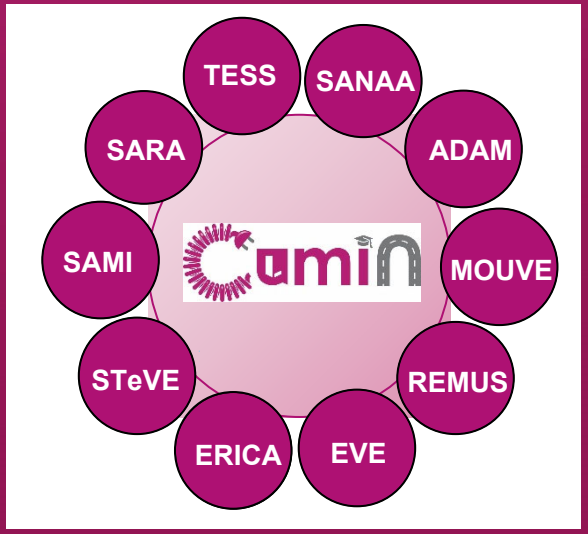
Campus of University with Mobility based on Innovation and carbon Neutrality

https://cumin.univ-lille.fr/



Green Mobility unit

"The Mobility challenges"

Prof. Alain BOUSCAYROL
(L2EP, Univ. Lille, France)

Outline

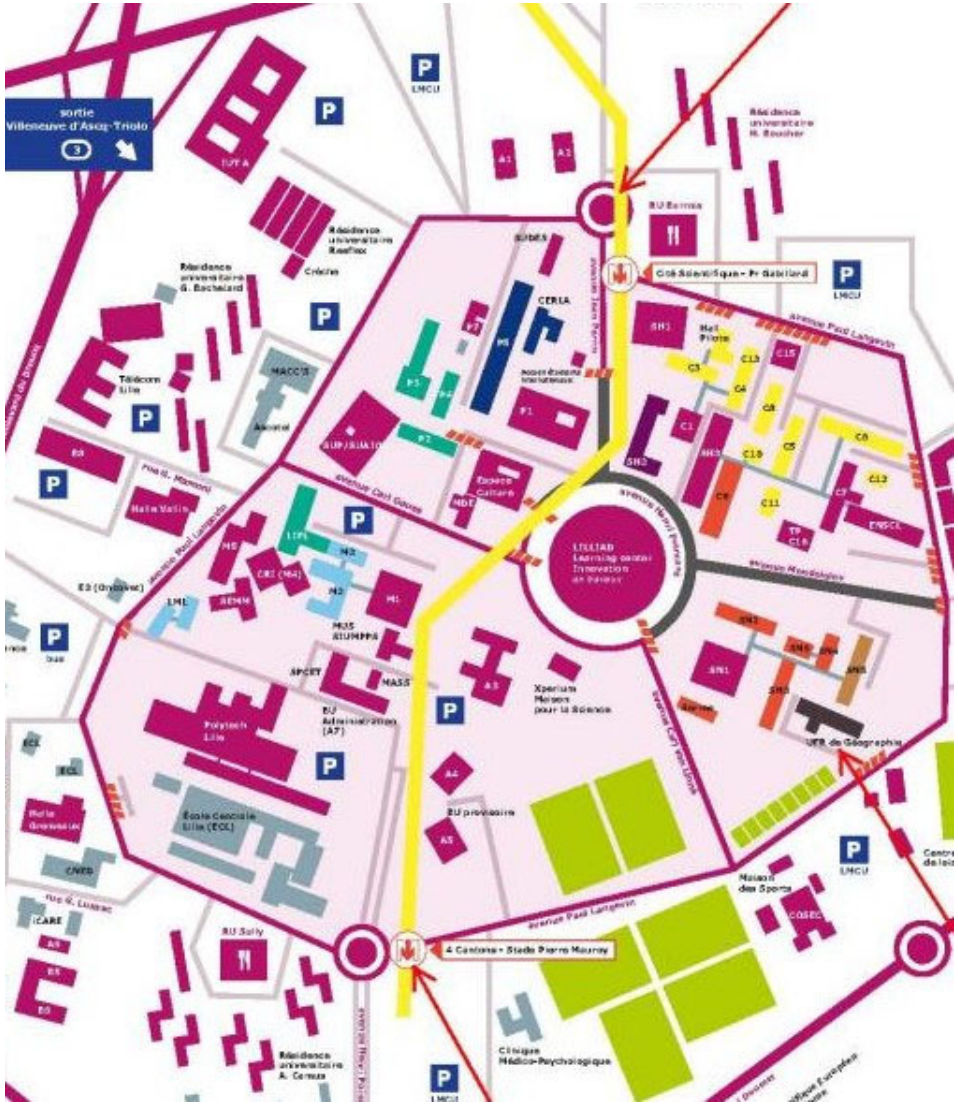
1. Unit introduction
2. Environmental challenges
3. Technological & social challenges

Campus of **U**niversity with **M**obility based on **I**nnovation and carbon **N**eutrality

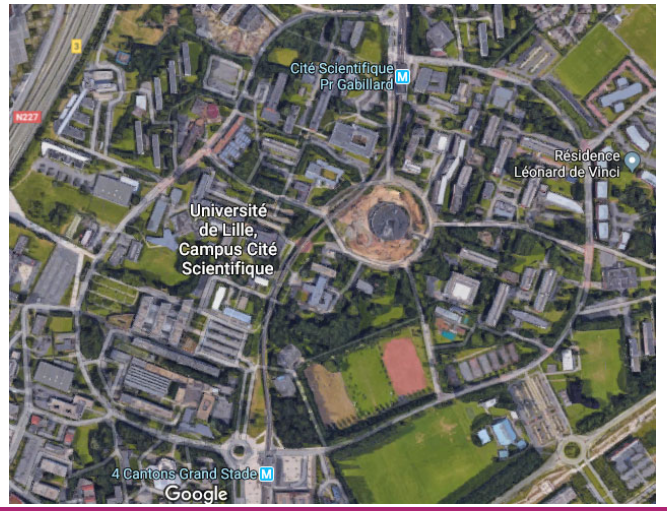
1. Introduction

Green Mobility unit

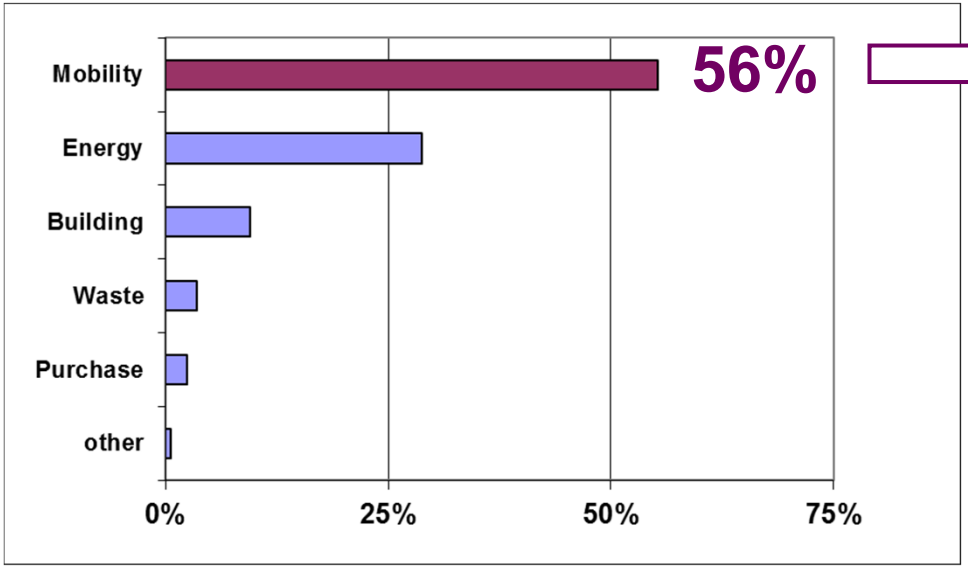
Campus “Cité Scientifique”
Université de Lille



20,000 students
80 building
110 Ha

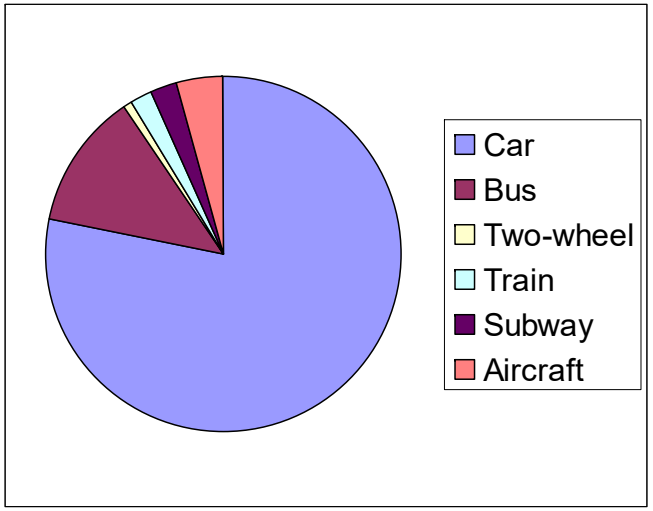


Greenhouse gazes
(ULille, campus Cité scientifique)



[Bilan Carbone, Lille1, COMUE 2015]

97 % home-university trips



Passenger cars: 27% of travels
78% of pollution

Which solution? Green mobility?

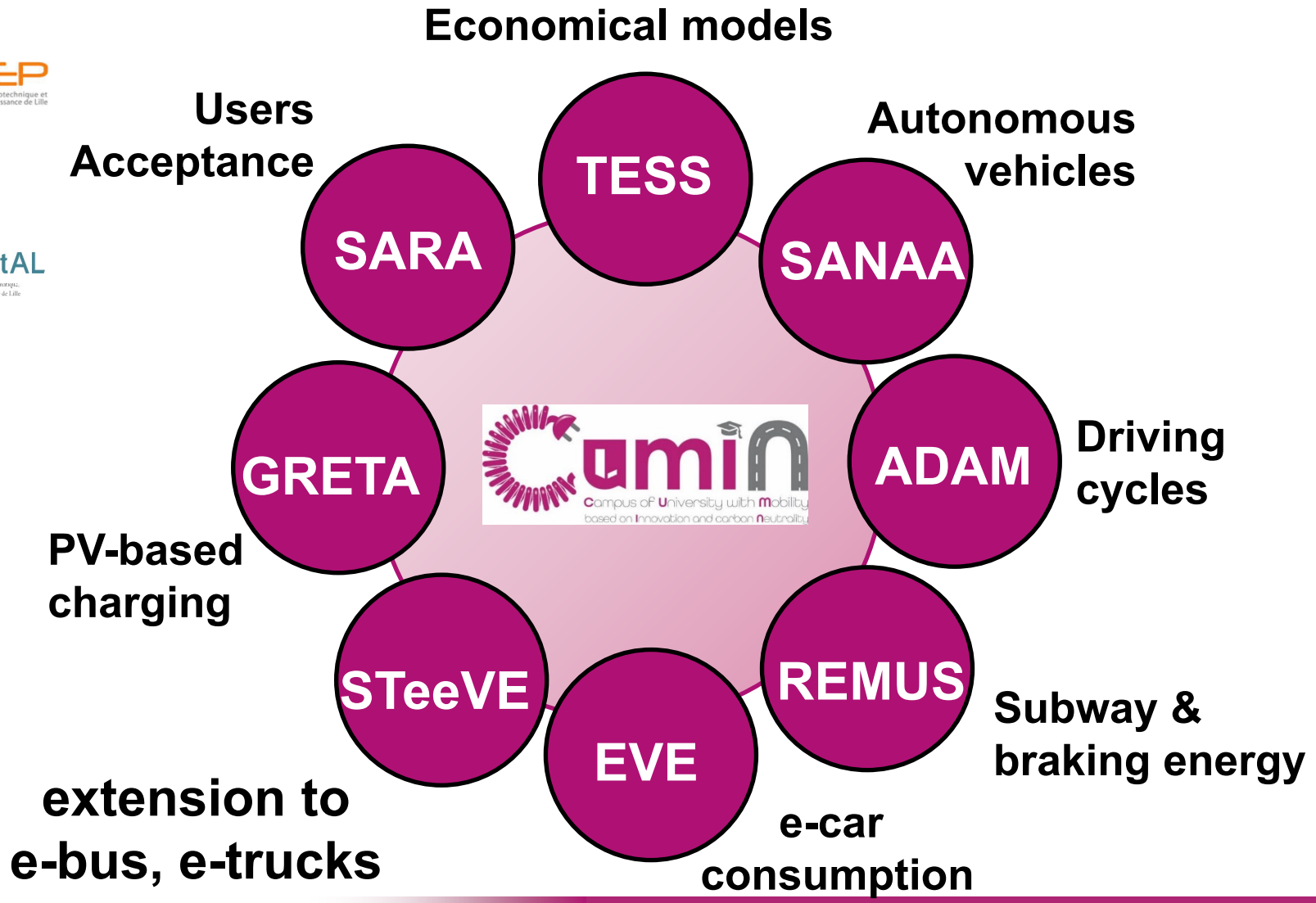
CUMIN – objective

First University Campus with mobility neutral in CO_2 equivalent :

- reduction of the campus GHG thanks to e-mobility (**sustainable develop.)**
- charging of electric vehicles using Renewable Energy
- involvement of the campus users in the development (**Living lab**)
- open database from experiences and survey (**open science**)
- flexible methods for extension to any eco-city or area.

Unique demonstrator campus (living Lab)
as a relevant example for new urban mobility → *Extensions to eco-cities…*

Campus of University with Mobility based on Innovation & carbon Neutrality



“Green Mobility” unit ny CUMIN members

Provisional schedule (Amphi ATRIUM, ESPRIT building, ULille, Campus “cite scientifique”)		
6 Jan. 2023 16:00-18:00	The mobility challenges	Prof A. Bouscayrol (L2EP, Univ. Lille), CUMIN coordinator,
13 Jan. 2023 16:00-18:00	Green mobility and economics	Prof. E. Hittinger (RIT, USA) **- Videoconference** CUMIN-TESS leader
20 Jan. 2023 16:00-18:00	Green mobility and hydrogen	Prof. L. Boulon (IRH, Univ. Trois Rivières, Canada) eCAMPUS coordinator **- Videoconference**
27 Jan. 2023 16:00-18:00	Green mobility and electrified cars	Prof A. Bouscayrol (L2EP, Univ. Lille), CUMIN-EVE leader
3 Feb. 2022 16:00-18:00	Green mobility and autonomous vehicle *(to be confirmed)*	Prof. M. El Badaoui El Najjar (CRIsTAL, Univ. Lille), CUMIN-SAANA leader
10 Feb. 2023 16:00-18:00	Green mobility and public policies	Prof. E. Castex (TVES, Univ. Lille) CUMIN-ERICA leader
17 Feb. 2023 16:00-18:00	CUMIN programme	Prof A. Bouscayrol (L2EP, Univ. Lille), CUMIN coordinator

Campus of **U**niversity with **M**obility based on **I**nnovation and carbon **N**eutrality

Université de Lille

2. Environmental challenges

Green Mobility unit

Sustainable development & human needs

renewable energy

Energy
(production and adaptation)

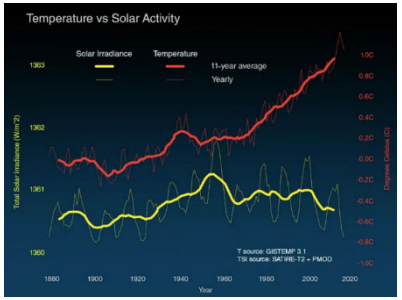
fossil energy

materials & natural resources

waste

Device
(manufacturing and usage)

waste

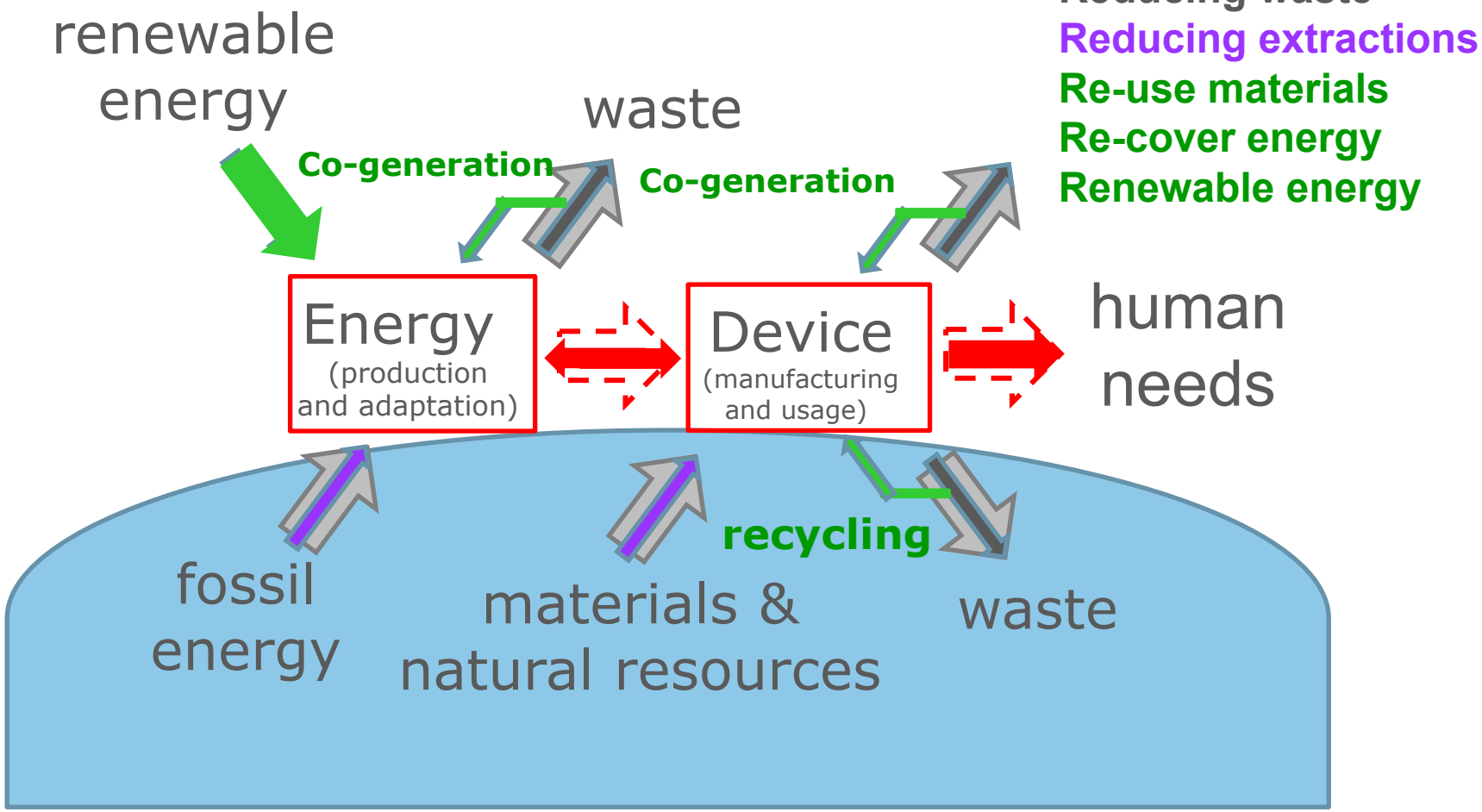


human needs

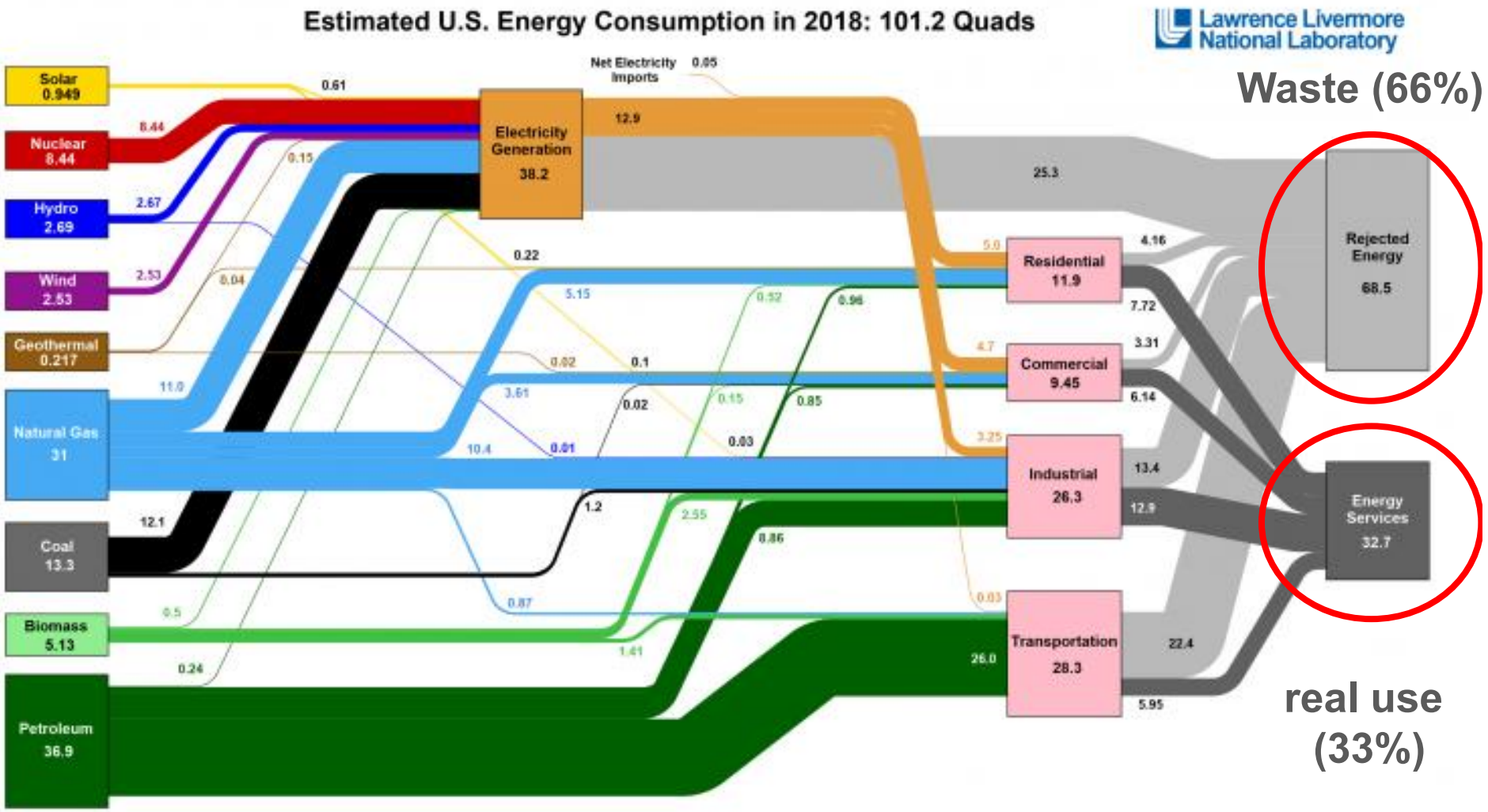
waste

Sustainable development & human needs

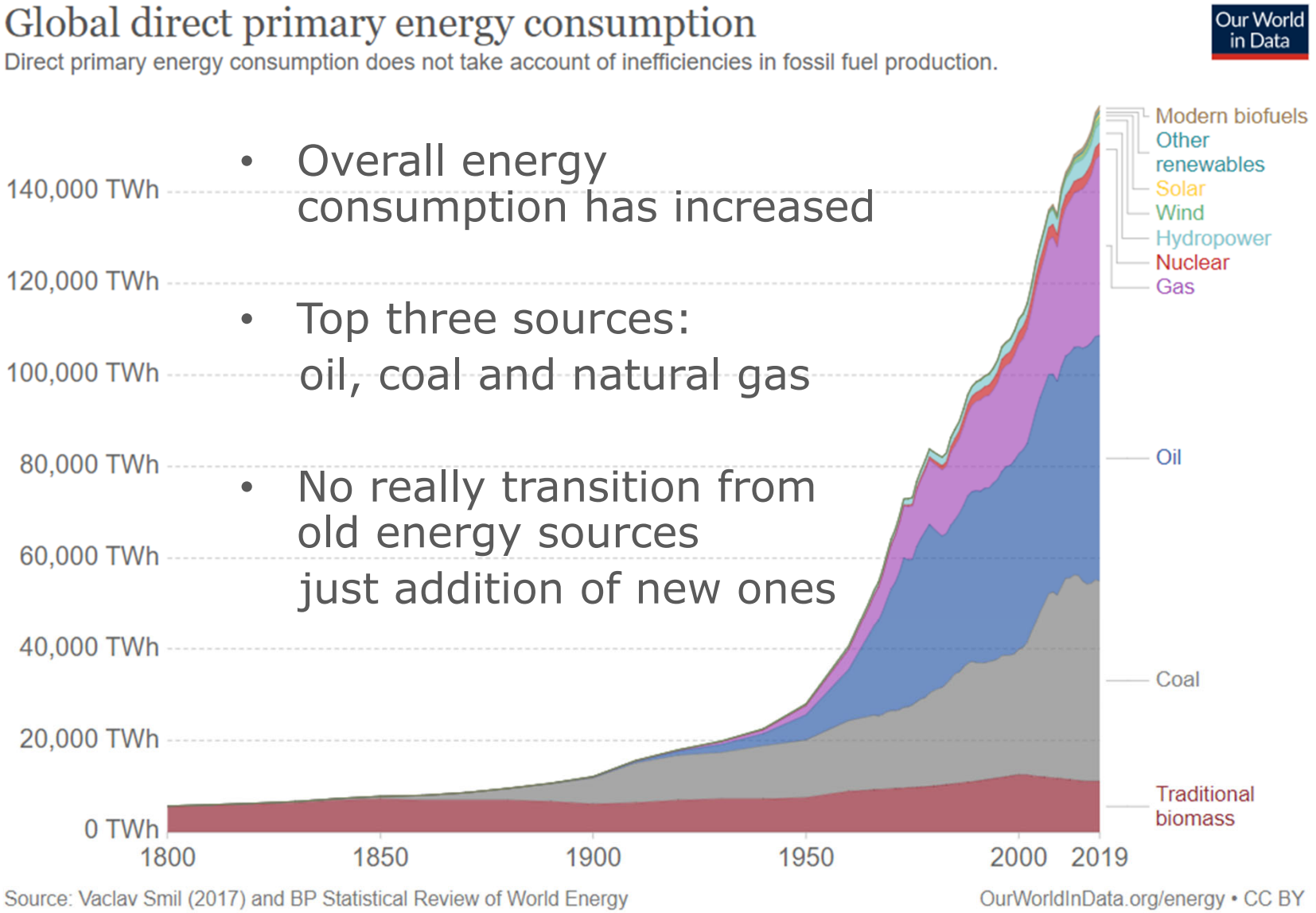
Reducing needs
Reducing losses
Reducing waste
Reducing extractions
Re-use materials
Re-cover energy
Renewable energy



Energy & waste

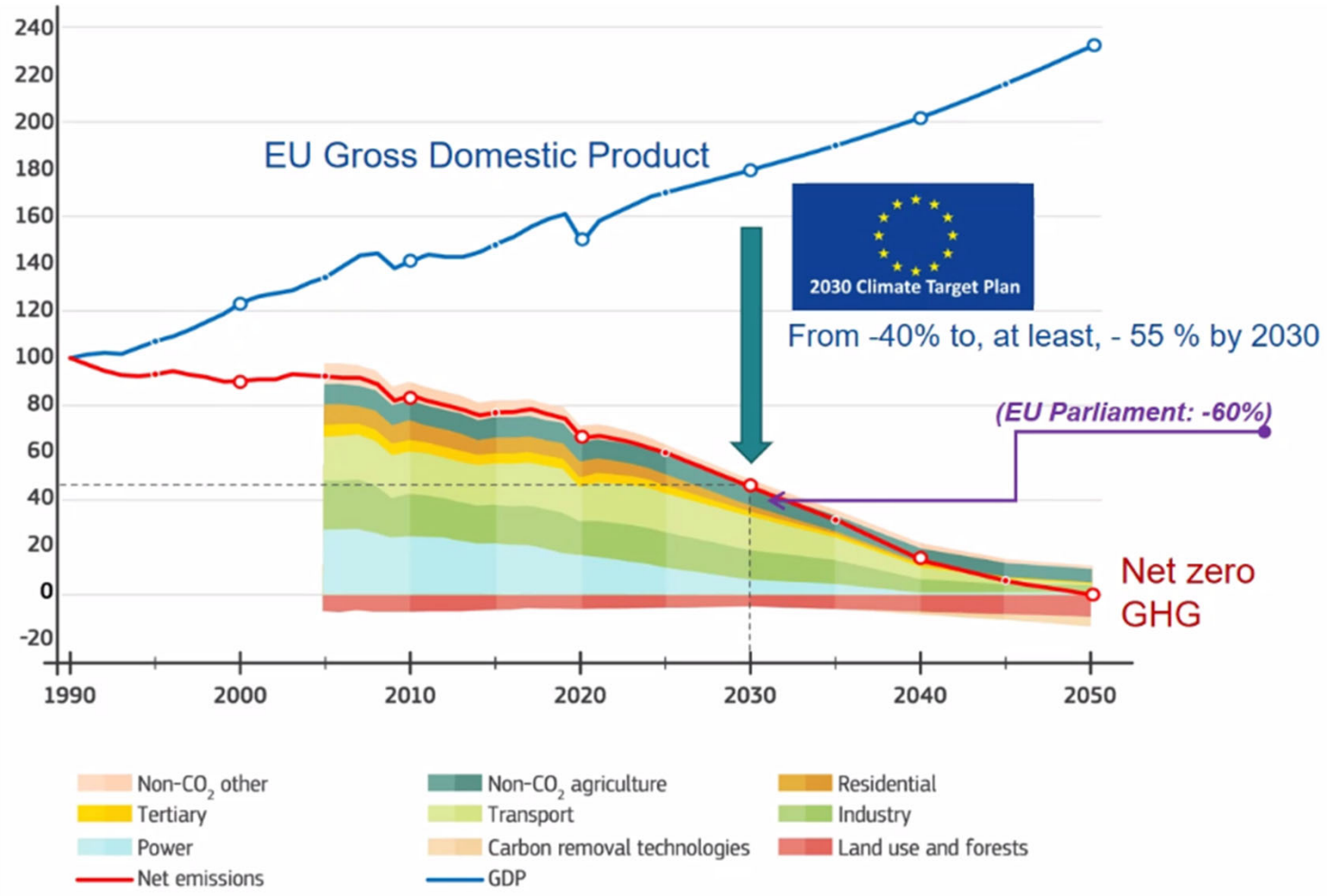


History of energy sources



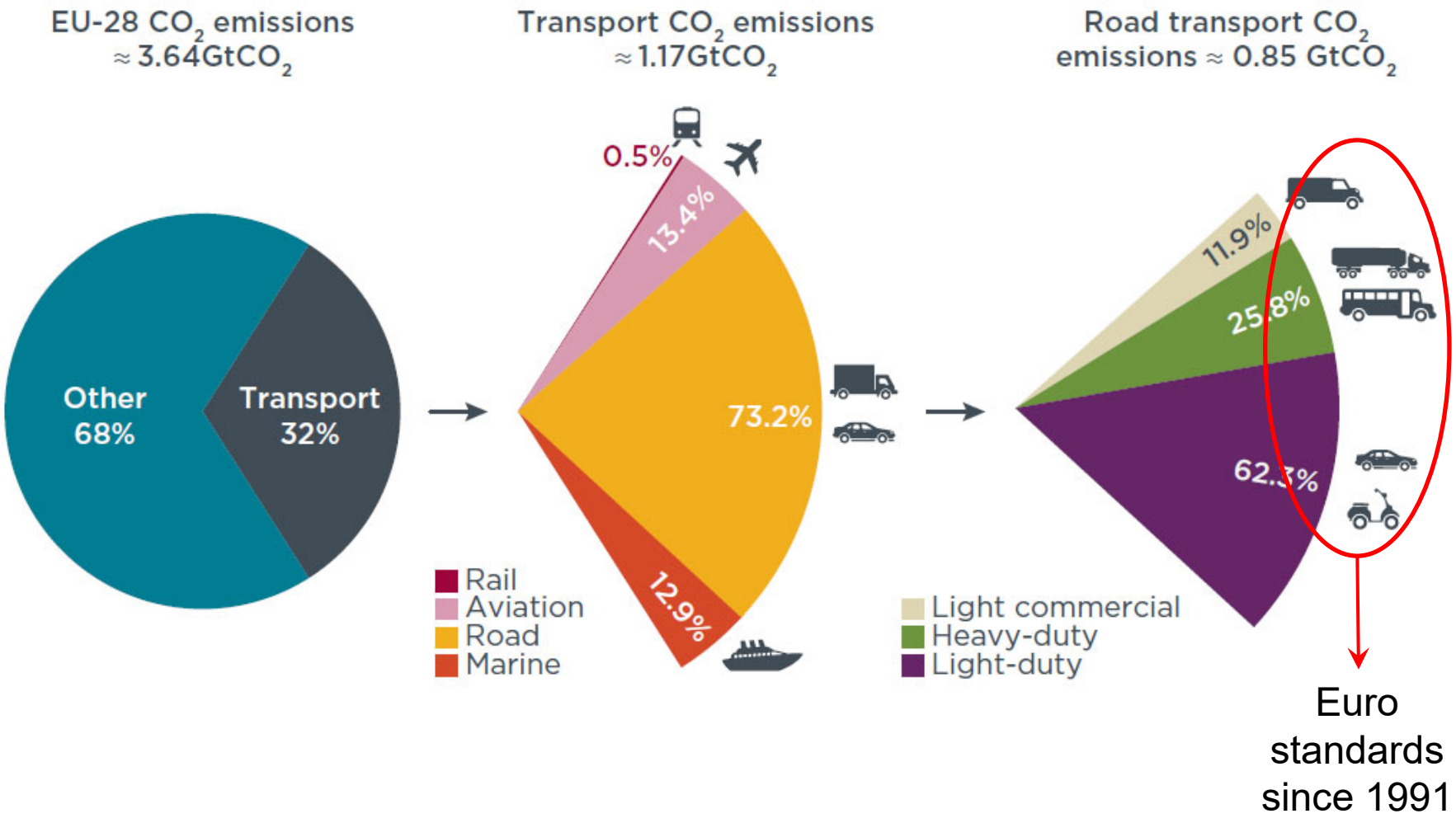
- Overall energy consumption has increased
- Top three sources: oil, coal and natural gas
- No really transition from old energy sources just addition of new ones

GHG prospective for the EU



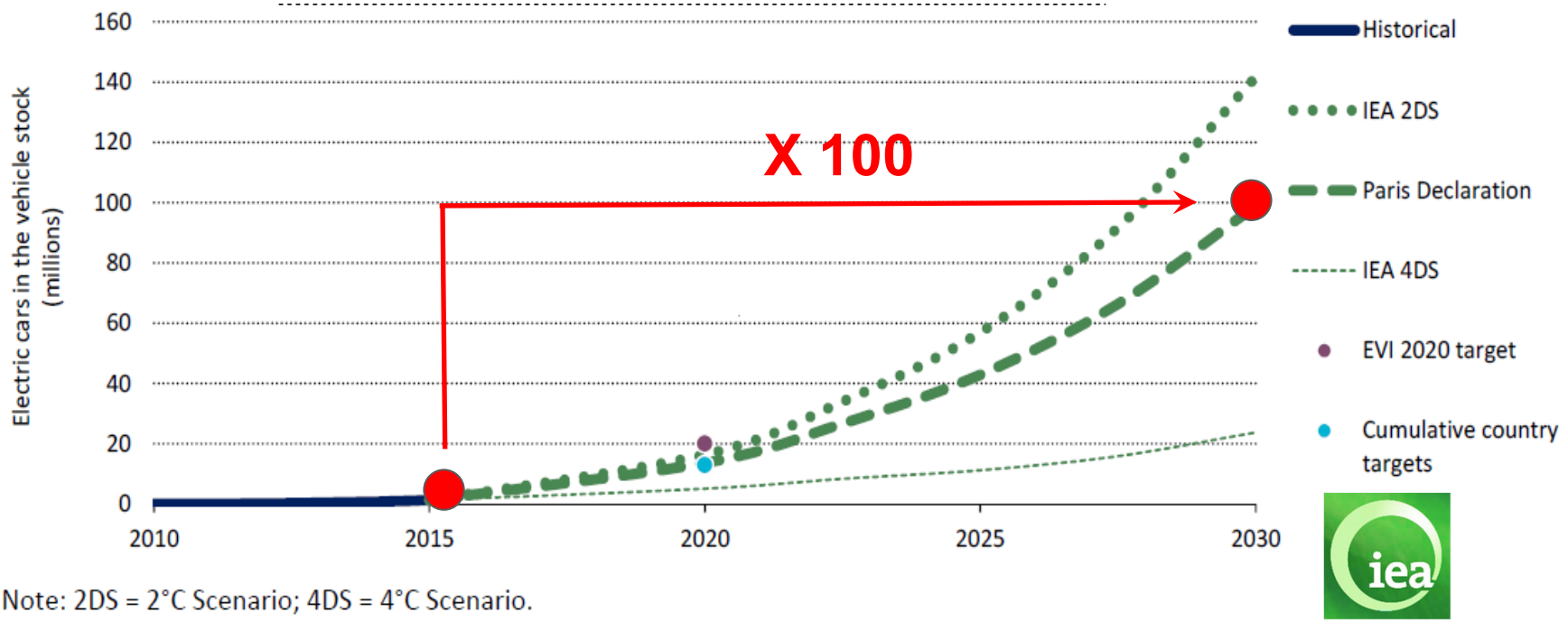
[EEA 19]

CO2 emissions in the EU for 2015



[Rodríguez 2018]

Challenges of mobility



Note: 2DS = 2°C Scenario; 4DS = 4°C Scenario.

Electrified vehicles (EV + Plug-in HEV):
- 2015: 1 M of electrified vehicles (0.1% of the market)
- **objective 2030: 100 M of electrified vehicles for global warming < +2°C**

Source: "Global EV outlook 2016, beyond one million electric cars", International Energy Agency report, 2016

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3. Technological & societal challenges

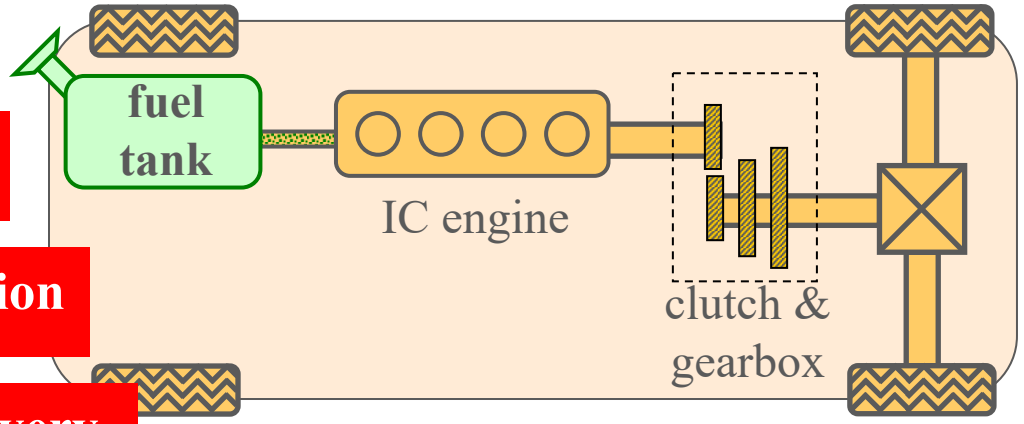
Green Mobility unit

- Thermal Vehicle -

low efficiency

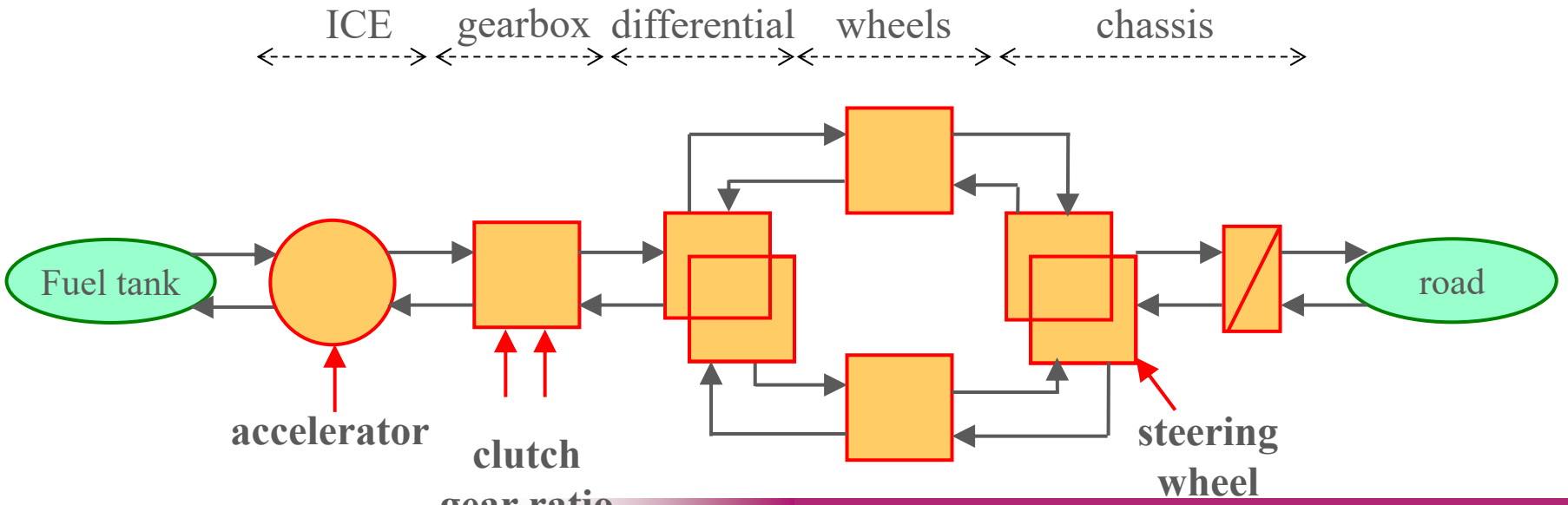
pollutant emission

no energy recovery



great autonomy

fast energy charge

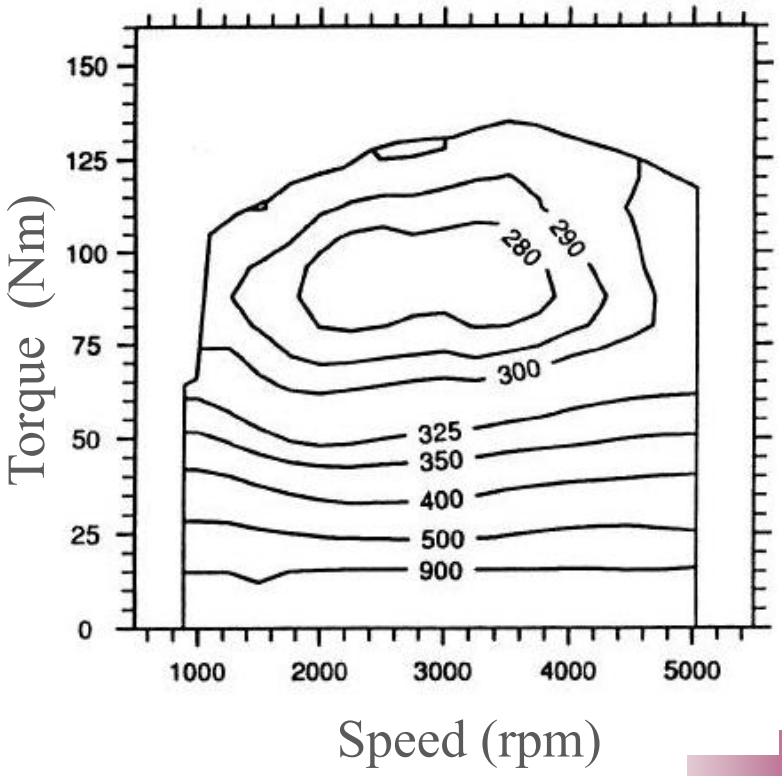


- Gasoline engine -

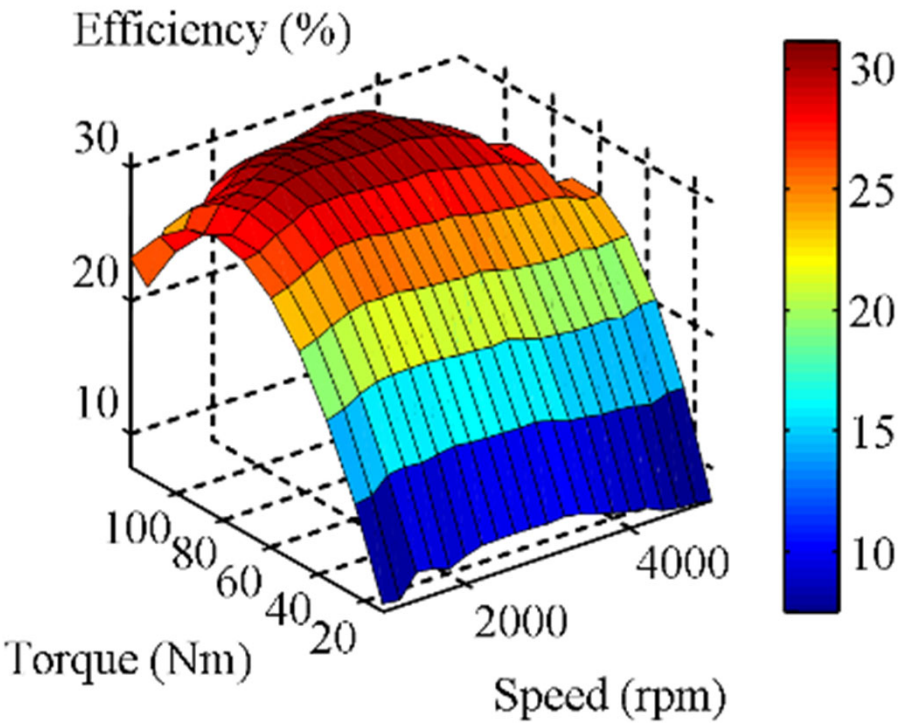
P_{max}=60 ch (45 kW) @ 3750 rpm T_{max}=119 Nm @ 3400 rpm

(1700 cm^3)

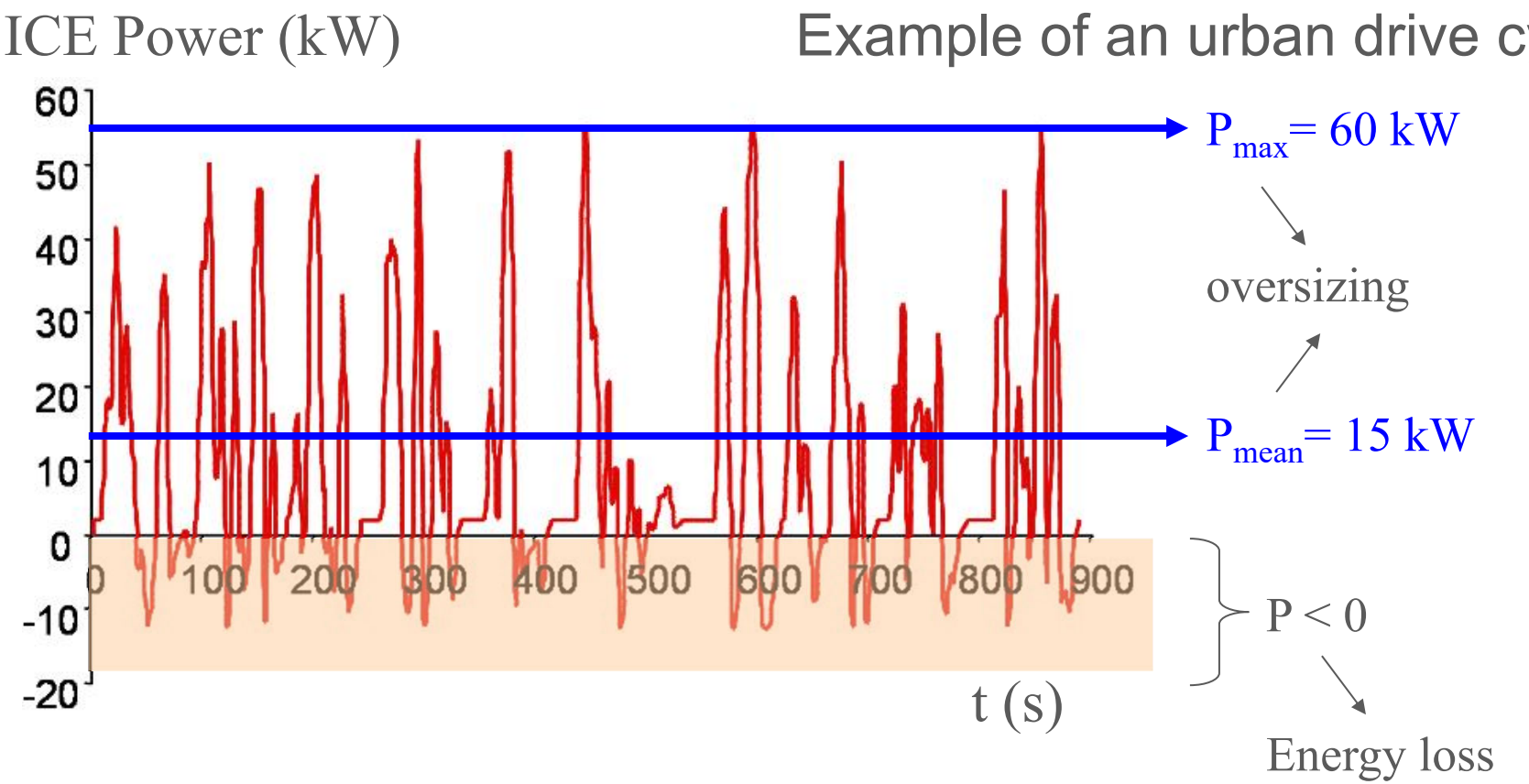
Iso specific consumption (g/kWh)



Efficiency map



- Power of a thermal vehicle -

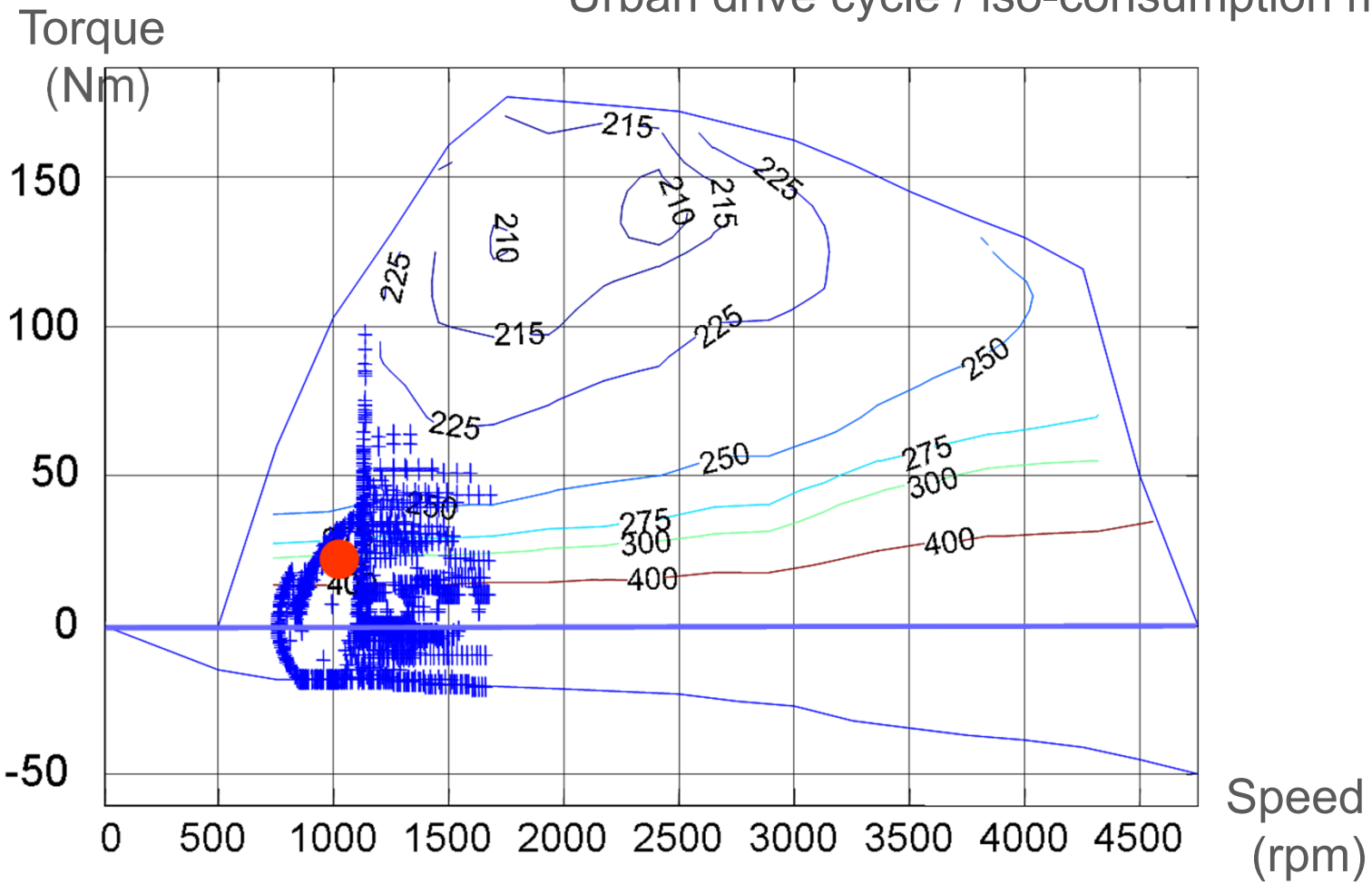


IFSTTAR

Interest of a system which:
- delivers peak power at high efficiency
- enables energy recovery

- Operation of an ICE -

Urban drive cycle / iso-consumption map



mean efficiency ~12% (88% of losses!!)

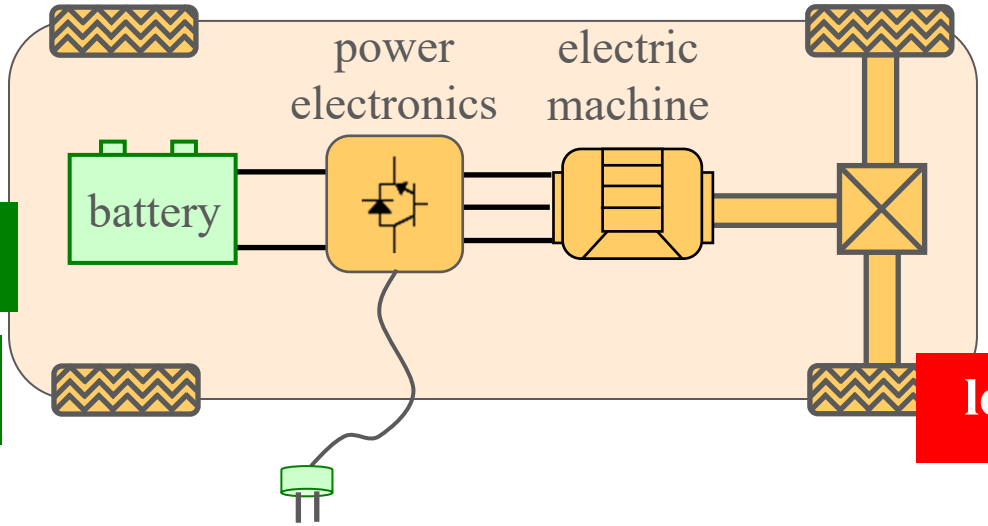
IFSTTAR

- Electric Vehicle -

high efficiency

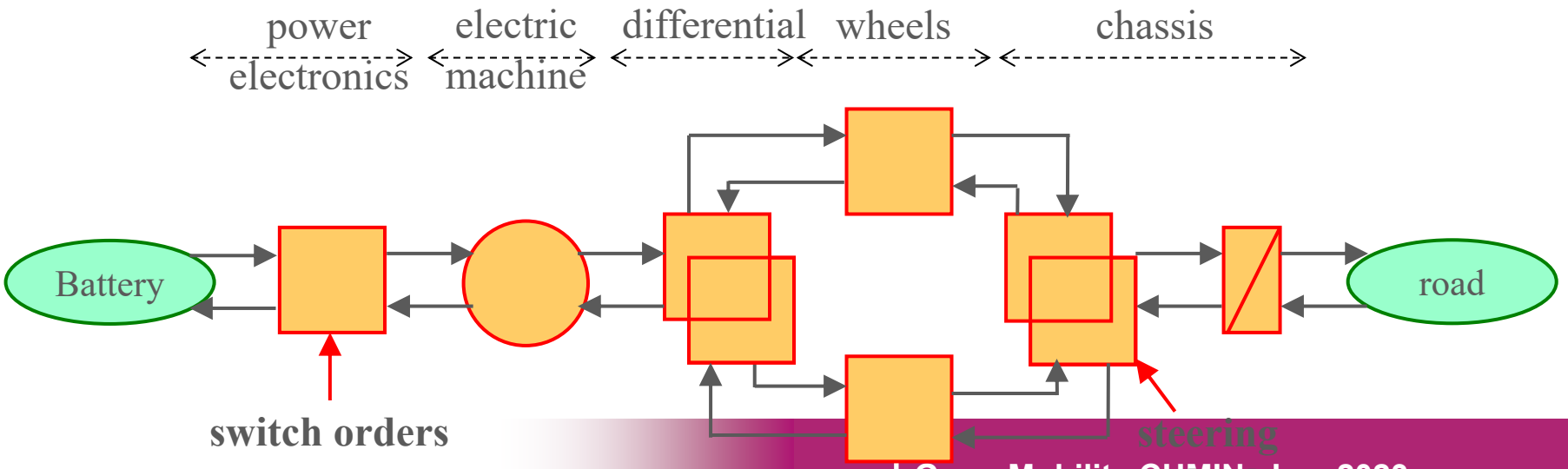
no local emission

energy recovery



low autonomy

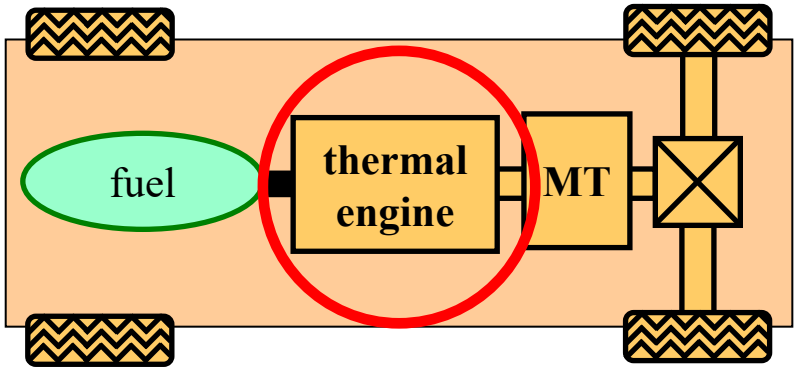
long energy charge

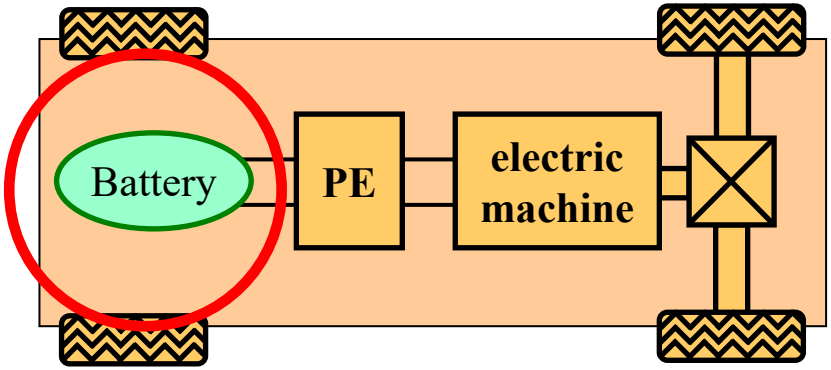


Which vehicles?

Thermal vehicle

- local pollution
- engine losses > 70%
- driving range > 600 km
- energy charging < 5 min





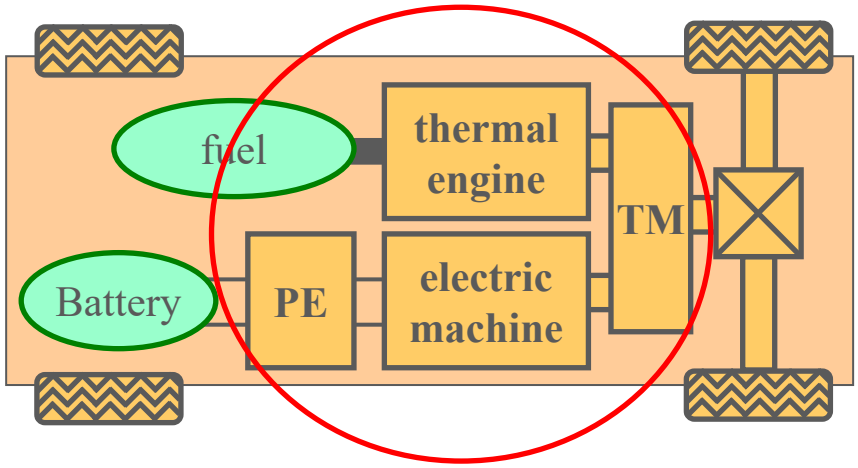
Electric Vehicles

- no local pollution
- e-motor losses < 10%
- driving range < 200 km
- energy charging > 5 h

EVs require a new mobility!

MT = Mechanical Transmission
PE = Power Electronics

- Hybrid Electric Vehicles -



Hybrid vehicle:
- advantage of each technology
- higher cost
- complex control

Toyota Prius 3

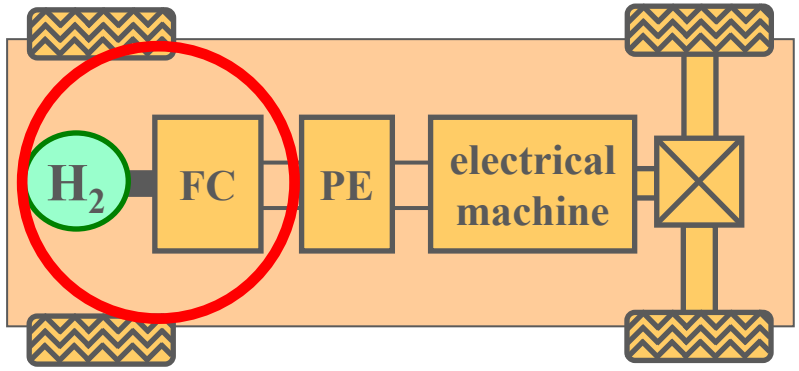
http://www.toyota.com/

Various configurations:
- different power ratios P_{ICE}/P_{EM}
- different component organization

Peugeot 3008 HY4

http://www.mpsa.com

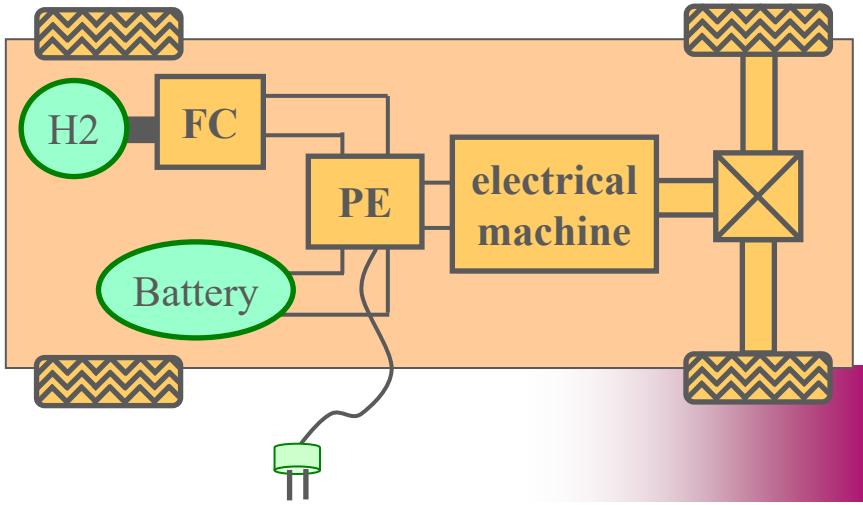
- Fuel Cell vehicles? -



Fuel cell vehicle :
= EV with battery replaced by a fuel cell and a H2 tank

Honda Clarity FX

http://www.honda.com/

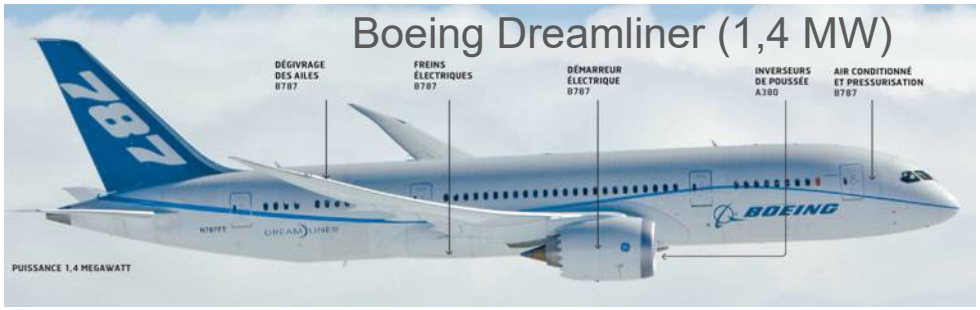


FC vehicle with hybrid storage
= another kind of RE-EV

Toyota Mirai

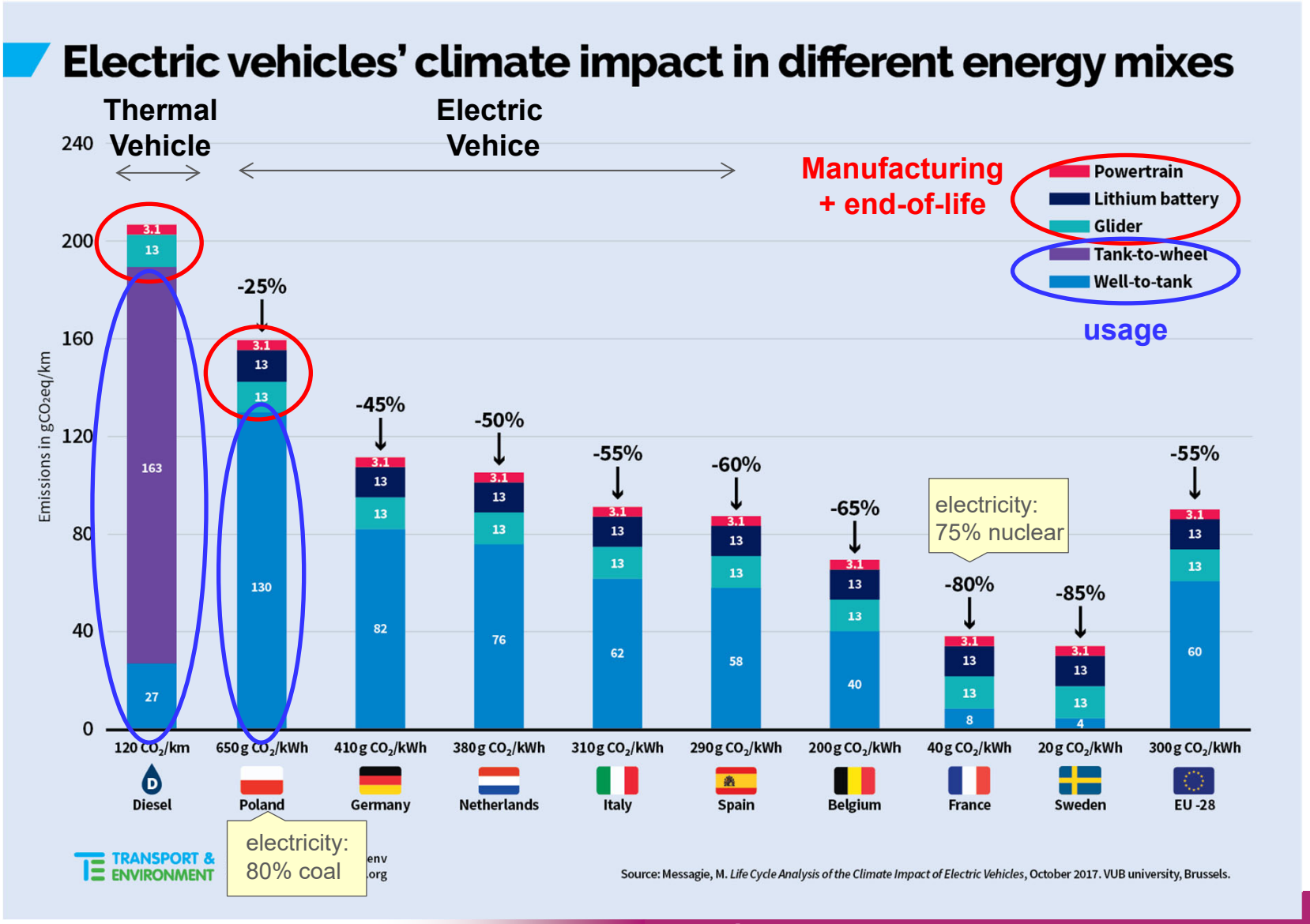
http://www.toyota.com/

- Other Electric Vehicles -



New technologies are also used in various vehicles in order to reduce the ecological footprint of transportation systems!

Life Cycle Assessment - GHG



- Energy charge -

- slow charge at home
  / at work (4-8h?)
  (plug or induction)
- ultra-fast charge at specific
  station (1/2h?)
- battery swap station
  (5-10 min?)

http://france.betterplace.com/

New technologies and developments? “Smart” charge?
but also
A new way to manage our energy charge?

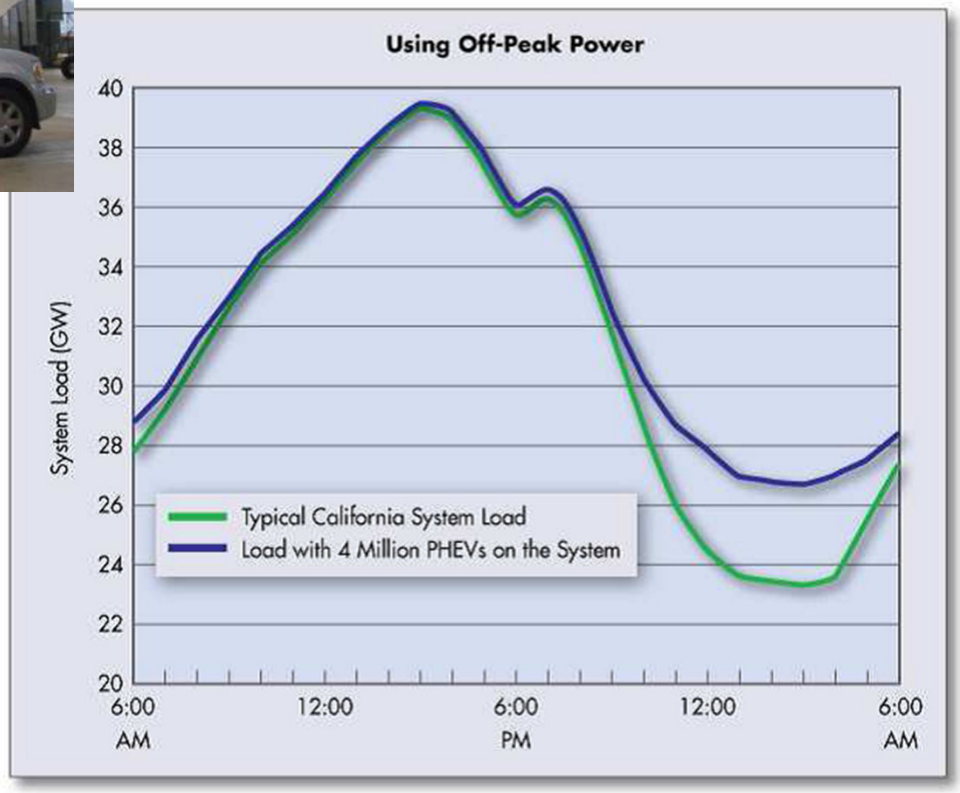
- Impact on the grid -

G2V

V2G

(Vehicle to Grid)

http://my.epri.com



New concepts for grid management?

but also

A new way to manage our energy prize?

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Conclusion on challenges?

Green Mobility unit

- Expectations from attendees -

- Social acceptability?
- Environmental aspects analysis?
- Evolution of batteries (technology, batteries)?
- How to produce the EV during the next 10 years?
- Life cycle assessment for vehicles?
- Different Infrastructure deployment and cost?
- Changes of the economics of the vehicle?
- Economical growth of the different sectors?
- Public policies for EVs?
- How long to replace TV by EV?
- Hydrogen vehicle comparison with EVs?
- Mining and resources for batteries?
- New technologies of batteries?
- Why not reducing the number of cars?

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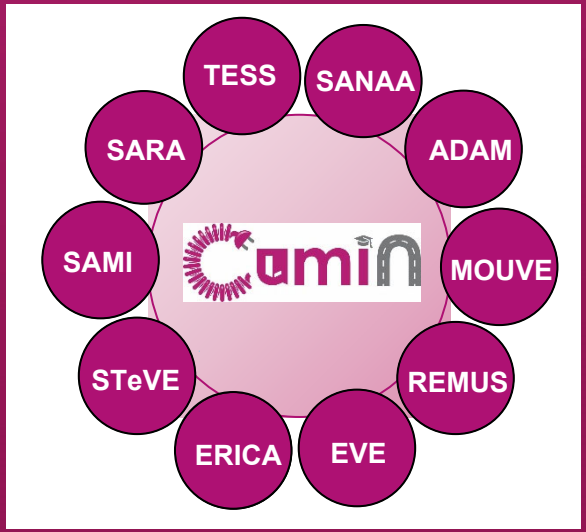

CUMIN programme

Our campus as an exiting living lab towards eco-cities!

Speaker

Prof. Alain BOUSCAYROL

L2EP, University of Lille,

- PhD in electrical Engineering, INPT Toulouse 1995
- research: electrified vehicles, energy management
- coordinator CUMIN programme
- coordinator MEGEVH scientific network on EVs
- coordinator of H2020 PANDA European project (EV testing)
- Co-director of eCAMPUS international Lab
- General chair of the steering committee of IEEE-VPPC (Vehicle Power Propulsion conference) of IEEE-VTS