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# Trajnostna mobilnost

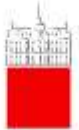
**Tomaž Kutrašnik**  
Univerza v Ljubljani  
Fakulteta za strojništvo



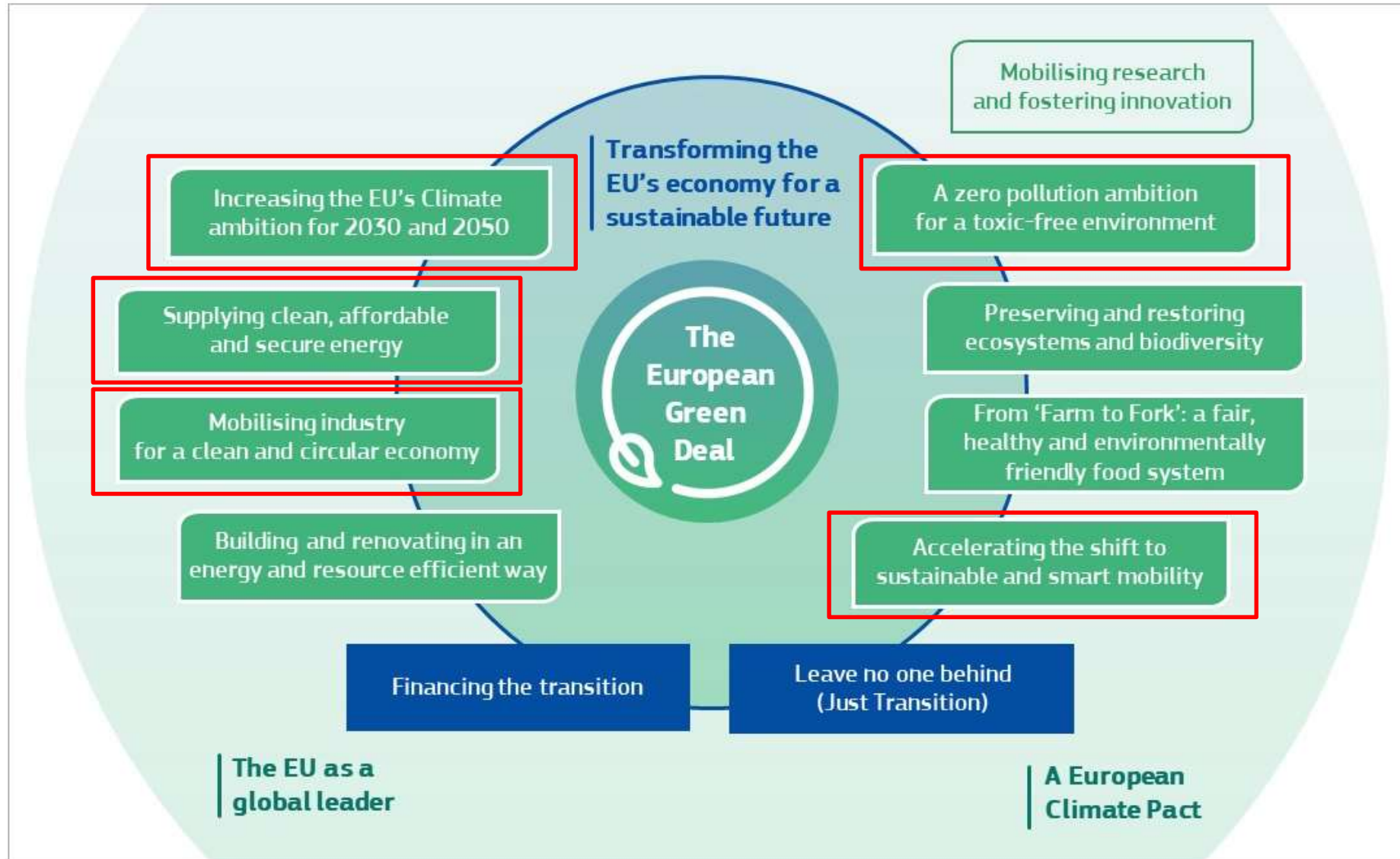
# Agenda

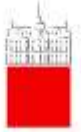
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- Directives and guidelines
- Options and challenges
- Life cycle perspective
- System approach



# Guidelines and directives

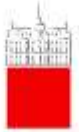




# Agenda

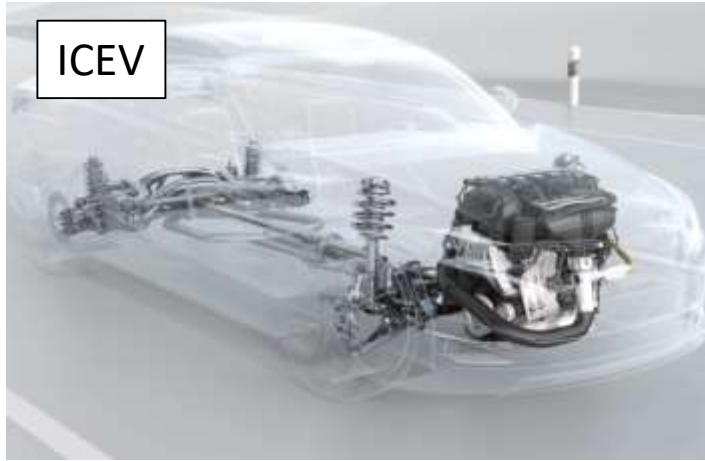
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- Directives and guidelines
- **Options and challenges**
- Life cycle perspective
- System approach



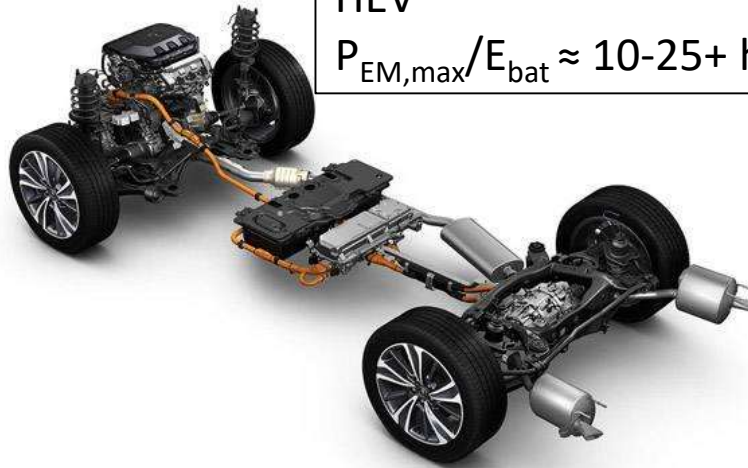
# Powertrain options

ICEV



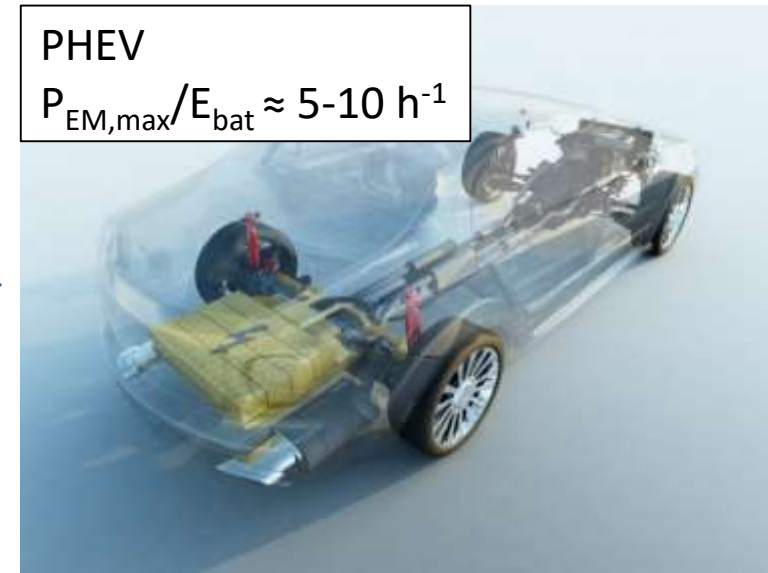
HEV

$$P_{EM,max}/E_{bat} \approx 10-25+ h^{-1}$$



PHEV

$$P_{EM,max}/E_{bat} \approx 5-10 h^{-1}$$



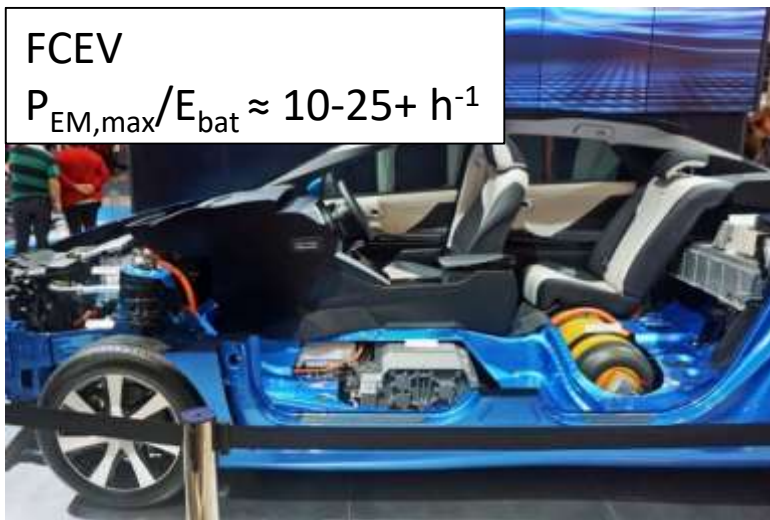
EV

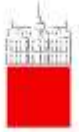
$$P_{EM,max}/E_{bat} \approx 2-5 h^{-1}$$



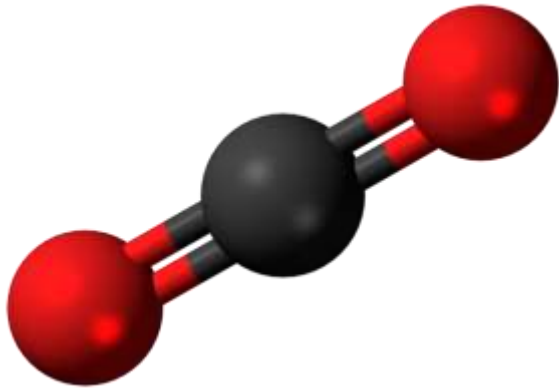
FCEV

$$P_{EM,max}/E_{bat} \approx 10-25+ h^{-1}$$

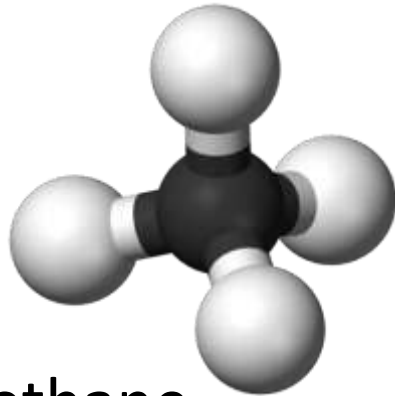




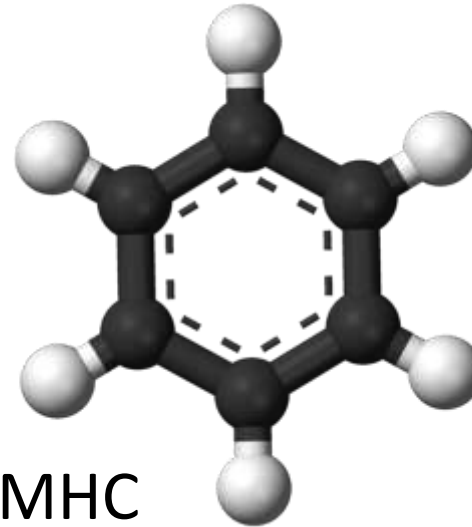
# Emissions



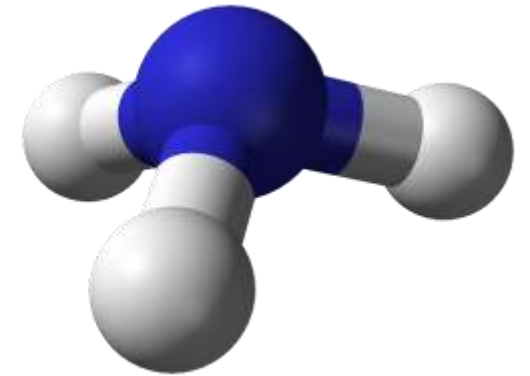
CO<sub>2</sub>



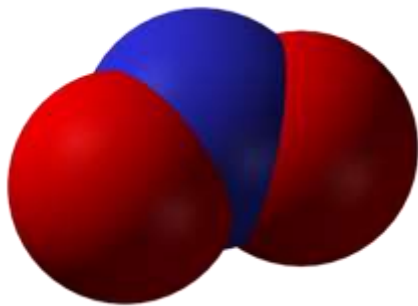
Methane



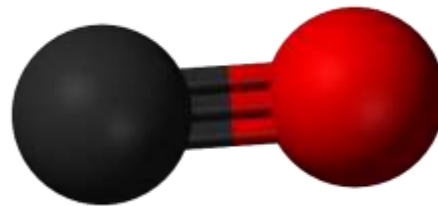
NMHC



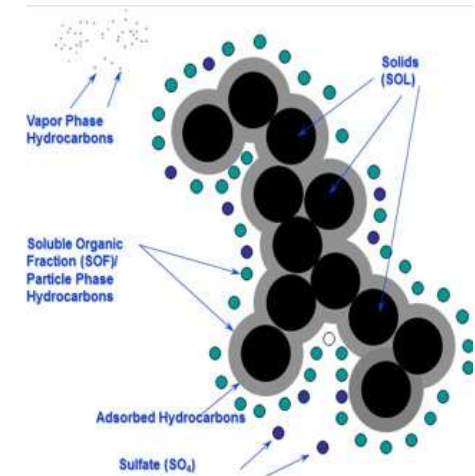
NH<sub>3</sub>



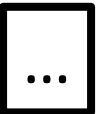
NO<sub>x</sub> in particular NO<sub>2</sub>



CO



Particles





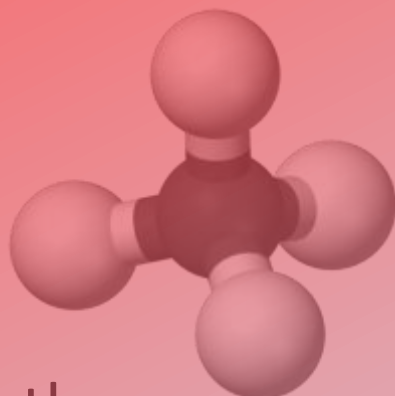
# Emissions

Global

Increasing the EU's Climate  
ambition for 2030 and 2050



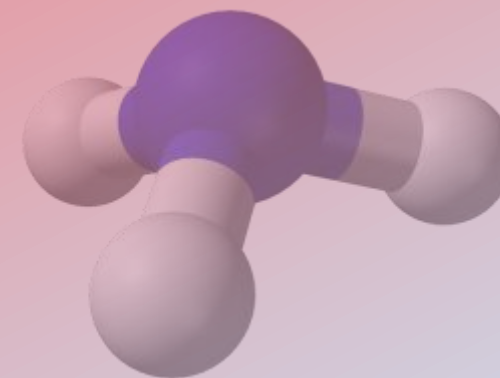
CO<sub>2</sub>



Methane



NMHC



NH<sub>3</sub>



NO<sub>x</sub> in particular NO<sub>2</sub>



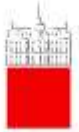
CO



A zero pollution ambition  
for a toxic-free environment

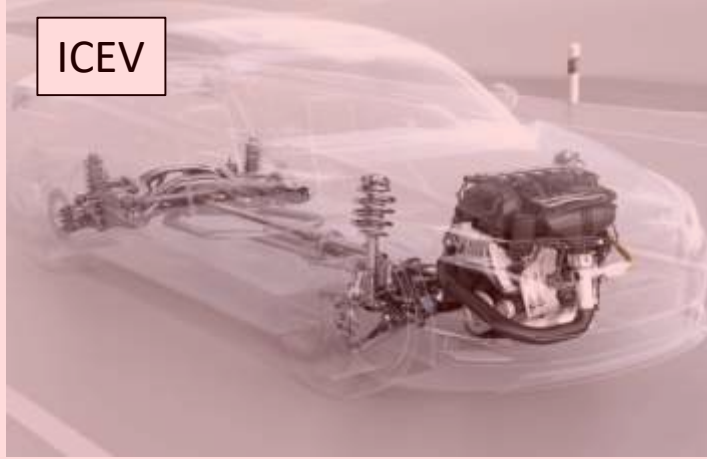
Particles

Local



# Powertrain options

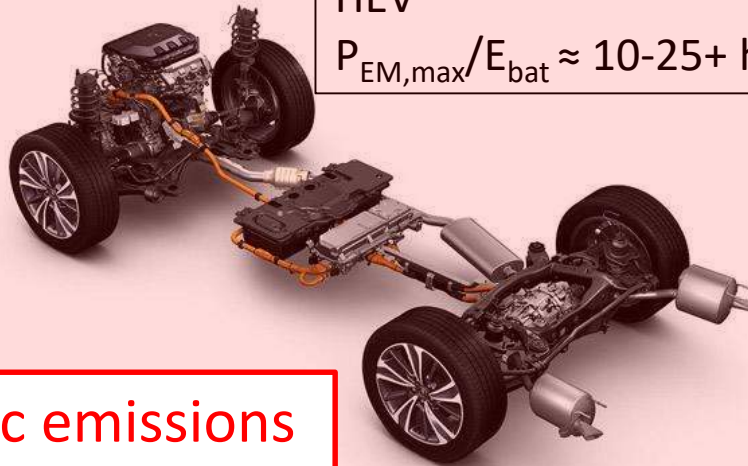
ICEV



Toxic emissions

HEV

$$P_{EM,max}/E_{bat} \approx 10-25+ h^{-1}$$



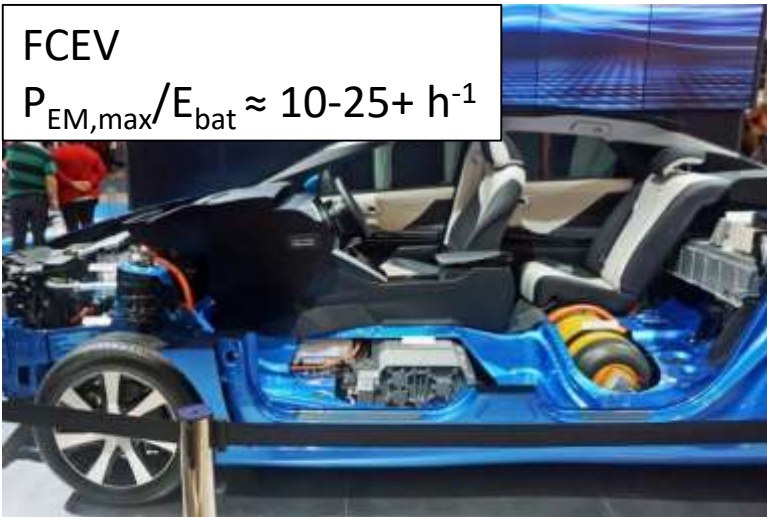
PHEV

$$P_{EM,max}/E_{bat} \approx 5-10 h^{-1}$$



FCEV

$$P_{EM,max}/E_{bat} \approx 10-25+ h^{-1}$$

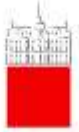


EV

$$P_{EM,max}/E_{bat} \approx 2-5 h^{-1}$$







# Interaction with the electric grid



EV

$E_{\text{bat}} \approx 50\text{-}100 \text{ kWh}$

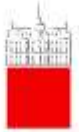
$P_{\text{charge,max}} \approx 350\text{+ kW}$

E-truck

$E_{\text{bat}} < 1000 \text{ kWh}$

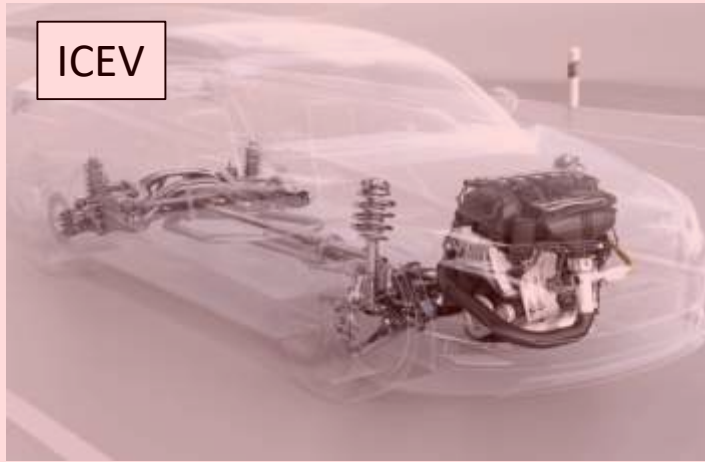
$P_{\text{charge,max}} \approx 0.5 - 2 \text{ MW}$





# Powertrain options

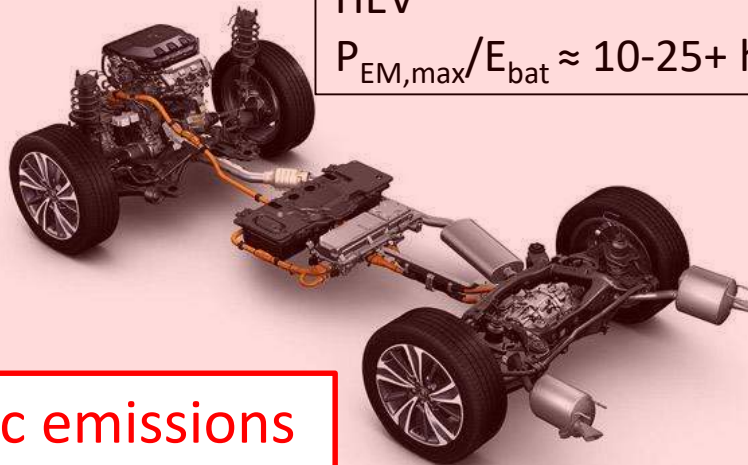
ICEV



Toxic emissions

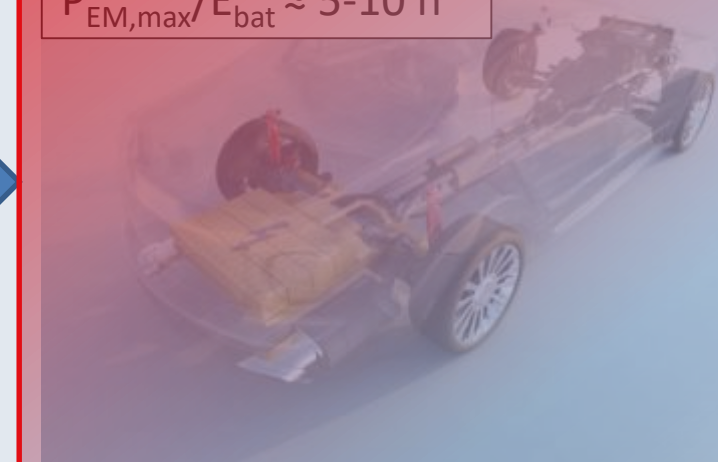
HEV

$$P_{EM,max}/E_{bat} \approx 10-25+ h^{-1}$$



PHEV

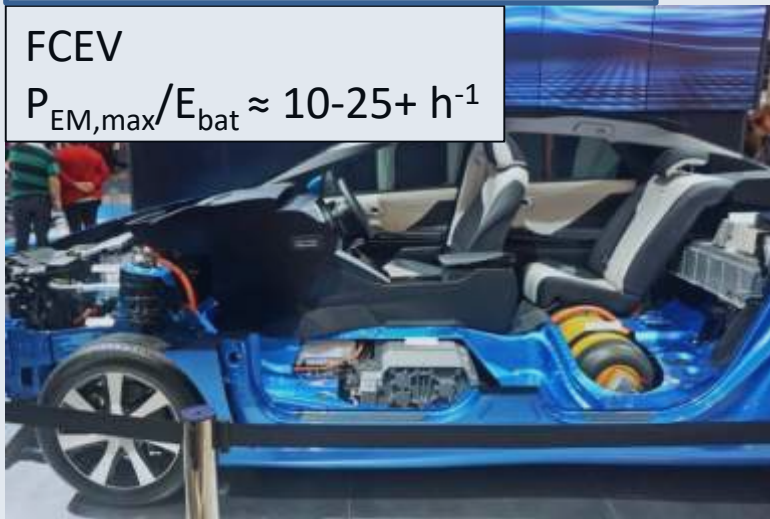
$$P_{EM,max}/E_{bat} \approx 5-10 h^{-1}$$



NEW infrastructure

FCEV

$$P_{EM,max}/E_{bat} \approx 10-25+ h^{-1}$$

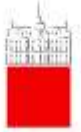


Charging infrastructure

EV

$$P_{EM,max}/E_{bat} \approx 2-5 h^{-1}$$

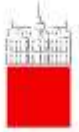




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# Big picture – the whole product cycle

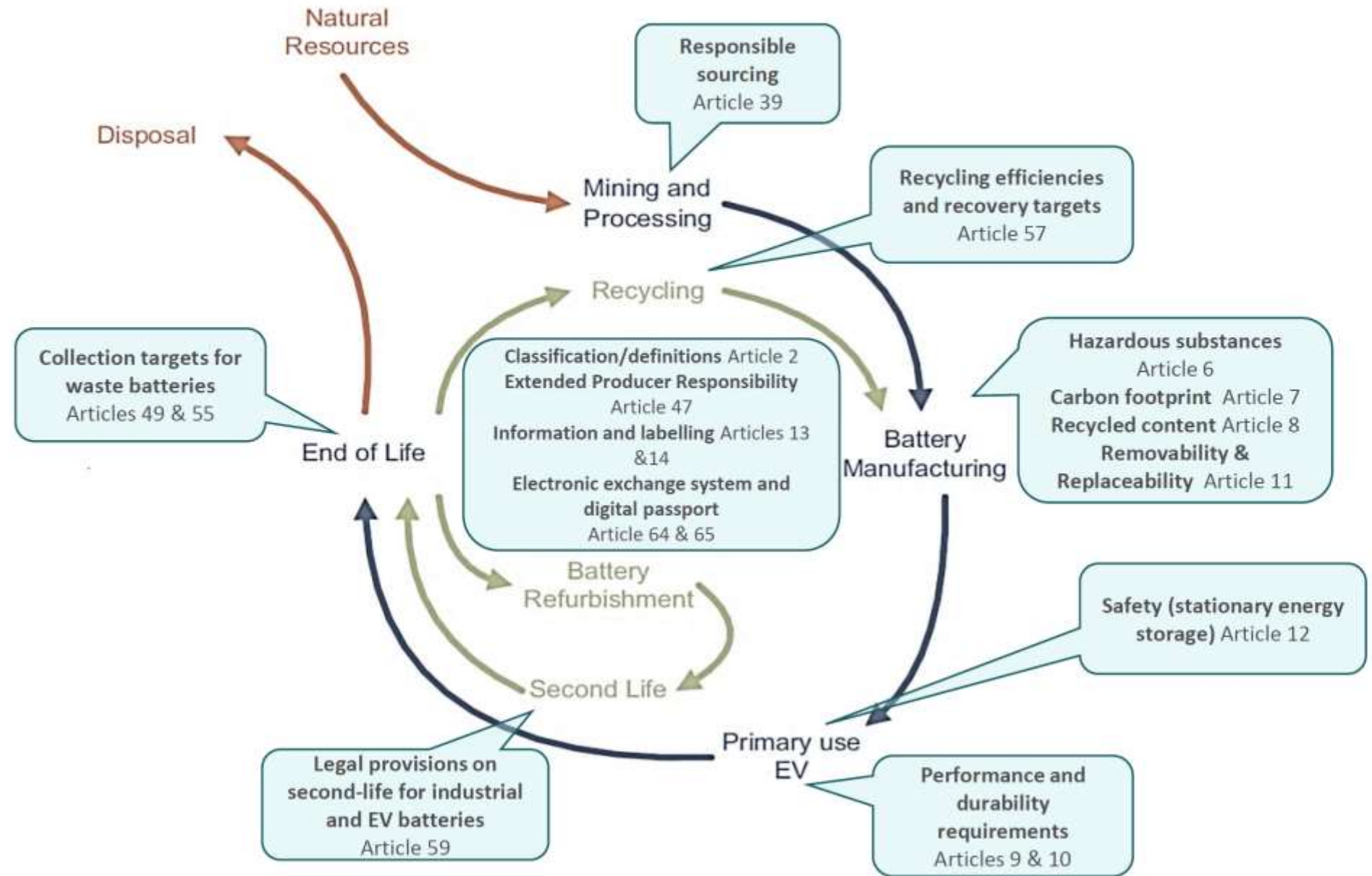
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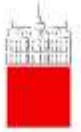
If it is really intended to **promote global reduction of emissions and depletion of resources**, then emissions and energy as well as material consumption **over the entire product cycle should be considered.**



**Tank-to-Wheel**  
**Well-to-Tank**  
**Life cycle**

# Batteries proposal: covering entire life cycle





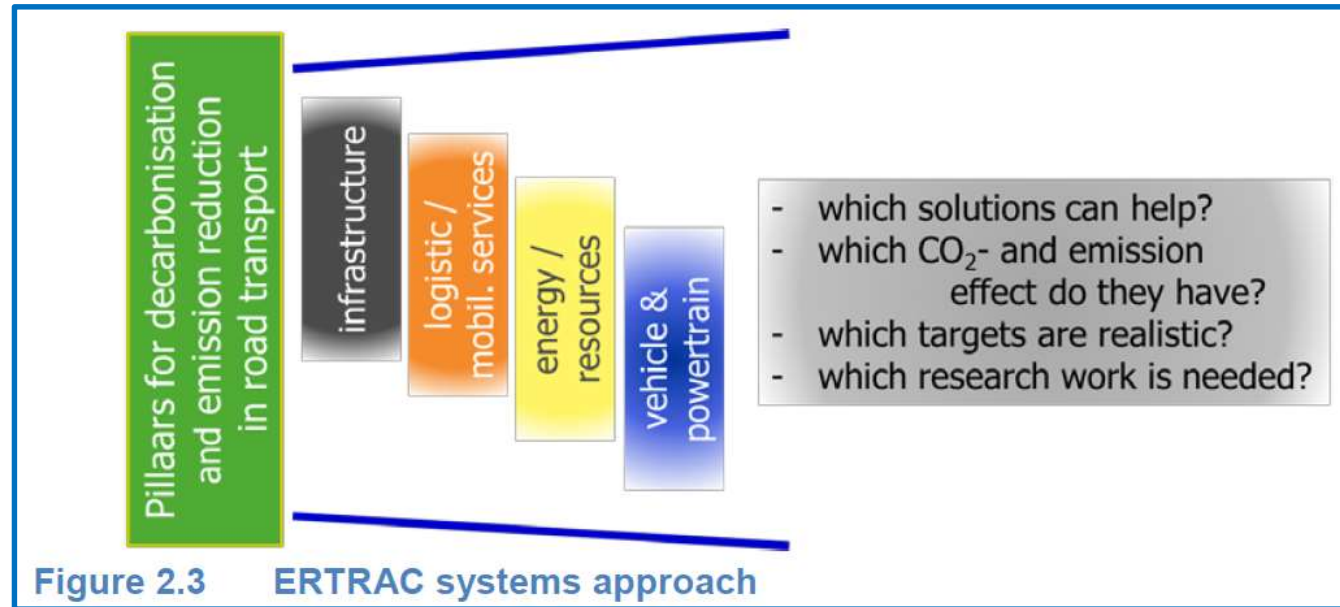
# Agenda

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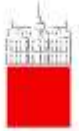
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# ERTRAC roadmap



Environmental goals will not be achieved (within reasonable economic constraints) just by changing the energy vector (fuel).



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Hvala za pozornost.