

Energy Infrastructure Day

ETOGAS
smart energy conversion

Why does a consultant become shareholder of a Power-to-Gas company?

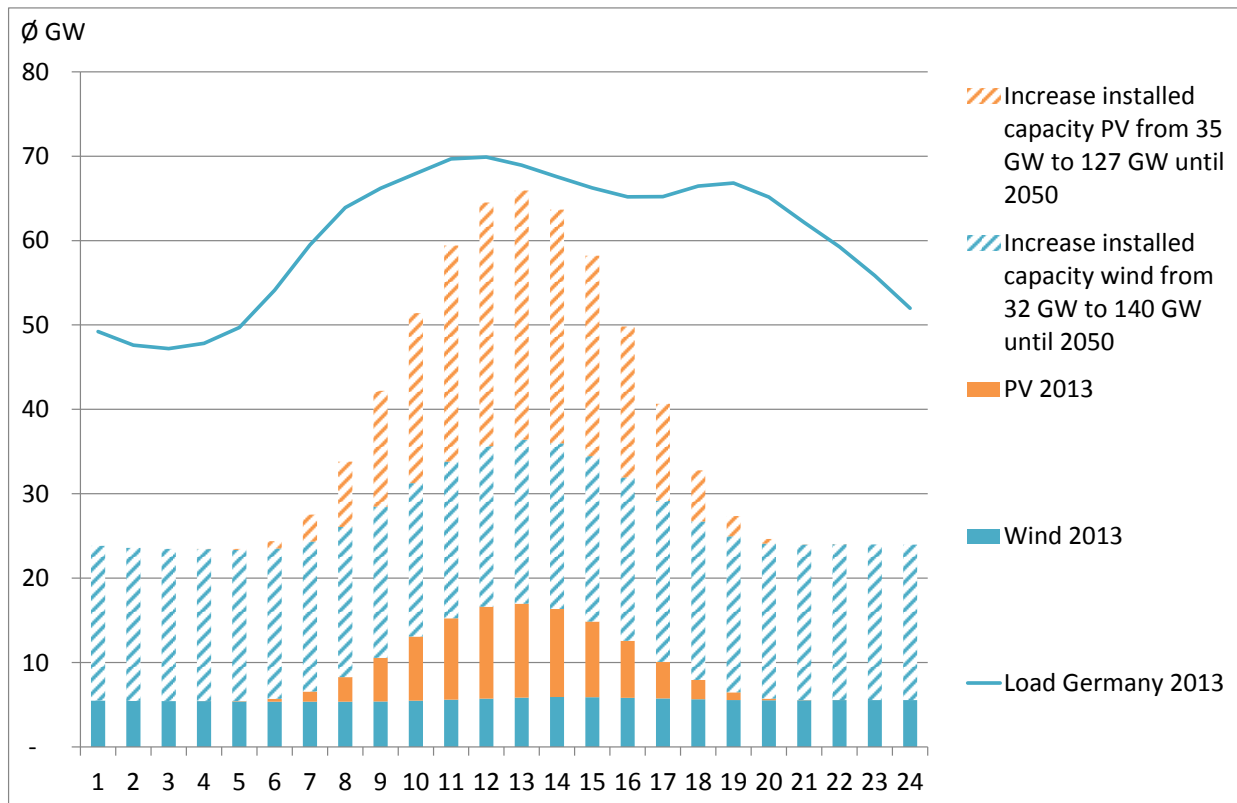
Hans Poser, Munich, 6 November 2014

Average wind and PV production will be close to average demand around noon in Germany

Day profile in 2050

Assumptions

- Installed capacity wind increases
 - Onshore with net 2.5 GW annually
 - Offshore to 6.5 GW until 2020 and to 15 GW until 2030
- Installed capacity PV increases with net 2.5 GW annually
- As a basis the German load curve for 2013 was applied and assumed constant



If volatility of load and production is included, many hours with surplus result – without taking into account other must-run production

Residual load Germany (load duration curve)

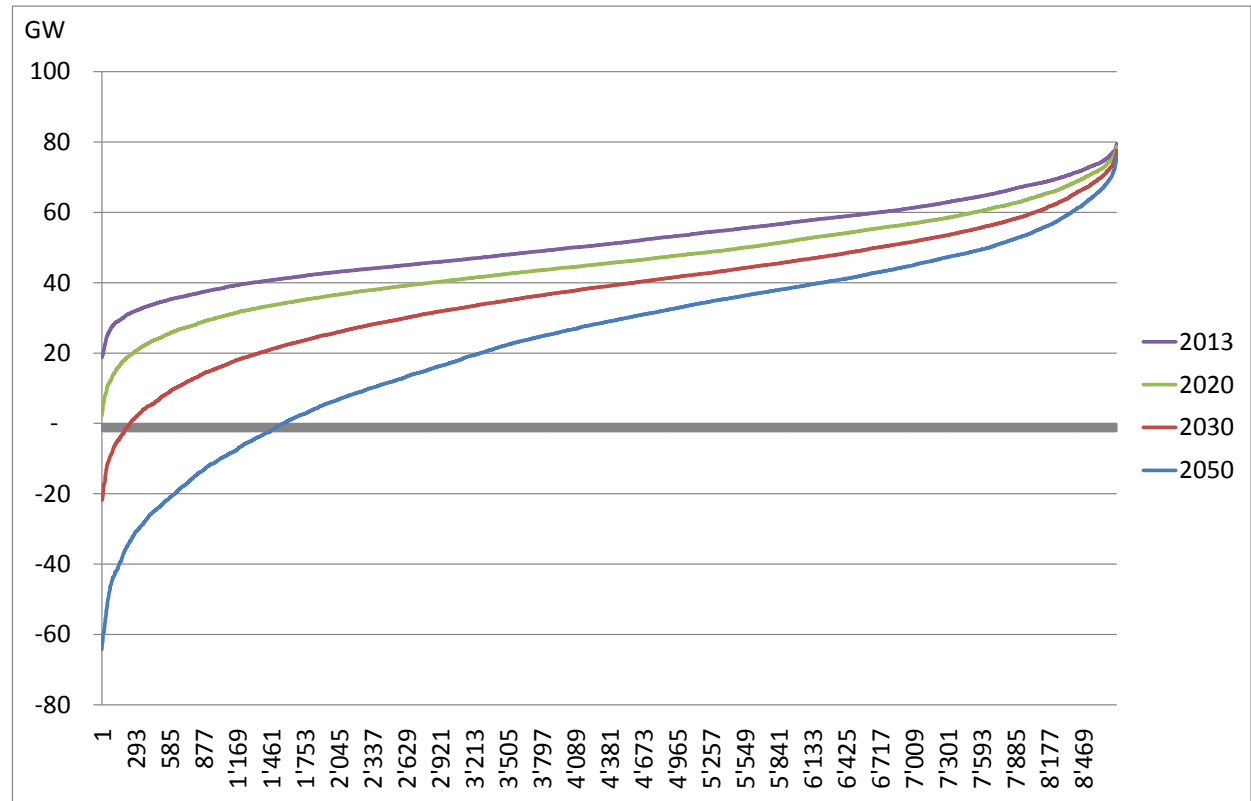
Further effects have to be taken into account, e.g.

- Some thermal plants need to run to stabilize the system with minimum load requirements
- CHP may have to run to supply heat or steam

Further renewables to be included e.g.

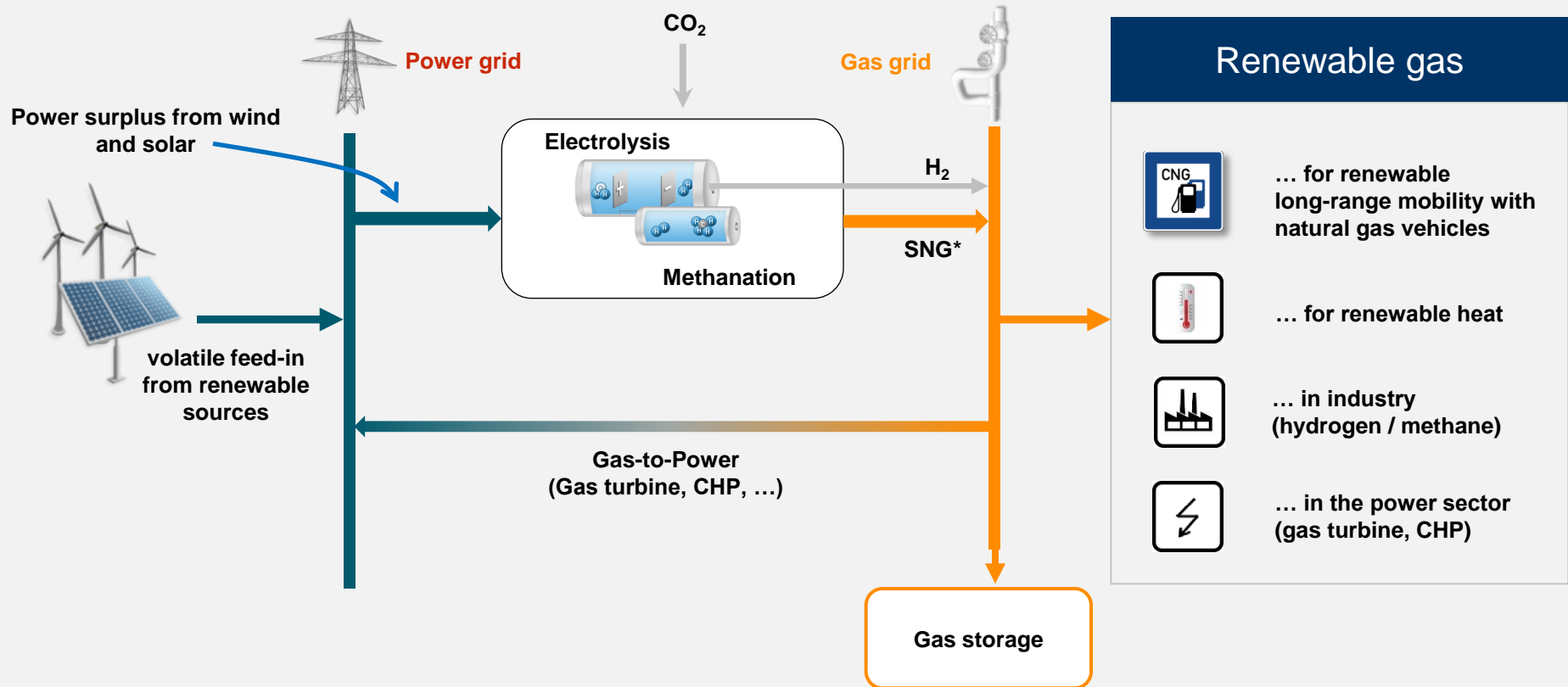
- Hydro plants
- Geothermal plants

Should all this power be discarded?

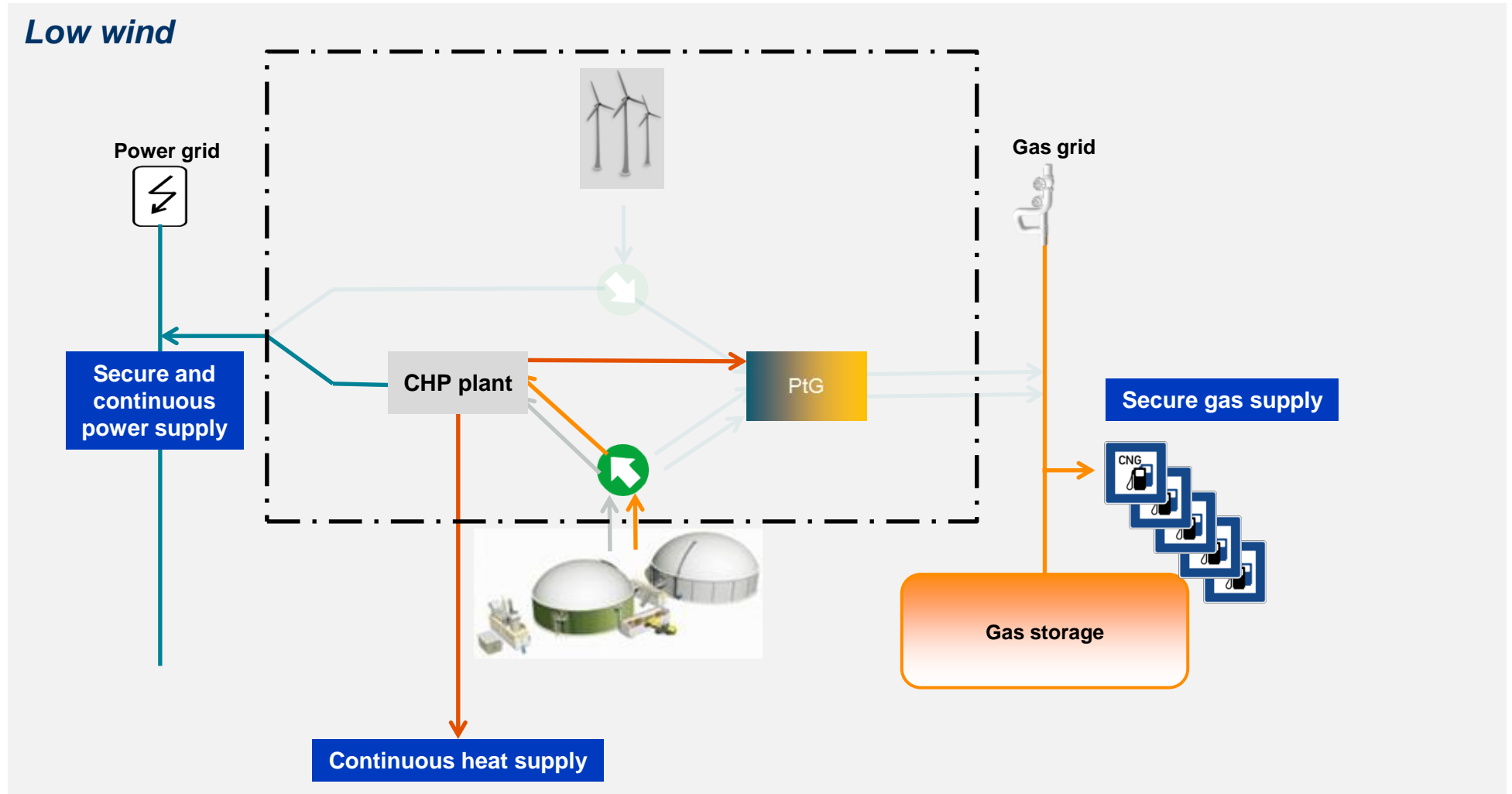


Power-to-gas can transform unused power from wind and PV plants to produce methane (SNG)

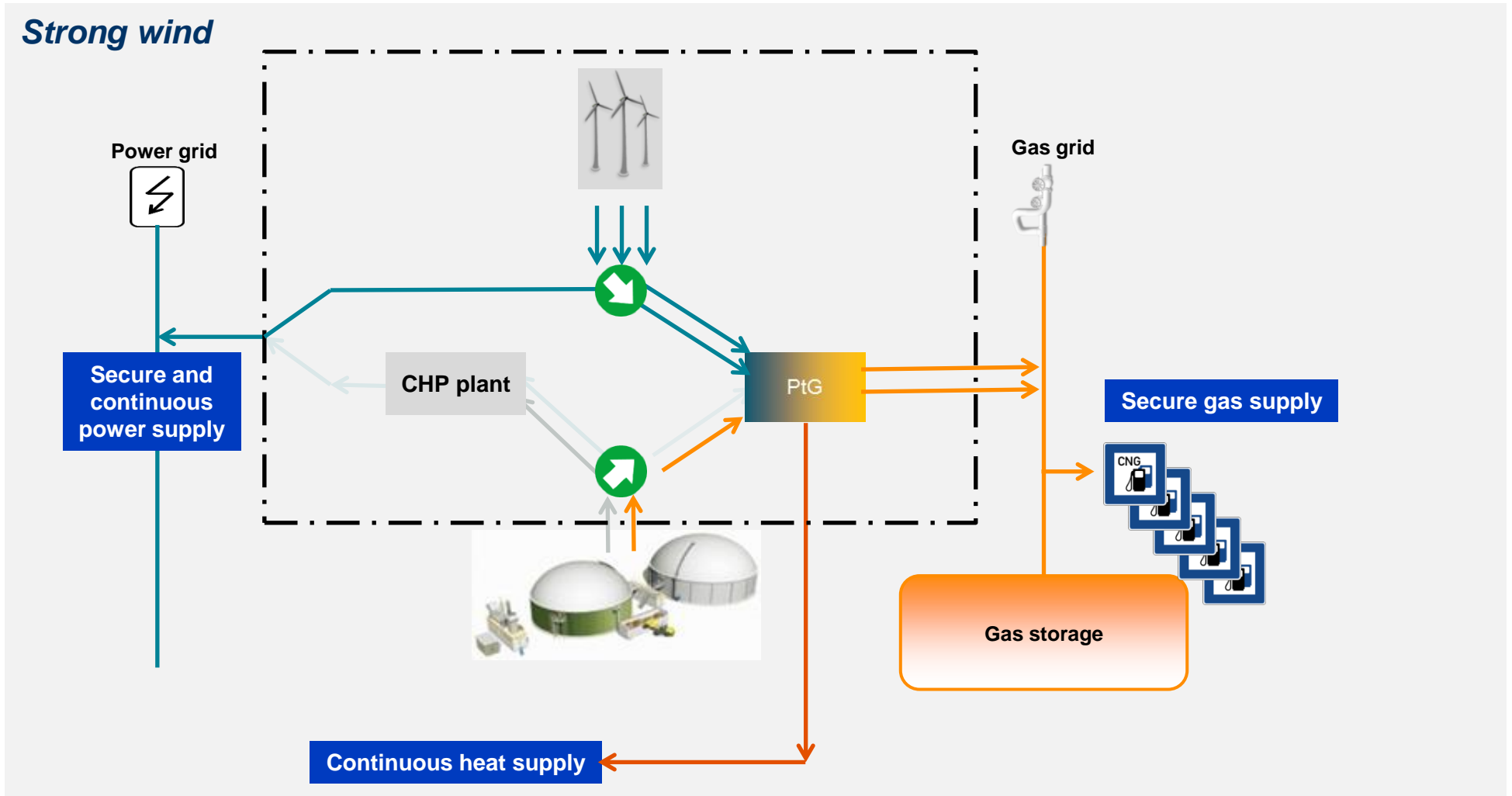
Synthetic Natural Gas can be easily stored and transported



Secure supply of power, heat and gas through combination of renewable sources – even suitable for islands and small grids



Secure supply of power, heat and gas through combination of renewable sources – even suitable for islands and small grids

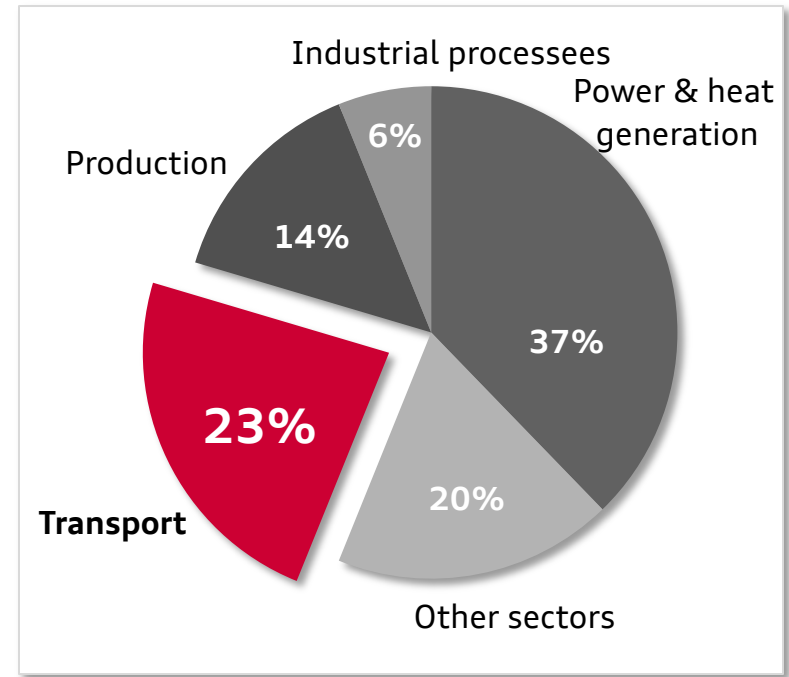
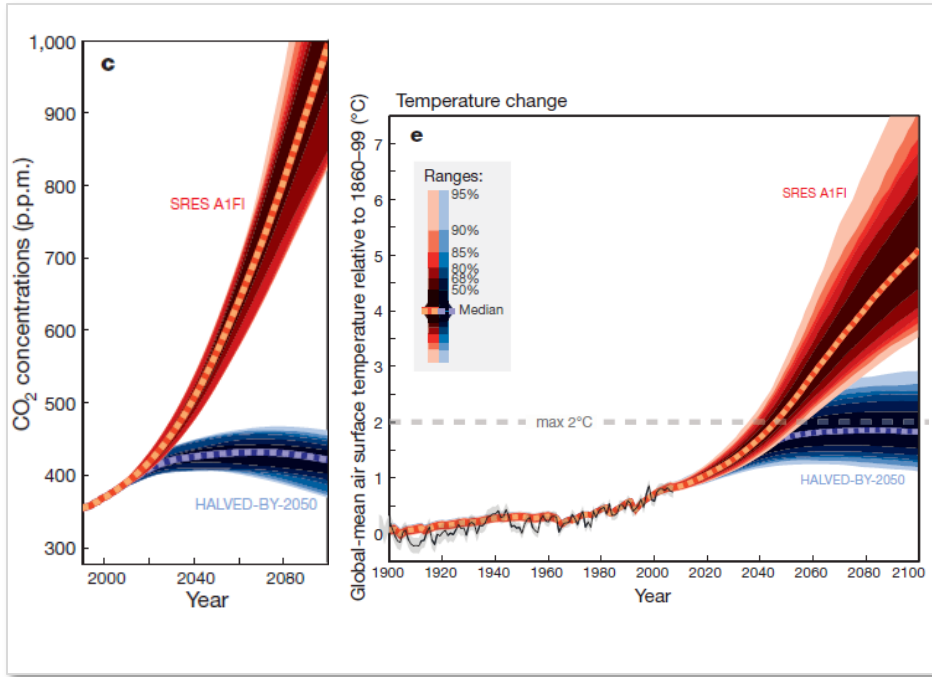




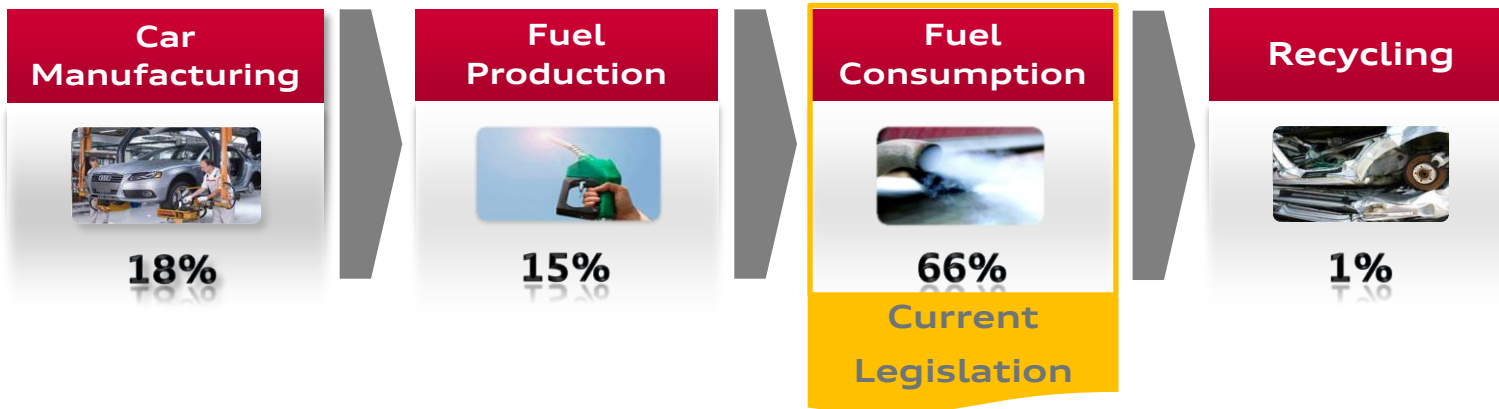
**The Audi e-gas project:
renewable mobility using Power-to-Gas**

Dr. Hermann Pengg, Projekt Management e-fuels, AUDI AG

How can the 2°C target be reached? What can car manufacturers contribute?



Audi's mission: Comprehensive awareness of environmental impacts using cradle-to-grave lifecycle analysis

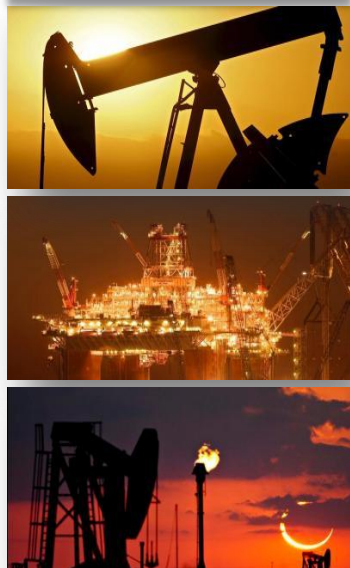


Life Cycle Analysis – „Cradle to Grave“

CO₂-eq. for an A3 TDI, 200Tkm (125k mi)

Fossil fuels (and biofuels) are limited in their availability: Audi's e-fuels will help fill the gap

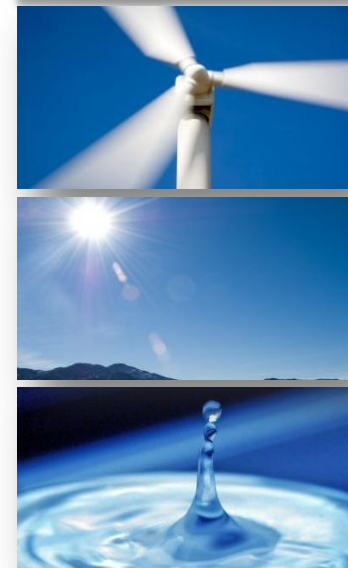
Fossil fuels



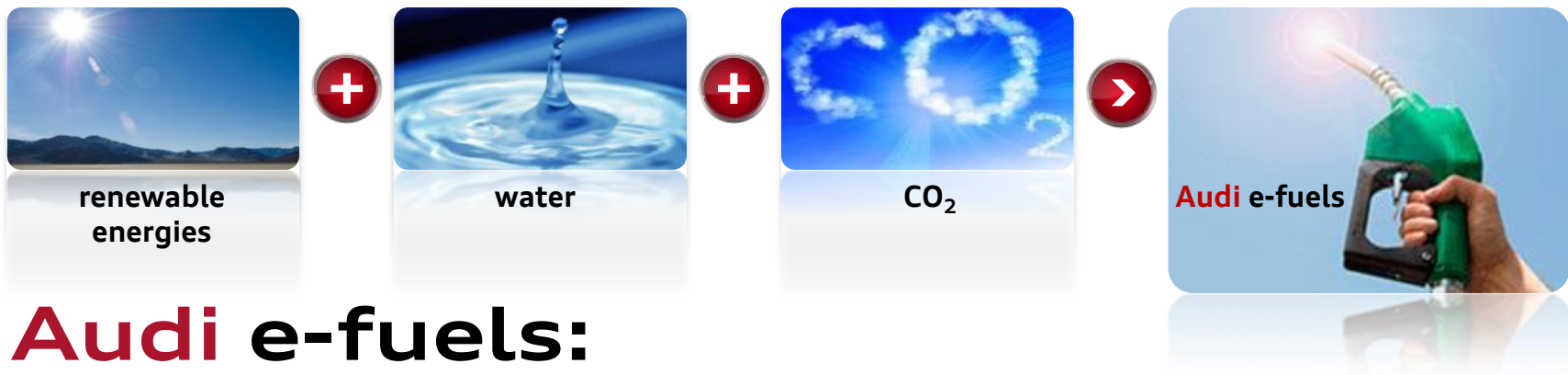
Biofuels



Audi e-fuels



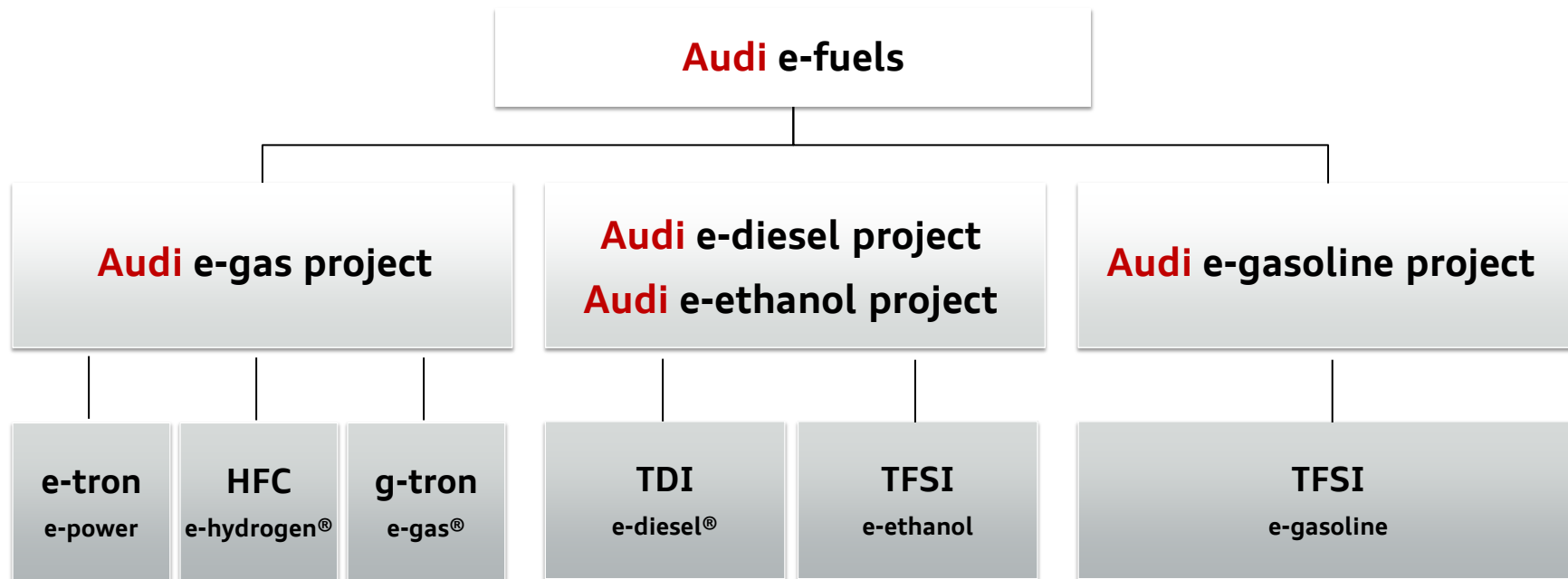
Audi e-fuels are fuels made from renewable energies, water and CO₂



Audi e-fuels:

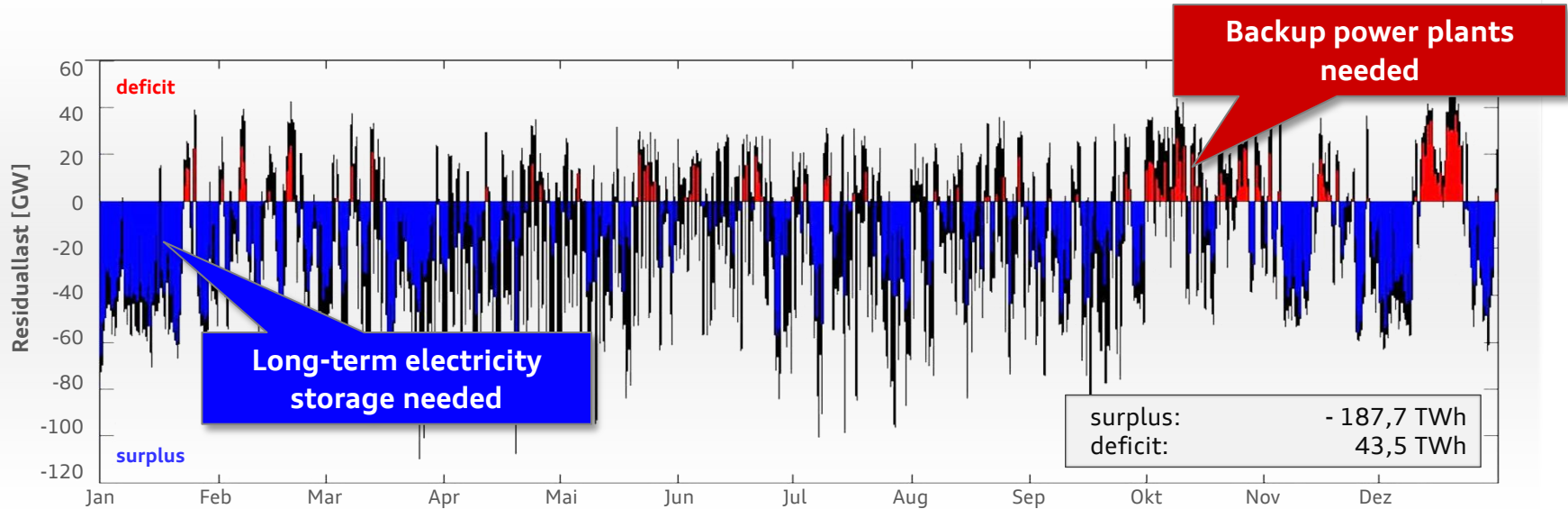
- ▶ **No** fossil sources
- ▶ **No** competition with food production
- ▶ **Compatibility** with present infrastructure
- ▶ Use of CO₂ as **raw material**

Overview Audi e-fuels

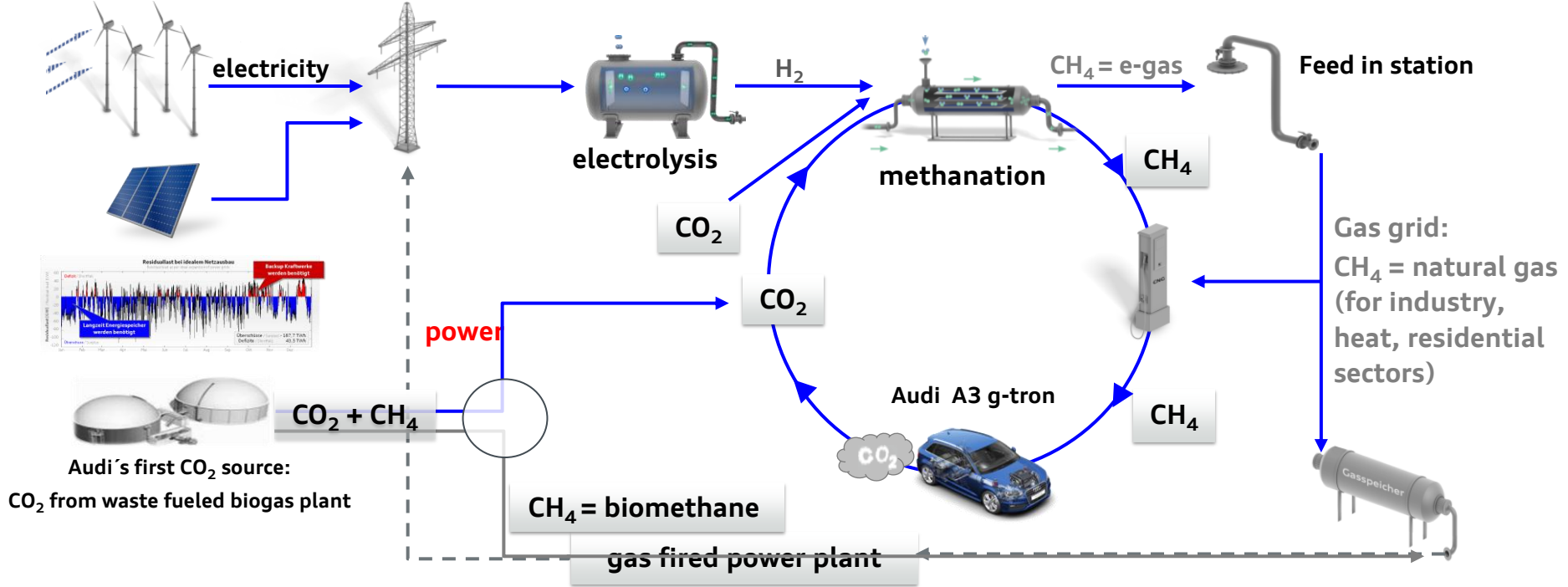


An excursion into the electricity sector: what would happen if a country would run on about 80% renewable sun&wind energy?

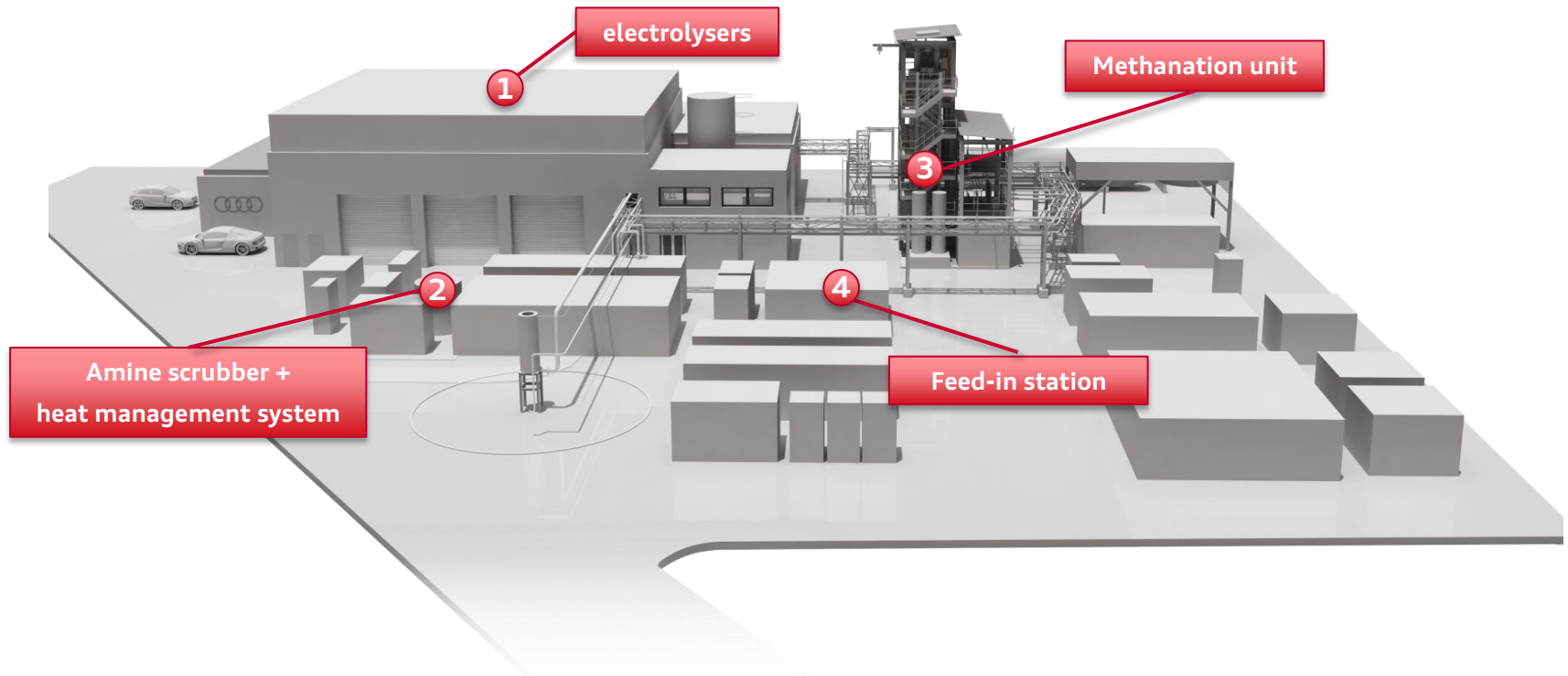
Residual load simulation for 78% renewable electricity in Germany, no exports/imports, copper plate, weather data 2007



Power-to-Gas: coupling the electricity sector and the gas / mobility / heat sectors



Overview Audi e-gas plant



Power-to-Gas: Audi e-gas plant in Werlte (Emsland)



Power-to-Gas plant Audi (Werlte, Emsland)



Electrolyser (3 x 2 MW)



methanation unit



Audi A3 Sportback g-tron



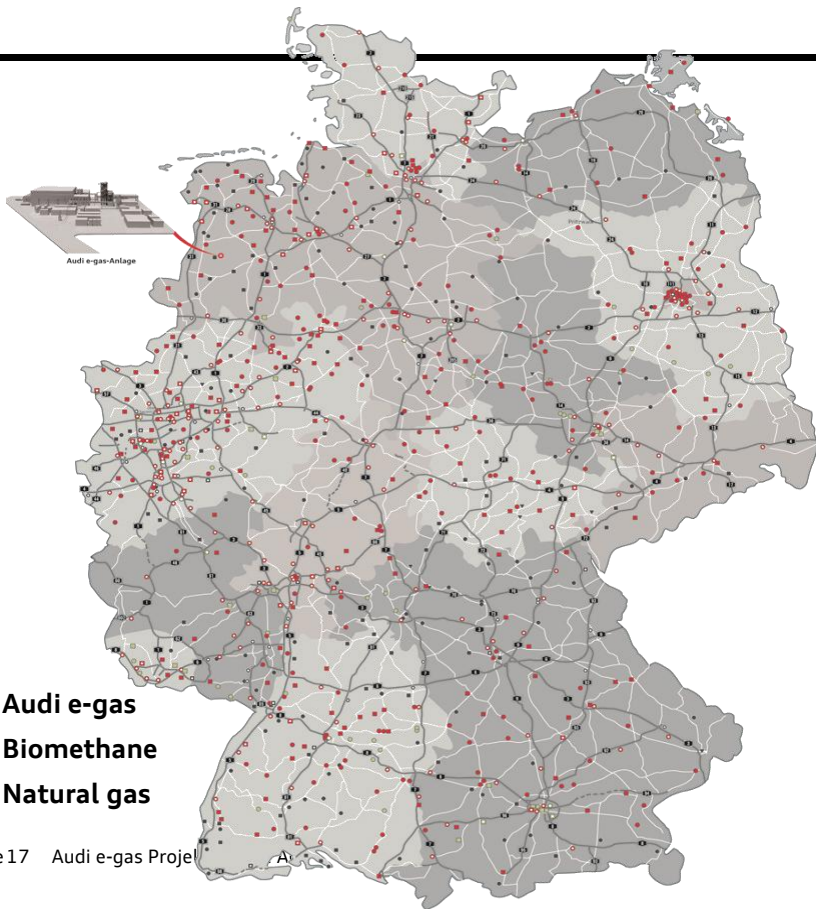
Audi A3 g-tron: technical data



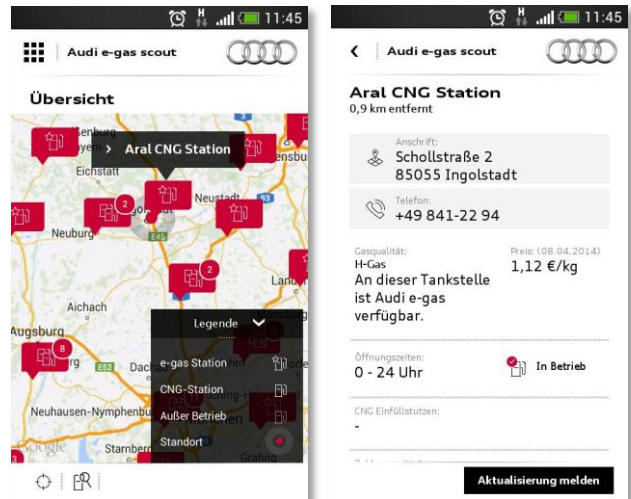
Gastanks Audi A3 g-tron

- ▶ 3,2 – 3,3 kg/100 km (88-92 g CO₂/km), s-tronic / 6-gear
- ▶ Cruising range CNG: 420-450 km
Cruising range gasoline: > 900 km
- ▶ 81 kW (110 PS), 200 Nm / 1.400 Upm
- ▶ 197 km/h, 0-100 km/h in 10,8 s
- ▶ Price in Germany:
starting at 25.900 EUR

Where can I get Audi e-gas in Germany?



Navigation with Audi's e-gas App



900 CNG stations

Audi e-gas on more than 600 stations

How do German customers use e-gas?



- ▶ opt for a pre-paid contract for Audi e-gas



- ▶ amount of fuel is registered via his e-gas card



- ▶ Monthly account statement of amounts of e-gas purchased and reduction in CO₂ emissions

- ▶ **Fill up on more than 600 German CNG stations**
- ▶ **Easy payment with e-gas credit card**

- ▶ **Monthly debiting of fuel price and e-gas climate fee**
- ▶ **Monthly reporting of saved CO₂ by using e-gas**

Comparison of fuel costs for Audi A3

Fuel prices in Germany (10/2014)

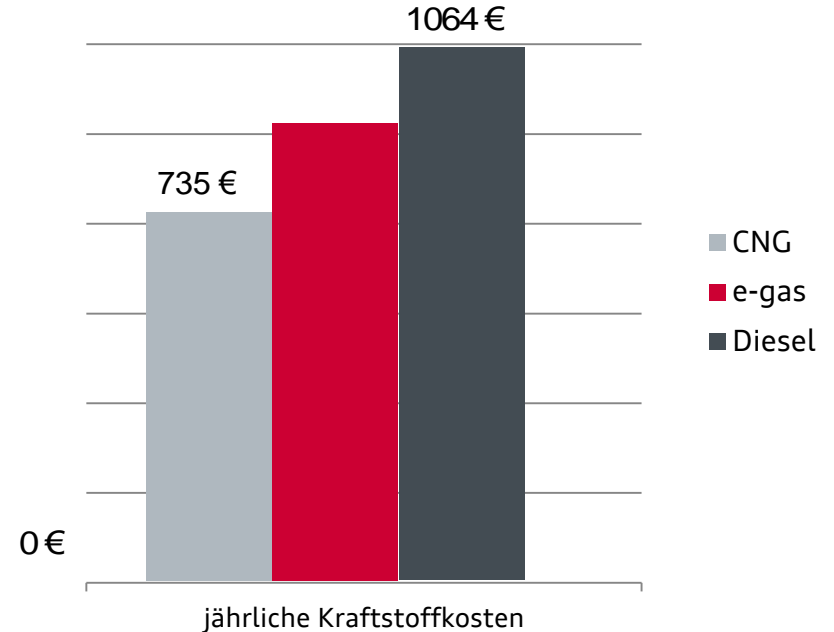
CNG:	<input type="text" value="1.05"/>	€/kg
e-gas Option:	<input type="text" value="14.95"/>	€/m
Diesel:	<input type="text" value="1.4"/>	€/l

Mileage (km/a)

km/a

Annual fuel costs:

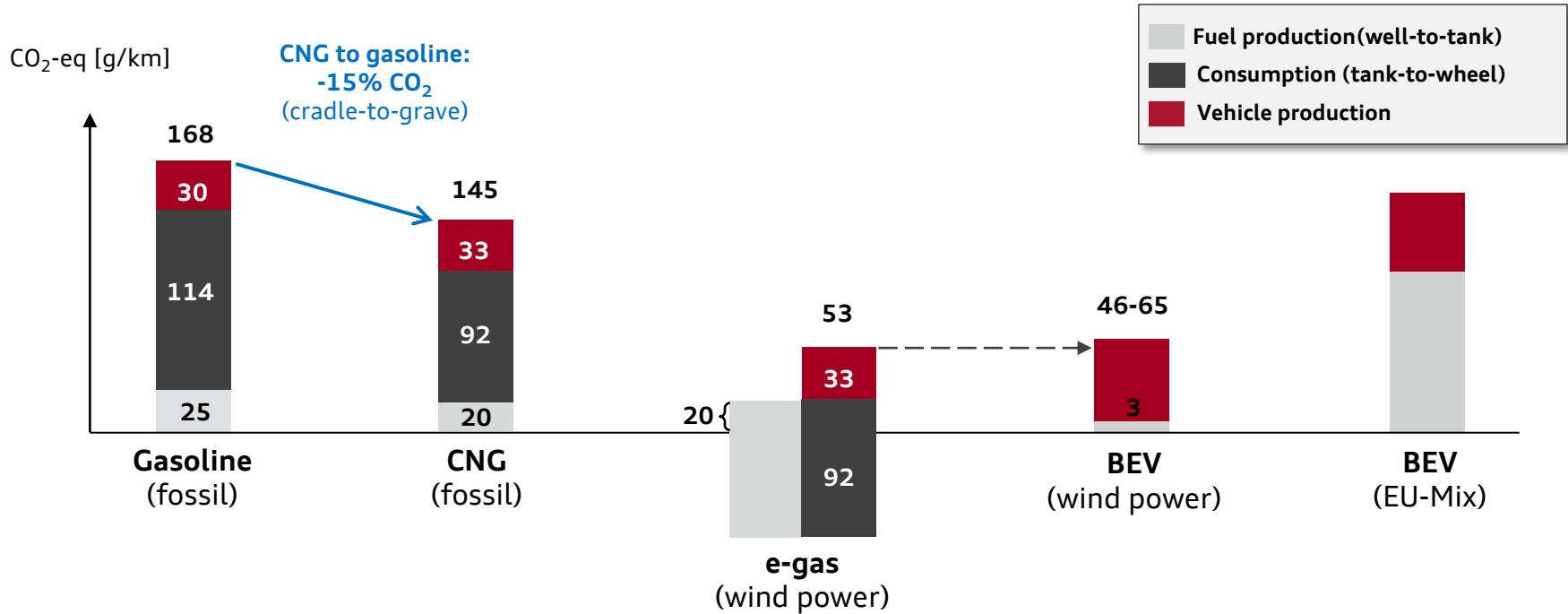
CNG:	<input type="text" value="735"/>	€/a
CNG inkl. e-gas:	<input type="text" value="914"/>	€/a
Diesel:	<input type="text" value="1064"/>	€/a



Fuel prices: ADAC Autokostenvergleich Stand Mai 2014: Diesel:1,40 €/l // CNG: 1,05 €/kg // e-gas-Option: 14,95 €/m

Consumption data: A3 1.4 g-tron: 3,5kg/100km // A3 1.6 TDI: 3,8 l/100km

Audi e-fuels vehicles show best-in-class emission values and are high leverage for CO₂-reduction in the mobility sector



assumptions: compact class (A3 TFSI & g-tron); 200.000 km over lifetime



Thank you!

www.audi.com

Dr. Hermann Pengg, Projekt Management e-fuels, AUDI AG