“EV-Ready” or Not!
Electric Vehicles in Texas

Texas Public Works Association Short Course
Killeen, TX
February 6, 2017

Presenter: Rachel Linnewiel
Presentation Contents

- Air Quality Basics: NAAQS and Ozone
- Benefits of EVs
- EV and EV Charging Basics
- Obstacles to Adoption
- Achieving EV Readiness
- Additional Resources
## Why EVs? NAAQS and Ozone

- **National Ambient Air Quality Standards (NAAQS)**
  - Established by the Environmental Protection Agency (EPA)
  - Address Six “Criteria” Pollutants:

<table>
<thead>
<tr>
<th>Air Pollutant</th>
<th>Abbreviation</th>
<th>DFW Status</th>
<th>Region</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Monoxide</td>
<td>CO</td>
<td>In attainment</td>
<td></td>
</tr>
<tr>
<td>Lead</td>
<td>Pb</td>
<td>In attainment</td>
<td></td>
</tr>
<tr>
<td>Nitrogen Dioxide</td>
<td>NO$_2$</td>
<td>In attainment</td>
<td></td>
</tr>
<tr>
<td>Ground-level Ozone</td>
<td>O$_3$</td>
<td><strong>Nonattainment</strong></td>
<td></td>
</tr>
<tr>
<td>Particulate Matter</td>
<td>PM</td>
<td>In attainment</td>
<td></td>
</tr>
<tr>
<td>Sulfur Oxides</td>
<td>SO</td>
<td>In attainment</td>
<td></td>
</tr>
</tbody>
</table>

- Impacts of Nonattainment Status
  - Health
  - Economic
NAAQS and Ozone

Criteria Pollutants

- Impact Human Health
- Are Addressed in Federal Legislation
  - Clean Air Act

Greenhouse Gas (GHG) Pollutants

- Taken Individually, Are Not Necessarily Damaging to Human Health
- Affect the Environment by Trapping Heat in the Earth’s Atmosphere Over Time
NAAQS and Ozone

Ozone pollution basics:

Formed by the reaction of pollutants in heat and sunlight

\[ \text{NOx} + \text{VOC} + \text{Heat} & \text{Sunlight} = \text{Ozone} \]
Air Quality in North Texas

Estimated 2017 Nitrogen Oxides (NO\textsubscript{x}) Emissions Inventory
Source Category Estimates = 296.73 tons per day (tpd)

- On-Road (Cars & Trucks): 130.77 tpd (44%)
- Non-Road (Construction, Agriculture, etc.): 45.64 tpd (15%)
- Off-Road (Locomotives, Aircraft, etc.): 25.20 tpd (8%)
- Point, Excluding Oil & Gas (Power Plants, Cement Kilns, etc.): 38.30 tpd (13%)
- Point - Oil & Gas: 16.50 tpd (6%)
- Area (Dry Cleaners, Bakeries, etc.): 26.55 tpd (9%)
- Oil & Gas (Production & Drill Rigs): 13.87 tpd (5%)

Source: Texas Commission on Environmental Quality, 2017 Dallas-Fort Worth 8-hour Ozone Attainment Demonstration State Implementation Plan
Ozone in Texas

Texas Ozone Nonattainment Status by County

Legend
- Counties Recommended for Nonattainment
- Designation Under the 70 ppb* Ozone Standard
- Counties Approaching Nonattainment Status
- Interstate Highways
- US Highways
- TX Highways

Source: NCTCOG
January 2017
US Petroleum Use by Sector

Figure 93. Liquid fuels consumption by sector, 1990-2035 (million barrels per day)

http://www.eia.gov/forecasts/aeo/source_oil.cfm
Benefits of EVs

- Zero Tailpipe Emissions, Lower Well-to-Wheels Emissions
- Energy Security
- Noise-free Driving Experience
- Local Economic Support
- Lower Fuel and Maintenance Costs
Benefits of EVs

- Well-to-Wheels Emissions Comparison

![Pie chart and bar graph showing state averages for TX and emissions comparison between different vehicle types (electric, plug-in hybrid, hybrid, and gasoline).](chart.png)
## Benefits of EVs

- **Lower Fuel and Maintenance Costs**

<table>
<thead>
<tr>
<th></th>
<th>Mileage</th>
<th>Internal Combustion Engine</th>
<th>Electric Vehicle</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$</td>
<td>Trips</td>
</tr>
<tr>
<td><strong>Tires</strong></td>
<td>Every 7,500 miles</td>
<td>$400</td>
<td>13</td>
</tr>
<tr>
<td><strong>Oil Change</strong></td>
<td>Every 5,000 miles</td>
<td>$400-$800</td>
<td>20</td>
</tr>
<tr>
<td><strong>Automatic</strong></td>
<td>At 100,000 miles</td>
<td>$30-$100</td>
<td>1</td>
</tr>
<tr>
<td><strong>Transmission</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fluid</strong></td>
<td>varies</td>
<td>$7,142</td>
<td>400</td>
</tr>
<tr>
<td><strong>Fuel</strong></td>
<td>varies</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Engine</strong></td>
<td>within first 100,000 miles</td>
<td>$200</td>
<td>1</td>
</tr>
<tr>
<td><strong>Park Plugs &amp;</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Wires</strong></td>
<td>within first 100,000 miles</td>
<td>$100-$250</td>
<td>1</td>
</tr>
<tr>
<td><strong>Muffler</strong></td>
<td>within first 100,000 miles</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Brakes</strong></td>
<td>2x within first 100,000 miles</td>
<td>$400</td>
<td>2</td>
</tr>
<tr>
<td><strong>Water Pump</strong></td>
<td>100,000 miles</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Big 100,000</strong></td>
<td>Timing Belt</td>
<td>$600-$800</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Water Pump</td>
<td>$300 (if combined with timing belt service)</td>
<td>1</td>
</tr>
</tbody>
</table>
EV Basics: History

- EVs Were First Invented in the 1830s
- First Road-Ready EV - 1890
- First Electric Taxi Cabs - New York City, 1897
EV Basics: History

- Downfall of the Early EV
  - 1908 - Model T
  - Desire for Longer-Distance Vehicles
  - Lack of Horsepower
  - Discovery of Texas Crude Oil
  - Electric Starter
Introduction to EVs

Hybrid Electric Vehicle (HEV)

Plug-In Hybrid Electric Vehicle (PHEV)

All-Electric Vehicle (EV) or Plug-In Electric Vehicle (PEV)
# Introduction to EVs

## All-Electric Miles per Model

<table>
<thead>
<tr>
<th>Model</th>
<th>Miles per Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015 Tesla Model S (85 kW-hr battery pack)</td>
<td>265</td>
</tr>
<tr>
<td>2015 Tesla Model S (60 kW-hr battery pack)</td>
<td>208</td>
</tr>
<tr>
<td>2015 Nissan Leaf</td>
<td>84</td>
</tr>
<tr>
<td>2015 Volkswagen e-Golf</td>
<td>83</td>
</tr>
<tr>
<td>2015 BMW i3</td>
<td>81</td>
</tr>
<tr>
<td>2015 Ford Focus Electric</td>
<td>76</td>
</tr>
<tr>
<td>2015 smart fortwo electric drive coupe</td>
<td>68</td>
</tr>
<tr>
<td>2016 Mitsubishi i-MiEV</td>
<td>62</td>
</tr>
<tr>
<td>2015 Chevrolet Volt</td>
<td>38</td>
</tr>
<tr>
<td>2015 Cadillac ELR</td>
<td>37</td>
</tr>
<tr>
<td>2015 Ford C-MAX Energi Plug-in Hybrid</td>
<td>20</td>
</tr>
<tr>
<td>2015 Ford Fusion Energi Plug-in Hybrid</td>
<td>20</td>
</tr>
<tr>
<td>2015 Toyota Prius Plug-in Hybrid</td>
<td>11</td>
</tr>
</tbody>
</table>
North Texas EV Registration and EVSE Distribution
**Registration by EV Model in North Texas**

*Total EV Registration:*
- **Texas:** 8835
- **DFW Area:** 3436
- **38.8% of TX total** (As of January 2017)

*NCTCOG staff plans to include additional models including: Cadillac ELR, Chevrolet Spark, Fiat 500e, Honda Accord Plug-In & Fit EV, Toyota Plug-In Prius, & RAV4 EV*
Introduction to Electric Vehicle Supply Equipment (EVSE)

<table>
<thead>
<tr>
<th>Type</th>
<th>Specifications</th>
<th>Time Needed to Charge 10 Miles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>AC 110–120 V 12 or 16 amps 1.44, 1.92 KW</td>
<td>1h 40 min</td>
</tr>
<tr>
<td>Level 2</td>
<td>AC 208–240 V 16 - 80 amps 3.3 - 19.2 KW</td>
<td>~ 30 min</td>
</tr>
<tr>
<td>Fast Charging</td>
<td>DC 200–450 V ≤ 200 amps ≤ 90 KW</td>
<td>&lt; 5 min</td>
</tr>
</tbody>
</table>

Image Source: NCTCOG
Introduction to EVSE

Level 1 and Level 2 Chargers

DC Fast Chargers

Images Courtesy of National Renewable Energy Laboratory
EVSE Hierarchy

- Public
  - Parking lots/garages
  - Public/municipal
  - Retail
  - Transportation hubs
  - Hotels
- Workplace
  - Business offices
  - Office parks or campuses
  - Industrial facilities
  - Fleets
- Home
  - On-street
  - Multi unit dwelling
  - Single family residential garages and driveways
  - Education
  - Medical
  - Leisure destinations
  - Non-profit meeting places
Public EVSE Management Options

- Host-Owned EVSE
  - Business or Property Owner Pays to Own and Install EVSE
  - Charging Time-Based or Provided as a Free Public Service
- Network-Owned EVSE
  - Installation Company (e.g. Chargepoint, NRG EVgo, Blink, etc.) Contracts with Host to Install EVSE
  - Installation Company Retains Ownership of EVSE
  - Users Pay Fee, Often Time-Based or Monthly Membership
- In Both Cases: Installation Requires Licensed Electrician Only
Obstacles to EV Adoption and Deployment

- Range Anxiety
  - Charging Time
  - Public Charging Availability
  - Interoperability
- Up-Front Costs
- Lack of Information
- Lack of Automaker Marketing
- Lack of Media Coverage/Publicity
Achieving EV Readiness

- Long-Term Vehicle and Infrastructure Planning
- Market Conditions
- Utility Involvement
- Education and Outreach
- Laws, Incentives, and Financing
- EVSE Permitting and Inspection Process
Long-Distance EV Infrastructure Planning

Map 2: Locations of TxDOT* Rest Areas and Information Centers, Electric Vehicle Fast Charging

Legend

- TxDOT Information Centers
- TxDOT Rest Areas
- Tesla Supercharger Locations
- DC Fast Charging Locations

Proposed Corridors

- Interstate Highways
- US Highways
- State Highways

Source: NCTCOG
January 2017
FAST* Act Designated EV Corridors

Comparison of FHWA* Designated Electric Vehicle Corridors with Corridors Nominated by NCTCOG

Legend
- Nominated and Designated -- Signage Ready
- Nominated and Designated -- Signage Pending
- Nominated Interstate -- Not Designated
- Nominated US/State Highway -- Not Designated
- Counties Proposed to Be Designated Ozone Nonattainment Under 2015 Revised Ozone Standard

*Federal Highway Administration
Clean Cities Coalitions

- **Goals:**
  - Reduce Petroleum Consumption
  - Facilitate Use of Alternative Fuel Vehicles and Supporting Infrastructure
  - Accelerate Sales of Electric and Hybrid Electric Vehicles
  - Promote Informed Consumer Choice on Fuel Economy
  - Encourage Use of Idle Reduction Strategies
Clean Cities Coalitions
Electric Vehicles North Texas: Initiatives and Focus Areas

- Promote EV Adoption
- Promote EV Readiness
- Evaluate EV Registration Data with Infrastructure Sites
- Engage Local Businesses in Workplace Charging Challenge
- Develop Marketing/Educational Materials
- Host National Drive Electric Week Events
- Create Region-Specific Fact-Sheets
- Monitor Local Interest-Group Activities
- Raise Awareness - #TexasEV
Alternative Fuels Data Center Tools: Plug-In EV Readiness Scorecard

- Assess Readiness for Wide-Scale EV and EVSE Adoption
- Receive Feedback about Strengths and Ways to Improve
- Record and Track Progress

http://www.afdc.energy.gov/
Workplace Charging Program

- Program of the Department of Energy
- EVNT Provides Support By:
  - Tenant Surveys
  - Fact Sheets and Online Resources
  - In-Person Consultation
  - Customized Events

https://energy.gov/eere/vehicles/workplace-charging
Alternative Fuels Data Center
Tools: Station Locator

http://www.afdc.energy.gov/
Available Incentives

- Texas Commission on Environmental Quality (TCEQ) Texas Emission Reduction Plan (TERP) Alternative Fueling Facilities Program (AFFP)
- Provides grants of up to 50% of total eligible costs or a max. of $600,000 for the construction or expansion of alternative fueling stations in specific counties

www.terpgrants.org
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