

National Charging Costs

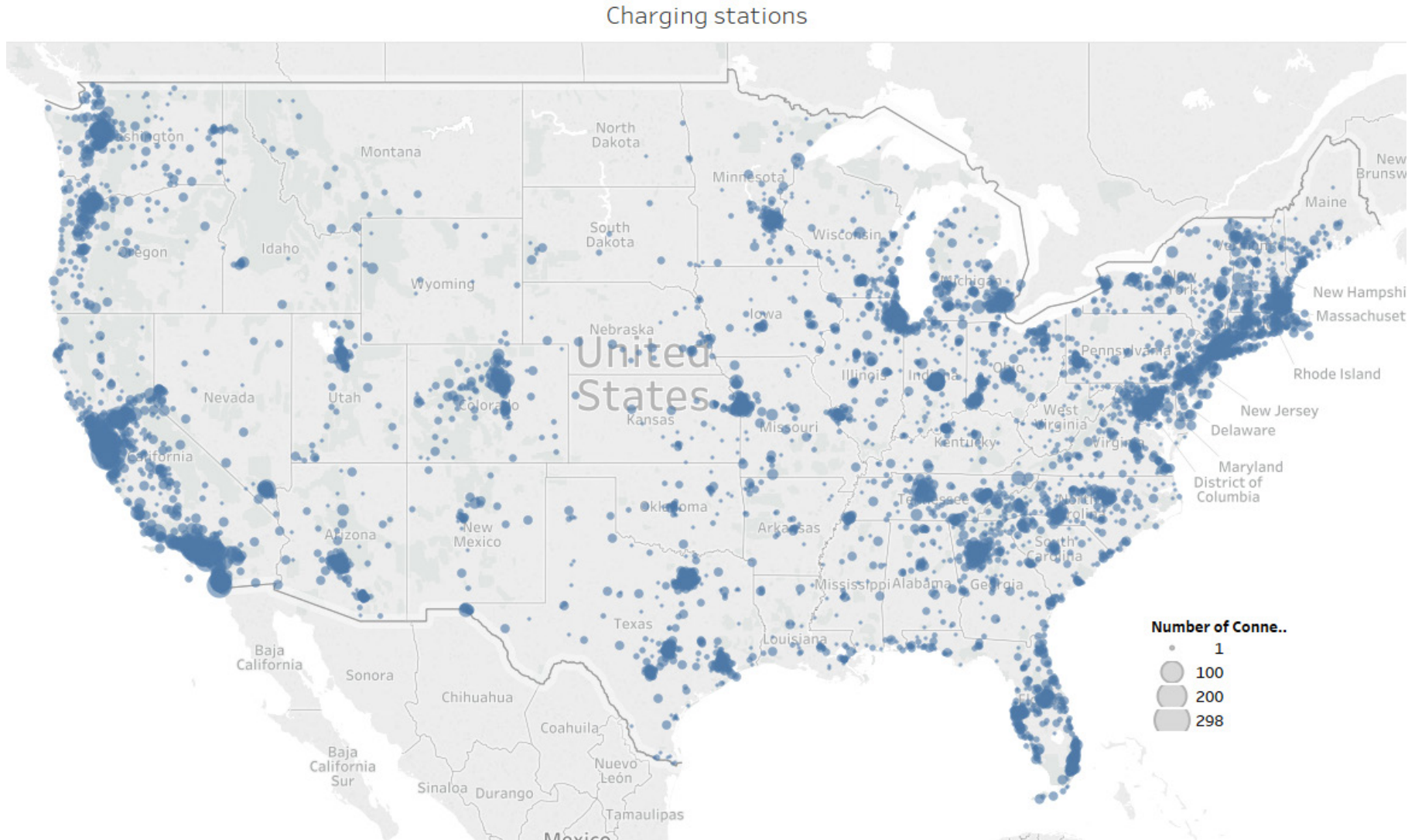
Jamie Dunckley
Engineer/Scientist III

Chanakya Valluri

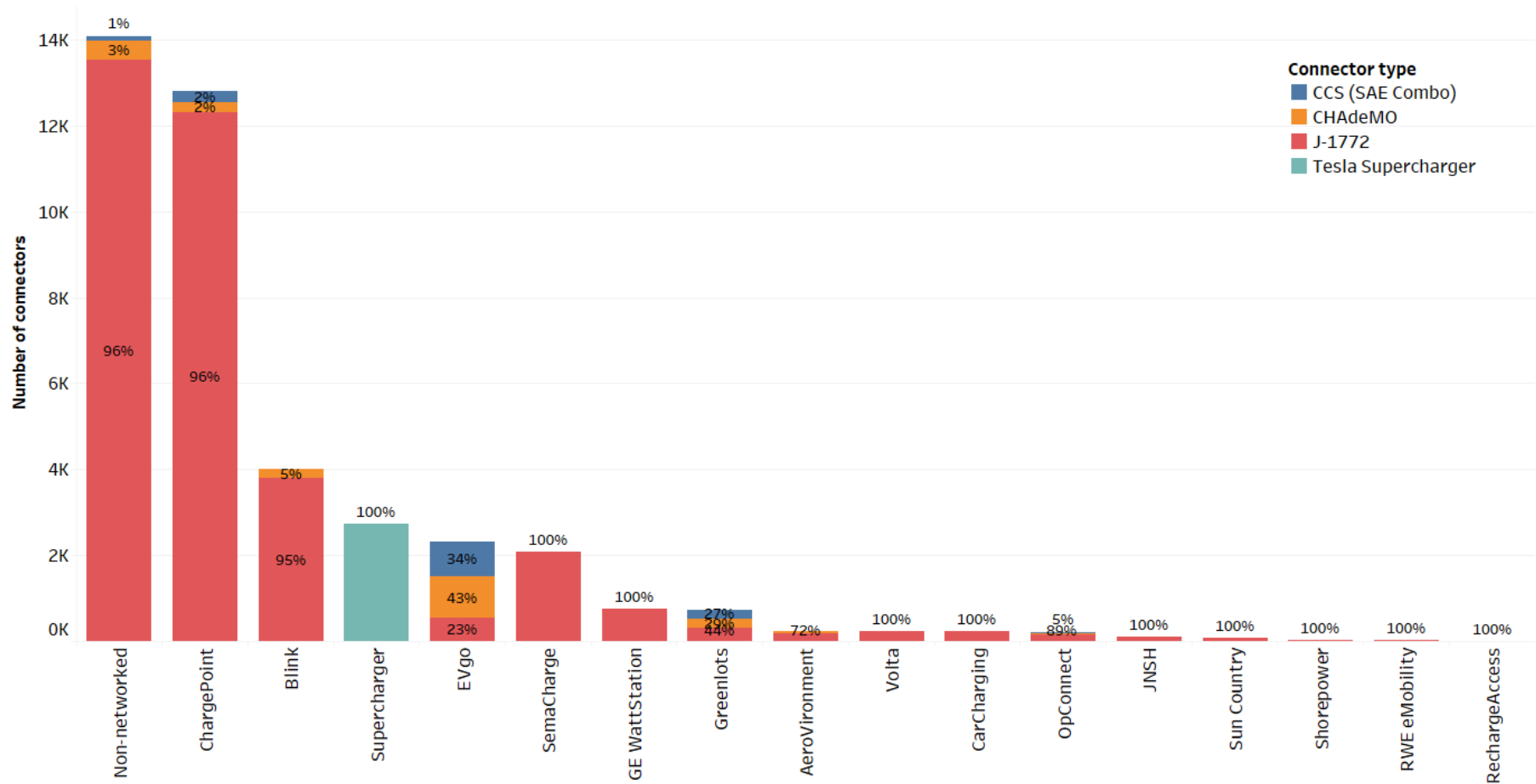
EPRI Fall Advisory 2017



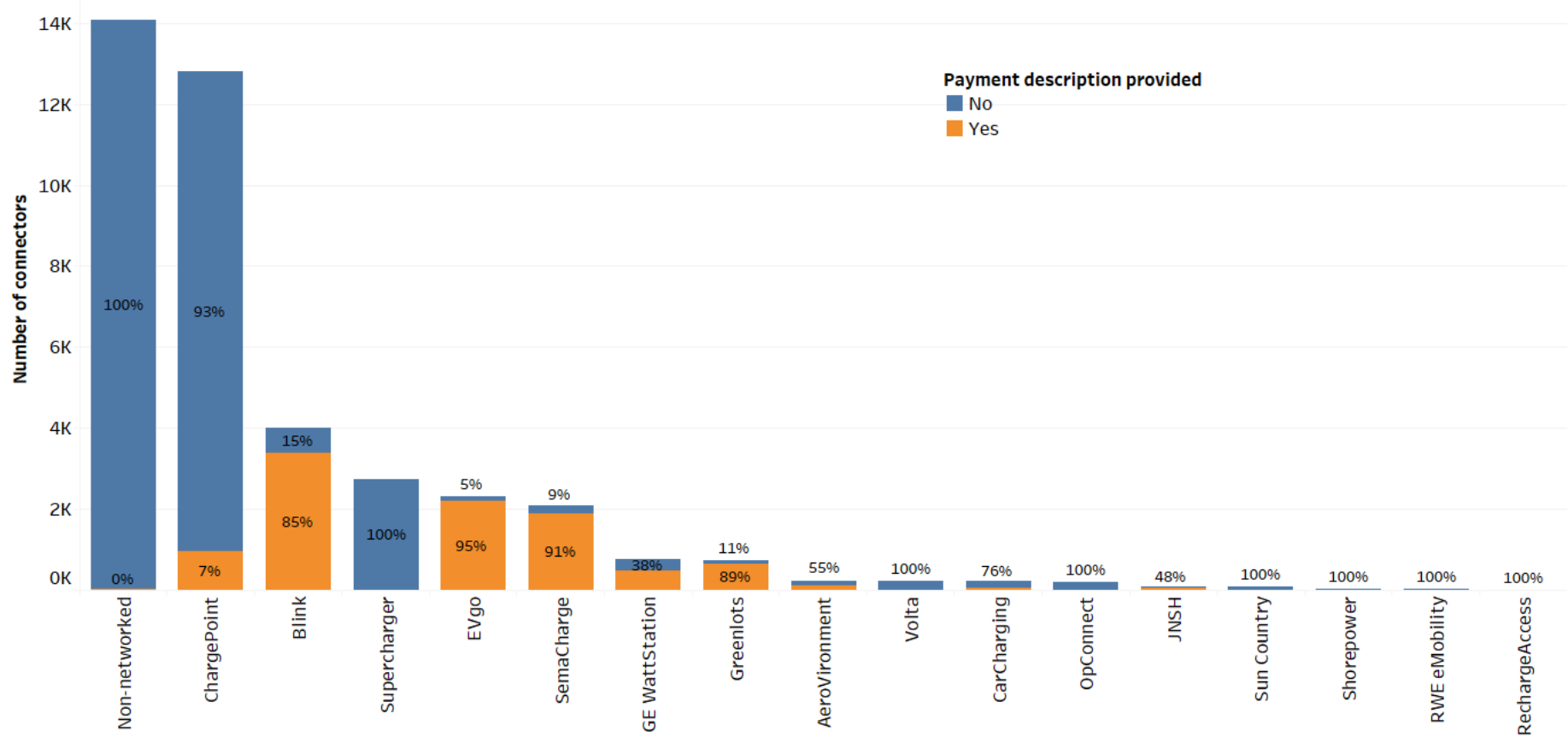
PlugShare Connector locations by zip



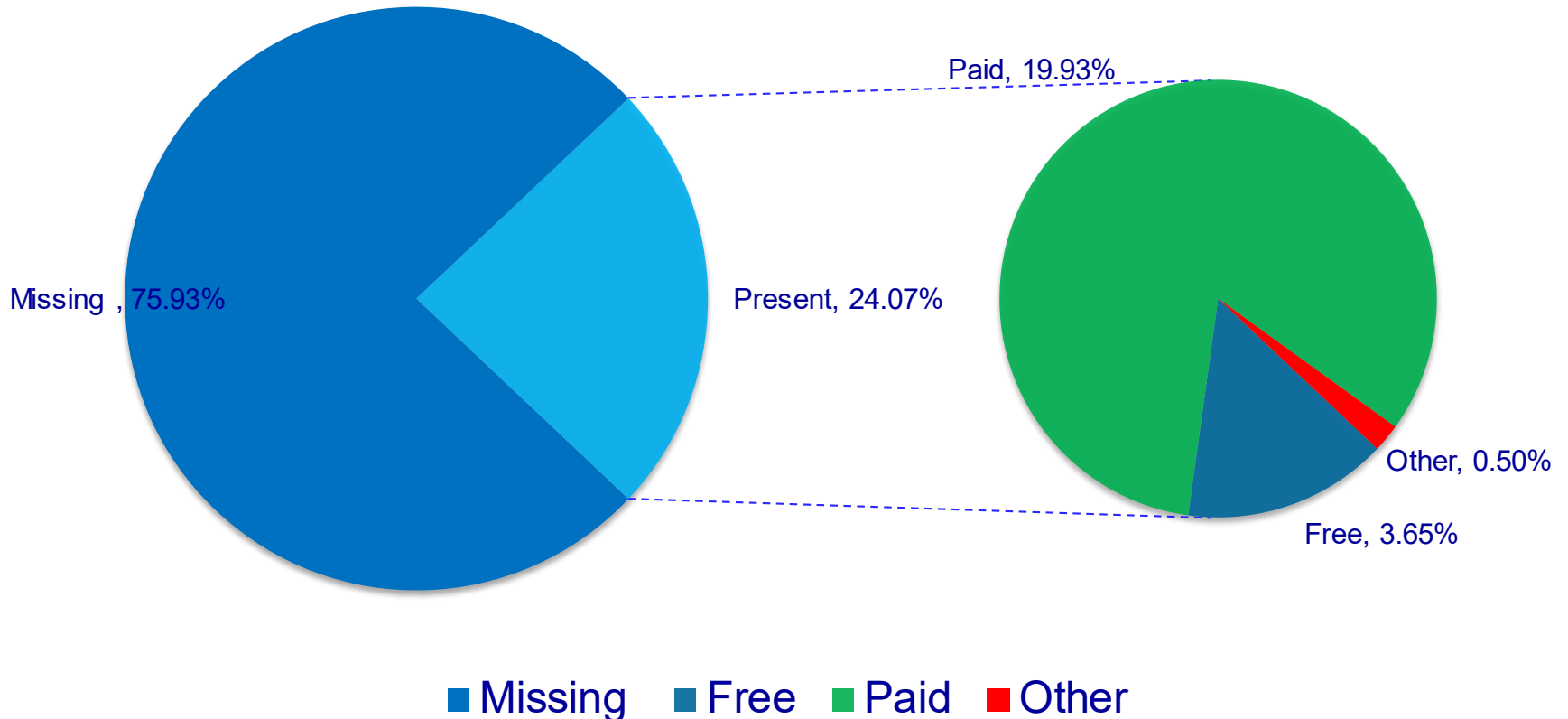
Connector type by Network



Cost information provided? By Network



What percentage of connectors have payment information?



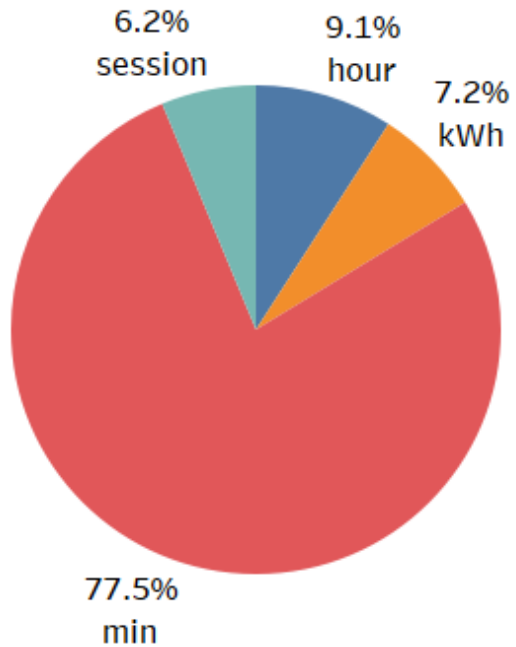
Charging Cost Examples: over 350 unique costs

- \$4 per session
- \$0.03/min
- \$0.69/kWh
- \$2.95/hour, max \$24
- \$0.29 per kilowatt hour (kWh) \$0.50 minimum. First 5 minutes are free.
- \$0.45/hour, min \$0.45, max \$4.50, time limit 10
- \$3.00/session, time limit 8
- \$9.95 for 30 minutes / Level 3 DC
- \$0.00/hour for first 1 hours, \$1.00/hour afterwards
- \$0.00/hour for first 1 hours, \$1.00/hour for next 1 hours, \$2.00/hour for next 1 hours, \$3.00/hour afterwards
- \$1.00 per hour of time connected. Fees continue until car is disconnected even if charging has ended. \$0.50 minimum. First 60 minutes are free.

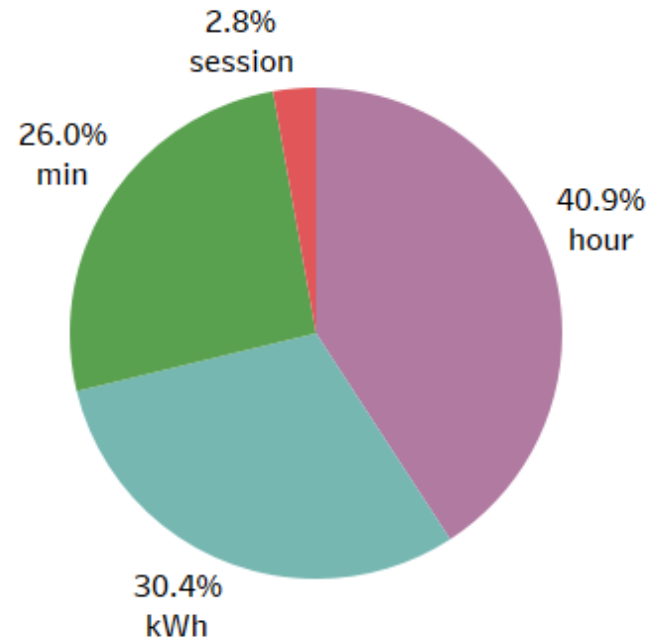
Some locations have cost minimums, some have maximums, and they charge by time, kWh and sessions

Cost Units

DCFC Units



L2 Units



Converting Currency

While the charging stations use kWh, time and sessions to charge, we chose to boil everything down to \$/kWh. We assumed a couple conversions and looked at different charge times and battery sizes to see the variability in costs. We kept L2 and DCFC separate for this analysis.

Charge Level: DCFC (assume 50 kW station)

Case 1: 12 kWh in 15 minutes

Case 2: 24 kWh in 30 minutes

Case 3: 48 kWh in 1 hour

Stations that charge by the session will have vastly different \$/kWh depending on how many kWh were transferred.

Similarly, stations that have a minimum charge will favor longer charge sessions

Example:

If it costs \$9.99 to charge for 30 mins,
 $\$9.99 / 30 \text{ kWh} = \$0.33/\text{kWh}$

Charge Level: L2 (assume 6.6 kW station)

Case 1: 6.6 kWh in 1 hour

Case 2: 13.2 kWh in 2 hours

Case 3: ~20 kWh in 3 hours

Example:

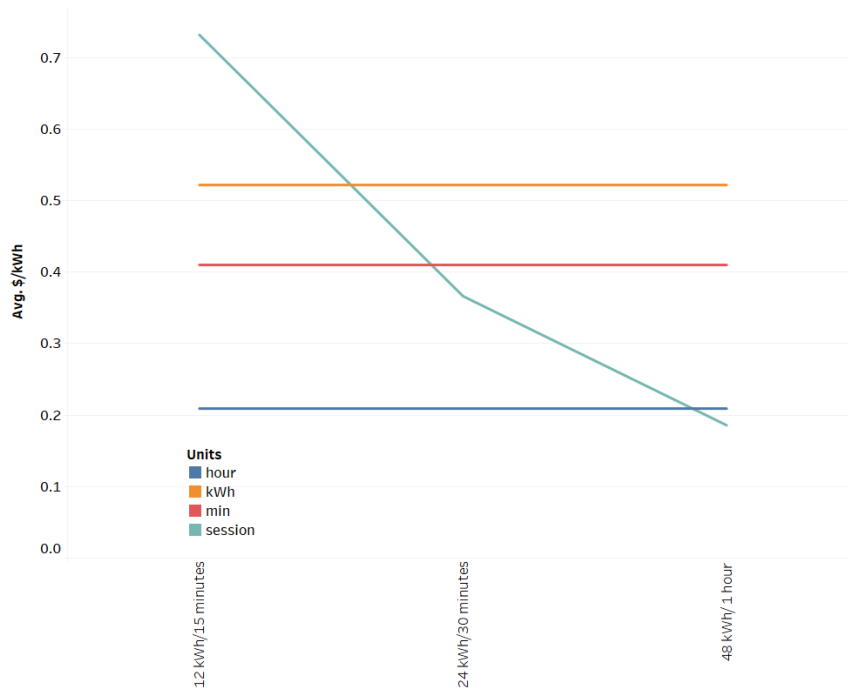
If it costs \$2.95/hour to charge,
for 3 hours it costs:

$(\$2.95 * 3) / 20 \text{ kWh} =$
 $\$0.44/\text{kWh}$

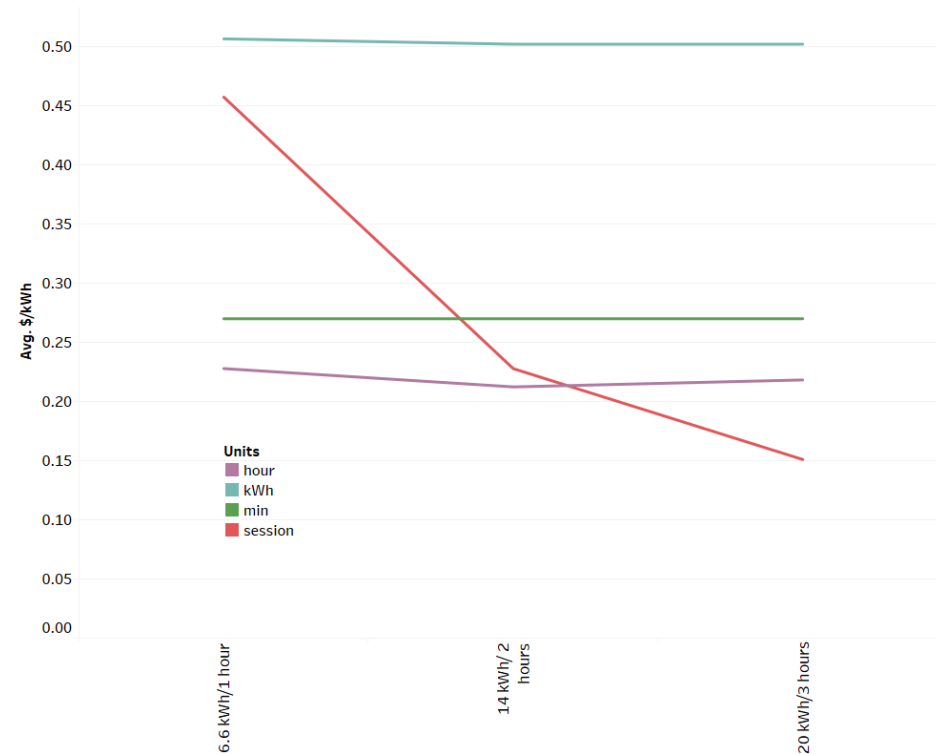
Cost by kWh and time

It is interesting to note that while charging by the hour and charging by the minute is the same, stations that post their rates by the minute tend to be more expensive than those that post their rates by the hour. Stations that charge by kWh are on average most expensive.

Charge Level: DCFC (50 kW)

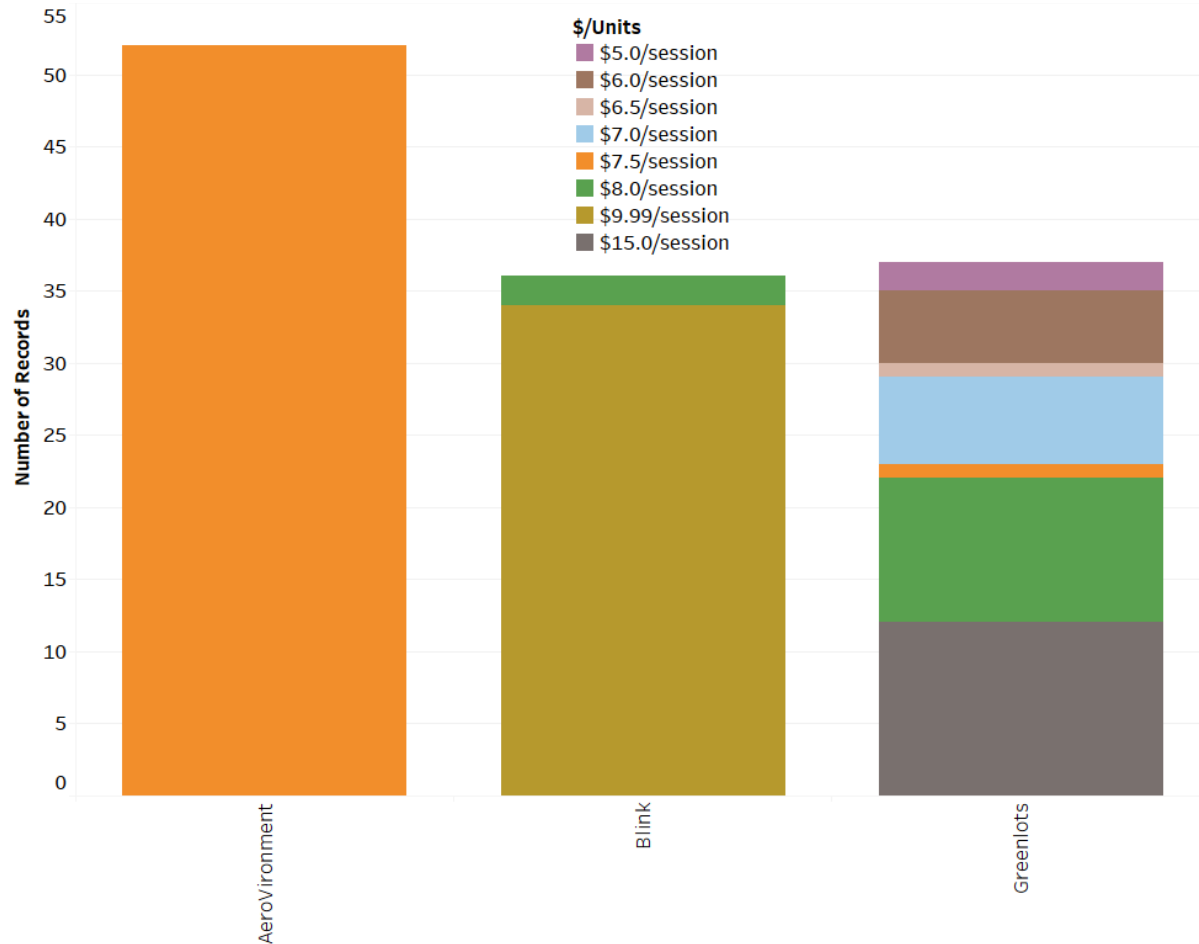


Charge Level: Level 2 (6.6 kW)



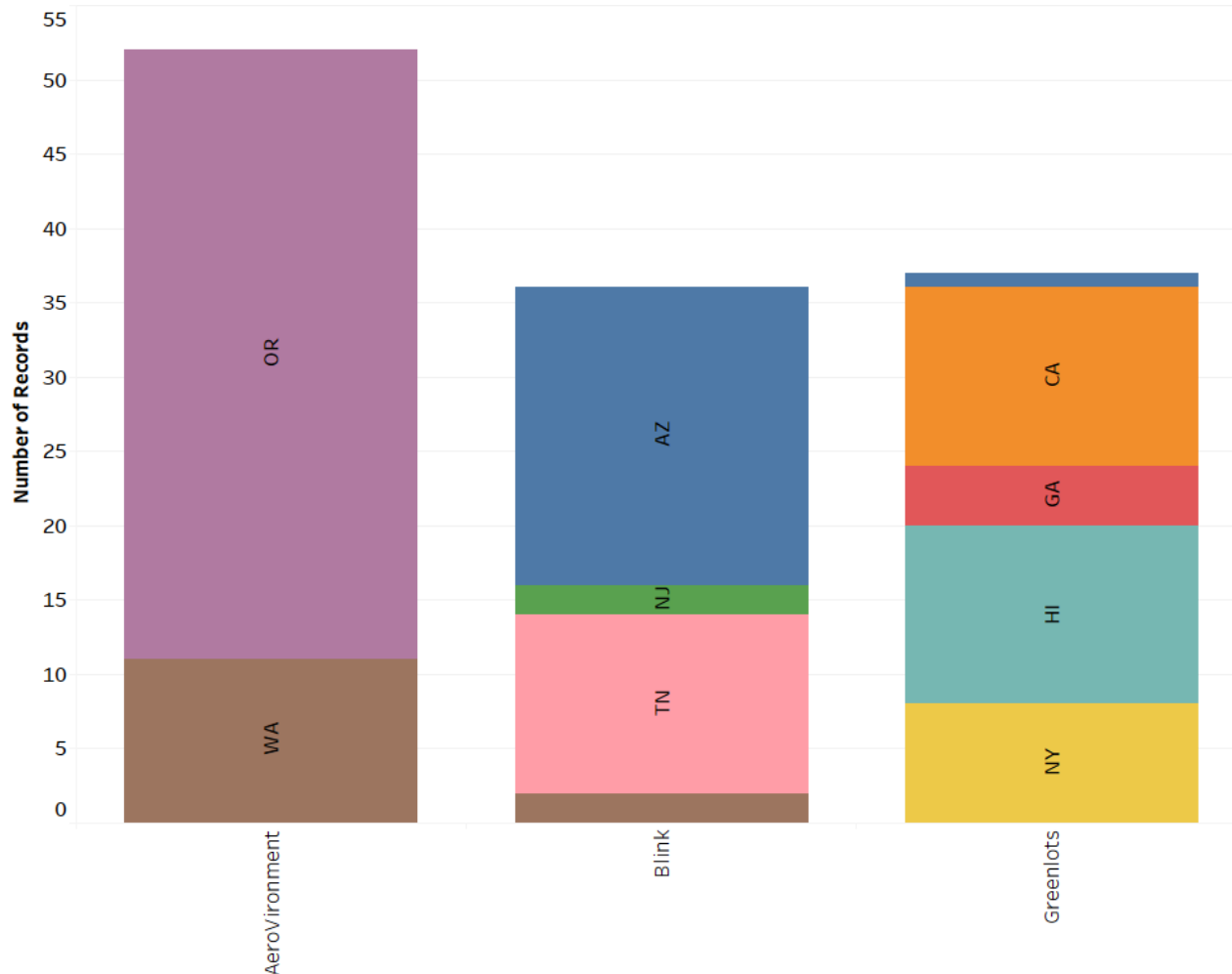
While the \$/kWh is relatively constant over the different charge times, the session stations are very different. The session charging stations will be investigated separately and will be removed from the rest of the analysis to not skew the results since there are relatively few charging stations that are charging by session.

Charging stations: Charging by session (\$), DCFC



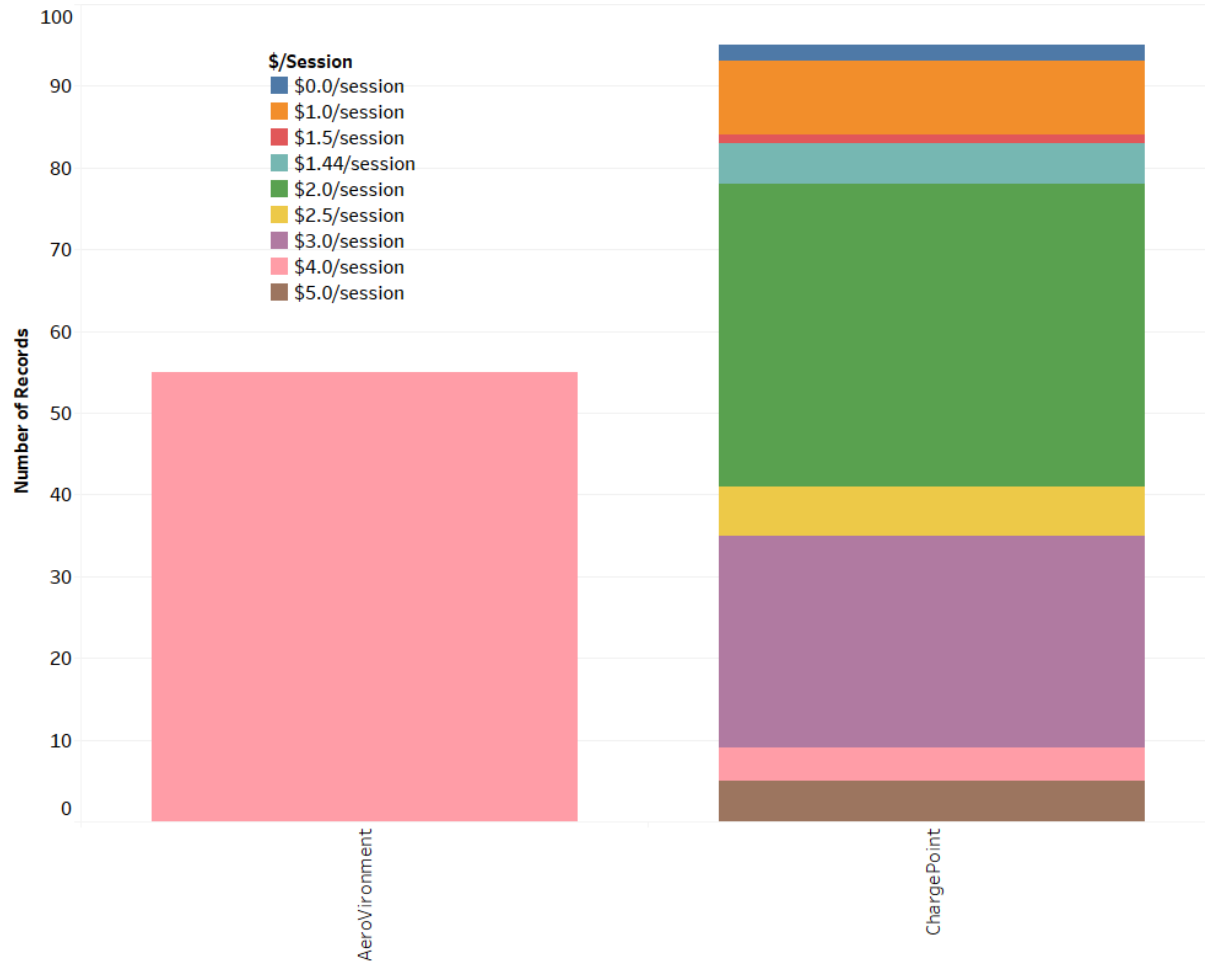
Of the data that we have, currently, 3 networks charge by session at their DCFast chargers. Price breakdown is shown.

Charging stations: Charging by session (state), DCFC



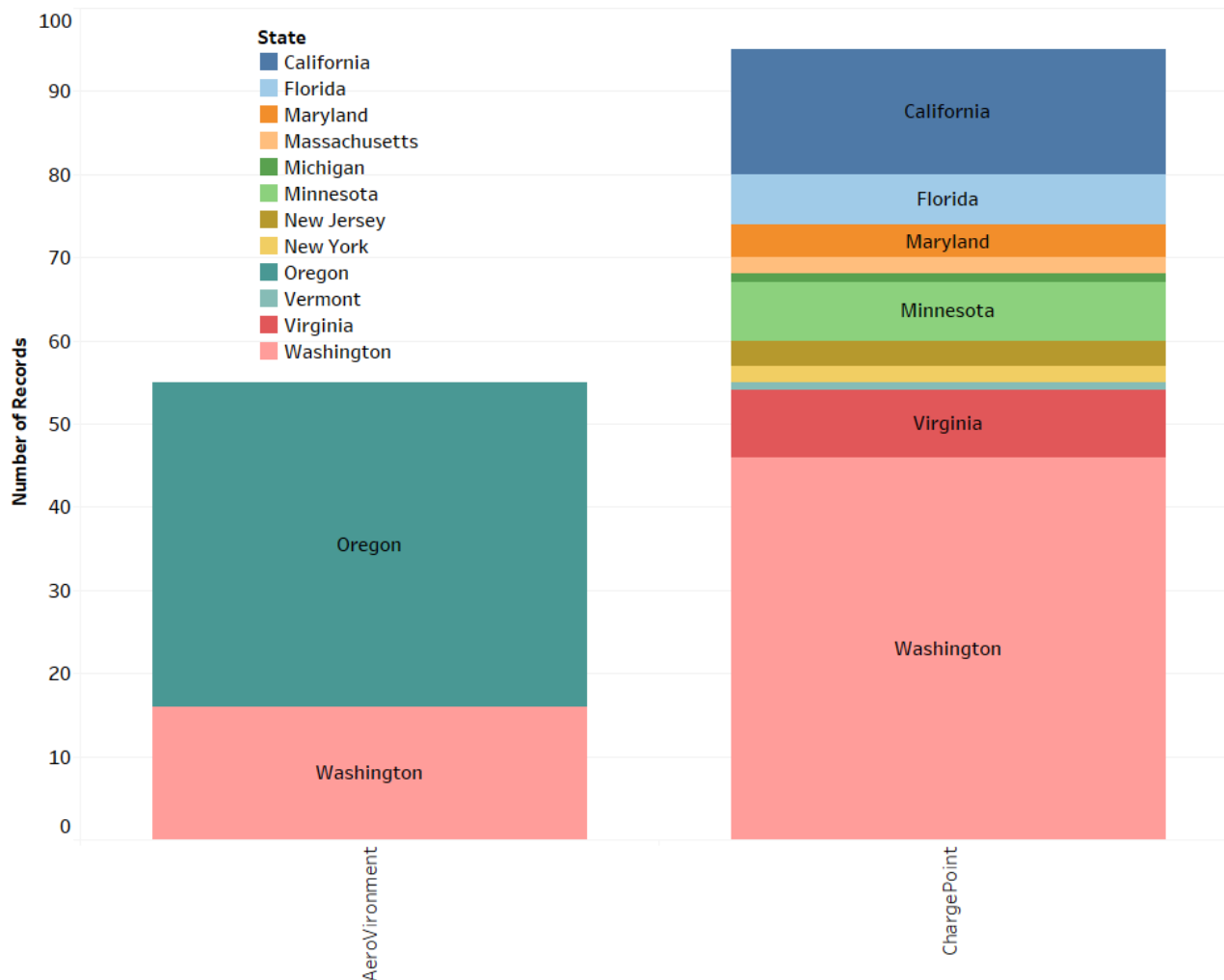
Of the data that we have, currently, 3 networks charge by session at their DCFast chargers. States where this occurs is shown

Charging stations: Charging by session (\$), L2



Of the data that we have, currently, 2 networks charge by session at their L2 chargers.
Price breakdown is shown.

Charging stations: Charging by session (state), L2

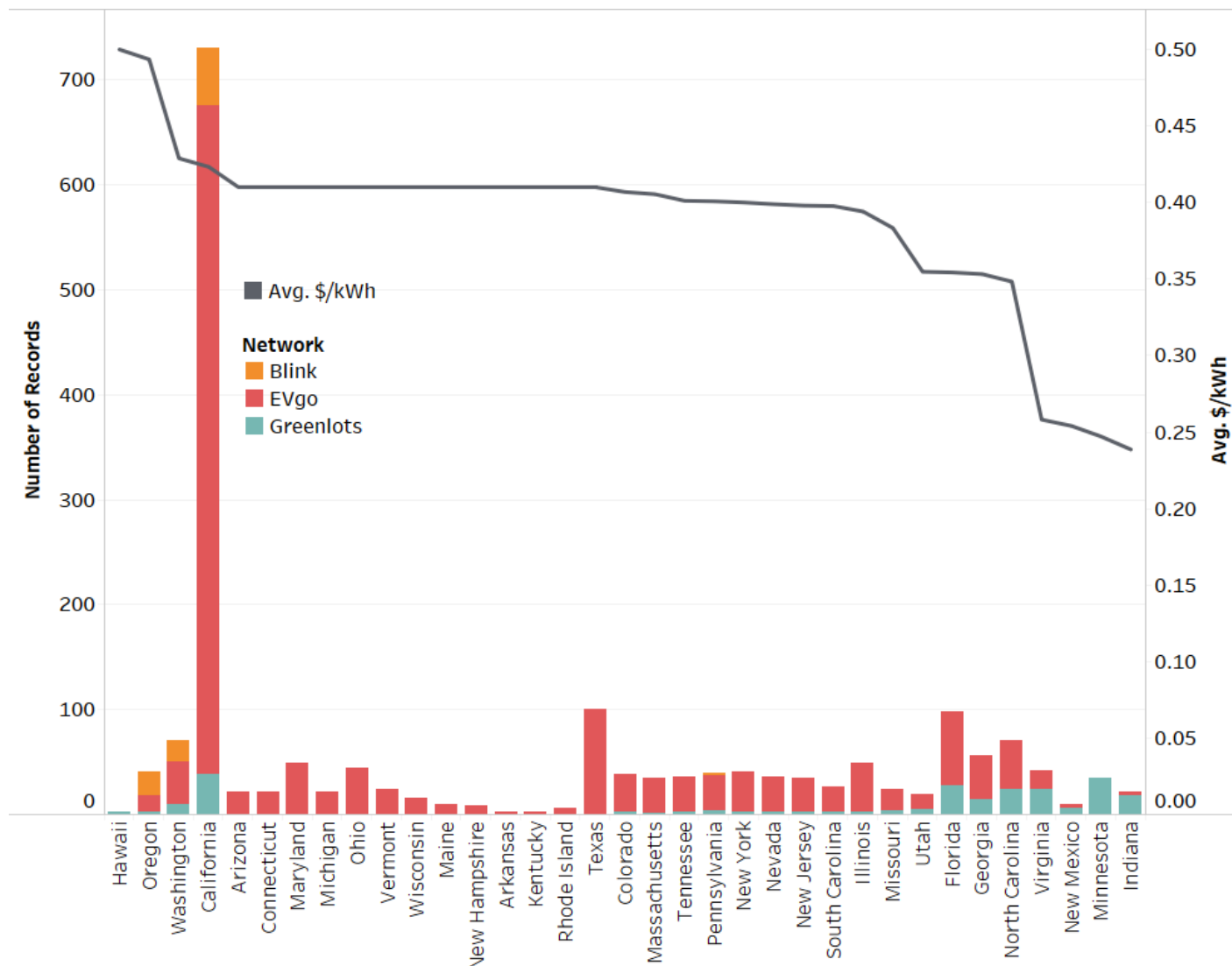


Of the data that we have, currently, 2 networks charge by session at their L2 chargers.
States where this occurs is shown

DCFC Price information

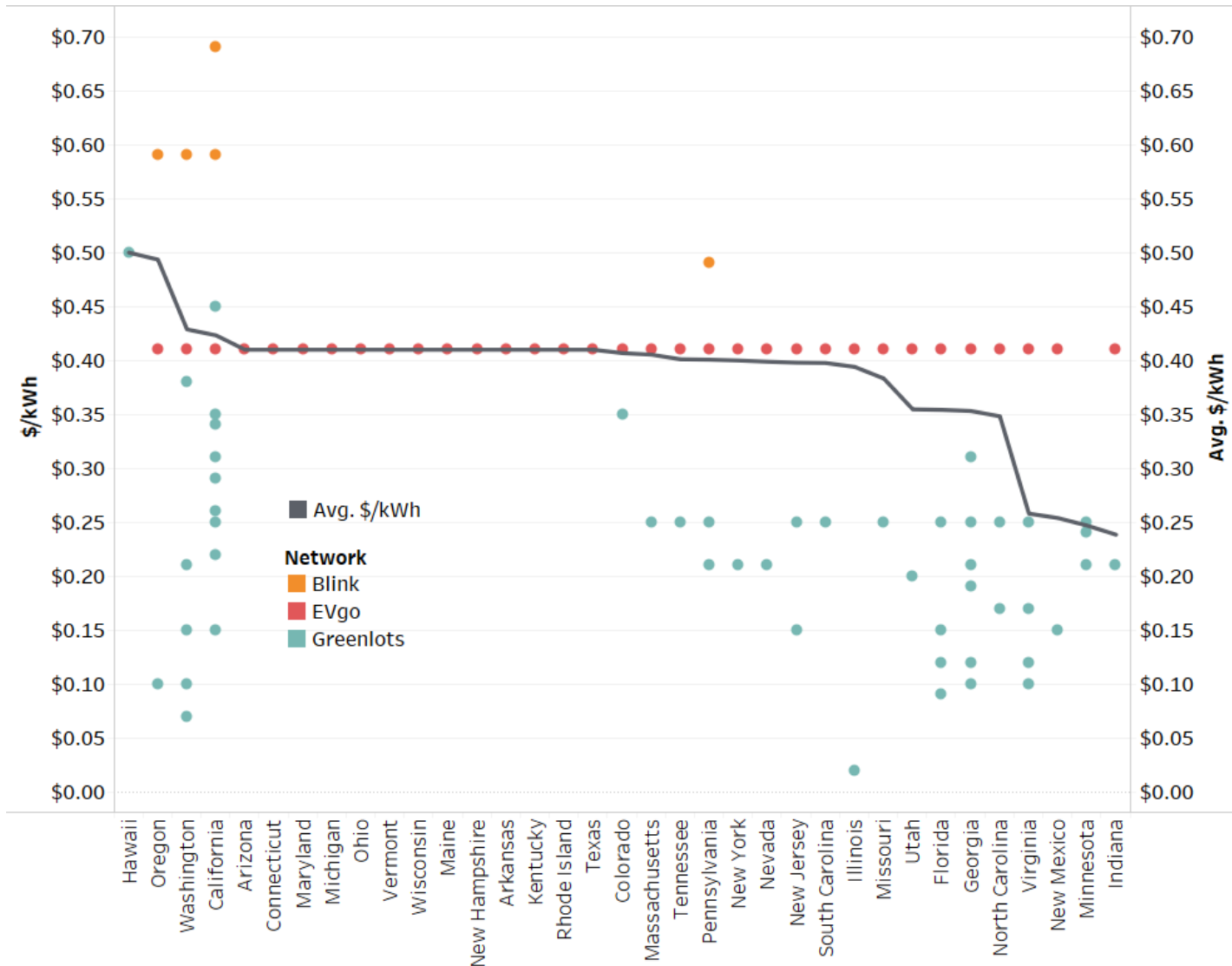
Stations charging by session have been removed from all further analysis.

DCFC: Average cost by state

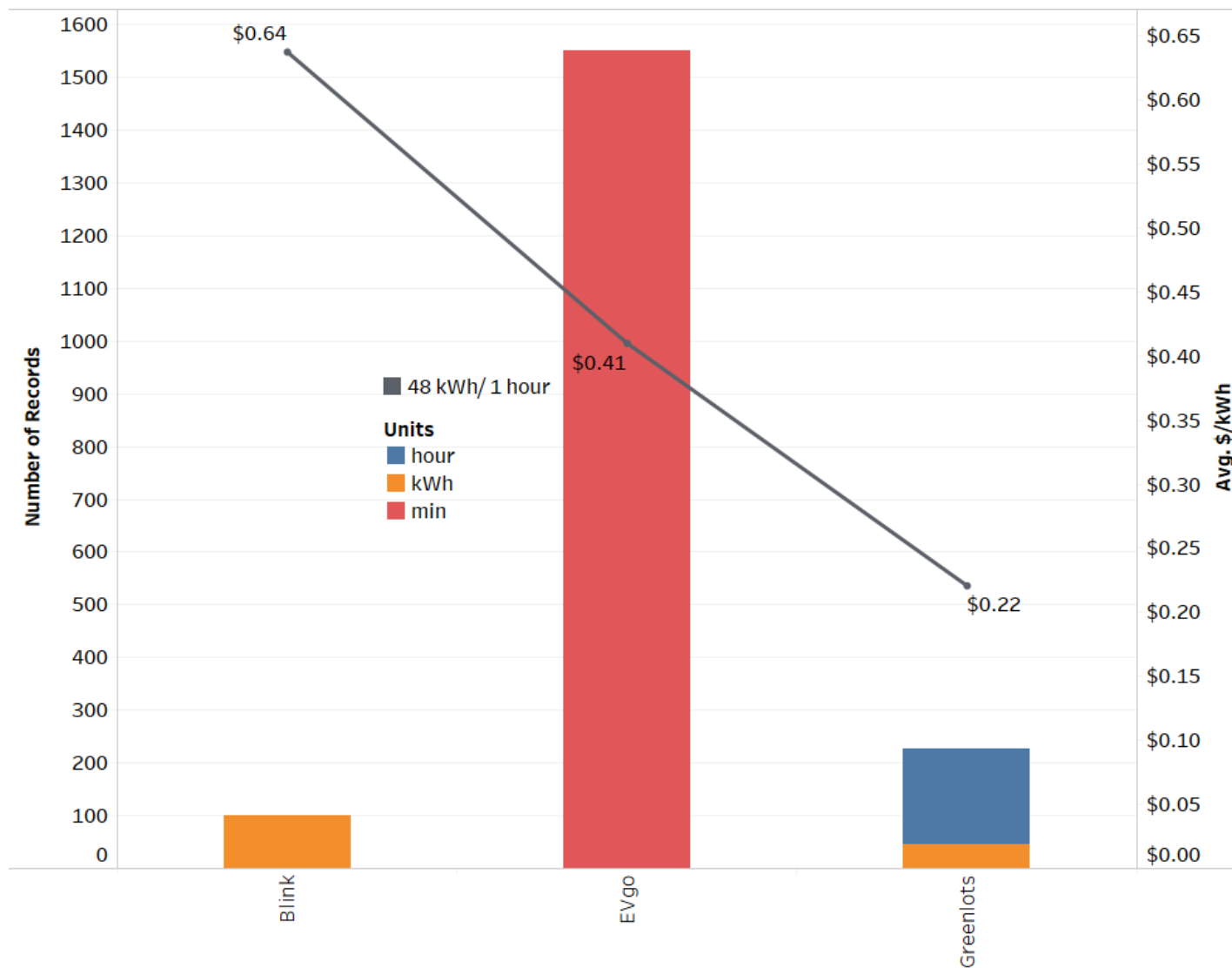


Note the axis have different labels. Number of records is shown as some states don't have very many stations reporting data.

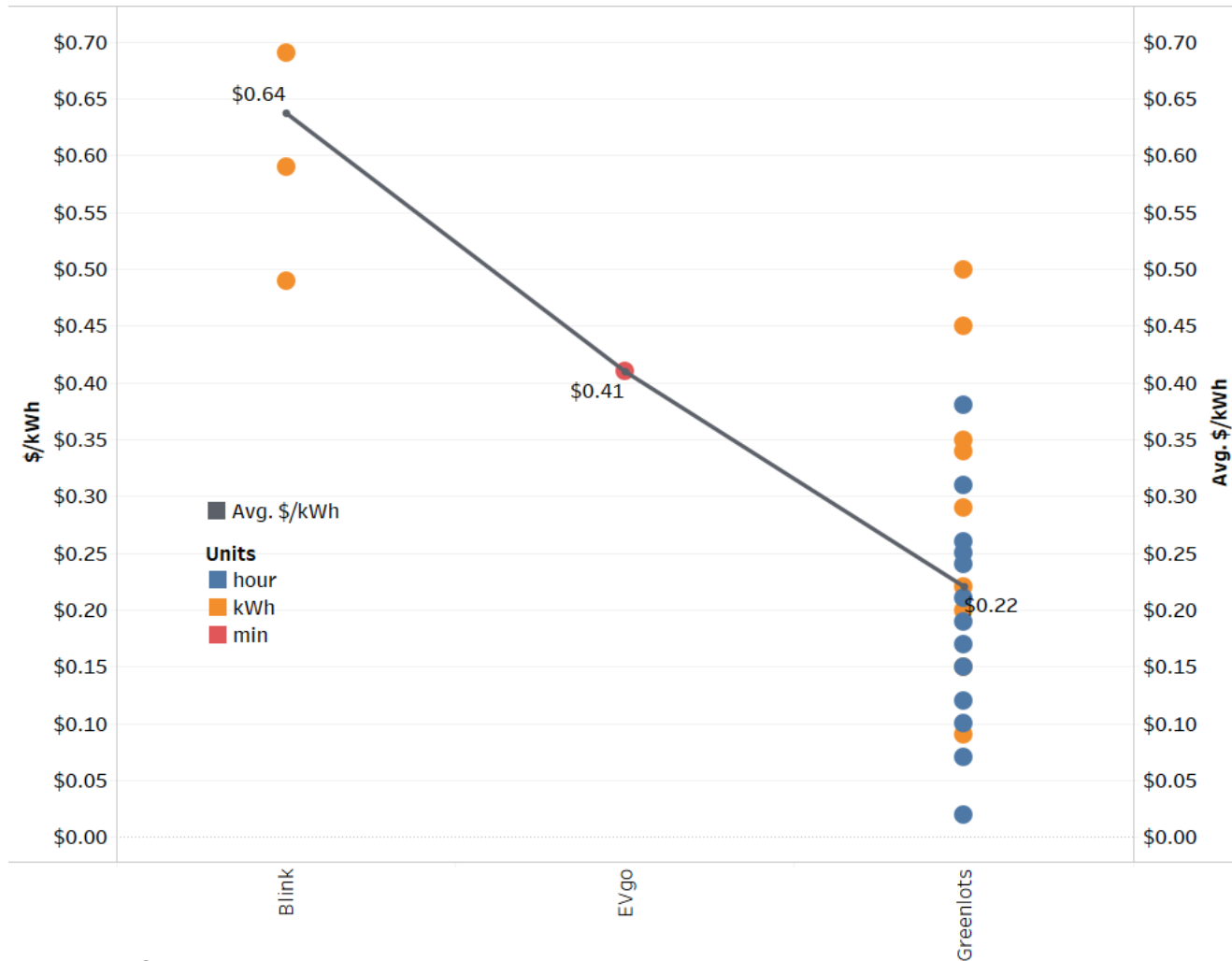
DCFC: State average, with each station showing a data point.



DCFC: Average cost by network and number of records



DCFC: Network average, each station showing a data point.

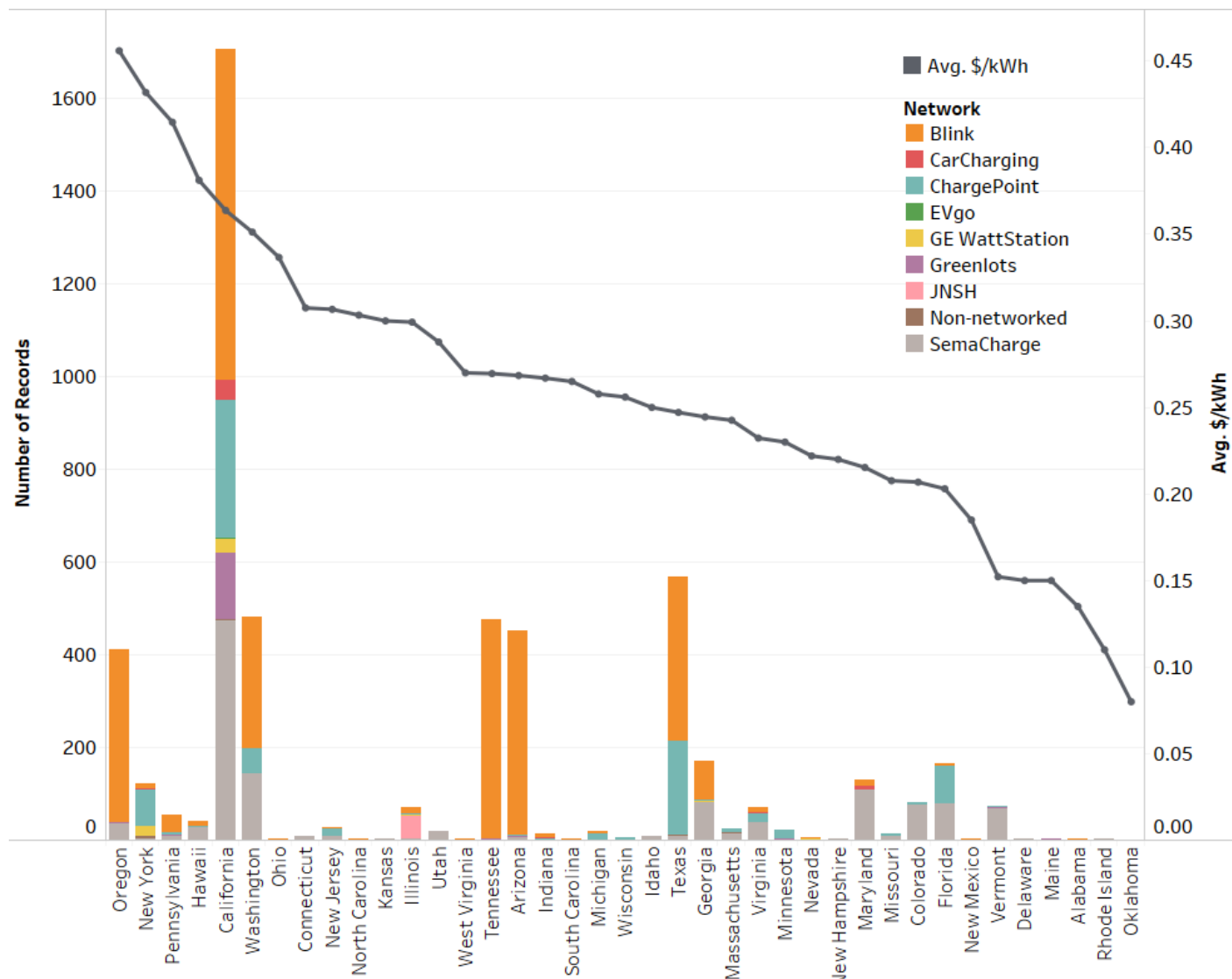


Note there are fewer stations here showing data points as they are overlaid on each other. Within a network there is not much price variability.

L2 Price information

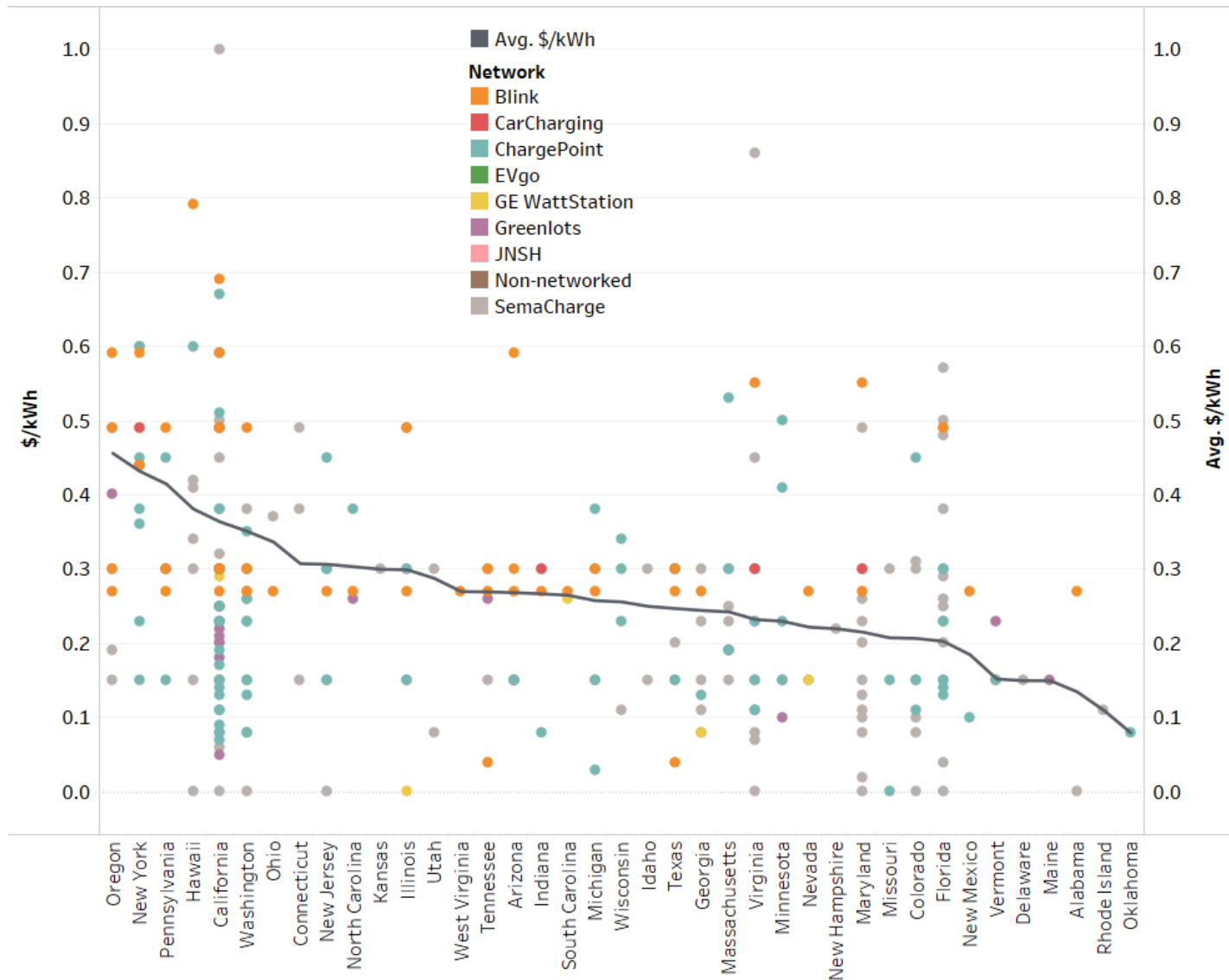
Stations charging by session have been removed from all further analysis.

L2: Average cost by state

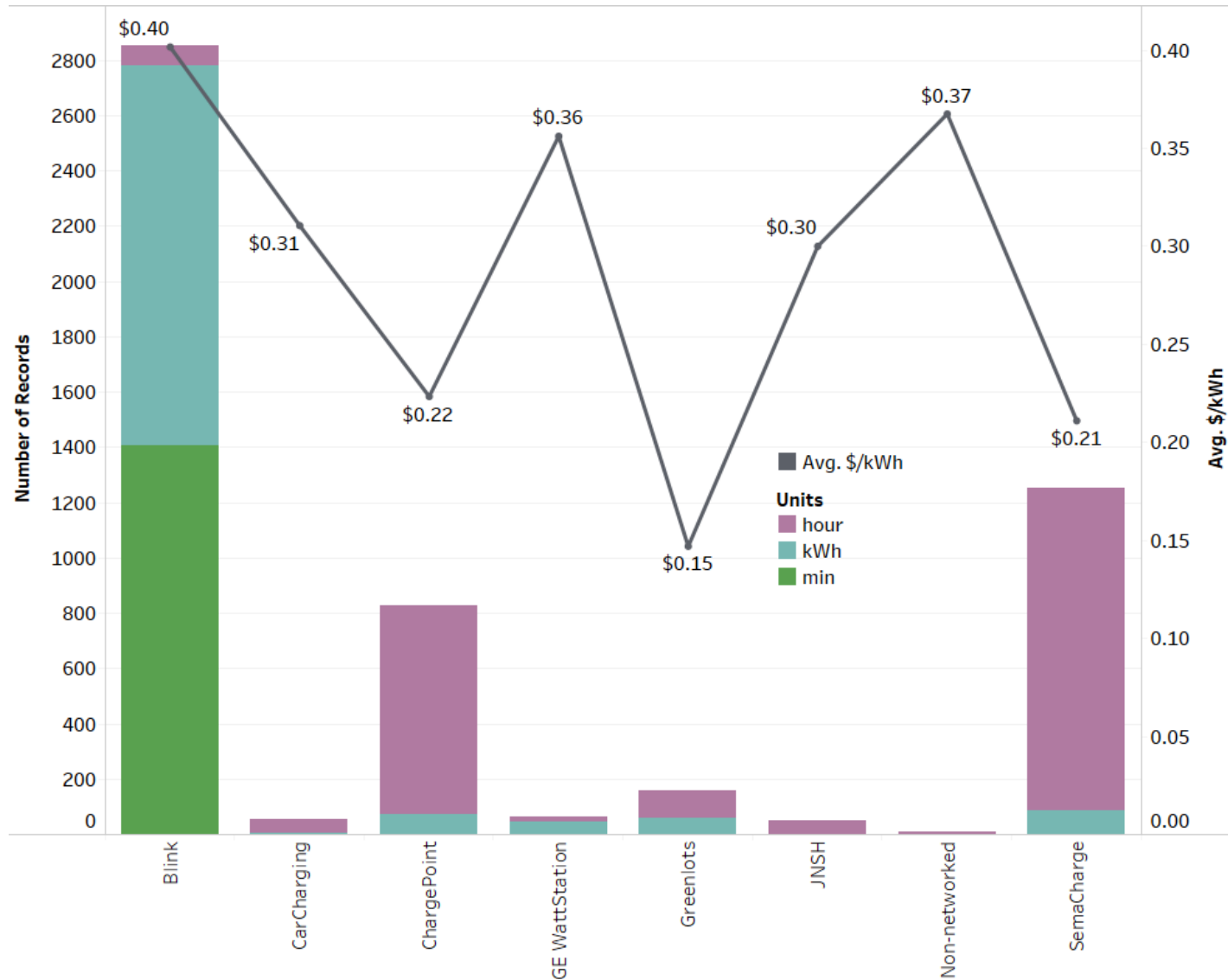


Note the axis have different labels. Number of records is shown as some states don't have very many stations reporting data.

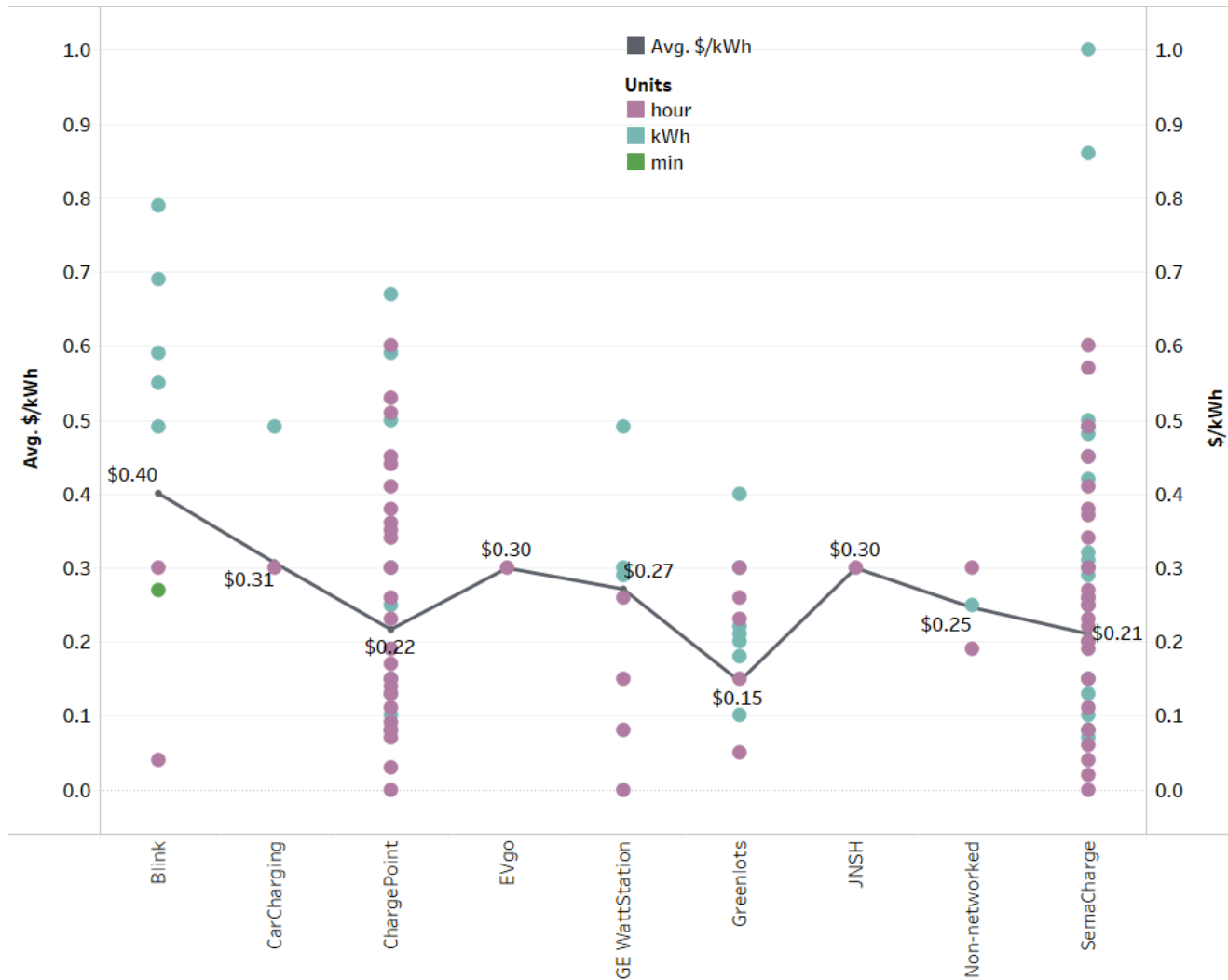
L2: State average, with each station showing a data point.



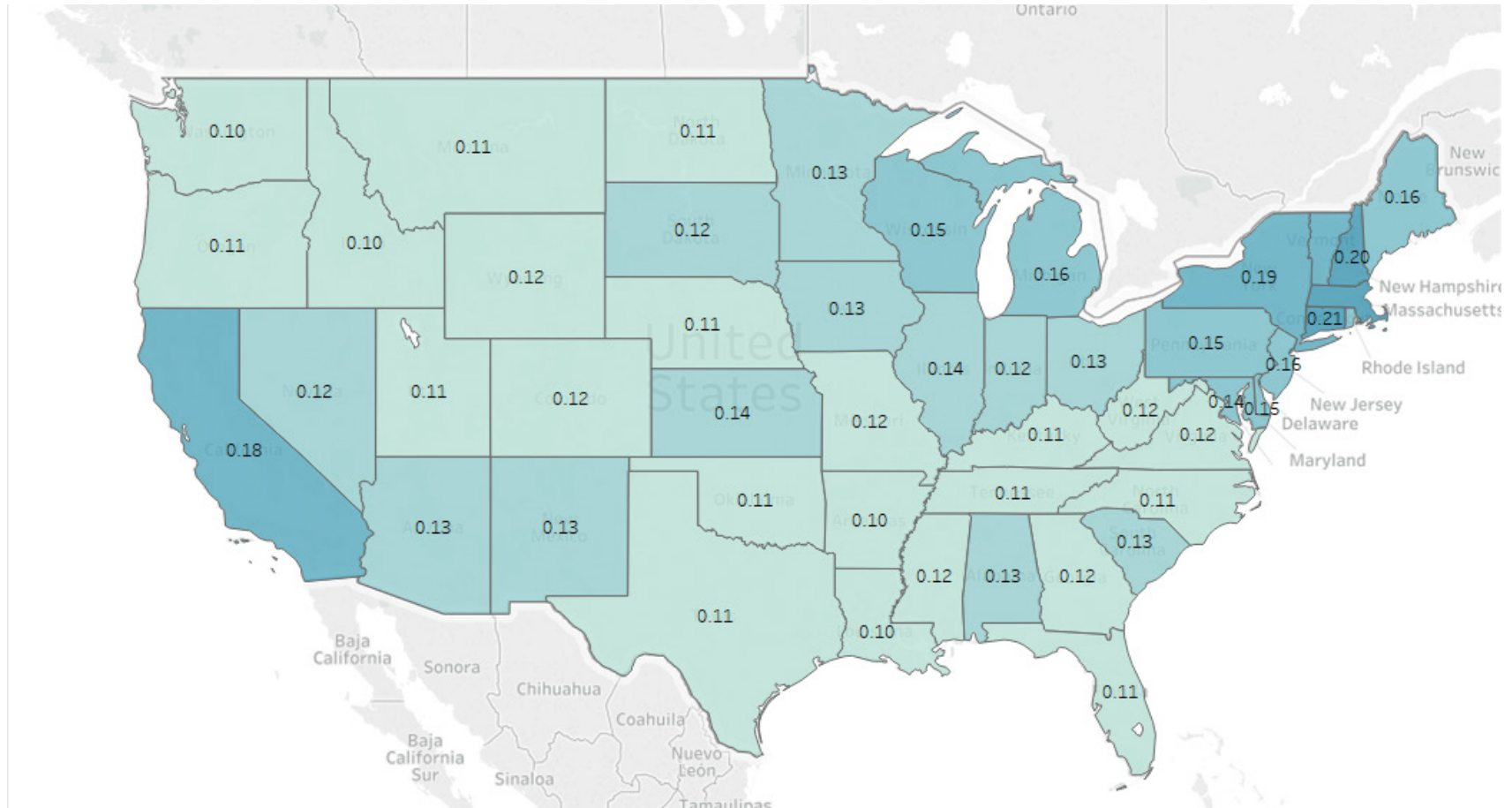
L2: Average cost by network and number of records



L2: Network average, each station showing a data point.



Average \$/kWh for residential electricity



Home charging prices (with many utilities offering TOU prices that are less)



Together...Shaping the Future of Electricity

Disclaimer of Warranties and Limitation of Liabilities

THIS DOCUMENT WAS PREPARED BY THE ORGANIZATION(S) NAMED BELOW AS AN ACCOUNT OF WORK SPONSORED OR COSPONSORED BY THE ELECTRIC POWER RESEARCH INSTITUTE, INC. (EPRI). NEITHER EPRI, ANY MEMBER OF EPRI, ANY COSPONSOR, THE ORGANIZATION(S) BELOW, NOR ANY PERSON ACTING ON BEHALF OF ANY OF THEM:

(A) MAKES ANY WARRANTY OR REPRESENTATION WHATSOEVER, EXPRESS OR IMPLIED, (I) WITH RESPECT TO THE USE OF ANY INFORMATION, APPARATUS, METHOD, PROCESS, OR SIMILAR ITEM DISCLOSED IN THIS DOCUMENT, INCLUDING MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, OR (II) THAT SUCH USE DOES NOT INFRINGE ON OR INTERFERE WITH PRIVATELY OWNED RIGHTS, INCLUDING ANY PARTY'S INTELLECTUAL PROPERTY, OR (III) THAT THIS DOCUMENT IS SUITABLE TO ANY PARTICULAR USER'S CIRCUMSTANCE; OR

(B) ASSUMES RESPONSIBILITY FOR ANY DAMAGES OR OTHER LIABILITY WHATSOEVER (INCLUDING ANY CONSEQUENTIAL DAMAGES, EVEN IF EPRI OR ANY EPRI REPRESENTATIVE HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES) RESULTING FROM YOUR SELECTION OR USE OF THIS DOCUMENT OR ANY INFORMATION, APPARATUS, METHOD, PROCESS, OR SIMILAR ITEM DISCLOSED IN THIS DOCUMENT.

REFERENCE HEREIN TO ANY SPECIFIC COMMERCIAL PRODUCT, PROCESS, OR SERVICE BY ITS TRADE NAME, TRADEMARK, MANUFACTURER, OR OTHERWISE, DOES NOT NECESSARILY CONSTITUTE OR IMPLY ITS ENDORSEMENT, RECOMMENDATION, OR FAVORING BY EPRI.

THE ELECTRIC POWER RESEARCH INSTITUTE (EPRI) PREPARED THIS REPORT.

This is an EPRI Technical Update report. A Technical Update report is intended as an informal report of continuing research, a meeting, or a topical study. It is not a final EPRI technical report.

NOTE

For further information about EPRI, call the EPRI Customer Assistance Center at 800.313.3774 or e-mail askepri@epri.com.

Electric Power Research Institute, EPRI, and TOGETHER...SHAPING THE FUTURE OF ELECTRICITY are registered service marks of the Electric Power Research Institute, Inc.

Copyright © 2017 Electric Power Research Institute, Inc. All rights reserved.

The Electric Power Research Institute, Inc. (EPRI, www.epri.com) conducts research and development relating to the generation, delivery and use of electricity for the benefit of the public. An independent, nonprofit organization, EPRI brings together its scientists and engineers as well as experts from academia and industry to help address challenges in electricity, including reliability, efficiency, affordability, health, safety and the environment. EPRI also provides technology, policy and economic analyses to drive long-range research and development planning, and supports research in emerging technologies. EPRI's members represent approximately 90 percent of the electricity generated and delivered in the United States, and international participation extends to more than 30 countries. EPRI's principal offices and laboratories are located in Palo Alto, Calif.; Charlotte, N.C.; Knoxville, Tenn.; and Lenox, Mass.

Together...Shaping the Future of Electricity

3002011098

Electric Power Research Institute

3420 Hillview Avenue, Palo Alto, California 94304-1338 • PO Box 10412, Palo Alto, California 94303-0813 • USA
800.313.3774 • 650.855.2121 • askepri@epri.com • www.epri.com