In-Use Performance of Electric Drive Vehicles and Infrastructure: EV Project Results to Date

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May 2, 2013

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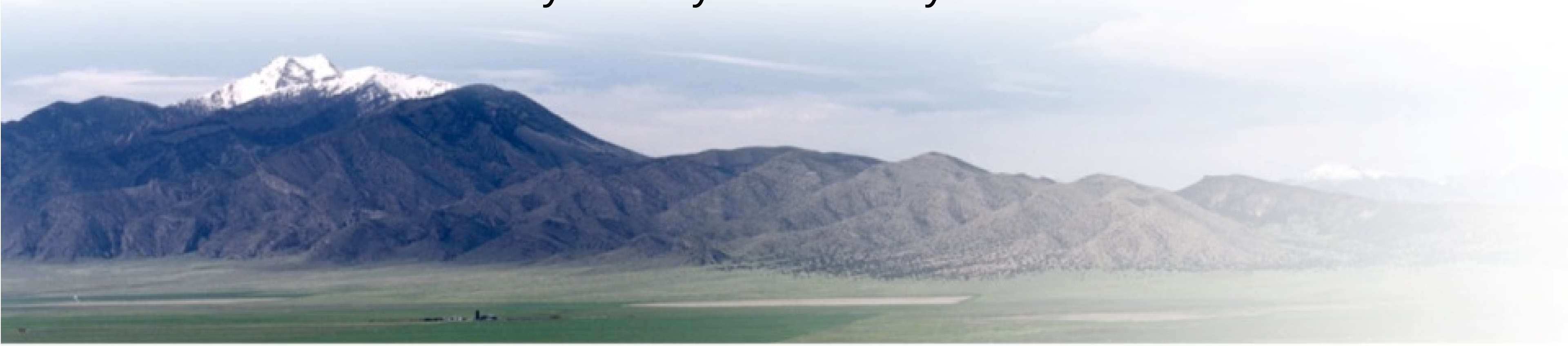
Idaho National Laboratory

Outline

- Advanced Vehicle Testing at INL
- Data Collection Methods
- EV Project Description
- EV Project Results to Date - Overall
- EV Project Results to Date - Tennessee
- Summary
- Where to find this presentation

Idaho National Laboratory

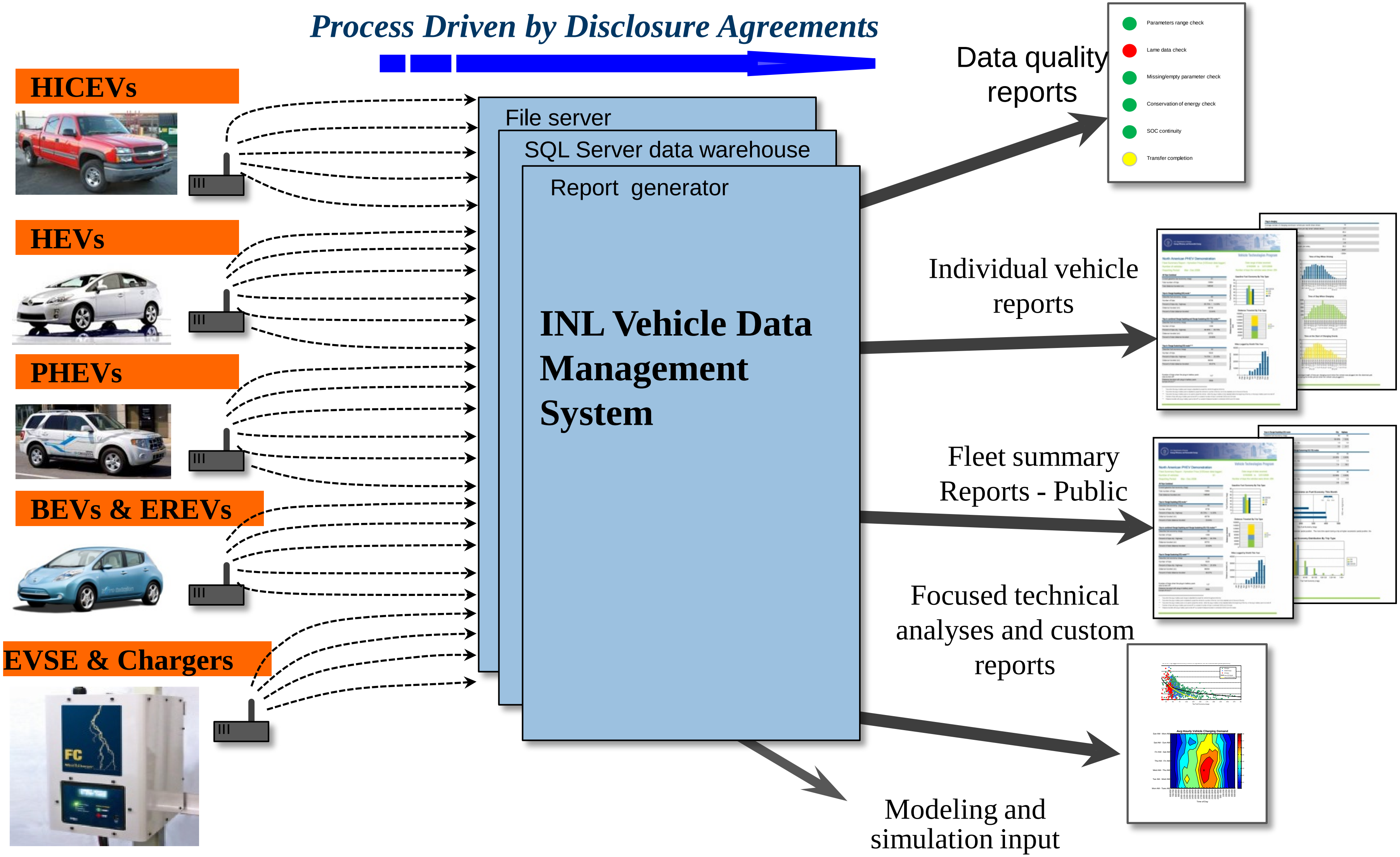
- U.S. Department of Energy (DOE) laboratory
- 890 square mile site – 4,000 Staff
- Support DOE's strategic goal:
  - Increase U.S. energy security and reduce the nation's dependence on foreign oil
- Multi-program DOE laboratory
  - Nuclear Energy
  - Fossil, Biomass, Wind, Geothermal and Hydropower Energy
  - Advanced Vehicles and Battery Development
  - Homeland Security and Cyber Security



AVTA Participants

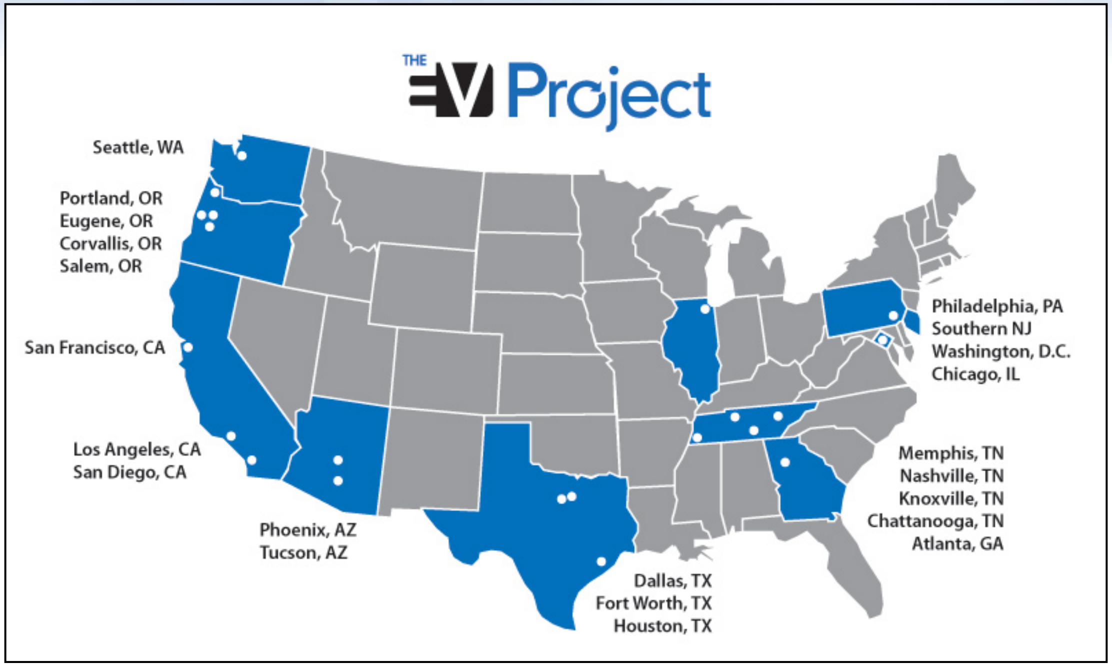
- DOE's Advanced Vehicle Testing Activity (AVTA), part of the Vehicle Technologies Program (VTP) conducts field-, test track-, and laboratory-based testing of light-duty vehicle systems and subsystems
  - Idaho National Laboratory provides technical direction and oversight of the AVTA for VTP
  - ECOtality provides testing support via a competitively bid NETL (National Energy Testing Laboratory) contract
- **For the EV Project, ECOtality is the project lead and INL provides data collection, analysis and dissemination support**
- Test partners include electric utilities, Federal, state and local government agencies, private companies, and individual vehicle owners

INL Vehicle/EVSE Data Management Process



EV Project

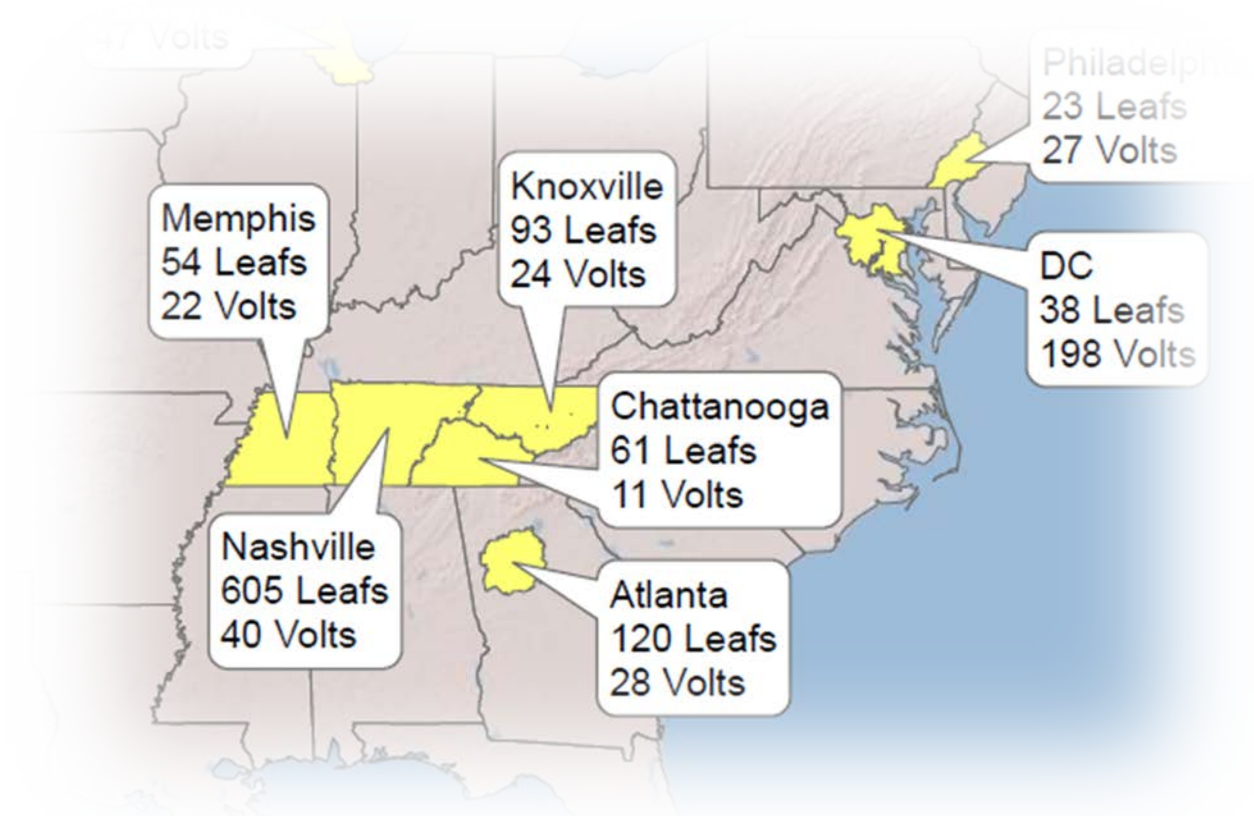
- Goal: Build and study mature charging infrastructures and take the lessons learned to support the future streamlined deployment of grid-connected electric drive vehicles



- Vehicle data is collected every trip via telematics providers from Volts and Leafs
- 8,715 Vehicles (6,329 Leafs, 1,255 Volts, 330 Smart EVs)
- 1 Million miles of data every 5.8 days
- EVSE Data is collected for each project charger as well

EV Project in the Southeast - Vehicles

- Nissan Leafs and Chevrolet Volts Reporting Data
  - Project-to-date through December 2012



Nissan Leaf Data – 4th Quarter 2012

	All	Chattanooga	Knoxville	Memphis	Nashville
Avg trip distance (mi)	6.9	6.8	**8**	5.4	7.3
Avg distance traveled per day when vehicle was driven (mi)	29.2	29.8	**33.4**	26.5	32.2
Avg number of trips between charging events	3.8	3.7	3.4	**4.3**	3.7
Avg distance traveled between charging events (mi)	26.3	25.1	**27.7**	23.4	26.6
Avg number charging events per day when vehicle was driven (mi)	1.1	1.2	1.2	1.1	1.2

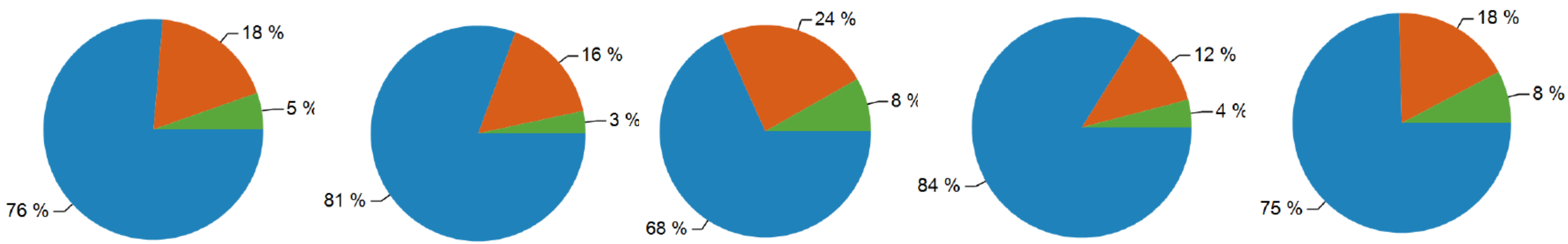
Chevrolet Volt Data – 4th Quarter 2012

	All	Knoxville	Memphis	Nashville
Overall Fuel Economy (mpg)	126	119	112	117
Overall electrical energy consumption (AC Wh/mi)	229	227	216	215
Avg trip distance (mi)	8.1	8.1	7	9
Avg distance traveled per day when vehicle was driven (mi)	40.5	43.1	38	45.1
Avg number of trips between charging events	3.5	3.5	3.9	3.5
Avg distance traveled between charging events (mi)	28.2	28.5	27.6	31.9
Avg number of charging events per day when vehicle was driven	1.4	1.5	1.4	1.4

Frequency of Charging by Charging Location

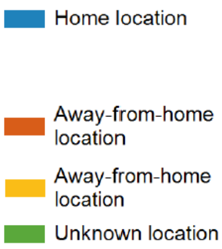
EV Project Nissan Leafs

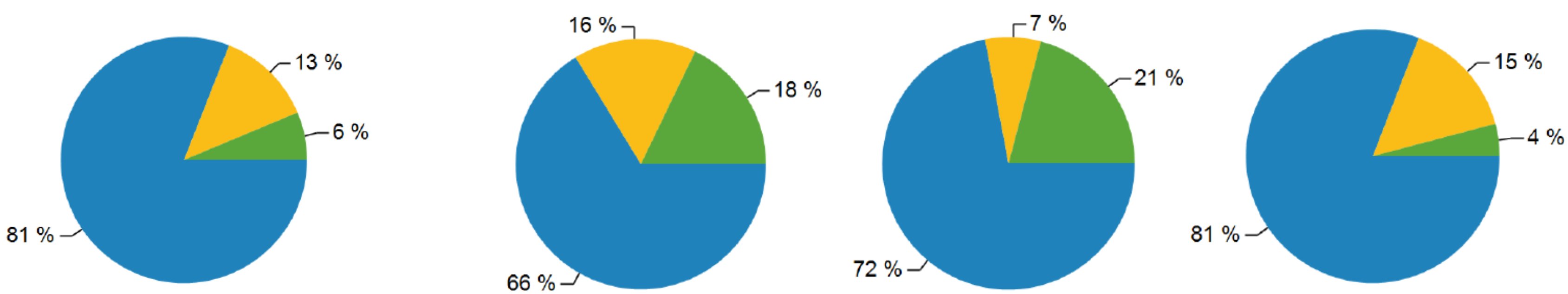
All	Chattanooga	Knoxville	Memphis	Nashville



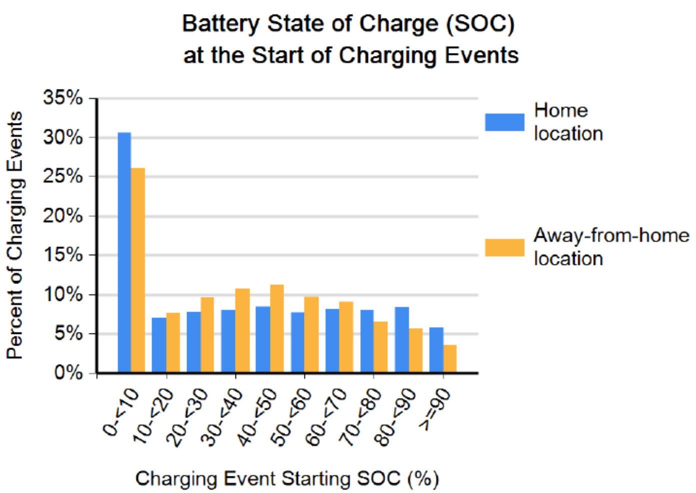
EV Project Chevrolet Volts

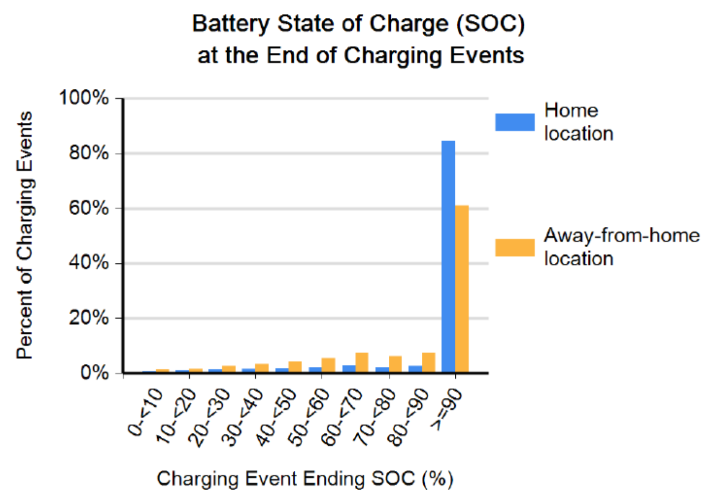
All		Knoxville	Memphis	Nashville



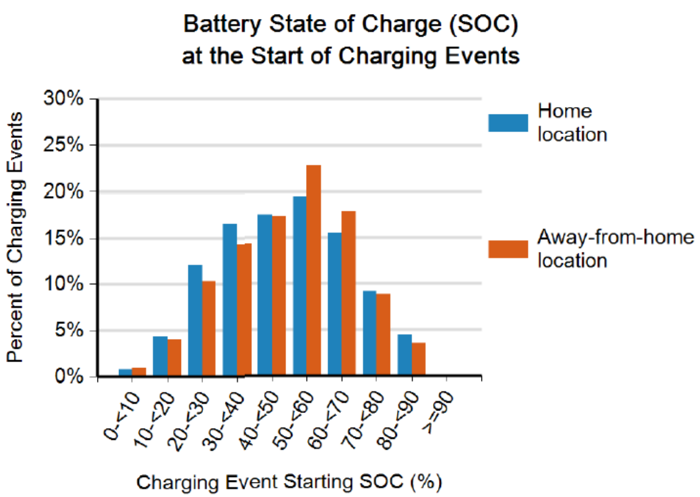


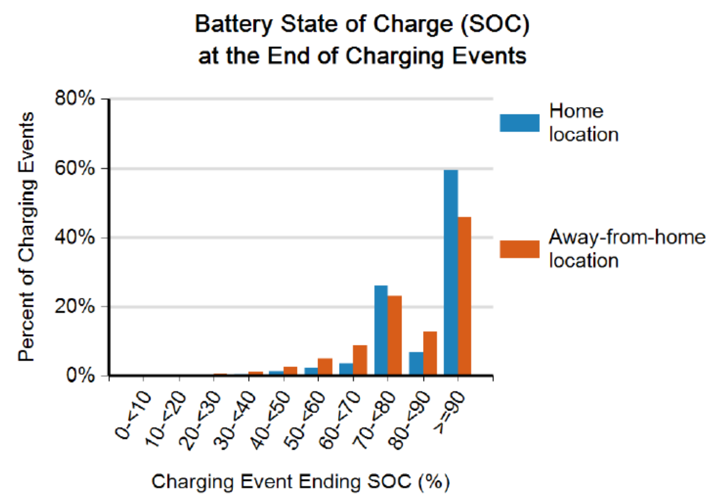
Vehicle State-of-Charge at Start, End of Charge





VOLTS





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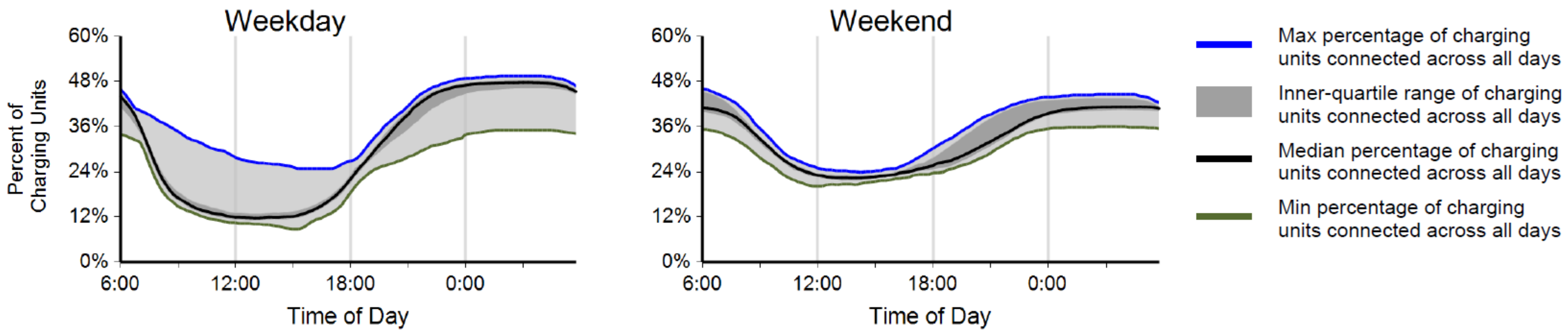
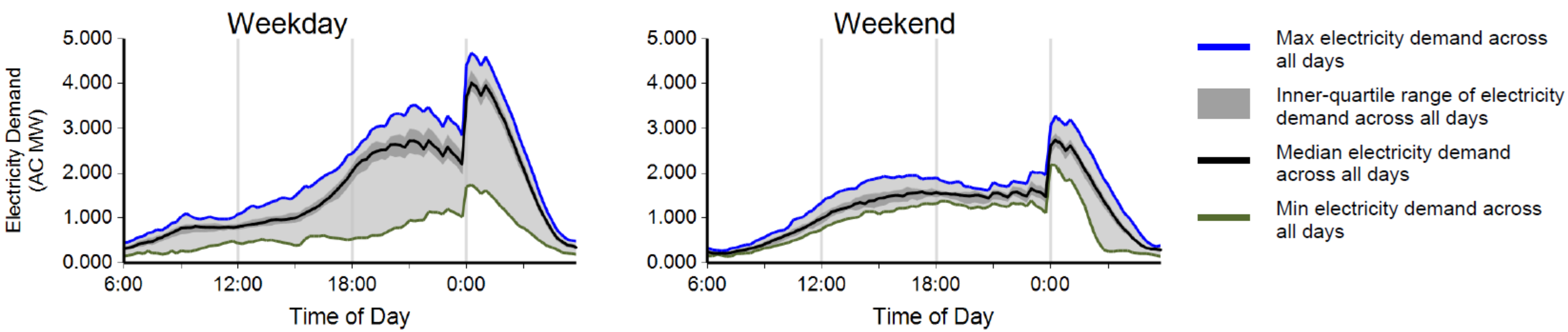
Charging Availability and Demand – All Regions

- All EVSE

Charging Availability: Range of Percent of Charging Units with a Vehicle Connected versus Time of Day[3]



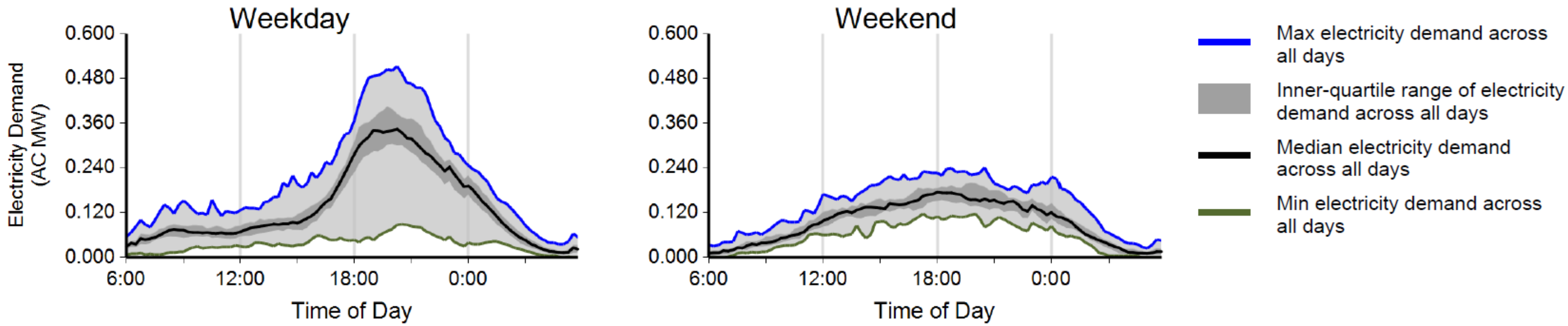
Charging Demand: Range of Aggregate Electricity Demand versus Time of Day[4]



Demand – Nashville, TN vs San Diego, CA

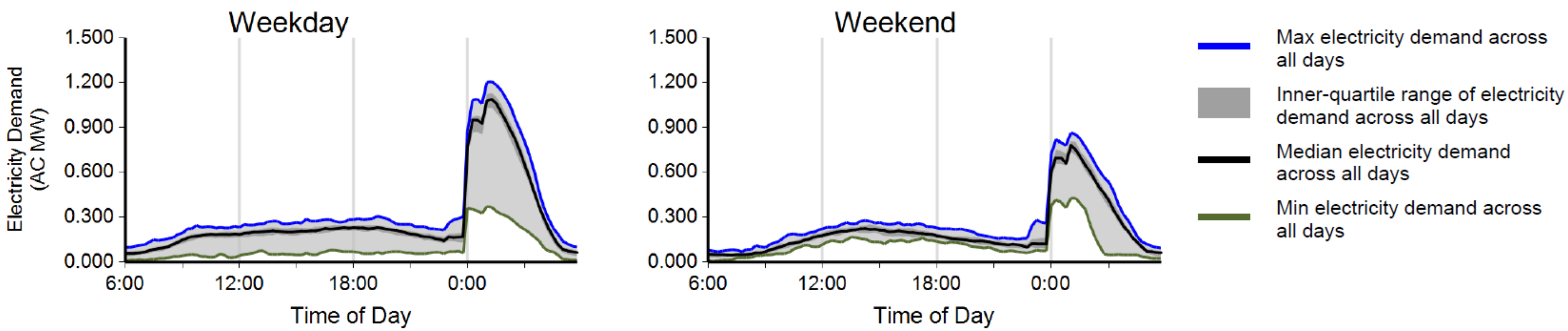
- Nashville, TN. All EVSE

Charging Demand: Range of Aggregate Electricity Demand versus Time of Day[4]



- San Diego, CA. All EVSE – Effect of TOU Electricity Rates

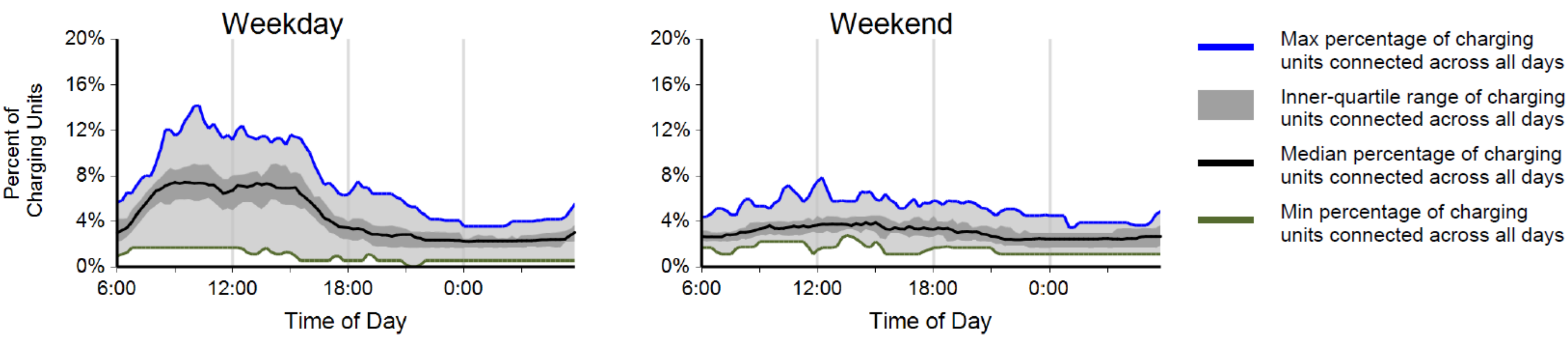
Charging Demand: Range of Aggregate Electricity Demand versus Time of Day[4]



Public EVSE – Nashville, TN and San Diego, CA

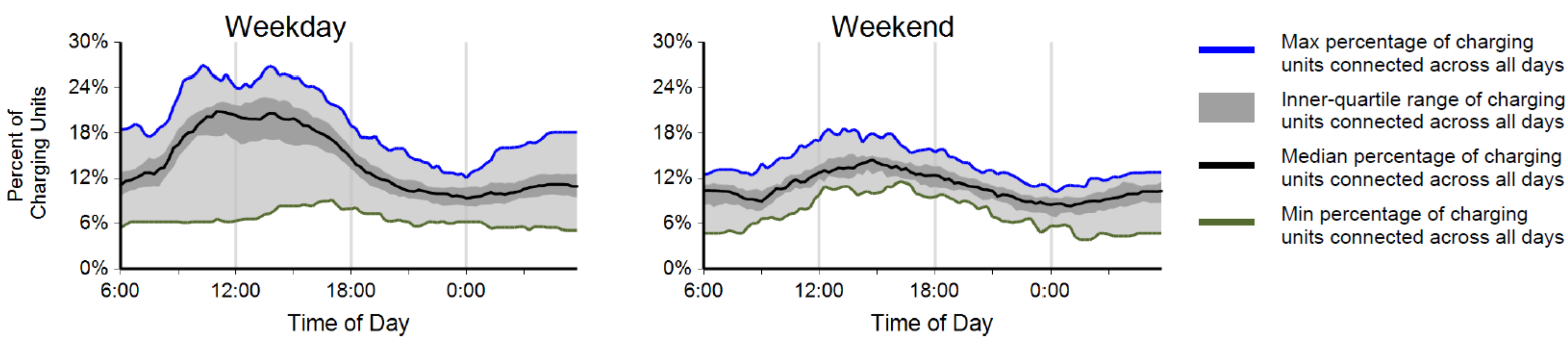
- Nashville, TN - Publicly Available Level 2 EVSE

Charging Availability: Range of Percent of Charging Units with a Vehicle Connected versus Time of Day[3]



- San Diego, CA – Public Level 2 EVSE – Supporting Car2Go Car Sharing

Charging Availability: Range of Percent of Charging Units with a Vehicle Connected versus Time of Day[3]



Observations on Charging

- Residential L2 Charging
  - On average, vehicle plugged in much longer than drawing power (about 5:1)
  - Some variation weekend to weekday, but averages are similar
- Public L2 Charging
  - Vehicles plugged in ‘on standby’ less than residential
  - More differences between weekend and weekday
- DC Fast Charging
  - Units average 1.9 events per day, each
  - Average DCFast charge connection time: about 20 minutes, drawing power the whole time
  - 7.2 kWh average energy consumed per DC fast charge

Summary/Discussion

- Utilities with TOU rates seem to drive consumer behavior, charging off-peak
- Significant opportunities exist for ‘smart’ shifting of vehicles charging at home, based on the long plug-in times, and short time drawing power
- EV Project data still being collected – much more analysis will follow completion of data collection.
- DC Fast Charge events have significant demand impacts.
- INL has many other projects studying vehicle technologies and infrastructure – much information available on the AVTA website…

Acknowledgement

This work is supported by the U.S. Department of Energy's EERE Vehicle Technologies Program

More Information

http://avt.inl.gov

This presentation is posted in the publications section of the above website, alphabetically as "Electrifying the Vehicle Market in the Southeast: EV Project Results to Date"

INL/CON-13-29016