THE EV Project

Lessons Learned – Deployment Barriers

EUEC 2013

Session E8

Donald Karner
ECOtality North America

January 30, 2013

ECOtality

- Publicly Traded Company [NASDAQ:ecty]
  - Formed in 1989
- Advanced vehicle testing and evaluation
  - 12+ million miles of advanced vehicle testing
  - Electric, CNG, hydrogen, diesel
- Industrial vehicle infrastructure
  - 6,000+ chargers installed
  - Distribution warehouses, factories and airports
- On road infrastructure
  - Planning, engineering, construction, operation, maintenance
  - EV Project

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EV Project Objectives

- Identify Infrastructure Deployment Barriers
- Demonstrate Infrastructure Technologies
- Evaluate Infrastructure Business Models
- Develop Guidance For Future Infrastructure Deployment

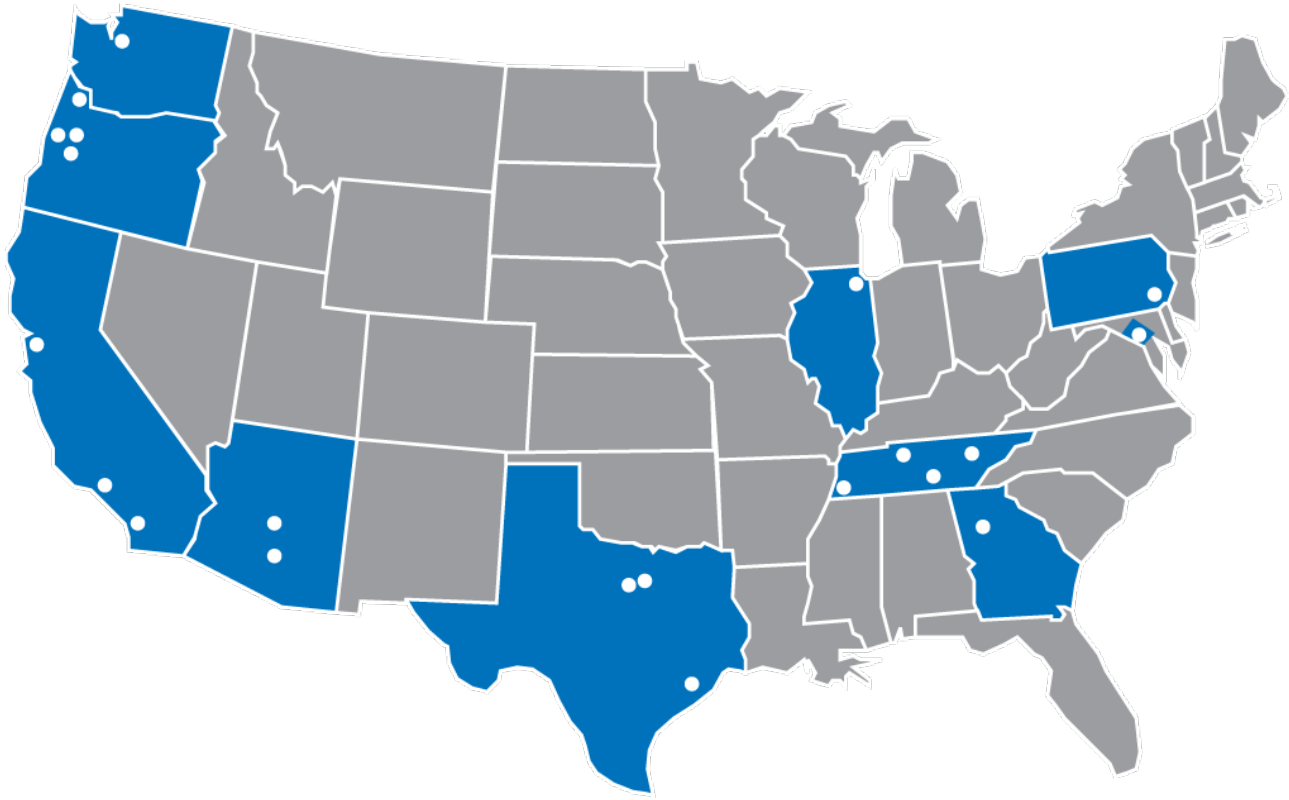
EV Project Deployment

60+ EV Project Partners Include:

U.S. DEPARTMENT OF ENERGY

NISSAN

INL Idaho National Laboratory



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Blink Chargers

- Smart UI
- Internet Connectivity
- Energy/Power Metering
- Access Control
- Business Model Support

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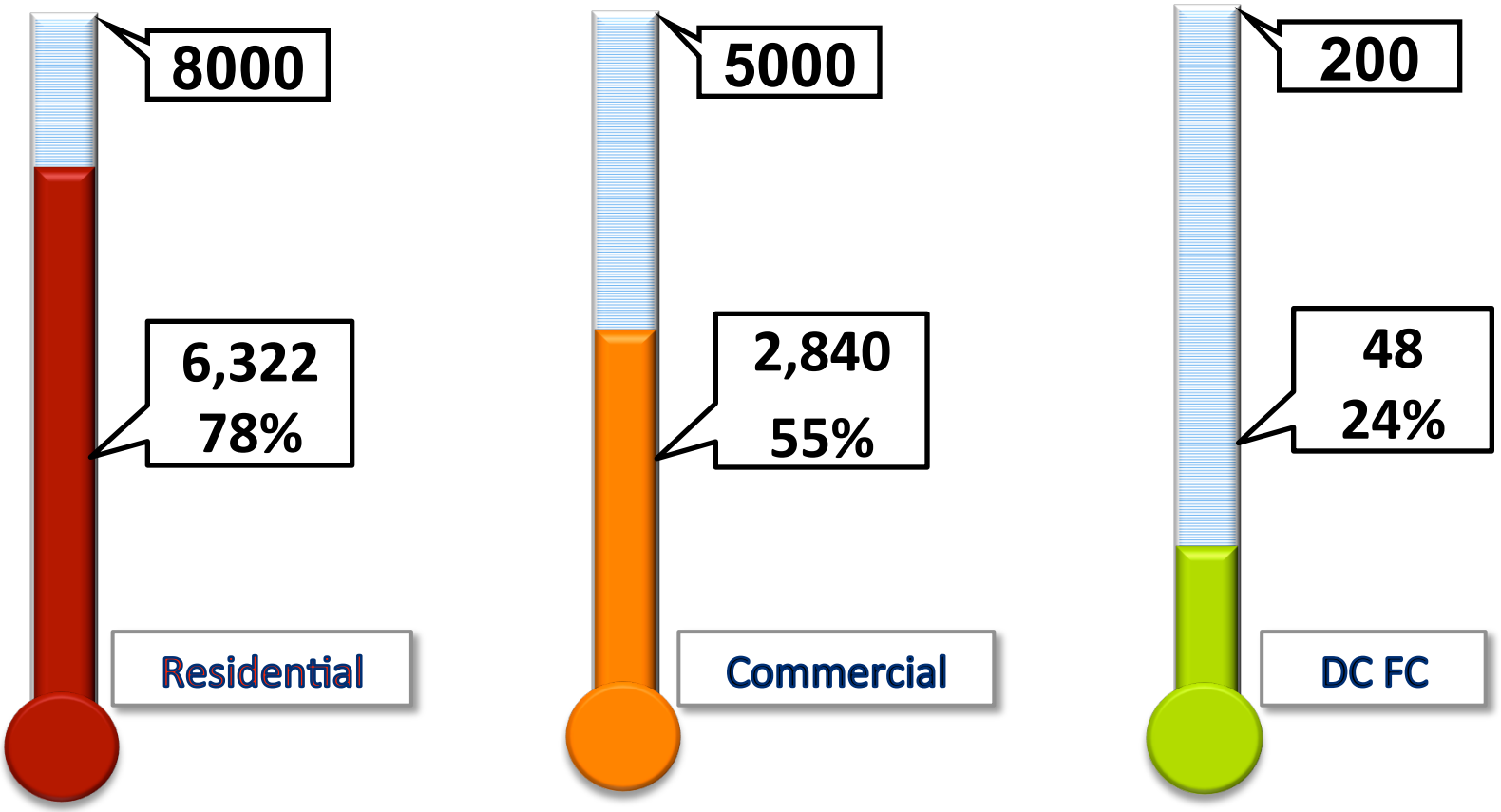
Deployment Status



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Vehicle Barriers – Observations

- Qualifier - What do we know? We only do infrastructure!
- Divergent Standards
  - Fast charge
    - CHAdeMO
    - SAE J1772 “Combo Connector”
  - Wireless charging
- Technology Issues
- Desire To Use Electric Fuel

Electric Fuel Use

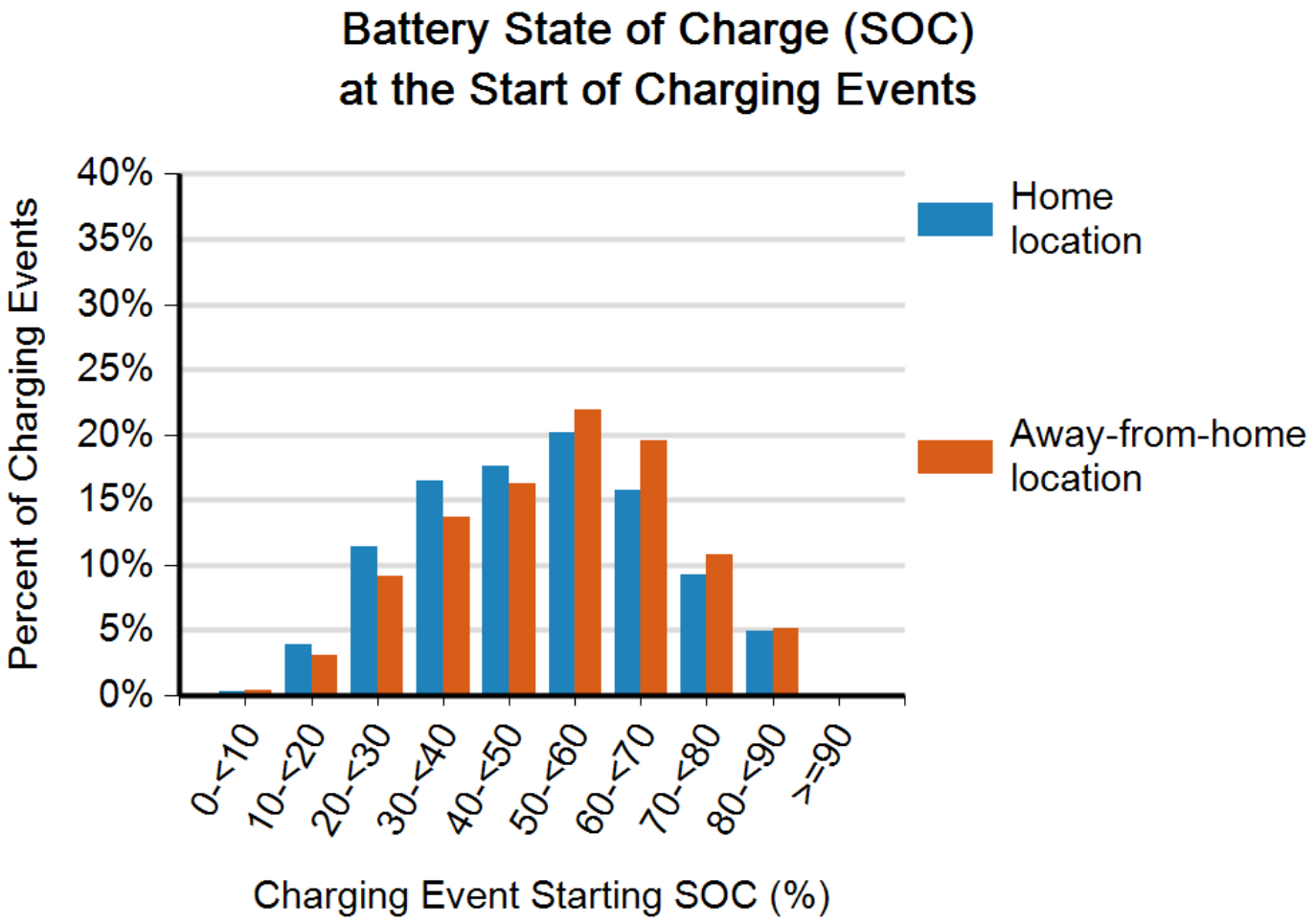
38 miles all electric

- Avg distance traveled per day (mi): 41.2
- Avg trip distance (mi): 8.3
- Avg # of trips between charging: 3.5
- Avg distance between charging (mi): 29.3
- Avg # of charging events/day: 1.4

73 miles all electric

- Avg distance traveled per day (mi): 30
- Avg trip distance (mi): 7.2
- Avg # of trips between charging: 3.9
- Avg distance between charging (mi): 27.9
- Avg # of charging events/day: 1.1

Leaf Use



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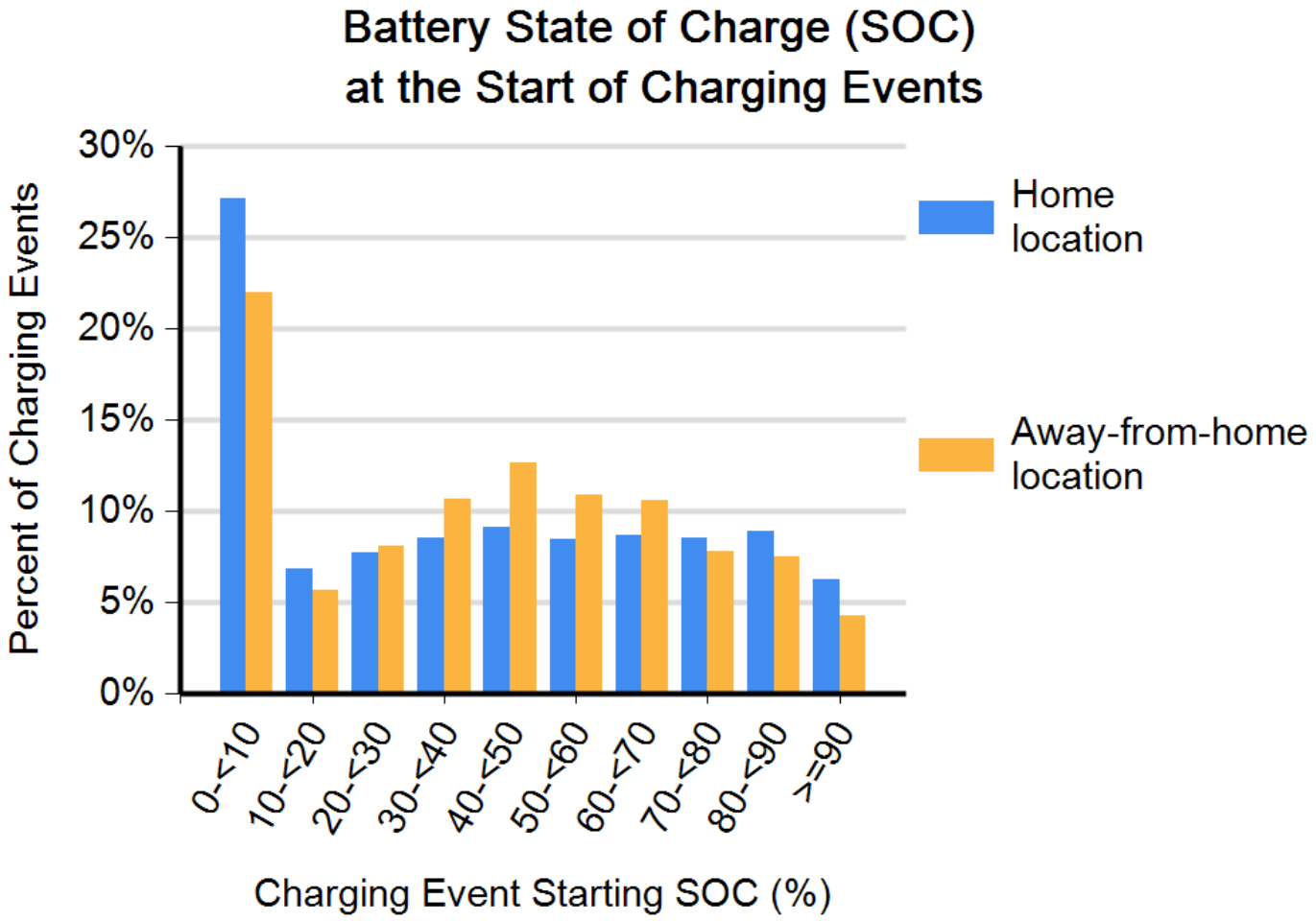
Volt Use



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Vehicle Barriers

CONCLUSIONS

- Objective Should Be To Maximize Electric Transportation Fuel Use
  - Higher power chargers – all about energy throughput
  - Blink Lifestyle – opportunity charge
  - Infrastructure is not the “Field of Dreams”
- The Past Does Not Predict The Future Of Infrastructure Use
  - Do not rely solely on ICE data
  - Do not ignore behavior change
- Value Remains King
  - Societal costs are not part of the value determination

Deployment Barriers - Observations

- Residential Permit Timeliness
  - Most cities have positively embraced PEVs
    - EV Project outreach
    - DOE Clean Cities
  - Majority of permits are over-the-counter
  - Several Cities allow self inspection
    - Eliminates wait time for a City inspector
    - Reduces City cost
  - This is not currently an issue

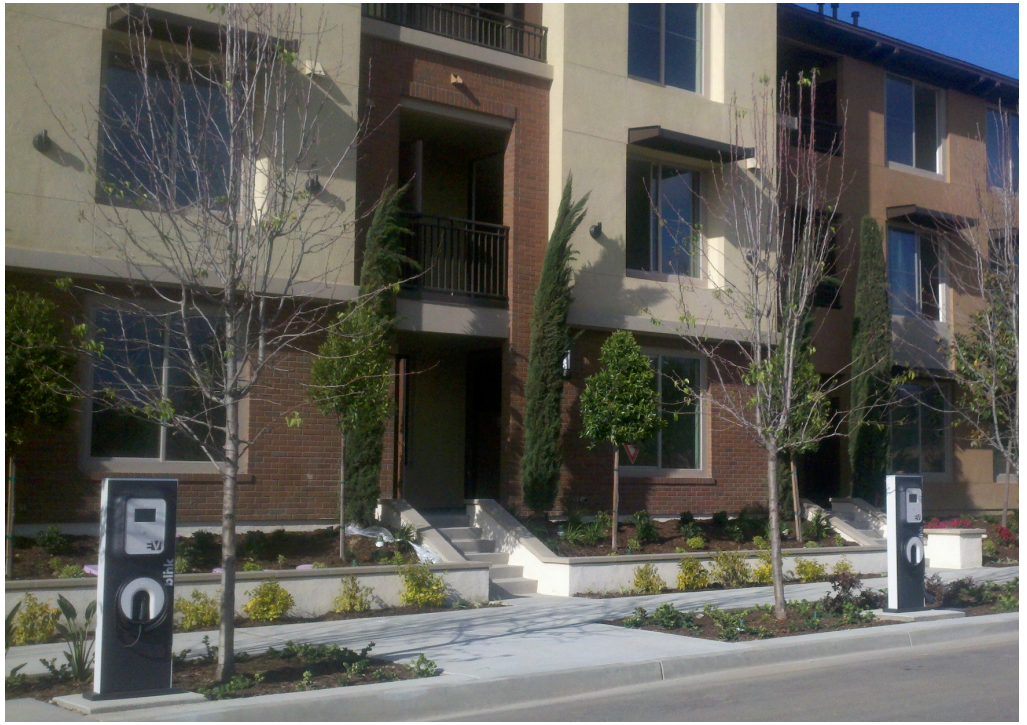
Deployment Barriers - Observations

- Residential Permit Cost
  - Permit fees vary significantly
  - Fees are often a significant portion of installation cost

Region	Count of Permits	Average Permit Fee	Minimum Permit Fee	Maximum Permit Fee
Arizona	66	$96.11	$26.25	$280.80
Los Angeles	109	$83.99	$45.70	$218.76
San Diego	496	$213.30	$12.00	$409.23
San Francisco	401	$147.57	$29.00	$500.00
Tennessee	322	$47.15	$7.50	$108.00
Oregon	316	$40.98	$12.84	$355.04
Washington	497	$78.27	$27.70	$317.25

Deployment Barriers - Observations

- Non-Residential Permitting
  - Costs and delays are significant
    - Load studies
    - Zoning reviews
    - Moving video
- Municipal Sites
  - Statutory delays
  - Legal barriers
  - Street side locations very limited



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Deployment Issues - Observations

- Non-Residential Cost
  - Hosts are value sensitive
    - Cost is a major driver
    - Revenue centric
    - Image counts
  - ADA compliance
    - Major cost implication
    - No uniform application
    - Accessibility issue
    - Parking space count
    - DOJ guidance critical

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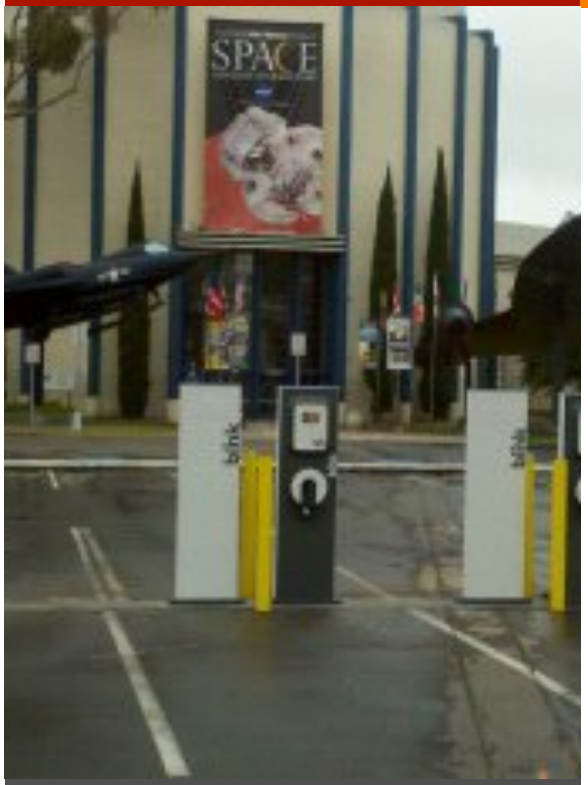

Deployment Barriers

CONCLUSIONS

- Residential Chargers
  - Cost is significant but not limiting
  - External factors drive cost
    - Permit fees and inspection costs
- Non-Residential Chargers
  - Not a “Field of Dreams”
  - ROI is everything
    - Cash
    - Intangibles
  - Permitting drives cost and delays
  - Lack of clear regulation drives cost
    - ADA
    - Connection standards
  - Revenue will be critical

Operating Barriers - Observations

- Utility commercial electricity rates do NOT promote PEVs
  - Demand costs are significant at many utilities
  - Some utilities offer commercial rates without demand charges
  - Others incorporate a 20 kW to 50 kW demand threshold
- Demand rates can be as much as $25/kW per month

No Demand Charges - Nissan Leaf	
CA	Pacific Gas & Electric
	City of Palo Alto
	Alameda Municipal Power
	Silicon Valley Power
AZ	Tucson Electric Power
OR	Eugene Water & Electric Board
	Lane Electric Co-op
TN	Middle Tennessee Electric
	Duck River Electric
	Harriman Utility Board
	Athens Utility Board
	Cookeville Electric Department
	Cleveland Utilities
	Nashville Electric Service
	EPB Chattanooga
	Lenoir City Utility Board
	Volunteer Electric Cooperative
	Murfreesboro Electric
	Sequachee Valley Electric Cooperative
	Knoxville Utility Board
	Maryville
	Fort Loudoun Electric
	Memphis Light Gas and Water Division

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Operating Barriers - Observations

- Monthly demand charges result in significant operating costs in many utility service territories

Utility Demand Charges - Nissan Leaf		Cost/mo.
CA	Glendale Water and Power	$ 16.00
	Hercules Municipal Utility:	$ 377.00
	Los Angeles Department of Water and Power	$ 700.00
	Burbank Water and Power	$ 1,052.00
	San Diego Gas and Electric	$ 1,061.00
	Southern California Edison	$ 1,460.00
AZ	TRICO Electric Cooperative	$ 180.00
	The Salt River Project	$ 210.50
	Arizona Public Service	$ 483.75
OR	Pacificorp	$ 213.00
WA	Seattle City Light	$ 61.00

Operating Barriers - Observations

- Non-residential charging is inherently more expensive than home charging
  - Equipment
  - Installation
  - Energy
- Higher costs of non-residential charging must be reduced
  - Vehicles will tether to home
  - Market limited to homeowners
- Commercial energy costs are universally higher than residential energy costs – particularly with residential TOU

Operating Barriers - Observations

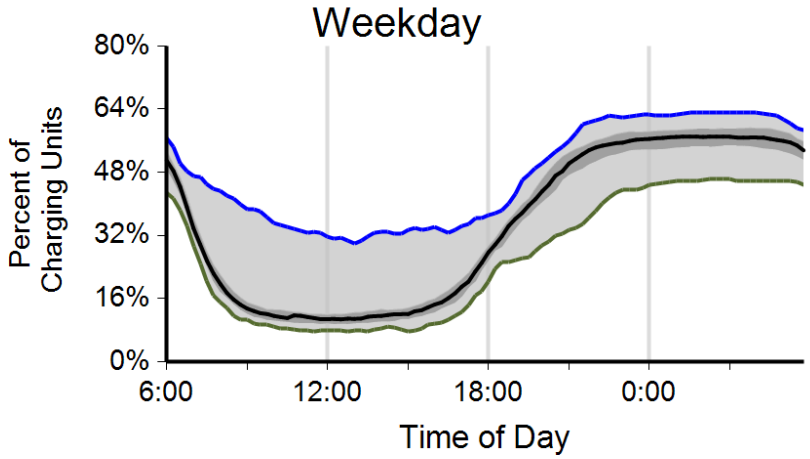
- Time-of-use rates are very effective in moving residential transportation energy use to preferred times
  - Time available to charge is much greater than the time required to charge (even with only a 3.3 kW charger)
  - Even modest on peak to off peak price ratios drive charging to off peak times
  - Convenient charge scheduling facilitates matching vehicle charging times to off peak times

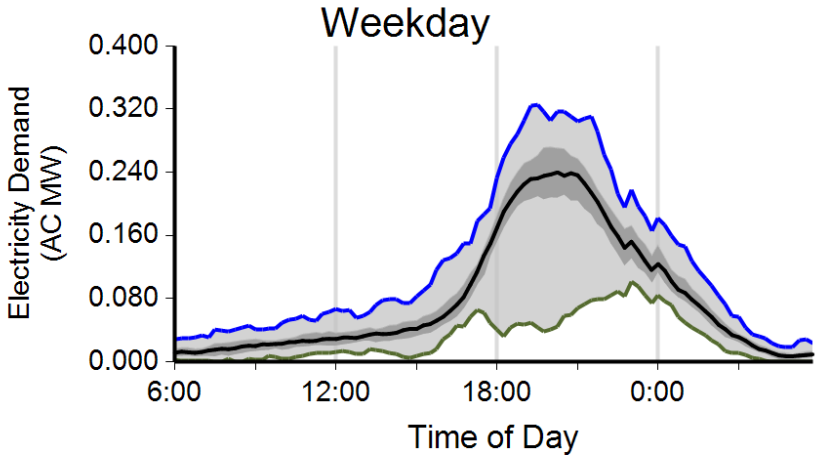
Operating Barriers

CONCLUSIONS

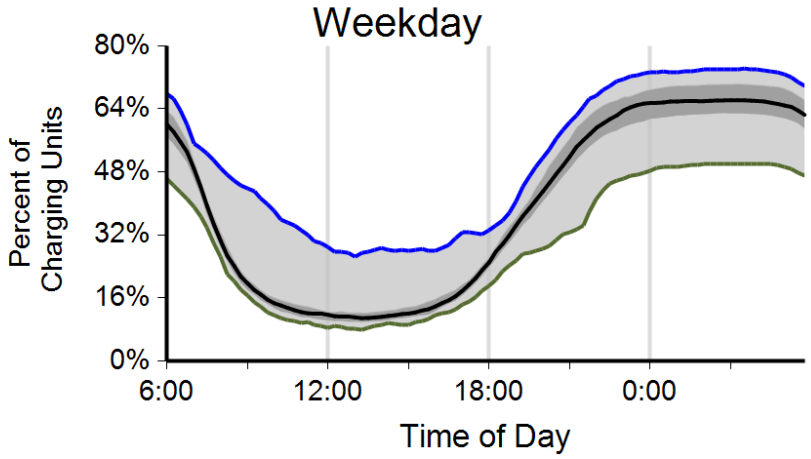
- EV chargers potentially represent the first wide – scale deployment of smart devices incorporating energy storage
- Faster is better – at least for EV charging
- Existing utility rate structures cannot take advantage of the inherent flexibility EV charging can provide
  - Carrot and stick rates used to promote efficiency and transfer cost
    - Tiered whole house rates
    - Inability to handle embedded meters
    - Significant demand costs
  - Real time cost based rates for transportation energy are required

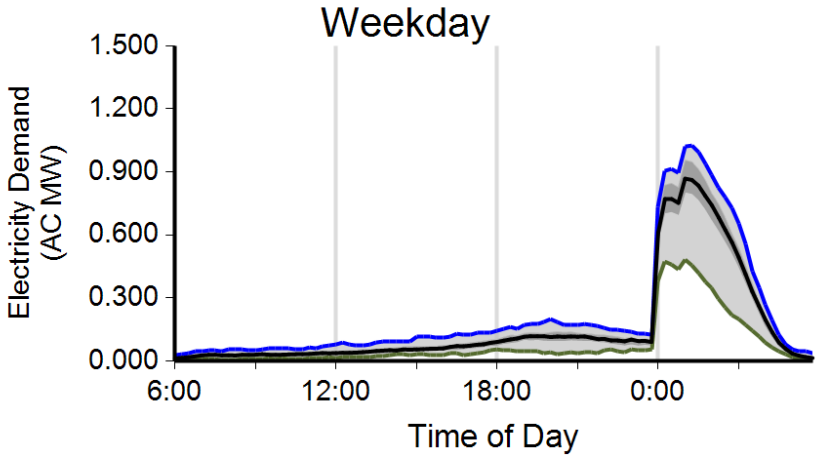
Nashville





San Diego





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Business Models - Observations

- Competition is Home Charging, Not Gasoline
  - Lowest energy costs
  - Special EV charging rates to encourage off peak use
- Free Charging Is Not Sustainable
- Access Fees Only Don't Work
  - Energy costs greater then home
  - Demand charges don't exist at home
  - Equipment costs greater than home
  - Maintenance costs greater than home

Sustainable Business

- Other value chains must support user and host value
  - Branding
  - Network services
  - Grid services
  - Advertising

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Branding

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Network Services

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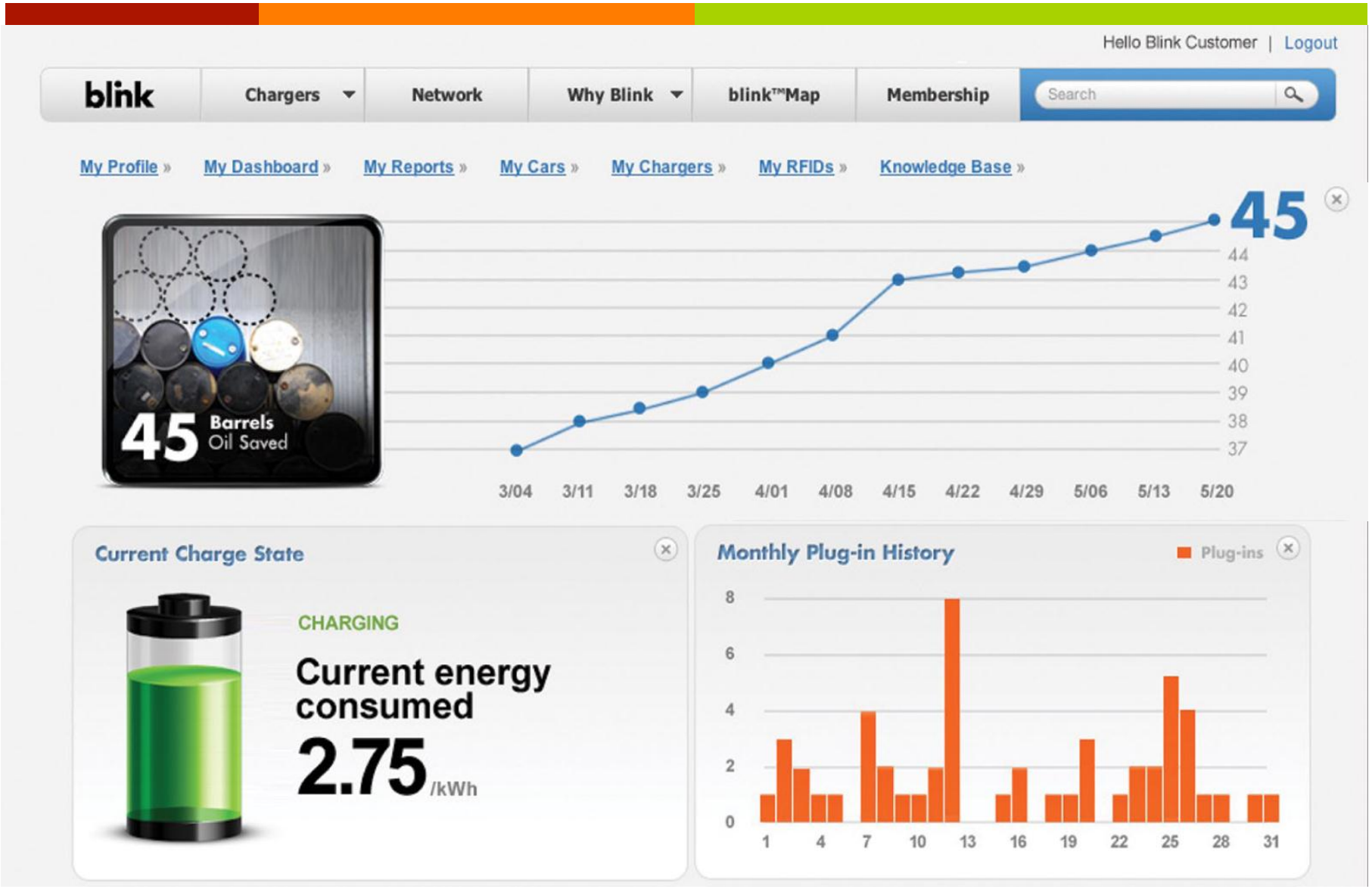

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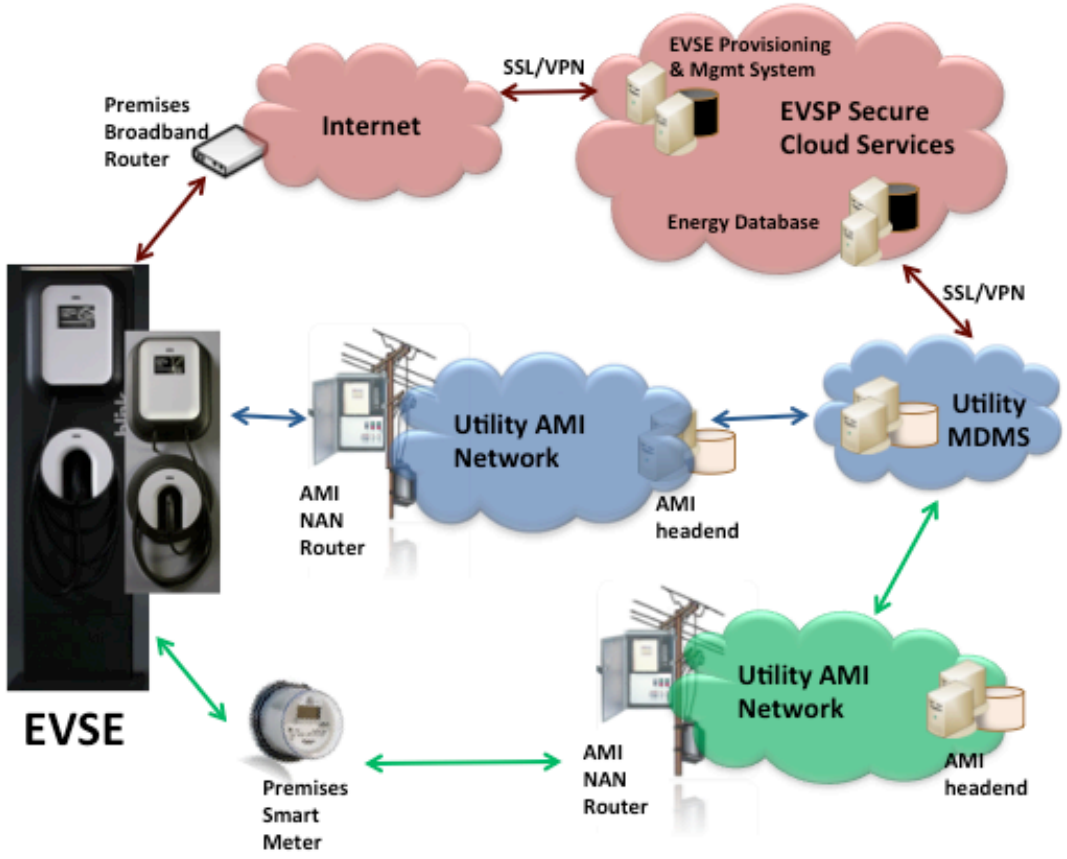
Grid Services

- Grid Connection
  - Cloud-to-Cloud
  - Utility AMI
  - Meter direct
- Dispatchable Load
  - Demand reduction
  - Renewables absorption
  - Economic dispatch



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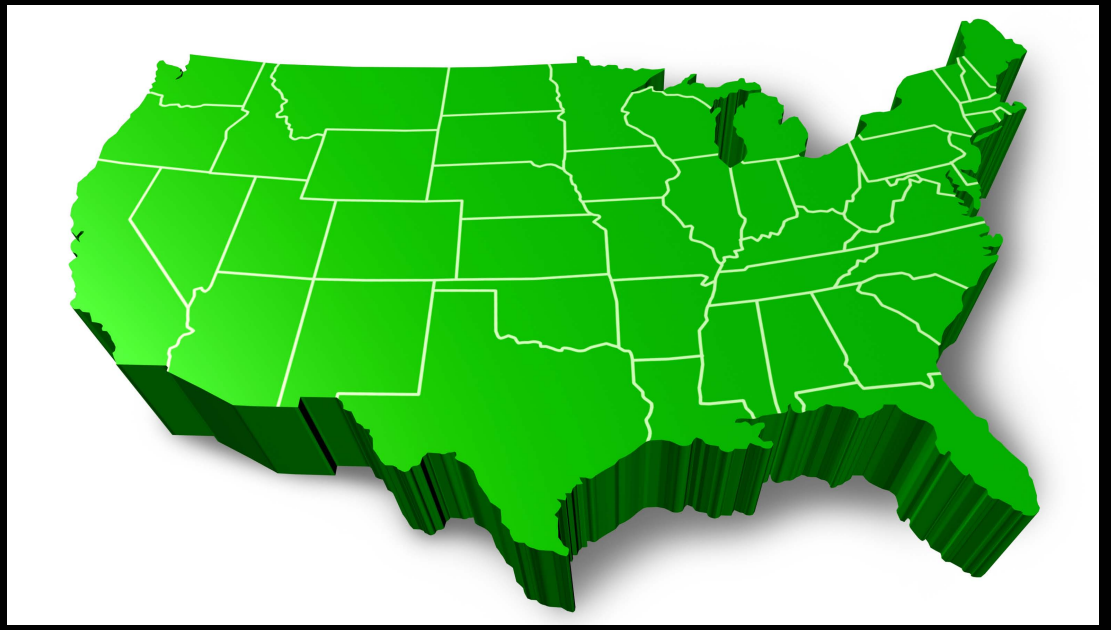
Advertising



Our mission and vision is simple.
Blink anywhere you go.

blink

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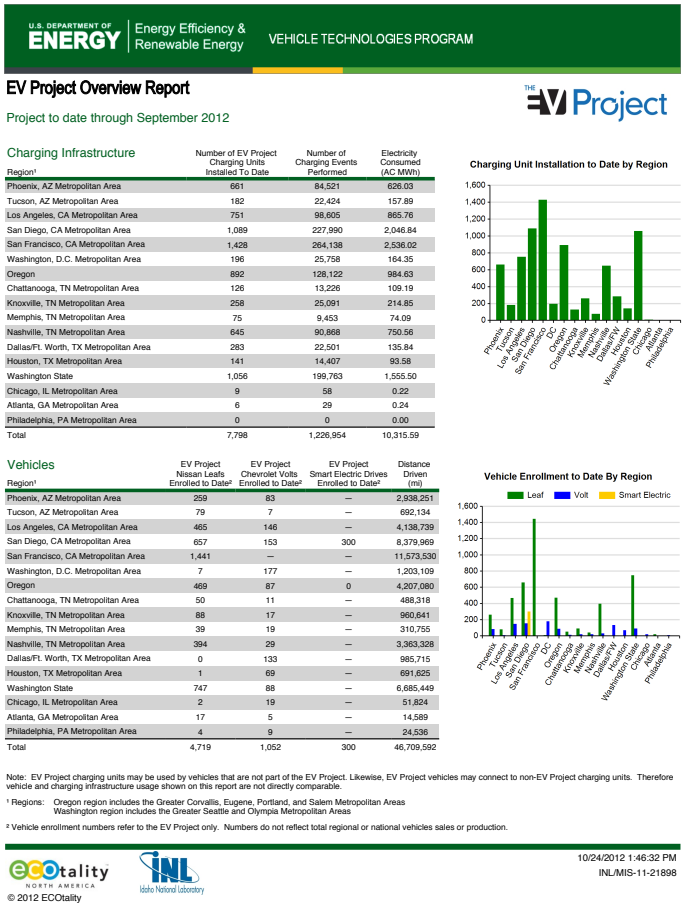
Information Dissemination

- 62 million miles in data base
- ≈100 million miles by end of EV Project
- 1.5 million charge events
- 10,000 MWh of electric fuel consumed
- Quarterly reporting of information
- Quarterly presentation of observations from data
- White papers present lessons learned and results
- Final report presents conclusions

Quarterly Reports

- Infrastructure Use
  - Residential
  - Commercial (non-residential)
- Vehicle Use
- Electric Utility
- Nearly 100 pages per Quarter



U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy — VEHICLE TECHNOLOGIES PROGRAM

EV Project Overview Report

THE EV Project

Project to date through September 2012

Charging Infrastructure

Region[1]	Number of EV Project Charging Units Installed To Date	Number of Charging Events Performed	Electricity Consumed (AC MWh)
Phoenix, AZ Metropolitan Area	661	84,521	626.03
Tucson, AZ Metropolitan Area	182	22,424	157.89
Los Angeles, CA Metropolitan Area	751	98,605	865.76
San Diego, CA Metropolitan Area	1,089	227,990	2,046.84
San Francisco, CA Metropolitan Area	1,428	264,138	2,536.02
Washington, D.C. Metropolitan Area	196	25,758	164.35
Oregon	892	128,122	984.63
Chattanooga, TN Metropolitan Area	126	13,226	109.19
Knoxville, TN Metropolitan Area	258	25,091	214.85
Memphis, TN Metropolitan Area	75	9,453	74.09
Nashville, TN Metropolitan Area	645	90,868	750.56
Dallas/Ft. Worth, TX Metropolitan Area	283	22,501	135.84
Houston, TX Metropolitan Area	141	14,407	93.58
Washington State	1,056	199,763	1,555.50
Chicago, IL Metropolitan Area	9	58	0.22
Atlanta, GA Metropolitan Area	6	29	0.24
Philadelphia, PA Metropolitan Area	0	0	0.00
Total	7,798	1,226,954	10,315.59

Charging Unit Installation to Date by Region

Vehicles

Region[1]	EV Project Nissan Leafs Enrolled to Date[2]	EV Project Chevrolet Volts Enrolled to Date[2]	EV Project Smart Electric Drives Enrolled to Date[2]	Distance Driven (mi)
Phoenix, AZ Metropolitan Area	259	83	—	2,938,251
Tucson, AZ Metropolitan Area	79	7	—	692,134
Los Angeles, CA Metropolitan Area	465	146	—	4,138,739
San Diego, CA Metropolitan Area	657	153	300	8,379,969
San Francisco, CA Metropolitan Area	1,441	—	—	11,573,530
Washington, D.C. Metropolitan Area	7	177	—	1,203,109
Oregon	469	87	0	4,207,080
Chattanooga, TN Metropolitan Area	50	11	—	488,318
Knoxville, TN Metropolitan Area	88	17	—	960,641
Memphis, TN Metropolitan Area	39	19	—	310,755
Nashville, TN Metropolitan Area	394	29	—	3,363,328
Dallas/Ft. Worth, TX Metropolitan Area	0	133	—	985,715
Houston, TX Metropolitan Area	1	69	—	691,625
Washington State	747	88	—	6,685,449
Chicago, IL Metropolitan Area	2	19	—	51,824
Atlanta, GA Metropolitan Area	17	5	—	14,589
Philadelphia, PA Metropolitan Area	4	9	—	24,536
Total	4,719	1,052	300	46,709,592

Vehicle Enrollment to Date By Region

Note: EV Project charging units may be used by vehicles that are not part of the EV Project. Likewise, EV Project vehicles may connect to non-EV Project charging units. Therefore vehicle and charging infrastructure usage shown on this report are not directly comparable.

[1] Regions: Oregon region includes the Greater Corvallis, Eugene, Portland, and Salem Metropolitan Areas
Washington region includes the Greater Seattle and Olympia Metropolitan Areas

[2] Vehicle enrollment numbers refer to the EV Project only. Numbers do not reflect total regional or national vehicles sales or production.

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EV Project White Papers

- DC Fast Charge-Demand Charge Reduction (May 2012)
- The EV Micro-Climate Planning Process (May 2012)
- Signage (April 2012)
- Greenhouse Gas Avoidance and Fuel Cost Reduction (June 2012)
- First Responder Training (March 2011)
- Accessibility at Public EV Charging Locations (October 2011)
- Battery Electric Vehicle Driving and Charging Behavior Observed Early in The EV Project (April 2012)
- A First Look at the Impact of Electric Vehicle Charging on the Electric Grid in The EV Project (May 2012)

EV Project Website

Much More to Come

This material is based upon work supported by the Department of Energy under Award Number DE-EE0002194.

www.theevproject.com

www.blinknetwork.com

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