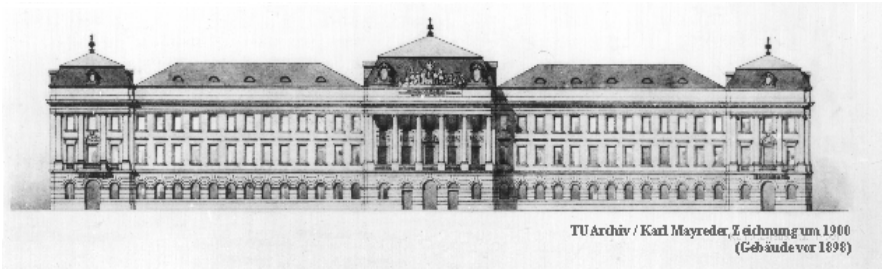
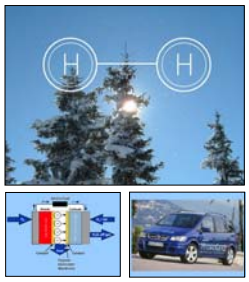
”Hydrogen Pathways 2020”



Ernst Pucher
Vienna University of Technology
Austria

”Hydrogen Pathways 2020”



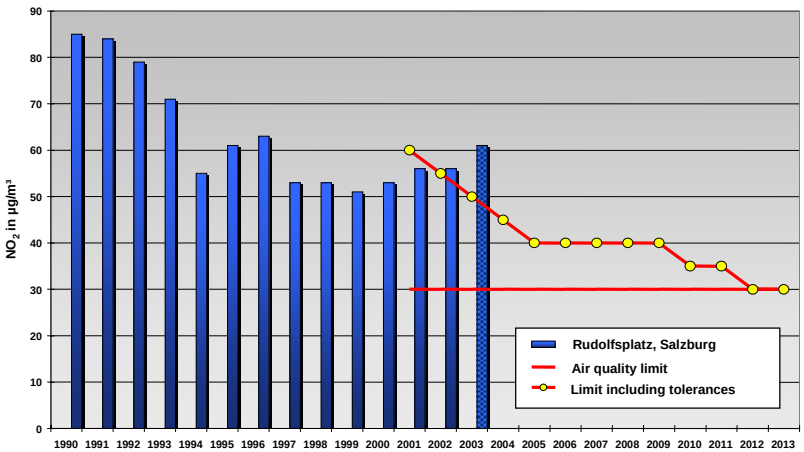
1. Motivation
2. Natural gas as short and medium term alternative
3. Hydrogen as medium and long-term strategy
4. Outlook

Road traffic knows three major emission problems:

- Particulate matter (PM)
- Nitrogen dioxide (NO_2)
- Carbon dioxide (CO_2)

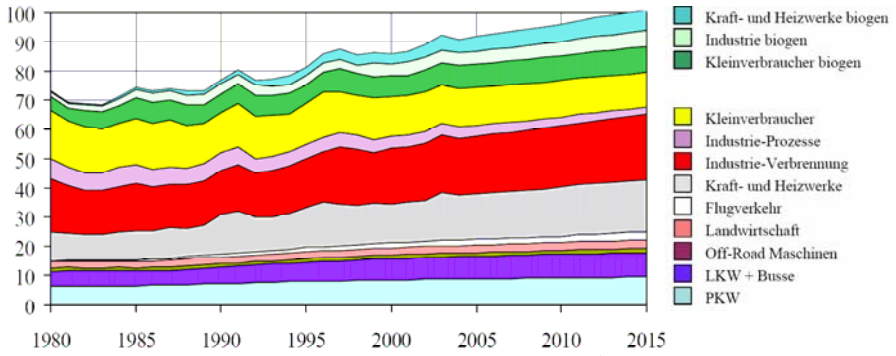
Trend of NO_2 Air Quaility in Salzburg, Austria

Reference: Glaeser, O., Kranabetter, A., 2003



CO_2 – Emission Trend in Austria

in Million Tons

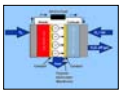


1990 2012

Kyoto – Agreement:
Austria –13%

As a result, the European Union aims at raising shares of renewable and alternative energy carriers to 20%, which divides in 10% natural gas, 5% bio fuels and 5% hydrogen, by 2020.

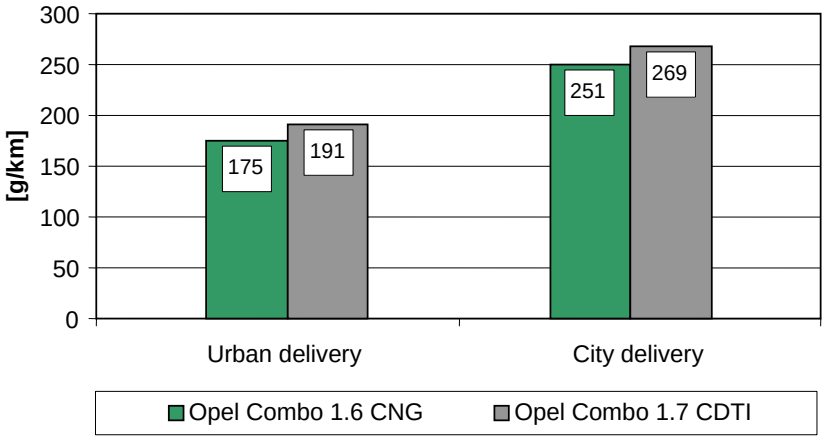
”Hydrogen Pathways 2020”



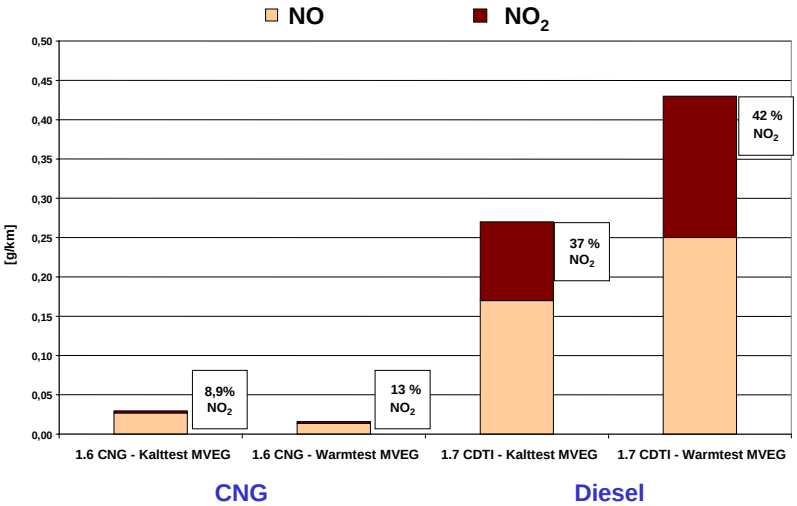
1. Motivation
2. Natural gas as short and medium term alternative
3. Hydrogen as medium and long-term strategy
4. Outlook

To determine the real life exhaust mass emissions, identical GM Opel Combo LDT with 1.6 liter monovalent plus CNG S.I. Engine and 1.7 liter common rail turbo charged diesel engine were tested on representative urban routes and in parcel service by use of a new in-car measurement equipment.

Real life CO_2-Emissions



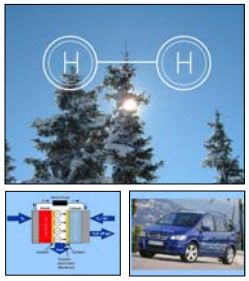
NO_x – Emissions in EUDC



- At the moment these positive effects can mainly be utilized in urban areas, as the operation range of the vehicles is currently limited to a maximum of 300 km.
- The combination of lightweight tanks with increased gas content and monovalent engine concepts should make operation ranges comparable to conventionally powered cars possible

CNG systems can additionally use renewable CO_2 neutral fuels like biogases as well and can be a preliminary stage to the application of 700 bar high-pressure storage infrastructure of hydrogen in a later stage.

”Hydrogen Pathways 2020”



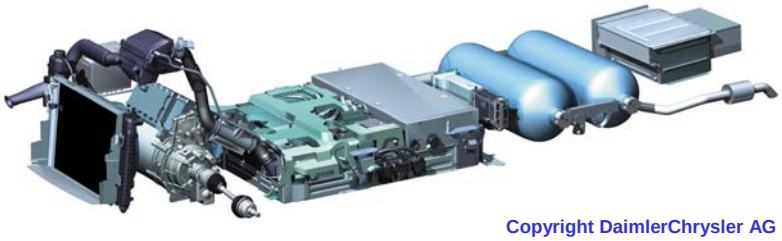
1. Motivation
2. Natural gas as short and medium term alternative
3. Hydrogen as medium and long-term strategy
4. Outlook

- **Fuel Cell Technology: Rapidly increasing energy density.**
- **Vehicle Technology: Reorientation in development toward electrical powered drive trains and electrical powered auxiliary systems.**

Energy Sources for Electrical Powertrain

Monitoring of Fuel Cell Car Fleet (about 60 Vehicles)

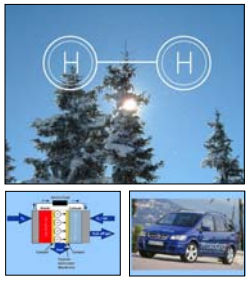
Ref.: Ch. Nitsche, 2005



Fuel Cell System Operational Parameters

- Fuel cell status, voltage, current
- Gas flow, pressure, temperature
- Motor speed, torque
- Cooling, tanks, battery

”Hydrogen Pathways 2020”



1. Motivation
2. Natural gas as short and medium term alternative
3. Hydrogen as medium and long-term strategy
4. Outlook