



# ANNUAL REPORT 2021



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## ANNUAL REPORT 2021

FME NTRANS – NORWEGIAN CENTRE FOR ENERGY TRANSITION STRATEGIES

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**Chair of the  
NTRANS Board,  
Henrik Sætness**

## MESSAGE FROM THE CHAIR OF THE BOARD

2021 was another year full of surprising developments. The pandemic kept rolling in waves, but maybe more significantly, we went from a 2020 with near record-low energy prices, to the last half of 2021 with record-high energy prices.

The gas prices in Europe have reached levels never seen before, and with overall very high prices on fuels and commodities, we have seen power prices across the continent driven to new records. Although this situation is not directly caused by the energy transition, it is obviously highly relevant to understand the reactions, consequences and developments caused by the situation.

NTRANS' broad approach to the energy transition, with a strong cross-disciplinary approach, is ever more relevant in light of these developments. The current circumstances in the world around us will influence the specific workshops, papers and use cases in the centre, but the overall strategy and direction is evidently correct.

NTRANS has had an active year in 2021. There has been many virtual, and even some physical gatherings, ranging from more internally focused events to the large annual conference.

The researchers have continued to be active in the media while still producing reports, working papers and policy briefs. Our Centre Director was even present physically in Glasgow for the COP26. NTRANS' valuable contributions will continue, driving the research agenda forward while engaging with, bringing insight to, and learning from the industry partners.



**Centre Director,  
Asgeir Tomasgard**

## REPORT FROM THE CENTRE DIRECTOR

This report will give an overview of FME NTRANS activities in 2021, as well as examples of the research in some selected areas. The majority of larger activities has been virtual also this year, but we are slowly getting back to normal meetings. On the positive side, we have become good at hybrid events, and we will see more of these in years to come!

The first round of use cases where researchers, industry, municipalities, government agencies and NGO's have joint actions are finishing or entering their final year. They have touched both transport, renewables, energy use and policy measures. We are also starting new use case activities on innovation in urban transition, freight transport, CCS, flexible energy markets and the Norwegian energy and climate measures.

I am also happy to see that the 12 PhD students and 3 Postdocs are contributing actively to the research. They play a central role for the productivity and cooperation in the centre, and we think they will be a fantastic resource for society in years to come, when implementing the energy transition.

I would like to take this opportunity to thank all the partners, and the people involved, and I am looking forward to meeting more of you in person in 2022. The NTRANS values are anchored in the aim to be curious, brave and inclusive in our research, together for an efficient and just transition. This is more important than ever.

# ABOUT NTRANS

We study the role of the energy system in the transition to the zero-emission society.

NTRANS researches the development of environmental-friendly energy from a social science perspective, in the interaction between technology and society.

The research in NTRANS will build a knowledge base for the paths to, and the consequences of, energy and climate change in Norway. The centre will bring together sociology, political science, economics, economic geography, science and technology studies and innovation studies.

NTRANS will work to understand how the transition can be done in a fair and democratic manner, and at the same time give businesses opportunities for innovation and value creation.

*In the Paris Agreement of 2015, world leaders committed themselves to reducing greenhouse gas emissions. The goals of rapid and deep decarbonisation will affect all sectors of society. A key challenge is the integration of large amounts of renewable energy through flexibility as well as decarbonising other sectors of the economy.*

## The main research objective

*The main goal of NTRANS is to develop theory, methods, competence and knowledge to support decision-making processes within the energy and climate area.*

We apply a whole systems perspective that sees social and technological development as tightly entangled, thus stressing that both changes within the energy system and in related sectors are vital in the transition to a low-carbon society.

New practices, increased involvement of the population and changes in behaviour are all central to stimulating demand for low-carbon solutions, to creating political legitimacy and to mobilising the resources needed for change.

The energy sector is crucial for transitions to low-carbon societies. As variable renewable energy enters a path of sustained growth, key energy transition challenges shift towards integrating large shares of renewables through additional flexibility and by decarbonizing other key emitting sectors, such as transport and industry.

## MAIN RESEARCH AREAS



**Research Area 1**  
Deep Decarbonisation and Wide Societal Changes



**Research Area 2**  
Accelerating the Transition



**Research Area 3**  
Future Energy Markets



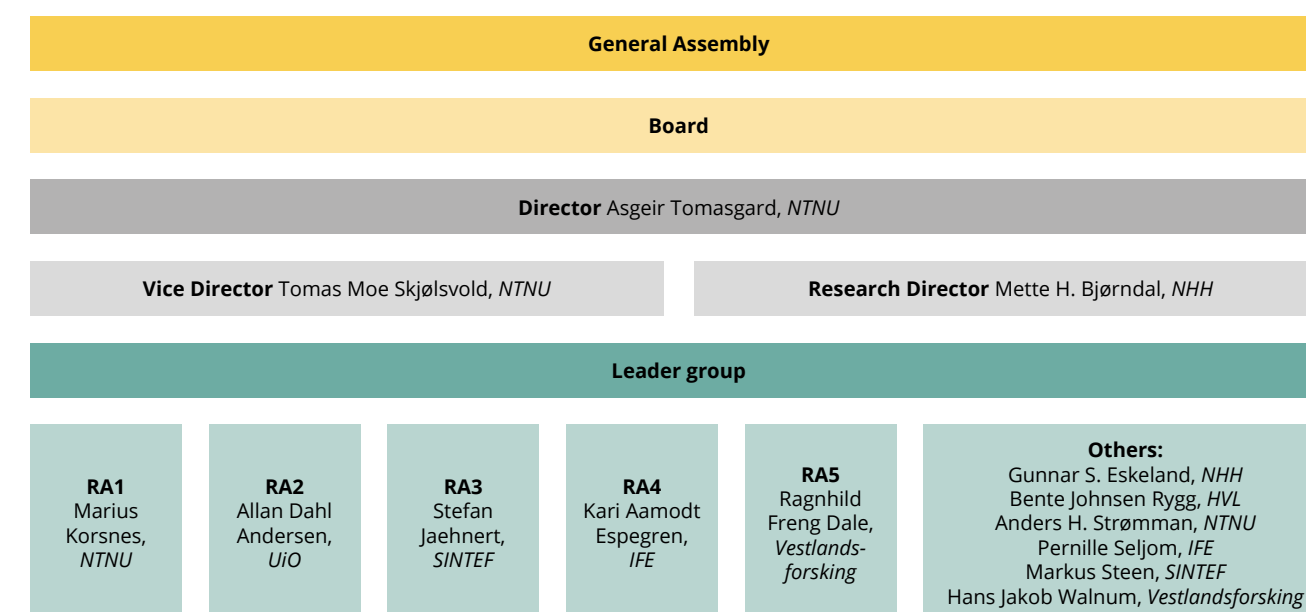
**Research Area 4**  
Pathways to a Sustainable Future



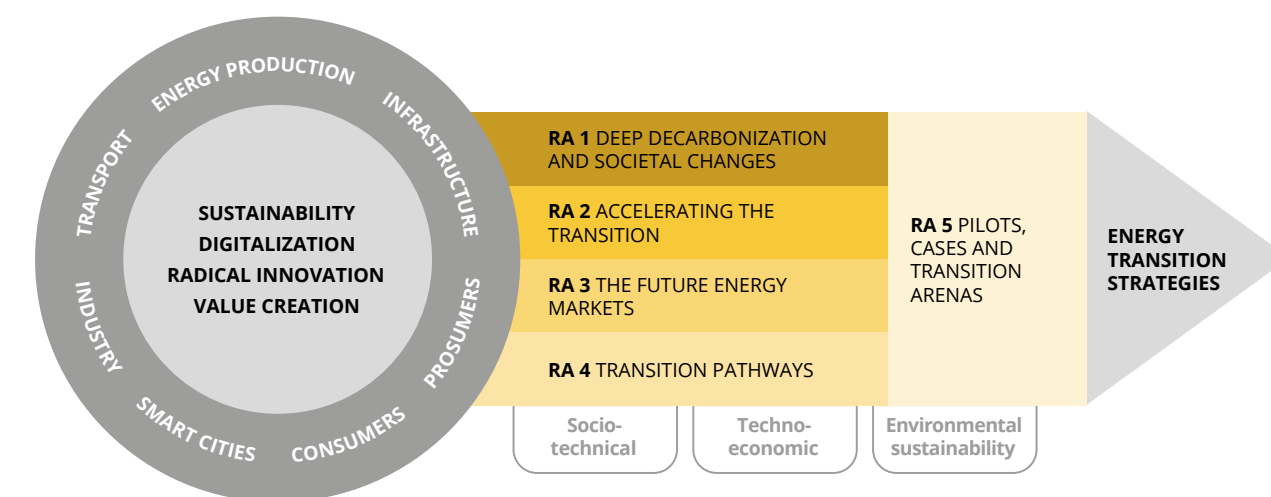
**Research Area 5**  
Use Case and Innovation

## VISION: TOGETHER FOR AN EFFICIENT AND JUST TRANSITION

## ORGANIZATIONAL CHART



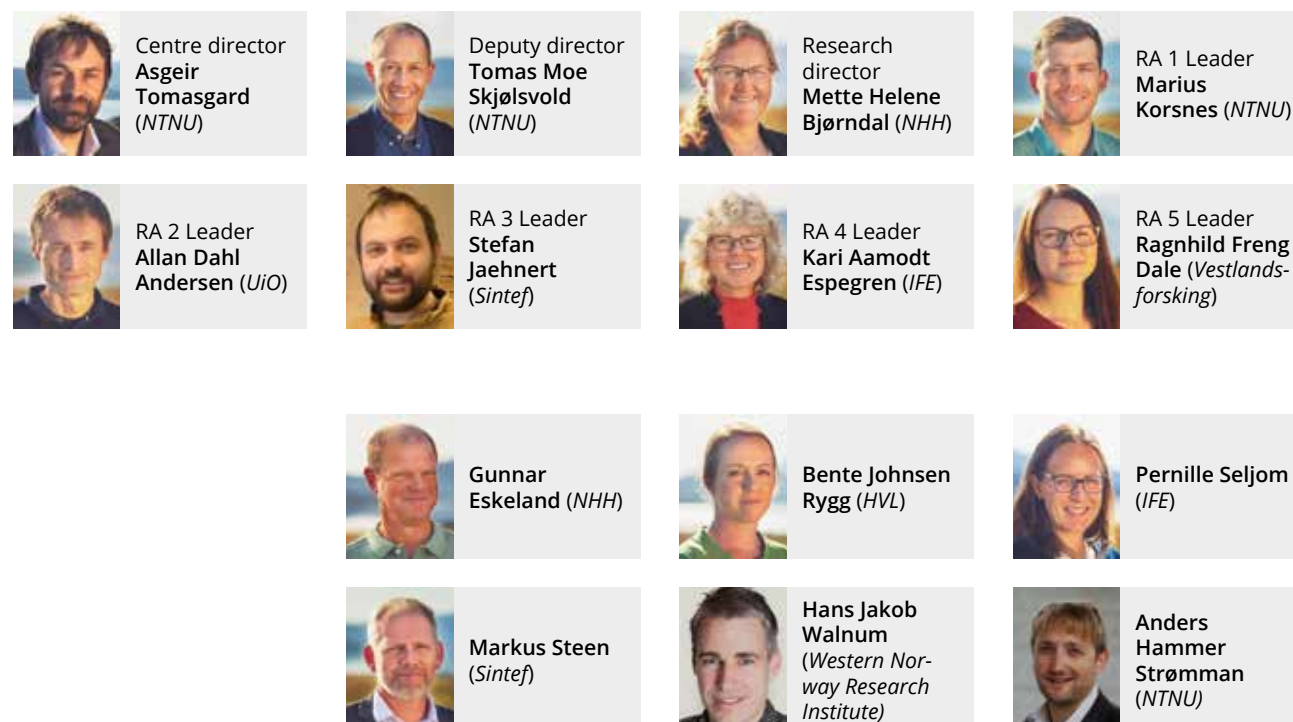
## THE ENERGY SYSTEMS OF THE FUTURE AND THE MOST IMPORTANT DRIVERS FOR DECISION



Research areas, user cases and innovation.



## THE MANAGEMENT GROUP

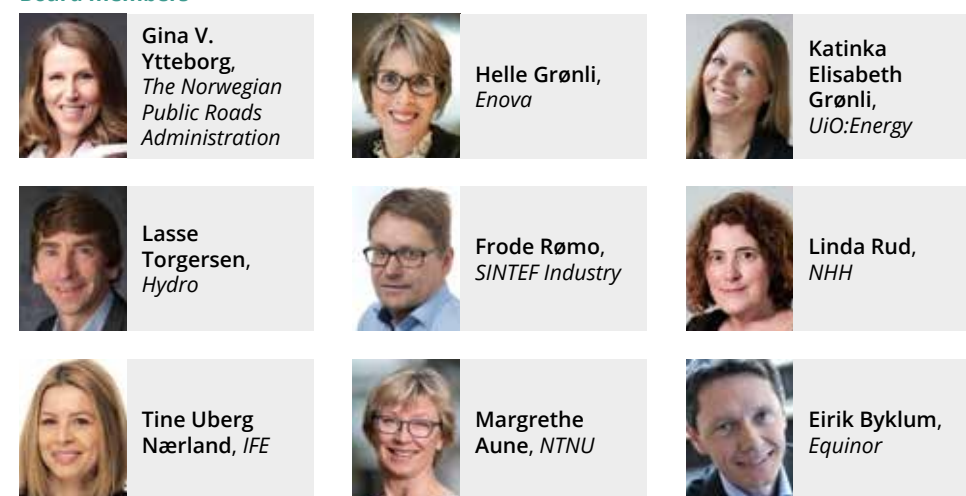


## THE BOARD

### Chair of the Board



### Board members



### Permanent deputy member



### Deputy members:

Kristin Rasdal, Forskningsrådet  
Tor Ulleberg, Equinor  
Ragnhild Stuland, Hydro  
Caroline Østlie, Statkraft  
Even Bjørnstad, Enova

## PARTNERS

### RESEARCH PARTNERS



### ENTERPRISE PARTNERS



### PUBLIC PARTNERS



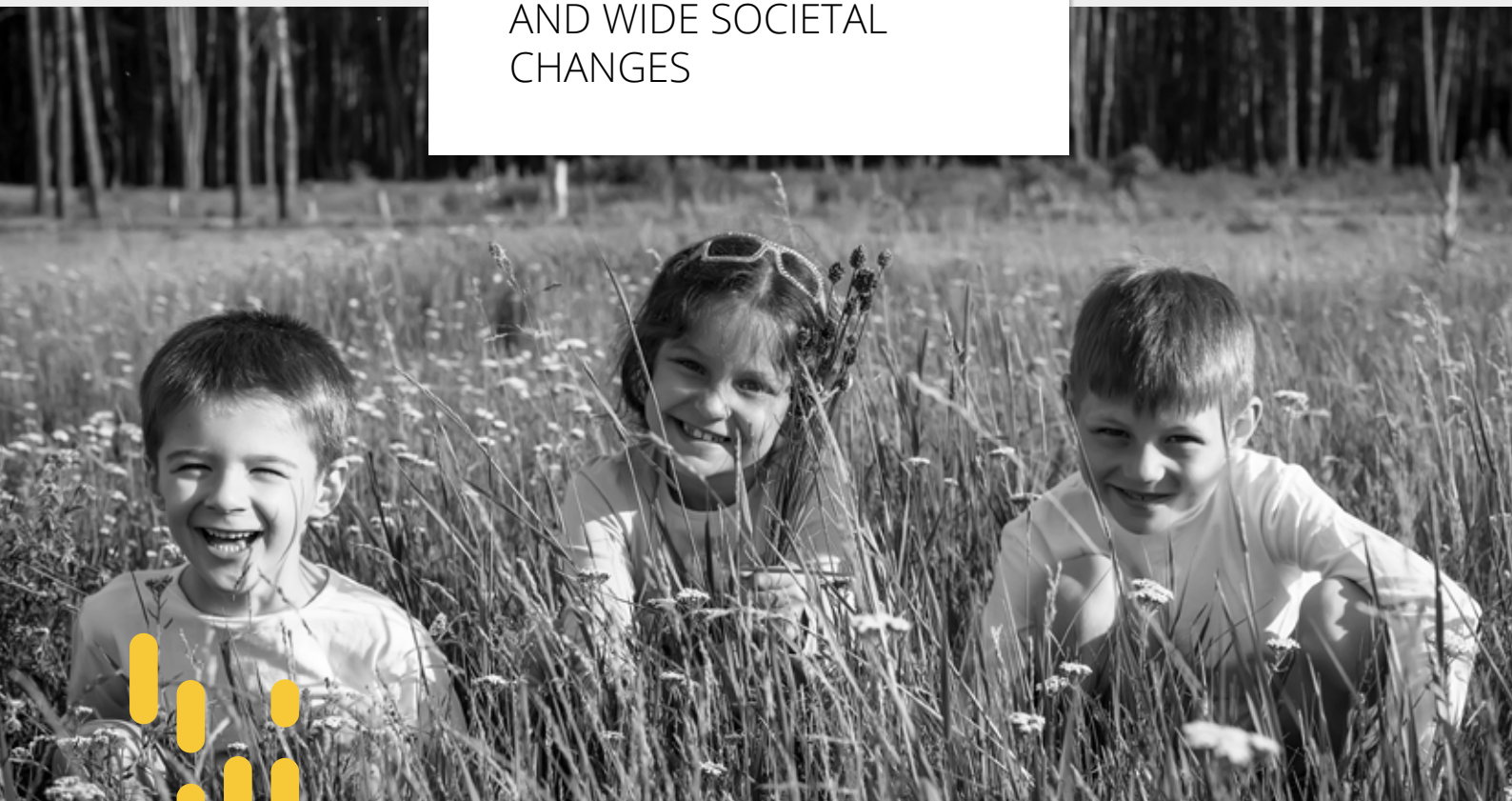
### INTERNATIONAL PARTNERS





## RESEARCH AREA 1

### DEEP DECARBONISATION AND WIDE SOCIETAL CHANGES



#### WHAT IS THIS RESEARCH AREA ABOUT?

Achieving deep decarbonisation and wide changes in society means more than implementing individual technologies for individual sectors. In addition to old and new technologies to achieve a more sustainable society, we focus on: everyday practice, energy cultures, institutions, social relations, consumer behaviour, and political processes.

Development and implementation of new technologies cannot be studied in isolation, but as part of major changes in society. Sustainability transitions in general, and energy transitions in particular, are socio-technical processes.

The transition provides an opportunity to create new and fair systems, institutions and practices. Achieving this will require inclusive and democratic processes, and the development of new forms of community participation.

# AGAINST THE WIND

“Some people are not being heard. Their opinions are often ignored by the decisionmakers,” says researcher Marius Korsnes.

That’s how controversies often start, for example when placing wind turbines on land. The Sami people have been especially ill-treated. Reindeer grazing areas have been occupied by wind parks in some areas like Fosen in Trøndelag county. The Supreme Court recently decided that indigenous rights of Sami people were violated through the wind park concession given there.

“Many researchers are already looking into those controversies now, so we decided to go more in depth on conflicts in other locations, like the island Frøya”, says NTNU researcher and leader of research area 1, Marius Korsnes. He has also been heavily involved in the research sprints and other activities in NTRANS use case 1, in close cooperation with IFE researcher Pernille Seljom.



Frøya Vindpark on the island Frøya. (Photo: Marius Korsnes/NTNU)



## FIELD WORK ON THE ISLAND FRØYA

During 2021 Korsnes and master's student Marte Austenå went on a field trip to Frøya in Trøndelag county to collect research data.

"The field work and the interviews we did on Frøya are also important for my master's thesis," says Austenå.

"We interviewed people in the Frøya community, which is very affected by the debate on wind power." Korsnes continues: "The debate is polarized and has led to division among people on the island. We wanted to talk to people on both sides of the conflict, but it was hard to find people who were in favour of wind turbines. Also neutral people were difficult to reach."

The opposition against wind power on the island is strong, and has affected the Norwegian debate for almost 20 years.

## EGO VERSUS COMMUNITY

One of the "pro wind farm" locals said: "Today we are more concerned with taking care of ourselves, me and what I want and what I need. This contrasts to the post war-period, when they were building communities – and surely, they sacrificed nature to build".

"Our temporary findings also show that this camp considers wind energy a necessary evil, and that renewable energy is needed to cope with climate change.

The local islanders opposing the wind farm pointed to distrust in the licensing process, and failing to preserve nature and species. They were also disappointed with the mitigating measures taken. The focus on economic growth that sacrificed nature was another great concern on that side of the conflict."

## WHAT CAN WE LEARN FROM THE FRØYA CONFLICTS?

"Controversy can be an important arena for understanding participatory processes," says Korsnes.

"Frøya has shown and created engagement for the resistance movement against wind power, with nationwide effects. One of our findings points at the role of the local municipality in such processes. In instances where about half the local population is against a project, it might not be a great idea to accept the project even with a slight majority. It is therefore important to look at each case individually and ask: how can we avoid polarization when local communities are so divided?" Korsnes also points out that we would have to take a closer look at the licensing process, which in several cases has been lengthy and potentially unfair.



Field work on Frøya: Marte Austenå joined Korsnes (both NTNU-KULT) in fieldwork on Frøya. Here in front of the Frøya Vindpark entrance. (Photo: Marius Korsnes)

## EVENTS ON CONFLICTS AND JUST TRANSITION

**3 March 2021:** "Land use conflicts in the transition to the low-emission and zero-emission society". This webinar was moderated by Hans Jakob Walnum, Western Norway Research Institute, Vestlandsforsking, and was attended by more than 70 people in total.

[The programme and presentations are available here](#) (in Norwegian).

**29 April 2021:** "Can participation and inclusion deliver just energy transitions?" This workshop was part of NTNU Energy Transition Week, and had participants from our user partners and also a number of international ones, like Jason Chilvers, University of East Anglia. Tomas Moe Skjølsvold was chair. [See more about the workshop](#)

**7 December 2021:** Workshop: "The Norwegian wind controversy"

This was also a popular event, and had both physical and virtual attendees, around 70 in total. Organised in cooperation with FME NorthWind. Moderators were Marius Korsnes and Sara Heidenreich. [See the programme and the presentations in the NTRANS event calendar](#) (in Norwegian).

## MAKING THE SMART GRID



By Tomas Moe Skjølsvold, Ida Marie Henriksen, Berit Kristoffersen, Johannes Hojem, Iva Stoykova

This report analyses 30 pilot and demonstration projects that advance smart grids with flexible consumption and high levels of renewable energy production in Norway. The report

investigates pilot and demonstration projects as key sites in the production of future societies. Such projects are usually evaluated based on techno-economic criteria, while their contribution to broader societal processes tends to be overlooked. This report explores how they contribute to the shaping of energy transitions and societies, and provide recommendations based on this analysis. Read more about this report on page 42 in this report.

[See the report here](#)



NTNU researcher Marius Korsnes. (Photo: Silje Nørstad/NTRANS)

## MARIUS KORSNES AWARDED AN ERC GRANT



Christmas 2021 came early for Marius Korsnes: He got the joyful message that he would be awarded an ERC Starting Grant from the European Research Council (ERC). He will explore the concept of "sufficiency" when it comes to urban, sustainable food in China. [Read more in Norwegian SciTech News](#) Eller les den på norsk i Gemini (Photo by: Vibeke Ann Pettersen/NTRANS)

when it comes to urban, sustainable food in China.

## THREE WORK PACKAGES IN RESEARCH AREA 1

- **Work package 1:** The role of citizens, public engagement, and culture in deep decarbonization  
Lead: Sara Heidenreich and Christian Klöckner, NTNU
- **Work package 2:** Controversies, conflicting visions, and value trade-offs  
Lead: Ragnhild Freng Dale and Hans Jakob Walnum, Western Norway Research Institute
- **Work package 3:** Governance through research, pilots and experimentation  
Lead: Tomas Moe Skjølsvold and Ida Marie Henriksen, NTNU





## RESEARCH AREA 2 ACCELERATING THE TRANSITION



### WHAT IS THIS RESEARCH AREA ABOUT?

Start-up, acceleration and stabilization are the three phases in which change often takes place. Central to the first phase is the establishment and preparation of new niche technologies.

The second phase is characterized by upscaling and massive diffusion of these core technologies. For example, around energy transitions and renewable energy technology that contribute to achieving important environmental goals such as decarbonisation.

In the third phase, a new, socio-technical configuration stabilizes. Most countries and sectors are still in the early stages. The international academic research has so far also focused on these early phases.

# WINNING SLOWLY IS LOSING ...

“We must really gear up the tempo to meet the Paris agreement goal of 1,5 degrees of future climate warming. Or it will probably be above 2 degrees instead.”



Allan Dahl Andersen, TIK-UiO (Photo: Silje Nørstad/NTRANS)

Unlike other grand challenges confronting our societies, the nature and scope of the climate crisis constantly worsens for each year of passivity, due to cumulative emissions and possible tipping points. At the same time, the decarbonization goals set by climate science imply that the scale of the challenge grows every year as we get closer to 2030 and 2050.

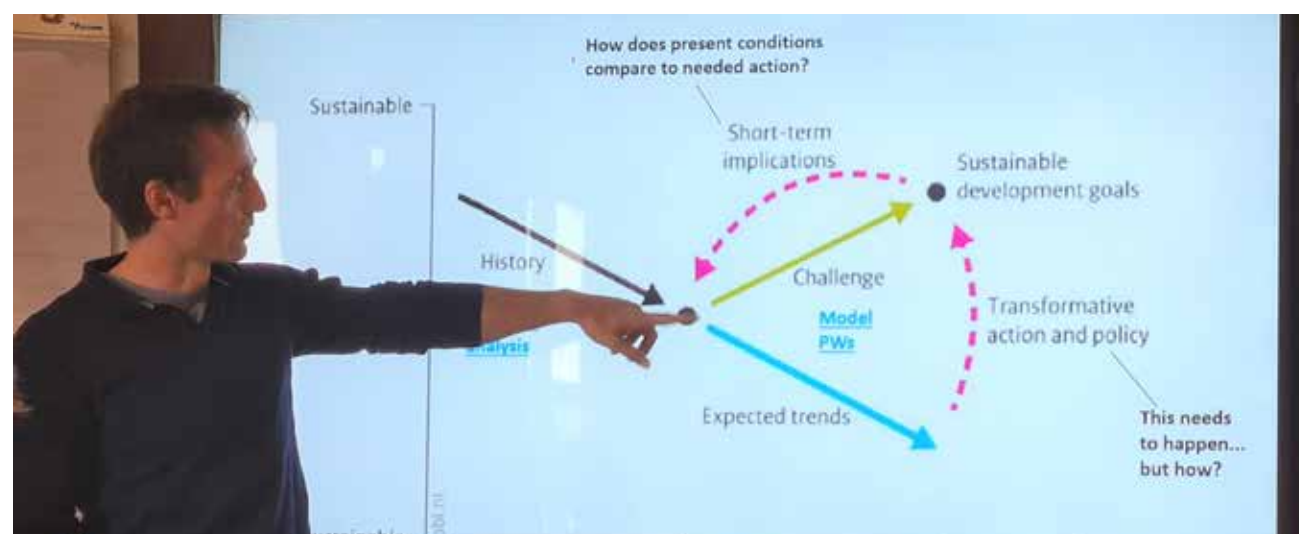
“The urgency of climate action places temporality and radically accelerated sociotechnical change at the heart of the net-zero 2050 challenge,” says NTRANS researcher

Allan Dahl Andersen (TIK-UiO) who is heading research area 2, which is about speeding up the transition.

### URGENCY, CROSS-SECTORAL STRATEGIES, AND POLICY SILOS

“One implication of urgency is that we cannot look at one sector like energy, farming or aviation separately. We must think across all sectors at once. Better coordination of this is vital for harnessing synergies across sectors and reaching the net-zero goal. Urgency also means that





Allan Dahl Andersen is presenting to his research colleagues in NTRANS autumn 2021 on the topic of integrating sociotechnical perspectives with technoeconomic energy systems models.

(Photo: Vibeke Ann Pettersen/NTRANS)

there is limited time for learning by experimenting, by testing and by failing now. Instead, cross-sectoral knowledge sharing can help. Decisionmakers must also think about trade-offs between speed of deployment and optimal solutions. In other words: become clearer about what the value of time is in decarbonization. The industry and the public sector must coordinate and cooperate. Politics and regulations are separated into silos for each area, and it's difficult to coordinate across sectors, but it's not impossible!" says the researcher.

#### THE PORTS – MULTISECTORAL GORDIAN KNOTS

"Ports are good examples of sites where several sectors meet, and the challenges are also very obvious in the ports. The diverse energy sectors are often all present there: electricity, gas, oil, and hydrogen. Complexity in the ports is very high, and it's interesting to look into. The research shows that there are possible solutions to this "gordian knot". The ports are important actors, and they must also change, according to other sectors, systems and technologies that are provided.

#### SOCIAL-TECHNICAL TENSIONS IN RAPID ELECTRIFICATION

Transport and energy sectors are the two main contributors in the run for less carbon emissions. Researchers and the industry are working together on understanding the acceleration issues in their sectors.

"We have been looking into rapid electrification during 2021, especially for ferries. The changes needed are complicated and slow to do, and we don't have time for this! The grid companies are not always prepared to adapt their systems. Maybe it's even necessary to bypass democratic processes in some cases."

Andersen and Postdoc Jakoba Sraml Gonzalez at the TIK centre talked about this new research at the NTRANS annual conference in December.

"Electrification of new user sectors is complicated enough. But when adding the factor of speed... This "double novelty" is really tricky!

#### NEW KNOWLEDGE NEEDED!

"Our recent perspective paper [Increasing the speed, scope, and level of decarbonization for meeting the Net-zero 2050 challenge](#) showed us that there's not yet much research on the topic of urgency and the time factor in transitions," says Andersen. The goal for coming years is to contribute in this area.

The well-known researcher from The University of Manchester, Professor Frank Geels, has been hired part time, because he has an outstanding expertise in this field.

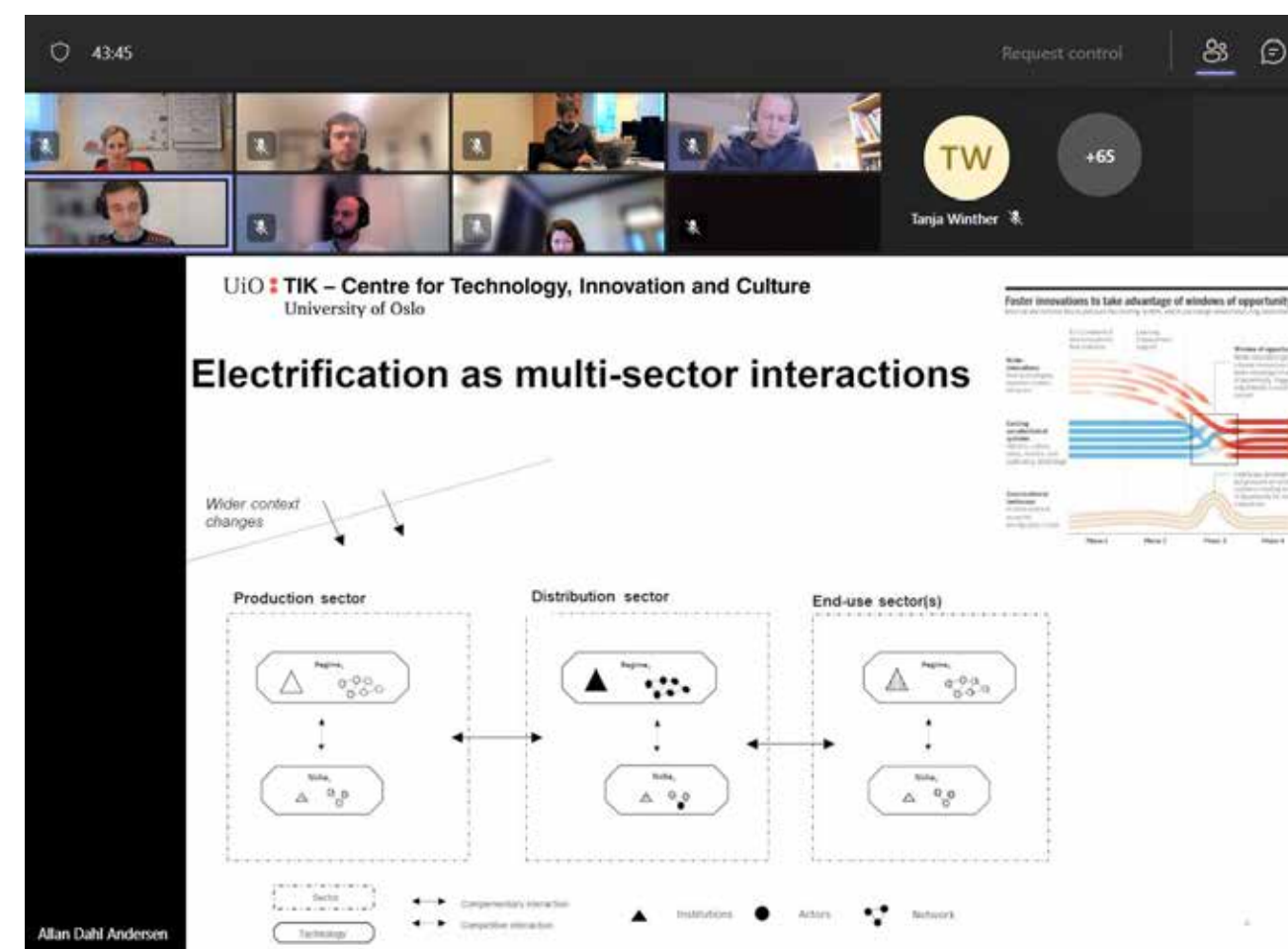
"He is assisting us in understanding the nature of these cross-sectoral challenges and the temporality of transitions" says Andersen. Also, new Postdoctoral candidate, Kejia Yang, will focus her project on these issues.



Frank Geels, Professor of System Innovation and Sustainability at University of Manchester.

#### THREE WORK PACKAGES IN RESEARCH AREA 2

- **Workpackage 1:** The rate of innovation: how to overcome barriers to upscaling and diffusion of key innovations to accelerate energy transitions Lead by Øyvind Bjørgum, NTNU-IØT
- **Workpackage 2:** Resource mobilization: how to increase the scale of resources allocated to energy transition? Lead by Tuukka Mäkitie, SINTEF Digital
- **Workpackage 3:** Transformative innovation policy: how to govern increasingly complex, urgent and contested energy transition? Lead by Allan Dahl Andersen, UiO-TIK



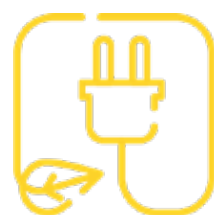
NTRANS annual conference 2021: Allan Dahl Andersen & Jakoba Sraml Gonzalez, (TiK-UiO) held a presentation on Social-technical tensions in rapid electrification.

#### THE RESEARCH PERSPECTIVE: WORKING PAPER



This viewpoint identifies three interrelated transition imperatives to achieve net-zero emissions by 2050 – increasing the speed, scope and level of decarbonization. First, the urgency of climate action places temporality and radically accelerated sociotechnical change at the heart of the net-zero 2050 challenge. Second, this challenge implies a broadening of decarbonisation efforts from the usual focus on electricity and transport to all sectors of the economy, and a need for thinking across multiple sectors. Third, increasing levels of decarbonization necessitates widespread and rapid diffusion of low-carbon solutions with limited time for experimentation and deliberation. Interactions between these imperatives create research challenges related to time frame tensions, tipping points, sector couplings, multi-sector technologies and massive upscaling.

[See the working paper here](#)



### RESEARCH AREA 3

#### FUTURE ENERGY MARKETS



#### WHAT IS THIS RESEARCH AREA ABOUT?

Reorganizing the energy sector is one of the cornerstones of the transition to a low-carbon society, driven by the Paris Agreement and EU's climate programme. We focus on the development, design and implementation of the future energy market in Norway and in Europe.

Our researchers will assess future European market design and integration of markets for energy and flexibility, with particular emphasis on decentralized markets that focus on consumers. We will also contribute to evaluating Norwegian interests, where our low-emission energy resources can be valued and utilized within such a market framework.

We will determine the role of the energy market and the potential in the future energy market – in the transition to an energy system with zero emissions, and to facilitate a future low-carbon society.

## WE ARE BRINGING THE FACTS TO THE TABLE

“Our researchers’ mission is to provide the knowledge base for the energy transition. It can’t be grounded on opinions and beliefs. Facts are king,” says Stefan Jaehnert, who is heading research area 3, and also Research Manager in SINTEF Energy Research.



“Our research is the important knowledge base for the energy transition,” says Research Manager Stefan Jaehnert.  
(Photo: Vibeke Ann Pettersen/NTRANS)



“Society, politicians and the industry need the knowledge base we are providing for the energy transition. The research and the knowledge is essential for the discussion – and for making good decisions”, says Jaehnert.

#### DEFINING THE RESEARCH QUESTIONS WITH USER PARTNERS

“Our PhD Candidates in NTRANS are really getting into the work, and we have also been very active in use cases 1 and 2 during 2021.

“We identify the research questions together with our user partners in the cases. Then we study and analyse those further in our research. There are specific topics we must investigate further: like new energy production and the effect on the energy sector. There is a lot of discussion now on how the market should be designed,” says Jaehnert.

#### ELECTRICITY PRICES – HOT TOPIC

Energy has certainly come on the agenda in 2021. From late 2020/early 2021 wind power issues were really debated in the public. NTRANS researchers also contributed a lot with their know-how in the ongoing debates.

At the end of the year the rising electricity prices, especially in the southern parts of Norway, have been a much-debated topic.

“Our job is to provide facts to this discussion, not opinions,” says Jaehnert.

“There are multiple factors to consider, for example natural gas, those prices also rocketed sky high, and this plays an important role in this picture.

#### RENEWABLE ENERGY VARIES MORE

Wind and sun are examples of renewable energy sources that change with weather conditions. When an increasing part of power production comes from renewable and unregulated sources, at the same time as power consumption becomes more power-intensive, the need for flexibility increases. This will mean that we need a new system for the energy market in the future.

#### FLEXIBILITY WILL HAVE GREAT VALUE

“So, how can today's energy market, with increasing need for flexibility, be operated?”

“One solution to this is to establish actors that represent several households or companies, and compile their offer of flexibility and then supply it in the markets. Such a company is often called an aggregator, and Tibber is one example.”

New technology makes it possible for the demand side to have a more active relationship with its electricity consumption. Some power consumption can be moved to other times without affecting the user's comfort or business activity to a great extent. That means, for example, to move your power consumption to other times of the day. Charging of electric cars during night-time when the general consumption is lower, is one measure that most people could easily adapt.

In the future, many devices will also be able to automatically respond to, for example, price signals or load conditions in the network.

#### CONSUMERS – ACCEPTABLE LEVEL OF COMFORT?

“The bottom-up perspective is important; we must always take the end user into consideration. We are working on different scenarios, with aggregators and models for the distribution of energy. The consumers also play an important part here. How much will they respond, and possibly also which loss of comfort are they willing to accept?” Jaehnert wonders.

“In this research area we work on finding the best way to distribute the energy we have. Not at an individual or household level, but on a national and possibly European level. NTRANS' research area 1 is covering more of the individual perspectives.

“There are so many questions that need to be answered. For example: Is it a good idea to have cables between us and other countries? Our research shows that on the whole, it is a plus, on the European level, but there can be significant effects for Norwegian actors.”



NTRANS researchers are providing the knowledge base for the energy transition.

#### THREE WORK PACKAGES IN RESEARCH AREA 3

##### Market design and integration (WP3.1.1)

Lead by: Endre Bjørndal, NHH

- EU policy framework/4th energy package
- Market design for sector integration

##### The consumer in the centre of the energy system (WP3.2)

Lead by: Jayaprakash Rajasekharan, NTNU

- Digitalisation, active consumers
- Local/decentralized markets

##### Value creation from Norwegian energy sources (WP3.3)

Lead by: Sambeet Mishra, SINTEF Energy Research

- Potential of renewable energy sources (economic/low-carbon society)
- Distribution effects of welfare/value creation

#### CASE STUDY ON EFFECTS FOR NORWEGIAN STAKEHOLDERS



This working paper by Vegard Viken Kallset and Stefan Jaehnert (both SINTEF Energy Research) aims to explore how the impact of building an offshore wind farm will be different depending on how it is connected to the existing grid. In chapter 2 the dataset and the four

cases are described in further detail. Then, the economic results of the cases are presented and compared in chapter 3. Finally, chapter 4 discusses the impact of historical weather years, infrastructure investment costs and effects on stakeholders.





## 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*

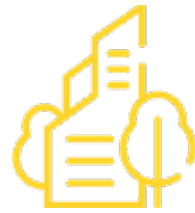
This paper discusses the sociotechnical interactions that are driving and hindering development of hydrogen value chains in Norway. A hybrid approach provides new knowledge on underlying system dynamics and contributes to the discourse on pathways in transition studies.

**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.





## RESEARCH AREA 5

### USER CASE AND INNOVATION

# SINK OR SWIM FOR THE CLIMATE...

"This is important work for the energy transition and the climate. And we are doing it together with our user partners."



(Photo: Vibeke Ann Petersen/NTRANS)

## WHAT IS THIS RESEARCH AREA ABOUT?

Researchers and user partners will collaborate to learn from each other - and create new knowledge. They will present and discuss existing knowledge base and preliminary research results. The collaboration ensures the involvement of the user partners, and facilitates relevant innovation activities.

We will have around ten use cases defined jointly by the user partners and the researchers. Each case lasts for one to two years, and is led by one or two researchers. Sometimes we work closely with other FMEs. User partners offer pilots which reflect on ongoing and planned activities in the energy sector, and which are of general interest to those involved.

"The cooperation with our partners is in a good flow. We have had a lot of workshops together, and we have completed two use cases in 2021," says Senior Researcher Ragnhild Freng Dale at Western Norway Research Institute (VF). She heads NTRANS research area 5, Use cases and innovation. Ragnhild Freng Dale also works a lot with climate issues in addition to energy research. "It's very connected," she says.

### LEARNING EACH OTHER'S LANGUAGES

The researchers in NTRANS come from different fields, and the multidisciplinary angle and scope requires a lot of cooperation - and also co-understanding. We are

joining the partnership with our different backgrounds and perspectives. We need to learn each other's languages, so to speak," says Ragnhild Freng Dale.

"It was really fruitful to eventually meet up, face to face, with researcher colleagues at Brimi in the autumn of 2021. We worked closely together on a few selected topics, and also made a new 10 step method for improving our outcome.

### UPPING THE TEMPO IN RESEARCH SPRINTS

"In spite of the Corona situation, there has been a lot of activity in the use cases throughout the year. Two of





Ragnhild Freng Dale, Western Norway Research Institute (VF)  
(Photo: Silje Nårstad/NTRANS)

them were more or less completed during 2021: number 3a and 1.

Local development of the low-emission society is the topic for use case 1, which is led by researchers Pernille Seljom (IFE) and Marius Korsnes (NTNU). They have been very motivated, and have collaborated with many of our user partners in research sprints. This form of sprinting is a new way of cooperating – invented by NTRANS researchers – where user partners and researchers work closely together to solve problems faster.

#### ELECTRIC CARS AS POWER BANKS?

In 2021 use case 1 has been looking into, among other things, vehicle to grid (V2G) and vehicle to building (V2B). In the future it may be possible to use the electric car as a "powerbank".

V2G is a transmission between the electric car and the electricity grid, where electricity from the electric car can be a resource when needed. This is also known as "two-way charging", and is at a trial stage, but NTRANS researchers worked with several partners to find good and feasible, local solutions to provide good societal benefits.

[See more in this newsarticle from November 2021](#) (in Norwegian).

#### THE CHICKEN AND HYDROGEN EGG ...

Use case 3a has focused on the role of hydrogen in the maritime sector, and has been very active, with several

workshops and a lot of cooperation with user partners. This work resulted in the report "Solving the chicken and egg problem in maritime hydrogen value chains in Western Norway".

Initially transport was just one use case, but it was split into three.

"The transport sector use cases have different focus areas that all deserve attention. By separating the cases it was possible to address them more accurately," says Ragnhild Freng Dale.

"We aim to complete in total 10 use cases within the NTRANS centre".

#### NEW CASES DEFINED WITH PARTNERS

On day 2 of the annual conference 2021 (9 December) there were four separate use case workshops for partners. One of them was dedicated for planning new use cases, and several new NTRANS cases were defined together with user partners.

One of them was case 6, which focuses on societal aspects of offshore wind. This case is a cooperation between FME NTRANS and FME NorthWind.

"Our user partners are showing great interest in the use cases, and our researchers are really eager to continue the work and cooperation. Hopefully we can meet up in person for next year's conference. It would be great to be able to work together in the same room with all our partners!"

#### USE CASES IN NTRANS

- Use case 1: Building the future societies (WP 5.3 UC1)  
Lead by: Pernille Seljom, IFE and Marius Korsnes, NTNU (Completed)
- Use case 2: Renewable power development and its potential uses (WP 5.4 UC2)  
Lead by: Ingeborg Graabak and Stephan Jaehnert, both SINTEF
- Use case 3a: Transport sector: the role of hydrogen in the maritime sector (WP 5.5 UC3).  
Lead by: Tuukka Mäkitie with assistance from Markus Steen, both SINTEF (Completed)
- Use case 3b: Decarbonisation of freight transport between big cities (WP 5.6 UC4). Lead by: Steffen J. Bakker, NTNU. Co-leader is Kari Espegren (IFE)
- Use case 3c: Transport within cities (WP 5.7). Led by Astrid Bjørgen, SINTEF, and Kristin Ystmark Bjerkan, SINTEF
- Use case 4: Carbon Capture and Storage (WP 5.8 UC5)  
Lead by: Asgeir Tomasgard, NTNU
- Use case 5: Sustainable development of innovation districts. Lead by: Pernille Seljom, IFE and Marius Korsnes, NTNU
- Use case 6: Societal aspects of offshore wind. Lead by Tomas Moe Skjølsvold and Sara Heidenreich, both NTNU
- Use case 7: Integrated markets for energy and flexibility. Lead by Stian Backe, SINTEF Energy
- Use case 8: Energy projection, scenarios and climate goals: Lead by Kari Espegren, IFE
- FME forum for innovation and cooperation with the 8 technological FMEs (WP 5.2).  
Lead by: Eirik Gjelsvik Medbø, NTNU

#### THE CHICKEN AND THE HYDROGEN EGG



The report from use case 3a: [Solving the chicken and egg problem in maritime hydrogen value chains in Western Norway](#).



This is a short [summary with recommendations from NTRANS](#) (in Norwegian). See also [Policy Brief in English](#)



# USE CASES IN 2021

The use cases in NTRANS are done in cooperation with our user partners. There has been a lot of activity in the cases through the year, and two of them were completed.

New use cases were also defined together with our user partners in a separate workshop during the annual conference in December.

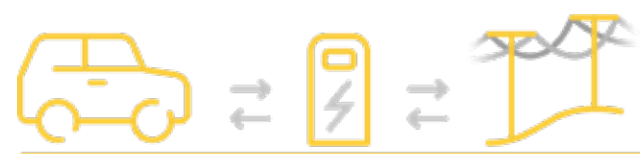
## WHAT IS THE PURPOSE OF USE CASES?

Researchers and user partners collaborate to learn from each other - and to create new knowledge. They present and discuss existing knowledge base and preliminary research results. This collaboration ensures the involvement of the user partners, and facilitates relevant innovation activities.

## THE ELECTRIC CAR – A POWER BANK?

Use case 1, *Building the future societies* was completed during 2021. It was led by Pernille Seljom, IFE and Marius Korsnes, NTNU.

They have been focusing a lot on "two-way charging" of electric cars this year. This is at the trial stage, and NTRANS researchers are working with several of our partners to find good and feasible, local solutions that can provide good societal benefits. The abbreviations V2G (Vehicle to grid) and V2B (Vehicle to building) are often used. Late 2021 the researchers were writing a policy brief with advice on this topic, published early 2022.



V2G is a transmission between the electric car and the electricity grid, where electricity from the electric car can be a resource when needed. V2B is the transmission of electricity from the electric car to the home and/or other buildings.

## HYDROGEN IN THE MARITIME SECTOR



See and download the report

This use case led by Tuukka Mäkitie with assistance from Markus Steen, both SINTEF, was also completed in 2021: Use case 3a, *Transport sector: the role of hydrogen in the maritime sector*.

The case explored the challenges around the "chicken or egg" problem in developing maritime hydrogen value chains in Western Norway. The second workshop was in collaboration with members of Ocean Hyway Cluster as well as NTRANS partners.

The researchers wrote this report on background of the partner collaboration: *Solving the chicken and egg problem in maritime hydrogen value chains in Western Norway*. Early 2022 a short version of this report, with strategic advice, was published in a policy brief.

## OVERVIEW OF SOME OTHER USE CASE ACTIVITIES

- Use case 2: *Renewable power development and its potential uses*. Lead by: Ingeborg Graabak and Stephan Jaehnert, both SINTEF. At the end of the year, during the annual conference, there was a workshop in this use case. On the agenda was the role of offshore wind in the future Norwegian energy system: *Offshore wind - landing and/or export?* This topic was discussed with the user partners involved, with intent to make a draft for a memorandum.
- Use case 3b: *Decarbonisation of freight transport between big cities*. Lead by: Steffen J. Bakker, NTNU with Kari Espegren (IFE) as co-leader. A workshop about the transition was organised with partners in October. On the agenda was: *Case development for multimodal freight transport*. They also looked at cases with focus on a specific transport corridor and product group, for example transport of fish from Trondheim to Stavanger.
- Use case 3c: *Transport within cities*. Led by Astrid Bjørgen and Kristin Ystmark Bjerkan, both SINTEF. This case had a start-up workshop in November, where the goal was to define the relevant topics and partners who were interested to join in, and the plan is to have a research sprint in 2022.
- Use case 4: *Carbon Capture and Storage*, lead by: Asgeir Tomasgard, NTNU. To reach the EU's 2050 goal of climate neutrality, the EU must remove substantial amounts of carbon from the atmosphere. A workshop on this topic was held during the NTNU Energy transition week 2021. [This policy brief](#) from the workshop summarises how negative emissions and CDR can offset emissions streams and remove emissions from the atmosphere.

## NEW USE CASES, STARTING IN 2022

- Use case 5: *Sustainable development of innovation districts*. Lead by: Pernille Seljom, IFE and Marius Korsnes, NTNU.
- Use case 6: *Societal aspects of offshore wind*. Lead by Tomas Moe Skjølsvold and Sara Heidenreich, both NTNU.
- Use case 7: *Integrated markets for energy and flexibility*. Lead by Stian Backe, SINTEF Energy
- Use case 8: *Energy projection, scenarios and climate goals*. Lead by Kari Espegren, IFE

See more about our use cases (in Norwegian):

<https://www.ntnu.no/ntrans/brukercase>

# WEEKLY WEBINARS – POPULAR MEETING POINT

Throughout 2021, the NTRANS lunch webinars have been a weekly gathering of the centre, despite heavy Corona restrictions. The lunch webinars gather researchers and user partners for presentations and informal discussions.

This weekly meeting point has become very popular, and allows us to discuss everything from fresh work by PhD students, to new strategies for transition in the industry. Beyond this we also invite a few guests from outside the centre. Last year, Jørgen Randers was amongst the most popular speakers.

Despite Corona restrictions now largely being lifted, NTRANS will continue with the lunch webinars. "The pandemic has taught us that this way of meeting informally really works", says Vice Director Tomas Moe Skjølsvold, "and this is one of the elements we will continue with also after the pandemic".



Postdoc Ida Marie Henriksen and Vice Director Tomas Moe Skjølsvold (both NTNU) have been happy to see so many partners present at the lunch box webinars during 2021. (Photo: Vibeke Ann Pettersen, NTRANS)

**Overall priorities in 2021**

- Holistic knowledge for decision-making processes in climate and environment policy
- Environmental challenges intertwined with other societal challenges and goals
- UN sustainable development goals
- Climate and environment in the European Green Deal

Below the text is a grid of the 17 Sustainable Development Goals (SDGs) icons. At the bottom of the screen, a video conference interface shows several participants in a grid view.

Screen shot from Sandrine Benard's (Miljødirektoratet/ Norwegian Environment Agency) presentation 11 February 2021.



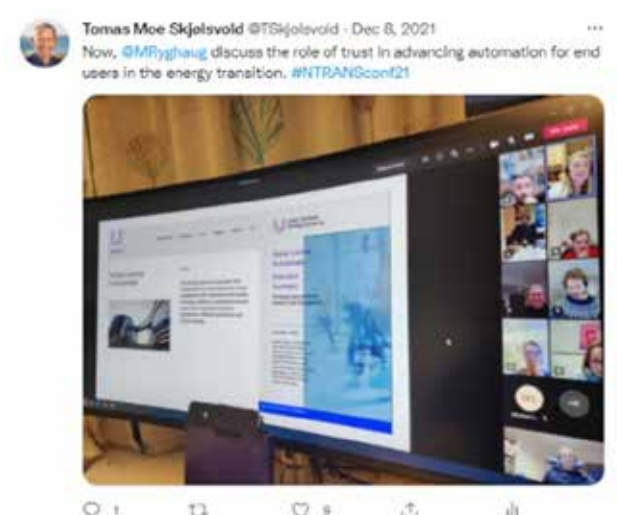
# ANNUAL CONFERENCE 2021

As 2021 was coming to an end, FME NTRANS was gearing up for a live annual conference in Oslo in December. The venue was booked and travel arrangements for many were made, but as corona made a strong comeback we were forced to cancel at the last minute. Hence, the annual conference last year was an online event as it was in 2020.



Chair of programme committee: Tomas Moe Skjølsvold, NTNU. (Photo: Silje Nårstad/NTRANS)

As an online event, however, the conference was a success. Around 100 participants took part in the discussions around three broad topics. The first was *Norway in transition: tempo, democracy and key dilemmas*. The second was *Norwegian resources and resource management: Current status and future prospects*. Finally, we discussed *The way forward: the future of distributed and digital energy systems*. The day also included a session with presentations of all PhD and post doc projects. On the second day of the conference, we hosted a series of workshops that were geared towards developing new user cases. Hence, we used the conference to combine hands on work with developing the centre further as well as strong discussions and dissemination.



# INNOVATION WITH OUR USER PARTNERS



An innovation is not realized until new knowledge has been applied. To contribute to implementation, FME NTRANS therefore focuses on user-owned pilots through Research Area 5, where researchers and user partners collaborate.

By working with specific pilots, partners connect both tacit and explicit knowledge to practice and implementation with a needs-driven process that complements the more research-driven process in other parts of the centre.

## NEW PATHWAYS TO TRANSITION

Some of our innovations are professional and methodical. Over the past year, for example, we have been actively working on model development and new ways of combining qualitative and quantitative methods in our development of pathways, the new 10-step-method. (See more under research area 4.)

## MACRO-LEVEL INNOVATION

FME NTRANS will investigate the interfaces, coordination and potential collaborations between companies, the public sector, consumers, public government and regulators. This will result in innovations that require parallel changes by multiple actors (macro-level innovation). As an example, increasing flexibility among electricity consumers might require adaptations of pricing regulations, adaptations within grid and utility companies, changes in consumer behaviour as well as smart technological solutions. Secondly, the questions we ask in our research are complex and often path dependent. Every step on the way could give implications for what we should do next, revealing new opportunities and barriers. In many cases it will therefore be hard, and sometimes even counter-productive, to recommend direct innovations - concrete new practices or solutions that actors should implement.

## DIRECT AND INDIRECT INNOVATION

It is more likely that the centre will develop knowledge that can influence the strategic orientation of partners, policy and society - like understanding processes, trends, interactions and consequences. While these topics do not directly lead to practical changes, they can create new arenas, topics or strategic directions for innovative practices, indirect innovations - through establishing new projects, investments, regulations and collaborations. Within the 2x2 matrix shown in the figure, it is likely that FME NTRANS will contribute to all types of innovations, but the main value will be created at macro-level, and through indirect innovation contributions.

	Micro-level Innovation	Macro-level Innovation
<b>Direct Innovation</b>	"Classical innovations" - concrete solutions implemented by a single actor	Concrete solutions that require adaptations by multiple actors
<b>Indirect Innovation</b>	Knowledge that opens strategic projects, positioning or investment within one actor	Knowledge that opens strategic interactions, collaborations and co-creations between actors

Figure: The Innovation outputs of FME NTRANS - direct and indirect innovations on micro- and macro-level.

## WHAT IS INNOVATION?

When discussing how we contribute to innovation, let us first agree on what we mean by the term "innovation" in FME NTRANS: Various existing definitions often (but not always) include three elements: novelty, value compared to current practices, and exploitation, meaning that the innovation is somehow used for a real-life purpose. In a social science centre like FME NTRANS, it makes sense to focus on non-technology oriented definitions of innovation, such as the N3 definition proposed by Kommunenes Sentralforbund (KS, 2015 - Nytt, Nyttig, Nyttiggjort). Innovations within FME NTRANS will arise from new knowledge that is useful for user partners and wider society, and that is used to develop partners or society.

# NTRANS RESEARCHERS APPOINTED TO PUBLIC COMMITTEES

Several NTRANS researchers have been appointed by the government to important public committees on energy and climate matters.

Asgeir Tomasgard (NTNU) is member of *The Government Climate Council* (Klimarådet). Tomasgard and Mette Bjørndal (NHH), have been appointed by the government as members of *Technical Calculation Committee for Climate* (Teknisk beregningsutvalg for klima).

Bjørndal was in 2021 also appointed to a *new public committee that aims to assess the development of the power grid* (Strømnettutvalget). Verena Hagspiel (NTNU) and Gunnar S. Eskeland (NHH) have been appointed by the government as members of *The Norwegian Government's Select Committee on Climate Friendly Investments* (Saltvedt-utvalget).



The NTRANS management team and administration. (Photo: Silje Nårstad/NTRANS)



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NTNU

SINTEF

IFE

UiO : Universitetet i Oslo

VESTLANDSFORSKING

Høgskulen på vestlandet

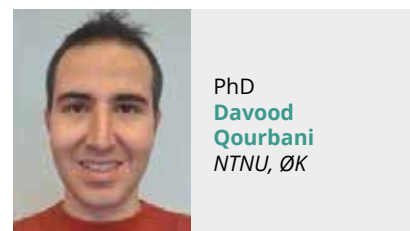
SNF

NHH



# PHDS AND POSTDOCS

Here is a short presentation of the PhD Candidates and Postdocs who joined NTRANS. Their project topics and supervisors are also listed.



PhD  
**Davood Qourbani**  
NTNU, ØK

Tentative title: "Pathways to sustainable mobility systems: Balancing social, technical, and environmental aspects while transforming."

Supervisor: Ruud Egging (NTNU-IØT)



PhD  
**Suzanne Øverlie**  
NTNU-IØT

Tentative title "Innovation and commercialization of environmentally friendly energy in University Industry Collaborations"

Supervisors: Roger Sørheim (NTNU-IØT), Øyvind Bjørgum (NTNU-IØT)



Postdoc  
**Maik Budzinski**  
NTNU, IV

Title: "Assessing the role of Norway for limiting global warming to 1.5°C or 2°C."

Supervisors: Anders Hammer Strømman (NTNU-EPT), Volker Krey (IIASA/ NTNU).



PhD  
**Milad Mehdizadeh**  
NTNU-IPS

Title: "The role of citizens in a transition of the mobility system: An agent-based modelling approach"

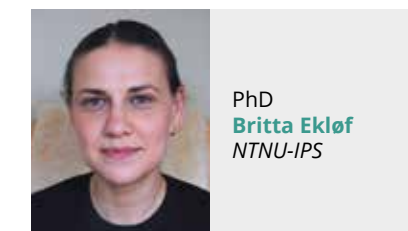
Supervisors: Christian A. Klöckner, main supervisor (NTNU-IPS), Trond Nordfjærn, co-supervisor (NTNU-IPS)



PhD  
**Meike Siefkes**  
NTNU-IØT

Title: "The transition towards the zero-emission society from the energy market's perspective"

Supervisors: Øyvind Bjørgum, main supervisor (NTNU-IØT), Roger Sørheim, co-supervisor (NTNU-IØT)



PhD  
**Britta Ekløf**  
NTNU-IPS

Tentative title: "Citizen engagement and participation in the energy transition - an application of Agent-Based Modelling"

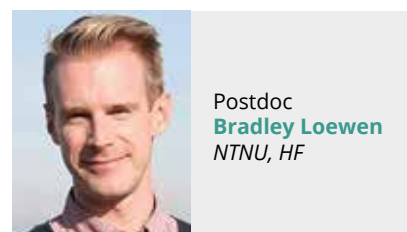
Supervisors: Christian A. Klöckner, main supervisor (NTNU-IPS), Erica Löfström, co-supervisor (NTNU-IPS)



PhD  
**Amber Joy Nordholm**  
NTNU, HF

Tentative title: "Barriers to accelerated diffusion: Socializing, learning and up-scaling of urban pilots."

Supervisors: Marianne Ryghaug (NTNU-KULT), Allan D. Andersen (UiO-TIK), Tomas M. Skjølsvold (NTNU-KULT)



Postdoc  
**Bradley Loewen**  
NTNU, HF

Topic: "Innovation, contestation and social change: Exploring radical ideas in the Norwegian energy transition."

Supervisors: Marianne Ryghaug (NTNU-KULT), Tomas Moe Skjølsvold (NTNU-KULT), Marius Korsnes (NTNU-KULT)



PhD  
**Felipe Van de Sande Araujo**  
NTNU, ØK

Tentative title: "Electricity Flexibility Market Analysis - Understanding the sources, motivations, risks, and viable solutions."

Supervisors: Stein-Erik Fleten NTNU-IØT) Co-supervisors: Mette Bjørndal and Endre Bjørndal (NHH)



PhD  
**Maximilian Koslowski**  
NTNU-EPT

Working title: "Scenarios to guide the reduction of environmental footprints"

Supervisors: Edgar Hertwich & Richard Wood (both NTNU-EPT, IndEcol)



PhD  
**Luke Whittington**  
NTNU-IEL

Topic: "Uncertainty analysis for robust optimization of energy markets"

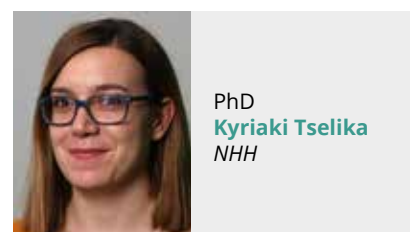
Supervisors: Hossein Farahmand (NTNU-IEL)



Postdoc  
**Simen Rostad Sæther**  
NTNU-ISS

Tentative title: "The politics and governance of decarbonizing the maritime sector - Prospects for accelerated transitions"

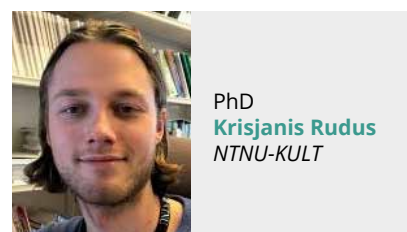
In close collaboration with Espen Moe (NTNU-ISS)



PhD  
**Kyriaki Tselika**  
NHH

Tentative title: "The distributional effects of renewable energy on electricity prices: A panel approach."

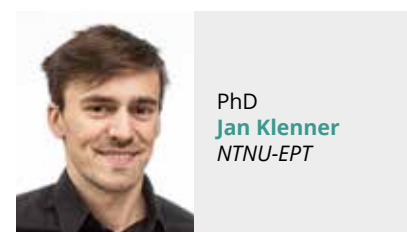
Supervisors: Gunnar Eskeland (NHH) Co-advisors: Leif Kristoffer Sandal (NHH), Evangelos Kyritsis (Statkraft)



PhD  
**Krisjanis Rudus**  
NTNU-KULT

Topic: "Power, inclusion and exclusion in the Norwegian energy transition. Exploring tools for increased engagement and participation across sectors."

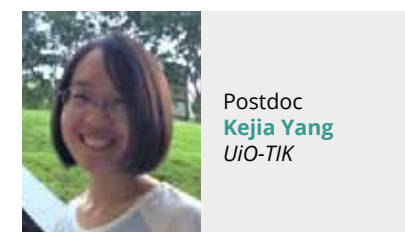
Supervisors: Tomas Moe Skjølsvold (NTNU), Marius Korsnes (NTNU), Jason Chilvers (University of East Anglia)



Postdoc  
**Jan Klenner**  
NTNU-EPT

Topic: "Climate change and air pollution mitigation in the aviation sector"

Supervisors: Anders Hammer Strømman (IndEcol, EPT-NTNU), Helene Muri (IndEcol, EPT-NTNU)



Postdoc  
**Kejia Yang**  
UiO-TIK

Tentative topic: "Accelerating low-carbon energy transition: speed and directionality"

In close cooperation with Allan Dahl Andersen (UiO-TIK)





# PHD GATHERING AT JEGTVOLDEN

NTRANS PhDs and Postdocs finally got the chance to meet in person the very last week of October. They were gathered for three days full of lectures, presentations and teamwork - and also socialising and fun.



Gathered at last: The whole group of PhDs, Postdocs and two of the lecturers at beautiful Jegtvolden, Inderøya. (All photos: Vibeke Ann Pettersen, NTRANS)

All of them presented their projects in front of the group, and they got questions and feedback on the topics afterwards.

They got an introduction to NTRANS, and also on each of the five research areas by the research area leaders. The gathering also included several workshops where they worked together on different topics, such as writing blogs and opinion pieces.

## SEEING THE BIGGER PICTURE

Amber Joy Nordholm was one of the PhDs at the gathering:

"It was so nice to finally meet up, and to see "the bigger picture" of the NTRANS centre. And to really feel part of it, and to be working together towards the Norwegian transition goals," says Amber.

"The sharing of ideas and brainstorming with others was great, it's so much better than trying to be creative in a vacuum. I think the organisers did a very good job, because they also made it fun, and everyone seemed to enjoy themselves," says Amber Joy Nordholm.

## IMPORTANT GROUP

"It was really great to finally meet all these scholars face-to-face", says Tomas Moe Skjølsvold, Vice Director of NTRANS. "The PhDs and Postdocs are an essential backbone of the NTRANS research efforts, and what we have done these last few days clearly shows that we have been able to recruit a creative, international and intellectually strong group of scholars. I'm sure they will be of great value both to the centre, and not least to Norwegian society over the coming years!"

## WORKING IN TEAMS

The PhDs and Postdocs worked on several topics in groups during the three days at Jegtvolden. Here they are working in teams to make a blog or opinion piece.



From the left: Milad Mehdizadeh, Max Koslowski and Ida Marie Henriksen.



From the left: Luke Whittington, Felipe Van de Sande Araujo, Britta Ekløf and Davood Qorbani.



From the left: Krisjanis Rudus, Simen Rostad Sæther, Bradley Loewen and Amber Joy Nordholm.



# "I WAS IMPRESSED BY THE QUALITY OF NorRen SUMMER SCHOOL!"

NTRANS PhD Felipe Van de Sande Araujo on his way to the wind farm at Midtfjellet.



"All the lectures during the week were really great. I wouldn't trade any of them. And I got several new work connections and friends!"

NTRANS PhD Felipe Van de Sande Araujo, recently got back from the NorRen summer school, which was organized in the Bergen area 16- 20 August.

Felipe is full of impressions after a very intense week: "We worked 11 hours a day, and nobody was fooling around. Both the PhDs and the lecturers were taking these important issues really seriously. It was really good to experience the enthusiasm and engagement in the group of 29 PhDs from the energy field."

## MORNING SWIMS IN THE FJORD

"I'm a morning person, so to start the week I enjoyed an early morning swim in the fjord by myself. Later, several of the other participants joined me. The surroundings were so beautiful, and the weather was fine, too."

Felipe admits that in the very beginning, after such a long time with corona and online lectures, he was a bit anxious to be there in person. But all precautions were taken to avoid any COVID spreading, tests were distributed to all participants, and everything was taken care of.

"On the second day the ice was broken, we felt safe and were getting back to a more normal, physical life again. We experienced a true group spirit and shared the enthusiasm as a team," says Felipe.

## PRESENTATIONS AND TEAMWORK

On the first day, the energy PhDs presented their projects to each other.

"It was great to learn that others are working in the same area of research as me. Research can often be lonely work, but now I have a whole new network of good contacts, and also new friends."

This year there was only one field trip, to the wind farm at Midtfjellet and the Stord shipyard. The rest of the week was filled with lectures. Two professors from NTRANS were among the lecturers, director Asgeir Tomasgard (NTNU) and research Director Mette Bjørndal (NHH).

"The lectures were so well balanced, and it was all so well organized. Even though we had a busy schedule, we always got small breaks so that we could digest all the new information."

At the end of the week the PhDs presented results from their team work to the whole group.

**CLIMATE CHANGE REQUIRES ALTRUISTIC THINKING**  
Felipe really feels strongly about the seriousness and urgency concerning the energy transition.

"The research for cleaner energies is really serious, this is important work for the whole world. Climate change will affect us all, like COVID. People must act altruistically and based on good science!"



NTRANS Director Asgeir Tomasgard was one of the excellent lecturers during the summer school. (Photo by Øystein Moen, UiO)



NorRen summer school was held in beautiful surroundings, near Bergen. (Photo by Felipe Van de Sande Araujo.)



The Summer school participants visited the wind farm at Midtfjellet. Kristin Guldbrandsen Frøysa (in front) was one of the organizers. (Photo by Øystein Moen, UiO)



The two NTRANS PhDs, Krisjanis Rudus (to the right) and Felipe Van de Sande Araujo enjoyed the trip to the wind farm at Midtfjellet.



The NorRen group 2021 gathered.



# EXPERIENCES FROM A REMOTE NTRANS INTERN

Iva Stoykova (23) was interning with NTRANS during the spring semester 2021. But interning has not been the same since COVID-19. She couldn't travel as she normally would, so she has been doing her internship virtually.



**Digital reality:** Iva Stoykova has been studying from her girls' room at home in Bulgaria since COVID-19 started. "I would have loved to come to Norway like a regular exchange student, but we are lucky to be able to communicate and continue our work". (Screen shot from Teams.)

"Of course, I would have loved to come to Norway to do my internship in a non-virtual manner! I prefer to meet people face to face, and also to experience different cultures and all the other benefits you get as a regular exchange student".

## IT'S NOT THE WORST-CASE SCENARIO!

She is talking about her experiences from her girl's room in her hometown Petrich in the southwest of Bulgaria through the Teams-screen. And like most students, she is getting used to communicating through several different digital platforms. It's the new normal. She is doing her bachelor's degree in Avans University of Applied Sciences in the Netherlands, but has studied mostly from home since March 2020.

"It's not the worst-case scenario! We are safe, and are actually lucky to be able to do our work". Iva is smiling and taking a positive outlook on the situation.

## THE ROLE OF INNOVATION IN THE ENERGY TRANSITION

Iva Stoykova has been interested in nature and protecting the environment from a very young age. She knew that she had to study abroad:

"We are behind on these matters in Bulgaria, so I needed to go to Western Europe to follow my heart. There's so much at stake".

The topic of her bachelor thesis is "*The role of innovation in the energy transition*", and she has interviewed six key people in six of the Norwegian technological FMEs.

## KEY FINDINGS

Four of the FME centres want to close the gap between partners and academia. Those four centres believe in sector coupling, which means making different sectors work together.

Three of the FME centres believe that the government has to be more active to support innovation, and that they must see the potential of the work that is being done in the research centres.

Iva has learned a lot through her work. For example, she didn't know that Norway had such a lot of hydro power and electric cars. "Norway is doing a good job, and is working together with the EU on major projects. I think that's really important. It's not everyone for himself! We are sharing both the knowledge and the need for innovation".



**First year diploma:** Iva Stoykova with her Propedeutic diploma after the first (of four) years of bachelor studies at Avans University in the Netherlands.

## LEARNING ON BOTH SIDES

"A few of the centres have reported that they have learned some things through my interviews, too. They are quite eager to receive my thesis when it's ready".

Vice Director of NTRANS, and Professor at NTNU, Tomas Moe Skjølsvold has been her supervisor during her internship.

"I'm so grateful for all of his help. He has been so open and given me a lot of feedback. I think I was really lucky to work with him", Iva rounds off the Teams conversation.

## USEFUL FOR THE CENTRE

"Corona has made it difficult to do international activities in a normal way", Tomas Moe Skjølsvold notes, "but students like Iva provide important impulses. She has done a really good job under difficult conditions, and the interviews she has conducted will also be used for research purposes. I hope we soon can welcome more students and researchers from abroad back to our campuses and research communities!"

# INNOVATIVE MASTER STUDENTS RECEIVED LEHMKUHL SCHOLARSHIP FOR HYDROGEN THESIS



"We were honored by being awarded the Lehmkuhl scholarship for the thesis. We greatly appreciate the recognition", said the two former master's students at NHH, Raag August Sandal Rolfsen and Lars Skaugen Strømholm. (Photo: Helge Skodvin / NHH).

Former master's students at NHH who wrote their thesis within NTRANS were awarded the Lehmkuhl scholarship.

"It's really cool that our master's thesis has received such recognition", Strømholm said at the award ceremony this autumn.

Raag August Sandal Rolfsen and Lars Skaugen Strømholm are the students behind the thesis "*Flexible Hydrogen Production*".

"We were very pleased to be awarded the Lehmkuhl scholarship for the thesis. It's a well-recognized award and indicates that the research we have done can actually contribute to new thoughts and innovation in an extremely important field", Rolfsen said to the NHH magazine Bulletin.

The two comrades from Oslo and Trondheim met as bachelor students in Handelshøyskolen at NTNU in Trondheim. Both chose to study further at NHH in Bergen, the business analytics profile.

## THE SUPERVISORS ABOUT THE THESIS

Mette Helene Bjørndal and Endre Bjørndal have been supervisors. They are both researchers in NTRANS and professors at NHH, Departement of Business and Management Science.

"The master's thesis by Strømholm and Rolfsen focuses on the production and storage of so-called green hydrogen - a question of great importance for sustainability and the transition to new, renewable energy sources. Specifically, they are developing a mathematical decision-making model to assess whether fluctuations in electricity prices can be exploited to produce green hydrogen through electrolysis in a profitable way. They look at different assumptions with regard to production capacity, storage capacity and price fluctuations in the electricity market", Mette and Endre Bjørndal explain.

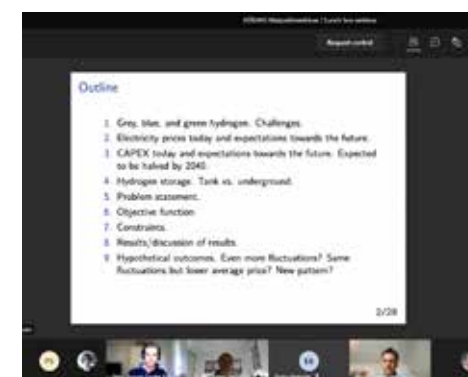
## IMPORTANT FINDINGS

"Among the important findings in the analysis is that large investments are required to be able to take advantage of price fluctuations, that profitability will depend critically on the technical solutions and the specific market situation, and that investments in storage capacity will be particularly important".

"These are good students, who have dug deep into the problem, and combined business economics with optimization and the knowledge they have acquired about the production processes. They have worked independently and together with a business actor, at the same time as they have made good use of the advice and input they have received from us during the work", say the very satisfied supervisors. These two students were also winners of the Best Master Thesis Award at the Department of Business and Management Science (NHH) for 2021.

## Presented at NTRANS lunch box webinar

Earlier this year, Rolfsen and Strømholm also presented the thesis and their findings in the NTRANS' lunch box webinar for partners. Both researchers and user partners, showed a lot of interest in the thesis and their analysis.



Presentation at NTRANS lunch webinar. Here Rolfsen and Strømholm have summarized the thesis in short main points.



Read the thesis: <https://openaccess.nhh.no/nhh-xmlui/bitstream/handle/11250/2770501/masterthesis.pdf?sequence=1&isAllowed=y>



# REPORT FROM UngEnergi

During the summer of 2021, UngEnergi employed two new motivated students to the editorial staff.



Some of the UngEnergi crew: From the left: Holger Ekker Setten, Petter Andreas Lona, Pernille Martinussen Ryghaug. Not present: Sofie Amalie Sørsum and Simonas Strassunskas.

Our sister organization UngKlima was also established in 2021. This resulted in UngEnergi having a greater focus on the energy-related part of our website, and to update and develop the content concerning renewable energy. Because of these new developments we decided to rebrand the UngEnergi trademark, with different fonts, colours and a brand-new logo.

We have been on some excursions this year. Together with UngKlima, we visited the wind farm at Stokkfjellet in Selbu. This was a very interesting event with great hands-on experience for us. It was great to learn more about wind power on location during the construction of the facility, and not just reading about it.

Loosening Covid-19 restrictions finally allowed us to be present with a stand at the annual Researcher's Night at NTNU. We participated with one of our previous projects, the bicycle that measures the amount of electricity you can produce. We simultaneously discussed different perspectives on renewable energy with the visiting students.

We are looking forward to many great projects and events in 2022: For example, the celebration of our ten-year anniversary, while continuing to convey the message of renewable energy to middle school and high school students.

[UngEnergi website](#)



# UngKlima IS IN ACTION!

Summer 2021 the start-up of UngKlima (Young Climate) took place. This is a new initiative where a young staff create good and easy-to-understand content about the climate for young people.



Climate cheering: The young people from UngKlima and UngEnergi were gathered for a start-up meeting at NTNU. Here with Bjørn Arild Silseth from Trondheim Municipality, Stig A. Larssæther and Hege Nakstad from NTNU on each side. (Photo: Vibeke Ann Pettersen/NTRANS)

Summer and part-time jobs were advertised, and six young high school students and students aged 17-22 were employed in the UngKlima editorial office. They are all passionate about climate, and will create written and graphic content for websites and other channels, or tell vividly and well about climate in classrooms in secondary schools and high schools regionally. Much of the content they create will also be used nationally in disseminating knowledge about climate to young people.

## COOPERATION WITH UNGENERGI

The staff in UngKlima will work together with a similar young editorial staff working with renewable energy communication. UngEnergi has existed for a number of years already, under NTRANS and its predecessor CenSES and the NTNU Energy Transition Initiative. This young group has already got a lot of experience in communicating with young people through web pages and social media.

## "EXCITED ABOUT PRESENTING IN THE CLASSROOMS"

UngKlima will also be communicating directly with pupils, in classrooms in secondary schools, and later probably also in high schools in the region.

Johanna Toutain (21) is one of the UngKlima staff preparing presentations. She's a master's student at NTNU-IØT.

"It's almost ready now, and I'm so looking forward to meeting the pupils live in the classrooms! We will do a trial round first, and will then go "on tour" to share this important message about the climate in 2022. We focus on the measures that can be taken – globally, nationally, locally – and also on a personal level. It's more positive to talk about what you can do, than the consequences. If you feel that you can contribute with something, that's much more engaging," says Johanna Toutain.

## PASSION FOR THE CLIMATE AND YOUNG PEOPLE

She's already experienced in tutoring young people, through working as a private teacher in Mentor Norway for a few years.

"I'm passionate about both the climate issues and communicating with young people. I think it's really important that they get good and understandable information!"

Johanna is also learning a lot herself through this work. "I think about it quite often during my everyday life. Especially on finding new ways to communicate in an engaging manner. I seek inspiration and follow the climate debate. I'm so happy to be a part of the UngKlima staff! I really enjoy working together in groups, and cooperating with UngEnergi."



"I'm passionate about communicating climate issues to young people," says Johanna Toutain (21) who is part of the UngKlima editorial staff. (Photo: Vibeke Ann Pettersen/NTRANS)

## THESE ARE BEHIND UNGKLIMA

- Trondheim Municipality, Grønn barneby
- NTNU Sustainability
- NTNU Energy
- SINTEF
- FME ZEN
- FME NTRANS
- Norsk klimastiftelse (Norwegian Climate Foundation)

[UngKlima website](#)



# HOW CAN NORWEGIAN RENEWABLE ENERGY SOURCES BE UTILISED BEST AND WHAT ARE THE CONSEQUENCES FOR STAKEHOLDERS

User case 2 in FME NTRANS assesses Norwegian renewable energy resources as well as the potential for value creation from these.

Based on several workshops with center partners a number of selected topics have been discussed, such as projections for power production and consumption. Furthermore, individual technologies, such as wind power, hydropower, data centers and hydrogen production have been addressed. This provides the basis for a final policy brief that aims to put together the perspectives and identify future research needs.

As part of the user case, a study is done targeting the development of offshore wind power production and possible market solutions for interconnection and pricing principles. The case study is done with existing market models from SINTEF Energy Research and a data set for 2030 developed in the research centre FME HydroCen and subsequent research projects. The cases include development in the area of "Sørilige Nordsjø II" and "Utsira Nord". In the case of "Sørilige Nordsjø II", a direct connection to Norway, a direct connection to Denmark and a so-called hybrid solution are assessed, where the offshore wind farm is part of a future ocean grid and is connected to Norway as well as to Denmark. The cases defined in the study are shown in the table below.

Figure 1 reports economic results for various stakeholders. The biggest difference in the cases is the distribution between consumers and hydropower producers. In case 2, prices in Norway decrease due to the increased amount of wind power. This means that hydropower producers' income decreases and that consumers receive less expenditure. In contrast, prices are higher in case 4 and the distribution is thus more in favour of hydropower producers.

Figure 2 to the right shows the achieved price for a non-flexible hydropower plant, a flexible hydropower plant and the new offshore wind farm in each

scenario, together with the area price of the power plant. The two hydropower plants are both located in the area of Southern Norway. The wind farm achieves a higher price when it is connected to Norway than when it is connected to only Denmark, despite the fact that the area price in Denmark is generally somewhat higher.

## CONTACT PERSONS

Vegard Viken Kallset, Stefan Jaehnert

See working paper [Integration of offshore wind power at Utsira Nord and Sørilige Nordsjø II](#)

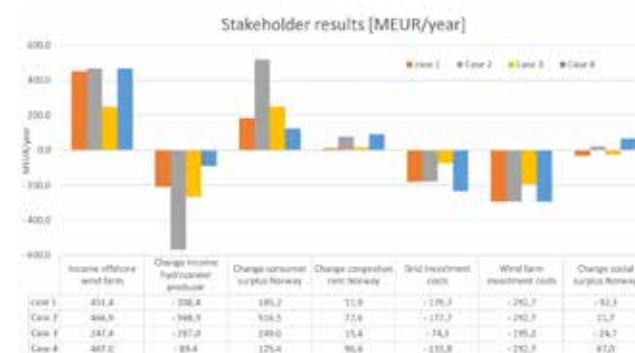


Figure 1 the type of connection has a significant effect for different markets



Figure 2 the case analysis confirms the value of flexibility the hydropower can provide

Case	Area for offshore wind park	Capacity offshore wind park	Interconnection
1	Sørilige Nordsjø II	3 GW	3 GW to Denmark
2	Sørilige Nordsjø II	3 GW	3 GW to Norway
3	Utsira Nord	1.5 GW	1.5 GW to Norway
4	Sørilige Nordsjø II	3 GW	Hybrid connection with 1.5 GW to Denmark and 1.5 GW to Norway

# PILOT PROJECTS SHAPE SOCIETY, BUT NEGLECTS THEIR SOCIETAL ROLE

Within the energy and transport domain, pilot and demonstration projects have become central tools for advancing the energy transition.

Such projects are important in more ways than by testing and demonstrating new technologies. They give content, direction, and speed to transitions across diverse sectors. They are sites where visions and ideas about how a low-carbon society should look is made real. For a social scientific FME-centre such as NTRANS, this makes such projects an important object of study, because they contribute to the shaping of future societies.

In the report [Making the smart grid through pilot projects. Insights, lessons and ways forward](#), NTRANS researchers' studied 30 active smart grid pilots. The key goal of these projects is to contribute to the electrification of society through processes of digitalization. Key insights from the report are:

- Many actors are involved in smart grid innovation, but a few actors dominate. Projects are similar in set-up. There is a form of power accumulation in the smart grid innovation field, which might hamper creativity and lead to new path dependencies and lock-ins.
- Smart grids need social change to work, but projects often take social aspects (trust, privacy, acceptance, ownership, access, behavior) for granted, or defines them as out of scope.
- Projects are often based on implicit assumptions about human rationality, access to technological capabilities, interest, and capital. Projects that involve users tend to recruit non-representative samples. Lessons might not be generalizable, and in the worst cases misleading. If scaled up, smart grids based on such assumptions might increase social and economic inequalities and lead to social backlash.
- Social science is marginal in this field.
- There is a large, untapped potential for transformative innovation that engages both social and technical aspects of needed change.

The report recommends developing a national strategy for societal electrification that addresses social, technical, and economic aspects. Further, the report recommends



a more inclusive funding strategy for pilot and demonstration activities both in terms of involving a broader set of actors in the work, and in knowledge production. Following its publication, the report has had significant impact, being discussed in the media, amongst industry actors and within a national committee discussing how to change the future power grid (strømnettutvalget).



# THE PORT – AN IMPORTANT TRANSITION ACTOR

Ports are crucial nodes in both sea- and land-based transport. The green shift necessitates that ports adapt to new needs, demands and expectations, both from users, owners, and other stakeholders. As service providers, authority and business actors, ports can play an important role in the energy transition.

How ports transition towards zero-emission energy hubs and contribute to emission reductions in the sectors that they serve are, therefore, key questions. With a focus on the Norwegian context, these questions have been addressed in the research project TRAZEPO. This has included attention to i) opportunities and challenges for energy transitions in ports, ii) strategies, solutions, and instruments for different types of ports, and iii) how ports' contribution to the energy transition can be developed and strengthened in a system perspective.

From the international literature on ports, we know that they play different roles, also related to sustainability. The traditional roles are 'landlord', 'regulator' and 'operator'. Via these roles, ports can improve not only their own but also their customers' and users' environmental footprint. More recently the role of the port as 'community manager' has gained more attention. This role has much in common with the 'intermediary' role that we know from innovation and transition studies. Intermediaries are crucial in transition processes because they perform 'relational work' between different actors, institutional change and new technology. Amongst other, intermediaries contribute to collaboration and learning across different organisations, and to the formation of networks and partnerships. Such processes are important in energy transitions because the different elements of socio-technical systems need to change and be configured in new ways.

TRAZEPO involved both qualitative and quantitative analysis of transition processes, focusing on the roles of the port. This includes in-depth case studies of the ports in Oslo, Narvik and Kristiansand. In all cases we found that the port organizations worked as 'intermediary' to influence or facilitate customers/port users to switch to other forms of energy than conventional fossil fuels (see e.g., Bjerkan et al. 2021; Damman & Steen 2021). The quantitative analysis confirms these findings, and also that intermediation is performed by many types of ports (Bjerkan et al. 2021). An interesting finding is that the more active ports are as intermediaries or community managers, the more progressive they are in terms of implementing solutions that contribute to the energy transition both in the port sector, local industry, and the transport sectors they serve. Further development of this role as community manager requires that the role of the ports as transition actors is acknowledged politically, and that ports have the necessary resources and framework conditions.

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Transition towards zero emission ports (TRAZEPO) Knowledge-building project funded by the Research Council of Norway (Energix programme) 2018-2022. Research partners: SINTEF Digital, SINTEF Community, SINTEF Industri, NTNU KULT, Chalmers tekniske høyskole, Copenhagen Business School. User partners: Kystverket, Norske Havner, Kristiansand Havn, Narvik Havn, Oslo Havn

Website:  
<https://www.sintef.no/prosjekter/2018/trazeipo/>

Publications:  
<https://www.researchgate.net/project/Transition-towards-zero-emission-ports-TRAZEPO>

# SPIN-OFF PROJECTS

A lot of applications for new projects have been sent during 2021, and a number of new projects have started up. Some examples are:

**Hydrogen Pathways 2050** is a four-year project that received funding from the Research council of Norway (NFR) in 2021. The project is led by IFE, with research partners SINTEF Energy, SINTEF Digital, NTNU Elkraft and NTNU IØT, and user partners Equinor, Gassco and Statkraft. Hydrogen Pathways 2050 will analyse the transformation of Norwegian society towards 2030 and 2050, with a special focus on hydrogen. It will include both production and use of hydrogen in Norway, but also look at hydrogen as a possible export product and the interplay between renewable power production, power transmission, hydrogen production and end-use.

**ACES (Accelerating Energy- and Sustainability Transitions in Ports: from national visions to coconstructed transition)** is a competence and collaboration project funded by the Research council of Norway (NFR). It is led by SINTEF Community with research partners SINTEF Digital, NTNU KULT, Dutch Research Institute for Transitions (DRIFT) and user partners: The Ports of Kristiansand, Bodø and Borg, CCB, The Norwegian Coastal Administration, Norwegian Maritime Authority, The Norwegian Public Roads Administration, The Railway Directorate, Norwegian Environment Agency, Norwegian Ports, NHO - Norwegian Logistics and Freight Association and Skift Norway. The purpose is to facilitate and accelerate energy transition in Norwegian ports and associated sectors.

**INTERPORT (Integrated energy systems in ports)** is a competence project for the business community funded by the Research council of Norway (NFR). It is led by SINTEF Energy, with research partners SINTEF Digital and NTNU. Norwegian District Heating, Energy Norway, Equinor, Statkraft and Saga Fjord Base are user partners. The purpose is to develop and disseminate knowledge about the design of integrated, decarbonised and cost-effective energy systems in ports.

**CaptureX (Socio-technical drivers, opportunities and challenges for large-scale CCUS)** is a research project funded by the Research council of Norway (NFR). It is led by SINTEF Digital, with research partners from NTNU KULT, the UiO TIK centre, Chalmers University of Technology and SINTEF Energy. The purpose is to develop new knowledge about drivers, opportunities and challenges for large-scale CCUS.



**SNAPSHOT (Understanding transport properties of e-commerce)** is a competence and collaboration project funded by the Research council of Norway (NFR). It is led by SINTEF Community, with research partners Molde University College and user partners the Norwegian Public Roads Administration and the municipalities of Oslo and Bodø. The purpose is to improve the authorities' decisions through more knowledge of the mobility of e-commerce shipments.

**PowerDig (Digitization of short-term resource allocation in power markets)** is a competence and collaboration project funded by the Research council of Norway (NFR). It is led by NTNU with research partners SINTEF Energy, SNF and user partners Statkraft and Statnett. The purpose is to develop new market design that ensures optimal short-term allocation of energy resources based on digital solutions.

**Gemini Centre Sustainability Transitions** was established with SINTEF Digital, NTNU KULT and the UiO TIK Centre as partners. The purpose is to contribute to further development of the field 'sustainability transitions' in Norway and internationally. The focus is on joint project development and progression of relevant educational options for research fellows and younger researchers.

**Gemini Centre Economic analysis and modelling** was established with NTNU IØT and SINTEF (Industrial Economics and Value Chains) and aims to develop a broad and professional project portfolio for various sectors and initiatives. Furthermore, the centre will pursue strategic development and professional management of models and tools, increase assessment capacity, provide advice to public and private actors and provide knowledge about valuation, optimisation and analysis in a systems and societal perspective.



# ENERGY TRANSITION WEEK

FME NTRANS co-hosts the annual NTNU Energy Transition Week, which normally consists of one physical conference and several workshops during the week.

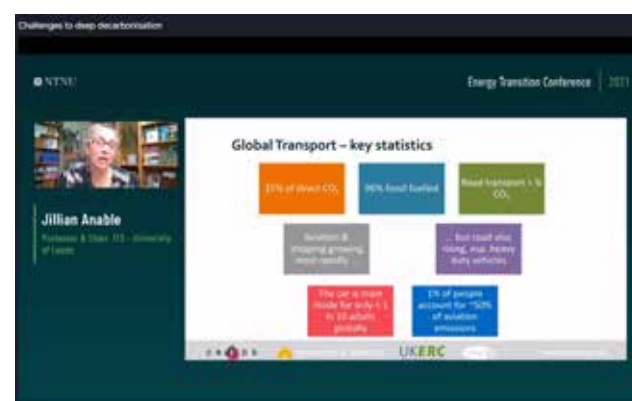


The 2021 edition of the Energy transition Conference had to go digital due to corona restrictions, and all the workshops also had to be virtual. Several Conference speakers were from the EU, UN and the government. It gathered an international crowd of 542 participants from 47 countries. Approx. 300 researchers, industry and business leaders and actors from the public sector participated in the workshops.

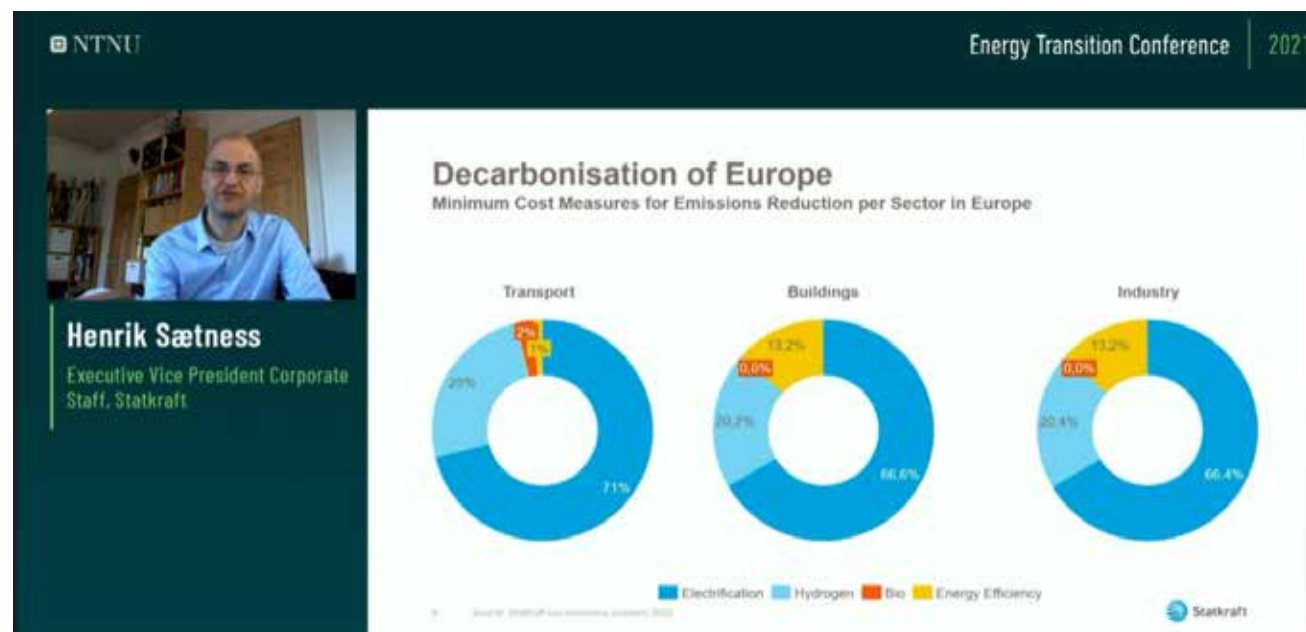
## Main topics for the conference:

- Fairness and justice in the energy transition
- On track to meet the Paris agreement?
- Challenges to deep decarbonisation
- The colour of hope is green
- Don't slow me down

See the talks on [NTNU Energy Transition Initiative's Youtube channel](#).



Jillian Anable, Professor and Chair in Transport and Energy, Institute for Transport Studies, University of Leeds, spoke in the session "Challenges to deep decarbonization".



Henrik Sætness, Executive Vice President Corporate staff in Statkraft, spoke in the session "Challenges to deep decarbonization".

# COP26 IN GLASGOW

NTRANS Director Asgeir Tomasgard gave advice to policymakers in an event at The UN Climate Change Conference in Glasgow – also called COP26.



In Glasgow: Nils Røkke (left) and Asgeir Tomasgard presenting at the COP26. The Norwegian Climate and Environment Minister Espen Barth Eide was listening intently. (Photo: Anne Steenstrup-Duch, SINTEF Energy)

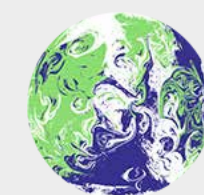
In between the Covid lockdowns during most of 2021, some NTRANS researchers managed to go abroad for some real-life international cooperation. NTRANS Director Asgeir Tomasgard was able to overcome a lot of practical Corona hurdles, and he presented research findings and advice on climate matters at The UN Climate Change Conference in Glasgow (COP26). COP26 brought together 120 world leaders and over 40,000 registered participants, including 22,274 party delegates, 14,124 observers and 3,886 media representatives.

## THE NORTH SEA AS A SPRINGBOARD FOR THE GREEN TRANSITION

On 9 November he presented advice to policy makers in an event together with SINTEF Sustainability Director Nils Røkke.

They presented recommendations based on a document on the North Sea's possible role in the green transition: the North Sea as a springboard for the green transition. NTRANS researchers have contributed to the content of the document, together with researchers from other FMEs. Climate and Environment Minister Espen Barth Eide also attended this event in Glasgow.

[See video from the COP26 event and the documents](#)



UN CLIMATE  
CHANGE  
CONFERENCE  
UK 2021

IN PARTNERSHIP WITH ITALY

## THIS IS COP26

COP26 was the annual UN climate change conference that took place in Glasgow 2021.

COP stands for Conference of the Parties, and the summit was attended by the countries that signed the [United Nations Framework Convention on Climate Change \(UNFCCC\)](#) – a treaty that came into force in 1994.

This was the 26th COP summit and was hosted in partnership between the UK and Italy. The conference was held in Glasgow from 1-12 November 2021, a year later than planned due to delays caused by the Covid pandemic.



## TACEMM IN HELSINKI AND STOCKHOLM

In November 2021 there was a slight Covid pause, and it was possible to go through with a planned TACEMM course in Finland and Stockholm.

The week from 8 to 12 November was filled with energy related lectures, but also social events, for the PhDs participating in the TACEMM short course on flexibility in the energy market. Five lecturers from the extended network of TACEMM and partner institutions gave talks. Christian Skar was in charge from NTRANS and NTNU. He is an Adjunct Associate Professor at NTNU, and at the same time formerly employed by NTRANS partner Volue, and now Statkraft.



*The cruise ferry M/S Silja Symphony took the group to Stockholm and back to Helsinki.*

### LECTURES AND FUN AT SEA

Christian Skar welcomed the young researchers to The TACEMM lectures that took place at Aalto university in Helsinki. The group then travelled to the Helsinki port to board the cruise ferry M/S Silja Symphony, for a night cruise bound for Stockholm. The next day the group went to visit Stockholm University, on campus Kista. "Post Covid we wanted to organize a special event, with extra focus on the social part in addition to the lectures by renowned international experts on the topic of flexibility

in energy markets. After the lectures and dinner on the boat we had social activities like karaoke and Mario Kart. The atmosphere was really good," says Skar.

### TRANS-ATLANTIC INFRADAY CONFERENCE

In Stockholm the institutions Aalto University, University of Maryland, Stockholm University, NTNU and their people introduced themselves. Before returning back to the ship to return to Helsinki the group were given some free time to explore Old Town, Stockholm.

Back in Helsinki they had more lectures, and could attend the Trans-Atlantic Infraday Conference, which was organized by our TACEMM partners, the University of Maryland and TU Berlin.

"The evening we returned to Helsinki the students were welcomed to a bridging conference event at the Fat Lizard restaurant on the Aalto University campus. The last two days they could join both the course lectures and conference sessions. It was all set in a very modern, inspiring, and cool environment, the Design factory at Aalto.

We are planning the next winter school at Oppdal and a Summer school in 2022," says Christian Skar.



*Lectures in the design factory at Aalto university. (Photos by Mary-Ann Alfthan, Aalto U.)*

### ABOUT TACEMM

TACEMM (Trans-Atlantic Consortium on Energy Markets Modelling) is an INTPART project with funding from the Norwegian Research Council. TACEMM facilitates international cooperation within research and education, with emphasis on education. Several countries worldwide are connected to the network.



*TACEMM lecturers gathered, from the left: Jalal Kazempour (DTU), Steven Gabriel (UMD, NTNU), Ramteen Sioshansi (OSU), Christian Skar (NTNU), David Daniels (Chalmers), Afzal Siddiqui (Stockholm U and Aalto U).*

## NTRANS IN NUMBERS 2021

47

SCIENTIFIC PUBLICATIONS

70

CONFERENCE PRESENTATIONS

9

NATIONAL RESEARCH PARTNERS

33

USER PARTNERS (INCLUDING TWO OBSERVERS)

30

MASTER'S DEGREES

51

EVENTS – CONFERENCE, WEBINARS AND WORKSHOPS

# STATEMENT OF ACCOUNT

## FUNDING

Funding	Amount	Total
The research council		8 207
The host institution (NTNU)		10 670
Research partners		3 553
Høgskulen på Vestlandet	799	
Institutt for energiteknikk	283	
Norges handelshøyskole	1 660	
Samfunns- og næringslivsforskning		
SINTEF AS	267	
SINTEF Energiforskning	201	
Universitetet i Oslo	33	
Vestlandsforskning	310	
Enterprise partners		5 082
Equinor	1 817	
Hydro	841	
Gassco	500	
Statkraft	540	
BKK	245	
Energi Norge	227	
ATB	100	
Ruter	136	
eSmart systems	127	
Nodes	20	
Powel	202	
Becour AS	60	
NLF	66	
Posten Norge	80	
Saga Fjordbase	100	
Hub for Ocean	23	

Public partners		3 273
Enova	340	
Innovasjon Norge	-	
Miljødirektoratet	53	
Statens vegvesen	500	
Statsbygg	219	
Kystverket	107	
Gassnova	275	
Jernbanedirektoratet	417	
Bergen kommune	113	
Oslo kommune	150	
Trondheim kommune	304	
Kinn kommune	200	
Trøndelag fylkeskommune	461	
Vestland fylkeskommune	134	
Total		30 785

The table shows the funding per partner, both cash and in-kind (all figures in NOK 1000).

## COSTS

Costs	Amount	Total
The host institution (NTNU)		16 233
Research partners		12 348
Høgskulen på Vestlandet	1 647	
Institutt for energiteknikk	1 988	
Norges handelshøyskole	2 268	
Samfunns- og næringslivsforskning	589	
SINTEF AS	2 307	
SINTEF Energiforskning	1 789	
Universitetet i Oslo	678	
Vestlandsforskning	1 082	
Enterprise partners		1 002
Equinor	217	
Hydro	241	
Gassco	-	
Statkraft	40	
BKK	45	
Energi Norge	77	
ATB	-	
Ruter	36	
eSmart systems	27	
Nodes	20	
Powel	102	
Becour AS	60	
NLF	66	
Posten Norge	50	
Saga Fjordbase	-	
Hub for Ocean	23	

Public partners		1 203
Enova	40	
Innovasjon Norge	-	
Miljødirektoratet	53	
Statens vegvesen	-	
Statsbygg	69	
Kystverket	107	
Gassnova	275	
Jernbanedirektoratet	117	
Bergen kommune	13	
Oslo kommune	-	
Trondheim kommune	104	
Kinn kommune	-	
Trøndelag fylkeskommune	311	
Vestland fylkeskommune	114	
Total		30 785

The table shows the cost per partner (all figures in NOK 1000).



# PERSONNEL

## KEY RESEARCHERS

Name	Institution	Main research area
Allan Dahl Andersen	UIO	RA2 Accelerating the energy transition, RA4 Transition pathways, RA5: User cases and innovation
Anders Hammer Strømman	NTNU IV	Cross cutting area 3
Asgeir Tomasgard	NTNU OK	Centre director
Astrid Bjørgen	SINTEF AS	RA5: User cases and innovation
Bendik Nybakk Torsæter	SINTEF EF	RA5: User cases and innovation
Benjamin Sovacool	VF	RA1 Deep decarbonization and wide societal changes, RA2 Accelerating the energy transition
Bente Johnsen Rygg	HVL	RA1 Deep decarbonization and wide societal changes, RA2 Accelerating the energy transition
Bård T. Haugland	NTNU HF	RA1 Deep decarbonization and wide societal changes, RA2 Accelerating the energy transition, RA4 Transition pathways, RA5: User cases and innovation
Carl-Johan Södersten	SINTEF AS	RA5: User cases and innovation
Carlo Aall	VF	RA1 Deep decarbonization and wide societal changes, RA2 Accelerating the energy transition
Christian Klöckner	NTNU SU	Citizen behaviour and attitudes in energy transition processes
Dejene Assefa Hagos	HVL	RA4: Transition pathways
Dhayalan Velauthapillai	HVL	RA5: User cases and innovation
Edgar Hertwich	NTNU IV	Cross cutting area 3
Endre Bjørndal	NHH/SNF	RA3 The future energy market
Erlend Dahl	SINTEF AS	RA5: User cases and innovation
Erling Holden	HVL	RA4 Transition pathways
Eva Rosenberg	IFE	RA3 The future energy market, RA4 Transition pathways, RA5: User cases and innovation
Fabian Rocha Aponte	SINTEF AS	RA5: User cases and innovation
Frode Rømo	SINTEF AS	RA4 Transition pathways, RA2 Accelerating the energy transition, RA5: User cases and innovation
Geoffrey Gilpin	HVL	RA5: User cases and innovation
Gerardo Perez-Valdez	SINTEF AS	RA1 Deep decarbonization and wide societal changes, RA2 Accelerating the energy transition, RA4 Transition pathways, RA5: User cases and innovation
Gunnar Eskeland	NHH/SNF	RA2 Accelerating the energy transition
Hans Jakob Walnum	VF	RA1 Deep decarbonization and wide societal changes, RA2 Accelerating the energy transition
Ingeborg Graabak	SINTEF EF	RA5: User cases and innovation
Janis Danebergs	IFE	RA4 Transition pathways, RA5: User cases and innovation

Name	Institution	Main research area
Jens Hanson	SINTEF AS	RA5: User cases and innovation
Julian Straus	SINTEF EF	RA5: User cases and innovation
Kari Aa. Espegren	IFE	RA4 Transition pathways, RA5: User cases and innovation
Kirsten Svenja Wiebe	SINTEF AS	RA2 Accelerating the energy transition, RA4 Transition pathways
Kristin Linnerud	HVL	RA2 Accelerating the energy transition, RA5: User cases and innovation
Kristin Ystmark Bjerkan	SINTEF AS	RA2 Accelerating the energy transition, RA5: User cases and innovation
Kristina Haaskjold	IFE	RA3 The future energy market
Lisa Kvalbein	IFE	RA3 The future energy market
Lisa S. Græslie	SINTEF AS	RA2 Accelerating the energy transition
Lone-Erin Lervåg	SINTEF AS	RA5: User cases and innovation
Mari Haugen	SINTEF EF	RA5: User cases and innovation
Maria Diez Gutierrez	SINTEF AS	RA5: User cases and innovation
Marius Korsnes	NTNU HF	RA1 Deep decarbonization and wide societal changes, RA2 Accelerating the energy transition, RA4 Transition pathways, RA5: User cases and innovation
Markus Steen	SINTEF AS	RA1 Deep decarbonization and wide societal changes, RA2 Accelerating the energy transition, RA4 Transition pathways, RA5: User cases and innovation
Marte Fodstad	SINTEF EF	RA5: User cases and innovation
Mette Bjørndal	NHH	Electricity Market Design, Congestion Management, Flexibility and Demand Response
Mette Bjørndal	NHH/SNF	RA3 The future energy market, RA5: User cases and innovation
Morten Simonsen	VF	RA1 Deep decarbonization and wide societal changes, RA2 Accelerating the energy transition
Nina Møllerstuen Bjørge	SINTEF AS	RA2 Accelerating the energy transition
Pernille Seljom	IFE	RA3 The future energy marked, RA4 Transition pathways, RA5: User cases and innovation; Cross-cutting activity
Ragnhild Freng Dale	VF	RA1 Deep decarbonization and wide societal changes
Rune Njøs	HVL	RA2 Accelerating the energy transition, RA5: User cases and innovation
Sahar Babri	SINTEF AS	RA2 Accelerating the energy transition, RA5: User cases and innovation
Sambeet Mishra	SINTEF EF	RA3 The future energy market
Sara Heidenreich	NTNU HF	RA1 Deep decarbonization and wide societal changes, RA2 Accelerating the energy transition, RA4 Transition pathways, RA5: User cases and innovation
Sigrid Damman	SINTEF AS	RA1 Deep decarbonization and wide social changes, RA4 Transition pathways
Stefan Gøssling	VF	RA2 Accelerating the energy transition
Stefan Jaehnert	SINTEF EF	RA3 The future energy market, RA5: User cases and innovation
Teis de Francqueville Hansen	SINTEF AS	RA2 Accelerating the energy transition
Tomas Moe Skjølsvold	NTNU HF	Deputy centre director
Tuukka Mäkitie	SINTEF AS	RA1 Deep decarbonization and wide societal changes, RA2 Accelerating the energy transition, RA4 Transition pathways
Vegard Viken Kallset	SINTEF EF	RA3 The future energy market

Name	Institution	Main research area
Venkatachalam Lakshmanan	SINTEF EF	RA5: User cases and innovation
Vibeke Stærkebye Nørstebø	SINTEF AS	RA4 Transition pathways, RA5: User cases and innovation
Ville Olkkonen	IFE	RA3 The future energy market
Stein-Erik Fleten	NTNU OK	RA3 The future energy market
Steffen Bakker	NTNU OK	RA5: User cases and innovation
Paolo Pisciella	NTNU OK	RA4: Transition pathways, RA5: User cases and innovation
Rita V. D'Oliveira Bouman	NTNU OK	RA5: User cases and innovation
Pedro Crespo del Granado	NTNU OK	RA5: User cases and innovation
Ruud Egging-Bratseth	NTNU OK	RA4: Transition pathways, RA5: User cases and innovation
Anne Neumann	NTNU OK	RA4: Transition pathways

VISITING RESEARCHERS

Name	Affiliation	Nationality	Gender	Duration	Topic
Michelle Geraerts	University of Amsterdam	Dutch	F	12 months	The afterlives of lithium batteries in the midst of Norway's energy transition to electric mobility
Iva Stoykova	Avans Hogeschool	Dutch	F	3 months	The role of innovation in the energy transition
Lukas Engel	TU Darmstadt	German	M	15.3.21-6.6.21	Literature review of modal transport shift in everyday mobility
Steven Gabriel	University of Maryland	American	M	one week nov 2021	Teaching and supervision

POSTDOCTORAL RESEARCHERS WITH FINANCIAL SUPPORT FROM THE CENTRE BUDGET

Name	Nationality	Period	Gender	Topic
Bradley James Loewen	Canada	20201101-20231031	M	Innovation, contestation and social change: exploring radical ideas in the Norwegian energy transition
Maik Budzinski	Tyskland	20200504-20220503	M	Integrated Assessment Modelling and Industrial Ecology
Jakoba Sraml Gonzales	Slovenia	20200501-20210930	F	RA 2 "Accelerating the energy transition", topic: accelerating electrification processes, an organisational perspective

PHD STUDENTS WITH FINANCIAL SUPPORT FROM THE CENTRE BUDGET

Name	Nationality	Period	Gender	Topic
Kyriaki Tselika	Greece	20200101-20230814	F	Energy Prices
Amber Joy ordholm	USA	20201001-20230930	F	Power, inclusion and exclusion inthe Norwegian energy transition. Exploring tools for increased engagement and practice change across sectors
Jan Klenner	Germany	20201102-20231101	M	Climate Change Mitigation in the Aviation Sector
Felipe Van de Sande Araujo	Brasil	20200901-20230831	M	Analysis of flexibility markets for electricity

Davood Qorbani	Iran	20200801-20230731	M	The transition to sustainable mobility from a systems perspective
Rudus Kris Janis	Latvia	20210111-20240110	M	Power, inclusion and exclusion in the Norwegian energy transition. Exploring tools for increased engagement and participation across sectors
Øverlie Suzanne	Norway	20210201-20240131	F	Innovation and commercialization of environmentally friendly energy in University Industry Collaborations
Siefkes Meike	Germany	20210816-20240815	F	The transition towards the zero-emission society from the energy market's perspective.
Whittington Luke	Great Britain	20211001-20240930	M	Short-term energy system integration in neighbourhoods, transport and industry - effects on long-term system design
Koslowski Maximilian	Germany	20210802-20240801	M	Scenarios to guide the reduction of environmental footprints
Eklöf Britta	Sweden	20210801-20240731	F	Collective action and climate change: drivers and barriers to climate engagement
Mehdizadeh Milad	Iran	20210801-20240731	M	The role of citizens in a transition of the transportation system

POSTDOCTORAL RESEARCHERS WORKING ON PROJECTS IN THE CENTRE WITH FINANCIAL SUPPORT FROM OTHER SOURCES

Name	Funding	Nationality	Period	Gender	Topic
Mario Blázquez de Paz	NHH	Spain	2020-2023	M	Electricity Market Design, Industrial Organization, Competition Economics
Isabel Montero Hovdahl	NoCeT Norwegian Centre for Taxation	Norway	2023-2023	F	Environmental Economics, Climate Change, Econometric Modeling, Machine Learning, Technological Change

PHD STUDENTS WORKING ON PROJECTS IN THE CENTRE WITH FINANCIAL SUPPORT FROM OTHER SOURCES

Name	Funding	Nationality	Period	Gender	Topic
Parinaz Aliasghari	NTNU	Iran	2021-2024	F	Flexibility in Energy Systems
Benjamin P. Fram	NHH	USA	2017-2021	M	Electricity Markets, Econometrics, Energy Finance, Risk Management
Raquel Alonso Pedrero	BEYOND (EU) / FlexBuild (RCN)	Spain	2020-2023	F	End-user flexibility, local markets and design of flexible power systems
Goran Durakovic	Clean Energy Exports (RCN)	Norway	2020-2023	M	Clean energy strategies for Norwergian exports
Guray Kara	FME CINELDI (RCN)	Turkey	2017-2021	M	Flexibility markets in distribution grids
Mohammadreza Ahang	ASSETS (RCN)	Iran	2018-2021	M	Energy transition analysis from a European and Norwegian perspective
Stian Backe	FME ZEN (RCN)	Norway	2017-2021	M	The role of Zero Energy Neighbourhods to the European Energy Transition
Olaf Lehn Tranås	NCCS	Norway	2020-2023	M	CCS in high RES energy systems needing flexibility and in connection to industry



MASTER DEGREES

Name	Gender	Topic
Jeanett Haugstulen Grinden	F	Master i kommunikasjon og medieteknologi. Topic: «Formidling av klimaforskning gjennom opinionsledere. En kvalitativ casestudie av CICERO, Bellona og Klimaetaten sitt samarbeid med opinionsledere»
Marte Hagen Solbrekken	F	STS Master: Å bygge mot strømmen. En sosioteknisk studie av utslippsfrie bygge- og anleggsplasser
Oda Elise Bekken Standal	F	STS Master: Å bygge mot strømmen. En sosioteknisk studie av utslippsfrie bygge- og anleggsplasser
Nora L. E. Kristiansson	F	STS Master: Bærekraftig boligpolitikk – en realitet eller en utopi? En kvalitativ studie som undersøker hvordan bærekraftig utvikling forsta’s og omsettes blant sentrale aktører innenfor norsk boligpolitikk
Negar Safara Nosar	F	The prospect of blue and green hydrogen in Norwegian maritime sector. Master Thesis in Climate Change Management, Dep. Of Environmental Sciences, Faculty of Engineering and Science. HVL.
Oskar Langeland	M	Social Acceptance of Hydrogen in the Norwegian Maritime Sector: Challenges and Experiences from an Industrial Perspective. Master Thesis in Climate Change Management, Dep. Om Environmental Sciences, Faculty of Engineering and Science. HVL.
Jørgen Osnes	M	How will different politics affect the energy system? - An energy political analysis of the political parties in Norway.
Julian Lahuerta	M	The Emerging U.S. Offshore Wind Industry: an analysis of cumulative change and regional context. . Master's thesis in Globalisation and Sustainable Development, Department of Geography, NTNU. Supervisor: Markus Steen
Anders Røthe Johannessen	M	Ambition to Transition? A Case Study of Norwegian Trade Unions
Ellen van den Boogaart	F	The Lithium-Ion Battery Value Chain: a Sustainability Paradox. A Global and Norwegian Perspective on Value Chain Transformation
Christopher Faust	M	Simplified Life Cycle Assessment of Onshore Power Supply
Ingvild Budal Jacobsen	F	Unblack-boxing the role of firms in sustainability transitions - A qualitative study of firm’s agency in the emerging offshore wind industry in Norway
Kristina Moe -	F	Electrification of Construction: Investigating Actor Roles and Interactions in Cross-Sector Sustainability Experiments
Ingeborg Encarnacion Wigen	F	AI for sustainability and decarbonisation in society - A case study of how AI can be implemented for sustainability and how TeleABC works to overcome challenges to incorporate climate goals in their business
M. Melgård og J. Sætherø		The Impact of Renewable Production in the Arctic. Supervisor: Mario Blázquez de Paz
Louis Le Grelle	M	Analysis of the European electricity grid scenarios Application to the Belgian renewable energies
Martine Utgård and Elise Tomt	F/F	Offshore wind and its effect on the Nordic power market
Micah Gentry	F	Understanding the Role of a Corporate Net-Zero Carbon Strategy in Value Chain Decarbonization
Antonia Lauterbach	F	Assessing the Profitability of Hybrid Microgrids for Rural Electrification
Stian Paulsen and Aasmund Bergsholm	M/M	Efficiency in the Nordic Futures Power Market
Richard Lischitzki and Ingrid Beisland	M/F	Norm Changes & Economic Decision-Making - An Examination of the Effects of Changes in Social & Moral Norms on Meat Consumption

Md Rahman and Juan Caro	M/M	Business Opportunities in Waste Heat Utilization in Norway - A new business research for the cloud data center pilot project at the Norwegian Center for Energy Transition Studies (NTRANS)
Stian Roness	M	Energilagring i mikronett
Lars Strømholm and Raag Rolfsen	M/M	Flexible Hydrogen Production: A Comprehensive Study on Optimizing Cost-Efficient Combinations of Production and Storage Capacity to Exploit Electricity Price Fluctuations
Tonje Cappelen and Øyvind Aasnæs	F/M	Vannkraftpotensialet i Norge
Eivind Haugen	M	LNG shipping in the Arctic
Mayuran Sivakumaran and Jessica Hirst	M/F	Sustainable Investment: Factors Influencing the Adoption of a Sustainable Investment Strategy
Abhimanyu Manimaran	M	The role of Business Ecosystems in restoring nature
Morten Følling and Andrea Månsson	M/F	Vertical Farming in Norway
Erik Sævareid	F	The impacts of a North Sea offshore grid solution and aluminium flexibility in the European power system until 2060

PROJECTS

Prosjekt	Status	Call/funder	NTRANS-partner	Koordinator
BEYOND	start-up 1.1.2020	ERA-Net Smart Energy Systems, med støtte fra H2020	NTNU	NTNU
ENTRANCES – Energy Transitions from coal and carbon: Effects on societies	start-up 1.5.2020	H2020 SSH, aspects of the Clean- Energy Transition: LC-SC3-CC-1-2018-2019-2020	NTNU	University of A Coruña, Spania
ENCHANT - Energy Efficiency through behaviour Change Transition	start-up 1.10.2020	H2020 Socio-economic research: non-energy impacts and behavioural insights on energy efficiency interventions LCSC3-EE-2020-1	NTNU	NTNU
SENDER – Sustainable consumer engagement and demand response	start-up 1.10.2020	H2020 Consumer engagement and demand response, LC-SC3-EC-3-2020	NTNU	Smart innovation Norway
CLEANcultures - An approach for innovative Climate Learning, Evaluation and Action in Neighbourhoods	start-up 1.12.2020	JPI Climate, Solstice call	NTNU	Johanneum Research
CAMPAIGNers - Citizens Acting on Mitigation Pathways	start-up 1.5.2021	H2020-LC-CLA-10-2020	NTNU	Energy Institute – JKU, Østerrike

Prosjekt	Status	Call/funder	NTRANS-partner	Koordinator
ENHANCERIA: developing a transformation agenda focusing on the role of universities as drivers and enablers of sustainable development.	start-up 1.9.2021	H2020-EU.5. - SCIENCE WITH AND FOR SOCIETY	NTNU	NTNU
European Universities of Technology Alliance Research and Innovation Action	start-up 1.9.2021	H2020-IBA-SwafS-Support-2-2020	NTNU	NTNU
TransformAR	start-up 13.10.2021	H2020-LC-GD-1-3-2020	NTNU	University of Antwerp
ENERGICA	start-up 18.11.2021	H2020-LC-GD-2-3-2020	NTNU	TU Berlin
Climate Change Resilience in Small Communities in the Nordic Countries project (ClicNord)	start-up 2021	Nordforsk, Nordic societal security in light of the emerging global and regional trends	NTNU	University college Copenhagen, Danmark
ACCTING	start-up 1.1.2022	H2020 Green Deal	NTNU	European Science Foundation
ARV	start-up 1.1.2022	H2020-LC-GD-4-1-2020	NTNU	ZEN/NTNU
JUSTUs	Applied okt. 2021	HORIZON-CL5-2021-D2-01	NTNU	IFO Institute
Protein Diversification Compass	Applied okt. 2021	HORIZON-CL6-2021-FARM2FORK-01	NTNU	Free University Brussels
PATTERN	Applied sep. 2021	HORIZON-CL5-2021-D1-01-07	NTNU	Complutense University of Madrid
JUST CLIMATE	Applied sep. 2021	HORIZON-CL5-2021-D1-01-05	NTNU	TU Berlin
INCLUDE: Involvement and deliberation for an inclusive transition	Applied 18.10.2021	HORIZON-CL5-2021-D2-01-12	NTNU	IEECP, Nederland
SSH Centre: Social Sciences and Humanities for Climate, Energy and Transport Research Excellence	Applied 18.10.2021	HORIZON-CL5-2021-D2-01-13	NTNU	University of East Anglia, UK

# PUBLICATIONS

## JOURNAL ARTICLES

- Bach, Hanna; Mäkitie, Tuukka Rainer Reinhold; Hansen, Teis; Steen, Markus.**  
Blending new and old in sustainability transitions: Technological alignment between fossil fuels and biofuels in Norwegian coastal shipping. Energy Research & Social Science 2021 ;Volume 74. p. - [SINTEF](#)
- Backe, Stian; Ahang, Mohammadreza; Tomasgard, Asgeir.**  
Stable stochastic capacity expansion with variable renewables: Comparing moment matching and stratified scenario generation sampling. Applied Energy 2021 ;Volume 302. [NTNU](#)
- Bakker, Steffen J.; Kleiven, Andreas; Fleten, Stein-Erik; Tomasgard, Asgeir.**  
Mature offshore oil field development: Solving a real options problem using stochastic dual dynamic integer programming. Computers & Operations Research 2021 ;Volume 136. p. - [NTNU](#)
- Bjerkan, Kristin Ystmark; Bjørge, Nina Møllerstuen; Babri, Sahar.**  
Transforming socio-technical configurations through creative destruction: Local policy, electric vehicle diffusion, and city governance in Norway. Energy Research & Social Science 2021 ;Volume 82. [SINTEF](#)
- Bjerkan, Kristin Ystmark; Hansen, Lillian; Steen, Markus.**  
Towards sustainability in the port sector: The role of intermediation in transition work. Environmental Innovation and Societal Transitions 2021 ;Volume 40. p. 296-314 [NTNU](#) [SINTEF](#)
- Bordin, Chiara; Tomasgard, Asgeir.**  
Behavioural change in green transportation: Micro-economics perspectives and optimization strategies. Energies 2021 ;Volume 14.(13) p. 1-20 [UiT](#) [NTNU](#)
- Bringedal, Amanda Sæbø; Søvikhagen, Anne-Marthe Liaklev; Aasgård, Ellen Krohn; Fleten, Stein-Erik.**  
Backtesting coordinated hydropower bidding using neural network forecasting. Energy Systems, Springer Verlag 2021 p. - [ENERGISINT](#) [NTNU](#)
- Bugge, Markus Michaelsen; Andersen, Allan Dahl; Steen, Markus.**  
The role of regional innovation systems in mission-oriented innovation policy: exploring the problem-solution space in electrification of maritime transport. European Planning Studies 2021 p. - [SINTEF](#) [UiO](#) [NIFU](#)
- Damman, Sigrid; Sandberg, Eli; Rosenberg, Eva; Piscella, Paolo; Graabak, Ingeborg.**  
A hybrid perspective on energy transition pathways: Is hydrogen the key for Norway?. Energy Research & Social Science 2021 ;Volume 78.(78) p. 1-15 [SINTEF](#) [IFE](#) [NTNU](#) [ENERGISINT](#)
- Damman, Sigrid; Steen, Markus.**  
A socio-technical perspective on the scope for ports to enable energy transition. Transportation Research Part D: Transport and Environment 2021 ;Volume 91. p. - [SINTEF](#)
- Egging-Bratseth, Ruud; Kauko, Hanne; Knudsen, Brage Rugstad; Bakke, Sara Angell; Ettayebi, Amina; Haufe, Ina Renate.**  
Seasonal storage and demand side management in district heating systems with demand uncertainty. Applied Energy 2021 ;Volume 285. p. - [NTNU](#) [ENERGISINT](#)
- Espegren, Kari Aamodt; Damman, Sigrid; Piscella, Paolo; Graabak, Ingeborg; Tomasgard, Asgeir.**  
The role of hydrogen in the transition from a petroleum economy to a low-carbon society. International Journal of Hydrogen Energy 2021 ;Volume 46.(45) p. 23125-23138 [SINTEF](#) [NTNU](#) [IFE](#) [ENERGISINT](#)
- Fjellså, Ingvild Firman; Ryghaug, Marianne; Skjølsvold, Tomas Moe.**  
Flexibility poverty: 'locked-in' flexibility practices and electricity use among students. Energy Sources, Part B: Economics, Planning and Policy 2021 p. - [NTNU](#)
- Fjellså, Ingvild Firman; Silvast, Antti; Skjølsvold, Tomas Moe.**  
Justice aspects of flexible household electricity consumption in future smart energy systems. Environmental Innovation and Societal Transitions 2021 ;Volume 38. p. 98-109 [NTNU](#)
- Golombek, Rolf; Lind, Arne; Ringkjøb, Hans-Kristian; Seljom, Pernille Merethe Sire.**  
The role of transmission and energy storage in European decarbonization towards 2050. Energy 2021 ;Volume 239. p. - [UiB](#) [FRISCH](#) [IFE](#)
- Hashemipour, Seyed Nasar; Aghaei, Jamshid; Kavousi-fard, Abdollah; Niknam, Taher; Salimi, Ladan; Crespo del Granado, Pedro; Shafie-Khah, Miadreza; Wang, Fei; P. S. Catalão, João.**  
Optimal Singular Value Decomposition Based Big Data Compression Approach in Smart Grids. IEEE transactions on industry applications 2021 ;Volume 57.(4) p. 3296-3305 [NTNU](#)



**17. Hegeman, Puck; Sørheim, Roger.**

Why do they do it? Corporate venture capital investments in cleantech startups. Journal of Cleaner Production 2021 ;Volume 294. p. - [NTNU](#)

**18. Holden, Erling; Linnerud, Kristin; Rygg, Bente Johnsen.**

A review of dominant sustainable energy narratives. Renewable & Sustainable Energy Reviews 2021 ;Volume 144. p. - [NMBU](#) [CICERO](#) [HVL](#)

**19. Holz, Franziska; Scherwath, Tim; Crespo del Granado, Pedro; Skar, Christian; Olmos, Luis; Ploussard, Quentin; Ramos, Andrés; Herbst, Andrea.**

A 2050 perspective on the role for carbon capture and storage in the European power system and industry sector. Energy Economics 2021 ;Volume 104. [NTNU](#)

**20. Korsnes, Marius; Throndsen, William.**

Smart energy prosumers in Norway: Critical reflections on implications for participation and everyday life. Journal of Cleaner Production 2021 ;Volume 306. p. - [NTNU](#)

**21. Linnerud, Kristin; Holden, Erling; Simonsen, Morten.**

Closing the sustainable development gap: A global study of goal interactions. Sustainable Development 2021 ;Volume 29.(4) p. 738-753 [CICERO](#) [NMBU](#) [HVL](#)

**22. Rygg, Bente Johnsen; Ryghaug, Marianne; Yttri, Gunnar.**

Is local always best? Social acceptance of small hydropower projects in Norway. International Journal of Sustainable Energy Planning and Management 2021 ;Volume 31. p. 161-174 [HVL](#) [NTNU](#)

**23. Selseng, Torbjørn; Linnerud, Kristin; Holden, Erling.**

Unpacking democracy: The effects of different democratic qualities on climate change performance over time.. Environmental Science and Policy 2021 ;Volume 128. p. 326-335 [HVL](#) [VF](#) [NMBU](#)

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