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EXPERTS IN GLOBAL INVESTING

Electric vehicles are the next revolution in automobiles

But problems need to be overcome to hasten the switch and cement the climate benefits.

For Formula E motorsport, the 2020-21 racing season was transformational. Seven years after electric single-seaters first raced, Formula E gained the elevated 'championship' status enjoyed by Formula 1, World Endurance, World Rally and World Rallycross.[1]

Then came the embarrassment, the "absolute catastrophe",[2] at the Valencia E-Prix in April that followed troubled races in Saudi Arabia and Rome. In a category with baffling rules around energy use, the Valencia Grande Finale turned shambolic when five appearances by the safety car forced an extra lap and the racers lacked the battery charge to compete at speed. Only nine of 24 qualifiers finished legitimately and three of these drivers crawled to the finish. Three other cars spluttered to a halt mid-last lap when they ran out of charge while five others were disqualified for exceeding energy limits to finish.[3]

Don't be put off electric cars because an event to showcase the emissions-free driving option highlighted some of the challenges holding back the switch to green cars. In coming decades, electric vehicles are poised to become so reliable they will outsell autos propelled by fossil fuels. The race is on to switch to cars whereby an electric motor, battery and single-gear gearbox replace an internal combustion engine, radiator, fuel tank and multi-geared transmission and clutch because fossil-fuel vehicles account for about 10% of the global greenhouse-gas emissions driving climate change.[4]

Governments worldwide are promoting or mandating the switch. As of April, 20 countries and 70 sub-national authorities have announced 100% zero-emissions vehicles or the phasing out of conventional cars by 2050.[5] The US is pondering tax credits to boost electric sales, has decreed to buy only electric,[6] and intends to expand charging stations numbers to 500,000 by 2030 (though owners mostly charge cars at home or work).[7] China, now responsible for about 27% of global greenhouse emissions (more than the OECD countries combined)[8] has directed money into green cars for more than a decade.[9]

Automakers have pledged at least US$300 billion to go electric.[10] General Motors will stop making petrol-powered vehicles by 2035.[11] Volvo has set a deadline of 2030 to be fully electric.[12]

The first fully electric Lamborghini will arrive later this decade.[13] Tesla Motors, which launched the Model S in 2012, is the leader of companies created to build electric. Others include China's Nio.[14] Buyers worldwide can nowadays choose from about 500 green models.

But there are issues that need solving to hasten the switch to electric. One is that batteries have power, thus distance, limits. But the improvements to batteries are expected to overcome this handicap before too long. Another is that the infrastructure to ensure country-wide charging needs to be built – it will be. Another hurdle to overcome is that while electric vehicles are simpler to make because they have fewer parts, a battery that is the size of the back seat makes the cars more expensive to produce. The 60% higher price tag on average is slowing sales[15] even though electric car owners save money on energy costs (up to 70%) and maintenance (electric cars have only 20 moving parts compared with about 2,000 in fossil-fuel vehicles).[16] Bloomberg New Energy Finance predicts that by 2040 about 58% of new global vehicle sales will be electric, from about 3% now. Such an outcome would mean that in 19 years' time about 31% of the world's then 1.5 billion vehicles would be electric.[17] The switch could well be faster.

Another challenge is that while green cars emit no local pollution their environmental benefits come with caveats.[18] The first is that generating the electricity they need to recharge produces emissions, a level that varies according to how and where the power is generated. But the emissions from generating electricity will fall over time as grids become more renewables based. A second qualification is that batteries make electric vehicles more emissions-intensive to manufacture. Part of the explanation is that the raw materials needed for battery cells, especially cobalt, lithium and rare earth elements (that aren't rare), give off emissions during the smelting needed to extract them from ore. (Another might be that batteries are a challenge to recycle.)[19] German's IFO Institute in 2019 unsettled the country's push to electromobility when it found that a Tesla Model 3 over an assumed life of 150,000 kilometres would have a carbon footprint 10% to 25% bigger than a similar-size conventional Mercedes. The conclusion, however, was because Germany's grid sourced 45% of its power from fossil fuels. As Germany heads towards reducing emissions by 65% by 2030 on the way to becoming greenhouse-gas-neutral by 2045,[20] Tesla will become the greener option.[21] Other more recent studies say green cars are already greener by up to 50%.[22]

The switch to electric, it needs to be acknowledged, comes with social costs. The typical electric car requires six times the mineral inputs of fossil-fuel counterparts by weight, and securing triple the number of raw materials can be problematic. (It's 200 kilos of copper, cobalt, graphite, lithium, manganese and nickel in an electric car versus about 30 kilos of copper and manganese in conventional ones.)[23] A notable social cost is that more than 60% of the world's cobalt supply comes from the Democratic Republic of Congo where children become ill and die mining for US$2 a day to attain the ore[24] – though Western companies are seeking to improve conditions.[25] Another possible side effect is that securing the supply of key battery ingredients that are located in far fewer countries than is oil might add to tensions between the West and China. The concern is that China produces about 70% of the world's rare earth elements[26] because other countries shun hosting such filthy refining.[27]

Electric cars right now are more a luxury purchase due to their higher price. But already 30% of global sales of mopeds, scooters and motorcycles are electric because the price differential over petrol equivalents is lower.[28] Car sales will trend the same way if the price gap to fossil power is eliminated as expected this decade as batteries become cheaper and greener grids enshrine the climate benefits of electric. The May arrival of Ford's new electric F-150 ute that, thanks to subsidies that make the US's most popular truck cheaper than petrol equivalents, hints that the tipping point in favour of electric is coming soon.[29] Of the three touted future trends in driving – namely, car sharing that makes ownership redundant, fully autonomous driving, and electric vehicles – a world of green cars is the most believable.

To be sure, more advancements in the fuel economy of fossil fuels would sap the case for electric vehicles. (Average fuel economy for cars doubled from 1975 to 2018.)[30] A halfway switch to hybrids might slow the switch to fully electric while unexpected leaps in hydrogen power could make electric cars passé. Governments might wind back green subsidies to repair their finances (especially as some will lose revenue from fuel excise). Any delay in battery improvements would slow the switch. Banning conventional cars might misfire if the masses can't afford electric. Sales of electric vehicles could disappoint if people adopt a mentality that green cars will be cheaper and better distance-wise in a few years.

While the pace of the switch is debatable, the climate benefits and economic case for going electric will only become enhanced. The world of electric cars is coming. Valencia E-Prix debacles aside, the breakthrough into mainstream should prove as seamless as the switch from manual to automatic.

BATTERIES ARE KEY

Around 1832, Robert Anderson of Scotland built the first 'crude' electric car. By the 1870s, electric cars had progressed to be 'practical'. Around 1890, William Morrison from Iowa built the first 'successful' electric vehicle in the US. In 1901, Ferdinand Porsche created the world's first petrol-electric hybrid car. In the decade before World War 1, electric vehicles reached their 'heyday' when they formed about one-third of vehicles on US roads. But then came the electric starter that ended crank-starts, Henry Ford's affordable Model T, and cheap Texas crude. By the mid-1930s, electric vehicles had vanished.[31]

In the 1970s, NASA's electricity-run Lunar rover, soaring oil prices and concerns about smog renewed interest in electric vehicles. Sebring-Vanguard's CitiCar, all 2,000 of them, became the most successful electric car of the decade in the US. But the era's batteries came with limited range. Governments, however, kept encouraging automakers. In 1996, GM's EV1 appeared. One year later, Toyota launched the hybrid Prius that won over celebrities. Then Silicon Valley start-up Tesla in 2006 promised luxury electric cars and the quest resumed for cars to go electric.[32]

The key boost for the shift to electric was the invention of lithium-ion batteries in the 1980s. The future of electric cars essentially rests on batteries matching the attributes of fossil fuels minus the pollution. Petrol, gas and LNG are energy efficient. They are portable. They are cheap because they are found in abundance the world over and are easy to extract. It takes little time to fill a car with petrol that will power the vehicle for a long trip.

The future is likely electric because batteries will power cars for longer as they become more efficient, quicker to charge, cheaper to purchase and more economical to maintain. Average battery density (the energy generated per unit) is increasing at a pace of 5% or so a year (which means smaller batteries). New chemistries are lifting maximum charging speeds (which means faster charging). Increased production deriving economies of scale, fresh manufacturing techniques (with the help of artificial intelligence)[33] and simpler designs are expected to lower battery prices by the 40% or so needed to reduce them towards what the industry sees as the breakthrough point; namely, US$100 per kilowatt-hour.[34]

Lithium-ion batteries prices plunged 87% from 2010 to 2019 and Bloomberg New Energy Finance forecasts the prices of electric vehicles to decline so much that by the mid-2020s they will be on parity with the equivalent fossil-fuel-propelled competitor.[35] UBS last year predicted 2024 as the breakeven year.[36]

One concern of the switch to electric is whether enough cobalt can be found to match the expected demand for green cars – there are few alternatives (although Tesla uses lithium-iron phosphate batteries and future batteries might need less cobalt). Chinese companies have moved into the Congo to ensure the supply of cobalt needed to make China the biggest producer of electric vehicles in coming decades.[37]

Such are worries about cobalt supplies, the International Energy Agency in April advised Western governments to stockpile rare-earth elements to ensure that their fights against climate change did not become hostage to China. "Concerns about price volatility and security of supply do not disappear in an electrified, renewables-rich energy system," the agency warned.[38] The CEO of Anglo-Swiss giant Glencore, the west's biggest presence in the Congo, suggests likewise.[39]

Another challenge for policymakers will be to ensure a country's charging network is extensive enough. UK think tank Policy Exchange says public charge points need to be installed "five times faster than the current rate" of 35,000 a year to meet the demand from an expected 10 million green cars by 2030 when the sale of fossil-fuel vehicles will be banned.[40] Cars will be charged at home and at work but that only means higher demand for charging points. (Most makers of electric cars offer free or cheap upgrades of home-charging facilities, to lift them from 3.5-kilowatt charging (standard current), which takes 12 hours, to say 7 kilowatts, which is overnight.)

The popularity of hybrid cars could slow the shift to fully electric.[41] In 2020, Toyota Prius sales since 1997 reached 15 million, and sales of other hybrids have been as steady.[42] Hybrids, which combine internal combustion and electric motors, are generally competitively priced compared with electric peers, reduce

emissions by up to 30%, are an easier shift for car makers production-wise, and offer the same range as petrol peers.[43] They comfortably power cars for 60 to 80 kilometres of stop-start city driving, which means that smog-free driving is possible in European cities that are restricting the use of petrol and diesel within their inner cities.

Sales of electric cars could fail to meet expectations if zero-emissions hydrogen ones were to appear in numbers. Hydrogen, the most common element and one full of chemical energy, could make battery-powered vehicles redundant because it's friendlier for the environment. Ignite it with air and hydrogen releases energy via an explosion (similar to how the internal combustion engine works). This means hydrogen cars don't need to source electricity from elsewhere.

Hydrogen, however, faces challenges as a reliable and economical green source of energy. The challenges include keeping hydrogen in liquid form and controlling its temperature, and sourcing hydrogen from renewable sources needs to become more cost-effective. Hydrogen cars are expensive and are more experimental than poised to break through into the mainstream. So, while Formula H racing could appear one day, it's more likely that Formula E will be the green racing category for a few years yet.

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