FME FORSKNINGS-SENTER FOR MILJØVENNLIG ENERGI

NTRANS

Norwegian Centre for Energy Transition Strategies

ANNUAL REPORT 2020

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FME NTRANS – NORWEGIAN CENTRE FOR ENERGY TRANSITION STRATEGIES

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Chair of the NTRANS Board, Henrik Sætness

MESSAGE FROM THE CHAIR OF THE BOARD

2020 was the year of Covid with lockdowns, home office and Teams meetings. This was also the first full NTRANS year and the year the centre was planning to get up to full speed.

Everyone that is planning anything, also NTRANS, has been influenced by the pandemic. In spite of the situation, most deliverables have been successful, and most objectives have been met. Workshops, articles, model development, reports, seminars and a lot more has been executed. Adapting to the pandemic has however also given new possibilities for cooperation and deliverables, for example weekly lunch webinars with good participation.

2020 was also the year that the energy transition became the hottest thing in the financial markets, suddenly became a household topic, and became a broadly accepted reality. This makes NTRANS' research more topical and the relevance of results and findings even more relevant than what we could imagine when the first application/prospectus was delivered to the research council in 2018. NTRANS' set-up with breadth across institutions and disciplines gives us high hopes for insightful research really on the leading edge. The ambition must be to make a difference, to really contribute to a more successful energy transition in Norway and globally.

The energy transition will continue. The political, societal and technological development will, fuelled by research, lead to a slow-down and eventual stop of global climate change, hopefully at a level with acceptable consequences for mankind.

Centre Director,
Asgeir Tomasgard

REPORT FROM THE CENTRE DIRECTOR

This report summarizes the first full year of activities in FME NTRANS, and I would like to take this opportunity to thank all the partners, and the people involved. As the report shows, the centre is now up to full speed with research activities, use cases, PhD and master supervision and a number of interesting events.

We already see the effects of having a long-term research centre in terms of new cooperation and multidisciplinary approaches to society challenges in energy, the built environment, industry and transport.

The next pages will give you some snapshots into examples of activities and results. While travel limitations have changed both the way we do international cooperation and the way we meet, this has only changed the way we work, not so much slowed us down.

That said, we are looking forward to meeting again eye to eye, and having real coffee breaks. In the long run, that is essential for the spontaneous and creative processes in a centre like NTRANS, happening in the places where people meet. These meeting places are also crucial to building a centre culture. The values we aim for are to be curious, brave and inclusive in our research. Together for an efficient and just transition!

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
User Case and Innovation

VISION: TOGETHER FOR AN EFFICIENT AND JUST TRANSITION

ORGANIZATIONAL CHART

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Vice Director Tomas Moe Skjølsvold, *NTNU*

Research Director Mette H. Bjørndal, *NHH*

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RA1 Marius Korsnes, *NTNU*

RA2 Allan Dahl Andersen, *UiO*

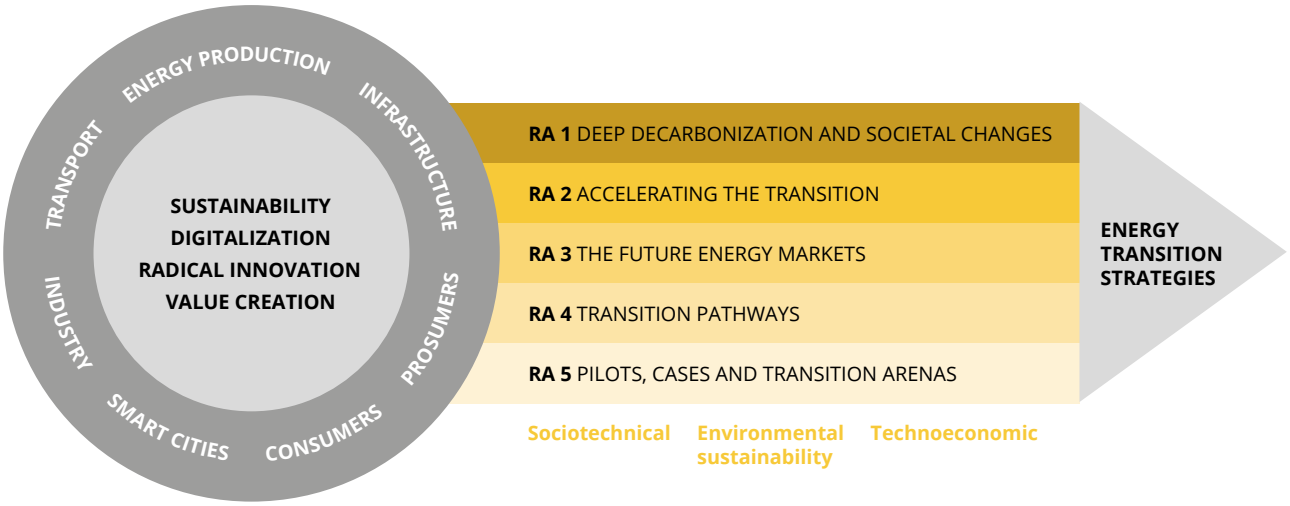
RA3 Stefan Jaehnert, *SINTEF*

RA4 Kari Aamodt Espegren, *IFE*

RA5 Kristin Linnerud, *HVL*

Others:
Gunnar S. Eskeland, *NHH*
Anders H. Strømman, *NTNU*
Pernille Seljom, *IFE*
Markus Steen, *SINTEF*
Hans Jakob Walnum, *Vestlandsforsking*

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



Research areas, user cases and innovation.

RESEARCH AREA 1
DEEP DECARBONISATION AND WIDE SOCIETAL CHANGES

CULTURE EATS ENERGY TRANSITION FOR BREAKFAST...

Humans do not like to change their habits and routines. We prefer things to stay exactly the same as we are used to. That is why energy transition is a slow process.

«Our research will look at what makes change difficult – and possible solutions to achieving a fair and inclusive sustainability transition in Norway. We look at it from different social science perspectives, and we are amongst others inspired by so-called sociotechnical perspectives».

«Sociotechnical can be explained by the fact that technology and society mutually shape and impact each other. For example, mobile phones, PCs and the internet: those technologies were previously unthinkable and useless. Now they are shaping our understanding of and ways of living in today's society: how we use technology, and how it in turn creates new needs, routines and habits. And consequently, what we have come to expect in terms of comfort and habits, we want to keep». Says researcher Marius Korsnes (NTNU) who leads Research Area 1 in NTRANS, *Deep Decarbonisation and Wide Societal Changes*.

Researcher Marius Korsnes heads Research Area 1, Deep Decarbonisation and Wide Societal Changes.

Photo: Vibeke Ann Pettersen, NTRANS

WIDE AND DEEP ...?

«What does that actually mean, simply explained?»

«Deep decarbonisation means that zero-emission technologies will not be enough: culture and social structures must also be changed. For example, understandings of profit, value and structures around our everyday lives, such as infrastructure and organisation of work and leisure. Broad societal changes are about participation and legitimacy in society, including all societal sectors, and that it is a fair and inclusive change», says Korsnes.

Research area 1 is interdisciplinary, and is based on further insights from sociology, psychology, political science, anthropology, innovation studies, and science and technology studies (STS).

GOT MORE GOOD RESEARCHERS AND A NEW FME

The research area leader talks about happenings in 2020, the start-up year.

«We have written a LOT of project applications! Among others, for the new FME centre that was launched at the end of the year, FME NorthWind. This is very important work that we are involved in.

Another essential start-up task has been hiring Doctoral Fellows and Post Docs. We have succeeded in getting great people on board the team!»

Korsnes was also one of the researchers leading the «Research Sprint» on Klimakur 2030, which is part of a user case under research area 5.

MAPPING OPPOSITION TO ENERGY INFRASTRUCTURE PROJECTS

As part of work package 2, the researchers are in the process of mapping controversies and opposition to a variety of energy infrastructure project domestically and internationally.

«We map controversies, especially around wind turbine projects, but also opposition against oil and gas development, and power cables. What is the role of the local population in these controversies? For example, the Sami, who have lost grazing areas for reindeer at Fosen and further north in the country. We compare the opposition with similar controversies in other countries around the world, where the goal is to gain a better understanding of how diverse energy infrastructure controversies vary between countries», says Korsnes.

INTERNATIONAL RESEARCH COLLABORATION

This is international cooperation with, among others, the University of Sussex and Vanderbilt University. Hans Jakob Walnum from Western Norway Research Institute leads the work from NTRANS. The purpose of the research database we are making is to include relatively new controversies (since 2010) related to energy development, and the project will map:

1. How opponents of energy development organise themselves to protest against energy development.
2. Who are the protesters, and how do they organise themselves?
3. What form do the protests take (is it, for example, through demonstrations or legal steps)?
4. What was the outcome of the resistance?

HOW TO ACHIEVE A FAIR TRANSITION?

NTRANS researchers will compare the controversies - and how the opposition was received, handled, and possibly also prevented. Based on such comparisons, researchers can find recommendable solutions for use here. Why are there differences between countries, and what can be done in Norway to prevent minorities from losing out in the transition?

«We plan to write an article and hope to get published in *Nature Energy* during 2021», Korsnes concludes.

They are setting the bar high, but NTRANS researchers have ambitions to make a difference.

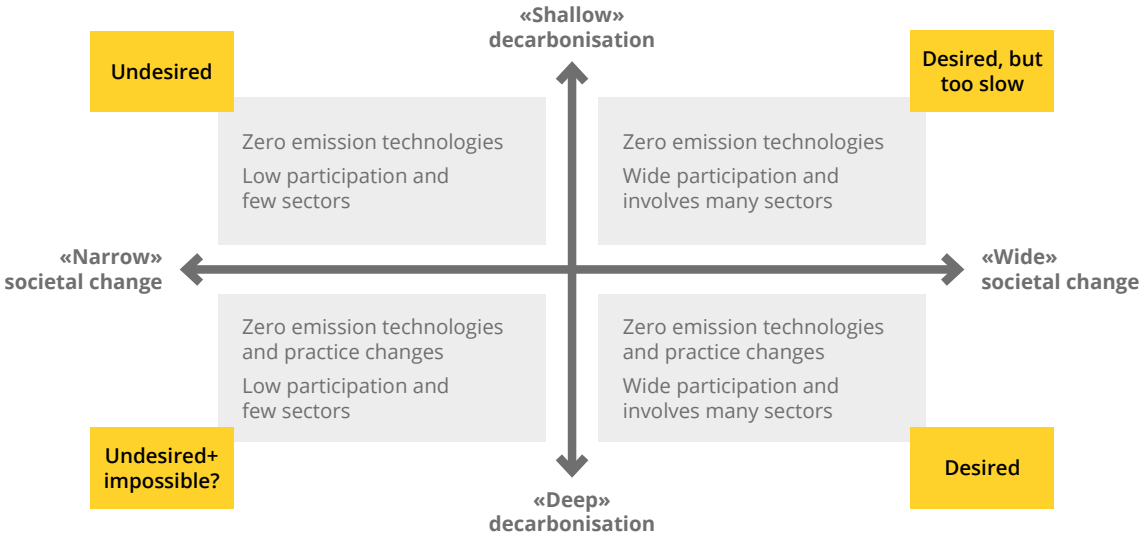
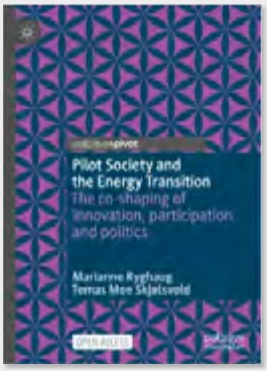


Illustration explaining deep decarbonisation and wide societal change.

«What we have come to expect in terms of comfort and habits, we want to keep». Says researcher Marius Korsnes (NTNU).

Photo: Vibeke Ann Pettersen, NTRANS

BOOK ABOUT THE PILOT SOCIETY AND THE ENERGY TRANSITION



NTRANS professors Marianne Ryghaug and Tomas Moe Skjølsvold published this book at the end of 2020: *Pilot Society and the Energy Transition*.

Open access, download the book as pdf (free) **here**, or buy it.

THREE WORK PACKAGES IN RESEARCH AREA 1

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

RESEARCH AREA 2
ACCELERATING
THE TRANSITION

THE TRANSITION MUST SPEED UP!

«The pace must be increased in terms of innovation, system transitions, and decarbonization, if we are to reach the Paris agreement goal, the 1.5°C target», says the leader of research area 2, Allan Dahl Andersen, who also works in the TIK centre at the University of Oslo (UiO).

Allan Dahl Andersen (UiO – TIK) leads research area 2.

«System transition in this context, refers to extensive change, not only technology but also in associated regulations, policies, markets, company routines, and - not least: people's habits.

While individual innovation processes can be rather quick, a broader system transition is typically a slow process due to the many dimensions that need to change», the researcher explains.

TRANSITION IN THREE PHASES

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.

INNOVATION AND SYSTEM TRANSITION: INTERDEPENDENT

«To solve the problem of global warming, we must enter the acceleration phase. Research area 2 (RA2) explores various aspects, drivers and barriers for entering the acceleration phase. We aim to extract the essence of this to provide useful policy advice and to make theoretical progress in the academic field.

«This area is similar to research area 1 (RA1), but we look into business strategies and actions as well as public policies and policymaking processes, while RA1 looks more at the role of civil society, culture and habits.»

WORKING PAPER ON INFRASTRUCTURE AT SEA

«We have started the research in all three work packages. In number two, we have written a working document, a so-called "working paper" (see fact box). The case is maritime sector, where new infrastructure must be built to shift from fossil fuels towards using renewable energy. There is uncertainty about which technological solution is best. It's important to find the best solutions, but technology and opportunities are changing rapidly. At the same time, the changes must be made in a socio-economic way, with cost-effective solutions. Innovation can change both price and function.

We also got well on the way with a policy brief during 2020, with Hans Jakob Walnum (Western Norway Research Institute) at the helm.

In addition, we have hired good people, a PhD and a postdoctoral fellow, who both will work in research area 2.»

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: *Resourcemobilization: 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

ABOUT RENEWABLE ENERGY AT SEA IN WORKING PAPER

The research is on the maritime sector, where new infrastructure for renewable energy must be built. It's important to choose the best solutions, but the technology and possibilities are changing rapidly. At the same time, it must be done in a socio-economic way, with cost-effective solutions.

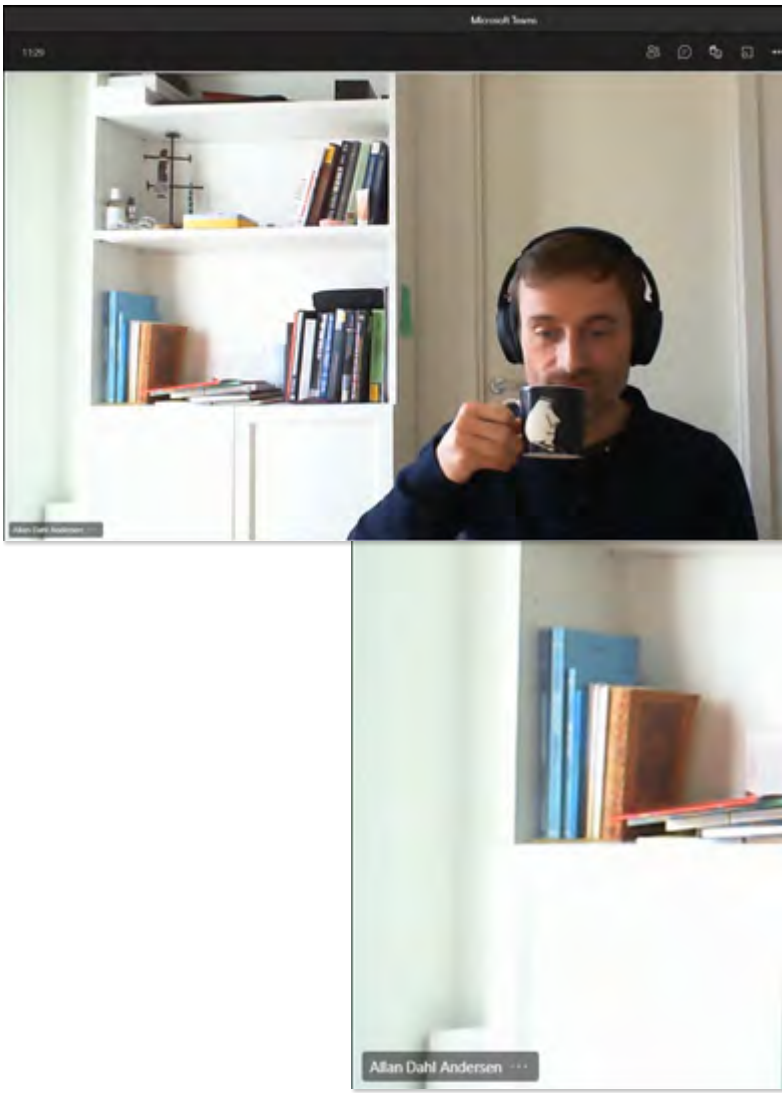
Title: *The sectoral interdependencies of low-carbon innovations in sustainability transitions*.
(NTRANS working paper 01/2020)
See the publication here: **www.ntnu.no/ntrans/working-papers**

ELECTRIFICATION - NOT EVERYONE WANTS CHANGE

Acceleration, at least here in Norway, involves electrification and expansion of renewable electricity. How can we use renewable electricity to decarbonize transportation and industry? It's important to expand the power grid in a smart way, so we get the flexibility we need.

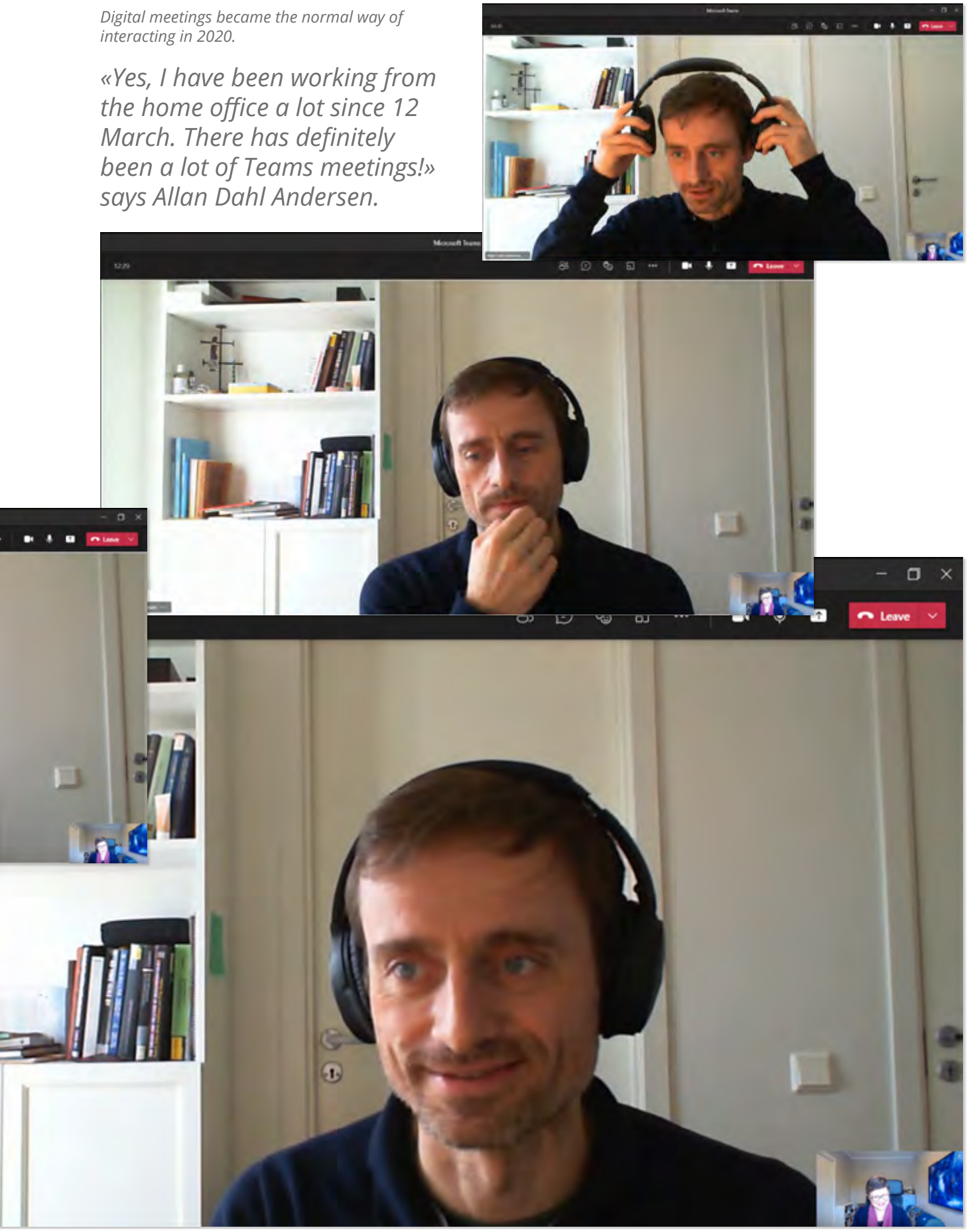
«It takes a long time to transform and expand traditional grids we have today. Currently, completely new and more flexible solutions are being developed and experimented with including technologies such as batteries, ICT platforms and demand response. Several innovation challenges around flexibility, regulation and policy emerge along the way.

A study we have done of Germany shows that some established industry stakeholders are holding back on development. They prefer the current solutions to continue», says the researcher. Identifying who is pushing towards acceleration and who is holding back is important for understanding drivers and barriers to change and what kind of public policy could be helpful.



Digital meetings became the normal way of interacting in 2020.

«Yes, I have been working from the home office a lot since 12 March. There has definitely been a lot of Teams meetings!» says Allan Dahl Andersen.



RESEARCH AREA 3
FUTURE ENERGY MARKETS

«GREEN CERTIFICATES» ARE GROWING ON US ...

People want to feel sure that their electricity is clean. That's why they want to get guarantees that show where their power originates from.

«Guarantees of origin are quite common in many European countries, where there is a lot of marketing of green energy. But they will probably become more popular here as well, because consumers have become more aware of where the power originates from. Is it imported from countries that use coal, gas and nuclear power to produce electricity? Or is it green and renewable? It can also be an additional and essential source of income for renewable producers», says Stefan Jaehnert. He heads research area 3 (RA3) in NTRANS, and is also Research Manager in SINTEF Energy.

10,000 kilometres of milage! «I have transported my two children to and from the kindergarten before and after work in this electric bike. They are growing out of it now, though», says Stefan Jaehnert.

A CORNERSTONE FOR THE TRANSITION

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 program. Well-functioning energy markets are one of the tools for achieving the goal of a sustainable future with low carbon emissions. Existing energy markets must adapt to change in order to be effective and must include a higher degree of integration between the sectors of electricity, transport and construction. These need to develop local, decentralized solutions. RA3 focuses on the development, design and implementation of the future energy market in Norway and in Europe.

CONFLICTING INTERESTS, ESPECIALLY ON WIND

The research has started in all three work packages included in this research area.

«In work package 3, where we are working together with user case 2, we have been active in 2020. We have had a series of workshops, and several of them together with user partners. The idea is that the user case defines research questions, and that those questions are more closely assessed and defined in the research area afterwards.

The discussions around the future possible energy resources and how to use them, have been quite lively. Especially on wind power, both offshore and onshore, there are consequences for nature and acceptance in the population. Some of the projects that have got concessions are having great difficulties, for example, in Fosen and Rogaland. The local resistance is massive, much more than anticipated, and it's uncertain if they will be completed. But there is now more focus on local decision-making», says Jaehnert.

CAN EVERYONE DRIVE AN ELECTRIC CAR?

«*Something many people are wondering about at the moment is if it's possible for absolutely everyone to drive an electric car. Do we have enough power for that*»?

«Yes, there is no problem with the cars! They only use around 4-5 Terawatt-hours of power. But if goods transport by land and water also is electrified, we have a greater challenge. But in the heavy-duty transport sector and marine sector we are researching the use of other energy sources than electricity. In the maritime sector, a lot of research is done on the use of hydrogen.

EU STRATEGY: CLEAN PLANET FOR ALL

There are new regulations concerning the energy transition on the way for Norway, from EU and the European commission. The strategy *Clean planet for all* will also affect Norway. The EU 4th energy market package is a tool for implementing the strategy. A lot of political debate will probably arise from this.

There is also an anticipation about the forthcoming EU taxonomy, as part of the European Green Deal, in the sector. EU Sustainable Finance Taxonomy is a list of economic activities with performance criteria for their contribution to environmental objectives.

«The *directive of renewable energy* will possibly play a major part of the change here in Norway. As members of the EEA Agreement, we will have to adapt to the regulations, and we will have less freedom of action. We are writing a policy brief about this topic», says the researcher.

WORK PACKAGES IN RESEARCH AREA 3

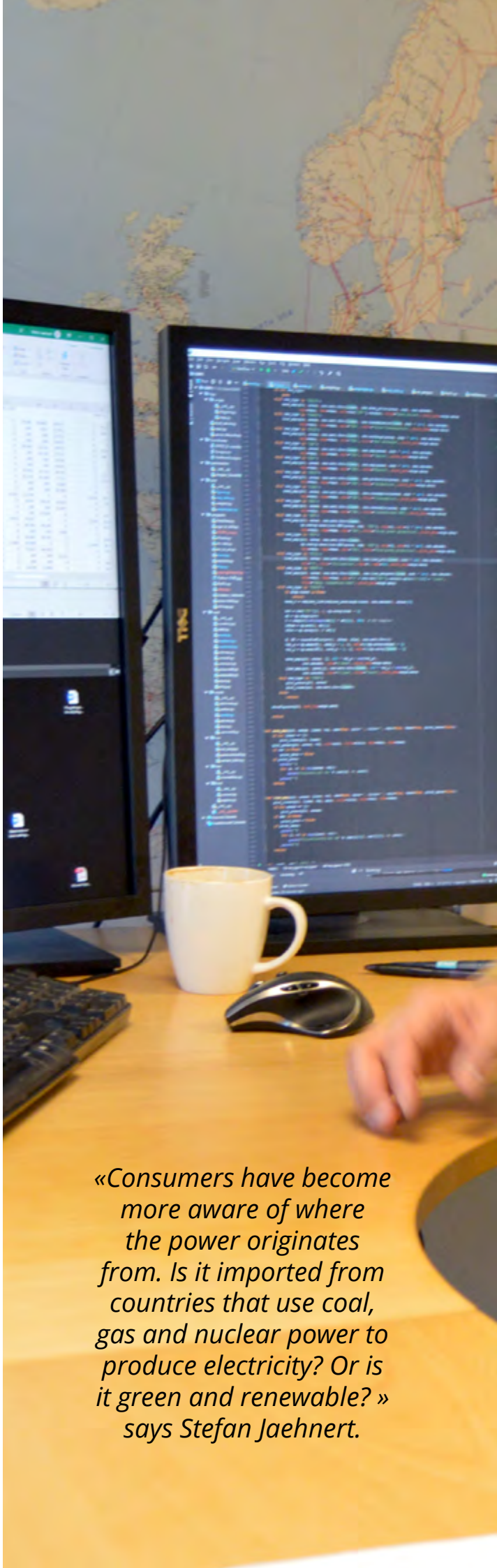
Market design and integration (WP3.1.1)
- EU policy framework/4th energy package
- Market design for sector integration

The consumer in the centre of the energy system (WP3.2)
- Digitalisation, active consumers
- Local/decentralized markets

Value creation from Norwegian energy sources (WP3.3)
- Potential of renewable energy sources (economic/low-carbon society)
- Distribution effects of welfare/value creation

COMMON WORKSHOPS WITH USER CASE 2

Renewable power production and green industry
- 2 internal researcher workshops
- 3 workshops with user partners
- Participants: Equinor, Statkraft, BKK, Hydro, Becour, IFE, NHH, NTNU, SINTEF



«Consumers have become more aware of where the power originates from. Is it imported from countries that use coal, gas and nuclear power to produce electricity? Or is it green and renewable? » says Stefan Jaehnert.

Photo: Vibeke Ann Pettersen, NTRANS

RESEARCH AREA 4
PATHWAYS TO A SUSTAINABLE FUTURE

«WE WILL FIND THE SMARTEST ROUTE»

Like orientation runners searching for the best path to follow from A to B, NTRANS researchers shall find the best direction towards the goal.

«The mission is sustainable transition. In NTRANS context, this is mainly about energy transition.» Says research leader at IFE, who also leads this NTRANS research area, Kari Aamodt Espegren.

«There's very exciting research going on in the field of hydrogen!» says Kari Aamodt Espegren, who heads this NTRANS research area.

BOTH TECHNOLOGY AND PEOPLE

The researchers will analyse different transition paths on the road to a low-emission society, with a special focus on Norwegian developments. But also look at how interaction with Europe can take place with the various alternatives.

«The restructuring must be cost-effective, fair and inclusive. It's about both technology and people», says Espegren. Her own background is technical-economic. But in this research area, she collaborates a lot with researchers in the social science disciplines.

Espegren and the other researchers will unite the different perspectives – in a multidisciplinary approach. Different research disciplines and research models are used to analyse the same issues.

DEFINING: WHERE ARE WE NOW?

«It's important that we experience where we are now, that our starting point is the same, and that we have a common platform. And that everyone is a team player! All the other research areas and user cases are relevant to include here», says the researcher.

Research area 4 (RA4) will benefit from the research in areas 1-3, and combine the different perspectives that characterise the directions for change in Norway, but also in the EU and globally. The planning of the transition to the low-carbon society is characterized by a high degree of uncertainty in many sectors and fields of knowledge. RA4 will work closely with various actors and stakeholders who make decisions.

LOOKING AT THE TRANSPORT SECTOR FIRST

«The area is large, so we have set a goal to focus on the transport sector for the first two years. There are many actors, and various research methods and models, including socio-technical models.»

In the first two-year period, the user case for radical change in transport (UC3) is the most relevant, and a close collaboration with the stakeholders and user partners from transport will be established. The user case for building the society of the future (U1) also has relevant activity within mobility, future transport needs and modal shifts.

«The state and municipality are major purchasers of goods and services, so public procurement schemes will be an important part of the transition. For example, the County Authority has an important role in ordering for public transport, including ferries and express boats. Through this, they can facilitate a faster in-phasing of zero-emission vessels. The ports are also a very important part of the puzzle, infrastructure is needed for refuelling for example electricity and hydrogen.

NINE STORIES ABOUT SUSTAINABLE MOBILITY

In 2020, NTRANS researchers have worked to describe various elements of sustainable mobility, in the article "Grand Narratives for sustainable mobility: A conceptual review", published in Energy Research & Social Science. Based on a concept and literature study, the article presents nine stories about sustainable mobility, including green regulators, compact cities, clean fuels, car sharing schemes, the simple life and various ICT solutions. Based on these stories – which influence and are influenced by each other – we present three so-called great narratives about sustainable mobility: electromobility, public transport 2.0 and the low-mobility society. The article concludes with an assessment in terms of feasibility (do they work?), acceptance (do we want them?) and importance (are they sustainable?).

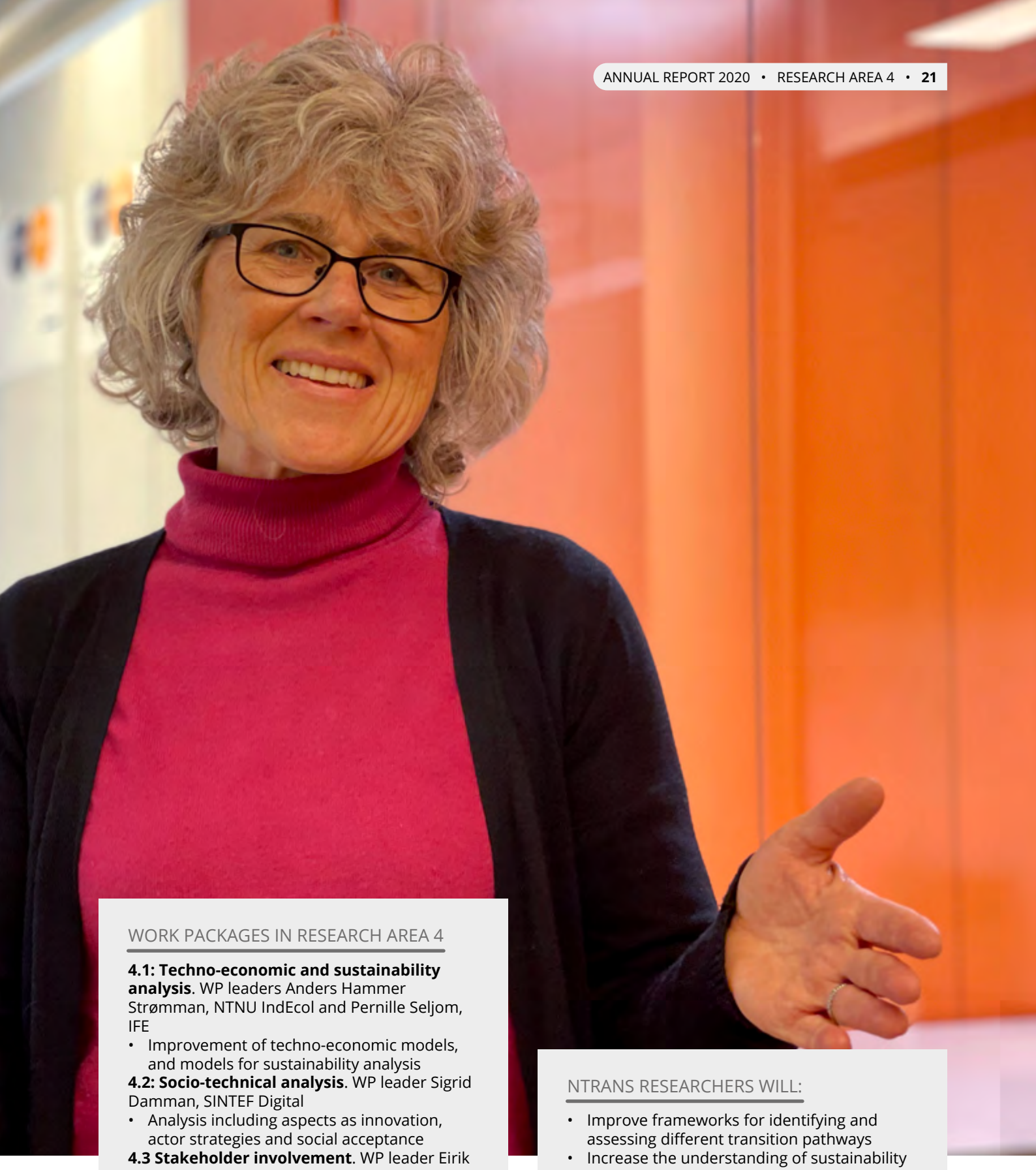
HYDROGEN IS EXCITING!

Espegren and her NTRANS colleagues in research area 4 have also been working on a research article on hydrogen. It's called: «The role of hydrogen in the transition from a petroleum economy to a low carbon society», and will hopefully be published in the International Journal of Hydrogen during spring 2021. The paper presents a radical decarbonization pathway for the Norwegian society towards 2050 and focuses on the role of hydrogen in the transition. Three analytical perspectives are combined. The first uses energy models to investigate the role of hydrogen in an energy and power market perspective, without considering hydrogen export. The second, uses an economic equilibrium model to examine the potential role of hydrogen export in value creation. The third analysis is a socio-technical case study on the drivers and barriers for hydrogen production in Norway.

Main conclusions are that access to renewable power and hydrogen are prerequisites for decarbonisation of transport and industrial sectors in Norway, and that hydrogen is a key to maintain a high level of economic activity. Structural changes in the economy, impacts of new technologies, and key enablers and barriers in this transition are discussed. «The article is also based on previous research, and concerns the role of hydrogen on the road to the low-emission society. There's very exciting research going on in the field of hydrogen!»

Photo: Gry Slotterøy, IFE

«It's important that we experience where we are now, that our starting point is the same, and that we have a common platform», says Kari Aamodt Espegren.



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 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.

NTRANS RESEARCHERS WILL:

- Improve frameworks for identifying and assessing different transition pathways
- Increase the understanding of sustainability transition as a phenomenon
- Develop a multidisciplinary approach in the interface between the socio-technical, technical-economic, and environmental sustainability perspectives
- Analyse and find the most cost-effective transition pathways for Norway, and the environmental, political and social opportunities and challenges of these directions

RESEARCH AREA 5
USER CASE AND INNOVATION

«TECHNOLOGY IS NOT ENOUGH!»

«We will not be able to cut emissions fast enough by only developing technological solutions. The barriers are in people's heads.»

«We must create acceptance for the major transition that will take place», says Professor Kristin Linnerud who heads research area 5. She also works at the Western Norway University of Applied Sciences (HVL) and in Cicero.

«Our researchers collaborate well with the technology environments, including the eight technological FMEs. NTRANS leads a joint FME innovation forum where the centres can benefit from each other's knowledge.»

«Technology alone can't provide cuts in greenhouse gas emissions. We must create acceptance and get the population on board», says Kristin Linnerud.

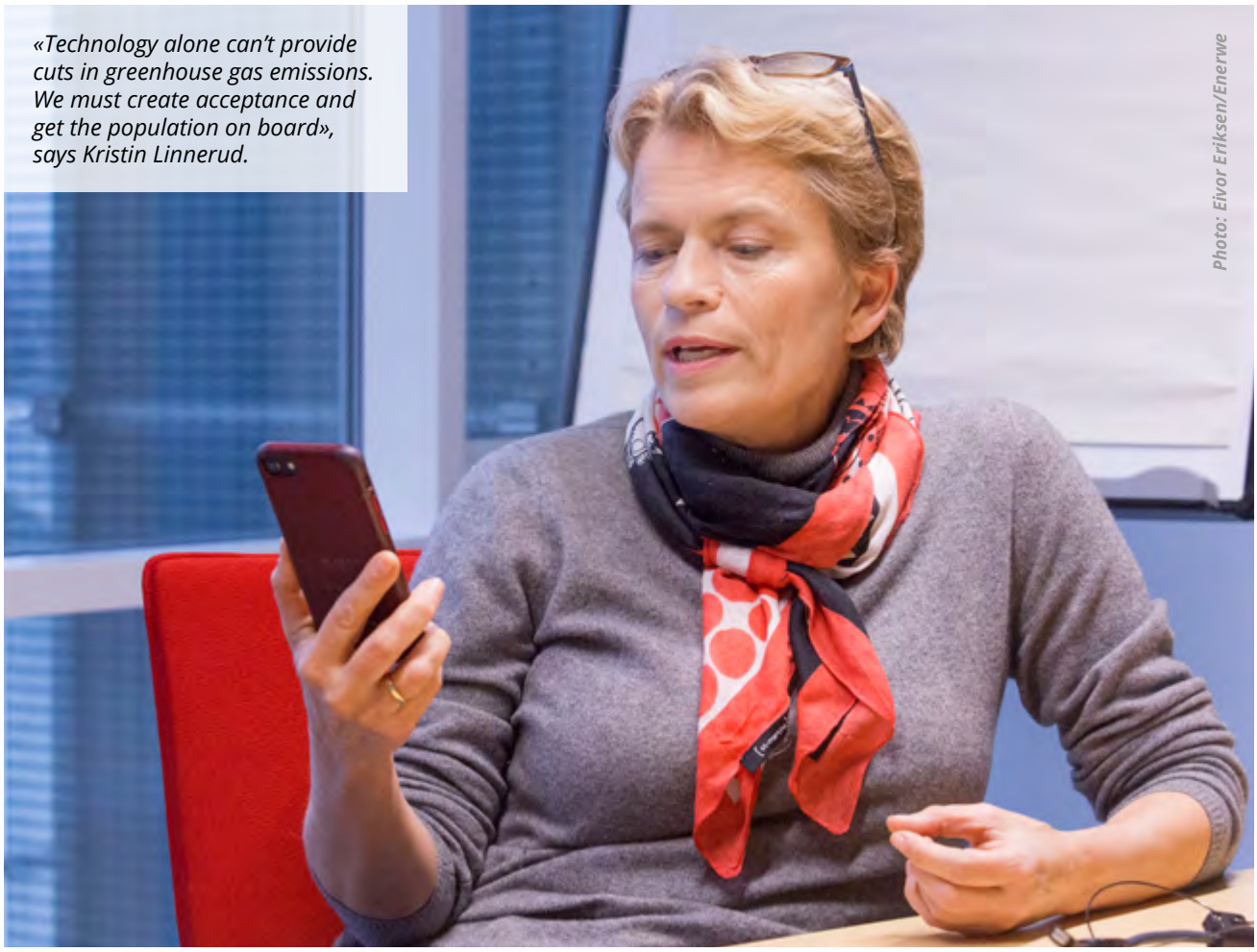


Photo: Eivor Eriksen/Enerwe

RESEARCH IN THE FLOW ZONE

«As researchers, we must dare to go outside the comfort zone. Dare to think about how society and politicians should be challenged. And, at the same time, we must base our advices on existing research,» Linnerud says eagerly and continues:

«We must build on the existing knowledge among our research, industry and public sector partners. Exchange of knowledge is the key, not to create completely new knowledge, but to make good use of what we already know.

We have experienced researchers and PhDs working on topics that are highly relevant to both business and public administration. And we have industry, municipalities and public bodies that have much more in-depth insight than us in a number of areas, such as technology, politics, regulations and markets. We researchers need to learn from them, in order to understand the context in which they make their decisions.

In Research Area 5, knowledge is exchanged so that we can answer current questions that arise.»

RESEARCH SPRINT ON KLIMAKUR

«I am very pleased with the implementation and outcome of the very first "research sprint". Of course, in retrospect one always sees things that could have been done differently. But overall – I am very happy!» Linnerud shines through the Teams screen.

«Researchers Marius Korsnes (NTNU) and Pernille Seljom (IFE) did a great job. They have collaborated well with the user partners along the way, and had several meetings and webinars.»

The NTRANS researchers involved user partners well in the sprint, making use of existing research, and providing research-based advice that refers to studies on how people respond to various measures.

(See more about the research sprint in a separate fact box and also on page 38 in this report.)

PROVIDING GOOD, RESEARCH-BASED ADVICE TO THE MUNICIPALITIES

A so-called policy brief, or recommendation, was written by the researchers in collaboration with the user partners after the sprint. It provides five specific pieces of advice to the municipalities on how the climate goals in «Klimakur2030» can be achieved. The recommendation from NTRANS «How can municipalities take successful climate action?» is found on our web site (in Norwegian) **ntnu.no/ntrans/policy-brief-anbefaling**

«It's brilliant that this work was linked to a political process and Klimakur2030. The focus here is on all emissions outside of the EU quota system, and they are much more challenging to capture, because they are not concentrated in large point emissions. Therefore, it is essential that we concentrate on what is realistic to achieve. Examples of such emissions are emissions from road transport, shipping, fishing and aquaculture, agriculture and waste management.»

FAIR SOLUTIONS THAT ARE ACCEPTED

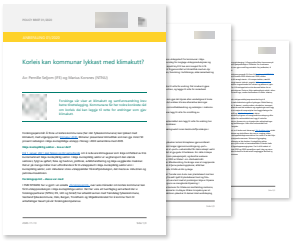
«We must look at accurate and cost-effective solutions that also are accepted. People affected by measures must consider them as socially just. Otherwise, it will be difficult to achieve anything. See, for example, how the strong opposition against land-based wind power many places in this country has slowed further development.»

«Researchers must dare to present research that is still in progress, and consequently make the necessary reservations. Greenhouse gas emissions need to be halved by 2030. Decision-makers in the public and private sectors need information to make decisions now.»

IMPORTANT TO ACHIEVE THE UN'S SUSTAINABILITY GOALS

The NTRANS research is important in enabling and reaching several of the UN's 17 sustainability goals. Especially number seven, «Affordable and clean energy» and number 13 «Climate action», but also several of the other goals are relevant to our research, such as numbers 14 and 15 on life at sea and on land.

«NTRANS, with both researchers and user partners, plays an important role. If we are to gain acceptance for the change, we must consider all consequences for society, climate and nature.»


Korleis kan kommunar lykkast med klimakutt?

The researchers give advice: In this policy brief, or recommendation, NTRANS researchers give advice on climate actions to the municipalities.

USER CASES IN NTRANS

- FME forum for innovation and cooperation with the 8 technological FMEs (WP 5.2
  Lead by: Eirik Gjelsvik Medbø at NTNU
- Building the future societies (WP 5.3 UC1)
  Lead by: Pernille Seljom at IFE
  and Marius Korsnes at NTNU
- Renewable power development and its potential uses (WP 5.4 UC2)
  Lead by: Ingeborg Graabak and
  Stephan Jaehnert at SINTEF
- Transport sector: the role of hydrogen in the maritime sector (WP 5.5 UC3)
  Lead by: Tuukka Mäkitie with assistance from Markus Steen, both at SINTEF
- Transport sector: Freight transport between and within cities (WP 5.6 UC4)
  Lead by: To be announced. Co-leader is Kari Espegren at IFE
- Carbon Capture and Storage (WP 5.7 UC5)
  Lead by: Asgeir Tomasgard at NTNU

«I am very pleased with the implementation and outcome of the very first research sprint», says Kristin Linnerud.

RESEARCH SPRINT – WHAT IS IT?

A new way of working, where researchers and user partners work together to solve problems faster. Read more about the research sprint and the policy brief on page 38 in this report.

Photo: Eivor Eriksen/Enerwe

A COMMON FME FORUM FOR INNOVATION

In december 2020, the last meeting of the FME Innovation Forum was held.

"I think we've achieved good discussions and sharing of experiences across very different centres", says Eirik Medbø, who leads the forum on behalf of FME NTRANS.

A Teams meeting lights up a projector screen at NTNU, and some of Norway's prominent researchers on future energy challenges are visible on the screen from their home offices, ready for a new meeting in the FME Innovation Forum. In the NTNU meeting room we find Eirik Medbø, Innovation Manager at FME NTRANS and leader of the Innovation Forum.

"*In today's meeting we'll talk about how many of our centres have worked with their innovation and societal impact in their centre's midway evaluation – and we'll establish some topics to collaborate on in 2021*", Medbø says.

Centre leaders and innovation managers from most of the FME centres participate in the meeting, in addition to representatives from the Norwegian Research Council. The forum was started in 2019 after an initiative from NTNU Energy and SINTEF Energy, to enhance innovation and collaboration across disciplines and research institutions. NTRANS took lead in the forum in 2020.

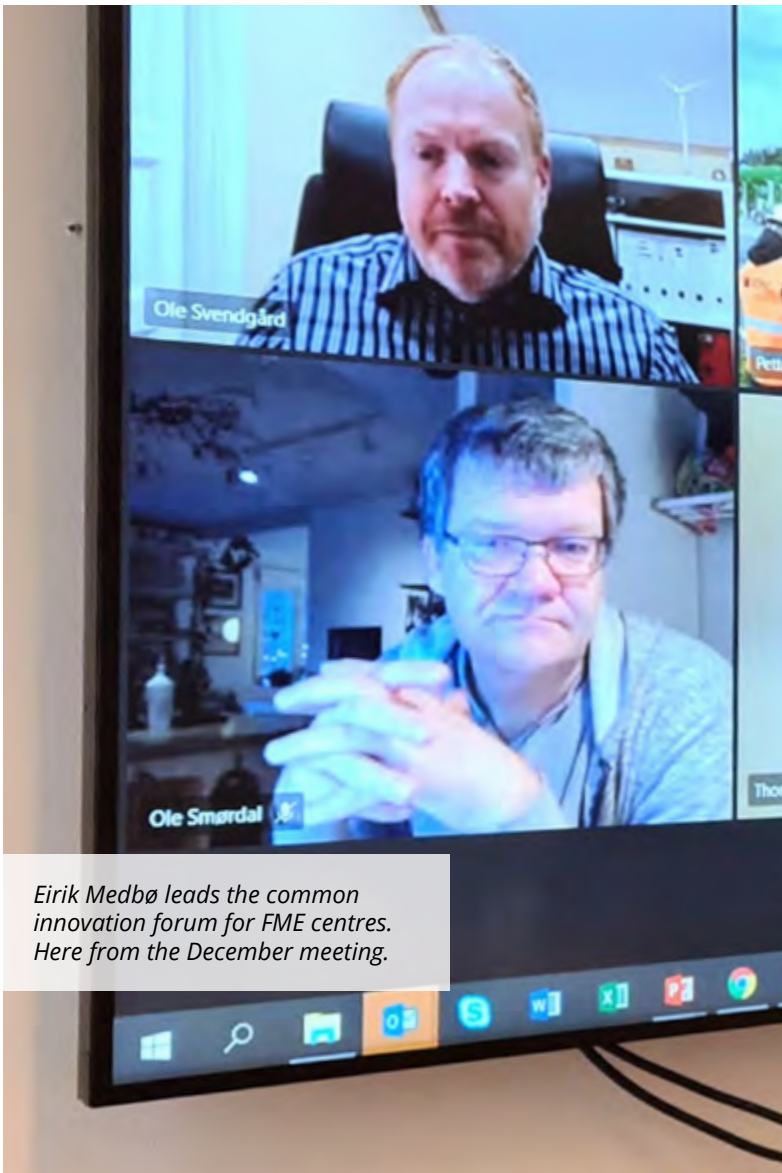
The goal is to improve on the centres' innovation output, so the excellent research can contribute to develop both our user partners and our energy society in general. "*Innovation is more than a technology, a product or a business idea*," Medbø elaborates.

"Innovations could be all types of knowledge that can contribute to a positive change or development – whether it be strategic advice, new insight, technology or change in collaborations or societal structures".

The topic in the meetings are for instance how the centres build a culture for innovation among researchers and user partners, measure results on innovation and societal impact, collaborate across partners and disciplines, develop innovation competences, and communicate results and achievements. The meetings have a sense of openness about strengths and weaknesses from each centre, and the common desire to share and learn from each other.

ALSO SHARE THE SILENT KNOWLEDGE

"*I think a forum like this could really succeed if we're also able to share our implicit knowledge; semi-structured and incomplete thoughts and ideas – in addition to more explicit and processed reports, presentations and results*", Medbø says. This year the forum has discussed both opportunities for innovation through the new EU framework



Eirik Medbø leads the common innovation forum for FME centres. Here from the December meeting.

programme Horizon Europe, and how the technical FME centres could highlight innovation in their ongoing mid-way evaluations. The participants in the meetings agree on what to continue working on in 2021: The centres will for instance collect and share their best practices for successful collaboration with user partners, and work on how to visualise the outputs from non-technical innovation.

"*We've got a lot to learn from each other. We've all got our own work and initiatives, but no one could be a world champion on all fronts*," Medbø explains. "*To mention some examples, FME ZEN have developed a good structure for innovation follow-up. FME HydroCen have worked with connecting their innovation outputs to the global SDG goals, and FME CINELDI have championed the work on system innovation, innovation that create value in the interfaces between different actors.*"

In addition, the Forum aims to invite knowledge and input from outside stakeholders.

"*We want to further develop the forum through inviting people or actors, to get input on how we could work, or new opportunities for collaboration. This could be industry actors, public actors or researchers that challenge or help us get better*".

VISIT FROM THE RENERGY CLUSTER

Today, the leaders of the Renergy Cluster are visiting. They work closely with industry companies and startups. Ole Svendgård in the Cluster gives an intro about how the cluster works with innovation, and how they could interact with larger research centres. "*One cluster can't collaborate with all centres, but this acted as a good intro to a general discussion on how we could work with clusters to get a bigger impact on industry*", Medbø adds.

The researchers in the Teams meeting wish each other a merry Christmas, before they disappear from the meeting one by one.

"*I think today's meeting went well. We got to discuss some valuable experiences and results, and managed to look ahead to the coming year, with ideas and topics that we all could benefit from in the year to come*," Medbø finishes.

Photo: Vibeke Ann Pettersen, NTRANS

INNOVATIONS FROM FME NTRANS

FME NTRANS is a centre with a broad range of partners and research areas, making the centre well suited to contribute to innovations.

The expected new knowledge developed by FME NTRANS through our research will be theories, methods, competence and knowledge to support decisions in the energy transition (see Figure.) While the popular preconception about innovation is that innovative solutions create value from or within one organisation (*micro-level* innovation), a lot of the new knowledge developed by NTRANS will address the interfaces between actors.

THE CHICKEN OR THE EGG?

One approach to the inter-dependencies that we often face in the energy transition ("the chicken or the egg" paradox), is to evolve practices within several actors in parallel. FME NTRANS will investigate the interfaces, coordination and potential collaborations between companies, the public sector, consumers, public government and regulators. This will result in innovations that require parallel changes by multiple actors (macro-level innovation). As an example, increasing flexibility among electricity consumers might require adaptations of pricing regulations, adaptations within grid and utility companies, changes in consumer behaviour as well as smart technological solutions.

Secondly, the questions we ask in our research are complex and often path dependent. Every step on the way could give implications for what we should do next, revealing new opportunities and barriers. In many cases it will therefore be hard, and sometimes even counter-productive, to recommend *direct innovations* - concrete new practices or solutions that actors should implement.

DIRECT AND INDIRECT INNOVATION

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

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

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

WHAT IS INNOVATION?

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

INSIGHTS FROM A SPECIAL KIND OF ANNUAL CONFERENCE

By chair of programme committee, Tomas Moe Skjølsvold

In December, NTRANS conducted its first annual conference. As corona-restrictions were tight, the conference was an all online event. This, however, did not stop it from becoming a highly engaging event, which combined insights from researchers, user partners, as well as inspiring keynote presentations.

We divided the day in two broad thematic sessions. The first half of the day provided a set of thought-provoking insights, which reflected on how strange 2020 had been as an energy-year. Covid-19 had affected the way user partners and researchers work, as well as patterns of transportation and energy consumption. Further, Norway had seen wind-power protests rise to a large popular movement, while environmental organizations launched a lawsuit against the state due to increasing petroleum activities. Hence, as the keynote Anne Therese Gullberg noted, 2020 has been a political polarization in energy issues. We also saw unusual levels of surplus power production.

Through a set of reflections from our user partners, it became clear that 2020 has had deep impact on their operations. This was particularly true for public transport actors who had more or less stopped their activities. However, there were also positive developments. Across sectors, 2020 fast-tracked digitalization, enabling new forms of collaborative practices that many highlighted would continue also post-covid. Actors working with CCS noted that corona stimulus packages had created a necessary boost for their technology. From researchers we got stories about the development of new research methods such as digital ethnography. Others still, pointed out that crisis stimulated innovation, and that the goal was now to ensure that the creative energy of responding to the crisis was put to good use over the coming years.

During the second half of the conference, we zoomed in on the blue aspects of the energy transition. Here, we learned about how key Norwegian actors work with offshore wind, as well as how transitions are enacted in diverse communities and amongst diverse actors such as coastal municipalities, ports, and amongst actors who are now venturing into hydrogen. The overall impression is that the Norwegian coastline is buzzing with activities that push towards decarbonization. The activities are strongly supported by Norwegian authorities, who see Norway's maritime history as a distinct advantage in this domain. Working with transitions close to the water also lends itself to synergies with other key Norwegian industries such as fisheries and petroleum. This, of course, also points towards some of the paradoxes of the Norwegian energy landscape. How can one deal with the tight links to industries that have large climate- and sustainability challenges? Dealing with such trade-offs are a key interest in NTRANS.

A key aspect of the discussions at the conference also circled around the relationship between Norwegian activities and what happens abroad. The European Union stands out as central here, and a key interest of the conference was how the new European taxonomy for sustainable activities would affect Norwegian interests. Responses to this question differed depending on the perspective, and from an NTRANS perspective this points towards a clear need for further research. All in all, the conference provided food for thought, stimulating ideas as well as great discussions.

Next year we hope to be able to see more of you again live!

THE MANAGEMENT GROUP

Centre director **Asgeir Tomasgard** (*NTNU*)

Deputy director **Tomas Moe Skjølsvold** (*NTNU*)

Research director **Mette Helene Bjørndal** (*NHH*)

RA 1 Leader **Marius Korsnes** (*NTNU*)

RA 2 Leader **Allan Dahl Andersen** (*UiO*)

RA 3 Leader **Stefan Jaehnert** (*Sintef*)

RA 4 Leader **Kari Aamodt Espegren** (*IFE*)

RA 5 Leader **Kristin Linnerud** (*HVL*)

Gunnar Eskeland (*NHH*)

Anders Hammer Strømman (*NTNU*)

Pernille Seljom (*IFE*)

Markus Steen (*Sintef*)

Hans Jakob Walnum (*Western Norway Research Institute)*

THE BOARD

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Ragnhild Stuland, *Hydro*
Caroline Østlie, *Statkraft*
Even Bjørnstad, *Enova*

KNOWLEDGE, LUNCH AND ESTABLISHING AN NTRANS-CULTURE

Photo: Vibeke Ann Pettersen, NTRANS

Ida Marie Henriksen (Postdoc, NTNU) and Deputy Director Tomas Moe Skjølsvold (NTNU) are ready for the next lunch box webinar at campus Dragvoll, NTNU in Trondheim.

Every Thursday during the fall of 2020, NTRANS has invited researchers and user partners to a lunch box webinar. The goal has been to establish a low-threshold and highly engaging arena where we can get to know each other, learn about activities across the centre, and to build new bridges and generate ideas. The webinars have been warmly welcomed, and 20-40 people meet on a weekly basis. We have been impressed both with the quality and diversity of talks, as well as with the level of discussion generated.

Broadly speaking, we have seen two types of presentations. First, we have seen presentations of scholarly work that has been conducted by researchers in the centre. This has covered a broad set off issues ranging from controversies about oil and gas innovation, actors and processes involved in electrification, discussions about developing markets for certificates of origin and future European energy markets, policies and politics, and systemic understandings of transition processes. The presentations have illustrated the diversity of the involved researchers in terms of theoretical understanding of transitions, and methodological approaches to research. Such discussions are valuable, as much of what we do in the centre consists of engagement across methodological and theoretical boundaries.

Second, we have seen presentations from user partners. Here too, the diversity has been strong. Some user partners present their own research outlooks and associated scenarios, thus providing valuable supplements to the research partners. Others have presented elaborate plans for how to decarbonize their own operations, while challenging researchers to provide input that is relevant for these processes. It has been impressive to see the work that is currently done from small municipalities, interest organizations and large corporations to decarbonize, collaborate in new ways and to engage in new perspectives and ideas.

Moving forward, our ambition is that the share of webinars that presents original research and perspectives from NTRANS will increase, and that we will see more presentations from our many promising PhD and post doc candidates. Further, as the NTRANS work progresses we will seek to use this arena as a way of presenting broad synthesis about insights generated. Finally, we want the webinars to be an arena that is increasingly also used to present the strong collaborative work that goes on in user cases, where researchers and user partners work together. We hope to see you for lunch also in the coming year!

PHDS AND POSTDOCS

Here is a short presentation of the PhD Candidates and Postdocs who joined NTRANS in 2020. 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)

Postdoc
Jakoba Sraml Gonzalez
UiO, TIK

Topic: "*Organisational perspective to industry transformations and transition*".

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

Postdoc
Maik Budzinski
NTNU, IV

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

Supervisiors: 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)

Blog post written by NTRANS PhD Felipe Van De Sande Araujo December 2020

FRESH NTRANS PERSPECTIVE

I am amazed by what we have going at the NTRANS research center. It has been three months since I joined and I could not help but notice, right from the start, the positive work culture that emerges from each one of its members as an effect of committing to a worthy cause and having the means to pursue it.

After working in very competitive work environments it feels really good to be on a team that provides mutual support and feedback and, as a newcomer, I am challenged by the quality of the work of my colleagues to improve myself. This does not mean that the drive provided by competition is out of the picture as we are stimulated and dedicate ourselves to provide research at high standards and international level. The balance thus attained provides for an inclusive and productive work environment.

Much has been said about background diversity and the beneficial impact of cross-discipline collaboration, and this has always been easier said than done. Because each field has its focus, methods, and "lingo" there are many difficulties for interdisciplinary communication, which requires effort from all participants. It seems easier for each specialist to dive deeply into their subject and enjoy the safety of their area.

At the NTRANS Annual Conference, I was able to see the collaboration being put in action, with researchers from different backgrounds sharing knowledge willingly and even searching for better ways to communicate their ideas to a diverse audience, answering questions with care and attention. Another highlight of the conference was the participation of the NTRANS partners, private company managers, and public authorities, sharing strategies and visions of the future, dedicating their time to contribute to this goal of finding a just and viable transition into a more sustainable future.

It has been said that the duty of academia is presenting the facts so that the community can then make informed decisions. Anyone that participated in the conference would see exactly this: researchers, business executives, and public sector representatives coming together to find practical solutions that cater to the common good. That shows that we are aware of another criticism made about academic work, that it often turns inwards building knowledge only for the sake of knowledge, in the allegorical ivory tower.

Sitting in my office in one of the high buildings of the Gløshaugen plateau and hearing different languages being spoken in the corridors I cannot help but remember another allegorical tower, the ill-fated tower of Babel. What separates this thousand year's old metaphor and our current initiative? What caused the former to fail and why is the latter succeeding? I think the answer is quite easy: the cautionary tale shows a colossal endeavor that failed because it was fueled by hubris, while the pursuit of our objective, which might be equally challenging, is firmly structured over a foundation of mutual respect and is focused on a better and collective human experience.

ENERGISING SUMMER SCHOOL FOR PHDS

Fresh PhD students (doctoral candidates) had fun and interesting times in the Bergen area in August days 2020.

WINDY EXPERIENCE: The fresh energy PhDs, Jonas Martin, Raquel Alonso Pedrero and Davood Qorbani on the way to the wind park Midtfjellet, which is seen in the background. (Photo: Davood Qorbani)

NTRANS PhD Davood Qorbani and energy PhD Raquel Alonso Pedrero, report directly from the summer school in Bergen:

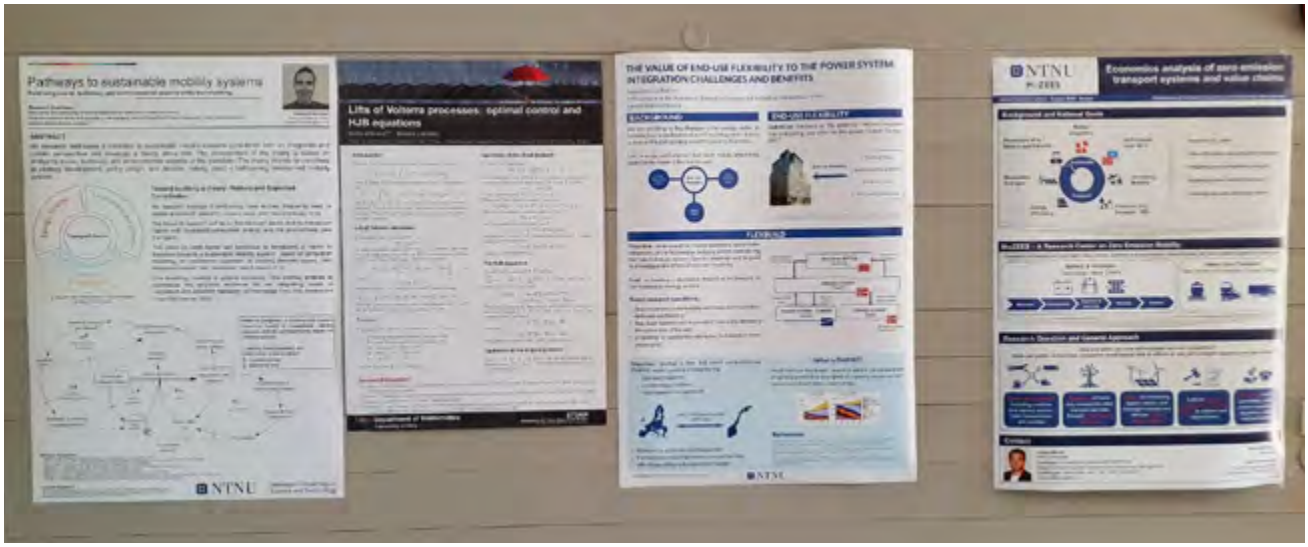
"It has been very nice so far, we have really enjoyed it! On the first day we all gave a short presentation of our PhD topics, and we got to know all the other students participating.

LEARNING ABOUT THE INDUSTRY'S PERSPECTIVE

The following day we went to Stord, where we had the opportunity to meet people from the Norwegian Catapult, Kværner Stord and NCE Maritime Clean Tech. They explained the industry's perspective towards the energy transition to us. These talks were very interesting. In the evening we went to Midtfjellet vindpark, wich can be seen in the background on the photo.

The two last days we spent in Bergen, we were working in groups with presentations. We presented them for each other before the summer school ended on Friday," the PhDs reported from Bergen.

POSTER PRESENTATIONS



ACADEMIC POSTERS: The PhD students presented their projects during summer school 2020. (Photo: Davood Qorbani)

NORREN SUMMER SCHOOL 2020

Topic: Flexible energy systems

Where and when: 17-21 August, Bergen (Os)

The University of Bergen (UiB), the Norwegian University of Science and Technology (NTNU) and the University of Oslo (UiO) invited all PhD-students working within the fields of energy to the 2020 interdisciplinary summer school on flexible energy systems.

SUMMER SCHOOL CONTENT

- Lectures by leading researchers and experts from industry and public administration
- Excursions with a total of 4-5 site visits to relevant actors in the Bergen region and at Stord
- The opportunity to interact with top scholars and experts, as well as with other summer school students from a wide range of disciplines
- A collaborative educational environment – participants will work in interdisciplinary groups throughout the week on a topical project
- Networking opportunities and social events.

NTRANS LECTURERS

Three of our researchers, Mette Helene Bjørndal, Marius Korsnes and Asgeir Tomasgard, have been amongst the lecturers for the group of around 30 Phd-students.

MAIN ORGANISERS

- Kristin Guldbrandsen Frøysa – Energy director at University of Bergen
- Vebjørn Bakken – Director UiO:Energy, University of Oslo
- Øystein Moen – Adviser UiO:Energy, University of Oslo
- Asgeir Tomasgard – Director FME NTRANS, Norwegian University of Science and Technology
- Gry Ekland Parker – Senior Executive Officer, University of Bergen

See more on the NorRen web pages: **https://norren.no/node/105**

TWO EXCELLENT MASTER THESES FROM NHH

Many good master's theses have been submitted within NTRANS. Here are two examples. The master students behind these theses have been supervised by NTRANS Professors at NHH (Norwegian School of Economics).

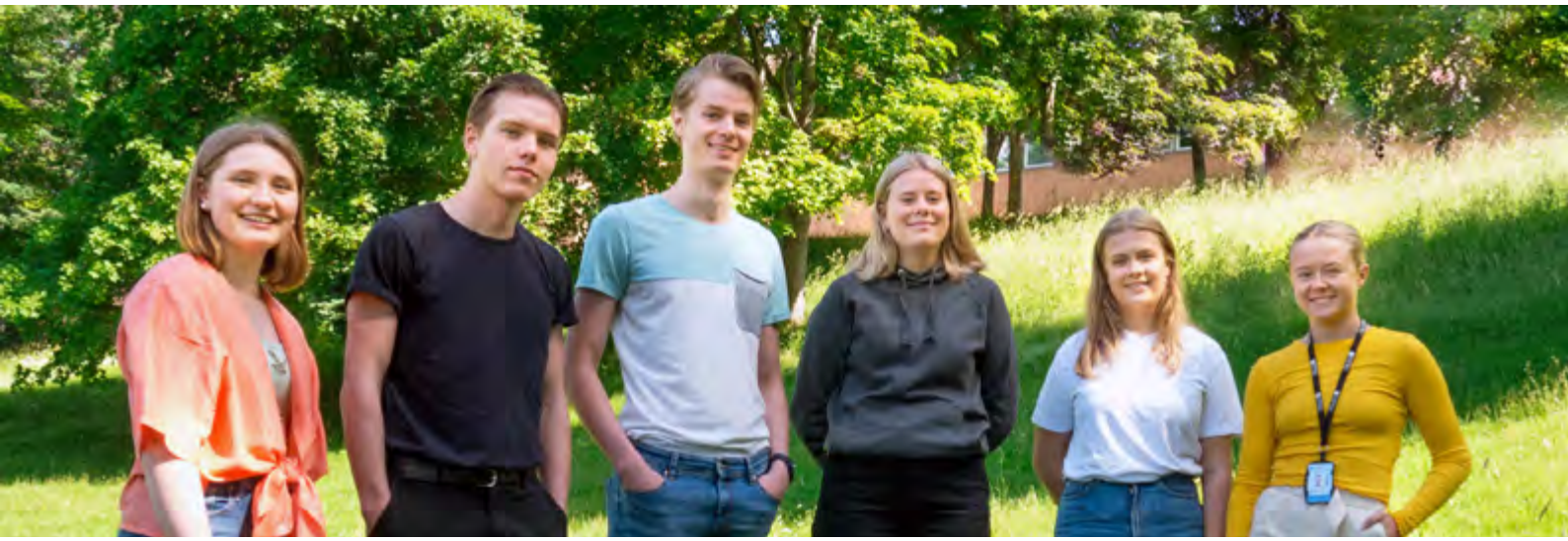
Blekastad, M., & Landa, K. J.: *The power of wind–a portfolio approach: a theoretical study of wind power characteristics in Norway* Supervisor: Professor Gunnar Eskeland. https://openaccess.nhh.no/nhh-xmlui/handle/11250/2682442

Summary: In this thesis, we analyse how geographical diversification and a portfolio approach lowers the variability in wind power production. Understanding variance of wind power production will increase system reliability. Evaluating the covariance of power production in different parts of Norway will become relevant as the share of variable renewable energy increases in the power energy mix. We use historical wind measures from the Norwegian coastline to evaluate how to minimise the variance of theoretical wind power production. The findings suggest that when utilising weekly aggregated wind data, the wind power correlation is low when the distance between two wind sites is approximately 900 km or more. We see that the correlation between wind power locations decreases as the distances increases regardless of the time interval studied. Portfolio theory states that assets' variance in a portfolio is not a problem if the assets do not covary. We argue that it is possible to handle wind power variability in the same way as stocks on the financial markets and that coordinating wind farms lowers the variability of wind power production. We present an optimal investment portfolio for onshore wind power production in Norway, utilising a Mean-Variance Portfolio (MVP). In the thesis, we have applied two different MVP approaches, first accounting for wind resources and second accounting for system demand. We find that how to best diversify wind locations differ depending on the optimisation problem. The empirical results reveal that geographical dispersion contributes to reducing variance in wind power production, associated with increased system reliability.

Strømholm, L.S., & Rolfsen, R.A.S.: *Flexible Hydrogen Production – A Comprehensive Study on Optimizing Cost-Efficient Combinations of Production and Storage Capacity to Exploit Electricity Price Fluctuations*. Supervisors: Professor Endre Bjørndal and Professor Mette Bjørndal.

Summary: Due to the high costs related to green hydrogen, most of the world's hydrogen today is supplied from grey hydrogen, resulting in a substantial carbon footprint. However, with decreasing capital costs, and the possibility to exploit electricity price fluctuations to reduce production costs, green hydrogen could prove to become a competitive alternative. This thesis focuses on evaluating the potential to reduce the total cost of hydrogen production stemming from alkaline water electrolysis. The method is based on exploiting electricity price fluctuations through excess production capacity combined with hydrogen storage. A mathematical, multi-period decision model was developed to find the most cost-efficient, long-term production schedule for an on-site, grid-connected production plant. Model results stem from various scenarios representing different horizons and storage options to determine the optimally combined capacities for production and storage. Thus, the effects of plant cost reductions, increased electricity price fluctuations, innovative storage solutions, and improving efficiencies are explored in regard to hydrogen production. The main findings show that it is costly to exploit electricity price fluctuations to reduce hydrogen costs when obligated to satisfy a required demand. In most cases, the cost of additional production and storage equipment counteracts the benefit of producing in hours of low-cost electricity. However, under certain circumstances, mainly very volatile electricity prices and underground hydrogen storage, hydrogen costs can be reduced through investments in excess production capacity. Additionally, under a special cost structure for grid fees, capacity expansions became substantially more attractive, in which an optimal solution pushed the determined limit for production capacity. In a future scenario, a 36% increase in daily production capacity was observed to be the economically preferred option, which resulted in a production cost reduction of 8.86% and an overall decrease in the levelized cost of hydrogen.

REPORT FROM UNGENERGI



The young editorial staff: From the left: Sofie Amalie Sørum, Holger Setten, Simonas Strasunskas, Pernille Martiniussen Ryghaug, Randi Marie Glomsrud, Sandra Munkhaugen. (Photo: Thor Ivar Helgesen)

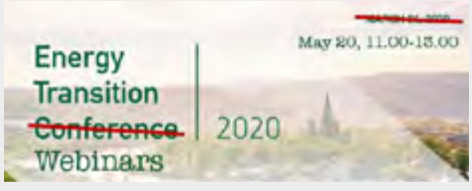
The year 2020 has been difficult for each one of us. Despite the challenges we have faced, UngEnergi hired five motivated students last summer. Covid-19 has limited our options to revising and improving our website, and we spent most of the summer months updating content.

In collaboration with NTRANS, we also developed a board game. The purpose was to educate younger students on sales and purchases of renewable electricity. We contributed by illustrating the game board and also inventing the basic rules for the game.

Furthermore, throughout the fall, we started a new project. We wanted to expand our social presence to reach out even better to our target audience. Therefore, we decided to open an Instagram account for UngEnergi. On Instagram, we publish relevant posts about the content we share on our website. Posts have for example been about renewable energy and sustainable buildings, consequences of petroleum extraction, biofuel and environmental measures.

We have been flexible, and are also well underway with 2021 tasks. We have been in contact with ZEB Flexible Lab and plan to document our visit. In the future, we will be continuing to create instructive and entertaining content for both the website and Instagram, in addition to updating existing content.

ENERGY TRANSITION WEEK



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

2020 had to be different, with three workshops and five webinars that gathered international researchers, industry- and business leaders and actors from the public sector to discuss topics like: The world in crisis, Is there a future for fossil energy?, Game changers in the energy transition, Visions of the future and Radical and social technological innovation.

The webinars and talks can be seen on NTNU Energy Transition Initiative's **Youtube channel**.

«HOW CAN MUNICIPALITIES TAKE SUCCESSFUL CLIMATE ACTION?»

FME NTRANS organised a «research sprint» that lasted for six months. The topic was how municipalities can take successful climate action within sectors outside of the EU emission trading system (ETS).

You can read what a research sprint is in the fact box. The process involved a start-up meeting with research and user partners, sketches from the research partners, meetings with user partners, final research contributions from the research partners, a discussions meeting, and the final publication of the Policy Brief «How can municipalities take successful climate action?» (In Norwegian). The Policy Brief was written by the researchers Pernille Seljom (IFE) and Marius Korsnes (NTNU-KULT). It is based on six research contributions, and shows a variety of aspects connected to «Klimakur 2030» that are relevant to municipalities and county councils.

The research contributions address topics connected to transportation, electrification, food and food waste, energy efficiency in buildings, the role of bio energy, and macro-economic side effects of the Klimakur-measures. Each contribution was based on the previous experience, research and interests of the research partners in question.

The work with the research sprint on Klimakur 2030 has achieved several things. First and foremost, the research partners and user partners have gotten to know each other more: The research partners have gained a better understanding of what types of challenges municipalities, county councils and government agencies face with regards to policy implementation. And the user partners have gained a better understanding of what the research partners can contribute with, in this respect.

In addition, the Policy Brief has been published, and we hope that the work and findings described there can play into government and municipalities' work, for instance with the white paper on the climate, which was launched early January 2021, in addition to other work associated with climate plans and implementation already ongoing in Norwegian municipalities and county councils.

The main findings of the research sprint were that the government and other relevant actors need to facilitate better for change if climate plans are to be transformed into action. This implies making the transition more attractive to the population, the agricultural and industrial sectors, as well as to accommodate better for collaboration across sectors and disciplines.

WHAT IS A RESEARCH SPRINT?

A research sprint is a new concept in FME NTRANS, and is a "concentrated", interdisciplinary collaboration format between researchers and user partners, with a duration of about 6 months. The point of departure in this case was to understand better how municipalities and county councils can move from climate plans to climate action.

THESE PARTNERS TOOK PART:

During the whole research sprint, research partners from NTNU, IFE, UiO and SINTEF have collaborated with the Trondheim County Council, Vestland County Council, the cities of Oslo, Bergen and Trondheim, and the Norwegian Environment Agency (Miljødirektoratet), in order to develop recommendations based on the research competencies that exist within FME NTRANS.

See the policy brief here:
https://www.ntnu.no/ntrans/policy-brief-anbefaling

SECTORAL COUPLINGS AND SUSTAINABILITY TRANSITIONS

FME NTRANS has established a working paper series to allow for faster dissemination of research results. See NTRANS working paper 01/2020, **The sectoral interdependencies of low-carbon innovations in sustainability transitions**.

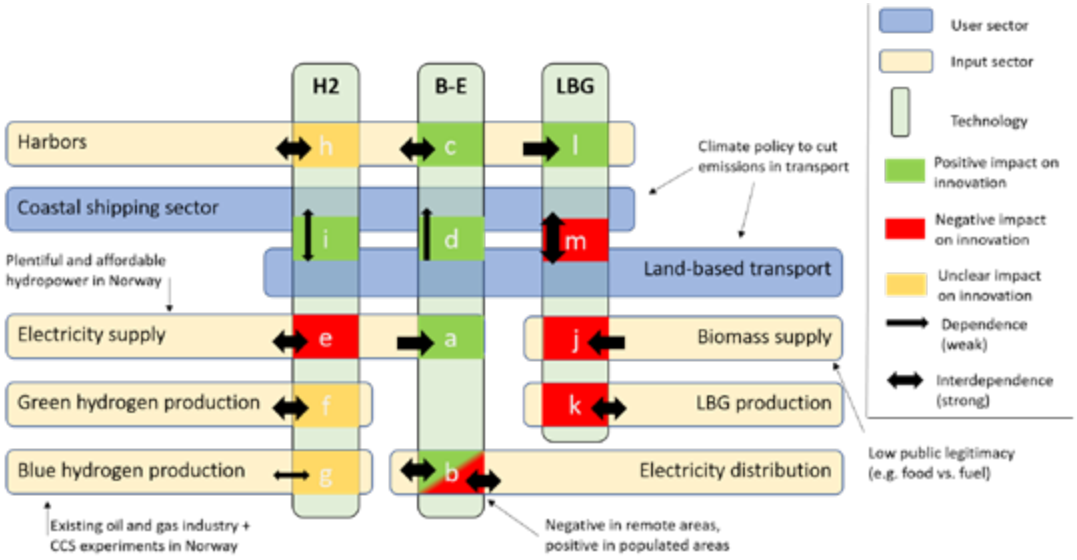
Within socio-technical research on sustainability transitions, focus until now has to large extent been on innovation processes for single sectors and technologies. When green solutions mature and are taken into more widespread use, it becomes increasingly important that entire value chains are developed, for instance to deliver the required low-emission energy (e.g. biofuels, hydrogen, electricity). This means that research needs to pay more attention to couplings and (inter)dependencies between sectors that produce, distribute and use new energy solutions.

In the research project GREENFLEET we have studied couplings between sectors in the value chains for hydrogen, liquefied biogas and battery-electric technologies used in Norwegian coastal shipping. Through analysis of interviews and secondary material (reports, media etc.) we find that sectoral configurations and couplings in the value chains of low- and zero-carbon fuels can influence acceleration of transition processes in different ways (see figure). Our results suggest that actors in the maritime industry perceive the value chain for electrification of coastal shipping to be the most promising for rapid diffusion. This is due to relatively cheap and available electricity from renewable energy sources and a well-developed grid, notwithstanding certain local challenges related for instance to high-voltage charging.

Hydrogen value chains appear more uncertain and challenged by chicken-or-egg issues: due to (current) limited demand for hydrogen in coastal shipping as well as in other sectors, production is limited. This results in a negative feedback whereby shipowners are reluctant to take on the risk of investing in hydrogen solutions. Liquefied biogas (LBG) is challenged by limited opportunities for production upscaling, in part due to limited availability of biomass. This has resulted in LBG not being seen as an alternative fuel that will play any important role in the sustainable transformation of coastal shipping domestically.

The study concludes that a better understanding of the value chains for production and distribution of various low- and zero-carbon fuels, and the potential barriers there may be for accelerated innovation, is not only important, but also need to be considered already in the early phase of innovation. Availability and scaling potential of energy solutions are a key aspect of actors' investment decisions. Perceived challenges in future value chains, for instance for hydrogen, thus need to be addressed by policy already when new technologies and solutions are in their early, formative development phases.

Authors:
Tuukka Mäkitie, SINTEF Digital, Dept. of Technology Management [1,2],
Jens Hanson, University of Oslo, TIK Center for Technology
Markus Steen, SINTEF Digital, Dept. of Technology Management [1],
Teis Hansen, Lund University, Dept. of Human Geography [1,3],
Allan Dahl Andersen, University of Oslo, TIK Center for Technology



Sectoral interdependencies of low-carbon technologies in the acceleration phase of innovation in coastal shipping (H2=hydrogen, LBG=liquified biogas, B-E=battery-electric).

OFFSHORE WIND – AN INDUSTRIAL OPPORTUNITY

Offshore wind is growing as a global industry, and is important in the future sustainable energy systems. **This report** (in Norwegian) summarizes both previous research and new studies showing that Norway has a much greater offshore wind potential if we work with the North Sea countries.

The North Sea is central to European offshore wind. The European Commission has adopted a goal to expand up to 450 gigawatts (GW) of offshore wind by 2050. Previous CenSES studies showed that Norway can have over 40 GW of wind power by 2050. Much of this can be built offshore. New model studies show a much greater potential, if North Sea countries collaborate on a North Sea region for offshore wind:

- In the baseline scenario, a significant offshore wind capacity is invested in the North Sea region with approx. 42 GW installed capacity and 217 TWh production in 2050. This joint investment in the North Sea region is preferred by the model over national investments in Norway, Germany, Denmark, Great Britain, Belgium and the Netherlands.

- In the scenario with a further 30% cost reduction compared to baseline, installed capacity is increased to 143 GW in the North Sea region, which results in an expected production of 718 TWh.

- A joint investment in infrastructure in the North Sea with branching to the surrounding countries gives greater flexibility. This means that the electricity can be sold where the price is highest and provide increased profits. Norway's current advantage in offshore wind is knowledge-based. To preserve this advantage Norwegian industry must develop robust and cost-effective solutions for a market in strong growth, which requires good interaction between industry, education, research and innovation. Offshore wind offers technical and operational challenges where the Norwegian R&D environment has strong expertise and where Norwegian industry has the opportunity to achieve significant benefits:

- Pillar A: chassis, materials and marine operations
- Pillar B: grid connection, system integration and energy storage
- Pillar C: digitization, operation and maintenance and management system for offshore wind farms

A large-scale development over a 30-year period will require building industrial capacity from one early phase where the technology is immature until it becomes a large-scale, cost-effective resource in Europe's power supply. This will require coordinated action between business, politics, research and education, and increased cooperation on development in selected regions, and must also be politically facilitated. The gain for Norway can lie in both power exports and technology exports - and give both export earnings and new green jobs.

We recommend:

- That Norway joins the North Sea cooperation
- A study of regulation and legal aspects of large-scale development of the North Sea region, which also considers how the countries can share the cost, income and risk of such a development
- Coordinated research efforts between the cooperating countries in the North Sea region
- Coordinated demonstration of immature technologies to gradually build capacity and profitability
- Establish pilot and demonstration projects to develop a domestic market that can contribute to develop competence, experience and market knowledge
- That a programme is established for the development of a certain number of offshore wind farms in Norway
- That this is combined with an ambitious research and development programme
- Scaling of competence development and education in line with the ambitions

WORKING WITH SCENARIOS FOR THE FUTURE IN THE IPCC

"My work in the IPCC – the intergovernmental Panel on Climate Change – gives very useful experience on working with scenarios for the future."

Says Anders Hammer Strømman, who is lead author to Working group three of the sixth assessment report of the IPCC (due in 2021). Professor Strømman is part of the NTRANS management group, and is responsible for sustainability. He also teaches and does research at the Industrial Ecology programme at NTNU.

"In the IPCC we have been working on the scenarios in a very rigorous and synthesizing manner, and it's a very good example to follow. So, I'm bringing back this very useful experience on scenario work in large groups to NTRANS."

IPCC EXPERIENCE ALSO FROM 5TH ASSESSMENT REPORT

Strømman was also selected to work with the 5th assessment report in 2012-2014. The current period as a lead author of the 6th assessment report started in 2018.

"In April 2020 we had the first virtual meeting for all of IPCC lead authors. And my group has virtual weekly meetings, and we also collaborate a lot through digital platforms.

The 2020 main efforts have revolved a lot around responding to comments on the report draft. We have been working on the second order draft for the sixth assessment report.

CLIMATE MITIGATION IN THE TRANSPORT SECTOR

Another researcher from the Industrial Ecology group in Trondheim, Helene Muri, is also involved in IPCC, as a contributing author.

Strømman is lead author in the group focusing on climate challenges and mitigation in the transport sector. "The second order draft is out on review now, so there will be more revising to do. I really enjoy working in this international environment, and with such an important agenda as climate change. The system is working smoothly, we have a lot of interaction across the chapters and sectors."

Anders Hammer Strømman is lead author to Working group three of the sixth assessment report of the IPCC (due in 2021).

ABOUT IPCC – THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

- is the United Nations body for assessing the science related to climate change.
- was created to provide policymakers with regular scientific assessments on climate change, its implications and potential future risks, as well as to put forward adaptation and mitigation options.
- Through its assessments, the panel determines the state of knowledge on climate change.
- identifies where there is agreement in the scientific community on topics related to climate change, and where further research is needed.

ABOUT WORKING GROUP III – MITIGATION OF CLIMATE CHANGE

- focuses on climate change mitigation, assessing methods for reducing greenhouse gas emissions, and removing greenhouse gases from the atmosphere.
- is responsible for one of the three reports that comprise the IPCC 6th Assessment, due in 2021.
- will also contribute to the Synthesis Report that integrates the findings of the three Working Group reports.
- also managed earlier reports: the IPCC Special Report on Climate Change and Land (2019) and contributed to the scientific leadership of the IPCC Special Report on Global Warming of 1.5°C (2018).

PARTNERS

RESEARCH PARTNERS

Høgskulen på Vestlandet
IFE Institutt for energiteknikk
NHH
SNF
UiO
SINTEF
VESTLANDSFORSKING
NTNU

ENTERPRISE PARTNERS

equinor
Hydro
AtB
BECOUR
NLF
NODES
Ruter#
posten
BKK
volue
Statkraft
Energi Norge
Hele Norge på strøm
eSmart SYSTEMS
GASSCO
SAGA FJORDBASE AS
hub for ocean

PUBLIC PARTNERS

Innovasjon Norge
Miljø-direktoratet
TRONDHEIM KOMMUNE
Kinn kommune
BERGEN KOMMUNE
KYSTVERKET
GASSNOVA
Statens vegvesen
Oslo
Jernbane-direktoratet
STATSBYGG
ENOVA
Vestland fylkeskommune
Trøndelag fylkeskommune

INTERNATIONAL PARTNERS

Technische Universität Berlin
IIASA
UNIVERSITY OF GOTHENBURG
UNIVERSITY OF COPENHAGEN
UEA University of East Anglia
DIW BERLIN
MIT Massachusetts Institute of Technology
ETH zürich
UNIVERSITY OF CAMBRIDGE
UNIVERSITY OF OXFORD

NTRANS IN NUMBERS 2020

27 SCIENTIFIC PUBLICATIONS

41 CONFERENCE PRESENTATIONS

9 NATIONAL RESEARCH PARTNERS

33 USER PARTNERS (INCLUDING TWO OBSERVERS)

25 MASTER'S DEGREES

22 EVENTS – CONFERENCE, WEBINARS AND WORKSHOPS

STATEMENT OF ACCOUNT

FUNDING

Funding	Amount	Total
The research council		5 744
The host institution (NTNU)		4 473
Research partners		2 887
Høgskulen på Vestlandet	146	
Institutt for energiteknikk	285	
Norges handelshøyskole	1 581	
Samfunns- og næringslivsforskning		
SINTEF AS	238	
SINTEF Energiforskning	210	
Universitetet i Oslo	85	
Vestlandsforskning	343	
Enterprise partners		3 604
Equinor	532	
Hydro	641	
Gassco	500	
Statkraft	549	
BKK	255	
Energi Norge	200	
ATB	100	
Ruter	122	
eSmart systems	100	
Nodes	5	
Volue	201	
Becour AS	87	
NLF	121	
Posten Norge	41	
Saga Fjordbase	100	
Hub for Ocean	50	

Public partners		5 091
Enova	340	
Innovasjon Norge	16	
Miljødirektoratet	50	
Statens vegvesen	542	
Statsbygg	184	
Kystverket	124	
Gassnova	171	
Jernbanedirektoratet	375	
Bergen kommune	191	
Oslo kommune	515	
Trondheim kommune	58	
Kinn kommune	200	
Trøndelag fylkeskommune	150	
Vestland fylkeskommune (tidl Hordaland)	200	
Vestland fylkeskommune (tidl Sogn og Fj.)	50	
Overføring av finansiering fra 2019	1 926	
Funding transfered to next year		*-2 652*
Total		19 147

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)		6 825
Research partners		10 333
Høgskulen på Vestlandet	942	
Institutt for energiteknikk	1 720	
Norges handelshøyskole	2 176	
Samfunns- og næringslivsforskning	583	
SINTEF AS	1 984	
SINTEF Energiforskning	895	
Universitetet i Oslo	814	
Vestlandsforskning	1 218	
Enterprise partners		924
Equinor	132	
Hydro	241	
Gassco	-	
Statkraft	49	
BKK	55	
Energi Norge	50	
ATB	-	
Ruter	22	
eSmart systems	-	
Nodes	5	
Volue	101	
Becour AS	87	
NLF	121	
Posten Norge	11	
Saga Fjordbase	-	
Hub for Ocean	50	
Public partners		1 065
Enova	40	
Innovasjon Norge	16	
Miljødirektoratet	50	
Statens vegvesen	42	
Statsbygg	34	
Kystverket	124	
Gassnova	171	
Jernbanedirektoratet	75	
Bergen kommune	91	
Oslo kommune	365	
Trondheim kommune	58	
Total		19 147

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

PERSONNEL

KEY RESEARCHERS

Name	Institution	Main research area	Gender
Kristin Linnerud	HVL	RA2 Accelerating the energy transition, RA5: User cases and innovation	F
Bente Johnsen Rygg	HVL	RA5: User cases and innovation	F
Geoffrey Gilpin	HVL	RA5: User cases and innovation	M
Erling Holden	HVL	RA4 Transition pathways	M
Dhayalan Velauthapillai	HVL	RA2 Accelerating the energy transition	M
Mette Bjørndal	NHH/SNF	Electricity Market Design, Congestion Management, Flexibility and Demand Response	F
Marius Korsnes	NTNU HF	RA1 Deep decarbonization and wide societal changes	M
Tomas Moe Skjølsvold	NTNU HF	Deputy centre director	M
Anders Strømman	NTNU IV	Cross cutting area 3	M
Asgeir Tomasgard	NTNU OK	Centre director	M
Markus Steen	SINTEF AS	RA2 Accelerating the energy transition, RA5: User cases and innovation	M
Sigrid Damman	SINTEF AS	RA4 Transition pathways	F
Tuukka Mäkitie	SINTEF AS	RA2 Accelerating the energy transition, RA5: User cases and innovation	M
Sahar Babri	SINTEF AS	RA2 Accelerating the energy transition, RA5: User cases and innovation	F
Kristin Ystmark Bjerkan	SINTEF AS	RA2 Accelerating the energy transition, RA5: User cases and innovation	F
Astrid Bjørgen	SINTEF AS	RA5: User cases and innovation	F
Maria Diez Gutierrez	SINTEF AS	RA5: User cases and innovation	F
Gerardo Perez-Valdez	SINTEF AS	RA4 Transition pathways, RA5: Usercases and innovation	M
Kirsten Svenja Wiebe	SINTEF AS	RA2 Accelerating the energy transition, RA4 Transition pathways, RA5: User cases and innovation	F
Vibeke Stærkebye Nørstebø	SINTEF AS	RA4 Transition pathways, RA5: User cases and innovation	F
Frode Rømo	SINTEF AS	RA1 Deep decarbonization and wide societal changes, RA2 Accelerating the energy transition, RA5: User cases and innovation	M
Marte Fodstad	SINTEF EF	RA5: User cases and innovation	F
Ingeborg Graabak	SINTEF EF	RA3 The future energy market, RA4 Transition pathways, RA5: User cases and innovation	F
Stefan Jaehnert	SINTEF EF	RA3 The future energy market, RA5: User cases and innovation	M

Endre Bjørndal	NHH/SNF	Electricity Market Design, Congestion Management, Flexibility and Demand Response	M
Gunnar Eskeland	NHH/SNF	Environmental Economics, Electricity Prices, Transport	M
Ragnhild Freng Dale	VF	RA1 Deep decarbonization and wide societal changes	F
Hans Jakob Walnum	VF	RA1 Deep decarbonization and wide societal changes, RA2 Accelerating the energy transition	M
Stefan Gøssling	VF	RA2 Accelerating the energy transition	M
Morten Simonsen	VF	RA1 Deep decarbonization and wide societal changes, RA2 Accelerating the energy transition	M
Carlo Aall	VF	RA1 Deep decarbonization and wide societal changes, RA2 Accelerating the energy transition	M
Benjamin Sovacool	VF	RA1 Deep decarbonization and wide societal changes, RA2 Accelerating the energy transition	M
Eva Rosenberg	IFE	RA4 Transition pathways	F
Pernille Seljom	IFE	RA3 The future energy marked, RA4 Transition pathways, RA5: User cases and innovation; Cross-cutting activity	F
Kari Aa. Espegren	IFE	RA4 Transition pathways, RA5: Usercases and innovation	F
Janis Danebergs	IFE	RA4 Transition pathways, RA5: User cases and innovation	M
Fredrik Aarskog	IFE	RA5: User cases and innovation	M
Lisa Kvalbein	IFE	RA3 The future energy market	F
Allan Dahl Andersen	UIO	RA2 electrification, CCS	M

VISITING RESEARCHERS

Name	Affiliation	Nationality	Gender	Duration	Topic
Eva Schischke	Fraunhofer UMSICHT	German	F	17.8.2020-30.11.2020	Market operations for compressed air energy storage
Christina Leinauer	University of Augsburg / Fraunhofer FIT	German	F	06.01.2020-31.03.2020	Storage operation in electricity markets
Dr. Michael Ornetzeder	The institute of Technology Assessment of the Austrian Academy of Sciences, Vienna	Austria	M	02.03.2020-14.03.2020	Energy Transitions
Dr. Tineke van der Schoor	Research Centre for Built Environment – NoorderRuimte, Hanze University of Applied Sciences, Groningen	Netherlands	F	04.03.2020-14.03.2020	Living Environment in Transition, Energy Transition

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	20200501-20240430	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	USA	20201001-20230930	F	Power, inclusion and exclusion inthe Norwegian energy transition. Exploring tools for increased engagement and practice change across sectors
Jan Klenner	Germany	20201102-20231101	M	Climate Change Mitigation in the Aviation Sector
Ingrid Lønset Solemdal	Norway	20201001-20230930	F	Sustainable transport policies
Felipe Van de Sande Araujo	Brasil	20200901-20230831	M	Analysis of flexibility markets for electricity
Davood Qorbani	Iran	20200801-20230730	M	The transition to sustainable mobility from a systems perspective

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

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

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

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

MASTER DEGREES

Name	Gender	Topic
Olav Skogen, Andreas Flått	M/M	Modelling liquidity in the Nordic electricity market

Ina Renate Haufe, Amina Ettayebi, Sara Angell Bakke	F/F/F	Low-temperature district heating with seasonal storage and demand side management
Amanda Njøten, Stine Morberg Larsen	F/F	Resource allocation and pricing for residential flexibility services
Ine Ingebrigtsen Svendsen	F	Characterization of electrical flexibility of water boilers
Aksel Holbek Sørbye,Signy Weisz	M/F	Multi-sectoral decarbonization pathways for the Norwegian energy system
Alexandra Eide Hvidevold, Malin Karlsen	F/F	Økonomiske utsikter for utbygging av Utsira Nord. En analyse av den langsiktige marginalkostnaden (Levelized Cost of Energy, LCOE) og lønnsomheten til en flytende havvindpark frem mot 2030.
Eirik Aronsveen	M	Insentiver for investering i strømnett ved ulike kalibreringsgrunnlag. En studie av hvordan ulike kalibreringsgrunnlag påvirker insentivene til nettinvesteringer
Thea Nystad Prøsch , Torunn Ølnes	F/F	Rammevilkårskorrigering ved ulike modellspesifiseringer i DEA. En videre studie av hvordan ulike modellspesifiseringer i DEA påvirker kompensasjon for rammevilkår i reguleringen av norske nettselskap
Hanne Marit Henriksen	F	En endring i luften - mot en mer bærekraftig jobbreisekultur blant vitenskapelige ansatte. En kvalitativ studie av vitenskapelige ansattes bruk av fly på jobbreiser.
Lena Wistveen	F	Bildeling i kommunen: et avansert puslespill? En studie av politikk, kommunal praksis og mobilitetskultur knyttet til utviklingen av bildelingsordningen i Trondheim.
Vebjørn Corneliussen Storvik	M	Greener Trondheim: A 'Nudge' in the Right Direction? A Socio-Material Study of a Public Innovation
Saumya Pankaj Bhavsar	M	Clean Hydrogen Deployment in the Hydrogen Sector: Risks and Public Financial Support Instruments in British Columbia, Canada
Tobias Edmund Biller	M	CO_2 abatement costs of long-haul heavy-duty truck technologies in Germany in 2020 and 2030 : a techno-economic analysis based on state-of-the-art research
Marie Blekastad, Karianne Johnsen Landa	F/F	The power of wind – a portfolio approach : a theoretical study of wind power characteristics in Norway
Lise Herland, Rebecca Høyerholt Olsvold	F/F	Collaboration for sustainability : a qualitative study of the objectives, enablers and barriers for collaborations entered with regard to sustainability
Mari Wolff Nedberge, Ingri Marie Saure	F/F	Batteri i offshoreskip : en investeringsanalyse av batteriinstallasjon i offshoreskip
Hugo Poitout	M	LaFed, an Alternative Solution to Present Day Environmental and Energetic Challenges
Senni Raunio	F	Emissions reduction in the Nordics : detecting sectoral differences over the three Phases of EU ETS
Tongxin Wu	M	Energy Efficiency in the USA: Challenges and Progress of the Lime Energy Company
Ragnhild Katrine Moltubakk, Srija Nagendrarasa	F	Fra lineær til sirkulær plastemballasje : en casestudie av BAMAs overgang fra en lineær til sirkulær plastemballasje
Jonatan Seemann, Peder Villum Moen	M/M	Strategisk kommersialisering av thoriumbasert kjernebrensel – En kvalitativ case - studie av Thor Energy AS
Magnus Aleksander Wendelborg	M	Wholesale electricity market sequencing in capacity expansion
Martine Halvorsen Sønju	F	Local electricity markets and optimization strategies in Norway and the UK
Marthe Fogdtad Dynge	F	Impact of Local electricity Markets in a Low-Voltage Distribution Grid
Johannes Predel, Bobby Xiong	M/M	The potential of Power-to-Gas for Congestion Management

PROJECTS

Prosjekt	Status	Call/funder	NTRANS-partner	Koordinator
ENTRANCES – Energy Transitions from coal and carbon: Effects on societies	Oppstart 1.5.2020	H2020 SSH, aspects of the Clean-Energy Transition: LC-SC3-CC-1-2018-2019-2020	NTNU	University of A Coruña, Spania
ENCHANT - Energy Efficiency through behaviour Change Transition	Oppstart 1.10.2020	H2020 Socio-economic research: non-energy impacts and behavioural insights on energy efficiency interventions LC-SC3-EE-2020-1	NTNU	NTNU
SENDER – Sustainable consumer engagement and demand response	Oppstart 1.10.2020	H2020 Consumer engagement and demand response, LC-SC3-EC-3-2020	NTNU	Smart innovation Norway
CLEANcultures - An approach for innovative Climate Learning, Evaluation and Action in Neighbourhoods	Oppstart 1.12.2020	JPI Climate, Solstice call	NTNU	Johanneum Research
Climate Change Resilience in Small Communities in the Nordic Countries project (CliCNord)	Oppstart 2021	Nordforsk, Nordic societal security in light of the emerging global and regional trends	NTNU	University college Copenhagen, Danmark
CONCISE: Co-Constructivist perspectives on citizenship for sustainable energy	Søkt, sept. 2020	H2020: SSH, aspects of the Clean-Energy Transition: LC-SC3-CC-1-2018-2019-2020	NTNU	NTNU
CAMPAIGNers - Citizens Acting on Mitigation Pathways	Søkt, sept. 2020	H2020-LC-CLA-10-2020	NTNU	Energy Institute – JKU, Østerrike
Response: Research to support policies and new lifestyles	Søkt, sept. 2020	H2020-LC-CLA-10-2020	NTNU	ENEA, Italia
CINERGY - Citizenship initiatives for a new energy system	Søkt, sept. 2020	H2020-LC-SC3-2018-2019-2020	NTNU	FCIENCIAS.ID, Portugal
CIT4COM – Enabling CITizens to enhance the role of prosumers	Søkt sept. 2020	LC-SC3-EC-1-2018- 2019-2020		ENEA, Italia
European Universities of Technology Alliance Research and Innovation Action	Søkt, nov. 2020	H2020-IBA-SwafS-Support-2-2020	NTNU	NTNU
EC-Nexus (Energy and Climate Modelling Nexus)	Søkt, sep. 2020	H2020-LC-SC3-2018-2019-2020	NTNU	NTNU
DECODE-BB	Søkt, sep. 2020	H2020-LC-SC3-RES-36-2020	NTNU	UNIBO, Italia

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