Future of Electric Vehicles

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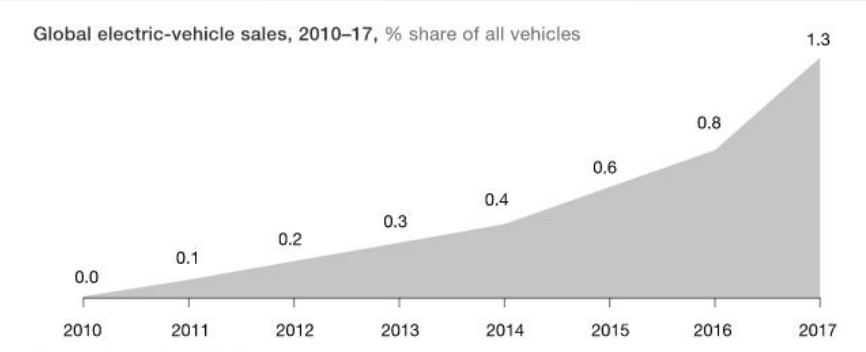
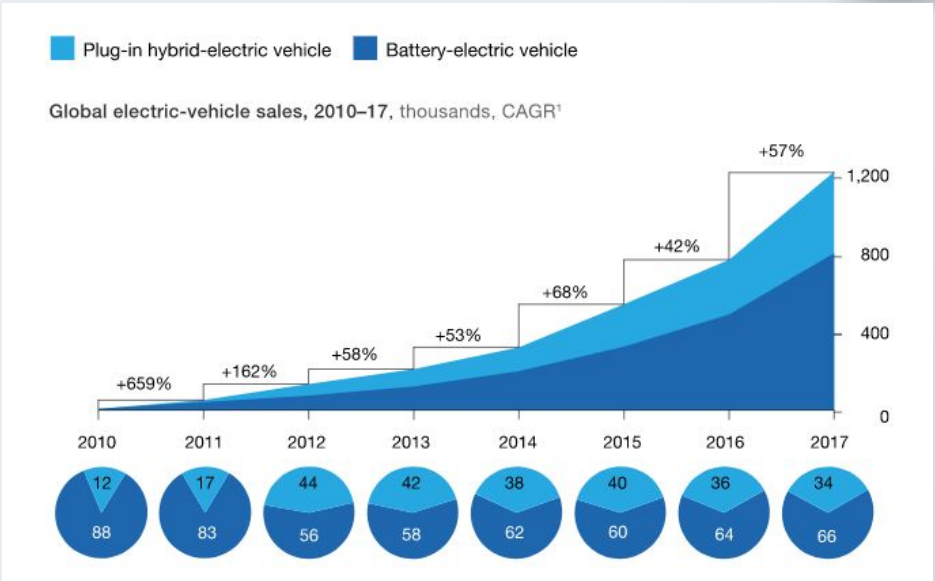
Rapid Growth of EV Sales

A 2017 survey by McKinsey & Co. found that EV sales have been increasing by ~50% per year:





Future of EV Viability

Electric vehicles have the potential to disrupt the transportation industry through 3 key areas:

Social Viability

3

Increasing levels of environmental awareness both on the consumer and governmental scale

Economic Viability

2

Decreases in EV pricing driven by new tech and subsidies

Technological Viability

1

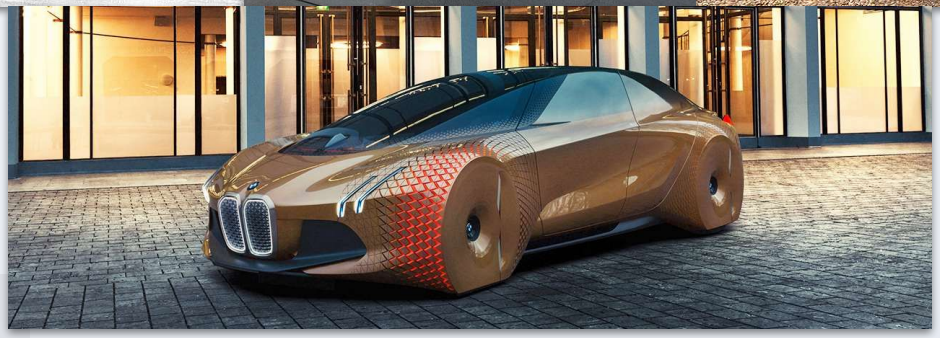
Vast improvements in EV technology

Technological Viability

1899

1997

2013



Concept car: BMW Motorrad VISION NEXT 100

Technological Viability - Present

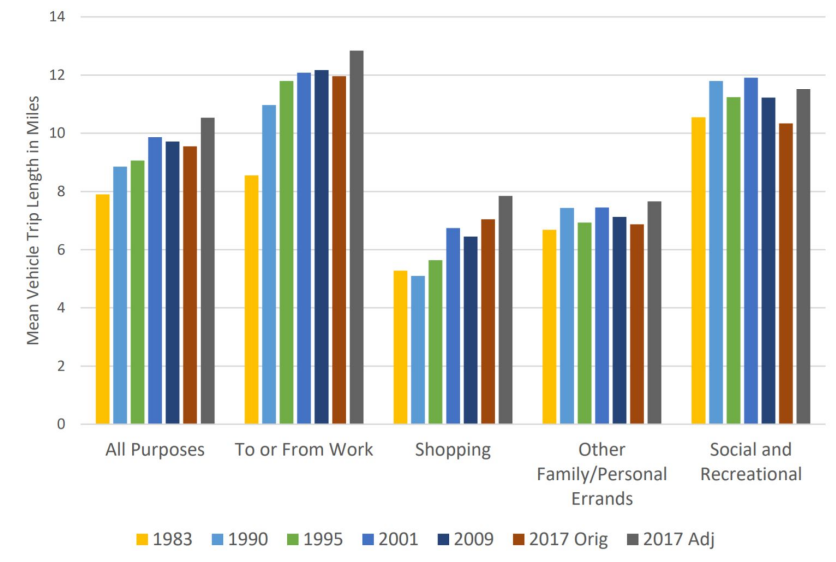
EV technology is well-developed and has many advantages:

		Gas Engine	Electric	Hybrid
1	Low center of gravity for safety and better handling	✗	✓	✗
2	Light Fuel Source	✓	✗	✗
3	Existing and Well Developed Fuel Supply Network	✓	✓	✓
4	Regenerative Braking	✗	✓	✓

Technological Viability - Battery Usage

Issue: “EV technology is somewhat limited range”

Trends in Mean Vehicle Trip Length by Purpose

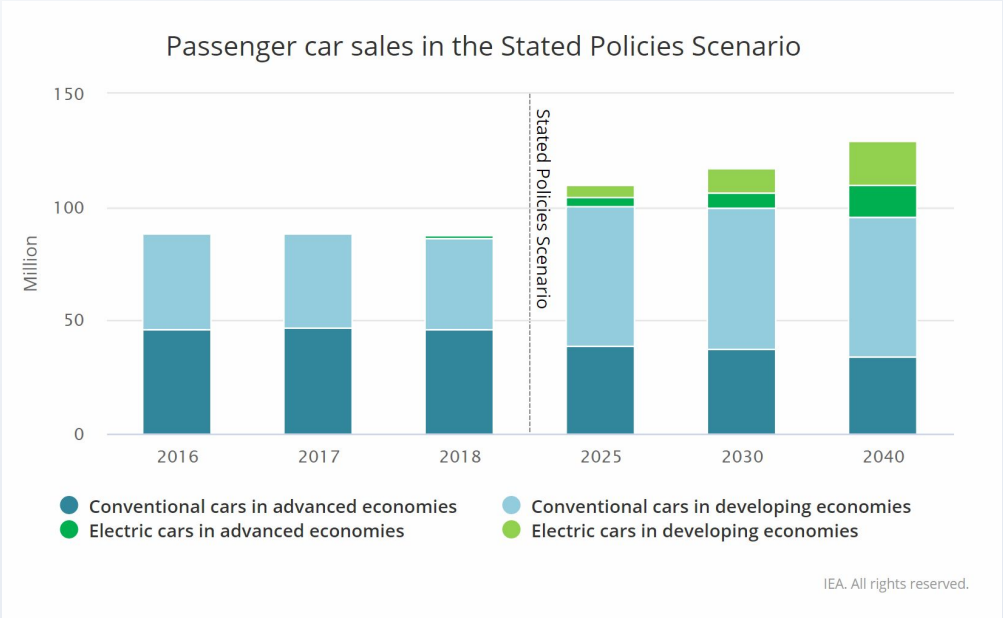


2017 National Household Travel Survey

Technological Viability - Battery Technology

Batteries are on a promising trajectory:

Technological Viability - Future Trends

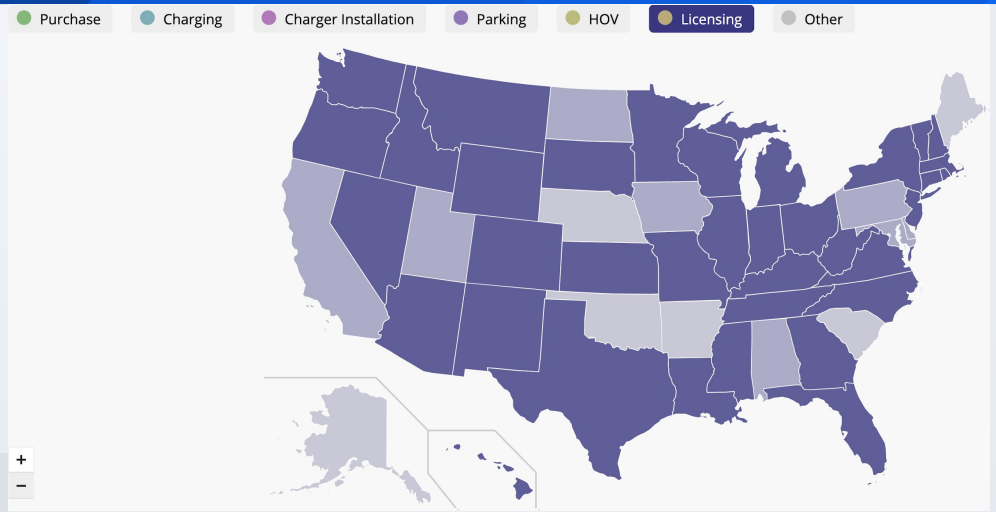


Economic Viability

1. Upfront Pricing
2. Ownership Pricing
3. Number of Potential Buyers

Economic Viability – Upfront Pricing & Subsidies

Direct Purchase | Charging Infrastructure | City | Producer



Economic Viability – Upfront Pricing

Payback Period

- 5-6 years for an average US buyer driving 13,000 miles/year
- 2-3 years for high-mileage drivers exceeding 30,000 miles/year

Decreasing Battery Costs

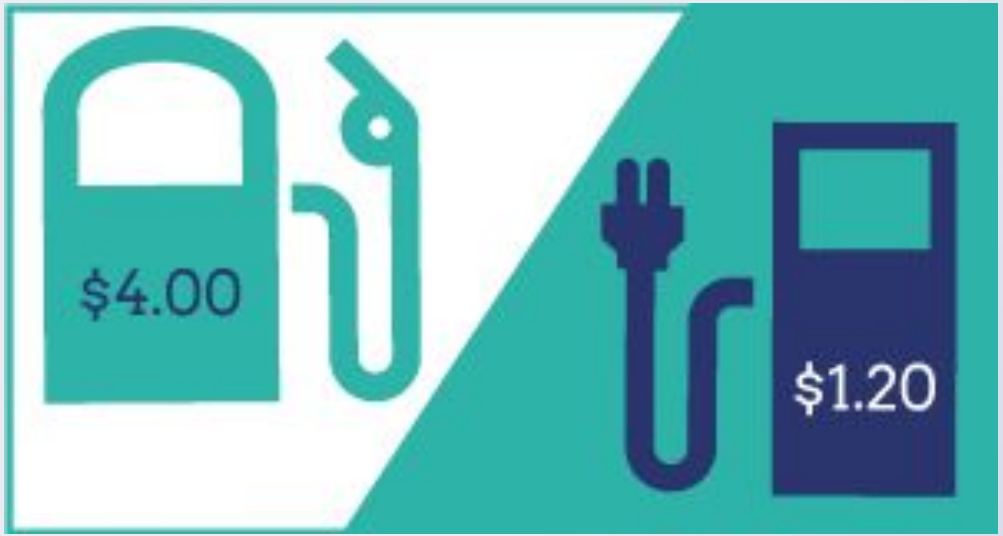
- 2015 - 50% of total cost
- 2019 - 33% of total cost
- 2025 - 20% of total cost

Looking Ahead

- Each 20-25% improvement in battery cost reduces payback by 1 year

Economic Viability – Ownership Pricing

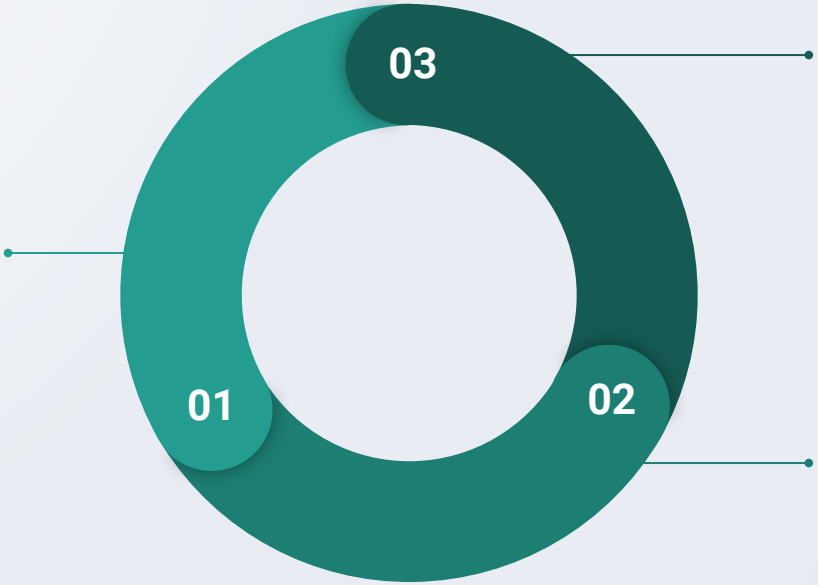
A 2018 Study from the University of Michigan found that EVs cost **less than half** as much to operate as gas-powered vehicle.



Economic Viability - Utilities Incentives

Reduced TOU rates

Rates are lower during the times of day or seasons when charging is less common.



Off-peak hour rates for electric vehicles

Lower rates for charging of electric cars during off-peak hours.

Per Kilowatt-Hour discounts

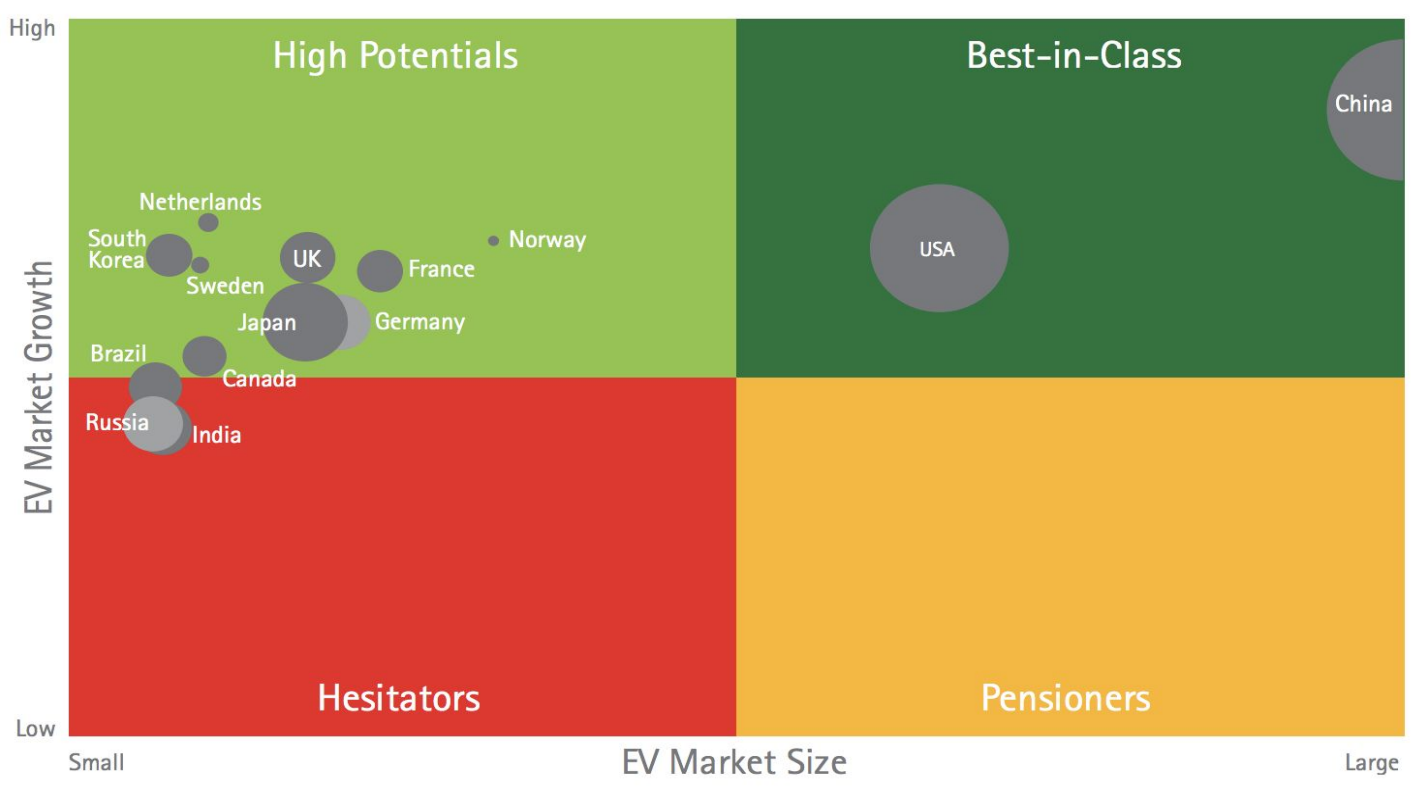
Discount on hours used to charge electric vehicles.

Economic Viability - EVs & Solar Panels

ROI **10-30%**

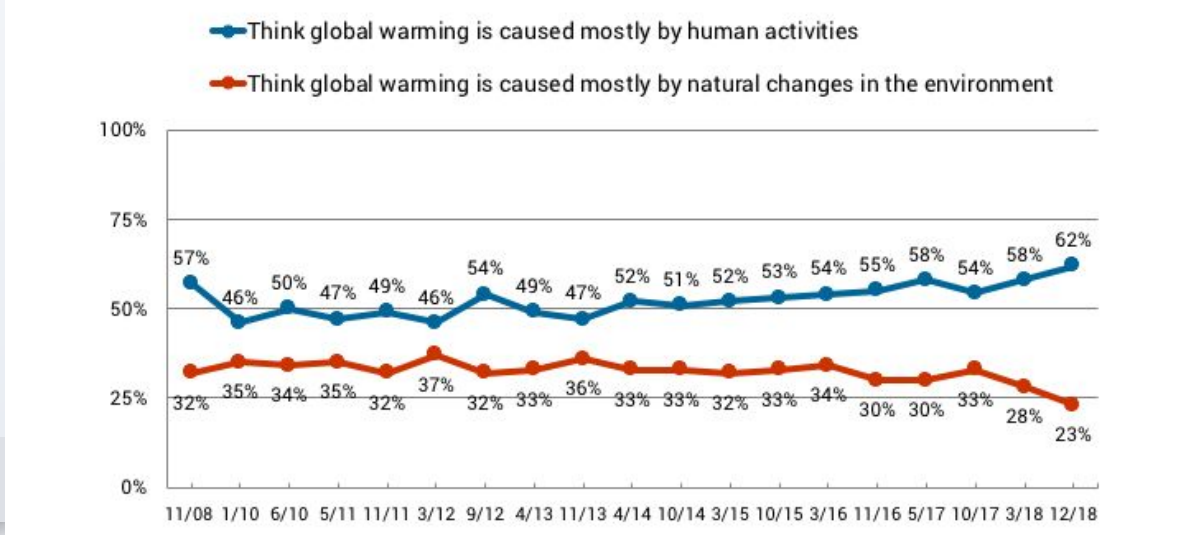
Break-even **7 ½** years

Economic Viability - Potential Buyers



Social Viability - Environmental Concerns

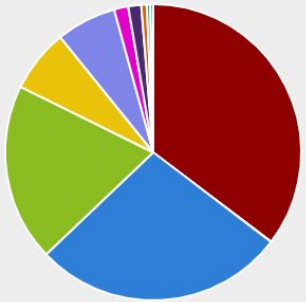
The percent of Americans that believe in human-driven global warming has increased by 16% over the last 8 years:



Social Viability – Environmental Benefits

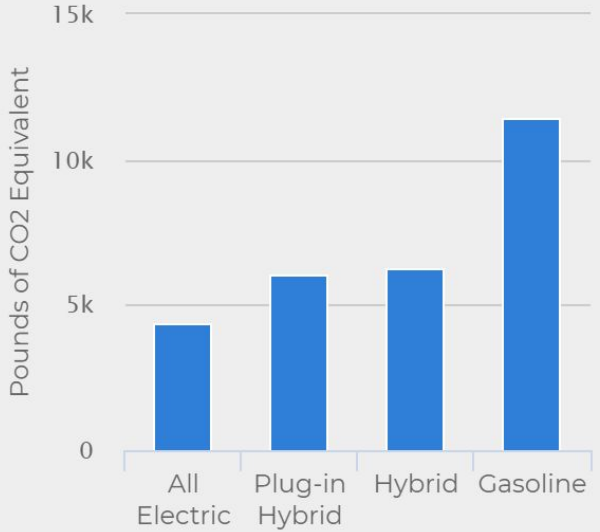
National Averages

Electricity Sources



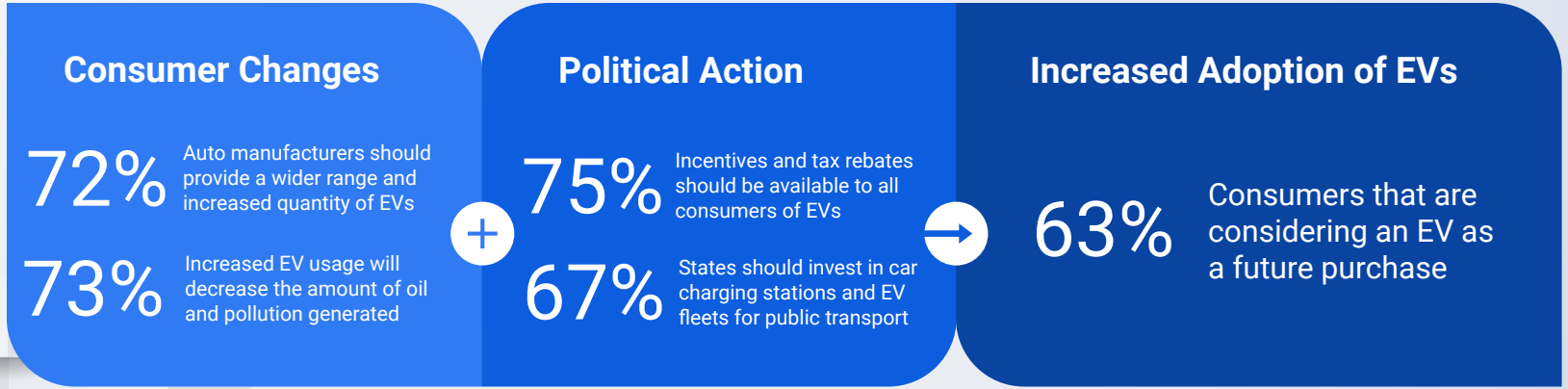
- Natural Gas: 35.33%
- Coal: 27.56%
- Nuclear: 19.41%
- Hydro: 6.89%
- Wind: 6.56%
- Solar: 1.54%
- Biomass: 1.41%
- Oil: 0.61%
- Geothermal: 0.38%
- Other Fossil: 0.31%

Annual Emissions per Vehicle

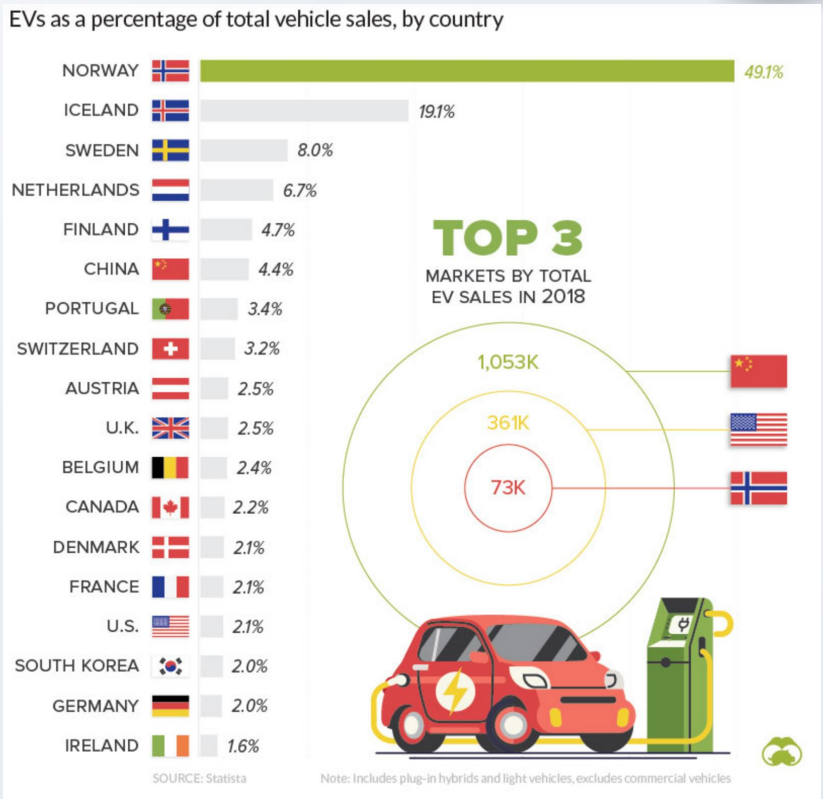


Social Viability – Impact on EV Adoption

A 2019 study by Consumer Reports shows that changes in consumer preferences and desire for government intervention are driving adoption of EVs:



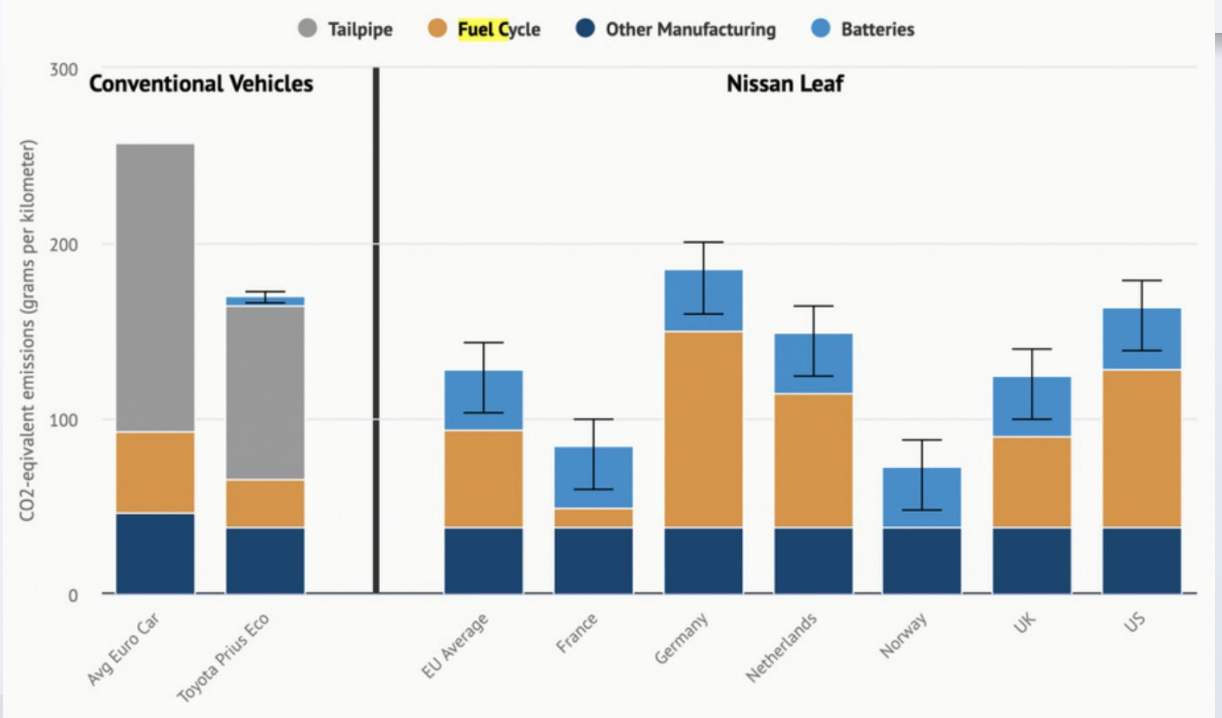
Social Viability – EVs in Other Countries



Bibliography

1. "The Race For The Electric Car." *CB Insights Research*, www.cbinsights.com/research/report/electric-car-race/.
2. 2017 National Household Travel Survey, https://nhts.ornl.gov/assets/2017_nhts_summary_travel_trends.pdf
3. Bloomberg New Energy Finance and Cambridge University, BMZ Germany
4. IEA World Energy Outlook, https://www.iea.org/weo2019/fuels/
5. *THE CURRENT STATE OF ELECTRIC VEHICLE SUBSIDIES: ECONOMIC, ENVIRONMENTAL, AND DISTRIBUTIONAL IMPACTS*. strata.org/pdf/2017/ev-full.pdf.
6. "Electric Car Incentives Map." *EV Compare.io*, evcompare.io/incentives/.
7. "Making Electric Vehicles Profitable." *McKinsey & Company*, www.mckinsey.com/industries/automotive-and-assembly/our-insights/making-electric-vehicles-profitable.
8. Gent, Edd. "Electric Cars Are Estimated to Be Cheaper Than Regular Cars by 2022." *Singularity Hub*, 2 May 2019, singularityhub.com/2019/04/29/electric-cars-are-estimated-to-be-cheaper-than-regular-cars-by-2022/.
9. McMahon, Jeff. "Electric Vehicles Cost Less Than Half As Much To Drive." *Forbes*, Forbes Magazine, 16 Jan. 2018, https://www.forbes.com/sites/jeffmcmahon/2018/01/14/electric-vehicles-cost-less-than-half-as-much-to-drive/#266431b63f97..
10. "Do Electric Cars Save Money?" *EnergySage*, https://www.energysage.com/electric-vehicles/advantages-of-evs/do-electric-cars-save-money/.
11. *Electric Vehicle Market Attractiveness*. www.accenture.com/_acnmedia/pdf-37/accenture-electric-vehicle-market-attractiveness.pdf.
12. Revkin, Andrew. "Most Americans Now Worry about Climate Change-and Want to Fix It." *Surveys Show Widening Worry on Climate Change-and Willingness to Fix It*, 23 Jan. 2019, www.nationalgeographic.com/environment/2019/01/climate-change-awareness-polls-show-rising-concern-for-global-warming/.
13. McMahon, Jeff. "Electric Vehicles Cost Less Than Half As Much To Drive." *Forbes*, Forbes Magazine, 16 Jan. 2018, https://www.forbes.com/sites/jeffmcmahon/2018/01/14/electric-vehicles-cost-less-than-half-as-much-to-drive/#266431b63f97..
14. "Do Electric Cars Save Money?" *EnergySage*, https://www.energysage.com/electric-vehicles/advantages-of-evs/do-electric-cars-save-money/.

Questions?



James Ellsmoor, Forbes
https://www.forbes.com/sites/jamesellsmoor/2019/05/20/are-electric-vehicles-really-better-for-the-environment/#5e54470876d2