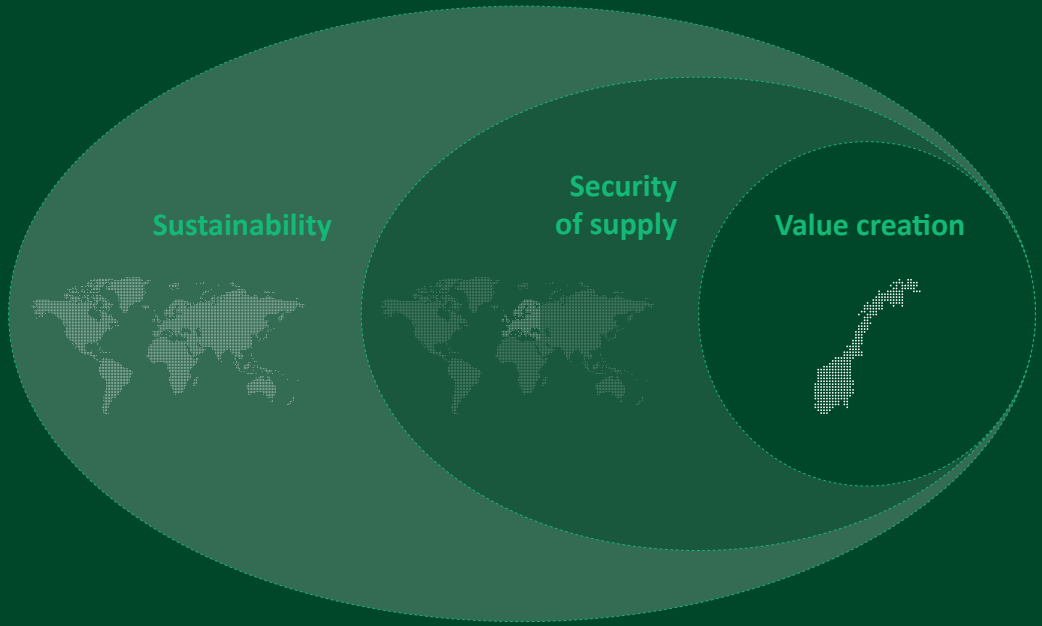
SINTEF Energy Research

Annual Report 2024

We shape the future's sustainable energy solutions

We shape the future's energy solutions



Cover photo: Henning Taxt, Vijay Venu Vadlamudi (NTNU), Gerd Hovin Kjølle and Oddbjørn Gjerde at NTNU and SINTEF's National Smart Grid Laboratory.

Technology for a better society

About SINTEF Energy Research

SINTEF Energy Research is an applied research institute dedicated to creating innovative energy solutions.

We specialise in cutting-edge, research-based knowledge and infrastructure both in Norway and internationally, with the aim of providing our clients with solutions and services that increase value and strengthen their competitive ability.

SINTEF Energy Research is a part of the SINTEF group, one of Europe's largest independent research organisations. Our particular task is to help adopt new technology, including new enabling technologies, to realise next-generation energy solutions.

Our research supports the UN's 17 Sustainable Development Goals (SDGs), and we have world-leading expertise in offshore wind, solar power, bioenergy, batteries, smart grids, electrical power components, hydropower market modelling, energy efficiency, zero-emission transport, hydrogen, CCS, and low-emission oil and gas production.

SINTEF Energy Research has cutting-edge laboratories, testing facilities, digital solutions, and software. We occupy a strong position in the EU's Framework Programmes for Research and Technological Development. We are involved in seven Centres for Environment-Friendly Energy Research (FME), funded by the Norwegian Research Council. We also lead a Research Centre for Petroleum, working to reduce emissions on the Norwegian continental shelf.

Energy security and a green tomorrow

2024 has been a year of strong achievements for SINTEF Energy Research. We have reached significant academic and financial milestones, with several innovative projects delivering real societal value.

Energy security is essential to both welfare and the green transition – something I see clearly in my role as head of SINTEF Energy Research. Therefore, Norway should prioritise energy security research even more, particularly to enhance the resilience of our energy system against intentional and malicious disruptions. While the Norwegian energy system is robust and the research conducted is of high quality, vulnerabilities do exist. To reduce these vulnerabilities, we must strengthen collaboration between industry, academia, and authorities in this area.

Our projects have played a central role in innovation and the energy transition in 2024. The recently concluded FME centres have delivered measurable results in bio-energy, hydropower, energy efficiency, smart grids, and carbon capture. Ongoing and new projects will further strengthen Norway's energy future. Equally important as the FME initiatives are other project schemes such as KSP, IPN, Green Platform, and INFRA, which ensure access to world-leading laboratories, innovations, and expertise-building in close collaboration with industry. These initiatives lay the foundation for groundbreaking research and technological development.

Participation in EU projects is increasingly important for SINTEF Energy Research. Such involvement provides access to international

collaboration and substantial funding opportunities, strengthening Norway's position within the global research landscape.

Our collaboration with NTNU is essential for our operations, both as a partner in research projects and laboratory infrastructure. This partnership also helps educate tomorrow's energy experts.

In 2025, we moved back to NTNU's Gløshaugen campus and into the new Energy Building. This facility will serve as a unique hub for research, education, and innovation, providing us with a stronger platform for collaboration between NTNU, SINTEF Energy Research, and the broader energy sector.

Thank you to all employees, partners, and supporters for your efforts in 2024. With even closer ties to NTNU and increased emphasis on energy security, we are well-equipped to meet the needs of the future with robust, profitable, and sustainable solutions.
Happy reading!

Inge Gran
CEO, SINTEF Energy Research,
May 2025

SINTEF Energy Research and the UN’s Sustainable Development Goals

Our mission is to shape the future of climate technology and sustainable energy solutions. The UN's Sustainable Development Goals (SDGs) guide our strategy and operations. SINTEF Energy Research primarily contributes to the UN's Sustainable Development Goals in the following areas:

Affordable and Clean Energy

Our research aims to ensure that various energy solutions have a low climate footprint and high security of supply while being efficient and profitable. Most of our research projects contribute to goal number 7.

Climate Action

SINTEF Energy Research develops technology to reduce emissions and limit global warming to 1.5°C, which aligns with goal 13. This includes developing sustainable energy solutions to replace existing technologies.

Industry, Innovation, and Infra-structure

Energy supply infrastructure on land and offshore is crucial for robust societies. Our projects contribute to building strong infrastructure, promoting innovative businesses, fostering sustainable industry, and providing energy-efficient solutions.

Sustainable Cities and Communities

SINTEF Energy Research works on smart cities and low-emission transport. Our research helps develop sustainable neighbourhoods without greenhouse gas emissions, and we develop solutions for safe and emission-free transport using various energy carriers.

Life on Land

SINTEF Energy Research develops energy solutions that balance energy needs with nature conservation, aligning with goal 15. We have extensive experience with this in hydropower.

SINTEF Energy Research takes part in seven new Centres for Environment-friendly Energy Research

On 11 April 2024, the Research Council of Norway announced eight new Centres for Environment-friendly Energy Research (FME). SINTEF Energy Research will host three of them: FME gigaCCS, FME InterPlay and FME SecurEL; and is a partner in four others: FME ZeMe, FME Battery, FME RenewHydro and FME Solar.

Left to right: Jacob Lamb (NTNU, FME Battery), Gerd Kjølle (SINTEF, FME SecurEL), Tor Grande (Rector, NTNU), Maria Gabriella Tranell (NTNU, FME ZeMe), Alexandra Bech Gjørv (CEO, SINTEF), Ingeborg Graabak (SINTEF, FME InterPlay), Trond Johnsen (SINTEF, FME MarTrans), Mona Mølnvik (SINTEF, FME gigaCCS)

Norwegian Centre for Environment-friendly Energy Research

These are the new FME centres led by SINTEF Energy Research:

SECUREL

FME SecurEL

Secure, resilient, and sustainable electricity distribution grids

SecurEL aims to enable a secure, resilient and sustainable power grid that ensures both security of electricity supply and progress towards a zero-emission society.

Read more:

→ securel.no

InterPlay

FME InterPlay

Integrated Hub for Energy System Analyses

Integrated Hub for Energy System Analyses

FME InterPlay brings together the knowledge and tools needed for an integrated adaptation of the Norwegian energy system, to help achieve emission targets for 2030 and 2050.

Read more:

→ interplayresearch.no

gigaCCS

FME gigaCCS

Norwegian Research Centre of Excellence for Carbon Capture and Storage

FME gigaCCS will strengthen Norway's leadership in carbon capture and storage (CCS) and support the global implementation of CCS technologies.

Read more:

→ gigaccs.no

SINTEF Energy Research also leads three other national research centres that contribute to the UN Sustainable Development Goals:

FME NorthWind

NorthWind aims to support a profitable Norwegian offshore wind export industry, create new green jobs, and promote wind power that respects both nature and people. In addition to the research partners SINTEF, NTNU, NINA, NGI and the University of Oslo, more than 40 Norwegian industry partners are involved.

Read more about what they achieved in 2024:

→ www.northwindresearch.no

LowEmission

LowEmission is a research centre for low-emission technology for the petroleum sector on the Norwegian continental shelf. The partners include world-leading national and international industry players—suppliers, operators and energy companies—as well as SINTEF, NTNU and other top-ranked universities and research institutes. The goal is to enable zero-emission production of oil and gas on the Norwegian shelf.

Read more about what they achieved in 2024:

→ www.lowemission.no

FME HYDROGENi

HYDROGENi opened in October 2022 and is dedicated to research and innovation in hydrogen and ammonia. The Centre's goal is to help establish a sustainable hydrogen value chain. Led by SINTEF Energy Research, HYDROGENi has more than 50 partners from industry and academia and will run for eight years. It will also establish the largest academic research programme ever within an FME, educating 35 PhD/postdoc candidates and more than 100 bachelor's and master's students.

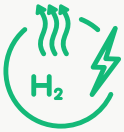
Read more about what they achieved in 2024:

→ www.hydrogeni.no

Our 10 focus areas

Smart grids

Power transmission



Integrated energy systems

Offshore wind

Energy efficiency

Carbon capture and storage (CCS)

Hydropower

Bioenergy

Hydrogen

Zero-emission transport

Research highlight

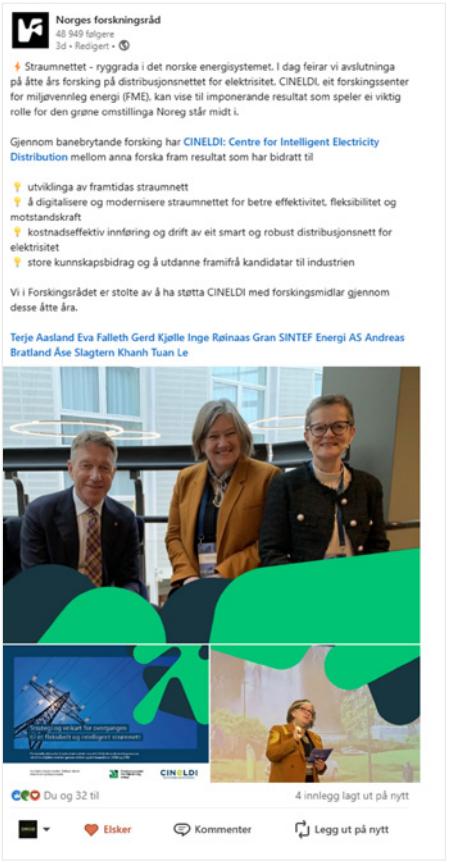
Smart Grids

The development of smart distribution grids is essential for electrification and the integration of renewable energy sources. A digitalised, cost-effective and flexible grid not only enables electric transport and more efficient energy use, but also ensures a high security of supply.

Our research spans from groundbreaking innovation projects to continuous improvements of today's power grid, in close collaboration with both public and private sector actors. SINTEF Energy Research leads the new FME centre SecurEL and also hosts the Norwegian Smartgrid Centre. By participating in and coordinating these collaborative arenas, we help develop innovative solutions for a more sustainable energy system.

CINELDI Final Conference

FME CINELDI held its final conference at the end of October 2024. Over 160 participants from government, public agencies, industry, and research gathered in Trondheim to reflect on eight successful years of research – and to look ahead to SecurEL. In his speech, Minister of Petroleum and Energy Terje Aasland emphasised this point: *"This is not the end – this is just the beginning."* He also described the FME centres as the crown jewels of the national research effort, where both public and private capital come together to support research and development.



The winner of the 2024 CINELDI Award was Heimdall Power, a startup with an invention called the "Power Neuron"—a metal sphere the size of a football that connects to the power grid. The device contains a built-in sensor that monitors cables and alerts operators of potential line faults. Heimdall Power has been an active participant in CINELDI's pilot projects.

Research highlight

Power transmission

The transmission grid is the part of the power system that transports high-voltage electricity across large areas. To meet the needs of an increasingly electrified society, the grid must not only be designed to withstand disturbances but also to minimise the risk of power outages.

The future power system is expected to become highly complex due to the integration of renewable energy sources and the development of smart grids. SINTEF Energy Research contributes to the development of reliable and cost-effective transmission systems through technology development at the material, component, and system levels, as well as through new digitalisation and market solutions.

MISSION

MISSION is a new EU-funded project led by SINTEF Energy Research. It aims to develop and demonstrate three SF_6-free switchgear components for medium- and high-voltage applications. Since SF_6 (sulphur hexafluoride) is a greenhouse gas that is 24,300 times more potent than CO_2, finding alternatives is critical to achieving a climate-neutral energy infrastructure.

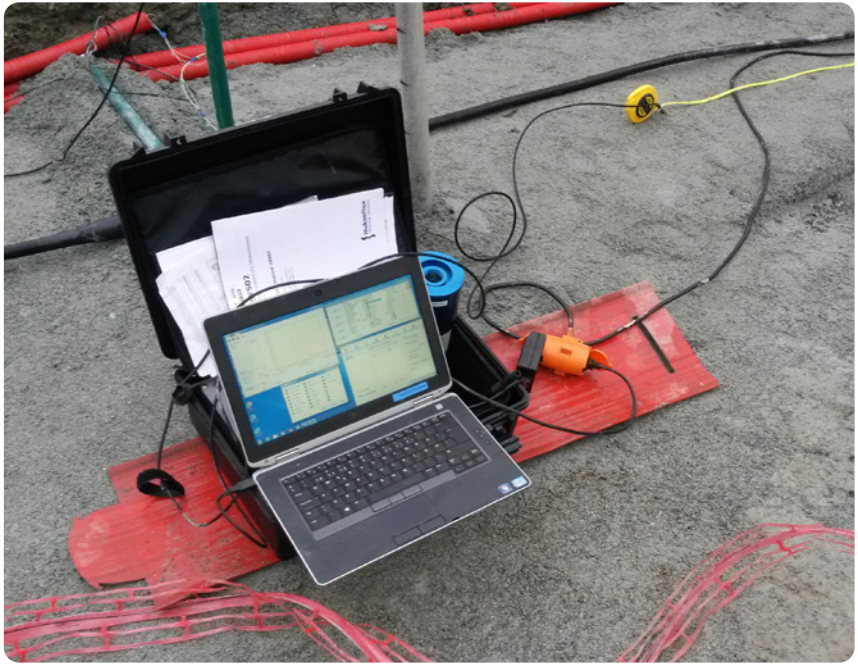
The MISSION project includes 12 partners from 9 European countries. Photo: From the kick-off meeting in Brussels, January 2024.

MISSION addresses an important technological gap and enables emission-free power transmission in both AC and DC systems, contributing to more flexible, sustainable, and fossil-free electrification worldwide.

INCA

INCA is a new Pilot-E project led by REN, with SafeBase, Arva, BKK, Glitre Nett, Tensio, Statkraft and Mellom as partners. SINTEF Energy Research is responsible for the research activities. The project develops advanced software and technology for real-time calculation of actual transmission capacity and cable monitoring.

By combining dynamic load modelling with temperature measurements and improved understanding of heat transfer to the surroundings, the project aims to identify and unlock available capacity – enabling greater flexibility and efficiency in grid operations.



The INCA project's advanced software and technology for real-time capacity calculations will help make better use of cable infrastructure.

Research highlight

Integrated energy systems

Effective integration of energy systems and sectors is essential for the transition to a zero-emission society. Decarbonisation will be the main driver of this transition, but digitalisation and decentralisation will also play important roles. Together, these three drivers bring both opportunities and challenges for the energy systems of the future.

SINTEF Energy Research contributes to the development of integrated energy systems by analysing the interactions between different energy carriers such as electricity, heat, biofuels, natural gas and hydrogen. This approach supports the goal of achieving an efficient and sustainable energy supply with high security of supply at low cost. We also have expertise in how market design, regulation and policy frameworks can help ensure efficient and integrated energy systems. SINTEF Energy Research hosts the new FME InterPlay.

In a collaborative project between FME CINELDI and FME HighEFF, researchers explored how industrial processes can be made more flexible to help balance electricity demand in the Grønland industrial area. This approach can reduce peak loads, free up grid capacity and lower electricity bills – without the need to expand grid infrastructure.

By shifting energy use to periods of lower demand, the project supports both decarbonisation and cost efficiency. Enabling industrial flexibility requires new technology, viable business models, and financial mechanisms that make it economically attractive. SINTEF Energy Research is addressing these challenges through several ongoing projects.

Read more:
→ https://blog.sintef.com/energy/industrial-flexibility-smart-strategy-future-power-grid

Photo of Herøya. Credit: gunnsteinlye. Colour modified. License: CC BY-NC-ND 2.0.

Research highlight

Offshore wind

Offshore wind has significant growth potential both nationally and internationally. Many point to offshore wind as a key solution for reaching climate targets, as it has the potential to supply many times today's global energy demand.

Although offshore wind is currently more expensive than onshore wind, research and innovation are driving costs down rapidly. Floating offshore wind, in particular, is still in its early stages – but Norway has an advantage thanks to its long-term commitment to research and technology development.

SINTEF Energy Research is home to world-leading offshore wind research groups and supports industrial partners in entering international markets. Our research covers a wide range of topics: from modelling and control of wind farms, electrical systems and components, offshore grids and HVDC, to digitalisation, machine learning, and environmental design. SINTEF Energy Research also hosts FME NorthWind.

EERA DeepWind 2024

The EERA DeepWind conference was held for the 21st time in Trondheim, 17–19 January 2024. This international offshore wind research conference was organised by SINTEF, NTNU and EERA, and drew around 300 researchers and industry experts. The yearly event makes an important scientific contribution to offshore wind development. Following the 2023 edition of EERA DeepWind, more than 74 open-access scientific articles have been published in the Journal of Physics:

→ *https://iopscience.iop.org/issue/1742-6596/2626/1*

SKARV

Through interdisciplinary collaboration, the KSP SKARV project – a spin-off of FME NorthWind – is working to prevent bird collisions with wind turbines. The project is developing a system that uses cameras and radar to detect approaching birds and predict their flight paths with the help of tools such as artificial intelligence. The turbine can then adjust its speed to allow the birds to pass safely.

↑ **BIRD DETECTION:** *KSP SKARV aims to prevent bird collisions through active control of wind turbines.*

Research highlight

Energy efficiency

Norwegian industry accounts for one third of the country's total energy consumption, which means that energy efficiency measures can have a significant impact on the national energy system. By reducing energy demand and developing new methods for energy reuse, industry can reduce its climate footprint both in Norway and internationally.

SINTEF Energy Research conducts research on energy efficiency for clients in sectors such as industry and transport. A key focus is improving the efficiency of Norway's energy-intensive industries and increasing the utilisation of excess heat. Together with our partners, we work to develop solutions that make the most of surplus energy from industrial processes.

HighEFF Final Conference

On 29-30 May, FME HighEFF's Final Conference was held, featuring a rich programme that showcased the 41 innovations the Centre delivered over its eight-year lifespan.

Rune Volla, Research Council of Norway; Inge Gran, SINTEF Energy Research; participants in the Final Conference; Toril Hernes, NTNU.

The Centre and its research scientists published 249 scientific articles and gave 173 conference presentations throughout the project's duration. Sixteen PhD candidates completed their degrees through the Centre, as well as 73 master's students.

One of HighEFF's 41 innovations is the spin-off company Cartesian, which develops thermal batteries. In May 2024, a new pilot project was launched to test one of these batteries at a REMA 1000 supermarket in Mjøndalen. These systems can help reduce both REMA 1000's electricity costs and power peaks in the grid – offering significant environmental and climate benefits in addition to the economic gains.

Read more about this exciting pilot project on NRK.no (in Norwegian):

→ *https://www.nrk.no/buskerud/lagrer-kulde-i-_batteri_-for-a-kutte-straumforbruket_-_klimagevinsten-kan-vere-stor_-trurforskarar-1.16891956*

Research highlight

Carbon Capture and Storage (CCS)

CCS encompasses the capture, processing, transport, injection, and storage of CO_2. These processes enable substantial reductions in emissions from industrial activities as well as from hydrogen and power production. CCS is also a crucial technology for carbon-negative solutions, such as bioenergy with carbon capture and storage (BECCS) and direct air capture (DAC).

SINTEF Energy Research hosts FME gigaCCS, a continuation of the Norwegian CCS Research Centre (NCCS).

NCCS Final Conference

After eight years of groundbreaking research, the FME Norwegian CCS Research Centre (NCCS) concluded its work at the end of 2024. The Centre developed over 30 innovations at various technology readiness levels and contributed directly to the realisation of the Norwegian government's Longship project, which is establishing the country's first full-scale CCS value chain. NCCS has also led to at least 15 new research projects and educated more than 100 students, including 24 PhD candidates. Its work has been instrumental in advancing CCS as a key technology in the transition to net-zero emissions. In the spring of 2025, work begins on FME gigaCCS, which builds on the legacy of NCCS. Read more:

→ https://nccs.no

COREu

SINTEF is leading a major EU-funded CCS project called COREu, focused on helping Europe reduce its CO_2 emissions. The project will demonstrate carbon capture and storage methods in Southern Europe and help connect CO_2 emission sources with storage sites in Central and Eastern Europe. The project includes 40 different partners—ranging from companies and technology providers to research institutes – and is the largest EU-supported CCS initiative of its kind.

Participants at the NCCS Final Conference.

Research highlight

Hydropower

Hydropower is a key resource for a renewable and sustainable energy supply. It provides energy, capacity and long-term storage – all of which are essential to maintaining security of supply. The International Energy Agency (IEA) has referred to hydropower as “the forgotten giant”, and in Norway, it forms the backbone of the electricity system.

With over 40 years of experience in hydropower research, SINTEF Energy Research holds specialised expertise across a wide range of fields – from power grid analysis, market modelling and optimal production planning, to hydrology and environmental conditions in rivers and around hydropower plants. We also study how hydropower interacts with other renewable energy sources like solar and wind, as well as emerging energy carriers such as hydrogen. Our goal is to develop cost-effective solutions that safeguard nature, ecosystems and wildlife.

ReHydro: Innovative solutions to increase the role of hydropower in Europe

In the autumn of 2024, research scientists from SINTEF Energy Research visited the Brattlandsdalsåi and Roalkvamsåi rivers in the Røldal-Suldal watercourse to collect data for the EU project ReHydro. Launched in June 2024, ReHydro focuses on the sustainable rehabilitation of hydropower plants across Europe. The project aims to demonstrate how European hydropower facilities can be upgraded and modernised to meet the needs of future energy markets—while ensuring environmental and societal sustainability.

ReAdapt: Adapting hydropower to future climate extremes

As the climate changes, so do patterns of precipitation, runoff and temperature. This creates both new challenges and new opportunities for Norwegian hydropower. "We expect more frequent, longer-lasting, and more severe extreme events such as floods, droughts, and high water temperatures," says SINTEF research scientist Ana Adeva-Bustos, who leads ReAdapt –a new Collaborative and Knowledge-building Project (KSP) that brings together research institutions and hydropower producers to explore how the hydropower system can adapt to a changing climate. Project partners include Statkraft, Eviny and Å Energi, along with NTNU, NINA, the University of Waterloo, and Universidad Politécnica de Madrid.

Left to right: Gry Walle, Eviny; Ana Adeva-Bustos , project manager, ReAdapt; Stian Backe, research scientist.

Bioenergy

There are numerous ways we can harness bioenergy. The simplest and perhaps oldest form is using wood to build fires. More modern and complex forms involve using biomass to produce biofuels, biocarbon or biochar (charcoal), district heating, or electricity. Biomass contains carbon, so burning it releases CO_2. However, bioenergy does not increase atmospheric CO_2 concentrations, as it forms part of a climate-neutral cycle.

For several decades, SINTEF Energy Research has been studying cost- and energy-efficient bioenergy, assisting industries, authorities, and other organisations in using biomass and waste for energy purposes. Because biomass has many potential uses, it must be applied where it delivers the greatest benefit. Therefore, our research addresses multiple perspectives, including improvements in biochar, biofuels, and efficient combustion processes. Simultaneously, we investigate sustainable resource utilisation to prevent overexploitation of biological resources. We also research methods for removing CO_2 from the atmosphere through a process known as BioCCS.

Research highlight

PRIMED: Redesigning the Primary Sector for Maximizing Bioeconomy Development

With over 900 million tonnes of residual biomass generated annually in Europe, the potential for creating a more sustainable future is enormous. At the end of January 2024, the PRIMED project, in which SINTEF Energy Research participates, held its kick-off meeting in Bochum, Germany. Here, 12 partners from seven European academic institutions and businesses gathered. In the PRIMED project, SINTEF Energy Research will explore relevant biomass resources and technologies to transform biomass into bio-based products – from bioplastics to biofuels. SINTEF will also evaluate the economic sustainability of these value chains using tailored software tools to ensure that the solutions are not only environmentally friendly but also economically viable.

Does waste go up in smoke?

Are we heading towards a circular economy, or is our waste merely going up in smoke? What happens to the waste we dispose of concerns everyone, yet waste management is a complex topic. In this blog, senior research scientist Michael Becidan shares figures and facts about today's waste management systems and ideas on how we can improve waste management.

The blog (in Norwegian) is based on ongoing work from the project "Energy Recovery from Waste & Waste Management Systems in a Circular Economy" (CircWtE):

→ *https://blogg.sintef.no/energi/avfalls-handtering-pa-vei-mot-en-sirkulaer-okonomi*

Photo: SINTEF

↑ *Research scientists at work at the wood combustion section of SINTEF Energy Research's bioenergy laboratory, where we develop innovative solutions and systems for residential heating.*

Hydrogen

Hydrogen can provide CO_2-free energy for power generation, energy storage, industrial and residential heating, and fuel (either as hydrogen or ammonia). These applications can be on land, offshore, or airborne. Hydrogen can also play a significant role in heavy industries, such as steel production. The EU considers clean hydrogen as a cornerstone of its future energy system. Meeting demand requires hydrogen produced either by electrolysis using renewable electricity or from natural gas with CCS.

SINTEF Energy Research studies the entire value chain of clean hydrogen – from production to transport, storage, and final use in various industries and sectors. Our projects focus on developing safe, cost-effective, and scalable hydrogen production methods. This includes studies on hydrogen transport and storage in Norway and Europe. SINTEF Energy Research hosts the research centre FME HYDROGENi.

HyPowerGT

SINTEF Energy Research will lead a new EU research project, HyPowerGT, demonstrating a hydrogen-powered gas turbine engine capable of running on both natural gas and hydrogen. At the core of this technology is a new combustion system (DLE H_2) that can operate with mixtures of natural gas and hydrogen, up to 100 percent hydrogen. This technology offers low emissions and high efficiency and can be adapted to existing gas turbines, enabling upgrades to current industrial plants and adding new capabilities to the electricity grid, such as balancing power supply and driving various machinery. HyPowerGT involves nine partners from five different countries.

H2Science: Advancing Hydrogen for Net Zero

In June 2024, HYDROGENi launched a new international conference dedicated to the latest scientific and technological advancements in hydrogen research: H2Science. On June 18 and 19, 132 hydrogen researchers, industry representatives, and experts gathered in Trondheim to discuss hydrogen technologies and their societal impacts, exploring opportunities for new collaborations. The two-day conference included 60 oral presentations covering the entire hydrogen value chain,

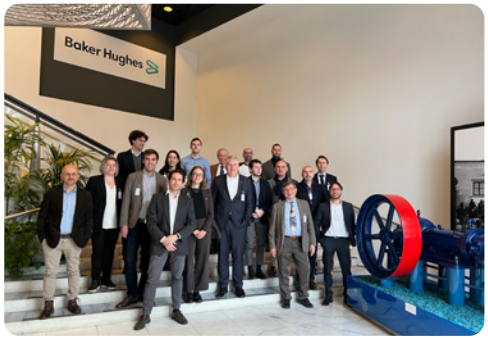
from production to end-use, underscoring the necessity of ongoing R&D activities to shape the hydrogen economy.

Read more about the conference here:

→ *https://hydrogeni.no/news/h2science-advancing-hydrogen-for-net-zero*

The next conference will take place in 2026.

↑ *A artistic segment in Nidaros Cathedral in connection with H_2Science.*



← *From the HyPowerGT kick-off meeting in Florence, Italy.*

Research highlight

Zero-emission transport

Norway is leading globally with ambitious targets for zero-emission transport. To meet the goal of halving CO_2 emissions from the transport sector by 2030, all vehicles and vessels acquired after 2030 must have zero-emission solutions. This makes it crucial to establish infrastructure for zero-emission solutions in maritime, land-based, and aviation transport. To meet diverse needs, propulsion systems must be developed based on electricity, hydrogen, ammonia, batteries, LNG with CCS, and biofuels.

SINTEF Energy Research has a diverse portfolio of projects and partnerships in this area, which will collectively enable the transport sector to transition to greener solutions. Charging technology and components are continually evolving, and within wireless charging technology, SINTEF Energy Research is conducting world-leading research. We are also researching the production, handling, and application of new zero-emission energy carriers and propulsion systems. Through techno-economic analyses, we provide decision-making support to industry and public stakeholders for the transition to an emission-free transport system.

reSail

reSail (Sailing with Wind-Assisted Propulsion in Realistic Wind Conditions) is a new project led by SINTEF Energy Research. Large ships account for approximately 90% of CO_2 emissions from the shipping industry, and zero-emission solutions like electrification pose significant challenges. Wind-assisted propulsion systems (WAPS) can reduce fuel consumption by up to 60% and significantly cut emissions. reSail aims to fully exploit WAPS by improving the understanding of varying wind conditions at sea through wind measurements, wind tunnel tests, and modelling, enabling optimised system usage and significant fuel and emission reductions.

MaritimeNH$_3$ Project

Ammonia and Maritime Transport: Shipping heavily relies on fossil fuels and accounts for 3% of global CO_2 emissions. To meet international climate targets, the UN's International Maritime Organisation (IMO) has set a goal of reducing emissions by 70% before 2040. Ammonia, which is carbon-free and has a high energy density, can be used both as fuel and as an energy carrier for hydrogen. Although robust procedures exist for handling and transporting ammonia in other industries, several challenges

remain before it can be adopted as a maritime fuel.

Over the past three years, the MaritimeNH₃ project, led by SINTEF Energy Research, has developed new knowledge to promote ammonia as a safe, cost-effective, and clean alternative to fossil fuels in shipping. The project summarised its findings in a report presented at the Maritime Hydrogen Conference on October 16, 2024, providing recommendations for future work. Read the MaritimeNH₃ report here:

→ *https://www.sintef.no/en/projects/2021/maritimenh3-enabling-implementation-of-ammonia-as-a-maritime-fuel*

↑ *SINTEF's Hans L. Skarsvåg and Truls Flatberg presenting MaritimeNH₃'s findings at the Maritime Hydrogen Conference.*

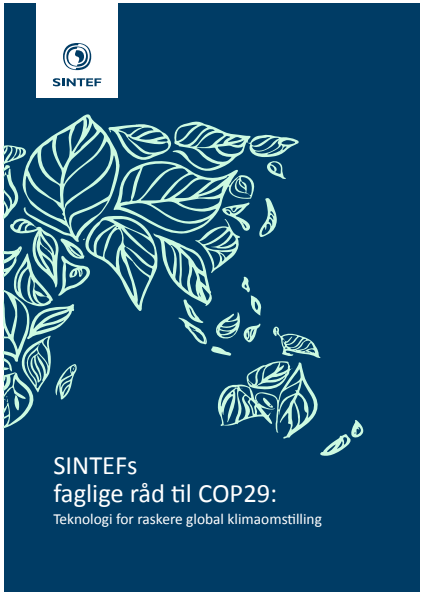
Shaping the agenda

In 2024, SINTEF Energy Research participated in key political arenas, including the UN Climate Summit in Baku, Norwegian political festival Arendalsuka, and other relevant venues to share research-based knowledge and advise policymakers.

UN Climate Summit

Four SINTEF institutes provided expert advice on 14 areas with significant emission-reduction potential to the Norwegian negotiating delegation, Norwegian businesses, and the media nationally and internationally. SINTEF's main recommendation was that Norway should lead the establishment of open, international research and development programmes for sustainable energy solutions, in close collaboration with low- and middle-income countries. SINTEF also participated in several events, including an official UN side event with NTNU.

→ *https://www.sintef.no/en/sintef-at-cop29/*



→ *https://www.sintef.no/siste-nytt/2025/resultatet-av-cop29-ble-en-tillitskrise-det-siste-verden-trengte/*

SINTEF's Executive Vice President for Sustainability, Nils Røkke, summarised COP29 in Baku: "The parties agreed on a new climate finance goal of USD 300 billion annually for 2026–2035, significantly below the expert group's estimate of USD 1.3 trillion, weakening trust, especially among developing countries. The lack of reference to fossil fuels and outdated definitions of 'developing countries' have increased frustration." He advocates reforming the COP process and rebuilding trust ahead of COP30.

E OG K

DEBATT

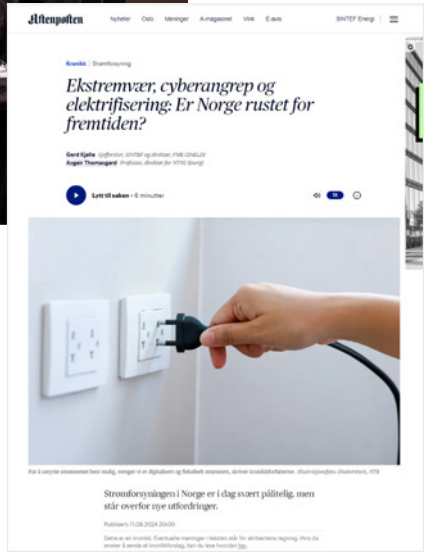
Resultatet av COP29 ble en tillitskrise – det siste verden trengte

Et veldig ineffektivt forhandlingssystem – det er hovedinntrykket etter klimatoppmøtet i Baku. Gjenreising av tilliten til dette systemet må bli jobb nummer en for den neste konferansen, skriver Nils A. Røkke.

Arendalsuka

In 2024, SINTEF participated for the ninth time at Arendalsuka, offering research-based energy recommendations on security of supply, climate solutions, CCS, energy waste reduction, data centres, collective energy action, and offshore wind. We presented six recommendations during two debates – "The Great Energy Debate: Securing Future Energy and Welfare" and "Norway and Europe" – both followed up by opinion pieces in Aftenposten and EuroPower. Additionally, we repeated the popular #Energitirsdag (Energy Tuesday) at Thon Hotel with 11 events featuring sign language interpretation, attracting over 900 participants in person and 1,600 via streaming.

↑ *Political panel at The Great Energy Debate. Left to right: Host Stein Mortensholm (SINTEF), Marius Arion Nilsen (FrP), Sofie Marhaug (R), Elisabeth Sæther (Ap), Une Bastholm (MdG) and Lars Haltbrekken (SV).*



Aftenposten

Ekstremvær, cyberangrep og elektrifisering: Er Norge rustet for fremtiden?

Strømforsyningen i Norge er i dag svært pålitelig, men står overfor nye utfordringer.

↑ *Aftenposten facsimile, opinion piece 11 August 2024*

Read the Aftenposten article (in Norwegian):
→ *https://www.aftenposten.no/meninger/kronikk/i/eM7bLg/er-norge-rustet-for-fremtiden*

The "Norway and Europe" event took place in Samfunns-teltet. Left to right: moderator Anne Jortveit; Frode Leversund (Gassco); Kari Thørud (Hydro Energi); Ellen Waldeland Hodell (Vår Energi); Julie Wedege (Statkraft); Asgeir Tomasgard (NTNU); and Nils Røkke (SINTEF).

An enthusiastic Minister of Energy, Terje Aasland, participated in the #Energitirsdag event: "Emissions reductions offshore and power balance—Yes to both!"

#Energitirsdag was organised by SINTEF Energy Research in collaboration with several major research projects, NTNU, and industry partners.

GreenShift

On January 30, SINTEF, together with several Norwegian embassies, organised the GreenShift event in Brussels. This event was the last in a series of four, bringing together representatives from government, industry, and academia to promote dialogue and research on the green energy transition in the North Sea region.

"Norway and the EU must collaborate even more closely in research and innovation to address the immediate challenges ahead," said Minister of Petroleum and Energy Terje Aasland at the event.

The Norwegian minister participated alongside his Belgian counterpart, Tinne Van der Straeten. Both energy ministers agreed that increased international cooperation is essential for achieving climate goals, reducing greenhouse gas emissions, ensuring secure green energy supplies, and maintaining the competitiveness of European industry.

Minister Terje Aasland discusses on stage with SINTEF's Executive Vice President for Sustainability, Nils Røkke.

Belgian Minister of Energy, Tinne Van der Straeten.

Energy efficiency in Europe

The European Energy Research Alliance (EERA) contributes to shaping Europe's energy agenda, particularly in energy efficiency. In June 2024, EERA launched a white paper examining the role and impact of energy efficiency in decarbonising European industry. The report was unveiled at SINTEF's offices in Brussels. Read the report and view the event recording:

→ *https://www.eera-eeip.eu/news-and-resources/5098-white-paper-the-role-and-impact-of-energy-efficienc*

"By addressing barriers and leveraging advanced techniques such as surplus heat recovery and digitalisation, we can make the transition to a greener, more sustainable industrial sector both feasible and cost-effective," said Amy Brunsvold from SINTEF Energy Research, one of the report's lead authors.

↑ *From the presentation of the report: Amy Brunsvold (SINTEF) and Eric Lecomte, DG ENER, European Commission.*

Data centres

In February, Research Director Petter Røkke, questioned Google's planned data centre in Skien during an interview on NRK's evening news, challenging the company to utilise surplus heat – enough to heat approximately 600,000 apartments. He cited FME HighEFF's public consultation response from April 2021 regarding lower thresholds for surplus heat utilisation in the Energy Act and linked it to Minister Terje Aasland's call for stricter regulations. The issue was further addressed in an opinion piece in Dagens Næringsliv on 1 March, and at a meeting with the Ministry of Energy.

Roadmap for addressing nature-related risks

In February 2024, the Nature Risk Committee presented its report recommending five actions for the renewable energy industry to manage increasing nature-related risks. Senior Research Scientist Atle Harby was part of the committee, emphasising the importance of balancing climate targets with environmental considerations. In 2024, the government established an expert committee tasked with studying the socioeconomic impacts of climate change, where Atle Harby will also serve:

→ *https://www.regjeringen.no/no/aktuelt/ekspertutvalg-skal-utrede-konsekvenser-av-klimaendringene/id3048004*

The power grid isn’t full after all

"Formulas from the 1950s hinder the full utilisation of the power grid, and digital tools alone could increase capacity by 20 percent in cable networks," wrote Espen Eberg, Camilla Espedal, Svein Hellesø, and Katharina Kuhlefelt Klusmeier from SINTEF Energy Research in an opinion piece in Dagens Næringsliv on 14 April 2024. In projects DynKap and FME NorthWind, we demonstrated that transmission capacity from a wind farm could increase by over 20% for several hours using digital solutions – specifically online temperature monitoring and precise data models. Read "The power grid isn’t full after all" (in Norwegian):

→ *https://www.sintef.no/siste-nytt/2024/stromnettet-er-ikke-fullt-likevel*

Espen Eberg, Camilla Espedal, Svein M. Hellesø og Katharina Kuhlefelt Eie-Klusmeier

Espen Eberg, forskningsleder, Camilla Espedal, forsker, Svein M. Hellesø, forsker og Katharina Kuhlefelt Eie-Klusmeier, master of science, alle i Sintef

Innlegg

Strømnettet er ikke fullt likevel

Formelverk fra 1950-tallet forhindrer full utnyttelse av strømnettet. Digitale hjelpemidler alene vil øke kapasiteten med 20 prosent i kabeldelen av nettet, viser ny forskning.

Elektrifiseringen har voksesmerter. Nettutbygging tar tid, og industriprosjekter må settes på vent til kraftnettet er bygget ut. (Foto: Statnett)

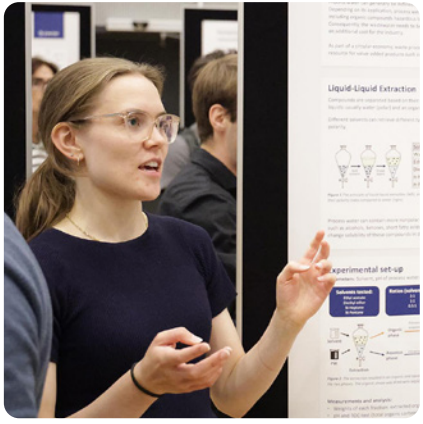
Publisert 14. april 2024, kl. 20.02

Jevnlige oppslag i mediene forteller at strømnettet i Norge er fullt. Og at tilknytning av ny kraftproduksjon og industri derfor må utsettes.

Summer scientists

In 2024, SINTEF Energy Research hosted 38 summer scientists. The students worked on diverse tasks across our projects, covering the full spectrum of SINTEF Energy Research's activities, from thermal energy storage and exploring new materials for subsea power cables, to excess heat utilisation, CCS, wind farm management, and electric vehicle charging. They held their annual summer scientist conference in August, presenting their results to supervisors from SINTEF and research scientists actively involved in the projects.

Amelia Madsen-Smistad spent her summer exploring how Carnot batteries (a type of thermal energy storage) can be combined with industrial surplus heat.



A byproduct of bio-oil production is contaminated water known as process water. Ingebjørg Neraas investigated how valuable chemicals can be extracted from this process water.

SINTEF Energy Research summer scientists 2024, with their supervisors.

Awards

In November 2024, Mona Mølnvik, research director at SINTEF Energy Research and director of the FME NCCS centre, was awarded the OG21 Technology Champion Award for her significant contributions to developing and implementing carbon capture, transport, and storage (CCS).

Mona Mølnvik was presented with the prestigious Green Award at the GHGT CCS conference held in Canada in October. Often described as the "Olympic gold medal" of the CCS field, this prize is awarded during GHGT to individuals who have made substantial and sustained contributions to advancing CCS/CCUS.

Tim Dixon, Director of IEAGHG, and Mona Mølnvik, SINTEF.

In June, SINTEF Energy Research's Edel Sheridan received an award – a "Battery Star" – for her efforts to advance battery technology in Europe. She is a member of BEPA (Batteries European Partnership Association). In total, nine individuals received a battery trophy recognising their long-standing commitment to the battery sector.

Edel Sheridan pictured with Rosalinde van der Vlies and Fabrice Stassin.

The Energy Building at NTNU's Gløshaugen campus

On Friday, 21 March 2025, SINTEF Energy Research officially took over the Energy Building at Gløshaugen from the contractor Veidekke. Construction began in May 2022. The 11,000 m² building comprises 10 floors and approximately 400 office spaces. Reuse of the original building structure was prioritised, and both the new and renovated sections meet the high environmental standard BREAM-NOR Excellent. Proximity to NTNU is crucial for SINTEF, and the building's central location at Gløshaugen facilitates strong strategic and operational collaboration between NTNU and SINTEF. The building has direct access to NTNU's Electro Building, and the café on the ground floor will open to NTNU staff, students, and other guests in early May 2025. The conference hall and open-zone meeting rooms can be booked by both SINTEF employees and external parties.

SINTEF Energy Research moved in during April, and in May, SINTEF Digital's Department of Mathematics and Cybernetics relocated to the third floor of the building.

SINTEF Energy Research has clients and projects throughout Norway and worldwide

SINTEF Energy Research maintains extensive international research activities

To help achieve the UN Sustainable Development Goals, address industry market demands, and build international alliances, it is essential that our research maintains excellence. Our close collaboration with industrial partners helps us secure internationally funded projects, particularly within EU research programs. Our Brussels office has been instrumental in establishing this position.

The institute's international revenue primarily comes from the EU.

SINTEF Energy Research actively participates in several international initiatives, including EERA, various EU technology platforms, and CIGRÉ (International Council on Large Electric Systems). These partnerships help advance research aligned with several UN Sustainable Development Goals.

In 2017, Nils A. Røkke, SINTEF's Executive Vice President for Sustainability, was appointed Chair of EERA, representing more than 55,000 energy researchers across Europe. He now serves as Vice President of EERA. His contributions to European energy and sustainability policy, including through his own column in Forbes, highlight SINTEF Energy Research's leading role in the European energy debate.

Read more of his views and analyses on Forbes' website:

→ www.forbes.com/sites/nilsrokke

SINTEF Energy Lab.

Our Laboratories

SINTEF builds and operates research infrastructure essential for developing future energy solutions. Through close collaboration with NTNU, SINTEF Energy Research has access to more than 12,000 m² of advanced laboratory facilities. Our laboratories are critical for maintaining our position at the forefront of international R&D and ensuring Norwegian industry's competitiveness.

In our laboratories, we test and verify solutions for finalised concepts and components, conducting measurements both in laboratory settings and in the field. We also operate laboratories that combine physical and numerical experiments.

Here are some of our largest laboratories:

- Electrotechnical Laboratories
- Thermal engineering laboratories
- SINTEF Energy Lab
- ElPowerLab
- HighEFFLab
- National Smart Grid Laboratory
- Pan-European CO_2 laboratories – ECCSEL

Discussion about tests at the subsea laboratory in SINTEF Energy Lab. Left to right: Jørund Aakervik, Hallvard Faremo, and Sverre Hvidsten.

Scientific Publications

Scientific publication is key to ensuring our research meets the highest international standards. SINTEF aims for at least one scientific publication per research scientist-year.

In 2024, SINTEF Energy Research once again achieved this target, with 1.08 publications per research scientist-year.

SINTEF Energy Research continues to publish research findings actively, with 242 scientific publications approved as of 25 February 2025. Here is a selection of key publications from 2024:

Ueckerdt, Falko; Verpoort, Philipp; Anantharaman, Rahul; Bauer, Christian; Beck, Fiona; Longden, Thomas; Roussanaly, Simon Nathanael.
On the cost competitiveness of blue and green hydrogen. *Joule* 2024 ;Volume 8.(1) s. 104-128

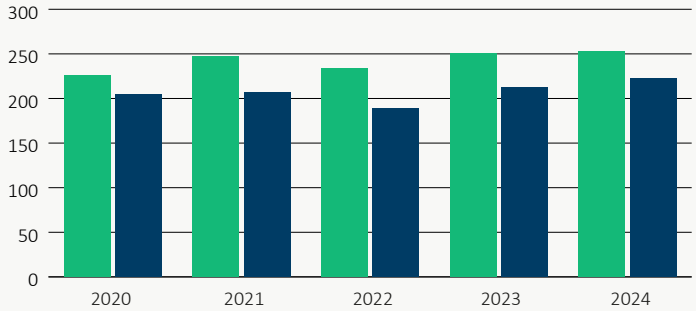
Tavakoli, Sadi; Gamlem, Gunnar Malm; Kim, Donghoi; Roussanaly, Simon Nathanael; Anantharaman, Rahul; Yum, Kevin Koosup; Valland, Anders.
Exploring the technical feasibility of carbon capture onboard ships. *Journal of Cleaner Production* 2024 ;Volume 452.

Ditaranto, Mario; Saanum, Inge.
Experimental study on the effect of pressure on single and two stage combustion of decomposed ammonia (NH3-H2-N2) blends over a swirl stabilized burner. *Combustion and Flame* 2024 ;Volume 262.

Magnusson, Niklas; Allais, Arnaud; Angeli, Giuliano; Bouvier, Gregory; Bruzek, Christian-Eric; Candido, José; Creusot, Christophe; Gammelsæter, Marte; Garofalo, Erik; Gomory, Fedor; Hodge, Eoin; Hole, Stephane; Marian, Adela; Morandi, Antonio; Reiser, Wolfgang; West, Beate.
SCARLET- A European Effort to Develop HTS and MgB2 Based MVDC Cables. *IEEE Transactions on Applied Superconductivity (TAS)* 2023 ;Volume 34.(3)

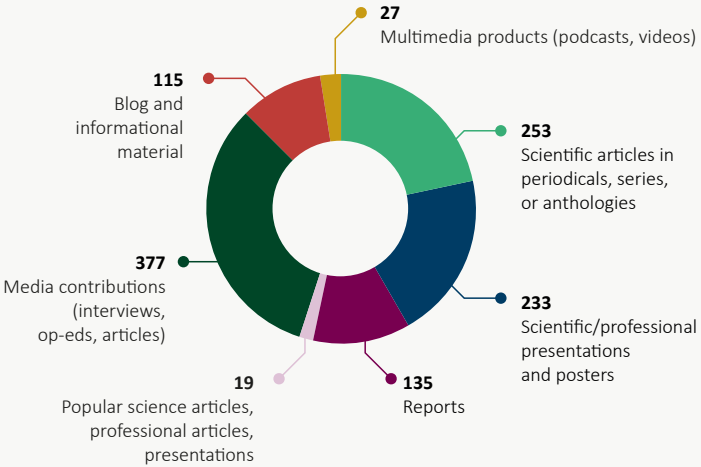
Garau, Michele; Torsæter, Bendik Nybakk.
A methodology for optimal placement of energy hubs with electric vehicle charging stations and renewable generation. *Energy* 2024 ;Volume 304.

Cali, Umit; Kantar, Emre; Pamučar, Dragan; Deveci, Muhammet; Taylor, Peter; Campos-Gaona, David; Anaya Lara, Olimpo; Tande, John Olav Giæver.
Offshore wind farm site selection in Norway: Using a fuzzy trigonometric weighted assessment model. *Journal of Cleaner Production* 2024 ;Volume 436.



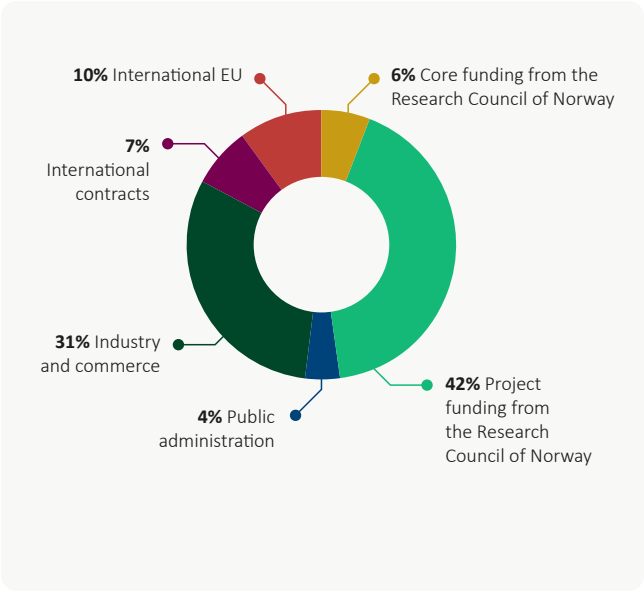
Research dissemination

The most significant dissemination of our research outcomes occurs when new technologies and solutions are adopted by our clients and society. We employ a variety of channels to achieve this successfully. We build networks and enhance the quality of our work through co-publication in scientific articles and project reports. Popular science communication is essential to encourage engagement and ensure our results are accessible to a broad audience.

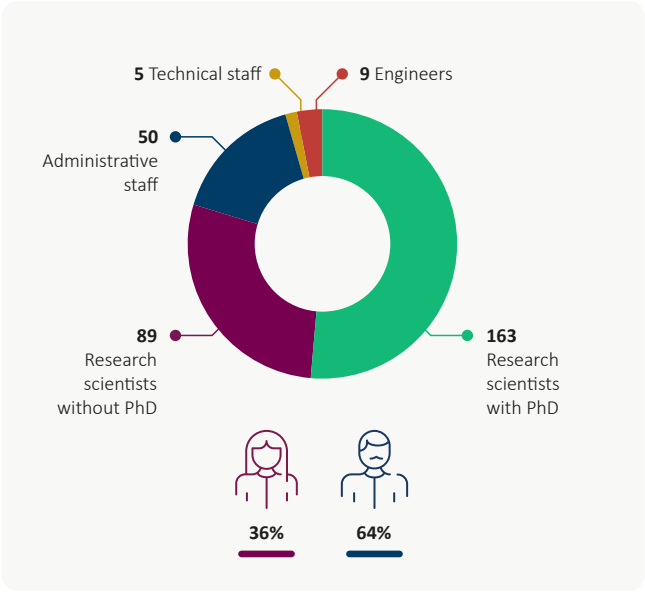


Key figures 2024

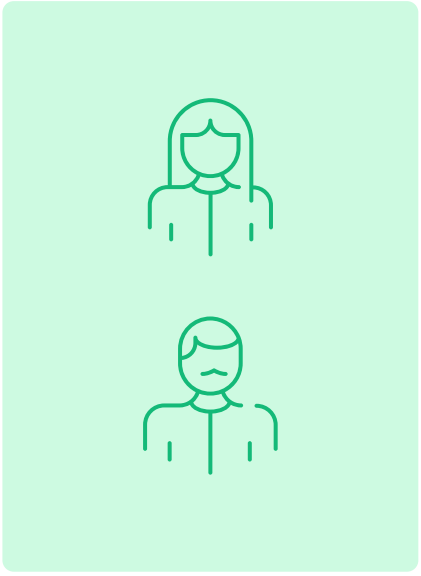
Funding sources (% of gross operating revenue)



Employees



2024



Board of Directors

- Alexandra Bech Gjørv (Chair), President and CEO, SINTEF
- Bård Standal, Deputy CEO and Director of Strategy & Energy Markets, Renewables Norway
- Geir Kulås, Executive Vice President Production and Energy Management, Skagerak Energi
- Nils Klippenberg, CEO, Siemens Norway
- Henriette Undrum, Senior Vice President, Equinor
- Ingrid Schjølberg, Dean, NTNU
- Maren Istad, Research Manager, SINTEF Energy Research
- Sverre Foslie, Research Scientist, SINTEF Energy Research
- Ingeborg Graabak, Senior Research Scientist, SINTEF Energy Research

Management

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

Key Financial Figures

Results	**2020**	**2021**	**2022**	**2023**	**2024**
Gross operating revenue	512	574	668	698	776
Net operating revenue	419	464	523	548	613
Operating result	**21**	**47**	**40**	**32**	**52**
Annual result	**23**	**45**	**38**	**48**	**64**
Balance sheet					
Fixed assets	200	201	246	422	519
Current assets	568	644	718	899	754
Total assets	**768**	**845**	**964**	**1321**	**1273**
Equity	451	496	534	582	645
Liabilities	317	349	430	739	628
Total equity and liabilities	**768**	**845**	**964**	**1321**	**1273**
Profitability					
Operating margin (%)	5,0	10,2	7,7	5,9	8,6
Return on total assets (%)	3,8	7,0	5,5	4,5	6,2
Return on equity (%)	6,3	11,9	9,7	10,3	12,5
Liquidity					
Net cash flow from operating activities	68	109	116	384	56
Liquidity ratio	1,8	1,9	1,7	1,2	1,7
Financial strength					
Equity ratio (%)	58,7	58,7	55,4	44,0	50,7
Operational working capital	252	296	289	161	289

Visit from Statnett to SINTEF Energy Lab; Eirik Bjerrehorn standing on a lift.

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