

Scoring the Convenience of EV Ownership in US Cities

Bryan Campbell, Mechanical Engineering and Engineering Sciences, UNC Charlotte

Dr. Anthony Bombik, Mechanical Engineering and Engineering Sciences, UNC Charlotte



Introduction

This study aims to score individual cities across the US on how convenient owning an EV would be. For our first Case Study we chose Charlotte, NC.

The metrics used to find the score are addressing the top concerns about driving EVs according to a 2022 national interest survey conducted by McKinsey Center for Future Mobility [1].

These categories were:

1. Charger Availability
2. Vehicle Range
3. Emissions of Charging
4. Cost (Initial + Ownership)

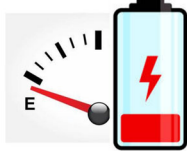
Objective

Develop an **EV Convenience Score** for Charlotte, NC based on equal weighting of the following city-dependent factors:

Charger Infrastructure



Range Accessibility



Cost of Ownership



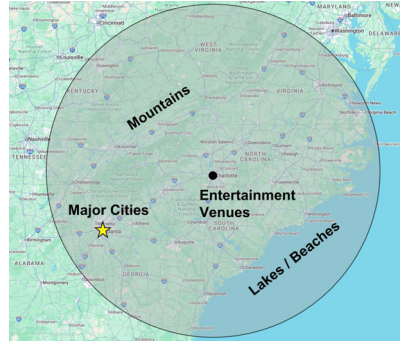
Grid Emissions



Method

Range Score:

Based on popular destinations within range of typical EVs ~300mi



Charger Score:

$$w_{charger} = \ln \left(\frac{chargers}{mi^2} \right) + 5$$

- 1 charger/mi² = 5/10
- 150 chargers/mi² = 10/10

Cost Score:

$$w_{cost} = 10 \left(1 - \frac{\$_{elec}/mile}{\$_{gas}/mile} \right)$$

- Electricity 40% cost of gas = 6/10
- Free electricity = 10

Grid Score:

$$w_{grid} = 10 \left(1 - \frac{state\ emissions}{2200\ lbs\ CO_2/MWh} \right)$$

- The worst US state is West Virginia at 1954lbs CO₂/MWh =
- Clean grid without emissions = 10

Collected Data

Charger Score

- Charlotte has 796 EV charging ports within a 10-mile radius of center city

Grid Score:

- North Carolina as a state emits 623.94 lbs CO₂/MWh of energy generated

Cost Score:

- Cost per mile was found by taking the average light-duty vehicle mpg (25.7) and dividing that into the cost of a gallon of gasoline (\$2.88 regular unleaded)*
- Electricity was found by taking the average cost of residential electricity (\$0.14)* and dividing that by the average energy consumption per mile of EV's (306Wh)*

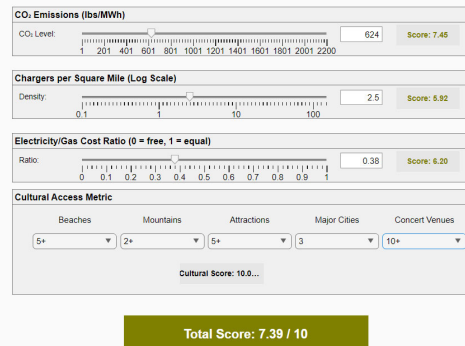
Range Score:

- Cultural access was found by cross-referencing a map with a 300-mile radius circle centered on Charlotte and lists of attractions within that range.

*At present time making this poster (July 2025)

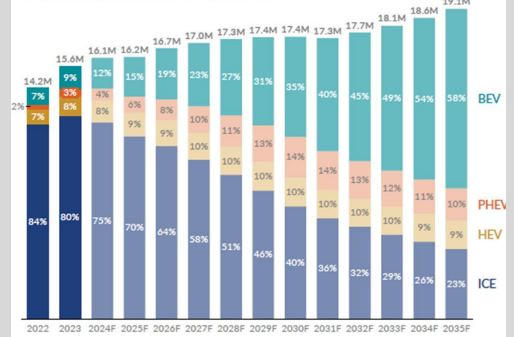
Results

Owning an EV in Charlotte NC



Motivation

North American Vehicle Production



Conclusions

Overall Assessment: Charlotte, NC, demonstrates a strong foundation for EV adoption, achieving an overall score of **7.39/10**.

Key Strengths:

Charlotte's key strengths lie in the lower electric cost per mile ratio (38% of gasoline) and in the ability to get to a large range of Cultural Activities.

Future Outlook: While strong in several areas, continued development in charging infrastructure and range-based amenities will further enhance EV appeal. Future work aims to provide a more holistic cost analysis for potential EV owners.

References

1. McKinsey Center for Future Mobility (MCFM) Insights; MCFM Consumer Pulse Survey, December 2022
2. Barrott, M., Hockenbrocht, D., September 2024 *Current State of the Industry*, Plante Moran