



## RESEARCH AREA 4 PATHWAYS TO A SUSTAINABLE FUTURE



### WHAT IS THIS RESEARCH AREA ABOUT?

We are analysing various transition paths heading towards a low-emission society, with special focus on the Norwegian development, and also on how interaction with Europe can take place within the various alternatives.

The NTRANS researchers are from different disciplines, and the most important research question is: How can we build a bridge between transition studies that include political science, innovation, technology, and techno-economic energy systems analysis, to promote a common understanding of change directions?

# TEN NEW STEPS TOWARDS THE TRANSITION PATHWAYS

“We have developed a new ten-step-method on how to work better together - across the different fields of research”, says leader of research area 4, Kari Aamodt Espegren.



*Balancing steps: “Team building is especially important when working together across research fields and institutions”, says Espegren. (Photo: Vibeke Ann Pettersen/NTRANS)*

“The greatest highlight from 2021? It was definitely to eventually be able to meet up physically and work closely together for a few really focused days at Brimi in the autumn. The virtual meetings can never replace the face-to-face cooperation. Especially when we are working across several disciplines”, says Espegren, who also is research leader at IFE.

#### WORKING FACE-TO-FACE AT LONG LAST

At the end of August and the first days of September the whole NTRANS management group was able to meet up physically at Brimi Fjellstugu in Jotunheimen. Some other

key researchers in the centre also joined the group for these three days of concentrated work. Research area 4 was the main focus for the researchers these days.

While the sun was shining all around the picturesque mountain surroundings, they presented their work and ideas to each other, and had good discussions. Sometimes indoors, and other times sitting outside or “walking and talking” in the beautiful autumn weather.

The joint work resulted in a new ten step method for this kind of interdisciplinary work, and it's listed below.



Groupwork in the autumn sun. (Photos: Vibeke Ann Pettersen/NTRANS)

#### TRANSITION SEEN FROM VARIOUS ANGLES

"NTRANS researchers are coming from different fields, and when we are cooperating, we must include all the different perspectives," says Kari Espegren.

This research area has mainly been looking into transport, in many forms, throughout the year. Electric vehicles of course, and hydrogen is also a hot topic, especially in the maritime sector. Several researchers have been involved in use case 3, and the report [Solving the chicken and egg problem in maritime hydrogen value chains in Western Norway](#). This work is described in more detail under research area 5.

#### ANALYSING IMPACTS FOR DIFFERENT DIRECTIONS

The work with the 10-steps method has already started, and research leader Espegren explains:

"The socio-technical researchers have been responsible for development of four contrasting futures or pathways, described by different developments and changes in culture/institutions and technology. These pathways have been developed in a joint process with the energy modelers. The pathways are called: Incremental innovation, Modular substitution, Architectural change and Radical transformative pathway, and they describe different future developments of the society. The techno-economic researchers have quantified these pathways and are now implementing changes and updates in the different models, to be able to analyse the impacts of the four different pathways. Our first impression is that the 10-step method will be a great tool for future transition research!"

#### WORK PACKAGES IN RESEARCH AREA 4

**4.1: Techno-economic and sustainability analysis.** WP leaders Anders Hammer Strømman, NTNU IndEcol and Pernille Seljom, IFE • Improvement of techno-economic models, and models for sustainability analysis

**4.2: Socio-technical analysis.** WP leader Sigrid Damman, SINTEF Digital • Analysis including aspects such as innovation, actor strategies and social acceptance

**4.3 Stakeholder involvement.** WP leader Eirik Gjelsvik Medbø, NTNU-IØT • Involvement of and discussion with user partners through workshops and meetings.

**4.4 Analysis of transition pathways.** WP leader Kari Espegren, IFE • The techno-economic, environmental, and sociotechnical approaches will be combined with input from stakeholders to develop and assess different transition pathways for Norway



Researcher Kari A. Espegren (IFE) is in lead of Research area 4, Pathways to a sustainable future. (Photo: Silje Nørstad/NTRANS)

#### 10-STEP METHOD FOR ANALYSIS OF TRANSITION PATHWAYS IN NTRANS

- 1. Develop scenarios**
  - Develop different (contrasted) pictures of the future based on socio-technical research (including a description on driving forces behind each scenario)
  - Describe national and sector/subsector development
  - Present and discuss scenarios with the user partners
- 2. Quantify the scenarios – in dialog with partners in NTRANS**
- 3. Analysis with NTRANS models**
  - Based on common assumption for each scenario
  - Interaction between models when useful
- 4. Discussion of analysis results and selection of case for in-depth analysis**
- 5. Quantitative case study – in depth-analysis (maritime transport, modal shift, freight transport)**
  - Based on common assumption for each future
  - Interaction between models when useful
- 6. Qualitative case study**
  - Socio-technical perspective on selected case (desktop, including supplementing interviews/analysis)
  - Focus on critical points and bottlenecks in transition
- 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**
  - Stochastics can be used to develop robust futures
- 9. Discuss policy implications from the model-based analysis and the socio-technical analysis**
- 10. Summarise the research in a Policy paper and a (interactive) results presentation**

#### 3 SELECTED PUBLICATIONS FROM RA4:

**Espgren, K.; Damman, S.; Pisciella, P.; Graabak, I.; Tomasgard, A.**  
[The role of hydrogen in the transition from a petroleum economy to a low-carbon society](#)  
*International Journal of Hydrogen Energy*

The paper focuses on the role of hydrogen in a radical decarbonization pathway for the Norwegian society towards 2050. Three analytical perspectives are combined. Main conclusions are that access to renewable power and hydrogen are prerequisites for decarbonization of transport and industrial sectors in Norway, and that hydrogen is a key to maintain a high level of economic activity.

**Damman, S.; Sandberg, E.; Rosenberg, E.; Pisciella, P.; Graabak, I.**  
[A hybrid perspective on energy transition pathways: Is hydrogen the key for Norway?](#), *Energy Research & Social Science*

This paper discusses the sociotechnical interactions that are driving and hindering development of hydrogen value chains in Norway. A hybrid approach provides new knowledge on underlying system dynamics and contributes to the discourse on pathways in transition studies.

**Dimanchev, E., Qorbani, D., & Korpås, M.**  
 Book chapter: in M. Asif (Ed.), *The 4Ds of Energy Transition: Decarbonization, Decreasing use, Decentralization, and Digitalization* (1st ed., Vol. ahead-of-print). John Wiley & Sons: Germany.  
[Electric vehicle adoption dynamics on the road to deep decarbonization.](#)

This chapter explores the integration of vehicle technology with decarbonization and the electric vehicles' role. It also provides a case study of electric vehicle policy in Norway.