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Insight
INVESTMENT

GLOBAL MACRO RESEARCH THE IMPACT OF ELECTRIC VEHICLES ON INVESTMENTS

MAY 2020



EXECUTIVE SUMMARY

THE DEMAND FOR ELECTRIC VEHICLES THROUGH 2040 IS SET TO SOAR

- Sales of global electric vehicle (EV) uptake has grown an average of over 60% per year from 2013 to 2018, to about 5 million light-duty electric vehicles on roads around the world.
- Public charging infrastructure has grown an average of over 60% annually from 2013 to 2018, reaching 600,000 charge points at the end of 2018. More available public charging increases drivers' confidence to move to electric vehicles, and additional electric vehicle drivers put more demand on governments, automakers, and property owners to install charging stations.
- EV demand is forecast to rise substantially over the coming decades, with most meaningful increases in demand beginning around the mid-2020s as technology, consumer taste, and government regulation gradually converge to hasten the adoption of greener technology. EVs are expected rise to about 10% of auto sales by 2025, 25% by 2030, and 50% by 2038, with Europe and China expected to be the leading adopters.

IDENTIFYING THE WINNERS AND LOSERS WITHIN THE AUTOMOBILE SECTOR

- Engine-related part suppliers are likely to face contraction owing to EVs possessing fewer moving parts. Analysis of moving and wearing parts showed that the highly lucrative spare parts business could shrink by ~60% in the endgame of a 100%-EV world, although this is still decades away.
- Lower servicing activity has the potential to dampen sales for after-market manufacturers of parts such as fluids and filters, labour demand for mechanics, and poses a headwind for the dealerships, which generate significant revenue from this activity.
- We expect battery providers and electronic firms could benefit from increased demand. Some Asian companies, which currently dominate the market for EV batteries, are expanding their production capacity in Europe, China and the US in a fight to win lucrative contracts from global automakers.
- While over the longer term we expect the traditional auto parts industry could lose out from increasing EV penetration, there are opportunities for traditional auto suppliers in the near term to benefit from higher content on PHEV models that overcome the range anxiety of full EVs.

- Legislation is needed to incentivise manufacturers due to prohibitively high costs associated with EVs. Less stringent emission regulation in the United States will likely cause a slower adoption of EVs and so negative impacts from any shift in production mix will be felt later than in the EU and China.

CONSIDERING THE IMPLICATIONS FOR THE ENERGY SECTOR

- Potential grid constraints in the short term, but expansion opportunities in the mid-term. In the near term, increased electricity demand should largely be met by existing power supply. However, over the long term, the extra demand will put upward pressure on prices and require increases in capacity and transmission.
- Renewable energy sources stand to benefit. Electricity demand peaks may rise more sharply in the evening when car charging will be most popular. One offset is that certain renewable energy forms, namely wind, actually produce more energy at night, which could help to meet these peak demand times.
- Utility companies are heavily investing in battery technology to store surplus energy during the day and meet peak demand at night with American firms announcing over USD\$5 billion in battery investments since 2018. This tailwind is likely to benefit lithium (a key component used in batteries) and battery suppliers.

EVALUATING THE IMPACT ON COUNTRY EXPOSURES

- Manufacturers in Eastern EU countries (due to high labour adoption) and South Korea (due to high exposure to final assembly and parts) are likely to suffer the most.
- Countries with large production shares combined with large surpluses likely face the most macroeconomic risk. Therefore, with over 60% of global auto production concentrated in China, the US, Japan, Germany and India, these countries are likely to suffer too, albeit to a lesser extent.
- Raw material-supplying countries stand to benefit from increasing battery demand. Lithium producers in South America (namely Chile and Argentina). Australia and China are the likely winners. China, the US, Australia, and Brazil will also benefit from the greater demand for cobalt, graphite, nickel, and aluminium.

WITH DEMAND FOR ELECTRIC VEHICLES CONTINUING TO SOAR, WE CONSIDER WHAT IMPACTS INVESTORS COULD EXPECT THE PROLIFERATION OF THE ELECTRIC VEHICLE MARKET TO HAVE ON THEIR PORTFOLIOS. WHILE THE IMPACT ON SOME AREAS, LIKE ENGINE-PART SUPPLIERS, MAY BE SELF-EXPLANATORY, OTHERS ARE LESS STRAIGHTFORWARD. IN THIS DOCUMENT, WE EXAMINE HOW THE RISING DEMAND FOR ELECTRIC VEHICLES MAY IMPACT INVESTMENTS IN THE AUTOMOBILE SECTOR, THE ENERGY SECTOR AND COUNTRY EXPOSURES.

THE SHIFT TO ELECTRIFICATION

The electric vehicle market continues to grow worldwide, enabled by sharp declines in battery cost and sustained policy from governments motivated to improve air quality, reduce greenhouse gas emissions, improve energy security, and develop new economic opportunities.

DEMAND CONTINUES TO GROW

In 2018, EVs accounted for 2.1 million global auto sales, or about 2.2% market share. While penetration remains low, sales are rapidly rising, enjoying 64% growth in 2018. Aided by government policy aimed at supporting 'Made in China 2025' and reducing pollution, **China is a major driver of this growth.**

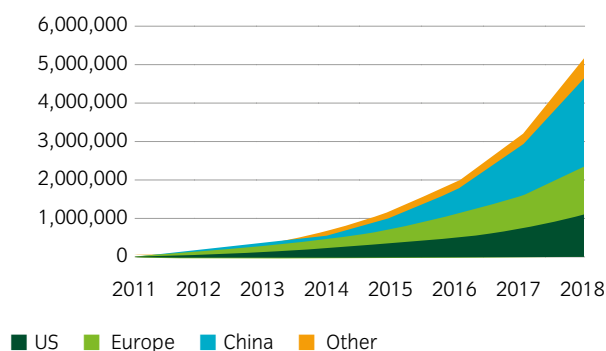
Among smaller markets, Norway is the stand-out, with electric vehicles accounting for 49% of electric sales in 2018 and reaching 58% of sales in March 2019. It is also the only country where an electric vehicle (the Nissan Leaf) is the top-selling model. That said,

pure electric cars are only 8% of the nation's auto stock. Including hybrids, the share rises to roughly 15%. Norway is targeting 100% emission-free vehicle sales in 2025 and has exempted electric vehicles from the 25% VAT and made ongoing ownership far cheaper by offering lower ongoing taxation and better road access.

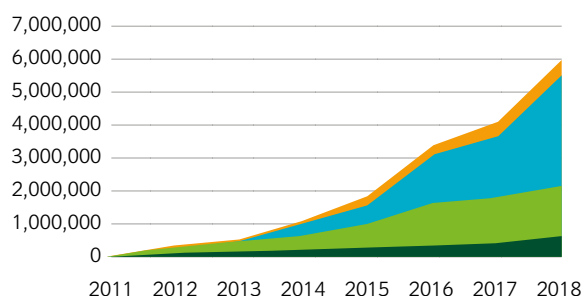
Norway, and to a lesser extent China, speaks to the degree to which **government incentives can hasten the transition to electric vehicles.** Sales of electric vehicles (EVs) are expected to rise to 10% of auto sales by 2025, reaching the 50% mark in 2038, with Europe and China expected to be the leading adopters.

Figure 1: Global electric vehicles and public charging points continue to surge higher¹


Cumulative electric vehicle sales



Electric vehicle charge points



¹ Source: ICCT. As at December 2019.



INCREASED INFRASTRUCTURE READINESS TO MEET GROWING DEMAND

As global electric vehicle uptake has grown an average of over 60% per year from 2013 to 2018, to about 5 million light-duty electric vehicles on roads around the world, so too has public charging infrastructure. Although most electric vehicle charging is done at home, public charging remains an important element to ensure electric vehicles are as convenient as conventional vehicles. In dense urban settings where home charging is typically less available, public charging plays a particularly crucial role.²

Public charging infrastructure has grown an average of over 60% annually over the same time period, reaching 600,000 charge points at the end of 2018. These trends are intertwined: more available public charging increases drivers' confidence to move to electric vehicles, and additional electric vehicle drivers put more demand on governments, automakers, and property owners to install charging stations. A robust public charging network is essential for EV growth, as it assures consumers that EVs are as convenient as conventional vehicles, and an expanded charging network increases electric vehicle drivers' confidence and their practical traveling range.

REGULATION ENABLES CHANGE

Similarly to charging infrastructure, regulation has an important role to play in EV adoption. Increasingly, government regulation is intended to incentivise the production and purchasing of electric vehicles, largely via fleet efficiency requirements for original equipment manufacturers (OEMs) and tax incentives for consumers.

The EU is several years ahead of the US on the regulatory front, with a stringent regulatory framework that is primarily focused on CO₂ reduction – meeting this from 2020 onwards will require a proportion of EV/plug-in hybrid electric vehicles (PHEV) or other Zero Emission technology (e.g. Hydrogen fuel cell).

China is also focused on increasing EV use, although the country's current regulations are more focused on auto sales than the existing vehicles on the road. For example, many larger Chinese cities will only issue licence plates for New Energy Vehicles (NEVs, e.g. pure EVs, hybrids and hydrogen). The country also has a system that sets minimum annual requirement for NEV sales for each vehicle brand.

In February 2020, UK Transport Secretary Grant Shapps suggested all cars with internal combustion engines could be banned from 2035. During the third quarter of 2019, the Department for Transport³ recorded 22,596 registrations of ultra-low emission vehicles, which includes electric cars – 39% more than the same period in the previous year. However, that still represented only 3.1% of new car registrations during the period.

In the US, two U.S. lawmakers unveiled legislation that would create a nationwide electric vehicle (EV) charging network to promote the shift from gasoline-powered vehicles and reduce greenhouse gas emissions.

² https://theicct.org/sites/default/files/publications/EV_Capitals_2018_20191121.pdf

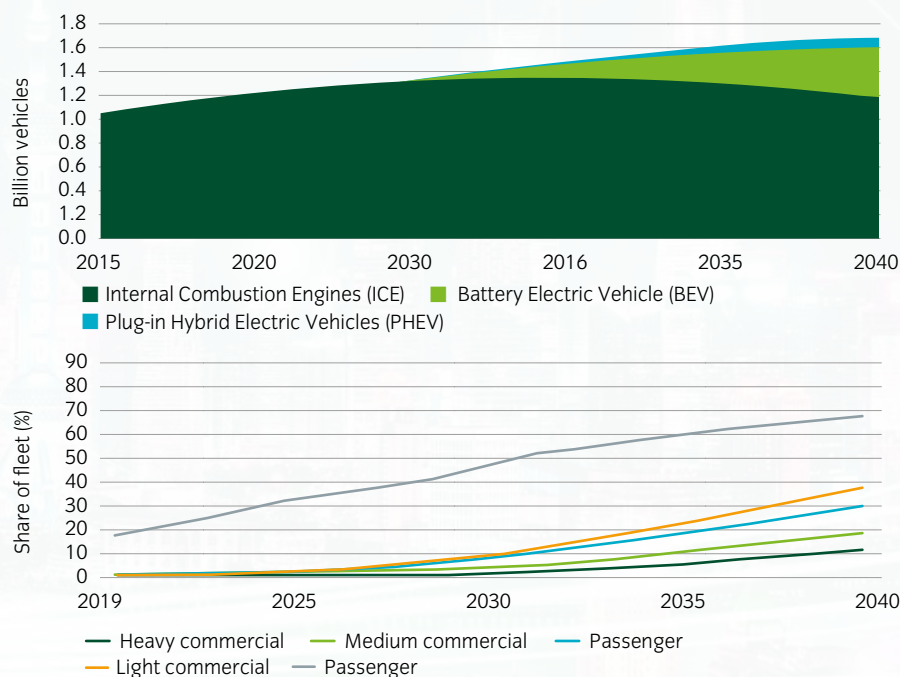
³ <https://www.gov.uk/government/statistical-data-sets/all-vehicles-veh01>

FORECASTING GROWTH THROUGH 2040: A FAD OR THE NEW NORMAL?

With all of this in mind, are the levels of growth expected to continue in the years ahead? Unsurprisingly, the answer is likely to be a resounding yes. While still a relatively small share of auto sales for now, EV demand is forecast to rise substantially over the coming decades, with most meaningful increases in demand beginning around the mid-2020s as technology, consumer taste, and government regulation gradually converge to hasten the adoption of greener technology. **EVs are expected to rise about 10% of auto sales by 2025, 25% by 2030, and 50% by 2038.**

We think it is important to emphasize that while EVs will become a substantial part of auto sales over the 10-15 years, which will impact OEMs and production-centric economies, EVs' share of the overall fleet (total number of vehicles on the road) will move much more slowly. Autos are a long-lived asset, so barring regulation that bans autos powered by internal combustion engines (ICE), which does not appear imminent, it will take a substantial amount of time for the auto fleet to roll over into EVs. According to Bloomberg forecasts, EVs will account for less than 10% of the fleet by 2030 despite accounting for over 25% of new total vehicle sales. Only by 2038, when sales are passing the 50% threshold, will fleet penetration pass 25%. As such, the impact on energy demand will be slower to materialize.

Figure 2: As automobiles are a long-lived asset, it will take time for EV fleet penetration to rise, despite soaring sales⁴



⁴ Source: Bloomberg. As at May 2019.

THREE WAYS TO ASSESS THE IMPACT OF ELECTRIC VEHICLES ON YOUR INVESTMENTS

Given current and forecast growth rates of EVs, we believe investors can assess the impact in three ways:

- 1 Identifying the winners and losers within the automobile sector
- 2 Considering the implications for the energy sector
- 3 Evaluating the impact on country exposures

1 VEHICLE MANUFACTURERS: IDENTIFYING THE WINNERS WILL BE KEY

While at present the cost to manufacture an EV is still higher than an ICE, we expect that continued market expansion will lower costs through economies-of-scale and more competition leading to innovations in design and manufacturing for EVs. To facilitate the process, auto manufacturers are increasingly entering into joint development programmes with other manufacturers on electric vehicles so that they can offset for the gross margin drag with lower R&D costs. A study from UBS found that, when fuel savings are accounted for, EVs are already at cost parity in some markets and that automakers could reap profits comparable to or greater than gas-powered cars by or before 2025⁵. This means that identifying which of the traditional ICE manufacturers is best positioned to transition into the EV world will be critical.

The part suppliers: if it's engine-related, you're facing contraction

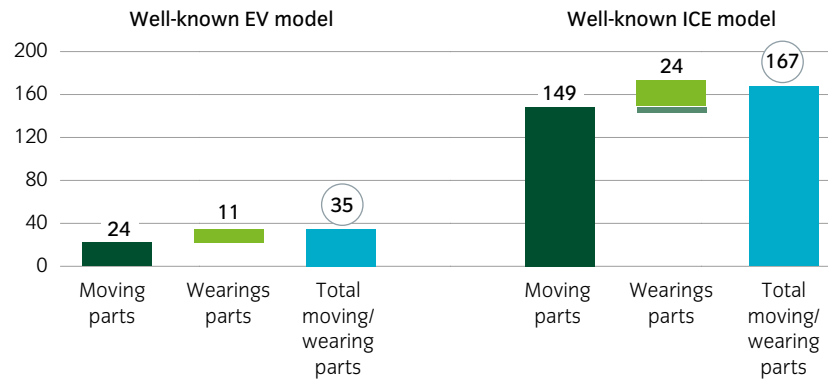
The traditional auto parts industry is likely to lose out in the longer term as pure EV penetration increases because these companies' vehicles have significantly lower content in the powertrains (the main components that generate power and deliver that power to the road surface) when compared to internal combustion engines. As a result, engine-related parts suppliers are likely to face declining demand and a contraction of their market. However, it is not all bad news, as in the near term, there are opportunities for the traditional auto suppliers to benefit from higher content on PHEV models that overcome the range anxiety of full EVs.

Fewer parts in engines translates into lesser replacement and servicing needs for EVs

Importantly, electric vehicles have many fewer parts in their engines, which means less moving parts to be replaced and serviced. For instance, UBS deconstructed a well-known EV model and compared it to a well-known ICE model, finding it had 80% fewer moving parts. We believe parts manufacturers could see a drop in demand, given EVs operate with fewer parts, which will require less replacing and servicing. This could have significant implications for firms focused on internal combustion engine (ICE) production and servicing over time.

⁵ Source: UBS. As at May 2017. <https://neo.ubs.com/shared/d1ZTxnvF2k/>

Figure 3: Electric vehicles have many fewer parts in their engines⁶



UBS' analysis of moving and wearing parts showed that the highly lucrative spare parts business could shrink by ~60% in the endgame of a 100%-EV world, although this is still decades away⁷. Lower servicing activity has the potential to dampen sales for after-market manufacturers of parts such as fluids and filters, labour demand for mechanics, and poses a headwind for the dealerships, which generate significant revenue from this activity.

Figure 4: A review of the parts supplies we believe to be positively, negatively or not affected by rising EV growth⁸

	Product Type	Relevant for
Not affected	Active safety and automation	All vehicles
	Body stamping and exterior mouldings	
	Interiors	
	Suspension and steering	
	Differentials and axles	
	HVAC and powertrain cooling	
	Passenger restraints, airbags	
	Info-tainment	
	Wheels	
	Lighting	
	Tyres	
	Body glass	
Positively affected	Battery charger and management	All vehicles
	Battery cells and packs	EVs and Plug-in Hybrid Electric Vehicles
	Electric drive moto	
	Electronics and wiring	
Negatively affected	Fuel system	All vehicles
	Engine parts	ICE and PHEV
	Gearbox	
	Emissions control	
	Turbos	
	Alternators and starter motors	
	Fluids – oil and coolant	
	Filtration	
	Brakes	

^{6,7} Source: UBS. As at November 2017.

⁸ Source: Insight, BAML, UBS. As at 30 April 2019.

Battery providers and electronic firms stand to benefit from increased demand

On the other hand, due to the parts included in EVs vs. traditional ICEs, battery providers and electronics firms may benefit from increased demand as the number of EVs being manufactured, and therefore the demand for the technology to power them, rises.

Asian companies, predominantly in China, South Korea and Japan, currently dominate the market for EV batteries and they are expanding their production capacity in Europe, China and the United States in a fight to win lucrative contracts from global automakers⁹.



Less stringent emission regulation in the US will likely cause a slower adoption of EVs



The current price of EVs is too high to incentivise manufacturers without legislation

At present, however, the high cost of the battery and electric powertrain components add around USD\$9,000 to the net component cost of a vehicle that typically competes against a \$25,000 to \$35,000 retail price of traditional ICE vehicles. **Given the currently more expensive parts, it is hard to incentivise manufacturers to build EVs without government incentives.** That being said, we have noted previously, that economies of scale and improvements in battery chemistry are expected to reduce the content cost differential and we expect that cost parity is unlikely to occur for several more years.

Extensive EV model rollout plans are only positive where it is required to meet regional environmental legislation. The €3bn-4bn development cost of a new vehicle that may not sell in volume or even at a positive gross margin has to be weighed against the regulatory risk.

In Europe, the EU 2020/21 CO2 requirements¹⁰ for the vehicle manufacturers is an important near-term regulatory risk facing the industry, with manufacturers effectively facing a choice between sizable fines or selling electric vehicles at low profit margins to bring down their fleet average CO2 emissions. However, since the VW diesel scandal, simply paying the fines is not politically palatable, which may result in the sale of EVs at a worsening margin.

Less stringent emission regulation in the United States will likely cause a slower adoption of EVs and so negative impacts from any shift in production mix will be felt later than in the EU and China.

⁹ <https://www.reuters.com/article/us-autos-batteries-factbox/factbox-the-worlds-biggest-electric-vehicle-battery-makers-idUSKBN1Y02JG>

¹⁰ https://theicct.org/sites/default/files/publications/ICCT_EU-CO2-stds_2020-30_brief_nov2016.pdf

Potential grid constraints in the short term, expansion opportunities in the mid term

As EVs become a larger share of the fleet, demands on the electric grid are likely to increase; however, given the fact EV share of the fleet is not expected to be significant until after 2030, this demand should largely be met by existing power supply. By 2025 in the US, EVs are only expected to account for 1.7% of the light vehicle fleet, which would translate into a 1% increase in electric demand. Similarly, by 2025, EVs are likely to account for just 2% of current EU auto demand, which is dwarfed by new renewable capacity coming online.

That being said, there will need to be multi-billion dollar investments in localized charging stations and local electricity distribution networks to meet charging demand as EVs gain scale. As noted earlier, we expect that the EV share of the fleet will substantially lag their share of sales over the next 15 years, and the impact on utilities will be more tied to EVs' share of the fleet.

When EVs become 25% of the US auto fleet, we estimate that the fleet would translate to a 10% increase in US electric demand, which would put upward pressure on prices and require increases in capacity and transmission. However, we forecast that 25% penetration is unlikely to be reached for at least two decades, and lower penetration rates result in more manageable electricity usage.

In our view, it is important to recognize that the global and developed world becomes more energy efficient with each passing year, which has led electricity and energy demand growth in the US and Europe to lag GDP growth. Globally, efficiency gains have averaged 2% in recent years, though it is closer to 1% in the developed world. These gains would largely offset the incremental demand from more EVs and mean that the rise of EVs will not force utilities to invest heavily in increased power generation beyond the existing power base.

Renewable energy sources stand to benefit

Despite the potential for a gradual ramp up of demand, it is true that demand peaks may rise more sharply than expected in an EV-centric world, particularly in the evening, as a large proportion of individuals would be likely to charge their cars when returning home from work. One offset is that certain renewable energy forms, namely wind, actually produce more energy at night, which could help to meet these peak demand times.

Another consideration is that an improvement in EV battery technology that allows for mass adoption of vehicles is unlikely to occur in a vacuum. In fact, utilities are heavily investing in battery technology to store surplus energy during the day and meet peak demand at night with American firms announcing over USD\$5 billion in battery investments since 2018. While EV demand is not the driver of utilities' need for industrial-scale batteries, their development is likely to be correlated as cheaper, better-lasting battery technology will both enable EV demand growth and make large-scale industrial battery investment feasible. This tailwind is likely to benefit lithium (a key component used in batteries) and battery suppliers.

3 IMPACT ON COUNTRY EXPOSURES

High geographical concentration and multinational original equipment manufacturers

The auto industry suffers from high geographical concentration; the top five producers of autos (China, the US, Japan, Germany, and India) account for over 60% of global auto production. Countries with large production shares combined with large surpluses likely face the most macroeconomic risk if they are unable to maintain the same market share in EVs as they have enjoyed in the age of the internal combustion engine.

However, it is also important to consider that many OEMs are multinationals, which could mean that the fate of a given country may be intertwined with that of another. For instance, while Spain is the world's ninth largest auto manufacturer, German brands account for about 33% of the production, so Spain's auto industry, like Germany's, will depend on Volkswagen and Daimler's ability to take the lead in EV manufacturing.

Figure 5: Which geographies which could be negatively impacted by the shift to EVs?¹¹

Countries	Economic Impact of Shift to EVs	Brief Rationale
China	Moderately positive	China is aggressively supporting battery cell production, and this will provide some offset to any losses on the assembly side. Also, a move to EVs relieves Chinese manufactures' high reliance on ICE powertrain IP provided by the global OEMs and part suppliers. China has some key positives, including Lithium and Cobalt reserves, that offset the assembly line impact.
Chile/ Argentina/ Australia	Potential positive	Global reserves of lithium are heavily concentrated in South America, namely Chile and Argentina, which will likely benefit these nations as demand for as this element increases. Australia is also a leading lithium producer.
US	Near term: Minimal Impact Longer term: Moderately negative	US benefits from later expected adoption of EVs. Position as an R&D centre means a proportion of the production jobs lost the sector should be able to be offset. However, net/net it is hard to see how this ends up being anything be a negative overall.
Germany/ France/ Japan	Moderately Negative	Position as an R&D centre means a proportion of the production jobs lost the sector should be able to be offset. However, net/net it is hard to see how this ends up being anything be a negative overall.
Eastern EU	Negative	Production jobs have been transitioning East from West for the last 2 decades and it is here that labour reductions are most at risk.
South Korea	Negative	Focus on mass market and high exposure to final assembly and parts production make it harder for South Korea to offset this GDP loss with higher R&D

¹¹ Source: Insight . As at 30 April 2019.

Car manufacturing countries face a race to transition to battery cell production

As discussed, EV production contains fewer components, so it stands to reason that EVs also require 30% less final assembly labour compared to an equivalent ICE-powered model. For this reason, countries which currently produce ICE-related auto parts could be vulnerable to a slowdown in labour demand if battery cell construction occurs elsewhere. For example, governments in China and Europe have been actively pursuing policies to encourage the expansion of local battery cell production, which will give them an advantage, but it is still early days.

Despite the potential impact on car manufacturing companies who do not transition to battery cell construction, it is worth noting that the automotive industry does not contribute to GDP solely through production employment, but also through R&D and a multitude of support services. This therefore would reduce the impact of the aforementioned 30% headline cut in required assembly labour.

A key factor that will determine the overall economic impact for countries will be the pace of the shift away from ICE-based vehicles. As discussed, production labour is likely to reduce as a result of the diminishing demand for ICE vehicles. Fortunately for those manufacturers, if this transition occurs broadly at the pace currently forecast, without significantly accelerating, the significant proportion of the cut in production labour required can be achieved in developed economies by not replacing Baby Boomers, who are now coming up for retirement.

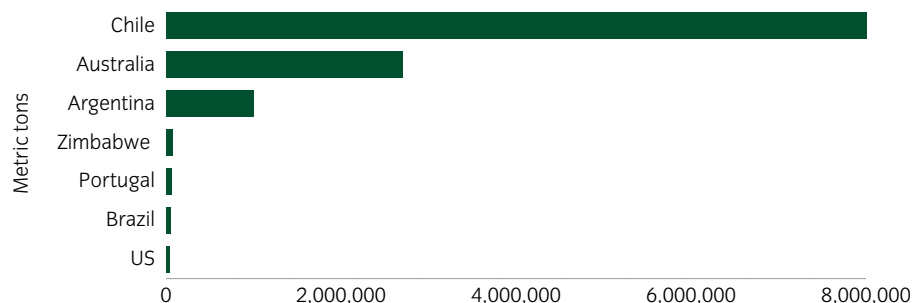
It's also worth noting that the economic contribution of these production jobs should be somewhat offset by seemingly ever higher number of software-related positions required in the design of automobiles. However, similarly to what we have covered in the Corporates and Energy sections, the question comes down to the pace of adoption – the faster the shift to EVs, the more difficult it will be to offset.

Raw material-supplying countries stand to benefit from increasing battery demand

Country winners due to lithium production

Currently, lithium is the primary component of electric car batteries. Global reserves of lithium are heavily concentrated in South America, namely Chile and Argentina. Australia and China are also leading producers (see Figure 6).

Figure 6: Chile leads the way regarding lithium reserves globally, while the US lags significantly¹²



¹² Source: US Geological Survey. As at 30 December 2019.



Pace of adoption is a key variable that could determine how great an impact the shift to EVs will have on investments



From 2015 to 2017, lithium prices rose dramatically on greater demand, which resulted in large expansion projects by the major producers (see Figure 7). This pushed the market into over-supply with an expected surplus of 60,000-75,000 tons in 2018 and 125,000-150,000 in 2019. While showing the large price volatility often seen in commodity markets, over time, rising EV penetration and demand for lithium should still be positive for these countries.

Figure 7: Rising lithium prices led to oversupply in 2018 and 2019¹³



Other country winners

Outside of lithium, cobalt, rare earth elements, graphite, nickel, and aluminium are likely to have greater content in autos, going forward. The Democratic Republic of Congo accounts for 60% of global cobalt production. Similar to lithium, prices have fallen heavily (over 60%) in the past 12-months¹⁴ as supply gains have exceeded incremental demand. Interestingly, China has directed several billion dollars of foreign direct investment as well. Meanwhile, for rare earth elements, the US geological survey 2019 noted the US, Australia, and Brazil are the biggest producers globally¹⁵. We expect that the countries such as these that produce these raw materials to benefit as the demand for EVs climbs.

¹³ Source: Bloomberg. As at 30 April 2019.

¹⁴ As at April 2019.

¹⁵ <https://prd-wret.s3-us-west-2.amazonaws.com/assets/palladium/production/atoms/files/mcs-2019-raree.pdf>



THE BOTTOM LINE

The impact of electric vehicle proliferation will be widespread, at both a corporate and a country level. That means that investors need to take these factors into account when analysing their portfolios.

Pace of adoption is a key variable that could determine how great an impact the shift to EVs has on any of the areas we have discussed, as ultimately a speedy transition would make it more difficult for corporates, the energy sector and countries to adjust. Investors can better gauge the potential impact on their investment portfolios by examining how the rising demand for electric vehicles may impact investments in the automobile sector, the energy sector and country exposures.

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