



The 4 A's of sustainable city distribution : an overview of innovative urban logistics solutions

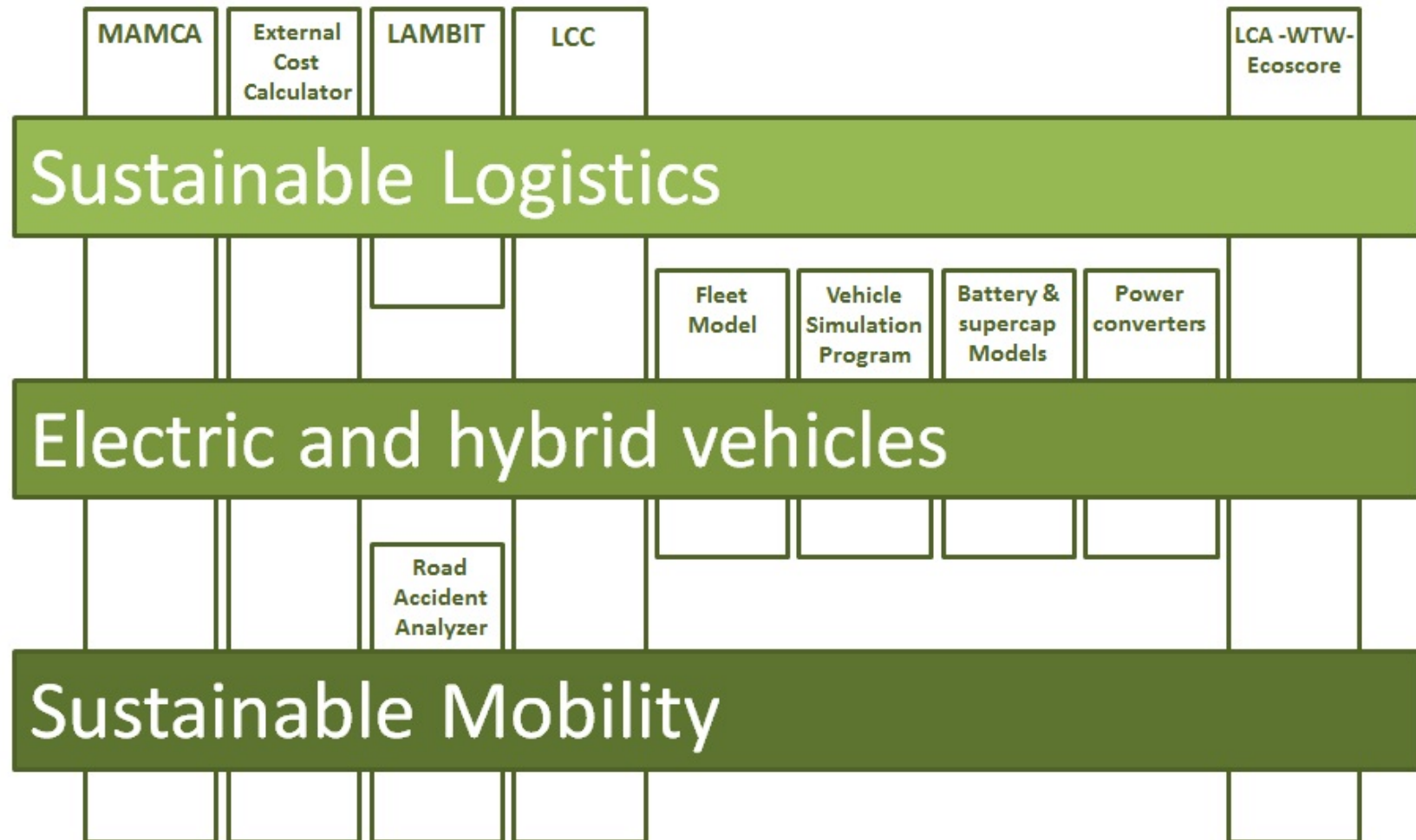
Prof. Dr. Cathy Macharis



Vrije Universiteit Brussel
MOSI Transport & Logistiek



MOBI: themes and tools



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STRAIGHTSOL

Strategies and measures for smarter urban freight solutions



Content

I. Options

II. Evaluation

III. Conclusions

4 A's of sustainable city distribution

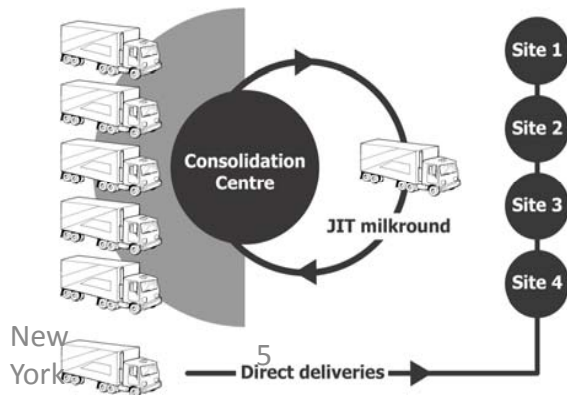
Awareness



Act and shift



Avoidance



Anticipation



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4 A's of sustainable city logistics

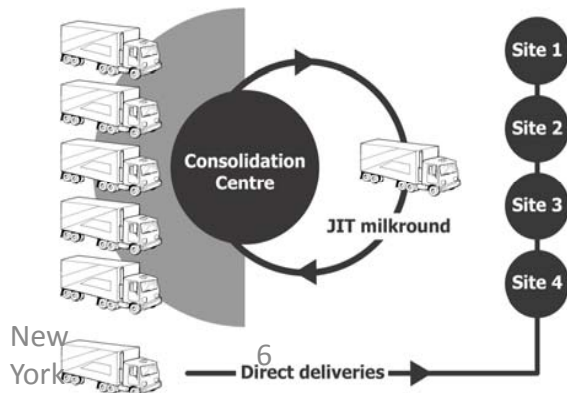
Awareness



Act and shift



Avoidance



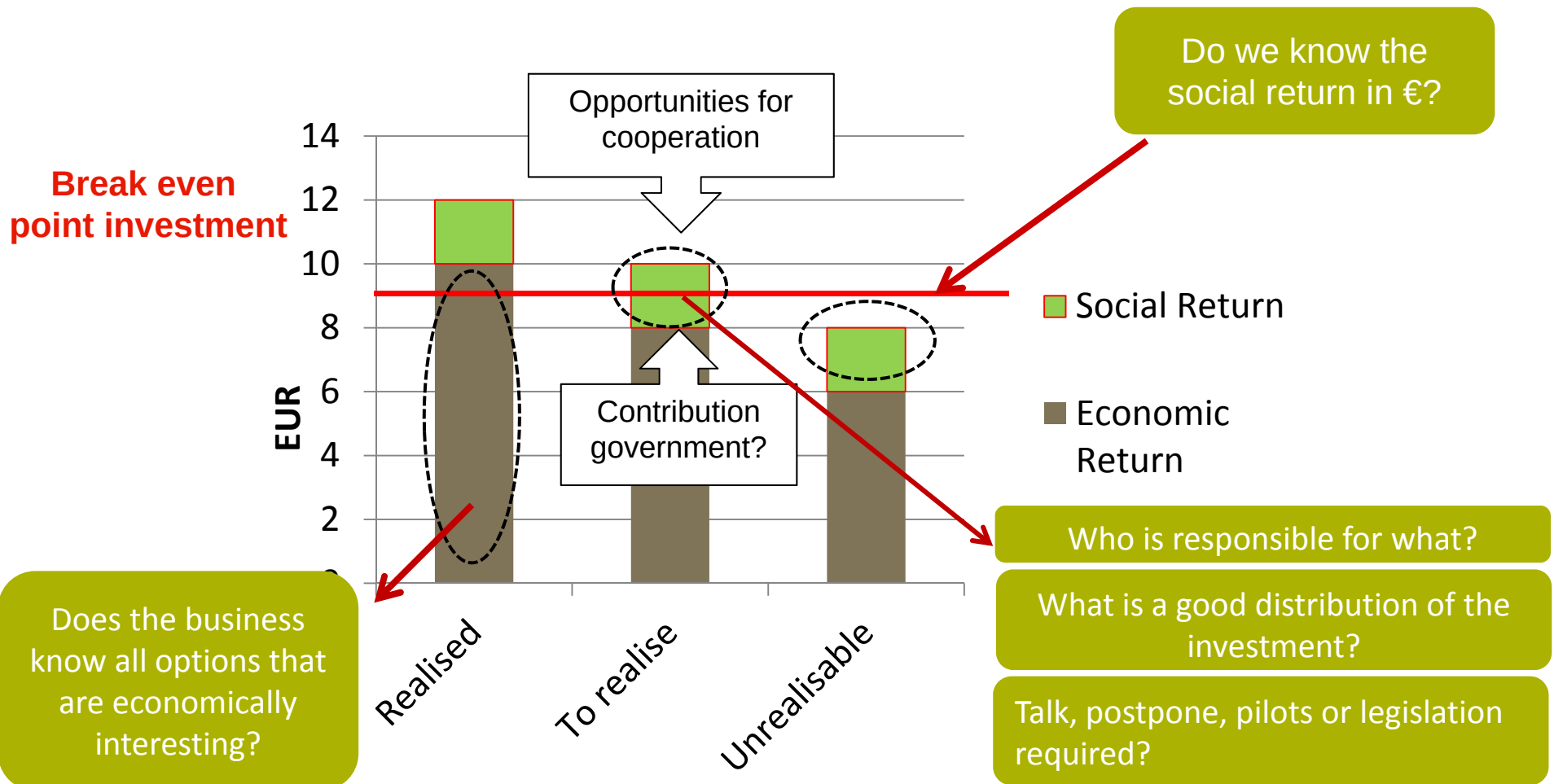
Anticipation



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Sustainable city distribution: Act?

Seems simple, but ...



Naar Scheffer et al., 2007

External cost calculator



Port of Brussels

Thanks to the port:

⇒ **688.000 trucks less**

⇒ **27,5 mio € less
external costs**



Programmes & Certification



New York



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4 A's of sustainable logistics

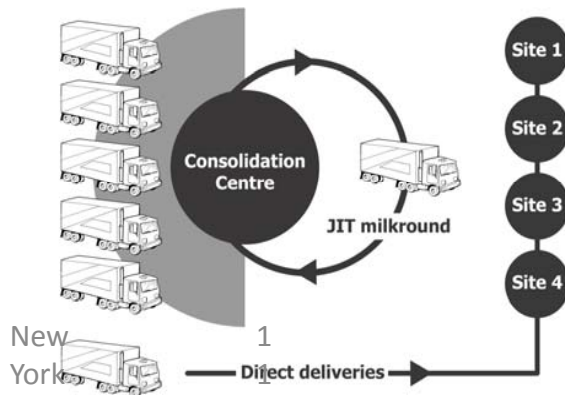
Awareness



Act and shift



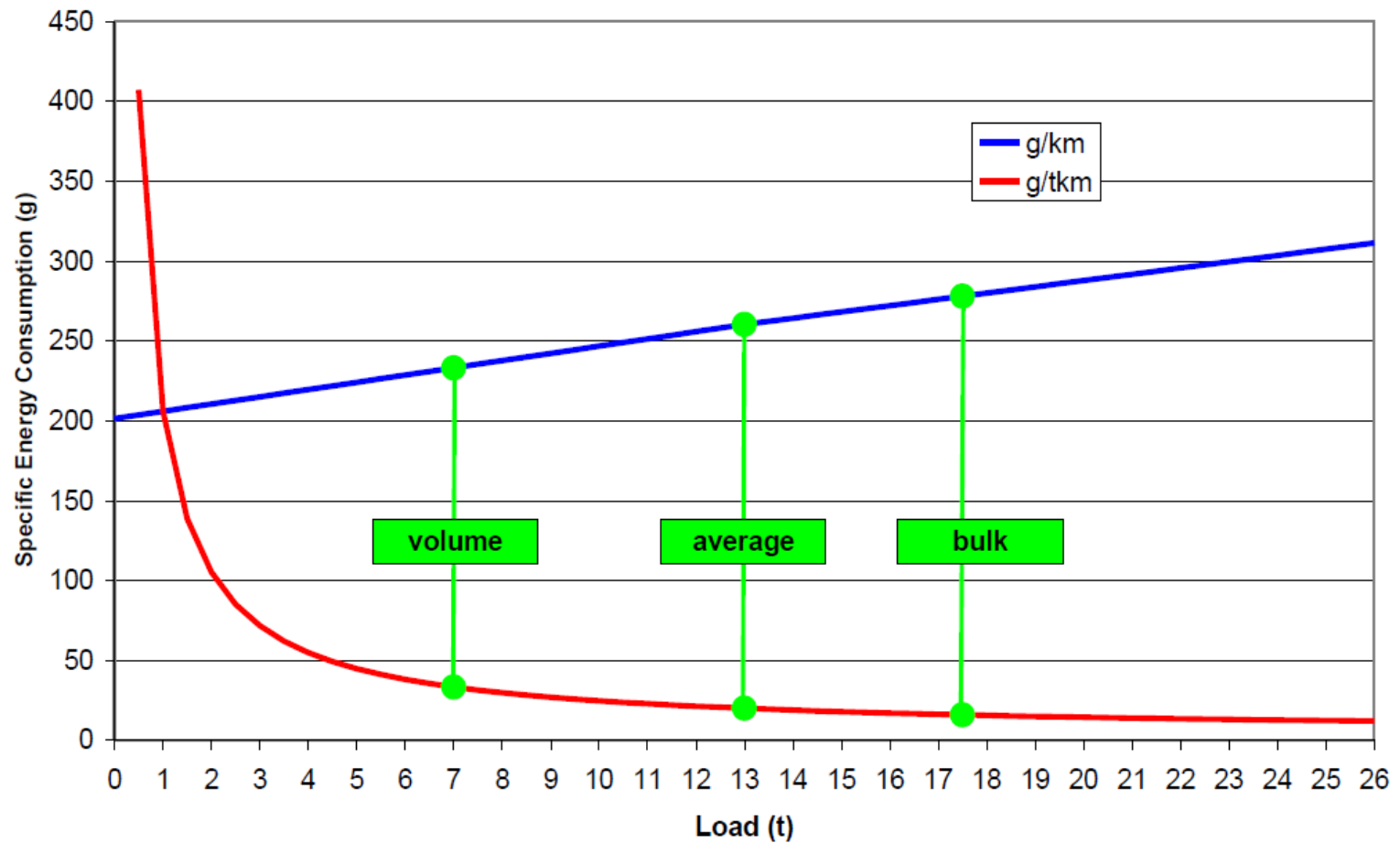
Avoidance



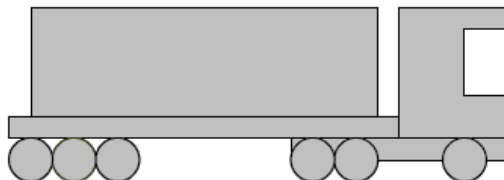
Anticipation



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ECF_{empty}
CU = 0%

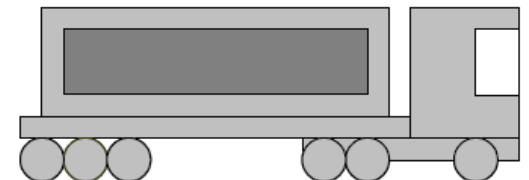


Definitions:

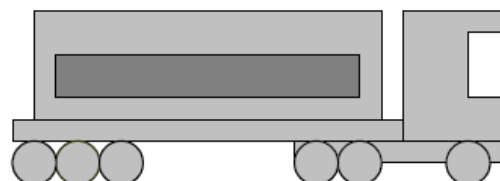
ECF	Final energy consumption with actual load (g/km)
ECF _{empty}	Final energy consumption without load (g/km)
ECF _{full}	Final energy consumption with full load (g/km)
M	Mass of freight (t)
CP	Payload capacity (t)
CU	Capacity utilisation (weight load / load capacity)

Remark: Load for volume/average/bulk goods including empty trips
Source: Handbook Emission Factors for Road Transport 3.1 (INFRAS 2010)

ECF_{full}
CU = 100%



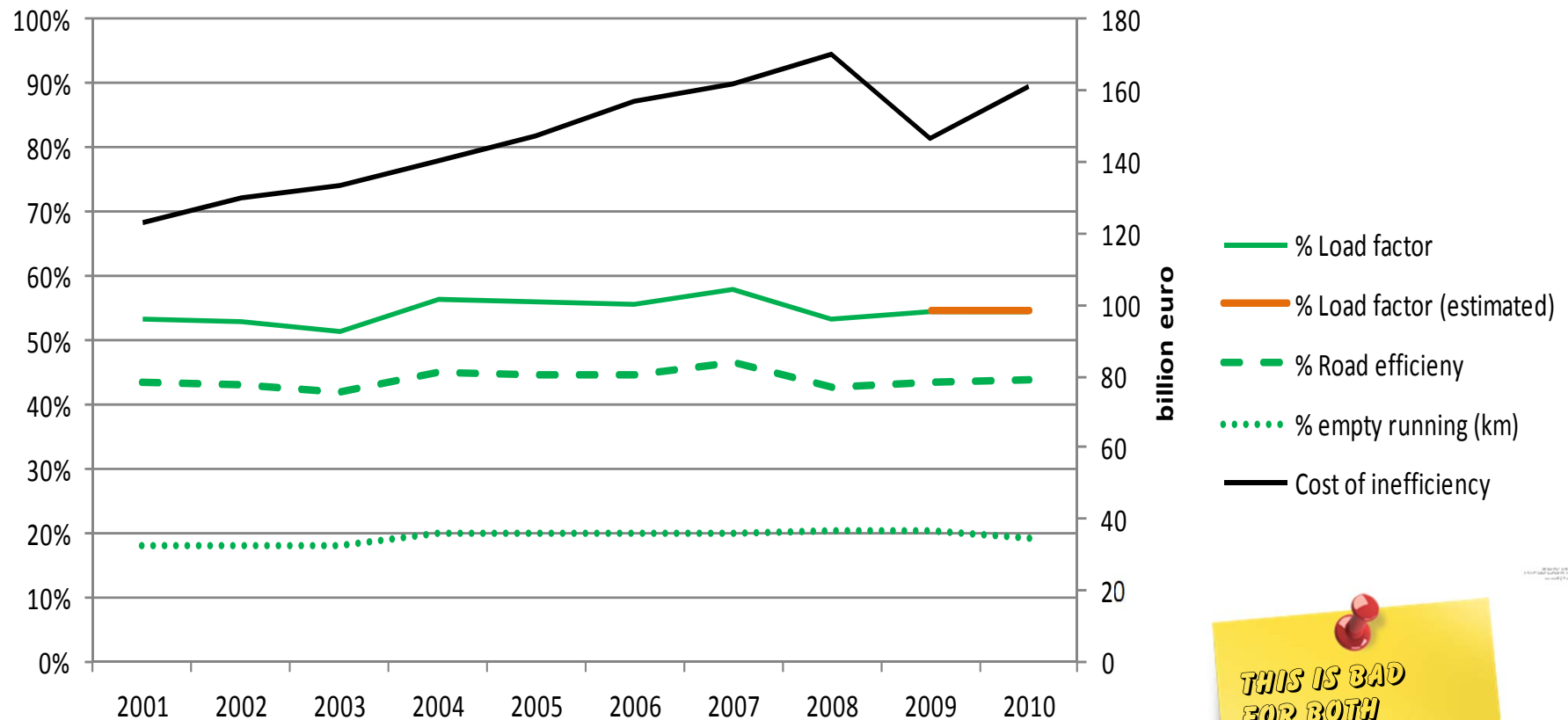
ECF
CU = M / CP



New York
ECF = ECF_{empty} + (ECF_{full} - ECF_{empty}) * CU

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Trucks are not filled to their maximum capacity.
This alone causes 1.3% of EU27 CO₂ footprint!!!



Source: Eurostat Data compiled by F Cruyssen,
www.co3-project.eu

**THIS IS BAD
FOR BOTH
PROFITABILITY
AND
ENVIRONMENT**

SC cooperation

Vertical Collaboration

**External
(Suppliers)**

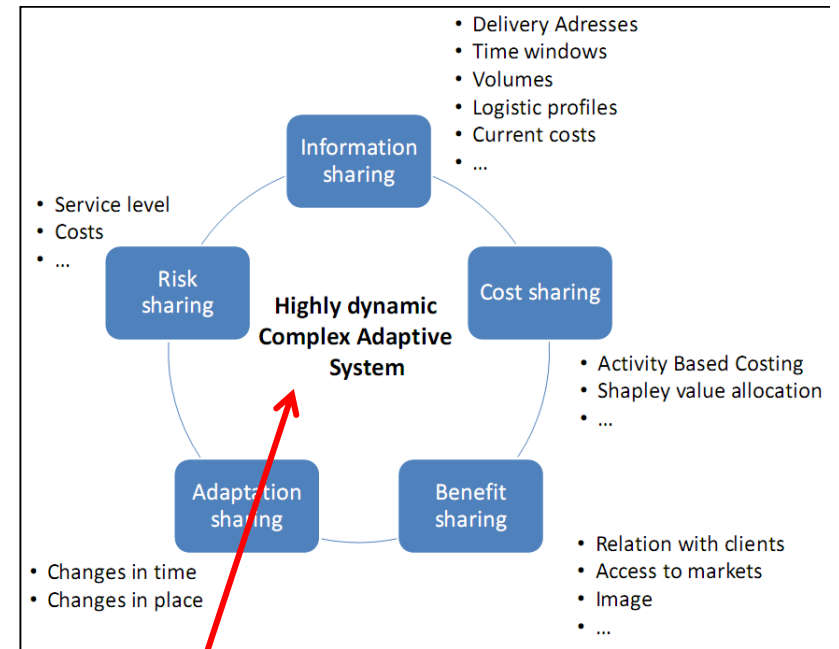
**External
(other
organisations)**

Internal

**External
(Clients)**

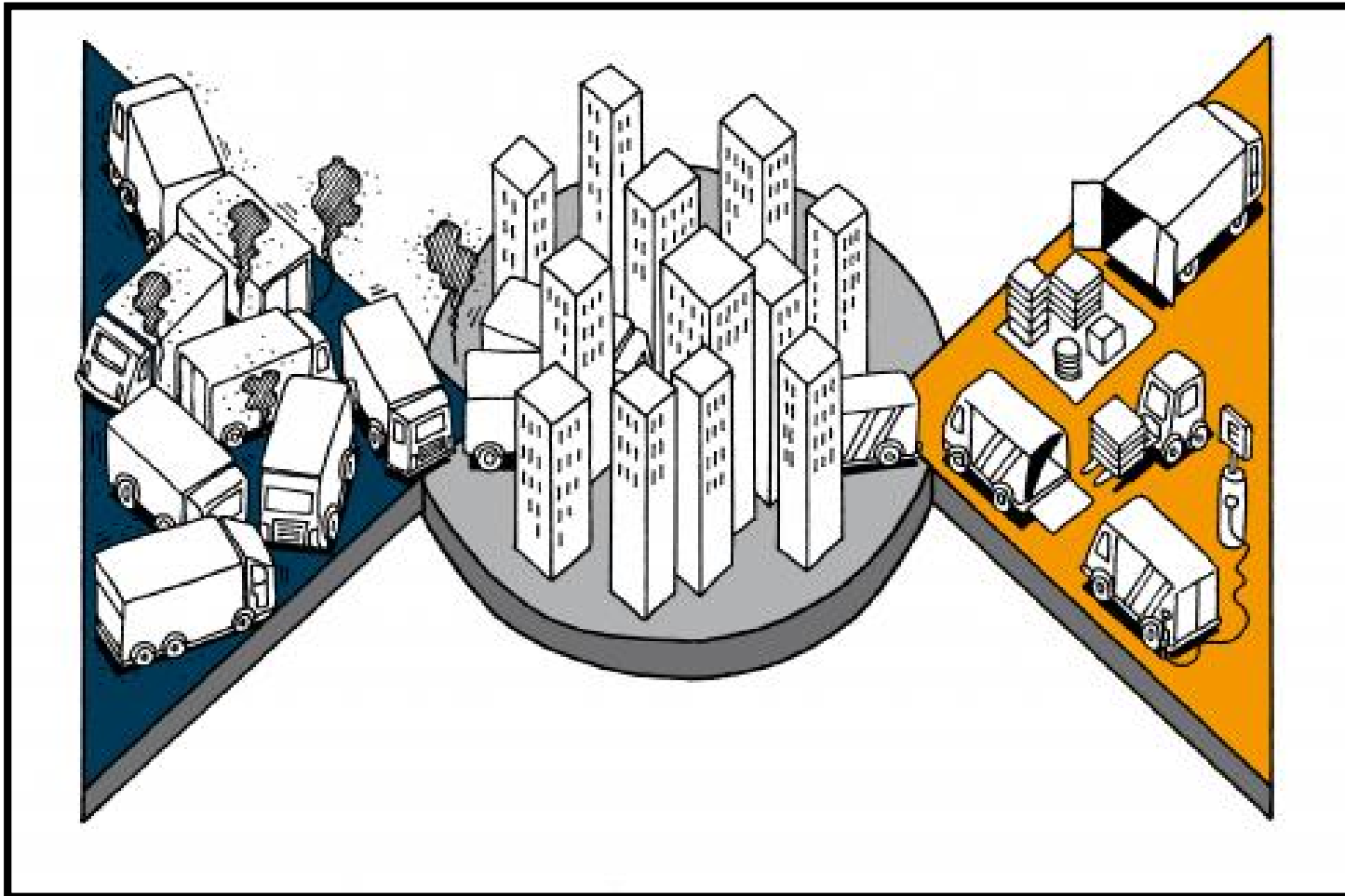
**External
(Competitors)**

Horizontal Collaboration

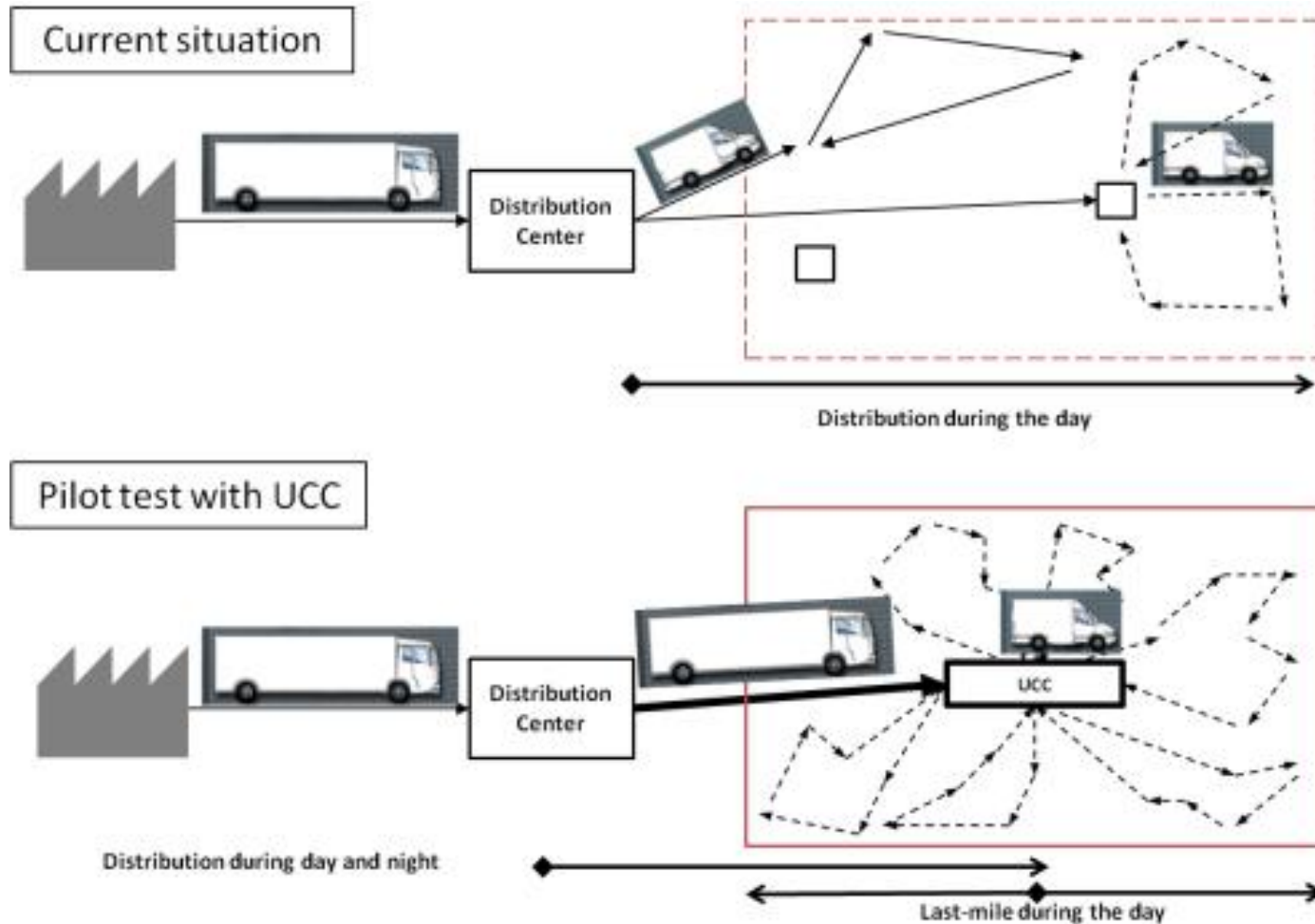


(Source: Altimedès Consulting)

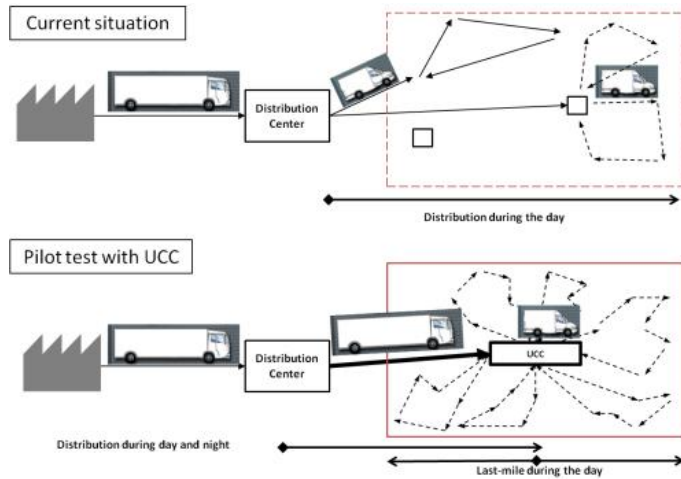
City distribution center



DHL pilot test within STRAIGHTSOL in Barcelona/L'Hospitalet



DHL pilot test within STRAIGHTSOL in Barcelona/L'Hospitalet



Results:

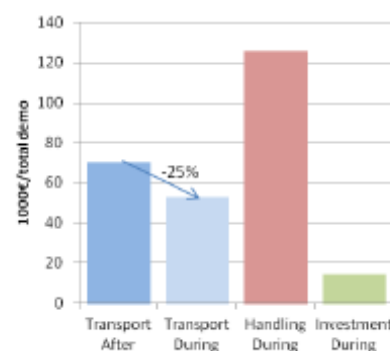
-25% transport costs
-high handling costs

-25% CO₂

DHL pilot test within STRAIGHTSOL in Barcelona/L'Hospitalet

WHAT DID WE FIND?

- Flexibility and synergy are key concepts to make a UCC viable:
 - Flexibility to mix different types of shipments
 - Synergy to combine and optimize the whole supply chain
- Big end-to-end supply chains are nearly fully optimized but allow inclusion of small volumes
- The use of an existing infrastructure is also a key for the success because it reduces investment costs
- Involving the Municipality is essential to involve retailers and for dissemination aspects



Economic indicators:

- Transport costs in urban delivery are reduced by approximately 25%
- Handling costs of the terminal (staff and IT/Engineering) are high and difficult to compensate
- Investment costs are low

Environment & Society indicators:

- Simulation results presented savings around 25% in CO₂ emissions with AIMSUN
- Space devoted exclusively to UCC is only 42.12m²

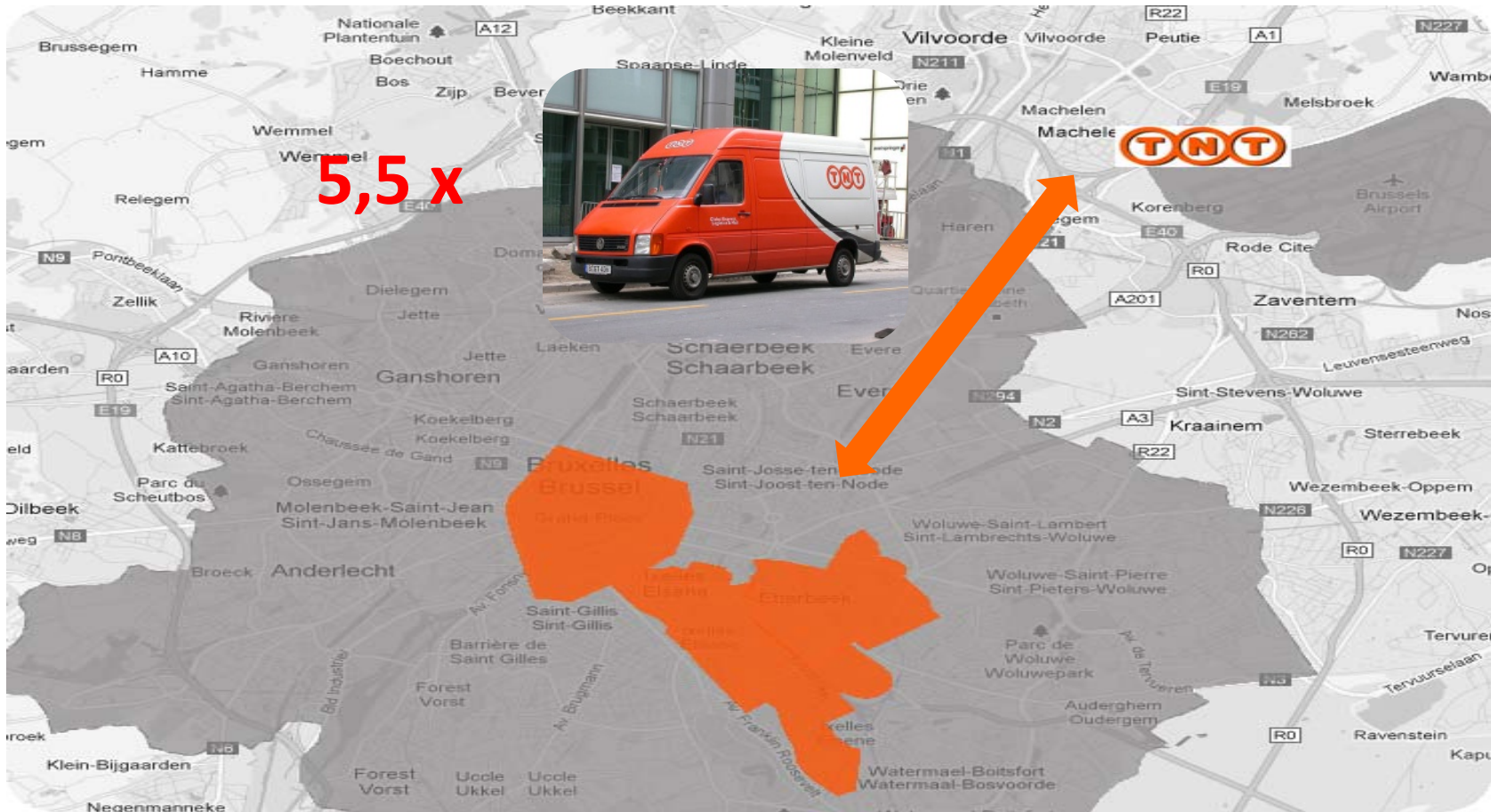
Transport indicators:

- Quality of service offered was 100% satisfactory
- Customer perspective was varied. The ones with most participation were satisfied with the service, but others experienced some problems when changing "shipping direction", or one-day delays
- 3.08 vehicles/day (1.93 trucks/day + 1.15 vans/day)
- Kilometres are reduced proportionally to transport costs (25%)
- Load factor has risen from 68% to 73%
- Total deliveries 727, with more than 350,000 packages. Corresponds to 9,7 deliveries/day
- 7% of total deliveries from small retailers
- Total vehicle time: driving 276 min, waiting 30 min, 205 min loading/unloading (Figure 1)



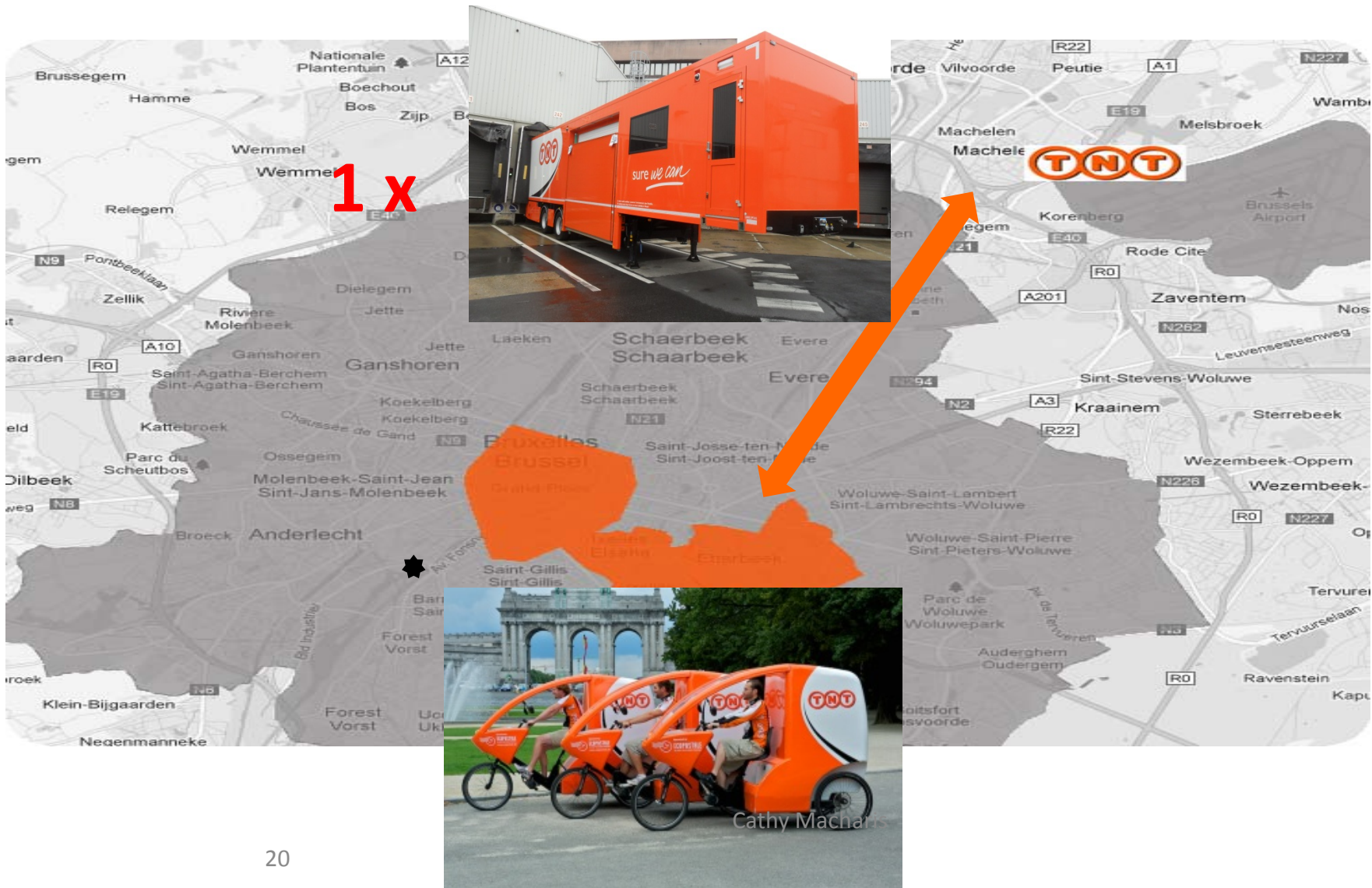
Screenshot of the simulation software AIMSUN

TNT-Brussels



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Mobile depot



Mobile depot



Results:

-high impact on emissions:

-24% CO₂

-98% PM_{2,5}

-operating costs :doubled!

Mobile depot



Results:

- high impact on emissions:
 - 24% CO₂
 - 98,5 % PM2,5
- operating costs :doubled!

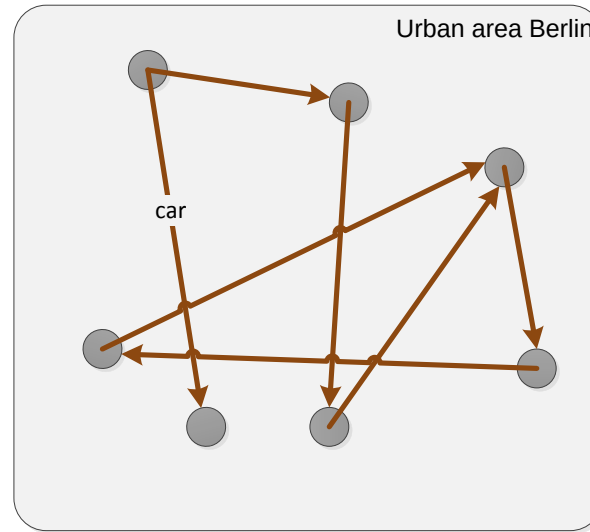


Bentobox (Citylog, 2012)

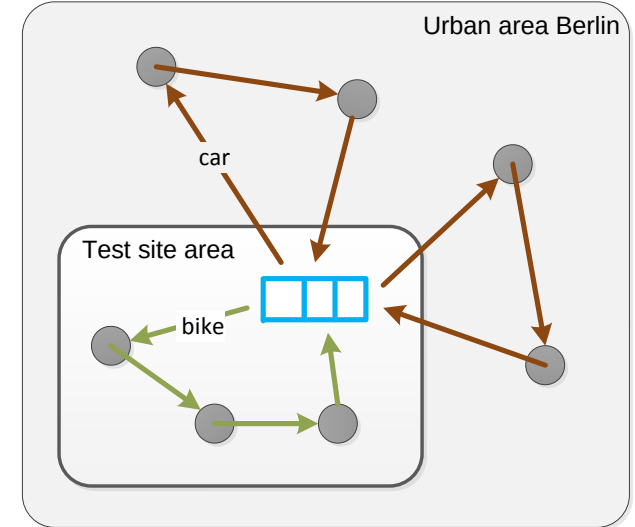


Source: TNO

Case 1: Bentobox transshipment bike –van



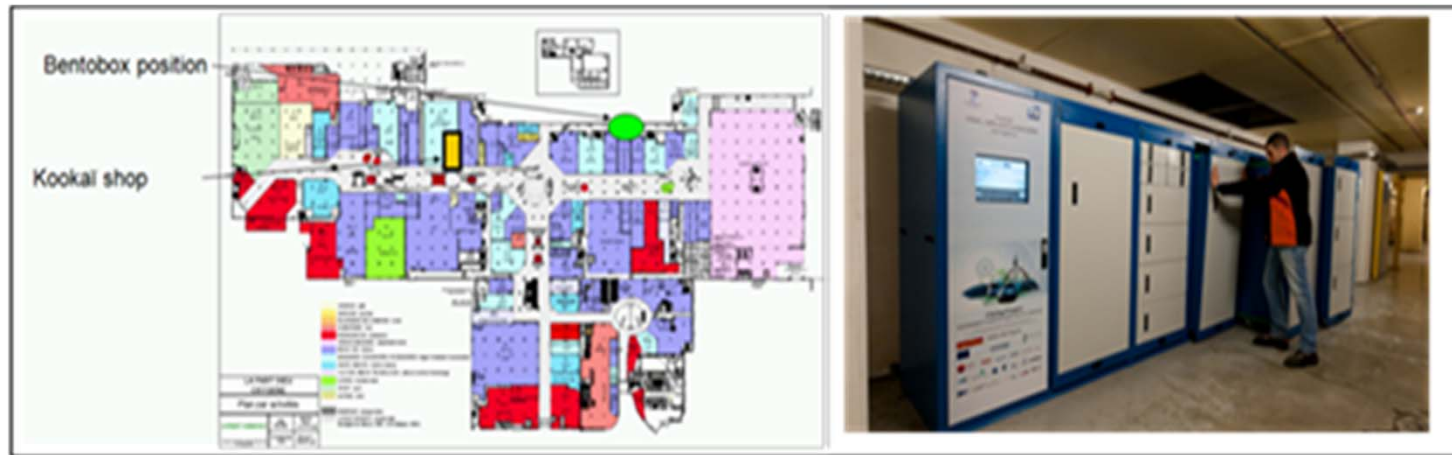
Initial situation



BentoBox situation



Case 2: Bentobox as drop off point for store deliveries



Mobile Depot Brussels

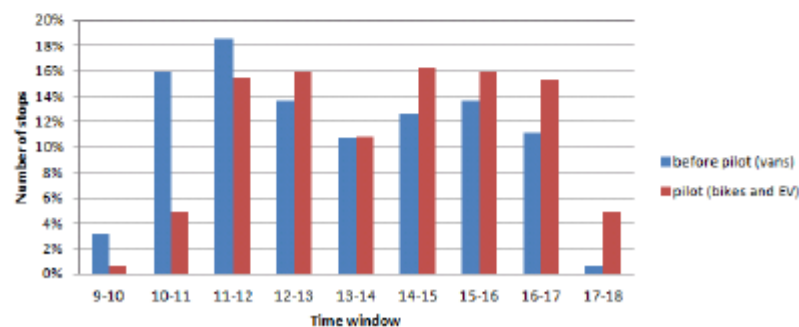
WHAT DID WE FIND?

- Savings of diesel kilometres: 0,92 km/stop before and 0,52 km/stop during the demonstration
- Savings of emissions (g/vkm):

Comparison of emissions before and during the demonstration	%
CO ₂	~ 24,0%
SO ₂	~ 24,2%
NOx	~ 78,4%
PM2,5	~ 98,5%
PM10	~ 22,1%

- Increase in operating costs: deliveries and pick-ups through the Mobile Depot are twice as expensive compared to the initial situation with vans
- Freight profile delivery area should match load capacity of the cyclocargo's to make the concept efficient
- Mobile depot needs to be located within delivery area to minimize the stem time of the cyclocargo's
- Slight impact on the quality of service: stops are performed slightly later during the day compared to the initial situation with vans (due to longer stem time of Mobile Depot in the morning)

Remark: the load rate of the Mobile Depot was deliberately kept low (40%) during the demonstration phase to guarantee the quality of service. Increasing the load rate will have a positive impact on diesel kilometre, emissions and operating cost savings.



Number of stops per time window—before and during demonstration

Straightsol demo of Oxfam: remote monitoring



4 A's of sustainable logistics

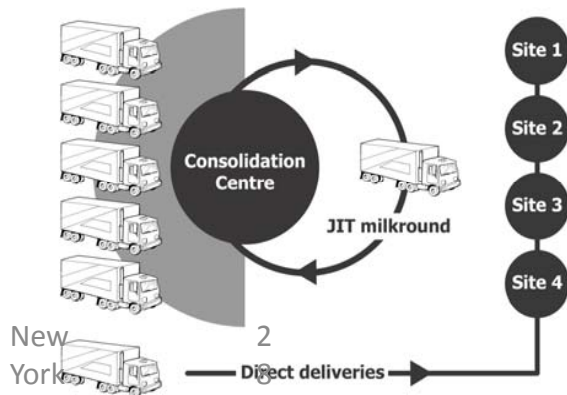
Awareness



Act and shift



Avoidance



Anticipation



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City barge transport



City barge transport



City barge transport



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City barge transport

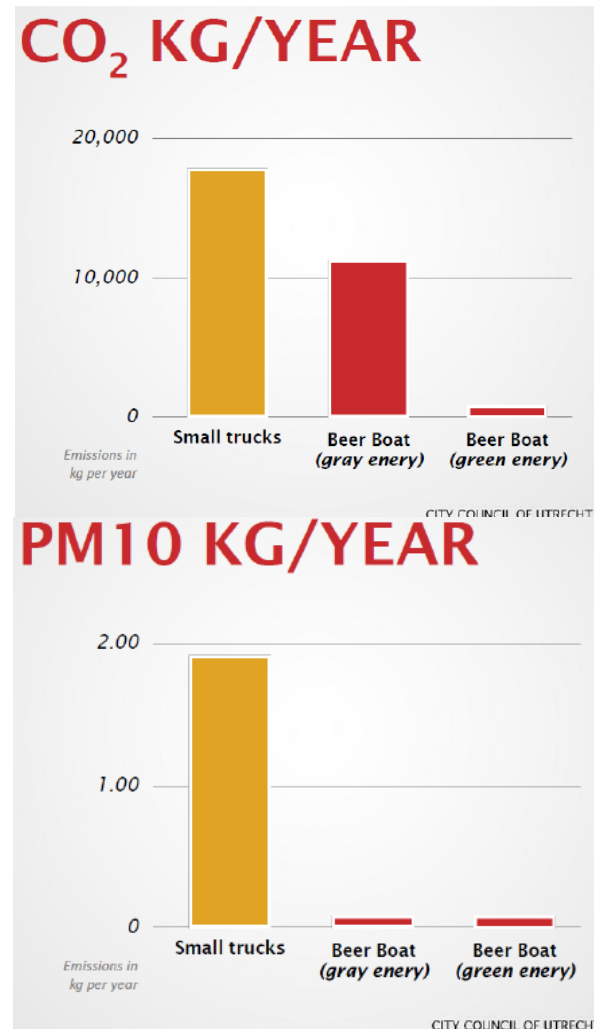


Impact / experiences

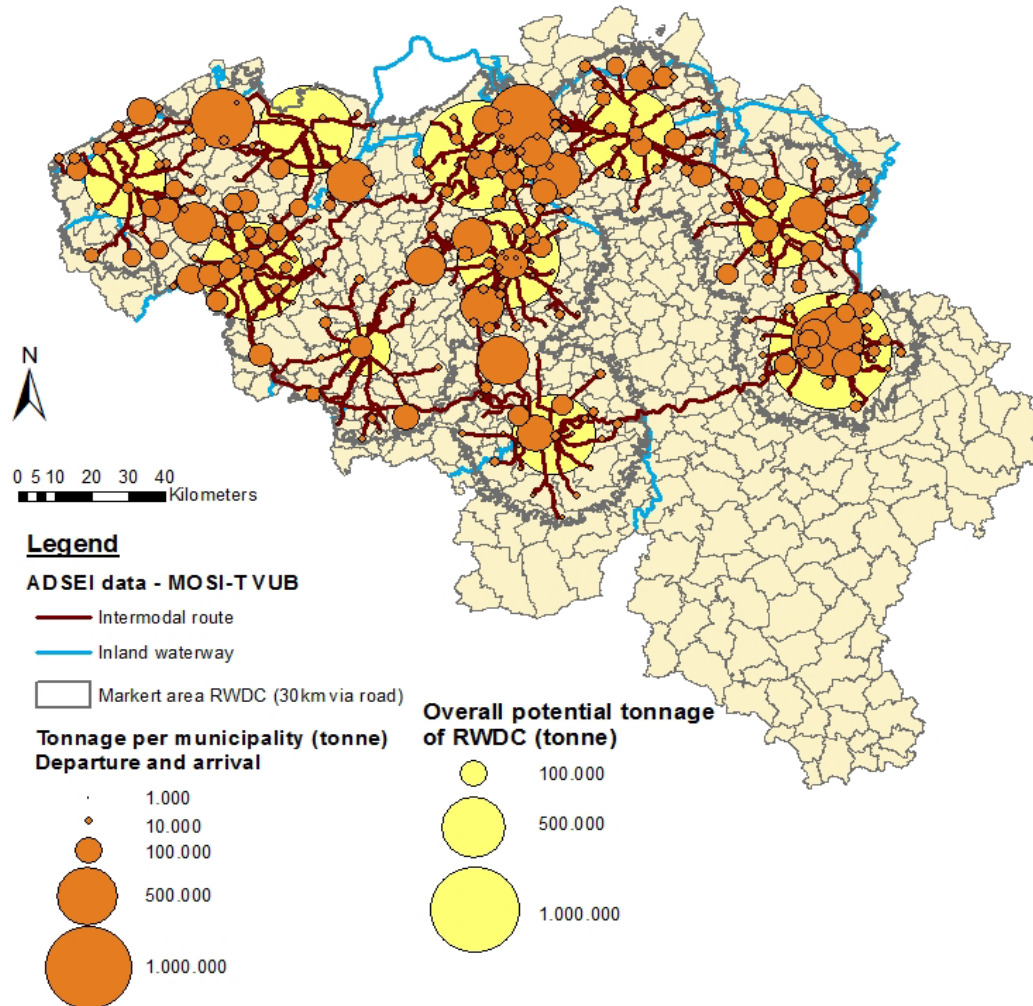
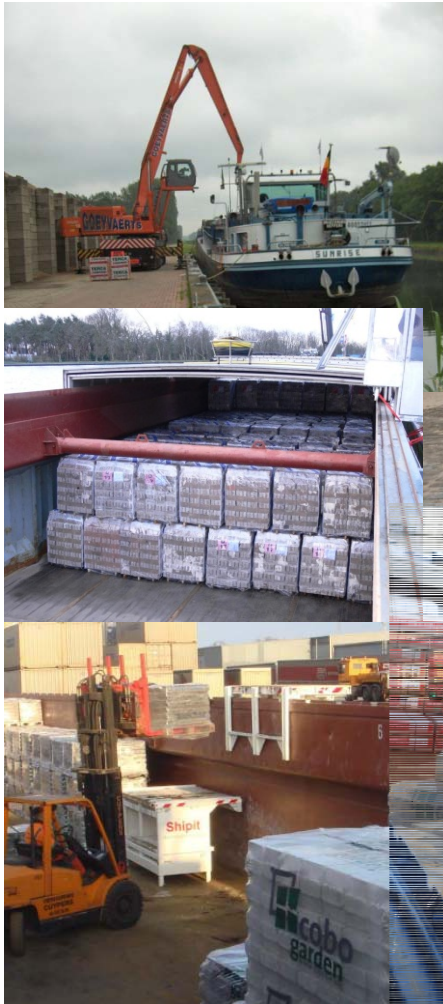
- Reduction of 17 t CO₂/year
- Reduction of PM10 and NOx and other emission
- Cost savings of operational costs
- Positive net present value for the future
- Preservation road infrastructure

(source: bestfact)

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Pallets on the waterway



Cargo tram Dresden



Day-time deliveries



Stressful for the driver

Busy urban traffic leads to expensive and unreliable deliveries



Inefficient operations

Unsustainable operations

Night-time deliveries



Night-time deliveries within STRAIGHTSOL



4 A's of sustainable logistics

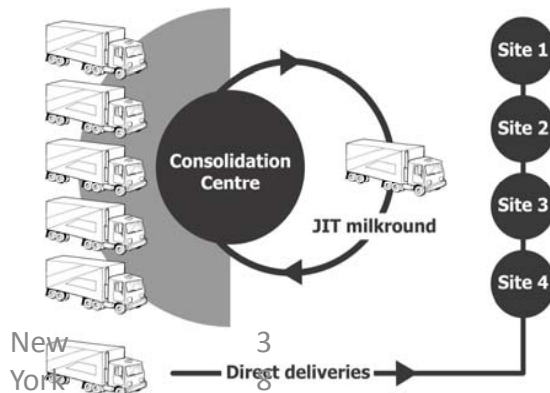
Awareness



Act and shift



Avoidance



Anticipation



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Natural gas



Electric vehicles



alkè
high performance utility vehicles



New York



IVECO

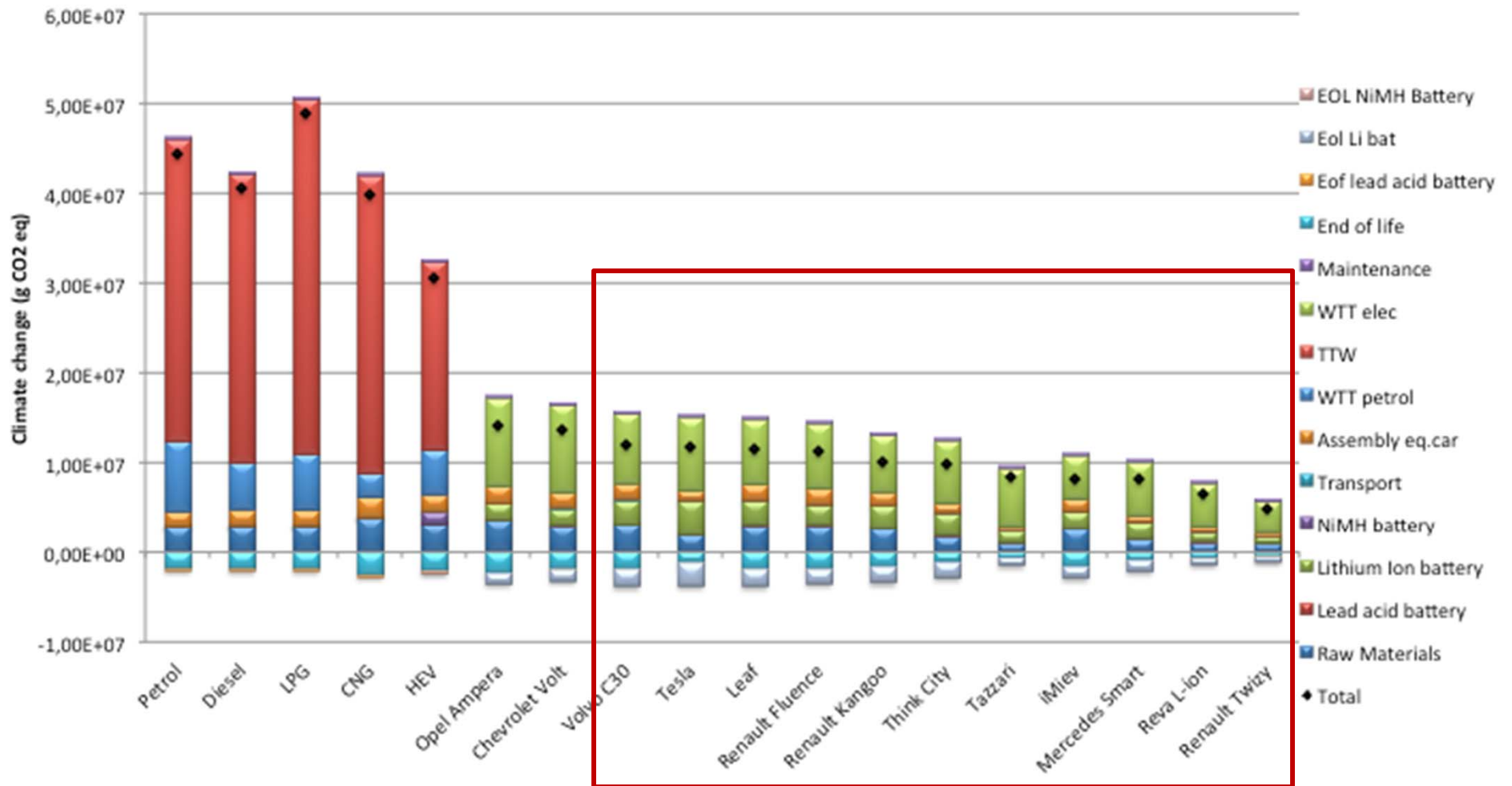


RENAULT
Z.E.



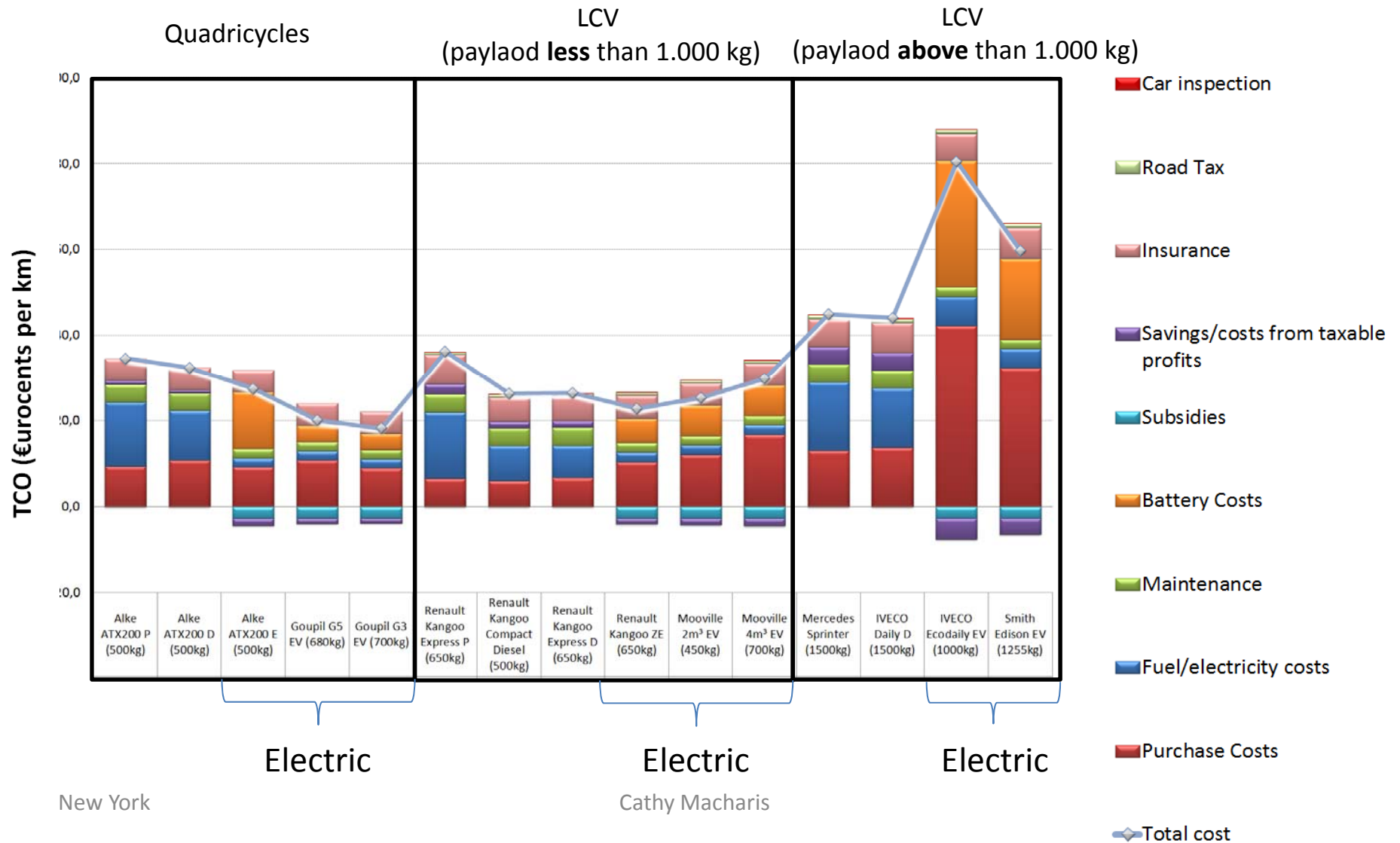
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Climate change (Life Cycle Assessment in g CO₂ eq)



Source: VUB-MOBI, Messagie et al., 2013

TCO analysis



The well known OEM's are coming...



Possible solutions

	Economical	Ecological	Social
Awareness!			
Internalisation of external costs			
Programmes & Certification			+
Avoid!			
Optimisation of loading factors	++	+++	+
Horizontal & Vertical Cooperation	++	+++	+++
Urban Distribution centres	-/+	+++	++
Act!			
...	+/-	+++	++
...	+/-	+++	++
Deliveries	+	++	-
Anticipate!			
Natural Gas	+	+	+
Electric Vehicles	+	+++	++

Actors involved

Shipper

Receiver

LSP

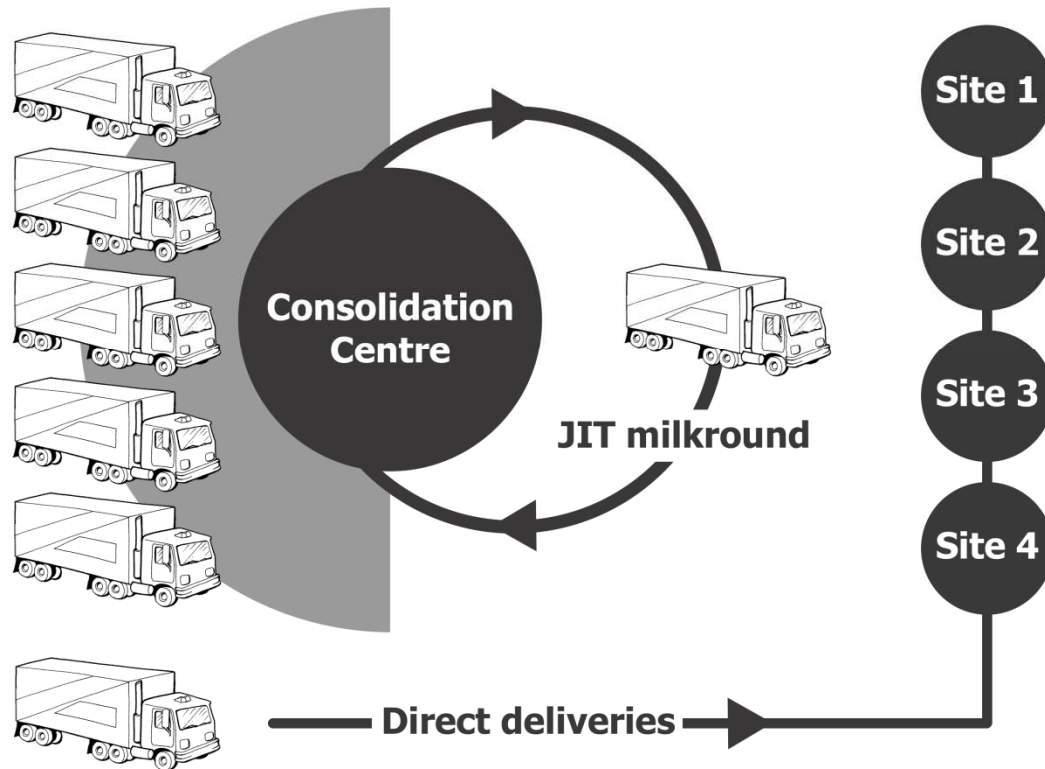
Authorities

Citizens

Why it fails



Why it fails

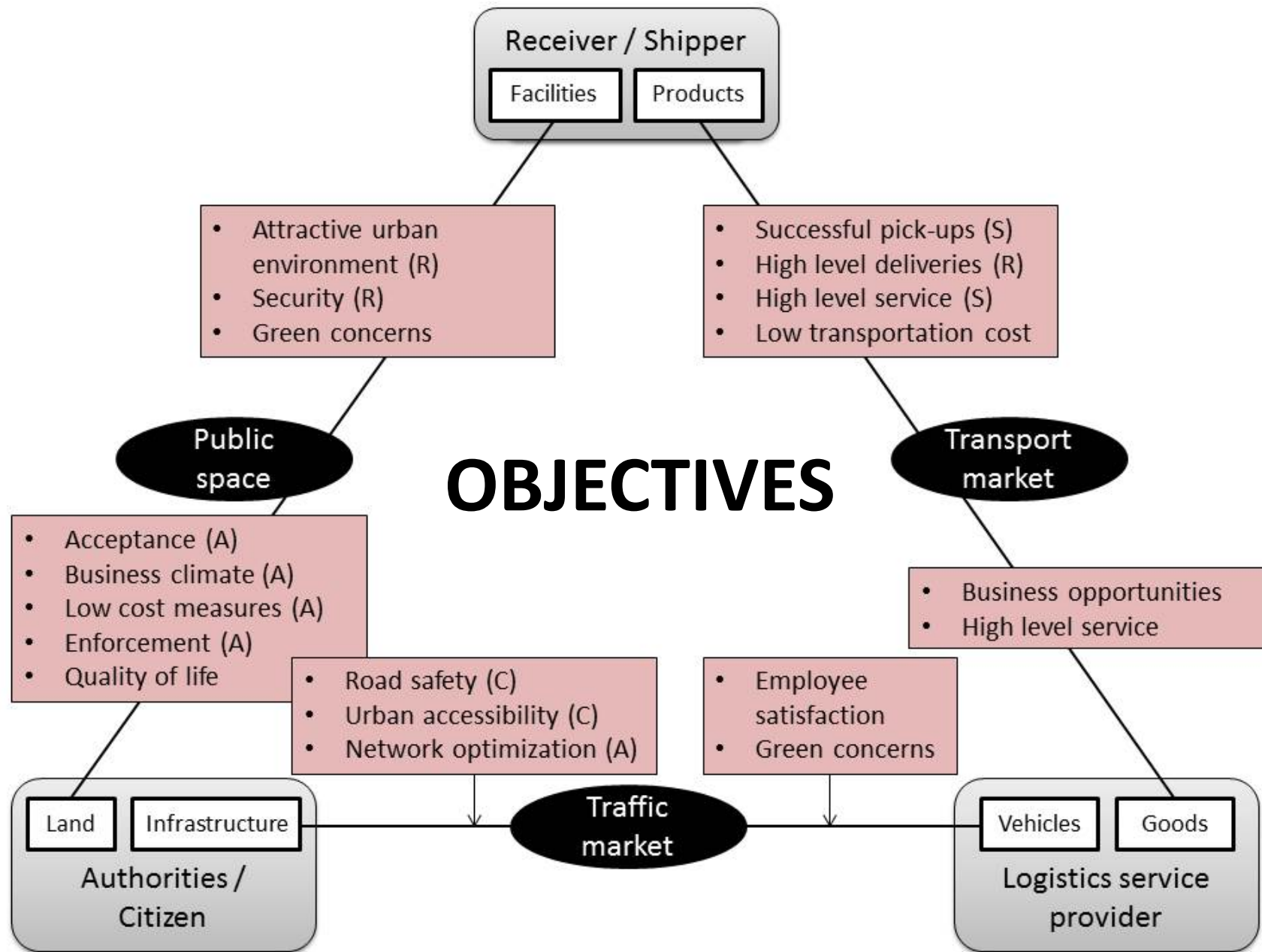


The list is

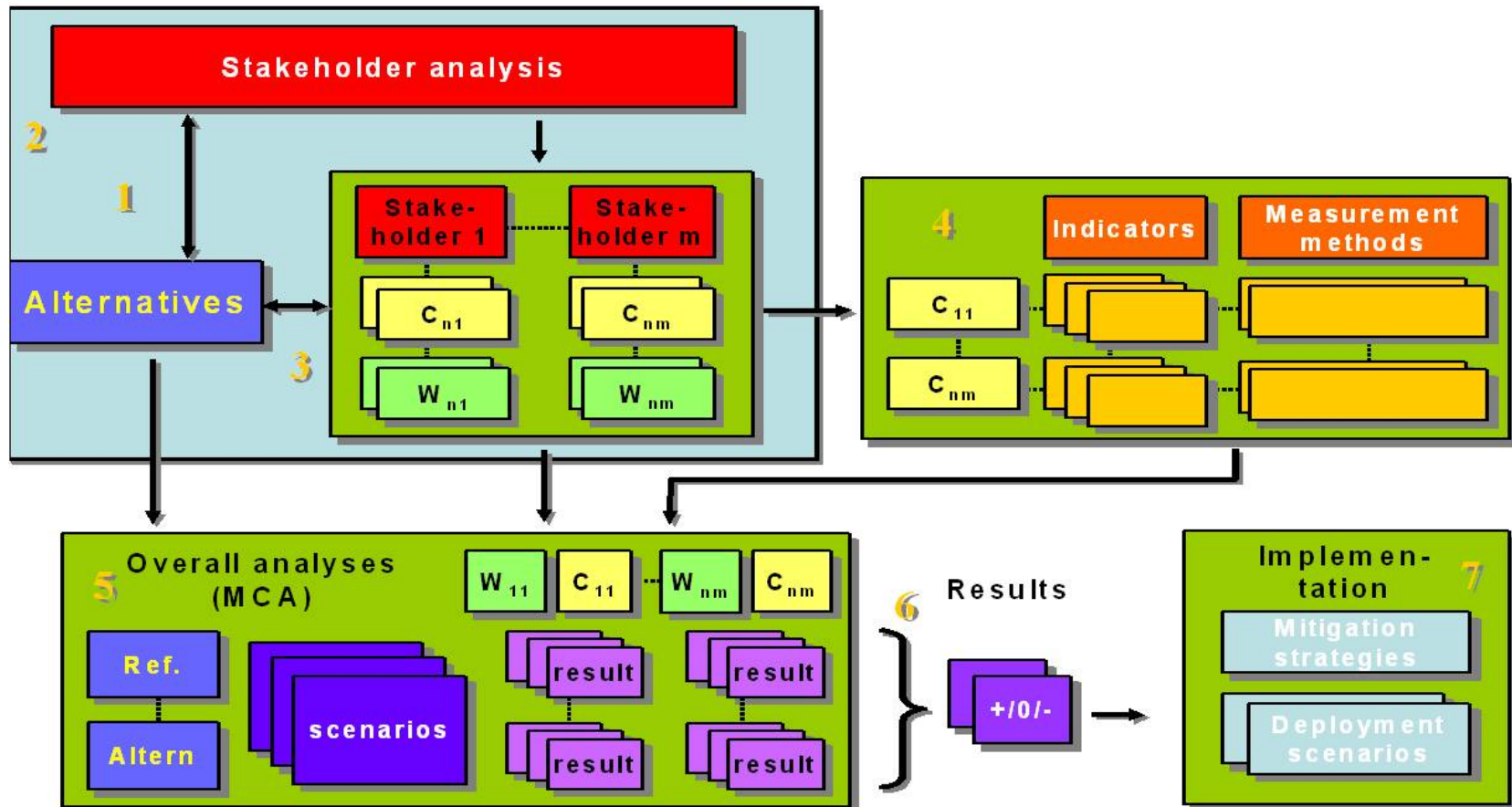
long:

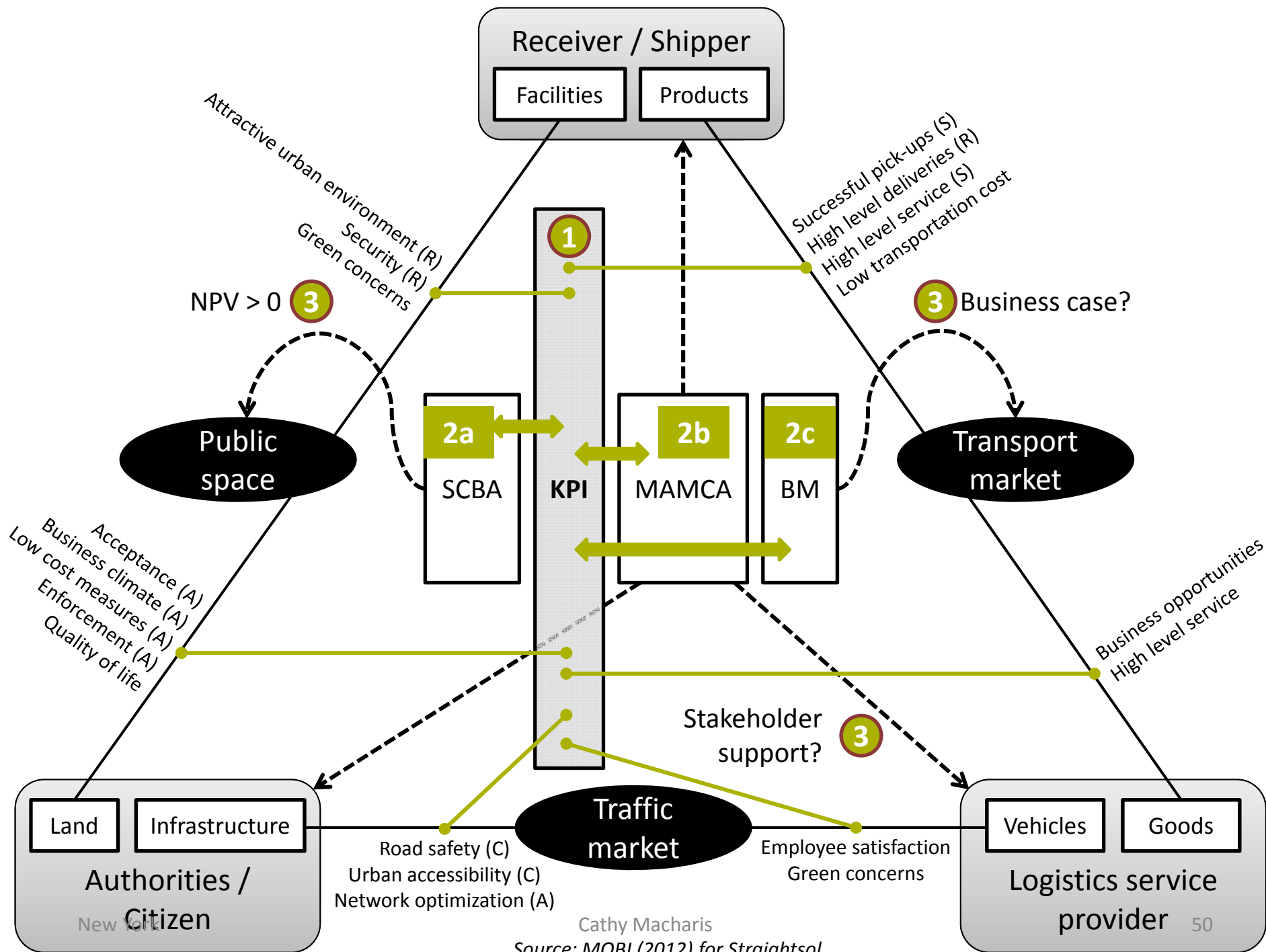
- Leiden
- Malaga
- Nuremberg
- Utrecht

....



Multi Actor Multi Criteria Analysis MAMCA (Macharis, 2004)





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Source: MOBI (2012) for Straightsol

Conclusion

- Sustainable city distribution is possible:
 - **A**wareness
 - **A**void
 - **A**ct
 - **A**nticipate
- Take into account the multi-actor setting of a city!



5th **A**: Actor involvement!

Thank you for your attention!

Get in touch with us

Address

MOBI
Pleinlaan 2
1050 Brussels

Website (new!)

<http://mobi.vub.ac.be>
<http://www.strightsol.eu>



New York

Cathy Macharis



Prof. Cathy Macharis

Phone: +32 2 629 22 86
Email: Cathy.Macharis@vub.ac.be
Office: Building B (2.20)



Koen Mommens

Phone: +32 2 629 21 66
Email: kmommens@vub.ac.be
Office: Building B (2.16)



Philippe Lebeau

Phone: +32 2 629 22 91
Email: Philippe.Lebeau@vub.ac.be
Office: Building B (2.18)



Sara Verlinde

Phone: +32 2 629 22 85
Email: Sara.Verlinde@vub.ac.be
Office: Building B (2.17)



Tom Van Lier

Phone: +32 2 629 20 67
Email: Tom.Van.Lier@vub.ac.be
Office: Building B (2.17)

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