INTRODUCTION TO ELECTRIC VEHICLES (EVs) & EV INFRASTRUCTURE
Review emerging technologies in the electric and alternative vehicle market, including alternative fuel sources.

EV Technologies
1. Plug-In Hybrid Electric Vehicle (PHEV)
   • Relatively short range on full battery (~40 miles), then Internal Combustion Engine (ICE) automatically starts
   • Not limited in range by electricity

2. Battery Electric Vehicle (BEV)
   • Battery-only propulsion, no ICE backup
   • 40-300 mile range, depending on make / model
   • Primary consideration for long-range travel and evacuations

EV Technology Trends
- Increased Battery Power Density
- Increased Battery Lifetime (Recharge Cycles)
- Higher Battery Voltages
- Decreased Charging Time
- Decreased Battery Cost ($/kWh)

BEVs HISTORICAL BATTERY COST & RANGE

<table>
<thead>
<tr>
<th>Year</th>
<th>Cost per kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>~$1,175</td>
</tr>
<tr>
<td>2015</td>
<td>~$375</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Year</th>
<th>Range</th>
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</thead>
<tbody>
<tr>
<td>2010</td>
<td>~75 miles</td>
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<td>~160 miles</td>
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BEVs FORECASTED BATTERY COST & RANGE

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<th>Year</th>
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<tbody>
<tr>
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<td>~450 miles</td>
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* Targeted cost to be competitive with traditional gasoline vehicles

EV Infrastructure
Level 2
- Slower charging speed (>2 hours-full charge)
- Short-range travel (commuting, intra-regional)
- Currently dominant

Direct Current Fast Charger (DCFC)
- Fast charging speed (~30 minutes-full charge)
- Long-range travel (evacuation, inter-regional)
- Future-oriented

PURPOSE - ELECTRIC VEHICLE MASTER PLAN (EVMP)
In 2020, Senate Bill 7018 was signed by Governor Ron DeSantis to enact Florida Statute 339.287 titled “Electric vehicle charging stations; infrastructure plan development.” The statute required Florida Department of Transportation (FDOT) to coordinate, develop, and recommend a Master Plan for the development of electric vehicle charging station infrastructure along the State Highway System (SHS). FDOT, in consultation with the Florida Department of Environmental Protection, the Florida Public Service Commission and other state agencies hereby submits this Status Report containing preliminary findings and recommendations for the Electric Vehicle Infrastructure Master Plan (EVMP) for legislative consideration.
The Status Report includes findings related to topics prescribed by F.S. 339.287. These findings are not yet conclusive as further review and vetting is necessary before submitting the final EVMP to the Governor, the President of the Senate, and the Speaker of the House of Representatives on July 1, 2021. Further, preliminary recommendations are proposed based on study findings and input provided by stakeholders. All findings and recommendations contained herein should be considered preliminary and subject to change upon subsequent legislative and stakeholder review.
The primary goals and objectives of the EVMP are as follows:

- Support both short-range and long-range electric vehicle travel;
- Encourage the expansion of electric vehicle use in this state; and
- Adequately serve evacuation routes in this state.

EV Infrastructure is also called:
- Electric Vehicle Supply Equipment (EVSE)
- Charging Stations

CONTENTS
Purpose
Introduction to EVs & EV Infrastructure
Status Updates on Florida Statute 339.287 Topics
Preliminary Recommendations

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EV Technology Trends
- Increased Battery Power Density
- Increased Battery Lifetime (Recharge Cycles)
- Higher Battery Voltages
- Decreased Charging Time
- Decreased Battery Cost ($/kWh)
**EXISTING EVSE TYPES & USE CASES**

Evaluating and comparing the types of electric vehicle charging stations available at present and which may become available in the future, including the technology and infrastructure incorporated in such stations, along with the circumstances within which each type of station and infrastructure is typically used, including fleet charging, for the purpose of identifying any advantages to developing particular types or uses of these stations.

### EVSE Type | Supply Voltage | Charger Examples | Power Level | Charge Rate (miles/hr) | Cost to Install | Use Cases
---|---|---|---|---|---|---
Level 1 | 120V (Toaster) | J1772 Connector | 1 - 1.8 kW | 3 - 7 | $ | Home / Overnight

#### Level 2

<table>
<thead>
<tr>
<th>Supply Voltage</th>
<th>Charger Examples</th>
<th>Power Level</th>
<th>Charge Rate (miles/hr)</th>
<th>Cost to Install</th>
<th>Use Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>208-240V (Clothes Dryer)</td>
<td>J1772 Connector</td>
<td>3.3 - 19.2 kW</td>
<td>10 - 60</td>
<td>$$</td>
<td>Home / Work Destination Charging</td>
</tr>
<tr>
<td>480V (Commercial HVAC Unit)</td>
<td>CHAdeMO / SAE Combo</td>
<td>50 kW</td>
<td>175</td>
<td>$$$</td>
<td>Roadside / Travel Emergency Charging</td>
</tr>
<tr>
<td>50 kW</td>
<td>150 kW</td>
<td>350 kW</td>
<td>1,200</td>
<td>$$$</td>
<td></td>
</tr>
</tbody>
</table>

### KEY POINTS

- **Obsolete for commercial purposes**: Currently dominant for commercial purposes.
- **Most applicable for long-range travel and evacuations**: Most applicable for long-range travel and evacuations.
- **Currently dominant for commercial purposes**: Currently dominant for commercial purposes.
- **Most applicable for long-range travel and evacuations**: Most applicable for long-range travel and evacuations.

### Future EVSE Technologies for Fleet & Passenger Operations

- Higher power charging, up to 350 kW with current standards
- Extreme Fast Charging (XFC), 1 MW+ for medium / heavy duty
- Wireless Power Transfer (WPT)

### WPT (Wireless Power Transfer) is Coming

**Today**

- **Light-Duty Passenger Vehicles**: 3 kW - 350 kW (Focus of NHTSA study)
- **Transit and Medium Duty Trucks**: ≤ 350 kW
- **Heavy-Duty Trucks**: 1 MW (mega-watt) - HD EVSE Infrastructure will need a dedicated network

**2030**

- **Static WPT**
- **Quasi-Dynamic WPT**
- **Dynamic WPT (Urban)**

**2040**

- **Static WPT**
- **Quasi-Dynamic WPT**
- **Dynamic WPT (Urban)**

**2050**

- **Static WPT**

### EV / EVSE ADOPTION BARRIERS & RESILIENCY

Identifying any barriers to the use of electric vehicles and electric vehicle charging station infrastructure both for short-range and long-range electric vehicle travel.

#### EV Adoption Barriers

- **EV cost parity with ICE vehicles - expected to occur 2025-2030**
- **Range anxiety during longer trips**
- **Lack of EV models available on the market - >50% of vehicles registered in FL are truck / SUV**
- **Lack of dealership knowledge / willingness to suggest EVs; lack of EVs available at FL dealerships**

#### EVSE Adoption Barriers

- **Low customer base / lack of public awareness regarding EVSE locations**
- **Low EVSE charging speed – function of power delivery of EVSE & how much power an EV can accept**
- **Service Providers locate EVSEs where EV adoption is highest – gaps of EVSEs, especially in low-utilization, rural, and income qualified communities**
- **Utility demand charges**
- **Lack of state-level public funding to deploy EVSEs, especially in low-utilization areas**
- **Additional costs when providing back-up power for emergency-critical EVSE locations**
- **Perception is that gasoline is cheap and / or familiarity with ICE vehicles**

### Resiliency and Emergency Preparedness

Similar to how gas stations on evacuation routes are required to have electrical infrastructure installed to accept roll on backup power generation, EVSE locations should also be wired to accept backup power generation. Alternatively, locations without existing EVSE could be host sites (i.e., rest areas) for Mobile DCFC EVSE stations.
State Transportation Trust Fund (STTF) - 2040 Net Revenue Loss Projections

Quantifying the loss of revenue to the State Transportation Trust Fund due to the current and projected future use of electric vehicles in this state and summarizing efforts of other states to address such revenue loss.

### Existing EV Market Adoption in Florida

All registered light-duty vehicles in the state of Florida were examined using anonymous vehicle identification number (VIN) data to determine the number and type of electric vehicles on the road in Florida today. There are 22,617 plug-in hybrid electric vehicles (PHEV) and 44,068 battery electric vehicles (BEV) for a total of 0.41% of all light-duty vehicles registered in Florida.

**Data Source:** FLHSMV VIN Registrations as of July 28, 2020.

### Scenarios

The EV market adoption analysis led to the development of three forecast scenarios for light-duty vehicle sales, registrations, and vehicle miles traveled (VMT) for the state of Florida:

- **Conservative Growth Scenario:** Growth is limited due to factors such as cost, the pace of technological innovation, and limited policy intervention.
- **Moderate Growth Scenario:** Growth occurs at a moderate or even expected pace with continued price decreases, technological improvements, and modest policy interventions.
- **Aggressive Growth Scenario:** Growth accelerates and continues for some time at a high rate due to reductions in cost, rapid technological improvements, and extensive policy or funding intervention.

The scenarios were developed using averages from 15 recent forecasts generated by 11 public and private organizations in combination with the Market Acceptance of Advanced Automotive Technologies (MA3T) Model developed by Oak Ridge National Laboratory. The EV share of vehicle registrations lags sales by several years due to the time vehicles typically remain in use.

### EV Projections of Light-Duty Vehicles by Scenario

- **Conservative:**
  - 2020: 100%
  - 2030: 25%
  - 2040: 15%
- **Moderate:**
  - 2020: 100%
  - 2030: 30%
  - 2040: 20%
- **Aggressive:**
  - 2020: 100%
  - 2030: 40%
  - 2040: 30%

### Potential Strategies to Mitigate STTF Revenue Loss

<table>
<thead>
<tr>
<th>Definition</th>
<th>EV Registration Fee</th>
<th>Road Usage Fee</th>
<th>EV Electricity Connection Fee</th>
<th>EV Electricity Usage Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Definition</strong></td>
<td>Addition to annual registration fee (may or may not be tied to inflation)</td>
<td>Per mile fee for EV usage</td>
<td>Flat fee per charge</td>
<td>Charge per kWh (e.g., utility to service provider fee)</td>
</tr>
<tr>
<td><strong>Range in Cost</strong></td>
<td>$32.50 to $213.88 per year</td>
<td>$.01 to $.03 per mile</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td><strong>Example Deployments</strong></td>
<td>26 states</td>
<td>Pilot projects in California, Delaware, Oregon, Utah, and Washington</td>
<td>Not yet deployed at a statewide level</td>
<td>Not yet deployed</td>
</tr>
</tbody>
</table>
On October 21, 2020, the PSC conducted a workshop to discuss the comments received. Initial observations are that among stakeholders there is a general consensus that Florida’s current regulatory structure is appropriate for the delivery of electricity to charging station infrastructure.

Managed vs. Unmanaged Charging Demand Charges

Energy and Demand Charges

Managed vs. Unmanaged Charging Demand Charges

Electrical infrastructure deployment and rates

Participation by public utilities in the electric vehicle charging marketplace involves two areas of consideration.

Florida is a traditionally regulated state, with vertically integrated public electric utilities serving exclusive service territories under the jurisdiction of the Public Service Commission (PSC), pursuant to Chapters 350 and 366, Florida Statutes.

Demand charges, especially for low-utilization sites, are one of the largest challenges for EVSE Service Providers (i.e., operators of charging stations).

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PUBLIC-PRIVATE BUSINESS MODELS & EVSE DEPLOYMENT STRATEGY

Considering strategies to develop supply of charging stations, including, but not limited to, methods of building partnerships with local governments, other state and federal entities, electric utilities, the business community, and the public in support of electric vehicle charging stations.

Potential Business Models

High initial investment costs, low and uncertain demand, and competition with home charging make for a challenging business case for commercial EV charging investments.

- **Make-Ready Utility Investment**
- **Third-Party Profit-sharing Public Investment**
- **Utility Owner-Operator**
- **EVSE Rebate**

Electric utilities invest in the supporting electrical infrastructure upgrades and the host site procures and owns EVSE. Benefits include lower capital costs for host sites, competitive bidding for EVSE equipment and pricing schemes, and the ability to cost effectively site EVSE in underserved communities.

A company assists a site host with site design, EVSE product selection, payment requirements, and marketing the site to customers in exchange for profit sharing with the site owner. The site owner is responsible for providing the remaining capital funding and maintaining the EVSE, minimizing their upfront costs and administrative responsibilities.

An electric utility invests in the electrical infrastructure upgrades and the EVSE. The utility is responsible for the siting, installation, interconnections, marketing, operations, and maintenance of the equipment. This model allows for a streamlined investment approach and rapid scaling.

Utilities offer site hosts financial incentives toward the installation of EVSE equipment to reduce costs for developers and drivers. However, the site owner is still responsible for operation and maintenance of the equipment.

Plan Over Time to Create EVSE Network

<table>
<thead>
<tr>
<th>EV Adoption %</th>
<th>Horizon</th>
<th>Objective</th>
<th>Action</th>
<th>Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low (0-10%)</td>
<td>Near-Term</td>
<td>Build Out the Network</td>
<td>Fill in the Gaps Between Locations</td>
<td>40 miles between Locations</td>
</tr>
<tr>
<td></td>
<td>(2020-2025)</td>
<td></td>
<td>(New Locations)</td>
<td></td>
</tr>
<tr>
<td>Medium (10-20%)</td>
<td>Mid-Term</td>
<td>Grow &amp; Densify</td>
<td>Increase # of Chargers at each Location</td>
<td>6 Chargers at each Location</td>
</tr>
<tr>
<td></td>
<td>(2025-2035)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High (&gt;20%)</td>
<td>Long-Term</td>
<td>Densify &amp; Maintain</td>
<td>Decrease Intervals Between Stations</td>
<td>20 miles between Locations</td>
</tr>
<tr>
<td></td>
<td>(&gt;2035)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Possible New Locations for EVSE on the State Highway System

Identifying the types or characteristics of possible locations for electric vehicle charging station infrastructure along the SHS to support a supply of electric vehicle charging stations that will support both short-range and long-range electric vehicle travel, encourage the expansion of electric vehicle use in this state, and adequately serve evacuation routes in this state.

**Potential Sites for New DCFC Locations**

Existing DC Fast Charging (DCFC) locations are shown as blue dots. The green dots represent potential new DCFC locations to fill the gaps in the existing EVSE network. These locations are the starting points for further consideration based on siting characteristics that will be defined in the EV Master Plan. DCFC stations are the most appropriate EVSE type to support a network of charging stations for evacuation and long-range travel on the State Highway System. Level 2, proprietary networks and FDEP (VW Settlement) stations will be included in separate analyses as part of the EV Master Plan.
### Areas of Focus

1. **Develop Goals & Targets**
2. **Promote the Installation of EVSE Infrastructure**
3. **Encourage Private EV Adoption**
4. **Encourage Public EV Adoption**
5. **Provide Guidance and Best Practices to Local Jurisdictions & Agencies**
6. **Mitigate Revenue Impacts**
7. **Develop an Outreach, Education, & Marketing Strategy**
8. **Coordinate Electrification Efforts**
9. **Establish Agency Roles & Responsibilities**
10. **Reexamine Utility Roles & Rates**
11. **Identify Funding Options**
12. **Prioritization Plan for Deploying EVSE**

### Innovative Strategies from Peer States

#### GOALS & TARGETS

States have developed goals that clearly describe the desired outcomes related to EVs and EV adoption. These goals are supported by targets that identify specific numbers or quantities to those goals. For example, California has recently adopted a target of 100% of vehicles sold in the state to be zero-emission by 2035. North Carolina has a goal of 80,000 zero-emission vehicles on the road by 2025, and Tennessee has a goal of 200,000 EVs on the road by 2028. These goals help state agencies to coordinate their efforts, allocate resources, and prioritize projects based on the future size of the EV fleet.

#### CA REST AREA CHARGING

The California Department of Transportation (Caltrans) created a program to install fast charger stations at 30 locations which included highway rest areas. The agency intended to build out the chargers in less-developed areas along the highway system, but ran into issues with a Federal law that prohibits commercial activities at rest areas. To date, California has built a handful of chargers, but cannot sell electricity to drivers, meaning the state must cover the cost for both maintenance and electricity. Just recently, Caltrans has partnered to provide solar charging stations with battery storage, which would lower electricity cost to the state.

#### GREEN BANK

The Connecticut General Assembly created the Connecticut Green Bank in 2011 as a funding and financing mechanism to support energy efficiency projects in the state. The bank uses a combination of public and private money to fund projects, including those supporting EVSE infrastructure. Through their Green Bank, a loan program called C-PACE (Commercial Property Assessed Clean Energy) allows commercial property owners the ability to fund EVSE infrastructure on their site, with repayment occurring through a special assessment on the property tax.

#### CHARGING PLAZAS

Colorado’s Energy Office developed a competitive grant program that funds DC Fast charging plazas around the Denver metro region. This program relies on the private sector to develop teaming arrangements, business cases, and identify locations based on criteria identified by the state, and constructed and operated in accord with a five-year agreement with the Colorado Energy Office.
<table>
<thead>
<tr>
<th>Area of Focus</th>
<th>Strategies / Potential Action Items</th>
<th>Funding / Incentives</th>
<th>Potential Action Type</th>
<th>Potential lead, coordinating agencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Develop Goals and Targets</td>
<td>Develop goals and objectives in line with state statute and existing agency priorities</td>
<td>E</td>
<td>EXECUTIVE ORDER</td>
<td>FDOT, FDACS</td>
</tr>
<tr>
<td>2. Promote Installation of EVSE Infrastructure</td>
<td>Require public EVSE to be open to all users regardless of membership to a specific charging network</td>
<td>L</td>
<td>LEGISLATIVE</td>
<td>FDACS</td>
</tr>
<tr>
<td>3. Encourage Private EV Adoption</td>
<td>Consider EV sales requirement to incentivize automakers to provide a wider range of vehicles for sale in Florida</td>
<td>L</td>
<td>Legislate</td>
<td>FLHSMV, FDACS</td>
</tr>
<tr>
<td>4. Encourage Public EV Adoption</td>
<td>Develop electric vehicle purchase incentive program</td>
<td>L</td>
<td>EXECUTIVE ORDER</td>
<td>FDOT, FDACS</td>
</tr>
<tr>
<td>5. Provide Guidance and Best Practices to Local Jurisdictions and Agencies</td>
<td>Provide guidance on incorporation of EVSEs into long-range transportation plans</td>
<td>L</td>
<td>LEGISLATIVE</td>
<td>FDOT, MPOAC</td>
</tr>
<tr>
<td>6. Mitigate Revenue Impacts</td>
<td>Evaluate potential EV registration fee structure</td>
<td>L</td>
<td>Legislative</td>
<td>FLHSMV, FDOR</td>
</tr>
</tbody>
</table>

**Potential Action Type**
- **L** = LEGISLATIVE
- **A** = AGENCY
- **E** = EXECUTIVE ORDER

### PRELIMINARY RECOMMENDATIONS

<table>
<thead>
<tr>
<th>Area of Focus</th>
<th>Strategies / Potential Action Items</th>
<th>Funding / Incentives</th>
<th>Potential Action Type</th>
<th>Potential lead, coordinating agencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. Develop an Outreach, Education, and Marketing Strategy</td>
<td>Develop a consumer-focused outreach, education, and marketing program</td>
<td>A</td>
<td>LEGISLATIVE</td>
<td>FDEP, FDOE</td>
</tr>
<tr>
<td>8. Coordinate Electrification Efforts</td>
<td>Provide guidance on incorporation of EVSEs into long-range transportation plans</td>
<td>L</td>
<td>LEGISLATIVE</td>
<td>MPOAC</td>
</tr>
<tr>
<td>9. Establish State and Local Agency Roles and Responsibilities</td>
<td>Develop memorandum of understanding with other states in the Southeast to harmonize interstate corridor electrification efforts</td>
<td>E</td>
<td>EXECUTIVE ORDER</td>
<td>FDOT, FDACS</td>
</tr>
<tr>
<td>10. Reexamine Utility Roles and Rates</td>
<td>Work with utility industry stakeholders to develop proposals for new rate structures that address transportation electrification</td>
<td>L</td>
<td>LEGISLATIVE</td>
<td>FPS, FDACS</td>
</tr>
<tr>
<td>11. Identify Funding Options</td>
<td>Develop a regional EVSE network and other shared goals</td>
<td>E</td>
<td>EXECUTIVE ORDER</td>
<td>FDOT, FDACS</td>
</tr>
<tr>
<td>12. Prioritization Plan for Deploying EVSE</td>
<td>Create a prioritization process for infrastructure implementation</td>
<td>L</td>
<td>EXECUTIVE ORDER</td>
<td>FDOE</td>
</tr>
</tbody>
</table>

**Potential Action Type**
- **L** = LEGISLATIVE
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**Potential lead, coordinating agencies**
- **FDACS**
- **FDOR**
- **FDOT**
- **FDEP**
- **FDOE**
- **FDMS**
- **FDEO**
- **FLHSMV**
Existing Publicly Accessible Level 2 Station Locations (773)
Existing Publicly Accessible DCFC Station Locations (59)
FDEP VW Settlement Round 1 Awardees (27)

State Highway System
- Interstate
- Expressway
- Principal Arterial
- Minor Arterial
- Collectors

Data Source: U.S. DOE Alternative Fuels Data Center (July 2020);
Florida Department of Transportation (August 2020)
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