Electric Vehicle Trends and Projections

October 24, 2019
2:00 – 3:30 PM Eastern

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Question and Answer

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How to Participate

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Today’s Agenda

- **Andrea Denny**, Local Energy and Environment Program Lead, Office of Atmospheric Programs
  - **Jessica Daniels**, Environmental Protection Specialist, Office of Transportation and Air Quality
  - U.S. Environmental Protection Agency
- **Dr. Rachael Nealer**, Transportation Chief of Staff
  - U.S. Department of Energy
- **Michael Nicholas**, Senior Researcher
  - The International Council on Clean Transportation
- **Garrett Eucalitto**, Transportation Program Director
  - **Matt Rogotzke**, Policy Analyst
  - National Governors’ Association
- Question and Answer Session

*The views expressed by speakers on this webinar are solely those of the participants and EPA does not endorse any products or commercial services mentioned in this webinar.*
Introduction

Andrea Denny
Local Energy and Environment Program Lead

Jessica Daniels
Environmental Protection Specialist

U.S. Environmental Protection Agency
Investing in energy strategies that lower emissions can be an effective way for state, local and tribal governments to achieve multiple goals:

- Improve air quality and public health
- Strengthen energy systems
- Reduce greenhouse gas emissions
- Save money

We offer free tools, data and technical expertise about energy strategies, including energy efficiency, renewable energy and other emerging technologies, to help state, local and tribal governments achieve their environmental, energy and economic objectives.

Access all of these resources at the Energy Resources for State, Local, and Tribal Governments site
U.S. EPA’s State and Local Energy and Environment Program

- Electrification Webinar Series
  - Electric Vehicle (EV) Trends and Projections--today
  - Utility Perspectives of Vehicle Electrification—November/December
  - Additional Topics--2020
  - Get notifications by subscribing to our newsletter
  - Access all webinar materials at: State, Local, and Tribal Webinar Series

- Past Webinar: State & Local Experience with Workplace EV Charging
  - Highlighting state and local government efforts to encourage workplace charging within the government and in partnership with local stakeholders.
  - Featuring speakers from EPA’s ENERGY STAR program; the Colorado Energy Office, and the City of Fort Collins, CO.

- ENERGY STAR Certified EV Supply Equipment
  - Level 1 and Level 2 Certified Chargers are available
  - Use 40% less electricity in standby mode
  - Buying guides and sample procurement language available
U.S. EPA’s State, Local, and Tribal Transportation Resources

- EPA’s Office of Transportation and Air Quality (OTAQ) protects human health and the environment by reducing air pollution and greenhouse gases from mobile sources and the fuels that power them, advancing clean fuels and technology, and encouraging business practices and travel choices that minimize emissions.

- We help state, local, and tribal governments achieve their environmental and other objectives by providing expertise on:
  - State Implementation Plans
  - Transportation Conformity
  - Vehicle Emissions Inspection & Maintenance and state fuel programs
  - Travel Efficiency and Greenhouse Gas (GHG) Planning
  - MOVES, Calculators, and Tools

- Access all of these resources at the State and Local Transportation Resources page
OTAQ’s Voluntary Programs and Initiatives

- EPA’s OTAQ also has several voluntary programs and initiatives for state, local, and tribal governments as well as other stakeholders

  - **Clean Diesel Program**—To reduce diesel emissions that impact public health
    - Includes grants and rebates under the Diesel Emissions Reduction Act (DERA)

  - **Ports Initiative**—To improve environmental performance near ports

  - **SmartWay**—To advance sustainable transportation supply chains
Electric Vehicle Trends

- **EPA Automotive Trends Report**
  - Public information about new light-duty vehicle greenhouse gas emissions, fuel economy data, technology data, and auto manufacturers’ performance in meeting the agency’s GHG emissions standards

- EVs, plug-in hybrid electric vehicles (PHEVs), and fuel cell vehicles (FCVs) are a small but growing percentage of new vehicles
EPA Resources for Consumers

- **Beyond Tailpipe Emissions Calculator**

- **Green Vehicle Guide**
  - Learn more about EVs, PHEVs, and hydrogen fuel cell vehicles
  - Learn more about the EPA Fuel Economy and Environment Label
  - Find low-emitting vehicles and information on vehicle emissions
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Overview of Department of Energy Sustainable Transportation and Trends

Dr. Rachael Nealer
Transportation Chief of Staff
U.S. Department of Energy
Overview of DOE Sustainable Transportation and Trends

Rachael Nealer, PhD
Transportation Chief of Staff
Department of Energy (DOE)
Market Trends: Electric Vehicle (EV) sales

Cumulative U.S. Plug-in Vehicle Sales

*Note: 2019 is through August; Tesla sales are estimated

Source: ANL sales tracking

PHEV: Plug-in hybrid electric vehicle
Market Trends: Fuel cell electric vehicle (FCEV) sales

Note: Scale has changed

U.S. Cumulative Fuel Cell Electric Vehicle Sales

- Hyundai Nexo
- Toyota Mirai
- Hyundai Tucson
- Honda Clarity

Source: ANL sales tracking

*Note: 2019 is through August*
Cost Trends: Batteries

Source: VTO Annual Merit review, 2019

Graphite/High Voltage NMC

Silicon/High Voltage NMC

$320/kWh (5x excess Li, 10% S)

Lithium-Metal or Lithium/Sulfur

$197/kWh

~$80/kWh

NMC: Nickel-manganese-cobalt
Impacts of EVs on the Road


BEV: Battery electric vehicle
PEV: Plug-in Electric Vehicle
DOE Technical Goals

• Continue to lower the costs of EV and FCEV components
  – Ultimate goals:
    • Battery pack: $80/kWh
    • Electric drive: $4/kW
    • Fuel cell storage system: $266/kg hydrogen (H₂)

• Decrease refueling time for EVs and FCEVs
  – 10-15 min refueling for 200-300 miles of range for EVs
  – 3-5 min fill time for FCEVs

• Lower the cost to produce and deliver hydrogen
  – Ultimate goal: H₂ at $4/gge

• Provide information to public about all technology solutions
Clean Cities can help you ...

- Educate fleets and consumers about electric vehicles
- Coordinate regional EV charging infrastructure development
- Access data & information related to EV equipment and vehicle choices
- Identify funding opportunities and facilitate project partnerships
- Provide training for technicians, first responders, fire marshals, etc.
- Connect with technical experts from DOE national labs
Dr. Rachael Nealer
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Global Electric Vehicle Sales and Trends

Michael Nicholas
Senior Researcher
The International Council on Clean Transportation
Global Electric Vehicle Sales and Trends

Electric vehicle trends and projections webinar
October 24th, 2019
Terms

- **Zero-emission vehicle (ZEV)**
  - Refers to vehicles with zero tailpipe emissions; includes battery electric and hydrogen fuel cell vehicles.

- **Battery electric vehicle (BEV)**
  - Only has a battery and no gasoline engine.

- **Plug-in hybrid electric vehicle (PHEV)**
  - Has battery and electric powertrain capable of zero emissions; has a gasoline backup when the battery is depleted.

- **Electric vehicle (EV)**
  - Inclusive term for both BEVs and PHEVs.

- **Internal combustion engine (ICE) vehicle**
  - Any vehicle that derives all its energy from gasoline. Also called a conventional vehicle.
Electric vehicles are rapidly gaining market share worldwide

- Through 2018, cumulative global EV sales passed 5 million
  - Mostly the sales are in China, U.S., and Europe
  - These markets have a complex system of regulation, incentives, charging, local action
Electric vehicle shares differ by region

- In 2017 EV uptake across 50 metro areas: Up to 13% of new vehicle sales
  - Uptake correlated with model availability, city/state policy, incentives, charging
  - Nearly two-thirds of EV sales are in ZEV regulation states (CA, OR, Northeast)

Electric vehicle registrations in 2017
Slowik & Lutsey, 2018. *The continued transition to electric vehicles in U.S. cities*
Electric vehicle sales are reaching more markets in 2018

- In 2018 EV uptake across 50 metro areas: Up to 20% of new vehicle sales
  - Coasts continue to grow
  - Midwest market begins in many metros

![Map showing electric vehicle share in U.S. cities](image)

*Slowik & Lutsey, 2018. The continued transition to electric vehicles in U.S. cities*
The world is shifting to larger vehicles generally, but fully electric vehicles are mostly available in smaller segments.

**Conventional vehicle market sales share 2005 - 2017**

**BEV models available in Europe 2018**

Worldwide vehicle size preference differs by country making the transition to electric easier in countries with smaller vehicles. 


When will EV costs reach purchase price parity with conventional gasoline vehicles?

- Purchase parity with conventional vehicle depends on vehicle range.
  - 150 mi (242 km) in 2023
  - 200 mi (323 km) in 2025
  - 250 mi (403 km) in 2027

- PHEVs will have a cost premium

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Regulatory policy can drive technology

- Carbon dioxide (CO₂)/efficiency regulations are essential for industry technology investments
- U.S. case: 5% electric vehicle penetration in 2025 → 13-23% in 2030

What is driving electric vehicle uptake in the U.S.?

- California policies are working and increasingly getting adopted more widely
  - Top markets address prevailing barriers: Model availability (with ZEV regulation), cost (incentives), convenience (charging infrastructure), awareness (local actions)

See: Expanding the electric vehicle market in U.S. cities; 2016 vehicle registration data from IHS Automotive
Metropolitan areas with more EV sales share tend to have more chargers, EV models and promotion actions.

Figure 10. 2018 electric vehicle uptake, charging infrastructure, model availability, incentives, and promotion actions in the 50 most populous U.S. metropolitan areas. (New vehicle registration data are from IHS Markit; charging infrastructure data are from PlugShare.)

Source: ICCT, 2019. The surge of electric vehicles in United States cities
Electric vehicles and public charging have grown together globally

- At end of 2016: About 2 million electric cars and 300,000 public charge points

See: Emerging best practices for electric vehicle charging infrastructure
The charging gap varies regionally with some areas more prepared for 2025

Charging infrastructure in 2017 as a percentage of that needed by 2025

- 1%-10%
- 11%-20%
- 21%-30%
- 31%-40%
- 41%-50%
- 51%-60%
- 61%-70
- 81%-90%
- 91%-100%
Is there a global EV-per-public-charger benchmark?

- Looking at the top EV markets, the EV-per-charger ratio varies greatly
  - China/Netherlands 2-7; Norway/Sweden/UK ~15-20; California ~30

See: Emerging best practices for electric vehicle charging infrastructure
Utilities can charge more for electricity in countries with higher gasoline prices. Utilities must focus on energy cost reductions.

- Vertical lines indicate the price of gasoline by country
- Lines indicate the point at which driving on gasoline and electricity are equal
- The consumer value proposition depends on the price of difference of gasoline and electricity

How much does electricity need to cost in order to be cheaper than driving a conventional or hybrid vehicle?

In the U.S. $0.40/kWh for electricity would be more expensive than $3/gal gas

In Norway, $0.40/kWh for electricity would be less than $7.80/gal for gas
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: France, Germany, India, Netherlands, Norway, United Kingdom
  - States/Provinces: British Col., Calif., Conn., Maryland, Mass., New York, Oregon, Québec, Rh. Isl, Vermont
  - Cities: Many registration and circulation restrictions, low emission zones, discussions of bans

See: ZEV Alliance COP21 announcement: International Alliance Aims for All New Cars To Be Zero-Emission by 2050

Global climate change mitigation potential from a transition to electric vehicles
Leading global EV markets keep innovating

- These 20 markets account for 40% of global electric vehicle sales
  - These areas represent just 3% of the world population and 8% of global vehicle sales
  - The markets have combination of national, state, city, and utility policies and actions

Based on total electric vehicles sales through 2016
See Electric vehicle capitals of the world: What markets are leading the transition to electric?
Transformation is a combination of monetary and non-monetary actions across sectors and jurisdictions.
Reflections and lessons learned

- Global and U.S. experience show what it takes to launch the market
  - Regulation: Long-term CO$_2$ + EV regulations ensure investment, model availability
  - Incentives: Address short-term (~5 year) market cost barrier
  - Charging infrastructure: Provide convenience, consumer confidence, education
  - Utilities: Provide charging infrastructure (home, workplace, public) at low cost
  - Cities: Promote electric vehicles locally (urban restrictions, preferential access)

- Lessons learned on the transition to electric
  - Just one of the above actions is insufficient; comprehensive action needed
  - Stable regulatory/incentive policy is key; uncertain/shifting policy is disruptive
  - To grow charging infrastructure, encourage many stakeholders to engage
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ICCT electric vehicle page: http://theicct.org/electric-vehicles
ZEV Alliance: http://www.zevalliance.org

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Transportation Electrification: States Rev Up

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Transportation Electrification: States Rev Up

EPA Webinar on Electric Vehicle Trends
October 24, 2019

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National Governors Association
What is NGA?

Founded in 1908, the National Governors Association (NGA) is the collective voice of the nation’s governors. Our members are the governors of the 55 states, territories and commonwealths. NGA provides governors and their staff with services that range from representing states on Capitol Hill and before the Administration to developing and implementing innovative solutions to public policy challenges through the NGA Center for Best Practices.
Energy, Infrastructure and Environment (EIE) Division

- Resource for Governors
- Research & Policy Analysis
- Technical Assistance
- Convenings and Workshops

NGA | Energy, Infrastructure & Environment
Transportation Technologies of Focus

- RIDE-HAILING AND CAR-SHARING
- ELECTRIC VEHICLES
- CONNECTED AND AUTONOMOUS VEHICLES
- UNMANNED AERIAL VEHICLES /DRONES
Why Governors Are Interested
Benefits from Electrified Transportation

- Lowering & shifting emissions
- Electricity market benefits
- Minimizing household expenses
- Reducing petroleum dependence
State Policies to Encourage Electric Vehicles
Terms

- CHEAPR – Connecticut Hydrogen and Electric Automobile Purchase Rebate
- EV – Electric vehicle
- EVSE – Electric vehicle supply equipment
- PHEV – Plug-in hybrid electric vehicle
- TOU – Time-of-Use
- VW – Volkswagen
- ZEV – Zero-emission vehicle
## State EV Incentives

<table>
<thead>
<tr>
<th>State</th>
<th>Incentive</th>
</tr>
</thead>
<tbody>
<tr>
<td>California</td>
<td>$2,500 EV rebate, up to $4,500 based on income eligibility</td>
</tr>
<tr>
<td>Connecticut</td>
<td>$2,000 EV rebate</td>
</tr>
<tr>
<td>Colorado</td>
<td>$5,000 tax credit</td>
</tr>
<tr>
<td>Delaware</td>
<td>$3,500 EV rebate</td>
</tr>
<tr>
<td>Louisiana</td>
<td>$2,500 income tax credit</td>
</tr>
<tr>
<td>Maryland</td>
<td>$3,000 excise tax credit for new EV purchases</td>
</tr>
<tr>
<td>Massachusetts*</td>
<td>$1,500 EV rebate</td>
</tr>
<tr>
<td>New York</td>
<td>$2,000 EV rebate</td>
</tr>
<tr>
<td>Oregon</td>
<td>$2,500 EV rebate</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>$1,750 EV rebate</td>
</tr>
</tbody>
</table>
California

- $2,500 EV purchase rebate, can increase to $4,500 given income eligibility
- 5 Million EVs on the road by 2030 – 2018 Executive Order
- ZEV multi-state Task Force – mandates 1 million EVs on the road by 2023
- Many utilities offer EVs and charging rebates
- Incorporates EVSE into building standard codes
Colorado

• Offers a $5,000 tax credit for eligible EV purchases – the highest tax credit of any state

• Offers grants for EVs and EVSE – 80% of EV cost, up to $8,260, 80% of EVSE cost, up to $6,260

• Governor Polis issued his first Executive Order to advance EV adoption. Revises use of VW funds to focus investment on transportation electrification

• 940,000 EVs on the road by 2040
Connecticut

- Up to $2,000 EV rebate – depends on battery range
- Provides funding for 50-100% of EVSE costs (up to $10,000 per site) depending on program alignment
- CT Green Bank offers low-interest loans up to $30,000 for EV buyers. Also available for EVSE purchases
- New registration fee for all vehicles to help pay for the CHEAPR program
Transportation Electrification: States Rev Up
Crafting Incentives and Policies

What’s the priority?
► Engage automakers
► Build consumer awareness
► Meet ZEV targets
► Incentivize auto dealers
► Structure incentives equitably
► Utilize VW settlement funding
Enhancing State Fleet Electrification

What can states do?

► Use VW funds to overcome high upfront costs
► Offer vouchers for EV deployment
► Establish action plans
Siting Charging Infrastructure

What were states saying?
► Address range anxiety
► Engage Electrify America
► Identify charging needs
Improving Regional Coordination

► Establish Alternative Fuel Corridors
► Participate in regional collaboratives
► Open rest areas for EVSE
Who Owns, Operates and Pays for EVSE

► Deploy make-ready installations
► Own and operate installations
► Provide financial incentives
► Determine if EVSE should be regulated as a public utility
Managing the Grid

► Shift energy peaks through TOU rates
► Explore vehicle-to-grid technology
► Engage utilities to ensure grid reliability
Electrification for All

How can everyone benefit?

► Design rebates through tiered-income structures
► Set aside VW funding for EVSE in low-income communities
► Support public awareness campaigns
► Include rural areas in charging buildout
Addressing Impacts to State Revenue

What’s fair?

► 28 states have assessed EV fees
► Some are using fees to support EVSE
► Others are looking into road user charge
State-Imposed Electric Vehicle Fees
Thank You

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Question and Answer Session
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Webinar Feedback Form

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