VEHICLE-TO-GRID
WITH SOLID OXIDE FUEL CELLS

How efficient mobility can accompany controlled energy supply to grid

Challenges in the context of the energy transition

Mobility sector
- Bringing requirements (especially the car range) in accordance with availability of renewable energy sources
- Reduction of final energy consumption

Electricity sector
- Flexible power plants to complement photovoltaics and wind turbines
- Growing demand of control reserve

Concept: Continuous operation of solid oxide fuel cells (SOFCs) in vehicles

Continuous operation is required due to high operating temperature

Vehicle in movement:
- Efficient mobility at minimized emissions
- Heavy vehicles with long ranges due to fuel variability within SOFCs

Vehicle not in movement:
- Connected to the grid ➔ Generation of (control-) energy in line with demand and at a high efficiency level
- Complement to the concept of Power-to-Gas ➔ Energy storage function

Final energy consumption in Germany by sectors (2012)\(^1\)

- Industry: 2,599 PJ
- Transport: 2,571 PJ
- Households: 2,431 PJ
- Services: 1,397 PJ
- Thereof electricity: 1,869 PJ

Reduced noise, particulate matter, NO\(_x\) emissions

Stabilization of the grid

Reduced fuel consumption/CO\(_2\) emissions

700 °C - 1,000 °C: Utilization of waste heat

Electrical efficiency reaches 60 % in existing devices

Comparison of vehicle motor capacity and electric power plant capacity in Germany

- Total vehicle engine power (2012)\(^2\): 3,400 GW
- Engine power of new trucks (2012): 47 GW
- Conventional power plant capacity (2011): 98 GW
- Renewable power plant capacity (2011): 70 GW

References

Garbage trucks as pioneers

- Feasibility should be tested in pilot projects
- Garbage trucks offer:
  - Small-scale SOFCs (cost, effort, interconnection) due to low average truck speed
  - High benefit of emission reduction when trucks operate in urban areas
  - Scheduled grid connection at a fixed location
- Experiences enable improvement of technology and thereby cost reductions - further fields of applications will arise