Freight transport systems: analysis and modelling

CIEM6210 (U3)   CIEQ6213   SEN173A

Assignment onboarding

Arjan van Binsbergen, Lóri Tavasszy, Stefano Fazi, Mahnam Saeednia, Allan Guzman Fallas

TUDelft

TIMETABLE CIEM6210-U3 / CIEQ6213 / SEN173A
**FREIGHT TRANSPORT NETWORKS AND SYSTEMS**
Timetable; version 23 April 2024

week: lecture week in quarter 4
(c.wk.: calendar week)

			Where	Type	Title/topic	Exercise/assignment	Lecturer involved
					Part A: Freight & logistics systems		
week 1	TUE 23 APR 2024	10:15-10:45	CEG-Lecture Hall E	Lecture	(L01-short) Short introduction to course		Stefano Fazi, Mahman Saeednia, Arjan van Binsbergen
(c.wk. 17)	TUE 23 APR 2024	10:45-12:45	CEG-Lecture Hall E	Lecture	(L02) Supply chains, logistics, freight transport systems		Arjan van Binsbergen
	THU 25 APR 2024	10:45-12:45	CEG-Lecture Hall E	Lecture	(L03) Intermodal transport networks: strategic, tactical, operational perspectives		Mahman Saeednia
					Part B: Models		
week 2	TUE 30 APR 2024	10:45-12:45	CEG-Lecture Hall E	Lecture	(L04) Demand models 1, mode and route choice		Lori Tavasszy
(c.wk. 18)	THU 2 MAY 2023	10:45-12:45	CEG-Lecture Hall E	Workshop	Introduction to exercise, including Python refresher etc.	Start exercise pt 1	staff
week 3	TUE 7 MAY 2024	10:45-12:45	CEG-Lecture Hall E	Lecture	(L05) Demand models 2, generation and distribution		Lori Tavasszy
(c.wk. 19)	{No lectures on Thursday}						
week 4	TUE 14 MAY 2024	10:45-12:45	CEG-Lecture Hall E	Lecture	(L06) Introduction to basic optimization models for network design for tactical/strategic decisions	Start exercise pt 2	Stefano Fazi
(c.wk. 20)	THU 16 MAY 2024	10:45-12:45	CEG-Lecture Hall E	Lecture	(L07) Stochastic two-stage mathematical models for operational decisions in freight transport		Stefano Fazi
week 5	TUE 21 MAY 2024	10:45-12:45	CEG-Lecture Hall E	Lecture	(L08) Freight transport policy - networks		Arjan van Binsbergen
(c.wk. 21)	THU 23 MAY 2024	10:45-12:45	CEG-Lecture Hall E	Guest lecture	(L09) Modelling in practice [Guest Lecture]		Jan Kiel (confirmed)
					Part C: Policy and practice		
week 6	TUE 28 MAY 2024	10:45-12:45	CEG-Lecture Hall E	Lecture	(L10) Freight transport policy - sustainability	Start exercise pt 3	Arjan van Binsbergen
(c.wk. 22)	THU 30 MAY 2024	10:45-12:45	CEG-Lecture Hall E	Guest lecture	(L11) Policy in practice [Guest Lecture]		Johan Visser (confirmed)
week 7	TUE 4 JUN 2024	10:45-12:45	CEG-Lecture Hall E	Lecture	(L12) Freight transport policy - cities		Arjan van Binsbergen
(c.wk. 23)	THU 6 JUN 2024	10:45-12:45	CEG-Lecture Hall E	Lecture	(L13) Applied freight models [Guest Lecture]		Michiel de Bok (confirmed
week 8	THU 13 JUN 2024	10:45-12:45	CEG-Lecture Hall E	Lecture	(optional) Exam preparation		to be discussed
(c.wk. 24)	FRI 14 JUN 2024	10:45	(via BrightSpace)		Exercise delivery deadline	Deadline exercise	
(c.wk. 26)	TUE 25 JUN 2024	13:30	Fellowship Studio Classroom 1&2			Exam	
(c.wk. 29)	TUE 16 JUL 2024	13:30	CEG 0.20			Exam (resit)	

You are here

14 June deadline

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Assignment in a nutshell
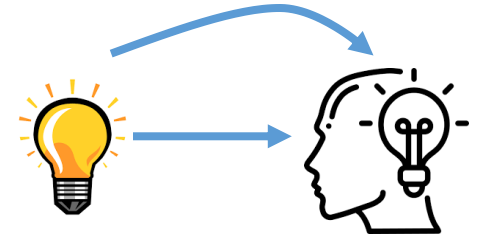
Function = to help internalize the theoretical knowledge of the lectures

Topic: network design for the European intermodal container transport system

Problems addressed

- Mode choice: user decides value of options

- Network design: choose the best place(s) to invest

- Policy evaluation: scenarios to incentivize use

Approach: simplified but realistic case, pre-programmed models, stepwise approach

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Goal: design a multimodal freight network for container flows in Europe

"how many terminals, where?"

Origin

Terminal

1   2   3

Destination
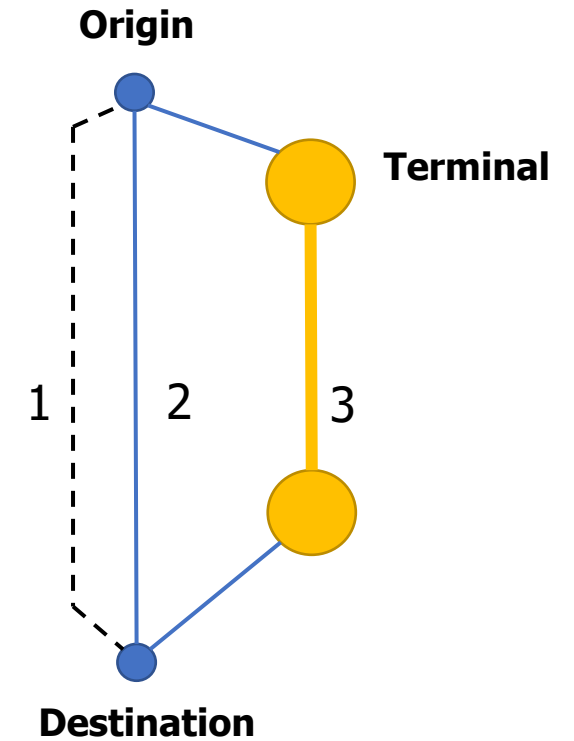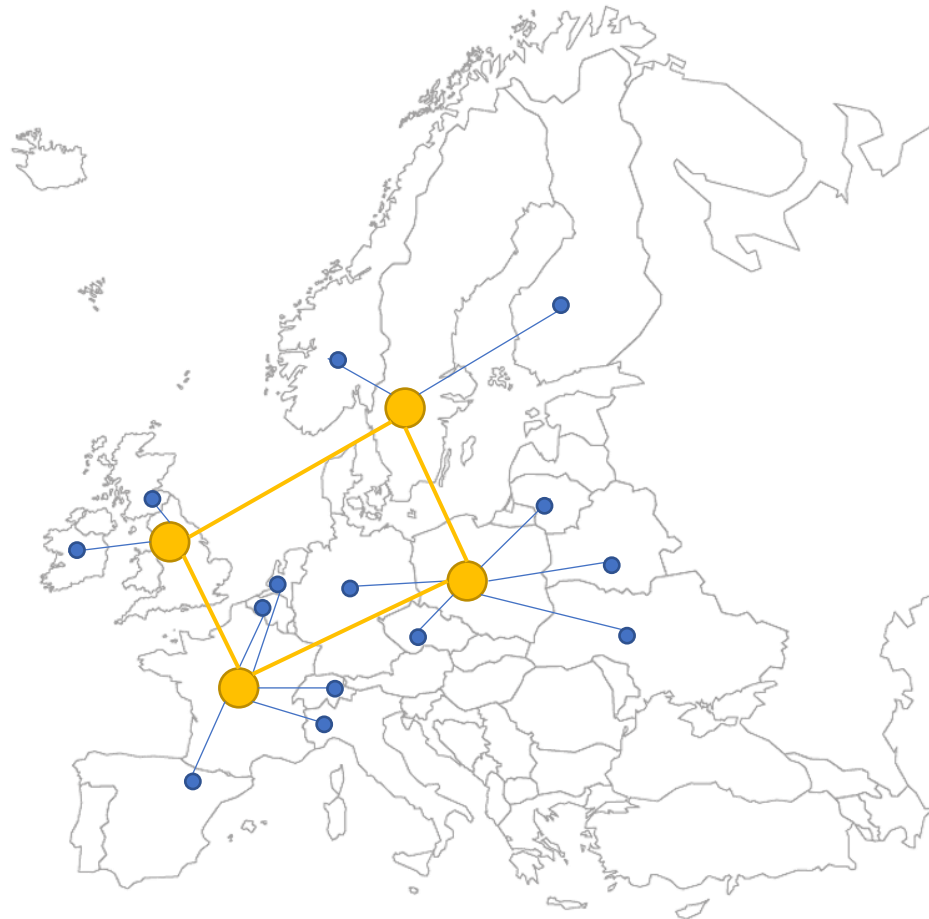
Modes
1. Conventional Rail
2. Road
3. Intermodal

Subgoals

1. Determine user preferences related to mode choice

2. Identify priority locations for intermodal terminals

3. Pricing policy to help achieve modal shift
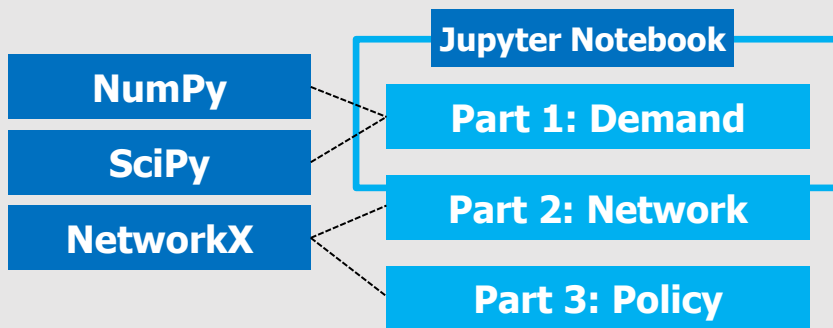
Implementation

Small system: 9 countries

Steps

1. Freight transport demand (coach: Tavasszy)
2. Network optimization (coach: Fazi)
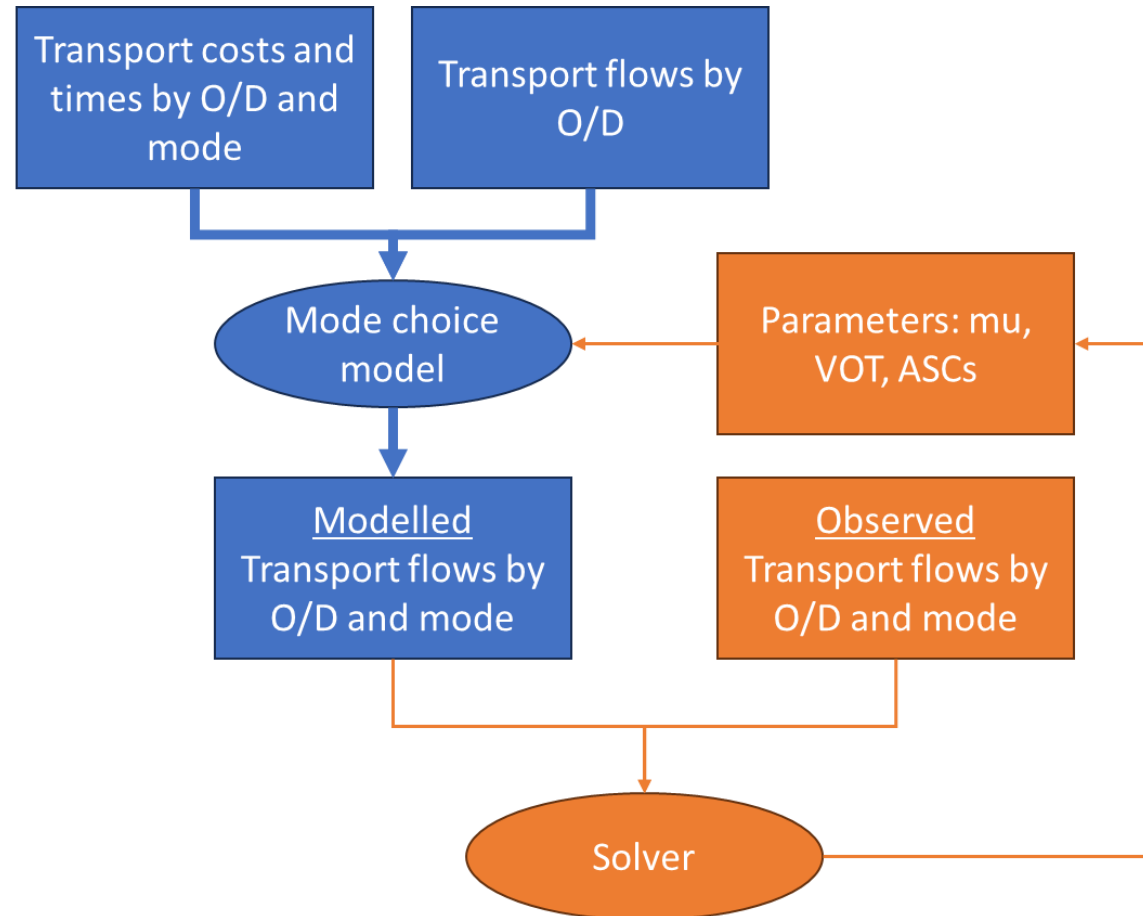3. Freight Policy Analysis (coach: van Binsbergen)

Python code prepared

Jupyter Notebook

NumPy

SciPy

NetworkX

Part 1: Demand
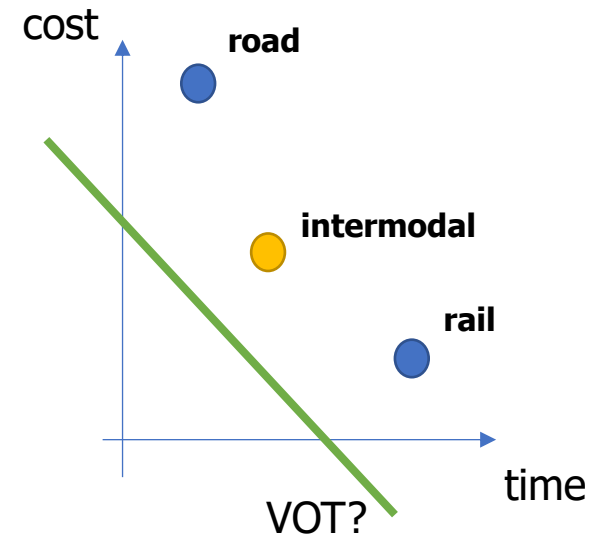
Part 2: Network

Part 3: Policy

Assignment in 3 parts
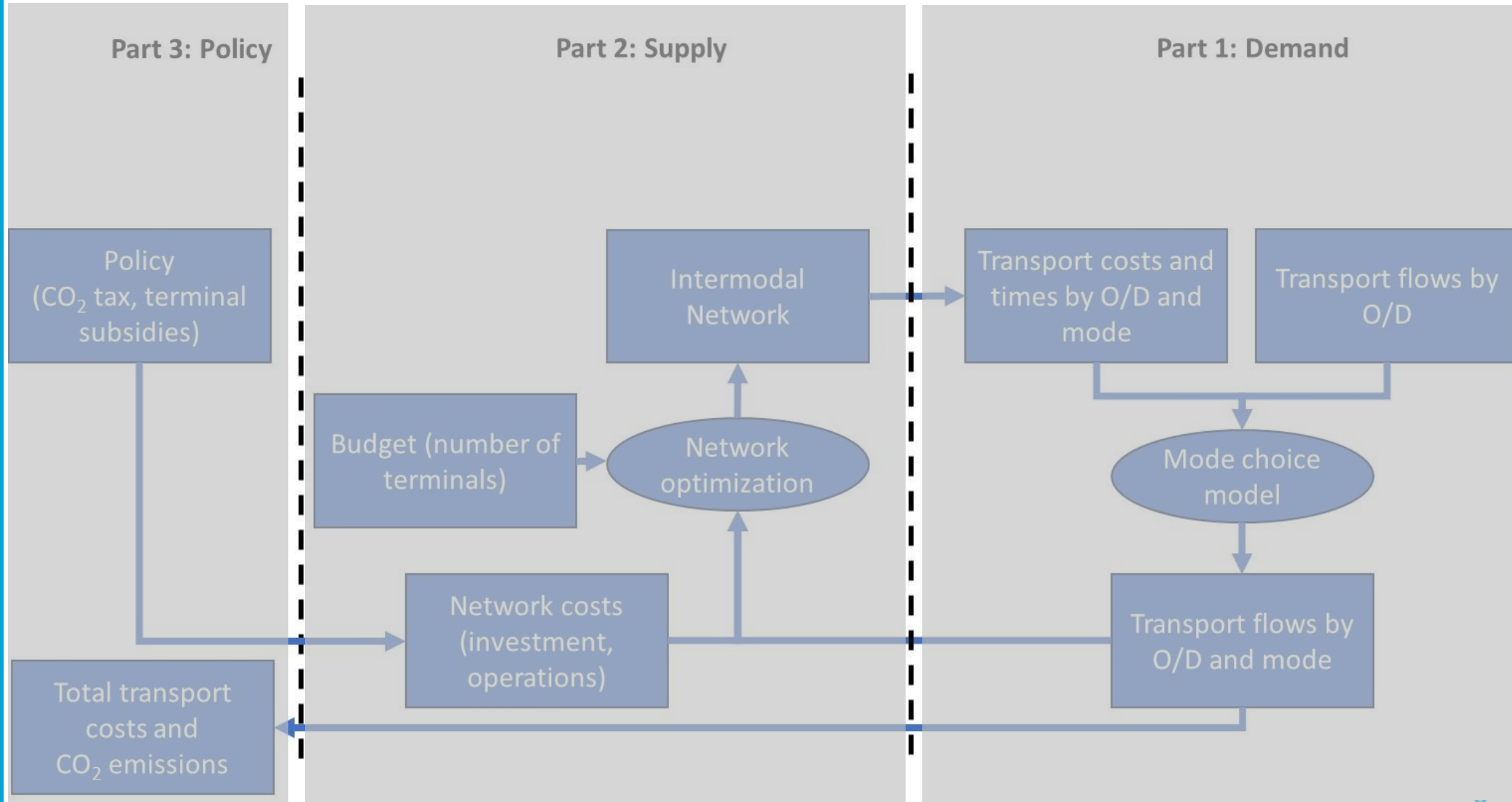
Part 1: estimate demand model

Pt 1: mode choice model

Purpose: behaviour of flows is input for network design

a) Check data: distance and time matrices, speeds, costs, all modes

b) Estimate an aggregate logit model to predict the share of transport modes

- <u>Check</u> model specification
- Solve in Python (code provided)

c) <u>Interpret</u> the estimated parameters in the context of multimodal freight transport.
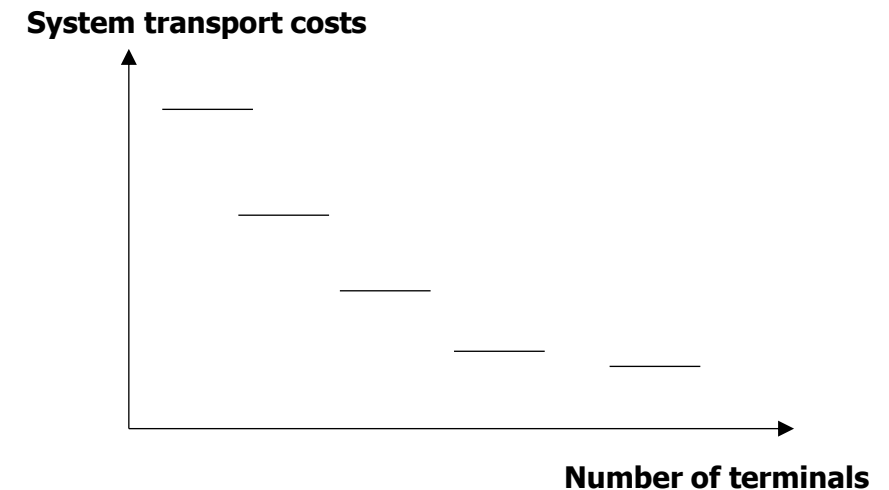
Pt 2: network design model

Design a multimodal network

1. Calculate optimal networks for different number of terminals
2. Create the Pareto frontier of best designs
3. Discuss modal split changes (if any)
4. Discuss feasibility of terminal investments

System transport costs

Number of terminals

Pt 3: policy

To achieve overall CO_2 emission reduction targets, the CO_2 emissions in the freight transport systems must be reduced by 30%.

You will look at the following approaches to achieve this target:

I. Internalize (part of the) external costs of CO_2 emissions for all transport modes
II. Subsidize specific modes

bank

CO₂ tax

subsidy

choice

shipper
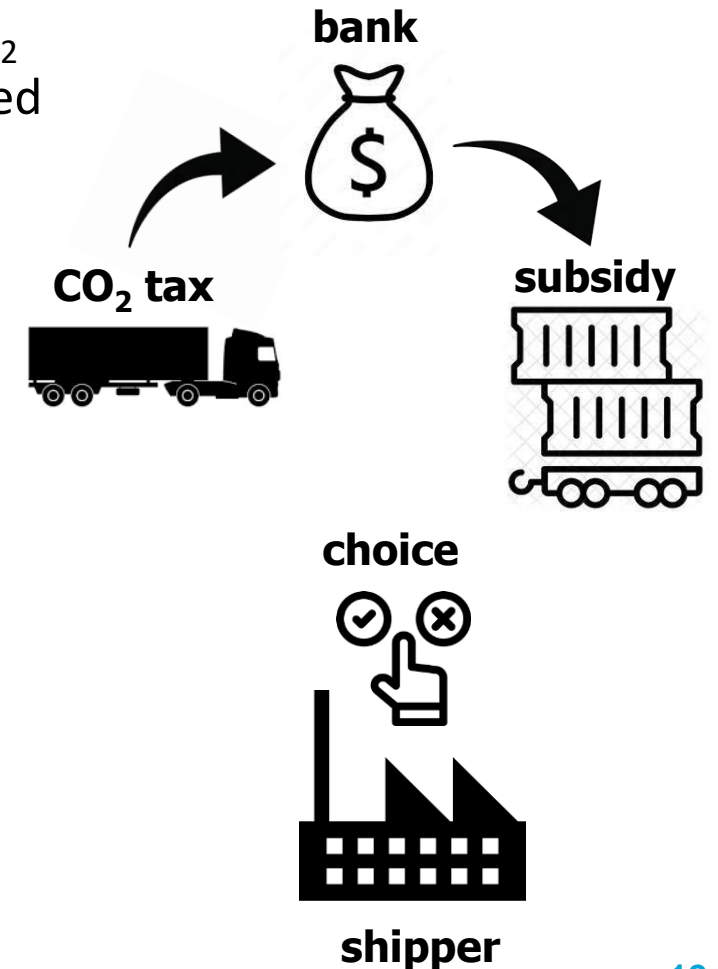
Organization

Group work

- Form your own group asap! **4 students per group**

- **Separate groups for SEN173A and CIEM6210-U3/SIEQ6213**

Delivery

- Max 3 page written report per part-assignment.
  Add file with model code (e.g. Jupyter Notebook) where applicable.

- Save the assignment files with group number and assignment number in the filename. Zip file is OK.

- Include student names & numbers in report

- Deliver to respective lecturers

Assessment

For CEG and TIL: formative assessment, meaning *no grading*

- As for all, group work

- Reflection report = recommended

- Feedback provided when asked

For CoSEM: summative assessment (graded)

- 30% of course grade; 1 EC extra

- Group report to be delivered by **14 June**

- Grade must be at least 5,0

- Assignments done last year are still valid for 2024

Exam may include question about the assignment

Preparations for programming

Teaching assistant: Allan Guzman Fallas

Install anaconda	▪ Installs *jupyter notebook*, spyder and the *packages* you need for the assignment ▪ Follow the instructions depending on your OS

Check packages / libraries

```
(base) C:\Users\username>conda list
(base) C:\Users\username>conda install package
```

▪ Go to: Environments

▪ Filter by: All

▪ Search: *package*

Preparations for programming

FILES	EXECUTE	PACKAGES / LIBRARIES
1 ▪ CIE5830 Part1 Question.py ▪ CIE5830_AssignmentPart1.xlsx	jupyter	openpyxl math numpy scipy
2 ▪ Network_design_assignment2.py ▪ Data2.xlsx	spyder	numpy matplotlib scipy seaborn pandas networkx itertools
3 ▪ Green_network_design_assignment3.py ▪ Data2.xlsx	spyder	

Helpful links

NetworkX	SciPy & NumPy	Python
• Documentation	• Documentation	• General tutorial
• Partial tutorial	• Tutorial	
• Another tutorial		