



ALMA MATER STUDIORUM  
UNIVERSITÀ DI BOLOGNA

# Cycling in Italy and in Europe:

## research on health and safety

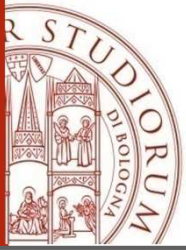
Prof. Luca Pietrantoni  
Università di Bologna

# Presentazione

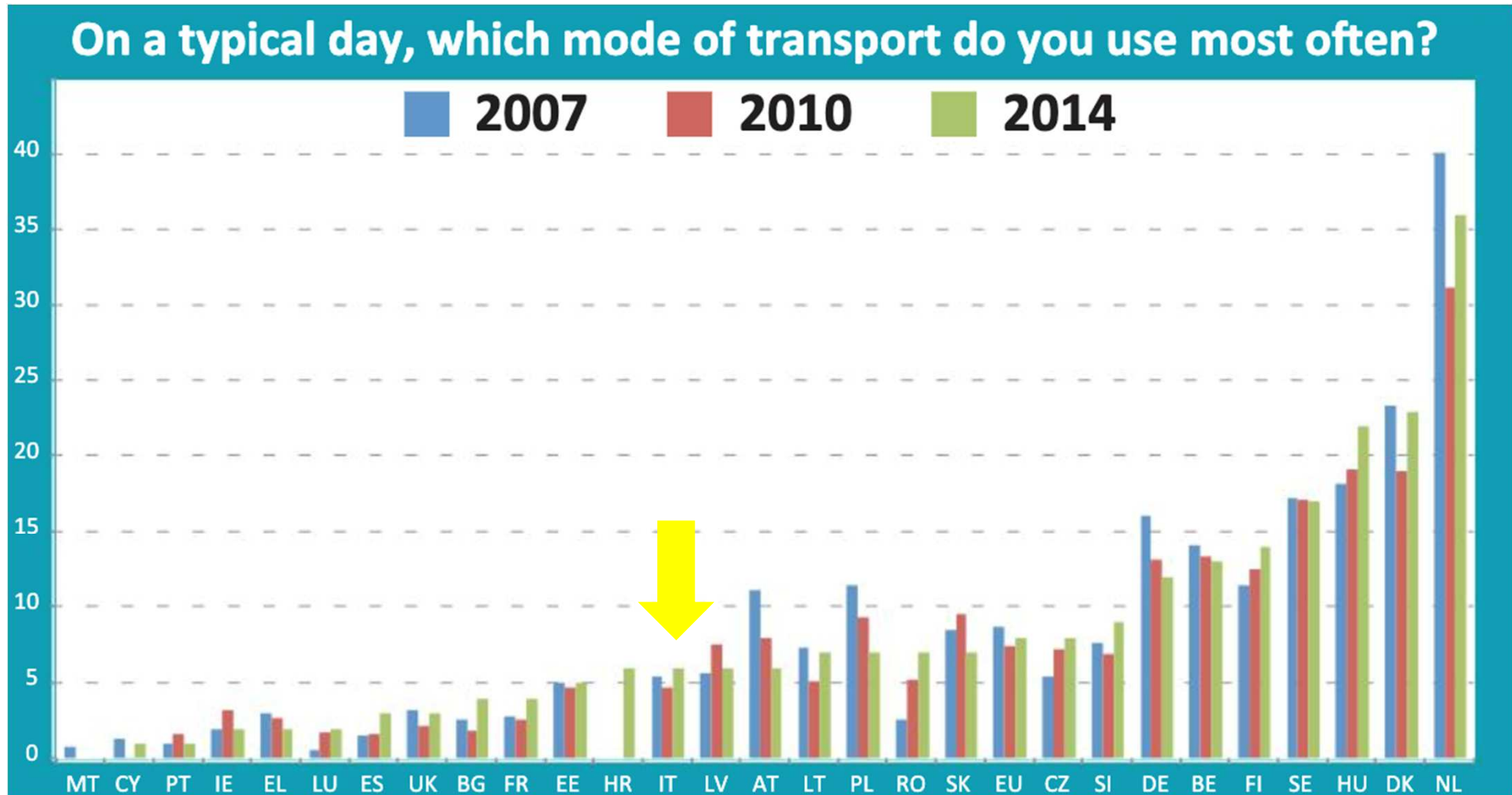


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1. **Alcuni dati su mobilità ciclabile e tendenze recenti**
2. **Linea di ricerca sui benefici di salute**
3. **Linea di ricerca sulla sicurezza nel traffico**
4. **Il progetto Europeo XCYCLE**



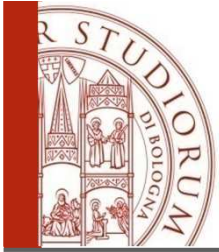
## Bicicletta come mezzo di trasporto quotidiano in EU



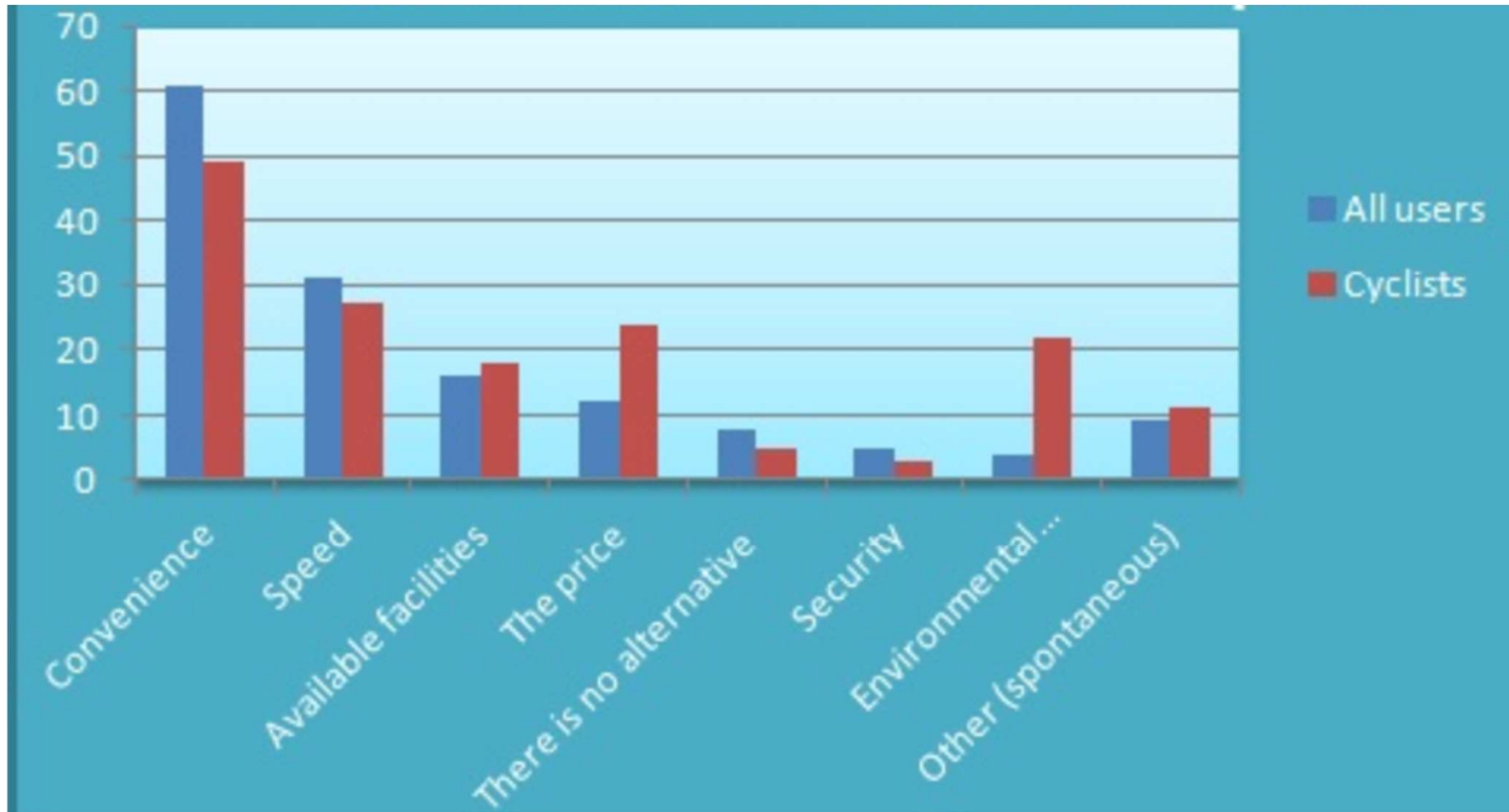
Source: European Cyclists' Federation



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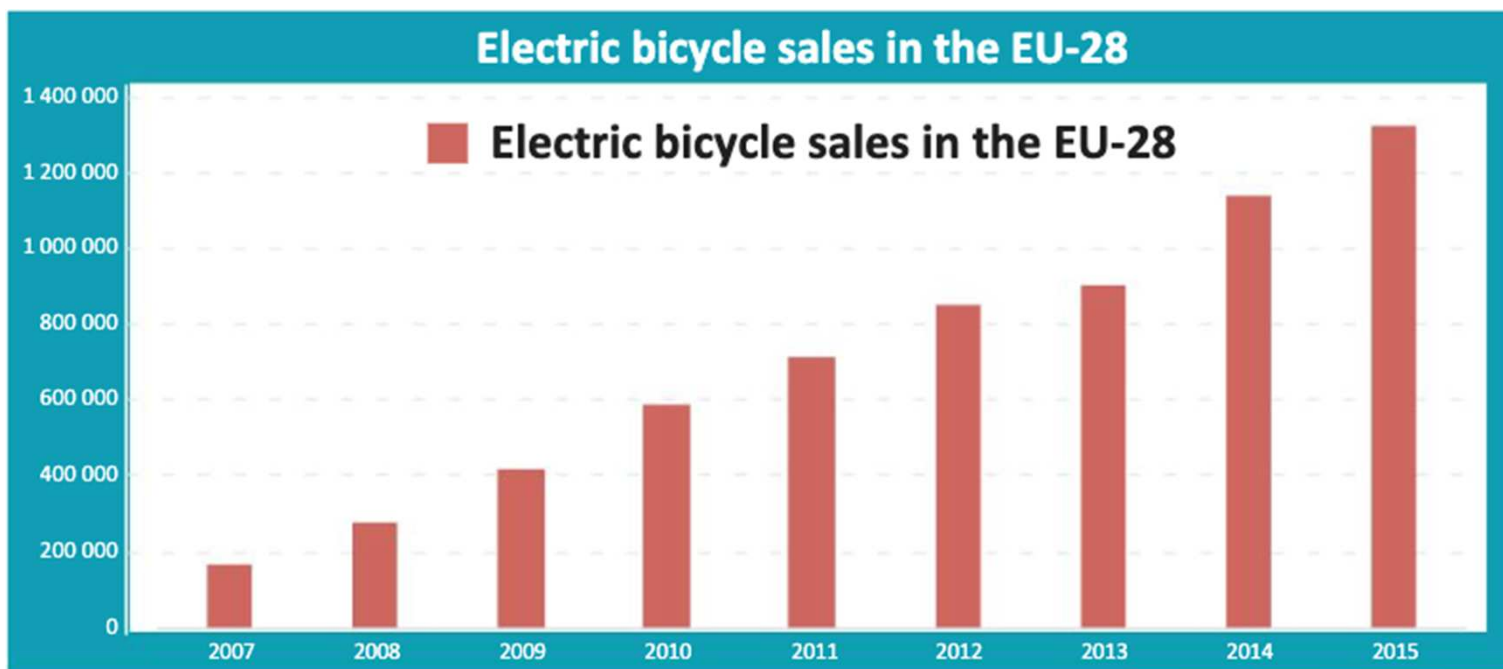
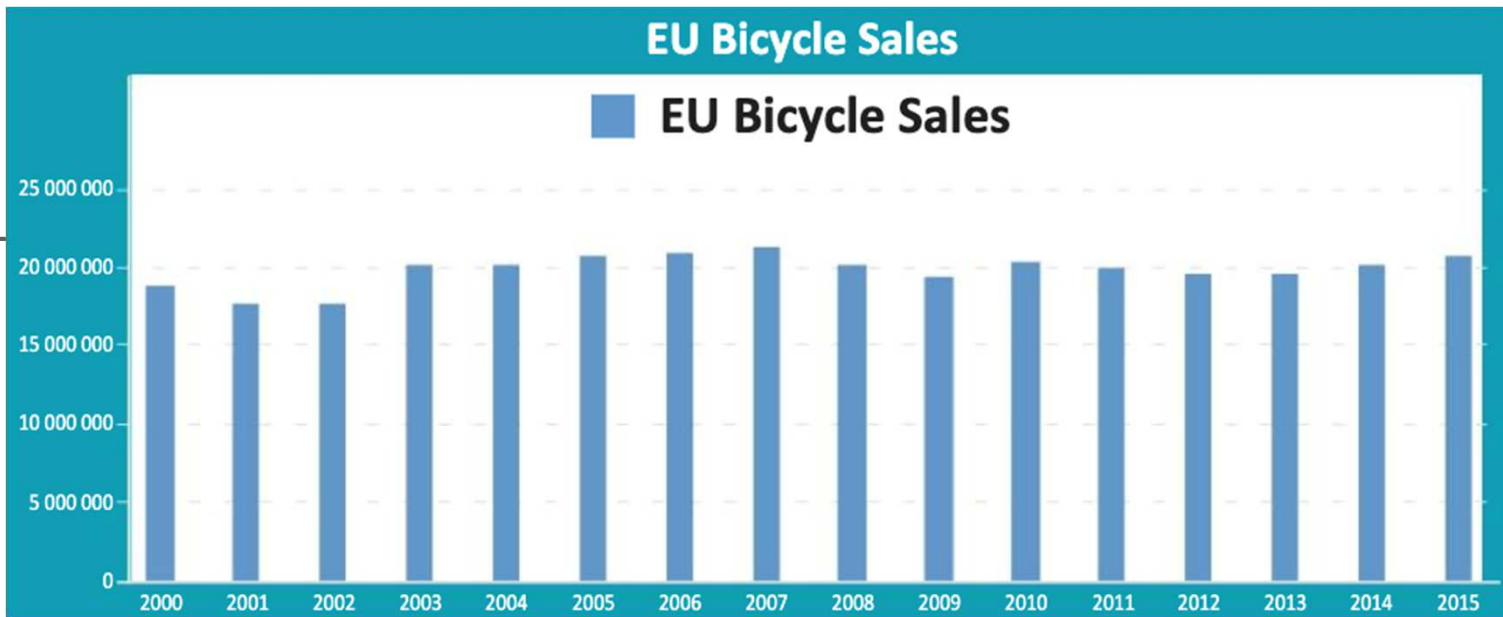
## Quali sono le ragioni per la scelta modale?



Source: European Cyclists' Federation



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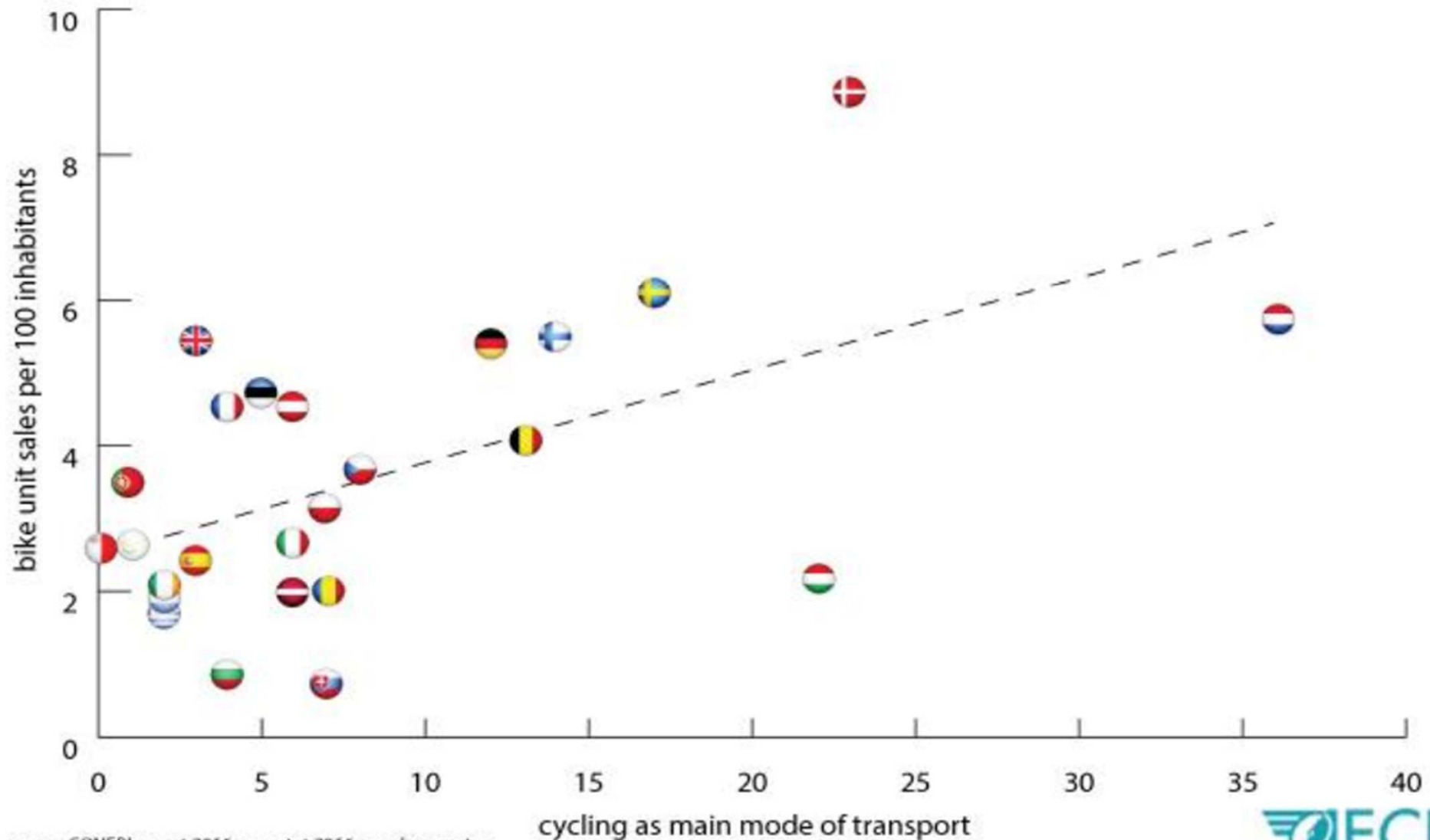


Source: European Cyclists' Federation

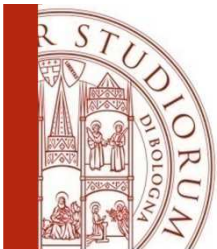




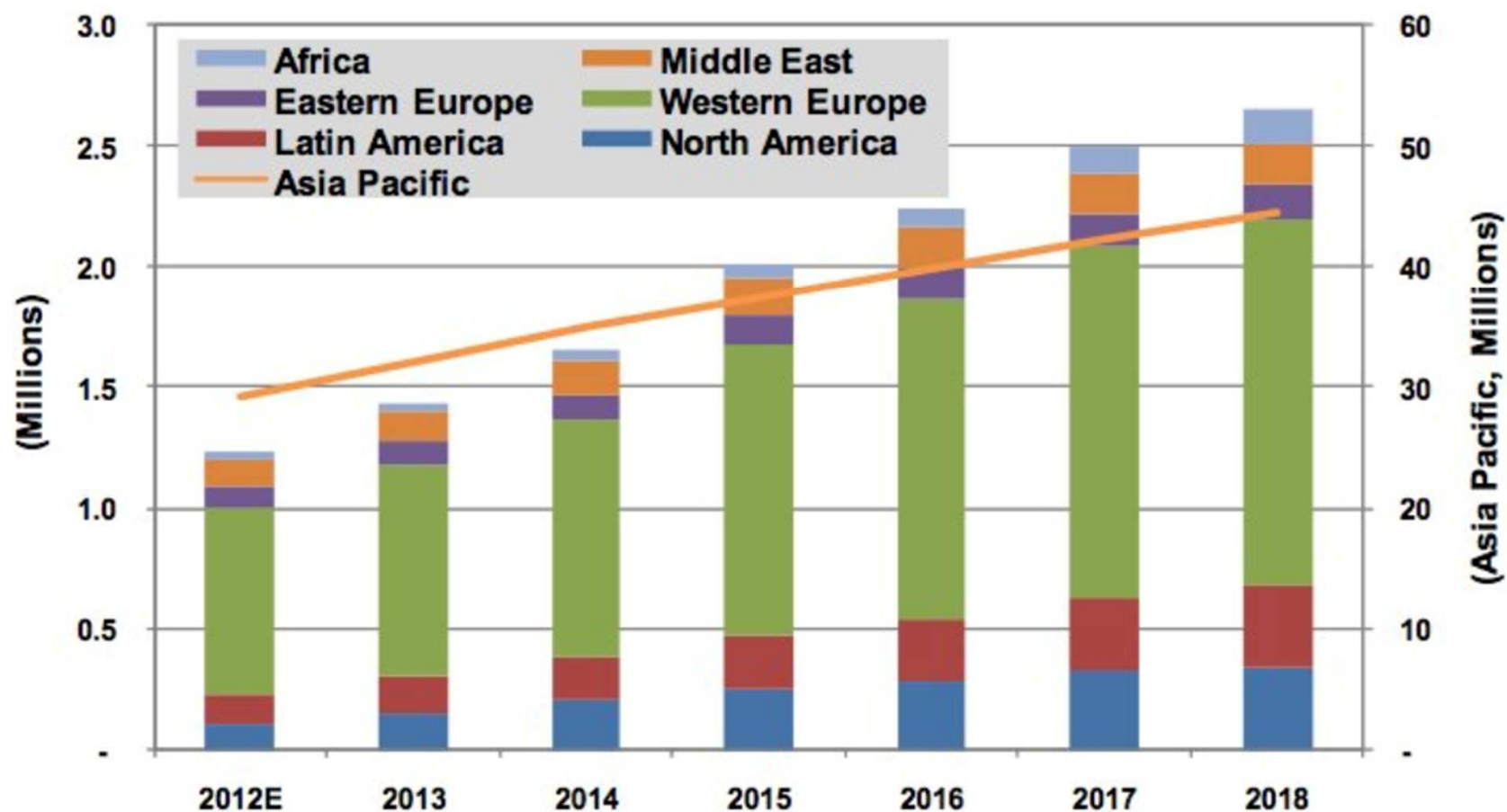
## Unit sales per 100 inhabitants and cycling as main mode of daily transport



source: CONEBI report 2016, eurostat 2016, eurobarometer

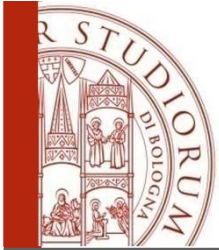


## L'aumento delle vendite delle biciclette elettriche nel mondo

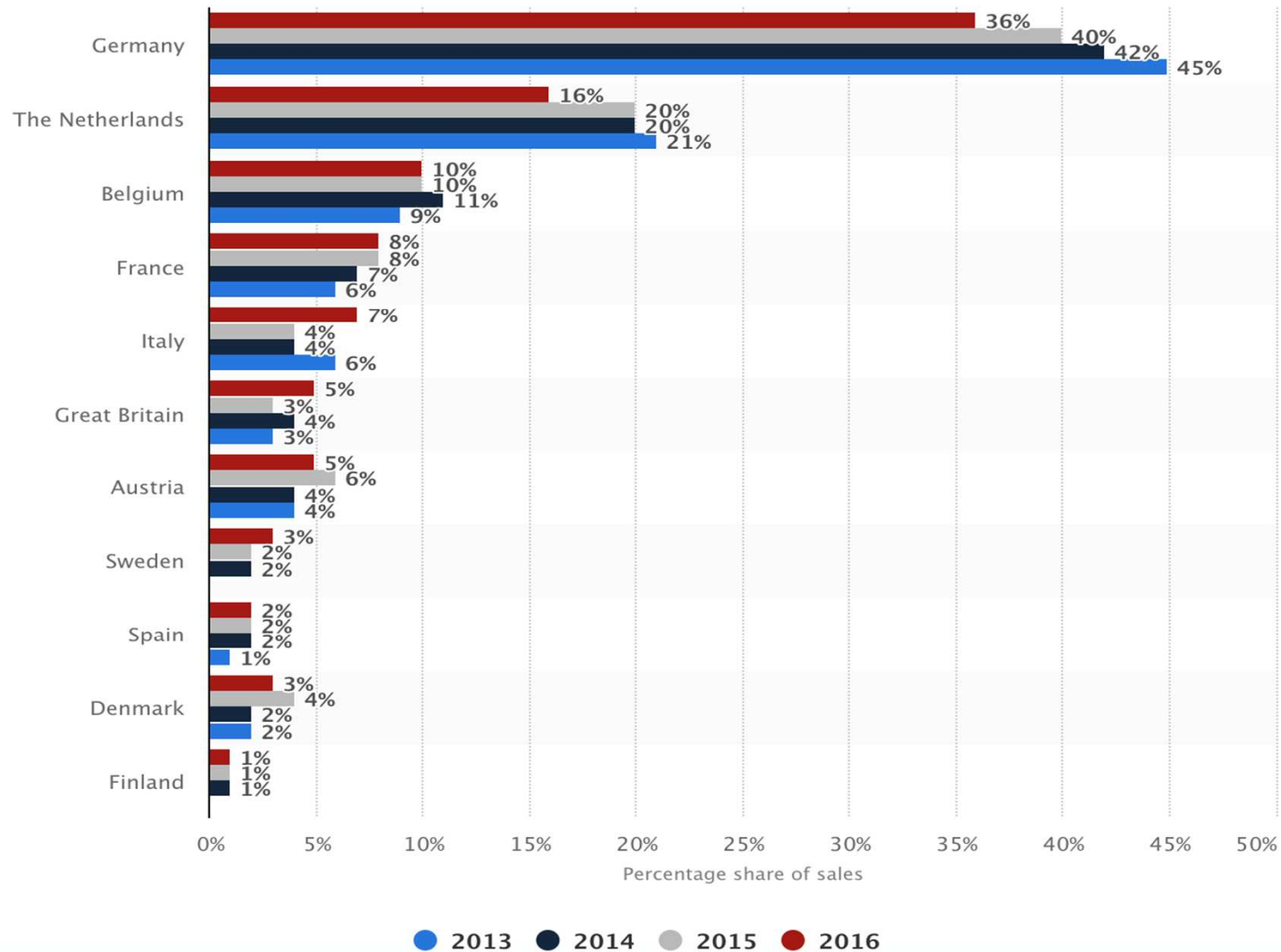


(Source: Pike Research)





# Qual è il «market share» delle e-bike in Europa?

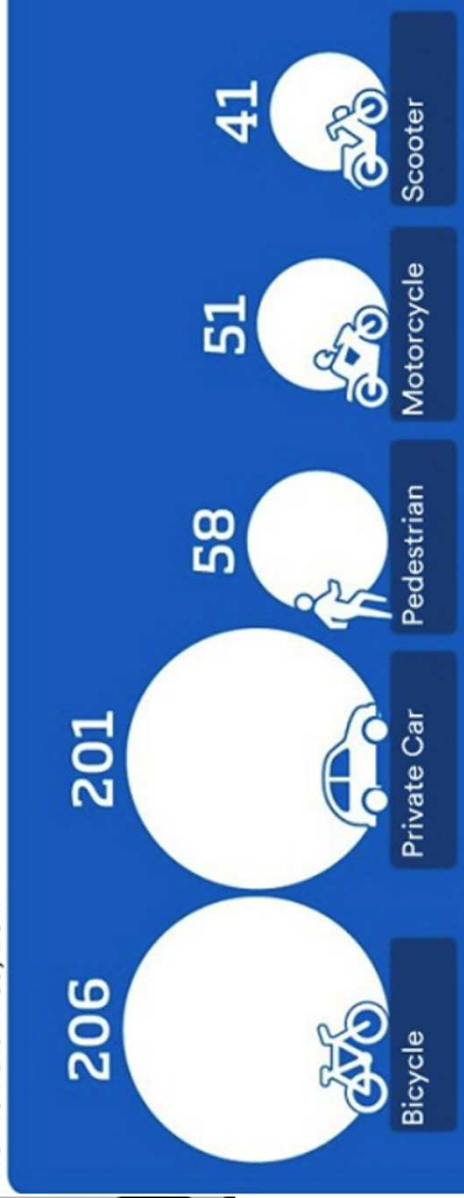




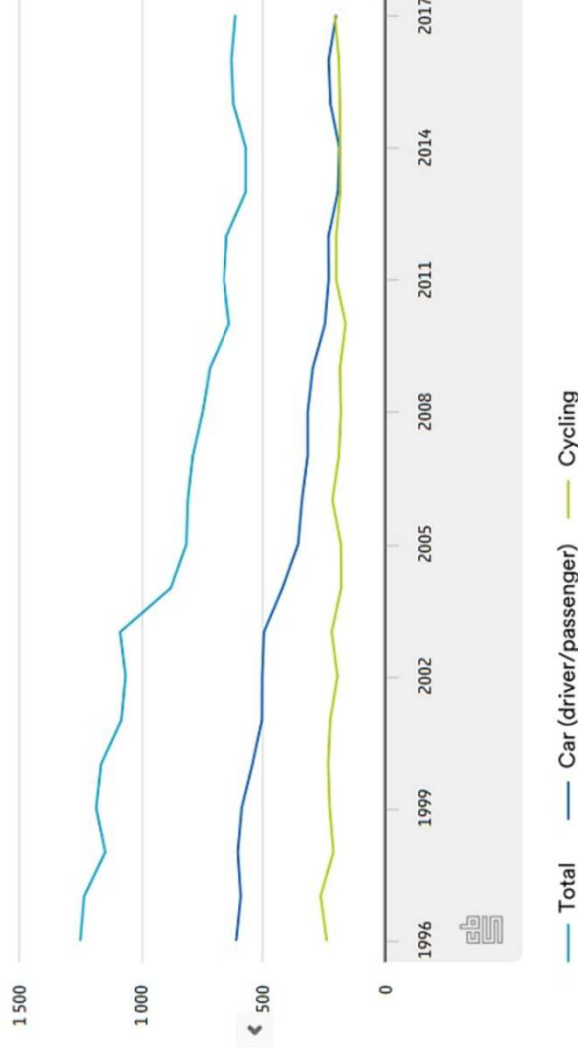
# Olanda, si muore più in bici che in auto. E-bike sotto accusa

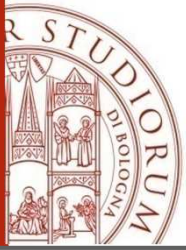


Traffic Fatalities, 2017



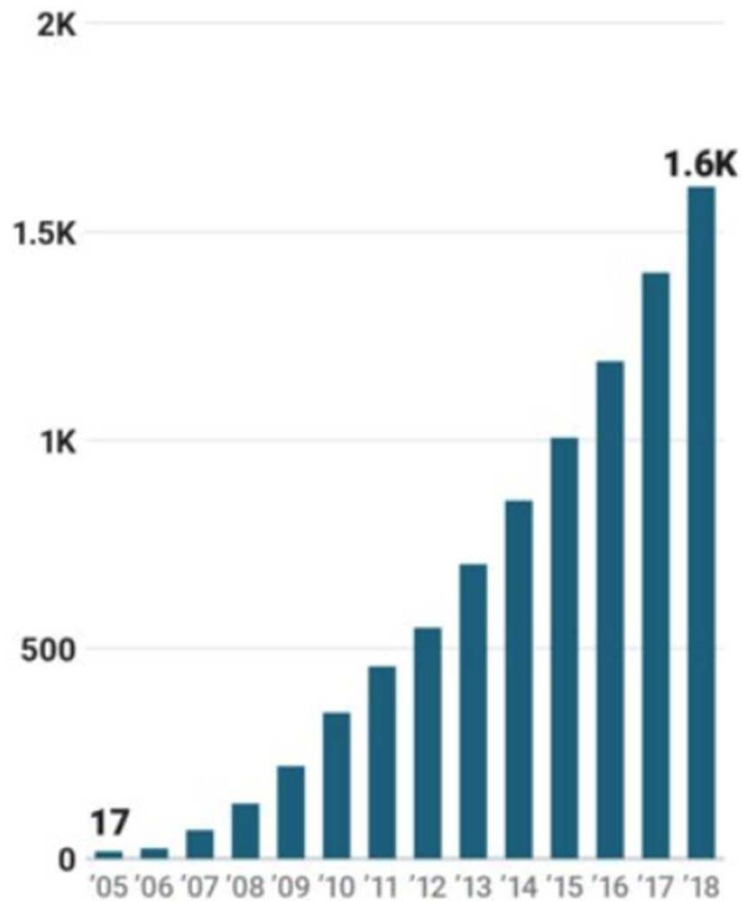
Traffic Fatalities



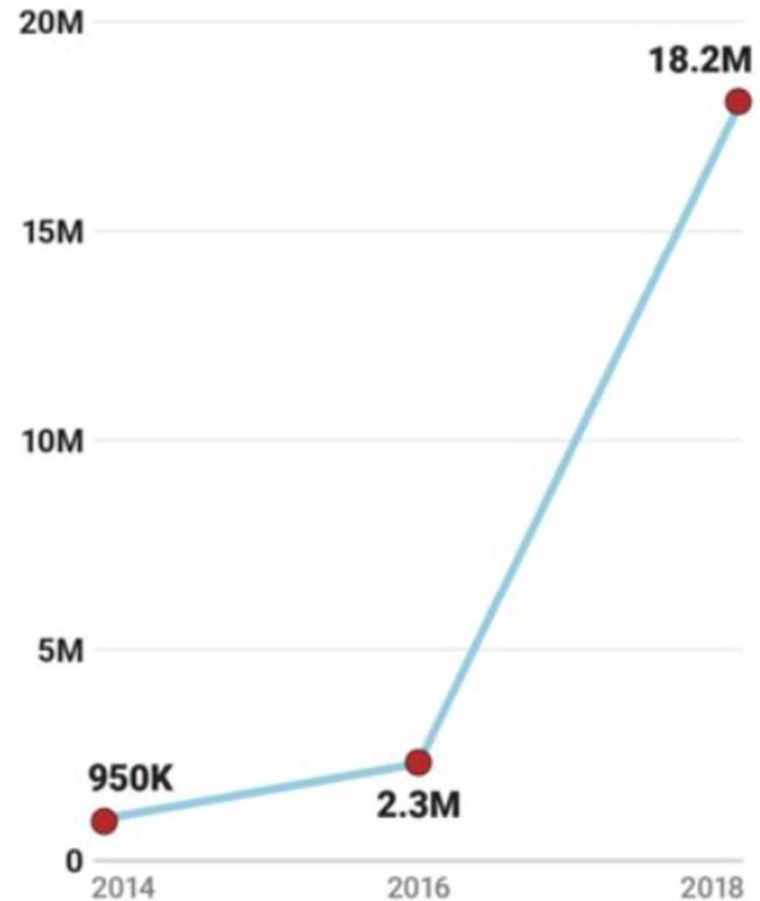


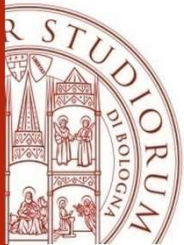
# L'aumento dei programmi di «bike sharing» nel mondo

Number of bike sharing programs worldwide

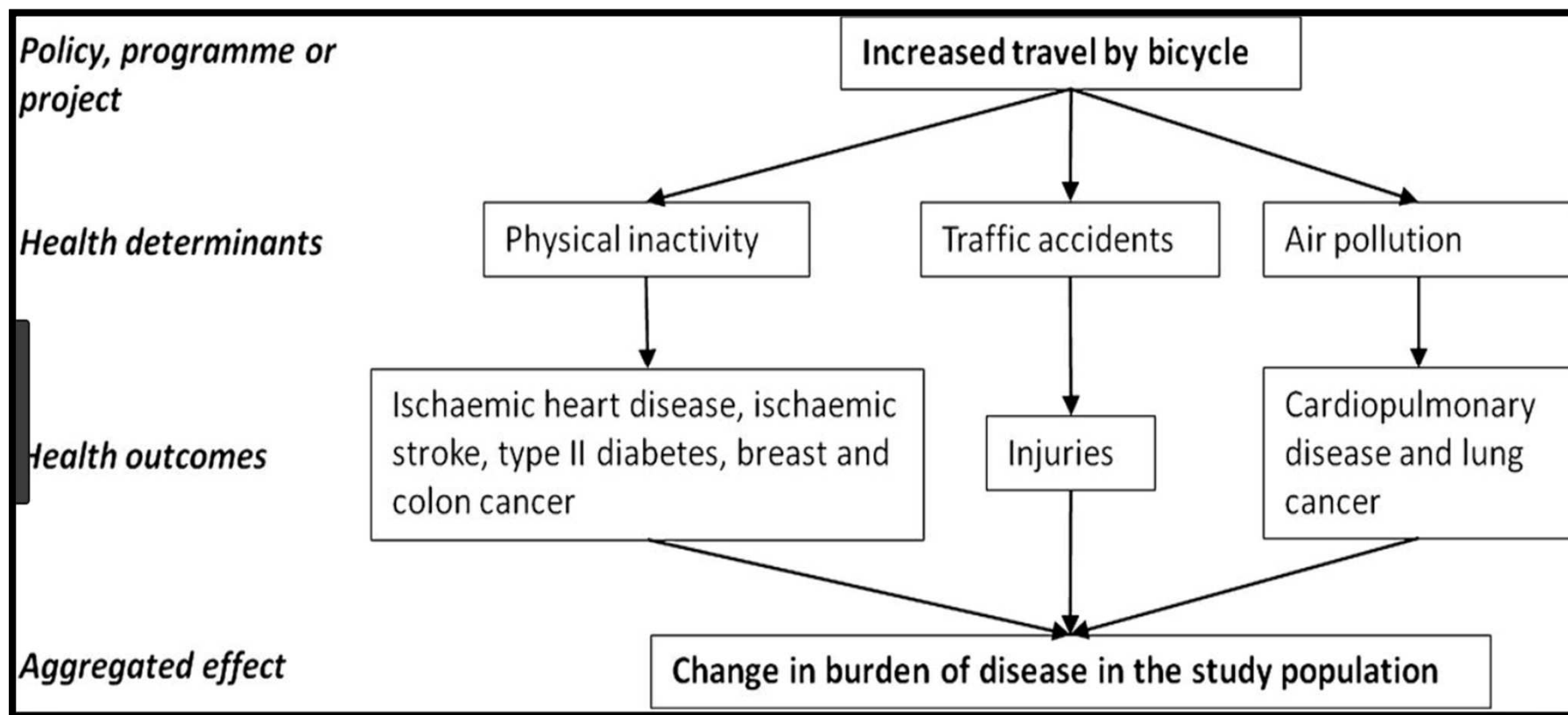


Number of public-use bicycles worldwide





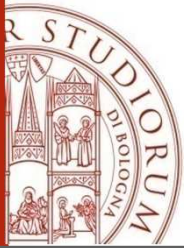
## Quali effetti sulla salute personale e collettiva?



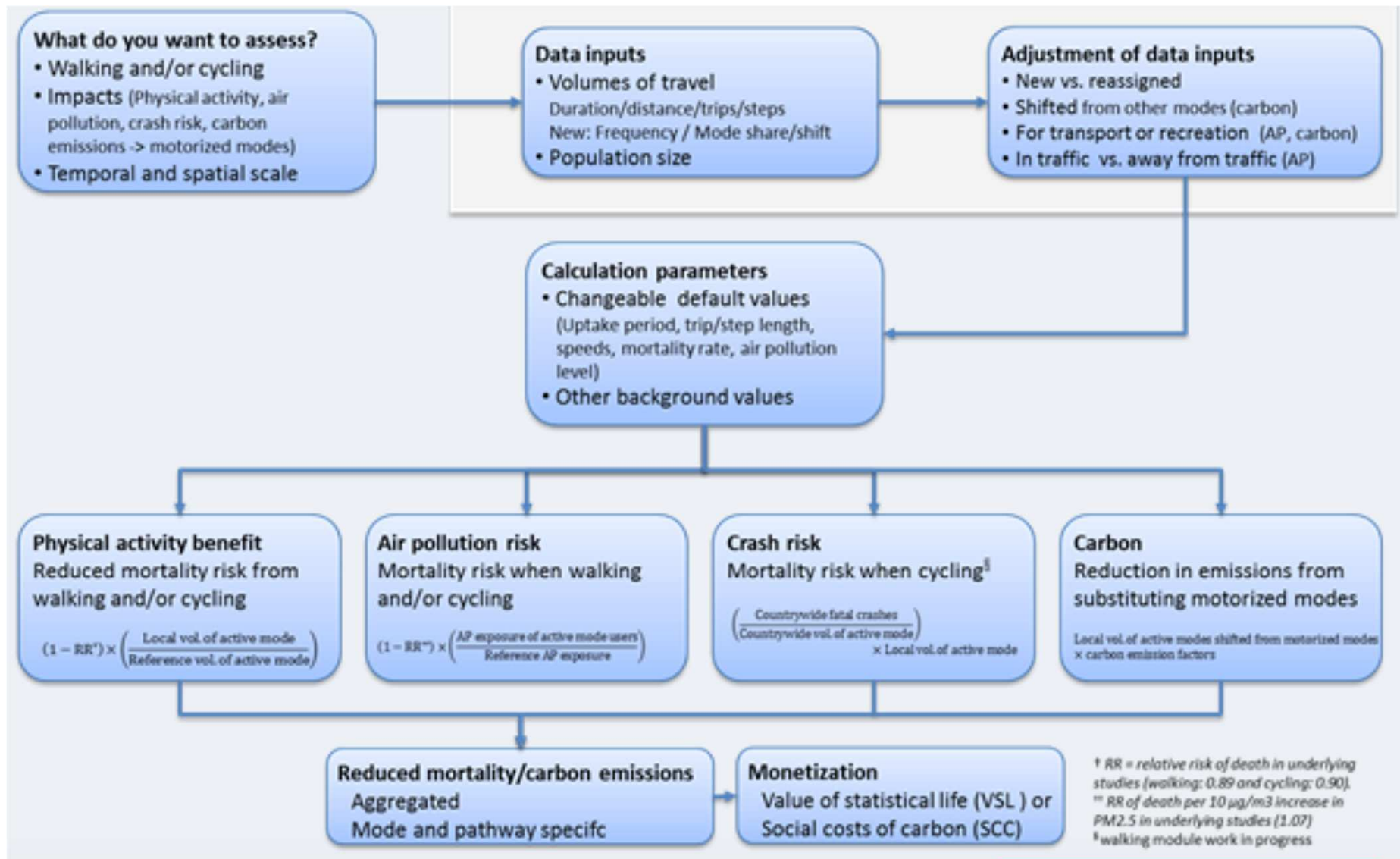
Source: British Medical Journal

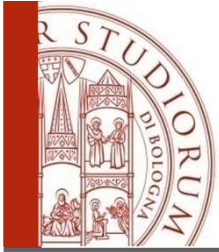
Holm, A. L., Glümer, C., & Diderichsen, F. (2012). Health Impact Assessment of increased cycling to place of work or education in Copenhagen. *BMJ open*, 2(4), e001135.





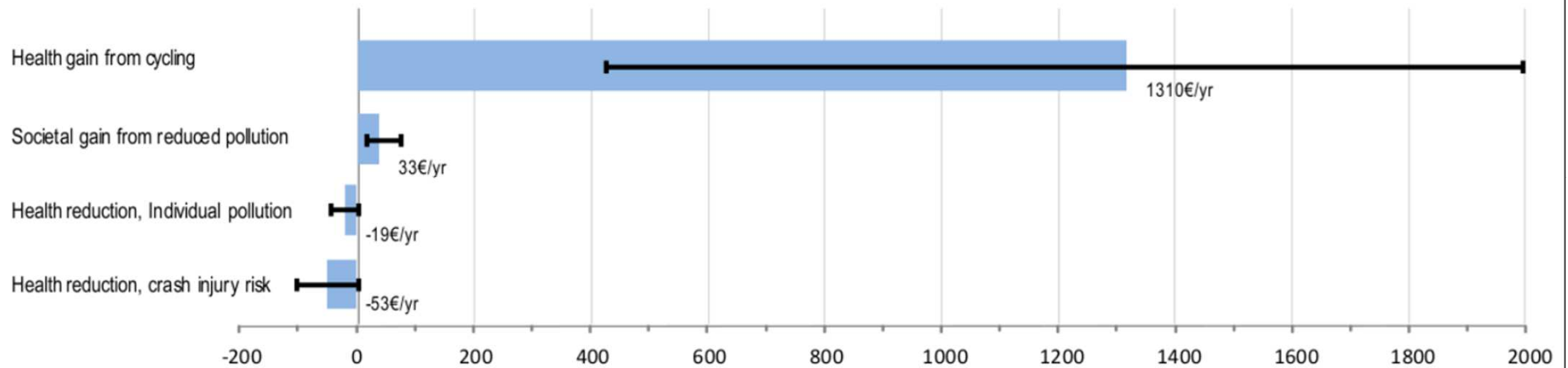
# Health Economic Assessment Tool (HEAT) for walking and cycling by WHO/Europe





# Quali benefici dal cambio modale nelle città europee?

**Figure 1: Estimated mortality costs and benefits per individual switching from car to bicycle for work trips\* in large European cities**

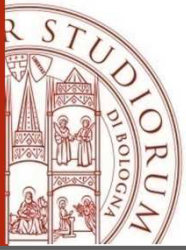


\* 2x5km daily roundtrip, 5 days per week, 46 weeks per year

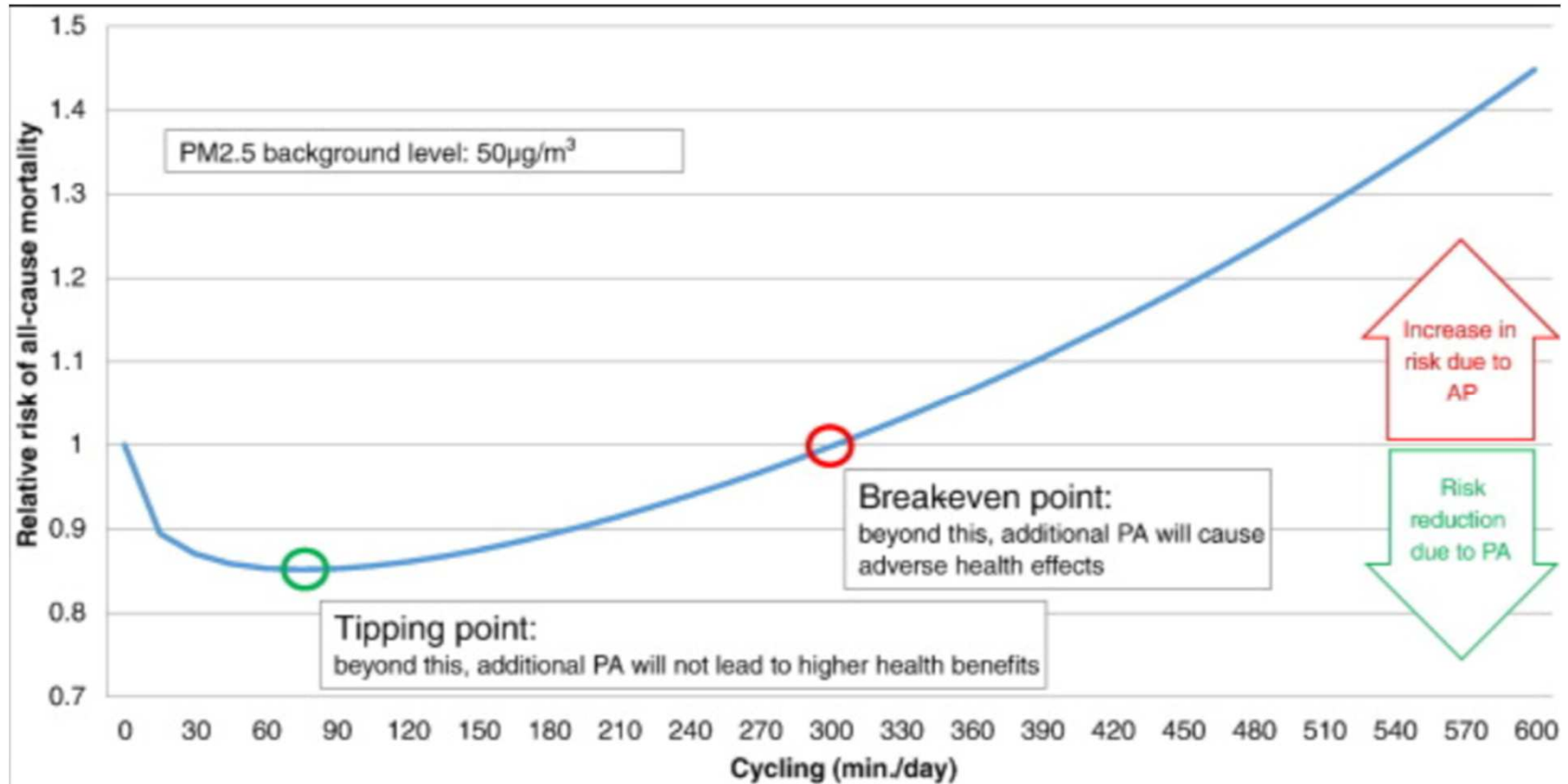
Source: Transport Policy

Rabl, A., & De Nazelle, A. (2012). Benefits of shift from car to active transport. *Transport policy*, 19(1), 121-131.



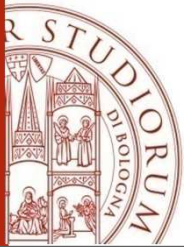


## Quale relazione tra cycling e mortalità considerando la qualità dell'aria?

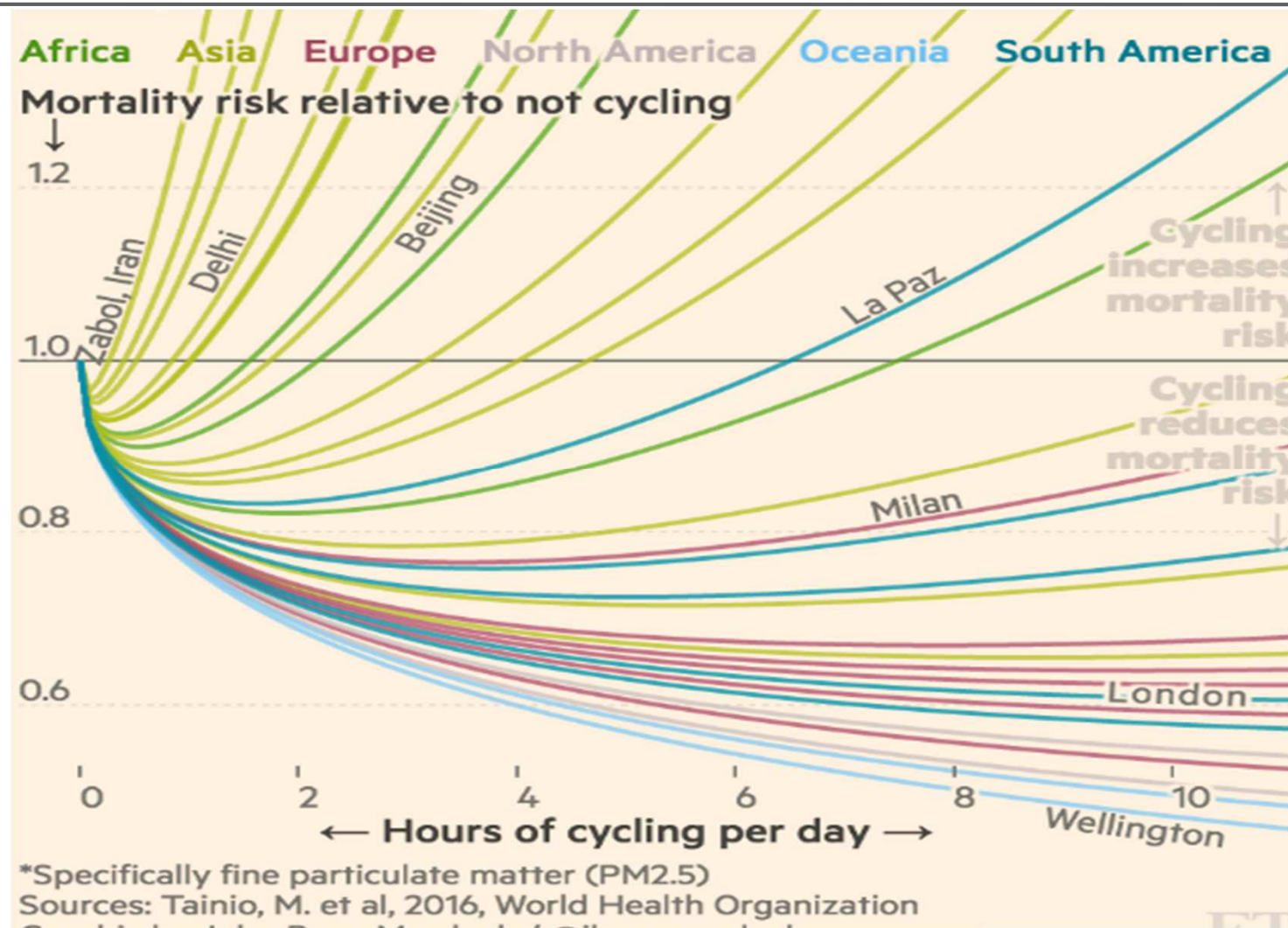


Source: ECF





## In una città come Milano il «breakeven point» è più di 8 ore al giorno!





# Quante persone in Europa perdono la vita mentre usano la bicicletta?

2000 morti  
6 al giorno

8% dei morti  
legati al traffico



Table 1: Number of cyclist fatalities by country, 2006-2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
BE	92	90	86	89	70	70	69	73	76	83
BG	-	-	35	29	-	-	-	-	-	-
CZ	110	116	93	84	80	63	78	74	68	84
DK	31	54	54	25	26	30	22	33	30	26
DE	486	425	456	462	381	399	406	354	396	383
EE	13	13	9	7	0	0	0	0	0	0
IE	9	15	13	7	5	9	8	5	-	-
GR	21	16	22	15	23	13	21	15	19	11
ES	72	90	59	57	67	48	74	70	75	58
FR	181	142	148	162	147	141	164	147	159	149
HR	-	28	47	29	28	28	21	23	19	34
IT	311	352	288	295	265	282	292	251	273	251
CY	2	3	6	2	2	2	1	2	1	1
LV	33	18	15	26	13	15	18	13	16	9
LT	-	-	-	-	-	-	-	18	19	22
LU	0	0	0	2	1	2	0	0	0	0
HU	153	158	109	103	92	85	84	68	98	83
MT	0	0	0	0	0	-	-	-	-	-
NL	179	147	145	138	119	144	145	112	118	107
AT	48	37	62	39	32	42	52	52	45	39
PL	509	498	433	371	280	314	300	306	286	300
PT	40	34	42	29	33	45	32	29	35	25
RO	198	179	179	157	182	140	154	161	151	162
SI	15	17	17	18	17	16	12	16	-	14
SK	52	61	46	22	27	-	-	-	-	-
FI	29	22	18	20	26	19	19	20	27	30
SE	26	33	30	20	21	21	28	14	33	-
UK	147	138	117	104	111	109	120	113	116	100
<b>EU</b>	<b>2.820</b>	<b>2.721</b>	<b>2.529</b>	<b>2.311</b>	<b>2.077</b>	<b>2.093</b>	<b>2.176</b>	<b>2.007</b>	<b>2.118</b>	<b>2.043</b>
Yearly Change		-3,5%	-7,0%	-8,6%	-10,1%	0,8%	3,9%	-7,8%	5,5%	-3,6%
IS	0	0	0	0	0	0	0	0	0	1
NO	-	-	-	-	-	-	-	-	-	-
CH	8	7	10	9	5	12	12	10	12	5

Source: CARE database, data available in May 2017

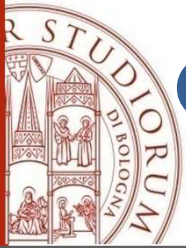




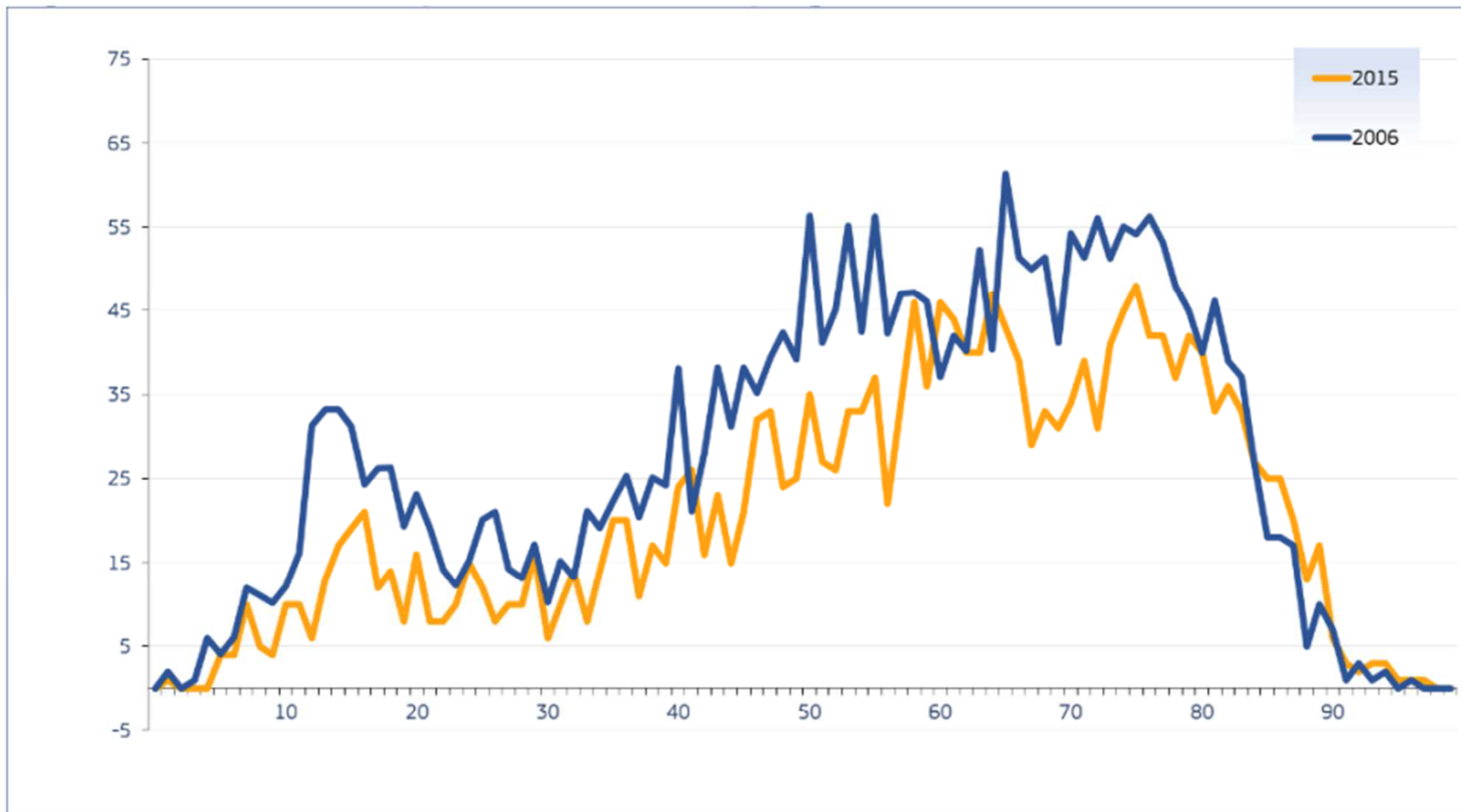
lower mass, stability and  
lack of physical protection

cycling is often associated with safety concerns

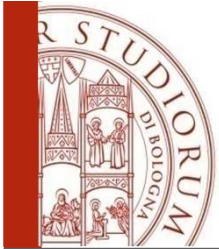




# Quali fasce di età sono più vulnerabili?

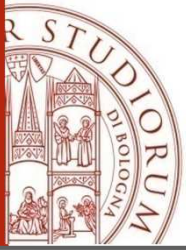


Source: CARE database, data available in May 2017

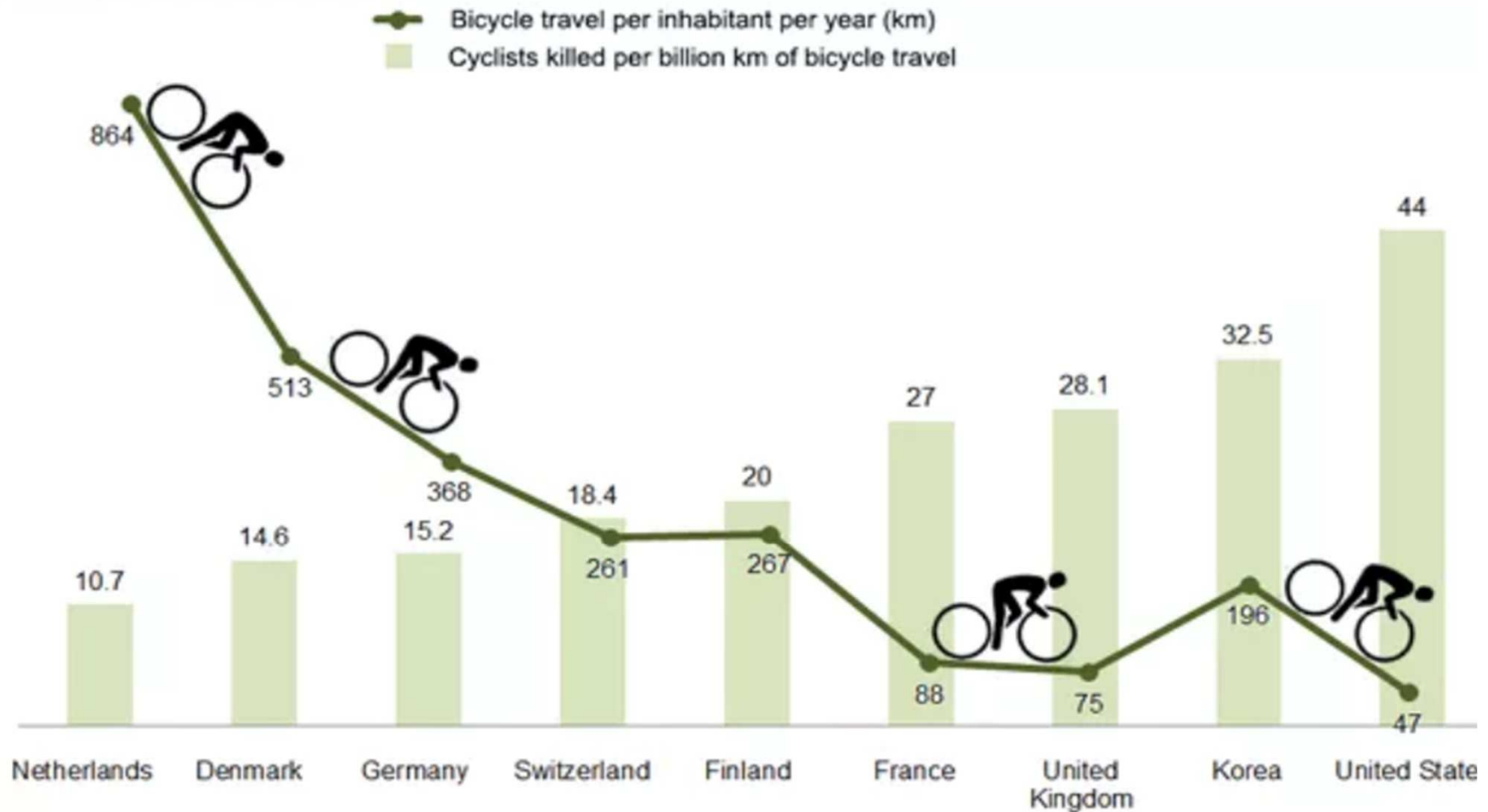


# «Sicurezza nei numeri»





# «Sicurezza nei numeri»



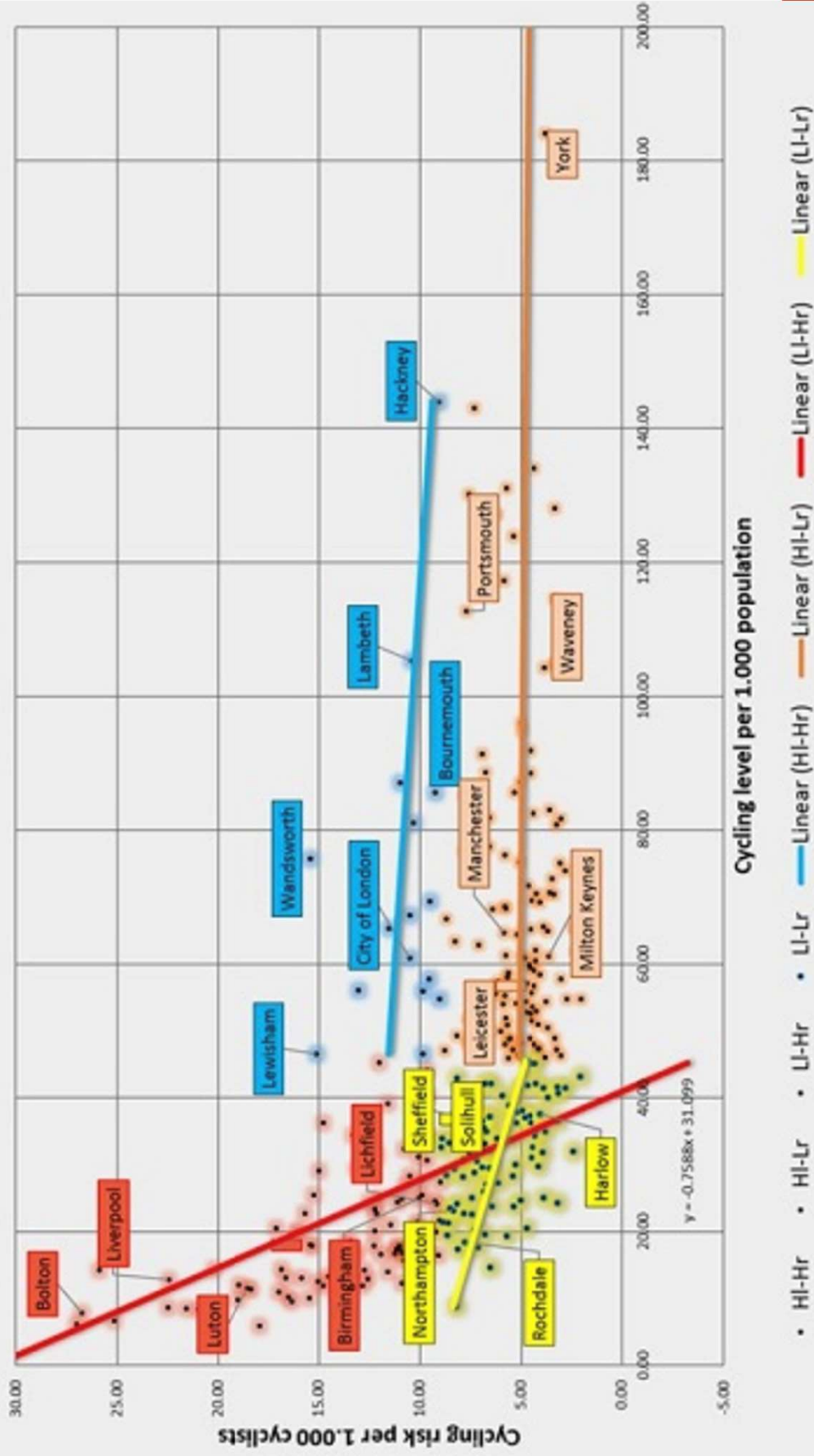
## Source: Injury prevention

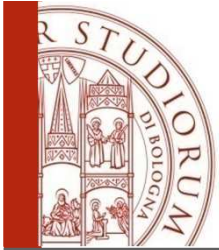
Jacobsen, P. L. (2015). Safety in numbers: more walkers and bicyclists, safer walking and bicycling. *Injury prevention*, 21(4), 271-275.





## Cycling level per 1.000 population and cycling risk per 1.000 cyclists in England's cities

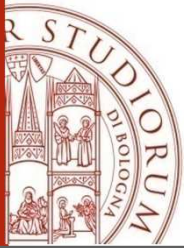




## «Sicurezza nei numeri» testata con le variazioni stagionali nel numero di ciclisti nel traffico

		April to June	June to September
H1	Cyclists overlooks by cars	↘	↘
H2	Cyclists overlooks by pedestrians	→	↘
H3	Car drivers surprise by cyclists	→	→
H4	Pedestrians' surprise by cyclists	→	→
H5	Cyclists near-misses with cars	↘	→
H6	Cyclists near misses with pedestrians	↘	↗
H7	Conflicts with cars (video)	→	↘
H15	Tram drivers' surprise by cyclists	↘	→



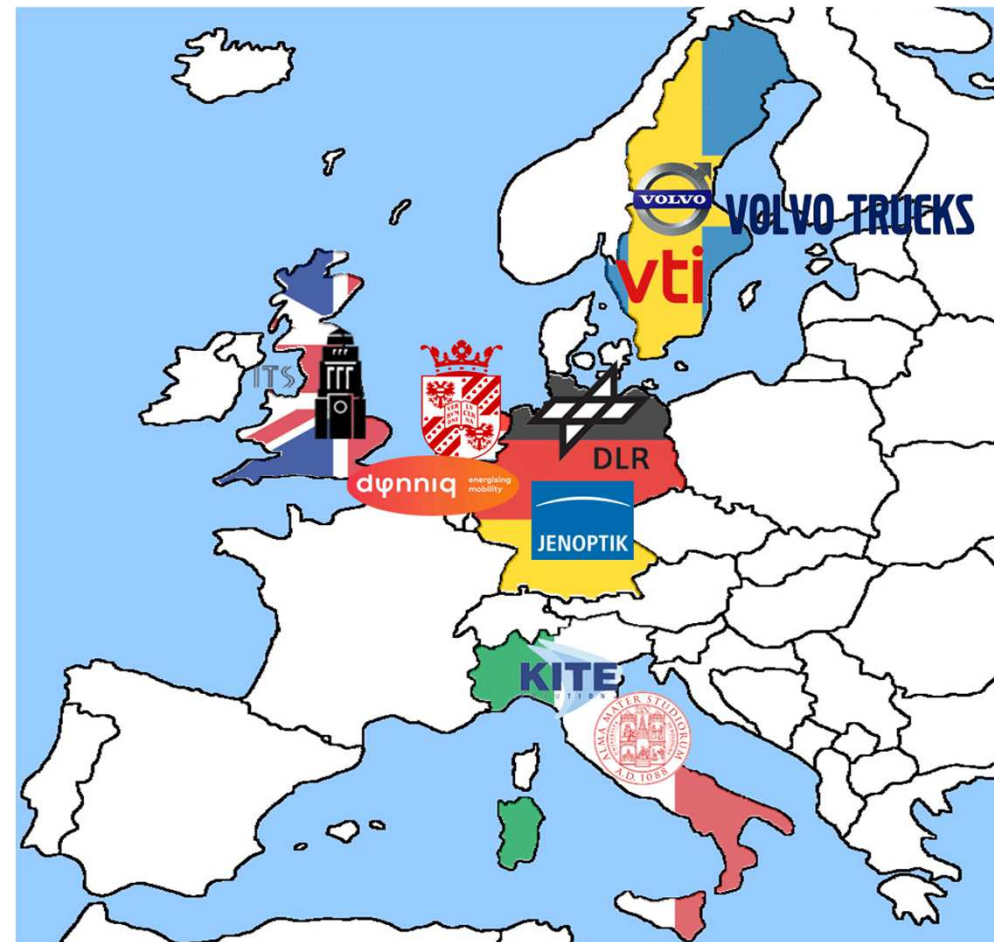


# The XCYCLE Project

Duration: 42 months  
(May 2015 - Nov 2018)

Coordinated by the University of  
Bologna, Italy

Advanced measures to reduce  
cyclists' fatalities and increase  
comfort in the interaction with  
motorised vehicles



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 723970



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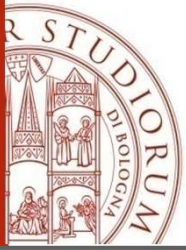


Bologna, KoM 2015



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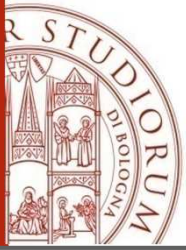


# Main scientific achievements 1: Accident analysis



- **New methods** for accident analysis based on big data and data mining techniques
- Identified factors contributing to B-MV collisions frequency, severity and **key features of cyclist crashes**
- Accounting for personal characteristics and EU countries national differences

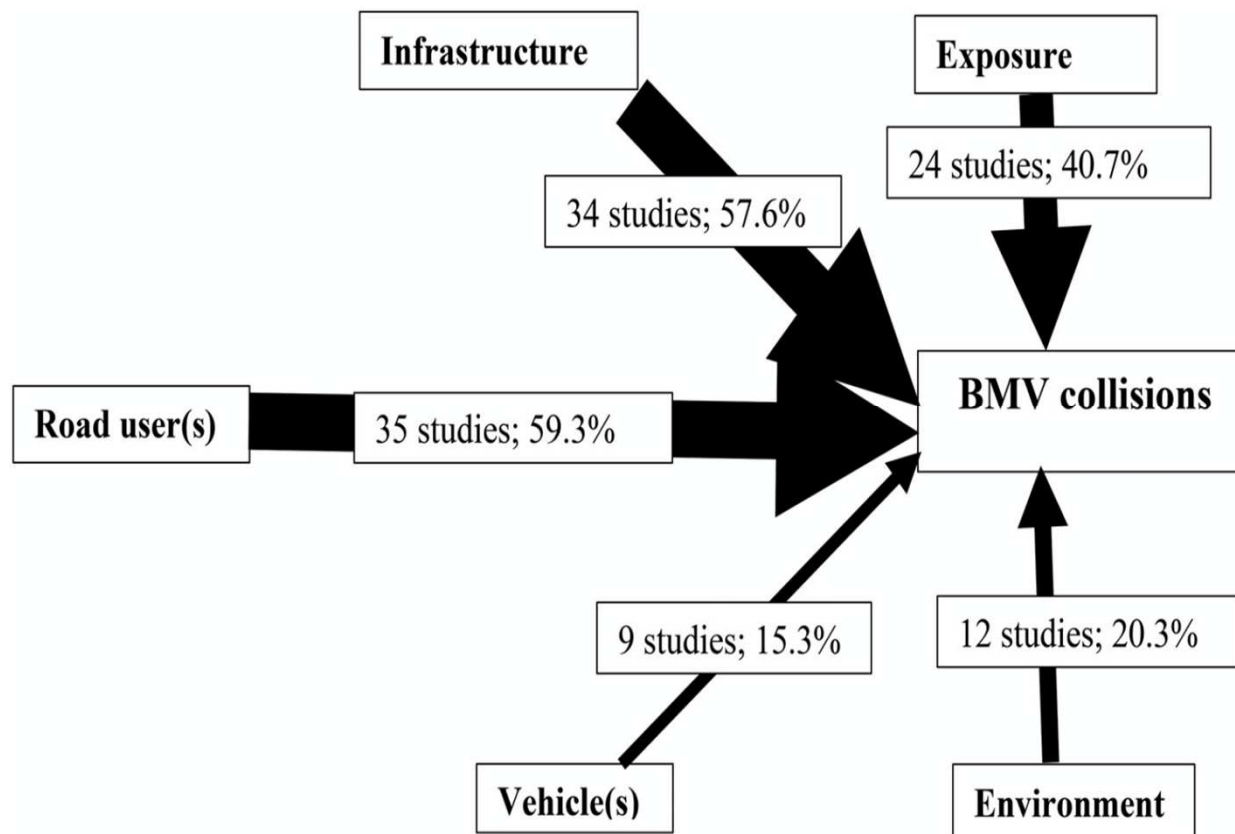


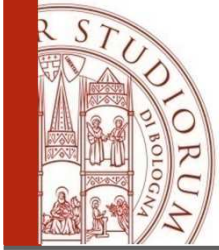


# Quali fattori contribuiscono alle Bicycle – Motorized Vehicles collisions?

Prati, G., Marín Puchades, V., De Angelis, M., Fraboni, F., & Pietrantoni, L. (2017). Factors contributing to bicycle–motorised vehicle collisions: a systematic literature review. *Transport Reviews*, 1-25

8525 studies screened → 355 full-text articles assessed → 59 studies reviewed  
Period: 1976-2016





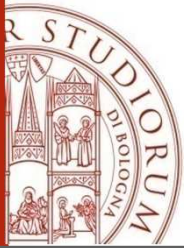
# What are the most dangerous scenarios?

Prati, G., De Angelis, M., Puchades, V. M., Fraboni, F., & Pietrantoni, L. (2017). Characteristics of cyclist crashes in Italy using latent class analysis and association rule mining. *PLoS one*, 12(2), e0171484.

Database: 575.093 road accidents → 49.621 accidents in which at least one cyclist ended up injured or killed in Italian roads (ISTAT)

Period: 2011-2013





# Main scientific achievements 2: Human factors in cycling



Errors and violations, unsafe behaviours, near misses

Perceived competence

Risk perception

Interaction between road users



## Red-light running behavior of cyclists in Italy: An observational study

F. Fraboni\*, V. Marín Puchades, M. De Angelis, L. Pietrantonj, G. Prati

*Department of Psychology, Alma Mater Studiorum, University of Bologna, Via Bertè Pichat 5, 40126, Bologna, Italy*



Fig. 3. BEV and observers' POV pictures of site 3.



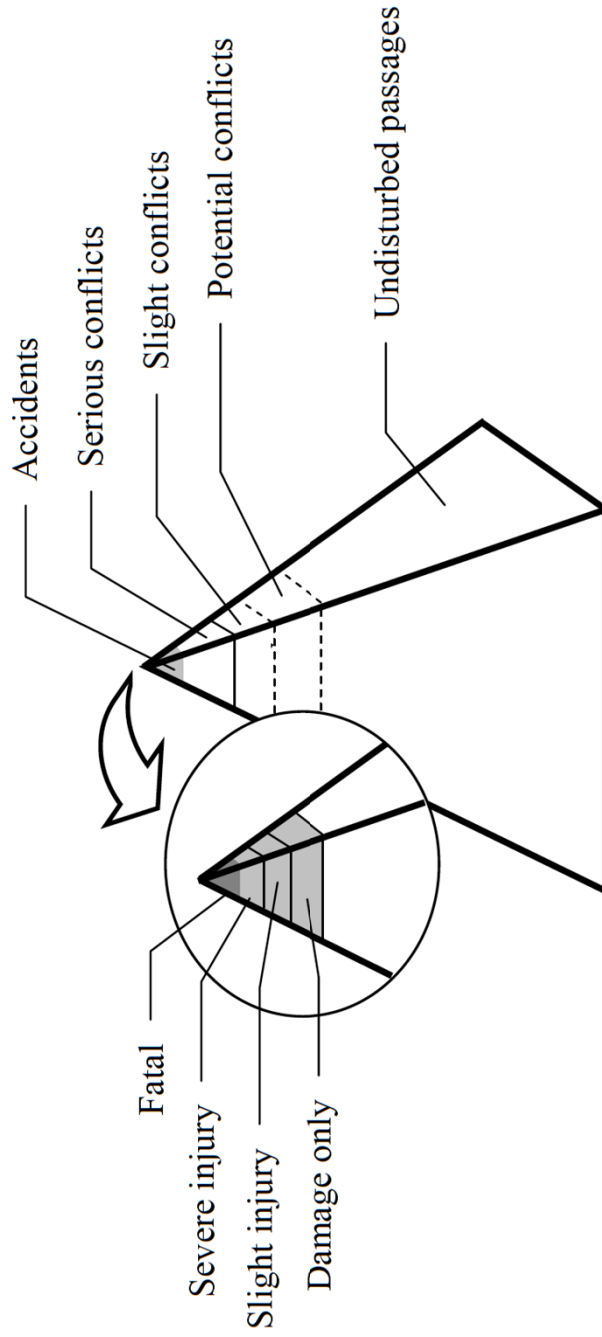
Fig. 4. BEV and observers' POV pictures of site 4.

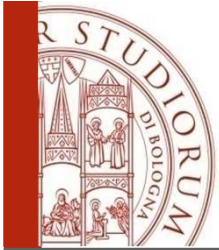


## Unsafe cycling behaviours and near crashes among Italian cyclists

Victor Marin Puchades, Luca Pietrantoni, Federico Fraboni, Marco De Angelis and Gabriele Prati

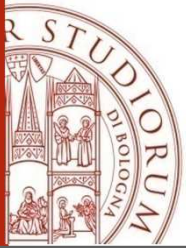
Dipartimento di Psicologia, Università degli Studi di Bologna, Bologna, Italy





# Installazione di Traffitower “stereo-cameras” ad una “intersezione di ricerca” nel traffico reale in Germania





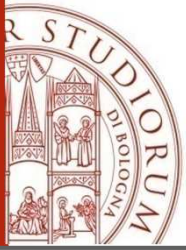
## Un mezzo pesante Volvo con un Sistema in-vehicle che interagisce con altri sistemi in modo cooperativo







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# Main technological achievements 1: Advanced cooperative systems



Transportation

Conference Paper

Mobile Information Systems  
Volume 2017, Article ID 8149348, 13 pages  
<https://doi.org/10.1155/2017/8149348>

Hindawi

Research Article

**High-Accuracy Tracking Using Ultrawideband Signals for Enhanced Safety of Cyclists**

Davide Dardari,<sup>1</sup> Nicolò Decarli,<sup>1</sup> Anna Guerra,<sup>1</sup> Ashraf Al-Rimawi,<sup>1</sup> Victor Marin Puchades,<sup>2</sup> Gabriele Prati,<sup>2</sup> Marco De Angelis,<sup>2</sup> Federico Fraboni,<sup>2</sup> and Luca Pietrantoni<sup>2</sup>

<sup>1</sup>Department of Electrical, Electronic and Information Engineering "Guglielmo Marconi", The University of Bologna, Bologna, Italy

em 16 of the provisional agenda  
new regulation on Advanced Driver Assistance Systems (ADAS)

**Proposal for a new Regulation on uniform provisions concerning the approval of motor vehicles with regard to the Blind Spot Information System**

Submitted by the expert from Germany\*

- XCYCLE in-vehicle perception system for blind spot detection and collision warning
- On-bike detection and warning system





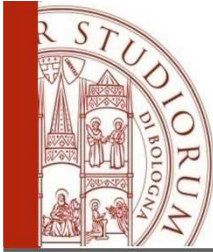
## Multimodal warnings



**AEB (Automatic Emergency Braking)**



**DRIN DRIN!!**  
I AM HERE



Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

## Transportation Research Part F

journal homepage: [www.elsevier.com/locate/trf](http://www.elsevier.com/locate/trf)



### Evaluation of user behavior and acceptance of an on-bike system

Gabriele Prati <sup>a,\*</sup>, Víctor Marín Puchades <sup>a</sup>, Marco De Angelis <sup>a</sup>, Luca Pietrantoni <sup>a</sup>, Federico Fraboni <sup>a</sup>, Nicolò Decarli <sup>b</sup>, Anna Guerra <sup>b</sup>, Davide Dardari <sup>b</sup>

<sup>a</sup> Department of Psychology, University of Bologna, Viale Europa 115, 47521 Cesena, EC, Italy

<sup>b</sup> Department of Electrical, Electronic and Information **Table 1**

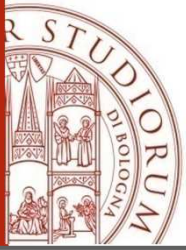
Reliability (Cronbach's alpha), correlations (Kendall rank correlation coefficients) among and descriptive statistics for key study variables.

	M	SD	$\alpha$	1	2	3	4	5	6	7	8	9	10	11	12
1. Risk perception of mixed traffic	3.39	0.90	0.73	-											
2. Perceived usefulness	3.71	0.82	0.90	0.24	-										
3. Perceived ease of use	4.22	0.97	0.78	-0.18	0.25	-									
4. Attitude toward technology	3.80	0.83	0.86	0.08	0.49	0.48	-								
5. Facilitating conditions	3.72	0.88	0.70	0.04	0.49	0.46	0.49	-							
6. Anxiety	2.05	0.99	0.84	-0.04	-0.43	-0.62	-0.61	-0.49	-						
7. Perceived safety	3.99	0.82	0.75	-0.05	0.48	0.31	0.53	0.27	-0.36	-					
8. Trust	4.16	1.25	-	-0.05	0.38	0.30	0.57	0.33	-0.48	0.42	-				
9. Social influence <sup>a</sup>	3.52	0.97	-	0.11	0.49	0.36	0.60	0.37	-0.53	0.17	0.49	-			
10. Behavioral intention to use	3.99	1.28	0.89	-0.01	0.40	0.35	0.56	0.45	-0.51	0.62	0.63	0.36	-		
11. WTP	57.83	43.06	-	0.06	0.12	0.00	0.22	0.26	-0.12	-0.15	0.24	0.17	-0.09	-	
12. WTA	43.73	31.59	-	-0.03	0.09	-0.02	0.28	0.16	-0.17	0.13	0.45	0.03	0.20	0.54	-

Note. All correlation coefficients higher than 0.33 are significant at the 0.05 level.

<sup>a</sup> Correlation between the two items was .41 ( $p < .05$ ).

Field study: 25 participants aged 19-57 years



# Main technological achievements 2: Green wave for cyclists

## 1 Bicycle modelling in SUMO for accurate traffic simulation

Robbin Blokpoel and Mahtab Joueiai; Dynniq  
{Robbin.Blokpoel, Mahtab.Joueiai}@Dynniq.com

Paper number EU-TP0252

## Sensory observation message and CAM extensions for VRU safety

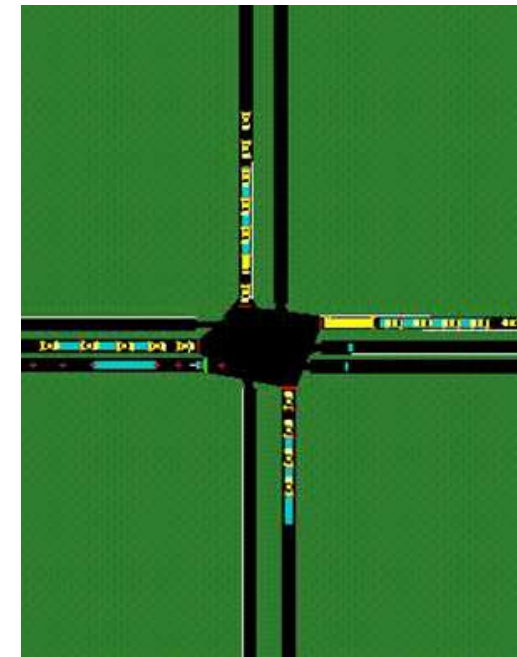
Robbin Blokpoel<sup>1</sup>, Arjan Stuiver<sup>2</sup>

15<sup>th</sup> ITS World Congress, Copenhagen, Denmark, 17–21 September 2018

Paper ID EU-TP1125

## A scale-up network level study of green wave with speed advice for cycling

Xiaoyun Zhang<sup>1\*</sup>, Robbin Blokpoel<sup>2</sup>



## Dynniq traffic simulations and **adaptive** traffic management algorithm

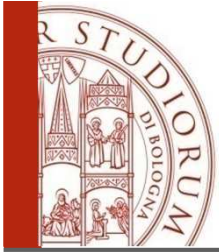
Participants: 450 Italian and Dutch young adults (aged 18-34 years)



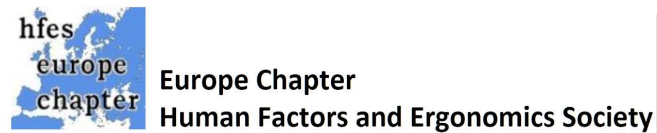
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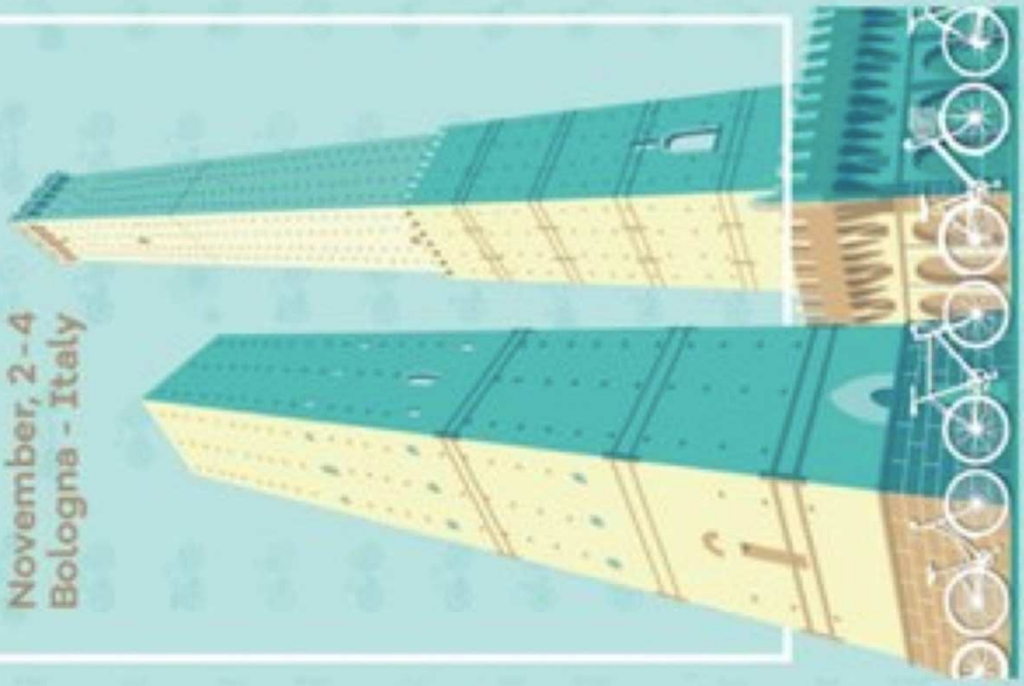
# Comunità scientifiche



ALMA MATER STUDIORUM  
UNIVERSITÀ DI BOLOGNA

# iCSC International Cycling Safety Conference 2016

November, 2-4  
Bologna - Italy



# #SALVAICICLISTI CITTÀ A MISURA DI BICICLETTA





## XCYCLE H2020 Project

45 follower

5m



Don't miss the chance to get updated on the latest European solutions for Traffic Safety. Three European Projects join for a Final Event dedicated to the protection of Vulnerable Road Users. Appointment in Spain, October 12th, 2018. ... vedi altro

 [Vedi traduzione](#)



**FINAL EVENT**  
of the European projects on  
Traffic Safety of Vulnerable Road Users

12<sup>th</sup> October 2018 at Appiulus IDIADA

**InDev** **XCYCLE** **PROSPER**  
Positive Safety for  
Pedestrians and Cyclists

These projects are co-funded by the European Union's Horizon 2020 Research and Innovation Programme under the following Grant Agreements: No. 631148, No. 635525, and No. 635973.

Consigliato 1 volta




Visualizzazioni organiche: 423 visualizzazioni

Mostra statistiche 





## THE XCYCLE SYSTEM: EFFECTS EVALUATION



**Objectives and Motivations**

Cyclists suffer a disproportionate share of serious injuries and mortality, stable in the recent years, and they are often not treated equally by traffic systems.

The XCYCLE project aims at reducing the number of cyclist fatalities, particularly due to the lack of infrastructure, by introducing a new type of infrastructure: the 'Green Wave' for road infrastructure, such as traffic light. To incentivize the everyday use of bicycle, not only safety, but also comfort must be improved. XCYCLE created a new algorithm for traffic management, which generates green waves fully adjusted to cyclists.

**Methods and Steps**

1. GREEN WAVE FOR CYCLISTS
2. GREEN WAVE FOR BICYCLISTS
3. GREEN WAVE FOR BICYCLISTS
4. GREEN WAVE FOR BICYCLISTS

**Results and Examples**

Tests in lab and in real environments assessed user acceptance and behavioral evaluation of the integrated system. Investigating actual behavior, attitudes and interaction with the systems. The AIM research interaction in Groningen and a crowded cross-road in Groningen were our main validation tests.

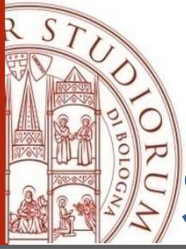
**FOR GREEN WAVE**

The XCYCLE team considered user acceptance and asked questions about the interaction with the system. The system implementation is a key factor in the early stages before implementation. The system is designed to be user-friendly and easy to use. The system is designed to be user-friendly and easy to use. The system is designed to be user-friendly and easy to use.

The XCYCLE system was evaluated through a series of tests. The tests were designed to evaluate the system's performance in terms of user acceptance, safety, and efficiency. The tests were conducted in a laboratory setting and in real-world environments. The results of the tests showed that the system was well-received by users and that it improved traffic flow and safety for cyclists.

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# Simulazione in realtà virtuale dei sistemi





# LET'S GET VISIBLE



**ACTION PLAN**

When and where to buy the equipment, how to install it and its scheduled periodical maintenance



**OTHERS APPROVAL**

People close to you, verify you'll be safe and justify about the pursuit. The law makes that, too



**FUTURE IMAGING**

This is what happens if you cycle without any safety lights or bicycle lights. Future get some glow!



## DOORING CYCLIST

**BTC NAME**

Demonstration of the correct behaviour

**TACKLING THE ISSUE**

A simple behaviour as the Dutch Reach to prevent cyclists dooring

Prompt / Cues

A bicycle shaped sticker in a visible place when opening car doors

Identification of self as role model

People close to you watch how you drive and deal with traffic

www.xcycle.it/2020

### XCYLE H2020 Project

31 followers  
8mo



Together. On the same road. Let's share it!  
#bikes and #cars on the same #road

... vedi altro

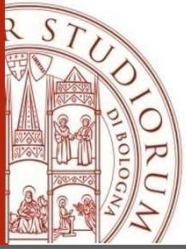


XCYLE dissemination activities in Bologna



## MOTORE PEDALI INSIEME

Insieme sulla strada si può.  
youtube.com



# Come aiutare i decisori ?

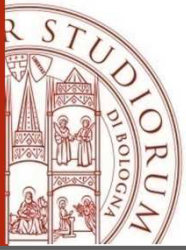
**SafetyCube** DSS  European Road Safety Decision Support

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- Road User Groups
  - [Cyclists](#)
  - [LGV / Van](#)
  - [Bus](#)
  - [Pedestrians](#)



# Quali contromisure sono efficaci? Grey, light green or green!

## Specific Measure

- reduction of speed limit
- dynamic & weather-variant speed limits
- Dynamic speed display signs
- speed cameras
- section control
- speed humps
- woonerfs implementation
- narrowings implementation
- 30-zones implementation
- traffic calming schemes
- school zones speed reduction measures

## Road User Group

- ALL



### Implementation of Woonerfs: ● GREY (UNCLEAR RESULTS) -

The results from the analysed literature show that implementing Woonerfs and similar schemes overall lead to reduced accident and speeding rates. Significant positive results were found in studies published before 1990, but the findings of the newer studies in this synopsis were not able to support the older findings because no statistical analysis was undertaken in the new studies. In addition, the results for shared space schemes were more mixed.



### Implementation of Narrowings: ● LIGHT GREEN (PROBABLY EFFECTIVE) -

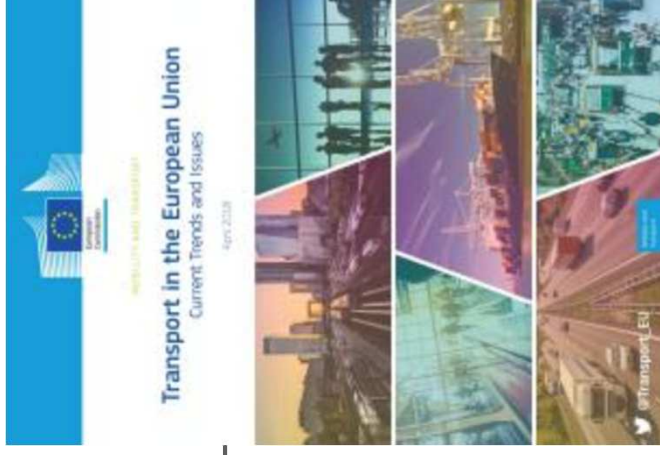
In this synopsis, the results of all but one study were based on speed, an indirect safety indicator. In the only accident study, other measures/features were also involved (e.g. speed-activated signs), which may have contributed to the positive effect. Overall, vehicle speeds decreased and drivers started to decelerate further away from the intersection/crossing when narrowings were implemented. Most results were statistically significant.



### School zones: ● LIGHT GREEN (PROBABLY EFFECTIVE) -

There is some indication that the installation of school zones can help to reduce speeds and improve road safety near schools. However, despite some improvements, there are still indications of frequent speeding and enhanced traffic risk in school zones.





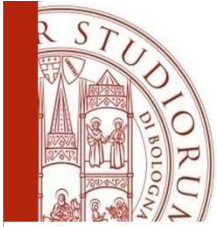
THE NEWSLETTER OF THE CONNECTED AUTOMATED DRIVING IN EUROPE INITIATIVE

#EUGoesDriverless

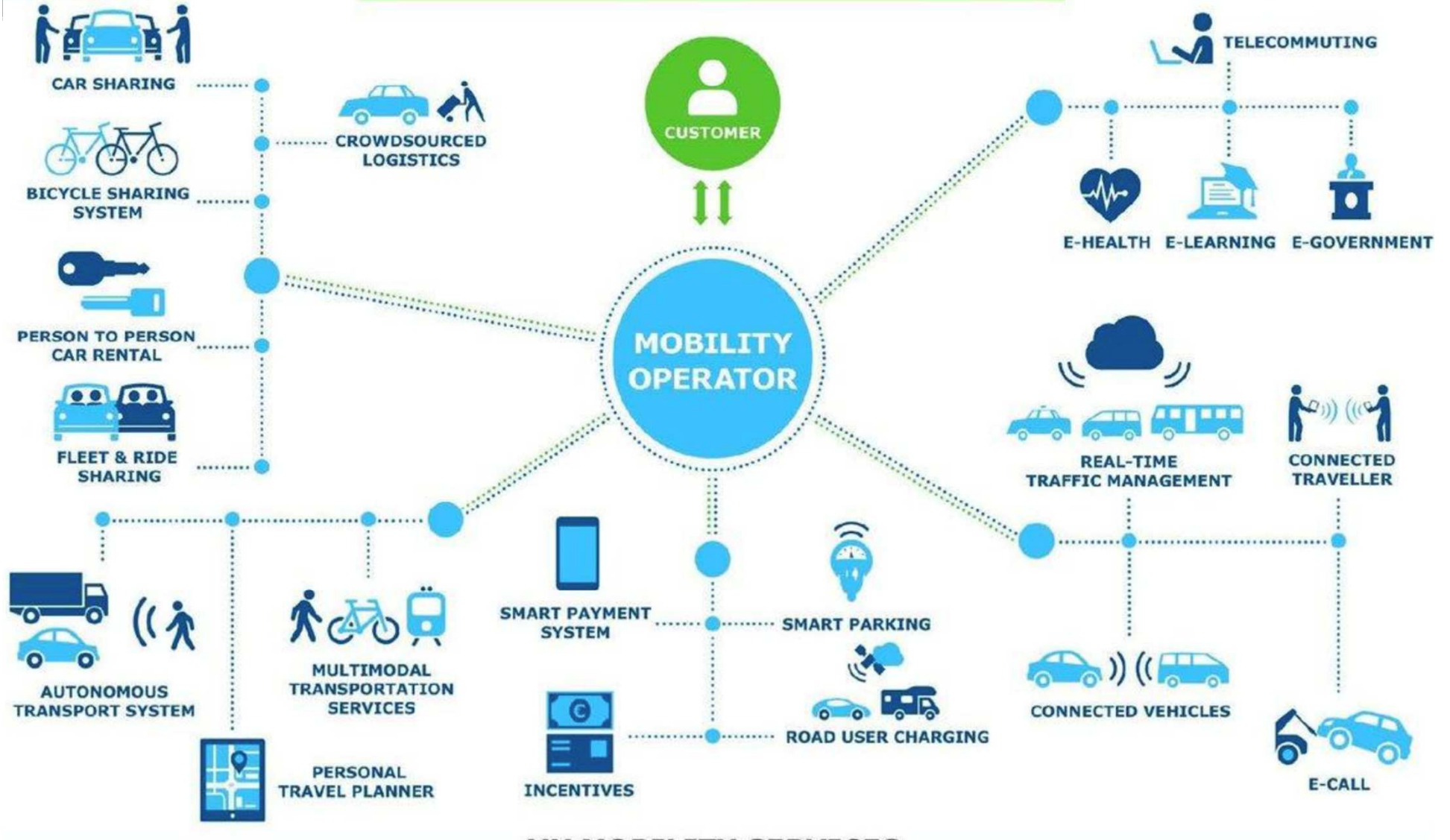
ISSUE N° 7 JUNE 2018

TOWARDS A COMPREHENSIVE EUROPEAN ROADMAP FOR CONNECTED AND AUTOMATED DRIVING





# MAAS Mobility As A Service







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*Grazie per  
l'attenzione*

<https://site.unibo.it/xcycle/en>



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**This Italian city gives you  
free beer and ice cream  
for riding your bike**

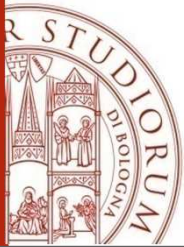
**Source: BBC**

	No EUCS	EUCS approved	Priority for cycling
Healthy lifestyle	+	++	+++
Urban planning	+	++	+++
Mobility as a service	+	++	+++
Importance of environment	+	++	++
Electric powered assisted cycles	+	++	+++
New bicycles	+	+	+
Innovative infrastructure for cyclists	+	++	+++
Autonomous cars	-	0	++
Price signals to customers	-	0	++
Behaviour – image of cycling	+	+	++
Growth in cycling by 2030:	+	+50%	+++

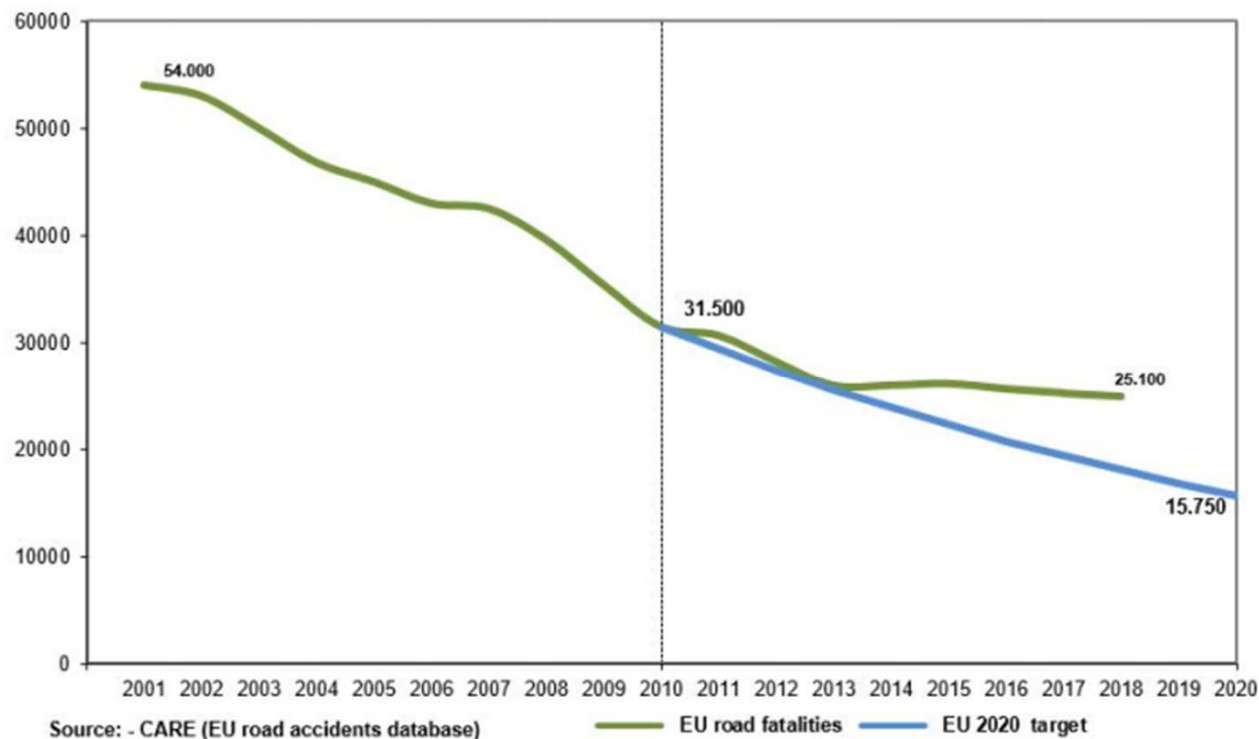
+ , ++ or +++ this trend/situation has positive impact on cycling

0 this trend has no impact on the level of cycling

- This trend has/can have negative impact on cycling in the specific scenario.



## Andamento del numero di vittime della strada a livello europeo



**in Italia il tasso di mortalità stradale è aumentato del 20% nel 2018 rispetto al dato del 2011.**

Source: European Commission

Fact Sheet - 2018 Road Safety statistics: what is behind the figures?



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