E-commerce and the environment: Finding the optimal location for in-store pick-up

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Agenda

Background

Methodology

Results Result Analysis

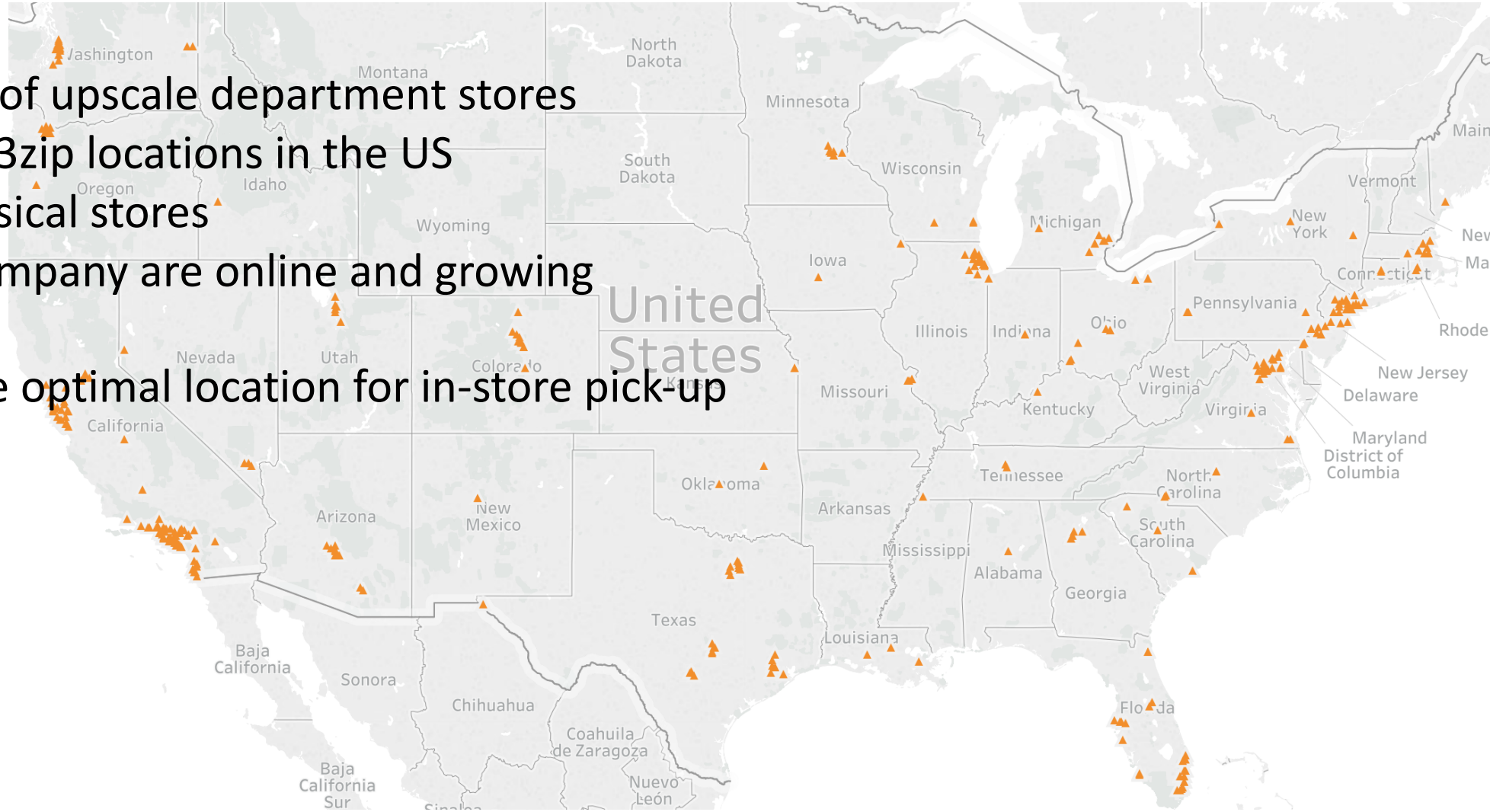
Conclusion And Recommendation

Q&A

Background

- An American chain of upscale department stores
- Customers in 800+ 3zip locations in the US
- More than 350 physical stores
- 26% sales of the company are online and growing

Objective: Finding the optimal location for in-store pick-up



Hypothesis

Two main hypothesis:

- ✓ It is profitable to determine some stores as pick up locations
- ✓ Having the customers pick up their orders in store reduces the environmental impact

Methodology

Demand Data analysis

More than 10 million records in 9 months

Cost reduction function

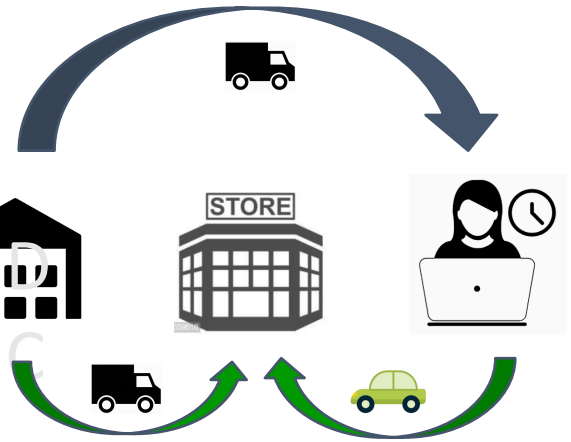
Binary integer linear programming
Optimal solution for maximizing saving

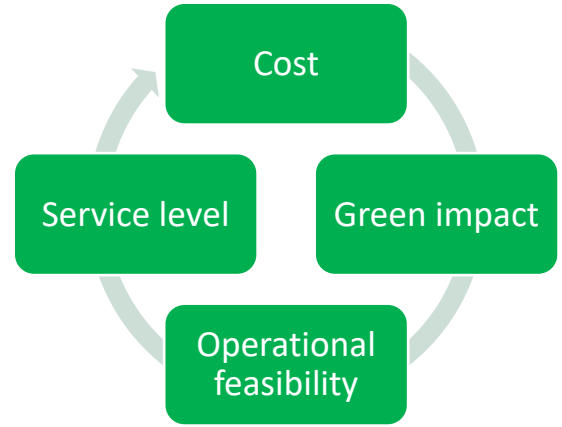
CO_2 emission function

Measured and evaluated environment impact

Results Analysis

Economic and Environmental Analysis





Methodology – Cost reduction model

Setup

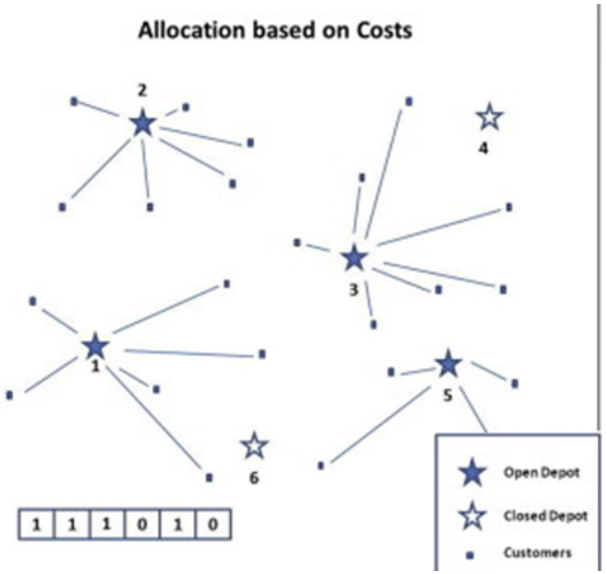
- P: Customers' willingness
- M: Maximum distance

Input

- C: Delivery cost
- D: Distance from store to customer
- F: Fixed cost of opening pick-up service

Output

- Cost saving
- Selected stores



$$\max \rightarrow Z = \sum_j \sum_i P * C_i * X_{ij} - \sum_j F_j * Y_j$$

Subject to:

$$\sum_j X_{ij} \leq 1, \forall\ i\ \in\ I, \forall\ j\ \in J$$

$$X_{ij} * D_{ij} \leq M, \forall\ i\ \in\ I, \forall\ j\ \in\ J$$

$$X_{ij} \leq Y_j, \forall\ i\ \in\ I, \forall\ j\ \in\ J$$

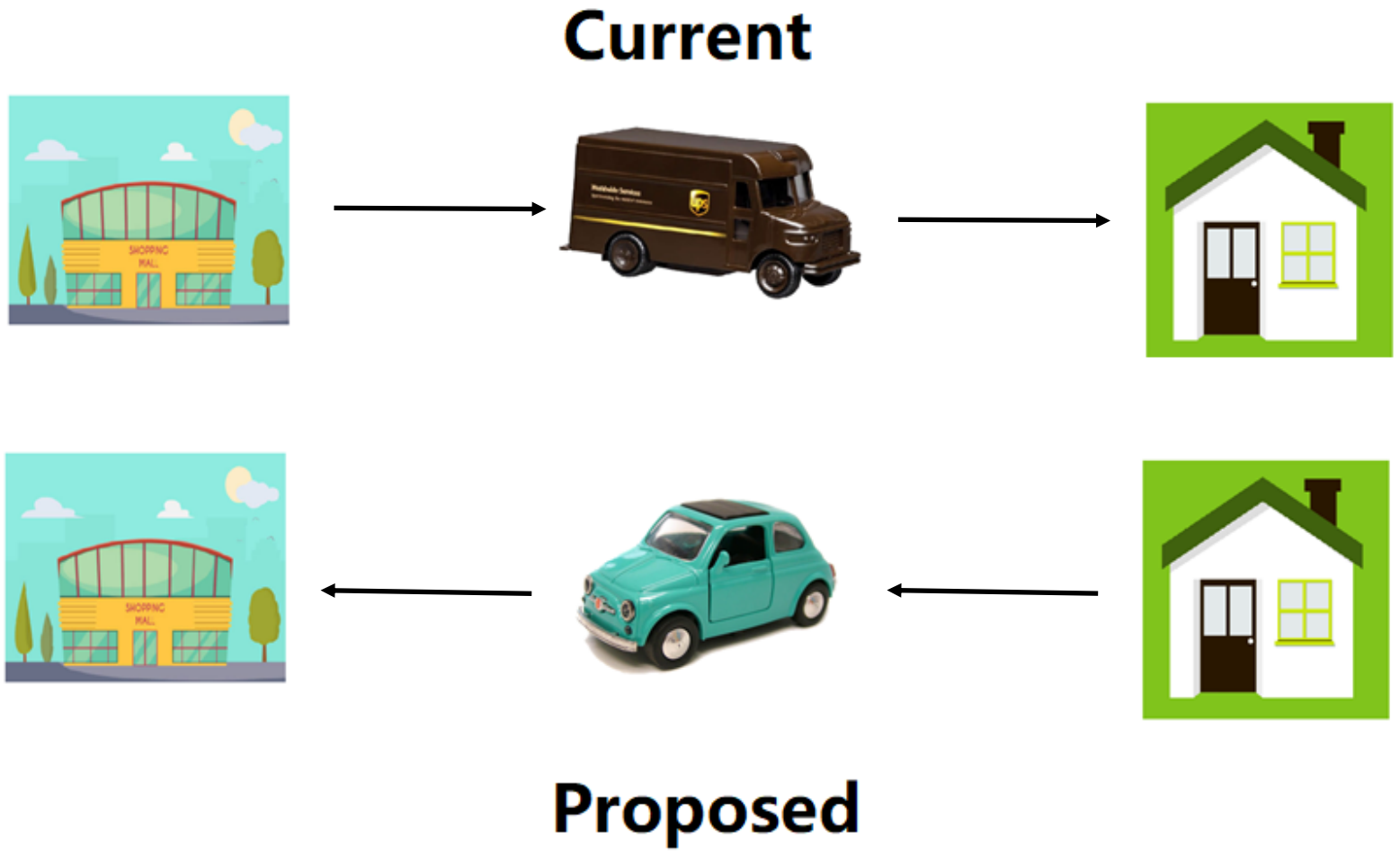
$$X_{ij}, Y_j\ = \{0,1\}$$

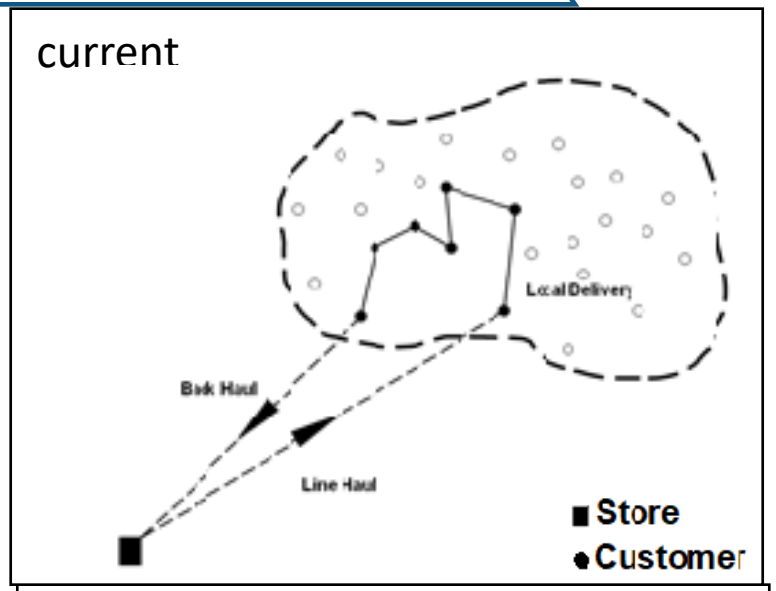
GeoPy GUROBI OPTIMIZATION +ableau

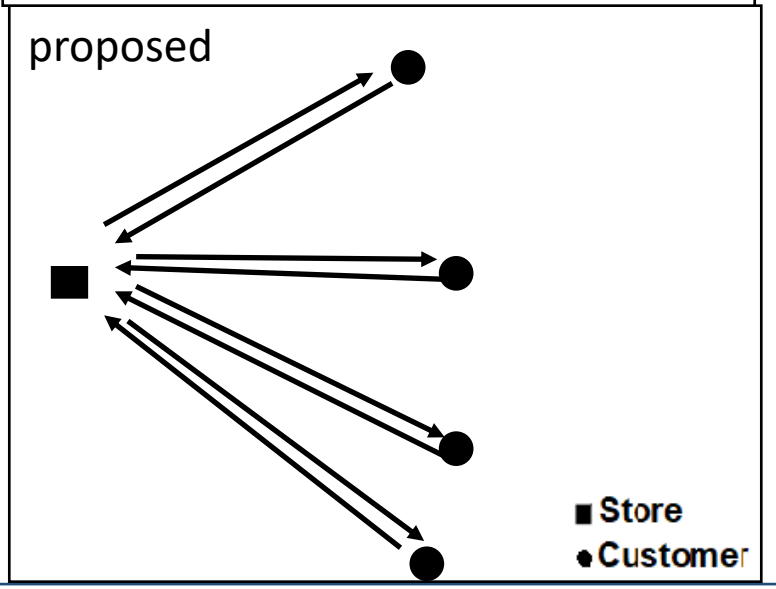
Supply Chain MANAGEMENT

Methodology – CO_2 emissions model

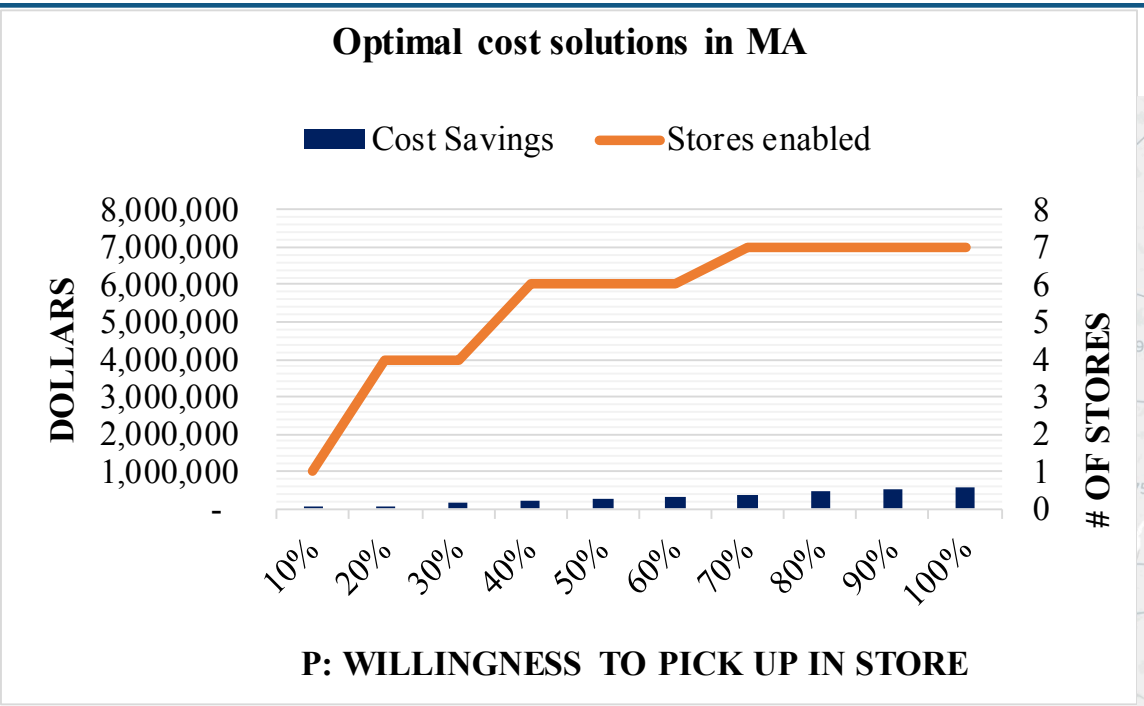
$$E^{savings} = E^{current} - E^{proposed}$$



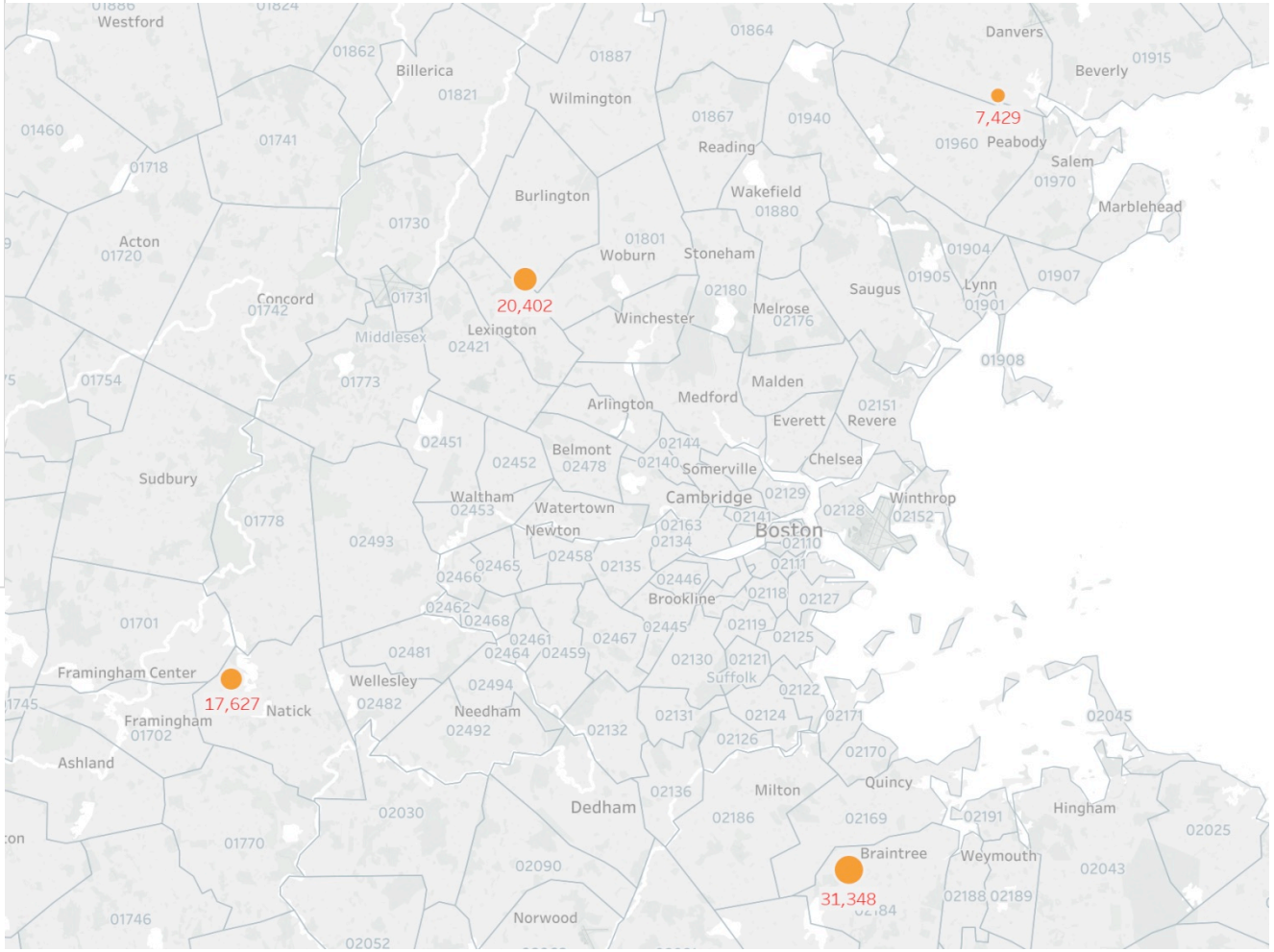




Result Analysis – Cost reduction model

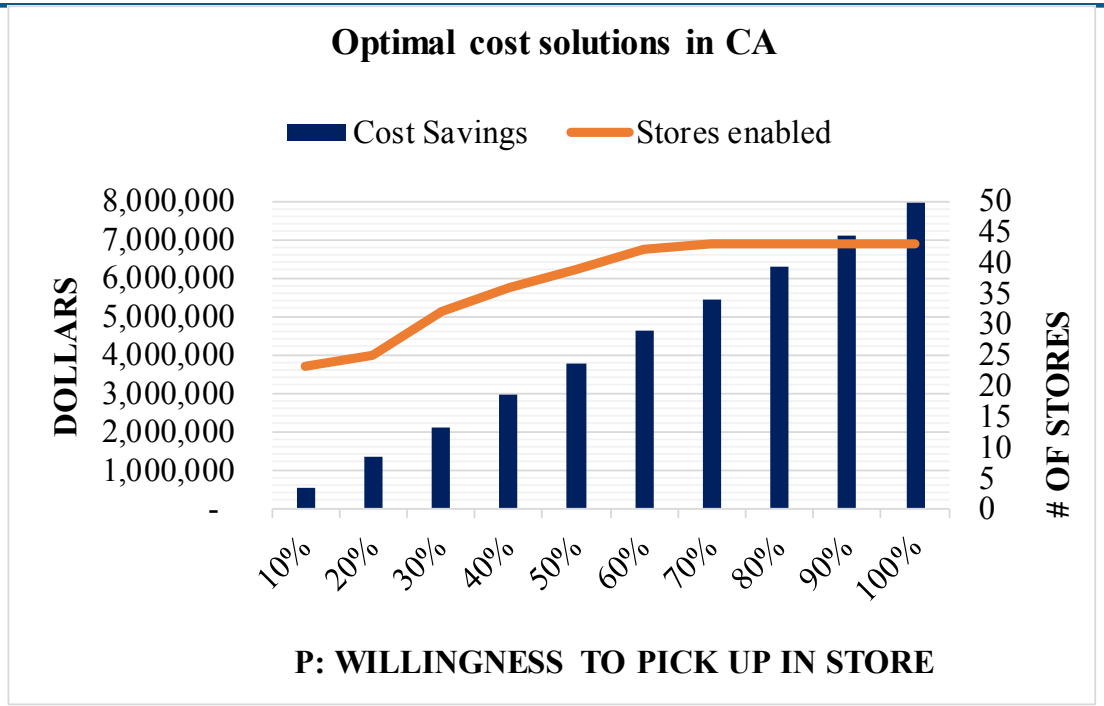


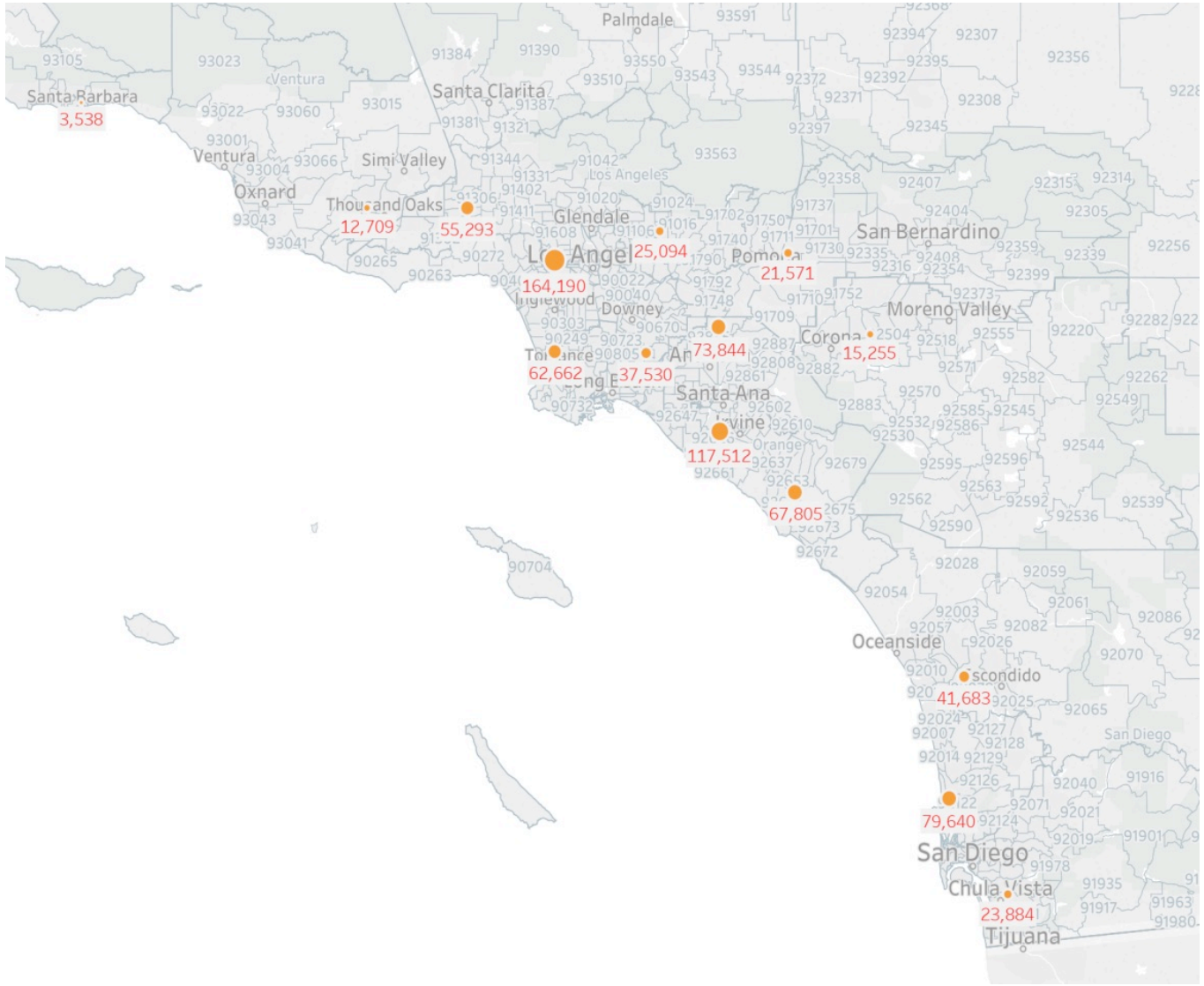
- Higher willingness leads to higher saving with more stores opening pick-up service;
- 4 stores selected as profitable candidates in MA with $77K in savings, with willingness = 20% and distance = 10 miles;
- Alternative scenario by choosing distance=6 miles and selecting stores in Boston.



Supply Chain MANAGEMENT

Result Analysis – Cost reduction model



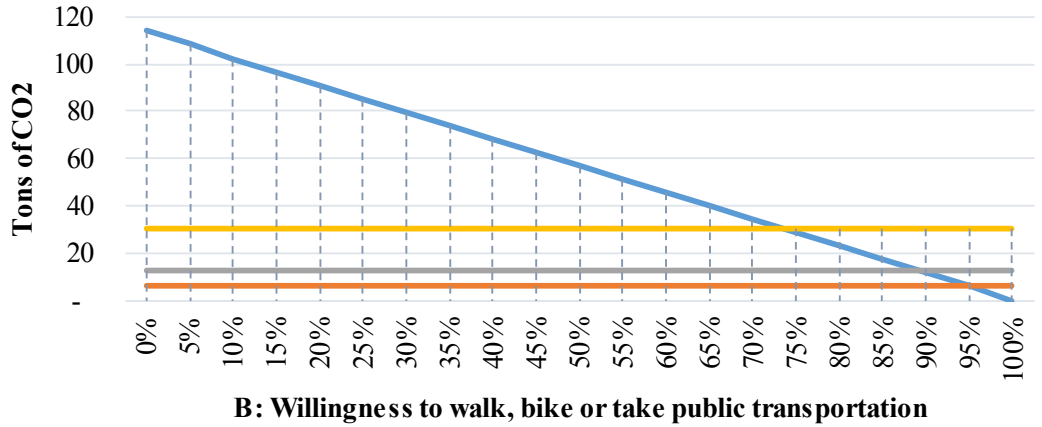


- CA can achieve more savings than MA as the demand is much denser;
- 15 stores would be profitable candidates in great LA area and 10 in the SF area;
- With willingness=20% and distance=10 miles, CA potentially can save $1,319K ;

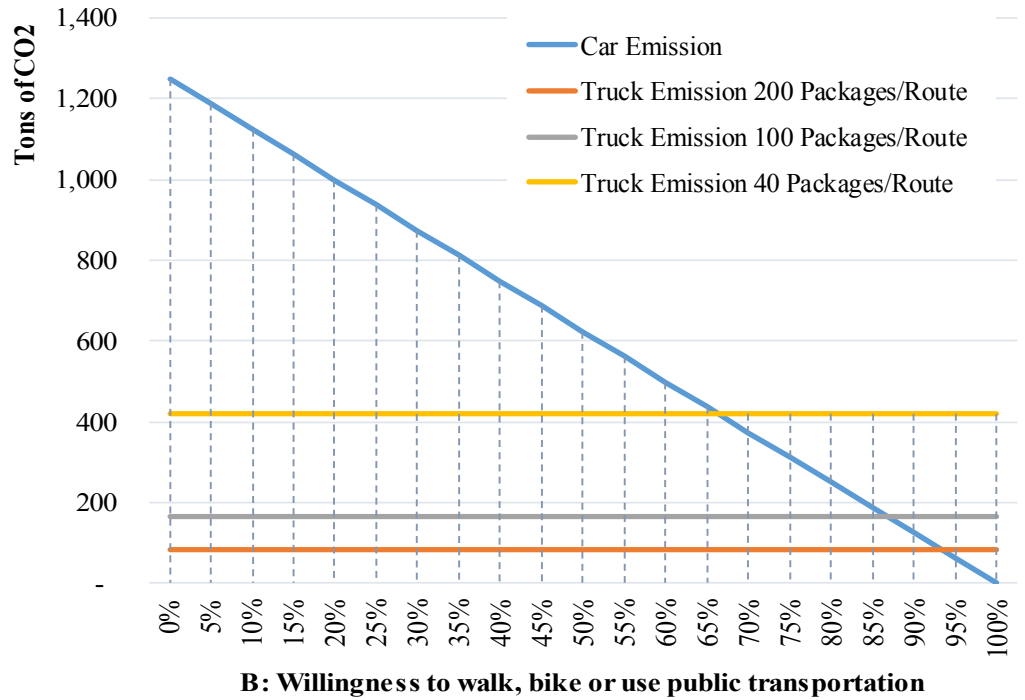
Result Analysis – CO_2 emissions model

Trucks vs. Cars CO_2 emission

MA



CA



	Minimum B required to have CO_2 savings	
	MA	CA
200 Packages/Route	95%	94%
100 Packages/Route	90%	86%
40 Packages/Route	74%	66%

- The efficiency of a route has great impact on CO2 emission;
- The denser of demand, the lower B needed to achieve CO2 saving;
- The more people come to store by walking, bike or public transportation, the more friendly to environment;
- In the sparse demand area , direct shipping may be more environment-friendly!

Conclusion And Recommendation

1. Cost saving highly relies on customers' willingness to pickup the order in store;

2. Customers' willingness to avoid driving and the efficiency of carriers' route design highly affect environment;

3. The company should first open pick-up-in-store service in denser locations;

4. The company should incentivize and educate customers in using more environmentally-friendly transportation modes;

5. In the event that carriers' route design is very efficient, direct shipment would be more environmentally-friendly;

Questions