SMART COMMUTING 3rd TRANSNATIONAL MEETING & Aktive Mobilität - Ringvorlesung
Vienna, Austria - June 6th 2018

Carbon consequences of active mobility

Università Iuav di Venezia / Prof. Silvio Nocera

OUTLINE

- What is active mobility?
- What is carbon dioxide?
- Dealing with CO_2 in transport planning: some basic concepts
- The economic issue of CO_2 in transport
- Planning active mobility for carbon purposes
- Conclusions and open issues
- Bottom lines

What is active mobility?

WHAT IS ACTIVE MOBILITY?

Active mobility is a form of transport of people and sometimes goods, that only uses the physical activity of the human being for the locomotion. The most known forms of active mobility are **walking** or **cycling**, though other and other non-motorised mobility means such as the **skateboard**, **kick scooter** or **roller skates** are also a form of active mobility.

The academical literature evidences that public policies which promote active mobility tend to increase health indicators by increasing the levels of physical fitness and reducing the rates of obesity and diabetes, whilst also reducing the consumption of fossil fuels and consequent particulates, nitrous oxide and carbon emissions

FEATURES OF ACTIVE MOBILITY

Focus:

Short/medium trips (urban)

Strongly depending from geography, latitude and travel culture

Often used in combination with transit means (i.e., bike-and-ride)

Health tourism (i.e. mountain tourism, transnational bike tourism)

Source: Polis (2014): Securing the benefits of active travel in Europe, pdf on line

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One of the benefits is connected to the reduction of carbon emissions

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What is carbon dioxide?

WHAT IS CARBON DIOXIDE?

- Carbon dioxide represents about 75% of the emissions responsible for global warming (minor shares are due to N_2O, methane CH_4, sulfur hexafluoride SF_6, hydrofluorocarbons HFCs)

- The CO_2 is harmful neither for the environment nor to health if it does not exceed the 350 ppmv (parts per million by volume) threshold. Over the last 150 years, its concentration is increased by 25%, going from about 288 ppmv to 390 ppmv from 1850 until 2010

- For this reason, the issue has had the adequate global attention from relatively few years (with the establishment of the IPCC - Intergovernmental Panel on Climate Change, 1988)

WHEN CARBON DIOXIDE BECOMES DANGEROUS FOR OUR HEALTH

- Fermentation is the process of converting grape juice into wine via yeast. It may take up to 10+ days to complete, depending on the grapes, the temperature of the must, and/or the wine style desired
- Fermentation produces carbon dioxide gas – about 40 times the volume of grape juice – whose released concentration fluctuates, reaching dangerous levels in the order of 500 parts per million by volume
- Carbon dioxide is a colorless and odorless gas having a heavier mass than oxygen; consequently it can displace oxygen or accumulate in undisturbed spaces or in low areas and at ground level. Employees working long shifts in the cellar during fermentation should be monitored for signs and symptoms of over-exposure to CO_2, such as dizziness, disorientation, or suffocation, as very high concentrations of CO_2 can lead to death by depressing the central nervous system.

MAIN IMPACTS OF CO_2

Impacts	
1. Sea level increase	• Costs for the implementation of protective measures; loss of wetlands and growth of barren areas • Rise of the chance of sea storms • Salt water in inland areas, high risks for the costal ecosystems • Economic and social effects for small islands' inhabitants and/or areas in contact with the sea • Migration level
2. Power consumption	• Increase of consumption during the summer due to air conditioning • Reduction of consumption due to winter heating
3. Impacts on agricolture	• Changes in temperature and rainfall • Changes in crops • Development of new cultivars and other aspects related to the irrigation system
4. Water consumption	• Changes in the percentages of precipitation and evapotranspiration • Changes in demand, influenced by climatic variations (rainfall, humidity) • Growth/increase of disparities and deficiencies in the most barren lands




MAIN IMPACTS OF CO_2

Impacts	
5. Impacts on health	• Increase of heat issues in summer and reduction of cold issues in winter • Social Damage to health caused by the previous points • Threats for people with low per capita income, especially in sub tropical regions
6. Impacts on ecosystems and biodiversity	• Changes in ecological productivity and biodiversity • Risk of extinction of vulnerable species • Risk for isolated systems, including the most specific ones (e.g. coral reef) • Ocean acidification and its impact on marine ecosystems • Impacts on gas streams in between the ocean and the atmosphere
7. Extreme weather condition	• Abnormal heat waves, droughts, floods, hurricanes, tropical cyclones
8. Extreme events	• Ice melting in the Arctic and Antarctic • Instability or loss of surface area of the Amazon rainforest • Change in the thermohaline circulation, Indian monsoons, reduction of the Sahara vegetation and so on

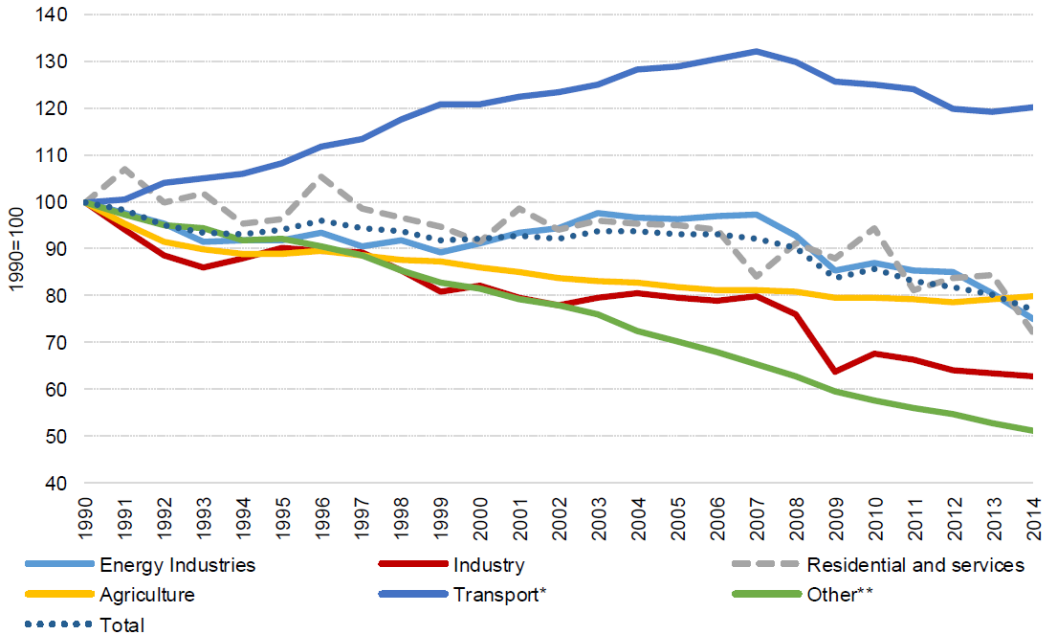
WHAT CARBON DIOXIDE IS NOT

Carbon dioxide does not belong to primary pollutants - injected into the atmosphere directly, such as:

- **carbon monoxide** (CO) - odorless, colorless, poisonous gas created by incomplete combustion (especially bad with older cars). It generates headaches, drowsiness, fatigue, can result in death
- **oxides of nitrogen** - (NOx, nitric oxide NO) emitted directly by autos, industry
- **sulfur oxides** (SO_x), SO_2 - sulfur dioxide, produced largely through coal burning and responsible for acid rain problem
- **volatile organic compounds** (VOCs), highly reactive organic compounds released through incomplete combustion and industrial sources
- **particulate matter** (dust, ash, salt particles), bad for your lungs

- Dealing with CO_2 emissions in transport planning: some basic concepts

GHG EMISSIONS FROM TRANSPORT



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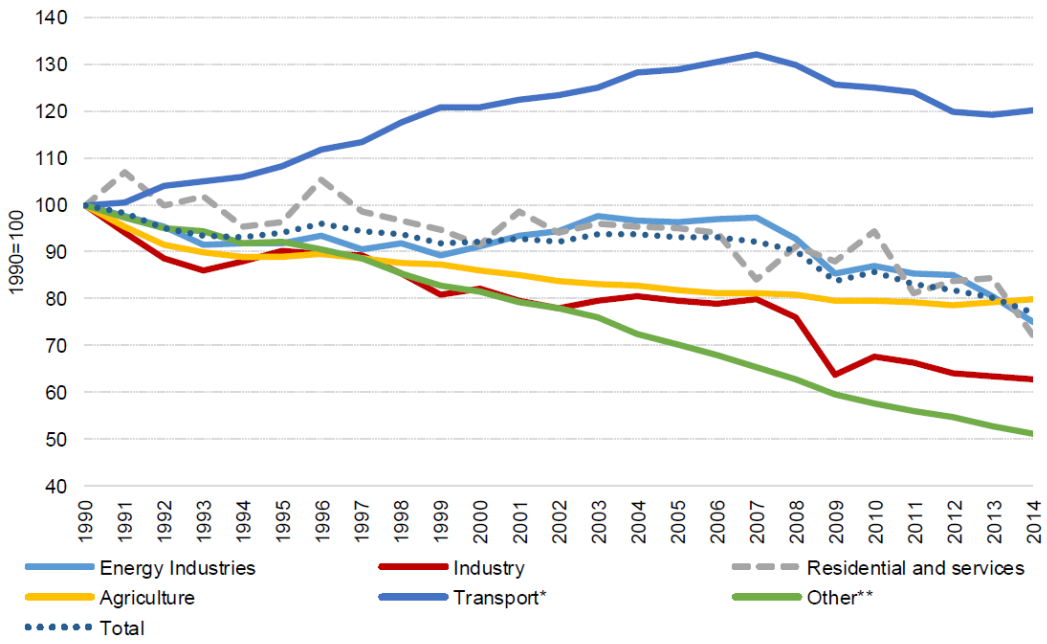
GHG EMISSIONS FROM TRANSPORT

- **Transport CO_2 emissions** have increased by 22% between 1990 and 2014, resulting the **only growing sector**



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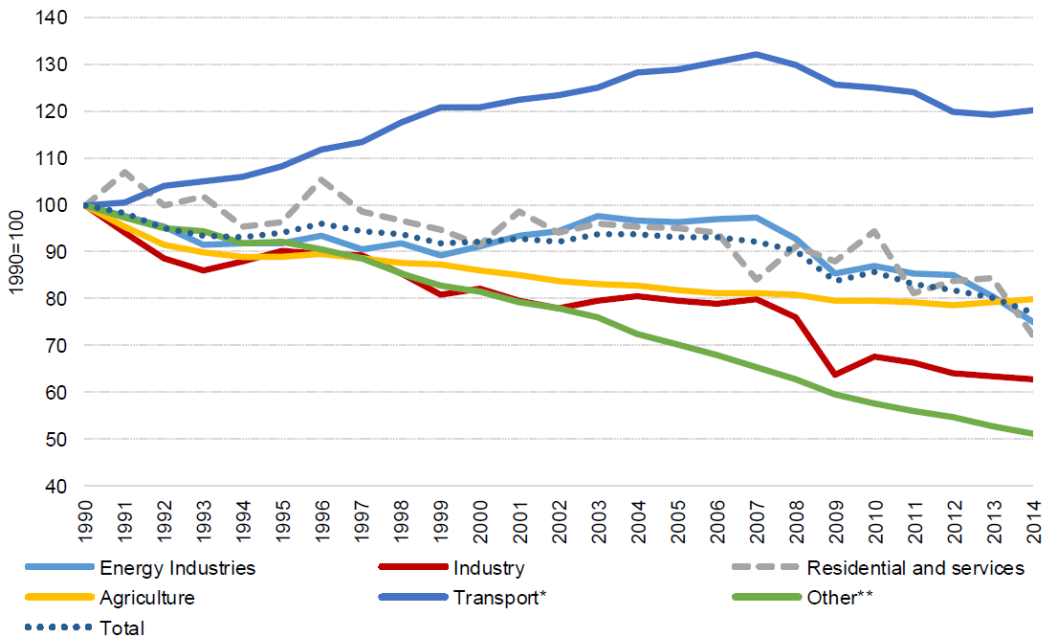
GHG EMISSIONS FROM TRANSPORT

- **Transport CO_2 emissions** have increased by 22% between 1990 and 2014, resulting the **only growing sector**

- In Europe, transport is responsible for roughly **26%** of **overall** CO_2 emissions. **The EU accounts for 11% of global CO_2 emissions**



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AVERAGE CARBON EMISSIONS FROM CARS

Country	Average CO_2 emissions from new passenger cars [g/km]
2000	**172,1**
2001	**169,7**
2002	**167,2**
2003	**165,5**
2004	**163,4**
2005	**162,4**
2006	**161,3**
2007	**158,7**
2008	**153,5**
2009	**145,7**
2010	**140,3**
2011	**135,7**
2012	**132,2**
2013	**126,7**
2014	**123,4**
2015	**119,5**
2016	**117,3**
2017	**116,8 (exp.)**
2018	**115,4 (exp.)**

Source: EEA (2017), data on-line

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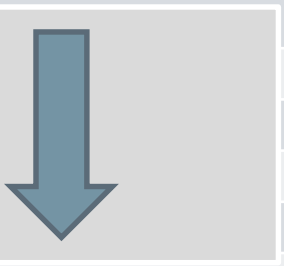

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2016 TOP CARBON EMITTERS

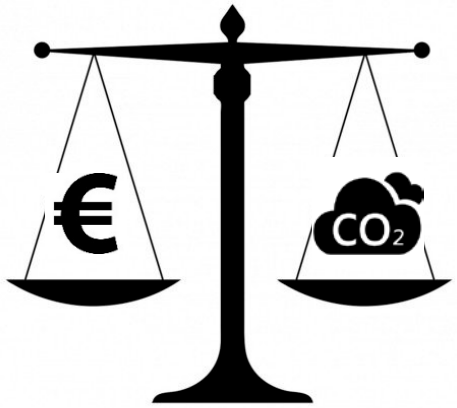
Year	Fossil fuel CO_2 emissions [kt] (2016)
China	10,432,751
U.S.A.	5,011,687
…	…
Italy (ranking 18th)	358,140
…	…
Austria (ranking 46th)	74,243

Source: EDGAR JRC (2017), data on-line

The economic issue of CO_2 in transport

ECONOMIC VALUATION

With the current methodologies, many difficulties in providing a fair economic valuation of CO_2 emission costs are unavoidable, due the numerous sources of economic and scientific uncertainty, such as the current level of emissions, the forecasting methodologies, the correlation emissions-concentration, temperatures and levels of emissions, the economic damage, the equity weight and the discount rate.



The range of the estimates, expressed in 2010 U.S. dollars, can go from -2.84 $/tCO$_{2eq}$ to 1,977 $/tCO$_{2eq}$ (Nocera et al., 2015), covering up to five orders of magnitude.

- Source: Nocera S., Tonin S., and Cavallaro F. (2015): The Economic Impact of Greenhouse Gas Abatement through a Meta-Analysis: Valuation, Consequences and Implications in Terms of Transport Policy. *Transport Policy* **37**: 31-43. doi: 10.1016/j.tranpol.2014.10.004

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In this context, the main problem is **how to estimate the impact of greenhouse gases** by providing an appropriate economic valuation of their unitary value

ZENO'S PARADOX

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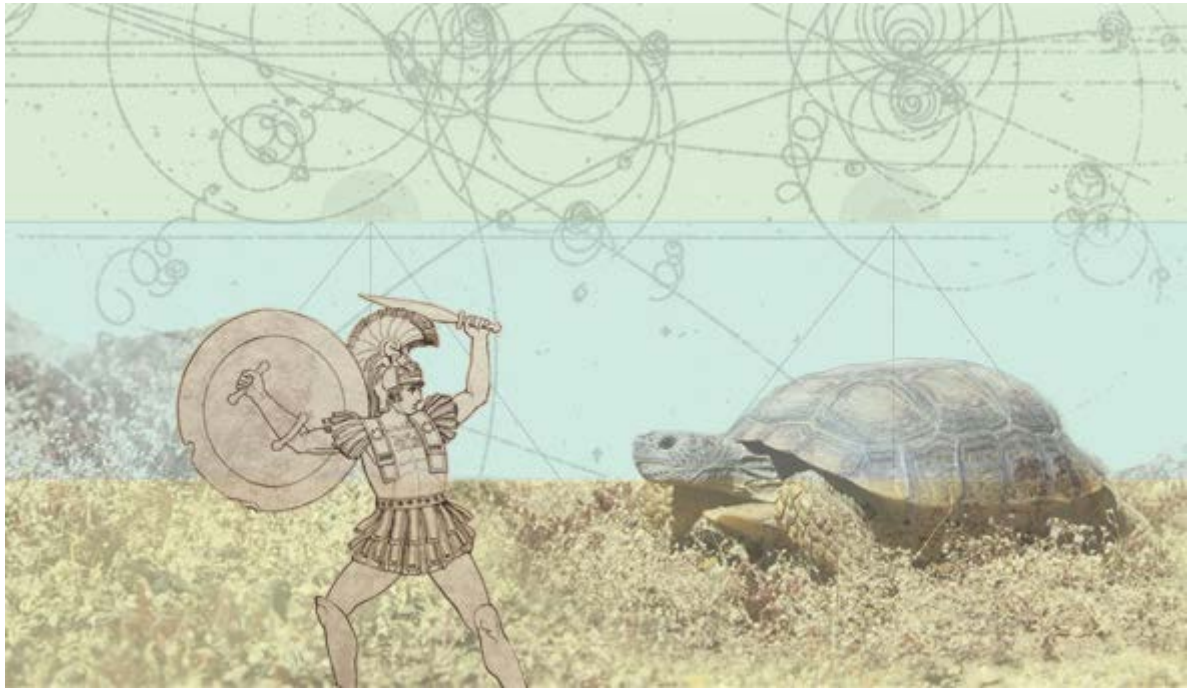
Achilles, the fleet-footed hero of the Trojan War, is engaged in a race with a lowly tortoise, which has **been granted a head start** and **never stops**



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Achilles' task initially seems easy, but he has a problem. Before he can overtake the tortoise, he must first catch up with it.

While Achilles is covering the gap between himself and the tortoise that existed at the start of the race, however, the tortoise creates a new gap.

The new gap is smaller than the first, but it is still a finite distance that Achilles must cover to catch up with the animal.

Achilles then races across the new gap. To Achilles' frustration, while he was scampering across the second gap, the tortoise was establishing a third, and so on..

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Conclusion/paradox: The upshot is that Achilles can never overtake the tortoise. No matter how quickly Achilles closes each gap, the slow-but-steady tortoise will always open new, smaller ones and remain just ahead of the Greek hero.

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Conclusion/paradox: a benefit is in question, even if deriving from a strategy universally acknowledged to be significantly helpful in terms of results! **(Note: for the paradox here to be held, the line of thought must be referred to the carbon emissions only)**

Conclusions & Open Issues

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- The challenge for transport planners will be in making sure that this changing is made to preserve the substance of the planning process, while at the same time taking care of the business effectively

Some literature

RECENT LITERATURE (2016-2018)

- Cavallaro F., Danielis R., Nocera S., Rotaris L.: Should BEVs be subsidized or taxed? A European perspective based on the economic value of CO_2 emissions. *Transportation Research Part D: Transport and Environment* (accepted for publication). doi: 10.1016/j.trd.2017.07.017

- Cavallaro F., Giaretta F. and Nocera S.: The Potential of Road Pricing Schemes to Reduce Carbon Emissions. *Transport Policy* (accepted for publication). doi: 10.1016/j.tranpol.2017.03.006

- La Notte A., Tonin S., Nocera S.: A screening procedure to measure the effect of uncertainty in air emission estimates. *Mitigation and Adaptation Strategies for Global Change* (accepted for publication). doi: 10.1007/s11027-018-9798-8

- Nocera S., Irranca Galati O., Cavallaro F. (2018): On the Uncertainty in the Economic Evaluation of Carbon Emissions from Transport. *Journal of Transport Economics and Policy* **52-1**: 68-94

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Bottom lines

BOTTOM LINE_1

BOTTOM LINE_2

Carbon consequences of active mobility

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