# CAN ELECTRIC VEHICLES COMPETE WITH COMBUSTION ENGINE?

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GLOBAL X
by **Mirae Asset**

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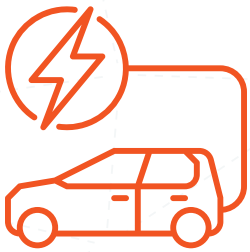

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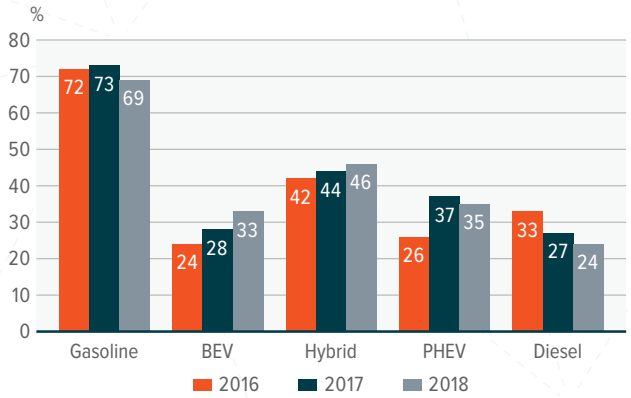
## CAN ELECTRIC VEHICLES COMPETE WITH THE COMBUSTION ENGINE?

- Analysts believe that total cost parity may have been reached
- Battery reliability is a vital issue for consumers
- Battery cost is also crucial
- Technological advances are improving efficiency

According to 2018 of Citi Research, electric vehicles (EVs) have already reached cost parity with internal combustion engine (ICE) cars from a total cost perspective, including upfront payment, maintenance, depreciation and fuel costs.

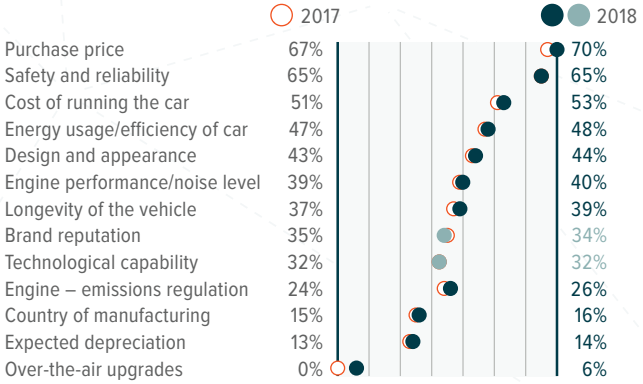
Consumers face four main barriers before they can fully embrace EVs: range, infrastructure, battery degradation, and cost. People want to know if the car will get them to their destination, whether they can recharge it, will the battery last long enough and is it cheaper than a regular gas or diesel passenger vehicle. Of these four factors, cost is the most important issue cited by consumers when purchasing an EV. We, therefore, believe it is crucial to consider the timeline when EVs finally achieve cost competitiveness with ICE cars.

**FIG 1. LIKELIHOOD OF PURCHASE CONSIDERATION BY VEHICLE TYPE**




Source: UBS Evidence Lab, 14 October 2019

**FIG 2. MOST IMPORTANT FACTORS WHEN PURCHASING AN EV**




Source: UBS Evidence Lab, 14 October 2019

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## BATTERY PRICES MUST FALL

For the penetration of EVs to truly increase, demand 'pull' factors will need to take over. Consumers must believe that the utility of an EV is higher than that of a conventional car. For this to happen, the price of batteries must come down to a level where cost parity with traditional vehicles is reached. Lower battery costs will also extend the range of EVs, and newer technologies will solve the problem of battery degradation. Finally, a network of charging stations will need to be installed to alleviate the 'plug-in' fear.

### INNOVATION IS LOWERING COSTS

Rapid advances in battery technology are improving EV economics. Innovations in chemistry and design, along with larger-scale effects, are leading to higher densities and lower costs. In particular, the development of higher-capacity cathodes with greater nickel content, silicon-carbon composite anodes and improved electrolytes that allow higher voltages will all drive significant improvements in energy density.

### ALREADY CHEAPER?

Citi estimates that over three years, the electric versions of the VW Golf and Ford Focus will be 3–16% cheaper than their ICE versions. The calculation assumes an annual mileage of 7,500 (based on the typical distance traveled by a privately owned car in the UK in 2016). Vehicle depreciation among EVs typically accounts for 97% of the total cost of ownership over the three years, while for the ICE, depreciation represents 63% of the ownership cost.



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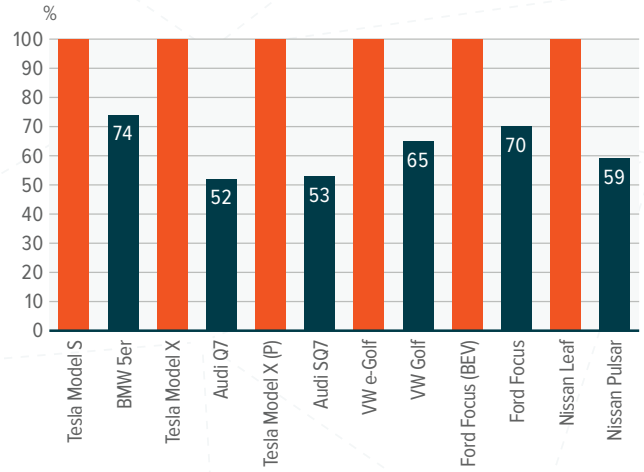
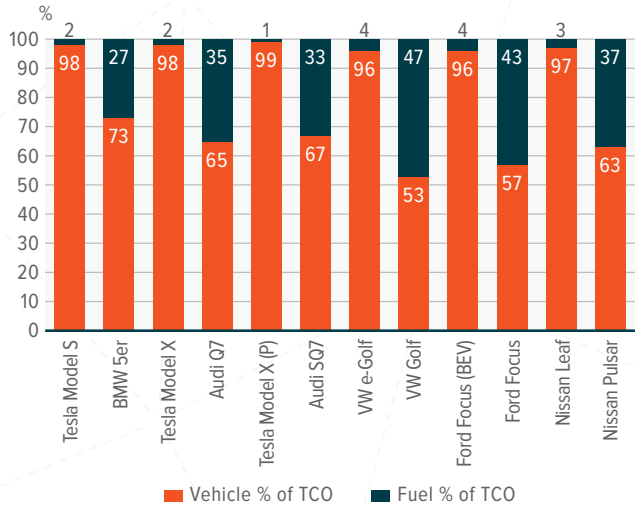
FIG 3. ICE ALTERNATIVE PRICE RELATIVE TO BEV MODEL




Source: Company data, Whatcar, Citi June 2018

FIG 4. THREE-YEAR TOTAL COST OF OWNERSHIP SPLIT BY VEHICLE DEPRECIATION AND FUEL COST

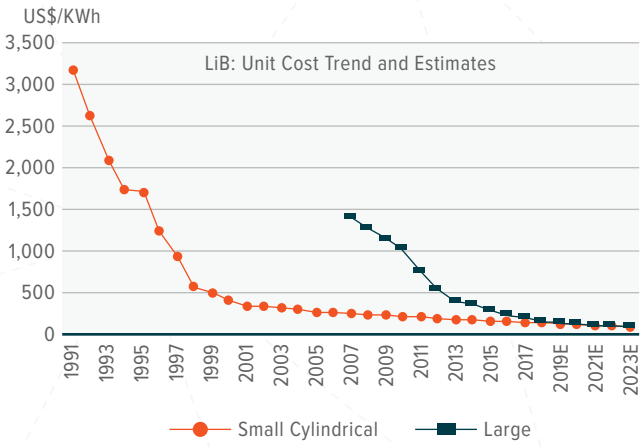



Source: Whatcar, eOn, DfT, Citi June 2018

## APPROACHING PARITY

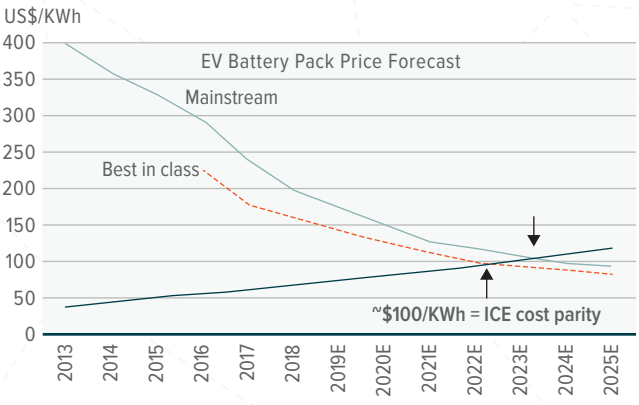
At the current rate of battery-cost reduction, most experts expect that pure EVs from the industry leaders should reach upfront cost parity with ICE cars by 2022–23, while mainstream EVs will hit cost parity with ICE cars by 2024. EVs are expected to be more cost competitive than even the least compliant ICE cars globally by 2029. These calculations only assume upfront costs without accounting for running cost savings (i.e. fuel and maintenance). If we include the latter, then the total annual savings would increase by US$700–1150.

FIG 5. THE LI-ION LARGE BATTERY-PACK PRICE IS EXPECTED TO FALL TO US$100/KWH BY 2023



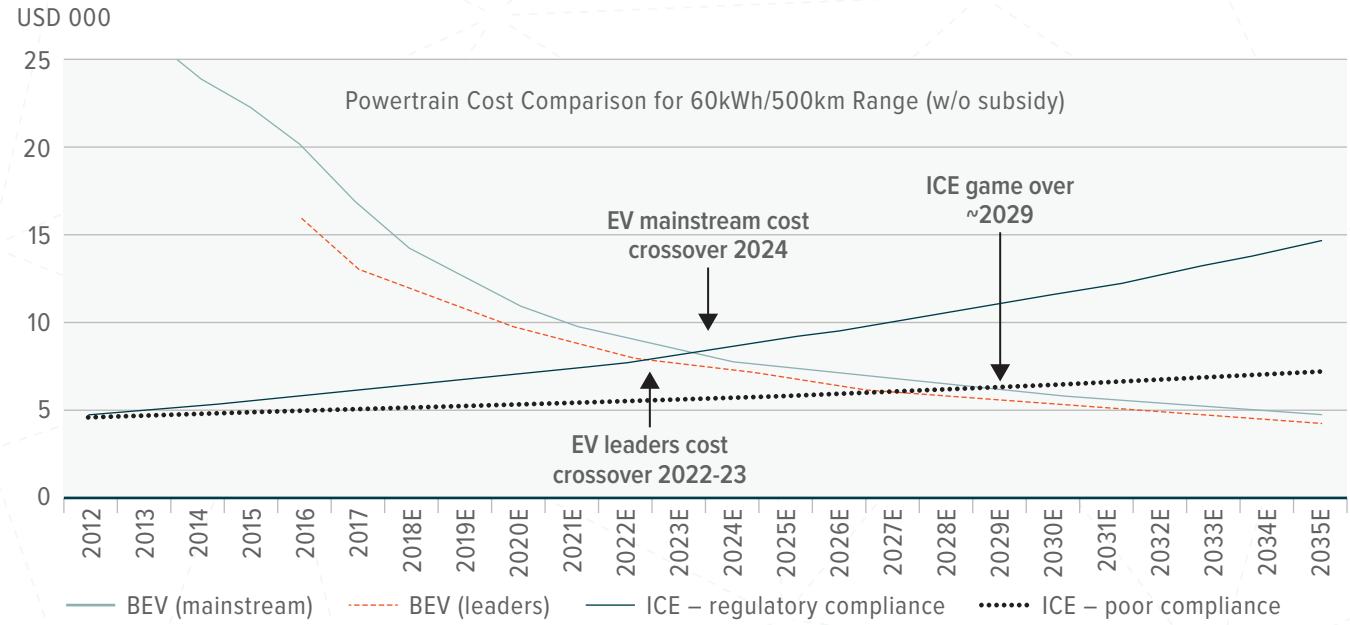

Source: Navigant, Bernstein March 2019

FIG 6. EV ECONOMICS ARE IMPROVING WITH BETTER AND CHEAPER BATTERIES




Source: Bernstein March 2019

## FIG 7. THE MAINSTREAM EVS COST CROSSOVER VS ICE CARS IS EXPECTED TO BE IN 2024




Source: Bernstein March 2019

## FIG 8. ANNUAL SAVINGS PER YEAR FOR FUEL AND MAINTENANCE BY REGION

| Running cost savings for EVs | USA & CA | Europe France | China |
|---|---|---|---|
| **Fuel cost savings per year ($)** | (1,024) | (779) | (675) |
| Saving ($ cents)/km | (5) | (6) | (7) |
| • *Electricity cost ($ cents per km)* | 2.14 | 3.34 | 1.24 |
| • *Gasoline cost ($ cents per km)* | 7.26 | 9.82 | 7.96 |
| Distance/year (km) | 20,000 | 12,000 | 10,050 |
| **+ Maintenance savings/year ($)** | **(124)** | **(75)** | **(62)** |
| **Total savings ($/year)** | **(1,148)** | **(853)** | **(738)** |

Source: Bloomberg, Energy Information Administration, Bernstein March 2019



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