ANNUAL REPORT 2020

sfi

KLIMA2050

Photo: m.c.herzog / visualis-images

Content

Organization

Photo: m.c.herzog / visuals-images

An effective innovation system

One of the recommendations of the Mid-Term Evaluation was to make the Centre's innovation system more visible. During 2020, the Board and management at the Centre have been addressing this topic, and the system is now highlighted by means of the Centre's Innovation Ladder. It is now currently on the website, and is illustrated using an example in the Annual Report.

Throughout the lifetime of the Centre, the Board and management have placed a major emphasis on innovation and the benefits of research to the Centre's user-partners and society in general. Teamwork and effective interaction between partners have been key factors. The choice of research topics, our extensive use of thematic meetings, and investment in pilot projects have been just some of the actions we have taken to raise awareness that research at the Centre

Photo: Erik Burås / Studio B13

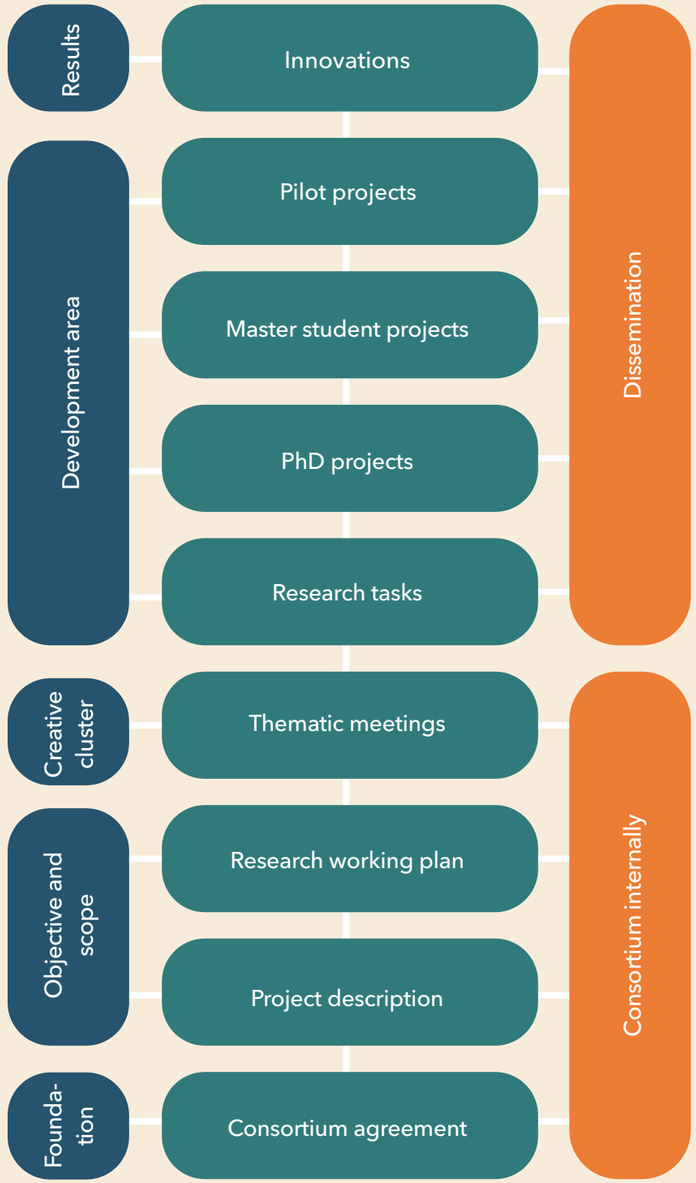
shall result in innovations in the public and private sectors, as well as for the research partners. On behalf of Multiconsult, I can say that the Centre's innovation focus and methods have enabled us more effectively than during previous R&D projects to establish the work carried out at the Centre within our own company.

In this year's report, we tell the story of one of the Centre's projects that illustrates the long road from the identification of a need, the launching of a PhD-project involving collaboration with the Centre's partners, scientific publication, international collaboration, pilot projects, links to Master's theses, research dissemination and the journey towards achieving the final product. In line with the wishes of the Centre's partners, the innovation has been integrated as a new set of instructions as part of the SINTEF Building Research Design Guides (Byggforskserien), enabling the construction of larger, ventilated, low-pitched, timber roofs than has been possible in the past. Many of the project participants are sharing their experiences, and other key players in the sector are emphasising the importance of establishing long-term research into innovations as a clear aim. This story is just one of many that we could have told.

The advice set out in the Mid-Term Evaluation regarding making the innovation system more visible has boosted our awareness of the value of communicating how long-term research can stimulate innovation, and how the Centre's Innovation Ladder can be used to relate good stories.

Grethe Bergly
Chair of the board

The Klima 2050 Innovation Ladder



Vision and main goal

VISION

The Centre for Research-based Innovation Klima 2050 shall be synonymous with excellence within risk reduction through climate adaptation of buildings and infrastructure exposed to enhanced precipitation and flood water. Klima 2050 shall be an effective instrument for the development and implementation of adaptive innovations for the Centre partners and society.

MAIN GOAL

Klima 2050 will reduce the societal risks associated with climate changes and enhanced precipitation and flood water exposure within the built environment. Emphasis will be placed on development of moisture-resilient buildings, stormwater management, blue-green solutions, measures for prevention of water-triggered landslides, socio-economic incentives and decision-making processes. Both extreme weather and gradual changes in the climate will be addressed.

The Centre will be recognised for its research training within the field of climate adaptation of the built environment. Through education of graduate students, training of highly qualified research personnel through PhDs and training of professionals in the sector, the Centre will stimulate new solutions and further research and development in the building, construction and transportation (BCT) sector long after the term of the Centre's existence.

THE RESEARCH IS ORGANIZED IN FOUR MAIN AREAS:

WP1
Climate exposure and moisture-resilient buildings

WP2
Stormwater management in small catchments

WP3
Landslides triggered by hydro-meteorological processes

WP4
Decision-making processes and impact

Photo: Unsplash

The partners / consortium

The user partners represent important parts of Norwegian building industry; consultants, entrepreneurs, property developers, producers of construction materials and authorities. The value chain within Klima 2050's fields of research is complete. Private partners in the consortium in 2020:

Finans Norge, Isola AS, Multiconsult AS, Mesterhus, Norgeshus AS, Powel, Leca AS, Skanska Norway and Skjæveland Gruppen. Public partners: Avinor AS, Jernbanedirektoratet, NVE (the Norwegian Water Resources and Energy Directorate), Statens vegvesen, Statsbygg, and the municiplity Trondheim kommune.

The host institution for SFI Klima 2050 is SINTEF, and the Centre is directed in cooperation with NTNU. *BI Norwegian Business School, Norwegian Geotechnical Institute (NGI) and Norwegian Meteorological Institute (MET Norway) are research partners.*

Private sector

SKANSKA
MESTERHUS
Multiconsult
Finans Norge
SKJÆVELAND GRUPPEN
NORGESHUS
Leca
isola
powel

Public sector

Statens vegvesen
Noregs vassdrags- og energidirektorat
NVE
AVINOR
Jernbane-direktoratet
STATSBYGG
TRONDHEIM KOMMUNE

Research & education

SINTEF
BI
NTNU
Meteorologisk institutt
NGI

The organization

CENTRE MANAGEMENT

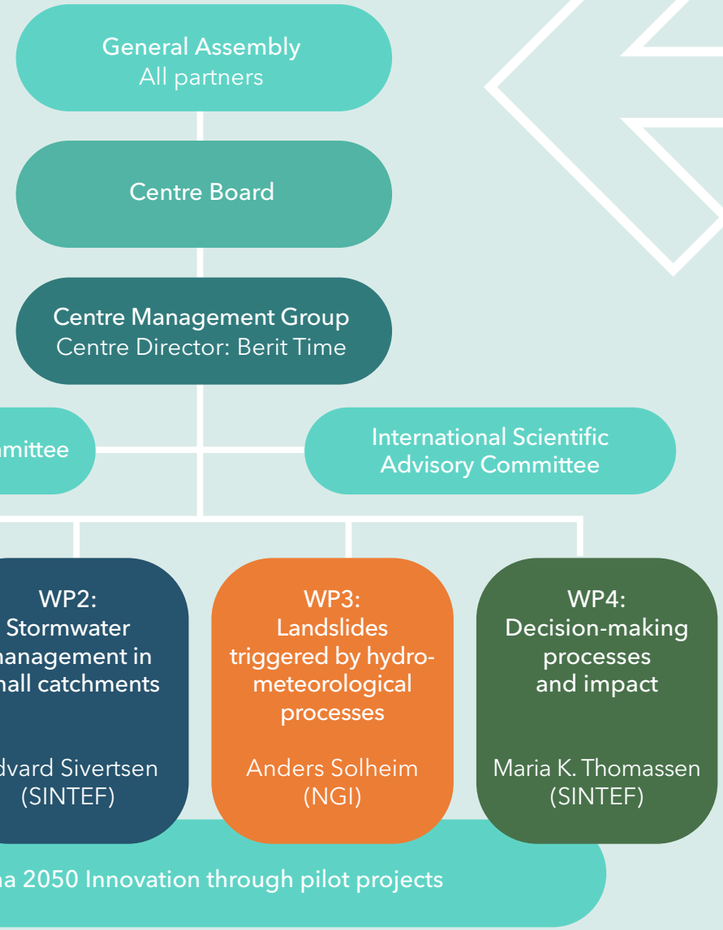
Berit Time, *chief scientist at SINTEF, Centre Director*
Tore Kvande, *professor at NTNU, Principal Investigator (WP1)*
Edvard Sivertsen, *senior research scientist SINTEF (WP2)*
Anders Solheim, *senior geologist at NGI (WP3)*
Maria K. Thomassen, *research manager SINTEF (WP4)*
Lena Bygballe, *associate professor at BI Norwegian Business School (WP4)*
Jorunn Auth, *administrative coordinator at SINTEF (adm)*

CENTRE BOARD

Grethe Bergly, *Multiconsult (Chair)*
Turid Stubø Johnsen, *(until July 2020),* **Grethe Vikane** *(from August 2020)*
Anders Fylling, *Statsbygg*
Einar Aassved Hansen, *Trondheim kommune*
Rune Egeland, *Skjæveland Gruppen*
Kristin Holte, *Skanska Norge*
Lars Andresen, *NGI*
Vikas Thakur, *NTNU*
Hanne Rønneberg, *SINTEF*
Svein Erik Moen, *The Research Council of Norway (observer)*
Veslemøy Nestvold, *SINTEF (observer)*

Christoffer Serck-Hanssen, *Jernbanedirektoratet, 1. Deputy*
Dag Runar Båtvik, *Norgeshus, 2. Deputy*

Chair of General Assembly: *Jørgen Young, Isola*



sfi Centre for Research-based Innovation
The Research Council of Norway

2

Innovations

Photo: Nicola Lolli

When dreams come true at Klima 2050

Tore Kvande
NTNU

Lars Gullbrekken
SINTEF

Nora Schjøth Bunkholt
SINTEF

Innovation doesn't happen overnight, but in 2021, six years after the launch of the climate-related research and innovation Centre Klima 2050, its work is beginning to bear fruit. The solar panel-covered ZEB Laboratory, a zero-emissions building, is about to be opened, and SINTEF's Building Research Design Guidelines are changing the recommendations for the length of a ventilated timber roof from 15 to 30 metres.

Many factors have to come together in order to make changes to SINTEF's Building Research Design Guidelines (*Byggforskserien*). Lars Gullbrekken was well aware that the requirements were strict when he embarked on his PhD in 2014 with the aim of investigating what it takes to build climate-resilient timber roofs. But by 1 April 2021, Design Guide number 525.101, entitled *"Pitched, ventilated wooden roofs with insulated roof surfaces"*, should be ready for use.

"When you started your PhD, did you ever think that it would lead to changes to the Design Guidelines?

"We know that such processes are difficult, and a lot of documentation is required", says Gullbrekken. "Our goal was to bring

Photo: m.cherzog / visualfs.images

“We recognised a need for better guidelines adapted to the requirements of the industry and society at large. The use of timber in building construction, including in load-bearing structures as a replacement for steel and concrete, is an important contribution to the reduction of greenhouse gas emissions.”

Tore Kvande, professor at NTNU

about change, so we decided to make every effort to achieve it. It is fantastic that the recommendations for the ventilation of longer and flatter roofs have been reviewed”, he says.

A good idea

Gullbrekken’s PhD formed part of the *Klima 2050* Centre’s application to be formally designated as a Centre for Research-based Innovation (SFI). One of the motivations behind his research was that SINTEF, where Gullbrekken works, was receiving more and more requests from an industry that was keen to know about the construction of ventilated timber roofs and uneasy that the existing Design Guides restricted roof lengths to 15 metres.

“This work was one of the original ideas developed at the Centre in response to input from NTNU, SINTEF and the industry”, says Tore Kvande, Gullbrekken’s supervisor, a Professor at NTNU and Principal Investigator at the *Klima 2050* Centre. “We recognised a need for better guidelines adapted to the requirements of the industry and society at large. The use of timber in building construction, including in load-bearing structures as a replacement for steel and concrete, is an important contribution to the reduction of greenhouse gas emissions”, he says.

Photo: Nicola Lolli

Pieces falling into place

The team needed reliable data and good calculations.

"The first challenge was to mobilise a manageable and relevant laboratory model", says Kvande. "We've involved six Master's students, each working for five months, carrying out various measurement experiments, field studies and calculations. A great deal of effort lies behind this work", he says.

The measurements and calculations enabled the team to build longer and flatter roofs. Kvande says that in recent years it has become popular to build houses in the modern, functional *(funkis)* architectural style that commonly employs a roof pitch angle of about seven degrees.

Ole Mangor-Jensen at Skanska says that the documentation developed during the project has been very useful to his company. Skanska's challenge when they want to test new construction solutions is that most contractors want the design phase to be completed quickly and efficiently according to documentated solutions.

"There is a great demand to verify new solutions and test different construction approaches for the future."

Ole Mangor-Jensen, Skanska

"There is a great demand to verify new solutions and test different construction approaches for the future", says Mangor-Jensen. "This is why we are participating in the work at the *Klima 2050* Centre", he says.

Great opportunity for a Master's thesis

Among the many pieces of the project that Kvande refers to and values very highly, is the Master's thesis completed by Nora Schjøth Bunkholt in 2019. Nora investigated the phenomenon of thermal buoyancy, which is a key factor in the ventilation of pitched timber roofs.

"It's been great to be able to complete my Master's as part of a research project. I was able to perform experiments in a well-equipped laboratory, and for a student like me this was a once-in-a-lifetime opportunity", she says. Nora also benefitted from establishing a network of contacts and close support from both NTNU and SINTEF.

"Among my motivations was that I was able to work on developing something that is needed by wider society, as opposed to a project driven entirely by self-interest", says Bunkholt, who now works at SINTEF and is involved in many projects being carried out at the Klima 2050 Centre.

Sector anticipating new guidelines

Gunhild Ella Reistad is the Head of Unit who supervises SINTEF's

Building Research Design Guidelines. She promises that the 25-page set of instructions, describing the design of pitched, ventilated timber roofs with insulated roof surfaces and exterior downspouts, will be published in April 2021. It has been a long and laborious process.

"It isn't often that we make such extensive changes to the Design Guidelines, so this represents something of a milestone", says Reistad. "They will present well-documented, high quality and safe solutions for a wide range of applications", she says.

The Design Guidelines consist of 800 separate sets of instructions covering 45 different technical fields, ranging in everything from the details of installing a window to how to understand the statutory regulations governing building construction in Norway (TEK17).

About 4,500 different companies are using the guidelines.

"What process is involved when the guides are changed?

"A team of ten people get together to review input to new or changed guides", says Reistad. "The team's conclusions are then sent to the industry for consultation before publication. We received a lot of feedback in connection with this particular guide, and this is a good indication that it is of interest and a topic greatly anticipated by the industry", she says.

Photo: m.cherzog / visualis.images

The company Skjævelandgruppen/ Storm Aqua has been responsible for designing the stormwater management system with innovative 'blue-green solutions', by which all rainwater run-off is collected in a storage tank.

Solar panels as roofing

As part of his PhD studies, and with the aim of saving materials and costs, Gullbrekken started to investigate the possibility of using solar panels as a roofing material in the form of so-called Building-Integrated Photovoltaics (BIPV). The technology has since been applied in the ZEB Laboratory and there is great demand for it in the construction industry, although there is also a need for further testing and documentation.

The ZEB Laboratory building has been tested with a view to weather predictions for the next 100 years, during which levels of precipitation are anticipated to be much greater than today. The most favourable roof pitch angle for optimum electricity generation has been found to be 32 degrees. The fact that it is a zero-emission building means that it produces more electricity than it needs for its own operation and to offset emissions generated by its construction and the manufacture of its component materials. Any surplus electricity is supplied to NTNU's electricity grid.

Sharing research generates expectations

Gullbrekken has given many presentations of his PhD results, and these have been met with great interest. He believes knowledge sharing is of great importance when the aim of the research is focused on innovation and societal change. Several mainstream Norwegian media have published the popular scientific article entitled 'Timber roof suitability in large buildings'.

"Popular scientific articles and presentations help to disseminate knowledge and generate interest in what you are doing. They also generate a level of expectation that stimulates the industry to demand change and innovation", says Gullbrekken.

Lars Myhre
Norwegian Home Builders' Association

Snorre Bjørkum
Norgeshus

Klima 2050 is essential for new solutions

"The collaboration between the construction industry and research at the Klima 2050 Centre is highly commendable", says Lars Myhre from the Norwegian Home Builders' Association. "Climate change and environmental challenges are increasing the need for more rapid changes in the industry", he says.

"Traditionally, the construction industry has based its competency on experience sharing by which knowledge passes from master to apprentice", says Lars Myhre, who is Technical Director at the Norwegian Home Builders' Association. "But climate change and other environmental problems mean that we can no longer wait a generation to see if a new solution works. We need a faster pace of change, and that is why we need *Klima 2050*", he says.

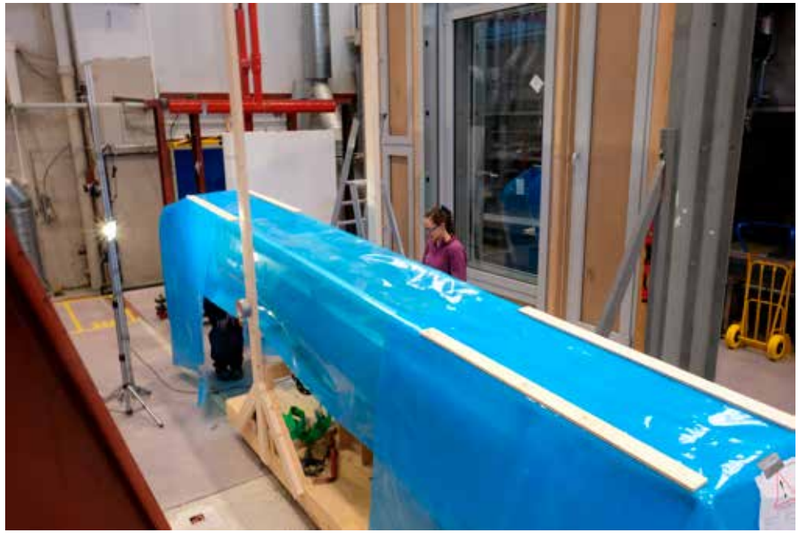
Myhre says that participation in research has traditionally been somewhat remote from the traditional conservative practices of the construction industry.

"It is highly commendable that two of our members, *Norgeshus* and *Mesterhus*, who are also competitors, are participating as research partners at the Klima 2050 Centre", says Myhre.

Research results must reach out

Myhre, who also has a seat on the Design Guides committee, believes that the close collaboration between research and the consumers of new knowledge is exciting, and that it represents a role model for other research projects. “Researchers get an opportunity to test their solutions in real life, while at the same time their research results are brought closer to the industry”, he says. “It is incredibly important that research results are communicated in an understandable way, directly to the industry, as is being achieved by the Klima 2050 Centre. Publications that are restricted to academic journals do little to promote new industry practices, even if the researchers benefit with their so-called publication credits”, says Myhre.

He continues. “When changes are made to the Building Research Design Guidelines, as is the case here, you are guaranteed that they will hit the mark. The guidelines represent the industry ‘bible’, and are an important form of quality assurance. Now we have the evidence to show that it is safe to build ventilated roofs that are longer than was possible in the past”.



Norgeshus: pilot projects are useful

Snorre Bjørkum is a Technical Manager at the construction company Norgeshus, and confirms that together with statutory regulations, the Design Guides are what the industry most depends on.

“We are faced with a challenge if documented solutions are not set out in the Design Guides”, he says. “The fact that they are continuously expanded and updated offers us greater flexibility and opportunities during our building projects”.

The company has participated in several pilot projects linked to the Klima 2050 Centre. Together with SINTEF, among others, they have participated in the development and progress of one of the projects. Bjørkum believes that the fact that the project started at the Klima 2050 Centre made it easier to get it approved and funded by the Research Council of Norway.
“We greatly value being part of pilot projects that enable us to gain experience that will benefit the entire industry”, he says. “We boost our in-house knowledge and establish new contacts who we can learn from. This is incredibly positive”, says Bjørkum.

An international collaboration with Chalmers University of Technology has been part of the project *Climate adaptation of wooden roofs*. The Centre had two master students from Sweden, Toivo Säwén and Martina Stockhaus, working with Nora Schjøth Bunkholt in the laboratory. They have been studying thermal buoyancy in cavity-ventilated roof constructions. The collaboration also resulted in two scientific journal articles, and it has been important knowledge for the new design guidelines. PhD Candidate Erlend Andenæs follows with interest the work.

3

Glimpses

Photo: NGI

Photo: Skanska

Stormwater management for the Rv3 highway

The new Rv3 highway from Ommangsvollen to Grundset was opened to traffic in July 2020. Stormwater is managed using swales and sand filtration, in which local sand is used as a filtration layer installed in the swales. Using these new installations for the Rv3 as its focus, the Klima 2050 research and innovation Centre has established a pilot project with the aim of documenting the functionality and efficiency of the stormwater systems, including maintenance needs over time. In order to monitor water balance and transport in the area, a weather station and associated sensors have been installed along 500 metres of the highway with the aim of monitoring water levels in the various layers making up the swales.

Two student projects were completed during autumn 2020, one of which focused on water transport, and the other on water quality.

The construction companies Skanska and Multiconsult, the Norwegian Public Highways Authority (Statens Vegvesen), NTNU and SINTEF all participates as partners in the pilot project.

ANNUAL REPORT 2020

Damage potential of a temporary floodway

In 2020, student Veronica Tørudstad was awarded the RIF (Consulting Engineers' Association) prize for best Norwegian Master's thesis in the field of water and waste engineering. Her degree was carried out in conjunction with a project linked to the Klima 2050 Centre. The RIF represents a group of knowledge-based companies that participate in planning, management and consultancy linked to the development of 'the Norway of Tomorrow'. Its members comprise more than three quarters of the Norwegian consulting industry, employing about 11,500 people and with combined annual revenues of about NOK 15 billion.

The title of Veronica's thesis is 'A method for mapping the vulnerability and damage potential of a temporary floodway'. A three-step strategy has become established as the industry standard in Norway for stormwater management. It involves 1) the infiltration of water from small precipitation events; 2) the delay and detaining of water from medium-sized events and 3) safe floodways for the discharge of water from the largest precipitation events. The last decade of research has focused mainly on the first two steps, but Tørudstad has written a thesis that addresses step three. Her work represents an original, systematic and relevant contribution to the discussion about how we should map and categorize urban floodways.

"The thesis was awarded an 'A' grade and meets all the award criteria set out in the RIF statutes", says Kristian Ohr, who is the leader of the RIF's expert group in water and environmental engineering.

Photo: NVE

Photo: NVE

Improved probability and impact analyses linked to natural hazards affecting roads

Current methods and tools available for cost-benefit analyses of Norwegian infrastructure's adaptation to climate change do not in fact capture climate change phenomena very well. The Klima 2050 Centre has entered this challenge on its research agenda. In collaboration with the Norwegian Public Roads Authority (Statens Vegvesen), the Norwegian Water Resources and Energy Directorate (NVE) and the Norwegian Railways Directorate (Jernbanedirektoratet), the Norwegian Business School (BI) has assessed and analysed the existing cost-benefit analysis methods and tools used by these agencies with the aim of obtaining a better understanding of this topic.

The work has been presented and discussed at a number of meetings, including a Klima 2050 thematic meeting held in April 2020 that attracted a wide audience, including participants from outside the three agencies. Specifically, the work has resulted in a new initiative adopted by the NPRA to develop a pilot version of a method for assessing floods and stormwater. This has been incorporated into its existing cost-benefit tool, EFFEKT, and will include parameters for probability and the impact on roads of variations in natural hazard phenomena.

ANNUAL REPORT 2020

A new methodology to promote effective interdis-ciplinary urban planning

Climate change has introduced major complexities and challenges for stormwater management in the context of urban planning. A Klima 2050 pilot project called *Stormwater planning*, involving the company Multiconsult, Trondheim municipality and SINTEF, is currently addressing climate risk management related to stormwater phenomena as part of future urban planning. The idea is that future planning in urban areas should incorporate a manageable risk of the impacts of climate change, while at the same time enabling the development of attractive and resilient urban environments. A new methodology is being developed that promotes effective interdisciplinary urban planning, and which can be applied in a number of consultancy business areas. Testing the methodology will enable municipalities to obtain new experience and to participate in evaluating design solutions in practice. Practical recommendations are also being developed on how climate adaptation can be taken into account in current planning processes. These innovative stormwater planning methodologies and tools are expected to have a major impact on society as a whole.

Photo: NTI

Protecting motorists along the legendary Trollstigen

The Trollstigen is without doubt a true masterpiece of highway engineering. The road incorporates eleven hairpin turns that wind their way up from the valley to the Trollstigen plateau, and offers majestic views down the valley to Romsdalsfjord. Trollstigen has become Norway's most-visited national scenic route, but it also has a darker aspect. The steep mountain slopes are susceptible to rockfalls and debris flows, and a single event can impact the road at multiple locations downslope. Such events are often triggered by short duration and high intensity rainfall events.

The aim of a pilot project, called Trollstigen, will be to develop the framework for an early warning system that integrates regional and local data as a basis for facilitating optimal risk management involving road closures of the shortest possible duration. The pilot project infrastructure includes a permanent weather station, a temporary mobile weather radar system and instruments to measure surface water flow.

The partners participating in this Klima 2050 project are the pilot owner, the Norwegian Public Roads Authority (Statens Vegvesen), the Norwegian Meteorological Institute (MET), the Norwegian Geotechnical Institute (NGI), the Norwegian Water Resources and Energy Directorate (NVE) and the company Multiconsult.

Use of regional landslide warnings in municipal contingency planning

Climate change means that in the future, Norwegian municipalities may be facing greater challenges related to landslides. Our current structural measures used to control landslides are neither realistic nor feasible in all situations, so it is essential to include landslide events in municipal contingency planning. The active use of regional landslide warnings will help to identify targeted emergency measures that will reduce risk. The Klima 2050 centre has prepared a draft report that addresses the use of landslide warnings in municipal contingency planning. The aim of the report is to increase the usefulness of the warnings provided to Norwegian municipalities. It provides knowledge about warning systems and landslides, as well as guidance on how information from various sources about landslide risk (e.g. vulnerable areas, risk maps and historical landslides) can be combined with regional warnings to provide improved decision support. Moreover, a survey has been prepared to investigate municipalities' needs and current practices in terms of their contingency planning preparation. The survey has been sent out recently and the results will be used to target and improve the content of the report.

Photo: Krister Kristensen, NGI

ANNUAL REPORT 2020

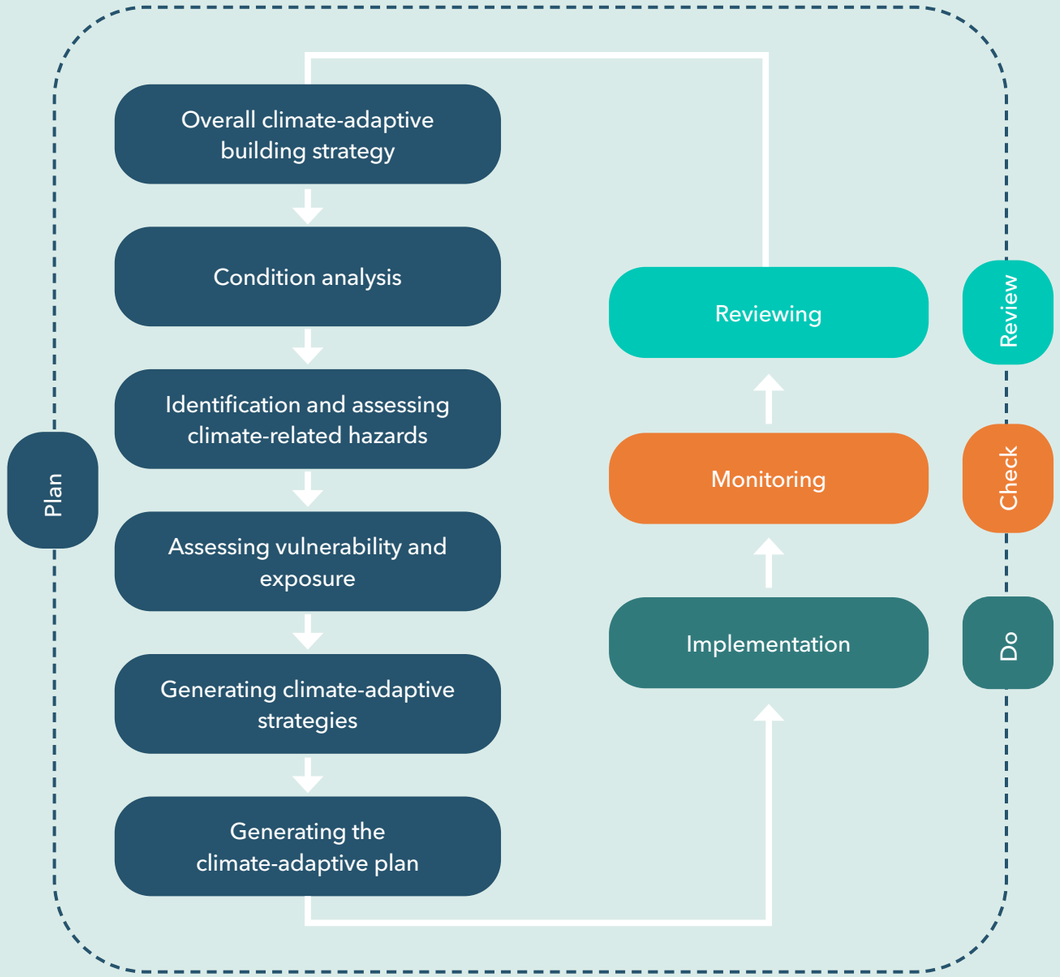


Illustration from: Grynning, S, Gradeci, K, Gaarder, J.E, Time, B, Lohne, J & Kvande, T: Climate Adaptation in Maintenance Operation and Management of Buildings. Buildings 2020, Vol 10(6), 107

Climate adaptation in building maintenance and operations management

The Klima 2050 centre has analysed the basic criteria, trends, applications and developments related to climate adaptation in building maintenance and operations management (MOM) practices in Norway. Investigations conducted as part of the study have included an analysis of current literature addressing climate adaptation in relation to MOM practices, supplemented by a review of existing research projects and initiatives in this field.

Three case studies involving different Norwegian building owner organizations were examined in order to investigate the current status of the application and the extent of climate adaptation practices as they relate to MOM. The work revealed a significant gap between theory and practice when it comes to the integration of MOM in a climate adaptation context.

The concept of climate adaptation is only addressed as a high-level strategic issue. The case studies serve to emphasise the need for a structured process that enables the incorporation of climate adaptation into current MOM practices.

The centre proposes a practical, generic and structured climate-adaptive MOM framework that will enable the concept of climate adaptation to be included in corporate MOM practices at different scales and organizational levels.

24

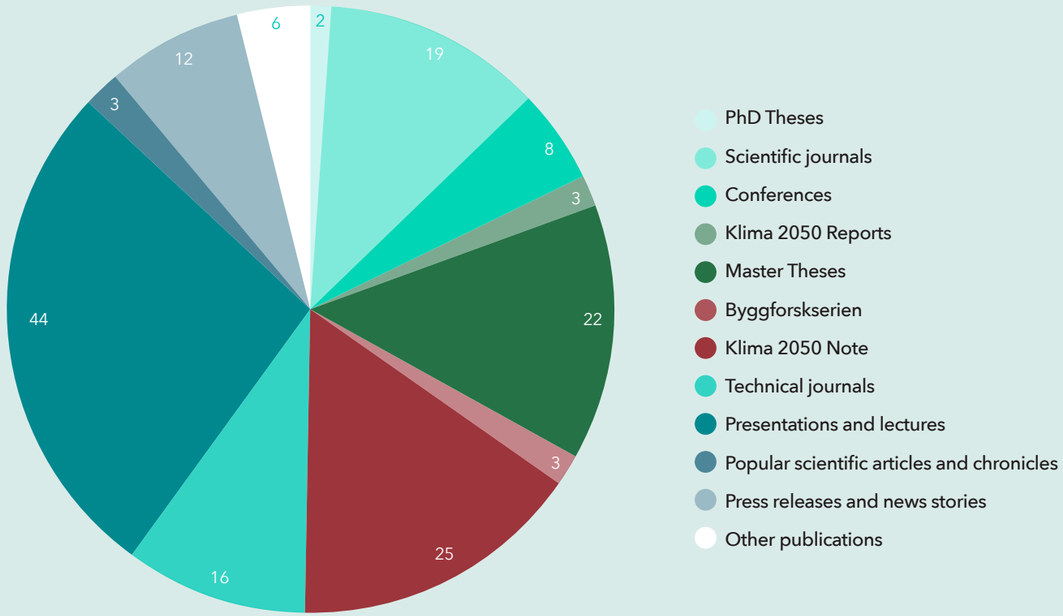
Key figures

Photo: SINTEF

Communication and visibility

The policy of the Centre is to publish at least one user-oriented/ public-oriented publication for each scientific publication focusing on the practical benefit of the scientific work. The counting by the end of 2020 shows following distribution of publications.

All publications are listed on **www.klima2050.no**



PhD

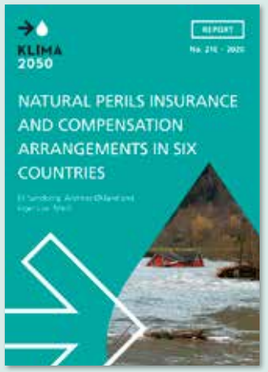
Defence of PhD-thesis: Vladimir Hamouz.

Vladimir Hamouz defended his thesis at NTNU with the title «Retention and detention-based roofs for stormwater management in urban environments in cold climates».

In the photo:
Vladimir, the committee and supervisors:
Professor Harri Juhani Koivusalo, Aalto University, Finland.
Assistant Professor Anna Palla, University of Genova, Italy.
Associate Professor Thomas Meyn, NTNU.
Professor Tone Muthanna, NTNU.
Head of Water treatment and planning section
Tor Håkonsen, Multiconsult

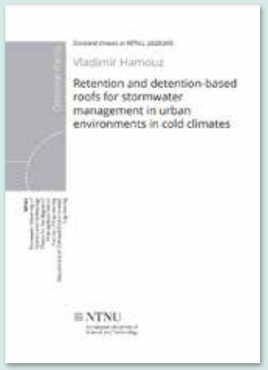
Publications

Some examples from publications in 2020



Klima 2050 Report


Scientific journal



PhD

Technical journal

Thematic meetings

- gatherings organized including all or part of the consortium with the purpose of contributing to the dissemination of knowledge, experience exchange, research exchange and innovation.
- a meeting point for the partnership.

The meetings, collecting between 25 and 150 people in 2020 are important in view of knowledge exchange, the researchers receive direct input to the research work and areas of closer collaboration are pointed out. Due to Covid-19 all meetings but one have been virtual, and many more participants have been able to participate.

- *Varsling av jord og skred.* NVE, Oslo 11. februar
- *Use of grey-green solutions for rooftops, permeable pavements and rain gardens to manage stormwater at ZEB Laboratory,* 17. Mars
- *Samfunnsøkonomiske aspekter ved klimatilpasning*, 20. april
- *Fuktsikre konstruksjoner mot bakken*, 28. april
- *Data Sharing: value propositions and business models in the context of climate risk mitigation,* 24. Juni
- *Naturbaserte løsninger – overvann og skred,* 14. september
- *Jølsterhendelsen – Hva har vi lært og hvordan tar vi dette videre?* 18. september
- *Begrepsbruk i overvannshåndtering – hva mener vi med de ulike uttrykkene*, 23. oktober
- *Klimarobuste kompakte tretak med smarte dampsperrer*, 9. november
- *Fordrøyende tak og utvendige taknedløp – hvorfor er det ikke rett fram?* 12. november

ANNUAL REPORT 2020

Recruitment

Klima 2050's PhD candidates financed by the Centre in 2020:

Jørn Emil Gaarder, NTNU
Silje Asphaug, NTNU
Erlend Andenæs, NTNU
Erin Lindsay, NTNU
Petter Fornes, NTNU
Bridget O'Brien Thodesen, NTNU
Hervé Vicari, NTNU
Vladimir Hamouz, NTNU - awarded PhD – 15. October
Aynalem Tasachew, NTNU - awarded PhD (2019)
Lars Gullbrekken, NTNU – awarded PhD (2018)

Associated PhD candidates in 2020:

Manuel Franco Torres, NTNU/Multiconsult
Kaj Pettersson, Chalmers University of Technology
Atle Engebø, NTNU
Ashenafi Lulseged Yifru, NTNU – awarded PhD 13. October
Birgitte Gisvold Johannessen, Trondheim kommune
– awarded PhD (2019)

Post.docs 2020:

Anne Kokkonen, BI
Jardar Lohne, NTNU

Fact

Master candidates are important labor for the industry and public sector.

96 master students have completed their master thesis since the launch of the Center. Our goal was 50 thesis throughout the Centre period. We achieved the goal before half-time!

A team of people from different partners involved at the site-visit at Trollstigen pilot project.

Annual account 2020

FUNDING

The Research Council	12 000
SINTEF (host institution)	2 362
Research partners	3 056
Private partners	8 562
Public partners	6 443
Sum	**32 423**

COSTS

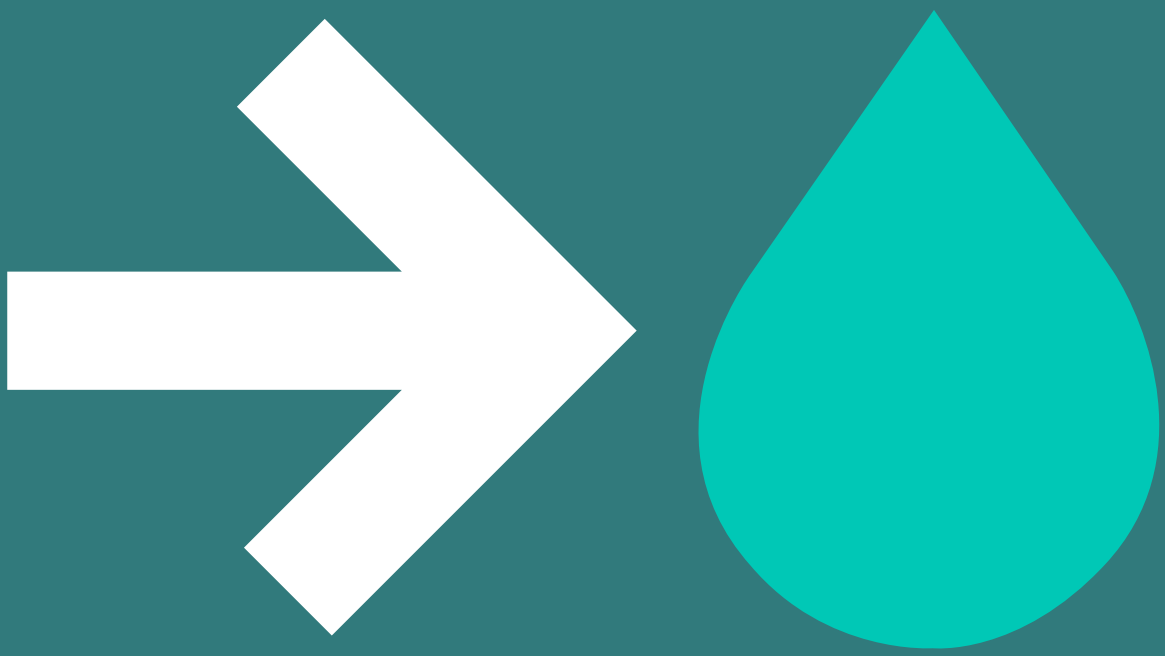
SINTEF (host institution)	9 866
Research partners	15 473
Private partners	6 877
Public partners	207
Sum	**32 423**

All figures in 1000 NOK

- 16 pilot projects running
- 9 private enterprises
- 6 public institutions
- 5 research institutions

Photo: Nicola Lolli

For more information about Klima 2050 go to our webpage:
www.klima2050.no



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