Transition pathways as “inter-disciplinary meeting place”

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NTRANS
Is a center for Energy Transition Strategies

• National research center (2020-2027)
• Research on the role of the energy system in the transition to a zero-emission society
• Interaction between technology and society – include the role of citizens and their interaction with technology and systems
• Fair and democratic transition
• Develop theory, methods, competence and knowledge to support decision-making processes
10-step methodology developed in NTRANS

1. Develop scenarios - based on socio-technical research
2. Quantify the scenarios – in dialog with partners in NTRANS
3. Analysis with NTRANS models
4. Discussion of analysis results and selection of case for in-depth analysis
5. Quantitative case study – in-depth analysis
6. Qualitative case study – in-depth analysis
7. Analysis/discussion: what are important measures to reduce bottlenecks in the transition?
8. Include uncertainty (short, medium, and long term) and bottlenecks in model analysis
9. Discuss policy implications from the model-based analysis and the socio-technical analysis
10. Summarize the research in a policy paper and a results presentation
NTRANS scenarios

Scenarios are based on socio-technical research:
- Technological change
- Societal change

- TECHnological change pathway
- RADical change pathway
- INCremental change pathway
- SOCial change pathway
Example of assumptions

Technological change

High activity/demand
High wind onshore
Unlimited transmission
10 % rate
Municipal waste as today

Wind offshore
Biofuel & bio coal
Hydrogen technologies
Blue hydrogen
CCS

Radical
Low activity/demand
Low wind onshore
No new transmission
4 % rate
No waste

Incremental
Medium activity/demand
High wind onshore
Unlimited transmission
10 % rate
Municipal waste as today

Wind offshore
Biofuel & bio coal
Hydrogen technologies
Blue hydrogen
CCS

Society
Low activity/demand
Low wind onshore
No new transmission
4 % rate
No waste

High cost
Unlimited
Low learning rate
No
Yes

High cost
Unlimited
Low learning rate
No
No
Energy use per sector

- Energy use in transport reduced in all scenarios, most in RAD and least in INC
- Energy use in buildings reduced with 1% in INC and TECH and 23% in SOC and RAD
- Energy use in industry incl. petroleum
  - Halved in SOC and RAD
  - 18% reduction in INC
  - Almost doubles in TECH
Net domestic energy use

- Electricity consumption increase in all scenarios
- Bio: increases compared to 2020, mostly used in INC
- Natural gas: used in production of blue hydrogen in TECH
- Still some use of fossil energy in industry in all scenarios
Electricity consumption

- Total use of el. in 2050
  - 270 TWh in TECH
  - Today’s level in SOC
- Use of el. in industry:
  - Highest increase in scenarios with low societal change (130 TWh in Tech in 2050)
  - Today’s level in 2050 in scenarios with high societal change
- Use of el in transport and for production of hydrogen:
  - Highest increase in scenarios with high technology change (75 TWh in TECH in 2050)
Power production

- **Hydro**
  - Increase of 12-14 TWh in all scenarios to 2050

- **Onshore wind**
  - Small increase in scenarios with high societal change (14 TWh in SOC and RAD in 2050)
  - Higher increase in scenarios with low societal change (53 TWh in TECH in 2050)

- **Offshore wind**
  - Increase largely in scenarios with high technology change (139 TWh in TECH in 2050)
  - Less development in scenarios with low technology change (21 TWh in INC and SOC)

- **Solar PV**
  - 13-19 TWh in 2050 (highest in RAD)
CO2 emissions

- All scenarios follow the same trend:
  - Road transport is faster decarbonized compared to sea transport
  - Still remaining emissions in industry, can be reduced with new technology (e.g., CCS or DAC)
- Production of blue hydrogen is not emission-free

Emission reduction:
- INC: 85%
- SOC: 86%
- TECH: 76%
- RAD: 90%
Electricity trade

- Net export for all periods and all scenarios
- Largest export volumes in RAD and TECH
- RAD - Example of why price elasticity is important
- Iterative process to make results more trustworthy
Learnings from the process

• Collaboration and dialogue with other disciplines is highly valuable
• Results reflect also societal change – increases credibility
• Inclusion of user-partners to give input based on their expertise
• Even if we have not completed the 10-step methodology yet, our experience is that it is valuable to work in close cooperation with the other research disciplines in the center.