ETSAP Winter Workshop 2022

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Columbia University, New York

NTRANS

Norwegian Centre for Energy Transition Strategies

Transition pathways as “inter-disciplinary meeting place”

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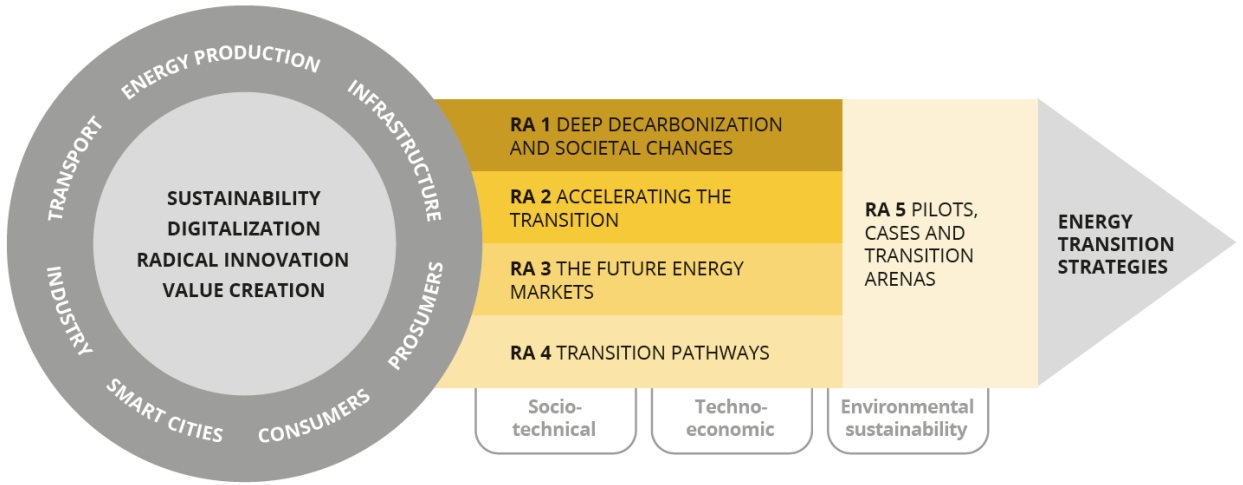
NTRANS

Is a center for Energy Transition Strategies

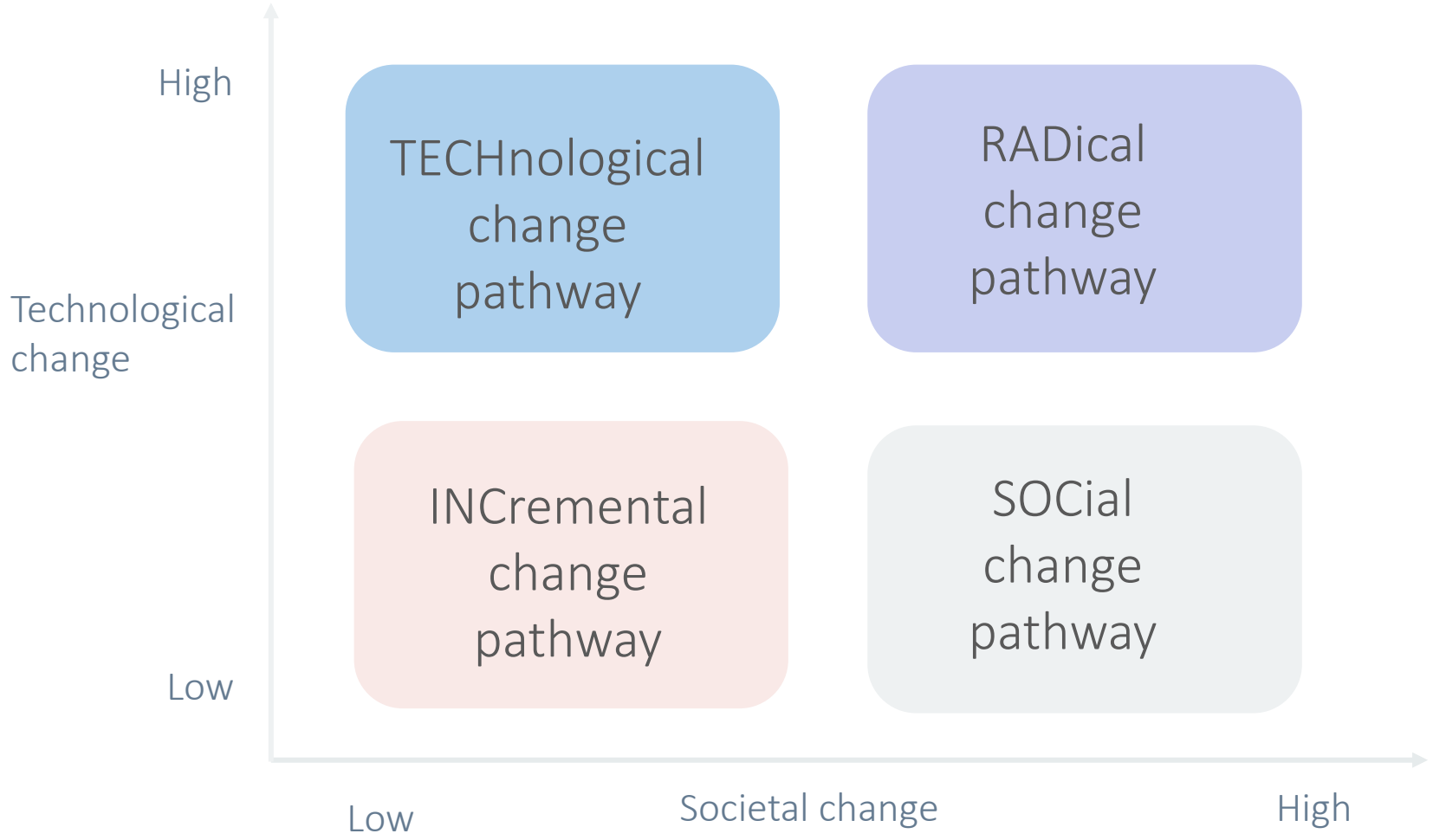
- National research center (2020-2027)
- Research on the role of the energy system in the transition to a zero-emission society
- Interaction between technology and society – include the role of citizens and their interaction with technology and systems
- Fair and democratic transition
- Develop theory, 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

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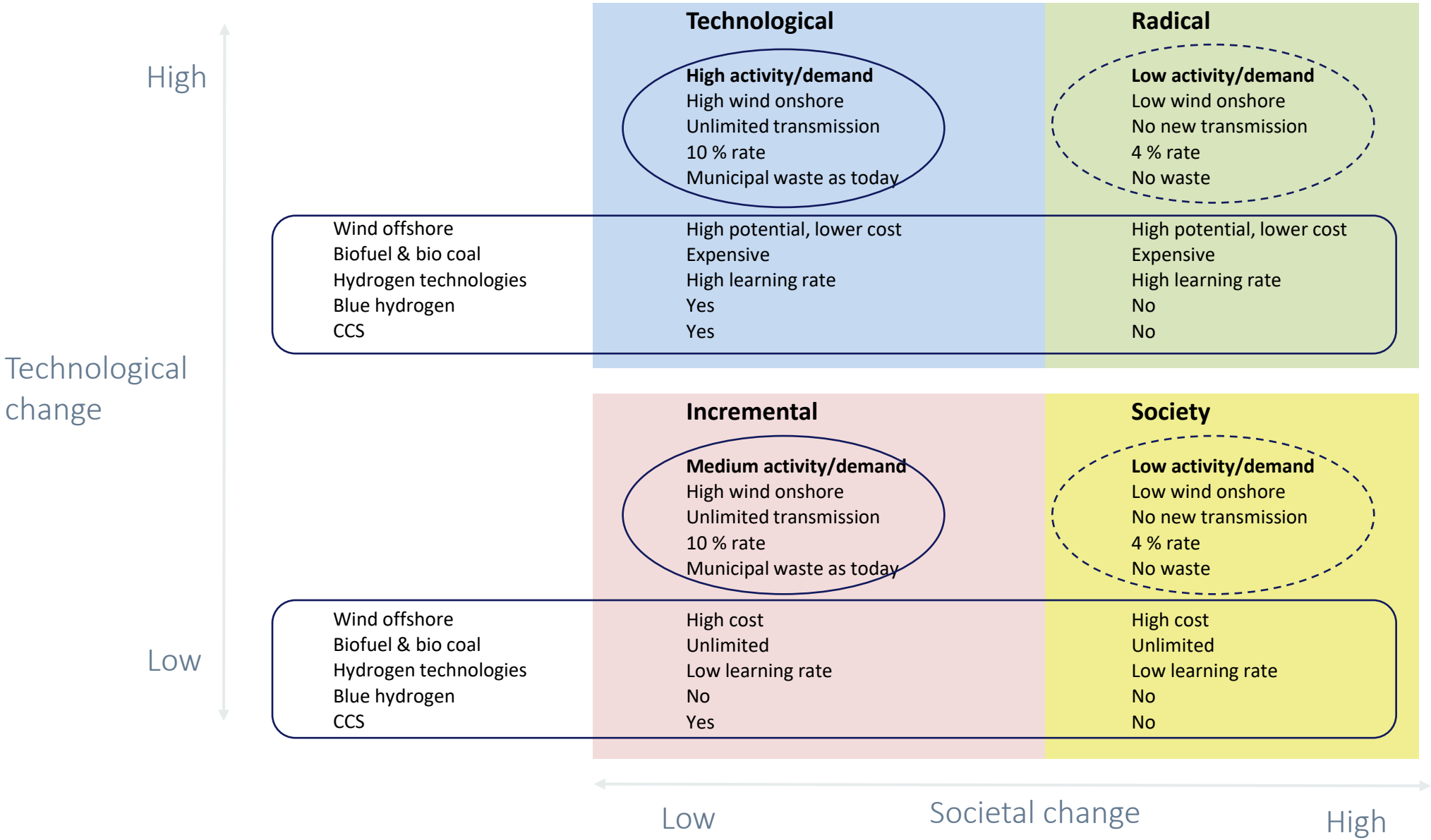
Example of assumptions



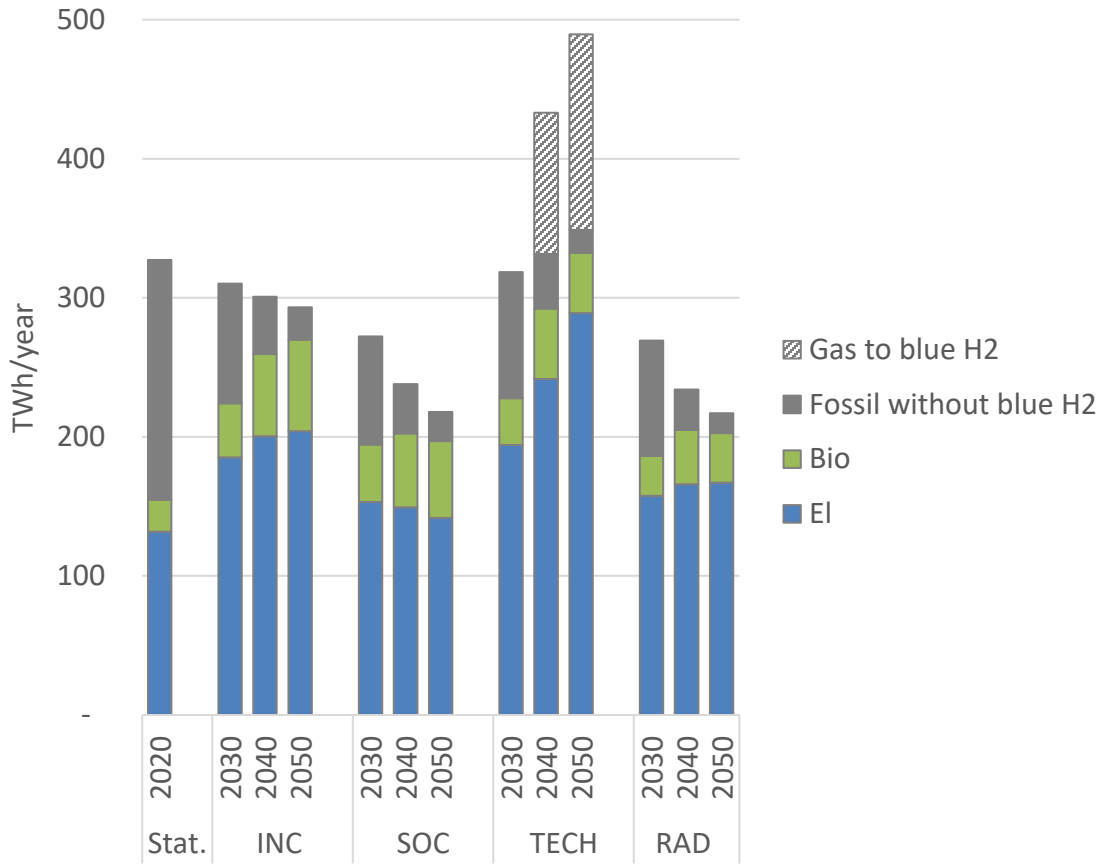
Energy use per sector

- 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

Technology change	Low	Low	High	High
Societal change	Low	High	Low	High

Net domestic energy use

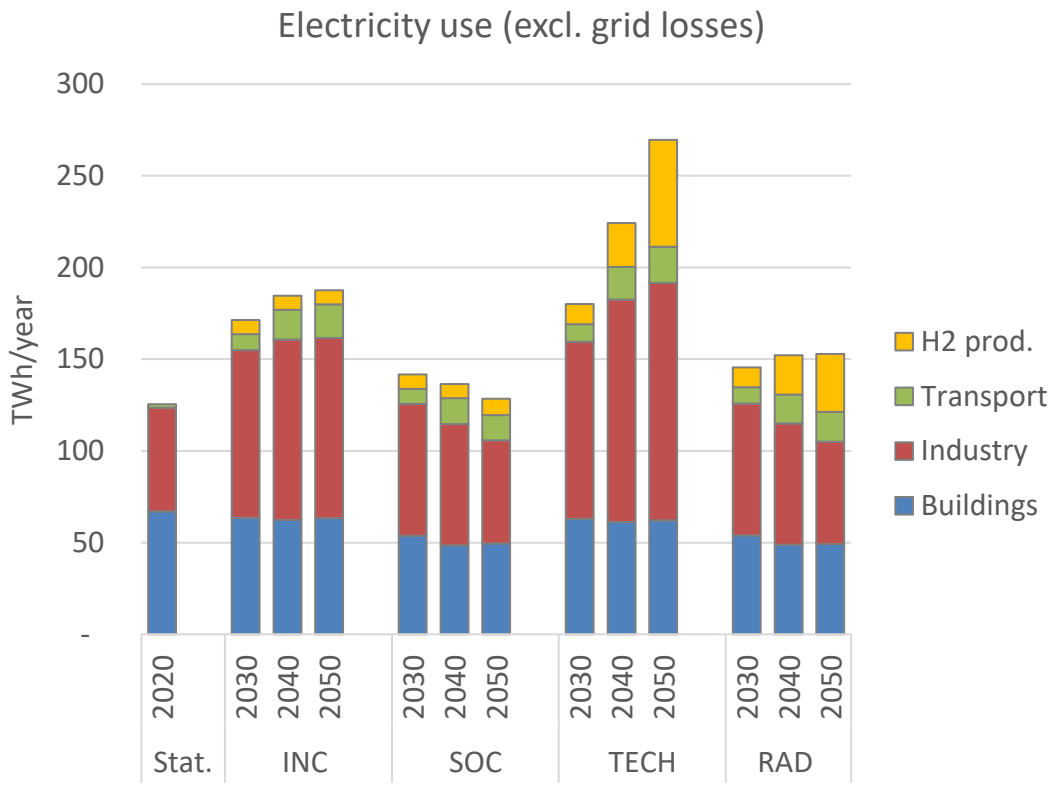
- Electricity consumption increase in all scenarios
- Bio: increases compared to 2020, mostly used in INC
- Natural gas: used in production of blue hydrogen in TECH
- Still some use of fossil energy in industry in all scenarios



Technology change	Low	Low	High	High
Societal change	Low	High	Low	High

Electricity consumption

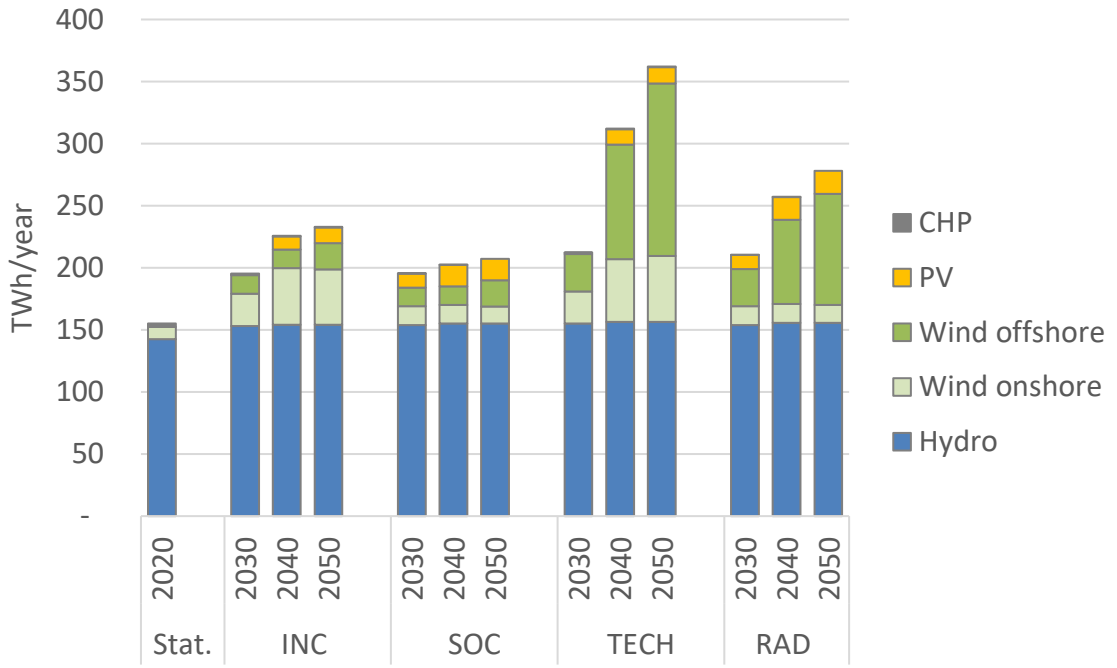
- Total use of el. in 2050
  - 270 TWh in TECH
  - Today's level in SOC
- Use of el. in industry:
  - Highest increase in scenarios with low societal change (130 TWh in Tech in 2050)
  - Today's level in 2050 in scenarios with high societal change
- Use of el in transport and for production of hydrogen: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



Technology change	Low	Low	High	High
Societal change	Low	High	Low	High

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)



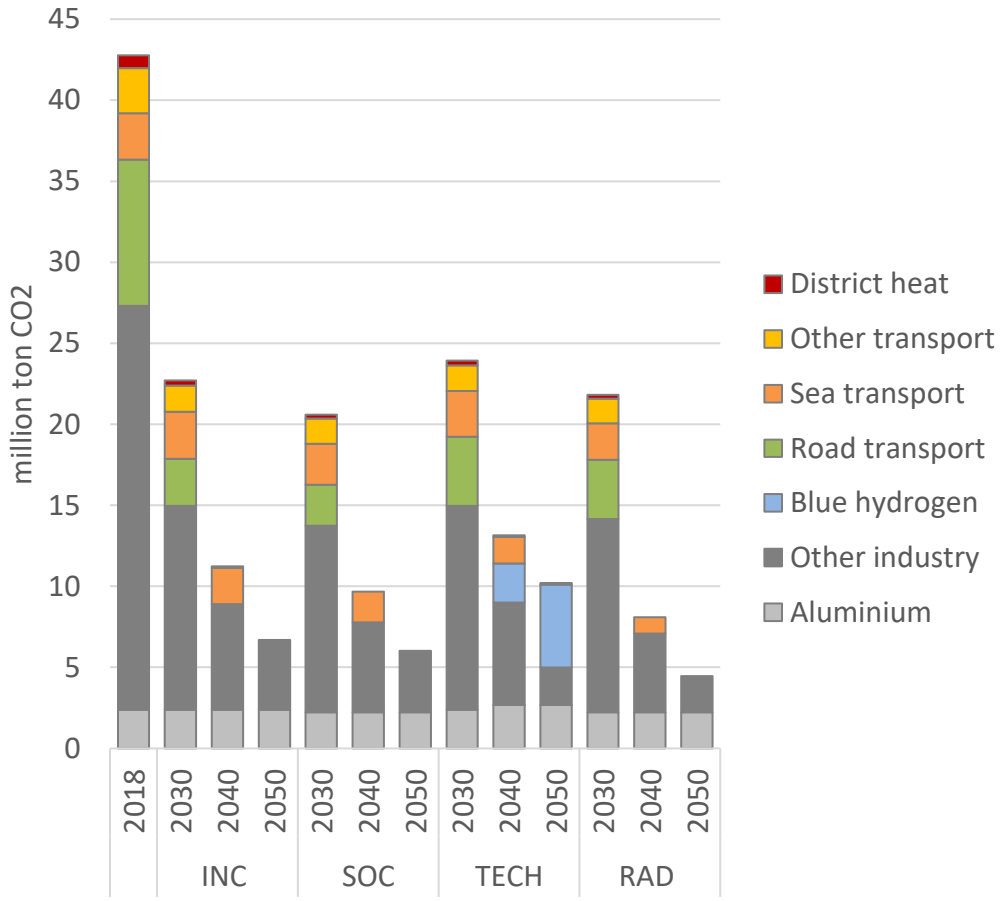
Teknologiendring	Low	Low	High	High
Samfunnsendring	Low	High	Low	High

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:

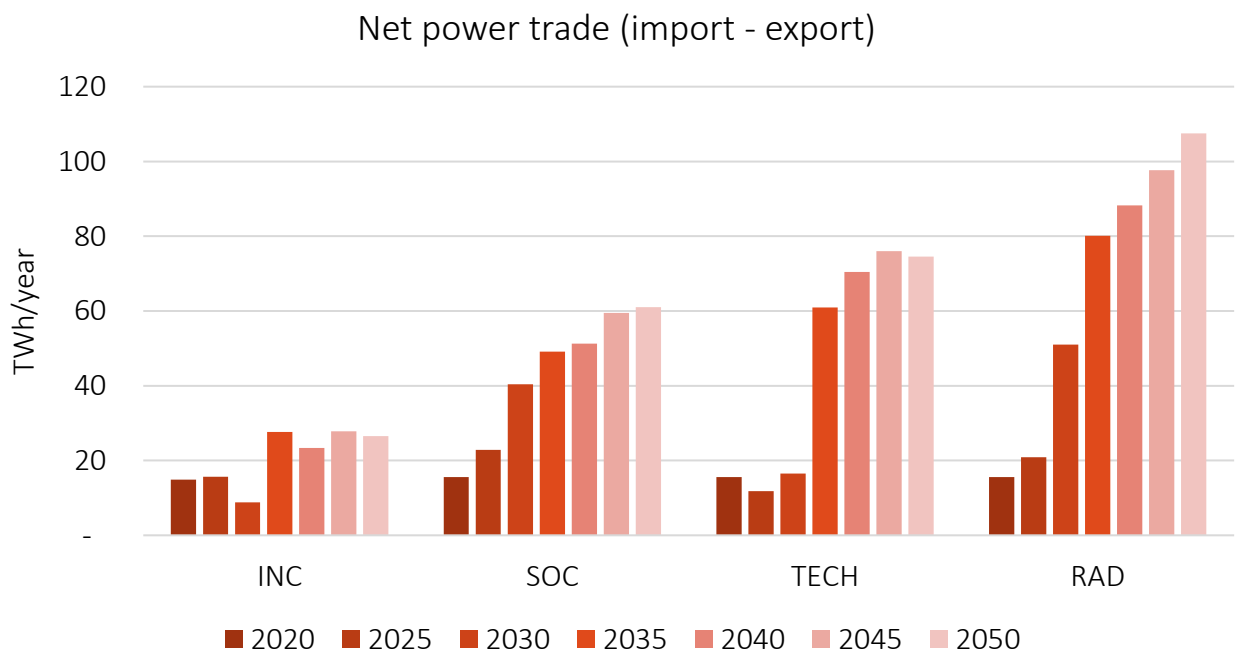
- INC: 85%
- SOC: 86%
- TECH: 76%
- RAD: 90%



Technology change	Low	Low	High	High
Societal change	Low	High	Low	High

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.