



FEDERAL FOREIGN OFFICE

The *ENERGIEWENDE* –

Achieving Greenhouse gas neutrality – the long and winding road

University of Alberta

Edmonton

21 November 2019

12.00- 12.45 (Video lecture + live stream))

Dr. Harry Lehmann

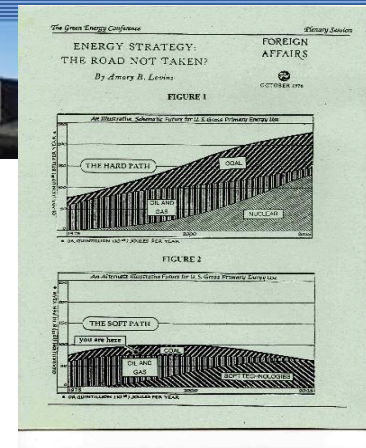
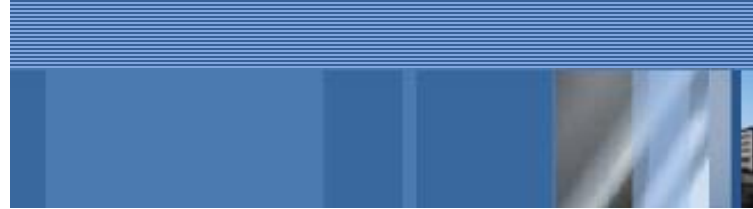
General Director - "Environmental Planning and Sustainability Strategies"

Federal Environment Agency of Germany (Umweltbundesamt - UBA)

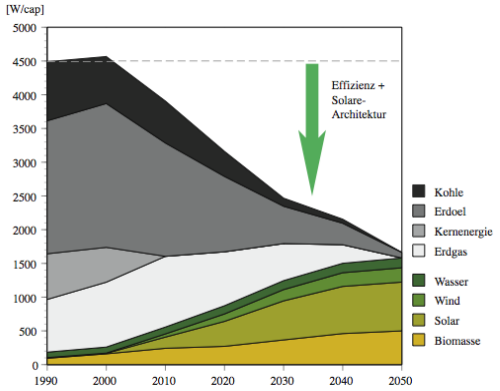


AGENDA

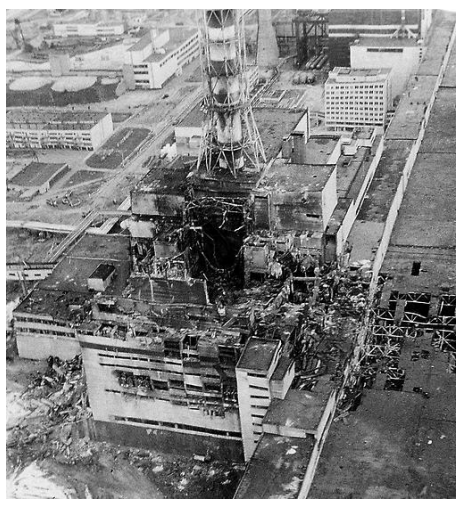
- **History of the energy transition**
- **Status of the energy transition (Energiewende)**
- **Future of the energy transition - Challenges and next steps**



A very short History of the Energiewende



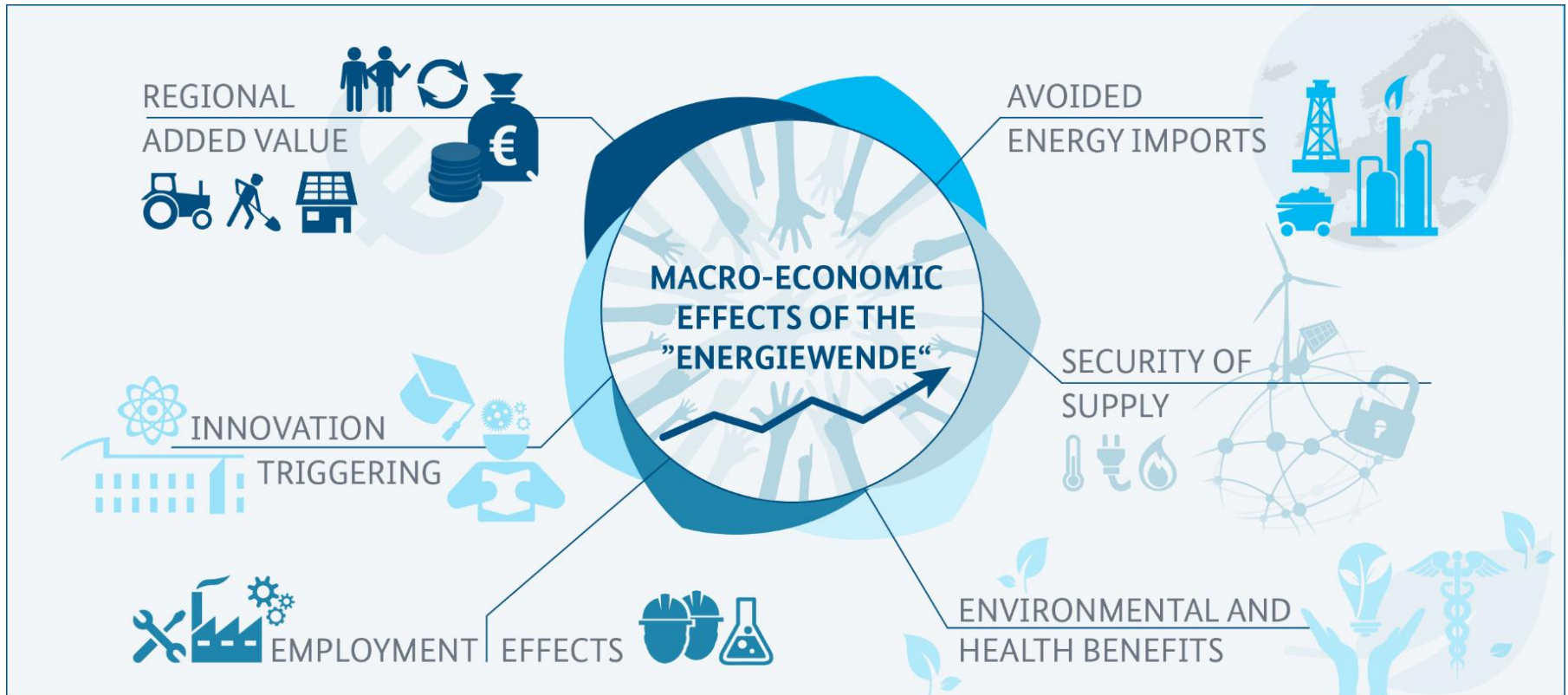
- 1973 Oil Embargo
- 1975... Building Codes and REN Institutions
- 1979 Harrisburg
- 1980 Energiewende
- 1986 Chernobyl Disaster
- 1990 Electricity Feed-In Act
- 1992 Rio-Conference → UNFCC 2°C target
- 2000 First decision to phase out nuclear power



Source: H.Lehmann



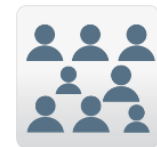
Historical Hopes + Benefits of the Energiewende





What is the energy transition ?

- ▶ The Energiewende is a **technological shift** away from fossil and nuclear energy towards renewables and energy efficiency.
- ▶ The Energiewende is a **fundamental transformation** of the energy system and **re-alignment of energy policy**.
- ▶ The Energiewende is an inter-generational **long-term process** with a time horizon **until 2050** and beyond.
- ▶ The Energiewende is a **public discourse** in society about the future of energy supply.



The Energiewende is Germany's long-term energy and climate strategy.



Reasons for the energy transition

- ▶ Reduce dependency on energy imports
- ▶ Reduce carbon emissions and reach climate protection targets
- ▶ Develop of new and innovative technologies
- ▶ Create new sources of growth and employment
- ▶ Enable nuclear and coal phase-out
- ▶ Demonstrate that energy supply can be both sustainable and economically successful



Climate protection is a strong driver for the Energiewende complemented by strong economic and social drivers for change.



Targets of the energy transition until 2050



		2018	2020	2030	2040	2050
Climate	% greenhouse gas reduction (vs. 1990)	-30.8 %	-40 %	-55%	-70%	-80-95%
Renewable energy	% gross final energy consumption	16.9 %	18%	30%	45%	60%
	% gross electricity consumption	38.2 %	Min 35%	Min 50%	Min. 65%	Min 80%
	Share in heat consumption	13.9 %	14%			
	Share in Transport sector	5.6 %	10% (EU)			
Energy efficiency	% primary energy consumption (vs. 2008)	-11.4 %	-20%			-50%
	Final energy productivity (2008-2017)	1.1% p.a *	2.1% per year (2008-2050)			
	Gross electricity consumption (vs. 2008)	-3.3 %*	-10%			-25%
	Primary energy demand (buildings) (2008)	-18.3 %*				- 80 %
	Heat consumption (buildings) (vs. 2008)	-6.9%*	-20%			
Transport	Final energy consumption in transport sector (vs. 2005)	+6.5%*	-10%			-40%
	Number of Electric vehicles (1/2018) (hybrid cars)	83.175 (341.411)	(1 million) 2022	(6 million)		

The Energiewende is Germany's long-term energy and climate strategy.

* = 2017

Sources: BMWi 2019, UBA 2019, AGEE-Stat 2019, BMU 2018, KBA 2019



Targets of the energy transition until 2050



		2018	2020	2030	2040	2050
Climate	% greenhouse gas reduction (vs. 1990)	-30.8 %	-40 %	-55%	-70%	-100%
	% gross final energy consumption	16.9 %	18%	30%	45%	60%
Renewable energy	% gross electricity consumption	38.2 %	Min 35%	Min 65%	Min. 65%	Min 80%
	Share in heat consumption	13.9 %	14%			
	Share in Transport sector	5.6 %	10% (EU)			
Energy efficiency	% primary energy consumption (vs. 2008)	-11.4 %	-20%			-50%
	Final energy productivity (2008-2017)	1.1% p.a *	2.1% per year (2008-2050)			
	Gross electricity consumption (vs. 2008)	-3.3 %*	-10%			-25%
	Primary energy demand (buildings) (2008)	-18.3 %*				- 80 %
	Heat consumption (buildings) (vs. 2008)	-6.9%*	-20%			
Transport	Final energy consumption in transport sector (vs. 2005)	+6.5%*	-10%			-40%
	Number of Electric vehicles (1/2018) (hybrid cars)	83.175 (341.411)	(1 million) 2022	(6 million)		

The Energiewende is Germany's long-term energy and climate strategy.

* = 2017

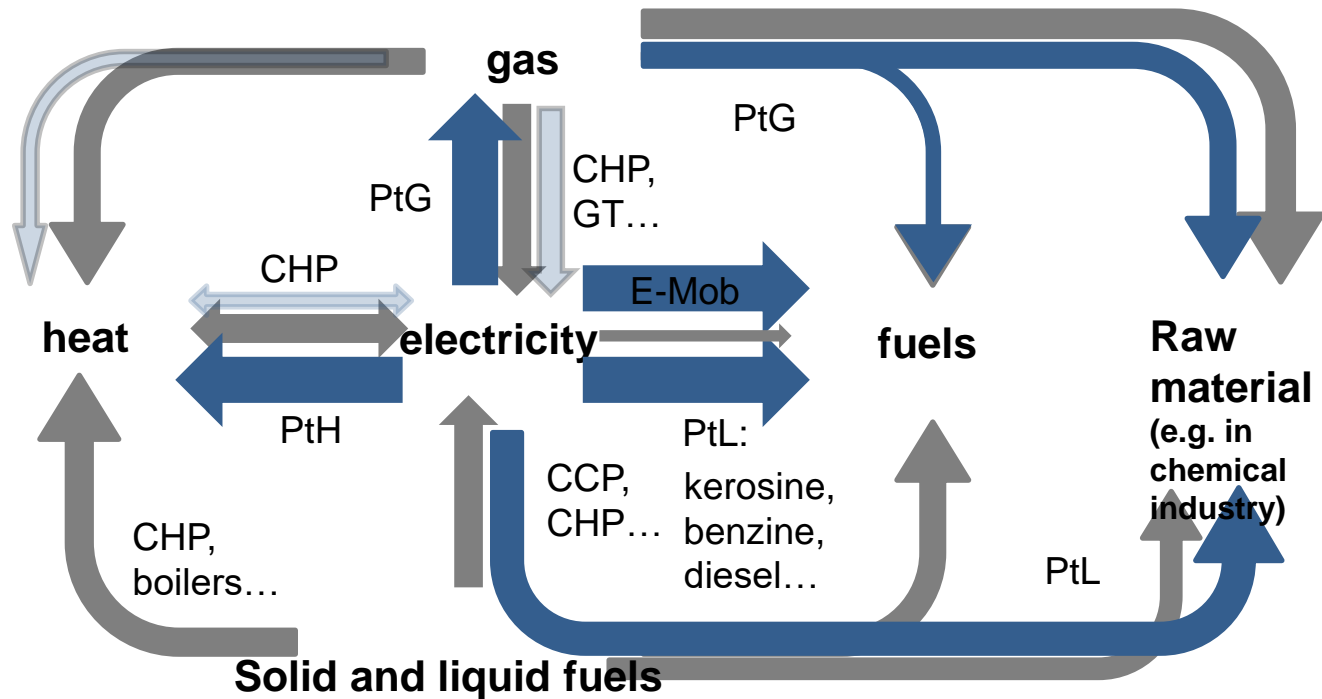
Sources: BMWi 2019, UBA 2019, AGEE-Stat 2019, BMU 2018, KBA 2019



What is the energy transition ?

Sustainable energy supply – no CCS, no nuclear energy, no use of energy crops for energy generation

Fast growing share of renewable energy: 100% and more

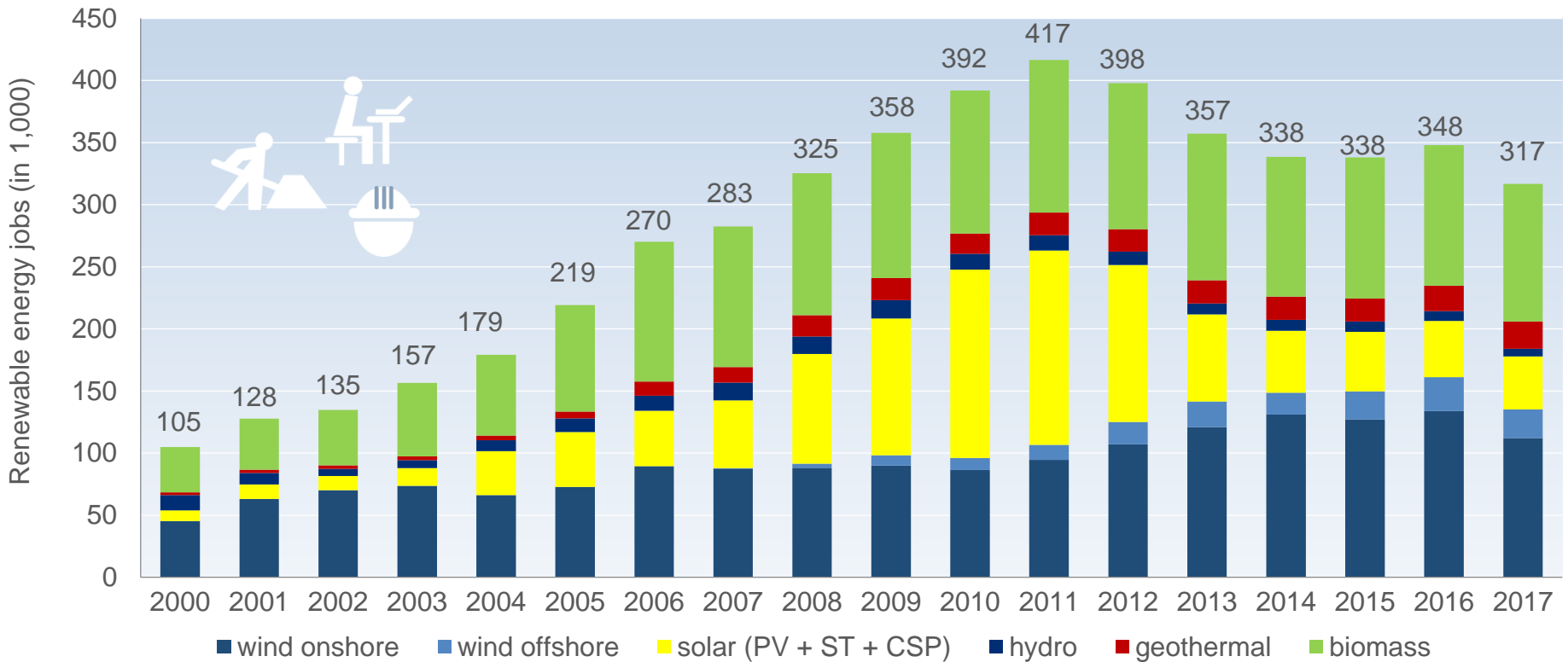




Benefits of the energy transition – job creation



Gross job creation in the German renewable energy sector



The renewables sector has positive employment effects in Germany.

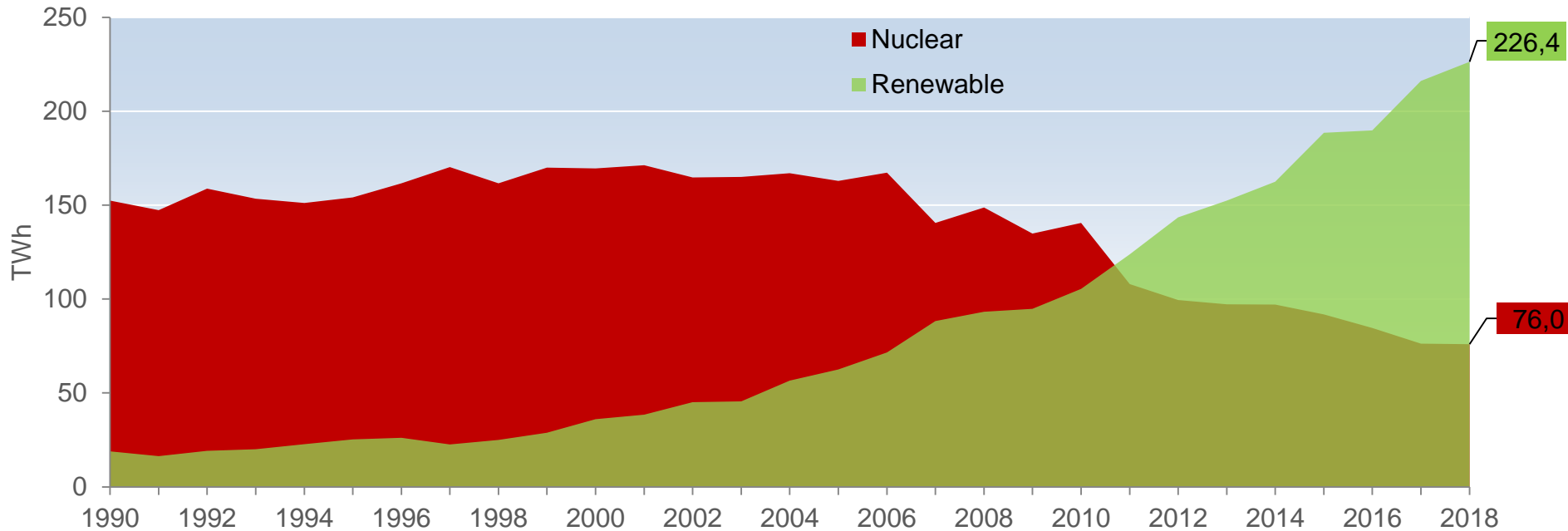
Source: BMWi 2019, DIW and GWS 2019



Renewable and nuclear power generation (in TWh)



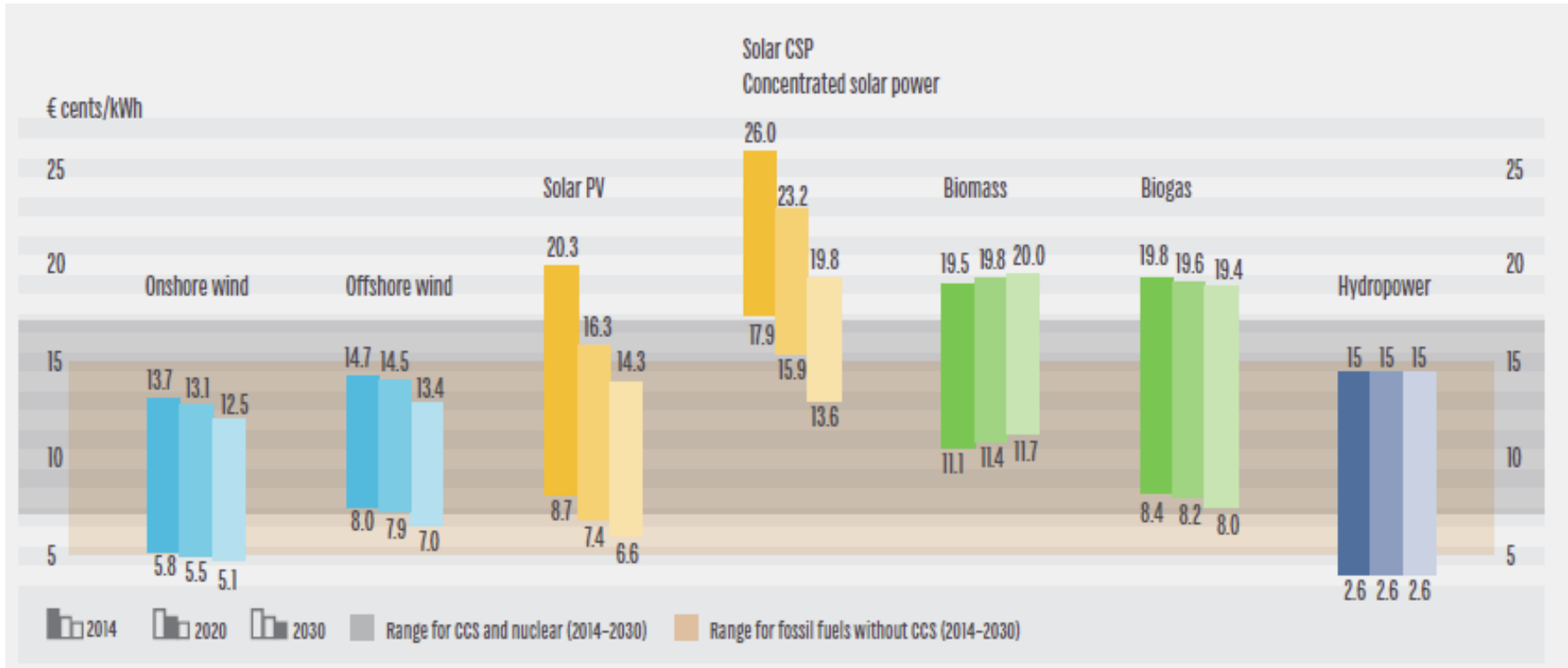
Renewable and nuclear power generation in TWh



Nuclear power generation will decline to zero until end of 2022. Renewable electricity is constantly rising.



RES levelized cost of electricity in Europe 2014, 2020, 2030



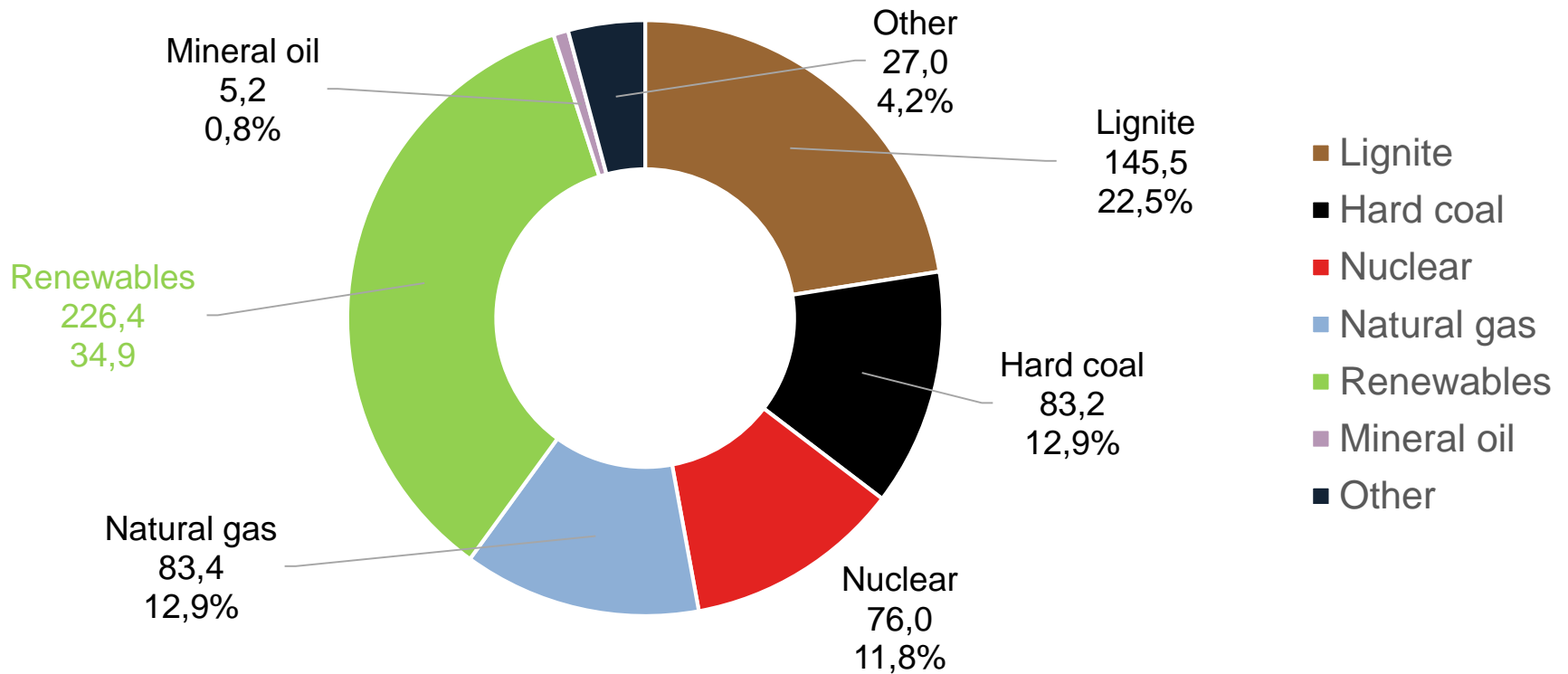
Renewables are increasingly competitive with conventional power plants.



Status of the energy transition – Gross electricity production in Germany 2018



Gross electricity production in 2018 (646,8 TWh)

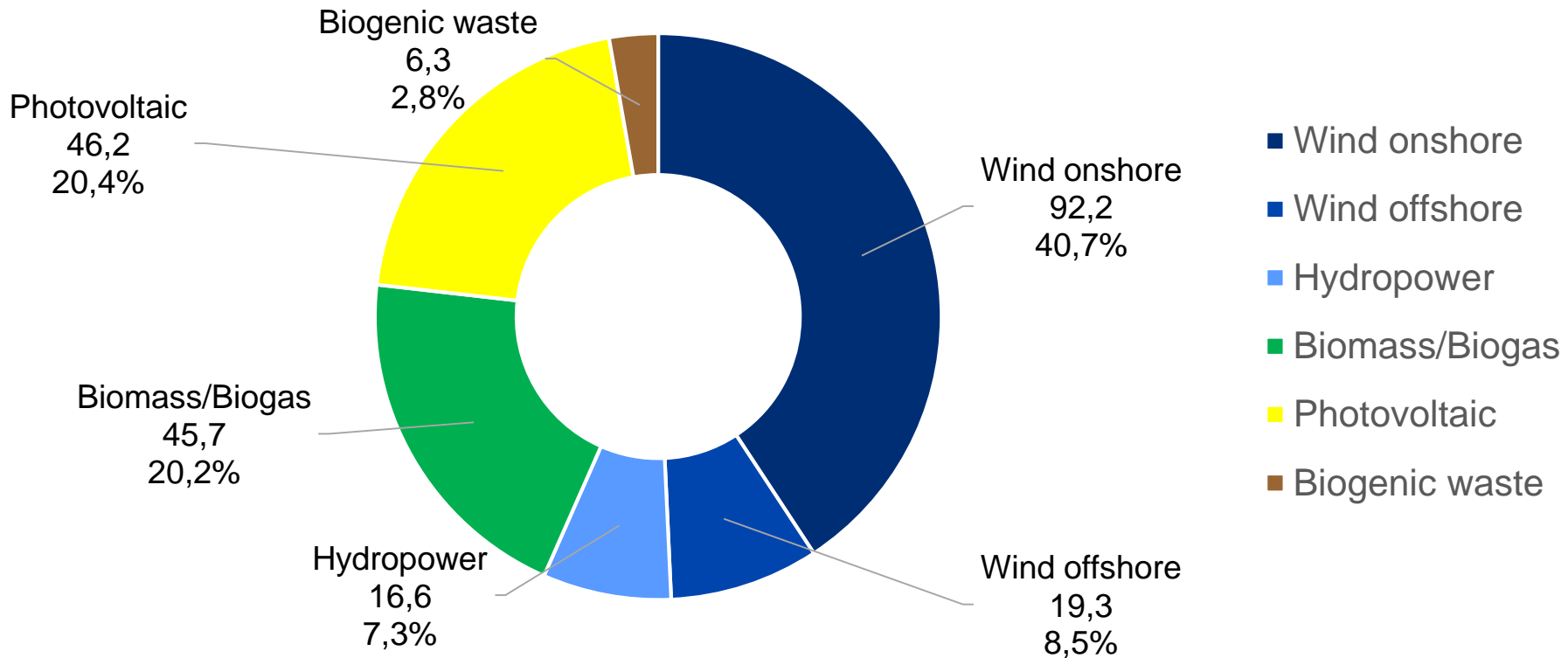


Renewables have become the biggest source of power generation.



Status of the energy transition – Renewable electricity production in Germany 2018

Renewable electricity production 2018 (226,4 TWh)

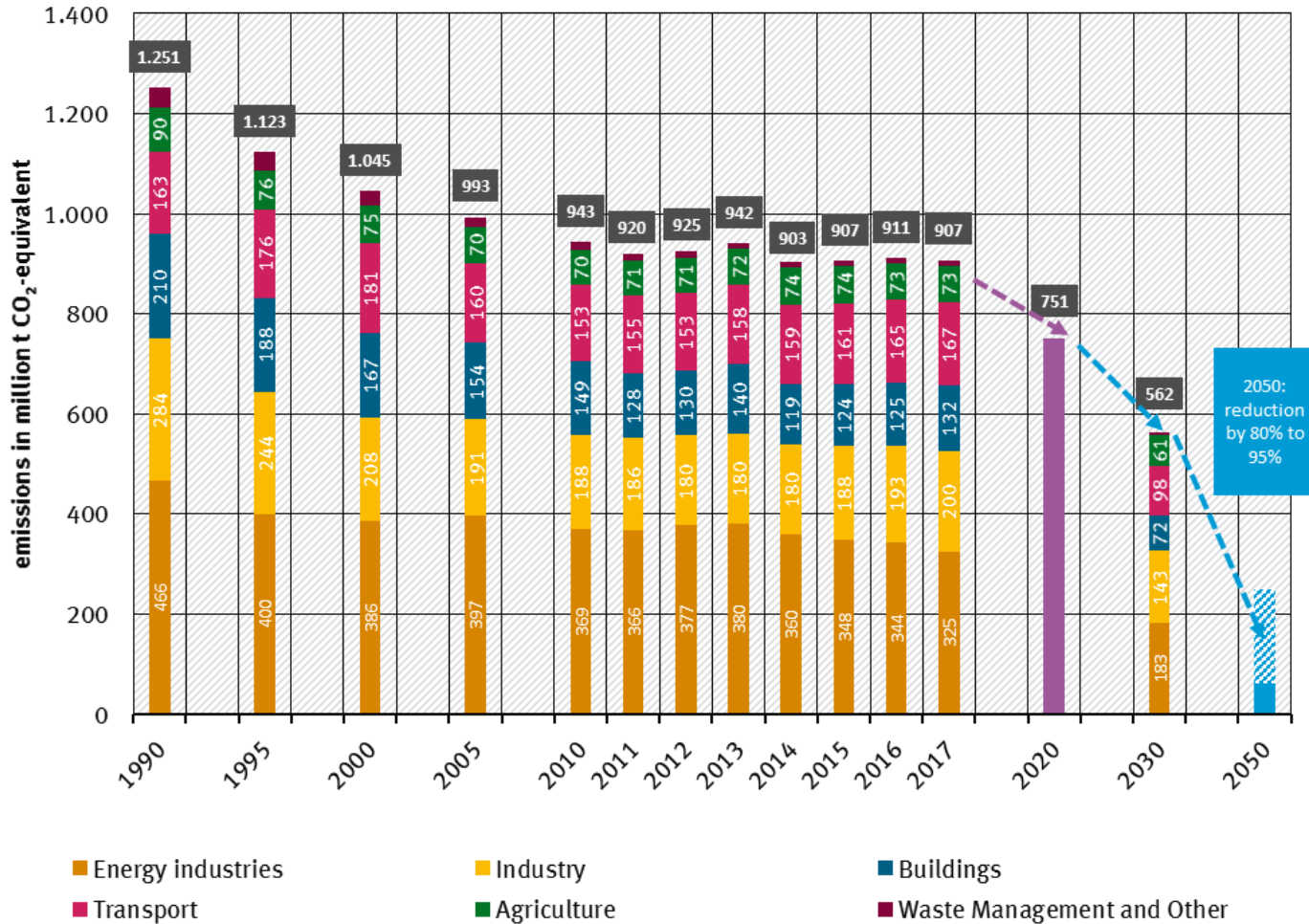


Wind and PV are the most important sources of renewable electricity generation in Germany.

Source: AGEB 2019



Development of emissions – Does Germany miss its targets?



Source: UBA 2018



Future - Planned next steps of the energy transition

- ▶ **Coal** phase-out (decarbonization of energy sector)
- ▶ **Climate Change Act** (2019)
- ▶ **Carbon pricing** (CO₂ tax or emission trading)
- ▶ Energiewende in **heat sector** (buildings)
- ▶ Energiewende in **transport sector**
- ▶ **Sector coupling** (power, heat, transport)
- ▶ **Electric mobility** and charging infrastructure
- ▶ **Grid integration** of growing shares of renewables
- ▶ **Grid** modernization / expansion
- ▶ **Cross-border** interconnections

The Energiewende is a long term process with some challenges ahead.



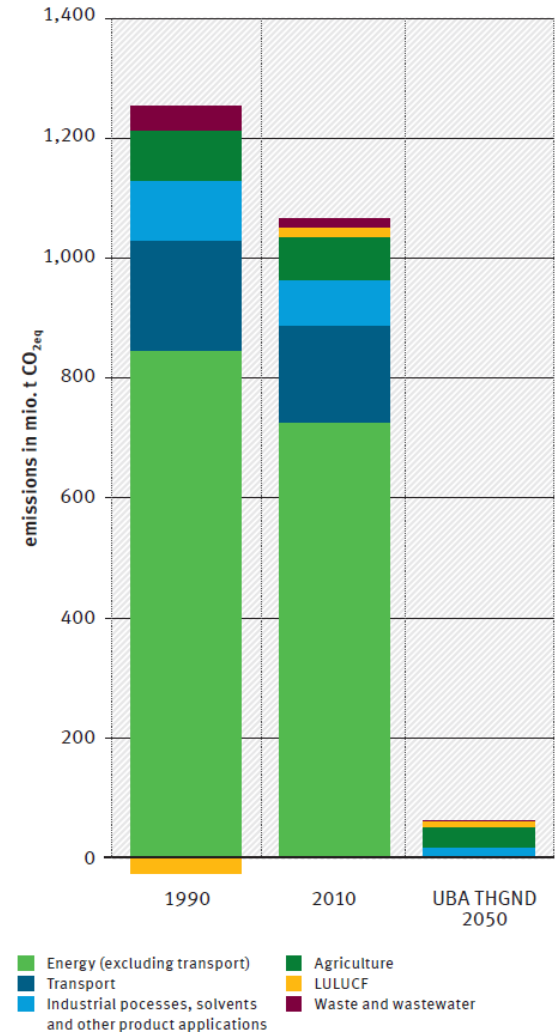
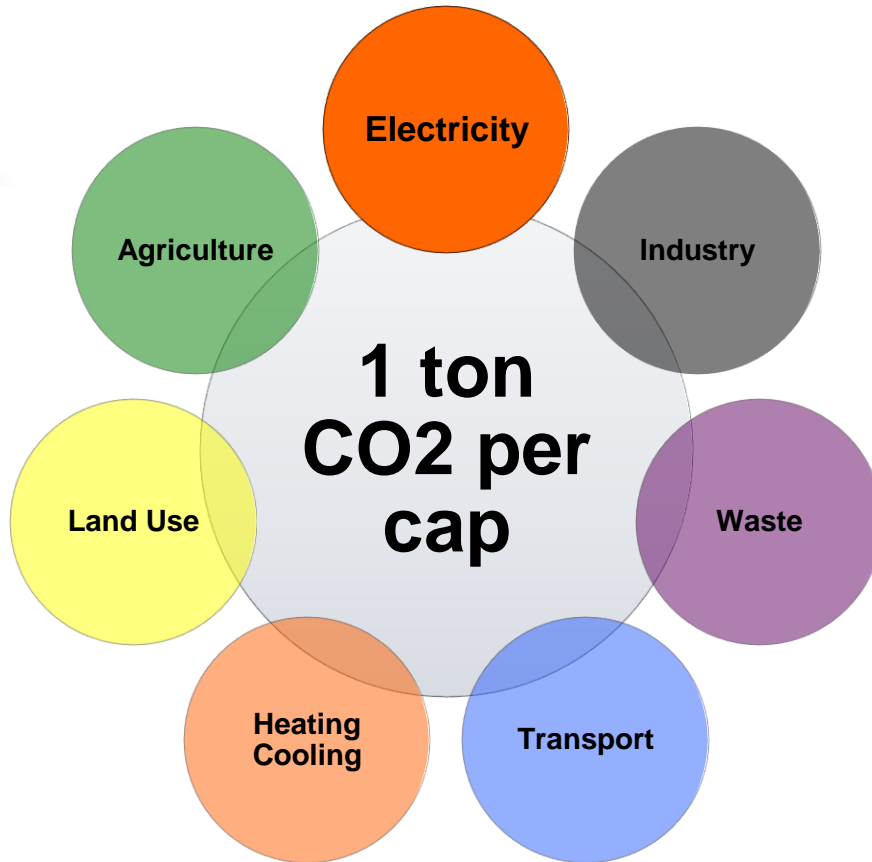
Future – **Going to ZERO**

- ▶ **Coal** phase-out (decarbonization of energy sector)
- ▶ **Climate Change Act** (2019)
- ▶ **Carbon pricing** (CO₂ tax or emission trading)
- ▶ Energiewende in **heat sector** (buildings)
- ▶ Energiewende in **transport sector**
- ▶ **Sector coupling** (power, heat, transport)
- ▶ **Electric mobility** and charging infrastructure
- ▶ **Grid integration** of growing shares of renewables
- ▶ **Grid** modernization / expansion
- ▶ **Cross-border** interconnections

The Energiewende is a long term process with some challenges ahead.



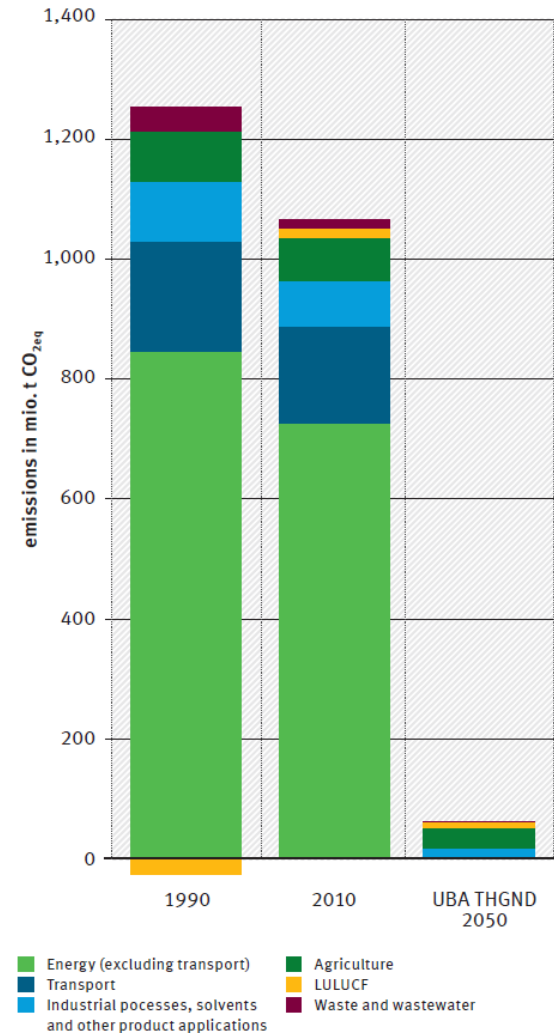
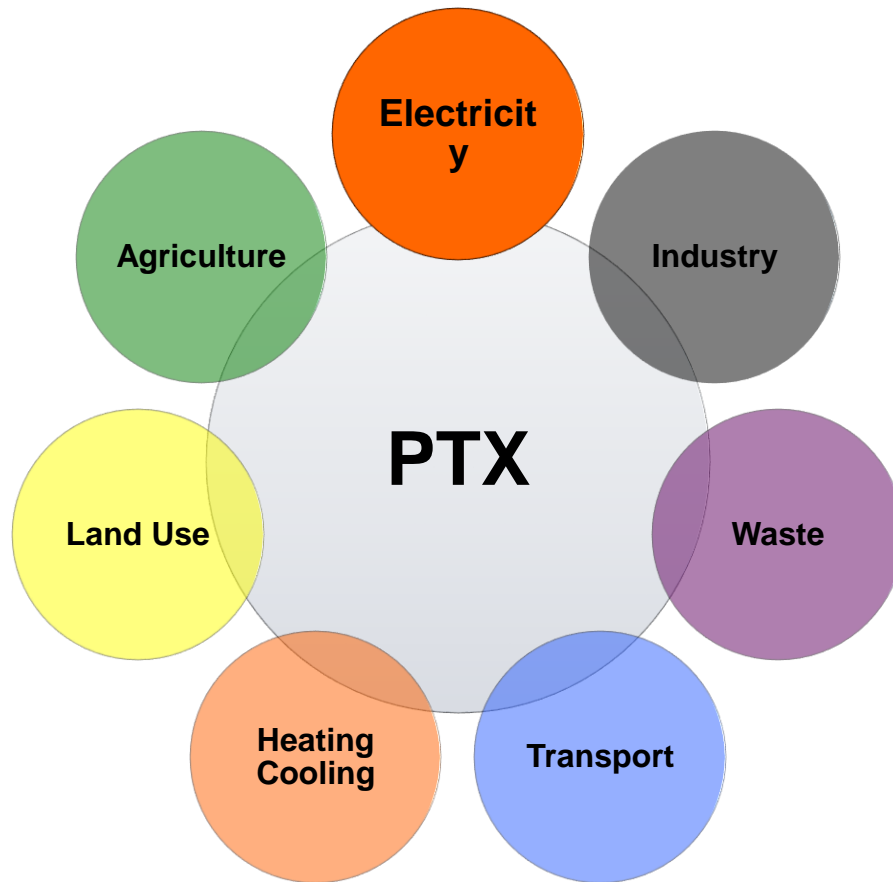
CO2 per capita



Source: Harry Lehmann (UBA)



Power to X (PTX)



Source: Harry Lehmann (UBA)

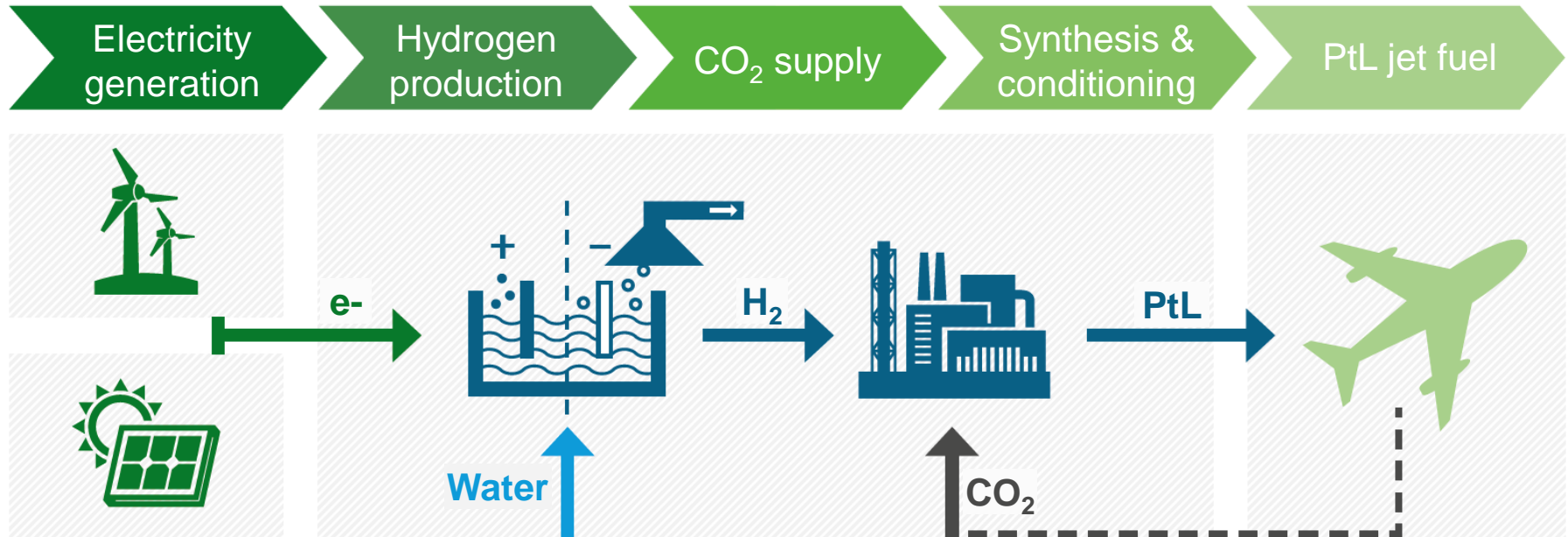


POWER TO





What are „Power-to-Liquids“?

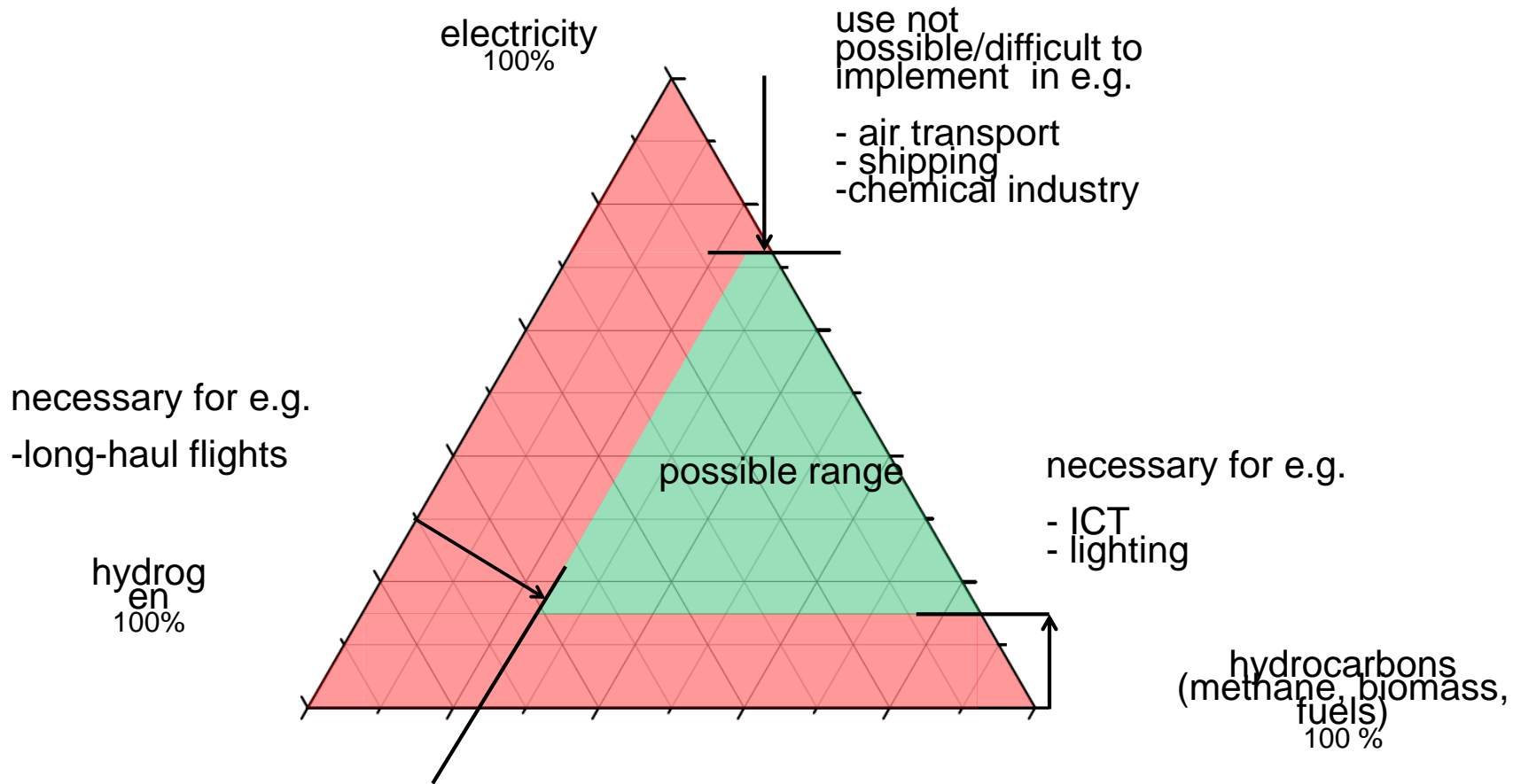


Power-to-Liquids – Potentials and Perspectives for the Future Supply of Renewable Aviation Fuel

Source: LBST/BHL, 2016



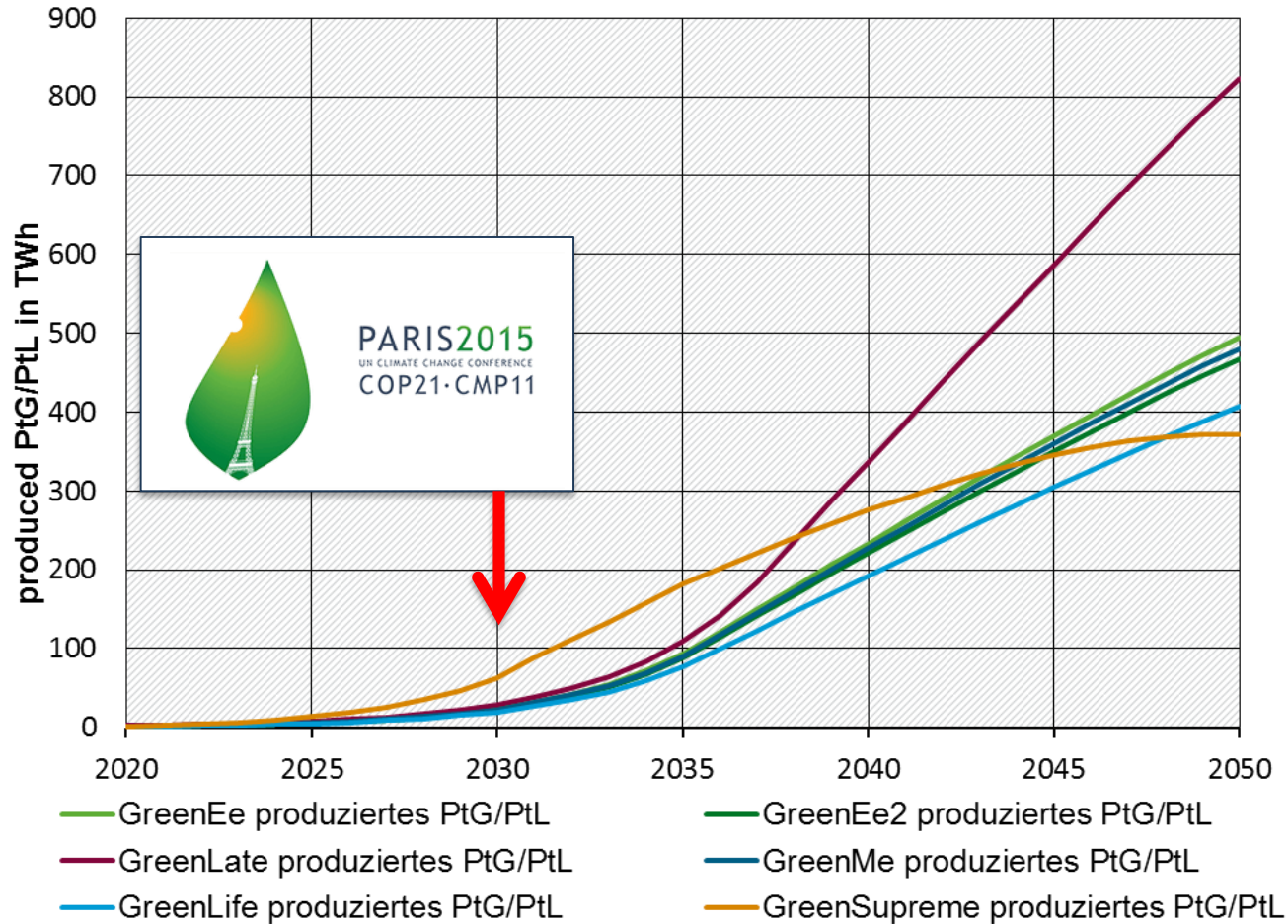
Possible range of GHG-neutral final energy sources



A renewable system needs hydrocarbons.



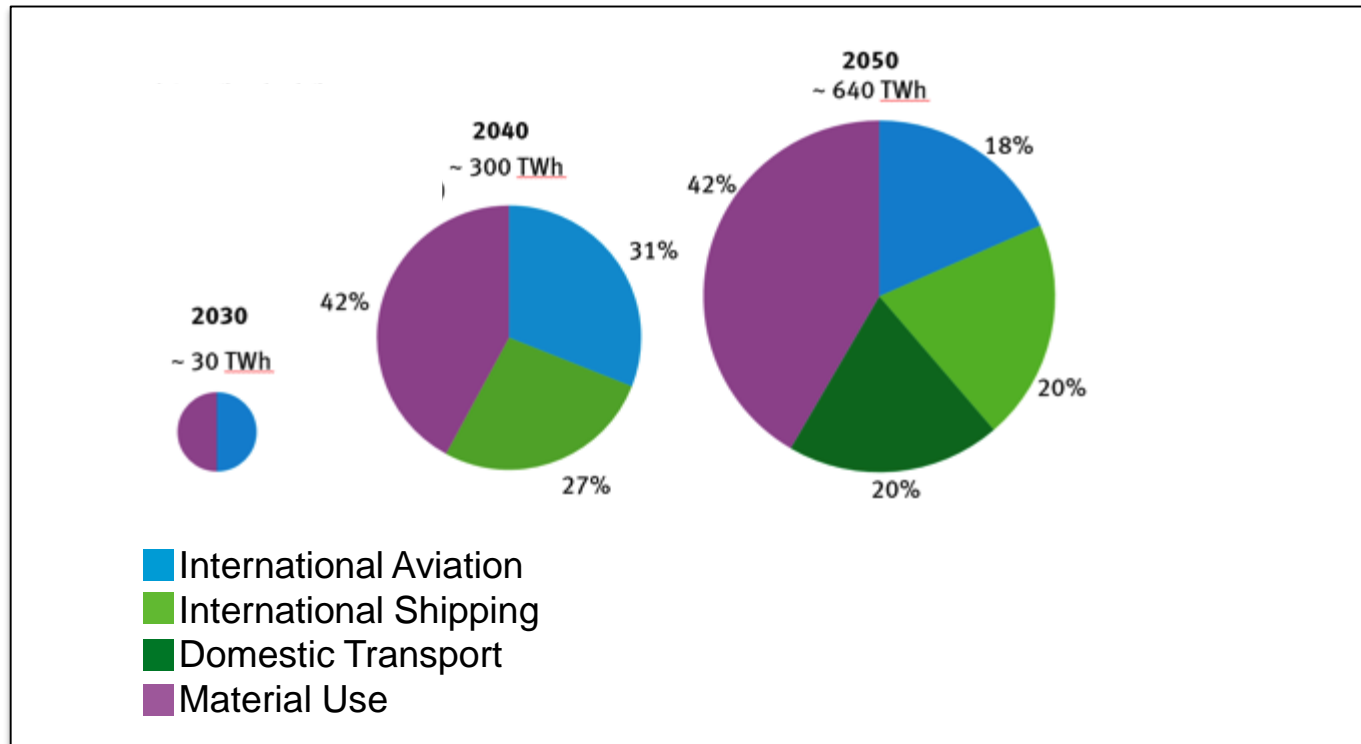
Necessary Imports for Germany



Source: Harry Lehmann (UBA)

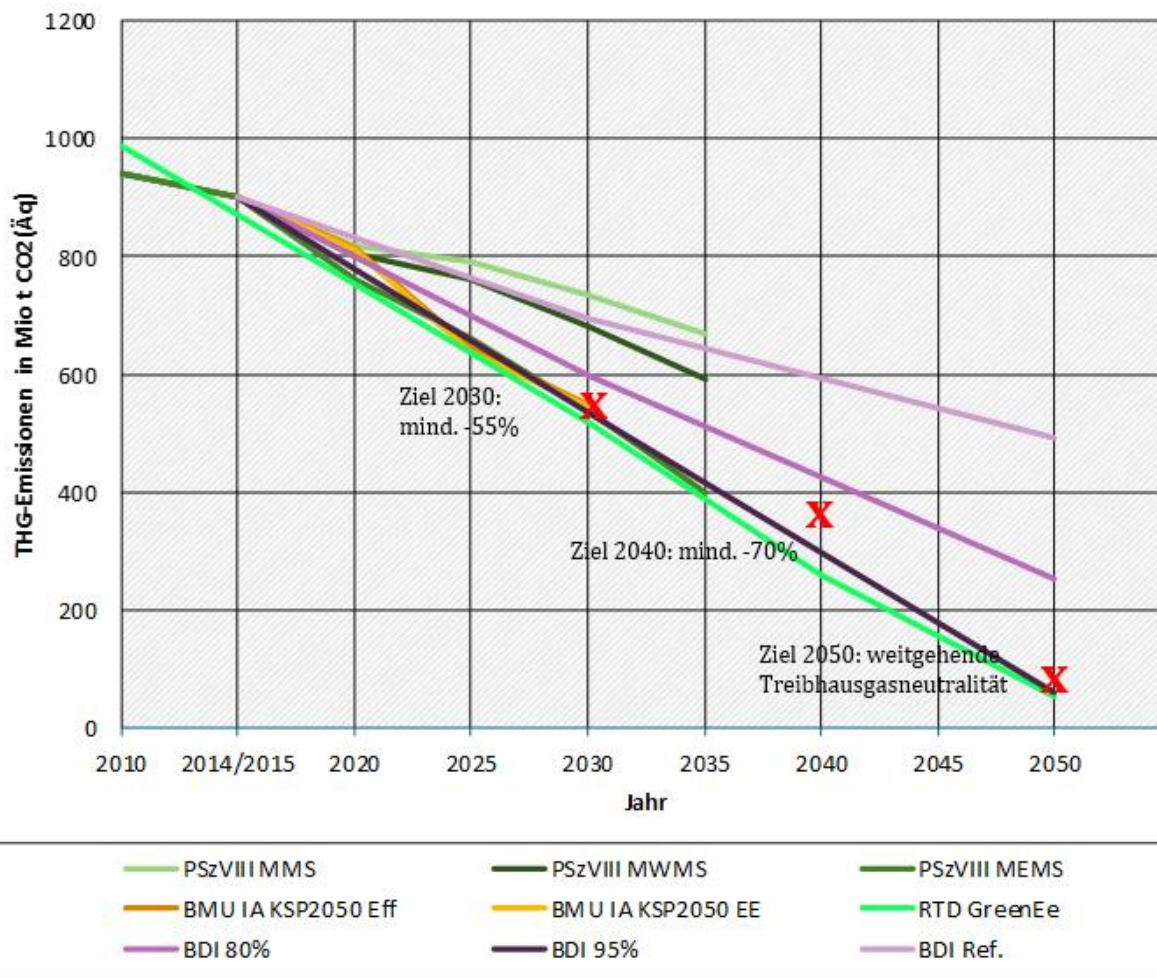


Necessary Imports for Germany





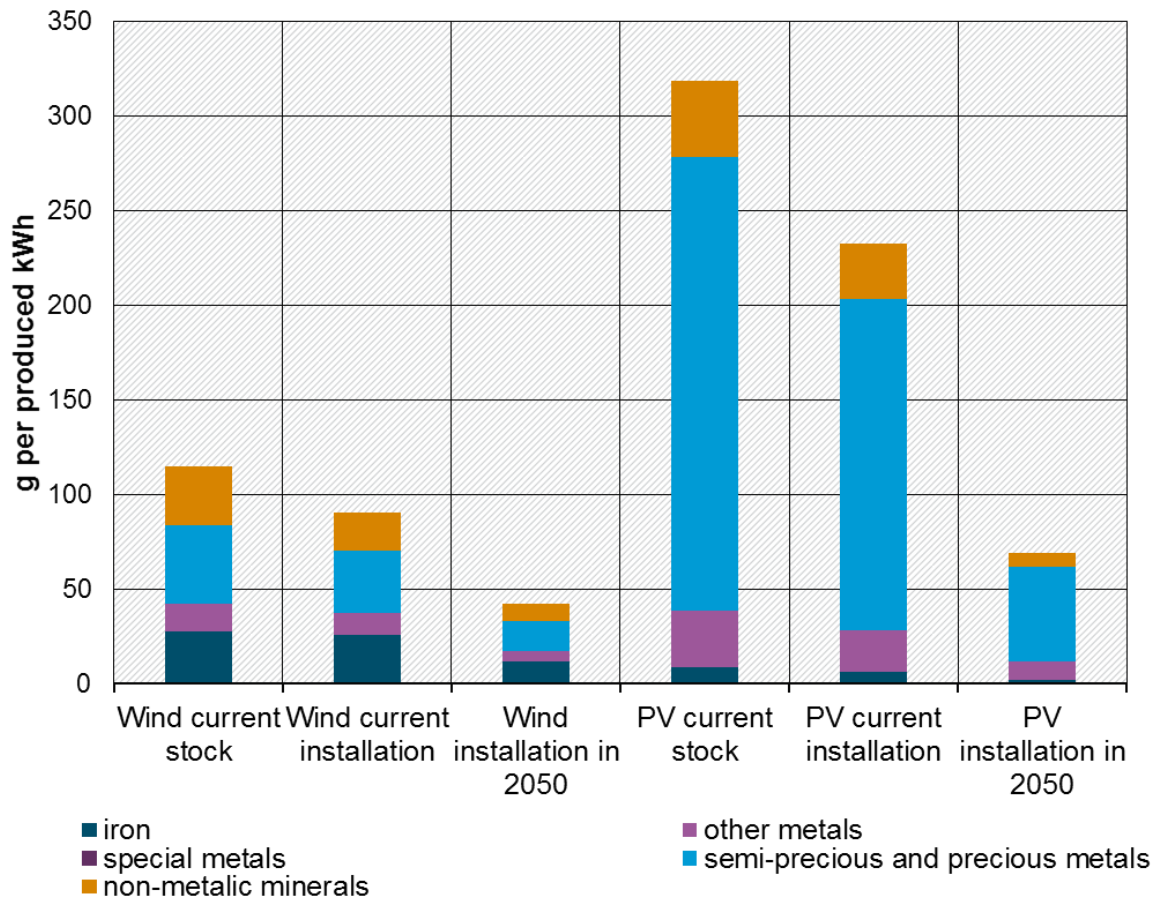
Comparison of Climate Protection Scenarios UBA / BMU / BDI



Source: Bundesregierung 2017, UBA 2018 (Projektionsbericht)



Greenhouse gas emissions and raw material use



Source: Wiesen et al (2017). Analyse des Rohstoffaufwands der Energieinfrastruktur in Deutschland. und RESCUE Study - - Resource-Efficient Pathways towards Greenhouse-Gas-Neutrality



0% ... 2050



SUSTAINABLE DEVELOPMENT GOALS
17 GOALS TO TRANSFORM OUR WORLD

