**Research Project Abstract (Please limit it to 250 words.)**

This research analyzes charge session data from 93 public Level 2 and DC fast charging stations across 7 U.S. states over a 5-year period (2019-2024) to understand electric vehicle (EV) charging behavior and guide investments in sustainable public charging infrastructure. With EVs surpassing 5% of new passenger vehicle sales, a tipping point for mass adoption, strategic charging infrastructure planning is critical. The study examines station utilization metrics including charge acceptance ratios, charge idling frequency, daily utilization patterns across location types, and impacts of adding capacity at urban, rural, and highway sites.

Machine learning methods including decision trees, random forests, LSTM neural networks, and regression analysis are applied to the multi-state charging data to assess the long-term viability of charging sites 5 years after initial investments. These methods are also used to determine the optimal power level ratio for different location types (urban, rural, interstate) and to identify the point where capacity additions at a site face diminishing returns on utilization. The results quantify the utilization impacts of various charging infrastructure investment scenarios, providing insights to inform projections of site viability over time.

Improving public charging accessibility promotes EV adoption, reducing greenhouse gas emissions and criteria air pollutants. Findings guide public-private infrastructure investments catalyzing the transition to electric mobility, ensuring charging availability meets demand in an equitable, cost-effective manner that maximizes environmental benefits.

**In what way(s) does your research advance science/policy/technology in the environmental field? (Please limit it to 250 words.)**

This research makes several important advances in science, policy, and technology related to reducing transportation emissions and enabling the widespread transition to electric mobility.

From a scientific perspective, the large-scale multi-state analysis of real-world charging session data provides valuable insights into evolving EV charging behavior and utilization patterns across diverse geographic areas. Applying machine learning techniques unlocks a deeper understanding of the factors influencing charging demand, site viability, and optimal power level provisioning.

The findings directly inform public policies and infrastructure investment strategies to catalyze EV adoption in an equitable and cost-effective manner. Quantifying utilization impacts allows policymakers to evaluate the environmental benefits and prioritize investments based on emissions reduction potential. Recommendations on viable long-term charging site characteristics and power level ratios by location type enable sustainable infrastructure procurement.

Technologically, this work illuminates the path for innovators to enhance EV charging management systems, pricing models, and smart charge scheduling capabilities aligned with observed utilization patterns. Insights on capacity upgrade tipping points and diminishing returns can drive more efficient, modular system designs attuned to varying use cases.

Overall, these scientific, policy, and technological advances provide a cohesive set of data-driven tools and actionable intelligence to holistically scale public charging infrastructure in parallel with accelerating EV uptake. This multipronged approach maximizes emissions reductions from electrified transportation.

**What are your future aspirations in the environmental field? (Please limit it to 250 words.)**

Our overarching aspiration is to leverage data science and machine learning to develop innovative solutions that tackle critical environmental challenges head-on. The research on EV charging infrastructure utilization is just an initial step toward the broader vision of accelerating the global transition to sustainable transportation and clean energy systems.

Looking ahead, we aim to expand the analytical approach to incorporate additional data streams beyond charging sessions, such as travel patterns, traffic flows, renewable energy availability, electricity pricing, and EV adoption forecasts. Integrating these multi-modal datasets through advanced machine learning models can enable optimization of dynamic wireless charging corridors, two-way vehicle-grid integration, and coordinated multi-modal electrified mobility solutions.

On the technology front, we hope to collaborate with automakers, utilities, and charging providers to pilot and refine predictive control and smart scheduling algorithms. These can intelligently manage charging to reduce grid impacts, align with renewable generation profiles, provide grid services, and seamlessly integrate EVs into the future distributed energy ecosystem.

Ultimately, we aspire to help shape environmental policies centered around transportation electrification by quantifying the emissions, air quality, equity, economic, and grid resilience implications of various regulatory and market-based approaches. Our goal is to conduct interdisciplinary research that informs and accelerates the synchronized transformation of transportation, energy, and environmental systems to a sustainable future state.