

Interim Report

**Emergency Evacuation of Florida
Electric Vehicles**

**For the
Florida Electric Vehicle Roadmap**

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Interim Report – Emergency Evacuation of Florida Electric Vehicles

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Introduction

This is the second interim report to be submitted for the Florida Department of Agriculture and Consumer Services, Office of Energy (FDACS OOE)'s *Florida Electric Vehicle Roadmap* (FEVR) project. The project and these reports address the Electric Vehicle Charger (EVC) infrastructure that is specific to light-duty electric passenger vehicles. Workplace charging and infrastructure to support heavy-duty vehicles and fleets is typically specific to their needs and is not included in the analysis. The need for particular policy or regulatory attention will be noted but not addressed in these reports. These are "Business-as-Usual" evaluations, impacts from the COVID-19 virus have not been considered.

FDACS OOE and its partner, the Central Florida Clean Cities Coalition, conducted six webinar's between April 28th and June 16th to discuss future infrastructure considerations with stakeholders. Individual webinars addressed the considerations with stakeholders representing power service providers, infrastructure network providers, advocacy groups, planners, and state agencies. A total of 15 industry representatives from all of the stakeholder groups participated as facilitators for the webinars. More than 500 stakeholders attended over eight hours of webinars. Discussions during the webinars were very productive and useful. Feedback from participants was very positive. Recordings of the webinars and other information is available on the project website at, <https://www.fdacs.gov/Energy/Florida-Electric-Vehicle-Roadmap>.

The FDACS OOE and Clean Cities will make a survey available to EV owners and the general public in early August. The survey is intended to solicited direct responses from stakeholders on questions such as, "How would you rank the availability of public charging?", "Do you live in a single-family residence or a multiple dwelling unit?", "What EV power charge level do you use most often?". The results of the survey and webinars will be included in subsequent reports.

Background

The FDACS OOE staff provides support for Emergency Support Function, ESF-12 Fuels, at the Florida Department of Emergency Management State Emergency Operations Center during all emergencies. Responsibilities for ESF-12 Fuels includes activities such as helping to procure fuel and propane for governments, utility crews, first responders and mass care kitchens. In addition, FDACS OOE staff facilitates the daily reporting of bulk fuel data for each port from private fuel vendors and reports on the fuel to be delivered in three to nine days.

This report primarily addresses the Direct Current Fast Charge network (also known as, DCFC, Fast Charge, Level 3); Level 2 and Level 1 charging are adequate for the charge needed to leave the home, but do not have the charging speed to support a large-scale large scale rapid evacuation. EV infrastructure problems discussed in this report are not unique to Florida, they are shared by every other state; in fact, Florida is seen a leader in addressing these issues.

Florida has a unique geography that makes it exceptionally susceptible to impacts from tropical storms and hurricanes, with a total of 18 named storms developing in the Atlantic Basin in 2019. Dorian, a Category 5 hurricane that inflicted severe damage in the Bahamas, also threatened Florida for several days and eventually passed less than 100 miles from our coast.¹ The frequency and strength of these storms is expected to increase in the future, along with the population of Florida. For the purposes of this report, a hurricane scenario has been assumed.

The owners of EVs in Florida face several challenges when needing to evacuate during an emergency, beginning the moment they know an evacuation is eminent. Their first orders of business will be to review their evacuation path, and start charging their car. Like most vehicle owners, EV owners are closely tied to refueling infrastructure. There is charging infrastructure in major metropolitan areas, infrastructure in other parts of the state is limited.

There are approximately 186 publically accessible high-speed chargers in Florida from a variety of providers, and Tesla currently has 327 fast chargers in the state.² The ratio of Tesla vehicles to fast chargers is 96 vehicles per fast charger, the ratio of all other EV vehicles in the state to publically available fast chargers is 138 vehicles per charging station.

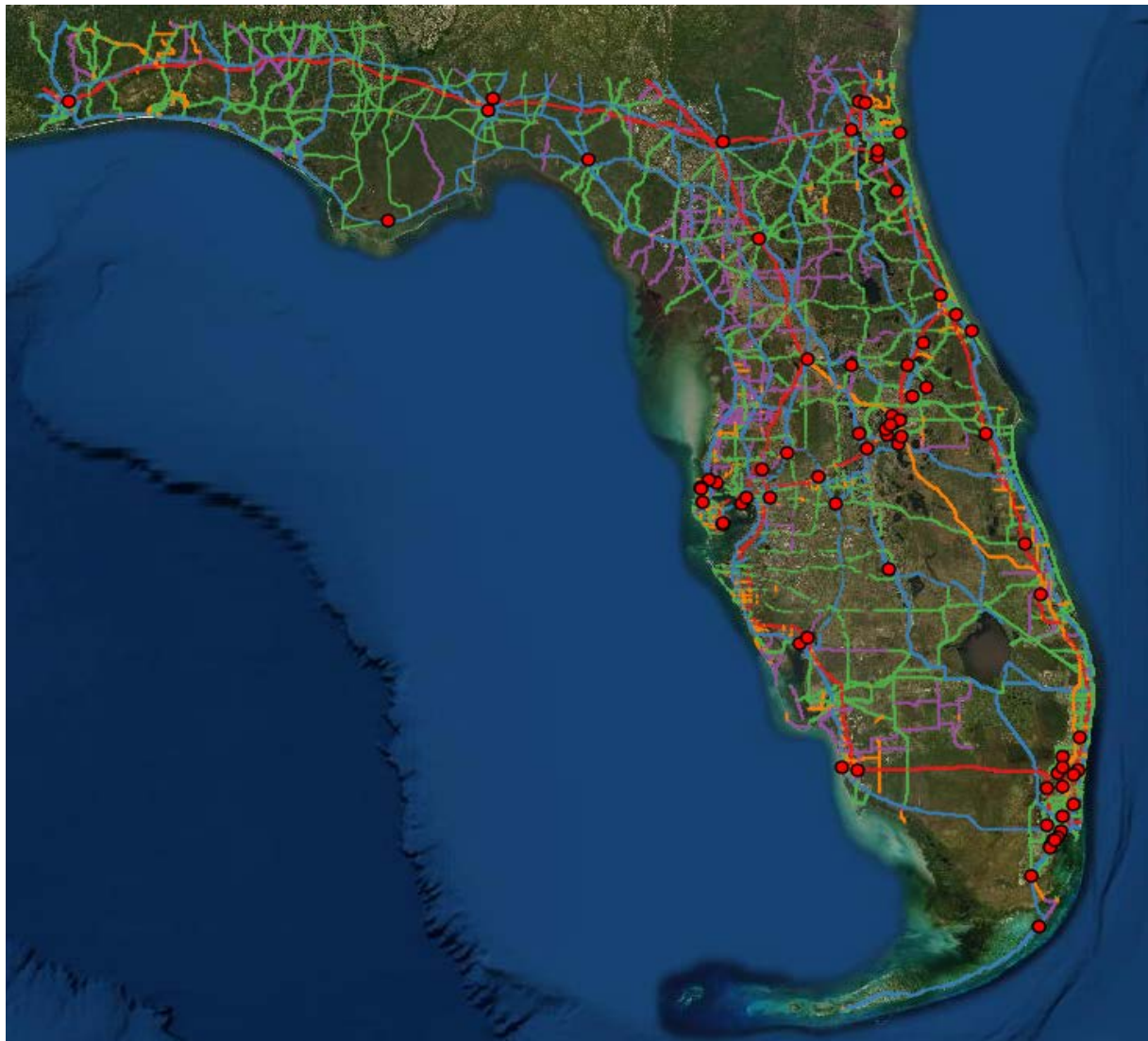
¹ <https://floridastorms.org/2019/12/01/florida-spared-a-significant-strike-during-the-2019-hurricane-season/>

² https://afdc.energy.gov/stations/#/analyze?region=US-FL&country=US&fuel=ELEC&status=E&status=T&ev_levels=dc_fast

Currently there is little infrastructure in the interior of the state to support evacuation, significant portions of I-75, and I-10 in the panhandle have very little fast charging. The table below details the need for DCFC charging times during emergency evacuations.³

EVSE General Characteristics (Completely depleted battery)

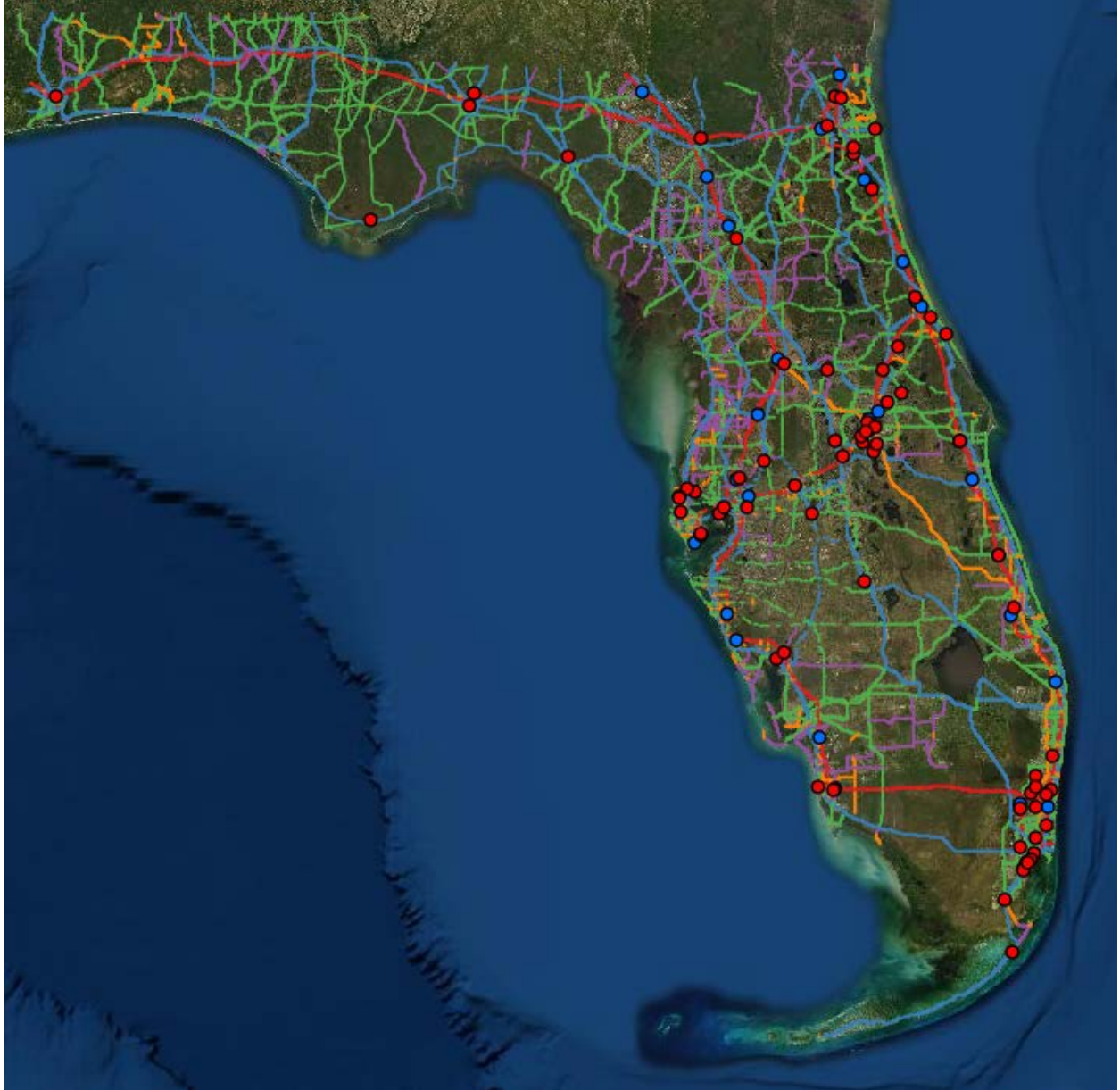
	Charge Time	Voltage/Amps	Power Equivalent	Installation
Level 1	Up to 20 hrs.	120/15	Toaster	Self
Level 2	Up to 7 hrs.	240/40	Clothes dryer	Professional
DC Fast Charge	Up to 30 min.	480/125	15 Central A.C.	Professional



Current fast charge network, June 2020

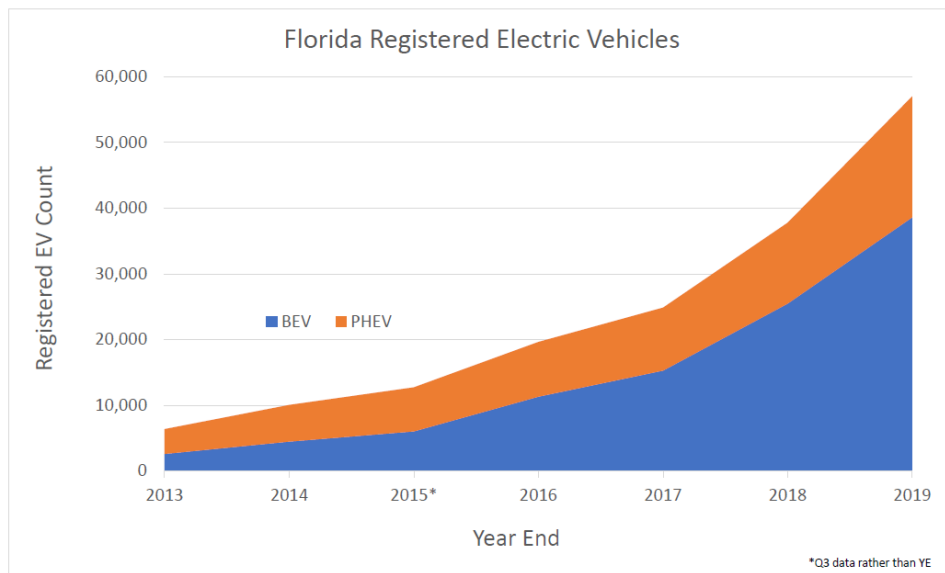
Source: AFDC/CFLCCC

³ <http://www.fsec.ucf.edu/en/publications/pdf/FSEC-CR-1996-15.pdf>

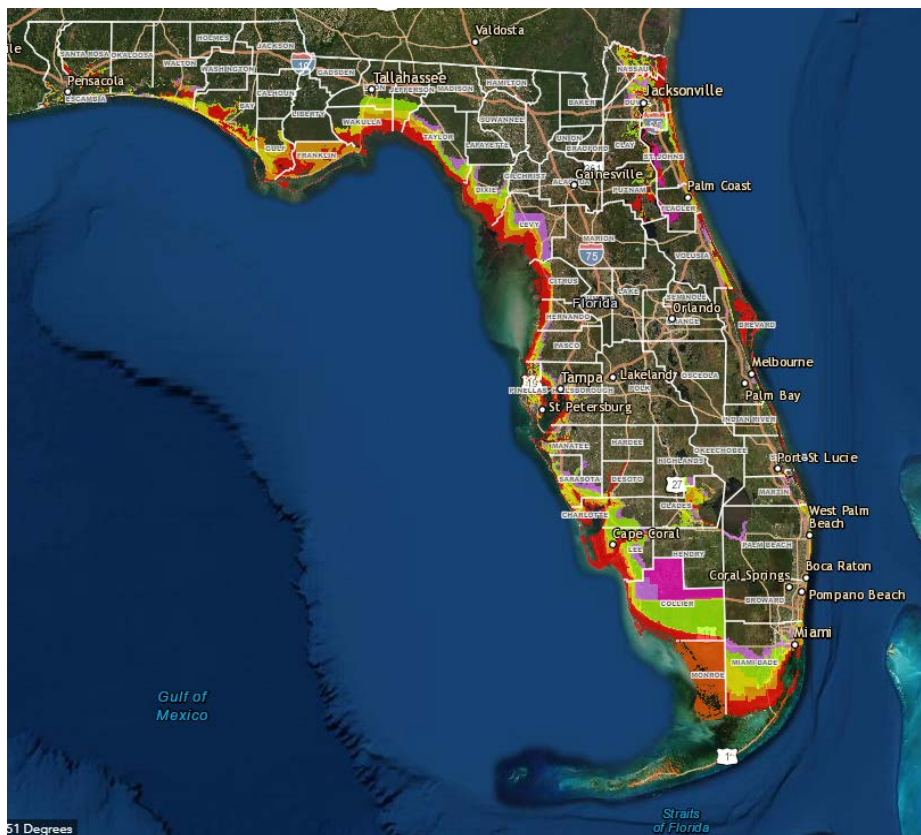


Current fast charge network, with VW funded chargers (blue), June 2020 Source: FDEP/AFDC/CFLCCC

There are over 60,000 light-duty EVs registered in Florida, and most of them are within a few miles from one of our coasts. The light-duty EV population grew by an average of 1600 vehicles per month in 2019, an adoption rate 32 percent higher than 2018, and more than four times the monthly adoption rate of 2017; the rate of adoption will continue to increase, bringing more urgency to addressing these issues. The acceptance and growth of electric vehicles continues to accelerate in Florida, and reliable, high-speed EV charging facilities are needed to support the evacuation of owners during an emergency.



Source: Florida Power & Light



Source: <https://floridadisaster.maps.arcgis.com>

Assuming only half of current EV owners evacuate Palm Beach, Broward and Dade Counties would result in an exodus of over 10,000 vehicles, transporting 15-20,000 Florida residents.⁴

⁴ Alternative Fuel Data Center, June 2020

Considerations Specific to EVs

Safety

Light duty EVs are required to have all of the safety features of conventionally fueled vehicles. EVs have fail-safe mechanisms to shut down their electrical systems very rapidly, and their sealed battery systems are impervious to water intrusion. EVs also have a low center of gravity, due to the batteries being carried in the chassis; roll overs during accidents is much less likely to occur.

Driving Range

Range anxiety, the fear of not having enough battery energy to complete a trip, limited the EV adoption rate for years; however, electric vehicle technology and efficiencies have consistently improved. The average range of yearly models has shifted from approximately 75 miles, to 250 miles in the past decade (Figure 3). The standard 2019 Chevy Bolt has a range of 259 miles, Tesla Model 3s can be upgraded to 322 miles of range. EV manufacturers have announced near-term production models with over 400 miles of range, equal to, and greater, than most models of conventionally fueled vehicles.

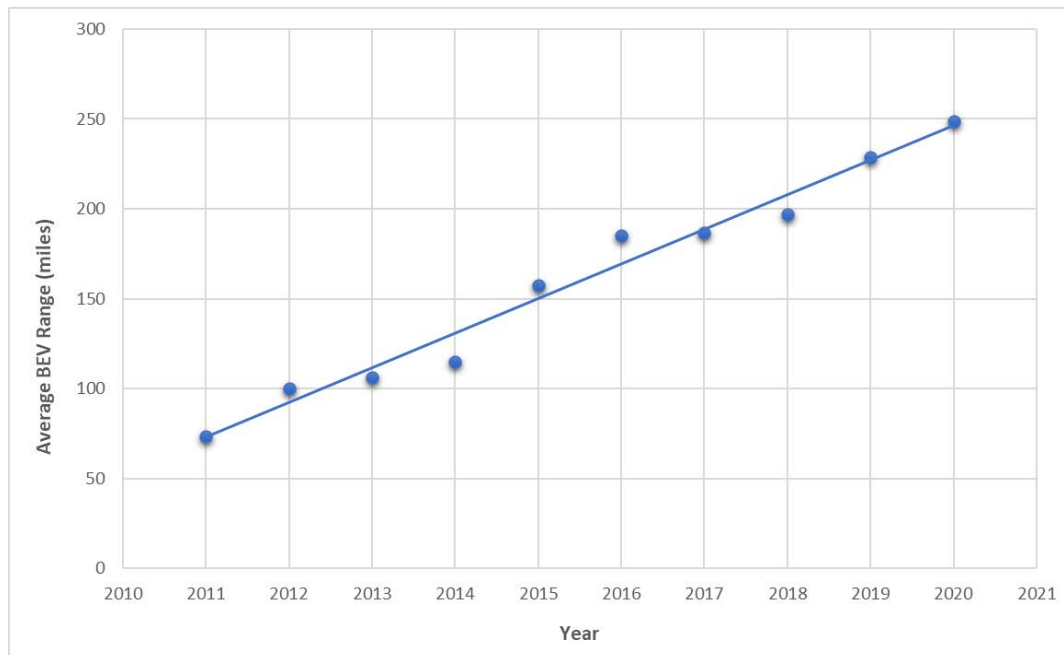


Figure 3. Average BEV Range

The 2020 Battery Electric Vehicle lineup features all-electric ranges between 123 and 402 miles, many older models have ranges under 100, which is not as practical for long distance highway travel. Despite the travel range increases, adequate infrastructure is still an issue, especially for those with EVs that have shorter travel ranges; a problem that seriously complicates planning for an evacuation.

Charging Speed

With the threat of a hurricane, EV drivers cannot spare much time to stop and charge their vehicles. Level 1 and 2 charging stations, which take hours to fully charge an EV's battery, are not adequate for evacuation travel. Alternatively, DCFC stations can charge many batteries to 80 percent capacity in a half hour or less. EV charging lengths vary depending on the model and charger type, but even the quickest chargers take over three times the amount of time it takes to fuel a gasoline vehicle.

DCFC has various power levels, most current installments charge at a maximum rate of 50 kilowatt (kW), but higher output stations are being deployed by infrastructure providers. In the near future, stations with speeds of 150 to 350 kW, can cut charge times to 10 minutes or less. Eventually, a robust network of high output DCFC stations will make EV charging times comparable to conventional fueling methods. Higher output DCFC stations will facilitate hurricane evacuations and daily long-distance travel.

Wait Times

Charger wait times may lead to more delays. During evacuations, thousands of drivers travel along the same roads around the same time. The heightened traffic flow leads to escalated fuel demands along major corridors, often to the point of depletion. It is common to see gas stations lines extending to five cars or more, but since it only takes a few minutes to fill up, the lines move relatively quickly. Drivers also have the option of finding another station nearby if wait times become too long.



Figure 2. Gas Station Demand during Hurricane Evacuation.
Source: <https://floridapolitics.com/archives/223590-evacuations-underway-2-florida-counties>

EV drivers do not have the same convenience. DCFC locations can only accommodate one or two vehicles at a time, and a fast charge takes about a half-hour. An expected charge time of a half hour can potentially turn into one or two hours due to high wait times. EV chargers are limited and not as widespread as gas stations, so drivers probably will not have the freedom of finding another station in the area.

Real-time data is a simple way to check charger availability before driving to the station. Most EV charging network providers have apps that display information such as availability and remaining charge time. Some providers offer ways to reserve chargers before arriving. This can help warn drivers ahead of time but might not provide much benefit in cases where that charger is their only option. A better way to reduce wait times, and prepare for more EVs on the road, is to install more charging outlets at each station. Tesla's proprietary fast charging stations have an average of 10 outlets per station, and drivers rarely complain about long wait times. Having more charging points will increase turnover, allowing more drivers to charge with less waiting. A station with

10 charging ports can service up to 240 vehicles during a 24-hour period, which can make a big difference during evacuations.

Moving Forward

EVs are a small but rapidly growing segment of the light-duty vehicle market, if only half of EV owners evacuate Palm Beach, Broward and Dade County evacuate, it would result in an exodus of over 10,000 vehicles, transporting 15-20,000 Florida residents. The current rate of EV adoption averages about 1600 units/month, if the adoption rate and evacuation rate remained constant for ten years, over 96,000 EVs with over 144,000 passengers would need to be accommodated. These numbers are based on a linear adoption rate. However, EV sales are expected to increase exponentially over the next 10-20 years.

Temporary EV Charging Installations

Power outages caused from major weather events are problematic and likely. Weather is the largest cause of electric disturbance events in the United States. A hurricane, can produce widespread power outages that last for days. In 2017, Hurricane Irma left 60 percent of the state without power at its peak, and over 300,000 customers were still without power a week later.⁵ Without electrical supply at charging stations, EV drivers who evacuated have no means to make it back home, and those drivers may be stranded without transportation for days.

Several methods of temporary charging have been developed, including small self-contained portable battery systems, larger scale battery systems on heavy duty trucks, and stand-alone, transportable, temporary charging installations.

All of these solutions have drawbacks, but some offer capabilities beyond charging EVs. Portable, self-contained systems are now available that can be used to charge EVs, and provide clean power for emergency installations such as field medical facilities and shelters. The systems can be tied to the electrical grid, or installed as stand-alone systems that use solar photovoltaic (PV) and battery storage to provide power for vehicle and equipment. These systems could also be deployed to determine the charging utilization potential, prior to an investment in a permanent installation.

⁵ <https://www.eia.gov/todayinenergy/detail.php?id=32992>

Optionally equipped with Emergency Power Panel Access

- Total continuous power - 25A @ 240VAC max
- Breakers
 - 1x 30A main 240V breaker
 - 2x 20A push to reset 120V breakers
 - Outlets (refer to [NEMA Guide](#) for outlet graphics)
 - 240V (not GFCI protected)
 - § 1x NEMA L14-30 (twist lock)
 - 120V (GFCI protected)
 - § 2x Duplex NEMA 5-20
 - § 2x NEMA L5-20 (twist lock)
- Protection
 - All outlets and breakers equipped with waterproof covers and boots
 - Lockable metal cover plate assembly when stowed and not in use
 - § Comes standard with generic padlock and key – can be swapped out for local standard emergency lock.
 - § Cover plate assembly unfolds to double as weather shield while system is in use
- Other features
 - Low battery red light
 - White night light
 - Manual on/off to disable EV charging if needed
 - Highly visible labeling and decals

Panel comes fully assembled and factory tested with power and control connector whips for rapid installation (mating harnesses required in ARC).



Photo: Envision Solar

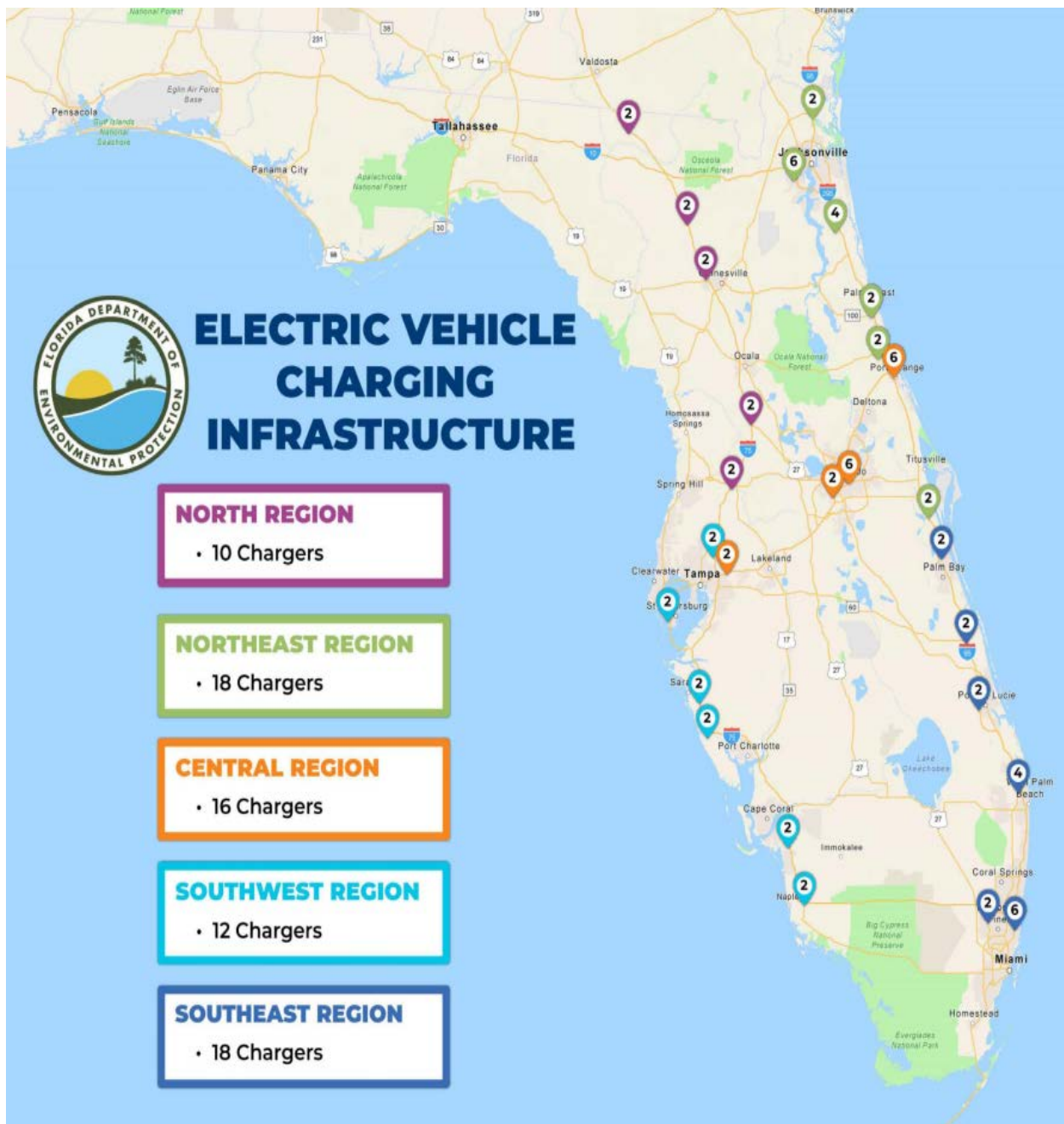
Infrastructure Provider Response

The state of Florida and infrastructure providers investing in our state have been diligent in preparing for the increasing adoption of EVs. Several processes and procedures addressing evacuations need to be understood more thoroughly; such as, staffing and restoration priorities of infrastructure providers, provisioning of spare equipment, security, notifications, and other critical factors need to be better understood.

Volkswagen Settlement (VW Settlement)

Florida is eligible for up to \$167 million in VW Settlement funds and has allocated \$25 million of those funds to installing EV infrastructure. The first, of three rounds of awards, was announced earlier this month, providing up to \$6.8 million for the installation of 74 new fast chargers. Awardees have up to two years to complete their installations. Another award cycle is expected late 2020 or early 2021. Additional information on the awards can be found on the FDEP VW website, floridadep.gov/air/air-director/documents/evci-phase-1-table-awarded-applicants-segment.

The first round of awards will do much to close charging location gaps on Interstates 4, 75, and 95, Interstate 10 was not included in the in the first round of awards but is expected to be addressed in the next award cycle.



VW - First round DCFC award locations

Planning

EV infrastructure is slowly being incorporated into planning processes. The Florida Department of Transportation has been very involved in new vehicle technologies, including autonomous and electric. They recently included discussion about new technologies and infrastructure in their taskforce webinars for [M-CORES](#), a planning project for three new transportation corridors in Florida.

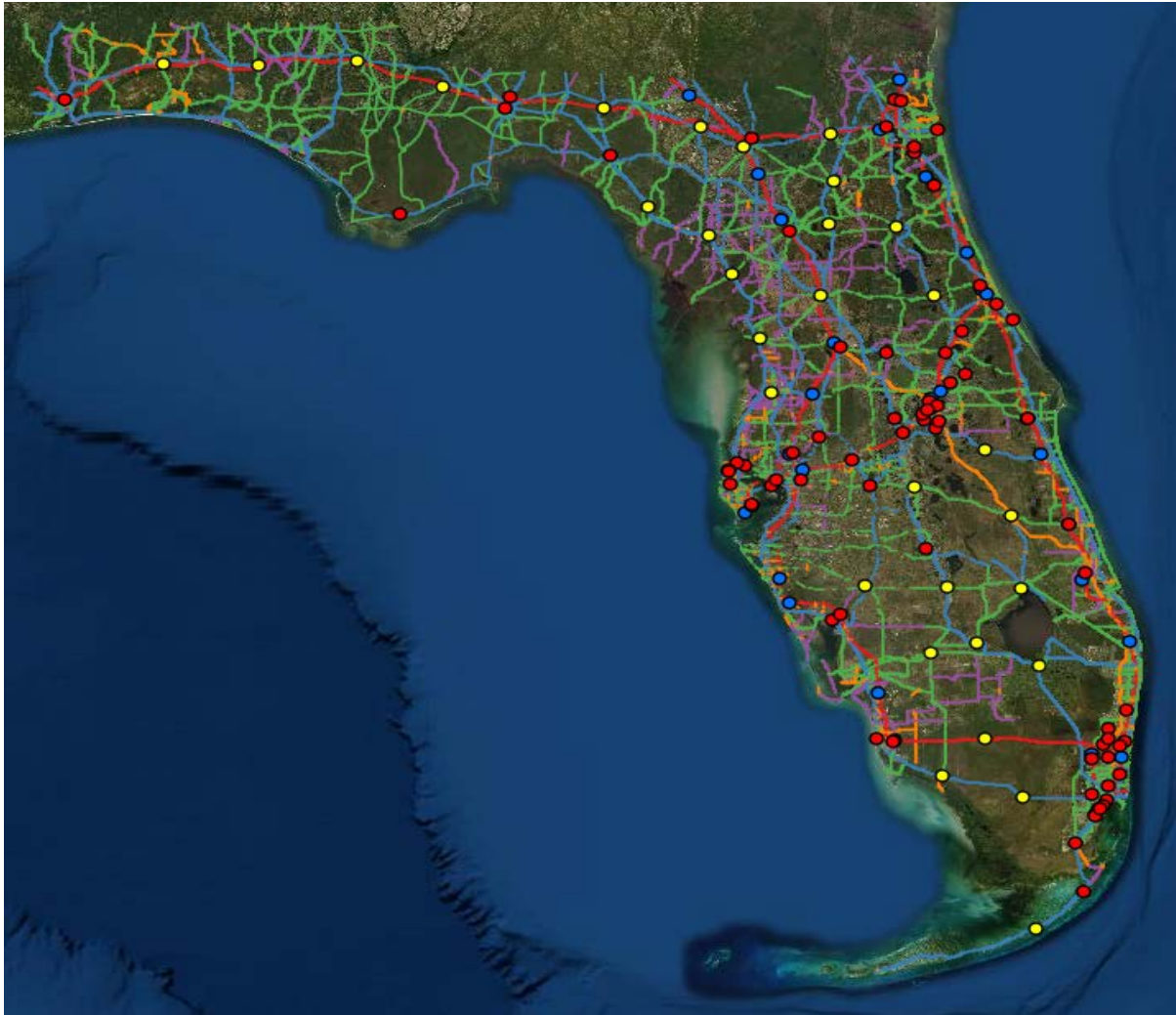
EV infrastructure planning is a difficult task under the best of circumstances, and especially so for private business. Return on investment (ROI) is complicated by the fact that capital is being invested today in a business that should produce revenue in the future; how much revenue depends on EV adoption, which is itself, a moving target. Funding from sources like the VW settlement is an enormous help in improving ROIs.

As has been mentioned, VW settlement will help close the charging gaps on our state's interstates; and it is assumed that some of the funding will be awarded to provide charging to less populated and rural areas of the state. Based on the latest round of Requests for Proposals, final installation of these chargers will not be completed for another three to four years.

Temporary Charging Installations

A possible short-term solution is the acquisition of portable charging, as has been previously described. Assuming that these portable charging systems would be deployed to either the north, central or southern part of the state in response to a particular hurricane, it is estimated that 12 of these units could provide significant capacity for EV owners in each particular region of the state. Based on current retail pricing, the estimated cost for 12 units is \$ \$840,000.

Below is a map illustrating recommended locations for installing temporary charging, they are largely in the underserved rural areas. Periodically, these locations also serve as a bridge between I-75 and I-4, providing alternative routes with less congestion and more opportunities to charge. The availability of commercial power has been confirmed, any required make-ready for the site has not been determined. A tie to the grid is not required since these are self-contained, solar powered units; a grid tie would be desirable to trickle charge the battery storage and provide grid power. These units can also provide emergency power to support other hurricane relief efforts.



Existing DCFC

VW Awards

Temporary DCFC

Renewable Energy and Storage

Given the probability of hurricanes in Florida, and the accompanying power outages, it is recommended that solar power with battery backup and storage be considered for critical installations. Solar power and battery storage are expensive add-ons to a charger; given the vulnerability of the rapidly growing population of EV owners, some methodology needs to be developed to support these ancillary systems. And, the environmental upside of EVs charging with renewable power is a win for the environment.

EVs as Emergency Power

There are several other future opportunities for EVs in addressing hurricane impacts, including home emergency power from the EV. As EV battery systems continue to grow in power capacity, the use of their stored energy capabilities will increase. The battery systems in the vehicles can provide emergency power to the owner's home for a

significant period of time; combining residential solar photovoltaics (PV) with an EV battery systems extends and increases the emergency power capabilities. The increase in storage capacity for vehicles is particularly useful when heavy-duty electric vehicles are considered; electric school buses, configured to output their stored power could be very valuable in an emergency situation. Florida currently has 46 schools with solar PV installed that provide power to the emergency shelter using 10kW arrays. An electric school bus with its 160kW of stored energy would be a dramatic improvement for the school shelters, extended care facilities, etc.

The broad availability of both light-duty and heavy-duty vehicles should be aggressively investigated by governmental agencies, most of whom have no requirement for the consideration of EVs. Many EV applications have been developed, from pickup trucks with exportable power, to garbage trucks and street sweepers; all using clean fuel, a lower cost of ownership and other potential benefits.

Conclusion

This report has explored the opportunities and obligations our state has in supporting the evacuation and safety of a rapidly growing population of EV owners. The opportunities are associated with the technology of electric transportation, including the use of the vehicles themselves as sources of clean, portable emergency power; and expanding the use of solar as a renewable energy source to charge EVs, and storage batteries to reduce operational costs. The obligation comes in the form of support for these owners as they realize the benefits of a lower cost of ownership, improved energy efficiency, and contributing to improved air quality in Florida.