



The road to carbon neutrality An electrifying future?

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The ICE-age: A dinosaur on the road to perdition

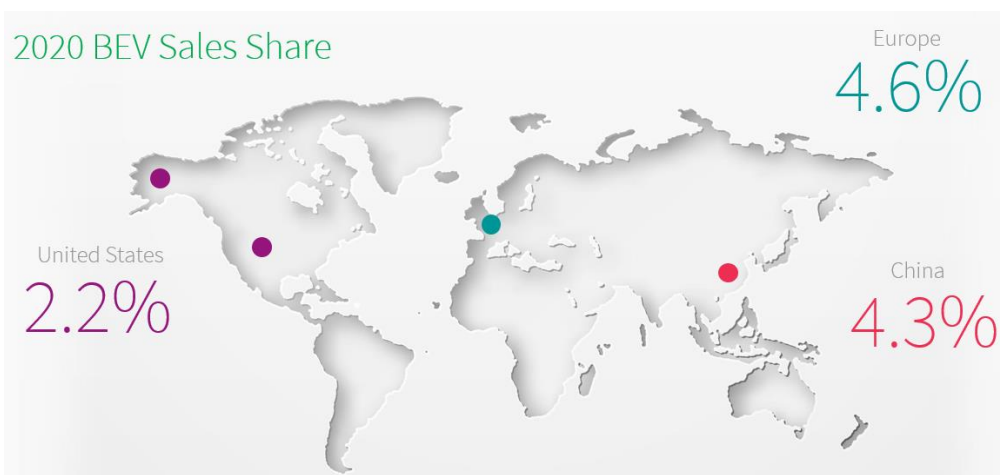
For the last three years or so an increasing number of vehicle manufacturers across the world have been signaling that their successful internal combustion engines appear to be nearing the end of the road, and since the beginning of 2021 this trend has become bolder with the GM (conditional 2035), Ford of Europe (2030) and Jaguar (2030) announcements that they will only sell zero emission cars (ZEV) from those respective dates. More announcements are expected given the increasing political capital being directed towards ZEVs to meet the ambitious climate goals agreed at the Paris climate conference (COP21).

The Paris Agreement: What was achieved?

- A goal of keeping global average temperature increases to well below 2°C above pre-industrial levels in this century; with the aim to limit the increase to 1.5°C
- A framework to support and strengthen the global response to the threat of climate change
- Commitments from all major emitting countries to cut their climate pollution, and a long-term goal to achieve net zero emissions

This feeling was further enhanced due to the impact of the devastating California 2020 wildfires, and of course the deadly impact of the COVID-19 pandemic across the world. Effectively, consumers have now experienced the benefits of less road traffic and the associated cleaner air and safer streets and appear increasingly willing to allow more emboldened regulators the freedom to pursue long-term restrictive climate actions that will impact consumer mobility behavior which in turn could lead to more OEM self-mandating ZEV targets.

Overall it could be argued that the automotive industry has been relatively slow to act upon the increasing climate pressures they face, due to the questionable consumer readiness to accept ZEV vehicles as well as the perceived upheaval that such a change could bring about to their legacy operations. That is not to say that no progress had been made, as witnessed by selected leading manufacturers dancing around the so-called “connected/autonomous/shared/electric” (CASE) paradigm, albeit with arguably limited success compared to numerous new mobility start-ups.



So, has the established automotive industry's time finally come? And could it be that this time around the industry, and its numerous stakeholders, can unlock a powerful new growth story for a future mobility industry based upon electric and/or autonomous vehicles (EV/AV) instead of continued reliance upon the internal combustion engine (ICE)? The drive for carbon neutrality -and the associated mobility electrification- could unlock new business opportunities across a wide-ranging spectrum of technologies and stakeholders. Ultimately the EV switch-over could potentially enable a whole host of new employment and revenue opportunities at least partially offsetting the ICE manufacturing losses; providing a further positive benefit to the wider society beyond the climate and social benefits already understood today.

Climate kickstart: Life in the fast lane

Recently, in a new development, several vehicle manufacturers as well as new mobility providers (like ride-hailing companies), have resorted to so-called ZEV "self-mandates" in which they commit themselves towards an even faster shift away from conventional ICE vehicles in favor of a future product offering featuring exclusively zero-emission vehicles (BEV/FCEV). These self-imposed targets are effectively CEO led ambitions but could lead to an "arms-race" between larger vehicle manufacturers looking to reposition themselves in the minds of consumers willing to go electric hence turning these self-mandates more into a self-(and system wide) beneficial strategy as a volume EV push could lead to faster EV price parity. At the same time it could help to turn their business into a more attractive long-term 'green/ESG' investment candidate to help secure easier/cheaper future access to capital which will be needed to fund the road to carbon neutrality.



ZEV self-mandate

19

196 brands

Carbon neutrality target

9

196 brands

The challenge ahead will be steep and require herculean efforts not just on behalf of the traditional vehicle manufacturers, but across the entire supply chain of the automotive industry. Gone are the days of vehicle manufacturers enjoying almost complete control over the entire vehicle manufacturing/supply chain, and new levels of co-operation will need to be explored rapidly. For incumbent OEMs the management of this transition from their embedded legacy operations is an unprecedented challenge, but at the same time their legacy operations have taught them how to plan meticulously for next generation model cycles and implement changes; a strength that potentially could prove to be welcome for this big new electric moonshot moment that will challenge many aspects of their traditional ecosystem.

The new frontier: A co-dependency ecosystem/supply-chain

The carbon neutral future will open-up the established automotive ecosystem and introduce many new stakeholders to the mobility sector. Obvious ones include -among others- energy providers, technology/EV start-ups, infrastructure and connectivity enablers, new manufacturing/design operators, battery suppliers and recycling expertise.

It becomes clearer that a new level of complexity within the mobility sector will emerge and signifies the importance of increased stakeholder discussion and co-operation.

Overall, roughly three groups of initial “impact areas” could emerge here: (1) operational issues, (2) the business model, and (3) the supply chain. Although likely more areas will emerge in the future once different stakeholders get involved but let us focus upon these three areas as the first ones to be exposed from an automotive perspective.

Operational issues

From an operational point of view the most immediate aspect that currently preoccupies many OEMs (especially those who have committed to ZEV self-mandates) concerns ICE product retirement planning. In other words, how do they gracefully or at least orderly exit the ICE market while still offering these variants in selected markets globally for the near term future, without too much self-inflicted wounds such as declining profit margins, layoffs, drastically changed product plans, and ultimately stranded manufacturing assets (which has the potential to become a critical issue in the automotive sector, as even today the industry is plagued with overcapacity).

However, the wider geopolitical situation -with many nations less inclined to aggressively move towards EVs- could pose more challenging obstacles on the complex road to a profitable electric future. A tepid approach towards EVs for selected markets could potentially pressurize OEMs to cut back vehicle offerings for rest-of-the-world (ROW) markets to only a few selected purpose vehicles to continue to secure some profitability and reduced complexity. This could then pose the question if dedicated ROW platforms will emerge to continue to offer ICE products for low budget markets?

The industry’s R&D development could also dramatically change over the longer-term once EVs become mainstream. The bare-bones EV propulsion system (featuring around 10-20 components versus thousands for an ICE powertrain) could quickly lead to electric motors and single speed transmissions becoming commodities; resulting in significant R&D expenditure cuts or reallocation of resources in the areas of new efficiency improvements or materials research, while software capabilities could start to dominate future R&D. Indirectly the ICE exit could lead to OEMs requiring completely new engineering skills and expertise, which are currently in short supply, that will require investment into more (re)training, recruitment drives, and support to Science, Technology, Engineering and Mathematics (STEM) education policies.

Business model

Another impact area of the ‘net-zero’ push for EV technology will likely concern the business model of the light vehicle sector, which has traditionally focused upon well-established retail/dealer networks. For the last few decades this area of strength of the incumbent OEMs has effectively represented a ‘barrier to entry’ for new vehicle brands and start-ups, but forward looking it appears this may lose potency.

The significantly reduced component content throughout the EV vehicles will without a doubt reshape many of the established maintenance/service activities for both OEMs and their retail/dealer networks. Expect a future featuring reduced service requirements (including for spare-parts and lubricants) and more remote diagnostics effectively anticipating imminent technical problems. And once EV powertrains scale-up rapidly the EV vehicle cost could potentially fall below ICE vehicle costs. While the commercial activities associated with exclusively retailing EVs (such as Tesla operating without any dealerships) will also experience major changes; among which “online sales” is one area anticipating major growth at the likely expense of dealer networks. Furthermore, in an industry that currently spends approximately 20% of the vehicle price on sales and marketing activities a move towards online sales could represent a further opportunity for vehicle price reductions.

If all of this should come to fruition it could shake-up the business model dramatically via

lower input prices (powertrain and retail costs reducing) leading to potentially lower sales price while servicing activities will become less profitable. And in the very long-term the EV era could lead to a potential further move away from retail buyers towards 'pay-per-mile' vehicle/mobility service users, which could even affect the financial services offered by most OEMs.

Supply chain

Finally, a rapid switch-over to EV vehicles will inevitably lead to scale economies starting to evaporate for ICE vehicle/engine manufacturing activities, which could further pressurize the upstream supply chain. For example, theoretically if the top-5 OEMs would commit to ZEV self-mandates by 2035 it would (on its own) represent approx. 47 million EV sales in 2035 which would account to a 43% share of the global market projected at that time. A switch-over of this volume would tremble throughout the supply chain, which would stand to lose hundreds of billions of dollars in value. Just the displaced value for engine pistons alone in 2035 could start to amount to revenue losses of more than US\$15 billion for the supply chain. Of course, there will be new revenue originating from the shift to EVs as those 47 million EVs would require as much as approx. 3.8 billion kWh of battery demand.

Over the last few decades much of the innovation in the automotive sector originated from the mid-size supplier community so indirectly they financed significant technology developments; however the pandemic has wreaked havoc among the supplier community and their margins have already dropped dramatically leaving many to struggle. So, while the 'net-zero' push could hurt many of the more traditional suppliers, they are also likely to face increasing pressure to help 'clean-up' the supply chain in terms of utilizing green energy sources and securing sustainably procured raw materials.

Stakeholder turbulence ahead: A storm is brewing

Once the initial three automotive "impact areas" have been exposed the next level of complexity that will hit the mobility sector will emerge: the significance and multitude of cross-sector stakeholders. Many of these stakeholders -be they governmental/regulatory or private companies- are also highly likely to be caught up in the crosswinds of the 'net-zero' storm affecting the EV transition. One only must consider some of the more obvious impacts such as the expected declines in oil demand, fuel taxation revenue, and the possible impending emergence of 'regulatory redundancy' especially for emission and fuel efficiency standards to understand that a variety of other relevant stakeholders will also imminently face further threat of externalities.

This stakeholder disruption initially could be grouped into three groups: (1) EV-Bill of Materials (BOM), (2) Regulatory/Government, and (3) Energy. Although more than likely several other areas will emerge in the future but let us focus upon these three stakeholder areas as the initial ones to be more exposed to the friendly fire.

EV-BOM

Arguably the most significant impact could be the EV-BOM as it will resonate across industry sectors and could lead to diminished security of supply of required raw materials across several industries (e.g. consumer electronics versus automotive usage). With national plans to achieve net-zero hinging on the electrification of transport, governments are increasingly promoting the development of local battery manufacturing; especially as more than 80% of global battery cell manufacturing was in mainland China at the end of 2020.

Natural availability of the critical raw materials that are required to manufacture batteries (e.g. Lithium, Nickel, Cobalt, etc.) is limited in major end-markets for EVs. This is one of the factors driving governments and corporations to increasingly investigate developing a local recycling industry, as materials recovered from used batteries may begin to

provide a local supply. Although recycling activities will remain very limited in 2021, early progress toward establishing this crucial industry will continue. And increasing regulation (e.g. EU Batteries Directive) will also help drive this ramp-up of battery recycling capacity.

Another increasingly important requirement will become the certified provenance of critical battery raw materials, as the ESG premise will no longer be compatible with conflict or child-labor minerals usage.

Regulatory/Government

The regulatory and/or government impact is also expected to face significant upheaval, especially concerning taxation revenue. While currently this is an area that remains not so well understood -apart perhaps from the more obvious liquid fuel tax loss- there is one clearer example: The Kingdom of Norway. Norway is arguably leading all other nations in terms of achieving net-zero carbon emissions and its government intends to have EVs account for 100% of new light vehicle sales by 2025.

While greater EV adoption is helping Norway to achieve its ZEV target of 2025, this progress has come at a price—in the form of foregone government revenue including from vehicle taxes, tolls, ferry parking fees, and gasoline and diesel taxes. This challenge has intensified as the EV share of light vehicle sales has risen, and the Norwegian Ministry of Finance indicates that revenue from taxes on cars and fuels has effectively halved from 75.8 billion NOK in 2007 (9.1 billion USD) to 39.6 billion NOK in 2020 (4.7 billion USD). And this is excluding the loss of the VAT exemption on new EV vehicle sales which the Ministry indicates amounted to another loss of 9.0 billion NOK in 2020 (1.1 billion USD).

Clearly the loss of taxation revenue for global governments around the world will become a major issue in the coming decade, especially when most will already need to prepare for the aftermath of the huge borrowing to deal with the ongoing COVID pandemic. Most stakeholders are aware but looking beyond the issue that once ZEV mandates have been rolled out that new taxes will be applied to the growing EV fleet of vehicles, and that the emergence of mobility services will open up new mileage/usage taxation opportunities as well. Overall, the potential alternatives and how they are implemented remain unknown in detail for now but will be significant to the eventual impact on private mobility.

Energy

One of the main issues affecting the EV take-rate over the last few years has been the classic ‘chicken or the egg’ dilemma; where the low number of EV sales is blamed for the slow rollout of EV charging infrastructure, and vice-versa. This imbalance in the ecosystem however is of critical importance, as any misjudgments from stakeholders could result in delays towards achieving the net-zero goals. And of course, the situation gets even more complex as the investment required is of such magnitude that most stakeholders are cautious before moving forward. There also needs to be a viable business case for those early to market, be it supported through government subsidy or forward-looking private investment.

What is clear is that the number of EV charging stations will need to expand significantly in the coming years, and it appears that many utilities as well as traditional oil majors and energy providers are now ramping up EV infrastructure spending. However, the reality of EV charging infrastructure is that future-proofing investments is not simple since there are various means by which to charge as well as important imminent technology developments to consider.

On the EV vehicle side, the current crop of EVs typically feature on-board chargers (OBC) to support alternating current (AC) charging with an a typical power output of 11kW charging power which is expected to become commonplace for EVs over the next decade; but more powerful OBC technology will increasingly support power outputs up to 22kW especially beyond 2027, which will be helpful in reducing costs associated with compact

urban EVs needing only small battery capacities but capable AC charging. Bi-directional AC chargers will see significant uptake to support Vehicle-to-Grid (V2G) applications in major markets. Direct Current (DC) fast charging negates the need for an OBC, facilitating much higher power and therefore faster charging, with 350kW currently an industry benchmark on the Porsche Taycan. By 2030 we anticipate seeing a shift towards higher capacity batteries and wider adoption of more powerful DC fast charging capability.

What does this mean for the grid? Carefully managed ‘smart’ charging strategies - featuring variable charging rates timed to coincide with peaks/troughs in demand- are likely to become key to manage future charging needs. The energy sector will need to start planning for a variable EV future or it could run the risk of eternally playing catch-up with the winds of change. And of course, there is the added imperative of planning to increasingly provide a greater proportion of energy needs from renewable sources so the future EV vehicles can indeed be perceived as clean mobility solutions.

A perfect storm: Upending global industries

Newfound global drivers such as net-zero, ESG, ZEV self-mandate and national ZEV mandates are converging to provide unidirectional strong tailwinds. Combined with the already convincing electrification arguments like rapidly declining battery costs, improving EV manufacturing economies of scale, an increasing number of EV models of all body types -especially sport utility vehicles- for consumers to choose from are now all converging to a trend that will make it easier for consumers to go electric over the course of the next decade or so.

This highlights that the momentum is growing towards a more united industry, supported by numerous other stakeholders which increases the likelihood of a ZEV future taking hold. However, the path towards this ZEV transition will require multi stakeholder cross-industry solutions, a prospect which the world at large has so far failed to pursue. Hence the anticipation is for heightened levels of preparation and increasingly create partnerships enabled by the common goal that is net-zero.

One further ‘make or break’ enabler in this quest for net-zero could be argued to be the world’s governments. While the world has experienced much political support and 196 nations originally signed the 2015 Paris climate agreement (COP21), as of January 2021, only 190 states remain parties to the agreement. So, the factor of government “perceived commitment” to net-zero could be an overall critical factor, especially with many nations already issuing national ZEV mandates for future compliance. More governmental support is anticipated later this year when the United Kingdom will host the 26th UN Climate Change Conference (COP26) in Glasgow. During the conference, a flurry of commitment announcements from governments -as well as large corporates- can be expected to support and accelerate further action towards the goals of the original Paris Agreement.

The automotive industry itself is getting ready to face a truly lifechanging transition towards a new mobility universe crossing numerous industry sectors. The change will be truly challenging and complex and not all incumbent OEMs will likely make it, but those who will are likely to be those that already feature an existing EV line-up, exhibit a dynamic and flexible attitude towards changing internal organizational structures and processes, embracing software competences or find suitable partners, and are able to secure their supply chain while remaining an attractive option for customers looking for new, exciting vehicles and mobility service offerings.

Ultimately the drive towards ‘net-zero’ in the automotive industry will undoubtedly be perceived as a race towards clean mobility solutions and sustainable supply chains, however the unintended consequences are still not completely clear yet. What is clear however is that the true impact of the net-zero movement will tremble throughout the wider stakeholder field far beyond the initial surface impact.

