Carbon Efficient Network Design for Middle-Mile Distribution

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MIT GLOBAL SCALE NETWORK

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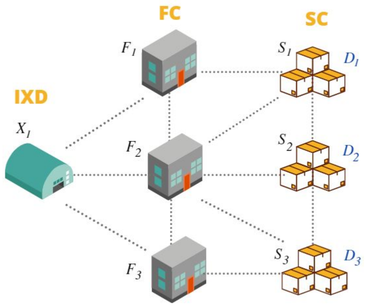
Motivation / Background



Transportation is a major carbon emitter especially in shipment industry. Well-designed transportation network, particularly for the middle mile, will help reduce carbon emissions to maintain the global temperature target of below 2ºC.

Problem Statement & Key Questions

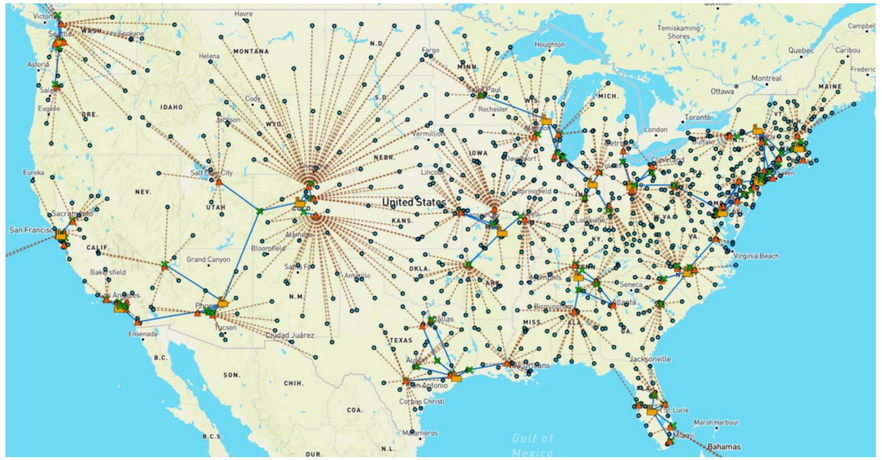
Solve for the optimal distribution network that fulfills customer demand with the lowest carbon footprint.

- **How many, what types, and where should the facilities be located? What vehicles should be used between facilities?**
- **How significant are the trade-offs between carbon emissions, transportation cost, and delivery time?**

Relevant Literature

- Greene, S., Lewis, A. (2019). GLEC Framework for Logistics Emissions Accounting and Reporting.
- Martínez, J. C. V., & Fransoo, J. (2017). Green Facility Location.
- Palacio et al. (2018). Analysing the factors that influence the Pareto frontier of a bi-objective supply chain design problem.

***GHG Emissions will be short-handed as carbon.**



Methodology

1. Build network design scenarios with candidate locations and GFLP
2. Sequentially optimize the three objectives and plot Pareto frontiers
3. Identify optimal target scenarios and their trade-offs

Green Facility Location Problem (GFLP)

Tri-objective Sequential Optimization

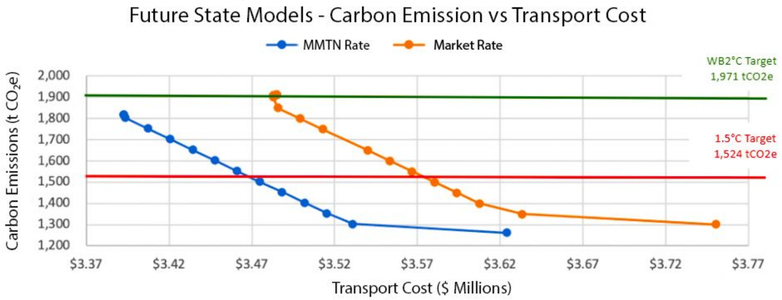
Carbon Emissions

GLEC GLOBAL LOGISTICS EMISSIONS COUNCIL

Transportation Cost

Delivery Time

Initial Results



- The trade-offs between CO_2e and delivery time was significant compared to the trade-off between CO_2e and transportation cost.
- Transition to alternative fuel transportation modes is required to realize a 42% decrease in emissions and reach CO_2e target.

Expected Contribution

Insight into trade-offs between carbon emission, transportation cost, and delivery time

Carbon-efficiency opportunities through alternative transportation and technologies

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