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GFEI Working Paper 16: Can we reach 100 million electric cars worldwide by 2030? A modelling/scenario analysis

GFEI Working Paper 16 uses models and scenarios to assess the feasibility of achieving the Paris Declaration on Electro-mobility target of 100 million cumulative sales for 4-wheel electric road vehicles (cars/LDVs) by 2030. Given the uncertainty inherent in all modelling, three very different models were developed, common data used, and the results compared.

This study follows on from GFEI Working Paper 13, which provided an overview of EV trends and key considerations in getting to the 100 million target. The vehicle data used covers vehicle registrations in 35 countries over a 6-year period (2010-2015), and includes a range of details about each vehicle model/configuration sold.

The main findings of Working Paper 16 are:

- **There are good prospects for Electric Vehicle (EV) sales to increase in the future.**
  While fewer than 2 per cent of vehicles sold in the major market countries in 2015 were Battery Electric Vehicle (BEV) or Plug-in Hybrid Electric Vehicles (PHEV), this is likely to increase due to reductions in battery costs (and thus model retail prices), increases in vehicle driving range, and increases in the numbers of makes/models available (and thus in the choices available to consumers).

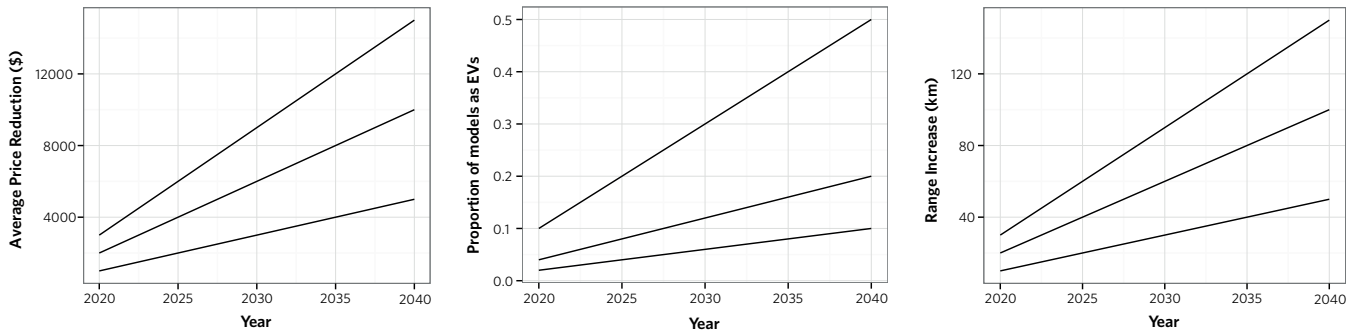
- **It may be difficult to hit the 100 million target.**
  The three models used all take into account a range of important drivers, which include vehicle costs, operating costs, driving range, the numbers of makes/models available, and country-specific factors. If there are strong improvements in all these drivers over the next 15 years, dramatic increases in the demand for electric vehicles could follow. However, none of the models/scenarios hit the 100 million target by 2030, although one scenario comes very close.

- **Vehicle price and number of models are the two main drivers of EV sales in the models.**
  The assumption that the cost of vehicles drops steadily to 2030 (which could relate either to reduced vehicle production costs or policies that cut the retail prices, such as subsidies), and numbers of vehicle makes and models available across market classes and across countries, drive increases in BEV/PHEV.

Scenarios

With each modelling approach, several projection scenarios were developed, based on low/medium/high assumptions of electric vehicle price reductions, vehicle model availability, and driving range (Figure 1). These enable a direct comparison between the three models by providing a consistent basis of future EV attributes necessary to generate the projections.

FIGURE 1: HIGH, MEDIUM AND LOW ASSUMPTIONS ON PRICE REDUCTION, RANGE INCREASE AND NUMBER OF EV MODELS

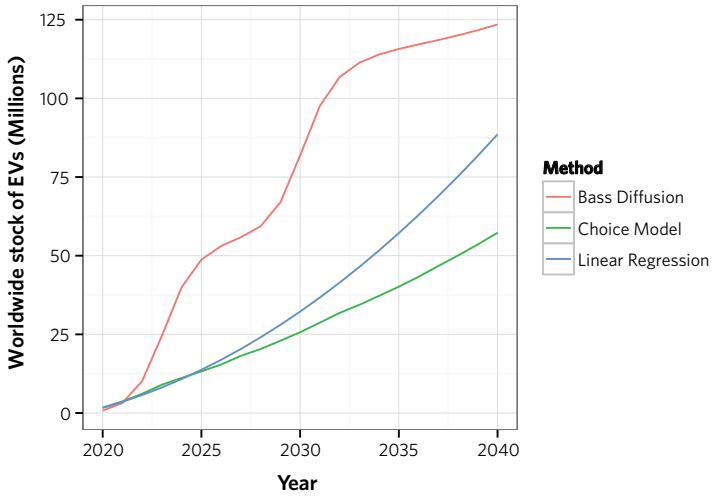


Model Projections

With each modelling approach, several projection scenarios were developed, based on low/medium/high assumptions of electric vehicle price reductions, vehicle model availability, and driving range (Figure 1). These enable a direct comparison between the three models by providing a consistent basis of future EV attributes necessary to generate the projections.

The Bass Diffusion model has a very rapid initial growth due to the aggressive adoption of EVs in China but the sales across the 35 countries reach a plateau by about 2025. It then increases again as other markets move rapidly up the "S" curve. Meanwhile, both the Choice Model and Linear Regression model grow continually in an exponential manner through 2040, though both are well below the target in 2030. Clearly there is much uncertainty here, and more work is needed, but this suggests that reaching 100 million by 2030 will not be easy.

FIGURE 2: MODEL COMPARISONS OF THREE DIFFERENT PROJECTION METHODS: THE DISCRETE CHOICE MODEL, BASS DIFFUSION OF INNOVATION MODEL, AND A LINEAR REGRESSION MODEL (SEE TECHNICAL NOTES)



Ongoing Work

Further work is underway to improve the models and scenarios, such as developing a variable for the availability of recharging stations in each country and developing a sub-national regional version of the models for specific countries. A key shortcoming of the model is its inability to capture the awareness and perception of consumers around electric vehicles, and how this might change. Future analysis could attempt to explicitly capture such effects. As data becomes available from years after 2015, the models could better reflect emerging developments such as new models of cars emerging, and increased consumer awareness.

Technical Notes

Consumer choice – this simulates consumers' decision-making process of choosing a vehicle based on its attributes (price, emissions rate, vehicle make, fuel type, vehicle segment, vehicle range, drive type, engine power, and engine size) in comparison to other vehicles.

Diffusion of innovation – this assumes that the adoption of any technology follows a general growth trend that is sigmoidal ('s-shaped' – increasing rapidly and then tailing off), using each country's current sales of electric vehicles to project adoption in the future.

Linear regression – this models the relationship between sales of a vehicle type (based on fuel technology), and factors that influence it (price, emissions, the number of models, population size, gas price, GDP, and employment rate.)

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