SINTEF

SINTEF Energy Research

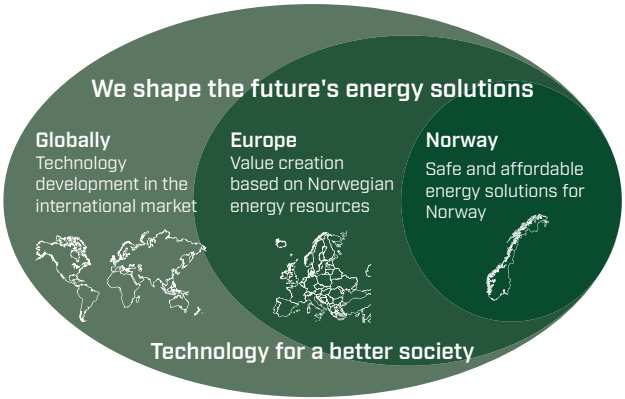
Annual Report 2020

We shape the future's energy solutions

Who we are and what we do

SINTEF Energy Research is an applied research institute dedicated to creating innovative energy solutions. We offer cutting-edge research-based knowledge and infrastructure both in Norway and globally with the aim of providing our clients with added-value solutions and services. SINTEF Energy Research is part of the SINTEF Group, which is one of Europe's largest independent contract research centres.

With the aim of supporting the UN's Sustainable Development Goals, SINTEF Energy Research carries out world-leading research in fields such as offshore wind, solar energy, bioenergy, batteries, smart grids, electrical power components, hydropower market modelling, energy efficiency, zero-emissions transport, hydrogen, CCS, and low-emission oil and gas production. We work closely with industry to boost Norwegian competitiveness in global markets. We offer world-leading laboratories and test facilities, supported by state-of-the-art digital software and systems. We occupy a strong position in the EU's Framework Programme and are involved in six of the Research Council of Norway's Centres for Environmentally-Friendly Energy Research (FMEs). We also act as coordinator for LowEmission, a recently established centre promoting research into low-emission oil and gas production on the Norwegian shelf.




SINTEF

The unusual year 2020

2020 was the year when people all over the world worried about their health and finances, as well as the future of their family and friends. It was also the year when we proved that we can face the future and make it even better.

In many ways, the world became smaller in 2020, as we were all attacked by a common enemy: the Covid-19 virus. The world united to fight this virus – and what's even more special is that we united around the *science*, as we recognised that it held the key to our emergence from the pandemic. More than ever, I believe that people understand that we need knowledge and research if we are to solve the big global issues.

After the pandemic has passed, we will still have another massive challenge to face, namely climate change. The vaccine will hopefully stop the coronavirus – but which vaccine will stop climate change?

At SINTEF Energy Research, we are working to find environmentally-friendly energy solutions, which constitute the most effective vaccine for reducing global greenhouse gas emissions.

We do this together with our most important partner, NTNU, and in close collaboration with industry and other partners. Our vaccine will be crucial for Norway's success in transitioning to more sustainable energy solutions.

In connection with one of the Norwegian government's crisis packages, all research institutes received an extraordinary grant, which enabled us to increase our efforts to produce new concepts.

In 2020, SINTEF Energy Research developed and investigated new concepts within a variety of areas, including:

- More sustainable data centres
- New e-infrastructures that will help achieving carbon neutrality
- Sensors in cables that will increase the security of supply and reduce societal costs
- Monitoring high-voltage submarine power cables
- Drones for mapping watercourses
- Using 3D printing to manufacture more efficient heat exchangers
- Producing Digital Twins (DT) of offshore windfarms
- Advanced simulation of hydropower turbines
- Battery cooling and heating based on phase changing materials (PCM)

This is sustainable technology that we believe has a lot of potential for Norwegian business. Therefore, despite all the difficulties surrounding us, I am optimistic about the future. Undeterred by everything that happened, our employees and partners managed to maintain normal operations and contributed to SINTEF Energy Research receiving many new and important projects both in Norway and abroad.

We even managed to conduct our Summer Scientist Project as “usual”. That is to say, we had around 30 students work with us from their home offices, dining rooms,

hammocks, sofas, and university reading rooms.

In many ways, this unusual year set a new course for the future of research and for us at SINTEF Energy Research. 2020 was the year for finding new possibilities in a difficult situation. The world will not be exactly as it was before the pandemic, and we will understand more about what this new normal looks like as we continue in 2021.

2020 showed us that we are a powerful organisation, and that together with NTNU and our other partners in the industry, we can adapt to any challenge that may arise. Together, I am confident that we are facing a positive future.

Inge R. Gran
CEO SINTEF Energy Research AS
April 2021

Our 10 areas of focus

Smart Grids

Transmission

Offshore energy system

Offshore wind

Hydrogen

Energy efficiency in industry

CCS

Hydropower

Bioenergy

Zero-emission transport

SINTEF Energy Research and the UN's Sustainable Development Goals

SINTEF's vision of "technology for a better society" and the objectives of SINTEF Energy Research are focused on shaping the sustainable energy solutions of the future. Sustainability is at the heart of all our research activities.

The UN's Sustainable Development Goals represent a global joint strategy to eradicate poverty, combat inequality and stop climate change by the year 2030. The UN has defined 17 sustainable development goals, and SINTEF Energy Research is contributing towards many of these. SINTEF Energy Research focuses on these UN sustainable development goals:

Affordable and clean energy

To ensure access to affordable, reliable, sustainable and modern energy for all

It is crucial that our research into various energy solutions contributes towards achieving a low carbon footprint and high levels of supply security, but it is also important that the solutions are both efficient and economically viable. The vast majority of our research projects contribute towards achieving this goal.

Climate action

To take urgent action to combat climate change and its impacts by regulating emissions and promoting developments in renewable energy

It is important to limit the global average rise in temperature to 1.5°C above pre-industrial levels if the planet is to avoid the worst impacts of climate change. Our work with innovative and sustainable solutions to replace less eco-friendly systems, and with emissions-reducing solutions, is making a direct contribution to the achievement of this goal.

Industry, innovation and infrastructure

To build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation

A well-functioning energy supply infrastructure, both onshore and offshore, is key to the maintenance of a robust society. Many of the projects carried out by SINTEF Energy Research contribute towards the development of a resilient energy infrastructure and a more innovative industrial sector. Many of our projects that promote industrial energy efficiency make an active contribution towards more sustainable industrialisation processes.

Sustainable cities and communities

To make cities and human settlements inclusive, safe, resilient, and sustainable

SINTEF Energy Research is working to promote smart cities and low-emission transport solutions that will contribute to more sustainable cities with more resilient infrastructures.

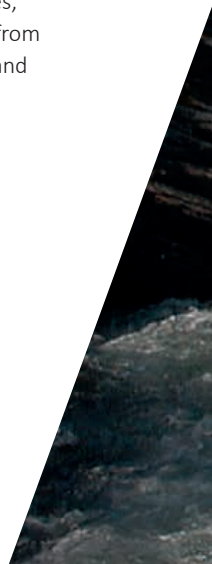
Life on land

To protect, restore and promote the sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

SINTEF Energy Research is working to develop energy solutions that safeguard the natural world. We have accumulated extensive experience in this field in connection with our hydropower projects.

#1 FIThydro:
Environmental design of hydropower systems

Environmental design is a method that considers both the natural environment and society in the development of new energy projects. Through the EU project FIThydro, scientists are developing new solutions to improve the conditions for fish in rivers affected by hydropower plants (HPP) without negatively impacting the power production levels. As part of this project, SINTEF Energy's scientists have launched a wiki that lists measures, methods and tools related to fish-friendly hydropower. This wiki is mainly targeted at hydropower producers that are looking to achieve a more environmentally-friendly energy production through adopting new measures and management strategies, and receiving guidance and support from consultants, various interest groups and scientists.



#2 New gasses for GIS:
Alternatives to the world's most potent greenhouse gas

Gas-insulated switchgear (GIS) are essential components of the power system. GIS are used at energy hubs, such as electrical substations, and contain switches that control the power in the grid.

SF_6 is used in GIS as it has excellent electrical insulation properties. Unfortunately, SF_6 is also the most potent greenhouse gas that we know about, being more than 23,000 times worse per kilogram for the environment than CO_2. Therefore, finding a suitable alternative to SF_6 would significantly reduce the environmental footprint of switchgear in both Norway and the rest of the world.

The main goal of the project "New gasses for GIS" is to contribute to a more sustainable and robust power grid in the future by investigating long-term alternatives for SF_6 in distribution and transmission systems.

#3 OPWIND:
Affordable energy from offshore wind

The OPWIND project develops the knowledge and tools required for optimised operation and control of offshore wind farms, with the goal of making wind power cheaper, and therefore more profitable, by increasing efficiency.

OPWIND's basic premise is that managing the entire wind farm as a one system will yield better results than overseeing each individual turbine, as it enables the operator to take into account how wind conditions and all the turbines in the farm mutually impact each other. This result can be quantified through measurements and calculations. The challenge is being able to do this quickly and precisely enough to secure optimal operation and control of the farm. If we succeed with this project, our research will be used to achieve a higher energy yield from offshore wind farms at a cheaper price, without increasing the farms' environmental footprint or use of materials.

#4 HighEFF:
CO_2 as a refrigerant

According to the "Drawdown project", changing the refrigerant in air conditioning units, heat pumps and cold storage plants around the world is the single, most important climate action. These refrigeration systems use hydrofluoro-carbons (HFCs), which are greenhouse gases that are used on a large scale globally. Phasing out the use of these HFC refrigerants will contribute to avoiding a 0.5-degree temperature increase.

Together with NTNU, SINTEF is investigating the use of CO_2 as a natural refrigerant (in this context, CO_2 is not a greenhouse gas). This work has been ongoing since the 1980s, and our world-leading research communities have developed technology that has been adopted in the majority of Norwegian supermarkets as well as European supermarkets and 6 million Japanese heat pumps. Currently, we are participating in projects that will introduce this technology to India. A lot of this research is conducted as part of the FME HighEFF project.

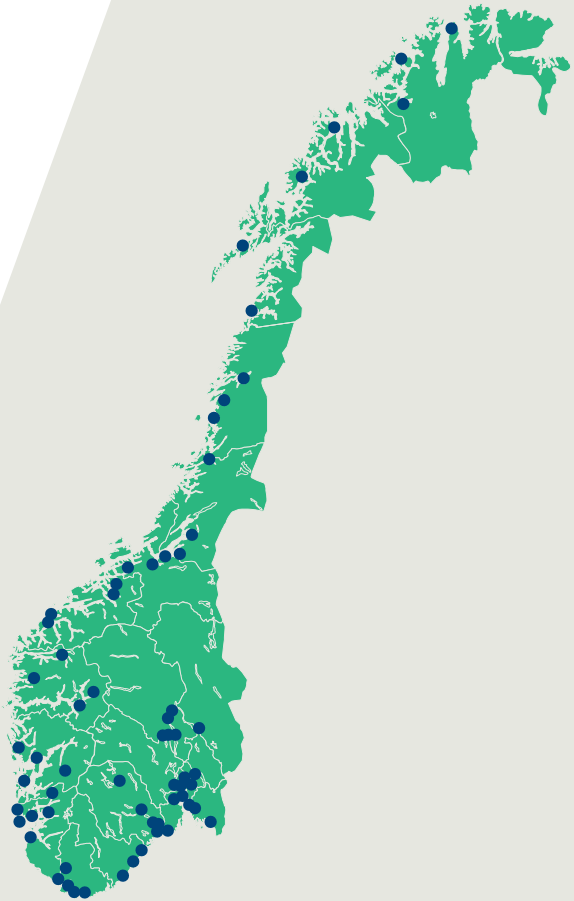
#5 NCCS:
Carbon Capture & Storage

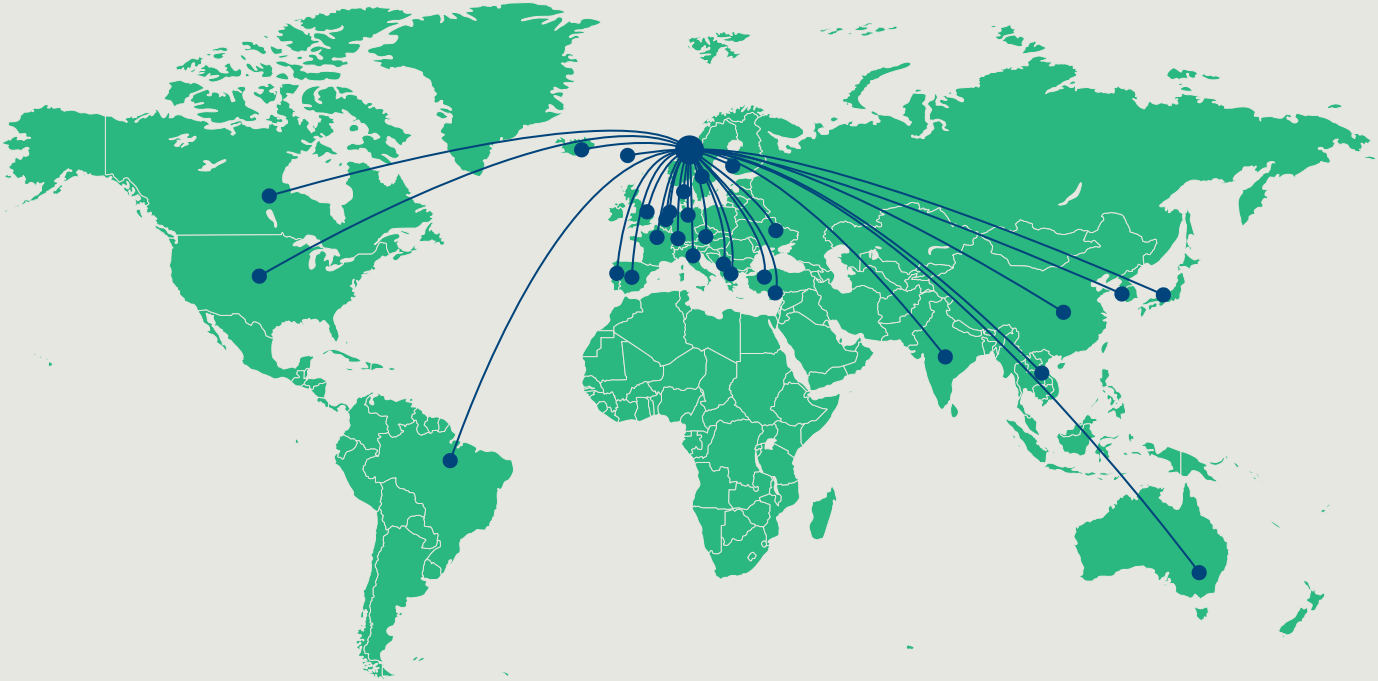
If we are to limit the increase of the average global temperature to 1.5°C, we need to do more than just reduce our CO_2 emissions; in the future, we must also remove them. Carbon capture and storage (CCS) is a technology that captures, transports and stores CO_2 safely underground – in other words, the CO_2 is sent back to where it came from. CCS technology has lots of applications. For example, it is the only technology that can enable industries such as the steel industry, fertiliser production and cement factories to achieve net-zero carbon emissions. In addition, CCS can produce so-called negative emissions if used to capture CO_2 from, for example, biological waste, and can remove CO_2 emissions from natural gasses, which creates pure hydrogen. Together with NTNU, SINTEF has established first-rate research communities that have worked with CCS technology since the 1980s. A lot of this research is conducted and coordinated as part of the FME NCCS project.

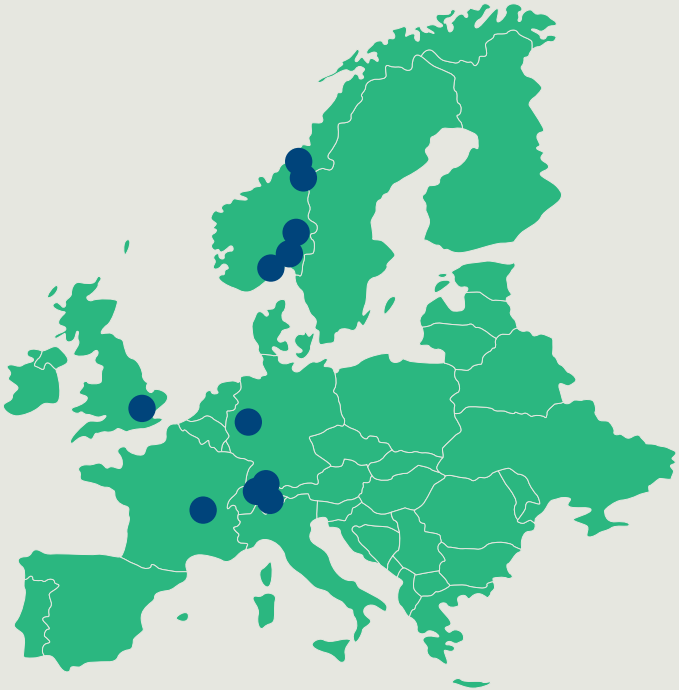
Previous internship student Ranisha S. Sitlapersad from University of Twente is adjusting one of the samplers of the CO_2Mix phase equilibrium setup. »


3M

SINTEF Energy Research has clients and projects all over Norway and across the world







An example of a national and international project lead by SINTEF Energy: New gasses for GIS (see page 12)

Partners:

- NTNU (Trondheim)
- ETH (Zürich, Switzerland)
- ABB (Skien)
- GE Power (Lyon)
- Hyundai Electric Switzerland (Zürich, Switzerland)
- ABB Power Grids Switzerland Ltd. (Zürich, Switzerland)
- Statnett (Norway)
- Elvia (Innlandet, Viken, Oslo)
- Tensio (Trøndelag)
- National Grid (London, UK)
- 3M (Düsseldorf)

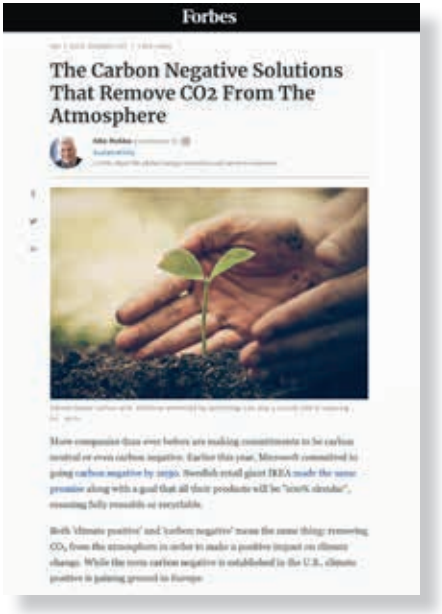
SINTEF Energy Research is very active in global research – especially in Europe

In order to contribute towards meeting the UN's Sustainable Development Goals, as well as the needs of the industrial markets, it is important that our research activities attain the highest global standards and that they contribute towards building alliances with overseas partners. The close collaborative relationship that SINTEF Energy Research enjoys with its industrial clients provides us with a sound basis for the exploitation of global market opportunities, especially those offered by EU research programmes. This is why SINTEF Energy Research has had an office in Brussels since 2015.

17% of the institute's sales are generated from foreign organisations, most notably from the EU and USA.

SINTEF Energy Research is closely involved in global collaborative research as part of organisations such as the European Energy Research Alliance (EERA) and a number of the EU's technology platforms. We are also involved in CIGRÉ (the International Council on Large Electrical Power Systems). In May 2017, Nils A. Røkke, who is Executive Vice-President for Sustainability at SINTEF, was appointed to head the EERA, an organisation that represents more than 55,000 European energy research scientists.

Our Executive Vice-President for Sustainability, Nils Røkke, has his own column in Forbes, where he writes about energy and sustainability policies in Europe. www.forbes.com/sites/nilsrokke


Forbes

The Carbon Negative Solutions That Remove CO2 From The Atmosphere

SINTEF Energy Research hosts three Norwegian Centres for Environmentally-Friendly Energy Research (FMEs)

FME NorthWind

On 11 December 2020, it was revealed that SINTEF Energy Research will lead NorthWind, the new Centre for Environment-Friendly Research (FME) on wind power. The centre will be headed by Chief Scientist in SINTEF Energy Research, John Olav Tande. NorthWind will contribute to Norway's profitable export of wind energy, new green jobs, and wind power that respects both nature and people. Over 40 Norwegian businesses have joined this project, in addition to research partners including SINTEF, NTNU, NINA, NGI and UiO.

From the announcement: NTNU Rector Anne Borg, Norwegian Minister of Petroleum and Energy Tina Bru on the screen, and SINTEF President and CEO Alexandra Bech Gjørv.

FME NCCS

The main objective of NCCS is to apply industry- and research-driven innovation to bring about the rapid implementation of carbon capture, transport and storage (CCS) technologies. NCCS also aims to ensure that Norway remains a global leader in the field of CCS and will contribute towards achieving the large-scale storage of CO_2 in North Sea reservoirs.

Read more about the centre and its achievements in 2020. www.nccs.no

FME HighEFF

HighEFF develops knowledge and technology that will promote more energy-efficient, competitive and environmentally-friendly industrial processes at equipment, factory and regional scales.

Read more about the centre and its achievements in 2020. www.higheff.no

FME CINELDI

Research carried out at CINELDI into future smart energy systems facilitates the feeding of greater volumes of renewable energy into the electricity supply grid, the electrification of transport, and the more efficient use of energy both in private households and by industry.

Read more about the centre and its achievements in 2020. www.cineldi.no

LowEmission
LowEmission will develop new technologies and concepts for offshore energy systems, energy efficiency and integration of renewable energy technologies for implementation on the Norwegian continental shelf.

Read more about the centre and its achievements in 2020 at:
www.lowemission.no

Chief Scientist Mario Ditaranto adjusts the optical instrumentation to capture the flame emission spectrum from hydrogen – ammonia – nitrogen mixture flames. SINTEF's high pressure combustion facility is used in the LowEmission Centre to investigate the characteristics of ammonia and hydrogen combustion in high-presssure environments like in gas turbines.

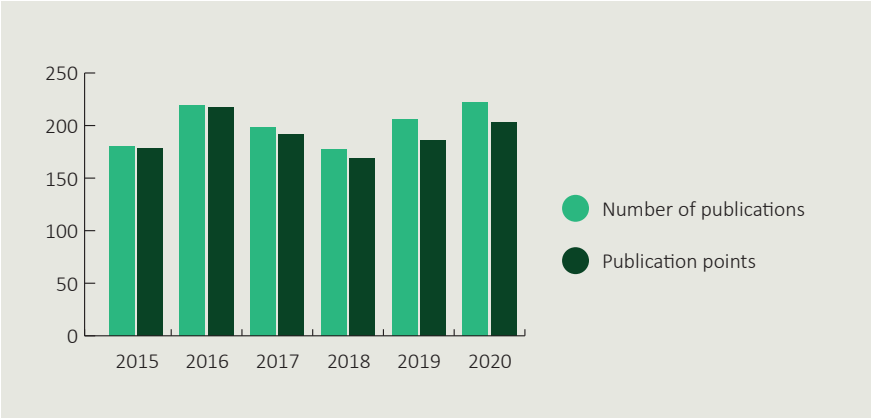
2020 was another excellent year for scientific publications produced by the institute

SINTEF Energy Research topped the publication list for technical-industrial institutions.

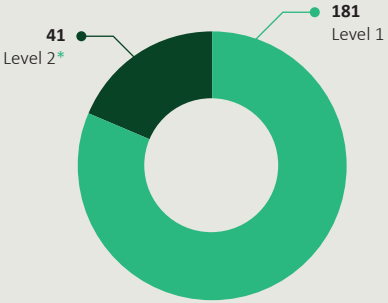
They were followed by NORSAR. You can view all the figures on Khrono's website (in Norwegian): Khrono.

"We partner with companies and other research institutions to apply cutting-edge knowledge in ways that are competitive and that address societal challenges," said Inge R. Gran CEO of SINTEF Energy Research. "Scientific publications are key to ensuring that our research maintains a high international standard. SINTEF Energy Research has the goal of at least one publication point per full-time equivalent researcher. This is something we consciously work towards, and I am satisfied that we have achieved this goal."

Publications and points

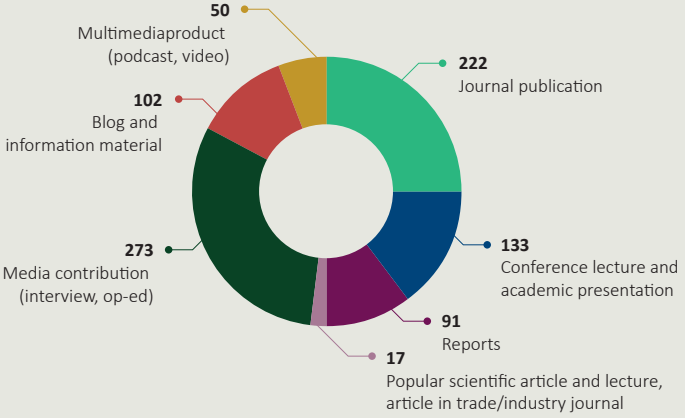


Publication level



* The Norwegian scientific index divides journals and publishers into “level 1” and “level 2”, where level 2 is reserved for the most prestigious international journals. No more than 20% are at level 2.

Publications (including dissemination)



A selection of scientific articles published in 2020

Dynamic modeling of municipal solid waste incineration. *Energy* 2020; Volum 209.
Magnanelli, Elisa; Tranås, Olaf Lehn; Carlsson, Per; Mosby, Jostein; Becidan, Michael.

Potential of Thermal Energy Storage for a District Heating System Utilizing Industrial Waste Heat. *Energies* 2020; Volum 13.
Kauko, Hanne; Rohde, Daniel; Knudsen, Brage Rugstad; Sund-Olsen, Terje.

In situ synthesis of epoxy nano-composites with hierarchical surface-modified SiO2 clusters. *Journal of Sol-Gel Science and Technology* 2020; Volum 95. s. 783-794
Adnan, Mohammed Mostafa; Tveten, Erlend Grytli; Miranti, Rany; Hvidsten, Sverre; Ese, Marit-Helen Glomm; Glaum, Julia; Einarsrud, Mari-Ann.

A Comprehensive Framework for Vulnerability Analysis of Extraordinary Events in Power Systems. *Reliability Engineering & System Safety* 2020; Volum 196.
Sperstad, Iver Bakken; Kjølle, Gerd Hovin; Gjerde, Oddbjørn.

Depressurization of CO_2 in a pipe: High-resolution pressure and temperature data and comparison with model predictions. *Energy* 2020; Volum 211.
Munkejord, Svend Tollak; Austegard, Anders; Deng, Han; Hammer, Morten; Stang, Hans Georg Jacob; Løvseth, Sigurd Weidemann.

2020

Board

- Alexandra Bech Gjørv (Chairman of the board), Senior Executive Vice President (Deputy CEO), SINTEF
- Geir Kulås, EVP Renewable Power in Skagerak Energi
- Eivind Heløe, Executive director, Power generation, Energy Norway
- Ragnhild A. Katteland, CEO Nexans Norway
- Liv Monica Stubholt, Partner, Law firm Selmer DA
- Ingrid Schjølberg, Dean and professor Faculty of Information Technology and Electrical Engineering, Norwegian University of Science and Technology (NTNU)
- Olav Bolland, Dean IV Faculty Administration Faculty of Engineering, Norwegian University of Science and Technology (NTNU)
- Svend Tollak Munkejord Chief Scientist, Employees representative
- Maren Istad, Research Scientist, Employees representative
- Gunnar Berg Research Scientist, Employees representative

Management

- Inge Røinaas Gran, President
- Per Normann Mikalsen, Vice President
- Petter Støa, Vice President, Research
- Anne Steenstrup-Duch, Communications Director
- Knut Samdal, Research Director
- Petter Egil Røkke, Research Director
- Mona Jacobsen Mølnvik, Research Director
- Dag Eirik Nordgård, Research Director

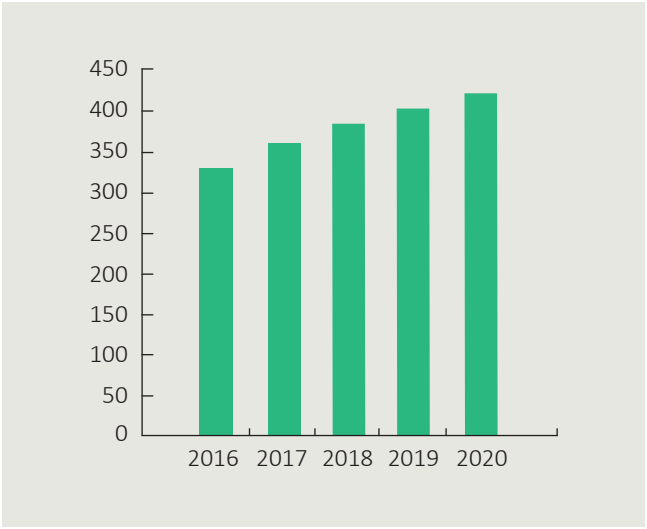
Key figures per 31.12.2020
Share capital NOK 7,5 mill. (€ 0.7 mill)
Equity NOK 451 mill. (€ 42 mill)

Ownership
SINTEF 61,0 %
Energy Norway 33,4 %
Federation of Norwegian Industries 5,6 %

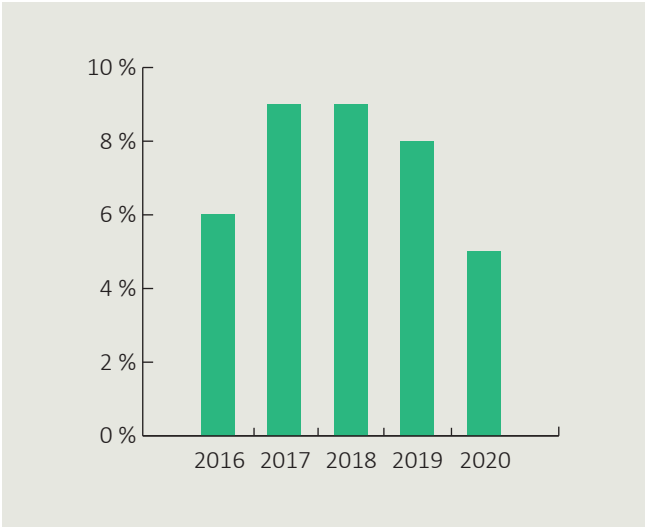
Read more on:
www.sintef.no/en/sintef-energy/about_us/

Key numbers 2020

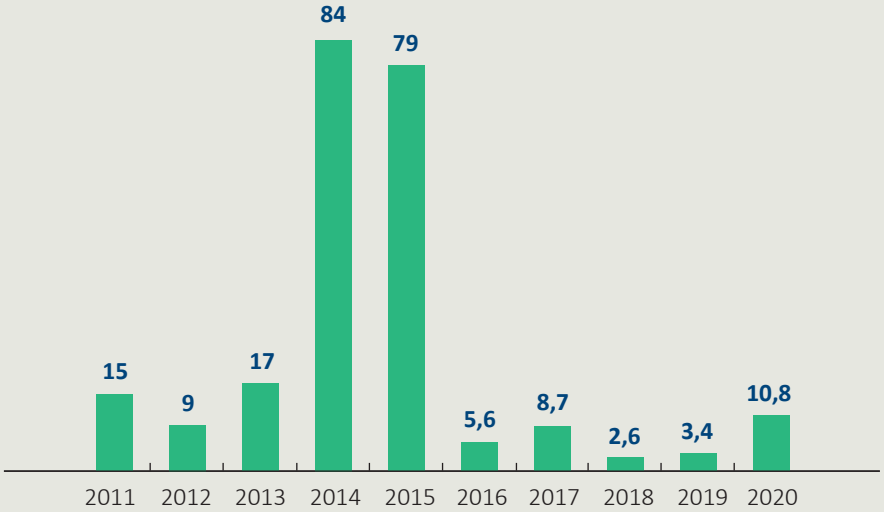
Net operating income (MNOK)



Net operating margin (%)

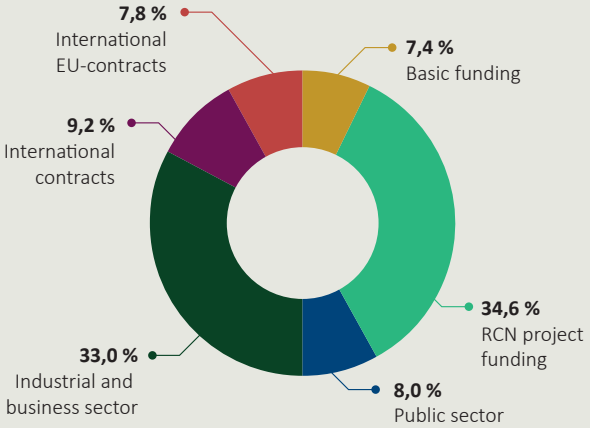


Profits are invested in new knowledge creation

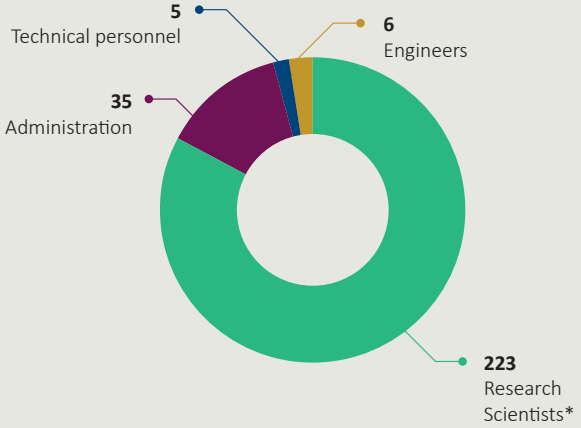


SINTEF Energy Research's profits are invested in laboratories, scientific equipment, facilities and the development of new knowledge. The accounts show an investment of NOK 234 million over the last ten years.

Sources of finance (% of gross operating income)



Employees



**146 Research Scientists with PhD*

Finances

MNOK	2016	2017	2018	2019	2020
Result					
Gross operating income	439	438	494	552	512
Net oprating income	331	362	385	403	419
Operating result	**18**	**33**	**35**	**32**	**21**
Annual result	**14**	**28**	**28**	**32**	**23**
Balance					
Fixed assets	237	221	210	202	200
Current assets	288	384	408	470	568
Sum assets	**524**	**605**	**618**	**672**	**768**
Equity capital	339	368	396	428	451
Liabilities	185	237	222	244	317
Sum equity and liabilities	**524**	**605**	**618**	**672**	**768**
Profitability					
Operating margin %	5,4 %	9,1 %	9,1 %	7,9 %	5,0 %
Total profitability %	4,6 %	7,0 %	6,5 %	6,4 %	3,8 %
Profitability of equity capital %	6,1 %	10,6 %	10,0 %	10,1 %	6,3 %
Liquidity					
Net cash flow from operational activities	33	98	14	57	97
Degree of liquidity	1,6	1,6	1,8	1,9	1,8
Solidity					
Equity capital %	64,7 %	60,8 %	64,1 %	63,7 %	58,7 %
Operating working capital	104	148	187	227	252

Highlights from 2020 – read more at www.sintef.no/energy_2020

January: The 17th annual EERA DeepWind conference took place ⌄⌄

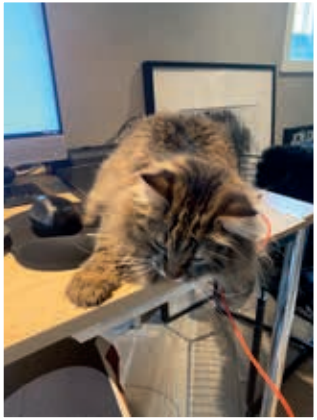
January: An ELEGANCY Project meeting was held at the EU Parliament ⌄⌄

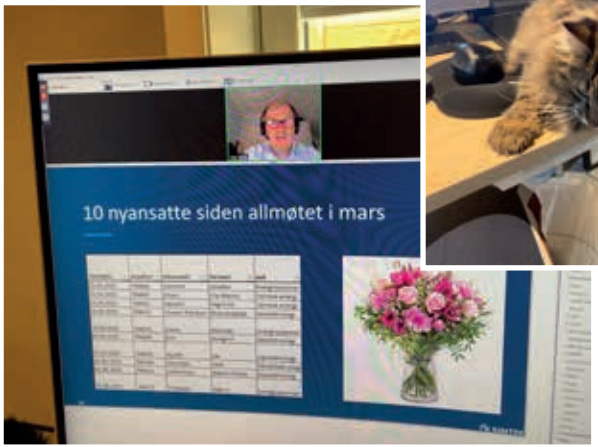
February: SINTEF launched an open, digital platform for sharing data on Carbon Capture and Storage (CCS) »

CO_2 DataShare launches open, digital data sharing portal – a push to advance innovation and deployment of CCS

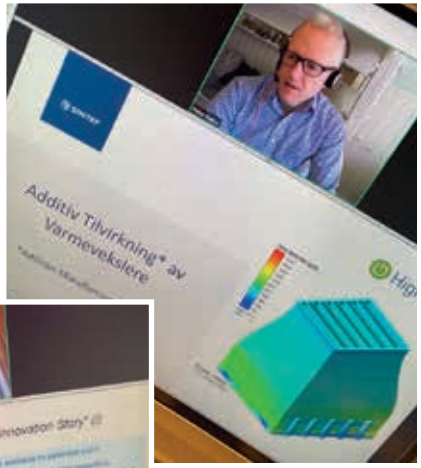
On February 4 2020, CO_2 DataShare launches a web-based digital portal for sharing reference datasets from pioneering CO_2 storage projects. The new portal will enable researchers and engineers to improve their understanding, reduce costs and minimize uncertainties associated with CO_2 storage.

March: A new type of workday began, as most SINTEF Energy Research staff work from home. Laboratories continue to operate as normal »





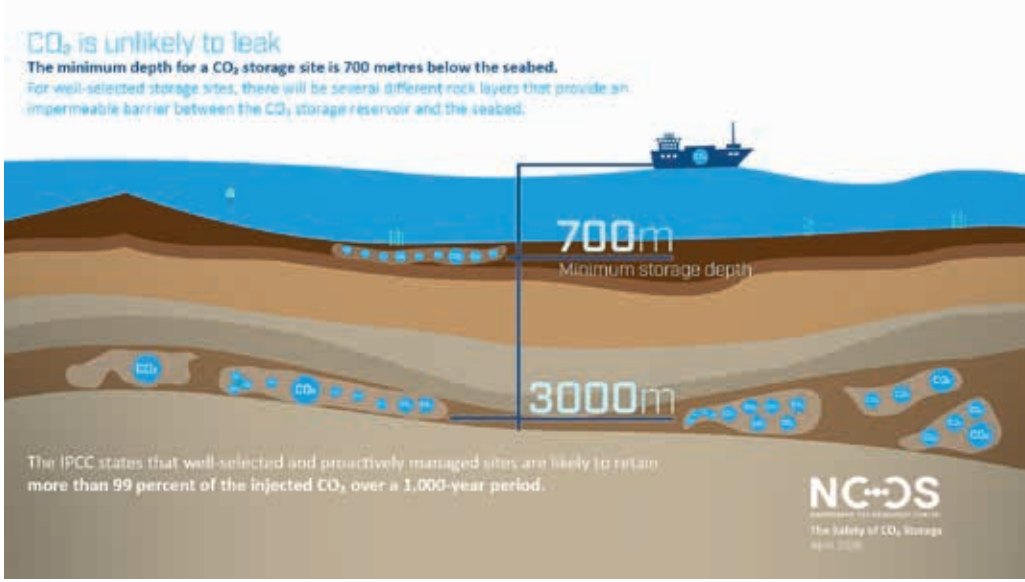
April: SINTEF and NTNU hosted a joint workshop on innovation in the Centres for Environment-friendly Energy Research (FME) »



« **May: SINTEF was present for the start-up of Sweden's largest CCS test facility**

On 26 May, Sweden's largest test facility for carbon capture and storage went into operation at Preem's oil refinery in Lysekil. The pilot project "Preem CCS" will analyse the entire CCS value chain by capturing CO_2 from the flue gasses emitted by Preem's hydrogen gas plant. The results of this project will be made public to enable others to reduce their CO_2 emissions using this technology. CCS is an important tool in reducing local greenhouse gas emissions and achieving Sweden's overall climate goals. The project is a collaboration between Preem, Aker Solutions, Chalmers University of Technology, Equinor and SINTEF Energy Research, and received funding from the Swedish Energy Agency and CLIMIT, the Norwegian research and development program.

May: Scientists from FME NCCS submitted a report showing that it is safe to store CO_2 »



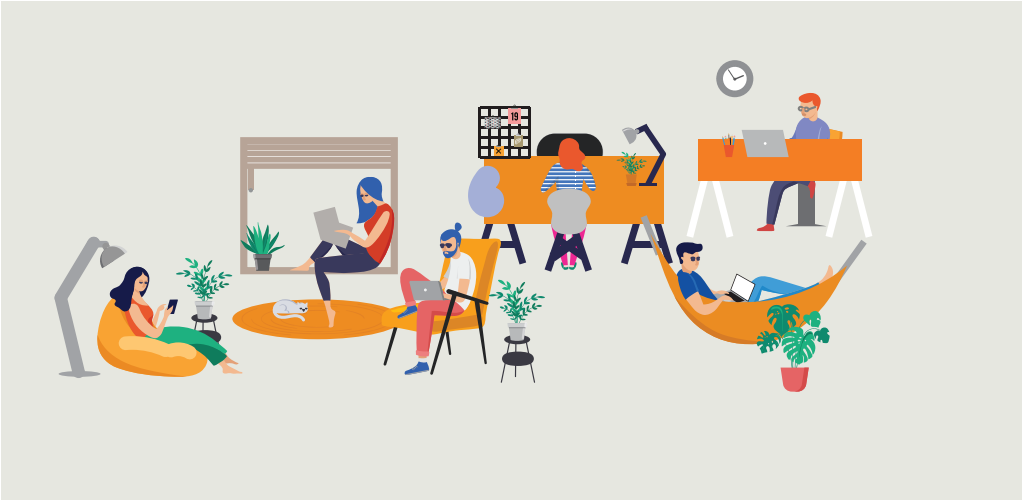
June: Gerd Kjølle received NTVA's Honorary Award

The Norwegian Academy of Technological Sciences' (NTVA) Honorary Award for 2019 was presented to Chief Scientist at SINTEF Energy Research Gerd Kjølle for her contributions to increasing reliability and security of supply in the electrical grid. "Gerd Kjølle has pushed the boundaries of international research within security of supply in the power grid. Her research has created significant value for Norwegian businesses and society in general," the Award Committee wrote in their report. NTVA's Honorary Award is presented annually to a person who has helped develop groundbreaking technology. »

June: Research from SINTEF and NTNU showed that the hospitality industry can reduce their electricity bills by 44% »

July: Summer scientists in the unusual year of 2020

"Would you like to be a scientist for a summer?" We ask students this question every year when we advertise the summer jobs at SINTEF Energy Research. Around 30 talented students come to us every summer to take part in the Summer Scientist Project, and then work with us on ongoing research projects.



However, when the time came last year to intensify our planning for the Summer Scientist Project, the tension was greater than usual. Everyone involved had just started working from home – and the students weren't on their campuses either. However, we still really wanted to have summer scientists in 2020.

The Summer Scientist Project has proven itself to be an extremely useful recruitment channel, as it enables us to make contact with skilled students. Today's students could be our future colleagues, partners, and customers, and it benefits us to give them a positive and stable impression of SINTEF, even in challenging times. However, we were nervous about how we could do this from behind a number of screens – we had been thrown into a new, digital workday that we had barely figured out ourselves, and now the summer scientists were suddenly on our doorstep!

The summer scientists each received their own “home office pack”, which contained a computer and any necessary equipment, and conducted their work from their dining rooms, hammocks, sofas, and university reading rooms – just as our permanent staff were doing. Some students also had projects in the laboratories, and we are very pleased that we were able to perform this work onsite in an efficient and safe manner.

In August, the Summer Scientist Project was concluded with the Summer Scientist Festival 2020, which took place online over three days. During this digital conference, all our summer scientists each gave a six-minute presentation on their project for their supervisors and SINTEF staff. It was a chance to really showcase the breadth of research that our summer scientists contribute to!

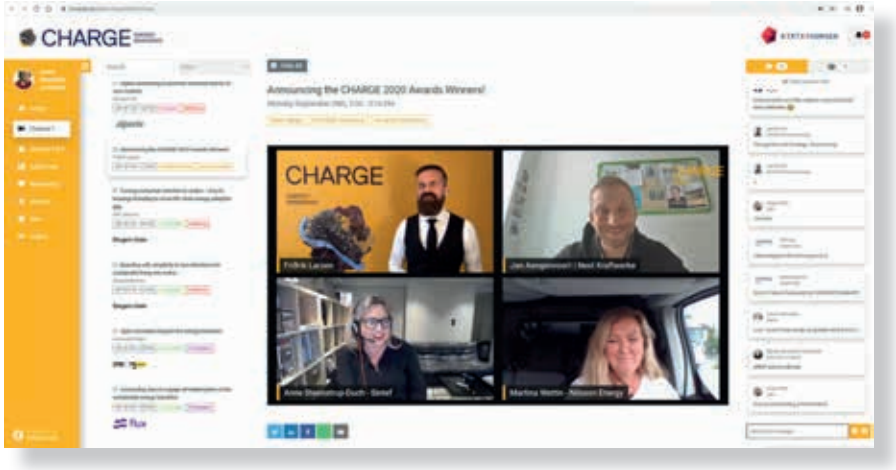
All in all, I am very satisfied with the Summer Scientist Project in 2020. One of our summer students said: “I cannot imagine that you could have done anything better, considering that everything suddenly had to be online”. Naturally, the students would have liked for there to have been more socialising as part of this summer job, and this traditionally has been a significant part of the project. However, we believe that we still got to show the students that SINTEF is an exciting and safe place to work!

Ellen Krohn Aasgård,
Project Manager for the Summer Scientist Project in SINTEF Energy Research »

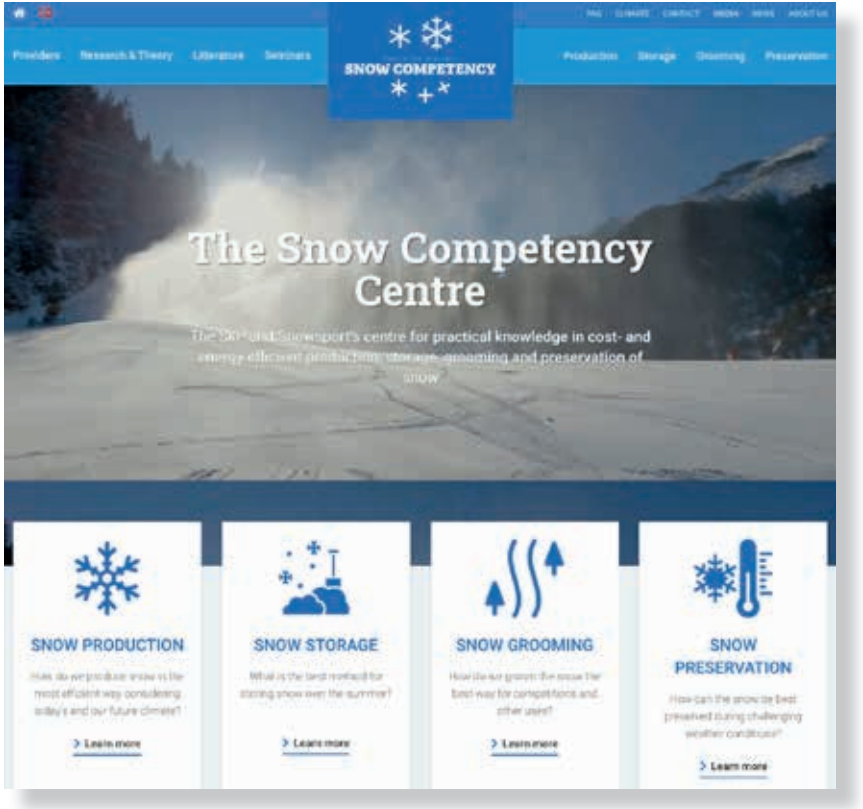
September: SINTEF won international branding award: CHARGE Energy Award World's Best Organisation Brand »

October: SINTEF Energy Research started rebuilding the high voltage facilities at Gløshaugen

Since its opening in 2015, the majority of high voltage tests have been conducted at SINTEF Energy Lab. This has reduced the need for the high voltage facilities at Gløshaugen, which has in turn reduced the need for the ceiling height. We will therefore establish new facilities at this site, with space for concrete- and plastic-testing labs that will develop and produce samples of electrical insulation material. There will also be multiple smaller laboratory rooms for further testing and developing these materials as well as smaller electrical components by, for example, studying basic failure and ageing mechanisms. »

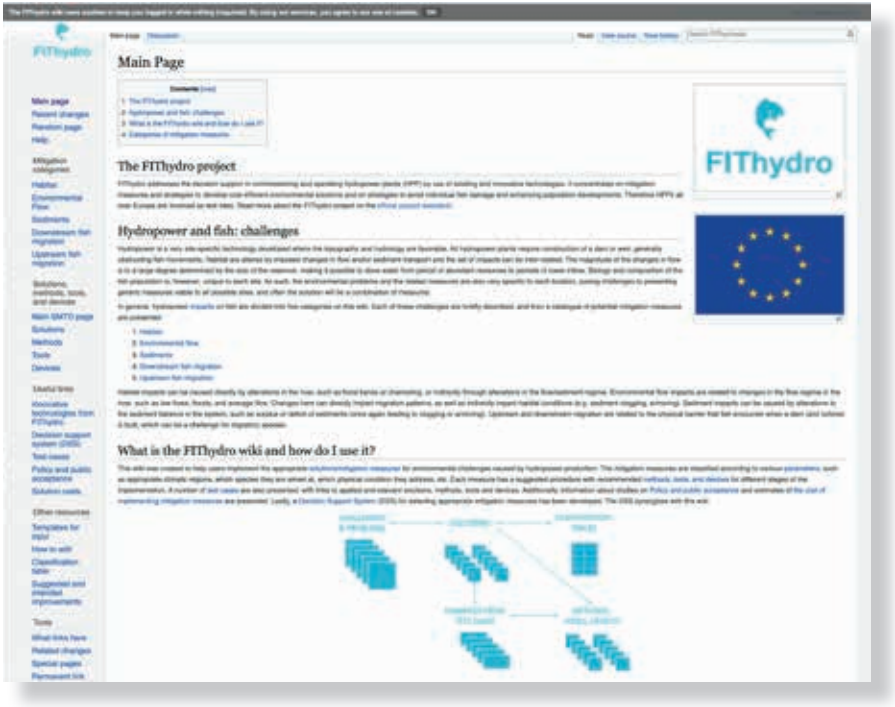


October: The launch of the world's first snow guide based on results from the Snow for the Future research project. The project researches effective and climate-friendly snow production »



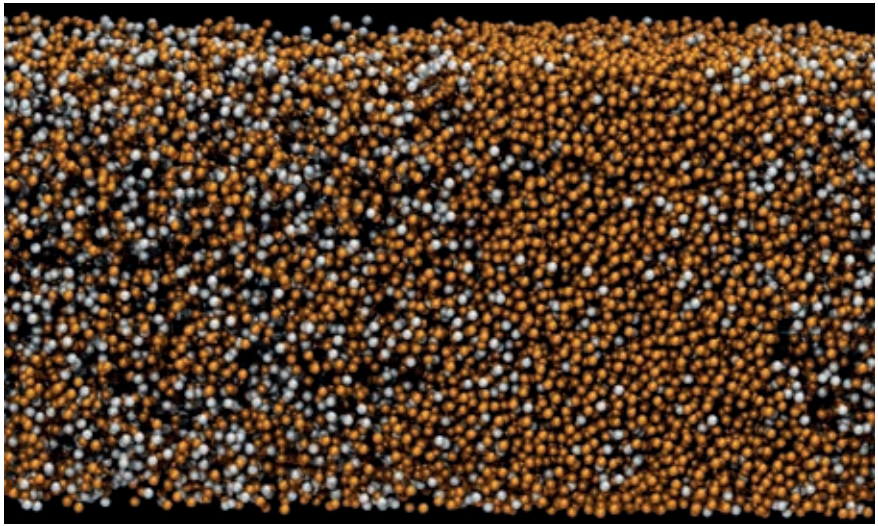
November: SINTEF scientists launch the FIThydro wiki for more fish-friendly hydropower

Development of hydropower must happen on nature's terms. Environmental design is a method that considers both nature and society in the development of new energy projects. As part of this, SINTEF Energy Research scientists have launched a website (wiki) that gathers all the measures, methods and tools that can be used to achieve a more fish-friendly hydropower while guaranteeing power production: www.fithydro.wiki. »



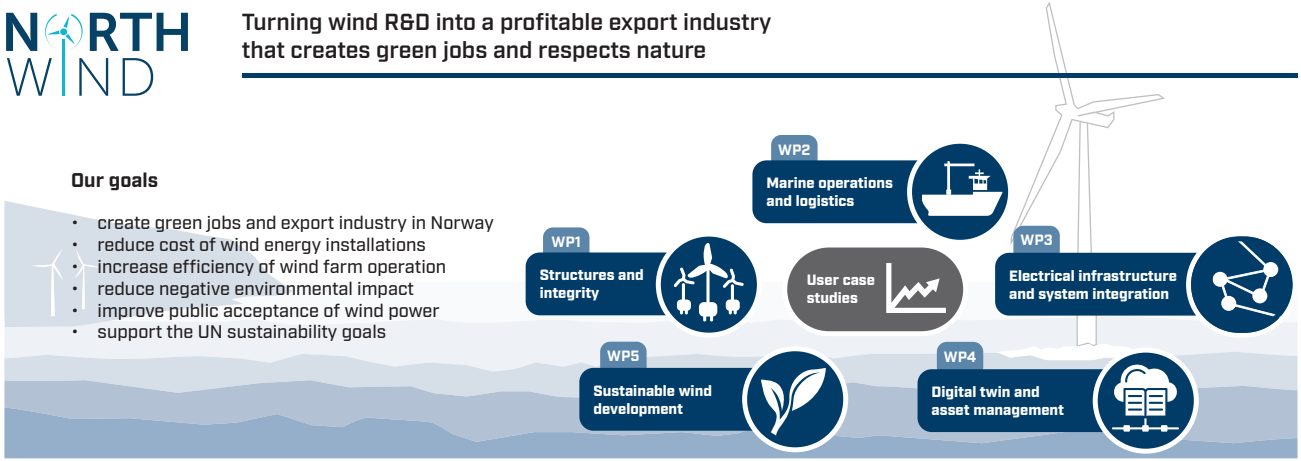
November: SINTEF releases open-source software for thermodynamic modelling

Thermopack is a free software that provides a flexible framework for modelling thermodynamic properties of fluids. It allows the user access to a wide variety of equations of state, mixing rules, and tools for calculating thermodynamic properties. Thermopack was developed by scientists at SINTEF Energy Research, who held a webinar on 11 November to demonstrate how the software works. »



December: Financial support for FME NorthWind

On 11 December, The Norwegian Minister of Petroleum and Energy, Tina Bru, announced that the Norwegian Centre for Environmental-Friendly Energy Research (FME) NorthWind will receive a total of NOK 120 million in funding over 8 years from the Research Council of Norway. NorthWind will contribute to Norway's profitable export of wind energy, new green jobs, and wind power that respects both nature and people. This project is led by SINTEF Energy Research, and we are joined by SINTEF Ocean, SINTEF Digital, SINTEF Industry and NTNU, as well as over 40 other research and business partners.



In the pyrolysis reactor at SINTEF Energy Research, roughly 0.5 kg of fuel can be pyrolyzed. The furnace can operate up to 1100 °C and thus simulate the majority of available carbonization or pyrolysis processes. All products (gas, charcoal and condensate) from experiments can be collected and analyzed.

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