Co-Benefits and Path Dependence in Urban Sustainable Transport

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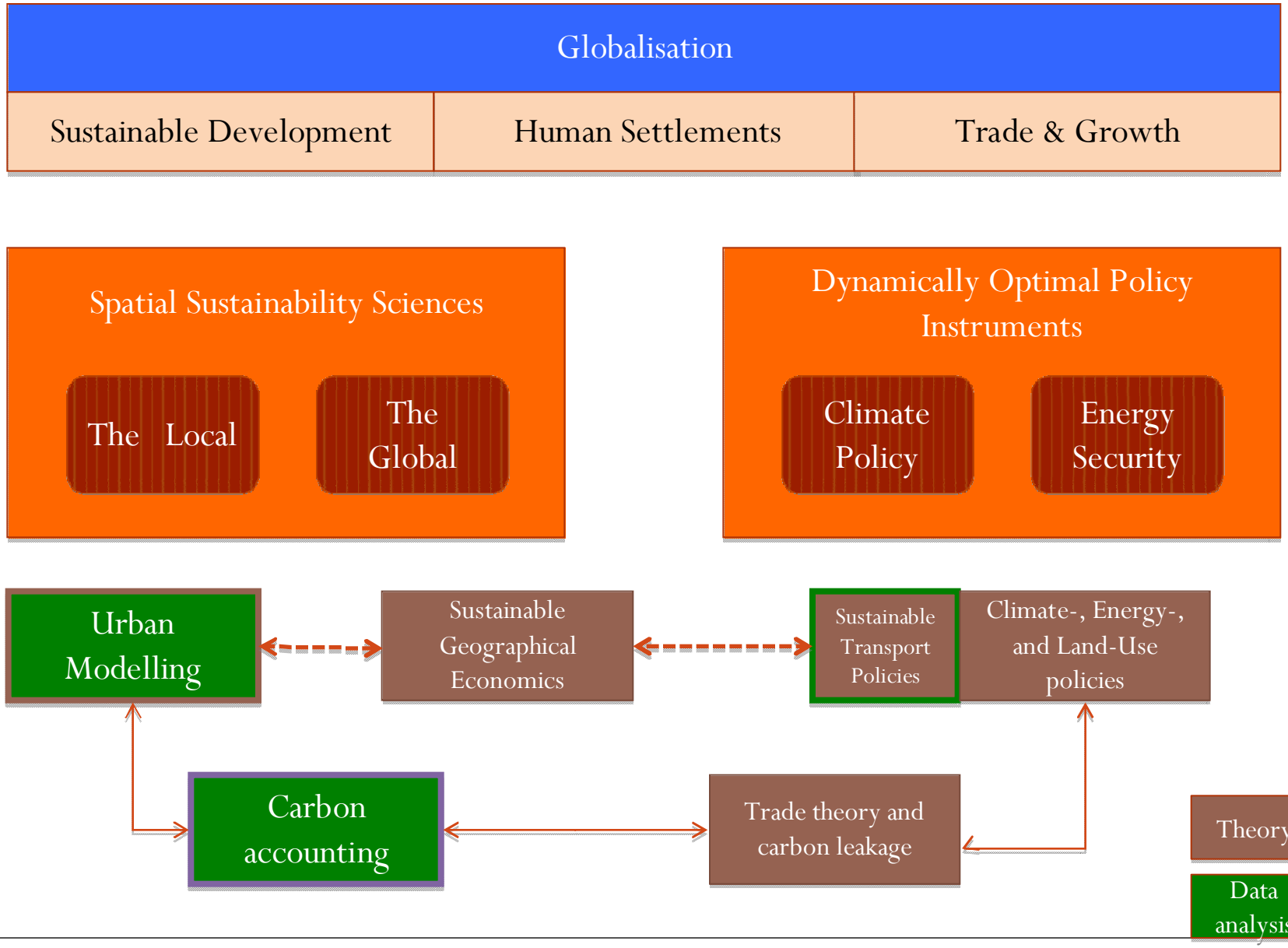
Economics of Climate Change



Climate & Transport Projects

Review of International Climate Transport Policies

- How should regulation change with alternative fuels and technologies (e.g. electric cars) getting into the market?
- Fuel efficiency regulation: Switch from gCO2/km to MJ/km
- Low carbon fuel standards: include life cycle accounting

One planet mobility

- Develop decarbonization scenarios for 5 European cities
  - Malmo
  - Freiburg
  - Sofia
  - Barcelona
  - Lille
- Co-Benefit approach
- Sponsored by WWF

Sustainability

Definition:

- Meeting the needs of the present without compromising the ability of future generations to meet their own needs

World Commission on Environment and Development, 1987; Norgaard 1994; Daly 2007; Costanza and Daly 1992

- How to operationalize this?

Economists: Genuine Savings

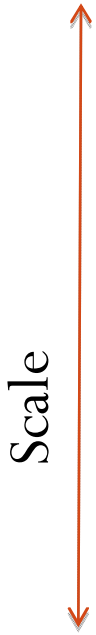
$$W_t = \int_t^{\infty} U(C_t) e^{-\delta(\tau - t)} d\tau$$

$$\frac{dW_t}{dt} = p_t \bullet Z_t = GS_t$$

Well-being is sustained, if genuine savings are positive.

Sustainability of urban transport

Environment | Equity | Economy



Sustainability is a concept that defines system's boundaries broadly! → **wide scope**

One does not want to optimize one aspect while not considering other dimensions (including soft, immeasurable ones) and the long term consequences.

Co-Benefits of Sustainable Transport

	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

Bottomline 1:

Use a variety of indicators to cover different scales, and different dimensions of sustainability.

The temporal aspect of sustainable urban transport

	Environmental	Social = Equity + Public Health	Transport + Economic Implications
Global citizen	CO2 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			

Bottomline 1:

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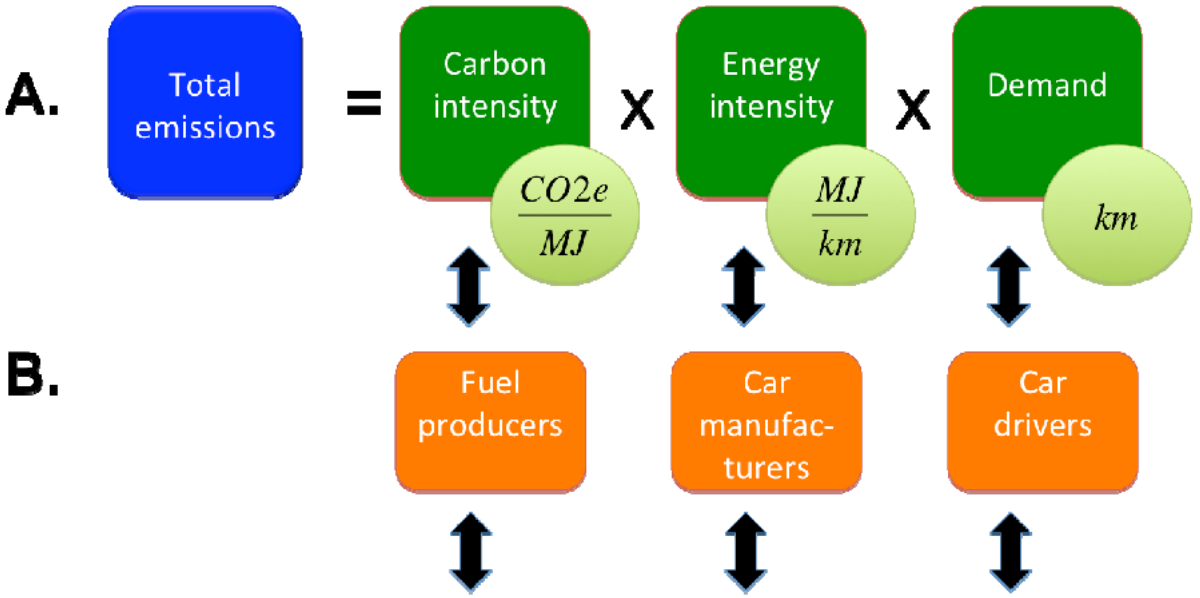
Bottomline 2:

A suggestion - use GHG abatement and resilience of accessibility as proxies for the intertemporal aspects of sustainable urban transport

Paradigm shifts

Mobility	→	Accessibility
Project approach	→	Holistic in time and space
GDP	→	Life Quality

International climate policies for transport



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

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

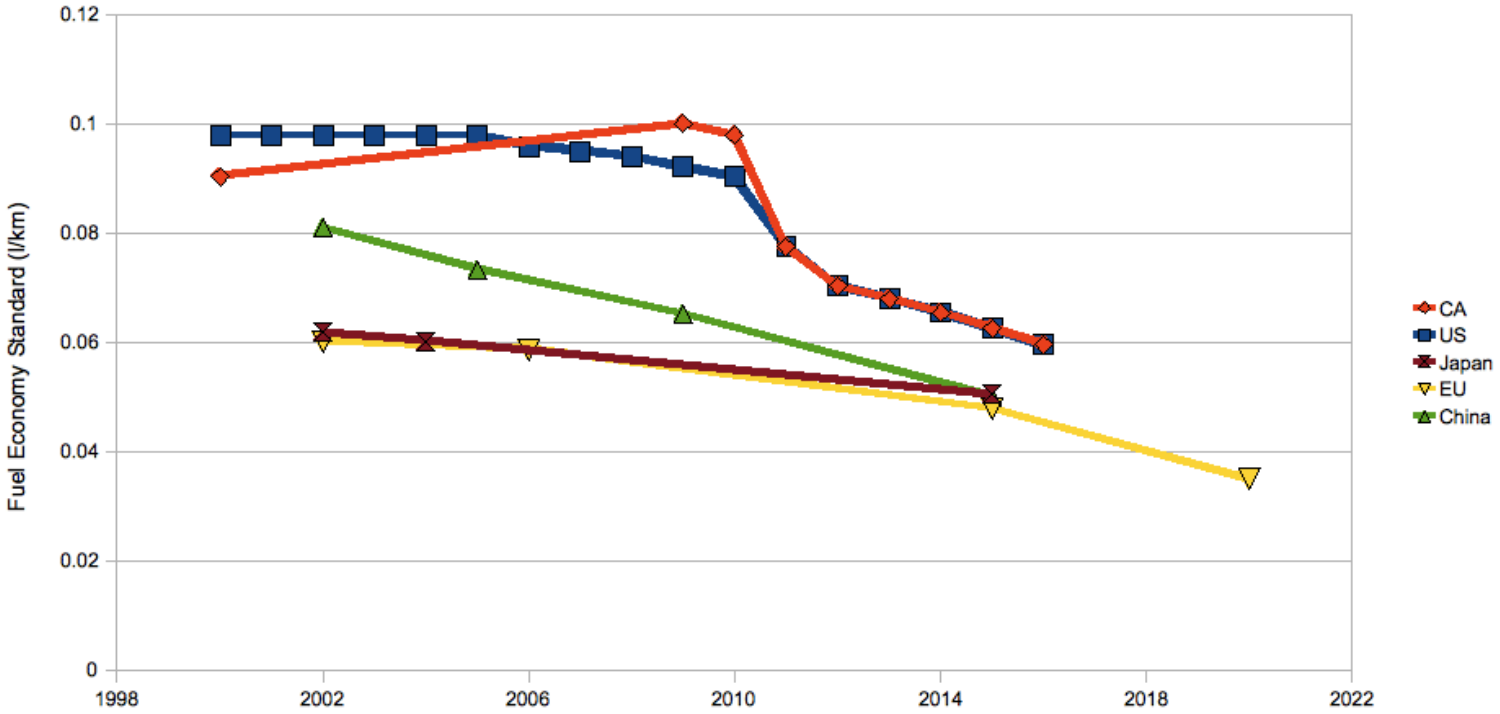
- Fuel efficiency regulation (EC) No 443/2009
  - 2005: 167gCO2/km
  - 2015: 130gCO2/km
  - 2020: 95gCO2/km
- Fuel quality directive, Fuel Quality Directive (EC) COM-2007-18
  - 2020: 6% less CO2e-intensity relative to 2010 (e.g. via biofuels)
  - 2% by electric cars and CCS (?)
  - 2% by CDM (?)
- Transport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

Effects

- If instruments are fully effective: reduction of 11% expected
- Doubts on Fuel Quality Directive → only 4% contribution from FQD
- In the order of magnitude of the 2020 EU transport target
- Effect of Great Recession 2008-2010: additional 3% reduction in 2020.

Creutzig, F., Flachsland, C., McGlynn, E., Minx, J., Brunner, S., Edenhofer, O. (2010). CITIES: Car industry, road transport and an international emission trading scheme – policy options.

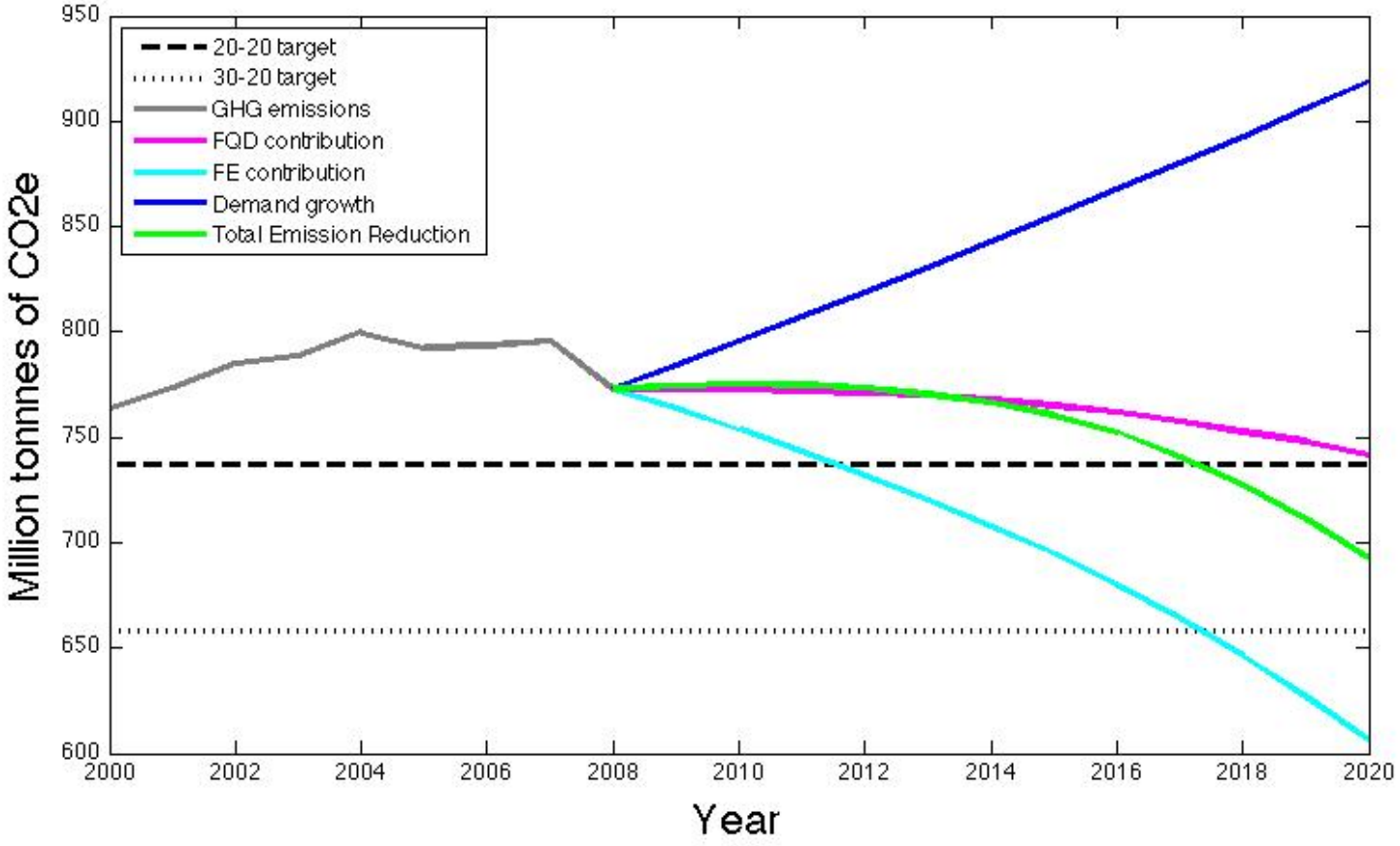
Fuel efficiency standards



Energy intensity standards (in l/km) extrapolated from current volume and GHG fuel efficiency standards.

Data adapted from An et al. (2007) with updated fuel efficiency regulations

EU transport policies - 2020



Source: Creutzig et al, submitted to Energy Policy

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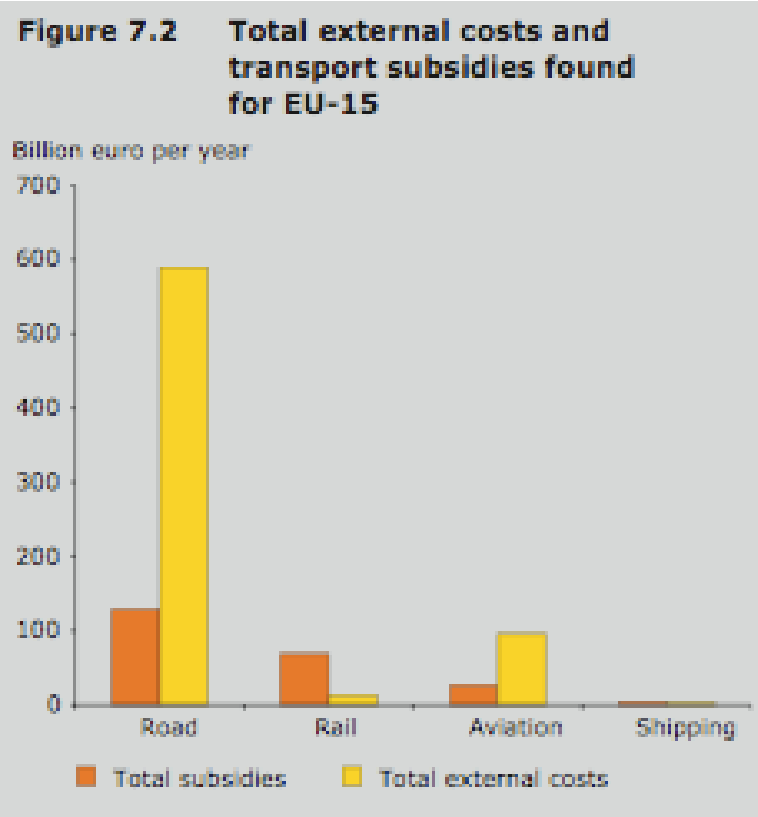
External costs of road transport



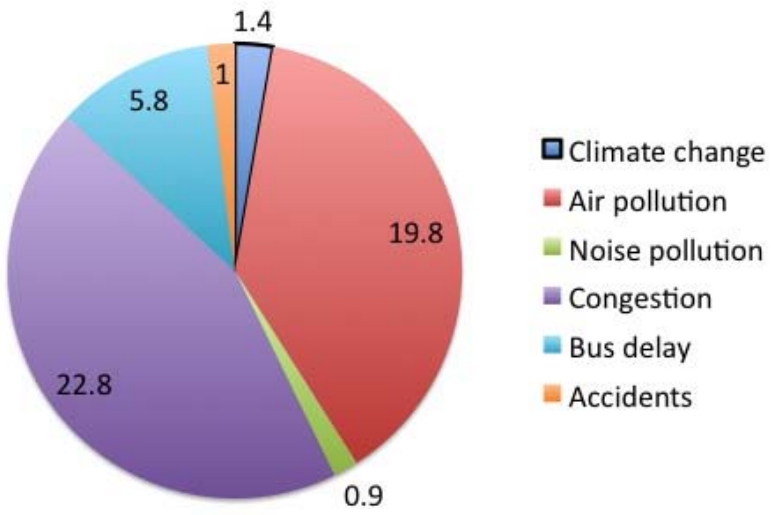
The numbers for subsidies comprise on-budget subsidies, annual public funding of infrastructure and exemptions from or reductions to fuel tax and VAT.

The numbers for external costs include costs of accidents, noise, air pollution, climate change, nature and landscape, up- and downstream processes and additional urban costs.

Quelle: EEA, 2007

Most social costs are not related to climate → other instruments

Example Beijing



F. Creutzig, D. He (2009) Climate change mitigation and co-benefits of feasible transport demand policies in Beijing. Transportation Research D 14: 120-131.

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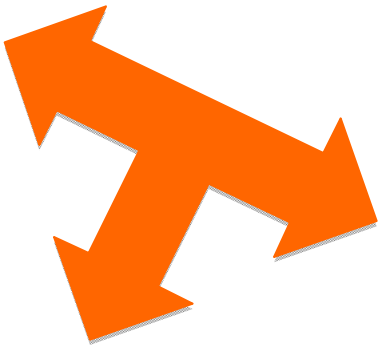
Synergies between urban transport policies

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

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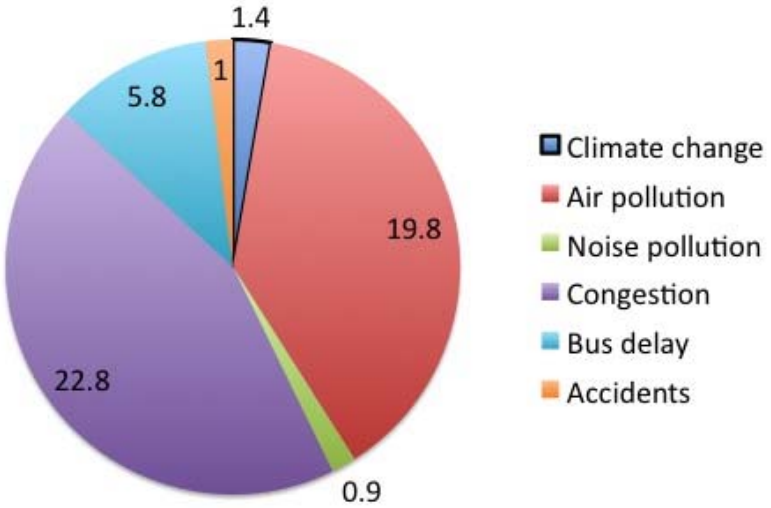
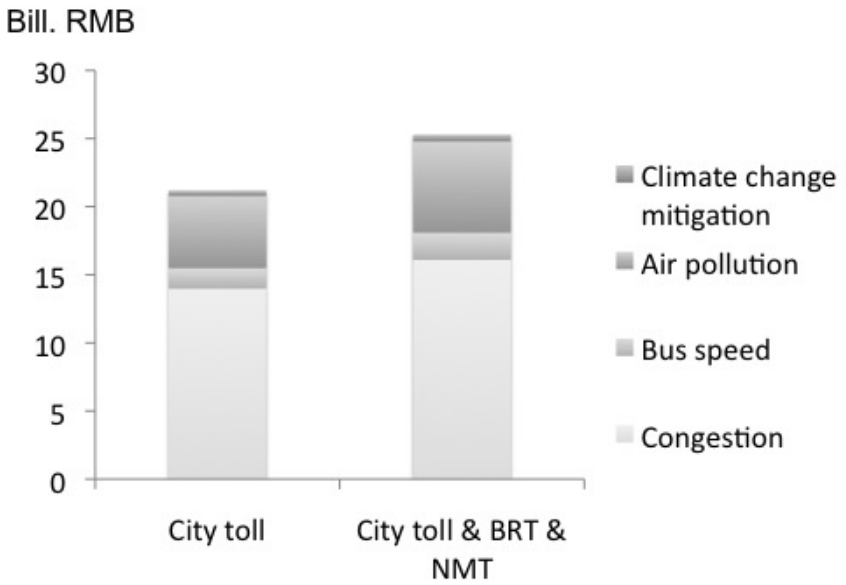


Effects of "Optimal" City Toll in Beijing



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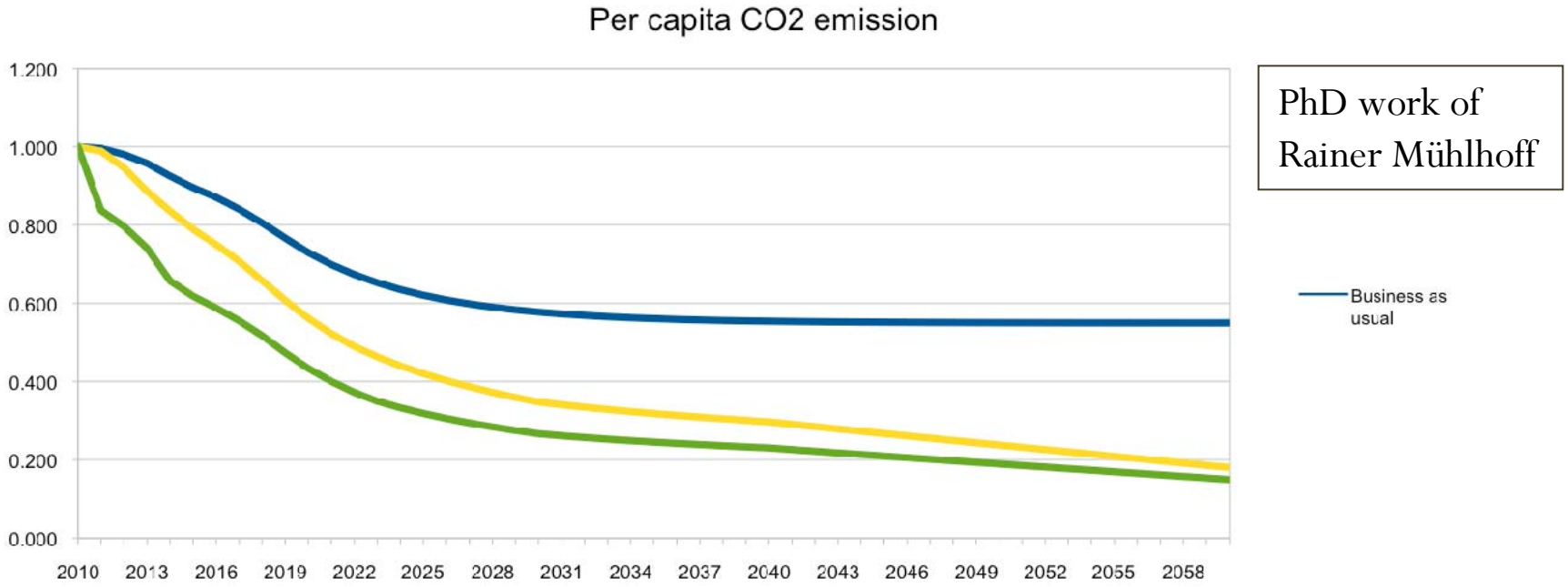
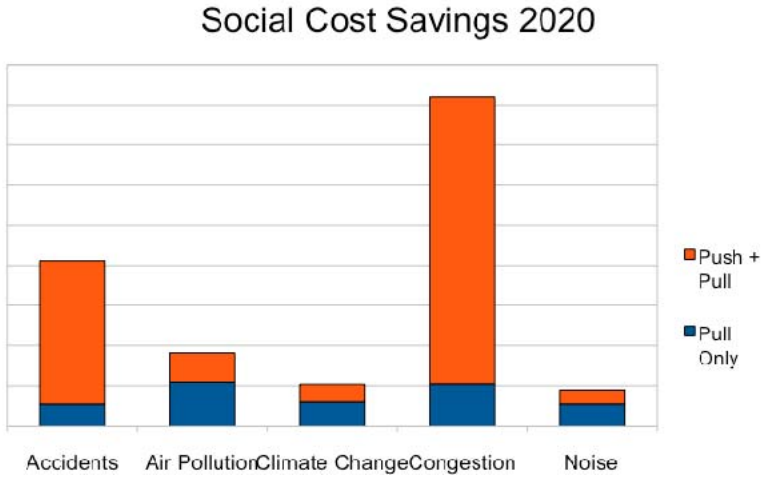
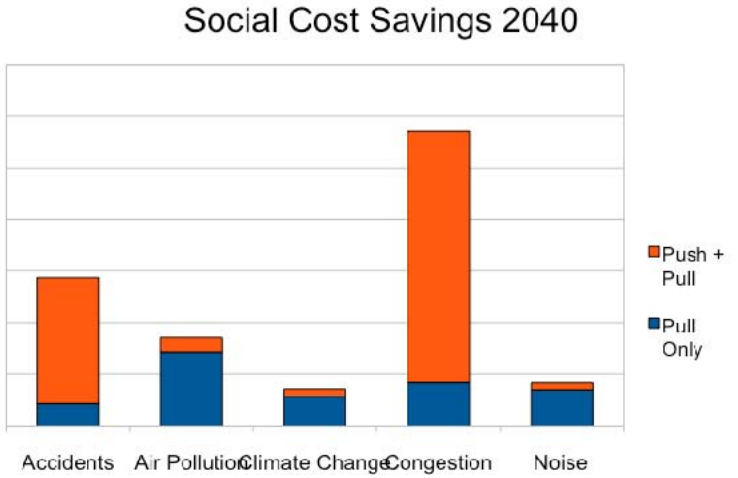
Case study: Malmö



PhD work of Rainer Mühlhoff





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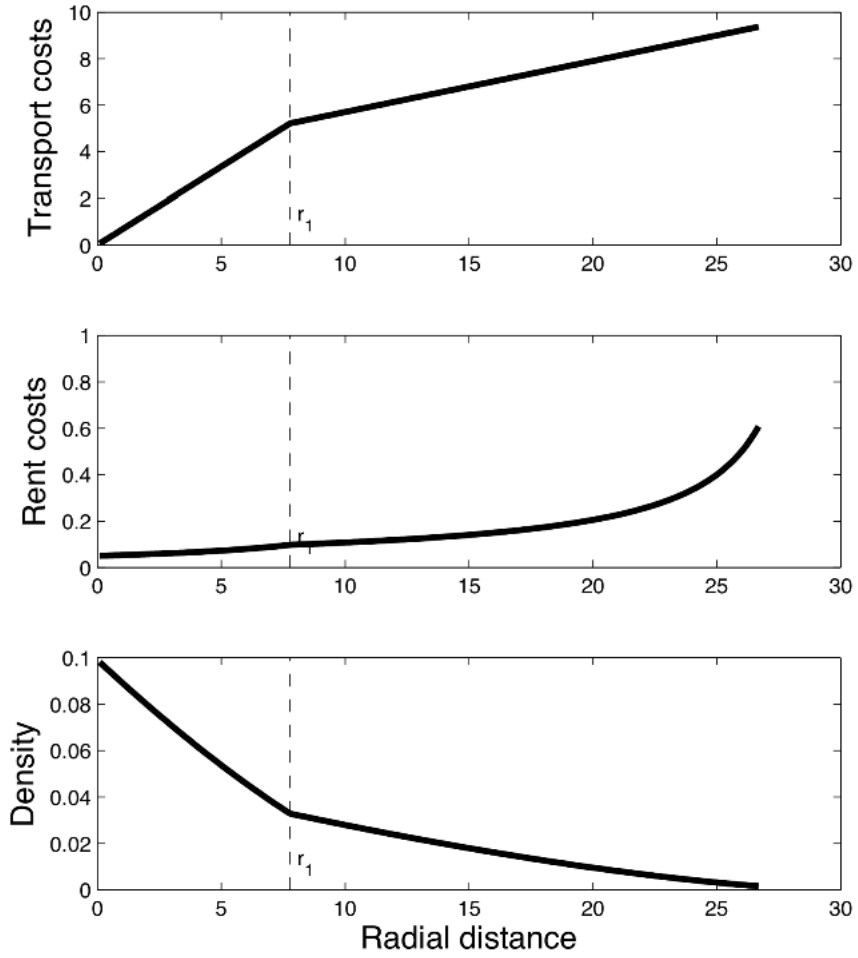
Ambitious 2050 CO_2 targets & sustainability improvements are possible.

Modeling public transport / car transport interrelationship



- Monocentric city
- 2 modes
- Public transport: high marginal costs
- Cars: Fix costs, but low marginal costs (fuel costs)

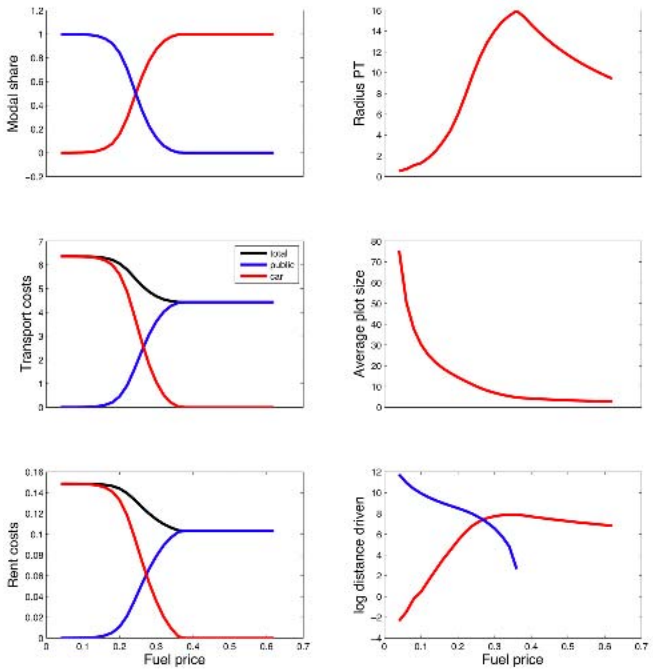
Fuel costs

→ Density profile

→ Ridership

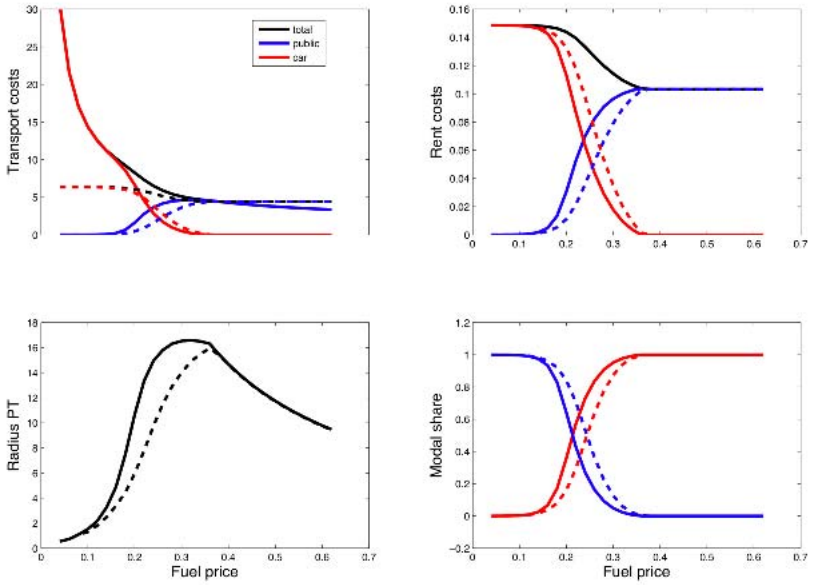
→ Marginal costs public transport

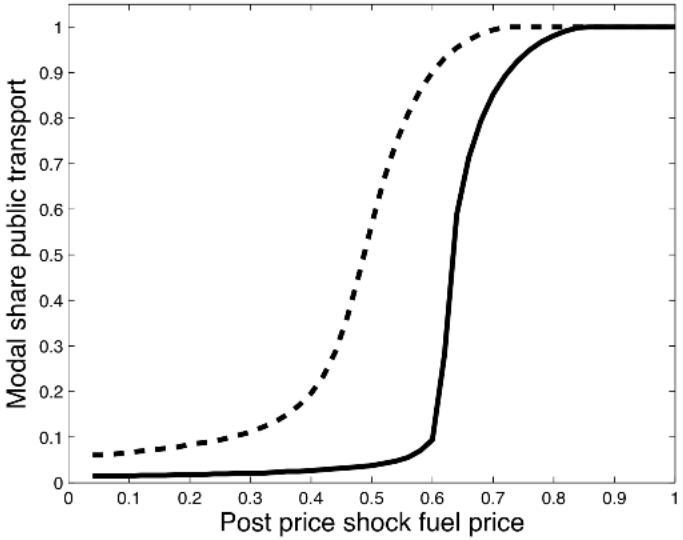
Two modal regimes



- For low fuel price, car transport is exclusive mode
- For high fuel price, public transit is exclusive mode
- In intermediate regime, the two modes coexist
- This is no linear relationship!

Path dependency after fuel price shock





After fuel price shock, high additional transport costs when starting from low fuel price level!

Accessibility from the urban fringe heavily impaired.

Modal share can be very different, depending on the pre-fuel price shock urban form!

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Bottomline 5:

Urban form exhibits path dependency → take into account!