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

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

With acknowledgements to:
Nick Cavill, Cavill Associates, United Kingdom
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

World Health Organization
REGIONAL OFFICE FOR Europe

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 CO_2
    - 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?

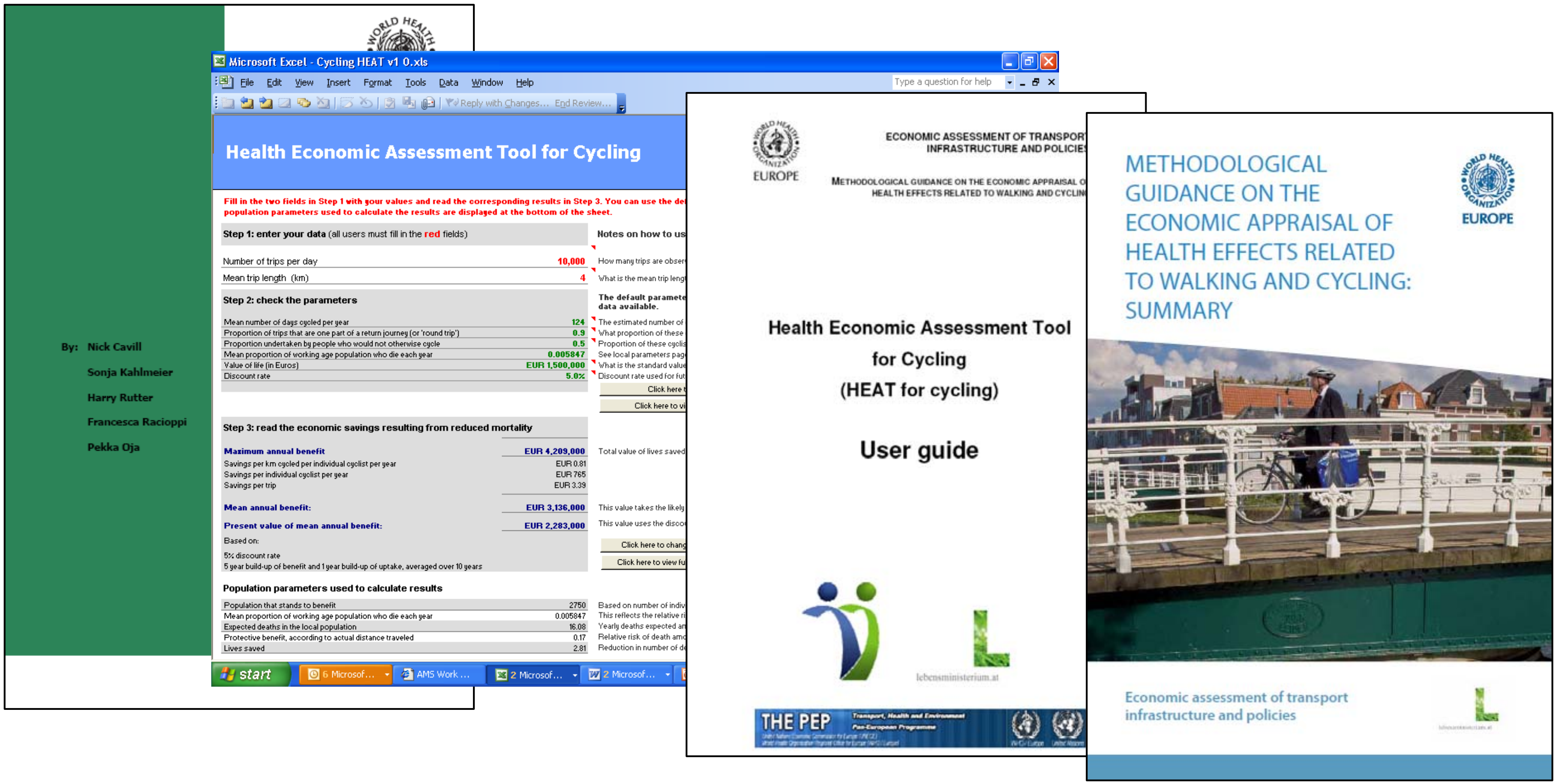
- Economic valuation is standard tool of transport planners
  → helps health sector to speak “their” language
- Public health benefits are likely to be great, esp. if inactive persons can be reached
- Increasingly applied to cycling and walking but not always in a transparent way based on a robust methodology

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)



Collaborative project

Core group

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

Contributors

Lars Bo Andersen, Finn Berggren, Hana Bruhova-Foltynova, Fiona Bull, Andy Cope, Maria Hagströmer / Michael Sjöström, Eva Gleissenberger / Robert Thaler, Brian Martin, Irina Mincheva Kovacheva, Hanns Moshammer, Bhash Naidoo, Kjartan Saelensminde, Peter Schantz, Thomas Schmid, Heini Sommer, Jan Sørensen, Sylvia Titze, Ardine de Wit / Wanda Wendel Vos, Mulugeta Yilma

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

lebensministerium.at

Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management
The Swedish Expertise Fund / Karolinska Institute, Sweden
National Institute for Health and Clinical Excellence (NICE)
University of Graz, Austria

World Health Organization
REGIONAL OFFICE FOR Europe

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

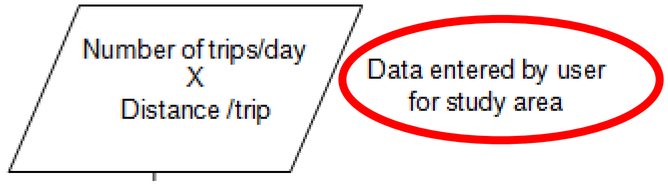


Figure 1. Basic workings of the HEAT for Cycling

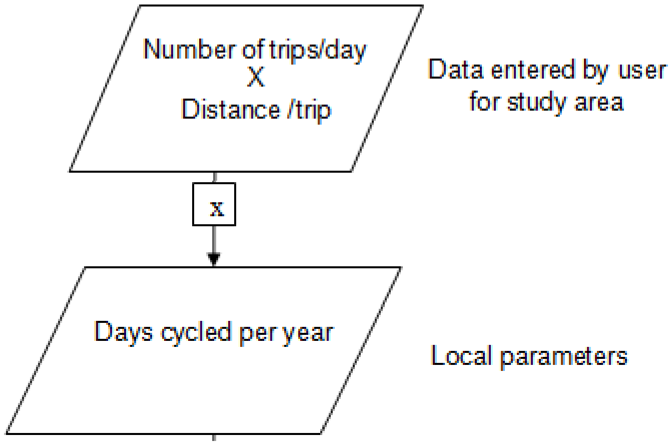


Figure 1. Basic workings of the HEAT for Cycling

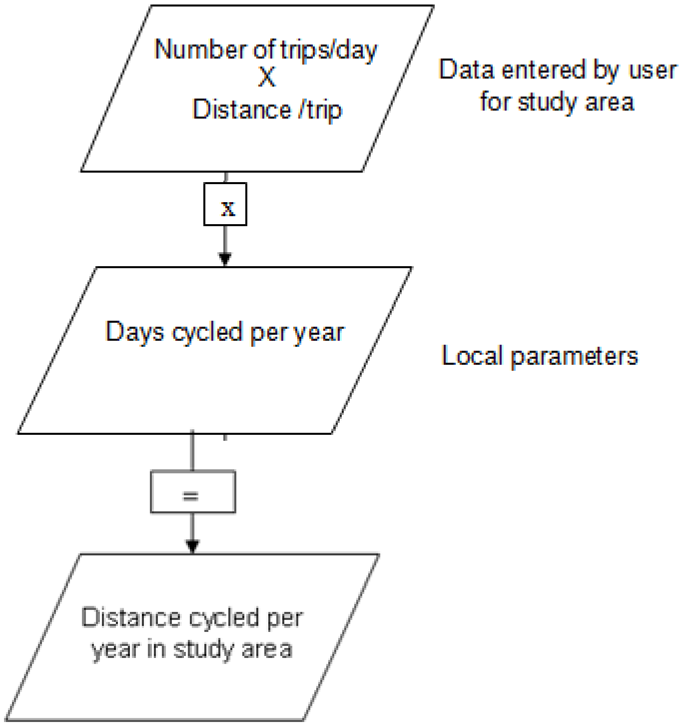
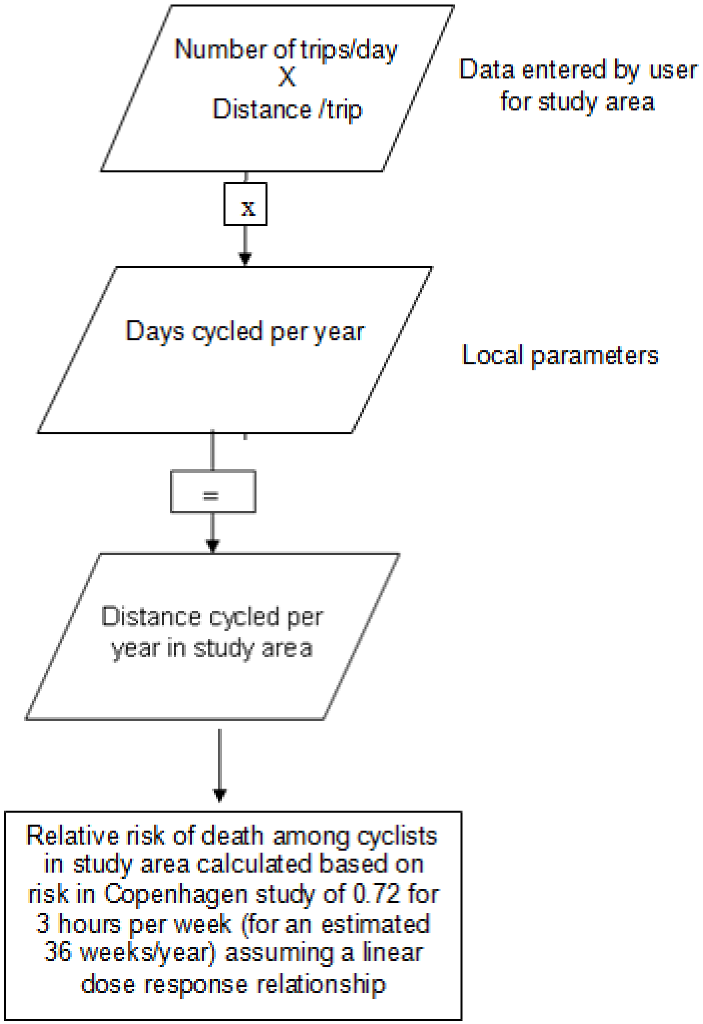
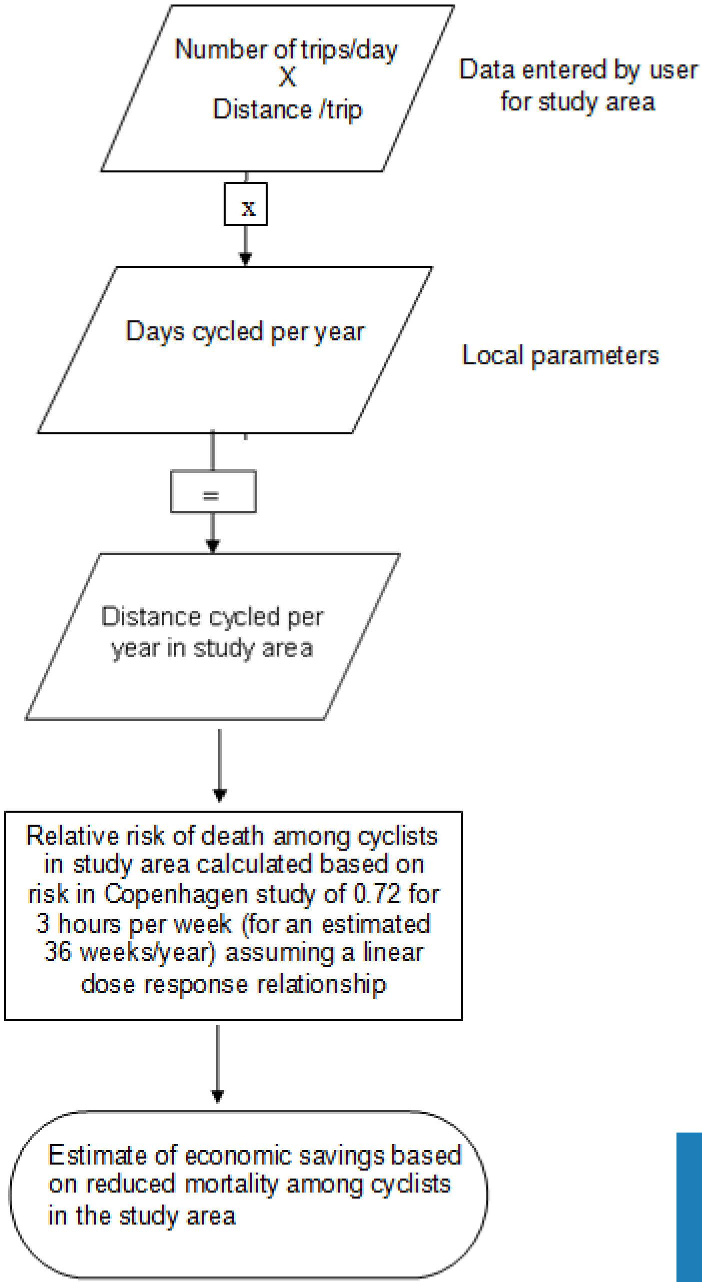


Figure 1. Basic workings of the HEAT for Cycling



World Health Organization
REGIONAL OFFICE FOR Europe

Figure 1. Basic workings of the HEAT for Cycling



Health Economic Assessment Tool for Cycling

UNITED NATIONS EUROPE

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 need
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)

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

Number of trips per day	300,000	How many trips are observed (or are estimated) on the specific route; across a city; or on a network, in any direction?
Mean trip length (km)	3.2	What is the mean trip length (estimated or measured)?

Step 2: check the parameters

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

Mean number of days cycled per year	124	The estimated number of days per year that people cycle
Proportion of trips that are one part of a return journey (or 'round trip')	0.9	What proportion of these observed cyclists do you expect will also be making a return trip later in the day?
Proportion undertaken by people who would not otherwise cycle	0.5	Proportion of these cyclists that are new users DIRECTLY as a result of the new infrastructure or policy
Mean proportion of working age population who die each year	0.005847	See local parameters page for explanation.
Value of life (in Euros)	EUR 1,500,000	What is the standard value of a statistical life used in the country of study?
Discount rate	5.0%	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

Maximum annual benefit	**EUR 101,015,000**	Total value of lives saved (mortality only) assuming 'steady state' of health benefits achieved
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	
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	Based on number of individual cyclists calculated from data in steps 1 and 2
Mean proportion of working age population who die each year	0.005847	This reflects the relative risk of all cause mortality in the age groups that are most likely to cycle
Expected deaths in the local population	482.35	Yearly deaths expected among the population of cyclists (assuming they are aged 25-64)
Protective benefit, according to actual distance traveled	0.14	Relative risk of death among cyclists, adjusted for the actual distance cycled (assuming regular trips per year)
Lives saved	67.34	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)

Input

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

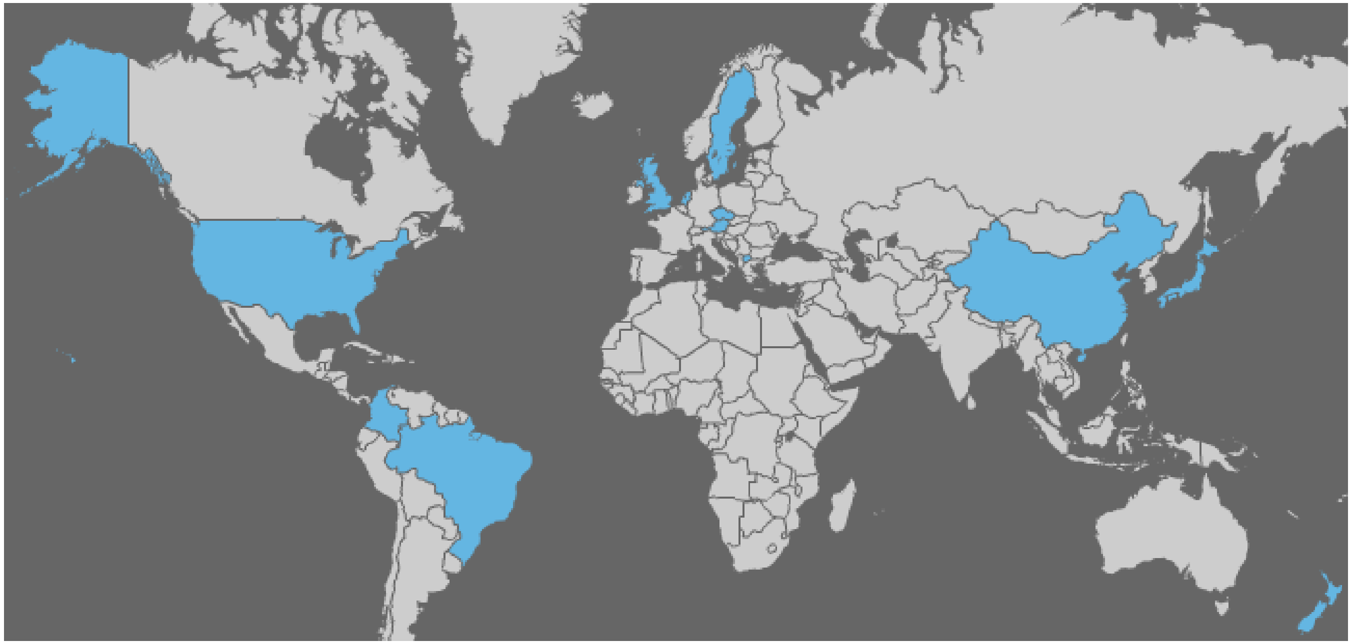
Population that stands to benefit	13000
Mean proportion of working age population who die each year	0.005113
Expected deaths in the local population	66.47
Protective benefit, according to actual distance traveled	0.06
Lives saved	3.94

HEAT is very conservative

- 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

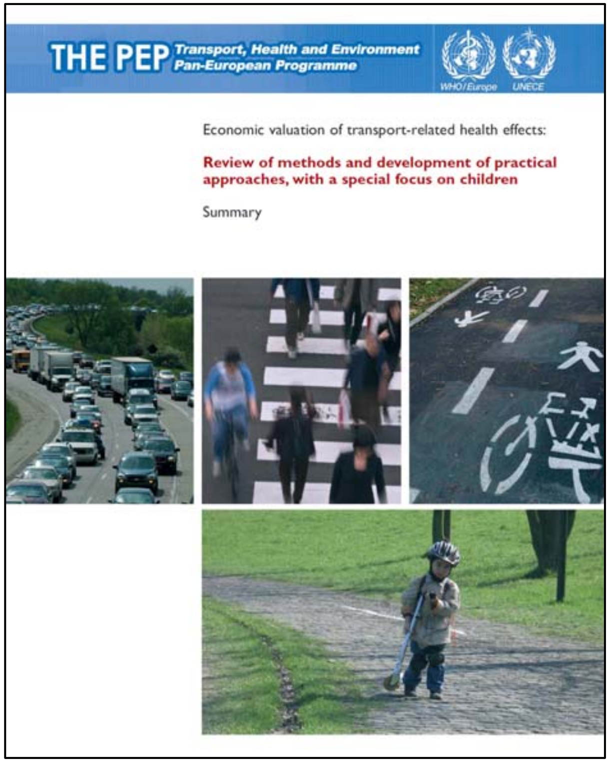
New developments: HEAT for walking (2009-2011)

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	
Costs in millions of US dollars													
Road crashes	3675		53[a]		119	923	438	5208	251	113	54	419	5627
Air pollution	461	33	3	NA	8	19[b]		523	126	176	91	393	916
Noise	365	18	0	1	9	165	1	559	72	114	57	243	802
Total	4470		108[a]		135	1547[b]		6290	449	404	202	1054	7345
Costs in US dollars per vehicle-km								Average					Average
Road crashes	0.071		0.177[a]		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[b]		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
Total	0.087		0.361		1.273	0.701[b]		0.115	0.14	0.283	0.286	18.9	0.122

Find more information at:

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

Advisory group

Anna Alberini, Peter Bickel, Charlotte Braun-Fahrländer, Olivier Chanel, Elisabetta Chellini, Göran Friberg, Max Herry, Nino Künzli, Charles Lloyd, Snejana Markovic-Chenais, Hans Nijland, Annette Prüss-Üstün, Andrea Ricci, Christian Schweizer, Marc Suhrcke, Pascale Scapecchi, Christoph Schreyer / Markus Maibach, Juliet Solomon

Reviewers

Tord Kjellström, Health and Environment International Trust, New Zealand

Michal Krzyzanowski, WHO Regional Office for Europe

Nathalie Simon, US.EPA National Centre for Environmental Economics

In collaboration with:

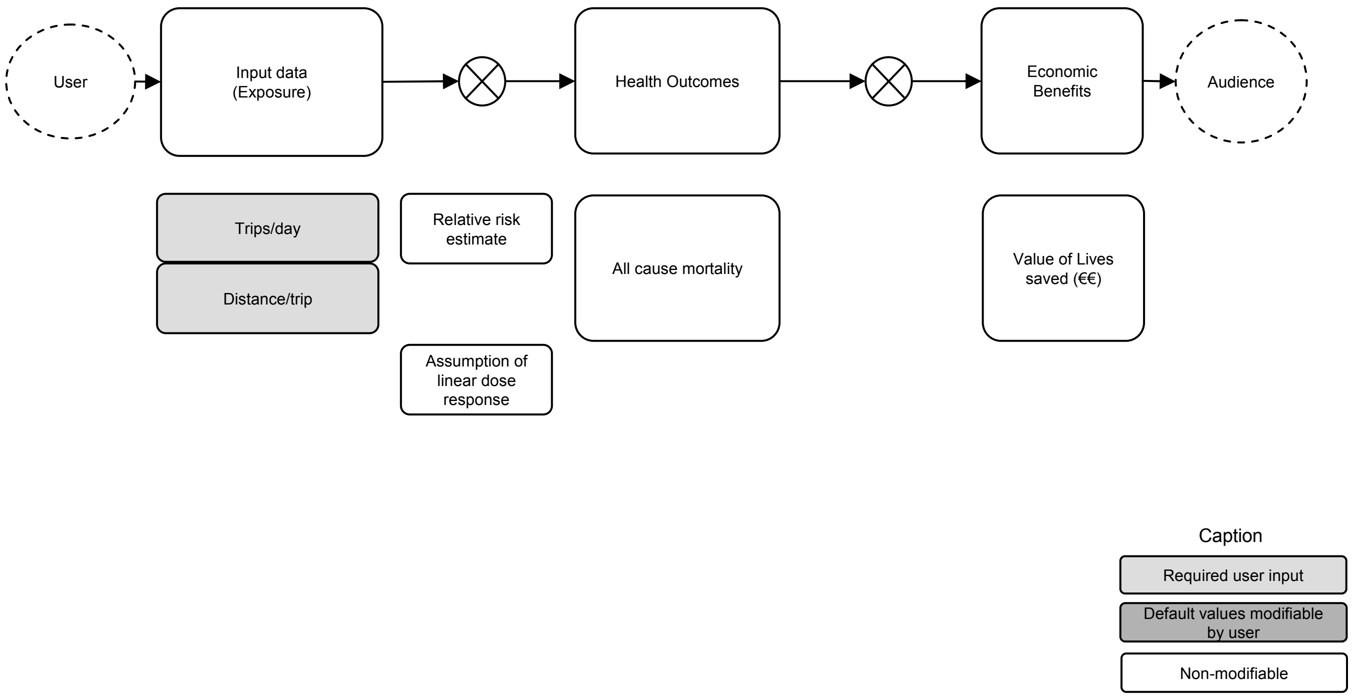
HEPA Europe
European network for the promotion of health-enhancing physical activity

Transport, Health and Environment Pan-European Programme THE PEP

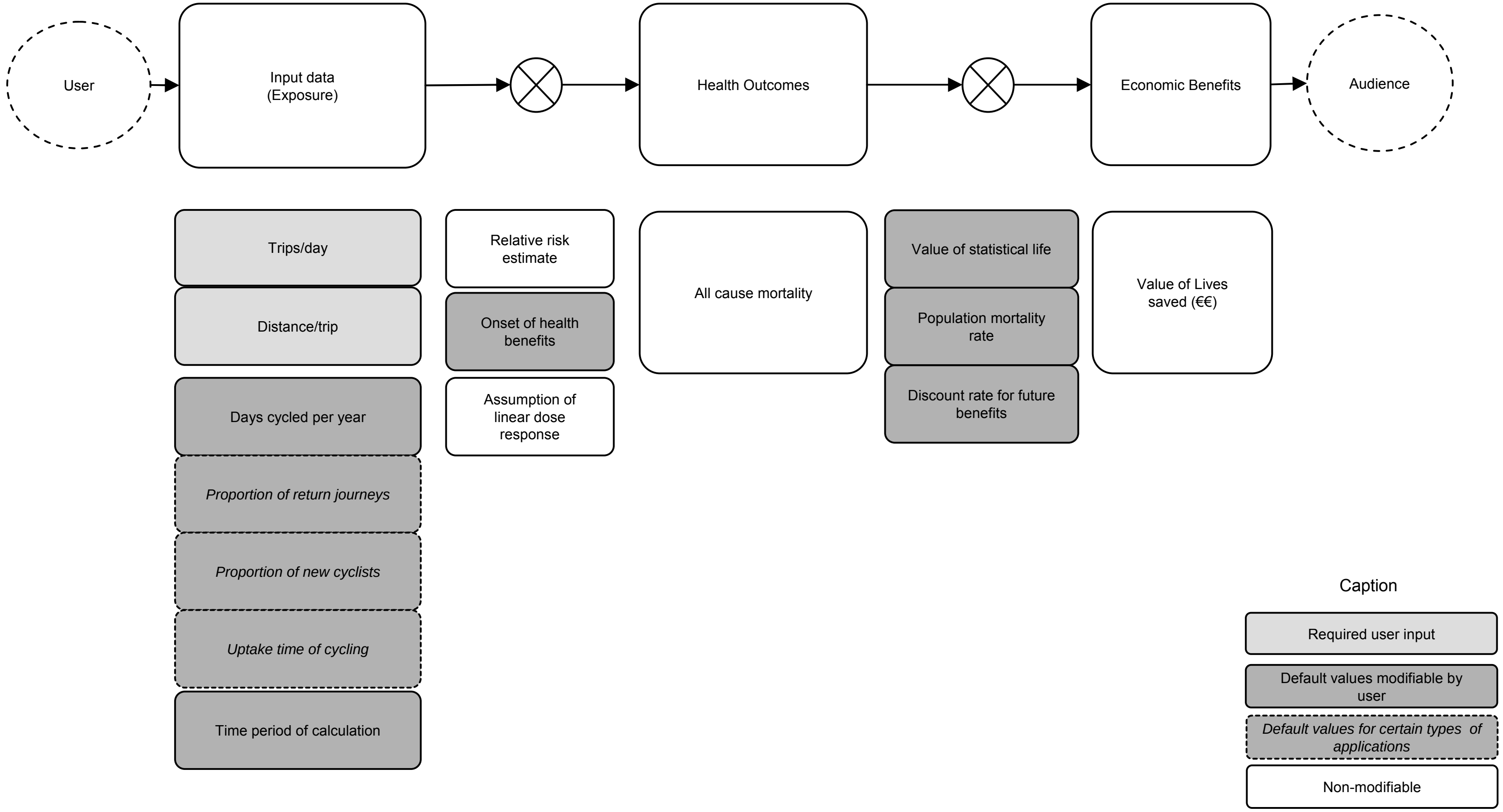
Pollution reductions options network

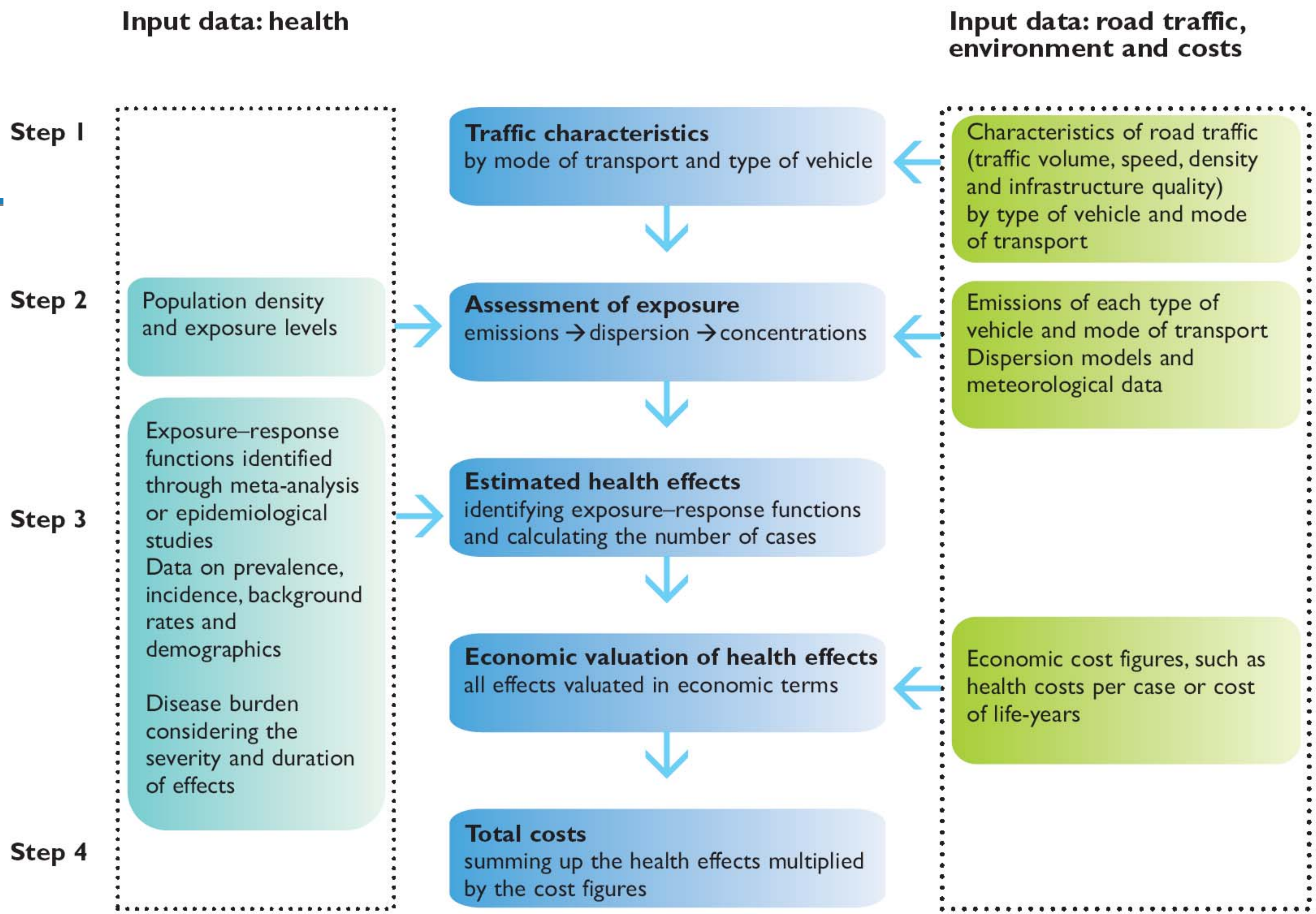
World Health Organization
REGIONAL OFFICE FOR Europe

HEAT for cycling



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
Disease burden considering the severity and duration of effects
Estimated health effects
identifying exposure–response functions and calculating the number of cases
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

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

	Risk factors related to transport/urban policies
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

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

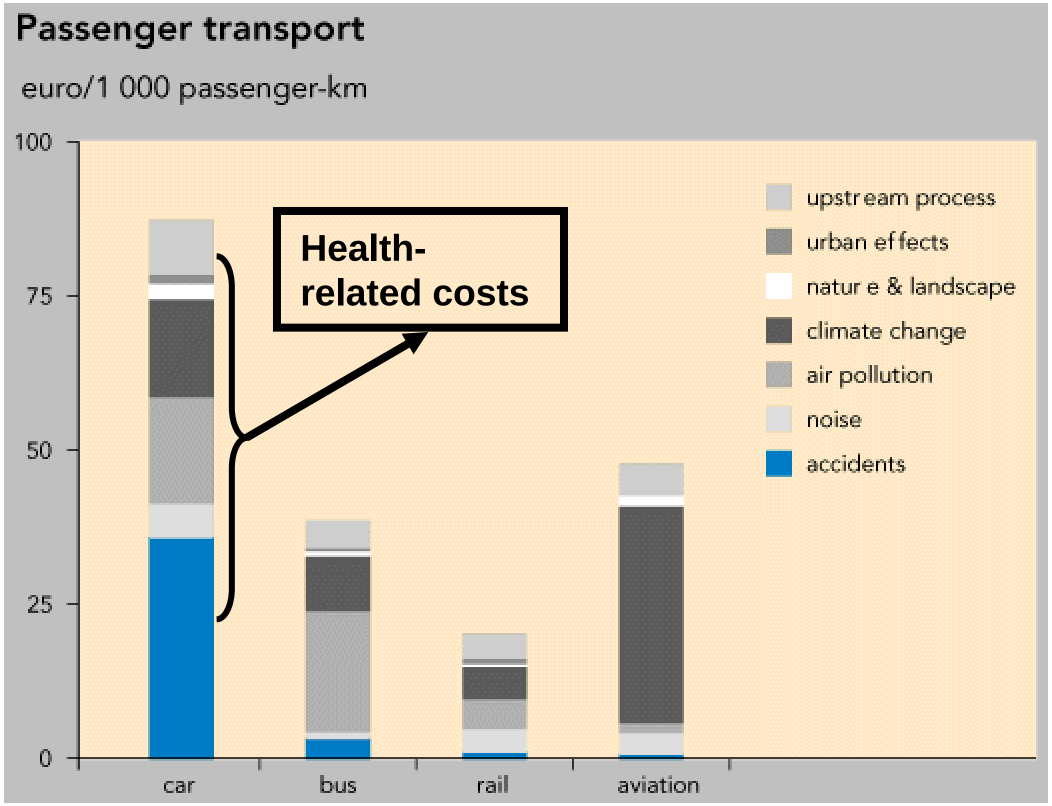
- **Advisory group** of 18 experts from 10 countries and WHO
- 3 **external reviewers**
- **Synergy** with key related initiatives:
  - OECD/EC VERHI project
  - THE PEP/HEPA Europe project on quantification of health benefits of cycling and walking
  - ENHIS/WHO guidelines for HIA air pollution, noise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

Supported by:

World Health Organization

REGIONAL OFFICE FOR Europe

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

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

World Health Organization
REGIONAL OFFICE FOR Europe