

PIONEER
NATURAL RESOURCES

MIT 2017 Energy Hackathon

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YOUR CHALLENGE

- 1) Create an adoption curve predicting the number of electric vehicles that will be on the road globally each year from now through 2050
- 2) Using your forecast determine the impact electric vehicles will have on the global demand for oil over the same time period.

THE LARGE UNCERTAINTY AROUND THE FUTURE OF ELECTRIC VEHICLES

The uncertainties facing electric vehicle adoption include:

- The support by governments of various countries in the form of subsidies, tax exemptions or other incentives
- Initial vehicle cost, which would depend on cost of batteries and other manufacturing inputs along with profit margins
- Maintenance costs, especially in terms of battery life
- Availability of charging stations, distance between such points and charging time
- Resale value of electric vehicles
- Decrease in customer anxiety and increase in their awareness, enthusiasm and adoption
- Infrastructure, permits, regulations on CO2 emission and industry standardization
- Oil prices; a rise in oil prices would make the adoption of electric vehicles a more natural and attractive option for customers
- The integration of electric vehicles in the product portfolio of original equipment manufacturers (OEMs). Currently, every major OEM has at least one model of EV in its portfolio

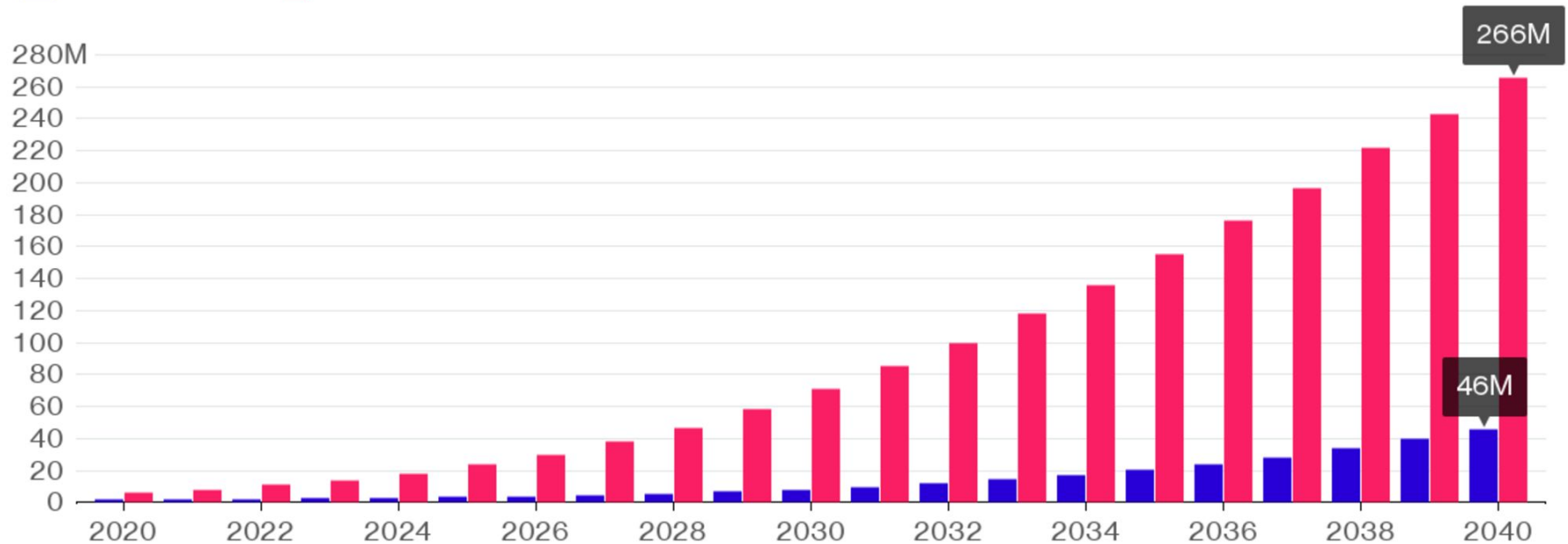
These challenges are a mix of technological, political, and social. All of them are coupled and each one could dramatically shift the adoption rate up or down

THE RESULT IS AN UNREASONABLY LARGE RANGE FOR EV ADOPTION FORECASTS

Growing Expectations

OPEC's electric vehicle forecast grew by almost 500% last year

■ 2015 Forecast ■ 2016 Forecast

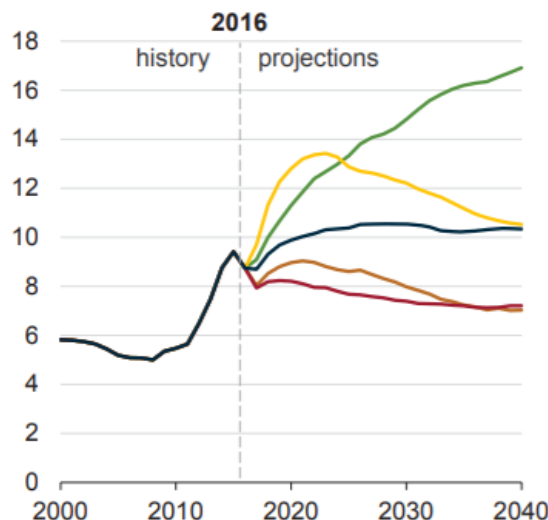


Source: Bloomberg New Energy Finance

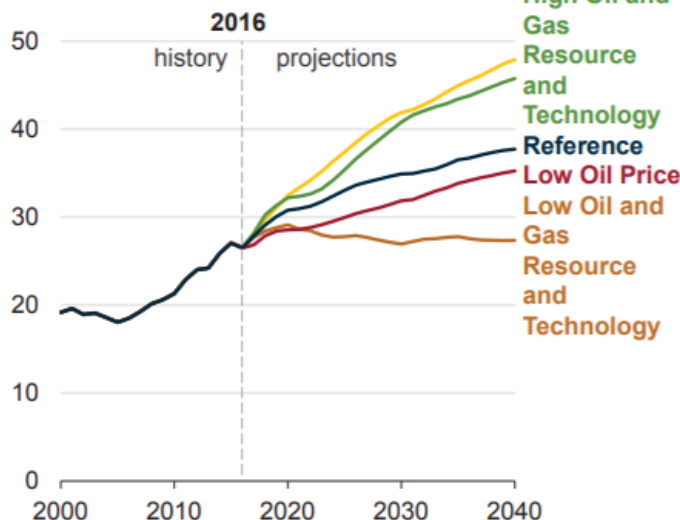
Bloomberg

HOW ELECTRIC VEHICLES EFFECT THE DEMAND FOR OIL

Crude oil production
million barrels per day



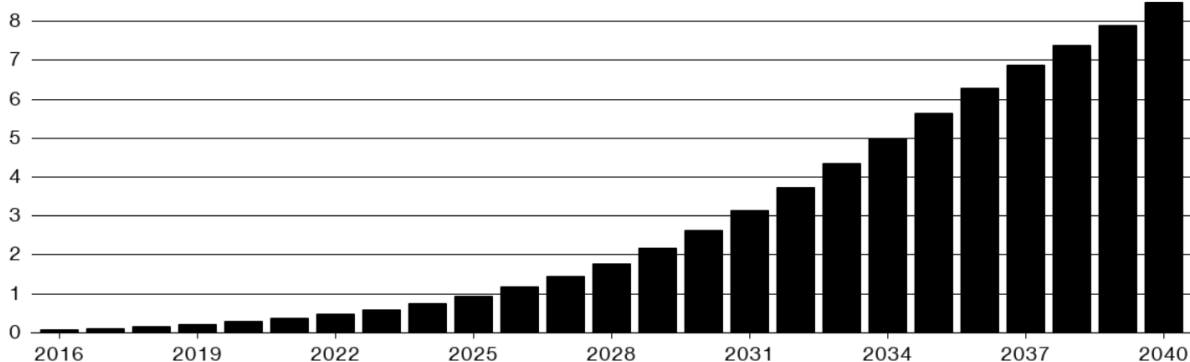
Dry natural gas production
trillion cubic feet



There is already a large amount of uncertainty around future oil production driven by future commodity prices and the development of new technology

EVs could cut 8 million barrels of use, or 25% of current OPEC output

9M Barrels Per Day



Depending on the adoption of electric vehicles over the next several decades, significant volumes of oil demand could be displaced

REQUIREMENTS

- 1) Both models must be global forecasts; however, you may choose to separate or combine regions as you see fit (i.e. consider Europe a single group, break it down by country, etc.)
*It is preferred that the models include the ability to look at the forecasts broken down by the regions you've identified
- 2) The models must be open and flexible. As new data is acquired, policies change, or assumptions are updated these should be easily incorporated into the models and rerun so new forecasts can be generated
- 3) The models should be linked, as you update the EV forecast the global oil demand forecast should update as well
- 4) You may submit as many or as few scenarios as you see fit (i.e. Optimistic, most likely, pessimistic, etc.)
- 5) Any and all assumptions you make need to be stated clearly
- 6) Any and all resources you use must be cited

SUGGESTED RESOURCES

Bloomberg New Energy Finance Electric Vehicle Outlook 2017:

<https://about.bnef.com/electric-vehicle-outlook/> (Download The Report)

Projecting Light-duty Electric Vehicle Sales In The National Energy Modeling System (NEMS) And World Energy Projection System Plus (WEPS+):

https://www.eia.gov/conference/2017/pdf/presentations/melissa_lynnes.pdf

EIA - Annual Energy Outlook 2017:

<https://www.eia.gov/outlooks/aeo/>

EIA - International Energy Outlook 2017:

<https://www.eia.gov/outlooks/leo/>

Total Vehicle Sales:

<https://fred.stlouisfed.org/series/TOTALSA>

EIA Short Term Energy Outlook:

https://www.eia.gov/outlooks/steo/report/global_oil.cfm

Vehicle Miles Traveled:

<https://fred.stlouisfed.org/series/TRFVOLUSM227NFWA>

Light Weight Vehicle Sales: Autos And Light Trucks:

<https://fred.stlouisfed.org/series/ALTSALES>

IEA Global EV Outlook 2017 (Reference Section At End Of Document Has Additional Resources):

<https://www.iea.org/publications/freepublications/publication/Globalevoutlook2017.pdf>

Dynamics In The Global Electric-vehicle Market:

<https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/dynamics-in-the-global-electric-vehicle-market>

Auto Inventory/Sales Ratio:

<https://fred.stlouisfed.org/series/AISRSA>

Domestic Auto Production:

<https://fred.stlouisfed.org/series/DAUPSA>

IMF Economic Data Search:

<http://www.imf.org/en/Data>

There are lots of additional resources out there, feel free to utilize any available to you but make sure to check their validity & cite them

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A photograph of an oil rig at sunset, with the sun low on the horizon and the sky filled with orange and yellow clouds. The rig is silhouetted against the bright sky. The image has a dark, moody feel with a teal overlay.

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Questions?