



**VELO-CITY  
SEVILLA 2011**  
EL CYCLO DE LA VIDA  
THE CYCLE OF LIFE  
MARZO 23-25



## Costs of Bicycle Traffic for the Overall Economy

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## Comparing economic effects of bicycle- and car-traffic in Vienna (2009)

### Contents

- General remarks, misconception of cycling
- Comparing car and bicycle traffic
- Cost components
- Future scenarios of cycling in Vienna
- Conclusions

#### Main source:

Trunk G. (2011) Overall economic comparison of bicycle- and car-traffic. A contribution to the sustainability debate. Master thesis, Institute for Transport Studies, University of renewable resources and life sciences (BOKU), Vienna (Gesamtwirtschaftlicher Vergleich von Pkw- und Radverkehr. Ein Beitrag zur Nachhaltigkeitsdiskussion. Masterarbeit am Institut für Verkehrswesen der Universität für Bodenkultur, Wien)

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A common misconception:  
cyclists are unkempt, poor and ignorant ...

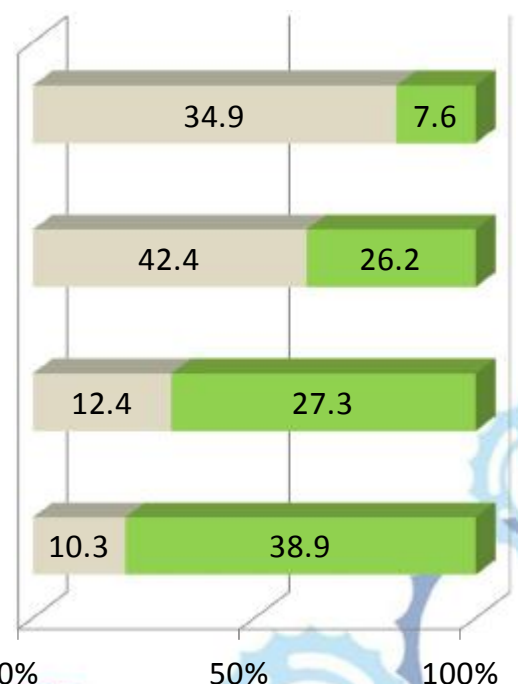


Source: Stückl A., Fahrradboten Kalender, "March" (2010)

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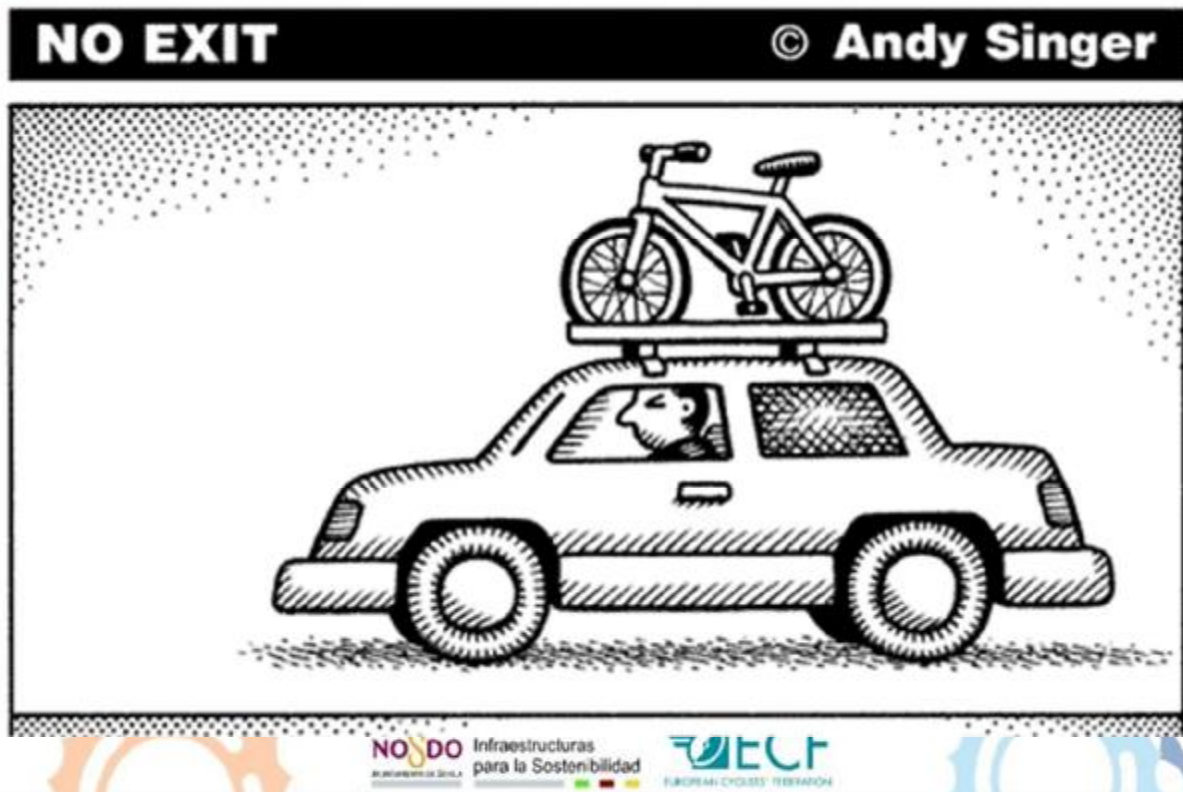
## Highest educational level of cyclists (city of Linz)

Highest educational level	Average citizens	„Active“ cyclists
Compulsory school only	34.9%	7.6%
Compulsory school and vocational training	42.4%	26.2%
Secondary education	12.4%	27.3%
University (tertiary education)	10.3%	38.9%



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Public perception: motorists “subsidise” bicycle traffic



Source: Andy Singer, <http://andysinger.com/>

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## Internal and external costs in transport

### Definitions:

- **Internal costs**  
paid by the respective user of this mode of transport
- **External costs**  
not paid by the individual transport user,  
thus paid by the general public

Both cost-components were identified and calculated in detail for both modes of transport (**car and bicycle**), then shown **per vehicle kilometre travelled**.

- **Costs-by-cause principle**  
who uses something pays for it  
(environmentally: “polluter pays principle”)  
(axiom of the eco-social market economy)

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## Costs for the overall economy: bicycle vs. car

Indicator [€-ct/km]	Internal		External		Total	
	Bicycle	Car	Bicycle	Car	Bicycle	Car
Health	-	-	89.89	-	89.89	-
Noise	-	-	-	-1.02	-	-1.02
Accidents	-6.29	-1.44	-8.42	-1.85	-14.71	-3.29
Running costs	-10.20	-38.30	-	-	-10.20	-38.30
Travel time	-66.53	-54.29	-	-	-66.53	-54.29
Pollutants	-	-	-	-0.63	-	-0.63
CO <sub>2</sub>	-	-	-	-0.85	-	-0.85
<b>TOTAL</b>	<b>-83.02</b>	<b>-94.03</b>	<b>81.47</b>	<b>-4.35</b>	<b>-1.55</b>	<b>-98.38</b>
DIFFERENCE bicycle-car	11.01		85.82		96.83	

## Health impacts

- The Austrian Ministry of Life (“Lebensministerium”) uses a calculator to assess health impacts of cycling, the “Health Economic Assessment Tool for Cycling” (HEAT)
- Basis: **mortality** (death rate) from a study in Copenhagen, (NOT morbidity rate).
- The **relative mortality risk of cyclists** is **0.72** (commuting at least three times a week per bicycle) compared to “non cyclists” (1.0)
- Takes also into account the accident risk and includes effects of the exposure to pollution during cycling
- **The “value of one persons’ life”: € 1,966,000**
- Cycling generates a **surplus of € 0.90 per kilometre cycled.**

## Noise immission costs

- Additive marginal costs of noise immissions (costs per extra car-kilometre)
- daytime 0.90 ct/car-km, night-time 1.64 ct/car-km, **weighted average noise costs** (over traffic flow) **1.02 ct/km**

## Road accident costs by accident severity

Specific internal and external cost-components

	internal		external		total
	[€]	[%]	[€]	[%]	
<b>Road deaths</b> (per killed person)	709,239	25	<b>2,127,717</b>	<b>75</b>	2,836,956
<b>Severely injured person</b>	134,290	40	<b>201,435</b>	<b>60</b>	335,725
<b>Slightly injured person</b>	9,634	40	<b>14,451</b>	<b>60</b>	24,085
<b>Property damage accident</b>	4,697	100	<b>0</b>	<b>0</b>	4,697

## Total yearly accident costs by accident severity

Total accident costs of car occupants and bicyclists (Vienna 2009)

	Car [million € per year]			Bicycle [million € per year]		
	internal	external	total	internal	external	total
Road deaths	5.0	14.9	19.9	0.8	2.1	2.8
Severely injured persons	16.8	25.2	42.0	9.4	14.1	23.5
Slightly injured persons	27.0	40.4	67.4	4.6	7.0	11.6
Property damage accidents	13.8	0	13.8	2.6	0	2.6
<b>Total [€ per year]</b>	<b>62.5</b>	<b>80.5</b>	<b>143.0</b>	<b>17.3</b>	<b>23.2</b>	<b>40.5</b>

## Kilometres travelled per year (car vs. bicycle)

Parameter	Car	Bicycle	Unit
Inhabitants of Vienna	1,692,067		--
Number of trips per person and day	2.86		--
average trip length (Viennese population)	7.5		km/trip
Bicycle: average trip length		3.9	
Car driver: percentage of trips (Viennese population)	25		% of modal split
Bicyclists: percentage of trips		4	
Car – mileage per year (Viennese population)	3,312		million km/year
Car – mileage per year (others)	718		
<b>Car – total mileage per year total</b>	<b>4,030</b>		
<b>Bicycle – total mileage per year</b>		<b>276</b>	million km/year

## Accident costs per kilometre (Vienna 2009)

	Internal [ct/km]	External [ct/km]	Total [ct/km]
Bicycle	6.29	<b>8.42</b>	14.71
Car	1.44	<b>1.85</b>	3.29

- **Accident costs are representing the risks of injury car occupants or cyclists are exposed to when travelling in Vienna**
- **This does NOT take into account the potentially high danger other traffic modes are exposed to by cars!**

## Vehicle running costs (€-cent per kilometre)

Vehicle	Average travel speed (door to door) [km/h]	Running costs per distance [ct/km]
Bicycle	15	<b>10.20</b>
Car	25	<b>38.30</b>

Calculation accounts for costs depending on vehicle kilometres travelled and vehicle operation time, such as:

- investment, interest payments and write off,
- maintenance and repairs,
- parking costs,
- fuel costs (energy).

## Travel time costs per hour (internal costs!)

Person's average travel time costs € 10.- per hour (9.98 €)

Trip purpose	Costs per hour [€/h]	Percentage of trips [%]
Business	30.-	6
Commuting	11.-	22
Education	8.-	9
Leisure	8.-	31
Shopping	8.-	26
Service	8.-	6
<b>Average</b>	<b>10.-</b>	<b>(100)</b>

## Travel time costs per hour → per kilometre

Time costs	per hour [€/h]	per kilometre [ct/km]
<b>Bicycle</b>	9.98	<b>66.53</b>
<b>Car</b>	9.98	<b>54.29</b>

Average time costs per vehicle-kilometre travelled calculated from:

- average travellers time costs (€ 9.98 per hour),
- average occupancy rate (1.36 persons per car, 1.0 per bike),
- average speed (25km/h car and 15 km/h bicycle),
- modal split of all trips (25% as car driver and 9% as car passengers).



## Pollution costs (car only) per unit and per kilometre

Pollutant	Volatile Organic Compounds VOH	Nitrogen Oxides NO <sub>x</sub>	Particulate matter PM <sub>10</sub>	Pollutants total
External costs [ct/km]	0.02	0.30	0.31	<b>0.63 [ct/km]</b>

- **Costs of CO<sub>2</sub>: 0.85 ct/km**  
(Average CO<sub>2</sub> emission: 170 g/km, 50 €/ton)

## Costs for the overall economy: bicycle vs. car

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<b>TOTAL</b>	<b>-83.02</b>	<b>-94.03</b>	<b>81.47</b>	<b>-4.35</b>	<b>-1.55</b>	<b>-98.38</b>
DIFFERENCE bicycle-car	11.01		85.82		96.83	

## Bicycle vs. car, costs in Mio. € per year (Vienna)

Indicator [Million € per year]	Internal		External		Total	
	Bicycle	Car	Bicycle	Car	Bicycle	Car
Health	-	-	247.7	-	247.7	-
Noise	-	-	-	-44.3	-	-44.3
Accidents	-17.3	-62.6	-23.2	-80.4	-40.5	-143.0
Running costs	-28.1	-1,665.2	-	-	-28.1	-1,665.2
Travel time	-183.3	-2,360.5	-	-	-183.3	-2,360.5
Pollutants	-	-	-	-27.4	-	-27.4
CO <sub>2</sub>	-	-	-	-37.0	-	-37.0
<b>TOTAL</b>	<b>-228.8</b>	<b>-4,088.3</b>	<b>224.5</b>	<b>-189.1</b>	<b>-4.3</b>	<b>-4,277.4</b>
<b>DIFFERENCE bicycle-car</b>	<b>-4,317.1</b>		<b>35.4</b>		<b>-4,281.7</b>	

[Vienna, status quo 2009], Source: Trunk G. (2011)

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## Future scenarios for cycling in Vienna

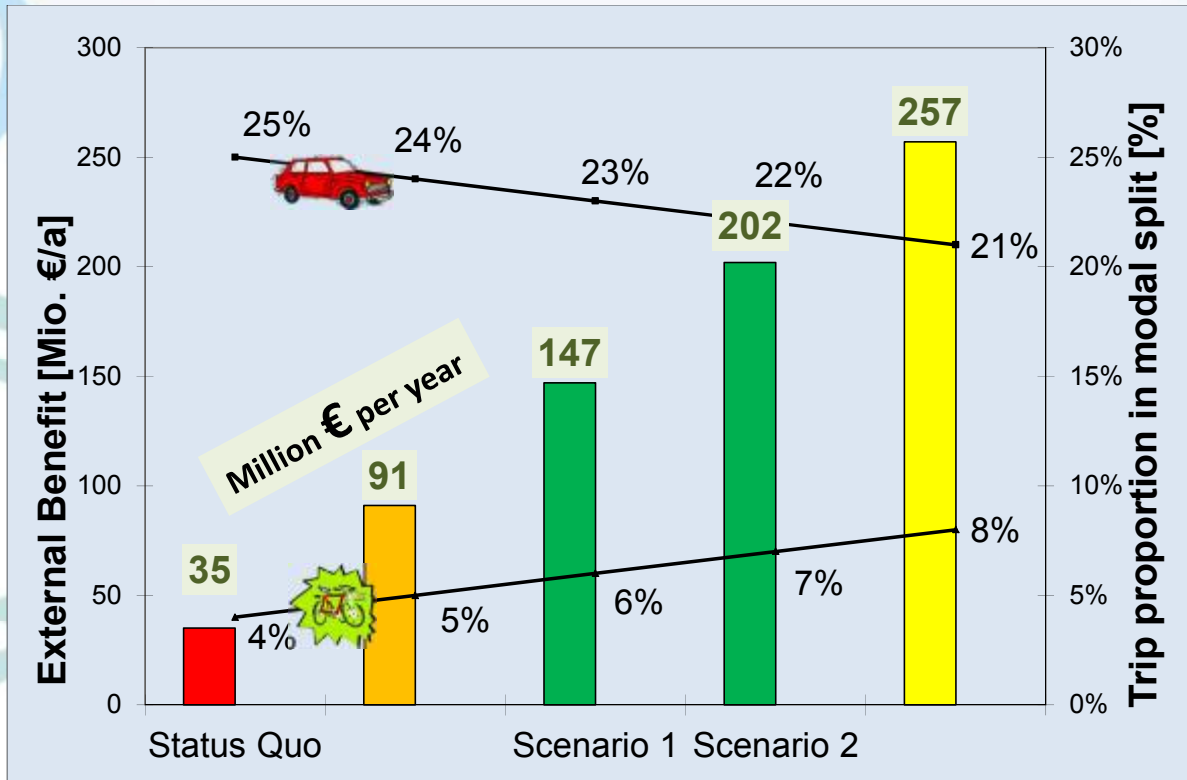
- 4% (5%) of all trips in Vienna are currently made by bicycle
- Targets in Vienna's "Masterplan Traffic" aim at 10% (8%)
- Two future scenarios of increased bicycle use were calculated
- Estimations:
  - half of the additional trips will come from trips previously made by car,
  - only car trips with the average trip length of bicycle trips (3.9km) are shifted
  - Necessary investments: increase bicycle facilities & campaigning

	Status quo	Scenario 1	Scenario 2
<b>Proportion of bicycle trips</b>	4 %	6 %	7 %
<b>Proportion of car trips</b>	25 %	23 %	22 %

Source: Trunk G. (2011)

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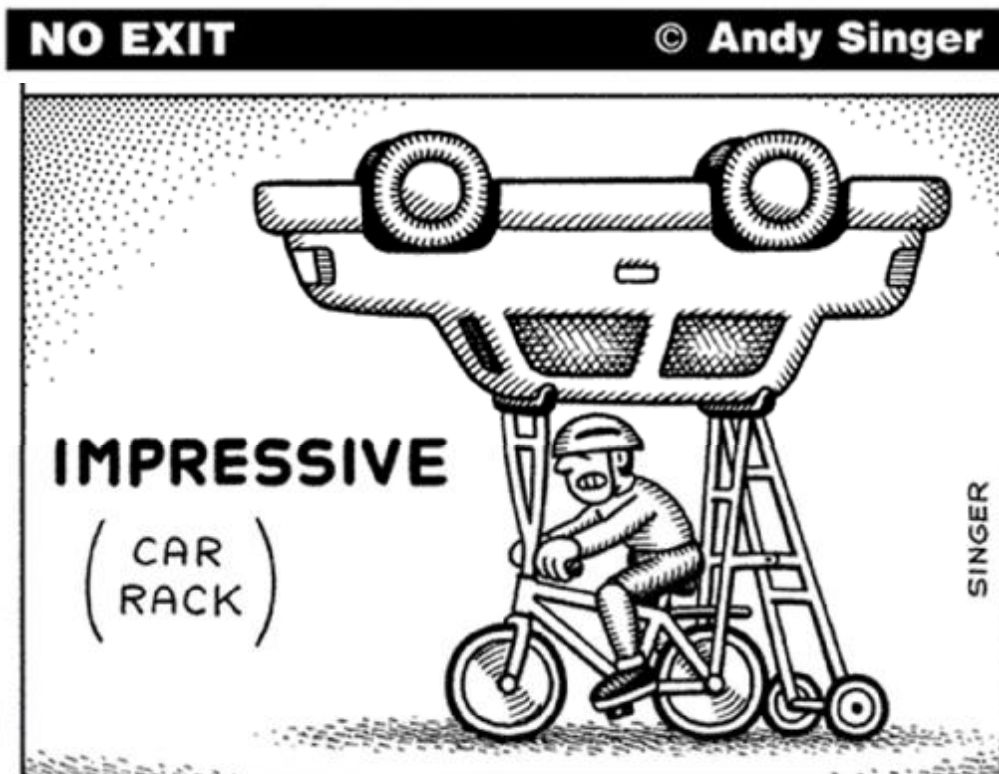
## Changing modal split – resulting external benefit



Source: Trunk G. (2011)

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## Perception and reality ...



Source: Andy Singer, <http://andysinger.com/>

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## Next steps:

Internalising external costs,  
Getting more bicycles into our cities and  
Creating space for people ...



**Thank you for your attention**

Source: City of Münster, Press Office

car

bus

bicycle

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**NO&DO** Infraestructuras  
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## References

**Calculations, main source:** Trunk G. (2011) *Gesamtwirtschaftlicher Vergleich von Pkw- und Radverkehr. Ein Beitrag zur Nachhaltigkeitsdiskussion. Masterarbeit am Institut für Verkehrswesen der Universität für Bodenkultur, Wien*

**Viennese traffic data:** Magistratsabteilung 18 (2008): *Evaluierung des Masterplans Verkehr 2003*, Wien

### Sources for Indicators:

**Health:** Andersen L.B., Schnohr P., Schroll M., Hein H.O. (2000) All-Cause Mortality Associated With Physical Activity During Leisure Time, Work, Sports and Cycling to Work. *Archives of Internal Medicine* 160(11): 1621-1628

Lebensministerium (2009) *Wirtschaftliche Evaluierung von Verkehrsinfrastruktur und Strategien*, Wien

**Infrastructure:** Magistratsabteilung 28 (2010) *schriftliche Auskunft der Magistratsabteilung 28*, 29.4.2010

**Noise:** Banfi S., Doll C., Maibach M., Rothengatter W., Schenkel P., Sieber N., Zuber J. (2000) *External Costs of Transport, Accident, Environmental and Congestion Costs in Western Europe*, Zürich / Karlsruhe

**Pollutants, CO2:** FSV (2010) *RVS 02.01.22 Entscheidungshilfen für Kosten-Nutzen-Untersuchungen im Verkehrswesen*, FSV Wien

HBEFA (2004) *Handbuch Emissionsfaktoren des Straßenverkehrs, Ver. 2.1*, Bern, Zürich, Heidelberg, Graz

**Running costs, travel time:** FSV (2010) *RVS 02.01.22 Entscheidungshilfen für Kosten-Nutzen-Untersuchungen im Verkehrswesen*, FSV Wien

**Accidents:** Kuratorium für Verkehrssicherheit (2010) *Kuratorium für Verkehrssicherheit auf <http://www.kfv.at>*, 6.5.2010

BMVIT (2007) *Unfallkostenrechnung Straße unter Berücksichtigung des menschlichen Leids; Endbericht, Langfassung*, Wien



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## References (2)

**Emberger G.** (2009) *Mobilitätsuntersuchung TU University 2015*, durchgeführt am Institut für Verkehrsplanung und Verkehrstechnik, TU Wien

**Magistratsabteilung 18** (2006) *Masterplan Verkehr Wien 2003 – Kurzfassung, aktualisierter Nachdruck*, Wien

**Magistratsabteilung 18** (2010) *P. Holzapfel, R. Riedel, Verkehrsmodell Wien, Stadtplanung Wien – MA 18*, Wien 2010

**Maibach M., Schreyer C., Sutter D., van Essen H. P., Boon B. H., Smokers R., Schrotten A., Doll C., Pawlowska B., Bak M.** (2008) *Handbook on estimation of external costs in the transport sector*, CE Delft

**Meschik, M., Meth D., Menšik K., Raser, E.** (2008): *Radverkehr Linz - Evaluierung des Radverkehrskonzepts der Landeshauptstadt Linz. Einstellungen, Zufriedenheit und Image*. Magistrat der Stadt Linz

**For more reference details see:** Trunk G. (2011)



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