

EV Charging Infrastructure Usage in Large-scale Charging Infrastructure Demonstrations: Public Charging Station Case Studies for ARB

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Idaho National Laboratory

Plug-in Electric Vehicle Infrastructure Information Gathering Meeting

July 15, 2014

www.inl.gov



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 Battery Testing
 - Homeland Security and Cyber Security



INL is a primary partner in two national electric vehicle (EV) 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



ChargePoint America

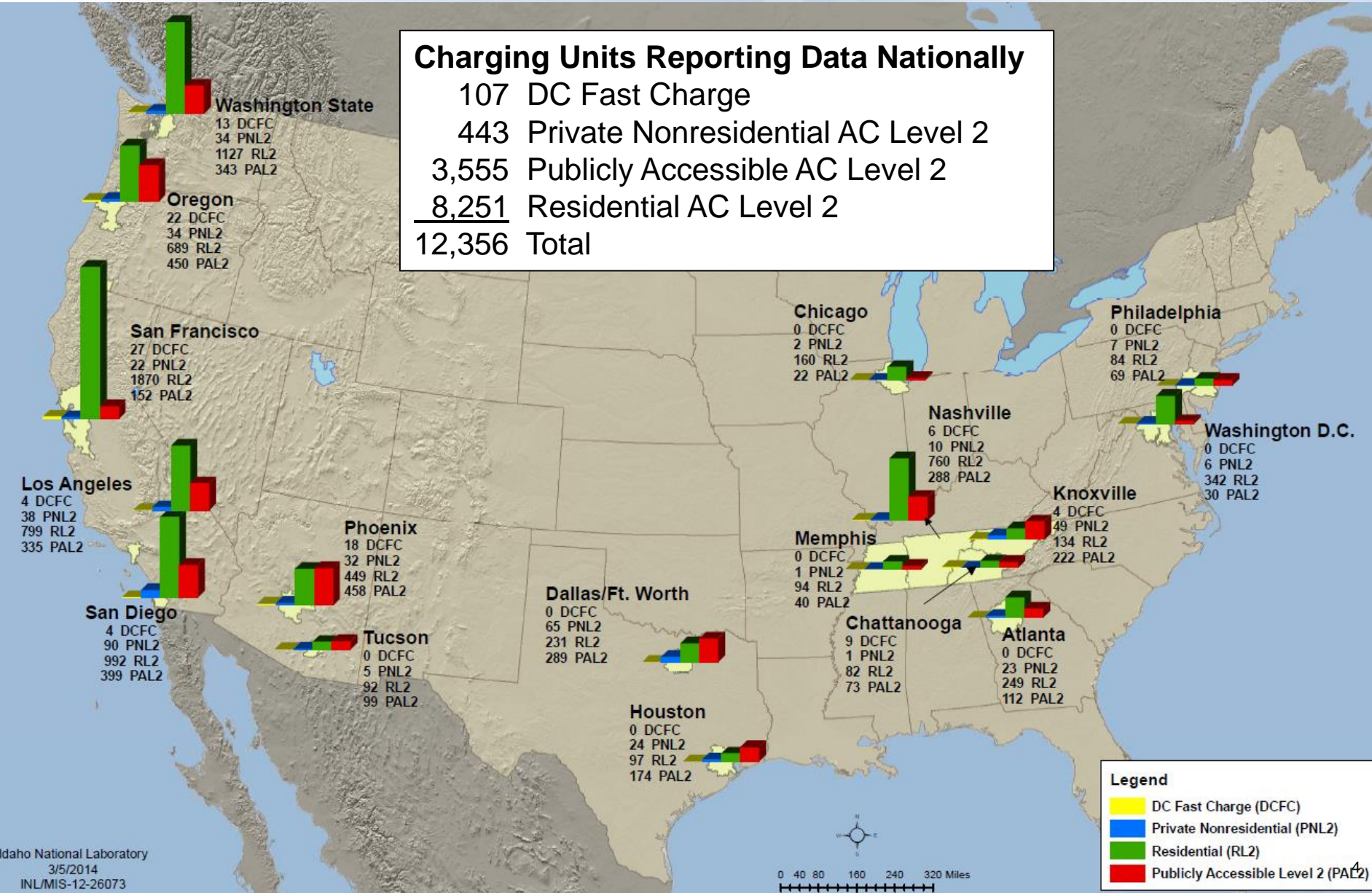
- Deploy 4,700+ residential and public AC level 2 charging units in 11 US regions
- Study customer usage of residential and public infrastructure
- INL data collection May 2011 – Dec 2013

-chargepoint+

Infrastructure Deployment in The EV Project through December 2013

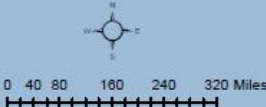
Charging Units Reporting Data Nationally

107 DC Fast Charge
443 Private Nonresidential AC Level 2
3,555 Publicly Accessible AC Level 2
8,251 Residential AC Level 2
12,356 Total

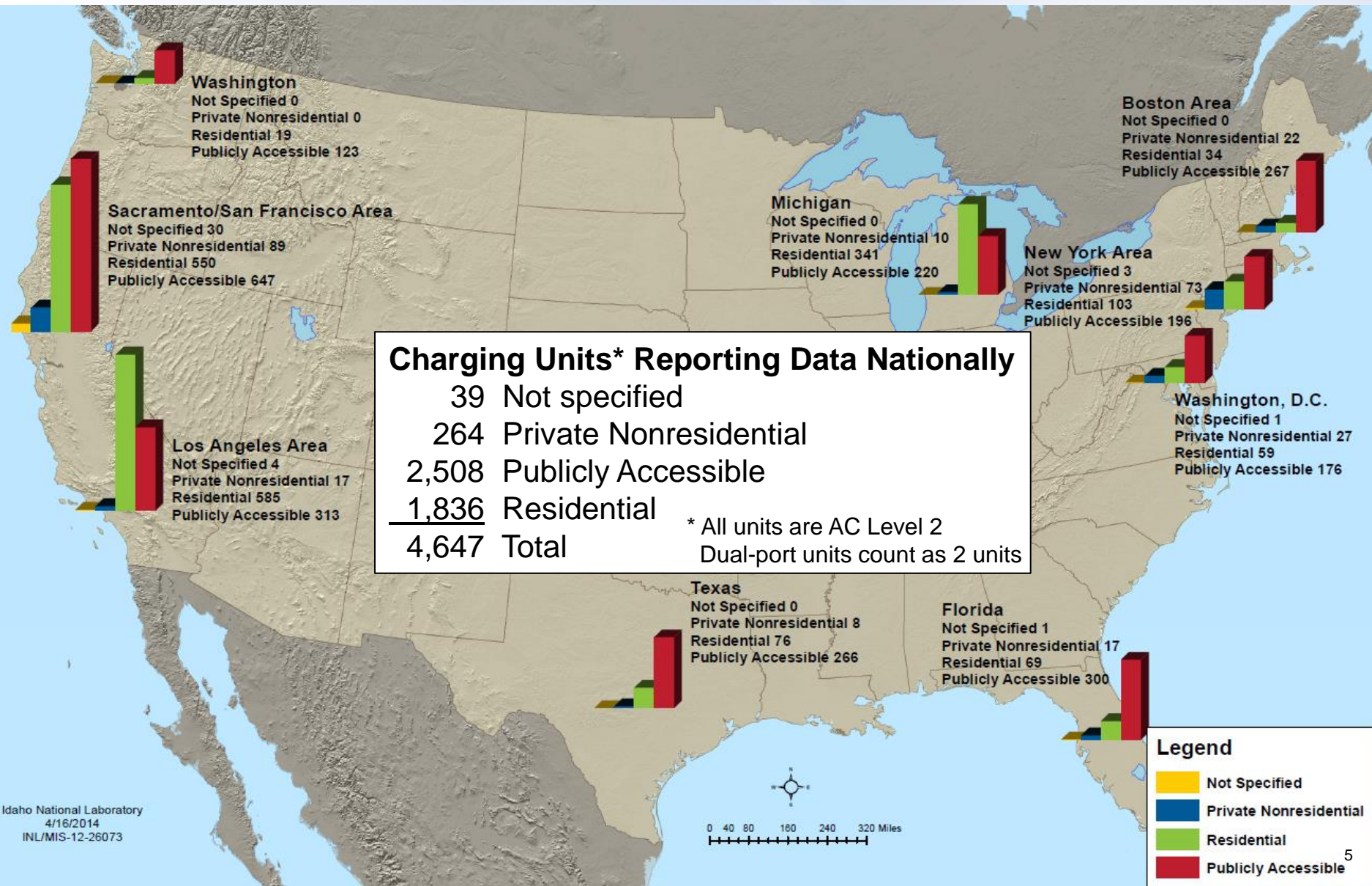


Legend

- DC Fast Charge (DCFC)
- Private Nonresidential (PNL2)
- Residential (RL2)
- Publicly Accessible Level 2 (PAL2)



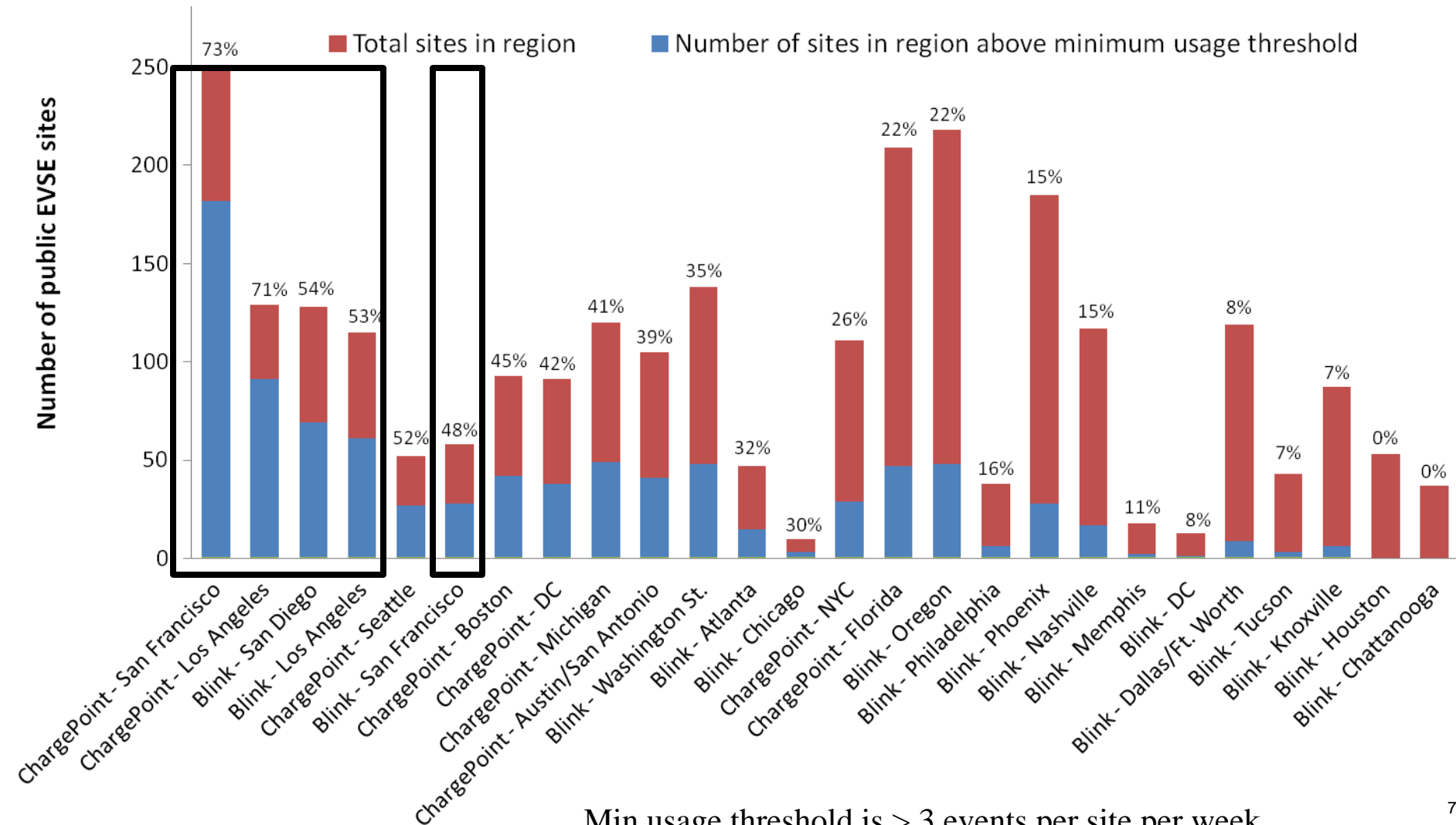
Infrastructure Deployment in ChargePoint America through December 2013



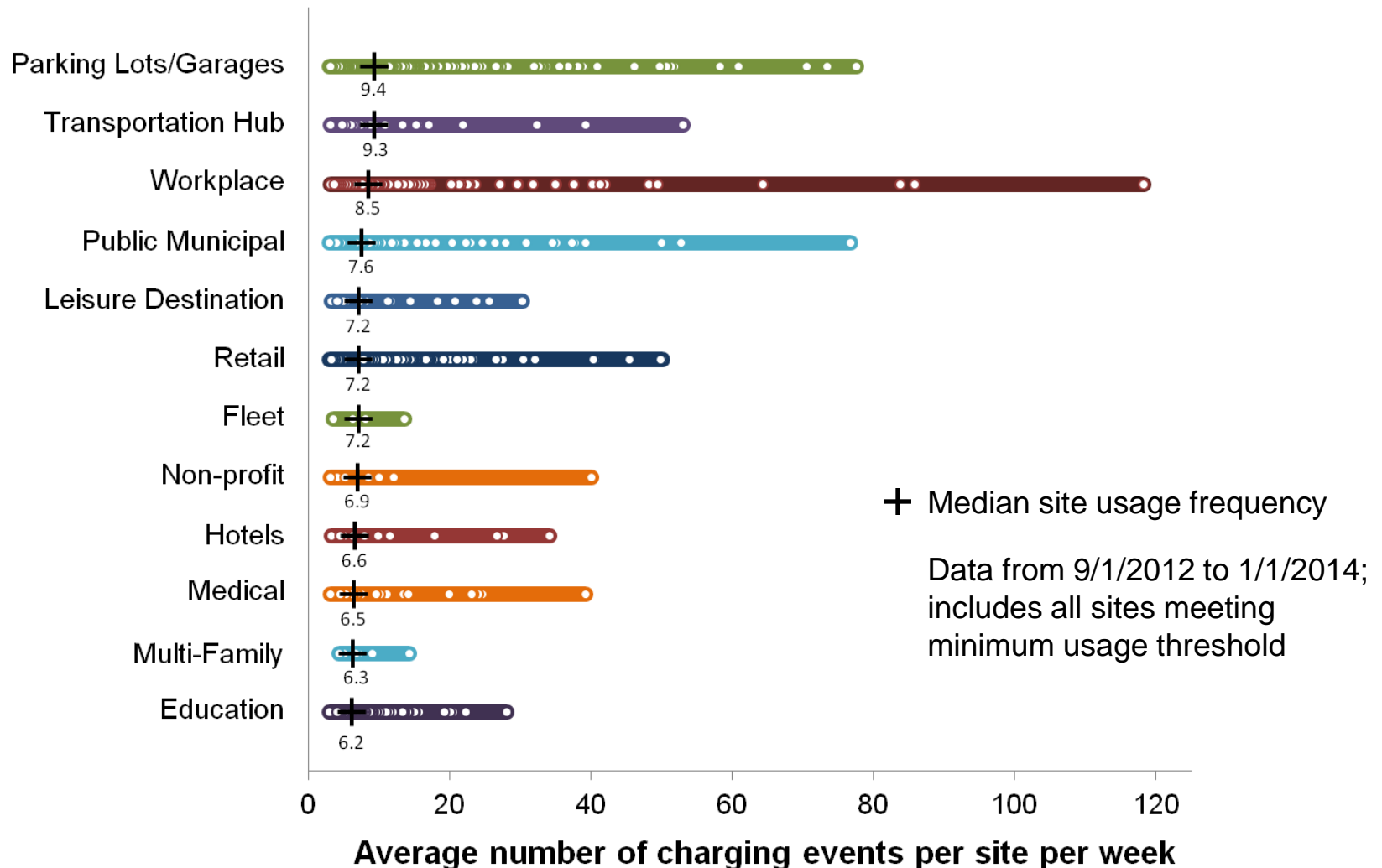
Outline

- Which stations are used most frequently?
 - By region and EVSE make
 - By charging level and venue
- Determining hot spots using vehicle data
 - Bay Area examples
- I5 Corridor EVSE usage preview

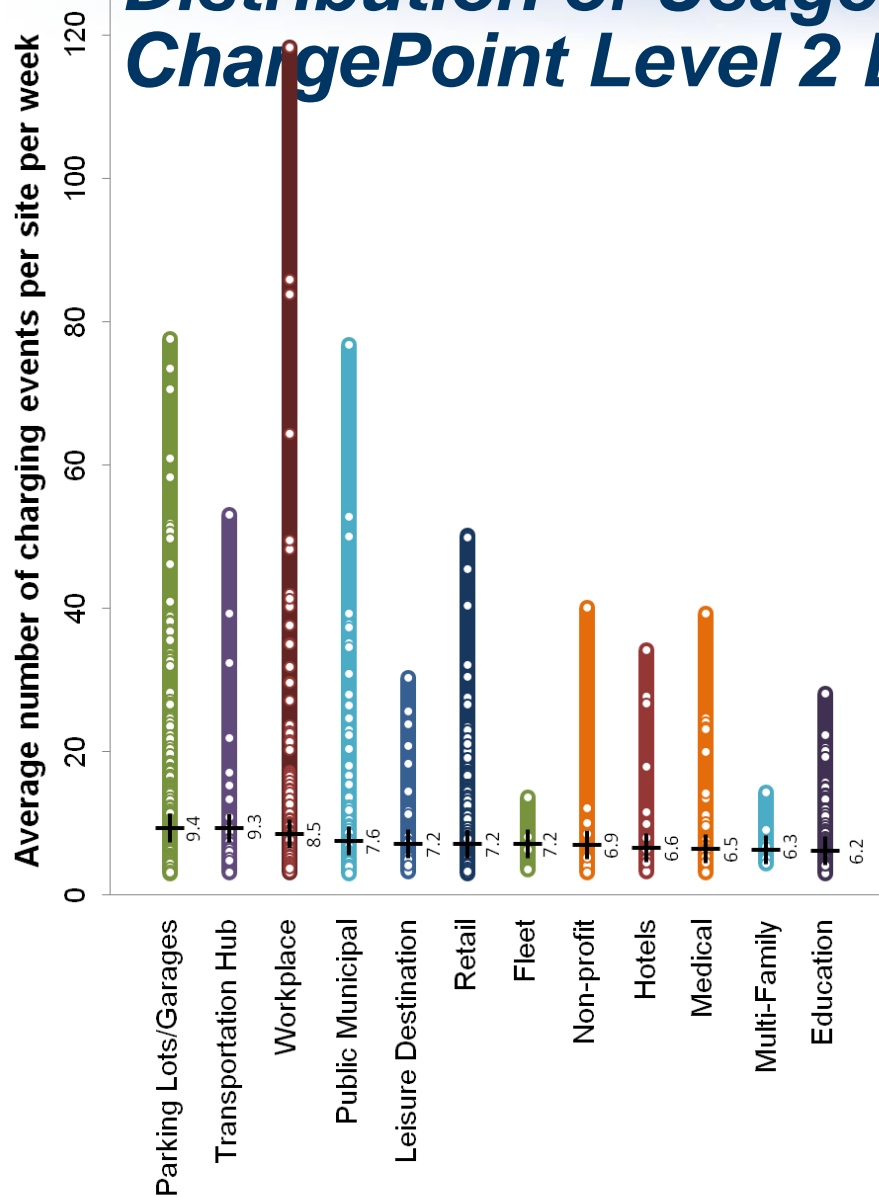
Public EVSE Sites Exceeding Minimum Usage Threshold by Region and EVSE make



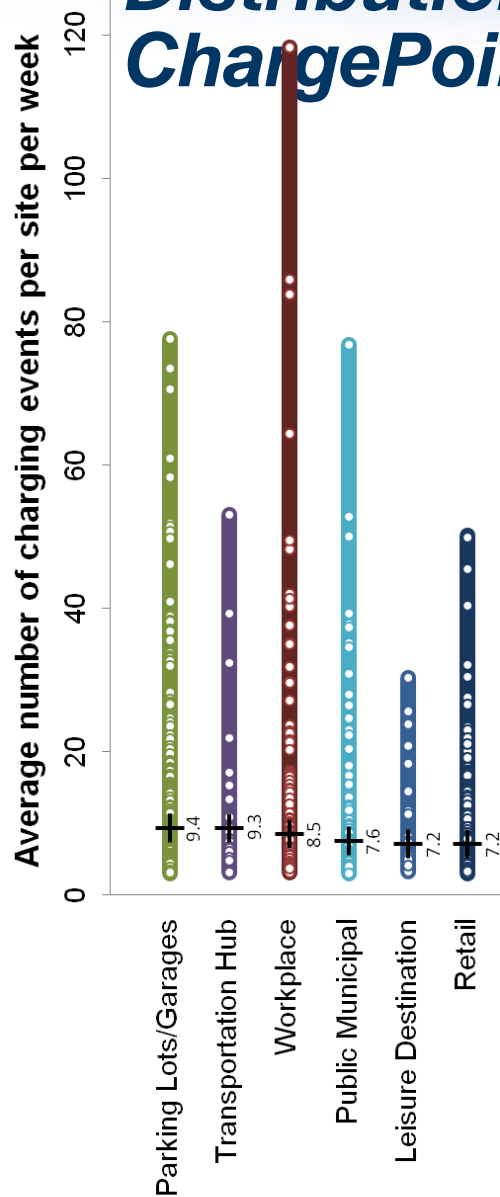
Distribution of Usage Frequency of Blink & ChargePoint Level 2 EVSE Sites by Venue



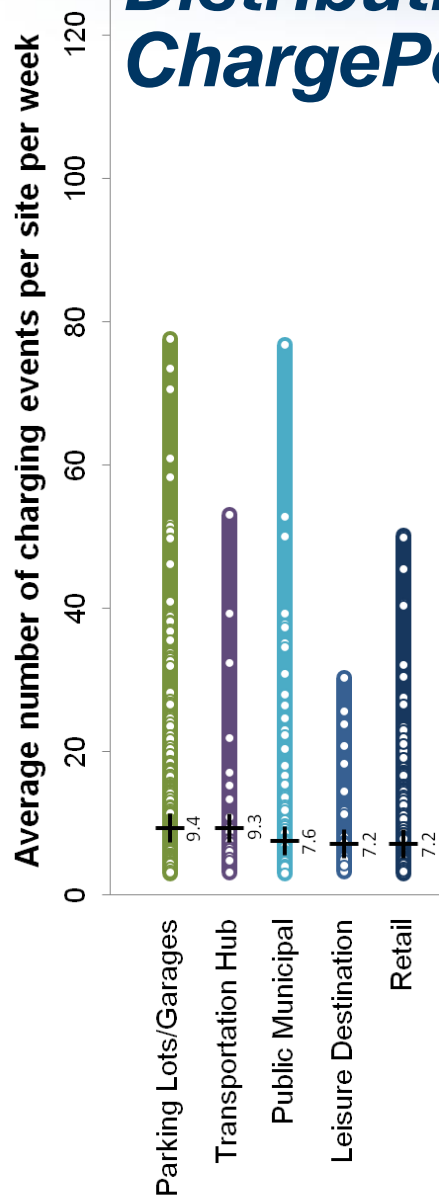
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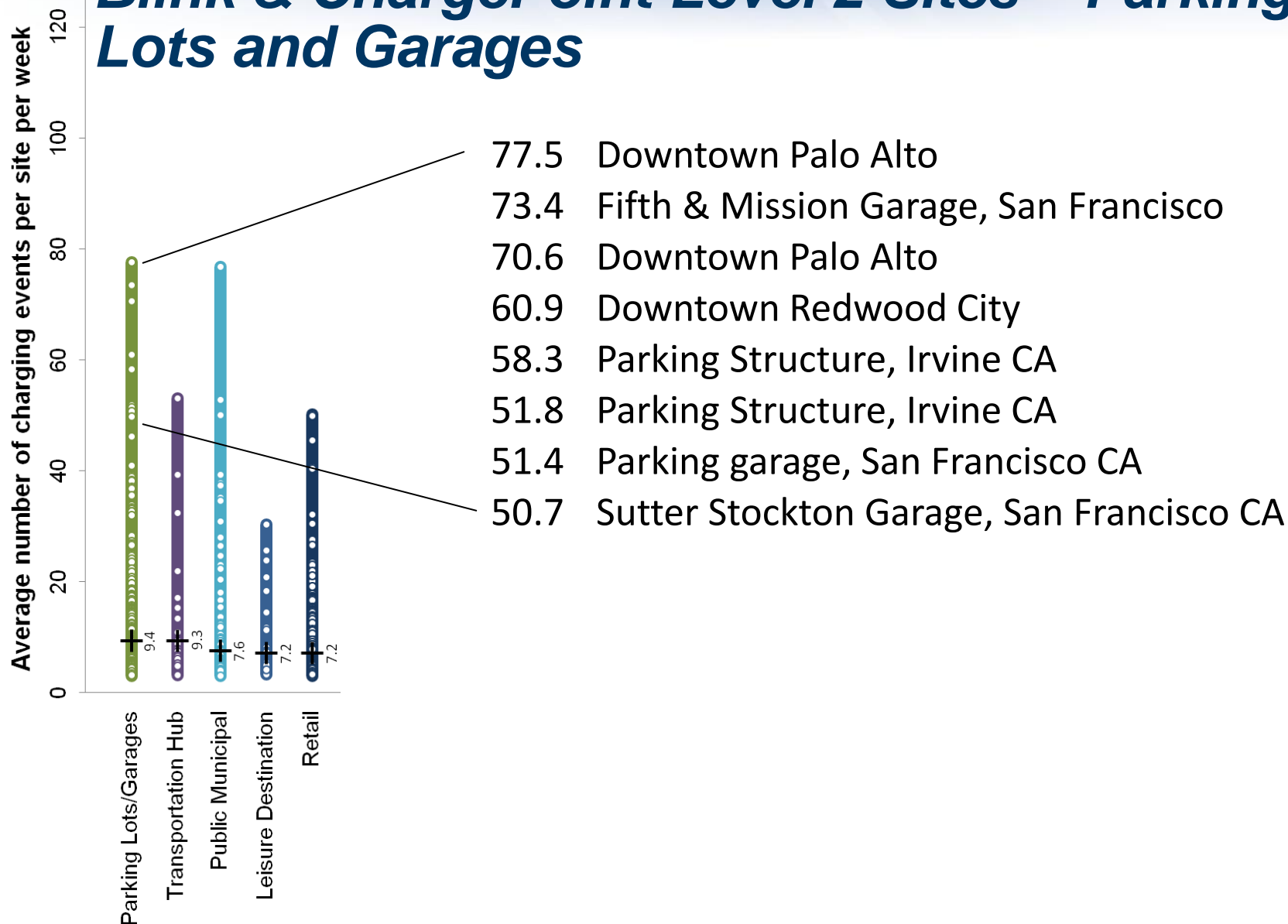
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Distribution of Usage Frequency of Blink & ChargePoint Level 2 EVSE Sites by Venue



Blink & ChargePoint Level 2 Sites – Parking Lots and Garages



Blink & ChargePoint Level 2 Sites – Transportation Hubs

Average number of charging events per site per week

120
100
80
60
40
20
0

Parking Lots/Garages

Transportation Hub

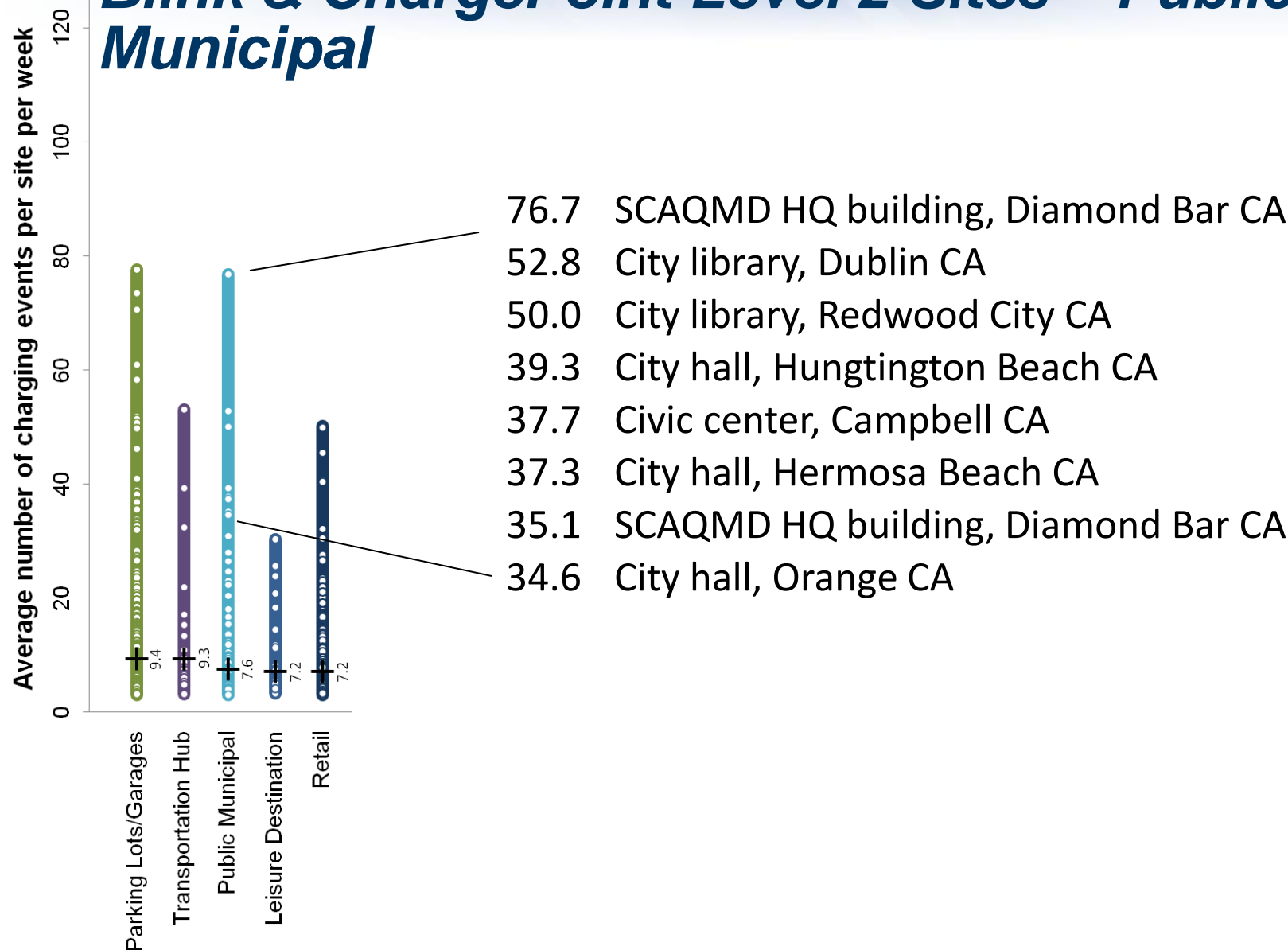
Public Municipal

Leisure Destination

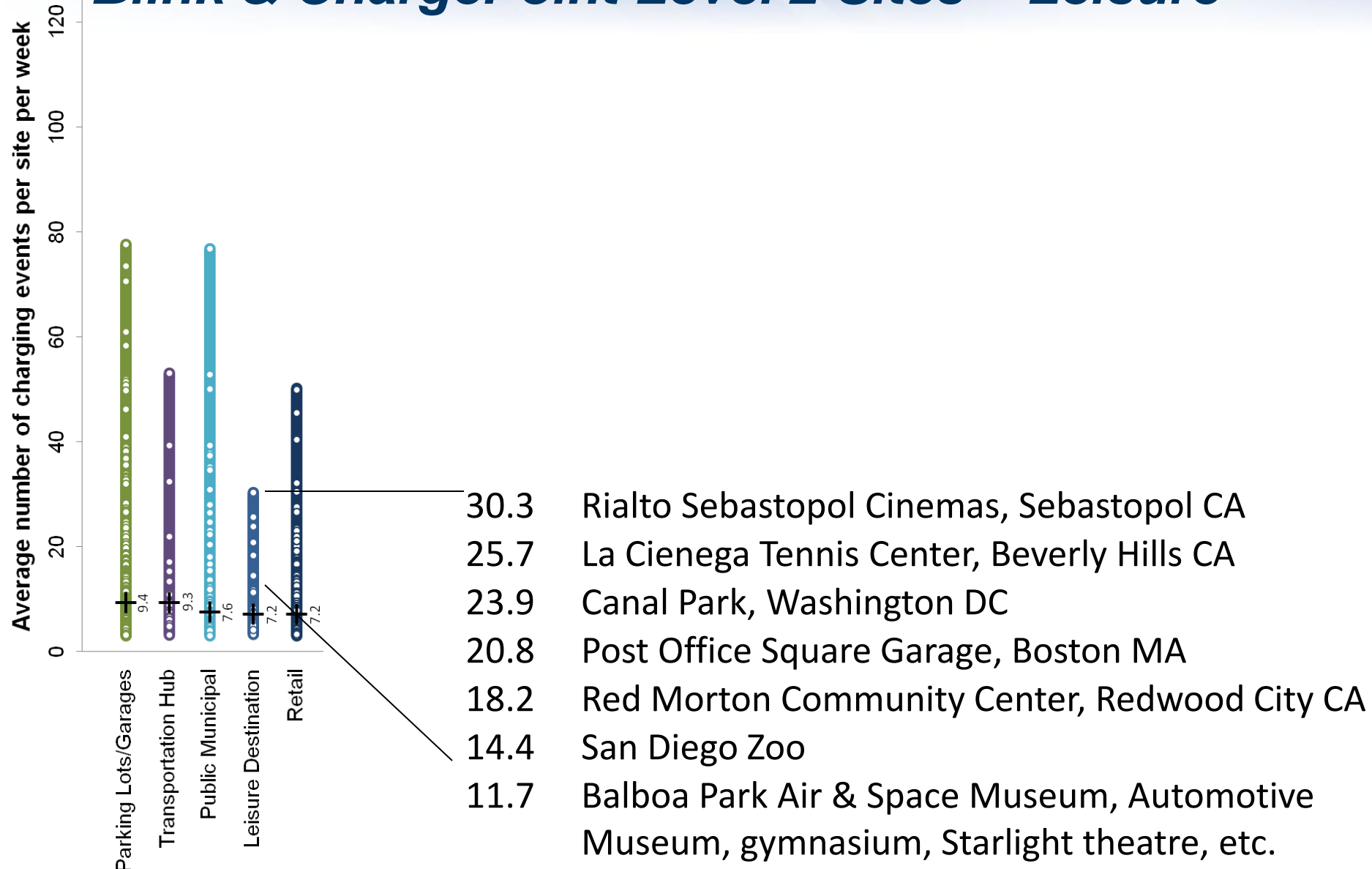
Retail

- 53.0 San Francisco Airport
- 39.3 Anaheim Canyon Metrolink
- 32.3 Oceanside Transit Center Metrolink train /light-rail/bus station park and ride
- 21.9 Oakland International Airport parking
- 17.0 San Francisco Airport
- 15.6 Expresso Airport Parking, San Leandro CA
- 15.2 San Francisco Airport
- 13.3 MBTA Alewife Station, Cambridge MA
- 10.9 Long Beach airport parking garage; all-electric vehicles can park free at Long Beach Airport.

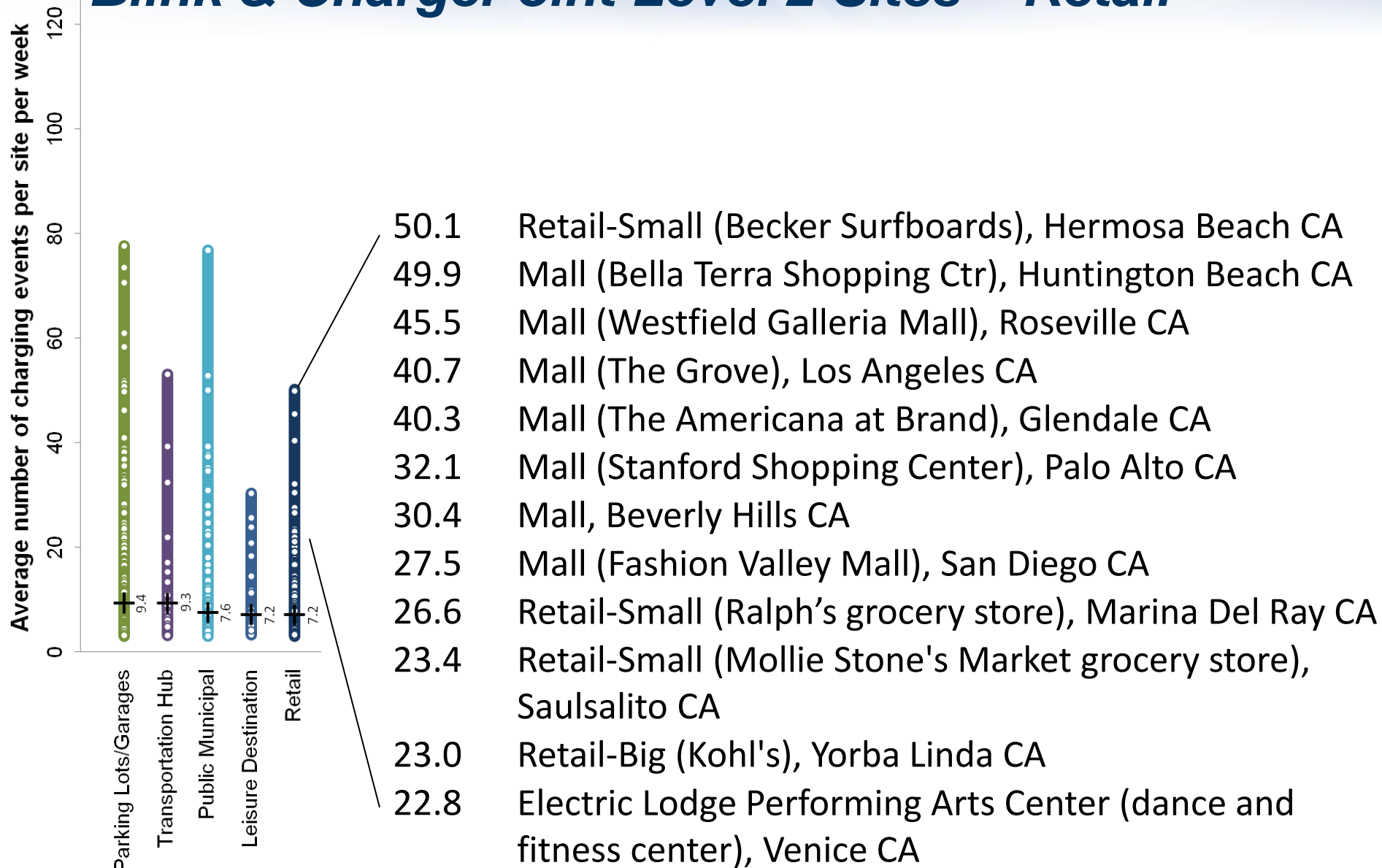
Blink & ChargePoint Level 2 Sites – Public / Municipal



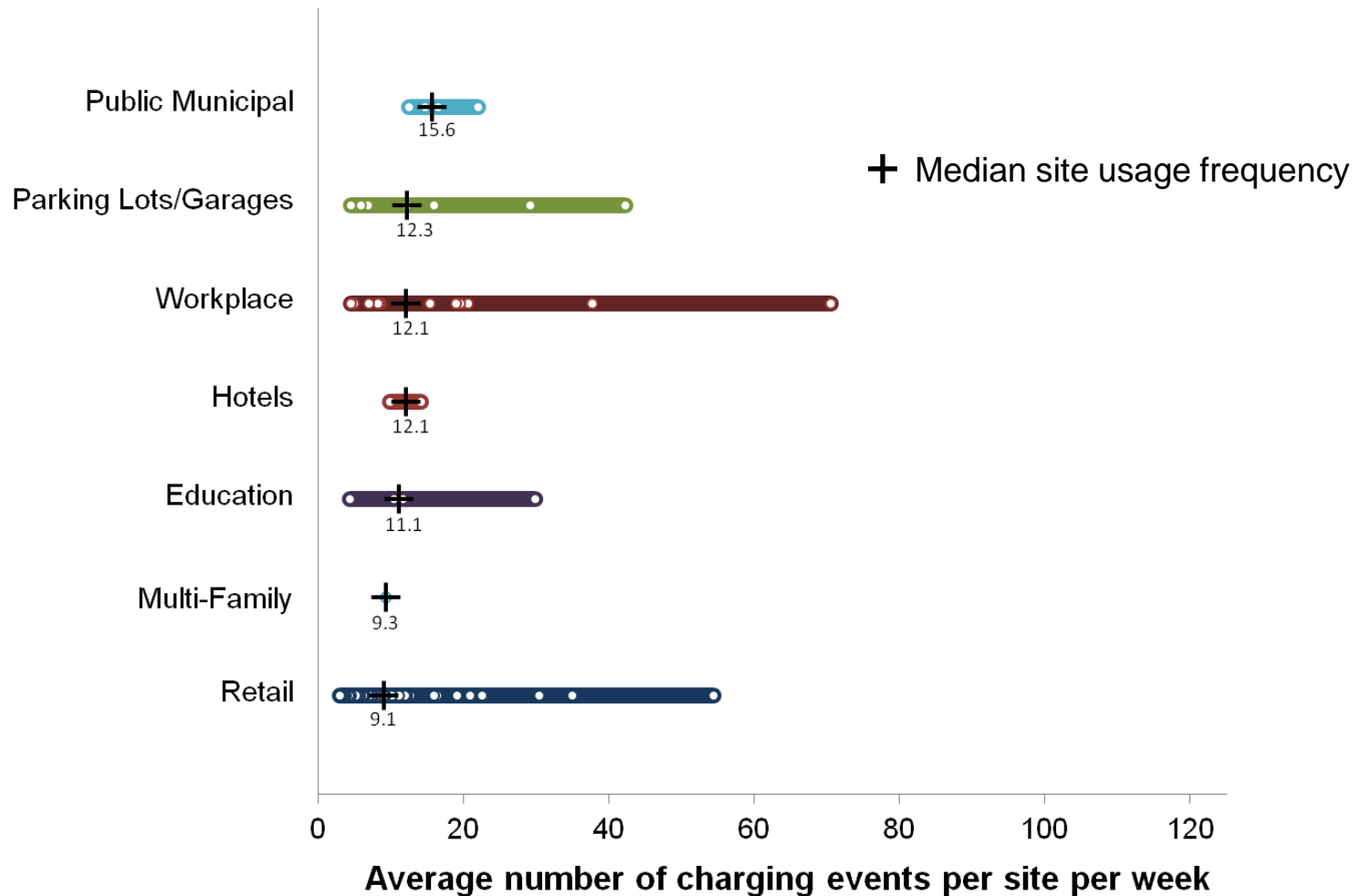
Blink & ChargePoint Level 2 Sites – Leisure



Blink & ChargePoint Level 2 Sites – Retail

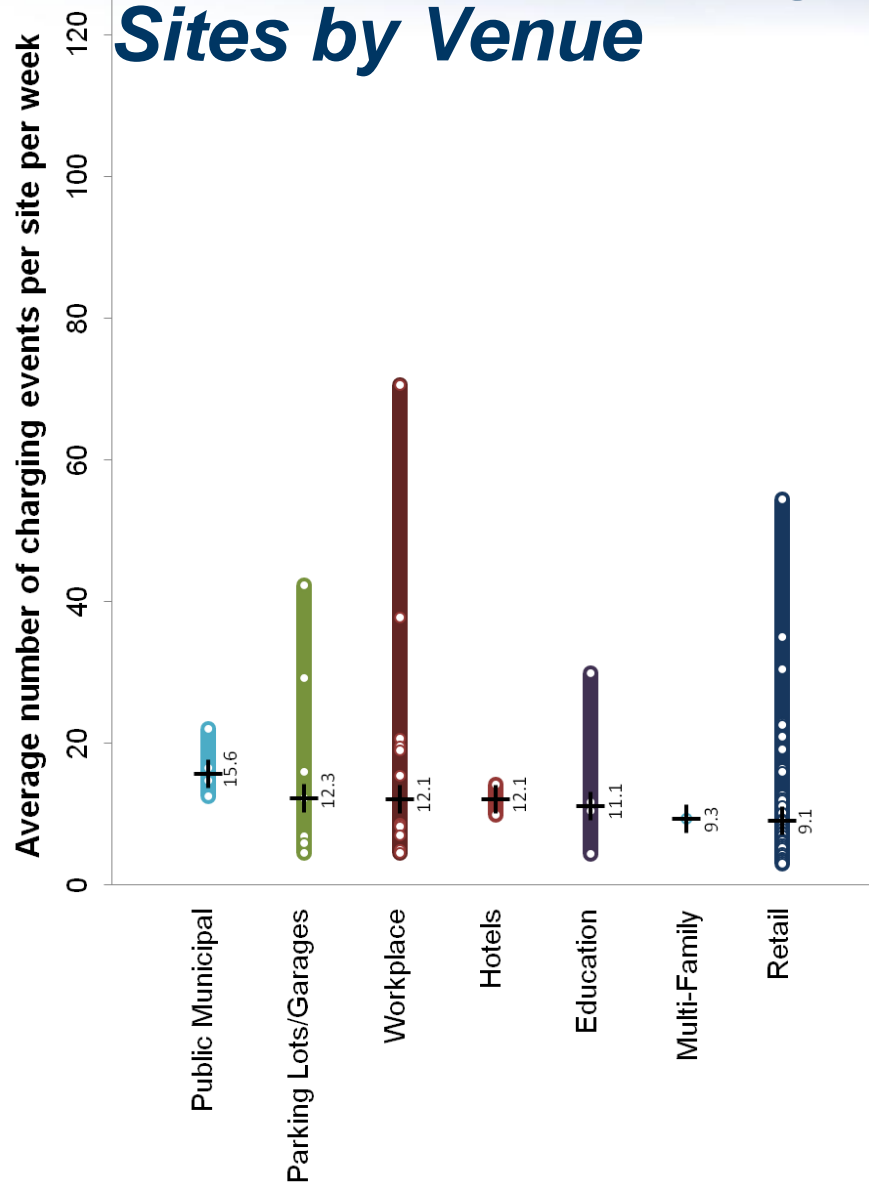


Distribution of Usage Frequency of Blink DCFC Sites by Venue

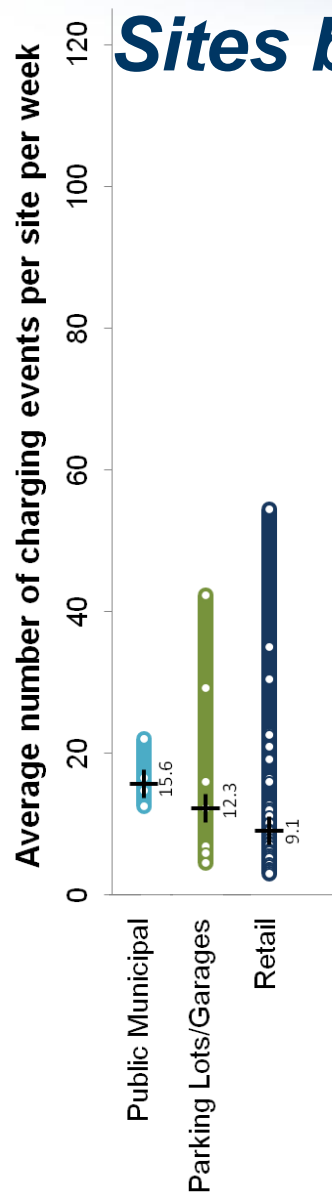


8/1/2013 to 1/1/2014 (after Blink network fees were instituted)

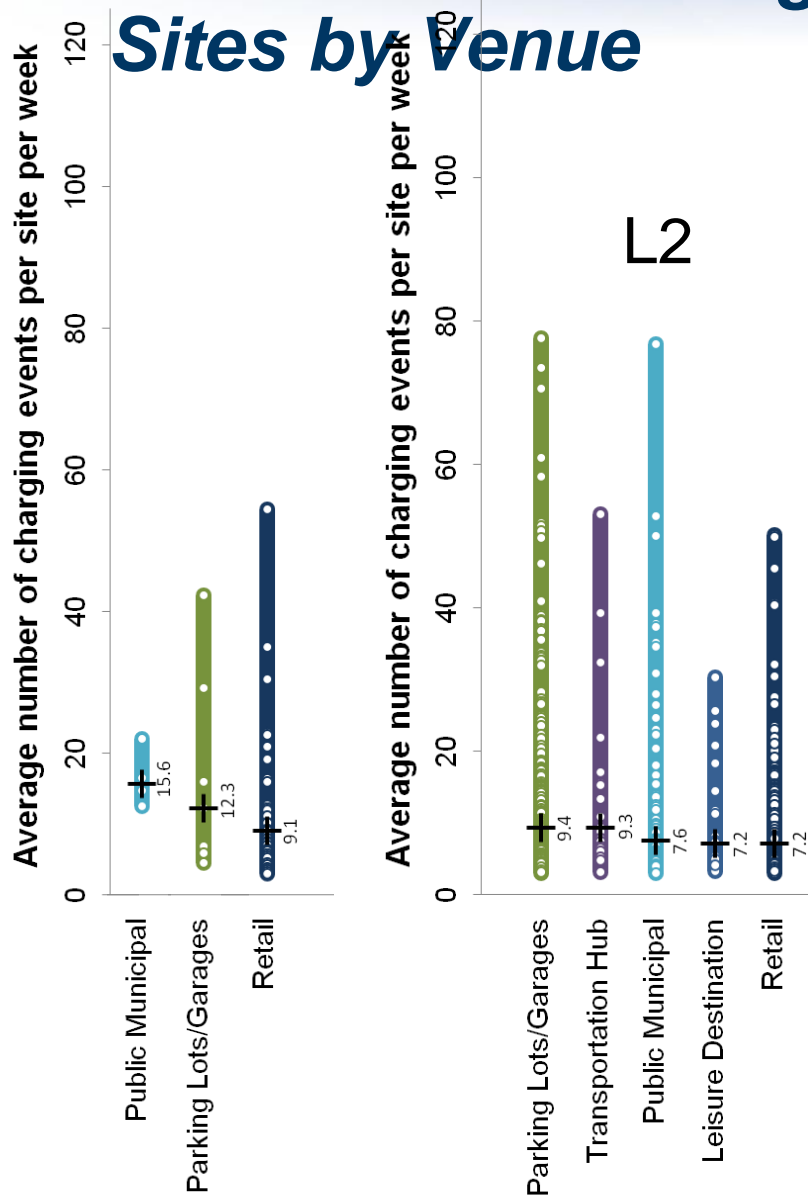
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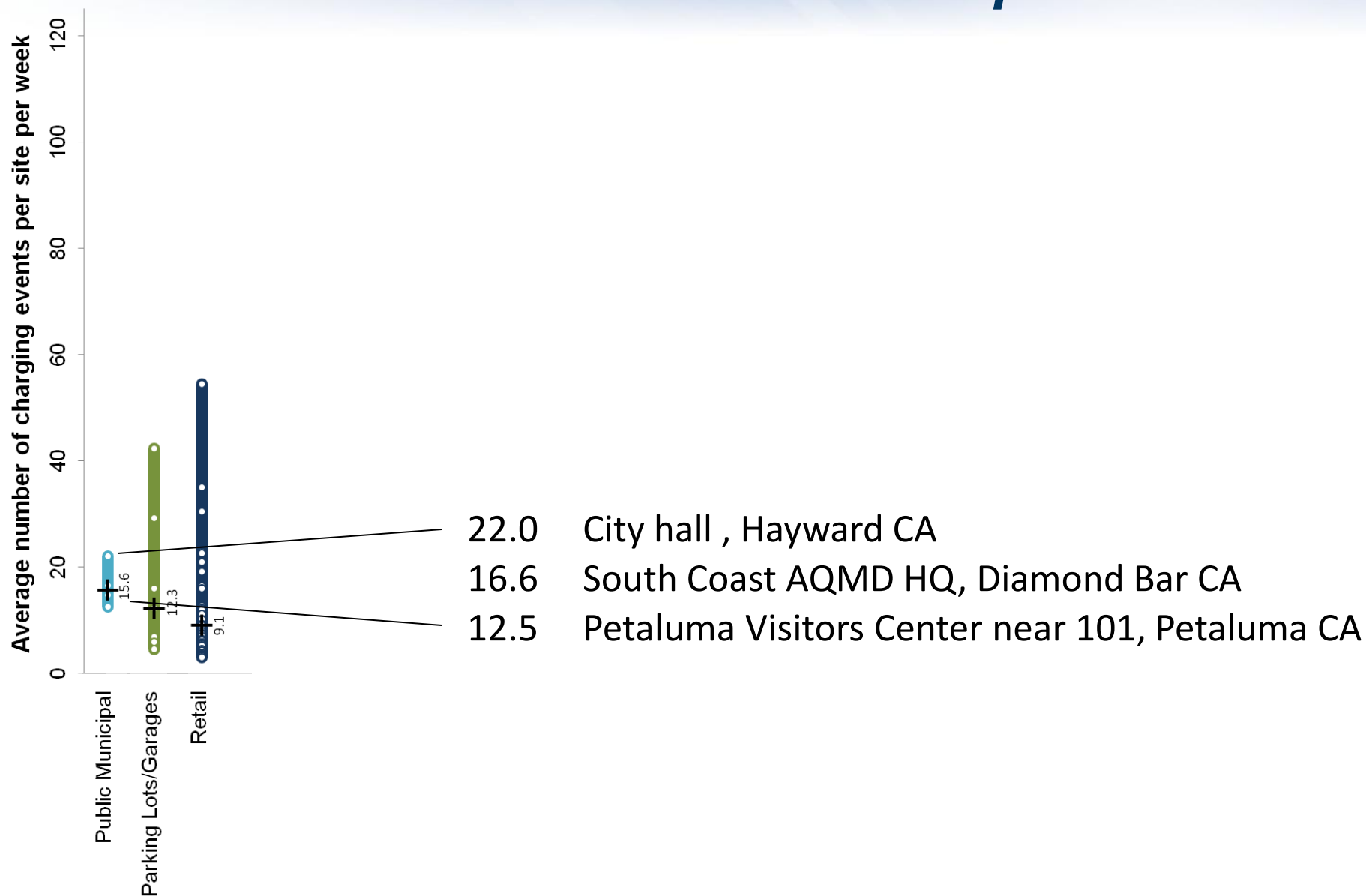
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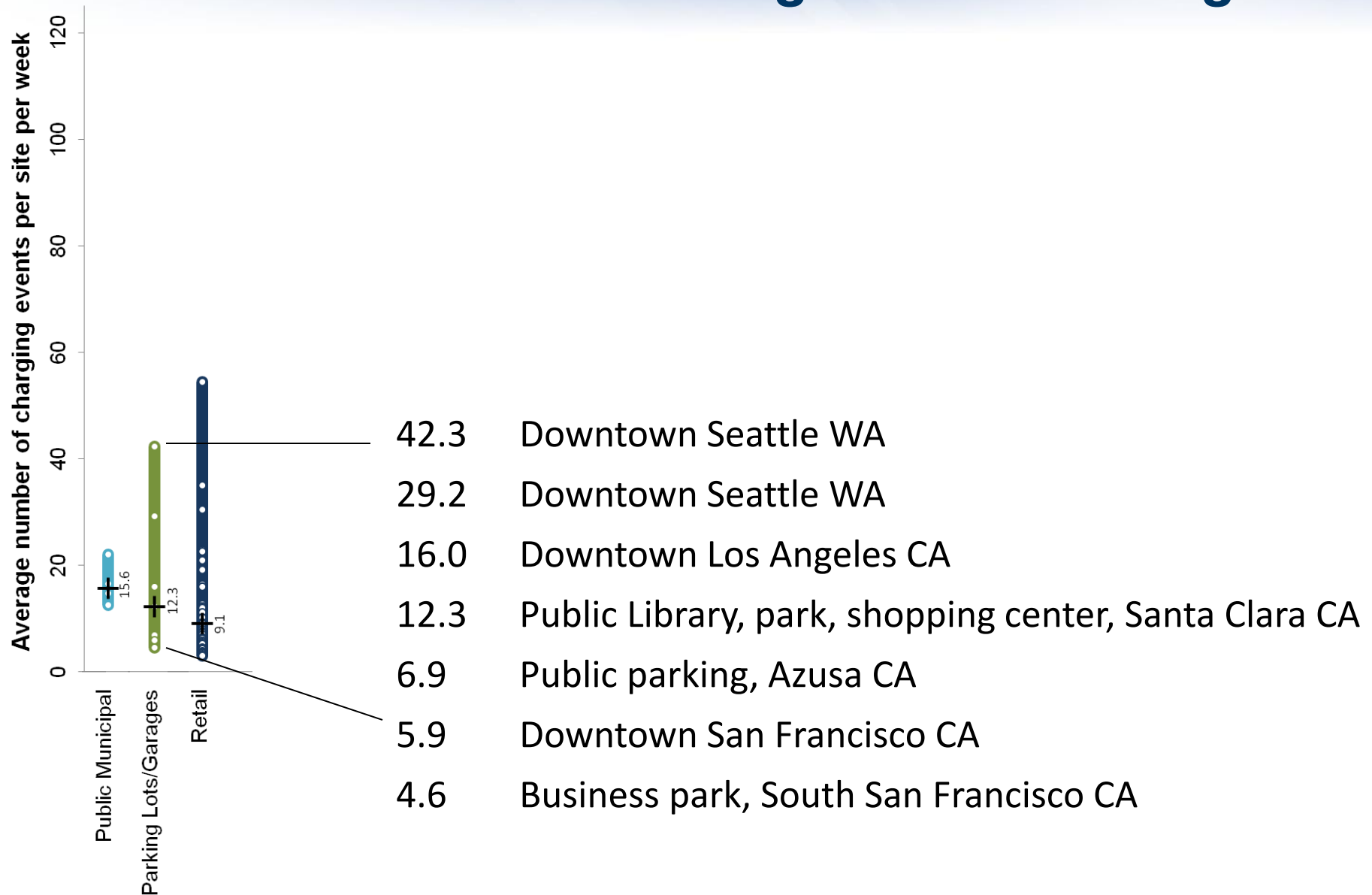
Distribution of Usage Frequency of Blink DCFC Sites by Venue



Blink DCFC Sites – Public / Municipal



Blink DCFC Sites – Parking Lots and Garages



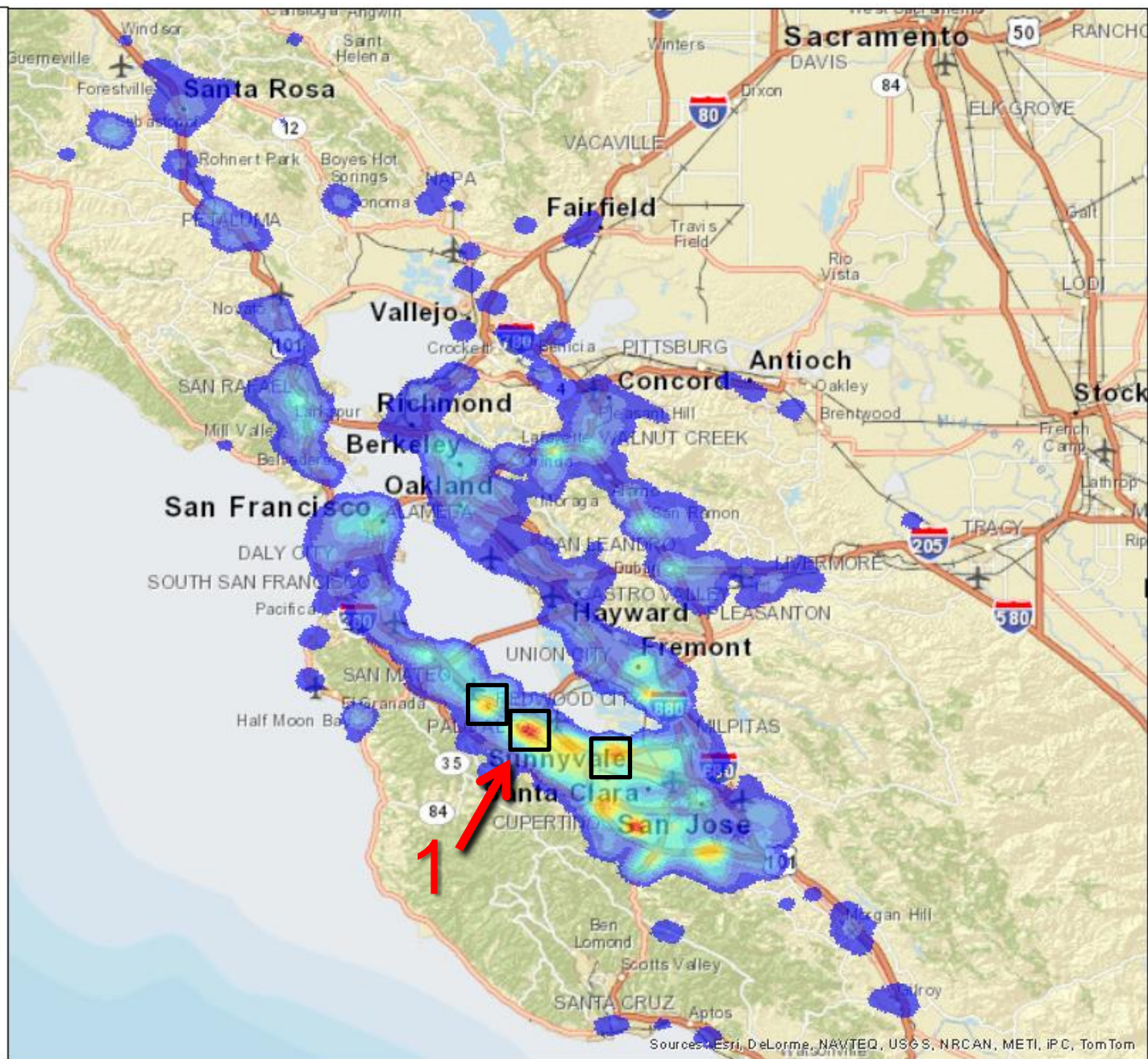
Blink DCFC Sites – Retail



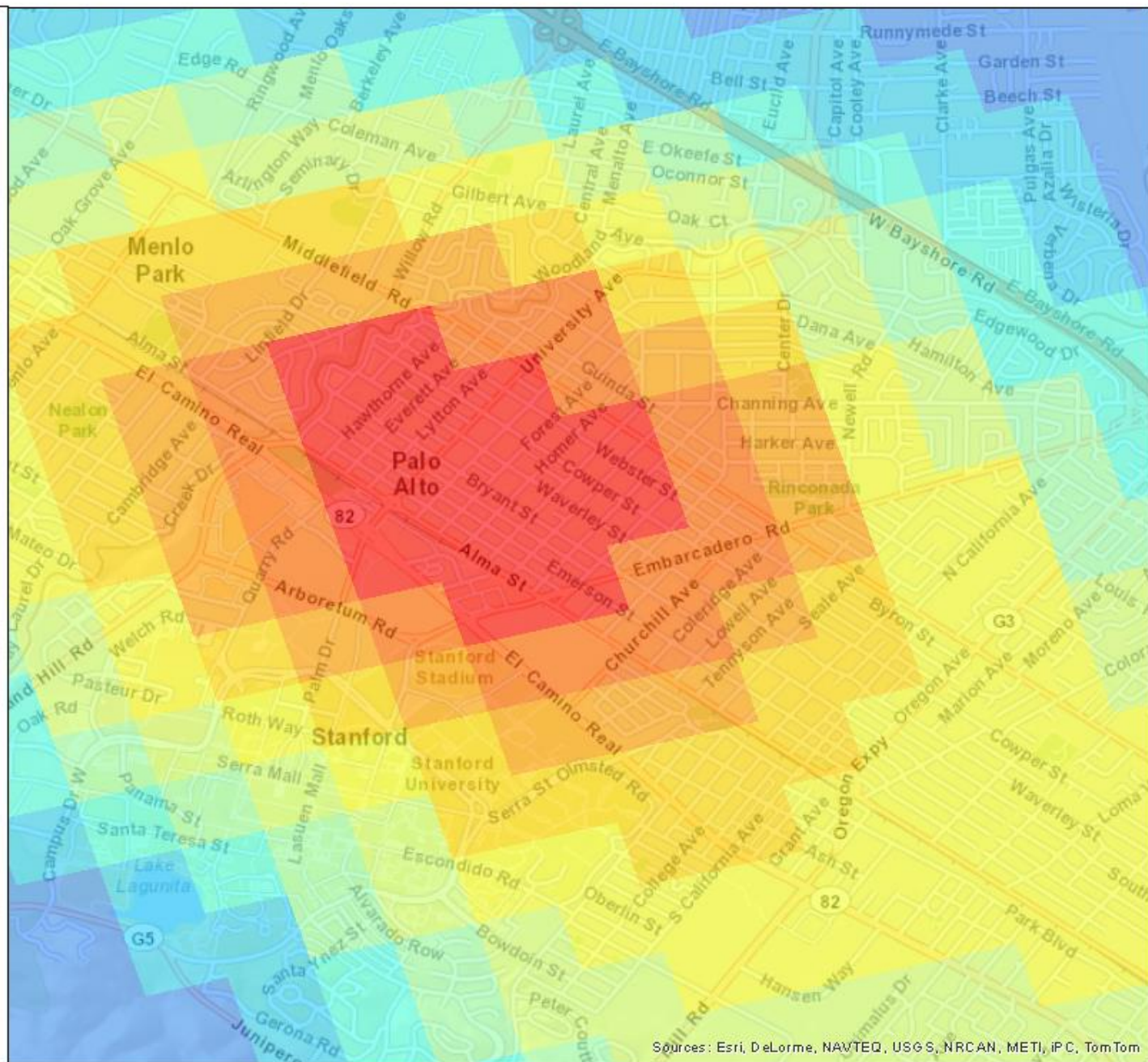
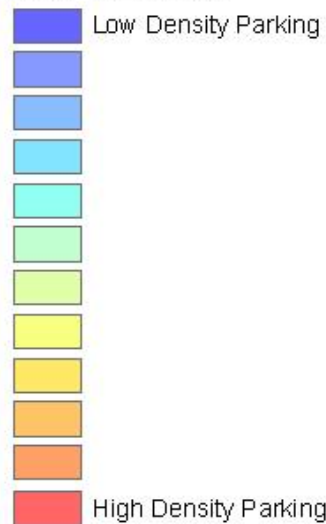
Identifying Hot Spots Using Vehicle Data

- EV Project Leaf away-from-home parking location density in San Francisco Bay Area
- Cumulative through the end of 2013

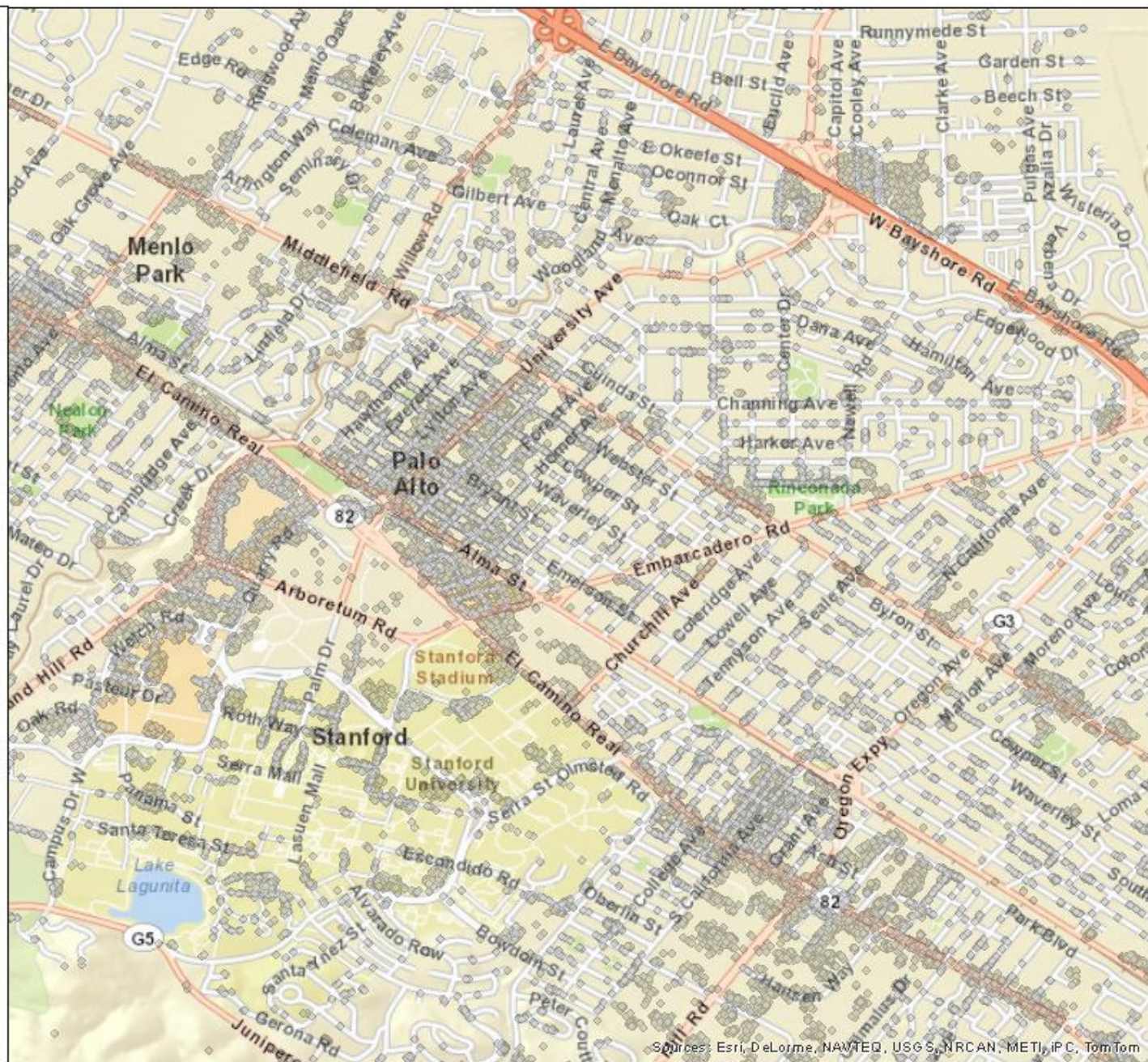
Leaf Heat Map



Leaf Heat Map



Leaf Heat Map













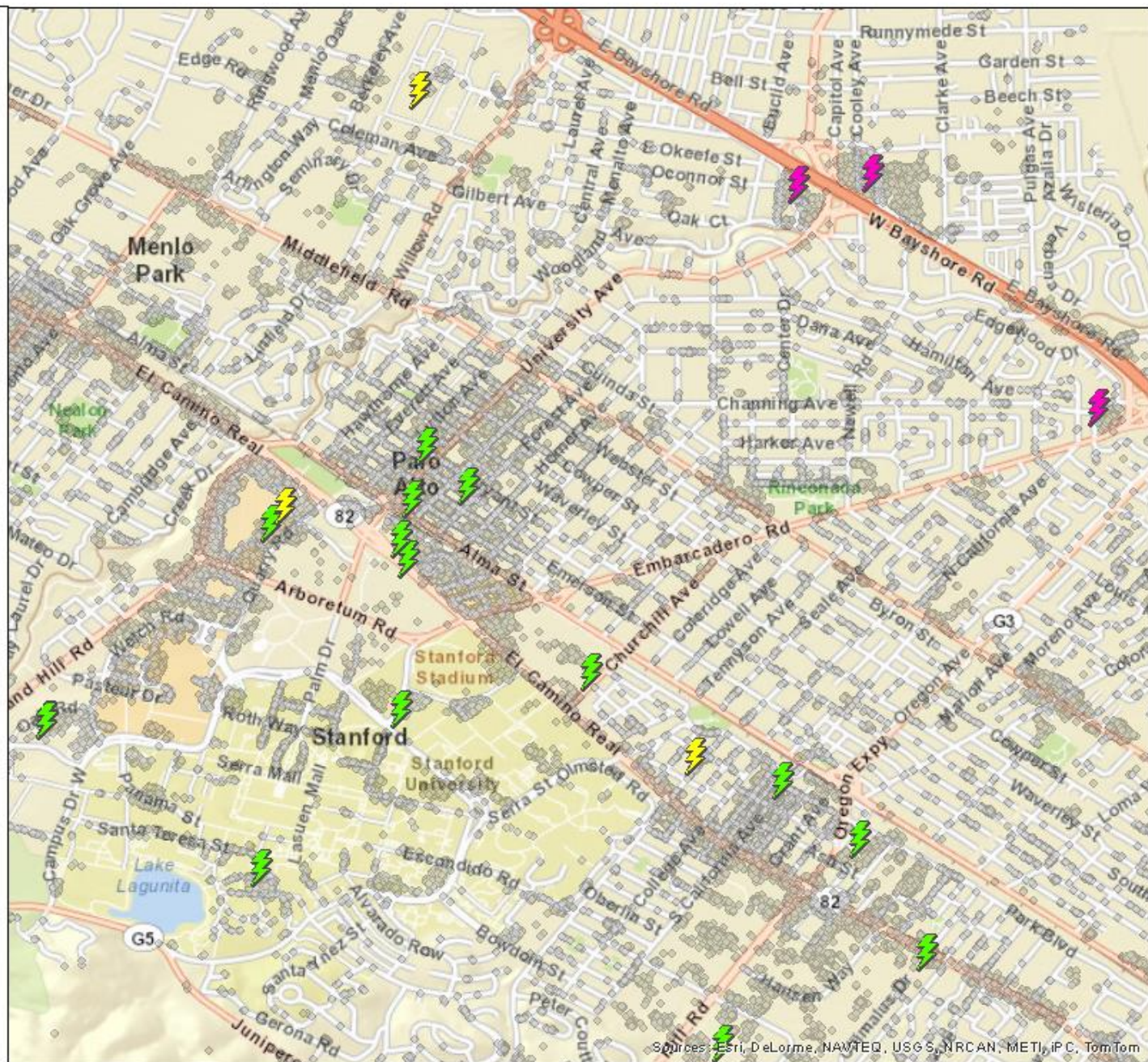
Sources: Esri, DeLorme, NAVTEQ, USGS, NRCAN, METI, IPC, TomTom

EVSE

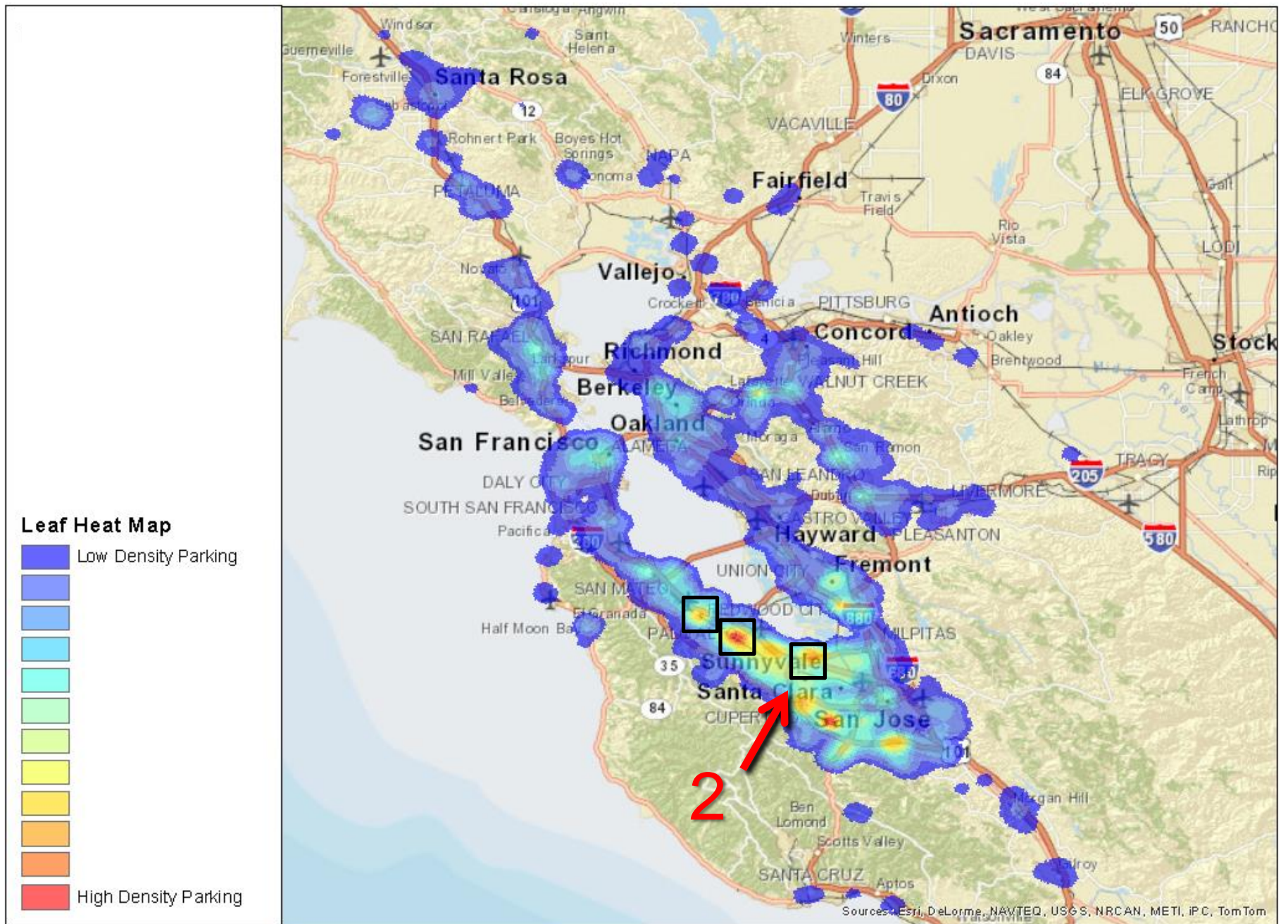
-  Private EVSE
-  AeroVironment Network
-  Blink Network
-  ChargePoint Network
-  Greenlots
-  OpConnect
-  RechargeAccess
-  SemaCharge Network
-  Shorepower
-  eVgo Network

Leaf Heat Map

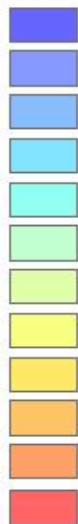
-  Low Density Parking
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-  High Density Parking



Sources: Esri, DeLorme, NAVTEQ, USGS, NRCAN, METI, IPC, TomTom

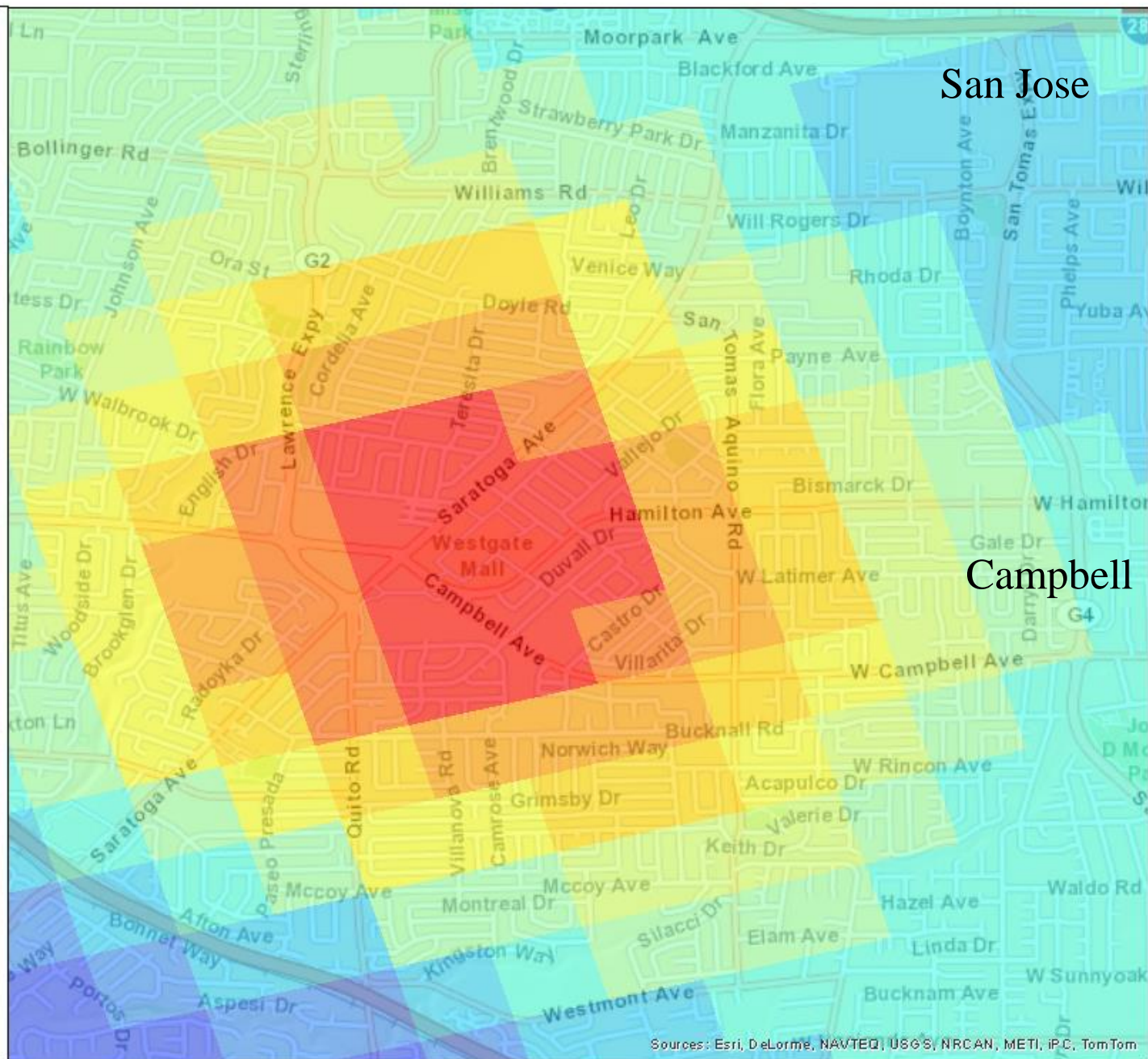


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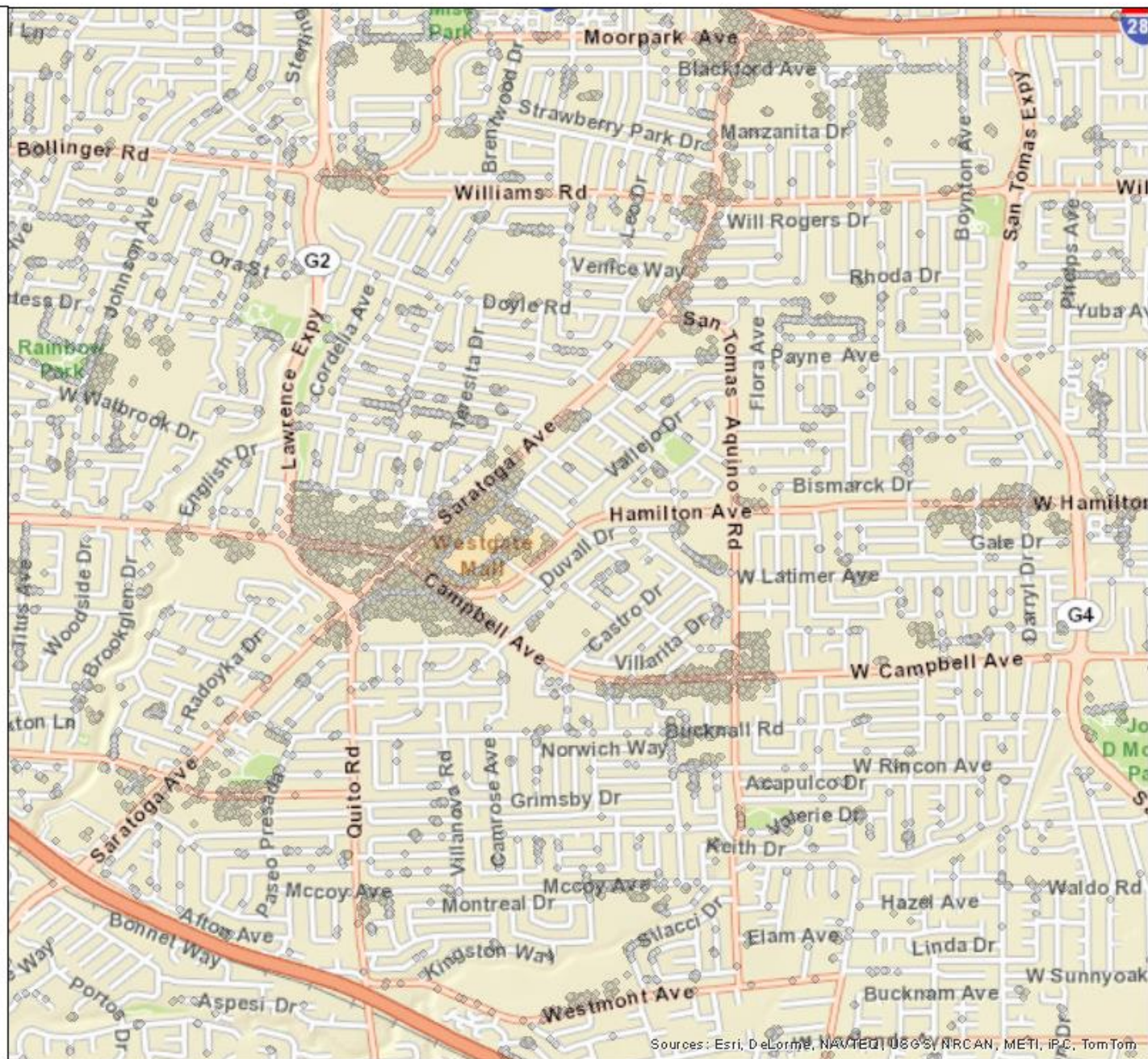
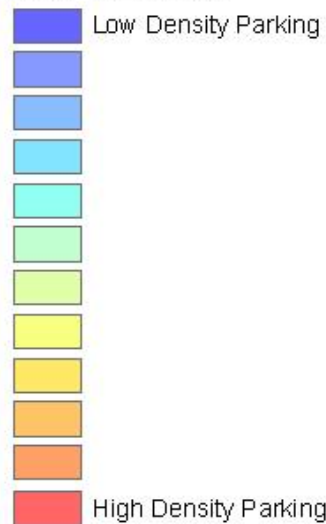


Low Density Parking

High Density Parking



Leaf Heat Map

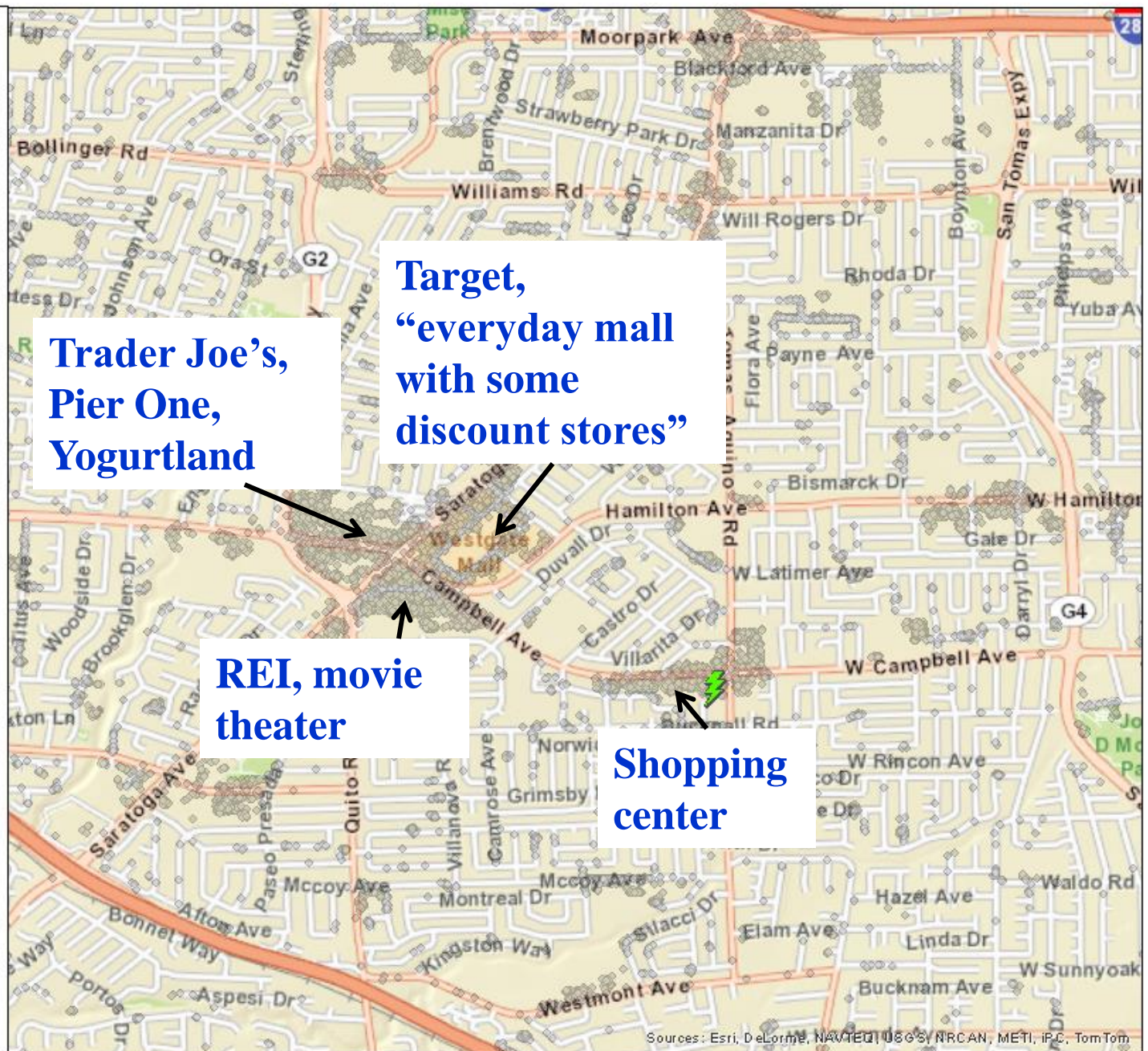


EVSE

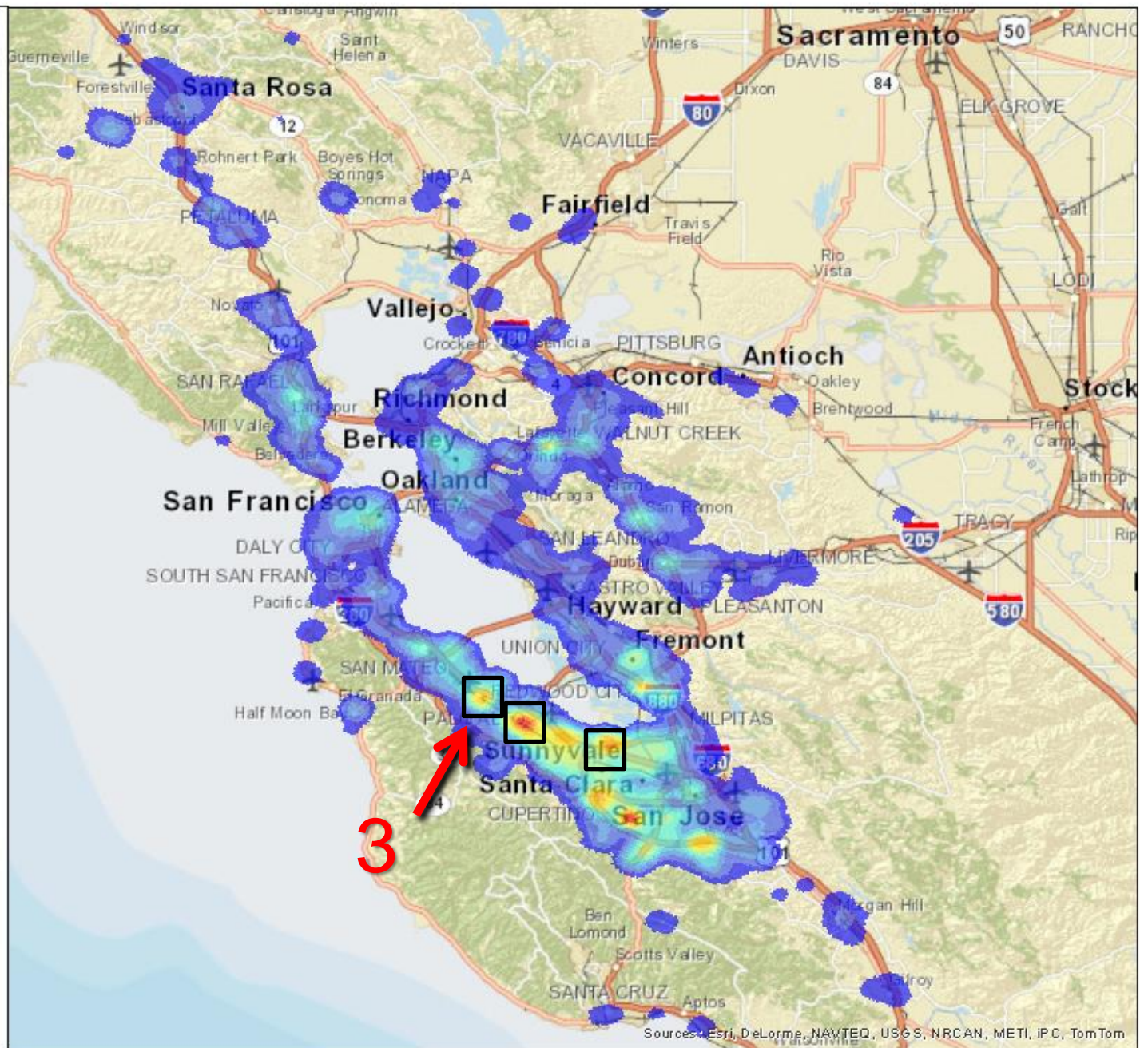
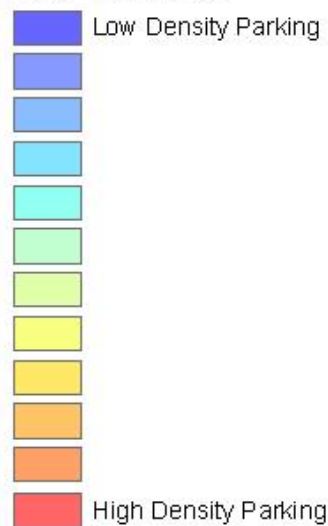
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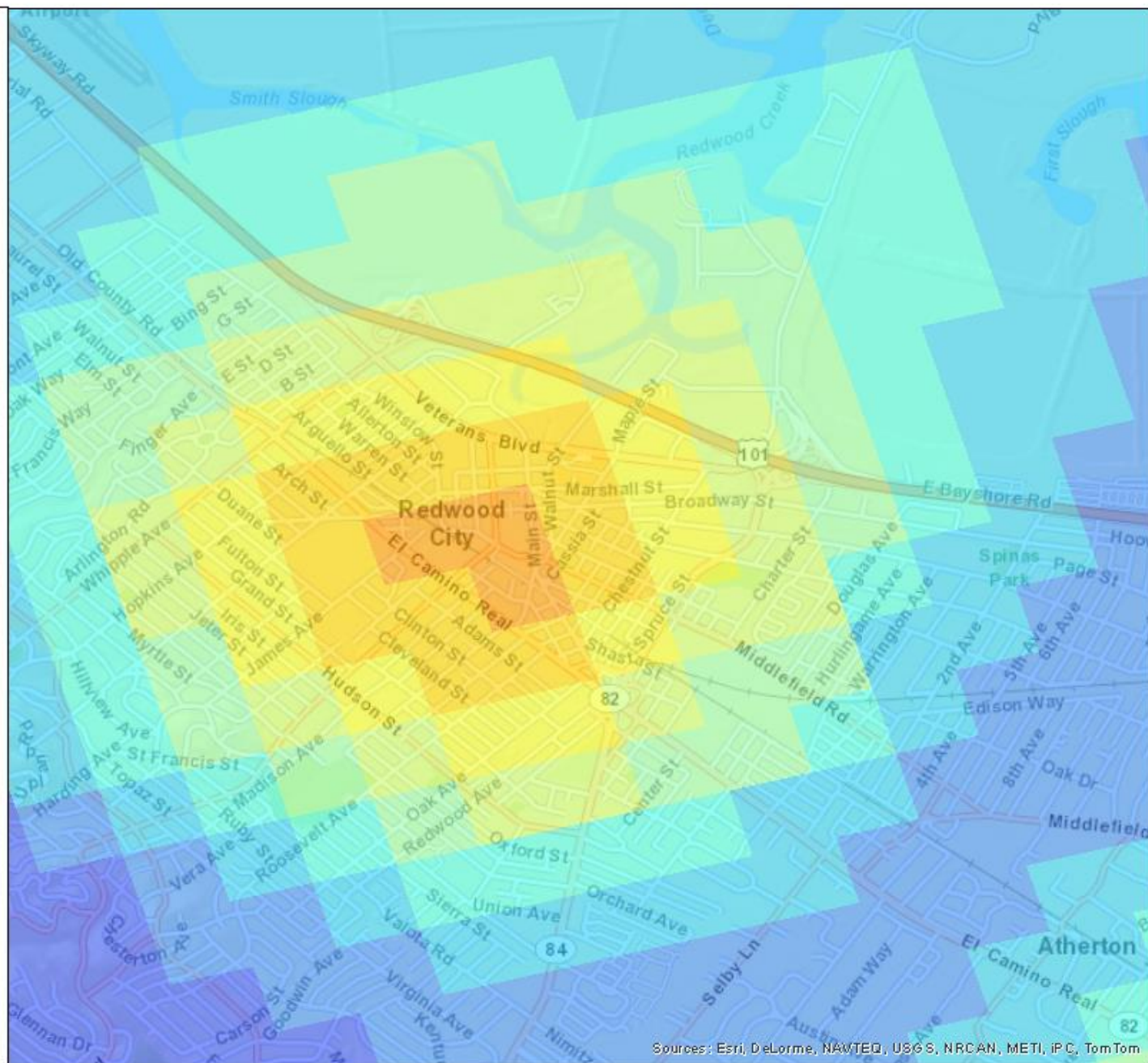
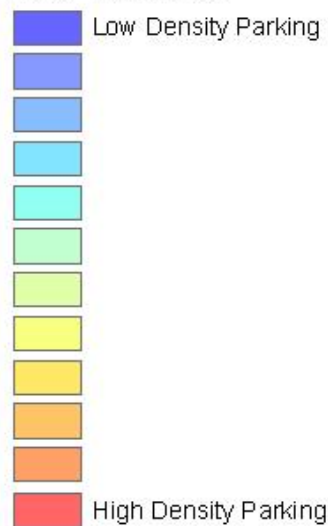
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- High Density Parking



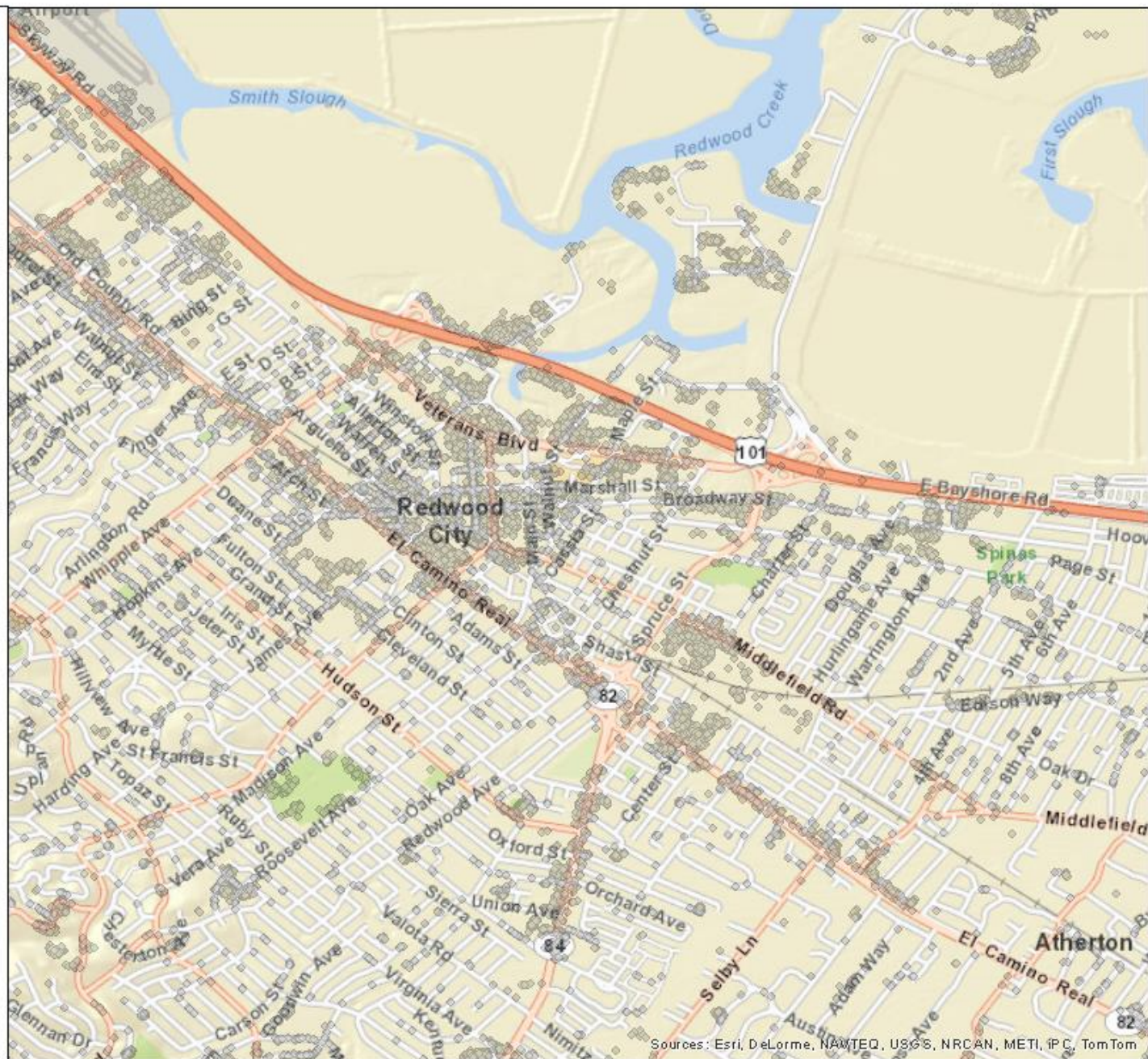
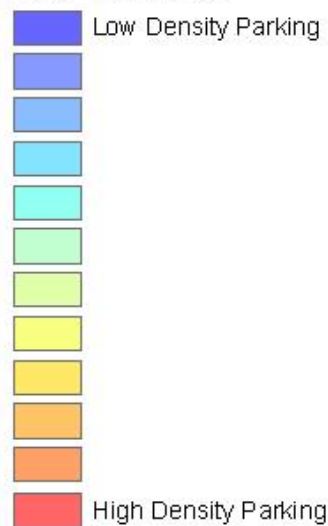
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







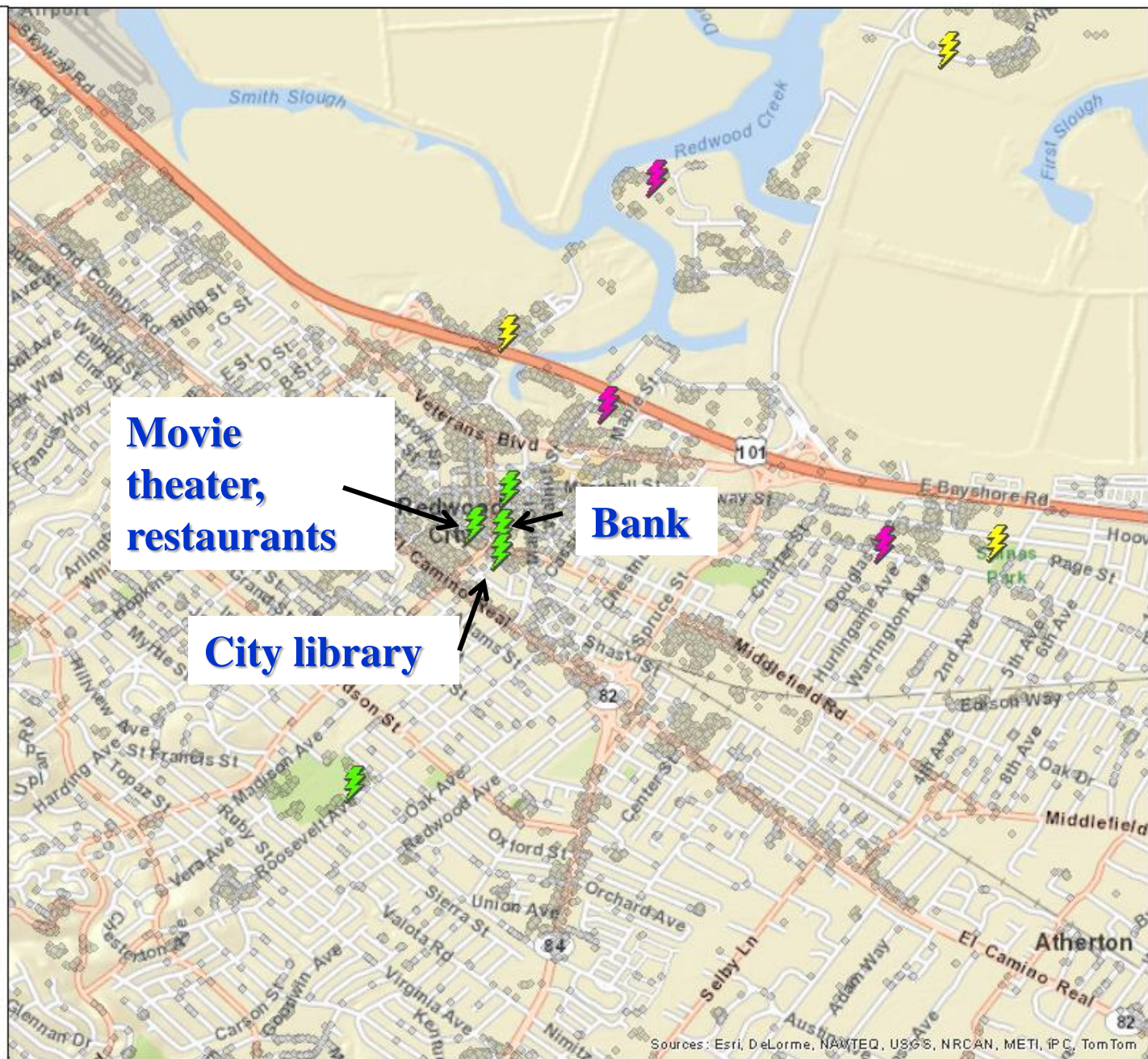
Sources: Esri, DeLorme, NAVTEQ, USGS, NRCAN, METI, IPC, TomTom

EVSE

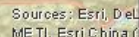
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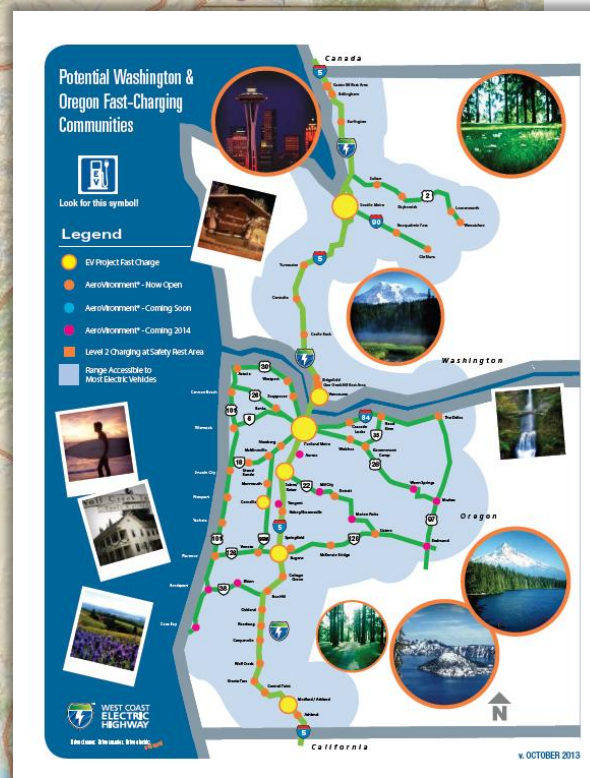
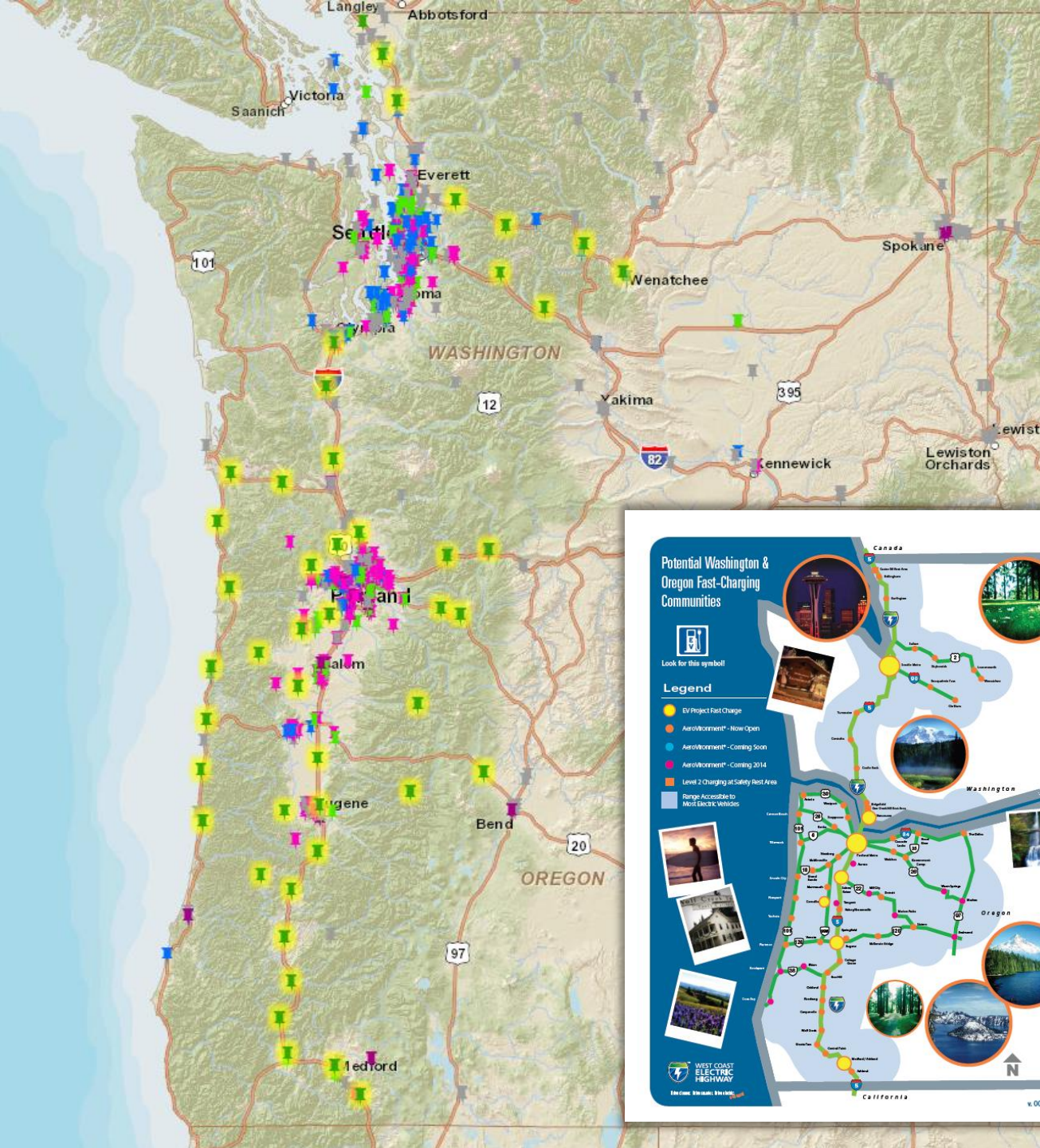


Sources: Esri, DeLorme, NAVTEQ, USGS, NRCAN, METI, IPC, TomTom



AeroVironment DCFCs near the I-5 Corridor in OR & WA

- AV DCFCs highlighted in yellow
- Other publicly available EVSE sites in blue and purple



Additional Information

Published since last meeting:

- Leaf vs. Volt eVMT
- Workplace charging case study: Facebook Offices, Menlo Park

Publications coming soon:

- Leaf away-from-home infrastructure usage vs. eVMT
- Usage of public EVSE at different venue types
- Additional Workplace charging case studies and driver behavior
- PEV travel on the OR/WA I5 corridor
- EVSE installation costs

For all EV Project and ChargePoint America publications, visit

avt.inl.gov/evproject.shtml
avt.inl.gov/chargepoint.shtml

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

BACKGROUND INFO

Measures of “Goodness”

There are numerous ways to assess how “good” public charging sites are:

- Charging frequency: number of charge events per day or week
- Charging time: hours connected
- Charging energy: kWh consumed / EV miles provided
- Parking time: time spent in parking space / in store
- Charging site host may want electric vehicle supply equipment (EVSE) for other reasons, such as image or cool factor
- etc.

Terminology

Charging site



Dual-port
DC fast charge
EVSE unit or
charging station

Charge port or
cord



Single-port
AC Level 2
EVSE unit or
charging station

Charging site

Dual-port
AC Level 2
EVSE unit or
charging
station

Dual-port AC
Level 2 EVSE
unit or
charging
station

Charge
port or
cord



Public EVSE Usage Fees

Blink usage fees

- Public AC Level 2 fees started Jul – Aug 2012
 - Varies from \$1.00 to \$2.00 **per hour connected**
 - 16% of sites were still free as of Dec 31, 2013 (per local site host discretion)
- DC Fast Charger fees started Jul 2013
 - \$5 for Blink member / \$8 for non-member **per session**

ChargePoint usage fees

- Vary by site (per local site host discretion)
- Many are free

Charging Site Location Considerations

- EVSE installations with respect to Americans with Disabilities Act (ADA) requirements are not consistent

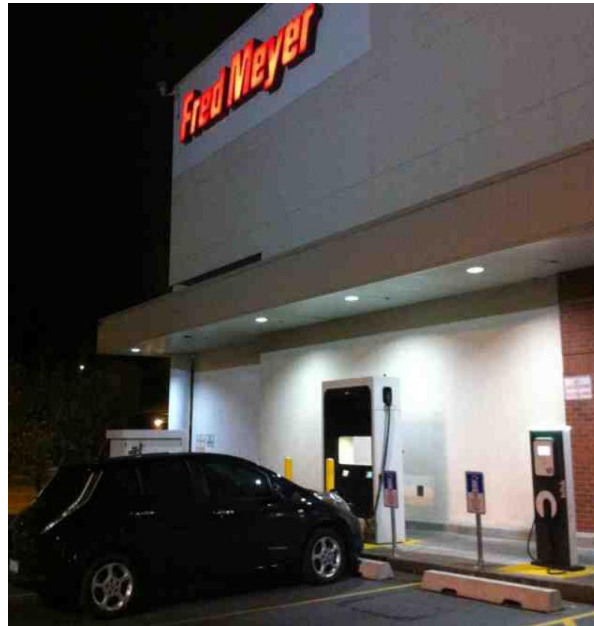
“Charger is between 2 handicap spaces. To charge and not get ticketed you need to park behind the charger in any of 3 spaces closest to the elevator / entrance in non EV dedicated spots. Good Luck.”
– Comment from plugshare.com user

- Parking lot or garage may have
 - limited hours of operation
 - parking fees
 - restricted access



Charging Site Location Considerations

- Parking spaces in front of charging units may not always be accessible
 - Construction
 - Non-electric vehicle in parking spot (“you’ve been ICE’d”)
 - Electric vehicles in parking spots but not charging



Fred Meyer in
Seattle, WA

Photos from
plugshare.com

Charging Site Location Considerations

- Charging unit maintenance and reliability is a big factor

“Both sides [of the DC fast charger] and level 2 not working. Had no electricians left. AAA couldn't send out the EV rescue truck because according to them they didn't have a tech trained to use it on hand. I ended up towing my car home. Not a good night.”

– Comment from plugshare.com user

