Transport: How can the disruption lead to decarbonization?

Drew Kodjak, Executive Director

Energy and Climate Research Seminar

The Liaison Capitol Hill

415 New Jersey Avenue, NW

Washington DC

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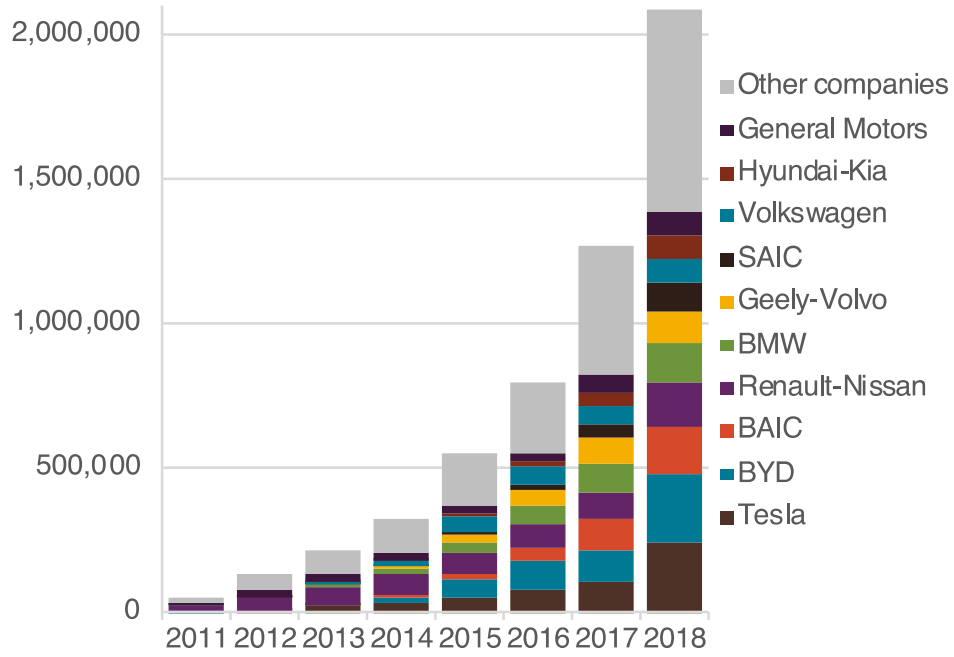
Starting points

- Electric vehicle growth
  - Growth: 60%+ annual growth rate, 2 million EVs per year and growing
  - Industry commitments showing order of magnitude higher scale are underway
  - Battery innovation and scale could enable mainstream market in years ahead
- Policies for the transition to electric vehicles
  - Top EV markets around the world show us a complete policy package
  - Reducing CO_2 emissions at triple the historical rate needed to decarbonize transport
  - As EV cost parity is reached, policies including durable fiscal incentives, regulation, infrastructure support, and consumer campaigns remain critical
  - We could proceed with similar steps for zero-emission trucks in the years ahead

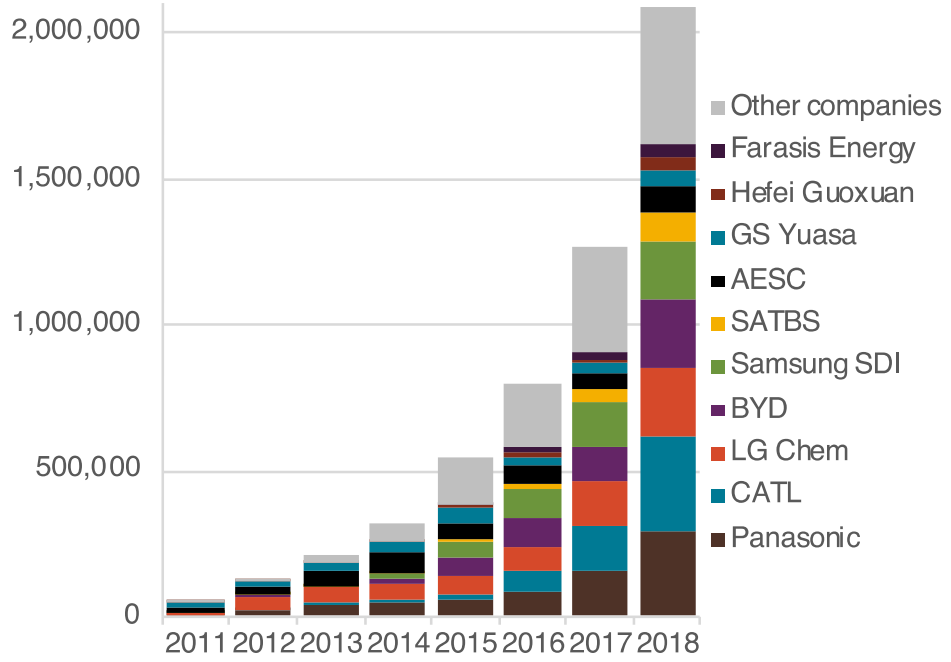
Global electric vehicle growth

- Annual global EV production surpassed 2 million/year in 2018
- There are now 10 automaker groups selling over 80,000 EVs per year
  - Battery production: 5 companies supplying batteries over 200,000 EVs per year

Electric vehicle sales by automaker



Electric vehicle sales by battery supplier



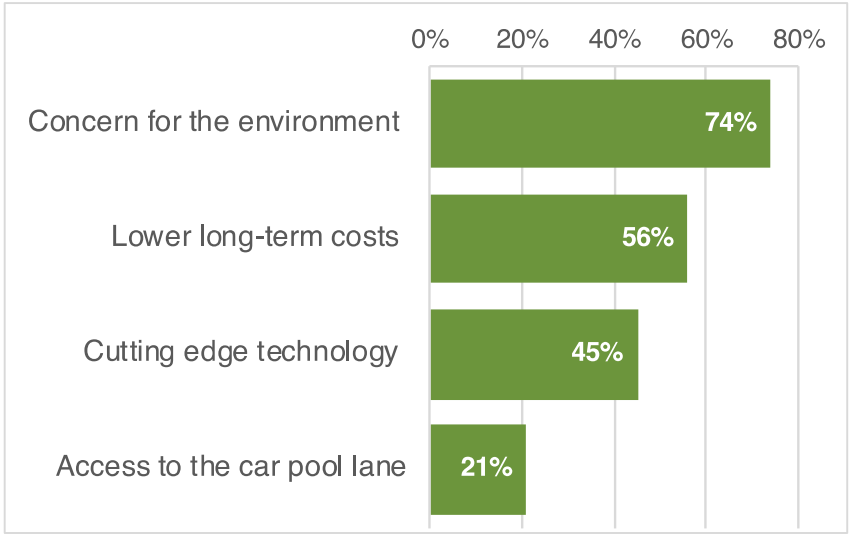
Source: www.EV-volumes.com

EV barriers: Results from a recent survey

Are you likely to buy an electric vehicle the next time you buy a new or used vehicle?

16% Yes

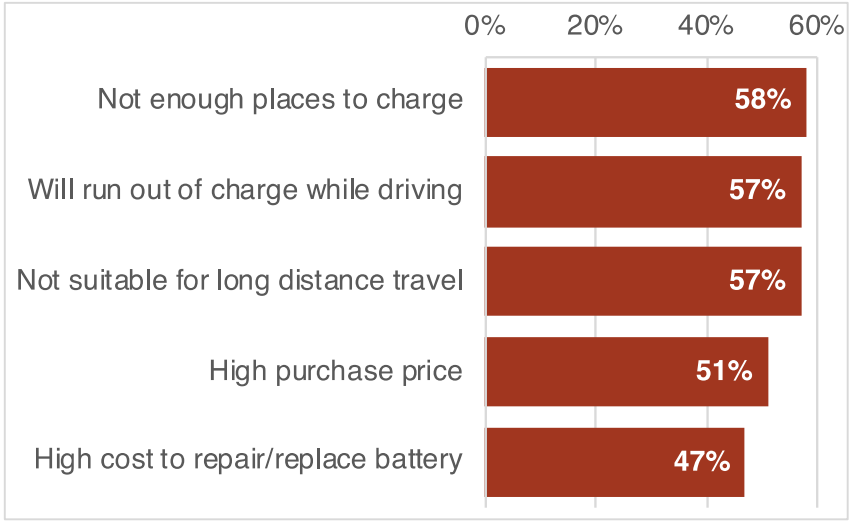
Reasons indicated



44% would pay up to $4,000 more for electric
23% would pay over $4,000 more for electric

84% No (or unsure)

Reasons indicated



These are down 6 to 11 percentage points from 2017

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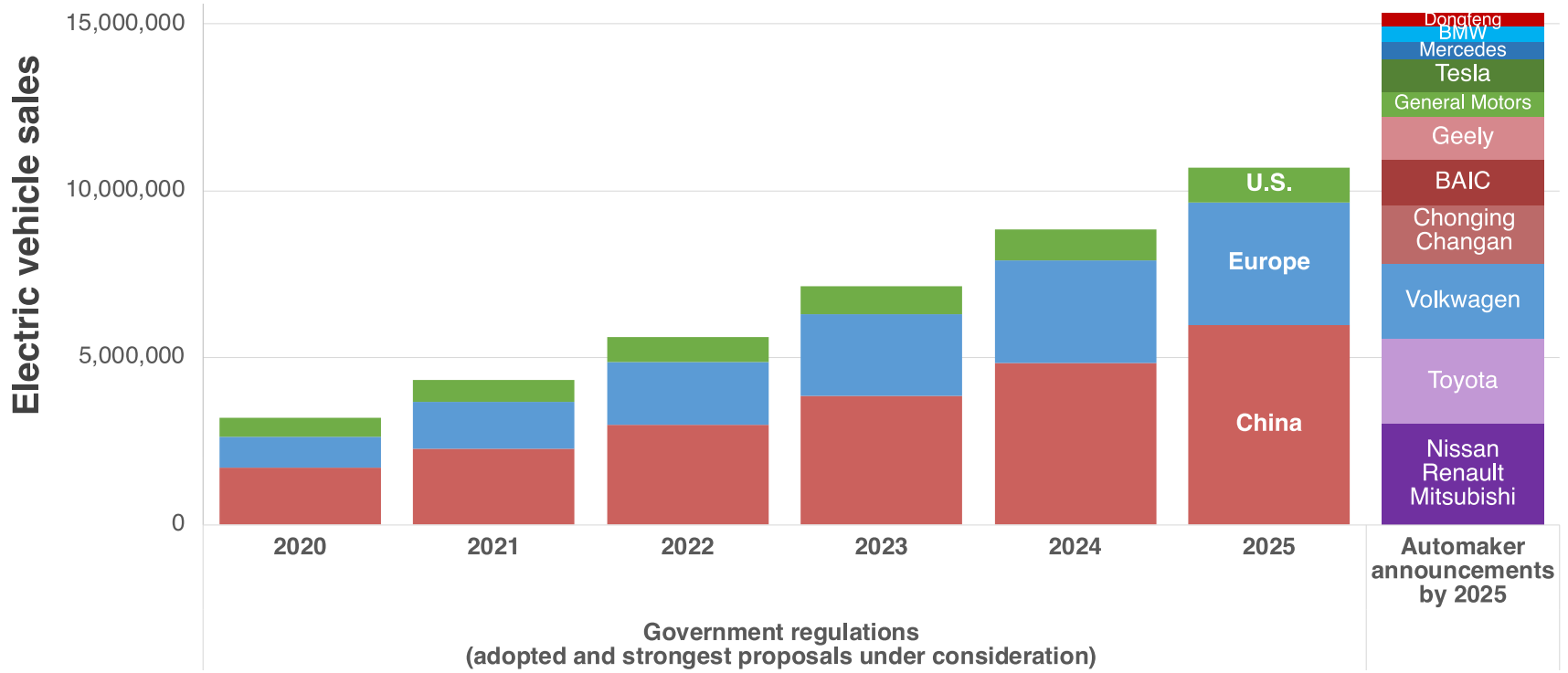
1000 phone surveys. AAA, 2019. https://newsroom.aaa.com/tag/electric-vehicle/

Automakers increasingly share all-electric vision

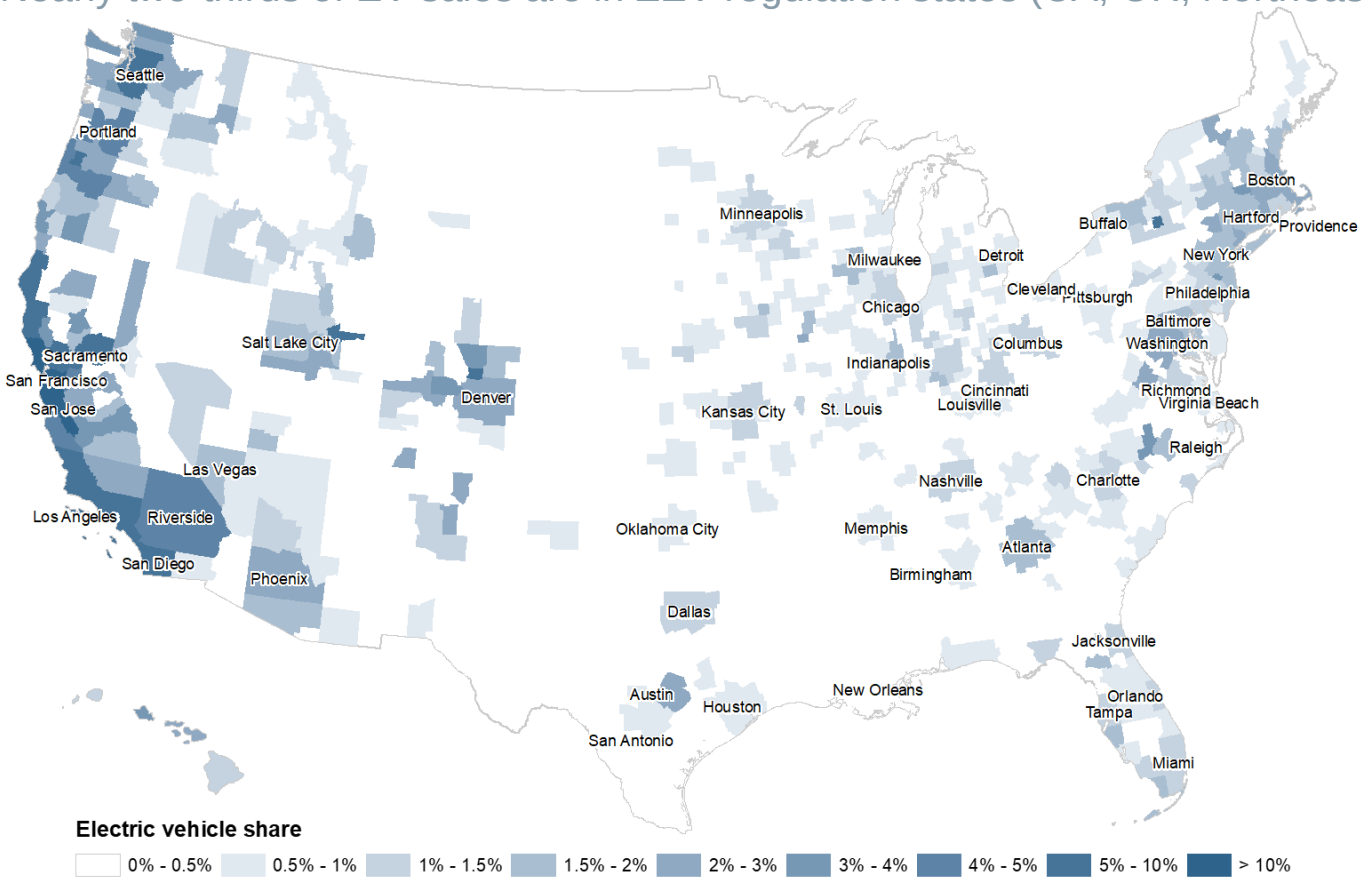
- Automaker announcements by 2025:
  - Hundreds of new EV models, over $200b in investments, and 15m EVs/year
  - Vehicle deployment would lead to higher volume than required by regulations
  - These will get the world to 10-15% electric sales by 2025



Based on company announcements for plug-in vehicles
Report: https://www.theicct.org/publications/modernizing-regulations-electrification

U.S. electric vehicle sales: Local markets

- Most EV sales are in markets with some combination of the following: ZEV regulation, incentives, extensive charging, city/utility promotions
  - Nearly two-thirds of EV sales are in ZEV regulation states (CA, OR, Northeast)



Source: Slowik (2019) updates from Slowik and Lutsey (2018):
https://www.theicct.org/publications/continued-EV-transition-us-cities-2018

Top EV markets have a complete policy package

- 44% of world's EVs are in just 25 markets in China, Europe, Japan, US
  - Each market has regulations, model availability, incentives, infrastructure, local action
  - These areas are striving to overcome all the prevailing electric vehicle barriers

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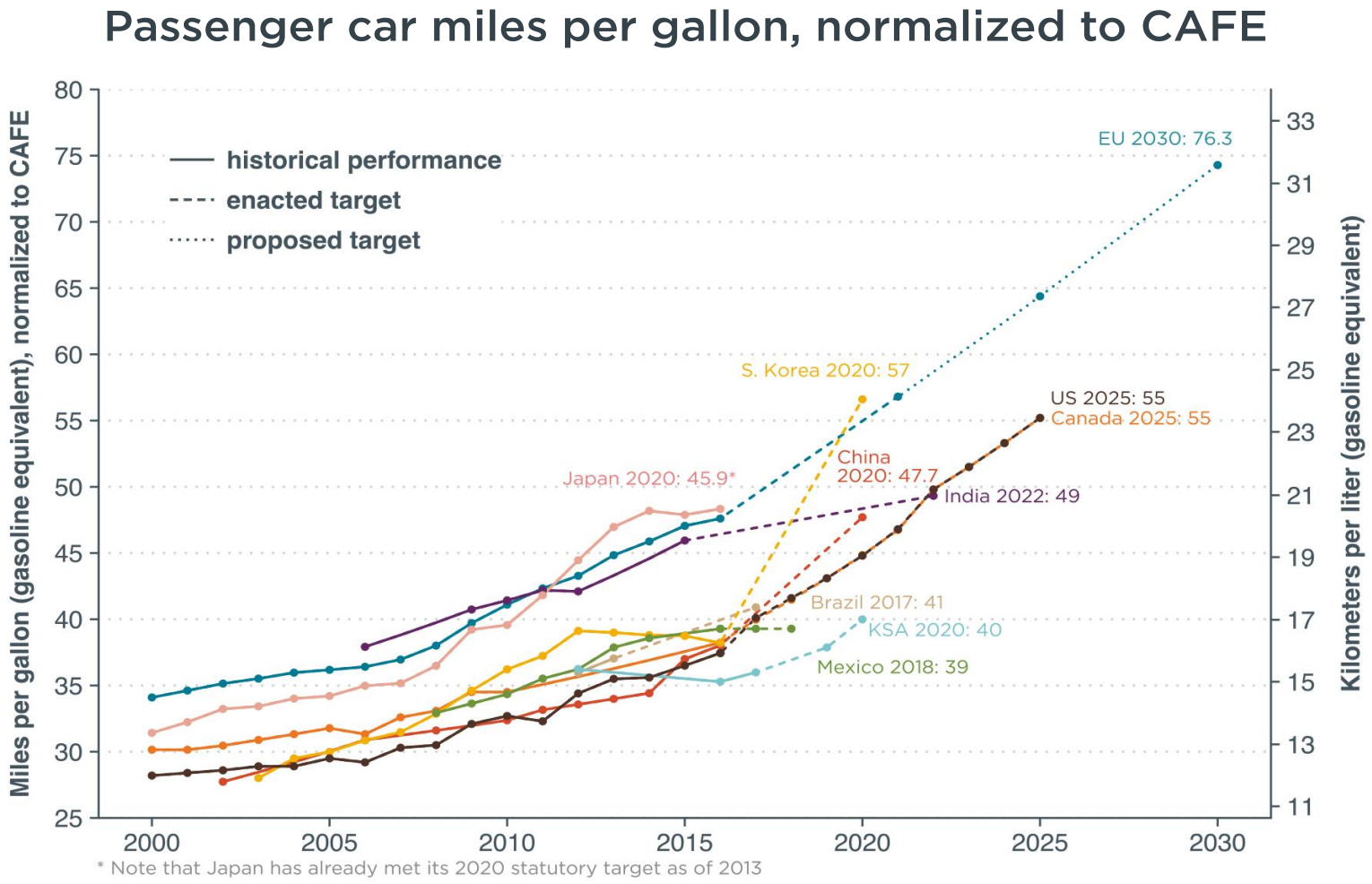
Based on total electric vehicles sales through 2017
See Hall, Cui, & Lutsey, 2018. http://www.theicct.org/publications/EV-capitals-of-the-world-2018

EV sales targets spread around the world

Government	Target year	Percentage of EV credits	ICCT estimate of percent EV sales
China	2020	12%	3 – 4%
California	2025	22%	8%
Quebec	2025	22%	10%
Europe	2025 2030	15% 37.5%	5 – 10% 15 – 20%

- China's New Energy Vehicle mandate is integrated into its existing fuel economy standards, an excellent first step but in need to substantial improvement in the next iteration of the standards.
- California forecasts only 8% EV penetration in 2025 due to credit multipliers which needs substantial enhancements to achieve a ~ 30% target by 2030.
- Quebec's policy is nearly identical to California's but with fewer credits
- Europe's policy – currently only a proposal – includes incentives for achieving substantial EV penetration levels but no penalties. We forecast substantial penetration levels due to major OEM commitments: VW (20 – 25% by 2025), BMW and Daimler (15 – 25% by 2025), Renault / Nissan (20% by 2020 depending on market conditions).

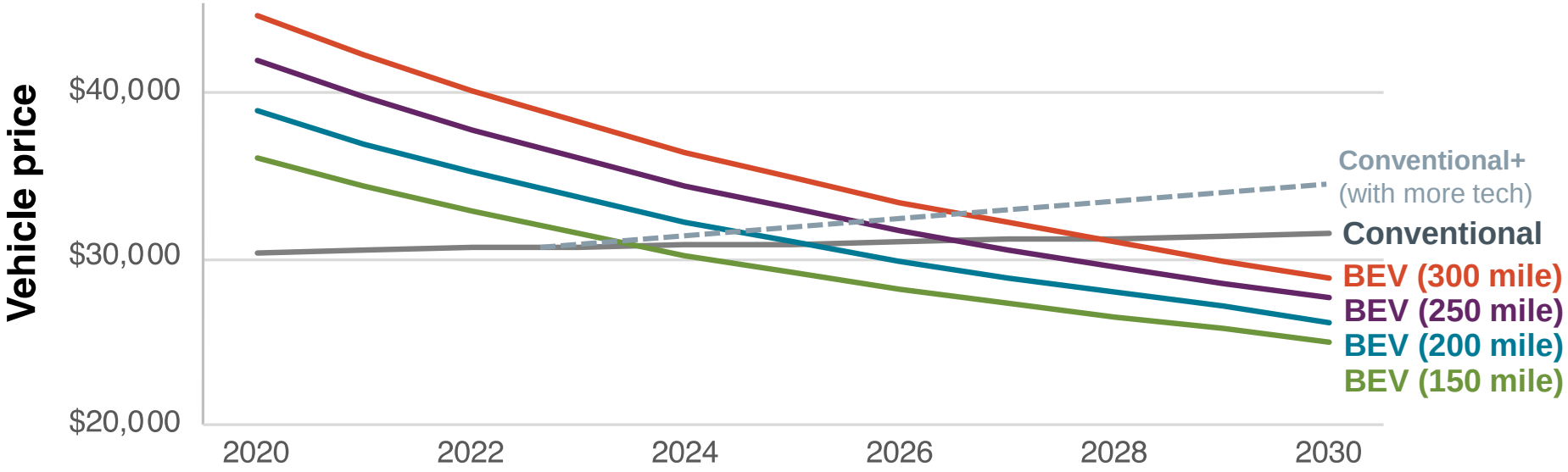
Energy efficiency and CO_2 standards will eventually drive EVs into the market



Source: https://www.theicct.org/chart-library-passenger-vehicle-fuel-economy

Volume and innovation drive EV costs down

- Battery cost reductions enable electric vehicle cost parity
  - Parity points shown below for cars: 2024-2029 for 150-300-mile electric range
  - Parity points for crossovers and SUVs tend to be several years later
  - Parity points are faster yet, if greater emission control technology is required



Based on ICCT, 2019. Update on electric vehicle costs in the United States through 2030.
https://www.theicct.org/publications/update-US-2030-electric-vehicle-cost

Questions for the power sector

1. **Size of the EV market.** What information to you need to know about the size of transition to electric vehicles for light and heavy-duty vehicles?
2. **Pace of transition.** How much does it matter to understand the speed of the transition?
3. **Risk or Opportunity.** Does the power sector view the transition to EVs as a threat to the stability of the grid, or as an opportunity to complement the rise in renewables?
4. **Expanding into the EV sector.** How does the power sector think about recharging infrastructure and consumer information about EVs?