# Workplace Lessons Learned through the Nation's Largest PEV Charging Projects

**DOE Workplace Charging Challenge Summit**
**Alexandria, VA**

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**11-18-2014**

**INL/MIS-14-33698**

www.inl.gov

Idaho National Laboratory

U.S. DEPARTMENT OF ENERGY

U.S. DEPARTMENT OF ENERGY workplace charging challenge

# Idaho National Laboratory

- U.S. Department of Energy (DOE) federal laboratory
- 890 square mile site with 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 Batteries
  - Homeland Security and Cyber Security

# INL was a primary partner in two national electric vehicle charging infrastructure demonstrations

## The EV Project

- Purpose is to build mature EV charging infrastructure in 17 US regions and study:
- Infrastructure deployment process
- Customer driving and charging behavior
- Impact on electric grid
- 12,000+ AC level 2 charging units, 100+ DC fast chargers
- 8,000+ electric drive vehicles
- INL data collection Jan 2011 – Dec 2013
- Project partners:

blink, NISSAN, GM, OnStar, CAR2GO

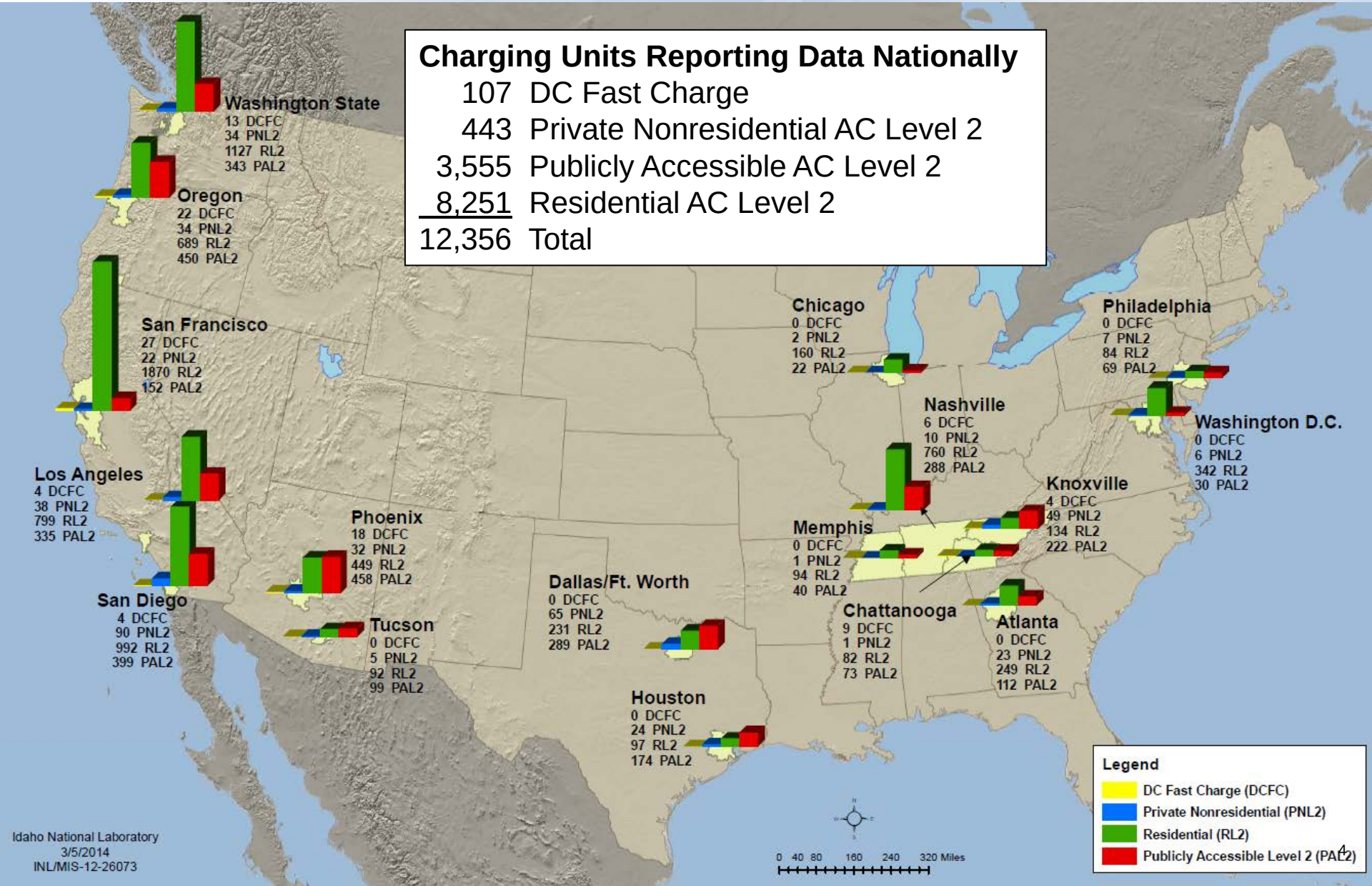
## ChargePoint America

- Deploy 4,700+ residential and public AC level 2 charging units in 11 US regions
- Study customer usage of residential and public infrastructure
- INL data collection May 2011 – Dec 2013

chargepoint

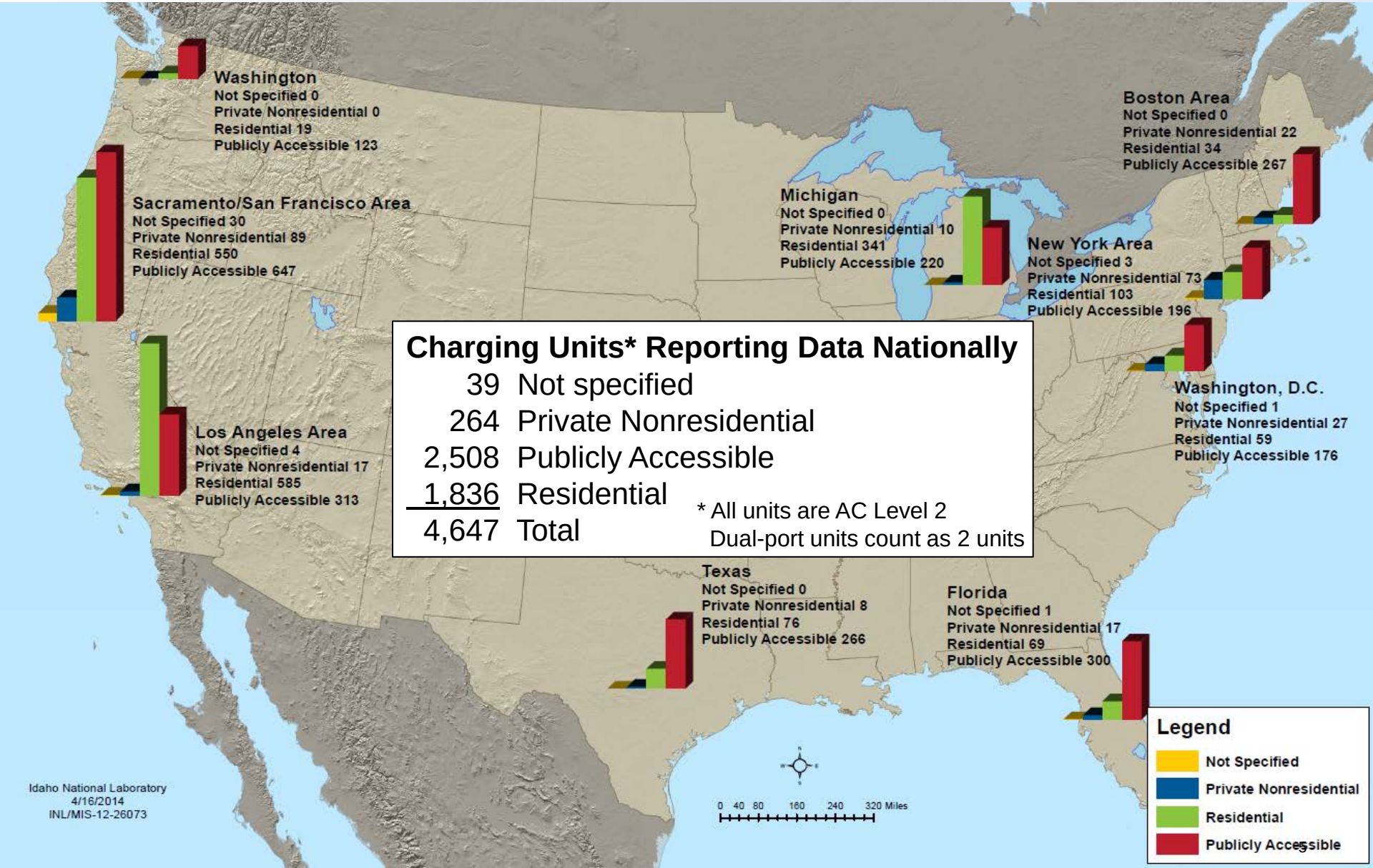
# Infrastructure Deployment in The EV Project through December 2013

Idaho National Laboratory



# Infrastructure Deployment in ChargePoint America through December 2013

Idaho National Laboratory



# *Workplace Charging Analysis*

- 250 work sites identified with workplace charging available
- 600+ Nissan Leafs and 100+ Chevrolet Volts in The EV Project who park at these sites
- 2012 – 2013

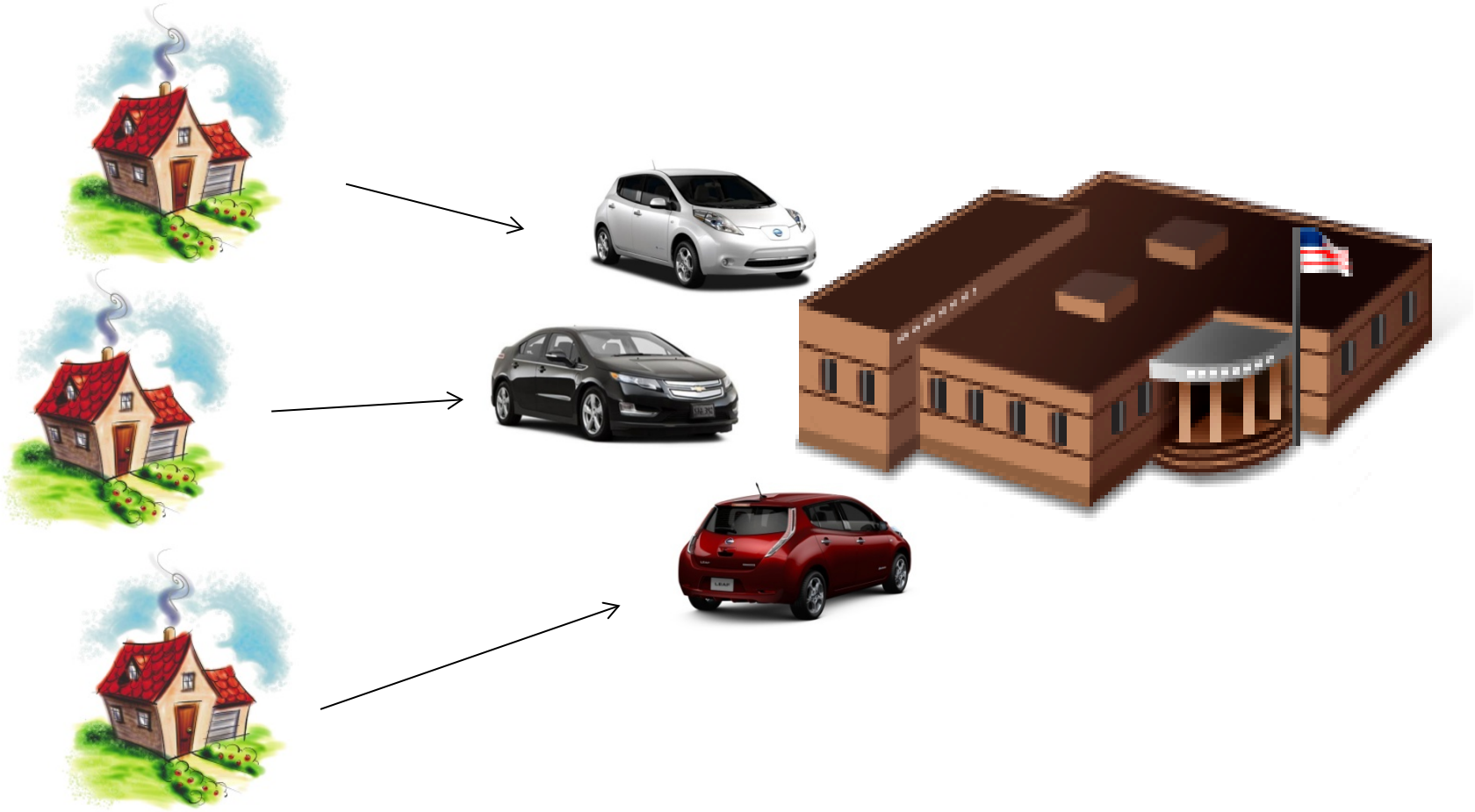
# *Workplace Charging Analysis*

3 ways to look at data

1. Charging station usage at a work site

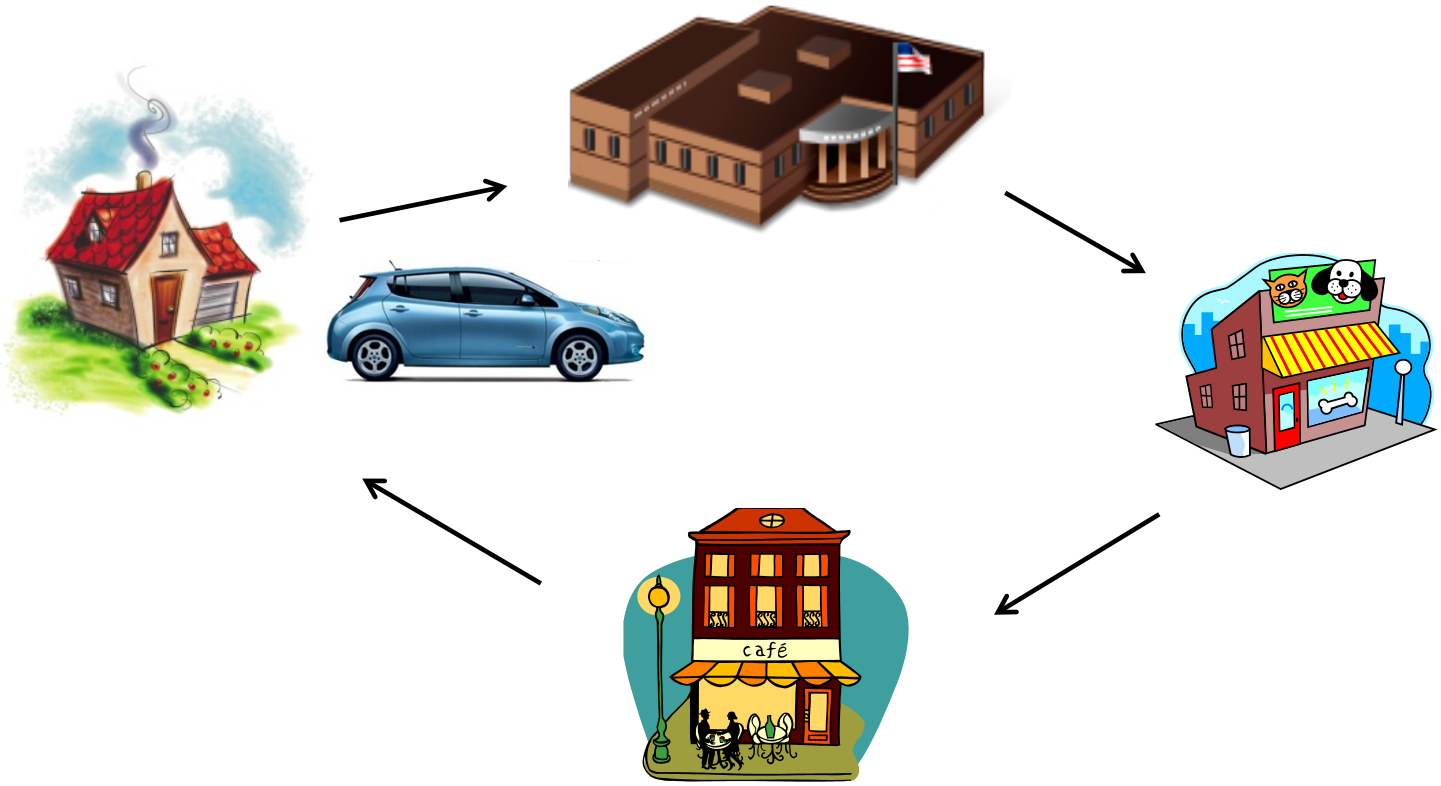
# Workplace Charging Analysis

2. Parking and charging at a work site by vehicles reporting data



# Workplace Charging Analysis

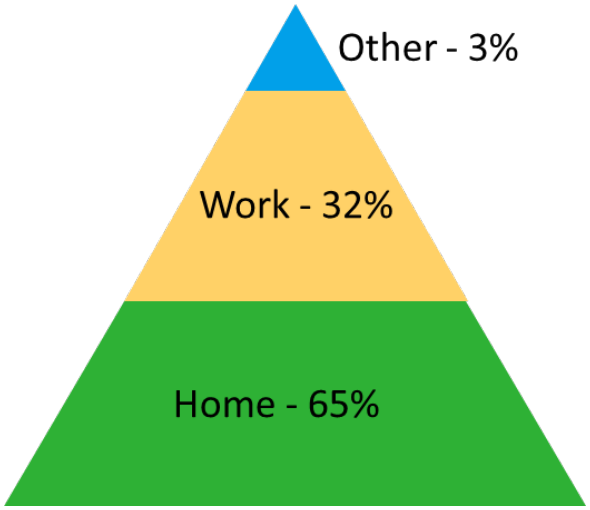
3. Vehicle driving and charging throughout the day



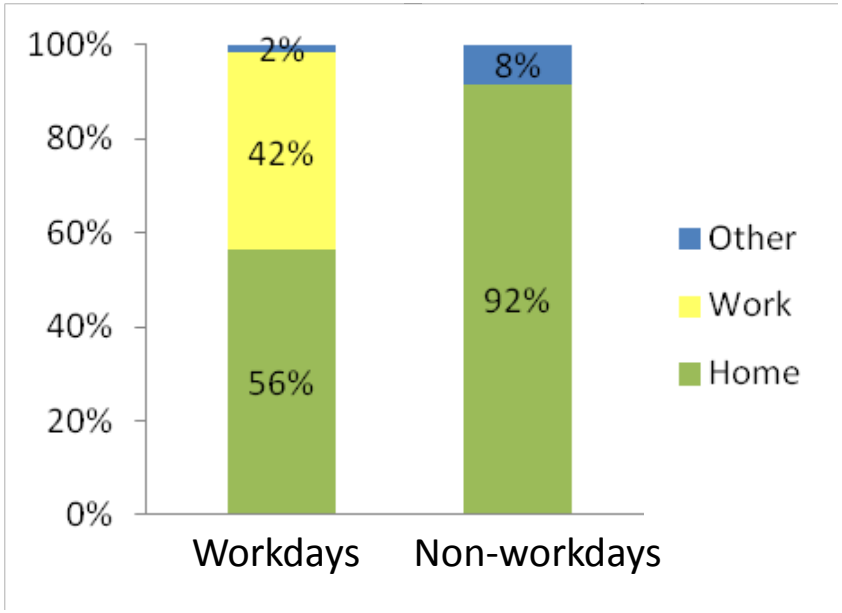
# *Where did PEV drivers with access to workplace charging choose to charge?*

Nissan Leafs

**Overall Charging Frequency by Location (to scale)**



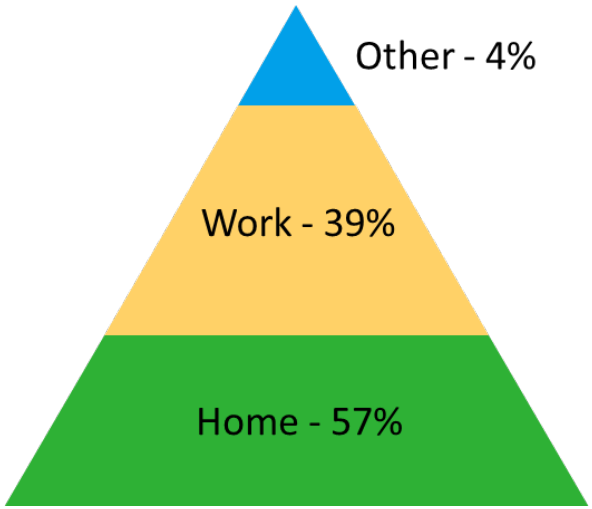

**Percent of Charging Events by Location and Day**



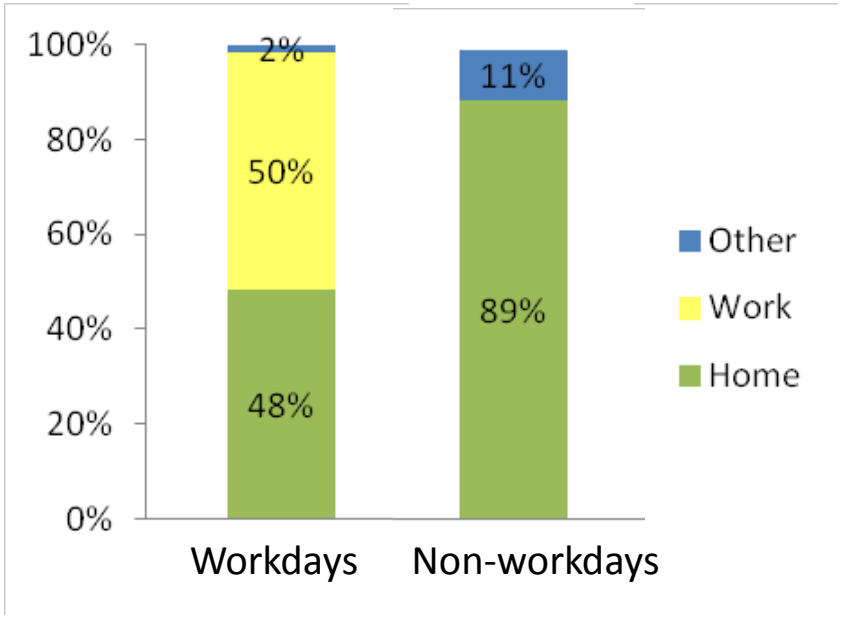
# *Where did PEV drivers with access to workplace charging choose to charge?*

Chevrolet Volts

**Overall Charging Frequency by Location (to scale)**




**Percent of Charging Events by Location and Day**

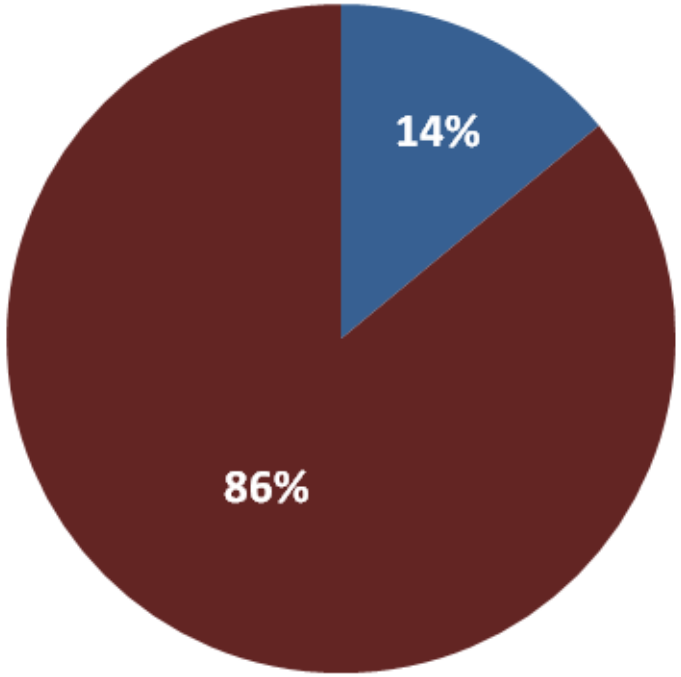


# How much did PEV drivers charge at work vs. home?

- Common assumption: If drivers have access to home and work charging, they will charge at home and “top off” at work

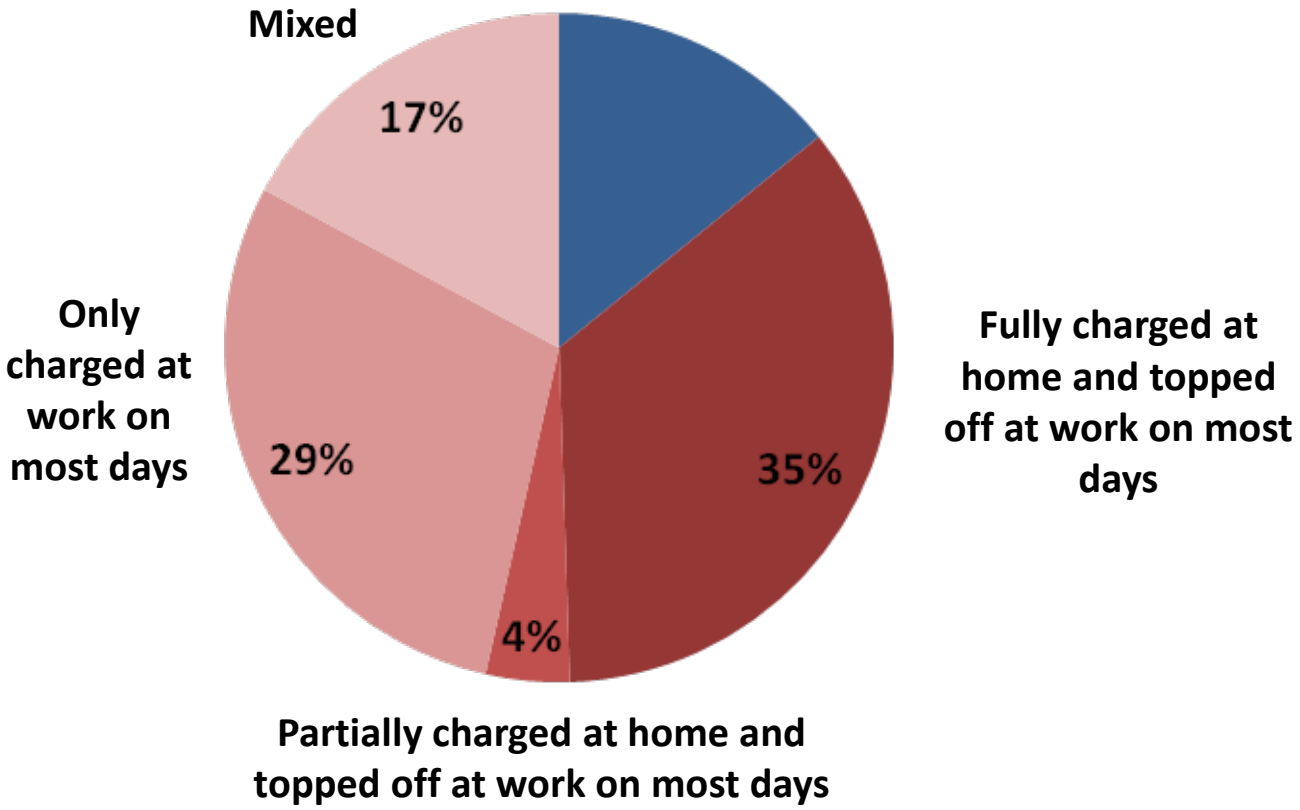
# How much did PEV drivers charge at work vs. home?

- 14% of Leafs studied needed to charge at work in order to complete their daily commute on most days
- On these days, they charged at home and topped off at work as expected



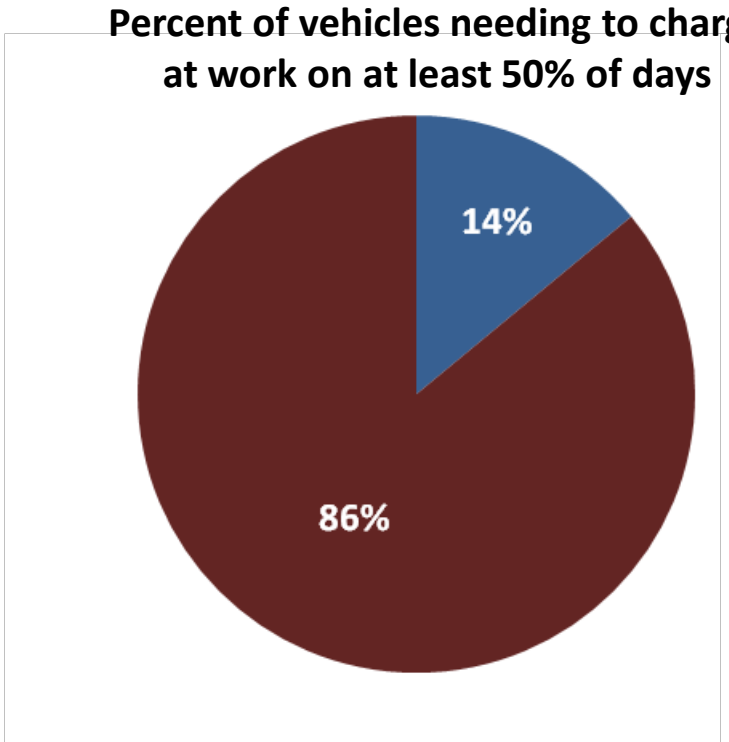
# How much did PEV drivers charge at work vs. home?

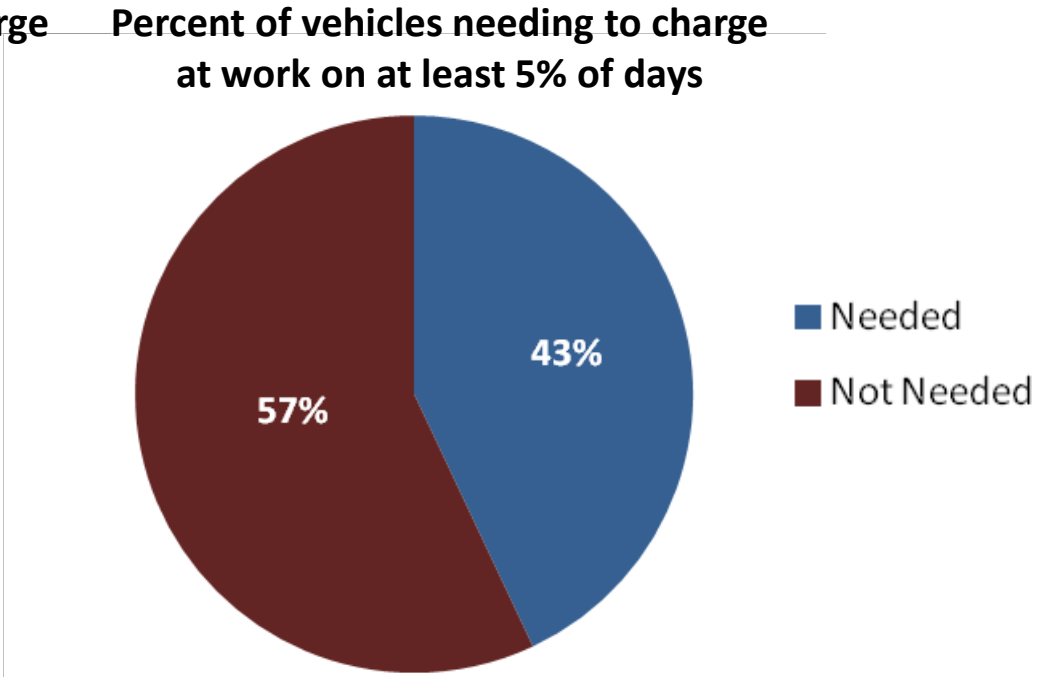
- Leaf drivers who did not need workplace charging on most days had varying behavior



# How many drivers needed to charged at work to complete their commutes?

- Assumption: if you need it, you need it; if you don't, you don't
- 14% of vehicles needed workplace charging to complete their daily driving on *most* days, but…
- 43% of vehicles needed workplace charging to complete their daily driving on *some* days



# *Does workplace charging increase electric vehicle miles traveled?*

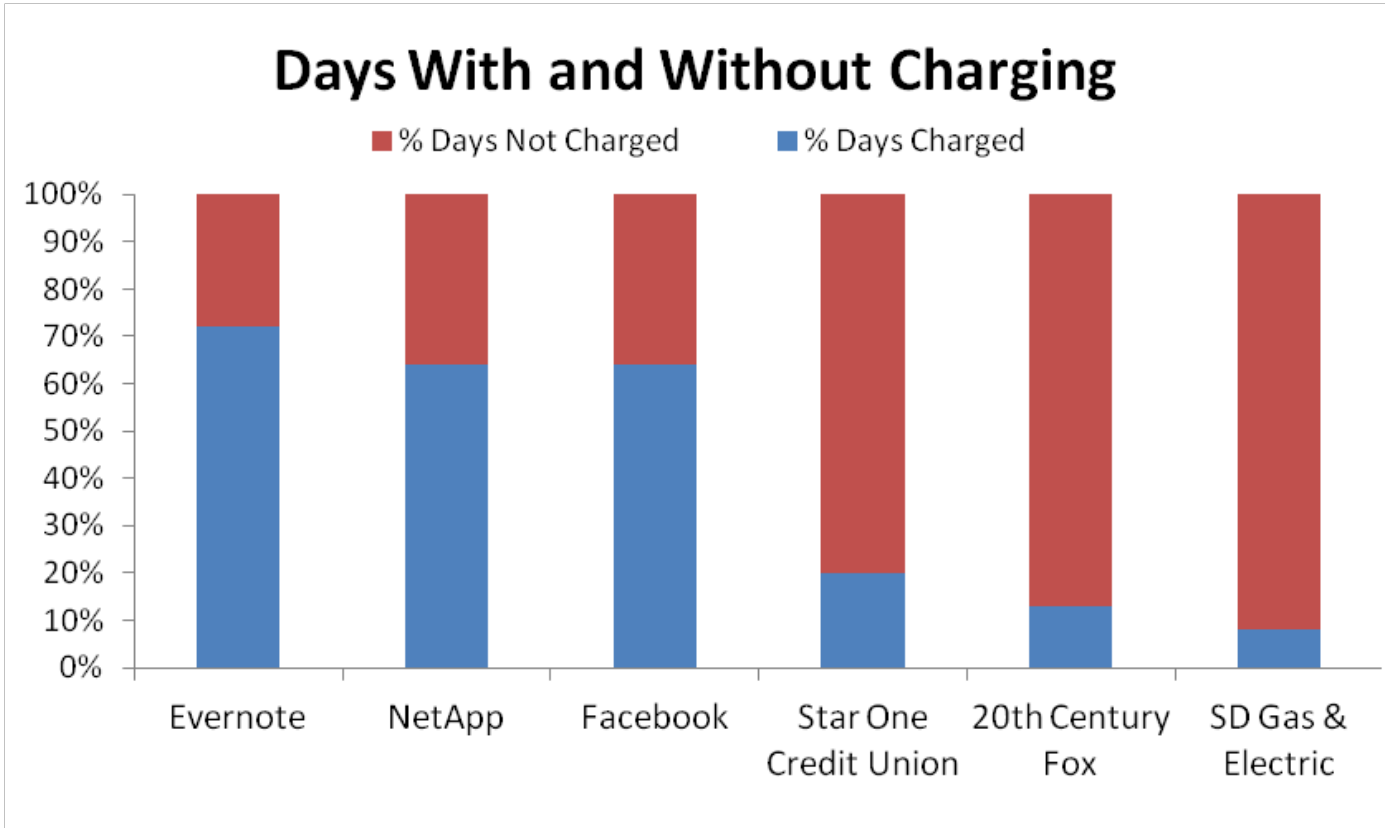
Yes!

- On days when Leaf drivers needed to charge at work, workplace charging extended their range by an average of 15 miles
- Round-trip commutes on these days averaged 73 miles

- On days when drivers did not need workplace charging but used it, they averaged 12% more miles than on days when they did not charge at work.

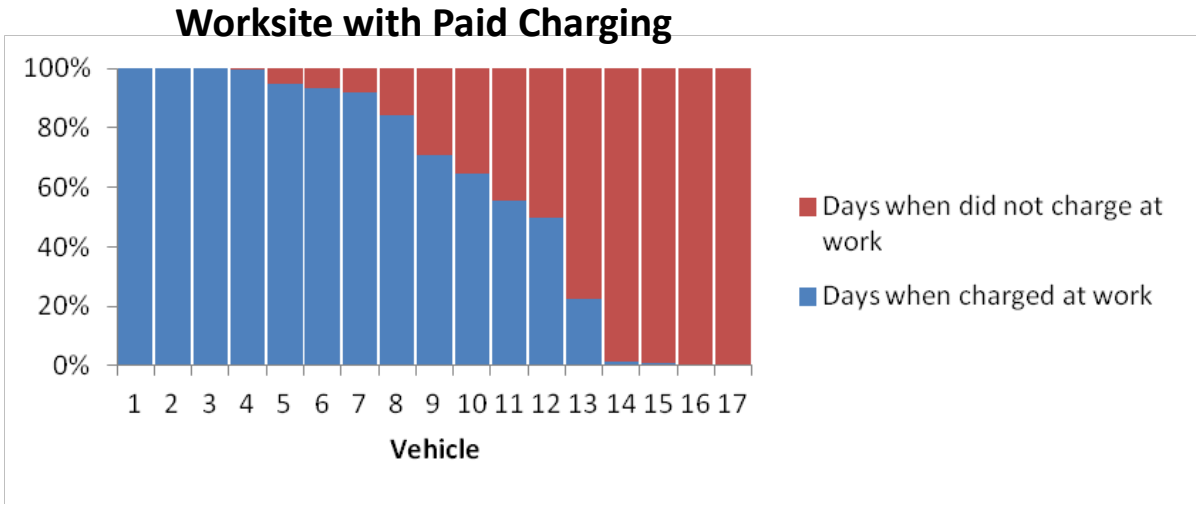
# How often did drivers charge at work?

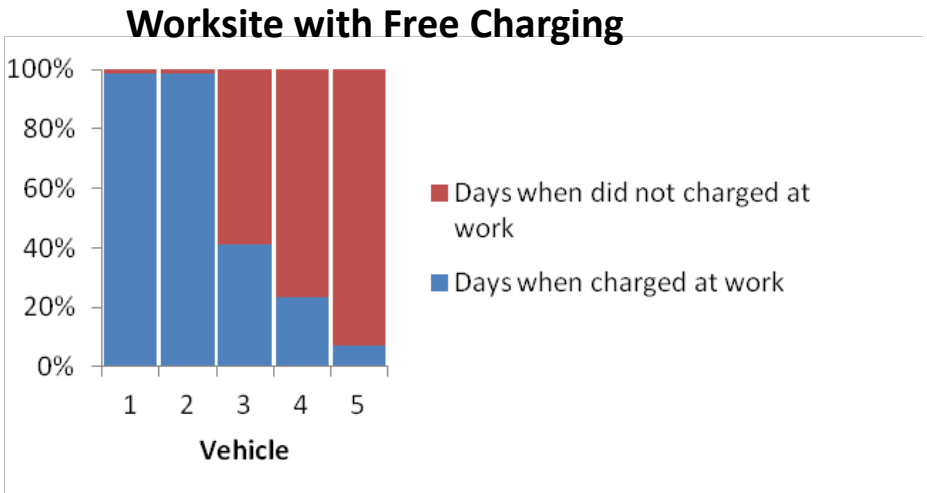
- Assumption: if they can charge at work, they will
- A study of Leaf and Volt parking and charging at 6 work sites showed dramatic differences from site to site…



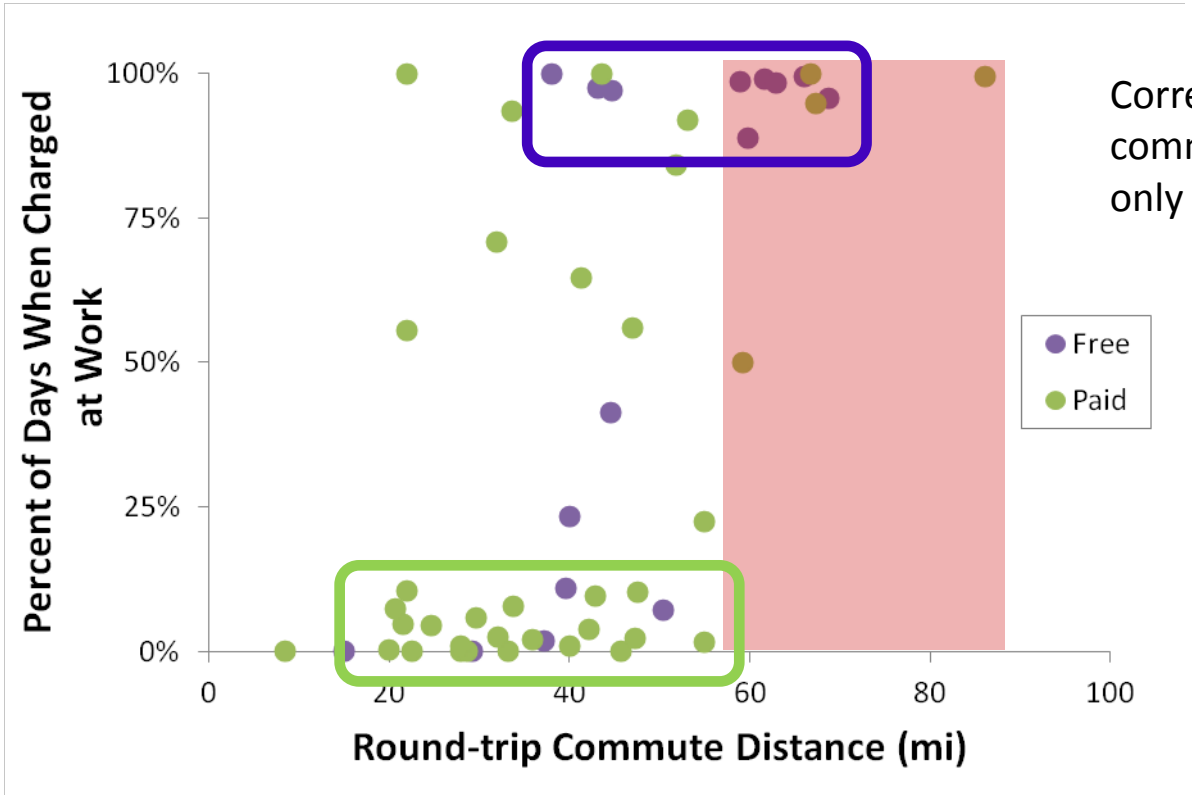
# How often did drivers charge at work?

- … and from vehicle to vehicle at the same site



# What determines whether drivers will charge at work?




Correlation to commute distance only on high end

Some correlation to free/cost

Ratio of vehicles to charging units, policy for use, and other factors also matter also – see paper

From 47 Leafs, 5 Volts at 6 worksites

# *Which is better: AC Level 1, Level 2, or DC Fast Chargers*

- Know your vehicles – charge power varies by vehicle
  - Toyota Prius Plug-in charges at only 2 kW
  - Thus far, only BEVs can use DCFC and connectors differ
- L2:
  - Can charge multiple vehicles per day
  - Provides option of managing load
- L1:
  - Employees can plug in and forget it
  - Cheaper equipment but probably same to install
  - Lower overall electricity demand
- DCFC:
  - Provides flexibility, good for “emergencies”
  - Expect visitors
  - Expensive (but do the math)

# *What policy should employers adopt to manage charging?*

It depends on your goals!

For more information, visit

avt.inl.gov/evproject.shtml

Lessons learned white papers related to workplace charging:

- Where do Nissan Leaf drivers in The EV Project charge when they have the opportunity to charge at work?
- Where do Chevrolet Volt Leaf drivers in The EV Project charge when they have the opportunity to charge at work?
- Workplace Charging Case Study: Charging Station Utilization at a Work Site with AC Level 1, AC Level 2, and DC Fast Charging Units
- Workplace Charging Behavior of EV Project Drivers at Six Work Sites (in review)
- Driving and Charging Behavior of Nissan Leaf Drivers in The EV Project With Access to Workplace Charging (in review)

INL's funding for this work comes from
DOE's Vehicle Technologies Office