Electrical Energy for Individual Mobility

Christoph Leitinger

EAEW

Institute of Electrical Power Systems and Energy Economics

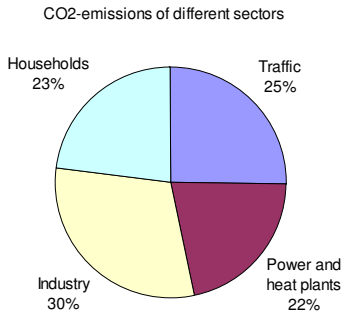
Main Questions

EAEW

- Why do we think of electrical energy as fuel?
- Will it be an option for future?
- What are the challenges on the way?
- Where does the electrical energy come from?

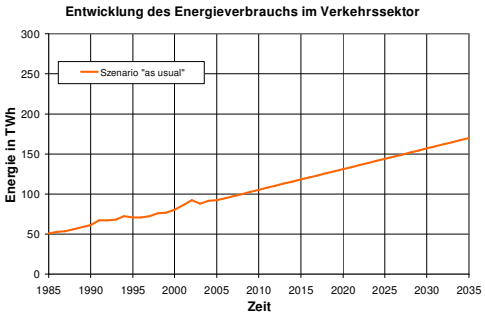
Present Situation:
Which effects occur due to the big traffic volume?

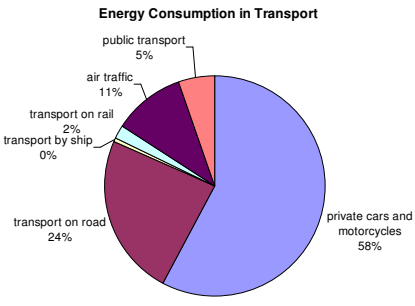
- environmental problems
  (local air pollution, harmful substances: HC, NO_x, PM, CO, SO_2)
- climate change problems (CO_2, …)
- import dependence
- high energy consumption
- congestions, lack of parkings, covered area



Source: BMLFUW

Energy in Transport





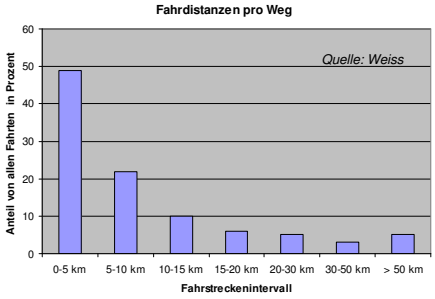
Source: BMLFUW

Energy consumption in transport:

total: 5,36 Mrd. liters of fuel
all passenger cars: 3,11 Mrd. liters

193 PJ or 54 TWh end use energy for private individual mobility

Distribution Inside Individual Mobility

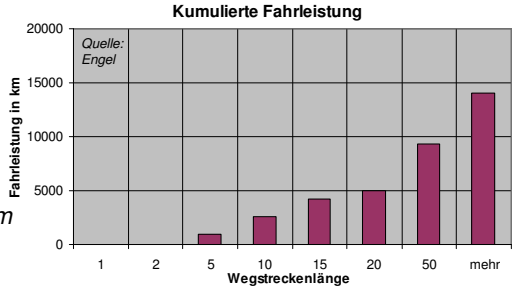


Driving Distances:

- *half of all ways shorter than 5 km*
- *80 % of all ways shorter than 15 km*

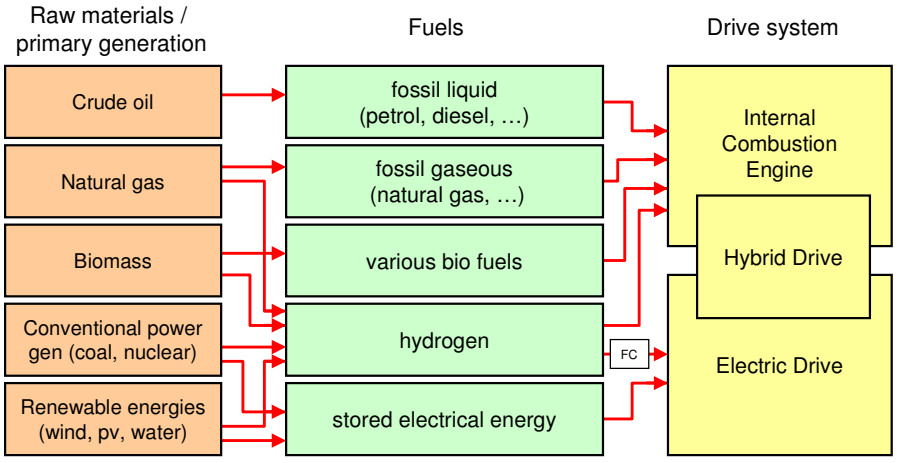
***Driving Performance** of an average passenger car:*

- *1/3 on ways shorter than 20 km*
- *1/3 on ways between 20 und 50 km*
- *1/3 on ways above 50 km*



Technological Energy Chains

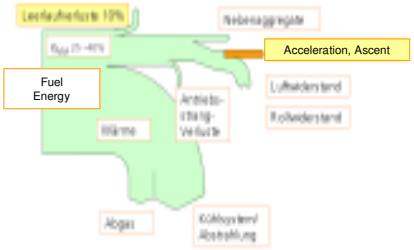
- ► Drive System
- ► Fuels
- ► Primary Energy

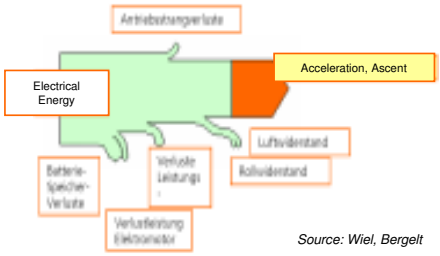


Compare of Efficiencies

EAEW

Sankey Charts





Source: Wiel, Bergelt

Internal Combustion Engine

~ 18 … 25 %

No-load losses,
Braking energy,
Operating point

Electrical Drive System

~ 65 … 70 %

Loading losses,
Battery losses

History of Battery Electric Vehicles

EAEW

i MiEV Switch:
Li-Ion Battery, 16 kWh
160 km range
consumption 10 kWh/100 km

Smart-EV, Mitsubishi, Citroen, Renault, Subaru, …

- *Conversion Design*
- *Purpose Design*

early years - - middle years - - current years

Challenges for Electric Vehicles

EAEW

- Mobile energy storage, battery
- Infrastructure for loading

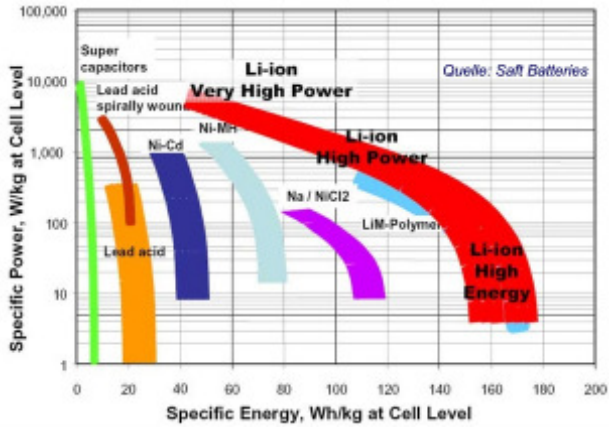
► **Battery**

new developments using Li-Ion and nanotechnologies

Important parameters:

- power density
- energy density
- life cycle
- costs
- safety

Ragone Chart

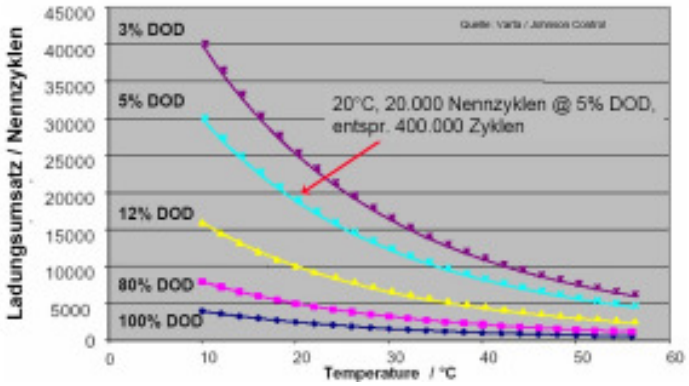


Important Parameters of Batteries

EAEW

➢ **life time of battery**

(aim: 250.000 km, 15 years)



➢ **costs**

(aim: 300 … 450 EUR/kWh)

Compare of Total Costs

EAEW

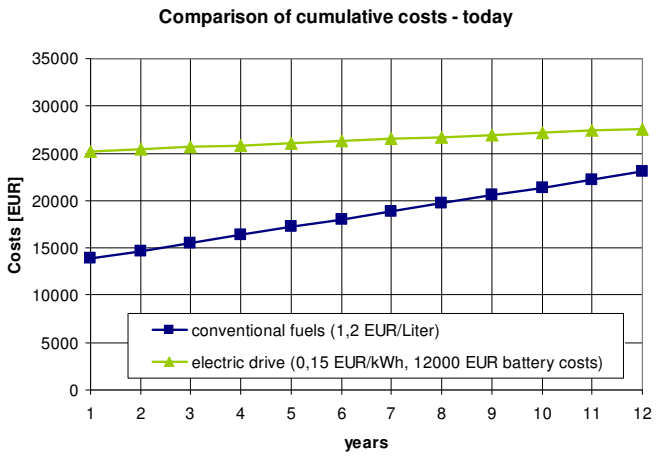
- *conventional car, investment and fuel costs*
- *electric vehicle, investment (car+battery) and energy costs*

10000 km / a

Convent. fuel:
1,2 EUR / liter

Electrical energy:
0,15 EUR / kWh

Present situation



TU Wien – Institute of El. Power Systems and Energy Economics

Compare of Total Costs

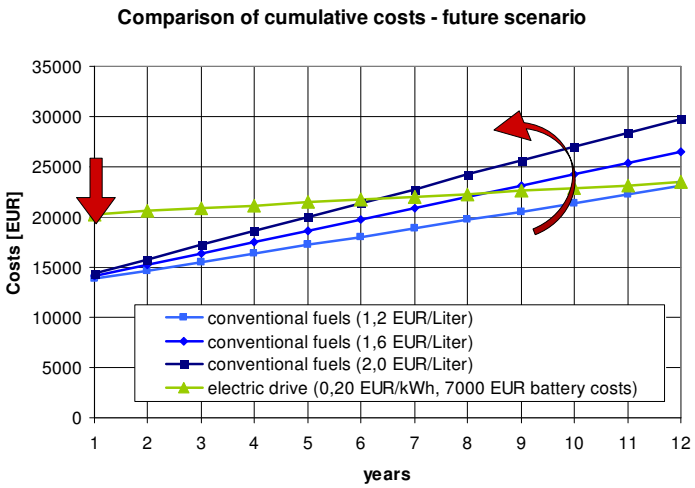
EAEW

10000 km / a

Convent. fuel:
2,0 EUR / Liter

Electrical energy:
0,2 EUR / kWh

Future scenario



TU Wien – Institute of El. Power Systems and Energy Economics

Aim: Break-even within lifetime of vehicle!

Transition

EAEW

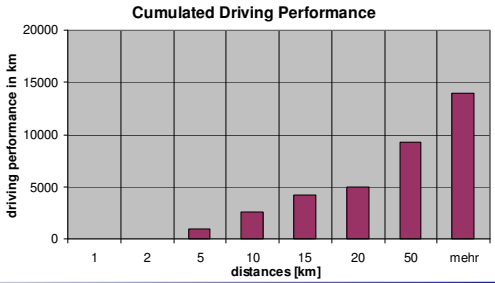
- *Battery electric cars for certain application (commuters, city cars, …)*

- *Plug In Hybrid Electric Vehicles*



Toyota, Ford, GM, …

- *covering distances up to 30, 60, 90 km by electric drive*
- *parallel / serial concepts of hybrids*



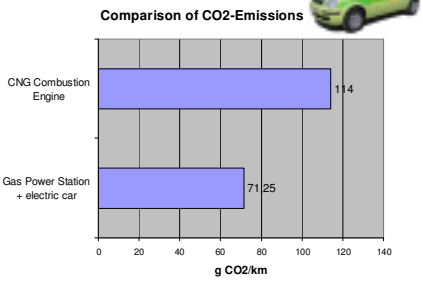
Electrical Energy Supply

EAEW

Advantage:
Several resources are possible

- ***Conventional** (natural gas, coal, etc.)*

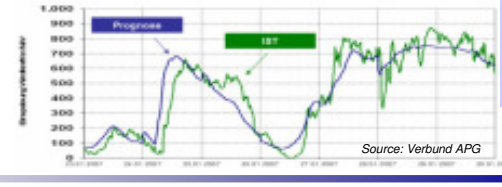
  CO2-Emissions lower even with conventional power



- ***Sustainable way: renewable energies like wind, solar, hydro***

  fluctuating supply of wind, solar energy
  use of batteries as (mobile) energy storages

  win-win-situation



Summery

EAEW

- Why do we think of electrical energy as fuel?
  energy efficient solution
- Will it be an option for future?
  yes, technical and economical
- What are the challenges on the way?
  mobile energy storage, behavior modification
- Where does the electrical energy come from?
  initially from conventional power plants, on sustainable way from renewables

TU Wien – Institute of El. Power Systems and Energy Economics

EAEW

Nothing is as strong as an idea, whose time has come!

TU Wien – Institute of El. Power Systems and Energy Economics

Contact

EAEW

DI Christoph Leitinger
leitinger@tuwien.ac.at
+43 (0)1 58801 37335

Vienna University of Technology – TU Wien
Institute of El. Power Systems and Energy Economics
Gusshausstraße 25 / E373-1, 1040 Wien, Austria
http://www.ea.tuwien.ac.at/ea

TU Wien – Institute of El. Power Systems and Energy Economics