DCFC Load Factor

What are we seeing out in the wild?

Jamie Dunckley, PhD
Sr. Project Manager

What is EPRI?

EPRI

Advancing safe, reliable, affordable, and clean energy for society through global collaboration, science and technology innovation, and applied research.



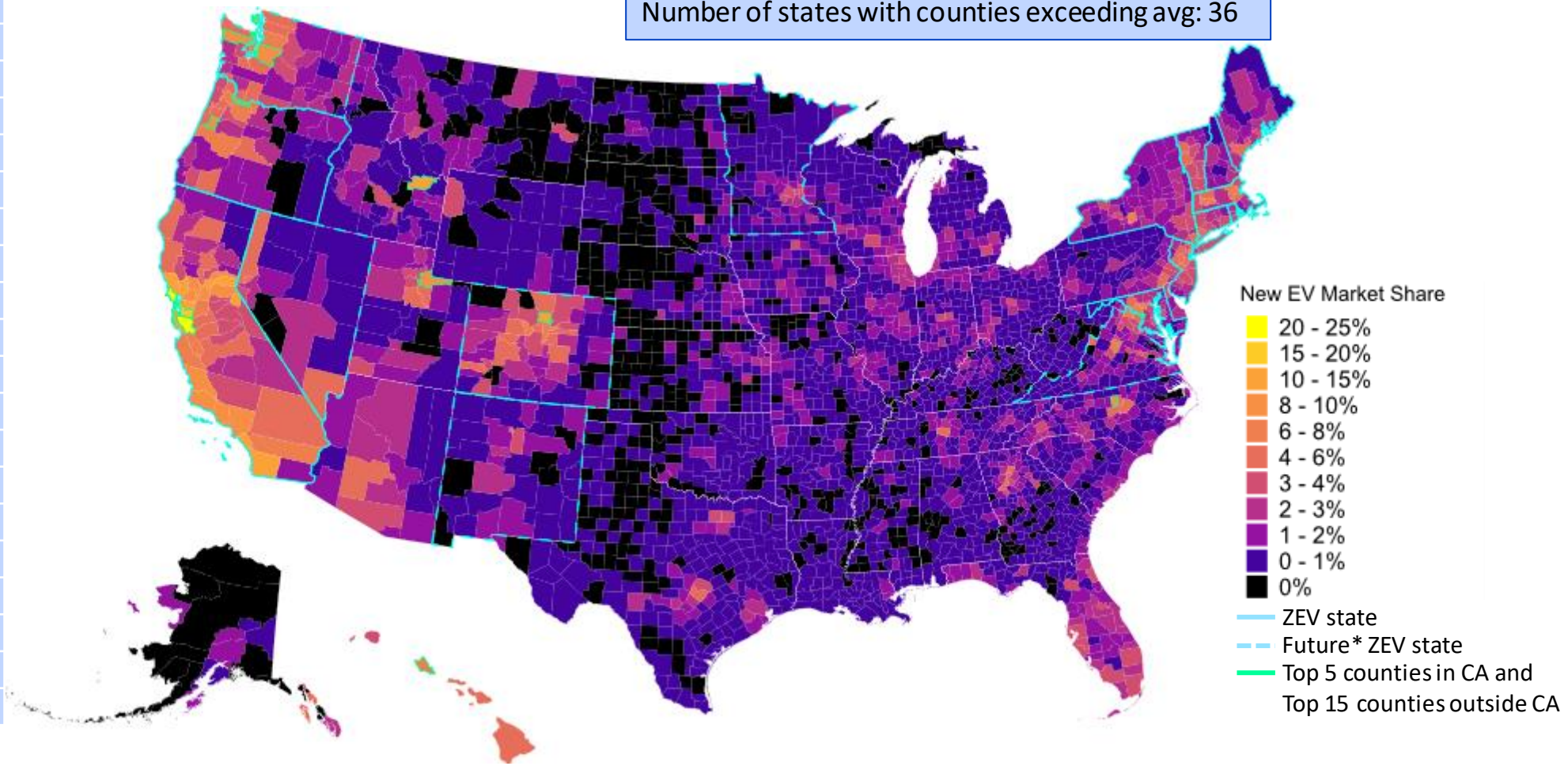




US Nationwide New EV Market Share Oct. 2020 – Sept. 2021

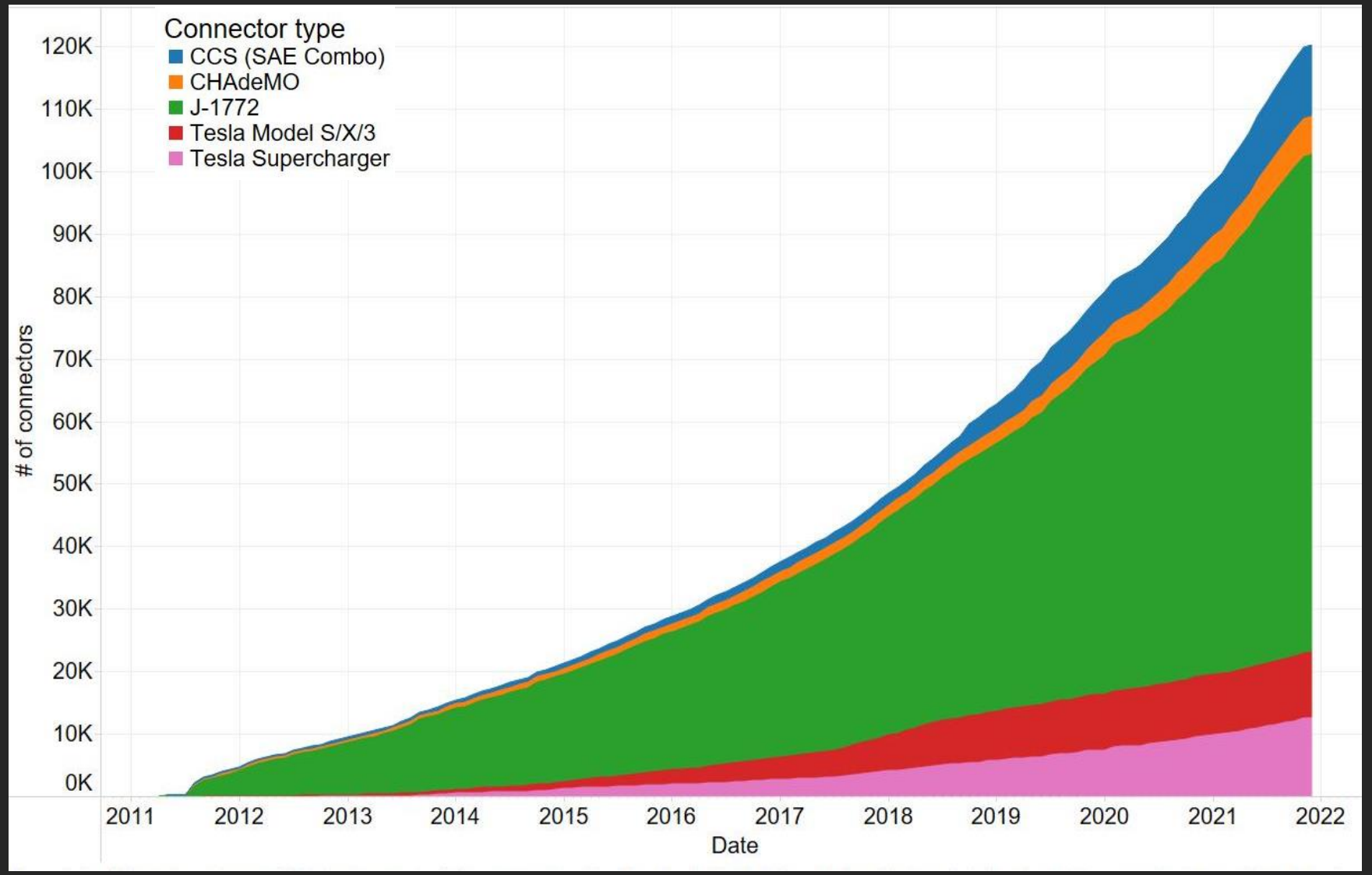
Top 5 counties in CA and Top 15 counties outside CA	
Marin, CA	21.4%
Santa Clara, CA	21.3%
San Francisco, CA	18.7%
Alameda, CA	17.8%
San Mateo, CA	14.5%
Boulder, CO	12.3%
Clark, ID	10.7%
San Juan, WA	10.5%
King, WA	9.9%
Washington, DC	8.6%
Jefferson, WA	8.6%
Summit, UT	8.5%
Multnomah, OR	8.4%
Benton, OR	8.3%
Falls Church City, VA	8.1%
Orange, NC	8%
Arlington, VA	7.9%
Honolulu, HI	7.9%
Charlottesville City, VA	7.8%
Broomfield, CO	7.5%

Nationwide avg new EV market share: 3.3%
Number of counties exceeding avg: 202
Number of states with counties exceeding avg: 36



*CO will become a ZEV state in 2022. WA and MN will become ZEV states in 2024. NM, NV, and VA have announced that they intend to become ZEV states in the future.

Charging Infrastructure Growth -USA



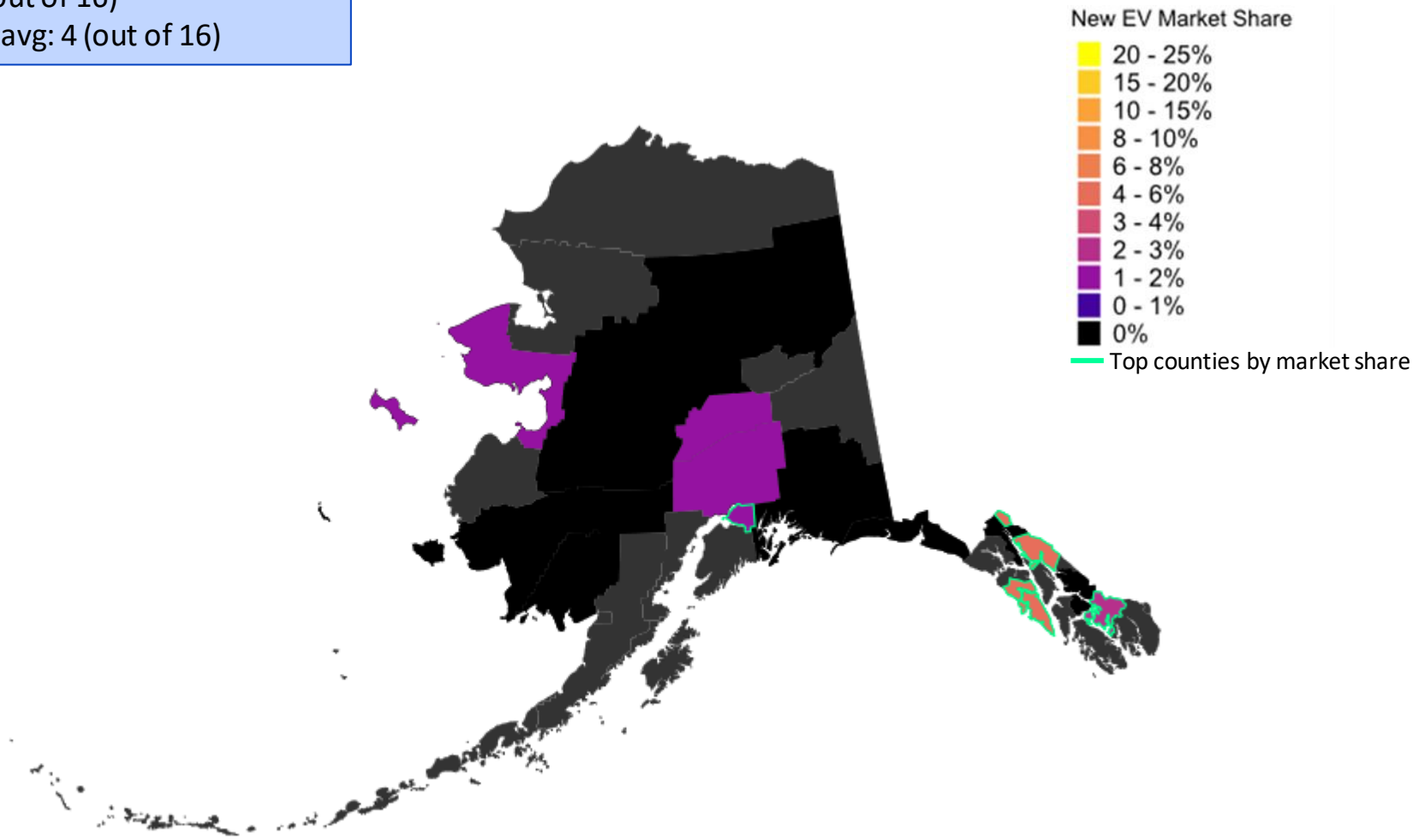
Data Curtesy of PlugShare

Alaska New EV Market Share Oct. 2020 – Sept. 2021

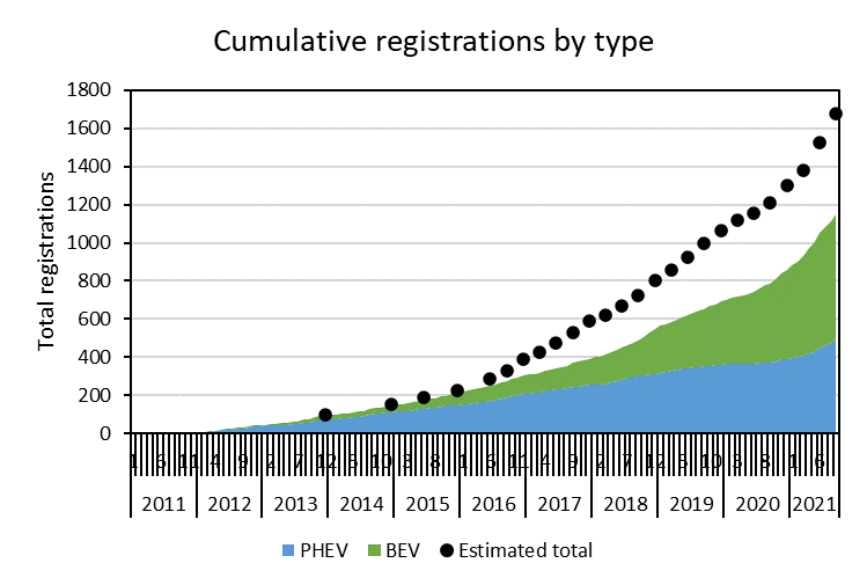
TVA Service Territory avg new EV market share: 1.4% (3.3% national avg)
Number of counties exceeding national avg: 3 (out of 16)
Number of counties exceeding service territory avg: 4 (out of 16)

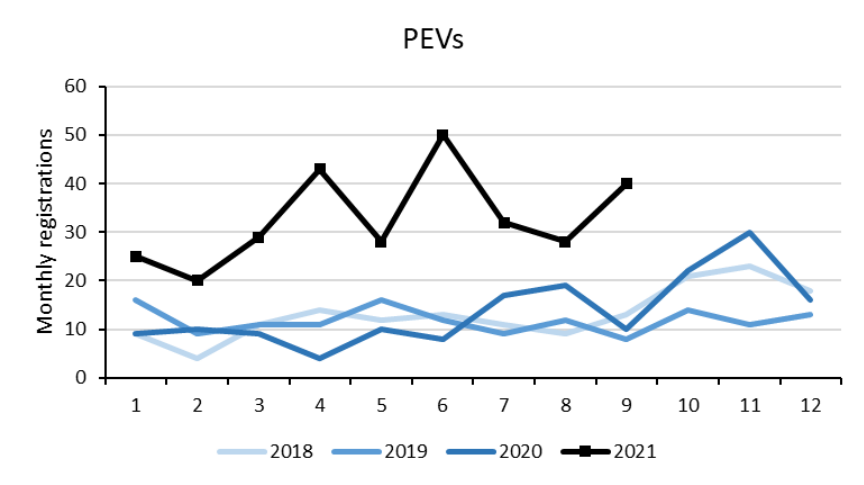
Top 5 counties by New EV Market Share	
County Name	New EV market share
Juneau City and Borough	5.6%
Sitka City and Borough	4.9%
Skagway Municipality	4.8%
Wrangell City and Borough	2.9%
Anchorage Municipality	1.3%

Top 5 counties by New EV Market Size	
County Name	# of EVs [new EV market share]
Anchorage Municipality	166 [1.31%]
Juneau City and Borough	51 [5.56%]
Matanuska-Susitna Borough	41 [1.17%]
Sitka City and Borough	5 [4.90%]
Skagway Municipality	1 [4.76%]

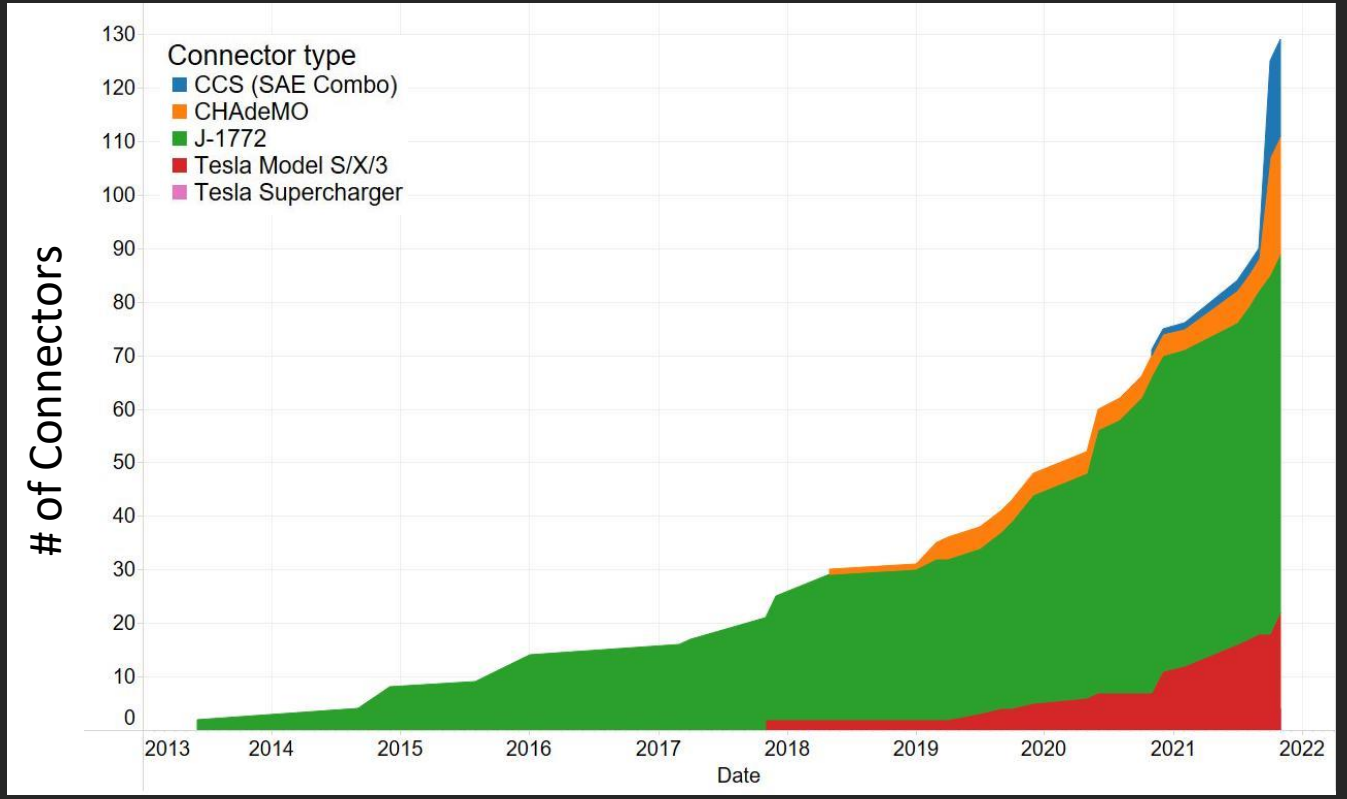


An Alaska Perspective





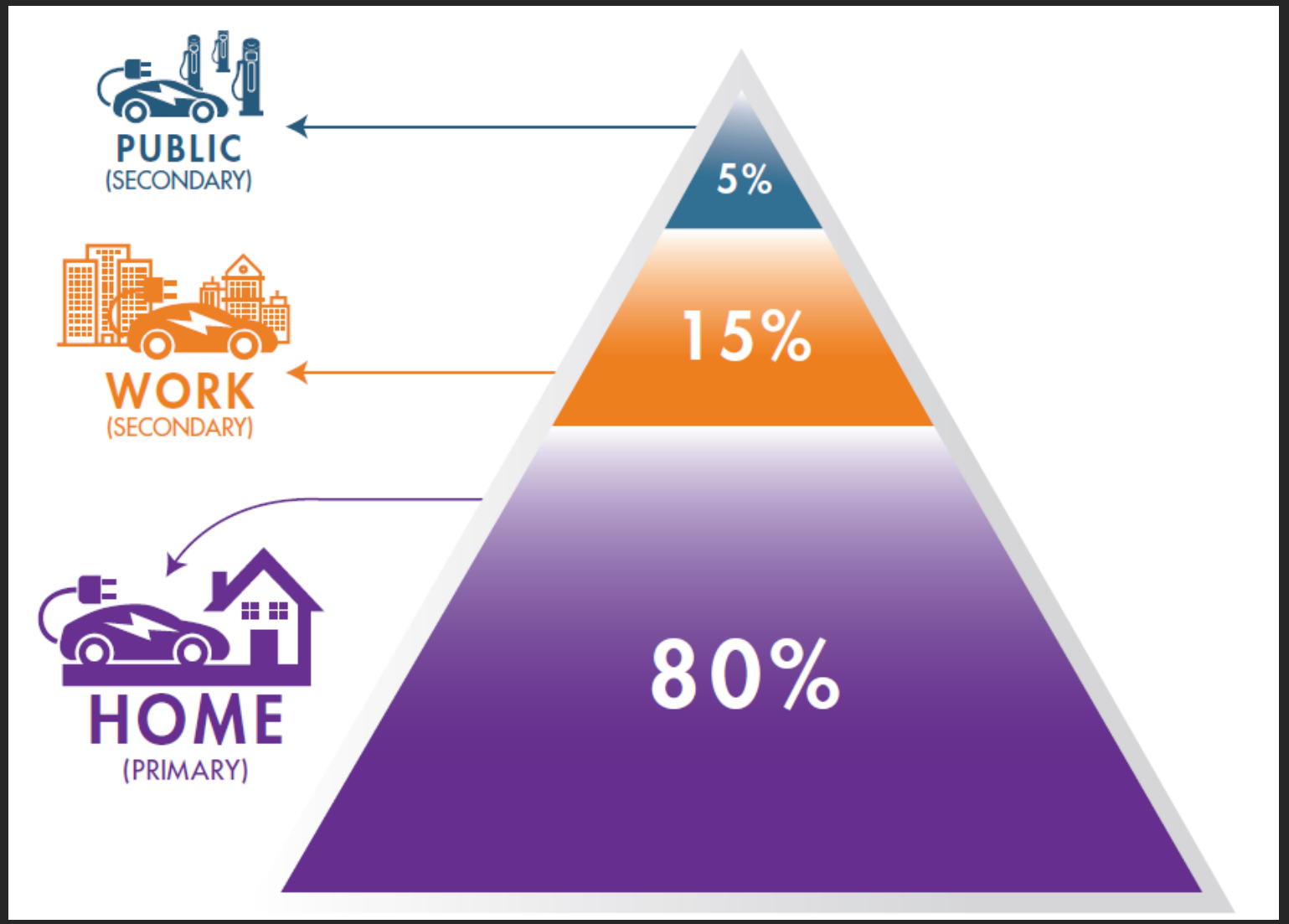
EPRI Analysis of IHS data



Data curtesy of PlugShare

- Approximately 1,600 EVs in Alaska as of Sept 2021
- 2021 has outperformed previous years for EV registrations
- There are 22 CCS connectors

A EV driver perspective



- Only approximately 5% of charging is public.
- BUT generally it is a very important 5%
  - Garage Orphans
  - Road Trips
  - There is little flexibility with timing

What Might we expect load factor to be?

$$\text{Load Factor} = \left(\frac{Monthly\ \ kWh}{Hours\ in\ a\ Month}\right)\left(\frac{1}{Demand}\right)$$

Monthly kWh – what does it depend on?

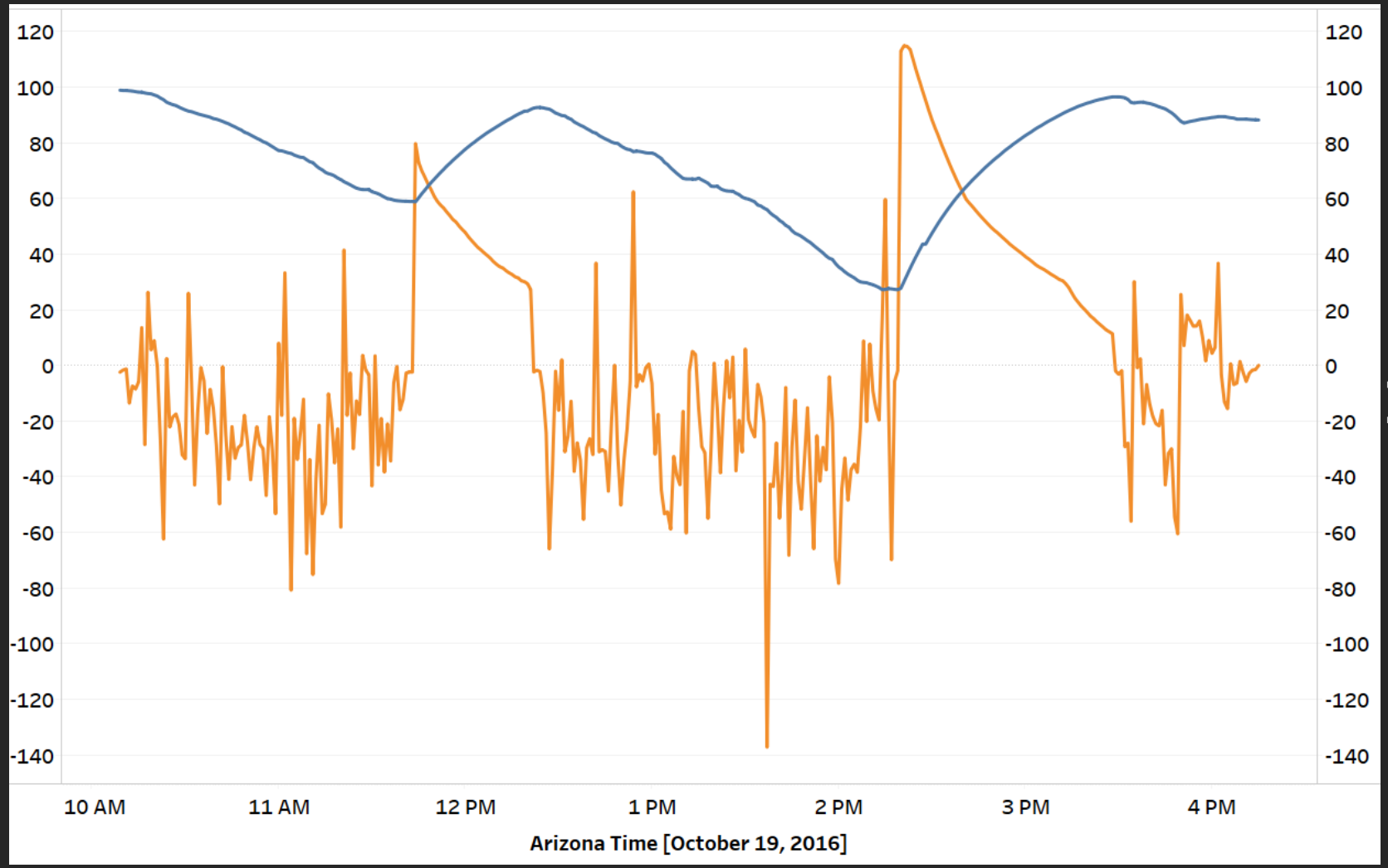
- *Time window that is reasonable for people to be at a public charger [16 hr?]*
- *Queuing limits – how long are drivers willing to wait to get a charge?*
- *Speed that a vehicle charges at [Vehicle, SOC and Temperature dependent] – see next slide*
- *Total energy + length of a charge*
- *Charger Max power*

Demand

- *50-350kW*

What does a fast charging load shape look like?

A Tesla on a road trip



Peak power is only achieved for a couple minutes and then it drops significantly.

Time to charge is lengthened when drivers try to charge to 100% SOC.

Load shapes are flatter for AC charging.

What are the load factor ranges to expect?

Demand (kW)	Time to Charge (Hrs)	Charging Window [hrs]	Number of Sessions per month	Energy (Month)	Load Factor
50	0.5	8	486	4,864	13%
50	0.5	16	973	9,728	27%
50	0.5	24	1,459	14,592	40%
150	0.3	8	811	8,107	7%
150	0.3	16	1,621	16,213	15%
150	0.3	24	2,432	24,320	22%
350	0.16	8	1,520	15,200	6%
350	0.16	16	3,040	30,400	12%
350	0.16	24	4,560	45,600	18%

Assuming:

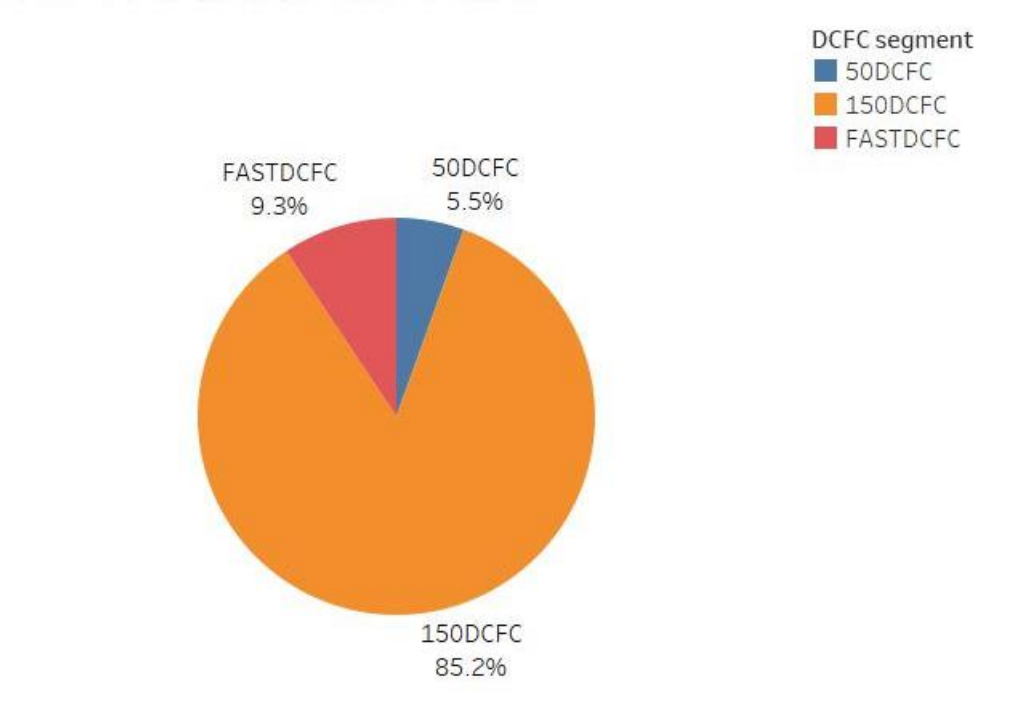
- Each charge is approximately 10 kWh
- All charging sessions in the active hours are filled

What does the data say- are our assumptions correct?

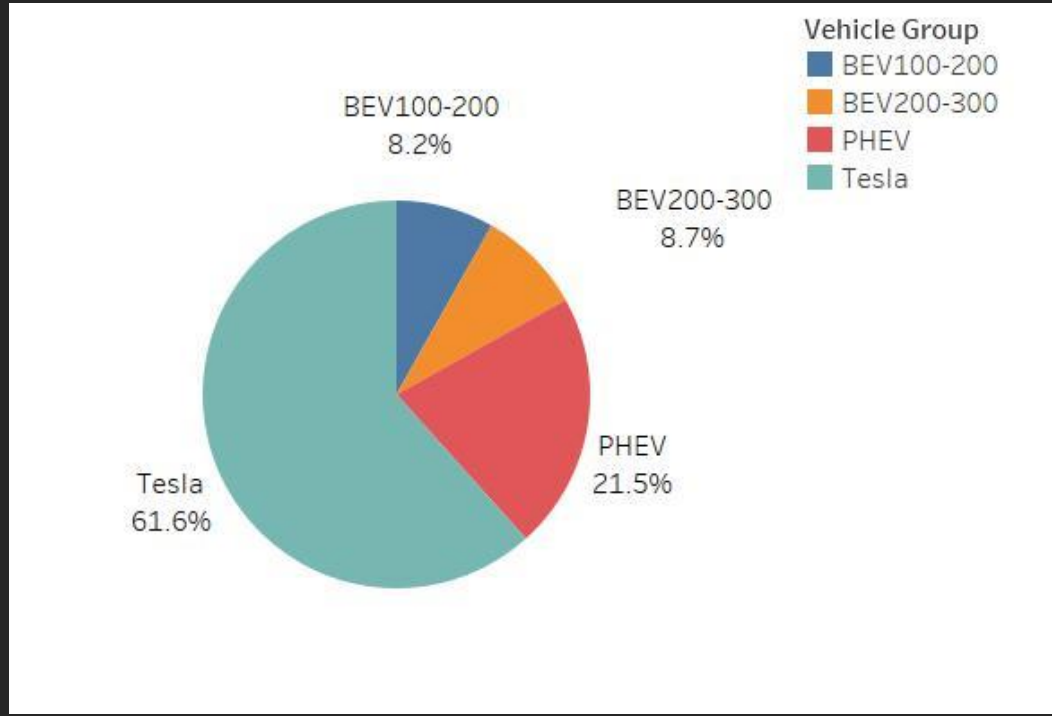
An EV Study with a years' worth of data from ~140 vehicles vehicles

Charge Label	Peak kW reached during a charge
50DCFC	20-50 kW
150DCFC	50-150 kW
FASTDCFC	Over 150 kW

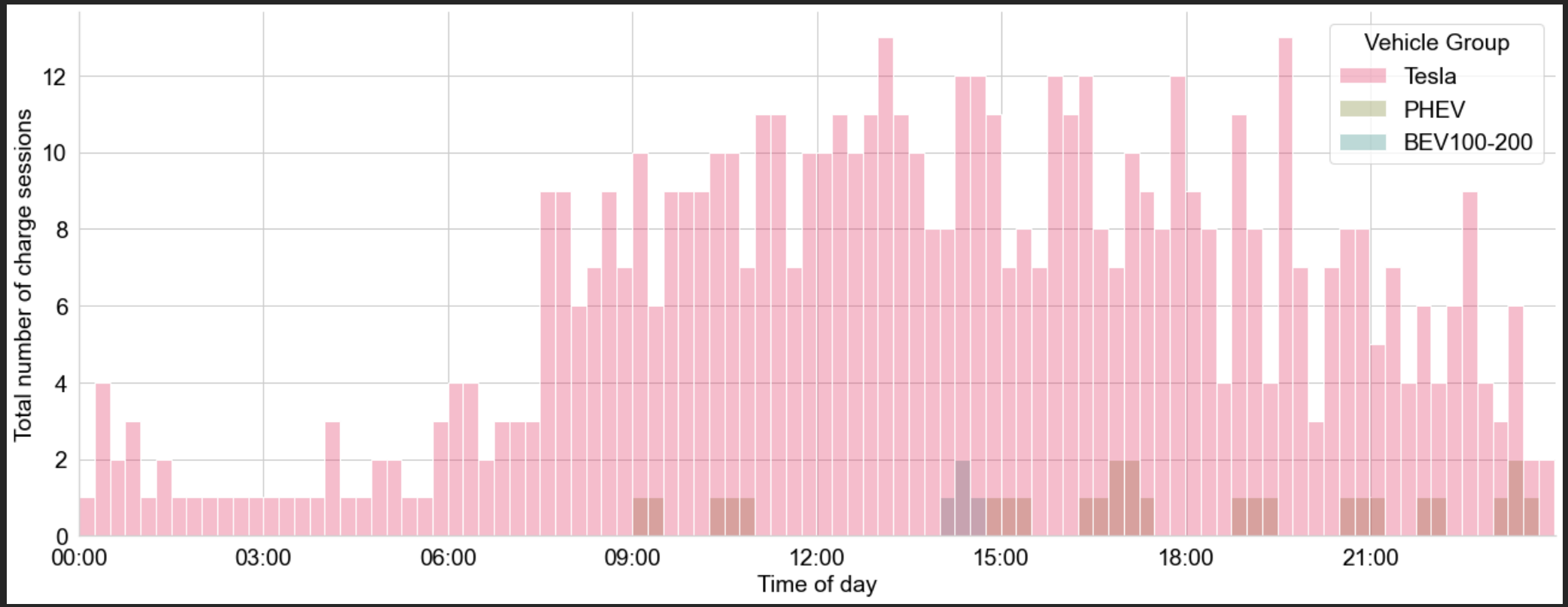
% of Charges at each power level (by energy)



% of charges (by energy) by vehicle type

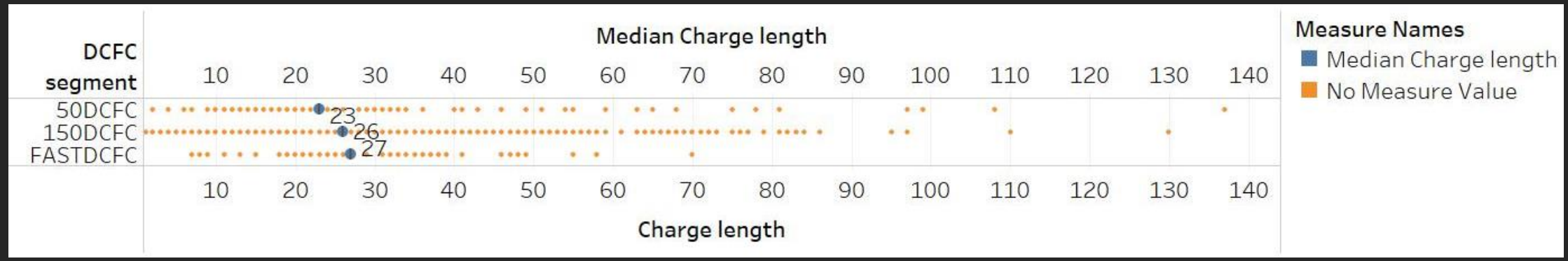


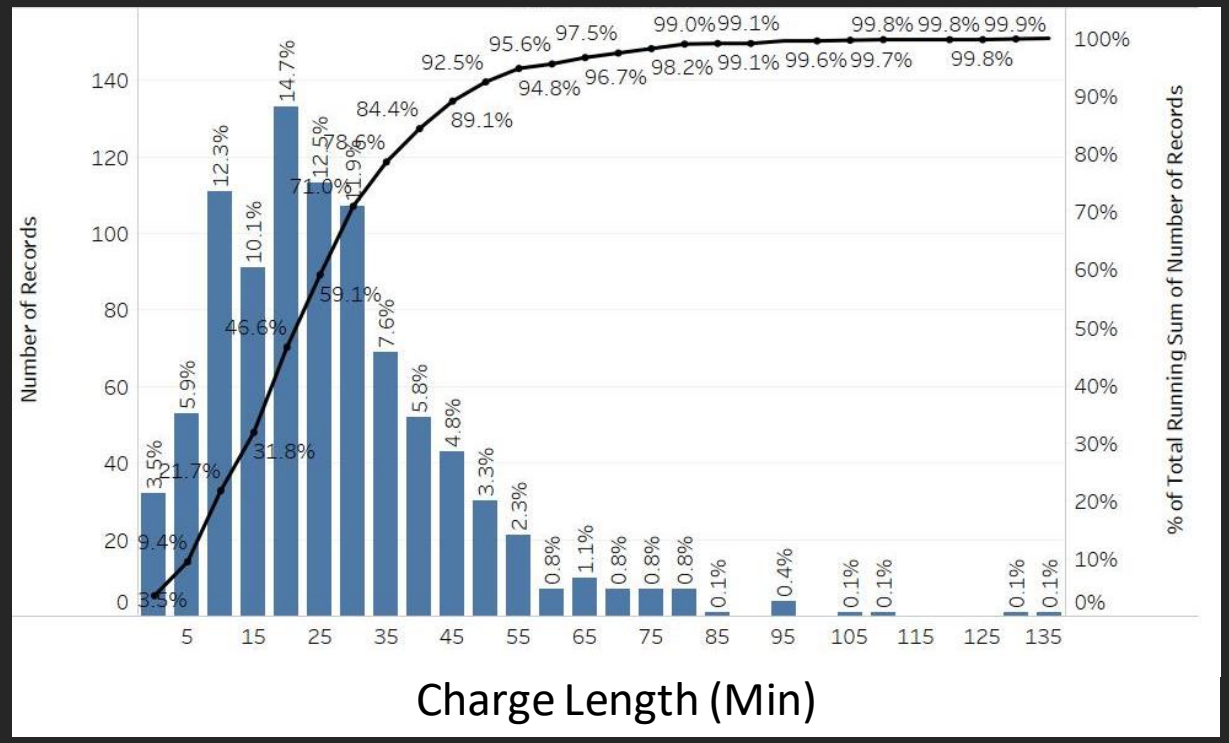
DCFC Charges – when do they happen?



In this data set, mainly between 6AM and 12AM, but this could vary greatly by region

Charge Length [min]



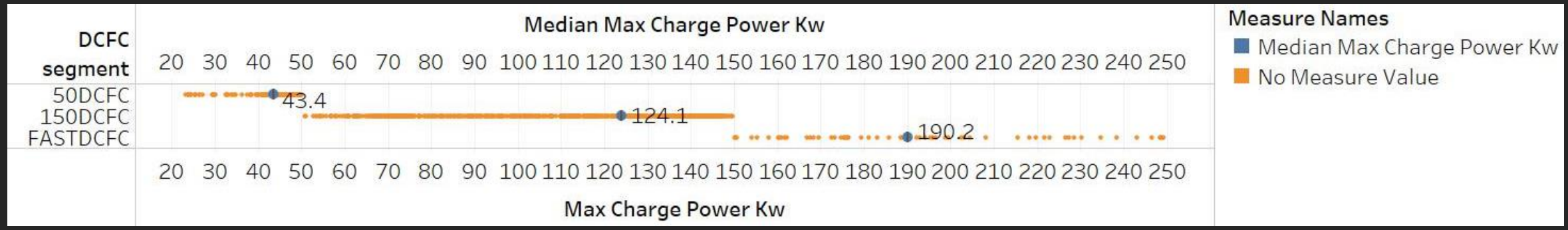


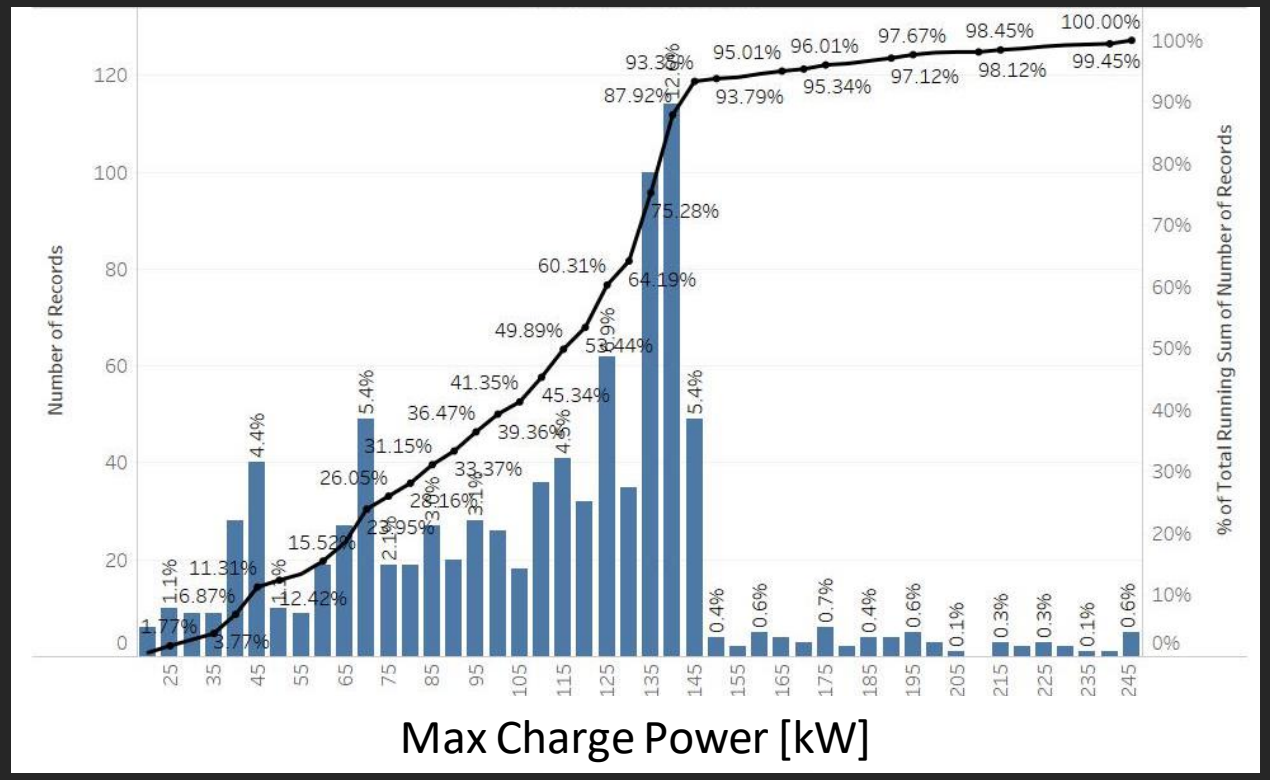
Takeaways

- Charge length is a bit longer for faster charging:
  - Need to fill more as long trip
  - Beginning SOC is less

- Histogram data:
  - 60% of charges are less than 30 minutes
  - 90% of charges are less than 45 minutes
  - Most charges are 20-25 minutes long

Charge Power

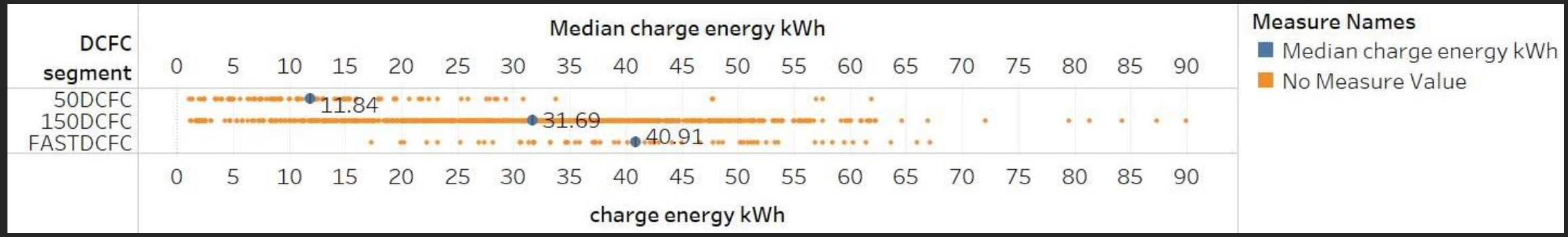




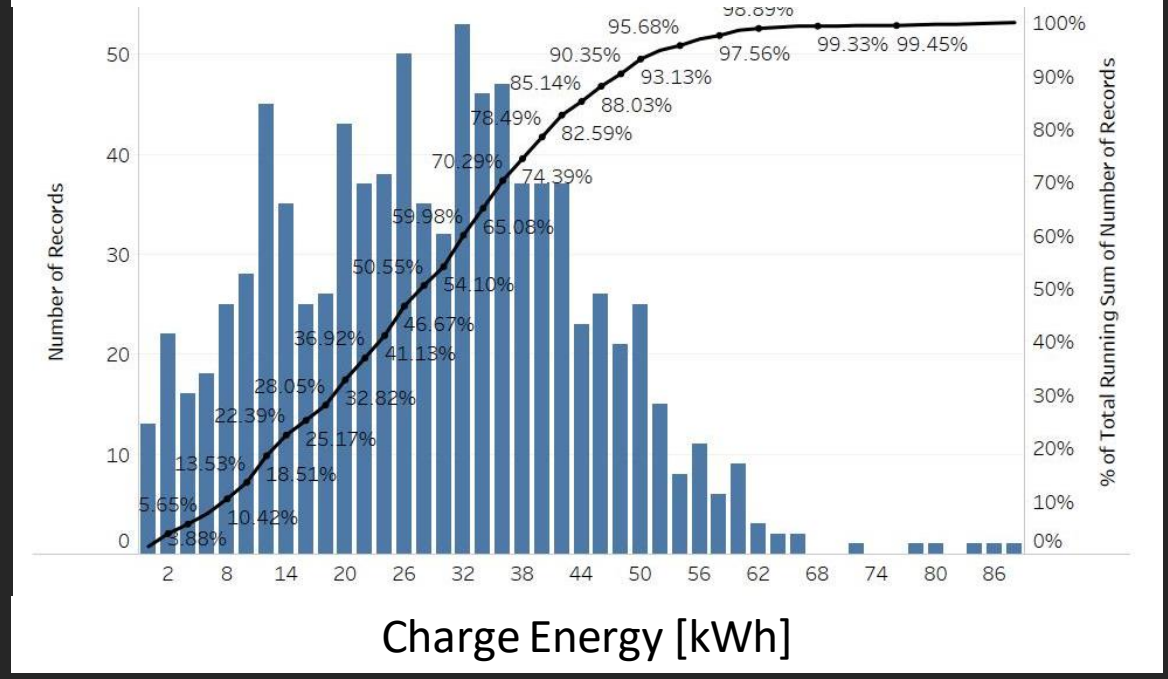
Takeaways:

- Max charge power is only for a couple minutes
- Most charges peaked at 140-145 kW (12%)- reflective of mainly Tesla habits
- 88% of the charges had a peak power less than 140 kW

Charge Energy



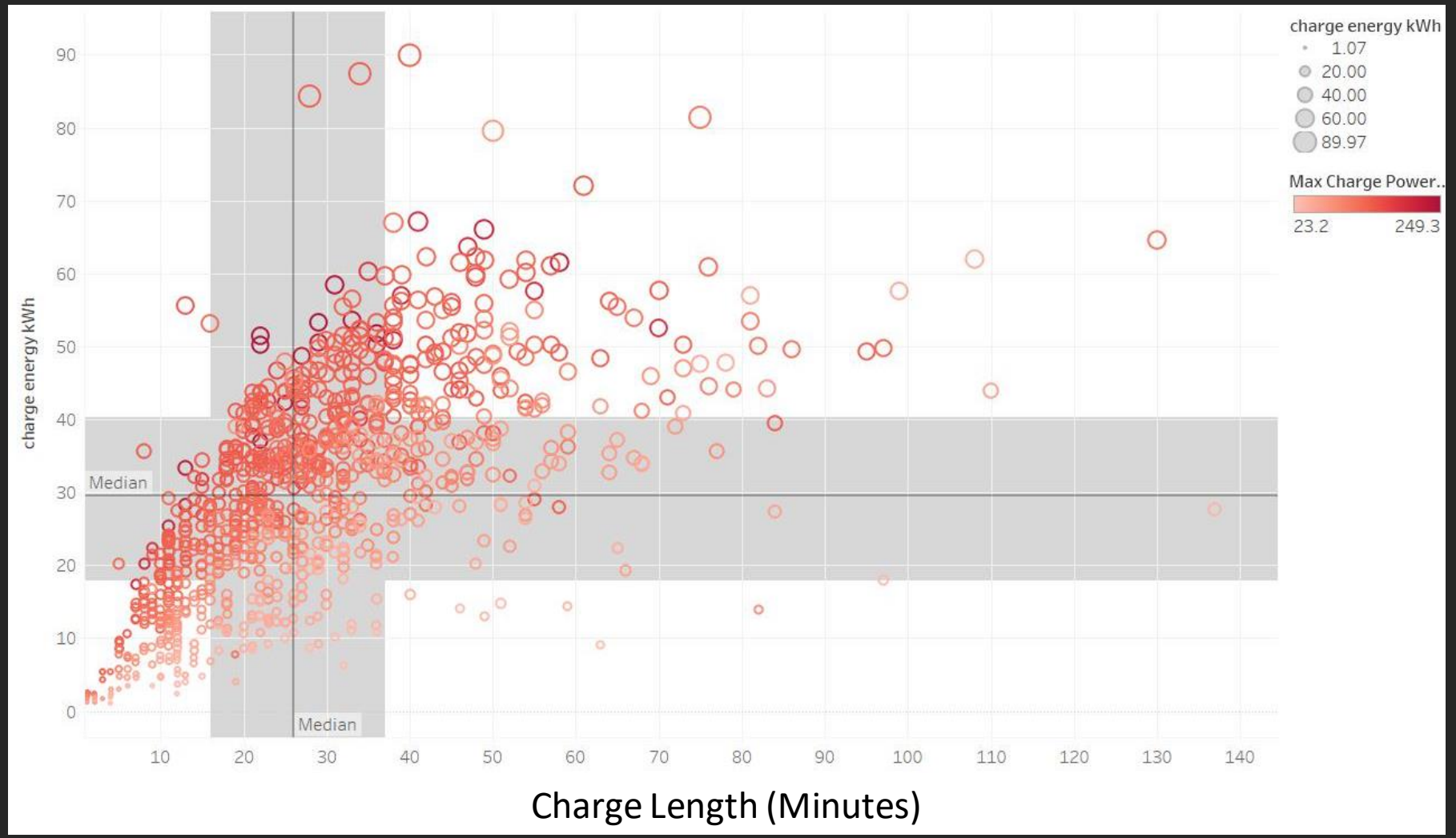
Charge Energy Histogram



Takeaways:

- Median charge energy increases as the power increases
- There is a wide range of data
- 50% of the charges are less than 28 kWh

Charge Length and Charge Energy over all charges



Takeaways (over all charges):

- Median Charge Energy [kWh]: ~30
- Median Charge Length [minutes]: 26
- Charge time and energy used depends on the vehicle and type of charger

Discussion thoughts

What are the utilities saying:

- "Our Tesla stations collectively (average) during the last 12 months are ~10% load factor. "
- "Load factors <5% are common (1-2% in rural areas). Teslas had a better load factor because they undersize their service compared to potential connected load. A few of them hit >15%."

Other thoughts:

- How does queuing weigh in? If you never want to wait in line, what does that mean for utilization? Is 18% (anecdotal) the natural limit? Does one size a station for holiday or weekend travel?
- How do these LF numbers change with more and more adoption? Technology advancement?
- How does one weigh rural areas that are very important when there is no where else to charge, but will never see a high utilization rate?
- How do the utility rates that get set impact public charging business models? How can they balance 'early days' with higher adoption days?
- How are the existing rates utilities have set working? For utilities, site hosts, per drivers?

DCFC charging, while a small percentage of the portion of charge energy, is fundamental to supporting EV adoption