

RobecoSAM Smart Mobility | 08/2018

Insight

For professional investors only

Rising currents are lifting EVs to new heights



By 2030 already 1/3 of all cars will be (plug-in) electric vehicles.

Technological advances in energy management and materials together with anti-pollution regulation are paving the way for low to no-emission vehicles. Further out, electrification, autonomous driving and shared mobility will revolutionize both the car and concepts of urban transport.

Bogged in smog

Air pollution is a distressing global topic that has unleashed outrage and action from not only environmentalists but also governments and corporations. Transportation is responsible for about a quarter of global greenhouse gas emissions, with passenger cars and other light vehicles accounting for 17% of the total.¹ In China, one-third of pollution comes from gas and diesel-burning engines and deaths due to air pollution in India and China have already reached a million per annum and continue to rise.² Developed and emerging economies face similar crises.³ The European Environment Agency reported that dirty air resulted in the premature death of nearly half a million EU citizens.

As air quality declines, total economic and welfare costs are rising.

¹ Credit Suisse Connection Series, "Drive Train to Supply Chain," April 14, 2016, p. 40

² Financial Times, "India air pollution deaths poised to exceed China's" February 14, 2017

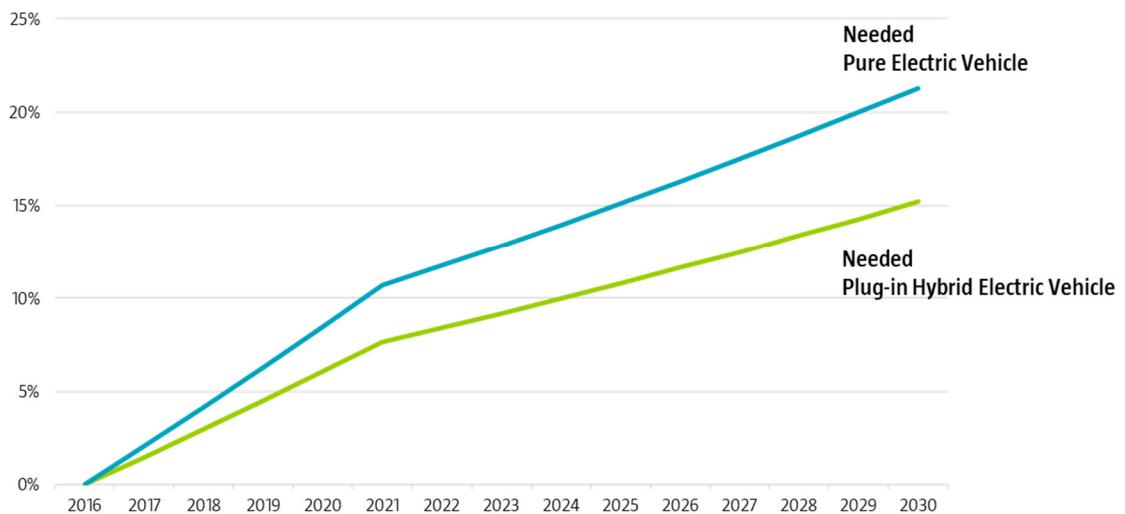
³ OECD Policy Highlights, Economic Consequences of Outdoor Air Pollution, 2018

As air quality declines, total economic and welfare costs are rising. Population growth and city density are also increasing, exacerbating a problem that is already out of control.

By 2060, the total cost of air pollution will account for 1% of global GDP (up from 0.3% in 2015).⁴ Combatting air pollution by targeting automotive transport is gaining momentum among governments worldwide. China is aggressively supporting the Electric Vehicles (EV) market through subsidies and restrictions on petroleum-powered vehicles in smog-choked cities. Similar measures have been introduced in urban settings around the world and are hastening the demise of conventional cars (Figure 1).

Figure 1: Emissions standards—spurring EV uptake

Example European Union: required EV share of new vehicle sales



Source: RobecoSAM, ICCT, 2018

Estimates assume fossil fuel car efficiency to improve 1% p.a. and 47g/CO2 per 100 km for Plug-in hybrid EVs

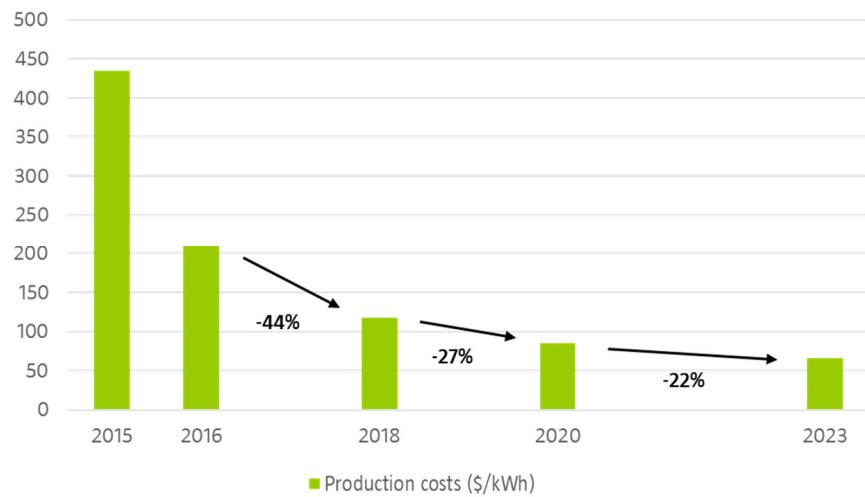
Although incremental improvements in fuel efficiency and exhaust technologies of traditional cars are advancing, the overall costs of carbon emission compliance are rising. As restrictions on ICEs (internal combustion engines) intensify and public awareness of climate change strengthens, EVs are in the crosshairs as a solution for pollution.

Lithium and lightweights

EV ascendency can't be achieved without battery power. Mass production of lower-cost, lighter-weight and energy-dense lithium-ion batteries are essential for charging the EV revolution. Driven by EV sales, RobecoSAM estimates the auto industry will consume 50% of total lithium output by 2020, up from around 18% in 2016. Batteries contribute, on average, to around a third of an EV's total cost and account for the EVs higher price tag.

⁴ Ibid

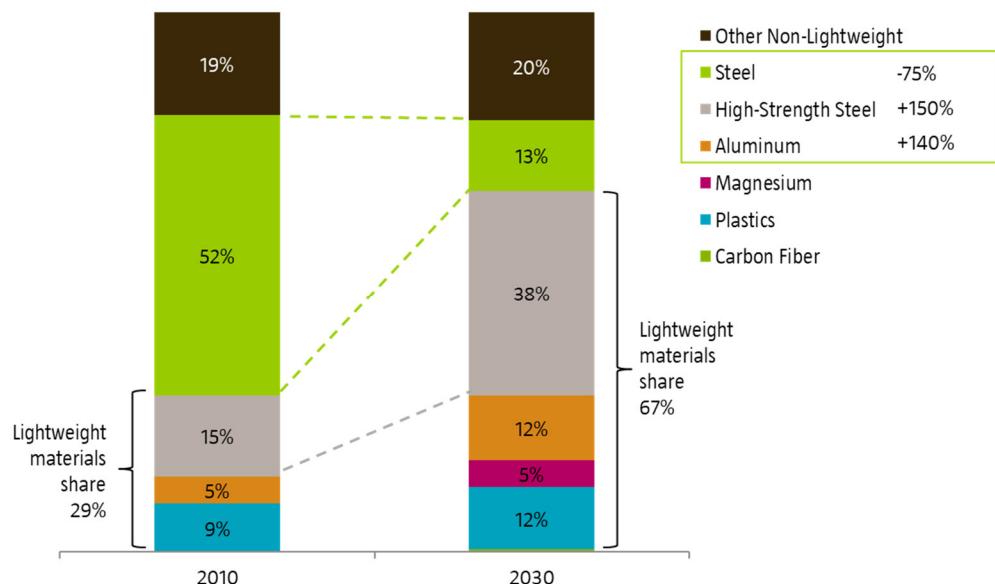
Figure 2: Battery production costs continue to decline



Based on pure economics, prices need to fall for EVs to overtake sales volumes of traditional vehicles. Innovation and economies of scale have already driven down the average battery cost to a fifth of 2010 prices and analysts are optimistic that figures will continue to fall rapidly.⁵ In fact, early movers, like Samsung and Tesla, are poised to half costs again (to \$100 per kWh) by 2020 (Figure 2). Cost parity with traditional cars is expected when battery pack prices fall in the \$125-150/kWh range, so a tipping point is fast approaching.⁶

Lithium isn't the only commodity needed to fuel the EV evolution. To maximize fuel efficiency, steel-heavy components of today's cars must be replaced with lighter weight materials like aluminum and polymer composites. Losing weight means gaining distance on less fuel and helps make room for the other essentials like bigger batteries, electronic motors, safety devices and onboard control systems which interface with external networks.

Figure 3: Shedding weight to gain distance — the share of lightweight materials in vehicles is rising



⁵ Bloomberg, "Electric cars may be cheaper than gas guzzlers in 7 years," 22 March 2018

⁶ Howell D. et all, 2016, Overview of the US Dept of Energy VTO Advanced Battery R&D program. Online at https://www.energy.gov/sites/prod/files/2016/06/f32/es000_howell_2016_o_web.pdf

Vehicle Electrification Part 1— overhauling the powertrain

EVs are considerably cleaner and more energy-efficient compared to petrol-powered vehicles—compelling features that will continue to improve with time and technology. But the benefits to consumers extend beyond fuel costs and low emissions. Production and maintenance costs are also sinking thanks to a radically re-engineered powertrain system. The powertrain is the EV's life force that converts battery power into horsepower.

The EV powertrain is structurally simpler and lighter compared to traditional cars resulting in more efficient assembly and lower production costs (See Figure 4). And as production scales up, costs come down. Structural simplicity means fewer breakable parts to service and lower maintenance costs over the life of the car.

Figure 4: Simple & Sleek vs. Complex & Clunky

Electric Powertrain (Top) vs. Conventional Powertrain (Bottom)



Source: Tesla, Audi

Advantages like these are making EVs price-competitive and increasing their mass appeal. Unsurprisingly, automakers have announced ambitious targets for EV models across product line-ups. As these positive forces converge, an inflection point in EV sales is expected early in the next decade.⁷

⁷ Bloomberg New Energy Finance, Electric Vehicle Outlook 2017

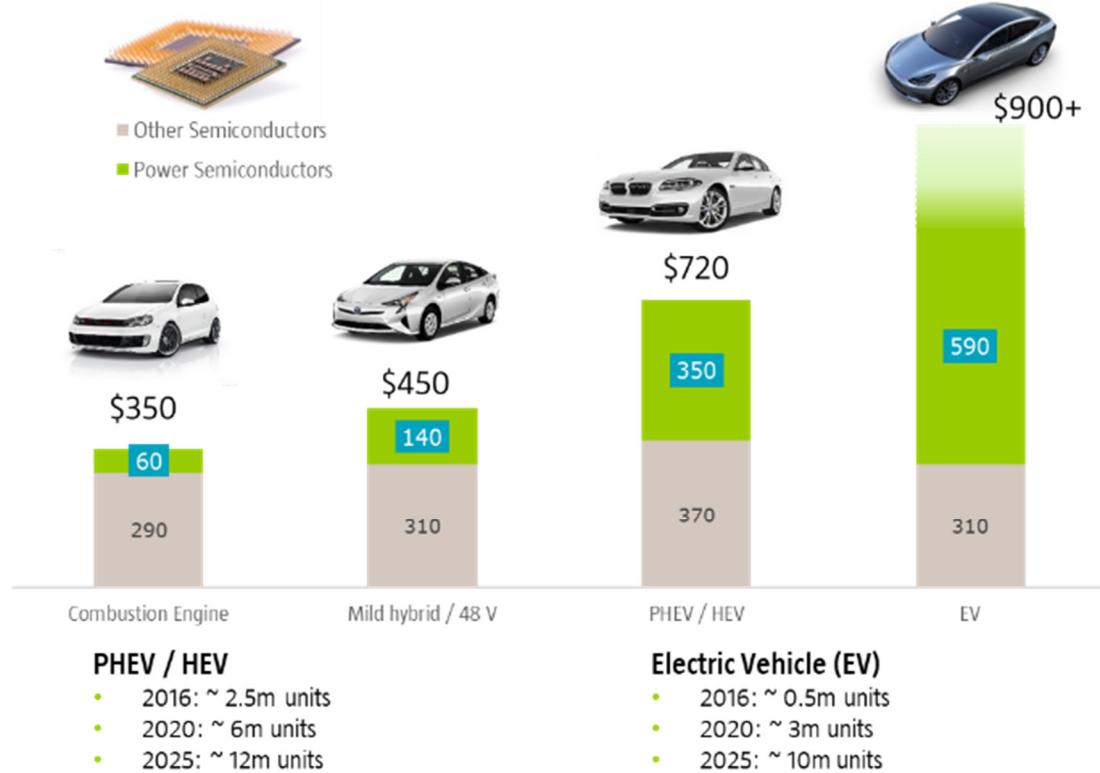
Vehicle Electrification Part 2—powering more than mobility

Electrification will revolutionize mobility quite literally from the inside out, starting with the car's internal design and then shifting to its external interactions within a larger transportation system.

Critical to this second stage of development are the IT technologies that enable cars to communicate information to centralized data hubs to prevent problems and optimize performance. In future, vehicle-to-vehicle (V2V) communication will improve passenger safety and reduce traffic congestion while vehicle-to-grid (V2G) applications will allow EV owners to optimize charging tariffs and help stabilize the energy grid.

Software, sensors and semiconductors are at the heart of this transition. Electric vehicles already have 10x more semiconductor content than traditional vehicles (Figure 5).

Figure 5: Circuits and semiconductors increasing in content



Source: RobecoSAM, company information (excludes ADAS semiconductors)

Conclusion

The demand and sophistication of vehicle electrification will intensify with the acceptance and expansion of autonomous driving. Ultimately, vehicle architecture, manufacturing, and engineering will undergo a complete overhaul. The car of the future will transform from one dominated by pure mechanics, hydraulics and hydrocarbons to one of circuits, silicon and software – a “computer on wheels” with the power to reduce pollution and improve urban life and infrastructure.

“The car of the future will be safe, green and connected. New business models will emerge and change our way of life. The electric revolution has just started. Join us on this electrifying journey!”



Thiemo Lang, PhD

Senior Portfolio Manager
RobecoSAM Smart Mobility



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Senior Portfolio Manager (deputy)
RobecoSAM Smart Mobility

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