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Sustainable Transport Scenarios for European Cities

Vienna, May 3, 2011

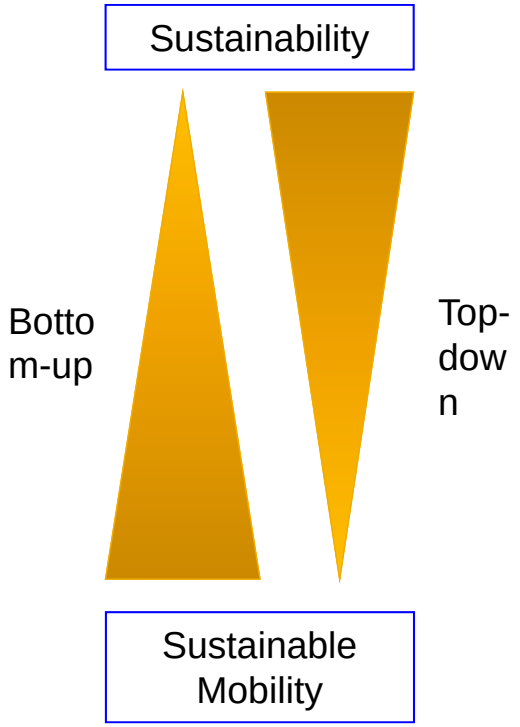
Conceptualizing sustainable transport

What is the goal?

The conceptual gap between sustainability & transport

- Sustainability is subject to rigorous but abstract definitions
- Sustainable transport comprises a number of process, evaluation and policy dimensions most researchers agree upon
- Not much communication between these concepts
- More generally, there is a wide gap between top-down and bottom-up approaches of sustainability

(Special Report on Renewable Energies and Sustainable Development, IPCC 2011)



Aim: Clarify possible points of communication between abstract, but analytically tractable sustainability definitions and messy, but real world sustainable mobility concepts.

Sustainable transport

THE US PERSPECTIVE

Sustainable transport (…) meets mobility needs while also preserving and enhancing human and ecosystem health, economic progress, and social justice now and for the future.

Key Policies

- Vehicle technology
- Road operations
- Demand management

Key agents: regional planner

E. Deakin. Sustainable Development and Sustainable Transport: Strategies for Economic Prosperity, Environmental Quality, and Equity. UCTC Working Paper 1734944, 2001

THE EUROPEAN VIEW

Key Policies

- Trip substitution
- Modal shift
- Land use/ distance red.
- Technol. innovation

<u>Paradigm shift:</u>
Transport as derived demand/ time minimization
→ quality transport

To achieve sustainable mobility: Increase public acceptability by 7 key elements!

D. Banister. The sustainable mobility paradigm. Transport Policy 15, 73-80, 2008.

From sustainability to sustainable mobility

Intertemporality – *maintain preconditions of well-being for future generations*	***GHG emissions*** ***resilience***
Capacity – *build/maintain/transform crucial infrastructures that enable future well-being*	***urban form*** ***pedestrian/cyclist/PT infrastructure*** ***vehicle stock***
Scale – *differentiate effects across scale to allow for adaptive and explicit prioritization*	***global*** ***local*** ***individual***

Sustainable mobility concepts tend to adhere to strong sustainability

Specify co-benefits across scale and domain

	Environmental	Social = Equity + Public Health	Transport + Economic Implications
Global citizen	▪ fight global warming ▪ natural resources	▪ equity in use of global commons	
Local citizen	▪ clean air ▪ noise reduction ▪ open space ▪ urban climate	▪ less pollution intake ▪ less noise induced stress ▪ equity in impact ▪ segregation	▪ investment costs of transport system ▪ cost of living ▪ attractiveness for business and tourism
Transport user		▪ physical activity → health	▪ accessibility (money and time) ▪ accidents

Focus on intertemporality

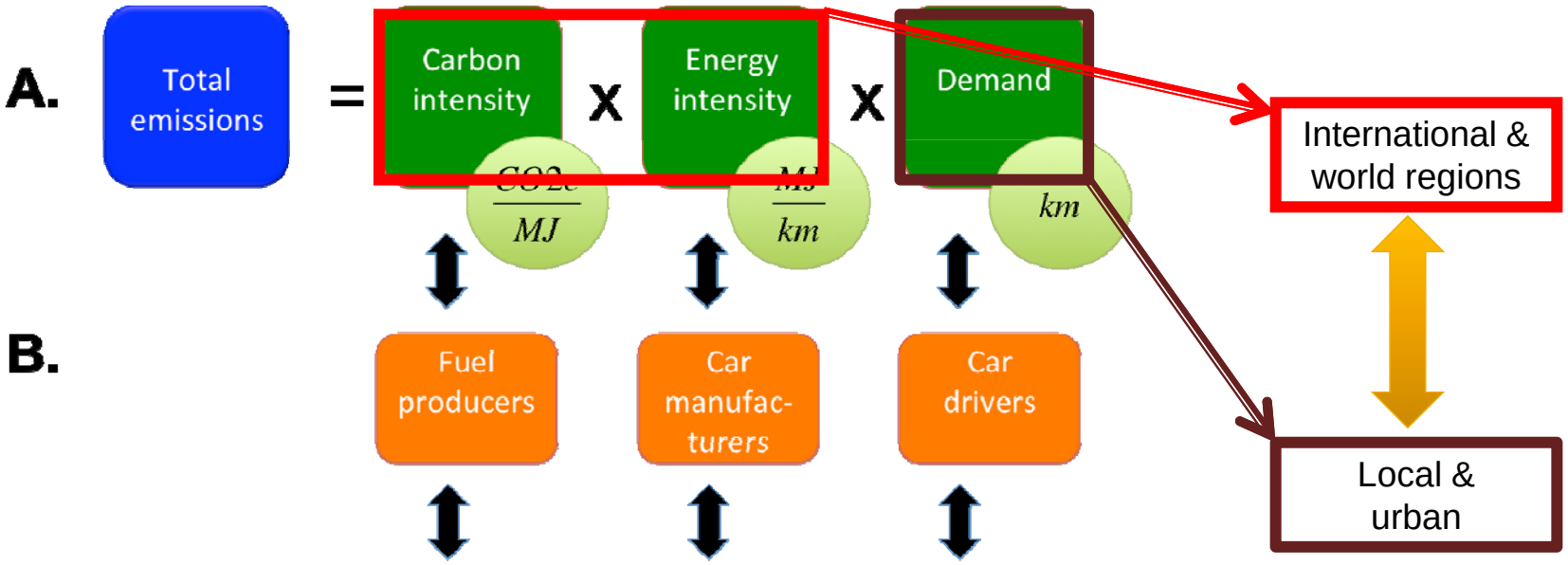
	Environmental	Social = Equity + Public Health	Transport + Economic Implications
Global citizen	CO_2 Abatement till 2020/2050 1. Covers suitable time frame 2. Addresses global issue directly 3. Is also proxy for air pollution/ noise, etc.		
Local citizen			The resilience of accessibility 1. Addresses transport user perspective 2. Focus on transport equity 3. Example: Resilience to fuel price shock
Transport user			

On policies and policy packages

1. The role of EU policies on cities' CO_2 emissions
2. Urban policies towards sustainable transport, and specifically, climate mitigation

How do we get there?

Factorizing decarbonization



C.

Comprehensive instruments	Reduction of carbon intensity	Reduction of energy intensity	Reduction of demand
Cap & Trade	Low carbon fuel standard	Fuel efficiency regulation	Infrastructure investments

Multiscale governance

Quelle: F. Creutzig, O. Edenhofer (2010) Mobilität im Wandel - Wie der Klimaschutz den Transportsektor vor neue Herausforderungen stellt Internationales Verkehrswesen 62(3):1-6

Existing policies and effects in EU transport sector

INSTRUMENTS

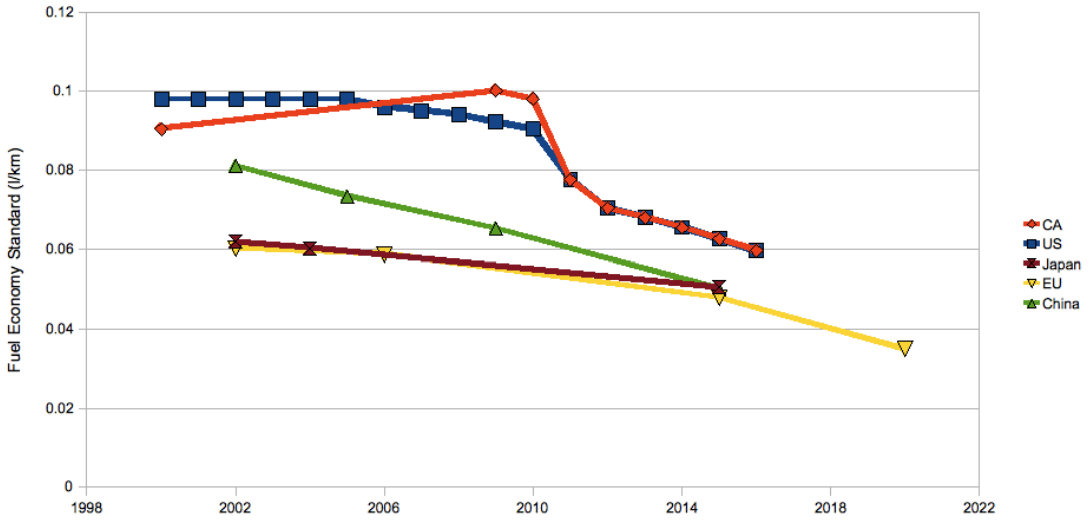
- Fuel efficiency regulation (EC) No 443/2009
  - 2005: 167gCO2/km
  - 2015: 130gCO2/km
  - 2020: 95gCO2/km
- Fuel quality directive, Fuel Quality Directive (EC) COM-2007-18
  - 2020: 6% less CO2e-intensity relative to 2010 (e.g. via biofuels)
  - 2% by electric cars and CCS (?)
  - 2% by CDM (?)
- Transport demand: 24% increase expected between 2005 to 2020

EFFECTS

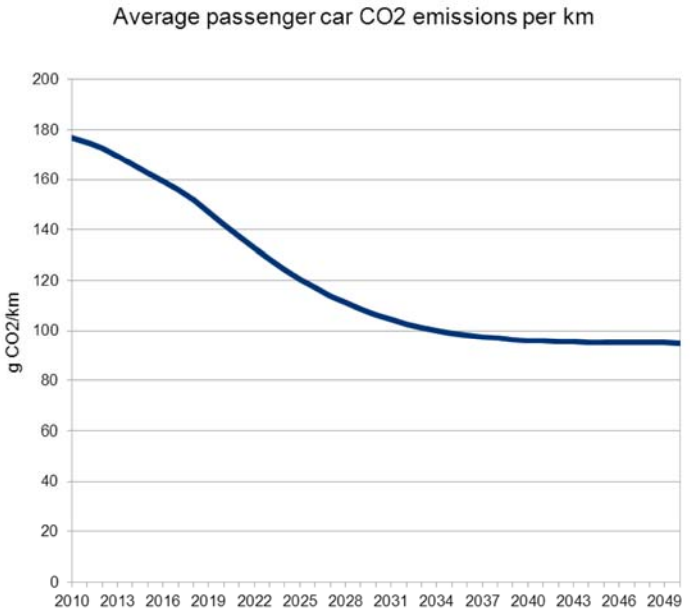
- If instruments are fully effective: reduction of 8-11% expected
- Doubts on Fuel Quality Directive (Biofuels don't really work)
- In the order of magnitude of the 2020 EU transport target
- Effect of Great Recession 2008/09: additional 3% reduction in 2020.

F. Creutzig, E. McGlynn, J. Minx, O. Edenhofer (2011) Climate policies for road transport revisited (I): Evaluation of the current framework. Energy Policy 39(5): 2396-2406

Fuel efficiency standards



Energy intensity standards (in l/km).



EU car fleet CO2 intensity

F. Creutzig, E. McGlynn, J. Minx, O. Edenhofer (2011) Climate policies for road transport revisited (I): Evaluation of the current framework. Energy Policy 39(5): 2396-2406. Data adapted from An et al. (2007) with updated fuel efficiency regulations

One Planet Mobility - WWF

PROJECT DESIGN

- Stakeholder interviews
- Evaluation
- Scenarios

CITIES

Freiburg

Barcelona

Malmö

Sofia

Synergies of urban transport policies

Push policies

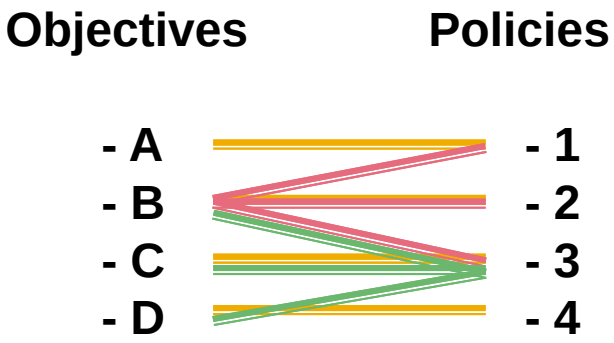
- Car traffic restrictions
- City toll
- Reduce available lanes
- Parking fees
- Speed limits

Pull policies

- Better public transport
- Safe space for cycling and walking
- Prioritisation of bicycles
- Bicycle racks

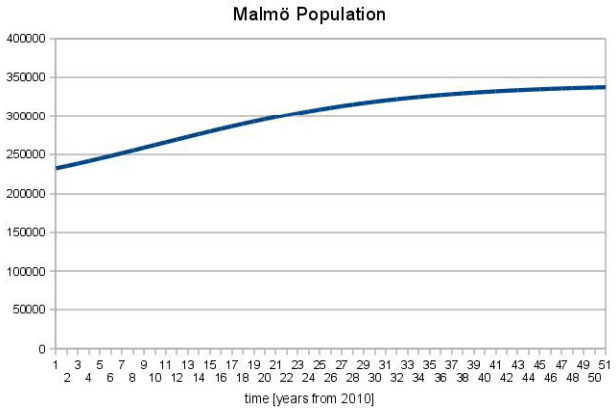
Land use policies

- Compact cities
- Polycentric cities
- Avoid urban sprawl
- No greenfield development
- Mixed use neighbourhoods



Case study Malmö, contextualizing

Driver

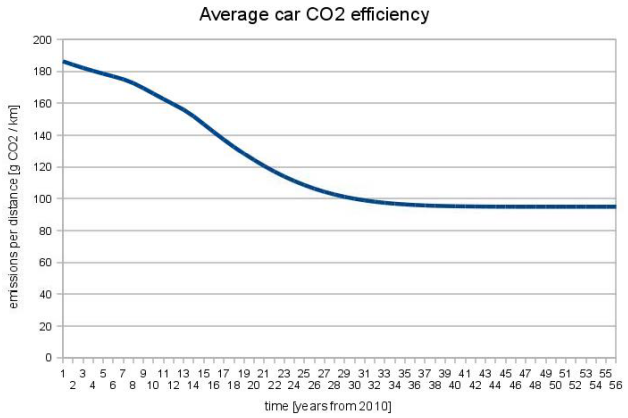


Aim: Identify crucial policies towards sustainability and decarbonization in 4/5 European cities.

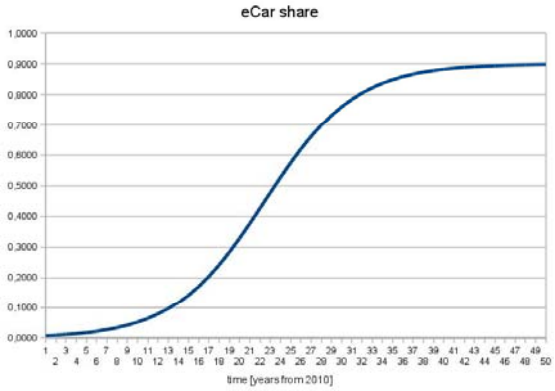
One Planet Mobiliy, funded by WWF

PhD work of Rainer Mühlhoff

Source: Mühlhoff & Creutzig, project report for Malmö

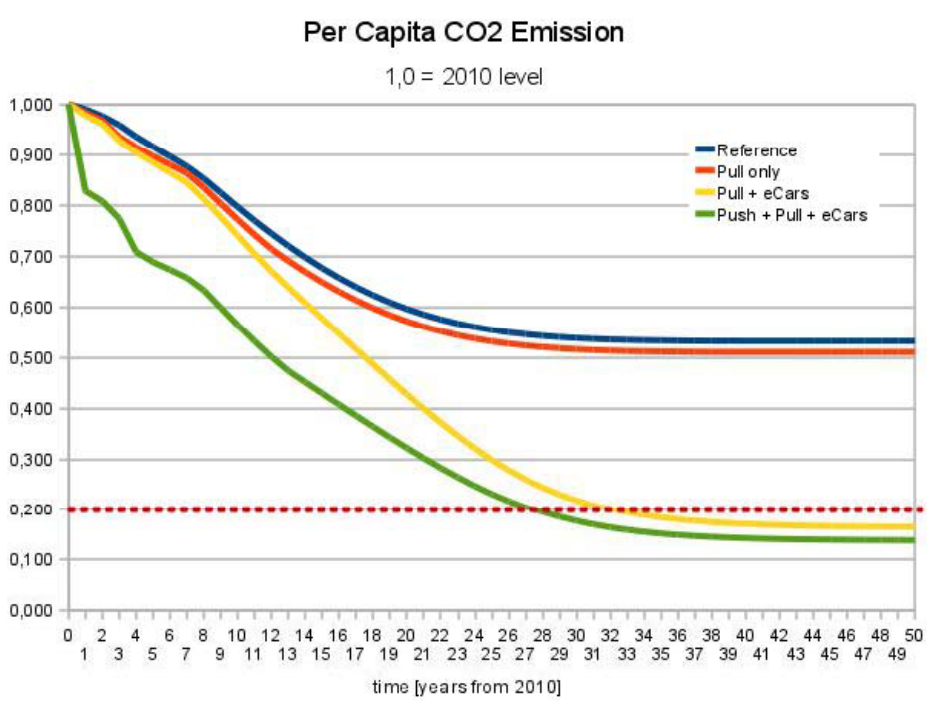


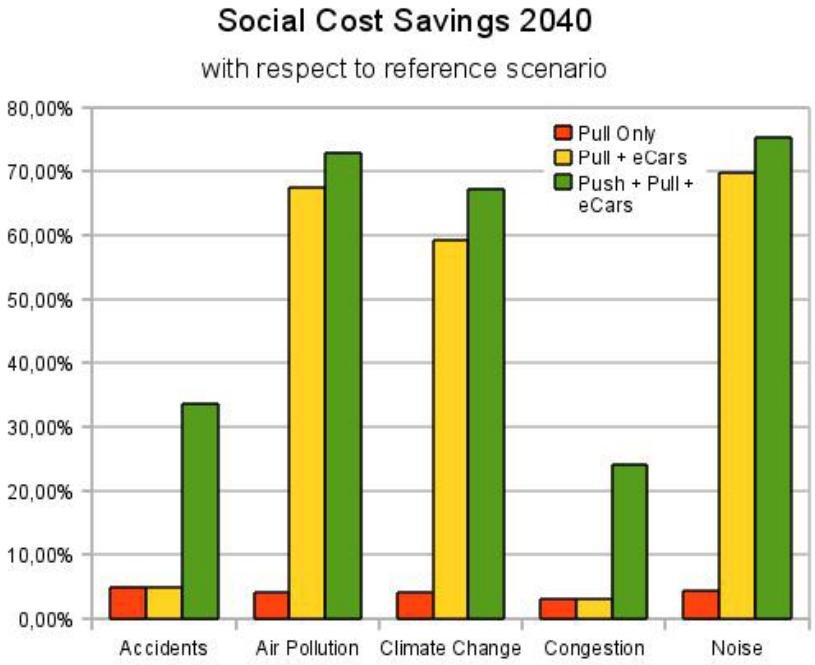
EU policies



Optimistic technological change

Scenario evaluation





Being nice (win-win) alone is insufficient!
Not only bicycle lanes, but take space away from the car.

Source: Mühlhoff & Creutzig, project report for Malmö

Scenario 1: reference / EU emissions policies

- Population increase: 15% urban, 28% region until 2050
- PT: 5% increase in PT speed and service quality
- Increase of car combustion engine CO2 efficiency according to the EU policies (EC, 2009; Creutzig et al., 2011)

Scenario 2: additional pull oriented measures

- PT: 40% improvement of speed, availability and service quality of urban bus system.
- PT: 24% improvement of speed, availability and service quality of regional bus and train network
- NMT: 50% more streets with cycle lanes used by bicycles only (not by motos); with the result of 10% less street area for cars

Scenario 3: additional push measures

- MIT: 30% more streets with low traffic zones (30 km/h) and cycle lanes used by bicycles only (not by motos)
- MIT: 37% increase in fuel taxation until 2030

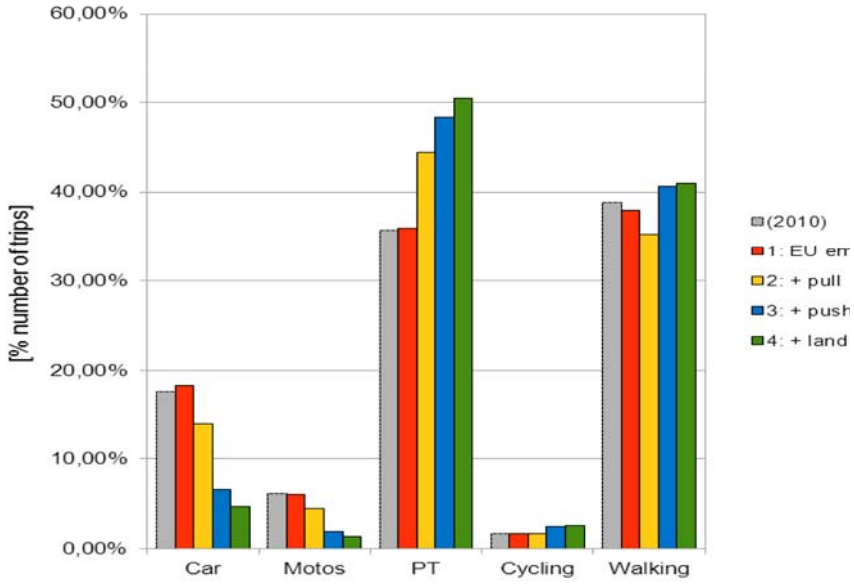
Scenario 4: additional land use policies

- Mixed use and neighborhood shopping policy, resulting in reduction of average trip length/number of trips by 20% until 2030
- Densification and connected settlement policy: Settlement only allowed in urbanized parts of city and only in PT connected neighborhood. Resulting in decrease of average trip length/number of trips by 20% until 2050

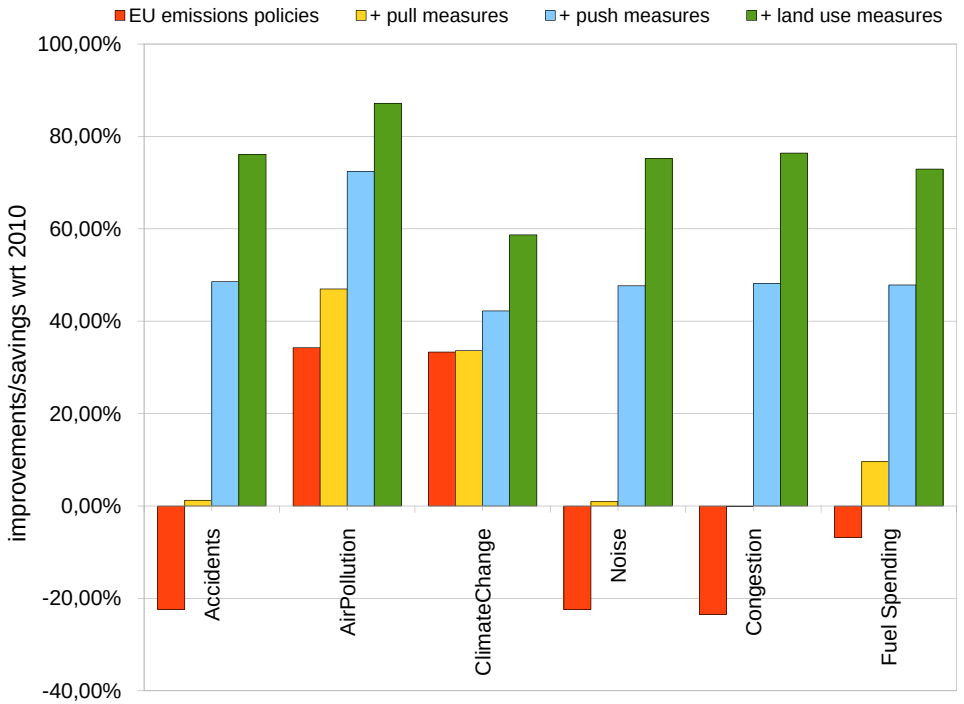
Modeling scenarios: policy packages of increasing ambition

Example: Barcelona

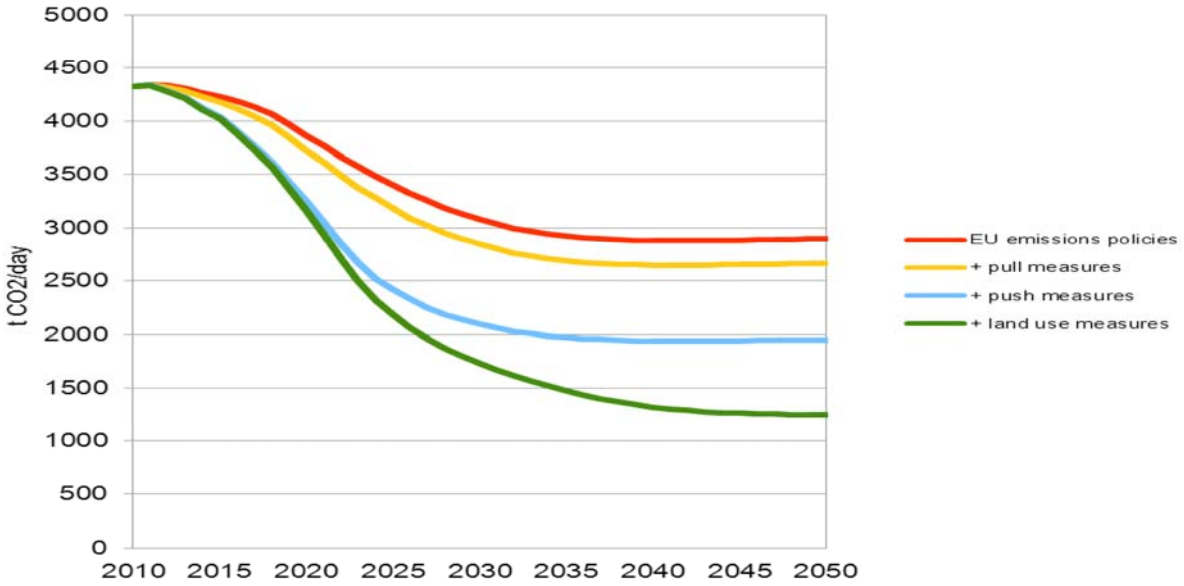
Barcelona Modal Share 2050



Barcelona co-benefit analysis 2050

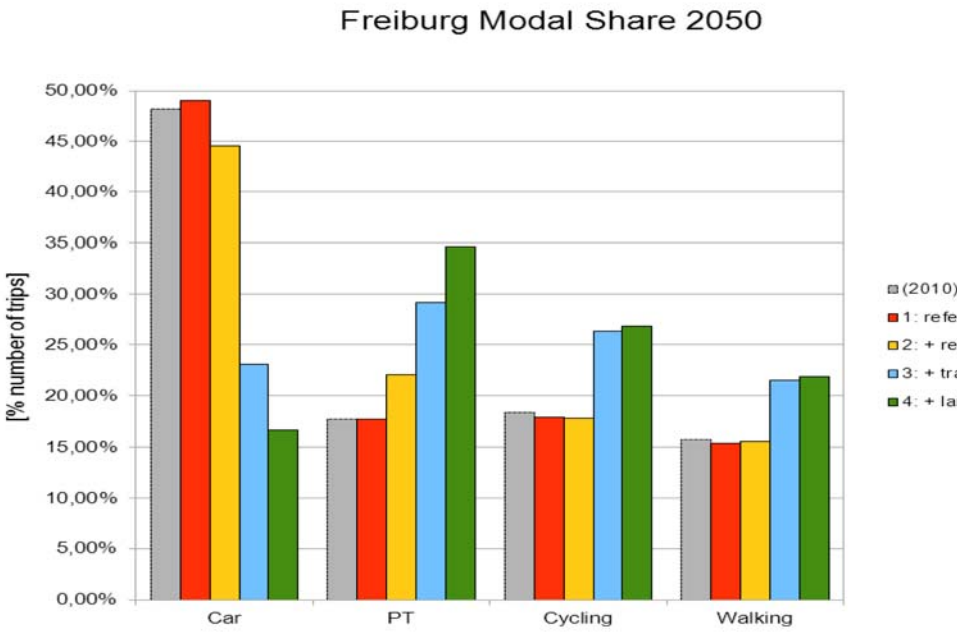


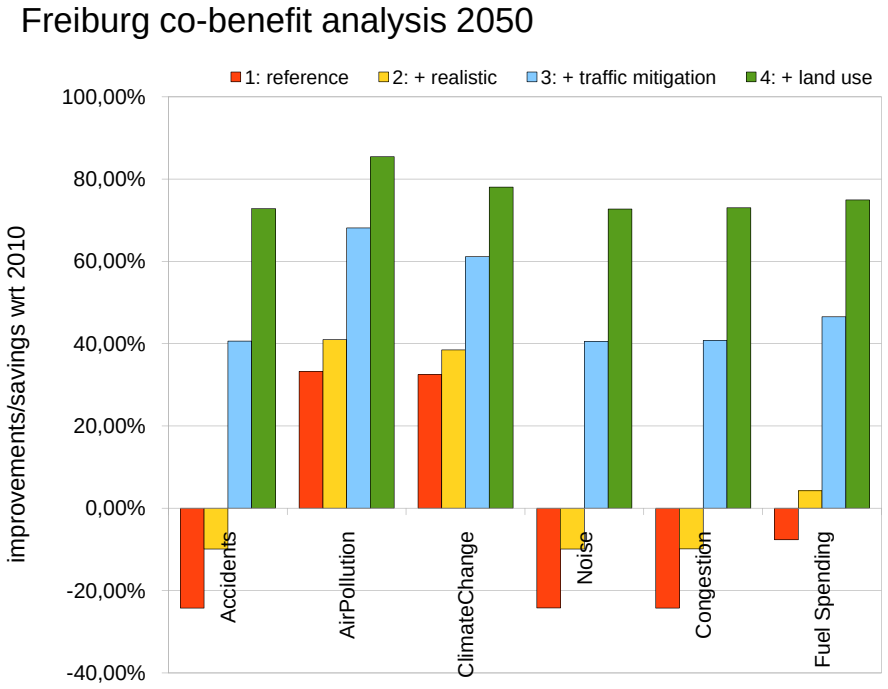
Barcelona transport CO2 emission

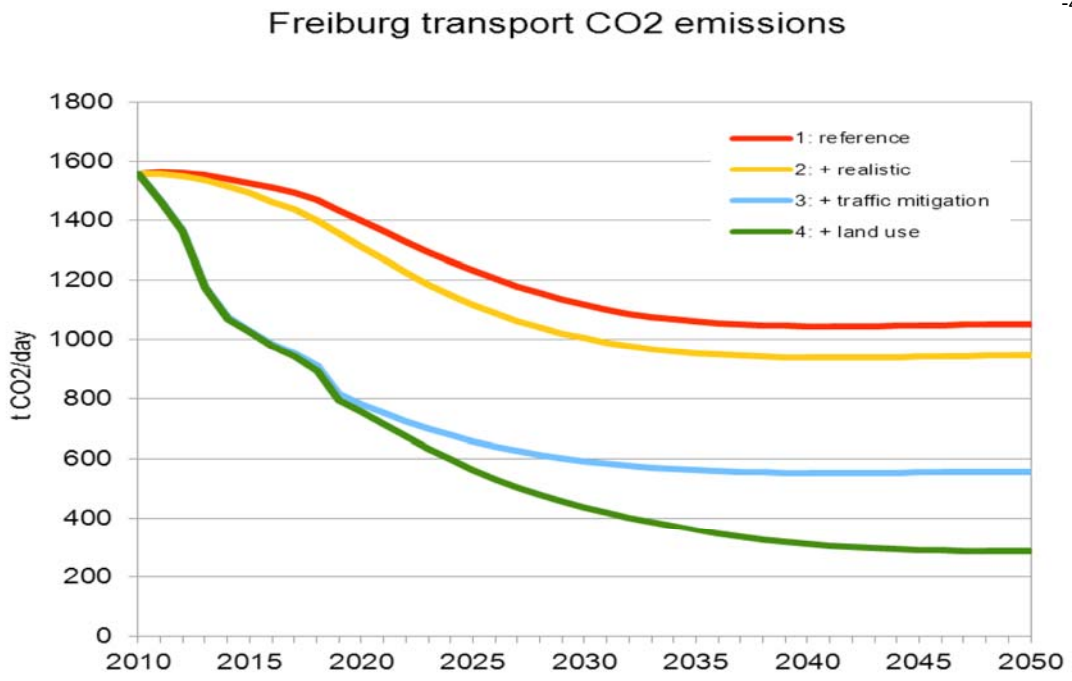


- All policy dimensions contribute
- Being nice is not enough → push needed
- Land-use for the long-run

Source: Mühlhoff & Creutzig, project report for BCN





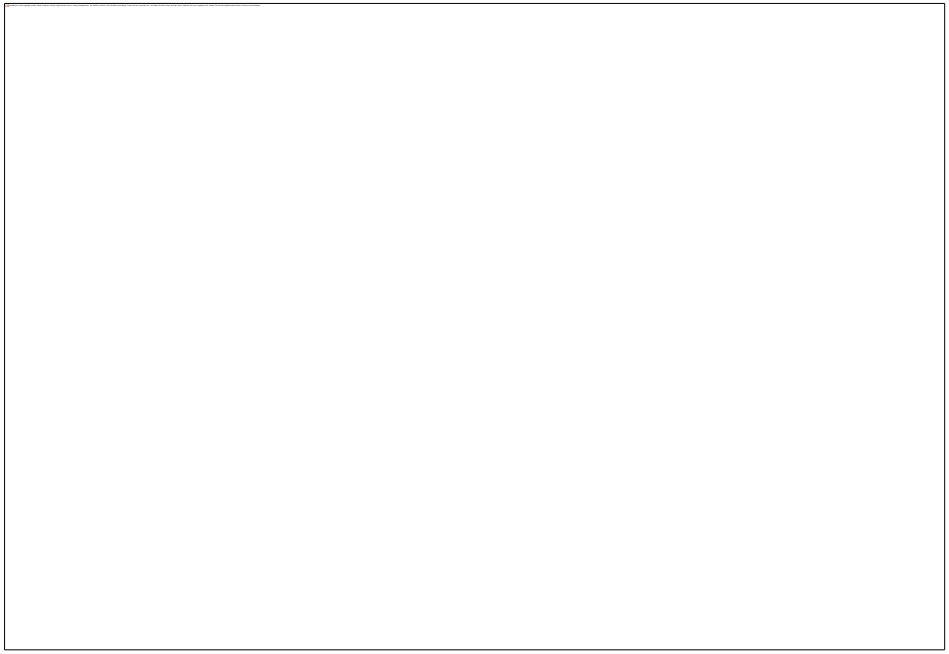


Comparison:

- Cars: FR>BCN
- FR smaller → more cycling for commuting
- BCN higher walking

Source: Mühlhoff & Creutzig, project report for Freiburg

Barcelona: land-use and fuel spending



Scenario:

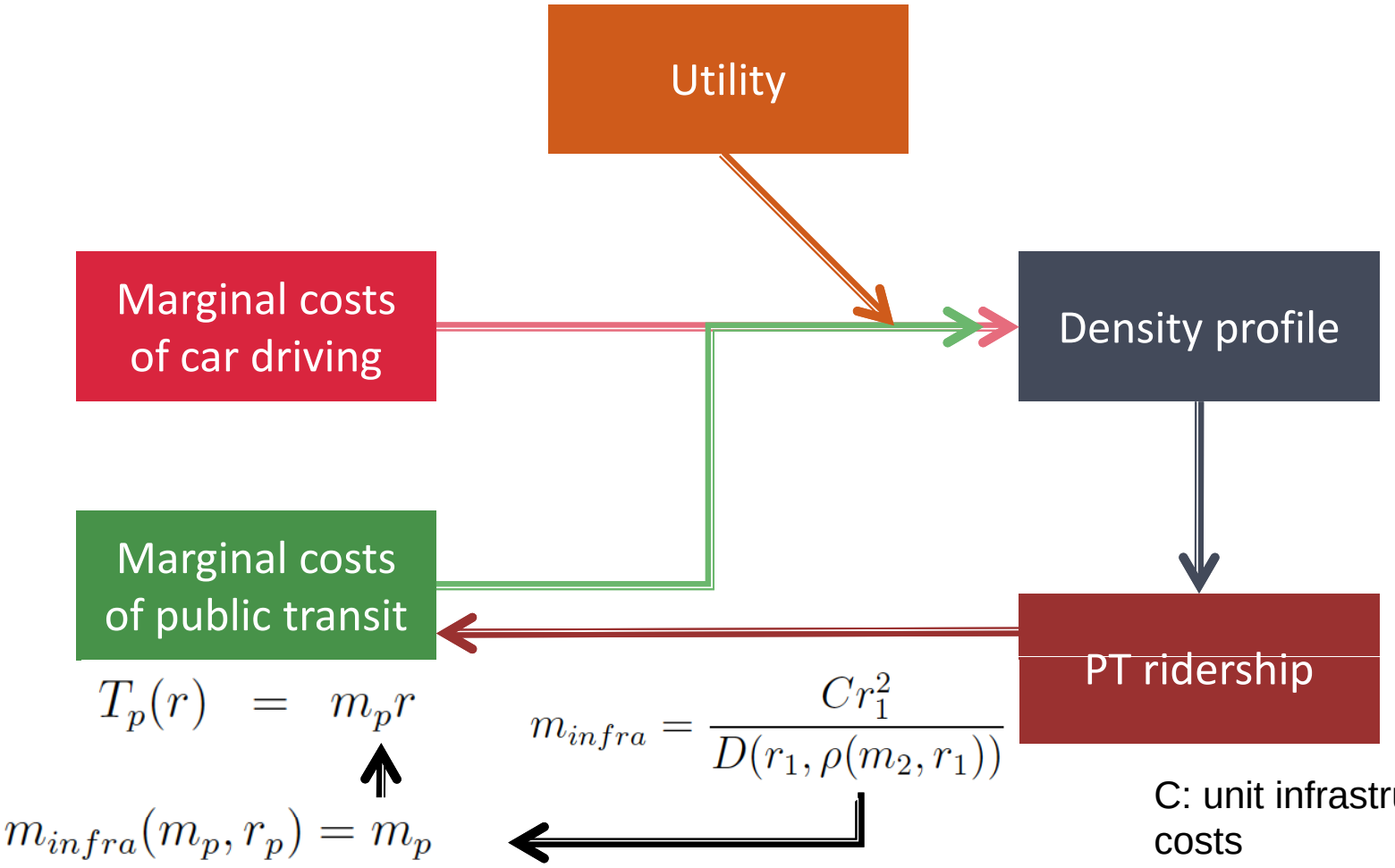
- improvement of urban and regional public transport
- extension of bicycle infrastructure
- population increase by ~20%
- 1% annual increase in fuel price

Land-use policy allows for total reduction in distance demand ➔ fuel expenditure savings

An economist's note

How to genuine transport policies impact urban form?

Abstract economic model: Endogenize public transit



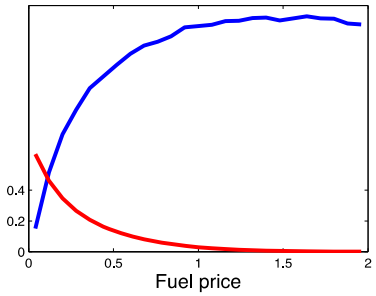
C: unit infrastructure costs
D: total km driven in PT

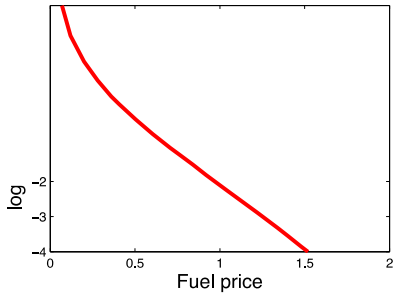
Fuel prices as systemic factor

Modal share and urban form changes non-linearly with fuel price.

Total transport distance and costs go down.

Rent costs a little bit up, and land consumption decreases a lot!





Felix Creutzig (2011). Optimal public transit. Working paper.

Conclusions

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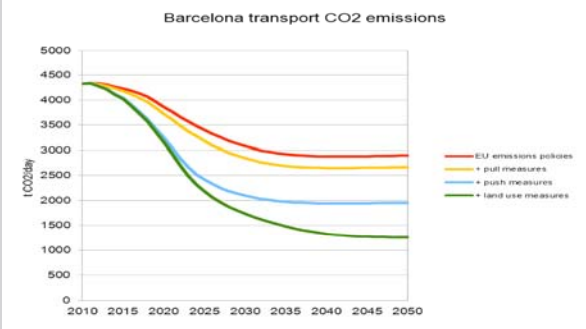
- One goal → co-benefits!
- One policy → policy packages
- Understand the impact of pricing on urban form!



Stakeholder interviews

Evaluation

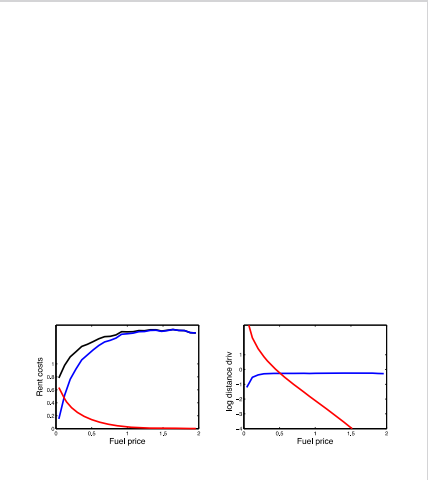
Scenarios

Key characteristics

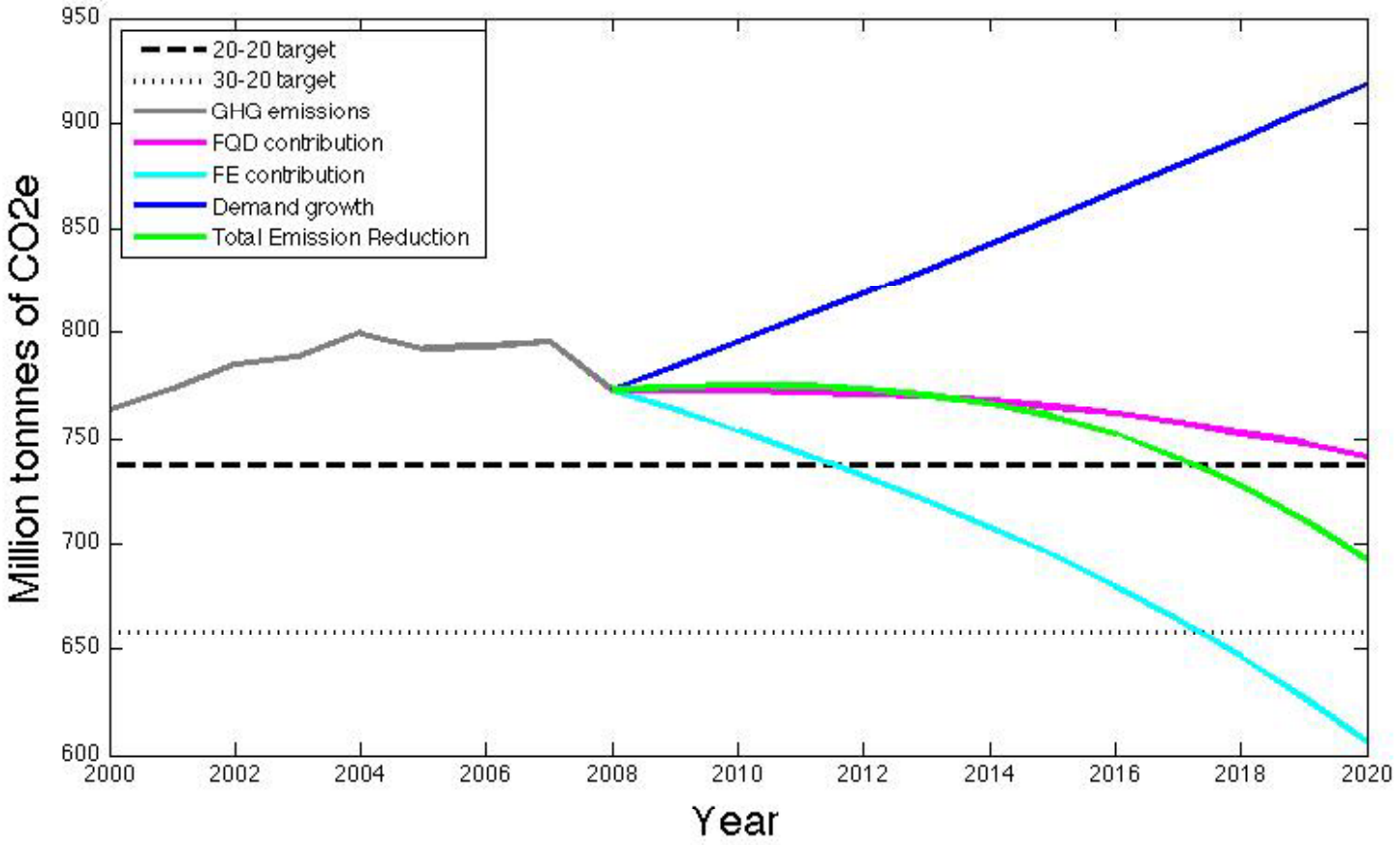
Intertemporal

Capacity

Scales



EU transport policies - 2020



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Endogenize public transit

Maximize:

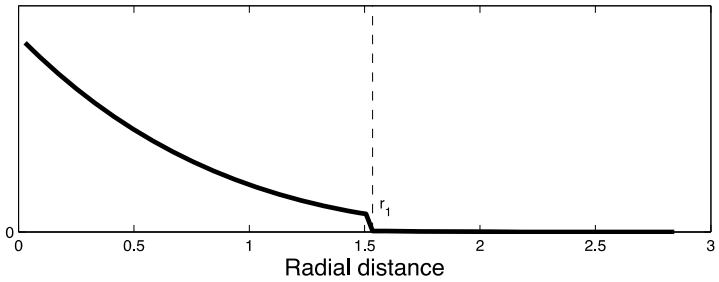
$$L(m_c) = \max_{m_p, r_p} u(m_p, r_p) + \lambda(m_p - m_{infra})$$

Hence, the first order conditions are:

$$\begin{aligned} \frac{du}{dm_p} + \lambda(1 - \frac{dm_{infra}}{dm_p}) &= 0 \\ \frac{du}{dr_p} - \lambda\frac{dm_{infra}}{dr_p} &= 0 \ . \end{aligned}$$

Felix Creutzig (2011). Optimal public transit. Working paper.

Non-continuity in urban form



Transport costs increase beyond PT radius.

But rent costs increase.

As reflected in urban form.

Felix Creutzig (2011). Optimal public transit. Working paper.