

*THE PEP Workshop on safe and healthy walking and cycling in urban areas  
Batumi, Georgia, 30 September – 1 October 2010*

# **Quantification of health benefits from cycling: the Health Economic Assessment Tool (HEAT) for cycling**

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World Health Organization Regional Office for Europe  
European Centre for Environment and Health

*With acknowledgements to:*

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*Harry Rutter, National Obesity Observatory England, United Kingdom*

*Hywell Dinsdale, South-East Public Health Observatory, United Kingdom*

*Sonja Kahlmeier, WHO Regional Office for Europe*

*Francesca Racioppi, WHO Regional Office for Europe*

*Pekka Oja, UKK Institute for Health Promotion Research*



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# Often urban environments / land use planning favour motorized transport...



# ... and hinder walking and cycling



# Why cycling and walking?

- Helps to address many of the transport-related health problems.
- It can have a big impact!
  - In Europe, many car trips are short:
    - about 10% of trips not longer than 1km
    - About 30% not longer than 3km
  - Shifting some of these trips to active transportation can help to:
    - Reduce congestion
    - Improve road safety
    - Improve air quality and noise
    - Reduce energy consumption and CO2
    - Co-benefits: e.g. health effects, more livable communities etc.
- It's easy!
  - Avoids dependence on facilities for sports
  - Most people can do it - equitable and easily accessible options

# Why economic assessment of walking and cycling?

- Economic valuation is standard tool of transport planners
  - helps health sector to speak “their” language
- Public health benefits are likely to be great, esp. if inactive persons can be reached
- Increasingly applied to cycling and walking but not always in a transparent way based on a robust methodology

# Integration of health effects in transport assessments: challenges

- Complex methodological questions for transport planners:
  - which health endpoints to include?
  - form of the relationship between exposure and effect?
  - activity substitution
  - which costs to include?
  - how to calculate costs?
  - which time lag periods to apply before benefits/costs occur?
- ⇒ easy to apply guidance and tools needed

# WHO guidance and tool for economic assessment of cycling (and walking)

**Health Economic Assessment Tool for Cycling**

Fill in the two fields in Step 1 with your values and read the corresponding results in Step 3. You can use the default population parameters used to calculate the results are displayed at the bottom of the sheet.

**Step 1: enter your data** (all users must fill in the red fields)

Number of trips per day	10,000	How many trips are observed
Mean trip length (km)	4	What is the mean trip length

**Step 2: check the parameters**

Mean number of days cycled per year	124	The estimated number of days cycled
Proportion of trips that are one part of a return journey (or 'round trip')	0.3	What proportion of these are round trips
Proportion undertaken by people who would not otherwise cycle	0.5	Proportion of these who would not otherwise cycle
Mean proportion of working age population who die each year	0.005947	See local parameters page
Value of life (in Euros)	EUR 1,500,000	What is the standard value of life
Discount rate	5.0%	Discount rate used for future value calculations

**Step 3: read the economic savings resulting from reduced mortality**

<b>Maximum annual benefit</b>	<b>EUR 4,209,000</b>	Total value of lives saved
Savings per km cycled per individual cyclist per year	EUR 0.81	
Savings per individual cyclist per year	EUR 785	
Savings per trip	EUR 3.39	
<b>Mean annual benefit:</b>	<b>EUR 3,126,000</b>	This value takes the likelihood of a return journey into account
<b>Present value of mean annual benefit:</b>	<b>EUR 2,283,000</b>	This value uses the discount rate

Based on:  
 5% discount rate  
 5 year build-up of benefit and 1 year build-up of uptake, averaged over 10 years

**Population parameters used to calculate results**

Population that stands to benefit	2750	Based on number of individuals in the population
Mean proportion of working age population who die each year	0.005947	This reflects the relative risk of death from cycling
Expected deaths in the local population	16.08	Yearly deaths expected in the population
Protective benefit, according to actual distance travelled	0.17	Relative risk of death from cycling
Lives saved	2.81	Reduction in number of deaths

By: Nick Cavill  
 Sonja Kahlmeier  
 Harry Rutter  
 Francesca Racioppi  
 Pekka Oja

**Health Economic Assessment Tool for Cycling (HEAT for cycling) User guide**

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THE PEP  
 Transport, Health and Environment Programme  
 Part of the European Programme for Intervention and Prevention (EPIP)

**Methodological Guidance on the Economic Appraisal of Health Effects Related to Walking and Cycling: SUMMARY**

Economic assessment of transport infrastructure and policies

# Collaborative project

## Core group

Nick Cavill, Harry Rutter, Sonja Kahlmeier, Hywell Dinsdale, Francesca Racioppi, Pekka Oja

## Contributors

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## In collaboration with:



**THE PEP**

**Transport, Health and Environment  
Pan-European Programme**

United Nations Economic Commission for Europe (UNECE)  
World Health Organization Regional Office for Europe (WHO/Europe)



WHO/Europe



United Nations

## Acknowledgements



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University of Graz, Austria*



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# The question

- If  $x$  people cycle a distance of  $y$  kilometers on most days, what is the economic value of the health benefits that occur as a result of the reduction in mortality due to their physical activity?

Figure 1. Basic workings of the HEAT for Cycling

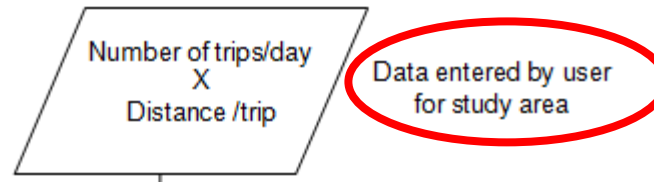


Figure 1. Basic workings of the HEAT for Cycling

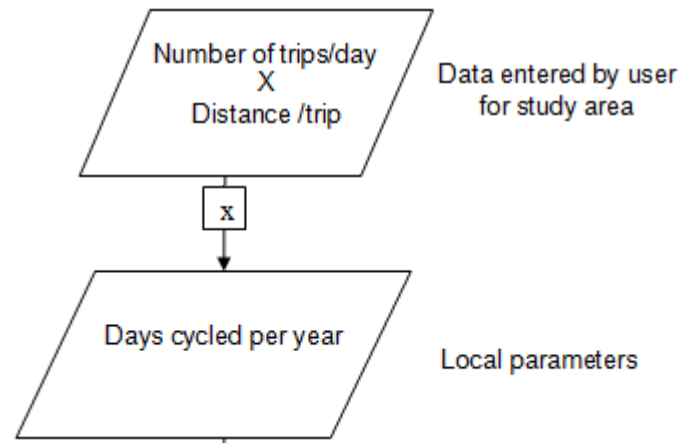


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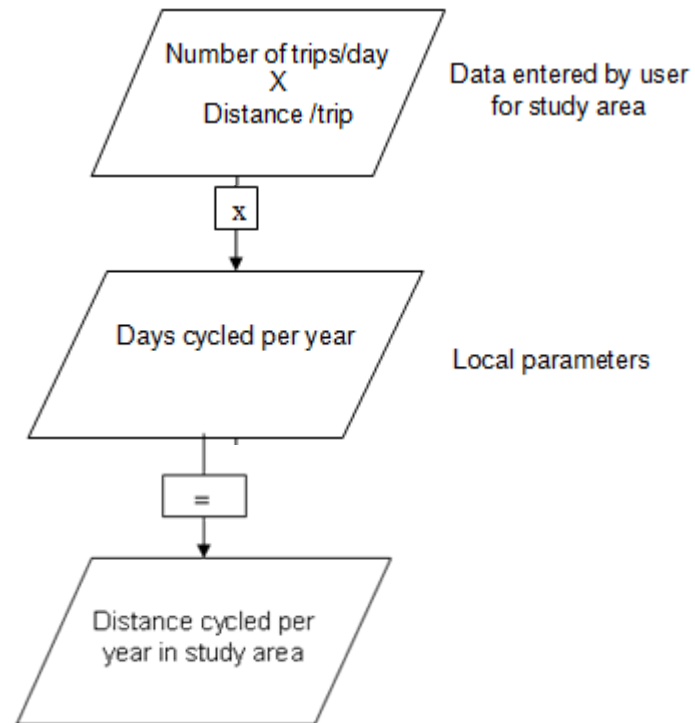


Figure 1. Basic workings of the HEAT for Cycling

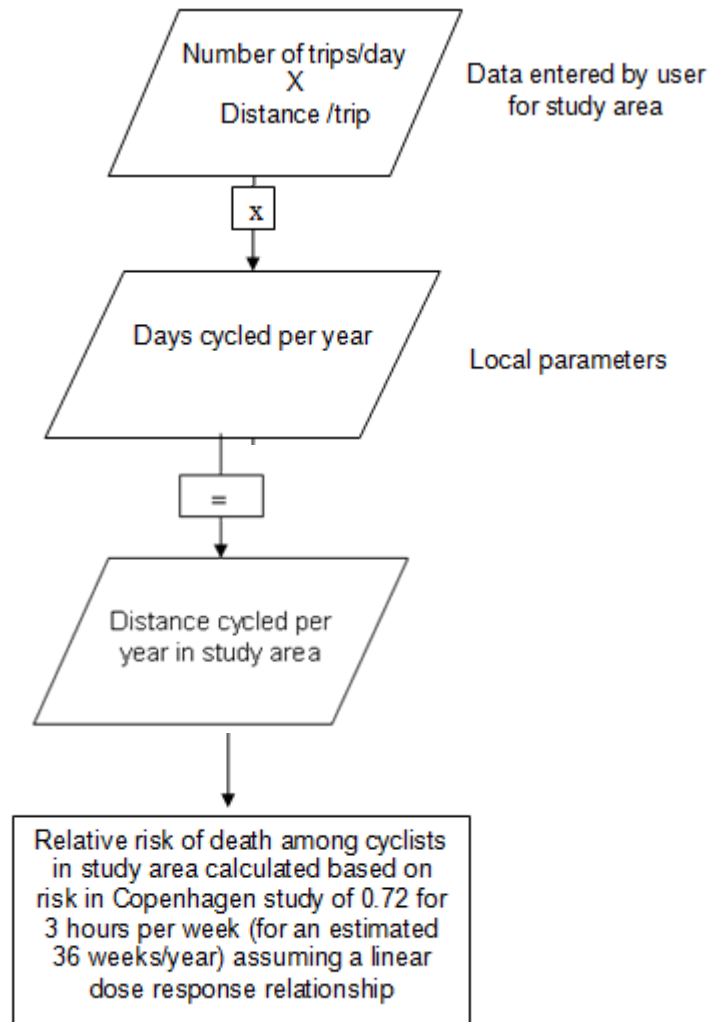
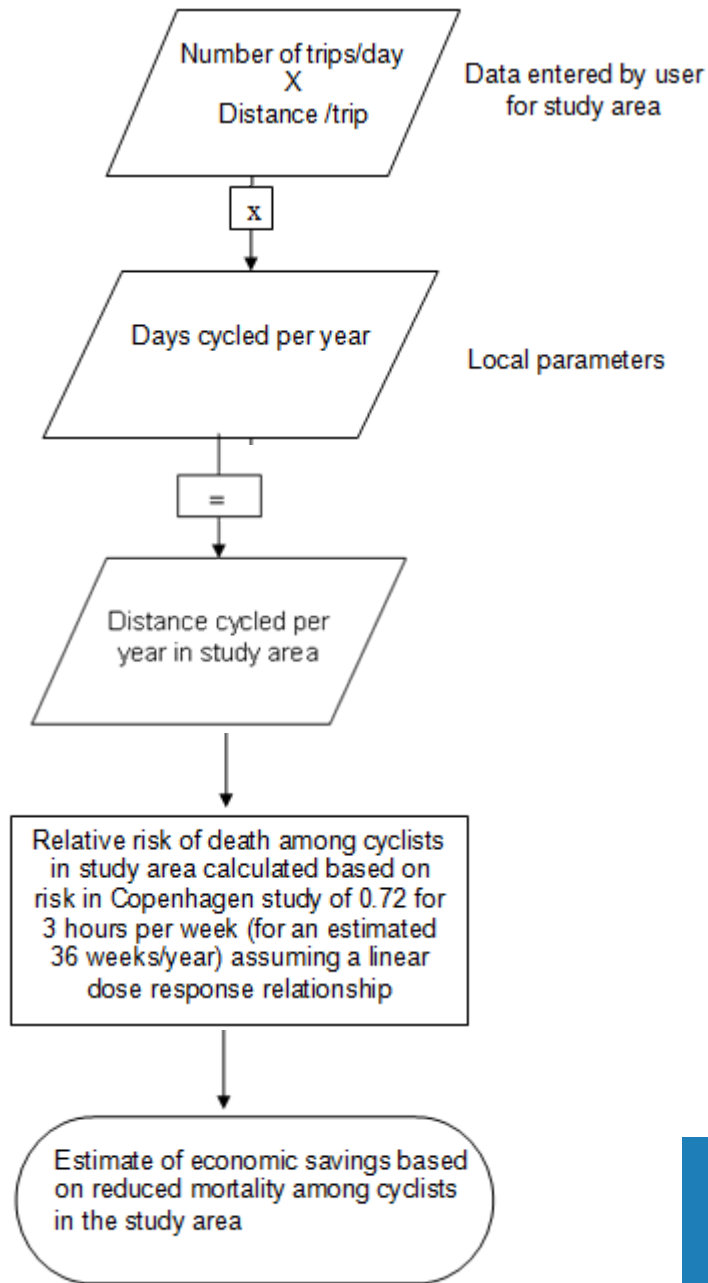


Figure 1. Basic workings of the HEAT for Cycling



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# Health Economic Assessment Tool for Cycling

Fill in the two fields in Step 1 with your values and read the corresponding results in Step 3. You can use the default parameters supplied in Step 2 or adjust them according to your needs. The population parameters used to calculate the results are displayed at the bottom of the sheet.

About this tool

## Step 1: enter your data (all users must fill in the red fields)

Number of trips per day	300,000
Mean trip length (km)	3.2

**Notes on how to use this tool.** For additional instructions, hold the mouse over any red triangle.

How many trips are observed (or are estimated) on the specific route; across a city; or on a network, in any direction?

What is the mean trip length (estimated or measured)?

## Step 2: check the parameters

Mean number of days cycled per year	124
Proportion of trips that are one part of a return journey (or 'round trip')	0.9
Proportion undertaken by people who would not otherwise cycle	0.5
Mean proportion of working age population who die each year	0.005847
Value of life (in Euros)	EUR 1,500,000
Discount rate	5.0%

**The default parameters in green are based on best available evidence and are to be changed only if local data available.**

The estimated number of days per year that people cycle

What proportion of these observed cyclists do you expect will also be making a return trip later in the day?

Proportion of these cyclists that are new users DIRECTLY as a result of the new infrastructure or policy

See local parameters page for explanation.

What is the standard value of a statistical life used in the country of study?

Discount rate used for future benefits. This is only used for the 'Present value of mean annual benefits', see step 3.

[Click here to change local parameters](#)

[Click here to view underlying study parameters](#)

## Step 3: read the economic savings resulting from reduced mortality

<b>Maximum annual benefit</b>	<b>EUR 101,015,000</b>
Savings per km cycled per individual cyclist per year	EUR 0.81
Savings per individual cyclist per year	EUR 612
Savings per trip	EUR 2.72

Total value of lives saved (mortality only) assuming 'steady state' of health benefits achieved

**Mean annual benefit:** EUR 75,256,000

This value takes the likely build up of benefit into account (see below)

**Present value of mean annual benefit:** EUR 54,801,000

This value uses the discount rate from section two to calculate the present value, taking inflation into account

Based on:

5% discount rate

5 year build-up of benefit and 1 year build-up of uptake, averaged over 10 years

[Click here to change the timeframe used in calculation](#)

[Click here to view full calculation, graphs and adjust error](#)

[Reset all default values](#)

## Population parameters used to calculate results

Population that stands to benefit	82500
Mean proportion of working age population who die each year	0.005847
Expected deaths in the local population	482.35
Protective benefit, according to actual distance traveled	0.14
Lives saved	67.34

Based on number of individual cyclists calculated from data in steps 1 and 2

This reflects the relative risk of all cause mortality in the age groups that are most likely to cycle

Yearly deaths expected among the population of cyclists (assuming they are aged 25-64)

Relative risk of death among cyclists, adjusted for the actual distance cycled (assuming regular trips per year)

Reduction in number of deaths expected due to the modelled increase in cycling

### Step 1: enter your data (all users must fill in the red fields)

Number of trips per day

13,000

Mean trip length (km)

2

### Step 2: check the parameters

Mean number of days cycled per year

160

Proportion of trips that are one part of a return journey (or 'round trip')

0

Proportion undertaken by people who would not otherwise cycle

1

Mean proportion of working age population who die each year

0.005113

Value of life (in Euros)

EUR 700,000

Discount rate

5.0%

### Step 3: read the economic savings resulting from reduced mortality

#### Maximum annual benefit

EUR 2,757,000

Savings per km cycled per individual cyclist per year

EUR 0.66

Savings per individual cyclist per year

EUR 212

Savings per trip

EUR 1.33

#### Mean annual benefit:

EUR 2,054,000

#### Present value of mean annual benefit:

EUR 1,496,000

Based on the following assumptions (see user guide for details)

5% discount rate

5 year build-up of benefit and 1 year build-up of uptake, averaged over 10 years

### Population parameters used to calculate results

Population that stands to benefit

13000

Mean proportion of working age population who die each year

0.005113

Expected deaths in the local population

66.47

Protective benefit, according to actual distance traveled

0.06

Lives saved

3.94

Input

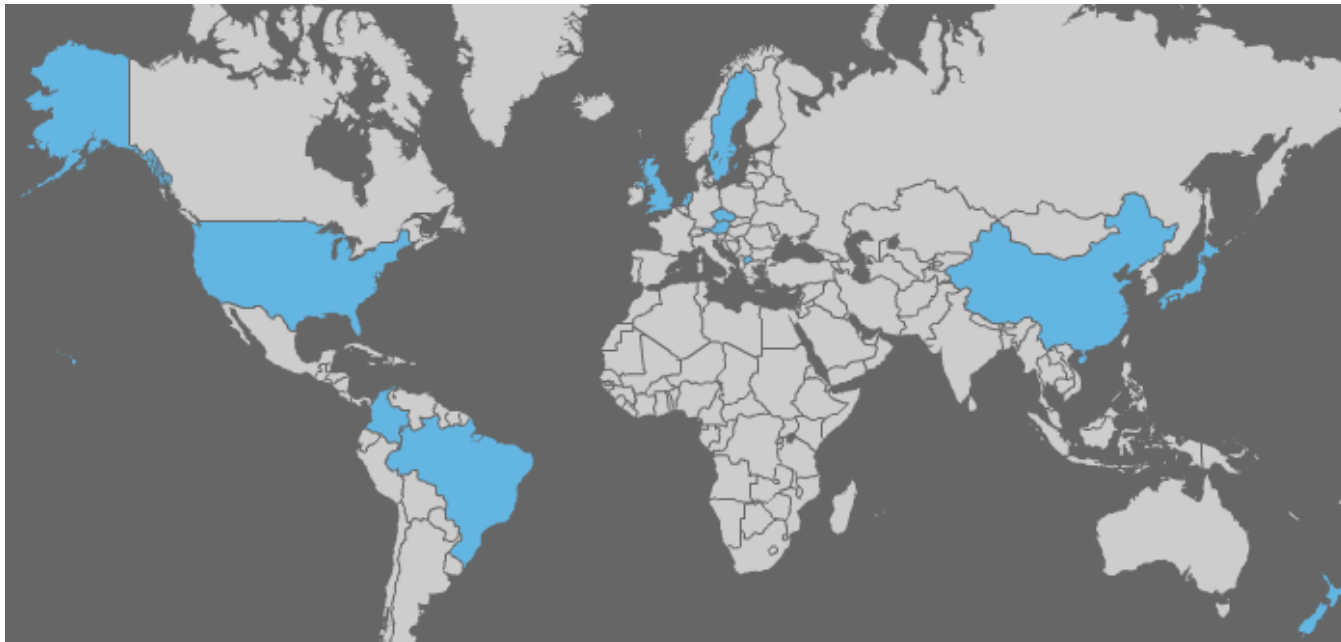
# HEAT is very conservative

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- Only effects from physical activity
- Only mortality
- No co-benefits considered

# Applications

- Project website visited over 7000 times, products downloaded over 650 times



# Selected applications

- **Czech Republic** used HEAT for cycling used to calculate potential benefits from cycling in the city of Pilsen
  - **USD 1.2million** if 2% of population took up regular cycling
- **Swedish Government** adopted HEAT for cycling as part of official toolbox for the economic assessment of cycling infrastructure
- **UK/England DfT:** adopted HEAT for cycling as part of official toolbox for the economic assessment of cycling infrastructure
- **UK/Scotland:** HEAT used to estimate benefit from reaching cycling targets
  - **USD 1.5-3 billion** per year if modal share goal of 13% reached
  - Recommended that Scottish Transport Appraisal Guidance should include health benefits from cycling and walking
- **New Zealand:** University of Auckland used HEAT to value adding cycling and pedestrian facilities to the Auckland Harbour Bridge
  - **900.000USD** per 1000 regular bike commuters
- **United States:** adaptation of tool for the US underway (by CDC)
- **Austria:** used HEAT for cycling to calculate current savings from cycling in Austria

# Now also in Russian

- Thanks to the German Federal Environment Agency and Federal Ministry for the Environment, Nature Conservation and Nuclear Safety



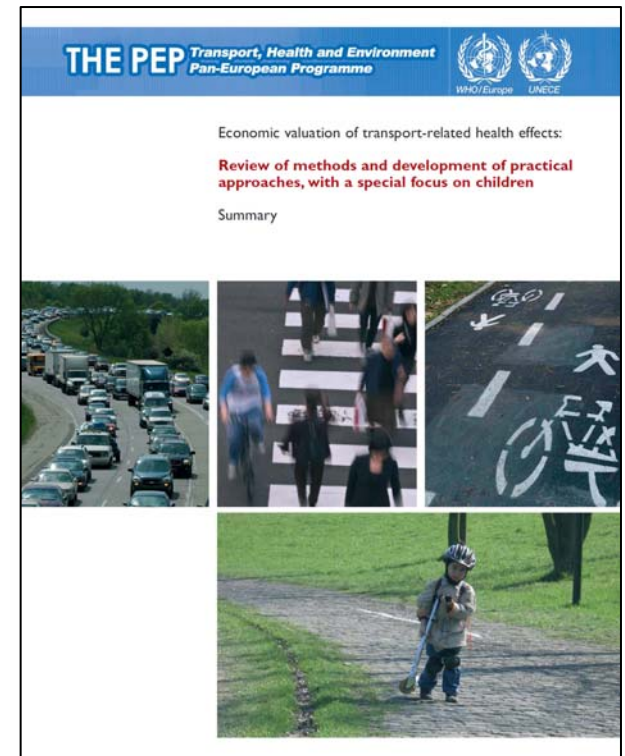
# New developments: HEAT for walking (2009-2011)

Development of HEAT walking:

- Supported by:
  - UK donor consortium – represented by Natural England
  - Swiss Federal Office of Public Health
  
- Preliminary estimates of the \$\$\$\$ benefits much greater than for cycling!
  
- Relevance for some countries much higher than cycling:
  - Walking is a universal behaviour;
  - Fewer barriers (infrastructure, safety, culture, attitudes)

# Costs: Economic valuation of transport-related health effects

- Selection of health effects in adults and children
- Relationships between exposure and health effect
- Estimated fraction of exposure coming from transport
- Assign costs to health effects
- Practical guidance for quantification of health effects of air pollution, injuries, noise and physical inactivity



# Example data from Switzerland

	Passenger transport							Freight transport				Total	
	Car	Public bus	Trolley	Tram	Private coach	Motor-bike	Moped or scooter	Total	Delivery van	Heavy goods vehicle	Articulated lorry		Total
<b>Costs in millions of US dollars</b>													
Road crashes	3675		53 <sup>a</sup>		119	923	438	5208	251	113	54	419	5627
Air pollution	461	33	3	NA	8		19 <sup>b</sup>	523	126	176	91	393	916
Noise	365	18	0	1	9	165	1	559	72	114	57	243	802
<b>Total</b>	<b>4470</b>		<b>108<sup>a</sup></b>		<b>135</b>		<b>1547<sup>b</sup></b>	<b>6290</b>	<b>449</b>	<b>404</b>	<b>202</b>	<b>1054</b>	<b>7345</b>
<b>Costs in US dollars per vehicle-km</b>													
								<b>Average</b>					<b>Average</b>
Road crashes	0.071		0.177 <sup>a</sup>		1.12	0.449	2.99	0.095	0.076	0.079	0.077	7.7	0.094
Air pollution	0.009	0.143	0.096	N.A.	0.073		0.009 <sup>b</sup>	0.010	0.038	0.124	0.129	7.2	0.015
Noise	0.007	0.08	0.007	0.022	0.08	0.080	0.007	0.010	0.022	0.080	0.08.0	4.5	0.013
<b>Total</b>	<b>0.087</b>		<b>0.361</b>		<b>1.273</b>		<b>0.701<sup>b</sup></b>	<b>0.115</b>	<b>0.14</b>	<b>0.283</b>	<b>0.286</b>	<b>18.9</b>	<b>0.122</b>

# Find more information at:

- Quantification of health benefits of cycling and walking: [www.euro.who.int/transport/policy/20070503\\_1](http://www.euro.who.int/transport/policy/20070503_1)
- Transport, Health and Environment Pan European Programme (THE PEP): [www.thepep.org](http://www.thepep.org)
- HEPA Europe (European network for promotion of health-enhancing physical activity): [www.euro.who.int/hepa](http://www.euro.who.int/hepa)

Thank you!



# HEAT

## Contributors

Lars Bo Andersen, Fiona Bull, Nick Cavill, Paul Fischer, Francesco Mitis, PierPaolo Mudu, Pekka Oja, Larissa Roux, Irene van Kemp, Erna van Balen, Rob Jongeneel, Hannah vd Bogaard

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## In collaboration with:

HEPA Europe  
European network for the  
promotion of health-  
enhancing physical activity



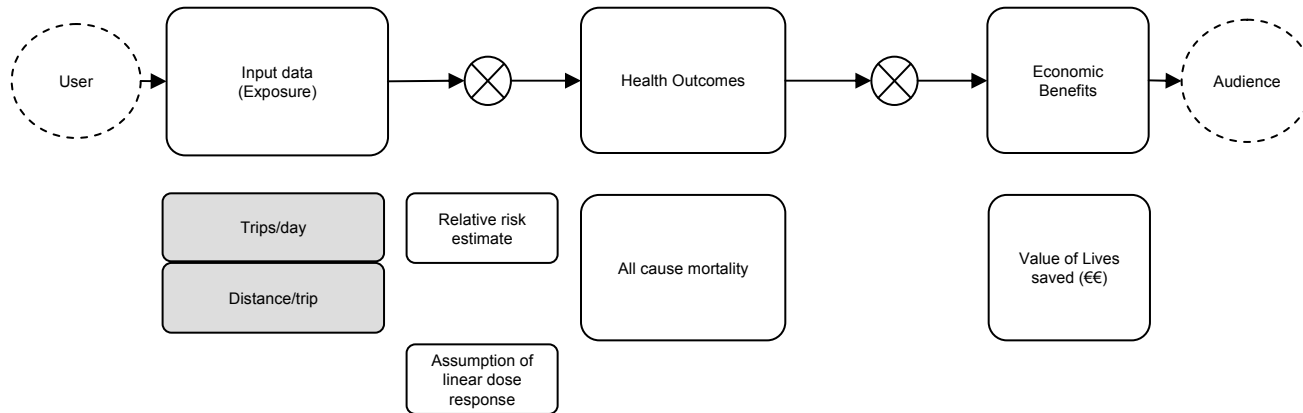
Transport, Health and Environment Pan-European Programme THE PEP



Pollution reductions  
options network



# HEAT for cycling



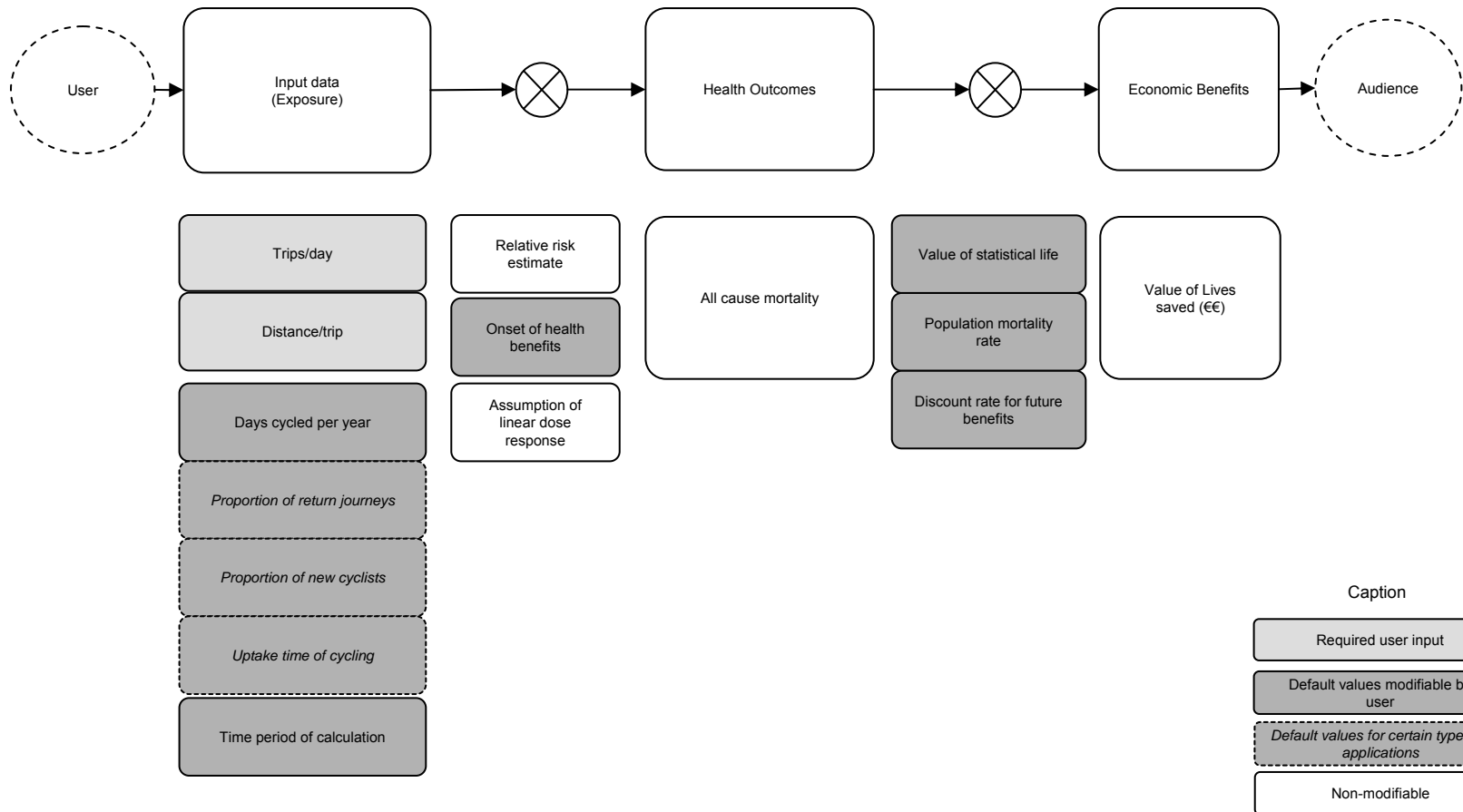
Caption

Required user input

Default values modifiable  
by user

Non-modifiable

# HEAT for cycling



## Input data: health

## Input data: road traffic, environment and costs

Step 1

**Traffic characteristics**  
by mode of transport and type of vehicle

Characteristics of road traffic  
(traffic volume, speed, density  
and infrastructure quality)  
by type of vehicle and mode  
of transport

Step 2

Population density  
and exposure levels

**Assessment of exposure**  
emissions → dispersion → concentrations

Emissions of each type of  
vehicle and mode of transport  
Dispersion models and  
meteorological data

Step 3

Exposure–response  
functions identified  
through meta-analysis  
or epidemiological  
studies  
Data on prevalence,  
incidence, background  
rates and  
demographics

**Estimated health effects**  
identifying exposure–response functions  
and calculating the number of cases

Disease burden  
considering the  
severity and duration  
of effects

**Economic valuation of health effects**  
all effects valuated in economic terms

Economic cost figures, such as  
health costs per case or cost  
of life-years

Step 4

**Total costs**  
summing up the health effects multiplied  
by the cost figures



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# Underlying study: Copenhagen cohorts

- 6,954 regular cycle commuters
- total study population of 30,640
- followed up for an average of 14.5 years
- mean journey time of 3 hours per week
- **relative risk of death 0.72 (95%CI 0.57-0.91)**
- adjusted for age, sex, educational status, leisure time physical activity, body mass index, blood lipid levels, smoking and blood pressure

Source: Andersen *et al. Arch Intern Med.* 2000;160:1621-1628

# Why has the health sector an interest in transport and urban development?

***Transport and the urban environment play a role in several of the leading risk factors for health***

	<b><i>Risk factors related to transport/urban policies</i></b>
High blood pressure	Physical activity/diet
High Body Mass Index	Physical activity/nutrition
Respiratory diseases	Urban air pollution
Cardiovascular diseases	Urban air pollution, physical activity, diet
Cancer (some)	Diet, physical activity
Injuries	Road traffic



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# Collaborative project: econ valuation

## Main partners:

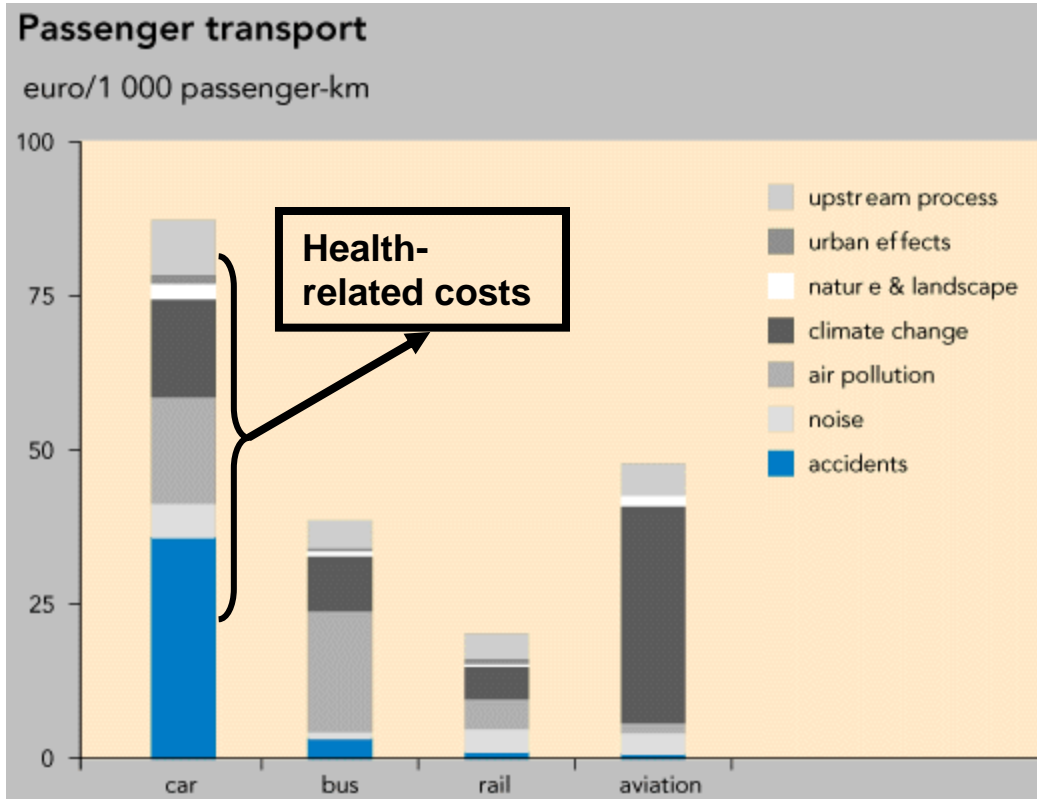
- WHO Regional Office for Europe
- Ecoplan (Switzerland) – economic aspects
- RIVM (Netherlands) and contributors – epidemiological aspects

## Contributors

Lars Bo Andersen, Norway; Fiona Bull, United Kingdom; Nick Cavill, United Kingdom; Luis Cifuentes, Chile; Paul Fischer, Rob Jongeneel, Erna van Balen, Hannah van den Bogaard, the Netherlands; Christoph Lieb, Switzerland; Francesco Mitis, Pierpaolo Mudu, WHO Regional Office for Europe; Pekka Oja, Sweden; Larissa Roux, Canada

- **Advisory group** of 18 experts from 10 countries and WHO
- **3 external reviewers**
- **Synergy** with key related initiatives:
  - OECD/EC VERHI project
  - THE PEP/HEPA Europe project on quantification of health benefits of cycling and walking
  - ENHIS/WHO guidelines for HIA air pollution, noise
  - INTARESE

# Health effects represent the largest part of the external costs of transport



- The external costs of transport are estimated at ca 8 % of GDP in the EU(\*)
- Savings from improved health could be re-invested in other societal priorities;

(\*) Source: EEA indicators,  
[http://themes.eea.europa.eu/Sectors\\_and\\_activities/transport/indicators/cost/TERM25,2002/index\\_html](http://themes.eea.europa.eu/Sectors_and_activities/transport/indicators/cost/TERM25,2002/index_html)

# Why should the transport and urban development sectors have an interest in health?

## Which Goals?

## Whose Interest?

Reduce emissions of:

- air pollutants;
- greenhouse gases;
- noise

Environment  
Health  
Transport  
Urban Development

Reduce congestion

Transport

Reduce road traffic injuries

Transport  
Health

Reduce investments in infrastructure to cater for more cars

Transport

Improve accessibility and quality of urban life

Transport  
Urban development  
Health

Complement technological improvements to vehicles and fuels

Transport

Increase physical activity

Health

Facilitate access to healthy diets

Health

Promote tourism

Tourism and leisure industry, urban development

Creation of new jobs

Economy, welfare, labour, urban development