BACKGROUND & MOTIVATION

- The transportation sector is the most polluting, least efficient and the 2nd most energy intensive end-use sector in the U.S.

Comparison of End-Use Sectors: U.S.

- Cars dominate the current vehicle fleet for personal commute and have a very poor passenger-vehicle weight ratio.

Cumulative Distribution Function

- 37% of all trips are under 5 miles distance while 20% of the trips are under 3 miles based on survey data.

- Shared electric micro-mobility has the potential to expand access to public transportation, reduce energy use and life cycle environmental footprint, and save costs.

OBJECTIVES

- Perform a quantitative analysis of replacing current mode of transportation with shared micro-mobility electric vehicles for short distances.
- Reduce the energy consumption of the transportation sector by 50%.
- Estimate related reduction in CO2 emissions.
- Investigate economic feasibility of this transition.

METHODS

- Analysis of travel modes and miles based on the weekly trip data for Pittsburgh by Western Pennsylvania Regional Data Center.
- Energy consumption and emission metrics for E-scooters and E-bikes are obtained from Monte-Carlo analysis in previous research. [1]
- Flowchart for the replacement of conventional modes of transportation with electric micro-mobility solutions:

RESULTS

- A 50% reduction in energy demand can be achieved by replacing conventional-powered vehicles with shared electric scooters and bikes for trips of 3 or 5 miles. Mentioned below are the statistical results of the analysis:

Effect of deploying shared electric micro-mobility

- To achieve the targets, ~7,700 e-mobility trips are required per day for distances under 3 miles, while ~15,800 such trips are required for distances up to 5 miles.

Trends of shared mobility usage in Pittsburgh

The average dollar per trip cost of commuting by electric scooters and bikes is approximately 6 times lower than driving alone for short trips.

Sensitivity Analysis

- Sensitivity for Energy Savings
- Sensitivity for Emissions Reduction

CONCLUSION

- 50% of the energy used (~2200 TJa) in short trips can be reduced by making ~56% of all trips in Pittsburgh with e-bikes and e-scooters.
- The results from our analysis are in agreement with Pittsburgh's current transportation demographic goals for 2030.
- In the 5 mile scenario, 50.5% of energy is saved and 27.5% of emissions are cut down.
- In the 3 mile scenario, 46.3% of energy is saved and 23.4% of emissions are cut down.
- An individual makes an annual saving of ~$2250 per year by switching to electric mobility.

CHALLENGES

- Deploying the changing infrastructure, vehicle collection & transportation in Pittsburgh and operational challenges that come along with it.

REFERENCES

- "EMAT and the Flinders Institute of Technology (Flinders Institute of Technology, Flinders University, Adelaide, SA, Australia)," (2016). Pittsburgh, Climate Action Plan, 3.3.3. [Accessed: 24 Feb, 2020]

ACKNOWLEDGEMENTS

This paper was supported in part by the Energy, Science, Technology and Policy Program at Carnegie Mellon University. Special thanks to Prof. (E.) Constantine Samaras.