Deployment of bicycles in a MaaS system

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BINAMICS Bicycle Technology

Binamics

RESEARCH

KU LEUVEN TECHNOLOGY CAMPUS GHENT

TGVelo: Measuring the Quality of an Electric Bicycle

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POWVER.ORG

Quantitative verification
Chair for Dependable
Systems and Software

Draisine 200.0

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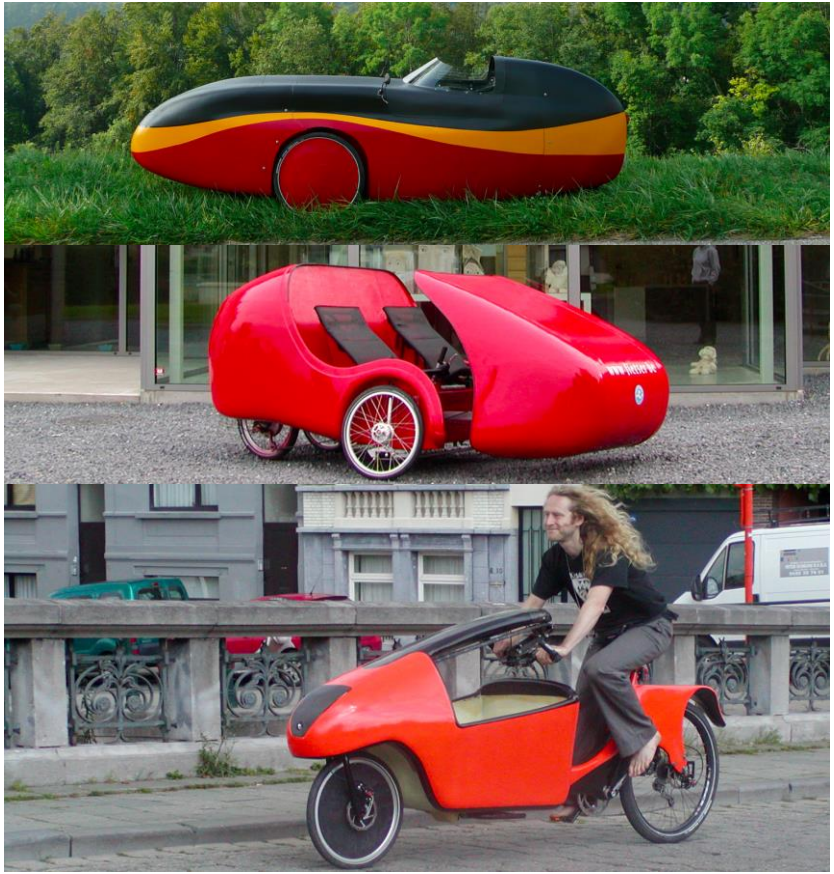
DEVELOPMENT



Alternatives in mobility

Mobility

Climate

Energy

Jams

Health

Safety

Spaces

Climate

Energy

Jams

Safety

Spaces

Electric / Hydrogen / CNG,…

Climate

Energy

Jams

Safety

Spaces

Electric cars

Autonomous vehicles

Climate

Energy

Jams

Safety

Spaces

Electric cars

Autonomous vehicles

Public transport

Climate

Energy

Jams

Safety

Spaces

Electric cars

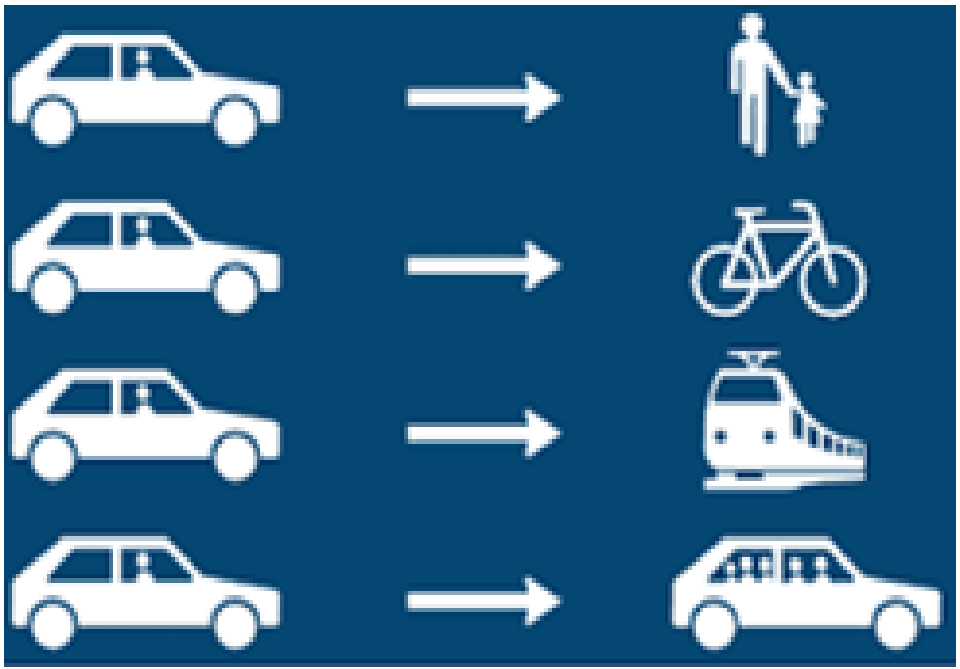
Autonomous vehicles

Public transport

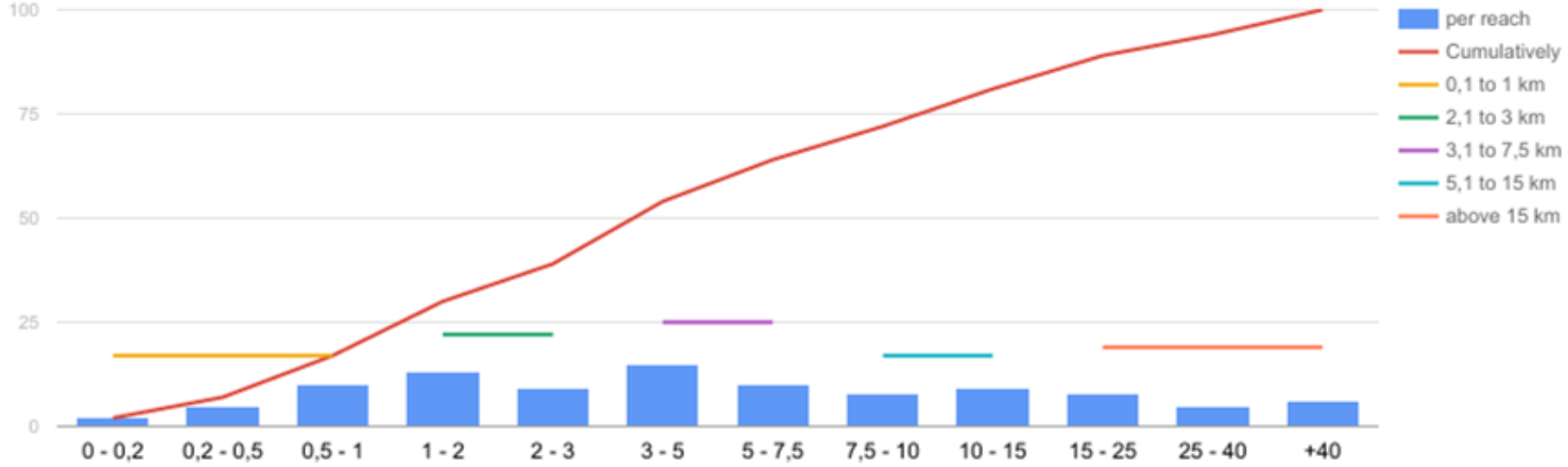
Hyperloop

Climate	Less emissions
Energy	Less energy use
Jams	Improved organisation (MaaS, Swarms, PT)
Safety	Less speed/mass or separation
Spaces	Less and/or smaller vehicles

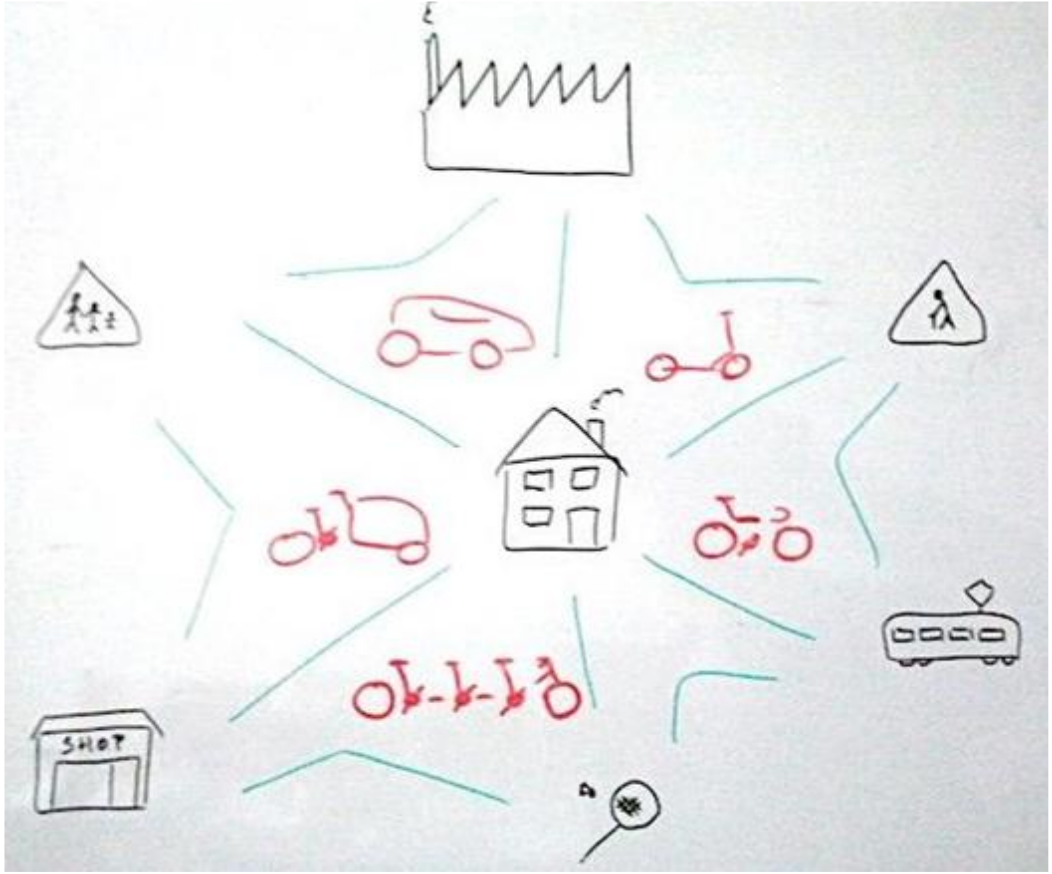
Modal shift



Mobility distances



Source figures: “Onderzoek Verplaatsingsgedrag Vlaanderen”
mobielvlaanderen.ovg

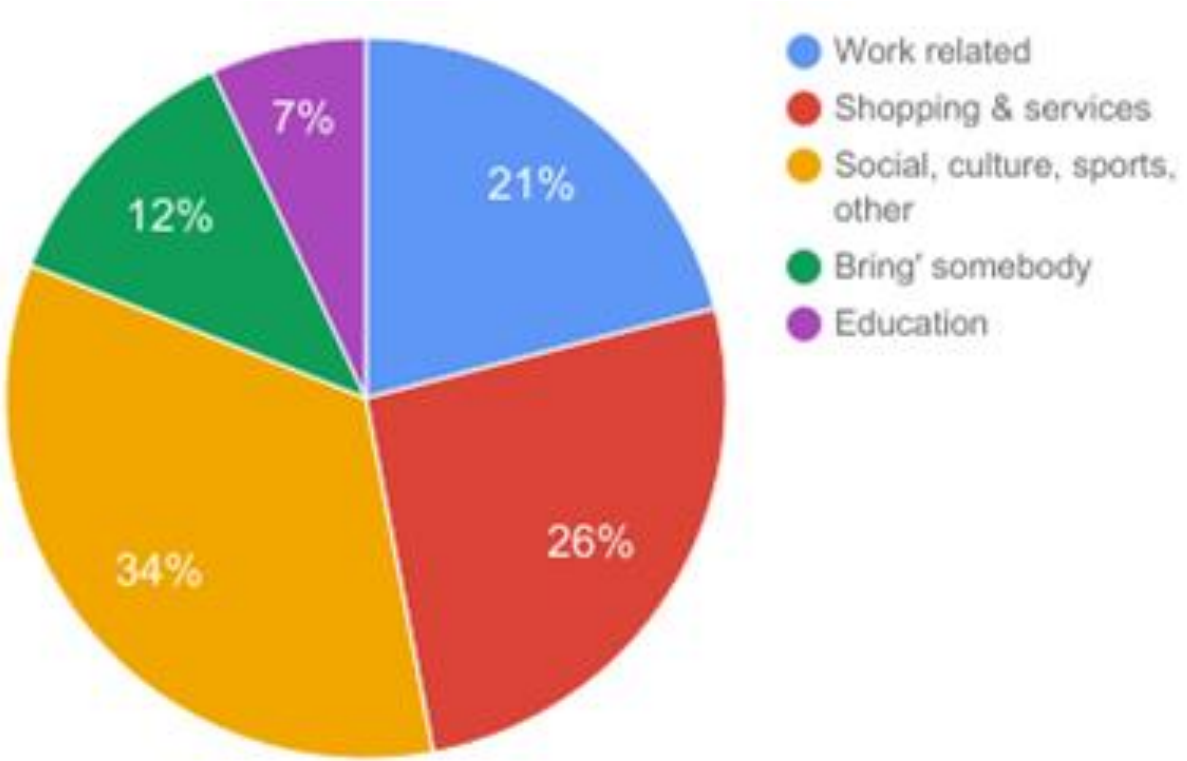

SHOP

BUT!

Luggage?
Distances?
Weather conditions?
Children?
Party dresses?
Testosteron?
Fear?
Habits?
Need for speed?
Lack of power?
Status?
Mastering the two-wheeler?
Insurance?
Law?
Protection?
Quality?

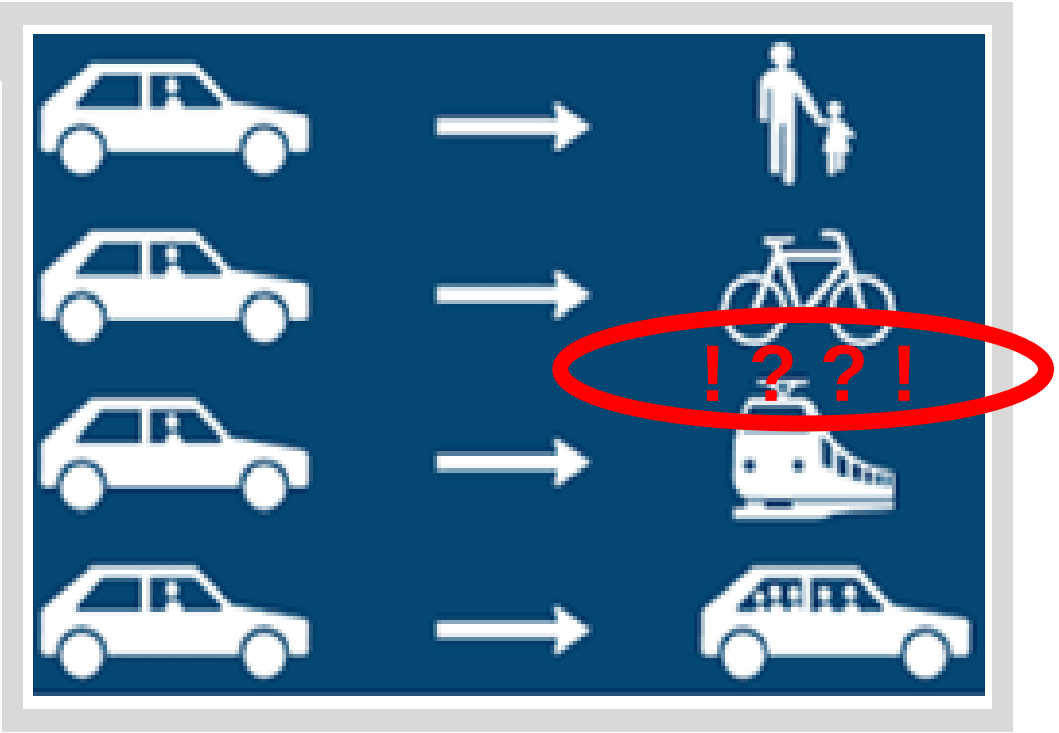
...

Mobility Mix



Source figures: “Onderzoek Verplaatsingsgedrag Vlaanderen” mobielvlaanderen.ovg

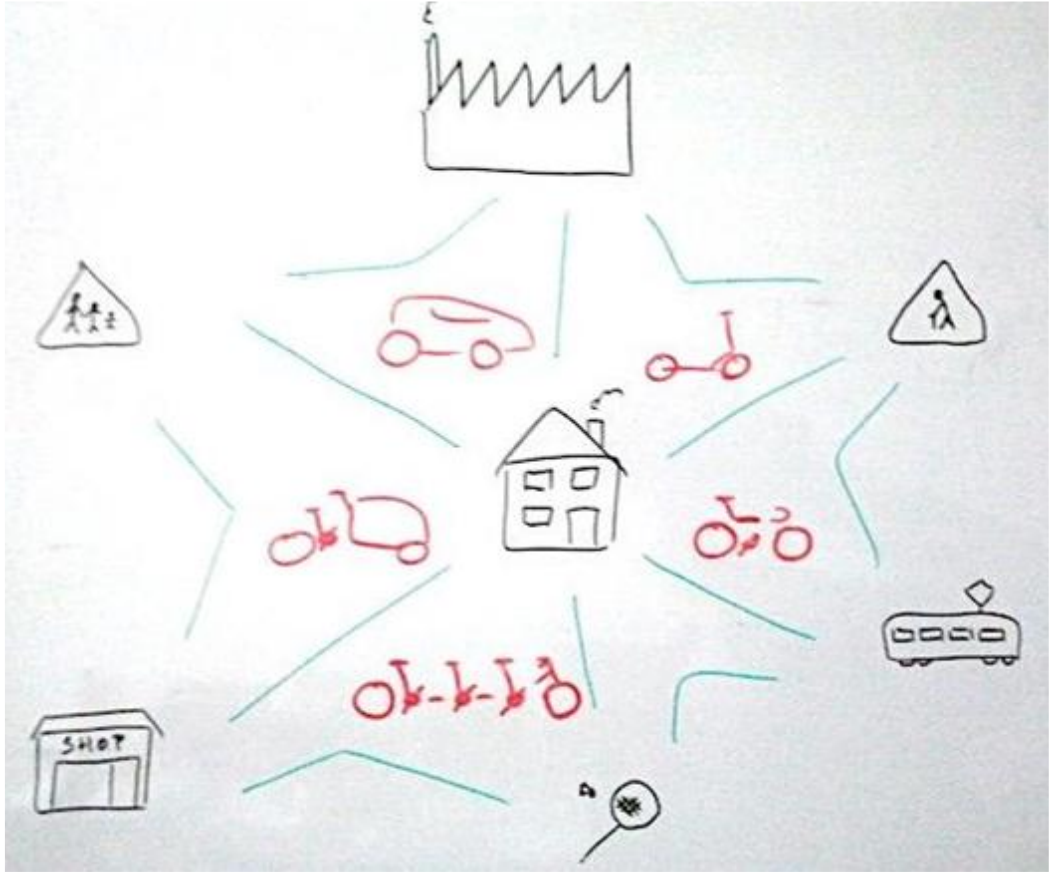
Modal shift



Bicycles in MaaS: Development needed

Usability

- Distances
- Luggage
- Passengers
- Multi-modality

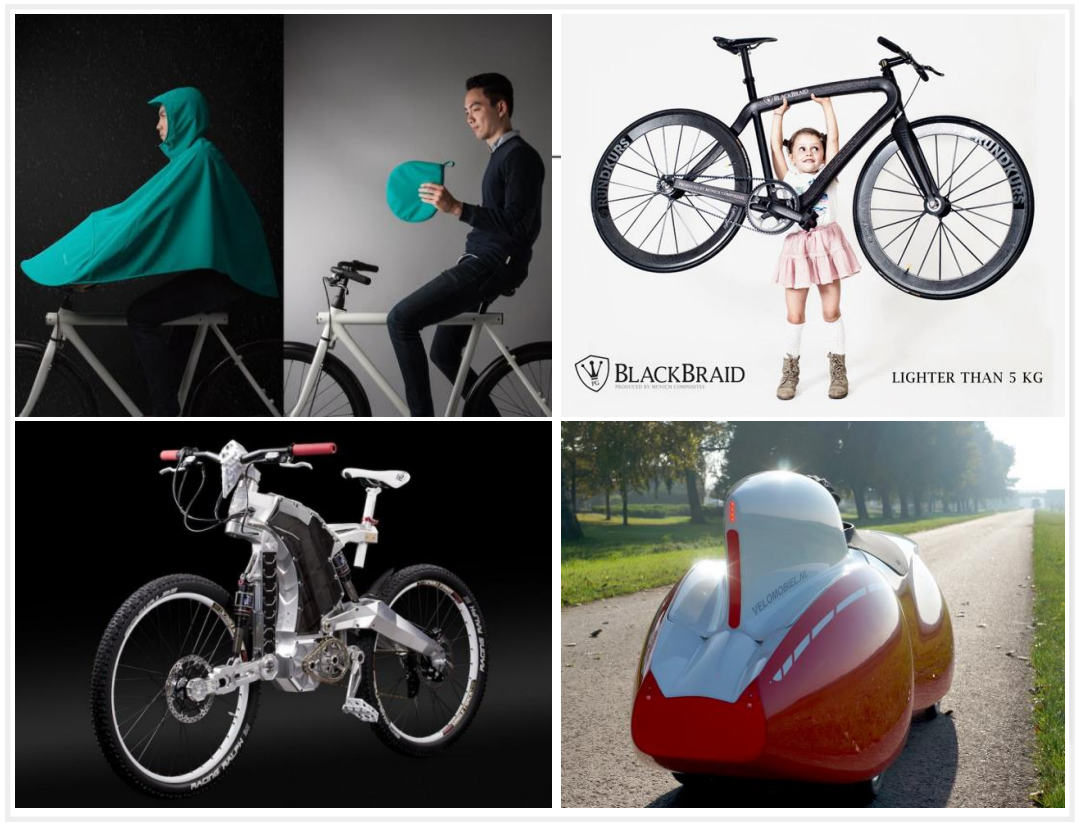


Bicycles suited for MaaS

- # bodies and preferences
- Locking, charging, location
- Maintenance

Attractiveness

- Image!
- Dry & Warm!
- Luggage!
- Safety!
- Dependable!



Legislation

- People learn the traffic code only when they want to drive a car

- Traffic code is complicated
- System with classification is discriminating the weaker
- Traffic code is good when traffic is separated

Infrastructure

- Separated traffic works in Holland, Denmark and Flanders
- The cost for separated bicycle infrastructure in the rest of Europe is very high
- Bicycle infrastructure must be fine-grained, is in contradiction with highways

Business Models

- Renting bikes at low cost?
- Only bikes in cities?
- Renting specialised and expensive bikes?
- Keeping specialised bikes outside 24/24?
- Peer to peer sharing?
- Bicycle fleets for events?

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Light vehicles: Innovation Possibilities

Bicycle assets:

- Simple
- Versatile
- Traditional

"The bicycle is one of the finest examples of engineering design all time. It uses so little in the form of material or resources to produce, yet it does so much so efficiently. Cheap healthy transport, enjoyable leisure, exciting sport and no harmful side effects. In fact, the best our little planet has to offer"

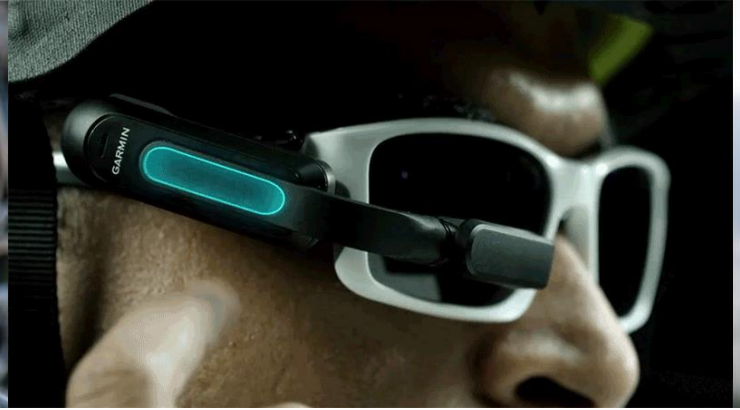
Mike Burrows
Bicycle design, 2008

Innovation opportunities

Ergonomy
Safety
Children
Luggage
Music
Alternative traction
Alternative positions
Beach
Communication
Tandem
Range
Easy acces
Experience
Folding
Laws
Off-road
Sports
Being seen
Climbing
Speed
Navigation
Cycling in darkness

Safety!

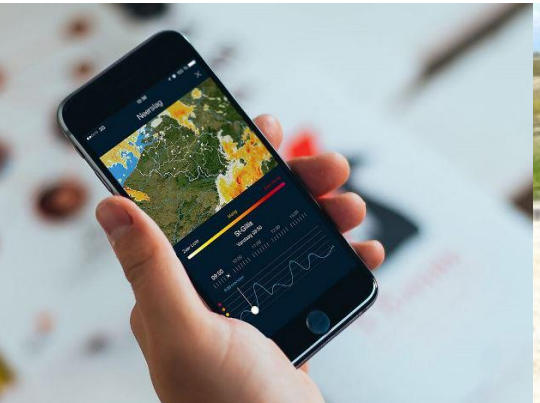
Communication



Radar

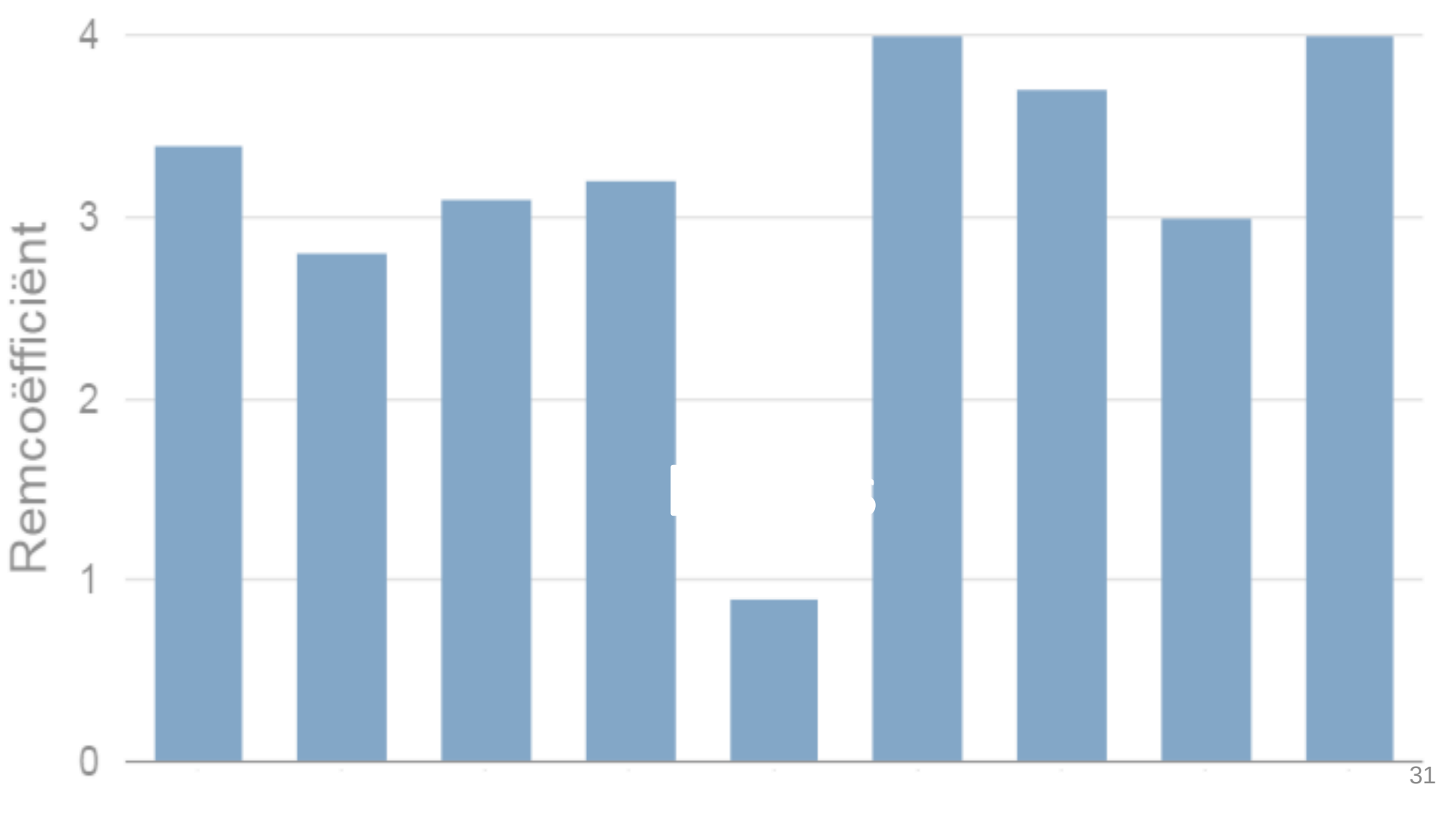
Concentration

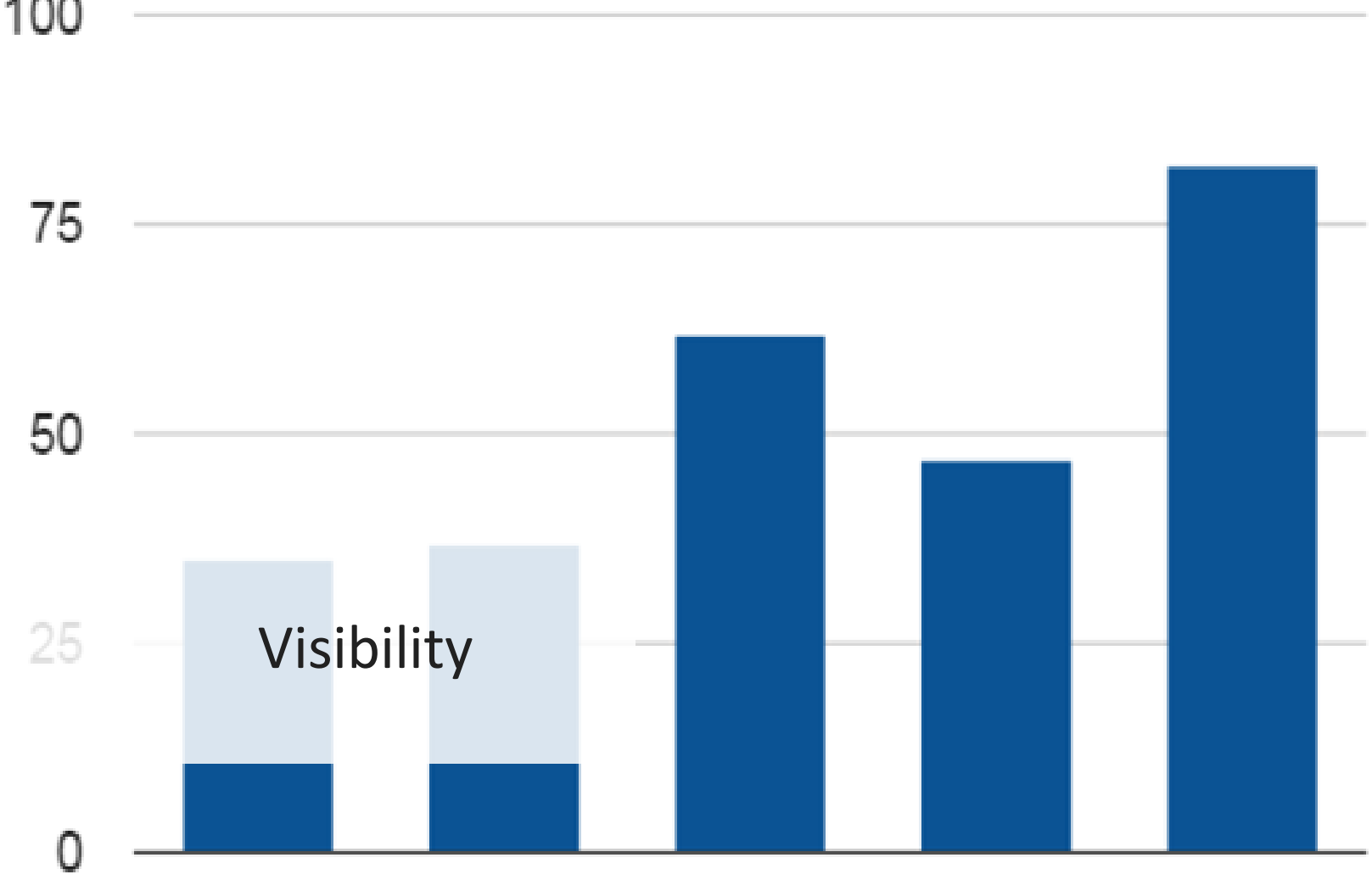
Weather forecast



Panic button

Anti-fall equipment


Remcoëfficiënt
4
3
2
1
0


100
75
50
25
0
Visibility

Length
&
Posture

Energy & Power

Motors

Resistance

Battery

Speed

Range

100W Human Power	Speed						
City bike	12km/h	16km/h	17km/h	20km/h	23km/h	24km/h	31km/h
Slope Wind	1% 10km/h	1% 0km/h	0% 5km/h	0% 0km/h	0% -5km/h	-1% 0km/h	-1% -10km/h

5 km/h: 1 to 2 beaufort
10 km/h: nearly 3 beaufort

1%: 1m climb on 100m

100W human power		Design Speed (km/h)
City Bike		12 20 31
Racing Bike		15 23 36

100W human power		Design Speed (km/h)
City Bike		12 20 31
Racing Bike		15 23 36
Velomobile		18 33 59

100W human power		Design Speed (km/h)
City Bike		15 25
+ 250 W		
Racing Bike		18 30
+ 250 W		
Velomobile		24 45
+ 250 W		

Learnings

Choose the motor wisely

Don’t mention range, use available energy instead

Promote and show the original bicycle character

The motor controller contains interesting innovation chances

Motor efficiency is more important than battery capacity

Intermezzo:

Difference between front wheel motor and mid motor

Electric bicycle assets:

+Faster
+Stronger
+Electricity

- Weight
- Dependency

Duurzaamheid		Onderhoud		Gebruik	
Tandwielen		Aantal onderdelen		Hellingsgraad	
Ketting		Uitwisselbaarheid		Regeling motorvermogen	
Kabelgeleiding		Standaardisatie		Fiets aan de hand	
Spaken				Shimmy	
Vork / kader				Effectiviteit pikkel	
Speedssensor				Geluid	
-4 … 2	**-3 … 0**	**0**	**-3 … 0**	**-7 … 4**	**-7 … 6**

-11 … 6	**-13 … 6**