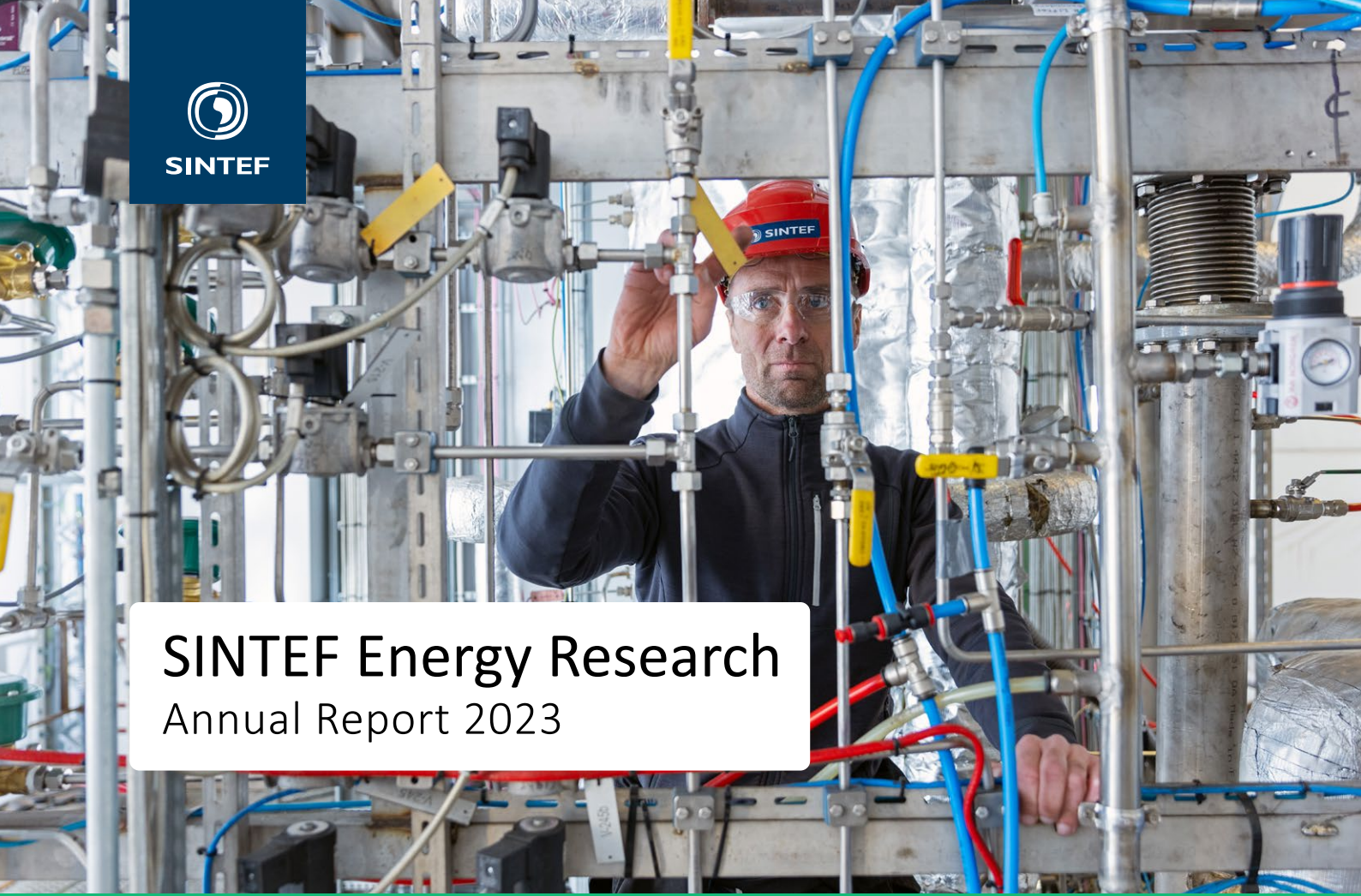
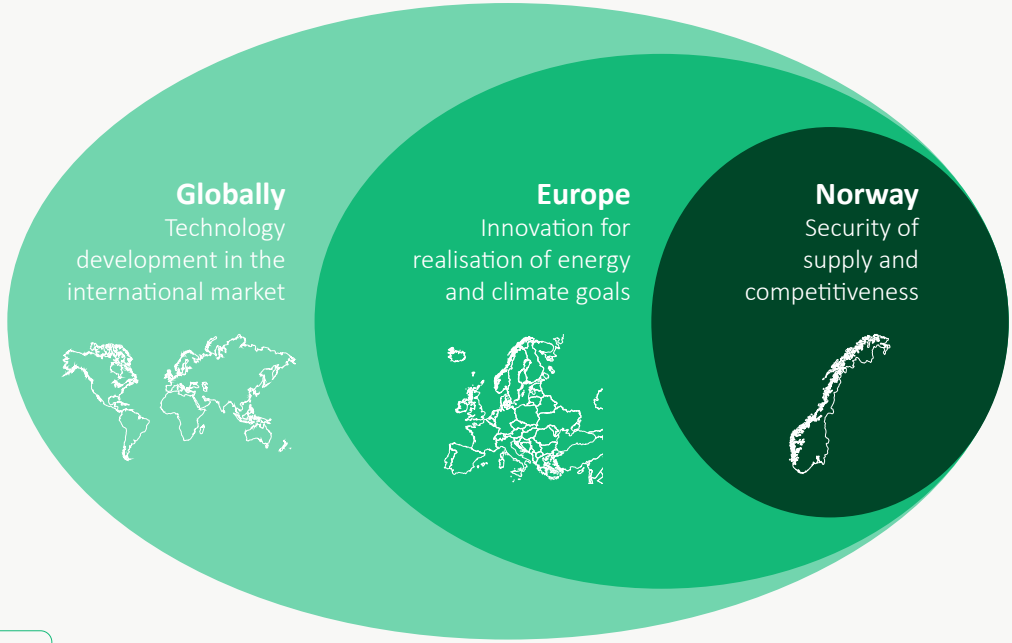


SINTEF Energy Research

Annual Report 2023

We shape the sustainable energy solutions of the future

We shape the sustainable energy solutions of the future



Technology for a Better Society

Front Cover

Nils Erland Haugen at the CLC rig in Tiller, Trondheim. Photo: SINTEF/Geir Mogen.

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 in Norway and internationally. We intend to provide our clients with solutions and services that increase their value and strengthen their competitive ability.

SINTEF Energy Research is 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.

Partnership for sustainable energy solutions

2023 has been an eventful year for SINTEF Energy and the world. Despite a turbulent backdrop, SINTEF Energy experienced good academic and economic results. The world is still reeling from the pandemic and geopolitical unrest. At home, Storm Hans damaged critical infrastructure and private property. This underscores the importance of our work in developing sustainable energy solutions for the future.

The EU is increasingly prioritising the economy, migration, and defence. Although the Green Deal received less attention, energy remains a crucial theme for Europe's economy and security. Our international collaboration, primarily through the EU framework programs, positions us well to exchange knowledge and drive innovation across borders.

The energy system is undergoing a non-linear transformation. New forms of production are introduced, consumption is changing, and distribution must be adapted. In this transformative process, artificial intelligence (AI) is playing an increasingly central role for us and our customers. By harnessing the power of AI, we can improve the efficiency and reliability of energy systems, from predicting demand to optimising distribution networks. SINTEF Energy Research, with its multidisciplinary expertise, is at the forefront of exploring and implementing these groundbreaking technologies.

Through our established model of collaboration with other research environments and industry customers, we are ready to lead this transition. SINTEF Energy Research cooperates particularly closely with NTNU in projects and laboratories and through summer jobs, student assignments, and PhD scholarships. The partnership is based on a shared will to meet challenges with

openness and determination, resulting in an internationally excellent research environment and numerous innovations.

The large centres in the FME scheme illustrate how effective this collaboration model is. One of the innovations from FME HighEFF has resulted in the establishment of the spin-off company Cartesian, which develops solutions to optimise energy consumption using phase-change materials (PCM). The technology can be used for both cooling and heat storage, and helps reduce energy consumption and costs in various industries.

SINTEF Energy is well positioned to develop safe, profitable, and sustainable solutions with our partners. Thank you for the great collaboration this year. I am looking forward to working on upcoming tasks together.

Best regards,

Inge Gran
Managing Director,
SINTEF Energy Research
May 2024

SINTEF Energy Research and 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. The majority of SINTEF Group's revenue in 2023 supports these goals. SINTEF Energy Research primarily contributes to the UN's Sustainable Development Goals in the following areas:

Affordable and Clean Energy

VOur 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 Infrastructure

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 focuses 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 works on energy solutions that balance energy needs with nature conservation, aligning with goal 15. We have particularly long experience with this in hydropower.

SINTEF Energy Research leads six research centres that contribute to the UN Sustainable Development Goals

FME NorthWind

NorthWind aims to support a profitable Norwegian export industry in offshore wind, creating new green jobs while ensuring that wind power is developed in a way that respects both nature and people. In addition to the research partners SINTEF, NTNU, NINA, NGI, and UiO, over 40 Norwegian business partners are involved.

Learn more about
their achievements in 2023:

→ www.northwindresearch.no

FME NCCS

NCCS's main task is to realise the rapid implementation of CO_2 capture, transport, and storage (CCS) through industry and research-driven innovation. NCCS also aims to ensure that Norway remains an internationally leading player in the CCS field and contributes to making large-scale CO_2 storage in the North Sea possible.

Learn more about
their achievements in 2023:

→ www.nccs.no

FME HighEFF

HighEFF develops knowledge and technology for more energy-efficient, competitive, and environmentally friendly industries at equipment, plant, and regional levels. The goal is to develop solutions for efficient energy utilisation so that the Norwegian industry can become the most energy-efficient in the world.

Learn more about
their achievements in 2023:

→ www.higheff.no

FME CINELDI

CINELDI researches the technologies and solutions that allow us to upgrade and digitise the power grid cost-effectively and securely so that it is equipped to handle increased electricity demand, increased power needs, and more non-regulatable renewable energy. The research aims to facilitate more renewable energy in the power grid, electrification of transport, and more efficient energy use in private homes and industry.

Learn more about
their achievements in 2023:

→ www.cineldi.no

LowEmission

LowEmission is a research centre for low-emission technology for petroleum activities on the Norwegian continental shelf. The partners include world-leading Norwegian and international industries, suppliers, operators, energy companies, SINTEF, NTNU, and other top-ranked universities and research institutes. The goal is to facilitate zero-emission oil and gas production on the Norwegian continental shelf.

Learn more about
their achievements in 2023:

→ www.lowemission.no

FME HYDROGENi

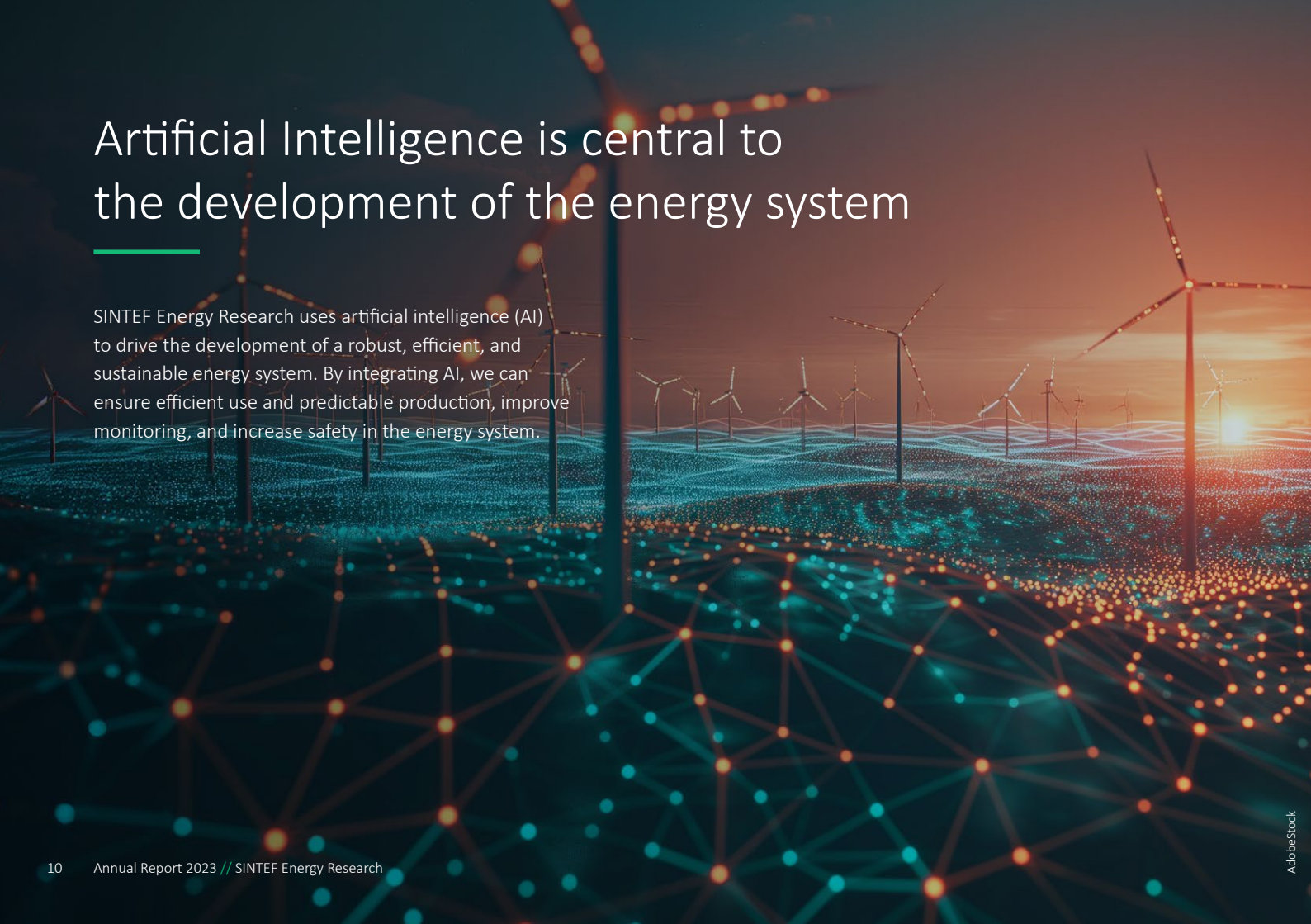
HYDROGENi is dedicated to research and innovation in hydrogen and ammonia. Knowledge, technological solutions, and a sustainable hydrogen economy must be developed for hydrogen to become a key driver in the green transition. These are precisely the challenges that SINTEF and 50 Norwegian and European partners in HYDROGENi are working to solve.

Learn more about
their achievements in 2023:

→ www.hydrogeni.no

Artificial Intelligence is central to the development of the energy system

SINTEF Energy Research uses artificial intelligence (AI) to drive the development of a robust, efficient, and sustainable energy system. By integrating AI, we can ensure efficient use and predictable production, improve monitoring, and increase safety in the energy system.

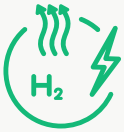


AdobeStock

Our 10 Focus Areas

Smart Grids

Transmission



Integrated Energy Systems

Offshore Wind

Energy Efficiency

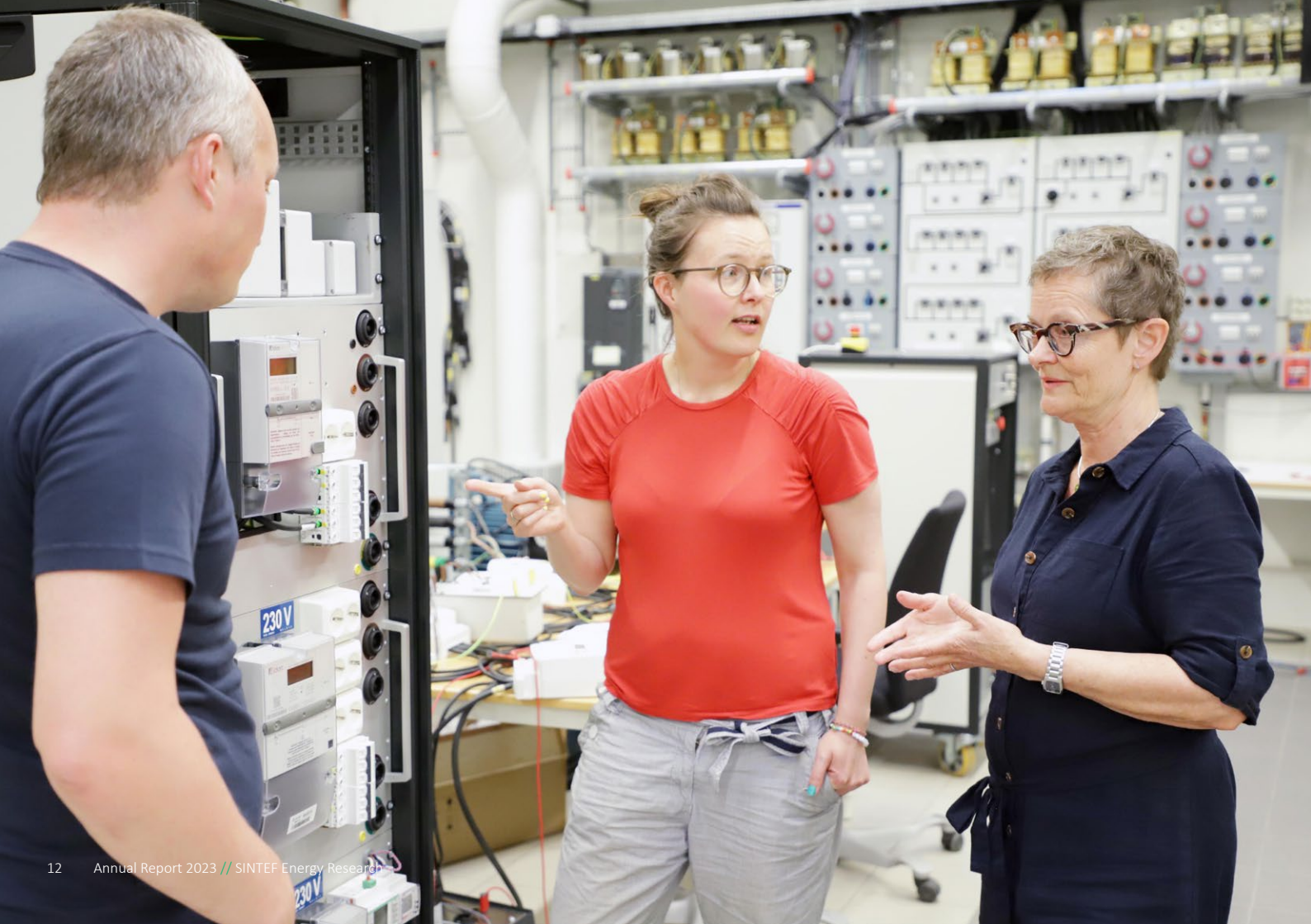
CCS

Hydropower

Bioenergy

Hydrogen

Emission-Free Transport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Focus area

Smart Grids

The development of smart distribution networks is crucial for electrification and the integration of renewable energy sources. A digitalised, cost-effective, and flexible distribution network enables electric transport, efficient energy use, and high supply security.

Our research ranges from groundbreaking innovation projects to improvements of the current network in collaboration with the private and public sectors. SINTEF Energy Research leads FME CINELDI and hosts The Norwegian Smartgrid Centre. We contribute to innovative solutions for a sustainable energy system by participating in and coordinating these collaborative platforms.

← *In the Smart Grid Laboratory, SINTEF and NTNU offer modern facilities for testing, verification, and research on everything from large-scale transmission to smart homes. In the picture; Henning Taxt, Maren Istad and Gerd Kjølle.*

The CINELDI research centre is in its final year of support from the FME scheme and has established an open knowledge base that collects all research results from the centre. The goal is to simplify access to new knowledge about the development of the power grid to meet future challenges. The knowledge base results can contribute to the digitalisation and modernisation of the power grid, ensuring higher efficiency, flexibility, and resilience.

In December, we received the excellent news that SINTEF Energy Research has secured a Green Platform project in collaboration with Heimdall Power, among others. NextGrid is a new research and innovation project that will prepare grid companies' control centres for future complex and automated power grid operation. NextGrid has received NOK 56.8 million from the Research Council of Norway to develop comprehensive solutions for the future operation of the distribution network.

Focus area

Transmission

The transmission network is the part of the power system that transports high-voltage power over large areas. To meet the needs of a more electrified society, the transmission network must withstand disturbances and have a minimal risk of power outages.

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

SINTEF Energy Research, in collaboration with industry partners and REN, has developed the software Grøft Design for planning and designing electrical infrastructure. The software allows for calculating the capacity of cable installations and evaluating different design alternatives. Calculations show that implementing Grøft Design can improve the capacity of Norwegian power cable installations by 5-20%, with a corresponding economic impact of between NOK 0.5 and 2 billion.

The Norwegian National Committee of the International Council on Large Electric Systems (CIGRÉ) Scientific Award for 2022 was presented to Hallvard Faremo, a senior researcher at SINTEF Energy Research. The award was given for the 31st time, marking the seventh win for a SINTEF researcher. CIGRÉ is a global network with 60 national committees in over 90 countries. Each year, the recipient is selected based on the high professional quality of their work, whether theoretical or practical. Since 1986, Hallvard has been an active contributor to CIGRÉ, and his work has led to increased knowledge and standardised procedures for testing and ensuring the quality of new cable designs, which are essential for reliable components in the power supply.

↑ *Hallvard Faremo was awarded "Elkraftprisen" for his work on the long-term properties of cables in wet environments. Research manager Dag Eirik Nordgård attended the award ceremony.*

Focus area

Integrated Energy Systems

Integrating energy systems and different sectors is essential to our transition to a zero-emission society. Decarbonisation will be the main driver towards such a society, but digitalisation and decentralisation will also be important. Together, these three drivers will ensure opportunities and challenges in the important work we face in energy systems.

SINTEF Energy Research contributes to developing integrated energy systems by mapping the interaction between various energy carriers, such as electricity, heat, biofuels, natural gas, and hydrogen. This approach aims to achieve an efficient and sustainable energy supply with high delivery security at a low cost. We also have expertise in how market structure, regulation, and legislation can contribute to securing an efficient and integrated energy system.

Artificial intelligence (AI) and the interest in how AI can revolutionise the energy sector is significant. SINTEF Energy Research takes a leading role in exploring and utilising AI technologies. By implementing AI, companies can achieve more efficient operations, reduce costs, and, most importantly, improve their ability to predict maintenance needs. This paves the way for developing smarter, more sustainable energy solutions that meet future needs and requirements. We must integrate domain knowledge with technological innovation to create the future energy system. This interplay between professional insight and new technology is fundamental to developing effective and sustainable energy solutions.

Investing in measures to achieve the 1.5-degree goal is cheaper than repairing climate damage afterwards. Every 100 NOK spent saves 500 NOK, as stated in a Dagens Næringsliv article by Ingeborg Graabak and Konstantin Löffler, based on research conducted in the EU project Open Entrance, led by Graabak. The analysis shows that Europe's energy system must be almost emission-free by 2040 to reach the goal, as climate neutrality by 2050 will lead to a temperature increase of over two degrees. Measures to achieve the 1.5-degree goal will cost only 5% more than the two-degree goal but will reduce climate emissions by 30%.

↑ *Christian Andresen appeared as a guest on EuroPower's podcast,* Teknologioptimistene *("The technology optimists"), where he discussed the significant potential of using AI to improve and streamline production processes in the energy sector.*

↑ *The Open ENTRANCE project developed a modelling platform that evaluates various low-emission scenarios and solutions for the European energy system. Here are the project partners at one of the meetings held in the European Parliament.*

Focus area

Offshore Wind

Offshore wind has significant growth potential, both nationally and internationally. Many have pointed to offshore wind as a key solution for meeting climate goals because it can cover the current global energy needs many times over. Although offshore wind is more expensive than onshore wind power today, research and innovation contribute to rapidly decreasing costs. Floating offshore wind, in particular, is in its early stages, but Norway has an advantage with its long-term commitment to research and technology development.

SINTEF Energy Research has world-leading research environments in offshore wind and helps industrial partners establish themselves in the international market. The institute has led FME NOWITECH, which started in 2009 and currently leads FME NorthWind. Our research ranges from modelling and regulating wind farms, electrical systems and components, offshore networks, and HVDC to digitalisation, machine learning, and environmental design.

In January, the DeepWind research conference on offshore wind was held for the 20th time in Trondheim. The conference is a collaboration between SINTEF, NTNU, and the European Energy Research Alliance (EERA). The 2023 conference set a new record, with nearly 400 engaged participants, 80 presentations, 150 posters, and extensive networking opportunities.

To promote the goal of net-zero greenhouse gas emissions by 2050, SINTEF and several Norwegian embassies have established the GreenShift Project. The goal is to bring together key government, industry, and research stakeholders from Germany, the Netherlands, Belgium, Denmark, and Norway to strengthen dialogue, collaboration, and innovation for a sustainable energy future. In September, two meetings were held under the GreenShift umbrella, focusing on CCS (carbon capture and storage) and offshore wind.

Norwegian researchers are developing wind turbines that can adjust the speed of rotor blades to prevent bird collisions. These technologies can identify birds at least five seconds in advance using sound signals, lights, rapid stops, cameras, and radars. A computer program predicts the bird's flight path and adjusts the rotation speed to avoid collisions, which takes 15-20 seconds for a 10 MW turbine. Simulations suggest that the system, known as SKARV, can potentially reduce collisions by up to 80%.

TU Ledige stillinger Nyhetsbrev Nyhetsstudio Video Abonner Logg inn Meny

ENERGI

Vindturbiner endrer fart for å unngå fuglekollisjoner

Norske forskere er i gang med å utvikle vindturbiner som kan tilpasse farten på rotorbladene for å unngå kollisjon med fugler.

Forskernes foreløpige resultater tyder på at fire av fem kollisjoner mellom turbin og fugl kan unngås. *Illustrasjonsfoto: Shutterstock*

↑ *SKARV, designed to prevent birds from colliding with wind turbines, is one of FME NorthWind's innovations.*

↑ *State Secretary Elisabeth Sæther from the Norwegian Ministry of Petroleum and Energy opened the 20th edition of EERA DeepWind in January, where she also presented the government's plans for offshore wind.*

Focus area

Energy Efficiency

Norwegian industry accounts for one-third of national energy consumption, and energy efficiency measures will significantly impact the energy system. The industry can reduce its national and international climate footprint by reducing energy demand and developing new methods to reuse energy.

SINTEF researches energy efficiency for our customers in the industrial, transport, and building sectors. An important research area is improving the energy efficiency of Norway's power-intensive industry and better utilising excess heat. Together with our customers, we develop solutions that maximise the use of surplus energy from industrial processes, whether in internal processes, for external potential users, or by returning the energy to an integrated energy system. SINTEF Energy Research hosts FME HighEFF.

Established in 2023, Cartesian is a spin-off company funded by SINTEF Venture. The company develops solutions using phase change materials (PCM) to optimise energy consumption. This technology can be utilised for both cooling and heat storage, offering potential reductions in energy consumption and costs across various industries. Cartesian originated directly from research conducted in FME HighEFF. In its initial stages, research on phase change materials received support from basic research funds.

SINTEF leads FME HighEFF, which in May, organised a conference with the theme "How to Unlock 20TWh of Conflict-Free Energy." Topics included the energy commission follow-up, excess heat utilisation, and rapid implementation of energy efficiency measures. The conference included several politicians on the speaker list and participants from the industry and research. Most participants agreed that the regulatory framework needs to be adjusted to achieve faster progress in energy efficiency. They also agreed that collaboration between industries must be simplified, especially industries that do not usually collaborate.

NemiTek 100 år

Nyheter Arrangementer Om foreningen VVS-dagene Nettbutikk Ledige stillinger

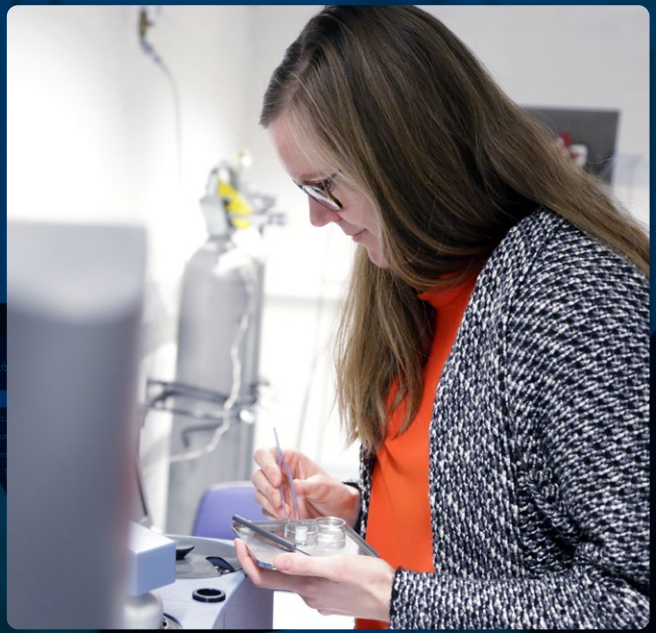
LYKKETREFF: Det startet da Håkon Selvnes (t.v.) og Alexis Sevault (t.h.) møttes med hvert sitt forskningsprosjekt for ti år siden. Snart er Cartesian AS – som også består av Asle Hovda, Mathias Kristensen, Frode Iglebæk og Arne Fredrik Lånke – klare for kommersialisering. Cartesian

ENERGI OG MILJØ

Nyutviklet termisk boks skal løse energikrisen

I ti år har Sintef holdt på med forskning på og utvikling av et eget system for termisk energilagring. Nå står det nystartede selskapet Cartesian AS på terskelen med resultatet, som de mener kan bidra til å løse energikrisen.

↑ *Cartesian is a spin-off from research activity in FME HighEFF.*



↑ *HighEFF is entering its final year and aims to ensure that results and innovations have the maximum impact on industrial energy efficiency. Line Rydså leads the work on innovation strategy and technological roadmaps.*

Focus area

CCS

Carbon capture and storage (CCS) involves capturing, processing, transporting, injecting, and storing CO_2. These processes enable significant reductions in CO_2 emissions from industrial processes, hydrogen production, and power generation. CCS is also crucial for climate-positive solutions, such as bioenergy with carbon capture and storage (BECCS) and direct air capture (DAC).

SINTEF Energy Research hosts the Norwegian CCS Research Center (FME NCCS), a continuation of the successful FME BIGCCS research centre. FME NCCS aims to address key technical and cost challenges to enable the rapid large-scale implementation of CCS. These activities also support the Norwegian full-scale CCS project Longship.

In February, SINTEF Research Scientists Simon Roussanaly and Gokul Subraveti, in collaboration with TU Delft, presented a research article showing that using materials such as cement and steel, which capture and store CO_2 emissions, increases material costs. However, the increased costs represent only a small portion of the total expenses in a construction project, while the emission reductions are substantial. The magazine "Science" highlighted the research in a "News at a Glance" summary.

In September, China opened the world's largest unit for chemical looping combustion (CLC). The test rig results from the EU project CHEERS CLC, led by SINTEF Energy Research. CLC technology can reduce up to 96% of CO_2 emissions from combustion. Additionally, the technology is nearly 70% cheaper than competing technologies.

In June, experts in CCS from around the world gathered in Trondheim for the 12th Trondheim CCS Conference (TCCS-12). The conference saw record attendance and nationalities and submitted technical contributions.

"We need CCS to reach our climate goals. We must reduce costs and optimise solutions across the value chain to make the technology commercially viable. R&D plays a key role here. TCCS is an important meeting place that contributes to knowledge sharing and momentum," said Norwegian Minister of Petroleum and Energy Terje Aasland. ↓

← *Using chemical looping combustion (CLC) on biomass can help reduce, and even remove, CO_2 from the atmosphere. Pictured is the CLC test rig installed in China through the CHEERS CLC project.*

Focus area

Hydropower

Hydropower is a vital resource for renewable and sustainable energy supply, providing the energy, capacity, and long-term storage necessary to maintain supply security. The International Energy Agency (IEA) refers to hydropower as "the forgotten giant". In Norway, hydropower forms the backbone of the electricity system.

With over 40 years of experience in hydropower research, SINTEF Energy Research has expertise in several fields. From power grid analysis, market models, and optimal production planning to hydrology and environmental conditions in rivers and around hydropower plants. We also examine the interaction between hydropower production and other renewable energy sources, such as solar and wind power, and new types of energy carriers, such as hydrogen. The goal is to develop cost-effective solutions while considering nature, local communities, and wildlife.

According to the research project SamVann led by SINTEF Energy Research, active hydropower regulation can significantly mitigate floods and prevent damage. Active regulation requires knowing how much water enters the system and managing the water volumes through turbines, dam gates, or transfers to other water bodies. If these conditions are met, reservoir drawdowns can be planned and executed before a potential flood peak. The cost savings for local and larger communities have enormous potential. After Storm Hans in August, insurance companies reported about 10,000 flood damages to buildings, equipment, and properties, with estimated compensation of up to 1.8 billion NOK.

In September, SINTEF, Akershus Energi, and Hafslund Eco conducted a research project at the Funnefoss power plant. The goal was to understand what happens to fish that pass downstream through the power plant. "When the fish go upstream, there are fish ladders, but there is no ladder to go down," said Senior Researcher Atle Harby at SINTEF Energy Research. In the project, they used digital fish with sensors to map what happens to the fish on their downstream journey. The sensors were developed at the Technical University of Tallinn in the EU project FIThydro on hydropower and fish. SINTEF has received funding from the Research Council to disseminate results from the EU project in Norway.

Meny Da 140 ÅR Kjøp abonnement Logg inn

NYHETER

Kraftverk kan ta kraften ut av flommene

Flomskader for millioner av kroner kan trolig unngås ved aktiv regulering av vannkraftproduksjonen, ifølge Håkon Sundt, forsker ved SINTEF Energi i Trondheim.

– Så lenge det er ledig kapasitet i et vannmagasin vil det dempe en flom, sier SINTEF-forsker Håkon Sundt. Under ekstremværet Hans i august, holdt blant annet Bagnsdammen i Innlandet fylke, igjen store vannmasser. Også vrakrester som følge av flommen, ble stanset på sin ferd nedstrøms. (Foto: Ole Berg-Rusten/NTB)

We can control the amount of water entering reservoirs by actively managing water flow using weather data, flow stations, and modelling tools. Solutions include increased flood mitigation by boosting power production, pre-drawdowns through the dam, or redirecting water to less vulnerable parts of the watercourse.

Screenshot YouTube/Akershus Energi

Bioenergy

There are countless ways to utilise bioenergy. The simplest and oldest form is using wood to build a fire. More modern and complex forms of bioenergy include using biomass to create biofuels, biocarbon or biochar (charcoal), district heating, or electricity. Biomass contains carbon, so when we burn it, we release CO_2. However, bioenergy does not increase CO_2 concentration in the atmosphere because it enters a climate-neutral cycle.

SINTEF Energy Research has conducted decades of research on cost-effective and energy-efficient bioenergy, benefiting industry, authorities, and other organisations by utilising biomass and waste for energy. Biomass can serve various purposes, so it must be used where it provides the most benefit. As a result, our research encompasses multiple perspectives. We work on improving biochar, biofuels, and efficient combustion processes. At the same time, we research sustainable resource utilisation to avoid overexploitation of our bioresources. Additionally, we look at how we can remove CO_2 from the atmosphere through a process called BioCCS.

"Much good has been done with Norwegian aid money, but current aid has only marginally helped low-income countries combat the global crises that threaten them more than others," wrote Petter Støa from SINTEF Energy Research and Anneli Alatalo Paulsen from SINTEF Community in a column in *Teknisk Ukeblad*. They point out that we must use available funds effectively to create lasting change. One example they use is a project where SINTEF has contributed to developing portable carbonisation stoves in Nepal. These stoves offer a cleaner cooking method and enable charcoal production, improving quality of life and creating income opportunities for households. This approach combines environmental and socio-economic benefits, demonstrating our commitment to promoting sustainable energy and economic development globally.

Using biomass in the most energy-efficient and resource-efficient way possible is essential. The SusWoodStoves project, led by SINTEF, has documented that emissions from wood burning have significantly reduced over the past decades, thanks to research and technological development. The results from testing various types of modern wood stoves show that the stoves have significantly reduced emissions of harmful particles and gases while also improving the energy efficiency of wood burning.

TU Ledige stillinger Nyhetsbrev Video Nyhetsstudio Innlogget Meny

KLIMA

Her er innovasjoner som bistands-Norge bør ta i bruk

Ved å tenke nytt om bistandsprosjekter kan store mengder plast holdes unna havet og bli til sement – for å nevne bare et av flere eksempler.

Dette avfallsdeponiet i Nakon Nayok i Thailand inneholder over 40 prosent plast. Det finnes 2500 liknende deponier i Thailand. Nå har Sintef vist land i Asia at ikke-gjenvinnbar plast fra overfylte søppeldynger kan bli en grønn gullgruve for lokal sementindustri. *Foto: Sintef*

Del Kommentar

Petter Støa, forskningsdirektør, og Anneli Alatalo Paulsen, forskningsleder, begge i Sintef
23. okt. 2023 · 11.58

Dette debattinnlegget gir uttrykk for skribentens meninger. Ønsker du selv å bidra i debatten, enten med et debattinnlegg eller en kronikk, les retningslinjene våre her.

Mye bra er gjort for norske bistandspenger. Men dagens bistand har kun i liten grad hjulpet lavinntektsland med å bekjempe de globale krisene som truer dem mer enn oss andre. Det vil si de store utfordringene knyttet til klima, natur, fattigdom, helse og matsikkerhet, som FNs toppmøte nylig diskuterte.

← *Petter Støa and Anneli Alatalo Paulsen called for green innovation partnerships in a column in Teknisk Ukeblad.*

Hydrogen

Hydrogen can generate CO_2-free energy for power, energy storage, industrial and residential heating, and as a fuel (hydrogen or ammonia). This can happen on land, at sea, and in the air. Hydrogen can also play a role in mainland industries, such as steel production. The EU views clean hydrogen as one of the pillars of its future energy system. Hydrogen must be produced from electrolysis with renewable power or natural gas with CCS to meet this demand.

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

SINTEF, along with the renewable energy cluster RENERGY, is leading the coordination of a "hydrogen valley" in Mid-Norway. The initiative was launched in May at Trondheim Maritime Center. The EU leads the "Hydrogen Valley" initiative, intending to establish functional hydrogen value chains locally through collaboration between different sectors and industries. The overarching goal is that the individual chains together form the basis for a full-scale hydrogen economy as a real alternative to the use of fossil fuels. This will enable the region to cut up to 200,000 tons of CO_2 emissions annually.

During "European Hydrogen Week" in Brussels in November, SINTEF and FME HYDROGENi participated with a stand, presentations, and a side event at SINTEF's Brussels office. "European Hydrogen Week" is an annual event that serves as a hub for discussions on the latest developments and innovations in hydrogen at national, European, and global levels. The event is organised by the European Commission, Hydrogen Europe, and the Clean Hydrogen Partnership.

Hydrogen Week in Brussels is a key arena for SINTEF, where we can strengthen our existing network and facilitate new partnerships. Our common goal is to establish a European hydrogen value chain.

Focus area

Emission-Free Transport

Norway is leading the way globally, with a market share of over 80 per cent for electric cars today and a target of 100 per cent by 2025. To halve CO_2 emissions from the transport sector by 2030, all vehicles and vessels acquired after 2030 must have zero-emission solutions. Developing infrastructure for zero-emission solutions for maritime, land-based transport, and aviation is crucial. Propulsion systems based on hydrogen, ammonia, batteries, CCS, and biofuels must be developed to meet the various needs.

SINTEF Energy Research has a diverse portfolio of projects and partnerships in this area to enable the transport industry to carry out the green transition. Charging technology and components are continuously evolving, and in the field of wireless charging, SINTEF Energy Research ‘s work is world leading. We also research the production, handling, and use of new emission-free energy carriers and propulsion systems. Through techno-economic analyses, we provide decision support to industry and public actors in the transition to an emission-free transport system.

OceanCharger is a new project that aims to develop and demonstrate an offshore charging solution for battery-powered ships, and describe the scaling and commercialisation of solutions for emission-free vessel operations in offshore wind farms. The project is part of the Norwegian government's Green Platform initiative, which supports research and innovation-driven green transformation in business to trigger more and faster investments in green, sustainable solutions and products.

Another project supported by the Green Platform is MegaCharge. The project brings together leading players to develop a complete value chain for charging infrastructure for electric heavy transport. This transformation aims to achieve the goal of a 50% emissions reduction for the transport sector by 2030. The need for charging infrastructure is a significant barrier for transport operators who want to invest in electric vehicles. Norwegian companies can gain an important international competitive advantage by leading the development of expertise in charging infrastructure for heavy transport, enabling the export of technology and services with substantial value-creation potential.


MegaCharge

SINTEF was an observer at the UN Climate Change Conference (COP) for the ninth time, where they discussed carbon capture, sustainable cooling, and renewable energy. SINTEF provided scientific input to the Norwegian negotiating delegation and urged Norway to help raise ambitions in climate negotiations, to accelerate the transition from a fossil fuel-based energy system to a renewable-based one.

↑ *Petter Nekså from SINTEF participated in COP28, where 71 countries signed the "Cooling Pledge", committing to reducing emissions from cooling systems by 68% by 2050 to combat climate change.*

↑ *Mona Mølnvik handed over SINTEF's policy brief to Foreign Minister Espen Barth Eide during COP28.*

In 2023, the institute had 37 summer researchers working on various projects. In total, over 70 researchers were supervisors and co-supervisors for the students. The Summer Scientist Project allows students to make real contributions to ongoing research projects.

In collaboration with NTNU's thematic focus area on Energy, we hosted a joint event at Arendalsuka to discuss future power shortages. All FME centres organised events during "Energy Tuesday" with participants from the industry and political parties.

The Electricity Price Committee was an expert group appointed by Jonas Gahr Støre's government to assess the current system for setting electricity prices in Norway. The committee was tasked with considering short- and long-term measures to ensure lower and more predictable prices for electricity users within the scope of the EEA Agreement. Inge Gran, CEO of SINTEF Energy, chaired the committee. On 12 October, the Electricity Price Committee presented its report to Minister of Petroleum and Energy Terje Aasland.

Foto: OED

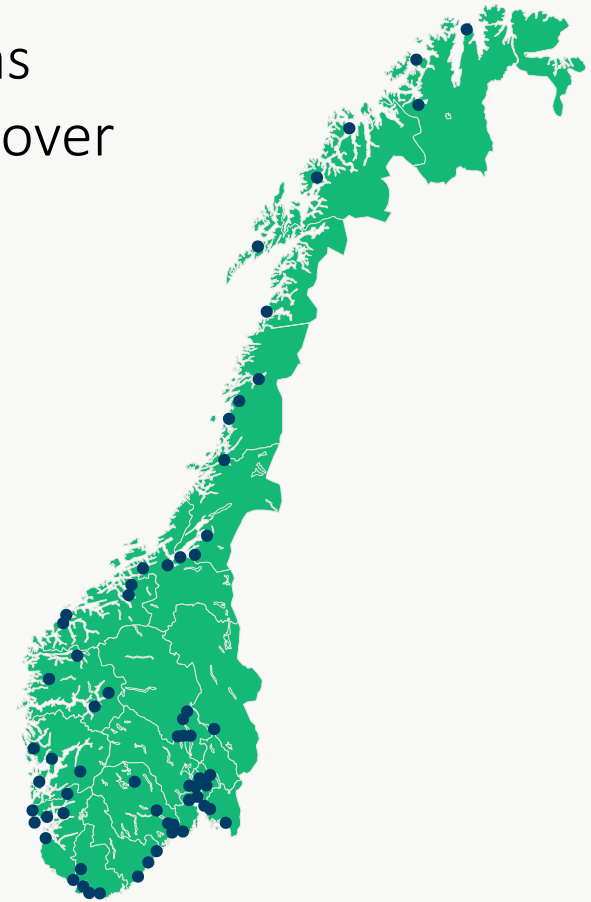
SINTEF Energy Builds for the Future

SINTEF Energy Research is experiencing increased demand, and to ensure we have the capacity for further growth, we are renovating our office building at Gløshaugen. The new building will be ready in 2024.

The construction project has a robust environmental profile. The preexisting building has been repurposed and expanded, reusing many building elements and interiors. Additionally, various environmental measures will be implemented in the old part, including better insulation, solar panels on the roof, and an energy concept utilising a heat pump for heating and cooling.

The building is designed to continue strengthening the co-location with NTNU and positively contribute to the community. The building will have better conference and meeting facilities and informal meeting spaces for SINTEF employees, NTNU staff, and students. The ground floor will feature a canteen open to everyone. The new building will be 11,000 m² with three new floors, making it eight stories high. The number of office spaces will increase from 230 to 400.

SINTEF Energy Research has customers and projects all over Norway and the world.



Our Laboratories

SINTEF builds and operates research infrastructure essential for developing future energy solutions.

In close collaboration with NTNU, SINTEF Energy Research has access to more than 12,000 m² of advanced laboratories. Our laboratories are essential for us to stay at the forefront of international R&D and help ensure the competitiveness of the Norwegian industry.

In our laboratories, we test and verify solutions for finished concepts and components and perform measurements that can be validated in the field. We also have laboratories that combine physical and numerical experiments.

↑ *Franziska Kausch and Judit Sandquist with the gasification reactor at SINTEF Energy Lab.*

Some of our largest laboratories include:

- Electrical Laboratories
- Thermal Engineering Laboratory
- SINTEF Energy Lab
- ElPowerLab
- HighEFFLab
- National Smart Grid Laboratory
- Pan-European CO_2 Laboratories – ECCSEL

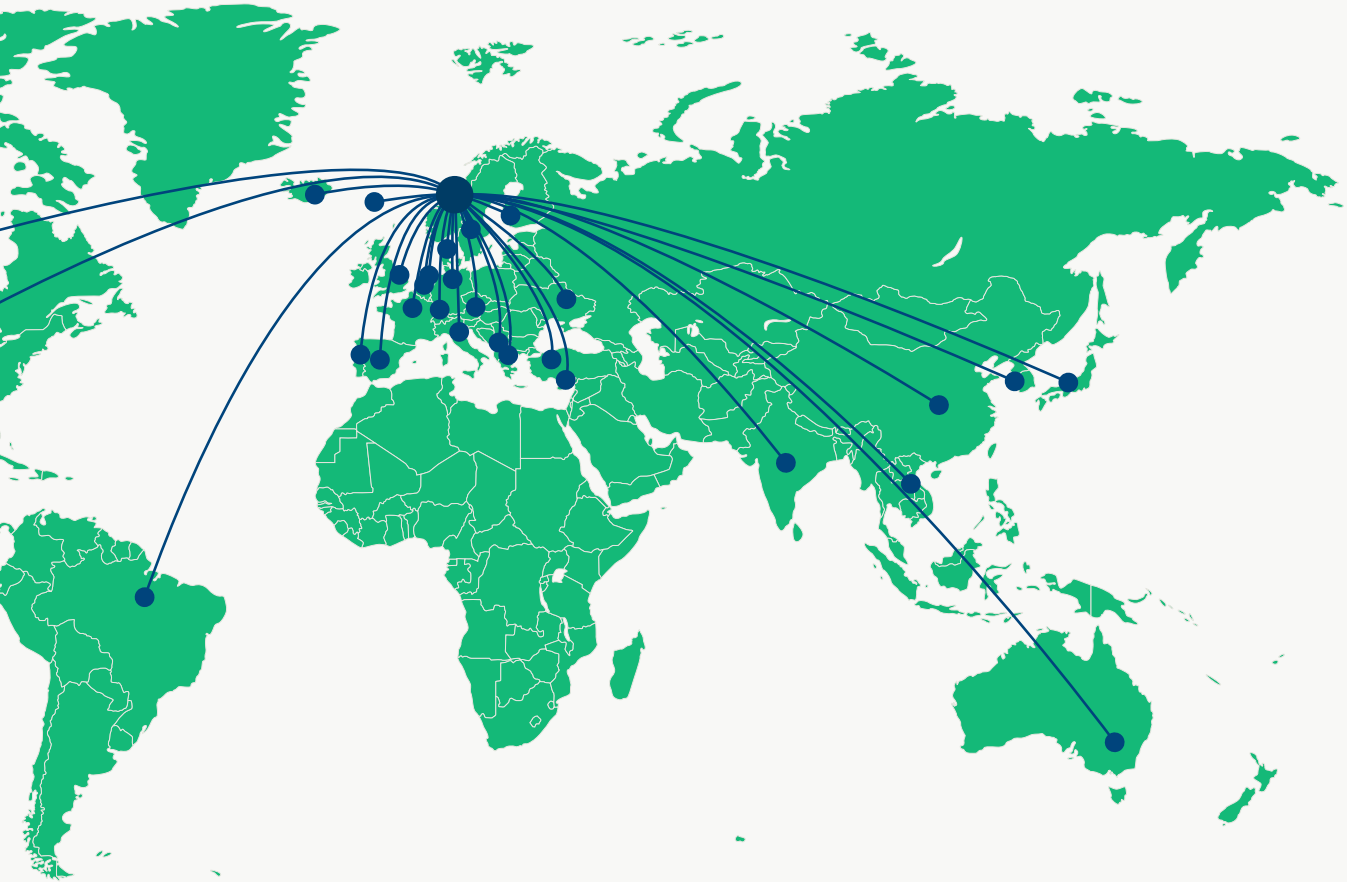
SINTEF Energy's International Research Activity

Our research must be of high quality to contribute to achieving the UN's Sustainable Development Goals, meet industry market needs, and build international alliances. Our close collaboration with industrial customers allows us to secure projects with international funding, particularly within the EU's research program. Our office in Brussels has been instrumental in achieving this position.

The institute's international revenue comes from entities in EU and non-EU countries, with the largest non-EU source being the USA. SINTEF Energy Research participates in several global initiatives, such as EERA, the EU's various technology platforms, and CIGRÉ (International Council on Large Electric Systems). These partnerships help promote research that supports several of the UN's Sustainable Development Goals.

In 2017, Nils A. Røkke, excutive vice president of sustainability at SINTEF, was appointed chairman of EERA, representing over 55,000 energy researchers in Europe. His contributions to energy and sustainability policy in Europe, including his column in Forbes, underscore SINTEF Energy Research's leading role in the European energy debate. Read more about his views and analyses on Forbes' website.

→ www.forbes.com/sites/nilsrokke

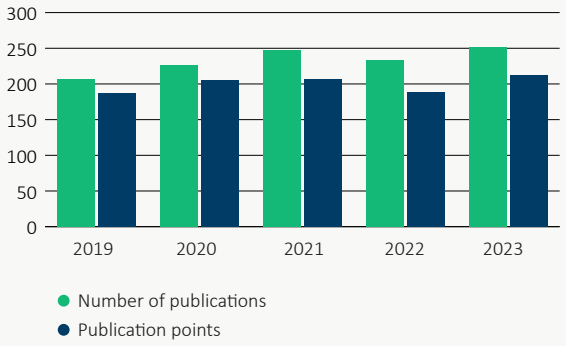


Scientific Publishing

Publications

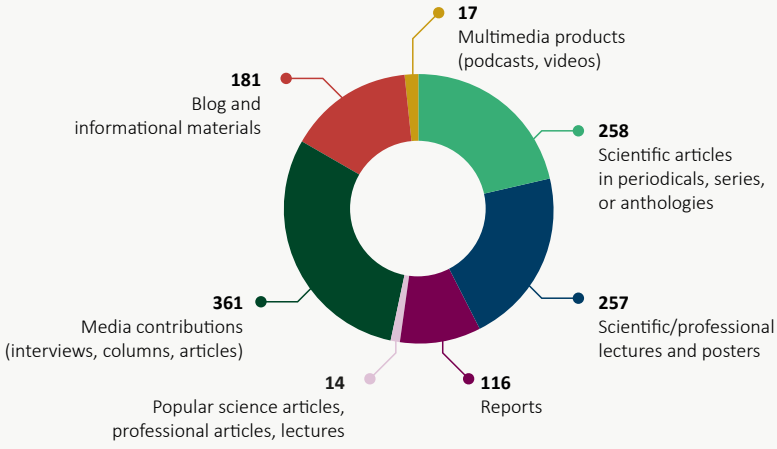
Scientific publishing is central to ensuring our research maintains high international quality. SINTEF aims for at least one scientific publication per researcher per year, and SINTEF Energy achieved this goal in 2023.

Starting in 2023, all of our peer-reviewed publications will be accessible in our archive, SINTEF Open.



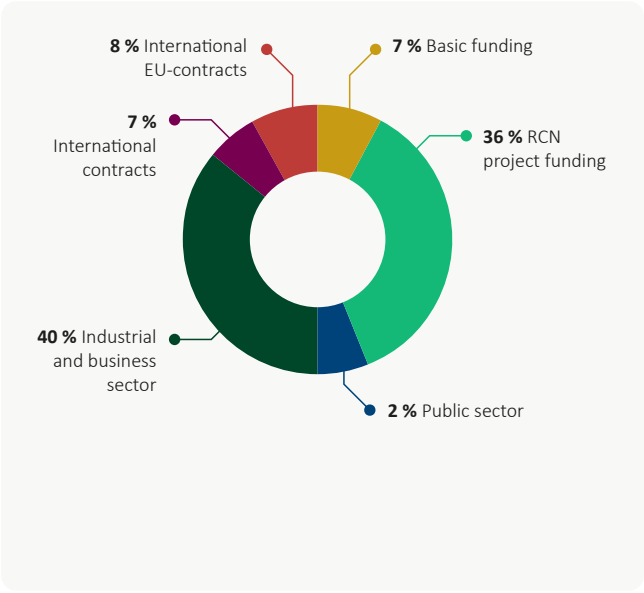
Research Dissemination

The most important dissemination of our research results happens through the adoption of new technology and solutions by customers and society. We use a variety of channels to succeed in this. We build networks and increase the quality of our work through co-publication in scientific articles and project reports. Popular science communication is important for fostering engagement and ensuring our results are accessible to a broad audience.

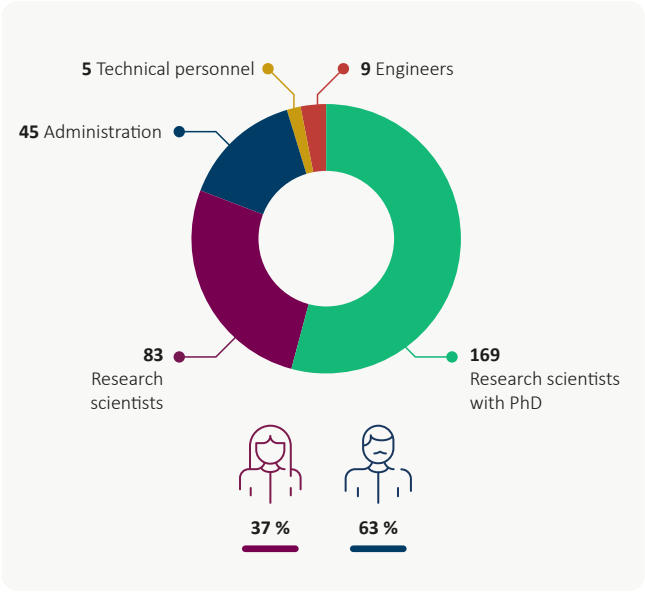


Key Figures 2023

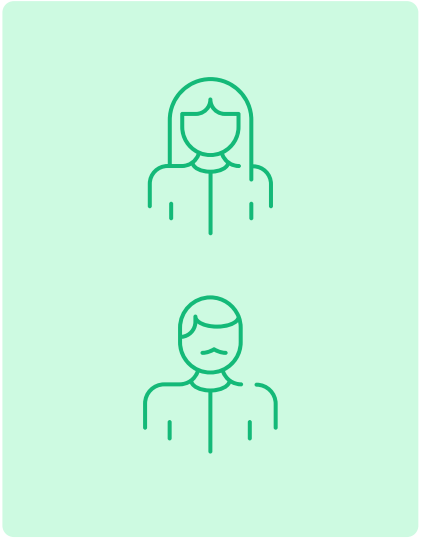
Funding Sources (% of Gross Operating Revenues)



Employees



2023



Board of Directors

- Alexandra Bech Gjørv (Chair), CEO, SINTEF
- Bård Næss Standal, Deputy CEO, Fornybar Norge
- Geir Kulås, CEO, Skagerak Nett AS
- Ragnhild A. Katteland, Director, Nexans Norway
- Liv Monica Stubholt, Partner, Advokatfirmaet Selmer DA
- Ingrid Schjølberg, Dean and Professor, NTNU IE Faculty Administration
- Olav Bolland, Dean and Professor, NTNU IV Faculty Administration
- Sverre Stefanussen Foslie, Researcher, SINTEF Energy
- Maren Istad, Researcher, SINTEF Energy
- Gunnar Berg-Karlsen, Researcher, SINTEF Energy

Management

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

Financial Key Figures

Results	**2019**	**2020**	**2021**	**2022**	**2023**
Gross operating revenues	552	512	574	668	698
Net operating revenues	403	419	464	523	548
Operating result	**32**	**21**	**47**	**40**	**32**
Annual result	**32**	**23**	**45**	**38**	**48**
Balance Sheet					
Fixed assets	202	200	201	246	422
Current assets	470	568	644	718	899
Total assets	**672**	**768**	**845**	**964**	**1321**
Equity	428	451	496	534	582
Debt	244	317	349	430	739
Total equity and debt	**672**	**768**	**845**	**964**	**1321**
Profitability					
Operating margin %	7,9	5,0	10,2	7,7	5,9
Total profitability %	6,4	3,8	7,0	5,5	4,5
Return on equity %	10,1	6,3	11,9	9,7	10,3
Liquidity					
Net cash flow from operating activities	57	68	109	116	384
Liquidity ratio	1,9	1,8	1,9	1,7	1,2
Solidity					
Equity %	63,7	58,7	58,7	55,4	44,0
Operational working capital	227	252	296	289	161

← *Ingrid Snustad explains CCS to school students.*

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