Looking ahead: Electric drive

Nic Lutsey

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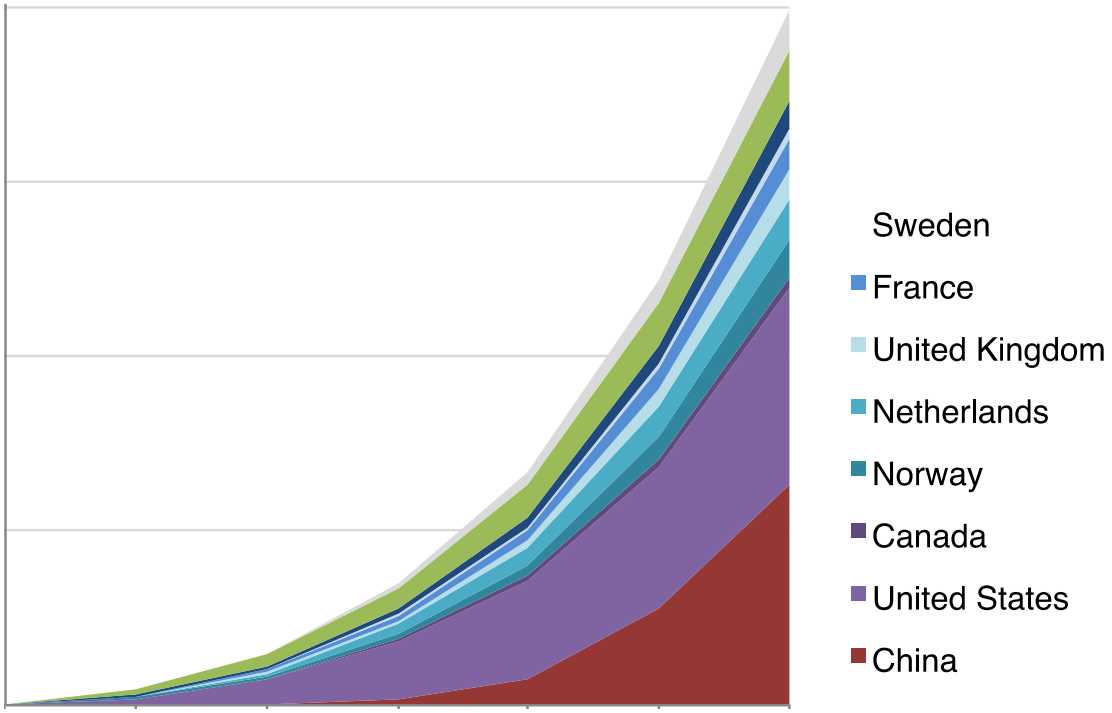
Outline

- State of the electric vehicle market
  - Global growth, annual production volume
  - Where is U.S. market uptake highest?
- Opportunities and challenges
  - Prospects for continued cost reduction
  - Incentives, regulatory policy, infrastructure
- Reflections

Global electric vehicle sales

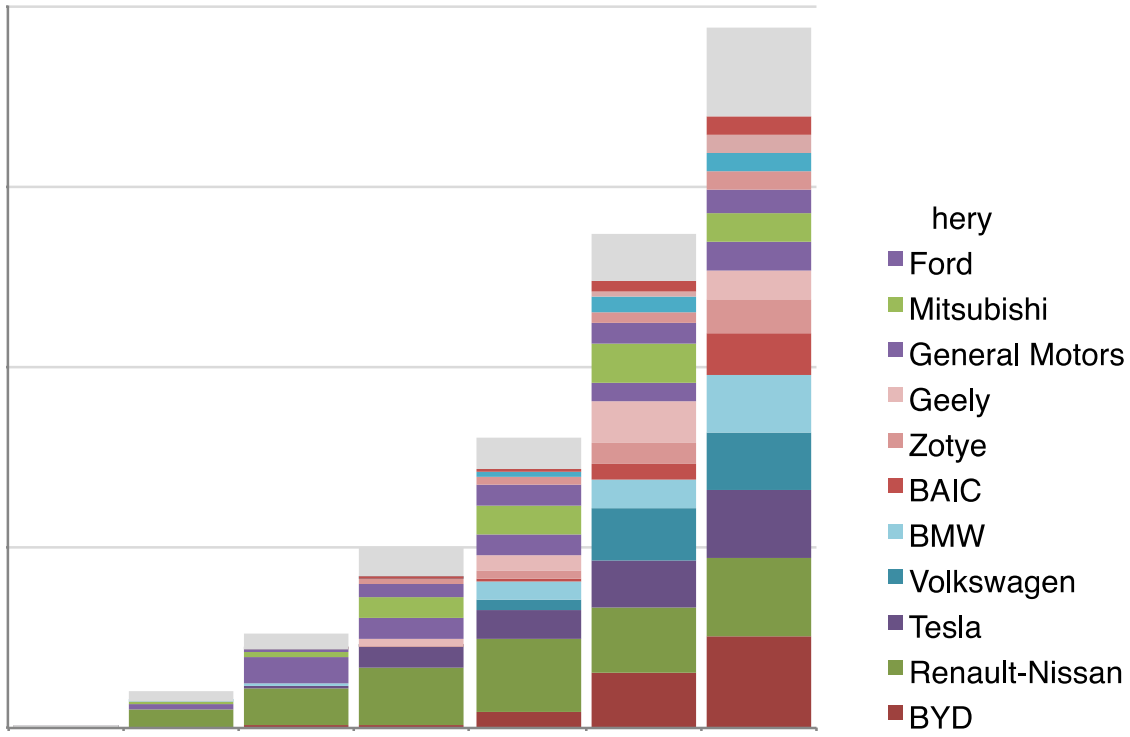
- In January 2017, cumulative global electric vehicle sales passed 2 million
  - Most of the sales are in China, U.S., and Europe



Lutsey, N. (2017). The rise of electric vehicles: The second million. http://www.theicct.org/blogs/staff/second-million-electric-vehicles. (Jan 31)

Annual electric vehicle sales, by automaker

- Most major autos are now in the game: 15 autos at 20k+ annual sales
  - Global annual 2015 to 2016 electric vehicle growth ~40%
  - Battery production more concentrated (5 companies make up 3/4 of production)



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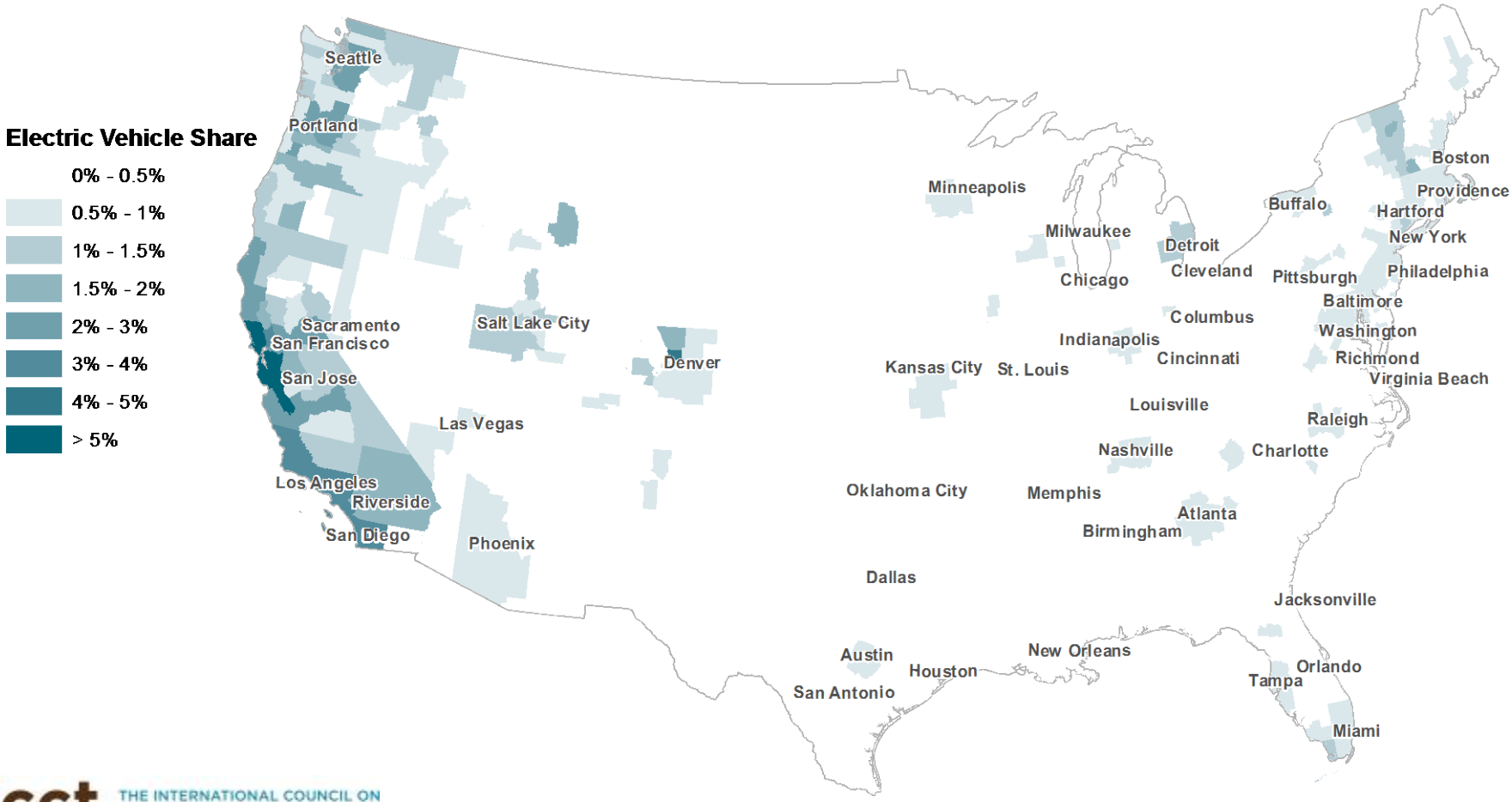
Based on Pontes, J. (2017) http://ev-sales.blogspot.com/search/label/World and Slowik et al (2016). Assessment of next generation electric vehicle technologies. http://www.theicct.org/next-generation-electric-vehicle-technologies

U.S. city electric vehicle uptake

- Where is electric vehicle uptake highest?
  - Top cities tend to have more available public charging, models, incentives, local actions



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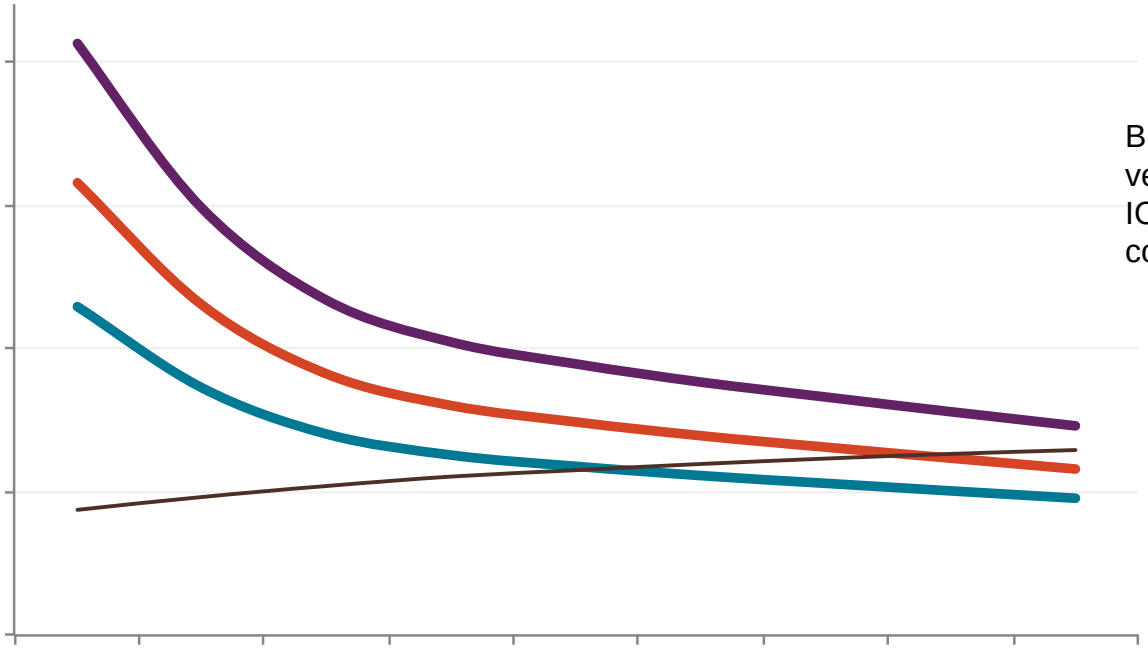
See: http://www.theicct.org/leading-us-city-electric-vehicle-2016
Updated report to be published in summer 2017, 2016 vehicle registration data from IHS Automotive

Opportunity: Electric vehicle costs are dropping

- Supplier competition, innovation, and volume → costs are dropping
  - Battery pack costs expected to drop from $200-$300/kWh in 2016 to ~$150/kWh in 2020-2025
  - Short- (100 mi) and medium-range (150 mi) electric vehicles will become cost competitive
  - *Challenge*: Sustain consumer incentives through 2020 while costs drop

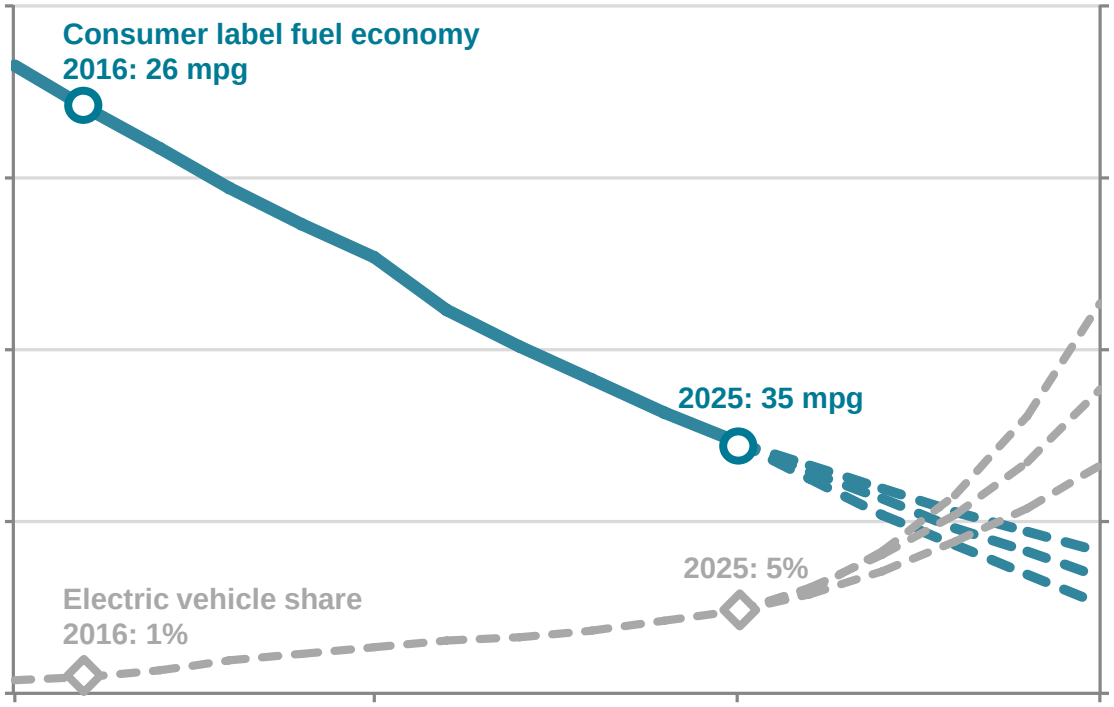


BEV = battery electric vehicle
ICE = internal combustion engine

Slowik et al (2016). Evolution of incentives to sustain the transition to a global electric vehicle fleet. http://www.theicct.org/evolution-incentives-electric-transition

Opportunity: Long-term regulatory policy

- Due to all the battery pack cost reductions, incremental performance standards for 2025+ timeframe push electric vehicles into the market
  - *Challenge*: Bigger investments need stable regulatory environment, longer lead time



Assumes adopted 2025 standards and hypothetical 2026-2030 standards at 4%-6% lower CO_2/year
Lutsey, Meszler, Isenstadt, German, Miller (2016). Efficiency technology and cost assessment for U.S. 2025–2030 light-duty vehicles. http://www.theicct.org/US-2030-technology-cost-assessment

Opportunity: Progress in cities

- These 14 markets account for a third of global electric vehicle sales
  - The sales leaders have 10,000 to 40,000 new electric vehicle sales per year
  - The sales share leaders have electric vehicle shares of 10-27% of new vehicle sales

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Hall, D., Moultak, M., Lutsey, N. (2017). Electric vehicle capitals of the world: Demonstrating the path to electric drive. http://www.theicct.org/EV-capitals-of-the-world

Electric vehicle capitals promotion actions

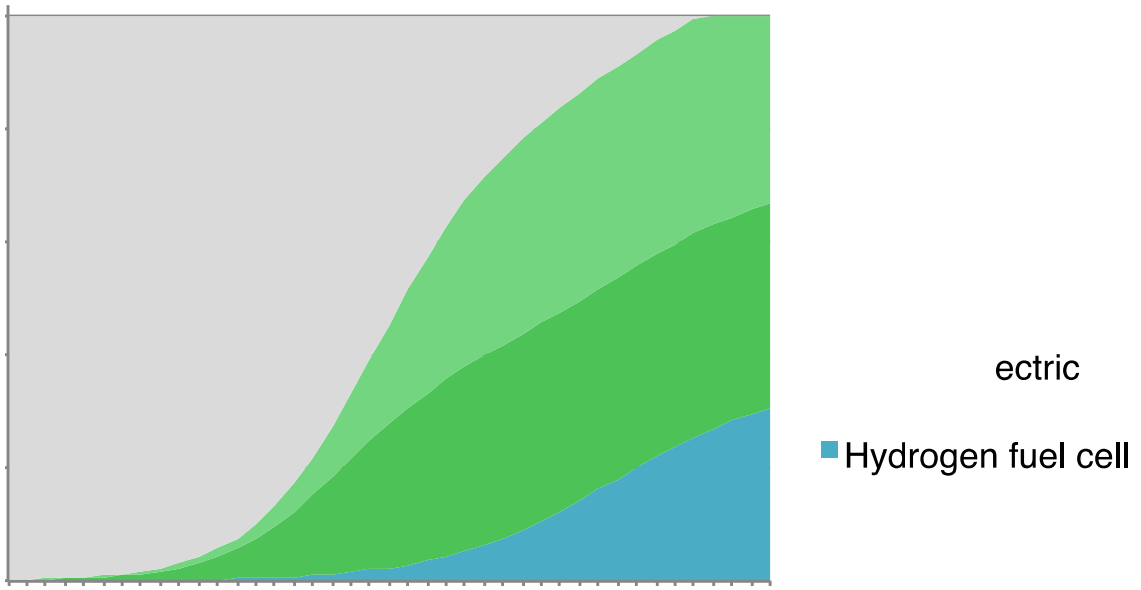
- What are the key features of the high electric vehicle uptake markets?
  - Comprehensive city, state, and national policy, including fiscal incentives, local perks, public charging infrastructure programs, and awareness campaigns

Country	City	Financial Incentives	Non-financial Incentives	Charging Infrastructure	Research and campaigns	Fleets
China	Shanghai	++	+	+	+	++
	Shenzhen	++	++	+		++
	Beijing	++	+	+	++	+
Europe	Copenhagen	+	+	++	++	++
	Paris	++	+	+	+	+
	Amsterdam	++	++	++	+	++
	Utrecht	++	++	++	++	+
	Oslo	++	++	++	+	++
	Stockholm	+	+	+	+	+
	Zürich	+		++	+	+
	London	+	++	+	++	++
United States	San Jose	++	++	++	+	+
	San Francisco	++	++	++	+	++
	Los Angeles	++	++	+	+	++

"+" indicates some action, and "++" extensive action. Source: Hall, Moultak, Lutsey (2017). Electric vehicle capitals of the world: Demonstrating the path to electric drive.http://www.theicct.org/EV-capitals-of-the-world

The challenge: Transition to electric drive

- Major governments have signaled the need to fully transition to electric drive in the 2025 to 2050 timeframe to achieve climate, air quality, and energy goals
  - National: Germany, India, Netherlands, Norway, United Kingdom
  - States/Provinces: British Columbia., California, Connecticut, Maryland, Massachusetts, New York, Oregon, Québec, Rhode Island, Vermont
  - Cities: Many registration and circulation restrictions, low emission zones, discussions of bans



ZEV Alliance COP21 announcement: http://zevalliance.org/content/cop21-2050-announcement
http://www.zevalliance.org/global-climate-change-mitigation-potential-from-a-transition-to-electric-vehicles/

Reflections

- Electric vehicle technology prospects
  - More models across vehicle types by all automakers
  - Innovation, volume → lower cost and higher range electric vehicles for mainstream buyers
- Select markets show what it takes to launch the market
  - Many policies help address market barriers of cost, convenience, consumer info
  - National and state: Consumer incentives, long-term CO_2 performance standards
  - Utility: Charging infrastructure (home, workplace, public)
  - Cities likely to be key drivers (restrictions, bans, access)

Contact

Nic Lutsey: *nic@theicct.org*

ICCT electric vehicle page: *http://theicct.org/electric-vehicles*

EV world capitals report: *http://www.theicct.org/EV-capitals-of-the-world*

U.S. city EV report: *http://www.theicct.org/leading-us-city-electric-vehicle-2016*

ZEV Alliance: *http://www.zevalliance.org*

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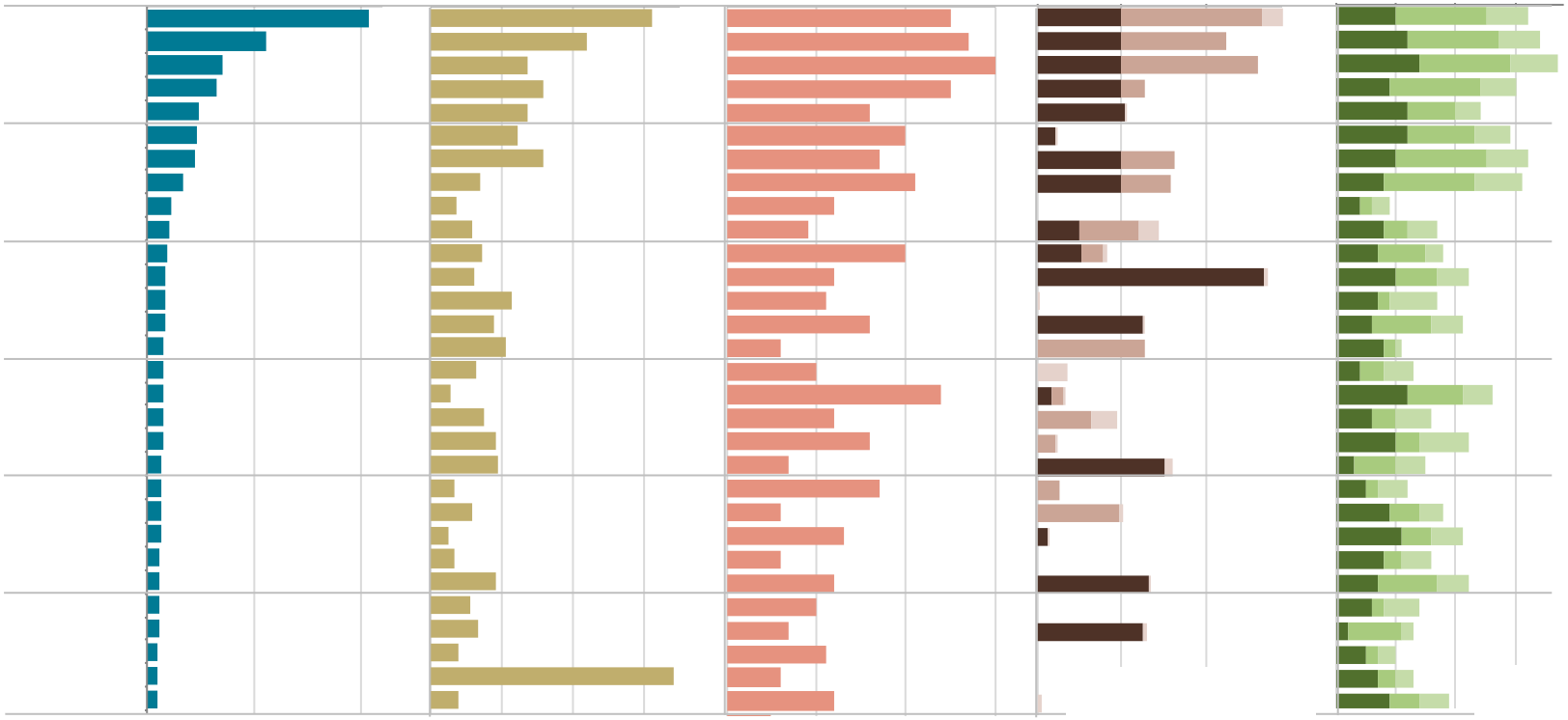
EV uptake and underlying factors by metro area

- Leading markets tend to have more public charging, more available electric vehicle models, consumer incentives, and local promotion actions



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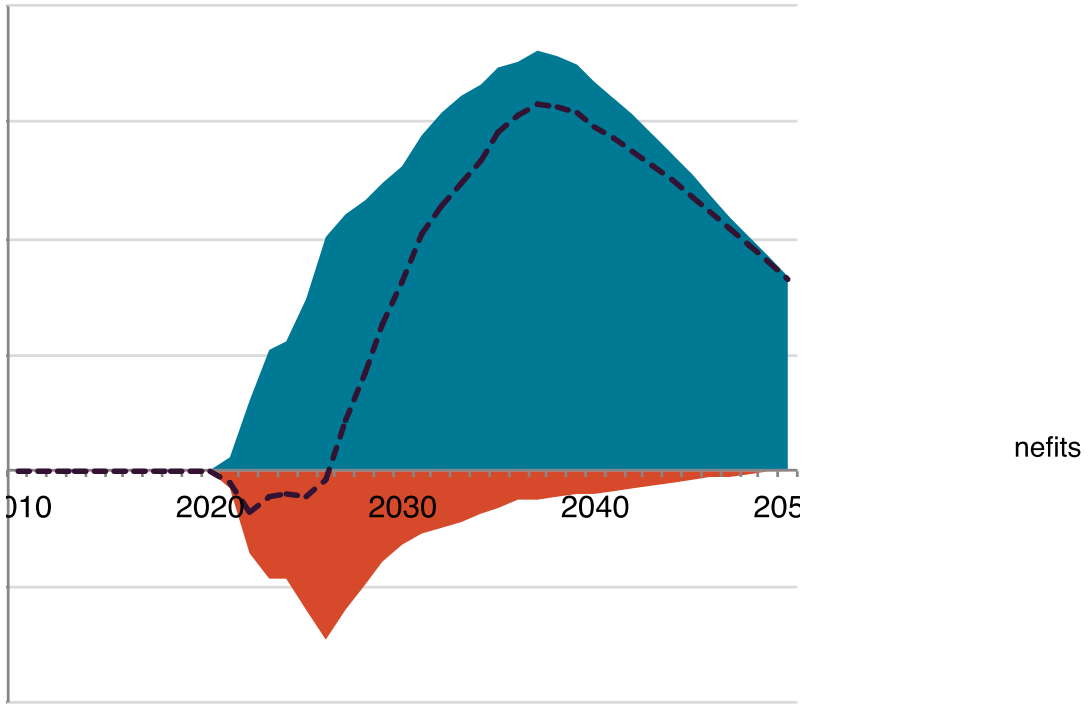
Updated report to be published in summer 2017, 2016 vehicle registration data from IHS Automotive

Opportunity: Benefits greatly exceed cost

- Electric vehicles reduce energy costs (and have major benefits)
  - Benefits are nearly many times higher than costs
  - *Challenge*: Transition will take time, prolonged policy support will be key



National Research Council (2015). http://www.nap.edu/catalog.php?record_id=18264
Slowik et al (2016). Evolution of incentives to sustain the transition to a global electric vehicle fleet. http://www.theicct.org/evolution-incentives-electric-transition