

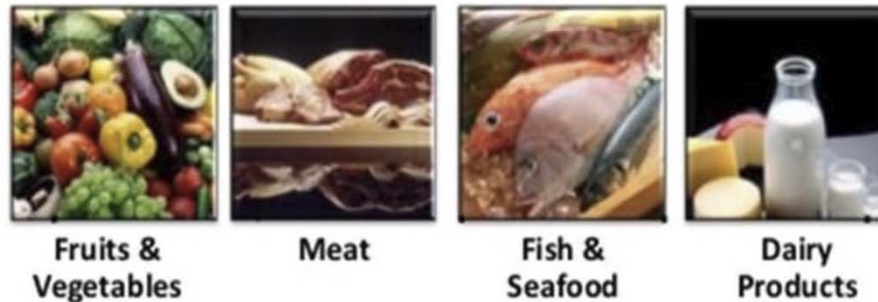
# Subject 3

## Comparison of Distribution Strategies and Analysis of CO<sub>2</sub> emission



Perishable goods are products that **tend to deteriorate over time** due to their characteristics. They become contaminated by living microorganisms such as fungi and bacteria and thus must be consumed before a specific date.

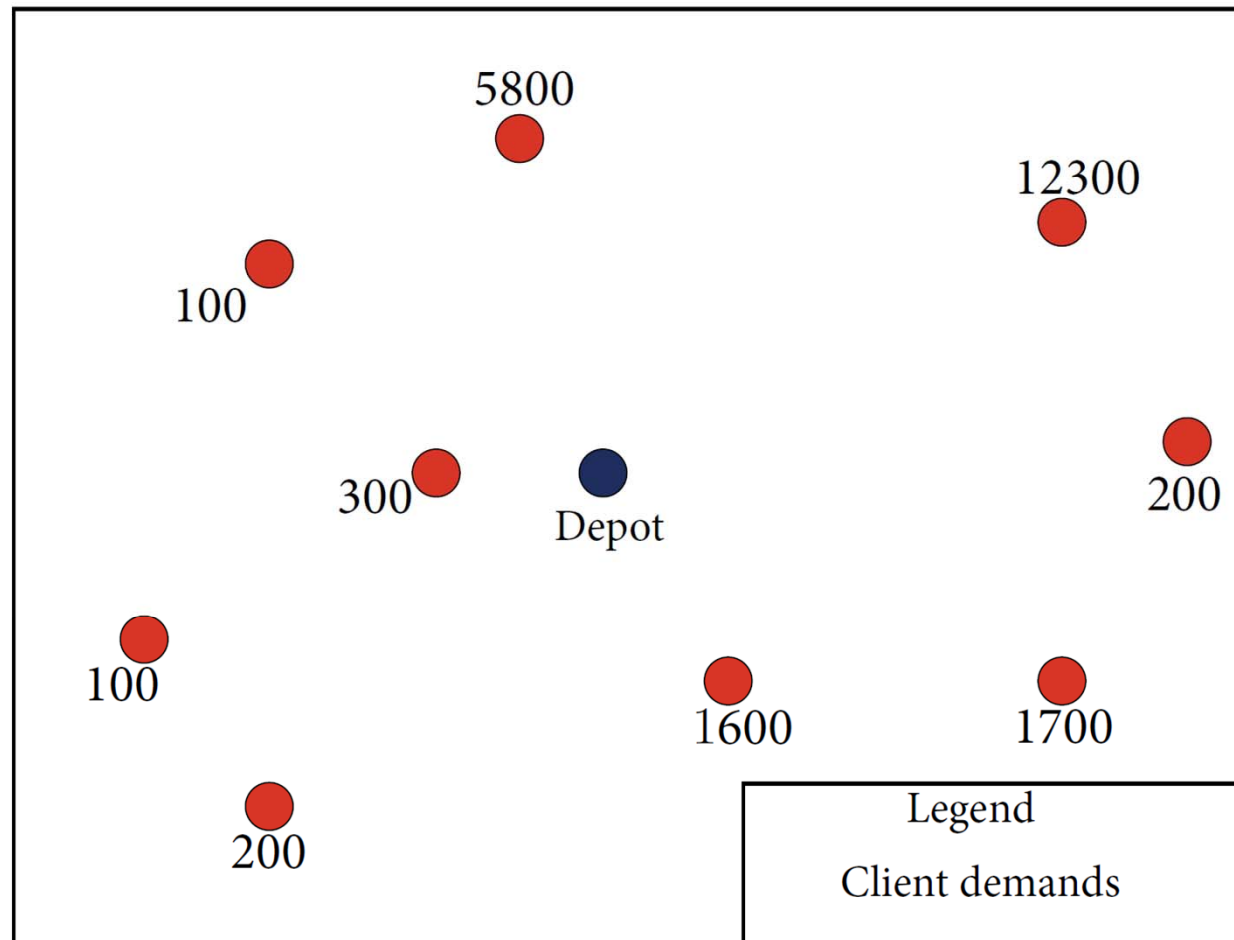
Although flowers and certain pharmaceutical and chemical materials are also perishable, when we talk about storing these types of goods, we're usually referring to the food industry and products like meat, milk, cheese, fruit, fish and vegetables.



Objective:

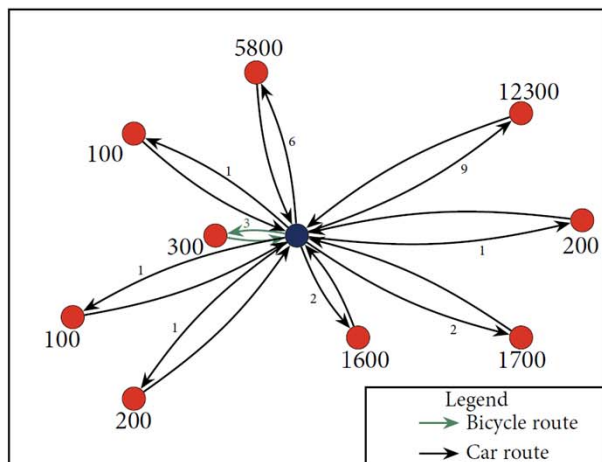
Examine several policies for transporting perishable goods and compare the CO<sub>2</sub> emissions related to each policy.

## Motivation



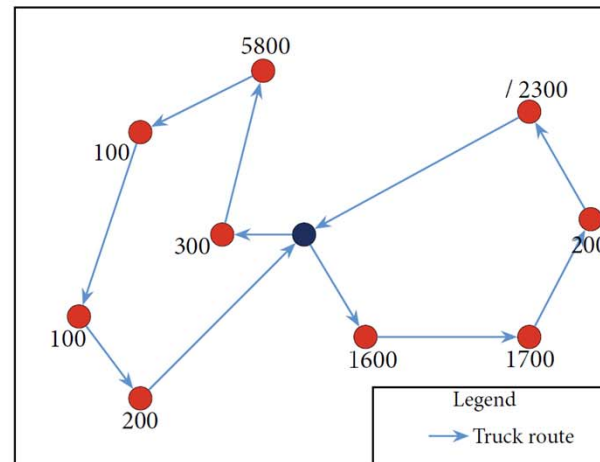
# At least 3 distribution schemes

We are going to consider the following three cases:



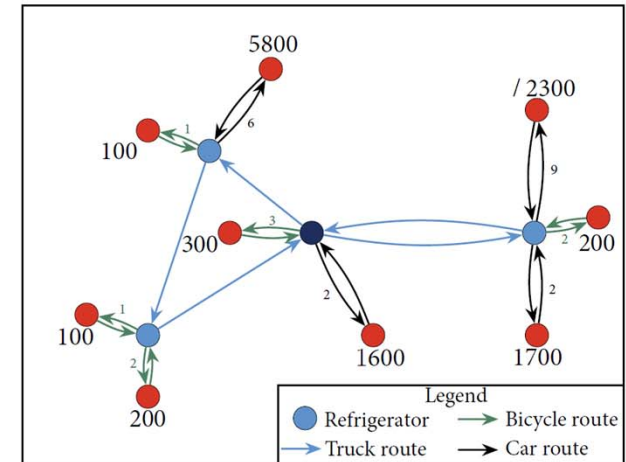
1. Clients come to the depot

« Drive » All-to-1



2. A fleet of trucks delivers all the goods to the clients

« Routing »  
1-to-ALL  
CVRP



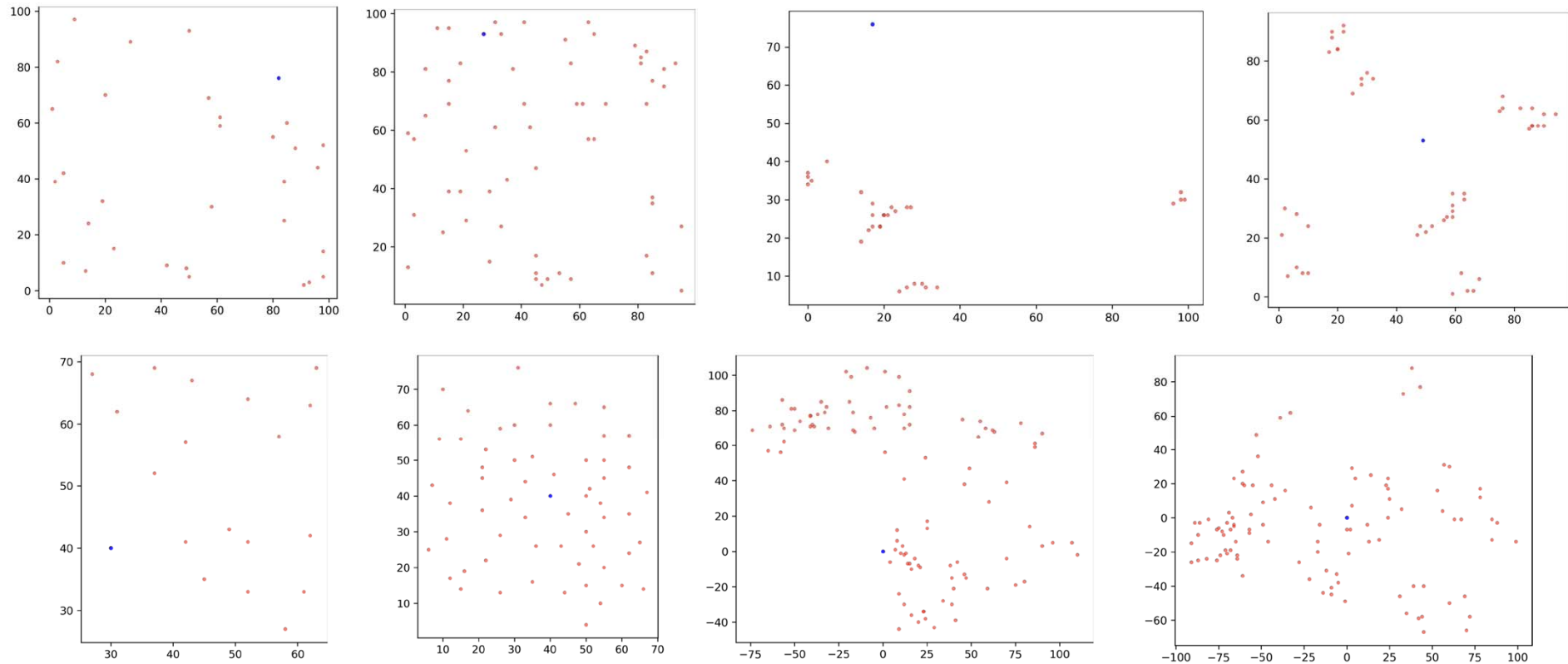
3. Installation of refrigerators.

- A fleet of trucks delivers the goods to the refrigerators.
- Clients come to the nearest deliver point (depot or refrigerator).

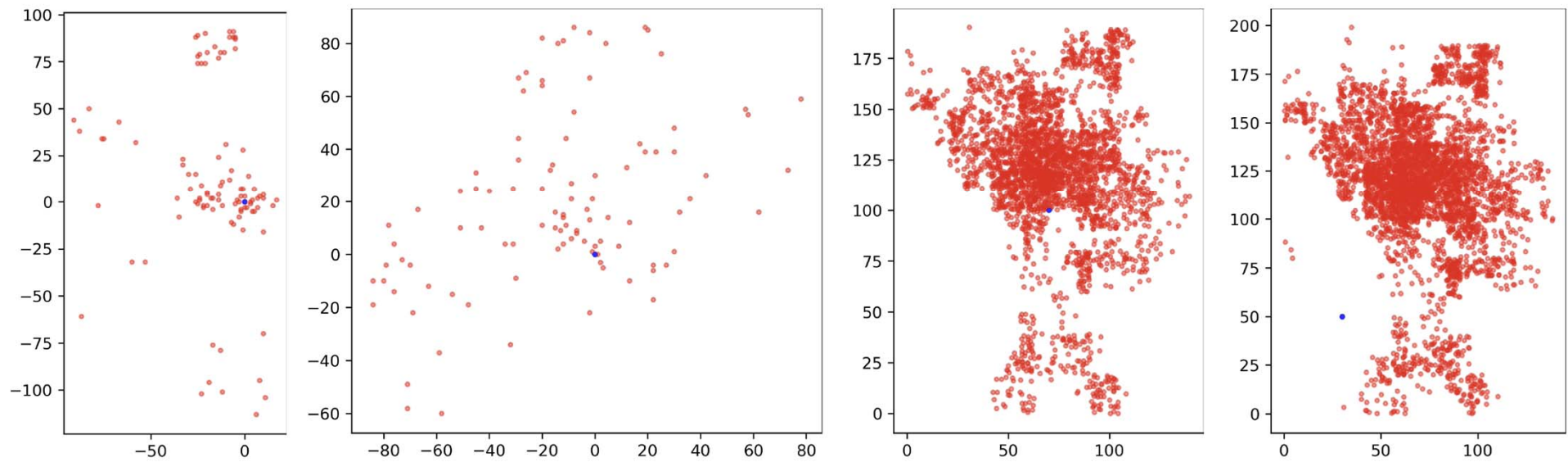
2-Echelon network  
(with local distributors)

# You have much bigger data instances...

12 Instances (10 small + 2 medium size)



12 Instances (10 small + 2 medium size)



- Each instance is given in a text file (extension .txt)
- DIMENSION: Number of points in the instance
- CAPACITY: Truck capacity in kg
- NODE\_COORD\_SECTION: List of coordinates (x,y) for each point in the instance
- DEMAND\_SECTION: List of demands in kg for each point in the instance

Additional notes:

- There is a single Depot point placed at point 1.
- We consider an Euclidean distance.
- Map units are Hectometres.

DIMENSION : 4

CAPACITY : 10000

NODE\_COORD\_SECTION

1 82 76

2 96 44

3 50 5

4 13 7

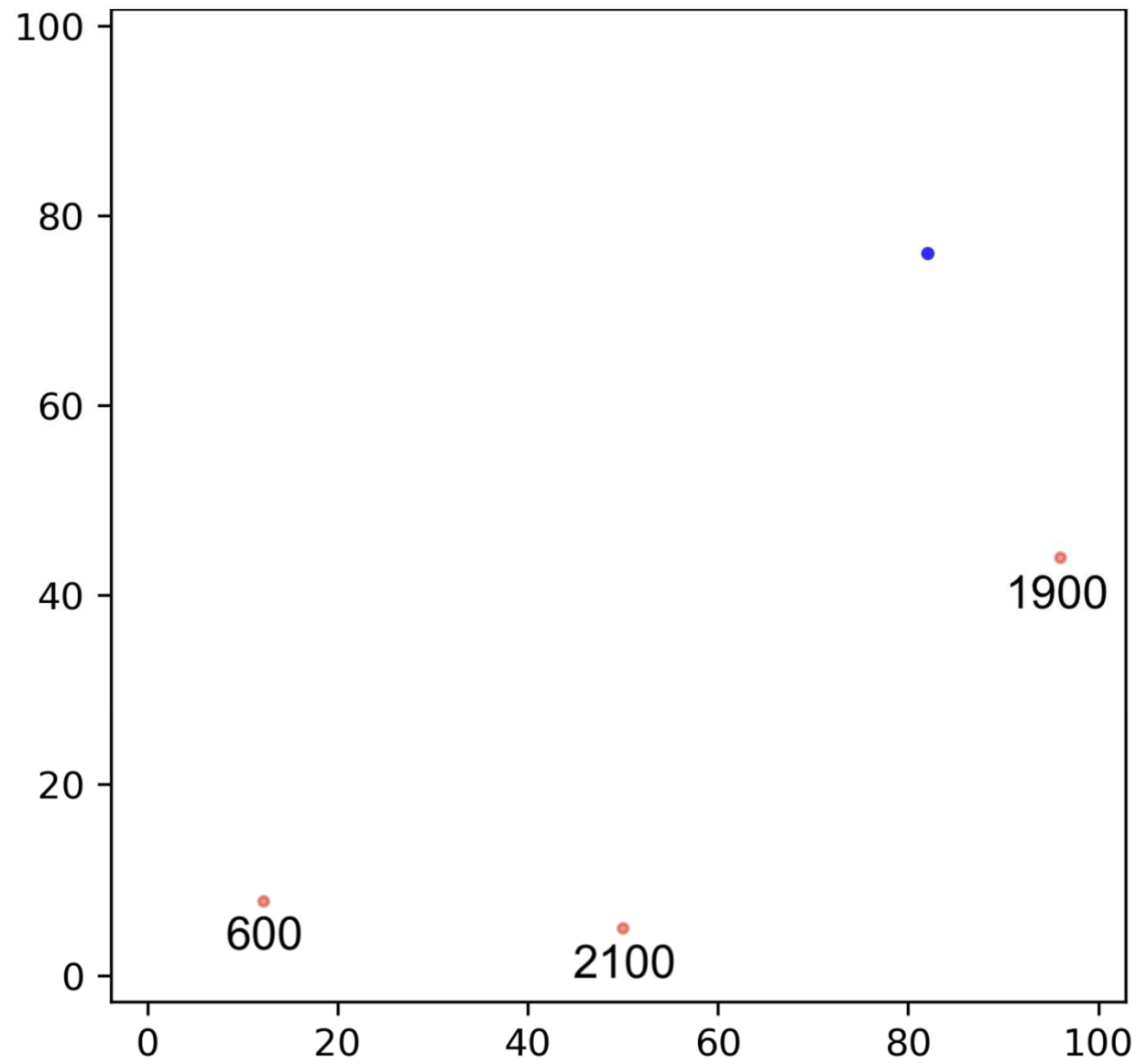
DEMAND\_SECTION

1 0

2 1900

3 2100

4 600



Initial assumptions (they must be included in the report as a base-case scenario)

Vehicle capacities:

- A frigorific truck can transport up to 21 t,
- A car can transport up to 1.5 t,
- A bicycle can transport up to 100 kg.

Routing CO<sub>2</sub> emissions:

- A frigorific truck generates 311 g of CO<sub>2</sub> to transport 1 t over 1km,
- A car generates 772 g CO<sub>2</sub> to transport 1 t over 1 km,
- Bicycles do not generate CO<sub>2</sub>

Refrigerators:

- A refrigerator generates 42 g of CO<sub>2</sub> to freeze 1 t during one day

## Initial assumptions

Bicycles can be used if and only if, the client demand is less than or equal to 500kg and the round trip distance is less than or equal to 6km. For longer distances or heavier demands we have to use cars.

## Other CO<sub>2</sub> emissions:

- Building a 21 t frigorific truck generates 15 000 000 g of CO<sub>2</sub>

- After analyzing the base-case scenario, you are free to examine other situations by modifying some of the parameters or by considering additional information.

For example:

- Building a 1.5 t car generates 600 000 g of CO<sub>2</sub>
- Building a bicycle generates 96 000 g of CO<sub>2</sub>
- Building a domestic refrigerator generates 257 000 g of CO<sub>2</sub>

- You can use any algorithm or software.

# Some links

- <https://impactco2.fr/outils>
- <https://librairie.ademe.fr/consommer-autrement/1189-modelisation-etevaluation-des-impacts-environnementaux-de-produits-de-consommation-etbiens-d-equipement.html>
- <https://www.statistiques.developpement-durable.gouv.fr/edition-numerique/chiffres-cles-du-climat/fr/>
- [https://www.webfleet.com/fr\\_fr/webfleet/blog/emission-co2-camion-km/](https://www.webfleet.com/fr_fr/webfleet/blog/emission-co2-camion-km/)
- <https://www.ncat.org/energy/energy-toolkit/energy-efficient-refrigeration/>
- [https://www.webfleet.com/fr\\_fr/webfleet/blog/connaissiez-vous-laconsommation-carburant-dun-poids-lourd/](https://www.webfleet.com/fr_fr/webfleet/blog/connaissiez-vous-laconsommation-carburant-dun-poids-lourd/)