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REGULATIONS FUELLING FLEET ELECTRIFICATION

By Younghun Choi

MARKET INSIGHT

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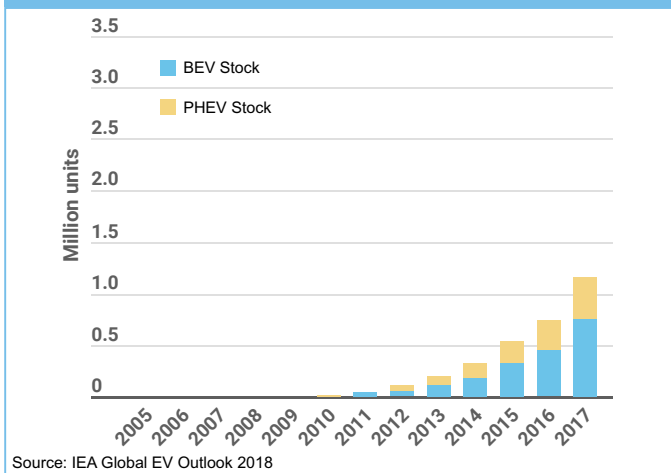
Over the past decade, the growing stringency of major economies' vehicle fuel efficiency requirements as well as monetary and fiscal incentives for electric vehicle¹ (EV) purchases have contributed to solid growth in the global EV sales and fleet. As more and more car manufacturers have been looking to increase EV sales as a viable path for compliance with fuel efficiency requirements and GHG emissions regulations, the number of EV model offerings has grown notably over the last decade. Thanks in part to a wider variety of options for consumers and lower prices brought on by financial incentives in many markets, the number of EVs sold annually in the world and their fleet each surpassed 1 million units by 2017 and 2015, respectively, and have since sustained double-digit growth.

Although the share of EVs as a percentage of passenger car sales and the overall fleet still remains marginal compared to the share of conventional passenger cars in most countries, EV penetration has been notable in several major economies, particularly China, the United States and Western Europe. The market share of new EV sales in these three regions has grown sharply in recent years:

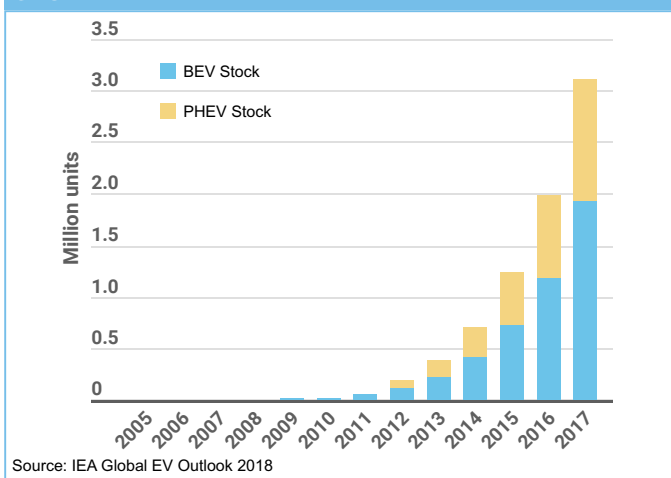
- China, from less than 0.1% in 2012 to 2.3% in 2017;
- United States, from 0.7% in 2012 to 3.3% in 2017; and
- Western Europe, from 0.2% in 2012 to 2.0% in 2017.

As briefly mentioned above, the key drivers for the strong EV penetration in these three regions have been vehicle fuel efficiency policies (or GHG emissions abatement regulations) and fiscal incentives for EV purchases. The EU, China, and the US all have passenger car fuel

GLOBAL EV SALES



GLOBAL EV FLEET



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¹Electric vehicles (EVs) in this article refer to both battery-electric vehicles (BEVs) and plug-in hybrid vehicles (PHV).

²NEVs defined by the China NEV mandate policy covers BEVs, PHEVs and FCEVs.

efficiency regulations in place, with an annually growing stringency of efficiency targets, along with several incentives associated with the EV purchase and circulation.

In addition, many countries within these three regions have introduced EV promotional policies. China has introduced its new energy vehicle (NEV)² mandate policy, which requires a certain share of NEV production or imports within the manufacturers' total passenger car sales and

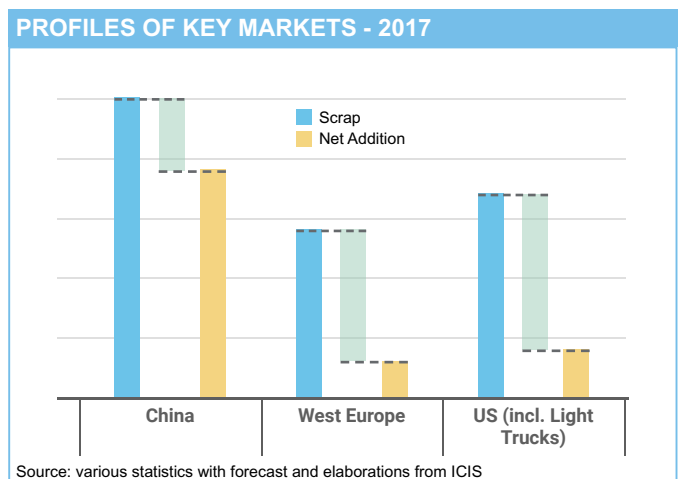
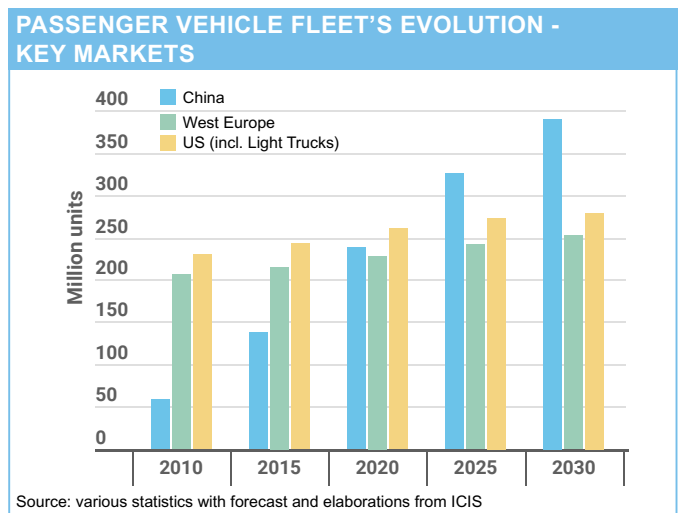
import volumes, while several European countries have announced the restriction on the sales and circulation of internal combustion engine (ICE) vehicles, or their plan for such restrictions. Although a reduction in subsidies and tax benefits is likely in these three regions in the long term, zero emissions vehicle promotional policies are projected to keep driving EV penetration together with vehicle fuel economy policies.

STRONG EV PENETRATION EXPECTED, DESPITE VARYING GROWTH IN REGIONAL FLEETS

Between 2010 and 2015, the global passenger vehicle fleet expanded by more than 20%, although the degree of growth differed substantially across regions. As shown in the chart below, while the size of the passenger car fleet in the US (including light trucks) and Western Europe increased by only 5% and 4%, respectively, between 2010 and 2015, China's vehicle fleet grew by more than 120%.

Due to the relatively low passenger vehicle coverage³ in China (13% in 2017), most of the new passenger vehicles sold in the country are added to the existing fleet, with only a minor share replacing the scrapped vehicles. Meanwhile, most of the new vehicle sales in Western Europe and the US replace retiring vehicles, given the already high level of passenger vehicle coverage. In Western Europe, the passenger vehicle coverage stands at over 50%, while it is over 75% in the US (including light trucks).

Hence, the growth in the share of EVs within the new vehicle sales driven by the increasing stringency of the vehicle fuel efficiency requirement and EV promotional schemes will leave a visible impact in all three regions, but to different extents.



³Passenger vehicle coverage reflects the percentage of passenger cars to the population.

ROAD FUEL DEMAND PROJECTION UNDER DIFFERENT EV PENETRATION SCENARIOS

Under the baseline scenario, the share of BEVs within the three regions' passenger vehicle fleet is expected to grow across the board, albeit at different rates, given the current (and targeted) regional regulations on vehicle fuel efficiency and transportation sector GHG emissions.

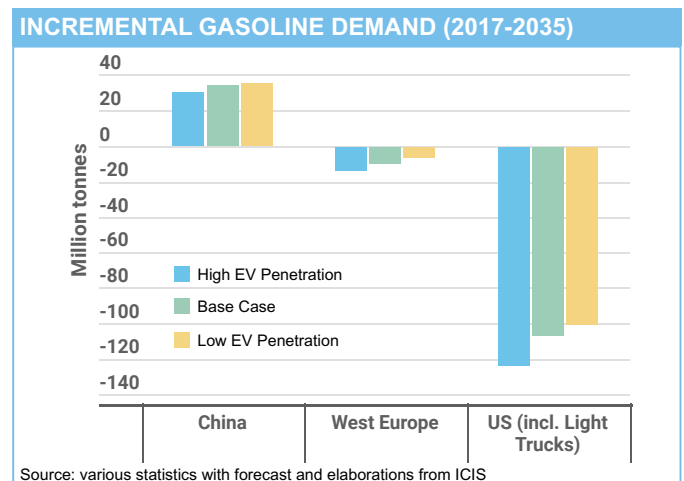
When different EV penetration scenarios are assumed—BEVs accounting for over 50% of the passenger car fleet by 2050 under the high EV penetration scenario, and for 10% lower than the base case scenario under the low penetration scenario—different trajectories for fuel demand emerge.

The chart below illustrates the expected impact of EV penetration on gasoline demand across the three regions. Because Western Europe's passenger fleet is primarily fuelled by diesel, the impact on road fuel demand in Europe is expected to be more significant than what is depicted. Meanwhile, the other regions' decline in demand is expected to be more aligned with the overall reduction in road fuel consumption from the passenger fleet.

In terms of sensitivities, when a faster pace of electrification of the passenger vehicle fleet is assumed, the fuel efficiency of new conventional ICE vehicles is not expected to improve substantially; however, the overall passenger car fleet's average fuel efficiency will remain very high due to the notable share of zero emissions vehicles. In contrast, if a weaker penetration of EVs is assumed, the

fuel efficiency of the new ICE vehicles should improve substantially, so that car manufacturers would be able to remain compliant with the vehicle fuel efficiency requirements that apply to the produced vehicle fleet.

Nevertheless, even though the road fuel demand is expected to decrease at the fastest rate under the high-EV penetration scenario, the difference in the rate of the fall in demand is not expected to vary significantly under all scenarios, demonstrating the stronger influence of regulations on efficiency standards and emissions than fleet electrification, at least out to 2030.



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