1st World Sustainability Forum
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URBAN FREIGHT TRANSPORT MEASURES:

ENVIRONMENTAL EVIDENCES FROM THE CITIES

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Summary

- Introduction
- Urban Freight Transport and City Logistics Measures
- Results and Discussion
  - *Aggregate class outcomes*
  - *Disaggregate class outcomes*
- Conclusions

Summary

Introduction

Growing interest in the concepts of **sustainable development**

it meets the needs of the present without compromising the ability of future generations to meet their own needs (Brundtland Commission, 1987)

➡ Generational Equilibrium (Naccari Carlizzi, 2010)

borrowing from the future (Mahatma Gandhi)

on **SUSTAINABLE TRANSPORT**

a sustainable transport system is one that is accessible, safe, environmentally-friendly and affordable (ECMT, 2004)

Introduction

The current development must be characterized by the definition of (European Commission, 2001)

- ***Economic*** sustainability
- ***Environmental*** sustainability
- ***Social*** sustainability

Introduction

The rapid freight transportation increasing in urban and metropolitan areas contributes to

- congestion, air pollution, noise (***environmental***),
- raise logistic costs, and hence the price of products (***economic***),
- have a combination of different types of vehicles on the road that increases the risk of accidents (***social***).

solutions to the problems in the city centres that reduce the **impacts** of urban goods movements **without penalising the life of the city** (**sustainable city logistics solutions/measures**)

Introduction

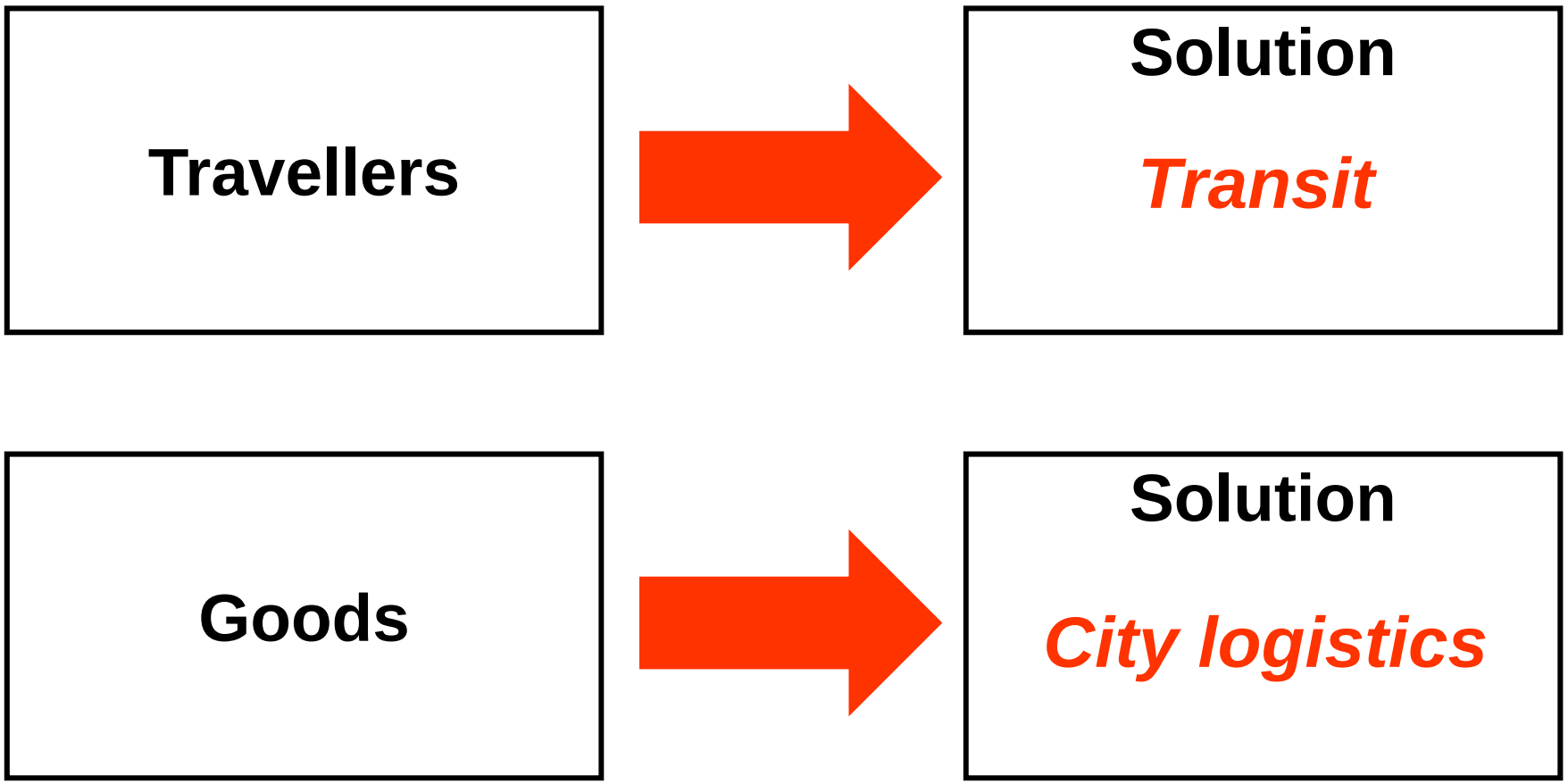
Objectives

Sustainable city logistics → solutions to the problems in the city centres, and its main goals is the research of solutions that **reduce the impacts** of urban goods movements **without penalising the life of the city**

As it happens in passenger mobility we can face the problems related to externalities due to transport addressing to transit. It allows us to do not reduce accessibility and penalise the life of the city.
At the same way, city logistics has to investigate the possible solutions that allow us to reduce externalities, to increase sustainability without damaging the city life.

Introduction

Objectives



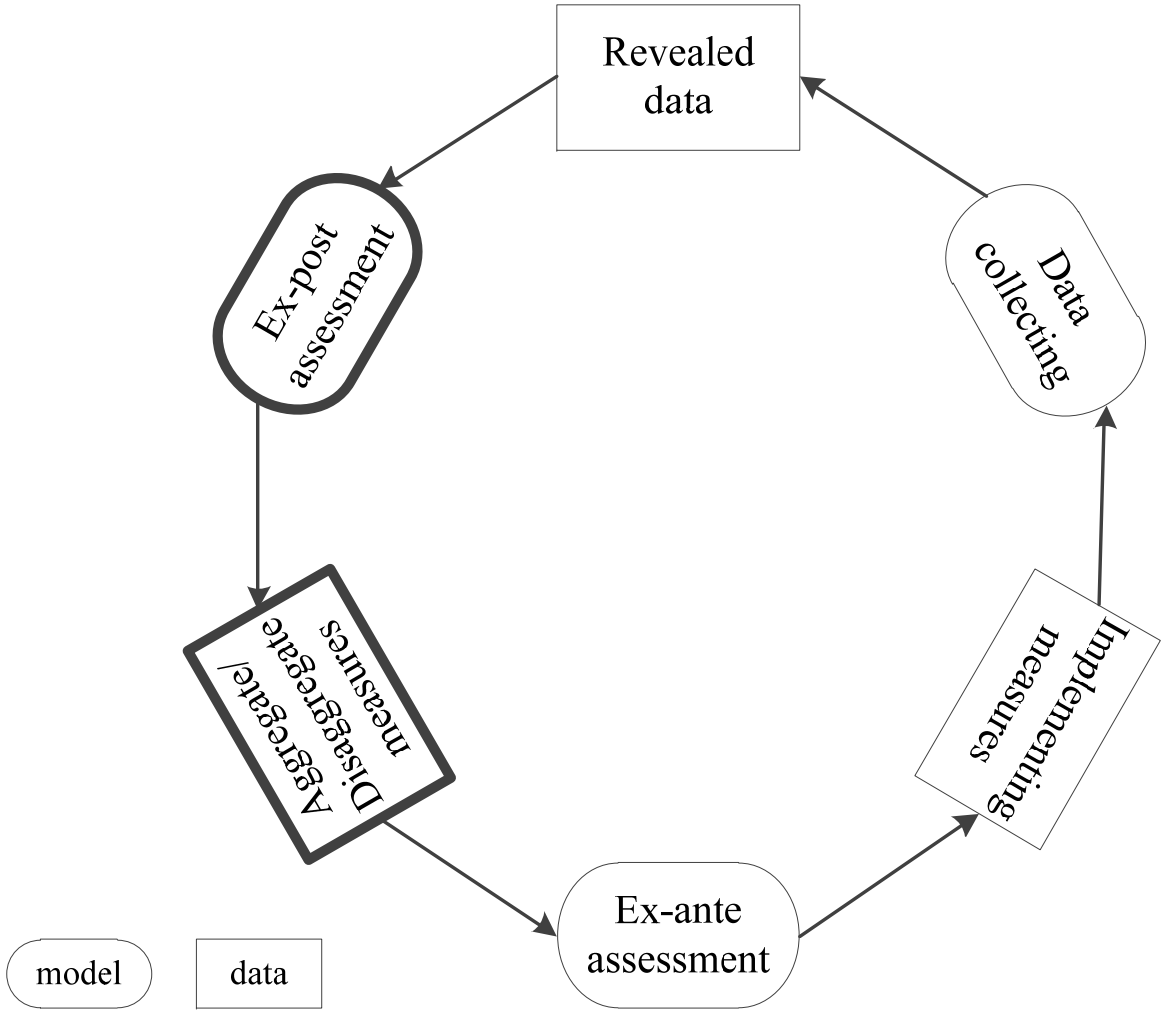
Introduction

Objectives

ex-post assessment

maximum expected reduction of externalities

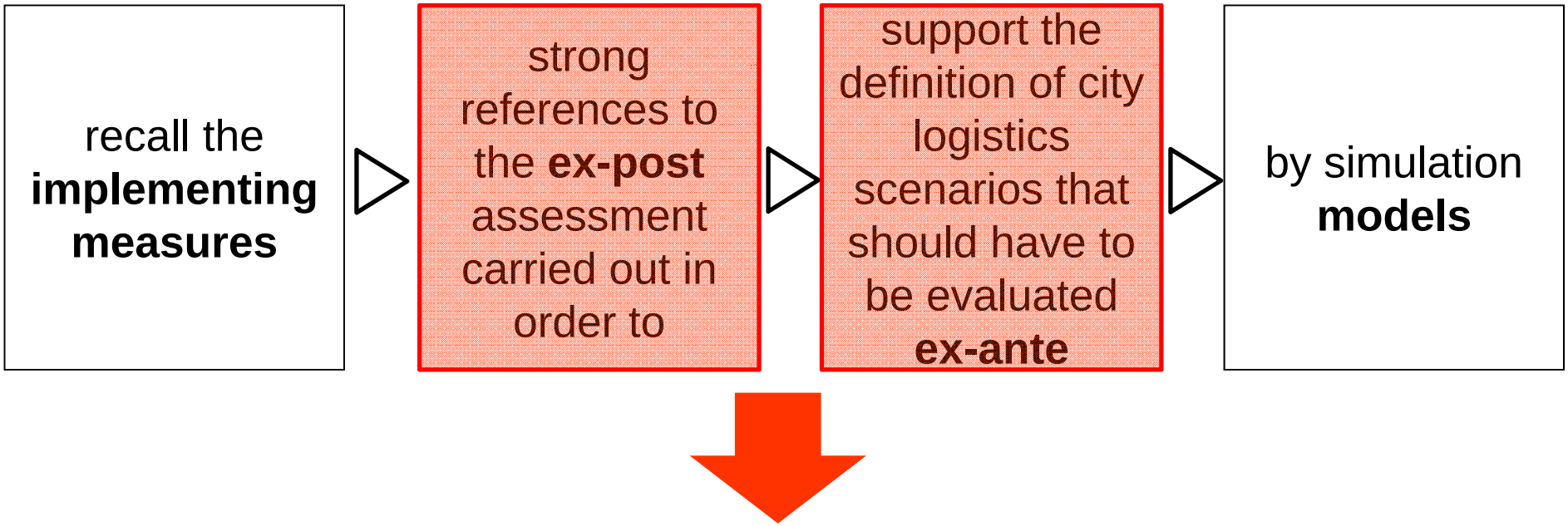
city logistics measures to be *ex-ante* assessed



Introduction

Objectives

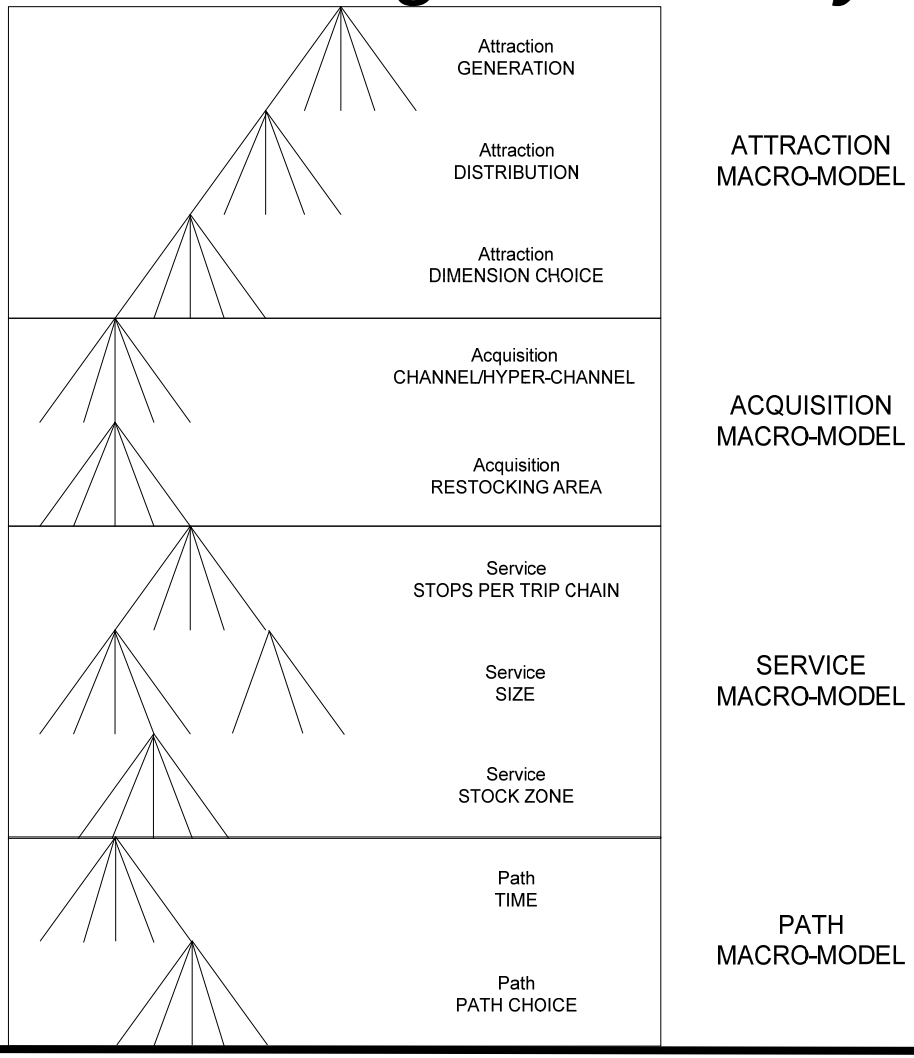
in a “what if” framework



Pre-guide that could be used in an *ex-ante* assessment methodology in order to **identify which measure** (or set of measures) works better in a given city in relation to the goals of **environmental sustainability to be pursued**.

Introduction

Example of urban freight model system



Russo, F. and Comi, A. (2010). A modelling system to simulate goods movements at an urban scale. In *Transportation 37 (6)*, DOI: 10.1007/s11116-010-9276-y, Springer Science+Business Media, LLC, 987-1009.

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Urban Freight Transport

✓ *External costs due to urban transport (Italy)*

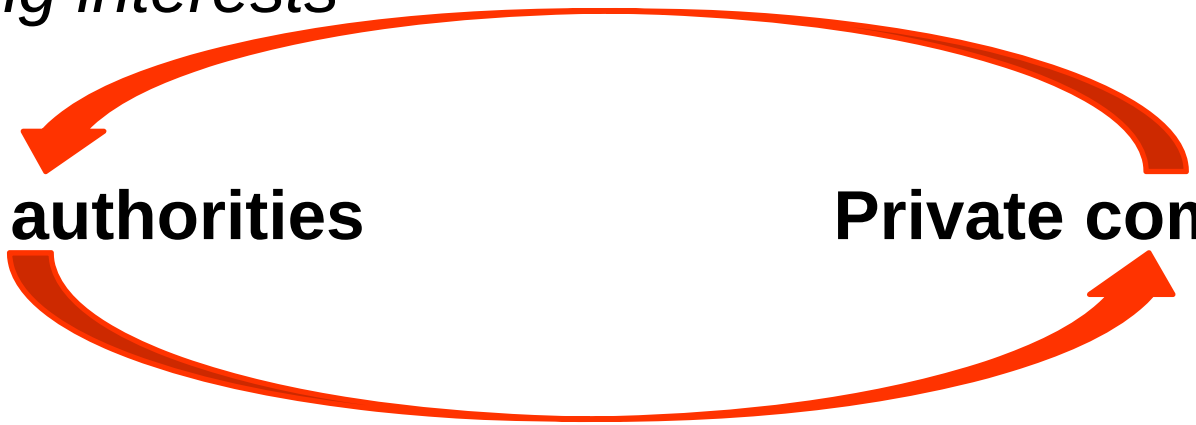
[in cent €/pass-km and cent €/t-km]

	Greenhouse	Pollutant	Noise	Safety	Congestion	Total
Passengers	1.17	4.84	2.62	5.44	4.38	**18.17**
Freight	1.73	24.81	5.31	0.3	10.79	**44.94**
• *Light Goods Vehicles*	*0.71*	*9.94*	*2.39*	*0.2*	*4.17*	***18.66***
• *Heavy Goods Vehicles*	*1.02*	*14.87*	*2.92*	*0.1*	*6.62*	***26.28***

Source: Uniontrasporti (2009)

Urban Freight Transport

✓ *Conflicting interests*



Public authorities

Private companies

They want to **reduce the transportation impacts** in order to have an **attractive city** for **inhabitants** and **visitors** (mainly *environmental* and *social* sustainability such as reduction of congestion, pollutant, accidents, and so on)

They want to delivery and pick-up the goods at the **lowest cost** but **high-quality transport** operation and **short lead-time** in order to satisfy at the best possible way the users' expectations (mainly *economic* sustainability).

Urban Freight Transport

✓ *Transportation impacts on sustainability*

Economic	Social	Environmental
Traffic congestion		
Mobility barriers	Inequity of impacts	Air pollution
Crash damages	Mobility disadvantaged	Climate change
Transportation facility costs	Human health impacts	Habitat loss
Consumer transportation costs	Community cohesion	Water pollution
	Community livability	Hydrologic impacts
Depletion of non-renewable resources	Aesthetics	Noise pollution

Source: TDM Encyclopedia (2010)

Urban Freight Transport

✓ *Transportation impacts on sustainability*

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City Logistics Measures

The classification should allow, in an easy way, to **aggregate and analyse** the city logistics measures in relation to

- who **takes the decision** (public authorities, private company, public-private partnership)
- which class of **outcomes and goals** can be pursued by their implementation
- and which **planning horizon** refers (strategic, tactical, operative)

FOUR classes: material and non-material infrastructures, equipment and governance.

City Logistics Measures (1/2)

Classification

Material infrastructures

impacted decision maker*: local government, logistics and transport operators*
goals*: to increase sustainability within the urban area by building new features (linear and surface) in order to optimise freight transport*
planning horizons*: strategic (or tactical)*

Non-material infrastructures, mainly Intelligent Transportation System (ITS)

impacted decision maker*: local government, logistics and transport operators*
goals*: to improve effectiveness (in terms of high service levels) and efficiency (in terms of cost reduction) of logistics flows, and reduce negative externalities, also improving enforcement efficiency and broadening the scope of enforcement.*
planning horizons*: tactical and operative (sometimes strategic e.g. traffic monitoring)*

City Logistics Measures (2/2)

Classification

Equipment

impacted decision maker*: logistics and transport operators*
goals*: to optimize handling and transport by new low-emission vehicles (loading units); to reduce environmental impacts of transport units (e.g. reduction in truck emissions and use of electric vehicles, methane vehicles, metropolitan railways, trams).*
planning horizons*: strategic or tactical or operative*

Governance

impacted decision maker*: logistics and transport operators*
goals*: to reduce the interference with other components of urban mobility, to reduce the number of driving vehicles.*
planning horizons*: strategic or tactical or operative*

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Indicators of Sustainability

For each field of sustainability, it is possible to define a set of *quantitative* and *qualitative variables* (**impact indicators**) representing the impacts and estimation of their variations included in each scenario

ECONOMIC

- traffic congestion (e.g. extra time spent to travel, travel time, travel speed)
- trip length
- delivery time
- infrastructures cost

SOCIAL

- reduction of interferences among segment of urban mobility
- reduction of operating vehicles
- reduction of road accidents
- livability of city

ENVIRONMENTAL

- reduction of pollutants,
- reduction of noise,
- habitat loss.

Indicators of Sustainability (1/2)

Dataset

In order to find possible relationships among city characteristics, city logistics measures and environmental outcomes (i.e. reduction of CO), a depth desk-research has been carried out.

The reduction of pollutant per month has been investigated for the following set of measures:

- *material infrastr.*: sub-network, Urban Distribution Centre and Nearby Delivery Area;
- *non-material infrastr.*: Intelligent Transportation System;
- *equipment*: sustainable performance and railway;
- *governance*: time windows and area-pricing.

Indicators of Sustainability (2/2)

Dataset

Investigated cities and city logistics measures

Implemented city logistics measures	City	Population * [inhabitants]	Density * [inh./km²]
Material infrastructures	Bordeax	215,374	4,672
	Bremen	547,685	1,676
	Bristol	433,100	3,639
	Canton Thurgau	244,33	247
	Genoa	59,883	2,5
	Kassell	194,774	1,824
	La Rochelle	76,711	2,737
	Lisbon	564,657	6,643
	London	1,806,200	10,792
	Lucca	84,939	458
	Padua	213,941	2,304
	Paris	2,203,817	20,909
	Regensburg	150,003	1,845
	Siena	54,391	461
	Vilnius	560,192	1,397
Non-material infrastructures	Gyır	130,476	731
Equipment	Amsterdam	767,849	4,618
	Gothenburg	240,000	5,714
	Milan	77,000	9,39
	Paris	2,203,817	20,909
	Rome	55,000	9,167
	Sorrentina Peninsula	84,827	1,156
	Utrecht	16,596	3,093
	Zurich	1,284,052	743
Governance	Enschede	157,321	1,116
	London	1,806,200	10,792
	Stockholm	1,440,000	1,176
	Tilburg - Eindhoven	214,036	2,441

** impacted /involved by city logistics measures*

Indicators of Sustainability (1/2)

ex-post analysis of implemented city logistics scenarios in Europe in the last 6 years

environmental indicators in order to support the definition of freight planning within the urban transport planning

pollutants can be directed measured or not, and then we can have **direct** (e.g. NO_x) or **indirect** (e.g. CO_2) measures

Indicators of Sustainability (2/2)

The outcomes to be obtained by each measure are analyzed in function of specific characteristics of cities (e.g. population, density):

✓ **Aggregate**: for class of city logistics measures

$$ROP_z = \beta_{POP,z} \cdot POP + \sum_h \beta_{h,z} \cdot X_h$$

where ROP_z is the monthly reduction of pollutant z, POP is the impacted population, X_h is a dummy variable specific for each class of city logistics measures h, and $\beta_{.,z}$ is the parameter to be calibrated

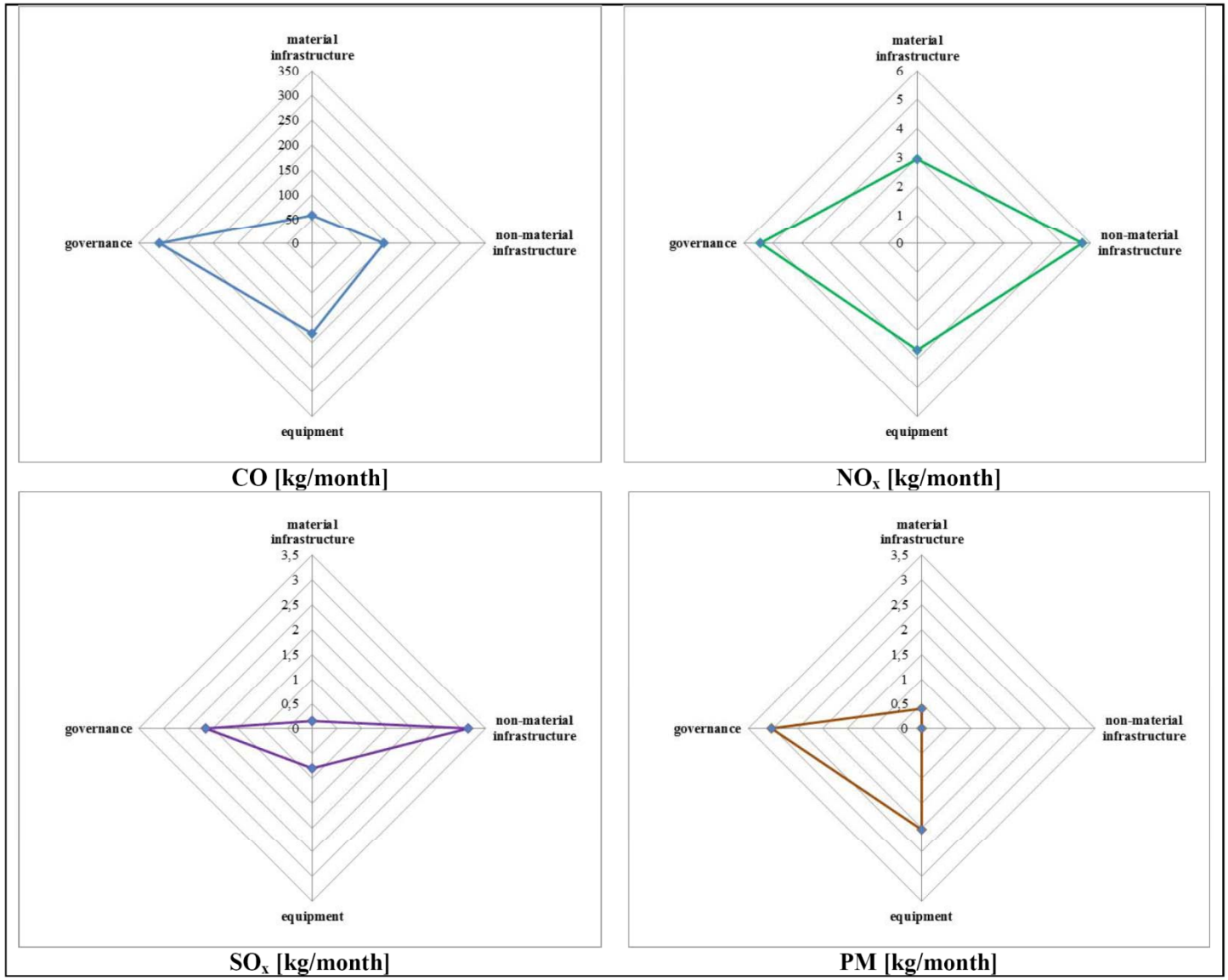
✓ **Disaggregate**: for specific city logistics measures

$$IR_z = \sum_k \beta_{k,z} \cdot X_k$$

where IR_z is the monthly reduction of pollutant z on city density, POP is the impacted population, X_h is a dummy variable specific for each class of city logistics measures h, and $\beta_{.,z}$ is the parameter to be calibrated

Aggregate class outcomes

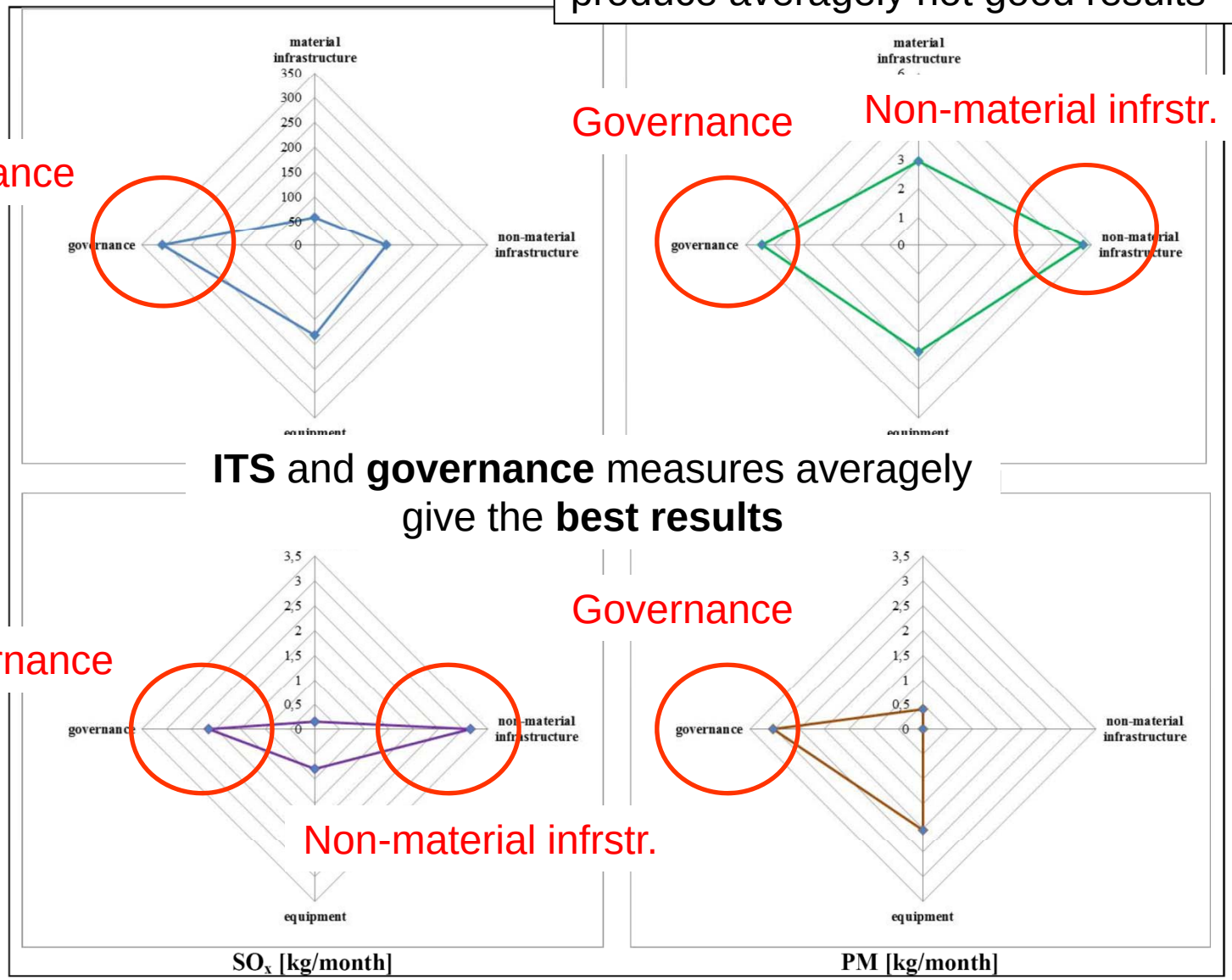
Direct measures



Aggregate class outcomes

Direct measures

The **material infrastructures** measures produce averagely not good results



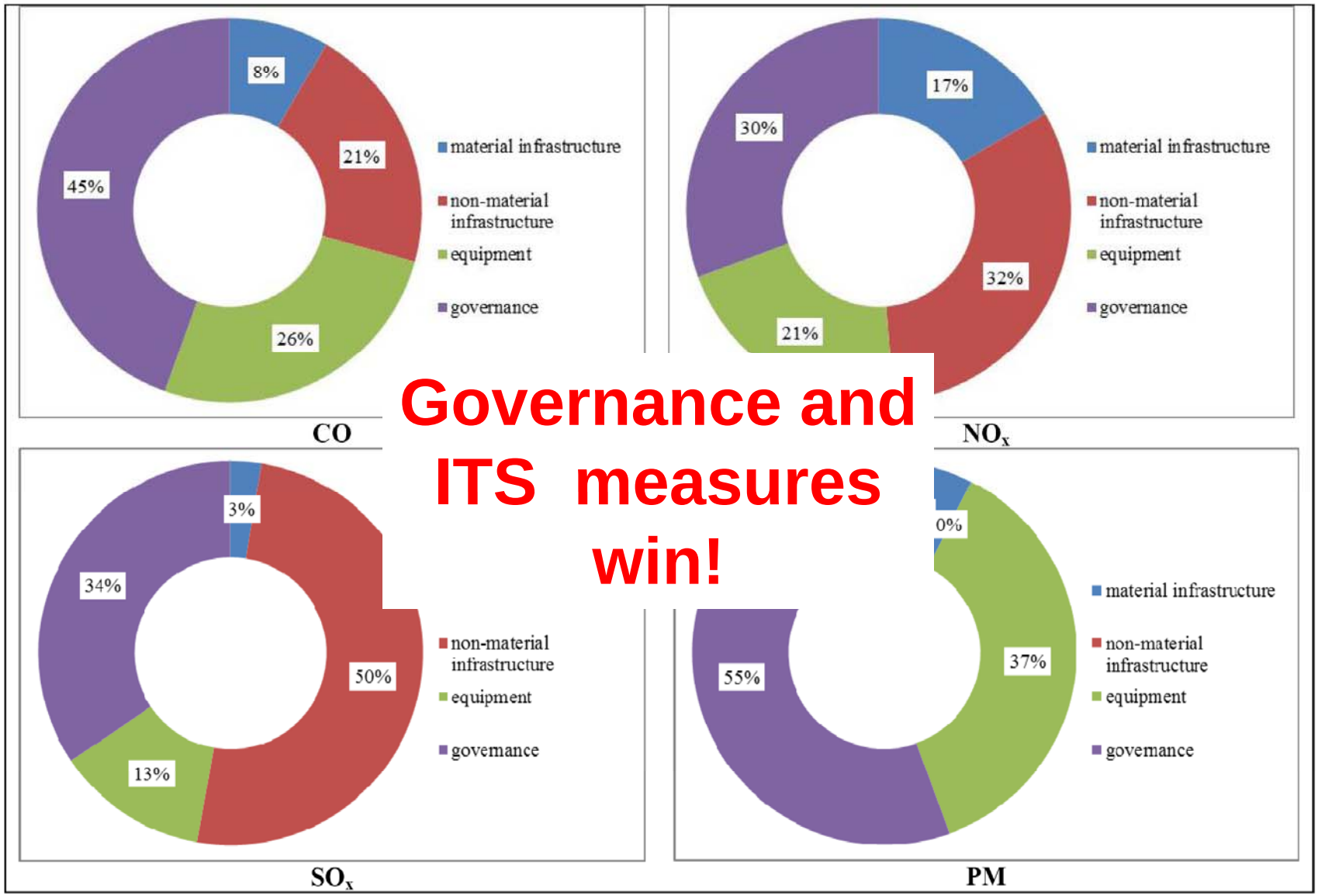
ITS and **governance** measures averagely give the **best results**

SO_x [kg/month]

PM [kg/month]

Aggregate class outcomes

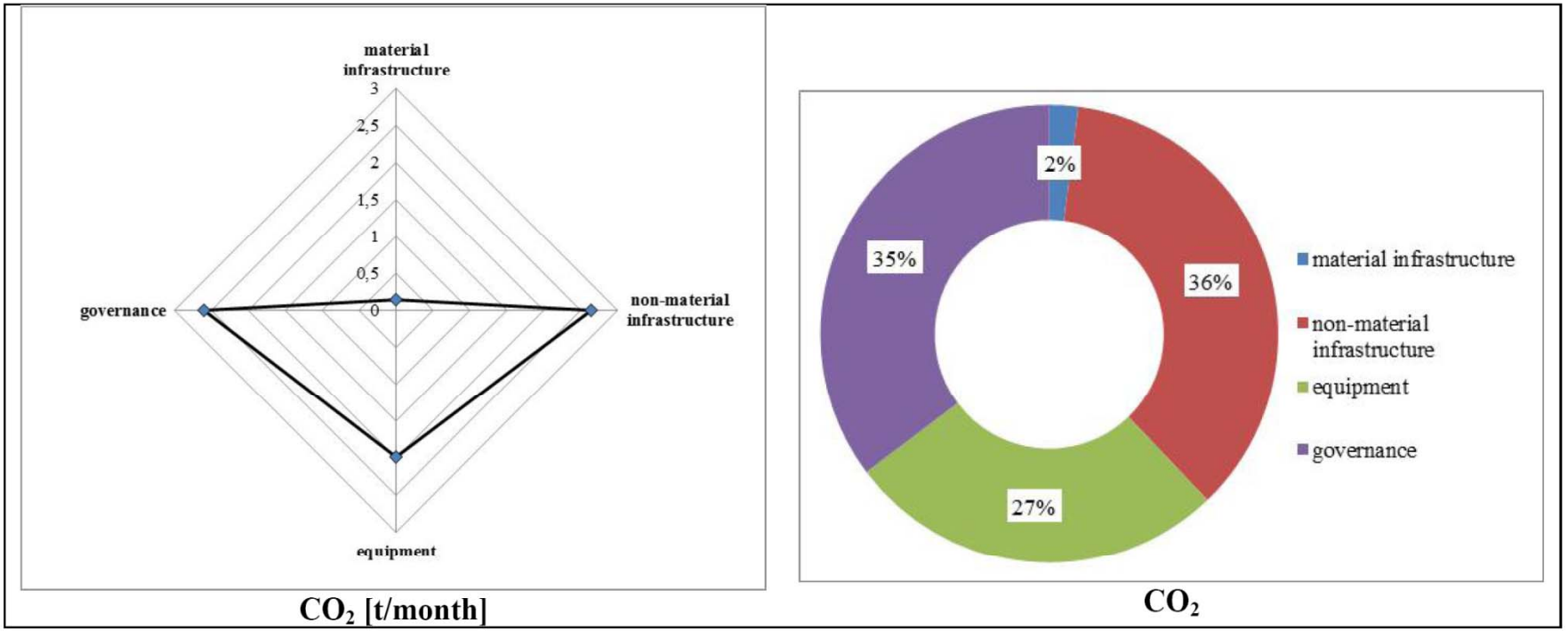
Direct measures: incidence on ROP



Governance and ITS measures win!

Aggregate class outcomes

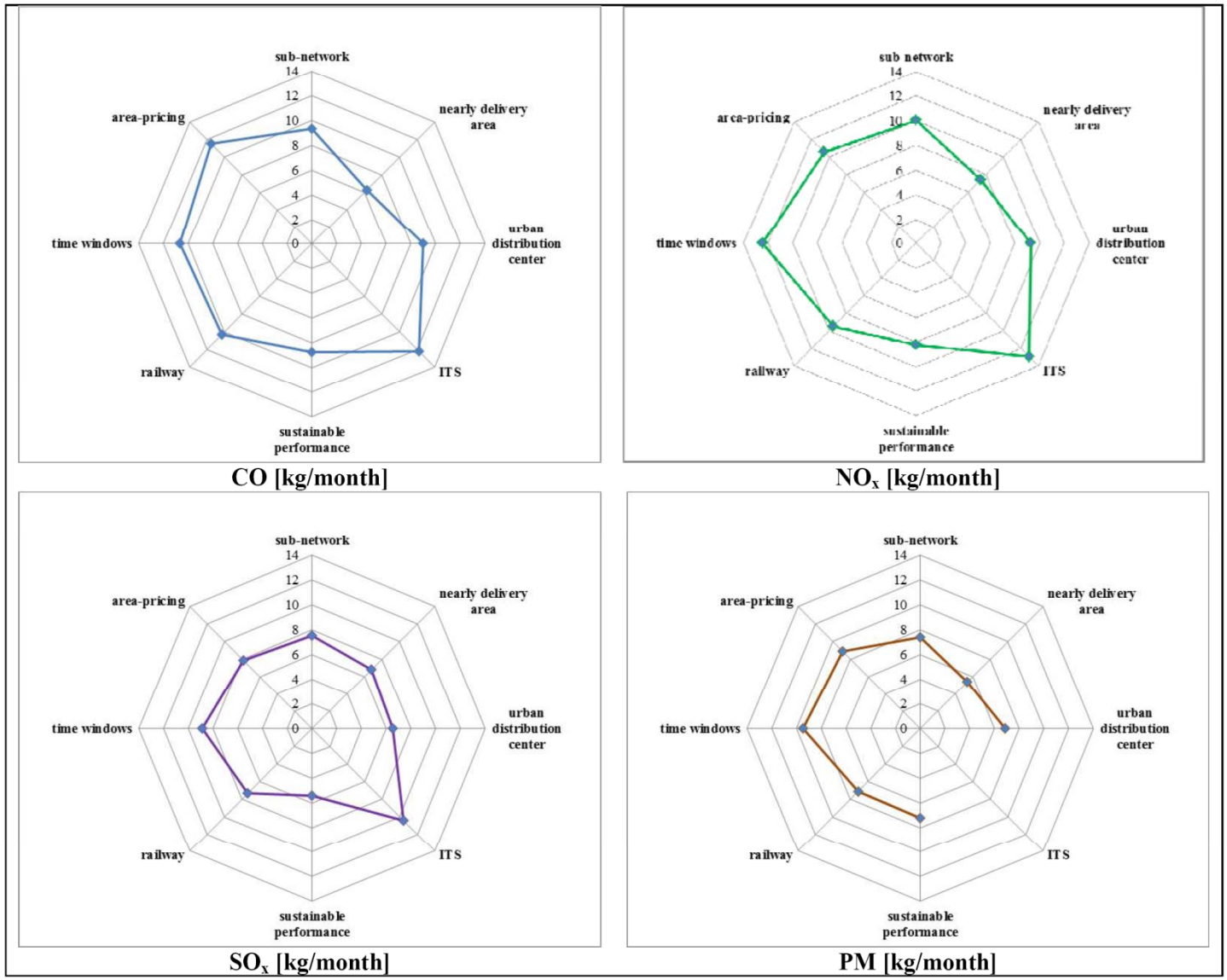
Indirect measures



the CO_2 emission (*it can be considered a proxy of energy consumption and air pollutant emissions*), we can see that the better results are always given by **non-material infrastructure**, but similar results could be also obtained by equipment measures

Disaggregate class outcomes

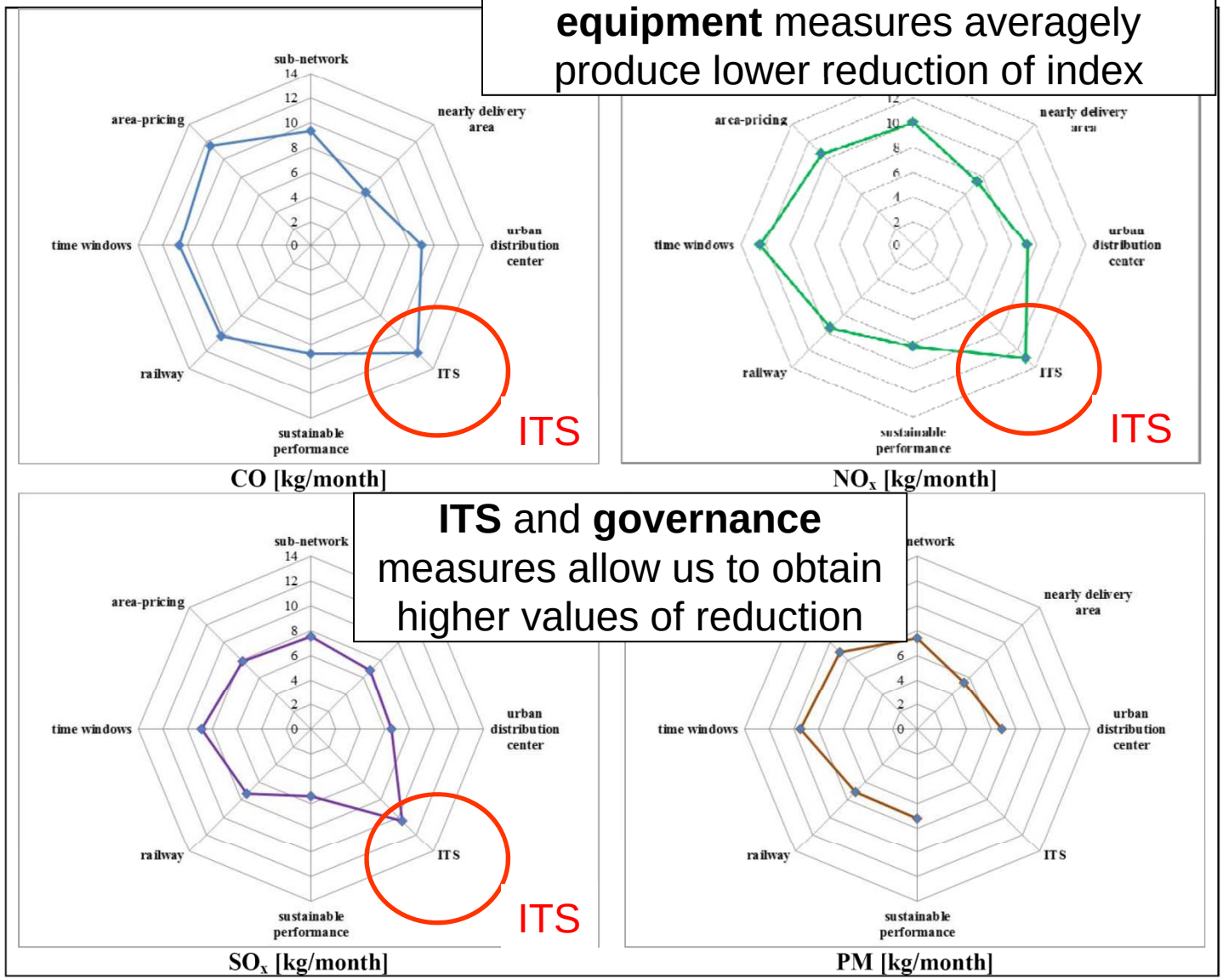
Direct measures



Disaggregate class outcomes

Direct measures

material infrastructures and **equipment** measures averagely produce lower reduction of index

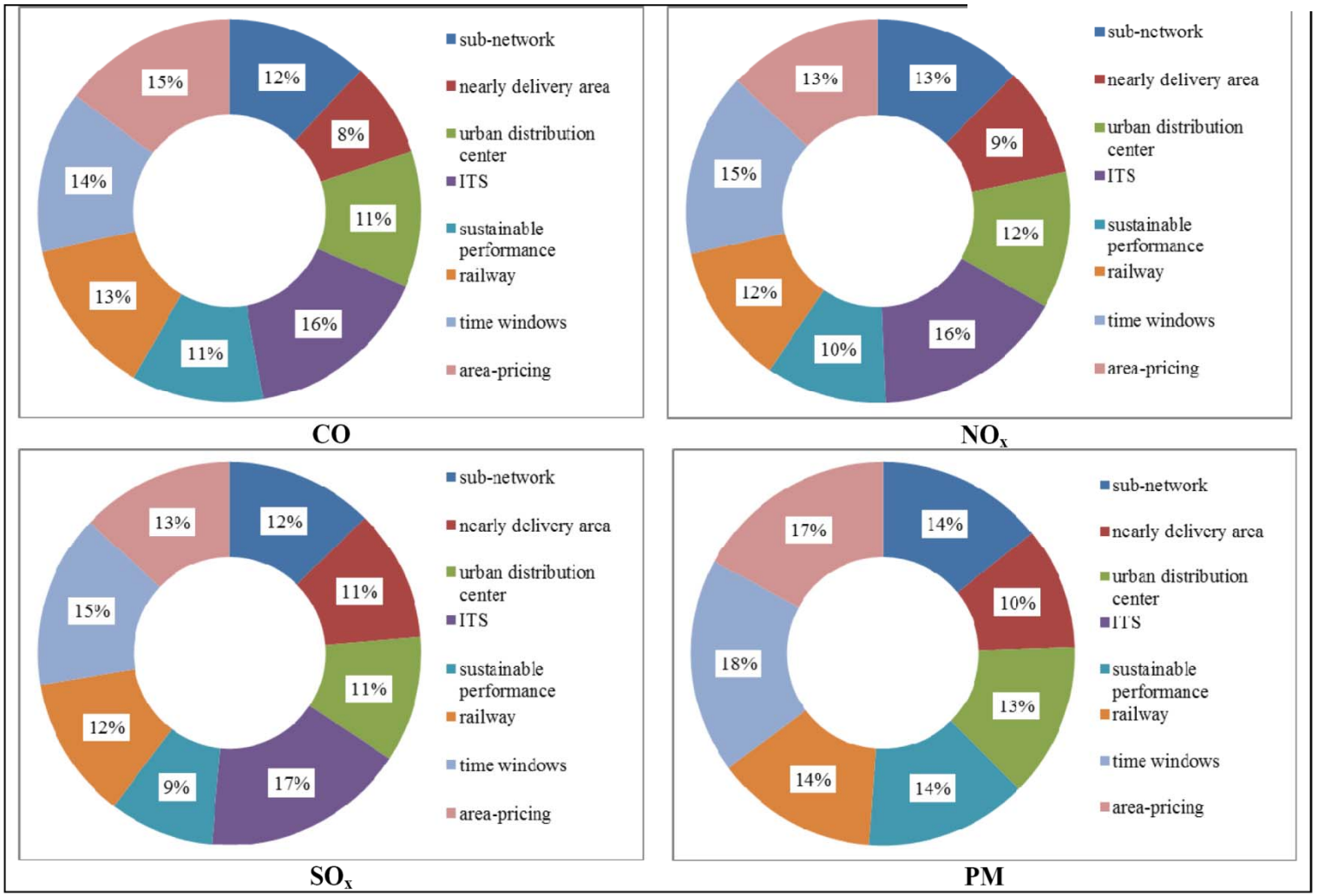


ITS and **governance** measures allow us to obtain higher values of reduction

Disaggregate class outcomes

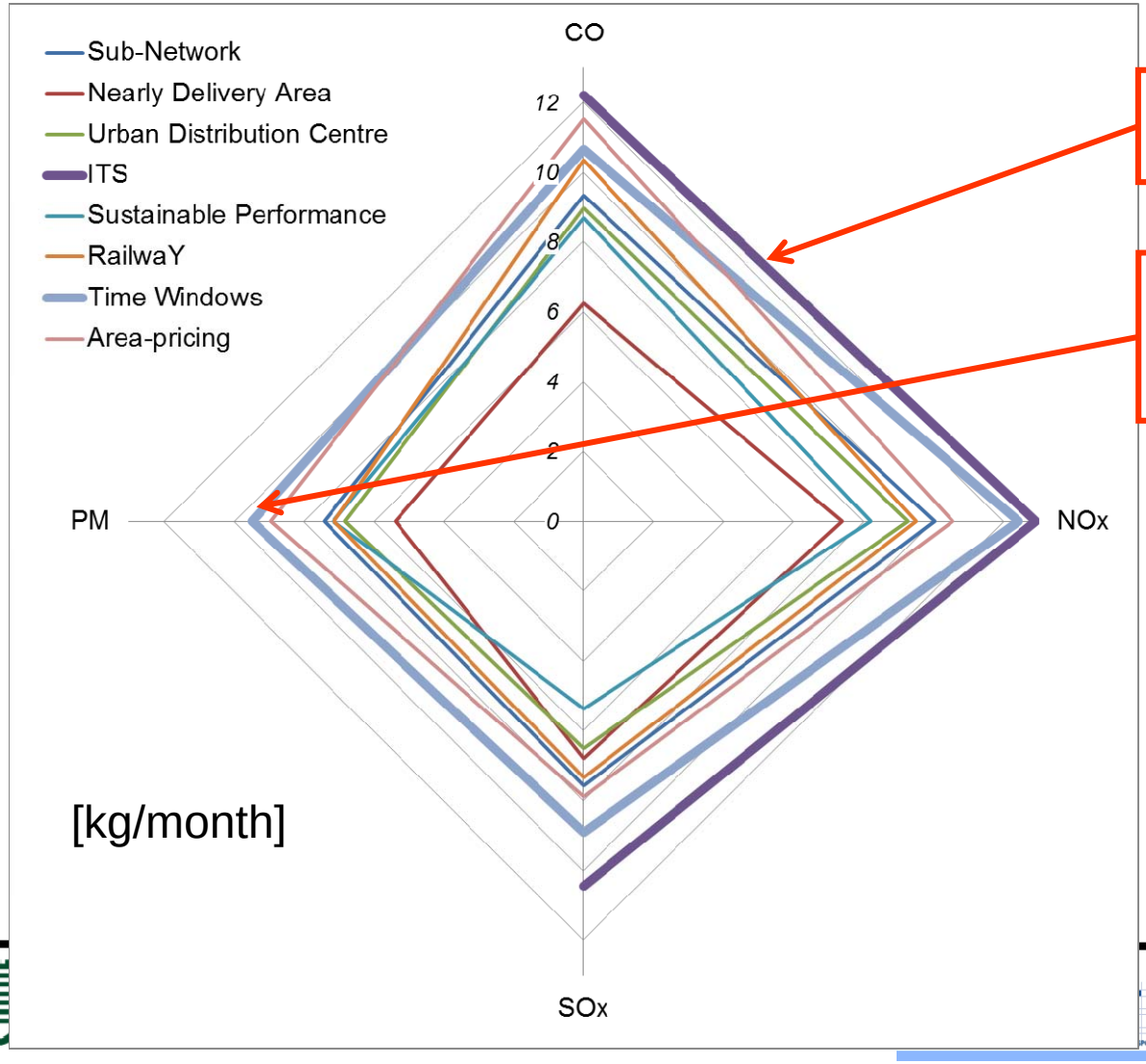
Direct measures

Governance and ITS measures win!



Disaggregate class outcomes

Direct measures

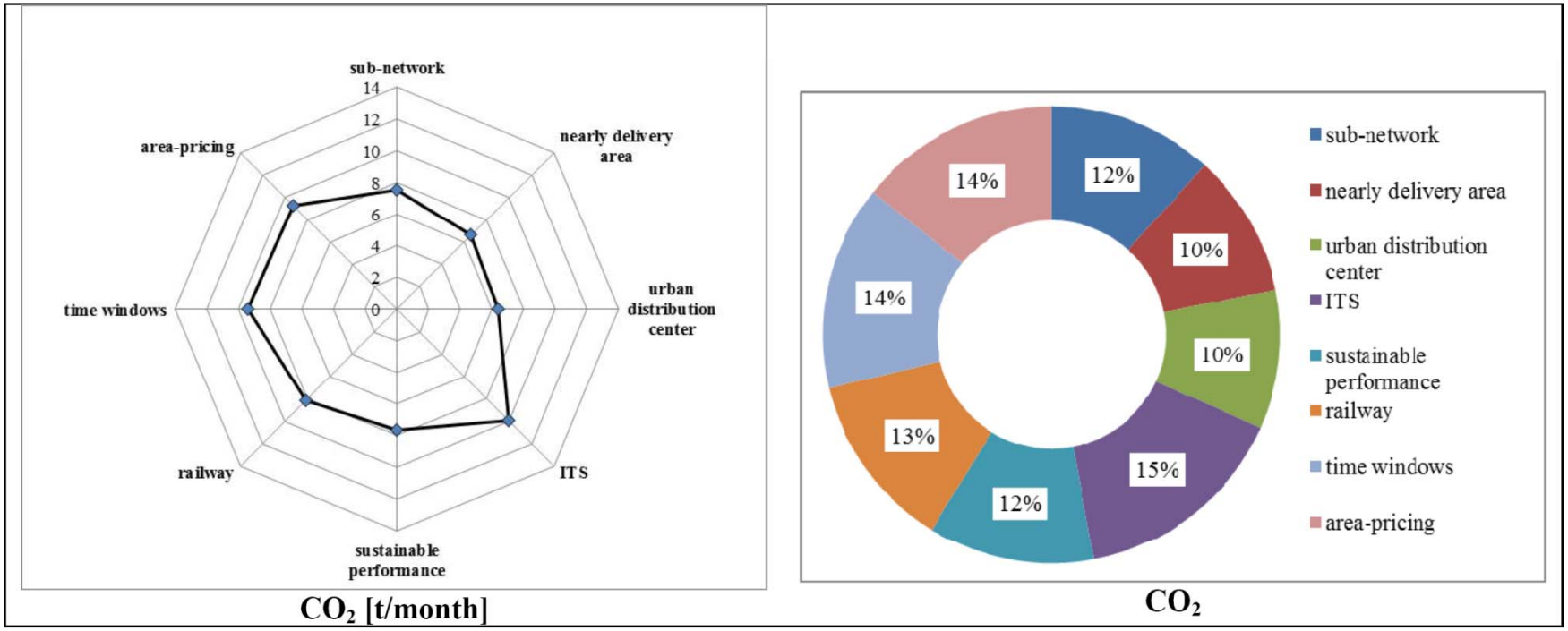


ITS measures averagely produce better results

Time windows averagely produce better results in terms of **PM**

Disaggregate class outcomes

Indirect measures



The diagrams confirm the role that could have the **ITS** and **governance** measures against the air pollutant emissions

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Conclusions (1/2)

- ✓ Some tested results obtained in several city around the Europe in order to reduce the impacts of freight transport within the city have been analysed, in terms of emission reduction. Some extensions can be made.

- ✓ While some measures are easier to implement and at least show a higher degree of acceptability among stakeholders, they could require a sound surveillance system to enforce compliance. A **consultation forum** or public-private partnership should be pursued.

Conclusions (2/2)

- ✓ This analysis does not consider the investment costs, but it has to note the investment costs are one of the most important factors for city logistics measures assessments.

- ✓ Further analyses are in progress in order to study the relationships between city logistics **outcomes and investment costs**.

- ✓ Other developments could aim to improve:
  - ➢ **the presented results**
  - ➢ **other field of sustainability: economic and social**

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