Designing a resource efficient pathway towards a greenhouse gas neutral Germany

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And others ...
Climate Action Plan 2050

Werte bis 2015
Zwischenziele 2020 bis 2040
Zielpfad 80 % Minderung
Zielpfad 95 % Minderung

*bis 2015 Ist-Werte (2015 Schätzung UBA), ab 2020 Ziele

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Climate Action Plan 2050
Goals and Scenarios

- Szenario 1
- Szenario 2
- Szenario 3
- Szenario 4

- Energy (excluding transport)
- Transport
- Industrial processes, solvents and other product applications
- Agriculture
- LULUCF
- Waste and wastewater

-emissions in mln. t CO₂eq

- heute
- Zukunftshorizont

- 1990
- 2010
- UBA THGND 2050
Goals and Scenarios

-50% Raw Material Use

Land Use

Germany still industrial region

Energy (excluding transport)
Transport
Industrial processes, solvents and other product applications
Agriculture
LULUCF
Waste and wastewater
Goals and Scenarios

Komplex System
Goals and Scenarios

Komplex System
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- Electricity
- Agriculture
- Industry
- Waste
- Land Use
- Heating Cooling
- Transport

2050
1 t/cap
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### Scenario variations

<table>
<thead>
<tr>
<th></th>
<th>GreenEe</th>
<th>Green</th>
<th>GreenMe</th>
<th>GreenLife</th>
<th>GreenSupreme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greenhouse gas reduction 2050</td>
<td>very high</td>
<td>very high</td>
<td>very high</td>
<td>very high</td>
<td>very high</td>
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<tr>
<td>Level of ambition on climate protection measures in the pathway (2030 and 2040)</td>
<td>high</td>
<td>medium</td>
<td>high</td>
<td>high</td>
<td>very high</td>
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<tr>
<td>Ultimate energy demand</td>
<td>low</td>
<td>high</td>
<td>low</td>
<td>very low</td>
<td>low</td>
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<tr>
<td>Raw material use</td>
<td>medium</td>
<td>high</td>
<td>low</td>
<td>low</td>
<td>low</td>
</tr>
<tr>
<td>Raw material efficiency</td>
<td>high</td>
<td>medium</td>
<td>very high</td>
<td>high</td>
<td>very high</td>
</tr>
<tr>
<td>Behavioral changes</td>
<td>medium</td>
<td>medium</td>
<td>medium</td>
<td>very high</td>
<td>high</td>
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</tbody>
</table>

### Basic assumptions in the GreenEe - Scenario

- **Population** in 2050 around 72 Mio.
- Germany is still a strong **industrialised** country with an export orientation
- **Economic** development 0.7 % annual growth in GDP
- Net zero built-up **area** in 2050
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Energy System Transformation -

- Sustainable energy system
  (no CCS, nuclear energy and crop-based bioenergy (to end after 2030))
- Fast introduction of renewables
- Full exploitation of the potential for increasing efficiency

Quelle: UBA 2010 ff
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Energy System Transformation -

efficient sector coupling

Quelle: UBA 2010 ff
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Raw material demand of technologies

Goals and Scenarios –

Phase out of coal - Renewables

- Batteries
- Hard coal
- Lignite
- Gas and others
- Photovoltaic
- Wind-Offshore
- Wind-Onshore
- Hydropower

Policies

Retrofitting Rate in Buildings

PTL Quota in air transport from 2030

Availability of copper?
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Global transferability– a system dynamic view - copper

- "Zooming in" semi-precious metals
- Demand (= extraction) strongly increase through extension of renewable energies ("copper mountain")
- Recycling capacities need to follow rapidly
- Persisting "gap" must be closed with primary raw materials
- Sensitivity (green dotted line) shows influence of technological assumptions
Comparison of Climate Protection Scenarios

Graph showing THG emissions in Mio t CO₂eq from 2010 to 2050, comparing various scenarios:
- PSzVIII MMS
- PSzVIII MWMS
- PSzVIII MEMS
- BMU IA KSP2050 Eff
- BMU IA KSP2050 EE
- RTD GreenEe
- BDI 80%
- BDI 95%
- BDI Ref.

Ziel 2030: mind. -55%
Ziel 2040: mind. -70%
Ziel 2050: weitgehende Treibhausgasneutralität

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-95% Greenhouse gas emissions until 2050

-60% Raw materials use
Vielen Dank für Ihre Aufmerksamkeit

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sowie Jens Günther, Philip Nuss, Ullrich Lorenz, Diana Nissler und Katja Purr