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# **ECE 398GG – ELECTRIC VEHICLES**

## **13. The *EV* Charging Infrastructure (*EVCI*): Social and Technical Considerations in *EV* Supply Equipment (*EVSE*) Placement Strategy**

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# BARRIERS TO EV ADOPTION

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- Access to en-route charging infrastructure**
- Limited battery range**
- High capital costs**

**All contribute to “Range Anxiety”:** the concern that an EV battery will deplete its charge prior to access to available charging.

# Driving and Parking patterns

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- ❑ Only few trips exceed the average range of an EV
- ❑ If drivers were willing to change driving habits only 10 times in a year, 75 % of drivers could meet their transportation need for the rest of the days of the year with a 150-*mi* range
- ❑ Range anxiety is likely to occur during the infrequent long-distance events each year

# PROPOSED STRATEGIC FRAMEWORK FOR *EVSE* PLACEMENT

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- ❑ Home charging
- ❑ Destination charging: charging at locations in which you already intend on spending time
- ❑ Add a proposed critical recharge zone (CRZ) – a geographic region where *EVs* require recharge
- ❑ The addition of CRZ will increase the range of travel for *EVs*, reducing driver's range anxiety for long trips

# Large Battery vs. Fast Charge

Table 1: Stated Value and Market Cost

	Battery Range	Charging Speed
2011 Hidrué Survey	\$1,750 - \$3750 per additional 50 mile of battery range	\$6,555 for a car that (can charge 50 miles in 1 hour)
2014 Market Price	\$5,600 per additional 50 mile of battery range (Tesla)	\$4,500 for a 19 kW EVSE (can charge 50 miles in 44 min)  \$30,000 for a 40 kW DC EVSE* (can charge 50 miles in 21 min)

## Socialized cost for 20 drivers:

**\$4,500 19 kW EVSE Installation / 20 users = \$225 per user**  
**\$30,000 40 kW EVSE Installation / 20 users = \$1,500 per user**

# Activity:

- ❑ **2022 Nissan Leaf with a battery capacity of 40 kWh**  
advertises a driving range of 149 mi; how much capability in kWh is required to drive for 50 mi?
- ❑ **Assume that the EV charges at a 19-kW EVSE: how much time is needed to charge to travel 50 mi?**
- ❑ **What about charging at 40-kW EVSE?**

# EVSE Placement Strategy

		Social Variables	Technical Variables
1	Locating the CRZ	Trip Origin / Destination Common Routes	Range limitation for EVs
2	Siting EVSE within CRZ	Signage Local Entertainment	Distance from Corridor Service Power at Site

# Parameter Determination

- Nissan Leaf used as baseline:
  - Lowest range on market (Average of 73 miles/ charge)
  - But can't count on 73 miles, lowered by:
    - Air-conditioning/ Heating
    - Cold battery
  - **50 miles** used as a “worst-case scenario”





# Locating the Critical Recharge Zone



- 50-*mi* radius circles were drawn around each major city
  - Ensures “worst-case scenario” is met.
- Circles were clipped to fit major roads
- The routes were overlaid
  - This created a “Critical Recharge Zone” (CRZ)
- The CRZ:
  - South Dover

# Siting within the CRZ

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The process of site-specific placement can be expressed as the calculation of a driver as they approach the need for a charge. Four of those primary questions are:

1. How far off the highway is the charging station?

2. Are there signs to direct me to the charging station?

3. How long will it take my car to charge?

4. What will I do while my car charges?

# Siting criteria

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- Distance from travel corridor
- Signs to find location
- Power supply sufficient for at least 19.2 kW
- Recreational activities or food

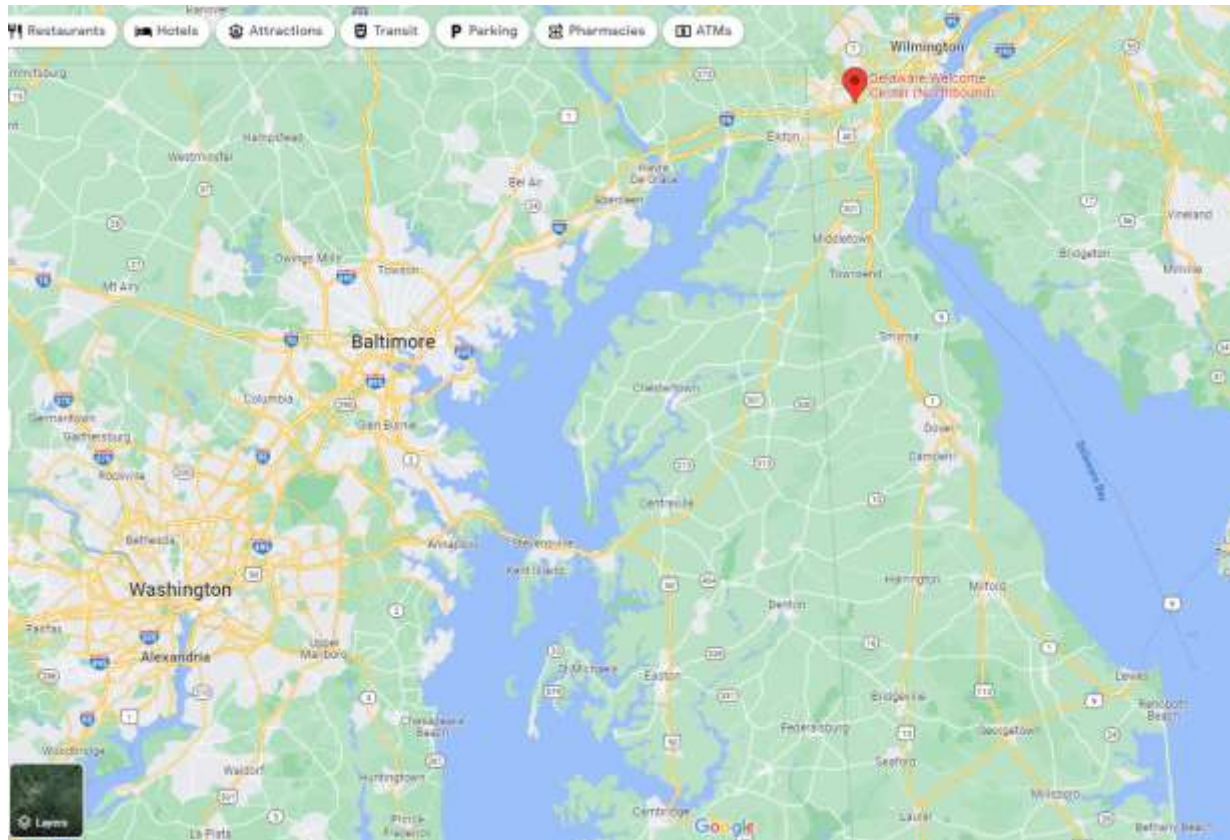
# Example of siting within the CRZ

within 2 miles of exit



# I-95 Welcome Center

- **Allows for en-route charging**
- **Travel to Dover (and therefore beaches)**
- **Travel to Maryland (and therefore Baltimore and D.C)**
- **Designed Signs for Site**



# I-95 Welcome Center



Pictures taken from user postings on PlugShare

# Surfside Park-Rehoboth Beach

- Serves as destination charging
- Allows *EV* drivers in Delaware to be able to take day-trips to Rehoboth Beach

