagen sell 17 and 12 times the number of electric vehicles, respectively, and both are laying out aggressive growth strategies for an electrified auto market while Toyota scrambles to catch up.
- **More governments have announced end dates for fossil fuel vehicle sales.** More than 20 countries have committed to new electrification targets. The International Energy Agency's net zero scenario recommends phasing out new fossil fuel vehicle sales by 2035, with all-electric vehicles accounting for the majority of global car sales. Europe is responsible for more than half of these targets, followed closely by Asia and some US states. Early phase-in of zero-emissions vehicles via stringent fuel economy standards sends a strong signal to automakers to reorient their strategy towards all-electric models.

INTRODUCTION

Globally, transportation is responsible for almost a quarter of CO₂ emissions from fossil fuel use, with on-road vehicles accounting for three-quarters of the total.¹ Without policy interventions, emissions from the transportation sector will more than double — from 7 GtCO₂eq in 2010 to 15 GtCO₂eq by 2050 — says the International Panel on Climate Change (IPCC).² This is equivalent to the CO₂ emissions of China and the US combined in 2018.³

This white paper explores the benefits of all-electric vehicles, notably their potential for significantly reducing carbon emissions. It outlines the commitments automakers have announced regarding electrification targets and investments, and it highlights the gathering global momentum for accelerating electric vehicle adoption.

ELECTRIC VEHICLES COULD RAPIDLY REDUCE ROAD TRANSPORTATION EMISSIONS

The automotive industry has been reluctant to reduce new car CO₂ emissions, stalling any significant improvement in the fuel economy of fossil fuel cars globally.⁴ In fact, on-road transportation emissions have increased 43% since 2000.⁵ Electrifying passenger vehicles could significantly reduce emissions from fossil fuel combustion. If 70% of all the vehicles on the road are electric by 2050, annual global CO₂ emissions would be about 3.3Gt lower — the equivalent of 8% of current total emissions.⁶

All-electric vehicles offer far more potential for significantly reducing emissions than do conventional cars and hybrids (see Appendix I). When powered with low-carbon electricity, all-electric cars significantly cut down a vehicle's carbon footprint compared to a conventional compact car. The average EV in the US produces global warming emissions equal to a gasoline car that gets 93 miles per gallon. And in the areas of the country with the cleanest electricity mix like California and parts of New York, driving an EV produces emissions on par with driving a gasoline car with over 130 mpg.⁷ As the electricity grid gets decarbonized with greater access to renewable energy sources, the emission reduction benefits of new and used all-electric vehicles increases.⁸

Plug-in hybrids offer limited emissions reductions when compared with similar-sized fossil fuel-powered cars under real world conditions.⁹ This is because car owners use the electric motor less often when driving a plug-in hybrid, resulting in over two and half times more emissions than those in test conditions. In the UK, the

average annual emissions of a plug-in hybrid is 117g CO₂/km on the road, which is only marginally better than a conventional hybrid, like a Toyota Prius (135g CO₂/km), or a new conventional car (164-167g CO₂/km).¹⁰

Hydrogen vehicles offer no emissions reduction benefit over fossil fuel vehicles when powered with fossil-based hydrogen. The majority of hydrogen today is produced from fracked gas (76%) and coal (23%) globally.¹¹ Hydrogen-powered vehicles on the road have a higher carbon footprint than fossil fuel cars due to the energy intensity required to create hydrogen fuel.¹² When fracked gas is used in hydrogen production ('grey hydrogen'), fueling a car like the Toyota Mirai produces almost double the emissions from a gasoline-filled conventional car and more than triple the emissions from charging a Tesla Model 3.¹³

FUEL ECONOMY AND CO₂ EMISSION STANDARDS ARE EFFECTIVELY ACCELERATING EV MARKETS

Stringent fuel economy standards mean higher levels of EV adoption. Key auto markets adopted fuel efficiency standards and emissions limits to accelerate the adoption of cleaner vehicles. In Europe and China, stronger fuel efficiency targets have led to higher EV sales, placing them as the top two EV markets globally.¹⁴

The EU car CO₂ emission standards resulted in tremendous growth in the last few years. EV sales in Europe rose from 500,000 in 2019 to over 1 million in 2020.¹⁵ Tougher emission rules require automakers to reduce 25% of emissions against previous levels or face steep fines for the first time.¹⁶ From 2021 onwards, automakers must ramp up their share of EVs to avoid fines. For Toyota, satisfying the 2020 target was difficult without significant EV sales. Instead, the company plans to hybridize its existing car models in the future.¹⁷ Even if Toyota sells only hybrids, it will be insufficient to meet the 2025 targets, according to the Transport and Environment study.¹⁸

TOYOTA'S LOBBYING AIMS TO WEAKEN VEHICLE CO₂ EMISSION STANDARDS AND SLOW DOWN EV ADOPTION

Toyota has actively lobbied for weak fuel economy standards, slowing down EV adoption. In the US, Toyota joined the group of automakers that sided with the Trump administration in its attempt to reverse Obama-era Corporate Average Fuel Economy (CAFE) standards.¹⁹ It also joined a lawsuit in October 2019 to block California from setting its own stricter-than-federal emission standards under the Clean Air Act waiver, but

withdrew from the litigation as of February 2021.²⁰ The fuel economy rollback (48 miles per gallon by 2026) puts the US behind the EU (56.8 mpg by 2021), China (47.7 mpg by 2020) and South Korea (56.6 mpg by 2020).²¹

Ford called on automakers like GM and Toyota to join California's voluntary framework as a middle ground between Obama-era targets and lax Trump-era targets.²² The Biden administration has now asked federal agencies to revise the proposals and signaled tougher targets than Obama's.²³ Obama-era targets would require 25% of total car sales to be electric by 2026, meaning a more stringent rule could be proposed in 2021 and require higher EV adoption in the US.²⁴ Ahead of those new rules, Toyota has been lobbying for a slower rollout of EVs. In March 2021, Toyota North America's director of Energy and Environmental Research testified in the Senate, warning the government against going electric too fast.²⁵

As the largest automaker in Australia, Toyota has lobbied for delaying legislation on vehicle emission standards. Toyota Australia's chief executive has cautioned against adopting stringent emission rules like the EU, arguing instead for weaker standards similar to those in the US.²⁶ As a result, Australia does not have a fuel economy standard in place, and consequently the country has low rates of EV adoption and the most heavily polluting vehicles in the developed world.²⁷

Toyota was fined the highest civil penalty in US history for its polluting cars. In January 2021, the Department of Justice and the Environmental Protection Agency (EPA) fined the company \$180 million for failing to comply with the federal emissions reporting rules.²⁸ From 2005 to 2015, Toyota failed to report defects in its conventional cars that interfered with the control of tailpipe emissions and endangered public health.²⁹ Toyota's tailpipe emissions have not improved notably over the years. Between 2014 and 2019, Toyota's real world CO₂ emissions decreased from 350 gram per mile (g/mi) to 345 g/mi.³⁰ Tesla's fuel economy (118 mpg) is almost five times higher than Toyota (25.8 mpg).

TOYOTA HAS LOBBIED HARD AGAINST A TRANSITION TO ALL-ELECTRIC VEHICLES

Top executives and decision-makers at Toyota are dragging their feet in the EV race and attempting to delay the transition to all-electric cars. On December 16, 2020, Toyota President Akio Toyoda questioned Japan's plan to phase out new gasoline-powered cars by the mid-2030s, saying "electric cars are overhyped" and claiming that they are disrupting traditional business models. In an auto industry news conference three days after Japan's

announcement Mr. Toyoda said, “Politicians out there saying, ‘Let’s get rid of all cars using gasoline,’ do they understand this?”³¹

Toyota executives warned policymakers against phasing out gasoline cars too quickly in Japan, the UK, and India. Since 2018, the company has shifted its focus to prioritizing the sales of hybrid vehicles over all-electric cars and supported the expansion of conventional hybrid sales beyond the fossil fuel vehicle phaseout dates.³²

In November 2020, the UK government accelerated its EV target from 2040 to 2030, with a commitment to phase out sales of hybrid vehicles after 2035.³³ However, Toyota Europe CEO Johan Van Zyl has already announced that for its next round of investments in 2027 it will focus on hybrids instead of all-electric cars. If it maintains its standard seven-year product cycles, the earliest a zero-emission vehicle would be manufactured in the UK would be 2034.³⁴

In December 2017, Toyota Kirloskar Motors’ former vice-chairman Shekar Viswanathan said India’s target of all-electric vehicles by 2030 was “not practical, and it’s not the way forward”.³⁵ Viswanathan instead proposed a “technology-agnostic” approach to decarbonizing India’s vehicle market, giving customers the option to buy hybrid and hydrogen cars. A year later, the Indian government set a new target: 30% of new passenger cars and 80% of two- and three-wheel vehicles would be electric by 2030.³⁶

Investors are questioning Toyota’s position. Five institutional investors, including Norway’s Storebrand Asset Management and the Church of England Pensions Board, with total combined assets of half a trillion dollars, criticized Mr. Toyoda for deriding Japan’s electrification plans.³⁷ Despite a recent shift in Toyota’s stance on lobbying for conventional technologies,³⁸ its CEO still questions the future of electric cars.

TOYOTA RISKS BEING STRANDED BY ELECTRIC VEHICLE DISRUPTION

Toyota is facing a “Kodak moment”, bleeding market share to competitors as electric vehicle adoption accelerates. Just as Kodak failed to respond to the revolution in digital technologies in the 1990s,³⁹ Toyota is betting on the wrong technologies and entering too late into the electric car race. The company has an incremental approach to developing new EV models, mainly due to overreliance on its existing hybrid expertise and slow-selling hydrogen cars.⁴⁰ But all-electric vehicles

are getting cheaper and they sell more than hybrids and hydrogen cars, a trend that will accelerate rapidly until 2030, says BNEF.⁴¹

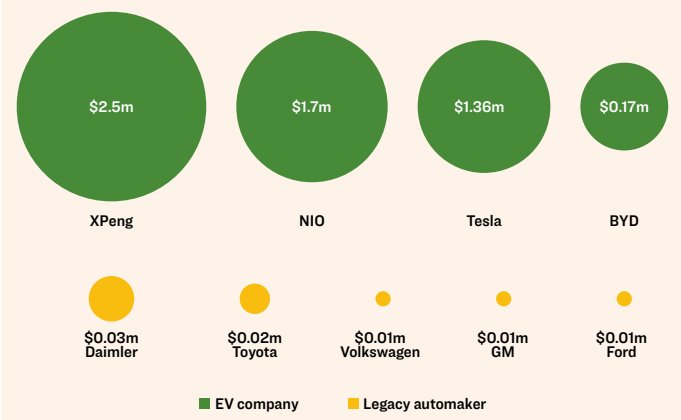
In late 1997, Toyota released its first mass-produced gasoline-powered hybrid car, the Toyota Prius, branding it as a “practical, low-emission family vehicle”.⁴² The company introduced a new hybrid car through its Lexus brand in 2018, running misleading advertising campaigns that portrayed hybrids as “self-charging vehicles” with an “infinite range”.⁴³ Norway banned Toyota’s ad for falsely playing into consumers’ range anxiety about all-electric cars.⁴⁴

Toyota promotes hydrogen cars as a foundational cornerstone of its decarbonization strategy.⁴⁵ In 2014, the company launched the world’s first mass-produced hydrogen passenger car, the Toyota Mirai, which means ‘future’ in Japanese. However, Mirai is too expensive, even with government subsidies, and very few have been purchased so far.⁴⁶ As of February 2020, there were just over 19,000 hydrogen cars on the road globally, compared to 6.7 million all-electric cars and 3.2 million plug-in hybrids.⁴⁷

A dearth of sufficient fueling infrastructure is another hurdle for hydrogen cars. Toyota invests heavily in hydrogen infrastructure projects that source hydrogen from fossil fuels. Toyota North America has partnered with Chevron to build a hydrogen fueling infrastructure in the US.⁴⁸ Toyota is also partnering with Kawasaki Heavy Industries to power hydrogen cars in Japan with, among other sources, brown coal exported from Australia.⁴⁹ Together with Nissan and Honda, Toyota signed an agreement with ten Japanese oil and gas companies to jointly develop a “hydrogen highway” in Japan.⁵⁰

Although electric vehicles make up a small fraction of the annual output of conventional vehicles, investors see electric vehicles as the future and are conferring higher valuations for pure EV companies (companies that only manufacture EVs as opposed to legacy automakers that produce fossil fuel powered vehicles as well). For example, Toyota is valued at \$0.02 million per car sold, whereas Tesla is worth \$1.36 million per car sold. Analysts expect sales of pure EV companies to ramp up massively in 2021/2022 in response to new EV incentives that are key to China’s carbon neutrality commitment, according to Bloomberg’s survey.⁵¹ As more governments join the global shift to EVs and sales continue to gain momentum, the market share of fossil fuel carmakers risks being captured by their electric counterparts.

Figure 1: Market valuation per car sold (USD m)

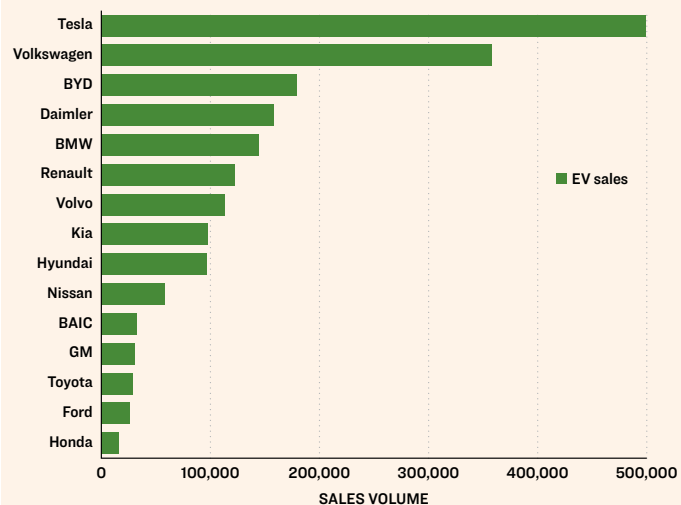


Sources: Bloomberg, company reports, based on researcher's own calculations. Not to scale.

TOYOTA FALLS FAR BEHIND ITS PEERS IN ELECTRIFICATION PLANS, FACES MARKET SHARE CRISIS

Other incumbent automakers are stepping up their electric vehicle sales volumes, both all-electric and hybrids. Global electric vehicle sales increased 47% year-on-year in 2020, hitting 3 million in total, according to BNEF.⁵² German automakers such as Volkswagen, Daimler and BMW are aggressively stepping into this market, while Toyota's sales remain low. At over 350,000 sales, Volkswagen currently outcompetes its incumbent peer group and is second only to Tesla in annual EV sales volumes.⁵³

Figure 2: Most of Toyota's competitors sold far more EVs in 2020

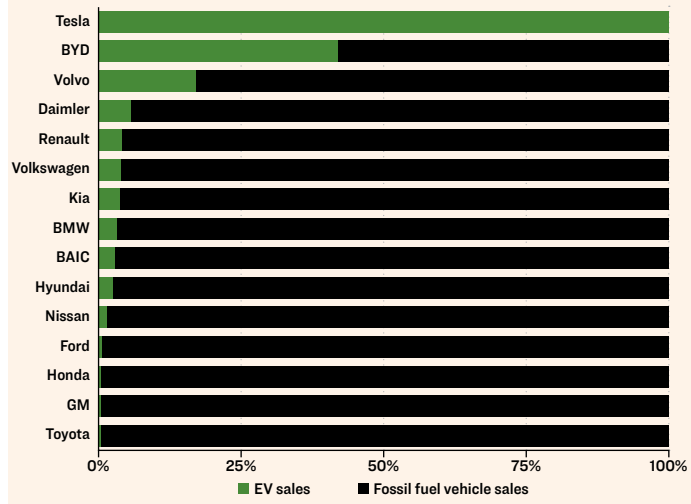


Sources: Bloomberg Network (accessed between 10-20 May 2021).

But EVs only account for a small share of traditional automakers' sales (see Figure 3). Tesla leads with the largest share of EVs in its sales mix (100%) followed by BYD (roughly 42%). Just under 4% of Volkswagen's sales are classified as electric, despite selling the second-largest volume of EVs in absolute terms.

Toyota comes in last, with less than 0.4% of its sales mix being EVs. General Motors and Honda (both around 0.5%) do only marginally better, with Ford inching above its competitors with a 0.6% sales mix. The only legacy automaker with a significant EV sales mix at the moment is Volvo, with over 17% of its sales mix being electric.

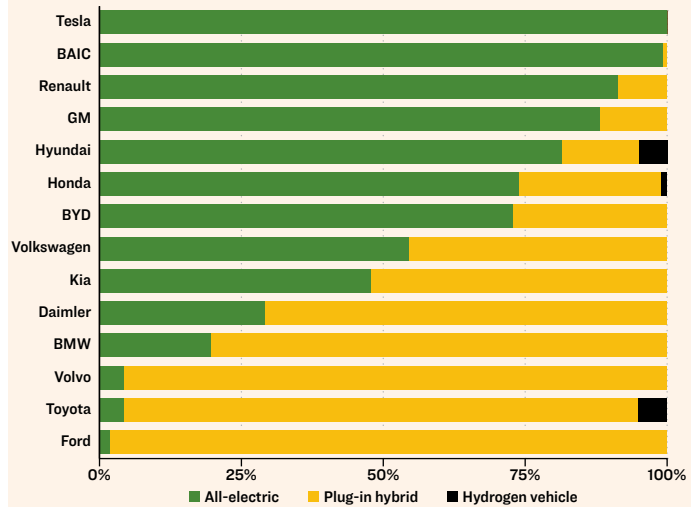
Figure 3: EVs still only account for a minority of total sales



Sources: Media reports, company filings and Bloomberg Network (accessed between 10-20 May 2021).

All traditional automakers rely on hybrids to a certain extent, but none so much as Toyota. The company claims to offer a "full menu" of zero-emission vehicle (ZEV) options, namely plug-in hybrids, hydrogen, or all-electric cars. Yet, over 90% of Toyota's ZEV sales were plug-in hybrids in 2020, whereas only 4% were all-electric (see Figure 4). It is also one of the few large automakers — the other being Hyundai — to bet on hydrogen-fueled cars, and others are increasingly setting their sights on all-electric vehicles.

Figure 4: Battery electric and plug-in hybrids account for the vast majority of sales in 2020



Sources: Media reports, company filings and Bloomberg Network (accessed between 10-20 May 2021).

Toyota lags behind its peers in the race to electrify. Many of its competitors have set ambitious battery-based EV targets between now and 2040 (see Table 2). Volkswagen has arguably the most ambitious and comprehensive strategy, aiming to surpass Tesla in EV sales by 2023 with 2 million annual sales, bridge the technological gap by 2025, and launch 70 new all electric models by 2030.⁵⁴ Volvo is also determined to transform itself, pledging to sell only 100% electric vehicles by the end of the decade.⁵⁵

Other Japanese automakers, including Honda, recognize that the transition is quickly approaching and have set specific targets. Honda plans to release 15 new all-electric models by 2025, have EVs account for 40% of its sales volume by 2030, and phase out fossil fuel vehicles entirely by 2040.⁵⁶

Toyota recently announced a new target of 70 “electrified” models by 2025.⁵⁷ However, only 15 will be

all-electric vehicles. The rest will be gas-powered hybrids and hydrogen vehicles. “Toyota isn’t behind Volkswagen and others when it comes to EV development, it just hasn’t been as vocal as others”, said Mr Toyoda.⁵⁸

In comparison to Volkswagen, Toyota’s EV strategy relies predominantly on selling more hybrids than all-electric models and investment levels of EV manufacturing are relatively small. The company projects 8 million electrified vehicle sales by 2030, yet only 2 million units will be all-electric and hydrogen vehicles.⁵⁹ In Japan and North America, the share of the latter will only be 10% and 15%, respectively. In Europe 40% and China 50%, the company plans to sell more all-electric and hydrogen vehicles by 2030 and 2035, respectively. While it just launched a new “Beyond Zero” strategy, their upcoming investments are dwarfed by the \$86 billion that Volkswagen intends to spend on electrification.⁶⁰

Table 1: Toyota lags behind its competitors in laying out an electrification target

COMPANY INFORMATION			TRANSITION STRATEGY		
Rank	Name	Headquarters	EV commitment	EV investments	Sales targets
EV automakers					
	TESLA	United States	N/A	USD 12 billion through to 2022 (battery investment undisclosed)	1.4 million BEV sales (2022) 4 new BEV models (2022) 100 GWh battery capacity (2022) 3,000 GWh battery capacity (2030)
	BYD⁶¹	China	N/A	<i>Announcement upcoming</i>	Launching new EV platform (2021) At least 2 new EV models (2021) Listing battery manufacturing arm (2022) <i>Further announcements to come.</i>
Legacy automakers					
1	VOLKSWAGEN	Germany	2036	USD 86 billion through to 2025	2 million annual BEV sales (2025) 20% BEV sales, Europe (2025) 60% BEV sales, Europe (2030) 50% EV sales, US (2030) 130 new EV models (70 BEVs) (2030)
2	VOLVO	Sweden	2030	80% of capital expenditure by 2025	50% BEV sales (2025) 100% BEV sales (2030) All models converted to EVs (2030)
3	HONDA	Japan	2040	USD 46.3 billion through to 2026	15 new BEV models (2025) 40% EV sales mix (2030) 80% EV sales mix (2035) 100% EV sales mix (2040)
4	RENAULT	France	No fixed date	USD 11.9 billion through 2025	30% BEV sales (2025) 10 new EV models (2025) 90% EV sales (2030)
5	DAIMLER	Germany	2039 (CO ₂ -free fleet)	USD 85 billion through to 2025	25% BEV sales (2025) 10 new BEV models (2025) 50% EV sales (2030)

COMPANY INFORMATION			TRANSITION STRATEGY		
Rank	Name	Headquarters	EV commitment	EV investments	Sales targets
6	FORD	USA	2030 (Europe only)	USD 30 billion through to 2025	40 new EV models (16 BEVs) (2022) 100% EV sales, Europe (2026) 100% BEV sales, Europe (2030) 40% EV sales, global (2030)
7	HYUNDAI-KIA	South Korea	No fixed date	USD 46.2 billion through to 2025	6 new EV models (3 BEVs) (2022) 26 new BEV models (2025) 20% BEV sales, Kia brand (2025) 1,060,000 annual EV sales (2026) 25% BEV sales (2030)
8	BMW	Germany	No fixed date	USD 36 billion through to 2025	25 new EV models (13 BEVs) (2023) 450,000 BEV sales (2025) 33% EV sales mix (2025) 50% BEV sales (Mini brand 100% BEV) (2030)
9	GM	USA	2035	USD 27 billion through to 2025	30 new EV models (2025) 100% EV sales (2035)
10	NISSAN	Japan	No fixed date	USD 10 billion through to 2022	60% EV sales mix (Japan) 50% EV sales mix (Europe) 23% EV sales mix (China) (2022) 1 million annual EV sales (2022) 18 new EV models (8 BEVs) (2024)
11	TOYOTA	Japan	2050	USD 13.5 billion through to 2030	70 new EV models (15 BEVs) (2025) 10% EV sales (2025) 8 million annual sales (2 million BEVs and FCEVs) (2030)

Sources: Media reports, company filings and Bloomberg Network (accessed between May 10 – July 6, 2021).

GLOBAL MOMENTUM FOR ELECTRIC VEHICLE TARGETS

Electric vehicle adoption will accelerate in the 2020s. Since the Paris Agreement was signed in 2015, EV's share of car sales worldwide has increased fivefold.⁶² The world reached 11 million electric cars in 2020, representing 5% of new car sales globally.⁶³ The EV market is expected to grow rapidly over the next decade, reaching 75-95% of new sales by 2030, according to the Paris compatible Climate Action Tracker benchmark.⁶⁴ The IEA net-zero scenario projects that EVs will account for more than 60% of global car sales by 2030 and 100% by 2050, reaching 350 million and 2 billion EVs, respectively.⁶⁵ In the light-duty vehicle segment, all-electric vehicles will win over plug-in hybrids and hydrogen vehicles in most 1.5°C aligned scenarios.

California has demonstrated climate leadership by announcing the first zero-emissions vehicle (ZEV) target, which other US states have adopted. Home to almost half of new EV sales in the US,⁶⁶ California became the first US state to announce a phase out of new gasoline vehicle sales by 2035.⁶⁷ In April 2021, governors of

12 states urged President Biden to phase out sales of gasoline-powered vehicles nationally by 2035.⁶⁸ Battery electric cars outcompeted plug-in hybrids in 2020, representing 80% of total EV sales in the US.⁶⁹ According to a recent study conducted at the University of California, Berkeley, all new cars and trucks can be fully electric by 2035, due to anticipated reductions in battery and manufacturing costs.⁷⁰

At this writing in June 2021, more than 20 countries set new electrification targets, with Europe leading the charge. These countries represented 56% of global auto sales in 2020.⁷¹ Despite the pandemic, electric car sales broke new records in 2020, growing by 40% in one year worldwide.⁷² Europe's new electric car sales almost doubled in 2020, overtaking China as the world's largest all-electric market.⁷³ The IEA net-zero scenario advises governments to follow the all-electric route to cutting CO₂ emissions from the light-duty segment as the world phases out new sales of fossil fuel cars by 2035.⁷⁴

European countries represent three-quarters of the national EV plans worldwide.⁷⁵ Norway set the earliest transition date to 100% electric cars by 2025, with over

half of its new car sales already electric in 2020.⁷⁶ Nordic countries will reach 100% all-electric cars by 2030, while Germany, France, and the UK will hit this target before 2035, according to BNEF forecasts.⁷⁷

China, Japan, and Singapore plan to reach 100% electrified sales in the mid-2030s. All new cars must be “new energy” in China by 2035, although this still permits half of the car sales to be gasoline-powered hybrids.⁷⁸ All-electric vehicles made up 5% of China’s vehicle sales in 2020, and are expected to rise to over 50% by 2035.⁷⁹

Japan plans to stop selling new gasoline cars in the mid-2030s, but it will continue to allow the sale of hybrids after this date.⁸⁰ All-electric vehicles accounted for 53% of Japan’s new EV sales in 2020, followed closely by plug-in hybrids (43%). Hydrogen-powered vehicles’ share (2%) was tiny in comparison.⁸¹ Hybrids’ share of total car sales in Japan is expected to reach 50% by 2030, BNEF forecasts.⁸²

Singapore will phase out gasoline and diesel vehicles by 2040, though consumers will still be able to buy hybrid cars.⁸³

Table 2: Global momentum for electrification targets

Fossil fuel vehicle phase out date	Target	Country or Region
2025	100% ZEV sales	Norway
2030	100% ZEV sales	Denmark, Iceland, Ireland, Israel, the Netherlands, Slovenia, Sweden, Scotland (United Kingdom)
2030	100% EV sales (includes hybrids)	United Kingdom
2035	100% ZEV sales	Cabo Verde, California (US), Canada, Hainan (China), United Kingdom
2035	100% EV sales (includes hybrids)	China, Japan
2040	100% ZEV sales	France, Portugal, Spain, Sri Lanka
2040	100% EV sales (includes hybrids)	Singapore
2050	100% ZEV sales	Costa Rica, Germany

Source: IEA 2021, ICCT 2020, and media resources.

CONCLUSION

Global transportation emissions must be reduced dramatically if we hope to meet the challenge of climate disruption. To that end, in recent years a growing number of countries have committed to setting ambitious emission-reduction targets, including phaseouts of fossil fuel-powered vehicles. The global race for vehicle electrification is underway, as countries compete to meet the regulatory and technological demands required to sell fleets in a clean energy economy that prioritizes electric vehicles.

As a result, traditional automotive giants including Volkswagen, GM, Ford, Honda, BMW, Nissan, and many others have made serious commitments ranging from total fleet electrification to investments in the development and manufacture of electric vehicle technology — including batteries — at rapid pace. On the other hand, EV startups such as Tesla and NIO are relying on innovation and a single-minded focus on selling electric vehicles to provide them a head start as they seek to disrupt the automotive industry.

At the crux of this seismic shift is Toyota, the current leader in global car sales, whose industry dominance is severely threatened by their continuing investments

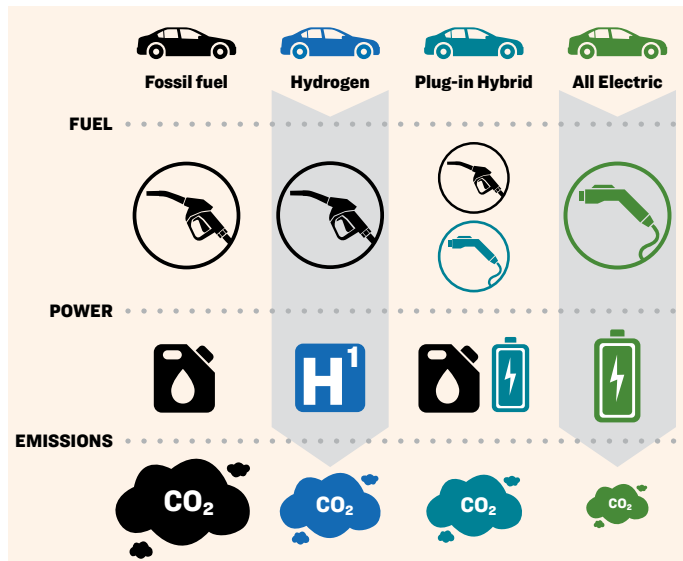
in, and reliance on, selling hybrids and hydrogen vehicles. Behind the scenes, they have actively lobbied governments around the world to slow the pace of vehicle electrification and encouraged business-as-usual policies that contribute to the status quo of vehicle pollution.

This has put Toyota in an awkward position where the automaker is actively lobbying against policies that would help curb climate disruption and opposing market trends that heavily favor an all-electric-vehicle future. Toyota risks being overtaken as an industry leader through short-sighted business and political calculations, while hungry upstarts, legacy automakers, and policymakers are committed to vehicle electrification.

APPENDIX I: TYPES OF ELECTRIC VEHICLE MODELS

Recent innovations have led to the rise of different types of electric vehicles (EVs). All-electric vehicles are the best example of an EV, as they only run on a battery and are fully powered by electricity.⁸⁴ Hydrogen-powered vehicles are also a type of EV, but instead of relying on a battery, they produce electricity with a fuel cell powered by hydrogen.⁸⁵ All-electric and hydrogen cars are collectively known as zero-emissions vehicles (ZEVs), because they have zero tailpipe emissions. But they are not zero-emissions when life-cycle emissions are taken into account. Their life-cycle emissions are determined by the energy-intensive process of manufacturing, plus the source of electricity and fuel cycle to generate hydrogen.⁸⁶

Hybrids rely on a combination of electricity and a gasoline engine. There are two types of hybrids: Conventional hybrid electric vehicles that use a battery to start the car before switching to a gasoline engine⁸⁷ and plug-in hybrids that are more dependent on electricity.⁸⁸ These vehicles need to be plugged in to recharge and can drive quite some distance using only the battery, switching back to the gasoline engine when the battery runs low.



APPENDIX II: TABLE 1 RANKING METHODOLOGY

Metrics

The electrification strategies of legacy automakers were assessed against six metrics: targeted date for phasing out fossil fuel vehicles; announced investments in electrification; sales target (in terms of volume); share of sales represented by electric vehicles; number of new models being released (and what kind of model, e.g. an all-electric); and by when the automaker wants to achieve these targets.

Weighting and scoring

Each metric was given a particular weighting depending on its relative importance. For example, investments were given the highest weighting because they are arguably the clearest indicator of ambition.

Based on each metric, automakers were assigned a score on a scale of 1 (the worst) to 10 (the best). This score was multiplied by the metric's weighting and the overall rank was the sum of each score.

Metrics	
Metric	Weighting
Fossil fuel phase out date	10%
Investments	30%
Sales target	15%
Share mix (of EVs)	15%
Number of new models	15%
Target dates	15%
100%	

ENDNOTES

- 1 IEA, [World Energy Outlook 2020](#), October 2020.
- 2 Sims et al., [Transport](#). In Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the IPCC, p. 603.
- 3 IEA, [Atlas of Energy - CO₂ Emissions by Country](#), 2018.
- 4 Transport and Environment, [CO₂ Emissions From Cars: The Facts](#), April 2018.
- 5 IEA, [World Energy Outlook 2020](#), October 2020.
- 6 Carbon Tracker, [Expect The Unexpected: The Disruptive Power of Low-Carbon Technology](#), February 2017.
- 7 Union of Concerned Scientists, [Plug In or Gas Up? Why Driving on Electricity is Better than Gasoline](#), June 7, 2021.
- 8 Carbon Brief, [Factcheck: How Electric Vehicles Help to Tackle Climate Change](#), February 2, 2020. Bloomberg, [How Green Is Your Electric Car?](#), February 28, 2018.
- 9 Transport and Environment, [The UK Plug-in Hybrid Con](#), September 15, 2020.
- 10 Transport and Environment, [The UK Plug-in Hybrid Con](#), September 15, 2020.
- 11 IEA, [The Future of Hydrogen](#), June 2019.
- 12 Simons, A. and Bauer, C., [Life-cycle Perspective on Automotive Fuel Cells](#), Applied Energy, November 1, 2015.
- 13 Wong et al., [Life Cycle Assessment of Electric Vehicles and Hydrogen Fuel Cell Vehicles Using the GREET Model - A Comparative Study](#), Sustainability, April 26, 2021.
- 14 BNEF, [G-20 Zero-Carbon Policy Scoreboard: Road Transport](#), February 16, 2021. Accessed via Bloomberg network.
- 15 Transport and Environment, [CO₂ targets propel Europe to 1st place in emobility race](#), February 2021
- 16 FT, [Europe Car Groups Face Huge Profit Hit To Cut CO₂](#), April 16, 2019.
- 17 Transport and Environment, [Mission \(Almost\) Accomplished: Carmakers' Race to Meet the 2020/21 CO₂ Targets and the EU Electric Cars Market](#), October 2020.
- 18 Transport and Environment, [Mission \(Almost\) Accomplished: Carmakers' Race to Meet the 2020/21 CO₂ Targets and the EU Electric Cars Market](#), October 2020.
- 19 Influence Map, [Toyota Motor Climate Lobbying](#). Accessed on May 10, 2021.
- 20 NYT, [More Automakers Drop Their Support of Trump-era Fuel Economy Standards](#), February 2, 2021.
- 21 ACEEE, [Fuel Economy Rollback Sets The US Further Behind The Leaders](#), May 8, 2020.
- 22 Reuters, [Ford Says Automakers Should Consider Backing California Emissions](#), December 1, 2020.
- 23 WSJ, [Biden Administration Moves To Unwind Trump Auto-Emissions Policy](#), April 21, 2021.
- 24 BNEF, [G-20 Zero-Carbon Policy Scoreboard: Road Transport](#), February 16, 2021. Accessed via Bloomberg network.
- 25 Electrek, [Toyota Lobbies US government in its Increasingly Delusional Effort to Slow Down EVs](#), March 17, 2021.
- 26 Influence Map, [Toyota Motor Climate Lobbying](#). Accessed on May 10, 2021.
- 27 BNEF, [Australia Missing Chance to Address Vehicle Emissions](#), September 7, 2020. Accessed via Bloomberg network.
- 28 US EPA, [Toyota Clean Air Act Emissions Defect Reporting Settlement Information Sheet](#), January 14, 2021.
- 29 New York Times, [Toyota to Pay a Record Fine for Decade of Clean Air Act Violations](#), January 14, 2021.
- 30 US EPA, [Automotive Trends Report](#), January 2021.
- 31 WSJ, [Toyota's Chief Says Electric Vehicles Are Overhyped](#), December 17, 2020.
- 32 Influence Map, [Toyota Motor Climate Lobbying](#). Accessed on May 10, 2021.
- 33 Financial Times, [UK Set to Ban Sale of New Petrol and Diesel Cars from 2030](#), November 15, 2020.
- 34 Guardian, [Toyota Will Not Invest in Electric Cars in the UK Until After 2027](#), December 7, 2020.
- 35 Financial Express, [Govt's Target of All-electric Fleet from 2030 "Not Practical": Toyota Kirloskar Motor](#), December 28, 2017.
- 36 Business Standard, [Rs 12.5 tn Investment Needed to Realise India's 2030 EV Targets](#), December 8, 2020.
- 37 Reuters, [Investors Chide Toyota's Toyoda for Questioning Combustion Car Ban](#), May 10, 2021.
- 38 Reuters, [Toyota to Review Climate Stance As Investors Turn Up The Heat](#), April 19, 2021.
- 39 Harvard Business Review, [Kodak's Downfall Wasn't About Technology](#), July 15, 2016.
- 40 BNEF, [The Toyota Way to Battery Electric Vehicles](#), June 12, 2019. Accessed via Bloomberg network.
- 41 BNEF, [Toyota Fuel Cell Technology Meets Its Match with Trucks](#), October 7, 2020. Accessed via Bloomberg network.
- 42 Toyota, [History of the Toyota Prius](#), February 10, 2015.
- 43 Electrek, [Lexus Trash Talks All-Electric Vehicles In Shameful Hybrid Vehicle Advertising](#), October 8, 2018.
- 44 Electrek, [Toyota's 'Self-Charging Hybrid' Ad is Banned in Norway, Deemed A Lie](#), January 24, 2020.
- 45 Toyota, [Toyota's Hydrogen Strategy: Why Did Toyota Remodel The Mirai?](#), December 29, 2020.
- 46 NPR, [Japan Is Betting Big on The Future of Hydrogen Cars](#), March 18, 2019.
- 47 BNEF, [EVs Are Miles Ahead of Fuel-Cell Vehicles](#), February 24, 2020. BNEF, [EV Numbers by Drivetrain in 2020](#). Accessed via Bloomberg Network.
- 48 Green Car Congress, [Chevron, Toyota to Explore Strategic Alliance on Hydrogen](#), April 22, 2021.
- 49 FT, [Kawasaki Heavy and Australia Lead A\\$500m Coal-to-Hydrogen Test](#), April 12, 2018.
- 50 Reuters, [Japan Venture Aims to Build 80 Hydrogen Fuelling Stations by 2022](#). March 5, 2018.
- 51 Bloomberg, [Stop Dissing Electric-Car Companies Already](#), December 3, 2020.
- 52 BNEF, [1Q 2021 Electrified Transport Market Outlook](#), March 9, 2021. Accessed via Bloomberg network.
- 53 Tech Crunch, [Tesla Delivers nearly 500,000 Vehicles in 2020](#), January 2, 2021.
- 54 Volkswagen AG, [How we become CO₂-neutral](#), May 18, 2021
- 55 BBC, [Volvo Cars to Go Fully Electric by 2030](#), March 2, 2021.
- 56 The Verge, [Honda Will Phase Out Gas-Powered Cars by 2040](#), April 23, 2021.
- 57 Toyota, [Toyota Announces its BEV Series, Toyota bZ, in Establishment of A Full Line-Up of Electrified Models](#), April 19, 2021.
- 58 Bloomberg, [Toyota Unveils New EV, Joins Volkswagen's Bet on Electric Future](#), April 19, 2021.
- 59 Bloomberg Intelligence, [Toyota Company Primer](#), May 18, 2021. Accessed via Bloomberg Network.
- 60 Reuters, [VW boosts investment in electric and autonomous car technology to \\$86 billion](#), November 13, 2020.
- 61 BYD has been included alongside Tesla as it is the world's largest EV producer and already has a large battery manufacturing business. It will be releasing an updated corporate strategy in 2021.
- 62 Systemiq, [The Paris Effect: How The Climate Agreement Is Reshaping The Global Economy](#), December 2020.
- 63 IEA, [Global EV Outlook 2021: Policies to Promote Electric Vehicle Deployment](#), May 2021. Full report can be accessed here. IEA, [Net Zero by 2050: A Roadmap for the Global Energy Sector](#), May 18, 2020.
- 64 UCL Institute for Sustainable Resources, [The Shape and Pace of Change In The Transport Transition: Sectoral Dynamics and Indicators of Progress](#), May 2021.
- 65 IEA, [Net Zero by 2050: A Roadmap for the Global Energy Sector](#), May 18, 2020.
- 66 ICCT, [Update on the Electric Vehicle Adoption Across US Cities](#), August 31, 2020.
- 67 California Office of Governor, [California Phase Out Gasoline-Powered Cars](#), September 23, 2020.
- 68 Reuters, [Twelve US States Urge Biden to Back Phasing Out Gas-Powered Vehicle sales by 2035](#), April 21, 2021.
- 69 BNEF, [Electric Vehicle Sales in the US](#). Accessed on May 10, 2021 via Bloomberg network.
- 70 UC Berkeley, [2035 Report: Plummeting Costs and Dramatic Improvements in Batteries Can Accelerate Our Clean Transportation Future](#), April 2021.
- 71 Based on researchers' own calculation, using OICA data, government and media sources.
- 72 IEA, [How Global Electric Car Sales Defied Covid-19 in 2020](#), January 28, 2021.
- 73 Bloomberg, [Europe's Electric-Car Share Surge Endures as Market Recovers](#), April 23, 2021.
- 74 IEA, [Net Zero by 2050: A Roadmap for the Global Energy Sector](#), May 18, 2020.
- 75 ICCT, [Growing Momentum: Global Overview of Government Targets for Phasing Out Sales of New Internal Combustion Engine Vehicles](#), November 11, 2020.
- 76 Electrek, [All-Electric Cars Hit 54% Market Share of Norway's New Cars Sales in 2020 - 100% Achievable by 2025](#), January 7, 2021.
- 77 T&E and BNEF, [Hitting the EV Inflection Point](#), May 2021.
- 78 Nikkei Asia, [China Plans to Phase Out Conventional Gas-Burning Cars by 2035](#), October 27, 2020.
- 79 BNEF, [Electric Vehicle Outlook in China 2020-2050](#). Accessed on May 10, 2021 via Bloomberg network.
- 80 WSJ, [Japan to Phase Out Gasoline-Powered Cars, Bucking Toyota Chief](#), December 25, 2020.
- 81 BNEF, [EV Sales in Japan](#). Accessed on May 10, 2021 via Bloomberg network.
- 82 BNEF, [Hybrid Vehicles in the Automotive Powertrain Mix](#), September 15, 2020. Accessed via Bloomberg network.
- 83 Reuters, [Singapore Aims to Phase Out Petrol and Diesel Vehicles by 2040](#), February 18, 2020.
- 84 US Department of Energy, [How Do All-Electric Cars Work?](#) Accessed on May 26, 2021.
- 85 US Department of Energy, [Fuel Cell Electric Vehicles](#). Accessed on May 26, 2021.
- 86 ICCT, [Effects of Battery Manufacturing On Electric Vehicle Life-Cycle Greenhouse Gas Emissions](#), September 2, 2018.
- 87 US Department of Energy, [Hybrid Electric Vehicles](#). Accessed on May 26, 2021.
- 88 US Department of Energy, [Plug-in Hybrid Electric Vehicles](#). Accessed on May 26, 2021.

Sierra Club National
2101 Webster Street, Suite 1300
Oakland, CA 94612
(415) 977-5500

Sierra Club Legislative
50 F Street, NW, Eighth Floor
Washington, DC 20001
(202) 547-1141

facebook.com/SierraClub
instagram.com/SierraClub
twitter.com/SierraClub

EXPLORE, ENJOY, AND PROTECT THE PLANET. **SIERRACLUB.ORG**

