

A summary of:

# Electric Vehicles in the United States: A New Model with Forecasts to 2030

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1. **Electric Vehicles in the United States forecasts the rate of adoption of electric vehicles (EV) in the U.S. through 2030.** The study examines the eventual effects EVs will have on trade, investment, employment, health, and emissions. **By 2030, EVs will:**
  - Represent 24% of the existing automobile fleet. Account for 64% of new light-vehicle sales.
  - Lower U.S. oil imports by 18% to 38%. Reduce the U.S. trade deficit by \$94B to \$266B.
  - Provide new sources of investment. EV charging infrastructure and battery manufacturing accounts for 1.1% to 1.5% of total U.S. business investment.
  - Increase overall employment by 130K to 350K jobs.
  - Save \$105B to \$210B in health care costs if charged using non-polluting sources of electricity.
  - Reduce emissions by 25% to 62% if charged using non-polluting sources of electricity.
2. **EVs will meet customer demand for pricing, reliability and driving range.**
  - A new ownership model – *pay-per-mile service contracts* – makes EVs cost competitive with gas vehicles.
  - Lithium-ion batteries will provide better performance than gas-powered automobiles.
  - Total cost of ownership for Lithium-ion vehicles will be lower than gas-powered cars.
  - Switchable batteries will reduce consumer uncertainty on battery durability. A charging network will provide driving ranges comparable to the existing gas station network.
3. **By 2030, EVs will represent 24% of the automobile fleet.** 64% of new vehicles will be EVs. If gas prices rise, 90% of new vehicles could be EVs. The adoption of EVs will occur first in the West Coast. EV adoption is dependent on a widespread charging network.
4. **Separating the purchase of an EV from the purchase of the battery is the best strategy for achieving wide-scale deployment of EVs.**
  - Batteries can be exchanged. Older vehicles can be upgraded with newer batteries. Vehicles can be immediately re-charged by switching batteries.
  - Switchable batteries enable network operators to offer pay-per-mile contracts that finance the cost of the battery, the cost of charging infrastructure, and the cost of the electricity.
  - Homes and offices will have battery charging stations. Highways will have battery switching stations.
  - Manufacturers will focus on core competencies. Car manufacturers will focus on automobiles. Battery manufacturers will constantly improve batteries.
5. **The three key factors for EV adoption are purchase price, operating cost and range anxiety.**
  - Purchase price versus gas-powered vehicles. The price of the battery drives the cost of the EV. It is unclear if consumers will pay additional costs upfront in return for lower operating costs.
  - Total operating costs are *battery costs* plus *electricity costs* plus *infrastructure costs*. A 2012 battery that holds 3000 charges (of 100 miles each) and is driven 15K miles per year will cost 6.7¢ a mile. Electricity is about 2.0¢ a mile. Charging infrastructure costs, divided over the network, cost of 2.0¢ a mile.

- Range anxiety. A sufficient network is needed to reduce range anxiety.
6. **Pay-Per-Mile Contracts.** Separating the purchase of the battery from the purchase of the car makes the EV cost comparable to gas-powered cars.
- Companies that offer pay-per-mile contracts can reduce battery purchase price in exchange for longer service contracts, much like cell-phone providers.
  - Pay-per-mile contracts are attractive to consumers because they eliminate most of the uncertainty over the future operating costs of the vehicle.
  - An integrated service contract for an EV that pays for battery, network, and electricity will be less expensive than the per-gallon price of a gasoline-powered car.
  - The per-mile cost of EVs decreases as battery costs fall (historically 6% per year) and electric motors become more efficient (historically 2% per year). Increasing government emissions standards increase the cost of gas-powered cars.
7. **The macroeconomic impact of electric vehicle adoption will be significant.** Cars are 7% of U.S household expenses. The U.S. ground transportation network represents 41% of world petroleum demand, generates 17% of U.S. emissions, and employs 20% of the U.S. population.
- Trade. By 2030, EVs reduce the trade deficit by \$94B to \$266B, and reduce oil imports by 18% to 38%. EVs decrease military costs and decrease the price of petroleum. Since almost all U.S. electricity is generated using domestic sources, increased electricity use has almost no effect on trade.
  - Capital. By 2030, EV battery manufacture and charging infrastructure accounts for 1.1% to 1.5% of U.S. business investment. Charging infrastructure supports 81 million EVs. Demand for batteries is \$37B to \$50B. Investment in electricity generation grows from 190 to 350 million MWh per year.
  - Employment. By 2030, EVs increase employment by 130K to 350K jobs in charging infrastructure, battery manufacturing, and electricity generation. This offsets job losses in gas station attendants, mechanics and parts manufacturers.
  - Health. By 2030, EVs save \$105B to \$210B in health care costs if charged using non-polluting sources of electricity.
  - Emissions. By 2030, EVs will reduce emissions by 25% to 62% if charged using non-polluting sources of electricity. When charged on the current grid, emissions are reduced 11% to 26%.
  - Government Policy. The best model for EV adoption assumes a \$7,500 U.S. government tax credit for EV purchases. Additional state tax credits should encourage manufacturing, especially batteries.
8. **Conclusion.** EVs will change the U.S. transportation network. The business model of pay-per-mile contracts and switchable batteries will increase EV adoption. Widespread adoption of EVs has positive effects on trade, capital, employment, health, and emissions.

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*McBreen eNote: If, as predicted, a quarter of the cars on the road in 2030 are EVs, the identified macroeconomic effects on trade, employment, health and emissions will be an important and significant boon to the U.S. economy and population.*

*However, "Electric Vehicles in the United States" is overly optimistic, I think, when predicting consumer behavior. The report rightly identifies batteries as the key EV enabler, and battery cost as the key EV challenge. Battery switching, separate battery purchases, and pay-per-mile service contracts may make financial sense, but will require significant changes to current consumer behavior and expectations. Consumers may not be willing to switch batteries and may be less willing to purchase service contracts, instead opting to pay by the charge. These consumer factors will have a larger role to play in the eventual speed of EV adoption than the technology itself.*