

Differences in Public Level 2 EVSE and DC Fast Charger Use Patterns

Jim Francfort

**11th U.S.-China Electric Vehicle and Battery
Technology Meeting
Denver, Colorado
April 2016**

*This presentation does not contain any proprietary,
confidential, or otherwise restricted information*

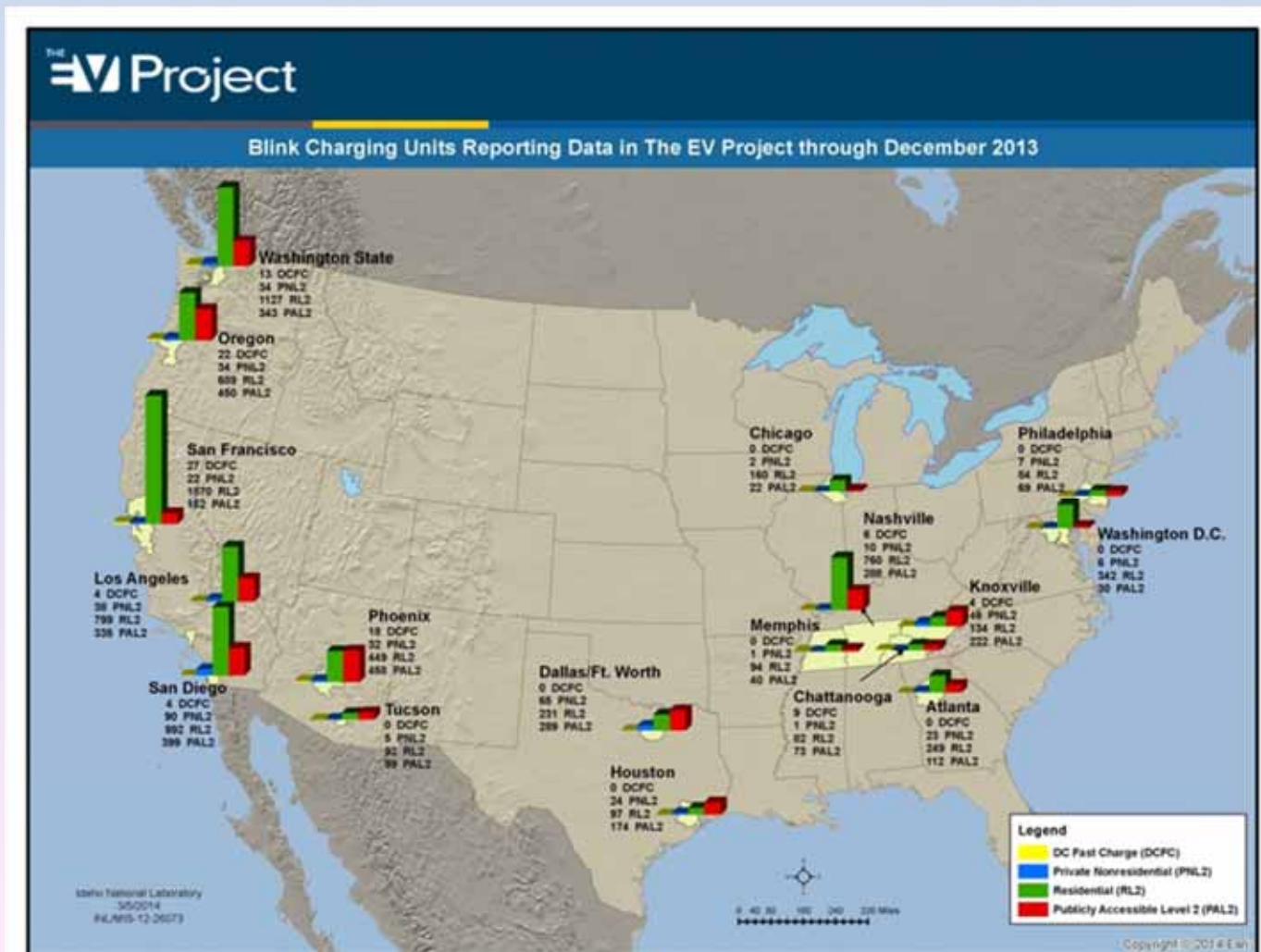
INL/MIS-16-38419

www.inl.gov



EVSE and DCFC Data From The EV Project

- 12,356 Blink electric vehicle supply equipment (EVSE) and DC fast chargers (DCFC) stations were deployed during The EV Project



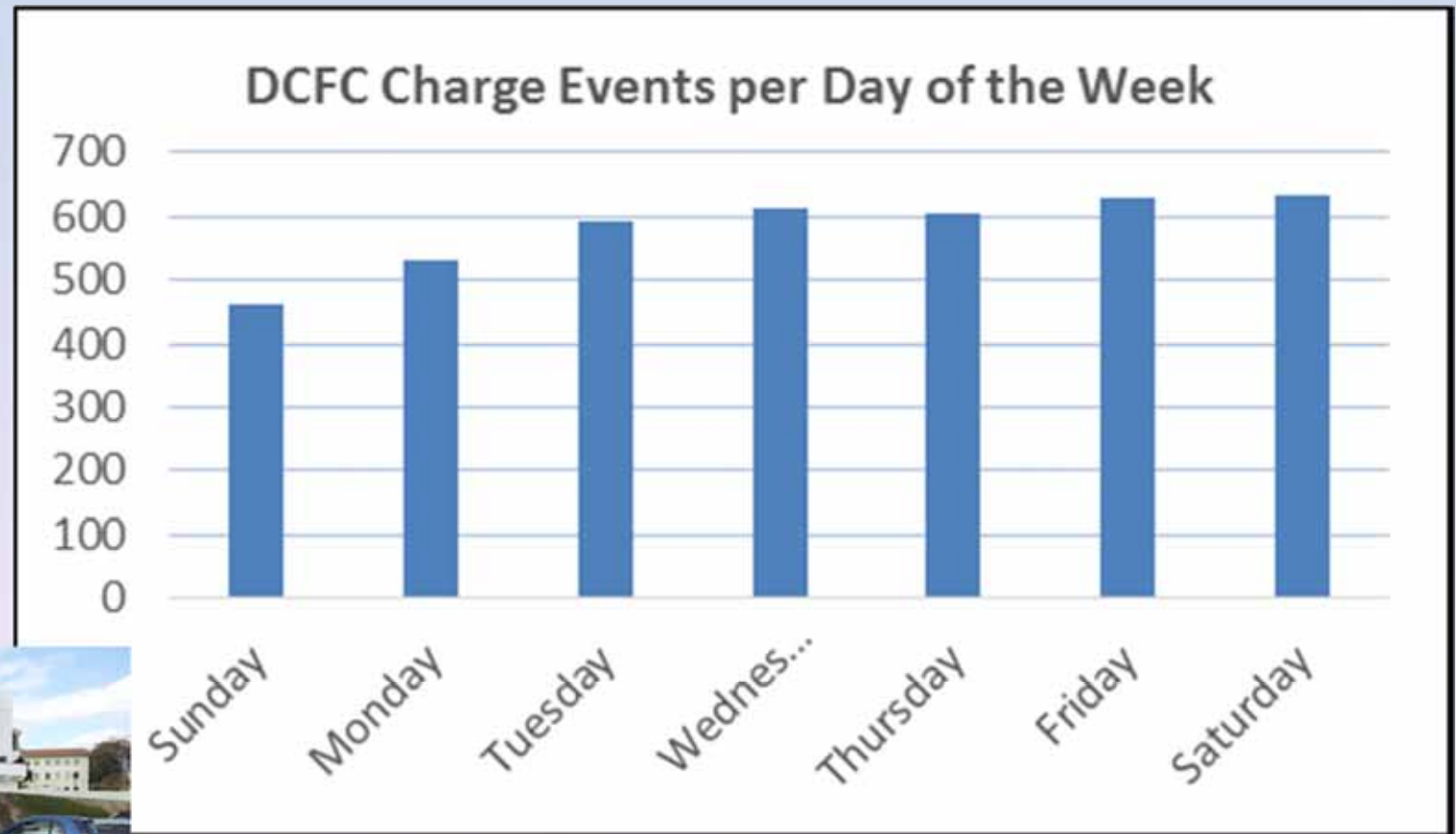
Use Patterns Observed At Highly Utilized DCFC

- 100 DCFC stations were deployed during The EV Project
- 20 of the most highly utilized DCFC stations were examined
- The 20 DCFC stations averaged 33 charge events per week, with a range of 21 to 66 charge events per week on average



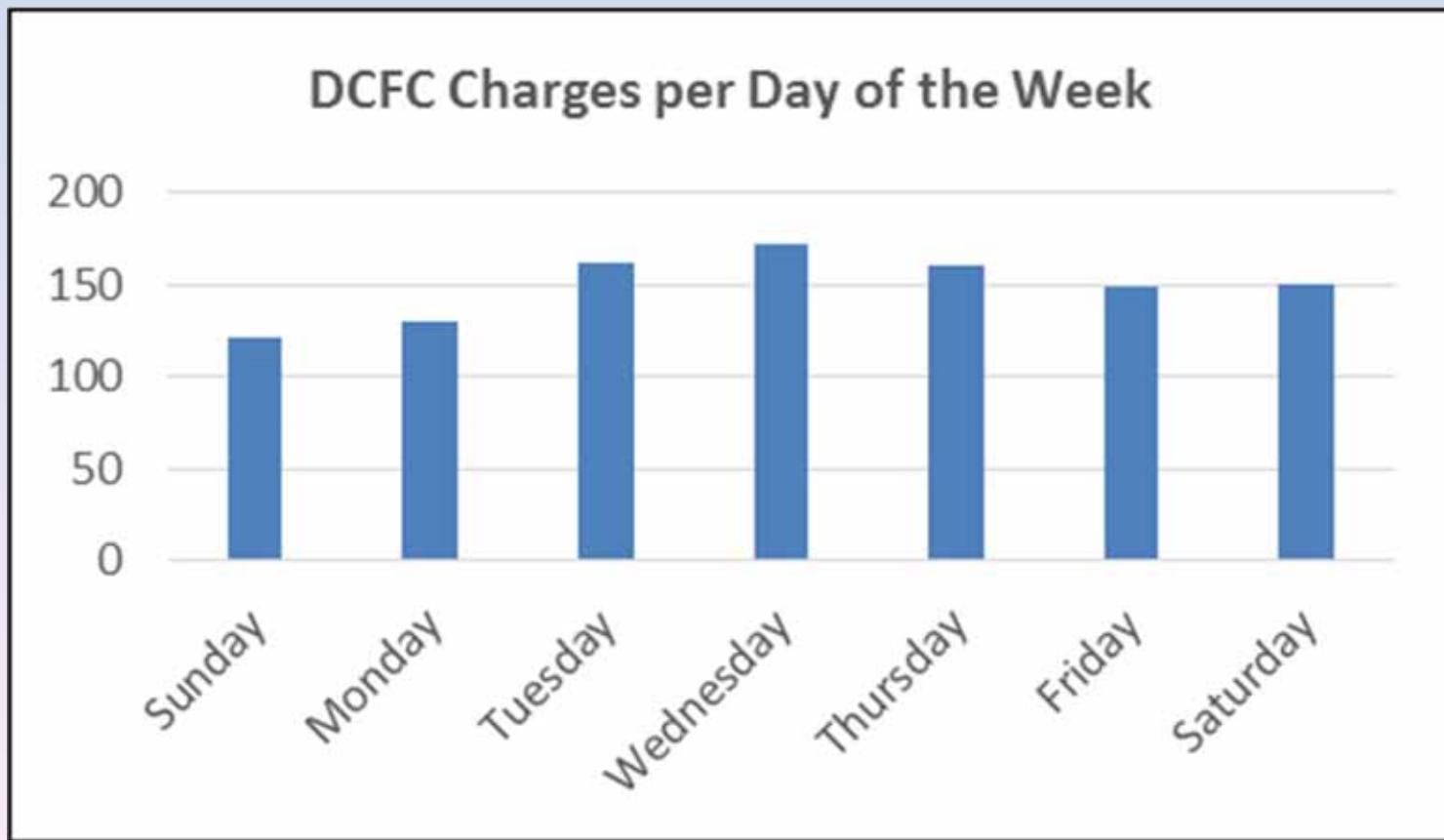
DCFC Day of Week Use – Full EV Project

- On Sundays, DCFC use was lowest
- Fridays and Saturdays had highest usage



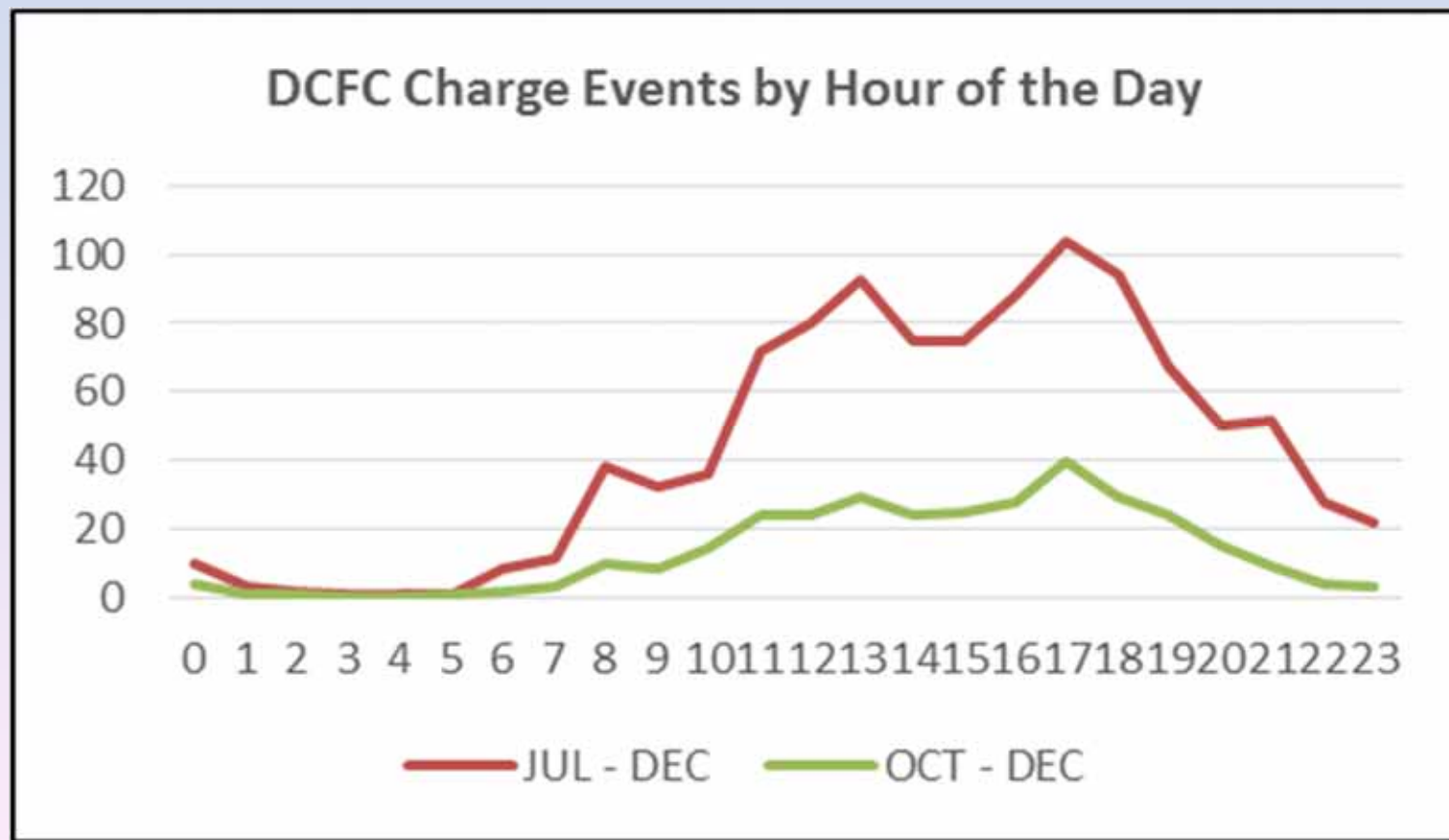
DCFC Day of Week Use With Fees, Last 6 Months of 2013

- Fees at DCFC were introduced the last 6 months of the project
- Tuesday, Wednesday and Thursday had highest use rates



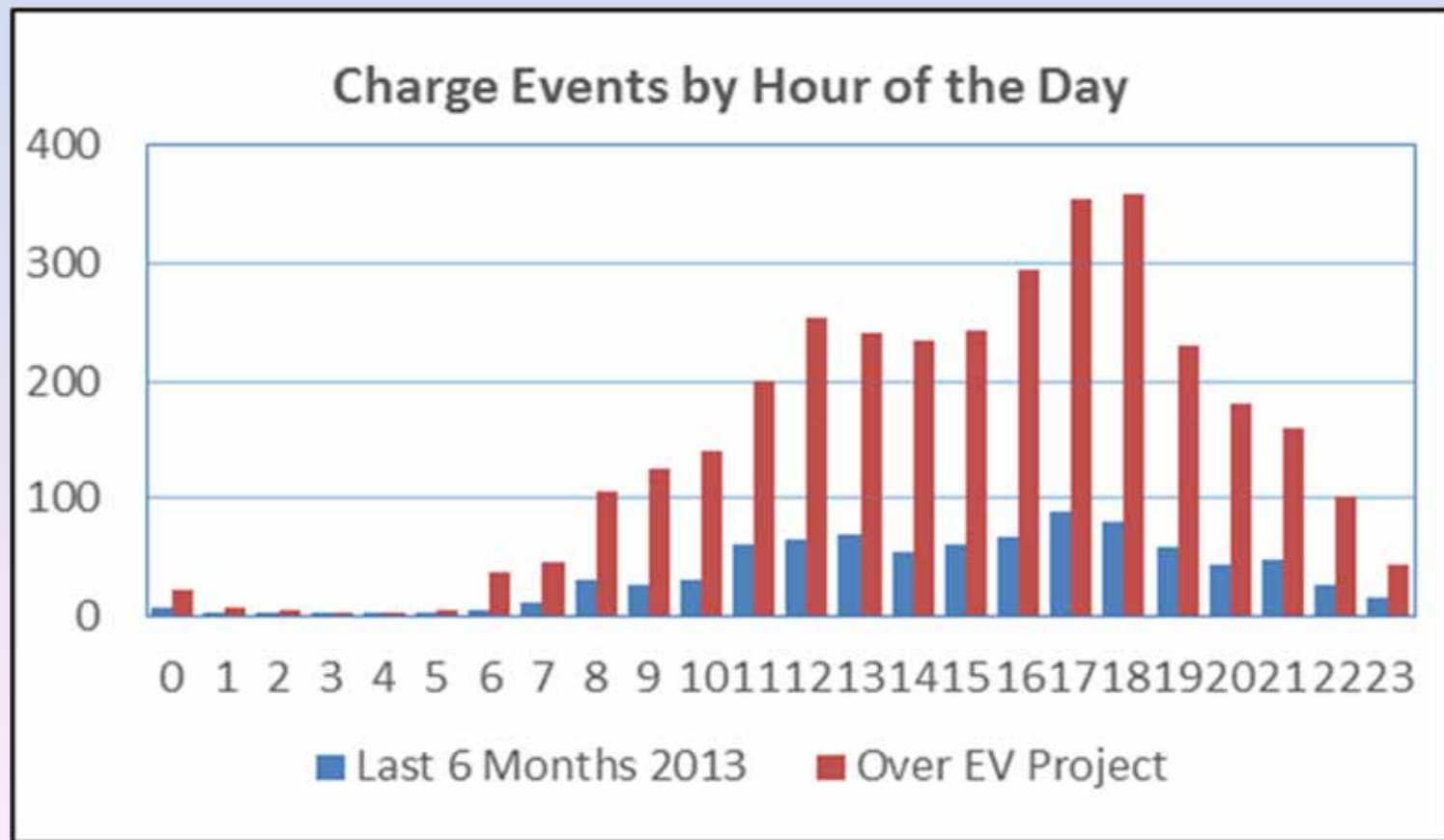
DCFC Hourly Use - Last 3 and 6 Months of 2013

- Fees were imposed starting last 6 months, fully imposed last 3 months
- Fees reduced usage somewhat during the last three months
- Most charging occurs 4 to 7 p.m., and around noon



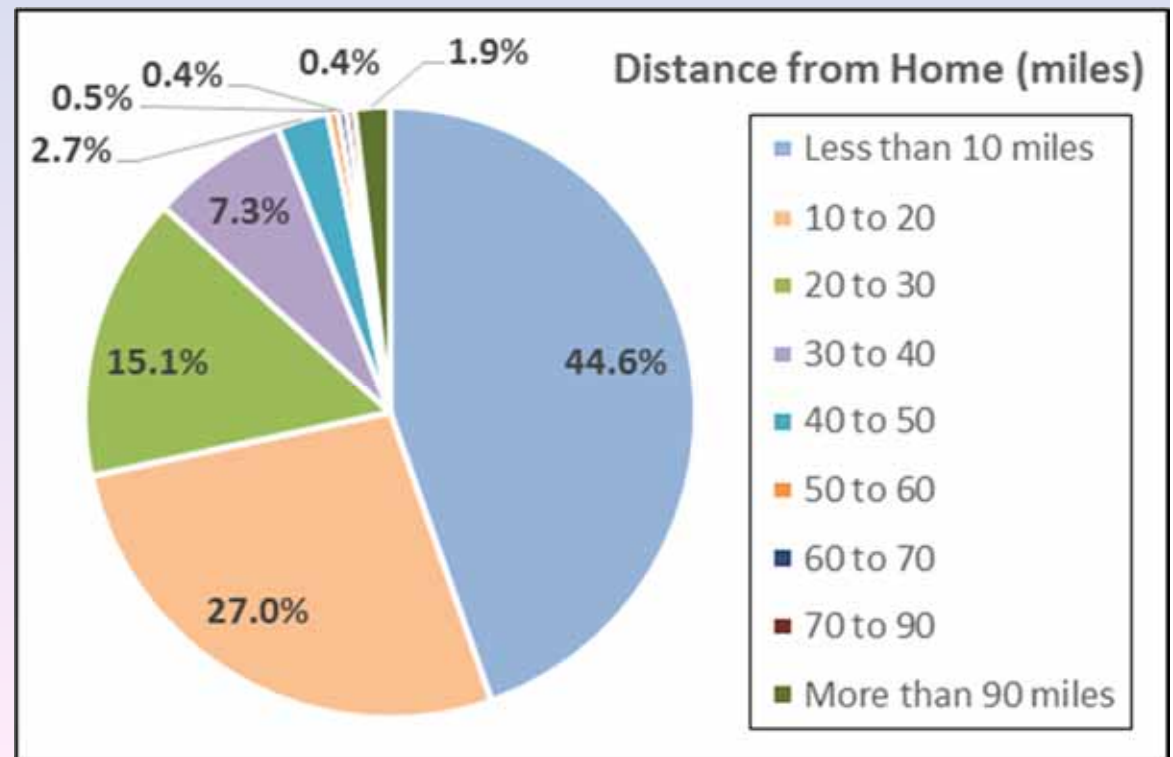
DCFC Hourly Use, Last 6 Months of 2013 and EV Project Life

- Between 4 and 7 p.m. was highest use rates
- There also was a bit of an increase in use around noon



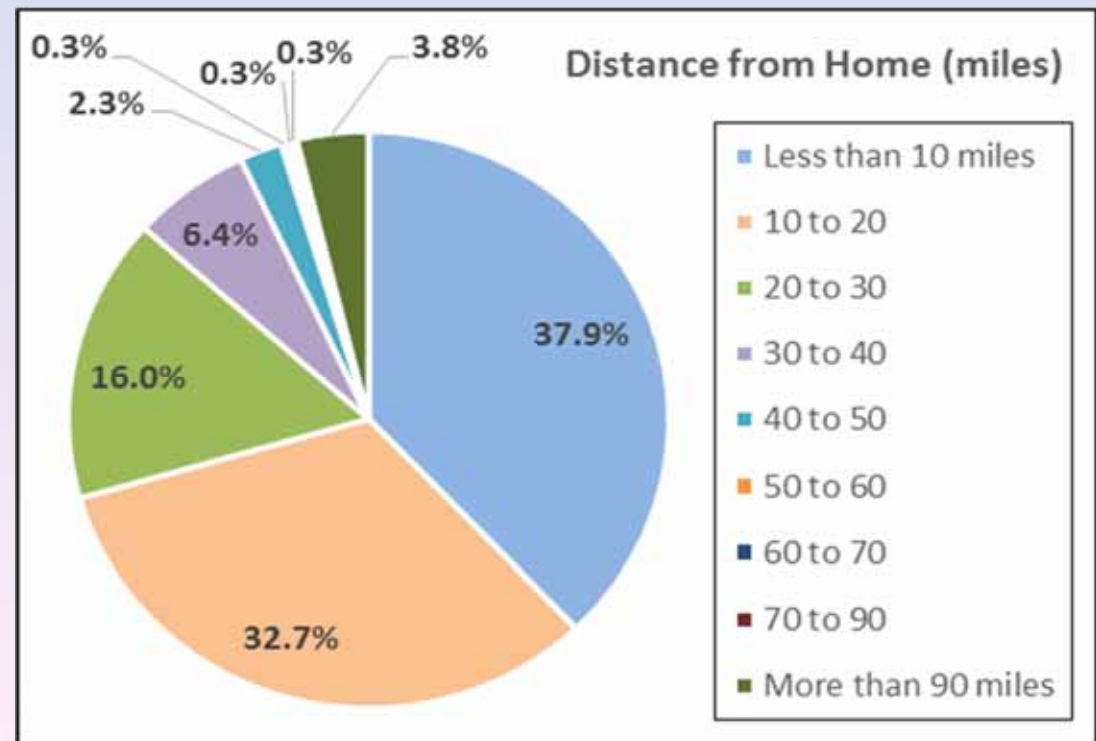
Leaf Drivers DCFC Use - Miles From Home Full EV Project

- **87% of all fast charging throughout The EV Project took place within 30 miles of the Leaf driver's home base**
- **Less than 4% of all fast charging throughout The EV Project took place more than 50 miles from home**
- **Suggests that few Leaf drivers were willing to take a long trip while relying on DCFC events**



Leaf Drivers DCFC Use - Miles From Home Last 6 Months of 2013

- Most used DCFCs were used by Leaf drivers who were an average of 17.1 miles away from their home base
- With fees, average distance from home when DCFC charging increased to 20.7 miles
- Significant percentage (37.9% of DCFC) still occurred within 10 miles of home
- Charging within 30 miles of home represents 86% of all DCFC events



DCFC Conclusions

- **Leaf drivers used DCFC**
 - **When needed regardless of the day of the week**
 - **At consistently lower initial state of charger percentage (SOC%) than at public AC Level 2 EVSE**
 - **Most frequently near the end of the work day when either headed home or to ensure sufficient SOC% for other evening plans**



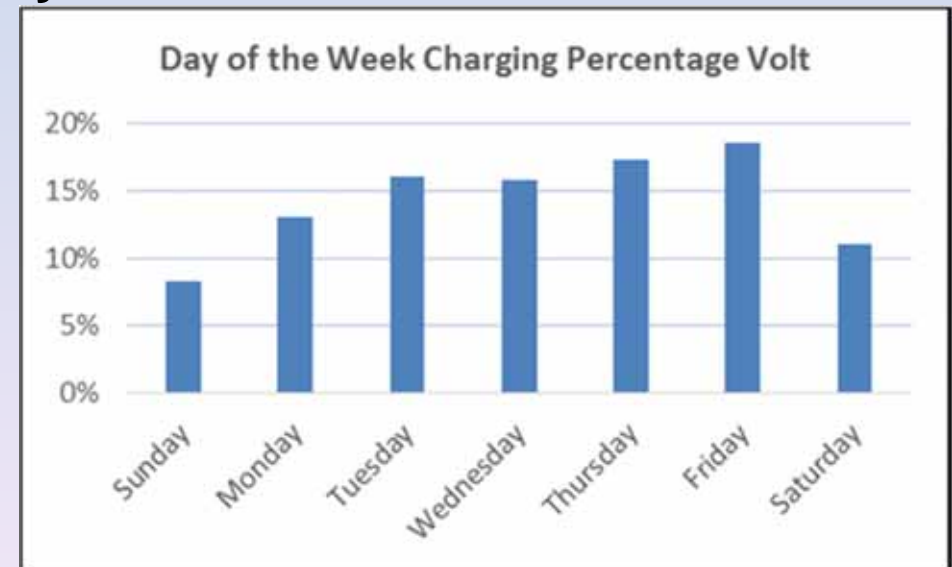
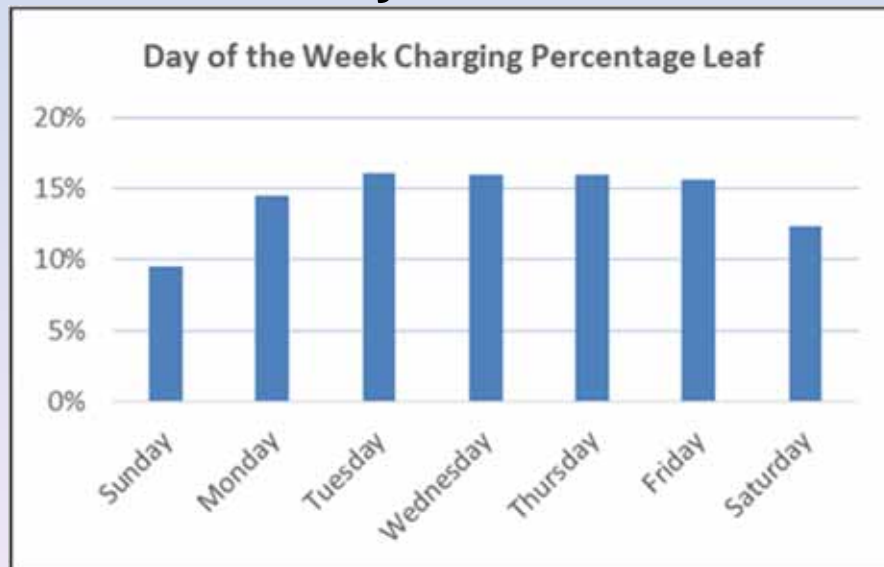
AC Level 2 Study

- 3,100 AC Level 2 EVSE installed at publicly accessible locations
- Workplace EVSE is excluded



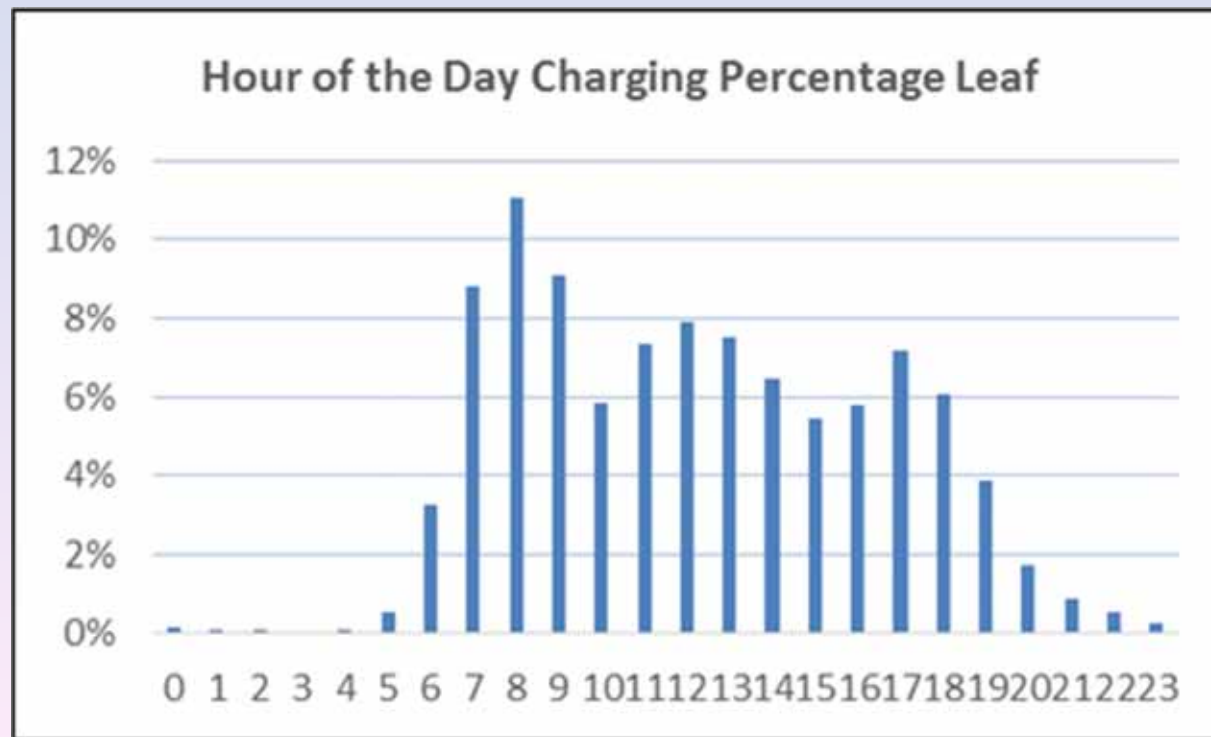
AC Level 2 Day of Week Usage

- Leaf drivers used AC Level 2 EVSE with less than 10% variation during the work week
- Volt drivers had higher use rates towards the end of the work week, with Mondays 30% less than Fridays



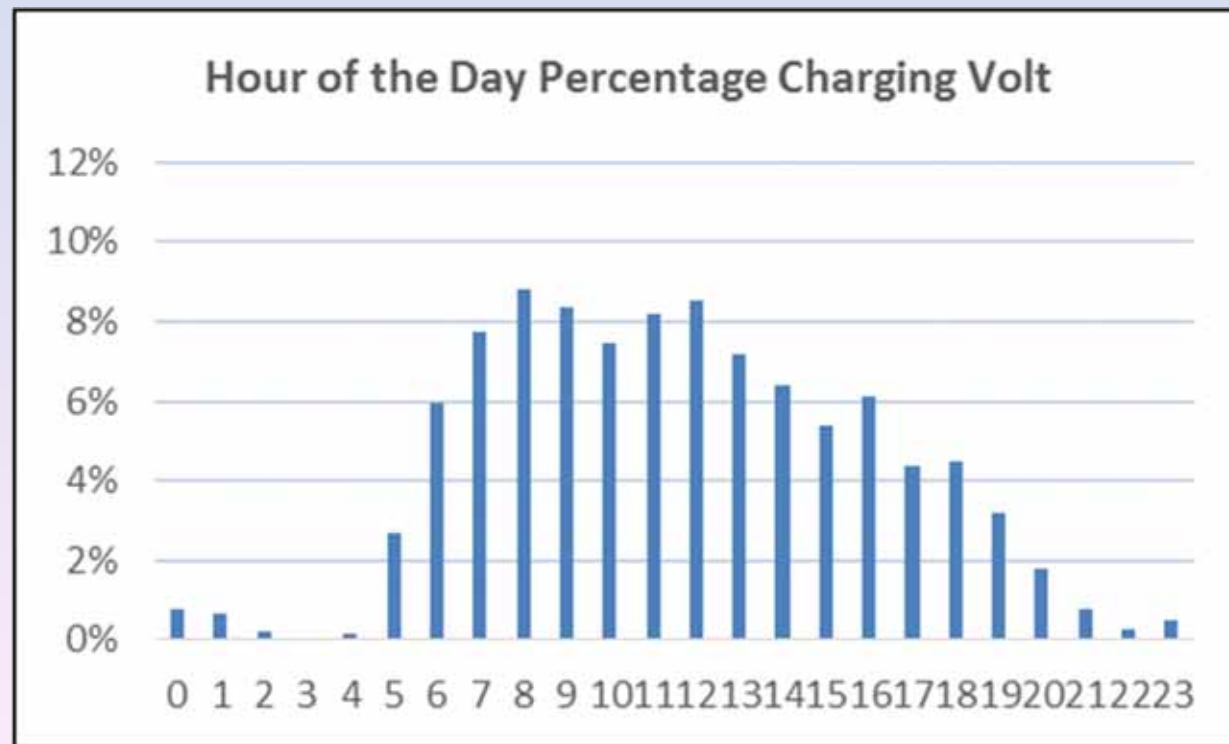
AC Level 2 Day of Week Usage by Leaf Drivers

- Leafs are most frequently charged at the beginning of the work day
- Above average Leaf use at lunchtime and at the end of the workday
- Suggests that Leaf drivers plug in as soon as they arrive at their public destination



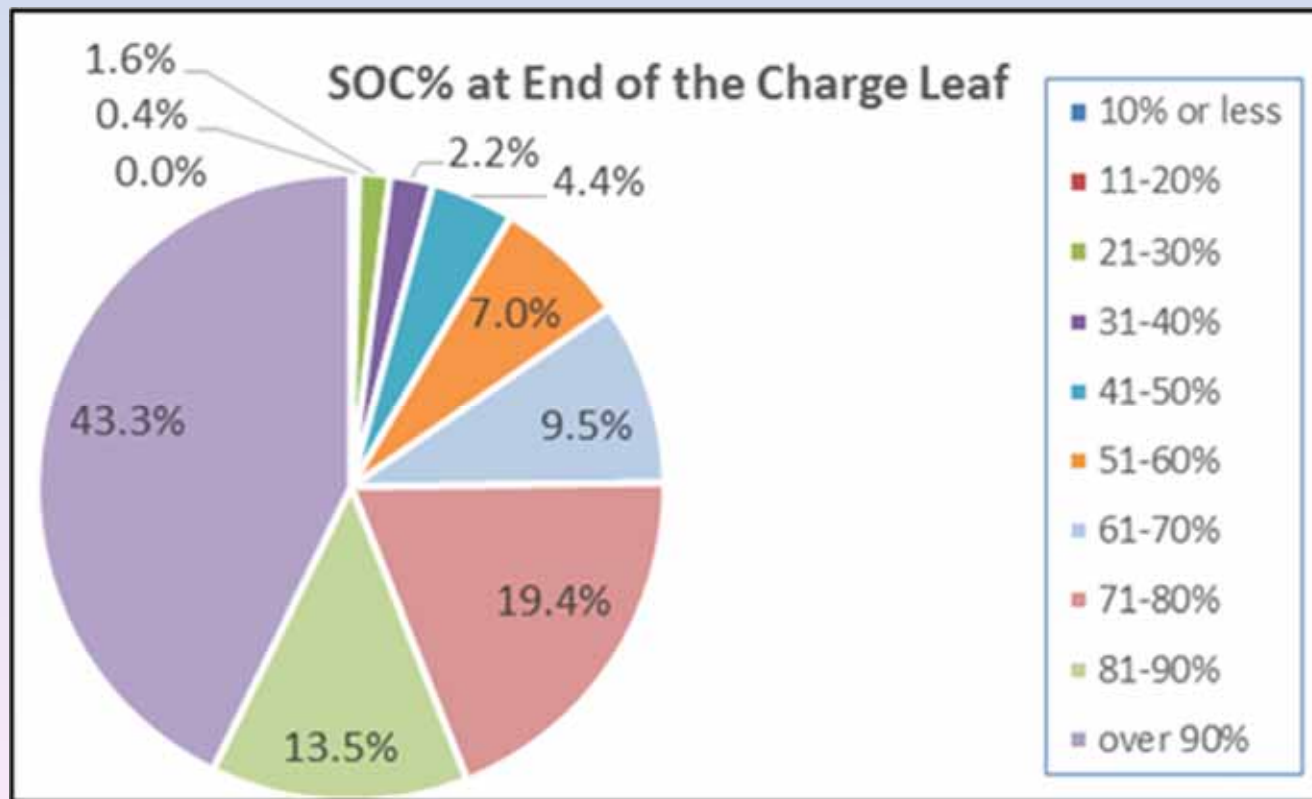
AC Level 2 Day of Week Usage by Volt Drivers

- Volts are most frequently charged at the beginning of the day, but not as distinctly as Leafs
- Volt drivers charged more uniformly throughout the day (0700 to 1600)
- Drivers of both vehicles rarely initiate their away-from-home charging before 6 a.m. or after 7 p.m.



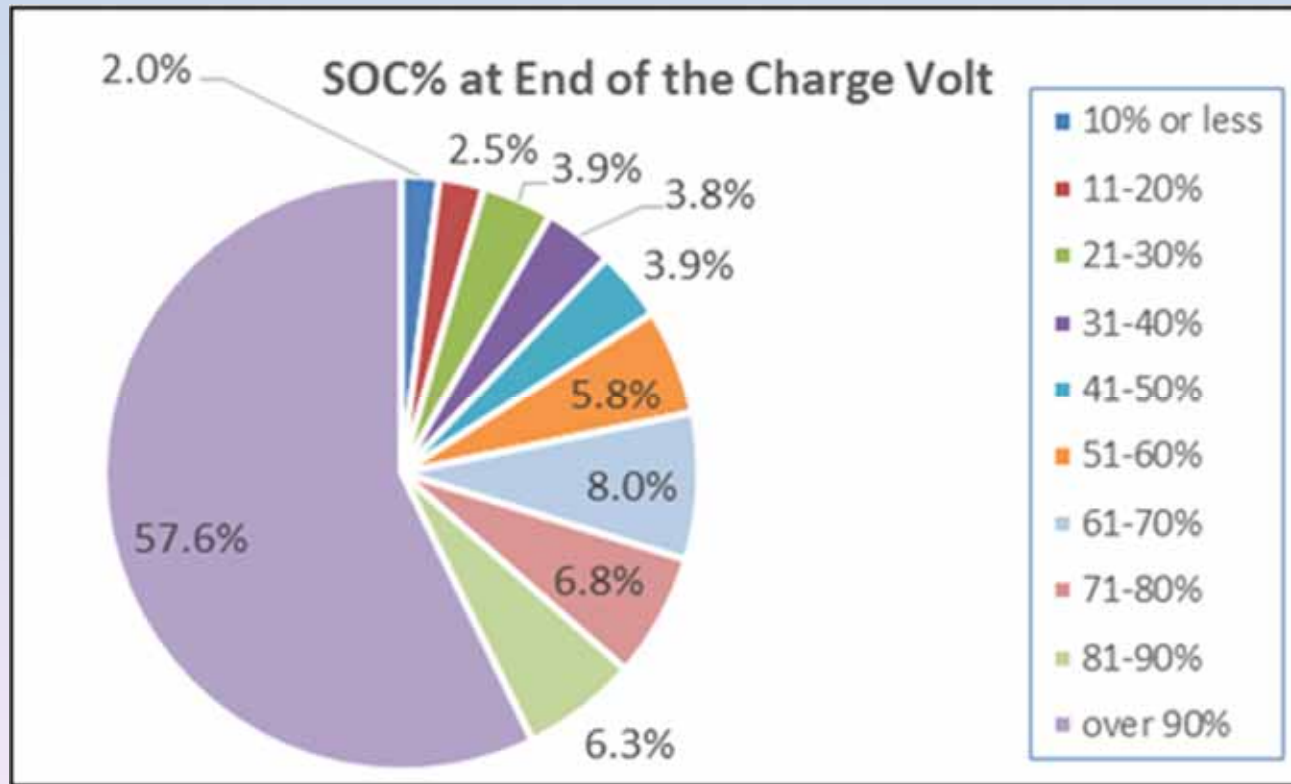
Leaf SOC At End Of AC Level 2 Charge Event

- Leafs charging to 80% SOC is most likely due to the vehicle's full charge default being set to 80 unless drivers change it
- 76% Leafs SOC at 70% or greater at end of charge



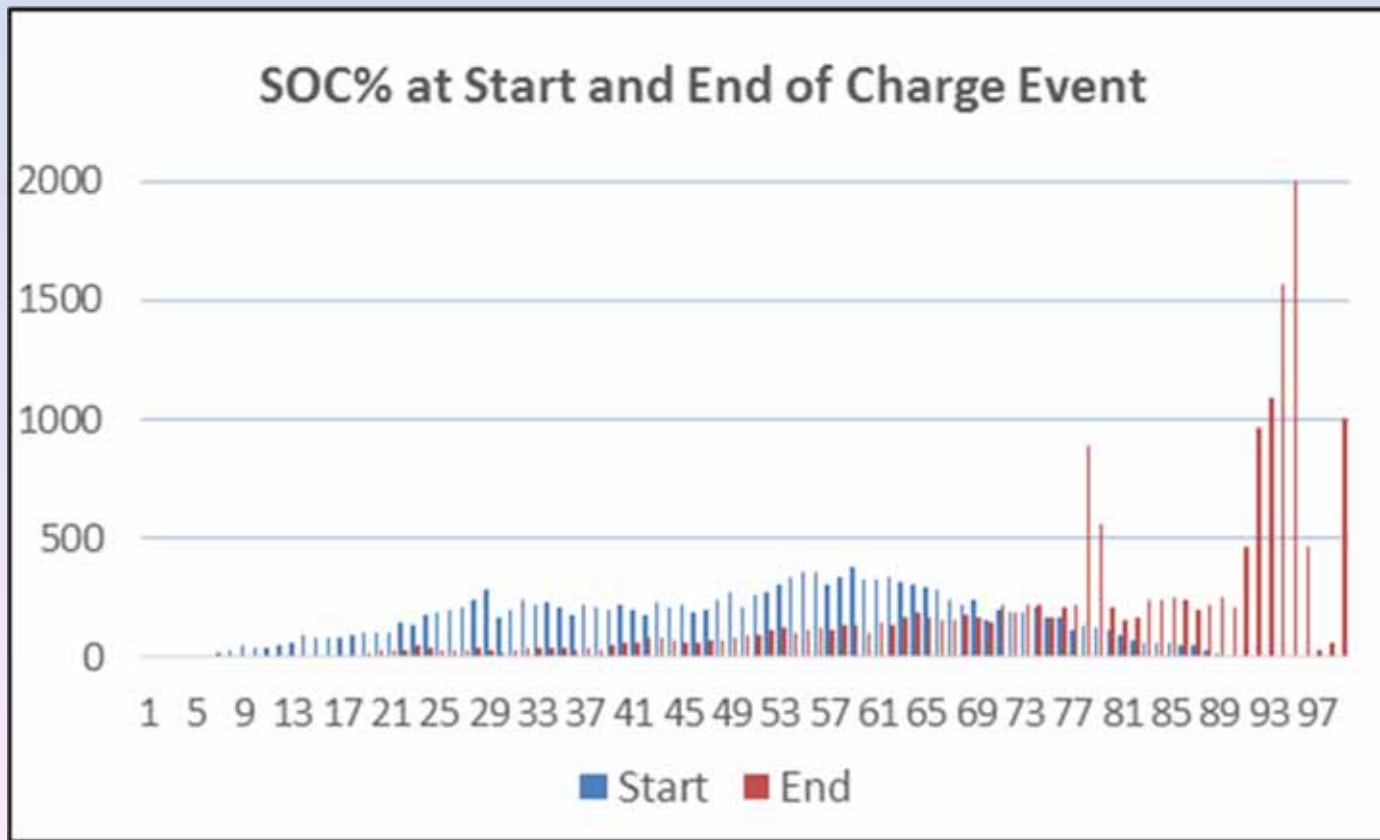
Volts SOC At End Of AC Level 2 Charge Events

- 71% Volts SOC at 70% or greater at end of charge



SOC At Start And End of Leaf and Volt AC Level 2 Charge Events

- Although the majority of charges go to full charge, nearly half end below a full charge, supports convenience aspect of public EVSE
- 80% SOC end of charge for Leafs can be seen



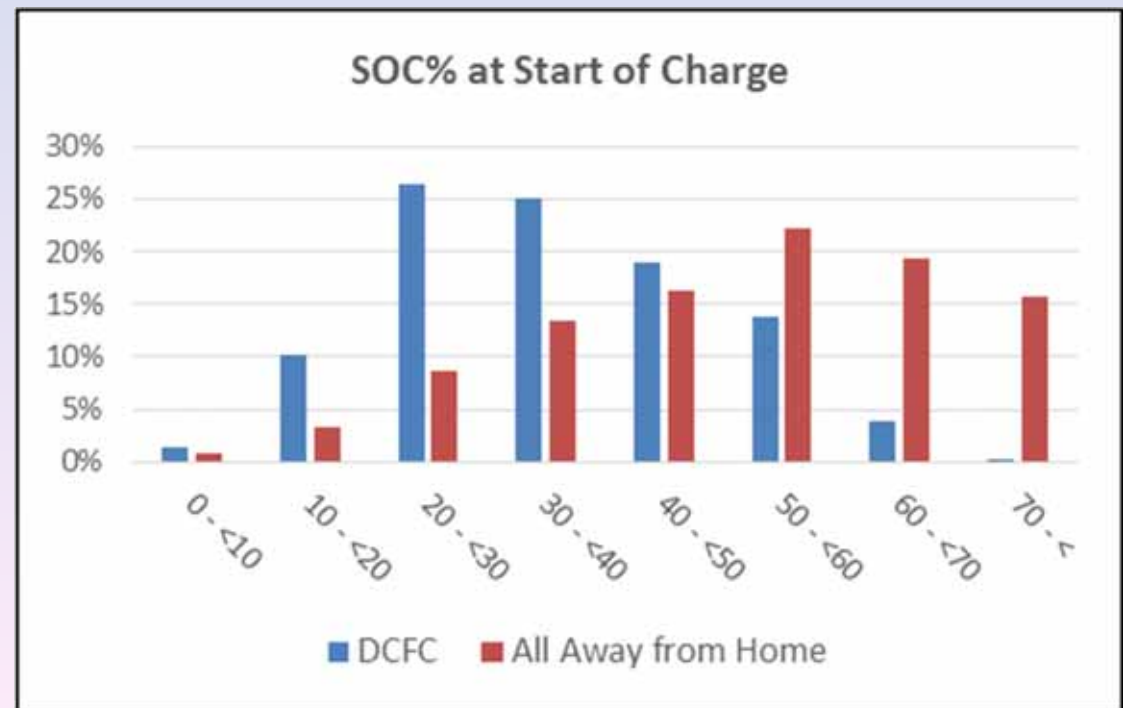
AC Level 2 Conclusions

- **The average battery SOC at the start of charging at public AC Level 2 EVSE was 49% for Leaf drivers and 39% for Volt drivers**
- **Most charging events at public AC Level 2 EVSE concluded with the battery SOC over 80%**



AC Level 2 And DCFC At Start Of Charge Events

- Based on SOC at the start of charge events, DCFCs appear to often times be a charging destination, while AC Level 2 charging is done when convenient to a destination
- Average SOC at the start of AC Level 2 charging at public EVSE is 49% for Leafs and 39% for Volts
- The average Leaf SOC was 35.3% when DCFC event was initiated

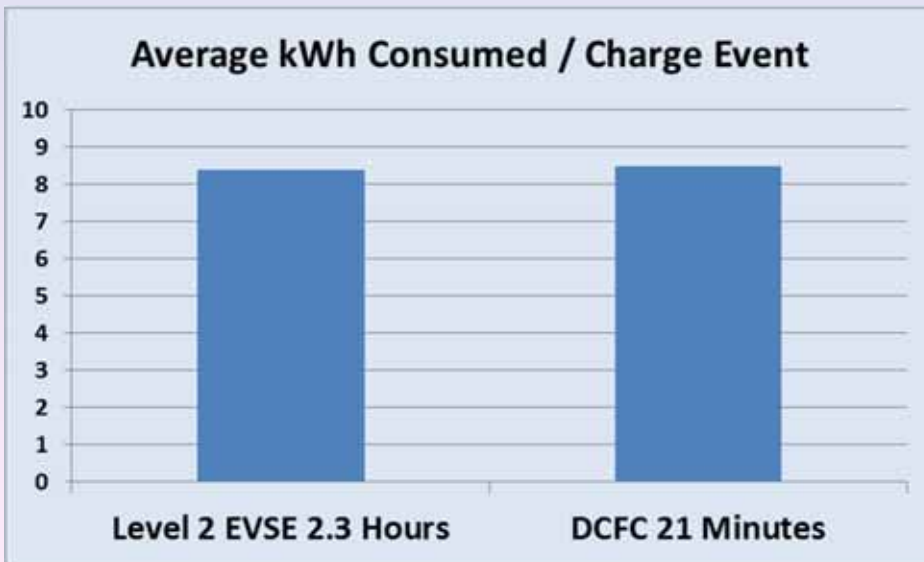
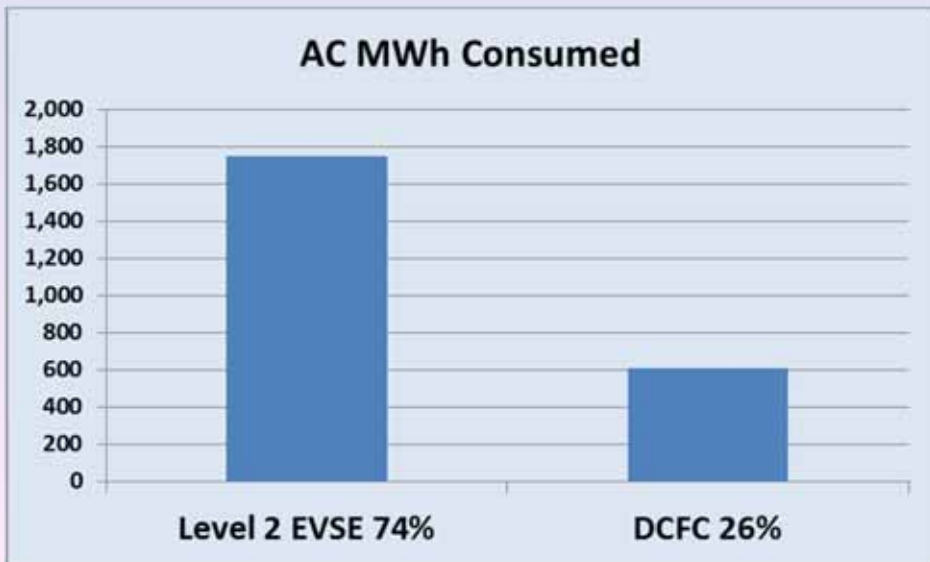
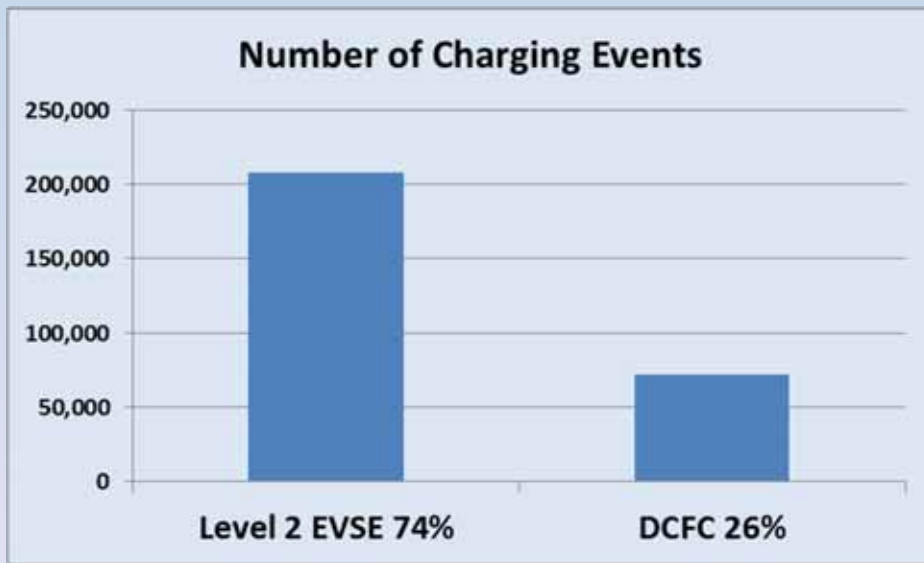
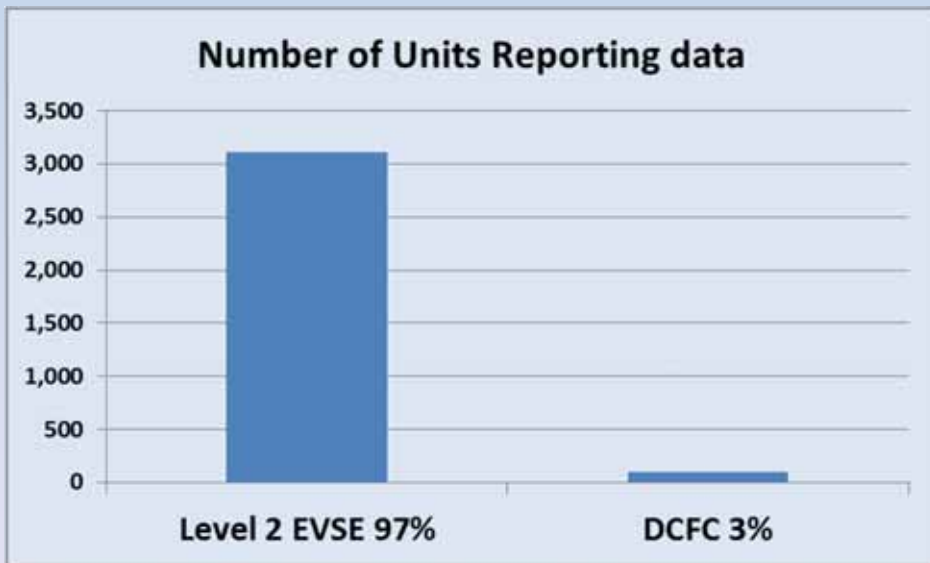


AC Level 2 And DCFC Conclusions

- **AC Level 2 use occurs most often early in the work day, while DCFC use is done more frequently at the end of the work day**
- **The average SOC% of the Leaf battery when a charge is initiated at an AC Level 2 EVSE is 40% higher than the average SOC% at the start of DCFC use (i.e., 49% SOC for AC Level 2 and 35% for DCFC).**



Comparing Level 2 and DCFC EV Project Last Year



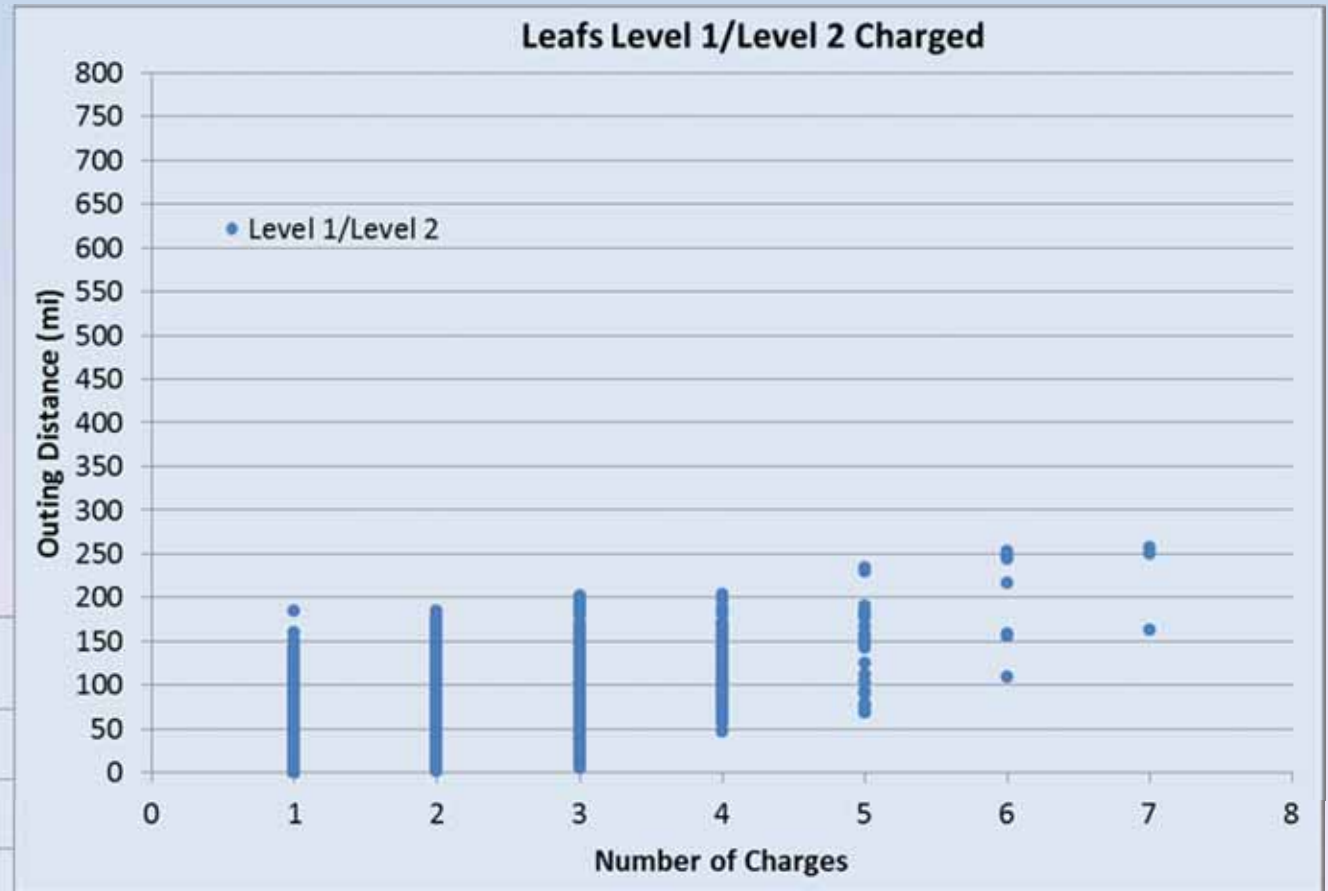
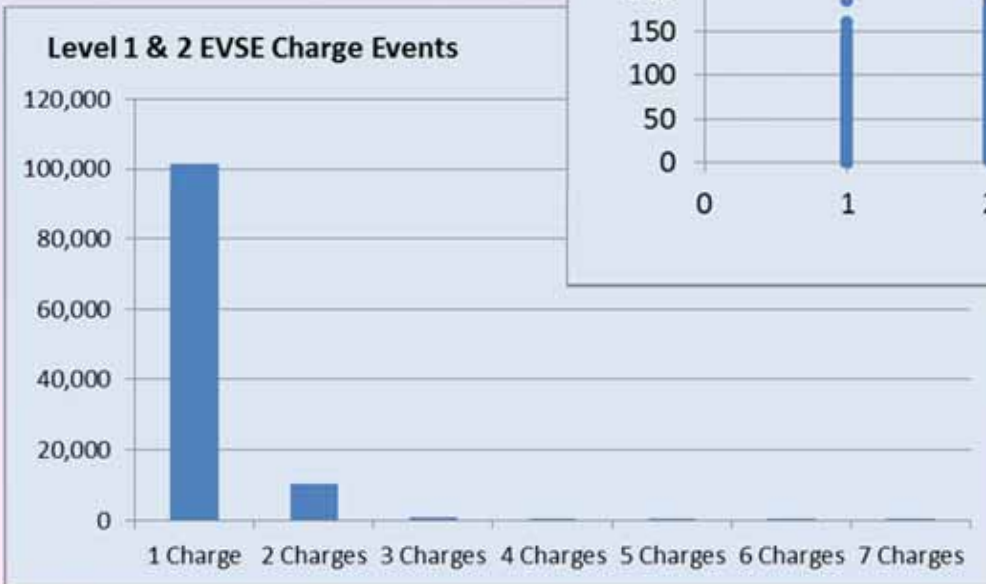
Nissan Leaf Charging Behaviors During Outings

- **An Outing is a trip or series of trips a PEV driver takes after leaving a private residence and before they return to the private residence**
- **1,292,310 Nissan Leaf Outings studied during The EV Project**
 - **No charging events: 1,170,785 (90.6%)**
 - **AC Level 1 or 2 charge event: 112,700 (8.7%)**
 - **DCFC charge event: 8,825 (0.7%)**
- **Outing events were used to identify public charging infrastructure's contribution to additional eVMT (electric Vehicle Miles Traveled)**



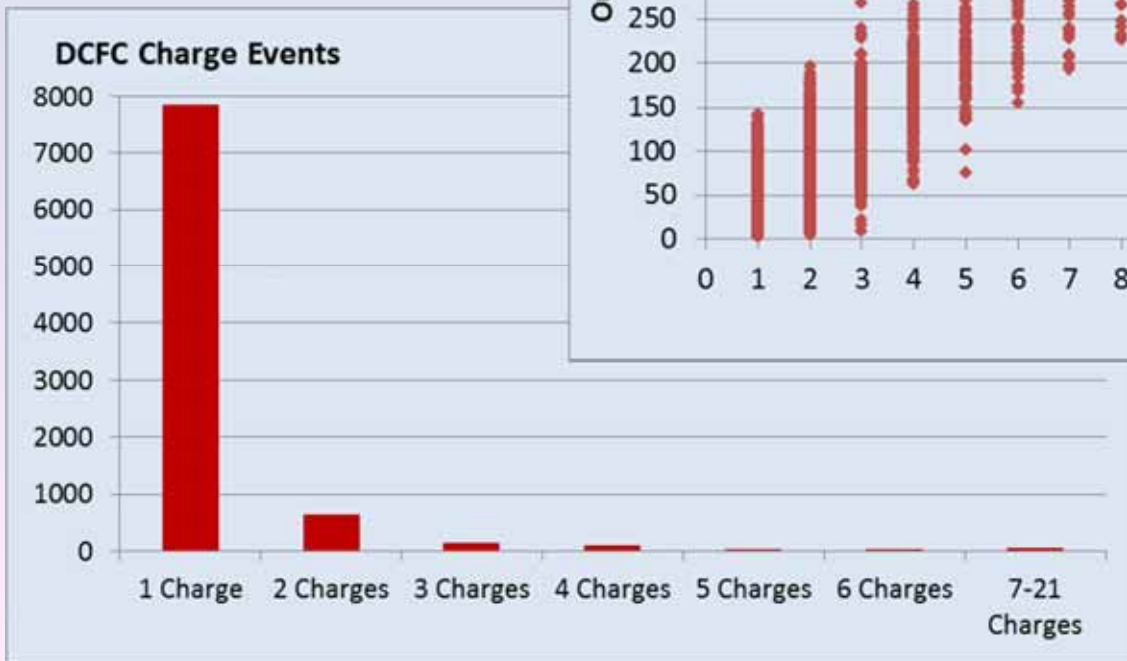
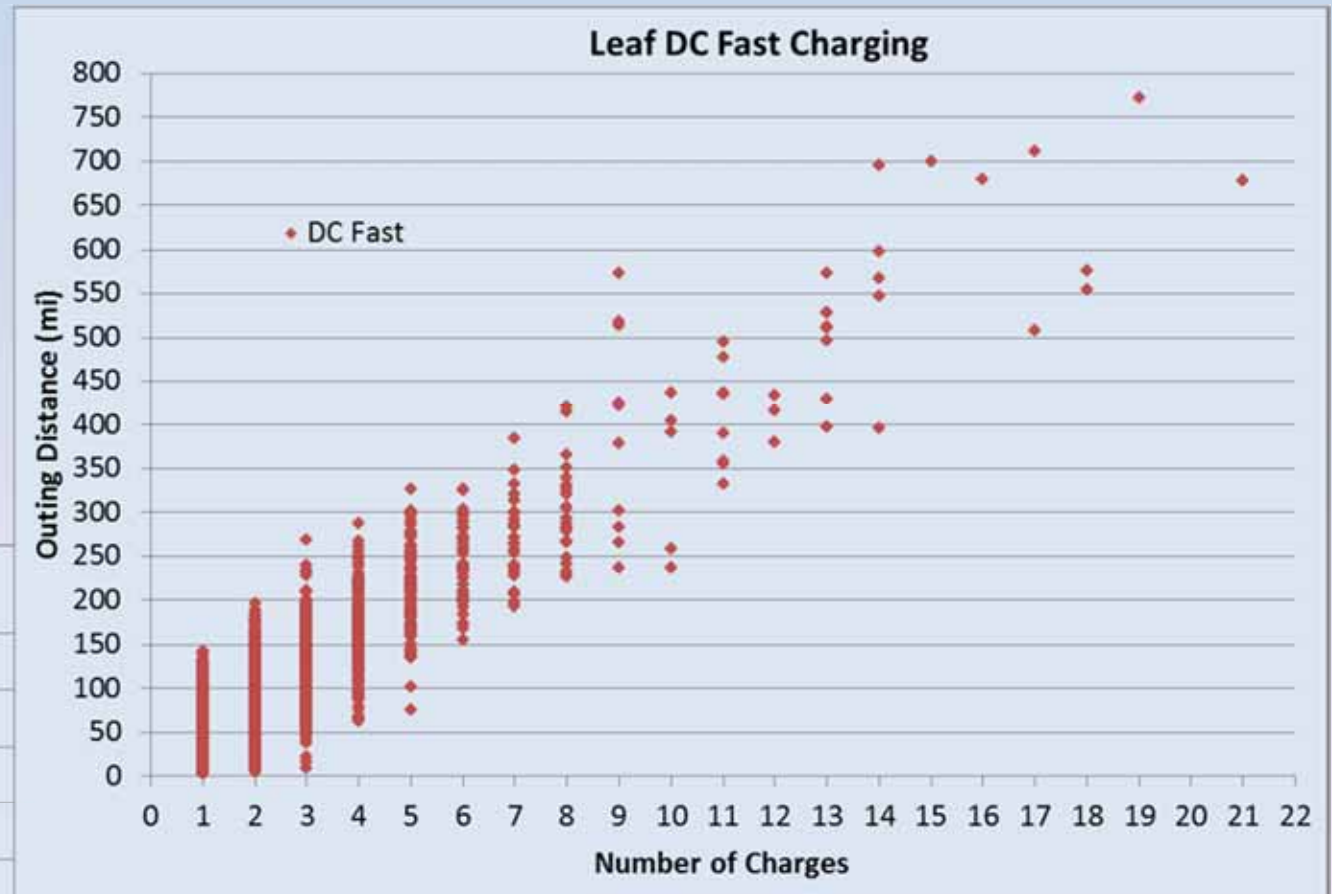
Leaf Public Level 1 & 2 Charges & Miles per Outing

- 112,700 total Level 1 and 2 charge events



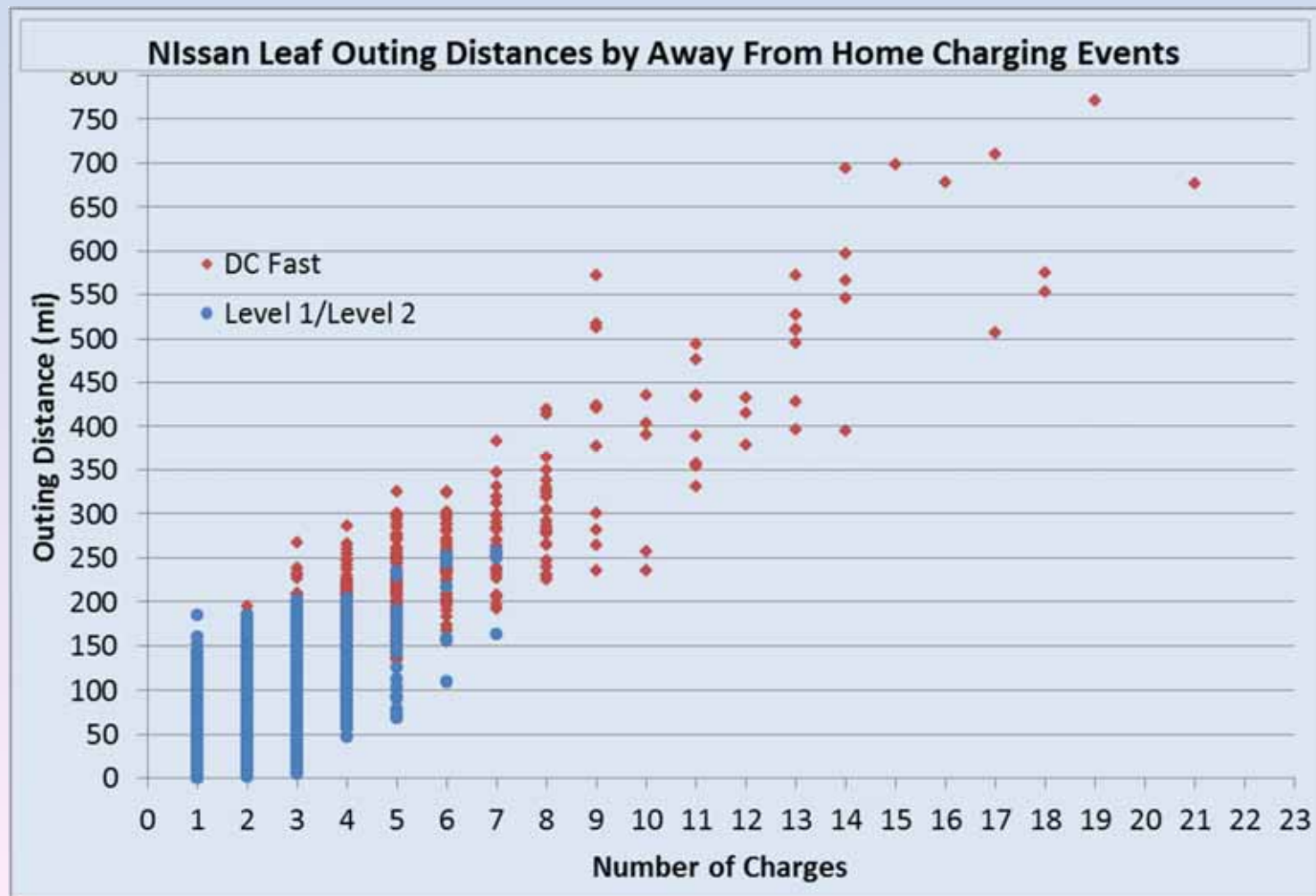
Leaf Public DCFC Charges & Miles per Outing

- 8,825 total DCFC charge events



Summary Public Charges And Miles per Outing

- DCFC clearly enables longer distances, but only for a small minority of the outings



Thank You

For additional information see:

<http://avt.inl.gov>

