



A Comparison of Public Electric Vehicle Charging Access Across the United States

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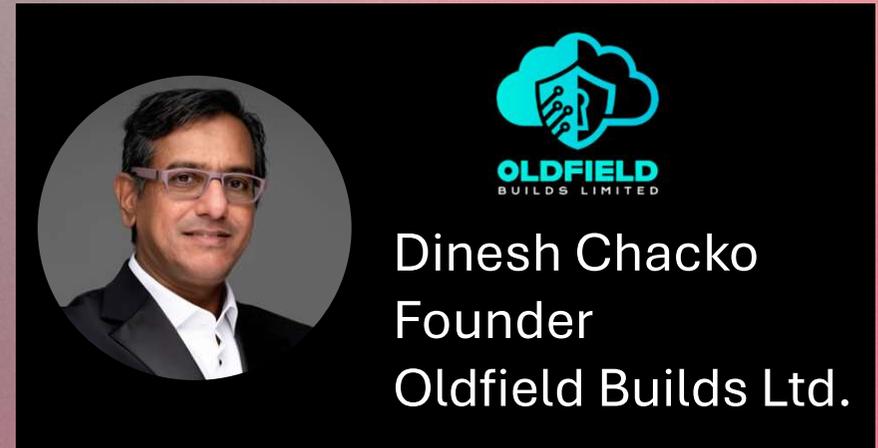
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Dinesh Chacko

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- Expertise: AI, cloud computing, blockchain, cyber security, IT solutions
- Domains: Banking, telecommunications, oil and gas, financial services, public institutions



Research Interests

- Sustainable energy
- AI algorithms
- Academic projects/publishing



Introduction

- Electric Vehicle (EV) ownership is low in the United States (US) relative to other countries
- Rate of new EV registrations in the US was 10% (representing 1.4 million) in 2023
- Europe in 2023 = 25%
- China in 2023 = 60%
- Nevertheless, EV owners in the US must have access to charge points (CPs)

Photo by Visitor7, available at https://commons.wikimedia.org/wiki/File:Electric_Vehicle_Charging_Station.jpg



Residential and Public CP Access

- Challenges to residential charging in the US
 - <50% of US households have parking where they could set up residential charging
 - Strains energy grid
 - Charging in the community needed for long trips
- “Chicken and egg” problem with establishing public CP infrastructure
- Inequity in access: Education, income, race, age, proximity to highways
- European countries have access to public CPs
- Article by Zema and colleagues (2023)
 - Top 10 European countries in terms of public CP access
 - Rates of public CPs per 10,000 population ranged from 10.4 to 52.5
 - Rates of EVs per public CP ranged from 0.6 to 3.0

Research Aim

- Current papers focused on US public CP access focus on a particular region
 - King County in Washington state (Esmaili et al., 2024)
 - New York City (Khan et al., 2022)
 - California (Hsu and Fingerman, 2021)
- In contrast, we compared public CP access between states

The aim of this investigation was to characterise the differences in public CP access across the states in the US, and to estimate if low access was associated with state-level rurality and low socioeconomic conditions.

Methodology

Data Sources

- State-level inquiry (n = 51)
- State rurality, education, income, and population level from US census
- EVs and public CPs per state from Alternative Fuels Data Center (AFDC) from US Department of Energy

Analytic Approach

- Access measures
 - Public CPs per 10,000 population in state (*CPP_{prev}*)
 - EVs per public CP in state (*EVPerCP*)
- Descriptive analysis (including maps)
- Correlation, analysis of variance (ANOVA)
- Linear regression

Results

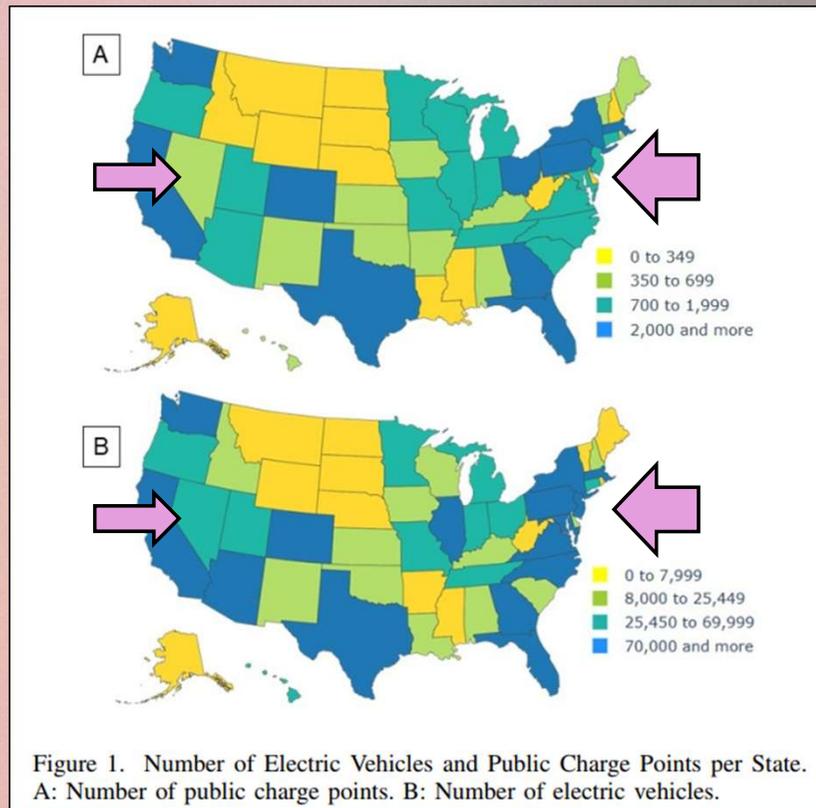
TABLE I
DESCRIPTIVE STATISTICS ABOUT ELECTRIC VEHICLES AND CHARGE POINTS BY DIVISION AND REGION

Division*	Number of States	Number of Public Charge Points	Charge Points per 10,000 Populations	Number of Registered Electric Vehicles 2024	Electric Vehicles per Public Charge Point
ENC	5	7,290	1.9	251,294	34
ESC	4	2,447	1.6	61,475	25
MA	3	9,111	2.7	336,157	37
MTN	8	6,859	3.4	291,764	43
NE	6	7,611	6.1	136,775	18
PAC	5	24,572	5.8	1,501,370	61
SA	9	13,931	2.5	614,617	44
WNC	7	4,112	2.4	93,767	23
WSC	4	5,320	1.6	268,226	50
Region**					
MW	12	11,402	2.1	345,061	30
NE	9	16,722	3.6	472,932	28
S	17	21,698	2.1	944,318	44
W	13	31,431	5.0	1,793,134	57

Note: * ENC = East North Central, ESC = East South Central, MA = Middle Atlantic, MTN = Mountain, NE = New England, PAC = Pacific, SA = South Atlantic, WNC = West North Central, WSC = West South Central. ** MW = Midwest (includes WNC and ENC), NE = Northeast (includes MA and NE), S = South (includes WSC, ESC and SA), W = West (includes MTN and PAC).

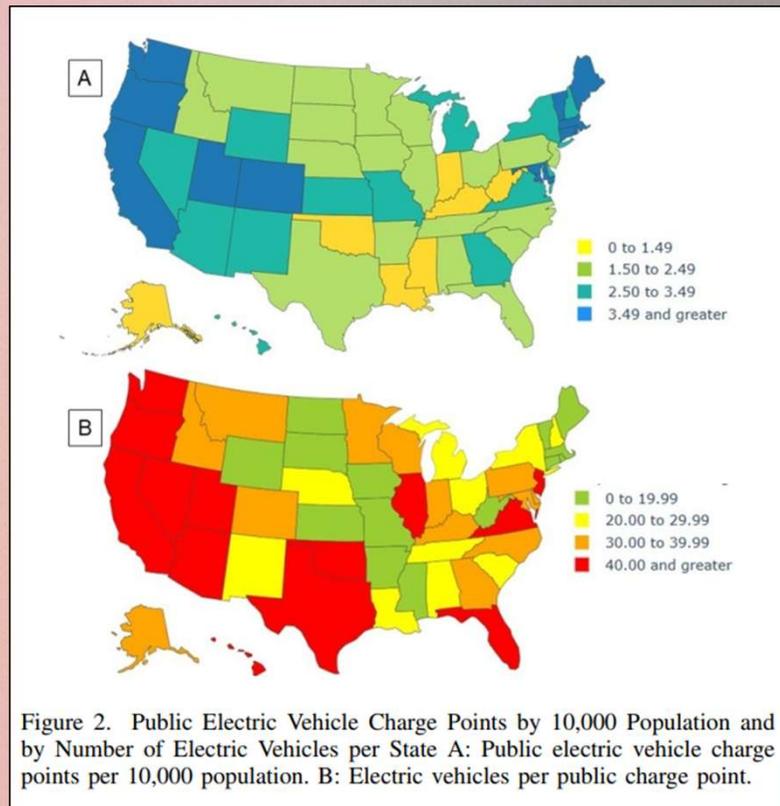
- Median *CPPrev* was 2.4 (IQR 1.7 to 3.4, range 0.9 to 9.9)
- Median *EVPerCP* was 30.4 (IQR 19.3 to 39.7, range 9.2 to 76.5)
- Evaluated by division and region
 - *CPPrev* for division ranged from 1.6 to 6.1
 - *EVPerCP* ranged from 18 to 61

Density of Public CPs and EV Ownership



- Top map shows density of public CPs
- Bottom map shows density of EV ownership
- Some disparities between public CP density and EV ownership density
 - South Atlantic (SA), East North Central (ENC) and Mountain (MTN), and Pacific (PAC) divisions
 - More EVs compared to public CPs

CPPrev and EVPerCP



- Top map shows *CPPrev*
 - When scaled to population, public CPs had a higher density in the New England, Pacific, and Mountain divisions (dark blue).
- Bottom map shows *EVPerCP*
 - States with the least access (red) mostly in Pacific and Mountain divisions.
 - Also in the south (Texas, Oklahoma, Florida).
 - Illinois in the Midwest.
 - Virginia and New Jersey in the east.

Predictors of CPP_{prev} and $EVPerCP$

Model A

$$\hat{y} = -1.1959 + 0.0026_{EV} - 0.0001_{MI} + 23.4885_{PCD} + 2.3771_{NE}$$

Model B

$$\hat{y} = 24.8170 + 0.0121_{POP} + 16.7633_{PAC}$$

- Model A: CPP_{prev}
 - Number of EVs, proportion with college degree, and New England division positively associated
 - Median income slightly negatively associated
- Model B: $EVPerCP$
 - Positively associated with population level and Pacific region

Discussion

- Contrary to our hypothesis, state rurality had no association with public CP access
- Higher proportion of college degrees was positively associated with one access measure (while median income was slightly negatively associated)
- More importantly, there was a “division effect” (New England and Pacific)



Image by Mimich , available at: https://commons.wikimedia.org/wiki/File:US_Census_geographical_region_map.svg

Influence of State-level Public Policy

- Public CP access, when considering number of EV users, was particularly challenging in the Pacific region
 - California Zero Emission Vehicle (ZEV) program since 1990s
 - Absent comparable public CP infrastructure program
- When considering population level CP access, the density of EVs in the Northeast was offset by CP access
 - Programs to expand public CP access have been implemented in Rhode Island, Massachusetts, and New Hampshire



Conclusion

- EV ownership is on an upward trajectory, so CP public access must be addressed
- States with many registered EVs but low levels of public CP access should implement initiatives aimed at increasing number of public CPs.
- Can also increase access public CPs through lowering charging costs or other incentives



Top left photo by 4300streetcar, available at https://commons.wikimedia.org/wiki/File:Nissan_Leaf_charging_in_Cumberland_RI_October_2025_2

Top right photo by Artaxerxes, available at https://commons.wikimedia.org/wiki/File:Rear_entrance_City_Theater_205_Main_Street_Biddeford_ME

Bottom photo by Mariordo (Mario Roberto Durán Ortiz), available at https://commons.wikimedia.org/wiki/File:Charging_City_Hall_04_2016_Sh12_2016.jpg

Selected References

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