Wege zur CO_2-freien Mobilität

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Sächsisches Fachsymposium ENERGIE 2013
Dresden, 18.11.2013

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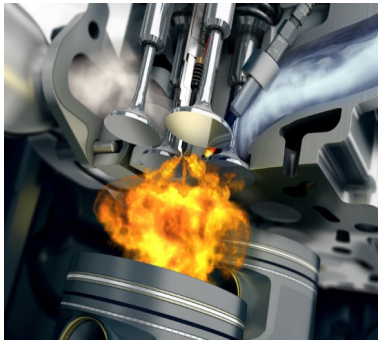
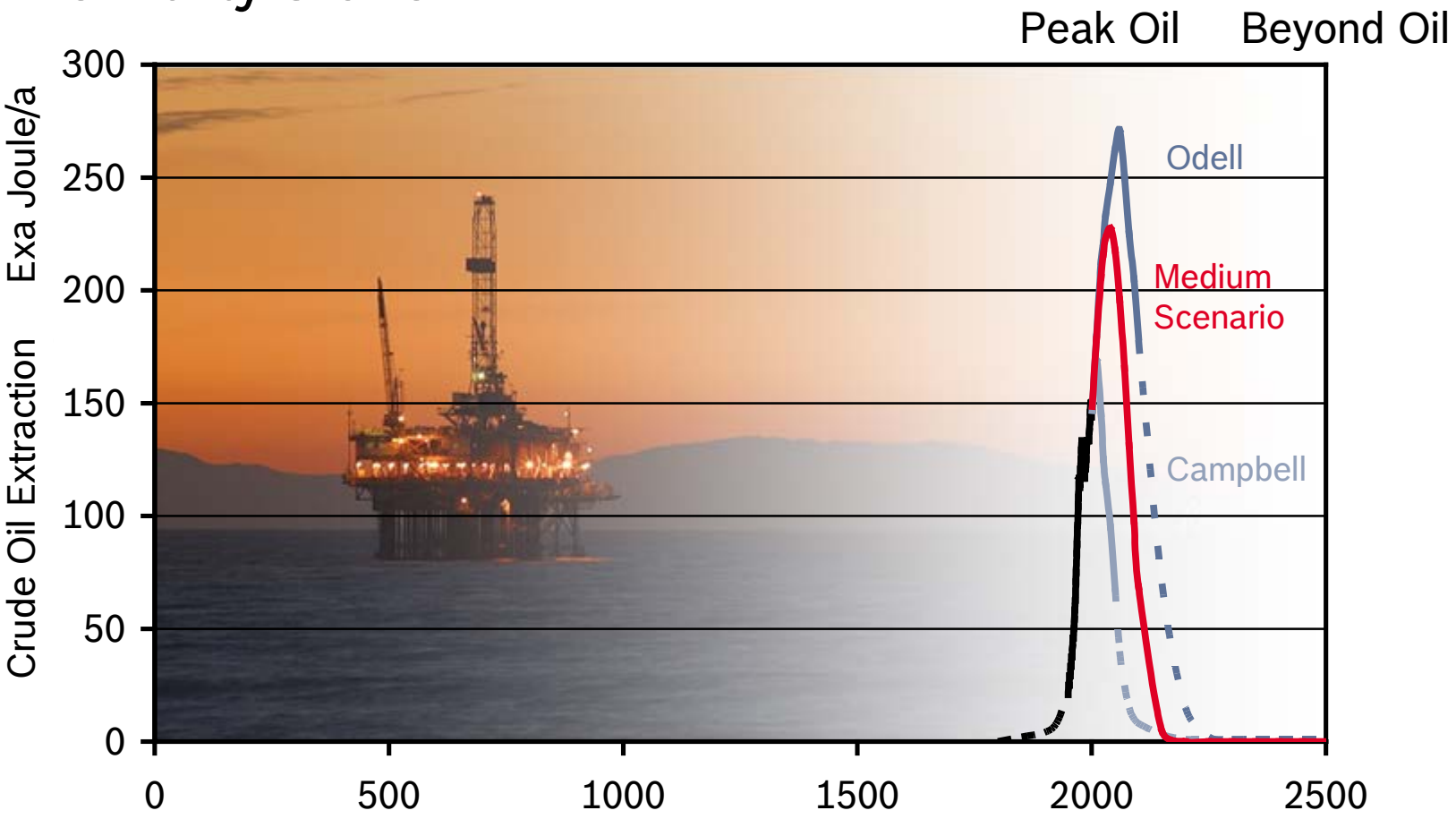
Ways to CO_2 free mobility

1. Mobility challenges
2. Driving with fire
3. Electric driving
4. Electrofuels
4. Conclusions

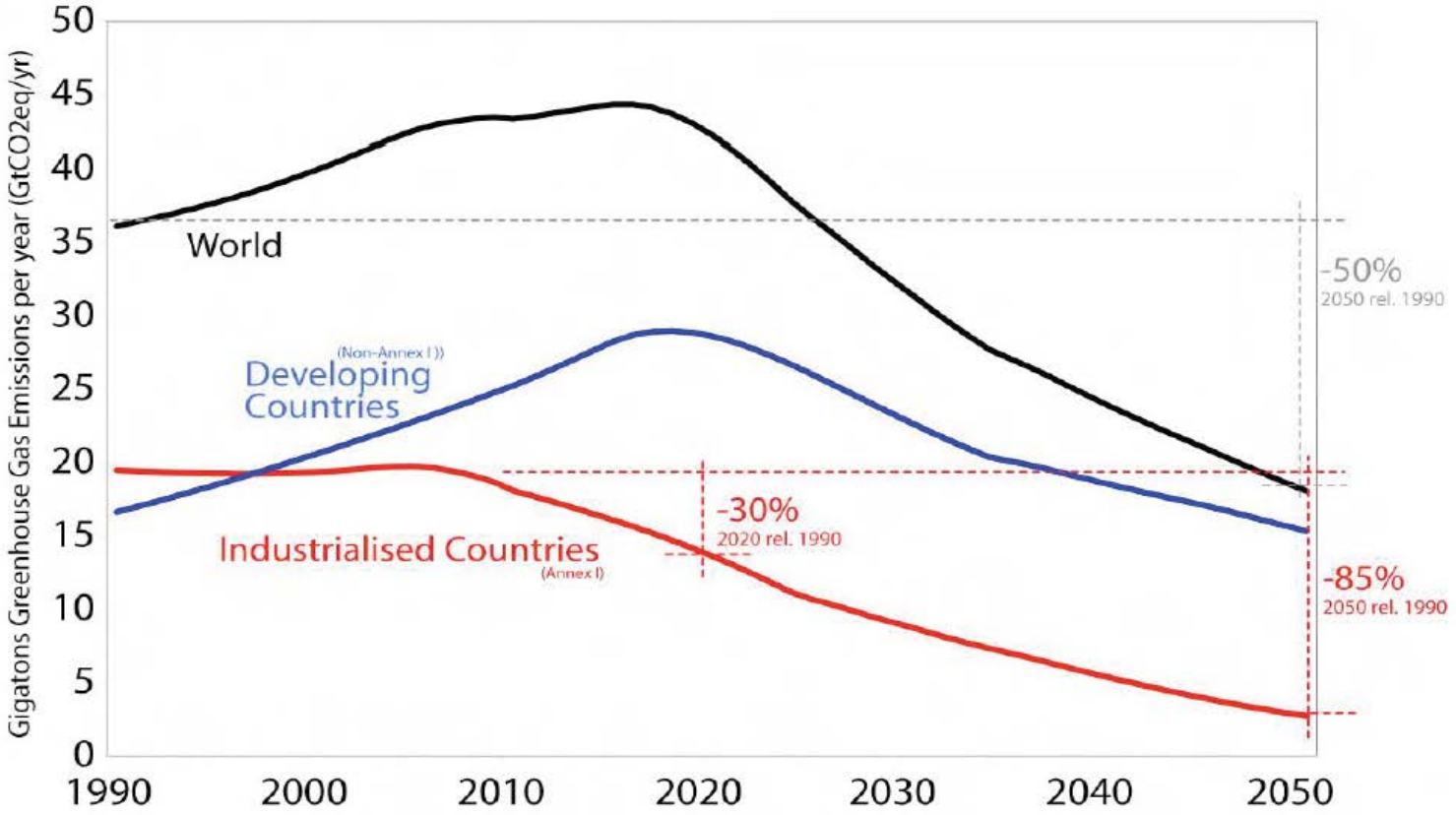


The Party's over



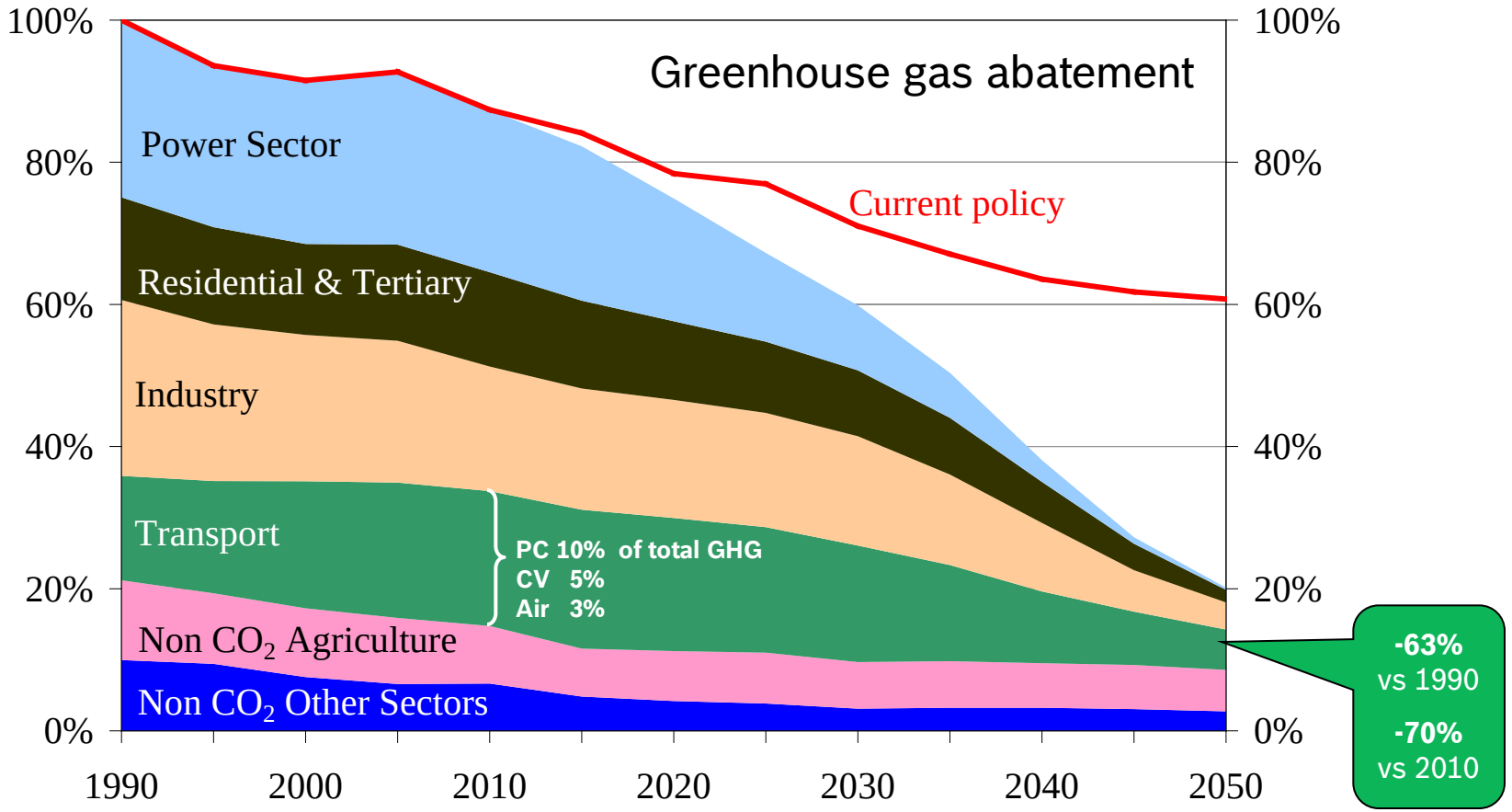
Contributions to greenhouse gas reduction

Comitted target: not to exceed 2° global warming

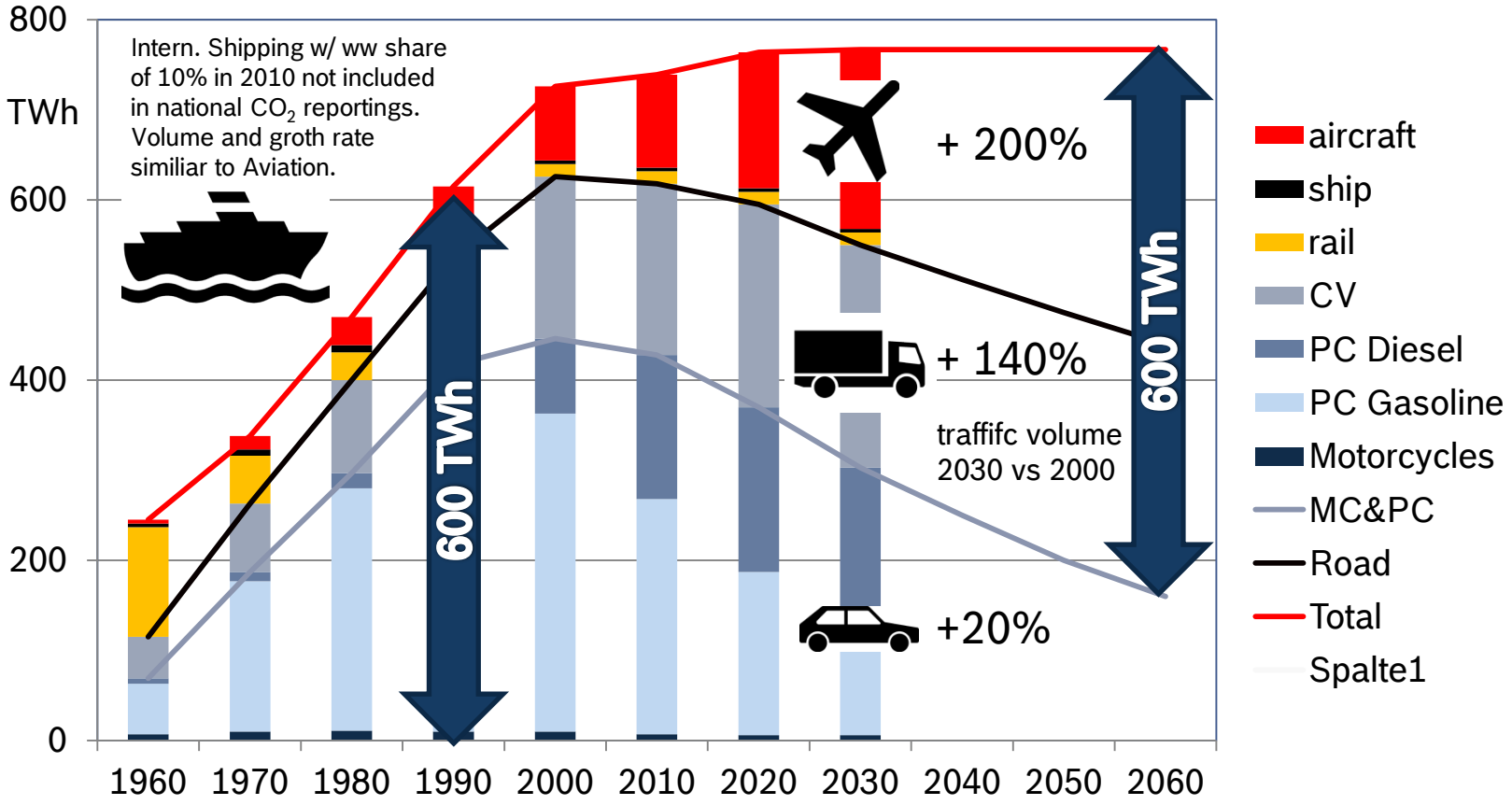


Source: M. Meinshausen, based on UNEP Human Development Report 2009

Energy Roadmap 2050, EU-Commission Dec 15th, 2011



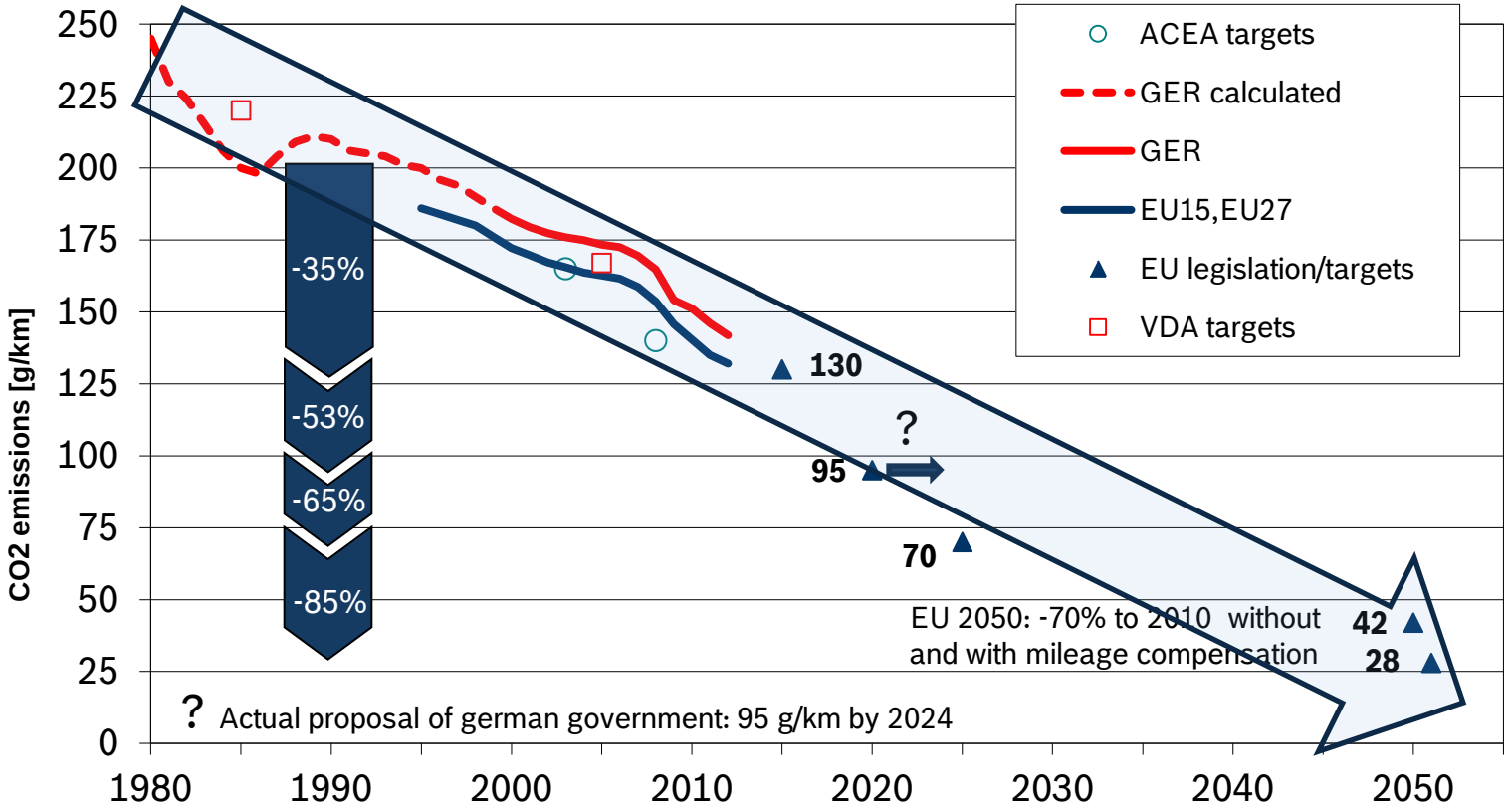
Energy consumption of traffic in/from Germany



E-mobility not sufficient to achieve CO_2 targets for traffic sector

Source 1960-2030: IFEU, Tremod 5.2

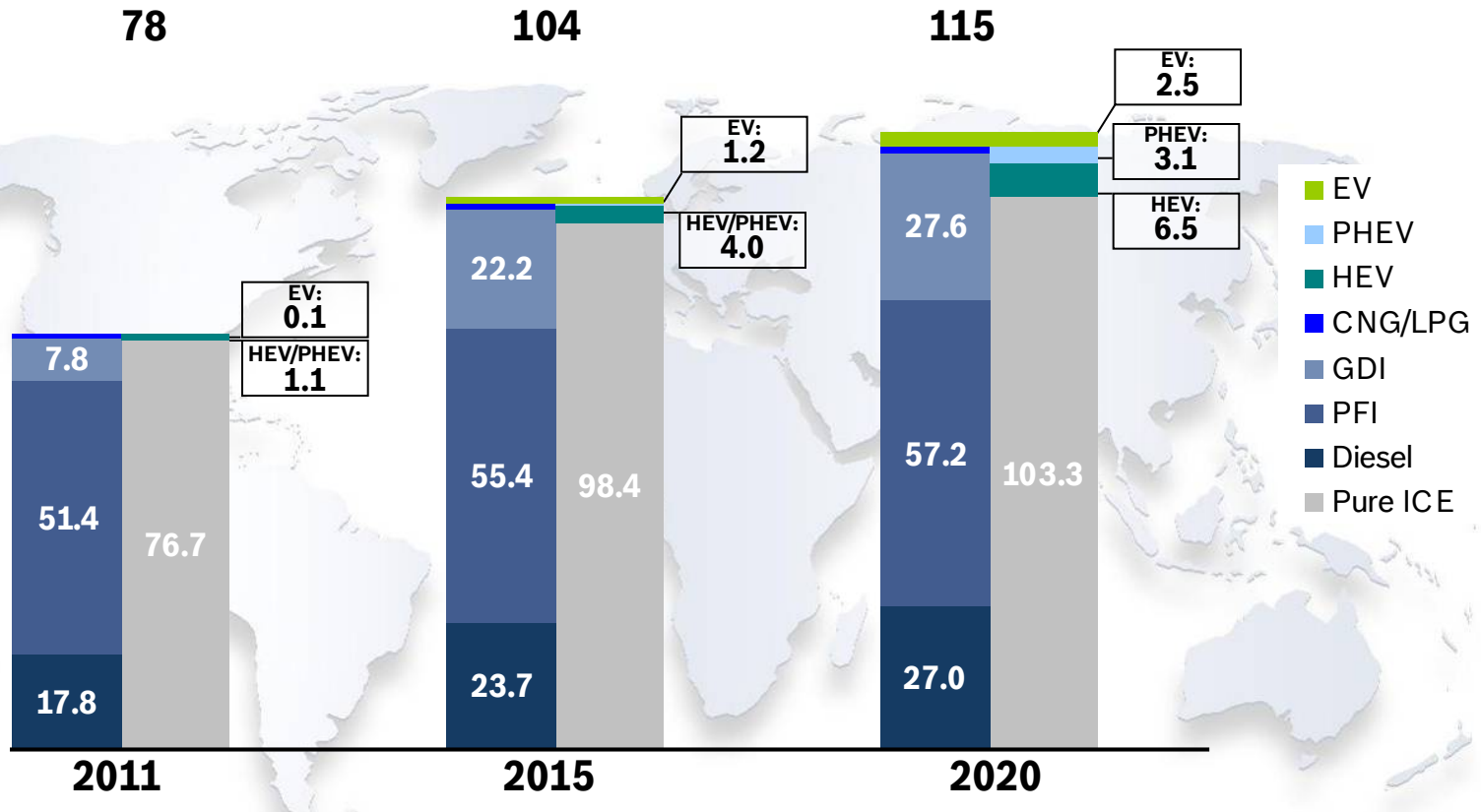
CO_2 emission of new released cars



Source:s: EU-COM Report 2010-655; 10.11.2010, DLR: Flottenverbrauch 2010, Jul. 2002

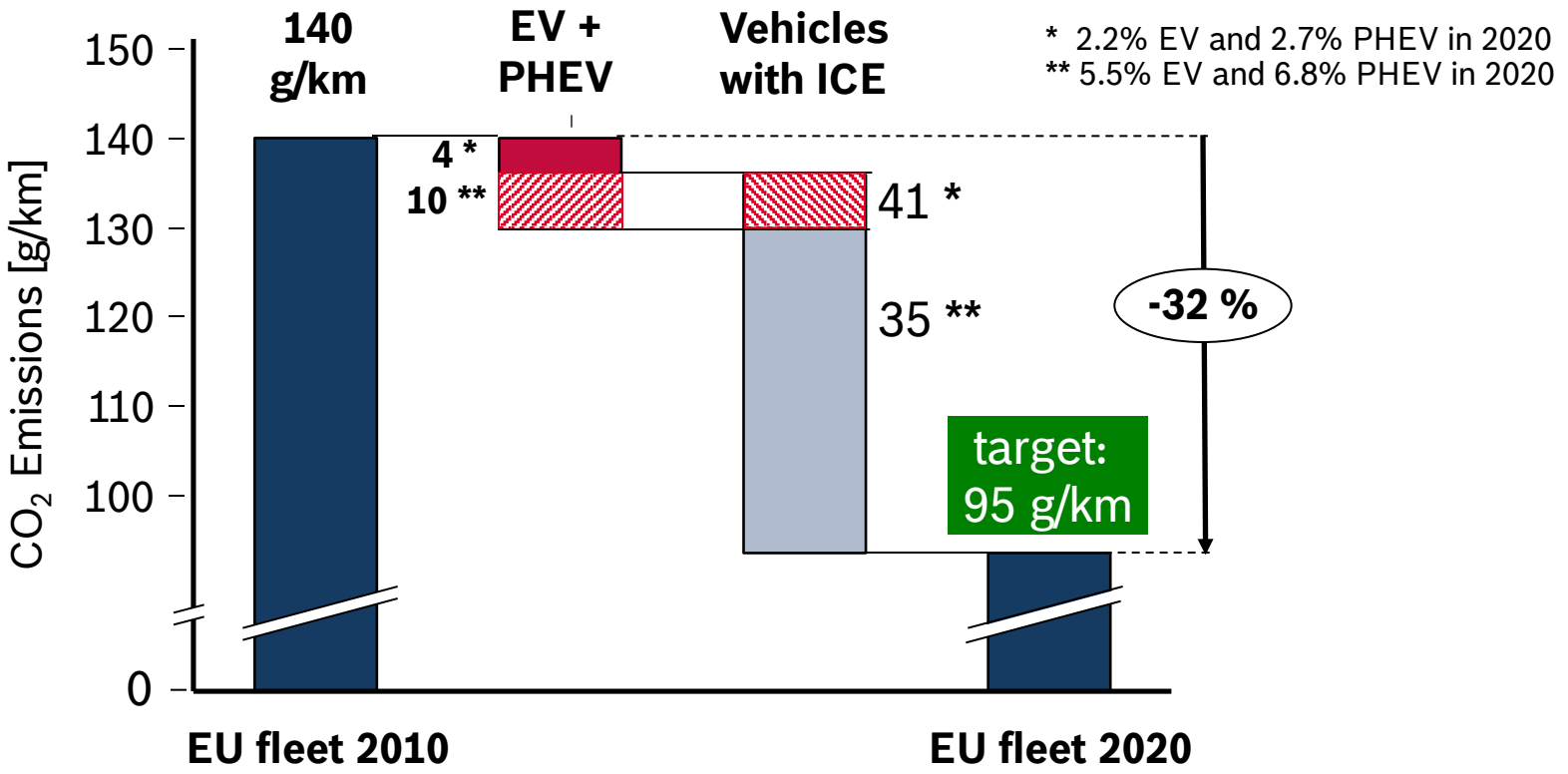
Market development

Mio new released passenger cars and light vehicles <6t



+2.4 mio EV ... + 10.9 mio electric engines ... + 34.6 mio combustion engines

Expected CO_2 reduction until 2020 – EU



ICE-powertrain measures have to contribute 80 to 90% to CO_2-reduction

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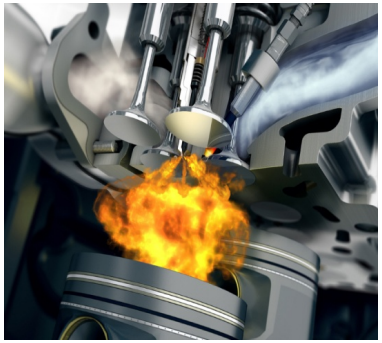
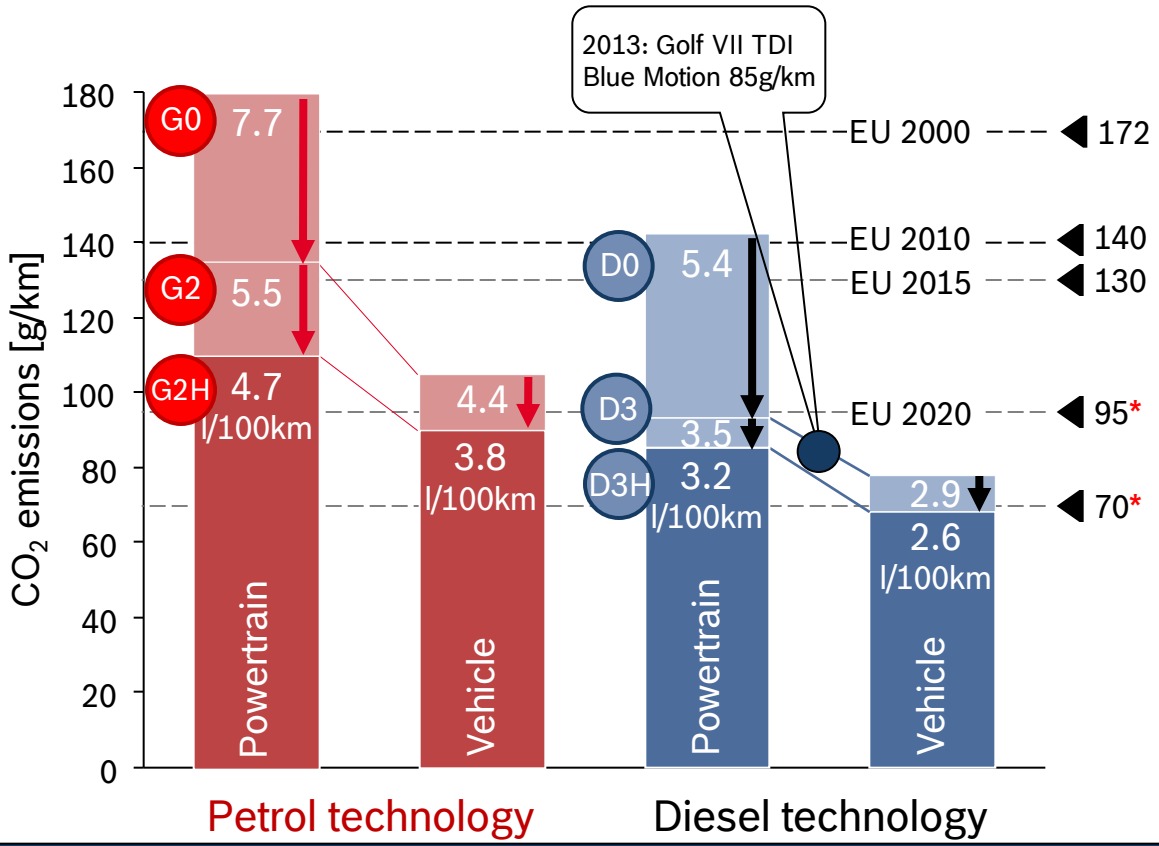


CO_2 reduction by engine & vehicle technology



Vehicle Measurements

Roll resistance tires f_R:	-1/3
Weight:	-10 %
Aerodynamic (c_w):	-14 %

Gasoline

- G0 PFI
- G2 Downsizing (DI)
- G2H Hybrid

Diesel

- D0 DI (Common Rail)
- D3 Downsizing+DeNOx
- D3H Hybrid

Vehicle Weight 1400 kg,
100 kW, NEDC
Hybrid w/ Automatic Transmission

"ICE-Age" Scenario is sufficient to achieve 95 g CO_2/km in 2020 !

Source: Bosch Engine Press Colloquium June 2009

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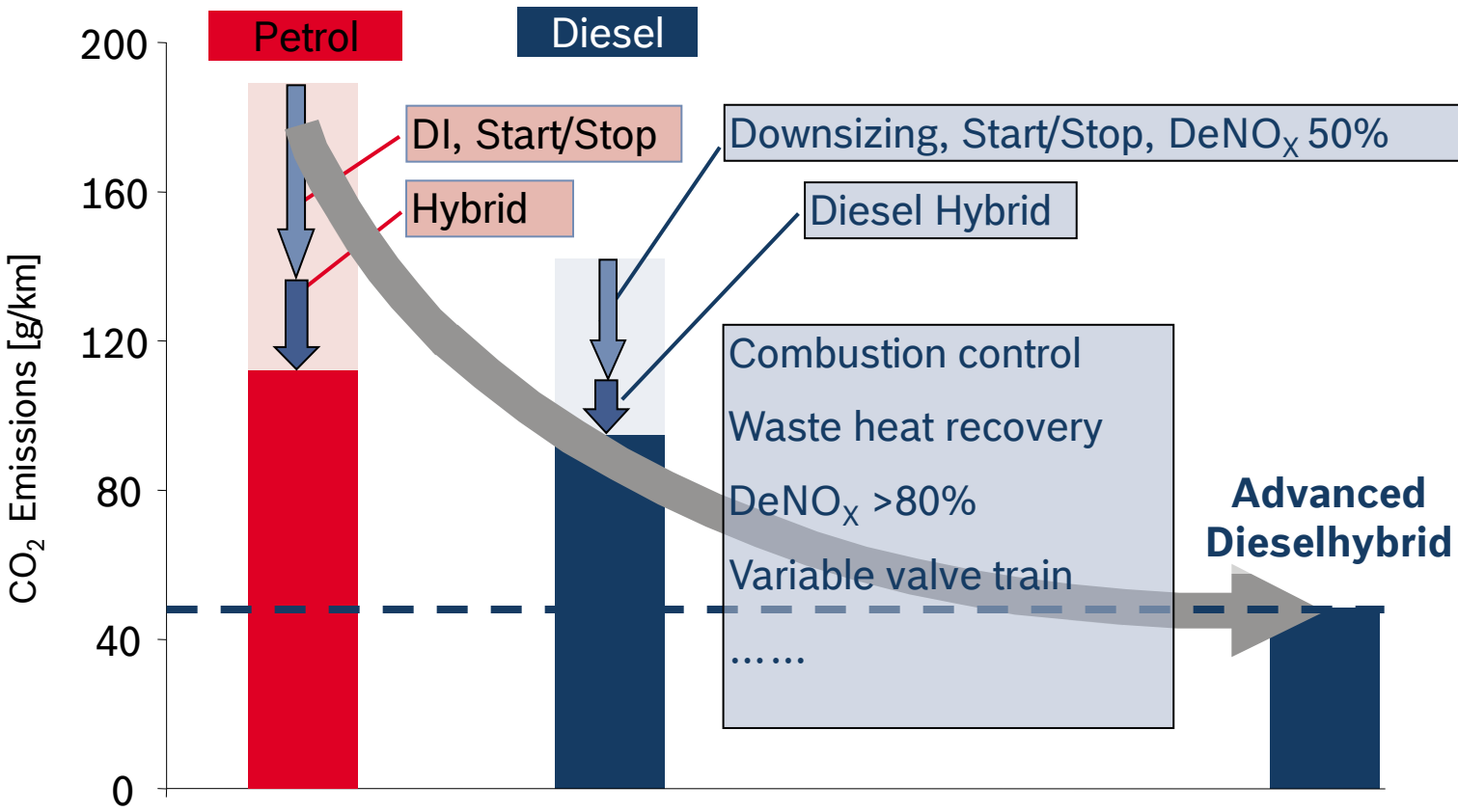
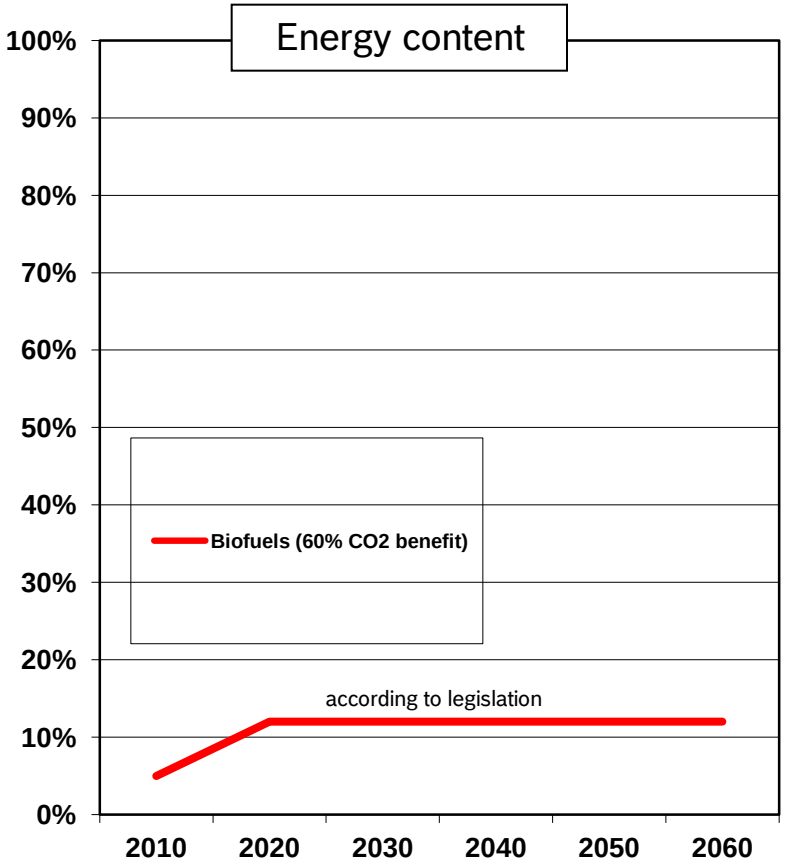
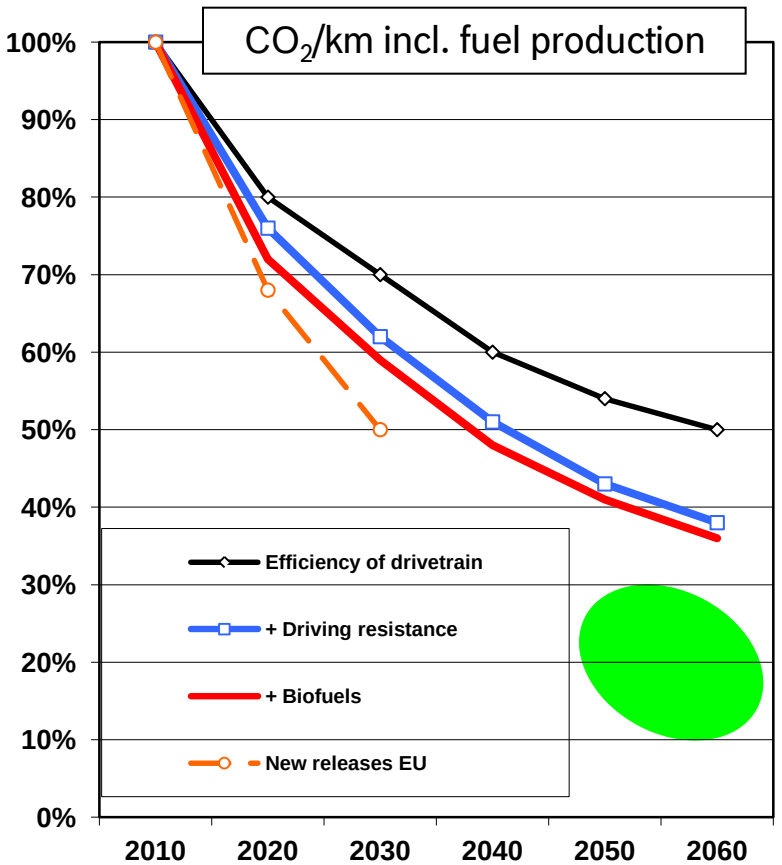
Approching 50g/km CO_2, EU



Compact class vehicle (1,400kg), 100kW, NEDC

CO_2 of vehicle population





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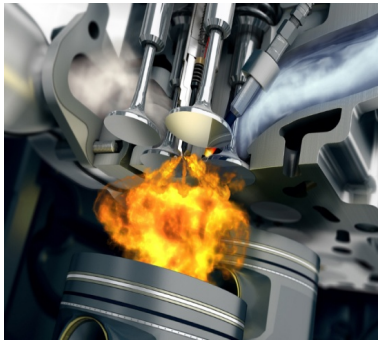
2 Driving with fire

3 **Electric driving**

4 Electrofuels

4 Conclusions



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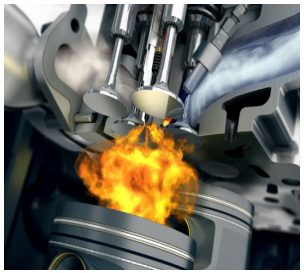
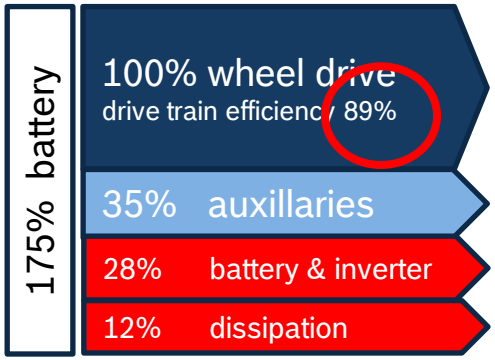
Recharging - Chance to slow up

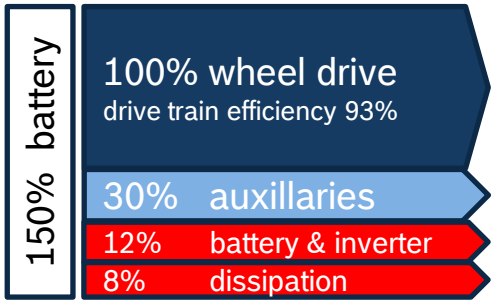
Energy flow	24,000 kW	10 kW
Energy/min.	400 kWh (40l)	0,17 kWh
Range (1 min)	800 km	1 km
Range (1 h)	48,000 km	60 km
15,000 km	< 20 min	> 10 d

Energy chain under real driving conditions [1)]



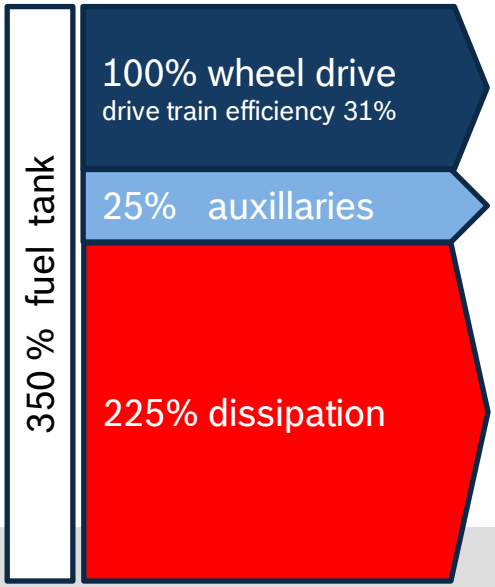


57%



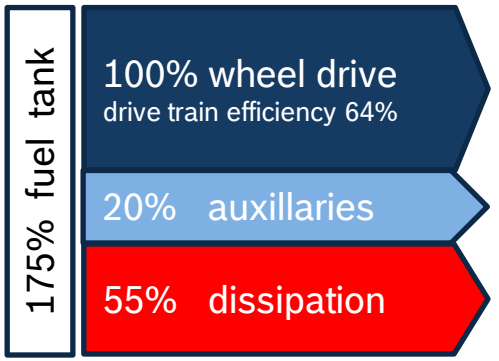
67%

2010



29%

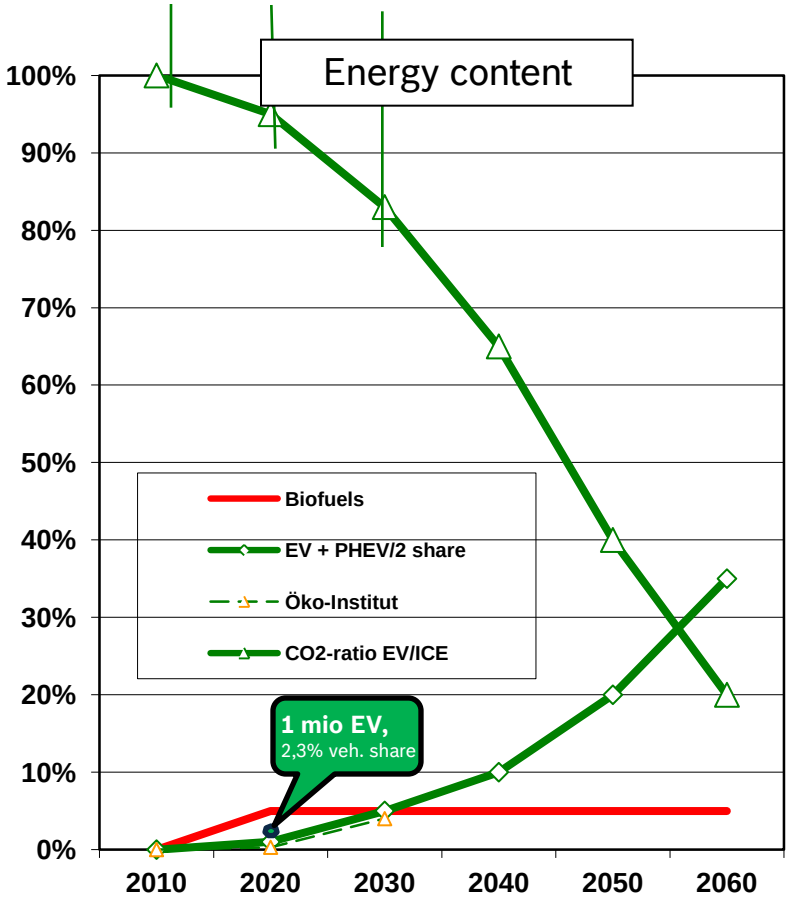
2060

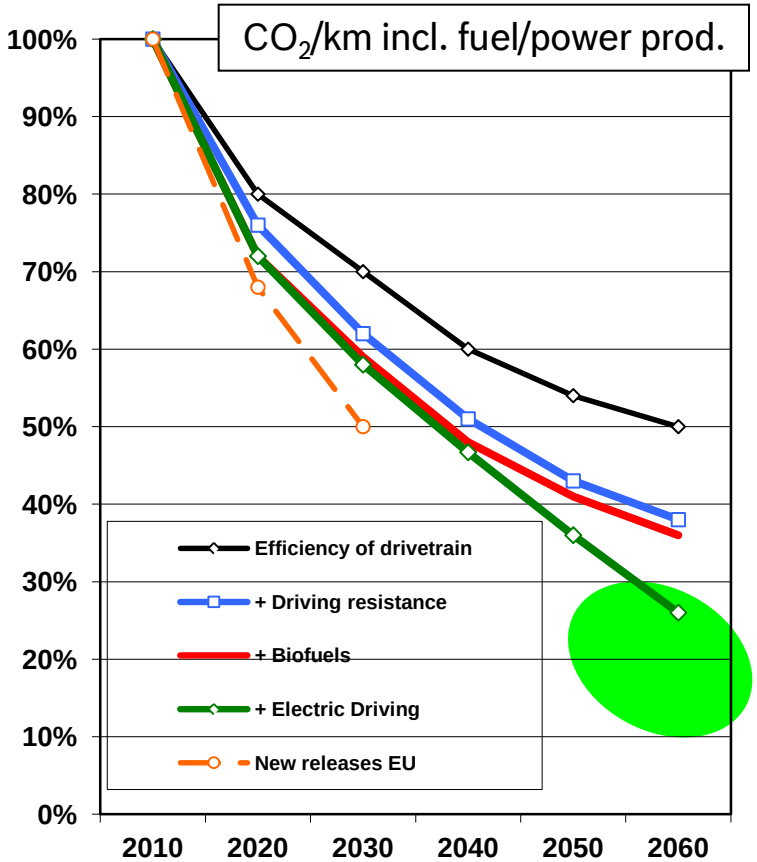


57%

1) ambient temp. 10°C, avrg. speed 60 km/h; heating at 0°C/-10°C is 60%/100% of wheel drive.
source: Spicher, U., 7. MTZ-Fachtagung 24., 25. 01.2012

CO_2 of vehicle population





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“Energiewende im Tank”

Storing electrical energy as liquid or gas fuels

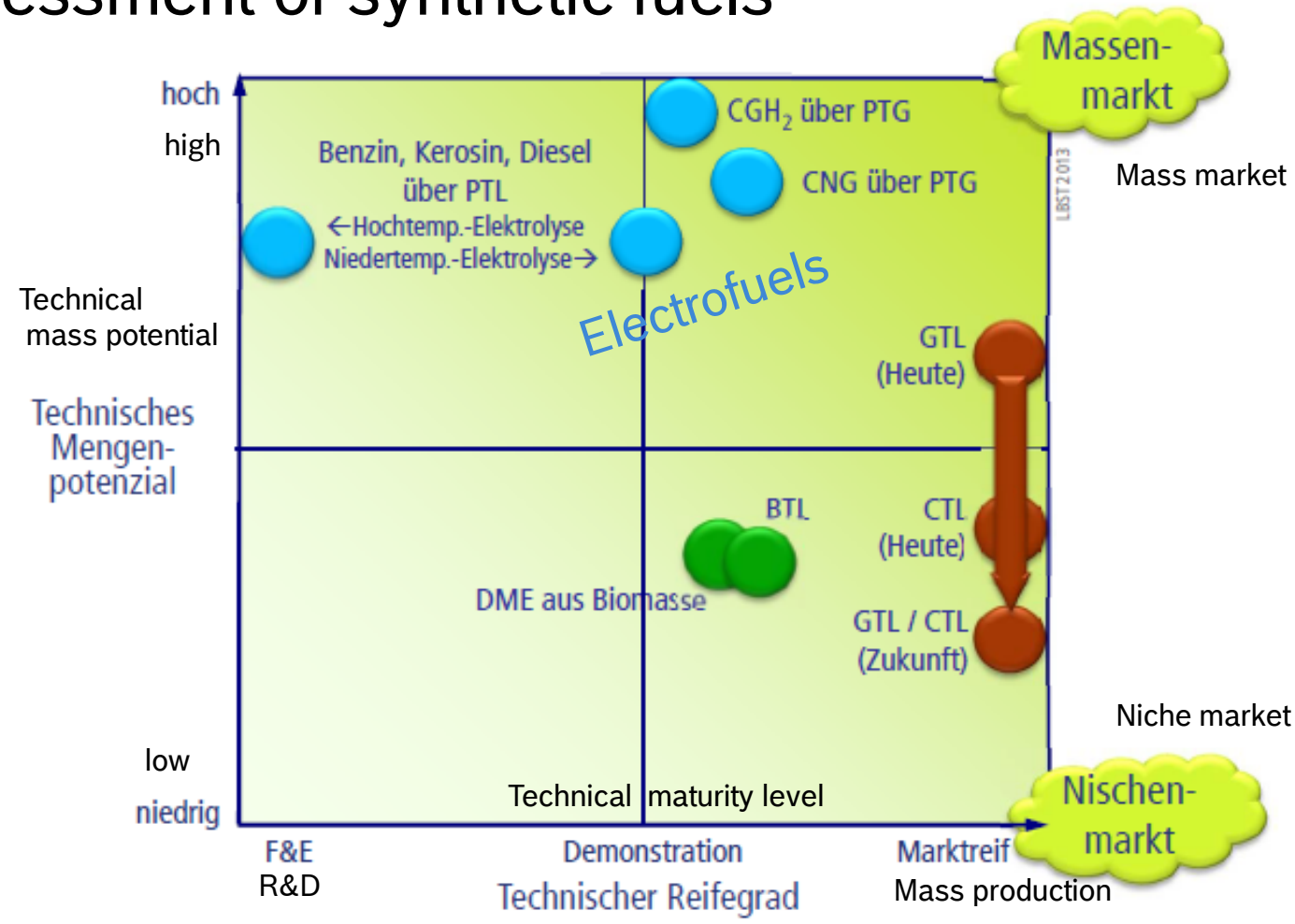
Electrofuels are an emerging class of carbon-neutral drop-in replacement fuels that are made by storing electrical energy from renewable sources in the chemical bonds of liquid or gas fuels. The primary targets are butanol, biodiesel, and hydrogen, but include other alcohols and carbon-containing gases such as methane and butane.

Source: wikipedia.com May 14th, 2012

Categories of Electrofuels:

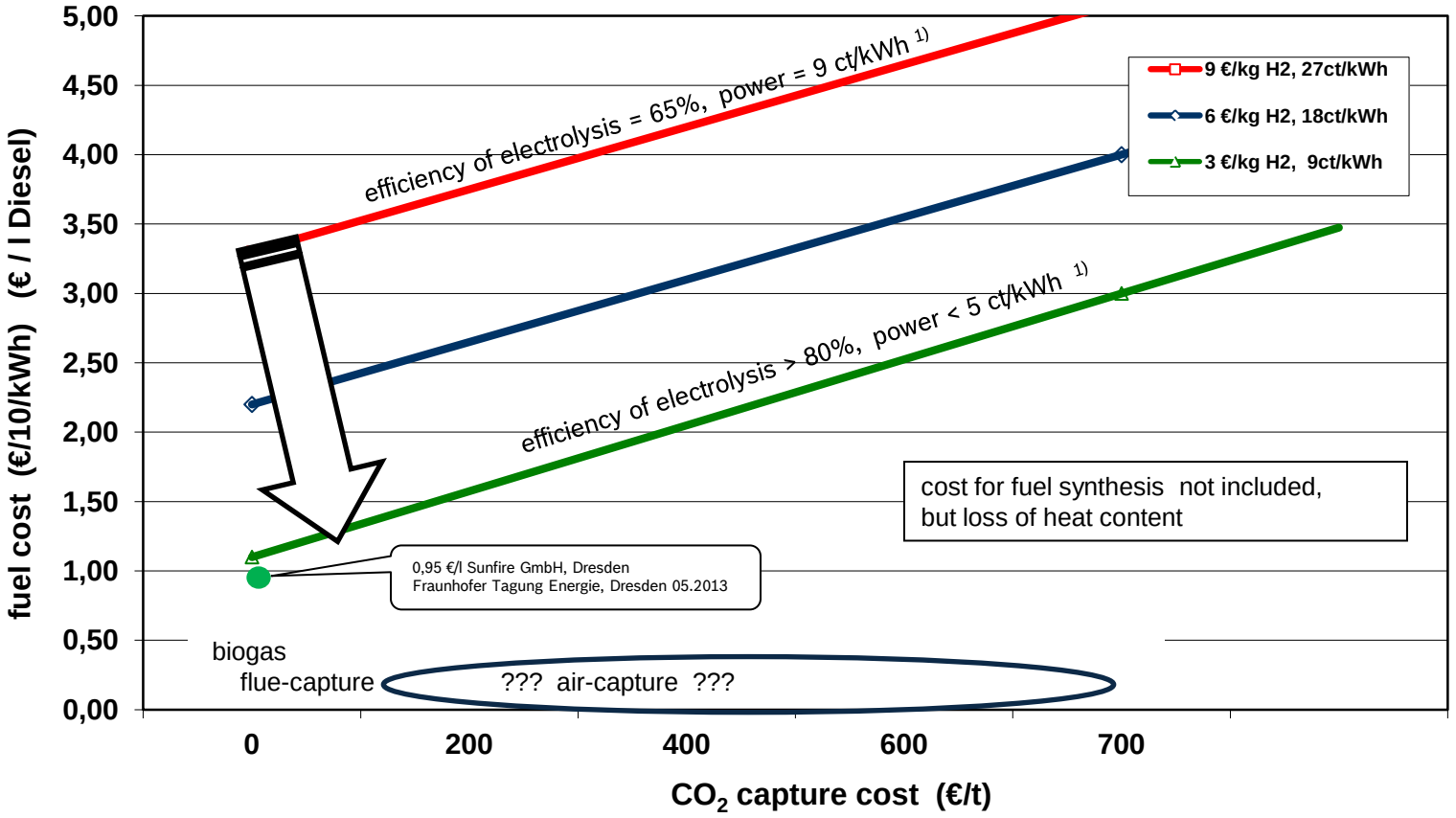
- Power to Gas, PtG — Hydrogen, Methane, 'e-gas', 'Windgas'... SNG: Substitute Natural Gas
- Power to Liquid, PtL — Methanol, Paraffins: Gasoline, Diesel

Assessment of synthetic fuels



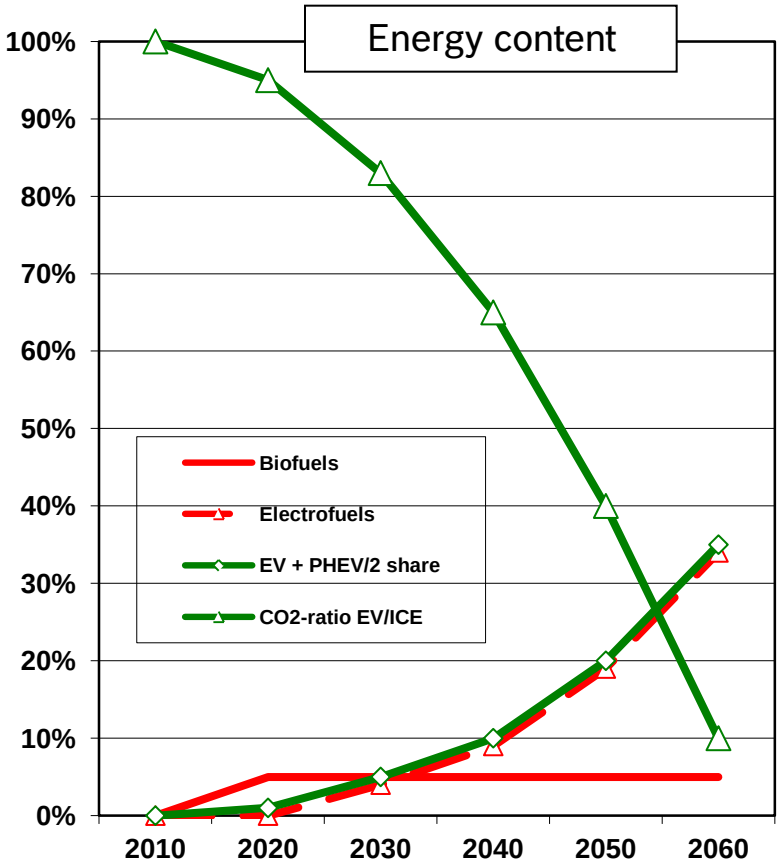
Source: Ludwig-Bölkow-Systemtechnik GmbH @ FVV 03.05.2013

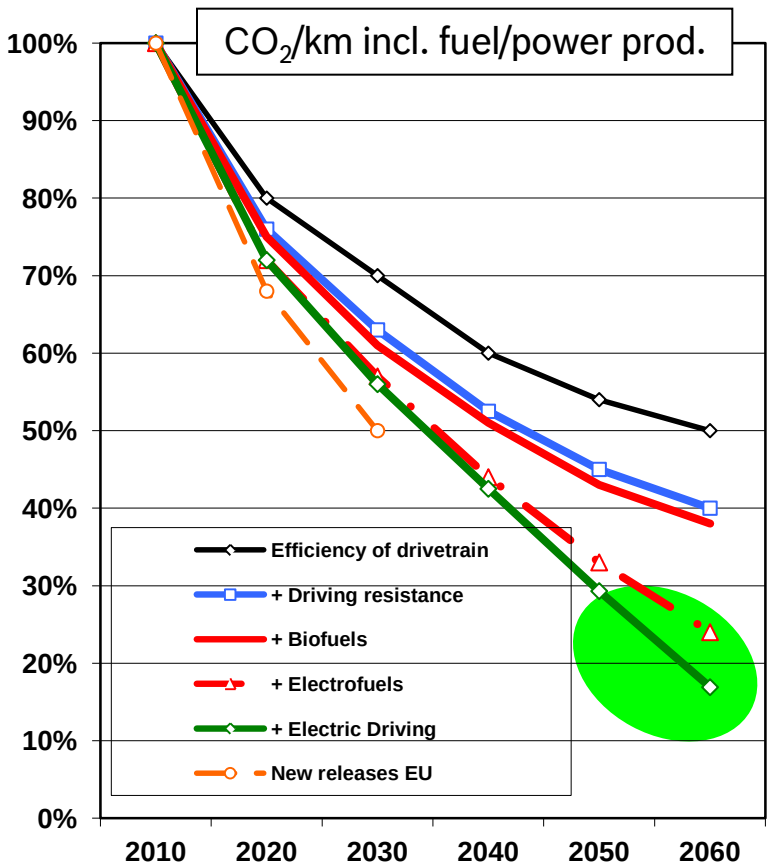
Fuel cost vs cost of CO_2 and H_2 input



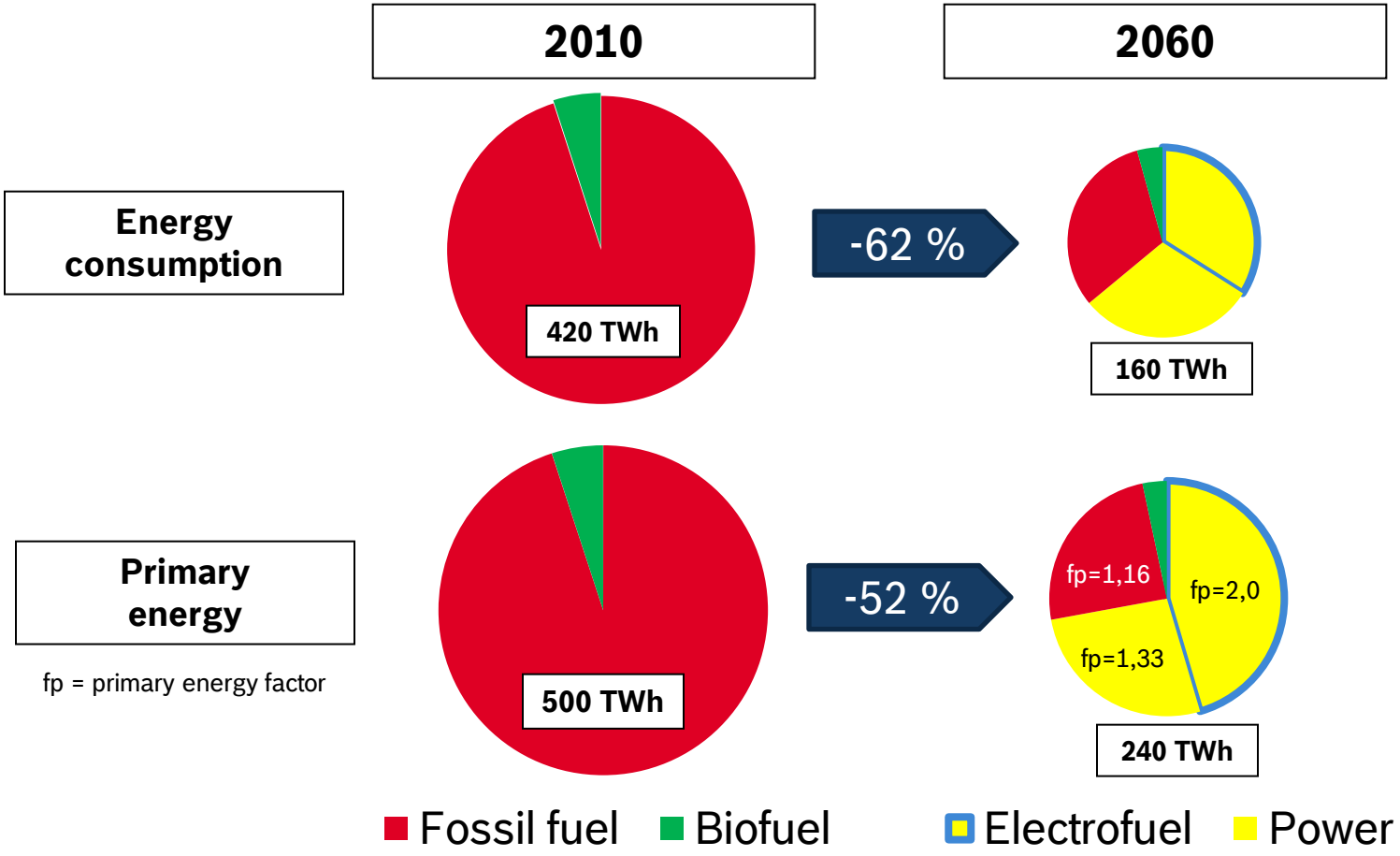
1) source: T. Smolinka, Günther, M., (Fraunhofer ISE), Garche, J. (FCBAT): NOW-Studie, Rev. 1, 05.07.2011

CO_2 of vehicle population: measures combined





Energy split for 85% CO_2 reduction



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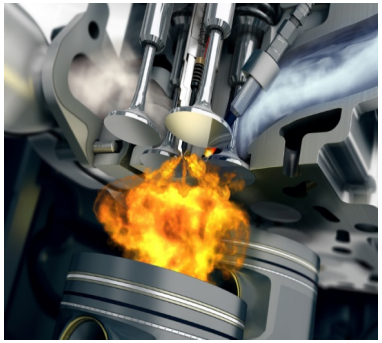

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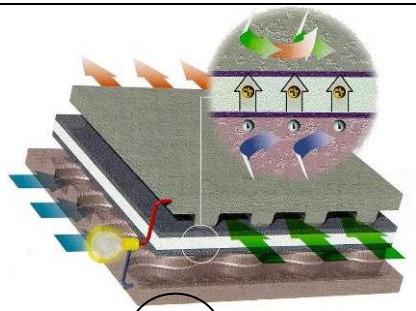
Ways to CO_2-free mobility

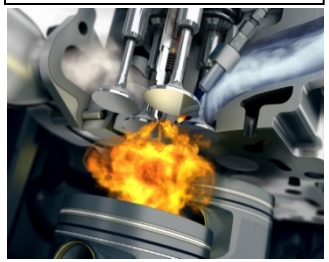
Electricity ← **Battery** | **Fuel Cell**



$O_2 + 2H_2 \leftarrow 2H_2O$

electricity overrun from renewable energy sources

Fuels ← **Biomass** | **CO_2 Recycling**



Vegetable oils
Ethanol

Vegatable garbage
Alga

$CO_2 + 2H_2 \rightarrow 2H_2O + CH_4$

$3CO_2 + 3H_2 \rightarrow H_2O + CH_3OH$

$nCO_2 + (2n+1)H_2 \rightarrow nH_2O + C_nH_{2n+1} + O_2$

Technical Photosynthesis

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Danke für Ihre Aufmerksamkeit

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