PGM Price Drivers

24 January 2021

Mining

Global Vehicle Sales, PGM Demand & Lithium Demand

Summary

- **Global vehicle sales fell -16.5% (est.) in 2020**
- -29% in the UK, -25% in Europe, -15% in the US, -1.9% in China
- **EU hybrid sales (including plug-ins) increased 700% over past six years**
- Despite substantial subsidies, EU BEV sales only up 163% over same period
- **Eventual global Lithium demand could be half of some predictions**
- EU diesel demand now at levels last seen in 1998
- **Flat Platinum demand**
- **BEV sales penetration is 5.2% in Europe, 5% in China, 2.3% in the US**
- EU, US and Chinese BEV demand strongly reliant on future Gov. policy
- Europe projected to overtake China's BEV sales by 2023
- BEV sales growth peaking both in China and US
- **Strong Hybrid sales ensuring continued growth in Palladium demand**

Global car sales have been largely saved by domestic demand from within China which was almost on par with the pcp; contrasting with our earlier predictions in April 2020 that global sales would be down 50%; which we revised upwards in August to 24%. Examining European fuel-type trends, we note that over the past six years, EU hybrid sales have increased 700% without any State financial intervention. By comparison, over the same period, BEV sales have risen a more modest ~163%, despite substantial Governmental grants in the form of tax breaks and subsidies. This progression can also be observed in the decline in diesel vehicles and the relative growth in petrol engines, particularly if one considers that the vast majority of hybrid models utilise a petrol/electric combination; which will continue to support robust Palladium pricing. We expect Platinum demand, however, to remain flat.

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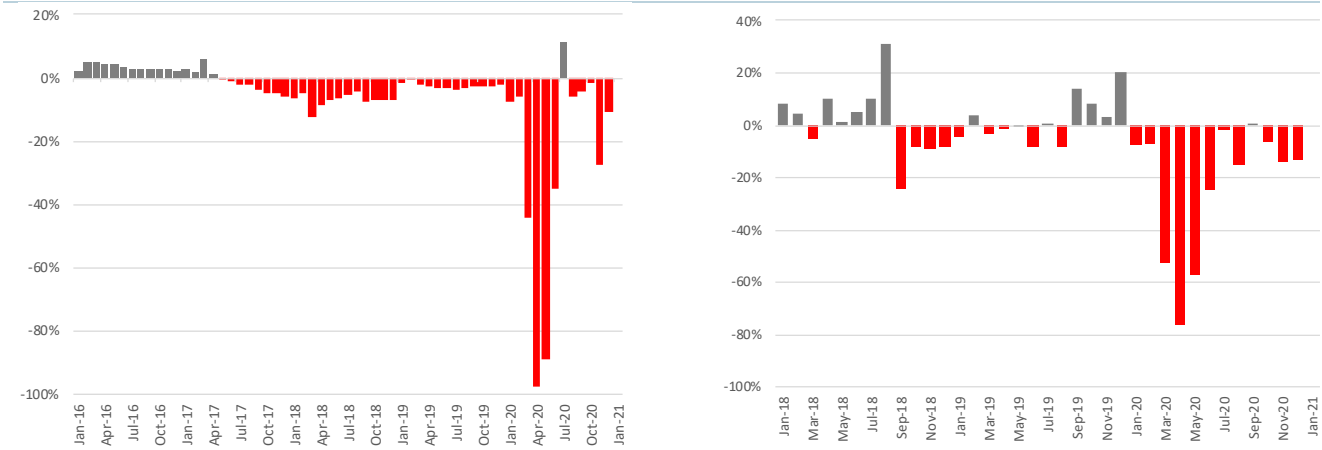
Global Vehicle Sales

UK car sales fell by 29.4% in 2020 over the pcp (~1.63m units), to their lowest level since 1992, recording the largest y-o-y fall since 1943. Although the shutdown in spring accounted for most of the lost sales (see Figure 1), it is important to note that sales have been falling since May 2017. Given recent pandemic restrictions, we expect soft domestic demand until spring, at the earliest.

The London Mayor has announced plans to create one of the largest car-free zones in any capital city in the world; raising the congestion charge to £15pd (~£5.5k pa), with pavements widened, closure of several bridges (across the Thames) and numerous roads to existing motorists. Furthermore, Britain plans to legislate and ban the sale of petrol and diesel cars by 2030, including, for the first time, extending these sanctions to hybrid cars (2035). Not just a UK phenomenon, there are proposals to ban all but electric/hybrid cars in numerous global city centres; including Paris, Munich, Lyon, Dijon, Madrid, Barcelona, Oslo, Tokyo, and Melbourne just to name a few.

Figures 1 & 2: Growth/decline in newly registered cars in the UK from 2016 to December 2020 (monthly y-o-y increase/decrease in percent). Remarkably in decline since May 2017 (Left); and newly registered cars in Europe from 2018 to December 2020, which has largely been in decline since September 2018 (Right).



Source: SMMT (2020), Marklines (2020), LMC Automotive (2020), Forbes (2020), CNBC (2020), FD

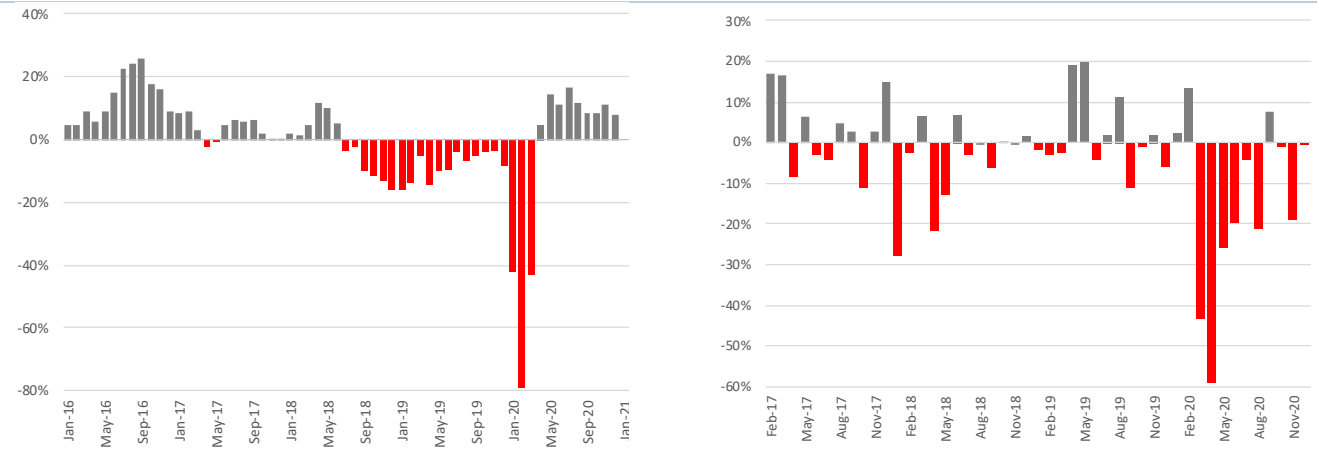
European car market still suffering from an inventory overhang.

Western European automotive sales have been falling for over two years (see Figure 2), reaching a 17-year low. Overall registrations fell 25% y-o-y, with sales plunging 32% in Spain, 28% in Italy, 25% in France and 20% in Germany. Only EV sales have been contrary, with hybrid, plug-in hybrid and battery-powered vehicles exceeding that of European diesel vehicles Q420 for the first time ever. But that doesn't tell the whole story; growth in EV sales in Northern and Western Europe have easily outstripped that of Southern and Eastern Europe as wealthier countries (e.g. Germany, the Netherlands, and Nordic countries) invest more in recharge infrastructure, offering greater cash and tax incentives in order to accelerate adoption.

Interestingly, studies looking at early adopters of electric vehicles suggest that in Germany[1], they are professional middle-aged men living in rural or suburban multi-person households, typically owning a number of existing vehicles, they are more likely to realise the economic benefits due to the annual number of kilometres travelled. In particular, their willingness to buy an EV was strongly associated with perceived higher socio-economic status. In contrast, according to carwow.co.uk, the UK's EV earliest adopters are males aged 25-34 living in Greater London, with 83% of those voting "*Remain*" in the referendum on the UK's membership in the EU. Again, like Germany EV ownership is strongly tied to income, with 49% ownership levels among those earning £61-£70k pa, half of those earning £81-£90k pa, and 61% earning more than £100k pa. In contrast to only 5% earning up to £20k pa[2].

However, focusing on the individual purchasing decisions may be misleading. According to JATO (2020), Fleet and businesses, not private consumers, are the largest purchasers of BEVs in Europe. Registrations in Q120 by businesses and fleets accounted for 59%[3] of the total. It could be argued, that the quantum is exacerbated by the recent pandemic, but it is remarkably similar to Q119, whereby 54% of BEV transactions were also fleet and business sales. We are unsure why this is, but the rise of low-emissions zones across could be incentivising fleet operators to actively avoid the costs of operating an ICE (Internal combustion-engine) fleet within a payment area. Additionally, EVs theoretically require less servicing and lower maintenance than an equivalent ICE with hundreds of moving parts; potentially lowering overall fleet expenditure.

Figures 3 & 4: Growth/decline in newly registered cars in China from 2016 to December 2020 (monthly y-o-y increase/decrease in percent) (Left); and updated car sales in the US, reflecting a surprising recovery. Note there have been downward numerical revisions in US sales since our last publication (Right).



Source: Marklines (2020), Reuters (2019), WSJ (2018), CAAM (2018), CPCA (2020), Cox Automotive (2020), GoodcarBadcar (2020), FD

[1] Plötz, P. et al. (2014) "Who will buy electric vehicles? Identifying early adopters in Germany". *Transportation Research Part A: Policy and Practice*, v. 67. DO - 10.1016/j.tra.2014.06.006

[2] Ironically, UK EV drivers are only half as likely as non-EV owners to make an effort to recycle.

[3] For comparison, in 2018 European fleet sales as a percentage of total sales, ranged from 5% in Belgium to 19.2% in Germany and the UK (Statista, 2021).

The Chinese car market has grown over the pcp for nine months straight. Interestingly driven by commercial vehicles rather than consumers

The Chinese car market is still continuing to show strength, according to CAAM, Chinese vehicle sales (see Figure 3) for the year were only down 1.9% over the pcp (prior consensus -8%), with monthly sales figures exceeding 2019 numbers for nine straight months. Japanese Auto makers are the largest winners, in particular Honda and Toyota. The numbers were underpinned by an 18% increase in commercial vehicles, offsetting a 6.1% decline in passenger units. The sales turnaround is attributed to the extension of local government subsidies, and the easing of number plate quotas (originally put in place in large cities to reduce congestion).

US vehicle sales for 2020 (see Figure 4) are forecast to be down 15% over the pcp, to their lowest level since 2012. Incidentally, is significantly better than forecast declines of 35% earlier in the year when much of the country went into lockdown, with the vast majority of U.S. dealers were compelled to close showrooms. Interestingly, unlike Europe with a large inventory overhang, the US industry now faces an inventory crunch expected to last well into 2021, with new-vehicle dealerships stocks running approximately at 25% below normal, in particular, shortages in larger pickup trucks. Purchases of luxury brands (e.g. Audi, Cadillac, Jaguar, Lexus and MB) are extremely depressed, suggesting that consumers are exercising budgetary discipline.

Despite the economic impact, we estimate that global 2020 car sales are only down 16.5% from 2019 levels. This modest impact largely the result of Chinese stimulus measures; estimating that the Middle Kingdom now accounts for ~39% of all cars sold globally (assuming that 2020 global sales ~64.7m units).

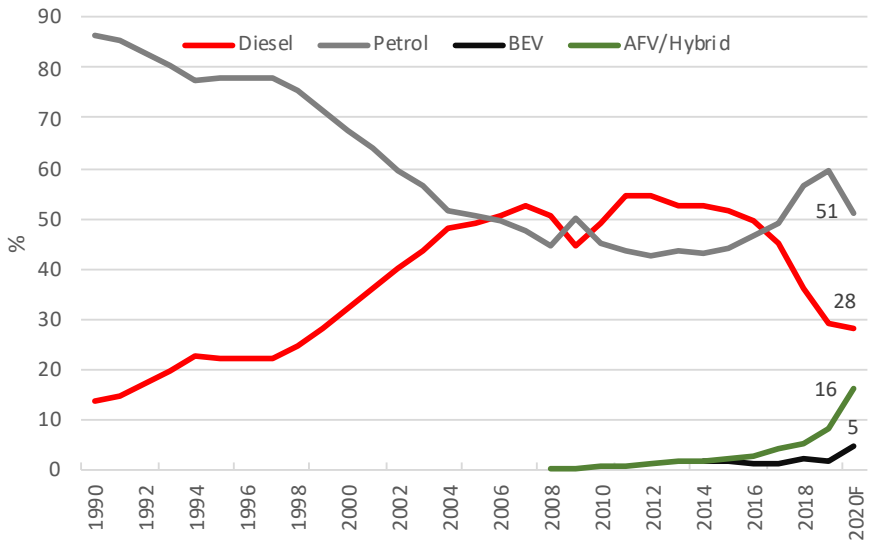
Vehicular Fuel-type Breakdown, Implications for Li Demand

EU hybrid sales up 700% in six years without any governmental support.

In the month of September, more EVs/BEVs were sold in Europe than diesel powered units.

The most recent numbers contained in Figure 5 regarding fuel-type breakdown in Q320. The trend clearly demonstrates the continual decline in diesel power-plants and the extra-ordinary rise in hybrids, now selling on a ratio 4:7 with their diesel counterparts. Predominantly utilising petrol/electric power plants, EU hybrid sales have increased 700% over the past six years (without State financial intervention). By comparison, over the same period, BEV sales have risen a more modest ~163% despite substantial Governmental grants in the form of tax breaks and subsidies. In fact, for the first time ever, in the month of September this year (according to JATO), the total number of EVs (including BEV, plug-in hybrids, full hybrids and mild hybrids) registered was higher than the equivalent number of diesel cars. A remarkable turnaround, given that five years ago, diesel cars were a dominant powerplant in Europe, but their decline and the rise of hybrids is a powerful portent of future consumption behaviour.

Figure 5: European car registration by fuel-type, updated to October 2020. Note, we have separated BEV and plug-in-hybrid numbers, attributing the latter to overall hybrid sales believing it's a closer definition fit.



Source: Assoc. JATO (2021), Auxiliarie de L'Automobile (2020), European Automobile Manufactures Assoc. (2019), Cargreencongress (2020), FD

The more radical of the European EV jurisdictions is Norway, whereby any motorist that purchases a BEV is exempt from substantial import duties, avoid 25% VAT, eschews all road taxes, tolls, qualifies for half-price ferries, gets free municipal parking and is, typically, allowed to use bus lanes. The average retail price of a petrol/diesel car registered September 2019 was ~€2.3k more expensive. Unsurprisingly, 54.3% of all new cars sold in Norway in 2020 were BEVs, up from 42.1% in 2019; compared with an estimated 5% of BEV sales across Europe (see Figure 5). However, we see Norway's experience as more of an aberration than an indicator of a long-term trend, with the level of government expenditure and

incentives unlikely (unable?) to be replicated elsewhere in the short to medium term by any other

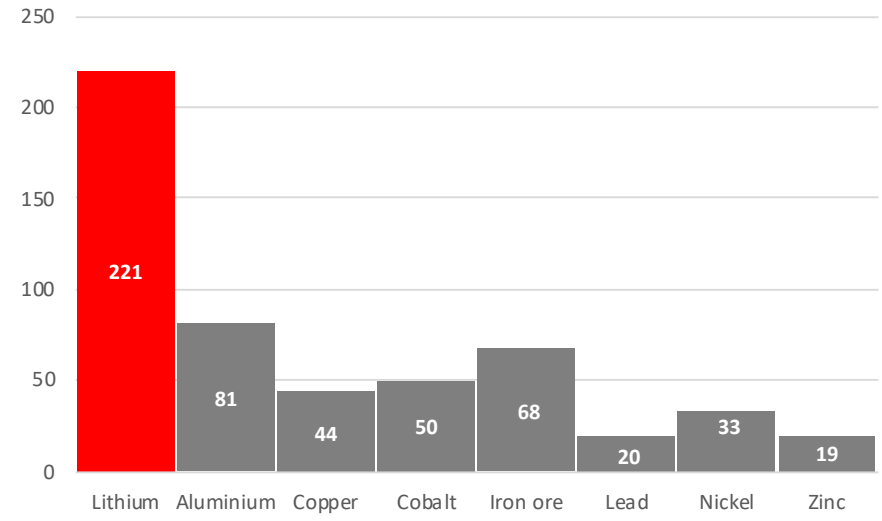
If we use European trends as a future indicator of vehicular fuel-type breakdown, what is the growth demand for lithium going forward?

Historically, it has been very difficult to accurately model future lithium consumption, not only accounting for the variance of different BEV battery types and capacities, but to also incorporate the rapid growth in hybrids. A Honda Fit has a 20kWh battery, whilst Tesla S can now be specified to have a capacity of up to 90kWh; with the energy cost per kilometre for both models ranging from 5.8 to 7.6c, respectively. Looking at 11 different BEV models, the average capacity was 39kWh. The recent arrival of numerous cheaper models with typically smaller capacities have driven recent sales volumes (on a weighted-average basis).

Hybrid vehicles typical use ~12-13% of the contained lithium in a BEV.

By contrast, Hybrid vehicle ranges vary dramatically (13 to 50km), with battery capacities ranging from 4-15kWh. The average appears to be ~4 to 6kWh. Meaning, if we take a snap-shot in time, it takes approximately eight hybrid vehicles to equal the equivalence of a single in-situ BEV battery capacity. The implication being, despite hybrids making up 16% of EU market sales (see Figure 9), in BEV-terms, they only add ~40% of additional overall battery demand despite being >200% more prolific.

Figure 6: Comparative Lithium Reserves with other common commodities, dividing Reserves over current production (in Years).



Source: USGS (2020), FD

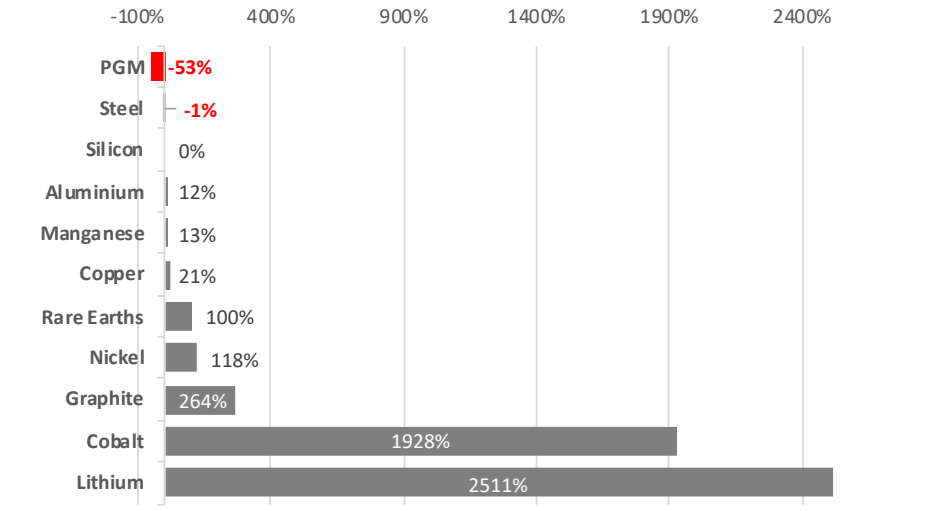
In Western Europe, politics will increasingly play a role in vehicle selection.

Why is this distinction important? Legislative impetus will, in the future, strongly dictate which types of vehicles will dominate roads, as seen in Norway, where financial incentives (financed from oil exports) and cheap hydro power has strongly skewed their purchasing decisions toward BEVs. In the UK, hybrid cars are mandated to outlawed by 2035. Looking at global consumption trends, BEV sales are clearly flattening (see Section Chinese, European and US BEV sales), possibly declining within

the next several years. Given their price and natural short-comings[4] (range and recharge times), BEVs will continue to be, in the short to medium term, associated with privilege. In contrast, with all its varied forms, hybrid vehicles are increasingly becoming the norm, following our working narrative that if a technology is useful and applicable, uptake is inevitable, with subsidies only influencing consumer choices whilst they endure. If true, it implies that eventual lithium demand may only be half that of many previously published projections; which may explain, in part, why the growth in lithium consumption is unable to match output increases.

Despite less than a decade of concerted lithium exploration and development, the longevity of current Reserves (not Resources) is more than ample to meet any conceivable demand scenario (see Figure 6). The potential enormous tonnages associated with newly-evaluated clay hosted lithologies in America/Mexico, and hard-rock Australian intrusives, could easily extend Reserve numbers to >250 years supply at current production rates. Underlying the fact that despite many claims otherwise, lithium cannot be construed as a critical metal.

Figure 7: Incremental commodity demand assuming all vehicles sold globally were 2017 Chevrolet Bolts; massive growth in demand for lithium, cobalt, rare-earths and graphite markets, whilst PGMs, used in auto-catalysts, are impacted negatively.



Source: UBS, FD

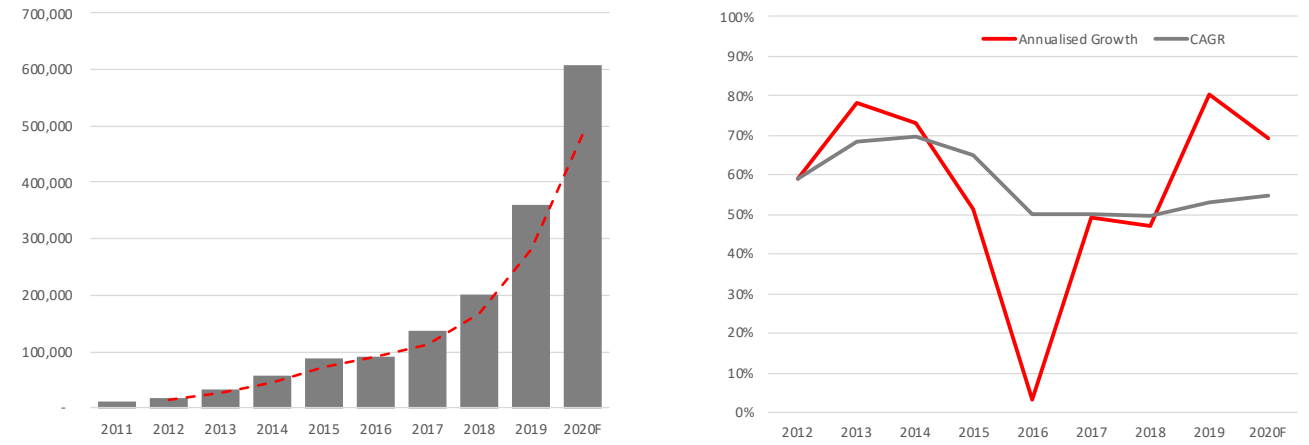
[4] These shortcomings are always subject to advancements in technology, more recently, US researchers claim that development using thermally modulated (working temperature ~60 °C) lithium iron phosphate (LFP) could allow 10-minute recharge times, in all climates [Yang, XG., Liu, T. & Wang, CY (2021) "Thermally modulated lithium iron phosphate batteries for mass-market electric vehicles". *Nat Energy*. https://doi.org/10.1038/s41560-020-00757-7]. Although it has to be noted that LFP batteries do have not had the energy density that other composites have, and may be the reason why they were ignored for so long.

European, Chinese, U.S. BEV Sales Trends

European EV growth is now the highest in the world.

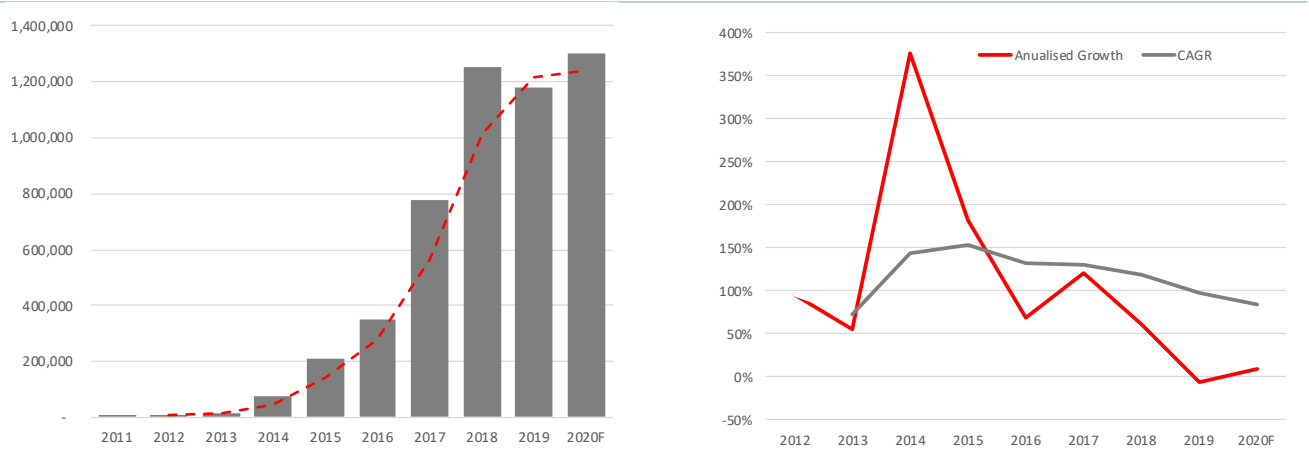
Over five percent of new vehicles sold in Europe is now a BEV (nearly 10% if you include plug-in hybrids), with 30% of the total being sold in Germany where a subsidy of up to €9k exists per vehicle purchase. As previously mentioned, in Norway, 54% of all new cars sold in 2020 were BEV, with the Nordic nation aiming to become the first nation to eschew the sale of all new petrol and diesel cars by 2025. On current growth trends, the European BEV market will numerically exceed that of China's within two years.

Figures 8 & 9: Newly registered EVs in Europe from 2011 to 2020E (left); and annualised versus CAGR growth rates over the same period (right). Estimated growth in EV car sales is ~69.2% in 2020, with (unlike China and the US) compound growth has been relatively stable. In a market that sold ~11.51m units in 2020, BEV market penetration was ~5.2%, helped by significant State subsidies.



Source: InsideEVs (2020), Wikipedia (2020), FD

Figures 10 & 11: Number of newly registered EVs in China from 2011 to 2020E (left); and comparing annualised versus CAGR growth rates over the same period (right). 2020 growth in Chinese BEV sales was ~10.5%, recovering from a -6.2% decline in 2019.



Source: S&P Global (2021), CAAM (2018), SCMP (2020), FD

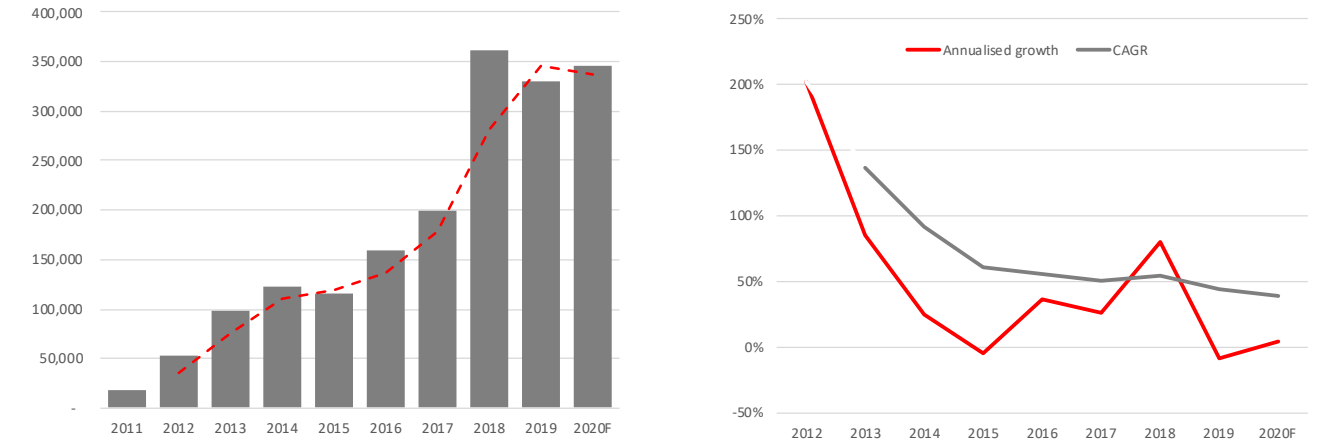
In a market that sells more than 25.5m (est.) cars pa, BEV market penetration in China is ~5%, stimulated by significant state subsidies. Historically, China has been the

China hosts more than half the world's EV market.

largest EV market globally, accounting for half of the world's consumer EV vehicles sold and >95% of the commercial vehicles in operation. For example, China has >97-98% of the estimated >450k of the global electric bus fleet, effectively adding 9.5k new units, which is the equivalent of London's entire working fleet every five weeks. Collectively, with both EV segments combined, it is substantially larger than the rest of the world combined.

This whole-hearted embrace of EV technologies by China is a result of previous central policy directives from the country's leadership, who believed that embracing EVs would allow the country to gain a technological jump over the West. In effect, making a technological bet. Theoretically, EVs should have substantially lower maintenance than an equivalent combustion engine with hundreds of moving parts, whereas an electric motor only has the motor shaft. But, as Tesla has effectively proven, in this technological age, it is never the case, because propulsion and operational systems are effectively a single integrated system. It is interesting to note that those initial claims of garnering a technological edge have not been repeated by any Chinese official (as far as we are aware) for a number of years, even though the official target for BEVs (including plug-in hybrids) and hydrogen fuel cell vehicles remains 20% by 2025. The government intends to cut current subsidies by 20% this year for private vehicles and 10% for EV public transport, including buses and taxis. The inevitable result, we believe, will be a drop in EV sales in 2021, possibly around 2019 levels (see Figure 12).

Figures 12 & 13: Number of newly registered EVs in US from 2011 to 2020E (left); and comparing annualised versus CAGR growth rates over the same period. Estimated growth in EV car sales is ~4.9% in 2020, compared with 80.8% in 2018 and a -8.9% decline in 2019. In a market that sells ~14.45m cars pa, EV market penetration in the US is 2.3% (right).



Source: EV volumes (2021), Inside EVs (2020), CleanTechnica (2019), FD

This change in focus[5] is being reflected in dropping purchase growth (see Figures 10 & 11), implying that, not unlike the US (see Figures 12 & 13), China may be approaching peak BEV sales.

In the US, BEV sales appear to have peaked, but this may be an aberration, and we await what environmental policies the new Biden administration introduces; especially toward oil-shale production, which has indirectly resulted in cheap global fuel prices. Biden was quoted during the campaign that he wanted to "transition from the oil industry" and may not be sympathetic to declining domestic oil production.

[5] We believe that this reflects a deliberate change in Chinese Government policy, with the current five-year plan emphasising semiconductor development and other technologies, as a direct response to the US is cutting chip and associated technologies access. An additional US$1.4tn has allocated toward semiconductor R&D by 2025 by CCP.

How Widespread will Eventual BEV Adoption Be?

Historically, new technology uptake is rapid. Over the past decade, BEV market penetration in Europe is ~5.2%.

We contrast the relatively stagnant BEV sales with that of hybrids (in all their variants), their rapid rise in popularity, combining both economic benefits of increased efficiencies and continued practicality. Which, if anything, demonstrates the boundaries of tax-breaks to achieve social goals. It also highlights the fact that EV shortcomings/compromises and costs are still too significant for the general public to accept. The sequence of photos (see Figures 14 & 15) speaks to our investment narrative, that if a technology offers more efficient production of superior goods and/or services (*e.g*. refrigeration, motorised transport, personal computing or even modern telephony), then adoption is rapid. Government subsidies,' by contrast, distort consumer preferences and more often than not, the net economic benefit is out-weighed by inefficient and wasteful allocation of resources.

Figures 14 & 15: Photograph from 1900 shows Fifth Avenue on Easter Morning with only two cars visible (left); and Easter 1913, Fifth Avenue looking north – spot the horse? (right).

Source: U.S. National Archives and Records Administration, George Grantham Bain Collection

Many of us, in our formative years, grew up in a household that owned several cars, a necessity for many working parents. We naturally assume the propagation of these inclinations going forward as irrevocable. Yet, a decade after BEV introduction, general uptake is extremely muted (with adoption rates ranging from 2 to 5% in major markets), with governments increasingly feeling the need to introduce significant subsidies, penalties and legislation to induce consumers choices.

Although it may be considered politically incorrect, we believe there are a number of increasingly valid questions that policy administrators need to answer:

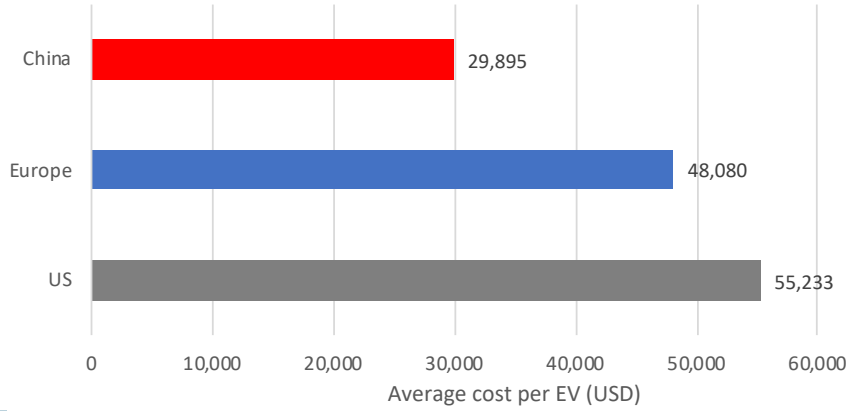
- ***Is total BEV adoption a realistic scenario?***
- ***If not, why not?***
- ***And if not, what is a more realistic/sustainable level?***

Why are EV prices not falling as expected?

According to Bloomberg (2020), battery pack prices have been recently cited at less than $100/kWh, by comparison prices were >$1,100/kWh in 2010, implying a price drop of ~88% in real terms[6]. Meaning, if the Tesla 75kWh battery that currently costs around $11,700, would have cost $97.5k a decade ago (if it existed!). Numerous publications are quoting that batteries make up approximately a third of an eventual EV vehicle's cost, it begs the question, shouldn't have we seen EV prices fall by the equivalent quantum of the battery input overtime?

Current EV prices is a large impediment to a widespread adoption.

Figure 16: Average retail price of EVs sold/registered in H120



Source: JATO (2020), FD

The oft used argument by many commentators that battery costs are the primary reason why EVs are currently so expensive implies, fails the simple Empirical test. For example, using historical prices published by JATO (2019), the retail price[7] in 2012 of a Renault Zoe has, in fact, has increased 18% to €26.6k (€32.6k without the Government subsidy) in 2020. The Nissan Leaf in the US was priced at $33.7k (2011), has managed a modest decrease of 6% to $31.6k (40kWh model, before state taxes) by 2020. Although more difficult to compare like-for-like, the Tesla Model S managed a small 3% increase over its model life to $80k from 2014 to 2020.

In fact, according to JATO (2019), EV sales prices in Developed Nations have increased on average 42%-55% over the past eight years, hence the conundrum, when you realise that over the same period Chinese[8] BEV prices halved! Although this is difficult to compare like for like, whilst there is substantial government support in the form of subsidies to auto firms as well as consumer subsidies from both central and local governments. The rationale for this discrepancy being that Western

[6] Average ~$US137/kWh or ~$126/kWh on a volume-weighted average basis, ignoring chemistry differences. The most expensive component variance being the cathode, because of the compositional differences, such as cobalt, nickel and potentially, manganese.

[7] Comparison ignores technical improvements such as increased range and additional options, which is not an unreasonable assumption, GPS Sat Nav, Rear View Camera, Dual Clutch Transmission, Automatic Parking (Park Assist), Collision Avoidance Systems, Tyre Pressure Monitoring (TMPS), 4G connection and Keyless ignition, were exclusive extras on many top tier vehicles, such as MB S-Class. But inside the past decade, are now common place on base model Toyotas.

[8] China has over 400 registered EV companies, some consolidation to be expected.

manufacturers have focussed on more premium offerings owing to demand for luxurious interiors and more sustainably sourced materials, leaving fewer entry-level possibilities. There is some evidence backing this argument (see Figure 16), but if this trend were to continue, then it is unlikely that future EV prices would be any more financially accessible for the average consumer than at present[9].

[9] The vast majority of EV models require permanent magnet motors, therefore, any meaningful increase in performance is (in part) dependent on stronger magnets, which in turn, require additional neodymium. The problem with that is >80% of the current production takes place in China. Fear of supply issues have most EV makers actively trying to reduce their REE dependence (with the exception of Tesla, which might explain why its cars are endowed with extra performance and range- https://www.youtube.com/watch?v=Lj1a8rdX6DU).

PGM Impact

Platinum demand will continue to be flat.

Palladium traditionally traded at half the price of Platinum, and it is notable that less than a decade earlier, Platinum was trading at a 400% premium to Palladium. This progression in price can largely be related to the decline in diesel powerplants (see Figure 5) and the relative growth in petrol combustion engines, in particular if one considers that the vast majority hybrid models utilise petrol/electric power plants and will continue to favour relative Palladium demand.

Palladium growth will ensure robust pricing.

In Europe, the transition from diesel powerplants to alternatives started to occur in 2016, resulting from an underlying change in consumer demand. The continual decline in usage has meant that diesel (utilising Platinum based catalysts) now only make up 28% of all unit sales. Coupled with the relative rise in hybrid popularity, now selling on a ratio 4:7 in the EU with their diesel counterparts, will continue to depress relative Platinum demand/prices (taking into account some degree of substitution).

Table 1: PGM recommendations

Status	Symbol/Ticker	Ref. Date	Entry Price	Closing Price	Gain/Loss	Reco.	P/E	P/Revenue
BUY	CHN: ASX	14/04/2020	0.57	4.24	650.4%	Open	NA	NA
SELL	IMP: JSE	14/04/2020	10,370	21,509	-107.4%	Close	11.26	2.59
SELL	SSW: JSE	14/04/2020	2,910	6,271	-115.5%	Close	18.14	1.75
SELL	NHM: JSE	01/06/2020	10,962	21,000	-91.6%	Close	35.92	4.7
SELL	RBP: JSE	01/06/2020	3,492	7,304	-109.2%	Close	20.25	2.36

Source: Trading View (2021), FD

We have decided to close a number of our PGM shorts, a trade that has gone strongly against us. We were incorrect in predicting the severity of the sales decline in vehicles, which we now estimate for 2020 as only down -16.5% on a global basis (had originally estimated 50% earlier in the year) from previous years' levels. Unless we get a major market correction, we cannot envisage a scenario whereby PGM demand declines precipitously so as to claw back some of our losses[10].

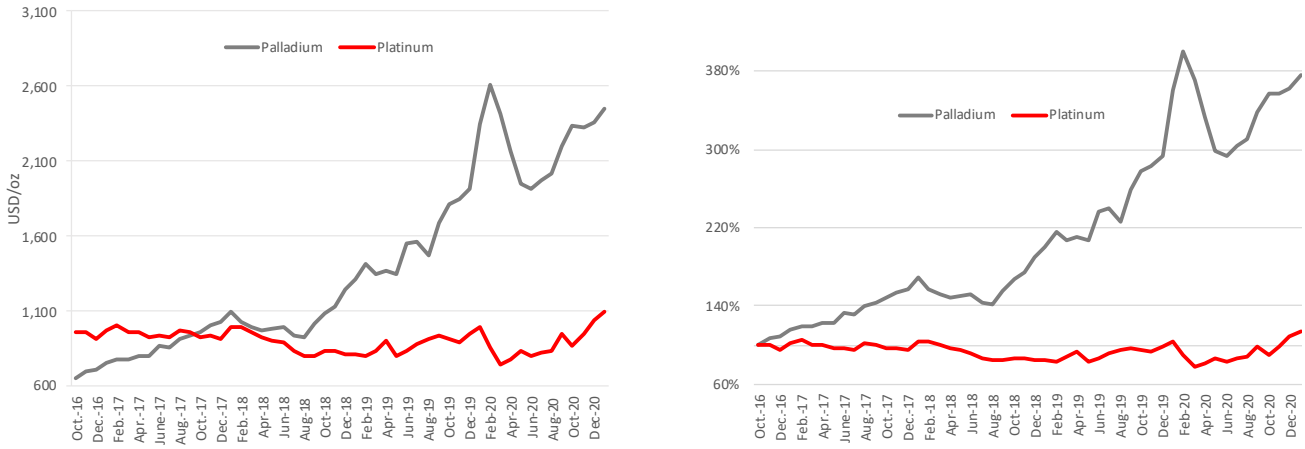
Taking into account the current reflation trade, PGMs could rise substantially higher if price expectations rise. As Charlie Munger recently commented, "*We're in uncharted waters… Nobody has gotten by with the kind of money printing now for a very extended period without some kind of trouble. We're very near the edge of playing with fire.*" The biggest danger associated with MMT is the belief that inflation can be managed by Central Bank actions. Critically, under the MMT programme if money supply continues to flood commercial banks with excess liquidity in order to stimulate private lending and inflation reappearance; would the FMOC and other Central Banks really raise interest rates and risk cutting the recovery? As Niall Ferguson points out in his book, The Ascent of Money, "*hyperinflation is always and*

[10] The only recommendation that we retain is CHN, a relatively recent discovery of a relatively high-grade PGE-Ni-Cu-Co-Au mineralisation, with seven sulphide zones identified over the southern end of the intrusion. We think this whole region will continue to grow in prospectivity for years to come. Major new 6.5km-long EM anomaly recently identified. The majority of the ~26km long Julimar Complex is yet to be explored, recently receiving approvals to conduct non-ground disturbing exploration activities.

everywhere a political phenomenon". The intended effect of an inflation spike (aside from wiping out the purchasing power of both private and public savings) is to be the elixir of the debtor, as the real value of the existing debt is decreases faster than the combined interest and principal that is being paid off. For example, the decline in UK national debt as a percentage of GDP in the post-war period was partly accelerated by inflation which hit 25% in 1975, thereby reducing the real burden of debt.

How much is too much inflation? Laurence Ball calls it "*the addictive theory of inflation*". Like an alcoholic's first drink, 4% inflation may not do great harm by itself, but it is merely the first step in a dangerous process. Excessive inflation distorts the economy in favour of extreme consumption and the hoarding of real assets, potentially we think that in intemperate circumstances that would include PGMs as well.

Figures 17 & 18: Platinum/Palladium prices (October 2016 to January 2021) (left); and both commodities recalculated to 100%. Palladium has increased 276%; by contrast, Platinum has risen only by ~14% over the same period, with no real signs of recovery (right).



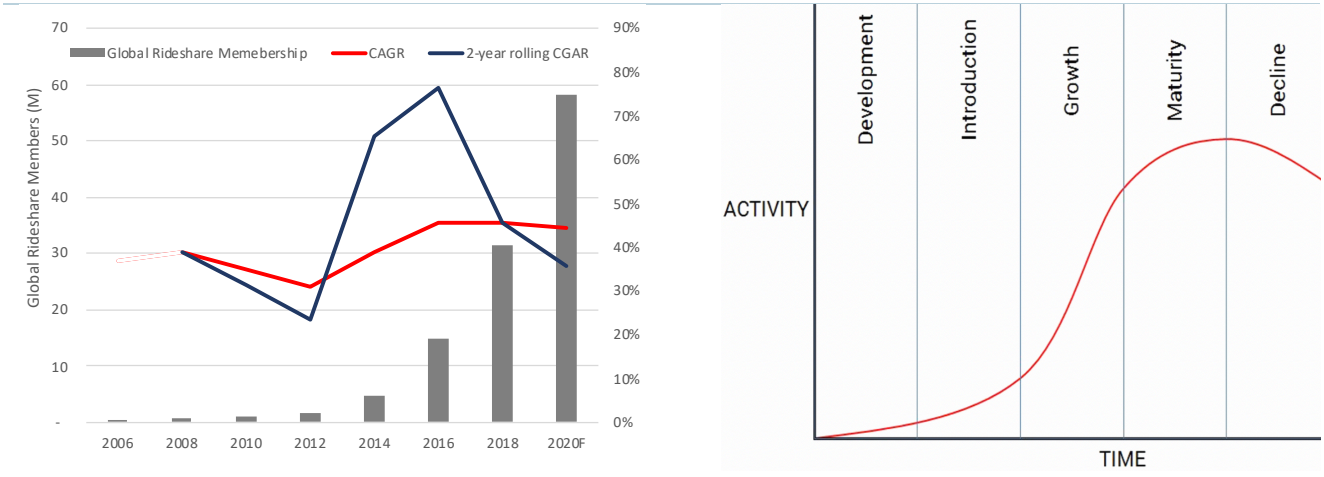
Source: Business insider (2021), Plats Metals (2020), USGS (2020), APMEX (2020), FD

The Invisible Megatrend - Carpooling/Ridesharing Growth

Ridesharing technologies are actively lowering latent demand for vehicles.

The great irony is that future vehicle numbers and their future form of propulsion at the end of the day is probably a secondary consideration. Carpooling/Ridesharing technologies have the ability to sate growing vehicle demand in many quarters of China, Vietnam, and India, where car ownership is not a realistic proposition due to population densities, lack of infrastructure, absence of parking and excessive pollution. The idea that 2018 could be "Peak-Auto", until recently, would have been thought preposterous; with the introduction of several billion consumers from the rise and development of China and India, simultaneously. Yet, sales in many markets had either been stagnating or declining 12-18 months prior to this recent pandemic (see earlier Figures 1 to 4). We accept the argument that not every carpool member will forgo buying their own vehicle, in particular in North America, whereby many casual members utilise rideshare vehicles, for instance, on shopping trips where they acquire numerous parcels and want the ease of pick up and drop off.

Figures 19 & 20: With the growth of carpooling/rideshare globally, we estimate global membership ~59m by the end of 2020. The comparison of life CAGR versus 2-year rolling CGAR indicates where we reside on the sigmodal growth curve, the fact that the two-year curve has only just dipped below that of the overall CGAR rate suggests that we are half way into the rapid "Growth" stage (left); with a clear differentiation in growth between Developed and Developing Nations (right).



Source: Shaheen & Cohen (2020)[11], Shaheen et al. (2019)[12], Cimpl (2018), FD

However, the largest single reason why we believe that auto sales had declined in many key markets synchronously 12-18 months before the recent pandemic, without an apparent decline in global consumer behaviour to provide an alternate economic rationale; is the advent of widespread carpooling and a host of other rideshare platform Apps. The rapid development of transportation as an integrated commodity, incorporating planning, booking, real-time information and fare payment into a single user interface, has the potential to transform personal

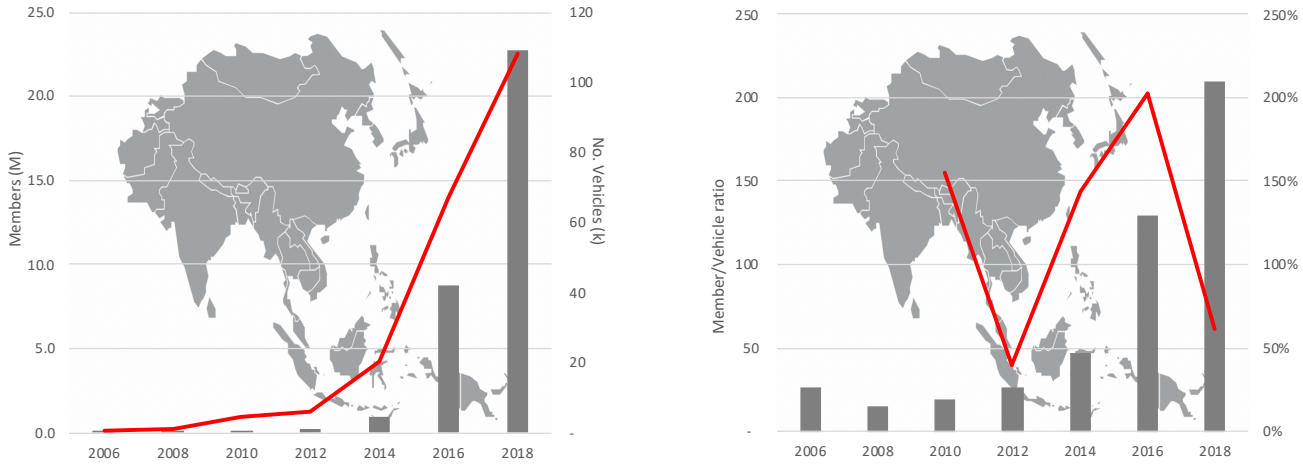
[11] Shaheen, S. & Cohen, A. (2020) "Innovative Mobility: Carsharing Outlook; Carsharing Market Overview, Analysis, and Trends". UC Berkeley, DOI 10.7922/G2125QWJ. 6 p. https://escholarship.org/uc/item/61q03282

[12] Shaheen S., *et al*. (2019) "Shared Mobility and Urban Form Impacts: A Case Study of Peer-to-Peer (P2P) Carsharing in the US". *Journal of Urban Design*. 19p. https://doi.org/10.1080/13574809.2019.1686350

transport. Coupled with the profusion of carpooling/rideshare platforms, could substantially affect future car ownership, marrying a number of social and environmental objectives with financial and urban realities.

Its effects will not only impact primary industries, from rubber, PGEs, copper, aluminium, nickel, iron ore; but also vehicle manufacturers' growth projections, model and powerplant selection.

Figures 21 & 22: Asian number of rideshare members vs number of operated vehicles by providers (left); and number of members divided by vehicles, versus 2-year CAGR (right). With an overall 75% CAGR over the past 13 years, it demonstrated 61% CAGR over the past two-years, indicating market growth is still very strong. N = 10: China, India, Indonesia, Japan, Kazakhstan, Malaysia, Singapore, South Korea, Thailand, and United Arab Emirates.



Source: Shaheen & Cohen (2020), Shaheen et al. (2018)[13], FD

The largest carpooling market globally is Asia, which is also the fastest growing (40% two-year CAGR).

Asia is both the largest and fastest growing market for carpooling, accounting for ~72% of global membership and ~54% of global fleets deployed (see Appendix A). Even large car companies are preparing for this trend. In October, 2019, Toyota launched its new car sharing service for the Japanese market, providing mobility services for short-term use; allowing the customer to swap cars at will, with the ability to unlock vehicles via an App; citing a paradigm shift of "car ownership to car use".

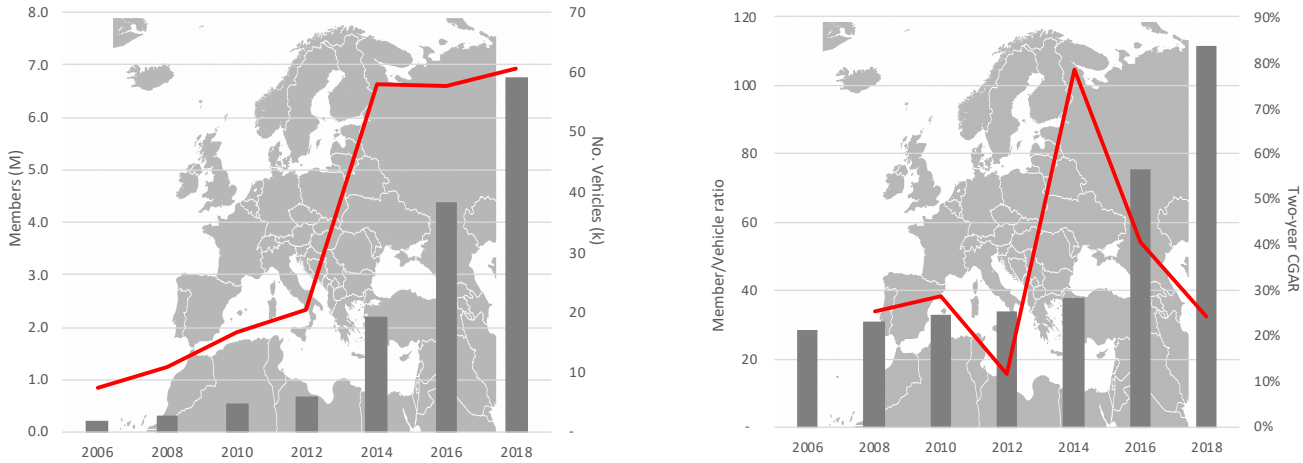
Other than China, and despite its current low penetration rate, we contend that India is likely to become the largest market for carpooling, with growth rates for fleet and membership numbers >24% pa, avoiding the inconvenience of ownership and parking in mega-metropolises (*e.g*. Mumbai or Bangalore). Using the most recent up-to-date 2-year CAGR of 61% (2016-2018), we forecast Asian membership to ~45m by the end of 2020 (see Appendix A).

The world's second largest carsharing market is Europe, accounting for ~21% of global membership, with the largest percentage of one-way (~ 72.3%) to total carsharing membership. That particular business model allows users to rent a car for their commute and park it at their convenience, increasing user flexibility, ultimately

[13] Shaheen S., *et al*. (2018) Innovative Mobility: Carsharing Outlook. DOI 10.7922/G2CC0XVW. 7 p. https://cloudfront.escholarship.org/dist/prd/content/qt49j961wb/qt49j961wb.pdf?t=pa6fa3

reducing the number of private cars on the road. According to Shaheen & Cohen (2020), one-way carsharing accounts for ~50% of global membership and 42% of global fleets deployed, representing a 238% increase in membership, and a 103% increase in fleet numbers since 2016. Providing a realistic platform for various jurisdictions who want to actively limit vehicle access within CBD environments, without incurring political agitation or impacting transportation links yet able decreasing traffic congestion and emissions, and potentially, without adversely affecting economic growth.

Figures 23 & 24: European number of rideshare members vs number of operated vehicles by providers (left); and number of members divided by vehicles, versus 2-year CAGR (right). 31% CGAR over the past 13 years, contrasting with a 2-year (2017-2018) 24% growth rate, indicates that the European market is still in its "Growth" stage. N=27: Austria, Belgium, Croatia, Czech Republic, Denmark, Finland, France, Germany, Hungary, Ireland, Israel, Italy, Lithuania, Luxemburg, Monaco, Netherlands, Norway, Poland, Portugal, Romania, Russia, Serbia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.



Source: Shaheen & Cohen (2020), Shaheen et al. (2018), FD

Compared with many other jurisdictions globally, EU vehicles are more expensive to purchase, fuel prices are typically double that of US, plus toll and congestion charges, making car ownership and driving, more structurally expensive. That economic rigidity provides a greater incentive for the individual to reduce transportation costs, making carpooling a more attractive financial option.

The largest carpooling market globally is Asia, which is also the fastest growing (40% two-year CAGR).

We contend that, increasingly, cars are no longer perceived as assets, but as a liability, with a paradigm shift metamorphosing from car ownership to car use. The reasons are multi-faceted and include increased debt levels, under-employment, inability to afford payments, petrol, insurance, maintenance and repairs. The proliferation of App platforms that allow many, at short notice, to utilise transportation that is flexible and affordable; in the long-term, this presents an alternative to car ownership. Key growth markets are in Asia and Europe, and in the future, South America and forecast ridesharing membership could be in-excess of 500m within a decade, and continue to be a major driver in declining vehicle sales globally.

We hypothesis that the current pandemic could actually speed up the transition substantially, with the largest negative financial impact will be felt by the younger and the less educated, whose jobs are often in the service and hospitality industries; which in many instances, businesses have shuttered. Even new graduate jobs are

increasingly located in large key cities, where employees reside in high-density, inner-city neighbourhoods; near existing, often substantial public transport infrastructure, with little free or even available parking.

This may in part explain why younger generations, increasingly, are not learning to drive. A study by the University of Michigan found that only three-quarters (76.7%) of ages 20-24 possess a driver's license, down from 82% in 2008, and 92% in 1983. According to The Economist, only 67% of the general population between the ages of 18 and 34 have a driver's licence, compared with 82% between the ages of 35 and 54.

Appendix A – Carpooling Data compiled by Berkeley University

Raw 2018 data on carpooling. Asia dominates number of members who hire cars on an intermittent basis (>70%). Using the LT growth, global carpool members should reach ~59m by the end of 2020.

	2006	2008	2010	2012	2014	2016	2018	2020F
Asia (n = 10)								
Members (k)	15.7	12.5	81.8	150.5	955.9	8,722.1	22,707	44,506
CAGR (2 yr)		-11%	155%	40%	144%	202%	61%	40%
Fleet (k)	0.6	0.8	4.3	6.2	20.3	67.3	108.1	
CAGR (2 yr)		15%	131%	19%	82%	82%	27%	
Member/Fleet Ratio	25.8	15.5	19.0	26.1	47.0	129.6	210.1	
South America (n = 3)								
Members (k)			0.1	1.5	3.5	7.4	16.9	37.3
CAGR (2 yr)				269%	53%	45%	52%	49%
Fleet (k)			0.001	0.06	0.1	0.1	0.4	
CAGR (2 yr)				115%	29%	10%	74%	
Member/Fleet Ratio			8.5	25	35	61.3	46.5	
Oceania (n = 2)								
Members (k)	1.1	5.2	12.8	25.5	50.7	96.6	201.0	399.6
CAGR (2 yr)		115%	56	41%	41%	38%	44%	41%
Fleet (k)	0.1	0.3	0.4	1.1	1.5	5.0	5.5	
CAGR (2 yr)		98%	31%	57%	19%	82%	4%	
Member/Fleet Ratio	17.4	20.4	29.00	23.6	33.3	19.2	36.5	
Africa (n = 2)								
Members (k)						15.1	16.8	17.7
CAGR (2 yr)						0%	5%	3%
Fleet (k)						0.4	0.5	
CAGR (2 yr)							10%	
Member/Fleet Ratio						39.8	36.5	
North America (n = 3)								
Members (k)	117.7	318.9	516.1	908.6	1,625.7	1,837.9	2,110.1	2,282.3
CAGR (2 yr)		65%	27%	33%	34%	6%	6%	4%
Fleet (k)	3.3	7.5	10.4	15.8	24.2	27.0	23.4	
CAGR (2 yr)		50%	18%	23%	24%	5%	-6%	
Member/Fleet Ratio	35.3	42.5	49.5	57.5	67.1	68.9	90.3	
Europe (n = 27)								
Members (k)	212.1	334.2	552.9	691.9	2,206.9	4,371.2	6,761.7	11,427.3
CAGR (2 yr)		26%	29%	12%	79%	41%	41%	30%
Fleet (k)	7.5	10.8	16.8	20.5	57.9	57.9	60.6	
CAGR (2 yr)		20%	24%	10%	68%	0%	2%	
Member/Fleet Ratio	28.3	30.8	32.9	33.8	38.1	75.6	111.5	
No. of Members	346.6	670.8	1,163.7	1,778.0	4,842.7	15,050.3	31,813.5	**58,669.8**
% Change from pcp		94%	73%	53%	172%	211%	111%	84%

Source: Shaheen & Cohen (2020), Shaheen *et. al.* (2018), FD

Research Disclosures


Gaius L.L. King

Gaius L.L King has 25 years' experience in mining, exploration, corporate finance, mineral economics and as a resource analyst. As a geologist, he worked five years in various underground operations, and was involved in discovering and delineating ~2.6 Mt @ 3.5% Ni from a variety of ore bodies. Gaius has analysed fundamental supply and demand of iron ore, nickel, PGE, uranium, gold, REE, borate and lithium, among others. As an analyst, he has specialised in the mid-tier/junior sectors, covering mining stocks on the ASX and AIM.

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