17. Electric Transportation

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Lessons learned, state of the electric vehicle market, and a look ahead

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EPRI Electric Transportation Program has global perspective and experience

55+ global utility members working collaboratively on ET since 1990

Source: https://mapchart.net/world.html
EPRI Electric Transportation Program’s 30 years of utility and auto industry collaboration

1990-2021 program successes and highlights

Multi-industry collaboration: In 1991, created Electric Transportation Infrastructure Working Council (IWC) to bring together utilities, automotive companies, charging companies, etc.
– Success: One standard charging plug design for light-duty cars (J1772)
– Success: Standard for automated electric bus charging (J3105)

EV demonstrations: Partnered with OEMs to deploy EVs to collect, and analyze driving and charging data

<table>
<thead>
<tr>
<th>Year(s)</th>
<th>Description</th>
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<tbody>
<tr>
<td>2003-2004</td>
<td>Mercedes Sprinter PHEV van</td>
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<tr>
<td>2008-2010</td>
<td>Ford Escape PHEV utility demo</td>
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<tr>
<td>2009-2012</td>
<td>GM smart charging demo AMI, HAN, and telematics</td>
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<tr>
<td>2010-2014</td>
<td>Chrysler RAM pickup PHEV and smart charging</td>
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<td>2009-2016</td>
<td>North American demo of Odyne bucket trucks and VIA pickups/vans</td>
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<td>2011-2014</td>
<td>Nationwide utility fleet of Chevy Volt PHEV</td>
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<tr>
<td>2011-present</td>
<td>Smart charging with eight automotive companies (OEMs)</td>
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<tr>
<td>2018-2020</td>
<td>New York City electric transit bus demo</td>
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<tr>
<td>2018-present</td>
<td>V2G with FCA and Honda</td>
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<tr>
<td>2020-present</td>
<td>Hawaii electric school bus</td>
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<tr>
<td>2020-present</td>
<td>Virginia electric school bus with V2G</td>
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Charging infrastructure:
– Provided roadmap and analysis for utilities and local governments to create network of charging stations
– Co-developed smart circuit breaker with EV option

Environmental impact:
– Showed EVs have lower emissions than gas-fuelled vehicles—with NRDC

Public education:
– Spoke at numerous public regulatory workshops and meetings

Economic analysis:
– Evaluated benefits of EVs and related charging for large utility

Customer tools:
– Developed easy-to-use forklift cost savings calculator for large utility and its customers

For more info, please see [https://et.epri.com/ResearchAreas_Vehicles.html](https://et.epri.com/ResearchAreas_Vehicles.html)
Lessons learned from the past two decades

EVs and charging

- EV technology improvements
- Decreased battery costs
- Impact of policy and incentives
- Importance of customer choice
- Compelling emotional reasons to drive an EV
- Charging can be as easy a 120V wall outlet
- Autonomous driving still very challenging

Photos: Dan Bowermaster, EPRI
Global challenges

EV Market Key Questions
Both fundamental similarities and differences exist across the globe

1. Where is the EV market today? Where is it going?

2. What are the prerequisites for the roll-out and expansion of EVs?

3. What has been learned around the world with the launch of EVs that might help emerging markets?

4. What are special considerations, technical solutions and business models that may be better suited to emerging markets?

5. How do EVs integrate with and improve the broader transportation ecosystem?
Why would customer drive an EV?

- Great **acceleration**
- **Quiet** ride
- Enjoy **high tech**
- Avoid **gas stations**
- **Lower** fuel costs
- **Easy** refueling – like a smart phone
- Potential **low maintenance**
Electric transportation is a global market

Despite global pandemic, EV sales exceeded 6.6M (8.5% of market) especially where supported by strong policy and EV supply.

Europe (2021): 17%
- Norway (72%)  - Finland (1%)
- Iceland (%)  - Denmark (%)
- Sweden (45%)  - Switzerland (%)
- Netherlands (30%)  - Germany (30%)
- France (15%)
- Belgium (%)
- U.K. (15%)
- Austria (%)

2020–2025 EV market highlights and key considerations

Global outlook contrasts with local policies and preferences

**China**
Remains the world’s largest car (and EV) market

**Europe**
2020 tougher CO₂ regulations began plus bonus credits

**USA**
No carbon policy, no national energy policy, and conflicting EV policy

- Light-, medium-, and heavy-duty fleets
- Key market launches of crossovers, SUVs, and pickups

<table>
<thead>
<tr>
<th>BEV</th>
<th>PHEV</th>
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<tr>
<td>Ford Mustang Mach-E</td>
<td>Ford Escape PHEV</td>
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<tr>
<td>KIA Soul Gen 2</td>
<td>Lincoln Corsair Grand Touring</td>
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<tr>
<td>Tesla Model Y</td>
<td>Jeep Wrangler 4xe</td>
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<tr>
<td>VW ID ID4</td>
<td>Toyota RAV4 Prime</td>
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<td>Rivian R1T</td>
<td>BMW X3 xDrive 30e</td>
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<td>Rivian R1S</td>
<td>Audi Q5 55 TFSI e</td>
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<td>GMC Hummer EV SUV</td>
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<td>Volvo XC40 Recharge</td>
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<td>Audi etron Sportback</td>
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But purchasing decisions are made locally

Adoption — What does it take for a customer to buy an EV?

1. **Automotive OEMs**

2. **Car Dealers**

3. **Customers**
   - Does it meet my needs?
   - Do I like it?
   - Can I afford it today?
   - How do I fuel it?

Of the top 25 best-selling cars, only one has a plug-in option today

**Wild Card**
Impact of COVID 19 and supply issues?
2021 U.S. EV Market Highlights

EV sales increase exceeded overall automotive market

1. **2021 U.S. EV sales 671K**
   (476K BEVs and 195K PHEVs)

2. **U.S. EV market now ~4.4% and ~2.5M EVs**
   (China ~12% and EU at ~10%)

3. **PHEVs not dead**

4. **Emerging trend – electric pickups and delivery vans**

5. **Battery size, AC charging power, and DC charging power increasing**

6. **Increasing role of broader transportation ecosystem**

Photo: Dan Bowermaster, EPRI, January 2022
~2.4M EVs have been sold since December 2010

U.S. EV sales through Dec 2021
NEW EV MARKET SHARE 2021

NATIONWIDE AVG NEW EV MARKET SHARE: 4.3%
NUMBER OF COUNTIES EXCEEDING AVERAGE: 200
NUMBER OF STATES WITH COUNTIES EXCEEDING AVERAGE: 35

NEW EV MARKET SHARE: NEW EV SALES (OR REGISTRATIONS) FOR A GIVEN TIMEFRAME (I.E., JAN. 2021 – DEC. 2021)

New EV market share = [Sum of EV sales / Sum of LDV sales]

TOP 5 COUNTIES IN CA AND TOP 15 COUNTIES OUTSIDE CA

Santa Clara, CA 25%
Marin, CA 25%
San Francisco, CA 21.4%
Alameda, CA 21.1%
San Mateo, CA 19.3%
Boulder, CO 14.6%
King, WA 11.9%
Falls Church City, VA 11.4%
Charlottesville City, VA 11.3%
Clark, ID 10.7%
San Juan, WA 10.4%
Washington DC 10.4%
Summit, UT 10%
Arlington, VA 10%
Benton, OR 9.9%
Orange, NC 9.9%
Jefferson, WA 9.9%
Multnomah, OR 9.6%
Skamania, WA 9.3%
Skagway, AK 9.1%

*CO will become a ZEV state in 2022. WA and MN will become ZEV states in 2024. NM, NV, and VA have announced that they intend to become ZEV states in the future.
Trend 1: Customer choice of EVs is increasing

127 EVs available by 2023

Number of Models Available

Vehicle Types
- SUV/Crossover
- Sedan
- Ultra-Luxury/Limited Edition
- Compact/Hatchback
- Minivan/Wagon/Van
- Subcompact
- Coupe
- Pickup Truck
- Sports Car
- Wagon

Updated 3/18/2020
A Look Ahead to 2023 and Beyond

What do utilities need to consider and what can they do?

Photos: Marcus Alexander, EPRI. Rob Schurhoff, EPRI. November 2021.
Trend 2: 
Policy Drivers Are Increasing Affecting All States

**Bold New Federal Policy**
- President Biden signed EO requiring replacement of entire Federal fleet with US built electric cars, vans and trucks (645,000 nationwide)
- $2T “Build Back Better” stimulus package (in development) designed to cut emissions while proving millions of good-paying jobs. Proposes $174B over 10 years to:
  - Build 500,000 public charging “outlets” (about 50% of market need through 2030) probably though Federal tax credits
  - Extend and create new tax credit incentives to encourage individuals, businesses to acquire EVs

**Growing State Policy (Regulations/ Legislation/ Incentives)**
- There are 14 states with an all-electric vehicle incentive
- 29 states have an EV annual registration fee
- 30 states have charger incentives
- 23 states had EV bills in 2020

**ZEV Mandate is Expanding Also**
- In addition to California, 14 other states and DC have committed to equivalent requirements with more states expected to adopt ZEV requirements in LDV/ MD/HD and Transit market segments
Global trends in the electric vehicle market today
Government policy and corporate EV business plans increasingly support EVs

New ICE Car Proposed Sales Ban

<table>
<thead>
<tr>
<th>2025</th>
<th>2030</th>
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<td>Costa Rica</td>
<td>Colorado</td>
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Trend 3:
EV growth is driving battery costs down

Source: BNEF 2019 Lithium Ion Price Survey
...Leading to longer driving ranges for fully electric EVs (BEVs)

Average BEV driving range increasing over time
Yet average PHEV Electric Range Remains Steady at around 26 Miles
Bigger EVs are coming too

Photo credits: Mark Kosowski, Dan Bawermaster
Electric bus deployments are increasing across the US

More numerous in Asia and Europe

Manufacturers

- 6 Volvo Bus UK
- 73 Null
- 215 BYD
- 45 Gillig
- 582 Proterra
- 198 New Flyer
- 1 Lightning Systems

Number of Buses

- 1
- 50
- 100
- 150
- 210
Trend 4:
DC charging power is increasing

Light-duty EVs
Trend 4: DC charging power is increasing

Medium and heavy-duty EVs

Future DC charging power level over time

Driving grid and load management concerns
Trend 5: Improvements in US electricity generation reduce emissions in other sectors –

Source: EIA
Trend 6:
Growing Utility and Regulator Commitments

North American electric utilities implementing ~$3.4B in EV Infrastructure Programs

Updated: 9/27/2021, Source: North American Utility Electric Transportation Charging Infrastructure: Program Overview, EPRI, March 2021; individual utility interviews
How and Where is EV Charging Taking Place?
The bulk of EV charging will be done at home and work
Some public charging is DC fast charging

Public Charging:
Necessary for BEVs, but not PHEVs

At-work Charging:
Extends electric range of PHEVs and short-range BEVs

Home Charging:
Charge at 120V AC or 240V* AC
* Use an existing dryer outlet or install new circuit

The EPRI Charging pyramid, M. Duvall, EPRI, circa 2007
Public charging infrastructure density is increasing

Source: PlugShare, February 2020
Fleet Charging matters
Often capacity is the constraint

- What does the impact of fleet charging mean
- How do we ensure proper charging to minimize grid impact
- What information do our customers need
- How do we help our customers deploy charging infrastructure

Source: PlugShare, February 2020
What are North American utilities doing to prepare?
What can utilities do to prepare for EVs big and small?

- **EVALUATE ROLE**
  in supporting or providing charging infrastructure (ETIPS)

- **STAFF UP**
  your ET teams

- **REVIEW PROCESSES**
  your service planning and distribution planning processes for residential and fleet customers

- **REVIEW RATES**
  your rate options for large ET customers

- **ENSURE FORECASTED LOAD PLACEMENT**
  from light-duty ET is in short- and long-term procurement, grid planning, etc.

- **REVIEW COST ALLOCATION POLICIES**
  for grid upgrades for ET residential customers as well as fleets

- **CONNECT WITH STATE AND LOCAL AGENCIES**
  to coordinate EV incentives and public education programs

- **OPEN DIALOGUE**
  with neighboring utilities to explore or coordinate regional EV charging networks for passenger EVs (highway)
Together...Shaping the Future of Energy™