Ambitious Mitigation Scenarios for Germany: A Participatory Approach

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AGENDA

1. Introduction

2. Methodology

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1. Introduction

German Government:
Target of 80-95% CO₂ emission reduction in 2050 relative to 1990

- Existing technology-oriented scenario studies suggest achieving the target is technologically feasible

- Do the projected developments align with public preferences? Is there a danger of public refusal?

- Transparency and participation in design and development of scenario studies helpful for establishing public acceptance

- Apply analytical-deliberative approaches (Renn et al., 2011)
1. Introduction

We present a set of model-based, long-term mitigation scenarios for Germany that are defined and evaluated in a participatory process with civil society organization (CSO) stakeholders from the transport and electricity sector.
2. Methodology

SCENARIO DEFINITION

DELiberATION

SCENARIO RESULTS

ANALYSIS

SCENARIO EVALUATION

DELIBERATION
2. Methodology

**SCENARIO DEFINITION**
Discuss mitigation options in the transport and electricity sector with civil society representatives, focus on likely/desirable futures

**SCENARIO RESULTS**
Translate judgments and preferences into coherent sets of parsimonious narratives

**SCENARIO EVALUATION**

**DELIBERATION**

**ANALYSIS**

**DELIBERATION**

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2. Methodology

**Scenario Definition**
Discuss mitigation options in the transport and electricity sector with civil society representatives, focus on likely/desirable futures.

**Deliberation**
Translate judgments and preferences into coherent sets of parsimonious narratives.

**Scenario Results**
Run energy-economic model in 3 configurations corresponding to sets of parsimonious narratives.

**Analysis**
Analyze scenario results, identify sectorial trends and mitigation costs.

**Scenario Evaluation**

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2. Methodology

**Scenario Definition**
Discuss mitigation options in the transport and electricity sector with civil society representatives, focus on likely/desirable futures

**Scenario Results**
Run energy-economic model in 3 configurations corresponding to sets of parsimonious narratives

**Scenario Evaluation**
Discuss plausibility of scenarios, identify where projected developments could raise concerns about social acceptance

**Deliberation**
Translate judgments and preferences into coherent sets of parsimonious narratives

**Analysis**
Analyze scenario results, identify sectorial trends and mitigation costs

**Deliberation**
Identify socio-political externalities of technology-focused mitigation strategies
3. Scenario Definition

• Define parsimonious narratives for each scenario

• Parsimonious narratives consist of
  – Contextual information on anticipated key future developments
  – Quantitative projections for boundary conditions

• Development of parsimonious narratives based on CSO stakeholder workshops results, corroborated by expert judgements

• Different scenarios consist of different parsimonious narratives
3. Scenario Definition

- Is an increase of total annual freight mileage unavoidable?
- Is multi-modality a viable option for decarbonizing the passenger transport sector?
- Which alternative low-carbon fuels ought to be dominant in the future?
3. Scenario Definition

- Is an increase of total annual freight mileage unavoidable?
- Is multi-modality a viable option for decarbonizing the passenger transport sector?
- Which alternative low-carbon fuels ought to be dominant in the future?

- Are landscape externalities of REG capacities and transmission lines problematic, and what are potential remedies?
- Which energy efficiency growth rate is feasible and what is the role of the rebound effect?
- Which thermal electricity generation capacities are acceptable in the next decades?
### 3. Scenario Definition

<table>
<thead>
<tr>
<th>Model Constraint</th>
<th>Continuation</th>
<th>Paradigm Shift</th>
<th>Paradigm Shift +</th>
</tr>
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<tbody>
<tr>
<td>Decoupling FT&amp;GDP</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>PT share in MS</td>
<td>Constant</td>
<td>Increase</td>
<td>Increase</td>
</tr>
<tr>
<td>REG potential</td>
<td>Medium</td>
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<tr>
<td>Energy efficiency</td>
<td>Medium</td>
<td>High</td>
<td>High</td>
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<tr>
<td>Decommission Coal PP</td>
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<td>Yes</td>
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<tr>
<td>CCS by 2025</td>
<td>No</td>
<td>No</td>
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<tr>
<td>Biofuel potential</td>
<td>Low</td>
<td>Low</td>
<td>High</td>
</tr>
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</table>

All scenarios are subject to a strict CO₂ emission budget constraint.
4. Scenario Results

1. CO$_2$ emissions by sector

2. Transport sector

3. Electricity sector

4. Mitigation costs
4. Scenario Results - CO₂ Emissions by Sector

<table>
<thead>
<tr>
<th>Sector</th>
<th>Continuation</th>
<th>Paradigm Shift</th>
<th>Paradigm Shift +</th>
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</thead>
<tbody>
<tr>
<td>Transport</td>
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<tr>
<td>Electricity</td>
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<td>Heat</td>
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<td><img src="image8.png" alt="Graph" /></td>
<td><img src="image9.png" alt="Graph" /></td>
</tr>
</tbody>
</table>

**CO₂ emissions [Mt CO₂/year]**

- 2005
- 2010
- 2015
- 2020
- 2025
- 2030
- 2035
- 2040
- 2045
- 2050

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4. Scenario Results - CO₂ Emissions by Sector

- Continuation
- Paradigm Shift
- Paradigm Shift +

<table>
<thead>
<tr>
<th>Sector</th>
<th>2005</th>
<th>2010</th>
<th>2015</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
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</table>

Carbon Lock-in
4. Scenario Results - Transport Sector

The chart illustrates the freight transport in Billion t-km/year for different modes of transport (Ship, Train, Truck) under three scenarios: Continuation, Paradigm Shift, and Paradigm Shift +. The data is presented for the years 2005 to 2050.
4. Scenario Results - Transport Sector

Carbon Lock-in

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4. Scenario Results - Transport Sector

The diagram illustrates the projected passenger transport [Bn. P-km/year] for different scenarios in the years 2005 to 2050. The scenarios are categorized into Continuation, Paradigm Shift, and Paradigm Shift + for short and long time frames. The colors represent different years, with distinct symbols indicating specific years for each scenario and time frame.
4. Scenario Results – Electricity Sector

<table>
<thead>
<tr>
<th></th>
<th>Nuclear</th>
<th>Coal</th>
<th>Gas</th>
<th>RES</th>
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<tbody>
<tr>
<td>Continuation</td>
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<tr>
<td>Paradigm Shift</td>
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<tr>
<td>Paradigm Shift +</td>
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</tbody>
</table>

Electricity Generation [MWh/year]

- 2005
- 2010
- 2015
- 2020
- 2025
- 2030
- 2035
- 2040
- 2045
- 2050

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4. Scenario Results – Electricity Sector

<table>
<thead>
<tr>
<th>Year</th>
<th>Continuation</th>
<th>Paradigm Shift</th>
<th>Paradigm Shift +</th>
</tr>
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<tbody>
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<tr>
<td>2050</td>
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</tr>
</tbody>
</table>

Electricity Generation [MWh / year]

- **Continuation**
- **Paradigm Shift**
- **Paradigm Shift +**

**Carbon Lock-in**
4. Scenario Results – Mitigation Costs

GDP losses versus reference case [%]

CO₂ emission reduction in 2050 relative to 1990

Continuation
Paradigm Shift
Paradigm Shift +

3.5 %
1.4 %
0.8 %
5. Scenario Evaluation

- CSO stakeholders perceive three projected developments in the ‘continuation’ scenario as implausible:
  1. Strong decrease of motorized individual transport (MIT) that is not compensated for by more public transport (PT) mileage
  2. Required electricity and heat demand reductions not politically enforceable
  3. Required CO2 emission reductions and efficiency improvements in the heat sector are not realistic

- These critical socio-political externalities motivate CSO stakeholders to assess the scenario as highly undesirable

- However, the carbon lock-ins are again judged as highly likely
5. Scenario Evaluation

• The ‘paradigm shift’ scenarios see the carbon lock-ins resolved

• CSO stakeholders prefer the ‘paradigm shift’ over the ‘paradigm shift + ‘ scenario as they predict substantial public protest against the large-scale development of CCS infrastructure and biofuel production

• Concerns raised with regard to the necessary structural changes:
  1. Quality of public transport needs to increase significantly
  2. Decommissioning of coal power plants may entail regional unemployment
  3. Fast deployment of renewable electricity generation and transmission line capacities are socially acceptable if procedural justice is high

• In order to deliver, the different policy arenas need to become more intertwined and resolve their conflicting goals
6. Conclusion

- Achieving an ambitious mitigation target of 85% CO₂ emission reduction in 2050 relative to 1990 is technically feasible.
- Critical socio-political externalities may pose a significant barrier to achieving ambitious mitigation targets.
6. Conclusion

- Deliberative stakeholder dialogues reveal strong discrepancies between likely and desirable future developments in the transport and electricity sector.

- Fossil-fuel based freight mileage and electrification of coal, deemed likely but not desirable, will lead to a cumulative carbon lock-in.

- Model results indicate this carbon lock-in to be 8.8 Gt CO₂ until 2050, accounting for 55% of the total CO₂ emission budget.

- Enforcing ambitious mitigation in the face of carbon lock-ins leads economic growth to slow down and bears severe socio-economic externalities.
6. Conclusion

- Solution Strategies:

  Avoid Carbon Lock-Ins
  Renewable Electricity Generation
  Increase Energy Efficiency

... require concerted political as much as societal will!
Please find more details in:

Ambitious Mitigation Scenarios for Germany
A Participatory Approach

Project END-LowCarb
Engaging Civil Society in Low-carbon Scenarios