



Universität Stuttgart

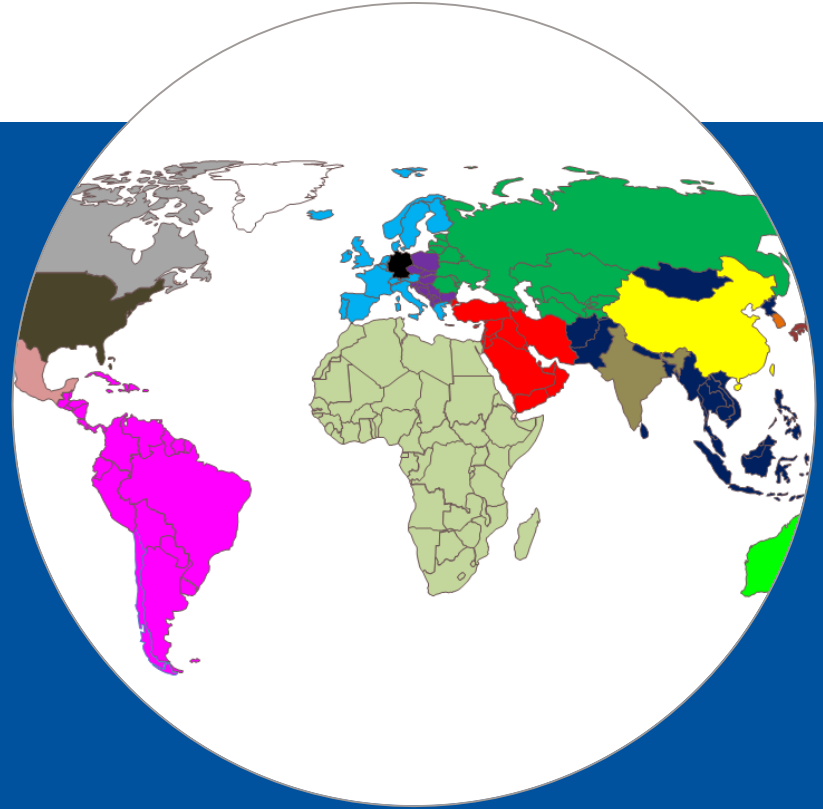
IER Institut für Energiewirtschaft und
Rationelle Energieanwendungen

Tackling the 1.5 °C target and the impact on the German energy system

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ETSAP WS

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Motivation

- The Paris Agreement will in the long term determinate the German GHG reduction target or budget
- Analysis impact and possibilities of Germany and Europe to benefit from cost efficient GHG reduction measures in other world regions.
- Describe in a techno economical way of energy, GHG and resource balance possibilities through the trade with other regions.
- Test the new base year version of TIAM

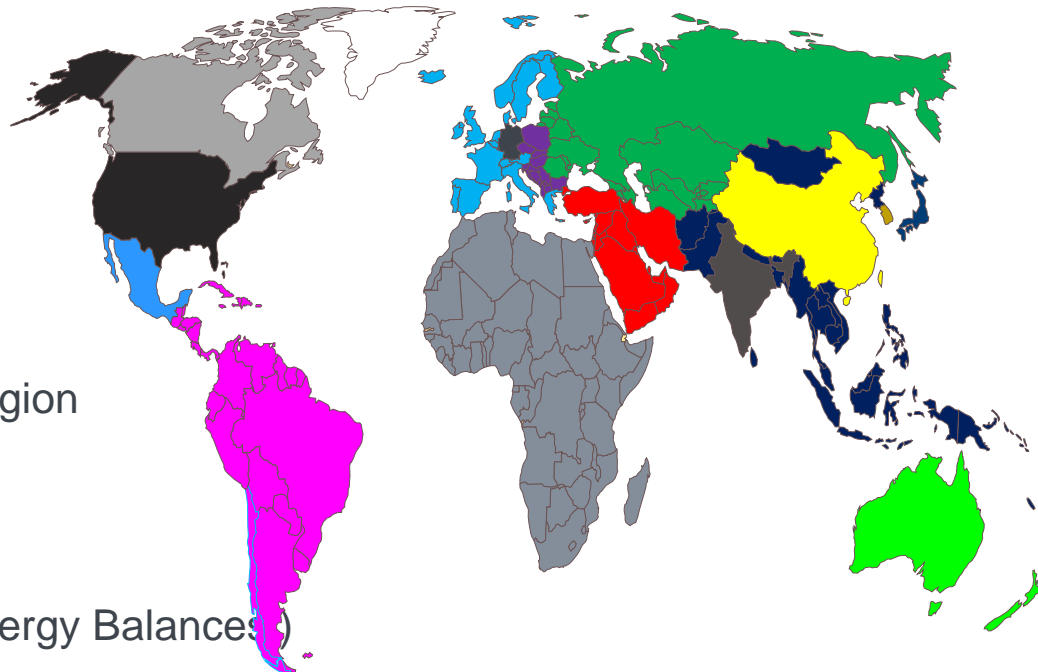
Current discussion related GHG reduction targets in the EU and Germany

Europe	<ul style="list-style-type: none"> Emission reduction targets according to the EU Emissions trading Scheme (ETS) Forerunner Alliance: Introduction of a national minimum CO2 price Member states: <ul style="list-style-type: none"> – Belgium – Denmark – France – Luxembourg – Netherlands – Sweden 																							
	<table border="1"> <thead> <tr> <th>Year</th> <th>2020</th> <th>2025</th> <th>2030</th> <th>2035</th> <th>2040</th> <th>2045</th> <th>2050</th> </tr> </thead> <tbody> <tr> <td>CO₂-Minimum price</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>[€₂₀₁₅ / t CO₂-Equi.]</td> <td>30</td> <td>45</td> <td>60</td> <td>75</td> <td>90</td> <td>105</td> <td>120</td> </tr> </tbody> </table>	Year	2020	2025	2030	2035	2040	2045	2050	CO ₂ -Minimum price								[€ ₂₀₁₅ / t CO ₂ -Equi.]	30	45	60	75	90	105
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[€ ₂₀₁₅ / t CO ₂ -Equi.]	30	45	60	75	90	105	120																	
Germany	<ul style="list-style-type: none"> Klimaschutzplan 2050 (Climate protection plan) with emission reduction targets compared to 1990 ("sector targets") For the transformation sector (public electricity and heat generation, refineries, other transformation), the achievement of the sector target is not a binding requirement. 																							

Sector	Year	2030	2050
Buildings		-65%	-94%
Transport		-40%	-90%
Industry		-49%	-81%
Agriculture		-34%	-89%

TIAM-IER

- Based on ETSAP TIAM
- structure:
 - 16 worldregions
 - up to 42 energy service demands per region
- 2018 / 2019 update:
 - Base year 2005 → 2015 (,IEA World Energy Balances)
 - OPEC status 2019:



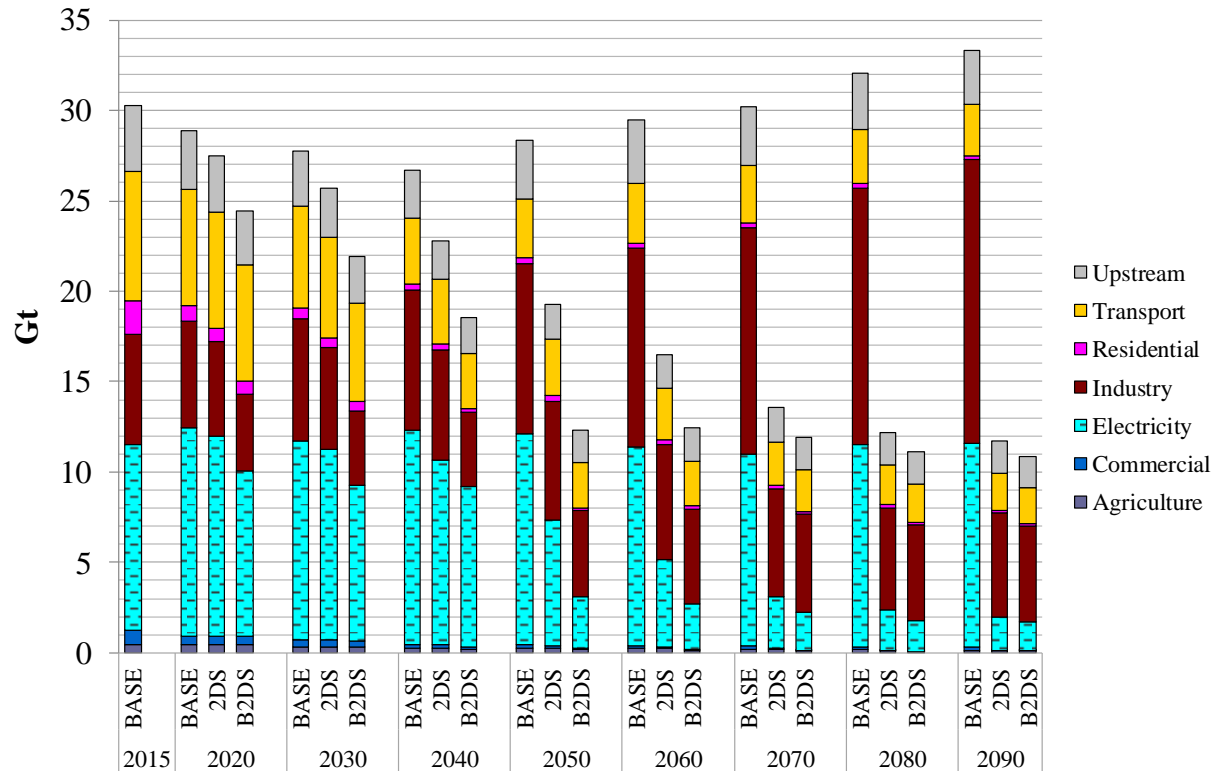
Region	TIAM OPEC-member
AFR	Algeria; Angola; Libya; Nigeria; Gabon; Republic of the Congo; Gabon
CSA	Ecuador, Venezuela
ODA	-
MEA	Iran; Iraq; Kuwait, Saudi Arabia, UAE

- increase of temporal resolution: 6 → 12 timeslices (as an intermediate step)

Scenario definition

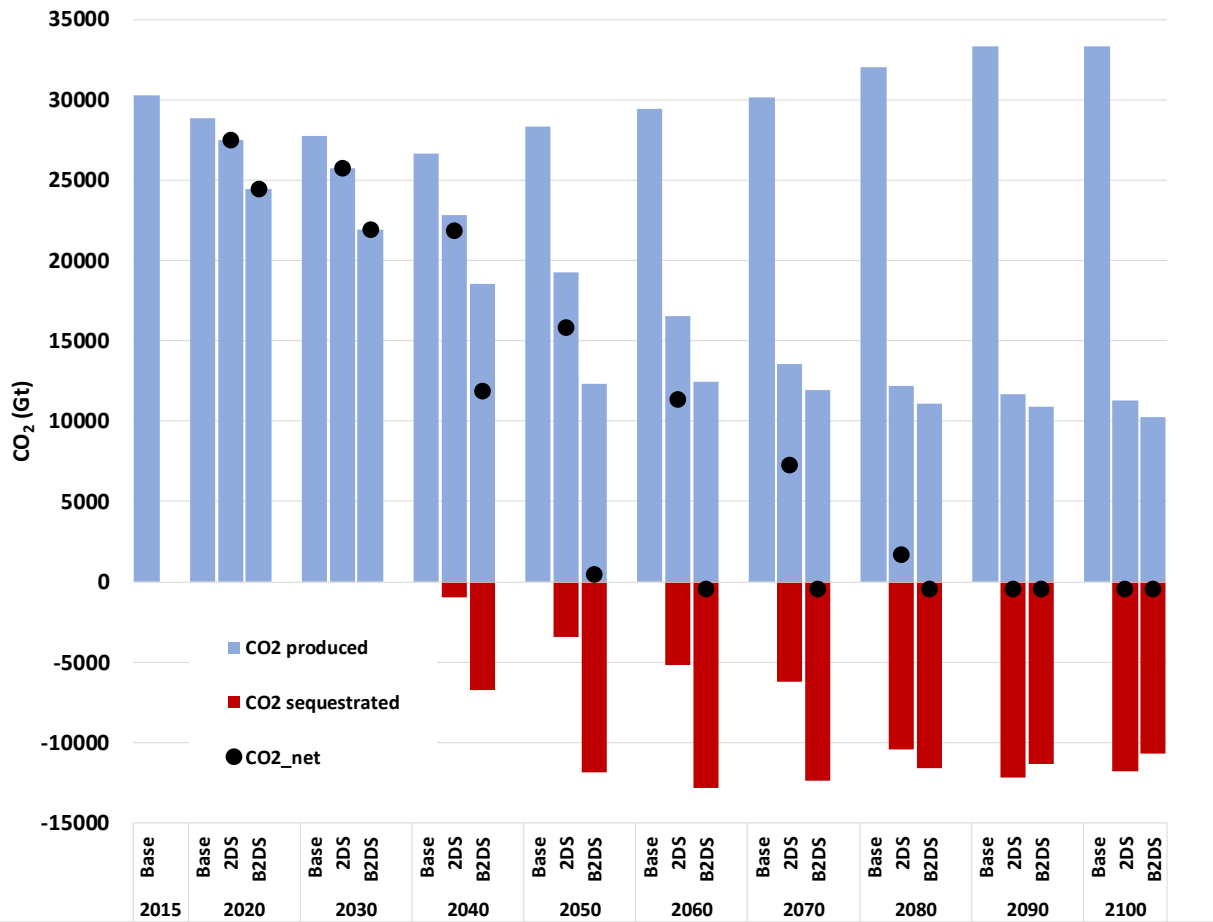
- Base:
 - LO-bounds for renewables (growth rate based on WEO2018)
 - LO-bounds for slow decline (increase in developing countries) of coal fired plants up to 2040
- 2DS:
 - Carbon Budget starting 2020: 1140 Gt
 - No CCS until 2030
 - Bounds for renewables and fossil-decline according to Base
- B2DS:
 - Carbon Budget starting 2020: 600 Gt
 - No CCS until 2030
 - Bounds for renewables and fossil-decline according to Base

Scenario comparison CO2 Emission World



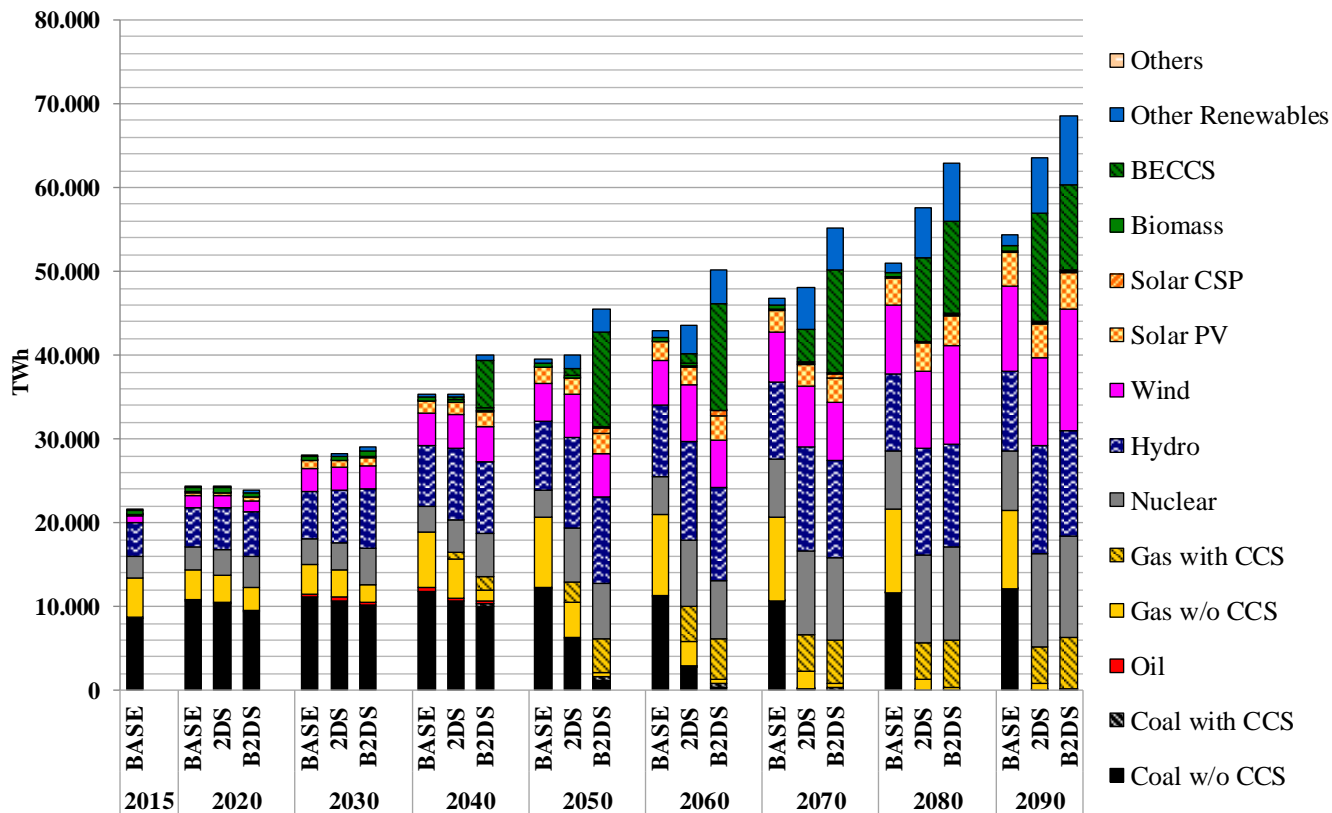
- Till 2100 there will be still CO2 emissions coming from the industry (process emissions)
- The different between the Budget scenarios is in the middle period and not at the end of the century
- It might be still economical to have some emissions for example in the Electricity sector

Scenario comparison net CO2 Emission balance World



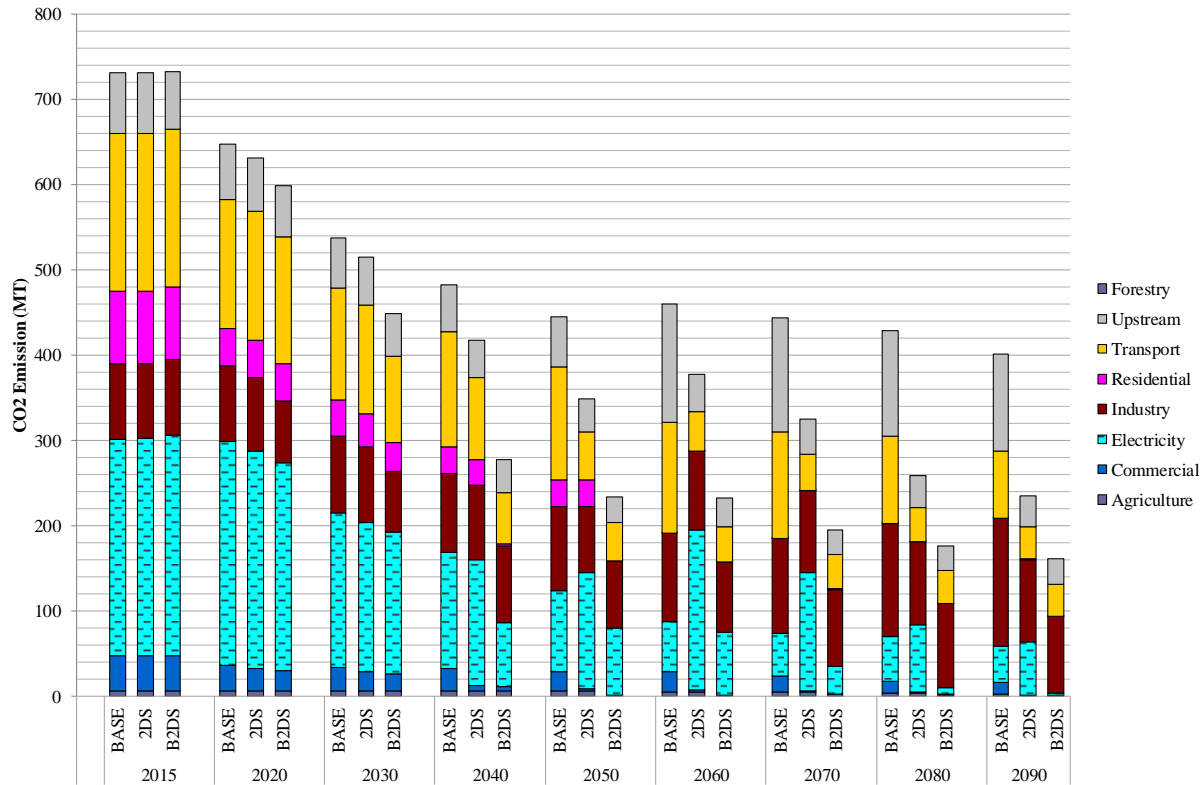
- In the 1.5 °C scenario we already achieve in 2050 net zero emissions.
- This is based on negative emissions from BECCS
- In the long term after 2080 also the 2°C scenario have net zero emissions.

Scenario comparison Electricity generation world



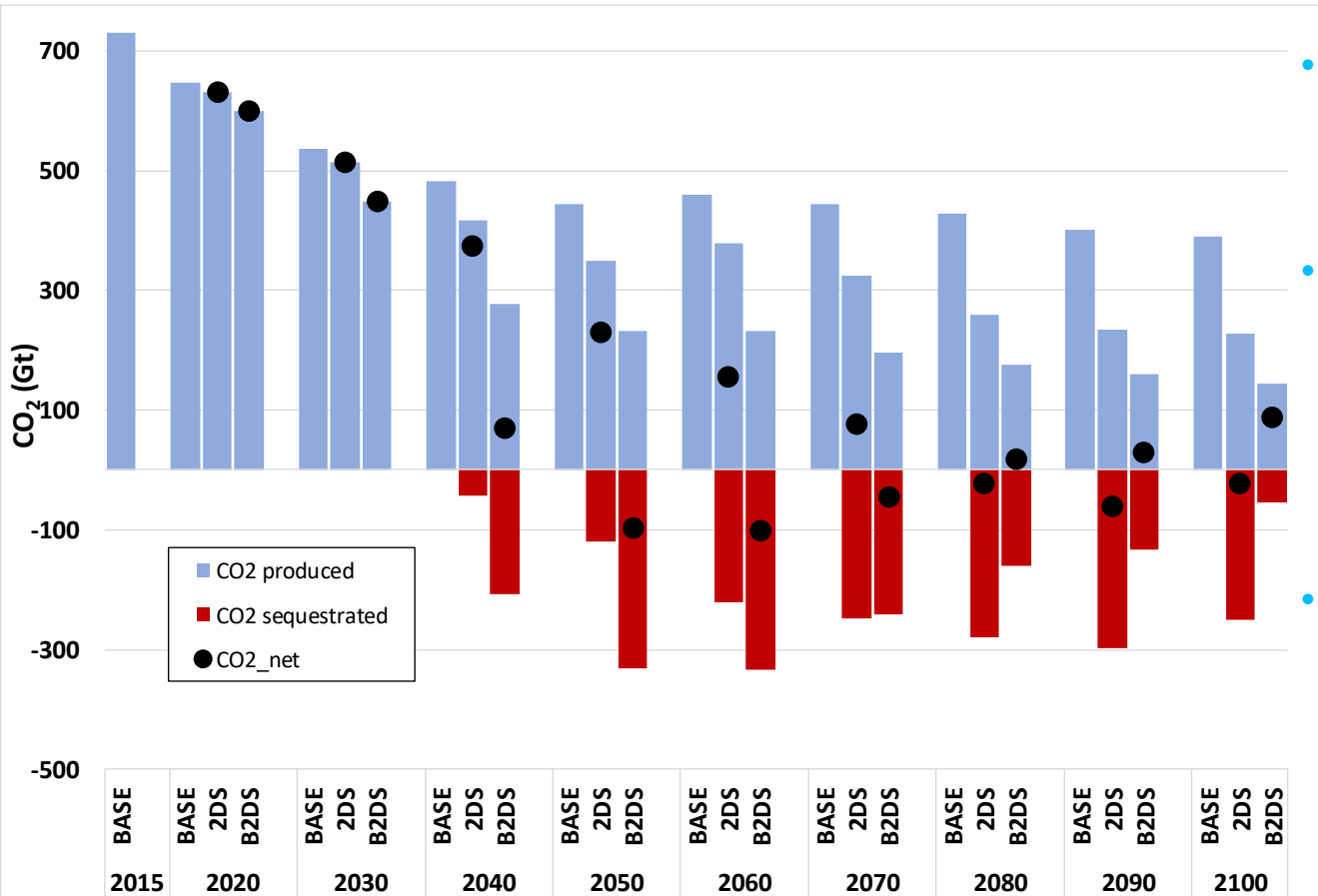
- After 2040 the share of renewable electricity generation is higher than the conventional sources
- At the end of the century 50 % based on VRE sources.
- Nuclear might stay without any other restrictions a role in the electricity generation

Scenario comparison CO2 Emission Germany



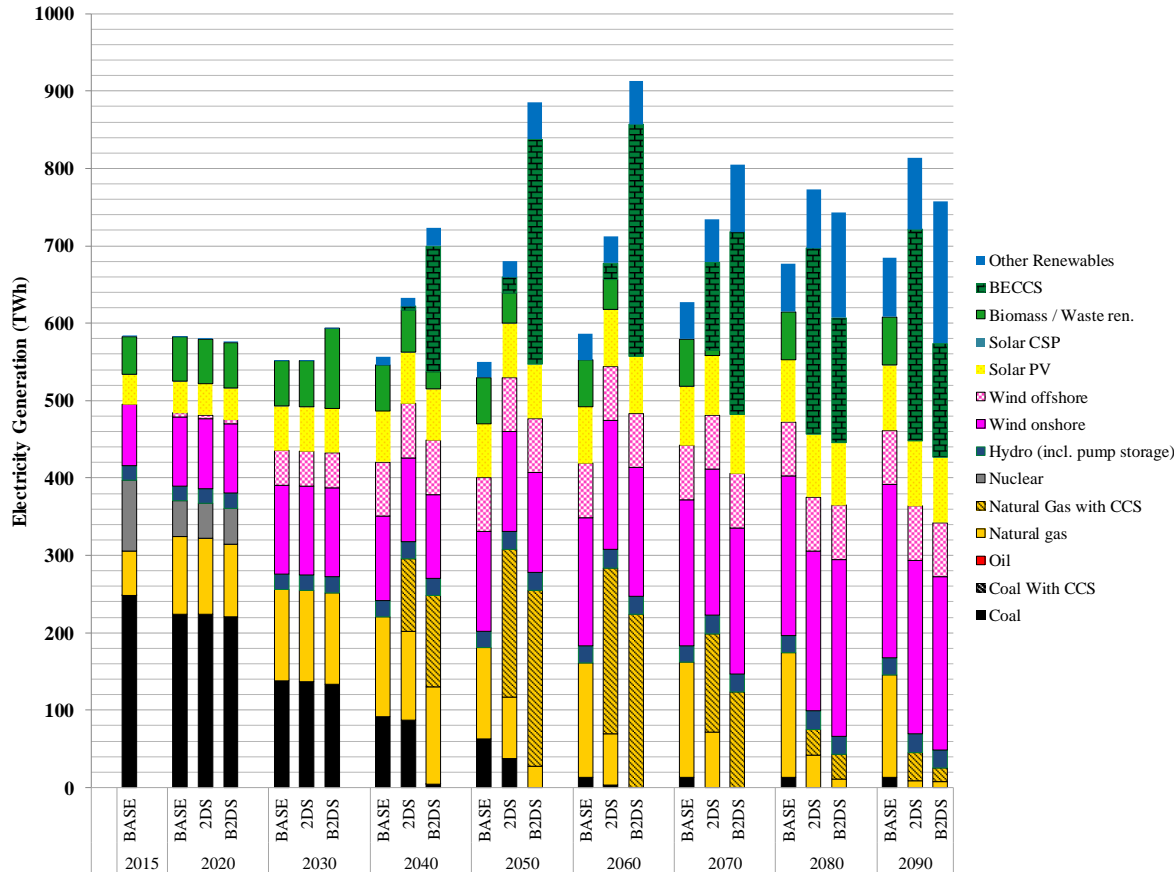
- In the 1.5 °C scenario we have a much faster reduction as in the 2° C.
- In the 1.5 °C target after 2040 the biggest share of the emissions comes from the industry sector.
- Zero emissions will not be achieved but when is Germany carbon neutral?

Scenario comparison net CO₂ Emission balance Germany



- In the 1.5 °C scenario Germany has to achieve in 2050 net negative emissions.
- Due to the assumption related the economic growth and the limited biomass potential end of the century Germany has again some emissions
- In 2°C scenario Germany has more or less a linear reduction till 2080 to achieve net zero emissions.

Scenario comparison Electricity generation Germany



- Without any restrictions related the use of CCS the 90 % renewable target for 2050 will be achieved in the 1.5 °C scenario we already achieve in 2080
- BECCS plays in the 2°C scenario after 2040 an important role.
- Natural gas will be used till end of the century

Conclusion and outlook

- The GHG target of an Country might depend very much from the overall target and the additional politics
- Germany might be one example why the overall dependency influence the strategy to achieve carbon neutral society.
- To take into account the acceptance of a technology mix in a scenario it's necessary to take into account additional indicators like land use, resource consumption and efficiency but also social behavior ...