Idaho National Laboratory

U.S. Department of Energy's Vehicle Technologies Program -

Electric Drive Vehicle Deployment Data Collection and Testing Activities

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Project Get Ready – Webinar
May 18, 2011

Presentation Outline

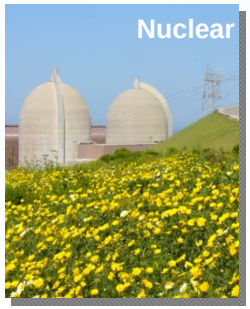
- INL and AVTA (DOE) Participants and Goals
- AVTA Background – Vehicle Testing
- ECOtality North America Background
- EV Project Micro Climate
  - Overview / Participants
  - Plan / Approach
  - Charging Infrastructure
- EV Project and Overall Data Collection Rational
- PHEV Conversion (Hymotion) Data Collection Examples
- EV Project Data Collection Parameters
- EV Project Reporting Parameters
- Acknowledgements

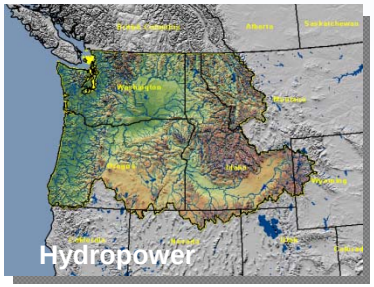
AVTA Participants and Goals

- **Participants**
  - **The Advanced Vehicle Testing Activity (AVTA) is part of DOE's Vehicle Technologies Program, within DOE's EERE**
  - **The Idaho National Laboratory (INL) and ECOtality North America (ECO) conduct the AVTA per DOE guidance**
  - **100+ fleets and organizations as testing partners**
- **The AVTA goals:**
  - **<u>Petroleum reduction and energy security</u>**
  - **Provide benchmark data to technology modelers, research and development programs, vehicle manufacturers (via VSATT), and target and goal setters**
  - **Assist fleet managers in making informed vehicle and infrastructure purchase, deployment and operating decisions**

Idaho National Laboratory

- Eastern Idaho based U.S. Department of Energy (DOE) Federal laboratory
- 890 square mile site with 4,500 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
  - Energy Critical Infrastructure Protection





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THE EV Project

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Vehicle Testing Experience

- **Plug-in hybrid electric vehicles: 14 models, 430 PHEVs, 5+ million (ml) miles**
- **Extended Range Electric Vehicles: 1 model, 150 EREVs, 400+ thousand (k) miles**
- **Hybrid electric vehicles: 19 models, 50 HEVs, 6+ ml miles**
- **Micro hybrid vehicles: 3 models, 7 MHVs, 200+ k miles**
- **Neighborhood electric vehicles: 24 models, 372 NEVs, 200k miles**
- **Hydrogen internal combustion engine vehicles, 7 models, 18 HICEVs, 500k miles**
- **Battery electric vehicles 47 models, 2,300 BEVs, 5+ million miles (includes 500+ USPS BEVs)**
- **Urban electric vehicles: 3 models, 460 UEVs, 1 million miles**
- **18+ million test miles accumulated on 2,300 electric drive vehicles representing 110 models**

ECOtality Background

- Established in 1996 (Phoenix Arizona), aka eTec
- Markets
  - On-Road EVs/PHEVs
    - Turn-key Infrastructure Service
    - Plug-In Vehicle Testing
    - OEM Engineering/Testing
  - Airline eGSE Charging Infrastructure
    - 12 Years Experience / 13 Airports
  - Industrial Applications
    - Minit-Charger Brand
  - Low Speed Vehicles (LSV)
    - Neighborhood electric vehicles (NEV)
    - Utility electric vehicles
  - Consulting/Engineering Services
    - Battery Cycling and Development
    - Product Development Programs
    - U.S DOE AVTA Primary Contractor
  - Hydrogen Infrastructure and HICE Vehicle Development & Conversions

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The EV Project

- **$230 million project**
  - **$115 million grant from US Dept. of Energy**
  - **$115 million match**
- **Purpose: To plan, build, study, and evaluate mature electric vehicle charging infrastructure in six states plus the District of Columbia**
- **Product: Lessons learned**

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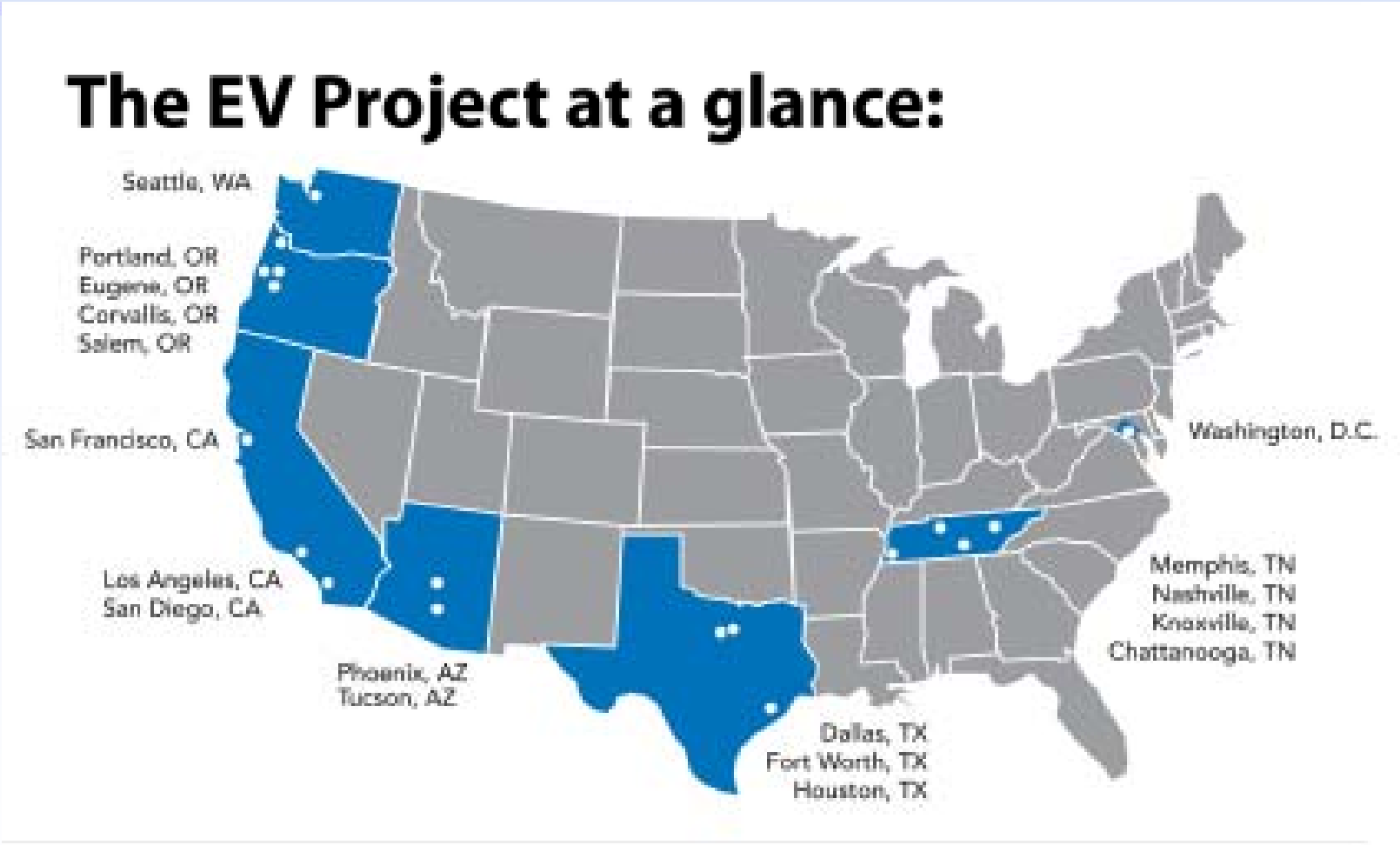
The EV Project Participants



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EV Project Micro-Climate Plan

Structured program to make regions “plug-in ready”

1) Community Planning

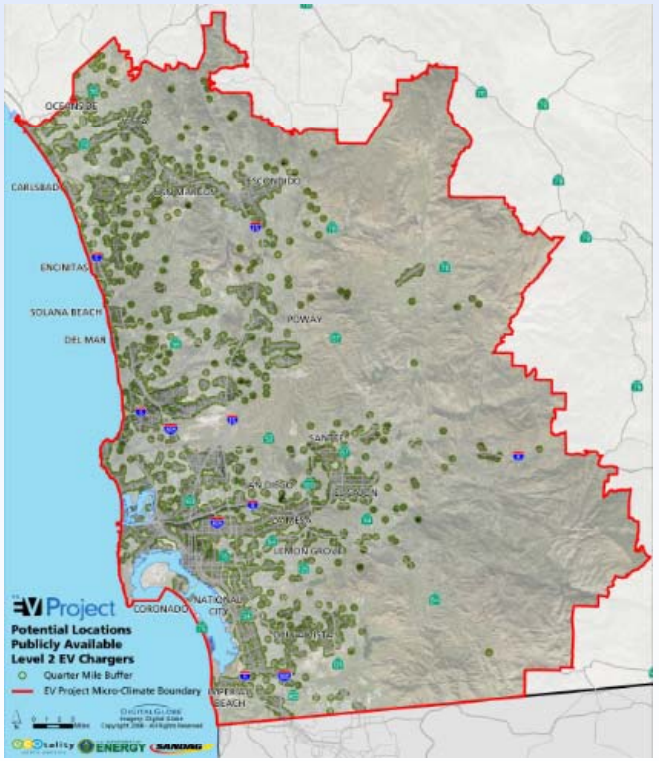
- Deployment Guidelines & Stakeholder Organization
- Long Range Plan (10 years)
- Micro-Climate Plan (1-3 years)

2) Road Mapping

- 1-3 year action plan
- Systematic GIS mapping

3) Infrastructure Implementation

- Deployment of EV charge stations
- Targets scalable national accounts
- Implement sustainable business models



EV Micro-Climates©

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EV Project Residential Infrastructure

- **Deploy 8,300 battery electric vehicles**
  - **5,700 Nissan Leaf battery EVs**
  - **2,600 Chevrolet Volt extended range EVs**
- **Install 8,300 level 2 residential EVSE**

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EV Project Commercial Infrastructure

- Deploy ~5,300 level 2 EVSE
  - Retail locations
  - Municipal locations
  - Employer locations
- Deploy 200 Dual Port DC Fast Chargers

EV Project Data Collection & Reporting

Vehicle Data

EV

Nissan GDC
GM OnStar

INL

EVSE Data

EVSE

ECOtality Data Center

INL

MATCH

- EV Project Participant
- EV Project Participant
- Non EV Project Participant

- Non EV Project EVSE
- EV Project EVSE
- EV Project EVSE

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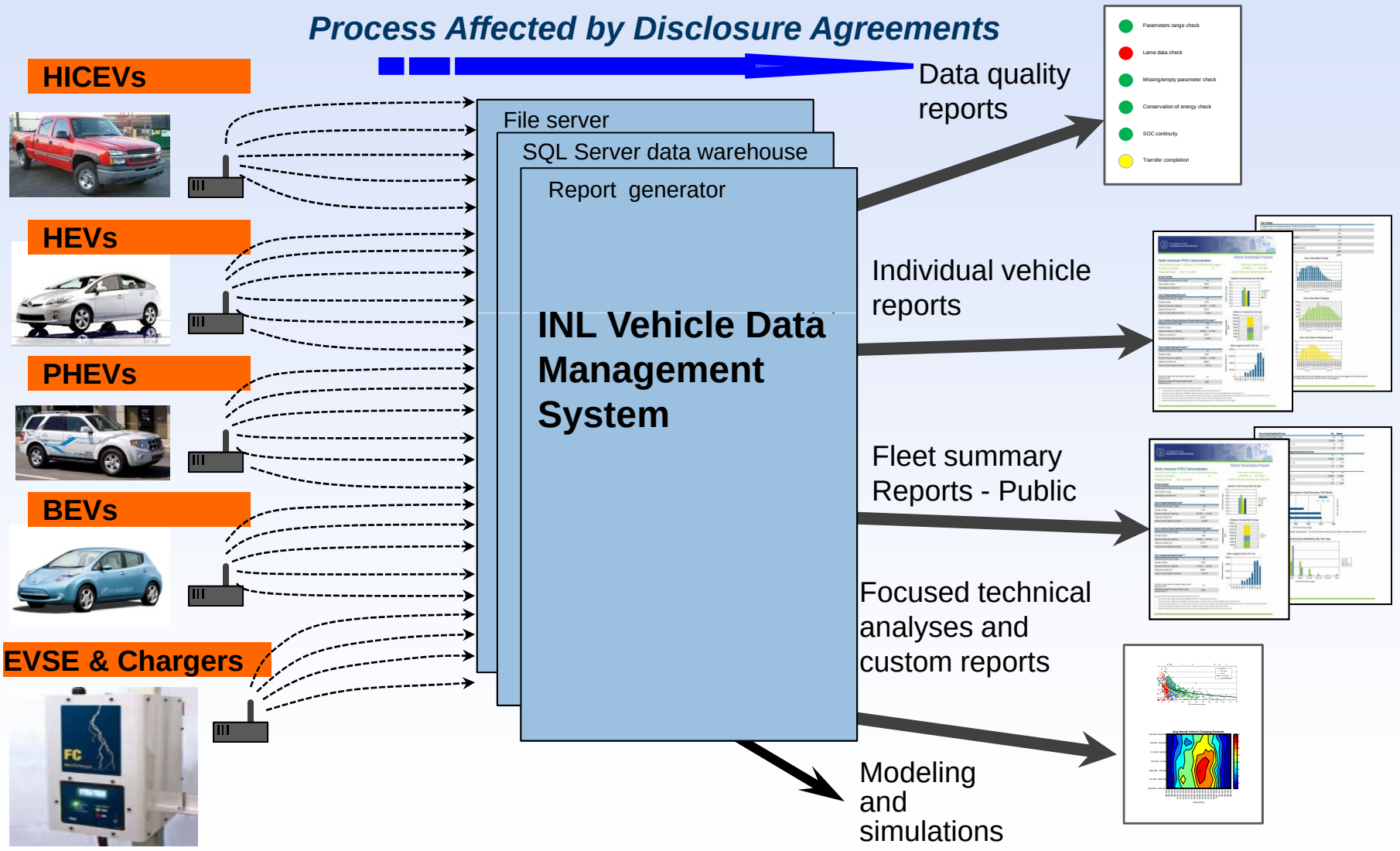
EV Project & Overall Data Collection Rational

- **Document electric drive vehicle technologies' ability to reduce petroleum use by collecting data on:**
  - **Vehicle performance**
  - **Operational profiles and ambient conditions**
  - **Charging profiles**
- **Document fueling infrastructure technology, including:**
  - **Sitting**
  - **Use**
  - **Time-of-day pricing**
  - **Charging level (I, II, fast charging) utilization**
  - **Public vs. private charging**
  - **At-home vs public charging**
  - **Micro versus macro grid issues / impacts**

EV Project & Overall Data Rational – cont'd

- **Quantified testing results that avoid subjective reporting results**
  - **No "best" or "worst" results**
  - **Only "highest" or "lowest", or "longest" or "shortest" achieved by reporting testing numbers**
  - **Minimize subjective and maximize quantitative measurements**

INL Vehicle Data Management Process



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INL ARRA / TADA Data Collection Support

- **INL tasked with data collection, analysis and reporting for charging infrastructure and light-duty vehicle ARRA and other DOE demonstrations:**
  - **EV Project: 8,300 Leaf EVs and Volt EREVs, and 15,300 ECOtality / Blink Level 2 EVSE and fast chargers. Data logging (DL) on all 23,600 pieces of equipment**
  - **140 Chrysler Ram PHEV Pickups with DL**
  - **150 General Motors EREV Volts with DL**
  - **21 Ford Escape PHEV SUVs with DL**
  - **4,000 Level 2 EVSE deployed by Coulomb with DL**
- **INL, and OEM and EVSE partners collecting real-time data**
- **Raw data and personal information protected by NDAs (Non Disclosure Agreements)**

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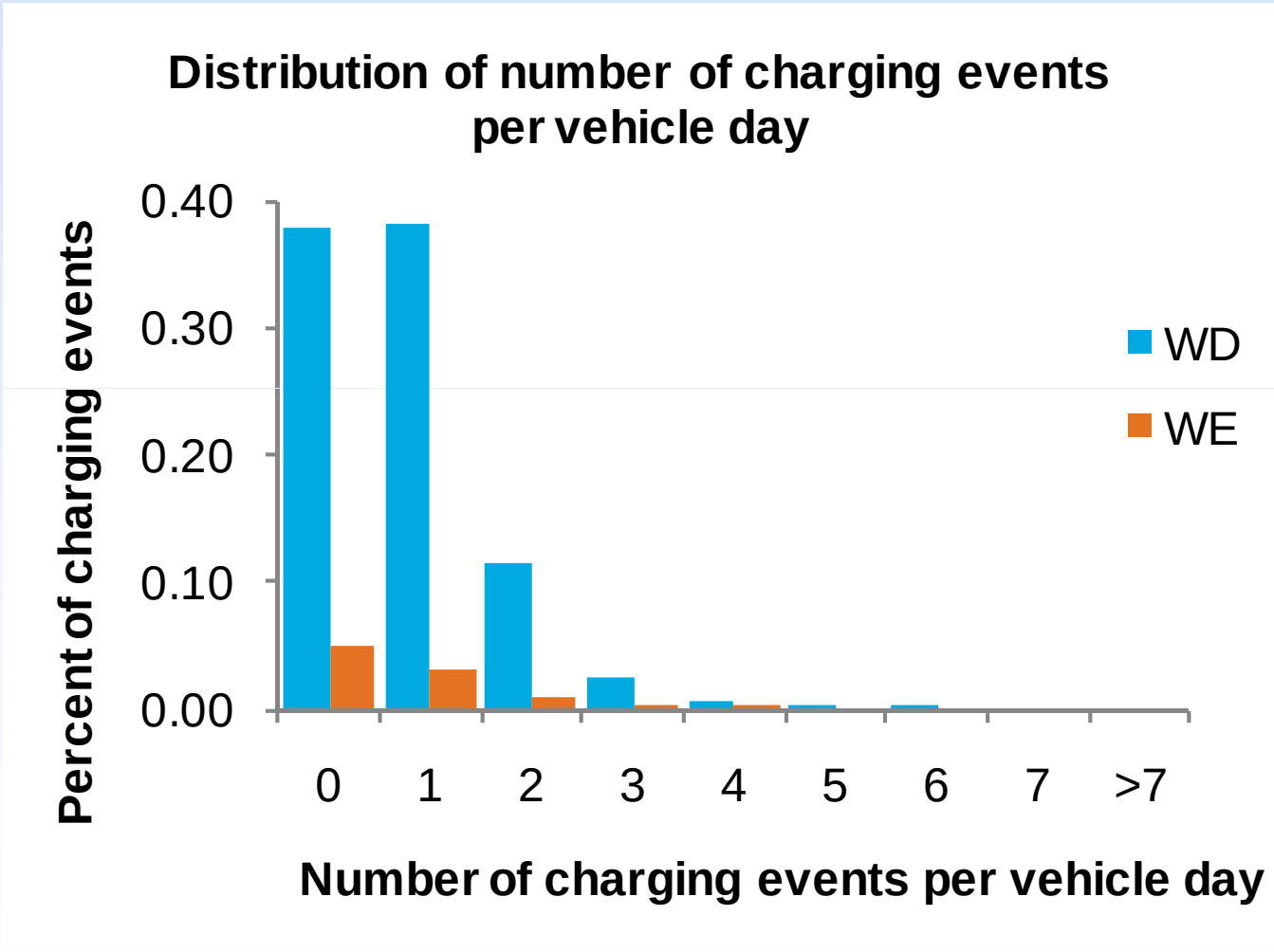
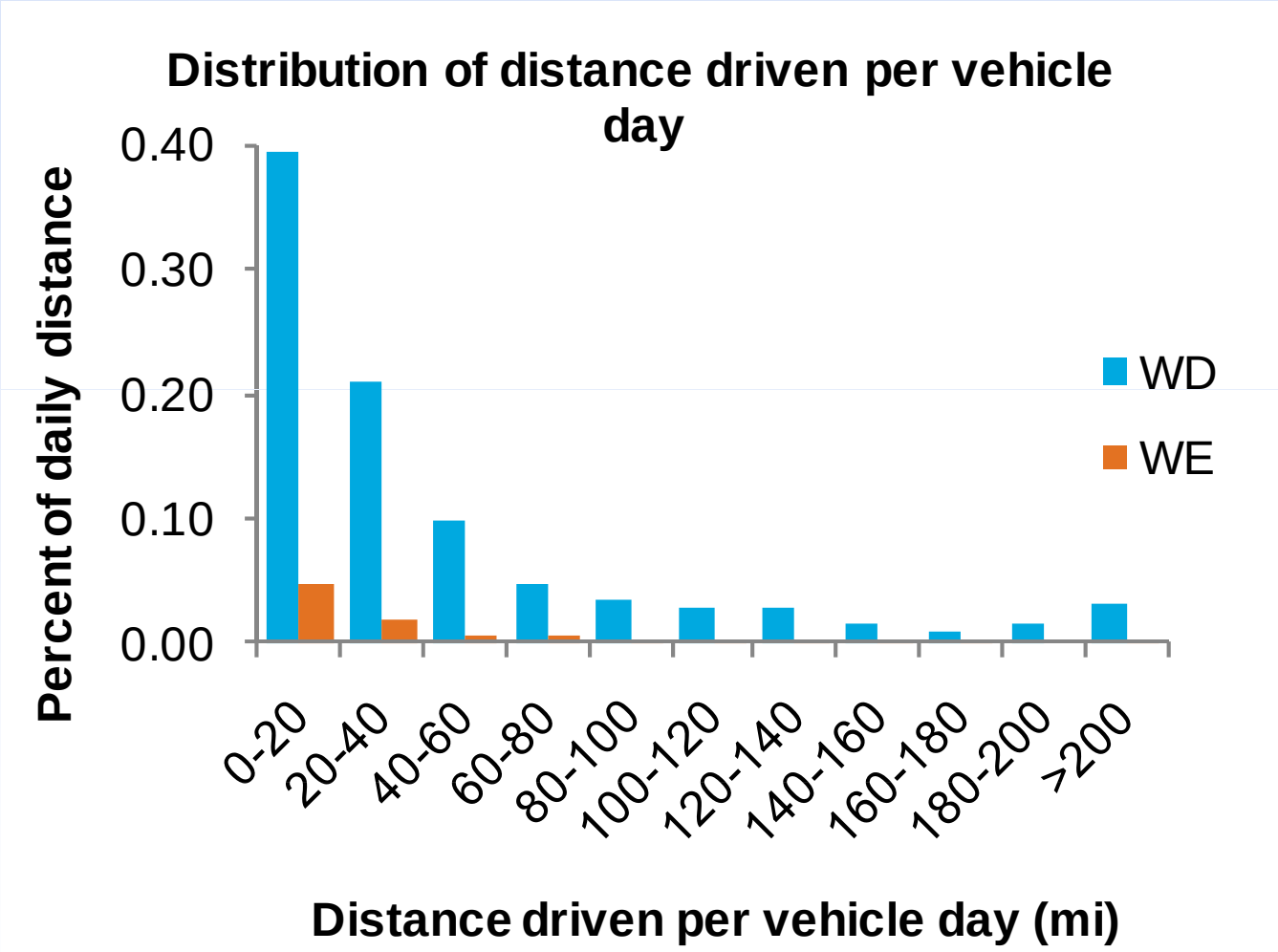
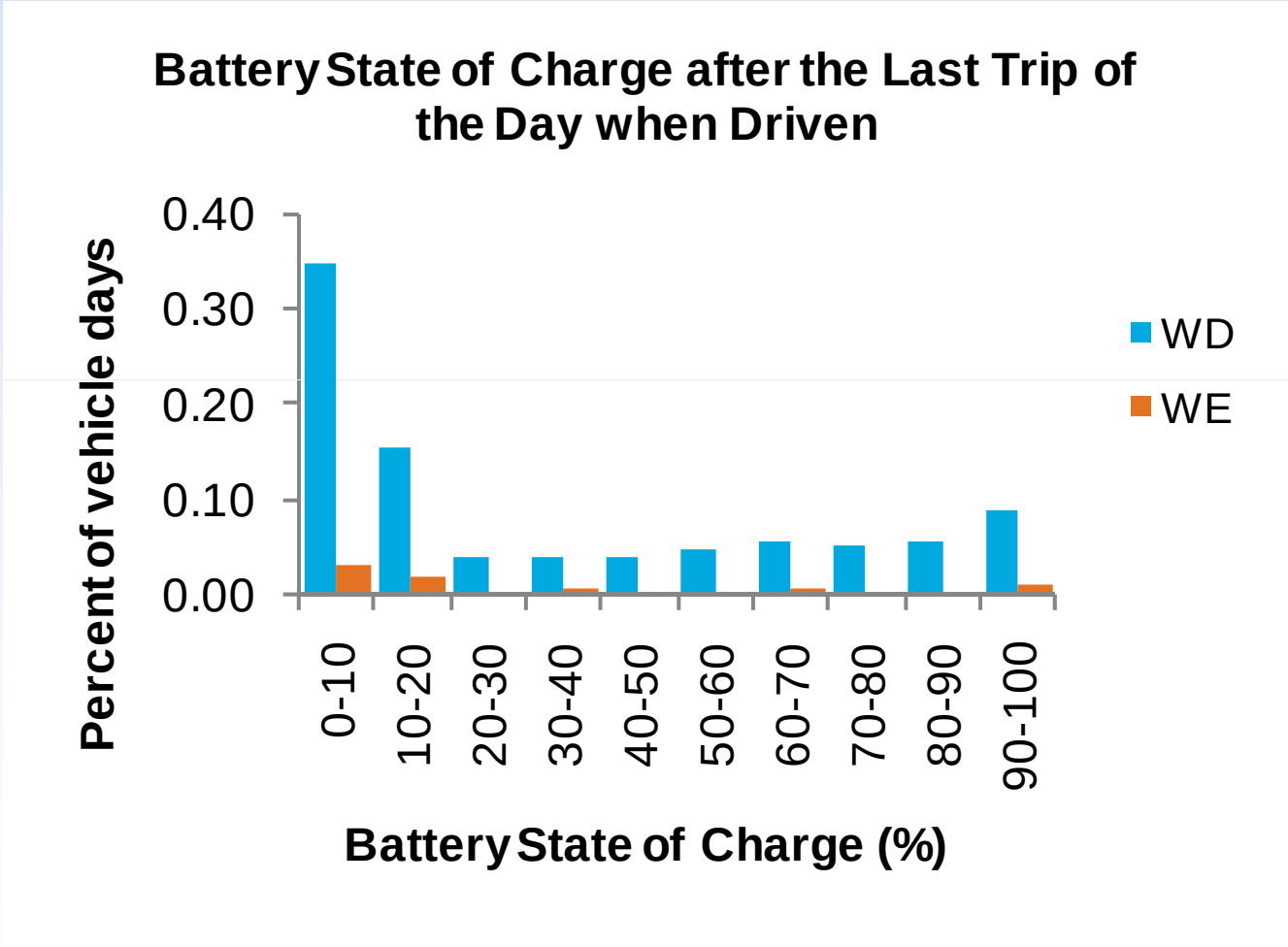
PHEV Conversions Data Collection Examples



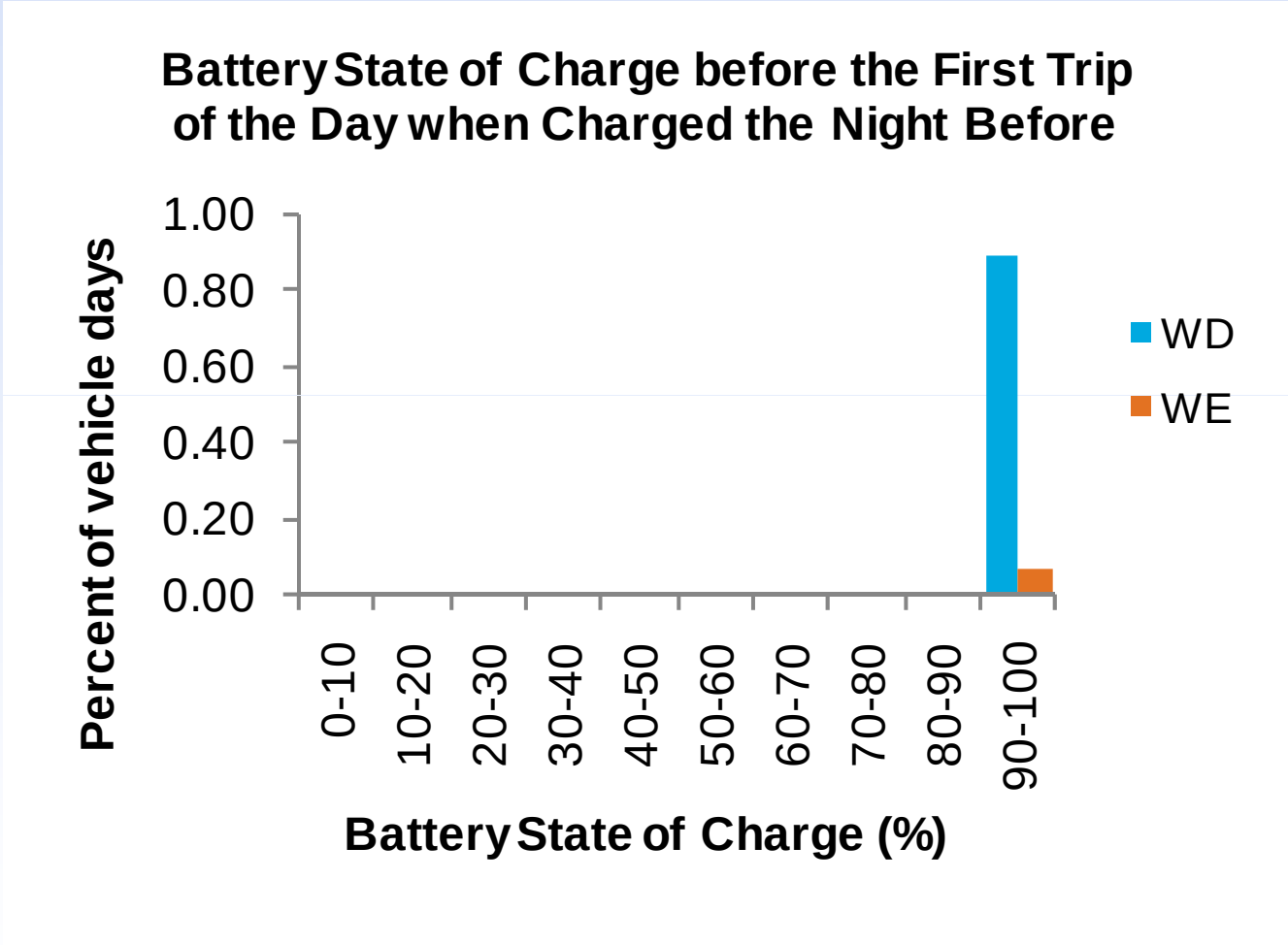
PHEV Conversions Data Examples – cont'd



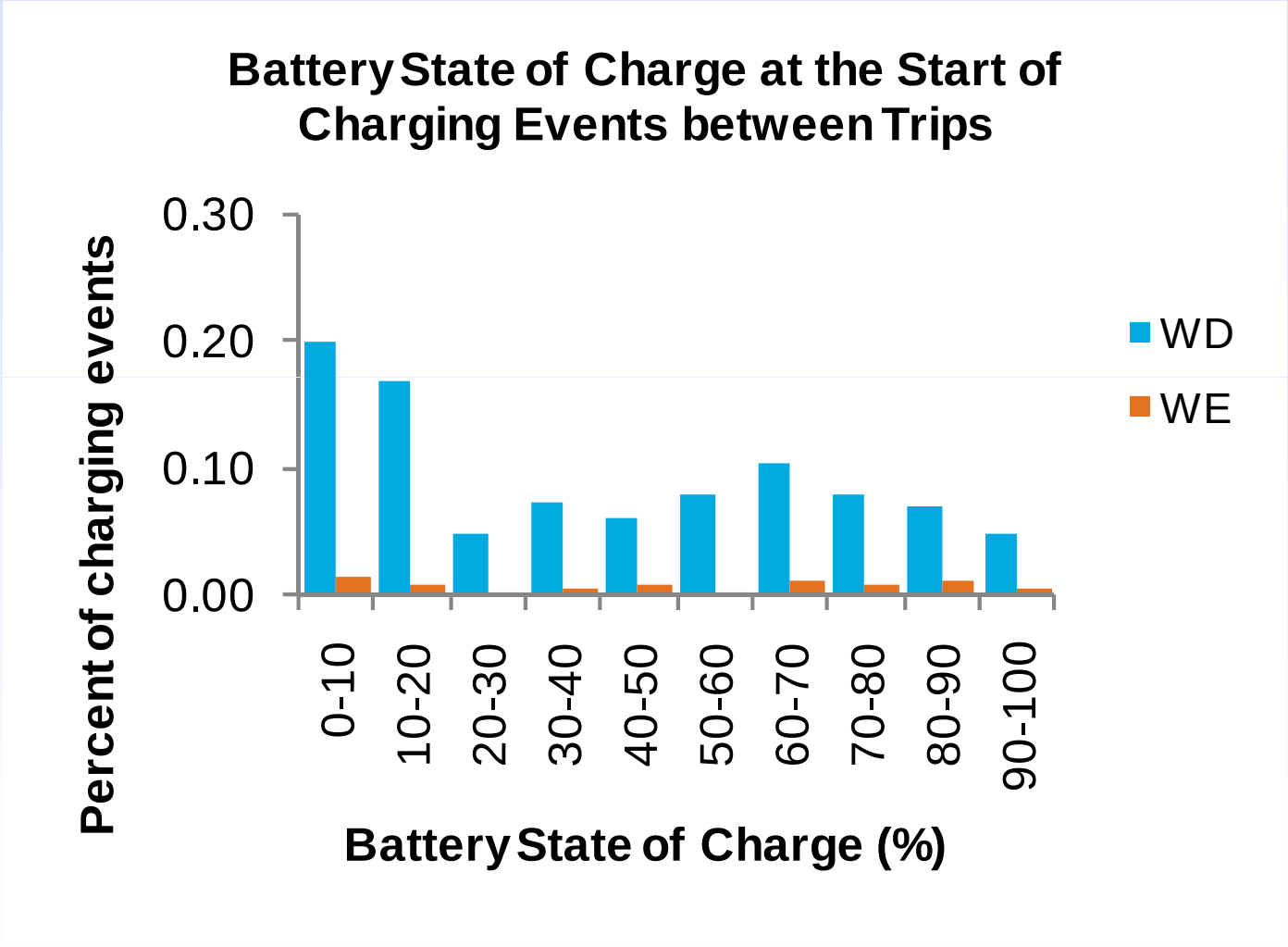
PHEV Conversions Data Examples – cont'd



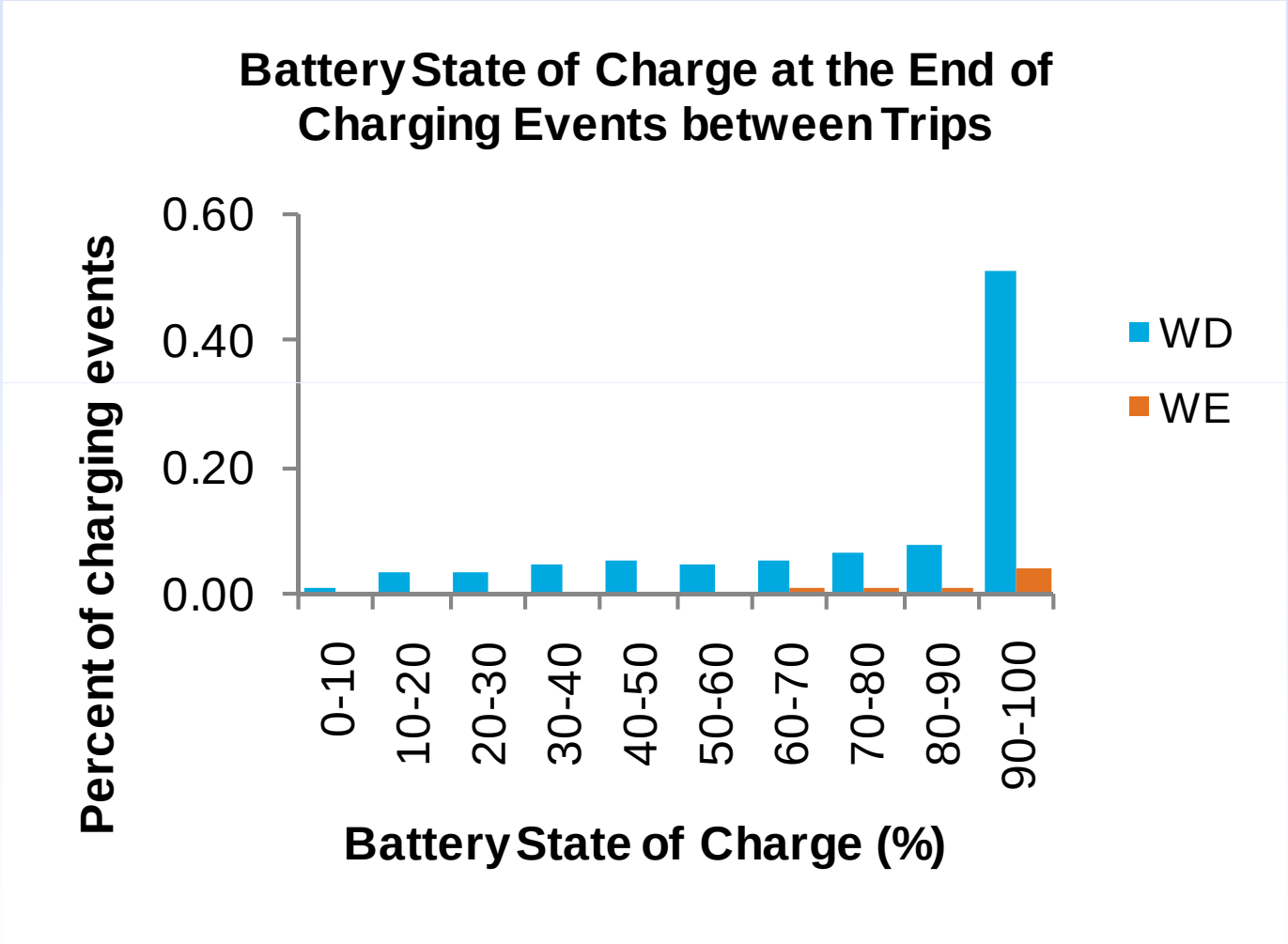
PHEV Conversions Data Examples – cont'd



PHEV Conversions Data Examples – cont'd



PHEV Conversions Data Examples – cont'd



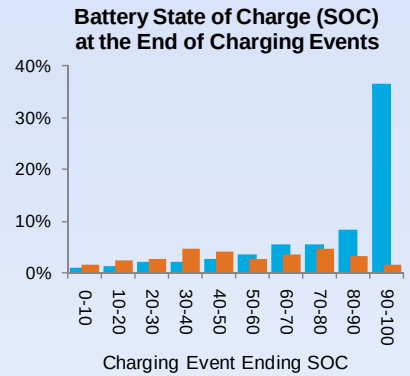
EV Project – Infrastructure Data Parameters Collected per Charge Event

- Date/Time Stamp
- Unique ID for Charging Event
- Unique ID Identifying the EVSE – may not change
- Connect and Disconnect Times
- Start and End Charge Times
- Max Instantaneous Peak Power
- Average Power
- Total energy (kWh) per charging event
- Rolling 15 Minute Average Peak Power
- And other non-dynamic EVSE information (GPS, ID, type, contact info, etc.)

EV Project – Vehicle Data Parameters Collected per Start/Stop Event

- Vehicle ID
- Date/Time Stamp
- Event type (key on / key off)
- Odometer
- Battery state of charge
- GPS (longitude and latitude)
- Fuel consumption (some vehicles)
- Recorded for each key-on and key-off event

EV Project – Nissan Leaf Usage Reports



- Vehicle Usage
  - Number of Trips
  - Total distance traveled (miles)
  - Average distance per day when driven
  - Average number of trips between charging events
  - Average distance traveled between charging events
  - Average number of charging events per day when a vehicle was driven
- Charging Location and Type
  - Number of charging events by home (Level 2) and away-from-home (Level 2, fast charge, non-project)
  - Total time plugged in (hours)
  - Total electricity consumed (AC MWh)

EV Project – Nissan Leaf Use Rpts – cont'd

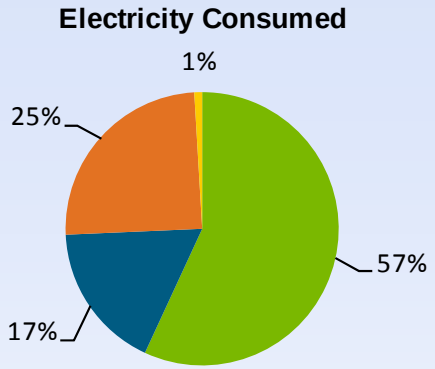
- **Charging Completeness**
  - **Number of complete charging events by home (Level 2) and away-from-home (Level 2, fast charge, non-project)**
  - **Number of partial charging events by home and away**
  - **Graphically, home and away from home battery state of charge (SOC) at start of charging events**
  - **Graphically, home and away from home battery state of charge (SOC) at end of charging events**
- **Future: 39 (Volt) and 47 (Leaf) metrics and plots, including:**
  - **Percent of distance driven in charge depleting vs. charge sustaining mode (Volt only)**

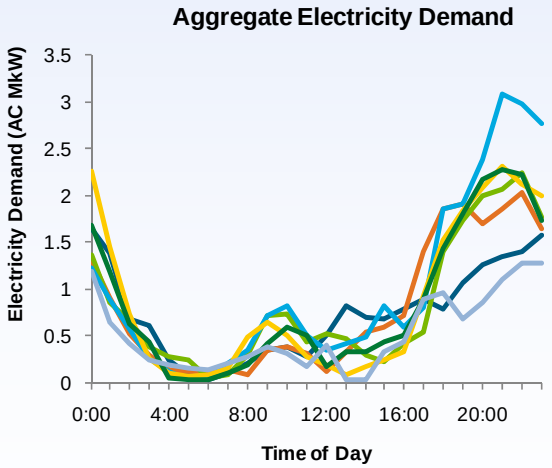
EV Project Overview Report

- Charging infrastructure reported by regions (MSA and states)
  - Number of EV Project EVSE and fast chargers installed
  - Number of charging events performed
  - Electricity consumed (AC MWh)
- Vehicles reported by regions (MSA and states)
  - EV Project Leafs and Volts enrolled to date
  - Number of trips
  - Distance driven

Future EV Project Activities - Infrastructure Usage Report

- 117 metrics and plots, including:
  - Charging unit utilization
  - Aggregate charging demand vs. time of day and day of the week
  - Individual charging event metrics
    - How often, how long, how empty, how full
  - Reporting by various subgroups





EV Project Data Collection Summary

- Utilize a systematic process for planning and installing charging infrastructure
  - Document travel patterns
  - Document charging patterns
- Provide feedback on infrastructure deployment decisions
- Successful grid connected electric drive vehicle deployment is dependent on successful infrastructure deployment
- Future charging infrastructure deployments must be based on real-world travel and charging patters
- Replace internal combustion engine vehicles with grid connected, and infrastructure dependant, electric drive vehicles

Acknowledgement

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

More Information

- **EV Project: www.theevproject.com**
- **ECOtality North America: www.ecotalityna.com**
- **Advanced Vehicle Testing Activity: http://avt.inl.gov**

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