Workshop: Decarbonisation – 100% and more

Umwelt Bundesamt

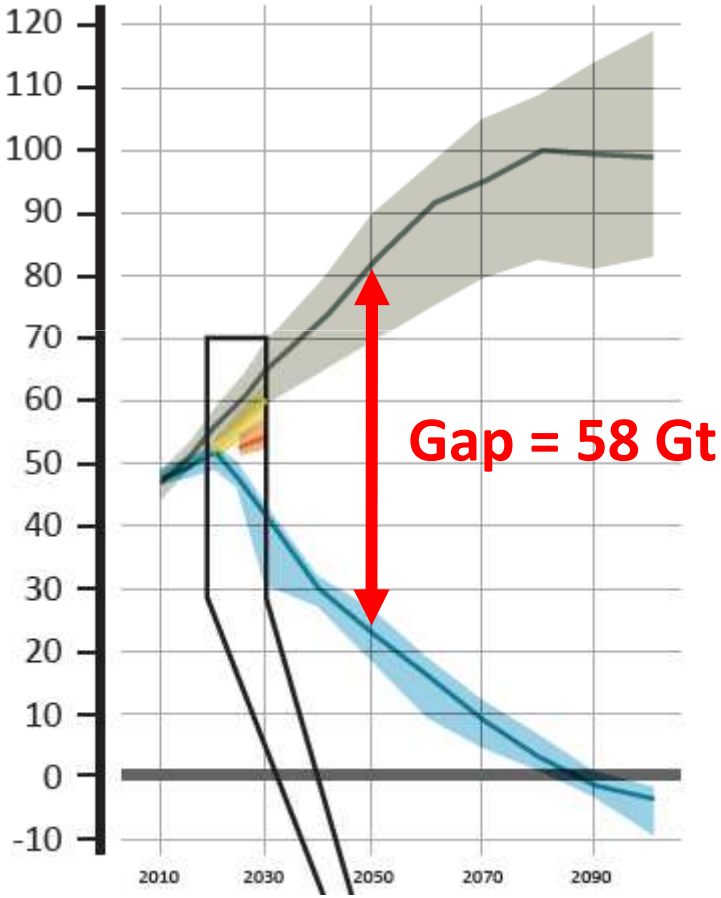
Greenhouse gas neutral Germany

Main parameters and findings

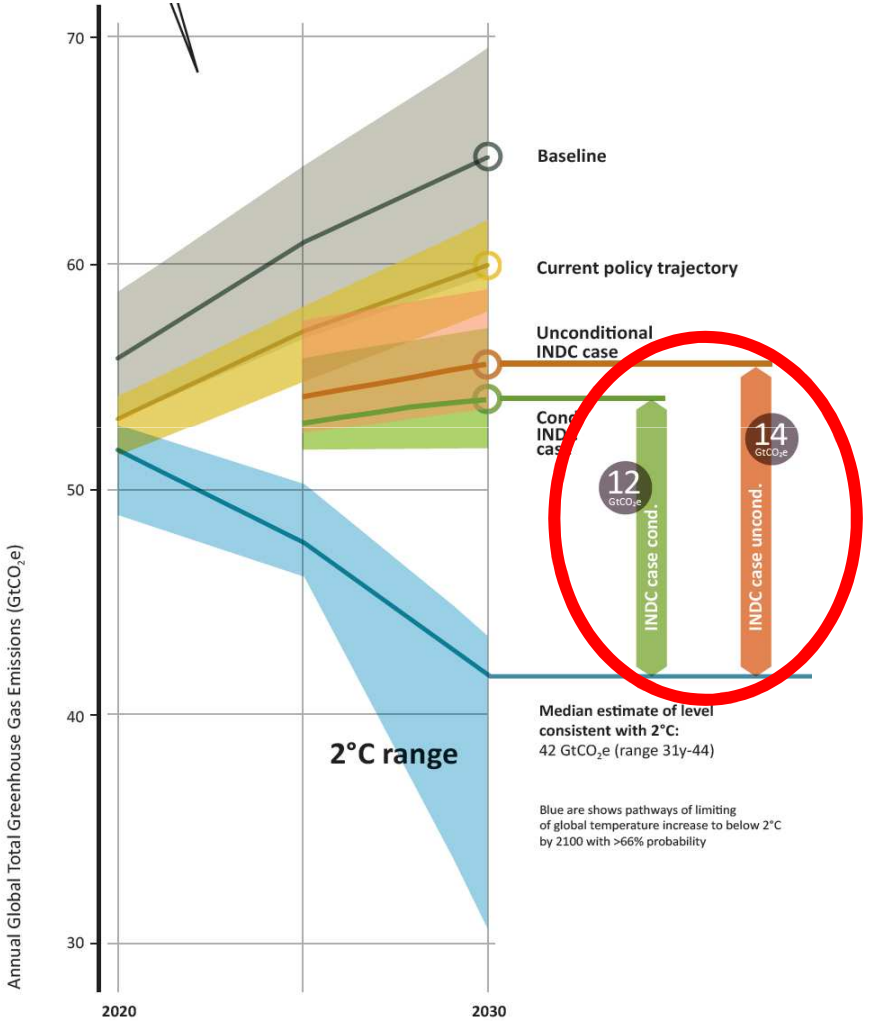
Benno Hain
Energy Strategies and Scenarios
German Environment Agency
Dessau-Roßlau

The Emissions Gap Report 2015 – Executive Summary

Annual Global Total Greenhouse Gas Emissions (GtCO2e)



The emissions gap (GtCO2e)



Source: UNEP (2015), Executive Summary of the Emissions Gap Report

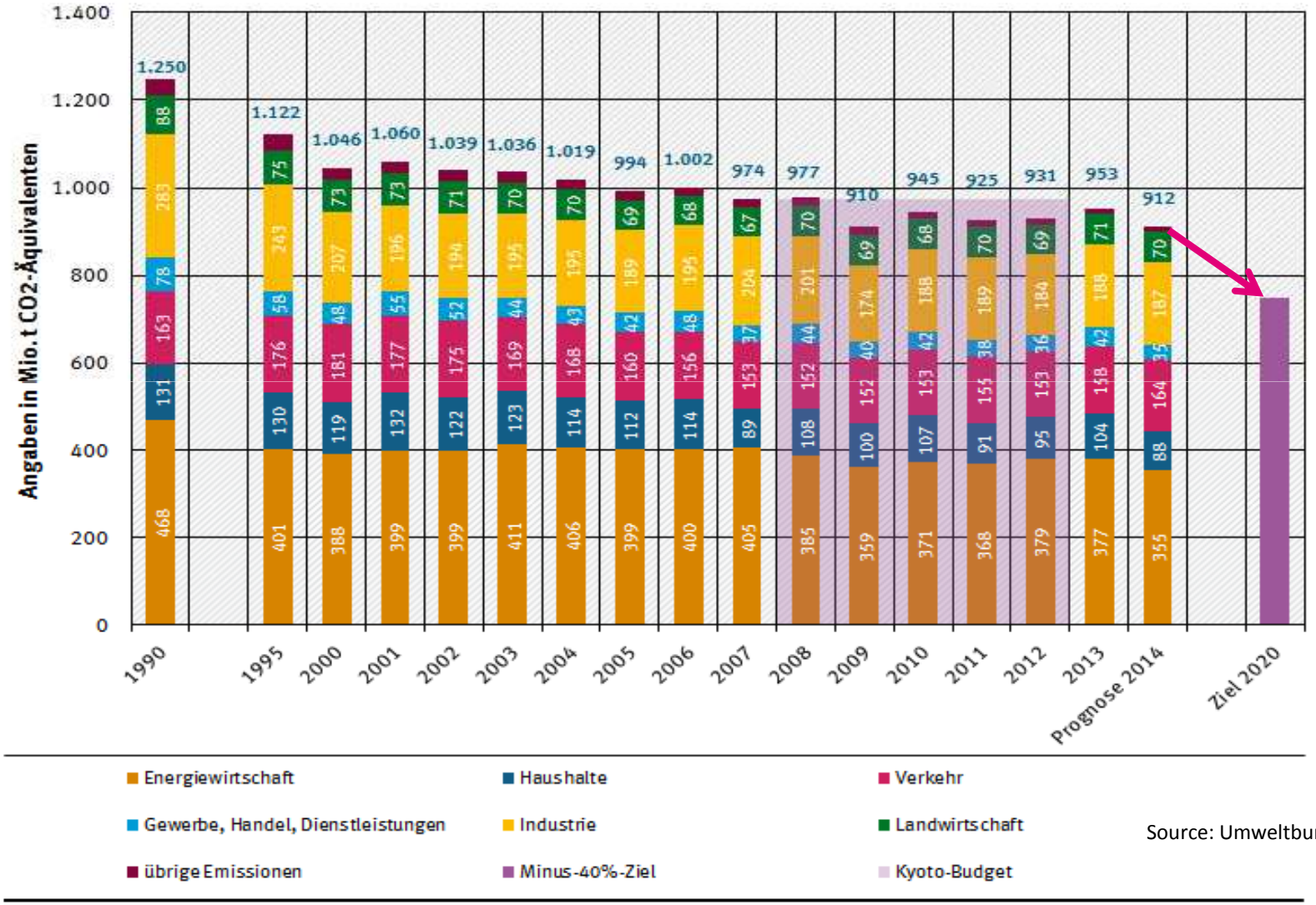
The New York Times

comments the release of the UNEP Gap Report 2015

ANDREW C. REVKIN November 6, 2015 12:03 pm

The message?
You're doing great, world, but raise your ambition some more and we'll really get on track toward a safe climate.

Trend of GHG emissions in Germany



Source: Umweltbundesamt 2015

Close the gap: Reducing 2.7 GW capacity equivalent 12,5 Mio. tonnes CO_2 emissions from lignite until 2020

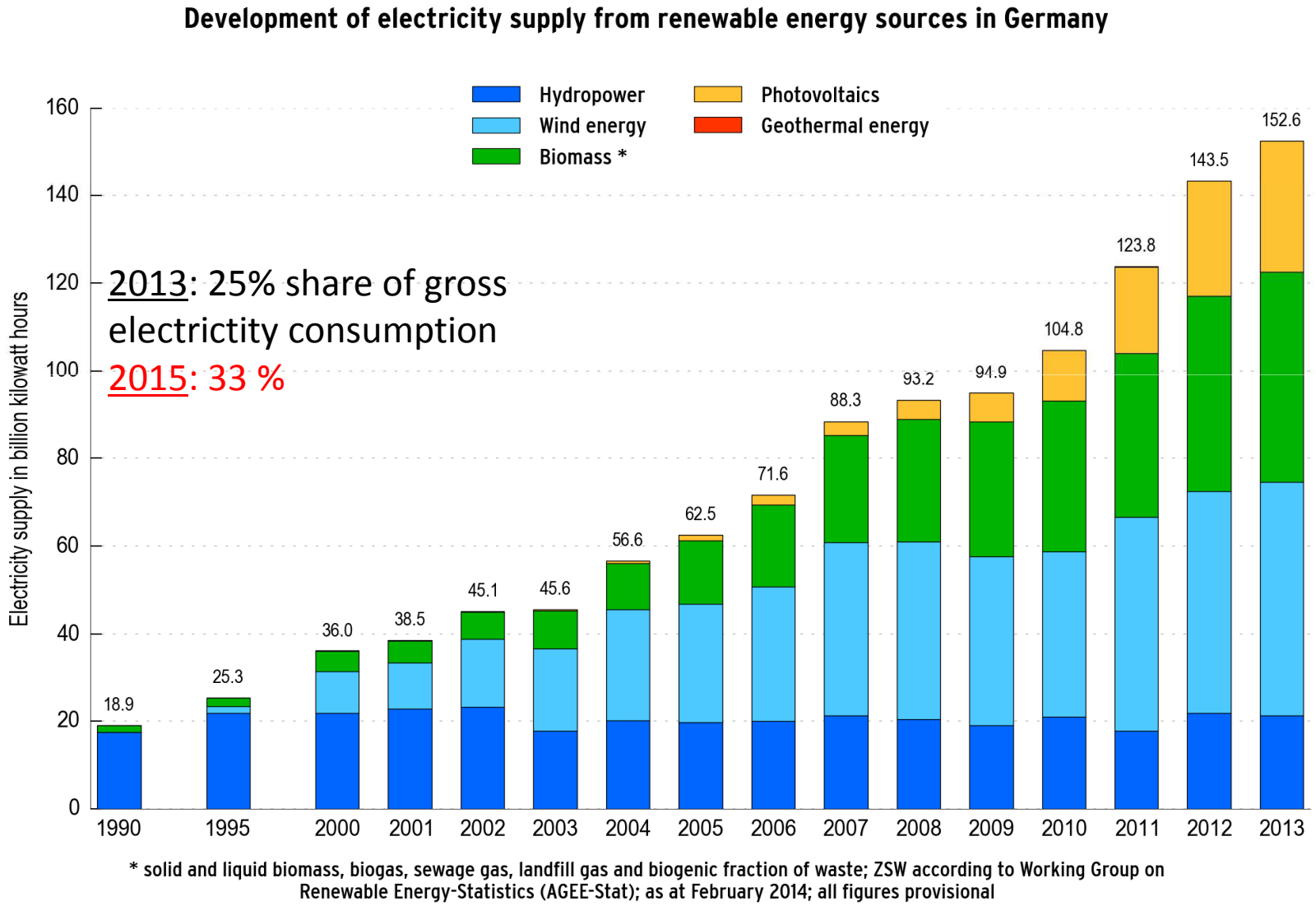
To ensure that the national 2020 climate target can be attained, the Act on the Further Development of the Electricity Market is setting up an arrangement whereby older, high-emission lignite power plants are gradually placed on "security stand-by“ for four years and will then be decommissioned. From the time they are placed on security stand-by, they will not normally emit any more carbon dioxide.

(GERMAN MINISTRY OF ECONOMY AND ENERGY, NOVEMBER 5, 2015)

Energy and climate protection targets of Germany

	Climate	Renewable Energy		Efficiency		
	GHG (vs. 1990)	Electric power	Total share	Primary energy	Energy productivity	Modernising buildings
2020	– 40 %	35%	18%	– 20%	increase to 2,1% p.a.	double rate 1% → 2%
2030	– 55 %	50%	30%			
2040	– 70 %	65%	45%			
2050	– 80-95 %	80%	60%	– 50%		

Germany‘s electricity production from RES since 1990



* solid and liquid biomass, biogas, sewage gas, landfill gas and biogenic fraction of waste; ZSW according to Working Group on Renewable Energy-Statistics (AGEE-Stat); as at February 2014; all figures provisional

Our central question:

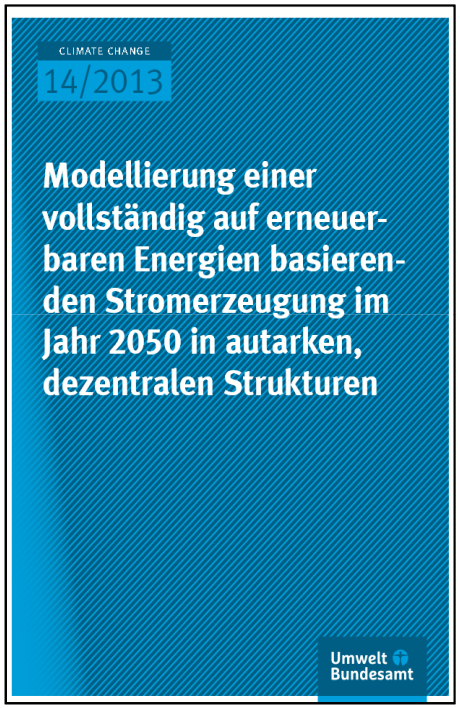
Can a 100% RE System cover

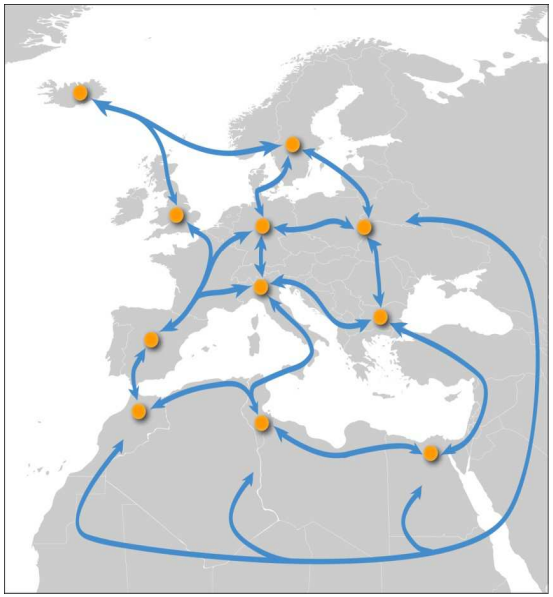
1. Germany‘s complete electricity demand
2. AND the annual peak load?

⇨ Security of supply on today‘s level?

UBA: Three “archetypal” scenarios:

100% RES Power is possible!





“Regions Network” (2010)

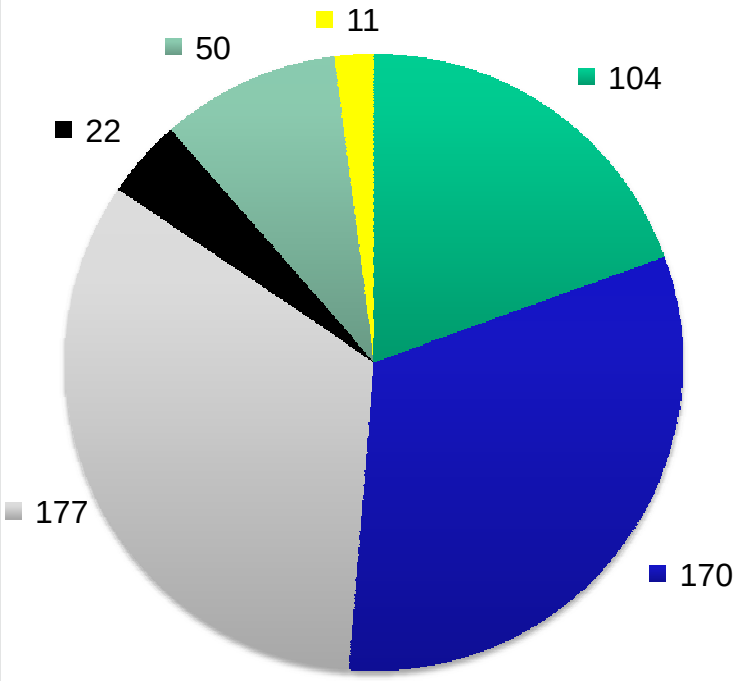
“Local Energy Autarky” (2013)

“International Large Scale” (2015)

Download: www.uba.de

‘Regions Network’ scenario 2050

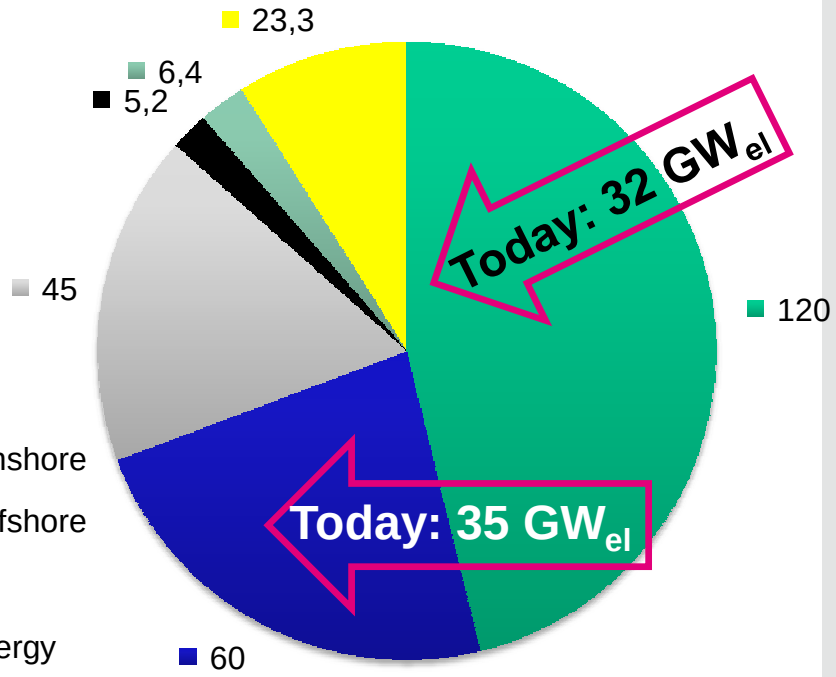
Generation [TWh]



∑ 534 TWh

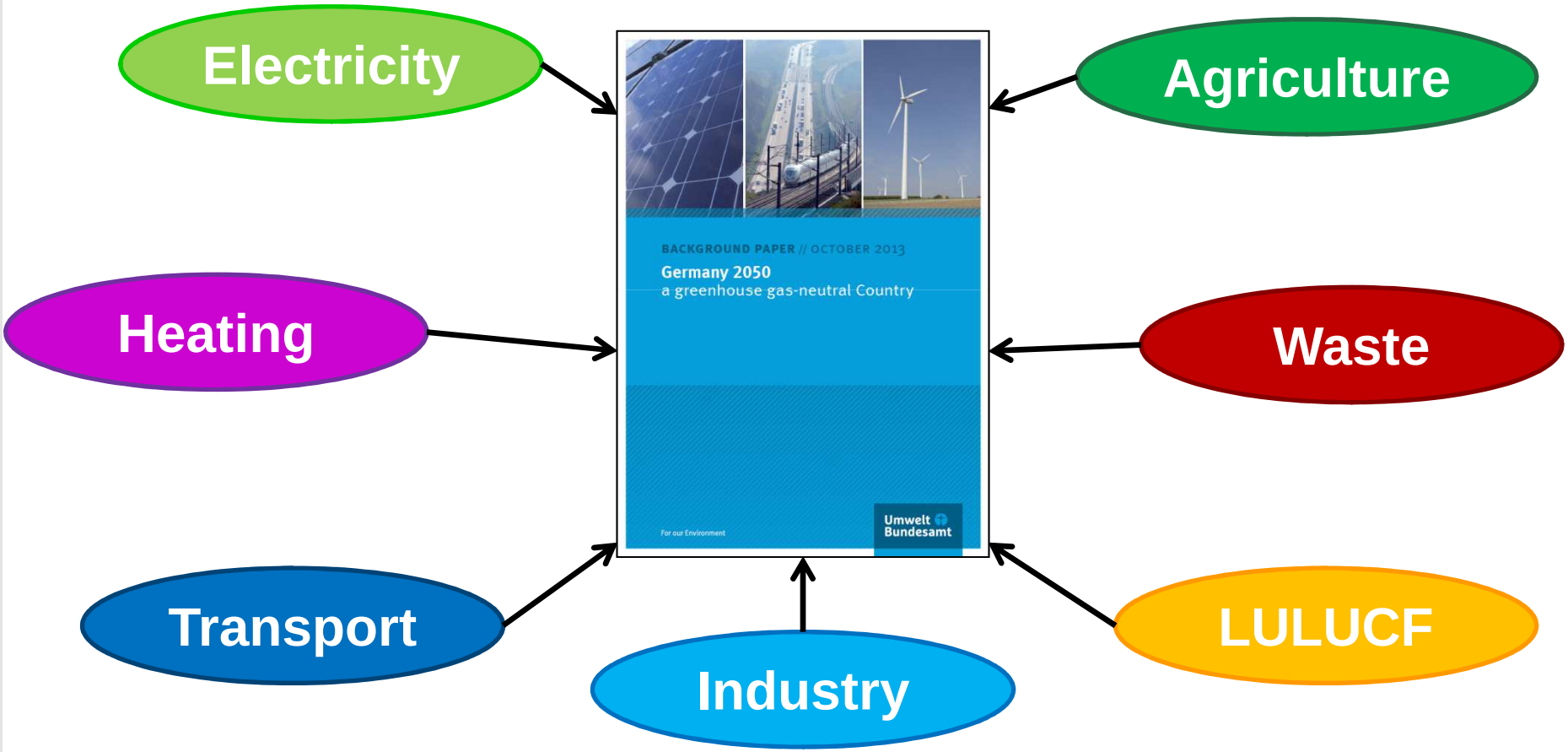
- Photovoltaic
- Wind energy onshore
- Wind energy offshore
- Hydropower
- Geothermal energy
- Waste biomass (biogas)

Installed Capacity [GW]



∑ 259,9 GW

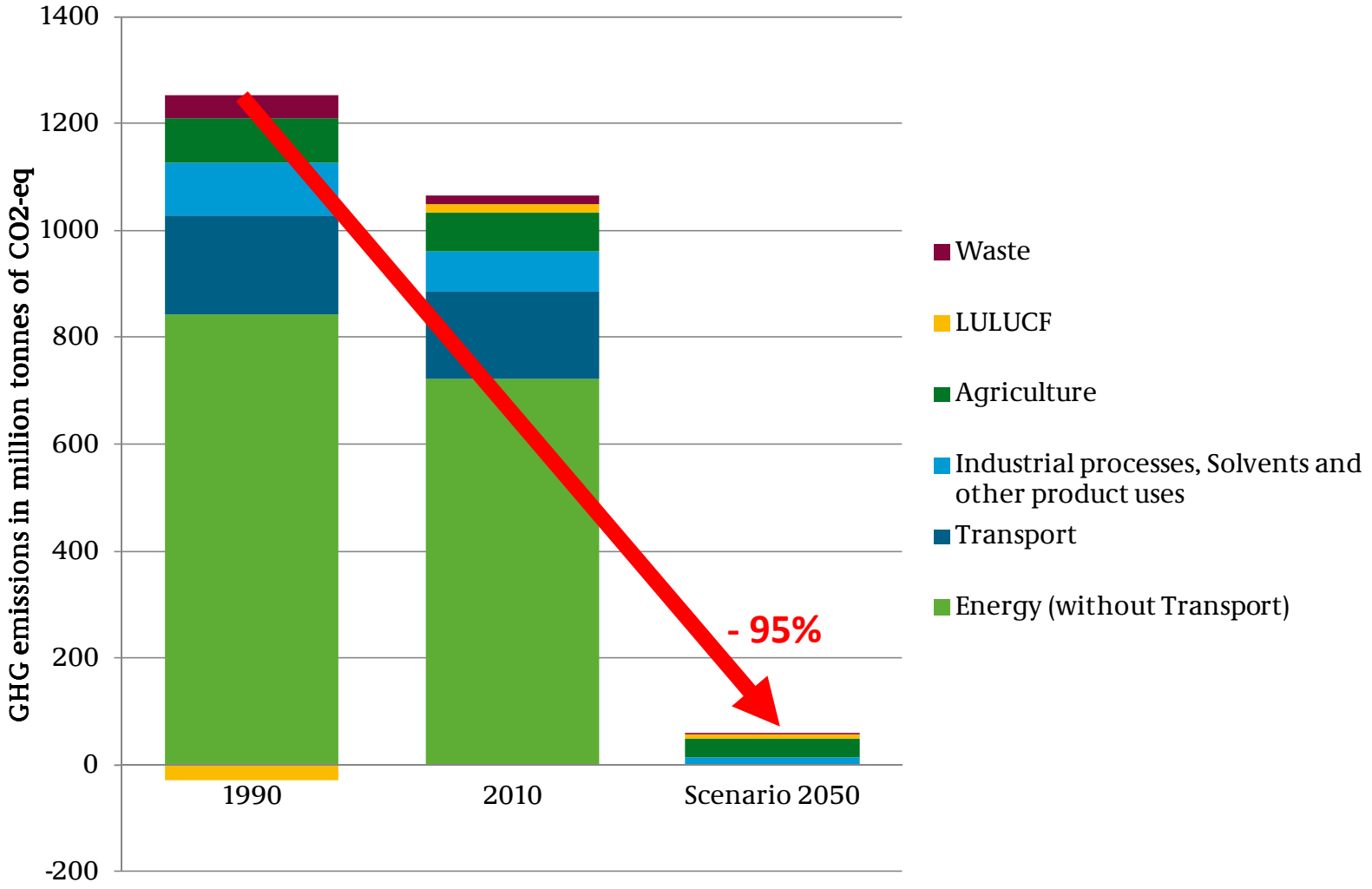
Elements of a Greenhouse Gas Neutral Society



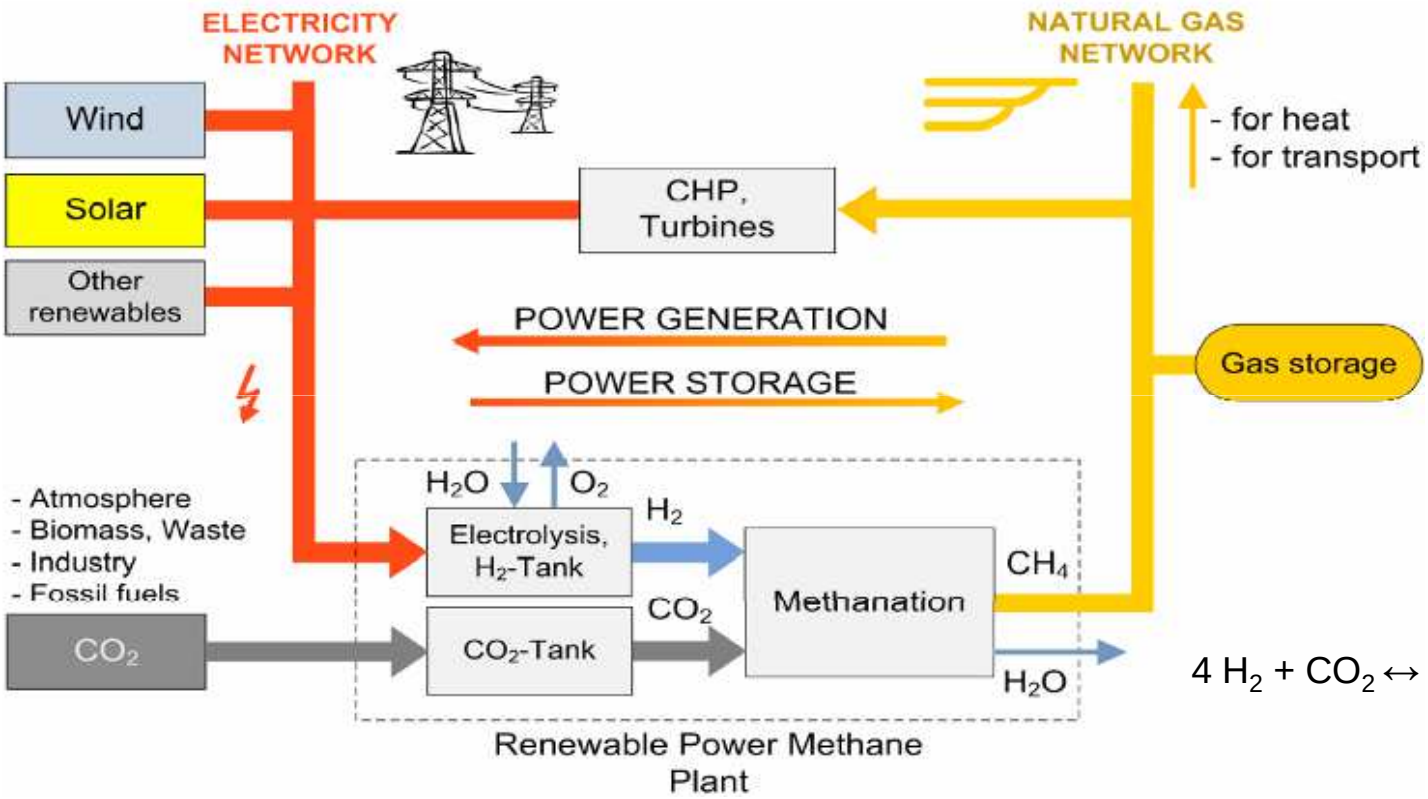
Elements of a Greenhouse Gas Neutral Society

- Per capita emissions of just one metric ton of CO_2eq in 2050
- Final energy demand for Germany in 2050 reduced by 50 % versus 2010
- Sector coupling via “Power to Gas” and “Power to Liquid” implies a steep rise in electricity consumption
- The net energy to be generated amounts to approximately 3.000 TWh p.a. predominantly produced by wind and PV installations (2014: 511 TWh)
- No use of neither energy crops nor CCS nor nuclear energy is assumed
- Hydrogen does not figure as a final energy carrier in our scenario which would open up further options, though

Consideration of possibilities for reducing greenhouse gases across all source categories



Sector Coupling: Power to Gas is the link between power grid and natural gas grid



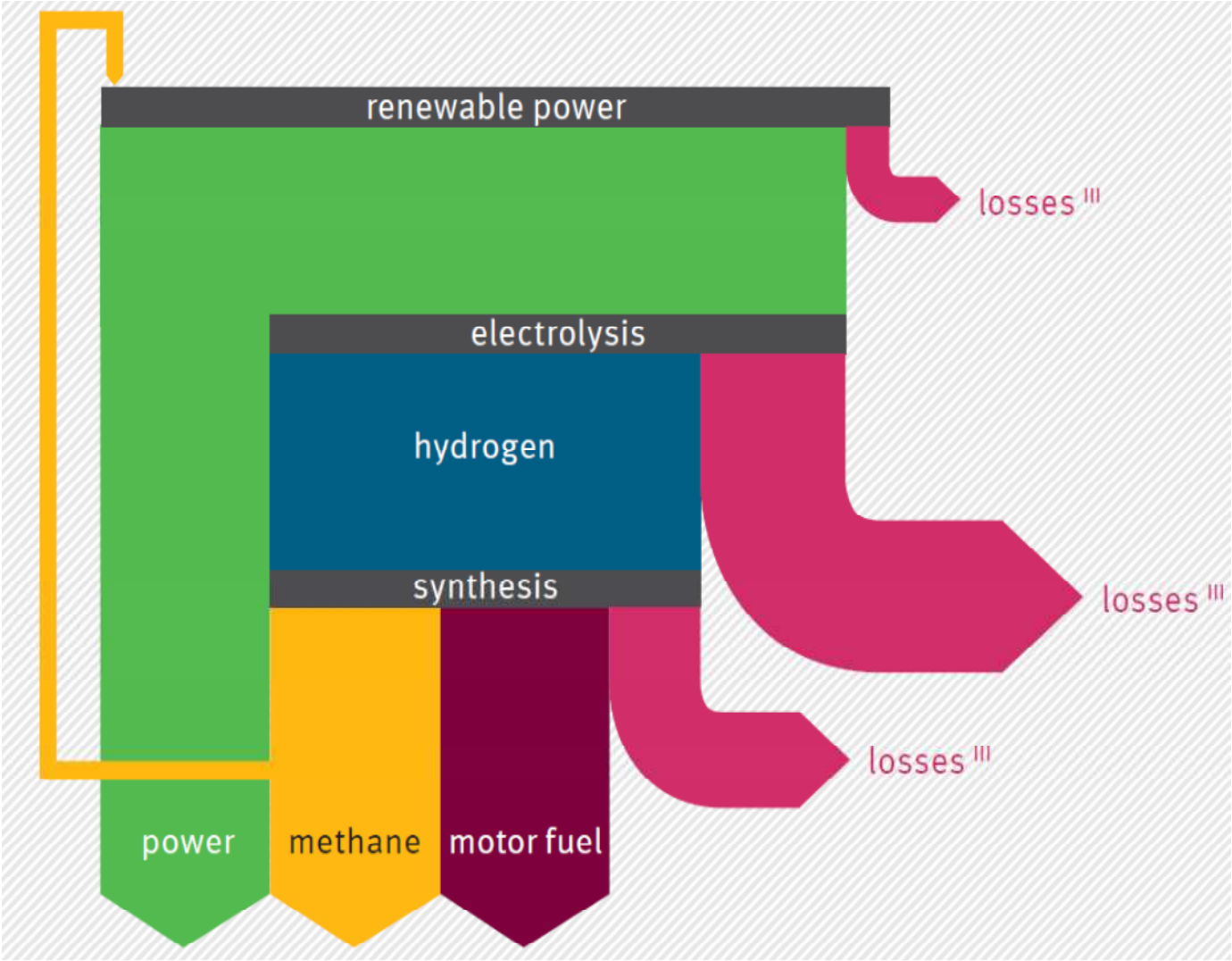
$4\ H_2 + CO_2 \leftrightarrow CH_4 + H_2O$

Source: Specht et al., 2010, Sterner, 2009

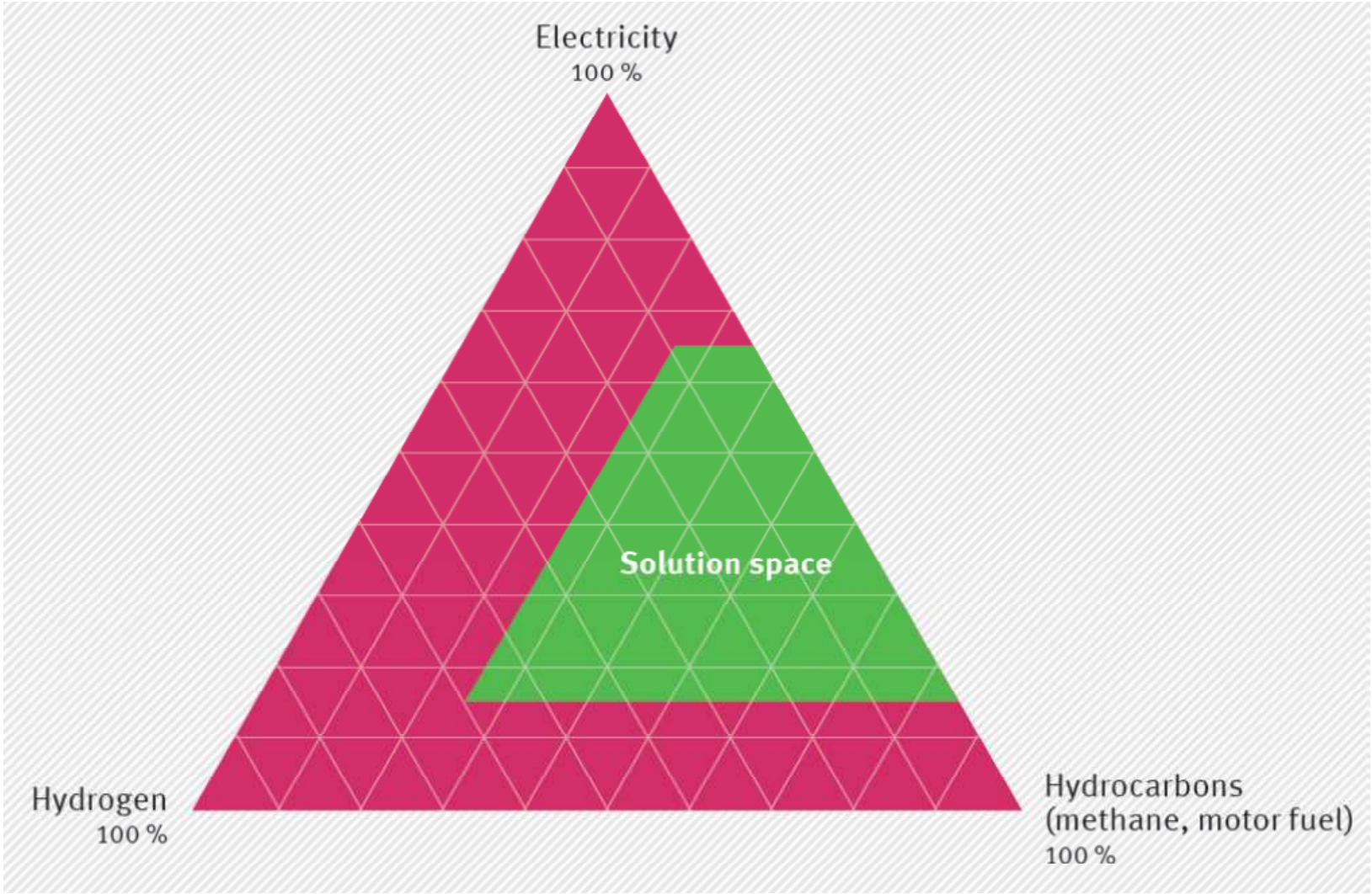
Generation → Electrolysis (H_2) → Methanation (CH_4) → Reconversion

η = 1 x 0,7 x 0,8 x 0,59 = 33%

Energy flow in UBA scenario for 2050 (qualitative)



Solution space for energy carriers in the UBA scenario



Conclusions from the UBA 2050 scenario

- A GHG-neutral energy supply is technically feasible.
- In the long run the final energy demand for electricity cannot be lowered substantially but will stabilise at today‘s level.
- If saving potentials are consistently exploited and efficiency is increased across sectors, final energy consumption can be halved.
- Sector coupling facilitates a substitution strategy for fossil energy carriers in all sectors in the long term.
- Conversion of renewable electricity into chemical energy sources (power to gas/liquid) is the key technology for sector coupling in the long run, not just to ensure a stable supply of electricity, but mainly to supply industry with fuels and chemicals and the transport sector with fuel.
- Hydrogen should play the key role as a final energy source.

Outlook: GHG Neutrality and Resource Efficiency

- In an ongoing study (publ. in 2017) we examine the link between GHG neutrality and resource demand.
- After 2050 target scenario we look at viable transformation paths towards a GHG neutral (-95%) and resource efficient (-80%) future for Germany.
- Deduction of possible transformation steps for 2030 and 2040 to reach the 2050 targets.
- **Which key measures, technologies, societal developments are necessary at different points in time? → Economic and ecological assessment**
- **Conflicts of goal between emission reductions and resource protection → Optimization approaches**

Final remark

A greenhouse gas neutral society in 2050 is much more than 100 % renewable energy.
It’s a tremendous change.
Therefore we need to foster public acceptance and a conjoint, well-coordinated collaboration throughout Europe.

Thank you for your attention

Benno Hain
benno.hain@uba.de

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