

Automotive, the Future of Mobility

Frank Rieck

Applied Research Professor Future Mobility
Chairman Dutch INCERT
Vice President AVERE



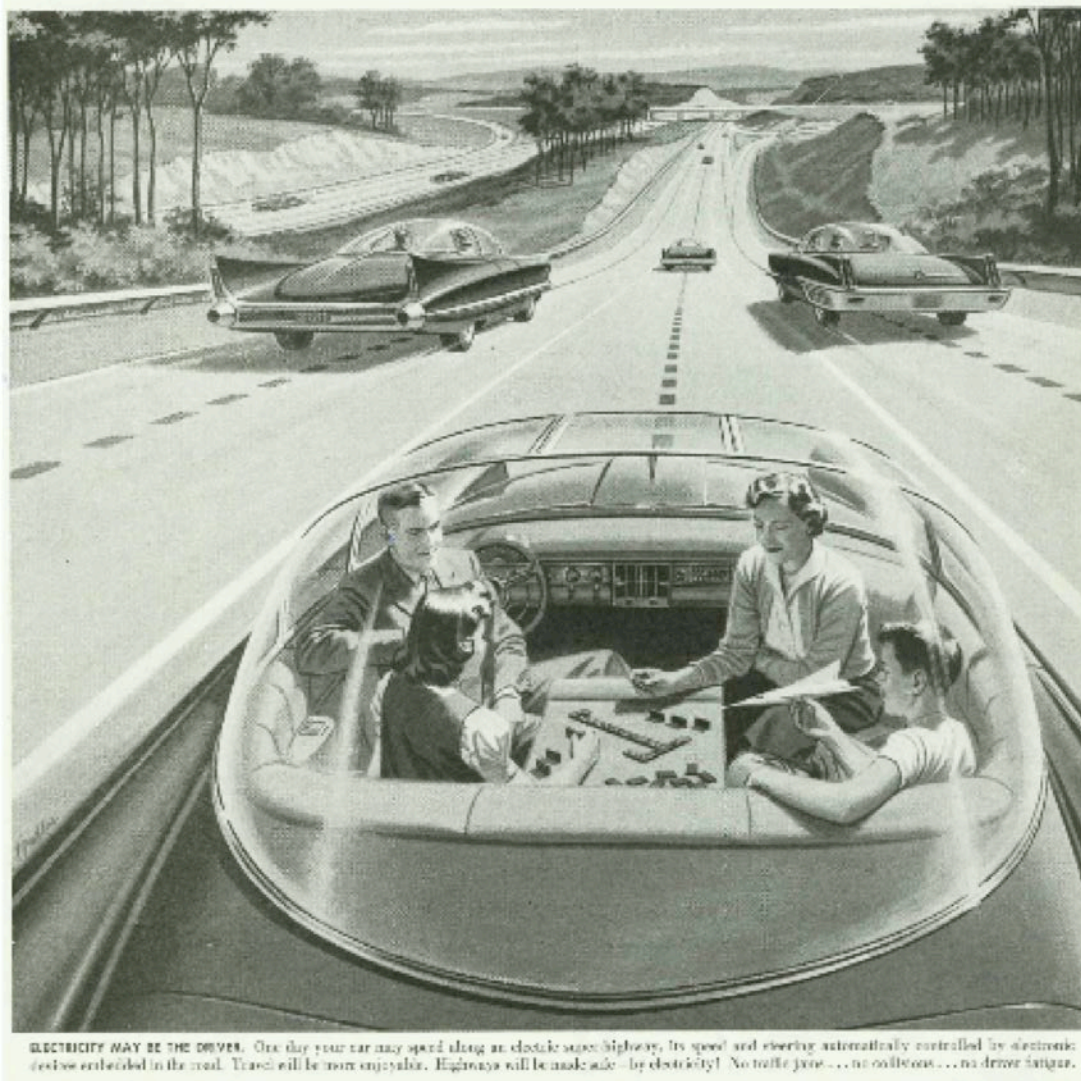
dutch-incert DUTCH INNOVATION CENTRE
FOR ELECTRIC ROAD TRANSPORT

AVERE
The European Association
for Electromobility

Smart e-Mobility at RDM

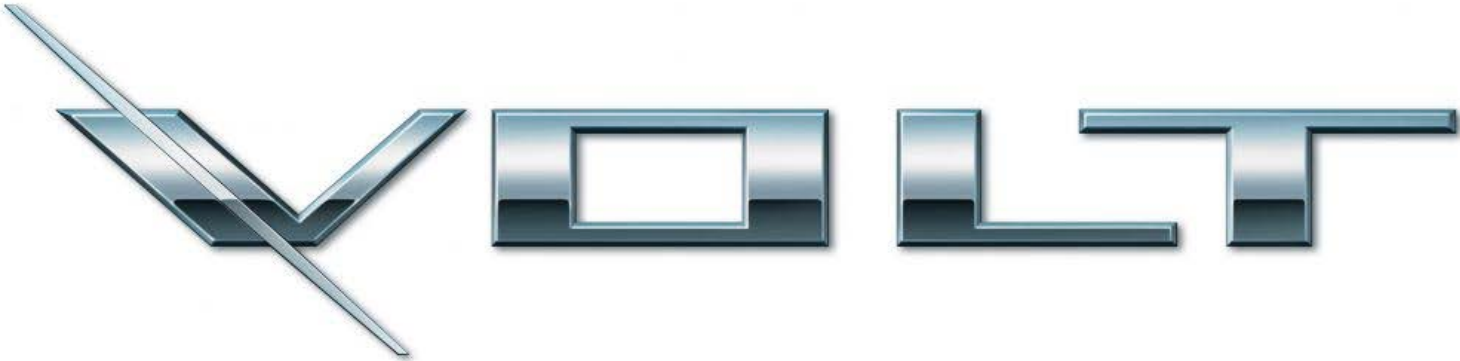


Future Mobility

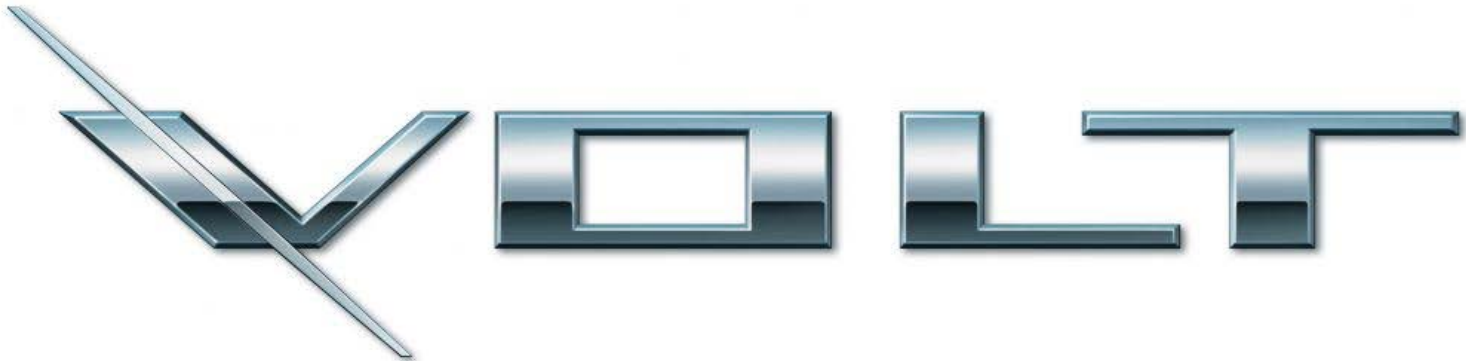


<https://www.youtube.com/watch?v=Rx6keHpeYak>

Who are they?



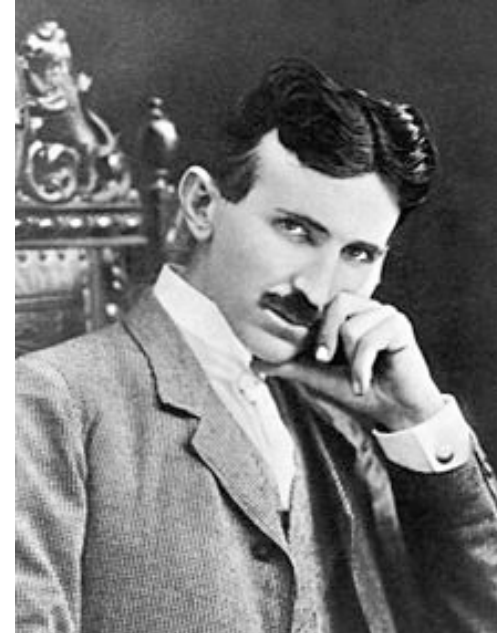
Alessandro Volta (1745)



Nicola Tesla (1856)

„Es schmerzt mich es zu sagen, aber **Tesla** hat bisher strategisch leider alles richtig gemacht. Wer einmal elektrisch gefahren ist, der ist für alle Zeiten für den Verbrenner verloren. Wir brauchen geile Autos - und eine nahtlose Infrastruktur!“

Dr. Stefan Niemand, Leiter Modellreihe Battery Electric Vehicles, **Audi** auf dem 18. Technischen Kongress des Verbandes der Automobilindustrie (VDA) in Ludwigsburg 2016



TESLA

Energy Transition

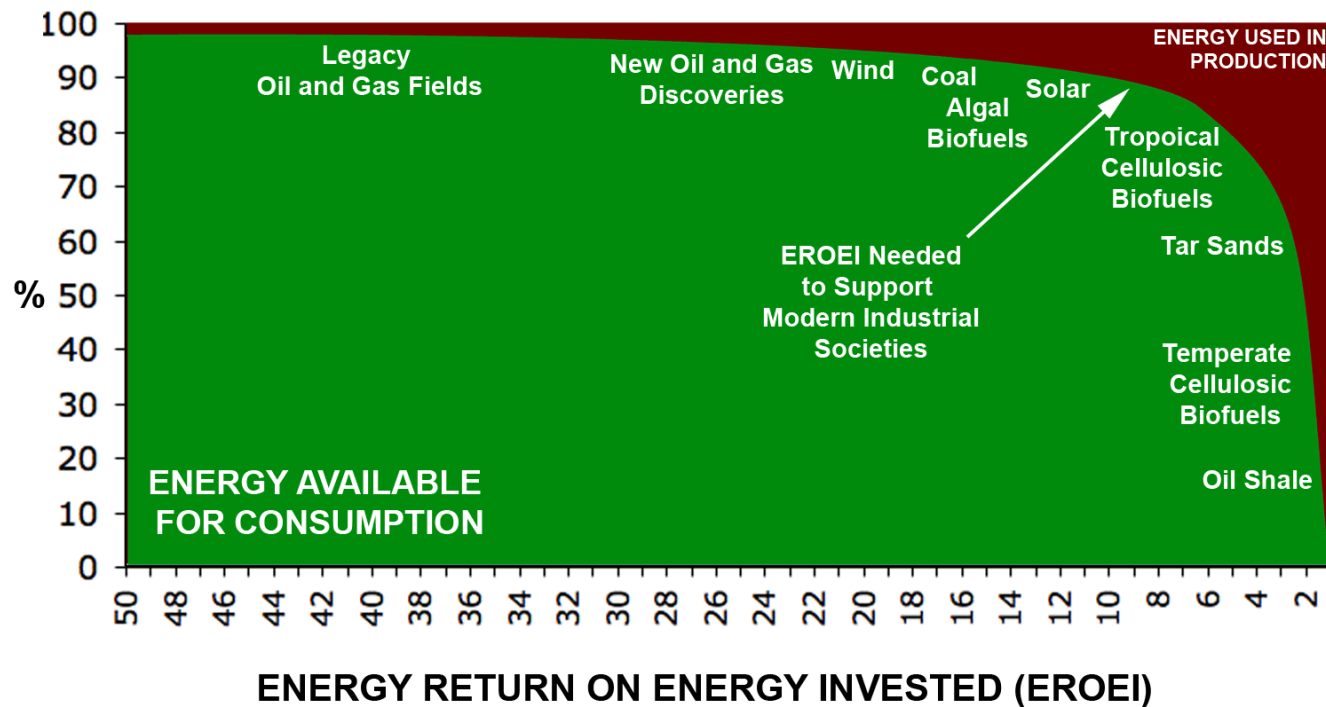


From Fossil to Renewable



Energy Cliff

THE NET ENERGY CLIFF



There is no single solution

System	Range	Charge	Cost	Emissions	Human
Battery-Electric system	Fair 300 km ↑	Bad 3 uur ↓	Good	Good	RA
Electric with range extender	Good 900 km	Good 10 min.	Fair cost ↓	Fair	FA
Fuel Cell-Electric system	Good 900 km	Good 10 min.	Bad cost ↓	Good	NA

‘Horses for Courses’

NICOLA (2016)



Will Automotive be the future of Mobility?

- Based on the ‘traditional’ values of *individual freedom* and *maximum flexibility*
- Major positive disruptive technologies will consolidate the automobile to be the preferred choice for mobility of persons and goods
 1. Electrification
 2. Automation
 3. Connectivity

Global Automotive Executive Survey, KPMG 2017

Regulatory pressure pushes awareness for electrification: Battery electric vehicles are this year's #1 key trend.

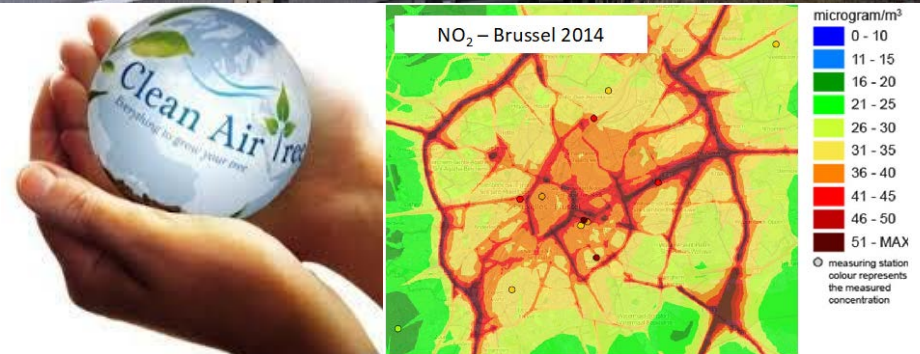


Emissions?



Drivers for Urban Mobility

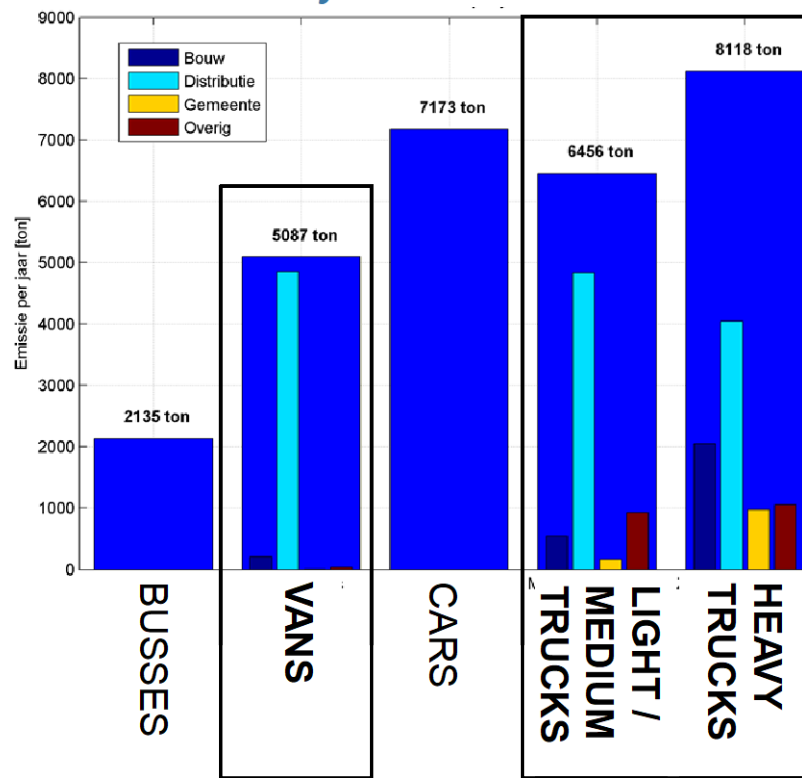
- Today: Air quality / Fine dust
- Today: Smart Logistics
- Today: Noise / Quality of live
- Tomorrow: Energy / CO₂
- **Always: €€€€€€€€**



The big three poluters



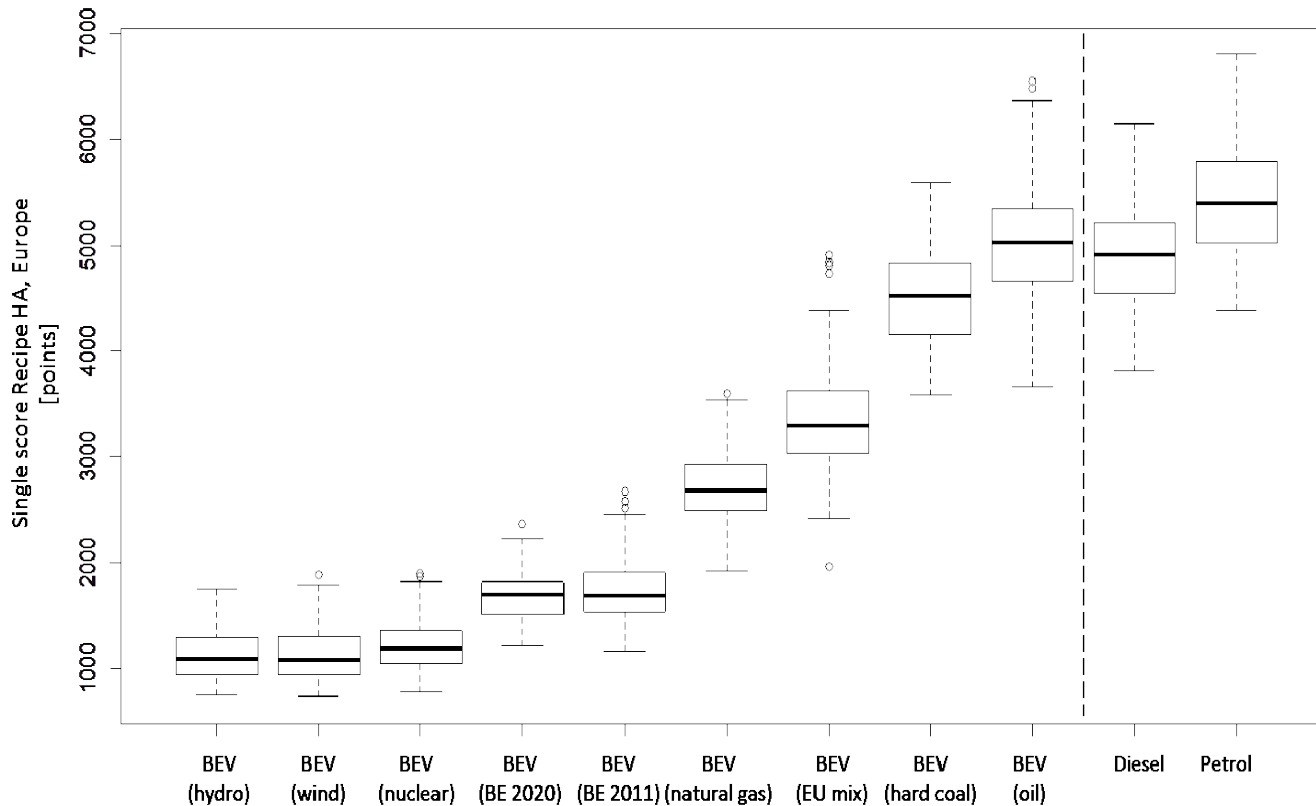
Urban freight transport Total NOx emissions city traffic in the Netherlands



Estimated total emissions per year per vehicle type for all urban traffic in the Netherlands (TNO, 2015)



Influence of the electricity mix on single (eco) score Recipe

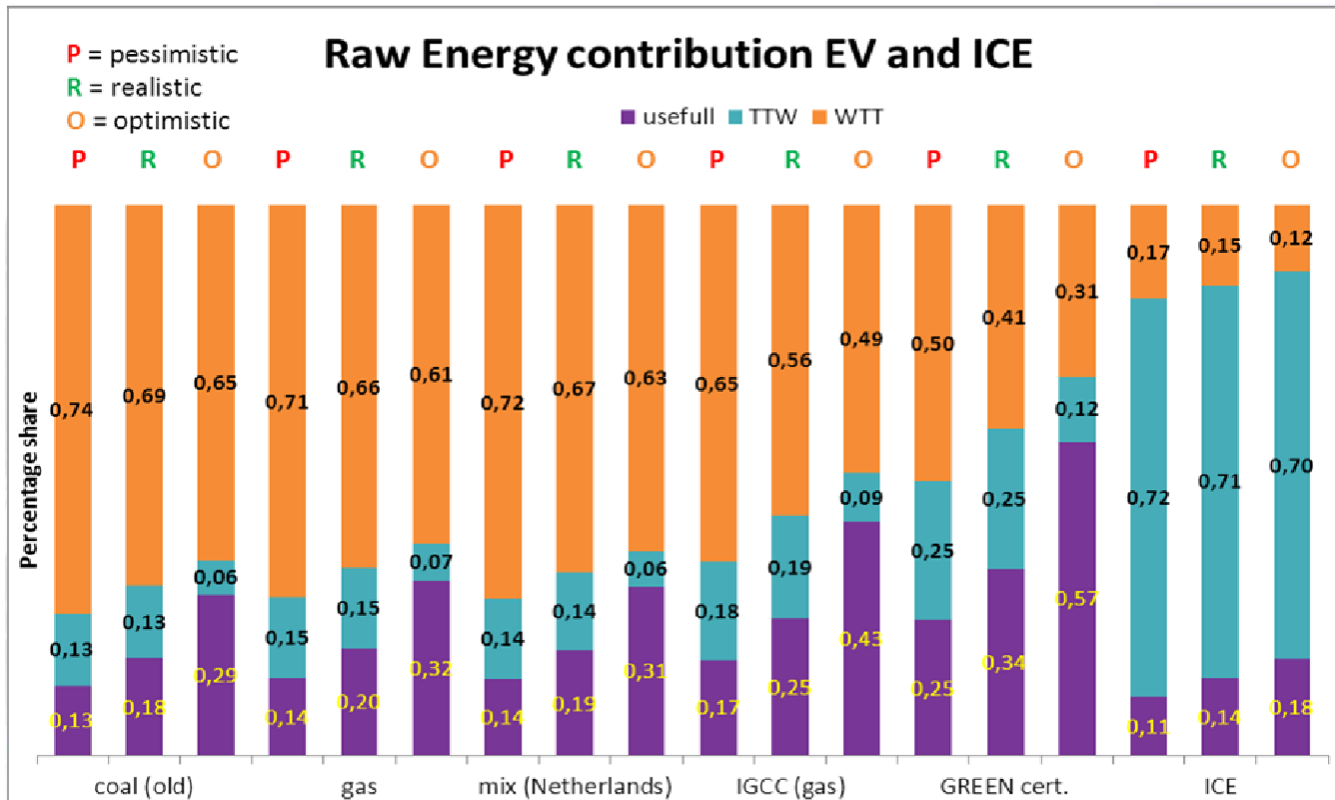


M. Messagie, J. v. Mierlo cs, A Range-Based Vehicle Life Cycle Assessment Incorporating Variability in the Environmental Assessment of Different Vehicle Technologies and Fuels. Energies, Vrije Universiteit Brussel, 2014

Energy?



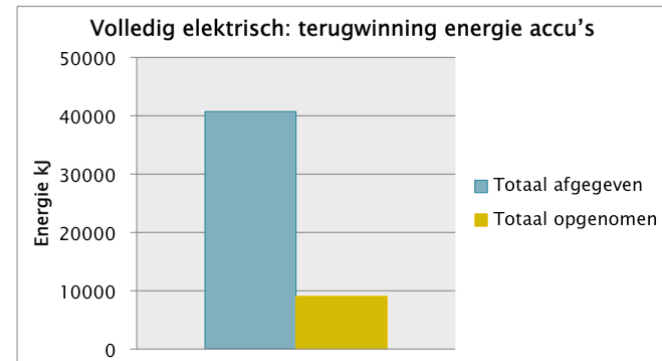
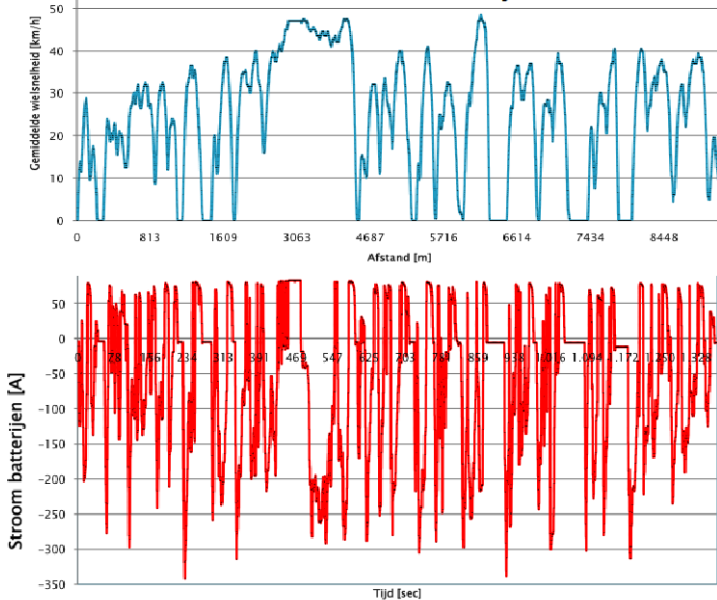
Well to Wheel comparison EV & ICE



Recuperation of brake energy



Maastunnel RET Lijn 46

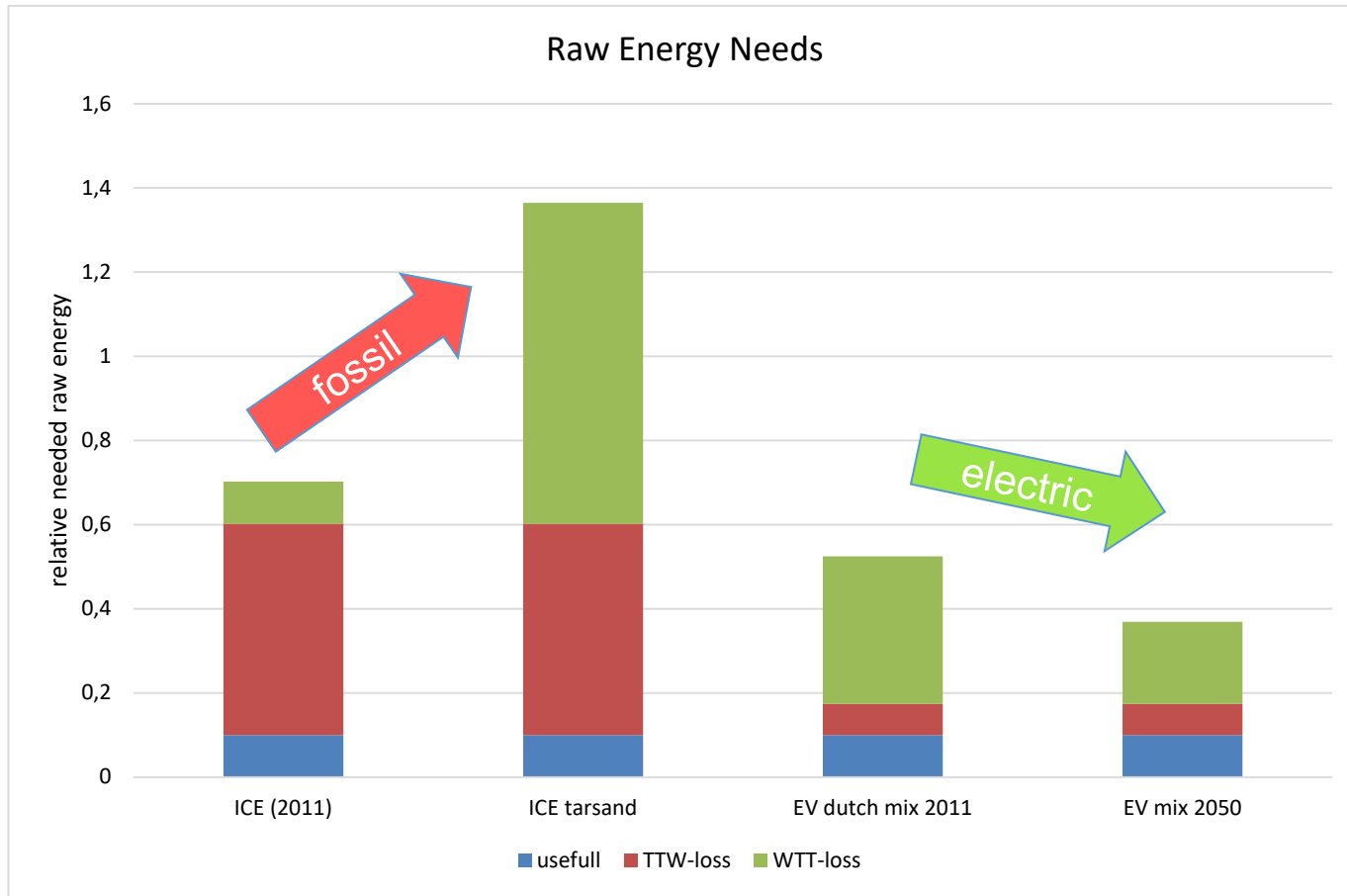


Well to Wheel Electrification

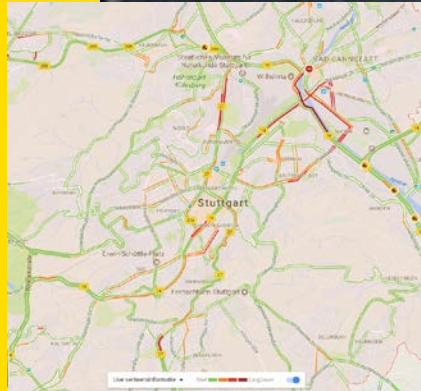


r)


Future Proof





Congestion?




Give-back freedom of time

 NIO
VISION CAR EXPERIENCE FORMULA E





In the past, cars gave people the freedom of mobility. In the future, cars will go one step further and free people from driving, giving them the freedom of time. **It's a future we're excited to shape.**



© TNO Mobility and Transport (Scheepers), the Netherlands

Pilot assist or self driving cars

Consumers Desire More Automated Automobiles

Consumers Trust Driverless Cars

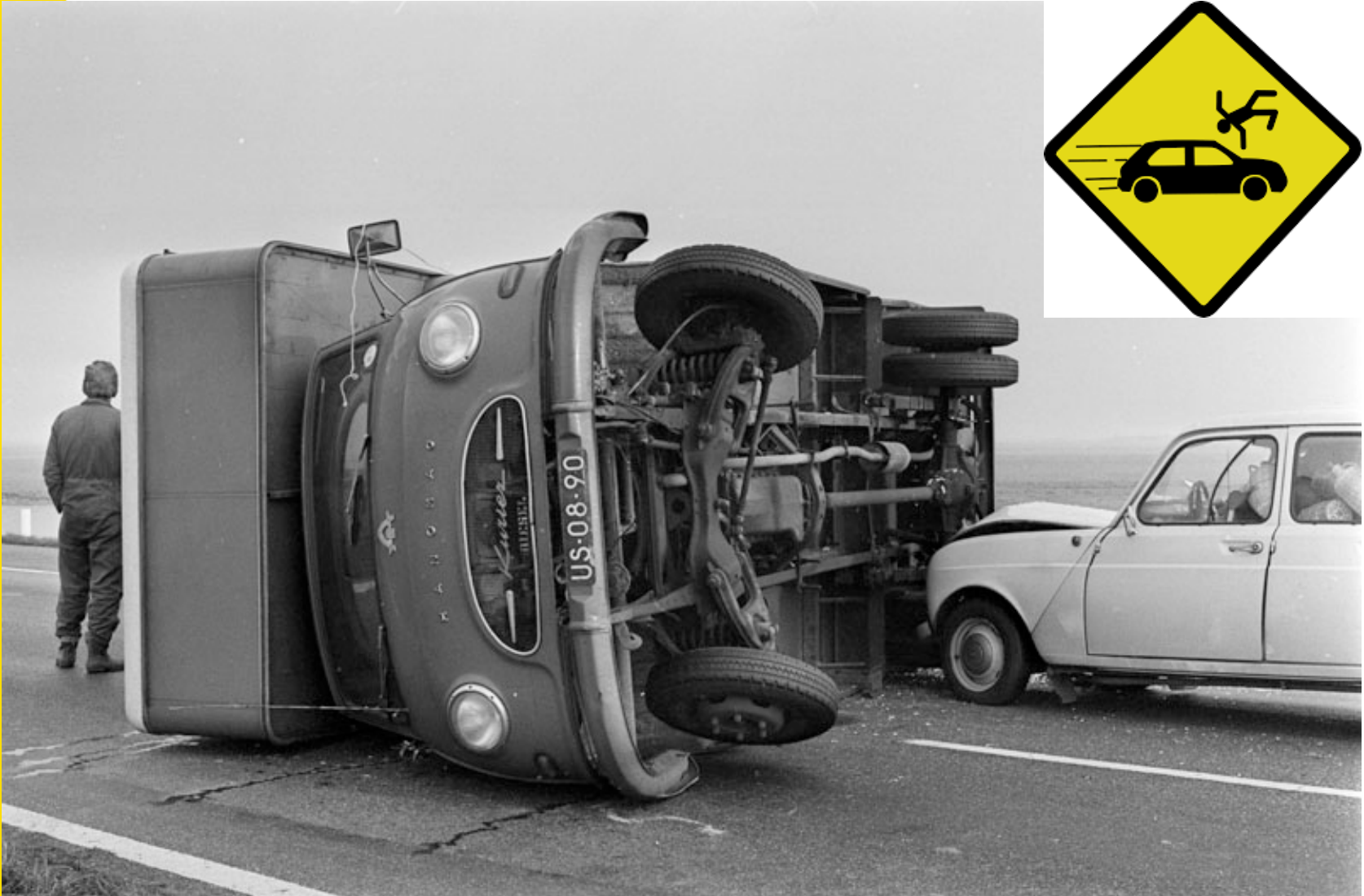


57% of consumers, globally, trust driverless cars—even more so in emerging markets



Source: Cisco Systems, 2013

Accidents?



Safety Levels



Level	Name	Narrative definition	Execution of steering and acceleration/deceleration	Monitoring of driving environment	Fallback performance of dynamic driving task	System capability (driving modes)	BASIS level	NHTSA level
Human driver monitors the driving environment								
0	No Automation	the full-time performance by the <i>human driver</i> of all aspects of the <i>dynamic driving task</i> , even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n/a	Driver only	0
1	Driver Assistance	the <i>driving mode</i> -specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the <i>human driver</i> perform all remaining aspects of the <i>dynamic driving task</i>	Human driver and system	Human driver	Human driver	Some driving modes	Assisted	1
2	Partial Automation	the <i>driving mode</i> -specific execution by one or more driver assistance systems of both steering and acceleration/deceleration using information about the driving environment and with the expectation that the <i>human driver</i> perform all remaining aspects of the <i>dynamic driving task</i>	System	Human driver	Human driver	Some driving modes	Partially automated	2
Automated driving system ("system") monitors the driving environment								
3	Conditional Automation	the <i>driving mode</i> -specific performance by an <i>automated driving system</i> of all aspects of the <i>dynamic driving task</i> with the expectation that the <i>human driver</i> will respond appropriately to a <i>request to intervene</i>	System	System	Human driver	Some driving modes	Highly automated	3
4	High Automation	the <i>driving mode</i> -specific performance by an <i>automated driving system</i> of all aspects of the <i>dynamic driving task</i> , even if a <i>human driver</i> does not respond appropriately to a <i>request to intervene</i>	System	System	System	Some driving modes	Fully automated	3/4
5	Full Automation	the full-time performance by an <i>automated driving system</i> of all aspects of the <i>dynamic driving task</i> under all roadway and environmental conditions that can be managed by a <i>human driver</i>	System	System	System	All driving modes		

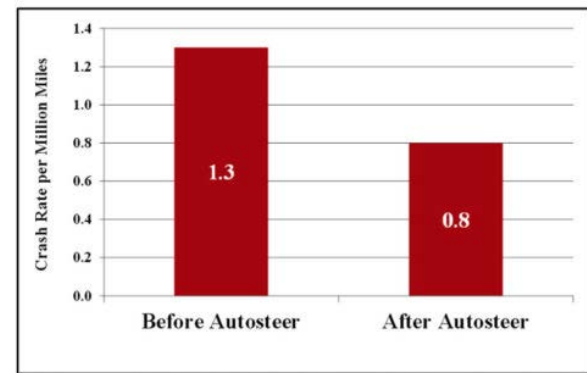
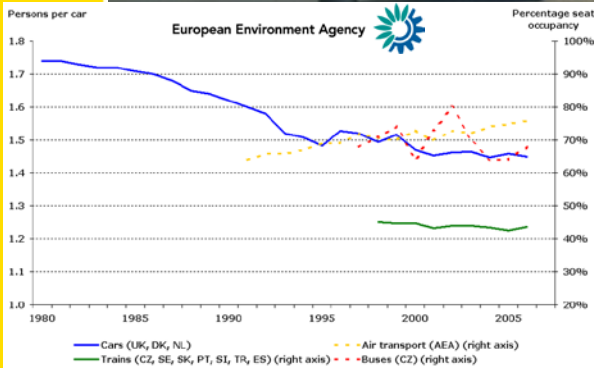


Figure 11. Crash Rates in MY 2014-16 Tesla Model S and 2016 Model X vehicles Before and After Autosteer Installation.

Empty?



Private, public or sharing

car2go provides “ON DEMAND” transportation that is unlike other conventional car-sharing



FEATURE	CAR2GO	TRADITIONAL CAR-SHARING
ECO-FRIENDLY	✓	✓
ONE-WAY TRIPS	✓	
BILLING TO PER-MINUTE RATES	✓	
FLEXIBLE, OPEN-ENDED RENTALS	✓	
DEDICATED PARKING SPACES	✓	✓
FLEXIBLE PARKING SOLUTIONS FOR CUSTOMERS	✓	
ON-DEMAND RENTALS	✓	
ROUND TRIPS ONLY		✓
ADVANCED RESERVATIONS	✓	✓
SCHEDULED RETURN TIMES		✓



UBER



Bla Bla Car

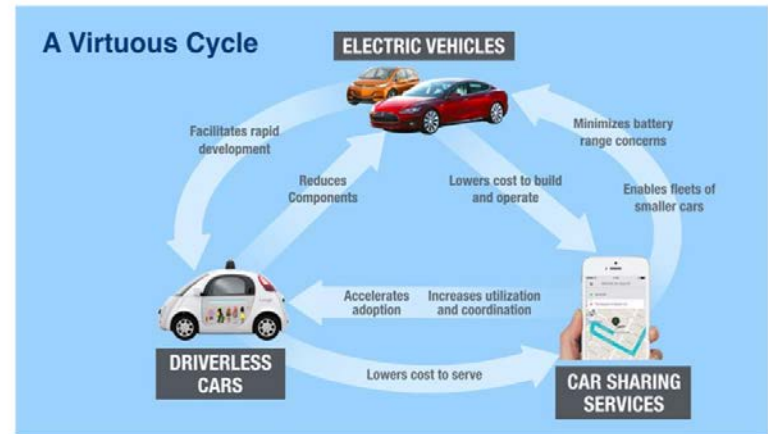
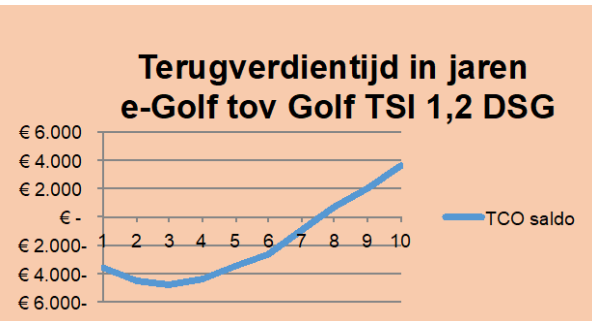


Cost?



EV's will break even soon, Sharing will make them earn money

Break even time in years



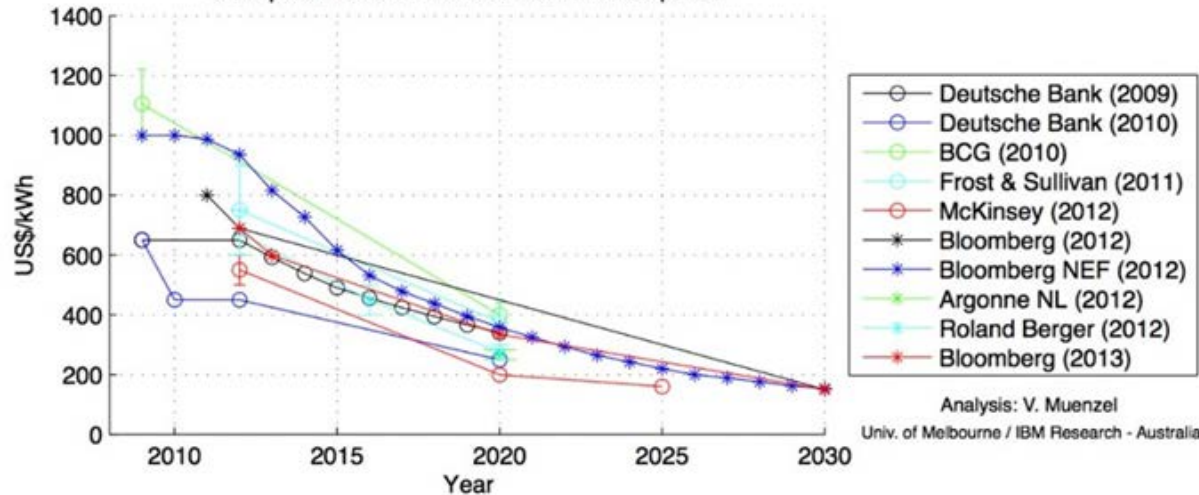
Chunka Mui



JEDLIX



Cost predictions for full automotive Li-ion packs



Analysis: V. Muenzel
Univ. of Melbourne / IBM Research - Australia

Maintenance and durability



Summary 3D-6Z



3 Disruptions



6 Zero's

Electrification

Automation

Connectivity

Zero Emission

Zero Energy

Zero Congestion

Zero Accident

Zero Empty

Zero Cost

Sibrandus Stratingh (1785)



Probably the first electric powered vehicle in the World (1834)

Free Online Course (2018)

Free Online Course

www.tiny.cc/evmoooc

ELECTRIC CARS: TECHNOLOGY, BUSINESS, POLICY



Start Date

20 Feb 2018

Course Length

7 Weeks

Estimated Effort

6-8 Hrs/Week

Enrollment Via

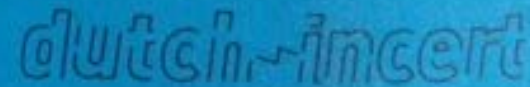
<http://www.tiny.cc/evmoooc>



TU Delft



Rijksdienst voor Ondernemend
Nederland



DutchIncent