

THE FUTURE OF MOBILITY

Velo City | 1st March 2016 | Taipei

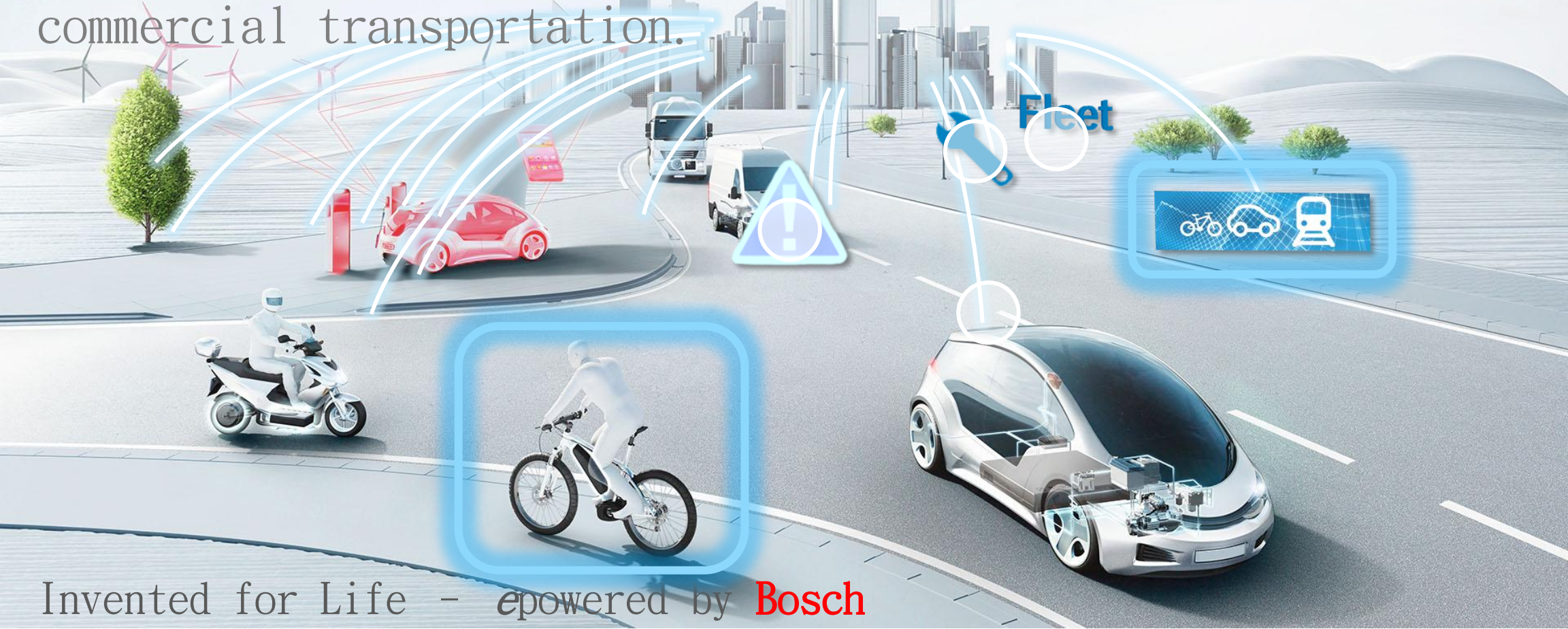
Claus Fleischer | Bosch eBike Systems | CEO



The **Mobility** of the **Future** will be electrified, automated and connected.



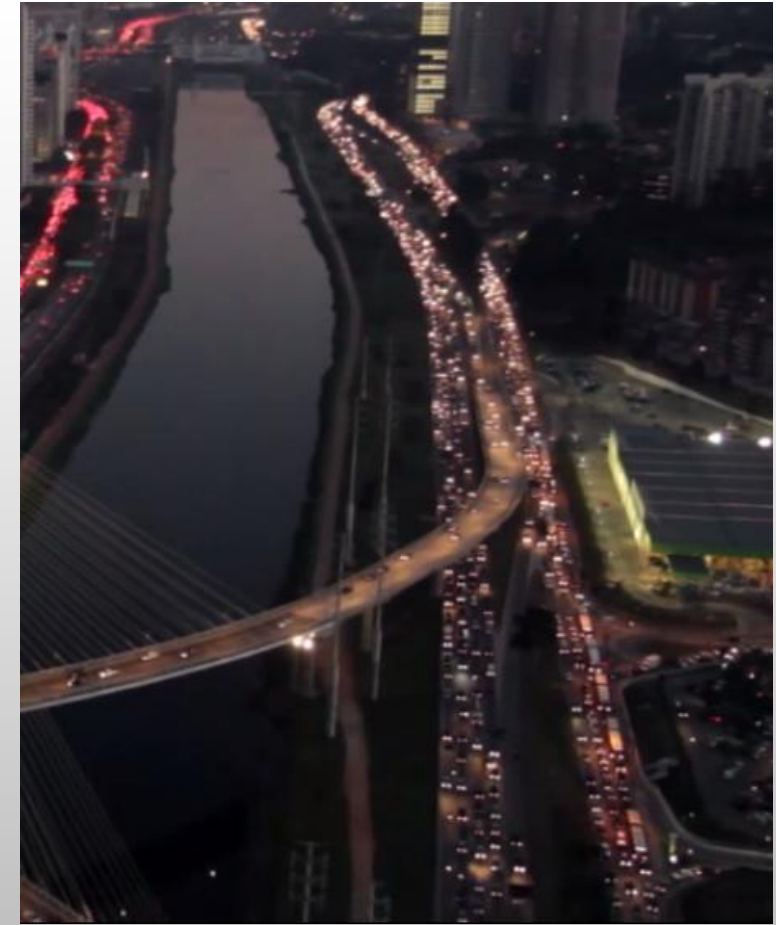
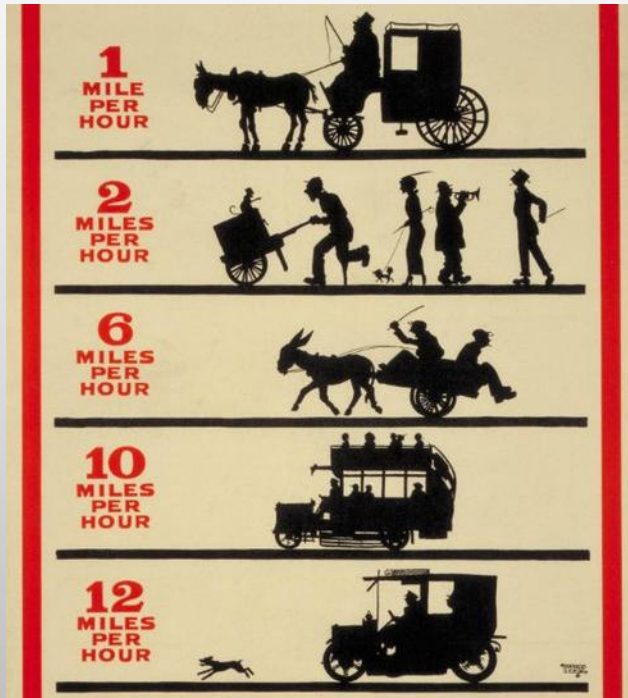
Bicycles and especially Electric Bicycles will play a major role in personal mobility, in recreation and in commercial transportation.



Invented for Life - *epowered* by **Bosch**

Mobility has been a basic need of human mankind and societies

- and always will
- Personal mobility
- Commercial transportation
- Recreation

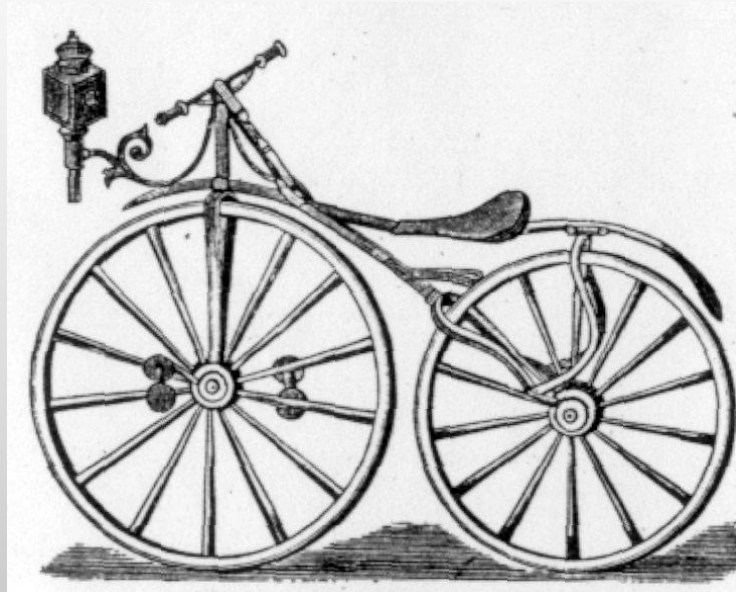


For almost **200 years cycling** has been a basic and affordable mode of transportation.

- Efficient use of human power
- Gain of speed and range



1817 Karl Drais
developed the walking
machine



1861 Pierre Michaux
developed the Vélocipède



1886 Robert Bosch
on his 1st Company Vehicle

For more than **100 years bicycles** coexist with scooters, motorbikes, cars and public transportation.

- Motorization to gain more range and comfort!
- Why pedal when you don' t have to?



Scooters



Motorbikes



Cars, Cars, Cars, ...

For more than **20 years bicycles** have been electrified – and gain interest of cyclist, industry and politicians –

~~Even more every year.~~ Efficient bio-electrical hybrid. → eBike = Pedelec

- Gain of range, comfort, fun → Excitement
- Maintain character of bicycle → Acceptance



1990 Michael Kutter
First Swiss Pedelec



1993 Yamaha PAS
Electric bicycle with pedal
sensor controlled power assist
system



2013 Angela Merkel
German Chancellor at Eurobike

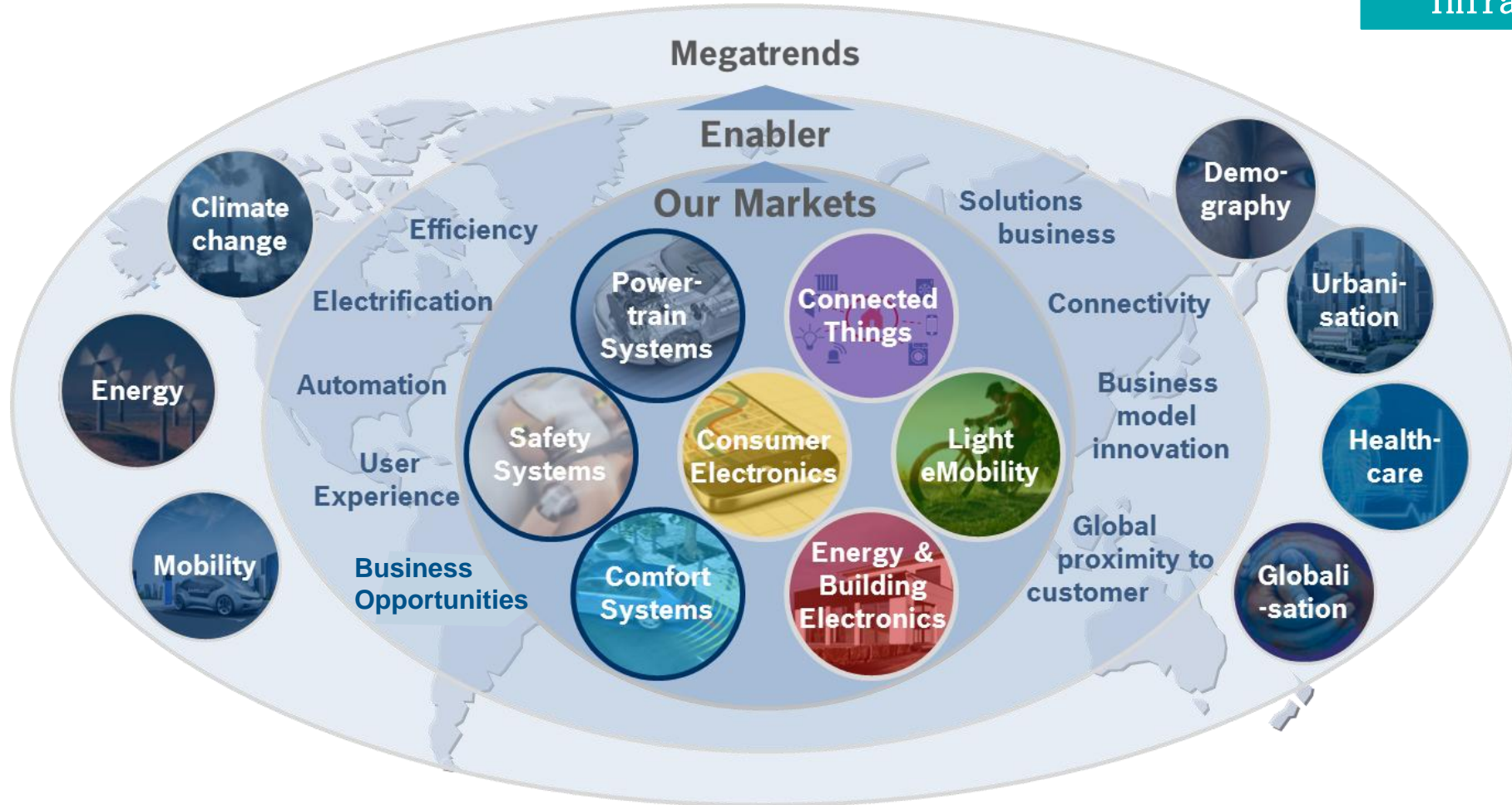
Global Megatrends

Our Response to new Challenges

People

Technology

Infrastructure

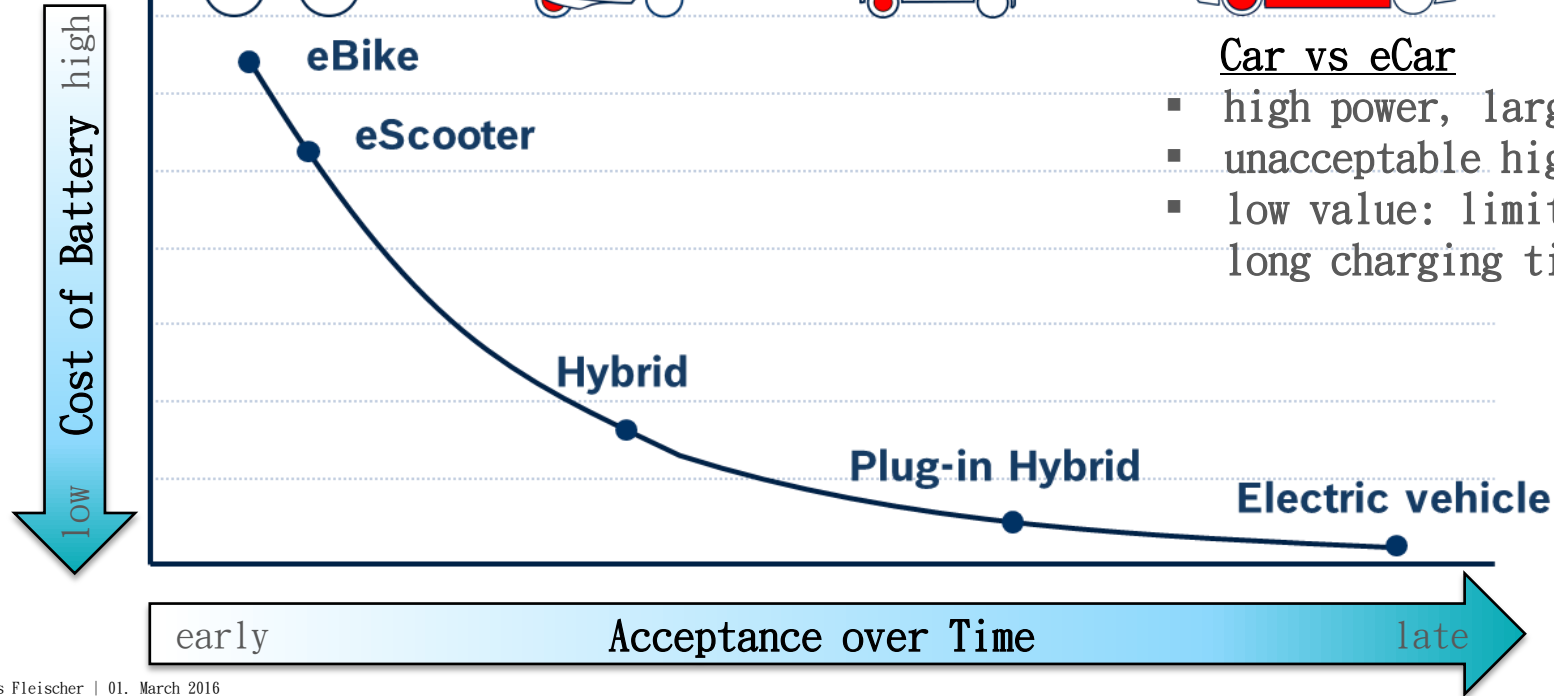
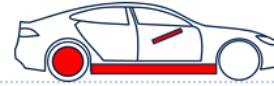


Electro Mobility

Why eBikes outpace eCars and Light Electric Vehicles (… today)

eBike vs bicycle

- low power, small battery
- acceptable cost
- added value: range, comfort, fun (!)



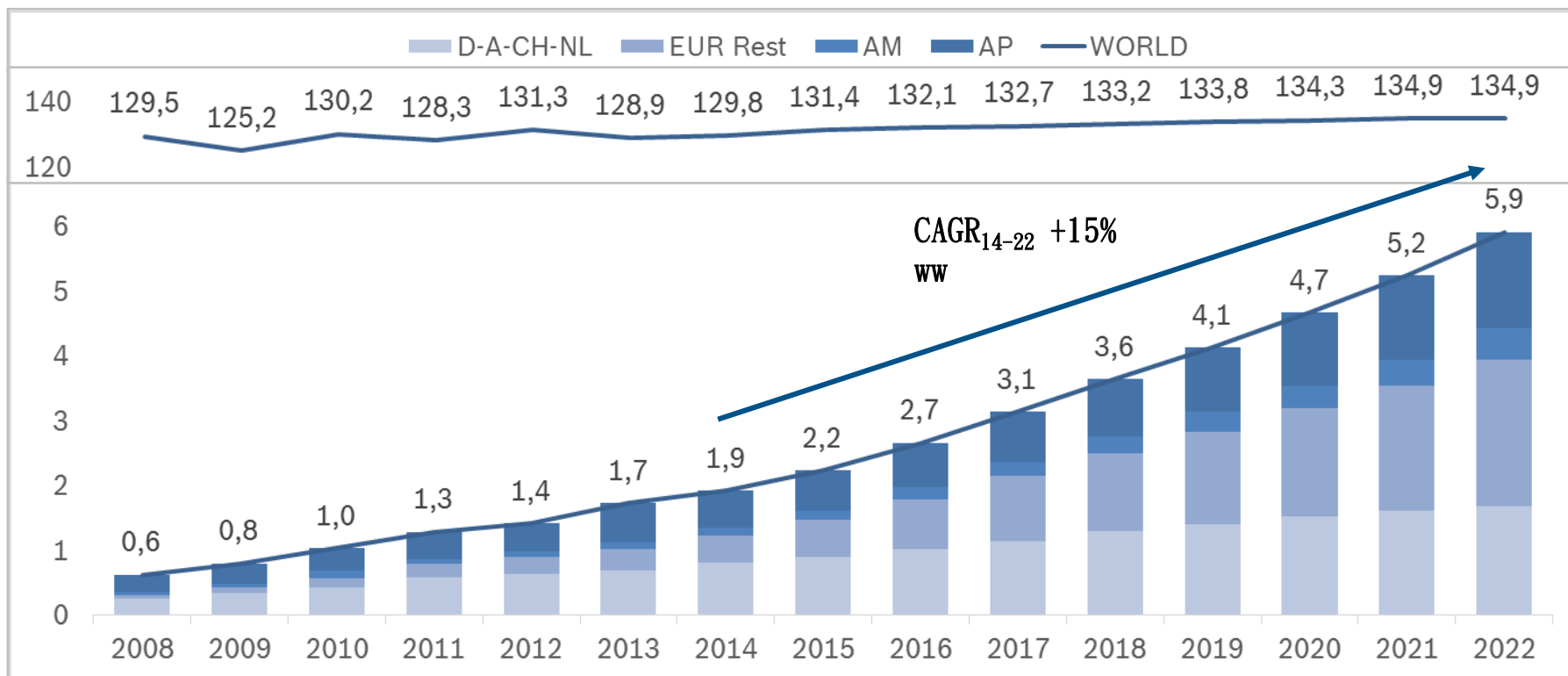
Car vs eCar

- high power, large battery
- unacceptable high cost
- low value: limited range, long charging time

Bicycle and Pedelec – market growth & electrification share

Bicycle
mio/year

Pedelec
mio/year



Pedelec
Share
%

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
D-A-CH-NL	4,0%	5,5%	7,0%	9,8%	11,2%	12,7%	13,7%	15,1%	17,0%	19,1%	21,6%	23,5%	25,6%	26,9%	28,2%
EUR Rest	0,4%	0,7%	1,1%	1,5%	1,8%	2,3%	2,8%	3,7%	5,0%	6,4%	7,7%	9,0%	10,4%	12,1%	14,2%
US+CAN	0,2%	0,3%	0,6%	0,4%	0,4%	0,5%	0,6%	0,7%	0,9%	1,0%	1,2%	1,4%	1,6%	1,8%	2,0%
JP	2,7%	3,2%	3,6%	3,8%	4,0%	6,0%	5,9%	5,6%	5,9%	6,2%	6,5%	6,8%	7,1%	7,5%	7,9%
WORLD	0,5%	0,6%	0,8%	1,0%	1,1%	1,3%	1,5%	1,7%	2,0%	2,4%	2,7%	3,1%	3,5%	3,9%	4,4%

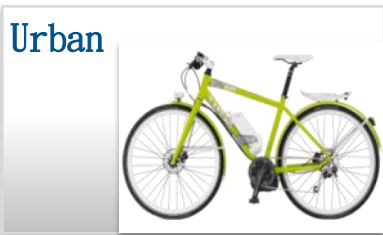
Pedelec target groups

Trend in all segments electrified!

2010

Target group 60+

→ 50+

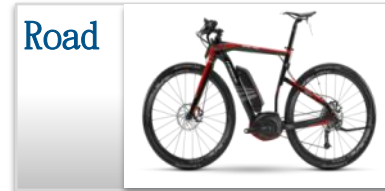


Commuter,
Hobby,
Tour

Private use

- all types of bicycles will be

→ 40+



2016

→ 30+

Lifestyle
& Sport

Tourism

Commuter
&
Hobby

Fleets

Family &
Commercial

Electric bicycles – ... are fun

eBikes are

- an affordable and fascinating mobility solution
- ecologically reasonable
- and they are fun!



Study Result:
eBikers ride more often
(2-3x) and longer (2-
3x) than comparable
cyclist

Electrification – eBike Systems

Bosch Power Tools

- > 32 Mio. Power Tools pa
- Li-Ion Battery Technology



Bosch eBike System

- Power train system and components



Bosch Automotive Technology

- >80 Mio. Electrical Drives pa
- Start-Stop, Power Steering, ...



Drive Unit

Center Drive Motor 250W

- ideal ride and handling
- highest efficiency
- compatible with all gear sets



Battery

- 36 V Li-ion
- Highest Energy density
- Battery Management System



HMI's

- 4 Assistance Modes
- Ride & Fitness features
- Navigation & Connectivity



Charger

- 36 V
- 4 A charging current
- 2...3,5 h charging time

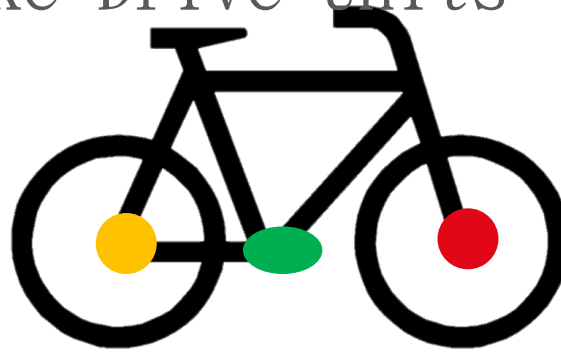


Electrification – eBike Drive Units

↗ Trend

Rear Hub Motor →

- + low noise
- + recuperation possible
- + no specific frame interface
- low efficiency
- center of gravity



↘ Front Hub Motor

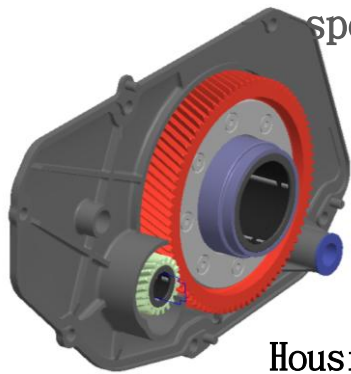
- + easy to install
- + lowest cost
- + no specific frame interface
- low efficiency, low power
- center of gravity, stability

↗ Center Drive Motor

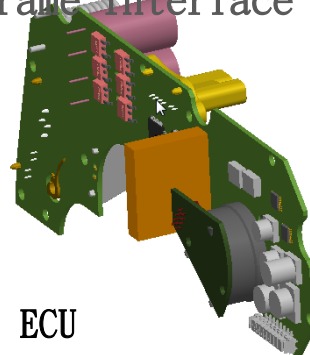
- + ideal ride and handling
- + highest efficiency
- + compatible with all gear sets
- technically higher effort
- specific frame interface

Trends

- Lower weight ↘
- Smaller size ↘
- Optimized motor controls ↗
- Higher design integration ↗

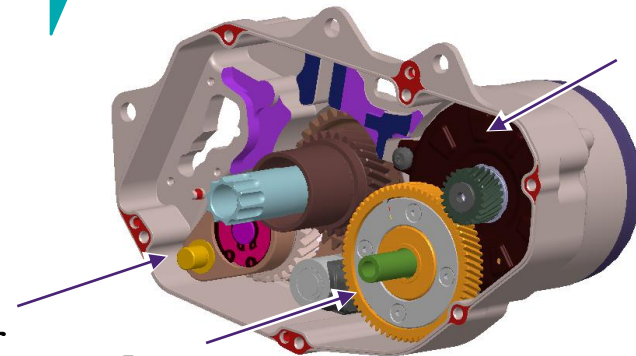


Housing



ECU

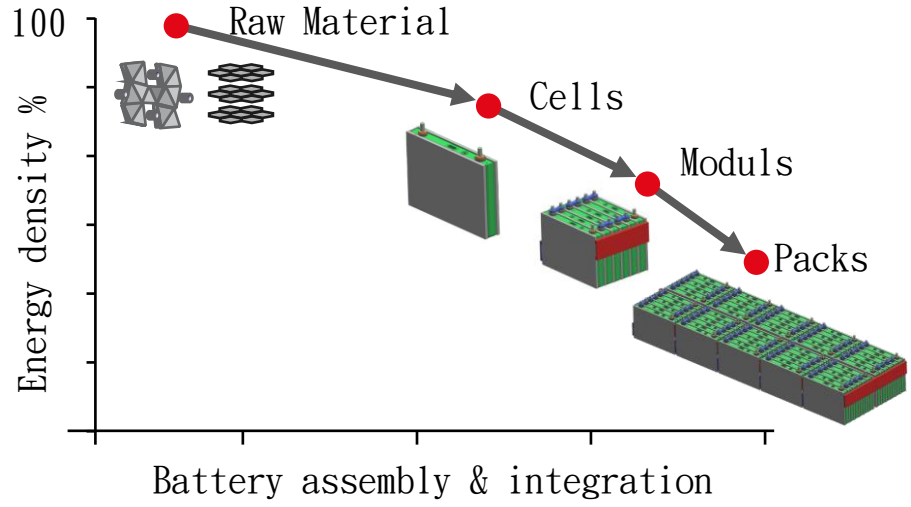
Sensor



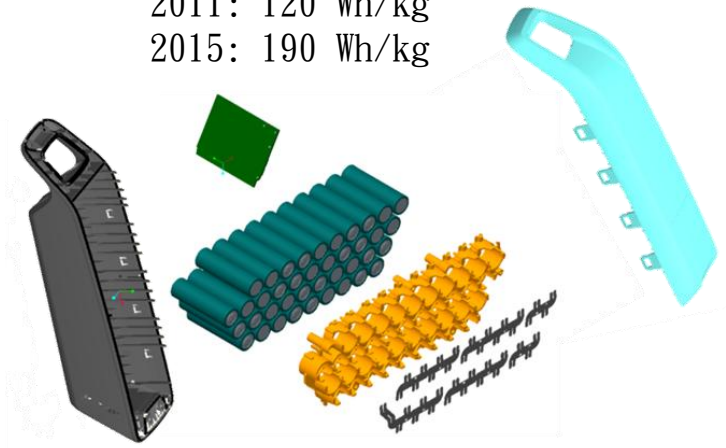
BLDC Motor

Internal Gear

Electrification – eBike Battery Packs



2011: 120 Wh/kg
2015: 190 Wh/kg



Racktype



- + compatible with wave frame / step thru
- + unobtrusive design
- center of gravity and stability
- mechanical load for rack



Frame



- + center of gravity and stability
- + universal installation
- + easy removable
- visible



In-Frame



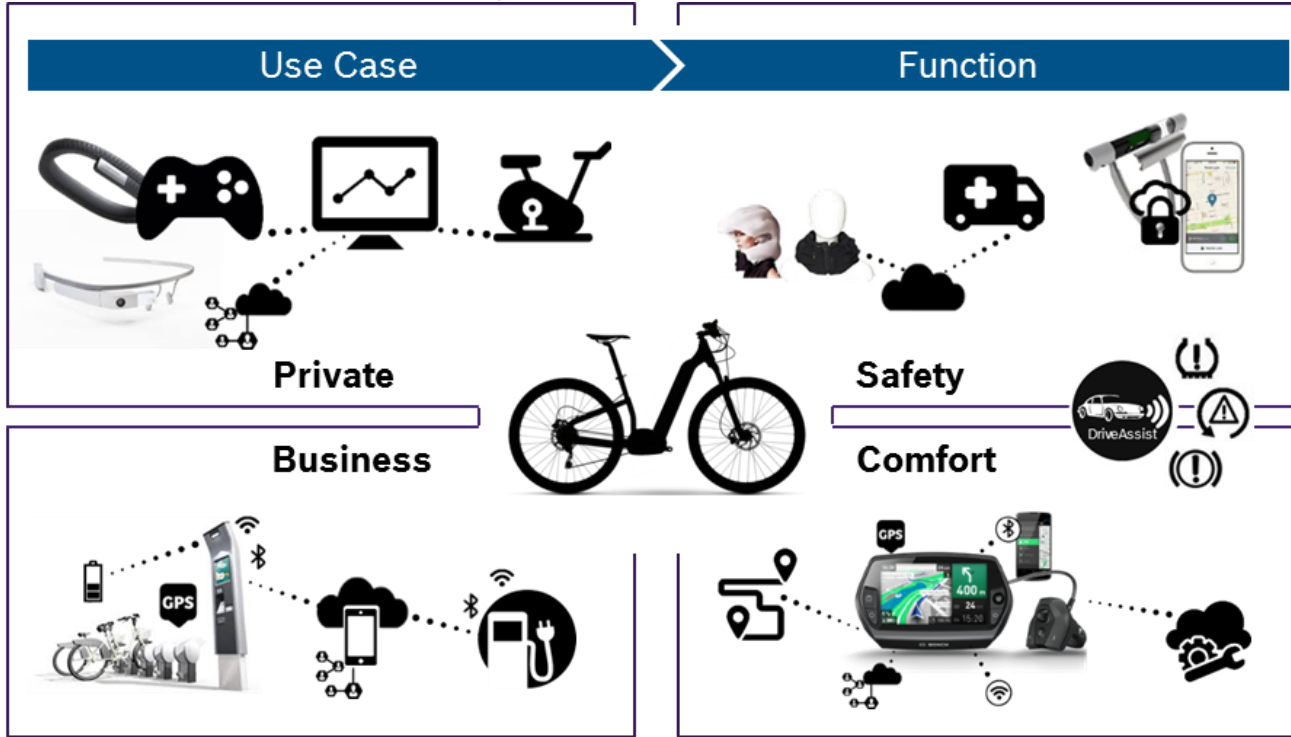
- + Design integration
- + center of gravity and stability
- universal usability
- difficult to remove

Trends

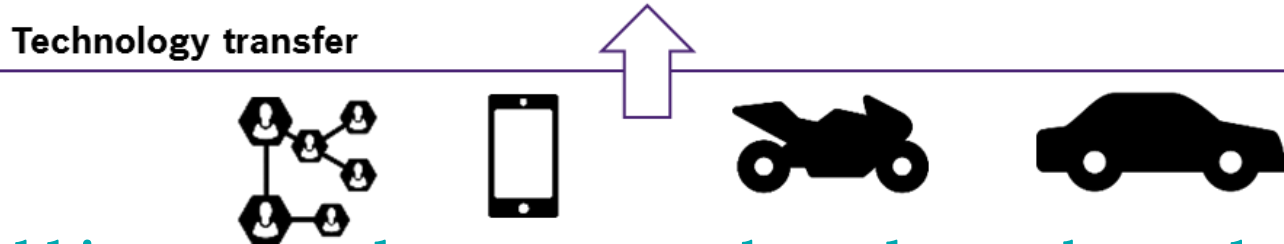
- Lower weight & Smaller size ↘
- Higher energy density ↗
- Higher design integration ↗

Automation & Connectivity – Innovative Solutions

- Fitness
- Health
- Intermodal mobility
- Fleet management
- ...



- GPS navigation
- Theft control
- Bike tracking
- Passive safety
- Active safety
- eCall
- Automatic gear shift
- ...



With intelligence and energy on board – what else can we do?

eBike trends - last mile: public fleets

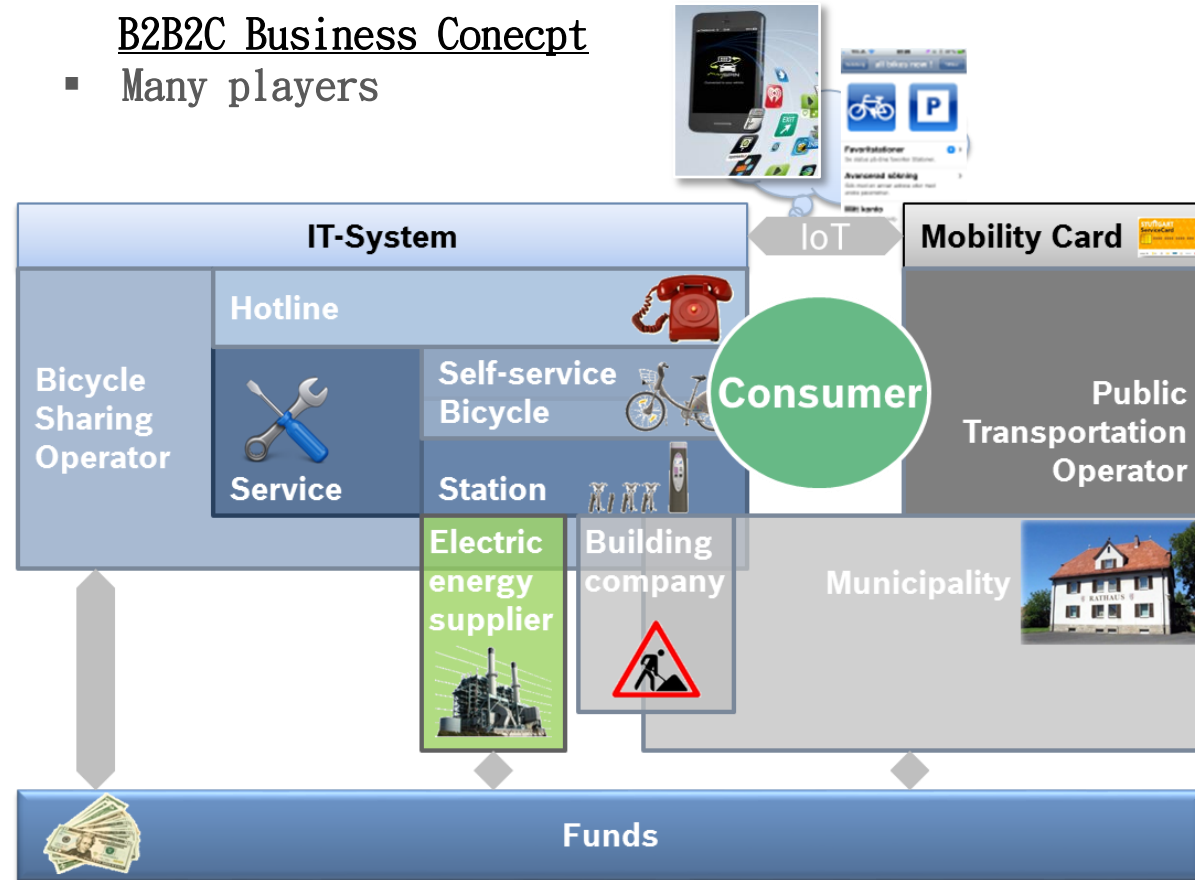
Trend

- Public rental & Charging stations



B2B2C Business Concept

- Many players

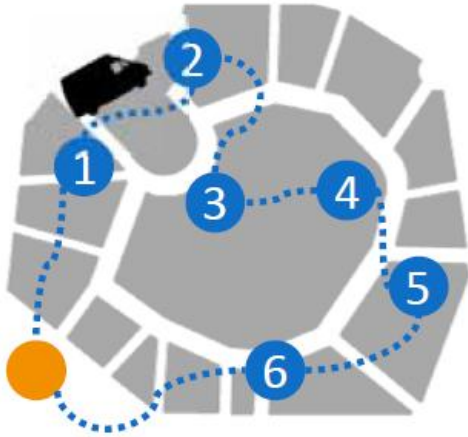


How do we get more people on bikes - daily?

eBike trends - last mile: cargo

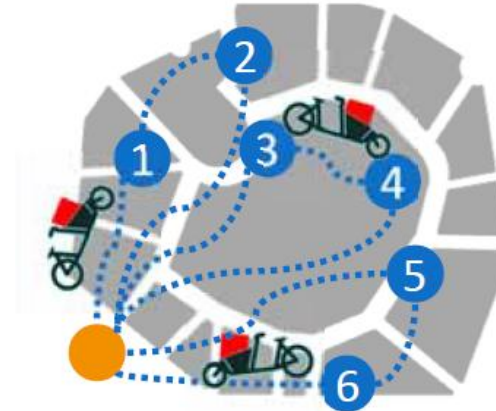
Inner city delivery today

- 1 delivery van



Last mile emission free

- 3 eCargo bikes



What happens if inner cities become emission free?

Bicycle trends Infrastructure

2014 Top 50 Bike-Friendly Cities

Our biennial ranking of the 50 most cycling-friendly cities in the United States first storm—and not just in the expected places. Read on to find out how your city fair

AUGUST 29, 2014 BY IAN DILLE



Infrastructure

Hamburg will be a cycling city

What we have to learn from Copenhagen ...



First section of the “eRadschnellweg” was re



Let's make Cycling a normal & safe mode of transportation – daily, worldwide. People –

What ever we “do” for Pedelecs will pay back on Bicycles by factor

Bosch eBike Systems | Claus Fleischer | 01. March 2016

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The Future of Mobility - The Mobility of the Future

Mobility will be electrified, automated and connected

People

Technology

Infrastructure



... and so will
evolve