

ANNUAL REPORT 2022



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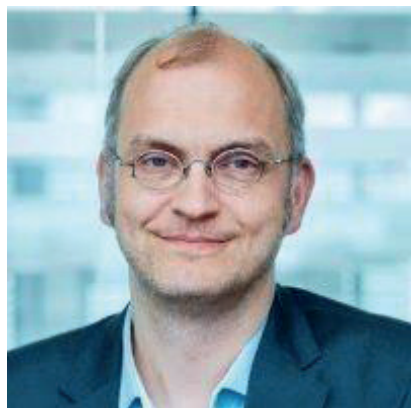
ANNUAL REPORT 2022

FME NTRANS – NORWEGIAN CENTRE FOR ENERGY TRANSITION STRATEGIES

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HOMEPAGE:
[HTTPS://WWW.NTRANS.NO/](https://www.ntrans.no/)



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

MESSAGE FROM THE CHAIR OF THE BOARD

The brutal Russian invasion of Ukraine in February 2022 marked the ultimate farewell of an era of interdependence, cooperation and globalisation. The Russian energy war on Europe started already late summer 2021 with reduced gas flows into an already tight market. With the further reductions in Russian gas flows in the first part of 2022, Europe was sent into an energy crisis of a magnitude not seen since the oil crisis in 1973.

Through a number of short-term measures and helped by favourable winter weather, Europe is currently coping, and the energy markets have weathered the first storm. The long-term responses from both Europe and the USA to this new geopolitical reality is intended to drive a further acceleration of the energy transition. Deployment of low carbon technologies at a faster pace is likely to be the result, and the ambitions to diversify the value chains for these technologies through more local manufacturing in the US and Europe will be very interesting to follow.

NTRANS research on the energy transition with a cross-disciplinary approach is well suited to address this situation where the energy transition increasingly becomes a societal and political challenge as well as the original technical energy systems challenge.

The centre has in 2022 been running at full steam, producing results, delivering insight, employing researchers, teaching students, holding workshops and appearing in the media. We are all looking forward to an exciting 2023, which among other things brings us closer to the mid-point of NTRANS in 2024.



**Centre Director,
Asgeir Tomasgard**

REPORT FROM THE CENTRE DIRECTOR

This report provides an overview of FME NTRANS activities in 2022, showcasing the progress made in our research areas and the successful collaboration between researchers, industry, municipalities, government agencies, and NGOs. As the world slowly returns to normalcy, we have adapted to a mix of virtual and in-person events, fostering a hybrid approach that will continue to evolve in the coming years.

Our use cases in 2022 have demonstrated the power of collaborative efforts in addressing various aspects of the energy transition, including decarbonization, sustainable development, and integrated markets for energy and flexibility. We are proud of the active contributions made by our 17 PhD students and 4 Postdocs. They are central to our research and cooperation in the center, but more importantly will be invaluable resources for society in the future, driving the implementation of the energy transition.

While we have made substantial research progress this year, the journey ahead is filled with opportunities and challenges. We will continue to uphold our commitment to being curious, brave, and inclusive in our research, striving for an efficient and just transition. With an ongoing energy crisis it is even more important than before to speed up the transition.

I would like to express my gratitude to all our partners and everyone involved in FME NTRANS. Your dedication and collaboration have been instrumental in our achievements this year. I look forward to further strengthening our partnerships and witnessing the impact of our research in the years to come.

Together, we will drive the transition towards a sustainable and net-zero society.

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.

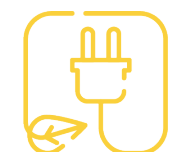
MAIN RESEARCH AREAS



Research Area 1
Deep Decarbonisation and Wide Societal Changes



Research Area 2
Accelerating the Transition



Research Area 3
Future Energy Markets



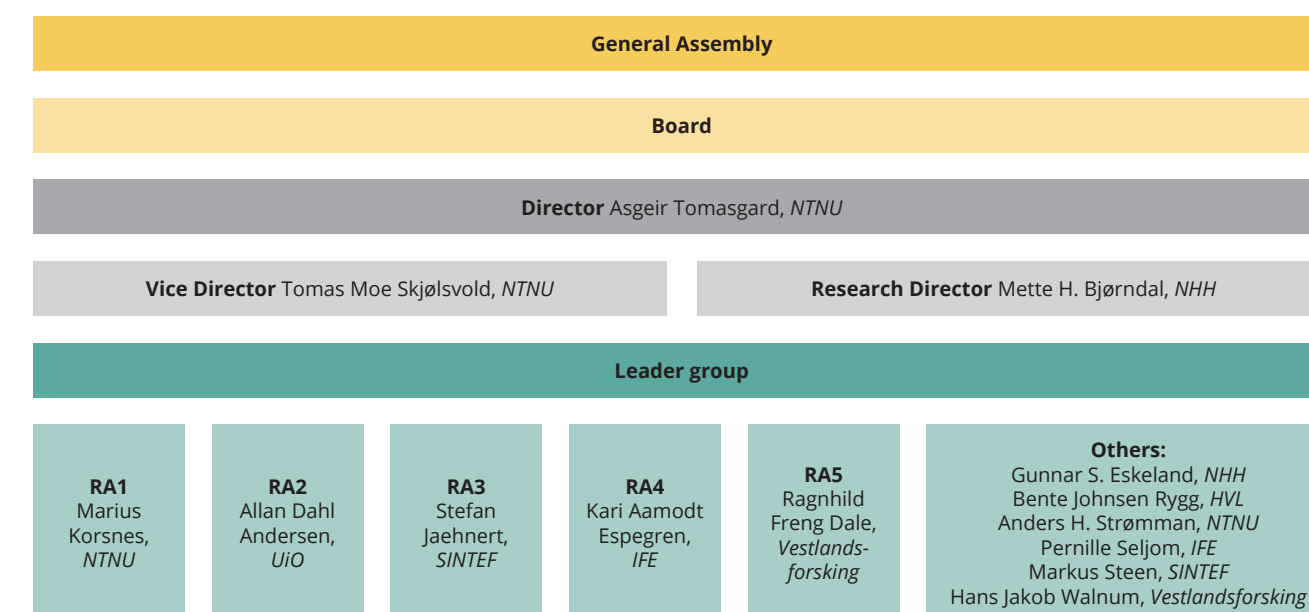
Research Area 4
Pathways to a Sustainable Future



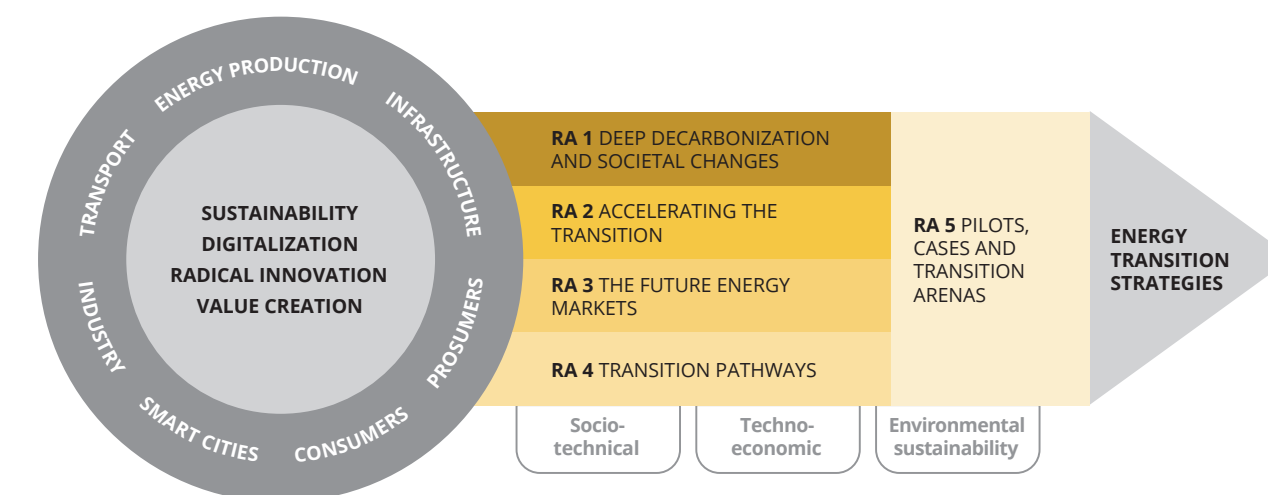
Research Area 5
Use Case and Innovation

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.

NTRANS IN NUMBERS 2022

 **36** SCIENTIFIC PUBLICATIONS

 **144** CONFERENCE PRESENTATIONS

 **9** NATIONAL RESEARCH PARTNERS

 **27** USER PARTNERS (INCLUDING TWO OBSERVERS)

 **109** MASTER'S DEGREES

 **66** EVENTS – CONFERENCE, WEBINARS AND WORKSHOPS

THE MANAGEMENT GROUP



Centre director
Asgeir Tomasgard
(NTNU)



Deputy director
Tomas Moe Skjølsvold
(NTNU)



Research director
Mette Helene Bjørndal
(NHH)



RA 1 Leader -
Gisle Solbu
(NTNU)



RA 2 Leader
Allan Dahl Andersen
(UiO)



RA 3 Leader
Stefan Jaehnert
(Sintef)



RA 4 Leader
Kari Aamodt Espegren
(IFE)



RA 5 Leader
Ragnhild Freng Dale
(Vestlandsforskning)



Gunnar Eskeland
(NHH)



Bente Johnsen Rygg
(HVL)



Pernille Seljom
(IFE)



Markus Steen
(Sintef)



Geoffrey Sean Gilpin
(HVL)



Anders Hammer Strømman
(NTNU)

THE BOARD

Chair of the Board



Henrik Sætness,
Statkraft

Board members



Gina V. Ytteborg,
The Norwegian Public Roads Administration



Helle Grønli,
Enova



Katinka Elisabeth Grønli,
UiO:Energy



Lasse Torgersen,
Hydro



Frode Rømo,
SINTEF Industry



Linda Rud,
NHH



Tine Uberg
Nærland, IFE



Margrethe Aune,
NTNU



Eirik Byklum,
Equinor

Deputy members:

Michel Bohnenblust, *Forskningsrådet*
Tor Ulleberg, *Equinor*
Ragnhild Stuland, *Hydro*
Caroline Østlie, *Statkraft*
Even Bjørnstad, *Enova*

PARTNERS

RESEARCH PARTNERS



ENTERPRISE PARTNERS



PUBLIC PARTNERS



INTERNATIONAL PARTNERS



TOGETHER FOR AN EFFICIENT
AND JUST TRANSITION



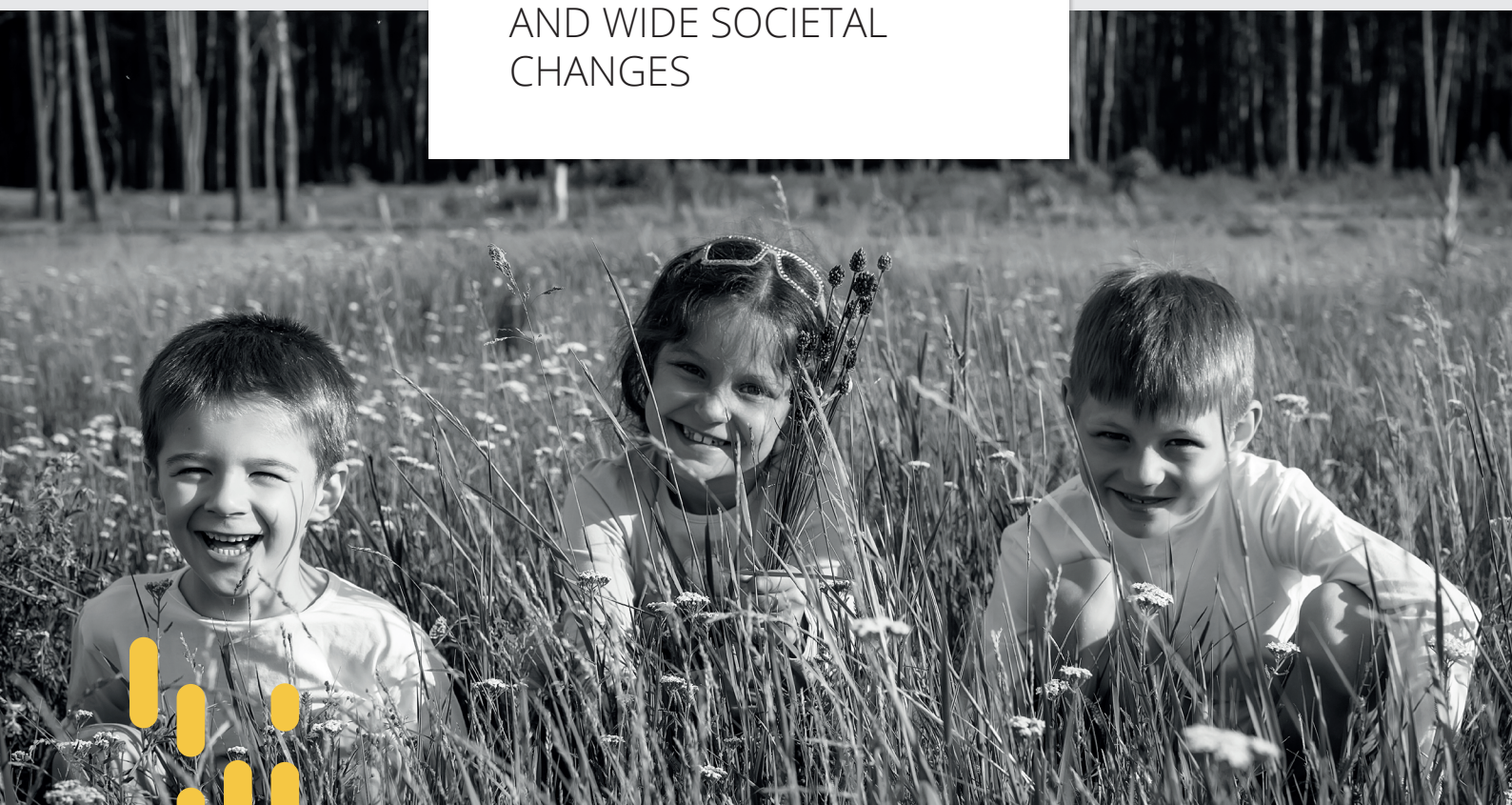
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RESEARCH AREA 1

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.

NAVIGATING CHALLENGES AND CONTROVERSIES IN THE NORWEGIAN ENERGY TRANSITION

The Norwegian energy transition, like any major societal transformation, involves significant challenges related to land use conflicts, resource allocation, value distribution, and social change. In 2022, tensions related to energy have intensified due to higher energy prices impacting Norwegian consumers and political conflict in Europe, creating uncertainty about the future of the energy landscape. In response, Research Area 1 (RA1) has focused on providing in-depth studies of central controversies, trade-offs, and challenges in the Norwegian transition, and developing strategies to address them.



CITIZENS, PUBLIC ENGAGEMENT, AND CULTURE IN DEEP DECARBONIZATION

The first focus area has centered around the role of citizens, public engagement, and culture in deep decarbonization. RA1's work in this area has explored topics such as understanding the potential of energy communities in the future Norwegian energy system, analyzing the social acceptance of pumped hydroelectric storage, exploring public attitudes towards vehicle-to-grid technology, examining sufficiency-oriented consumption practices, and developing effective communication strategies to reach the public on climate change issues.

CONTROVERSIES, CONFLICTS, AND VALUE TRADE-OFFS

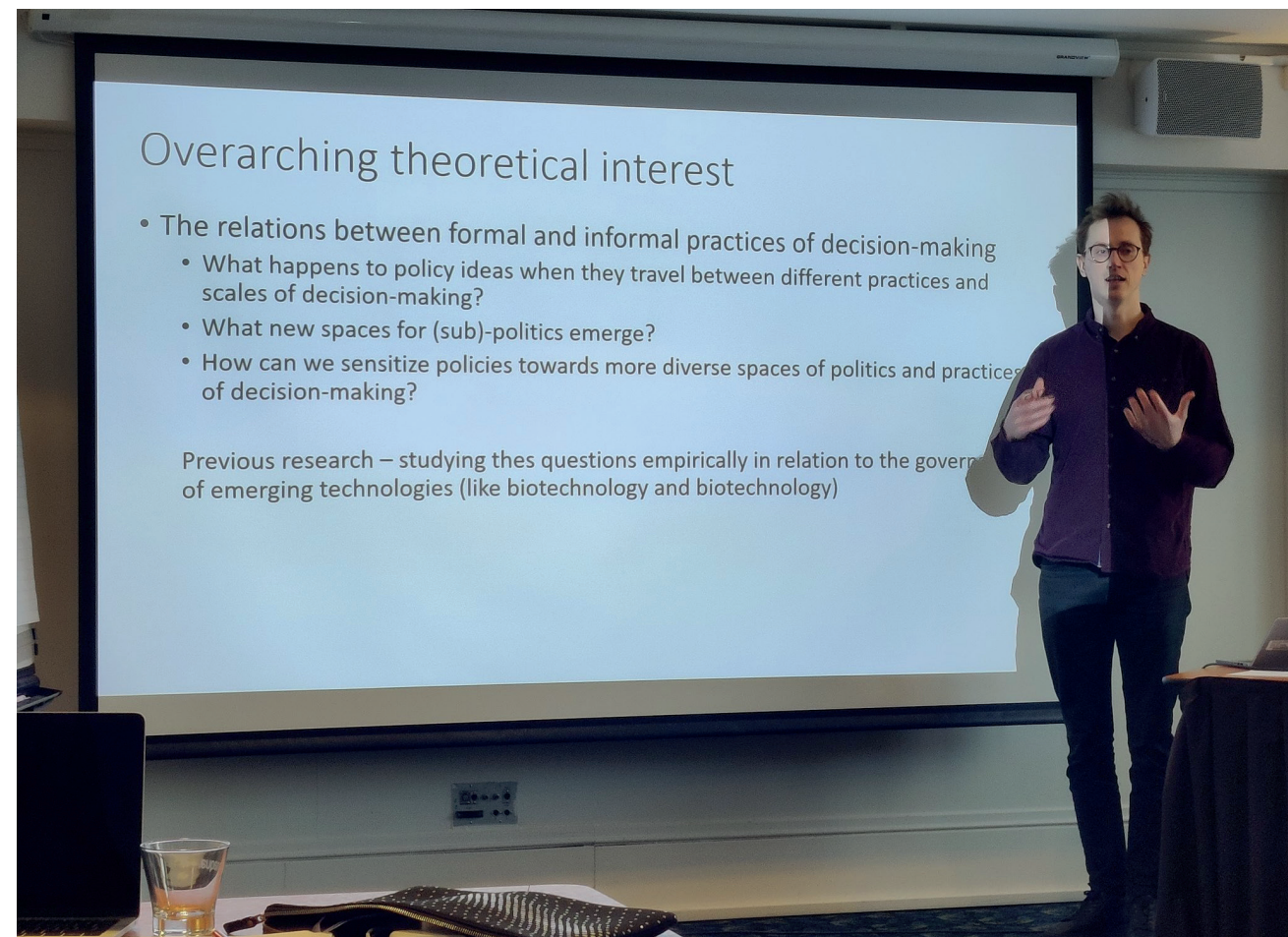
The second area of focus has addressed controversies, conflicts, and value trade-offs. Recognizing that any significant change process inevitably creates controversies and conflicts, RA1 has mapped central conflicts related to wind farming, mineral extraction, and land use. Additionally, the research has investigated potentially negative rebound effects arising from energy efficiency instruments. Insights from RA1 research have contributed to a major international study exploring opposition against energy infrastructure. (Lenke til publikasjonen: <https://www.sciencedirect.com/science/article/pii/S0959378022000115>)

GOVERNANCE THROUGH RESEARCH, PILOTS, AND EXPERIMENTATION

The third focus area has revolved around governance through research, pilots, and experimentation. Effective transitions require collaboration and coordination across different stakeholders, including government agencies, industry actors, civil society organizations, and local communities. RA1 has worked to develop tools to assist decision-makers in taking just, inclusive, and democratic action towards deep decarbonization in Norway. Significant progress has been made through a series of co-creation workshops with NTRANS partners, government agencies, and municipalities, in collaboration with the RCN-funded research project Cojust. These workshops aimed to devise strategies for inclusive and just transition initiatives related to mobility, housing, and consumption, minimizing negative impacts on vulnerable groups. The workshops resulted in three new policy briefs summarizing the main outcomes of the co-creation process.

INVESTIGATING PARADOXES AND CONTROVERSIES

A significant outcome of RA1 in 2022 was the release of a research study investigating paradoxes and controversies and their implications for justice in the Norwegian energy transition. Led by Marrius Korsnes, the publication was a collaborative effort among numerous researchers associated with RA1 and drew on a wide range of insights from various Norwegian research institutions.

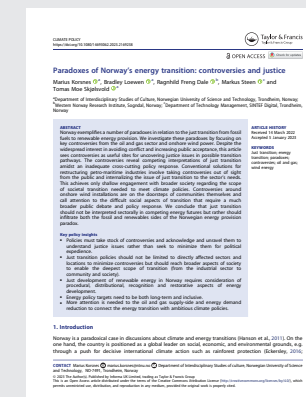


THREE WORK PACKAGES IN RESEARCH AREA 1

- **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



PARADOXES OF NORWAY'S ENERGY TRANSITION: CONTROVERSIES AND JUSTICE



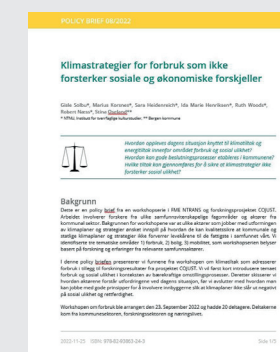
By Marius Korsnes, Bradley Loewena, Ragnhild Freng Daleb, Markus Steenc and Tomas Moe Skjølsvold.

The article investigates the paradoxes of Norway's just transition from fossil fuels to renewable energy by focusing

on controversies in the oil and gas sector and onshore wind power. Controversies reveal competing interpretations of just transition and inadequate cross-cutting policy responses. The authors argue that just transition should not be interpreted sectorally but should infiltrate both fossil and renewable energy provision sides. Key policy insights include the need to acknowledge and unravel controversies for understanding justice issues, extending just transition policies to broader aspects of society, considering various aspects of energy development, setting long-term and inclusive energy policy targets, and connecting the energy transition with ambitious climate policies through attention to the oil and gas supply-side and energy demand reduction.

Read the article here: <https://www.tandfonline.com/doi/epdf/10.1080/14693062.2023.2169238?needAccess=true&role=button>

CLIMATE STRATEGIES FOR HOUSING THAT DO NOT REINFORCE SOCIAL AND ECONOMIC INEQUALITIES: THREE POLICY BRIEFS



By Robert Næss, Gisle Solbu, Sara Heidenreich, Ida Marie Henriksen, Ruth Woods, Marius Korsnes and Stina Oseland.

Three policy briefs from a workshop series in FME NTRANS and the research project

COJUST present the findings from workshops on climate actions addressing mobility, consumption, and housing in addition to research results from the COJUST project. The actors understand the challenges of the current situation, and the briefs conclude with how to work with good principles to involve citizens so that climate plans do not have negative effects

Read the briefs here: <https://www.ntnu.no/ntrans/policy-brief-anbefaling>



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.

ACCELERATING NET-ZERO TRANSITIONS



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

In 2022, Research Area 2 (RA2) witnessed significant advancements in the study of accelerating net-zero transitions. Researchers from various institutions contributed to a better understanding of the challenges and opportunities associated with the transition to sustainable energy systems, transport, and technology development.

VENTURE CAPITAL INVESTMENTS IN GREEN ENERGY

At the Norwegian University of Science and Technology (NTNU), Puck Hegeman successfully defended her thesis titled "IS IT EASY BEING GREEN? The Role of Venture Capital Investors in Green Venture Financing." Hegeman's research emphasized the diverse motivations and barriers for Venture Capital investments in green energy, with implications for technology funding. PhD candidate Meike Siefkes presented papers at the RENT conference in Naples and NORSI conference in Oslo and participated in the ESU doctoral conference in Sevilla. Siefkes' research focuses on green energy funding from private investors (business angels) and their role in the early stages of technology development.

Master students Tage Ringstad and Sven Marius Hofgaard conducted a qualitative comparative analysis to investigate the factors explaining renewable energy developers' performance, which is crucial for understanding how to support continuing investments in renewable energy.

INNOVATION AND SECTORAL TRANSFORMATION

SINTEF Digital researchers were involved in various studies and publications in 2022, addressing key RA2-related topics such as innovation, sectoral transformation, resource mobilization, system building, market formation, technology adoption, firm strategies, and policies. Tuukka Mäkitie led a study on the emergence of novel energy value chains based on the case of maritime decarbonization in Norway. The paper, published in *Research Policy*, conceptualized three key mechanisms leading to the formation of complementarities: synchronization, amplification, and integration. These mechanisms were argued to be essential for accelerating the development of full value chains around novel solutions such as hydrogen or battery-electric vessels.

Mäkitie also led a survey-based analysis of Norwegian shipowners' adoption of alternative fuels, published in *Energy Policy*, identifying key features describing leaders, followers, and laggards in terms of alternative fuels adoption. Markus Steen contributed to a paper published in *Competition and Change* on how Equinor and Ørsted have managed to become lead firms in the offshore wind industry. Another line of research focused on the development and diffusion of carbon capture, transport, and storage, with a conference paper assessing the development of CCS in Norway.

ACCELERATION MECHANISMS AND CROSS-SYSTEM AGENCY IN TRANSITIONS

At the University of Oslo's TIK Center, postdoc researcher Kejia Yang and associate professor Allan Dahl Andersen collaborated on a literature review aimed at synthesizing insights into the acceleration of transitions. This work stemmed from the observation that while there

is growing discussion about the need for accelerating transitions, our theoretical understanding of acceleration mechanisms remains limited. Allan Dahl Andersen also organized a NTRANS seminar and workshop on cross-system agency in transitions, exploring actor strategies, business models, and sense-making in sector couplings in transitions. Kejia Yang is also working on EV transition in China, but has just started.

TRANSPORT SYSTEM TRANSITIONS

The Western Norway Research Institute focused on the transition of transport systems within RA2. Their work covered psychology (Gössling 2022, Gössling and Dolnicar 2022; Gössling and McRae 2022; Gössling et al. 2023; Haustein et al. 2022; Humpe et al. 2022), politics (Gössling et al. 2022a, 2023), and economics (Gössling et al. 2022a,b), as factors underlying behavior and decision-making, as well as enabling and/or preventing change. The research is ongoing and focuses on aviation, automobility, and cycling. Further works are expected to be published in 2023. This research highlights the importance of understanding the multifaceted aspects of transport system transitions to facilitate and accelerate the shift towards sustainable transportation.

E-MOBILITY AND ELECTRIC VEHICLE ADOPTION

Researchers at the Institute for Energy Technology (IFE) investigated the adoption of electric vehicles (EVs) and the impact of policy interventions on consumer behavior, although IFE is not formally included in RA2. Their work included an assessment of consumer preferences and attitudes towards EVs, as well as the effectiveness of various policy instruments to promote EV adoption. These findings contribute to the development of effective strategies to accelerate the transition to electric mobility, which is critical for achieving net-zero emissions in the transport sector.



CIRCULAR ECONOMY AND SUSTAINABLE BUSINESS MODELS

Research on circular economy and sustainable business models also gained traction in 2022. Studies focused on understanding the challenges and opportunities in transitioning to a circular economy, as well as the development of sustainable business models that minimize resource use and waste generation. This research supports the implementation of innovative business strategies that promote resource efficiency, reduce environmental impact, and enhance economic competitiveness.

NETWORK DEVELOPMENT AND ELECTRIFICATION

At the TIK Center, two UiO master's thesis projects on network development were completed in 2022. These projects focused on technical, regulatory, and social bottlenecks in network development that delay electrification. The first project, "Brokers and Bottlenecks- A qualitative case study on how grid bottlenecks are delaying the sustainability transition in Western Norway," explored how institutional tensions across socio-technical systems influence electrification processes and highlighted the role of actors in shaping institutional arrangements in favor of new and sustainable industrial initiatives. The second project, "Societal embedding of industrial energy prosumerism in Norway," investigated the diffusion of prosumer innovations among industrial actors with high energy consumption, which can help Norway reach its electrification targets.

In conclusion, 2022 was a productive year for Research Area 2, with researchers from various institutions contributing valuable insights into the challenges and opportunities associated with accelerating net-zero transitions. Continued research in these areas will be essential for guiding policy, business, and societal decisions to ensure a rapid and effective transition to a sustainable future.

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

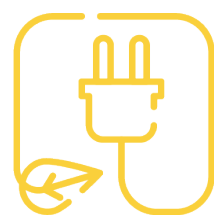
ARCHITECTURAL CHANGE IN ACCELERATING TRANSITIONS: WORKING PAPER



By Allan Dahl Andersen, Jochen Markard, Dierk Bauknecht and Magnus Korpås

This paper introduces the concept of system technology to explore the role of technologies that generate system-level complementarities in socio-technical systems undergoing architectural change during sustainability transitions. The authors illustrate the usefulness of this concept in studying potentially disruptive architectural changes and actor preferences in the German electricity system. Their main finding is that incumbents prefer established centralized system technologies but reluctantly accept a role for novel decentralized system technologies, while challengers prefer a mix of old and new system technologies. Actor shifts are a dynamic process that unfolds in the acceleration phase. The authors caution that their findings may not apply to other systems and suggest exploring other transition phases to better understand actor tensions over system architecture.

Read the full paper here: <https://www.ntnu.no/documents/1284688443/1285504199/Architectural+change+in+accelerating+transitions+NTRANS+WP.pdf/4510c53c-a44a-8697-036a-2a38ef3a1fd3?t=1655194113566>



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.

FUTURE ENERGY MARKETS

In the light of the ongoing energy crisis, security-of-supply and energy security have become important topics. To handle the challenges the EU proposes a significant re-design of the existing energy markets, where it is uncertain how well the specifics of the Nordic power system is accounted for. The latest policy proposed by the EU in its program REPowerEU sets focus on clean, affordable, and secure energy. Energy markets play a central role in efficiently coordinating supply and demand as well as providing incentives for expansion of new energy resources.



Research Manager Stefan Jaehnert. (Photo: Vibeke Ann Pettersen/NTRANS)

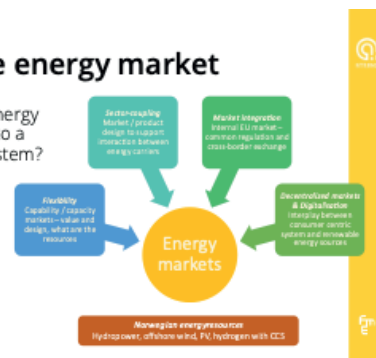
RESEARCH FOCUS

RA3 has its focus on the development, design and implementation of the future energy market in Norway and in Europe, as shown in the figure. Important topics for energy markets in the framework of the energy transition are flexibility, sector-coupling, market integration and decentralised/local markets. This provides a basis for value creation from renewable Norwegian energy resources.

RA3 The future energy market

What is the role of the energy market in the transition to a zero-emission energy system?

- Focus on:
 - Market design
 - Digitalisation
 - Value sharing



ONGOING CHALLENGES RELATED TO THE RESEARCH AREA

The continuous energy crisis and aims for energy transition provide significant challenges to the Norwegian energy and especially power system. This creates a tension between one the one side keeping the system stable in order to ensure security-of-supply and on the other side changing the system rapidly in order to achieve ambitious climate goals, while maintaining value creation.

These three perspectives are the corners of the well-known energy trilemma, becoming more difficult to solve than ever before. In order to address and discuss a number of these challenges and dilemmas the research area contributed to a seminar series arranged by FME NTRANS.

RESEARCH ON MARKET DESIGN

Flexibility contracts

The first paper of PhD student Felipe Van de Sande Araujo co-authored by Stein-Erik Fleten (NTNU), Endre Bjørndal (NHH) and Steven Gabriels (University of Maryland) is looking at the effect of introducing “flexibility contracts” in a two-stage electricity market similar to what is found in most of Europe. They are measuring the cost-reduction for end-users and the hedging effect those contracts can have on wind producers’ supply uncertainty, allowing for more renewable generation to be used.

Inc-Dec gaming

A collaboration with two Master’s students, Audun Systad and Jens Eilertsen, as well as Professor Ruud Egging-Bratseth (NTNU) is looking at the incentives for conventional generators to place strategic bids on the market when congestion on a line within the same zone can be forecasted. This type of game is called Inc-Dec. The work is looking into mitigating measures for the Inc-Dec game using an original EPEC (equilibrium problem

with equilibrium constraints) formulation. Avoiding this kind of gaming is essential for market-based solutions, which enable the participation of distributed electricity resources, such as prosumers and small producers, in buildings and households.

Review of flexibility in power markets

In cooperation with KSP PowerDig, a review of scientific work on flexibility in the form of characterisation, aggregation and market designs is done. The motivation for the review is the expected necessity for flexibility resources in the future power market and hence to better understand which and what types of flexibility resources exist as well as how these can be traded. The review reports latest trends and concludes that especially the demand-side flexibility holds great potential.

Other work on market design

Work on market design in the research area also addressed the questions on the ownership and bidding strategies of energy storage operators, which concludes that market design affects the potential for strategic behaviour of storage operators. Furthermore, work has been done on the design and potential of intraday markets as a congestion management tool, showing the possibility of improving capacity constraints in the system, however requiring nodal information of the system.

Agent-based modelling in the power sector

Beside the topic of market design, the research area also addresses modelling energy markets and the energy system. In 2022, work has been done to assess and understand the potential of agent-based modelling (ABM) in the energy sector. A number of workshops together with national and international partners resulted in an extensive review and a characterisation of modelling approaches at different levels in the energy system. The work sets out to investigate how agent-based models could tackle different energy system problems. The investigation covers four segments of the energy system - consumer, city, microgrid, and market. The work highlights the scope, advantages, challenges, and trends of the agent-based models in energy sector applications as well as proposes a framework with metrics to evaluate the characteristics of an agent-based model.

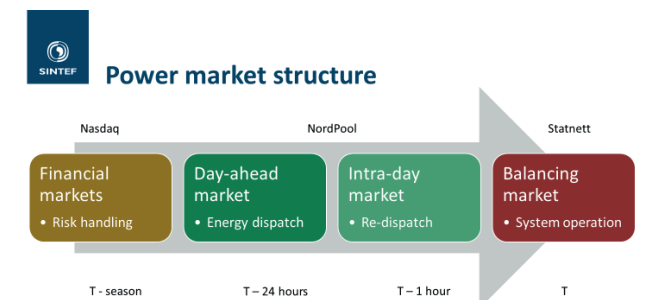
THE VALUE OF ENERGY RESOURCES

The research area contributed with finalising a set of analyses as part of UC2 targeting the value of Norwegian renewable energy resources, specifically offshore wind. The analyses assess effects for different market actors as well as addresses different connection alternatives for the prospective area of Sørliche Nordsjø II.

Furthermore, related work done by Kyriaki Tselika in her PhD enlightened the value and cannibalisation effects for large-scale investments of renewable energy sources. The results show that there is some complementarity between wind and solar. However, especially for solar power production significant negative effects on profitability can be observed at large-scale investments.

CO-OPERATION WITH USER CASES

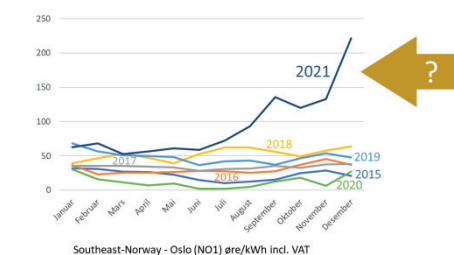
In 2022 RA3 was co-operating closely with User Case 7, investigating markets for flexibility in electricity. We conducted 5 workshops, where we invited researchers from partnering research centres to provide presentations on the latest findings related to the topic. For each workshop, we also welcomed business partners and other interested parties to join in a round table and present user-specific experience on first-hand accounts. To consolidate the knowledge gained from the workshop, all participants were invited to join smaller breakout groups, where they debated the topic’s most prominent issues. After the meetings, the ensuing debate and a summary of the presentations and participations were collected in a Workshop Summary Report published on the NTRANS website. We are currently in the process of finalising our last report and intend to create a research paper which will aggregate all information obtained in the workshop series.



Power markets are an efficient tool in order to achieve balance between supply and demand on all time horizons.



Electricity price shock i Norway



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

LARGE-SCALE WIND DEVELOPMENT - FOR NATIONAL INDUSTRIAL DEVELOPMENT AND EXPORT: WORKING PAPER



By Vegard Kallset, Stefan Jaehnert, Ingeborg Graabak, Kristina Haaskjold and Pernille Seljom

Description automatically generated Norway faces a potential energy imbalance by 2027 due to increased demand and lack of new power production development, while oil

and gas production is declining. The country has good potential for energy production from wind, solar, and hydropower, which can be used for exports and industrial development. However, the development of energy production and transmission networks must keep up with consumption trends to avoid missed opportunities. New energy production is necessary to reduce greenhouse gas emissions and ensure supply security, and a strong transmission network is needed to level out regional differences in renewable production. Political work and research are needed to address cost-effectiveness, supply security, and environmental issues for the power system to meet future needs.

Read the full paper here: <https://www.ntnu.no/documents/1284688443/0/NTRANS+User+Case+2+Offshore+vind+-+ilandfööring+og+eksport.pdf/8ed42bcd-d1ae-0340-b1c0-0e2669f4ada5?t=1671192709338>



RESEARCH AREA 4

PATHWAYS TO A SUSTAINABLE FUTURE

NAVIGATING SUSTAINABLE TRANSITION PATHWAYS

Research Area 4 (RA4) continues its mission to examine the multifaceted transition paths leading to a low-emission society, with a primary focus on Norway's unique developmental journey and its potential interplay with Europe. Throughout the previous year, the RA4 team has made significant strides in expanding our understanding of these complex transition pathways by delving into four core work packages, which include techno-economic and environmental analysis, socio-technic analysis, stakeholder involvement, and analysis of transition pathways.

Building on the momentum of 2021, RA4 has centered its research activities around a 10-step approach, which seamlessly bridges techno-economic and socio-technical perspectives on sustainability transition pathways. This innovative methodology has been specifically designed

to offer a systematic approach for analyzing transition pathways in the context of Norway, ultimately providing critical insights that can help shape the nation's 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?



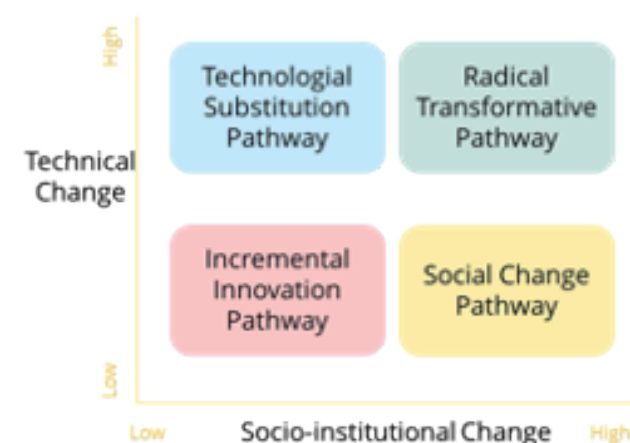
Researcher Kari A. Espegren (IFE) is in lead of Research area 4, Pathways to a sustainable future.
(Photo: Silje Nørstad/NTRANS)

SOCIO-TECHNICAL SCENARIOS

The research partners from SINTEF, NTNU, and UiO collaborated on initial pathway definitions based on socio-technological typologies. The resulting transition pathways focused on the interplay between actors, institutions, and technology, and the degree of disruption to the existing sectoral regime. Four pathways were identified: Incremental Innovation, Technological Substitution, Social Change, and Radical Transformation.

QUANTITATIVE ANALYSIS

Researchers from IFE and NTNU quantified the four scenarios and performed an initial analysis using the energy system model (IFE-TIMES-Norway) and the economic model (REMES) to determine the impact on the energy system, emissions, and the economy.



IN-DEPTH STUDY OF THE MARITIME SECTOR

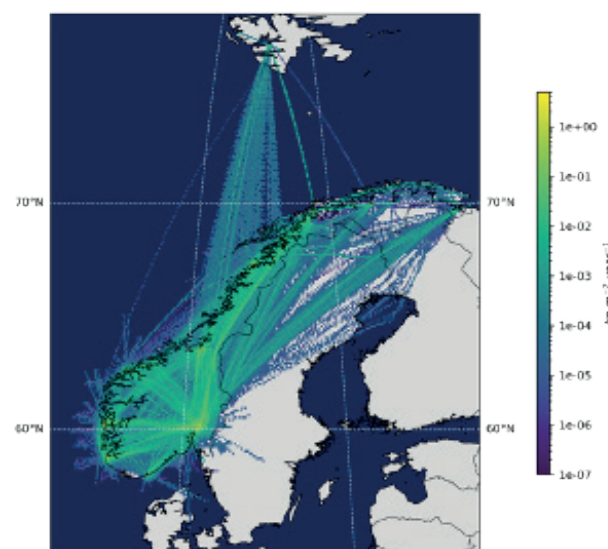
A qualitative and quantitative study of the maritime sector was initiated by researchers from NTNU, SINTEF, and IFE. This work is expected to be completed in 2023.

INTERNAL MEETINGS AND WORKSHOPS

Research Area 4 partners contributed to a series of internal meetings and workshops to test the 10-step approach. They presented their work on socio-technical studies and modeling at the NTRANS Research Festival in Røros and the NTRANS Annual Conference.

PHD AND POSTDOC CONTRIBUTIONS

Two full-time PhD positions and one postdoc position at NTNU's Industrial Ecology Program contributed to the RA4 research, focusing on modeling improvements and pathway analysis. They explored the integration of integrated assessment models (IAMs) and input-output (IO) models to improve the robustness and level of integration across different domains. One of the key findings was the development of the Aviation Transport Emissions model, which provided a detailed computational model of the aviation sector's emissions. The model revealed that per capita aviation emissions in Norway were more than twice the European average.



SCIENTIFIC ARTICLES

Two scientific articles were published in 2022:

1. Klenner, J., Muri, H., Strømman, A.H., 2022. High-resolution modeling of aviation emissions in Norway. *Transportation Research Part D: Transport and Environment* 109, 103379. <https://doi.org/10.1016/j.trd.2022.103379>.
2. Rosenberg, E., Espegren, K., Daneberg, J.; Fridstrøm, L., Hovi, I. B., Madslien, A. Modelling the interaction between the energy system and road freight in Norway, *Transportation Research Part D: Transport and Environment*, Volume 114, available online in 2022, <https://doi.org/10.1016/j.trd.2022.103569>

CONCLUSION AND OUTLOOK

Research Area 4 made significant progress in 2022 by developing a 10-step approach to analyze transition pathways for Norway and initiating an in-depth study of the maritime sector. As we move forward into 2023, RA4 will continue to explore new research questions, engage with emerging technologies and innovations, and refine the developed methodologies to better understand and assess the potential impacts of different transition pathways on Norway's energy system, economy, and environment.

ONGOING AND FUTURE RESEARCH

In 2023, RA4 aims to finalize the in-depth study of the maritime sector, building upon the qualitative and quantitative research conducted in 2022. Additionally, the research team will further test and refine the 10-step approach, incorporating feedback from internal meetings and workshops, as well as input from stakeholders.

COLLABORATION WITH STAKEHOLDERS

RA4 emphasizes the importance of stakeholder involvement in its research process. The team will continue to collaborate with NTRANS stakeholders and other research activities to ensure that the developed transition pathways are not only academically rigorous but also relevant and actionable for policymakers and industry stakeholders.

DISSEMINATION AND OUTREACH

The research partners will continue to present their work at conferences, workshops, and other academic events to share their findings and gather feedback from the broader research community. Furthermore, the team will engage in outreach activities to communicate their results to the general public, ensuring that the importance of sustainable transition pathways and the implications of their research are understood by a wider audience.

CAPACITY BUILDING AND TRAINING

As part of RA4's commitment to fostering the next generation of researchers, the team will continue to support PhD and postdoc positions, offering them the opportunity to work on cutting-edge research in the field of sustainability transitions. This capacity-building effort will help ensure that future research in this area benefits from a diverse and talented pool of researchers, equipped with the necessary skills and knowledge to tackle complex sustainability challenges.

FINAL REMARKS

In summary, Research Area 4 made advancements in 2022, with a focus on bridging techno-economic and socio-technical perspectives on sustainability transition pathways. As we enter 2023, RA4 will continue to push the boundaries of our understanding of sustainable transition pathways, fostering collaboration with stakeholders, and engaging in outreach and capacity-building

efforts to ensure that our research has a lasting and meaningful impact on the path towards a more sustainable future.

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

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
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**



RESEARCH AREA 5

USE CASES AND INNOVATION



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.

UNLOCKING SUSTAINABLE INNOVATION THROUGH COLLABORATION

As the world faces the urgent need for a sustainable future, NTRANS Research Area 5, Use cases and innovation, continues to lead the change by fostering cooperation between researchers and user partners. This collaboration has sparked exciting breakthroughs and innovative use cases, laying the foundation for a cleaner, more sustainable tomorrow. The Research Area have in 2022, continued to showcase how its collaborative efforts have shaped the future of energy and sustainability.



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



Møte mellom NTRANS-forskerne i utvidet ledergruppe. (Foto: Vibeke Ann Pettersen/NTRANS)

A YEAR OF COLLABORATION AND KNOWLEDGE EXCHANGE

Ragnhild Freng Dale, Senior Researcher at the Western Norway Research Institute (VF) and head of NTRANS research area 5, emphasizes the importance of cooperation with partners. The institute has had an active year, with several new user cases and the continuation of ongoing projects. This work is crucial for the transition to clean energy and addressing climate change. It is being done in collaboration with user partners.

Throughout 2022, Research Area 5 has facilitated the exchange of knowledge and ideas between researchers and user partners. The researchers in NTRANS come from different fields, and the multidisciplinary nature

of the work requires a lot of cooperation and mutual understanding. We bring different backgrounds and perspectives to the partnership.

This exchange has taken many forms, from lunchtime webinars with user partners to workshops that address the challenges of transitioning the transport sector. These collaborative events have generated new ideas and opened avenues for further research.

Direct research collaborations have also resulted in valuable outcomes, such as the co-creation of tools for fair transition in transport, housing, and consumption. These joint efforts have led to policy briefs, showcasing the tangible impact of this partnership.

NEW USE CASE: OFFSHORE WIND AND SOCIETY

FME NTRANS and FME NorthWind have worked on a joint user case with a focus on societal aspects of offshore wind. The user partners were challenged to reflect on the most important societal aspects of the technology, and four societal challenges stood out: 1) Strategies for better public debate, 2) Participation and involvement of interest groups and citizens, 3) Space, place, and coexistence, 4) Tempo, political dynamics, and geopolitics.

There is a great interest in this user case from both user partners and researchers. I was impressed by the level of reflection from the user partners who face these societal challenges every day, says Tomas Moe Skjølvold.

INVESTIGATING KNOWLEDGE NEEDS

In the years to come, there will be a greater need for flexibility, as more renewable energy, including solar and wind, is weather-dependent. The first workshop in user case 7 on energy flexibility had great participation, with 74 digital participants. The workshop series is developed in collaboration with FME CINELDI. The need for flexibility is increasing due to weather-dependent renewable energy, and the researchers aim to investigate knowledge needs with user partners. The workshop started with questions on the need for flexibility, who can offer it, and how the market can be organized.

"Historically in Europe, we have mostly had power plants with gas, coal, and adjustable hydropower. Electricity is

difficult to store, so we now need more flexibility," says Stian Backe.

"There is uncertainty about the energy situation when we plan to shut down fossil power plants, and there is more and more electrification," says Felipe Van de Sande Araujo.

"We do not know what the best solution is, that is what we will find out together with the user partners," say the researchers.

A PATH TO A SUSTAINABLE FUTURE

In 2022, Research Area 5 has demonstrated that collaboration between researchers and user partners is key to unlocking innovative solutions for a sustainable future. By working together, this partnership has facilitated discussions, exchanged ideas, and developed valuable policy briefs and research outcomes. Our user partners are showing great interest in the use cases, and our researchers are really eager to continue the work and cooperation.

As we continue to strive for a greener, more sustainable world, the collaborative efforts of Research Area 5 and its user partners will undoubtedly play a crucial role in shaping our shared future.

USE CASES IN ACTION

The heart of Research Area 5's work lies in its use cases. In 2022, a diverse range of active use cases have demonstrated the power of collaboration between researchers and user partners in driving relevant innovation and creating new knowledge.

- User Case 3b - Decarbonization of Freight Transport Between Cities: This use case analyzed the future of the Norwegian freight transport system over a 20- to 30-year period, with the involvement of user partners from various sectors.
- User Case 3c - Decarbonization of Goods and Commercial Transport in Cities: In this research sprint, researchers worked alongside user partners to examine the design and implementation of low-emission zones and zero-emission zones.
- User Case 4 - CCS, CDR, and Negative Emissions: This ongoing use case organized workshops focusing on the social science aspects of deploying CCS value chains and negative emissions.
- User Case 5 - Sustainable Development of Innovation Districts: In collaboration with FME ZEN, this use case explored the innovation potential of sustainable neighborhood development in major cities.
- User Case 6 - Social Aspects of Offshore Wind: Partnering with FME NorthWind, researchers and user partners conducted workshops addressing topics such as public discourse, participation and inclusion, space and coexistence, and geopolitics.
- User Case 7 - Integrated Markets for Energy and Flexibility: This use case studied flexibility markets among power actors, buildings, and market actors, in collaboration with FME ZEN and FME CINELDI.
- User Case 8 - Energy Foresight, Scenarios, and Climate Goals: Launched in November 2022, this use case examined energy demand and policy assumptions, closely related to the work on transition paths in RA4.



Tavle med postits fra første workshop i brukercase 6.

OFFSHORE WIND AND SOCIETY: ADDRESSING SOCIETAL CHALLENGES FOR A JUST AND SUSTAINABLE FUTURE

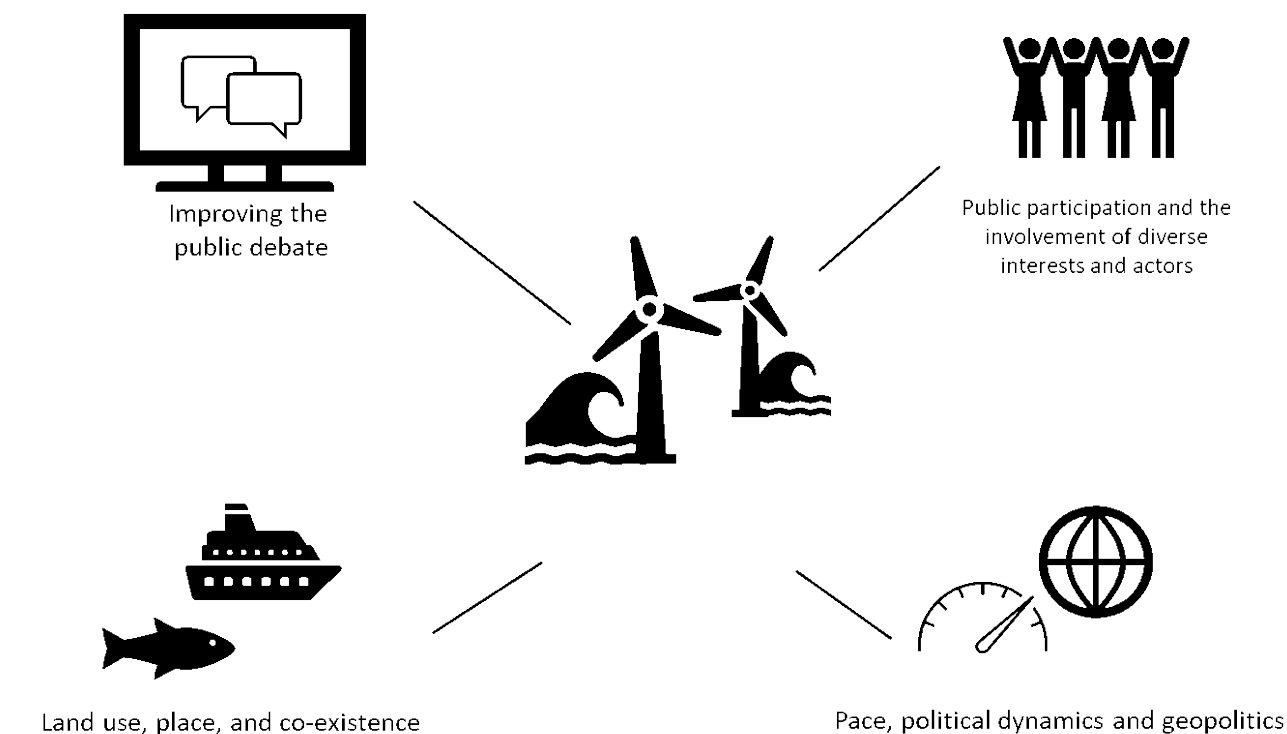
There are strong political ambitions for ramping up offshore wind energy in the North Sea, and the process of realizing these ambitions are well under way. Many actors hope that these developments will prove less controversial than their onshore wind power counterparts. However, as the realization of the industry approaches, it is evident that offshore wind has societal implications. There is a strong need for both research and improvement of practices with respect to societal engagement to ensure that offshore wind developments are not only profitable, legitimate in society.

To strengthen the understanding of such issues, FME NTRANS and FME NorthWind established a joint user case to identify and address the central societal challenges for offshore wind power. We gathered 19 key stakeholders from government, industry, and civil society, along with an interdisciplinary team of social scientists from various academic backgrounds, to co-create a shared understanding of the most pressing societal challenges and provide guidance for how different stakeholders can address these.

The collaboration has resulted in a set of policy briefs addressing four main challenges: 1) [Strategies for better public debate](#), 2) [Participation and involvement of interest groups and citizens](#), 3) [Space, place, and coexistence](#), 4) [Tempo, political dynamics, and geopolitics](#).

STRATEGIES FOR BETTER PUBLIC DISCOURSE

Constructive public debate is a critical challenge for offshore wind energy, and many actors want to get away from what they perceive as a public debate dominated by emotions, lack of knowledge, and political ideology rather than facts. Instead, they want to promote public discussions that are concrete, knowledge-based, open, and inclusive. Offshore wind actors are encouraged to recognize different societal interests, be open about uncertainties, discuss legislation and democratic procedures, and build communication around values, norms, and emotions. Effective communication strategies involve customized campaigns, identifying social norms, emotion-based measures, and locally oriented, visually engaging communication.



Fire samfunnsutfordringer for havvind

PARTICIPATION AND INVOLVEMENT OF INTEREST GROUPS AND CITIZENS

Engaging and involving interest groups and citizens in the development of offshore wind power projects is essential. A good participation process should be based on ecological and social sustainability, recognize relevant actors, and ensure coexistence between offshore wind power and existing industries and local populations. Principles for good participation processes include early and continuous involvement, transparency, and real influence on the outcome. Offshore wind power actors should develop participation strategies, involve diverse groups, and ensure transparent participation processes to support a fair, democratic, and inclusive energy transition.

SPACE, PLACE, AND COEXISTENCE

Offshore wind development in Norway must coexist with other actors at sea. Spatial conflicts, lack of knowledge on the impact of offshore wind on society and nature, and poor regulation can hinder development. A broad discussion of coexistence, including all actors, research-based knowledge, efficient use of space, and inclusive and credible processes, is necessary. Good coexistence should underlie all offshore wind development, integrated management plans should be used for planning across sectors, and all relevant actors, including nature, should be included in discussions. Harmonizing regulations and ensuring transparent and understandable decision-making processes related to spatial use at sea are crucial for good coexistence.

TEMPO, POLITICAL DYNAMICS, AND GEOPOLITICS

The political dynamics surrounding offshore wind development in Norway have implications for its pace. It is essential to understand offshore wind in relation to broader energy and climate transition processes and international relations with the EU. Offshore wind power development may face challenges similar to those experienced by onshore wind power, such as opposition from municipalities and political forces based on

national sovereignty and self-determination arguments. The lack of clear guidelines for nature, ecosystems, and maritime interests exacerbates these challenges. Recommendations include strengthening research and innovation, early mapping of social, political, and business interests, and developing political instruments that contribute to a fair distribution of values created.

CONCLUSION

To make offshore wind development in the North Sea just and legitimate, stakeholders must work together to address four key societal challenges identified through a co-creation process involving the offshore wind power industry, government representatives, NGOs, and social scientists. These challenges require an integrated approach that considers economic, social, environmental, and cross-sectoral governance factors.

Decision-making cannot rely solely on techno-economic factors, as societal interests and the natural environment must also be taken into account. To address these challenges, public authorities must establish a supportive framework and encourage diverse perspectives within the industry.

The co-creation process has shown that transdisciplinary action research can facilitate dialogue, exploration of underrepresented issues and perspectives, and collaboration among stakeholders. These conversations will be crucial in ensuring the development of legitimate, fair, and inclusive policies over time.

Led by Sara Heidenreich from NorthWind and Tomas Moe Skjølsvold from NTRANS, this joint user case recognizes the societal challenges faced by North Sea offshore wind development and aims to unlock its full potential for a more sustainable, just, and legitimate future. Moving forward, the goal is to mobilize the general insights from this user case in a more targeted discussion around specific offshore wind power projects.

OFFSHORE WIND AND SOCIETY

Policy briefs by Sara Heidenreich, Tomas Moe Skjølsvold, Dorothy Dankel, Kristin Linnerud, Espen Moe, John Birger Skjærseth, Ivana Suboticki, Mikaela Vasstrøm and Isabel Richter.

The joint user case to identify and address the central societal challenges for offshore wind power, resulted in a set of policy briefs. Our first policy brief identified four societal challenges for offshore wind power based on in-depth discussions among the centers' partners. These were: 1) Strategies for better public debate, 2) Participation and involvement of interest groups and citizens, 3) Space, place, and coexistence, 4) Tempo, political dynamics, and geopolitics.

Read the briefs here: <https://www.ntnu.no/ntrans/policy-brief-anbefaling>

DECARBONIZATION OF FREIGHT TRANSPORT BETWEEN CITIES

User case 3b analyzes the development of the Norwegian freight transport system over a 20- to 30-year period, with the involvement of user partners from various sectors.

To achieve carbon emission targets, decarbonization of the freight transport sector will be an important factor. To this end, national governments must make plans that facilitate this transition. The Norwegian national freight transport model (NGM) is a useful tool that provides input to the national transport plan (NTP). While appropriate for short-term policy assessment, this model is less suitable for the long-term planning (policies and investments) necessary to facilitate the transition to low-carbon transportation in the upcoming decades.

With the help of the user partners in this use case we have developed a novel framework for strategic national freight transport modeling, called STraM, which can be considered an extension of the existing national freight transport models. In STraM, we explicitly include several aspects that are lacking in state-of-the-art national freight transport models: the dynamic nature of long-term planning, the explicit modeling of infrastructure investment, the inclusion of new, low-carbon fuel technologies and the consideration of long-term uncertainties in the development of these technologies.

User partners have provided input to this work through the provision of data, one-to-one discussions as well as participation in workshops within transport infrastructure; model scope; and the role of biofuels. The modeling framework has been finalized and is described, along with an illustrative case study of Norway, in a preprint available at <https://arxiv.org/abs/2304.14001>. In this preprint we demonstrate the relevance of modeling multiple time periods, the importance of including long-term uncertainty in technology development, and the efficacy of carbon pricing.

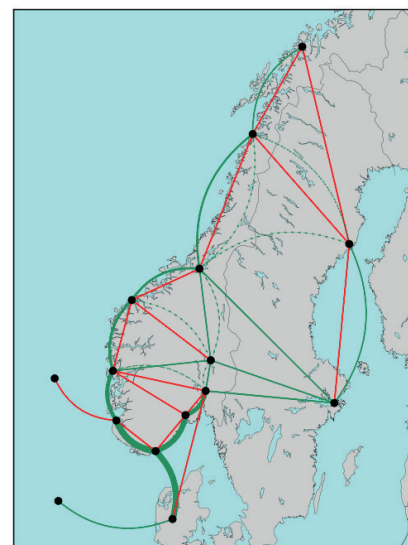


Figure 1: geographical results can be plotted. This includes the flow of goods in a time period, or between time periods (difference plot), and the timing and localization of infrastructure investments.

Ongoing work in this user case is aligning and verifying all data input and constructs a detailed case study for Norway that focuses more on policy insights, rather than model development.

Contact person:
Steffen Jaap Skotvoll Bakker

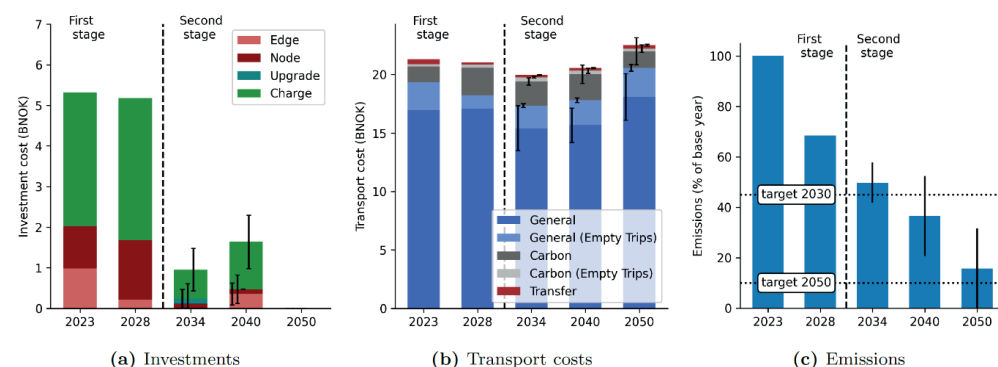


Figure 2: Typical model output includes investment- and transport costs, emissions as well as mode-fuel splits per time period. Black error bars describe the standard deviation across scenarios.

WHAT IS THE STATUS AND PROSPECTS OF INTEGRATED MARKETS FOR ENERGY AND FLEXIBILITY?



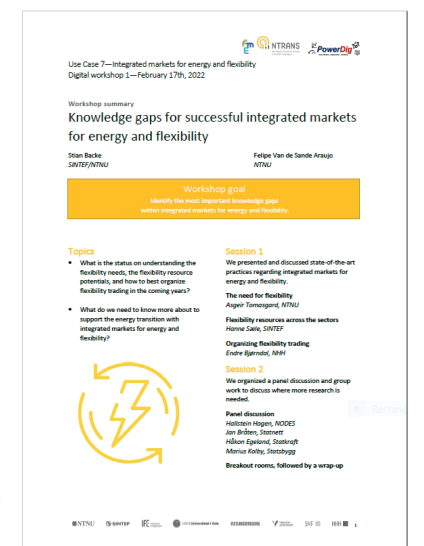
Motivated by the increased relevance of flexibility in electricity markets and the new possibilities in market design that consequently arise, this user case has explored the challenges and contributions of flexible assets throughout the many industry participants and sectors. Five digital workshops have been organized where state-of-the-art research on relevant questions from user partners has been addressed to advance knowledge in a bidirectional structure. The user case prioritizes a wide sectoral scope to facilitate the exchange of ideas "across the silos" and to accelerate sector coupling.

The first workshop took place in February 2022 in collaboration with Powerdig and aimed to detail the knowledge gaps and state-of-the-art practices regarding challenges and opportunities for flexibility. This workshop served to gather practical information and experiences from researchers and market participants from different perspectives: Supply-side, demand-side, grid perspectives, and market design. The workshop format facilitated the collection of relevant information through presentations and discussions, and the identified knowledge gaps were further explored.

Three more workshops were held in 2022 to deal with demand-side assets management, grid coordination/development, and digital market innovation. The fifth and last workshop was completed February 10th, 2023, to deal with supply-side aspects of flexibility.

The leaders of this UC are Felipe Van de Sande (NTNU) and Stian Backe (SINTEF/NTNU). Many user partners have participated in successful collaboration between FME NTRANS and other relevant research centers, including FME ZEN, FME CINELDI, and FME HydroCen.

Within each workshop, a digital panel has been organized with contributions from center partners, including NODES, Statsbygg, Statnett, Statkraft, Elvia, Trondheim kommune, Enova, Fornybar Norge, Volue, Aneo, Clevair, Celsio, Oslo kommune, and Eviny. Workshop summaries have been produced and are openly available here:



<https://www.ntnu.no/ntrans/integrerte-marked-er-for-energi-og-fleksibilitet-brukercase-7>

The final deliverable from the user case will be submitted by the end of 2023, and it will be a synthesis paper presenting the findings from the digital workshops.



WORK TO DEFINE, MAP AND FOLLOW UP ON INNOVATIONS

Innovation is a key concept in and integral to FME NTRANS activities. Transition requires the creation and adoption of new products, processes, and business models. At FME NTRANS, therefore, innovation is a phenomenon of interest that we examine using theories and methods from innovation studies, as well as other social science disciplines. We study the conditions for innovation, how it can be accelerated, and we keep an eye out for unintended consequences. At the same time, we work with innovation with a view to influence change. We do this through knowledge contributions in the form of strategic advice on markets, restructuring and investment, understanding of social and cultural responses, and economic and political instruments. This can be direct - in the form of concrete tools, advice and measures, or indirect - in the form of understanding and strategies that form frameworks and rationales for actions. Furthermore, contributions can be at the micro level - for individual actors in the private or public sector, or at the macro level - which requires cooperation and restructuring at the interfaces between several actors (CenSES Innovation Study, 2019). Our knowledge contributions are geared towards bringing about changes that can result in the development of new and improved products or services; new and more efficient ways of production and delivery, i.e. new processes, and new means of engaging users and other stakeholders in the way services and products are delivered to users, i.e. new business/value models. For example, our research activities focus on understanding users community perspectives on adoption of new technologies (RA1); barriers, opportunities and resources needs for accelerating adoption of new technologies, both in general and in specific sectors like transportation, that can have greater influence in green transition (RA2); energy market design in relation to value for different stakeholders including customers (RA3); and modeling and analysing different transition pathways, which include new ways of combining qualitative and quantitative methods (RA4).

In addition to developing knowledge that can contribute to the development of innovative products, processes and models, this new knowledge and its combination in models can be an innovation in itself.

To stimulate innovations from knowledge contributions, NTRANS focuses on structures for knowledge transfer, where the challenges are to map transferred knowledge and to facilitate the transfer and implementation of knowledge.

STRUCTURE FOR KNOWLEDGE TRANSFER

Knowledge can be transferred in many ways. Of the 10 channels for knowledge transfer proposed by the OECD ('University-Industry Collaboration: New Evidence and Policy Options', 2019), *active research collaboration, publications, training and education, mobility of researchers/employees and networks, meetings and conferences* are the most important channels for FME NTRANS to facilitate, define and map innovations, summarized in Nonaka and Takeuchi's (1995) framework for knowledge transfer in organizations.

An innovation is not realized until new knowledge has been put into use. To contribute to implementation, FME NTRANS focuses on user-owned pilots and user cases through RA5, where researchers and user partners collaborate. By working with concrete pilots and user cases, partners can link 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 center. In addition, FME NTRANS leads the FME Innovation Forum, to enable the exchange of best practices between the various FMEs, where the FMEs can learn from each other's experiences. Further, NTRANS collaborates with other FMEs in its user cases, bringing in and building upon knowledge developed in other FMEs and vice-versa.

Transfer method	Method for facilitating innovation (knowledge transfer)	How to define, map and follow up
Socialization (tacit knowledge to tacit knowledge)	NTRANS conferences, packed-lunch webinars, workshops with partners in RA1 - RA4, collaboration on pilots and user cases in RA5	Leaders and innovation leaders actively involved in collaborative platforms
Externalization (tacit to explicit knowledge)	Preparation of 'policy briefs' around thematic areas, publications, participation in public debate	Focus on "actionable" knowledge - advice and implications for practice
Internalization (Explicit to tacit knowledge)	Presentations and dissemination: conferences, packed-lunch webinars, workshops. Education of master's and PhD students.	Involvement with and conversations with researchers and partners about knowledge uptake
Combination (Explicit to explicit knowledge)	Collaboration on the development of 'policy briefs', reports and research sprints in RA5. Conducting action-oriented research, such as in the ACES project, where the goal is to develop restructuring strategies for and with ports.	Collect results relevant to other partners, communicate results and implications

ZERO-EMISSION VALUE CHAINS: THE FUTURE OF MARITIME TRANSPORT

As the world continues to face the consequences of climate change, the need for a rapid transition from fossil fuels to greener alternatives has never been more urgent. In a recent article published in Research Policy, a leading scientific journal in research on innovation studies and sustainable transition, researchers Tuukka Mäkitie, Markus Steen, Allan Dahl Andersen, Jens Hanson, and Teis Hansen discuss the development and interaction between different value chain segments and their implications for transition processes in the Norwegian maritime transport sector.

The research focuses on three different zero-emission solutions with the potential to accelerate the shift from fossil fuels to more sustainable energy sources: batteries, hydrogen, and bio-gas. To replace fossil fuels, functional technology value chains (TVK) must be established, and they need to be profitable. While all three energy sources hold great potential, hydrogen and bio-gas are currently lagging in terms of TVK development.

The article presents three mechanisms—synchronization, amplification, and integration—that describe different forms of value chain dynamics and their impact on the three zero-emission solutions in the Norwegian shipping industry. The researchers found that, of the three green energy alternatives, batteries have the most developed value chain due to factors such as existing Norwegian infrastructure and renewable power supply supporting battery use in the maritime sector.

However, despite the progress made with battery technology, Norway and the rest of the world still lack TVKs for other maritime zero-emission solutions. Understanding how complementarities in value chains support the development of these solutions is crucial for achieving a more sustainable future.

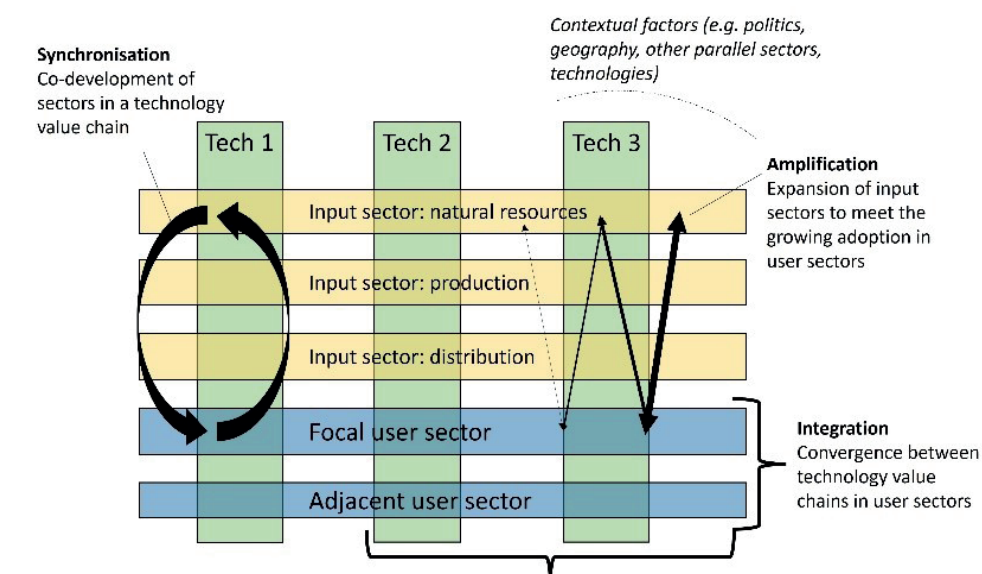
The research process that led to the article aimed to create knowledge that could help accelerate the transition to green energy—a process currently moving too slowly. By examining different

complementarities and the mechanisms that create them, the researchers were able to identify how these factors affect and accelerate the shift to green energy.

The researchers are now looking at the perspectives of various actors regarding the emergence of positive synergies across different links in value chains. They are also keen to understand how companies can use their research to accelerate climate change. While their current research has focused on a macro level, they plan to shift their focus to the micro-level, examining how companies can apply the research results to drive change.

User case 2 in FME NTRANS explores Norwegian renewable energy resources and opportunities for value creation from these resources. Through a series of workshops with center partners, selected topics have been discussed, including projections for power production and consumption, as well as a focus on specific technologies such as wind power, hydropower, data centers, and hydrogen production. These discussions form the basis for a final policy brief aimed at bringing together perspectives and identifying future research needs.

The researchers believe that their work will contribute to a better understanding of the transition to green energy, ultimately helping society move toward a more sustainable future. As the need for renewable energy sources continues to grow, further research and collaboration will be essential to develop and implement zero-emission solutions in the maritime transport sector and beyond.



TACKLING AVIATION EMISSIONS IN NORWAY

Norway, known for its breathtaking fjords and mountains, has a unique geographical landscape that poses challenges for transportation. Consequently, Norwegians rely heavily on air travel, leading to substantial aviation emissions. NTRANS has made significant strides in researching these emissions, providing valuable insights for reducing aviation's environmental impact and moving towards a zero-emission aviation sector.

THE ENVIRONMENTAL COST OF AVIATION IN NORWAY

In 2019, each Norwegian citizen generated an average of 580 kg of CO₂ from aviation, making Norway's per capita aviation carbon footprint 7.3%, more than double the global average of 2.8%.

According to climate researcher Helene Muri at NTNU, there is a strong need to reduce emissions from aviation in Norway to achieve the goal of zero emissions.

The total CO₂ emissions from domestic flights and outgoing international flights from Norway amounted to over 3,000,000 tons of CO₂. About one-third of these emissions (around 1 million tons of CO₂) are caused by

domestic travel, with short-haul flights connecting Oslo with Trondheim, Bergen, and Stavanger contributing almost 30% or 300,000 tons of CO₂ per year. International flights accounted for an additional 2,000,000 tons of CO₂.

NTRANS RESEARCH METHODOLOGY

Researchers at the Program for Industrial Ecology (IndEcol) at NTNU developed an emissions model using positional data from planes and route statistics from AVINOR. This model, called AviTEAM (Aviation Transport Emissions Assessment Model), enables the researchers to create a comprehensive dataset of fuel consumption and various emissions for all flight routes in Norway, including flights in and out of the country. The researchers are among the first to use Automatic Dependent Surveillance – Broadcast (ADS-B) data, as the source for positional data.

Jan Klenner, a doctoral student and first author of the article "High-resolution modeling of aviation emissions in Norway" together with Helene Muri and Anders H. Strømman, says that aviation has lagged behind in reducing greenhouse gas emissions. "It's easier to regulate



and influence domestic flights. What we have done in this study is to set up a new model with a fairly detailed dataset for Norwegian aviation. The model calculates different types of emissions from aviation based on travel route, aircraft type, engine type, and atmospheric conditions. One benefit is that it allows us to calculate domestic and international emissions separately," says Klenner.

POTENTIAL EMISSION REDUCTION SOLUTIONS

The research indicates that there is room for reducing emissions from domestic flights in Norway. The researchers suggest looking at various solutions, such as using trains on high-emission routes, electrifying routes, or exploring alternative fuels like hydrogen. Shorter routes have higher emissions per distance since more fuel is required for take-off and landing. The research provides a foundation for policymakers to make informed decisions on effective measures and investments in transport infrastructure to have a positive climate impact.

ALTERNATIVE FUELS AND ELECTRIFICATION

Alternative fuels like sustainably produced biofuels and synthetic fuels can help reduce emissions from aviation. In addition to electric and hydrogen-powered aircraft, these alternative fuels could be used on routes where electric aircraft are not suitable. Researchers are also working on a model to examine global emissions and alternative fuel types.

INTERNATIONAL COMPARISON

Data from the International Council on Clean Transportation (ICCT) shows that the average Norwegian emits approximately twice as much CO₂ from flying as citizens in Sweden, France, and Germany. This highlights the need for aggressive emission reduction strategies in Norway.

ENVIRONMENTAL IMPACT BEYOND CO₂ EMISSIONS

According to the United Nations' Intergovernmental Panel on Climate Change (IPCC), the transport sector

accounted for about 15% of total human-made greenhouse gas emissions in 2018, with aviation contributing 2.4%. However, aviation emissions have a more significant impact on the climate due to their release at high altitudes. Non-CO₂ emissions like NO_x and water vapor account for about 60% of aviation's climate pollution, making the climate impact of aviation twice as high as CO₂ emissions alone. For example, contrails from high-altitude emissions can contribute to the formation of ice clouds or cirrus clouds, which have a warming effect on the climate.

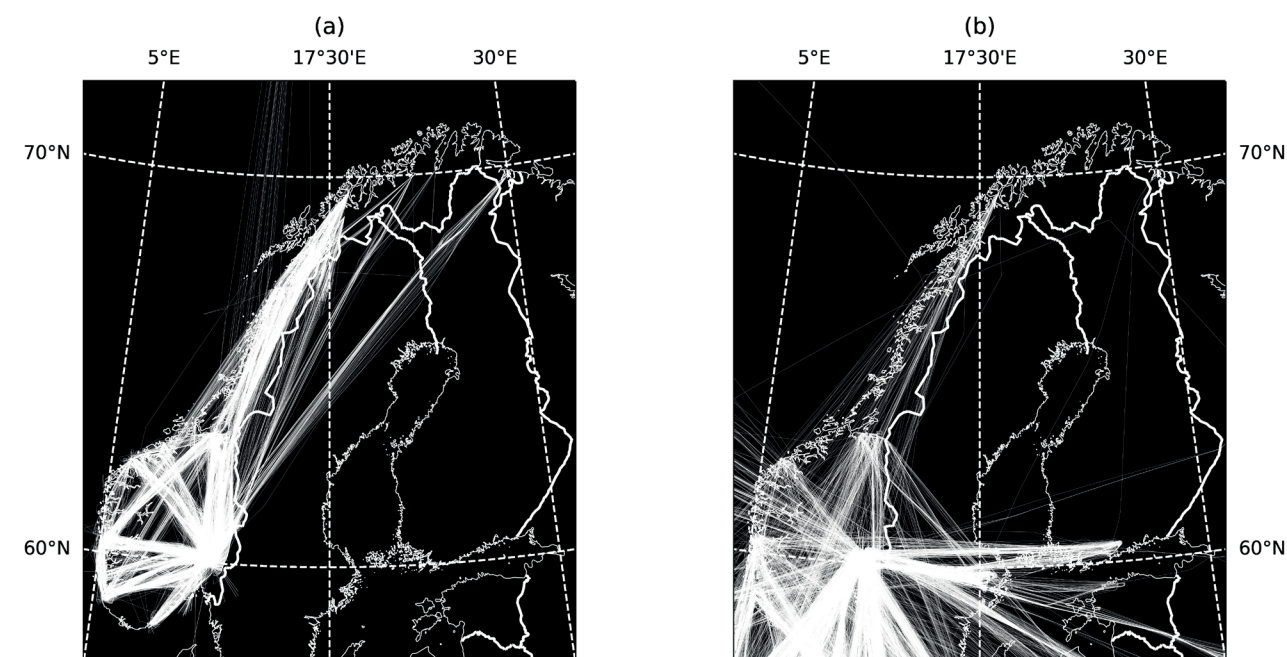
POLICY RECOMMENDATIONS

Achieving a zero-emission aviation sector may seem like a daunting task, but it is crucial to take steps in that direction. Reducing air travel, investing in alternative fuels, and developing more fuel-efficient aircraft are just some of the measures that can be taken to reduce the environmental impact of aviation.

The study's authors hope that their findings will spur policymakers, industry leaders, and the public to take action to address the environmental impact of aviation in Norway and around the world.

The findings from NTRANS research can serve as a foundation for policymakers and the aviation industry to develop and implement effective strategies to reduce emissions and achieve a zero-emission aviation sector in Norway. By implementing these policy recommendations, Norway can make substantial progress in reducing its aviation emissions and mitigating the environmental impacts of air travel.

Klenner, Jan, Helene Muri, and Anders Hammer Strømman. 2022. "High-resolution modeling of aviation emissions in Norway." *Transportation Research Part D: Transport and Environment* 109: 103379. doi: <https://doi.org/10.1016/j.trd.2022.103379>.



ADS-B data matched to (a) domestic and (b) international flight records for January 2019 as an example (Klenner, J., Muri, H., Strømman, A.H., 2022)

INTERNATIONAL COOPERATION

In 2022, NTRANS has had significant international activity, highlighting its commitment to driving sustainable change on a global scale. From research exchanges to collaborative projects and workshops, NTRANS has cemented itself as a hub for international dialogue on sustainability and energy transition.

CROSSING BORDERS: INTERNATIONAL EXCHANGE AND COLLABORATION

NTRANS has placed a strong emphasis on international exchange, with many of its scholarship holders embarking on international stays, and welcoming various international guests to its institutions. One such guest was Prof. Chris Foulds from A.R.U. Global Sustainability Institute, who conducted research at NTNU in the summer of 2022.

Further cementing its international presence, NTRANS co-organized a study trip in the fall of 2022, where young researchers from NTNU, SINTEF, and the University of Oslo visited leading transition research institutions in the Netherlands and Belgium.

FORMING STRATEGIC PARTNERSHIPS WITH RENOWNED EXPERTS

Collaboration with key international researchers such as Frank Geels and Benjamin Sovacool has allowed NTRANS to benefit from their expertise through workshops and publications. The center's researchers have consistently published alongside highly regarded international environments.

INFLUENCING THE GLOBAL STAGE

NTRANS researchers have taken on active roles in important international forums, including the European Energy Research Alliance and the European Academies' Science Advisory Council (EERA and EASAC, both represented by Tomasgard), and the IPCC (represented by Strømman).

EDUCATIONAL INITIATIVES AND INTERNATIONAL PARTNERSHIPS

NTRANS has also made strides in international cooperation through educational offerings. Its international partners have been particularly involved as co-supervisors of scholarship holders. As part of this initiative, the center

participated in TACEMM (Trans-Atlantic Consortium on Energy Markets Modeling), an INTPART project linked to FME NTRANS. Physical meetings, such as a "Winter school on planning under uncertainty in electricity markets" and a course on "Pricing mechanisms and revenue deviations," were held in Oppdal, Norway, and Florianopolis, Brazil, respectively.

ESTABLISHING THE EUROPEAN FORUM FOR ENERGY AND CLIMATE TRANSITION

NTRANS partners NTNU, SINTEF, and IFE initiated the creation of the European collaboration forum, European Forum for Energy and Climate Transition ([EFFECT.EU](https://www.effect.eu)). This forum brings together several European and international partners to collaborate on "modeling missions" that involve sharing data and analysis within transition studies.

During Energy Transition Week 2022, NTRANS co-organized several workshops and collaborated with EERA on the event "Energy crisis: challenges and opportunities for a fair transition." A special issue of Energy Policy will also be dedicated to the forum's work.

BUILDING INTERNATIONAL BRIDGES THROUGH PUBLICATIONS AND PROJECTS

NTRANS's commitment to global sustainability is reflected in its numerous international projects and publications. In 2022, the center began several new international projects and has applied for funding from the EU and other international sources.

As NTRANS continues to forge new partnerships and develop innovative solutions, its international cooperation efforts will undoubtedly play a critical role in shaping a sustainable future on a global scale.

From "The Energy Crisis in Europe - WS3: Energy Production and Use in Norway"



Project	Status	Call/funder	NTRANS-partner	Coordinator
SSH Centre (Social Sciences and Humanities for Climate, Energy and Transport Research Excellence)	Starting 1.9.2022	HORIZON-CL5-2021-D2-01-13	NTNU	Anglia Ruskin University
PATTERN (Providing operational economic appraisal methods and practices for decision-making on climate and environmental policies)	Starting 1.6.2022	HORIZON-CL5-2021-D1-01-07	NTNU	Complutense University of Madrid
CircoMod	Starting 1.6.2022	https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-search;callCode=HORIZON-CL5-2021-D1-01	NTNU	University of Utrecht
ACCTING (Advancing behavioural Change Through an Inclusive Green deal)	Starting 1.2.2022	H2020-LC-GD-2020-4	NTNU	European Science Foundation
ARV	Starting 1.1.2022	H2020-LC-GD-4-1-2020	NTNU	ZEN/NTNU
iDesignRES	Applied in April 2022 - on waiting list	HORIZON-CL5-2022-D3-01	NTNU	NTNU
JUSTUs	Applied in Oct. 2021 - on waiting list	HORIZON-CL5-2021-D2-01	NTNU	IFO Institute
Open4cec (Service-oriented Open Platform for Citizen Energy Communities (CEC) – a scalable and extensible platform)	Applied in Nov. 2022	DUT (Driving Urban Transitions Partnership) call 2022	NTNU	Bucharest University of Economic Studies
Man0EUvRE (Energy System Modelling for Transition to a net-Zero 2050 for EU via REPowerEU)	Applied in Nov. 2022	CETPartnership Joint Call 2022	NTNU, Sintef, IFE	Sintef
Nordic Energy Outlook	Applied in 2022	Nordic Energy research	NTNU, Sintef, IFE	Sintef
NordicH2ubs (Nordic hydrogen hubs – roadmaps towards 2030 and 2040)	Applied in Oct. 2022	Nordic Energy Research	NTNU, Sintef, IFE	Sintef
Nord_H2ub - Rally to the Valley: Establishing Hydrogen Value Chains for the Nordics	Applied in Oct. 2022	Nordic Energy Research	NHH, NTNU	CBS
EPICURUS (Energy Positive human-Centric Usage of smart Buildings)	Applied in Sept. 2022	HORIZON-CL5-2022-D4-01	NTNU	University of Pisa
POTENT - Ports as Energy Transition Hubs	Applied in Nov. 2022	HORIZON-MSCA-DN-2022	NHH	CBS
WindUP	Applied in Feb. 2022 - rejected	HORIZON-CL5-2021-D3-03	NTNU	Sintef Ocean
RISKNAVI	Applied in Feb. 2022 - rejected	HORIZON-CL5-2022-D1-01-two-stage	NTNU	Forschungszentrum Jülich
NETWORK4ENERGY	Applied in Jan. 2022 - rejected	HORIZON-CSA	NTNU	Kadir Has Universitesi

BRIDGING THE GAP: NTRANS FORGES COLLABORATIVE TIES WITH FELLOW RESEARCH CENTERS



At NTRANS, fostering collaboration with other research centers is at the core of its mission to understand and navigate the complexities of energy and climate transformations. This commitment to cooperation is demonstrated in two primary ways: through joint research and user cases and by partnering on events, education, and guidance initiatives.

CROSS-CENTER RESEARCH: BUILDING KNOWLEDGE TOGETHER

One standout example of NTRANS' collaborative research efforts is the report *How to Create Trust and Acceptance for Automation of Power Consumption*, which was produced in partnership with FME Cineldi. Building upon their participation in an IEA task, the two centers will continue to explore gender and flexible consumption in a forthcoming IEA task.

Over the past year, NTRANS has also established new user case collaborations with various centers. These include a joint project with FME Zen focused on the sustainable development of innovation districts, a partnership with FME NorthWind to investigate societal aspects of offshore wind, and a collaboration with FME NCCS centered on carbon capture and negative emissions. Additionally, NTRANS continues its fruitful collaboration with FME MoZEEZ in studying transport models.

EVENTS, EDUCATION, AND GUIDANCE: LEARNING FROM EACH OTHER

In addition to research collaborations, NTRANS works closely with other centers to create educational opportunities and share expertise. The center has participated in the NORREN Summer School, contributing students, instructors, and program committee members, as well as joining the program committee for the Smart Grid Conference alongside FME Cineldi.

Furthermore, NTRANS has played a leading role in organizing a comprehensive workshop series addressing the energy crisis. This initiative brings together technology-focused FMEs and FME Include, emphasizing the importance of interdisciplinary collaboration.

As a social science center, NTRANS relies on strong partnerships with other research centers to ensure a comprehensive understanding of the ongoing transformation in the energy sector. In return, NTRANS brings valuable insights and perspectives, helping to contextualize and enrich the work of its fellow centers.

EXPANDING NETWORKS: CLUSTERS, CATAPULTS, AND BEYOND

While NTRANS is not currently linked to any FORINFRA-funded research infrastructure, the center continues to forge connections with other organizations. For instance, the MAREN II project has seen SINTEF Community and SINTEF Energy partner with the renewable energy cluster RENERGY, working together to develop tools for a maritime energy transformation.

By embracing the power of collaboration and cross-disciplinary knowledge sharing, NTRANS and its fellow research centers are better equipped to tackle the multifaceted challenges of the energy and climate landscape, driving innovation and progress towards a more sustainable future.

THE ENERGY SITUATION IN EUROPE

The energy crisis has far-reaching effects and has been particularly prominent this year, as Europe faces an unparalleled energy predicament and shifting geopolitical dynamics. As a social science FME, NTRANS is uniquely positioned to address these emerging challenges.

New inquiries concerning the interplay between geopolitics, local value creation, energy markets, energy projections, scenarios, and climate goals have informed our upcoming user case workshops. For instance, RA1 organized the international workshop "Energy Crisis and Inflation: Implications for Research on Rebound Effects." This theme is also reflected in other forms of dissemination, such as policy briefs and publications.

COLLABORATIVE WORKSHOP SERIES ON THE ENERGY CRISIS

The European energy crisis has resulted in consistently high electricity prices and significant regional price disparities in Norway. There has been a surge of interest in energy access, security, and pricing. The rapid and extensive nature of the situation caught us off guard, revealing an immediate need to gather facts and develop understanding. NTRANS took the lead in inviting researchers and industry leaders to discuss and systematize an interdisciplinary knowledge base through a seven-part workshop series titled "The Energy Crisis in Europe" (<https://www.youtube.com/watch?v=snKOxlfqK-Q&list=PLV3-HZTMhvPbX-zl3mLrD-wLSTQzOQtLB&index=1>).

Collaborating partners in the workshop series included FME centers NTRANS, CINELDI, ZEN, HighEFF, Include, NorthWind, and HydroCEN, alongside the Norwegian Academy of Technological Sciences (NTVA) and the Norwegian Academy of Science and Letters.

SUMMARIZING INSIGHTS AND LESSONS LEARNED

Conclusions from the workshops are now summarized and presented in the report "The Energy Crisis in Europe and the Norwegian Power Market," which also synthesizes the learnings from these sessions. (Read the report here: https://www.ntnu.edu/documents/1276062818/0/Policy_Brief_Energikrisen+i+Europa_v13.pdf/f45ccc2a-2c35-ea1b-71f1-cbfa910c76b1?t=1676710166348)

CONTRIBUTING TO PUBLIC DEBATE

Description automatically generatedText BoxThe workshop series and NTRANS' internal research activities have progressed alongside the public debate. Our researchers have frequently contributed to the media through opinion pieces and interviews, elevating

the discourse surrounding the energy crisis. In times of uncertainty and alarming climate reports, we have been able to both reassure and caution with fact-based knowledge. For example, we responded live to VG readers' electricity inquiries, commented on the crisis's impact on climate change, assessed changes in the power market, energy conservation, power exports, gas supply, energy support, rationing, and low-cost power.

EXPLORING THE ENERGY CRISIS AND ACCELERATING THE TRANSITION

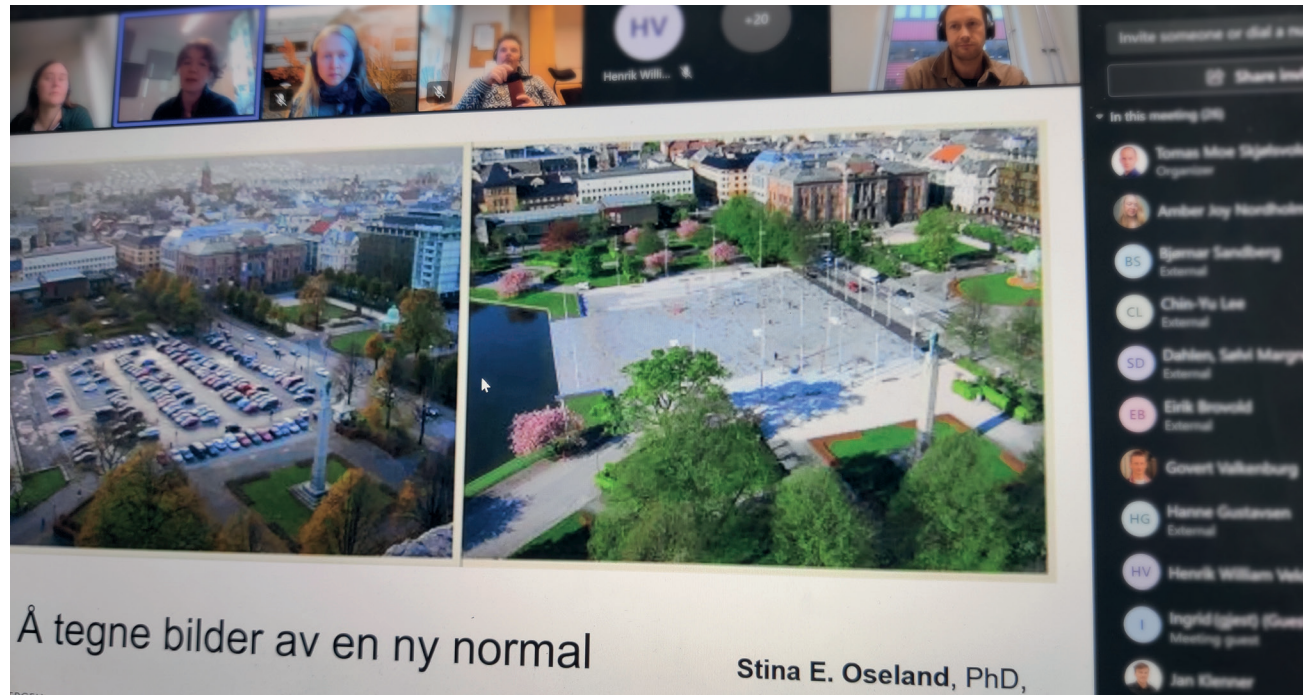
Drawing from our report, "How can we accelerate the pace of energy transition?" (<https://www.ntnu.no/documents/1284688443/1285504199/Hvordan+kan+vi+få+opp+farten+i+energiomstillingen.pdf/be185623-5174-3fd9-ed81-8896df512ed4?t=1660216289261>), we also organized a session at Arendalsuka. During this event, we examined how the energy crisis could potentially accelerate Europe's energy transition through dialogue with politicians and industry representatives.

In December, we hosted the 2022 annual conference, dedicating the opening sessions to the energy crisis, with a focus on assessing the journey so far and charting the path forward. The energy crisis in Europe has created challenges for the whole world, and at NTRANS, we are proud of our adaptability in the face of the new realities that the transition brings. By addressing emerging research questions, collaborating on workshop series, summarizing insights, and engaging in public debate, we remain committed to providing fact-based knowledge and fostering dialogue to accelerate the pace of the energy transition.



Center Director, Asgeir Tomasgard, weighing in on proposals for a lower limit on tapping of power reservoirs. Dagsrevyen

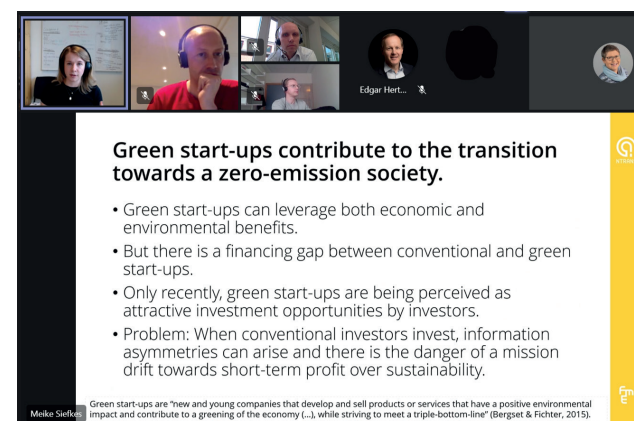
WEEKLY WEBINARS – POPULAR MEETING POINT



NTRANS has been organizing biweekly lunch box webinars throughout 2022, an event that has by now become cherished across the centre. These events provide researchers and user partners with a low-threshold arena for engaging in discussions about various transition processes related to energy markets, circular economy, energy justice, and more. These talks are primarily given by partners in the centre representing academic institutions, industry, and government organizations, who provide unique perspectives on how they work to understand or advance the transition.

On May 19th, we had a small anniversary with our 50th lunchtime webinar. One of our PhD students, Meike Siefkes (NTNU) gave a presentation titled: "Green angels: who are they and how do they contribute to their start-ups?"

The popularity of these webinars is not surprising, given that they allow us to discuss everything from fresh work by PhD students to new strategies for transition in the industry. We hope to increase the share of webinars that presents original research and perspectives from NTRANS, and to see more presentations from our many promising PhD and post doc candidates. Furthermore, we aim to use this arena as a way of presenting broad synthesis about insights generated as the NTRANS work progresses. We also want the webinars to be an arena that is increasingly used to present the strong collaborative work that goes on in user cases, where researchers and user partners work together. We look forward to seeing you for lunch also in the coming year!



ANNUAL CONFERENCE 2022



Navigating Energy Crises and Advancing Climate Transitions: Insights From FME NTRANS Annual Conference 2022

After a turbulent time with the global pandemic, FME NTRANS hosted its annual conference for the first time in person, in Oslo on December 7th and 8th, exploring the theme of *navigating energy crises and advancing energy- and climate transitions*. The conference brought together researchers, scientists, and industry professionals to share insights and discuss potential solutions to the challenges facing the energy sector today.

On the first day of the conference, Mette Bjørndal, director of research at FME NTRANS, delivered a welcome address and opening reflections, setting the tone for the day's sessions. The first session, "Navigating the Energy Crisis and Beyond," featured presentations by Johan Schot, Professor of Global History and Sustainability Transitions at Utrecht University, and Asgeir Tomasgard, Director of FME NTRANS at NTNU, among others. The presentations were followed by a Q+A session and a panel discussion, providing attendees with the opportunity to engage with experts in the field.

The second session, "What's Next for Renewable Energy, Energy Use, and the Energy Transition?" focused on identifying and addressing societal aspects of offshore wind power in the North Sea, the role of climate engagement and social movements in the transition, and electrification of heavy-duty transport and construction in Oslo. The day concluded with a session on funding and financing an accelerated transition, featuring a keynote speech by Thina Saltvedt from Nordea, followed by a panel debate.

The second day of the conference featured several user case sessions, moderated by industry professionals and researchers. These sessions provided attendees with the opportunity to explore specific topics related to energy and climate transition, such as sustainable innovation and transition of urban areas and CCS, CDR, and negative emissions.

Throughout the conference, the importance of understanding user needs and working collaboratively as part of a team of researchers and industry professionals was emphasized. Attendees were encouraged to share their ideas and insights, fostering a collaborative and supportive environment.

Overall, the FME NTRANS annual conference 2022 provided attendees with valuable insights and solutions to the challenges facing the energy sector today. As we continue to navigate multiple crises, the conference's focus on advancing energy- and climate transitions remains crucial for creating a more sustainable and equitable future.

Here you can see the presentations from the 7th of December: <https://www.ntnu.no/web/ntrans/presentasjoner-for-arskonferanse>



ENERGY TRANSITION WEEK 2022



NTNU Energy Transition Week is an annual event co-hosted by FME NTRANS, which normally consists of one physical conference, several workshops and networking events during the week in Trondheim. It brings together academics, experts, industry professionals, policymakers, researchers, and students to discuss the latest trends, challenges, and opportunities in the field of energy transition to a net-zero society.

The 2022 conference was organized as a hybrid event due to regional differences regarding Covid-19. The Energy Transition Week took place from March 28th to April 1st, 2022. The theme for the 2022 edition of the Energy Transition Week was "Accelerating Transition." Physical attendees gathered in Trondheim on March 29th, while over 25 000 unique viewers visited the stream.

Experts from a wide field of disciplines met to discuss how to accelerate the transition to renewable energy systems. After giving keynote presentations, speakers engaged in discussions with an expert panel and the audience.

See the conference here: <https://www.ntnu.edu/web/energytransition/conference-2022>



Foto: Sandra Skillingsaas

NTRANS-FESTIVAL 2022: UNITING MINDS AT RØROS, NORWAY'S HISTORIC MINING TOWN



As the sun dipped below the horizon, casting a warm glow over the picturesque Norwegian town of Røros, the electrifying energy of the NTRANS Festival 2022 permeated the crisp air. Researchers, scientists, and innovators convened at this UNESCO World Heritage site, renowned for its copper mining legacy, to share their groundbreaking work in sustainable technology and innovation.

From August 24th to 26th, 2022, the NTRANS Festival served as an incubator for ideas, fostering a collaborative and engaging atmosphere for participants. The event's primary aim was to provide insights into the center's research, facilitate socializing, and encourage discussions about various projects spanning multiple research areas.

PhD candidates and postdoctoral researchers had the opportunity to showcase their work through short presentations and poster sessions. These sessions generated considerable interest and sparked numerous conversations among attendees.

NETWORKING AND ENGAGEMENT: BUILDING LASTING CONNECTIONS

The Festival's dynamic environment fostered abundant opportunities for networking and engagement. Researchers exchanged ideas and forged new partnerships during coffee breaks, while interactive workshops enabled attendees to learn from experts and delve into novel tools and methodologies.

The NTRANS Festival's vibrant social program combined Røros' rich history with contemporary entertainment, outdoor activities, delectable cuisine, and an enchanting

evening concert. Guided tours of the town's historic center allowed participants to immerse themselves in Røros' copper mining heritage. A dinner and concert featuring local music and stories brought the inspiring event to a fitting conclusion.

NTRANS director Asgeir Tomasgard expressed his hopes for the future, stating, "We hope to be able to organize several research festivals in the coming years." He added, "There was a good atmosphere, people seemed to enjoy themselves, and these meeting places are important for those of us who have partners spread around the country. Collaboration often works better between people who have met face to face."



ARENDALSUKA: ACCELERATING THE ENERGY TRANSITION: A CLOSER LOOK



The race is on to meet climate goals by 2030, and the Norwegian Centre for Energy Transition Strategies (FME NTRANS) is leading the charge. As part of their efforts to accelerate the energy transition, FME NTRANS hosted their own debate at Arendalsuka event on August 16th.

The event, titled "Accelerating the Energy Transition: Speed must increase to reach the climate goals by 2030," featured a variety of speakers and topics. One of the main questions explored was: what can be done politically to speed up the transition to cleaner energy sources?

Another key topic discussed was "the importance of increasing the pace of the energy transition. With climate goals looming just a decade away, there is an urgent need to act quickly and decisively. But how can we ensure that the transition is both effective and equitable?"

To help shed light on these issues, FME NTRANS lined up an impressive array of experts and stakeholders. The event began with a series of speed presentations, in which three NTRANS researchers had three minutes to present their research on the energy transition from different perspectives.

From there, the discussion moved on to a panel debate featuring politicians, business leaders, and other experts. Marianne Sivertsen Næss, leader of the Energy and Environment Committee, was on hand to discuss climate and environmental policy. And representatives from

key energy companies like Hydro Energi, Equinor, and Statkraft also took part.

Overall, "Accelerating the Energy Transition" was a thought-provoking and informative event for anyone interested in the future of energy. By bringing together such a diverse group of voices, FME NTRANS is helping to foster a more inclusive and collaborative approach to the challenges ahead.

Did you miss our event at Arendalsuka 2022?

Watch the recording of everything - both our three researchers with speed presentations and the panel debate with business and politicians here:

<https://lnkd.in/d2-GBU9A>

Or read the report here:

<https://www.ntnu.no/documents/1284688443/1285504199/Hvordan+kan+vi+få+opp+farten+i+energi-omstillingen.pdf/be185623-5174-3fd9-ed81-8896df512ed4?t=1660216289261>



TACEMM WINTER SCHOOL AT OPPDAL

The picturesque town of Oppdal played host to the TACEMM (Trans-Atlantic Cooperation on Energy Market Modeling) Winter School from February 28th to March 4th, 2022. This workshop united PhD students and researchers from around the world to discuss "Planning Under Uncertainty in Energy Markets" and foster international connections.

Two NTRANS PhD students, Felipe Van de Sande Araujo and Luke Whittington, were among the attendees, participating in a week filled with enlightening lectures, stimulating discussions, and lively social activities, including skiing in the idyllic surroundings of Oppdal.

NTRANS researchers not only delivered lectures throughout the week but were also key members of the organizing committee. The event provided an invaluable opportunity for participants to engage with international researchers sharing similar interests.

Felipe Van de Sande Araujo, an NTRANS PhD student, praised the event, stating, "The Oppdal Winter School allowed us to meet and talk with international researchers with aligned interests. I was able to connect directly with PhD students from the USA, Brazil, and many countries in Europe. Speaking to the authors you cite during lunch is a great way to make sure you're on the right track!"

The Winter School featured a mix of senior lecturers' talks and PhD student presentations, with attendees given the chance to earn 2.5 credits upon completing the coursework. Those not enrolled at NTNU were provided with a diploma, which can typically be used to gain 2-3 ECTS at their home institutions.

With limited spaces available and a competitive application process, the TACEMM Winter School at Oppdal 2022 offered an exceptional opportunity for those passionate about energy market modeling to learn, network, and be inspired.



REPORT FROM UNGENERGI



UngEnergi: The Future is Sustainable

UngEnergi has made a great effort to promote sustainable energy among young people. In 2022, the editorial team celebrated its tenth anniversary and continued to spread the message about renewable energy to middle and high school students. Throughout the year, they made even more adjustments that led to increased engagement and interest from the public.

UngEnergi has increased its presence on social media in 2022, with their Instagram account now containing relevant information about renewable energy, sustainable buildings, and environmental measures. UngEnergi has focused on creating informative and entertaining content, which has helped them increase their followers and reach a larger audience.

To make the texts on ungenergi.no more engaging, a new quiz system has been created, which is available on the website. These quizzes summarize the most important points from a variety of texts and provide visitors with an interactive way to learn about renewable energy. In addition to quizzes, UngEnergi has developed a Kahoot.

In 2022, UngEnergi also participated in stand at Researcher's Night and UNG Agenda (Unicef's sustainability conference) alongside UngKlima. This has been a

great opportunity for UngEnergi to showcase its work and spread knowledge about renewable energy to a wider audience.

UngEnergi's website is regularly updated to ensure correct and up-to-date information. The organization will continue to pave the way for a sustainable future by teaching young students about renewable energy. In this way, they are creating a brighter future for us all.

To learn more about UngEnergi's mission and activities, visit their website at <https://ungenergi.no/>.



UNGKLIMA IS IN ACTION!



UngKlima - The Year That Was

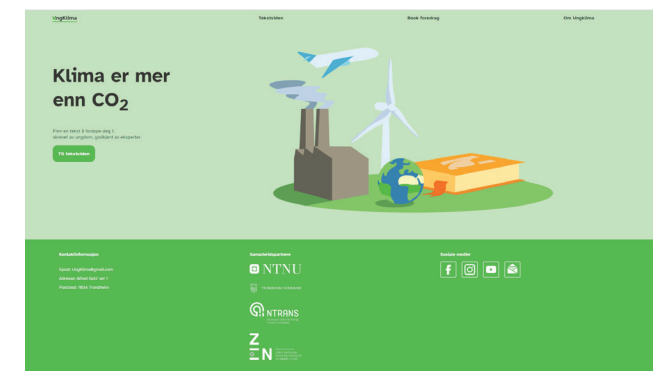
2022 was a year marked by climate engagement and initiatives aimed at making a difference. UngKlima was one of the most inspiring movements of that year. A group of committed young people took the initiative to create awareness about climate change and what can be done to combat it. UngKlima consisted of six young people aged 17-21, and their goal was to spread knowledge about climate change and inspire other young people to take action.

UngKlima worked hard throughout the year to create written and graphic content for the website and other channels. They collaborated with UngEnergi, a similar editorial team that works on communicating about renewable energy. This collaboration allowed them to reach a wider audience and have a greater impact.

In 2022, UngKlima launched its website and published texts and illustrations on it. They also posted on social media and exchanged experiences with Klimapilotene. They created an animation video about the greenhouse effect, collaborated with Adressa, and contributed to the Youth Climate Summit. Stand at Researcher's Night and posts and stands at UNG Agenda (Unicef's sustainability conference) in Oslo were also on the agenda.

Lecturing is also an important part of UngKlima's work. During 2022, they gave lectures at middle schools, adult education, and Scandic Lerkendal. They believed it was important to engage young people personally and provide them with the knowledge and resources they needed to make informed decisions.

The lectures address the consequences and causes of climate change, but also place great emphasis on what can be done – both by individuals and society. The idea



is that by focusing on actions and opportunities, young people would be more engaged and motivated to take action. The lectures are also illuminated with surprising examples, interesting facts, and carefully thought out pictures and illustrations that capture attention and create discussion and engagement.

The emphasis on action and measures in the lectures is based on the editorial team's perception that many young people feel hopeless and paralyzed in connection with climate change. Many know the consequences but not what they can do about it. UngKlima is a counterweight to this hopelessness – the focus is not only on hard facts, but also on concrete actions and opportunities for change.

UngKlima is a shining example of how young people can make a difference and take action against climate change. With initiatives like this, we can create a better future for ourselves and future generations. To learn more about UngKlima and their work, visit their website at <https://ungklima.no/>.

SPIN-OFF PROJECTS

Over the past year, we have been working on several applications, and new projects have been initiated. Some examples include:

Hydrogen Pathways 2050 is a four-year project funded by NFR in 2021. The project is led by IFE, with research partners SINTEF Energy, SINTEF Digital, NTNU Power Engineering, and NTNU IØT, and user partners Equinor, Gassco, and Statkraft. Hydrogen Pathways 2050 will analyze the transition of the Norwegian society towards 2030 and 2050, with a special focus on hydrogen. The project will include both the production and use of hydrogen in Norway, but also looks at hydrogen as a possible export product and the interplay between renewable power production, power transmission, hydrogen production, and end-use of hydrogen.

NextGenVPP (Next Generation Virtual Power Plant) is a national E-Pilot project coordinated by NTNU IEL with participation from NTNU IØT. The project focuses on "smart grids" and coordination of "small energy assets."

FINE (Flexible Integration of Local Energy Communities into the Norwegian Electricity Distribution System) is a national KPN project coordinated by Sintef Energy with participation from NTRANS partner NTNU.

Regulation and Investment Incentives for Grid Companies in the Green Shift: In 2022, NHH/SNF and the University of Innlandet will carry out a project for Energy Norway on investment incentives for regulated grid companies. The first part deals with whether it is possible to make grid companies more proactive through changes in regulation, and the second part deals with incentives for adopting new technology and flexibility compared to traditional grid investments.

SusHydro – Sustainable hydropower development and reservoir management as an enabler of the renewable energy transition and an accelerator to meet the UN Sustainable Development Goals (SDGs). SusHydro is a four-year project funded by NTNU and is part of the university's sustainability initiative. There are seven doctoral candidates from different departments. SusHydro seeks to find innovative solutions across sectors that shed light on the services that can be delivered from hydropower and reservoirs, and focuses on how synergies and conflicts between different sustainability goals can be identified and balanced. SusHydro has assembled a group of experienced and younger researchers with backgrounds in hydrology and water resource analysis, life cycle analysis, energy system modeling, economics, biology, and social sciences. Solutions are developed based on case studies from Norway and areas in Africa with hydropower resources.



R-Deco (Center for Recommissioning, Redevelopment, Decommissioning and Circularity), funded by the Hordaland County Council, is exploring the establishment of a competence center for research on environmental benefits of closing and removing offshore installations. A competence center can unlock potential both in terms of valuable circularity innovations and in terms of reduced conflicts with other industries and stakeholders.

FME HyValue is developed as a collaboration in Energy Transition West (EOV consists of NHH/SNF, UiB, NORCE, HVL, and UiS). NORCE coordinates the project, and NHH and SNF are partners. The project is funded by NFR and more than 30 partners in Norway and internationally. NHH/SNF's engagement focuses on the potential of hydrogen development for Norway, through research on business models and value chains, policy, financial and regulatory frameworks in Norway and Europe, interaction between energy carriers, and maritime transport as an end-user and transporter.

FME HYDROGENi is the second FME that received funding in 2022. HYDROGENi is led by SINTEF with research partners including NTNU, UiO, and IFE. Researchers from power engineering, psychology, industrial ecology, UiO, and KULT are involved in supervising doctoral candidates, while researchers from IFE and SINTEF are also involved. We expect good synergies between NTRANS and the hydrogen FMEs.

THE PERSPECTIVE ON GENDER EQUALITY

At NTRANS, the pursuit of gender equality and inclusion goes beyond numbers – it's a commitment to fostering a culture that celebrates diversity, embraces different perspectives, and empowers individuals from all walks of life. From recruitment to research, NTRANS is steadfast in its dedication to creating a more equitable and inclusive environment for everyone.

STRIVING FOR BALANCE: GENDER EQUALITY IN RECRUITMENT

NTRANS' commitment to gender equality is evident in its recruitment process, with a strong focus on achieving a balanced gender representation across all positions. Currently, the center's management team is predominantly male (4 women, 9 men), while its board boasts a majority of women (6 women, 4 men). Among the PhD and Postdoc group, the gender balance is nearly equal, with 7 women and 9 men. The percentage of women among Key Researchers is just below 40%, reflecting NTRANS' ongoing efforts to promote gender equality in its workforce.

INCLUSIVE ENGAGEMENT: CELEBRATING DIVERSITY IN EVENTS AND BEYOND

NTRANS' dedication to inclusivity extends to its events, where organizers strive for an even distribution of female and male speakers. This commitment is further demonstrated through the promotion of "inclusive engagement," a concept developed by NTRANS researchers in the H2020 project energy-SHIFTS. This initiative seeks to build a culture that encourages the expression of different perspectives in research, communication, and interaction with user partners and others.

RESEARCH FOCUS: GENDER, INCLUSION, AND DIVERSITY

NTRANS is also dedicated to exploring the intersection of gender, inclusion, and diversity in its research, particularly in Research Area 1 (RA1). Notably, NTRANS researchers are participating in the new IEA-task, "The Role of Gender and Diversity Factors in Flexibility." This groundbreaking initiative investigates how gender and diversity play a role in the ability to reduce or make power consumption more flexible.

Furthermore, NTRANS researchers are collaborating with the Center for Gender Research (NTNU) to develop a project involving actors in the power industry. This project aims to understand how energy research can better incorporate gender dimensions into its work, fostering a more inclusive approach to energy-related challenges.

By actively promoting gender equality and inclusivity in all aspects of its operations, NTRANS is leading the way in creating a more equitable, diverse, and inclusive future for the energy sector. With a firm belief in the power of diverse perspectives, NTRANS is committed to empowering individuals and driving innovation that benefits everyone.

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"

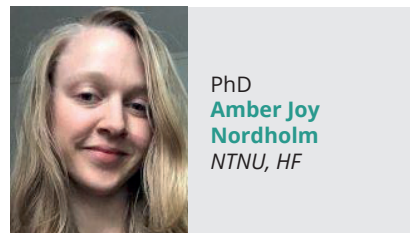
Supervisors: Roger Sørheim (NTNU-IØT), Øyvind Bjørgum (NTNU-IØT)



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
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."

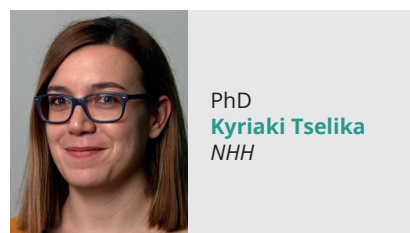
Supervisors: Marianne Ryghaug (NTNU-KULT), Tomas Moe Skjølsvold (NTNU-KULT), Marius Korsnes (NTNU-KULT)



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
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)



PhD
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)



PhD
Mario Blazques de Paz
NHH

Title: "Guarantees of origin and market power in the electricity market"

Supervisors: Mette Bjørndal (NHH)



PhD
Jørgen Finstad
UiO - TIK

Title: "The effect of new user sectors on carbon capture and storage's innovation system."

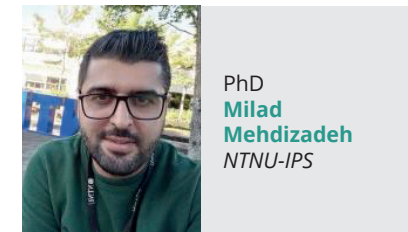
Supervisors: Allan Dahl Andersen (UiO - TIK), Taran Thune (UiO - TIK)



PhD
Jarand Hole
NTNU & NVE

Tentative title: "Integration of solar power in the Norwegian power system"

Supervisors: Magnus Korpås(NTNU-IEL), Steve Völler(NTNU -IEL), Harald Endresen(NVE)



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
Maximilian Koslowski
NTNU-EPT

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

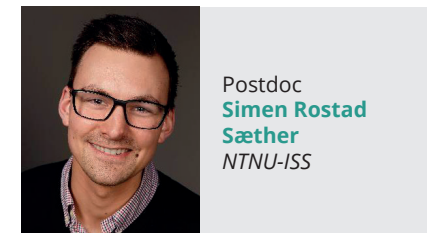
Supervisors: Edgar Hertwich & Richard Wood (both NTNU-EPT, IndEcol)



PhD
Luke Whittington
NTNU-IEL

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

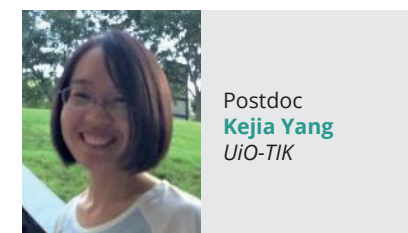
Supervisors: Hossein Farahmand (NTNU-IEL)



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)



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
Negar Safara
HvL

Topic: "Approaching context in transition studies; The case of energy-hub-ports"

Supervisors: Bente Johnsen Rygg (HvL), Geoffrey Sean Gilpin (HvL) & Rune Njøs (HvL)

STATEMENT OF ACCOUNT

FUNDING

Funding	Amount	Total
The research council		10 530
The host institution (NTNU)		12 715
Research partners		4 784
Høgskulen på Vestlandet	1 204	
Institutt for energiteknikk	230	
Norges handelshøyskole	1 854	
Samfunns- og næringslivsforskning		
SINTEF AS		
SINTEF Energiforskning	251	
Universitetet i Oslo	956	
Vestlandsforskning	289	
Enterprise partners		6 307
Equinor	1 210	
Hydro	771	
Gassco	500	
Statkraft	610	
Eviny	251	
Energi Norge	205	
ATB	100	
Ruter	136	
eSmart systems	42	
Nodes	24	
Volue Technology	194	
Becour AS	84	
NLF	119	
Posten Norge	36	
Saga Fjordbase	100	
Hub for Ocean	-	
Funding transfered from previous years	1 926	

Public partners		3 165
Enova	357	
Innovasjon Norge	-	
Miljødirektoratet	39	
Statens vegvesen	500	
Statsbygg	240	
Kystverket	103	
Gassnova	284	
Jernbanedirektoratet	337	
Bergen kommune	182	
Oslo kommune	225	
Trondheim kommune	291	
Kinn kommune	200	
Trøndelag fylkeskommune	323	
Vestland fylkeskommune	83	
Total		37 500

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)		20 132
Research partners		15 215
Høgskulen på Vestlandet	1 931	
Institutt for energiteknikk	2 214	
Norges handelshøyskole	3 602	
Samfunns- og næringslivsforskning	657	
SINTEF AS	1 602	
SINTEF Energiforskning	2 072	
Universitetet i Oslo	1 940	
Vestlandsforskning	1 197	
Enterprise partners		1 059
Equinor	210	
Hydro	271	
Gassco	-	
Statkraft	110	
BKK	51	
Energi Norge	55	
ATB	-	
Ruter	36	
eSmart systems	-	
Nodes	24	
Powel	94	
Becour AS	84	
NLF	119	
Posten Norge	6	
Saga Fjordbase	-	
Hub for Ocean	-	

Public partners		1 095
Enova	57	
Innovasjon Norge	-	
Miljødirektoratet	39	
Statens vegvesen	-	
Statsbygg	90	
Kystverket	103	
Gassnova	284	
Jernbanedirektoratet	37	
Bergen kommune	82	
Oslo kommune	75	
Trondheim kommune	91	
Kinn kommune	-	
Trøndelag fylkeskommune	173	
Vestland fylkeskommune	63	
Total		37 500

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

PERSONNEL

KEY RESEARCHERS

Name	Institution	Main research area
Dhayalan Velauthapillai	HVL	RA5: User cases and innovation
Rune Njøs	HVL	RA2 Accelerating the energy transition, RA5: User cases and innovation
Bente Johnsen Rygg	HVL	RA1 Deep decarbonization and wide societal changes, RA2 Accelerating the energy transition
Kristin Linnerud	HVL	RA2 Accelerating the energy transition
Geoffrey Gilpin	HVL	RA5: User cases and innovation
Dejene Assefa	HVL	RA2 Accelerating the energy transition
Erling Holden	HVL	RA5: User cases and innovation
Ville Olkkonen	IFE	RA3 The future energy market
Kari Aamodt Espegren	IFE	RA4 Transition pathways, RA5: User cases and innovation
Eva Rosenberg	IFE	RA4 Transition pathways, RA5: User cases and innovation
Pernille Seljom	IFE	RA4 Transition pathways, RA5: User cases and innovation
Mari Lyseid Authen	IFE	RA4 Transition pathways, RA5: User cases and innovation
Lisa Kvalbein	IFE	RA4 Transition pathways, RA5: User cases and innovation
Janis Danebergs	IFE	RA4 Transition pathways, RA5: User cases and innovation
Kristina Hasskjold	IFE	RA4 Transition pathways, RA5: User cases and innovation
Pernille Seljom	IFE	RA3 The future energy market
Miguel Chang	IFE	RA4 Transition pathways, RA5: User cases and innovation
Stine Fleicher Myhre	IFE	RA4 Transition pathways, RA5: User cases and innovation
Endre Bjørndal	NHH/SNF	RA3 The future energy market
Gunnar Eskeland	NHH/SNF	RA2 Accelerating the energy transition
Mette Bjørndal	NHH/SNF	Research director
Tomas Moe Skjølsvold	NTNU HF	Deputy centre director
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
Marius Korsnes	NTNU HF	RA1 Deep decarbonization and wide societal changes, RA2 Accelerating the energy transition, RA4 Transition pathways, RA5: User cases and innovation
Sara Heidenreich	NTNU HF	RA1 Deep decarbonization and wide societal changes, RA2 Accelerating the energy transition, RA4 Transition pathways, RA5: User cases and innovation
Gisle Solbu	NTNU HF	RA1 Deep decarbonization and wide societal changes, RA2 Accelerating the energy transition, RA4 Transition pathways, RA5: User cases and innovation
Ida Marie Henriksen	NTNU HF	RA1 Deep decarbonization and wide societal changes
Marianne Ryghaug	NTNU HF	RA1 Deep decarbonization and wide societal changes

Name	Institution	Main research area
Edgar Hertwich	NTNU IV	Cross cutting area 3
Anders Hammer Strømman	NTNU IV	Cross cutting area 3
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
Asgeir Tomasgard	NTNU OK	Centre director
Christian Klöckner	NTNU SU	Citizen behaviour and attitudes in energy transition processes
Aponte Fabian Rocha	SINTEF AS	RA2 Accelerating the energy transition
Astrid Bjørgen	SINTEF AS	RA5: User cases and innovation
Carl-Johan Södersten	SINTEF AS	RA5: User cases and innovation
Endre Brunner Furu	SINTEF AS	RA5: User cases and innovation
Erlend Dahl	SINTEF AS	RA5: User cases and innovation
Fabian Rocha Aponte	SINTEF AS	RA5: User cases and innovation
Frode Rømo	SINTEF AS	RA5: User cases and innovation
Gerardo A Perez-Valdes	SINTEF AS	RA4 Transition pathways, RA5: User cases and innovation
Jens Hanson	SINTEF AS	RA2 Accelerating the energy transition, RA5: User cases and innovation
Kirsten Svenja Wiebe	SINTEF AS	RA2 Accelerating the energy transition, RA5: User cases and innovation
Kristin Ystmark Bjerkan	SINTEF AS	RA5: User cases and innovation, RA2 Accelerating the energy transition
Lisa S. Græsli	SINTEF AS	RA2 Accelerating the energy transition
Lone-Erin Lervåg	SINTEF AS	RA5: User cases and innovation
Maria Diez Gutierrez	SINTEF AS	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
Nina Møllerstuen Bjørge	SINTEF AS	RA2 Accelerating the energy transition
Sahar Babri	SINTEF AS	RA5: User cases and innovation
Sigrid Damman	SINTEF AS	RA4: Transition pathways
Teis de Francqueville Hansen	SINTEF AS	RA2 Accelerating the energy transition
Tuukka Mäkitie	SINTEF AS	RA1 Deep decarbonization and wide societal changes, RA2 Accelerating the energy transition, RA4: Transition pathways, RA5: User cases and innovation
Vibeke Stærkebye Nørstebø	SINTEF AS	RA4 Transition pathways, RA5: User cases and innovation
Christian Andresen	SINTEF EF	RA3 The future energy market
Stian Backe	SINTEF EF	RA5: User cases and innovation
Ingeborg Graabak	SINTEF EF	RA3 The future energy market
Odd Andre Hjelkrem	SINTEF EF	RA4: Transition pathways

Name	Institution	Main research area
Stefan Jaehnert	SINTEF EF	RA3 The future energy market
Vegard Kallset	SINTEF EF	RA3 The future energy market
Sambeet Mishra	SINTEF EF	RA3 The future energy market
Bendik Nybakk	SINTEF EF	RA5: User cases and innovation
Frank Geels	UiO	RA2 Accelerating the energy transition
Ingvild Jacobsen	UiO	RA2 Accelerating the energy transition
Allan Dahl Andersen	UIO	RA2 Accelerating the energy transition, RA4 Transition pathways, RA5: User cases and innovation
Benjamin Sovacool	VF	RA1 Deep decarbonization and wide societal changes, RA2 Accelerating the energy transition
Carlo Aall	VF	RA1 Deep decarbonization and wide societal changes, RA2 Accelerating the energy transition
Morten Simonsen	VF	RA1 Deep decarbonization and wide societal changes, RA2 Accelerating the energy transition
Hans Jakob Walnum	VF	RA1 Deep decarbonization and wide societal changes
Ragnhild Freng Dale	VF	RA5: Usercases and Innovation, RA1 Deep decarbonization and wide societal changes
Stefan Gøssling	VF	RA2 Accelerating the energy transition

VISITING RESEARCHERS

Name	Affiliation	Nationality	Gender	Duration	Topic
Chris Foulds	Anglia Ruskin University	UK	M	One month 2022	Social science and humanities energy research. Mission on climate Neutral cities
Declan Kuch	Western Sydney	Australian	M	11-19 august 2022	Social liscence to automate
Sebastian Zwickl-Bernhard	TU Wien	Austrian	M	1.jun-31.sept. 2022	Energy communities
Thomas Florian Klatzder	TU Graz	Austrian	M	8.aug-31. sept. 2022	Capacity expansion models
Ekaterina Dudkina	University of Piza, Italy	Russian	F	1.april - 31.may 2022	Rural energy communities in developing countries
Selina Kercher	University of Oviedo; Spain	German	F	1.oct - 31.dec 2022	Energy communities and grids
Francesco Gulota	University of Bergamo, Italy	Italian	M	1.jan. - 31.mars 2022	Virtual power plants

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 Nordholm	American	20201001-20230930	F	Power, inclusion and exclusion inthe Norwegian energy transition. Exploring tools for increased engagement and practice change across sectors
Jan Klenner	German	20201102-20231101	M	Climate Change Mitigation in the Aviation Sector
Felipe Van de Sande Araujo	Brasilian	20200901-20230831	M	Analysis of flexibility markets for electricity
Davood Qorbani	Iranian	20200801-20230731	M	The transition to sustainable mobility from a systems perspective
Krisjanis Rudus	Latvian	20210111-20240110	M	Power, inclusion and exclusion in the Norwegian energy transition. Exploring tools for increased engagement and participation across sectors
Suzanne Øverlie	Norwegian	20210201-20220614	F	Innovation and commercialization of environmentally friendly energy in University Industry Collaborations
Meike Siefkes	German	20210816-20240815	F	The transition towards the zero-emission society from the energy market's perspective.
Luke Whittington	Bristish	20211001-20220430	M	Short-term energy system integration in neighbourhoods, transport and industry - effects on long-term system design
Maximilian Koslowski	German	20210802-20240801	M	Scenarios to guide the reduction of environmental footprints
Britta Eklöf	Swedish	20210801-20240731	F	Collective action and climate change: drivers and barriers to climate engagement
Milad Mehdizadeh	Iranian	20210801-20240731	M	The role of citizens in a transition of the transportation system
Simen Rostad Sæther	Norwegian	20161201-20210131	M	
Negar Safara	Iranian	20220101-20241231	F	Approaching Contexts in Transition Studies-The case of energy-hub-ports
Mario Blazques de Paz	Spanish	20210801-20230731	M	RA3, Designing Electricity Markets for the Energy Transition
Jørgen Finstad	Norwegian	20220101-20221231	M	RA 2 “Accelerating the energy transition”, topic: accelerating electrification processes, an organisational perspective
Jarand Hole	Norwegian	20221001-20250930	M	RA3, Designing Electricity Markets for the Energy Transition, topic: Integrasjon av solkraft i det norske kraftsystemet

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
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
Olaf Lehn Tranås	NCCS	Norway	2020-2022	M	CCS in high RES energy systems needing flexibility and in connection to industry

MASTER DEGREES

Name	Gender	Topic
Wivi Amundsen	F	«Mysteriet ACER». En kvalitativ studie av hvordan kraftkrevende industri og relevante energiaktører fortolker EUs energibyrå ACER
Torjus Dahl	M	Fra sporadisk innovasjon til innovasjonsstruktur. En kvalitativ analyse av deltakelse som en samprodusert innovasjonspraksis i skjæringspunktet mellom teknologi og samfunn på Hitra og Frøya
Tina Berntsen Flobak	F	Stille vann har dypest grunn. Skjær i sjøen for Norges nye industrieventyr. En kvalitativ studie av verdiforståelse som en kilde til utfordringer for fremtidens energiomstilling i Norge
Marte Austenå	F	Wind Power on Frøya: From Controversy to Decision-Making
Iver Jørum Almås & Åsta Halse	M/F	Fra kalde vintre til grønn luftfart. Green Flyway - møtet mellom distriktssamfunn og framtidens mobilitet
Alice Elizabeth Dalsjø	F	Crafting Lovable Futures and Measuring their Impacts A qualitative study of how sustainability reporting is developed and implemented as a part of a design consultancy firm's sustainability strategy
Sofie Aandahl Børresen	F	Evaluating Modeling Approaches for State-Dependent Environmental Constraints in Medium-Term Hydropower Scheduling
Anne Marthe Ter Woerds Christensen	F	"Application of Stochastic Dual Dynamic Programming to evaluate long-term price signals in short-term optimisation of energy use in buildings"
Mathias Espeland Trondal, Marius Eriksen	M/M	Short-term hydropower scheduling in congested areas: A novel approach employing DC power flow and grid limitations
Runar Hillestad	M	A co-simulation framework to coordinate battery optimization and load flow - Improving voltage quality in the distribution grid
Jørgen Kipperberg Pedersen	M	TSO-DSO Operational Planning Coordination- SWW Wunsiedel case study
Ine Solsvik Vågane	F	Local Flexibility Market - TSO and DSO coordination
Petry Kristine Nøttum Haaland	F	Impact of CO2 compensation methods on the sizing of PV panels in Zero Emission Neighbourhoods

Name	Gender	Topic
Mathilde Klungland Ljøkjel - Amaleen Jeyaseelarajah	F/F	Analysis of Power System Scenarios for Norway 2030 using the Fundamental Market Model FanSi
Mikkel ærby	M	Towards zero-emission power systems – A generation expansion study of the North Sea region 2040
Mikal-André Tvedt	M	Optimal Operation of Flexible Assets in a Residential Energy System: A Rolling Horizon Approach
Andreas Aadnøy	M	A Case Study on the Grid Integration of Electric Vehicles in Norway - In combination with Solar Power, Fast Charging Stations and an Electric Ferry
Renate Høvik Berge	F	Accessing Flexibility in Batteries Through a Local Flexibility Market
Abraham Paulsen Sjørdalen	M	Optimal Integration and Control of Distributed Batteries for Multiple Grid Services
Marthe Vågen, Simran Jit Kaur Sandhu	F/F	Baseline Estimation for Flexibility Validation
Paul Erich Seifert	M	The Value of Large-Scale Offshore Distribution Islands
Clara Pfister	F	Minimization of energy supply costs for a smart building complex
Gro Lill Økland	F	Demand Response in bottom-up planning models
Nithish Kini Ullal	F	Zonal Level Disruption Response Considering Transmission Line Outage from Large-Scale Offshore Wind Farms
Michel Kevin Masilungan Caibigan	M	Offshore Wind Development in an Integrated Energy Market in the North Sea : Defining regional energy policies in an integrated market and offshore wind infrastructure.
Oda Johanna Larsdatter Agdal'	F	Investigation of Future Global Trade of Hydrogen from Renewable Energy Sources
Simon Pearson, Sonja Juliane Elisabeth Wellnitz	M/F	Marketplaces for DSO side flexibility providers: Insights regarding future TSO-DSO coordination mechanisms in Germany
Curd Schade	M	The impact of electric vehicle charging schemes and battery degradation on energy supply costs for a local energy community
Jakob Heilman, Marthe Wensaas	M/F	Expanding the notions of local electricity markets: A study on trading among and within energy communities
Carl Jasper Specht, Victor Lancelot Vincent de Lestrade	M/M	Empowering residential end-users in the electricity market: Insights from European demand response and new perspectives on local markets
Ingvild Synnøve Brynildsen, Marit Siqueland, Anette Sandvig	F/F/F	Stochastic Network Design Modelling for Decarbonization of the Norwegian Freight Transportation System
Anders Bennæs, Martin Skogset, Tormod Svorkdal	M/M/M	Supply Chain Optimization for Carbon Capture and Storage: A German–Norwegian Case Study
Oscar Ask Andreassen, Felix Rying Borge	M/M	Applying a Monte Carlo approach to economically assess a deep sea mining project on the Norwegian continental shelf
Markus Bjørkli Jansen, Gaute Nepstad	M/M	Biodiversity impact assessment of the aquaculture industry in Norway - a company level application
Magnus Harstveit, Christian Aasved	M/M	Biorefinery procurement risk hedging under multi-commodity price and exchange rate uncertainty
Martin Egeli, Anniken Skeisvoll Grimsmo	M/F	Disentangling determinants of CDS spreads: A machine learning approach
Erling Stray Bugge, Tarje Rusten Wang	M/M	Electricity Price Forecasting Benchmark of ENTEN on Nordic Bidding Areas

Name	Gender	Topic
Eivind Almeland Rolstad	M	Long-Term Extrapolation of Electricity Forward Curves - A Novel Approach Utilizing Forecasts and Risk Premia
Amalie Heitmann Kristoffersen, Maren Larsen,Catherine Xu	F/F/F	Missing Pieces of the Greenium Puzzle: Time Variations and Issuer Characteristics
Tarjei Lindvåg Johre, Magdalena Uyen Bao Tran	M/F	Movers of the cryptocurrency market
Una Bosnjak, Olav Lund Vigerust	F/M	Playing Style and Performance in Association Football: How to Invest Smarter
Herman Marelus Zahl	M	Predicting Distributions of Credit Spread Changes in the Era of Quantitative Easing
Ulrik Leinan Baksjøberget, Elisabeth Skåland Netland, Håkon Melgård Sveen	M/F/M	Probabilistic forecasting of the equity risk premium using quantile machine learning
Maria Fjelltun Dalvik, Sølvi Herabakka	F/F	Real Option Analysis of Hydro Turbine Replacements
June Bakken Hodt, Ane Bakken Hodt	F/F	Real Options Approach to Analyse the Attractiveness of Different Grid Solutions for Offshore Wind Projects: A Case Study from Norway
Fredrik Shaughnessy Ahlborg, Andreas Johannesen	M/M	Risk Premia in the German Electricity Forward Market: The Impact of Variable Renewable Energy Sources
Larsson, O.K.	F	Varför ser den svenska och norska politiska vänstern olika på vindkraft?
Schaefer, J.M.L	F	Concept analysis and life cycle assessment of large-scale offshore hydrogen production, storage and distribution options
Milde-Andersen, A.	F	Renegotiating the Social Contract of the EU: An Investigation of the EU Climate Pact. HVL. Supervisors
Chloe Depledge	F	The key to our energy future? Unravelling the transformative potential of green path creation
Jenny Tomasgard	F	Green autonomous technology for maritime transport in Norway
Hylke Havinga	M	Diversification or fierce competition? Interactions between nascent floating offshore wind and maturing fixed-bottom offshore wind in Norway
Jeroen Hageman	M	Hydrogen Value Chain Development in the Northern-Netherlands, a Technological Innovation Systems Perspective. Hydrogen – a Gift from HEAVENN
Jasmin Milke	F	Residential Electricity Consumption: The Role of Psychological Factors
Håkon Frisell Krattum and Jonas Bertil Englund	M/M	Miljøvennlige fergeløsninger i Nordland fylke
Per Kristian Haldorsen and Thor-Bjørn Andresen Brunborg	M/M	The Impact of Carbon Emissions on US Stock Returns
Signe Ellevold Nytrøen and Anniken Aarrestad	F/F	CBAM - Steering the World Trade to Fit the Future
Tobias Myrvoll and Peder Undeli	M/M	Assessing the Impact of NordLink on Day-Ahead Prices in NO2 and Germany
Thorvald Mosvold and Anneli Grindstad	M/F	Anleggsbidrag i strømnettet – en diskusjon av effekter og egenskaper
Arild Mevatne and Einar Antoine Ørn Michel	M/M	NEXIT: A Norwegian Decoupling Scenario in the European Power Market
Sondre Arne Hoff and Eivind Trym Wikshåland	M/M	An accounting-based profitability analysis of deploying offshore wind at Sørlige Nordsjø II

Name	Gender	Topic
Hanna Braut and Marthe Christine Aleksandersen	F/F	Bærekraftsarbeid hos små og mellomstore eiendomsutviklere
Ole Morten Gjøsæter and Vegard Schjelderup	M/M	Development of Environmental Costs
Henrik Fang Liland	M	Hedging against weather related risks with weather derivatives
Kine Høve Johnsen	F	Hvordan vokser en missions-basert offentlig organisasjon frem, og hva må til for å lykkes? Case-studie om fremvekst og bruk av missions-orientert og transformativ innovasjonspolitikk i Enova SF
Simen Lillekjendlie Nybu	M	Numerical simulations of fluid flow and particle deposition in a cascade impactor
Sigurd Skoglund	M	"High Temperature Heat Pumps Using Zeotropic Refrigerant in Integrated Energy Systems"
Eivind Hvistendahl	M	"A generic lifetime estimation model for Francis turbines"
Hilde Vindenes	F	Mixing turbulence: a new approach to active grid turbulence generation
Frida Sæther	F	Development of an Intermediate PCM Storage for a Wood Stove
Simon Margido Urdahl	M	Influencing fish migration by creating and altering vortices in turbulent flow
Ivan Fernandez Valencia	M	Three-dimensional thermo-coupled modelling of Lithium-ion batteries
Kristine Midtbø	F	CFD modelling of mixing in a small-scale UASB biogas reactor
Astri Nore	F	The effect of turbulence on oxygen uptake of water
Simon Baraki Aaland	M	Process simulation based life cycle assessment of a subsea compression system: identifying the largest influences on environmental impact
Stian Ranøyen Bratsberg	M	Experimental investigation of carbon nanotube photo ignition for combustion in ICes
Madita Kruse	F	"Investigation of a high temperature cascade heat pump as an energy-efficient solution for generating process heat Cost and CO2 emission comparison to fuel-based heating technologies for the application case of a dairy."
Tom Ebel	M	Experimental and numerical performance evaluation of R744 transcritical system for space heating and hot water production
Igor Koshelkov	M	Evaluation of mid-scale hydrogen distribution chains for compressed hydrogen
Paloma Romero Hernandez	F	Design and evaluation of a method to produce hydrogen via water electrolysis at large scale
Prem Kumar Sherman	M	SUSTAINABLE PRODUCTION OF FISH PROTEIN HYDROLYSATES: OVERALL SYSTEM ARCHITECTURE AND FOOTPRINT
Leon Hendrik Henke	M	Numerical simulation of an integrated CO2 heat pump/chiller and thermal storage system for a hotel in tropical weather conditions
Elly D'Alcantara Fonseca Holness	F	Voyage Prediction for ME-GI LNG Carriers
Magnus Egerdahl	M	Integrated thermal system for hydrogen and ammonia driven cruise ship
Sviatoslav Eroshkin	M	Volatile Organic Components Adsorption on Activated Carbon
Christian Berge Foyen	M	Temperature measurement in lithium-ion batteries using FBG
Kristen Bernhard Holtaas Sandaas	M	Implementing Renewable Electrification: Forecasting Requirements for Global LIB ESS Deployment
Sandra Emilie Aasestrand Løvvold	F	Energieffektivisering og bærekraftig drift av bygningsinstallasjoner gjennom sensorteknologi og renovering.

Name	Gender	Topic
Maria Barbara Pauline Bollwein	F	Comparative life cycle assessment of prospective battery-grade material production in Norway
Allan Nathan Leo Quesnel	M	"Numerical simulation of the airborne transmission of COVID-19 due to respiratory activities under different ventilation conditions."
Johannes Grov	M	Assessing the feasibility of utilizing IC Technology's storage solution in land-based long-term storage of liquid hydrogen
Martin Lysnæs-Larsen	M	Cooling potential assessment for automated window operation algorithms
Viola Frederikke Loktu Telstø	F	Energieffektivisering i typiske norske svømmehaller ved hjelp av smale tiltak
Vanja Revold Olberg	F	Thermal energy recovery and storage for a hydrogen fuel cell and battery driven cruise ship
Andreas Undheim Øgreid	M	Indirect Evaporative- and Desiccant Wheel Cooling for Norwegian Office
Roshan Jayakaran	M	"Fluid structure interaction in circular blade cascade
"		
Henrik Lia	M	Computational Aspects of the Two-phase Isothermal Flash
Gaute Elde Vefring	M	HydroFlex - Modellprøve av Francis turbin
Thor Gudmund Dost Weisz	M	Pragmatic Modeling of Flow in the Human Upper Airways for Sleep Apnea Treatment
Rimsha Zafar	F	Life Cycle Assessment of Food Waste Management - A case of Oslo
Vedant Pushpahas Ballal	M	Exploring the climate impacts of aviation e-fuels in Europe through a prospective Life Cycle Assessment
Baitong Huang	M	LCA of Unmanned Aerial Vehicle Delivery
Ina Charlotte Berntsen	F	A Life Cycle Assessment of a waste management system introducing sorting of food waste and a central sorting facility
Caroline Berntsen Markeng	F	Mulighet for energieffektivisering og bærekraftig drift av bygningsinstallasjoner gjennom kosteffektive tiltak
Inger Adele Haugnes Helseth	F	Metode for timesoppløst marginal utslippsprofil og anvendelse i klimagassberegninger for Nyhavna
Anne Cecilie Løvenskiold	F	Estimates of climate change mitigation potentials from landbased solutions in 2050
Eivind Wadstensvik Roland	M	Energiforsyning for utslippsfri byggeplass
Mikkel Åsgard Mandt	M	Norsk kraftforvaltning i et integrert europeisk energimarked

EVENT ORGANIZED BY FME NTRANS

Title	Organizer	Date	Target group	Number of attendees
Agent-based modelling for a consumer-centric energy transition	FME NTRANS	06.12.2021	Researchers and partners	ca. 20
Knowledge gaps for successful integrated markets for energy and flexibility	FME NTRANS and KSP PowerDig	01.02.2022	NTRANS partner and researcher	>40
UC 6 workshop 1: social aspects of wind power	FME NTRANS/FME Northwind	04.02.2022	User partners, researchers	40
Planning under uncertainty in energy markets	NTNU / NHH / NTRANS	28.02-04.03.2022	Doctoral students, researchers	50
Communication seminar for early career researchers	FME NTRANS/NTNU energi team society	01.03.2022	PhDs, postdocs	15
Workshop om “verktøy” i Norges omstilling	FME NTRANS, RA1	09.03.2022	User partners	8
Oppstartsmøte NTRANS UC5 - Bærekraftig innovasjonsdistrikt	NTRANS, ZEN	11.03.2022	User partners in NTRANA	
UC6 workshop2: Den offentlige debatten	FME NTRANS/FME Northwind	11.03.2022	User partners, researchers	40
ETW WS: The unusual suspects - communication for climate action by new societal actors	NTNU Energy Transition Initiative og FME NTRANS	28.03.2022	Politicians, industry, academia, and students	27
ETW WS: To speed up or to give up	NTNU Energy Transition Initiative og FME NTRANS	28.03.2022	Politicians, industry, academia, and students	69
NTNU Energy Transition Conference - Accelerating transition	NTNU Energy Transition Initiative og FME NTRANS	29.03.2022	Politicians, industry, academia, and students	300/26194
ETW WS: An opportunity not to be missed: why and how the clean energy transition should be just and contribute to a fairer Europe	NTNU Energy Transition Initiative og FME NTRANS	30.03.2022	Politicians, industry, academia, and students	93
ETW WS: The future of nuclear energy	NTNU Energy Transition Initiative og FME NTRANS	30.03.2022	Politicians, industry, academia, and students	71
Workshop: Why and how the Clean Energy Transition should be Just	NTNU Energy Transition initiative, FME NTRANS, EEERA	30.03.2022	Researchers, industry, public sector	45
ETW WS: Flexible energy demand in buildings: user & energy system perspectives	NTNU Energy Transition Initiative og FME NTRANS	31.03.2022	Politicians, industry, academia, and students	52

Title	Organizer	Date	Target group	Number of attendees.
ETW WS: Energy crises - challenges and opportunities for a fair transition	NTNU Energy Transition Initiative og FME NTRANS	01.04.2022	Politicians, industry, academia, and students	38
ETW WS: Negative emission and CDR - including ocean scenarios	NTNU Energy Transition Initiative og FME NTRANS	01.04.2022	Politicians, industry, academia, and students	94
Energikrisen i Europa: Workshop 1: Energikrisen – mer enn en priskrise	FME NTRANS, DNVA, CINELDI, INCLUDE, HYDROCEN, ZEN, NTVA	07.04.2022	Research, industry, and politics	87
UC6 workshop3: Deltakelse og inkludering	FME NTRANS/FME Northwind	07.04.2022	User partners, researchers	40
Energy grids of the future – Connecting the dots	FME NTRANS and FME Cineldi	10.04.2022	NTRANS partner and researcher	>40
Energikrisen i Europa: Workshop 2: Rettferdig fordeling og markedsdesign	FME NTRANS, DNVA, CINELDI, INCLUDE, HYDROCEN, ZEN, NTVA	25.04.2022	Research, industry, and politics	~40
Transitions - Engaging Knowledge, Interest, and Critique	FME NTRANS, NTNU Sustainability, NTNU energy team society, Dept. of anthropology & geography, NTNU, NTNU Environmental Humanities	02.05.2022	Researchers, students	35
TIMES-masterstudentsamling	NTRANS	06.05.2022	Master's students	8
Energikrisen i Europa: Workshop 3: Energiproduksjon og bruk i Norge	FME NTRANS, DNVA, CINELDI, INCLUDE, HYDROCEN, ZEN, NTVA	13.05.2022	Research, industry, and politics	66
Energikrisen i Europa: Workshop 4: Karbonprising	FME NTRANS, DNVA, CINELDI, INCLUDE, HYDROCEN, ZEN, NTVA	03.06.2022	Research, industry, and politics	48
Flexibility Trading in Power Markets: New Market Designs ensuring optimal short-run allocation	FME NTRANS and KSP PowerDig	07.06.2022	NTRANS partner and researcher	>40
Kick-off seminar on Sustainable innovation and transition of urban areas (UC5)	NTRANS, ZEN	08.06.2022	Research and user partners	
UC6 workshop4 og 5: Sameksistens, politisk dynamikk, tempo	FME NTRANS/FME Northwind	09.06.2022	User partners, researchers	40
Energikrisen i Europa: Workshop 5: Energieffektivisering i bygg og industri	FME NTRANS, DNVA, CINELDI, INCLUDE, HYDROCEN, ZEN, NTVA	17.06.2022	Research, industry, and politics	22
Energikrisen i Europa: Workshop 6: Forsyningssikkerhet	FME NTRANS, DNVA, CINELDI, INCLUDE, HYDROCEN, ZEN, NTVA	23.08.2022	Research, industry, and politics	~50
NTRANS RA4 Workshop 10-steg	NTRANS	05.09.2022	User partners + researchers	35
Workshop on current modelling practices on human dimension in energy system models	NTRANS	15.09.2022	Researchers	25 from 10 countries

Title	Organizer	Date	Target group	Number of attendees.
Workshop on current modelling practices on energy trade in energy system models	NTRANS	16.09.2022	Researchers	28 from 10 countries
CCS innovasjon, legitimitet og markedsmekanismer	CaptureX og FME NTRANS UC4	27.09.2022	Politicians, industry, and academia	30
Energikrisen i Europa: Workshop 7: Fellessynopsium	FME NTRANS, DNVA, CINELDI, INCLUDE, HYDROCEN, ZEN, NTVA	29.09.2022	Research, industry, and politics	~70
NTRANS UC5 WS om «Bærekraftige liv i urbane strøk – Utfordringer, behov og løsninger»	NTRANS, ZEN	26.10.2022	Research and user partners	
Tariffs, retail competition, and demand response	NHH / Bergen Energy Lab	02.11.2022	Students, researchers, business	50
NTRANS Workshop: Cross-system agency in transitions	NTRANS, RA2	03.nov	RA2, researchers	13
Building and heating flexibility	FME NTRANS and FME ZEN	04.11.2022	NTRANS partner and researcher	>40
FME NTRANS UC8: Energibruksutvikling mot 2050, energiscenarier og klimatiltak.	NTRANS	14.11.2022	User partners in NTRANS	
Hvordan sikre at klimastrategier/ tiltak ikke forsterker sosiale og økonomiske forskjeller? Forbruk	FME NTRANS, RA1/ COJUST	23.11.2022	User partners, researchers	
Energy crisis and inflation implications for research on rebound effects	FME NTRANS/HJ Walnum	24.11.2022	Researchers	
Hvordan sikre at klimastrategier/ tiltak ikke forsterker sosiale og økonomiske forskjeller? Bolig	FME NTRANS, RA1/ COJUST	28.11.2022	User partners, researchers	
Hvordan sikre at klimastrategier/ tiltak ikke forsterker sosiale og økonomiske forskjeller? Mobilitet	FME NTRANS, RA1/ COJUST	29.11.2022	User partners, researchers	
Workshop on challenges on modelling human dimension in energy system models	NTRANS, GCEP, LTU	29.11.2022	Researchers	
Workshop on challenges on modelling energy trade in energy system models	NTRANS, GCEP, LTU	30.11.2022	Researchers	
Gemini centre Sustainability Transition (GemST) - TransitionTour2022	GemST	15-17.11. 2022	Academia, funding agencies	11 (+10/5/15)
NTRANS Lunch box webinars	FME NTRANS	Bi-weekly	Researchers, user partners	20-40 every time

PLENARY OR KEYNOTE SPEAKER

Dato	Name of NTRANS researcher	Tittel	Event	Organizer/ type of event	Location
05.07.2022	Mette Bjørndal	Bidding zones in electricity markets	SynErgie Expert Workshop on Market Design 2030-2050 – Renewables and Flexibility	SynErgie Kopernikus Projekte m.fl.	Germany
04.07.2022	Stefan Jaehnert	Kraftmarkeds- utvikling	Fagseminar om kraftprisen og betydningen for smartgrids	Smartgrid-senter	Norge
14.01.2022	Tomas Moe Skjølsvold	Societal implications of transport electrification. Lessons from Norway	Fluvius dialogue day	Annual dialogue day of Belgian grid company Fluvius	Belgium
23.09.2022	Gunnar S. Eskeland	What - if anything - is 'smart' in transport?	Research Workshop on Smart and Future Mobility	International Business School Suzhou at XJTLU	Online / Kina
21.10.2022	Mette Bjørndal	Zonal Pricing vs Nodal Pricing – Simple or Complex?	Energidagene	NVE	Norge
26.06.2022	Asgeir Tomasgard	The European energy transition – the role of hydropower	IAHR2022, -31st Symposium on hydraulic machinery and systems	NTNU, NTNU Wapower Laboratory, IAHR - AIRH, IAHR - YPN	Trondheim, Norge
24.03.2022	Asgeir Tomasgard	Can Europe handle the transition from fossil fuels to renewable energy?	Kraftmarkedssymposiet	Energy in Norway	Oslo, Norge
24.03.2022	Asgeir Tomasgard	Should we reduce power exports?	Kraftmarkedssymposiet	Energy in Norway	Oslo, Norge
26.10.2022	Asgeir Tomasgard	Technologies in the green transition	YS-konferansen	YS	Oslo, Norge

PROJECTS AND APPLICATIONS IN NTRANS

EU/International projects	Status	Call/funder	NTRANS-partner	Coordinator
SSH Centre (Social Sciences and Humanities for Climate, Energy aNd Transport Research Excellence)	Start-up 1.9.2022	HORIZON-CL5-2021-D2-01-13		
	NTNU	Anglia Ruskin University		
PATTERN (Providing operational economic appraisal methods and practices for decision-making on climate and environmental policies)	Start-up 1.6.2022	HORIZON-CL5-2021-D1-01-07	NTNU	Complutense University of Madrid
CircoMod	Start-up 01.06.2022	HORIZON-CL5-2021-D1-01		
NTNU	University of Utrecht			
ACCTING (AdvanCing behavioural Change Through an Inclusive Green deal)	Start-up 01.02.2022	H2020-LC-GD-2020-4	NTNU	European Science Foundation
ARV	Start-up 1.1.2022	H2020-LC-GD-4-1-2020	NTNU	ZEN/NTNU
ENERGICA (ENERGy access in urban and rural AfrICA)	Start-up 18.11.2021	H2020-LC-GD-2-3-2020	NTNU	TU Berlin
TransformAR (Accelerating and upscaling transformational adaptation in Europe: demonstration of water-related innovation packages)	Start-up 13.10.2021	H2020-LC-GD-1-3-2020	NTNU	University of Antwerp
ENHANCE (European Universities of Technology Alliance Research and Innovation Action)	Start-up 01.09.2021	H2020-IBA-SwafS-Support-2-2020	NTNU	NTNU
CAMPAIGNers (Citizens Acting on Mitigation Pathways)	Start-up 01.05.2021	H2020-LC-CLA-10-2020	NTNU	Energy Institute – JKU, Østerrike
CliCNord (Climate Change Resilience in Small Communities in the Nordic Countries)	Start-up 2021	Nordforsk, Nordic societal security in light of the emerging global and regional trends	NTNU	University College Copenhagen
SENDER (Sustainable consumer engagement and demand response)	Start-up 1.10.2020	H2020-LC-SC3-2020-EC-ES-SCC	NTNU	Smart innovation Norway
ENCHANT (Energy Efficiency through behaviour Change Transition)	Start-up 1.10.2020	H2020-LC-SC3-EE-2020-1	NTNU	NTNU
ENTRANCES (Energy Transitions from coal and carbon: Effects on societies)	Start-up 1.5.2020	H2020-LC-SC3-2019-NZE-RES-CC	NTNU	University of A Coruña, Spania

EU/internasjonale prosjekter	Status	Call/funder	NTRANS-partner	Koordinator
BEYOND (Block-chain based electricity trading for the integration of national and decentralized local markets)	Start-up 1.1.2020	ERA-Net Smart Energy Systems, med støtte fra H2020	NTNU	NTNU
HONOR (holistic flexibility provision and coordination)	1.12.2019	ERA-Net Smart Energy Systems, med støtte fra H2020	NTNU	TU Dortmund
+CityxChange (Positive City ExChange)	Start-up 01.11.2018	H2020-LC-SC3-2018-ES-SCC	NTNU	NTNU
CLEANcultures (An approach for innovative Climate Learning, Evaluation and Action in Neighbourhoods)	Start-up 1.12.2020	JPI Climate, Solstice call	NTNU	Johanneum Research

EU/International applications under review	Status	Call/funder	NTRANS-partner	Coordinator
iDesignRES	Applied, april 2022 – on wait list	HORIZON-CL5-2022-D3-01	NTNU	NTNU
JUSTUs	Applied, okt. 2021 – on wait list	HORIZON-CL5-2021-D2-01	NTNU	IFO Institute
Open4cec (Service-oriented Open Platform for Citizen Energy Communities (CEC) – a scalable and extensible platform)	Applied, nov. 2022	DUT (Driving Urban Transitions Partnership) call 2022	NTNU	Bucharest University of Economic Studies
Man0EUvRE (Energy System Modelling for Transition to a net-Zero 2050 for EU via REPowerEU)	Applied, nov. 2022	CETPartnership Joint Call 2022	NTNU, Sintef, IFE	Sintef
Nordic Energy Outlook	Applied, 2022	Nordic Energy research	NTNU, Sintef, IFE	Sintef
NordicH2ubs (Nordic hydrogen hubs – roadmaps towards 2030 and 2040)	Applied, okt. 2022	Nordic Energy Research	NTNU	Sintef
Nord_H2ub - Rally to the Valley: Establishing Hydrogen Value Chains for the Nordics	Applied, okt. 2022	Nordic Energy Research	NHH, NTNU	CBS
EPICURUS (Energy Positive human-Centric Usage of smaRt bUildings)	Applied, sep. 2022	HORIZON-CL5-2022-D4-01	NTNU	University of Pisa
POTENT - Ports as Energy Transition Hubs	Applied, 15.11.2022	HORIZON-MSCA-DN-2022	NHH	CBS

National projects	Status	Call/funder	NTRANS-partner	Coordinator
Hydrogen Pathways 2050	Start-up 2022	NFR	NTNU	IFE
NextGenVPP	Start-up 2022	NFR	NTNU	NTNU
FINE	Start-up August 2022	NFR	NTNU	Sintef Energy
PowerDig	Start-up 1.8.2021	NFR	NTNU	NTNU
Flexbuild	May 2019	NFR	NTNU	Sintef Community
CleanExport	August 2020	NFR	NTNU	Sintef Energy
SusHydro	Start-up Q3-22	NFR	NTNU	NTNU

National applications under review	Status	Call/funder	NTRANS-partner	Coordinator
PROCITY - Profitable city-friendly micromobility		Pilot-T (NFR)	NTNU og Bergen Kommune	Urban sharing

Rejected applications	Status	Call/funder	NTRANS-partner	Coordinator
WindUP	Applied, feb. 2022	HORIZON-CL5-2021-D3-03	NTNU	Sintef Ocean
RISKNAVI	Applied, feb. 2022	HORIZON-CL5-2022-D1-01-two-stage	NTNU	Forschungszentrum Jülich
NETWORK4ENERGY	Applied, jan. 2022 -Rejected	HORIZON-CSA	NTNU	Kadir Has Universitesi
CO-Neutral Europe	Applied, jan. 2021	H2020-LC-GD-1-2-2020	NTNU	HAW Hamburg
TRENDy	Applied, jan. 2021	H2020-LC-GD-2-2-2020	NTNU	DEPA
RUBENS	Applied, jan. 2021	H2020-LC-GD-2-3-2020	NTNU	NILU
Food Futures	Applied, jan. 2021	H2020-LC-GD-6-1-2020	NTNU	University of Zagreb
FarmAware	Applied, jan. 2021	H2020-LC-GD-6-1-2020	NTNU	Sintef
BASMATY	Applied, jan. 2021	H2020-LC-GD-10-3-2020	NTNU	Bilkent University
Protein Diversification Compass	Applied, okt. 2021	HORIZON-CL6-2021-FARM2FORK-01	NTNU	Free University Brussels

Rejected applications	Status	Call/funder	NTRANS-partner	Coordinator
JUST CLIMATE	Applied, sep. 2021	HORIZON-CL5-2021-D1-01-05	NTNU	TU Berlin
CONCISE (Co-Constructivist perspectives on citizenship for sustainable energy)	Applied, sep. 2020	H2020: SSH, aspects of the Clean-Energy Transition: LC-SC3-CC-1- 2018-2019-2020	NTNU	NTNU
Response (Research to support policies and new lifestyles)	Applied, sep. 2020	H2020-LC-CLA-10-2020	NTNU	ENEA, Italia
CINERGY (Citizenship initiatives for a new energy system)	Applied, sep. 2020	H2020-LC-SC3-2018-2019-2020	NTNU	Faculdade Ciências, Portugal
CIT4COM (Enabling CITizens to enhance the role of prosumers)	Applied, sep. 2020	LC-SC3-EC-1-2018-2019-2020		ENEA, Italia
EC-Nexus (Energy and Climate Modelling Nexus)	Applied, sep. 2020	H2020-LC-SC3-2018-2019-2020	NTNU	NTNU
DECODE-BB	Applied, sep. 2020	H2020-LC-SC3-RES-36-2020	NTNU	UNIBO, Italia

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